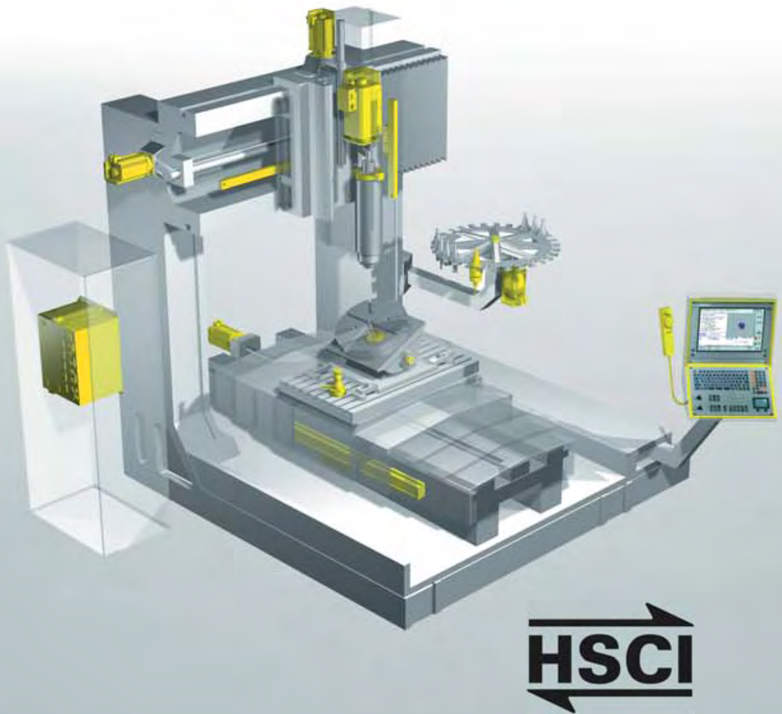


HEIDENHAIN

Service Manual

iTNC 530 HSCI

February 2012

1 How to use the iTNC 530 HSCI Service Manual **11**
1.1 Target group 11
1.2 About this manual 11
1.3 Other service manuals 12
1.4 Other documentation 12
1.5 Support 12
1.6 Service training 13
1.7 Meaning of the symbols used in this manual 13
1.8 Safety 13

2 Safety precautions **15**
2.1 Introduction 15
2.2 Overview 15

3 Code numbers **17**
3.1 Introduction 17
3.2 Overview 17
3.3 Input of code numbers 18

4 Error messages **21**
4.1 Introduction 21
4.2 HELP key 24
4.3 ERR key 25
4.4 CE key 26
4.5 List of NC error messages 27

5 Errors **51**
5.1 Introduction 51
5.2 Overview of possible errors 51

6 Procedures and tips for error diagnosis in the field **55**
6.1 Introduction 55
6.2 Power off and on 55
6.3 Sequence for finding serious electrical errors 56
6.4 Sequence for finding errors in the control loop 58
6.5 Error localization by process of interchange 61
6.6 Error localization by process of exclusion 63
6.7 Observing essential values with the integrated oscilloscope 65
6.8 Finding position differences of direct and indirect encoders 67
6.9 Error localization by switching from direct to indirect position measurement 69
6.10 Notes and tips for the field service 71

7 Creating and reading out service files **75**
7.1 Introduction 75
7.2 Automatic generation of service files 76
7.3 Manual generation of service files 76
7.4 Generating service files with TNCremoNT 77
7.5 Evaluation of the service files 78

8 Log **79**
8.1 Introduction 79
8.2 Calling the log 80
8.3 Reading out the log with TNCremoNT and filtering by event types 81
8.4 Overview of log entries 83
8.5 Log entries at program termination 89

9 DriveDiag ... 91
9.1 Introduction ... 91
9.2 Activation and operation ... 91
9.3 Troubleshooting with DriveDiag ... 93
10 Integrated oscilloscope ... 95
10.1 Introduction ... 95
10.2 Activation and settings ... 96
10.3 Recording and adjusting the signals ... 101
10.4 Saving and loading recordings ... 106
10.5 For error diagnosis ... 107
10.5.1 Triggering on error marker ... 107
10.5.2 Circular interpolation test ... 109
10.5.3 Finding compensation values ... 111
10.5.4 Working with delta triggers ... 113
10.5.5 Descriptions in this manual ... 114
11 PLC diagnosis ... 115
11.1 Introduction ... 115
11.2 Error messages ... 118
11.3 Possible error causes ... 118
11.4 Diagnosis tools in the PLC mode ... 119
11.4.1 The ABLE function ... 119
11.4.2 The LOGIC diagram ... 124
11.4.3 The TRACE function ... 127
11.4.4 The WATCH LIST function ... 128
11.4.5 The I/O-FORCE LIST ... 131
11.5 Non-volatile PLC markers and words ... 134
11.6 Overviews ... 136
11.7 Specifications ... 144
11.7.1 PLC inputs ... 144
11.7.2 Analog inputs ... 144
11.7.3 Inputs for Pt 100 thermistors ... 144
11.7.4 PLC outputs ... 145
11.7.5 Analog outputs ... 146
11.7.6 Assignment of the inputs and outputs ... 146
12 Bus diagnosis ... 147
12.1 HSCI bus ... 147
12.1.1 Introduction ... 147
12.1.2 Possible error causes ... 147
12.1.3 Calling and operating the HSCI bus diagnosis ... 148
12.1.4 Identification of the PLC operands ... 149
12.1.5 Read-back outputs ... 150
12.1.6 Master, slaves and clients ... 152
12.1.7 For error diagnosis ... 153
12.2 PROFIBUS ... 162
12.2.1 Introduction ... 162
12.2.2 Possible error causes ... 162
12.2.3 Calling and operating the PROFIBUS diagnosis ... 163
12.2.4 Identification of the PLC operands ... 164
12.2.5 Troubleshooting with DriveDiag ... 164
12.2.6 Log files ... 165

13 Data media and file management of the iTNC 530 HSCI 167
13.1 Introduction 167
13.2 Structure of the data medium 168
13.3 Possible error causes 168
13.4 Test of the data medium 169
13.5 Setting the system time 173
13.6 Settings in the program manager 174
13.7 File management in the TNC partition 175
13.8 File management in the PLC partition 177

14 Data backup.. 181
14.1 Introduction 181
14.2 Connection setup 183
14.2.1 Via Ethernet 183
14.2.2 Via RS-232-C/V.24 serial interface 192
14.2.3 Via USB.. 195
14.3 Reading in and out individual files and directories 196
14.4 Backup on an external data medium 202
14.5 Extracting files from the backup file 206
14.6 Restoring data 207
14.7 Cable overview 209
14.7.1 Ethernet interface RJ45 connection 209
14.7.2 RS-232-C (V.24)... 210
14.8 Operating modes of the data interfaces 213
14.9 Drive symbols 214

15 Reloading the currently used NC software 215
15.1 Introduction 215
15.2 Preparations.. 215
15.3 Procedure 216

16 Loading service packs 219
16.1 Introduction 219
16.2 Preparations.. 220
16.3 Procedure 221

17 Checking the enables on the iTNC 530 HSCI... 225
17.1 Introduction 225
17.2 Examination 228
17.2.1 "Control is ready" output and input (EMERGENCY STOP chain)....................... 228
17.2.2 Axis-specific drive enable via axis groups.. 232
17.2.3 Readiness of the inverter system... 233
17.2.4 PLC modules, markers and words for drive enabling 238
17.3 EMERGENCY STOP test during switch-on 240

18 Power supply.. 243
18.1 Introduction 243
18.2 Supply voltages in the HSCI system 243
18.3 PSL 130 low-voltage power supply unit 246
18.4 PSL 135 low-voltage power supply unit 250
18.5 Power supply for the MC 62xx computer unit 255
18.6 Buffer battery 257
18.7 Information menu 261
18.8 Power supply of the CC 61xx feedback control unit 262
18.9 Power supply of the UEC 11x feedback control unit.. 267
18.10 Power supply of the MB 620 machine operating panel 268
18.11 Power supply of the BF 250 visual display unit 269
18.12 Power supply of the TE 6xx keyboard unit 270
18.13 Power supply for the control-is-ready signal... 271

18.14 Power supply of the PLB 62xx system module 272
18.15 Supply voltage for PLC outputs 274
18.15.1 Introduction 274
18.15.2 Supply voltage for PLC outputs on the UEC 11x 275
18.15.3 Supply voltage for PLC outputs on the MB 620 275
18.15.4 Supply voltage for PLC outputs on the PLB 62xx 275
18.15.5 Supply voltage for PLC outputs on the PLD-H xx-xx-xx 276

19 Encoder interface 277
19.1 Position encoders 277
19.1.1 Introduction 277
19.1.2 Machine parameters 279
19.1.3 Error messages 280
19.1.4 Possible error causes 281
19.1.5 Troubleshooting 281
19.1.6 Possibilities with DriveDiag 289
19.1.7 Possibilities with the integrated oscilloscope 290
19.1.8 Corrective action 293
19.1.9 Determining the field angle on linear motors, torque motors and synchronous spindles 294
19.1.10 Resetting the machine datum 295
19.1.11 Restoring the spindle orientation 299
19.2 Speed encoders 300
19.2.1 Introduction 300
19.2.2 Machine parameters 302
19.2.3 Error messages 303
19.2.4 Possible error causes 303
19.2.5 Troubleshooting 304
19.2.6 Possibilities with DriveDiag 306
19.2.7 Possibilities with the integrated oscilloscope 307
19.2.8 Corrective action 310
19.2.9 Readjusting the trip dog for reference end position 311
19.2.10 Resetting the machine datum 312
19.2.11 Restoring the spindle orientation 312
19.3 Error codes for encoders with EnDat interface 313
19.4 Further examination of position and speed encoders 314
19.5 Position measurement via motor encoder (indirect position measurement) 317
19.6 Switching over the position display for servicing 321

20 Reference run 323
20.1 Definition 323
20.2 Traversing the reference marks 324
20.3 Error messages 324
20.4 Possible error causes 324
20.5 Troubleshooting 325
20.6 Corrective action 326
20.7 Deselecting axes referencing 326

21 Interfaces to the drives 327
21.1 Digital PWM interface 327
21.1.1 Introduction 327
21.1.2 Machine parameters 330
21.1.3 Tables for power supply modules, power stages and motors 332
21.1.4 Reading out power module data 338
21.1.5 Error messages 339
21.1.6 Possible error causes 340
21.1.7 Sequence for finding errors in the control loop 340

21.1.8 Error finding: Axes swapping 341
21.1.9 Error finding: Swapping power modules or output stages of the same type 343
21.1.10 Error finding: Swapping the HEIDENHAIN expansion boards for the SIMODRIVE 611 system 347
21.1.11 Corrective action 348
21.2 Analog speed value interface 349
21.2.1 Introduction 349
21.2.2 Machine parameters 350
21.2.3 Error messages 350
21.2.4 Possible error causes 351
21.2.5 Sequence for finding errors in the control loop 351
21.2.6 Checking the analog speed value interface 352
21.2.7 Adjusting the electrical offset (drift adjustment) 355
21.2.8 Speed adjustment at the servo amplifier (tachometer adjustment) 358
21.2.9 Corrective action 360

22 Visual display unit 361
22.1 Introduction 361
22.2 Possible error causes 362
22.3 Troubleshooting 363
22.4 Corrective action 364

23 Keyboard unit 365
23.1 Introduction 365
23.2 Signal paths in the console and to the MC 62xx 367
23.3 Possible error causes 369
23.4 Checking the keys 370
23.5 Checking the potentiometers 376
23.6 Checking the touchpad 380
23.7 Corrective action 381
23.8 Key matrix of the keyboard units 382
23.9 Key matrix of the screen soft keys 392

24 Machine operating panel 393
24.1 Introduction 393
24.2 Possible error causes 395
24.3 Checking the power supply 396
24.4 Checking the HSCI connection 396
24.5 Checking the keys 397
24.6 Checking the outputs 399
24.7 Corrective action 400

25 Handwheel 401
25.1 Introduction 401
25.2 Error messages 402
25.3 Possible error causes 402
25.4 Error diagnosis of HR 520 portable handwheel with display 404
25.5 Error diagnosis of HR 410 portable handwheel 409
25.6 Deselecting and disconnecting the portable handwheel 412
25.7 Error diagnosis of HR 130 panel-mounted handwheel 413
25.8 Corrective action 414

26 Touch probes 415
26.1 Introduction 415
26.2 Error messages 420
26.3 Possible error causes 420
26.4 Error diagnosis on TS touch probes 422
26.5 Error diagnosis on TT touch probes 427

26.6 Error diagnosis on the laser touch probe ... 431
26.7 Deselecting and disconnecting the touch probe ... 433
26.8 Corrective action ... 434

27 Features of HEIDENHAIN components ... 35
27.1 HEIDENHAIN components in a machine too ... 435
27.2 Hardware identification ... 436
27.3 Display of important system information ... 451

28 Connector designations and pin layouts ... 453
28.1 Important note ... 453
28.2 MC main computer ... 453
28.2.1 Designations and positions of connectors ... 453
28.2.2Pin layouts ... 455
28.3 CC controller unit ... 461
28.3.1 Designations and positions of connectors ... 461
28.3.2 Pin layouts ... 464
28.4 Controller unit with integrated UEC inverter ... 473
28.4.1 Designations and positions of connectors ... 473
28.4.2 Pin layouts ... 474
28.5 PLB basic modules ... 481
28.5.1 Designations and positions of connectors ... 481
28.5.2 Pin layouts ... 483
28.6 Digital I/O modules ... 485
28.6.1 Designations and positions of connectors ... 485
28.6.2 Pin layouts ... 486
28.7 Analog I/O modules ... 487
28.7.1 Designations and positions of connectors ... 487
28.7.2 Pin layouts ... 488
28.8 SPI expansion module ... 490
28.8.1 Designations and positions of connectors ... 490
28.8.2 Pin layouts ... 490
28.9 PSL low-voltage power supply unit ... 493
28.9.1 Designations and positions of connectors ... 493
28.9.2 Pin layouts ... 494
28.10 Display unit ... 497
28.10.1 Designations and positions of connectors ... 497
28.10.2 Pin layouts ... 497
28.11 Keyboard units ... 498
28.11.1 Designations and positions of connectors ... 498
28.11.2 Pin layouts ... 499
28.12 Machine operating panel ... 500
28.12.1 Designations and positions of connectors ... 500
28.12.2 Pin layouts ... 501
28.13 HSCI adapter PLB 6001 ... 504
28.13.1 Designations and positions of connectors ... 504
28.13.2 Pin layouts ... 505
28.14 Handwheels ... 509
28.14.1 HR 4xx or HR 5xx portable handwheel ... 509
28.14.2 HR 130 panel-mounted handwheel ... 510
28.15 Touch probes ... 511
28.16 Encoders ... 511
28.16.1 Position encoders ... 511
28.16.2 Speed encoders ... 513
28.17 Inverters and motors ... 514
28.18 Interface boards for the SIMODRIVE 611D drive system ... 514

29 Exchange of HEIDENHAIN components 515
29.1 Important information 515
29.2 Recognizing and accepting hardware updates 523
29.3 Detecting and loading firmware updates 524
29.4 Exchanging the MC 6222 531
29.5 Exchanging the MC 6241 534
29.6 Exchanging the SSDR 537
29.7 Replacing the HDR 543
29.8 Exchanging the CC 550
29.9 Exchanging the UEC 551
29.10 Exchanging the buffer battery 551
29.11 Exchanging other HEIDENHAIN components 552
29.12 Exchanging HEIDENHAIN interface boards in the SIMODRIVE system 553

30 Measuring, testing and inspection equipment 559
30.1 Important notes 559
30.2 Test adapter 560
30.3 PWM 9 encoder diagnostic kit 564
30.4 PWT 10/17/18 test unit 566
30.5 IK 215 adjusting and testing package 568
30.6 PWM 20 encoder diagnostic kit 569

31 Machine parameters 571
31.1Explanation 571
31.2 The machine parameter editor 572
31.3 Meaning of the machine parameters 579
31.4 List of machine parameters 580
31.4.1 Format: Encoders and machines 580
31.4.2 Positioning 585
31.4.3 Operation with velocity feedforward control 591
31.4.4 Operation with following error 592
31.4.5 Integrated speed and current control 593
31.4.6 Spindle 602
31.4.7 Integrated PLC 605
31.4.8 Configuration of the data interface 607
31.4.9 3-D touch probe 609
31.4.10 Tool measurement with TT 611
31.4.11 Tapping 614
31.4.12 Display and operation 615
31.4.13 Colors 623
31.4.14 Machining and program run 625
31.4.15 Hardware 631
31.4.16 Spindle, second 639

1 Annex: Principle of function of the iTNC 530 HSCI control 641
1.1 Introduction 641
1.2 The control loop 641
1.3 The HSCI bus 648

1 How to use the iTNC 530 HSCI Service Manual

1.1 Target group

This Service Manual has been written for **specialist electricians** for service, maintenance and commissioning.

Specialists who perform work on the electrical system of a machine tool and its components must have the required **technical knowledge and competence**.

1.2 About this manual

Objective

This Service Manual **assists service staff in the field in diagnosing and correcting errors** on **machine tools** equipped with the HEIDENHAIN control **iTNC 530 HSCI**.

HSCI

This Service Handbook was specifically written for field service of iTNC 530 with HSCI.
The HSCI, the **HEIDENHAIN Serial Controller Interface**, connects the main computer, controller(s) and other control components by means of a bus system.

The diagnostic functions of the iTNC 530 HSCI are the same as those of the iTNC 530 plus a special HSCI bus diagnostics.

> Note
>
> For the field service of iTNC 530 without HSCI, refer to the iTNC 530 Service Manual.

Contents

This manual includes:

- **Specific explanations of the HEIDENHAIN Serial Controller Interface (HSCI)**
- **Error messages and types of errors that indicate technical defects**
- **Information on possible error causes**
- **Descriptions for error diagnosis**
- **Application descriptions of the diagnosis tools**
- **Information on corrective action**
- **Data backup instructions**
- **Theoretical explanations of functions and their correlations**

The "List of NC error messages" on page 4 – 27 and the "Overview of possible errors" on page 5 – 51 contain many references to the descriptions for error diagnosis.
You will find these descriptions in the chapters of this Service Manual sorted by topics.

Commissioning support?

The Service Manual does not provide any commissioning support!

Validity

This manual comprises the servicing possibilities with the **control hardware and software up-to-date** at the publishing date of this manual. The servicing possibilities of your equipment may differ from those described here. The descriptions also provide information on any differences in servicing that are due to changes in the hardware or software.

This manual is valid for:

- Single-processor iTNC 530 with HSCI and NC software 606420 / 421 (without "Functional Safety")

Prerequisites

For the instructions for the field service it is assumed that ...

- **the machine had been working perfectly before the error occurred.**
- **only original spare parts are used!**

> Note
>
> **Basic knowledge of Windows** is required for some of the descriptions in this Service Manual that deal with the use of a service laptop.

Update service

This Service Manual is updated at irregular intervals.
You find the current printable version of this **SHB iTNC 530 HSCI** in **HESIS-Web Including Filebase**.
If you are not a registered customer with access to this HEIDENHAIN database, you will receive this Service Manual either on the occasion of a service training course or from your machine tool builder.

Print version

If you take part in a service training, you will receive the Service Manual in printed form.
.

1.3 Other service manuals

- iTNC 530 Service Manual (for machine tools with iTNC 530 without HSCI)
- Service Manual for Inverter Systems and Motors

1.4 Other documentation

For further important information please refer to the following documentation:

- Machine documentation by the manufacturer
  (circuit diagrams, wiring diagrams, machine operating manual, etc.)
- HEIDENHAIN User's Manual for iTNC 530 HSCI
- HEIDENHAIN TNCguide on DVD
- Mounting instructions by HEIDENHAIN
- Brochures of the respective HEIDENHAIN products
- PWM 9 User's Manual
- PWT Operating Instructions
- IK215/PWM 20 Operating Instructions

Note

You can find up-to-date issues of this and other HEIDENHAIN documents quickly on our website --> www.heidenhain.de

Note

HEIDENHAIN software tools (e.g. TNCremoNT) feature detailed on-line help.

1.5 Support

Attention

The machine manufacturer must be contacted first for error diagnosis on your machine tool!

However, support will also be provided by the Service Department of HEIDENHAIN Traunreut or by the HEIDENHAIN agencies.

You will find telephone numbers as well as e-mail addresses on the back cover of this Service Manual, or on the HEIDENHAIN website (www.heidenhain.de).

1.6 Service training

HEIDENHAIN Traunreut offers service training courses in German language. We recommend the HEIDENHAIN service training courses for iTNC 530 HSCI for technicians who work with this Service Manual.
Please contact HEIDENHAIN Traunreut or visit our website (www.heidenhain.de).

Note

If required, please inquire at the HEIDENHAIN subsidiary in your country whether service training courses are offered in your language.

1.7 Meaning of the symbols used in this manual

DANGER

Failure to comply with this information could result in most serious or fatal injuries, and/or in substantial material damage.

Attention

Failure to comply with this information could result in injuries and interruptions of operation, including material damage.

Note

These boxes contain important and useful information.

1.8 Safety

DANGER

It is extremely important that you read the safety precautions in this manual before you start servicing!
See “Safety precautions” on page 2 – 15.

2 Safety precautions

2.1 Introduction

The safety precautions below are provided to ensure your personal safety and the safety of the machine tool.

Please read this information carefully before you start servicing the machine!

2.2 Overview

Equipment ground

DANGER

Ensure that the equipment ground is continuous!
Interruptions in the grounding conductor may cause damage or injury to property or persons.

Zero potential

DANGER

Ensure that the main switch of the control is switched off and that connected devices are not under power when you engage or disengage any connectors or terminals.
Take precautions against restart!
Use an appropriate voltage test unit to ensure that the unit is not under voltage!

Fundamental knowledge

DANGER

In order to be able to judge the behavior of an NC controlled machine, service engineers need to have fundamental knowledge of controls, encoders, drives, electronics and mechanics.

Inappropriate use may cause considerable damage to persons or property.

Know-how and competence

DANGER

Technicians who work on the electrical system of the machine must have the required know-how and competence.

Suitable tools

DANGER

Use suitable tools, e.g. insulated screwdrivers and pincers!

Safety precautions of the machine manufacturer

Attention

Note the safety precautions on the machine (e.g. labels, signs) and the safety precautions in the documentation of the machine manufacturer (e.g. operating instructions).

Regulations for power installations and instructions for safety and prevention of accidents

DANGER

Observe the national regulations for power installations and the general instructions for safety and prevention of accidents!

Basic insulation

DANGER

The interfaces for the PLC inputs/outputs, machine operating panel and PL expansion cards comply with the basic insulation in accordance with **IEC 742 EN 50 178**.
Only units that comply with the requirements of **IEC 742 EN 50 178** for basic insulation may be connected, otherwise damage to persons or property may be caused.
The **maximum** mean dc voltage of the PLC inputs is 31 V.

Vertical axes

DANGER

Always secure vertical axes to prevent them from falling down before you perform tests on these axes!

Changes to entry values

DANGER

Incorrect or non-optimized input values can lead to faulty machine performance and therefore to serious injury to persons and damage to equipment.
Machine parameters may only be changed by or after consultation with the machine manufacturer!
Uncontrolled axis and spindle movements must be expected.
Settings that have an effect on the control's feedback loops may only be altered when the EMERGENCY STOP button of the machine is pressed.

Liability

Attention

HEIDENHAIN does not accept any responsibility for indirect or direct damage caused to persons or property through incorrect use or operation of the machine!

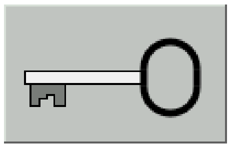
3 Code numbers

3.1 Introduction

With code numbers …

- certain areas of the hard disk
- certain file types
- certain functions

... can be called.



DANGER

Code numbers may only be passed on to and be used by trained service technicians.
Keep the code numbers confidential!
Inexpert handling may result in a loss of important data, in faulty machine performance and thus lead to damage or injury to property or persons.

3.2 Overview

Code number	Brief description	Description in this manual
0	Reset the previously entered code numbers --> Soft keys such as MP EDIT or PLC EDIT are deleted.	In this chapter
123	Edit subset of machine parameters for the machine operator	See page 31 – 571
75368	Offset adjustment for analog axes	See page 21 – 355
79513	Info menu (U[BATT], U[ACCU], U[VCC], TEMP, T[CPU1]),	See page 18 – 261
95148	Call the active machine parameter list	See page 31 – 571
531210	Reset non-volatile PLC markers and PLC words in the RAM	See page 11 – 134
688379	Integrated oscilloscope	See page 10 – 95
807667	Call the PLC area	See page 11 – 115
857282	Reset the operating times	- - -
LOGBOOK	Call and save the internal log of the iTNC	See page 8 – 79
NET123	Network settings for the single-processor control	See page 14 – 183
SETUP	Call for loading service packs and NC software for the single-processor control	See page 16 – 219
SIK	Display of the number of the system identification key and of the enabled options	See page 29 – 517
VERSION	Create the file TNC:\Version.a System data is saved in this file for diagnostic purposes. The file can be read out for diagnosis.	- - -

Note

Machine tool builders may define their own MP and PLC code numbers.
In this event the HEIDENHAIN code numbers do not function any longer, or only function to a limited extent. --> Contact your machine tool builder!

3.3 Input of code numbers

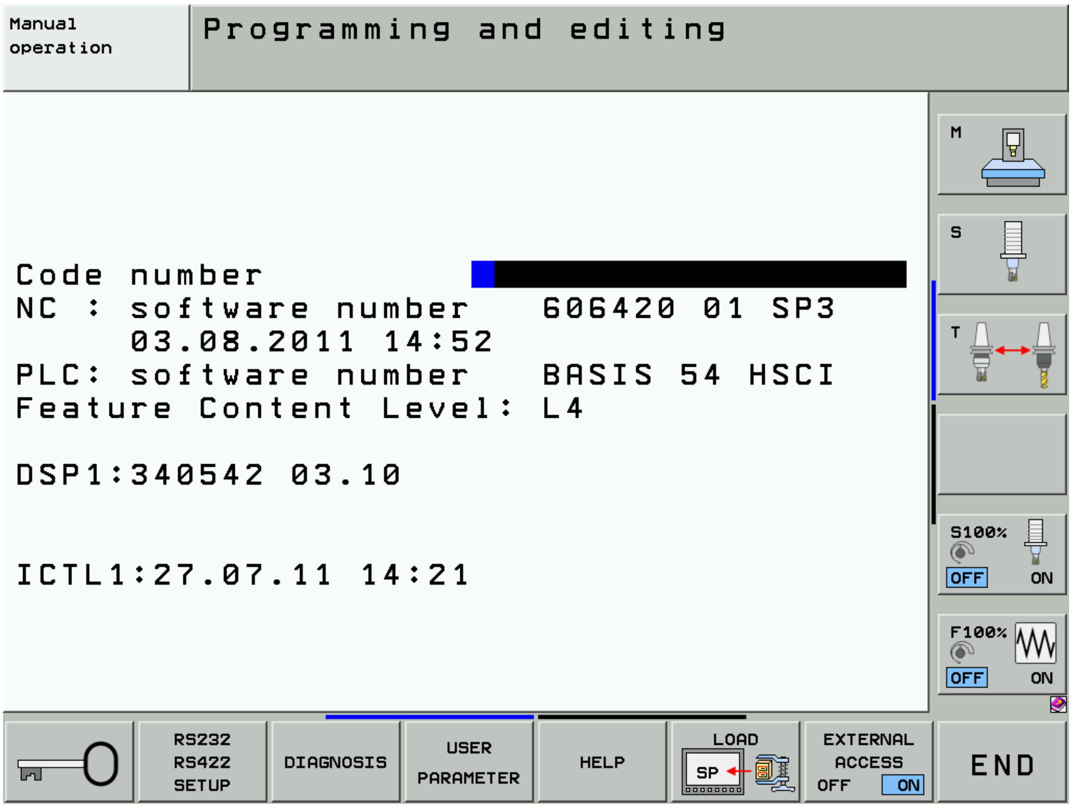
▶ Select the **Programming and Editing** operating mode.

▶ If open: Close the program management by pressing the END button.

Note

Pressing the MOD key while the program manager is open calls the screen where you can make the interface settings.

▶ Call the code number window.



▶ Enter the code number and press ENT to confirm.

Note

When certain code numbers are entered, **new soft keys** are displayed, e.g. CONFIG EDIT, PLC EDIT, OSCI.
With these soft keys you can also change to the corresponding areas **without having to enter the code number again**.

When you have finished your work, reset all previously entered code numbers:

▶ Enter the code number 0 and press ENT to confirm.

▶ Press END to exit the code-number page.

Note

All key codes are reset when the control is restarted.

Additional information

■ As long as the **machine parameter list is in the editor**, **no further code number** can be entered. I.e., first close the MP editor if you want to enter a new code number

Figure: As long as the text **`Machine parameter programming`** is displayed in the header, no further code numbers are accepted (exception: NET123).

■ After you have entered the **code number for the machine parameters** the **PLC tree** can be seen in the program management.
Only files with the **extension .MP** are displayed.

■ After entering the **PLC code number**, **all files in the PLC tree** can be seen and loaded in the editor. However, **to edit machine parameters** you must **press the MP EDIT soft key first**.

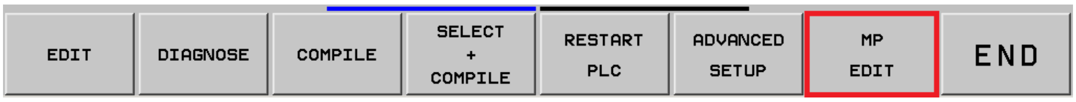


Figure: The soft key **`MP EDIT`** must be pressed (or the code number 95148 entered) before you are entitled to edit machine parameters.

4 Error messages

4.1 Introduction

The iTNC 530 features a comprehensive integral monitoring system for the prevention of **input or operation errors**, as well as for identification and diagnosis of **technical defects** on the control and the connected devices. The monitoring system is an integral component of the iTNC hardware and software and is active as long as the control is switched on. The presence of a technical fault or an operation error is made known through a plain-language message.

Moreover, the machine manufacturer can define specific PLC error messages.

Type of error message

PLC error messages

- Machine-specific error messages
- Are defined by the machine manufacturer (e.g., coolant pump defective, protective door open)
- The machine manufacturer defines how the control reacts to a PLC error message (NC Stop, EMERGENCY STOP, etc.)
- The machine manufacturer defines whether the control can still be operated or has to be rebooted after a PLC error message.
- If you have any questions, please contact your machine manufacturer.

NC error messages

- Are part of the HEIDENHAIN NC software.
- Can be subdivided into error messages that result from operation, programming and machine applications and those that indicate a technical defect (devices, electronic and mechanical components, etc.)
- HEIDENHAIN defines how the control reacts to an NC error message (NC Stop, EMERGENCY STOP, etc.)
- HEIDENHAIN defines whether the control can still be operated or has to be rebooted after an NC error message.
- If you have any questions, please contact your machine manufacturer and/or HEIDENHAIN.

Is the displayed error message an **NC or PLC error message?**
Call the ERR window or the log to answer this question:

Display	PLC error message	NC error message
ERR window In the **Group** column. Call --> See "ERR key" on page 4 – 25.	**PLC**	**GENERAL** or **OPERATION** or **PROGRAMMING**
Log In lines that start with the entry **ERR**. Call --> See "Log" on page 8 – 79.	**P** (number and text of error message)	**N** (number and text of error message)

Note

No error numbers are assigned to NC error messages that begin with **N-1**.

Operating-system error messages

- Often contain the note **CHILD PROCESS ERROR**.
- The control cannot be operated any more and has to be rebooted.
- If you have any questions, please contact your machine manufacturer and/or HEIDENHAIN.

Display of error message

All error messages that can be acknowledged with the CE key are …

- displayed **in the screen header** (at the top of the screen), usually in red color
- as a plain-language message.

Figure: Error message in the header

The machine manufacturer can display additional information on PLC error messages in the small PLC window (above the soft-key row).

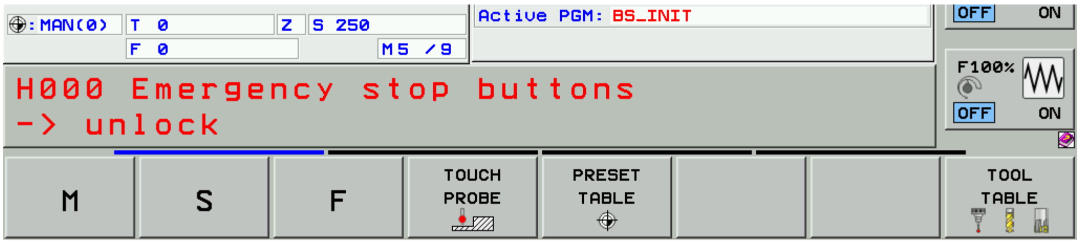


Figure: Additional information in the small PLC window

Error messages that require a restart of the control ...

- are displayed in the middle of the screen **in a gray window**
- as a plain-language message.

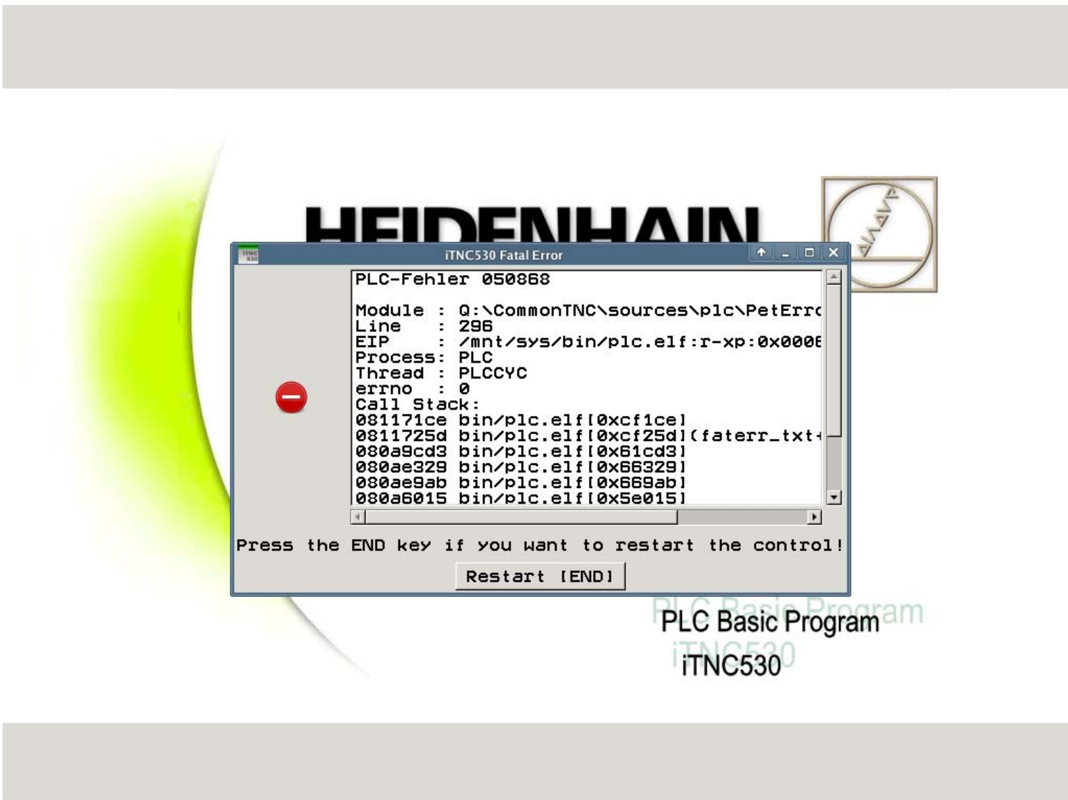


Figure: Gray error window

Reaction of control and machine

Display only

- A message (info, warning, error) is only displayed.
- The machine does not react; programs are not stopped.
- The error message can be acknowledged anytime.

Feed stop

- The feed-rate enable is reset. The **"F"** symbol for the feed rate is highlighted.
- The axes are braked at the nominal value characteristic.
  I.e., the contour of the workpiece is usually not damaged.
- Once the error message has been acknowledged, the machine continues to operate at the set feed rate.

NC Stop

- The running NC program is stopped. The **control-in-operation symbol** (STIB) flashes.
- The axes are braked at the nominal value characteristic.
  I.e., the contour of the workpiece is usually not damaged.
- After the error message has been acknowledged, the NC program can be restarted at the position where it was interrupted (NC START key).

Program cancelation

- The running NC program is canceled (internal stop).
- The axes are braked at the nominal value characteristic.
  I.e., the contour of the workpiece is usually not damaged.
- After the error message has been acknowledged, the NC program needs to be restarted (GOTO 0, NC START).

EMERGENCY STOP

- An EMERGENCY STOP is triggered at the machine.
- Axes and spindles decelerate at the current limit; the machine must be brought to a standstill as quickly as possible.
  The contour of the workpiece is not taken into account and may be damaged.
- After the error message was acknowledged, the machine must be switched on completely.
  Now, the PLC program can be restarted (GOTO 0, NC START).

RESET

- An EMERGENCY STOP is triggered at the machine.
- Axes and spindles decelerate at the current limit; the machine must be brought to a standstill as quickly as possible.
  The contour of the workpiece is not taken into account and may be damaged.
- The error message cannot be acknowledged. The control must be shut down and restarted.
  Now, the PLC program can be restarted (GOTO 0, NC START).

Automatic generation of service files

In the event of serious NC software errors or especially defined PLC error messages, service files are generated automatically.

See “Creating and reading out service files” on page 7 – 75.

4.2 HELP key

- Display help texts for error messages
  (If you press this key again, the window will close.)

When the service technician presses the HELP key, a window is shown that describes the **cause of the error and possibilities of corrective action in addition** to the displayed error message. The machine manufacturer may also have implemented this function for PLC error messages.

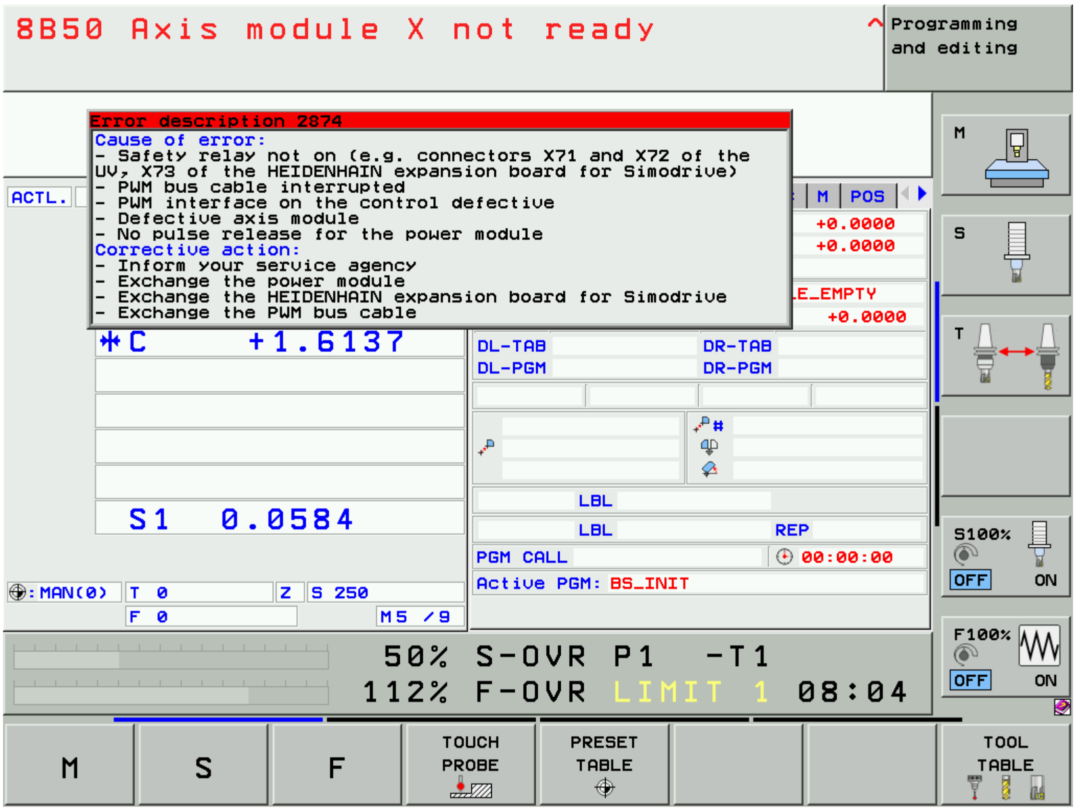


Figure: HELP window

> **Note**
>
> HELP texts cannot be displayed for error messages in gray windows.
> The control must be rebooted.
> For information on these errors refer to the list of NC error messages.
> --> See "List of NC error messages" on page 4 – 27.

4.3 ERR key

- Display all pending error messages in a list.
  (When you press this key again, the window will close.)

If there is an AND symbol (red caret) in the header in addition to the error message, there is more than one error message pending.

The ERR key (ERROR) is located directly above the HELP key. When this key is pressed all NC and PLC error messages pending at the control are displayed in their own window.

List of error messages	
In the ERR window	**In the log**
By priority	In chronological order
Errors with a higher priority are higher up in the list.	The log is written from top to bottom, i.e. older errors are at the top, more recent errors at the bottom.

In addition to the error list, the help window can be called with the HELP key.
The contents of the Help window refers to the error message highlighted in the ERR window.

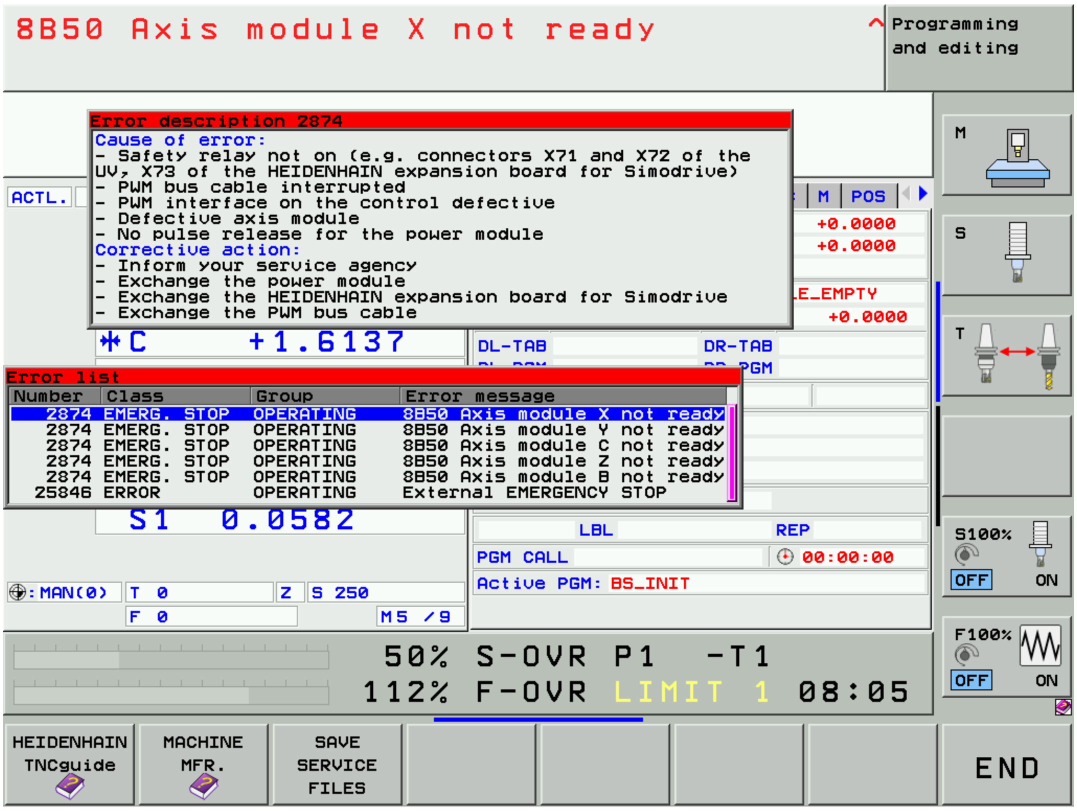


Figure: ERR window with open HELP window

The columns in the ERR window have the following meanings:

Column in ERR window	Description
Number	Error number defined by HEIDENHAIN or the machine manufacturer (-1: No error number defined)
Class	Error class; defines the reaction of the control: ■ ERROR Group error The error reaction depends on the status or current operating mode of the control. ■ FEED HOLD The feed-rate enable is deleted. ■ PGM HOLD The program run is interrupted (the control-in-operation symbol blinks) ■ PGM ABORT The program run is interrupted (INTERNAL STOP.) ■ EMERG. STOP An emergency stop is triggered. ■ RESET The iTNC executes a system restart. ■ WARNING Warning message, program run resumes ■ INFO Information message, program run resumes
Group	Error source; shows the cause of the error: ■ GENERAL General error ■ OPERATING Error during machining and machine traverse ■ PROGRAMMING Error in programming and editing ■ PLC PLC error message of the machine manufacturer
Error message	Displayed error text

The individual error messages can be selected with the cursor; the open Help window shows the associated text.

4.4 CE key

CE

▶ Clear error message (Clear Error)

Acknowledge displayed error messages by pressing the CE key.
If the error cause is still existing, the error message will be displayed again. --> Correct the error!

Note

Messages reporting particularly severe errors cannot be confirmed with the CE key.
The control must be restarted.--> Press the END key.
If this does not work --> Switch off the power switch of the machine and wait for several seconds before switching it on again.

4.5 List of NC error messages

Complete list

You can find the complete list of all NC error messages (including operator errors) on the **TNCguide DVD** in several languages and sorted by error numbers.
This TNCguide information is also available on our website -->
www.heidenhain.de/....

This list is the official list of NC error messages. It contains all error messages of HEIDENHAIN controls that operate with the HeROS operating system.
It consists primarily of error messages related to operation and handling as well as technical error messages.

Filtered list

The list below contains the **most important error messages that indicate a technical defect** in numerical and in alphabetical order.

A reference is made, if there are additional descriptions in this Service Manual.

Error message	Possible cause of error / Additional information and descriptions in the manual	Measures for error diagnosis and/or corrective action / Additional information and descriptions in the manual
8040 Heat sink temp. in UV 1xx	■ Heat-sink temperature of UV 1xx power supply unit too high ■ If the heat-sink temperature continues to increase, the unit will be switched off.	■ Stop the machine and let it cool down. ■ Continue working with lower power (reduce the feed rate).
		■ See Service Manual Inverter Systems and Motors.
8041 Excessive Iz in UV 1xx	■ DC-link current of UV 1xx power supply unit too high	■ Continue working with lower power (reduce the feed rate).
		■ See Service Manual Inverter Systems and Motors.
8043 No inverter-ready signal	■ Readiness signal of the inverter (supply unit) is inactive after the feedback control starts. ■ Master contactor has opened. ■ Error in PLC program ■ Inverter defective	■ Try restarting the inverter. ■ Check the wiring (master contactor). ■ Check the PLC program. ■ Exchange the inverter (supply unit).
		■ See "Readiness of the inverter system" on page 17 – 233. ■ See Service Manual Inverter Systems and Motors.
8060 Leakage current in UV 1xx too high	■ Insulation problem (e.g. defective motor).	■ Check the motor. ■ Check the wiring.
		■ See Service Manual Inverter Systems and Motors.
8061 No inverter-ready signal	■ Readiness signal of the inverter (supply unit) is inactive after the feedback control starts. ■ Master contactor has opened. ■ Error in PLC program ■ Inverter defective	■ Try restarting the inverter. ■ Check the wiring (master contactor). ■ Check the PLC program. ■ Exchange the inverter (supply unit).
		■ See "Readiness of the inverter system" on page 17 – 233. ■ See Service Manual Inverter Systems and Motors.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
8080 Uz UV 1xx too high	■ DC-link voltage of the power supply unit too high.	■ Check the machine parameter (braking the spindle). ■ Check the braking resistor. ■ Replace the power supply unit.
		■ See Service Manual Inverter Systems and Motors.
8092 Pos. contr. cyc. time error	■ MC is outputting erroneous cycle time for CC position controller. ■ A hardware error has occurred.	■ Check machine parameter 7600.x. ■ Exchange drive control board.
8130 Motor brake defective <axis>	■ Motor brake defective.	■ Traverse the axis to a safe position before power-off. ■ Check controls for motor brakes. ■ Exchange the motor.
		■ See Service Manual Inverter Systems and Motors.
8140 Error <axis> field orientation	■ Field orientation impossible for mechanical reasons. ■ Incorrect relation between electrical field and mechanical motor motion. ■ Incorrect motor encoder signal. ■ Incorrect motor connection. ■ Mechanical brakes not released.	■ Check the machine parameters for number of signal periods and distance for the number of signal periods. ■ Check the machine parameter for the linear distance of one motor revolution. ■ For linear motors: Check column STR of the motor table. ■ Check the speed encoder connection. ■ Check the motor connection. ■ Release brakes during orientation.
	■ See "Speed encoders" on page 19 – 300.	■ See "Sequence for finding errors in the control loop" on page 6 – 58. ■ See "Speed encoders" on page 19 – 300. ■ See Service Manual Inverter Systems and Motors.
8300 Motor brake defective <axis>	■ Motor brake defective.	■ Traverse the axis to a safe position before power-off. ■ Check controls for motor brakes. ■ Exchange the motor.
		■ See Service Manual Inverter Systems and Motors.
8310 No current in brake test <axis>	■ Motor connected incorrectly ■ Inverter connected incorrectly ■ Inverter defective ■ Motor defective	■ Check the wiring of motor and inverter. ■ Check the inverter. ■ Check the motor.
		■ See Service Manual Inverter Systems and Motors.
8610 I2T value is too high <axis>	■ Excessive load over the time of the drive.	■ Reduce the load or the duration. ■ Check the motor table, power module table, and machine parameters. ■ Check whether the motor and power module are designed for the load.
		■ See Service Manual Inverter Systems and Motors.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
8620 Load is too high <axis>	■ Drive has maximum current and cannot accelerate. ■ Excessive load (torque, power) on the drive.	■ Reduce the load on the drive. ■ Check the motor table, power module table, and machine parameters. ■ Check whether the motor and power module are designed for the load.
		■ See ”Sequence for finding errors in the control loop” on page 6 – 58. ■ See Service Manual Inverter Systems and Motors.
8640 I2T value of motor is too high <axis>	■ The load of the motor is too high over the duration.	■ Reduce the load or the duration. ■ Check the motor table and machine parameters. ■ Check whether the motor is designed for the load.
		■ See Service Manual Inverter Systems and Motors.
8650 I2T value of motor is too high <axis>	■ The load of the power module is too high over the duration.	■ Reduce the load or the duration. ■ Check the motor table and machine parameters. ■ Check whether the power module is designed for the load.
		■ See Service Manual Inverter Systems and Motors.
8800 Signal LT-RDY inactive <axis>	■ Inverter switch-off during closed-loop control of a vertical axis (cause = vertical axis).	■ Check the PLC program. ■ Check the wiring of the inverter.
		■ See Service Manual Inverter Systems and Motors.
8810 Signal LT-RDY inactive <axis>	■ Inverter switch-off during closed-loop control of a vertical axis (cause = vertical axis).	■ Check the PLC program. ■ Check the wiring of the inverter.
		■ See Service Manual Inverter Systems and Motors.
8820 Field angle unknown <axis>	■ Field angle of the motor on the reference point of the speed encoder has not yet been ascertained.	■ Run a field orientation. ■ Check the motor table (column SYS).
		■ See ”Speed encoders” on page 19 – 300.
8830 EnDat: No field angle <axis>	■ Field angle of the motor with unaligned speed encoder with EnDat interface has not yet been ascertained. ■ The transferred EnDat serial number does not match the one saved. ■ Connected EnDat encoder or encoder cable is defective.	■ Run a field orientation. ■ Check the motor table (column SYS).
		■ See ”Speed encoders” on page 19 – 300.
8860 Input frequency from speed encoder <axis>	■ Noise on speed encoder signals	■ Check the encoder signals. ■ Check the shielding.
		■ See ”Further examination of position and speed encoders” on page 19 – 314.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
8870 Input frequency from position encoder <axis>	■ Noise on position encoder signals	■ Check the encoder signals. ■ Check the shielding.
		■ See "Further examination of position and speed encoders" on page 19 – 314.
88C0 Max. nominal motor speed %s exceeded	■ Axis: Maximum feed rate is greater than the maximum motor speed (N-MAX) multiplied by MP1054. ■ Spindle: Maximum spindle speed is greater than the maximum motor speed (N-MAX) multiplied by the gear transmission ratio. ■ The relationship between the line count of the position encoder and that of the motor encoder is faulty. ■ The N-MAX entry in the motor table is faulty. ■ Incorrect entry in MP2200 ■ EcoDyn: The selected feed rate exceeds the max. permissible voltage.	■ Check the N-MAX entry in the motor table. ■ Check MP1010 and MP1054. ■ Check the machine parameters for spindle speed. ■ Check the STR column in the motor table and MP3142. ■ Check MP2200.x.
8A00 No inverter enabling %.2s	■ Power-on of the drive not possible due to missing enabling of the inverter via –SH1.	■ Check the wiring.
		■ See "Readiness of the inverter system" on page 17 – 233. ■ See Service Manual Inverter Systems and Motors.
8A10 AC fail %.2s	■ Power-on of the drive not possible, because an AC-fail signal (power supply) is active.	■ Test the power supply. ■ Check the wiring of the power supply.
		■ See Service Manual Inverter Systems and Motors.
8A20 Powerfail %.2s	■ Power-on of the drive not possible, because a powerfail signal (power supply) is active.	■ Test the power supply. ■ Check the wiring of the power supply.
		■ See Service Manual Inverter Systems and Motors.
8A40 Enabling of axis group %.2s	■ Power-on of the drive not possible due to missing drive enabling for axis groups (X150/ X151).	■ Check the connector on X150/X151 for correct fit. ■ Check the wiring of X150/X151. ■ Check MP2040.x.
		■ See "Axis-specific drive enable via axis groups" on page 17 – 232.
8A50 Inverter not ready %.2s	■ Power-on of the drive not possible, because an inverter is not ready (RDY signal).	■ Check the Ready LED of the inverter. ■ Check the wiring of the inverter. ■ On interface PCBs for Siemens inverters, the second axis is not enabled.
		■ See "Readiness of the inverter system" on page 17 – 233. ■ See Service Manual Inverter Systems and Motors.
8AF0 Encoder <axis> defective	■ Contamination of the position encoder ■ Encoder cabling defective ■ Motor control board defective	■ Exchange the position encoder. ■ Check the encoder cable. ■ Exchange the motor drive-control board.
	■ See "Position encoders" on page 19 – 277.	■ See "Position encoders" on page 19 – 277.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
8B00 <axis> motor encoder defective	■ No encoder signal available ■ Interruption in motor encoder cable ■ Signal amplitude of motor encoder is missing or too small.	■ Check connection of motor encoder. ■ Check the motor encoder. ■ Check the amplitude of the encoder signal.
	■ See "Speed encoders" on page 19 – 300.	■ See "Speed encoders" on page 19 – 300.
8B00 Zn track %.2s error	■ Contamination of the motor encoder (Zn track) ■ Motor encoder cable defective. ■ Motor control board defective	■ Exchange the motor. ■ Check the motor table entry. ■ Exchange the motor drive-control board.
	■ See "Speed encoders" on page 19 – 300.	■ See "Speed encoders" on page 19 – 300.
8B10 Wrong traverse direction <axis>	■ DIR entry in motor table is incorrect. ■ Incorrect motor power connection.	■ Check the DIR entry in the motor table. ■ Check the motor power connection.
		■ See Service Manual Inverter Systems and Motors.
8B20 Error <axis> field orientation	■ Field orientation impossible for mechanical reasons. ■ Incorrect relation between electrical field and mechanical motor motion. ■ Incorrect motor encoder signal. ■ Incorrect motor connection. ■ Mechanical brakes not released.	■ Check the machine parameters for number of signal periods and distance for the number of signal periods. ■ Check the machine parameter for the linear distance of one motor revolution. ■ For linear motors: Check column STR of the motor table. ■ Check the speed encoder connection. ■ Check the motor connection. ■ Release brakes during orientation.
	■ See "Speed encoders" on page 19 – 300.	■ See "Sequence for finding errors in the control loop" on page 6 – 58. ■ See "Speed encoders" on page 19 – 300. ■ See Service Manual Inverter Systems and Motors.
8B30 Motor temperature %.2s too high	■ Measured motor temperature is too high ■ No temperature sensor ■ Motor encoder cable is defective (wire broken) ■ Entry in motor table is incorrect. ■ Incorrect or defective temperature sensor was installed.	■ Let the motor cool down. ■ Check the motor table entry. ■ Check the entry in the motor table. ■ Measure the temperature sensor (576 [ohms] at 20 [°C], 1000 [ohms] at 100 [°C]).
	■ See "Speed encoders" on page 19 – 300. ■ See Service Manual Inverter Systems and Motors.	■ See "Speed encoders" on page 19 – 300. ■ See Service Manual Inverter Systems and Motors.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
8B40 No drive enabling %.2s	■ Inverter is not ready for operation ■ No pulse release for the power module ■ Uz too high ■ Power-fail signal is active ■ With M controls: I32 input inactive ■ With P controls: Drive release at X50 inactive ■ **In addition, for 246 261-xx (digital current controller):** ■ For the given axis an illegal motor model (e.g. linear motor) was selected. ■ The CC receives a "Drive on" command for a non-existing axis. ■ The power module is not ready when the field orientation starts. ■ Readiness of the power module is detected through the Ready signal on the PWM cable. ■ The power module is not ready when the current controller adjustment begins. ■ Motor control board defective ■ PWM cable defective ■ Noise pulses	■ Check the activation and wiring of the pulse release. ■ Check Uz. ■ Check the emergency stop circuit. ■ For a non-regenerative system: Is the braking resistor connected? ■ For a regenerative system: Is the energy recovery activated? ■ Check the grounding and shielding of the cable. ■ Exchange the power module. ■ For SIEMENS power converter (inverter): Exchange the interface card. ■ Exchange drive-control board. ■ Check the control and cabling of the pulse release.
		■ See "Checking the enables on the iTNC 530 HSCI" on page 17 – 225. ■ See Service Manual Inverter Systems and Motors.
8B50 Axis module %.2s not ready	■ No pulse release for the power module ■ Uz too high ■ 5-V power supply too weak ■ Inverter is not ready for operation ■ Motor control board defective ■ PWM cable defective ■ Noise pulses	■ Check the activation and cabling of the pulse release. ■ Check Uz. ■ For a non-regenerative power supply unit: Is the braking resistor connected? ■ If the power supply is regenerative: Is the energy recovery activated? ■ Check the grounding and shielding of the cable. ■ Exchange the power module. ■ For P controls: Exchange the interface card. ■ Exchange the motor drive-control board.
		■ See "Checking the enables on the iTNC 530 HSCI" on page 17 – 225. ■ See Service Manual Inverter Systems and Motors.
8B60 Overcurrent cutoff %.2s	■ Undervoltage, temperature, or short-circuit monitor of an IGBT in the inverter has responded.	■ Let the inverter cool down. ■ Check the motor connection for a short circuit. ■ Examine the motor for short circuit in the windings. ■ Exchange the power module.
		■ See "Sequence for finding errors in the control loop" on page 6 – 58. ■ See Service Manual Inverter Systems and Motors.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
8BA0 Incorrect reference signal or line count %.2s	■ Invalid entry for the line count STR in the motor table ■ Faulty reference signal ■ Noise pulses ■ Motor encoder cable defective (break or short circuit)	■ Check the entry in the motor table. ■ Check the signals from the speed or rotational speed encoder (PWM8). ■ Check encoder cable for interruption or short circuit under mechanical load (bending, stretching, etc.) ■ Check the shielding and shield connection in the encoder cable. ■ Exchange the encoder cable. ■ Exchange the motor.
		■ See ”Speed encoders” on page 19 – 300. ■ See Service Manual Inverter Systems and Motors.
8BB0 Motor temp. too low %.2s	■ Measured motor temperature too low ■ Temperature sensor wired incorrectly (short circuit) ■ Temperature sensor defective ■ Incorrect temperature sensor (KTY84 required) ■ Hardware error on encoder input PCB	■ Check the wiring. ■ Check temperature sensor. ■ Deselect monitoring of excessively low temperature with MP2220 bit 5. ■ Exchange the encoder input PCB.
		■ See ”Speed encoders” on page 19 – 300. ■ See Service Manual Inverter Systems and Motors.
8BC0 Motor current %.2s too high	■ Incorrect motor or power module selected ■ Incorrect current controller parameters ■ Incorrect parameters in the motor table ■ Power module defective ■ Motor cable defective (short circuit). ■ Motor defective (short circuit, ground fault) ■ Motor control board defective	■ Correct motor and power module selected? ■ Check the current controller adjustment. ■ Check the motor and motor cable for a short circuit. ■ Exchange the power module or the drive control board.
		■ See ”Sequence for finding errors in the control loop” on page 6 – 58. ■ See Service Manual Inverter Systems and Motors.
8BD0 Excessive servo lag in <axis>	■ The following error of a moving axis is greater than the value given in machine parameter MP1720.x (lag mode) or MP1420.x (feedforward mode). ■ The acceleration entered is too large. ■ The motor is not moving even though drive-on was given.	■ Reduce the feed rate and increase the spindle speed. ■ Remove potential sources of vibration. ■ The motor current must not be limited during acceleration.
	■ Overloaded driver ■ Insufficient lubrication ■ Mechanical stiffness ■ Machine vibration ■ Hardware error in the control loop ■ For analog axes: Servo defective	■ Check the lubrication. ■ Remove mechanical stiffness. ■ Analog axes: Check the servo. ■ Check the acceleration. ■ See ”Sequence for finding errors in the control loop” on page 6 – 58. ■ Carry out offset adjustment. (See ”Adjusting the electrical offset (drift adjustment)” on page 21 – 355.) ■ Carry out speed adjustment. (See ”Speed adjustment at the servo amplifier (tachometer adjustment)” on page 21 – 358.)

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
8BE0 Encoder defective <axis>	■ Incorrect nominal distance between two reference marks	■ Check the entry in the motor table and MP2206.x. ■ Check the entry in MP334.x. ■ Check if the reference signal is disturbed.
		■ See "Encoder interface" on page 19 – 277.
8BF0 Input frequency from speed encoder <axis>	■ Noise on speed encoder signals	■ Check the encoder signals. ■ Check the shielding.
		■ See "Further examination of position and speed encoders" on page 19 – 314.
8C00 Input frequency from position encoder <axis>	■ Noise on position encoder signals	■ Check the encoder signals. ■ Check the shielding.
		■ See "Further examination of position and speed encoders" on page 19 – 314.
8C10 Motor encoder <axis> defective	■ No encoder signal available ■ Interruption in motor encoder cable ■ Signal amplitude of motor encoder is missing or too small.	■ Check connection of motor encoder. ■ Check the motor encoder. ■ Check the amplitude of the encoder signal.
		■ See "Speed encoders" on page 19 – 300. ■ See Service Manual Inverter Systems and Motors.
A080 CC%d operating state not equal MC	■ The automatic SRG, SBH, and SH operating states of the MC and CC are compared cyclically. If the values remain unequal for longer than 500 ms, a Stop 1 is released.	■ Press CE to acknowledge the error message. ■ Switch on the machine. ■ Check the software version.
AC00 CC amplitude too high %.2s	■ The amplitude of the encoder signal is too high or the contamination signal active. ■ Noise on motor encoder signal ■ Short circuit in motor encoder cable. ■ Motor encoder signal amplitude too high	■ Check connection of motor encoder (ground connection). ■ Check the motor encoder.
	■ Noise on signal ■ Scanning head too close to scale ■ For very old encoders: Incandescent lamp too bright (spiral-wound filament short-circuited)	■ Adjust the scanning head. ■ See "Encoder interface" on page 19 – 277.
AC10 Motor encoder <axis> defective	■ No encoder signal available ■ Interruption in motor encoder cable ■ Signal amplitude of motor encoder is missing or too small.	■ Check connection of motor encoder. ■ Check the motor encoder. ■ Check the amplitude of the encoder signal.
		■ See "Encoder interface" on page 19 – 277.
AC20 CC frequency too high %.2s	■ The maximum input frequency was exceeded at an encoder input. ■ Noise on motor encoder signal	■ Check connection of motor encoder (ground connection). ■ Check the motor encoder. ■ Check encoder signal input frequency.
		■ See "Speed encoders" on page 19 – 300.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
AC40 CC ampl. too low %.2s (position)	■ The position encoder signal amplitude is too small or the contamination signal is active. ■ Interruption in encoder cable ■ Encoder signal amplitude missing	■ Check connection of encoder. ■ Check the encoder. ■ Check the amplitude of the encoder signal. ■ Inform your service agency.
		■ See "Position encoders" on page 19 – 277.
AC50 CC freq. too high %.2s (position)	■ The maximum input frequency was exceeded at a position encoder input. ■ Noise on encoder signal	■ Check connection of encoder (ground connection). ■ Check the encoder. ■ Check the input frequency of the encoder signal.
		■ See "Further examination of position and speed encoders" on page 19 – 314.
B900 CC%d supply voltage %d	■ The Vcc supply voltage (x) was out of range. ■ +4 = Undervoltage Vcc (+5 V) Excessive load from external components (e.g. encoders). ■ +6 = Overvoltage Vcc (+5 V) The power supply unit is defective. ■ +14 = Undervoltage Vcc (+15 V) The power supply unit is defective. ■ +16 = Undervoltage Vcc (+15 V) The power supply unit is defective. ■ -14 = Overvoltage Vcc (-15 V) The power supply unit is defective. ■ -16 = Overvoltage Vcc (-15 V) The power supply unit is defective.	■ Measure supply voltage Vcc (x). ■ Vcc (+5 V) < +4.75 V Check encoder connections. ■ Vcc (+5 V) > +5.50 V Exchange power supply unit. ■ Vcc (+15 V) < +14.25 V Exchange power supply unit. ■ Vcc (+15 V) > +16.50 V Exchange power supply unit. ■ Vcc (-15 V) < -14.25 V Exchange power supply unit. ■ Vcc (-15 V) > -16.50 V Exchange power supply unit.
		■ See "Power supply" on page 18 – 243.
BA00 CC%d operating temperature %d	■ The temperature inside the LE was out of the permissible range. (-128... 0...+127 = measured temperature [°C]) ■ Temperature sensor on PCB is defective. ■ Insufficient ventilation of the electrical cabinet (fan defective). ■ The ambient temperature is too high or too low.	■ Check the ventilation conditions.
		■ See "Information menu" on page 18 – 261. ■ See "Temperature" on page 6 – 74.
C003 MC/CC%d system clock mismatch	■ Hardware error (quartz generator) ■ Software error	■ Exchange the drive-control board or processor board. ■ Check the software version.
C004 Undefined interrupt	■ Software error ■ Hardware error: Disturbance results in internal interrupt.	■ Switch off the machine. ■ Switch on the machine. ■ Check the software version. ■ Check the grounding.
C005 Unknown hardware identifier	■ Software does not fit the hardware. ■ Hardware defective	■ Check the software version. ■ Exchange drive-control board.
C007 DC-link voltage too low	■ Inverter defective ■ Line power interrupted	■ Check your line power supply. ■ Check the inverter.
		■ See Service Manual Inverter Systems and Motors.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
C00A PWM triangular signal error	■ Hardware error: Triangular signal does not oscillate or it oscillates at the wrong frequency.	■ Exchange drive-control board. ■ Inform your service agency.
C00B Too little main memory	■ Internal software error	■ Check the software version.
C00D Program checksum error	■ An internal software or hardware error has occurred.	■ Check the software version. ■ Exchange drive-control board.
C00E Controller software timeout	■ An internal software or hardware error has occurred.	■ Check the software version. ■ Exchange drive-control board. ■ Inform your service agency.
C012 Pos. contr. cyc. time err.	■ MC is outputting erroneous cycle time for CC position controller. ■ A hardware error has occurred.	■ Check machine parameter MP7600.0. ■ Exchange drive-control board.
C016 Double speed not possible	■ Control loop on X51 or X52 is defined as "double speed," although the control loop on X53 or X54 is active. ■ Control loop on X55 or X56 is defined as "double speed," although the control loop on X57 or X58 is active (only CC 4xx with 8 control loops).	■ Define the control loop on X51 or X52 as "single speed," or deactivate the PWM output X53 or X54. ■ Define the control loop on X55 or X56 is defined as "single speed," or deactivate the PWM output X57 or X58 (only CC 4xx with 8 control loops).
C017 PWM frequency too high	■ For a single-speed control loop, the PWM basic frequency set in MP2180.x is twice as high, and the current controller cycle time set in MP2182.x is half as high.	■ Check MP2180.x and MP2182.x. ■ Use a double-speed control loop instead of single-speed.
C018 Master-slave torque: Axis assignment incorrect	■ Axes in master-slave torque control are only permitted at X15/X17 or X16/X18.	■ Change the axis assignment.
C2A0 Encoder input %.2s	■ Incorrect entry in MP112.x or MP113.x (speed encoder) ■ Internal software error	■ Check the entry in MP112.x or MP113.x. ■ Check the software version.
C300 Zn track %.2s error	■ No encoder signal available ■ Interruption in motor encoder cable ■ Signal amplitude of motor encoder is missing or too small.	■ Check connection of motor encoder. ■ Check the motor encoder. ■ Check the amplitude of the encoder signal.
	■ See "Speed encoders" on page 19 – 300.	■ See "Speed encoders" on page 19 – 300.
C310 Z1 track %.2s error	■ Contamination of the motor encoder (Z1 track) ■ Motor encoder cable defective. ■ Motor control board defective	■ Exchange the motor. ■ Check the motor table entry. ■ Exchange the motor drive-control board.
	■ See "Speed encoders" on page 19 – 300.	■ See "Speed encoders" on page 19 – 300.
C330 Motor temp. too high %.2s	■ Measured motor temperature is too high ■ No temperature sensor ■ Motor encoder cable defective. ■ Entry in motor table is incorrect ■ Incorrect or defective temperature sensor was installed	■ Let the motor cool down. ■ Check the motor table entry. ■ Check the entry in the motor table. ■ Measure the temperature sensor.
	■ See "Speed encoders" on page 19 – 300. ■ See Service Manual Inverter Systems and Motors.	■ See "Speed encoders" on page 19 – 300. ■ See Service Manual Inverter Systems and Motors.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
C340 Unknown counter compnt. %.2s	■ Hardware defective ■ Motor encoder defective ■ Incorrect software version	■ Check the software version. ■ Operate the motor at another encoder input. ■ Exchange drive-control board.
C350 Axis module %.2s not ready	■ No pulse release for the power axis module ■ Uz too high ■ 5-V power supply too weak ■ Inverter is not ready for operation ■ Motor control board defective ■ PWM cable defective ■ Noise pulses	■ Check the control and cabling of the pulse release. ■ Check Uz. ■ For a non-regenerative power supply unit: Is the braking resistor connected? ■ If the power supply is regenerative: Is the energy recovery activated? ■ Check the grounding and shielding of the cable. ■ Exchange the power module. ■ For P controls: Exchange the interface card. ■ Exchange the motor drive-control board.
		■ See "Checking the enables on the iTNC 530 HSCI" on page 17 – 225. ■ See Service Manual Inverter Systems and Motors.
C370 Angle error motor enc. %.2s	■ Motor encoder defective ■ Motor encoder cable defective. ■ Drive control board defective	■ Check the motor encoder and leads. ■ Exchange the motor control board.
		■ See "Speed encoders" on page 19 – 300.
C380 Motor %.2s not controllable	■ Motor cables were crossed (e.g. X with Y) ■ Motor encoder cable switched ■ Phases connected incorrectly to motor ■ Motor encoder cable defective ■ Incorrect motor table entry (direction of rotation) ■ Motor defective ■ I2t monitoring has responded	■ Check the motor cabling. ■ Check motor and motor encoder cable. ■ Check motor table entry. ■ Check I2t monitoring (MP2302.x).
	■ See "Speed encoders" on page 19 – 300. ■ See Service Manual Inverter Systems and Motors.	■ See "Speed encoders" on page 19 – 300. ■ See Service Manual Inverter Systems and Motors.
C390 Error in 3-D touch probe %.2s	■ Software error ■ Hardware error on drive-control board	■ Exchange the motor drive-control board. ■ Check the software version.
		■ See "Touch probes" on page 26 – 415.
C3A0 Incorrect ref. position %.2s	■ Incorrect motor selected (MP2200) ■ Ground error on the motor encoder cable (noise on Ref) ■ Motor encoder defective	■ Check the motor selection (MP2200). ■ Check the cabling of the motor encoder (grounding). ■ Exchange the motor.
		■ See "Speed encoders" on page 19 – 300.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
C3B0 Motor %.2s: is not turning	■ Inverter is not ready ■ Disturbance on RDY input of PWM output connector ■ Motor jammed ■ Inverter defective ■ Motor defective ■ Incorrect motor selected (MP2200.x) ■ Assignment of PWM outputs incorrectly entered in MP120.x ■ Assignment of encoder inputs incorrectly entered in MP112.x ■ Motor power cables crossed ■ Motor encoder cable switched ■ Motor connection defective ■ I2T monitoring is responding	■ Check the inverter. ■ Check the motor and cabling. ■ Check the machine parameters. ■ Check I2t monitoring (MP2302.x).
		■ See "Sequence for finding errors in the control loop" on page 6 – 58. ■ See Service Manual Inverter Systems and Motors.
C3C0 Motor current %.2s too high	■ Incorrect current controller parameters ■ Incorrect parameters in the motor table ■ Power module defective ■ Motor cable defective ■ Motor defective ■ Motor control board defective	■ Correct motor and power module selected? ■ Check the current controller adjustment. ■ Check the motor and motor cable for a short circuit. ■ Exchange the power module or drive-control board.
		■ See "Sequence for finding errors in the control loop" on page 6 – 58. ■ See Service Manual Inverter Systems and Motors.
C3D0 PWM component defective %.2s	■ An internal hardware error has occurred.	■ Inform your service agency. ■ Exchange drive control board.
C3E0 Err. in rated U of motor %.2s	■ Motor rated voltage outside of permitted input range	■ Check the entry in the motor table.
C3F0 EnDat not found <axis>	■ Connected EnDat encoder or encoder cable is defective. ■ EnDat communication error	■ Check the motor table (column SYS). ■ Exchange the motor control board. ■ Check speed encoder cable (defective or too long). ■ Check speed encoder. ■ Check the grounding and shielding of the cables.
		■ See "Speed encoders" on page 19 – 300.
C400 Line count error <axis>	■ Line count from the motor table does not match the downloaded values.	■ Check machine parameters for linear distance of one motor revolution and distance for the number of signal periods. ■ Check the motor table (columns TYPE and STR). ■ Check speed encoder.
	■ See "Speed encoders" on page 19 – 300.	■ See "Speed encoders" on page 19 – 300.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
C410 Rotor position <axis> undefined	■ Contamination of the speed encoder (Zn track) ■ Speed encoder cable defective ■ Motor control board defective ■ Speed encoder defective	■ Exchange the motor. ■ Check the speed encoder cable. ■ Exchange the motor control board.
	■ See "Speed encoders" on page 19 – 300.	■ See "Speed encoders" on page 19 – 300.
C420 Ctrlr parameters incorrect %s	■ Feedforward-control parameters are set incorrectly (acceleration, friction) ■ Excessive acceleration ■ Controller parameters are set incorrectly (Ki, Kp, Kd) ■ Filters are set incorrectly (band rejection, low pass) ■ Inverter defective (IGBT) ■ Incorrect motor selected in motor table	■ Check the adjustment of the axis. ■ Check the inverter.
		■ See "Sequence for finding errors in the control loop" on page 6 – 58. ■ See Service Manual Inverter Systems and Motors.
C430 Error of position input <axis>	■ Position encoder input does not exist ■ Position encoder input not connected correctly ■ Position encoder input defective	■ Install position encoder input. ■ Check connection of the position encoder input. ■ Exchange the position encoder input.
		■ See "Position encoders" on page 19 – 277.
C440 PWM frequency <axis> incorrect	■ PWM frequency within a control group is incorrect.	■ Check the machine parameters for PWM frequency. ■ PWM frequency > 5000 Hz only with suitable hardware and only with PWM outputs X51, X52, X57 or X58. ■ PWM frequency <= 5000 Hz must be identical within the control group. ■ PWM frequency > 3200 Hz
C450 Wrong encoder <axis>	■ Entry in column SYS of the motor table incorrect ■ Speed encoder cable defective ■ Speed encoder defective ■ Motor control board defective	■ Check the motor table (column SYS). ■ Check the speed encoder cable. ■ Exchange the motor. ■ Exchange the motor control board.
	■ See "Speed encoders" on page 19 – 300.	■ See "Speed encoders" on page 19 – 300.
C460 Motor speed too high <axis>	■ Motor not controllable	■ Check the software version. ■ Inform your service agency.
C4A0 Inverter %s is not active	■ Inverter switched off (PLC, SH1) ■ Inverter defective ■ Motor defective ■ Incorrect motor selected in motor table ■ Motor connected incorrectly ■ Motor power cables crossed	■ Check the inverter and wiring. ■ Check the motor and wiring.
		■ See Service Manual Inverter Systems and Motors.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
C4C0 No motor current %s	■ Motor connected incorrectly or not at all ■ Inverter defective ■ Motor defective ■ Incorrect motor selected in motor table ■ Motor power cables crossed	■ Check the motor and wiring. ■ Check the inverter.
	■ Conductor bars not tightened sufficiently	■ Tighten the conductor bars securely. ■ See Service Manual Inverter Systems and Motors.
C5F0 Wrong position-encod. input	■ An incorrect input was selected for the position encoder (MP110.x/MP111.x) Possible configurations: CC 4xx/6 control loops: X201 to X206 CC 4xx/8 control loops: X201 to X208 CC 4xx/10 control loops:: PWM outputs X51 to X56: X201 to X206 PWM outputs X57 to X60: X207 to X210	■ Check MP110.x/MP111.x.
E170 Position error too large <axis>	■ Parameter value in MP640.x is too small ■ Defect in the mounting of the position encoder ■ Incorrect temperature compensation, or linear or nonlinear compensation ■ Excessive backlash	■ Check the parameter value in MP640.x (maximum position deviation between MC and CC during operation). ■ Check the parameter value in MP720.x (linear axis error compensation for analog axes). ■ Check the parameter value in MP710.x (backlash compensation). ■ Check the mounting of the position encoder.
		■ See ”Sequence for finding errors in the control loop” on page 6 – 58.
F010 DSP error in axis %.2s	■ Error in the power stage of the displayed axis	■ Inform your service agency.
Axis <axis> motor current not equal to 0	■ The axis motor is receiving current, although its inverter was switched off!	■ Inform your service agency.
Switch-off pos. %.2s unequal ENDAT	■ Last saved axis position does not correspond to the current position of the rotary encoder with EnDat interface.	■ Check MP960. ■ Inform your service agency.
	■ See ”Encoder interface” on page 19 – 277.	■ See ”Encoder interface” on page 19 – 277.
Operating parameters erased	■ The machine parameters have been erased and the PLC program is missing.	■ Enter new operating parameters.
		■ See ”Restoring data” on page 14 – 207.
Movement monitoring error in <axis> A	■ The axis is moving at least 4 times slower or faster than commanded by the nominal speed command output. ■ Large backlash ■ Overloaded driver ■ Insufficient lubrication ■ Mechanical stiffness ■ Machine vibration ■ For analog axes: Servo defective	■ Check machine parameter MP1140.x. ■ Remove any large backlash. ■ Check the lubrication. ■ Remove mechanical stiffness. ■ Analog axes: Check the servo. ■ Inform your service agency.
		■ See ”Sequence for finding errors in the control loop” on page 6 – 58.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
Movement monitoring error in <axis> B	■ The motor is moving while the axis slide is stationary or vice versa. ■ Excessive difference between the positions calculated from the position encoder pulses and the speed encoder pulses. ■ Excessive backlash ■ Defective coupling, gear, etc. ■ Belt torn	■ Check MP1144.x. ■ Check the backlash. ■ Repair the defective coupling, gear, etc. ■ Replace the belt. ■ Inform your service agency.
		■ See ”Sequence for finding errors in the control loop” on page 6 – 58.
CC%d +5V LE out of tolerance	■ The 5V power supply of the LE is outside the permissible tolerance range.	■ Inform your service agency.
		■ See ”Power supply” on page 18 – 243. ■ See ”Error localization by process of exclusion” on page 6 – 63. ■ See Service Manual Inverter Systems and Motors.
CC amplitude too low %.2s	■ See "Position encoder %2: Amplitude too small".	■ See "Position encoder %2: Amplitude too small".
CC frequency too high %.2s	■ The maximum input frequency was exceeded at an encoder input.	■ Check encoder signal input frequency.
		■ See ”Further examination of position and speed encoders” on page 19 – 314.
CC%d NC temperature out of tol.	■ The temperature inside the LE is outside the permissible tolerance range.	■ Ensure adequate ventilation in the electrical cabinet.
		■ See ”Information menu” on page 18 – 261. ■ See ”Temperature” on page 6 – 74.
CC%d S checksum error	■ Checksum error due to faulty data.	■ Inform your service agency.
CC standstill monitoring %.2s	■ See "Standstill monitoring err. in %2".	■ See "Standstill monitoring err. in %2".
CC%d inverter for axes RDY=0	■ The power supply of an axis could not be switched to ready condition.	■ Check the wiring.
		■ See ”Checking the enables on the iTNC 530 HSCI” on page 17 – 225. ■ See Service Manual Inverter Systems and Motors.
CC%d inverter for axes RDY=1	■ The power supply for a spindle or for an axis is ready for operation although it ought to be switched off.	■ Inform your service agency.
		■ See ”Checking the enables on the iTNC 530 HSCI” on page 17 – 225. ■ See Service Manual Inverter Systems and Motors.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
CC%d inverter for spindle RDY=0	■ The power supply of the spindle could not be switched to ready condition.	■ Check the wiring. ■ Inform your service agency.
		■ See "Checking the enables on the iTNC 530 HSCI" on page 17 – 225. ■ See Service Manual Inverter Systems and Motors.
CC%d inverter for spindle RDY=1	■ The power supply for a spindle is ready for operation although it ought to be switched off.	■ Inform your service agency.
		■ See "Checking the enables on the iTNC 530 HSCI" on page 17 – 225. ■ See Service Manual Inverter Systems and Motors.
The PLC program has been stopped 6796	■ The PLC program has been stopped due to a system error in the PLC.	■ Inform your machine tool builder.
		■ See "Bus diagnosis" on page 12 – 147.
Nominal speed value too high %.2s	■ An excessively high nominal speed value was calculated. Analog axes: Maximum nominal value +-10 V Analog spindle: Maximum nominal value +-10 V Digital axes and spindle: Maximum nominal value = maximum motor speed	■ Inform your service agency.
	■ The machine does not reach the set acceleration and braking ramps. ■ Hardware error in the control loop	■ Analog axes: Check the servo. ■ See "Sequence for finding errors in the control loop" on page 6 – 58.
EnDat defective %X <axis>	■ The encoder with EnDat interface is defective. The error codes have the following meanings: 001 Light source defective 010 Signal amplitude too low 100 Position value incorrect	■ Inform your service agency.
		■ See "Encoder interface" on page 19 – 277.
Ext. in-/output not ready	■ The interface is not connected. ■ The external device is not switched on or not ready. ■ The transmission cable is defective or incorrect.	■ Check the data transmission line.
		■ See "Connection setup" on page 14 – 183.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
External EMERGENCY STOP 26599	■ The "control-is-ready" PLC input is not active. ■ The emergency stop circuit was interrupted manually or by the control.	■ Enable the emergency stop button, switch on the control voltage, and acknowledge the error message. ■ Check the emergency-stop circuit. (EMERGENCY STOP button, axis limit switches, wiring, etc.)
	■ EMERGENCY STOP key pressed on machine operating panel or handwheel ■ Axis is on hardware limit switch ■ Wiring interrupted ■ Relays, safety contactor combinations defective ■ “Control is ready“ output is not powered with 24 V. ■ "Control is ready" output of UEC or PLB defective	■ Retract the axis. ■ Check the EMERGENCY STOP chain. (See ”"Control is ready" output and input (EMERGENCY STOP chain)” on page 17 – 228.) ■ If "Control is ready“ output is defective --> replace UEC or PLB. (See ”Exchange of HEIDENHAIN components” on page 29 – 515.) ■ See ”Checking the enables on the iTNC 530 HSCI” on page 17 – 225.
Incorrect reference position <axis>	■ Signal of the reference pulse is disturbed (ground shield). ■ Position determination via Z1-track is defective. ■ Wrong encoder line count	■ Take measures for noise suppression. ■ Check the motor table. ■ Inform your service agency.
		■ See ”Speed encoders” on page 19 – 300.
Error in HSCI communication 21112	■ An error occurred during communication with a unit on the HSCI bus.	■ Check all devices and connections.
		■ See ”Bus diagnosis” on page 12 – 147.
Error: Profibus configuration	■ Evaluation of the Profibus configuration resulted in an error.	■ Inform your service agency.
Synchronization monitoring <axis>	■ The positions of two synchronized axes differ by a value greater than that defined in machine parameter MP855.	■ Reduce the feed rate and increase the spindle speed. ■ Remove potential sources of vibration. ■ If this occurs frequently: Inform your service agency.
Handwheel?	■ Electronic handwheel not connected ■ Incorrect handwheel selected in machine parameter MP7640 ■ The transmission line is defective or incorrect.	■ Connect the handwheel via cable adapter. ■ Check machine parameter MP7640. ■ Inspect the data transfer line for damage.
		■ See ”Handwheel” on page 25 – 401.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
Handwheel not ready x	x = ... ■ A: Handwheel not attached ■ B: No agreement between handwheel identification and MP7640 ■ C: x contamination (x = axis) ■ D: Transfer error while receiving ■ E: Received BCC check sum incorrect ■ F: Handwheel recognized wrong identification ■ G: Handwheel recognized wrong BCC check sum ■ H: Handwheel is signaling transmission error ■ I: Handwheel is signaling wrong number of initializing parameters ■ J: Handwheel is signaling wrong value of initializing parameters ■ K: Transfer error while sending ■ L: Handwheel recognized wrong axis number of the secondary axis ■ M: New data received during evaluation ■ N: Undefined error code	■ Connect a handwheel. ■ Check the cables.
		■ See "Handwheel" on page 25 – 401.
Hardware error 17527	■ There are too many HSCI devices connected to the control.	■ Disconnect some of the HSCI devices. ■ Inform your machine tool builder.
		■ See "Bus diagnosis" on page 12 – 147.
Hardware error 17528	■ HSCI device is not running. ■ The CCU did not respond within the expected time. ■ CCU is defective or the firmware version is incorrect.	■ Inform your machine tool builder.
		■ See "Bus diagnosis" on page 12 – 147.
HSCI Ethernet connection interrupted 14749	■ The Ethernet transmission is disturbed.	■ Check the cabling.
		■ See "Bus diagnosis" on page 12 – 147.
HSCI Ethernet configuration without CC 14750	■ If the HSCI is configured or connected, a CC must also be connected to the HSCI.	■ Check the cabling.
		■ See "Bus diagnosis" on page 12 – 147.
HSCI: Hardware error 19791	■ An error occurred during access to the HSCI hardware.	■ You can find more diagnostic information in the diagnostics menu.
		■ See "Bus diagnosis" on page 12 – 147.
HSCI: Initializing error 19792	■ An error occurred during initialization of the HSCI hardware.	■ You can find more diagnostic information in the diagnostics menu.
		■ See "Bus diagnosis" on page 12 – 147.
HSCI: IOC file is missing 19845	■ Entry in OEM.SYS does not exist ■ IOC file does not exist	■ Restart the control. ■ Check the IOC file and OEM.SYS.
		■ See "Bus diagnosis" on page 12 – 147.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
HSCI connection error 21113	■ A connection error was found on the HSCI bus.	■ Check all devices and connections. ■ Check the connector sequence of the HSCI cable (X500 -> X502 or X501 -> X502).
		■ See ”Bus diagnosis” on page 12 – 147.
HSCI watchdog could not be deleted 21111	■ The HSCI watchdog could not be deleted.	■ Inform your service agency.
		■ See ”Bus diagnosis” on page 12 – 147.
HSCI/Profibus: Configuration error 25411	■ HSCI/Profibus configuration file is not entered in the OEM.SYS file (keyword: IOCCFG= / PROFIBUSCFG=) ■ HSCI/Profibus configuration file was not found or is faulty ■ Hardware configuration of the HSCI system differs from the HSCI configuration file. ■ Interruption in the HSCI bus	■ Check the hardware configuration of the HSCI system in the HSCI bus diagnostics. ■ Check the HSCI connection.
		■ See ”Bus diagnosis” on page 12 – 147.
Internal software error 19794	■ HSCI initialization not completed	■ Inform your service agency.
		■ See ”Bus diagnosis” on page 12 – 147.
Internal software error 19795	■ High-speed inputs not initialized on the PLB 6xxx (HSCI)	■ Inform your service agency.
		■ See ”Bus diagnosis” on page 12 – 147.
No connection to network	■ The connection to the NFS server was interrupted.	■ Check whether the NFS server is available. ■ If necessary, inspect the connections, the cables and the Ethernet card.
Check the position encoder %.2s.	■ Contradiction apparent from comparison of position before power-off and after power-on of the line voltage.	■ Inform your service agency.
		■ See ”Position encoders” on page 19 – 277.
MC +5V LE out of tolerance	■ The 5V power supply of the LE is outside the permissible tolerance range.	■ Inform your service agency.
		■ See ”Power supply” on page 18 – 243. ■ See ”Error localization by process of exclusion” on page 6 – 63. ■ See Service Manual Inverter Systems and Motors.
MC standstill monitoring %.2s	■ See "Standstill monitoring err. in %2".	■ See "Standstill monitoring err. in %2".
MC amplitude too high %.2s	■ See "Amplitude too high at position encoder %1".	■ See "Amplitude too high at position encoder %1".
MC amplitude too low %.2s	■ See "Position encoder %2: Amplitude too small".	■ See "Position encoder %2: Amplitude too small".
Op. state of MC not equal CC	■ The automatic SRG, SBH, and SH operating states of the MC and CC are compared cyclically. If the values remain unequal for longer than 500 ms, a Stop 1 is released.	■ Switch on the machine and acknowledge the error message with CE.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
MC frequency too high %.2s	■ The maximum input frequency was exceeded at an encoder input.	■ Check encoder signal input frequency.
		■ See ”Further examination of position and speed encoders” on page 19 – 314.
MC NC temperature out of tol.	■ See "Temperature too high (CPU%1 := %2°C)".	■ See "Temperature too high (CPU%1:= %2 °C)".
%.2s encoder: amplitude too large	■ The amplitude of the encoder signal is too high or the contamination signal active.	■ Check the amplitude of the encoder signal.
		■ See ”Position encoders” on page 19 – 277.
%.2s encoder: amplitude too small	■ The amplitude of the encoder signal is too small or the signal for contamination is active.	■ Check the amplitude of the encoder signal.
		■ See ”Position encoders” on page 19 – 277.
%.2s measuring system defective	■ Contradiction apparent from comparison of absolute and incremental positions	■ Inform your service agency.
		■ See ”Encoder interface” on page 19 – 277.
%.2s encoder: frequency too high	■ The maximum input frequency was exceeded at an encoder input.	■ Check encoder signal input frequency.
		■ See ”Further examination of position and speed encoders” on page 19 – 314.
NC: Program memory erased	■ After the control was switched on, a file in NC memory was found faulty and deleted.	■ Create the file again.
		■ See ”Restoring data” on page 14 – 207.
EMERGENCY STOP defective	■ The internal or external EMERGENCY STOP circuit is found by the system CPU to be defective.	■ Check the emergency-stop circuit.
	■ Relays, safety contactor combinations are defective or too slow. ■ Input I3 (X42/4) is continuously at 24 V. ■ MC defective	■ Check input I3. (See ””Control is ready" output and input (EMERGENCY STOP chain)” on page 17 – 228.) ■ Replace relays, safety contactor combinations. ■ See ”Error message: EMERGENCY STOP defective” on page 17 – 230.
Excessive offset in <axis>	■ During offset adjustment (with code number or cyclic) an offset voltage of more than 100 mV was determined.	■ Inform your service agency.
		■ See ”Analog speed value interface” on page 21 – 349.
Parallel operation not possible	■ You edited the machine or user parameter list and tried to exit the editor with END. This is not permitted if the part program or a PLC positioning operation is running.	■ Wait until the part program run is ended, or interrupt the NC program.
PLC: timeout	■ PLC run-time error	■ Edit the PLC program.
		■ See ”PLC main page” on page 11 – 116.
PLC partition: Not enough memory	■ Not enough free memory on the PLC partition	■ Inform your service agency. ■ Delete unneeded files from the PLC partition.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
PLC program could not be started 20353	■ Time out during initialization of the Profibus or HSCI hardware	■ Inform your service agency.
		■ See "Bus diagnosis" on page 12 – 147.
Positioning error	■ The following error of a moving axis is greater than the value given in machine parameter MP1710 (in following error mode) or MP1410 (feedforward mode).	■ Reduce the feed rate and increase the spindle speed. ■ Remove potential sources of vibration.
	■ Blunt tool ■ Excessive machining feed rate ■ Spindle speed too low ■ Insufficient lubrication ■ Mechanical stiffness ■ Machine vibration ■ Hardware error in the control loop ■ Analog axes: Excessive drift ■ Analog axes: Defective tachometer ■ Analog axes: Defective carbon brushes	■ Replace the worn tool. ■ Check the lubrication. ■ Remove mechanical stiffness. ■ Analog axes: Adjust the drift. ■ Analog axes: Replace the carbon brushes of the tachometer, adjust the tachometer. ■ Analog axes: Replace the carbon brushes of the motor. ■ See "Sequence for finding errors in the control loop" on page 6 – 58. ■ Carry out offset adjustment. (See "Adjusting the electrical offset (drift adjustment)" on page 21 – 355.) ■ Carry out speed adjustment. (See "Speed adjustment at the servo amplifier (tachometer adjustment)" on page 21 – 358.)
Profibus: file/memory error	■ A file access error or an error in the error management occurred with Profibus functions.	■ Inform your service agency.
Profibus: Hardware error	■ An error occurred during access to the Profibus hardware.	■ You can find more information in the diagnostics menu.
		■ See "PROFIBUS" on page 12 – 162.
Profibus: Initialization error	■ Initialization of the Profibus hardware resulted in an error.	■ You can find more information in the diagnostics menu.
		■ See "PROFIBUS" on page 12 – 162.
Profibus: Configuration error	■ HSCI/Profibus configuration file is not entered in the OEM.SYS file (keyword: IOCCFG= / PROFIBUSCFG=) or this file could not be found.	■ Inform your service agency.
Profibus: PCI hardware error	■ Access to the Profibus master board is not possible.	■ Inform your service agency.
Program incomplete	■ Data transmission was interrupted with the <END> key.	■ Transfer the program again.
Processor 1 temperature too high	■ The temperature sensor on processor 1 (processor board) has detected excessively high temperature.	■ Check the heat transfer in the electrical cabinet. ■ Check the fan of the logic unit.
		■ See "Information menu" on page 18 – 261. ■ See "Temperature" on page 6 – 74.
Processor 2 temperature too high	■ The temperature sensor on processor 2 (RTPC processor board) has detected excessively high temperature.	■ Check the heat transfer in the electrical cabinet. ■ Check the fan of the logic unit.
		■ See "Information menu" on page 18 – 261. ■ See "Temperature" on page 6 – 74.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
Exchange buffer battery	■ The voltage of the buffer battery has dropped below the minimum value.	■ Exchange the buffer battery.
		■ See ”Buffer battery” on page 18 – 257.
Ref mark <axis>: incorrect spacing	■ During a reference run on an encoder with distance-coded reference marks a distance of more than 1000 grating periods was covered without passing over a reference mark.	■ Correct the machine parameter MP1350.
		■ See ”Encoder interface” on page 19 – 277.
Traverse reference points	■ In a part program block you attempted to move an axis that has not yet traversed the reference point.	■ Move the axis over the reference point.
		■ See ”Reference run” on page 20 – 323.
Relay: n.c. contact open?	■ In the relay chain, the normally closed contact of one or more relays is open.	■ Check the relay for proper function.
		■ See ”Checking the enables on the iTNC 530 HSCI” on page 17 – 225.
Nonvolatile PLC data deleted	■ The code number 531210 was entered.	
		■ See ”Non-volatile PLC markers and words” on page 11 – 134.
Excessive servo lag in <axis>	■ See "8BD0 Excessive servo lag in <axis>".	■ See "8BD0 Excessive servo lag in <axis>".
Spindle motor current not equal to 0	■ The spindle motor is receiving current, although its inverter was switched off.	■ Inform your service agency.
		■ See ”Checking the enables on the iTNC 530 HSCI” on page 17 – 225. ■ See Service Manual Inverter Systems and Motors.
Standstill monitoring %2	■ The position deviation at standstill is greater than the value entered in machine parameter MP1110.x.	■ Inform your service agency.
	■ Analog axes: Excessive drift ■ Vertical axes: Poor brake or defective weight balance ■ Clamped axes: Great mechanical effects during machining	■ Analog axes: Adjust the drift. ■ Vertical axes: Check the brake or the weight balance. ■ Clamped axes: Remove any great mechanical effects during machining. ■ See ”Sequence for finding errors in the control loop” on page 6 – 58. ■ Carry out offset adjustment. (See ”Adjusting the electrical offset (drift adjustment)” on page 21 – 355.)

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
Relay external DC voltage missing	■ Error message after power interruption	■ Switch on the control voltage separately.
	■ EMERGENCY STOP key pressed on machine operating panel or handwheel ■ Axis is on hardware limit switch ■ Wiring interrupted ■ Relays, safety contactor combinations defective ■ X34 is not powered with 24 V ■ "Control is ready" output of MC defective	■ Release the EMERGENCY STOP switch. ■ Retract the axis. ■ Check the EMERGENCY STOP chain. (See ""Control is ready" output and input (EMERGENCY STOP chain)" on page 17 – 228.) ■ If "Control is ready" output is defective --> replace the MC. (See "Exchange of HEIDENHAIN components" on page 29 – 515.) ■ See "Checking the enables on the iTNC 530 HSCI" on page 17 – 225.
Stylus already in contact	■ The stylus is already deflected at the start of probing movement.	■ Retract touch probe, repeat probing. ■ Inspect touch probe for damage.
		■ See "Touch probes" on page 26 – 415.
Exchange touch probe battery.	■ Battery dead	■ Replace the battery.
		■ See "Touch probes" on page 26 – 415.
Touch probe not ready	■ The touch probe is not connected. ■ Battery dead ■ No connection between infrared probe system and receiver unit.	■ Connect the touch probe. ■ Replace battery ■ Clean the receiver unit.
	■ Penetration of humidity ■ Touch probe cable defective ■ Cable to transceiver unit defective ■ Contamination of probe and/or transmitter/receiver unit --> No infrared connection ■ Obstacle in the infrared connection or strong shading of transmitter or receiver ■ Several touch probes may be within the receiving range of one SE; the infrared signals cannot be allocated any more; faulty operation. ■ Interface to touch probe or transmitter/receiver unit on MC defective	■ Dry the touch probe. ■ Replace the cable. ■ Clean touch probe and transmitter/receiver unit. ■ Remove the obstacle in the infrared connection. ■ Readjust receive range of SE. ■ If the interface to touch probe or transmitter/receiver unit on the MC is defective --> replace the MC. (See "Exchange of HEIDENHAIN components" on page 29 – 515.) ■ See "Touch probes" on page 26 – 415.
TNC temperature warning %dC	■ The temperature sensor in the control has detected an excessively high temperature inside the control housing. If the temperature continues to increase, the control hardware may be damaged.	■ Check the heat transfer in the electrical cabinet. ■ Check the fan in the control.
		■ See "Information menu" on page 18 – 261. ■ See "Temperature" on page 6 – 74.
TNC temperature too high %d°C	■ The temperature sensor in the LE has detected an excessively high temperature inside the control housing.	■ Check for adequate heat transfer in the electrical cabinet. ■ Check the fan of the logic unit.
		■ See "Information menu" on page 18 – 261. ■ See "Temperature" on page 6 – 74.
TS: Inadequate consistency	■ During multiple measurement with the automatic probe cycle the variance of the individual measured values is greater than the value defined in machine parameter MP6171.	■ Check whether the probe point and the stylus are clean. ■ Increase the tolerance in MP6171.
		■ See "Touch probes" on page 26 – 415.

Error message	Possible cause of error	Measures for error diagnosis and/or corrective action
	Additional information and descriptions in the manual	**Additional information and descriptions in the manual**
5 V power supply too high	■ The 5 V supply voltage of the control is too high.	■ Check the power supply. ■ Inform your service agency.
		■ See "Power supply" on page 18 – 243. ■ See "Error localization by process of exclusion" on page 6 – 63. ■ See Service Manual Inverter Systems and Motors.
5-V power supply too low	■ The 5 V supply voltage of the control is too low.	■ Check the power supply. ■ Check the current consumption of the consumers (encoders). ■ Inform your service agency.
		■ See "Power supply" on page 18 – 243. ■ See "Error localization by process of exclusion" on page 6 – 63. ■ See Service Manual Inverter Systems and Motors.
Supply voltage missing at X44	■ Missing supply voltage on connector X44	■ Check the wiring. ■ Inform your service agency.
		■ See "Supply voltage for PLC outputs" on page 18 – 274.
Unknown device on HSCI bus (%s) 26109	■ The NC software identifies every connected device by means of a device table. The table indicates whether the device is supported by the software version installed on the control. A device that the software does not support or that is not yet entered in the device table is connected with the HSCI bus. The device concerned is indicated in the additional information.	■ Run an update of the NC software if the device is not supported by the currently installed version of NC software. ■ Update the device table. A new device that is not yet listed in the device table might be supported by the installed software. In this case an update of the device table is required.
		■ See "Bus diagnosis" on page 12 – 147.
Inverter is not ready for operation	■ After a "safe stop" the inverter did not return to the ready state.	■ Inform your service agency.
		■ See "Checking the enables on the iTNC 530 HSCI" on page 17 – 225. ■ See Service Manual Inverter Systems and Motors.
Insufficient system memory	■ There are too many NC software versions on the control.	■ Delete old NC programs that are no longer required.
		■ See "Reloading the currently used NC software" on page 15 – 215.

5 Errors

5.1 Introduction

Not all error conditions on the control or machine can be shown by error messages on the monitor. Therefore, this chapter gives you an overview of errors with notes and tips on how to proceed.

Permanent and reproducible errors

An interruption in the electrical cabinet or a defective device are a permanent error.
If you can generate an error on a machine at any time, the error is reproducible.
By their very nature, permanent and reproducible errors can be located more easily.

Sporadic and non-reproducible errors

Sporadic errors may, for example, be caused by a loose connection, shielding problems or interference.
Non-reproducible errors cannot be generated reliably by certain actions. They "randomly" appear on the machine.
The integrated log, the PLC logic diagram or the integrated oscilloscope can be used to investigate sporadic, non-reproducible errors.

5.2 Overview of possible errors

The following table shows an overview of specific errors on the machine or control, possible causes of the errors as well as measures for finding these errors.
The potential measures for finding and correcting the errors are described in more detail in the corresponding chapters.

DANGER

In case of errors that may lead to very high currents, e.g. **ground fault or short circuit** in the drive, do not switch on the machine again!
First ensure that there are no defective units, cables, etc.
Then eliminate all ground faults and short circuits in the machine!

Note

Where it is possible and useful, you may switch the control off and on (after several seconds) to observe, whether the error is generated again.

Error	Possible cause of error	Measures for error diagnosis and/or corrective action	Descriptions in this manual
The iTNC monitor remains dark after the machine has been switched on.	■ iTNC monitor defective ■ Power supply to monitor defective ■ Power supply to MC defective ■ Defective unit connected to the control (short circuit, etc.)	■ Check the monitor ■ Check the power supply to the MC ■ Disconnect defective or suspicious units or cables	■ See "Visual display unit" on page 22 – 361. ■ See "Power supply" on page 18 – 243. ■ See "Error localization by process of exclusion" on page 6 – 63.
The control does not boot completely (error messages related to the booting procedure may be displayed).	■ Hard disk defective	■ Exchange MC or HDR or drive assembly	■ See "Exchange of HEIDENHAIN components" on page 29 – 515.
The `Power interrupted` message cannot be confirmed.	■ Key is stuck	■ Check the keyboard	■ See "Keyboard unit" on page 23 – 365.

Error	Possible cause of error	Measures for error diagnosis and/or corrective action	Descriptions in this manual
The message **RELAY EXTERNAL DC VOLTAGE MISSING** does not disappear, although the key CONTROL VOLTAGE ON is pressed.	■ EMERGENCY STOP chain interrupted ■ 24 V power supply from connector X34 missing ■ MC defective	■ Check the output "Control is ready" and acknowledgment I3.	■ See "Checking the enables on the iTNC 530 HSCI" on page 17 – 225.
When the machine is switched on, the error message **EMERGENCY STOP defective** appears.	■ Wiring defective, contactors defective or too slow ■ MC defective	■ Check the related components.	■ See "Error message: EMERGENCY STOP defective" on page 17 – 230.
iTNC monitor is "frozen". The control is inoperable. The main switch must be switched off and on again. After reset of the control **"Power fail Interrupt!"** is entered in the log of new software versions.	■ Power failure ■ Failure of one or several phases in the supply line ■ Supply voltage has fallen below minimum ■ Interruption in the electrical cabinet ■ Inverter (power supply module) defective ■ Short circuit of drives (drive modules, motors)	■ Check the primary supply (cables, fuses, terminals, etc.) ■ Check the wiring of the inverter system; see circuit diagrams of the machine manufacturer. ■ Check the function of inverter system and motors.	■ See "Power supply" on page 18 – 243. ■ See "Service Manual for Inverter Systems and Motors".
DSP errors are generated repeatedly on power-on and during operation. A mechanical reason or a defective unit can be ruled out.	■ Data loss on the hard disk in the SYS partition area	■ Check the hard disk. ■ Reactivate the NC software.	■ See "Test of the data medium" on page 13 – 169. ■ See "Reloading the currently used NC software" on page 15 – 215.
Hard disk errors continue to be generated	■ Defects on the hard disk ■ Defective unit connected to the control (short circuit, etc.)	■ Check the hard disk. ■ Disconnect suspicious devices.	■ See "Test of the data medium" on page 13 – 169. ■ See "Notes and tips for the field service" on page 6 – 71.
NC functions are no longer executed. (The control may have reported that the corresponding files have been deleted).	■ Data loss on the hard disk in the SYS partition area	■ Check the hard disk. ■ Reactivate the NC software.	■ See "Test of the data medium" on page 13 – 169. ■ See "Reloading the currently used NC software" on page 15 – 215.
Error messages regarding encoders or other connected units are generated although you find out that these do not cause the errors.	■ Defective unit connected to the control Probe or handwheel may have been exposed to humidity (coolant, etc.) or have been damaged --> Supply voltages (5 V, 12 V, 15 V) are impaired. A variety of error messages may be generated.	■ Disconnect defective or suspicious devices or cables.	■ See "Error localization by process of exclusion" on page 6 – 63.
Various error messages are generated which, however, are not substantive.	■ Connection (short circuit) of shield potential (chassis, cable shielding) with 0 V potential of the NC power supply	■ Check the cables for damage. Check the machine for correct shielding (ask the machine manufacturer).	■ See "Notes and tips for the field service" on page 6 – 71.
The machine cannot be referenced after switch-on, or during operation neither the axes can be moved nor the spindle switched on.	■ Interruption between NC Stop key and control (the NC Stop signal is low-active)	■ Eliminate the interruption, repair the key element, etc.	■ See "Machine operating panel" on page 24 – 393.
The machine is in the mode **Cross over reference points** which is neither possible with the NC START key nor with the axis direction keys.	■ Inverter system is not ready for operation	■ Check whether the inverter system is ready.	■ See "Readiness of the inverter system" on page 17 – 233.

Error	Possible cause of error	Measures for error diagnosis and/or corrective action	Descriptions in this manual
During reference run, the machine hits the limit switch.	■ The trip dogs for direction reversal during reference run are defective.	■ Check the trip dogs.	■ See "Reference run" on page 20 – 323.
During reference run, the machine hits the mechanical stop (for machines without limit switches). An error message may be displayed, e.g. **`8640 I2T value of motor is too high ...`**	■ The machine was switched off at a wrong position.	■ Reference run with axis-direction keys (no automatic reference mark traverse)	■ See "Reference run" on page 20 – 323.
The machine executes the reference run properly but stops at a wrong position.	■ A wrong reference mark was evaluated. ■ When executing a reference run via the motor encoder, the trigger signal is too close to the desired reference mark. ■ A scale magnet is shifted or defective. ■ The ref. mark selector plate of a scale is shifted. ■ The paint covering a reference mark is damaged or was removed from the scale.	■ Readjust the trip dog relative to the reference mark of the motor encoder. ■ Realign the magnet (outside or inside the scale housing) and fix it with spacers. ■ Readjust the ref. mark selector plate inside the scale housing with special slider. ■ Cover the ref. mark not to be evaluated with paint or replace the scale.	■ See "Readjusting the trip dog for reference end position" on page 19 – 311.
`STIB` ("Control-in-operation = "*" in status display) remains in place even though positioning appears to be completed. In the automatic operating modes the next NC block is not executed; the NC program hangs.	■ Axis did not reach the positioning window. ■ Excessive drift of analog axes ■ Approach behavior of axis not optimized	■ Perform drift adjustment ■ Re-optimization or new optimization of the axis by the machine manufacturer	■ See "Interfaces to the drives" on page 21 – 327.
"Oscillating" axes, sometimes involving loud noise.	■ Poor shielding or grounding ■ Connectors on grounding terminal X131 of infeed/regenerative module (Simodrive 611D) not properly wired ■ Grounding terminal X131 on infeed/regenerative module (Simodrive 611D) or grounding connection damaged	■ Check the grounding of your machine; consult your machine manufacturer. ■ Ensure that all grounding clamps are secure. ■ Check the shielding, e.g. the covers.	■ See "Notes and tips for the field service" on page 6 – 71. ■ See "Exchanging HEIDENHAIN interface boards in the SIMODRIVE system" on page 29 – 553.
The following error is too high at axis standstill.	■ Electrical offset of analog axes	■ Carry out offset adjustment.	■ See "Adjusting the electrical offset (drift adjustment)" on page 21 – 355.
Jerking movement of the analog axis	■ Carbon brushes to supply the motor with energy or to pick off the speedometer are abraded on one side or used up.	■ Exchange the carbon brushes.	
The axes cannot be traversed and the red SH2 LEDs of all HEIDENHAIN drive modules light up (or the red LEDs SH2 or RESET of the HEIDENHAIN interface cards for the SIMODRIVE system).	■ Drive enabling is missing	■ Check the enablings.	■ See "Checking the enables on the iTNC 530 HSCI" on page 17 – 225.

Error	Possible cause of error	Measures for error diagnosis and/or corrective action	Descriptions in this manual
During machining the motors (axes, spindle) coast out of loop to a stop.	■ Defective braking resistor (conversion of electrical energy into heat energy not possible) ■ Defective infeed/ regenerative feedback module (energy recovery not possible) ■ Interruption in the primary supply (fuses, wires, etc.; energy recovery not possible)	■ Check the primary supply (cables, fuses, terminals, etc.) ■ Check the function of inverter system and braking resistor. ■ Check the wiring of the inverter system; see circuit diagrams of the machine manufacturer.	■ See ”Power supply” on page 18 – 243. ■ See "Service Manual for Inverter Systems and Motors".
During operation, the single-processor iTNC 530 HSCI slows down until it becomes inoperable.	■ A defective USB unit is connected to the control.	■ Disconnect all USB units (e.g., touchpad) from the control and reboot it.	

6 Procedures and tips for error diagnosis in the field

6.1 Introduction

The following **systematic procedures** have proven themselves for error diagnosis at a machine tool. They are described below.

Note

Make use of the **extensive diagnosis options** of the iTNC 530 HSCI.

Diagnostic option	Description in this manual
Integrated drive diagnosis	See “DriveDiag” on page 9 – 91.
Integrated Oscilloscope	See “Integrated oscilloscope” on page 10 – 95.
PLC diagnosis	See “PLC diagnosis” on page 11 – 115.
Bus diagnosis	See “PLC diagnosis” on page 11 – 115.
Log	See “Log” on page 8 – 79.

Note

Please also note: “Notes and tips for the field service" on page 71.

6.2 Power off and on

DANGER

In case of errors that may lead to very high currents, e.g. **ground fault or short circuit** in the drive, do not switch on the machine again!
First ensure that there are no defective units, cables, etc.
Then eliminate all ground faults and short circuits in the machine.
--> See ”Sequence for finding serious electrical errors” on page 6 – 56.

Where it is possible and useful, you may restart the control:

- Press the EMERGENCY STOP button.
- Shut down the control.
- Press the power switch to switch off the machine.
- Wait for several seconds.
- Switch the machine back on again.
- Observe, whether the error message is generated again.

6.3 Sequence for finding serious electrical errors

The most serious electrical error on a machine tool is a **ground fault or short-circuit**!
.

DANGER

Ground faults or short circuits have to be eliminated before further investigation is possible!

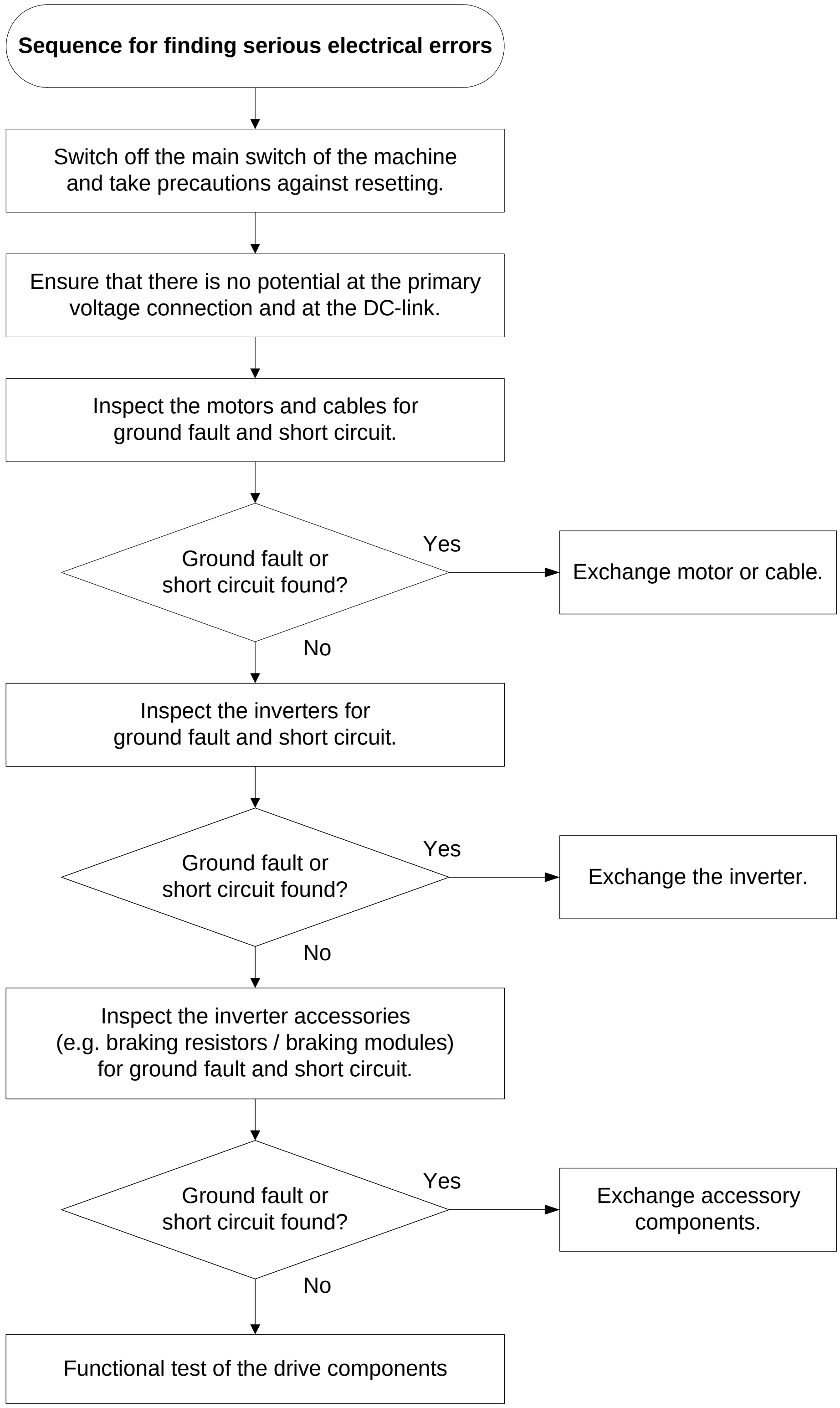
A **ground fault or short circuit** may be suspected in case of:

- Blowing fuses (semiconductor fuses for the primary voltage supply in the electrical cabinet of the machine tool or in a sub-distribution)
- Error messages, such as **`Leakage current in UV 1xx`** or **`Overcurrent cutoff`**
- Scorch marks and/or burnt smell
- Destroyed units

Note

For **detailed descriptions** on how to find ground faults/short circuits, refer to the **Service Manual "Inverter Systems and Motors"**.

Flowchart


Sequence for finding serious electrical errors
Switch off the main switch of the machine and take precautions against resetting.
Ensure that there is no potential at the primary voltage connection and at the DC-link.
Inspect the motors and cables for ground fault and short circuit.
Ground fault or short circuit found?
Yes
Exchange motor or cable.
No
Inspect the inverters for ground fault and short circuit.
Ground fault or short circuit found?
Yes
Exchange the inverter.
No
Inspect the inverter accessories (e.g. braking resistors / braking modules) for ground fault and short circuit.
Ground fault or short circuit found?
Yes
Exchange accessory components.
No
Functional test of the drive components

6.4 Sequence for finding errors in the control loop

In the event of error messages related to movement, acceleration or standstill, for example:

- **Positioning error**
- **Excessive servo lag**
- **Nominal speed value too high**
- **Movement monitoring**
- **Standstill monitoring**

or if there are problems such as:

- Poor workpiece quality
- Unusual noise during axis movements
- Unusual vibrations

... you can check the machine components in a defined order to find the fault --> See flowchart in this chapter.

> Note
>
> If you need information on lubrication, mechanics, hydraulics, pneumatics, brakes, coupling system, please contact your machine manufacturer!

Integrated oscilloscope

The integrated oscilloscope for iTNC 530 HSCI is a handy tool for analyzing errors in the control loop.

Activation and operation --> See "Integrated oscilloscope" on page 10 – 95.

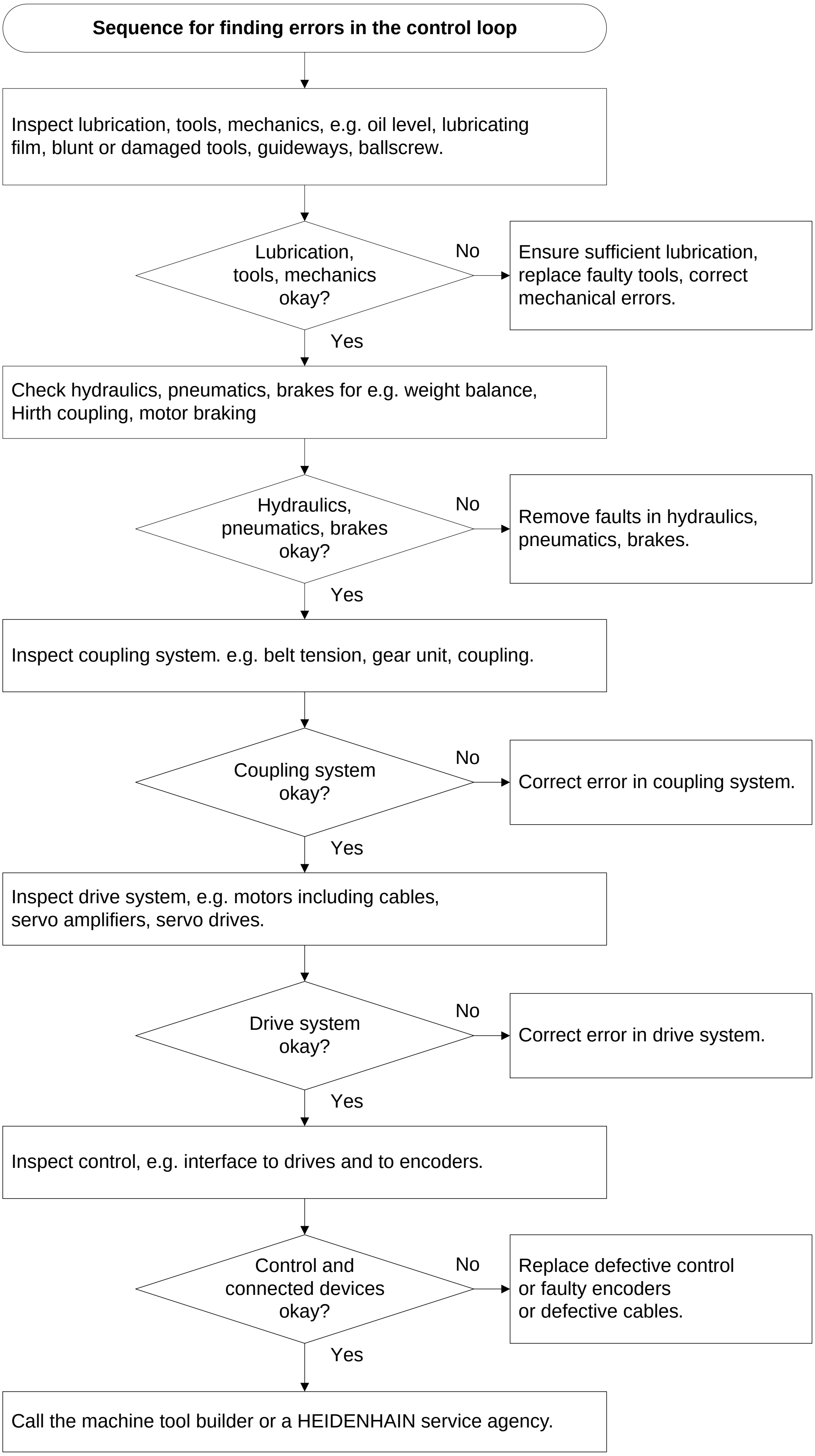
Error message	Recommended signals	Additional signals
Positioning error	**s diff**	**I (noml)**, **I2-t (mot.)**, **I2-t (p.m.)**, **Utilization**
Excessive servo lag	**s diff**	**I (noml)**, **I2-t (mot.)**, **I2-t (p.m.)**, **Utilization**
Nominal speed value too high	**v noml, v (n noml), v actl, v (n actl)**	**I (noml)**, **I2-t (mot.)**, **I2-t (p.m.)**, **Utilization**
Movement monitoring	**v noml, v (n noml), v actl, v (n actl), pos. diff.**	**I (noml)**, **I2-t (mot.)**, **I2-t (p.m.)**, **Utilization**
Standstill monitoring	**s diff, s actl**	**I (noml)**, **I2-t (mot.)**, **I2-t (p.m.)**, **Utilization**

> Note
>
> The torque-determining current **I noml** in particular is an important characteristic for the mechanics of the axis concerned (stiffness, blunt tool, lubrication, utilization, etc.)
>
> Other signals, such as **I2-t (mot.)**, **I2-t (p.m.)** and **Utilization** are calculated from the current.

See also:

- "Finding position differences of direct and indirect encoders" on page 6 – 67
- "Error localization by switching from direct to indirect position measurement" on page 6 – 69

Flowchart


Sequence for finding errors in the control loop
Inspect lubrication, tools, mechanics, e.g. oil level, lubricating film, blunt or damaged tools, guideways, ballscrew.
Lubrication, tools, mechanics okay?
No
Ensure sufficient lubrication, replace faulty tools, correct mechanical errors.
Yes
Check hydraulics, pneumatics, brakes for e.g. weight balance, Hirth coupling, motor braking
Hydraulics, pneumatics, brakes okay?
No
Remove faults in hydraulics, pneumatics, brakes.
Yes
Inspect coupling system. e.g. belt tension, gear unit, coupling.
Coupling system okay?
No
Correct error in coupling system.
Yes
Inspect drive system, e.g. motors including cables, servo amplifiers, servo drives.
Drive system okay?
No
Correct error in drive system.
Yes
Inspect control, e.g. interface to drives and to encoders.
Control and connected devices okay?
No
Replace defective control or faulty encoders or defective cables.
Yes
Call the machine tool builder or a HEIDENHAIN service agency.

Note

Before starting any extensive inspections of the mechanics, the "electrician" can also check the components in the electrical cabinet (power modules, etc.) first.

Note

For **detailed descriptions** of how to examine HEIDENHAIN drives, refer to the **Service Manual ”Inverter Systems and Motors”**.

Possible effects of contaminated, loose, defective encoders

The mentioned error messages and errors in the control loop can also be caused by **contaminated or defective encoders**!

For example, a contaminated field of a scanning head with 4-field scanning can degrade the on-to-off ratio which has a negative effect on the feedback control of the machine axis. As long as the on-to-off-ratio is not outside the tolerance, **no encoder error message** is generated.

If a scanning head or a motor encoder has become loose, the encoder signals may still be sufficiently evaluated. This means that **no encoder error message** is generated. During traverse, and in particular when the direction is changed and if the machine axes vibrate, the above error messages may be generated, as the machine and the encoder are no longer connected firmly.

In exceptional cases, due to defective electronics or a damaged cable, constant voltages may be supplied to the control that are within the tolerance range of the encoder specifications. This means **no encoder error message** is generated.

For an **analysis** you can proceed as follows:

- Increase the monitoring limits (e.g. for the servo lag). -- > A longer distance can be traversed before an error is generated.

DANGER

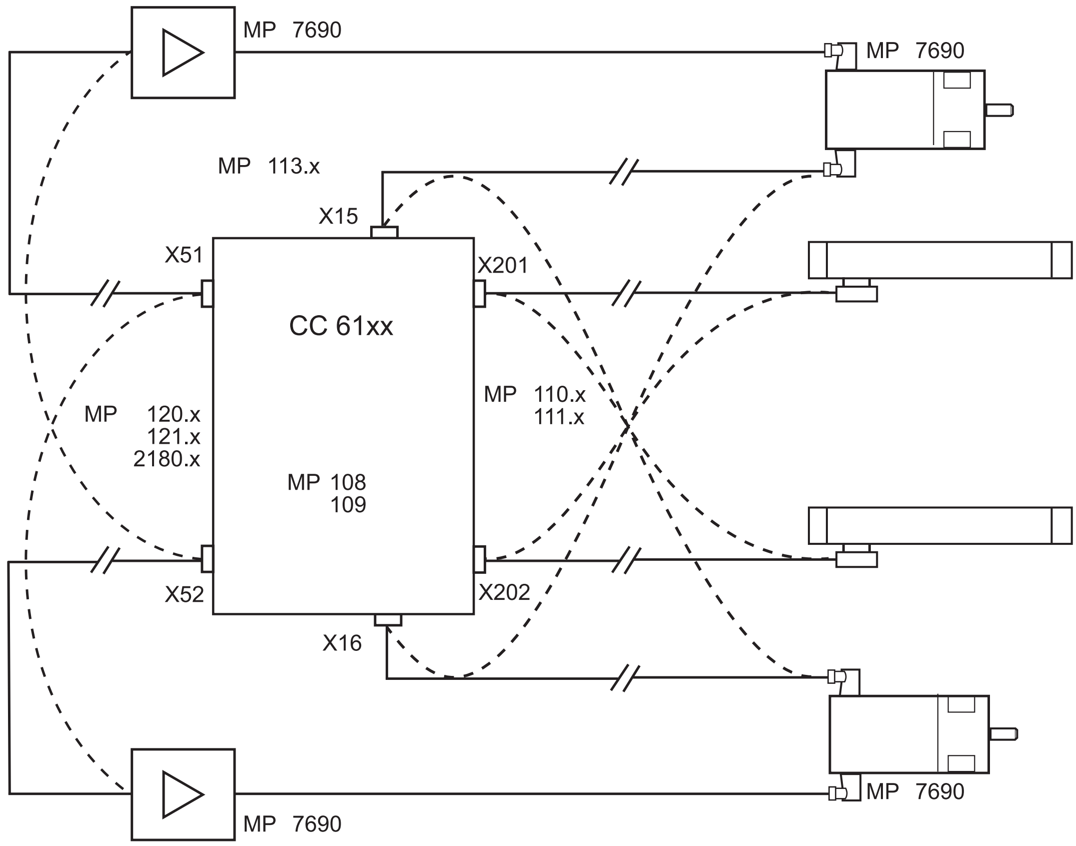
Increasing the monitoring limits reduces the safety of the machine!

- Now inspect the encoder signals with an appropriate measuring device (e.g. PWM 9, See ”PWM 9 encoder diagnostic kit” on page 30 – 564).
  --> When the axis is moved, the signal must change (sine, cosine)!
- Observe the on-to-off ratio, the amplitude height, etc.
- **Finally, restore the original monitoring tolerances!**
- If necessary, clean or replace the encoder. The mechanics may also require reconditioning.

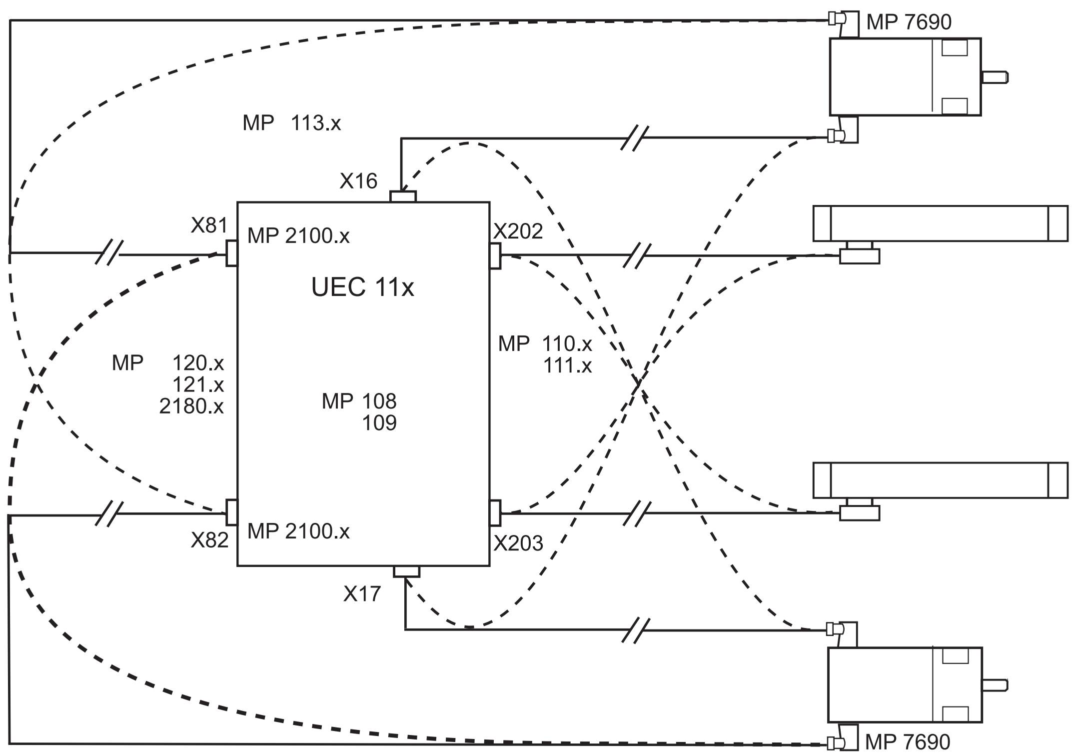
6.5 Error localization by process of interchange

For checking machine-tool components that are available more than once (servo amplifiers, motors, expansion boards, etc.) **the "interchange method" can be used**.
To do this, interfaces or identical devices are interchanged in order to find out, whether the error "moves".

Example: Interchange possibilities on iTNC 530 HSCI with CC 61xx



Example: Interchange possibilities on iTNC 530 HSCI with UEC 11x



For detailed descriptions on how to interchange devices, please refer to the respective chapters of this Service Manual or to the Service Manual for Inverter Systems and Motors.

- Interchanging position encoders --> See "Position encoders" on page 19 – 277.
- Interchanging speed encoders --> See "Speed encoders" on page 19 – 300.
- Interchanging PWM interfaces --> See "Error finding: Axes swapping" on page 21 – 341.
- Interchanging motor outputs --> See "Error finding: Axes swapping" on page 21 – 341.
- Interchanging expansion boards --> See "Error finding: Swapping the HEIDENHAIN expansion boards for the SIMODRIVE 611 system" on page 21 – 347.
- Interchanging inverters, motors --> See "Service Manual for Inverter Systems and Motors".

Attention

When troubleshooting do not connect obviously defective devices (e.g. position encoder with short circuit caused by ingress of moisture) to other interfaces (e.g. X201 - X206) of the control.

6.6 Error localization by process of exclusion

For the **"exclusion method"** probably **defective devices or entire axes** are **deselected** in the NC software and **physically separated** from the control component, i.e. disconnected from the interface of the control component including the cable.
Then a check is made, as to whether the previous error message or error recurs.

The "exclusion method" is useful in the following events:

- The monitor remains dark after the machine is switched on
  --> See "Troubleshooting" on page 22 – 363.

- Errors occur that concern the handwheel
  --> See "Deselecting and disconnecting the portable handwheel" on page 25 – 412.

- Errors occur that concern the touch probe
  --> See "Deselecting and disconnecting the touch probe" on page 26 – 433.

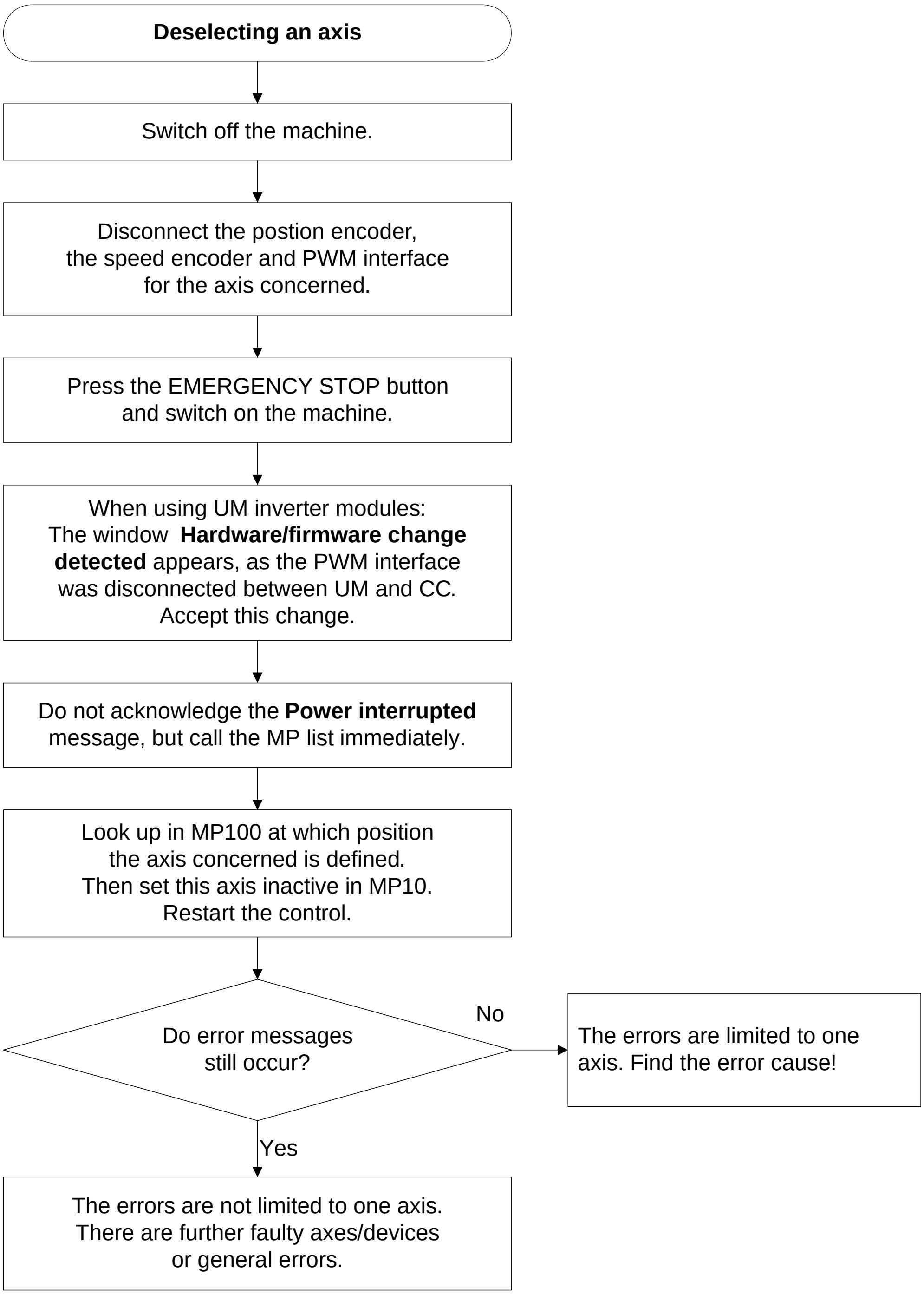
- Errors occur that concern a **certain axis**
  --> See flowchart on next page "Deselecting an axis".

- Errors occur that do **not uniquely refer to a certain axis or connected device**.
  --> Sequentially deselect the axes or disconnect the devices and deselect them in the NC software.

Note

If you intend to use the exclusion method for the tool changer, chip conveyor, Profibus modules, etc., contact your machine manufacturer!

Flowchart



Note

It may be impossible to deselect individual axes when the machine kinematics is active, or the PLC program may prohibit traversing the machine when axes are missing.
--> Ask the machine manufacturer!

Attention

It is not sufficient to deactivate a suspicious axis with machine parameter MP10 (without disconnecting suspicious units).
The units concerned (e.g., position encoder for this axis) are not monitored any more but still supplied with power. The defective scale can thus influence the low voltages of the control, for example.

6.7 Observing essential values with the integrated oscilloscope

The control receives three actual values:

- Current
- Spindle speed
- Position

The actual current is evaluated by means of current sensors in the power output stage.
The actual speed is captured via the motor encoder.
With direct measurement the actual position is provided by, e.g., the linear scale.
From this information most of the signals in the integrated oscilloscope are formed.

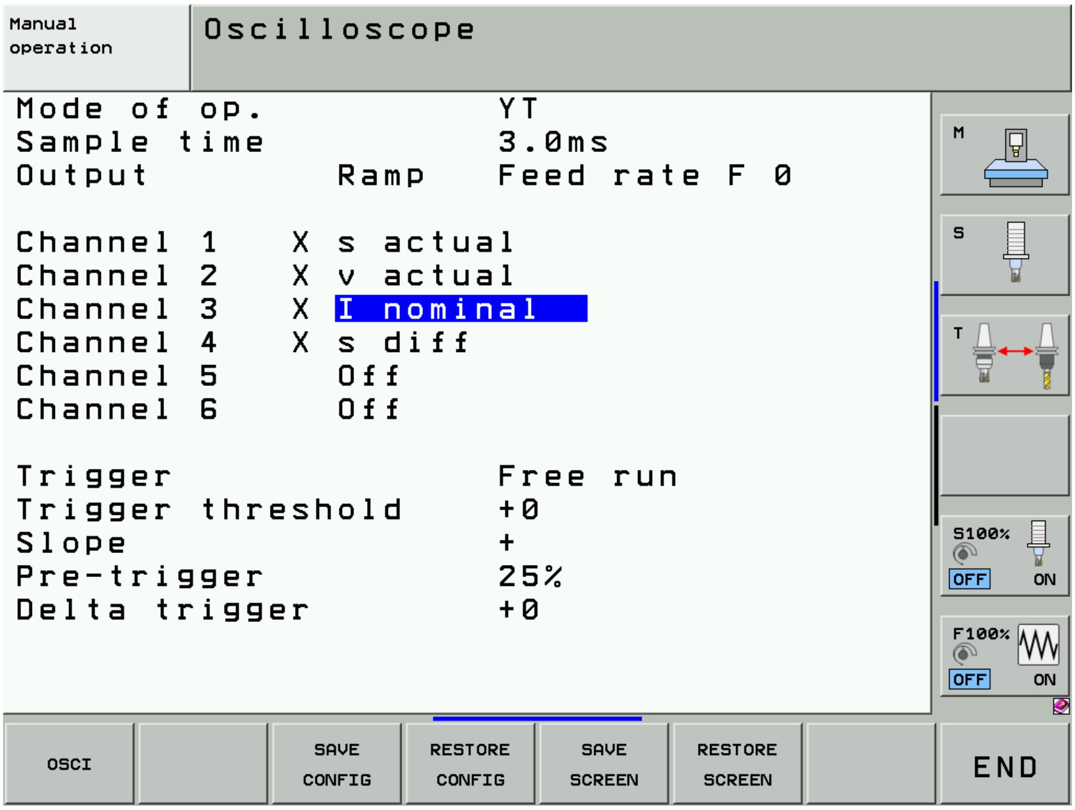
The torque-determining current **I noml** is an important characteristic for the mechanics of the axis concerned (stiffness, blunt tool, lubrication, utilization, etc.)

> Note
>
> Other signals, such as **I2-t (mot.), I2-t (p.m.)** and **Utilization** are calculated from the current.

Like the current, also the servo lag **s diff** is an important characteristic for the mechanics of an axis. At the moment of reversal the following error also allows for conclusions about insufficient feed-forward adjustment, backlash, characteristics of belt, gear, coupling, etc.
For analog axes **s diff** also provides information on the speed adjustment.
(See "Specific for pre-triggering" on page 10 – 104).

Example for a recording of essential values
(Activation and operation --> See "Integrated oscilloscope" on page 10 – 95):

- Make the following settings:



- Move the machine axis in automatic or manual mode.
- Start the oscilloscope recording.
- Stop recording and adjust the signals.

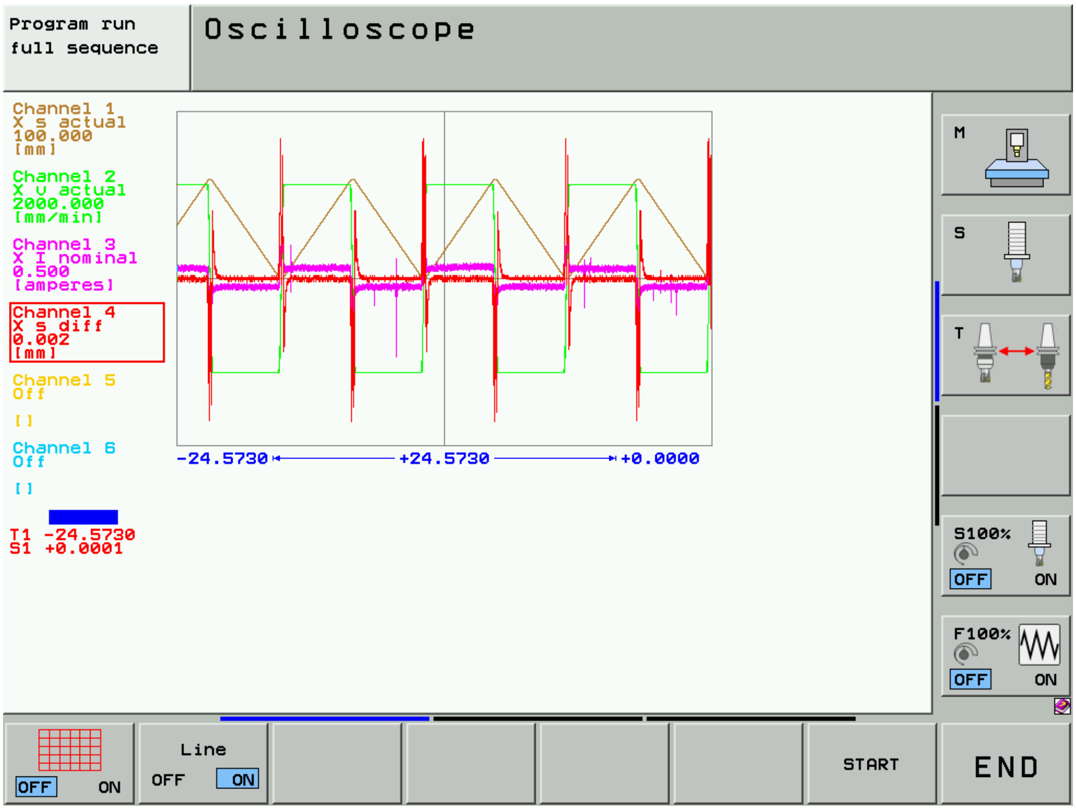
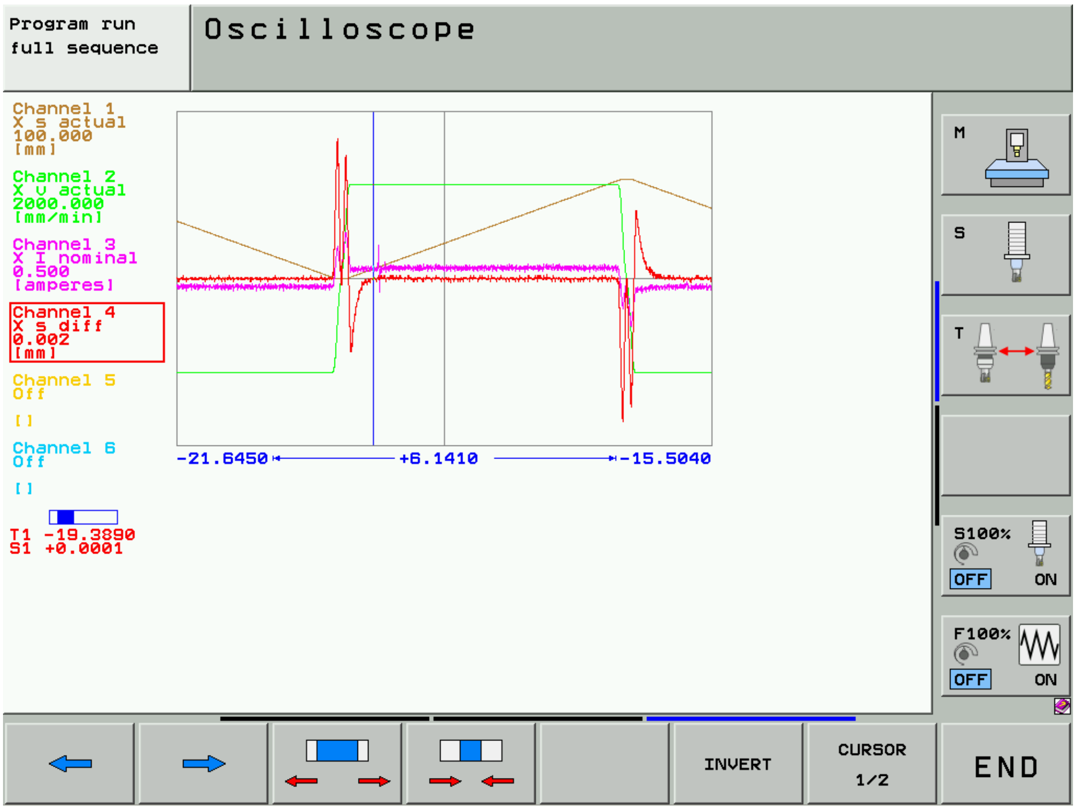


Figure: Peaks in the current and servo-lag signals

- Place the cursor at a prominent spot on the current or servo-lag signal and stretch the time axis -->Details can be observed more easily.



Conclusion

Ideally, you have older recordings of the machine which you can now compare with the new ones.

Striking signal changes, abrupt fluctuations or continuously high values indicate **problems with the mechanics of the axis**.

6.8 Finding position differences of direct and indirect encoders

This procedure serves to compare the signals of the motor encoder to those of the position encoder. This allows to draw conclusions about the quality of the mechanics and the coupling system.

Prerequisite

The **machine tool** to be investigated must be equipped **with digital drives and direct encoders** (dual encoder system).

These instructions do not apply for digital axes with linear motors.

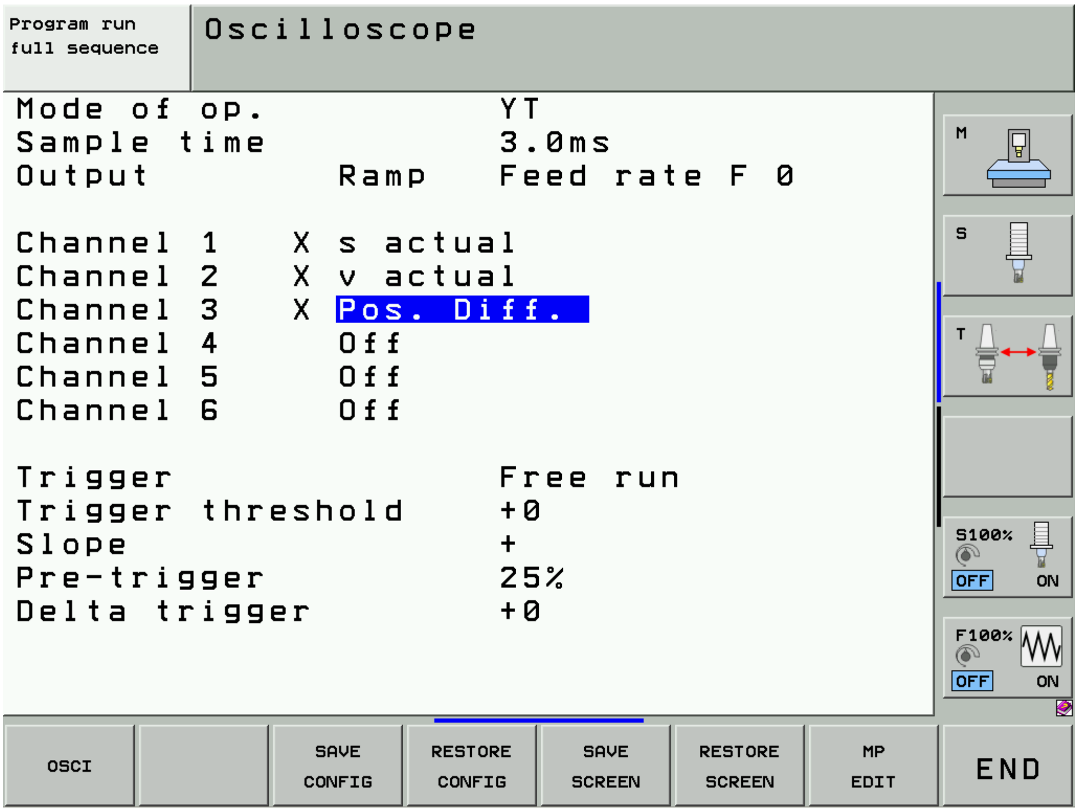
Integrated oscilloscope

The integrated oscilloscope features the **`Pos. Diff.`** signal (difference between position and speed encoder in mm).

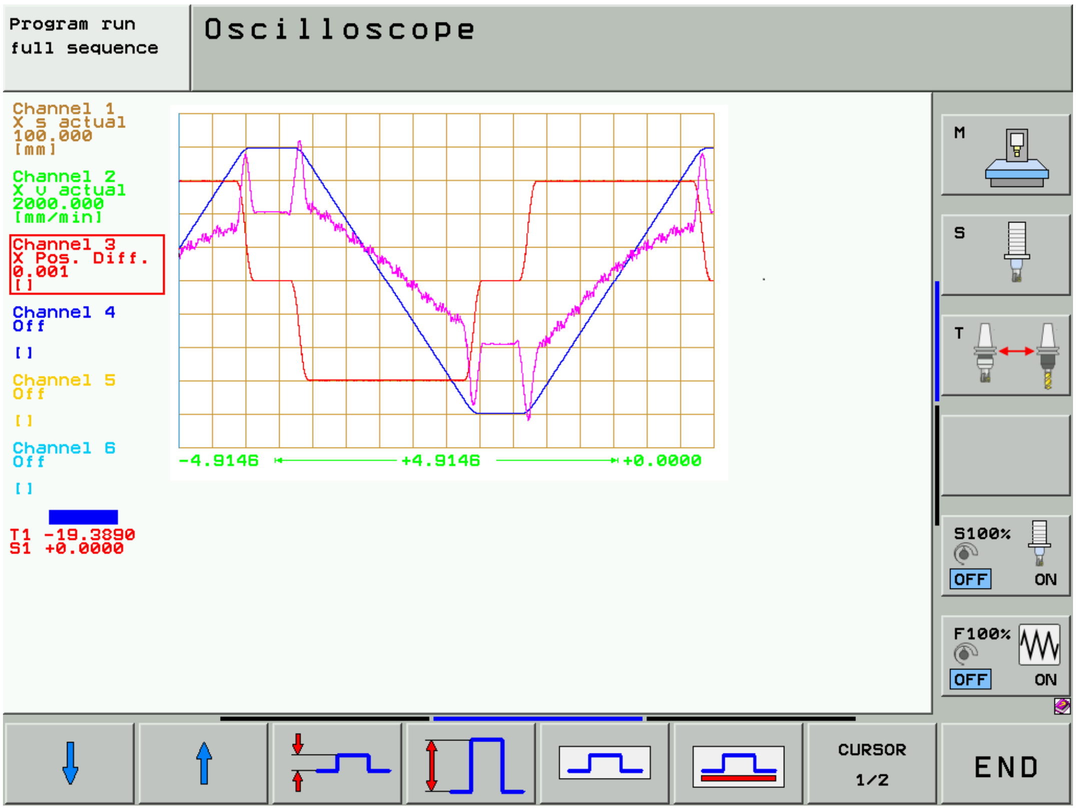
Activation and operation –> See "Integrated oscilloscope" on page 10 – 95.

An **example** of recording a position difference:

- Make the following settings:



- Use an NC program which moves the X axis back and forth several times. (Ask the machine operator.)
- Start the NC program and start oscilloscope recording.
- Stop recording and adjust the signals.



There are peaks in the **`Pos.Diff.`** signal when the direction is changed during braking and acceleration. Between the rotary encoder in the motor and the scanning head at the table there are coupling systems (belts, gears, couplings) and the mechanics (recirculating ball nut, guideways, etc.)
The machine at which the recording was made features a belt drive.
It can also be seen that the **`Pos.Diff`** signal increases and decreases depending on the traverse direction. This behavior is due to an inaccuracy in the transmission ratio of the drive (e.g. belt, ball screw).

Conclusion

Ideally, you have older recordings of the machine which you can now compare with the new ones.

If the position difference has increased, in most cases **improvements of the mechanics or the coupling system** are required.

6.9 Error localization by switching from direct to indirect position measurement

With this procedure, the direct encoder (scale, scale tape, etc.) is deselected. Instead, the position is measured with the motor encoder.

Switching to the motor encoder is useful in the following events:

- The characteristics of an **axis** have **degraded** (unusual noise during traverse, poor surface quality, controller oscillations, etc.)
- Errors occur that do **not clearly refer to an encoder or the mechanics of an axis**.

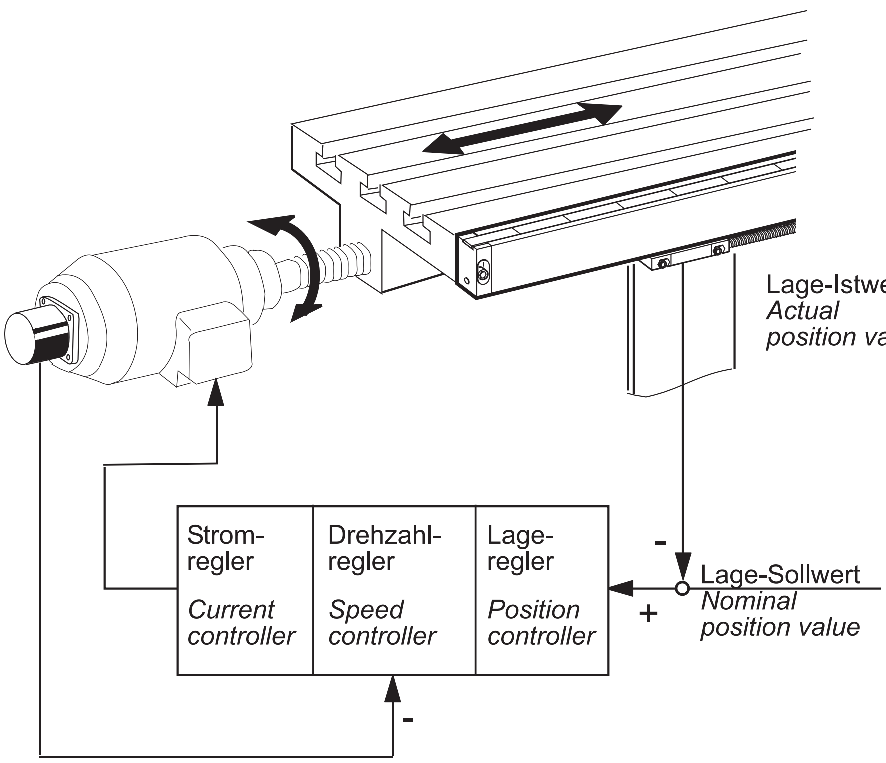
Prerequisite

The **machine tool** to be investigated must be equipped **with digital drives and direct encoders** (dual encoder system).

These instructions do not apply for digital axes with linear motors.

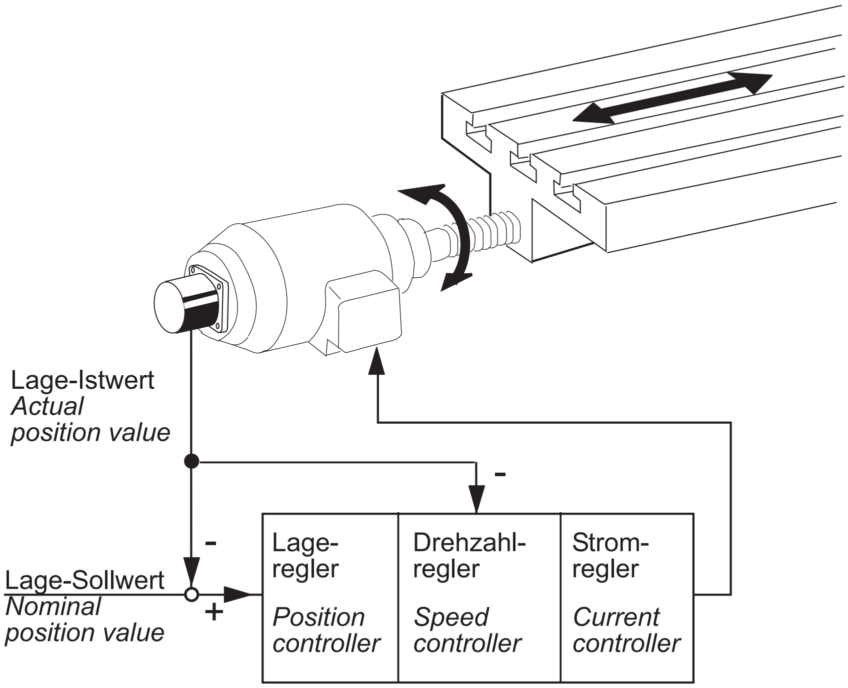
Direct position measurement

With direct position measurement, couplings and transmission systems (belts, gears, etc.), ball screw with recirculating ball nut and guideways are **part of the control loop.**
Deteriorations of these components may have a negative effect on the control loop.



Indirect position measurement

With indirect position measurement, couplings and transmission systems (belts, gears, etc.), ball screw with recirculating ball nut and guideways are **outside the control loop.**



Flowchart

See "Position measurement via motor encoder (indirect position measurement)" on page 19 – 317.

Conclusion

If with indirect measurement, e.g., the unusual traversing noise is fainter or if there is no noise at all, the **error cause may be due to the mechanics of the machine** (e.g., reversal error, worn guideways).

For indirect path measurement the direct encoder (scale, scale tape) is not required. Consequently, the direct encoder may be the error cause.
Observe the quality of the encoder signals (e.g. with a PWT 18 (for 1Vpp) or with PWM 9 while moving the table with indirect path measurement.

6.10 Notes and tips for the field service

What is the cause of this error?

- Ask the operator or technician who **worked last with or on the machine** about the detailed course of events.

Were there any particular incidents such as …

- A loud bang in the electrical cabinet
- Overload
- Leaky hydraulic, coolant or water lines
- Condensation on boards
- Cleaning of the machine (humidity, etc.)
- Thunderstorms
- Modifications to the machine
- Tests on the machine
- NC software update
- New part program
- Tool breakage
- Collision
- Power failure
- Etc.

Were there any repeated error messages indicating overload (e.g., **`I2T monitoring`**, **`Motor temperature too high`**, **`Motor current too high`**, **`Load is too high`**) or a defect (e.g., **`Overcurrent cutoff`**) of the drive?

> Note
>
> Tracking back the error cause together may facilitate troubleshooting.

First steps

- If possible, ask the person in charge to show you the error.
- Check together, whether the error can be reproduced and always occurs reliably at a certain position.
- Then back up the machine data to save the current configuration.
- Isolate the error.

Visual inspection

A visual inspection may often be useful.

- Any tools damaged?
- Machine crash?
- Heavily contaminated devices?
- Defective cables?
- Defective tubes, sealings, threaded joints?
- Defective fuses?
- Visibly destroyed power amplifiers?
- Defective coupling system, belt, gear, etc.?
- Moisture inside devices?
- Scorch marks / burnt smell?

Comparison with functioning machines or devices

If identical machines or devices are available, you can compare the functions.

This can be very helpful for troubleshooting!

Low voltages and polyfuses

All **units connected to the control are powered by it** (encoders with long cables may in addition be provided with voltage amplifiers).
It is thus possible that **defective units or even damaged cables** have an influence on the low voltages in the control and generate a variety of error messages.
The current control hardware thus features "polyfuses".
Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., handwheel) from the low voltages of the control.
Polyfuses have a self-resetting function ("self-healing effect").

When polyfuses blow, ideally those error messages are displayed that are related to the respective device . However, error messages may appear that give no clear indication as to which device is defective.

> Note
>
> For troubleshooting disconnect probably defective devices incl. cable from the control.
> --> See "Error localization by process of exclusion" on page 6 – 63.

Cables

Defective cables may lead to interruptions and short circuits. Undefined statuses and indirect error messages may be generated.

Therefore, check in particular, whether the cables show signs of wear or were squeezed, and inspect the connection points.

Males and females

Observe the following instructions for connecting or disconnecting any connectors:

D-sub males or females

- Connect and disconnect straightly! Otherwise, the spring contacts in the D-sub female connectors could be widened. This may result in contact problems!

Ribbon connectors or sockets

- Connect carefully and straightly with constant pressure in order not to bend any pins.

Signal socket at the motor

- Carefully slide the nib of the connector into the notch of the signal socket and screw the connector straightly. Do not use force! Otherwise the pins could be bent or even pressed into the socket.

Terminals

Ensure that the terminals are firmly tightened.
Wires and leads must not be damaged or corroded.

Shielding and grounding

Defective shieldings and groundings may also result in undefined errors or in a malfunction of the machine. The reason are compensating currents that are caused by potential differences.
Therefore, check the terminals, shielded cables (the shielding braid must not contact the 0 V conductor inside the cable), cover plates, grounding bars, contact plates, etc.

> Attention
>
> If HEIDENHAIN expansion boards are used for the SIMODRIVE system, please check whether the grounding is implemented as prescribed. --> See "Exchanging HEIDENHAIN interface boards in the SIMODRIVE system" on page 29 – 553.

Sources of interference

Also observe **possible sources of interference** that may have a negative effect on the control and its peripherals.

Interference is mainly produced by capacitive and inductive coupling from electrical conductors or from device inputs/outputs, such as ...

- Strong magnetic fields, e.g. from transformers, electric motors, magnetic clamping tables
- Relays, contactors and solenoid valves
- High-frequency equipment, pulse devices, and stray magnetic fields from switch-mode power supplies
- Adjoining welding facilities
- Power lines and leads to the above equipment
- Open lines on serial data interfaces (e.g. RS-232)

Make sure that …

- There is a minimum distance of 20 cm from the control and its leads to interfering equipment.
- There is a minimum distance of 10 cm from the control and its leads to cables that carry interference signals. For cables in metallic ducting, adequate decoupling can be achieved by using a grounded separation shield.
- The cross section of potential compensating lines is **at least 6 mm^2**.
- Genuine HEIDENHAIN cables, connectors and couplings are used.
- Cover plates are available for the ribbon cables.

Note

Contact the machine manufacturer if these conditions are not fulfilled!

Contamination

Pay special attention to **contaminated units** (oil, grease, dust, etc.)!

What could be the reason for the contamination?
Some examples:

- Machining of cast blanks or graphite
- Coolant or coolant vapor
- Defective filter system in the electrical cabinet (filter pads)
- Oil or oil vapor
- Oil in the compressed-air system
- Door of electrical cabinet open

Attention

The deposition of dust from the ambient air, precipitation of chemical contamination contained in the air or the natural formation of dew after switching off the machine can form a conductive layer on the live parts of electrical equipment and may cause flashovers resulting in corresponding damage.

Temperature

Use the appropriate equipment to measure, whether the **temperature is exceeded**.

What could be the reason?
Some examples:

- Climate control unit in electrical cabinet defective
- Clogged filter pads
- Defective fans
- Motors and inverters overloaded
- Defective temperature sensors
- Unfavorable mounting of components

DANGER

The permissible ambient temperature during operation is 0 °C to 40 °C.
Any deviation from this may impair operating safety!

Attention

Temperatures of up to 145 °C may occur on the motor surfaces.

Humidity

Check whether **humidity** has entered the units or condensed water has spread.

What could be the reason?
Some examples:

- Incorrectly set or defective climate control unit in the electrical cabinet
  (The activation temperature of the climate control unit should be set to 35 °C; the switching hysteresis must not exceed 5 °C.)
- Coolant or coolant vapor
- Condensation of boards due to changes in temperature
- Defective tubes, sealings, screw connections, etc.
- Electrical cabinet not sufficiently tight

Attention

Maximum 75 % humidity allowed during continuous operation.

Shipping brace of the hard disk

Check whether the shipping brace of the hard disk of the mounted control has been removed.

7 Creating and reading out service files

7.1 Introduction

Service files can be read out from iTNC 530 HSCI.

- Files selected by HEIDENHAIN and the machine manufacturer are stored in a ZIP file.
- The selected files may be located on the TNC or on the PLC partition.
- The compressed service files are stored under **TNC:\service\Service<xxxxxxxx>.zip.**
- The name of the file is generated automatically, where **<xxxxxxxx>** is the system time shown as an unambiguous character string in hexadecimal code.
- Which ZIP file is the most recent can be seen from the date and time columns in the program manager.

The following data (and other information) is saved in the service file:

- Log
- PLC log
- Selected files (*.H/*.I/*.T/*.TCH/*.D) of all operating modes
- *.SYS files
- Machine parameters
- Information and log files of the operating system
- Contents of the PLC memory
- NC macros defined in PLC:\NCMACRO.SYS
- Information about the hardware
- Error outputs and configuration files of the PLC compiler
- Current Feature Content Level (FCL) and active software options, including the option designations through the file PLC:\SIK.INFO
- Changes to machine parameters via the PLC, LSV2 and NC programs through the MPSERVER.TXT file
- The HANDWHEEL.LOG file

> **Attention**
>
> The compressed service files also include the **milling program** the customer was using when the error occurred or when the service files were created manually.
> When a service file was created, a corresponding message is displayed on the screen of the control.

> **Note**
>
> Files that are saved in an encrypted PLC partition **PLCE:** cannot be written to the service file.

7.2 Automatic generation of service files

Service files are created automatically ...

- in the event of serious NC error messages requiring a reset of the control.
- if the NC software crashes due to a fatal error.
- in the event of PLC error messages for which the machine manufacturer has defined that service files are to be generated.

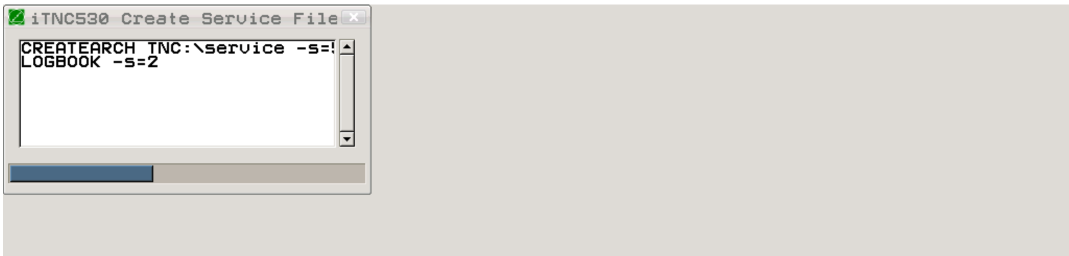


Figure: A service file is created automatically in the event of a serious error

7.3 Manual generation of service files

Service files can be created manually at any time:

- Press the ERR key.

- Press the soft key SAVE SERVICE FILES.

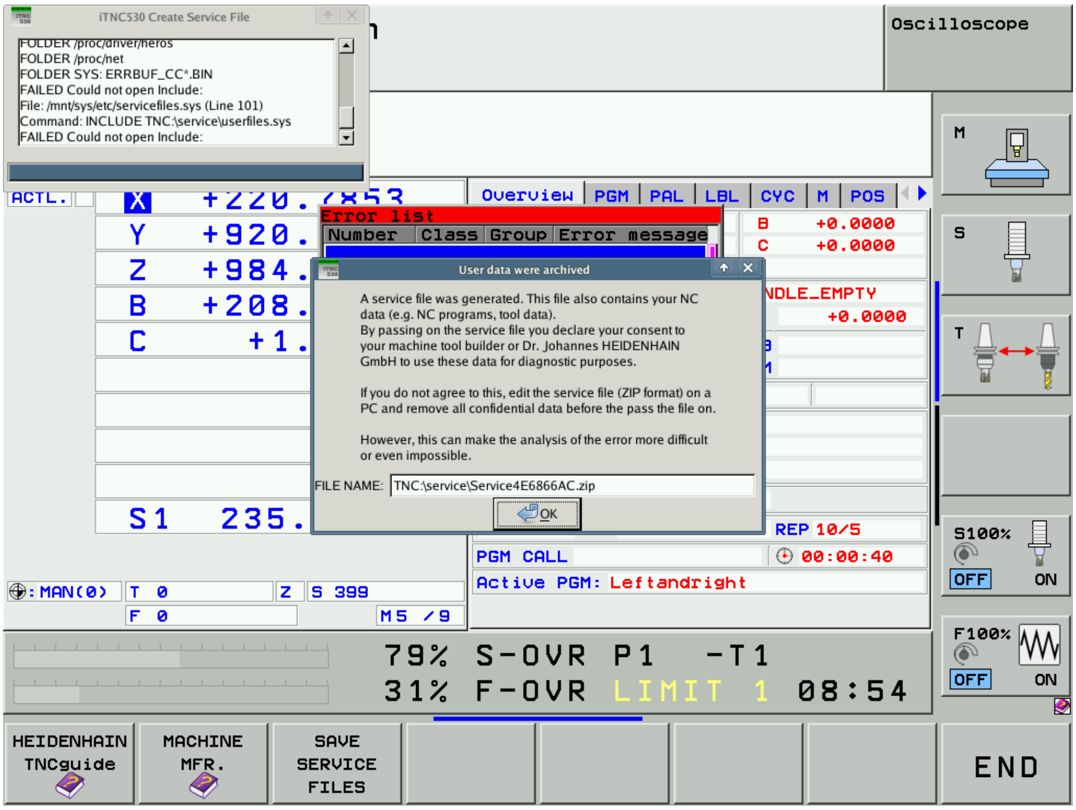
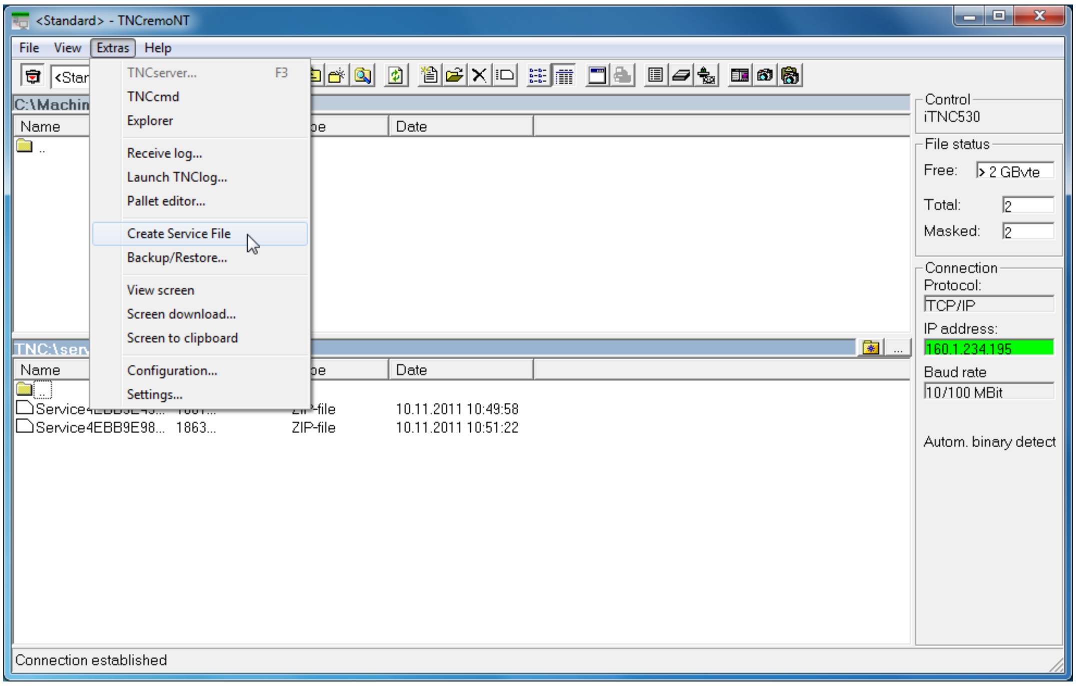


Figure: The Service file is generated manually

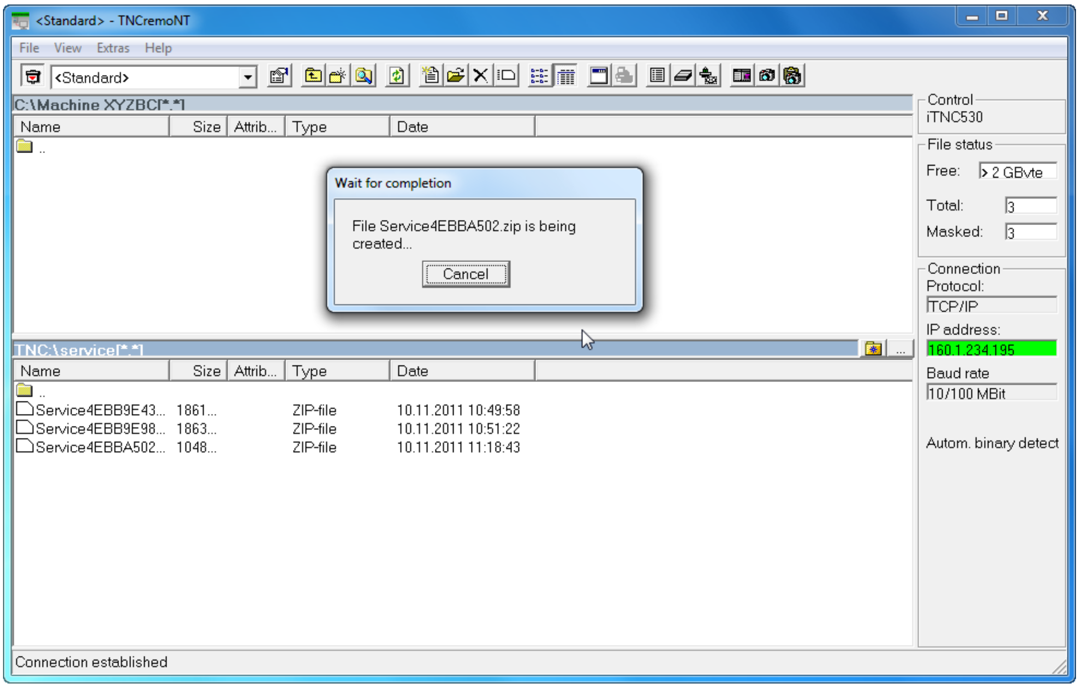
7.4 Generating service files with TNCremoNT

With the current **TNCremoNT** program it is possible to **generate service files directly from the laptop/PC**:

- Connect the control to the laptop/PC with TNCremoNT.
- Click **`Extras/Create service file`** in the menu bar.



- The service file is created and the path **`TNC:\service\`** opened automatically on the control's hard disk.



Attention

The compressed service files also include the **milling program** the customer was using when the error occurred or when the service files were created manually.
If the customer does not wish the milling program to be forwarded, it can be removed from the **`Service.zip`** file.

7.5 Evaluation of the service files

The compressed service files cannot be viewed on the control.

- Read out the ZIP file (e.g. service4CF4D383.zip) to an external data medium.
- Decompress the ZIP file.

The compressed service file contains a large number of files. Some examples:

File	Meaning	Open with ... (recommended)
$mdi.h	Command lines for the operating mode **Programming with manual data input**	Text editor
_hwstree.txt	Information on hardware, firmware, HSCI bus addresses, etc,	Text editor
xxx.mp	Machine parameter list	Text editor
bootprotocol.lis	List of initialized processes	Text editor
cpuinfo	Features of the main computer	Text editor
herosdiagnose.txt	Information on the HeROS version, size of main memory, etc.	Text editor
if0.cfg	Ethernet IP address and subnet mask of the control	Text editor
kinelist.tab	Contents of the kinematics table	Text editor
kinemat0.tab	Description of (possible) machine kinematics	Text editor
lb_act.log	Contents of the log	Text editor
ncdata.sys	Information on EnDat positions, active preset tables, active kinematics, handwheel, display mode, etc.	Text editor
ncpath.sys	Information on the active tool table, active preset table and on the active kinematics as well as on the NC program machined last, etc.	Text editor
meminfo	Information on the main memory	Text editor
plcmem.txt	State of the PLC operands at the time the service file was generated	Text editor
report.txt	Information on the HSCI devices used	Text editor
S_State.service.sco	Oscillogram of selected signals	TNCscopeNT
sik.info	Information on the system identification key	Text editor
times.sys	Operating hours	Text editor
Tnctime.sys	Operating time of the control (**Control on**)	Text editor
tool.t	Tool table	Text editor
tool_p.tch	Pocket table	Text editor
updatehistory.txt	Log of NC software updates	Text editor
<name>.h	Milling program of the customer	Text editor

Not all service files can be **evaluated by the service engineer himself**. They serve primarily to provide the machine manufacturer or a HEIDENHAIN service agency with comprehensive information on an error that occurred on a machine.

Upon agreement, the ZIP file can be sent to the OEM or to HEIDENHAIN.

Attention

Confidential data (e.g., customer's milling program) can be removed before the service file is sent in ZIP format.

8 Log

8.1 Introduction

- The log serves as a troubleshooting aid.
- There are 4 MB of process memory available for this purpose.
- Error messages and keystrokes are recorded in the process memory.
- When the code number **LOGBOOK** is entered and the soft key EXECUTE pressed, the log entries are copied from the process memory into an ASCII file on the control's hard disk and are displayed.

> Note
>
> If you want to perform tests and to view the new entries in the log, you have to call the log again.

- NC error messages are distinguished by an **N**, PLC error messages by a **P** before the error number and the error text.
- The sources of the keystroke inputs are entered in **INFO: MAIN KEYSOURCE: <source>**.
  A <Source> may be:
  - KEYBOARD
  - PLC
  - PLCNCSTART
  - HANDWHEEL
  - LSV2

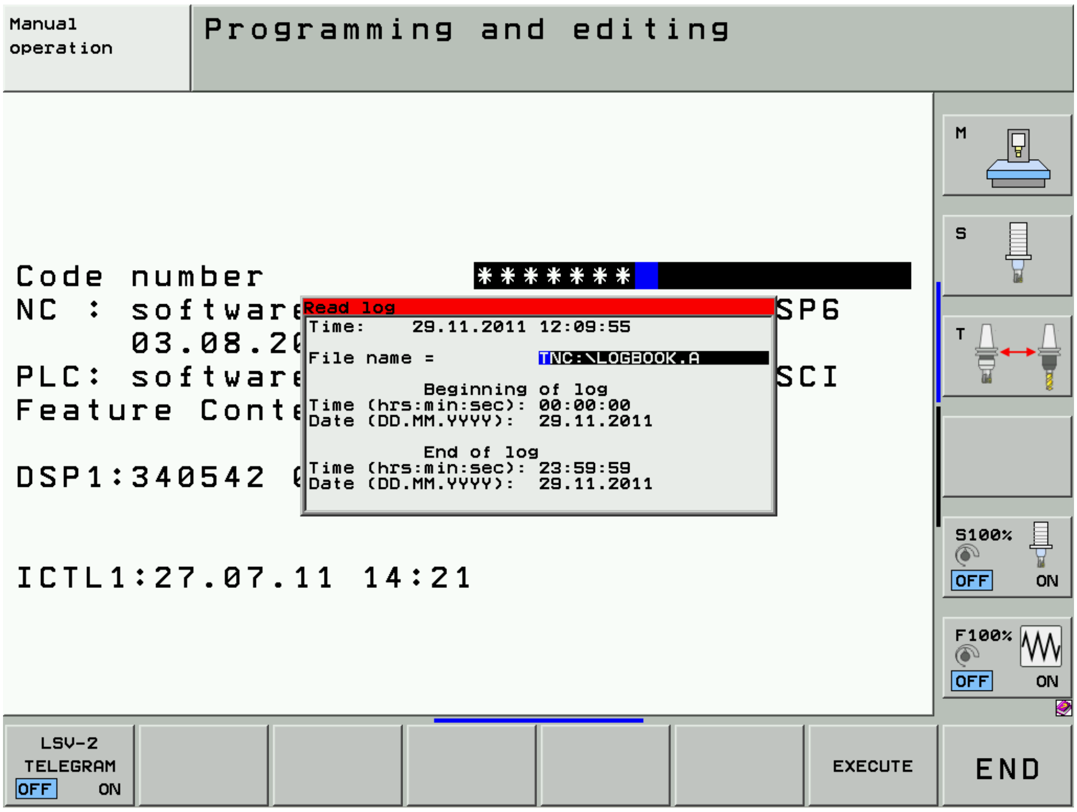
> Note
>
> In the log, the first horizontal soft key (at bottom left on the screen) is recorded as soft key 0, the second soft key as soft key 1, etc.
> The first vertical soft key (top right on the screen) is recorded as V soft key 0, the second soft key as V soft key 2, etc.
> The soft keys are **numbered from left to right and from top to bottom**.
> The arrow keys for the switching of the soft-key rows are logged.
> Any newly called soft-key row starts with soft key 0 or V soft key 0.

- All entries show the date and the local time.
- Information on the start and end of NC programs is logged.
- The machine manufacturer can use up to 8 additional OEM logs. –> If necessary, ask your machine manufacturer if these OEM logs exist and whether they contain information relevant for service technicians.

> Note
>
> The following messages are not shown in the log:
>
> **File system error x**
> Reason: In the case of a write or read error, all write activities on the hard disk are ceased as data cannot be written reliably any more.
>
> **Relay external DC voltage missing**
> Reason: This message is always displayed on the monitor after the **Power interrupted** message is confirmed. It is an information, not an error message. No entry is made to the log.

8.2 Calling the log

- Enter the code number **LOGBOOK.** --> See "Code numbers" on page 3 – 17.
  The following window appears:



- If you wish, you can change the path and the file name here.
  (Default setting: **TNC:\LOGBOOK.A**)
- You can also define the starting point and the end point for reading out the log.

> Note
>
> Ensure correct spelling when making any changes in the log window.

- Then start reading out the log by pressing the EXECUTE soft key.

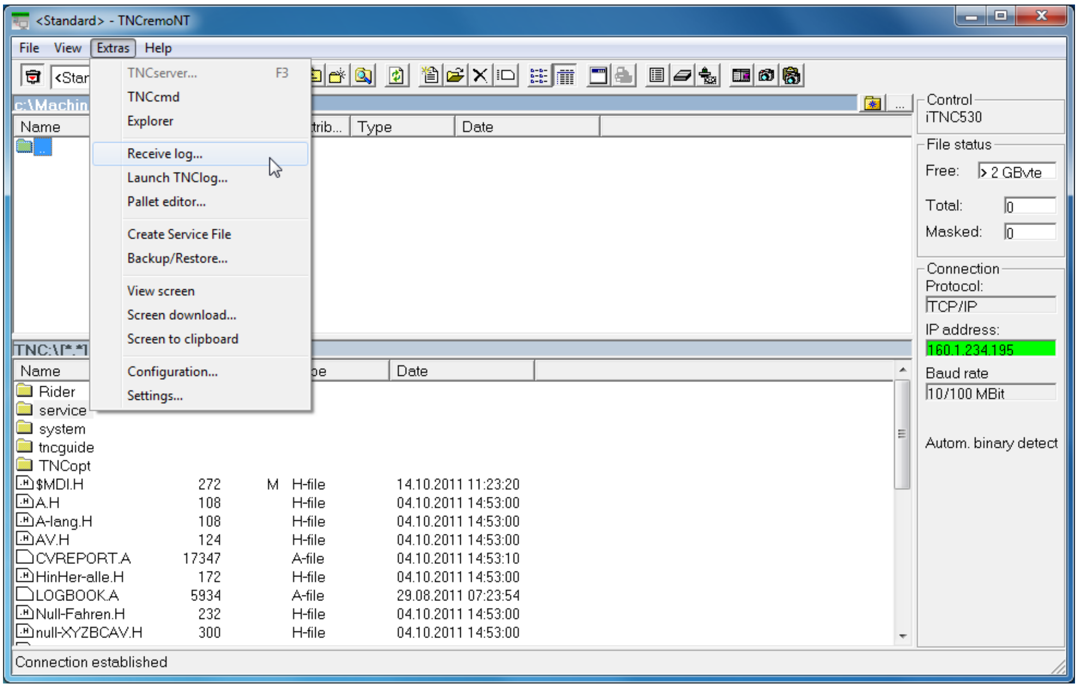
An ASCII file with the log entries is generated and displayed on the screen.

8.3 Reading out the log with TNCremoNT and filtering by event types

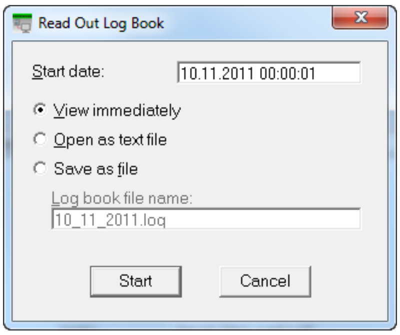
With the current version of **TNCremoNT** it is possible to **read the log directly from the laptop/PC and to filter it by event types**:

> Note
>
> The local time on the control and the PC/laptop should be identical.

- Connect the control to the laptop/PC with TNCremoNT.
- Click **`Extras/Receive log`** in the menu bar.



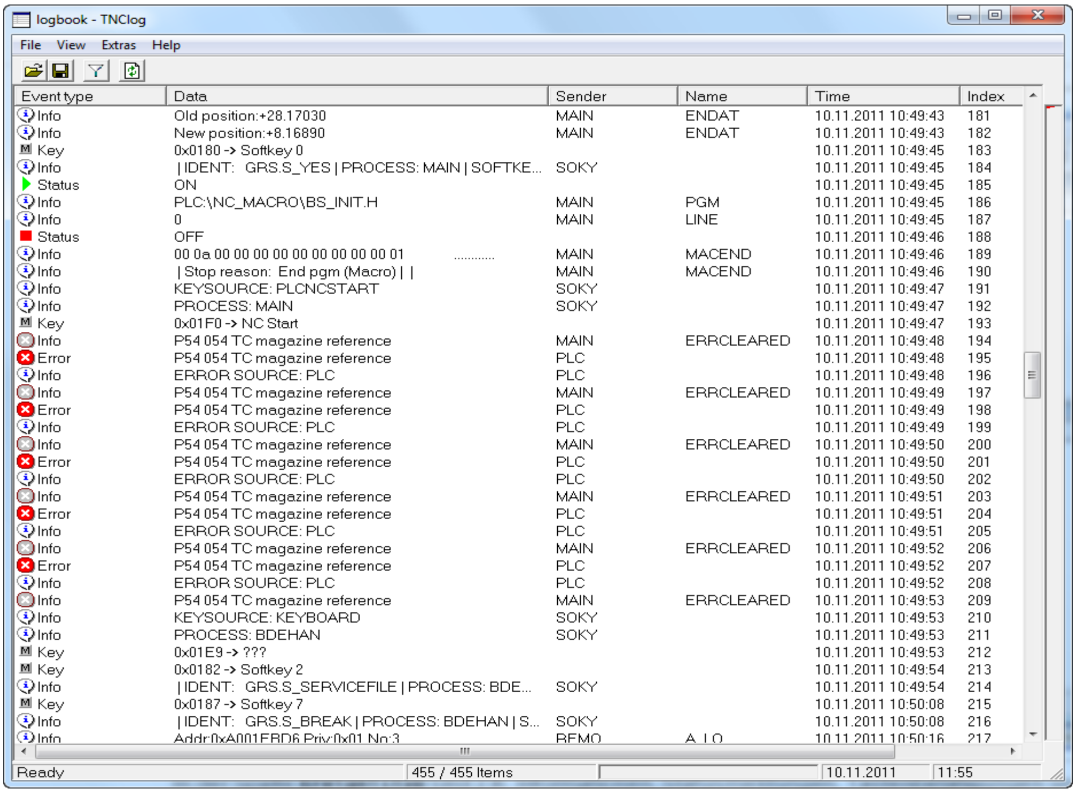
- The window **`Read Out Log Book`** appears.



- Make a selection.

Selection	Meaning
`View immediately`	The contents of the log are displayed with the new log viewer **`TNClog`** which serves to filter by event types (information, keystrokes, error messages).
`Open as text file`	The contents of the log are displayed in a text editor. Display as on the control monitor.
`Save as file`	The log is saved on the laptop in the current directory. This file can then be opened with a text editor or with the TNClog viewer.

The screen below is displayed, when you click **View immediately**:



logbook - TNClog

File View Extras Help

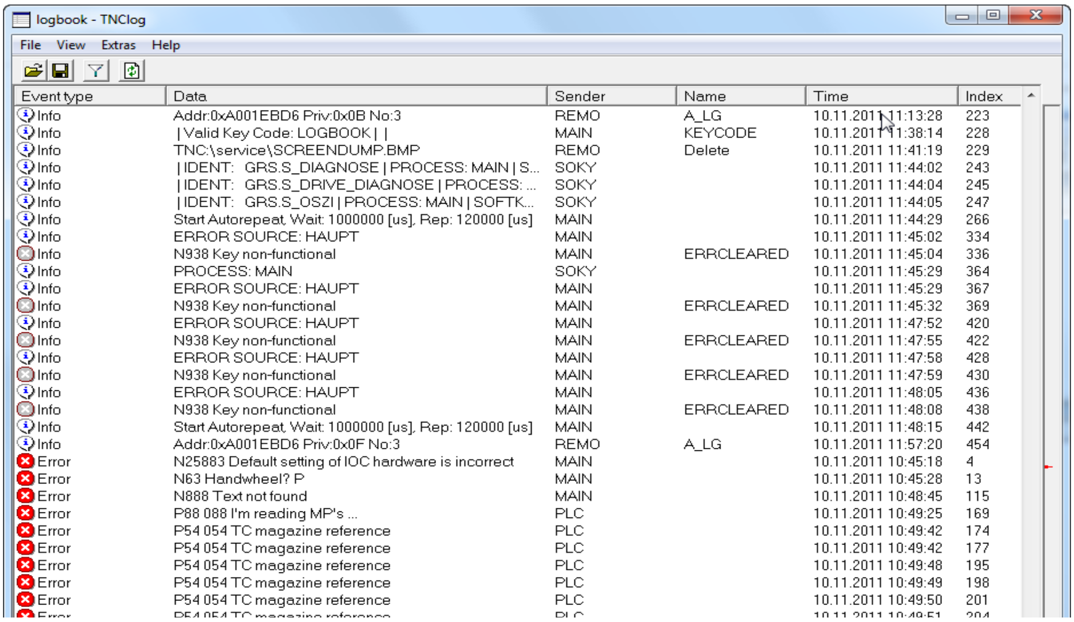
Event type	Data	Sender	Name	Time	Index
Info	Old position:+28.17030	MAIN	ENDAT	10.11.2011 10:49:43	181
Info	New position:+8.16890	MAIN	ENDAT	10.11.2011 10:49:43	182
Key	0x0180 -> Softkey 0			10.11.2011 10:49:45	183
Info	| IDENT: GRS.S_YES | PROCESS: MAIN | SOFTKE...	SOKY		10.11.2011 10:49:45	184
Status	ON			10.11.2011 10:49:45	185
Info	PLC:\NC_MACRO\BS_INIT.H	MAIN	PGM	10.11.2011 10:49:45	186
Info	0	MAIN	LINE	10.11.2011 10:49:45	187
Status	OFF			10.11.2011 10:49:46	188
Info	00 0a 00 00 00 00 00 00 00 00 00 01	MAIN	MACEND	10.11.2011 10:49:46	189
Info	| Stop reason: End pgm (Macro) | |	MAIN	MACEND	10.11.2011 10:49:46	190
Info	KEYSOURCE: PLCNCSTART	SOKY		10.11.2011 10:49:47	191
Info	PROCESS: MAIN	SOKY		10.11.2011 10:49:47	192
Key	0x01F0 -> NC Start			10.11.2011 10:49:47	193
Info	P54 054 TC magazine reference	MAIN	ERRCLEARED	10.11.2011 10:49:48	194
Error	P54 054 TC magazine reference	PLC		10.11.2011 10:49:48	195
Info	ERROR SOURCE: PLC	PLC		10.11.2011 10:49:48	196
Info	P54 054 TC magazine reference	MAIN	ERRCLEARED	10.11.2011 10:49:49	197
Error	P54 054 TC magazine reference	PLC		10.11.2011 10:49:49	198
Info	ERROR SOURCE: PLC	PLC		10.11.2011 10:49:49	199
Info	P54 054 TC magazine reference	MAIN	ERRCLEARED	10.11.2011 10:49:50	200
Error	P54 054 TC magazine reference	PLC		10.11.2011 10:49:50	201
Info	ERROR SOURCE: PLC	PLC		10.11.2011 10:49:50	202
Info	P54 054 TC magazine reference	MAIN	ERRCLEARED	10.11.2011 10:49:51	203
Error	P54 054 TC magazine reference	PLC		10.11.2011 10:49:51	204
Info	ERROR SOURCE: PLC	PLC		10.11.2011 10:49:51	205
Info	P54 054 TC magazine reference	MAIN	ERRCLEARED	10.11.2011 10:49:52	206
Error	P54 054 TC magazine reference	PLC		10.11.2011 10:49:52	207
Info	ERROR SOURCE: PLC	PLC		10.11.2011 10:49:52	208
Info	P54 054 TC magazine reference	MAIN	ERRCLEARED	10.11.2011 10:49:53	209
Info	KEYSOURCE: KEYBOARD	SOKY		10.11.2011 10:49:53	210
Info	PROCESS: BDEHAN	SOKY		10.11.2011 10:49:53	211
Key	0x01E9 -> ???			10.11.2011 10:49:53	212
Key	0x0182 -> Softkey 2			10.11.2011 10:49:54	213
Info	| IDENT: GRS.S_SERVICEFILE | PROCESS: BDE...	SOKY		10.11.2011 10:49:54	214
Key	0x0187 -> Softkey 7			10.11.2011 10:50:08	215
Info	| IDENT: GRS.S_BREAK | PROCESS: BDEHAN | S...	SOKY		10.11.2011 10:50:08	216
Info	Addr:0xA001EBD6 Priv:0x01 No:3	REMO	A_LG	10.11.2011 10:50:16	217

Ready 455 / 455 Items 10.11.2011 11:55

In the column **Event type**, e.g., information, status messages, keystrokes and error messages are displayed with different symbols.

The default sorting order is by time (**Time** column). However, you can resort the log contents by clicking the column header (**Event type, Contents, Source, Name, Time, Index, Comment**).

The screen below is displayed, when you click **Event type**:



logbook - TNClog

File View Extras Help

Event type	Data	Sender	Name	Time	Index
Info	Addr:0xA001EBD6 Priv:0x0B No:3	REMO	A_LG	10.11.2011 11:13:28	223
Info	| Valid Key Code: LOGBOOK | |	MAIN	KEYCODE	10.11.2011 11:38:14	228
Info	TNC:\service\SCREENDUMP.BMP	REMO	Delete	10.11.2011 11:41:19	229
Info	| IDENT: GRS.S_DIAGNOSE | PROCESS: MAIN | S...	SOKY		10.11.2011 11:44:02	243
Info	| IDENT: GRS.S_DRIVE_DIAGNOSE | PROCESS: ...	SOKY		10.11.2011 11:44:04	245
Info	| IDENT: GRS.S_OSZI | PROCESS: MAIN | SOFTK...	SOKY		10.11.2011 11:44:05	247
Info	Start Autorepeat, Wait: 1000000 [us], Rep: 120000 [us]	MAIN		10.11.2011 11:44:29	266
Info	ERROR SOURCE: HAUPT	MAIN		10.11.2011 11:45:02	334
Info	N938 Key non-functional	MAIN	ERRCLEARED	10.11.2011 11:45:04	336
Info	PROCESS: MAIN	SOKY		10.11.2011 11:45:29	364
Info	ERROR SOURCE: HAUPT	MAIN		10.11.2011 11:45:29	367
Info	N938 Key non-functional	MAIN	ERRCLEARED	10.11.2011 11:45:32	369
Info	ERROR SOURCE: HAUPT	MAIN		10.11.2011 11:47:52	420
Info	N938 Key non-functional	MAIN	ERRCLEARED	10.11.2011 11:47:55	422
Info	ERROR SOURCE: HAUPT	MAIN		10.11.2011 11:47:58	428
Info	N938 Key non-functional	MAIN	ERRCLEARED	10.11.2011 11:47:59	430
Info	ERROR SOURCE: HAUPT	MAIN		10.11.2011 11:48:05	436
Info	N938 Key non-functional	MAIN	ERRCLEARED	10.11.2011 11:48:08	438
Info	Start Autorepeat, Wait: 1000000 [us], Rep: 120000 [us]	MAIN		10.11.2011 11:48:15	442
Info	Addr:0xA001EBD6 Priv:0x0F No:3	REMO	A_LG	10.11.2011 11:57:20	454
Error	N25883 Default setting of IOC hardware is incorrect	MAIN		10.11.2011 10:45:18	4
Error	N63 Handwheel? P	MAIN		10.11.2011 10:45:28	13
Error	N888 Text not found	MAIN		10.11.2011 10:48:45	115
Error	P88 088 I'm reading MP's ...	PLC		10.11.2011 10:49:25	169
Error	P54 054 TC magazine reference	PLC		10.11.2011 10:49:42	174
Error	P54 054 TC magazine reference	PLC		10.11.2011 10:49:42	177
Error	P54 054 TC magazine reference	PLC		10.11.2011 10:49:48	195
Error	P54 054 TC magazine reference	PLC		10.11.2011 10:49:49	198
Error	P54 054 TC magazine reference	PLC		10.11.2011 10:49:50	201

Note

By clicking **Extras/Log filter settings** (or the corresponding icon) you can filter out event types.

8.4 Overview of log entries

Entry		Description
RESET		Restart the control
ERR		Error messages ■ **P** --> PLC error message with the line number in the PLC error text file ■ **N** --> NC error message with number ■ **Power fail interrupt!** --> The control was switched off by a POWERFAIL. ■ Result of the file system test: If the control is not properly shut down, the file system is checked during the next startup and the result is entered in the log. --> Search for **"dosfsck"** in the log.
INFO	"xxx"	"xxx": Name of the control process that enters the information in the log ■ PLC ■ SYS ■ MAIN ■ REMO ■ CTRL ■ SMARTNC ■ SMARTNC_LDF ■ BDEHAN ■ SOKY ■ GEO ■ PYTHON ■ FIXTURE ■ FILEMAN
INFO	CTRL KINEMATIC	Active tool with tool number, radius (R=) and length (L=)
INFO	CTRL collision	Status of collision monitoring in the Manual and Automatic operating modes
INFO	CTRL REG AXIS xx START REF=yy	Position yyyy of axis xx at start of movement
INFO	CTRL REG AXIS xx STOP REF=yy	Position yyyy of axis xx at stop of movement
INFO	MAIN ERRCLEARED	Acknowledgment of an error message
INFO	MAIN ERR_RECURED	Error message entered several times
INFO	MAIN ENDAT	Entry for the position upon switch-on, if the switch-off and switch-on positions of an EnDat encoder do not match
INFO	MAIN RUNPROC	Status information about the current process
KEY		Keystrokes
INFO	MAIN SOFTKEY	Path with associated image file of a pressed soft key
Control-in-operation[a]	ON	Control-in-operation on
	OFF	Control-in-operation off
	BLINK	Control-in-operation symbol blinking

a. Control-in-operation symbol = " * " in the screen display

Entry		Description
INFO	MAIN START	Type of control, NC software and valid Feature Content Level (FCL)
INFO	MAIN FILE DEL	Faulty files on the hard disk, to be erased during booting
INFO	MAIN HDD	Designation of the hard disk
INFO	MAIN DSP	ID number of the active controller software
INFO	MAIN CYCLES	Test results for fixed cycles and touch probe cycles
INFO	MAIN KEYSOURCE	Source of the keystrokes ■ KEYBOARD ■ PLC ■ PLCNCSTART ■ HANDWHEEL ■ LSV2
INFO	MAIN KINEMATIC	Listing of the definition tables with collision objects that are monitored for collision with option #40, DCM.
INFO	MAIN PGM	Started NC program or NC macro
INFO	MAIN LINE	Line number of the running NC program or NC macro
INFO	MAIN PGMEND	Information about the program end in program run (You can find byte 0 and byte 1 in the second line from the left.) Byte 0 / 1 00 01 EMERGENCY STOP 00 02 Positioning error 00 03 Programmed stop 00 04 Block end in single block mode 00 05 Geometry error 00 06 END PGM, M02 00 07 TNC STOP button 00 08 Data transmission error (RS-422/RS-232) In addition, when an NC program is stopped by an error message, the following information is entered in the log: NC program, line number, actual position, datum, datum shifts, tool number
INFO	MAIN MACEND	Information about the end of an NC macro Byte 0 / 1 00 01 EMERGENCY STOP 00 02 Positioning error 00 03 Programmed stop 00 04 Block end in single block mode 00 05 Geometry error 00 06 END PGM, M02 00 07 TNC STOP button 00 08 Data transmission error (RS-422/RS-232)

Entry			Description
INFO	MAIN PATH	PLCEDIT	File for PLC Editor
		NCEDIT	File for NC Editor
		RUNPGM	Main program for program run
		RUNPALET	Pallet table for program run
		RUNDATUM	Datum table for program run
		RUNTOOL	Tool table for program run
		RUNTCH	Pocket table for program run
		SIMPGM	Main program for program test
		SIMDATUM	Datum table for program test
		SIMTOOL	Tool table for program test
		RUNBRKPGM	Stopping point for block scan
		SIMBRKPGM	Stopping point for program test
		RUNPRINT	Path for FN15: PRINT for program run
		SIMPRINT	Path for FN15: PRINT for program test
		MDIPGM	File for positioning with manual data input
		NCFMASK	Mask for file management in the NC area
		PLCFMASK	Mask for file management in the PLC area
		EASYDIR	Paths for standard file management
		TCHPATH	Datum table for manual measurement
		SIMTAB	Freely definable table in program test
		RUNTAB	Freely definable table in program run
		KINTAB	Active kinematics table
INFO	MAIN NCEVENT		Entries via **FN38: SEND** from the **Program Run, Full Sequence** or **Program Run, Single Block** operating modes
	MAIN NCTEVENT		Entries via **FN38: SEND** from the **Test Run** operating modes
INFO	MAIN BUTTON MOUSE "x" "y" "z" "a" "b"		Recording of mouse movements/buttons ■ "x": P = Press, R = Release ■ "y": L = Left button, R = Right button ■ "z": Key pressed simultaneously N = None, S = Shift, C = Control, A = Alt, W = Windows, L = Left key, M = Middle key, R = Right key ■ "a": Position of the mouse pointer in X ■ "b": Position of the mouse pointer in Y
INFO WARNING ERROR	PLC <log identifier>		Entries through PLC modules 9275 and 9276
INFO	SYS	SHUTDOWN	Control was shut down
		REBOOT-TNC	Control was rebooted (automatically)
		REBOOT-BIOS	Control was rebooted (automatically)
INFO[a]	REMO A_LG		Log in with LSV2 protocol
	REMO A_LO		Log out with LSV2 protocol
	REMO Delete		Deletion of a file via the LSV2 protocol
	REMO Receive		Reception of a file via the LSV2 protocol
	REMO C_LK		LSV2 protocol: Locking and releasing the keyboard; the key codes between locking and releasing are sent via LSV2 protocol

<table>
<tr><th colspan="3">Entry</th><th>Description</th></tr>
<tr><td rowspan="7">INFO</td><td rowspan="7">SOKY</td><td>KEYSOURCE:</td><td>Source of information on a key:
■ KEYBOARD
■ PLC
■ PLCNCSTART
■ HANDWHEEL
■ LSV2
■ KEYLOGGER</td></tr>
<tr><td>PROCESS:</td><td>Name of the target process to which the key information is sent.</td></tr>
<tr><td>IDENT:</td><td>Control-internal name of the soft key</td></tr>
<tr><td>SOFTKEY:</td><td>Name of the BMX image file of the soft key</td></tr>
<tr><td>OVERLAY:</td><td>Current overlay number of the soft key</td></tr>
<tr><td>Autorepeat ...</td><td>Status information on the Autorepeat function (start, stop, waiting times, ...)</td></tr>
<tr><td>Key Logger:</td><td>Status information on key recording (start, stop, repeat, ...)</td></tr>
<tr><td>INFO</td><td colspan="2">SYS WINEVENT
FILEMAN.STARTUP.READY</td><td>File manager (PGM MGT) started</td></tr>
<tr><td>ERROR</td><td colspan="2">"xxx": "yyy"</td><td>"xxx": Name of the control process that enters the information in the log
■ PLC
■ SYS
■ MAIN
■ REMO
■ CTRL
■ SMARTNC
■ SMARTNC_LDF
■ BDEHAN
■ SOKY
■ GEO
■ PYTHON
■ FIXTURE
■ FILEMAN
“yyy“: Optional information: Name of the process causing the error</td></tr>
</table>

a. For test purposes, all LSV-2 telegrams can be entered in the log. After entering the code word LOGBOOK, this function must be enabled with the LSV-2 TELEGRAM OFF/ON soft key.

Entry of IP addresses

If the control is accessed remotely via LSV2 protocol, the IP address of the external device is entered in addition to the entry **REMO A_LG**.

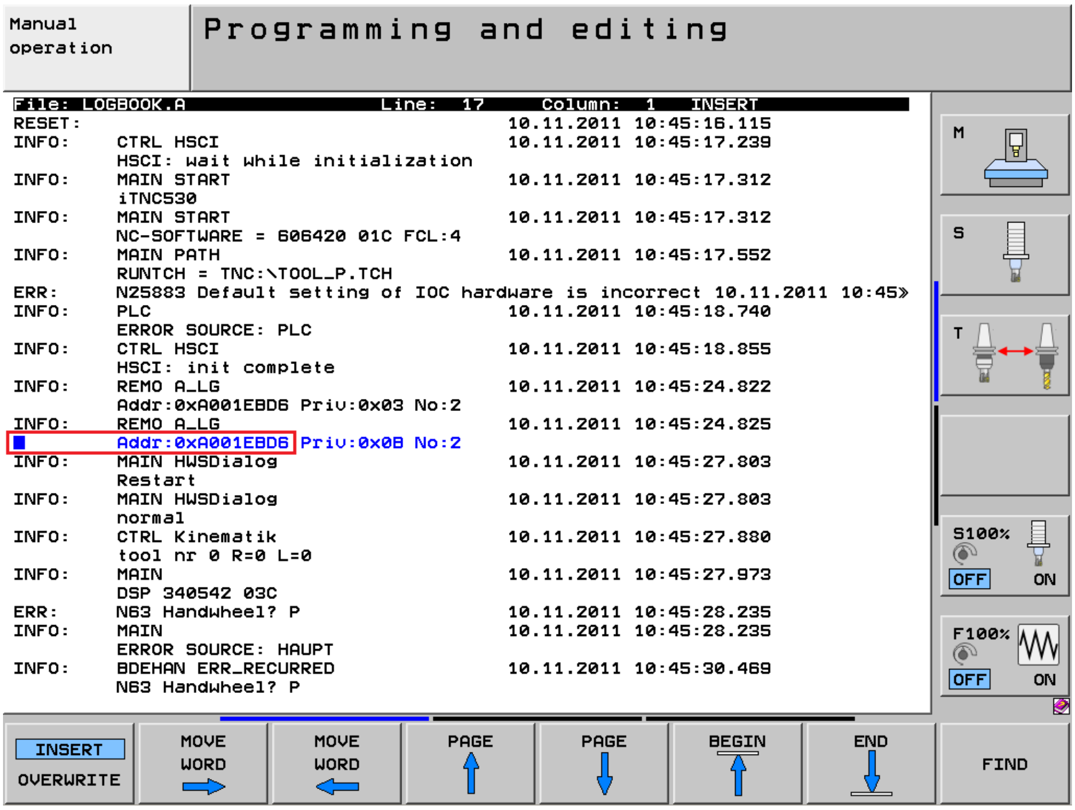


Figure: Log entry of IP address of accessing unit (laptop/PC)

The IP address is shown in hexadecimal notation and can be converted to decimal as follows:
The first two HEX digits from the left become the first 3-digit decimal number of the IP address; the next two HEX digits from the left become the second 3-digit decimal number of the IP address, etc.

Example for the IP address 0xA001EC21:

Conversion of IP address	
Hexadecimal format	**Decimal format**
21	33
EC	236
01	1
A0	160

Resulting IP address	
Hexadecimal format	**Decimal format**
0xA001EC21	160.1.236.33

Entry of operating system error messages

Operating-system error messages require a control restart. During the restart, the operating-system error message is entered in the log. The restart time (i.e., the time when the operating-system error message was entered in the log) is added. In the heading of the operating-system error message the Greenwich Mean Time (universal time) is shown.

Entry of NC programs

Not every single block of an NC program is recorded in the log (as the size of the log file has not been designed for this purpose). Information is recorded at the start and at the end of an NC program.

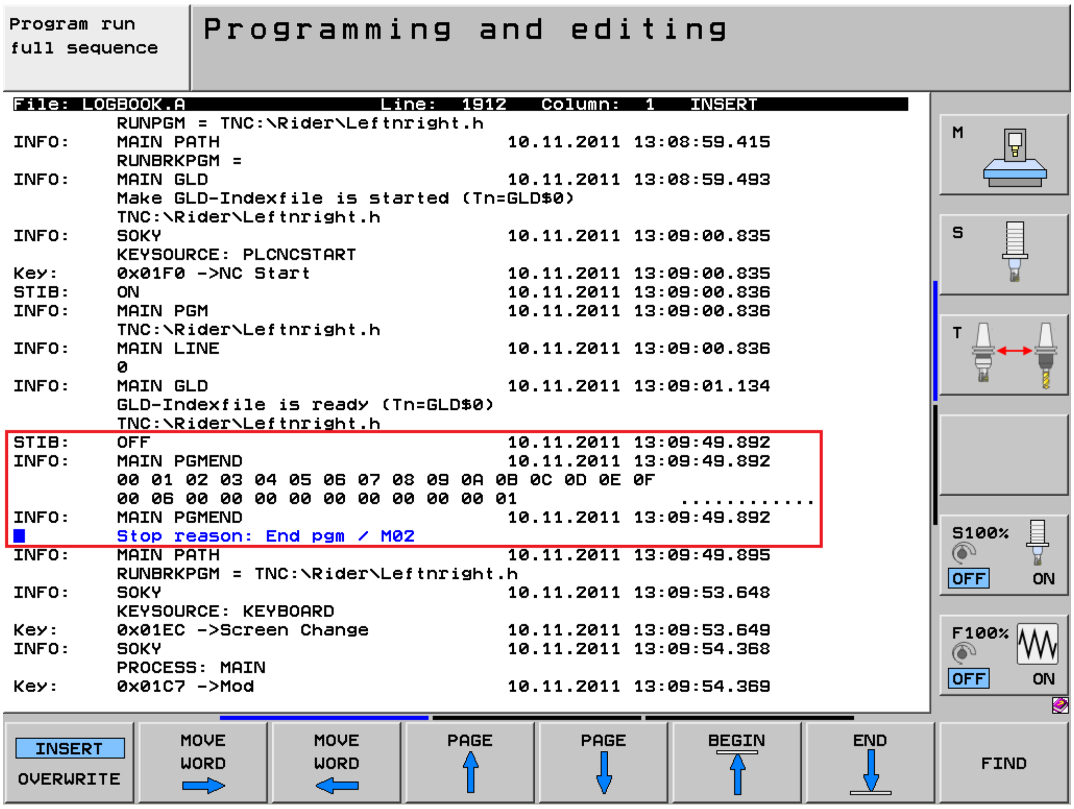


Figure: Example for information at end of program

Here, an NC program was finished properly:

- **`STIB: OFF`**
  The machine does not operate any more; the "*" in the display goes out.
- **`INFO: MAIN PGMEND`**
  The code 00 06 in the second line means END PGM, M02.
  (See "Overview of log entries" on page 8 – 83.)
- **`INFO: MAIN PGMEND`**
  Information about the end of program in plain language.

8.5 Log entries at program termination

If an NC program is not terminated properly but aborted before completion due to an error, additional information is entered in the log:

- Path and name of the aborted NC program
- Line number of the NC program at program termination
- ACTUAL position at program termination
- Offsets to machine datum (preset)
- Possibly set datum shifts
- Tool number
- Tool length, tool radius, etc.

```
Key:     0x01F0 ->NC Start                01.12.2010 11:11:50.918
STIB:    ON                               01.12.2010 11:11:50.919
INFO:    MAIN PGM                         01.12.2010 11:11:50.919
         TNC:\Reiter\Hinuher.h
INFO:    MAIN LINE                        01.12.2010 11:11:50.919
         0
INFO:    CTRL REG                         01.12.2010 11:12:04.430
         EMERGENCY STOP from hsci node 3
INFO:    CTRL DSP                         01.12.2010 11:12:04.430
         DSP MESSAGE 0x48c0 from board 0: 1 654929 1 1 -2147483647
INFO:    CTRL DSP                         01.12.2010 11:12:04.430
         DSP MESSAGE 0x48c0 from board 0: 3 654961 1 1 -2147483647
INFO:    CTRL DSP                         01.12.2010 11:12:04.430
         DSP MESSAGE 0x48c0 from board 1: 1 655097 1 1 -2147483647
INFO:    CTRL DSP                         01.12.2010 11:12:04.430
         DSP MESSAGE 0x48c0 from board 1: 3 655097 1 1 -2147483647
ERR:     N24973 Externer NOT-AUS          01.12.2010 11:12:04.700
ERR:     N25387 18019 Löschbarer Positionierfehler X, ES 3 01.12.2010 11:12:0»
INFO:    CTRL REG                         01.12.2010 11:12:04.439
         Set Stop Reason: PLC_STOP
STIB:    OFF                              01.12.2010 11:12:04.442
INFO:    MAIN PGMEND                      01.12.2010 11:12:04.442
         00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
         00 01 00 00 FF FF FF FF 00 00 00 03          ............
INFO:    MAIN PGMEND                      01.12.2010 11:12:04.442
         Stop reason: Emergency stop
         NC program : TNC:\Reiter\Hinuher.h line 3
INFO:    MAIN PGMEND                      01.12.2010 11:12:04.442
         Actual pos.:
          X = 171.1153
          Y = 115.3504
          Z = 161.0133
          B = 322.2375
          C = 24.8189
         Preset     : (Range = 0)
          X = -5.0000
          Y = -20.0000
          Z = 450.0000
          B = -59.4970
          C = -8.8153
         Datum shift:
          X = 0.0000
          Y = 0.0000
          Z = 0.0000
          B = 0.0000
          C = 0.0000
         Tool number: 3 (length = 50.0000, radius = 3.0000,
                        DL = 0.0000, DR = 0.0000)
         PalletPreset: no
INFO:    MAIN PGMEND                      01.12.2010 11:12:04.678
         PGM: SK_2DGER: bewegt: X koordkenz: XY
         Flags: stetig singleend eilgang
         L=300.0000 BESCHL=2.000 PROGF=10000.000 MAXF=10000.000 STARTF=322.000
         ABSCHNITT(X)=300.0000 POS(X)=300.0000
         ABSCHNITT(Y)=0.0000 POS(Y)=115.3504
STIB:    OFF                              01.12.2010 11:12:04.757
INFO:    MAIN PATH                        01.12.2010 11:12:04.759
         RUNBRKPGM = TNC:\Reiter\Hinuher.h
INFO:    SOKY                             01.12.2010 11:12:10.268
         KEYSOURCE: KEYBOARD
INFO:    SOKY                             01.12.2010 11:12:10.268
         PROCESS: MAIN
Key:     0x01EC ->Screen Change           01.12.2010 11:12:10.268
INFO:    SOKY                             01.12.2010 11:12:11.996
         PROCESS: MAIN
Key:     0x01C7 ->Mod                     01.12.2010 11:12:11.996
INFO:    SOKY                             01.12.2010 11:12:12.788
         PROCESS: MAIN
Key:     0x002A ->*                       01.12.2010 11:12:12.788
Key:     0x002A ->*                       01.12.2010 11:12:13.058
Key:     0x002A ->*                       01.12.2010 11:12:13.454
Key:     0x002A ->*                       01.12.2010 11:12:13.778
Key:     0x002A ->*                       01.12.2010 11:12:14.264
Key:     0x002A ->*                       01.12.2010 11:12:14.444
Key:     0x002A ->*                       01.12.2010 11:12:14.624
INFO:    SOKY                             01.12.2010 11:12:15.254
         PROCESS: MAIN
Key:     0x01A8 ->Enter                   01.12.2010 11:12:15.254
INFO:    MAIN KEYCODE                     01.12.2010 11:12:15.255
         Valid Key Code: LOGBOOK
Key:     0x0186 ->Softkey 6               01.12.2010 11:12:16.334
INFO:    SOKY                             01.12.2010 11:12:16.334
         IDENT:   GRS.S_EXECUTE
         PROCESS: MAIN
         SOFTKEY: /SYS:/resource/sk/1024x768/allg/command.bmx
         OVERLAY: 1
[END]
```

Figure: Excerpt from a log at program termination

Consideration of tool length

If the position display is set to ACTUAL, the operator can see the position of the tool tip.
The tool length is not taken into account in the log!
The ACTUAL value in the log for the tool axis minus the tool length is the ACTUAL value displayed on the monitor of the control.

In this example:
+161.0133 - 50.0000 = +111.0133 (displayed ACTUAL position of the tool axis Z)

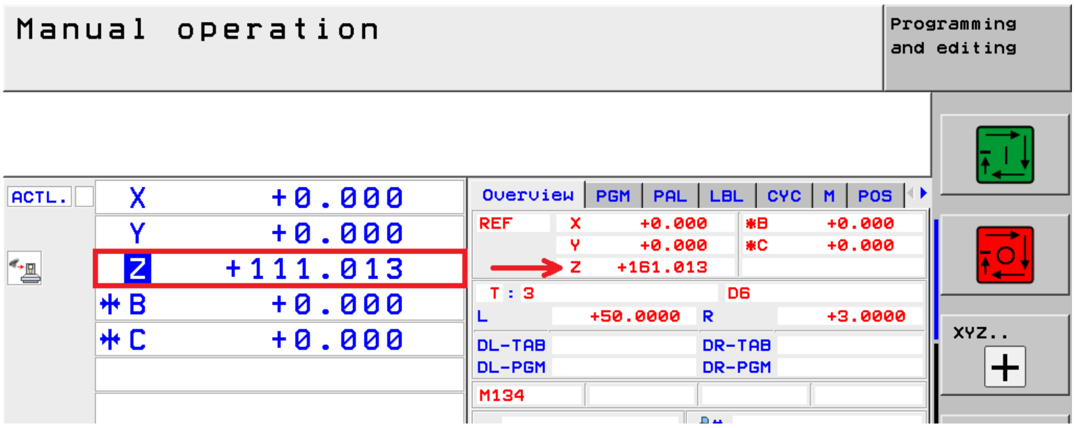


Figure: The tool (50 mm long) is taken into account in the ACTL display (the tool tip is displayed), whereas it is not in the REF display and in the log.

Calculation of REF position

Service engineers are not so much interested in the ACTUAL values at the time of the program termination, but in the REF values which represent the positions with reference to the machine datum.

To calculate these REF values, the offset values (**`Preset`**) recorded in the log are subtracted from the ACTUAL positions (**`Actual pos.`**).

In this example:

Actual pos.		Preset		REF position	Axis
171.1153	-	(-5.0000)	=	176.1153	X axis
115.3504	-	(-20.0000)	=	135.3504	Y axis
161.0133	-	450.0000	=	-288.9867	Z axis
322.2375	-	-59.4970	=	(381.7345 - 360 =) 21.7345	B axis
24.8189	-	-8.8153	=	33.6342	C axis

Note

Here, 360° must be deducted from the calculated value for the rotary axis B in order to get the correct REF position.

The REF position of the tool axis Z calculated in the example (- 288,9867) is also displayed on the control monitor in the REF position display setting.
This display always refers to the datum of the tool holder.
To determine the REF position of the tool tip, the tool length needs to be subtracted (-288.9867 - 50.0000 = - 338.9867).

9 DriveDiag

9.1 Introduction

The iTNC 530 HSCI features the diagnosis tool **DriveDiag**.

DriveDiag provides information on ...

- Operating states and signals;
  for this purpose, **traffic lights** (red, yellow, green) are used.
- Voltage values
- Current values
- Temperature values
- Electronic ID labels
- Motor data
- EnDat encoders
- Position controller, speed controller, current controller

9.2 Activation and operation

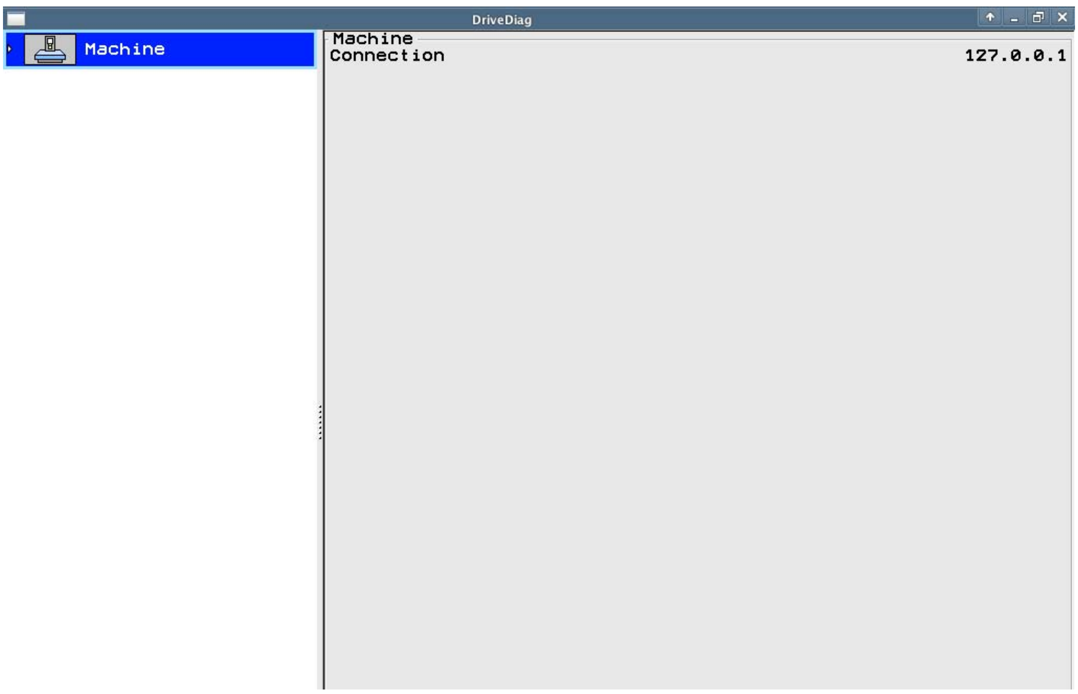
- Select the **`Programming and Editing`** operating mode.

- If open: Close the program management by pressing the END button.

> Note
>
> Pressing the MOD key while the program manager is open calls screen where you can make the interface settings.

- Press the MOD key.
- Press the DIAGNOSIS soft key.
- Press the DRIVE DIAGNOSIS soft key.

- Press the DRIVEDIAG soft key. --> Various data of connected devices is read out and a new window opens:



- You can open and close the tree structure on the left side of the DriveDiag window with the arrow keys.

- Navigation is also effected with the arrow keys or a mouse.
- Press ENT to activate the box to the right, and END to activate the box to the left.

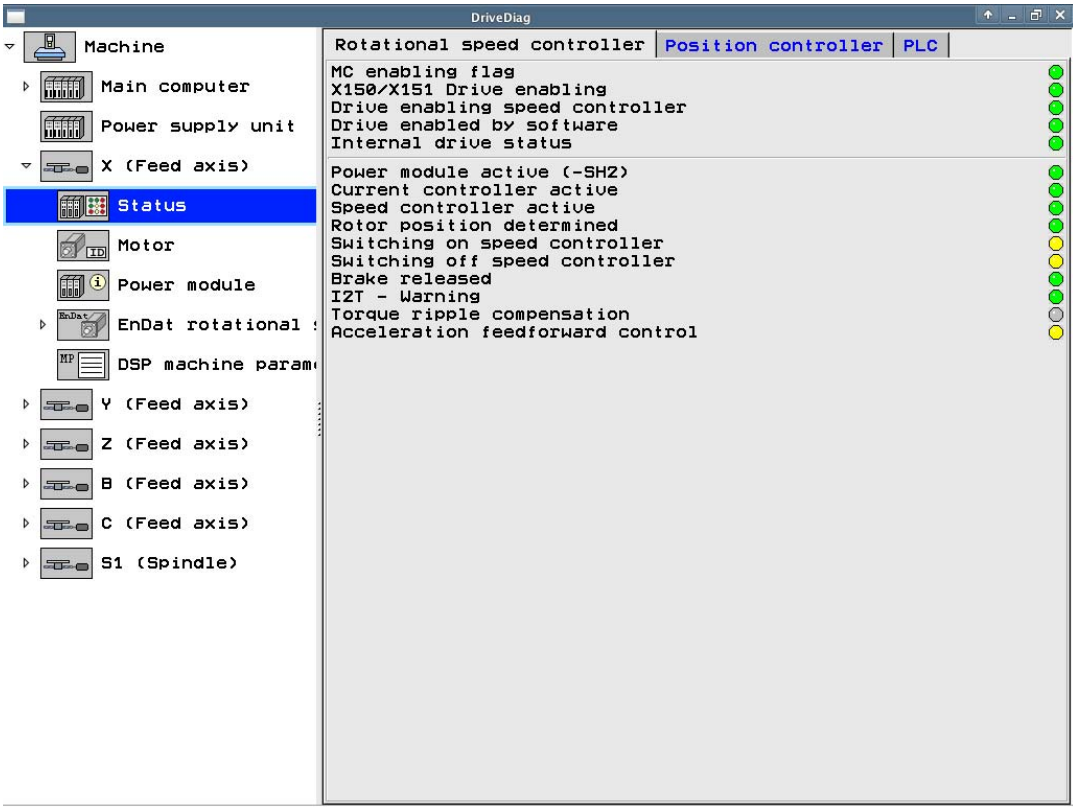


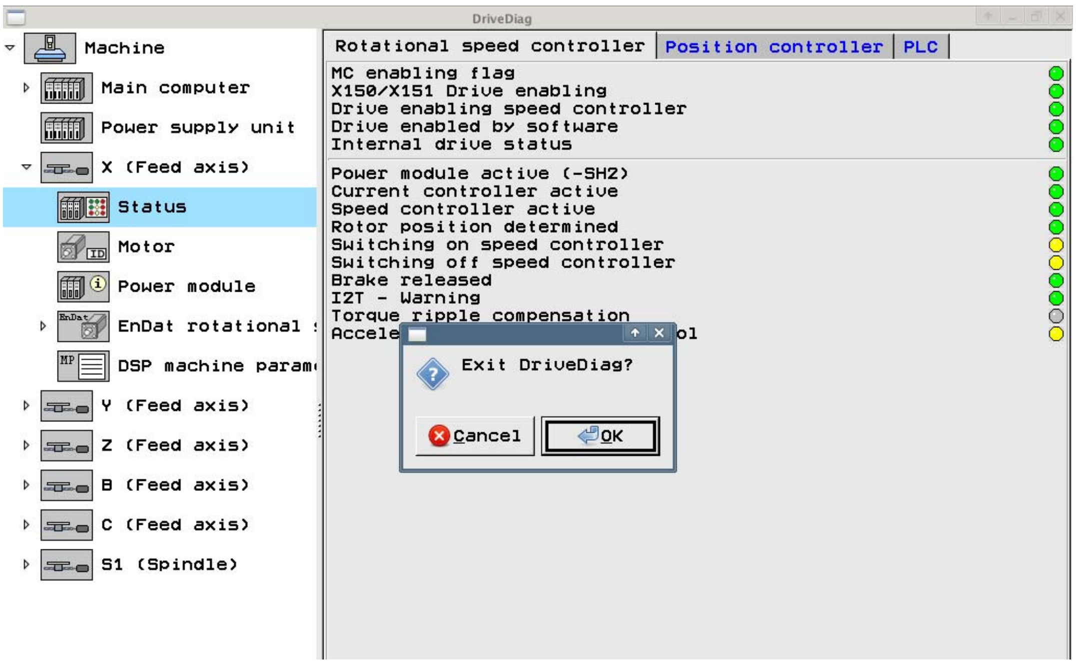
Fig: DriveDiag with open tree structure

Note

We recommend using a USB mouse to navigate in DriveDiag.

- With the screen switchover key you can switch between the screen displays for the machine operating modes, programming modes and DriveDiag.

- To close DriveDiag, press END and click the OK button.



9.3 Troubleshooting with DriveDiag

The use of DriveDiag for troubleshooting is described **in the respective chapters** of this **Service Manual**.

10 Integrated oscilloscope

10.1 Introduction

The iTNC 530 HSCI features an integrated oscilloscope

This oscilloscope has six channels, of which no more than four can be used for signals from the current and speed controller. If more than four channels of the current and speed controller are to be displayed, the error message **`Channel <number> cannot be displayed`** appears.

Benefits of the integrated oscilloscope **for field service**:

- The **actual values** of physical quantities such as distance, velocity, acceleration can be compared **with the respective nominal values**.
- Observing the current **`I noml`** and the signals derived from the current value, such as **`I2-t (mot.), I2-t (p.m.), Utilization`** permits conclusions about the tool in use, about lubrication, the mechanics and the electrical drives.
- The following error **`s diff`** and the signal **`Pos.Diff.`** are also significant for the mechanical quality of a machine.
- For analog axes, **`s diff`** provides information on the speed adjustment at the servo amplifier.
- By **triggering to error markers** it is possible to record the behavior of the machine shortly before an error condition occurs.
- **Physical signals** such as current, speed, etc. can be recorded **together with PLC signals**.
- **Static and sliding friction** at the quadrant transitions can be analyzed in a **circular interpolation test**.
- **Encoder signals** (position encoder, motor encoder) can be recorded.

10.2 Activation and settings

▶ Select the **Programming and Editing** operating mode.

▶ If open: Close the program management by pressing the END button.

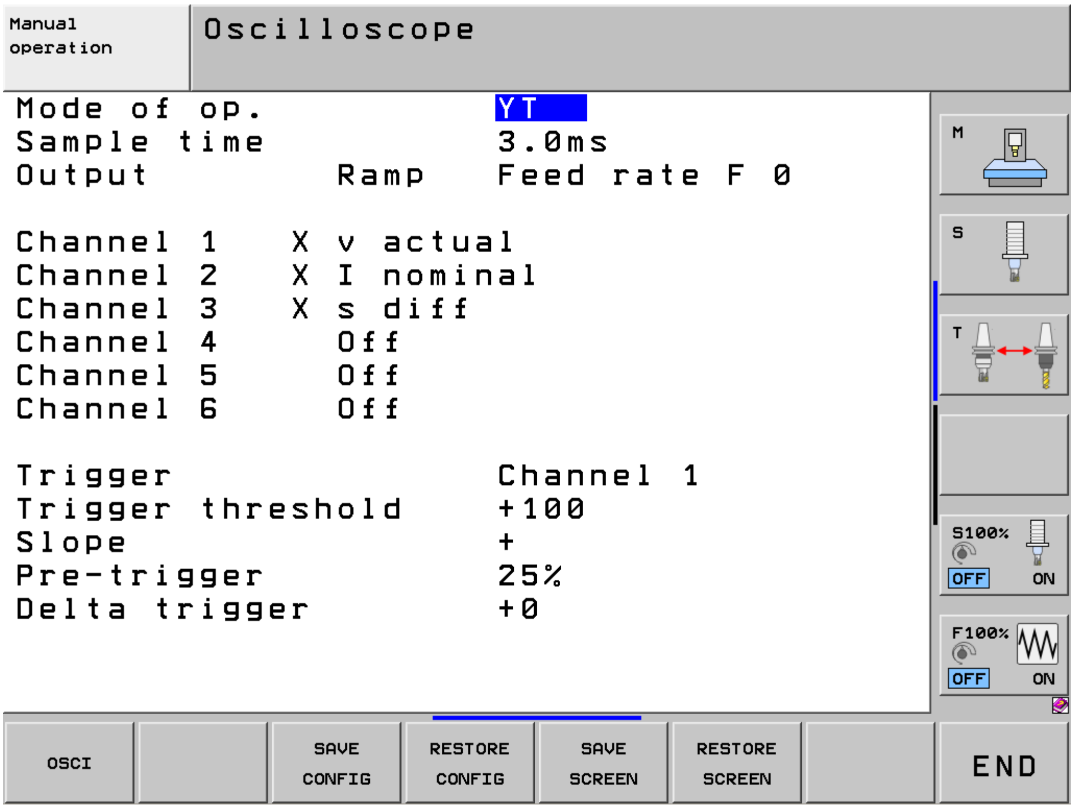
> Note
>
> Pressing the MOD key while the program manager is open calls screen where you can make the interface settings.

▶ Press the MOD key.

▶ Press the DIAGNOSIS soft key.

▶ Press the DRIVE DIAGNOSIS soft key.

▶ Press the OSCI soft key. --> The setup menu appears.

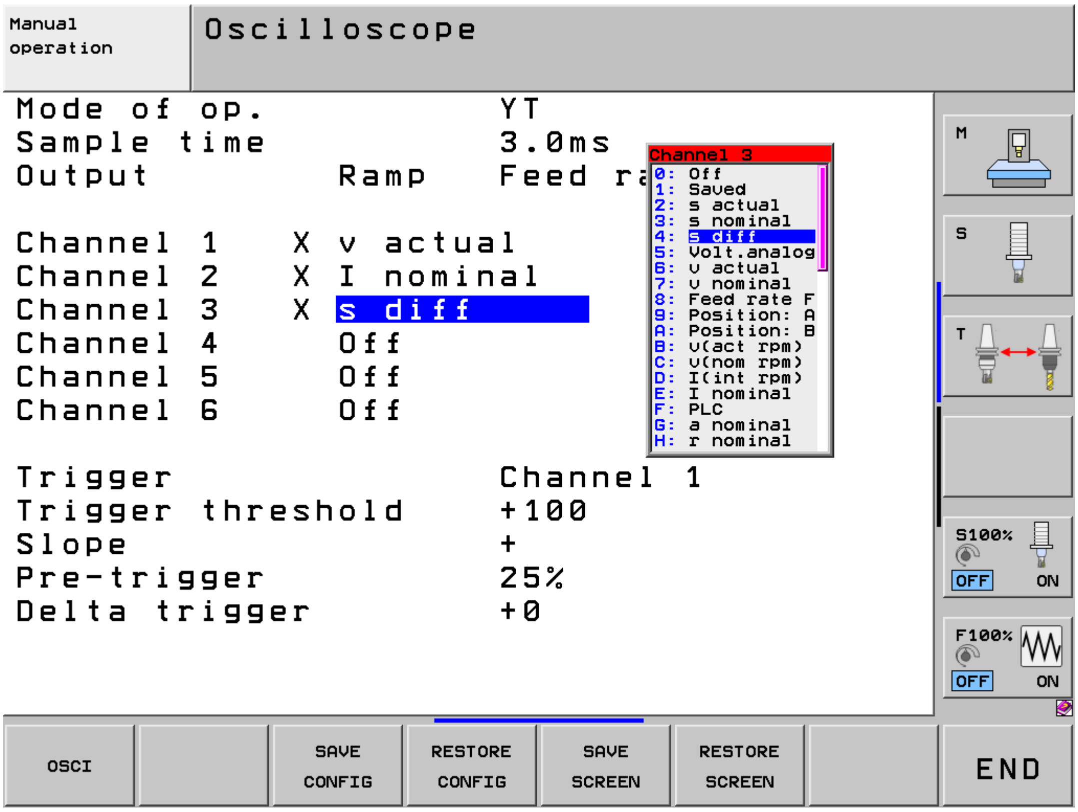


> Note
>
> The integrated oscilloscope can also be called by entering the code number 688379.

▶ Use the arrow keys to position the cursor to the respective input fields.

▶ Press the GOTO key to open one of the drop-down boxes.

▷ Use the cursor to select a value and confirm it with the ENT key.



Operating mode

▷ Select the desired setting or choose the circular interpolation test.

- **YT:** Chronological depiction of the channels (function of the time)
- **XY:** X/Y graph of two channels
- **CIRC:** Circular interpolation test

Sample time

▷ Set the time interval for recording the signals.

Enter e.g. 0.6 ms, 3.0 ms, 6.0 ms and 0.1 ms (depending on the specified cycle times).
4096 grid points are saved. The time interval determines the duration of recording.

Example:

0.6 ms	x	4096	=	2.4576 s
3.0 ms	x	4096	=	12.2880 s
6.0 ms	x	4096	=	24.5760 s
0.1 ms	x	4096	=	0.4096 s

Output

▷ For the field service, always select **Ramp**!

- If you select **ramp** output, then the programmed feed rate, k_V factors and acceleration values that you have specified on the machine go into effect.
- If you select **step** output, a step will be output as nominal velocity value when you press the axis-direction buttons in the **Manual operating mode.**
  While the step is output, the position control loop is opened. For safety reasons, step response is only possible after entering a code number.

DANGER

With the step function, the machine can accelerate with maximum force.

- Improper use of the step function may cause damage to the machine or even personal injury!
- Recordings made with the step function in the integrated oscilloscope are mainly used to optimize the control loops of the machine. Optimization may only be performed by trained specialists from machine tool builders.
- The specified feed rate corresponds to the height of the step. --> As a precaution, set the feed rate to zero!
  When the internal oscilloscope is activated again, "Ramp" output is automatically selected.

Feed rate

- Height of the step for the nominal velocity value (mm/min); this entry has no effect for ramp output.

Channel 1 to 6

- Select a signal and an axis or a spindle for the respective channel.
- Specify the operand type (B,W,D,I,O,T,C) and the address for recording PLC operands.
- Use the **SAVED** setting to “freeze” the signal last recorded for this channel. This means that the recorded values remain available on the display. For example, you can use them to record a reference curve for use in future measurements.

Note

To compare a **SAVED** signal to a newly recorded signal, both recordings should be made with the same trigger conditions.
Otherwise, shifts on the time axis may make signal comparison difficult or impossible.

Signals

The following **signals** can be recorded:

Signal	Meaning	Unit
Off	No recording for this channel	-
Saved	The signal last recorded on this channel is "frozen."	-
s actual	Actual position	[mm] or [°]
s nominal	Nominal position	[mm] or [°]
s diff	Following error of the position controller	[mm] or [°]
Volt.analog	Analog axis/spindle: Analog voltage = nominal velocity value	[mV]
v actual	Actual value of the axis feed rate; calculated from position encoder	[mm/min] or [°/min]
v nominal	Nominal value of the axis feed rate; axis feed rate calculated from the difference from the nominal position values. The following error is not included.	[mm/min] or [°/min]
Feed rate F	Machining feed rate	[mm/min] or [°/min]
Position: A	Signal A of the position encoder	[mV]
Position: B	Signal B of the position encoder	[mV]
V (act rpm)	Actual speed value; calculated from rotary speed encoder and standardized with MP1054.	[mm/min] or [°/min]
V (noml rpm)	Nominal speed value; output quantity of the position controller	[mm/min] or [°/min]
I (int rpm)	Integral-action component of the nominal current value; CC 61xx and UEC 11x: effective value	[A]
I nominal	Nominal current value that determines torque; CC 61xx and UEC 11x: effective value	[A]
PLC	The PLC operands (B, W, D, I, O, T, C) are recorded. Enter the operand in the text box next to PLC.	-
a nominal	Nominal value of the acceleration	[m/s^2] or [°/s^2]
r nominal	Nominal value of the jerk	[m/s^3] or [°/s^3]
Pos. diff.	Difference between position and speed encoder	[mm] or [°]

Signal	Meaning	Unit
a actual	Actual value of the acceleration; calculated from position encoder	[m/s^2] or [°/s^2]
r actual	Actual value of the jerk; calculated from position encoder	[m/s^3] or [°/s^3]
I2-t (mot.)	Current value of the I^2-t monitoring of the motor	[%]
I2-t (p.m.)	Current value of the I^2t monitoring of the power module	[%]
Utilization	Current utilization of the drive	[%]
Block number	Block numbers of the NC program	-
Gantry Diff	Difference between synchronized axes	[mm]
U nominal	Nominal voltage	[V]
P mech.	Mechanical power	[kW]
P elec.	Electrical power	[kW]
M actual	Actual value of the torque	[Nm]
s noml (f.)	Nominal position as per nominal position value filter	[mm]
DSP debug	Diagnosis function for internal purposes	-
Contour deviat.	Circular interpolation test, contour deviation [mm]	[mm]
F TCPM	Feed rate at the tool tip with TCPM	[mm/min]
Int. diagn.	Reserved for internal purposes	-
DC-link P	DC-link power (if MP2198.x and MP2199.x are configured)	[kW]
Amplitude	Amplitude of the position encoder	[mV]
Motor: A	Signal A of the speed encoder	[mV]
Motor: B	Signal B of the speed encoder	[mV]
CC DIAG	Axis-specific signal with additional input box. Consult your machine manufacturer or a HEIDENHAIN service agency.	-
SPLC	Reserved	-
SPLC-CC	Reserved	-
Compensat.	Position compensation value (composed of temperature compensation, axis-error compensation, backlash compensation, etc.)	[mm] or [°]
I actual	Actual value of current	[A]
Actl. Id	Actual value of magnetizing current	[A]
Max. Iq	Maximum torque current	[A]

Note

For the **CC 610x** and the **UEC 1xx** controller units, the **current signals** are displayed as **effective values** in the integrated oscilloscope.

Note

The oscillogram remains stored until you start a new recording.

Trigger

▶ Set the trigger:

- **`Free run`**
  The recording is started and ended by soft key. When you press the STOP soft key, the last 4096 points are saved.
- **`Single shot`**
  When you press the START soft key, the next 4096 points are stored.
- **`Channel 1`** to **`channel 6`**:
  Recording begins when the triggering threshold of the selected channel is exceeded.

Trigger threshold

▶ Enter the trigger threshold.

> Note
>
> The height of the threshold depends on the expected signal amplitude.
> The units of measure result from the signal type.
> For the PLC signals M, I, O, enter a threshold of 1 or 0.

Edge

▶ Define whether recording will be triggered with the rising (positive) or falling (negative) edge.

Pre-trigger

The setting of the pre-trigger defines the duration of the recording after the trigger threshold is reached.

- Pre-trigger = 0%:
  4096 grid points are recorded beginning from the fulfilled trigger condition.
  The trigger threshold reached first is on the left edge of the record (position of cursor 1).
- Pre-trigger = 25% (or 50% or 75%)
  75% (or 50% or 25%) of the 4096 grid points beginning from the fulfilled trigger condition are recorded.
  The trigger threshold reached first is at 25%, in the middle or at 75% of the record (position of cursor 1).
- Pre-trigger = 100%:
  Recording is stopped. The last 4096 grid points before the fulfilled trigger condition are saved.
  The trigger threshold reached first is on the right edge of the record (position of cursor 1).

> Note
>
> If the trigger condition is fulfilled **before** the corresponding number of grid points have been stored when the pre-trigger is set to 25, 50, 75 or 100%, then correspondingly fewer grid points are recorded.

Delta trigger

You can specify a second trigger threshold in the oscilloscope, which enables you to use a value range to define the event triggering a recording. Depending on the trigger edge and the first trigger value, you can determine whether a trigger signal is output when the value range is reached or exceeded. The inverse of the edge of the first trigger value is always selected as the active trigger edge of the delta trigger. The delta trigger is given as a value relative to the first trigger threshold. If a value of zero (0) is entered for the delta trigger (default setting), then the delta trigger is off.

▶ Enter the second trigger threshold for a value range if needed.

10.3 Recording and adjusting the signals

- Press the OSCI soft key.

- Press the START soft key.

The selected signals are recorded continuously.

After recording ends, the memory contents are displayed.

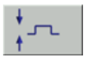
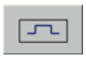
You can stop the recording anytime by hand with the STOP soft key.

> Note
>
> The oscillogram remains stored until you start a new recording.

Vertical resolution

Now, adjust the **amplitude** of the signals:

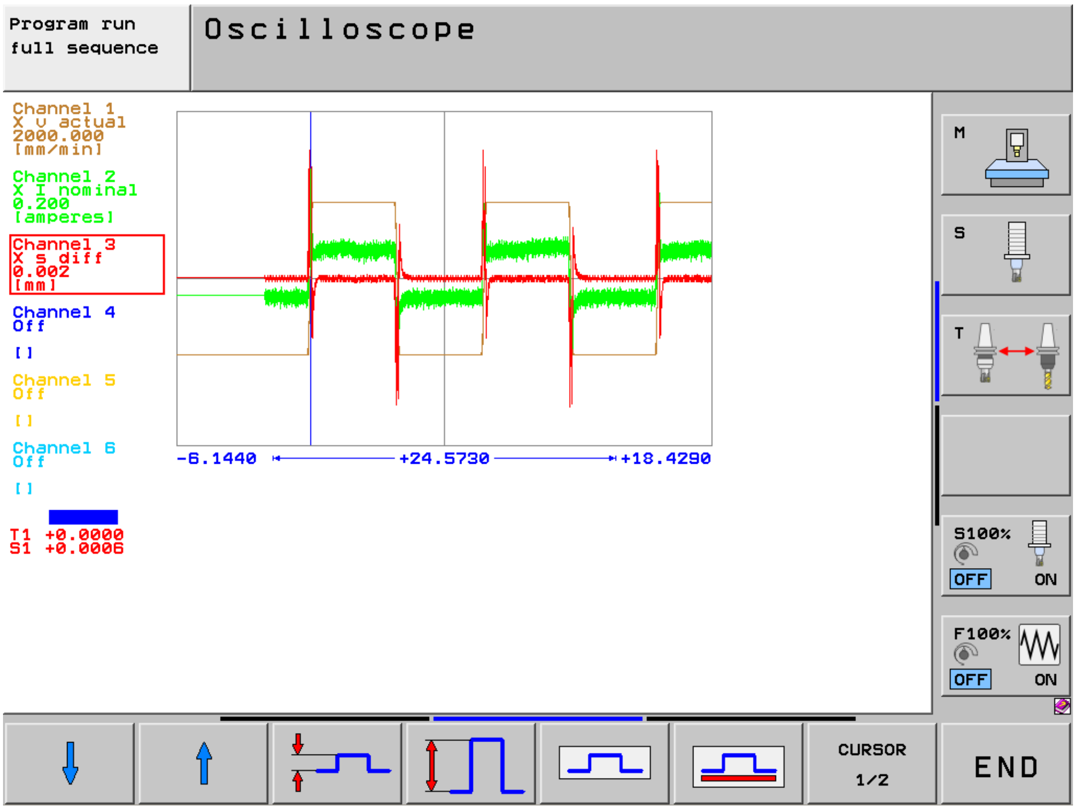
- Switch to the next soft-key row and use the following soft keys:

	Shift the signal downward.
	Shift the signal upward.
	Decrease the vertical resolution.
	Increase the vertical resolution.
	Optimum vertical resolution; the signal is centered on the vertical center and always remains in the display area.
	Optimum vertical resolution under consideration of offsets to the zero line.

- Select the next channel with the arrow keys on your keyboard and adjust the signal amplitude there. Proceed accordingly with the other channels.

> Note
>
> The selected channel is distinguished by a frame.
> At the same time, the cursor is placed on the selected channel.
> The active channel and the corresponding signal are mostly displayed in red color.

The result is an optimally visible oscilloscope display:



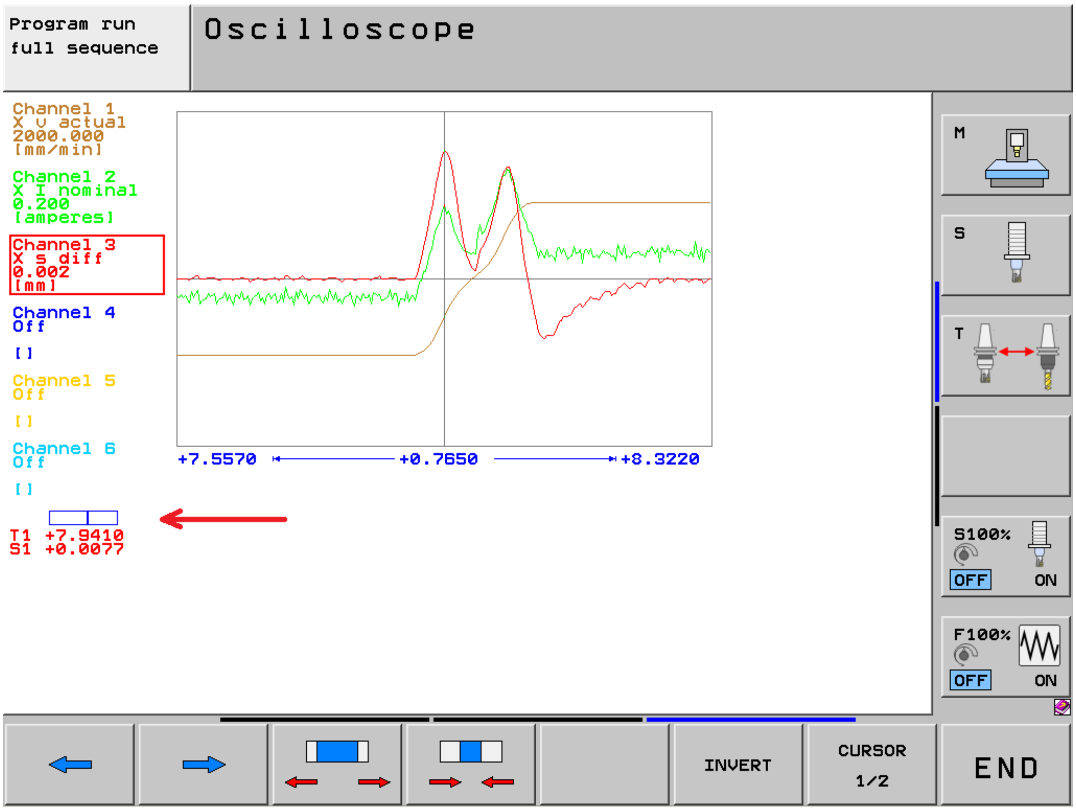
Horizontal resolution

Now, you can spread the **time axis**:

- Switch to the next soft-key row.
- Use the arrow keys on the keyboard to place the cursor 1 on a horizontal position of the recording. This position serves as anchor for time spreading.
- Use the following soft keys:

	Display a larger detail of the time axis (up to entire image)
	Display a smaller detail of the time axis

The signal details can be made visible:



Note

The displayed time detail is shown in a small bar at the bottom left (see arrow in the screenshot). Every new recording is displayed with this setting.

With the following soft keys the recording can be shifted on the time axis:

	Shift the display range to the left.
	Shift the display range to the right.

Other soft keys

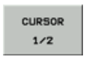
Other soft keys are available:

	Hide/show gridlines.
	Hide/show connecting lines between measured points.
	Invert the signal.
	Exit the oscilloscope.

Cursor information

You find the cursor information to the left below the channel display and the time bar.
First, the signal amplitude of **the selected channel** and the time (related to the trigger event) are displayed here.

> **Note**
>
> Grid points that were recorded before the trigger condition was fulfilled are given a negative time.

	Activate the second cursor.

When this soft key is pressed, a second cursor is activated; information on this cursor is displayed.
For the **cursor 2**, the signal amplitude and the time (in seconds) are displayed **in relation to cursor 1**.
By means of this function you can e.g. measure the acceleration time of an axis.

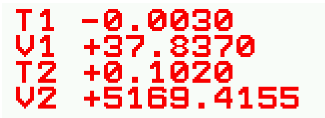


Figure: Cursor information

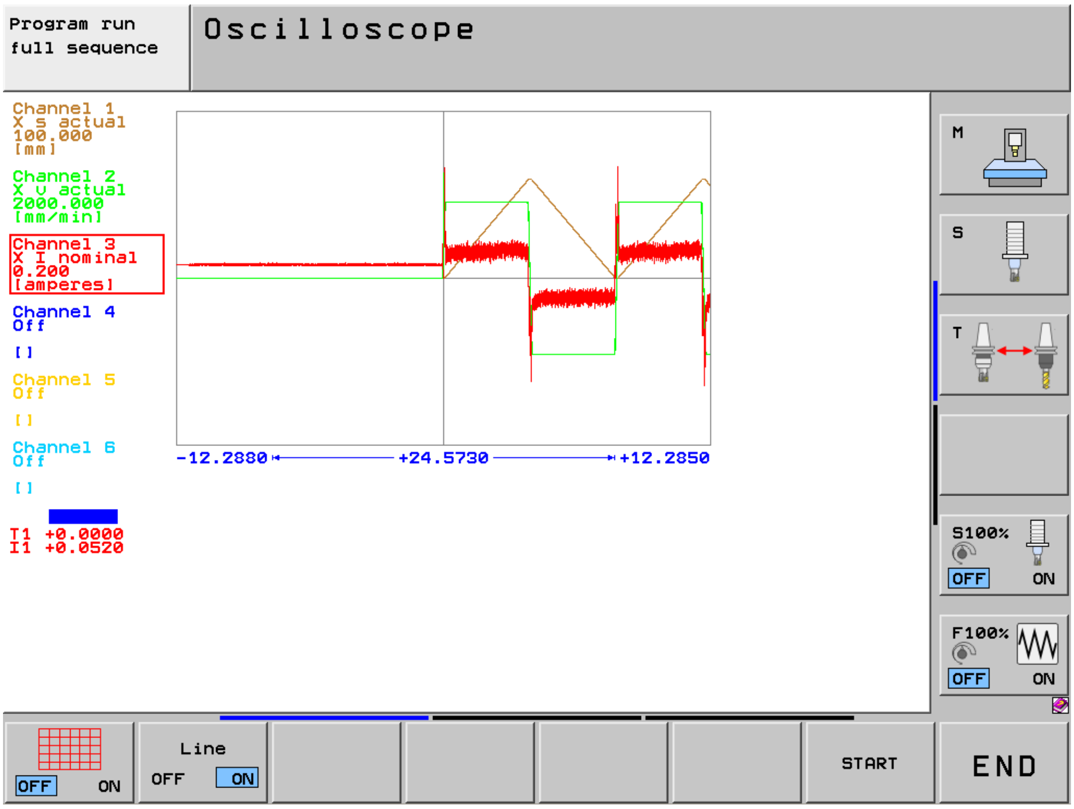
Cursor information	**Comment**
T1:	Position of cursor 1 in [s], related to the trigger event
V1:	Signal amplitude at position of cursor 1
T2:	Position of cursor 2 in [s], related to cursor 1 (time difference)
V2:	Signal amplitude at position of cursor 2, related to signal amplitude at position of cursor 1

Specific for pre-triggering

See “Pre-trigger” on page 10 – 100.

> **Note**
>
> If the trigger condition is fulfilled **before** the corresponding number of grid points have been stored when the pre-trigger is set to 25, 50, 75 or 100%, then correspondingly fewer grid points are recorded.

Example:
Oscillogram with 50 % pre-trigger.
The trigger condition was fulfilled immediately when the recording was started.



10.4 Saving and loading recordings

You can **save** recorded **oscillograms** together with the related settings to files on the hard disk of the iTNC 530 HSCI. The files must have the extension *.DTA.

- Record an oscillogram.
- Exit the oscillogram by pressing the END soft key. --> You return to the setup screen for the integrated oscilloscope.
- Now press the SAVE SCREEN soft key. --> Path and name for the oscilloscope file are suggested in the heading:

> Note
>
> You can change the path and name of the oscilloscope file. The file extension must always be **DTA**.

- Press the ENT key. --> The file is created.

> Note
>
> This file can then be moved to an external data medium (e.g. using TNCremoNT or a USB flash drive).

You can call saved oscillograms in the integrated oscilloscope **at any time**:

- Now press the RESTORE SCREEN soft key in the setup menu. --> Path and name for the oscilloscope file are suggested in the heading:

> Note
>
> If the oscillogram was saved with a different name in another path, you must enter this here.

- Press the ENT key. --> The oscillogram is displayed.

10.5 For error diagnosis

10.5.1 Triggering on error markers

With the integrated oscilloscope, you can make recordings with trigger on the following error markers (defined by HEIDENHAIN):

- **M 4177** (erasable error message)
- **M 4178** (error message that causes an external EMERGENCY STOP)

Note

It is also possible to trigger on the error markers defined by the OEM that are documented in the PLC error table (e.g., M4812).

Advantage of this method:
The integrated oscilloscope, which is started at any point in time, continuously makes recordings, until an error message is issued on the machine.
The behavior of the selected signals shortly before the error event takes place can be examined at a later time.

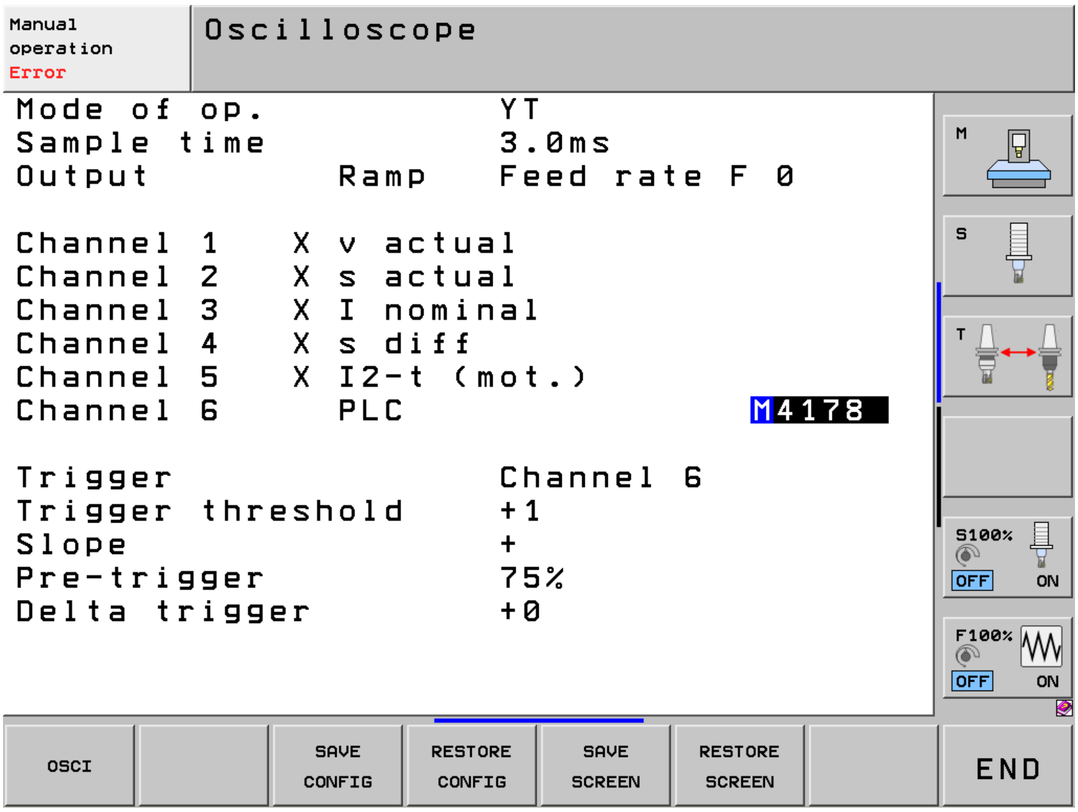


Figure: 75 % triggering on error marker M 4178, channel 6

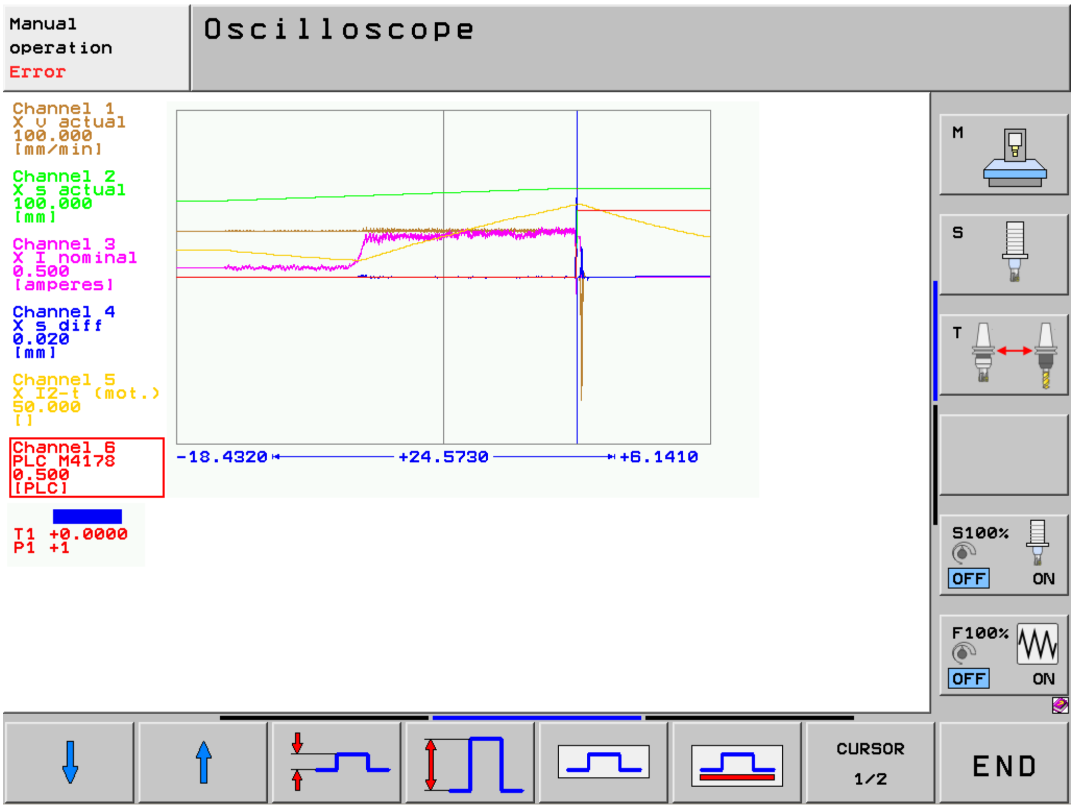


Figure:
An overload generates an I2T error message on the machine, which in turn triggers an EMERGENCY STOP. The error marker M 4178 changes from zero to one. On the time axis, 75 % before the error event are displayed.

10.5.2 Circular interpolation test

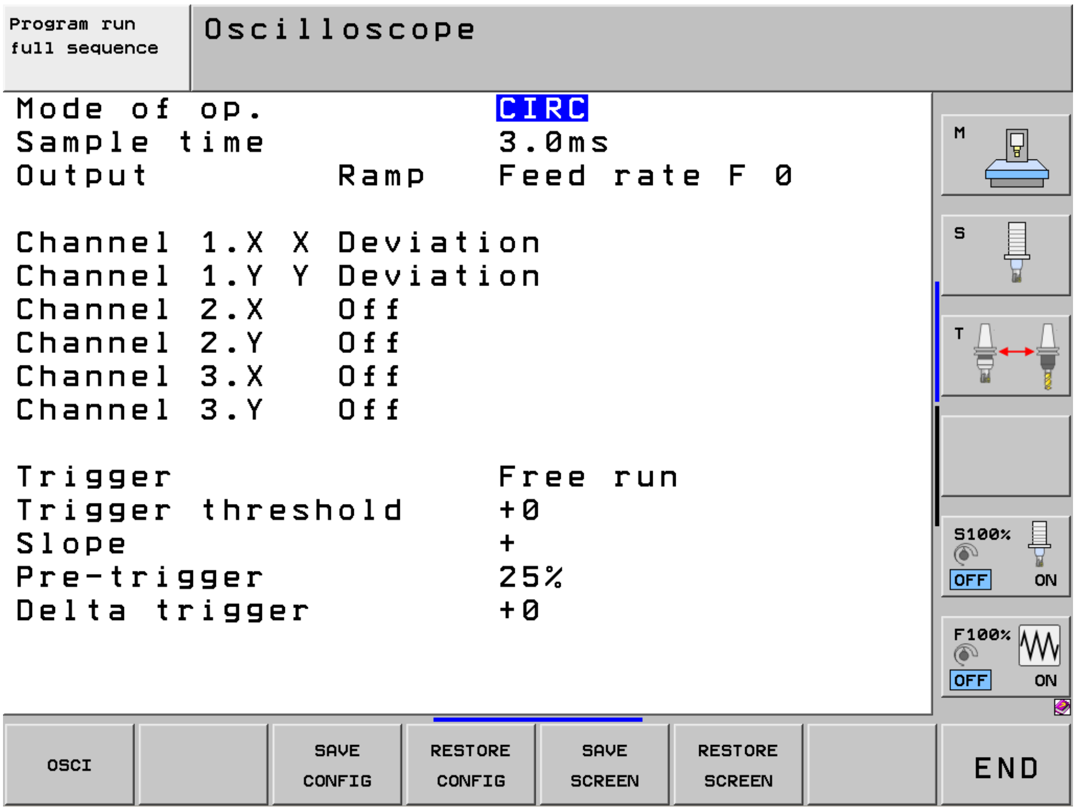
The integrated oscilloscope of iTNC 530 HSC also features a circular interpolation test.

With this test, for example the **static and sliding friction** at the quadrant transitions can be analyzed.

Note

The integrated circular interpolation test with the mounted encoders (e.g., linear encoders) does not serve to test the geometry of the machine.
Additional measuring equipment (e.g., KGM grid encoder from HEIDENHAIN) is required for this purpose.

- Choose the `CIRC` operating mode in the oscilloscope.
- Set `Contour deviat.` twice.
- Select the axes involved (XY, YZ, XZ).



Example of a circular interpolation test with the integrated oscilloscope:

Note

If required, ask the machine operator how to operate the machine and how to create and execute the NC program!

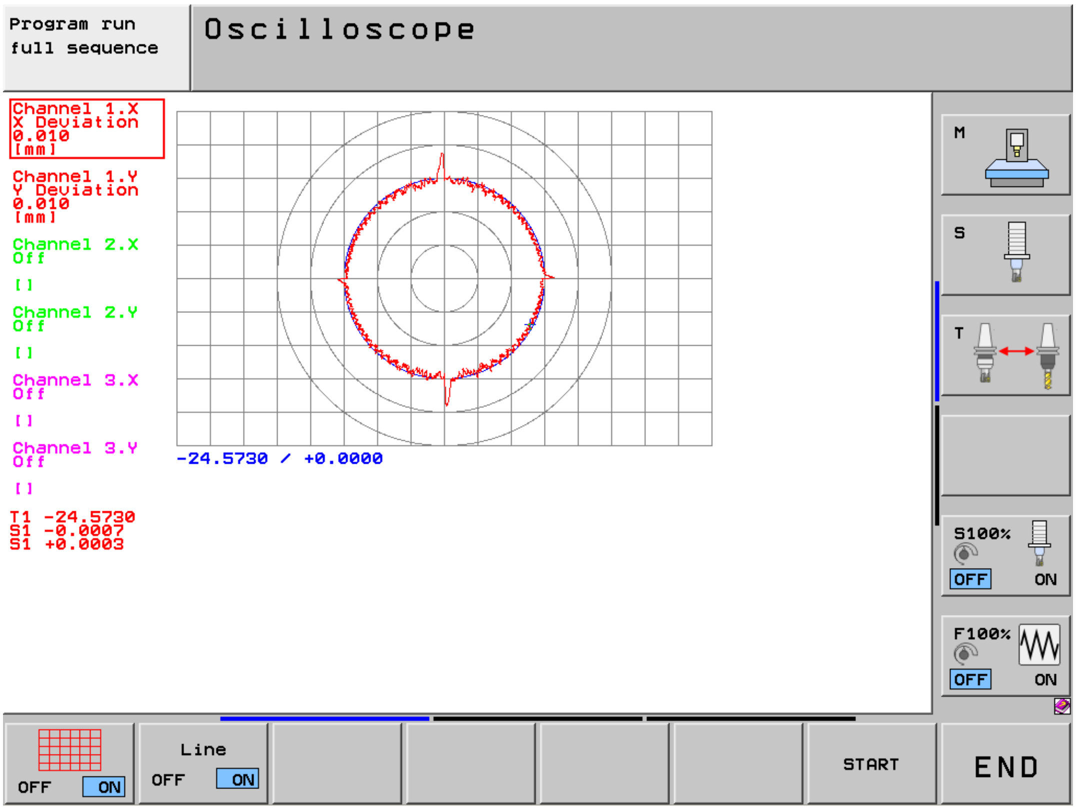
- Position the axes in an area that allows safe traverse of the circle.
- Set the reference points for X and Y as follows:

Actual position:
X +30
Y +0

- Write a simple NC program, such as:

```
0 BEGIN PGM Circular interpolation test MM
1 CC X+0 Y+0
2 CP IPA+5000 DR+ F1000
3 M30
4 END PGM Circular interpolation test MM
```

- Start this NC program in the automatic mode and start oscilloscope recording.
- Stop recording and adjust the display.



Note

You can run the circular interpolation test at different positions, at different speeds and with different radii!

10.5.3 Finding compensation values

To improve the positioning accuracy of machine tools, the machine tool builder can choose from a variety of compensation possibilities the iTNC 530 HSCI offers:

- Backlash compensation
- Linear axis error compensation
- Nonlinear axis error compensation
- Compensation of thermal expansion
- Compensation of reversal spikes during circular traverse
- Compensation of static friction
- Compensation of sliding friction
- Torsion compensation

All selected and activated compensations are combined and transferred to the position controller.

Note

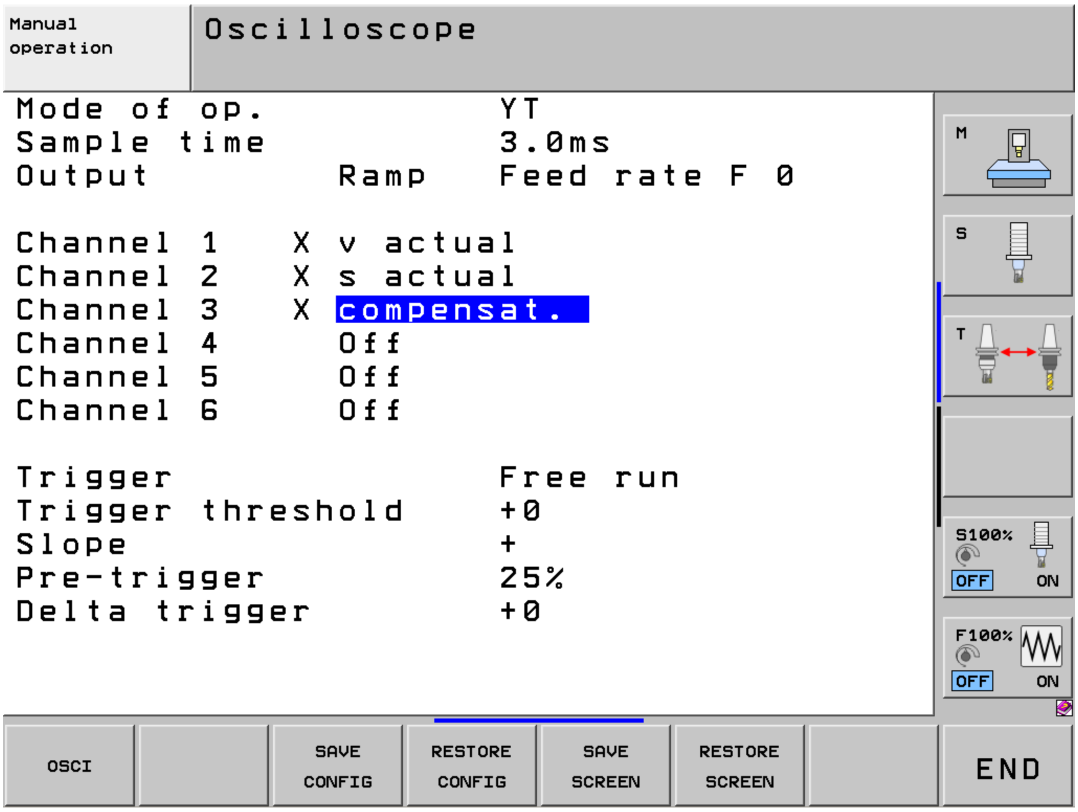
Compensation values are not noticeable to the operator.

Example:

You have replaced a position encoder. According to the instructions of the machine tool builder, the components must be switched off, before the machine datum can be reset.

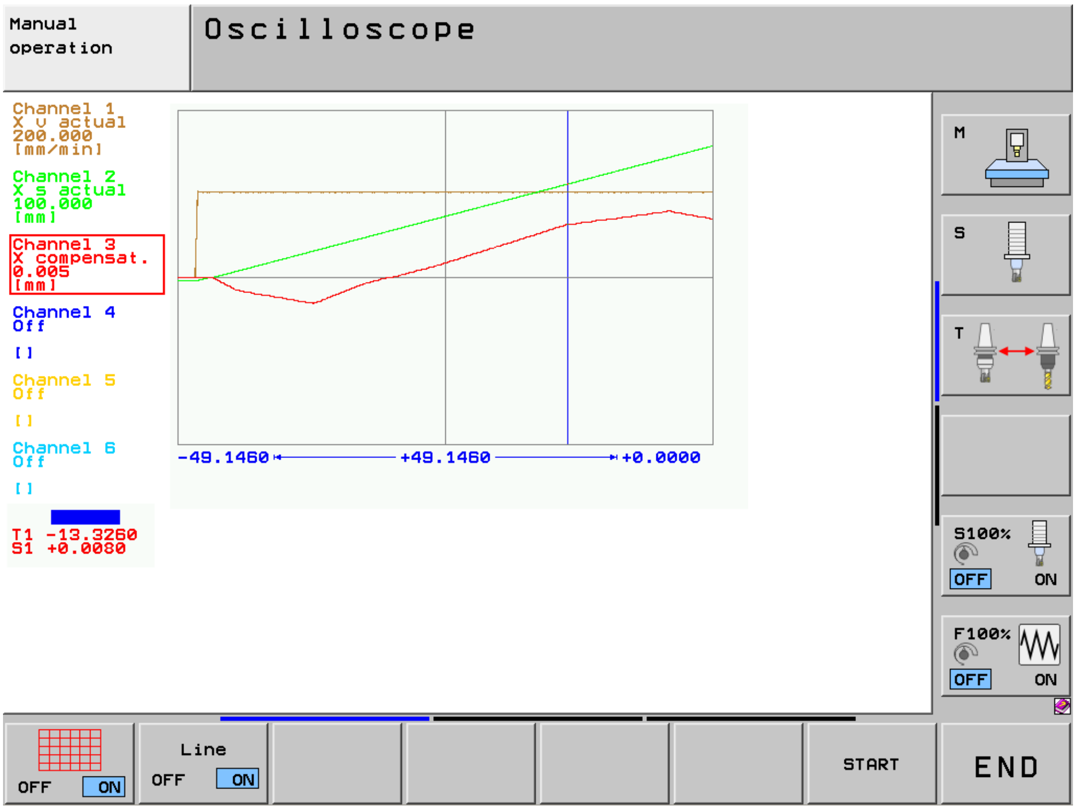
With the integrated oscilloscope, you can find out whether or not compensations are still active.

- For example, set the oscilloscope like this:



- Start the oscilloscope recording.
- Traverse the axis concerned at low speed.
- Stop recording and adjust the display.
- Traverse the axis again wit the adjusted display.

▶ Now you can see, whether or not compensations are effective.



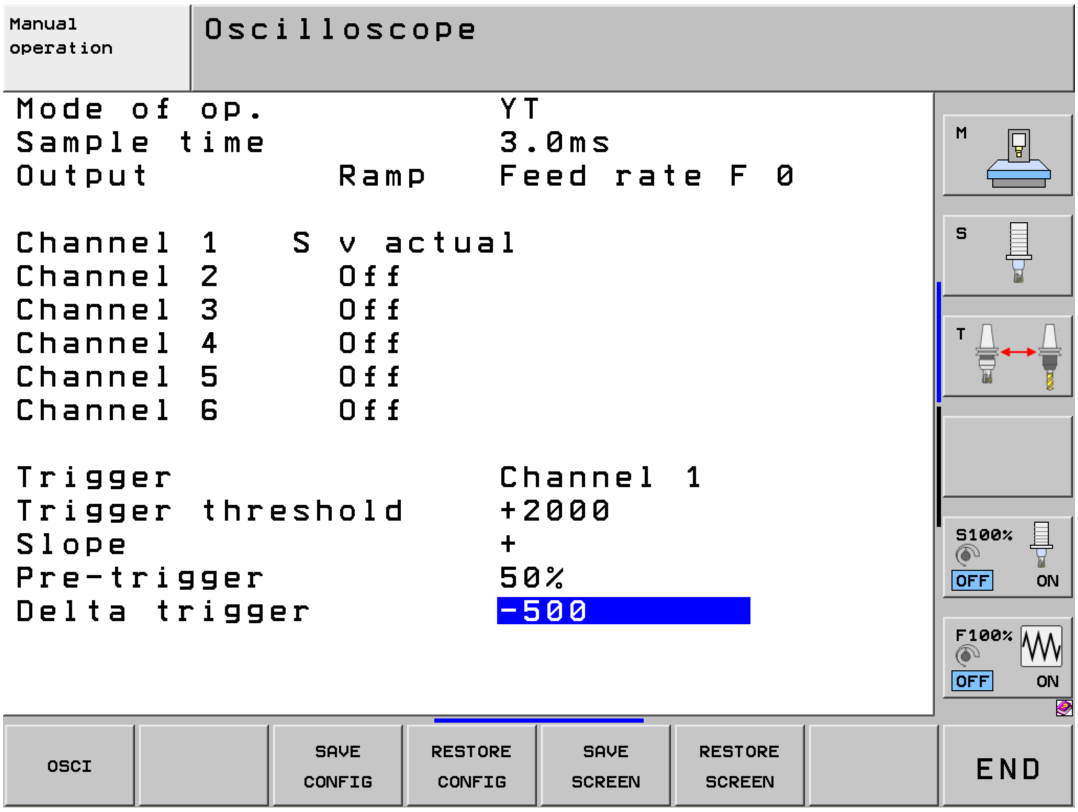
10.5.4 Working with delta triggers

With the delta trigger, you can define a "corridor" a physical signal must not leave.

Example:

You want to observe an actual speed value. This value must not exceed a lower and an upper limit.

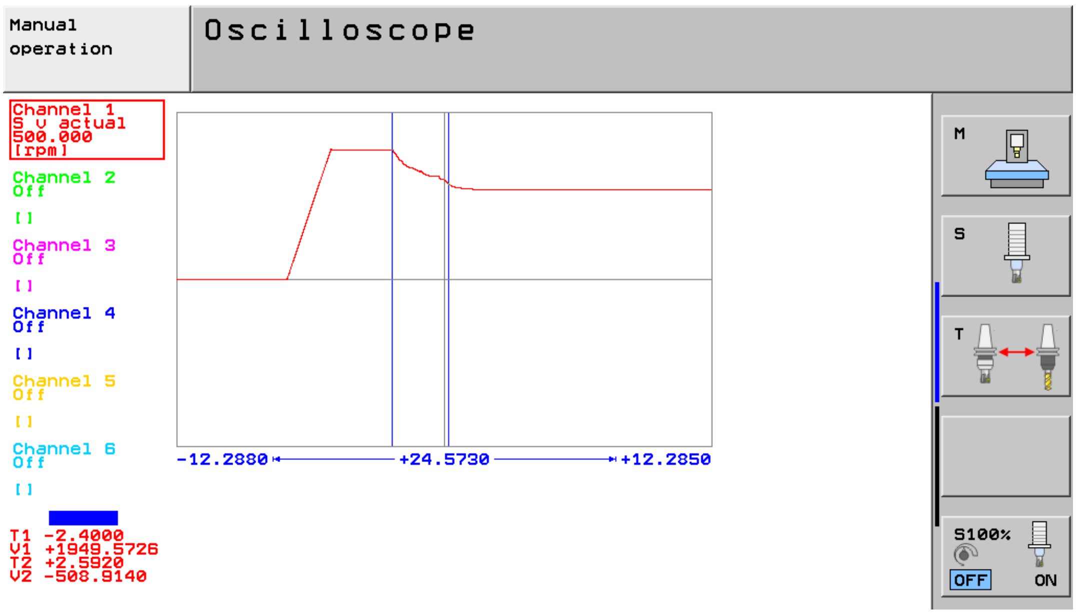
▶ For example, set the oscilloscope like this:



▶ Start the oscilloscope recording.

▶ Ask the operator to mill a workpiece.

▶ Now you can see, whether or not the "speed corridor" is observed.



10.5.5 Descriptions in this manual

Further use of the integrated oscilloscope for error diagnosis is **described** in the **respective chapters** of this Service Manual.

11 PLC diagnosis

11.1 Introduction

Definition of PLC

PLC is a generic term from control technology and is the abbreviation of:
Programmable **L**ogic **C**ontroller (programmable control).

The PLC of the iTNC 530 HSCI is located in different units and is therefore referred to as **integrated PLC**.

Tasks of the PLC

- Adaptation of different machine types to HEIDENHAIN controls
- Assuming control tasks

> Note
>
> The machine manufacturer creates the PLC program for the machine or adapts an existing PLC project to his machine.

> DANGER
>
> Changes to the PLC program or to the PLC wiring may influence not only the function but also the safety of the machine!
> This could lead to damage to property or persons.
> **Changes to the PLC may only be performed by the machine manufacturer!**

Data exchange with the PLC

In order to take on interfacing and control tasks, the PLC must exchange data with the machine and with the NC part of the control.

Depending on the type of control, various **inputs and outputs** are available for **data exchange with the machine**.

Data is exchanged between PLC and NC by **markers, bytes, words, double words and PLC modules**.

Calling the PLC mode

▶ Select the `Programming and Editing` operating mode.

▶ If open: Close the program management by pressing the END button.

> Note
>
> Pressing the MOD key while the program manager is open calls screen where you can make the interface settings.

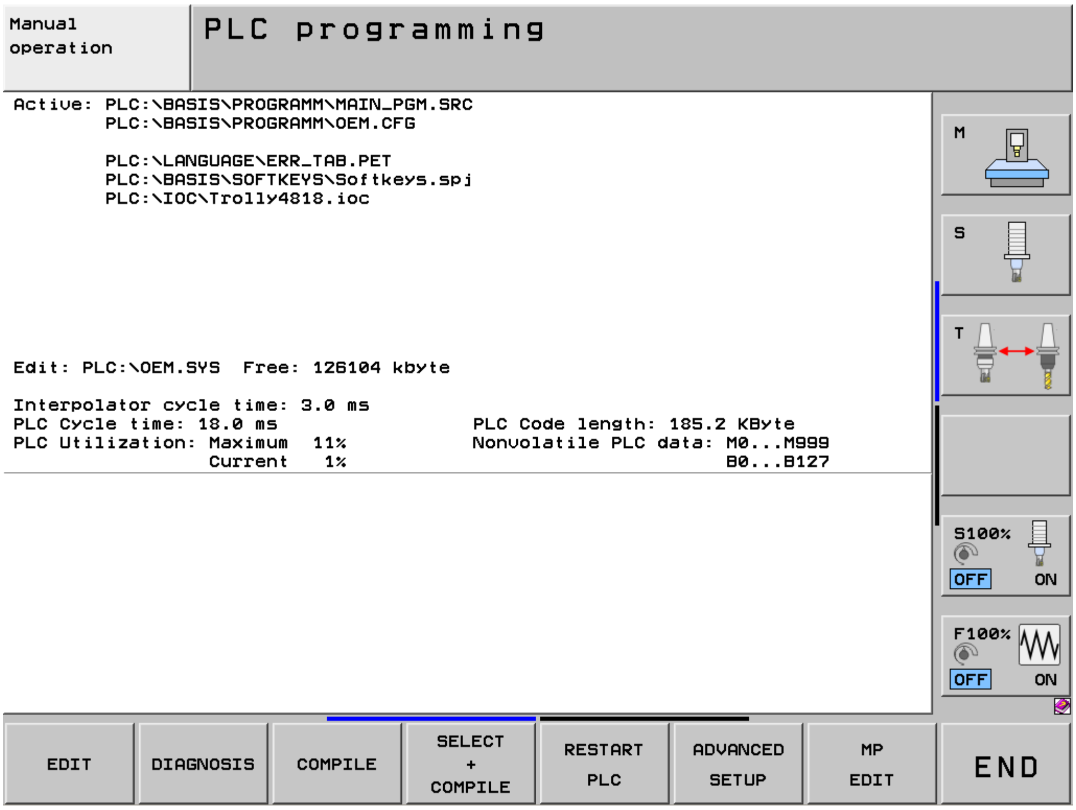
MOD ▶ Call the code number window.

8 0 7 6 6 7 ENT ▶ Enter and confirm the code number.

▶ The PLC main page is displayed.

> Note
>
> If **READONLY** appears on the left side of the screen, the machine manufacturer has protected the PLC mode by his own code number.
> With the standard PLC code number 807667 the diagnosis options are limited.
> --> Ask your machine tool builder!

PLC main page



On this page you can see, e.g.:

- Which PLC main program is running.
- Which PLC error table is used.
- The size of vacant memory on the PLC partition.
- The range of non-volatile PLC markers and words (or bytes)
- The PLC utilization

Note

The processing time of the PLC (time for one PLC cycle) is given as a percentage:
100% is the equivalent of a run time of 1 ms at a cycle time of 21 ms.
Depending on the currently running machine functions and the PLC program used, values considerably above 100% may be displayed for the PLC utilization. You do not have to take any action!
Only when the permissible PLC utilization is exceeded, is the error message **PLC: time out** displayed. --> Contact your machine tool builder!

PLC functions of the main menu

From the PLC main menu you can use soft keys to access the following PLC functions:

Soft key	Function	Description in this manual
EDIT	Edit the file located in RAM memory.	
DIAGNOSIS	Call the diagnostic functions.	See “DriveDiag” on page 9 – 91.
COMPILE	Compile files registered in OEM.SYS.	
SELECT + COMPILE	Select and compile files.	
RESTART PLC	Stop and restart the PLC program (M4173 is supported).	
ADVANCED SETUP	Call further soft keys for the Windows manager, the SIK, the encrypted drive, the machine kinematics.	
MP EDIT	Display the machine parameter list.	See “The machine parameter editor” on page 31 – 572.
I/O-FORCE LIST	Set inputs and outputs. The PLC program is ignored.	See “The I/O-FORCE LIST” on page 11 – 131.
WATCH LIST	Display states of selected operands in tabular format.	See “The WATCH LIST function” on page 11 – 128.
TABLE	Display the logical states of the PLC operands.	See “The TABLE function” on page 11 – 119.
LOGIC DIAGRAM	Display the logic diagram.	See “The LOGIC diagram” on page 11 – 124.
TRACE IN-CODE	Display the TRACE function.	See “The TRACE function” on page 11 – 127.
PROCESS MONITOR	Display the process monitor.	
OSCI	Activate the integrated oscilloscope.	See “Integrated oscilloscope” on page 10 – 95.
END	End PLC programming.	

11.2 Error messages

See “Error messages” on page 4 – 21.

PLC error messages (text, reaction of the control, etc.) are defined by the machine manufacturer.

11.3 Possible error causes

General information

- PLC power supply missing
- Overload, short-circuit on an output
- Defective PLC input at the MC or the at PLC expansion card
- Defective PLC output at the MC or at the PLC expansion card
- Defective cables or connectors
- Faulty clamp or screw connection
- Bouncing switches (e.g. mechanical pushbutton switches)
- Poor shielding and grounding
- Electromagnetic fields
- Fault in the PLC bus
- Compensating currents caused by different potentials
  Example:
  Several electrical cabinets are connected with a bus.
  Due to poor grounding, these cabinets do not have the same potential.
  The shielding of the bus is connected to each electrical cabinet.
  Result: Compensating currents

Additionally for PROFIBUS

- Fault in the PROFIBUS
- Fault in a bus (e.g. ASI bus) connected to the PROFIBUS
- Terminating resistors missing at the ends

11.4 Diagnosis tools in the PLC mode

iTNC 530 HSCI provides comprehensive PLC diagnosis options.

> **Note**
>
> Since the PLC program was written by the machine manufacturer, PLC diagnosis often requires his support.

11.4.1 The TABLE function

The TABLE function provides the possibility of displaying the **logic states of of PLC operands in a table**.

Activation

You are on the PLC main page.

- Switch to the next soft-key row.

TABLE

- Soft key to call the TABLE function.

The first soft-key row appears for selecting the operand types:

SET	RESET	M MARKER	I INPUT	O OUTPUT	C COUNTER	T TIMER	END

> **DANGER**
>
> Press the SET and RESET soft keys only after prior consultation with the machine manufacturer! (In general, only those inputs and outputs can be set or reset that do not already have a potential defined by the wiring or are firmly assigned or managed by the PLC.)

- Other soft-key rows can be called.

B BYTE	W WORD	D DOUBLE	S STRING	HEX DEZIMAL	SAVE M/B/W/D	RESTORE M/B/W/D	END
IB BYTE	IW WORD	ID DOUBLE		HEX DEZIMAL	ADD TO I/O-FORCE LIST	ADD TO WATCH LIST	END
OB BYTE	OW WORD	OD DOUBLE		HEX DEZIMAL			END

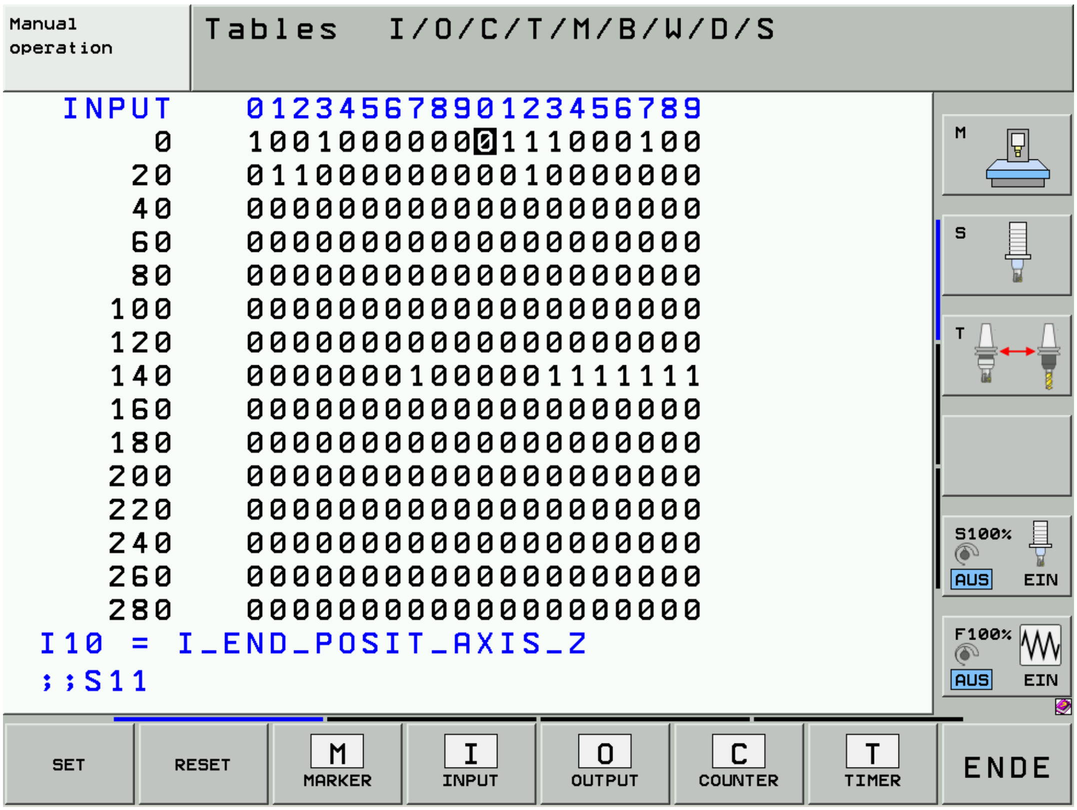
- Select a certain operand type. --> The corresponding table opens.

> **Note**
>
> The operand type is displayed in the table at top left.
>
> In the tables for **BYTE**, **WORD** and **DOUBLEWORD**, the display can be switched between **HEX** and **DECIMAL** by soft key.
>
> With the cursor keys or the GOTO key followed by an entry, the operands in the table can be selected.

The following describes the testing of PLC inputs and outputs for which the TABLE function can be very helpful.

Checking the PLC inputs

- You have called the TABLE.
- Press the INPUT soft key.



- Place the cursor on the input to be examined (e.g. GOTO I10 ENTER).
- Observe the logical state of the input to be checked.
- For this purpose measure the voltage for the input to be checked, e.g.
  - At the terminal strips in the electrical cabinet where the PLC inputs are connected.
  - Directly at relay terminals, etc.
  - At the terminals (X6) of the MB 620 machine operating panel.
  - At the terminals (X4, X5) of the UEC 11x compact controller unit.
  - At the terminals (X9) of the PLB 62xx system module.
  - At the terminals (X11, X12) of the I/O module PLD-H 16-08-00 or PLD-H 08-16-00.

For the input signals of the switching inputs applies:

Voltage range	MB 620, UEC 11x, PLB 62xx, PLD-H
"1" signal: U_i	11 V to 30 V
"0" signal: U_i	–3 V to 2.2 V

Note

An active input is signaled by a yellow LED at the PLD-H.

Assignment --> See "Connector designations and pin layouts" on page 28 – 453.

Note

It is not possible to measure PLC inputs directly at the handwheel or at the cable adapter for the handwheel.

Figure: Measurement at a terminal of the I/O module PLD-H 16-08-00 using a needle tip probe

Conclusion

The logic states in the PLC table must be in agreement with the voltage levels for each input.
--> See "Specifications" on page 11 – 144.

If there is a difference (e.g., the voltage level is within the tolerance range but the logic state is 0), you can narrow further the error cause.

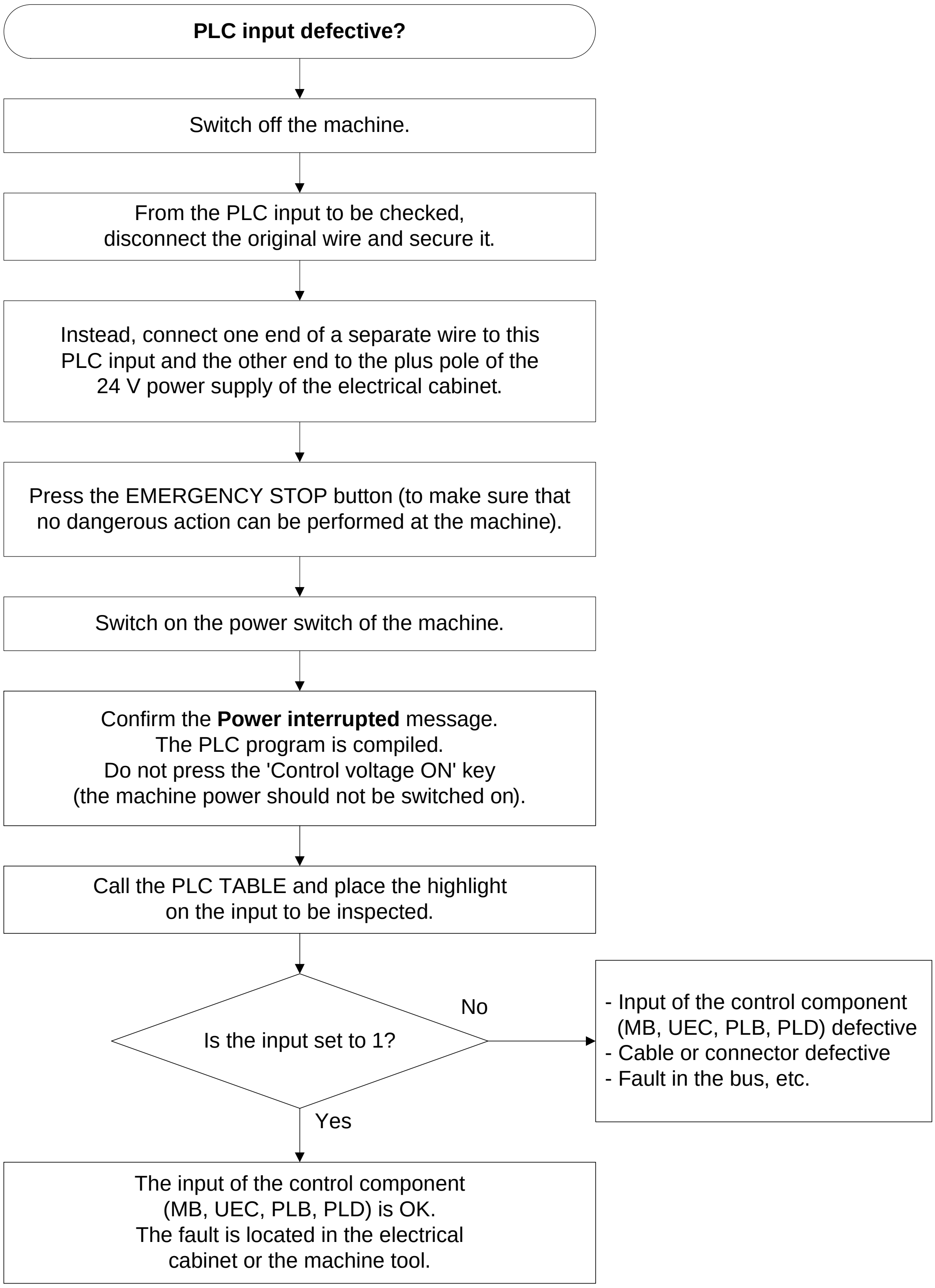
Error localization PLC input

DANGER

For this examination it must be ensured that no dangerous action can be performed at the machine. Therefore, press the EMERGENCY STOP button and contact the machine manufacturer.

Attention

If several 24-V sources are used on your machine, use exactly the one intended for the PLC inputs.



Checking the PLC outputs

- You have called the TABLE.
- Press the OUTPUT soft key.
- Place the cursor on the output to be examined (e.g. GOTO O2 ENTER).
- Observe the logical state of the output to be checked.
- Check whether the connected actuator (relay, etc.) has triggered or whether the connected device operates.
- Measure the 24-V supply voltage for the PLC.
- Measure the voltage for the output to be checked, e.g.:
  - At the terminal strips in the electrical cabinet where the PLC outputs are connected.
  - Directly at relay terminals, etc.
  - At the terminals (X7) of the MB 620 machine operating panel.
  - At the terminals (X6) of the UEC 11x compact controller unit.
  - At the terminals (X9) of the PLB 62xx system module.
  - At the terminals (X21, X22) of the I/O module PLD-H 16-08-00 or PLD-H 08-16-00.

Note

The output voltage for the "1" signal must not be more than 3 V below the measured 24-V supply voltage (e.g., 22.7 V - 3 V = 19.7 V).

Note

An active output is signaled by a yellow LED at the PLD-H.

Assignment --> See ”Connector designations and pin layouts” on page 28 – 453.

Note

It is not possible to measure PLC outputs directly at the handwheel or at the cable adapter for the handwheel!

Conclusion

The logic states in the PLC table must be in agreement with the voltage levels for each output.
--> See ”Specifications” on page 11 – 144.

Meaning of the LEDs on the I/O module PLD-H

LED	Status	Meaning
Red LED at X11, pin 1	Blinking	I/O module OK
	Permanently on or off	I/O module faulty
Yellow LEDs at X11, X12 and X21	On	Inputs/outputs set
Green LEDs at X21, pin 9 and pin 10	On	24-V power supply of the outputs

Note

In order to recognize a short circuit, a current of least 20 A must be able to flow for approximately 3 ms. If this is not the case (e.g. the 24-V supply limits the current sooner), the short-circuit monitoring might not become effective.

If an output is short-circuited the output voltage is reset. Short-circuit monitoring remains active. It can be reset with the PLC program of the machine manufacturer or by switching the machine off and on.

11.4.2 The LOGIC diagram

With the LOGIC DIAGRAM function you can display the **course of the dynamic changes of PLC operands (M/I/O/T/C)**.

Activation

You are on the PLC main page.

- Switch to the next soft-key row.

LOGIC DIAGRAM

- Soft key to call the LOGIC DIAGRAM function.

Selecting the operands

SELECT M/I/O/T/C

- Open the selection table.

> **Note**
>
> Up to 16 operands can be selected from the table being shown.

- Enter the desired operands.

> **Note**
>
> If you work with the **WATCH LIST** , you can also use the ADD TO LOGIC DIAGRAM soft key to add operands to the logic diagram.

Defining the trigger conditions

- Define the trigger conditions.

The following trigger conditions are defined:

1	Record if operand is logically 1 (trigger on positive edge)
0	Record if operand is logically 0 (trigger on negative edge)
CE	No trigger

Defining the trigger logic

SELECT TRIGGER LOGIC

- Define the trigger logic.

Two possibilities are available:

OR	Recording starts as soon as one of the defined trigger conditions is fulfilled.
AND	Recording starts when all of the defined trigger conditions are fulfilled.

Selecting the recording time

SELECT SCAN TIME

- Select a recording time.

Here you specify how long the signal states are recorded from the defined trigger time point.
Four different times are available, depending on the PLC cycle time.
2048 PLC cycles are recorded.

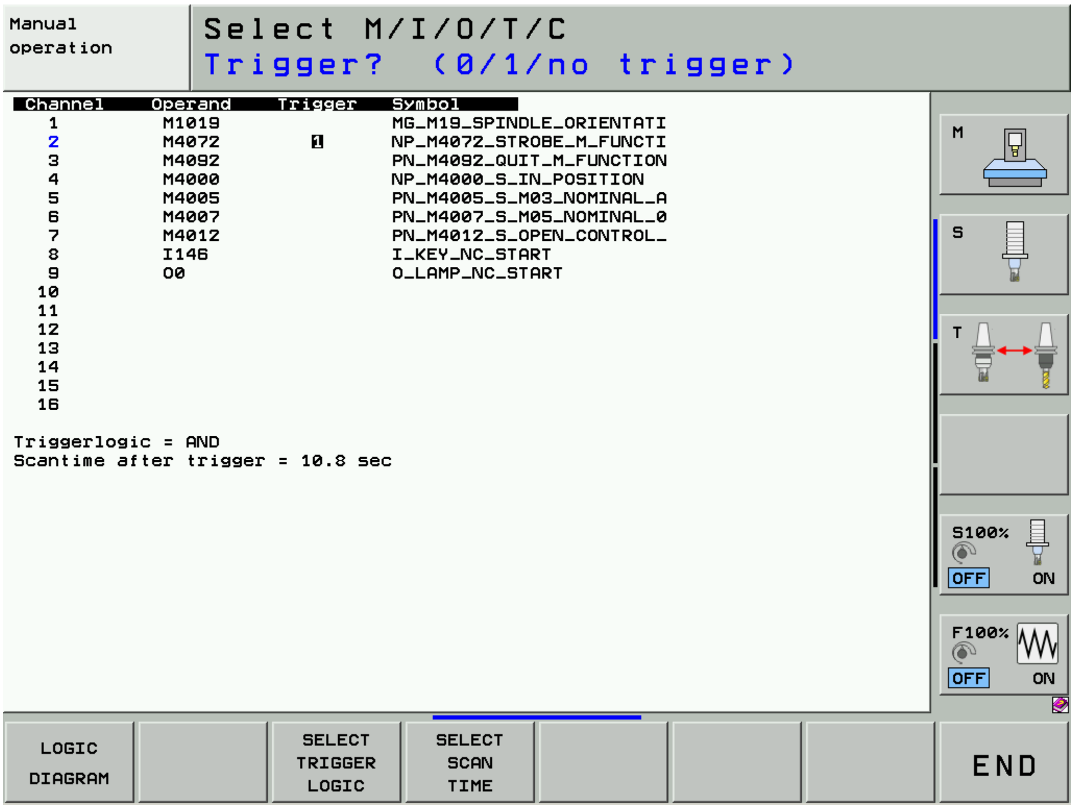
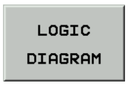


Figure: Example of selected operands, trigger conditions, trigger logic and recording time

Start of recording



▶ Call the LOGIC DIAGRAM again.

▶ Start the LOGIC TRACE function.

Note

Recording begins with START LOGIC TRACE and ends when when the trigger event occurs or the STOP LOGIC TRACE soft key is pressed.
During recording, **`tracing ...`** is displayed above the logic diagram.
If the screen displays a machine operating mode, the signal word **`PCTR`** is shown during recording.

▶ Switch to Machine mode (key on VDU).

PCTR blinking:	Trigger condition has not occurred yet
PCTR on:	Trigger condition has occurred, buffer is filled
PCTR off:	Buffer is full, LOGIC DIAGRAM can be called

Evaluation of recording

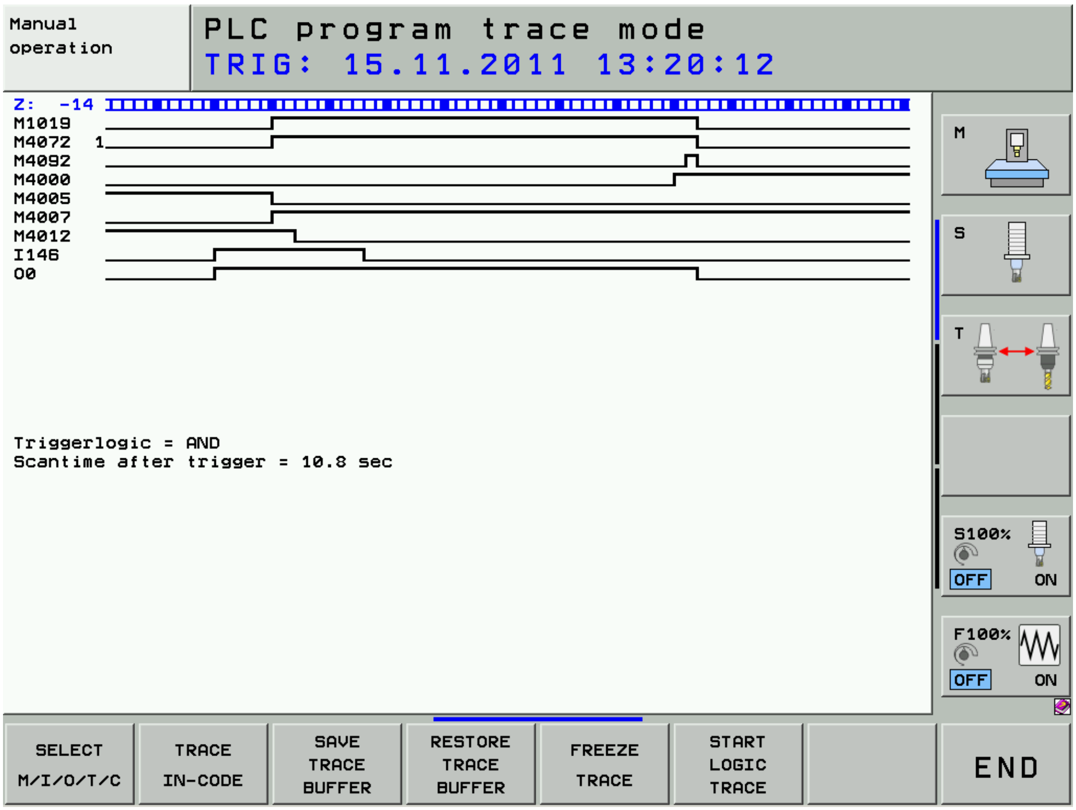


Figure: Recording of PLC operands during an oriented spindle stop

The trigger event is displayed on the left edge of the display with the PLC cycle 0.
You can shift the logic diagram left or right with the arrow keys.

Note

The distance of two narrow bars in the upper line represents the duration of one PLC cycle.
The distance of two thicker bars accordingly represents the duration of 5 PLC cycles.
The PLC cycle time can be seen on the PLC main page.

Saving a LOGIC DIAGRAM recording

After having recorded a LOGIC DIAGRAM, you can save it on the control's data medium:

- Press this soft key --> Path and name **PLC:\TRCSAVE.A** are proposed for saving the logic diagram.

- Press ENT to confirm (or enter another name).
  --> The logic diagram is saved.

Calling a recorded LOGIC DIAGRAM

A saved LOGIC DIAGRAM recording can be called again:

- Press this soft key. --> Path and name of the last saved logic diagram are proposed.

- Press ENT to confirm (or enter another name).
  --> The content of the file is loaded into the LOGIC DIAGRAM.

Further recording options with the integrated oscilloscope

The **integrated oscilloscope** also offers the possibility of recording inputs, outputs, markers and the control signals of timers and counters. It is also possible to record bytes, words and double words. Six channels are available for this purpose.
See “Integrated oscilloscope” on page 10 – 95.

11.4.3 The TRACE function

The TRACE function makes it possible to **check the logical conditions of PLC operands (M,I,O,T,C) within the respective PLC files (statement list)**.
Furthermore, the contents of bytes, words and double words can be checked.

Activation

You are on the PLC main page.

▶ Switch to the next soft-key row.

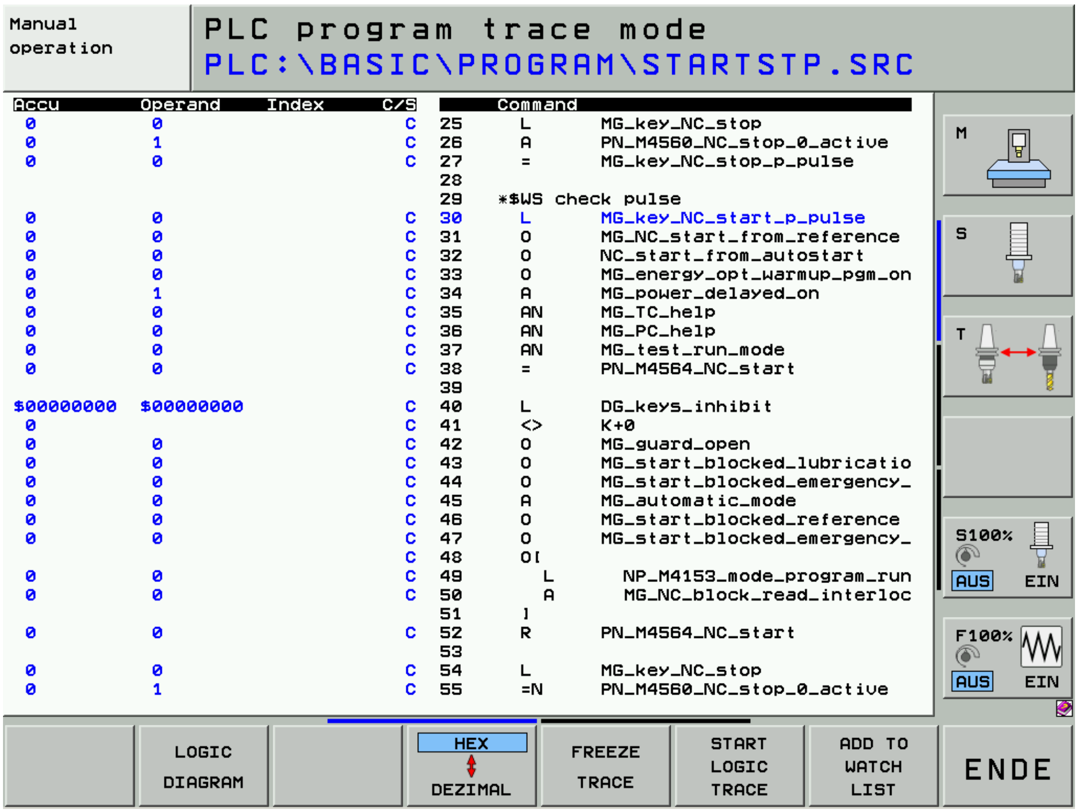
▶ Soft key to call the TRACE function.

Selecting a PLC program section

▶ Call the program management.

▶ Select the file to be checked with the cursor.

▶ Press the ENT key to load this file in the TRACE mode.



The statement list (STL) of the compiled program is displayed.

In addition, the contents of the operand and the accumulator are displayed in HEX or decimal code for every program line (can be selected by soft key).

Each cyclically executed command of the STL is identified with a **C** or with an **S** if it is a Submit program section.

▶ Place the cursor on the program section to be examined (e.g., with the GOTO key, the FIND soft key, the cursor keys).

Evaluation

Evaluate the PLC program sections in the TRACE mode together with the machine tool builder!

11.4.4 The WATCH LIST function

The WATCH LIST function enables you to create **a table of different operands** whose **states** are then **displayed altogether**.

Activation

You are on the PLC main page.

▶ Switch to the next soft-key row.

▶ Soft key to call the WATCH LIST function

Selecting symbolic operands from the WATCH LIST

- ▶ You have called the WATCH LIST.
- ▶ Switch to the next soft-key row.
- ▶ Press the INSERT LINE soft key.
- ▶ Place the cursor in the **SYMBOL** column to the right.
- ▶ Press the SYMBOL LIST soft key to open a list box with all local and global operands used in the PLC program.
- ▶ Use the cursor keys or the FIND soft key to select the desired operand.
- ▶ Load the operand by pressing the SELECT soft key or the ENT key.
- ▶ Press the END soft key to close the list box.

> **Note**
>
> Operands can only be selected with the SYMBOL LIST soft key, if the control operates with the *.SRC source files of the PLC program.
> Otherwise the error message **Selection list is empty** is displayed.

> **Note**
>
> If necessary, create a WATCH LIST with the aid of the machine manufacturer.

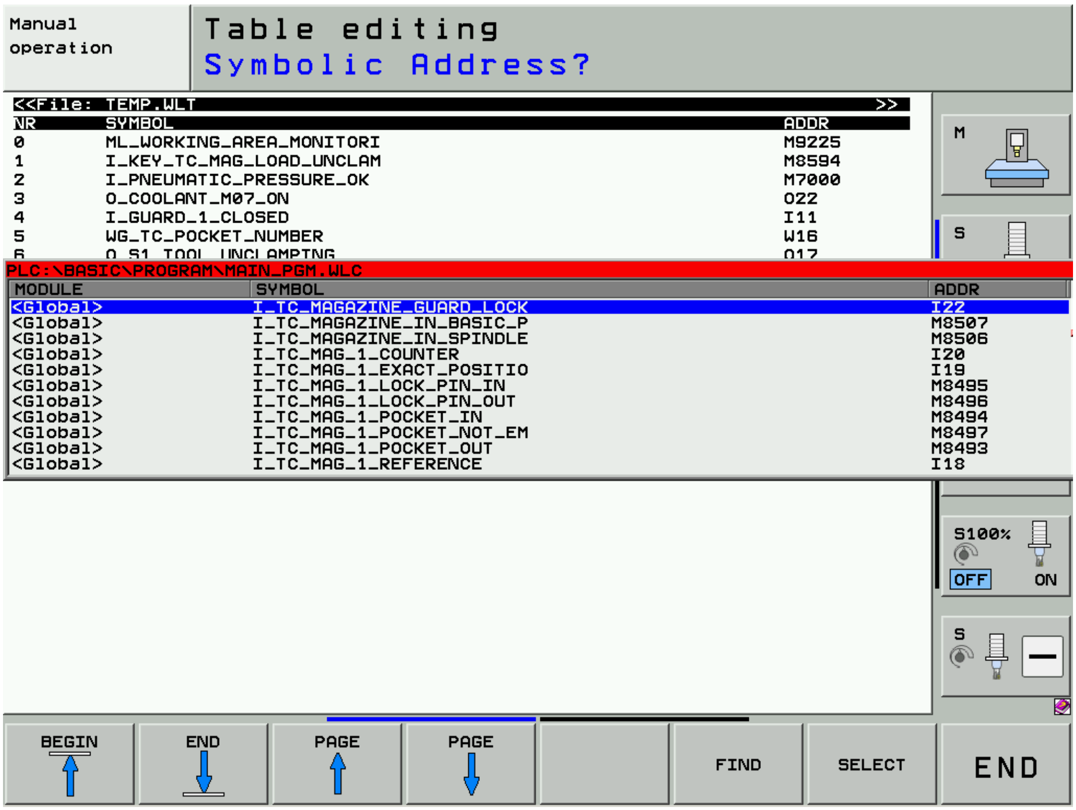


Figure: Example of a selection of symbolic operands

Selecting absolute operands from the WATCH LIST

- You have called the WATCH LIST.
- Switch to the next soft-key row.
- Press the INSERT LINE soft key.
- Place the cursor in the **ADDR** column to the right.
- Enter the absolute address of the operand, e. g. W1022.
- Press the ENT key.

> **Note**
>
> If necessary, create a WATCH LIST with the aid of the machine manufacturer.

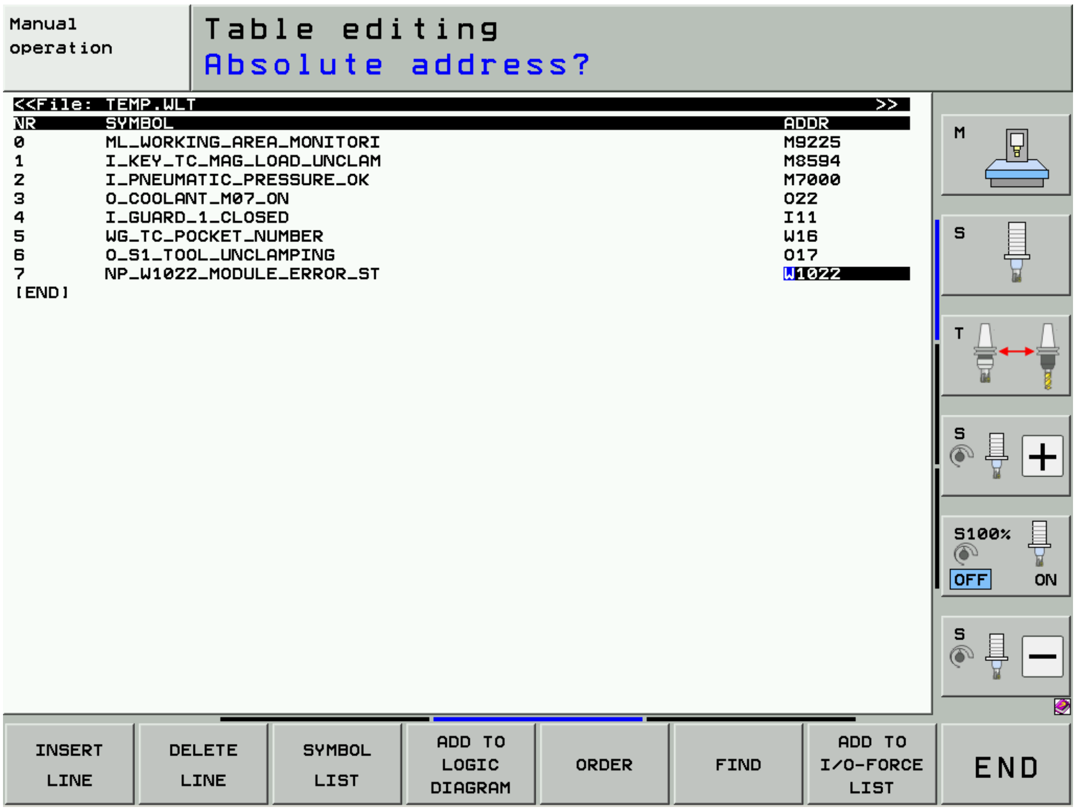


Figure: Example of a selection of absolute operands

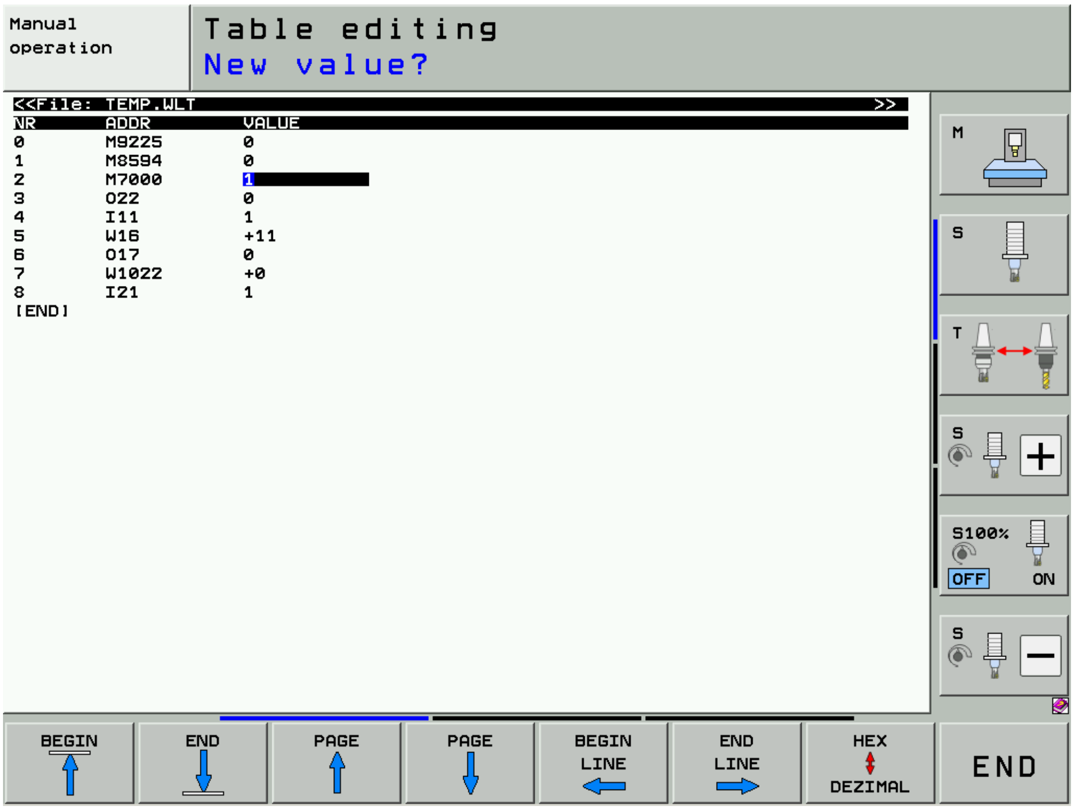
> **Note**
>
> You can also call the TABLE or the TRACE IN-CODE function and add operands to the WATCH LIST with the ADD TO WATCH LIST soft key.

> **Note**
>
> If the cursor is in the **SYMBOL** or **ADDR** column, you can sort the list alphanumerically by pressing the ORDER soft key.

Evaluation

- Place the cursor in the **VALUE** column to the right.

▶ Observe the states of the selected operands with certain machine functions.



Note

If the cursor is in the **SYMBOL** or **ADDR** column, you can sort the list alphanumerically by pressing the ORDER soft key.

Saving the WATCH LIST file

After you have created a WATCH LIST file, you can save it in order to be able to call it again at a later date:

▶ Press the PGMMGT key. --> The program management opens and the cursor is placed on the file **TEMP.WLT** in the path **PLC:\DEBUG**.

▶ Press the COPY soft key.

▶ Enter a target file (e.g. Watch123.wlt) and press the OK soft key.

Calling a WATCH LIST file

A saved WATCH LIST file can be called any time:

▶ Open the WATCH LIST function.

▶ Press the PGMMGT key. --> The program management is opened.

▶ In the path **PLC:\DEBUG**, place the cursor on the saved WATCH LIST file (e.g. Watch123.wlt).

▶ Press the ENT key. --> The file is loaded in the WATCH LIST function.

11.4.5 The I/O-FORCE LIST

Independently of the currently running PLC program and the status of the hardware, the **PLC inputs and outputs** can be **set or reset** via the I/O-FORCE LIST.

DANGER

The I/O-FORCE LIST can overrule safety-relevant monitoring operations in the PLC program!
This could lead to damage to property or persons.
Ensure that hanging axes are supported.
Consult the machine manufacturer!

Activation

You are on the PLC main page.

- Switch to the next soft-key row.

- Soft key for calling the I/O-FORCE LIST function.

Selecting inputs and outputs for the I/O FORCE LIST

- Press the INSERT LINE soft key.
- Select the inputs and outputs by entering their symbolic or absolute addresses.

Note

The TABLE, the WATCH LIST or the TRACE IN-CODE function can be called before and inputs and outputs added to the I/O-FORCE LIST via the soft key ADD TO I/O-FORCE LIST.

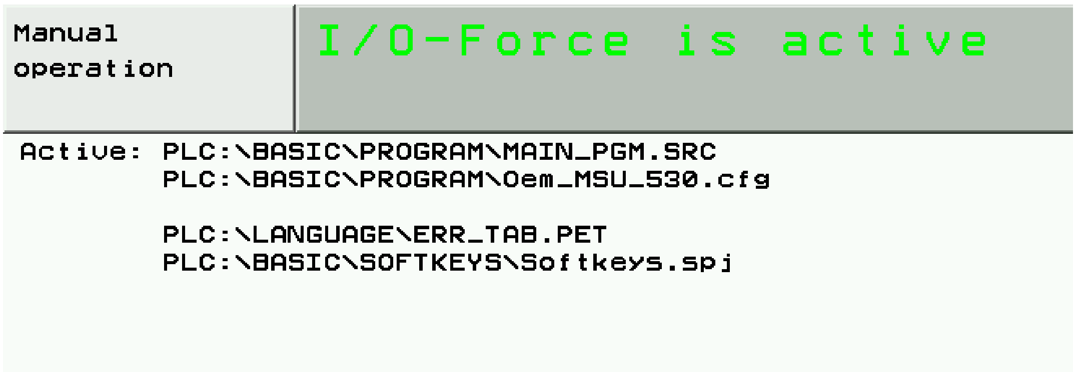
- Enter the value 0 or 1 which is to be "forced".
- If required, add a comment.

Note

If the cursor is in the **SYMBOL** or **ADDR** column, you can sort the list alphanumerically by pressing the ORDER soft key.

Activating the I/O-FORCE LIST

- Press this soft key.
- ON is highlighted; the I/O-FORCE LIST is active.
- If you now exit the I/O-FORCE LIST with END, the following display will appear:



DANGER

The text **`I/O-Force is active`** is **shown only in the PLC mode**.
If a machine operating mode is displayed on the monitor (e.g., Program Run, Full Sequence), this information is not visible.

Note

If you call the TABLE with the INPUTS and OUTPUTS, the "forced" inputs and outputs are displayed in a different color (e.g., blue).

Saving the I/O-FORCE LIST file

After you have created an I/O-FORCE LIST file, you can save it in order to be able to call it again at a later date:

- The I/O-FORCE LIST is displayed.
- Press the PGMMGT key. --> The program management opens and the cursor is placed on the file **`MAIN_PGM.FLT`** in the same path as the PLC main program.
- Press the COPY soft key.
- Enter a target file (e.g. Force123.wlt) and press the OK soft key.

Calling an I/O FORCE LIST file

A saved I/O-FORCE LIST file can be called any time:

- Open the I/O FORCE LIST function.
- Press the PGMMGT key. --> The program management opens with the correct path.
- Place the cursor on the saved I/O-FORCE LIST file (e.g., Force123.flt).
- Press the ENT key. --> The file is loaded in the I/O-FORCE LIST function.

Deactivating and closing the I/O-FORCE LIST

> DANGER
>
> After having worked with the I/O-FORCE LIST, **it is essential that you terminate** this function!

- Press the EMERGENCY STOP button.

- Press this soft key. --> OFF must be highlighted!

- As a precaution remove all PLC operands in the I/O-FORCE LIST with the DELETE LINE soft key.
- Exit the function I/O-FORCE LIST with the END soft key.
- Exit the PLC mode.
- Restart the control for safety reasons.

11.5 Non-volatile PLC markers and words

Certain **PLC markers and words** are not deleted when the machine is switched off but remain **battery-buffered** in the RAM of the control.
The non-volatile PLC memory area is displayed on the PLC main page.

For example: **When a control is exchanged** this information in the process memory of the control to be replaced is saved on the data medium in order to load it into the process memory of the new control later.

For test purposes the non-volatile PLC memory can be saved and re-loaded.

Saving on data medium

- Call the PLC mode. --> See "Calling the PLC mode" on page 11 – 115.

- Switch to the next soft-key row.

- Call the TABLE function.

- Switch to the next soft-key row.

- Press this soft key. --> A preset memory area is displayed.

Note

The iTNC 530 HSCI automatically enters the maximum defined area of non-volatile PLC markers and words (e.g., B0 ... B127, M0 ... M999).
You may change this area after consultation with the machine manufacturer.
Note: Here the unit B (bytes) instead of W (words) is not an error. --> A byte is the smallest subset of a word.

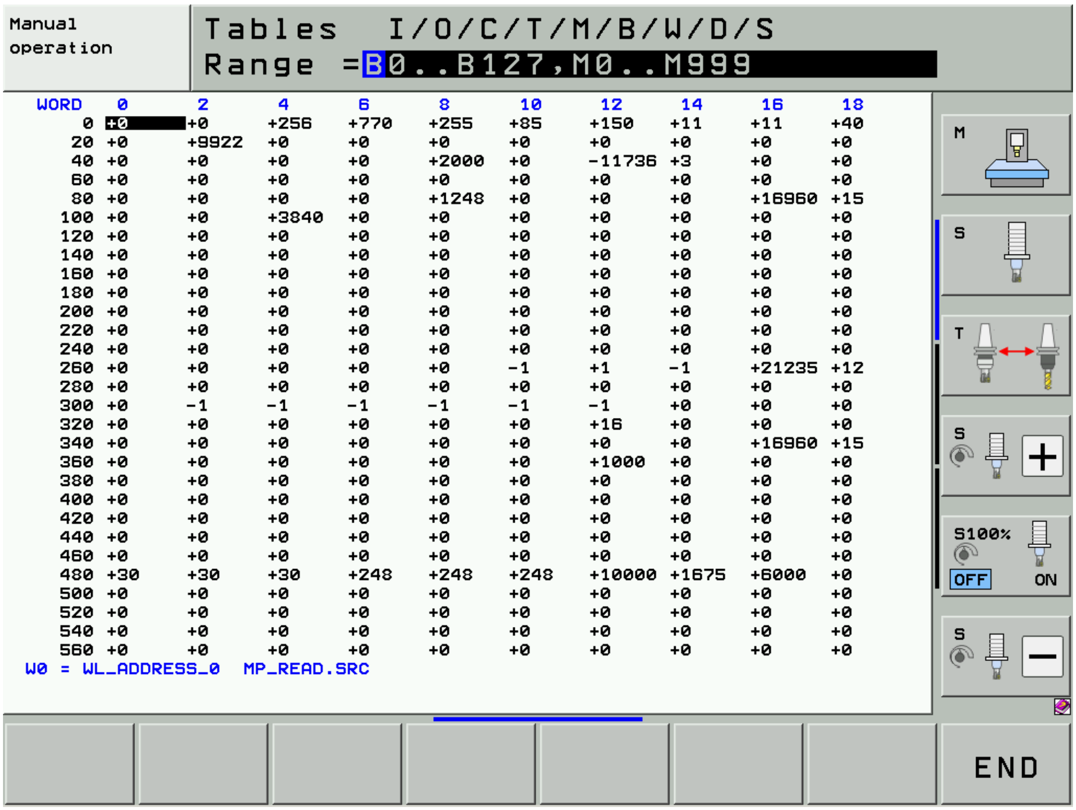


Figure: Saving non-volatile PLC markers and words

ENT

- Confirm the setting. --> The iTNC 530 HSCI proposes **PLC:\PLCMEM.A** as path and file name.

ENT

- Confirm the file name. --> The states or contents of the PLC markers and words are saved in PLC:\PLCMEM.A on the data medium.

END END

- Exit the PLC mode.

Writing back to RAM

- Call the PLC mode. --> See "Calling the PLC mode" on page 11 – 115.

- Switch to the next soft-key row.

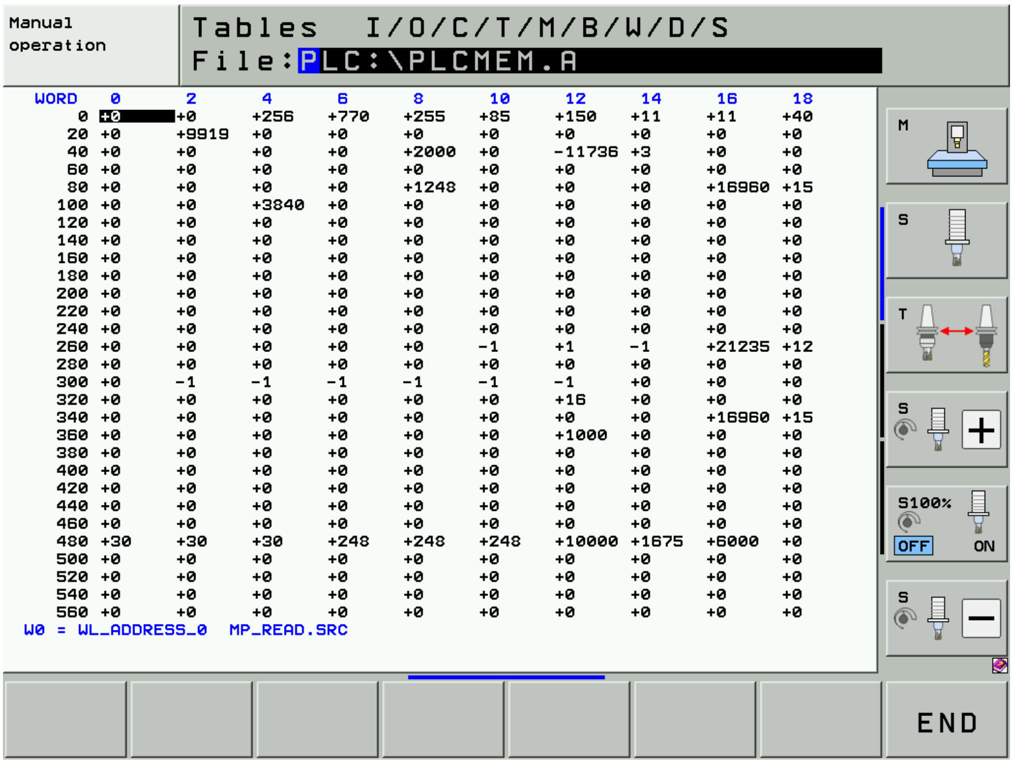
TABLE

- Call the TABLE function.

- Switch to the next soft-key row.

RESTORE M/B/W/D

- Press this soft key. --> The iTNC 530 HSCI proposes **PLC:\PLCMEM.A** as path and file name.


Manual operation

Tables I/O/C/T/M/B/W/D/S

File:PLC:\PLCMEM.A

WORD	0	2	4	6	8	10	12	14	16	18
0	+0	+0	+256	+770	+255	+85	+150	+11	+11	+40
20	+0	+9919	+0	+0	+0	+0	+0	+0	+0	+0
40	+0	+0	+0	+0	+2000	+0	-11736	+3	+0	+0
60	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
80	+0	+0	+0	+0	+1248	+0	+0	+0	+16960	+15
100	+0	+0	+3840	+0	+0	+0	+0	+0	+0	+0
120	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
140	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
160	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
180	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
200	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
220	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
240	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
260	+0	+0	+0	+0	+0	-1	+1	-1	+21235	+12
280	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
300	+0	-1	-1	-1	-1	-1	-1	+0	+0	+0
320	+0	+0	+0	+0	+0	+0	+16	+0	+0	+0
340	+0	+0	+0	+0	+0	+0	+0	+0	+16960	+15
360	+0	+0	+0	+0	+0	+0	+1000	+0	+0	+0
380	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
400	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
420	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
440	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
460	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
480	+30	+30	+30	+248	+248	+248	+10000	+1675	+6000	+0
500	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
520	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
540	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
560	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0

W0 = WL_ADDRESS_0 MP_READ.SRC

Figure: Writing back non-volatile PLC markers and words

ENT

- Confirm the file name. --> The saved states or contents of the PLC markers/words are written back to the RAM.

END END

- Exit the PLC mode.

11.6 Overviews

The following tables are excerpts from the iTNC 530 Technical Manual, September 2010 edition.

Overview of the markers

A list of PLC operands with brief descriptions in English and German (**GLB_NC_de.DEF, GLB_NC_en.DEF**) is available on the control under **PLC:\JH**.

Operand		Description	Set	Reset
M	1900 - 1999	Decoded M function if M4571 is set	NC	NC

Spindle

Operand		Description	Set	Reset
M	4000	Spindle in position	NC	NC
M	4001	Nominal speed command signal of the spindle not in the ramp	NC	NC
M	4002	Nominal speed value = 0	NC	NC
M	4003	Nominal speed value output analog or digital (MP3010 = 3 to 8)	NC	NC
M	4004	Impermissible speed was programmed	NC	NC
M	4005	Status display and nominal speed value output for M03	PLC	PLC
M	4006	Status display and nominal speed value output for M04	PLC	PLC
M	4007	Status display M05 and spindle stop	PLC	PLC
M	4008	Disable speed output for spindle	PLC	PLC
M	4009	Counterclockwise spindle rotation (for gear change)	PLC	PLC
M	4010	Clockwise spindle rotation (for gear change)	PLC	PLC
M	4011	Activate rotational speed MP3520.0 and direction of rotation from M4013	PLC	PLC
M	4012	Open the spindle control loop	PLC	PLC
M	4013	Direction for spindle orientation from a standstill (M03 = 0; M04 = 1)	PLC	PLC
M	4014	Reverse the direction of spindle rotation	PLC	PLC
M	4015	Renewed evaluation of the spindle reference mark	PLC	NC
M	4016	Cycle 13 is executed	NC	PLC
M	4017	Servo-controlled spindle in motion	NC	NC
M	4018	Reference mark for spindle not yet traversed	NC	NC
M	4019	Reversing the counting direction of the position encoder on the spindle	PLC	PLC

Thread cutting

Operand		Description	Set	Reset
M	4030	Cycle 2 or Cycle 17 active	NC	NC
M	4031	Cycle 17 or cycle 18 active	NC	NC

Coolant status

Operand		Description	Set	Reset
M	4040	Status display M07, M08, and M09 highlighted	PLC	PLC
M	4041	Status display M07, M08, M09, MK	PLC	PLC
M	4042	Status display M07, M08, M09, MK	PLC	PLC

Touch probe

Operand		Description	Set	Reset
M	4050	Touch probe not ready, ready signal is missing	NC	NC
M	4051	Stylus deflected before start of probing cycle	NC	NC
M	4052	Stylus is deflected, probing process is completed	NC	PLC
M	4053	Probing process has been completed or canceled	NC	NC
M	4054	Battery voltage too low (battery warning at touch probe connection); evaluated only during the probing process	NC	NC
M	4055	Enable the probing process	NC	PLC

Operand		Description	Set	Reset
M	4056	NC stop in all operating modes if stylus is deflected	PLC	PLC
M	4057	Touch probe cycle active (FN17: ID990 NR2)	NC	NC
M	4060	Cycle for tool measurement started	NC	NC
M	4061	0: Measure the tool 1: Check the tool	NC	NC
M	4062	0: Wear tolerance not exceeded 1: Wear tolerance exceeded	NC	NC/PLC
M	4063	0: Breakage tolerance not exceeded 1: Breakage tolerance exceeded	NC	NC/PLC
M	4065	Workpiece dimensions are OK	NC	PLC
M	4066	Workpiece must be reworked	NC	PLC
M	4067	Workpiece is scrap	NC	PLC

Strobe signals from the NC to the PLC

Operand		Description	Set	Reset
M	4070	Strobe signal for gear code	NC	NC
M	4071	Strobe signal for S code	NC	NC
M	4072	Strobe signal for M function	NC	NC
M	4073	Strobe signal T code (P code) with TOOL CALL	NC	NC
M	4074	Strobe signal T code (P code) with TOOL DEF	NC	NC
M	4075	Transfer active with FN19	NC	NC

Acknowledgment of NC strobe signals

Operand		Description	Set	Reset
M	4090	Acknowledgment of “gear change completed”	PLC	PLC
M	4091	Acknowledgment of S code	PLC	PLC
M	4092	Acknowledgment of M function	PLC	PLC
M	4093	Acknowledgment of T code (P code) with TOOL CALL	PLC	PLC
M	4094	Acknowledgment of T code (P code) with TOOL DEF	PLC	PLC
M	4095	Acknowledgment of transfer with FN19	PLC	PLC

Strobe signals from the PLC to the NC

Operand		Description	Set	Reset
M	4120 - 4128	PLC positioning axis 1 to 9 active	NC/PLC	NC/PLC
M	4130	Activation of spindle orientation, or spindle orientation has been started with Module 9171	NC/PLC	NC
M	4131	Activation of Q-parameter transfer to the NC; data from D258, Q number from W516	PLC	NC
M	4132	Activate datum shift from D528 to D544, or call Module 9230	PLC	NC
M	4133	Start and stop the free rotation function	PLC	NC
M	4134	Activation of a gear range and speed through the PLC	PLC	NC
M	4135	Strobe marker for selecting the traverse range	PLC	NC

C operating modes and status

Operand		Description	Set	Reset
M	4150	Operating mode: Manual Operation	NC	NC
M	4151	Operating mode: Electronic Handwheel	NC	NC
M	4152	Operating mode: Positioning with Manual Data Input	NC	NC
M	4153	Operating mode: Program Run, Single Block	NC	NC
M	4154	Operating mode: Program Run, Full Sequence	NC	NC
M	4155	Operating mode: Traversing the Reference Marks	NC	NC

Operand		Description	Set	Reset
M	4156	MANUAL TRAVERSE soft key pressed	NC	NC
M	4157	Returning to the contour (MOVE TO POSITION) is active	NC	NC
M	4158	Block scan active	NC	NC
M	4159	PLC editor: END key or soft key pressed	NC	NC/PLC
M	4160	Pallet table selected	NC	NC
M	4161	M/S/T/Q transfer after block scan	NC	NC
M	4162	DNC mode (0 = DNC inactive, 1 = DNC active)	NC	NC
M	4163	Alternative operating mode smarT.NC is active	NC	NC
M	4170	END PGM, M02 or M30 was executed	NC	NC
M	4172	1st PLC cycle after power on	NC	NC
M	4173	1st PLC cycle after interruption of the PLC program	NC	NC
M	4174	1st PLC cycle after editing the MPs (MP Edit was exited and the MPs were altered)	NC	NC
M	4175	Program interruption, control-in-operation symbol is blinking	NC	NC
M	4176	Control is in operation, control-in-operation symbol is on or is blinking	NC	NC
M	4177	Clearable error message displayed	NC	NC
M	4178	Error message EXTERNAL EMERGENCY STOP is displayed	NC	NC
M	4179	Control is being shut down	NC	NC
M	4180	Rapid traverse programmed (FMAX)	NC	NC
M	4181	NC program selected	NC	PLC
M	4182	AUTOSTART active	NC	NC
M	4183	Time from AUTOSTART expired	NC	NC
M	4185	Internal stop performed	NC	PLC
M	4186	NC program is active in the Test Run mode	NC	PLC
M	4188	Compilation process of the PLC project active	NC	NC
M	4189	Emergency-stop test or self-test of the control has been concluded	NC	NC
M	4190	Control is ready for emergency-stop test or self-test, or test is active	NC	NC
M	4191	Control is ready	NC	NC
M	4192	Request for machine control voltage ON	NC	NC

Arithmetic or module error in the PLC

Operand		Description	Set	Reset
M	4200	Overflow during multiplication	NC	PLC
M	4201	Division by 0	NC	PLC
M	4202	Incorrectly executed modulo	NC	PLC
M	4203	Error status for PLC module	NC	NC/PLC
M	4204	Reserved for errors that the PLC programmer would like to catch	NC	NC
M	4210	Error from Python script with F stop active	NC	NC
M	4211	Error from Python script with NC stop active	NC	NC
M	4212	Error from Python script with emergency stop active	NC	NC
M	4213	Error from Python script with NC Cancel active	NC	NC
M	4220	Error from PET table with F stop active	NC	NC
M	4221	Error from PET table with NC stop active	NC	NC
M	4222	Error from PET table with emergency stop active	NC	NC
M	4223	Error from PET table with NC Cancel active	NC	NC
M	4225	Activate an alternative error reaction		
M	4227	PLC error message with priority 0 (error)	NC	NC
M	4228	PLC error message with priority 1 (warning)	NC	NC
M	4229	PLC error message with priority 2 (info)	NC	NC
M	4230	NC start via LSV2	NC	NC
M	4231	NC stop via LSV2	NC	NC
M	4260	Acknowledgment of control-is-ready signal (I3)	NC	NC

Markers that can be influenced by machine parameters

Operand		Description	Set	Reset
M	4300 - 4315	Value from MP4310.0	NC	NC
M	4316 - 4331	Value from MP4310.1	NC	NC
M	4332 - 4347	Value from MP4310.2	NC	NC
M	4348 - 4363	Value from MP4310.3	NC	NC
M	4364 - 4379	Value from MP4310.4	NC	NC
M	4380 - 4395	Value from MP4310.5	NC	NC
M	4396 - 4411	Value from MP4310.6	NC	NC

Tool change

Operand		Description	Set	Reset
M	4520	Additional T code (P code) follows with TOOL CALL	NC	NC
M	4521	Tool number zero programmed	NC	NC
M	4522	Tool with pocket number programmed is in effect with MP7480.0 = 3 or 4 and TOOL CALL	NC	NC
M	4523	Tool without pocket number programmed is in effect with MP7480.0 = 3 or 4 and TOOL CALL	NC	NC
M	4524	Special tool called, TOOL CALL	NC	NC
M	4525	TOOL CALL after expiration of tool life	NC	NC
M	4526 - 4534	Axis 1 to axis 9 is the tool axis	NC	NC
M	4538	Geometry of the tool from W264	PLC	NC
M	4539	Tool number highlighted in the status display	PLC	PLC
M	4540	Sequence of tool number or pocket number transfer (M4520 = 1)	PLC	PLC
M	4541	Special tool in original pocket in spite of variable pocket coding	PLC	PLC
M	4542	Do not update pocket number in the pocket table	PLC	PLC
M	4543	Tool life 1 expired (TIME1 in the tool table)	NC	NC/PLC
M	4546	Tool life 2 expired (TIME2 in the tool table)	NC	NC/PLC
M	4547	T and G strobes with TOOL CALL	NC	NC

Additional keys

Operand		Description	Set	Reset
M	4560	NC stop (0: stop)	PLC	PLC
M	4561	Rapid traverse	PLC	PLC
M	4562	Memory function for axis direction keys (MP7680 Bit 0 = 1)	PLC	PLC
M	4563	Feed-rate enable for all axes	PLC	PLC
M	4564	NC start	PLC	PLC

General functions

Operand		Description	Set	Reset
M	4570	Unit of measure for transfer with FN19	NC	NC
M	4571	Activation of decoded M-code transfer in M1900 to M1999	PLC	PLC
M	4574	Select the traverse range (with M4575)	PLC	PLC
M	4575	Select the traverse range (with M4574)	PLC	PLC
M	4576	Disabling the handwheel	PLC	PLC

Operand		Description	Set	Reset
M	4577	Disabled key was pressed	NC	PLC
M	4579	INCREMENT OFF/ON soft key	NC	NC
M	4580	Suppress emergency stop, open all position control loops, NC stop	PLC	PLC
M	4581	Open all position control loops, NC stop, activate "Approach position"	PLC	PLC
M	4586	Enable AUTOSTART	PLC	NC/PLC
M	4587	Rescind feed rate limit above F MAX	PLC	PLC
M	4589	Activate datum management via preset table	NC	NC
M	4590	Status of fast PLC input from MP4130.2	NC	PLC
M	4591	Status of fast PLC input from MP4130.3	NC	PLC
M	4592	Status of fast PLC input from MP4130.4	NC	PLC
M	4593	Status of fast PLC input from MP4130.5	NC	PLC
M	4600	Faulty internal communication between HeROS and Windows	NC	NC
M	4620	Enable LIFTOFF function	PLC	NC/PLC
M	4622	Delay NC macro with **RESETINIT =** from NCMACRO.SYS	PLC	PLC
M	4623	Disable starting of DNC mode (LSV2 access)	PLC	PLC
M	4624	Changed axis-traverse limits	NC	PLC
M	4625	Disable NC axes when velocity semifeedforward control is active	PLC	PLC
M	4626	Disable all key inputs of the TE keyboard unit, including the soft keys	PLC	PLC
M	4627	Trigger condition for integrated oscilloscope fulfilled	NC	PLC
M	4628	Recording of integrated oscilloscope ended	NC	PLC
M	4660	HR 420/HR 5x0 assumes control	NC	NC
M	4661	NC start on HR 420/ HR 5x0	NC	NC
M	4662	NC stop on HR 420/ HR 5x0	NC	NC
M	4663	Rapid traverse key on HR 420/HR 5x0	NC	NC
M	4664	Spindle start on HR 420/HR 5x0	NC	NC
M	4665	Spindle stop on HR 420/HR 5x0	NC	NC
M	4666	Plus (+) key on HR 420/HR 5x0	NC	NC
M	4667	Minus (–) key on HR 420/HR 5x0	NC	NC
M	4668	CTRL key on HR 420/HR 5x0	NC	NC
M	4670	Potentiometer on HR 420/HR 5x0 active	NC	NC
M	4680	Disable activation of the HR 420/HR 5x0	PLC	PLC
M	4753	Write errors from PLC modules in the PLC log	PLC	PLC
M	4754	Write diagnostic information in MYDEBUG.LOG	PLC	PLC

PLC error markers

Operand		Description	Set	Reset
M	4800 - 4999	Reserved markers for PLC error messages	PLC	NC/PLC

Overview of words

	Operand	Description	Set	Reset
W	256	Gear code	NC/PLC	NC/PLC
W	258	S code	NC	NC
W	260	Code for M function	NC	NC
W	262	Tool pocket number	NC	NC
W	264	Tool number	NC	NC
W	266	Index number of a programmed indexed tool	NC	NC
W	268	Tool magazine number	NC	NC
W	270	Line number in help file	NC	NC
W	272	Mode of op.	NC	NC
W	274	Code of the depressed key	NC	NC
D	276	Code of the code number last entered via MOD	NC	NC
D	280	First numerical value from FN19	NC	NC
D	284	Second numerical value from FN19	NC	NC
W	302	Number of the horizontal PLC soft key that was pressed	NC	NC
W	304	Number of the vertical PLC soft key that was pressed	NC	NC
W	320	Nominal speed value [min^{-1}]	NC	NC
W	322	Actual speed value [min^{-1}]	NC	NC
W	336	Setting of the AFC soft key	NC	NC/PLC
W	342	Value from column PLC in table AFC.TAB	NC	NC/PLC
W	348	Current AFC status (0 = inactive, 1 = learn, 2 = control)	NC	NC/PLC
W	350	Error from AFC that led to NC stop	NC	NC/PLC
D	356	Programmed speed [0.001 min^{-1}]	NC	NC
D	360	Programmed feed rate	NC	NC
D	364	Nominal speed value [min^{-1}]	NC	NC
D	368	Actual speed value [min^{-1}]	NC	NC
D	372	Maximum spindle speed including spindle override [min–1]	NC	NC
D	388	Current contouring feed rate [mm/min]	NC	NC
W	480 - 484	Analog input at X48 [0.1 V]	NC	NC
W	486 - 490	Temperature input at X48 [0.5 °C]	NC	NC
W	492	Percentage for spindle override (NC to PLC)	NC	NC
W	494	Percentage for feed-rate override (NC to PLC)	NC	NC
W	516	Q no. 0-7 for numerical data transfer PLC to NC	PLC	PLC
B	518	Definition of the free rotation function	PLC	PLC
B	519	Traverse direction for free rotation	PLC	PLC
W	522	Enabling the fast PLC inputs	PLC	PLC
W	524	Open the control loop if drive enabling via X150/X151 is missing	PLC	PLC
D	528	Double word with multiple function; here data for transfer from PLC to NC	PLC	PLC
D	528 - 544	Target position for PLC positioning	PLC	PLC
D	528 - 544	Datum shift for axes 1 to 5	PLC	PLC
W	560 - 568	Feed rate for PLC positioning	PLC	PLC
W	576 - 584	Lag-tracking axis error compensation	PLC	PLC
D	592	Nominal position for spindle orientation	PLC	PLC
D	596	Max. feed rate from PLC [mm/min]	NC/PLC	PLC
D	604	Maximum possible spindle speed	PLC	NC/PLC
W	632	Alternative control input variable for AFC	PLC	NC/PLC
W	754	% function for feed-rate override for free rotation	PLC	PLC
D	756	Programmed rotational speed or rotational speed from the PLC [0.001 min^{-1}]	NC/PLC	NC/PLC
D	760	Offset in tilting axes touch probe center offset [1/10 000°]	PLC	PLC
W	764	Percentage for spindle speed override (PLC to NC)	NC/PLC	NC/PLC
W	766	Percentage for feed-rate override (PLC to NC)	NC/PLC	NC/PLC

	Operand	Description	Set	Reset
D	768 - 956	Value from MP4210.0 to MP4210.47	NC	NC
W	960 - 968	Value from MP4220.0 to MP4220.4	NC	NC
W	976 - 994	Value from MP4310.0 to MP4310.9	NC	NC
W	1002	Last PLC run-time error that occurred	NC	NC
W	1008	S code for minimum speed	NC	NC
W	1016	PLC module that was last processed incorrectly	NC	NC
W	1018	Number of files opened by the PLC	NC	NC
W	1020	Number of all open files	NC	NC
W	1022	Error status of the last called PLC module	NC	NC

Expanded PLC interface for 18 axes

Up to 18 axes can be operated in a system with HSCI.
Up to now, the PLC interface supported only 14 axes.
In order to use the increased number of axes, you must set bit 14 of MP4020 to 1.

If the control is set to 14 axes, the words below are used.
If it is set to 18 axes, the double words below are used (so that all information for up to 18 axes can be displayed).

16-bit word for the PLC interface for up to 14 axes	32-bit double words for the PLC interface for up to 18 axes	Description	Set	Reset
W1024	D1100	Axis enabling	NC	NC
W1026	D1104	Axes in position	NC	NC
W1028	D1108	Axes in motion	NC	NC
W1030	D1112	Current direction of traverse	NC	NC
W1032	D1116	Reference marks not yet traversed	NC	NC
W1034	D1120	Positive software limit switch was approached	NC	NC
W1036	D1124	Negative software limit switch was approached	NC	NC
W1038	D1128	Prepare to open the position control loop	PLC	PLC
W1040	D1132	Axis-specific opening of the position control loop	PLC	PLC
W1042	D1136	Deactivation of monitoring functions	PLC	PLC
W1044	D1140	Actual-to-nominal value transfer	PLC	PLC
W1046	D1144	Manual traverse in positive direction	PLC	PLC
W1048	D1148	Manual traverse in negative direction	PLC	PLC
W1050	D1152	Incremental jog positioning in positive direction	PLC	PLC
W1052	D1156	Incremental jog positioning in negative direction	PLC	PLC
W1054	D1160	Reference end position	PLC	PLC
W1056	D1164	Lubrication pulse: Value in MP4050.x exceeded	NC	NC
W1058	D1168	Reset the accumulated distance (lubrication)	PLC	PLC
W1060	D1172	Axis-specific feed-rate enable	PLC	PLC
W1062	D1176	Lock the handwheel for specific axes	PLC	PLC

Overview of operands

Operand	Abbreviation	Address range
Marker	M (marker)	**M0 to M9999** **M0 to M999** are free; they are deleted only after entry of the code number 531210, not by a reset (non-volatile range). The range can be reduced in the *.CFG file of the PLC compiler. **M1000 to M3999** are free; they are deleted during reset. **M4000 to M5999** reserved for NC/PLC interface (M4800 to M4999 are deleted before the first run of the PLC program, e.g. after compilation or restarting.) **M6000 to M9999** are free; they are deleted during reset.
Input	I (input)	**I0 to I999** Maximum of 8 external PLC input/output systems (PL 6xxx) are allowed in the HSCI system, and of these, one system PL 62xx or one UEC 11x controller unit. Inputs are assigned to symbolic operands using the PC software IOconfig.
Output	O (output)	**O0 to O999** Maximum of 8 external PLC input/output systems (PL 6xxx) are allowed in the HSCI system, and of these, one system PL 62xx or one UEC 11x controller unit. Outputs are assigned to symbolic operands using the PC software IOconfig.
Counter	C (counter)	Set counter: **C0 to C47** Counter contents: **C48 to C95** Counter pulse enable:**C96 to C143**
Timer	T (timer)	Timer start: **T0 to T47** Timer is running: **T48 to T95 and T96 to T999**
Byte Word Double word	B (byte) W (word) D (double word)	**B0 to B9999** (8 bits) **B0 to B255** are free; depending on the definition in the *.CFG file of the PLC compiler, the defined range is deleted only after entering the code number 531210, not during reset (nonvolatile range). If no range is defined in the *.CFG file, B0 to B127 is the nonvolatile range. **B256 to B2047** reserved for NC/PLC interface. **B2048 to B9999** are free; they are deleted during reset.
Constant	K	**–2 147 483 647 to +2 147 483 647**
String	S	**S0 to S99**

Note

1 byte = 8 bits
1 word = 2 bytes = 16 bits
1 double word = 2 words = 4 bytes = 32 bits

11.7 Specifications

11.7.1 PLC inputs

Input signals of the switching inputs:

Voltage range	PLD-H (with LED)	UEC 11x, X9 of PL 62xx, and machine operating panel (without LED)
"1" signal: U_i	11 V to 30.0 V	11 V to 30.0 V
"0" signal: U_i	–3.0 V to 2.2 V	–3 V to 2.2 V

Current range	PLD-H (with LED)	UEC 11x, X9 of PL 62xx, and machine operating panel (without LED)
"1" signal: I_i	2.0 mA to 6.1 mA	2.1 mA to 6.0 mA
"0" signal: I_i when U_i = 2.2 V	0.3 mA	0.43 mA

Number of switching inputs:

Device	Digital inputs
UEC 11x	38
PLD-H 16-08-00	16
PLD-H 08-16-00	8
MB 620	8
PLB 62xx (safety-related)	12

Note

Maximum of 8 external PLC input/output systems (PL 6xxx) are allowed in the HSCI system, and of these, one system PL 62xx or one UEC 11x.

11.7.2 Analog inputs

Number of analog inputs:

Device	Analog inputs (±10 V)
PLA-H 08-04-04	8

Voltage range: –10 V to +10 V
Input resistance: > 40 kΩ
Resolution: 10 mV

11.7.3 Inputs for Pt 100 thermistors

The PLA-H 08-04-04 features inputs for the Pt 100 thermistors.

Device	Inputs for Pt 100 thermistors
PLA-H 08-04-04	4

Constant current: 4.096 mA
Temperature range: 0 °C to 100 °C
Resolution: 0.01 °C
Increment: 0.03 °C

11.7.4 PLC outputs

Output signals and addresses

The switching outputs are transistor outputs with current limitation.

Please note:

- PLD-H: The outputs are short-circuit proof.
- Permissible load: Resistive load (ohmic load)
  Inductive loads (e.g. relay, contactor) with an energy content of up to 100 mJ do not require a quenching diode. If the energy content exceeds 100 mJ: only with quenching diode parallel to inductance. Pay attention to the manufacturer's specification of the energy content when selecting the switching devices.
- If an output is operated with an inductive load without a quenching diode and is read back to an input, the input must be protected by varistors or RC circuits.
- For component-related reasons, the switching outputs should be loaded with at least 5 mA in "1" state. They conform to EN 61131-2. If a resistive load consumes less than 5 mA, it is necessary to insert, e.g., a relay.
- For component-related reasons, a current of I_{Off} = 500 µA flows through the switching outputs also in "0" state. If high-impedance loads with a low-level lower switching threshold are connected directly to the output, the voltage drop can lead to a "1" state. In such a case, a shunt resistor must be connected to the output.

Output signals:

	PLD-H, UEC 11x, X9 of PL 62xx, and machine operating panel
Min. output voltage for "1" signal	3 V below supply voltage

Attention

PLC outputs must neither be connected to a 24-V supply, nor to other PLC outputs with a difference in potential. Otherwise, the voltage present at the PLC outputs is transmitted to the power supply. As a result, the PLC outputs that can be switched off may nevertheless be supplied with this voltage.
This could lead to damage or injury to property or persons!

Number of digital outputs:

Device	**Digital outputs**
UEC 11x	23
PLD-H 16-08-00	8
PLD-H 08-16-00	16
MB 620	8
PLB 62xx (safety-related)	7

Note

Maximum of 8 external PLC input/output systems (PLB 6xxx) are allowed in the HSCI system, and of these, one system PLB 62xx or one UEC 11x.

Supply voltage for PLC outputs

See “Supply voltage for PLC outputs” on page 18 – 274.

11.7.5 Analog outputs

Number of analog inputs:

Device	Analog outputs (±10 V)
PLA-H 08-04-04	4

Voltage range:	–10 V to +10 V
Load impedance:	> 5 kΩ
Output current:	< 2 µA
Resolution:	10 mV

11.7.6 Assignment of the inputs and outputs

The **inputs and outputs are assigned to symbolic operands** using the PC software IOconfig. The absolute address of the input or output, the pertaining device, the slot and the terminal name can be seen from the **Bus Diagnosis**. --> See "Identification of the PLC operands" on page 12 – 149.

12 Bus diagnosis

12.1 HSCI bus

12.1.1 Introduction

HSCI is the abbreviation of:
HEIDENHAIN **S**erial **C**ontroller **I**nterface

The main computer (MC 6222, MC 6241), the controller unit (CC 61xx, UEC 11x) and other control components (PLB 6xxx, MB 620) are connected to each other via the HSCI bus.

For further information refer to the annex of this Manual. --> See "The HSCI bus" on page 1 – 648.

12.1.2 Possible error causes

- Fault in the HSCI bus
- Defective cable or connector
- Defective device
- PLC or NC power supply missing
- Poor shielding and grounding
- Electromagnetic fields
- Compensating currents caused by different potentials
  Example:
  Several electrical cabinets are connected with a bus.
  Due to poor grounding, these cabinets do not have the same potential.
  The shielding of the bus is connected to each electrical cabinet.
  Result: Compensating currents

12.1.3 Calling and operating the HSCI bus diagnosis

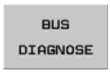
▶ Select the **Programming and Editing** operating mode.

▶ If open: Close the program management by pressing the END button.

> Note
>
> Pressing the MOD key while the program manager is open calls screen where you can make the interface settings.

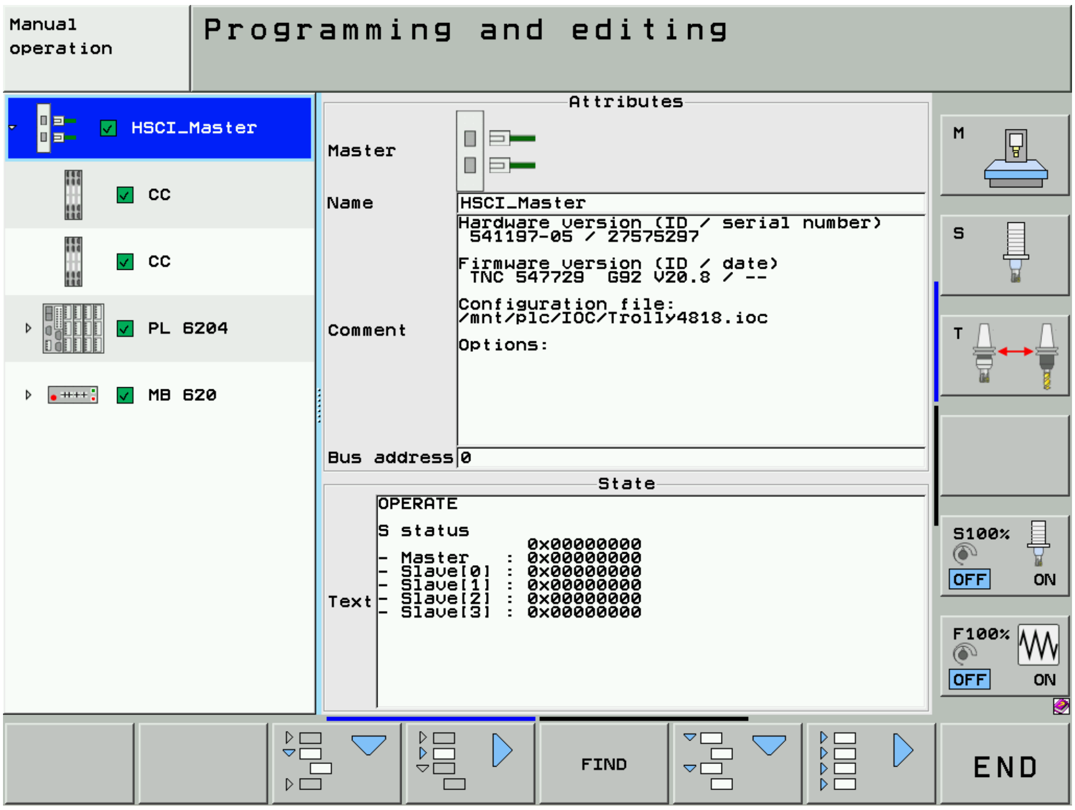
▶ Press the MOD key.

▶ Press the DIAGNOSIS soft key.



▶ Press the BUS DIAGNOSIS soft key.

▶ Press the HSCI soft key. --> A new window opens.



This screen shows the structure of the HSCI system together with details on the HSCI components.

▶ You can open and close the tree structure on the left side of the window with the arrow keys or the mouse.

▶ Navigation is also effected with the arrow keys or a mouse.

12.1.4 Identification of the PLC operands

By means of the HSCI bus diagnosis you can obtain important information on PLC operands, such as the absolute address, the slot and the terminal name:

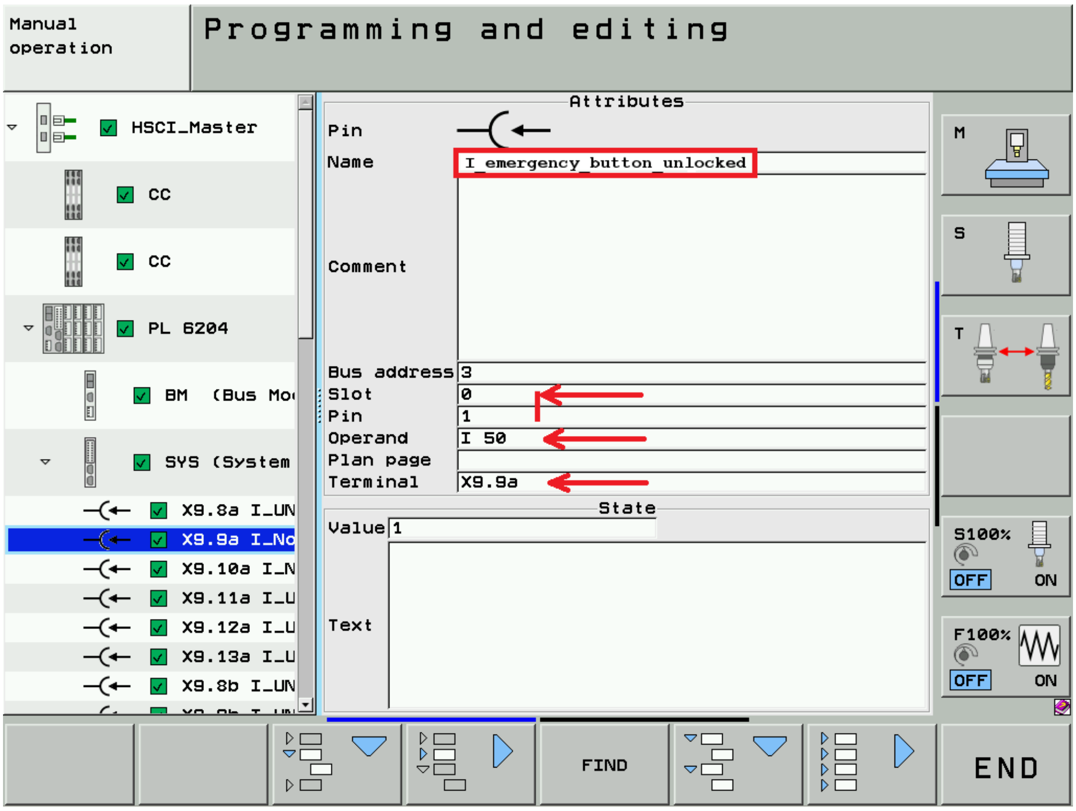


Figure: Display of the attributes of **I_emergency_button_unlocked** in HSCI bus diagnosis

Figure: PLB 6204 with four PLD-H 16-08-00 inserted, terminal X9.9a on system module

12.1.5 Read-back outputs

The read-back outputs are a special feature of the HSCI bus diagnosis.

With this method, important outputs can be interrogated at the terminal and returned as inputs. This increases the safety of these outputs.
With standard outputs only the output level 0 or 1 is set, without "checking back", whether this level is actually output at the terminal.

Example:
In the HSCI bus diagnosis, the "Control is ready" output is available as input. It is, however, not a normal input, but a read-back output!
The signal designation is I_RO_MC_RDY (Input Readback Output MC Ready).

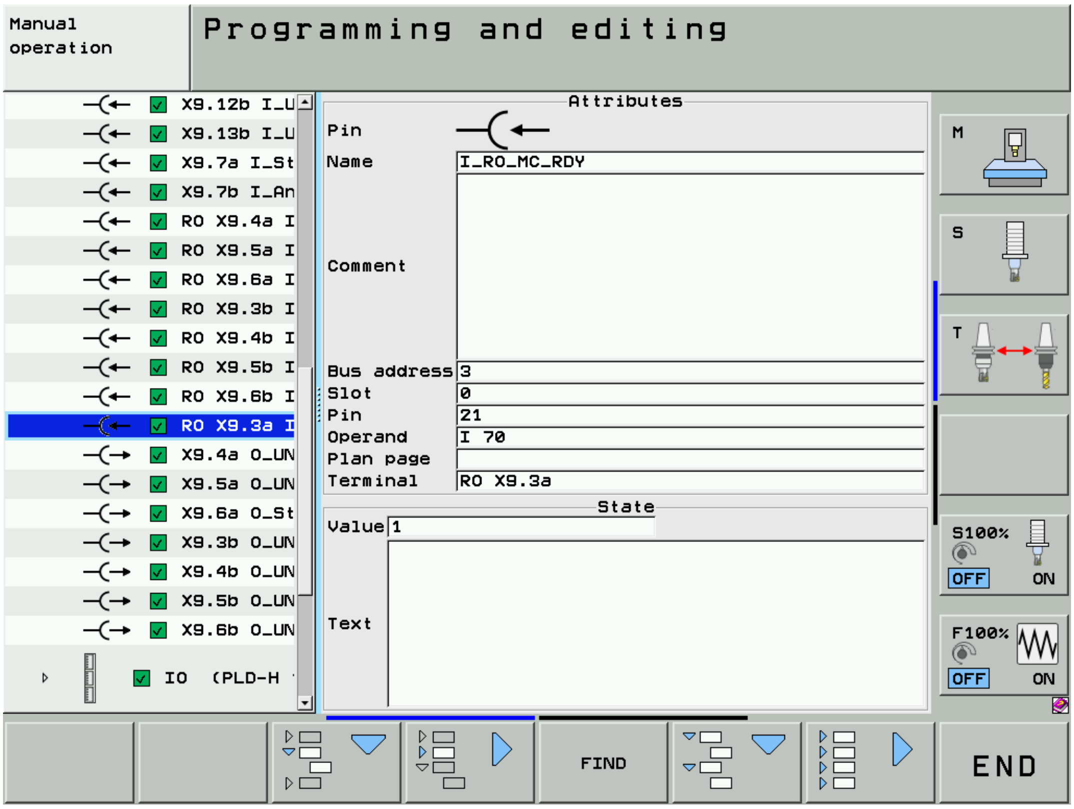


Figure: The input I_RO_MC_RDY is a read-back output.

Figure: The level can be measured at the terminal RO X9.3a.

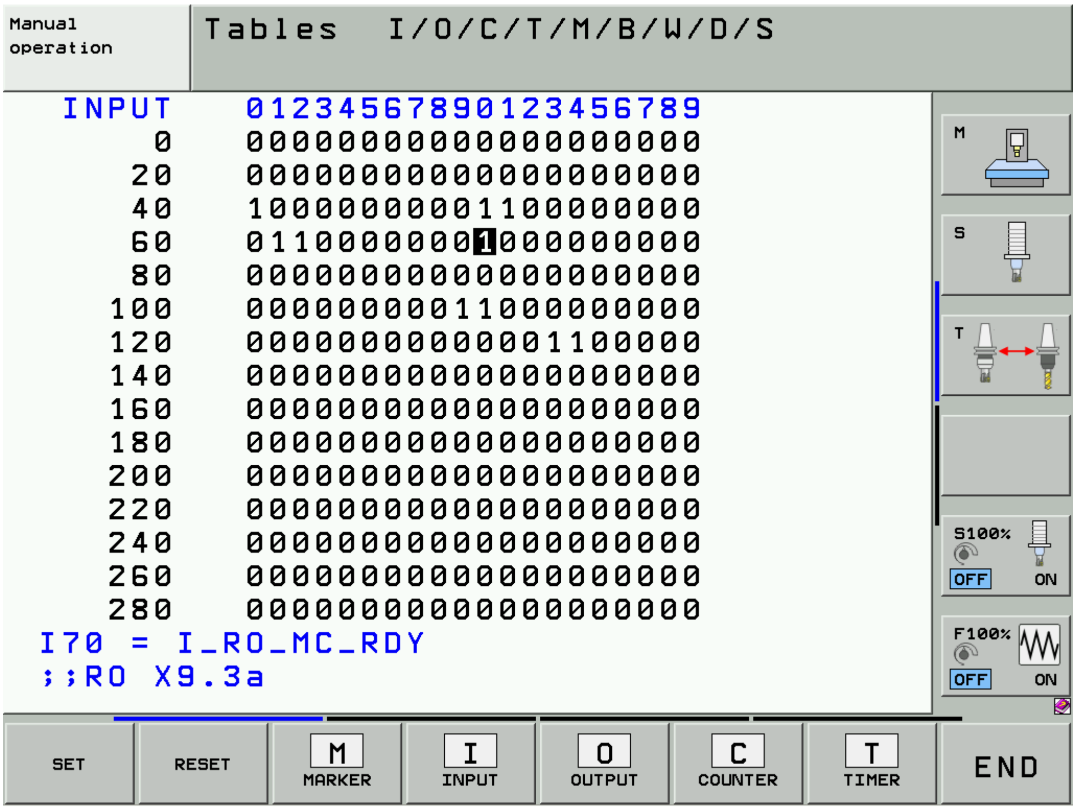


Figure: In the table, the read-back output I_RO_MC_RDY is represented as Input 70.

12.1.6 Master, slaves and clients

In HSCI bus diagnosis, one speaks of master, slaves and clients.

The example below is supposed to illustrate the relation of these bus participants:

Relation of master, slaves and clients		
MC	Master	Master
CC (first controller basic board)	Slave (0)	Client 1
CC (second controller basic board)	Slave (1)	Client 2
PL	Slave (2)	Client 3
MB	Slave (3)	Client 4

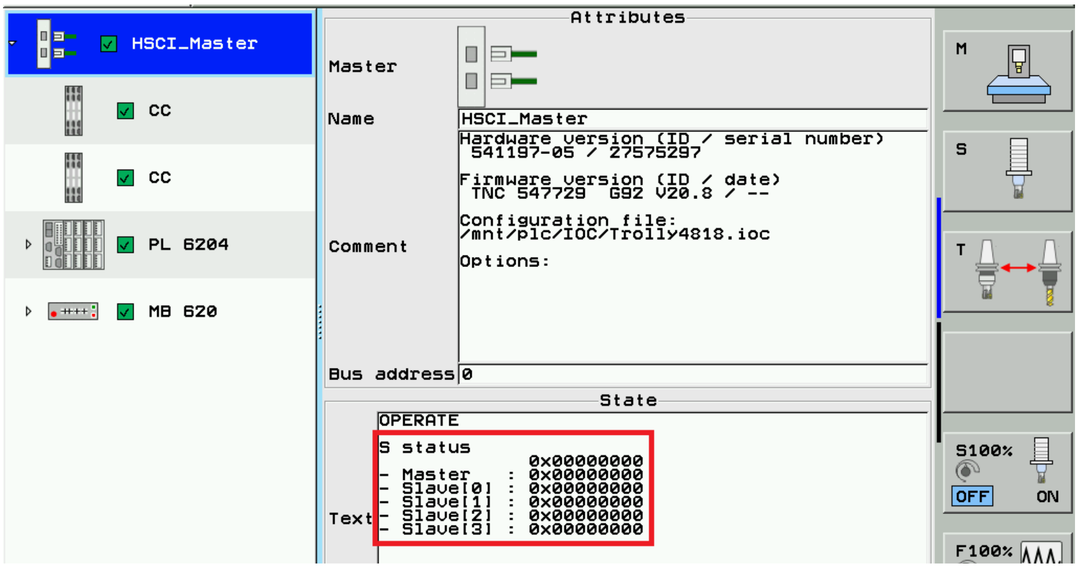


Figure: Display of master and slaves in the HSCI bus diagnosis

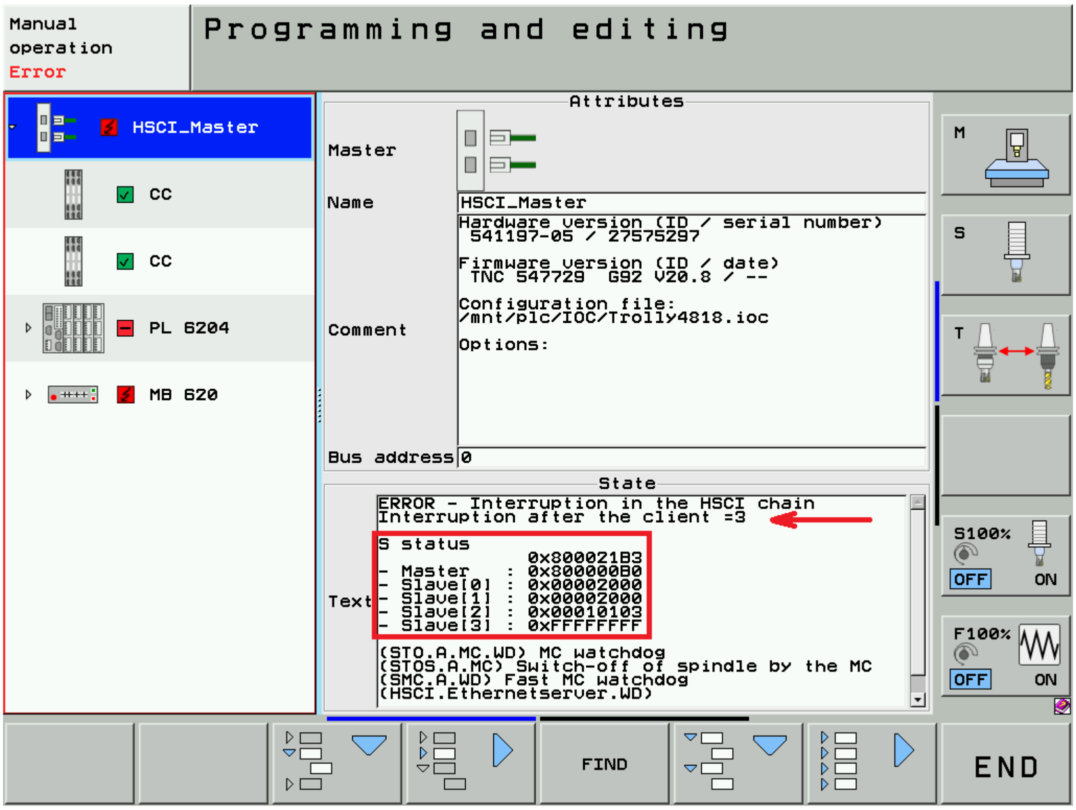


Figure: The HSCI bus is interrupted after Client 3 (= Slave 2 = PL 6204).

12.1.7 For error diagnosis

In the left window of the HSCI bus diagnosis you can see the arrangement, the names and the status of the HSCI components and terminals.

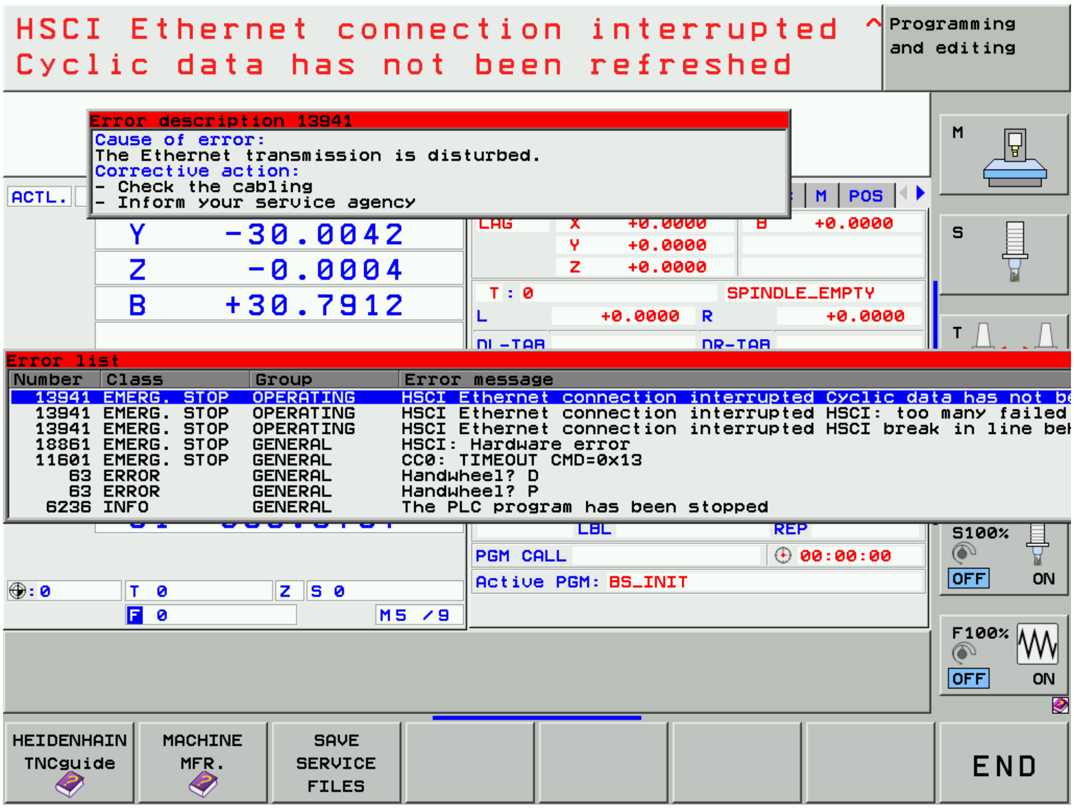
▶ Observe the status of the HSCI components and terminals.
Here, you already can detect and locate errors in the HSCI system.

Display	Color	Status
	Green	OK
	Red	Error (further information in the text window)
	Yellow	Warning (further information in the text window)
	Gray	Undefined condition (further information in the text window)

HSCI errors during operation

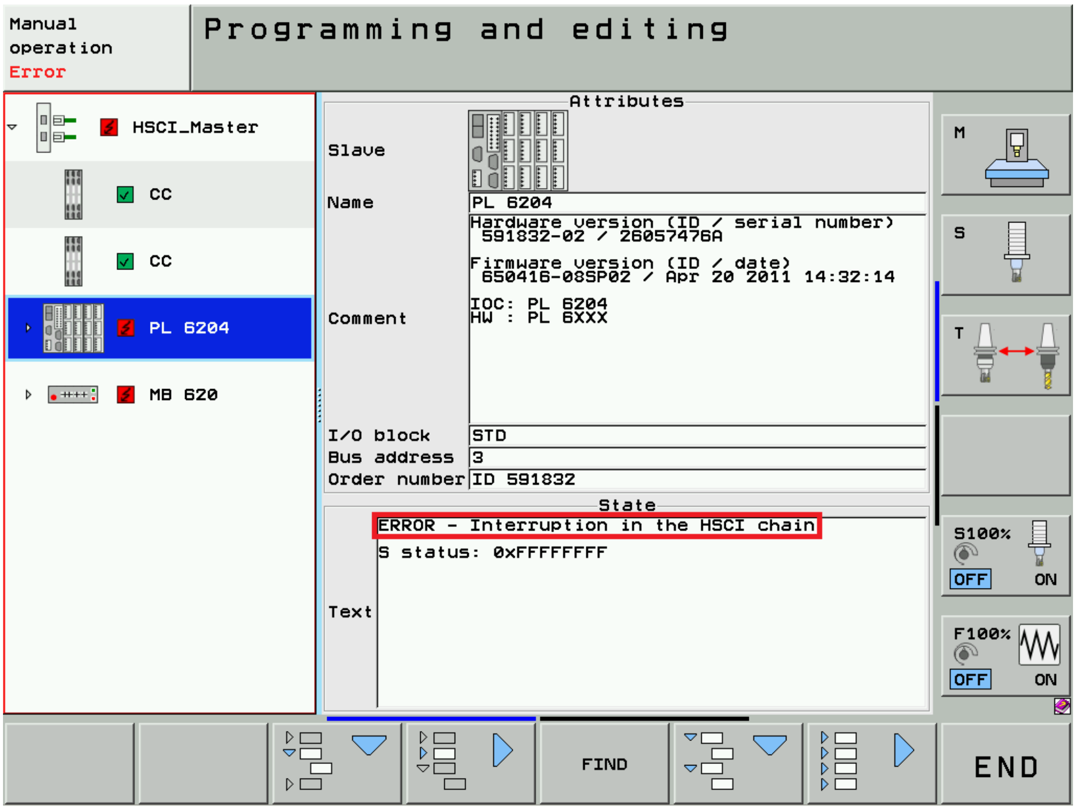
Example 1:
HSCI connection X502 interrupted at PLB 6204 system module

The following error messages may be displayed:



▶ Call the HSCI bus diagnosis.

- Now you can see which HSCI devices cannot be addressed.
  The PLB 6204 and the downstream MB 620 show ERROR condition:

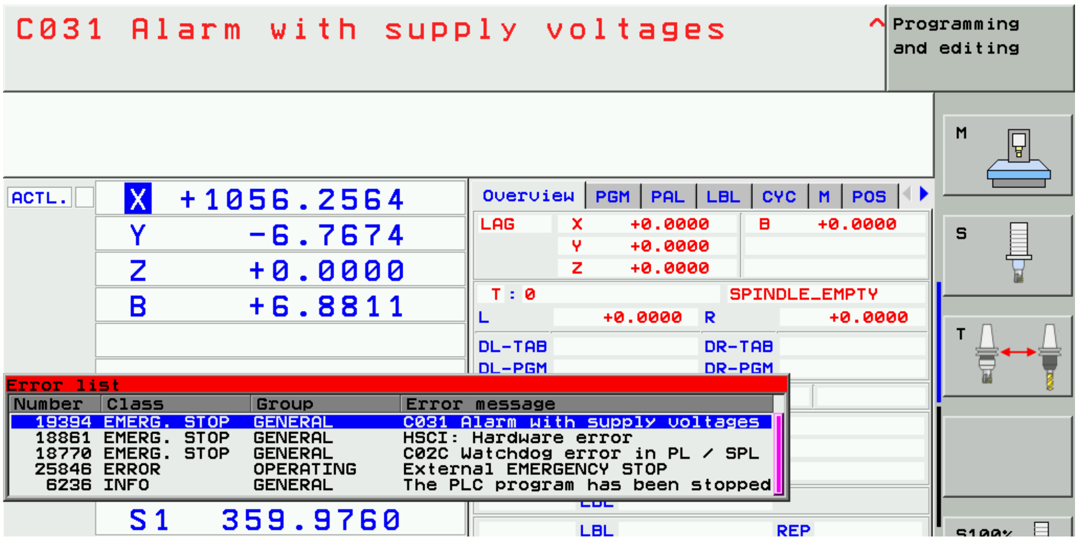


If this error occurs, the LEDs on the PLB 6204 behave as follows:

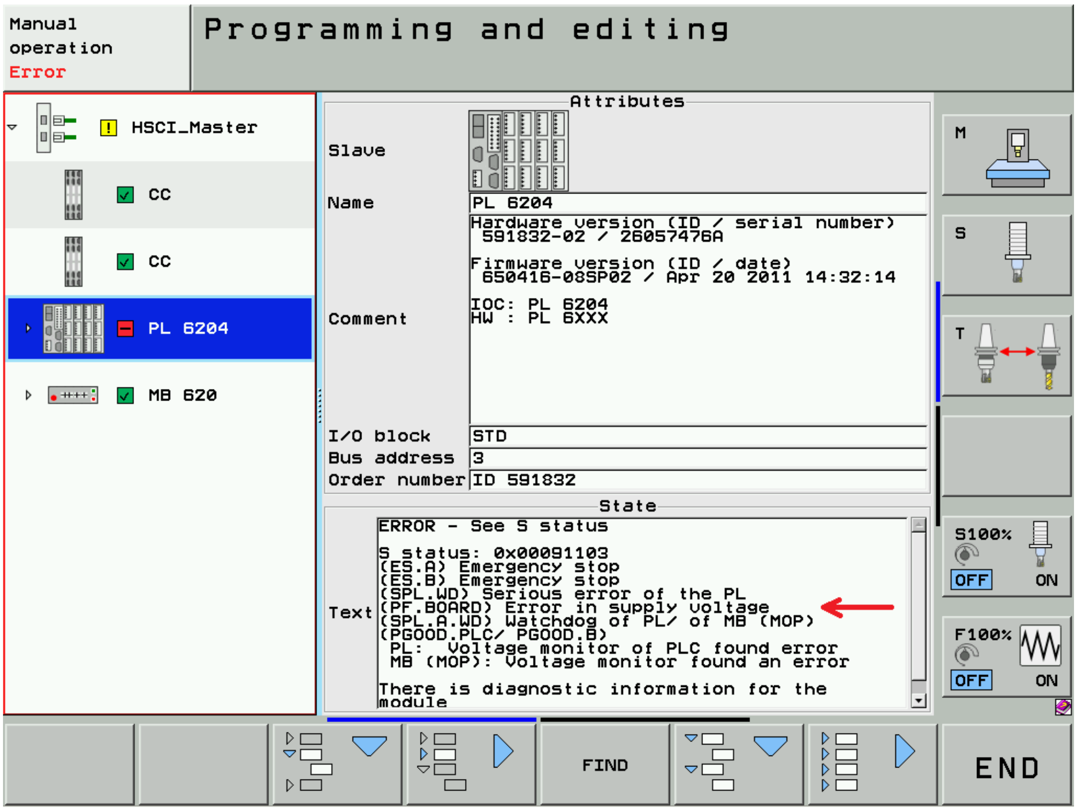
Status		
Orange LED	**Green LED**	
Fast blinking	Fast blinking	PL
Fast blinking	Slow blinking	HSCI

Example 2:
PLC supply voltage interrupted at PLB 6204 system module

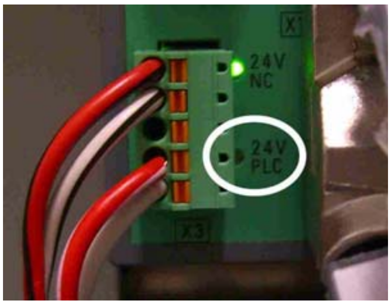
The following error messages may be displayed:



The PLB 6204 is not powered with 24 V (PLC) and shows ERROR condition:

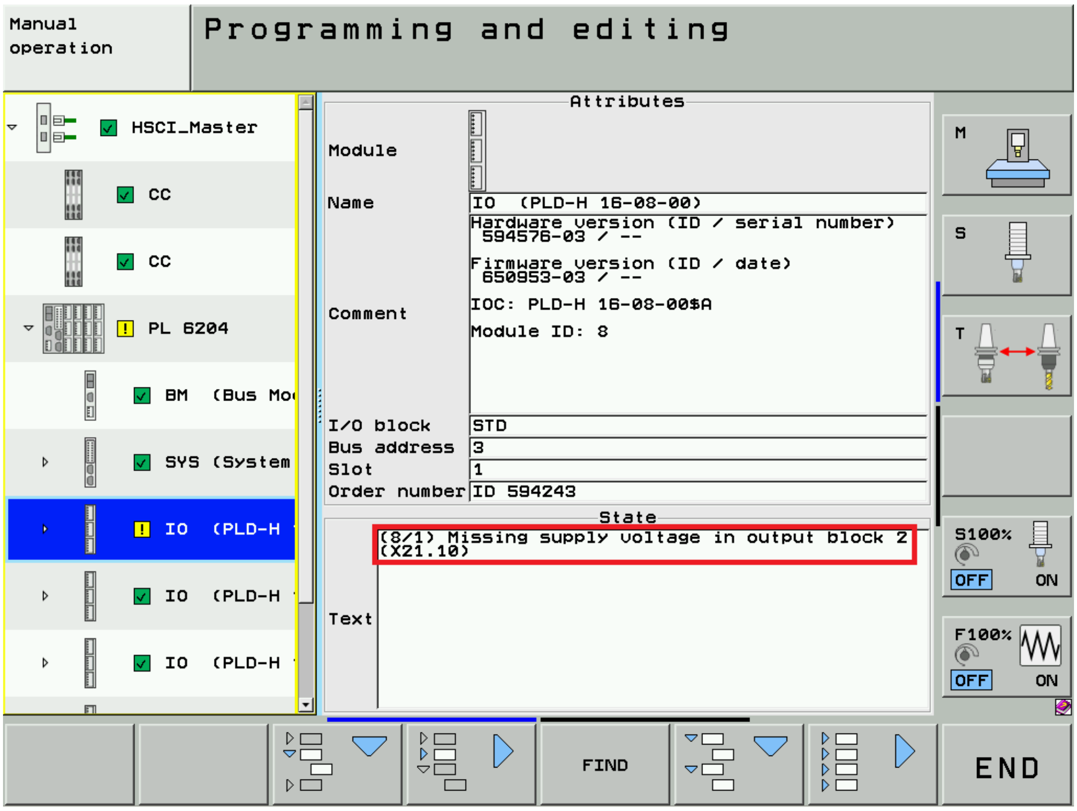


The green LED for the 24 V PLC supply voltage of the PLB 6204 is extinguished:

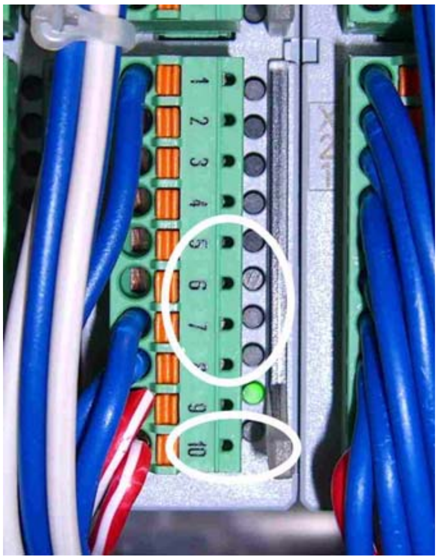


Example 3:
PLC supply voltage interrupted at the PLD-H 16-08-00 input/output module

The PLD-H 16-08-00 is no longer powered with 24 V (PLC) and shows WARNING condition:



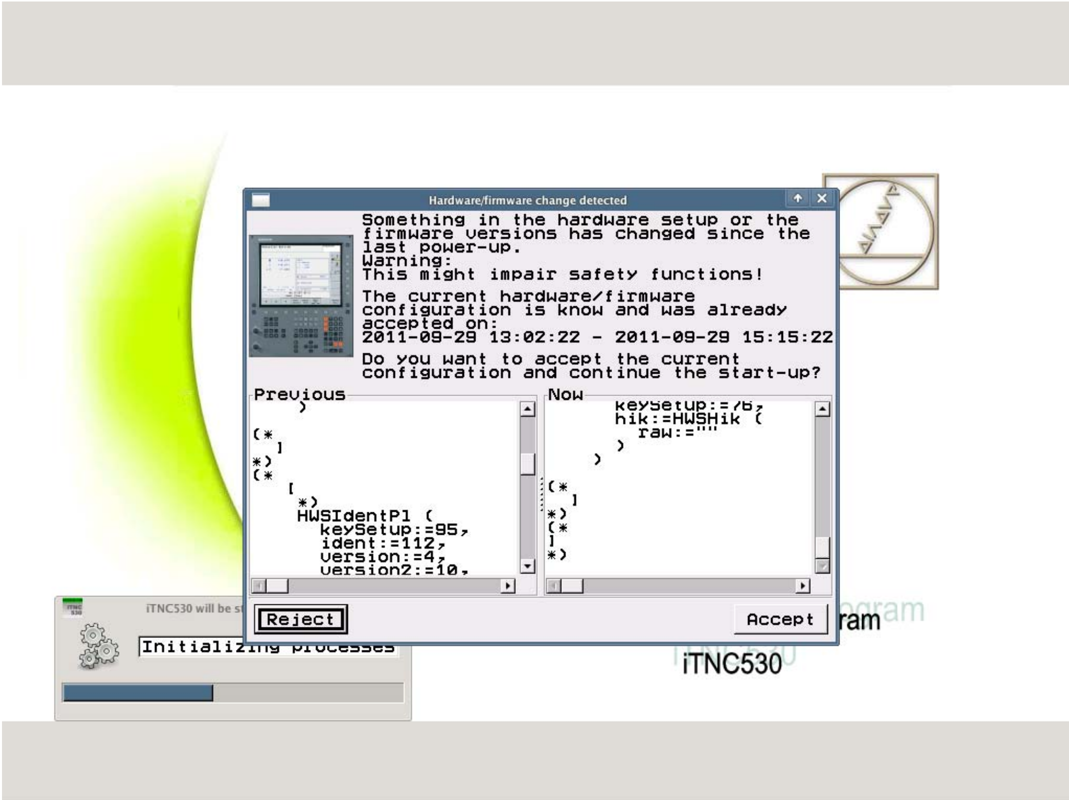
The green LED for the 24 V PLC power supply is not lit; neither are the associated orange LEDs for the PLC outputs:



HSCI errors during start-up

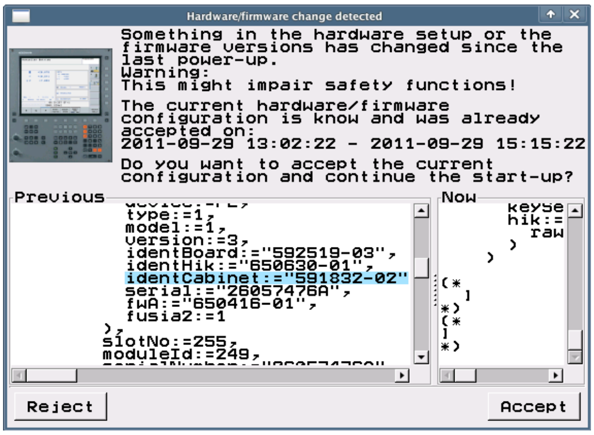
Example 1:
HSCI connection X502 interrupted at PLB 6204 system module

The following message is displayed:



The control has detected that an HSCI device is missing.
In the columns **Previous** and **Now** the display stops at where there are differences.

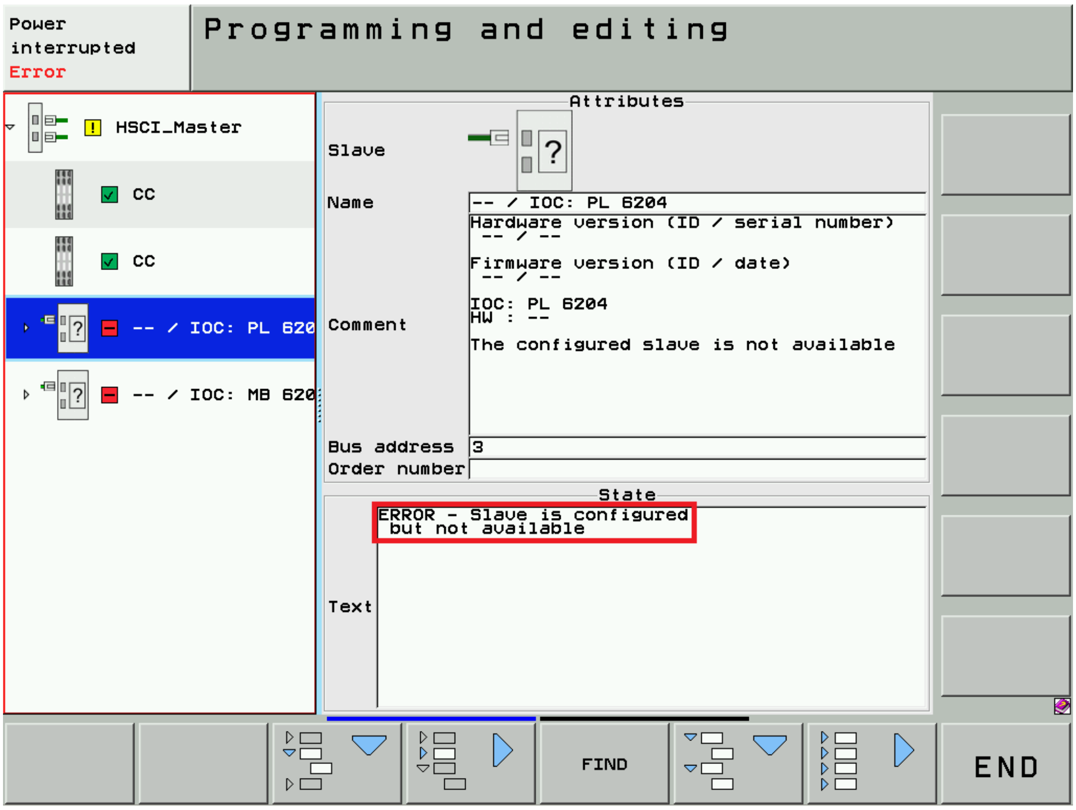
In this example there is no communication with the PLB 6204. If you scroll down a bit in the **Previous** column, you will find the line **identCabinet:= "591832-02",**.
This is the ID of a PLB 6204 that is missing in the **Now** column.



- Press the Reject button (the configuration with the missing HSCI device should not be loaded).
  --> The control resumes booting and shows this error message:

- Call the HSCI bus diagnosis.

▷ Now you can see which HSCI devices cannot be addressed.
The PLB 6204 and the downstream MB 620 show ERROR condition:

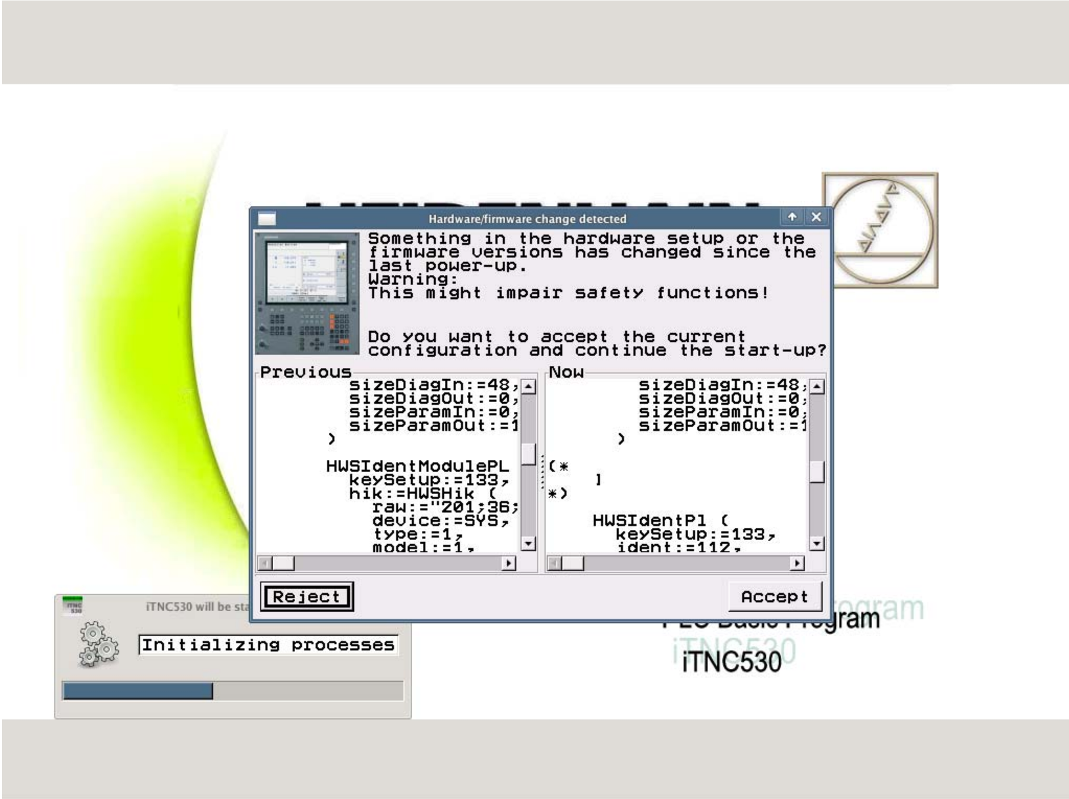


If this error occurs, the LEDs on the PLB 6204 behave as follows:

Status		
Orange LED	**Green LED**	
Off	Off	PL
Off	On	HSCI

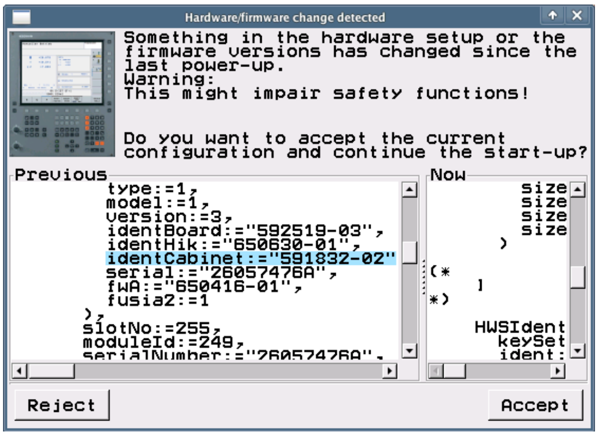
Example 2:
PLC supply voltage interrupted at PLB 6204 system module

The following message is displayed:



The control has detected that an HSCI device is missing.
In the columns **Previous** and **Now** the display stops at where there are differences.

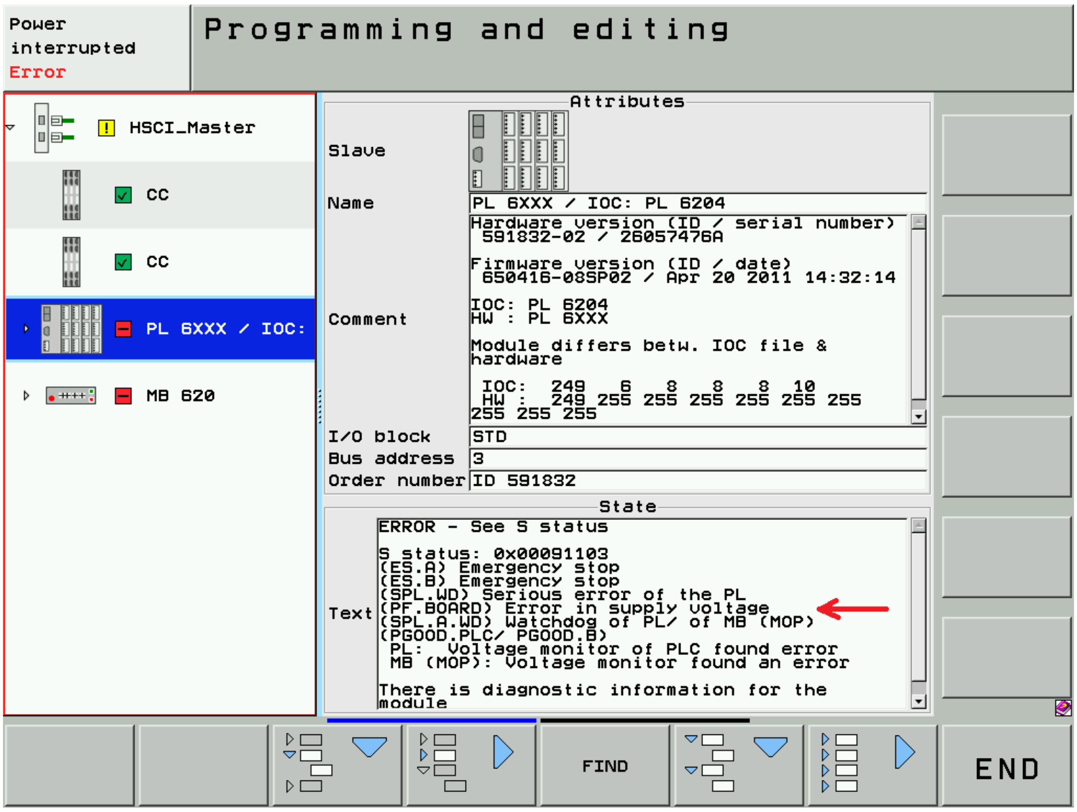
In this example there is no communication with the PLB 6204. If you scroll up a bit in the **Previous** column, you will find the line **identCabinet:= "591832-02",**.
This is the ID of a PLB 6204 that is missing in the **Now** column.



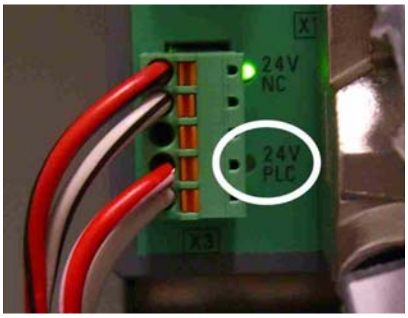
- Press the Reject button (the configuration with the missing HSCI device should not be loaded).
  --> The control resumes booting and shows this error message:

- Call the HSCI bus diagnosis.

▶ Now you can see which HSCI devices cannot be addressed.
The PLB 6204 and the downstream MB 620 show ERROR condition:



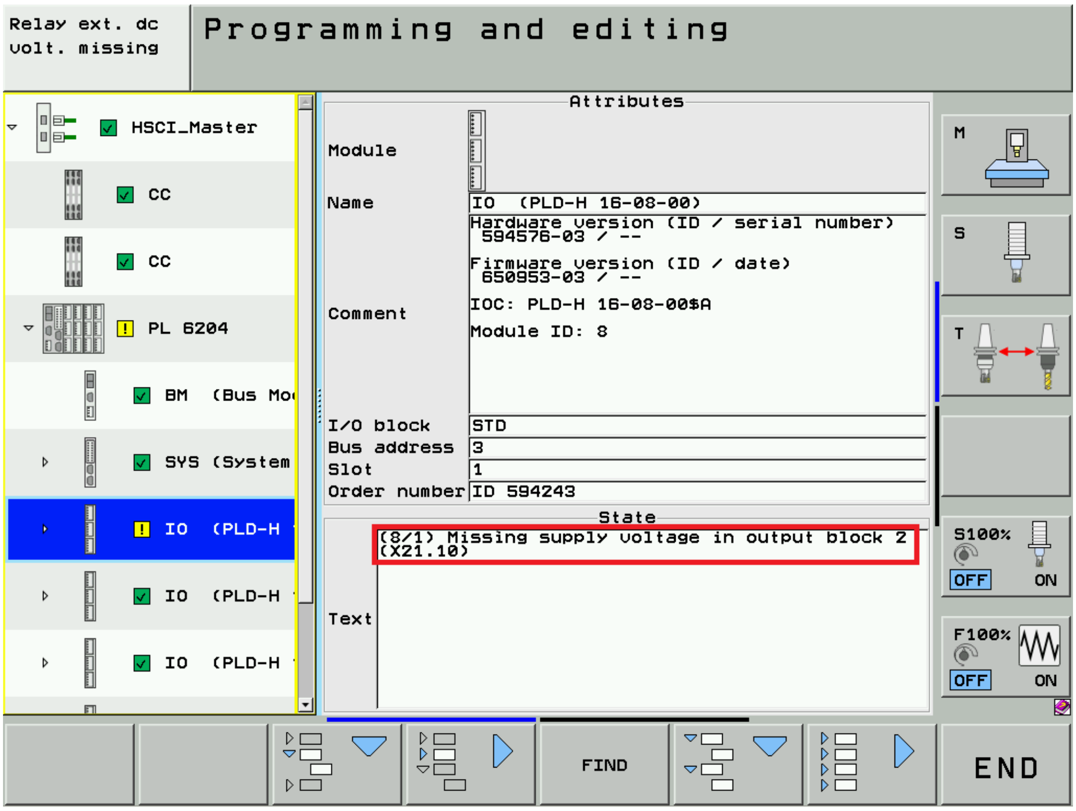
The green LED for the 24 V PLC supply voltage of the PLB 6204 is extinguished:



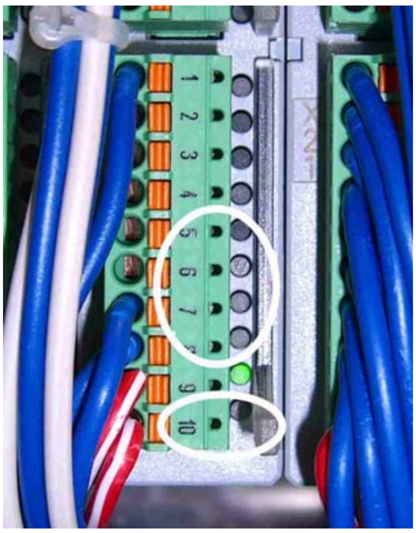
Example 3:
PLC supply voltage interrupted at the PLD-H 16-08-00 input/output module

It may not be possible to switch the control on (depending on which PLC outputs are concerned).

The PLD-H 16-08-00 is not powered with 24 V (PLC) and shows WARNING condition:



The green LED for the 24 V PLC power supply is not lit; neither are the associated orange LEDs for the PLC outputs:



12.2 PROFIBUS

12.2.1 Introduction

- The iTNC 530 HSCI also cooperates with PROFIBUS components.
- For this purpose, the MC must feature a PROFIBUS interface board.
- PROFIBUS components are available from HEIDENHAIN or other manufacturers.
- The machine manufacturer configures the PROFIBUS system.

The described PROFIBUS diagnosis may facilitate troubleshooting.

Note

Special **line testers and analyzers** on which the service engineer has been trained are very helpful at any rate for troubleshooting PROFIBUS systems.

For troubleshooting the PROFIBUS system of your machine, always contact the machine manufacturer!

12.2.2 Possible error causes

- Fault in the PROFIBUS
- Fault in a bus (e.g. ASI bus) connected to the PROFIBUS
- Terminating resistors missing at the ends of the PROFIBUS
- Defective cable or connector
- Defective device
- PLC power supply missing
- PROFIBUS interface of the MC defective
- Poor shielding and grounding
- Electromagnetic fields
- Compensating currents caused by different potentials
  Example:
  Several electrical cabinets are connected with a bus.
  Due to poor grounding, these cabinets do not have the same potential.
  The shielding of the bus is connected to each electrical cabinet.
  Result: Compensating currents

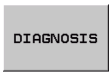
12.2.3 Calling and operating the PROFIBUS diagnosis

▶ Select the **Programming and Editing** operating mode.

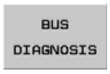
▶ If open: Close the program management by pressing the END button.

> **Note**
>
> Pressing the MOD key while the program manager is open calls screen where you can make the interface settings.

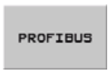
▶ Press the MOD key.



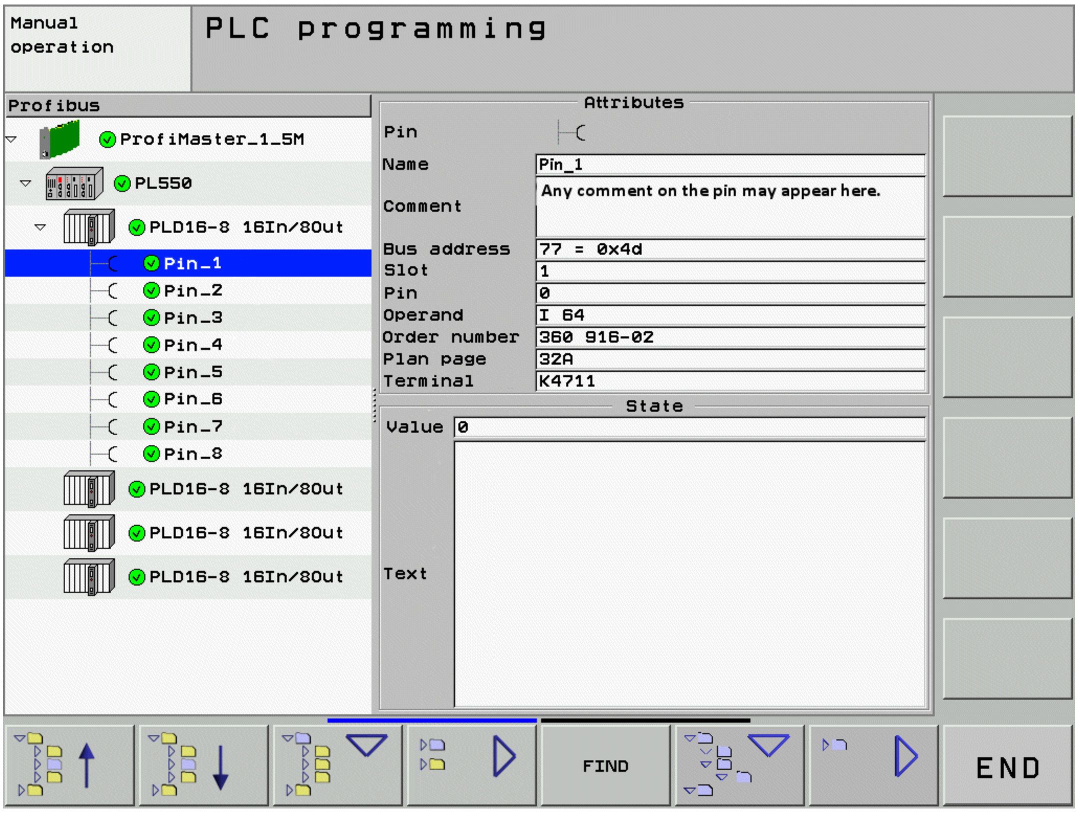
▶ Press the DIAGNOSIS soft key.



▶ Press the BUS DIAGNOSIS soft key.



▶ Press the PROFIBUS soft key. --> A new window opens.



This screen shows the structure of the PROFIBUS system together with details on the PROFIBUS components.

▶ You can open and close the tree structure on the left side of the window with the arrow keys or with a USB mouse.

▶ Navigation is also effected with the arrow keys or a USB mouse.

> **Note**
>
> The search function assists you in finding PROFIBUS components whose names are known.

12.2.4 Identification of the PLC operands

By means of the PROFIBUS diagnosis you can obtain important information on PLC operands, such as the name, the absolute address and (depending on the configuration by the OEM) the terminal name:

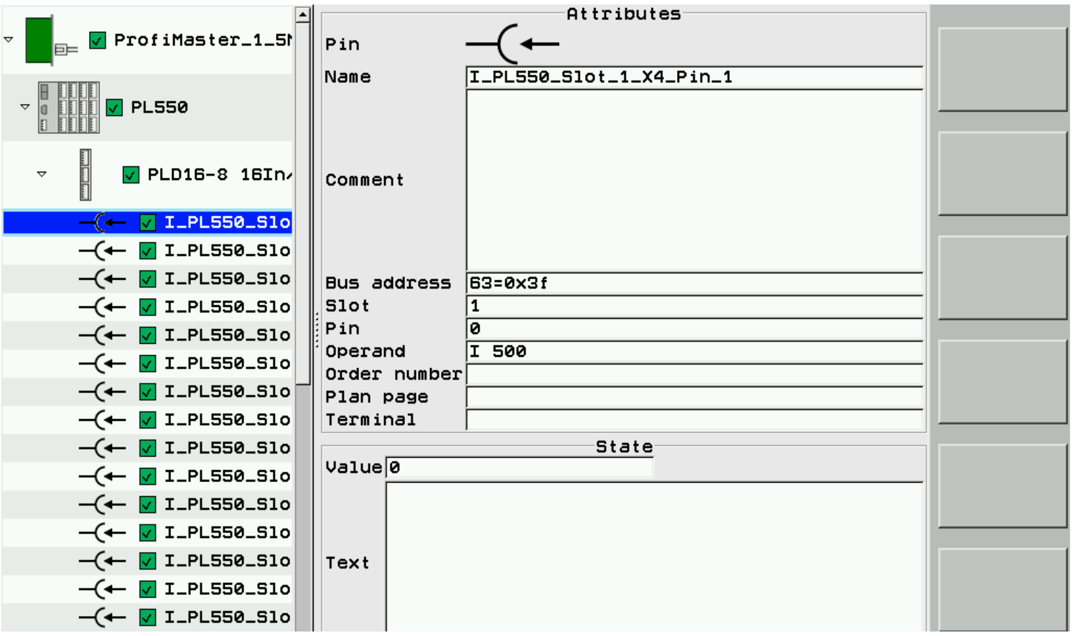


Figure: Display of the properties of **I_PL550_Slot_1_X4_Pin_1** in PROFIBUS diagnosis

12.2.5 Troubleshooting with DriveDiag

In the left window of the PROFIBUS bus diagnosis you can see the arrangement, the names and the status of the PROFIBUS components and terminals.

▶ Observe the status of the PROFIBUS components and terminals.
Here, you already can detect and locate errors in the PROFIBUS system.

Display	Status
	OK
	Error (further information in the text window)
	Warning (further information in the text window)
	Undefined condition (further information in the text window)

12.2.6 Log files

The PROFIBUS diagnosis described is mainly suitable for static failures.
Sporadic failures can hardly be analyzed this way.
Experience has shown, however, that sporadic failures account for the majority of PROFIBUS errors.

For the analysis of sporadic failures, special PROFIBUS log files are available in which all important events during start-up and run time are recorded.

- **PBCONFIG_FAIL.LOG**
  Log recording the last start of the PROFIBUS system (if the start was aborted due to an error).

- **PBCONFIG_OK.LOG**
  Log recording the last successful start of the PROFIBUS system.

- **PBLOGBOOK.LOG**
  Log of the PROFIBUS system start indicating the software versions and possible errors. The log is continuously added to.
  As of 1 MB the data is copied to**PBLOGBOOK.LOG.OLD**.

- **REPORT.TXT**
  Log recording the last PROFIBUS start (will be overwritten during the next PROFIBUS start).

- **REPORT_EXT.TXT**
  Saves diagnostic messages of the slave. The log is continuously added to, but it is limited to approx. 1 MB. After the limit has been reached, the "old" diagnostic messages will be moved to **REPORT_EXT.TXT.OLD**.

All these files are saved in the path **`PLC:\PROFIBUS`**.

Note

For the analysis of a PROFIBUS error, read out **this folder** from the control using TNCremoNT and send the data **to your machine manufacturer or to a HEIDENHAIN service agency**.

13 Data media and file management of the iTNC 530 HSCI

13.1 Introduction

- Depending on the main computer, the HDR hard disk or the SSDR solid state disk is used as a data medium.

Main computer	Data medium	Size (in 2011)
MC 6222	**SSDR** (Solid State Disk Removable)	■ TNC: > 21 GB ■ PLC: 1 GB ■ SYS: 2 GB
MC 6241	**HDR** (Hard Disk Removable)	■ TNC: > 138 GB ■ PLC: 1 GB ■ SYS: 2 GB

- The data medium of the iTNC 530 HSCI contains the TNC and PLC data as well as **all NC software**.

Attention

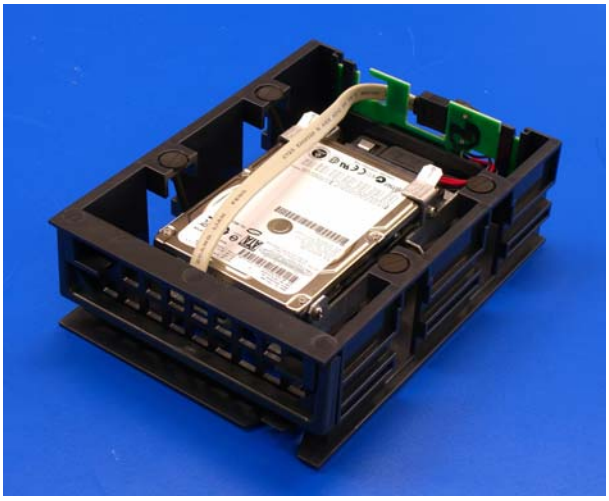
Defects in the data medium may have the result that no functions can be called any more.

- Depending on the operating conditions (e.g., vibration load, dirt), the HDR hard disk is exposed to more or less strain. HEIDENHAIN therefore recommends to have the HDR inspected after 3 to 5 years.

Attention

As the entire NC software is on the HDR or SSDR, these hard disks are subject to **export restrictions!**

HDR and SSDR



Removing and inserting the HDR; shipping brace
--> See "Replacing the HDR" on page 29 – 543.

Removing and inserting the SSDR
--> See "Exchanging the SSDR" on page 29 – 537.

13.2 Structure of the data medium

The data medium is divided into three partitions:

TNC:	**User-specific data:** NC programs, tool tables, datum tables, pallet tables, etc. are stored here.
PLC:	**OEM-specific data:** System files, PLC programs, machine parameters, help files, PLC dialogs, PLC error tables, compensation value tables, OEM cycles, etc. are stored here. The PLC partition is visible only after you have entered the code number 807667.
SYS:	**System-specific data:** This partition contains the entire NC software (NC dialogs, HEIDENHAIN cycles, etc.) and the HeROS operating system (HEIDENHAIN real-time operating system). A daily password is required to open the SYS partition.

Attention

Alterations to the SYS partition can impair proper function of the control!

13.3 Possible error causes

- Mechanical wear
- Vibration
- Contamination
- Humidity
- Hard disk crash
- Defective cable or connector
- No communication due to defective processor board
- No power supply
- Manipulation of the data medium
  (e.g. use of non-permissible programs for refragmentation, data medium test, duplication)

13.4 Test of the data medium

No communication with the data medium

If there is no communication with the data medium when the control is started, usually the following error message is displayed:

`Boot: Giving up`
`Reason is: Load processes failed`
or
`DISK BOOT FAILURE, INSERT SYSTEM DISK AND PRESS ENTER`

- Check, whether the HDR / SSDR is firmly in the slot, or check the data medium on a functioning iTNC 530 HSCI (if available).

At present no further tests are possible in the field!

Communication with the data medium

If the control still communicates with the data medium, some tests might be carried out in the field.
–> See following instructions.
Here too, **additional and more comprehensive tests can only be performed at HEIDENHAIN agencies!**

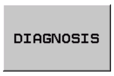
> Attention
>
> Do not use your own data medium test or repair programs!
> Data recovery at HEIDENHAIN or a specialized company could thereby become more difficult or even impossible.

Data medium test using soft keys

> **Note**
>
> This test can be called if the NC software still starts up completely.

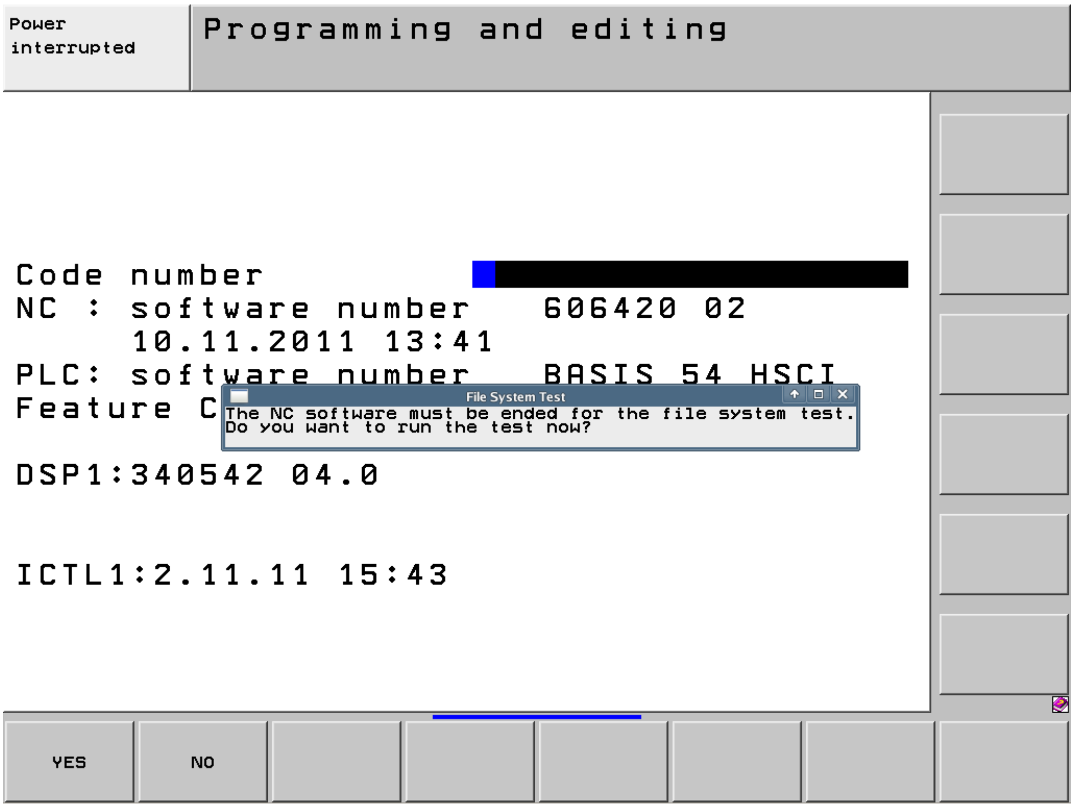
- Press the EMERGENCY STOP button.
- Restart the control.
- Switch to the **`Programming and Editing`** operating mode.

- Press the MOD key.



- Press the DIAGNOSIS soft key.

- Press the CHECK THE FILE SYSTEM soft key. –> A new window opens:

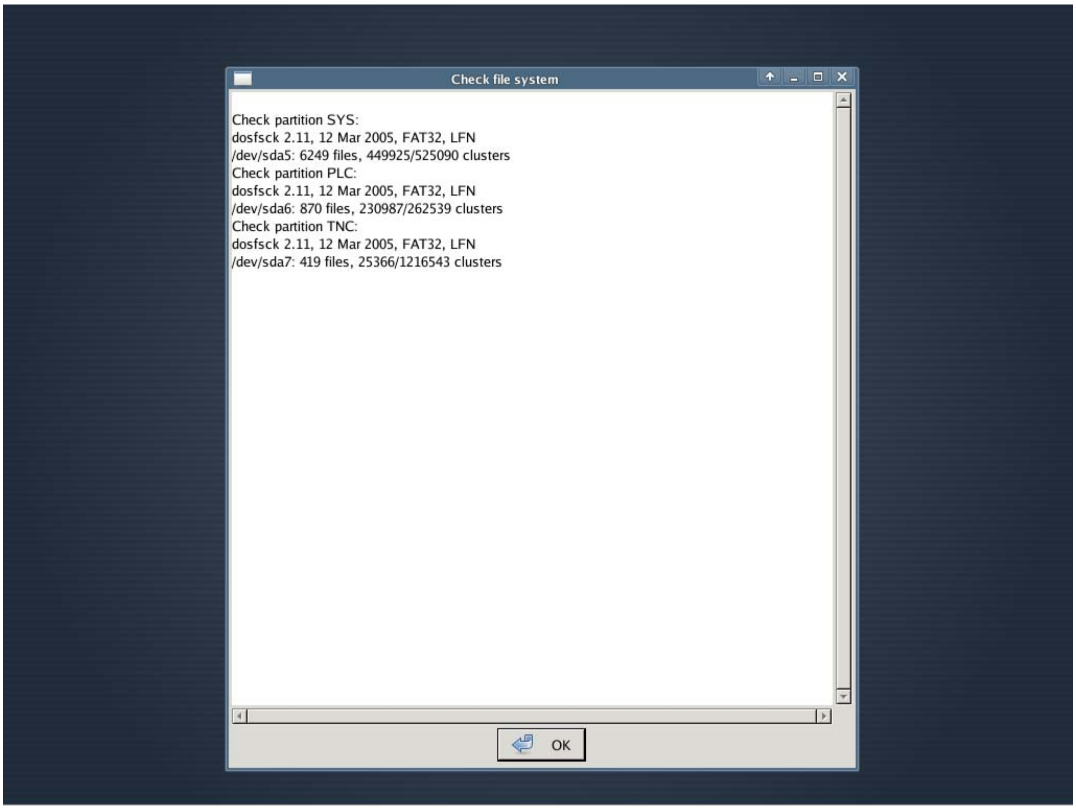


- Press the YES soft key.

> **Note**
>
> The NC software is terminated and an EMERGENCY STOP triggered, before the file system will be checked.

- Then the file systems of the SYS partition (**`hda5/sda5`**), the PLC partition (**`hda6/sda6`**) and the TNC partition (**`hda7/sda7`**) are checked and automatically repaired, if necessary.

The result is displayed and written to the log.



- Click OK or press the ENT key. --> The control restarts.
- If required, call the log. (See "Calling the log" on page 8 – 80.)

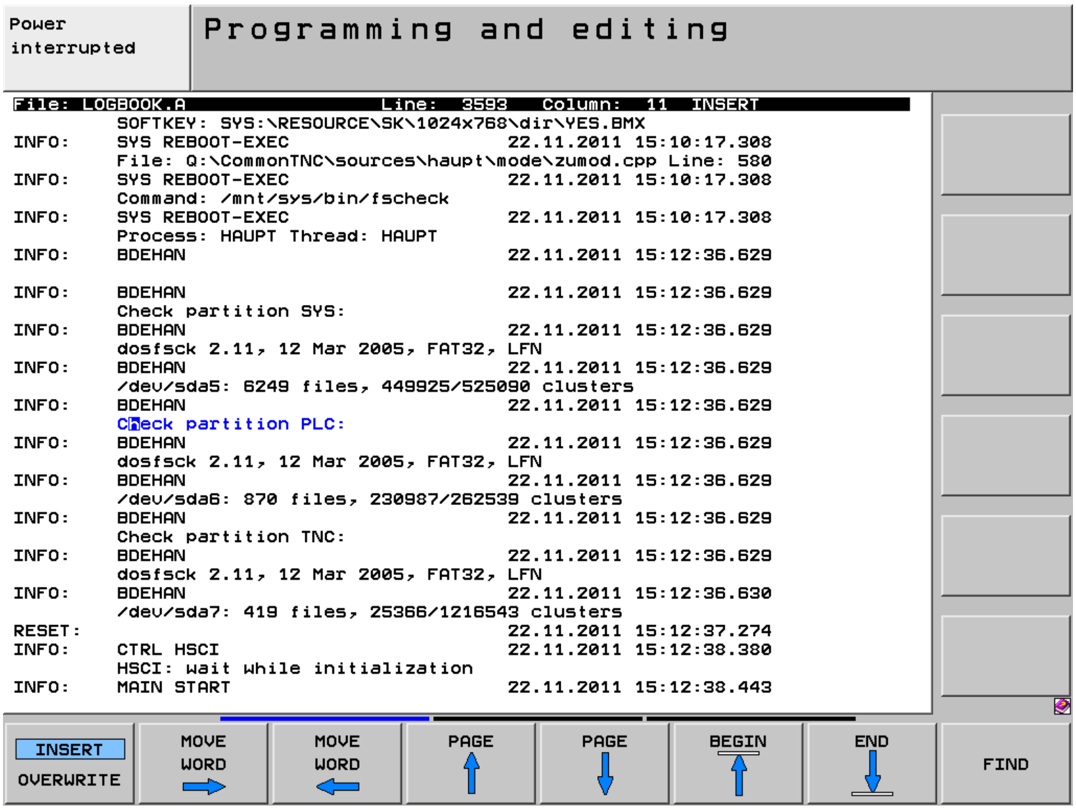


Figure: Excerpt from the log with entries after checking the file system

- If corrupted files or clusters were found, you should exchange the data medium.
--> Contact the machine tool builder or a HEIDENHAIN service agency!

Data medium test on the HeROS 5 level

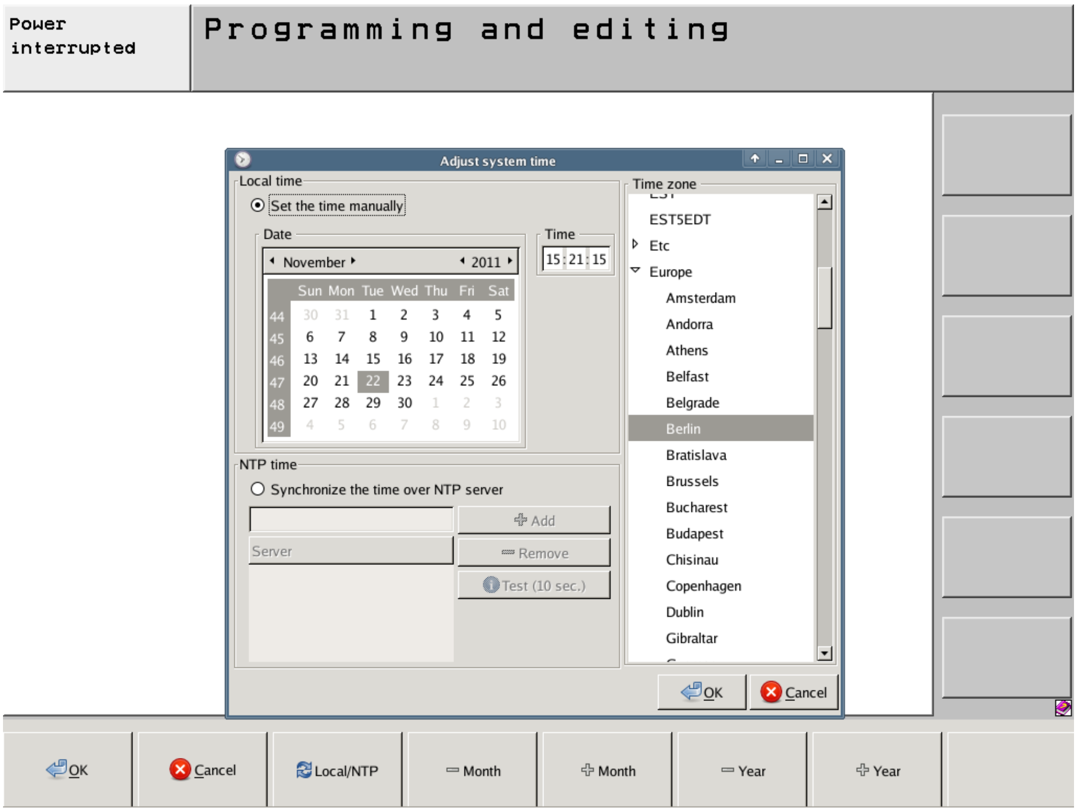
If the NC software no longer starts up completely, data medium tests can also be performed on the HeROS level (HEIDENHAIN real-time operating system).

- Contact the HEIDENHAIN helpline!

13.5 Setting the system time

- Select the **`Programming and Editing`** operating mode.
- Press the MOD key.
- Switch to the next soft-key row.

- Press the soft key. --> The following window opens:



- Choose, whether you want to make the settings by hand, or whether they should be synchronized via the NTP server.
- For manual setting:
  Use the mouse and click the correct time zone first.
  Then set date and time (**local time**).

Note

Changeover to winter / summer time is automatic.

- Then click the OK soft key. --> The new settings are loaded.

13.6 Settings in the program manager

The iTNC 530 HSCI offers several possibilities of setting the program manager.

PGM MGT setting	Advantages, e.g.
Enhanced 2	Complete mouse function, adjustable window sizes
Enhanced 1	Frequently used setting
Standard	Display as with old HEIDENHAIN controls

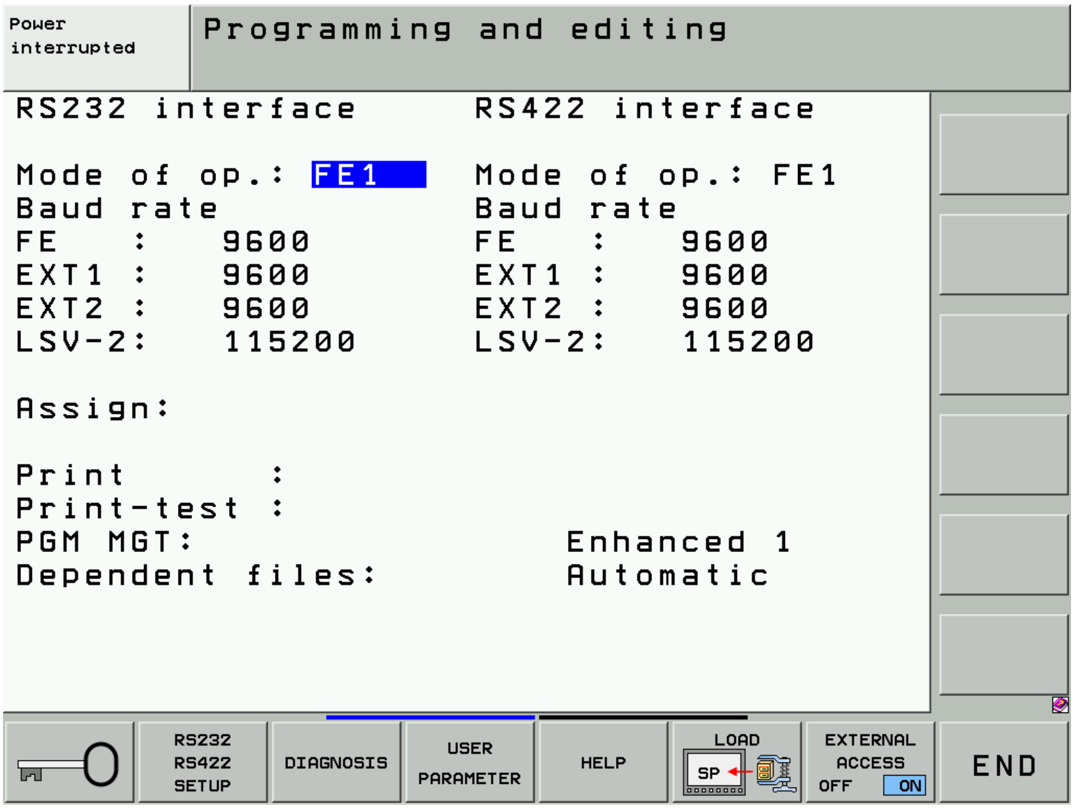
You can change these settings as follows:

▶ Select the **Programming and Editing** operating mode.
(The program manager should not be open).

▶ Call the code number window..

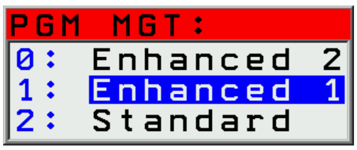
▶ Call the interface setups. Here you also find the setting for the program manager.

The following window appears:



▶ Place the cursor in the line **PGM MGT**.

▶ Press the GOTO key. --> A selection window opens.



▶ Select a setting and confirm with the ENT key.

▶ Leave the settings page with the END soft key or the END key.

Note

For the descriptions in this iTNC 530 HSCI Service Manual the program manager was set to **Enhanced 1**.

13.7 File management in the TNC partition

Calling the TNC partition

▶ Select the **`Programming and Editing`** operating mode.

▶ Call the **`Program Management`**.

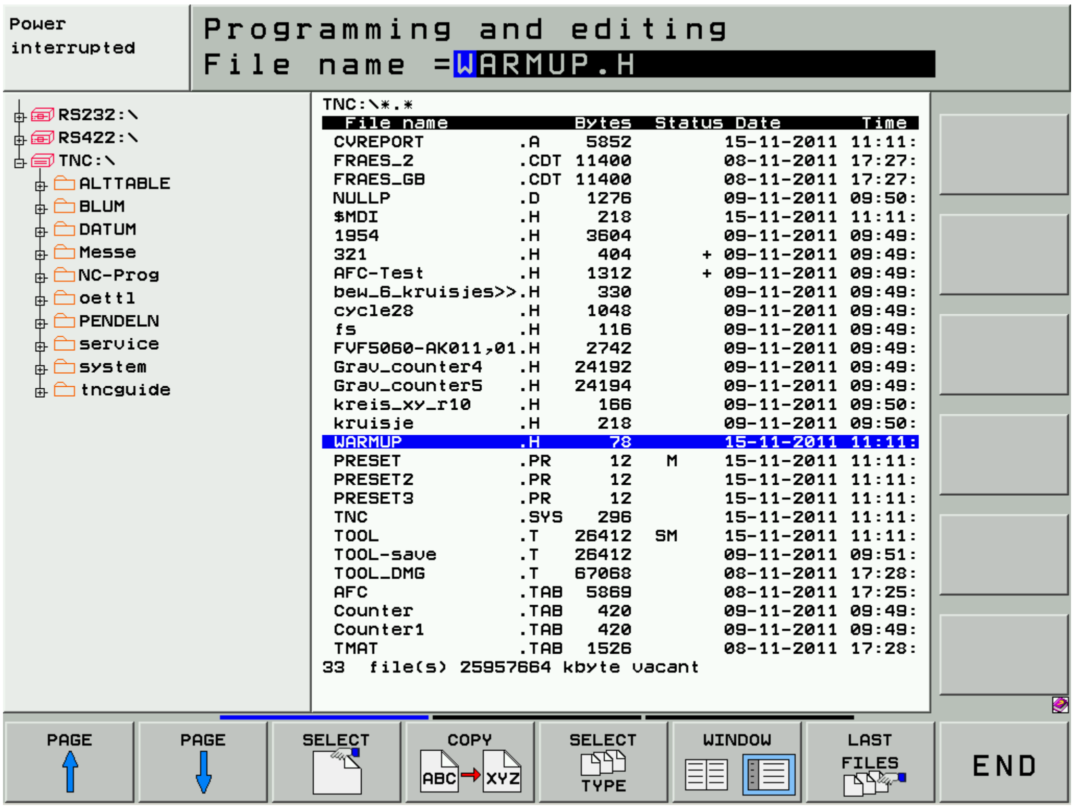


Figure: Program management of iTNC 530 HSCI

The directory structure is displayed on the left side, the associated files are listed on the right.

With the +/- key or with ENTER you can open and close subdirectories.

Select subdirectories or files by pressing the UP and DOWN arrow keys.
The selected path and file name are displayed in the header.

Use the LEFT and RIGHT arrow keys to toggle between directory field and files field.

Using the mouse

With the setting **`Enhanced 2`** for the program manager, you can also use the mouse for navigation (see "Settings in the program manager" on page 174).

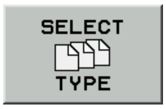
Overview of the most important TNC file types

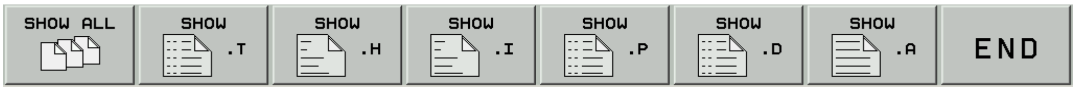
File type	File extension
NC program, HEIDENHAIN plain language	.H
Tool table	.T
NC program, DIN/ISO	.I
Pallet table	.P
Datum table	.D
ASCII file (text file)	.A
Point table	.PNT
Pocket table (tool changer)	.TCH
Preset table	.PR
Cutting-data table	.CDT
Freely definable tables (e.g., tables of tool material and workpiece material)	.TAB
Dependent data (such as structure items)	.DEP

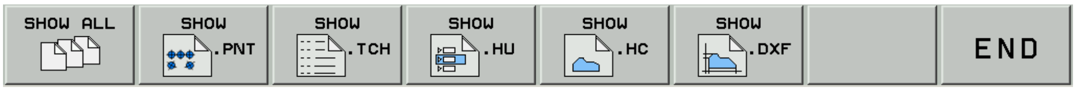
Note

If you cannot find certain files although the cursor is placed in the correct directory, a file types filter may be active.
The filter setting is displayed above the file list, for example **TNC:*.H**.
To remove this filter use the soft keys SELECT TYPE --> SHOW ALL.

Which file type is to be listed?







Use this key to switch between soft-key rows.

File information

File name	Name consists of up to 25 characters plus file extension	
Byte	File size in bytes	
Status	File properties:	
	E	The file is selected in Programming and Editing.
	S	The file is selected in Test Run (simulation).
	M	The file is selected in a Program Run mode of operation.
	P	Protected file that cannot be deleted or edited.
	+	This file has dependent files (section file, tool usage file; see User's Manual).
Date	Date on which file was last changed	
Time	Time at which the file was last changed	

Note

Refer to the iTNC 530 HSCI User’s Manual for detailed information about file management.

13.8 File management in the PLC partition

Calling the PLC partition

- Select the **`Programming and Editing`** operating mode.

- If open: Close the program management by pressing the END button.

> **Note**
>
> Pressing the MOD key while the program manager is open calls screen where you can make the interface settings.

MOD

- Call the code number window.

8 0 7 6 6 7 ENT

- Enter and confirm the code number.

- The PLC main page is displayed.

> **Note**
>
> If the dialog **`READONLY`** appears on the left side of the screen, the machine manufacturer has protected the PLC partition with his own code number. As a result, the **OEM.SYS** system file can no longer be called. All other PLC files can still be read but not edited any more.

PGM MGT

- Call the **`Program Management`**.

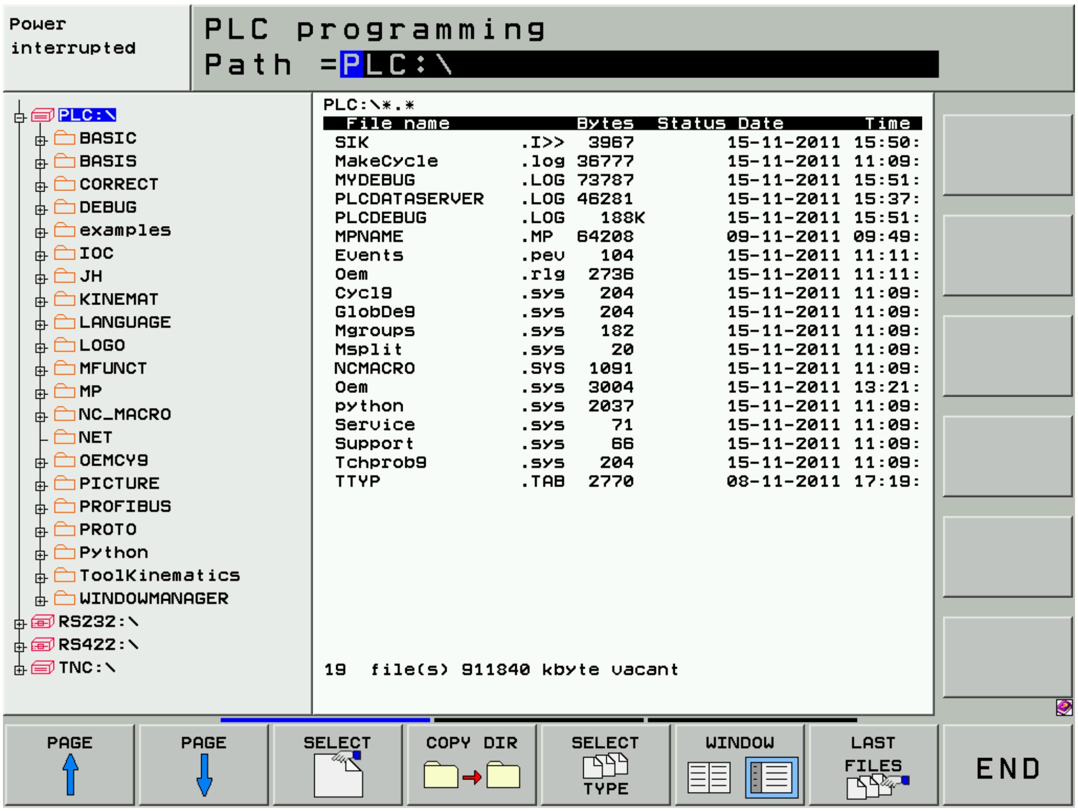
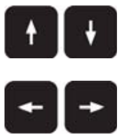


Figure: Program management of iTNC 530 HSCI

The directory structure is displayed on the left side, the associated files are listed on the right.

With the +/- key or with ENTER you can open and close subdirectories.



Select subdirectories or files by pressing the UP and DOWN arrow keys.
The selected path and file name are displayed in the header.

Use the LEFT and RIGHT arrow keys to toggle between directory field and files field.

Using the mouse

With the setting **Enhanced 2** for the program manager, you can also use the mouse for navigation (see "Settings in the program manager" on page 174).

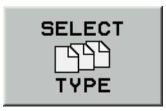
Overview of the most important PLC file types

File type	File extension
Compiled PLC programs	.PLC
ASCII files (text files, e.g., PLC dialogs and error messages)	.A
Help files	.HLP
Important system file	OEM.SYS
System files	.SYS
Compensation value tables	.COM
Compensation value assignments	.CMA
Standard PLC error messages	.PET
Source files	.SRC
Soft-key project files	.SPJ
Machine parameter lists	.MP
OEM cycles	.CYC .DES .PIC .ELE
Oscilloscope recordings	.DTA
Network settings	.N00 .M00 .P00

Note

If you cannot find certain files although the cursor is placed in the correct directory, a file types filter may be active.
The filter setting is displayed above the file list, for example **PLC:*.SRC**.
To remove this filter use the soft keys SELECT TYPE --> SHOW ALL.

Which file type is to be listed?



Use this key to switch between soft-key rows.

File information

File name	Name consists of up to 25 characters plus file extension	
Byte	File size in bytes	
Status	File properties:	
	E	The file is selected in Programming and Editing.
	S	The file is selected in Test Run (simulation).
	M	The file is selected in a Program Run mode of operation.
	P	Protected file that cannot be deleted or edited.
	+	This file has dependent files (section file, tool usage file; see User's Manual).
Date	Date on which file was last changed	
Time	Time at which the file was last changed	

Note

Refer to the iTNC 530 HSCI User's Manual for detailed information about file management.

14 Data backup

14.1 Introduction

Backup recommended

For servicing it is advised that you back up certain control data!

You should always **back up the original machine parameters** before you make any **changes to the settings of the machine**. This can be done on the HDR or SSDR of the iTNC 530 HSCI without having to transfer data to an external medium.
--> See "Creating a copy of the original MP file" on page 31 – 574.

Moreover, all **PLC data**, i.e. the specific machine data determined by the machine manufacturer, are of priority interest for service technicians.

Note

The **machine data for the factory default condition** of the machine tool are often enclosed with the machine (e.g. on CD-ROM, DVD, USB flash drive) or can be obtained from the machine tool builder.

Backup required

Attention

If **permanent changes were made to the machine** (e.g., NC software update, modifications, etc.) that result in changes or adaptations of the machine data (machine parameters, PLC program, etc.), **a new backup must be created for this machine**!

Available data interfaces

Data interface	Connectors
Ethernet	X26 and X116
RS-232-C (V.24)	X27
USB (Universal Serial Bus)	X141 and X142

Note

For creating backups with TNCremoNT, the use of the Ethernet interface is advisable.
It is always integrated in the iTNC 530 HSCI and is the fastest way to transfer data.

Note

With a USB flash drive, one or more files and directories can be read in and out quickly and without much effort.

Windows knowledge

Depending on the Windows system of your laptop/PC, the proceedings for requesting and setting the Ethernet configuration may be slightly different.
The following description contains examples of Windows XP.
Windows knowledge is required! If necessary, ask your system administrator.

Permissions

To **access the network settings** on your laptop/PC and on the control, you require the **appropriate access rights** (passwords, code numbers, etc.)
If required, contact your system administrator or the machine tool builder!

TNCremoNT data transfer software

For data transfer and data backup the HEIDENHAIN data transfer software **TNCremoNT** as of version 2.7 is used in this description.

You can download the **current version of TNCremoNT** from the **HEIDENHAIN website** (www.heidenhain.de) and install it on your laptop or stationary computer.

Note

Please use the most recent version of TNCremoNT.

Note

The **TNCremoNT** program includes detailed operating descriptions including a table of contents in **Menu/Help**.

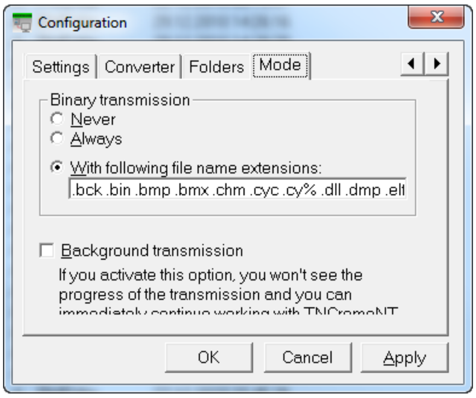
BINARY-to-ASCII conversion

Some files (e.g., NC programs) on the data medium (HDR, SSDR) of the control are saved in BINARY format.

Important advantages of this data format are the relatively fast access and the relatively low memory requirements.

If the setting of the HEIDENHAIN data transfer software TNCremoNT is correct, data read from the control to an external data medium (e.g. a laptop or a PC) is automatically converted from BINARY into ASCII format.
When data is transferred from an external medium to the control, it is converted from ASCII format into BINARY format.

The figure shows the correct setting in the TNCremoNT configuration:



Note

The data of an iTNC 530 HSCI are archived externally in the defined ASCII format as the BINARY format on the control may be changed, e.g., after an NC software update.

Protection from unauthorized access

The machine manufacturer may have activated the soft key below on the iTNC 530 HSCI.
Before data are read from or written to the control, such an action must be approved.

- Press the MOD key and subsequently the soft key EXTERNAL ACCESS ON/OFF.
  --> Access must be permitted!

Note

Like internal access (at the control), the machine manufacturer may have locked **external access** (via laptop/PC) to partitions on the control's data medium disk (e.g., PLC partition) **with passwords**.
If necessary, ask the machine manufacturer!

14.2 Connection setup

14.2.1 Via Ethernet

Requirements

- A laptop/PC with an **Ethernet card**
- Either an **Ethernet crossover cable** for direct connection of laptop and control **(peer-to-peer connection)** or a non-transposed Ethernet cable (patch cable) for connection via your local network (Intranet).

> Note
>
> Mark your cable as "transposed" or "non-transposed"!

> Note
>
> On modern laptops the Ethernet interface is set automatically.
> Here, it is of no importance, whether the connected Ethernet cable is transposed or non-transposed.

Management of the Ethernet interface on the iTNC 530 HSCI

The Ethernet interface is managed by the HeROS HEIDENHAIN operating system. The settings of the Ethernet interface can be requested via the **code number NET123**.

Connection via your local network

Ask your system administrator!

Connection setup at the customer's (service call)

It is advisable to set up a direct connection between your laptop and the control (peer-to-peer).

- Ask your customer whether you may disconnect the control from his in-house network for the duration of your work.
- Connect your laptop directly to the control by means of an Ethernet crossover cable.

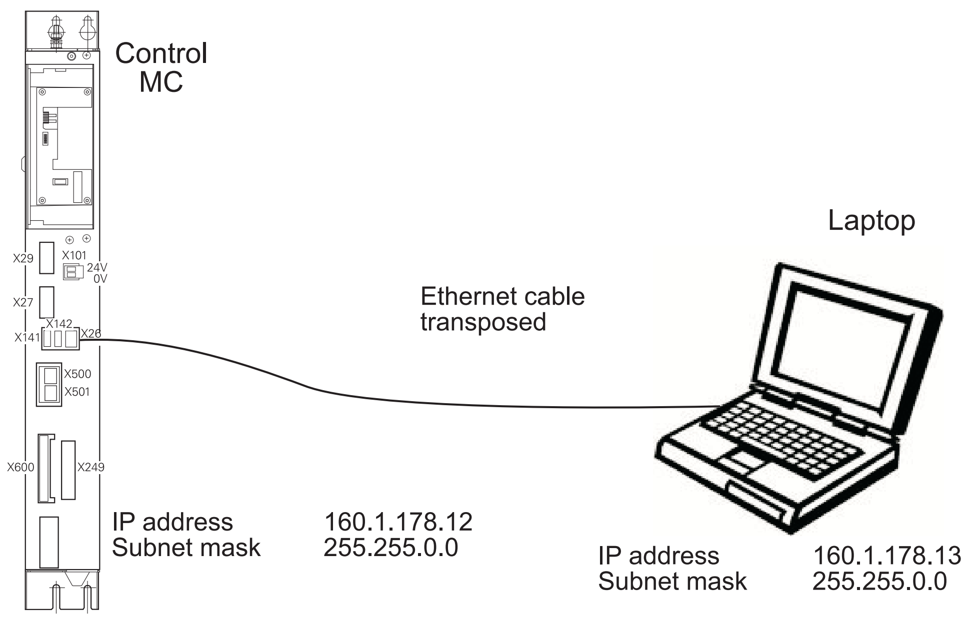


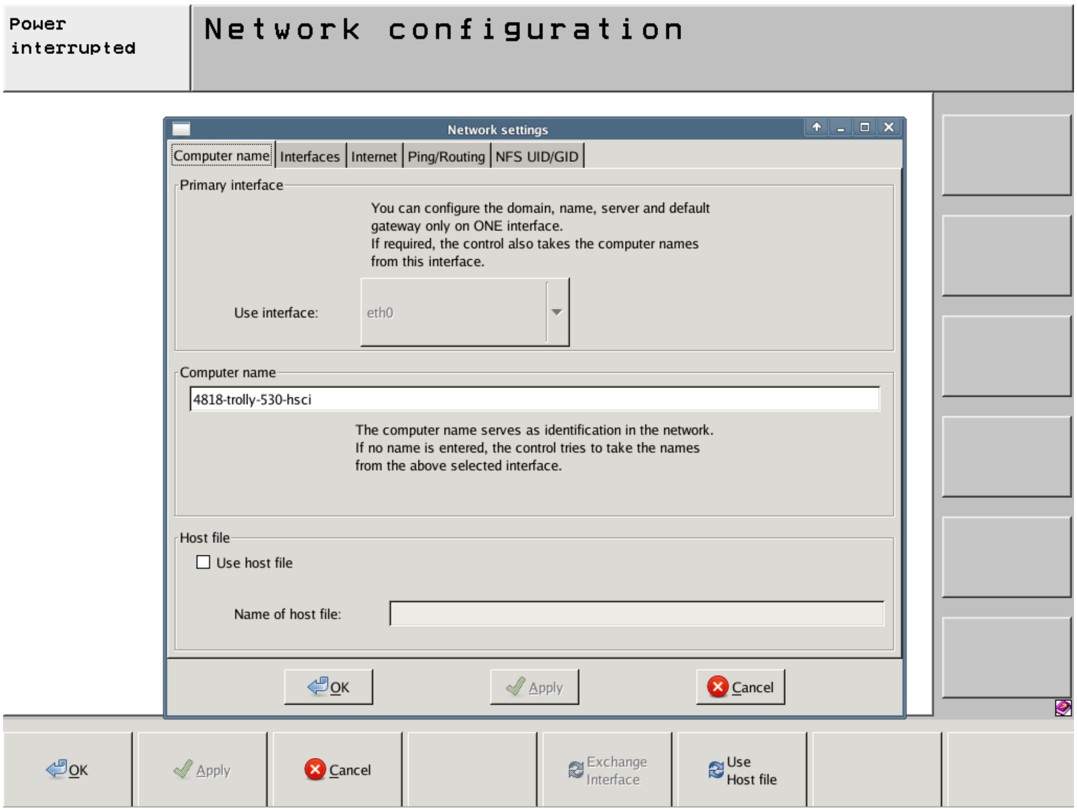
Figure: Example of a peer-to-peer connection

- Now either adapt the **IP address and** the **subnet mask** of your laptop to the IP address and the subnet mask of the iTNC 530 HSCI , or vice versa.

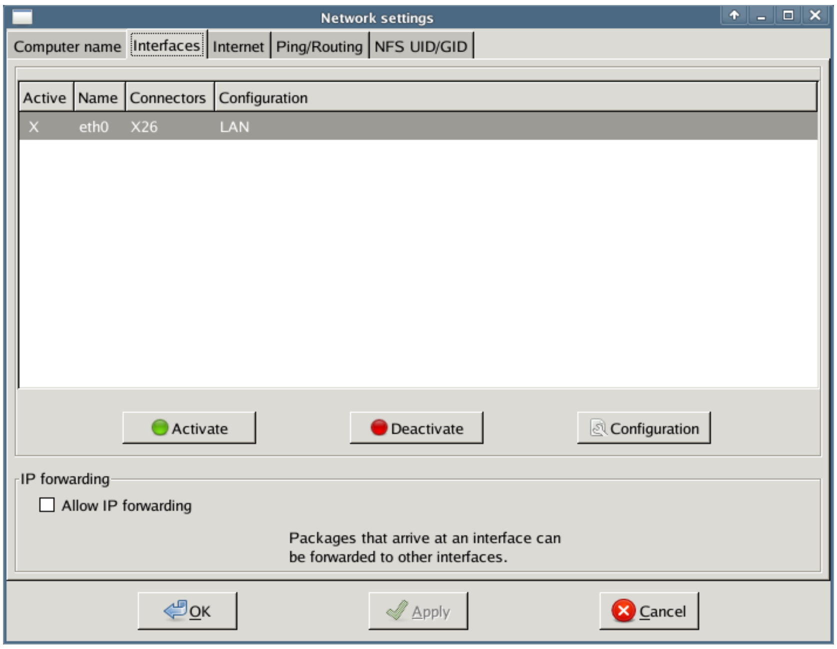
On the following pages you will find the descriptions for requesting and adapting the Ethernet settings.

Requesting Ethernet settings on the control

- Enter the code number NET123.
- Press the DEFINE NET soft key. --> The window **Network Settings** opens:

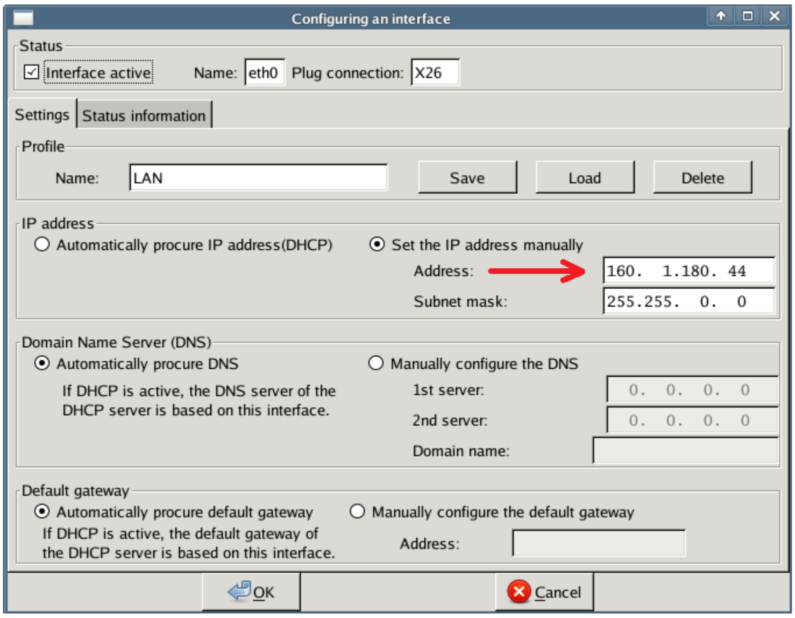


- Click the **Interfaces** tab.

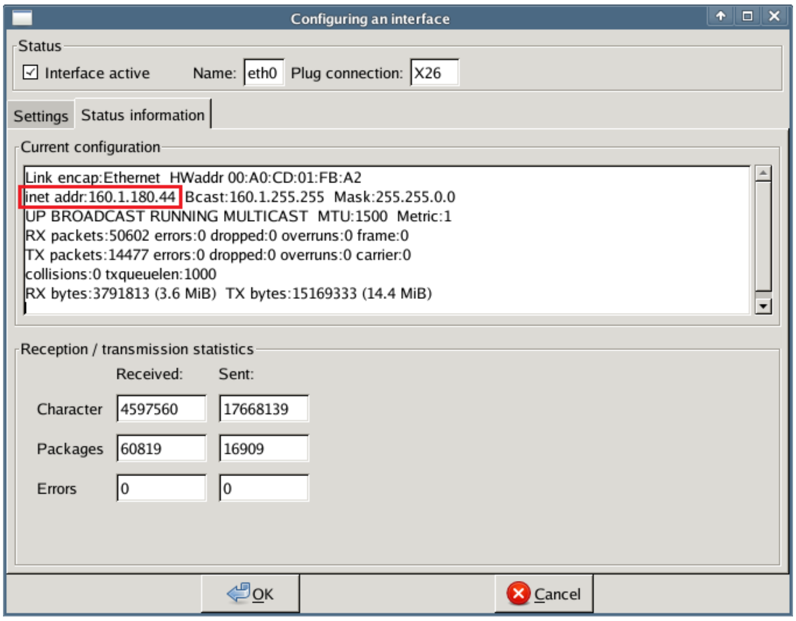


- Click the line of connector X26.
- Click the **Configuration** button.

▷ If the IP address is fixed, you can read it here:

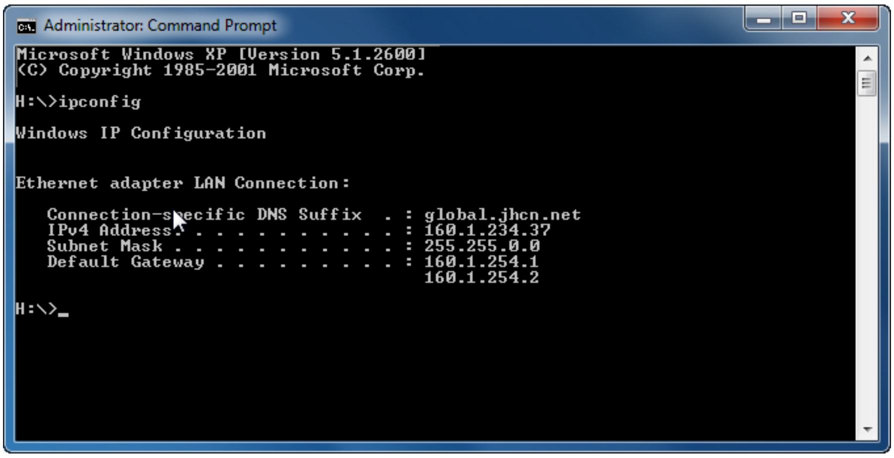


▷ If the IP address is generated automatically, click the **Status Information** tab. You can read the IP address of the control in the line **inet addr**.



Requesting Ethernet settings of the laptop

▶ In the command prompt enter, e.g. the **ipconfig** command:



Note

You can also find this information in My Computer \ Control Panel \ Network ...

Adjusting Ethernet settings on the laptop

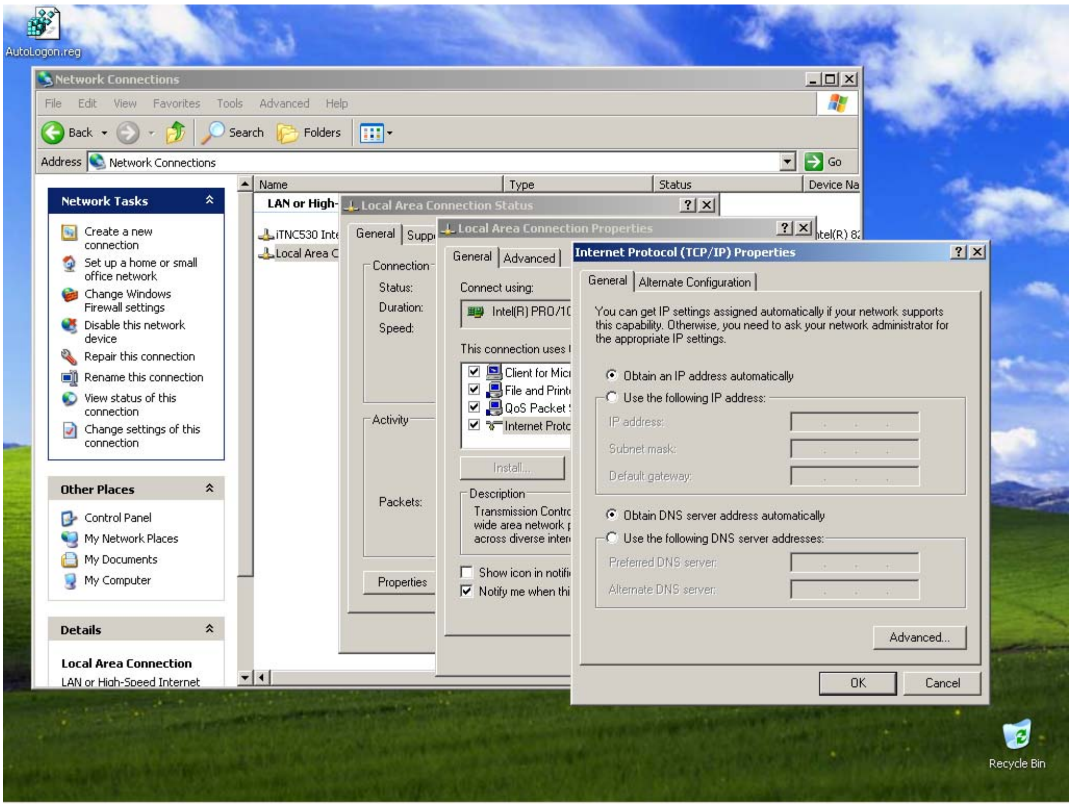
If you want to adapt your laptop to the iTNC 530 HSCI:

▶ First, write down the Ethernet settings of the control. (See "Requesting Ethernet settings on the control" on page 14 – 184.)

▶ On your laptop, click on My computer --> Control Panel --> Network (or Network and Communication, or similar) --> LAN connection.

▶ Call the properties of the **TCP/IP protocol** of the Ethernet card of your laptop. (For this purpose you may have to read the Windows Help or ask your system administrator.)

In the following **example of Windows XP** the characteristics of the TCP/IP protocol are stored in LAN connection --> Properties --> Internet protocol (TCP/IP) --> Properties:



Note

On laptops with Windows XP or Windows 7 you can also click the "Alternate configuration" tab and set a fixed IP address there.
Remember:
The laptop first tries to connect to the control using the "General configuration (DHCP may be configured there). This may take several minutes. The "Alternate configuration" is only used after a timeout.

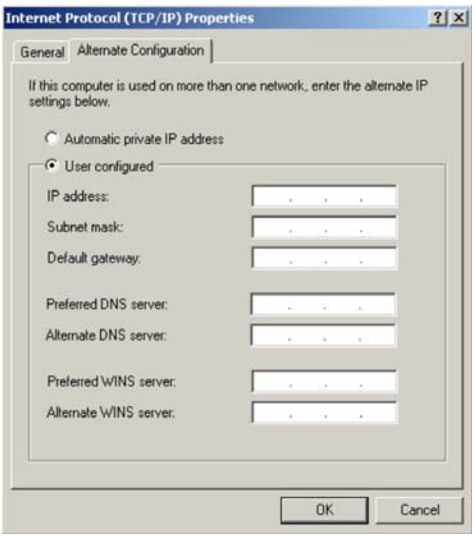


Figure: "Internet Protocol (TCP/IP) Properties, Alternate Configuration"

Attention

Write down the original settings of "General" or "Alternate Configuration" which you are going to overwrite and will have to restore later!

To make the following changes, you require the relevant permissions. If necessary, contact your system administrator.

- The IP address must not be generated automatically.
  (DHCP = Dynamic Host Configuration Protocol)
  You require a fixed IP address. --> Define this accordingly!
- Enter an appropriate IP address.

Note

We recommend using the IP address of the iTNC 530 HSCI and increasing the last place by one.

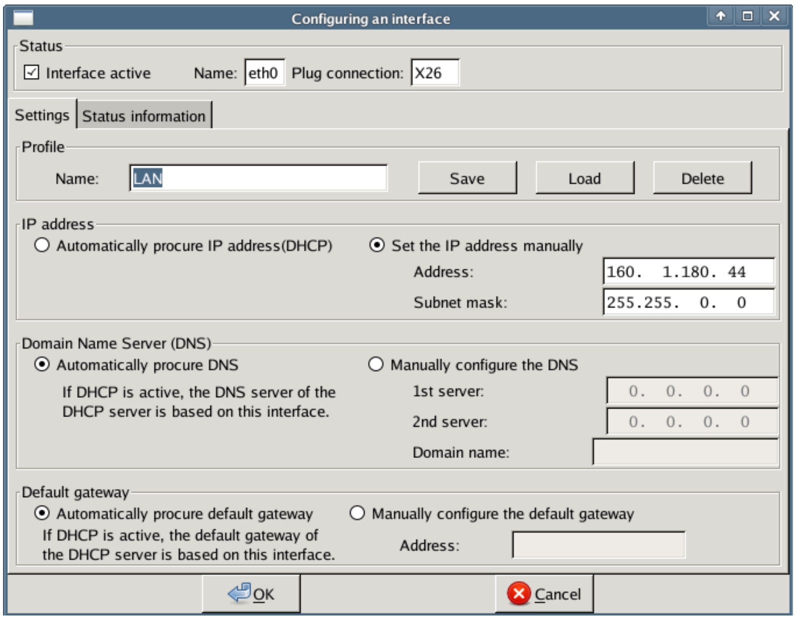
Example:
Address of the iTNC 530 HSCI: 160.1.180.5
Address of the laptop: 160.1.180.6

- The subnet mask of your laptop must be identical with that of the iTNC 530 HSCI.
  Enter this accordingly (the standard gateway is of no significance here).
- Confirm the settings with OK.

Adjusting Ethernet settings on the control

If you want to adapt the iTNC 530 HSCI to your laptop:

- Write down the IP address and subnet mask of your laptop.
  (See "Requesting Ethernet settings of the laptop" on page 14 – 186.)
- Enter the code number NET123.
- Press the DEFINE NET soft key. --> The window **Network Settings** opens.
- Click the **Interfaces** button.
- Click the line of connector X26.
- Click the **Configure** button. --> A new window opens:



- If the IP address is fixed:
  Write down the original settings of IP address and subnet mask.
- If the IP address is procured automatically:
  Click "Set the IP address manually":
- Enter an appropriate IP address.

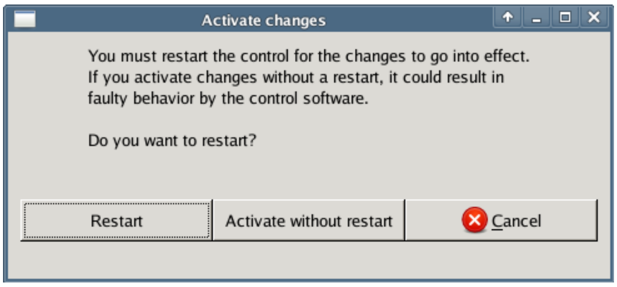
Note

We recommend using the IP address of the laptop and increasing the last place by one.

Example:

Address of the laptop:	160.1.11.227
Address of the iTNC 530 HSCI:	160.1.11.228

- Enter the same subnet mask as that of your laptop.
- Confirm by clicking **OK** in the window **Configuring an interface**.
- In the window **Network settings** also click **OK**.
- In the window **Activate changes** click **Restart**.



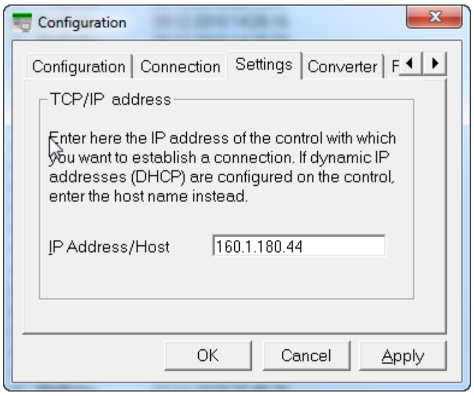
- The control reboots, the new settings are active.

TNCremoNT

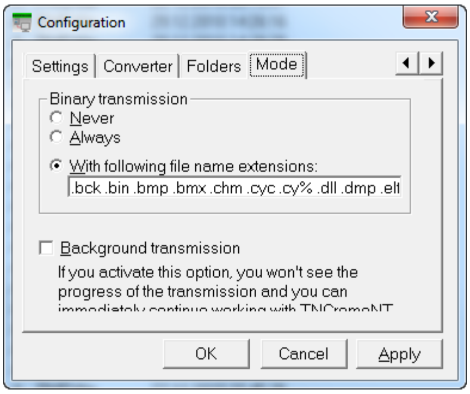
- Start the HEIDENHAIN data transfer program TNCremoNT.

- Click this icon to open the configuration window.
  (Can also be called via **Extras / Configuration ...** .)

- Now click on **Connection** and select **Ethernet (TCP/IP)**.
- Subsequently, click on **Settings** and enter the IP address of the control.



- Check the data transfer mode (BINARY-to-ASCII conversion). It should be set as follows:



- Confirm with **Apply** and **OK**.

- Click this icon. --> The connection is set up.

- The TNCremoNT screen is split and the data medium of the control shown in the lower half of the screen.

Note

If this does not work, check the connecting cable and the settings.
You can also try, whether pinging works --> see next pages!

Note

If the following error message is displayed when the connection is set up, ...

... external access to the data medium of the control is not permitted!

In this case press the MOD key and subsequently the EXTERNAL ACCESS ON/OFF soft key in order to permit access.

"Pinging"

If no TNCremoNT connection is established, you can check by pinging, whether the ...

- Ethernet card in the laptop
- Ethernet card in the control
- connection of both cards via Ethernet

... function properly.

"Ping-loopback-test" on the laptop (test of the Ethernet card of the laptop):

- In the prompt enter the **`ping`** command followed a blank and the IP address of the Ethernet card of the laptop (e.g. ping 160.1.178.23).
- Confirm with ENTER . --> If the Ethernet card functions, it will respond!
  If the Ethernet card does not function, a timeout message is displayed.

"Ping-loopback-test" on the control (test of the Ethernet card of the control):

- Enter the code number NET123.
- Press the DEFINE NET soft key. --> The window **`Network Settings`** opens.
- Click the **`Ping/Routing`** tab.
- Enter the IP address of the iTNC.
- Click START. --> If the Ethernet card functions, it will respond.

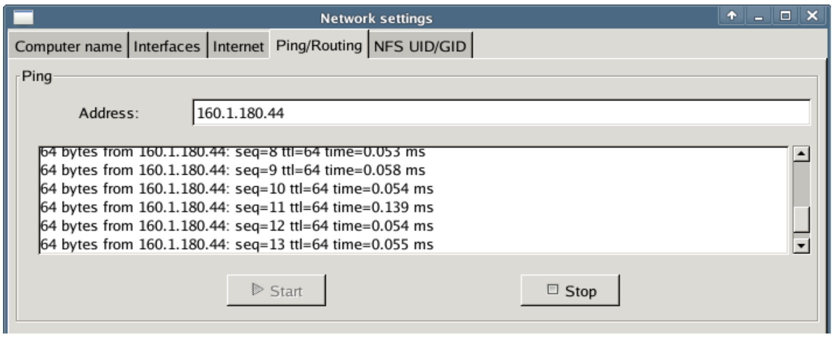


Figure: "Ping-loopback test" at the control successful

Pinging from the laptop to the control (test of the connection):

- In the prompt enter the **`ping`** command followed by a blank and the IP address of the control.
- Press ENTER to confirm. --> If the connection works, the control will respond.
  If the connection does not work, a timeout message is displayed.

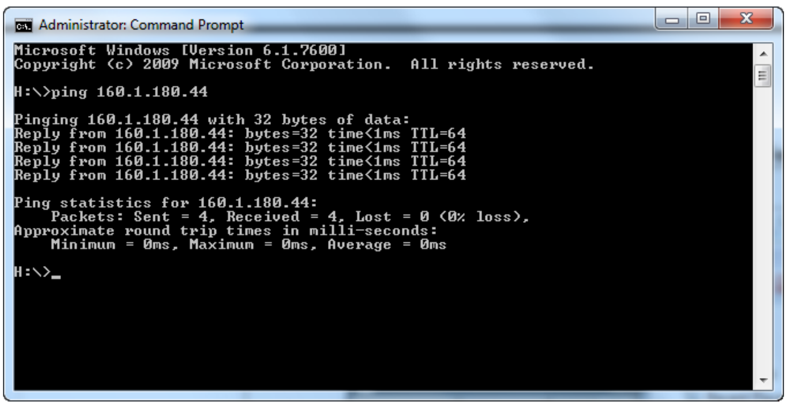


Figure: Pinging from the laptop to the control successful

Pinging from the control to the laptop (test of the connection):

- Enter the code number NET123.
- Press the DEFINE NET soft key. --> The window **`Network Settings`** opens.
- Click the **`Ping/Routing`** tab.
- Enter the IP address of the laptop.
- Click START. --> If the connection works, the laptop will respond.

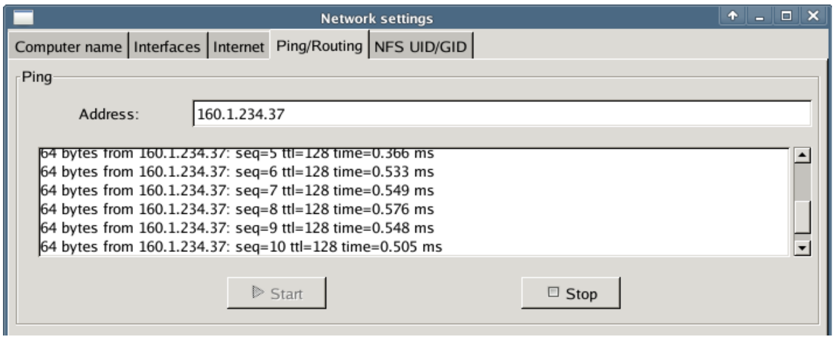


Figure: Pinging from the control to the laptop successful

> Note
>
> If pinging does not function, check all settings and the hardware (Ethernet cables, Ethernet cards) once again.
> If pinging from control to laptop does not work, an **active firewall** on the laptop may be the reason.

Meaning of the LEDs on the Ethernet data interface X26:

LED	Condition	Meaning
Green	Blinking	Interface active
	Off	Interface inactive
Yellow	On	100 Mb network
	Off	10 Mb network

Restoring the original settings

After having finished data back-up, etc. and separated the connection, do not forget to reactivate the original network settings of your laptop or of the iTNC 530 HSCI.

14.2.2 Via RS-232-C/V.24 serial interface

Requirements

- A laptop/PC with an **RS -232-C** interface or a **USB interface** (for connection of a USB/RS -232-C adapter)
- A **transposed serial data transfer cable** ("null-modem cable") for the connection of laptop and **D-sub connector on the electrical cabinet** or **on the console** (HEIDENHAIN adapter block). Possible configurations, also for direct connection of the laptop to the iTNC 530 HSCI --> See "Cable overview" on page 14 – 209.
- An **opto bridge"**

> Note
>
> Do not use self-made cables (shielding problems, contact problems, short circuits, etc.).
> Mark your cable as "transposed" or "non-transposed"!

> Attention
>
> HEIDENHAIN recommends using an "Opto Bridge".
> This serial adapter connector ensures metallic isolation via optocouplers and can thus protect the serial interface against overvoltage, different load potentials and interference voltages on the ground lines.
> "Opto bridges" are available in specialized computer stores.
> Please note:
> If the machine manufacturer has already mounted an opto bridge, a further opto bridge will not function, as such components must be powered from both sides!

Connection setup

- Connect your laptop to the RS-232-C adapter connector on the electrical cabinet or on the console with a transposed serial data transfer cable (and possibly an opto bridge).

> Note
>
> Usually, the machine tool builder mounts the HEIDENHAIN adapter connector for RS-232-C to one of the walls of the electrical cabinet or in the console.
> If this is not the case, note that mostly you must use a different data transfer cable for direct connection of the iTNC 530 HSCI . --> See "Cable overview" on page 14 – 209.

- Now configure the serial interface on the iTNC 530 HSCI.

Configuring the serial interface on the iTNC

- Call --> See "Operating modes of the data interfaces" on page 14 – 213
- Select a baud rate for the LSV/2 protocol.
  You can select the highest possible baud rate. Should there be any transmission problems, you can revert to lower baud rates.

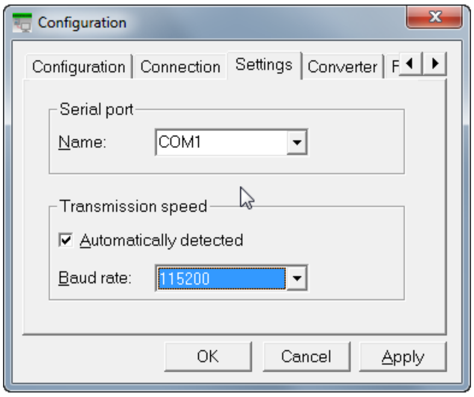
> Note
>
> The iTNC 530 HSCI automatically recognizes when the LSV-2 protocol is used (e.g., data transfer with TNCremoNT).
> No setting is required in the line `Operating mode`.

TNCremoNT

- Start the HEIDENHAIN data transfer program TNCremoNT.

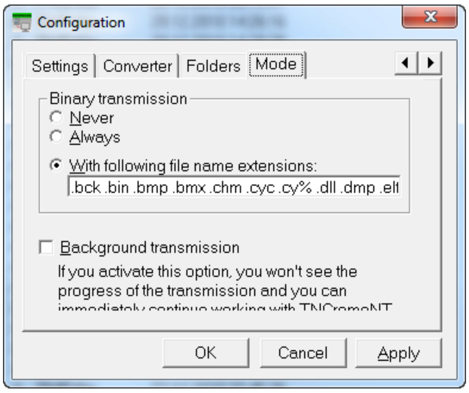
- Click this icon to open the configuration window.
  (Can also be called via **`Extras / Configuration ...`** .)

- Click on **`Connection`** and select **`serial connection (LSV-2).`**
- Then click on **`Settings`** and select the serial interface (e.g. COM1).
- Activate automatic detection of the data transfer rate on connection setup. --> The baud rate you have set on iTNC 530 HSCI is activated.



> **Note**
>
> If you use a USB/RS -232-C adapter, automatic detection of the baud rate should not be active. In this event set the transfer rate at the control and at the laptop to the same value.

- Check the data transfer mode (BINARY-to-ASCII conversion). It should be set as follows:



- Confirm with **`Apply`** and **`OK`**.

- Click this icon. --> The connection is set up.

- The TNCremoNT screen is split and the data medium of the control shown in the lower half of the screen.

> **Note**
>
> If this does not work, check the connecting cable and the settings.

Note

If the following error message is displayed when the connection is set up, …

... external access to the data medium of the control is not permitted!

In this case press the MOD key and subsequently the EXTERNAL ACCESS ON/OFF soft key in order to permit access.

14.2.3 Via USB

Requirements

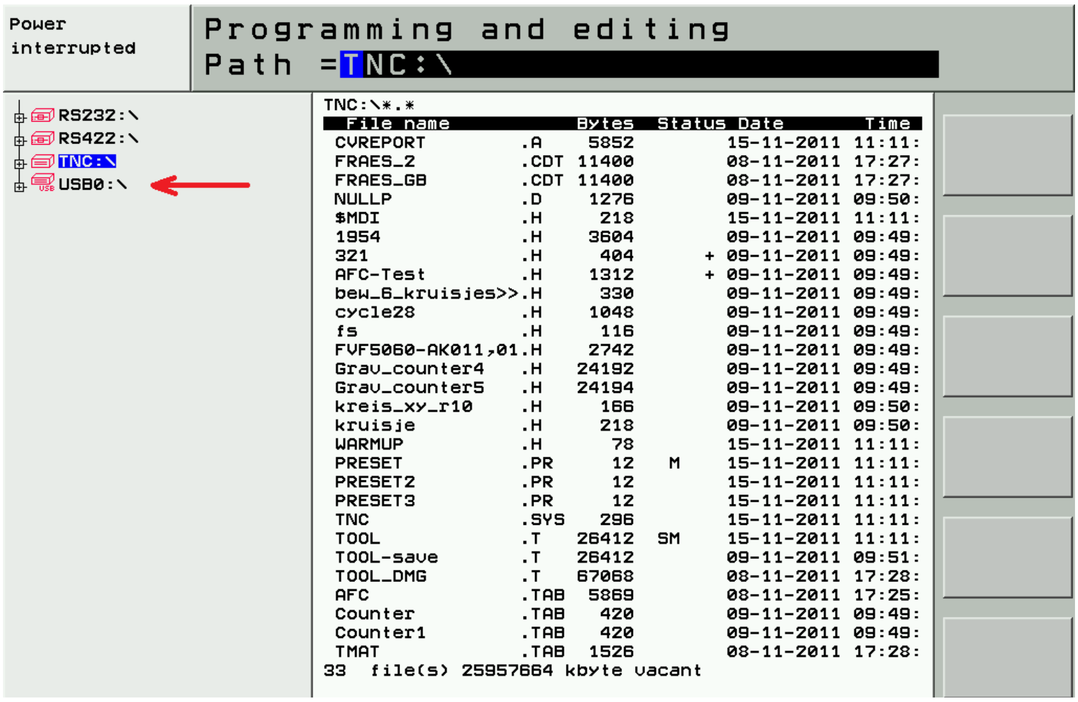
A **USB device** (e.g. USB flash drive) with the following properties:

- USB 2.0
- FAT or VFAT file system or as per ISO 9660
- Current consumption below 0.5 A (otherwise a separate power supply is required)
- USB cable, max. 6 m (for longer cables amplifiers must be used)

> **Note**
>
> iTNC 530 HSCI identifies standard USB flash drives.
> HEIDENHAIN cannot guarantee that all USB flash drives available on the market work with the iTNC 530 HSCI.

Connecting the USB flash drive

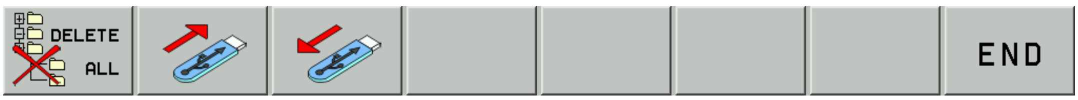
- Call the **Programming and editing** mode of operation and press the PGMMGT key.
- Connect the USB flash drive to the control or to the monitor. --> The USB device is added to the directory tree:



Disconnecting the USB flash drive

You are in the program management.

- In the directory tree, place the cursor on the USB device.
- Switch the soft-key row until you see the MORE FUNCTIONS soft key.
- Press this soft key. --> Now you see the soft keys with the "USB flash drive" symbols:



- Press the soft key with the symbol "Remove USB flash drive". --> The USB device is deleted from the directory tree.
- Remove the USB flash drive.

> **Attention**
>
> If you remove the USB flash drive without having pressed the "Remove USB flash drive" soft key before, you may loose data on the drive!

14.3 Reading in and out individual files and directories

There are several possibilities of reading in and downloading files and directories:

- Connection of a USB device; transfer using the split screen concept in the program management
- Transfer with TNCremoNT
- Transfer using TNCserver

> **Note**
>
> Information on setting data interfaces and transferring data (e.g., **TNCserver** operation) can be found in the User's Manual for the iTNC 530 HSCI.

Connection setup

- Connect a USB flash drive. --> See "Connection setup" on page 14 – 183.
  Or ...

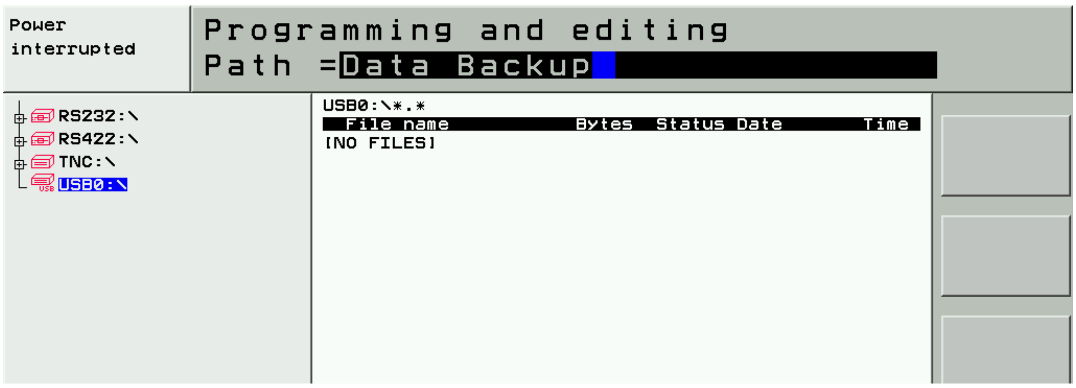
- Establish the connection between the control and the laptop using TNCremoNT.
  --> See "Connection setup" on page 14 – 183.

Transferring data to the USB flash drive

> **Note**
>
> To change to the PLC partition you must have entered the PLC code number before.

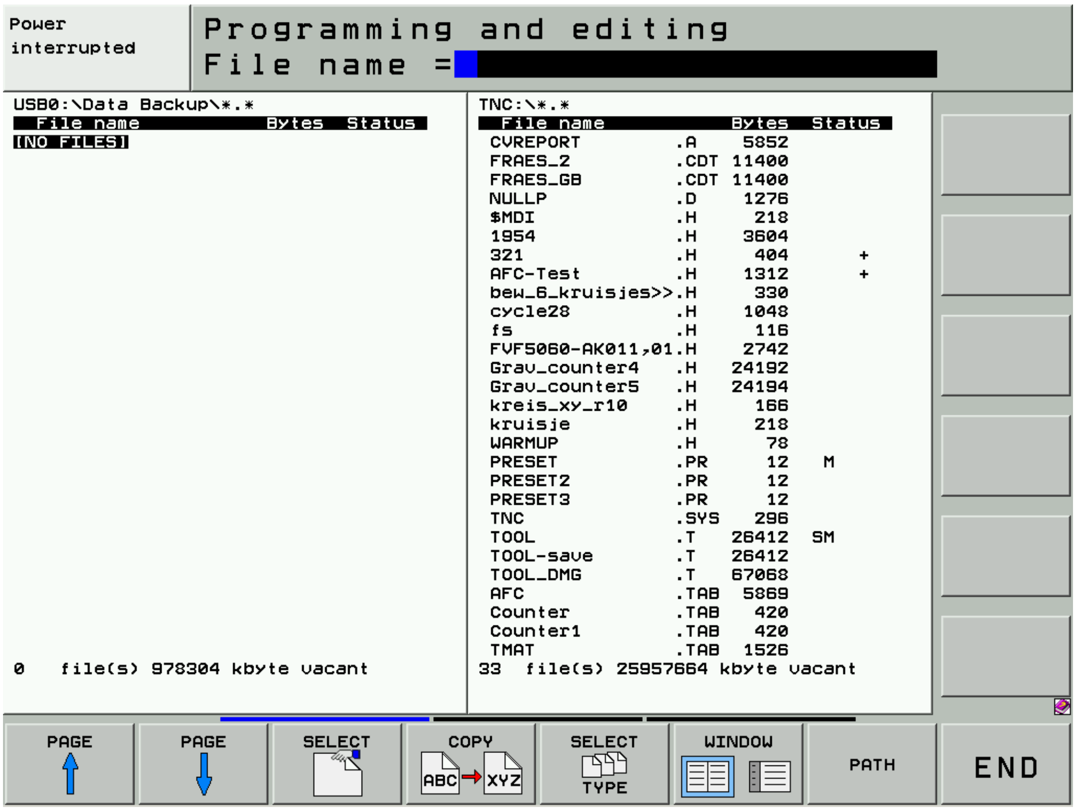
> **Note**
>
> In the following description the program manager is set to **Enhanced 1** mode.
> --> See "Settings in the program manager" on page 13 – 174.

- Switch to the **Programming and Editing** operating mode (for TNC data) or to **PLC programming** (for PLC data) and press the PGMMGT key.
- Place the cursor on the **USB0:** directory.
- If required, you can create a new directory (e.g. data backup) on the flash drive. Enter the name of the new directory.



- Conclude your entry with the ENT key and the YES soft key.

- Place the cursor on the new directory.
- Press the WINDOW soft key (you may have to switch to the next soft-key row).
  --> The display changes to split screen:



- Place the cursor in the right half on the directory, subdirectory or file you wish to transfer.

Note

Press the soft keys PATH and FILES to activate the respective view.

- Press the soft key COPY DIR. or COPY ABC -> XYZ.

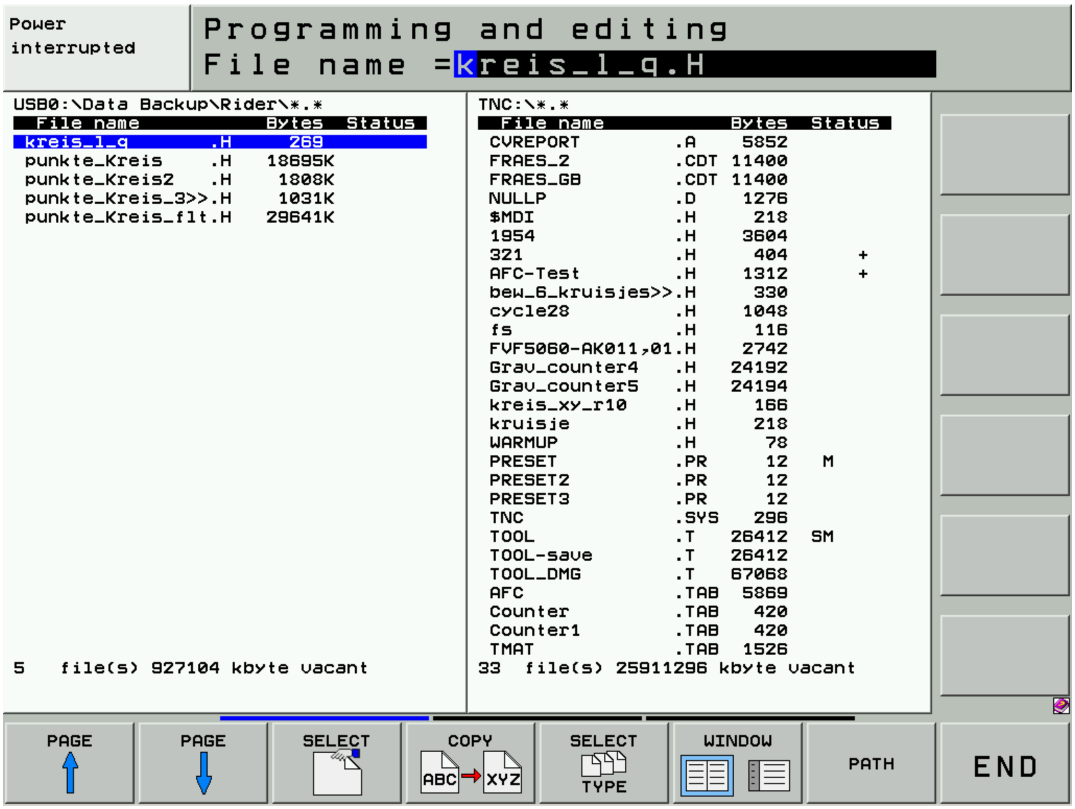
- Press the EXECUTE soft key and confirm further interrogations. --> The directory with the entire contents or the individual file is transferred to the USB flash drive.
- Press the WINDOW soft key (you may have to switch to next soft-key row). --> The split screen display is closed.
- Place the cursor on the USB device and check, whether the data was transferred correctly.
- Press the soft key "Remove USB flash drive" before removing it. --> See "Disconnecting the USB flash drive" on page 14 – 195.

Transferring data from the USB flash drive

> Note
>
> To change to the PLC partition you must have entered the PLC code number before.

> Note
>
> In the following description the program manager is set to **Enhanced 1** mode.
> --> See "Settings in the program manager" on page 13 – 174.

- Switch to the **Programming and Editing** operating mode (for TNC data) or to **PLC programming** (for PLC data) and press the PGMMGT key.
- Place the cursor on the **USB0:** directory (or on the subdirectory from which you wish to take the data).
- Press the WINDOW soft key (you may have to switch to next soft-key row). --> The display changes to split screen:

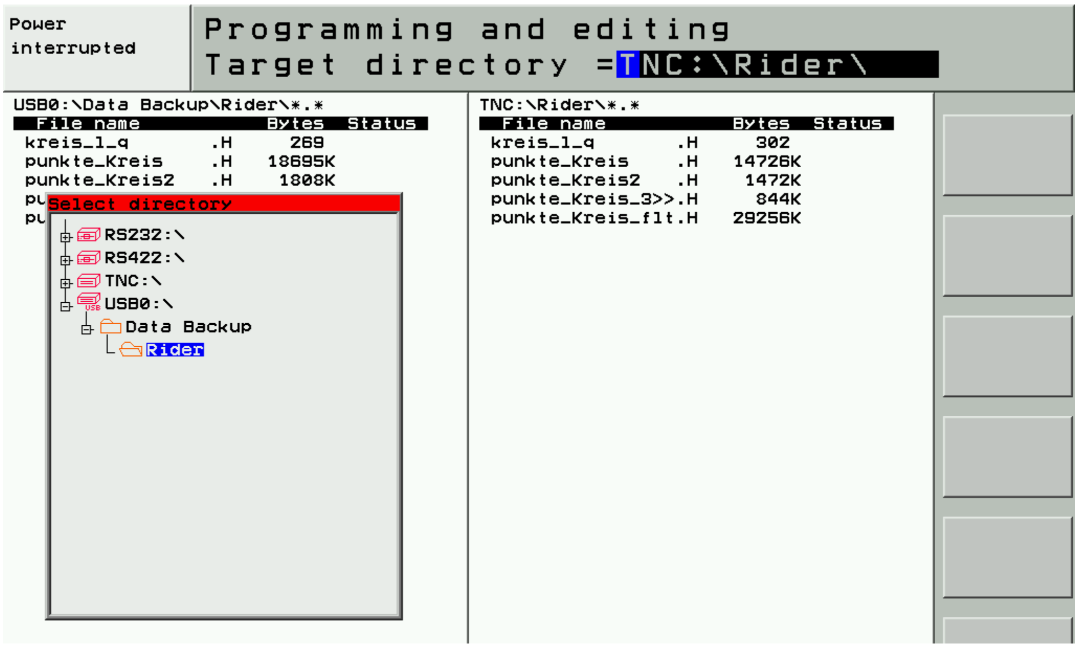


- Place the cursor in the right half on the directory or subdirectory to which you wish to transfer the data.

> Note
>
> Press the soft keys PATH and FILES to activate the respective view.

- Return to the other side now.
- Select a file or a directory.

▶ Press the soft key COPY DIR. or COPY ABC -> XYZ.



▶ Press the EXECUTE soft key and confirm further prompts. --> The directory with its entire contents or the individual file is transferred from the USB flash drive to the control.

▶ Press the WINDOW soft key (you may have to switch to next soft-key row). --> The split screen display is closed.

▶ Place the cursor on the USB device.

▶ Press the soft key "Remove USB flash drive" before removing it. --> See "Disconnecting the USB flash drive" on page 14 – 195.

Reading out data using TNCremoNT

Select the **target drive** and the **target directory** from the **upper half of the screen display** (contents of laptop/PC).

▶ Click the bar with the drive information. --> Its color changes, and two buttons appear at the right side in the bar.

▶ Click the `Change folder/drive...` button. --> A new window opens.

▶ Select the drive and the folder. --> The path is displayed in the bar.

Note

For the data to be read out, you can create a folder on your laptop with TNCremoNT. For this purpose, click the icon `Create folder` or select `File / Create folder ...` from the menu.

In the **lower half of the screen** (iTNC 530 HSCI contents), select the **source drive** and the **source directory**:

▶ Click the bar with the drive information. --> Its color changes, and two buttons appear at the right side in the bar.

▶ Click the `Change folder/drive...` button. --> A new window opens.

▶ Select the drive and the folder. --> The path is displayed in the bar.

Note

For changing to the PLC: und SYS: control partitions, you are prompted the respective code numbers.

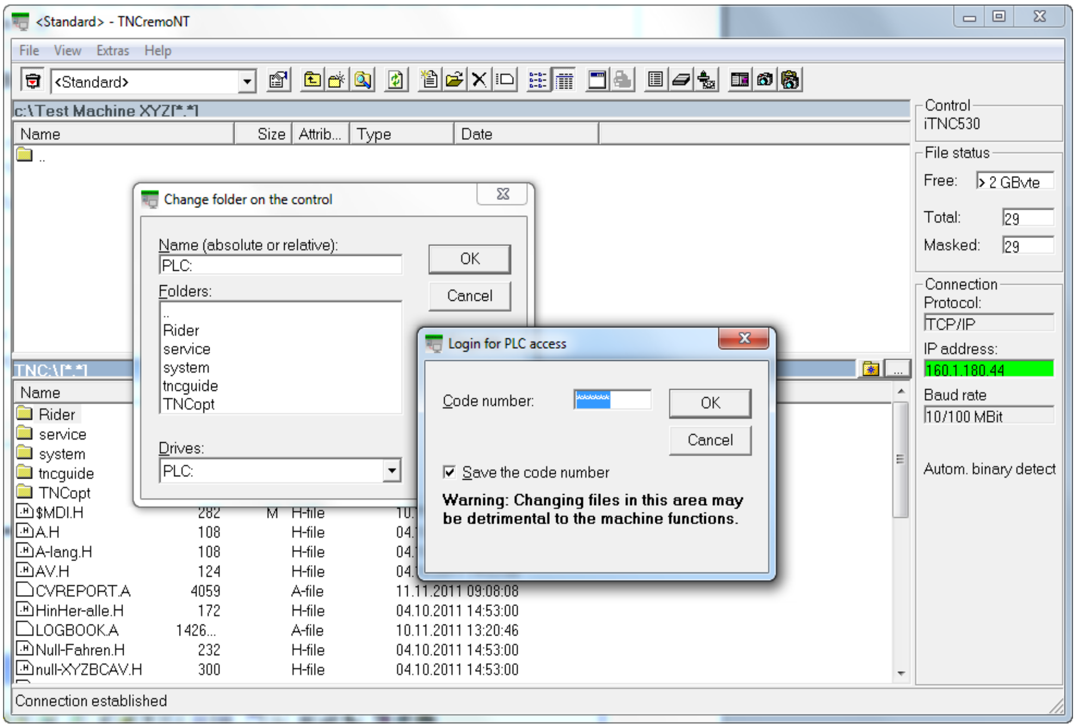


Figure: Changing to the PLC partition

Transfer the data:

- Using the mouse, click the directory you wish to read out.
- Press and hold the left mouse button and pull the directory or the file into the upper window.
- Release the mouse button. --> The directory or the file is being transferred.

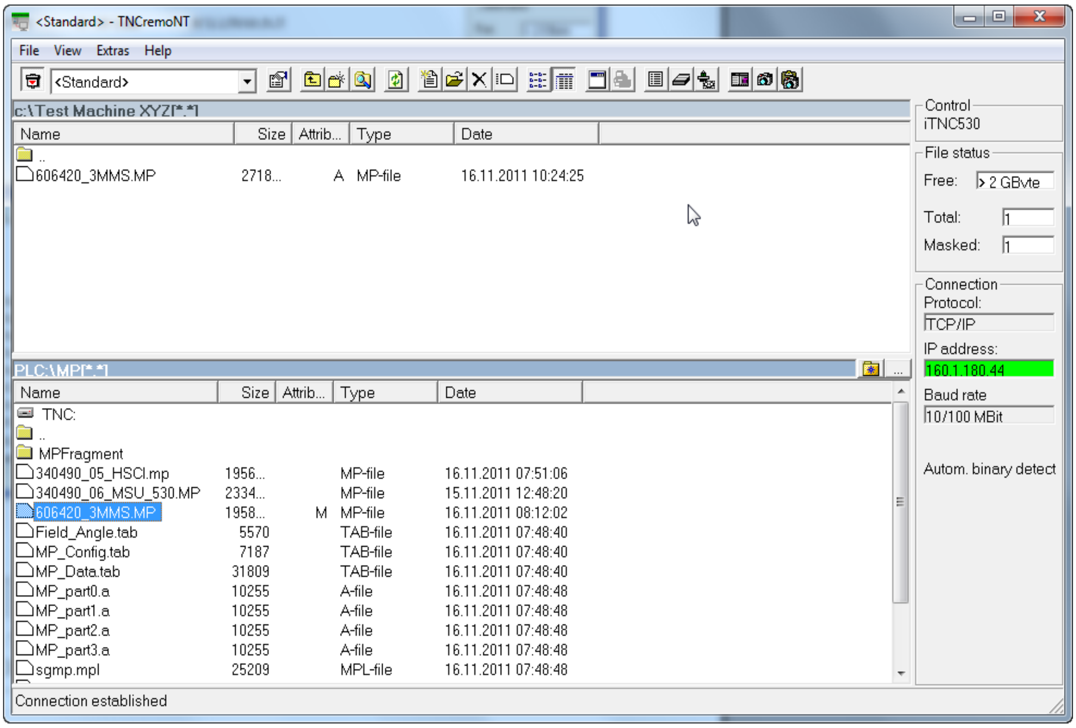


Figure: Read-out file

Note

When data is transferred with TNCremoNT, the data format is automatically converted from BINARY (control) to ASCII (laptop/PC).

Reading in data using TNCremoNT

In the **lower half of the screen** (iTNC 530 HSCI contents), select the **target drive** and the **target directory**:

- Click the bar with the drive information. --> Its color changes, and two buttons appear at the right side in the bar.
- Click the `Change folder/drive...` button. --> A new window opens.
- Select the drive and the folder. --> The path is displayed in the bar.

> **Note**
>
> For changing to the PLC: und SYS: control partitions, you are prompted the respective code numbers.

In the **upper screen half** (laptop/PC contents), select the **source drive** and the **source directory**:

- Click the bar with the drive information. --> Its color changes, and two buttons appear at the right side in the bar.
- Click the `Change folder/drive...` button. --> A new window opens.
- Select the drive and the folder. --> The path is displayed in the bar.

Transfer the data:

- Using the mouse, click the directory you wish to read in.
- Press and hold the left mouse button and pull the directory or the file into the lower window.
- Release the mouse button. --> The directory or the file is being transferred.

> **Note**
>
> When data is transferred with TNCremoNT, the data format is automatically converted from ASCII (laptop/PC) to BINARY (control).

14.4 Backup on an external data medium

For backup, the control data is stored on an external data medium (e.g. laptop).

Either the contents of the control partitions PLC:\ and TNC:\ are archived long-term or all available data of the control (full backup) is used for, e.g., a replacement of the HDR or SSDR.

> Note
>
> If possible, the control should be in **`Power interrupted`** state while the backup is run.

Connection setup

- Set up a connection to the iTNC 530 HSCI via TNCremoNT.
  –> See "Connection setup" on page 14 – 183.

Selecting the target drive on the laptop

Select the **target drive** from the **upper half of the display** (contents of laptop/PC):

- Click the bar with the drive information. –> Its color changes, and two buttons appear at the right side in the bar.
- Click the **`Change folder/drive...`** button. –> A new window opens.
- Now, select the drive. –> The path is displayed in the bar.

Creating the target directory on the laptop

- Click the icon **`Create folder`** or select **`File / Create folder ...`** from the menu.
  –> A new window opens.
- Enter the name of the new directory (e.g. backup HUGO machine) and confirm with OK.

> Note
>
> The folder where you save the backup should have an identifying name (e.g. the machine number) so that it can clearly be assigned to the machine to which it belongs!
>
> Avoid long path and file names! The file name should not be longer than 25 characters; do not use more than 256 characters in total.

- Double-click the newly created folder. –> It appears in the bar.

Selecting the control partition

Select the **source directory** from the **lower half of the display** (contents of iTNC 530 HSCI):

- Click the bar with the drive information. –> Its color change, and two buttons appear at the right side in the bar.
- Click the **`Change folder/drive...`** button. –> A new window opens.
- Now, select the drive (TNC: or PLC:). –> The path is displayed in the bar.

> Note
>
> For changing to the PLC control partition, you are prompted the respective code number.

- Ensure that your are in the root directory of the selected partition (in the example PLC:).

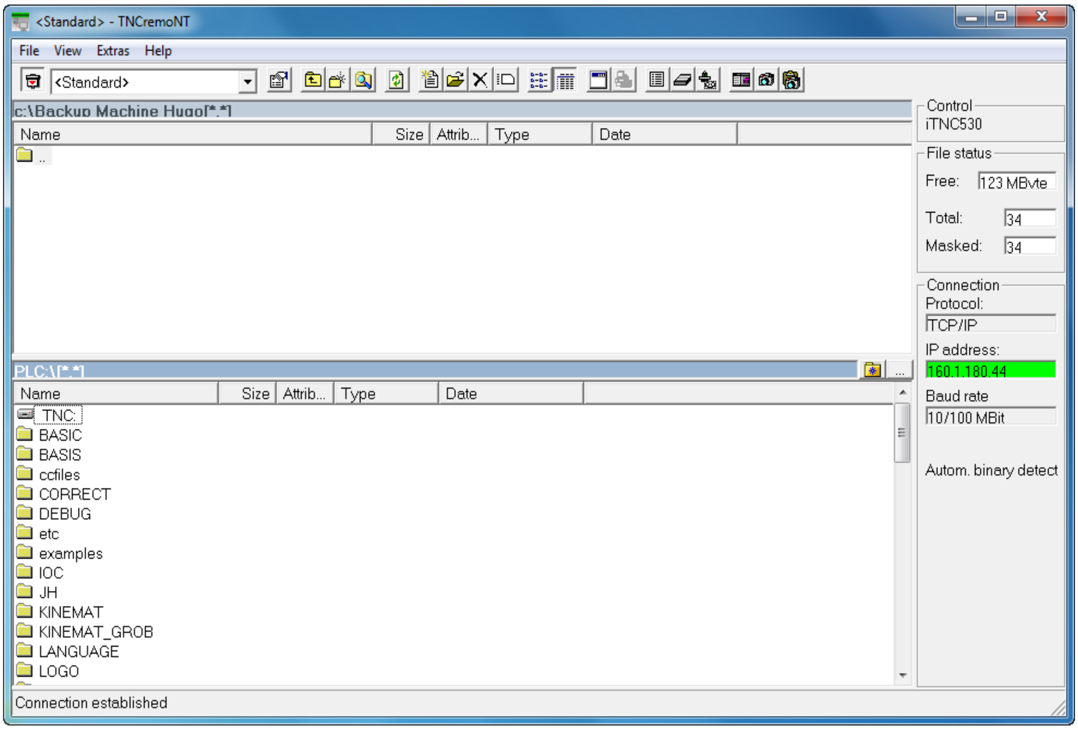
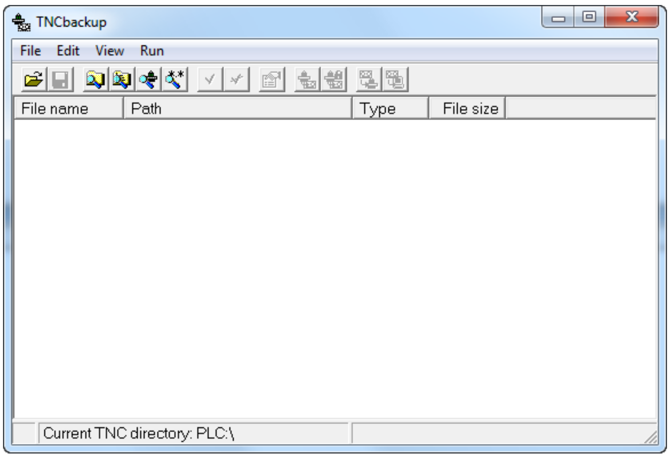


Figure: PLC partition selected for data backup

Calling the backup function

- Activate the backup menu with this icon (or via **`Extras/Backup/Restore ...`**).

The following window appears:



Selecting the backup type

If you want to create a **backup archive** for your TNC or PLC data:

- Click **`Scan directory tree`**. --> All data of the selected partition is listed.

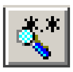
- The backup should have an identifying name (for example the machine number).

Note

HEIDENHAIN recommends creating separate archives for the TNC partition (customer data) and the PLC partition (data of the machine tool builder).
As long as no changes are made to the machine (modifications, NC software updates, etc.) the data in the PLC archive is up-to-date. Experience has shown that customer data (NC programs, etc.) is changed more frequently.
In these archives, there is no short-time information such as operating hours or the calibration of touch probes or overflows of multiturn EnDat encoders.

If you intend to **replace the HDR or SSDR**:

- Click one of the two buttons...



- **`Scan all`** (full backup) --> All files in the TNC: and PLC: partitions and some of the files in the partitions SYS: and HEROS: are listed.

- **`Scan system and machine files`** --> All files in the PLC: partition and some of the files in the partitions SYS: and HEROS: are listed.
(The TNC data should have been backed up earlier or the TNC source files stored on an external data medium; you may have to ask the customer.)

Attention

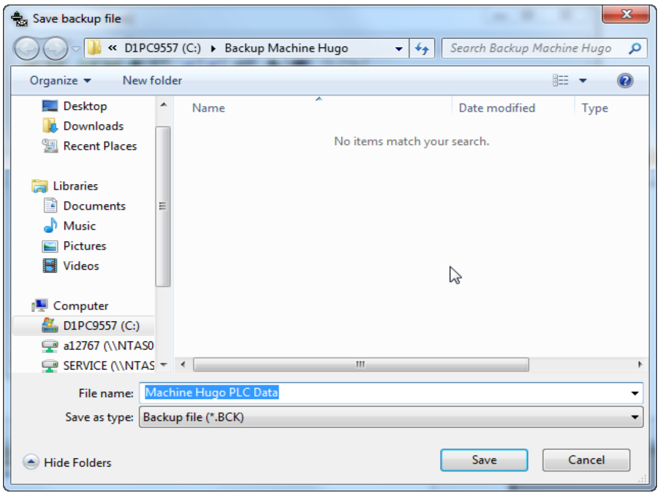
The machine operating hours (TIMES.SYS), the calibration data of the touch probes, possible overflows of multiturn EnDat encoders, traverse range settings, etc. (NCDATA.SYS) are included in these backup types so that they can subsequently be transferred to the new HDR or SSDR.
These backup types are **not intended for an archive**, since machine operating hours, calibration data, overflows of multiturn EnDat encoders etc. permanently change.

Note

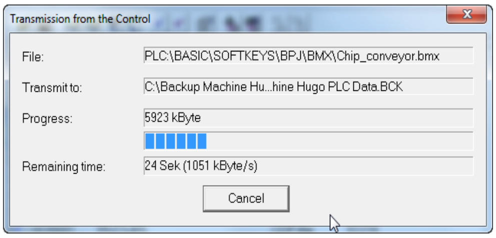
For these backup types the settings of date and time on control and laptop must be the same. Otherwise the error message **`Wrong password!`** is displayed.

Starting the backup

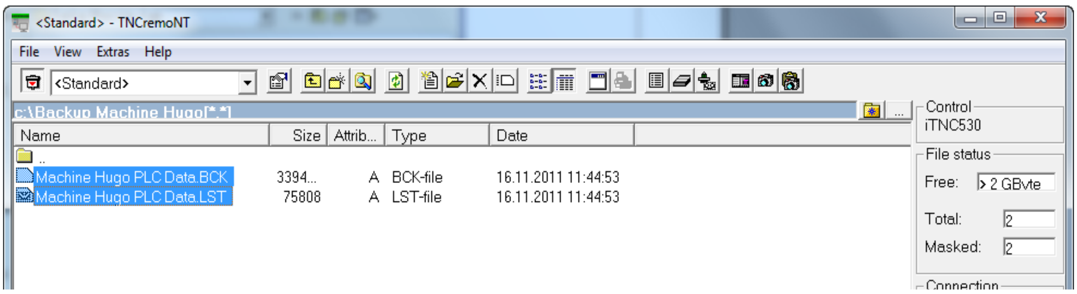
- Click **Run/Backup** (or the corresponding icon).
  The following window appears:



- Enter an identifying name for the backup file in the line **File name**, e.g. Machine HUGO PLC data.
- Start the data transfer with **Save**.
  The following window appears:



- When the backup is finished, this window is closed.
- You can now close the **TNCbackup** window.
- Check on your laptop, whether there are two files with the extensions *.BCK and *.LST.



Attention

The backup is only complete and can be restored at a later date, if these two files are available:
***.BCK**: Backup file with the files in compressed form
***.LST**: Reference list containing the directories and the files

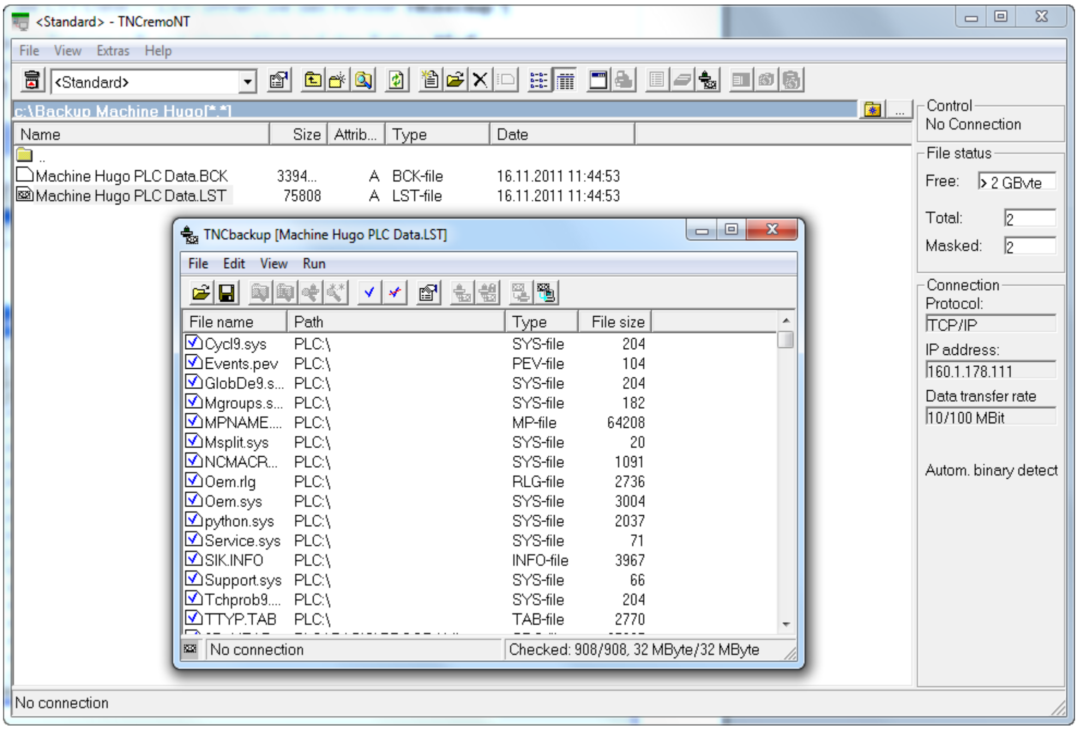
- Separate the connection.

- Close the **TNCremoNT** window.

14.5 Extracting files from the backup file

When a backup is created with TNCremoNT (e.g. of the PLC partition), all related files are stored in one *.BCK file using a compression algorithm.
To view individual, several or all files, you can extract them from the *.BCK file by means of TNCremoNT.

- Start TNCremoNT.
- Open the folder that contains the backup of the machine.
- Double-click the **LST file** (*.LST) to open the **TNCbackup** window.
- Sort the files listed here, e.g. by clicking on the bar **Path**.
  (You can sort by file name, path, type and file size; just click the corresponding bar.)



- Click **Edit/Select all**.
- Remove the blue check mark by clicking the corresponding icon (blue tick crossed out).
- Double-click to mark the files you want to extract. --> The blue check mark appears in front of the file name.
- Click **Run/Extract** (or the corresponding icon).
- You can extract the selected files either directly or together with the corresponding directory structure into your backup directory.
- Now the extracted files can be read, transferred individually, etc.
- Close the **TNCbackup** window.
- Do **not** save the changes you made to the blue check marks.

Attention

If you store the changes in your *.LST file after the extraction, only the marked files of this backup will be restored in a later process!

14.6 Restoring data

When restoring the backup of a machine, the data (e.g., PLC data, TNC data, "full backup") is restored from an external data medium (e.g. laptop) to the control.

Attention

- The machine must not operate while the data is being restored!
- The control should be in **`Power interrupted`** condition.
- Never press any key on your control while data transfer is running!

Note

If you work with Ethernet connection, check or make the necessary settings. --> See "Connection setup" on page 14 – 183.
Tip: For the original settings for the Ethernet interface, refer to the file **`if0.cfg`** which you have extracted, e.g., from the full backup of the corresponding machine. --> See "Extracting files from the backup file" on page 14 – 206.

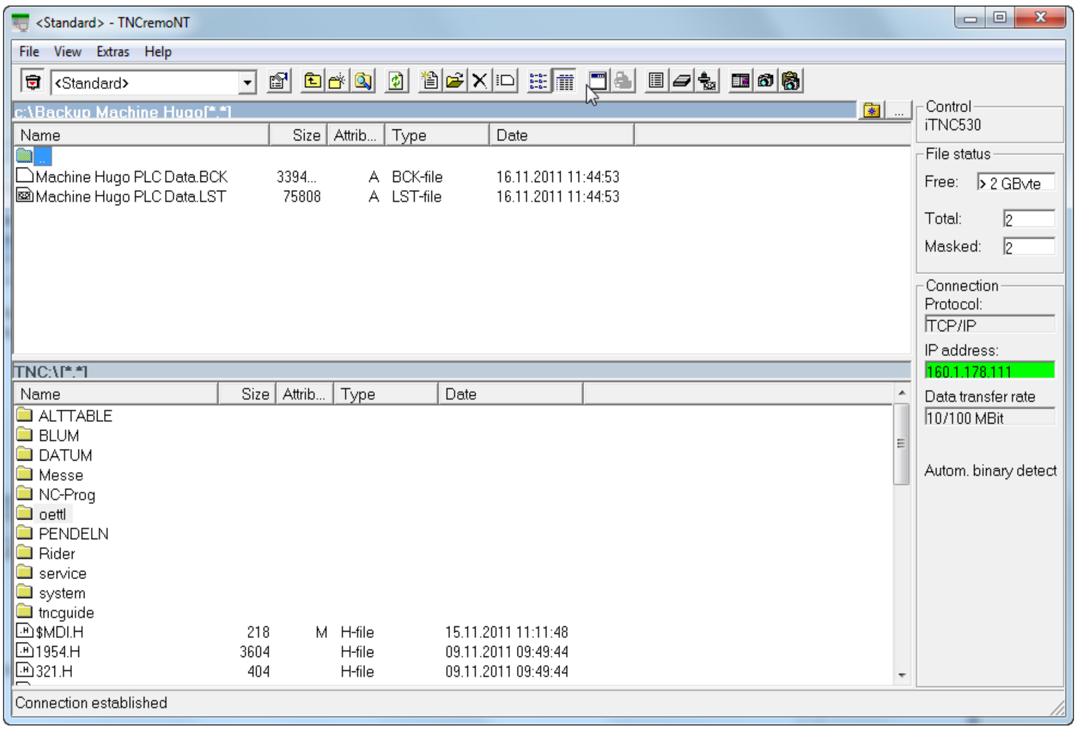
Connection setup

- Set up a connection to the iTNC 530 HSCI via TNCremoNT. --> See "Connection setup" on page 14 – 183.

Selecting the backup file

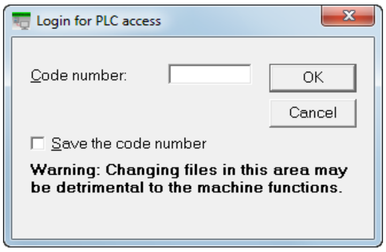
In the **upper screen half** (laptop/PC contents), select the **drive** and the **directory** where you have stored the backup file.

- Click the bar with the drive information. --> Its color changes, and two buttons appear at the right side in the bar.
- Click the **`Change folder/drive...`** button. --> A new window opens.
- Now, select the drive and the folder (in the example: C:\Backup Machine Hugo). --> The path is displayed in the bar.

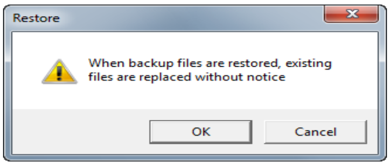


Starting the restore process

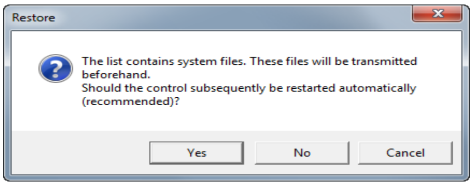
- Double-click on the **LST file** to open it. –> The **`TNCbackup`** window appears.
- Start the data transfer with the menu item **`Run/Restore`** (or with the corresponding icon).
- To restore PLC data (PLC archive, full backup) you need to know the PLC code number:



- Enter and confirm the code number.
- Confirm the following warning with **`OK`**:



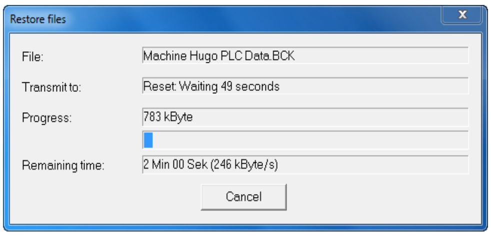
- Confirm the message regarding automatic control reset with **`Yes`**!



Note

If you receive the error message **`Wrong password`**, date and time of the control and the laptop probably do not correspond.
You may have to reset the system time on the control. –> See "Setting the system time" on page 13 – 173.

- The data is being restored:



- When restoring is finished, this window is closed.
- You can now close the **`TNCbackup`** window.

- Separate the connection.

- Close the **`TNCremoNT`** window.
- **Restart the control after successfully restoring the machine backup (reboot).**
  Now the machine should operate as usual.

14.7 Cable overview

Please note the maximum cable lengths:

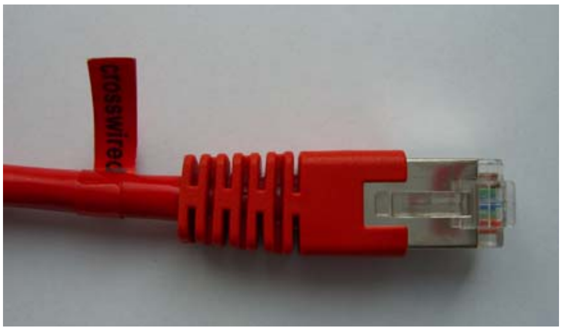
Interface	Maximum cable length
Ethernet	Unshielded 100 m
	Shielded 400 m
RS-232-C (V.24)	Up to 20 m

Note

Do not use self-made cables (shielding problems, contact problems, short circuits, etc.).
Mark your cable as "transposed" or "non-transposed".

14.7.1 Ethernet interface RJ45 connection

For direct connection between laptop and control (**"peer-to-peer"**) you require a **transposed Ethernet cable ("crossover cable").**



Note

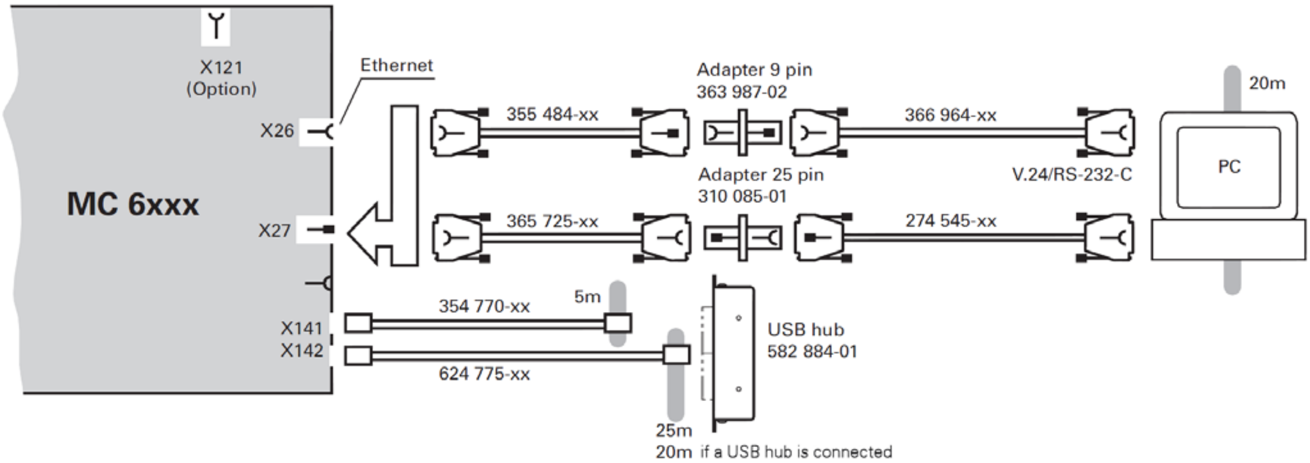
Mark your Ethernet cable as "transposed" in order to avoid confusion.

If you establish the connection via your local network (intranet), you normally use a non-transposed Ethernet cable (patch cable).

14.7.2 RS-232-C (V.24)

> **Note**
>
> The RS-232-C has different pin layouts at the iTNC 530 HSCI (connector X27, X127) and at the RS-232-C adapter block (D-sub connector on electrical cabinet).
> Exception: The cable with the ID 366964-xx may be connected to the 9-pin adapter block or directly to the control.

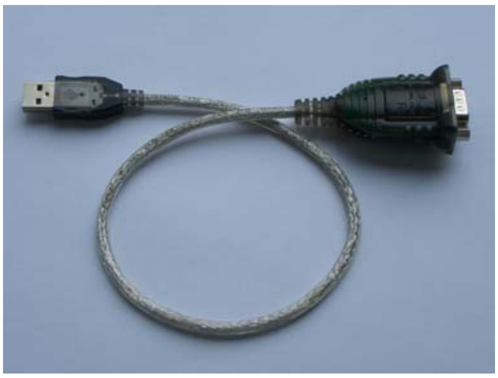
Possible combinations:

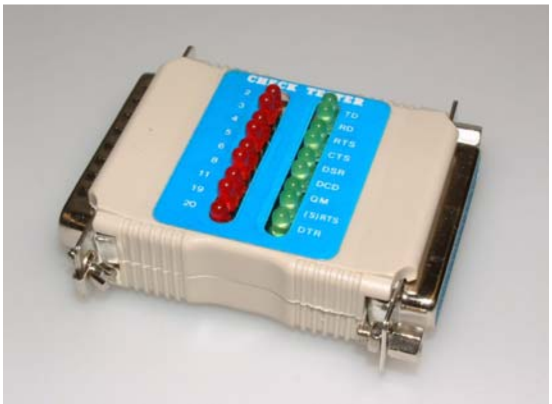


> **Note**
>
> You find detailed information on cables and cable layouts for serial data transfer in the **help menu of TNCremoNT** under the catchword **"Cable assembly"**.

> **Attention**
>
> For data transfer via RS-232-C HEIDENHAIN recommends using an "opto bridge".
> This serial adapter connector ensures metallic isolation via optocouplers and can thus protect the serial interface against overvoltage, different load potentials and interference voltages on the ground lines.
> "Opto bridges" are available in specialized computer stores.
> Please note:
> If the machine manufacturer has already mounted an opto bridge, a further opto bridge will not function, as such components must be powered from both sides!

Accessories The following accessories can be helpful; they are available in specialized computer stores:

	**D-sub adapter connector, 25-pin** **"OptoBridge"** Metallically isolates the serial interface by means of integrated optocouplers and thus protects from: - Overvoltages - Different load potentials due to different supply circuits - Interference voltages on ground lines Please note: If the machine manufacturer has already mounted an opto bridge, a further opto bridge will not function, as such components must be powered from both sides!
	**D-sub adapter connector, 25-pin** Adapts female to male
	**D-sub adapter connector, 9-pin** Adapts female to male
	**Adapter RS -232-C to USB** For laptops or PCs without RS -232-C interface, but with USB interface

<table>
<tr><td></td><td>D-sub adapter connector, 25-pin

To test the data transfer lines;
display by LEDs</td></tr>
<tr><td>
</td><td>D-sub adapter connector, 25-pin

To transpose the data transfer lines</td></tr>
<tr><td></td><td>D-sub adapter connector

Adapts 25-pin connector to 9-pin connector

Background:
The adapter block RS -232-C on the electrical cabinet usually has a 25-pin connector, the COM interface on the laptop usually a 9-pin connector.</td></tr>
</table>

14.8 Operating modes of the data interfaces

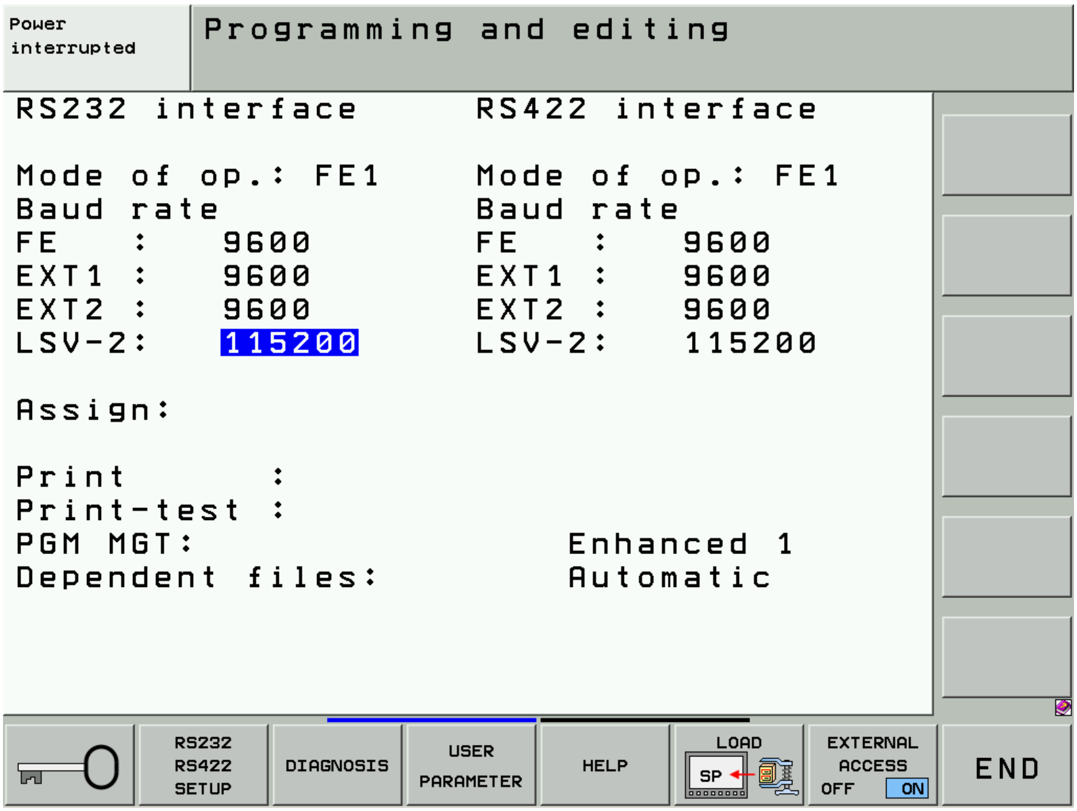
Calling the interface configuration

Press the following keys to call the main screen for interface configuration:

▶ Select the **Programming and Editing** operating mode.

▶ Press the MOD key.

▶ Call the setup menu for the serial data interfaces.



Selecting operating mode and baud rate

The data interface RS-232-C (V.24) is configured on the left half of the screen, and the data interface RS-422-C (V.11) on the right. The operating mode and the baud rate can be selected.

To edit operating mode, baud rate and assignment of interfaces:

▶ Place the cursor on the entry you wish to edit.

▶ Press the GOTO key to display a popup window.

▶ Place the cursor on the desired value.

▶ Press ENT to confirm.

▶ Leave the interface settings with the END soft key or the END key.

Note

The iTNC 530 HSCI automatically recognizes when the LSV-2 protocol is used (e.g., data transfer with TNCremoNT). No setting in the line **operating mode** is required for this purpose!

14.9 Drive symbols

The drives are shown in the program management of the HEIDENHAIN control:

RS232:\....	V.24 data interface (X27)
RS422:\....	V.11 data interface (X28)
TNC:\	TNC partition (user data)
PLC:\	PLC partition (machine data via code number)

Depending on the selected operating mode, a symbol is displayed in front of the external drive symbol:

Operating mode	Drive symbol in PGM MGT
FE1	
EXT1, EXT2	
Ethernet	

15 Reloading the currently used NC software

15.1 Introduction

For servicing, it can be helpful to load the currently used NC software once again onto the iTNC 530 HSCI, if **data of the SYS partition was lost**.
For example if:

- HEIDENHAIN cycles were lost
- DSP errors are generated frequently that were obviously caused by a loss of data
- Messages are generated that refer to a loss of data

Every installed NC software version and service pack is archived on the control's data medium, in the path **`SYS:\zip`**.

The NC software used can be reloaded from these archives. The data is extracted again for this purpose. This way you can restore corrupted files on the data medium.

15.2 Preparations

Test of the data medium

- Run a test of the SYS partition of the data medium before you reload the NC software. The **`Test for bad clusters`** must be activated for this purpose. Contact a HEIDENHAIN service agency if you wish to carry out this special data medium test.

> Note
>
> If defective areas are found in the test, these areas are disabled which means that they are no longer used when the data is reloaded.

Active NC software version and service pack

- Find out which NC software version and which service pack are active on the control. Press the MOD key for this purpose.
  If the NC software number is followed by **`SP`** (e.g., **`606420 01 SP1`**), a service pack is active in addition to the NC software.
- **Write down the number of the NC software version and the service pack!**

> Note
>
> First the NC software version is reloaded, then the associated service pack.

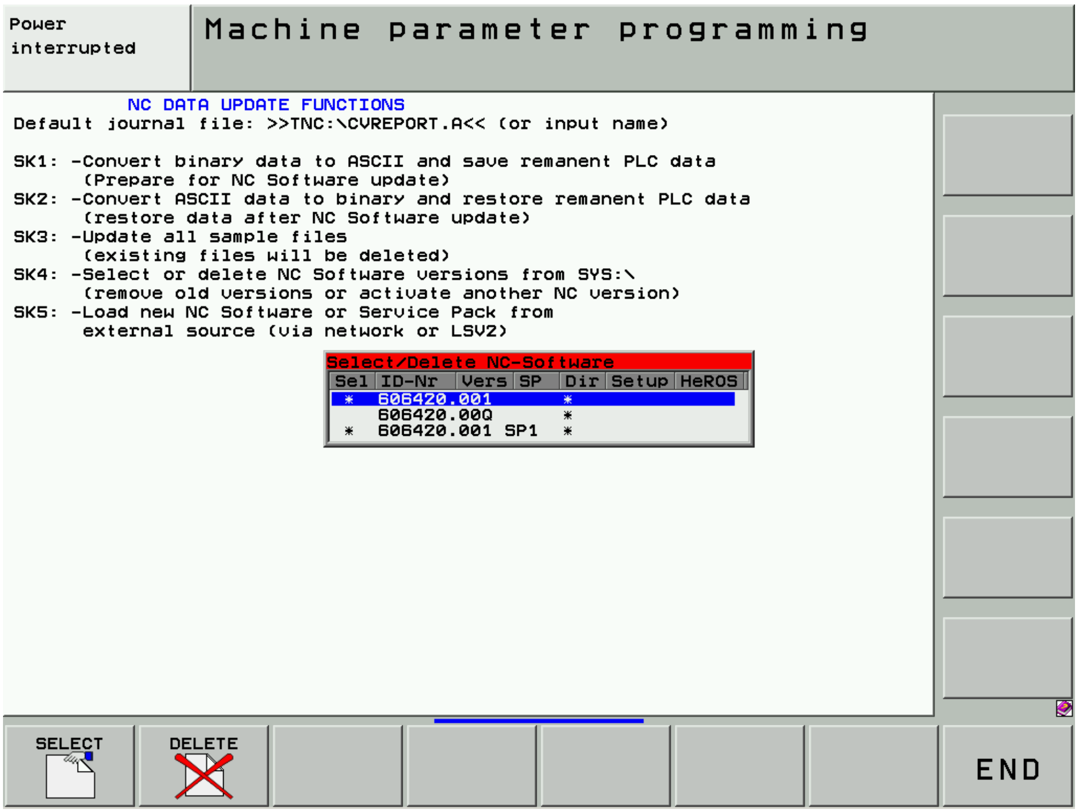
Preparing the machine tool

- If still possible:
  Move the machine to home position (axes, tool changer, tilting head, etc.)
  Ask the machine operator!
- Press EMERGENCY STOP.
- Restart the control, do not acknowledge the **`Power interrupted`** message.

> Note
>
> HEIDENHAIN recommends backing up the control data before reloading the NC software.
> --> See "Backup on an external data medium" on page 14 – 202.

15.3 Procedure

- Enter the code number to call the **machine parameter list**.
- Press the MOD key.
- Press the UPDATE DATA soft key.
- Press the SELECT SOFT KEY. --> All NC software versions and service packs on the control now appear in the selection window..



- The currently used software version and possibly the corresponding service pack are distinguished by an asterisk in the **Sel** column.
  Place the cursor on the marked NC software version.

Note

NC software versions do **not have the extension SP** (e.g., **606420.001**).
Service packs are distinguished by **SP**. The name of a service pack includes the NC software version so that it can be assigned uniquely (e.g. **606420.001 SP1**).

Load the software in the correct order:
First load the NC software, then the associated service pack!

Exception:
There are "full versions" that contain the NC software including service pack. In this case an NC software without SP version is NOT displayed in the selection window. Load the full version!

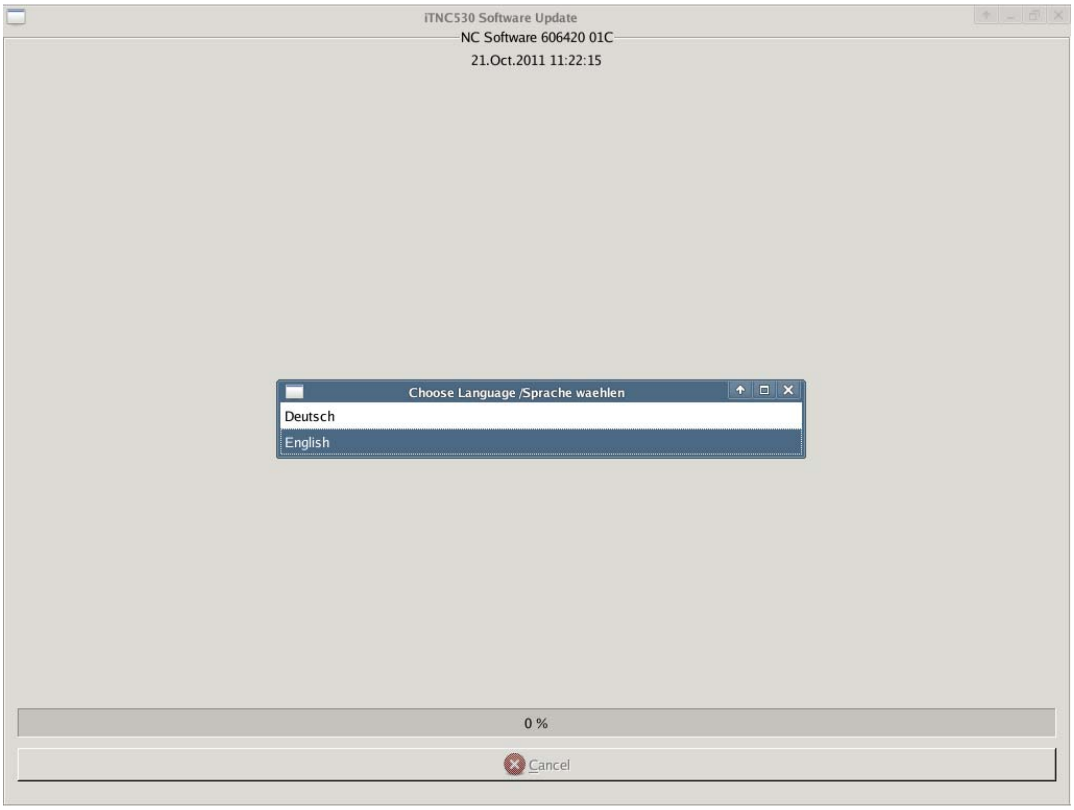
DANGER

You may only reactivate the NC software currently used by the machine!

A change to another NC software version is not described in this Service Manual and may only be made in agreement with the machine manufacturer.

- Press the SELECT soft key.
- Confirm your selection with the YES soft key.

- The control now displays the **`iTNC530 Software Update`** menu.



- Select a language and confirm the following questions by pressing ENT or by mouse click. --> The NC software is loading.

Note

If the error message **`Not enough space on SYS:`** is generated, delete compressed NC software versions and service packs from the SYS partition. This is done by pressing the DELETE soft key in the aforementioned selection window.
Ask the machine manufacturer which NC software versions and service packs you may delete.

- When the NC software has been successfully loaded, the message **`Update successful`** is displayed.
- Click OK or press the ENT key. --> The control restarts.
- If a service pack was active on the machine (what you have noted down), you must now load it in the same way as the NC software before.
- Check the NC software version incl. associated service pack. --> Press the MOD key.
- Finally, check the machine functions!

16 Loading service packs

16.1 Introduction

- Errors in the current HEIDENHAIN NC software are corrected by means of service packs.
- Service packs are loaded in addition to the NC software.
- The service pack must match the released NC software version.
- The latest service pack version includes all changes of earlier versions, i.e. it is sufficient to load only the service pack with the highest version number.
- It is not necessary to convert data (binary to ASCII) and to backup the non-volatile PLC operands.
- In addition to loading a service pack, the machine tool builder can update the PLC program or machine parameters via the control file **`setup.ini`**.

Attention

Normally, a service pack must be loaded by or in agreement with the machine tool builder.

Attention

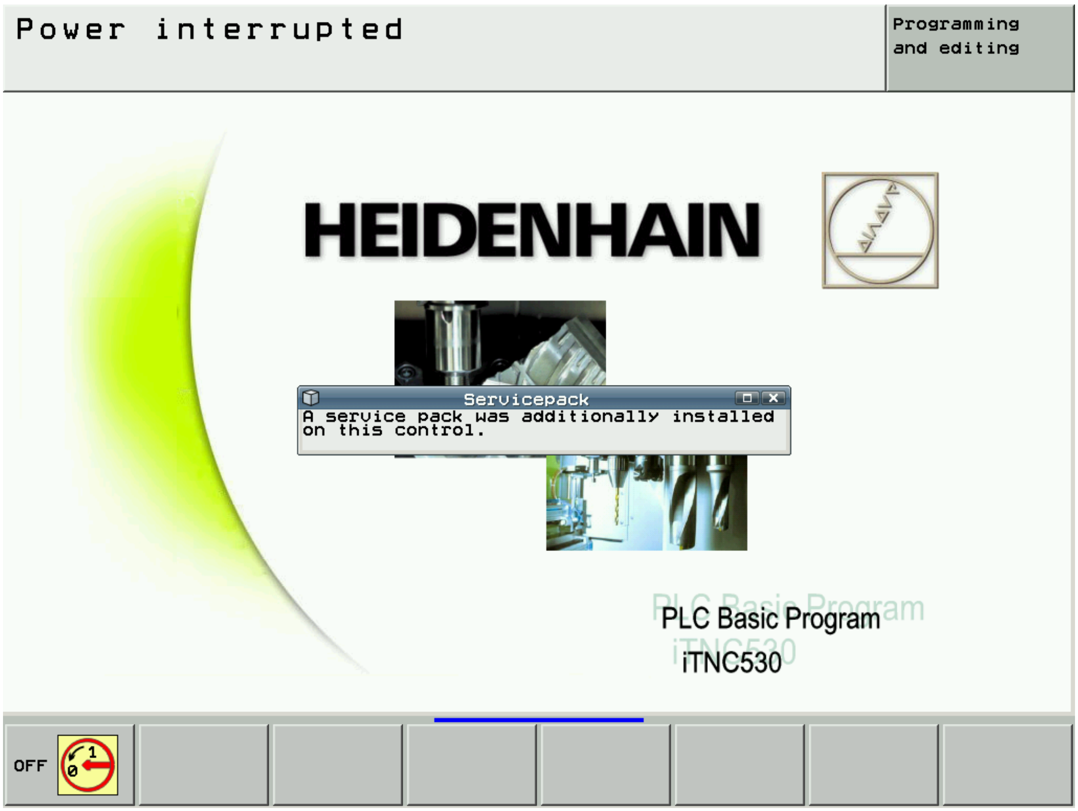
If a service pack has already been installed, it will not be possible to install a service pack with a lower version number. This is checked during the installation of a service pack and a message is displayed if an error is found.

Note

Sometimes, service packs are included in "full versions", i.e. a service pack is loaded together with the associated NC software. This involves a conversion of the data from binary to ASCII format (automatically in the menu logic).
It is possible to downgrade to full software versions.

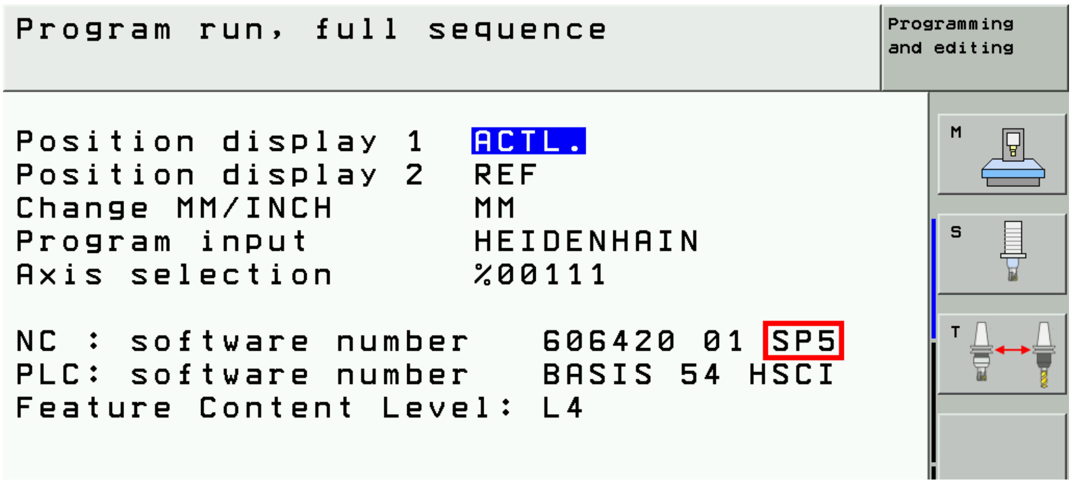
Screen display

If a service pack is installed on the iTNC 530 HSCI , a corresponding message is shown after the control has started up (before the **`Power interrupted`** message is confirmed).



The machine manufacturer, however, may have covered this message window.

If you press the MOD key while the machine is on, you can see whether a service pack is active. In this case you find the letters **SP** followed by the version number after the ID number of the NC software (e.g., **606420 01 SP5**).



Export restrictions

As iTNC 530 HSCI features more than 4 axes interpolating with each other (contouring with calculation of more than 4 axes), it is subject to **export licensing**.

An export license is thus required for:

- The **NC software** of the iTNC 530 HSCI
- Associated **service packs**

> Attention
>
> Contact your OEM, if you suspect conflicts!

> Attention
>
> NC software and service packs that are on your laptop or a USB flash drive also require an export permit!

16.2 Preparations

Who provides the new service pack?

The machine manufacturer receives the service pack directly from HEIDENHAIN.

Service engineers and end users receive the new service pack from the machine manufacturer.

Preparing the machine tool

- Move the machine to home position (axes, tool changer, tilting head, etc.)
  Ask the machine operator!
- Press EMERGENCY STOP.
- Restart the control, do not acknowledge the **Power interrupted** message.

> Note
>
> HEIDENHAIN recommends backing up the control data before loading a service pack.
> --> See "Backup on an external data medium" on page 14 – 202.

16.3 Procedure

Extracting the ZIP file

The provided ZIP file (e.g., **60642001sp2.zip**) needs to be extracted to a data medium (USB flash drive recommended).
A folder with the number of the NC software (e.g., **60642001**) is created in which there is a subdirectory (e.g., **606420_001_SP2**) containing the following files:

- **setup.elf**
- **setup.ini** (optional)
- **setup.zip**

Access to service pack files via the customer's network

If the control is integrated in the company network and the service pack files were filed on a shared network folder, you have access to these data. --> If necessary, ask the system administrator.

Otherwise, you can also use a USB flash drive as data medium (or transfer the service pack from your laptop to the control).

Loading the service pack

▶ Connect the USB flash drive to the control or to the monitor.

> Note
>
> iTNC 530 HSCI identifies standard USB flash drives.
> HEIDENHAIN cannot guarantee that all USB flash drives available on the market work with the iTNC 530 HSCI.
> If the USB device is not detected, you can use TNCremoNT to transfer the service pack to the data medium of the control.

▶ Select the **Programming and Editing** operating mode.

▶ If open: Close the program management by pressing the END button.

> Note
>
> Pressing the MOD key while the program manager is open calls screen where you can make the interface settings.

MOD

▶ Press the MOD key.

▶ Enter the code word **SETUP** and press ENT to confirm. --> A pop-up window is displayed.

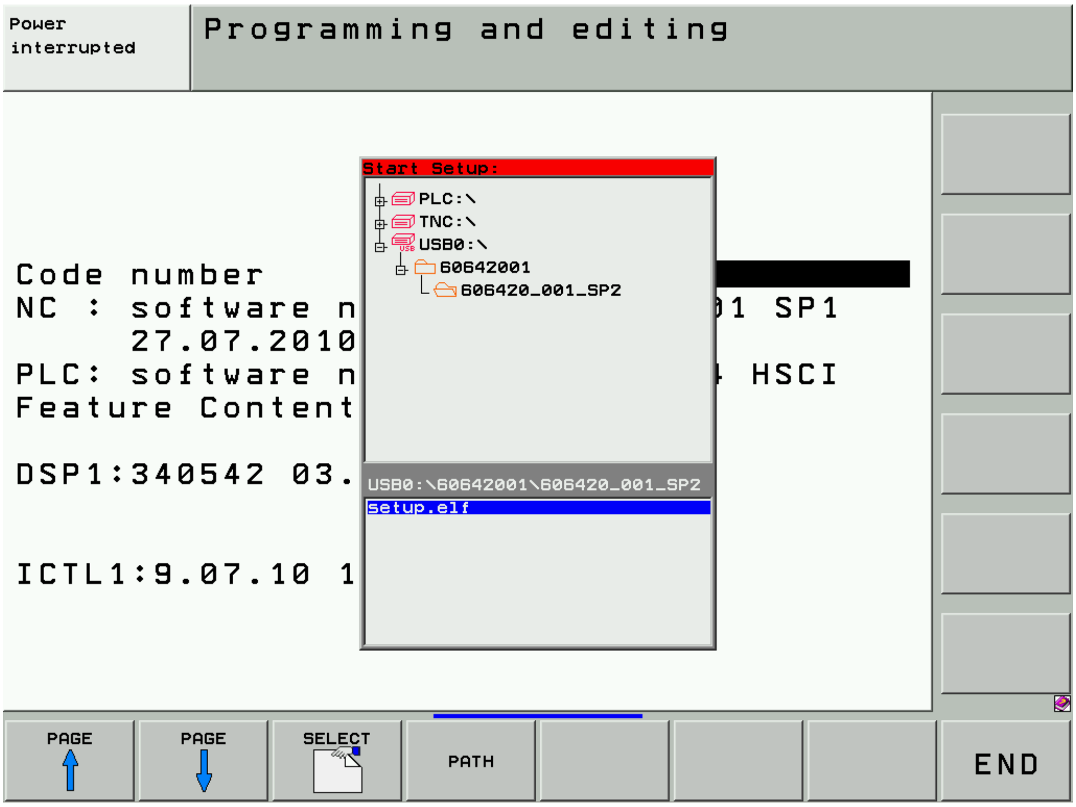
▶ In the upper part of the window, place the cursor on the USB data medium (or on the partition of the control's hard disk where you have transferred the service pack with TNCremoNT).

> Note
>
> With the +/- key you can open and close the directory trees.

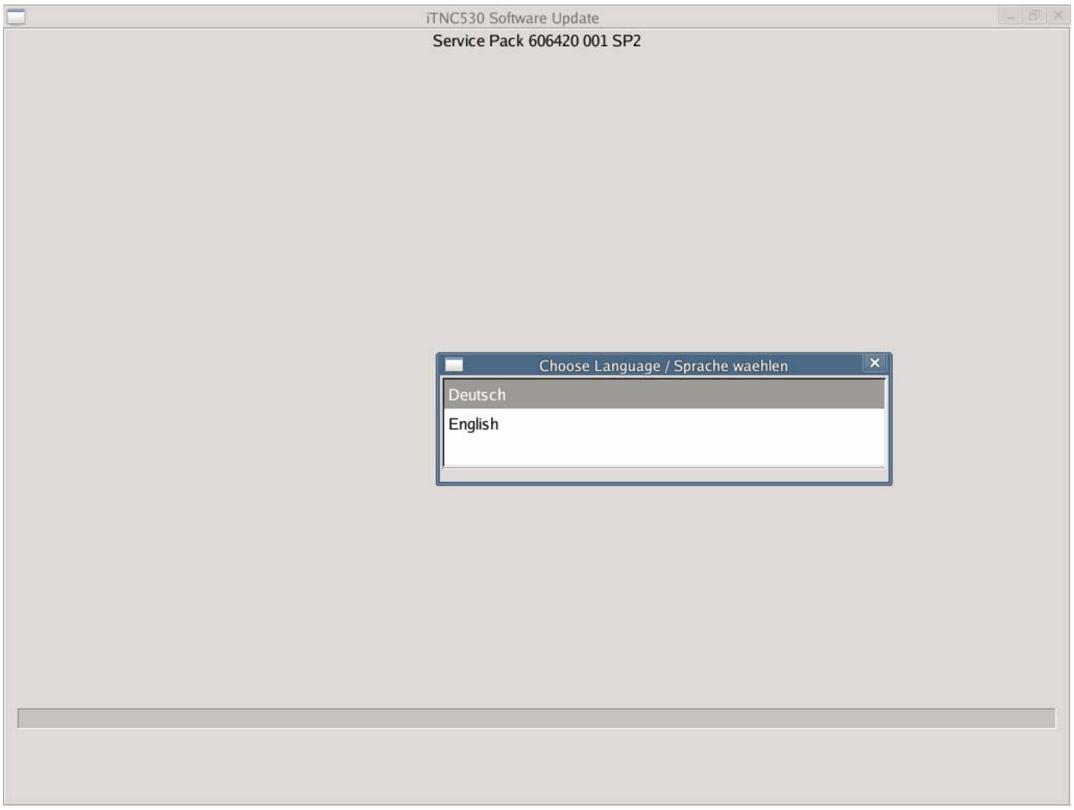
▶ Now set the cursor to the folder with the designation of the NC software + service pack (e.g., **606420_001_SP2**).

▶ Press ENT. --> The file **setup.elf** is shown in the lower part of the window.

▶ Press the FILES soft key. --> The cursor jumps to the lower part of the window.

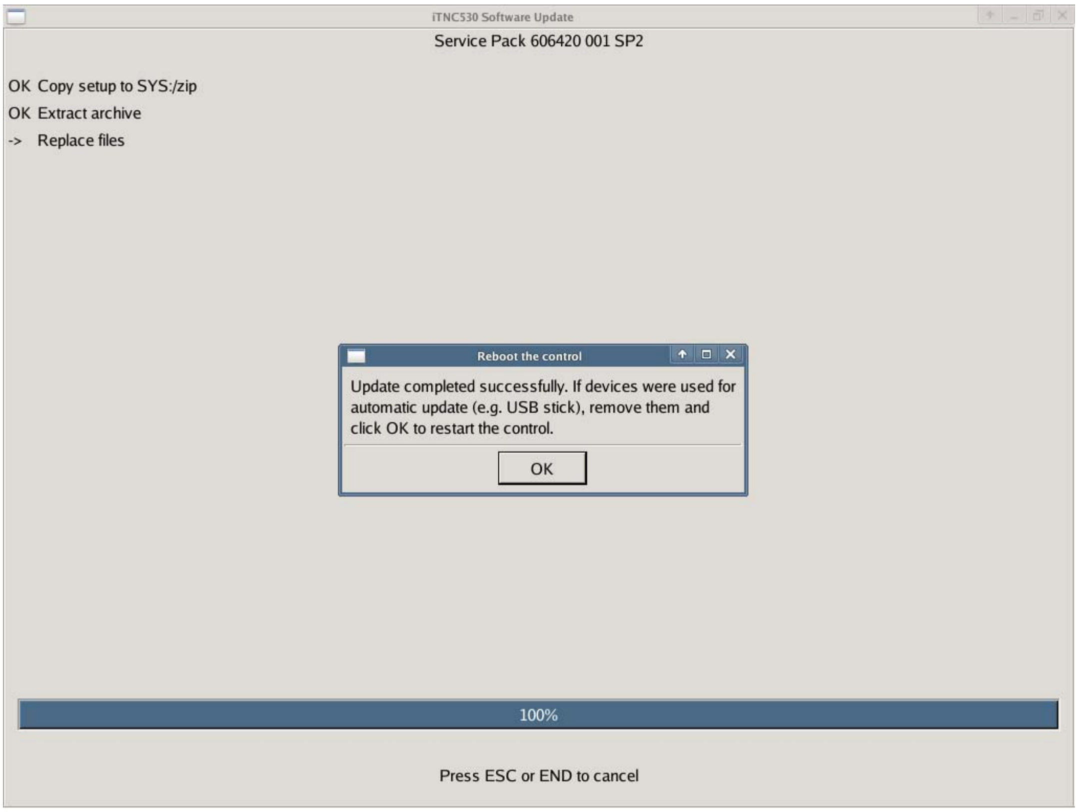


▶ Press the SELECT soft key.
--> The control now displays the **`iTNC530 software update`** menu.



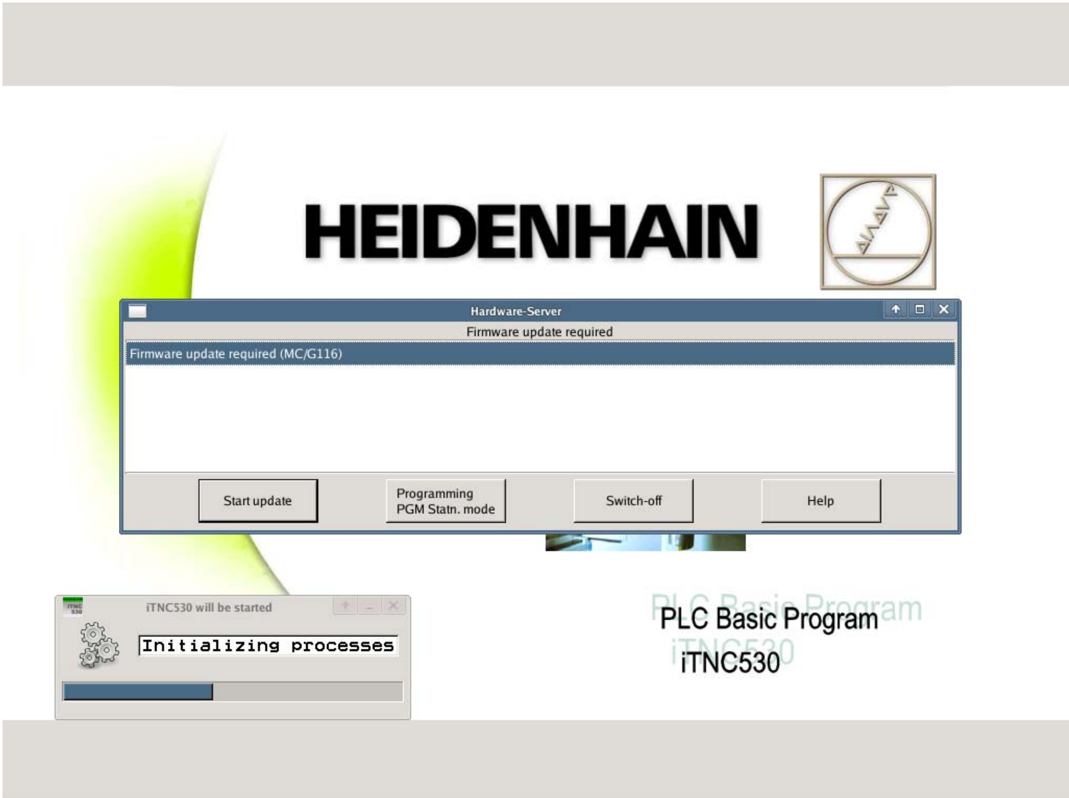
▶ Select a language and confirm the following questions by pressing ENT or by mouse click.
--> The service pack is loading.

▶ When the service pack has been successfully loaded, the following message is displayed:



▶ Disconnect the USB drive and click OK or press the ENT key. --> The control restarts.

The control may display the following window:



Note

The NC software with the new service pack detects that the firmware of an HSCI device needs to be updated.

- Run all firmware updates. --> See "Detecting and loading firmware updates" on page 29 – 524.
- Check the NC software version incl. associated service pack. --> Press the MOD key.

Note

After you have transferred the service pack from your laptop to the control (e.g., on PLC:\servicepack), you may delete it from the laptop in order to free memory space on the hard disk. The service pack was automatically archived in the SYS partition of the hard disk and can be called at any time.

Functional test

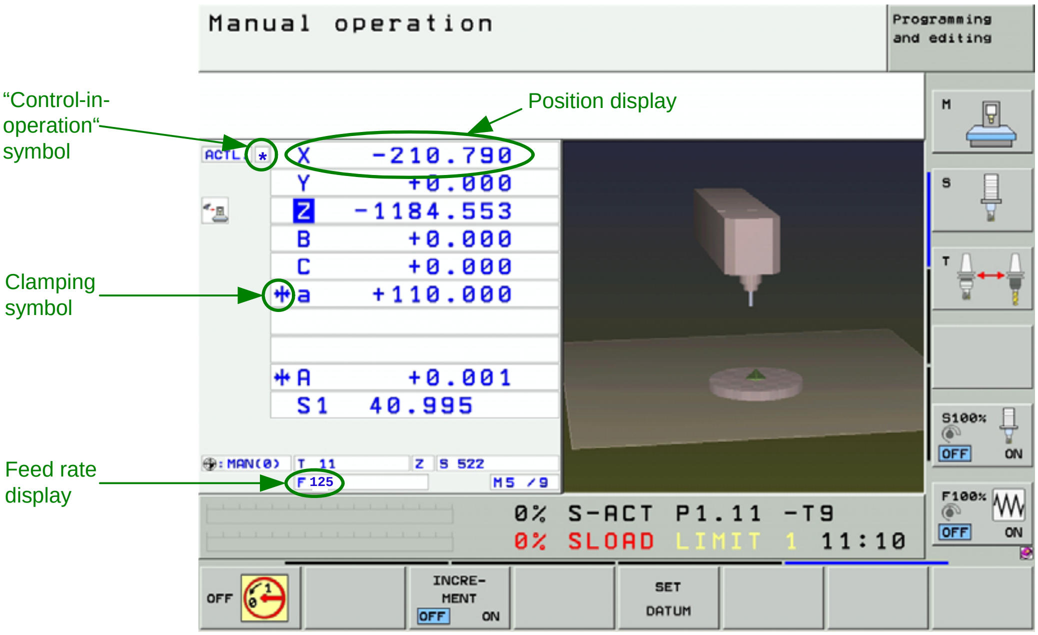
- Finally, check the machine functions!

17 Checking the enables on the iTNC 530 HSCI

17.1 Introduction

For an operating axis (axis in control loop / being positioned) ...

- no "Axis clamped" symbol is shown
- the "STIB" asterisk (control-in-operation) is visible
- the feed rate display must not be highlighted
- the position display (ACTL, NOML) changes when the axis moves



The appropriate enables are required in order to work with axes or spindles.

If one or several enables are missing, an error message is output or the axes and/or the spindles cannot be operated.

The following **conditions** must be fulfilled to drive **axes and spindles**:

EMERGENCY STOP chain

The **EMERGENCY STOP chain** must be closed.

The EMERGENCY STOP chain includes ...

- the EMERGENCY STOP button on the machine operating panel
- the EMERGENCY STOP button on the handwheel (if available)
- hardware axis limit switches (if available)
- the iTNC 530 HSCI itself (through a PLB 62xx system module or a UEC 11x controller unit)

The "Control is ready" output of the iTNC 530 HSCI switches, for example, a relay whose contacts are part of the EMERGENCY STOP chain.

In the event of severe errors (e.g. defective encoder), the iTNC 530 HSCI resets the "Control is ready" output and thus interrupts the EMERGENCY STOP chain.

The precondition is that the machine manufacturer has correctly integrated the "Control is ready" output and input into the EMERGENCY STOP chain.
--> See "Annex: Basic circuit diagrams of the iTNC 530 HSCI control" on page 2 – 651.

Integration of iTNC 530 HSCI into EMERGENCY STOP chain	PLB 62xx	UEC 11x	Signal
Supply of "Control is ready" output	X9, terminal 1a	X4, terminal 1a	- - -
"Control is ready" output	X9, terminal 3a	X6, terminal 12a	MC.RDY or STO.A.G (Safe Torque OFF)
"Acknowledgement of Control is ready" input	X9, terminal 7a	X5, terminal 9a	ES.A (emergency stop A)
	X9, terminal 7b	X5, terminal 10a	ES.B (emergency stop B)

Note

Either the "Control is ready" output and input on the PLB 62xx system module or on the UEC 11x compact controller unit are used.

Control-is-ready acknowledgement

The iTNC 530 HSCI receives information on the status of the EMERGENCY STOP chain trough the two signals ES.A and ES.B (PLC inputs).

Both signals must be set. --> The EMERGENCY STOP chain is closed.

Axis-specific drive enable via axis groups

24 V must be available for the associated axis group at each of the **PLC inputs defined** by the machine tool builder.
The axis-specific drive enable is defined in the following machine parameters:

- **MP4132** (PLC inputs for switch-off groups)
- **MP2040** (Assignment of the axes to the switch-off groups)

Drives ready for operation

The **drives must be ready for operation** and report this condition.

- With the HEIDENHAIN inverter system the green **READY LEDs** on the UM xxx drive modules or on the output stages of a compact inverter/controller unit with integrated inverter must be lit.
- When non-HEIDENHAIN inverter systems are used, the counterpart displays must be lit.

Note

When a drive is added to the control loop, the READY signal of the power output stage must be transmitted to the control via the PWM cable within a defined period. For this purpose the corresponding relays must have switched.
The iTNC monitors the time between the activation of the control loop and the READY signal of the power output stages.
If the READY signal is missing after the waiting time has passed, the error message `8B40 No drive release <axis>` appears.
A connection may be interrupted (wiring in the electrical cabinet, PWM cable between CC and UM), the relays may switch too slowly or the drive be defective.
The permissible waiting time is entered in **MP2170**.

This error message may not be generated, as the PLC program does not hook up the current and speed controllers as long as the ready signal of the drives is missing.
--> Watch the green READY LEDs of the drives.
--> See "Readiness of the inverter system" on page 17 – 233.

Note

Many **analog servo drives** provide a ready signal that can be evaluated by the PLC program of the iTNC 530 HSCI . Normally, the drive is only enabled, after the servo drives have reported that they are ready. --> Observe LEDs and LCD displays of the drives!

A number of servo drives do not provide a "ready" signal. In this event the drive enable must be set without actually knowing the status of the drives. If an axis or spindle cannot be operated, as the drive is not ready, an error message (e.g. Servo lag) is generated.

Current and speed controllers switched on

The **PLC module 9161** must be called.

- This module serves to activate the current and speed controllers for digital control loops individually for each axis.
  (If necessary, ask the machine manufacturer in which program section this module is called.)

Note

The word W1024 or the double word D110 contains the axes enabled by the NC.

The word W1060 or the double word D1172 contains the axes for which the feed rate was individually enabled by the PLC.

If the marker M4563 is set, the PLC enables the feed rate in all axes (either W1060 / D1172 or M4563 is used).

The word W1040 or the double word D1132 contains the axes in which the control loop is opened by the PLC (e.g. clamped axes).

Note

Whether words or double words are used, depends on the setting of bit 14 of MP4020:
Bit 14 = 0 --> PLC interface for up to 14 axes
Bit 14 = 1 --> Expanded PLC interface for up to 18 axes

Some machine parameters

MP2040	**Axis groups for drive enabling via fixed PLC inputs**
Format:	%xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (bit #31 = spindle)
Input:	0: Axis/spindle not assigned 1: Axis/spindle assigned
MP2040.0-2	Group 1 to 3
MP2040.3-7	Reserved, enter %00000000000000000000000000000000

MP2170	**Waiting time between the switch-on of the drive and the drive’s standby signal**
Input:	0.001 to 4.999 [s] 0: 2 [s]

MP4132	**Axis-specific or axis-group-specific PLC input for drive enabling**
Input:	0 to 2000: Number of the PLC input or symbolic PLC operand -1: Function inactive

17.2 Examination

The iTNC 530 HSCI features comprehensive diagnosis tools, such as DriveDiag, HSCI bus diagnosis, PLC-TRACE or PLC-TABLE.

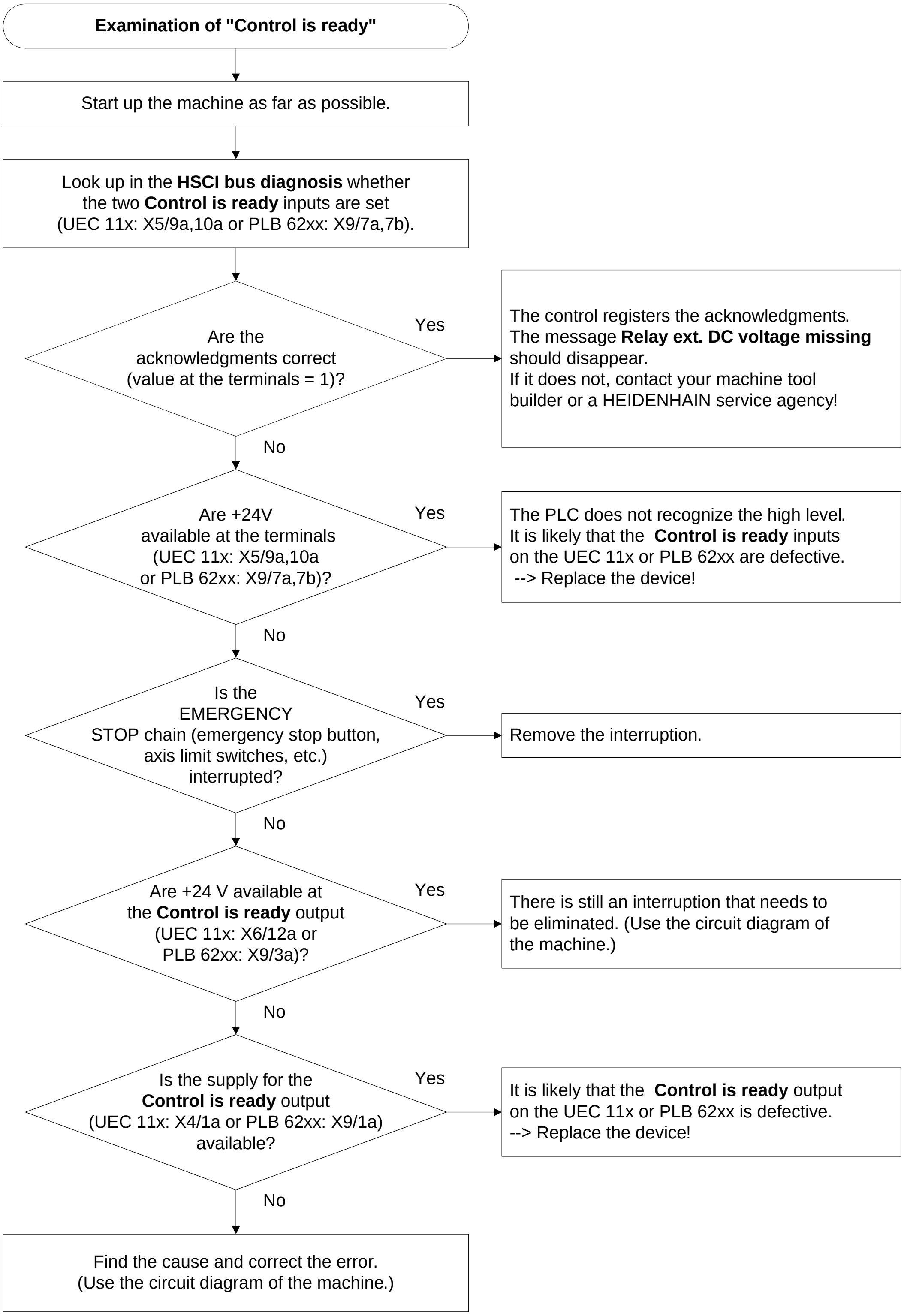
These **diagnosis tools** are suitable for checking the enables on the iTNC 530 HSCI .

Moreover, the service engineer requires **measuring equipment**, such as a multimeter, etc.

17.2.1 "Control is ready" output and input (EMERGENCY STOP chain)

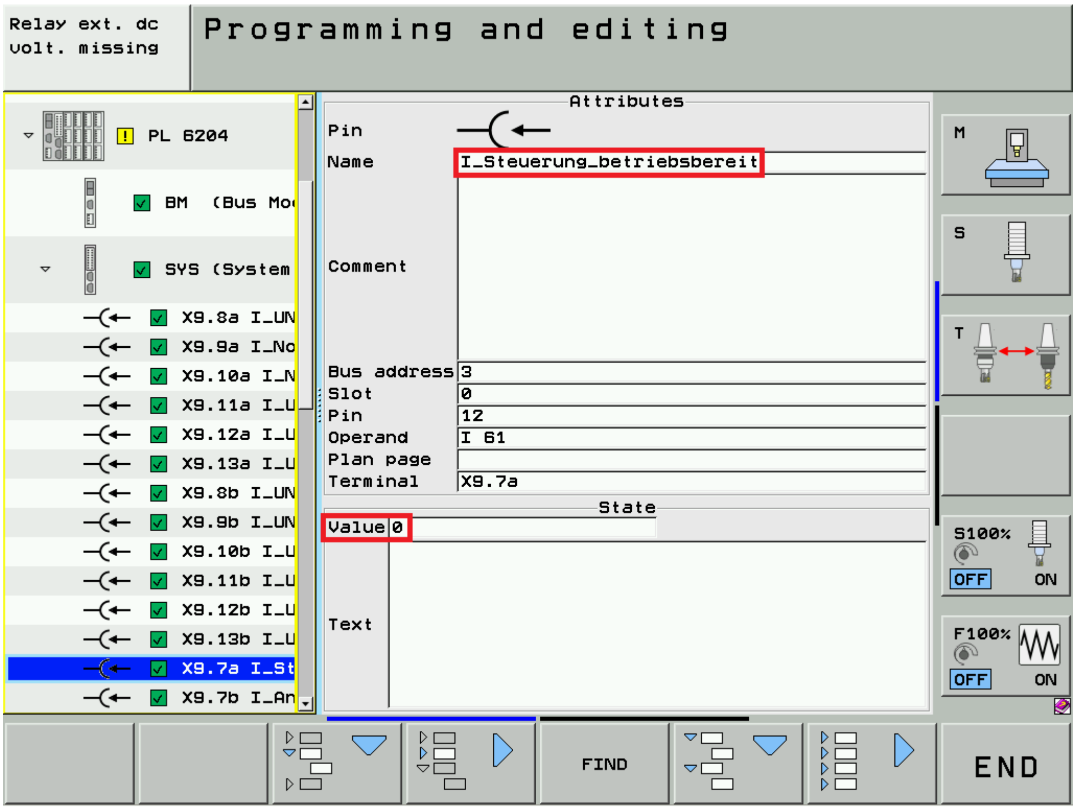
Error: Message "Relay external DC voltage missing" continuously displayed

If the message `Relay external DC voltage missing` does not disappear after you press the CONTROL ON key, carry out fault diagnosis as follows:



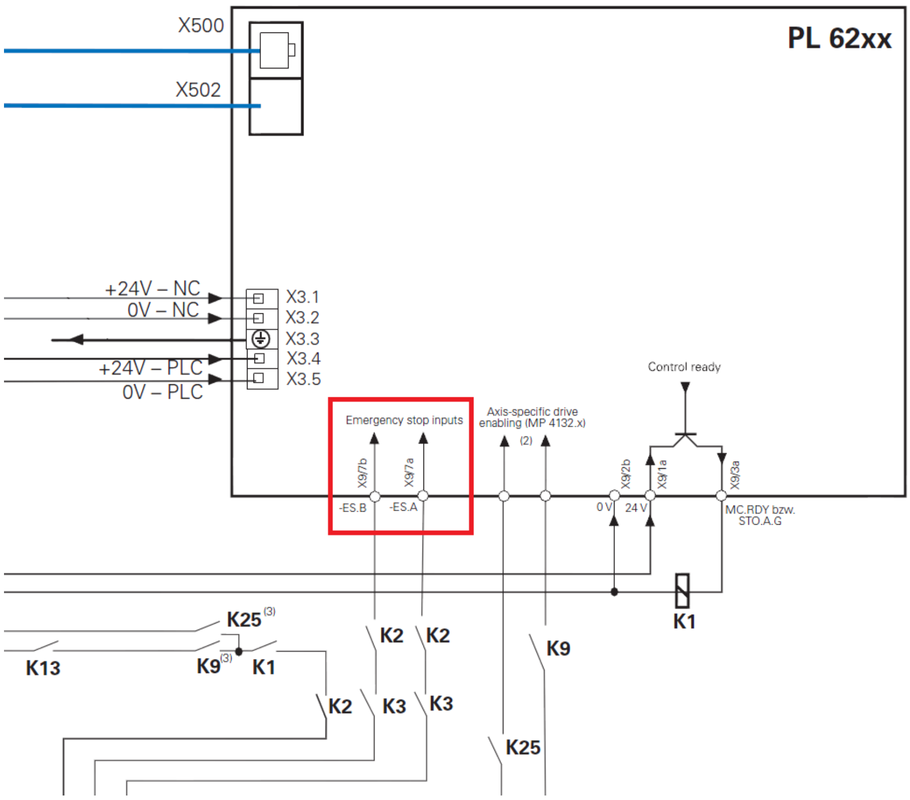
Control-is-ready in the HSCI bus diagnosis

Activation –> See "HSCI bus" on page 12 – 147.



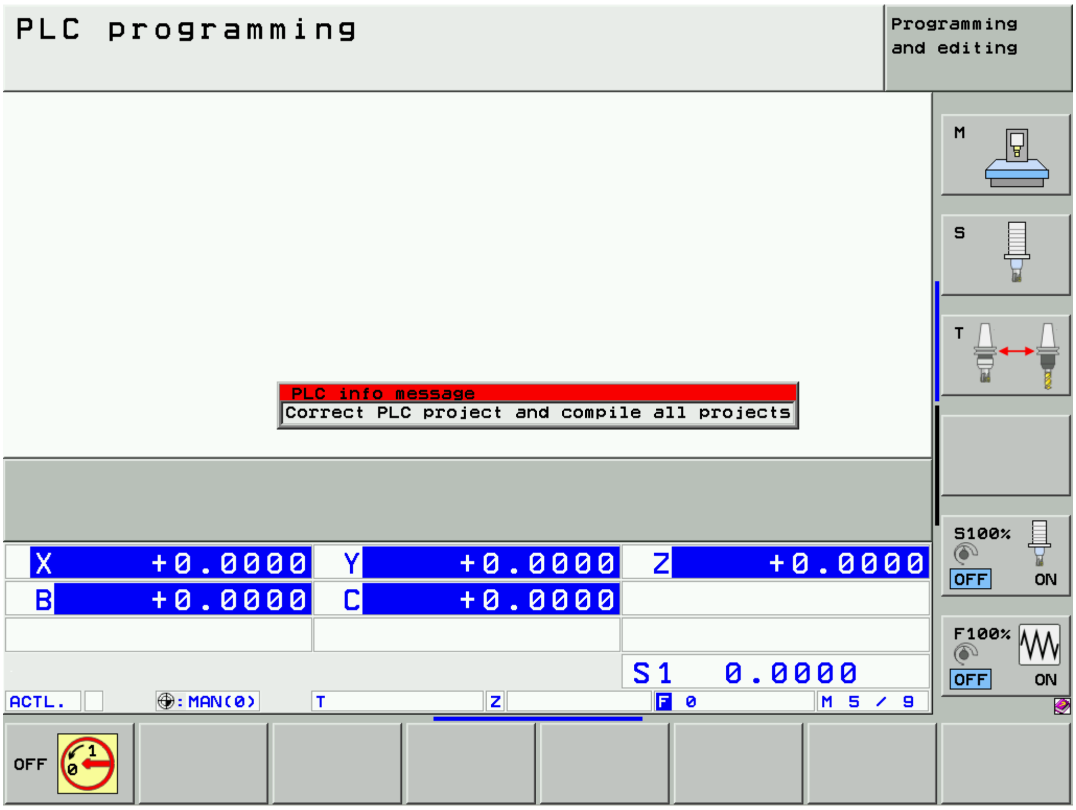
Excerpt from the basic circuit diagram

Here you can see the terminals on PLB 62xx that can be measured.

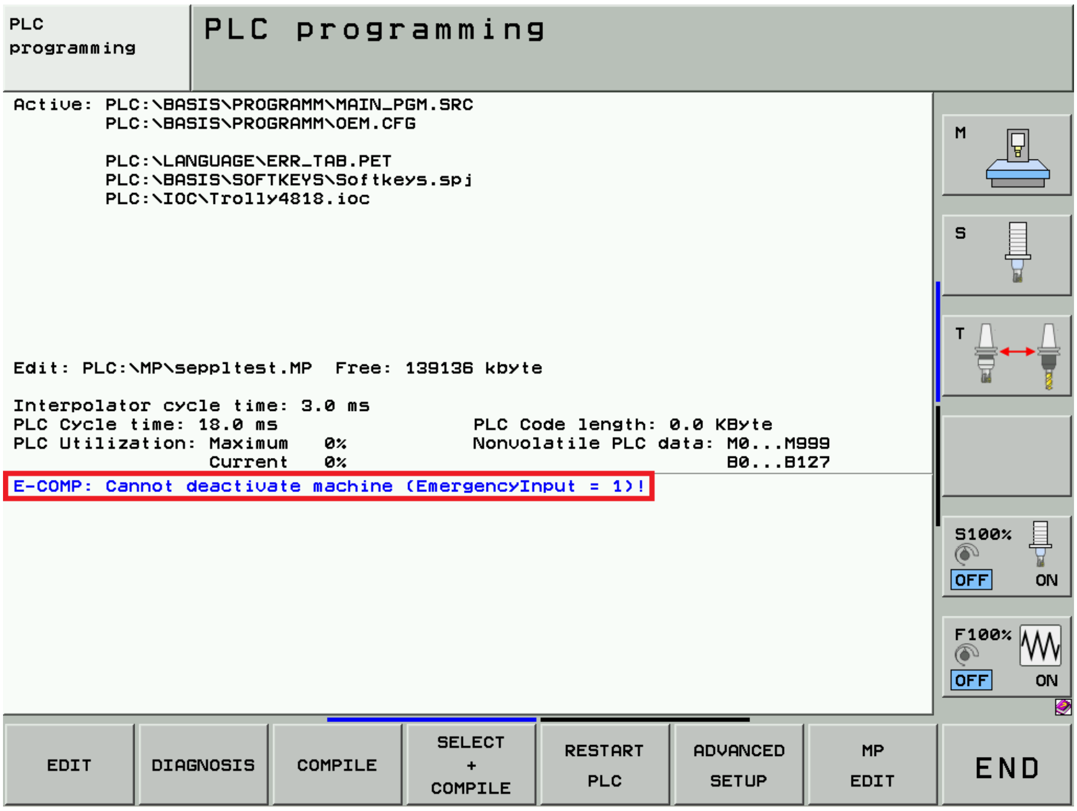


Error message: EMERGENCY STOP defective

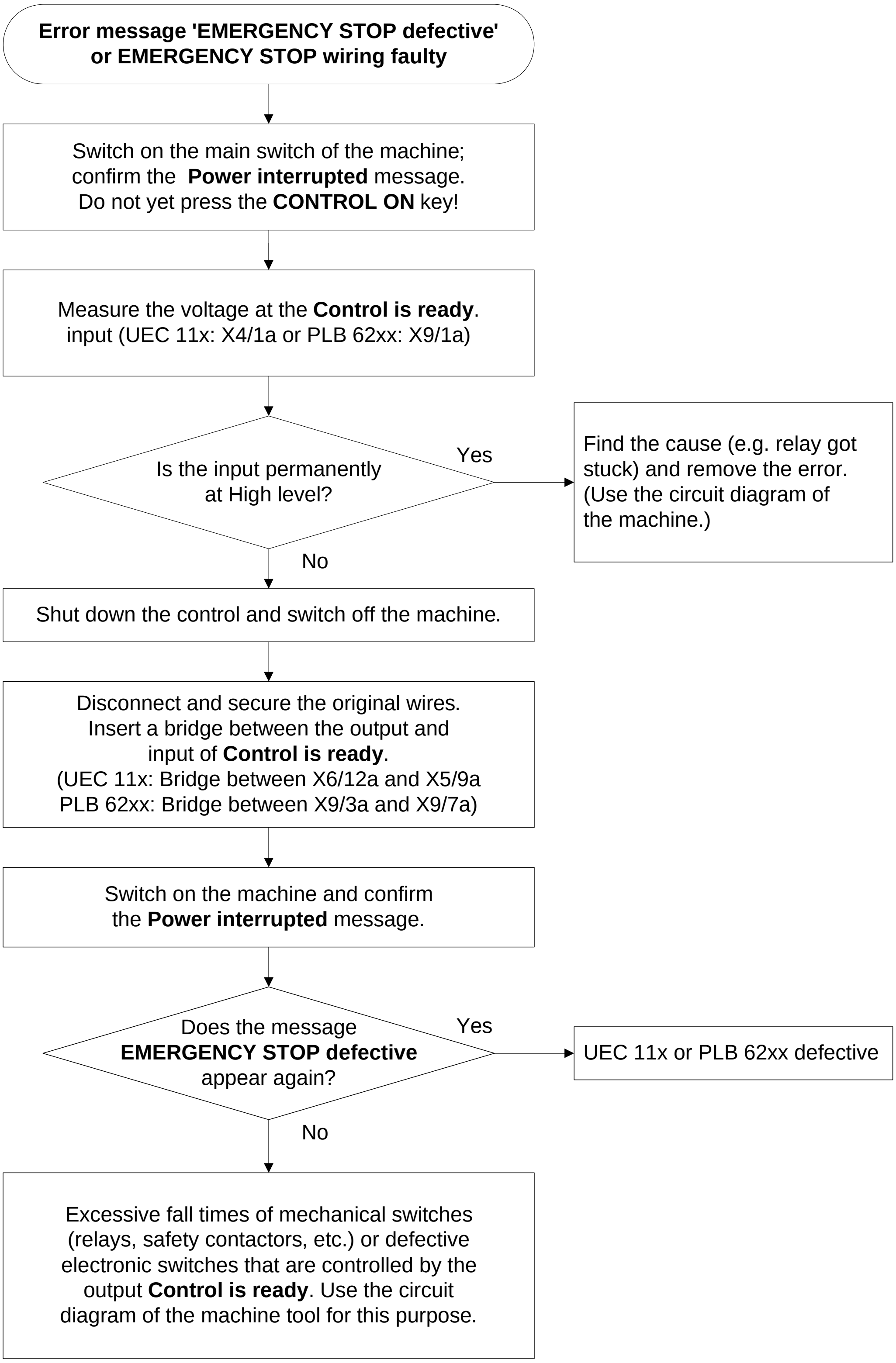
If the error message **EMERGENCY STOP defective** is displayed or if the following display appears ...



... that provides the following information after you have entered the PLC code number ...



... carry out the error diagnosis as follows:


Error message 'EMERGENCY STOP defective' or EMERGENCY STOP wiring faulty
Switch on the main switch of the machine; confirm the Power interrupted message. Do not yet press the CONTROL ON key!
Measure the voltage at the Control is ready. input (UEC 11x: X4/1a or PLB 62xx: X9/1a)
Is the input permanently at High level?
Yes
Find the cause (e.g. relay got stuck) and remove the error. (Use the circuit diagram of the machine.)
No
Shut down the control and switch off the machine.
Disconnect and secure the original wires. Insert a bridge between the output and input of Control is ready. (UEC 11x: Bridge between X6/12a and X5/9a PLB 62xx: Bridge between X9/3a and X9/7a)
Switch on the machine and confirm the Power interrupted message.
Does the message EMERGENCY STOP defective appear again?
Yes
UEC 11x or PLB 62xx defective
No
Excessive fall times of mechanical switches (relays, safety contactors, etc.) or defective electronic switches that are controlled by the output Control is ready. Use the circuit diagram of the machine tool for this purpose.

Bridge inserted

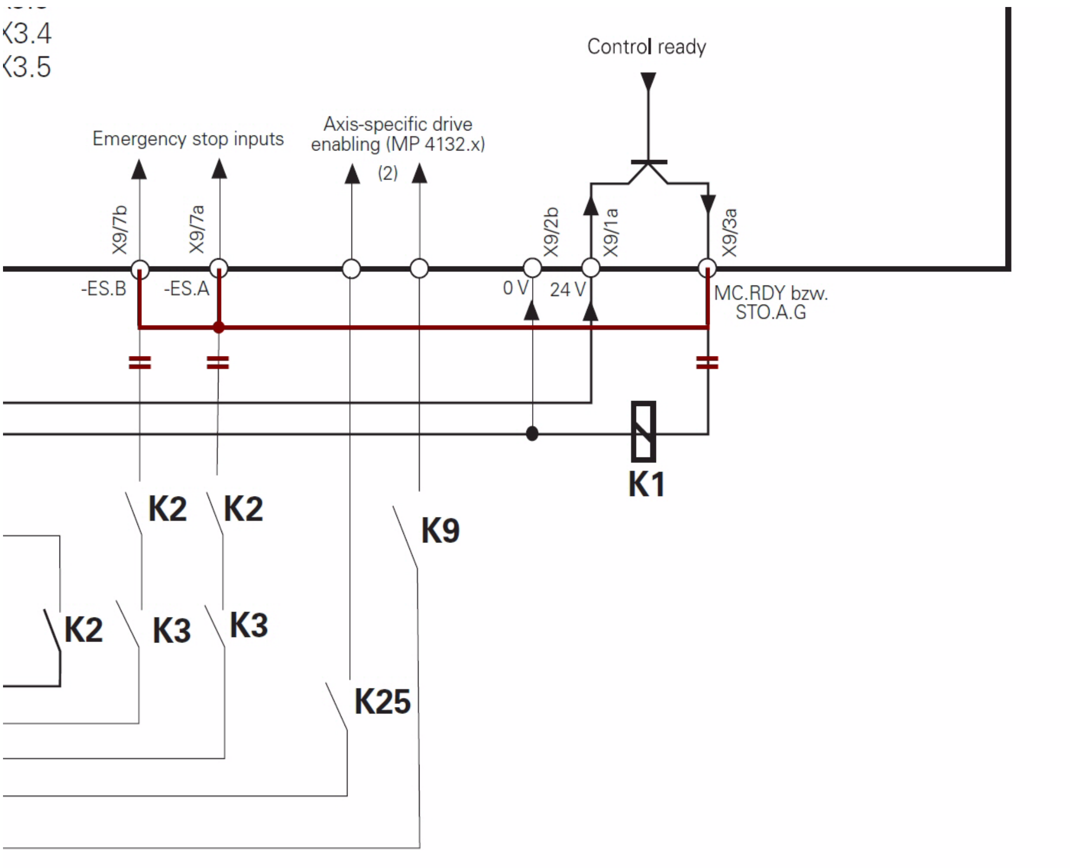


Figure: Bridge between output and control-is-ready acknowledgment on PLB 62xx

> Note
>
> The function of the **control-is-ready** output of a UEC 11x compact controller can also be tested with this method.

> Note
>
> Procedure for the EMERGENCY STOP test --> See "EMERGENCY STOP test during switch-on" on page 17 – 240.

17.2.2 Axis-specific drive enable via axis groups

The PLC inputs for the axis groups are defined in MP4132. The assignment of the axes to the axis groups can be seen from MP2040.

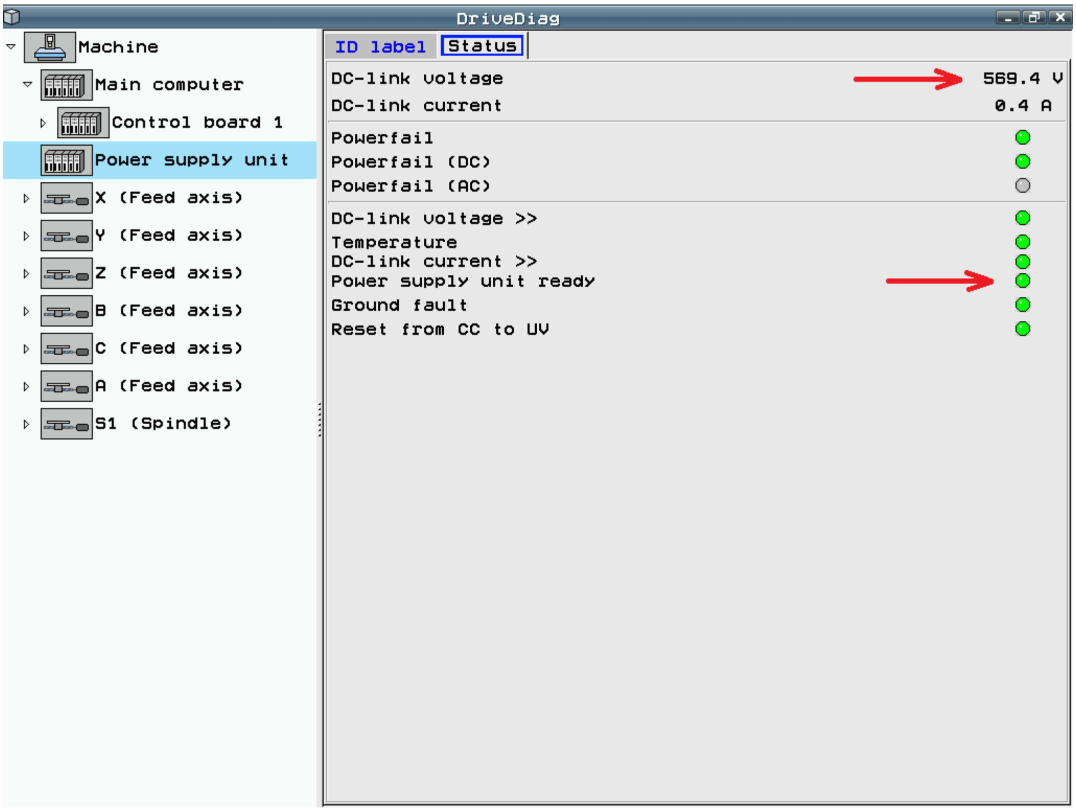
- Check (e.g. by means of the HSCI bus diagnosis or in the PLC table), whether the PLC input for the axis group to be traversed is set to the value 1.
- Measure, whether 24 V are available at the PLC input for the axis group to be traversed.

17.2.3 Readiness of the inverter system

- Switch on the machine.
- Check with DriveDiag, whether the power supply unit is ready and the DC-link voltage built up:

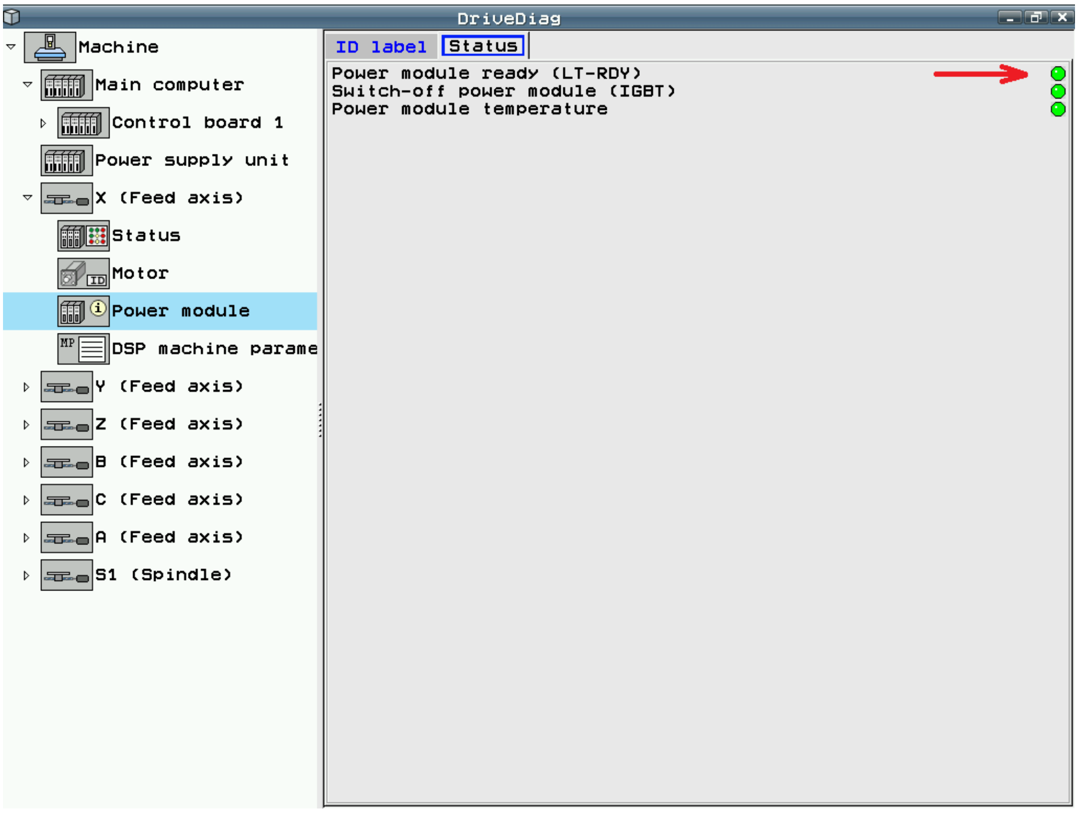
Power supply unit in DriveDiag

Activation --> See "DriveDiag" on page 9 – 91.



- Check with DriveDiag, whether the power modules are ready:

Power module in DriveDiag



Green READY LEDs on the drives

▶ Open the electrical cabinet and check, whether the **compact inverter / power supply unit / UEC 11x controller unit with integrated inverter** are **ready** (green READY LEDs). (Non-HEIDENHAIN inverters presumably feature such an LED or display as well.)

Inverter	Green LED
UEC 11x compact controller	READY
UE 1xx, UE 2xx B, UE 2xx D compact inverters	READY
UE 2xx compact inverter	+5 V
UR 2xx, UR 2xx D compact inverters	READY UV
UV 120, UV 140, UV 150, UV 1xx D, UVR 1xx, UVR 1xx D, UVR 160 DW power supply units	READY UV and POWER MODULE READY
UV 130 power supply unit	READY
UV 130 D power supply unit	READY UV

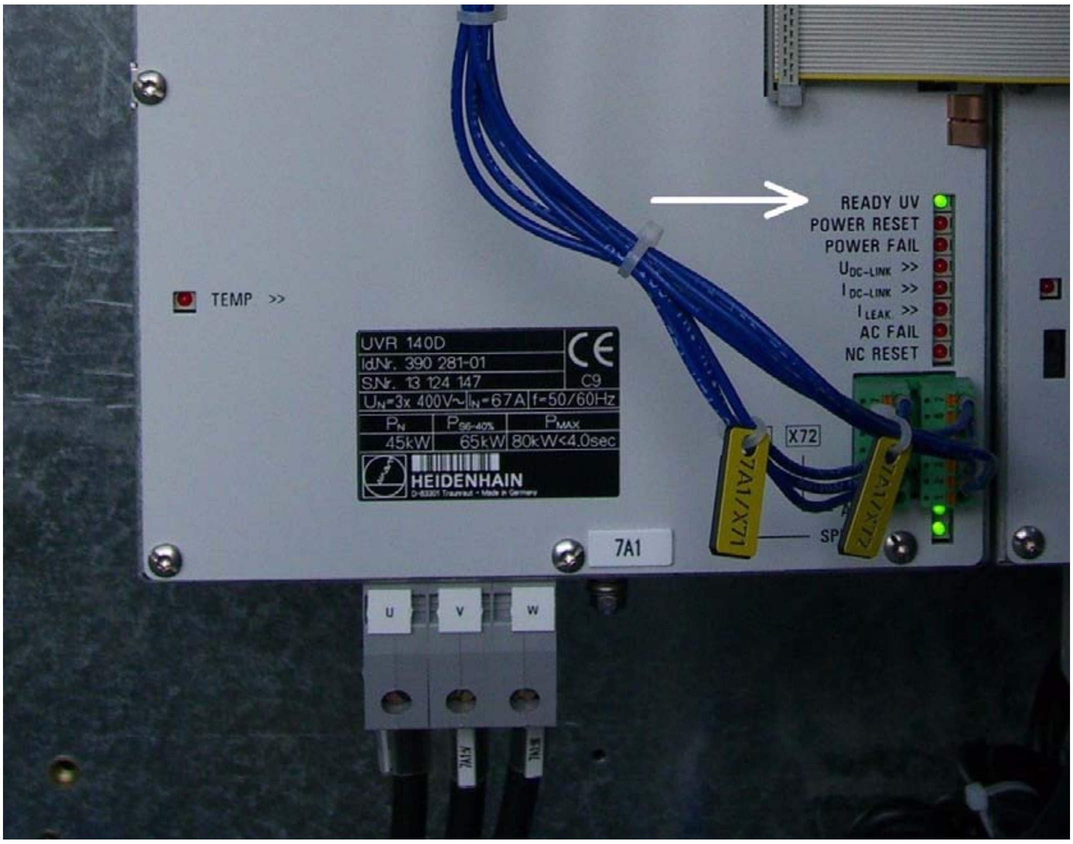


Figure: Green LED READY UV on UVR 140 D (the green LED POWER MODULE READY at the top left must also be lit)

▶ Check, whether the green LED **U DC-LINK ON** of the connector X70 (on the upper part of the front panel) is lit as well. This LED indicates that the charging contactor for the **DC link** has switched.

Note

The connector X70 and the associated green U DC-LINK ON LED do not exist on UEC 11x controller units. These units build up the DC link immediately when the primary voltage is switched on; no charging contactor is activated via the connector X70.

▶ Check in addition, whether the green LEDs (PULSE RELEASE) **SPINDLE/AXES** at the connectors X71 and X72 (in the lower part of the front panel) are lit. These LEDs indicate that the safety relays for the axes and the spindle(s) are on.

▶ Check if the green **READY** LED lights up on, e.g.

- the UEC 11x controller unit
- the compact inverter
- the UM power module (inverter module)
- HEIDENHAIN expansion board for the SIMODRIVE system

for the axis to be traversed / the spindle to be rotated.
(A non-HEIDENHAIN inverter is probably also equipped with a corresponding LED or display.)

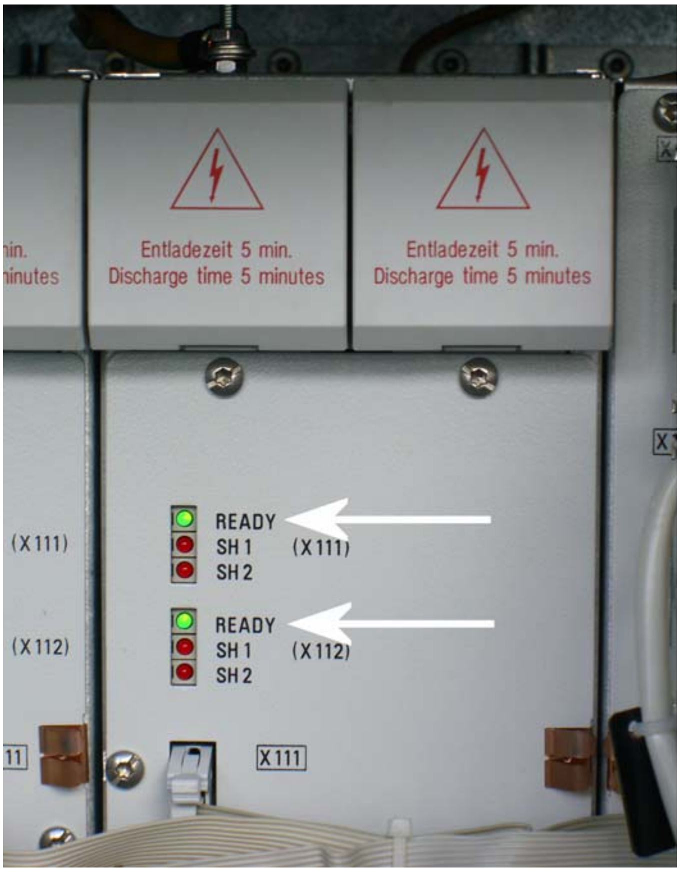


Figure: READY LEDs on a two-axis module

> **Note**
>
> The UEC 11x compact controller units feature LEDs that can change color from red to green.

> **Note**
>
> As long as the axis or the spindle are operating, the red LEDs **SH 1 / STO A** and **SH 2 / STO B** must not be lit!

If the READY LEDs are not lit, continue as follows:

▶ Check the power supply of the inverter system.

▶ Check the electrical cabinet (relays, wiring, etc.).

▶ Check the ribbon cables and the plug-type connectors at the inverter system.

> **Note**
>
> Use the circuit diagram of the machine tool for this purpose.
> Further inspection routines –> See Service Manual for Inverter Systems and Motors.

Note

Within the framework of standardization and adaptation to the machine directives 2006/42/EC binding as of January 1, 2010, the designation of the enabling signals SH 1 (Safe Stop 1) and SH 2 (Safe Stop 2) was changed for inverter models from the current production program.

The signal "**SH 1**" was renamed to "**STO A**" (Safe Torque Off - channel A) and the signal "**SH 2**" to "**STO B**" (Safe-Torque Off - channel B).

Red LED SH 1 / STO A

The old red **SH 1** LED has been superseded by the red **STO.A** LED.

- SH 1 means "Safe Stop 1" (*Sicherer Halt*)
- STO A means "Safe Torque Off cutout channel A"
- SH 1 / STO A is indicated by a red LED on the inverter system
- SH 1 / STO A is generated by the **processor (MC 6222, MC 6241) of the iTNC 530 HSCI**
- SH 1 / STO A is low-active, i.e. line-break proof

If the processor is not ready for operation or if an error is active, SH 1 / STO A is output.
The red SH 1 / STO A LED and the green READY LED at the inverter can never be lit a the same time. They are mutually locked.

Red LED SH 2 / STO B

The old red **SH 2** LED has been superseded by the red **STO.B** LED.

- SH 2 means "Safe Stop 2"
- STO B means "Safe Torque Off cutout channel B"
- SH2 / STO B is indicated by a red LED on the inverter system
- SH 2 / STO B is generated by the **controller (CC 61xx or UEC 11x) of the iTNC 530 HSCI**
- SH 2 / STO B is low-active, i.e. line-break proof

If an axis or spindle is not controlled, SH 2 / STO B is active and the red LED is on.
This is, for example, the case with clamped axes or if a spindle is not controlled.
SH 2 / STO B and READY are on simultaneously.

Figure: LEDs SH 1 / SH 2 and STO A / STO B on HEIDENHAIN UM units

Note

HEIDENHAIN interface cards for the SIMODRIVE system:
The cards for the plug-type connectors (ribbon cables) are equipped with the green **READY** LED and the red LEDs **SH 1** and **SH 2**.
For further information on the drives please refer to the service manual "Inverter Systems and Motors".

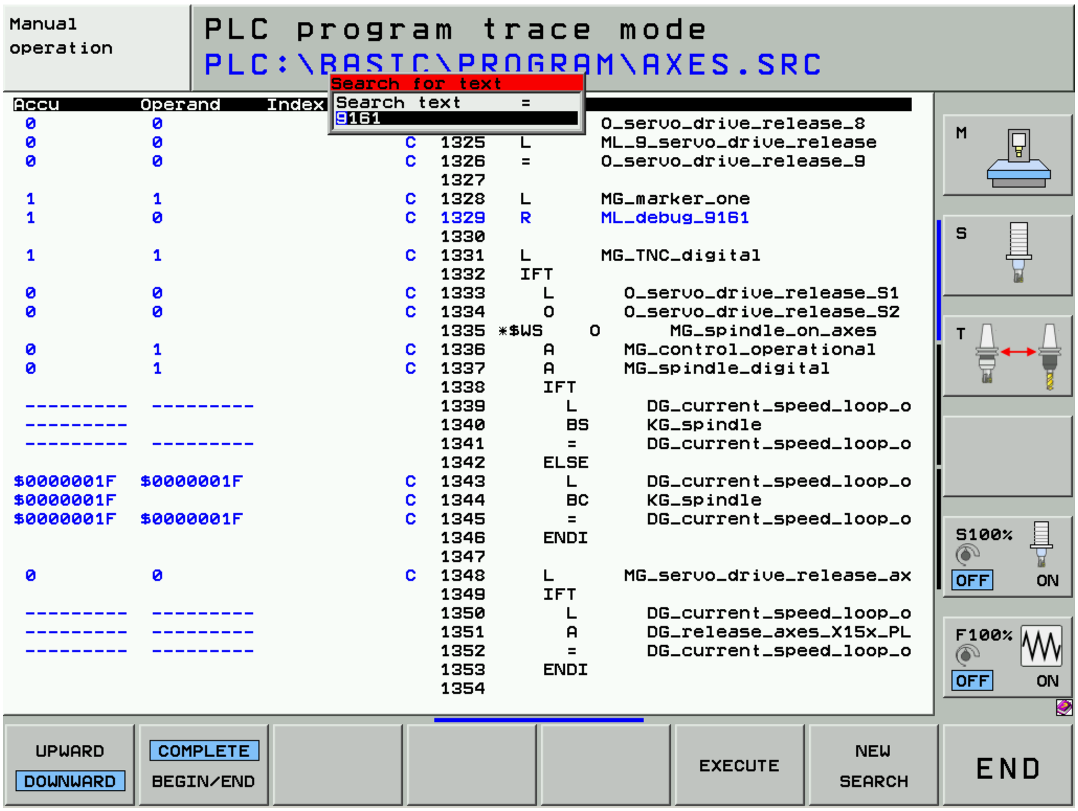
Figure: LEDs READY, SH 1 and SH 2 on a HEIDENHAIN expansion board

17.2.4 PLC modules, markers and words for drive enabling

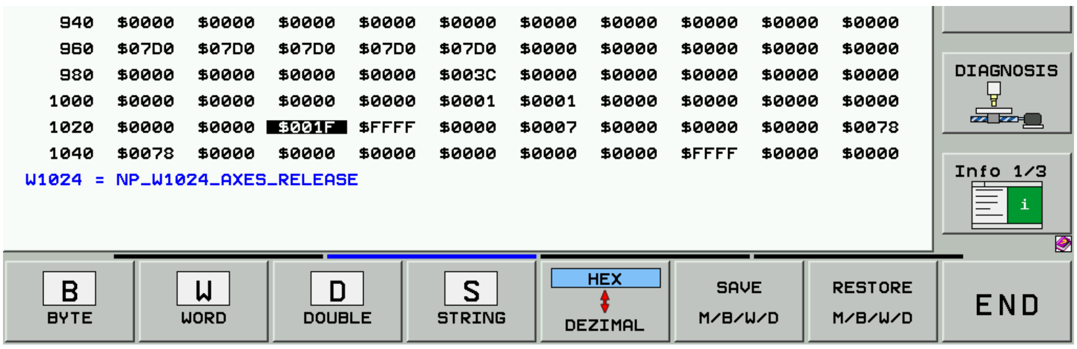
For the following investigations, the PLC diagnosis functions are used.
--> See “PLC diagnosis” on page 11 – 115.

> **Note**
>
> For these PLC analyzes support from the machine manufacturer may be helpful or often even necessary.

- Enter the PLC TRACE mode.
- Call the program section in which there is the PLC module 9161 (ask your machine tool builder).
- Search for 9161.
- Move and stop axes and spindles and observe the columns **Accu** and **Operand**. (With the PLC module 9161 the current and speed controllers are switched on individually for each axis.)



- Call the PLC TABLE of the words.
- Set the display to **HEX**.
- Check the value in the **word 1024** or the **double word 1100**.
  The word W1024 contains the axes enabled by the NC.



▶ Check the value in the **word W1060** or the **double word 1172**, or whether the marker 4563 is set.
The word W1060 contains the axes for which the feed rate was individually enabled by the PLC.
If the marker M4563 is set, the PLC enables the feed rate in all axes.
(Either W1060 or M4563 is used.)

▶ Check the value in the **word 1040** or the **double word 1132**.
The word W1040 contains the axes in which the control loop is opened by the PLC (e.g. clamped axes).

Note

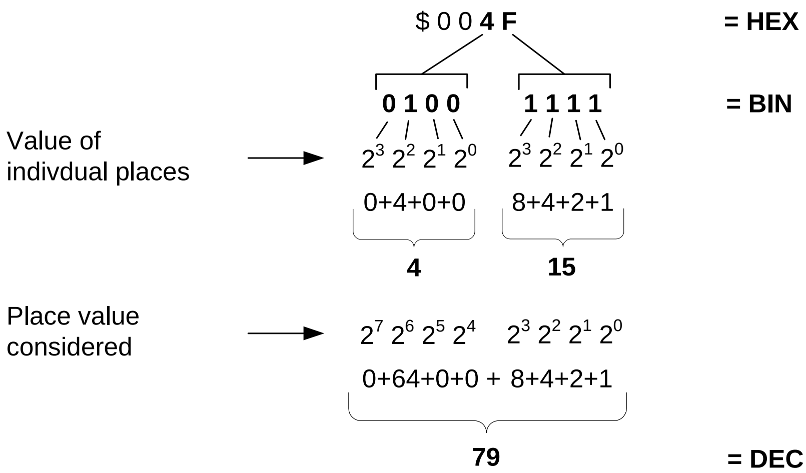
Whether words or double words are used, depends on the setting of bit 14 of MP4020:
Bit 14 = 0 --> PLC interface for up to 14 axes
Bit 14 = 1 --> Expanded PLC interface for up to 18 axes

Note

The value of the words is displayed in hexadecimal or decimal format.
The hexadecimal format is distinguished by a leading $.
A hexadecimal digit consists of 4 bits. I.e. you can, for example, calculate for which axes the feed rate is enabled.

Example of evaluating a word:

W1024 = $004F
The first HEX digit has the value F, i.e. the first 4 axes are enabled ($2^0+2^1+2^2+2^3$ = 1+2+4+8 = F).
The second HEX digit has the value 4, i.e. the 7th axis is enabled (2^2 = 4).
In binary format this is 0100 1111 and in decimal format the value 79.



17.3 EMERGENCY STOP test during switch-on

In the event of hazardous errors the control switches off the **Control-is-ready** output.
An EMERGENCY STOP must be generated. --> The EMERGENCY STOP chain must be interrupted.

Since this is a function important for the safety on the machine, it is checked via the **EMERGENCY STOP test** every time the line power is switched on.

One of the requirements of EN ISO 13849-1 is that the power-up test (EMERGENCY STOP test and braking test) must be repeated within no more than **168 hours**.

Note

The **Control-is-ready signal acknowledgment** has to occur within 1 s.

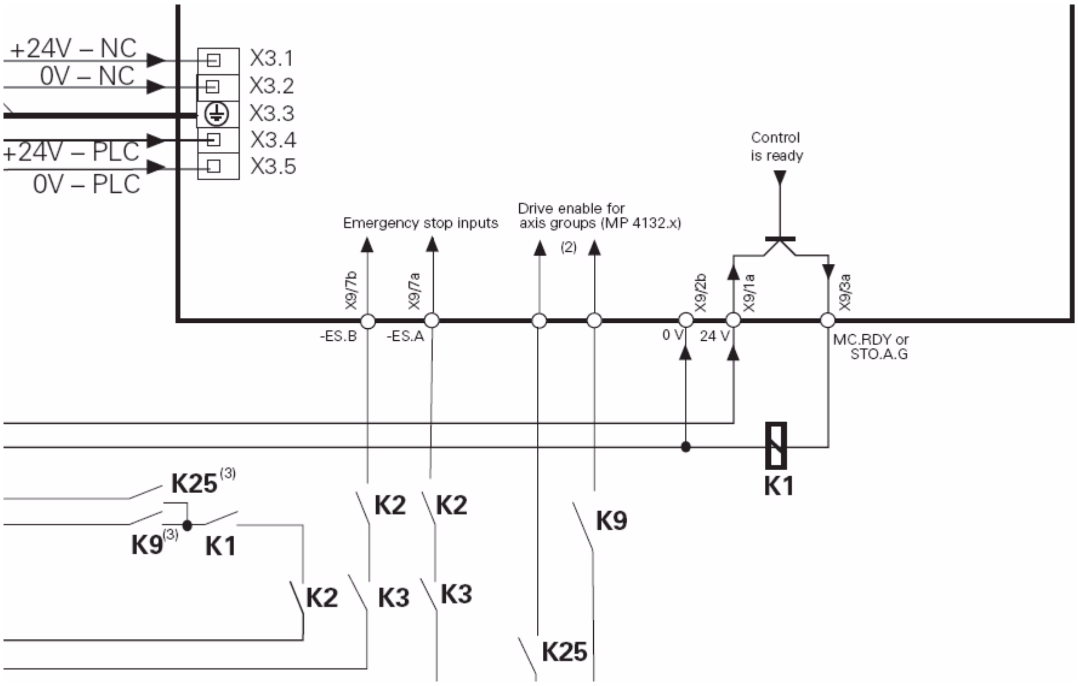


Figure: Detail of the basic circuit diagram with PL 62xx

Integration of iTNC 530 HSCI into EMERGENCY STOP chain	PLB 62xx	UEC 11x	Signal
Supply of control-is-ready output	X9, terminal 1a	X4, terminal 1a	- - -
Control-is-ready output	X9, terminal 3a	X6, terminal 12a	MC.RDY or STO.A.G (Safe Torque Off)
Input for control-is-ready acknowledgement	X9, terminal 7a	X5, terminal 9a	ES.A (emergency stop A)
	X9, terminal 7b	X5, terminal 10a	ES.B (emergency stop B)

Note

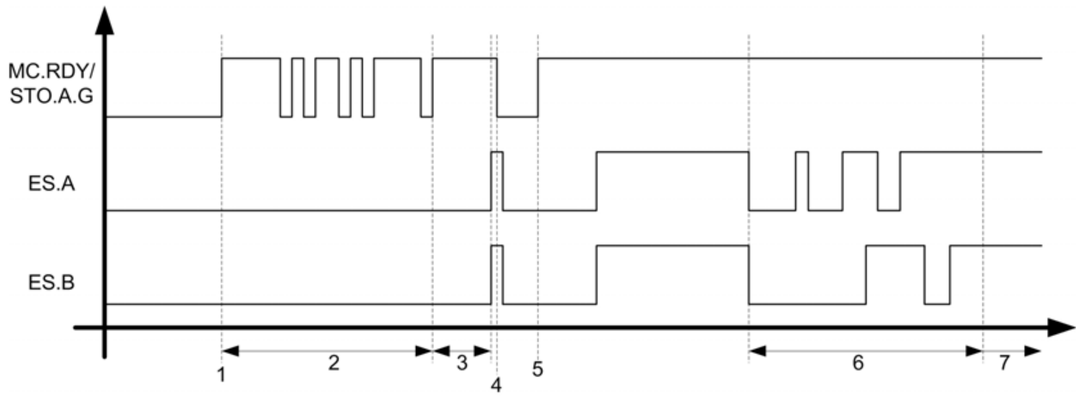
Either the control-is-ready output and input on the PLB 62xx system module or on the UEC 11x compact controller unit are used.

The emergency stop test was expanded for HSCI controls without functional safety (FS).
After the emergency stop test or a self-test is started, internal signals of the HSCI participants are now tested for proper function in a first phase. In a further, second phase the emergency stop test and brake test are conducted with external signals (ES.A, ES.B, STO.A.G).

But it still applies that, in the event of an error, a drop-off of the control-is-ready output (MC.RDY or STO.A.G) always triggers an emergency stop.

Time diagram

Time diagram of essential signals after the control is booted and during the self-test:



Step	Function	Screen display
1	Start of the self-test, immediately after compilation of the PLC program	Pop-up window **`Self test`** **`HSCI components are tested`**
2	Phase 1 of the self-test: Triggering and detection of essential internal signals are tested. In this phase of the self-test, the signals STO.A.G (X9/3a) and STOS.A.G (X9/2a) are set and deleted several times.	
3	Waiting for machine control voltage	**`RELAY EXT. DC VOLTAGE MISSING`**
4	Detection of the control voltage and cut-off of the STO.A.G/ STOS.A.G signal by the NC software. ES.A/ES.B must switch to zero within one second.	**`EMERGENCY STOP test`**
5	Switch-on of the STO.A.G/STOS.A.G signal by the NC software.	
6	Phase 2 of the self-test: Release and detection of the emergency stop signals ES.A and ES.B are tested internally. No hardware terminals are switched!	
7	Normal control operation Control voltage is on, STO.A.G/STOS.A.G output and ES.A/ES.B are at "1".	**`TRAVERSE REFERENCE POINTS`**

The following error messages can occur during the test:

- **`Timeout during self-test`**
  At least one HSCI participant has not answered a request or has not correctly detected a signal condition to be tested.
  Possible causes:
  - HSCI participant/device is defective
  - HSCI cabling is faulty
  - The hardware components used and/or software are not compatible with each other.

- **`Error during self-test`**
  The sequence of the individual test steps and processes in the self-test do not fulfill the requirements. A signal condition to be tested is not in the required initial condition.
  Possible causes:
  - HSCI participant/device is defective
  - HSCI cabling is faulty
  - The hardware components used and/or software are not compatible with each other.

- **`Error in self-test`**
  Has same causes as **`Error during self-test`**. However, after the cause of error is corrected (e.g. by closing the guard door), the test can be continued without the control having to restart.

Possible errors and error messages

- The message **`Relay external DC voltage missing`** does not disappear although the key **Control voltage ON** is pressed.
- When the key **Control voltage ON** is pressed, the error message **`EMERGENCY STOP defective`** is displayed.

Possible causes of error

- EMERGENCY STOP chain interrupted
- 24 V- supply of connector X9/1a (PLB 62xx) or X4/1a (UEC 11x) is missing
- MC defective
- Wiring defective, contactors defective or too slow

Troubleshooting

See ""Control is ready" output and input (EMERGENCY STOP chain)" on page 17 – 228.

18 Power supply

18.1 Introduction

A machine tool uses different voltages ranging from few volts up to almost 1000 volts.

Some examples:

- 5 V voltage for powering the electronics
- 24 V voltage for powering the PLC
- 12 V voltage for powering the handwheel
- 650 V dc-link voltage for powering the drives

The voltages are supplied from different voltage sources.

Some examples:

- 400 V primary voltage
- 24 V PLC power supply unit
- 24 V NC power supply unit
- Low-voltage power supply unit in the inverter or the UEC

In this chapter, the voltage sources are described as well as the systems and devices that operate with these voltages.

18.2 Supply voltages in the HSCI system

Two 24 V supply voltages

Two separate 24 V power supplies must be used to supply the **+24 V power** to the individual control components in the HSCI system:

- +24 V NC
- +24 V PLC

Insulation of the 24 V supply voltages

Designation	24 V-NC	24 V-PLC
Insulation	**Double basic insulation** according to EN 50 178 (PELV).	**Simple basic insulation according to EN 61800-5-1 (ELV)**
Reason	Electrical safety, e.g. accessibility of connecting elements supplied with +24 V NC voltage.	

DANGER

The two supply voltages must not be connected to each other.
The double basic insulation of the NC power supply would be removed through "mixed operation," i.e. +24 V NC voltage with double basic insulation connected to PLC components with simple basic insulation. This is not permitted in an HSCI system.

DANGER

VDE 0160/EN 50178 is to be observed for the +24 V NC voltage lines and cable routing.
Lines or cables for safely separated electric circuits thus must have double or reinforced insulation between the wire and the surface if they are routed without spatial separation from other cables and lines.

Powered components

The following components / functional groups are powered with **+24 V NC**:

- MC 62xx main computer unit
- IPC industrial computer
- BF2xx TFT visual display unit
- MB 6xx machine operating panel
- TE 6xx keyboard unit
- HSCI component (bus module and logic) of PLB 6xxx and PLB in UxC

The following components / functional groups are powered with **+24 V PLC**:

- PLB 6xxx input/output module
- PLD-H digital plug-in module for PLB
- PLA-H analog plug-in module for PLB
- Motor holding brakes
- PLC sensors and actors
- PLC component (PLC input/output assemblies) of PLB 6xxx and PLB in UxC

The CC 6xxx controller unit is powered via the X69 supply bus of the HEIDENHAIN supply module and X74 (+5 V).

When using a UEC

Total current consumption of all HSCI components	Power supply by...
< 3.5 A	24 V power supply unit of UEC 11x (connector X90)
> 3.5 A	PSL 130

Functional ground and protective ground

Grounding	Functional ground (signal ground)	Protective ground
Character	B	PE
Task	Functional equipotential bonding	Protective equipotential bonding
Connected devices	The signal-ground connections (B) of the HEIDENHAIN control components must be connected to the central functional ground of the machine. The same is true for 0 V of the NC supply voltage.	All protective-ground connections of the HEIDENHAIN control components must be connected to the central protective ground (PE) of the machine. The same is true for 0 V of the PLC supply voltage.
Minimum diameter	6 mm^2	6 mm^2
Connection	The central signal ground and the central protective ground must be connected with each other once for the machine!	

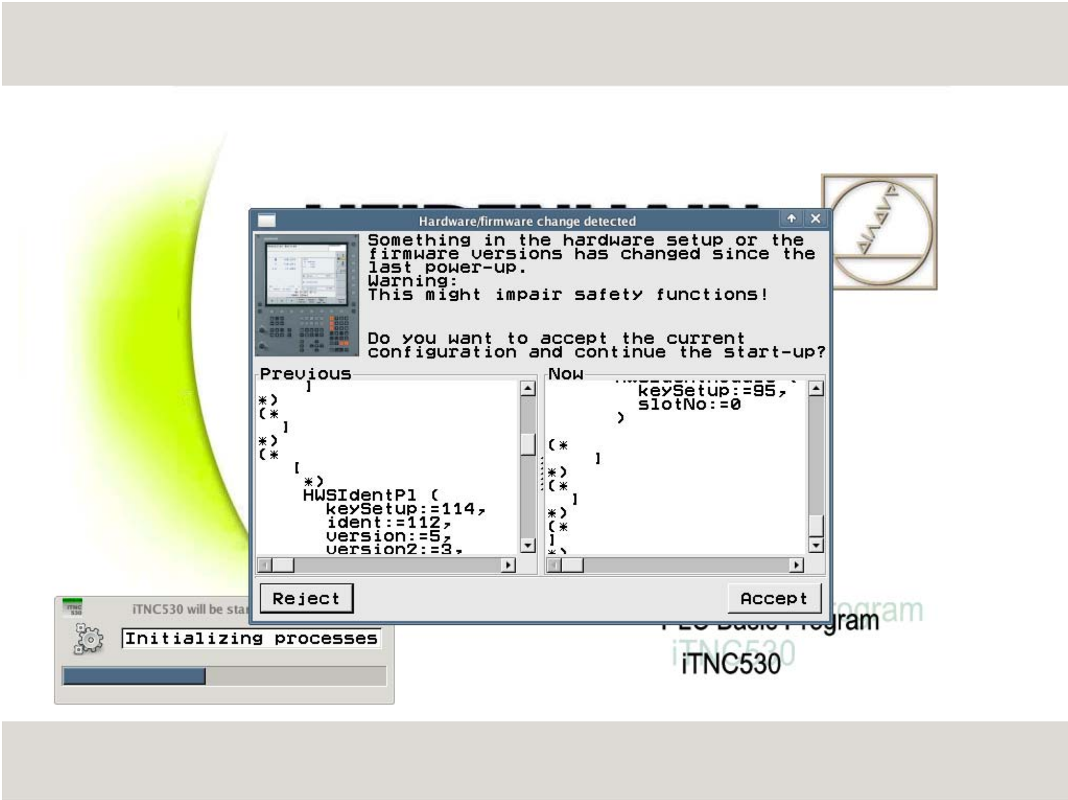
> **Note**
>
> The machine tool builder defined the line cross section of the +24 V NC power supply for the power consumption of the connected devices. The protection was defined from the line cross section according to EN 60204-1.
> The **cross section of the +24 V NC supply line** must be **at least 0.75 mm²**!

> **Note**
>
> The motor brakes are controlled by 24 V PLC voltage. The trigger circuit and the brake itself are usually separated from the line power only by basic insulation according to EN 618100-5-1 (also EN50178). Also, other add-on devices that are controlled by PLC circuits usually have only basic insulation from the line power.

Message Hardware/firmware change detected

If the 24 V power of an HSCI component is already missing on power-on, the HSCI bus system does not detect this component.
The message **`Hardware/firmware change detected`** is displayed during startup.

Example:
During startup, the 24 V NC supply is missing at X3/terminal 1 of a PLB 62xx.
The PLB 62xx is not detected by the HSCI bus system.
The following message appears:



18.3 PSL 130 low-voltage power supply unit

The PSL 130 power supply unit was especially designed to power HSCI components.

It provides two output voltages of 24 V each.

Output voltage of PSL 130	Tolerance	Insulation	Output current
+24 V NC	+/- 5 %	Double insulation	Max. 20 A
+24 V PLC	Variations between 20 V and 28 V, depending on the load	Basic insulation	Max. 20 A

These two output voltages can also be connected in parallel and used as desired for NC or PLC supply.

Power supply for the PSL 130	Connection for PSL 130 power supply	HSCI components powered by PSL 130
Phases L1 and L2 (400 Vac +/- 10%, 50 Hz)	X33	■ MC 6222 ■ MC 6241 ■ MB 620 ■ PLB 62xx ■ PLB 61xx
DC-link voltage Uz (400 Vdc to 750 Vdc)	Conductor bar	

Note

The connection to X33 is obligatory, that to the conductor bar optional, though recommended by HEIDENHAIN.

Further information and connector layouts --> See "Connector designations and pin layouts" on page 28 – 453.

Power consumption: max. 1000 W
Internal protection: 4 A

LED display The operational status indicator is the green **ON** LED:

Functional check

- Is the green **ON** LED lit?
- Are the fans running?
- Are the output voltages +24 V NC and +24 V PLC present?

Possible causes of error

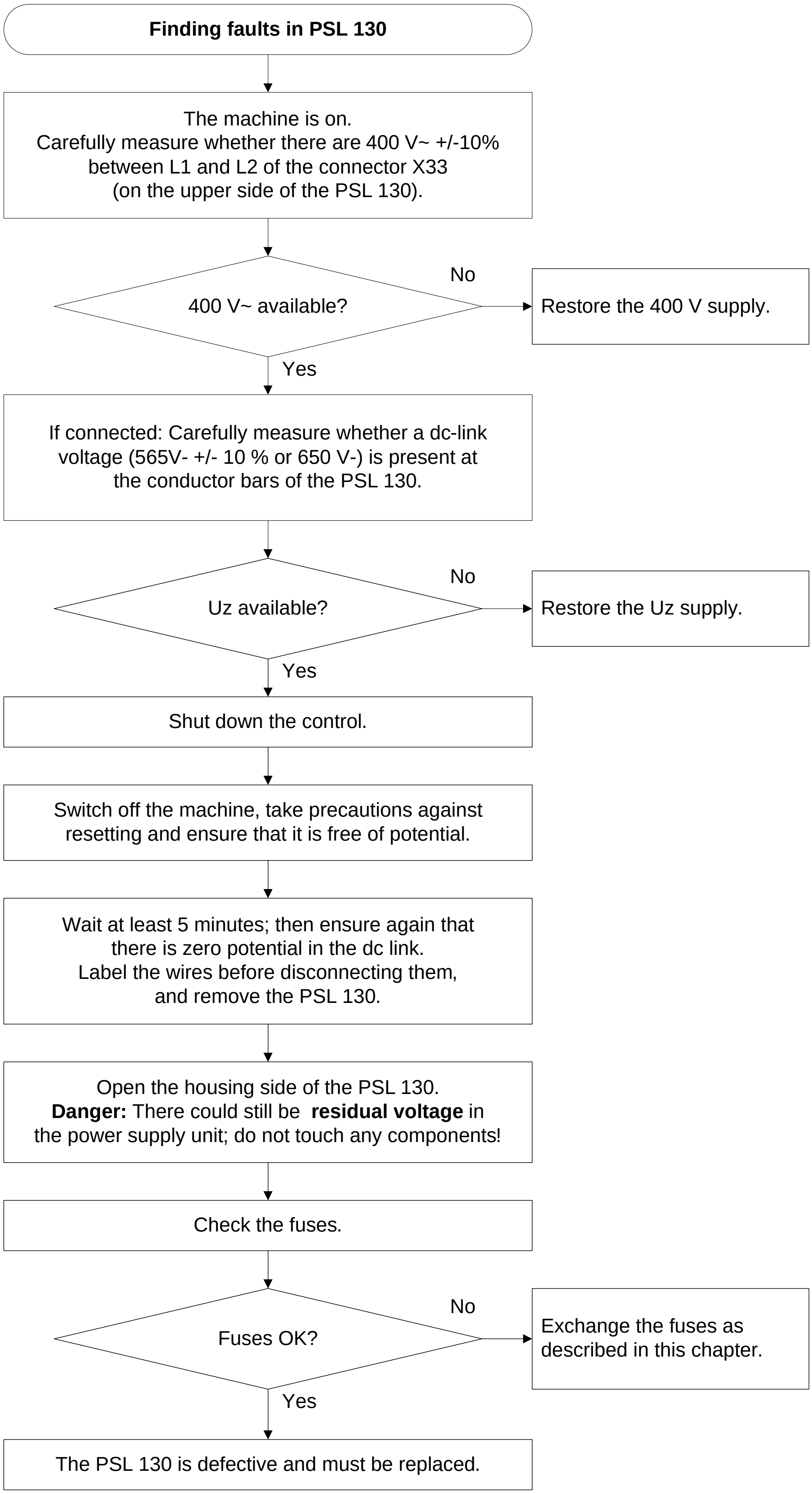
- Supply voltage missing at L1 and L2
- Fan has failed
- Fuse on board of the PSL 130 has blown
- PSL 130 defective
- DC-link voltage missing

Troubleshooting

DANGER

Danger to life due to high voltages and currents!

Flowchart



Finding faults in PSL 130
The machine is on.
Carefully measure whether there are 400 V~ +/-10%
between L1 and L2 of the connector X33
(on the upper side of the PSL 130).
400 V~ available?
No
Restore the 400 V supply.
Yes
If connected: Carefully measure whether a dc-link
voltage (565V- +/- 10 % or 650 V-) is present at
the conductor bars of the PSL 130.
Uz available?
No
Restore the Uz supply.
Yes
Shut down the control.
Switch off the machine, take precautions against
resetting and ensure that it is free of potential.
Wait at least 5 minutes; then ensure again that
there is zero potential in the dc link.
Label the wires before disconnecting them,
and remove the PSL 130.
Open the housing side of the PSL 130.
Danger: There could still be **residual voltage** in
the power supply unit; do not touch any components!
Check the fuses.
Fuses OK?
No
Exchange the fuses as
described in this chapter.
Yes
The PSL 130 is defective and must be replaced.

Fuses in the PSL 130

DANGER

Danger of electrical shock!
A switching power supply is located in the PSL 130. This switching power supply may still be under voltage although separated from the power source. (Without consumer, the voltage on the board only reduces very slowly.)
Therefore, do not touch the board or the fuses with bare hands!
Use insulated pincers, if you intend to remove the fuses!

Attention

Be careful not to touch any components on the power supply board sensitive to electrostatic discharge and observe the ESD regulations!

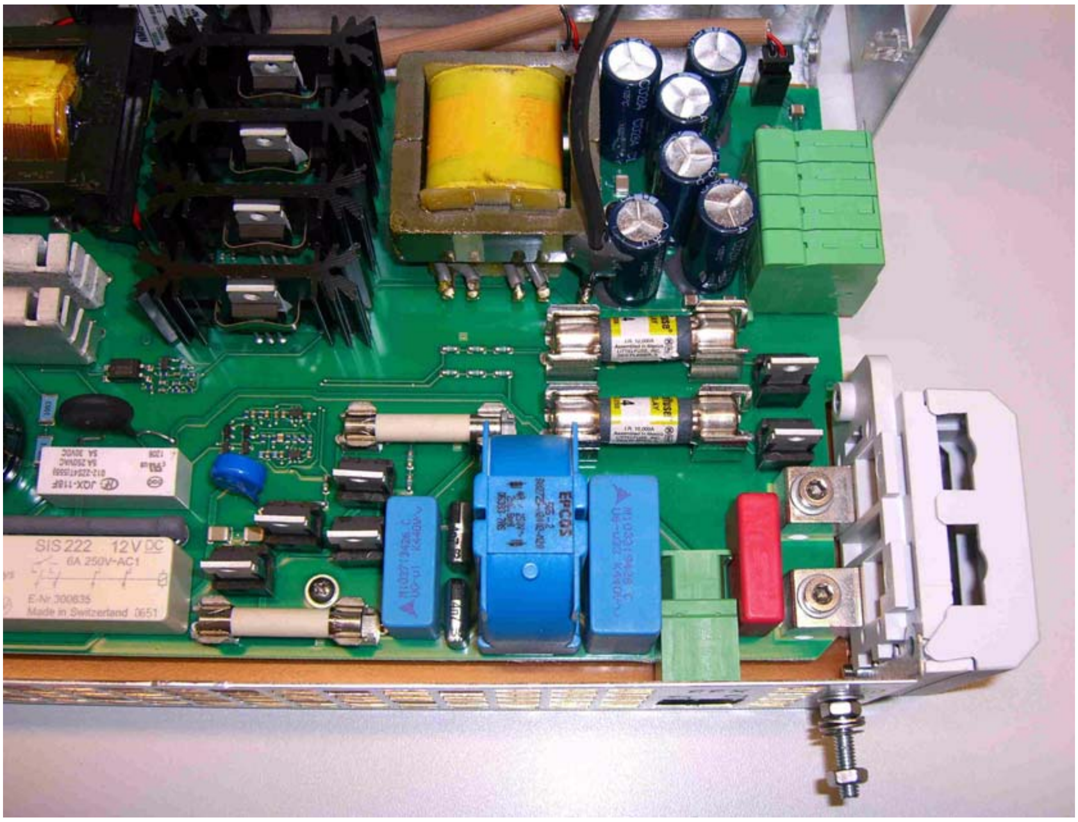


Photo: Position of the fuses in the PSL 130

Attention

Use only original replacement fuses.

Mounting the PSL 130

DANGER

Do not confuse the leads for the +24 V NC and +24 V PLC supply voltages!
Restore the ground connections by means of lines and/or conductor bars!

18.4 PSL 135 low-voltage power supply unit

The PSL 135 power supply unit was especially designed to power HSCI components when non-HEIDENHAIN inverters are used.

It provides three output voltages ...

Output voltage of PSL 135	**Tolerance**	**Insulation**	**Output current**
+24 V NC	+/- 5 %	Double insulation	Max. 14.5 A
+24 V PLC	Variations between 20 V and 28 V, depending on the load	Basic insulation	Max. 20 A
+5 V	+/- 5 %		Max. 20 A

... as well as the low voltages for the supply bus X69.

The two 24 V output voltages can also be connected in parallel and used as desired for NC or PLC supply.

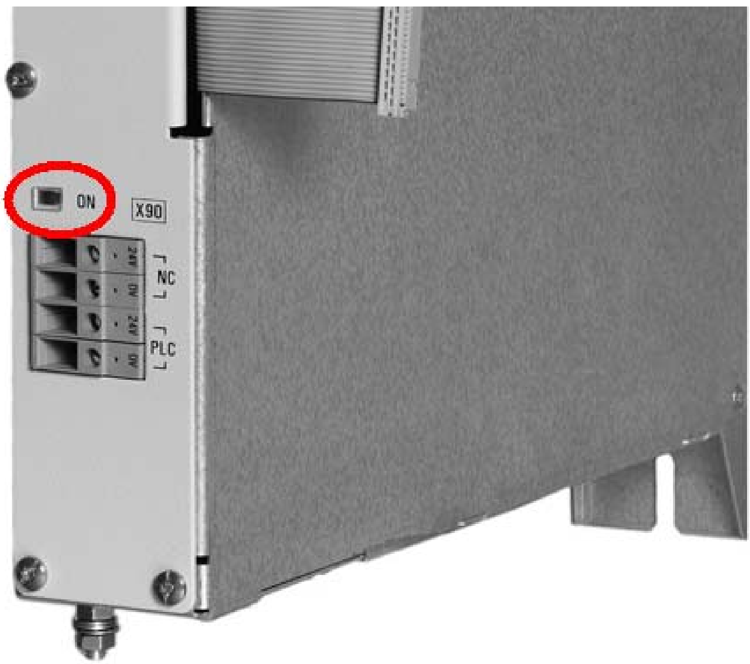
Power supply for PSL 135	**Connection for PSL 135 power supply**	**HSCI components powered by PSL 135**
Phases L1 and L2 (400 Vac +/- 10%)	X31	■ MC 6222 ■ MC 6241 ■ MB 620 ■ PLB 62xx ■ PLB 61xx ■ CC 61xx
DC-link voltage Uz (400 V - 750 V)		

Further information and connector layouts --> See "Connector designations and pin layouts" on page 28 – 453.

Power consumption: max. 1000 W
Internal protection: 4 A

LED display

The operational status indicator is the green **ON** LED:



Functional check

- Is the green **ON** LED lit?
- Are the fans running?
- Are the output voltages +24 V NC and +24 V PLC present?
- Is the +5 V output voltage present?

Possible causes of error

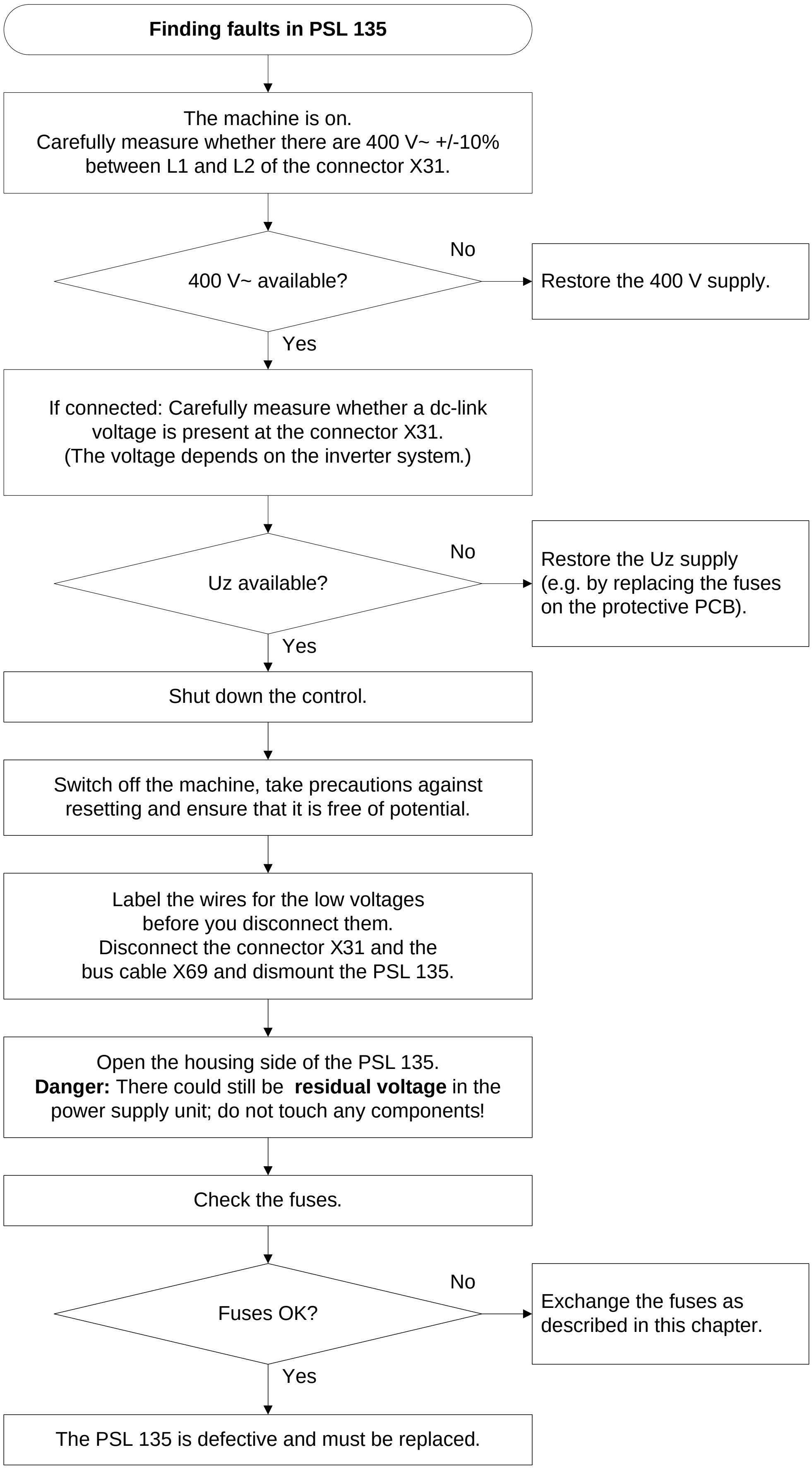
- Supply voltage missing at L1 and L2
- Fan has failed
- Fuse on board of the PSL 135 has blown
- PSL 135 defective
- DC-link voltage missing
- Fuse on the protective PCB has blown
(connected to the conductor bar of a Simodrive system)

Troubleshooting

DANGER

Danger to life due to high voltages and currents!

Flowchart

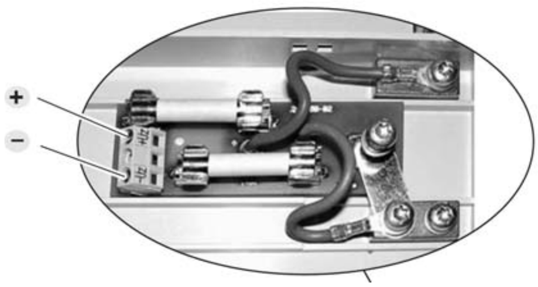

Finding faults in PSL 135
The machine is on.
Carefully measure whether there are 400 V~ +/-10% between L1 and L2 of the connector X31.
400 V~ available?
No
Restore the 400 V supply.
Yes
If connected: Carefully measure whether a dc-link voltage is present at the connector X31.
(The voltage depends on the inverter system.)
Uz available?
No
Restore the Uz supply (e.g. by replacing the fuses on the protective PCB).
Yes
Shut down the control.
Switch off the machine, take precautions against resetting and ensure that it is free of potential.
Label the wires for the low voltages before you disconnect them.
Disconnect the connector X31 and the bus cable X69 and dismount the PSL 135.
Open the housing side of the PSL 135.
Danger: There could still be residual voltage in the power supply unit; do not touch any components!
Check the fuses.
Fuses OK?
No
Exchange the fuses as described in this chapter.
Yes
The PSL 135 is defective and must be replaced.

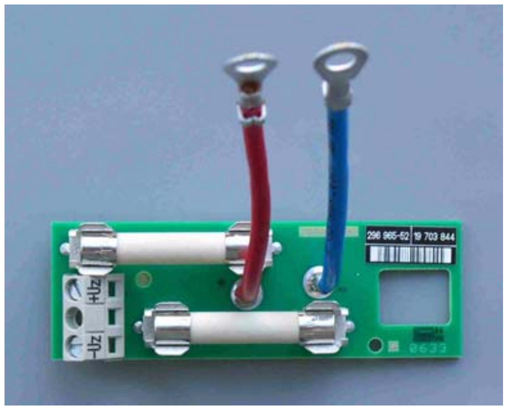
Uz of a HEIDENHAIN inverter system

When using a non-HEIDENHAIN inverter system (e.g., Simodrive 611), the power supply from the DC-link is mostly conducted via a protective PCB. This board is mounted to the conductor bars of the
non-HEIDENHAIN inverter.

DANGER

Danger to life due to high voltages and currents!
Only replace the fuses while the device is free of potential!





Figures: Protective PCB

Fuses in the PSL 135

DANGER

Danger of electrical shock!
A switching power supply is located in the PSL 135. This switching power supply may still be under voltage although separated from the power source. (Without consumer, the voltage on the board only reduces very slowly.)
Therefore, do not touch the board or the fuses with bare hands!
Use insulated pincers, if you intend to remove the fuses!

Attention

Be careful not to touch any components on the power supply board sensitive to electrostatic discharge and observe the ESD regulations!

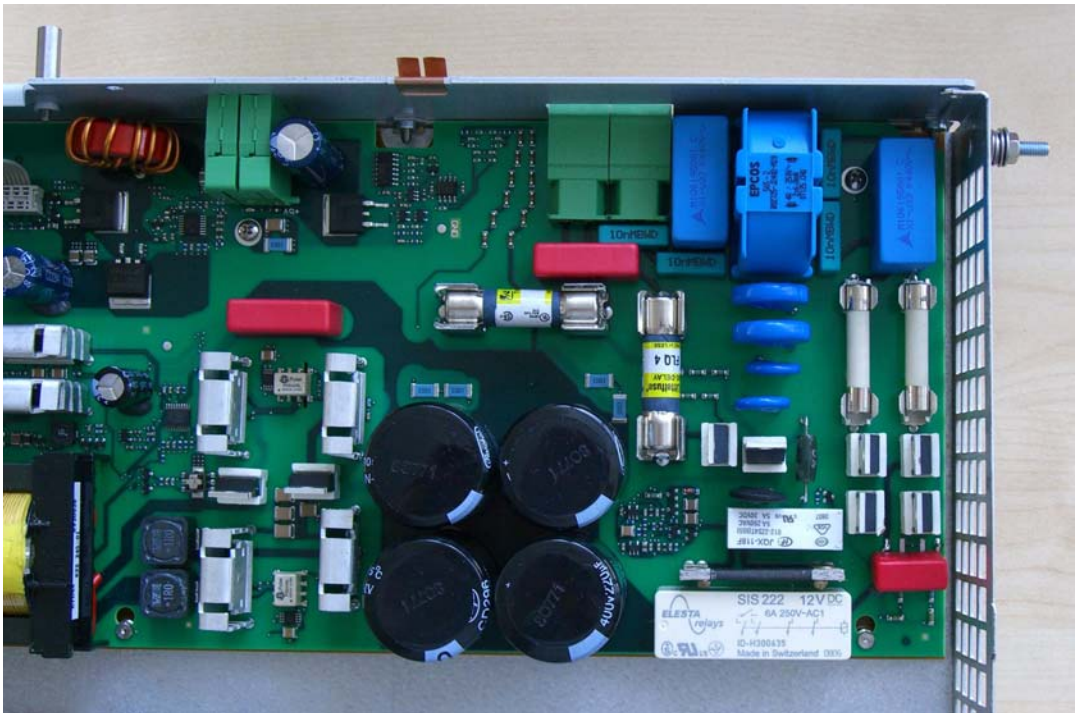


Photo: Position of the fuses in the PSL 135

Attention

Use only original replacement fuses.

Mounting the PSL 135

DANGER

Do not confuse the leads for the +24 V NC and +24 V PLC supply voltages!
Restore the ground connections by means of lines and/or conductor bars!

18.5 Power supply for the MC 62xx computer unit

Device powering the MC 62xx (alternatives)	Connector for MC 62xx power supply	Devices powered by the MC 62xx
■ UEC 11x ■ PSL 130 ■ PSL 135	X101	■ USB devices ■ TE 6xx

Further information and connector layout of X101 --> See "Connector designations and pin layouts" on page 28 – 453.

Supply voltage: **+24 V NC**
Power consumption of MC 6241: 40 W
Power consumption of MC 6222: 60 W

Note

The MC 62xx features "power distribution switches."
These are electronic fuses that separate USB devices that draw too much current from the MC 62xx.

LED display

Green LEDs indicate that the connector X101 is correctly supplied with 24 V.
In the MC 6222, you can see them through the grating on the rear side:

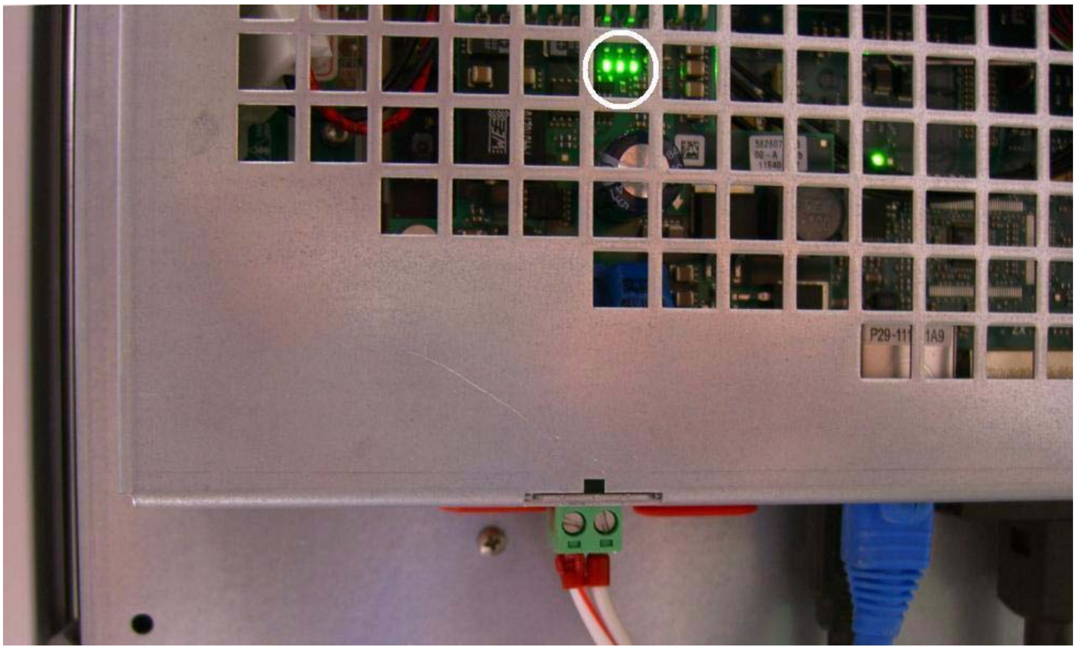


Figure: Rear side of MC 6222; LEDs indicate that the power supply is correct.

Position of the LEDs on the picture	Designation of the LED	Meaning
Left	D1	**+5 V**
Center	D2	**-RES.PS** There is no problem at the power source (UEC 11x, PSL 130, PSL 135).
Right	D3	**+ 12 V**

Error messages

> Note
>
> The most important voltage for powering the electronics is the 5 V supply voltage. The control monitors these 5 V and generates an error message (e.g. **`5-V power supply too low`**), if the deviation becomes too large.

Errors

- The screen remains black.
- The connected USB device cannot be addressed.
- The device connected via RS-232-C cannot be addressed.

Troubleshooting

- Observe the LEDs. --> In normal operation all three green LEDs must be lit.
- Measure the 24 V voltage at X101.
- Try USB devices with lower current consumption.

> Note
>
> If USB components that are connected to X141/X142 require more than 0.5 A, a separate power supply becomes necessary for these components. One possibility is the USB hub from HEIDENHAIN.

- Disconnect all USB devices, the RS-232-C and Ethernet interfaces and the TE 6xx keyboard unit from the MC 62xx.

18.6 Buffer battery

Introduction

The buffer battery ...

- is the power source for the RAM when the machine is switched off.
- is mounted inside the MC 62xx.
- has a rated voltage of 3 V.
- has a typical service life of three to five years.

For safeguarding the RAM data during battery exchange, a special capacitor ("Gold cap") was integrated onto the PCB of MC 62xx. This capacitor stores the RAM content for approx. one day without battery.

The following information is stored in the battery-buffered memory:

- Non-volatile PLC operands
- Most recent log entries
- Information about the trace function
- Information about program interruption
- Information from absolute encoders with EnDat interface
- Information about the boot process
- Information about errors

Message

> Attention
>
> If the voltage of the buffer battery falls below 2.6 V, the error message **Replace buffer battery** is generated.
> The error message reappears every 30 minutes.
> **Replace the buffer battery at the next opportunity!**

Figure: "Replace buffer battery" message after power-on

Checking the charge status of the "Gold cap"

Before you replace the buffer battery, the charge status of the Gold cap should be checked:

- Enter the code number 79513. --> See "Information menu" on page 18 – 261.
- Read the value in the line U [ACCU]. --> The voltage must be **>= 3 V**.

> Note
>
> The capacitor (Gold cap) is only being charged when the iTNC is switched on. If the Gold cap is still not sufficiently charged, wait a few seconds and then enter the code number 79513 again to read the new voltage value.
> If the voltage of the Gold cap does not reach 3 V or more, the MC must be replaced.

Exchanging the buffer battery of the MC 6222

To exchange the buffer battery of the MC 6222, proceed as follows:

- As a precaution back up the non-volatile PLC markers and words in the RAM on the data medium. --> See "Non-volatile PLC markers and words" on page 11 – 134.
- Back up the data. --> See "Data backup" on page 14 – 181.
- Switch off the machine, take precautions against restart, ensure that the equipment is free of potential.
- Open the console.

DANGER

Housing parts of the MC 6222 need to be removed to replace the buffer battery.
The device must not be under power; observe the safety precautions.
---> See "Safety precautions" on page 2 – 15.

- Screw off the rear cover plate.

Note

Replacing the buffer battery may be easier, if you dismount the entire MC 6222 from the console. In this event, label all cables before you disconnect them.

- Remove the cover plate.

Attention

Take ESD-preventive measures (See "ESD protection" on page 29 – 520) and work with great care!

- Remove the old buffer battery.
- Insert the new buffer battery.

Due to the non-symmetric shape of the battery there is only one possibility of inserting.
Battery type: Lithium battery, type CR 2450N (Renata), ID 315878-01

Note

The buffer battery can be purchased from specialized dealers (e.g. www.renata.com).

▶ Screw the cover plate back on and remount the MC 6222 in the console.

Note

If the battery was exchanged although the Gold cap was not loaded sufficiently, the battery-buffered ranges of the RAM may be deleted. The non-volatile PLC markers and words belong to this range. This may mean that several components of the machine must be set again (tool changer, swivel head, etc.) --> Ask the machine tool builder!
The datum and the time of the BIOS setting were lost. Set these values again.
--> See "Setting the system time" on page 13 – 173.

Exchanging the buffer battery of the MC 6241

To exchange the buffer battery of the MC 6241, proceed as follows:

▶ As a precaution back up the condition of non-volatile PLC markers and words from the RAM to the data medium. --> See "Non-volatile PLC markers and words" on page 11 – 134.

▶ Back up the data. --> See "Data backup" on page 14 – 181.

▶ Switch off the machine, take precautions against restart, ensure that the equipment is free of potential.

▶ Label the cables and disconnect them from the MC 6241.

▶ Remove the MC 6241 from the electrical cabinet.

DANGER

Housing parts of the MC 6241 need to be removed to replace the buffer battery.
The device must not be under power; observe the safety precautions.
---> See "Safety precautions" on page 2 – 15.

▶ Screw off the lateral cover plate.

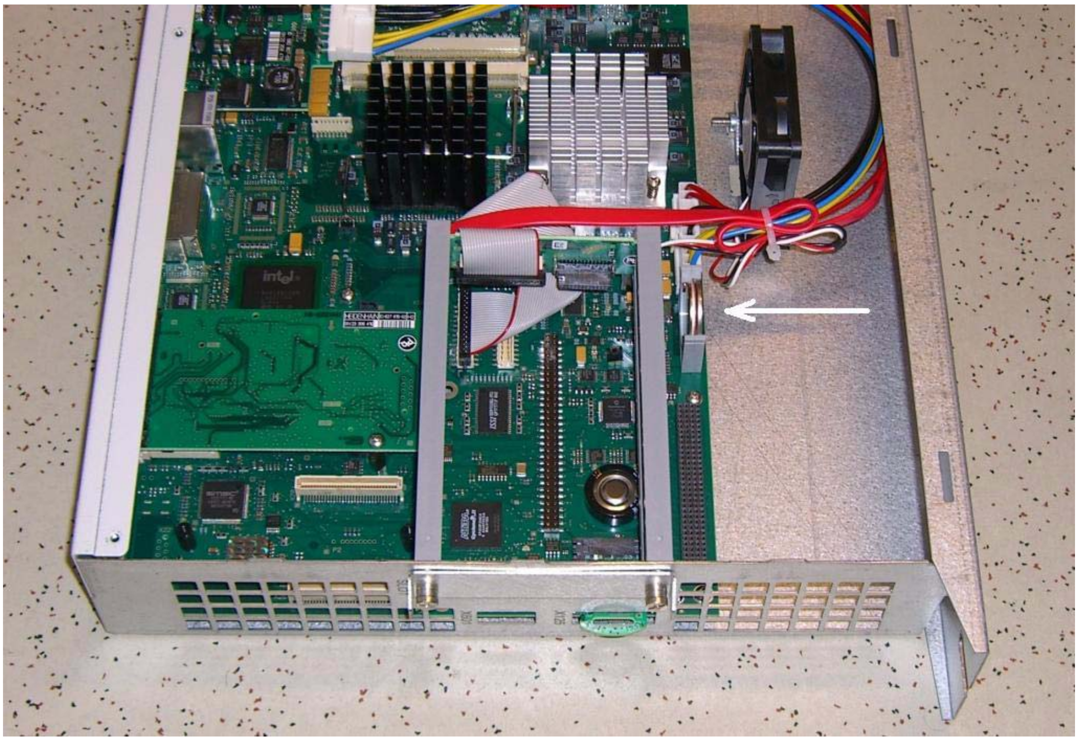
▶ Remove the cover plate.

Attention

Take ESD-preventive measures (See "ESD protection" on page 29 – 520) and work with great care!

▶ Remove the old buffer battery.

▶ Insert the new buffer battery.



Due to the non-symmetric shape of the battery there is only one possibility of inserting.
Battery type: Lithium battery, type CR 2450N (Renata), ID 315878-01

Note

The buffer battery can be purchased from specialized dealers (e.g. www.renata.com).

▶ Screw the cover plate back on and remount the MC 6241.

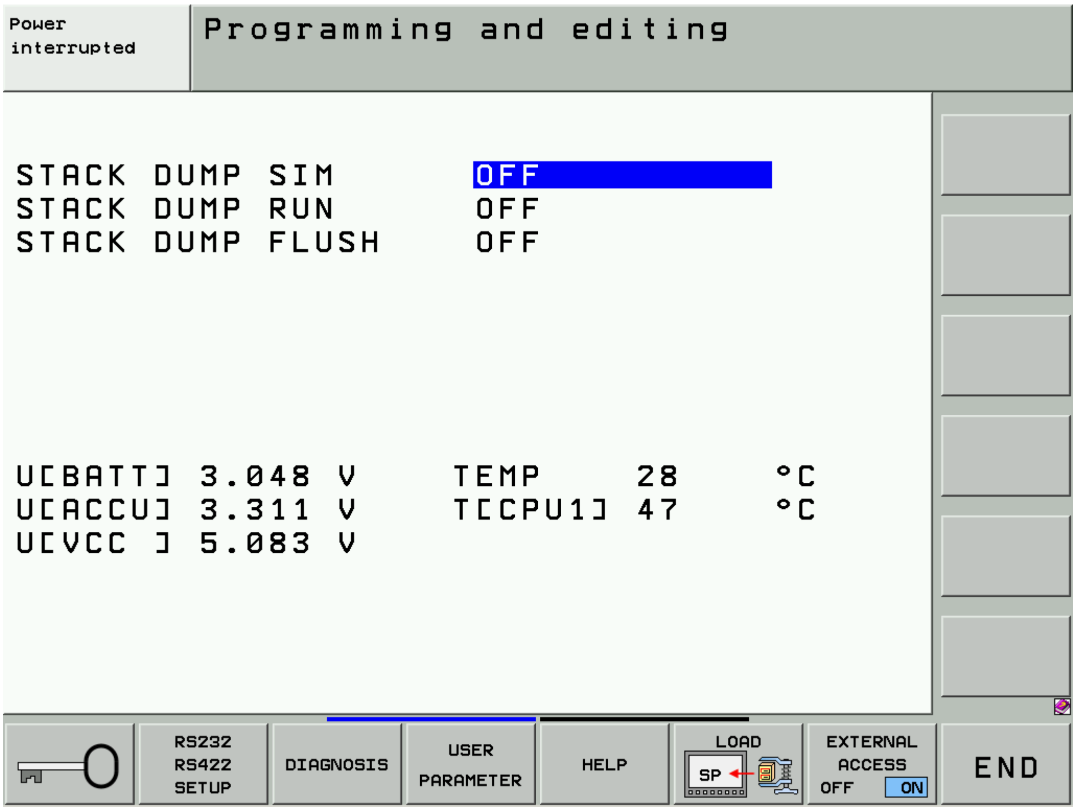
Note

If the battery was exchanged although the Gold cap was not loaded sufficiently, the battery-buffered ranges of the RAM may be deleted. The non-volatile PLC markers and words belong to this range. This may mean that several components of the machine must be set again (tool changer, swivel head, etc.) --> Ask the machine tool builder!
The datum and the time of the BIOS setting were lost. Set these values again.
--> See "Setting the system time" on page 13 – 173.

18.7 Information menu

Activation

- Enter the code number **79513**.
- Press ENTER to confirm. --> The following screen appears:



Description

The following information is displayed on the screen (the stack information is not important for the service technician):

U [BATT]	**3.049 V**	Voltage of buffer battery
U [ACCU]	**3.049 V**	Charge status of the capacitor ("Goldc ap")
U [VCC]	**4.891 V**	Supply voltage 5 V
TEMP	**23 °C**	Temperature in the housing of the MC
T [CPU1]	**32 °C**	Temperature of the CPU1

Note

These values are updated internally every minute.
The display is only refreshed when the Info menu is called again, i.e. the code number **79513** must be entered again.

18.8 Power supply of the CC 61xx feedback control unit

Device powering the CC 61xx (alternatives)	Connector for the CC 61xx power supply	Devices powered by the CC 61xx
HEIDENHAIN inverters: ■ UE ■ UR ■ UV ■ UVR HEIDENHAIN low-voltage power supply unit: ■ PSL 135	X69 (supply bus) X74 (additional +5 V)	■ Speed encoders ■ Position encoders

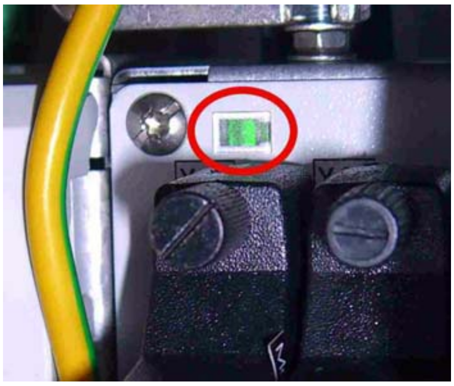
Further information and connector layout of X69 and X74 --> See "Connector designations and pin layouts" on page 28 – 453.

Note

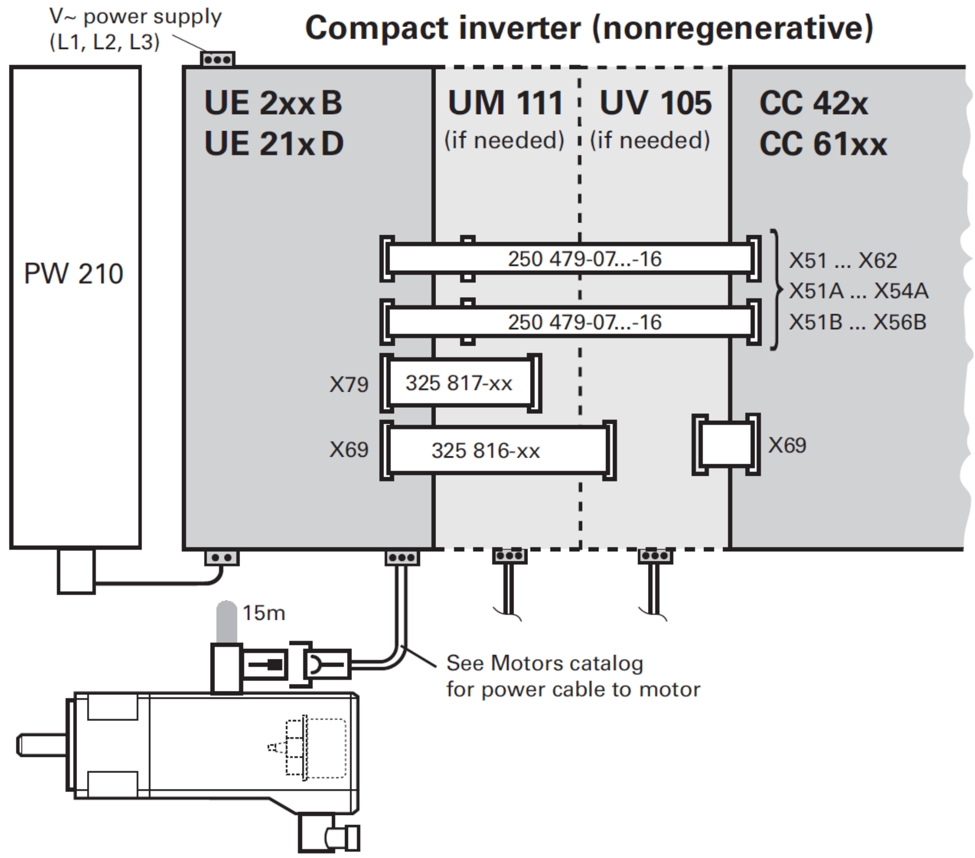
The CC 61xx features "polyfuses".
Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., scales, motor encoders) from the low voltages of the CC 61xx.
Polyfuses are equipped with a self-resetting function ("self-healing effect").

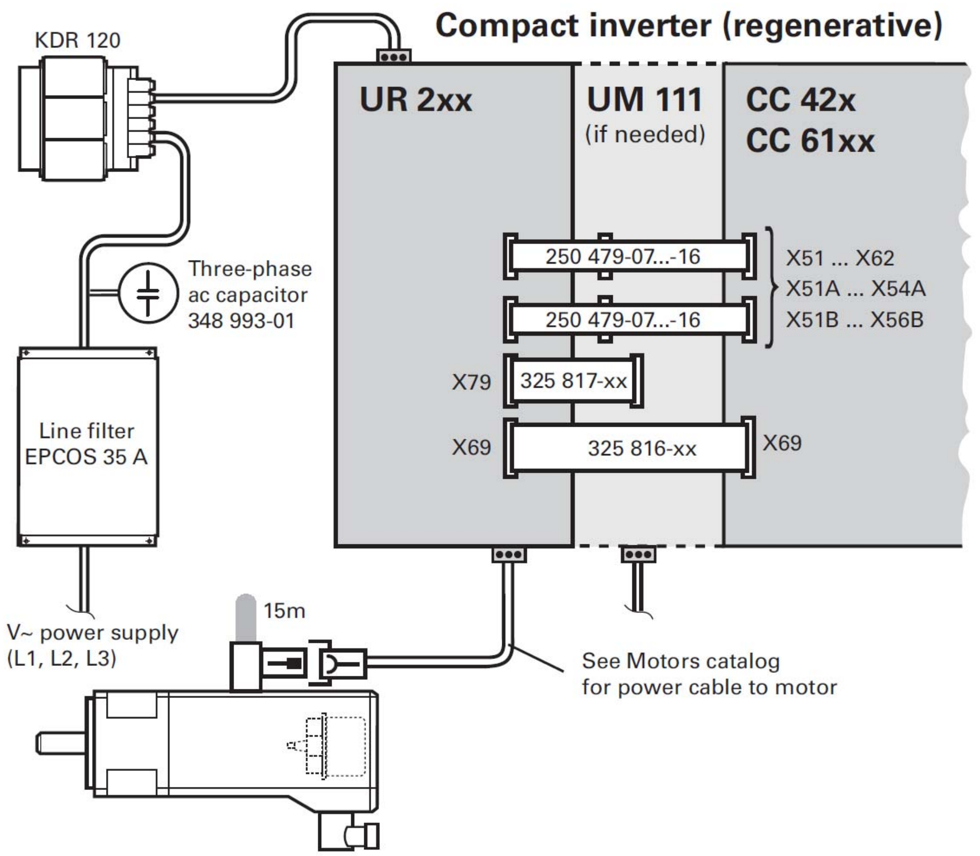
LED display

The CC 61xx features green LEDs (on top) as operational status indicators for each drive-control board; these LEDs indicate the HSCI address by a blink code.

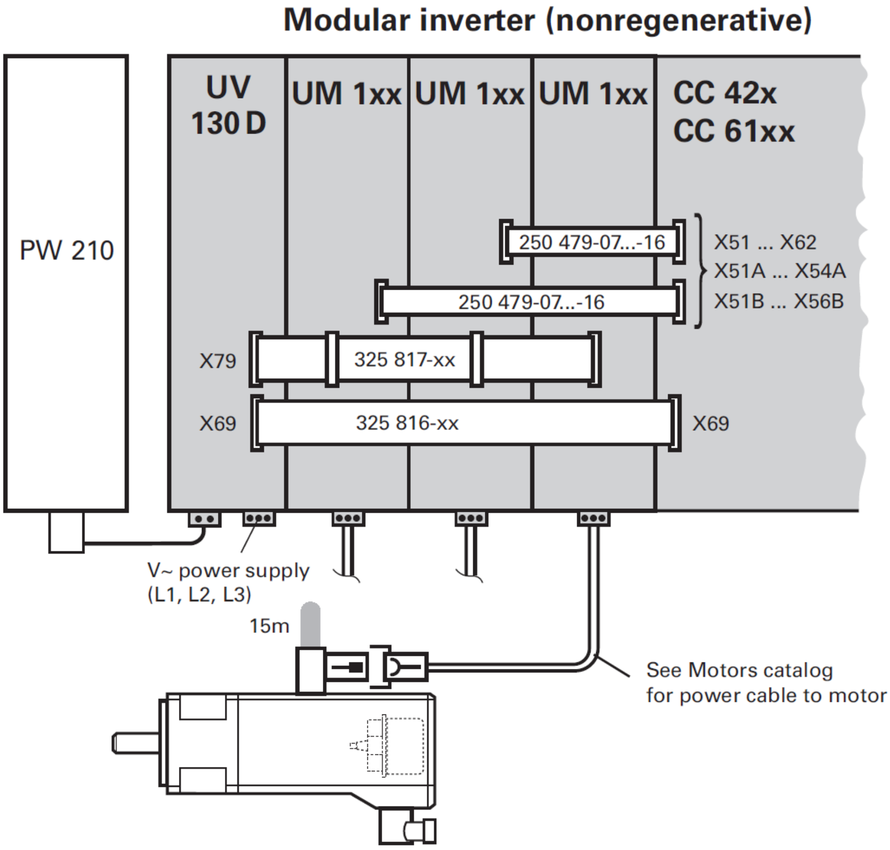


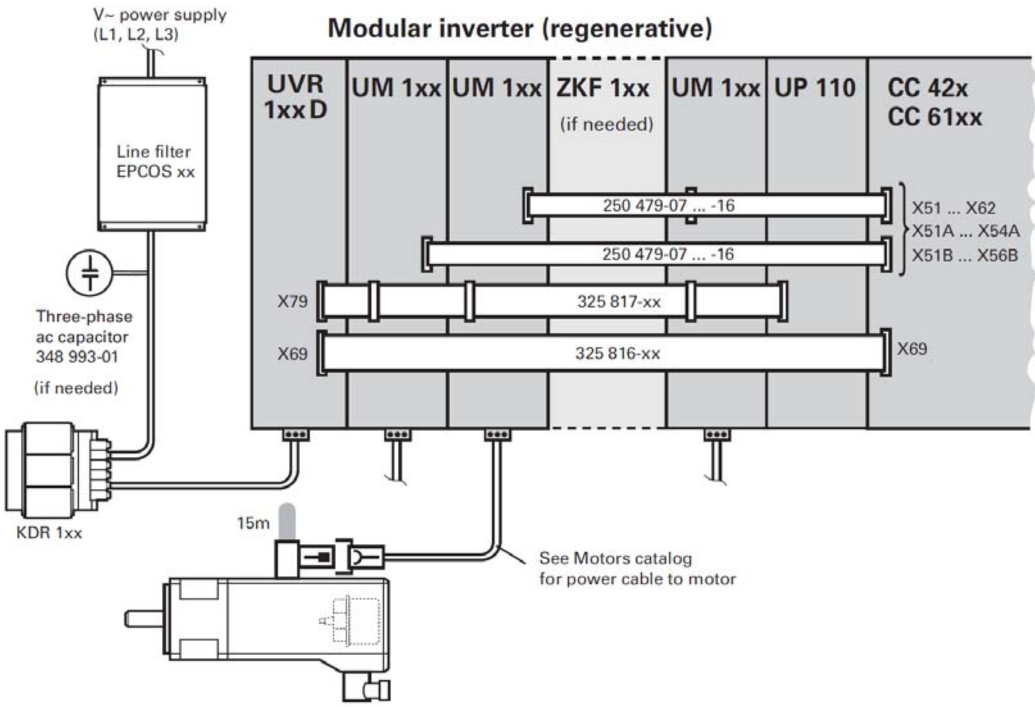
Power supply via compact inverter





Power supply via modular inverter system





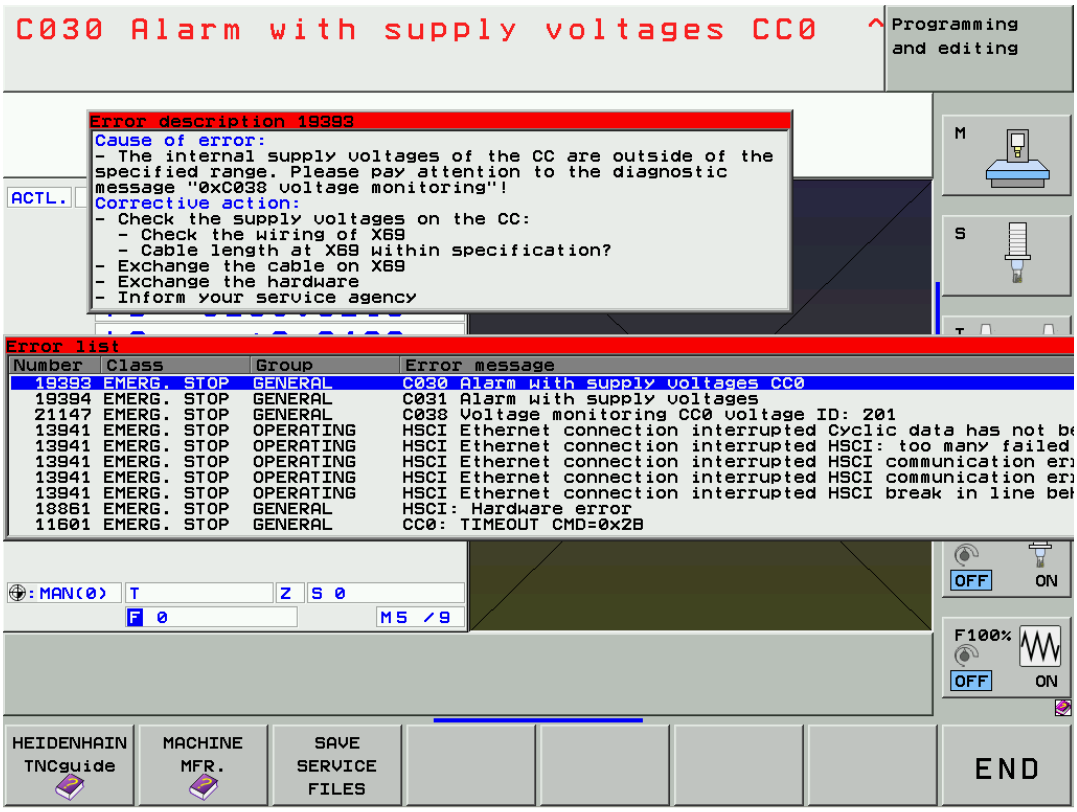
Note

The most important voltage for powering the electronics is the 5 V supply voltage. The control monitors these 5 V and generates an error message (e.g. **CC +5V out of tolerance**), if the deviation becomes too large.

Other error messages that may be displayed:

- B900 CC supply voltage
- 5-V power supply too high
- 5-V power supply too low
- C030 Alarm with supply voltages CC
- C031 Alarm with supply voltages
- C038 Voltages monitor CC

If the voltage at X69 and X74 drops **during machine operation**, the following error messages may be issued:



▶ Try to delete all error messages with the CE key. --> The permanent errors will remain in the ERR list.

If the supply voltage at X69 and X74 is already missing **during startup**, the CC 61xx is not found in the HSCI bus system.
The message **Hardware/firmware change detected** is displayed.
--> See "Message Hardware/firmware change detected" on page 18 – 245.

Troubleshooting

- Observe the operational status indicator LED on top of the CC 61xx. It is supposed to indicate the HSCI address of the CC by a blink code.
- Measure the 5 V voltage at X74.
- You can also measure the low voltages on the supply bus X69, provided that you have a test adapter available. (See "Test adapter" on page 30 – 560.)
- In the window **Hardware/firmware change detected**, click **Reject** and then call the HSCI bus diagnosis. --> See "Bus diagnosis" on page 12 – 147.
- Call DriveDiag. --> See "DriveDiag" on page 9 – 91.
- Place the cursor on **Control board 1.**, call the screen **Voltages and currents** and check the voltage in the line **Supply voltage +5 V**. The value of this voltage should not be below +4.90 V.
- Repeat this check for all drive-control boards (**Control board 2**, etc.)

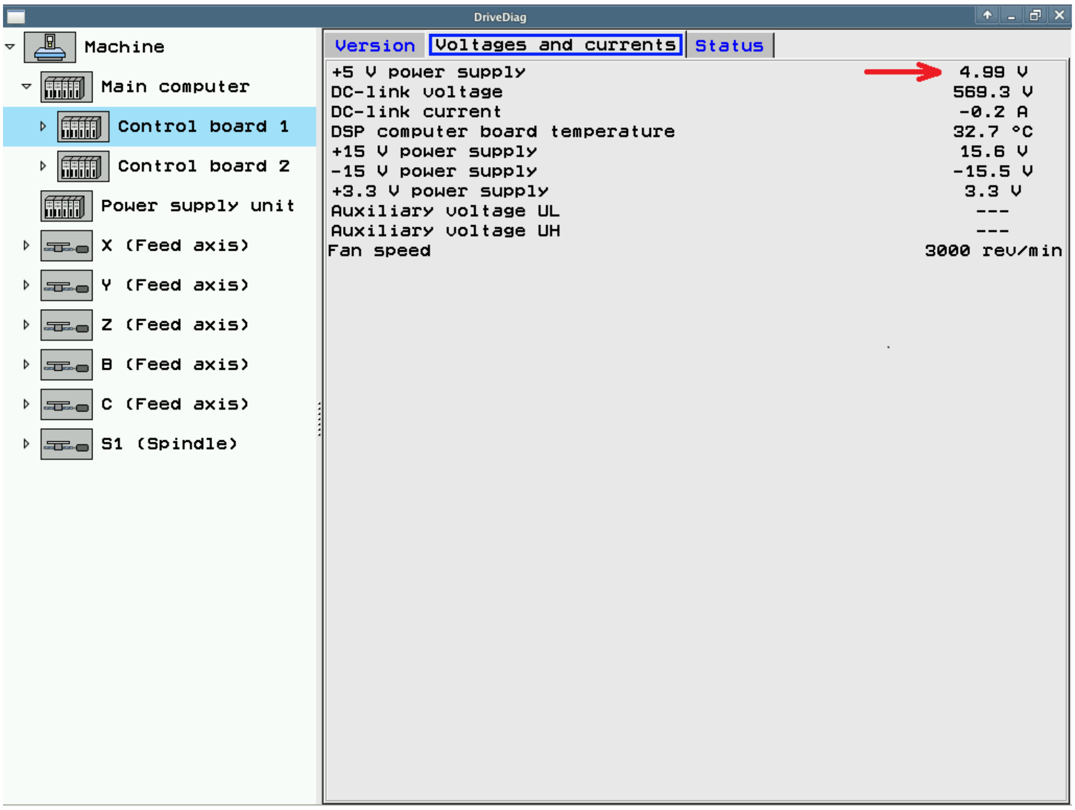


Figure: Display of the +5 V supply voltage of the drive-control boards in the CC with DriveDiag

- Disconnect the position and speed encoders and the PWM outputs from the CC (label them beforehand).
- Then observe, whether the 5 V voltage is stable.

18.9 Power supply of the UEC 11x feedback control unit

Power supply of UEC 11x	Connector for UEC 11x power supply	Devices and outputs powered by UEC 11x
3 x 400 Vac (+/- 10%) or 3 x 480 Vac (+/- 10%)	X31	■ MC 62xx ■ Speed encoders ■ Position encoders ■ Touch probes ■ PLC outputs ■ Motors for axes and spindle

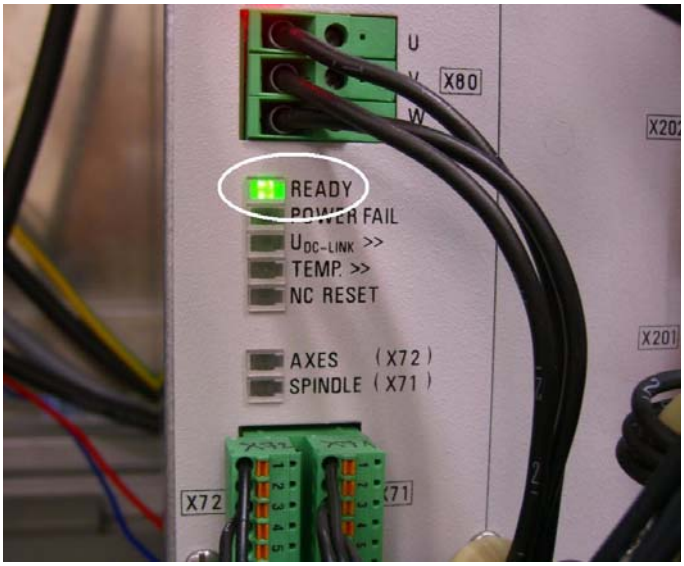
Further information and connector layout of X31 --> See "Connector designations and pin layouts" on page 28 – 453.

Note

The UEC 11x features "polyfuses".
Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., scales, motor encoders) from the low voltages of the UEC 11x . Polyfuses are equipped with a self-resetting function ("self-healing effect").

LED display

The readiness indicator of the UEC 11x is the green **READY** LED.
During machine operation no red LEDs should shine!



Error messages

Note

The most important voltage for powering the electronics is the 5 V supply voltage. The control monitors these 5 V and generates an error message (e.g. **5-V power supply too low**), if the deviation becomes too large.

Errors

- If two or all three phases are missing at X31, the UEC 11x cannot operate.
- If only one phase is missing, the UEC 11x may operate until the load becomes too high (e.g. when milling a workpiece).

Troubleshooting

- Observe the LEDs.
- Measure the voltage at X31.
- Disconnect all devices from the UEC (label them beforehand).

18.10 Power supply of the MB 620 machine operating panel

Device powering the MB 620 (alternatives)	Connector for MB 620 power supply	Devices and outputs powered by MB 620
■ UEC 11x ■ PSL 130 ■ PSL 135	X101	■ Handwheels ■ PLC outputs ■ Potentiometers on the keyboard unit

Further information and connector layout of X101 --> See "Connector designations and pin layouts" on page 28 – 453.

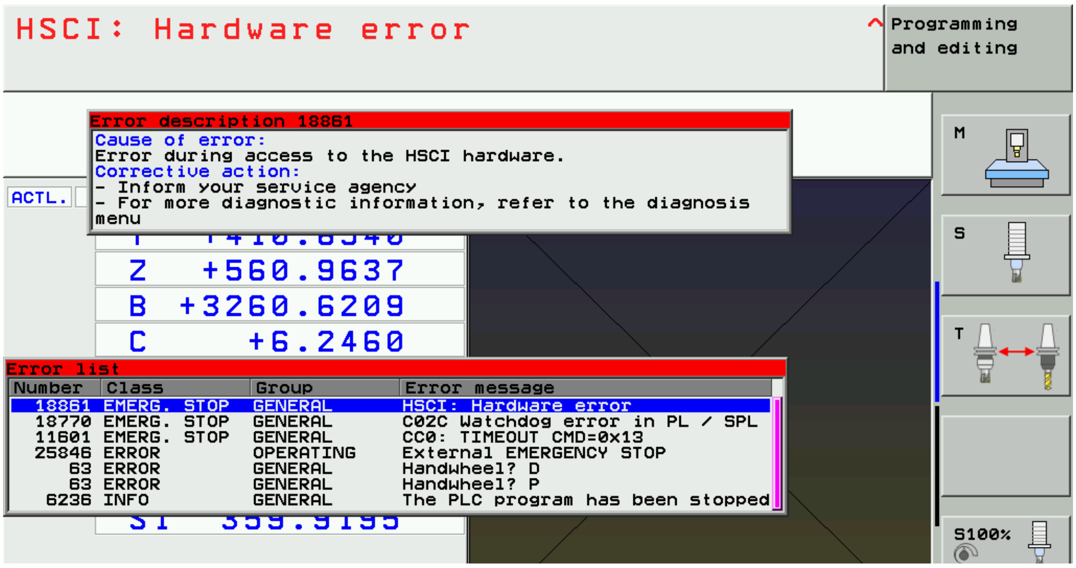
Supply voltage: **+24 Vdc**
Current consumption: 1.0 A

Note

The MB 620 features "polyfuses".
Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., handwheel) from the low voltages of the MB 620.
Polyfuses have a self-resetting function ("self-healing effect").

Error messages

If the 24 Vdc voltage at X101 drops **during machine operation**, the following error messages may be issued:



▶ Try to delete all error messages with the CE key. --> The permanent errors will remain in the ERR list.

If the 24 V supply voltage at X101 is already missing **during startup**, the MB 620 is not found in the HSCI bus system.
The message **`Hardware/firmware change detected`** is displayed.
--> See "Message Hardware/firmware change detected" on page 18 – 245.

Troubleshooting

▶ Measure the 24 V voltage at X101.

▶ Check the function of the potentiometers on the keyboard unit.

▶ If available: Check the function of the connected handhweel. You may have to disconnect it from the MB.

▶ In the window **`Hardware/firmware change detected`**, click **`reject`** and then call the HSCI bus diagnosis. --> See "Bus diagnosis" on page 12 – 147.

18.11 Power supply of the BF 250 visual display unit

Device powering the BF 250 (alternatives)	Connector for BF 250 power supply	Devices and outputs powered by BF 250
■ UEC 11x ■ PSL 130 ■ PSL 135	X1	■ USB devices ■ TE 6xx keyboard unit

Further information and connector layout of X1 --> See "Connector designations and pin layouts" on page 28 – 453.

Supply voltage: **+24 Vdc**
Power consumption: 50 W

> Note
>
> The BF 250 features "power distribution switches."
> These are electronic fuses that separate USB devices that draw too much current from the BF 250.

Errors

- The screen remains black.
- The connected USB device cannot be addressed.

Troubleshooting

- Measure the 24 V voltage at X1.
- Try USB devices with lower current consumption.

> Note
>
> If USB components that are connected to X141 to X144 require more than 0.5 A, a separate power supply becomes necessary for these components. One possibility is the USB hub from HEIDENHAIN.

- Disconnect all USB devices and the TE 6xx keyboard unit from the BF 250.

18.12 Power supply of the TE 6xx keyboard unit

Device powering the TE 6xx (alternatives)	Connector for TE 6xx power supply	Devices and outputs powered by TE 6xx
■ MC 6222 ■ BF 250	USB type B	USB devices at USB connector type A

Further information and layout of USB
–> See "Connector designations and pin layouts" on page 28 – 453.

Supply voltage: **+5 Vdc**

Note

The TE 6xx features "power distribution switches."
These are electronic fuses that separate USB devices that draw too much current from the TE 6xx.

Errors

- Keystrokes are not transmitted.
- The connected USB device cannot be addressed.

Troubleshooting

- ▶ Try USB devices with lower current consumption.

Note

If USB components that are connected to the free USB connector on the TE 6xx require more than 0.1 A, a separate power supply becomes necessary for these components. One possibility is the USB hub fromHEIDENHAIN.

- ▶ Disconnect the USB devices from the USB connector type A on the TE 6xx.

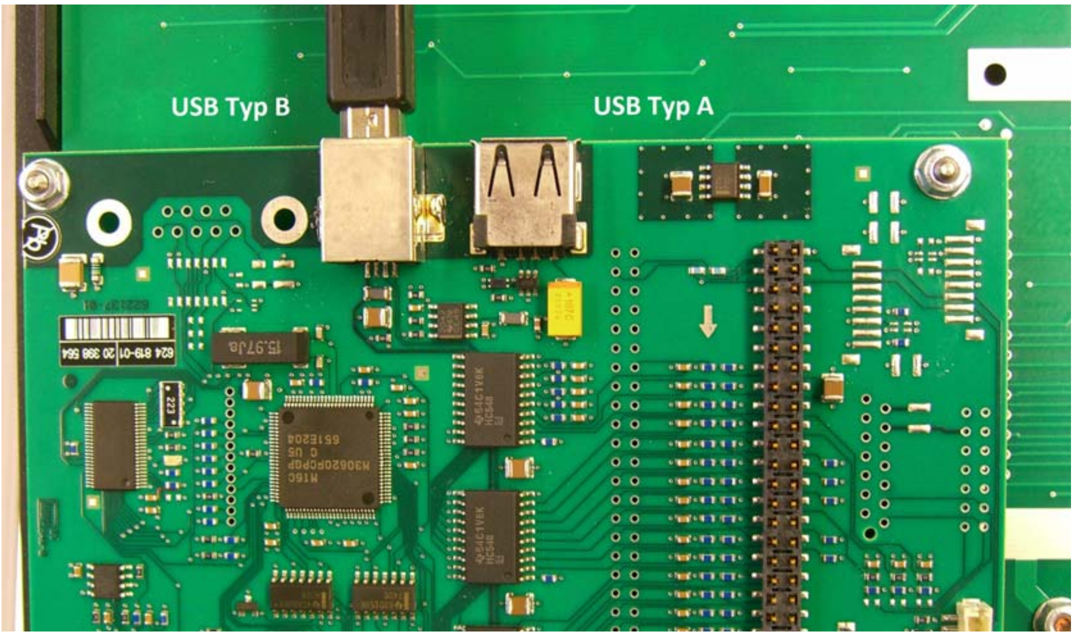


Figure: USB connectors type A and B on the rear side of the TE 630

18.13 Power supply for the control-is-ready signal

UEC 11x

The Control-Is-Ready output of the UEC 11x is powered with 24 V PLC voltage via **connector X34 / terminal 1a** (0 V PLC on terminal 6a).

PLB 62xx

The Control-Is-Ready output of the PLB 62xx is powered with 24 V PLC voltage via **connector X9 / terminal 1a** (0 V PLC on terminal 2b).

Error messages

If the 24 V supply for the Control-Is-Ready output is missing, the machine cannot be switched on completely. The EMERGENCY STOP chain is interrupted.
The control remains at the message **`Relay ext. dc voltage missing`**:

If the 24 V supply for the Control-Is-Ready output drops **during machine operation**, the EMERGENCY STOP chain is interrupted. The error message
`EXTERNAL EMERGENCY STOP` is displayed:

Note

The Control-Is-Ready output must be integrated correctly in the EMERGENCY STOP chain.
--> See "Annex: Basic circuit diagrams of the iTNC 530 HSCI control" on page 2 – 651.

Troubleshooting

- UEC 11x: Measure the 24 V voltage at connector X4 between terminal 1a and 6a (tolerance range 20.4 - 28.8 V).
- PLB 62xx: Measure the 24 V voltage at connector X9 between terminal 1a and 2b (tolerance range 20.4 - 28.8 V).
- Check the wiring. (Use the circuit diagram of the machine tool for this purpose.)

18.14 Power supply of the PLB 62xx system module

Device powering the PLB 62xx (alternatives)	Connector for PLB 62xx power supply	Devices and outputs powered by PLB 62xx
■ UEC 11x ■ PSL 130 ■ PSL 135 ■ 24 V power supply unit	X3	■ Touch probes ■ Safety-related PLC outputs

Further information and connector layout of X3 --> See "Connector designations and pin layouts" on page 28 – 453.

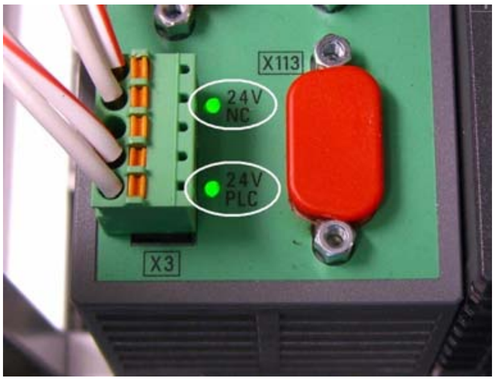
Supply voltages: **+24 V NC and +24 V PLC**
Current consumption NC: 0.5 A

Note

The PLB 62xx features "polyfuses".
Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., touch probes) from the low voltages of the PLB 62xx.
Polyfuses have a self-resetting function ("self-healing effect").

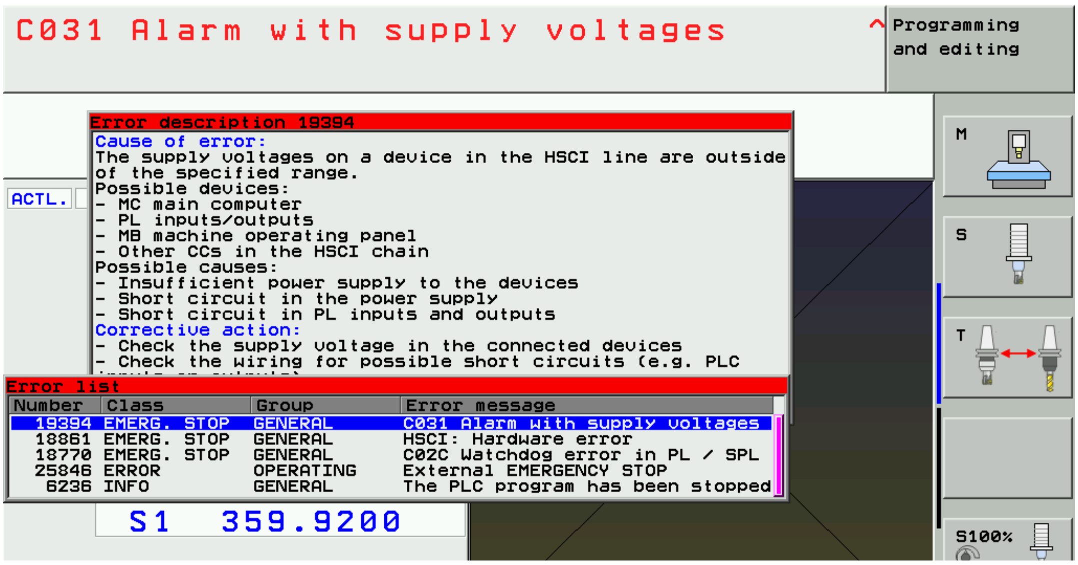
LED display

The green LEDs indicate that the connector X3 is correctly supplied with **24 V NC** and **24 V PLC**.



Error messages

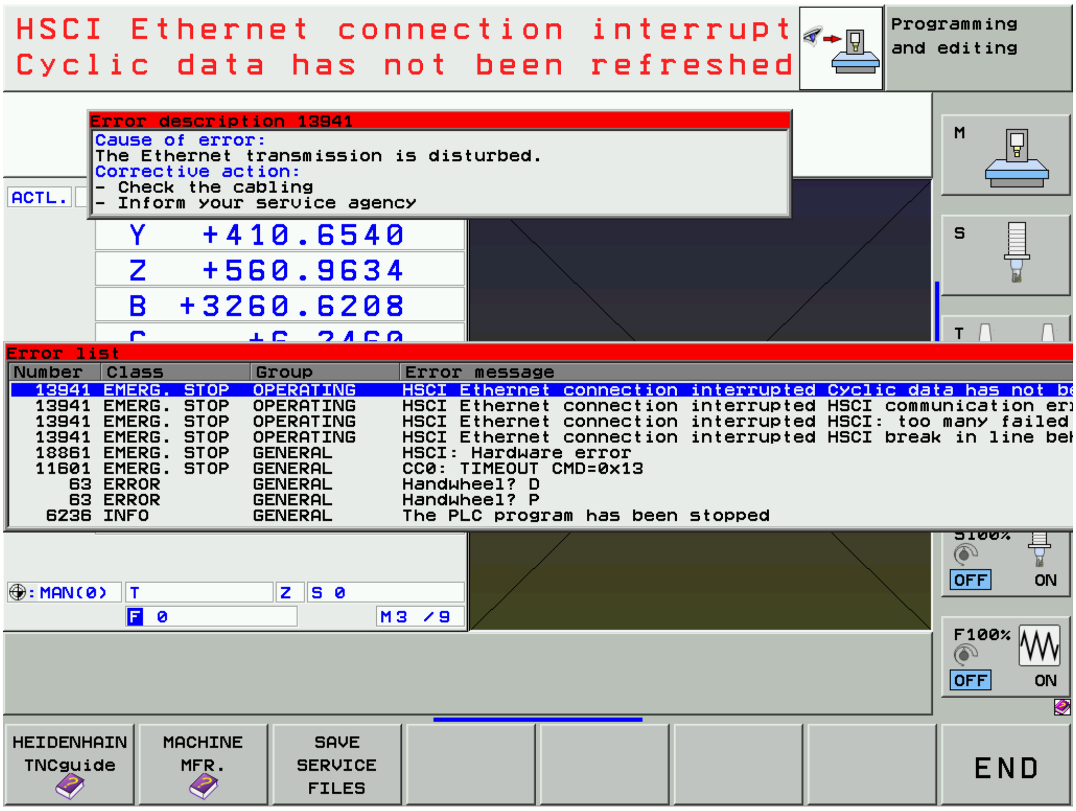
If the 24 V PLC voltage at X3 / terminal 4 drops **during machine operation**, the following error messages may be issued:



▶ Try to delete all error messages with the CE key. --> The permanent errors will remain in the ERR list.

If the 24 V-PLC supply voltage at X3 / terminal 4 is already missing **during startup**, the PLB 62xx is not found in the HSCI bus system.
The message **`Hardware/firmware change detected`** is displayed. --> See "Message Hardware/firmware change detected" on page 18 – 245.

If the 24 V NC voltage at X3 / terminal 1 drops **during machine operation**, the following error messages may be issued:



- Try to delete all error messages with the CE key. --> The permanent errors will remain in the ERR list.

If the 24 V-NC supply voltage at X3 / terminal 1 is already missing **during startup**, the PLB 62xx is not found in the HSCI bus system.
The message **`Hardware/firmware change detected`** is displayed. --> See "Message Hardware/firmware change detected" on page 18 – 245.

Troubleshooting

- Observe the LEDs on the PLB 62xx system module.
  If the power supply is correct, the green **`24V NC`** and **`24V PLC`** LEDs shine.
- Measure the 24 V voltagse at X3.
- In the window **`Hardware/firmware change detected`**, click **`Reject`** and then call the HSCI bus diagnosis. --> See "Bus diagnosis" on page 12 – 147.
- Disconnect the touch probe systems and the safety-related PLC outputs from the PLB.

18.15 Supply voltage for PLC outputs

18.15.1 Introduction

The following components of iTNC 530 HSCI have PLC outputs:

- UEC 11x
- PLB 62xx
- PLD-H 16-08-00
- PLD-H 08-16-00
- MB 620

The PLC outputs are powered by the 24 V control voltage of the machine (in accordance with VDE 0551).

The control voltage must be smoothed with a capacitance of 150 µF per amp of rated current, and in any case with at least 1000 µF. At a current load of 15 A, for example, this corresponds to a capacitance of 2250 µF. If the PSL13x is used as 24 V supply unit, this additional smoothing is not necessary.

> Note
>
> HEIDENHAIN recommends the PSL13x as 24 V power supply unit.

EN 61 131-2:1994 permits:

- Minimum absolute value: 20.4 Vdc
- Maximum absolute value: 25.4 V– at 200W power output
- Maximum absolute value: 28.8 V– at 100 W power output

Power consumption

If half of the outputs are switched at the same time, the following are the values for power consumption:

PLB 62xx: Approx. 485 W
UEC 11x: Approx. 48 W

Power output

The maximum permissible output of a PLD-H xx-xx-xx is 200 W.

Rated operating current per output

UEC 11x: 0.150 A
PLD-H: 2 A

Simultaneity with a supply voltage of 25.4 V:
4 outputs with 2 A each
8 outputs with 1 A each
Total current:
Out0 to Out7: ≤ 8 A
Out0 to Out3: ≤ 4 A
Out4 to Out7: ≤ 4 A

For all PLD-H xx-xx-xx units, it must be remembered that a total current of max. 8 amperes per slot (PLD-H) must not be exceeded! This applies regardless of the number of PLD-H outputs.

18.15.2 Supply voltage for PLC outputs on the UEC 11x

X31:

Pin layout on the UEC 11x

Connecting terminal	Assignment
L1	400 Vac +/- 10% 50 Hz to 60 Hz
L2	
L3	

Error messages and analysis with incorrect power supply at X31
--> See "Power supply of the UEC 11x feedback control unit" on page 18 – 267.

18.15.3 Supply voltage for PLC outputs on the MB 620

X101:

Assignment on MB 620:

Connecting terminal	Assignment
1	+24 V
2	0 V

Error messages and diagnosis with incorrect power supply at X101
--> See "Power supply of the MB 620 machine operating panel" on page 18 – 268.

18.15.4 Supply voltage for PLC outputs on the PLB 62xx

X3:
+24 V NC and
+24 V PLC

Assignment on PLB 62xx:

Connecting terminal	Assignment
1 (top terminal)	+24 V NC
2	0 V NC (ground +24 V NC)
3	Protective ground: Minimum wire cross section of the power line for 24 V PLC
4	**+24 V PLC**
5 (bottom terminal)	0 V PLC (ground +24 V PLC)

Error messages and analysis with incorrect power supply at X3
--> See "Power supply of the PLB 62xx system module" on page 18 – 272.

18.15.5 Supply voltage for PLC outputs on the PLD-H xx-xx-xx

X11:

Pin layout on the PLD-H input/output module:

Connecting terminal	Assignment
1	0 V PLC
2	0 V PLC

X12:

Pin layout on the PLD-H input/output module:

Connecting terminal	Assignment
1	0 V PLC
2	0 V PLC

Note

The 0 V terminals of X11 and X12 of the PLD-H are connected internally. These connections are used for connecting the potential of the electronics and for operating the LEDs. Since only a low current is required (max. 50 mA), it is sufficient to establish only one 0 V connection (preferably at X11).

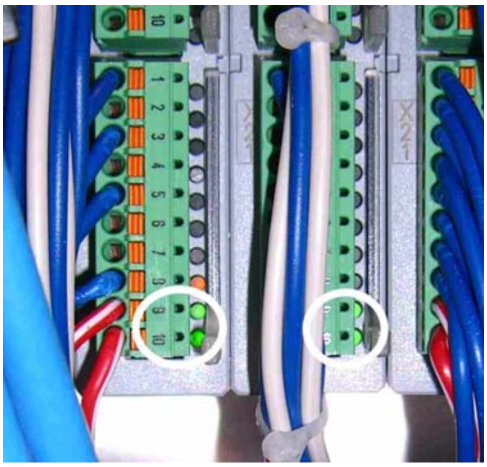
X21:

Pin layout on the PLD-H input/output module:

Connecting terminal	Assignment
9	+24 V PLC for outputs on terminals 1 - 4
10	+24 V PLC for outputs on terminals 5 - 8

LED display

Green LEDs at terminals 9 and 10 of connector X21 indicate that the power supply is correct.



Errors and error messages

If the voltage at X21 / terminal 9 or 10 drops **during machine operation**, the related PLC outputs drop as well. This can lead to various error messages.

If the voltage at X21 / terminal 9 or 10 is already missing **upon switch-on**, it may not be possible to switch the control on completely (depending on the PLC outputs concerned).

Troubleshooting

Observe the LEDs on the PLD-Hxx-xx-xx input/output module.
Further analysis --> See "Bus diagnosis" on page 12 – 147.

19 Encoder interface

19.1 Position encoders

19.1.1 Introduction

Position encoders are also referred to as **linear encoders** or **angle encoders**.
They report positions and movements of the machine to the control.
The iTNC 530 operates with **incremental** and **absolute** encoders.

Permissible encoders:

- Encoders with one reference mark
- Encoders with distance-coded reference marks
- Encoders with EnDat interface 2.1, 2.2

Scales and **scale tapes** (e.g. LF, LC, LS, LB) are **linear position encoders**.

Angle encoders (e.g. RCN, RON, ROD, ERP, ERA) are **rotational position encoders**.

> Note
>
> On machines with digital axes and spindles that are not equipped with position encoders, the position is captured via motor encoders.
> See "Speed encoders" on page 19 – 300.

Position encoder inputs

CC 6106	CC 6108	CC 6110
■ **X201 to X206**	■ **X201A to X204A** (controller basic board A) ■ **X201B to X204B** (controller basic board B)	■ **X201A to X204A** (controller basic board A) ■ **X201B to X206B** (controller basic board B)

UEC 111	UEC 112
■ **X201 to X204**	■ **X201 to X205**

Scales for linear axes or **angle encoders for rotary axes/spindles** may be connected here.

Polyfuses

> Note
>
> CC 61xx and UEC 11x feature "polyfuses".
> Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., scales) from the low voltages of the CC 61xx or the UEC 11x.
> Polyfuses are equipped with a self-resetting function ("self-healing effect").

Fixed assignment on CC61xx and UEC 11x

On the **CC 61xx** there is a **fixed assignment** between the PWM output, the input of the speed encoder and the input of the position encoder:

CC 6106		
PWM output	**Speed input**	**Position input**
X51	X15	X201
X52	X16	X202
X53	X17	X203
X54	X18	X204
X55	X19	X205
X56	X20	X206

CC 6108		
PWM output	**Speed input**	**Position input**
X51A	X15A	X201A
X52A	X16A	X202A
X53A	X17A	X203A
X54A	X18A	X204A
X51B	X15B	X201B
X52B	X16B	X202B
X53B	X17B	X203B
X54B	X18B	X204B

CC 6110		
PWM output	**Speed input**	**Position input**
X51A	X15A	X201A
X52A	X16A	X202A
X53A	X17A	X203A
X54A	X18A	X204A
X51B	X15B	X201B
X52B	X16B	X202B
X53B	X17B	X203B
X54B	X18B	X204B
X55B	X19B	X205B
X56B	X20B	X206B

On the **UEC 11x** there is a **fixed assignment** between the motor output, the input of the speed encoder and the input of the position encoder:

UEC 111			
Motor output	**Rated current at 5 kHz**	**Speed input**	**Position input**
X80	20 A (spindle)	X15	X201
X81	5 A	X16	X202
X82	5 A	X17	X203
X83	7.5 A (stronger axis)	X18	X204

UEC 112			
Motor output	**Rated current at 5 kHz**	**Speed input**	**Position input**
X80	20 A (spindle)	X15	X201
X81	5 A	X16	X202
X82	5 A	X17	X203
X83	7.5 A (stronger axis)	X18	X204
X84	5 A	X19	X205

EnDat encoders — **EnDat encoders** may be connected to all position encoder inputs of a CC 61xx or a UEC 11x.

Memory areas in the EnDat encoder — EnDat encoders offer the possibility of storing **machine or system-dependent data** in the memory area reserved for the machine tool builder.

19.1.2 Machine parameters

Monitoring of the position encoders

The monitoring functions for the position encoders of the axes are activated in **MP20.x**.
The monitoring functions for the position encoders of the spindles are activated in **MP21.x**.
The following criteria are checked:

Criterion	Error message
Absolute position with distance-coded reference marks	`Position encoder <AXIS> defective`
Amplitude of encoder signals	`Position encoder <AXIS >: amplitude too high` `Position encoder <AXIS>: amplitude too low`
Edge separation of encoder signals	`Position encoder <AXIS>: frequency too high`

DANGER

The monitoring functions for the position encoders (MP20.x, MP21.x) must always be active!
Safe machine operation is not ensured without these monitoring functions.
Exception:
MP20.0 and MP21.0 are only active for position encoders with distance-coded reference marks.

Connection of the position encoders

MP100 is read from the right to the left and contains the information which axis is the first, the second, the third, etc.

Attention

MP100 must not be changed!

In **MP108** you can see the assignment of the axes to the controller basic boards.

In **MP109** you can see the assignment of the spindles to the controller basic boards.

Note

The input value (0 ... 3) represents the HSCI address of the respective controller basic board.

In **MP110** you can see the assignment of the axes to the position encoder inputs (connector X201 and following).

In **MP111** you can see the assignment of the spindles to the position encoder inputs (connector X201 and following).

Signal type and input frequency

In **MP118, bit 0** the signal type (1 Vpp or 11 µApp) is defined for the position encoder of the axis concerned.

> Note
>
> For other signal types (TTL, etc.) adapters can be used.
> --> See "Position encoders" on page 28 – 511.

In **MP118, bit 2** the input frequency is defined for the position encoder of the axis concerned.

In **MP118, bit 3** you can see, whether the position encoder for this axis transmits analog 1 Vpp or 11 µApp signals to the control (conventional position encoders, EnDat 2.1), or whether position and distance are transmitted digitally with a serial data protocol (EnDat 2.2).

In **MP119, bit 0** the signal type (1 Vpp or 11 µApp) is defined for the position encoder of the spindle concerned.

> Note
>
> For other signal types (TTL, etc.) adapters can be used.
> --> See "Position encoders" on page 28 – 511.

In **MP119, bit 2** the input frequency is defined for the position encoder of the spindle concerned.

In **MP119, bit 3** you can see, whether the position encoder for this spindle transmits analog 1 Vpp or 11 µApp signals to the control (conventional position encoders, EnDat 2.1), or whether position and distance are transmitted digitally with a serial data protocol (EnDat 2.2).

19.1.3 Error messages

The following error messages may be displayed, if there are problems related to position encoders:

- 8870 Input frequency from position encoder
- 8AF0 Encoder defective
- 8BE0 Encoder defective
- 8C00 Input frequency from position encoder
- AC30 CC amplitude too high
- AC40 CC amplitude too small
- AC50 CC frequency too high
- C430 Error of position input
- E170 Pos. deviation too large
- E170 Position error too large
- EnDat defective
- Check the position encoder
- Position encoder: Amplitude too high
- Position encoder: Amplitude too small
- Position encoder defective
- Position encoder: Frequency too high
- Ref. mark: Incorrect spacing

> Note
>
> Other error messages may also indicate problems with a position encoder.

19.1.4 Possible error causes

- Contamination of the position encoder
- Chips inside the scale housing
- Damage to the position encoder
- Scanning head misaligned (parallelism, distance, etc.)
- Roller bearing in scanning head defective
- Cable damaged
- Signal error caused by high frequency, strong magnetic fields, etc.
- Penetration of humidity
- Short circuit in cable or scanning head
- Light unit defective (LED)
- Strong machine vibrations
- Defective position encoder interface on CC 61xx or UEC 11x

> Attention
>
> The amplitude of the reference marks is not monitored!
> For example, if a reference mark cannot be evaluated due to contamination, with distance-coded encoders a corresponding error message (e.g., `Reference marks <AXIS>: Incorrect spacing`) is generated.
> With encoders with **one** reference mark, an error message is not generated immediately.
> The reference run is continued until, e.g., the axis hits a limit switch.

19.1.5 Troubleshooting

To find out, whether **the connected encoder** or **the encoder interface of the control component** is defective, the **interchange method** can be used.

> Note
>
> Encoder error messages are mostly due to the encoders / scanning heads / cables. In rare cases, the reason is a defective interface of a CC or UEC.
> The interchange method is quite complex here, as in addition to the position encoder inputs, you also have to swap the speed encoder inputs and the PWM outputs or motor outputs, and you must adapt the parameter settings.
> Checking the suspicious position encoder with a PWM 9 or a PWT 18 may be more effective. --> See "Further examination of position and speed encoders" on page 19 – 314.

Exchange constellations

CC 61xx	
Exchange constellations	**Flowchart**
Swapping two single-speed axes or two double-speed axes	Swapping axes on a CC 61xx
Swapping single-speed axis <--> single-speed spindle or double-speed axis <--> double-speed spindle	Swapping axis and spindle on a CC 61xx

UEC 11x	
Exchange constellations	**Flowchart**
Swapping two single-speed axes or two double-speed axes with the same rated current	Swapping axes with the same rated current on a UEC 11x
Swapping two single-speed axes or two double-speed axes with different rated currents	Swapping axes with different rated current on a UEC 11x
Swapping single-speed axis <--> single-speed spindle or double-speed axis <--> double-speed spindle	Swapping axis and spindle on a UEC 11x

Notes and preparatory action

- CC 61xx:
  If axes/spindles with different power modules and motors are supposed to be swapped, these devices (if equipped with electronic ID labels) would try to log on to the control during start-up.
  A new assignment would be requested according to the changed wiring, even before the service engineer can edit the machine parameter values. To avoid this, **deactivate** the **evaluation of the electronic ID labels** with MP7690 before the exchange.

- Use the **position encoder input of a functioning axis/spindle**.
  (The permanently assigned PWM output or motor output must be connected, since - depending on the configuration of single-speed and double-speed control loops - non-connected outputs may not be active.)

- **The permanently assigned speed inputs and PWM or motor outputs must be swapped, too!**

Note

Due to the fixed assignment, the interchange method cannot be used independently for position encoders, speed encoders or PWM/motor outputs. The axes must be swapped altogether.

- To find the correct machine parameters in the MP2xxx.y group, call the machine parameters MP130 (axes) and MP131/132 (spindles). Here you find the assignments of the axes/spindles to the respective indexes 'y' of the MP2xxx.y group.

- The **same PWM frequency** should be set for axes and spindles to be swapped!
  If there are different PWM frequencies in the machine parameters MP2180.x , you may enter 5 kHz for the axes/spindles for testing.

- CC 61xx:
  If the swapped PWM outputs are on a compact inverter or a two-axis module, the control generates the `Power interrupted` message as usual.
  If, however, the swapped PWM outputs lead to two different power modules (different ID or SN), the control generates the message `Hardware/firmware change detected` during start-up.
  --> See "Reading out power module data" on page 21 – 338.

- UEC 11x:
  Check, whether the axes to be swapped have the same rated current (MP2100.x and power-module table).
  If the rated current is not the same, or if an axis is swapped with a spindle, the power output stages need to be assigned correctly.

DANGER

Swapping **power output stages with different rated currents** for testing and not assigning them correctly (MP2100.x) may cause damage to the machine or personal injury!

DANGER

Always secure vertical axes to prevent them from falling down before you perform tests on these axes!

Block diagrams for axis swapping

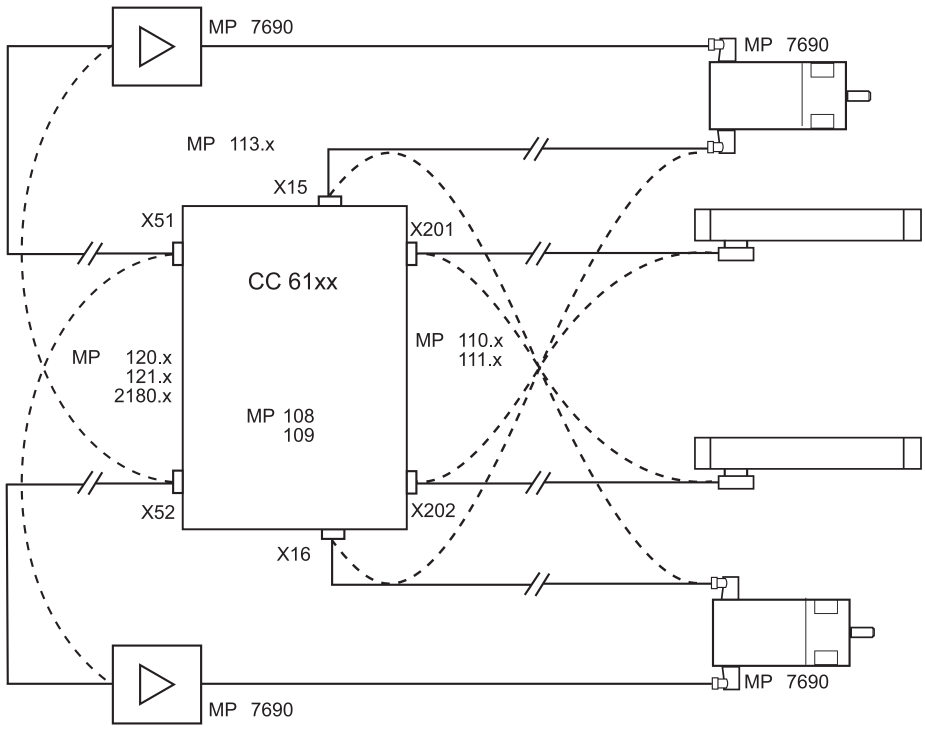


Figure: Swapping axes on a CC 61xx

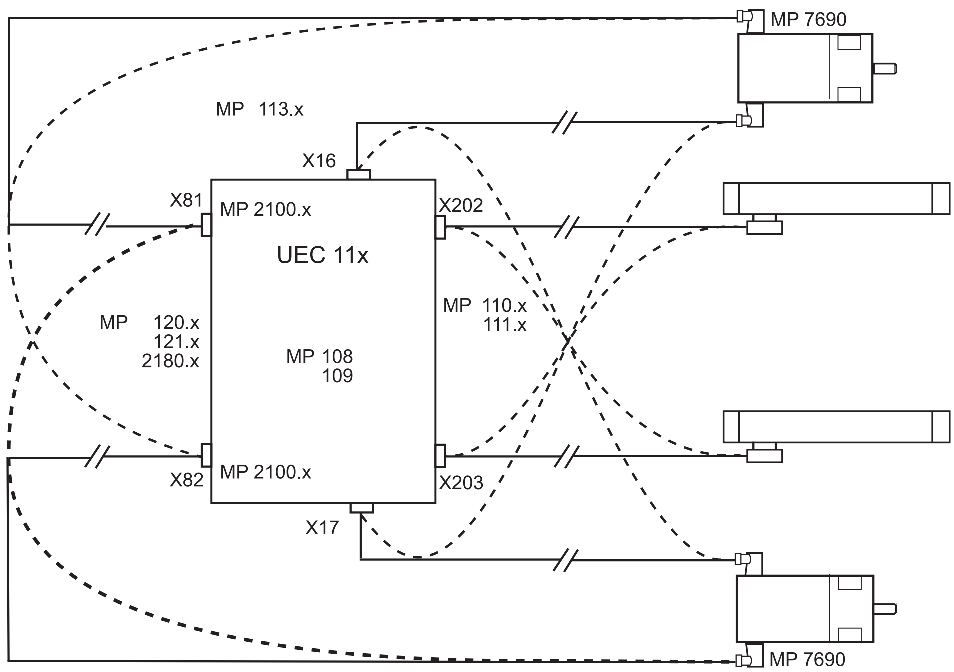
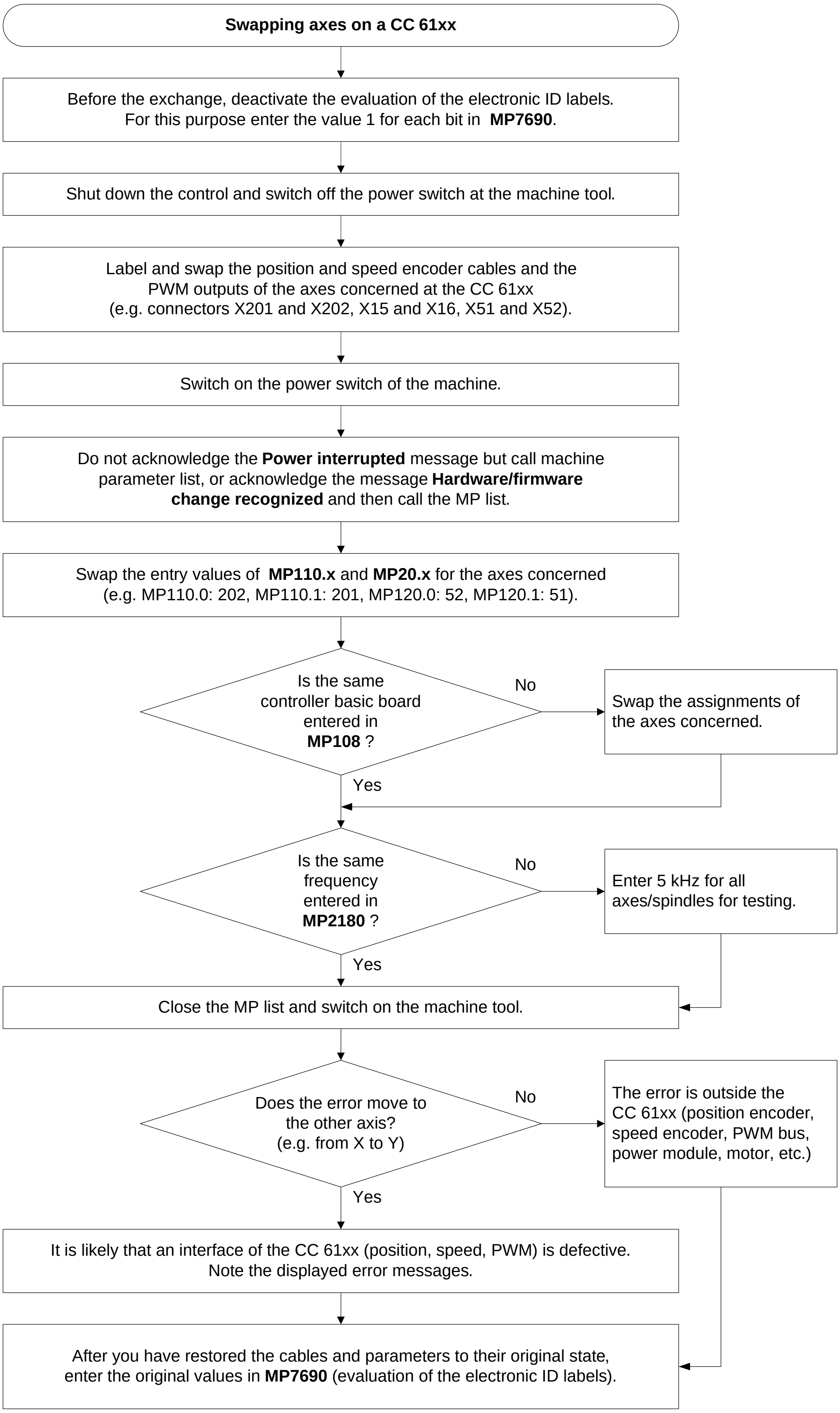


Figure: Swapping axes on a UEC 11x

Note

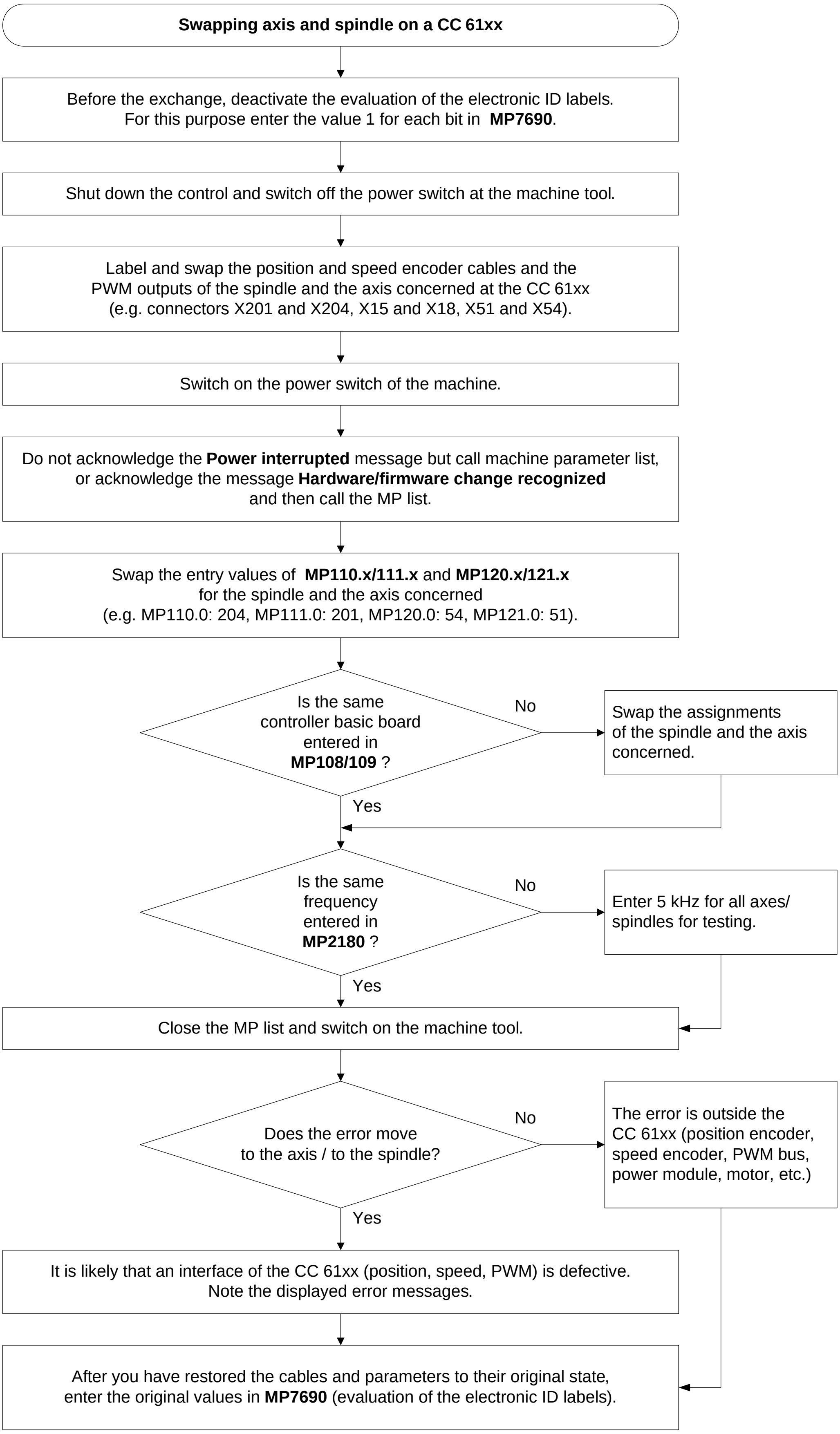
Always swap both the cable and the interface assignment by machine parameter!

Flowcharts for axis swapping



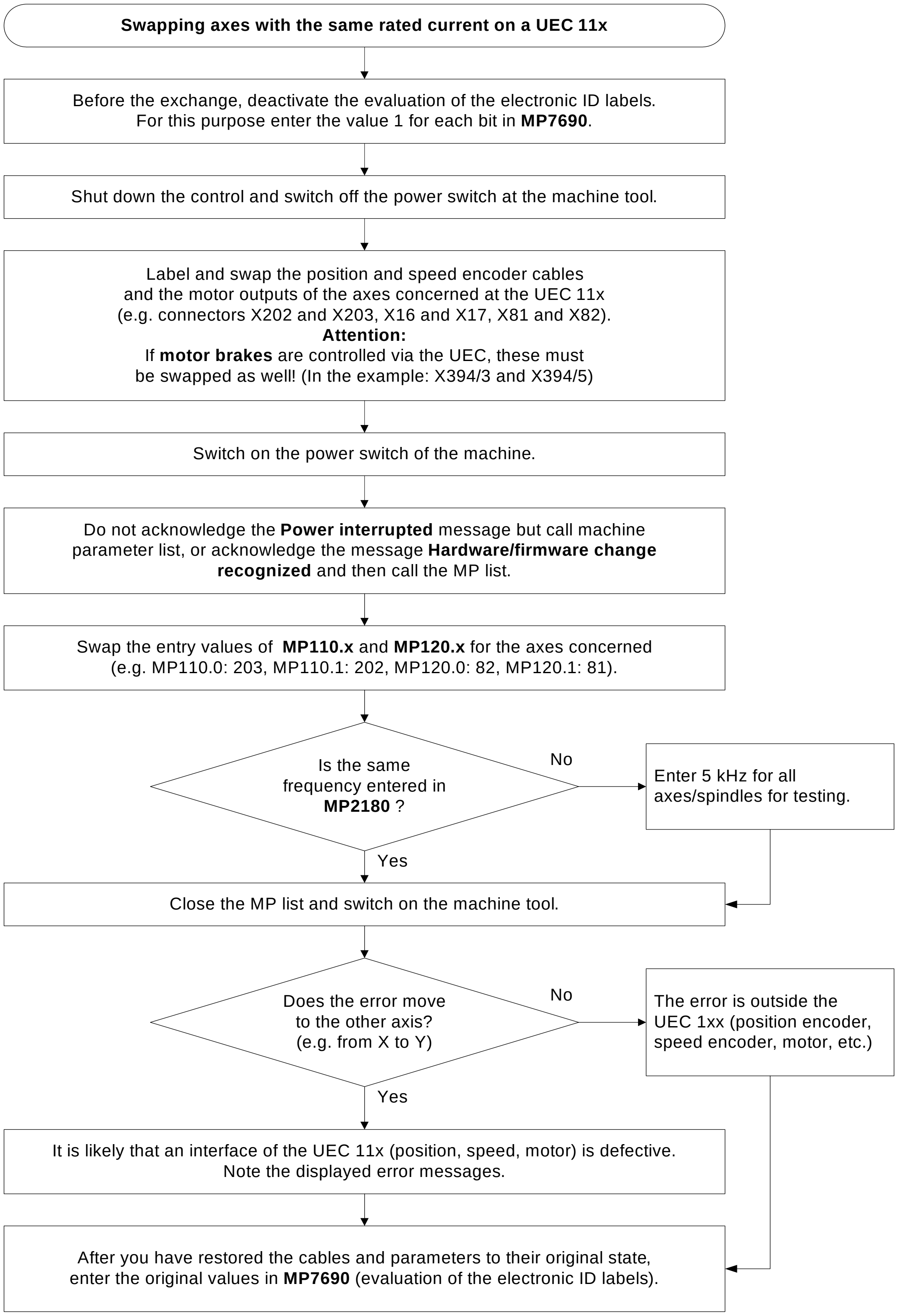
Note

This flowchart does not apply for swapping a single-speed with a double-speed axis!



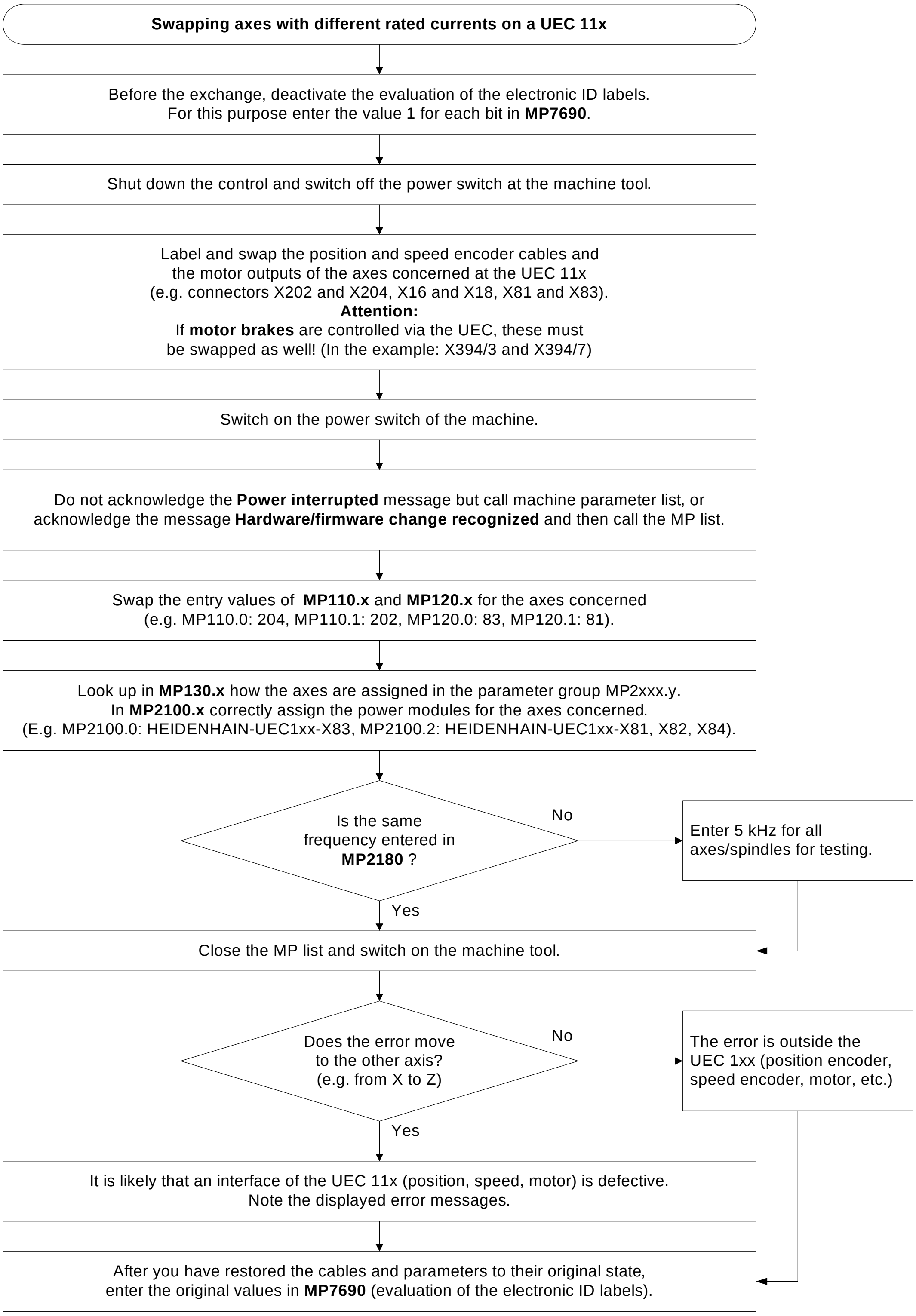
Note

This flowchart does not apply for swapping a single-speed axis with a double-speed spindle or a double-speed axis with a single-speed spindle!



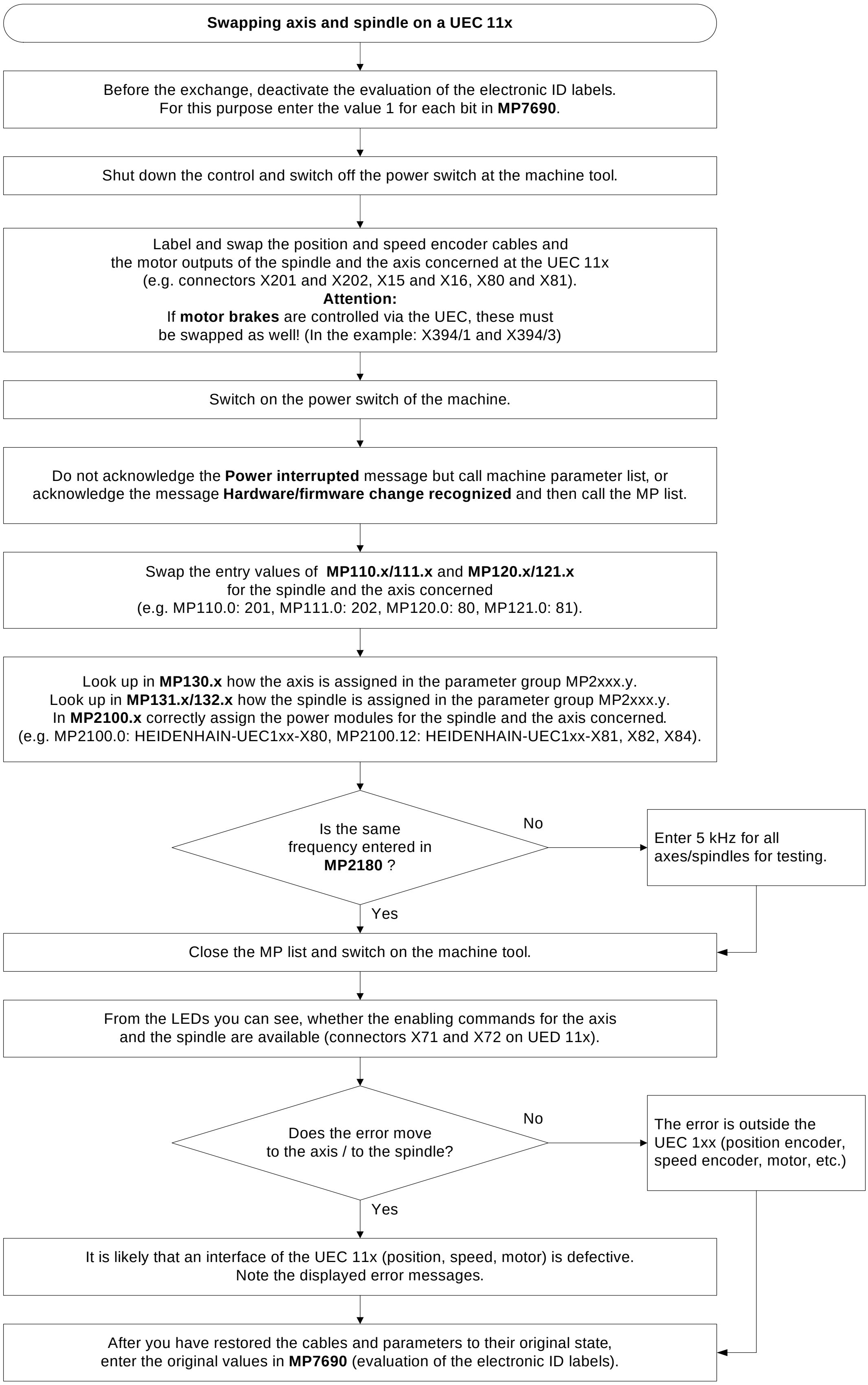
Note

This flowchart does not apply for swapping a single-speed with a double-speed axis!



Note

This flowchart does not apply for swapping a single-speed with a double-speed axis!



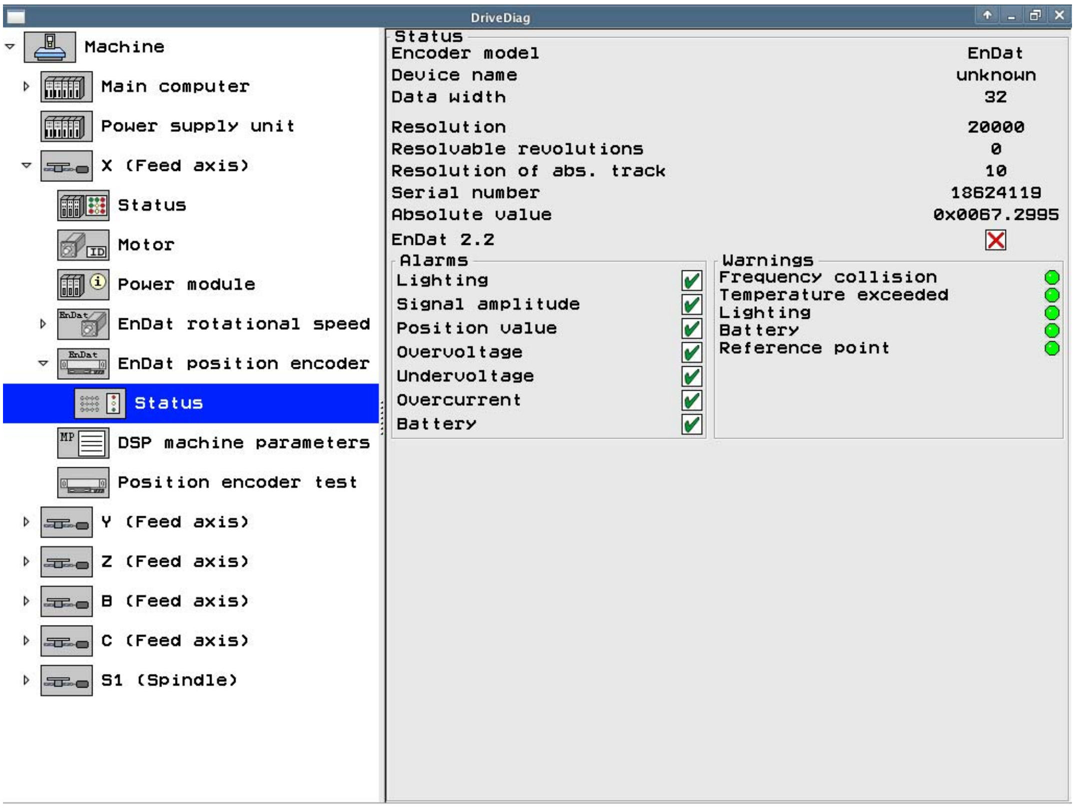
Note

This flowchart does not apply for swapping a single-speed axis with a double-speed spindle or a double-speed axis with a single-speed spindle!

19.1.6 Possibilities with DriveDiag

EnDat position encoder

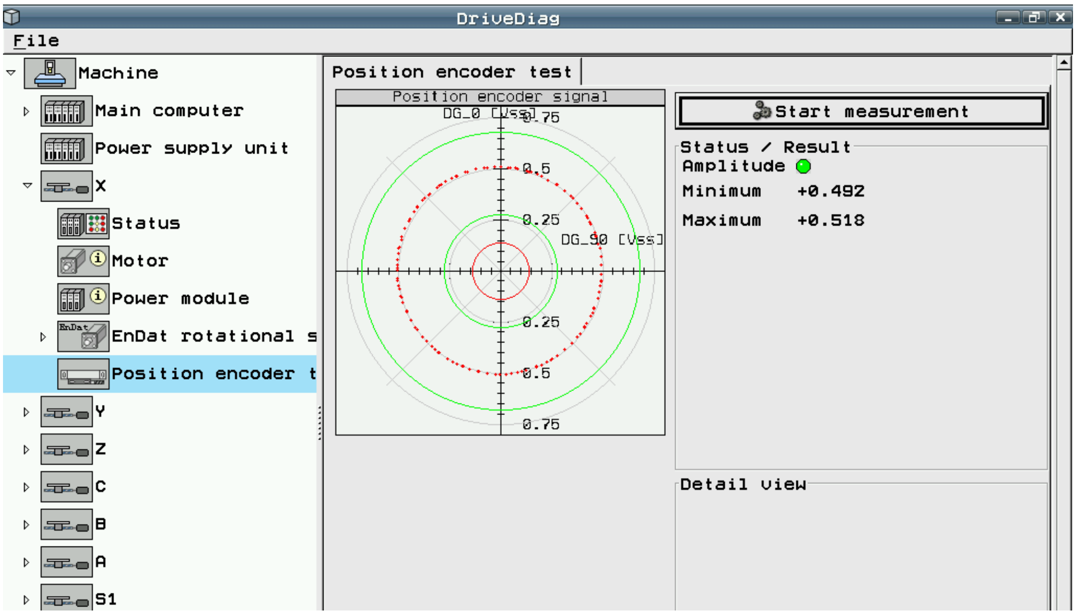
On the info screen "EnDat Position Encoder" you can see, whether alarm bits are set:



Calling the screen --> See ”DriveDiag” on page 9 – 91.

Position encoder test

The integrated diagnostic functions and DriveDiag also feature a simple position encoder test:



Calling the screen --> See ”DriveDiag” on page 9 – 91.

The signal quality is evaluated at the current position of the scanning head.
This test can be run with a stationary or traversing axis.
If the axis is stationary, the measuring points are at a fixed place; if it rotates, they are arranged on a circle. The measuring points must be located between the two green tolerance circles.

19.1.7 Possibilities with the integrated oscilloscope

The integrated oscilloscope is used to record the incremental signals (A, B or I1, I2) of position encoders.

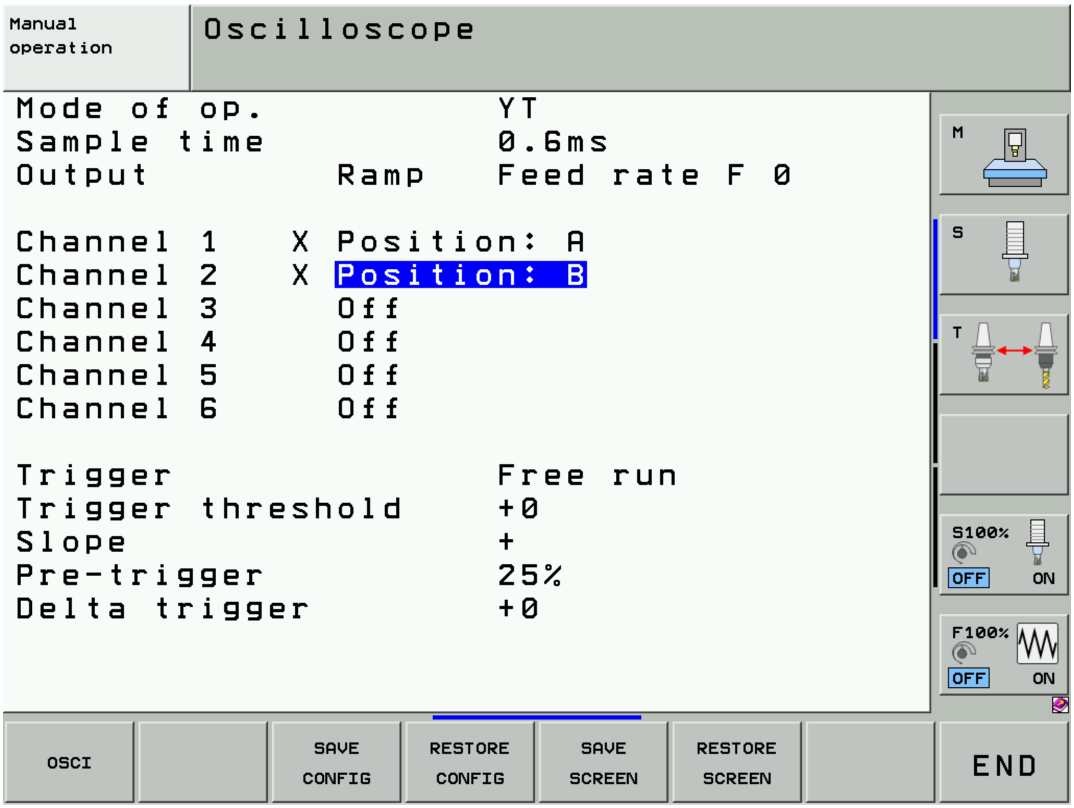
Activation and operation --> See "Integrated oscilloscope" on page 10 – 95.

Note

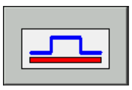
Reference signals and EnDat signals cannot be displayed!
A phase angle measuring unit (e.g. PWM 9) should be used for accurate signal tracing.

Example of an oscilloscope recording of position encoder signals:

- Make the following settings (select the minimum value in the 'time resolution' line; here 0.6 ms):

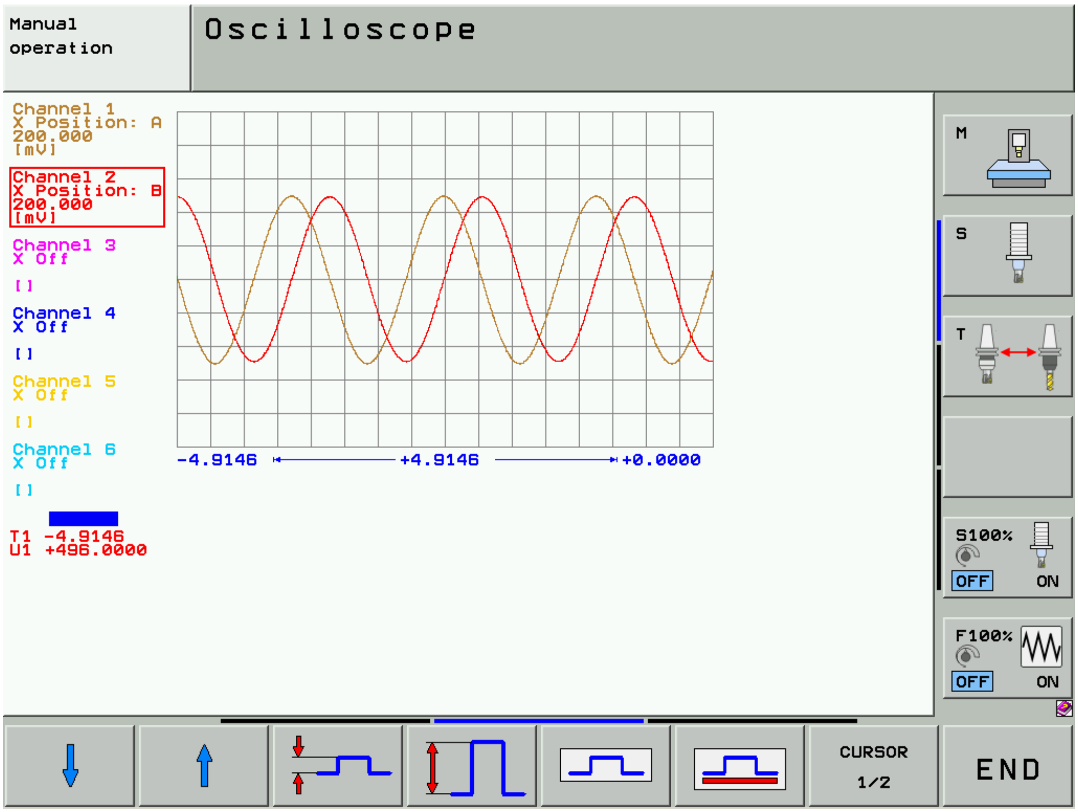


- Move the X axis at very low speed in the manual mode.
- Start the oscilloscope recording.
- Stop recording.



- Adapt the signals taking the zero line into account.

- Adapt the time axis to get a more detailed view.



The A and B signals must be of equal size and move symmetrically about the same vertical axis **(no vertical offset)!**

The **90° offset of the signals A and B** on the horizontal axis is clearly visible.
A drop of the amplitudes during traverse could e.g. be an indicator of a contaminated scale section.
If the amplitude is too low in standstill, the scanning head may be contaminated.

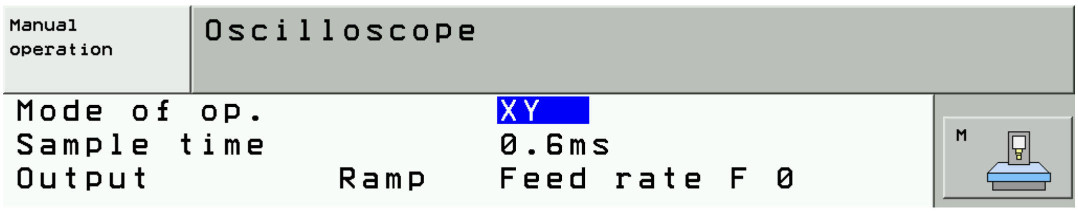
The signals in the integrated oscilloscope are always displayed in **mV**, irrespective of the type of encoder connected (1 Vpp or 11 µApp).

▶ Check whether the sinusoidal signals have an **offset (2.5 V)**.

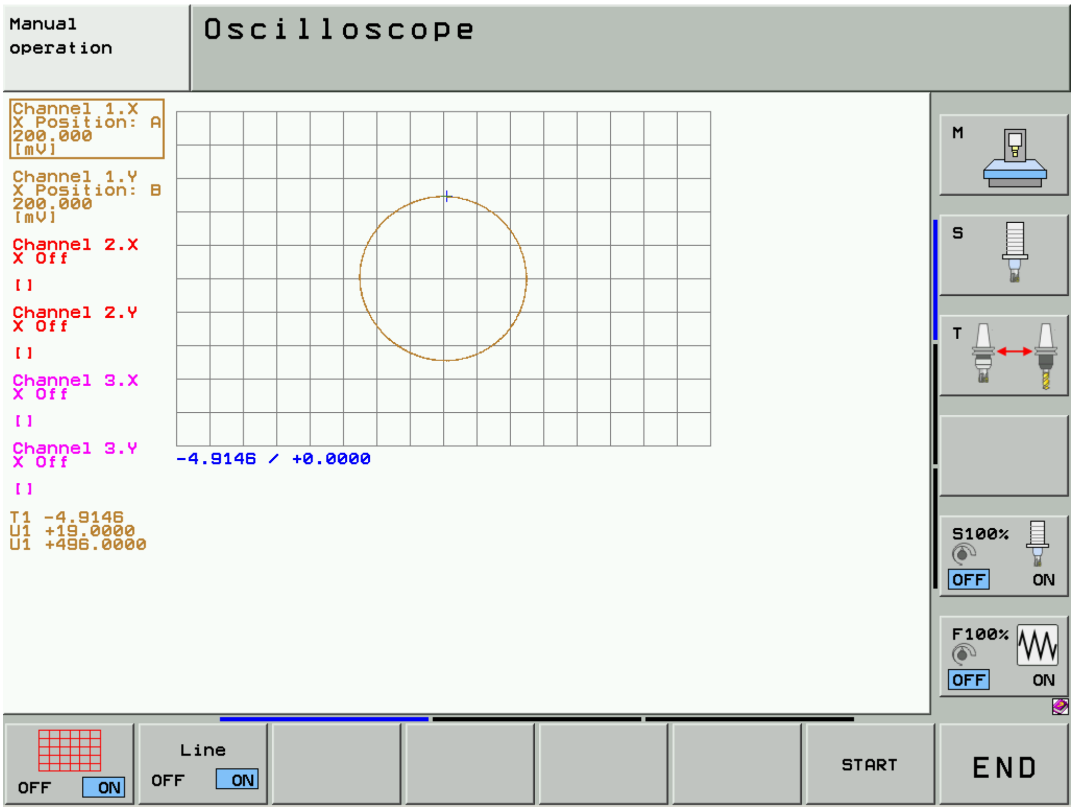
You will also find that the sinusoidal signals do not correspond to 1 Vpp or 11 µApp.
In this case, the signals **must** be **converted** according to special formulas:

Current signal 11 µApp	Oscilloscope display [mV] / 284 = encoder signal at input [µA] e.g.: 3124 [mV] / 284 = 11 [µA]
Voltage signal 1 Vpp	Oscilloscope display [mV] / 3480 = encoder signal at input [V] e.g.: 3480 [mV] / 3480 = 1 [V]

▶ Now you can switch the oscilloscope display to XY(Lissajous figure):



▶ Observe the signal in the oscilloscope while traversing the X axis at low speed:



If signal evaluation is correct, a circle will be displayed.
If the display shows an oval, the scanning head is probably poorly adjusted or partly contaminated.

19.1.8 Corrective action

Encoder components

If you have found that the position or angle encoder, the scanning head or the cable is defective:

▶ Exchange the encoder or the encoder component or perform corrective action (e.g. clean the scale).

Note

To exchange the encoder components, use the enclosed mounting gauges, check gauges, mounting aids as well as the mounting and replacing instructions.

If available, use special HEIDENHAIN equipment (PWM 9, PWT) for adjustment and signal assessment.

In a special encoder training course you can learn about corrective action (e.g. cleaning of scales) and how this equipment is used.

The following tolerances apply by default:

- For 1 Vpp encoders: 0.6 ... 1.2 Vpp
- For 11 µApp encoders: 7 ... 16 µApp

The exact tolerances of the encoders can be found in the HEIDENHAIN mounting instructions and brochures.

Note

The scanning head of an EnDat linear encoder is programmed to match the scale (datum shift, etc.) For this reason EnDat linear encoders in the field must be replaced together with the scanning head!

DANGER

EnDat encoders offer the possibility of storing **machine or system-dependent data** in the memory area reserved for the machine tool builder. The data **may comprise safety-relevant information**.
Ask your machine tool builder whether and which information is saved in the EnDat encoder. Make sure that the replacement unit also contains this information!

Failure to do so may result in machine damage or personal injury!

Control components

If you have found that the position encoder interface on the CC 61xx or UEC 11x is defective:

▶ Exchange of CC 61xx or UEC 11x
--> See "Exchange of HEIDENHAIN components" on page 29 – 515.

19.1.9 Determining the field angle on linear motors, torque motors and synchronous spindles

If an encoder was replaced that is also used to control a linear or torque motor or a synchronous spindle, the commutation (position of the field angle) needs to be reset for this motor.

Attention

The method of defining the field angle of the respective axis / spindle is defined by the machine manufacturer.
Follow the instructions of the machine manufacturer.

Note

If only the scanning unit (AE) of an encoder was exchanged, the field-angle adjustment may not be required.

19.1.10 Resetting the machine datum

As the machine datum (machine reference) refers to the position encoder datums, it may be necessary to reset it after removing and mounting scales, scale tapes, scanning heads or angle encoders.

Note

On simple 3-axis machines, it is often not required to reset the machine datum. Here, it is sufficient to the check the software limit switches and to reset them, if necessary.
If you have any questions, contact your machine tool builder!

Attention

Setting the machine datum is **absolutely essential** on most machine tools **with 5-axis machining and with tool changers**.
Even if the NC programs are written with relation to the machine datum, it needs to be exactly determined again.

Note

The OEM **may have defined** the machine datum **beyond the range accessible by the machine axes**, i.e. it cannot be approached.
In such a case the OEM will specify a fixed point (reference hole or stud, etc.) in the machine's work envelope with an offset to the machine datum (e.g. 500 mm).

Note

The **OEMs frequently provide instructions** for setting the machine datum. Sometimes the axis compensations and kinematics settings need to be deactivated before you can reset the machine datum; they have to be reactivated and reset afterwards.
Consult the machine tool builder!
The following descriptions are only possibilities.

Individual axis

- Always try to mount the encoder as exactly as possible to its original position!
- Set the display to **REF**. --> Now you can see the **current actual position of the axis referenced to the machine datum**.
- Set the position display step in MP7290.x to the highest resolution.

Note

Sometimes the axis compensations and kinematics settings need to be deactivated before you can reset the machine datum. --> Ask the machine manufacturer.

- Reference the axis concerned.
- Position the axis to the machine datum or a machine's reference point defined by the machine manufacturer (e.g., table edge and surface, ring in the middle of the rotary table, reference hole, reference stud, etc.).

Note

Before you probe the reference mark, equate the ACTL values with the REF values (set datum).

> **Note**
>
> You may have to expand the traverse range (software limit switches).
> (The software limit switches are defined as of MP910.x. The operator may have limited the traverse range even further.)

- Write down the displayed REF value.
  (If required, subtract the position value defined by the machine manufacturer.)
- Invert the displayed REF value (or the result).
- Add this value to the value in MP960.x for the axis concerned and enter the result.

Example 1: Positioning to the machine datum (e.g., using a touch probe system)

A: Displayed REF value	-0.123 mm
B: Position value defined by the OEM at this position	+0.000 mm
C: A - B	-0.123 mm
D: Inverted value of C	+0.123 mm
E: Original entry in MP960.x	+630.500 mm
F: D + E = **New entry in MP960.x**	**630.623 mm**

Example 2: Positioning to a reference mark defined by the OEM (e.g., using a touch probe system)

A: Displayed REF value	299.877 mm
B: Position value defined by the OEM at this position	300.000 mm
C: A - B	-0.123 mm
D: Inverted value of C	+0.123 mm
E: Original entry in MP960.x	+630.500 mm
F: D + E = **New entry in MP960.x**	**630.623 mm**

- **Check, whether the new machine datum is correct (e.g., with M91).**
- If required, reset the traverse range to its original values.

> **Note**
>
> Activate the axis compensations and kinematics settings and determine them again, if necessary.
> --> Ask the machine manufacturer.

- Check the proper function of the tool changer.
- Set the display to **ACTL**.
- If necessary, ask the customer to mill a workpiece and check it for dimensional accuracy.

Further information --> See "Reference run" on page 20 – 323.

Gantry axes with two linear encoders

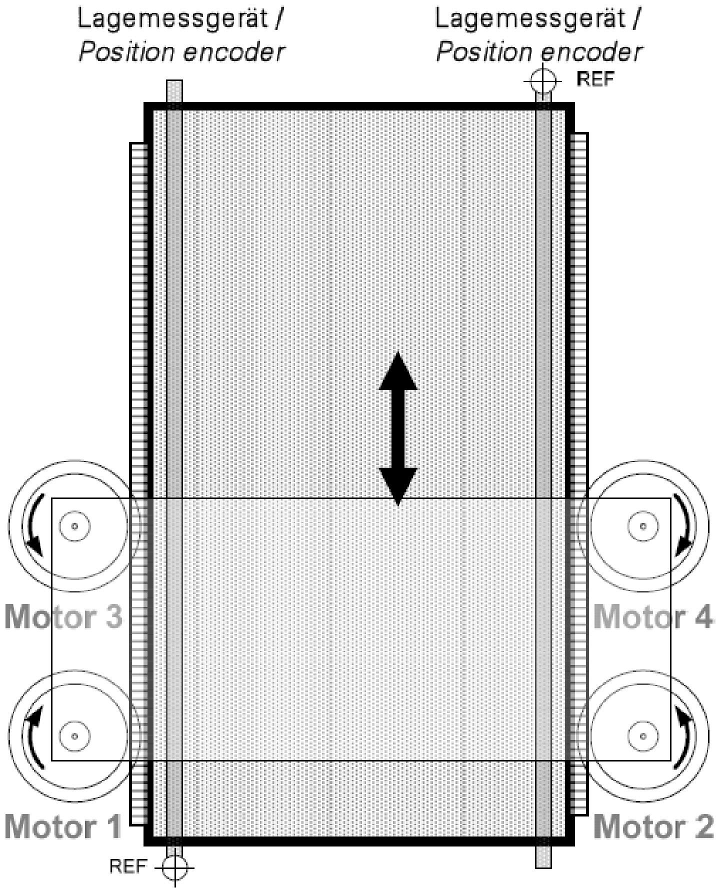


Figure: Example of a combination of gantry and master-slave torque drive

> Note
>
> If a position encoder fails in a gantry combination, the machine datum stays as it is because of the second position encoder.
> As the mechanical structure is rigid (portal, etc.), the unchanged axis can be used to find the value for MP960.x for the axis to be reset.

- Always try to mount the position encoder as exactly as possible to its original position!
- Ask the machine manufacturer which MP list is active.

> Note
>
> Machine manufacturers may use special MP lists or MP subfiles for gantry operation.
> See "Changes by the PLC" on page 31 – 572.

- In MP860.x (datum for synchronous control), set the bit 0 for the slave axis to 0.
  --> After the reference marks have been traversed, no compensating motion is made.
- The slave axis must be displayed. --> Enter the slave axis in MP7291.x.
- Set the display to **REF**. --> Now you can see the **current positions of the axes referenced to the machine datum**.
- Set the position display step in MP7290.x to the highest resolution.

> Note
>
> Sometimes the axis compensations and kinematics settings need to be deactivated before you can reset the machine datum. --> Ask the machine manufacturer.

- Reference the gantry axes (master and slave).

- Read the values of the **REF** display for the master and slave axis. The values will differ slightly.
- Add the difference of the displayed values to the value in MP960.x for the axis with the newly mounted encoder.
- Enter the result.

Example 1: Position encoder of the slave axis was remounted

A: Displayed REF value for master axis	500.000 mm
A: Displayed REF value for slave axis	500.345 mm
C: Difference between A and B	+0.345 mm
D: Original entry in MP960.x for the slave axis	+2000.000 mm
F: C + D = **New entry in MP960.x**	**2000.345 mm**

Example 2: Position encoder of the master axis was remounted

A: Displayed REF value for master axis	499.678 mm
A: Displayed REF value for slave axis	500.000 mm
C: Difference between A and B	+0.322 mm
D: Original entry in MP960.x for the master axis	+0.000 mm
F: C + D = **New entry in MP960.x**	**0.322 mm**

- **Check, whether the values of the new axis are correct** (master or slave):
  If the algebraic sign is wrong, the difference is twice as large.
  If the calculation is correct, the displayed values will be the same for master and slave axis.
- Reset MP860.x to its original value.

> Note
>
> Activate the axis compensations and kinematics settings and determine them again, if necessary.
> --> Ask the machine manufacturer.
> The machine manufacturer could also check the geometry of the gantry axes.

- Check the proper function of the tool changer.
- Set the display to **ACTL**.
- If necessary, ask the customer to mill a workpiece and check it for dimensional accuracy.

Further information --> See "Reference run" on page 20 – 323.

19.1.11 Restoring the spindle orientation

If you have replaced an angle encoder used for oriented spindle stop (e.g. for tool change), you must now readjust the **spindle preset**.

DANGER

Ask the machine manufacturer and observe the machine manufacturers's safety precautions (set-up mode, etc.)!

- Set **MP3430** to zero.
- Run the spindle at low speed.
- Orient the spindle to zero position.

Attention

The machine manufacturer may have defined several spindle positions. Orient the spindle to the zero position defined in MP3430.
If necessary, contact the machine manufacturer!

- Check the position that is established.
- Stop spindle orientation (M5); the spindle must be free to rotate.

DANGER

Press the EMERGENCY STOP button.
It must be ensured that the spindle cannot be switched on!

- Set the display to **REF**. --> Now you see the **deviation of the reference mark from the desired position**.
- Rotate the spindle to correct position (use e.g. dial indicator, touch probe, orientation point, etc.)
- Subtract the displayed value from 360° and enter the result in MP3430 (spindle preset).
- Check, whether spindle orientation is correct!
- Set the display to **ACTL**.

Further information –> See "Reference run" on page 20 – 323.

19.2 Speed encoders

19.2.1 Introduction

Speed encoders in motors are also referred to as **motor encoders**.
They report the speeds of the axes and spindles to the control.
The iTNC 530 operates with **incremental** and **absolute** encoders.

Permissible encoders :

- Encoders with one reference mark
- Encoders with distance-coded reference marks
- Encoders with EnDat interface 2.1, 2.2

Speed encoder inputs

CC 6106	CC 6108	CC 6110
■ **X15 to X20**	■ **X15A to X18A** (controller basic board A) ■ **X15B to X18B** (controller basic board B)	■ **X15A to X18A** (controller basic board A) ■ **X15B to X20B** (controller basic board B)

UEC 111	UEC 112
■ **X15 to X18**	■ **X15 to X19**

Polyfuses

Note

CC 61xx and UEC 11x feature "polyfuses".
Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., motor encoder) from the low voltages of the CC 61xx or the UEC 11x.
Polyfuses are equipped with a self-resetting function ("self-healing effect").

Fixed assignment on CC61xx and UEC 11x

On the **CC 61xx** there is a **fixed assignment** between the PWM output, the input of the speed encoder and the input of the position encoder:

CC 6106		
PWM output	**Speed input**	**Position input**
X51	X15	X201
X52	X16	X202
X53	X17	X203
X54	X18	X204
X55	X19	X205
X56	X20	X206

CC 6108		
PWM output	**Speed input**	**Position input**
X51A	X15A	X201A
X52A	X16A	X202A
X53A	X17A	X203A
X54A	X18A	X204A
X51B	X15B	X201B
X52B	X16B	X202B
X53B	X17B	X203B
X54B	X18B	X204B

CC 6110		
PWM output	**Speed input**	**Position input**
X51A	X15A	X201A
X52A	X16A	X202A
X53A	X17A	X203A
X54A	X18A	X204A
X51B	X15B	X201B
X52B	X16B	X202B
X53B	X17B	X203B
X54B	X18B	X204B
X55B	X19B	X205B
X56B	X20B	X206B

On the **UEC 11x** there is a **fixed assignment** between the motor output, the input of the speed encoder and the input of the position encoder:

UEC 111			
Motor output	**Rated current at 5 kHz**	**Speed input**	**Position input**
X80	20 A (spindle)	X15	X201
X81	5 A	X16	X202
X82	5 A	X17	X203
X83	7.5 A (stronger axis)	X18	X204

UEC 112			
Motor output	**Rated current at 5 kHz**	**Speed input**	**Position input**
X80	20 A (spindle)	X15	X201
X81	5 A	X16	X202
X82	5 A	X17	X203
X83	7.5 A (stronger axis)	X18	X204
X84	5 A	X19	X205

EnDat encoders

EnDat encoders may be connected to all speed encoder inputs of a CC 61xx or a UEC 11x. With EnDat 2.1, the incremental signals are of the **1 Vpp** type.

Memory areas in the EnDat encoder

Motor encoders with EnDat interface may feature an **electronic ID label**. It contains the **motor data**, such as device name, ID number, serial number, motor brake.

Furthermore, the machine manufacturer has the possibility of storing **machine or system-specific data** in a memory area reserved for this purpose.

Temperature sensor lines

The **signal cable** for the motor encoder also contains the **temperature sensor lines** of the motor.

19.2.2 Machine parameters

Monitoring speed encoders

The speed encoders of digital axes or spindles are always monitored!

Connecting speed encoders

MP100 is read from the right to the left and contains the information which axis is the first, the second, the third, etc.

Attention

MP100 must not be changed!

In **MP108** you can see the assignment of the axes to the controller basic boards.

In **MP109** you can see the assignment of the spindles to the controller basic boards.

Note

The input value (0 ... 3) represents the HSCI address of the respective controller basic board.

The parameter **MP112** (as on iTNC 530) is no longer required due to the fixed assignment of PWM/motor output and speed encoder input.
These interfaces are assigned via the machine parameters MP120 and MP121.

MP113 contains see the assignment of the spindles to the speed encoder inputs.

Note

The MP113 is still available for special cases.
(For example, if two spindle motors are operated with one power module. The respective motor encoders are assigned to two different speed encoder inputs.)

MP120 contains the assignment of the axes to the PWM/motor outputs and thus also to the speed encoder inputs (connector X15 and following).

MP121 contains the assignment of the spindles to the PWM/motor outputs and thus also to the speed encoder inputs (connector X15 and following).
(In special cases, also refer to MP113.)

19.2.3 Error messages

The following error messages may be displayed, if there are problems related to speed encoders:

- 8140 Error field orientation
- 8830 EnDat: No field angle
- 8860 Input frequency from speed encoder
- 8B00 Zn track error
- 8B20 Error field orientation
- 8BA0 Incorrect reference signal or line count
- 8BA0 Incorrect line count
- 8BF0 Input frequency from speed encoder
- AC00 Amplitude too high
- AC00 CC amplitude too high
- AC10 Amplitude too small
- AC10 CC Amplitude too small
- AC20 Frequency too high
- AC20 CC Frequency too high
- C160 Grating per. motor enc.
- C300 Zn track error
- C310 Z1 track error
- C370 Angle error motor encdr.
- C380 Motor not controllable
- C3A0 Incorrect reference position
- C3B0 Motor does not rotate
- C3F0 EnDat not found
- C400 Encoder line count error
- C400 Line count error
- C410 Rotor position undefined
- C450 Encoder incorrect
- C450 Wrong encoder
- Switch-off pos. unequal EnDat
- EnDat defective
- EnDat interpolation not possible
- Frequency too high
- Line count of rotary encoder

> **Note**
>
> Other error messages may also indicate problems with a speed encoder.

19.2.4 Possible error causes

- Contamination by condensed oil, grease, water
- Signal socket damaged
- Cable damaged
- Signal error caused by high frequency, strong magnetic fields, etc.
- Penetration of humidity
- Encoder electronics (e.g., light unit) defective
- Motor encoder is loose (e.g., loose or defective coupling between motor encoder housing and motor housing)
- Strong machine vibrations
- Defective speed encoder interface on CC 61xx or UEC 11x

19.2.5 Troubleshooting

To find out, whether **the connected encoder** or **the encoder interface of the control component** is defective, the **interchange method** can be used.

> Note
>
> Encoder error messages are mostly due to the encoders / signal sockets / cables. In rare cases, the reason is a defective interface of a CC or UEC.
> The interchange method is quite complex here, as in addition to the speed encoder inputs, you also have to swap the position encoder inputs and the PWM outputs or motor outputs, and you must adapt the parameter settings.
> Checking the suspicious speed encoder with a PWM 9 or a PWT 18 may be more effective.
> --> See "Further examination of position and speed encoders" on page 19 – 314.

Exchange constellations

CC 61xx	
Exchange constellations	**Flowchart**
Swapping two single-speed axes or two double-speed axes	Swapping axes on a CC 61xx
Swapping single-speed axis <--> single-speed spindle or double-speed axis <--> double-speed spindle	Swapping axis and spindle on a CC 61xx

UEC 11x	
Exchange constellations	**Flowchart**
Swapping two single-speed axes or two double-speed axes with the same rated current	Swapping axes with the same rated current on a UEC 11x
Swapping two single-speed axes or two double-speed axes with different rated current	Swapping axes with different rated current on a UEC 11x
Swapping single-speed axis <--> single-speed spindle or double-speed axis <--> double-speed spindle	Swapping axis and spindle on a UEC 11x

Notes and preparatory action

- CC 61xx:
  If axes/spindles with different power modules and motors are supposed to be swapped, these devices (if equipped with electronic ID labels) would try to log on to the control during start-up.
  A new assignment would be requested according to the changed wiring, even before the service engineer can edit the machine-parameter values. To avoid this, **deactivate** the **evaluation of the electronic ID labels** with MP7690 before the exchange.

- Use the **speed encoder input of a functioning axis/spindle**.
  (The permanently assigned PWM output or motor output must be connected, since - depending on the configuration of single-speed and double-speed control loops - non-connected outputs may not be active.)

- **The permanently assigned position inputs and PWM or motor outputs must be swapped, too!**

> Note
>
> Due to the fixed assignment, the interchange method cannot be used independently for position encoders, speed encoders or PWM/motor outputs. The axes must be swapped altogether.

- To find the correct machine parameters in the MP2xxx.y group, call the machine parameters MP130 (axes) and MP131/132 (spindles). Here you find the assignments of the axes/spindles to the respective indexes 'y' of the MP2xxx.y group.

- The **same PWM frequency** should be set for axes and spindles to be swapped!
  If there are different PWM frequencies in the machine parameters MP2180.x , you may enter 5 kHz for the axes/spindles for testing.

- CC 61xx:
  If the swapped PWM outputs are on a compact inverter or a two-axis module, the control generates the `Power interrupted` message as usual.
  If, however, the swapped PWM outputs lead to two different power modules (different ID or SN), the control generates the message `Hardware/firmware change detected` during start-up.
  –> See "Reading out power module data" on page 21 – 338.

- UEC 11x:
  Check, whether the axes to be swapped have the same rated current (MP2100.x and power-module table).
  If the rated current is not the same, or if an axis is swapped with a spindle, the power output stages need to be assigned correctly.

> DANGER
>
> Swapping **power output stages with different rated currents** for testing and not assigning them correctly (MP2100.x) may cause damage to the machine or personal injury!

> DANGER
>
> Always secure vertical axes to prevent them from falling down before you perform tests on these axes!

Block diagrams

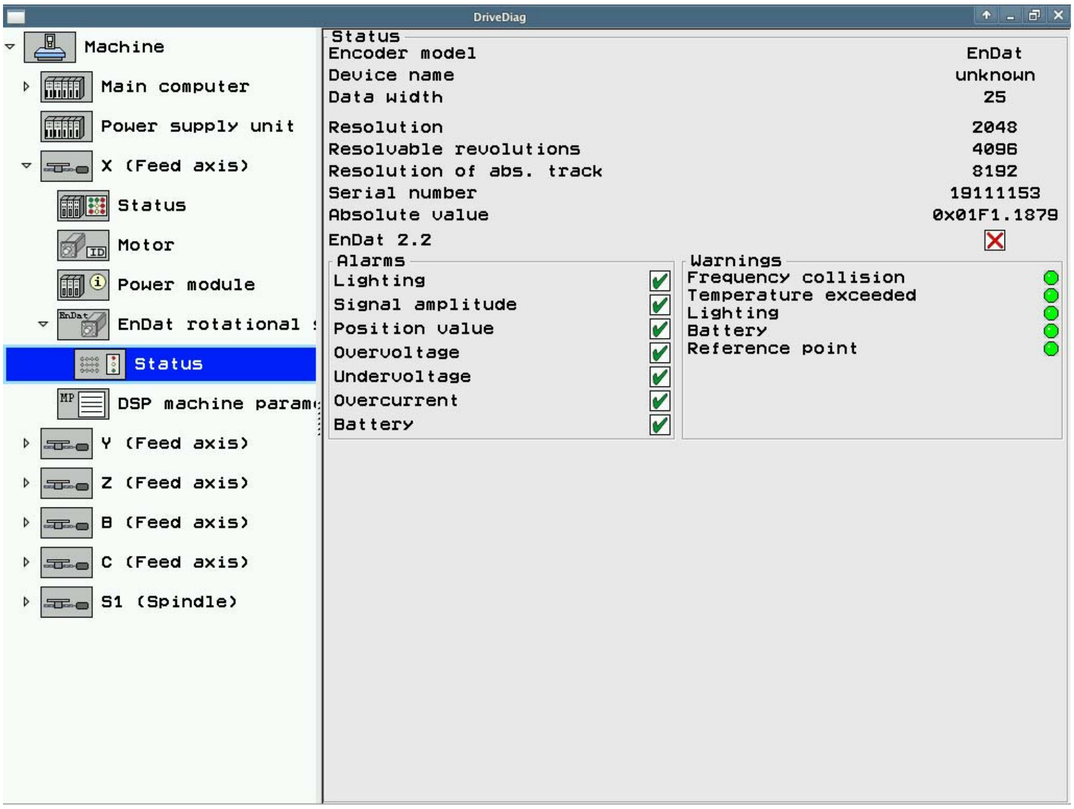
See "Block diagrams for axis swapping" on page 19 – 283.

Flowcharts

See "Flowcharts for axis swapping" on page 19 – 284.

19.2.6 Possibilities with DriveDiag

On the info screen "EnDat rotational speed encoder" you can see, whether alarm bits are set:



Calling the screen --> See "DriveDiag" on page 9 – 91.

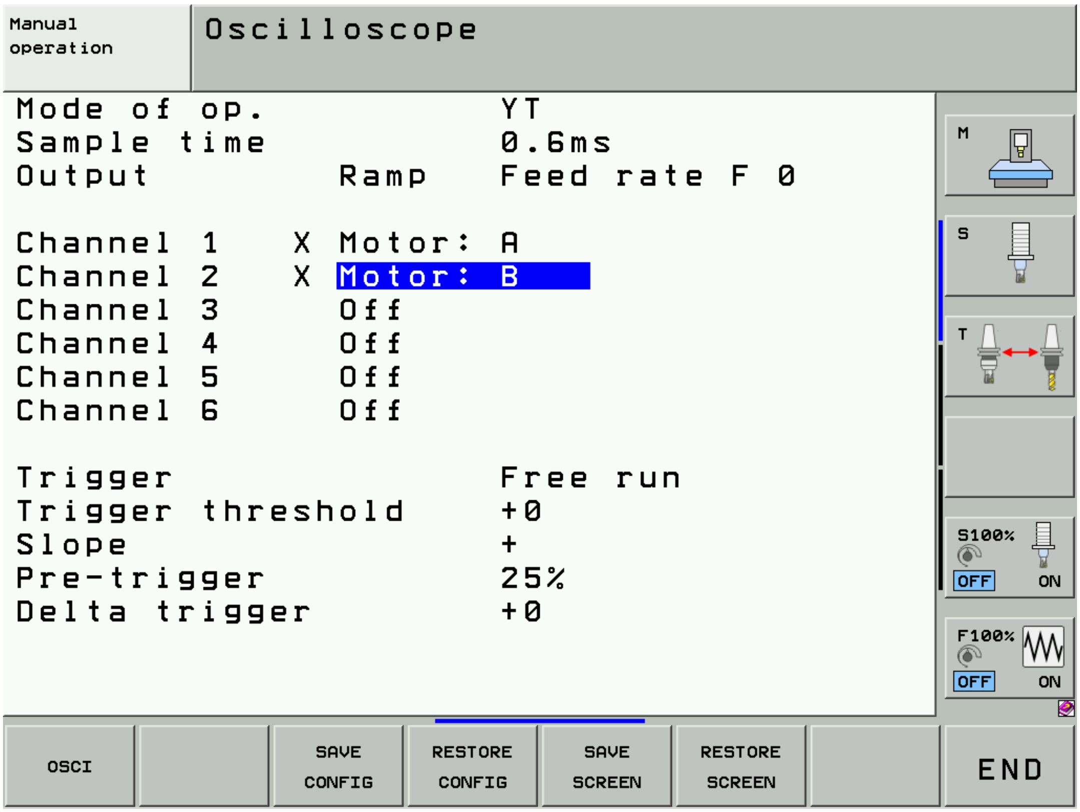
19.2.7 Possibilities with the integrated oscilloscope

With the integrated oscilloscope you can record the incremental signals (A, B) of motor encoders.

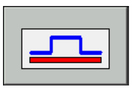
Activation and operation –> See "Integrated oscilloscope" on page 10 – 95.

Example of an oscilloscope recording of motor encoder signals:

- Make the following settings:

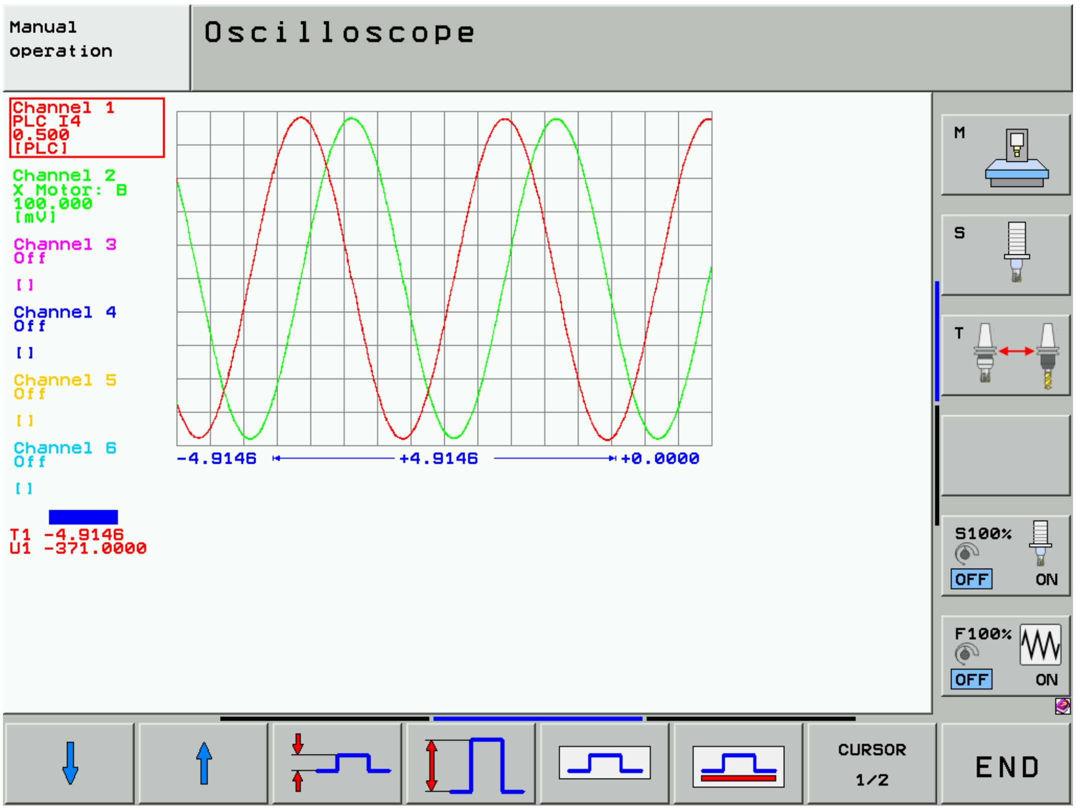


- Move the X axis at very low speed in the manual mode.
- Start the oscilloscope recording.
- Stop recording.



- Adapt the signals taking the zero line into account.

- Adapt the time axis to get a more detailed view.

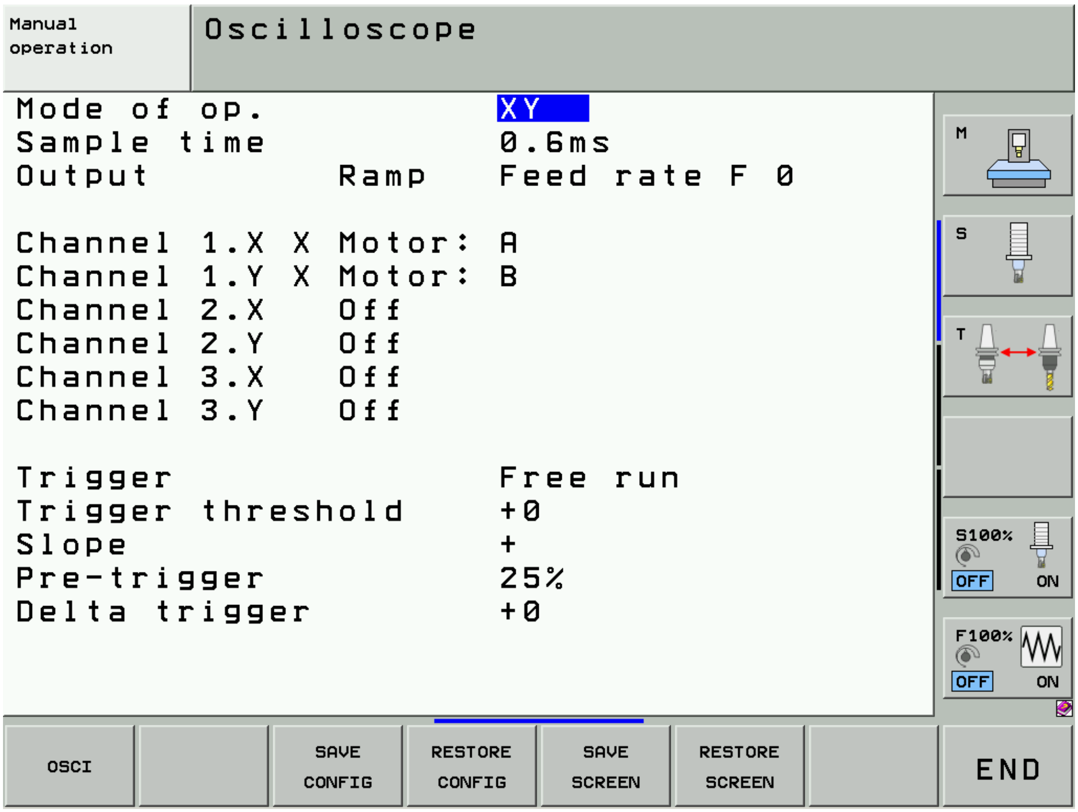


The A and B signals must be of equal size and move symmetrically about the same vertical axis **(no vertical offset)!**

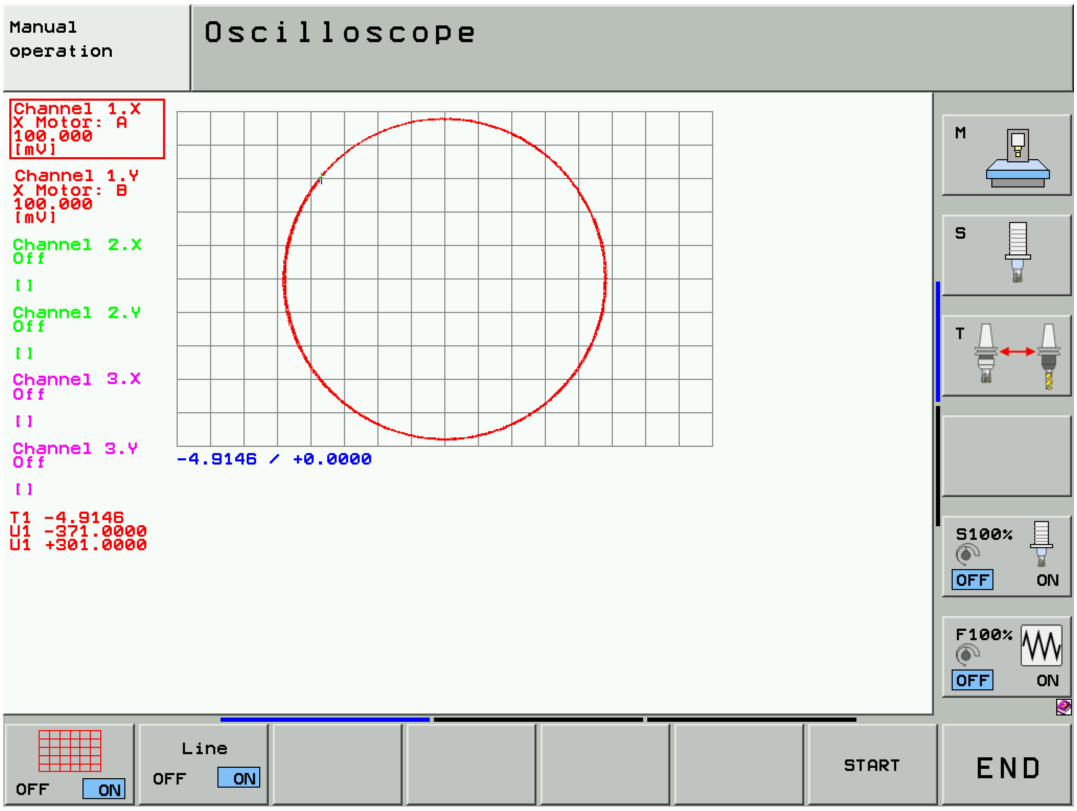
The **90° offset of the signals A and B** on the horizontal axis is clearly visible.

The signals are displayed in **mV**.

- Now you can switch the oscilloscope display to XY (Lissajous figure):



▶ Observe the signal in the oscilloscope while traversing the X axis at low speed:



If signal evaluation is correct, a circle will be displayed.

Note

If the signal 'pumps' or fluctuates, the encoder does not work correctly.
In most cases, the encoder is contaminated.

19.2.8 Corrective action

Motor encoder in a synchronous motor

If you have found that the motor encoder in a synchronous motor is defective
(synchronous motors from HEIDENHAIN are designated QSY xxx; they are used for machine axes):

- Exchange the entire synchronous motor!

Attention

Motor encoders in synchronous motors must be adjusted to a certain rotor position.
The **adjustment** is made by the motor manufacturer.

In addition, motors may have an **electronic ID label**. This electronic ID label for the motor is stored in the EnDat motor encoder. When you exchange the motor encoder, the electronic ID label must be written anew.
This is done at the motor manufacturer.

DANGER

EnDat encoders offer the possibility of storing **machine or system-dependent data** in the memory area reserved for the machine tool builder. The data **may comprise safety-relevant information**.
Ask your machine tool builder whether and which information is saved in the EnDat encoder.
Make sure that the replacement unit also contains this information!

Failure to do so may result in machine damage or personal injury!

Motor encoder in an asynchronous motor

If you have found that the motor encoder in an asynchronous motor is defective:
(asynchronous motors from HEIDENHAIN are designated QAN xxx; they are used for spindles):

- Exchange either the entire asynchronous motor or the motor encoder.

If you want to exchange the motor encoder of the asynchronous motor:

- Read the instructions in the service manual "Inverter Systems and Motors".
- Use the enclosed mounting instructions (all motor encoders are supplied with mounting instructions).

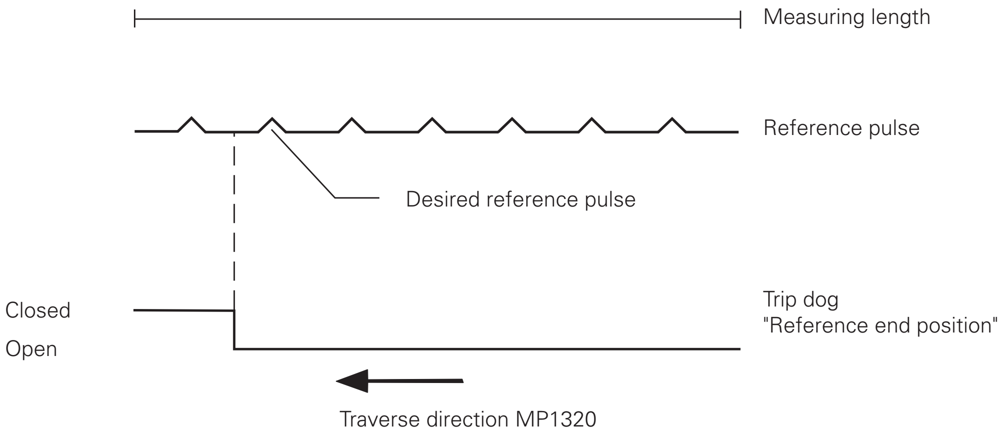
Control components

If you have found that the motor encoder interface on the CC 61xx or UEC 11x is defective:

- Exchange of CC 61xx or UEC 11x --> See "Exchange of HEIDENHAIN components" on page 29 – 515.

19.2.9 Readjusting the trip dog for reference end position

For **position capture using a conventional motor encoder** (not an EnDat encoder), one reference pulse is produced at each revolution of the encoder. To ensure that always the same reference pulse is evaluated when the machine is switched on, a trigger signal is used (PLC input).
The trigger signal should be at the correct axis position, in the center between two reference pulses; see figure.



> **Note**
>
> The **OEMs frequently provide instructions** for adjusting the trip dog. Use these instructions! The following brief description is only one possibility.

- Set the display to **REF**. –> You can now see **the current axis position referenced to the machine datum.**
- Reference the axis concerned at a low speed of the newly mounted motor.
- Read the display and compare the value for this axis to that in MP960.x.
- Position the axis with M91 to the value of MP960.x (e.g. 321.456 mm) and check, whether the axis is approximately at the correct position. (The exact position will be determined later. –> See "Resetting the machine datum" on page 19 – 312.)
  Ask the machine operator.
- Starting from this point, position the axis with M91 by half the value in MP1054.x (distance covered in one motor revolution) in the traverse direction specified in MP1320.x.
  If, for example, the motor is directly coupled, the spindle pitch 10 mm and the traverse direction positive, the position would be 321.456 mm + 5 mm = 326.456 mm.

> **Note**
>
> You may have to expand the traverse range (software limit switches).
> (The software limit switches are defined as of MP910.x. The operator may have limited the traverse range even further.)

- Adjust the trip dog at this position. Ask the OEM for the related PLC input and observe this input, e.g., with the integrated oscilloscope or in the PLC logic diagram.
- Restart the machine several times and test referencing. –> The reference mark must always be evaluated at the same position.

> **Note**
>
> If available, you can also use a PWM 9 to observe the reference mark.
> –> See "PWM 9 encoder diagnostic kit" on page 30 – 564.

Further information –> See "Reference run" on page 20 – 323.

19.2.10 Resetting the machine datum

If an axis motor was replaced whose motor encoder is used for position capture (indirect path measurement), the machine datum (machine reference) may have to be reset.

The procedure for restoring the machine datum when using indirect encoders is the same as with direct encoders. --> See ”Resetting the machine datum” on page 19 – 295.

Special case: Double reference run

(If you have exchanged a motor with an EnDat encoder which is used for the first rough reference run; no changes were made to the position encoder.)

DANGER

Ask the machine manufacturer for the reason why a double reference run of the machine axis was configured! The double reference run may be required to avoid collision. Follow the **instructions of the machine manufacturer** to restore the double reference run.

General procedure:

- Reset MP1355.x for the respective axis to 1 (= double reference run) and MP1356.x (distance between speed and position encoder for double reference run) to 0.
- Reboot the control.
- Confirm the position message of the EnDat motor encoder.
- If required, expand the traverse range.
- Slowly and carefully traverse the reference mark of the position encoder.
- The message **`Set MP1356.x to <value>`** appears.
- Note down this value.
- Enter this value in MP1356.x.
- Reset the traverse range to its original value.
- **Test the entire reference run of the machine again!**

Further information --> See ”Reference run” on page 20 – 323.

19.2.11 Restoring the spindle orientation

If you have replaced a motor encoder used for oriented spindle stop (e.g. for tool change), you must now readjust the **spindle preset**.

The procedure for restoring the spindle orientation when using motor encoders is the same as with angle encoders. --> See ”Restoring the spindle orientation” on page 19 – 299.

19.3 Error codes for encoders with EnDat interface

In the event of a disturbance, the error message **`EnDat defective <error code> <axis>`** will appear.

The error code is shown in hexadecimal notation. Error codes may also appear combined, in which case they are added together.

There are two different types of errors:

- The encoder reports an error.
- Access to the encoder via the EnDat interface is faulty.

Codes for errors reported by the encoder:

Error code	Meaning
0x00000001	Light source defective
0x00000002	Signal amplitude too low
0x00000004	Incorrect position value
0x00000008	Overvoltage
0x00000010	Undervoltage
0x00000020	Overcurrent
0x00000040	Replace the battery
0x00000080	Reserved
0x00000100	Reserved
0x00000200	Reserved
0x00000400	Reserved
0x00000800	Reserved
0x00001000	Reserved
0x00002000	Reserved
0x00004000	Reserved
0x00008xxx	EnDat could not be read. Possible causes: ■ Encoder defective ■ Check the wiring (cable and EnDat amplifier) ■ Encoder not connected ■ Encoder connected to wrong connector ■ Motor and position encoder switched ■ Check cable lengths

Error codes if the access to the encoder via the EnDat interface is faulty:

Error code	Meaning
0x80010000	Delete the alarm bit
0x80020000	Read the alarm status
0x80040000	Read the number of pulses
0x80080000	Read the number of signal periods
0x80100000	Read the number of differentiable revolutions
0x80200000	Read the measuring steps
0x80400000	Read the serial number
0x80800000	Read the type of encoder
0x81000000	Read the position value
0x82000000	Reserved
0x84000000	Reserved
0x88000000	Read the checksum
0x90000000	Alarm bit remains set
0xA0000000	Timeout while waiting for data signal "high"
0xC0000000	Timeout while waiting for data signal "low"
0x80000000	Error during access to EnDat interface

19.4 Further examination of position and speed encoders

Introduction

If you want to make **further examinations** of incremental and absolute HEIDENHAIN encoders, you can use special HEIDENHAIN measuring equipment.

The HEIDENHAIN measuring equipment described below can also be used for **preventive maintenance**.
If you find out, for example, that the specifications (e.g. the signal amplitude) of an encoder are very close to the tolerance limits, you can replace this encoder as a preventive measure, in order to guard against machine standstill at a later date!

PWM 9

With the PWM 9 **Phase Angle Measuring Unit** you can examine incremental encoders as well as the incremental signals of EnDat encoders.
--> See "PWM 9 encoder diagnostic kit" on page 30 – 564.

> DANGER
>
> If the PWM 9 is connected in the signal path between the encoder and the control:
> Do not change the settings of the PWM 9 (e.g., parameters, encoder voltages) and do not switch it off while the machine tool is operating.
> Ignoring this may cause machine damage or personal injury!
> Read the **User's Manual** of the PWM 9 in detail, before you use the device.

Photo: Example of a recording with the PWM 9

> Note
>
> A detailed explanation of the device is part of our **training courses on measuring systems**.
> We recommend that you participate in a HEIDENHAIN service training course so that you can use the PWM 9 correctly and efficiently.
> Contact HEIDENHAIN Traunreut or your regional agency.

PWT

The PWT **Phase Angle Testing Unit** serves to evaluate the signal amplitude and quality as well as the position and width of the reference mark.
--> See "PWT 10/17/18 test unit" on page 30 – 566.

Using the PWT instead of the PWM 9 has advantages and disadvantages.

Advantages:

- Small, lightweight device
- Easy handling

Disadvantages:

- The PWT has an input but no output. This means that it **cannot** be connected in series between encoder and control.
  Thus, the motor encoder can hardly be checked at "operating speed".
- The motor shaft or the spindle must be turned manually.

> **Note**
>
> Every **PWT** is delivered with **operating instructions**.

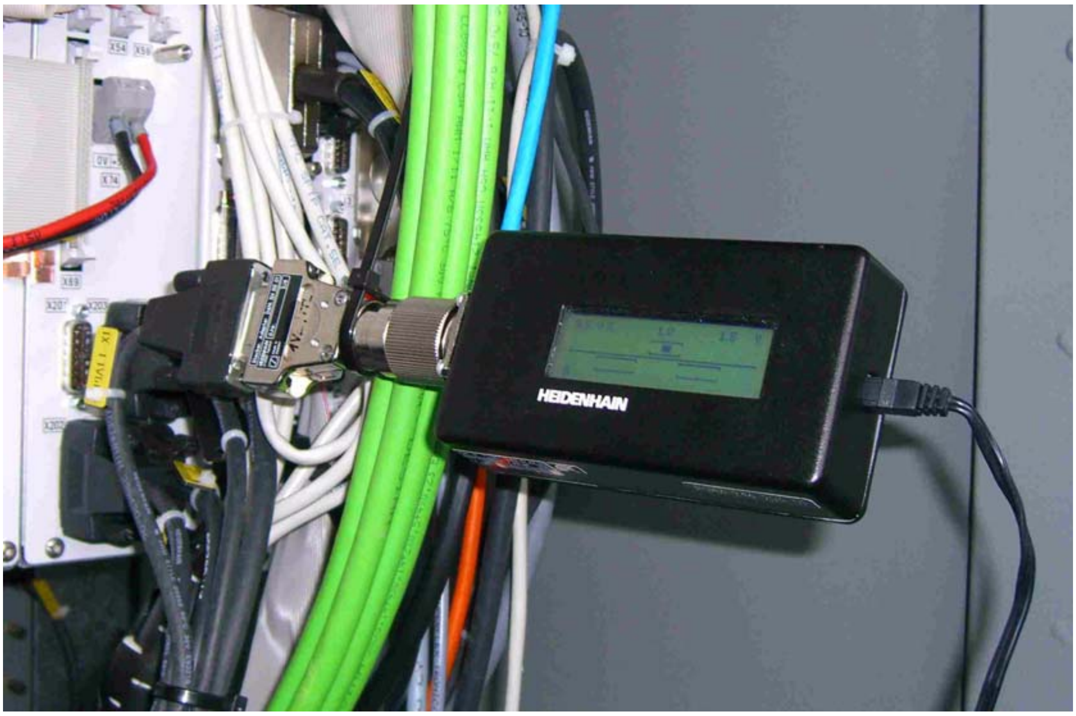


Photo: Example of a recording with the PWT 18:
A linear encoder (1 Vpp) is connected to the PWT 18 with the signal cable and the adapter connector ID 324555-01. The axis is traversed using a motor encoder with indirect path measurement.
(See "Position measurement via motor encoder (indirect position measurement)" on page 19 – 317.)

> **Note**
>
> A detailed explanation of the device is part of our **training courses on measuring systems**.
> We recommend that you participate in a HEIDENHAIN service training course so that you can use the PWT correctly and effectively.
> Contact HEIDENHAIN Traunreut or your regional agency.

IK 215

Use the IK 215 interface card for inspecting and testing an EnDat encoder. --> See "IK 215 adjusting and testing package" on page 30 – 568

DANGER

If the IK 215 is connected in the signal path between the encoder and the control component:
Do not change the settings of the IK 215 (e.g., parameters, encoder voltages) and do not switch it off while the machine tool is operating.
Ignoring this may cause machine damage or personal injury!
Read the **operating instructions** of the IK 215 in detail, before you use the device.

Note

A detailed explanation of the device is part of our **training courses on measuring systems**.
We recommend that you participate in a HEIDENHAIN service training course so that you can use the IK 215 correctly and effectively.
Contact HEIDENHAIN Traunreut or your regional agency.

PWM 20

You can also use the new PWM 20 for inspecting and testing EnDat encoders. --> See "PWM 20 encoder diagnostic kit" on page 30 – 569.

DANGER

If the PWM 20 is connected in the signal path between the encoder and the control:
Do not change the settings of the PWM 20 (e.g., parameters, encoder voltages) and do not switch it off while the machine tool is operating.
Ignoring this may cause machine damage or personal injury!
Read the **operating instructions** of the PWM 20 in detail, before you use the device.

Note

A detailed explanation of the device is part of our **training courses on measuring systems**.
We recommend that you participate in a HEIDENHAIN service training course so that you can use the PWM 20 correctly and efficiently.
Contact HEIDENHAIN Traunreut or your regional agency.

19.5 Position measurement via motor encoder (indirect position measurement)

Switching path measurement from the linear encoder to the motor encoder may be helpful to ...

- **facilitate the dismounting of a defective position encoder**.
  (E.g. if the axis is at a position at which you cannot dismount the scale)

- **analyze the quality of the encoder signals from the position encoder with a PWT.**
  (See "Further examination of position and speed encoders" on page 19 – 314.)

- **analyze errors in the control loop.**
  (See "Error localization by switching from direct to indirect position measurement" on page 6 – 69.)

Please note!

Read this information carefully before you switch to position capture via motor encoder!

DANGER

Traverse with indirect position measurement is described for servicing only!
You must not continue working with the machine tool!

Reasons:

- No reference point is evaluated for the axis concerned; thus, you could traverse to the limit switches or the mechanical stops. Automatic tool change is usually not possible any longer.
- The manufacturer has not prepared the machine for traverse with motor encoders as position information systems.

DANGER

When switching from the scale / scale tape / angle encoder to the motor encoder, **the counting direction of the position encoder signals** (MP210.x) or the **sign of the nominal speed value** (MP1040.x) may no longer be correct!
In this case the feedback for a control loop is transformed into **positive feedback**, which in the worst case could cause the affected axis to race.

Normally, this quickly results in error messages such as `Excessive servo lag`, etc. and the control generates an EMERGENCY STOP.

Moreover, the iTNC 530 HSCI runs an automatic **plausibility check** for the MP1040.x (sign of nominal speed value). The error message `Incorrect entry in MP1040.x` means that MP1040 must be inverted now.

DANGER

Always secure vertical axes to prevent them from falling down before you switch to position capture via motor encoder!

With **axes in master-slave torque control**, two motors (master and slave) are mechanically coupled. Because of the coupling, only **one** position encoder is required for the master. The motor to which the position encoder is assigned is the master.
If the position encoder is defective or shall be examined, in principle the proceeding is the same as with a single axis. --> See "Flowchart for axes in master-slave torque control" on page 19 – 320.

With **gantry axes (synchronized axes)** normally **two position encoders** are used. If a position encoder is defective or is to be inspected, ask the machine manufacturer whether the gantry axes can also be operated with one drive ("service function", e.g., the portal is moved by one drive only).

Note

Please clarify with the machine tool builder, whether the axis concerned is operated as individual axis, with master-slave torque control, with gantry axes or gantry axes with master-slave torque control.

Preparations

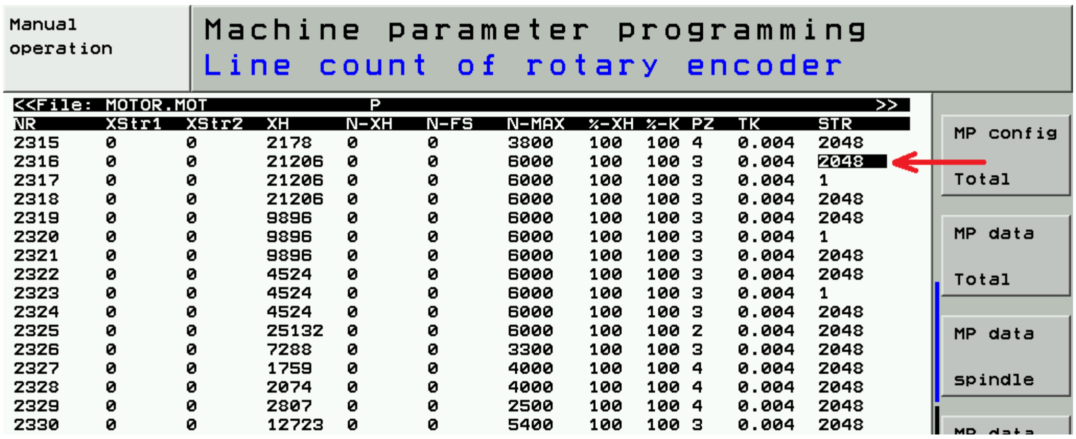
- A defective scale or scanning head or a defective encoder cable could influence the low voltages of the control. This could impair the overall function.
  Therefore, switch off the machine and separate the position encoder from the control!
- The changes to the machine parameter list are quite extensive.
  Proposal:
  Copy the original MP list and name the copy, e.g., `Motor encoder X.MP`.
  Activate this list and make your changes there (not in the original MP list)!
- You may have to expand the traverse range limits.
  This is done in the machine parameters MP910.x and following.
  The traverse range limits set by the machine operator can be called and expanded via the MOD key and the TRAVERSE RANGE soft key.

Line count of the motor encoder

For traverse with indirect position measurement the line count of the encoder must be known.

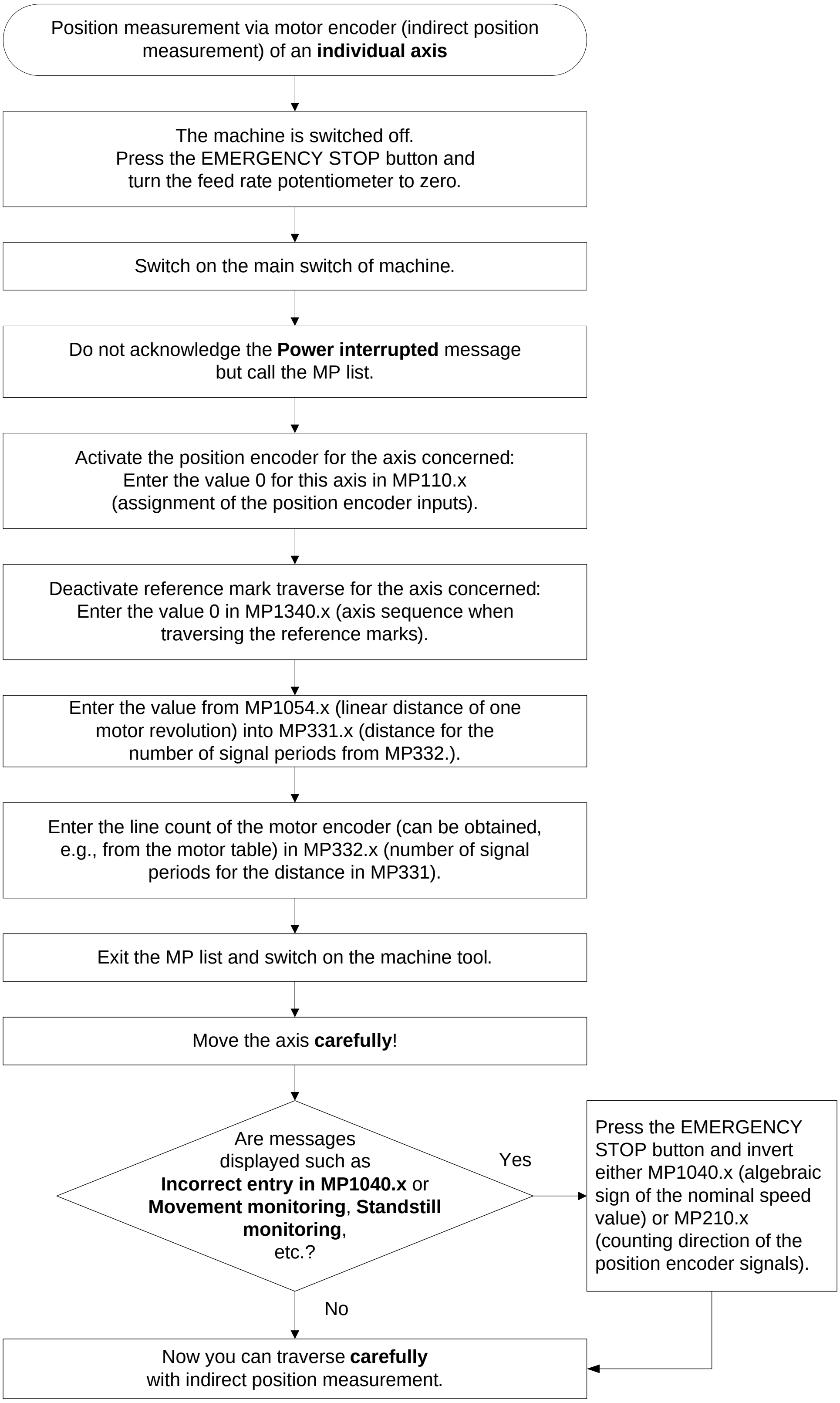
The motor table contains this information:

- Call the machine parameter list.
- Place the cursor on MP2200.x for the motor concerned.
- Switch to the next soft-key row.
- Press the soft key with the motor symbol.
- Press the SHOW ACTUAL VALUE soft key.
- Press the right arrow key until the cursor is in the STR column.
- Read the line count of the encoder (e.g. 2048).

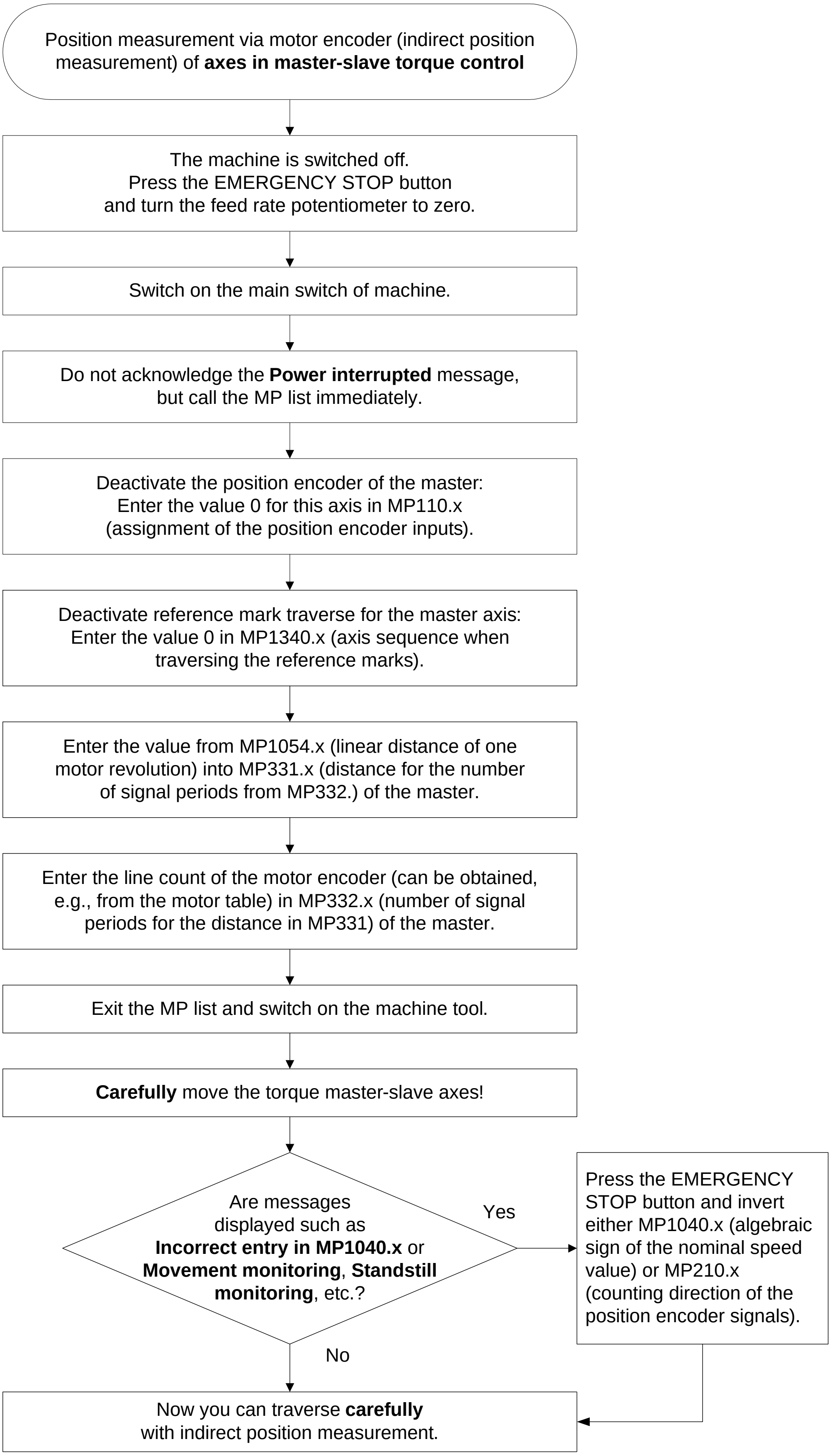


NR	XStr1	XStr2	XH	N-XH	N-FS	N-MAX	%-XH	%-K	PZ	TK	STR
2315	0	0	2178	0	0	3800	100	100	4	0.004	2048
2316	0	0	21206	0	0	6000	100	100	3	0.004	2048
2317	0	0	21206	0	0	6000	100	100	3	0.004	1
2318	0	0	21206	0	0	6000	100	100	3	0.004	2048
2319	0	0	9896	0	0	6000	100	100	3	0.004	2048
2320	0	0	9896	0	0	6000	100	100	3	0.004	1
2321	0	0	9896	0	0	6000	100	100	3	0.004	2048
2322	0	0	4524	0	0	6000	100	100	3	0.004	2048
2323	0	0	4524	0	0	6000	100	100	3	0.004	1
2324	0	0	4524	0	0	6000	100	100	3	0.004	2048
2325	0	0	25132	0	0	6000	100	100	2	0.004	2048
2326	0	0	7288	0	0	3300	100	100	3	0.004	2048
2327	0	0	1759	0	0	4000	100	100	4	0.004	2048
2328	0	0	2074	0	0	4000	100	100	4	0.004	2048
2329	0	0	2807	0	0	2500	100	100	4	0.004	2048
2330	0	0	12723	0	0	5400	100	100	3	0.004	2048

Flowchart for an individual axis



Flowchart for axes in master-slave torque control

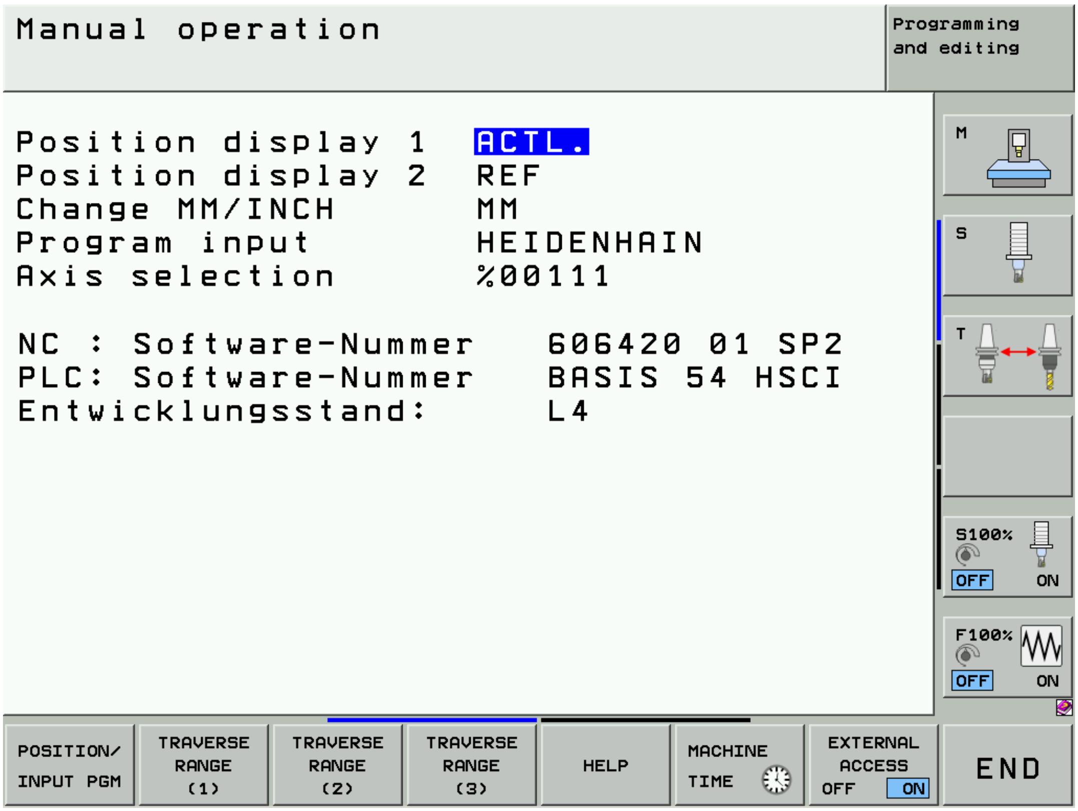


19.6 Switching over the position display for servicing

When servicing it is often important to switch over the position display (e.g., to **REF** when resetting the machine datum).

Activation

- Press the following key combination to switch the position display:
  - Select a machine operating mode (Manual Operation, Program Run/Full Sequence, etc.)
  - Press the MOD key.



- Press GOTO. --> A selection window opens.

Description of the settings

Possible position displays:

ACTL.	Actual position
REF	Distance to machine datum
LAG	Current following error
NOML.	Nominal position
DIST	Distance-to-go in the machine coordinate system
DG 3D	Distance-to-go in a tilted coordinate system
M118	Handwheel superimposition during program run

- Using the arrow keys, select the desired position display.
- Press ENTER to activate the position display.
- Close the window.

END

20 Reference run

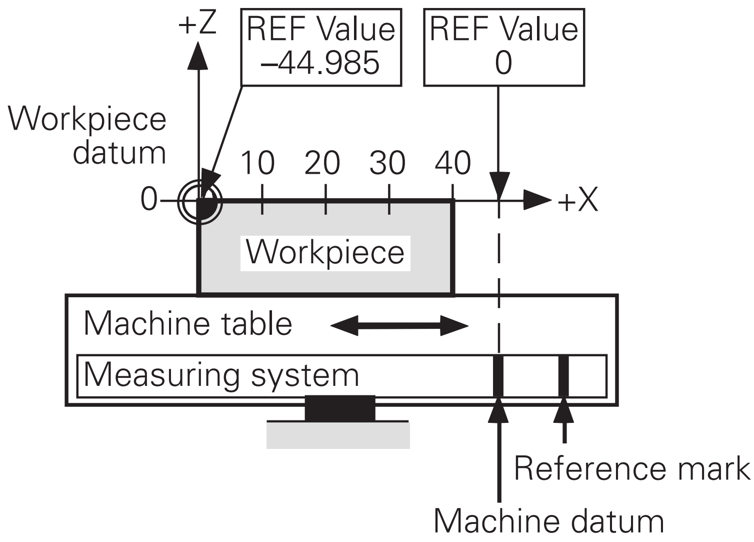
20.1 Definition

The position value (the coordinates) of an axis position is defined with respect to a freely selectable datum. When the axes are moved, the ACTUAL position is calculated incrementally. As soon as the machine is switched off, the reference between the axis position and the position value is lost.

Reference marks

HEIDENHAIN linear encoders (except EnDat) feature one or more reference marks. The reference marks identify an axis position at a known distance from the machine datum. The position of the datum selected by the machine operator is defined with respect to the machine datum.

The datum and the actual position can be reproduced as soon as the reference marks are traversed.



Machine datum

The machine datum is the central reference point of your machine tool.
It is defined by the machine tool builder.
The machine datum is required to ...

- Define the axis traverse limits (software limit switches)
- Approach machine-referenced positions (such as tool change positions)
- Set a workpiece datum

Distance between scale reference point and machine datum

For position encoders with distance-coded reference marks, the machine datum is defined with respect to the scale reference point, which is at the first reference mark after the beginning of the measuring length.
If EnDat encoders are used, the machine datum refers to the datum of the EnDat encoder.

- **MP960.x** contains the distance between the scale reference point and the machine datum.

> Note
>
> After removing and remounting a measuring system (position, angle), MP960.x may have to be altered.
> See "Resetting the machine datum" on page 19 – 295.

Spindle preset

An appropriate angle encoder or even the motor encoder in the spindle motor can be used for oriented spindle stop.

- **MP3430.x** contains the deviation of the reference mark from the desired spindle position.

> Note
>
> You may have to reset the MP3430 after an encoder for spindle orientation was removed and remounted or when the spindle motor was exchanged.
> See "Restoring the spindle orientation" on page 19 – 299.

20.2 Traversing the reference marks

If no EnDat encoders are used, the reference marks need to be retraversed after every power interruption.

Note

Ask the machine operator about the referencing procedure at the machine concerned. Respective information should also be included in the machine manual.

After the reference marks have been traversed:

- The software limit switches are activated.
- The most recently saved datum and machine datum are reproduced.
- PLC positioning and positioning with M91 and M92 become possible.
- For axes in an open loop, the counter is set to the value in the machine parameter MP960.x.

20.3 Error messages

Error messages related to the encoders may also have an effect on reference mark traverse.
--> See "Error messages" on page 19 – 280.
--> See "Error messages" on page 19 – 303.

Moreover, the following error messages may be generated during reference mark traverse:

- 8BA0 Incorrect reference signal or line count %.2s
- 8BE0 Encoder defective <axis>
- 8CA0 Incorrect reference signal or line count %.2s
- Double referencing is active
- Incorrect reference position <axis>
- C3A0 Incorrect ref. position %.2s
- Ref mark <axis>: incorrect spacing
- Set MP1356.%d to %.4f
- Reference the spindle!
- 3DROT active: use axis buttons

20.4 Possible error causes

Here, the same causes of error apply as for the encoders.
--> See "Possible error causes" on page 19 – 281.
--> See "Possible error causes" on page 19 – 303.

Especially for referencing, causes of error may be:

- Defective trip dog
  (The reference end position is not detected.)
- The trigger signal of the trip dog is too close to the reference pulse.
  (During reference run via the motor encoder --> the reference mark signal is not detected at the correct position, but one motor revolution too early or too late.)

With old position encoders:

- Magnet inside or outside scale housing shifted or defective
  (A wrong or no reference mark is evaluated.)
- Ref. mark selector plate displaced
  (inside the scale housing, where there is the ref. mark label on the outside the scale housing)
- Enamel wiped off or damaged
  (On some scales the ref. marks were deactivated with enamel; if it is removed by using unsuitable cleaning agents and equipment, these marks are "reactivated".)

20.5 Troubleshooting

Examining the encoders

- See "Encoder interface" on page 19 – 277.

Examining the reference mark

- See "Further examination of position and speed encoders" on page 19 – 314.

Examining the trigger signal of the trip dog

- Ask the machine manufacturer for the PLC input for the trigger signal.
- Move the axis to the presumed position of the trip dog.
- Observe the trigger signal, e.g. in the integrated oscilloscope or in the PLC logic diagram.

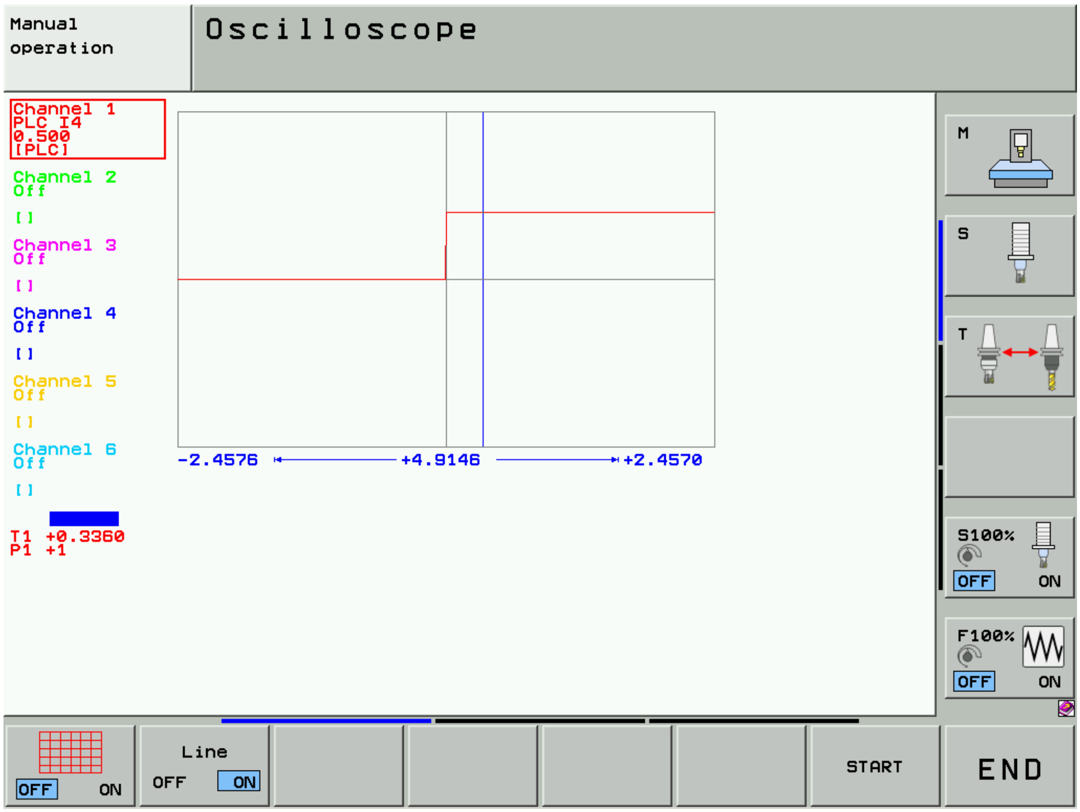


Figure: Trigger signal of the trip dog in the integrated oscilloscope

20.6 Corrective action

- Repair the trip dog.
- Replace the encoder. See "Encoder interface" on page 19 – 277.
- Readjust the displaced magnet or replace the damaged magnet. Do not forget the spacer plates (filler pieces)!
- Readjust the displaced ref. mark selector plate.
  Use a special slider for this purpose. --> Ask a HEIDENHAIN service agency!
- Have the removed or damaged enamel repainted. --> Ask a HEIDENHAIN service agency!
- Adjust the trip dog to the reference pulse of the motor encoder. --> See "Readjusting the trip dog for reference end position" on page 19 – 311.

20.7 Deselecting axes referencing

For axis examinations it is possible to deselect referencing in MP1340.x.

DANGER

Non-referenced axes have no relation to the machine datum. Software limit switches may be at a wrong position.
Traversing these axes bears the risk of a crash!

▶ Enter the value 0 (= no evaluation of the reference mark) for the axis concerned or for all axes.

Note

MP1340.x contains the **sequence in which the reference marks are traversed**.

This means, if the sequence is ...

- MP1340.0 : 3
- MP1340.1 : 2
- MP1340.2 : 1

... first the 3rd axis is referenced (e.g., Z axis), then the 2nd axis (e.g., Y axis) and subsequently the 1st axis (e.g., X axis).

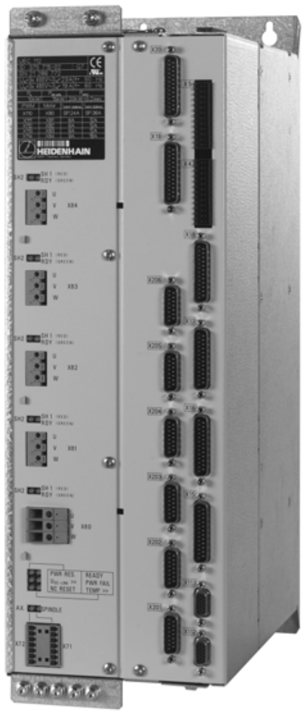
If you now want to deselect the X axis, you have to enter 0 in MP1340.2.

Normally however, the reference run is deselected for all axes.

21 Interfaces to the drives

21.1 Digital PWM interface

21.1.1 Introduction



HEIDENHAIN controls feature position, speed and current controllers.
The "result" of position, speed and current control - i.e. the controller output - is pulse-width modulated.
Digital servo amplifiers are controlled via PWM interfaces (PWM = pulse-width modulation).

Digital drive systems are also referred to as **inverter systems**.

For digital drives **three-phase ac motors** are used.

The most important motors are:

- Synchronous motors (e.g., HEIDENHAIN QSY axis motors)
- Asynchronous motors (e.g., HEIDENHAIN QAN spindle motors)
- Linear motors
- Torque motors

PWM outputs of CC 61xx

CC 6106	CC 6108	CC 6110
■ **X51 to X56**	■ **X51A to X54A** (controller basic board A) ■ **X51B to X54B** (controller basic board B)	■ **X51A to X54A** (controller basic board A) ■ **X51B to X54B** (controller basic board B)

The **PWM interfaces of the UEC 11x controller unit** are located **inside the unit**.

Motor outputs of UEC 11x

UEC 111	UEC 112
■ **X80 to X83**	■ **X80 to X84**

Fixed assignment on CC61xx and UEC 11x

On the **CC 61xx** there is a **fixed assignment** between the PWM output, the input of the speed encoder and the input of the position encoder:

CC 6106		
PWM output	**Speed input**	**Position input**
X51	X15	X201
X52	X16	X202
X53	X17	X203
X54	X18	X204
X55	X19	X205
X56	X20	X206

CC 6108		
PWM output	**Speed input**	**Position input**
X51A	X15A	X201A
X52A	X16A	X202A
X53A	X17A	X203A
X54A	X18A	X204A
X51B	X15B	X201B
X52B	X16B	X202B
X53B	X17B	X203B
X54B	X18B	X204B

CC 6110		
PWM output	**Speed input**	**Position input**
X51A	X15A	X201A
X52A	X16A	X202A
X53A	X17A	X203A
X54A	X18A	X204A
X51B	X15B	X201B
X52B	X16B	X202B
X53B	X17B	X203B
X54B	X18B	X204B
X55B	X19B	X205B
X56B	X20B	X206B

On the **UEC 11x** there is a **fixed assignment** between the motor output, the input of the speed encoder and the input of the position encoder:

UEC 111			
Motor output	**Rated current at 5 kHz**	**Speed input**	**Position input**
X80	20 A (spindle)	X15	X201
X81	5 A	X16	X202
X82	5 A	X17	X203
X83	7.5 A (stronger axis)	X18	X204

UEC 112			
Motor output	**Rated current at 5 kHz**	**Speed input**	**Position input**
X80	20 A (spindle)	X15	X201
X81	5 A	X16	X202
X82	5 A	X17	X203
X83	7.5 A (stronger axis)	X18	X204
X84	5 A	X19	X205

21.1.2 Machine parameters

Connecting the digital axes and spindles

MP100 is read from the right to the left and contains the information which axis is the first, the second, the third, etc.

> Attention
>
> MP100 must not be changed!

In **MP108** you can see the assignment of the axes to the controller basic boards.

In **MP109** you can see the assignment of the spindles to the controller basic boards.

> Note
>
> The input value (0 ... 3) represents the HSCI address of the respective controller basic board.

MP120 contains the assignment of the axes to the PWM/motor outputs (connector X51 and following / connector X80 and following).

MP121 contains the assignment of the spindles to the PWM/motor outputs (connector X51 and following / connector X80 and following).

Index y of the MP2xxx.y group

To find the correct machine parameters in the MP2xxx.y group, call the machine parameters **MP130** (axes) and **MP131/132** (spindles). Here you find the assignments of the axes/spindles to the respective indexes 'y' of the MP2xxx.y group.

Single and double-speed control loops

With CC 61xx and UEC 11x the OEM has the possibility of installing **single-speed and double-speed control loops**.

Single-speed control loops are used for, e.g.:

- Spindles
- Conventional axes

Double-speed control loops are used for, e.g.:

- Linear motors
- Torque motors
- High-frequency spindles
- "Axes that are difficult to control"

Double-speed control loops operate with shorter cycle times and higher processing power. If **double-speed control loops are configured**, the **adjacent PWM outputs or motor outputs are not active**, since in this case the DSP (digital signal processor) only processes one double-speed channel instead of two single-speed channels.

Single and double-speed control loops are defined in the **MP2000**.

PWM frequency

With the **MP2180** the control loops can be assigned different PWM frequencies.

There are three fundamental PWM frequencies: 3333 Hz, 4000 Hz and 5000 Hz. A control loop can be operated at the fundamental PWM frequency or at double (6666 Hz, 8000 Hz and 10000 Hz) this frequency.

If a control loop is operated at double the fundamental PWM frequency, the current controller cycle time is halved. However, this is possible only with double-speed control loops.

In a configuration with double-speed control loops and **higher PWM frequencies** the **adjacent PWM outputs are not active**!

Power supply modules, power stages and motors

Machine parameter	Meaning	Examples
MP2100	Power stages (inverter modules) and output stages that are used	**HEIDENHAIN UM121BD** **HEIDENHAIN UEC1xx-X81,X82,X84**
MP2196	Designator for the power supply module defined in MP2198.x	**P, Q, R or T** (e.g. to display the power supply module in the oscilloscope)
MP2198	Power supply module(s) used	**UVR140D**
MP2199	Assignment of the axes/spindles to the power supply modules of MP2198.x	**0, 1, 2, 3 or 4** (as index for MP2198)
MP2200	Axis and spindle motors used	**QSY096G-EnDat** **QAN-200M-9000**

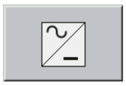
21.1.3 Tables for power supply modules, power stages and motors

Via the name of the power supply module (MP2198.x), of the power stage used (MP2100.x) and of the motor (MP2200.x), the control can access the values in the respective power supply module, power stage and motor tables.

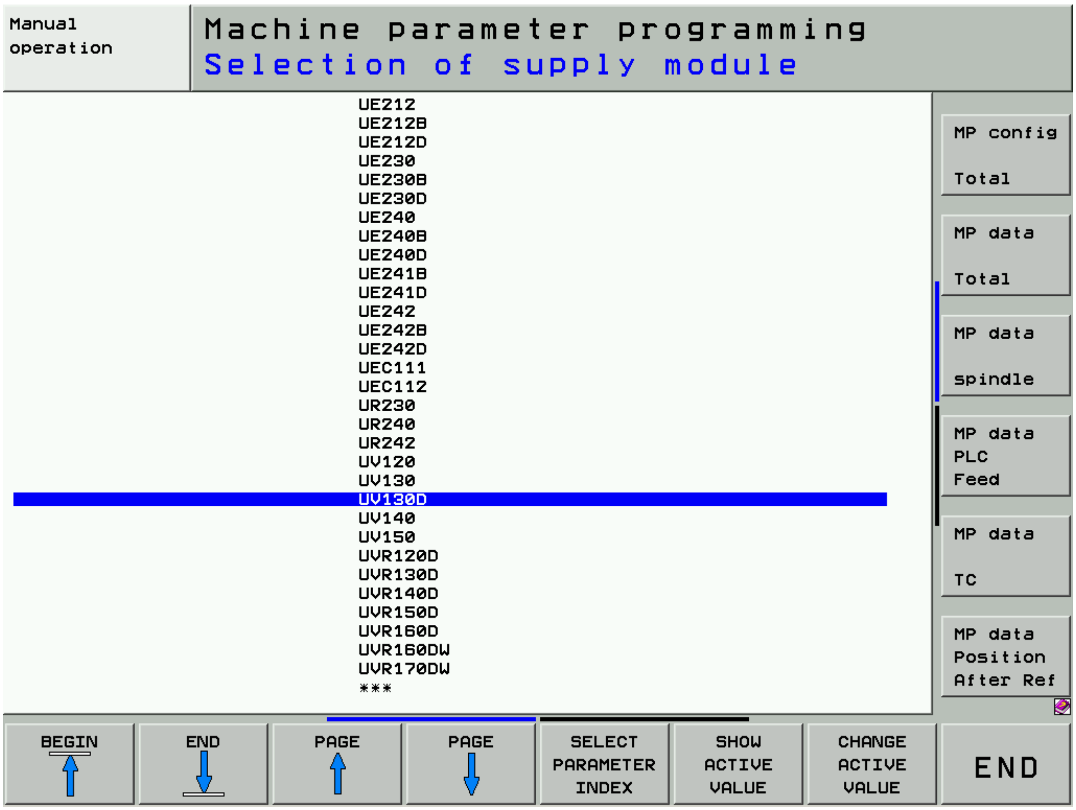
How to access the tables:

Table of power supply modules

- Open the machine parameter list.
- Place the cursor on the power supply module concerned (MP2198.x).
- Switch to the next soft-key row.



- Press this soft key. –> The table with the power supply modules appears:



Note

The original table (**SUPPLY.SPY**) contains supply modules of various OEMs as well as HEIDENHAIN supply modules, HEIDENHAIN compact inverters and HEIDENHAIN controller units with integrated UEC1xx inverter.

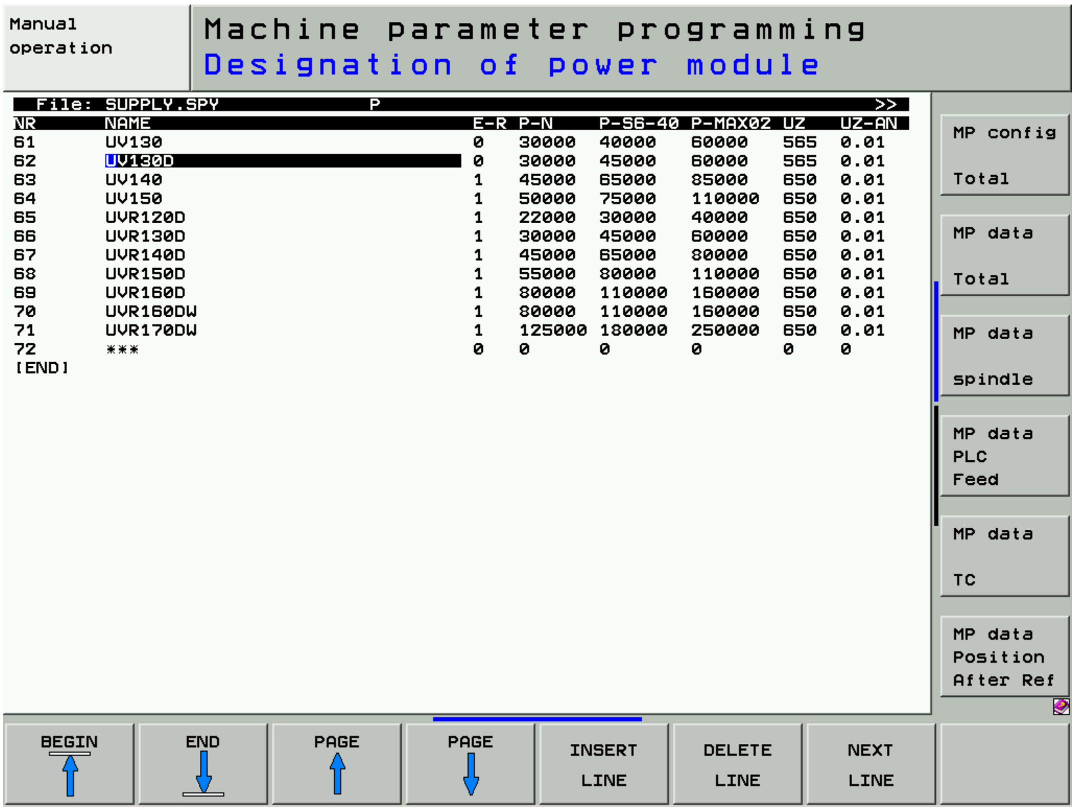
Note

The original HEIDENHAIN table of the power supply modules is stored in the SYS partition of the data medium.
The OEM can create his own table of power supply modules (with additional power supply modules and/or edited data) which is stored in the PLC partition of the data medium.
If the supply module tables have the same name (**SUPPLY.SPY**), the data of the OEM table in the PLC partition have priority.

DANGER

Do not change any values in the supply module table! This could lead to damage to property or persons!

▶ Press the SHOW ACTUAL VALUE soft key. --> The specifications of the selected power supply module are displayed:



▶ You can now move the cursor in the line of the highlighted power supply module and read all available data.

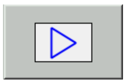
Note

The meaning of the selected column is displayed in the header (e.g. **`Rated power [W]`**).

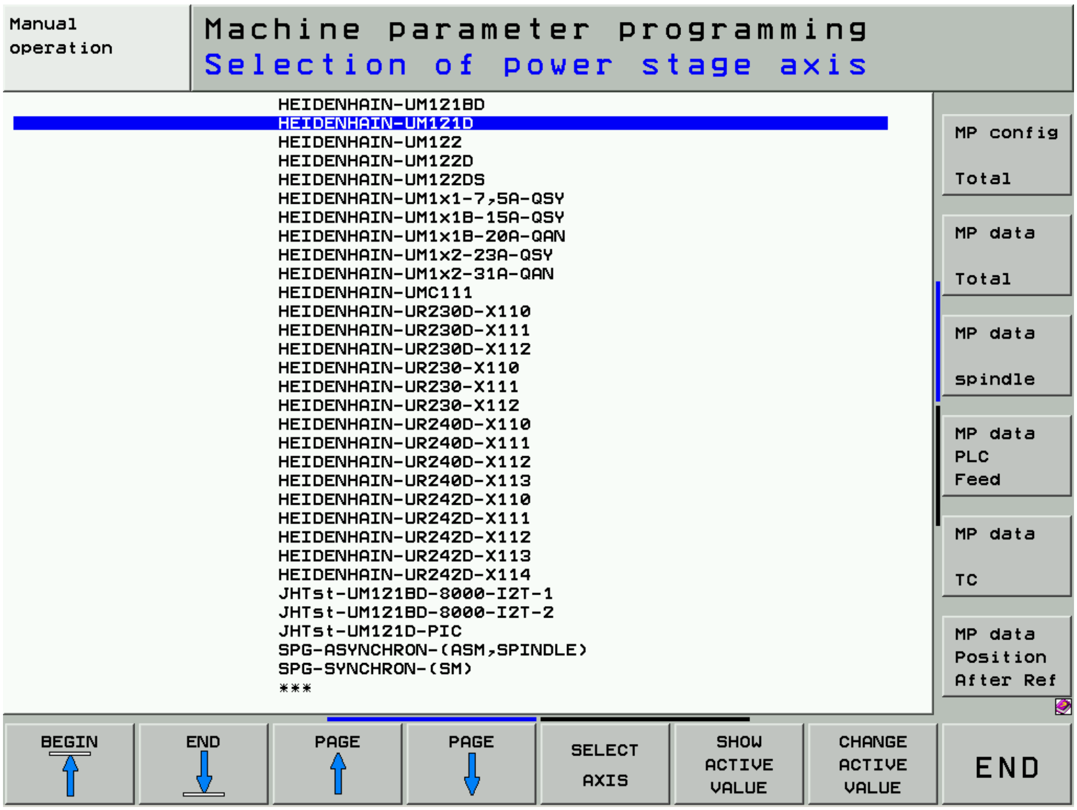
▶ Press the END key to exit the supply module table.

Table of power stages

- Open the machine parameter list.
- Place the cursor on the power stage concerned (MP2100.x).
- Switch to the next soft-key row.



- Press this soft key. --> The table with the power stages appears:



Note

The original table (**INVERTER.INV**) contains power stages of various OEMs as well as HEIDENHAIN power modules and the output stages of HEIDENHAIN compact inverters and HEIDENHAIN controller units with integrated UEC1xx inverter.

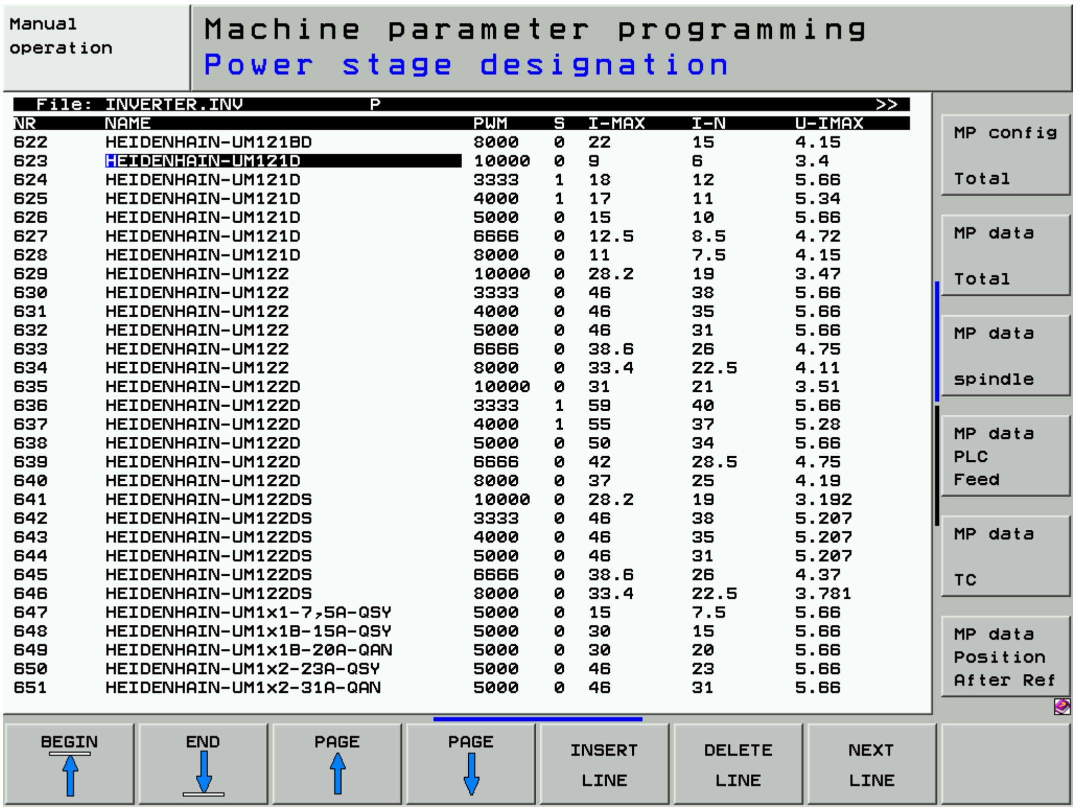
Note

The original HEIDENHAIN table of the power stages is stored in the SYS partition of the data medium.
The OEM can create his own table of power stages (with additional power stages and/or edited data) which is stored in the PLC partition of the data medium.
If the power stage tables have the same name (**INVERTER.INV**), the data of the OEM table in the PLC partition have priority.

DANGER

Do not change any values in the power stage table! This could lead to damage to property or persons.

▶ Press the SHOW ACTUAL VALUE soft key. --> The specifications of the selected power stage are displayed:



NR	NAME	PWM	S	I-MAX	I-N	U-IMAX
622	HEIDENHAIN-UM121BD	8000	0	22	15	4.15
623	HEIDENHAIN-UM121D	10000	0	9	6	3.4
624	HEIDENHAIN-UM121D	3333	1	18	12	5.66
625	HEIDENHAIN-UM121D	4000	1	17	11	5.34
626	HEIDENHAIN-UM121D	5000	0	15	10	5.66
627	HEIDENHAIN-UM121D	6666	0	12.5	8.5	4.72
628	HEIDENHAIN-UM121D	8000	0	11	7.5	4.15
629	HEIDENHAIN-UM122	10000	0	28.2	19	3.47
630	HEIDENHAIN-UM122	3333	0	46	38	5.66
631	HEIDENHAIN-UM122	4000	0	46	35	5.66
632	HEIDENHAIN-UM122	5000	0	46	31	5.66
633	HEIDENHAIN-UM122	6666	0	38.6	26	4.75
634	HEIDENHAIN-UM122	8000	0	33.4	22.5	4.11
635	HEIDENHAIN-UM122D	10000	0	31	21	3.51
636	HEIDENHAIN-UM122D	3333	1	59	40	5.66
637	HEIDENHAIN-UM122D	4000	1	55	37	5.28
638	HEIDENHAIN-UM122D	5000	0	50	34	5.66
639	HEIDENHAIN-UM122D	6666	0	42	28.5	4.75
640	HEIDENHAIN-UM122D	8000	0	37	25	4.19
641	HEIDENHAIN-UM122DS	10000	0	28.2	19	3.192
642	HEIDENHAIN-UM122DS	3333	0	46	38	5.207
643	HEIDENHAIN-UM122DS	4000	0	46	35	5.207
644	HEIDENHAIN-UM122DS	5000	0	46	31	5.207
645	HEIDENHAIN-UM122DS	6666	0	38.6	26	4.37
646	HEIDENHAIN-UM122DS	8000	0	33.4	22.5	3.781
647	HEIDENHAIN-UM1x1-7,5A-QSY	5000	0	15	7.5	5.66
648	HEIDENHAIN-UM1x1B-15A-QSY	5000	0	30	15	5.66
649	HEIDENHAIN-UM1x1B-20A-QAN	5000	0	30	20	5.66
650	HEIDENHAIN-UM1x2-23A-QSY	5000	0	46	23	5.66
651	HEIDENHAIN-UM1x2-31A-QAN	5000	0	46	31	5.66

▶ You can now move the cursor in the correct line (PWM frequency) of the highlighted power stage and read all available data.

Attention

The specifications of the power modules depend on the PWM frequency.
As a rule, HEIDENHAIN power modules are operated at 5000 Hz.
Check the PWM frequency selected for this axis in **MP2180**.
Highlight the correct line!

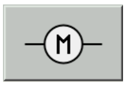
Note

The meaning of the selected column is displayed in the header (e.g. **Peak current [A]**).

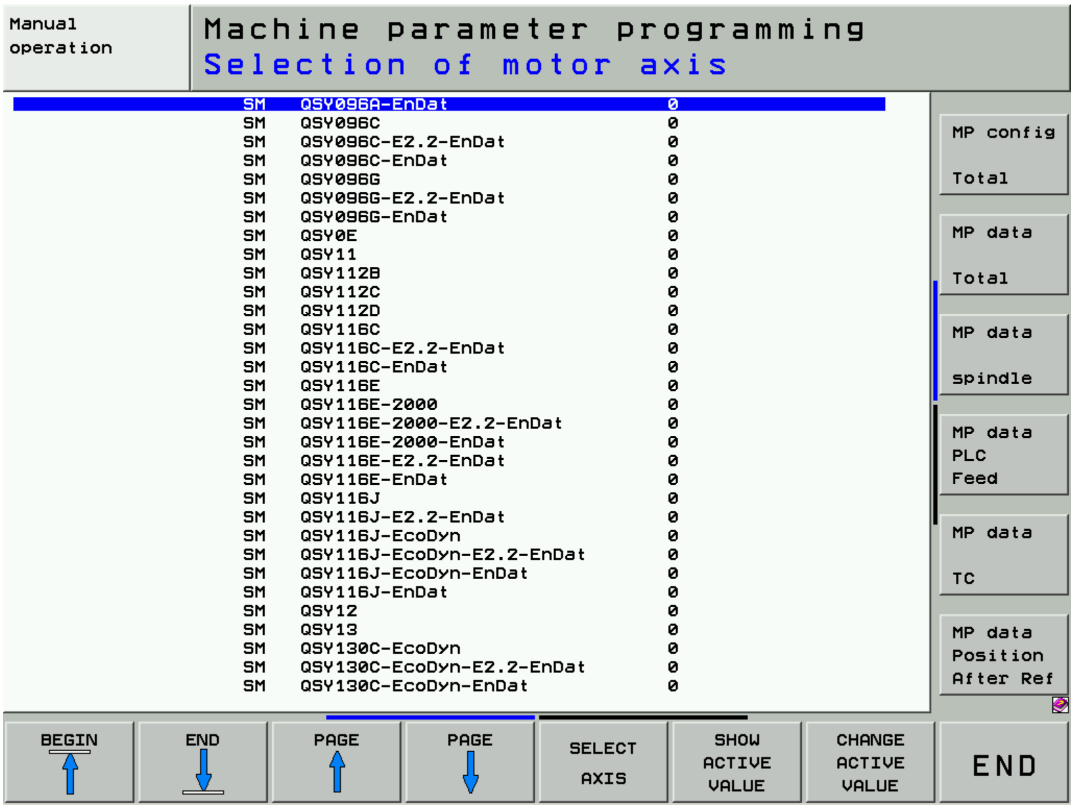
▶ Press the END key to exit the power stage table.

Motor table

- Open the machine parameter list.
- Place the cursor on the motor concerned (MP2200.x).
- Switch to the next soft-key row.



- Press this soft key. --> The table with the motors appears:



Note

The original table (**MOTOR.MOT**) contains asynchronous motors, linear motors, synchronous motors, torque motors and special spindle motors for the volts-per-hertz control mode of various manufacturers.

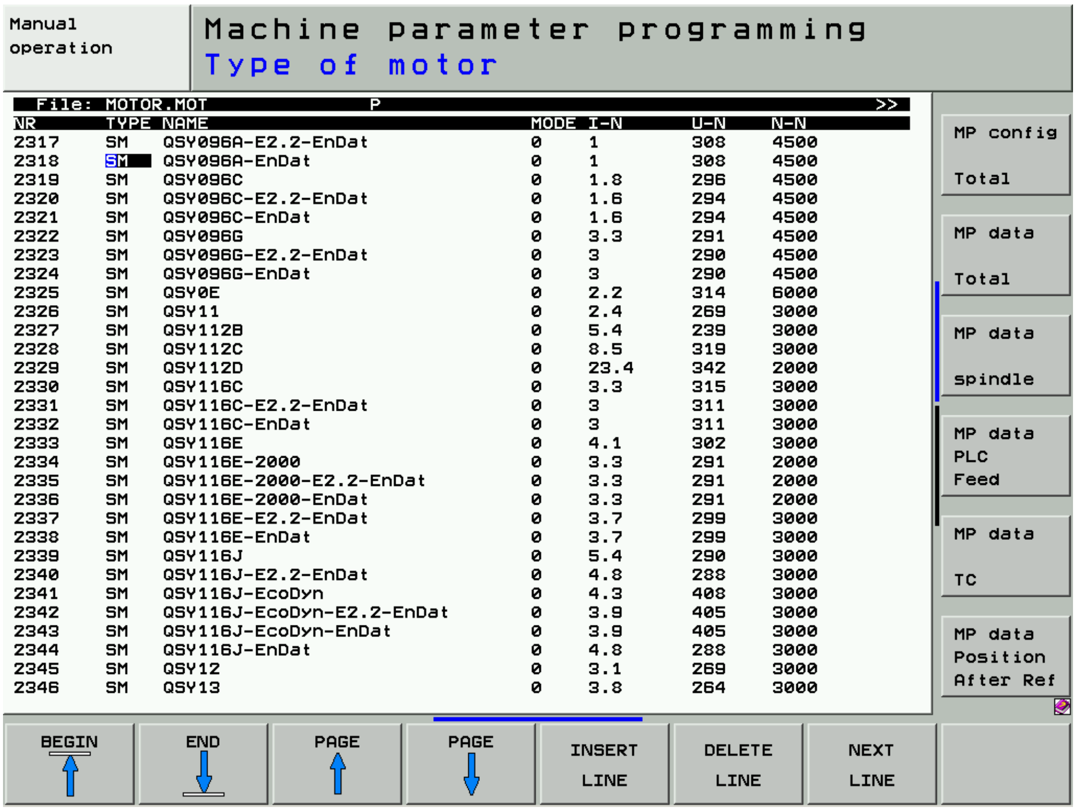
Note

The original HEIDENHAIN motor table is stored in the SYS partition of the data medium.
The OEM can create his own motor table (with additional motors and/or edited data) which is stored in the PLC partition of the data medium.
If the motor tables have the same name (**MOTOR.MOT**), the data of the OEM table in the PLC partition have priority.

DANGER

Do not change any values in the motor table! This could lead to damage to property or persons.

▶ Press the SHOW ACTUAL VALUE soft key. --> The specifications of the selected motor are displayed:



▶ You can now move the cursor in the line of the highlighted motor and read all available data.

Attention

Especially spindle motors can be operated with wye or delta connection (depending on the spindle speed).
The specifications of the spindle motors depend on the operating mode:
Mode 0 = wye operation
Mode 1 = delta operation
Place the highlight in the correct line!

Note

The meaning of the selected column is displayed in the header (e.g. **`Line count of rotary encoder`**).

▶ Press the END key to exit the motor table.

21.1.4 Reading out power module data

When the control is started up, the CC 61xx controller unit fetches the data (ID number, serial number, etc.) of the HEIDENHAIN power modules (UM xxx D) via the PWM ribbon cables.

The sequence for reading out is defined by the HSCI addresses of the controller basic boards (MP108/MP109) and the connectors (X51, X52 and following) on the CC 61xx. This means that the data of the power module connected to X51 of the first controller basic board is read out first, etc.

While the data is being transferred, the corresponding **SH 2** LED blinks rapidly.

If, however, PWM cables that lead to two different power modules were swapped for error localization, the control generates the message **Hardware/firmware change detected** during start-up.

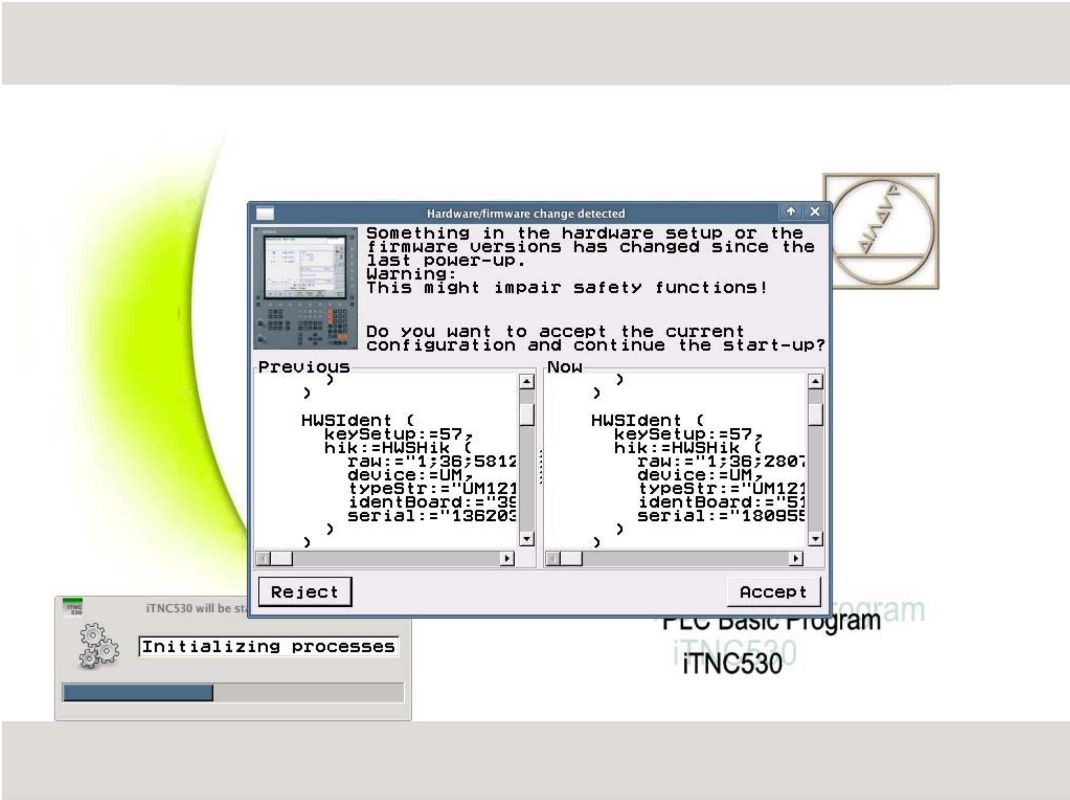


Figure: Control display, if PWM cables were swapped

- Accept the change to continue error localization.

21.1.5 Error messages

The following error messages may be displayed, if there are problems related to drives:

Possible error messages	
■ 8040 Heat sink temp. in UV 1xx	■ E150 Inverter ready
■ 8041 Excessive Iz in UV 1xx	■ E160 Inverter is not ready
■ 8042 Leakage current in UV 1xx	■ Axis motor current not equal 0
■ 8043 No inverter-ready signal	■ Movement monitoring
■ 8060 Leakage current in UV 1xx too high	■ CC inverter for axes RDY = 0
■ 8080 Uz UV 1xx too high	■ CC inverter for axes RDY = 1
■ 8130 Motor brake defective	■ CC inverter for spindle RDY = 0
■ 8140 Error field orientation	■ CC inverter for spindle RDY = 1
■ 8300 Motor brake defective	■ Speed out of range
■ 8310 No current in brake test	■ Nominal speed value too high
■ 8410 I2t value is too high	■ Synchronization monitoring
■ 8430 Load is too high	■ I2t warning
■ 8450 I2t value of motor is too high	■ I2t monitoring
■ 8460 I2t value of power module is too high	■ Switch-off of power module (IGBT)
■ 8410 I2t value is too high	■ Power module ready
■ 8620 Load is too high	■ Temperature of power module
■ 8410 I2t value of motor is too high	■ MC nominal-to-actual position error too large
■ 8650 I2t value of power stage is too high	■ Motor temperature
■ 8800 Signal LT-RDY inactive	■ Excessive offset
■ 8A00 No inverter enabling	■ Positioning error
■ 8A10 AC fail	■ Dif. in position <> shaft speed too high
■ 8A20 Powerfail	■ Excessive servo lag
■ 8A40 Enabling of axis group	■ Spindle speed out of tolerance range
■ 8A50 Inverter is not ready	■ Spindle motor current not equal to 0
■ 8B10 Wrong traverse direction	■ Standstill monitoring
■ 8B20 Error field orientation	■ Inverter is not ready for operation
■ 8B30 Motor temp. too high	■ Power supply unit is ready
■ 8B40 No drive enabling	■ DC-link voltage >>
■ 8B50 Axis module not ready	■ DC-link current >>
■ 8B60 Error in axis module	
■ 8B60 Overcurrent cutoff	
■ 8B70 External drive lock	
■ 8B80 External drive stop	
■ 8BB0 Motor temp. too low	
■ 8BC0 Motor current too high	
■ 8BD0 Excessive servo lag	
■ B900 Error in supply voltage	
■ C330 Motor temp. too high	
■ C350 Axis module not ready	
■ C380 Motor not controllable	
■ C3B0 Motor does not rotate	
■ C3C0 Motor current too high	
■ C4A0 Inverter is not active	
■ C4C0 No motor current	

Note

Other error messages may also indicate problems with a drive.

21.1.6 Possible error causes

- Excessive machining feed rate
- Spindle speed too low
- Blunt tool
- Insufficient lubrication
- Mechanical shock, strong machine vibrations
- Mechanical stiffness
- Wear and tear of mechanical parts, aging of the machine tool
- Mechanical defects
- Fault in hydraulics
- Fault in pneumatics
- Overloaded drive
- Motor defective
- Power module defective
- Defective power supply module
- Defective cables
- Insufficient contacting
- Pins in PWM connector bent
- Poor shielding and grounding
- HEIDENHAIN expansion board for the SIMODRIVE 611 drive system defective
- Old HEIDENHAIN expansion board in a modified SIMODRIVE 611 power module
- Wrong grounding in connection with the HEIDENHAIN expansion boards
- PWM interface or CC 61xx defective
- UEC 11x defective

Note

There is a large variety of possible error causes.
Profound knowledge of the machine and the interaction of the components is very helpful especially for this type of errors.
When error messages are generated, press the HELP key. You will obtain information on possible error causes and tips for corrective action.

21.1.7 Sequence for finding errors in the control loop

In the event of error messages related to movement, acceleration or standstill, for example:

- **`Positioning error`**
- **`Excessive servo lag`**
- **`Nominal speed value too high`**
- **`Movement monitoring`**
- **`Standstill monitoring`**

or if there are problems such as:

- Poor workpiece quality
- Unusual noise during axis movements
- Unusual vibrations

... you can check the machine components in a defined order to find the fault.
--> See "Sequence for finding errors in the control loop" on page 6 – 58.

21.1.8 Error finding: Axes swapping

To find out whether the **connected drive system** or the **PWM output of the CC** or the **motor output of the UEC** is defective, you can use the **interchange method**.

Note

Error messages related to the drives of a machine tool are mostly caused by the machine tool (mechanics, hydraulic/pneumatic system, lubrication), the tools or the electrical drives (motors, power modules, output stages of a UEC) themselves.
A defective PWM interface on a CC 61xxx is rarer.
The interchange method is quite complex here, as in addition to the PWM/motor outputs, you also have to swap the position encoder inputs and the speed encoder inputs, and you must adapt the parameter settings.

DANGER

Before you connect drives to other interfaces for error localization:
Make sure that there are no ground faults or short circuits in the drive components (inverters, motors, etc.) --> See service manual "Inverter Systems and Motors".

Exchange constellations

CC 61xx	
Exchange constellation	**Flowchart**
Swapping two single-speed axes or two double-speed axes	Swapping axes on a CC 61xx
Swapping single-speed axis <--> single-speed spindle or double-speed axis <--> double-speed spindle	Swapping axis and spindle on a CC 61xx

UEC 11x	
Exchange constellation	**Flowchart**
Swapping two single-speed axes or two double-speed axes with the same rated current	Swapping axes with the same rated current on a UEC 11x
Swapping two single-speed axes or two double-speed axes with different rated currents	Swapping axes with different rated currents on a UEC 11x
Swapping single-speed axis <--> single-speed spindle or double-speed axis <--> double-speed spindle	Swapping axis and spindle on a UEC 11x

Notes and preparatory action

- CC 61xx:
  If axes/spindles with different power modules and motors are supposed to be swapped, these devices (if equipped with electronic ID labels) would try to log on to the control during start-up.
  A new assignment would be requested according to the changed wiring, even before the service engineer can edit the machine-parameter values. To avoid this, **deactivate** the **evaluation of the electronic ID labels** with MP7690 before the exchange.

- Use the **PWM/motor output of a functioning axis/spindle**.
  (Depending on the configuration of single-speed and double-speed control loops, unassigned outputs may not be active.)

- **The permanently assigned position and speed encoder inputs must be swapped, too!**

Note

Due to the fixed assignment, the interchange method cannot be used independently for position encoders, speed encoders or PWM/motor outputs. The axes must be swapped altogether.

- To find the correct machine parameters in the MP2xxx.y group, call the machine parameters MP130 (axes) and MP131/MP132 (spindles). Here you find the assignments of the axes/spindles to the respective indexes 'y' of the MP2xxx.y group.

- The **same PWM frequency** should be set for axes and spindles to be swapped!
  If there are different PWM frequencies in the machine parameters MP2180.x , you may enter 5 kHz for the axes/spindles for testing.

- CC 61xx:
  If the swapped PWM outputs are on a compact inverter or a two-axis module, the control generates the **`Power interrupted`** message as usual.
  If, however, the swapped PWM outputs lead to two different power modules (different ID or SN), the control generates the message **`Hardware/firmware change detected`** during start-up.
  --> See "Reading out power module data" on page 21 – 338.

- UEC 11x:
  Check, whether the axes to be swapped have the same rated current (MP2100.x and power-module table).
  If the rated current is not the same, or if an axis is swapped with a spindle, the power output stages need to be assigned correctly.

DANGER

Swapping **power output stages with different rated currents** for testing and not assigning them correctly (MP2100.x) may cause damage to the machine or personal injury!

DANGER

Always secure vertical axes to prevent them from falling down before you perform tests on these axes!

Block diagrams

See "Block diagrams for axis swapping" on page 19 – 283.

Flowcharts

See "Flowcharts for axis swapping" on page 19 – 284.

Next test

If you have found that the **error is outside the CC 61xx** (servo amplifier, motor, cables, etc.) run the following routine.
--> See "Error finding: Swapping power modules or output stages of the same type" on page 21 – 343.

21.1.9 Error finding: Swapping power modules or output stages of the same type

If you have found that the PWM interface on the CC 61xx is in order, you can test whether you can traverse the faulty axis with …

- an identical power module (modular inverter system) or
- an output stage with equal power (2-axis module, compact inverter)

> DANGER
>
> If you want to use **other types of power stages or output stages**, we recommend contacting your machine manufacturer or HEIDENHAIN. Otherwise you could cause damage or injury to machine or persons!

Use one of the following:

- Either the power stage or output stage of a functioning axis
- Or a replacement unit

> Note
>
> It is not necessary to swap any machine parameters for this test routine!
> It is of no importance, whether the power stages in the machine are from HEIDENHAIN or other manufacturers.

> DANGER
>
> Before you connect drives to other interfaces for error localization:
> Make sure that there are no ground faults or short circuits in the drive components (inverters, motors, etc.) --> See service manual "Inverter Systems and Motors".

> DANGER
>
> Always secure vertical axes to prevent them from falling down before you perform this test!

> DANGER
>
> Danger of electrical shock!
> Make sure that the main switch of the machine is switched off and that all connectors and terminals are free of potential before you engage or disengage them.

Assumed configuration for two 1-axis power modules

UM 111D: **X111** (PWM connection of channel 1) connected with **X51** (iTNC, X axis)
X81 (motor connection of channel 1) connected with motor **X axis**

UM 111D: **X111** (PWM connection of channel 1) connected with **X52** (iTNC, Y axis)
X81 (motor connection of channel 1) connected with motor **Y axis**

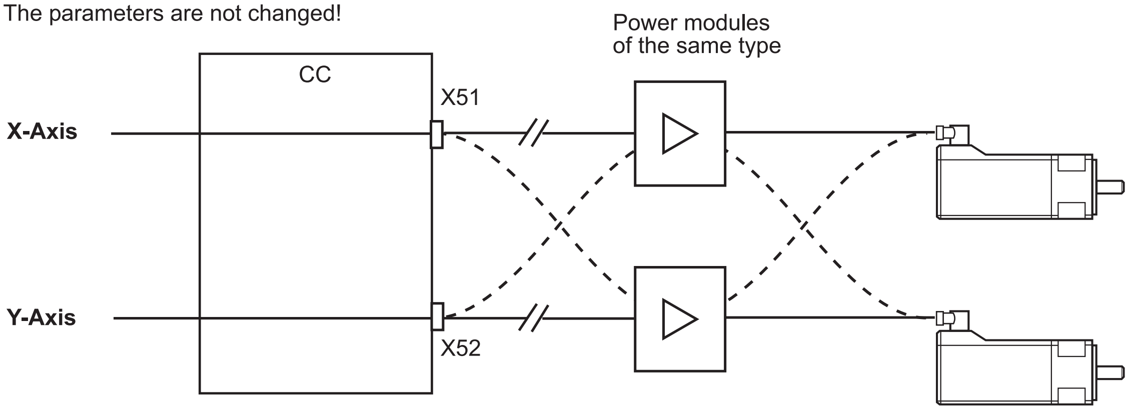
Assumed configuration for a 2-axis power module

UM 121D: **X111** (PWM connection of channel 1) connected with **X51** (iTNC, X axis)
X112 (PWM connection of channel 1) connected with **X52** (iTNC, Y axis)
X81 (motor connection of channel 1) connected with motor **X axis**
X82 (motor connection of channel 2) connected with motor **Y axis**

Assumed configuration for a compact inverter

UM 242 D: **X111** (PWM connection of channel 1) connected with **X51** (iTNC, X axis)
X113 (PWM connection of channel 1) connected with **X52** (iTNC, Y axis)
X81 (motor connection of channel 1) connected with motor **X axis**
X83 (motor connection of channel 2) connected with motor **Y axis**

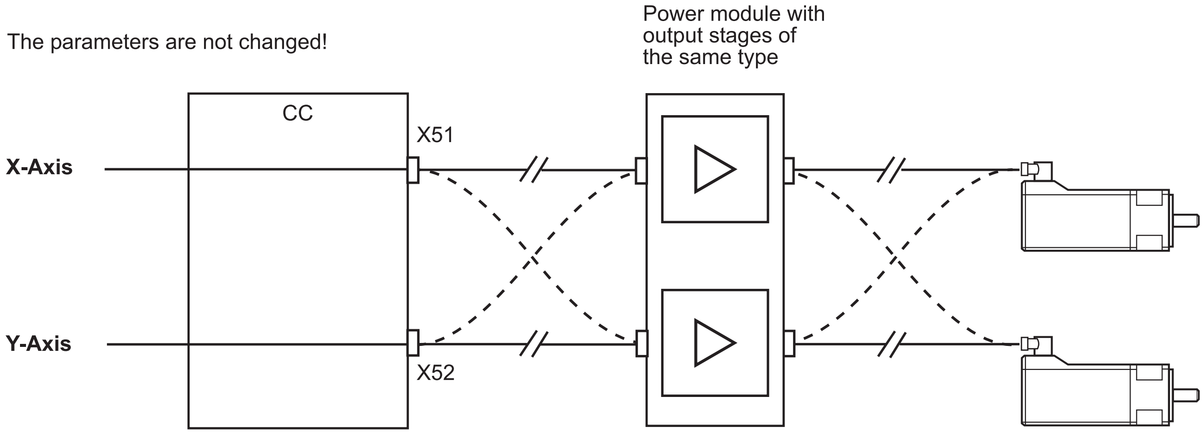
Block diagram for two 1-axis power modules



DANGER

If **motor brakes** are connected to the power modules or output stages, they **must** be **swapped as well** (X344, X392, X393, X394, depending on the model. --> See Service Manual for Inverter Systems and Motors)!
Background:
Motor brakes can be connected to current HEIDENHAIN power modules (inverter modules) and compact inverters. The motor brake is also powered with 24 V via a connector on the inverter. The trigger signals for the motor brakes are transmitted via the PWM bus.

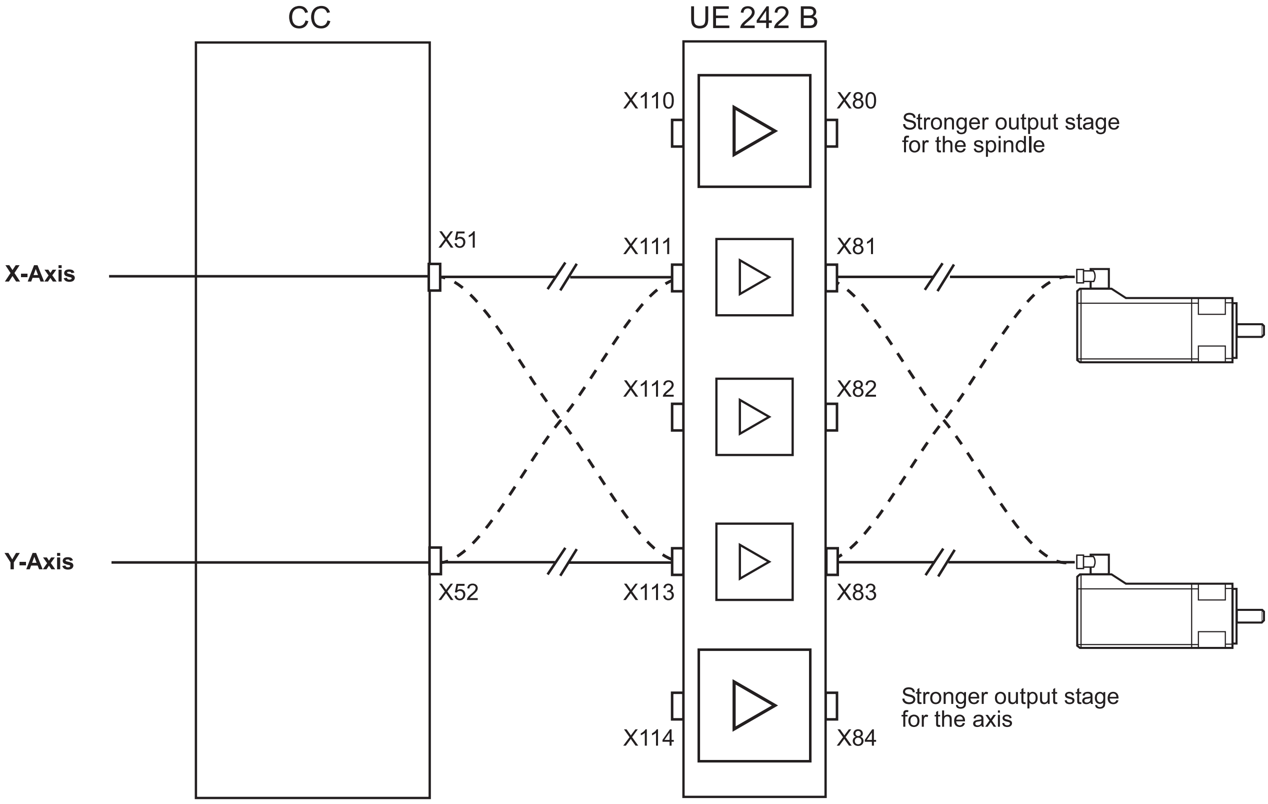
Block diagram for a 2-axis power module



DANGER

If **motor brakes** are connected to the power modules or output stages, they **must** be **swapped as well** (X344, X392, X393, X394, depending on the model. --> See Service Manual for Inverter Systems and Motors)!
Background:
Motor brakes can be connected to current HEIDENHAIN power modules (inverter modules) and compact inverters. The motor brake is also powered with 24 V via a connector on the inverter. The trigger signals for the motor brakes are transmitted via the PWM bus.

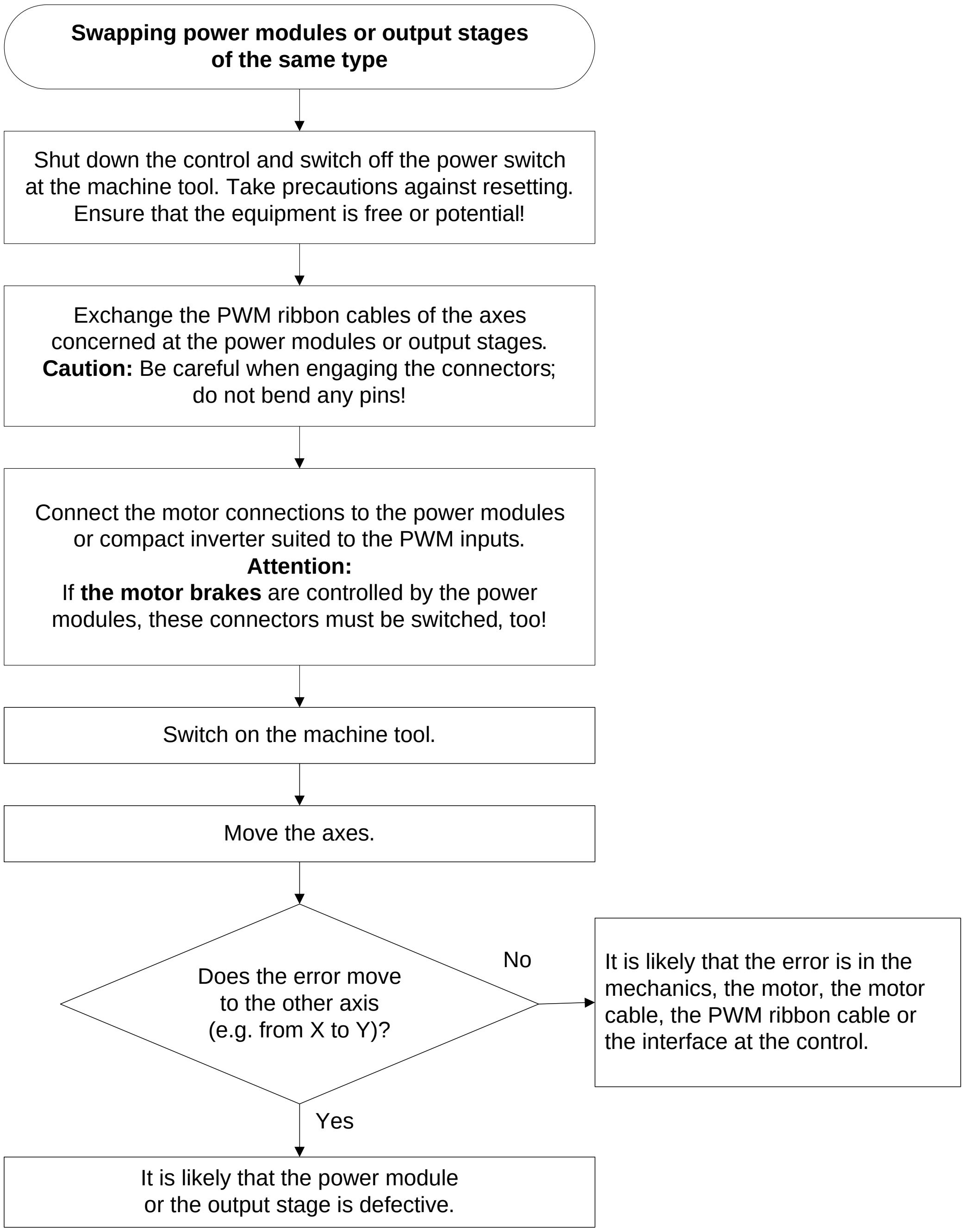
Block diagram for a compact inverter



DANGER

If **motor brakes** are connected to the power modules or output stages, they **must** be **swapped as well** (X344, X392, X393, X394, depending on the model. --> See Service Manual for Inverter Systems and Motors)!
Background:
Motor brakes can be connected to current HEIDENHAIN power modules (inverter modules) and compact inverters. The motor brake is also powered with 24 V via a connector on the inverter. The trigger signals for the motor brakes are transmitted via the PWM bus.

Flowchart for swapping power modules or output stages of the same type



21.1.10 Error finding: Swapping the HEIDENHAIN expansion boards for the SIMODRIVE 611 system

When a SIMODRIVE 611 system is used with a HEIDENHAIN control, there are HEIDENHAIN expansion boards in the SIEMENS drive modules to adapt the PWM signals.

> Attention
>
> When troubleshooting do not insert obviously defective devices into the slots of the drive system!

Boards of the same type

Before using other drive modules for the examination of faulty axes, you may insert **identical interface boards**.
Please observe:

- Replace the boards while the machine is switched off.
- Insert boards of the same type (1-axis module or 2-axis module, metallically isolated or not metallically isolated. --> See "Exchanging HEIDENHAIN interface boards in the SIMODRIVE system" on page 29 – 553).
- The grounding must be correct. --> See "Exchanging HEIDENHAIN interface boards in the SIMODRIVE system" on page 29 – 553.

Boards of different types

If you do not have boards of the same type, under certain circumstances you may exchange boards for 1-axis modules for boards for 2-axis modules and vice versa.
"Stumbling blocks" may be:

- Some 2-axis module boards (ID number smaller than 359002-xx) require the corresponding enabling signals of the control on every PWM interface. If such a board is inserted in a 1-axis module and one PWM interface is not assigned, the entire board is not enabled.
- If a 1-axis module board is inserted in a 2-axis module for testing, the corresponding axis can be inspected.
  If the other axis is to be inspected, the motor output on the power stage must be switched.
  For these tests it might be necessary to deselect axes that cannot be controlled in MP10. With some machines this might be difficult.
  --> Ask your machine tool builder!

> Attention
>
> Boards with metallic isolation of HEIDENHAIN PWM signals and the SIEMENS interface must not be replaced by boards without metallic isolation and vice versa. --> See "Overview of possible errors" on page 5 – 51.

> Attention
>
> "Older" HEIDENHAIN interface boards must not be operated with modified SIMODRIVE power modules. --> See "Compatibility of HEIDENHAIN expansion boards to SIMODRIVE power modules" on page 29 – 558.

21.1.11 Corrective action

Mechanics

If you have found that the fault is due to the mechanics of the machine tool:

- Replace mechanical components. --> Ask your machine tool builder.

Drive components

If you have found that the power module, the compact inverter, the expansion card or the motor is defective:

- Replace the drive component. --> See "Service Manual for Inverter Systems and Motors".

Control components

If you have found that the interface on the CC 61xx is defective:

- Replace the CC 61xx. --> See "Exchanging the CC" on page 29 – 550.

If you have found that the UEC 11x controller unit is defective:

- Replace the UEC 11x. --> See "Exchanging the UEC" on page 29 – 551.

21.2 Analog speed value interface

21.2.1 Introduction

Picture: CMA-H 04-04-00, additional module for analog axes and spindles
The module is inserted into a slot of the CC 61xx or UEC 1xx controller units.

For the operation of analog axes and spindles, the position controller is in the HEIDENHAIN control, the speed controller and the current controller are in the analog servo amplifier.
The "result" of position control - i.e. the controller output - is transferred to the analog servo amplifier via the **±10 V nominal speed value interface**.

Analog servo amplifiers are also referred to as analog servos.

DC motors are often used for analog drives.

Additional module for analog axes/ spindles

In the HSCI system, analog nominal-value outputs (e.g. for **controlling spindles and auxiliary axes**) are available via the **CMA-H 04-04-00**.

The CMA-H 04-04-00 is an optional SPI expansion module. It adds **four analog ±10 V nominal value outputs** to the CC 61xx and UEC 1xx controller units.

Controller units	Number of CMA-H 04-04-00 modules per unit	Max. number of nominal value outputs
CC 61xx	2	8
UEC 11x	1	4

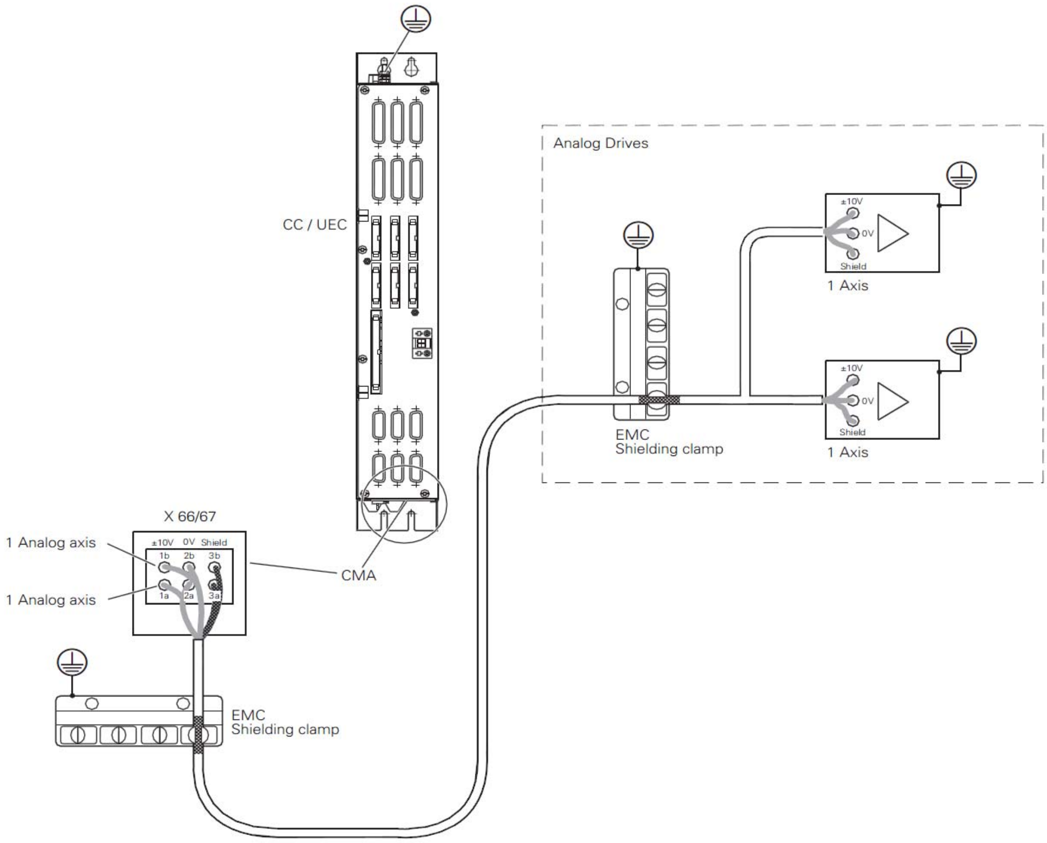
Note

- The analog nominal-value outputs can only be accessed via the NC, and not via the PLC. The PL 6xxx provides PLC analog outputs.
- It is not possible to control interpolating axes; only spindles and auxiliary axes that are not interpolated together with other digital axes can be controlled.

Specifications of the analog channels

CMA-H 04-04-00	
Output voltage	+/- 10 V
Load capacity	$R_L \geq 1$ kΩ, I ≤ 10 mA
Short-circuit stability	Permanent short circuit 20 mA
Resolution	16 bits = 65536 increments
Smallest step	$\frac{10\text{V}}{65536} = 0.1525\text{ mV}$

Wiring overview



21.2.2 Machine parameters

MP100 is read from the right to the left and contains the information which axis is the first, the second, the third, etc.

> Attention
>
> MP100 must not be changed!

MP120 contains the assignment of the axes to the analog outputs (connectors X66 and X67 on the CMA-H).

MP121 contains the assignment of the spindles to the analog outputs (connectors X66 and X67 on the CMA-H).

MP1050 contains the analog voltage at rapid traverse (1.000 - 9.000 V).

21.2.3 Error messages

The following error messages may be displayed, if there are problems related to analog drives:

- Movement monitoring
- Nominal speed value too high
- Excessive offset
- Positioning error
- Excessive servo lag
- Standstill monitoring

> Note
>
> Other error messages may also indicate problems with an analog drive.

21.2.4 Possible error causes

- Excessive machining feed rate
- Spindle speed too low
- Blunt tool
- Insufficient lubrication
- Mechanical shock, strong machine vibrations
- Mechanical stiffness
- Wear and tear of mechanical parts, aging of the machine tool
- Mechanical defects
- Fault in hydraulics
- Fault in pneumatics
- Overloaded driver
- Motor (carbon brushes, tachometer brushes, winding, etc.) defective
- Servo defective
- Defective cables
- Insufficient contacting
- Poor shielding and grounding
- Excessive drift
- Defective speedometer
- Nominal speed value interface of CMA-H defective

> **Note**
>
> There is a large variety of possible error causes.
> Profound knowledge of the machine and the interaction of the components is very helpful especially for this type of errors.
> When error messages are generated, press the HELP key.
> You will obtain information on possible error causes and tips for corrective action.

21.2.5 Sequence for finding errors in the control loop

In the event of error messages related to movement, acceleration or standstill, for example:

- **`Positioning error`**
- **`Excessive servo lag`**
- **`Nominal speed value too high`**
- **`Movement monitoring`**
- **`Standstill monitoring`**

or if there are problems such as:

- Poor workpiece quality
- Unusual noise during axis movements
- Unusual vibrations

... you can check machine components in a defined order to find the fault.
--> See "Sequence for finding errors in the control loop" on page 6 – 58.

21.2.6 Checking the analog speed value interface

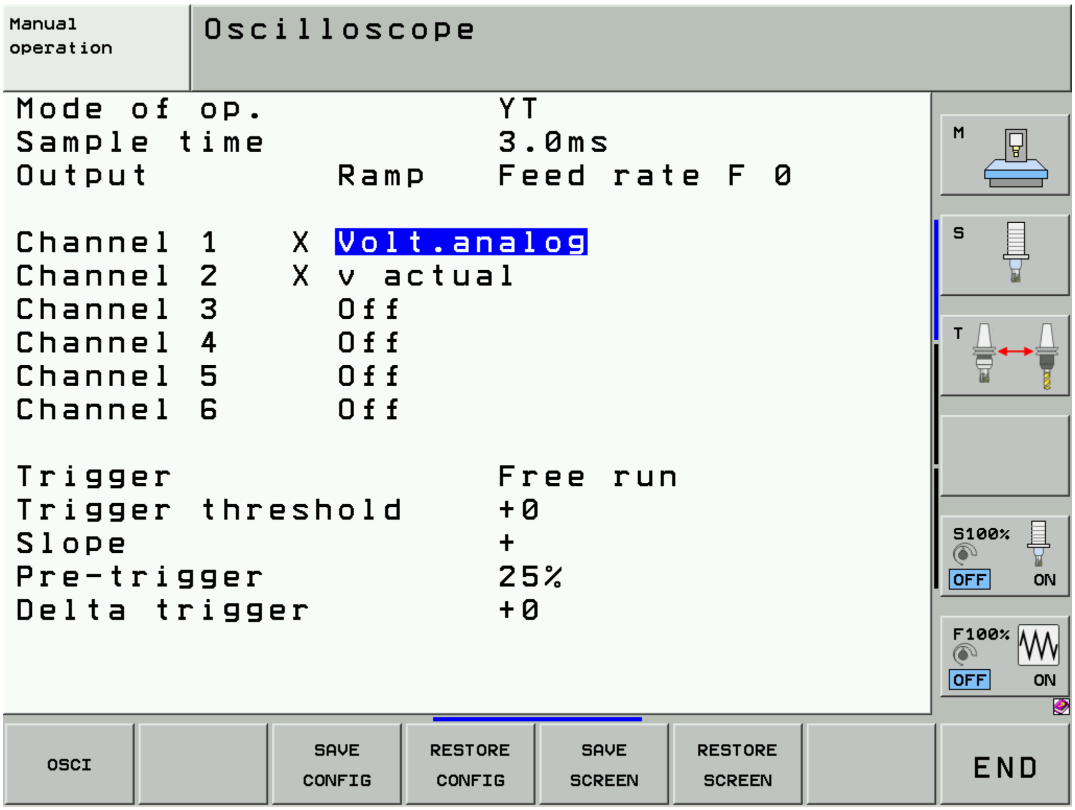
Measuring the output voltage

The control outputs an analog voltage of 0 V to maximum ±10 V in proportion to the traversing speed (the analog voltage is entered in MP1050.x).

This voltage can be measured at the connecting terminals of the servo amplifier or directly at the terminals of the CMA-H.

Observation with the integrated oscilloscope

The `U analog` voltage can be observed with the integrated oscilloscope:



Activation and operation --> See "Integrated oscilloscope" on page 10 – 95.

Error: No axis movement!

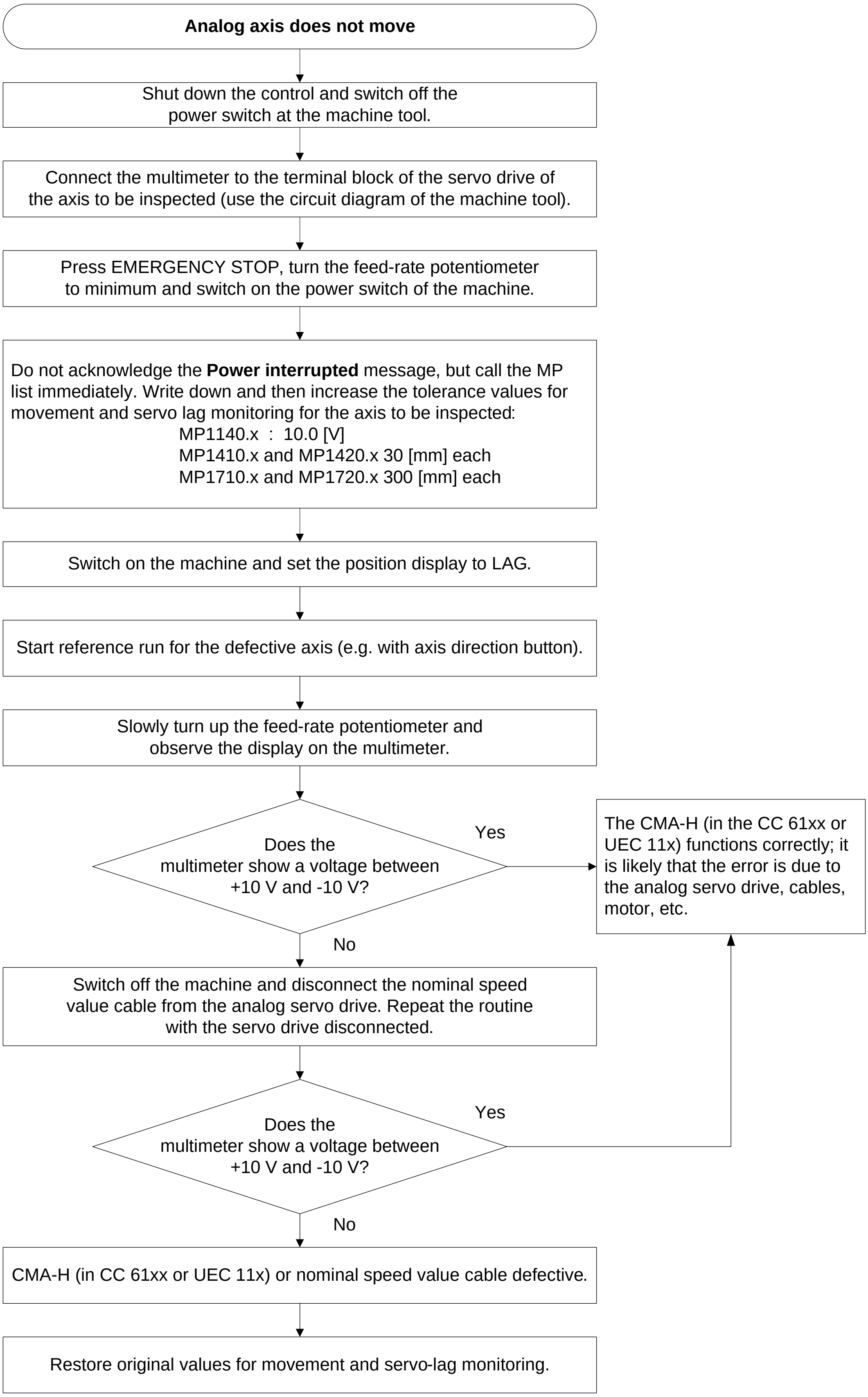
A **precondition** is that the **release conditions** (e.g., door contacts, permissive buttons) for the axis movements are **fulfilled**.

For the axis to be traversed ...

- no "Axis clamped" symbol must be shown,
- the "STIB" symbol (control-in-operation) must be displayed when NC START or an axis-direction button is pressed,
- the feed rate display (F ...) must not be highlighted,
- the position display (ACTL, NOML) changes when the axis moves.

If necessary, ask the machine operator!

Flowchart



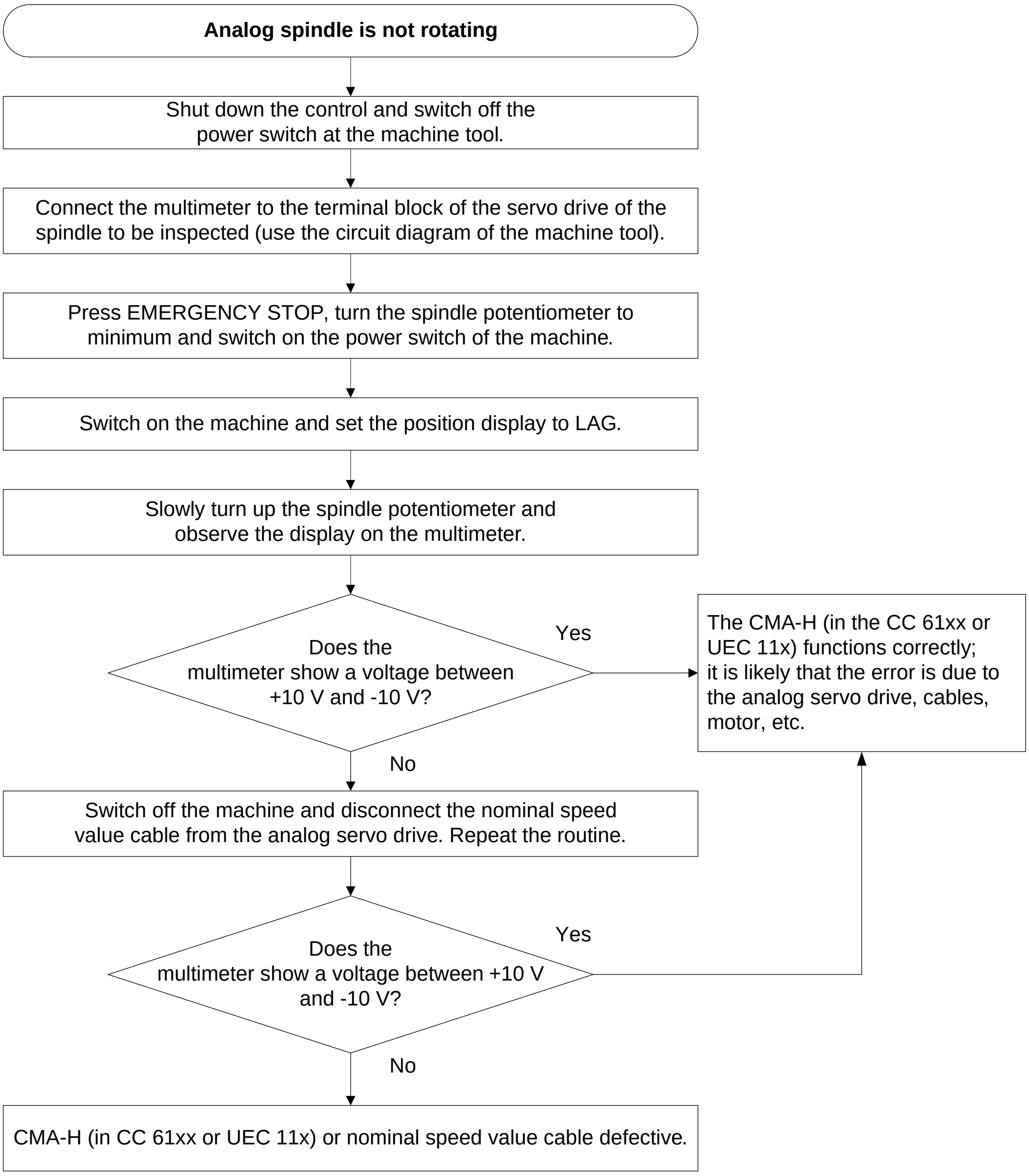
Note

If the control operates properly, a nominal speed command voltage can be read during the above routine until the monitoring values (movement, following error, etc.) are reached.

Error: No spindle movement!

A **precondition** is that the **release conditions** (e.g., door contacts) for the spindle movement are **fulfilled**.

Flowchart



Battery box

If you have a **"battery box"** (not a HEIDENHAIN product), you can check whether the analog servo amplifier can be operated with it.
This battery box replaces the control and provides the analog servo amplifier with a nominal speed value around ±10 V.
(The controller enabling at the servo amplifier must be available. --> If necessary, ask the machine manufacturer!)

21.2.7 Adjusting the electrical offset (drift adjustment)

Offset adjustment is required or recommendable, if ...

- the error message **EXCESSIVE OFFSET <AXIS>** is displayed
- the axis or spindle drifts
- the servo lag of the axis at standstill is impermissibly high
- you have exchanged the motor
- you have replaced the carbon brushes
- you have exchanged the analog servo amplifier
- you have replaced cables or electrical lines on the machine
- you have exchanged the CMA-H 04-04-00

> Note
>
> Offset adjustment is only required for analog axes or spindles.
> First the analog servo amplifier is adjusted, followed by fine adjustment in the HEIDENHAIN control.

Offset adjustment at the analog servo amplifier

> Note
>
> Analog servo amplifiers are not HEIDENHAIN products.
> **Follow the instructions of the servo manufacturer (operating instructions, etc.)!**

Below you will find two proposals.

Proposal 1:

- Set the machine parameters listed below as follows (note down the original values):
  - MP1080.x (integral factor): **0** (off)
  - MP1391.x, 1392.x (velocity feedforward): **1** (on)
  - MP7290.x (display step): **6** (0.1 µm)
- Switch on the machine.
  The axis to be compensated must be in the position control loop. –> If necessary, ask the machine operator!
  Orient the spindle with M19.

- Select the **Programming and Editing** operating mode.

- If open: Close the program management by pressing the END button.

> Note
>
> Pressing the MOD key while the program manager is open calls screen where you can make the interface settings.

MOD

- Call the code number window..

7 5 3 6 8 ENT

- Enter and confirm the code number.

CANCEL

▶ Cancel compensation for axes/spindles.

Note

Before the adjustment at the servo amplifier, offset fine adjustment by the control is cancelled.

- Switch the position display to LAG and observe the display.
- Adjust the offset at the servo amplifier until the individual axes/spindles either display the value 0 or oscillate around 0 (approximate value ± 3 - 5 µm).

Note

You can also use the integrated oscilloscope with the settings `s actl.`, `s noml.`, `s diff`.
--> See "Integrated oscilloscope" on page 10 – 95.

- Reset the machine parameters and the position display to their original values.
- Carry out an offset fine adjustment via code number 75368.
--> See "Offset fine adjustment in the control" on page 21 – 357.

Proposal 2:

- Shut down the control and switch off the machine.
- Disconnect the nominal speed value cable from the CMA-H.
- Bring the **nominal value** of the axis to be adjusted **to zero potential** (short-circuit the ±10 V line with the 0 V line of the axis/spindle concerned).
- Switch on the power switch of the machine.
- Do not acknowledge the `Power interrupted` message, but call the machine parameter list immediately.
- Set the parameter MP120.x / MP121.x to zero. --> No output of the nominal value; axes/spindles are only displayed (if required, deselect reference point traverse for the axes in MP1340.x).
- Switch on the machine.
- Check the controller enabling on the servo amplifier and activate it, if required.
(If necessary, ask the machine manufacturer!)
- Select `Manual operation`, set the display to ACTL value and set the axis to zero.
- Adjust the servo amplifier as close to standstill as possible. The axis/spindle movement can be seen on the actual value display (and possibly on a pulley in addition).
- Restore the original condition (cabling, parameters).
- Carry out offset fine adjustment with the code number 75368. -->See "Offset fine adjustment in the control" on page 21 – 357

Offset fine adjustment in the control

Note

Before you carry out offset fine adjustment via code number, you must first adjust the offset at the servo amplifier!
With the offset fine adjustment via code number the control can only compensate ±100 mV. This corresponds to 1% of the ±10 V interface.
Thus, insufficient offset adjustment at the servo amplifier cannot be compensated with adjustment via code number.

The axes to be compensated must be in the position control loop. –> If necessary, ask the machine operator!
Orient the spindle with M19.

- Select the **`Programming and Editing`** operating mode.

MOD

- Call the code number window.

7 5 3 6 8 ENT

- Enter and confirm the code number.

The iTNC displays the offset values of the analog axes/spindles in the dialog line.
The values show the setting of the voltage in 0.15-mV steps.
Display value 10 means: 10 · 0.15 mV = 1.5 mV.

Note

The displayed offset value consists of the offset values that are generated in the analog servo amplifier and in the control.

- Press the respective soft key …

CONTINUE

... to carry out offset fine adjustment.
The values are stored in the nonvolatile memory. Offset adjusting via code number compensates the current offset values of the entire control loop. Later changes in offset are not compensated.

CANCEL

... not to carry out offset fine compensation, or to cancel a previous compensation.

END

... to exit the menu without making any changes.

21.2.8 Speed adjustment at the servo amplifier (tachometer adjustment)

You should adjust the speed at the servo amplifier, if ...

- You have updated the mechanics of the axis
  (guideways, bearings, belts, coupling, ball screw, etc.)
- You have exchanged the analog servo amplifier or the motor.
- You have replaced the carbon brushes.
- The servo lag is impermissibly high at constant traverse.

The aim of speed adjustment is to achieve that the output nominal speed value is equal to the really measured actual speed value (**v nom** = **v act**).

> Note
>
> This adjustment is only necessary for analog axes!
> Before speed adjustment, the offset adjustment for the axis concerned should be performed.
> --> See "Adjusting the electrical offset (drift adjustment)" on page 21 – 355.

Suggestion for performing the adjustment

> Note
>
> Analog servo amplifiers are not HEIDENHAIN products.
> **Follow the instructions of the servo manufacturer (operating instructions, etc.)!**

Below you find a **proposal**:

- Set the machine parameter as follows (note down its original value):
  - MP7290.x (display step): **6** (0.1 µm)
- In the machine parameters MP1391.x and MP1392.x you can see whether the axis is operated with following error or feedforward control.
- Switch the position display to LAG.
- Enter the following test program (e.g. for the X axis; choose a larger traverse range if possible and select a speed that fits your machine):

```
0    BEGIN PGM tacho_adjustment  X MM
1    LBL 1
2    L      X+ 0   F 5000
3    L      X + 300   F 5000
4    CALL  LBL 1  REP 100
5    END PGM tacho_adjustment X MM
```

> DANGER
>
> Enter this test program together with the machine operator. Take care that there is no collision (retract Z axis first, etc.)!

- Set the feed rate potentiometer to zero.
- Run the program in the **Program Run, Full Sequence** operating mode and slowly turn the feed rate potentiometer to 100 %.

▶ Using the servo lag display, adjust the tachometer at the servo amplifier as follows:

Operation with ...	Displayed servo lag
Velocity feedforward control	Ideally 0
Servo lag	According to the following formula: $\text{LAG [mm]} = \dfrac{\text{Traversing speed} \left[\frac{\text{m}}{\text{mm}}\right]}{\text{kv factor}}$

Note

Read the traverse speed from the display.
The kv factor for the lag mode is defined in MP1810.x.
A multiplication factor for the kv factor may be active for the displayed traverse speed (MP1820.x). For this purpose a characteristic curve kink point is defined in MP1830.x. If necessary, contact the machine tool builder!

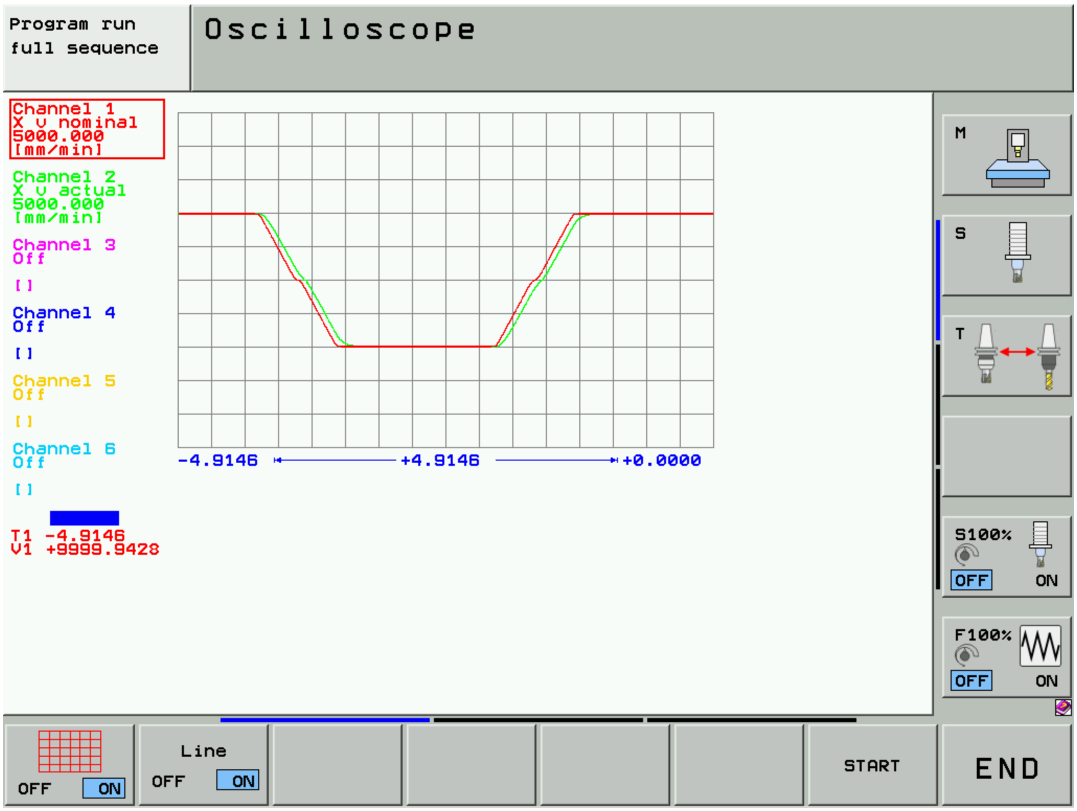
▶ Run the adjustment for all axes.

▶ Reset the machine parameter MP7290.x to its original value.

Note

Here, it might be helpful to use the integrated oscilloscope. The signals **V (nom rpm) and V (act rpm) can be recorded and compared**. Thus, the quality of the speed adjustment can be controlled and improved, if required.

Comparison of nominal and actual speed in the integrated oscilloscope



21.2.9 Corrective action

Mechanics

If you have found that the fault is due to the mechanics of the machine tool:

- Replace mechanical components. --> Ask your machine tool builder.

Drive components

If you have found that the analog servo amplifier or the motor is defective:

- Replace the drive component. --> Ask the respective manufacturer.

Control components

If you have found that the CMA-H 04-04-00 is defective:

- Replace the CMA-H 04-04-00.

22 Visual display unit

22.1 Introduction

BF 250 or MC 6222

Depending on the main computer, the flat-panel display is either integrated in the housing of the MC or is a stand-alone unit.

Main computer	Flat-panel display	Soft keys	Screen diagonal	Pixels
MC 6222 (in the console)	**Integrated**	8 horizontal and 6 vertical soft keys	15.1 inches	1024 x 768
MC 6241 (inside the electrical cabinet)	**BF 250**			

USB interfaces

The integrated flat-panel display and the BF 250 feature an **USB interface (USB 2.0) on their front side**.

The BF 250 has an additional **USB hub (USB 2.0) with 4 USB interfaces** on its back side.

Note

If USB components that are connected to the MC 6222 or BF 250 require more than 0.5 A, a separate power supply becomes necessary for these components.
One possibility is the USB hub from HEIDENHAIN.

Power distribution switches

Note

The MC 6222 and BF 250 feature power distribution switches.
These are electronic fuses that separate USB devices that draw too much current from the MC 6222 or the BF 250.

Power supply and display signals

The BF 250 …

- is powered with **24 Vdc** (e.g. +24V-NC from PSL 130).
- receives **display signals from the MC 6241**.

The **HDL display interface** (HEIDENHAIN display link) ...

- Connector **X249** on the MC 6241
- Connector **X2** on the BF 250

... is HEIDENHAIN-specific.

A conventional flat-panel display cannot be connected.

The MC 6222 is ...

- powered with **24 Vdc** (e.g. +24V-NC from PSL 130)

Control with display signals takes place internally in the MC 6222 housing.

Signal paths

Overview --> See "Signal paths in the console and to the MC 62xx" on page 23 – 367.

22.2 Possible error causes

- Faulty 24 Vdc power supply
- Defective screen soft keys
- Monitor defective
- Defective monitor cable
- No display signals from the graphic card
- Defective fan
- Defective cover glass
- Defective USB devices
- USB devices draw too much current
- TE 6xx keyboard unit defective

22.3 Troubleshooting

Screen soft keys

The soft-key rows of the BF screens are connected to the keypad board of the TE 6xx via ribbon cables.

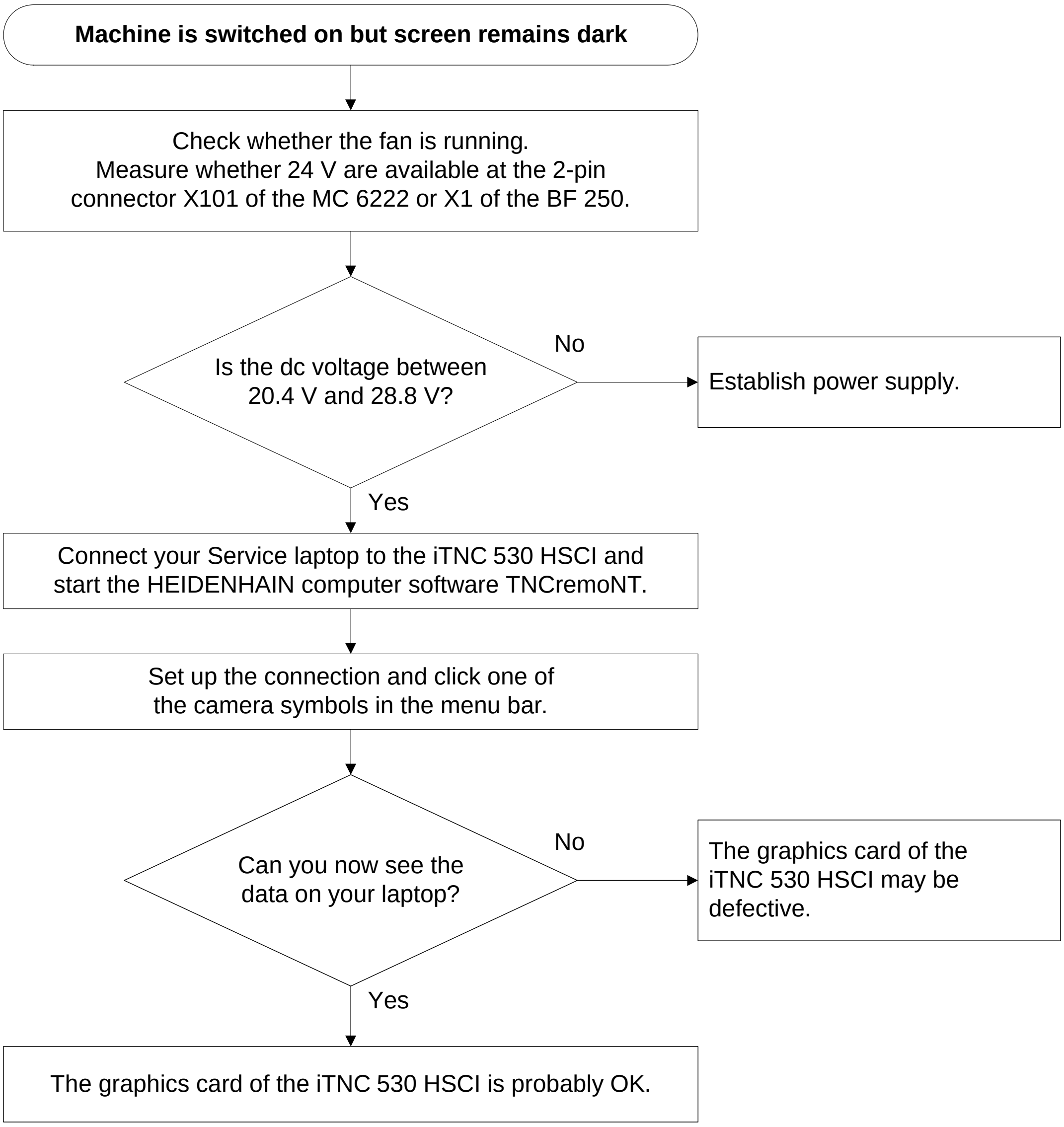
Troubleshooting --> See "Checking the keys" on page 23 – 370.

USB interface

- Try USB devices with lower current consumption.
- Disconnect the TE 6xx keyboard unit from the MC 6222 or the BF 250.

Monitor

Proposal for troubleshooting, if the screen remains black when the machine is switched on:



Note

By means of a **dongle** for the USB interface, TNCremoNT can be enhanced to **TNCremoPlus**.
With this version you can view the control display on your service laptop.
You can call this function with the icon `View TNC screen`.
The symbol is in the menu bar, next to the camera symbols.
The dongle can be ordered from HEIDENHAIN.

Note

Even if you can see the display information with TNCremoNT, it is still not 100% sure that all areas of the graphic card are in good order!

The **screen function** is normally **not impaired by defective units** connected to the MC 6222 or BF 250.

To ensure that the proper function of the monitor is not impaired by a defective device (short-circuit, etc.) in combination with a defective power distribution switch, you can remove all connected devices from the MC 6222 or BF 250 (exception: power supply unit and HDL interface) and then check, whether the monitor works.

22.4 Corrective action

Screen soft keys

Replace the soft-key rows.
.

USB interface

Exchange the USB board.

Fan

Exchange the fan.

Front glass

Exchange the front panel with cover glass.

Monitor

Exchange the complete visual display unit.

Control components

If you have found that the power source is defective:

- Exchange the power supply unit (e.g. PSL 130).

If you have found that the HDL interface on the MC 6241 is defective:

- Replace the MC 6241. --> See "Exchanging the MC 6241" on page 29 – 534.

If you have found that the BF 250 is defective:

- Exchange the BF 250.

If you have found that the MC 6222 is defective:

- Replace the MC 6222. --> See "Exchanging the MC 6222" on page 29 – 531.

23 Keyboard unit

23.1 Introduction

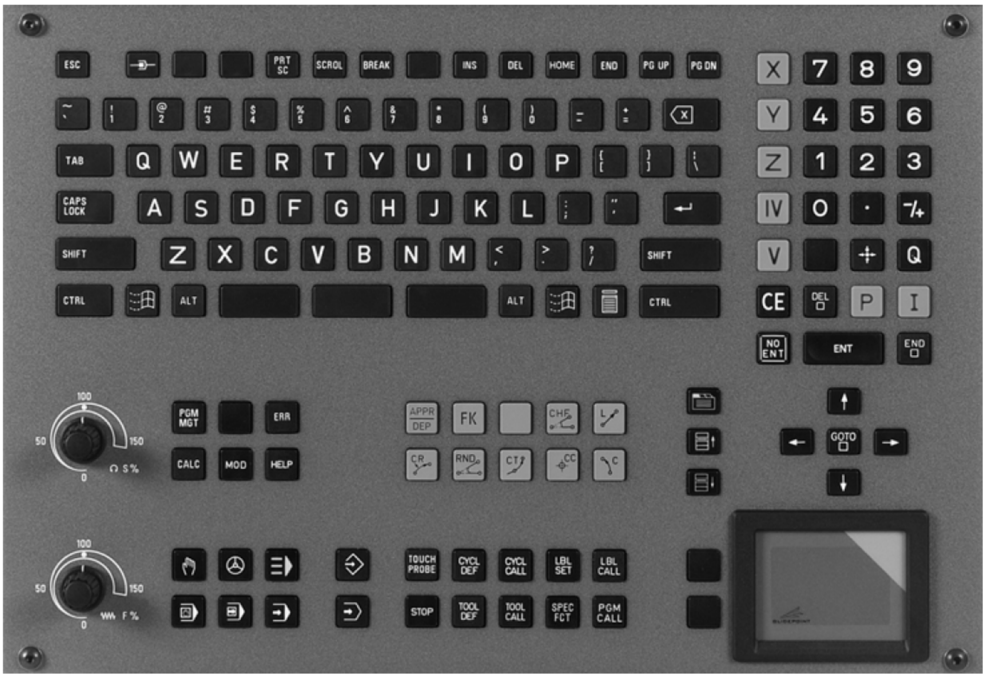


Photo: TE 630

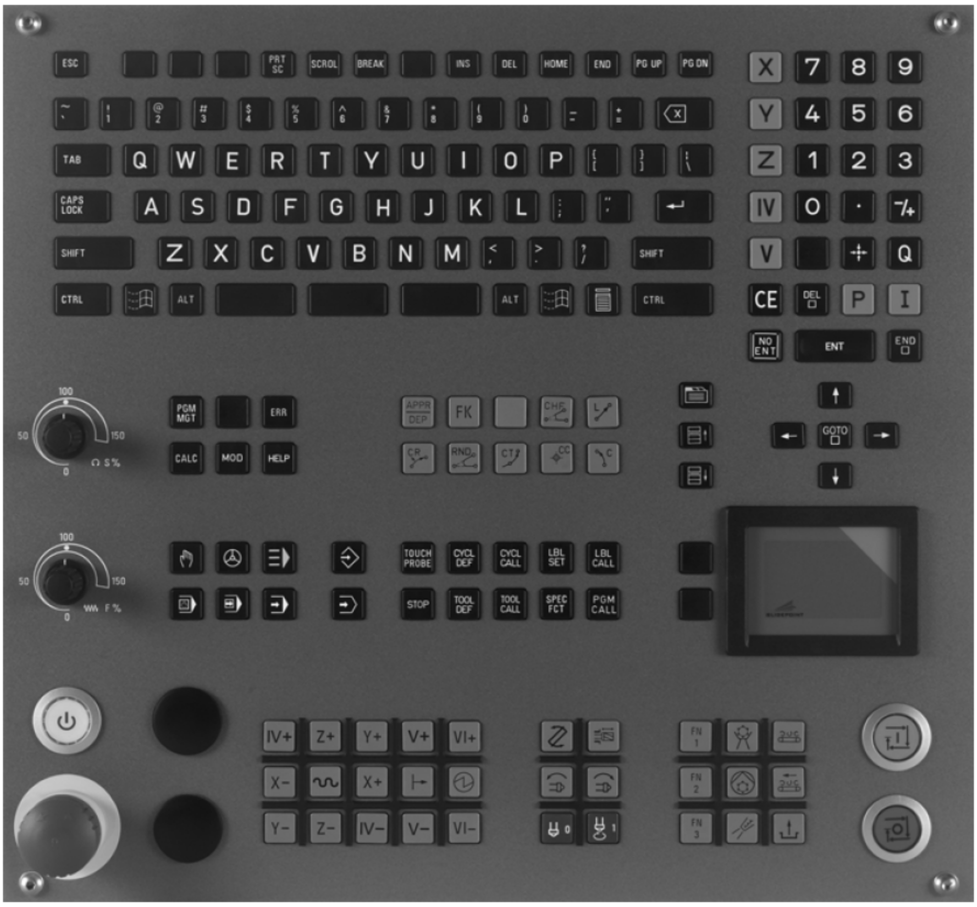


Photo: TE 635 Q (keyboard and machine-operating panel)

TE 620, TE 630 and TE 635 Q

Keyboards currently used:

Keyboard	Windows keys	smarT.NC keys	Touchpad	Machine-operating panel included
TE 620	X	X	-	-
TE 630	X	X	X	-
TE 635 Q	X	X	X	X

Machine-specific keyboards are also used, most of which work according to the same principle.

Power supply

The TE 6xx is powered by the MC 6222 or BF 250 via the USB cable.

Screen soft keys

The screen soft keys are on separate boards (horizontal and vertical soft key rows) that are connected to the keyboard PCB via ribbon cables.

Key signals

The key signals are transmitted to the controls by means of a matrix with every crosspoint of a **ScanLine (SL)** being assigned to a certain key via a **ReturnLine (RL)**.

The key signals are transferred to the MC 62xx (possibly via a BF 250) with a USB cable.

Touchpad signals

The touchpad signals are transferred to the MC 62xx (possibly via a BF 250) with the same USB cable that transfers the key signals.

Potentiometers

With a ribbon cable, the **potentiometers of the TE 6xx** are **powered and evaluated by the MB 620 machine operating panel**. The information is transferred to the control via the HSCI bus.

USB interfaces

The TE 6xx keyboard units feature two **USB interfaces (USB 1.1) on the rear side**.

One USB interface is connected to the MC 6222 or BF 250, the other one is freely available (e.g. for connecting a trackball).

> Note
>
> If USB components that are connected to the TE 6xx require more than 0.1 A, a separate power supply becomes necessary for these components. One possibility is the USB hub from HEIDENHAIN.

Power distribution switches

> Note
>
> The TE 6xx features "power distribution switches."
> These are electronic fuses that separate USB devices that draw too much current from the TE 6xx.

Active handwheel

If an HR 520 electronic handwheel is active, machine operation via keyboard is locked.

23.2 Signal paths in the console and to the MC 62xx

The illustration below shows:

- Signal paths
- Signal directions
- Power supplies
- Different bus systems
- Various cables

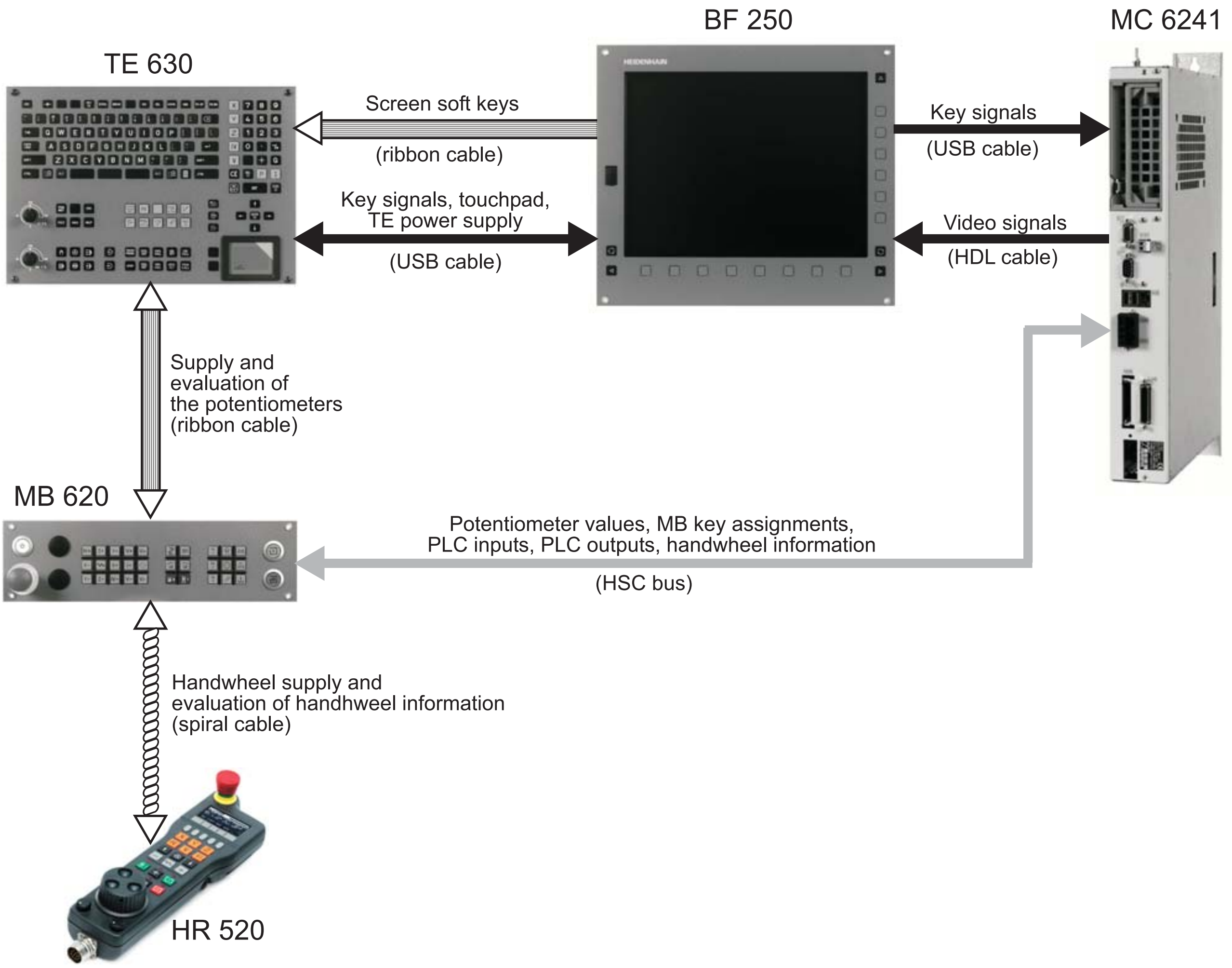


Fig.: Signal paths in the console and to the MC 6241

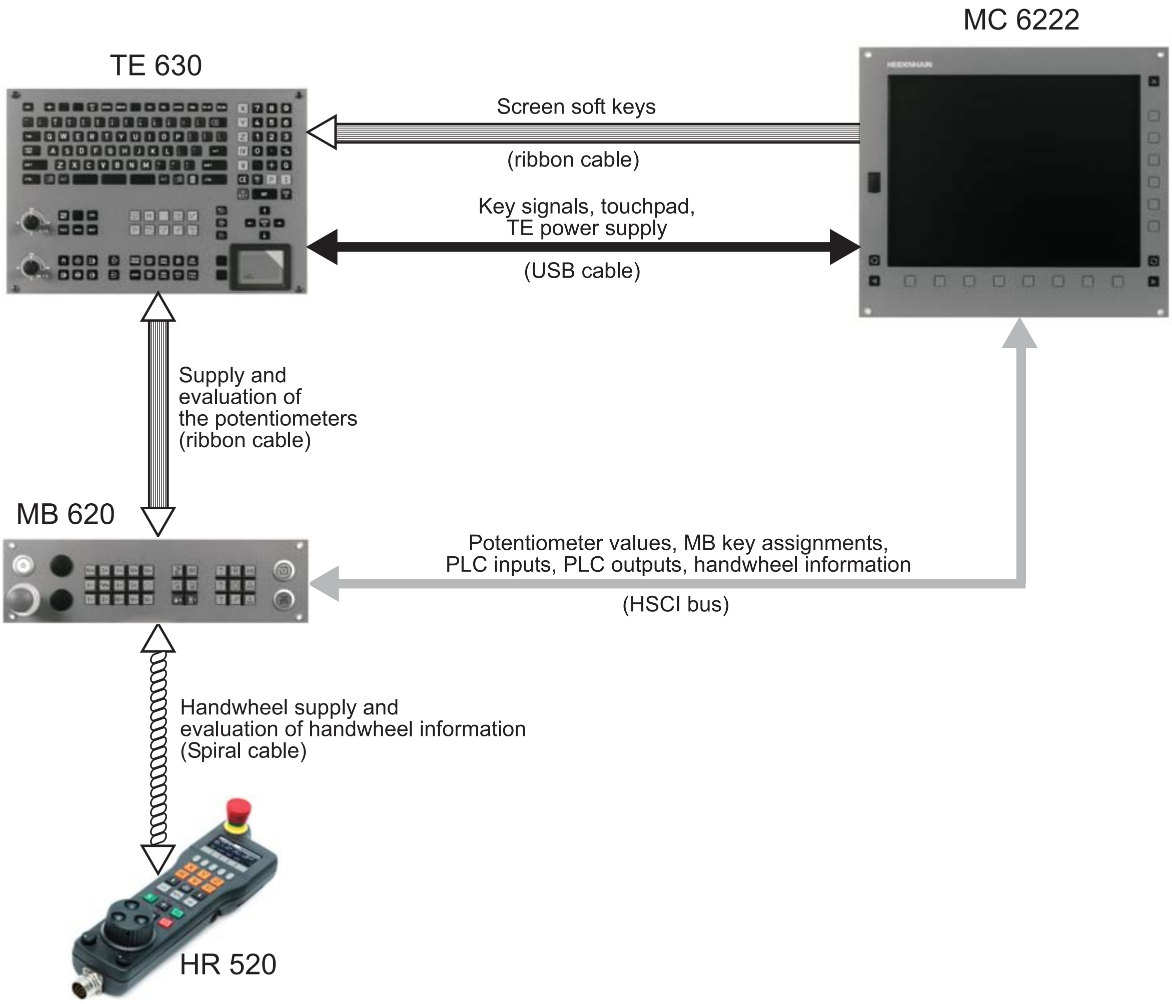


Fig.: Signal paths in the console when using an MC 6222

23.3 Possible error causes

- Heavy contamination –-> Key functions may be impaired.
- Jammed chips –-> Key gets stuck.
- Pressure contact defective. –-> Key no longer reports actuation.

> Note
>
> Defective keys either do not contact any more or are in permanent contact.

- Liquid has penetrated
- Defective keyboard PCB
- Defective ribbon cable between screen and keyboard (screen soft keys)
- Defective ribbon cable between keyboard and machine operating panel (potentiometer)
- Defective USB cable between keyboard and MC 6222 or BF 250
- Potentiometer wiper worn
- Defective touchpad
- Interface of a control component defective

23.4 Checking the keys

This inspection includes:

- The **hard keys on the the TE 6xx keyboard unit**
- The **soft keys on the MC 6222 or the BF 250 flat-panel display**

The soft-keys rows on the screen are connected to the keyboard PCB via a ribbon cable.

> Note
>
> The inspection of the keys on the machine operating panel of the TE 635 Q is described in the chapter Machine operating panel.

Correct operation?

Ensure that the key really has to function in the selected operating mode. --> Consult the machine operator or the User's Manual!

Visual inspection

Start with a visual inspection:

- Is the **key heavily contaminated** (grease, dust, oil, etc.)?
- Are there any **jammed chips**?

The key may thus get stuck.

In such events carefully clean the keyboard. --> See "Corrective action" on page 23 – 381.

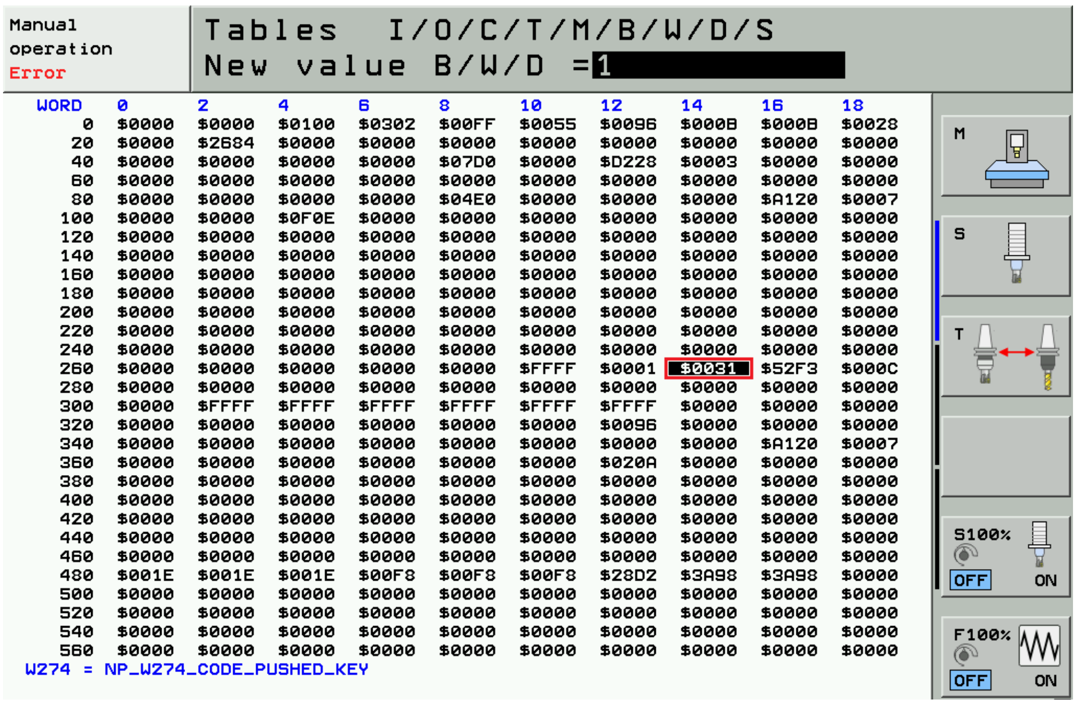
- Is the **key or the area around it heavily worn?**

This is an indication that the service life of the key has expired and that it does not make contact any longer.

Does the control receive the key signal?

Observe the **key code in PLC word W274** when pressing the keys:

- ▶ Switch on the machine.
- ▶ Press the EMERGENCY STOP button.
- ▶ Call the table with the PLC words. --> See "The TABLE function" on page 11 – 119.
- ▶ Place the cursor on the word 274.
- ▶ Press the key to be examined and check, if the display **changes to a key code** or if the reaction **expected for this key takes place**.


Manual operation
Error
Tables I/O/C/T/M/B/W/D/S
New value B/W/D =1

WORD	0	2	4	6	8	10	12	14	16	18
0	$0000	$0000	$0100	$0302	$00FF	$0055	$0096	$000B	$000B	$0028
20	$0000	$2684	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
40	$0000	$0000	$0000	$0000	$07D0	$0000	$D228	$0003	$0000	$0000
60	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
80	$0000	$0000	$0000	$0000	$04E0	$0000	$0000	$0000	$A120	$0007
100	$0000	$0000	$0F0E	$0000	$0000	$0000	$0000	$0000	$0000	$0000
120	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
140	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
160	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
180	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
200	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
220	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
240	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
260	$0000	$0000	$0000	$0000	$0000	$FFFF	$0001	$0031	$52F3	$000C
280	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
300	$0000	$FFFF	$FFFF	$FFFF	$FFFF	$FFFF	$FFFF	$0000	$0000	$0000
320	$0000	$0000	$0000	$0000	$0000	$0000	$0096	$0000	$0000	$0000
340	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$A120	$0007
360	$0000	$0000	$0000	$0000	$0000	$0000	$020A	$0000	$0000	$0000
380	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
400	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
420	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
440	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
460	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
480	$001E	$001E	$001E	$00F8	$00F8	$00F8	$28D2	$3A98	$3A98	$0000
500	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
520	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
540	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000
560	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000	$0000

W274 = NP_W274_CODE_PUSHED_KEY

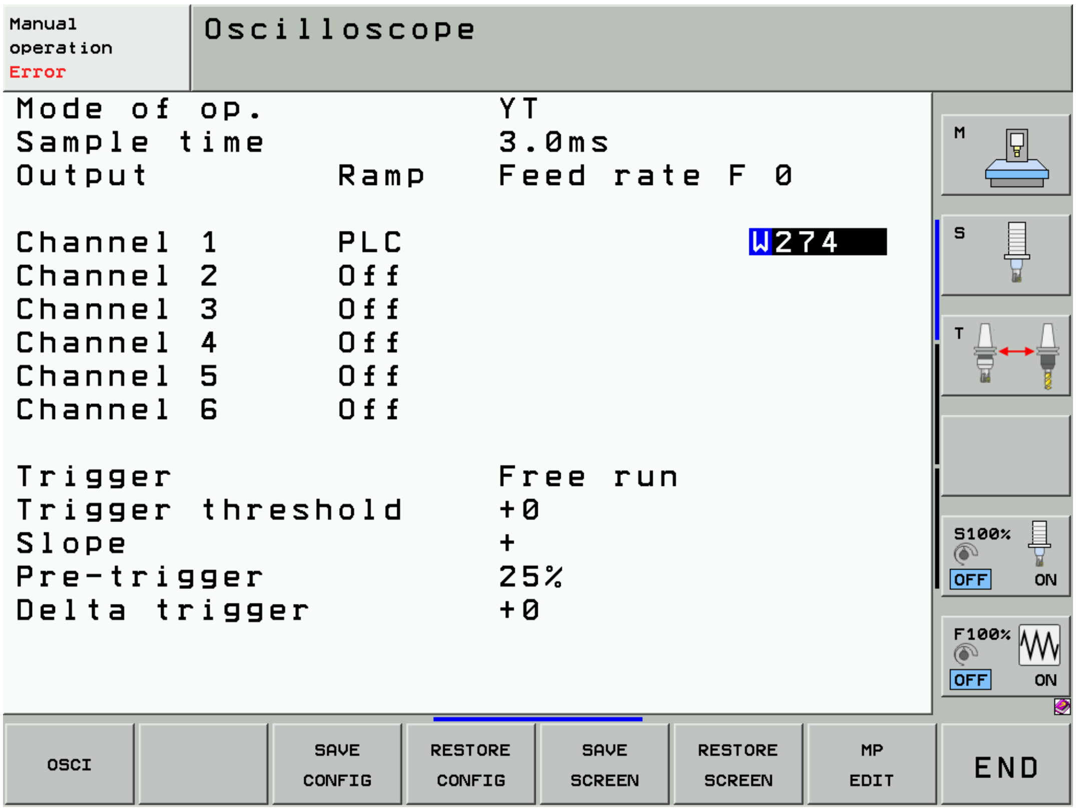
Figure: Key code in the PLC table

Note

The key code is of secondary importance. Important is, whether or not the control detects the keystroke.

The key code can bee seen very well in the **integrated oscilloscope**:

- Switch on the machine.
- Press the EMERGENCY STOP button.
- Call the integrated oscilloscope. --> See "Integrated oscilloscope" on page 10 – 95.
- Make the following selection:



- Start recording.
- Press several keys.
- Stop recording and adjust the signals.
- Restart recording.
- Press the key to be examined and check, if the integrated oscilloscope produces **an amplitude** or if a **reaction takes place that corresponds to this key**.

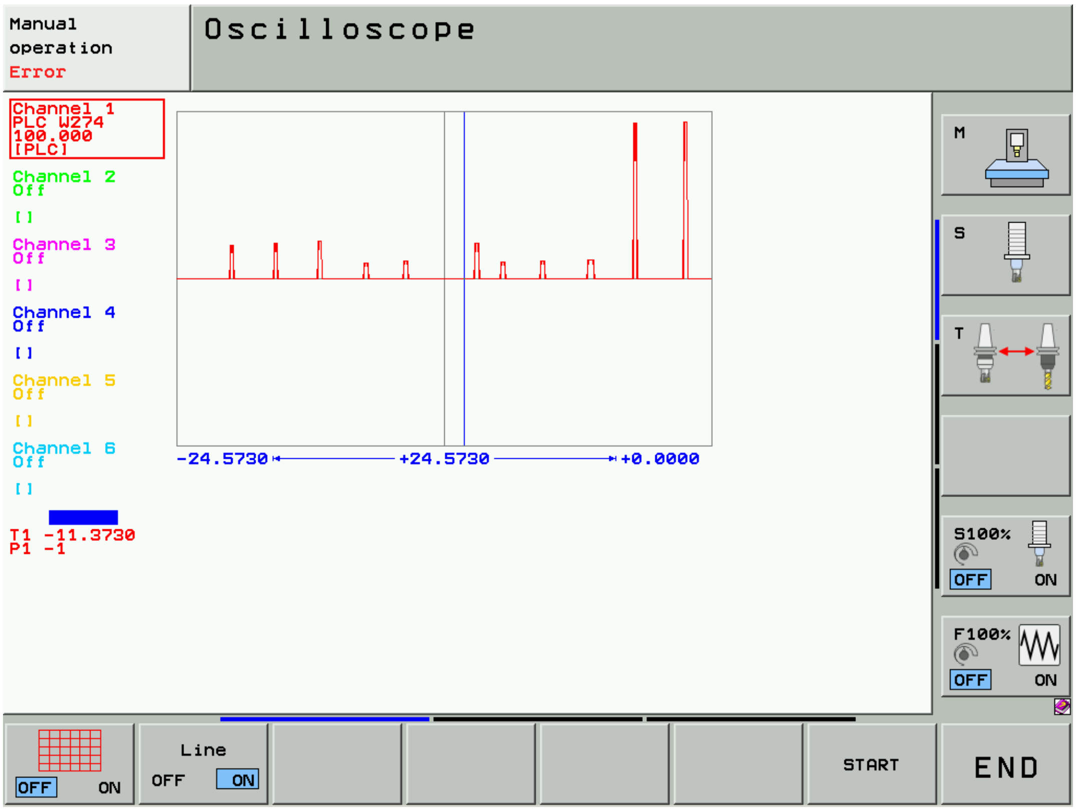


Figure: Key code in the integrated oscilloscope

Note

The key code is of secondary importance. Important is, whether or not the control detects the keystroke.

Note

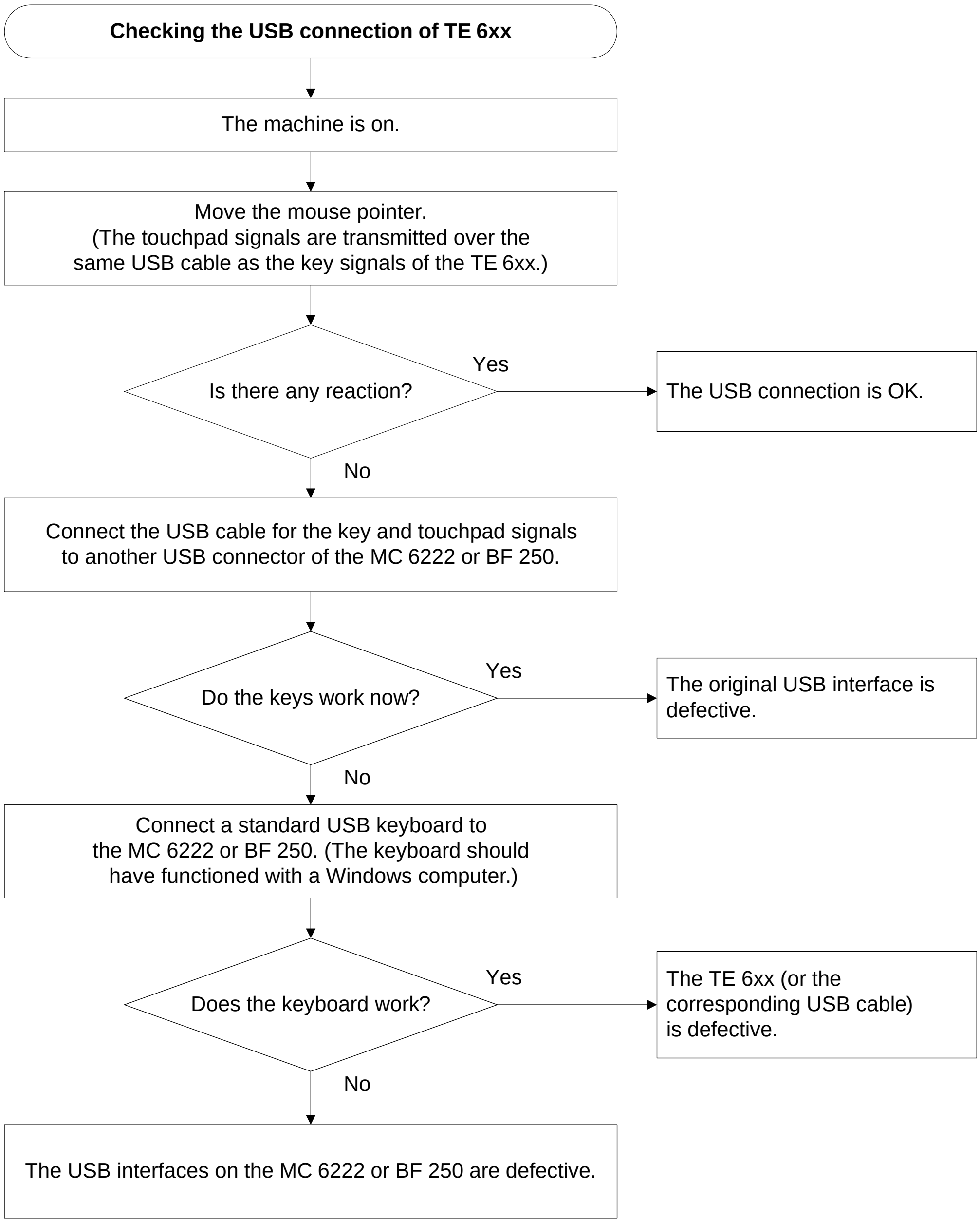
If a key does not produce a reaction of the control, one does not know, whether the pushbutton itself or the keyboard PCB, the USB cable or the control component is defective.
Further tests can be performed. --> See descriptions later on in this chapter.

Is the USB connection OK?

The key and touchpad signals are transferred to the MC 62xx (possibly via a BF 250) with a USB cable.

If the keys do not work, carry out the following tests to find out, whether the keys, the USB cable or the USB interface of the control component are defective.

Flowchart



Note

The key assignment of a HEIDENHAIN keyboard differs from that of a standad computer keyboard. For example, F12 switches the screen, and the DEL key on the numerical keypad executes the CE command. The screen soft keys are assigned to F1 - F8.
The decisive factor is whether the control recognizes keystrokes via the USB line.
For a HEIDENHAIN key assignment plan for computer keyboards refer to the documentation of the HEIDENHAIN iTNC 530 Programming Station.

Evaluation using the key matrix

The **keys are evaluated via a matrix**. Every key is located at a crosspoint of SL (= scan line) and RL (= return line).
--> See "Key matrix of the keyboard units" on page 23 – 382 and
--> See "Key matrix of the screen soft keys" on page 23 – 392.

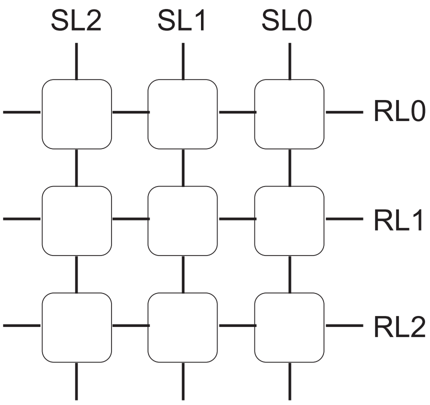
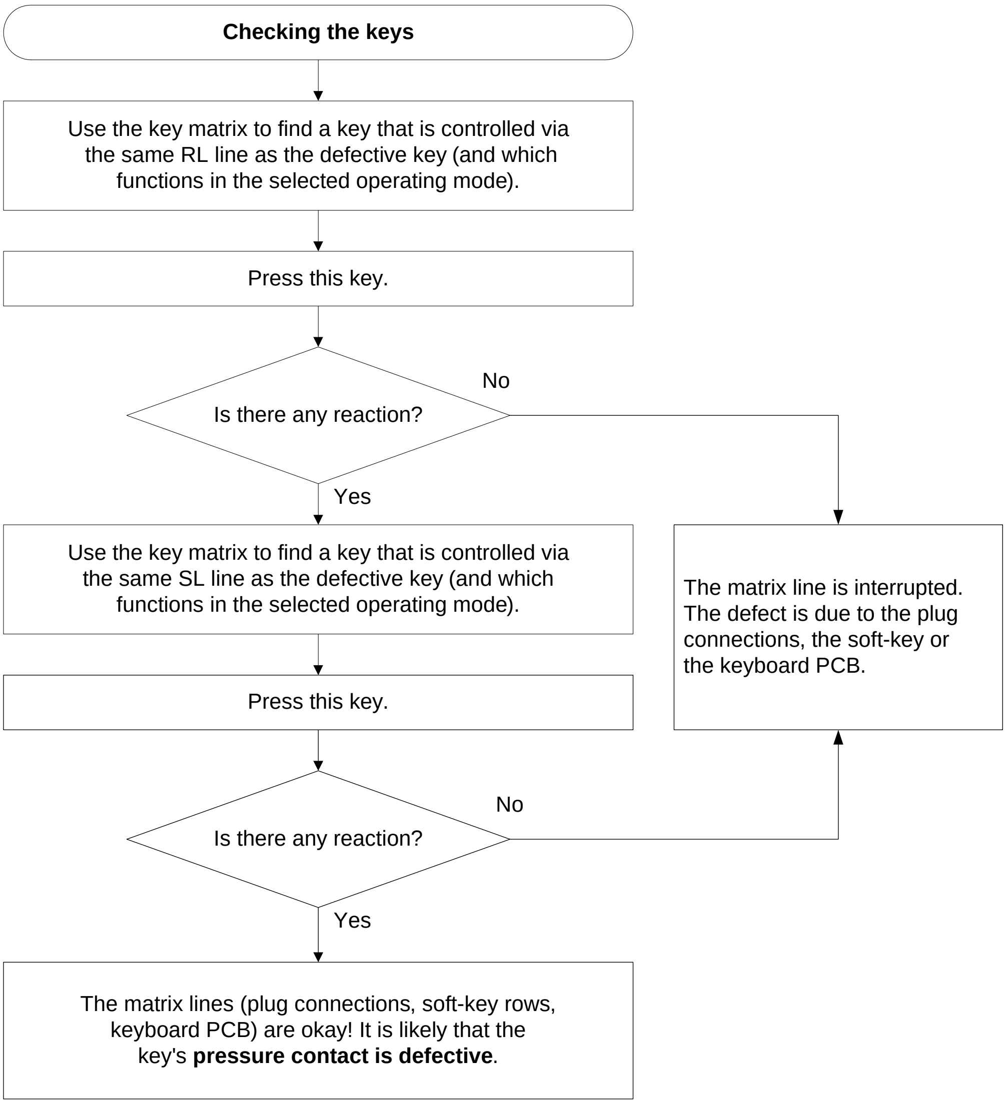


Figure: Principle of the key matrix

Flowchart

Is a line (connecting element, board), the key element of the keyboard or the soft-key row of the screen defective?



Measure key matrix

An almost complete statement about the condition of the keys can be made by way of **ohmic measurement of the key matrix**.

- Shut down the control and switch off the machine.

> Attention
>
> Observe the ESD precautions. --> See "Important information" on page 29 – 515.

- Remove the keyboard from the console.
- Place the front panel of the keyboard on a soft surface.
- Leave the ribbon cable to the screen soft keys connected.
- Set a multimeter to "alarm" (acoustic signal) or to ohmic measurement.
- Hold the needle tips to the pins of the key to be examined.
  --> See figure "Terminal strip X57 for the key matrix".
  Use the key matrix with the pin layout.
  --> See "Key matrix of the keyboard units" on page 23 – 382;
  --> See "Key matrix of the screen soft keys" on page 23 – 392.
- Press the key to be examined. If the key functions, the multimeter will "ring". If you use ohmic measurement, the measured resistance is approx. 1 ohm (consider the resistances of the measuring lines and the test adapter).

> Note
>
> **Limitation:**
> The alarm method cannot be used to test the cross points of the scan lines (SL) and the **return line 0** (RL 0).
> There are logical gates between RL 0 and the related keys. These gates serve for keyboard identification of TE 6xx.
> Direct ohmic measurement is thus not possible here.

Terminal strip X57 for the key matrix

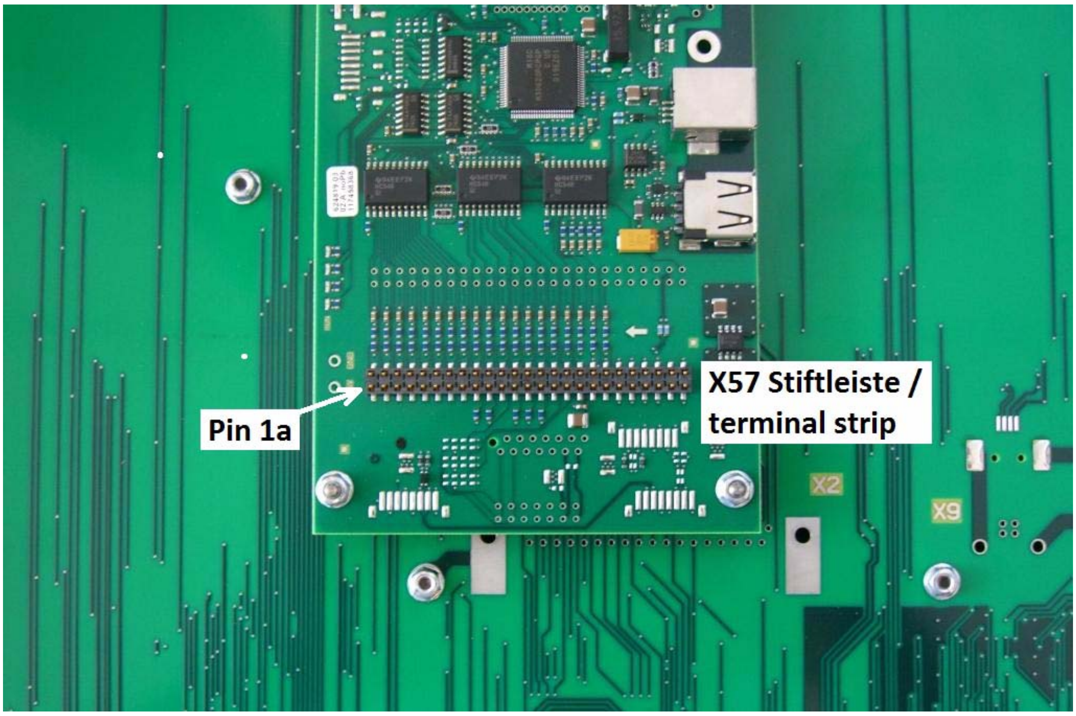


Figure: Terminal strip X57 for the key matrix (lower row: pins 1a to 25a; upper row: pins 1b to 25b)

23.5 Checking the potentiometers

The potentiometer setting is shown in the following PLC words:

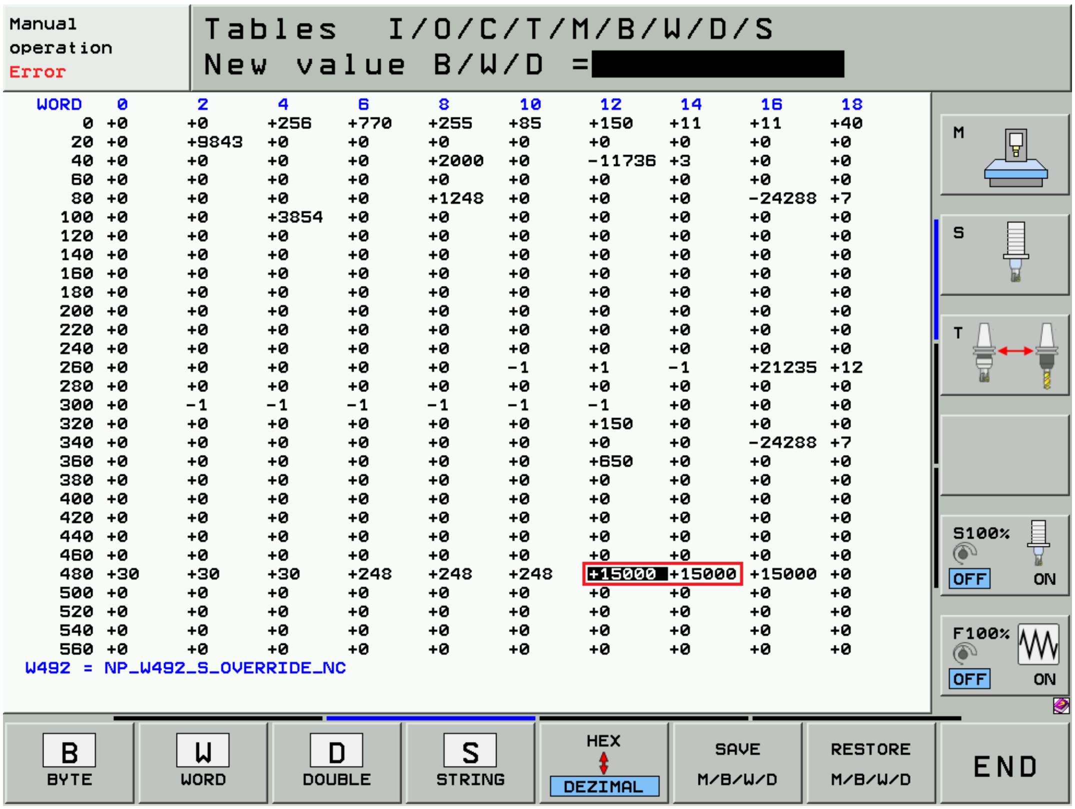
- W492 (= S override)
- W494 (= F override)

Potentiometer values in the PLC TABLE

You can use the **table for the PLC words** to find out, whether the control receives the potentiometer signal.

Proceed as follows:

- Switch on the machine.
- Press the EMERGENCY STOP button.
- Call the table with the PLC words. --> See "The TABLE function" on page 11 – 119.
- Place the cursor on W492 or W494.
- Select decimal display (soft key HEX<->DECIMAL).
- Turn the potentiometer to be examined.
- Check, whether the display **changes from 0 to 15000 (with nonlinear characteristic curve)** or from **0 to 150 (with linear characteristic curve)**.
  The characteristic curve is defined in MP7620, bit 3.



WORD	0	2	4	6	8	10	12	14	16	18
0	+0	+0	+256	+770	+255	+85	+150	+11	+11	+40
20	+0	+9843	+0	+0	+0	+0	+0	+0	+0	+0
40	+0	+0	+0	+0	+2000	+0	-11736	+3	+0	+0
60	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
80	+0	+0	+0	+0	+1248	+0	+0	+0	-24288	+7
100	+0	+0	+3854	+0	+0	+0	+0	+0	+0	+0
120	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
140	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
160	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
180	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
200	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
220	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
240	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
260	+0	+0	+0	+0	+0	-1	+1	-1	+21235	+12
280	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
300	+0	-1	-1	-1	-1	-1	-1	+0	+0	+0
320	+0	+0	+0	+0	+0	+0	+150	+0	+0	+0
340	+0	+0	+0	+0	+0	+0	+0	+0	-24288	+7
360	+0	+0	+0	+0	+0	+0	+650	+0	+0	+0
380	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
400	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
420	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
440	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
460	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
480	+30	+30	+30	+248	+248	+248	+15000	+15000	+15000	+0
500	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
520	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
540	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
560	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0

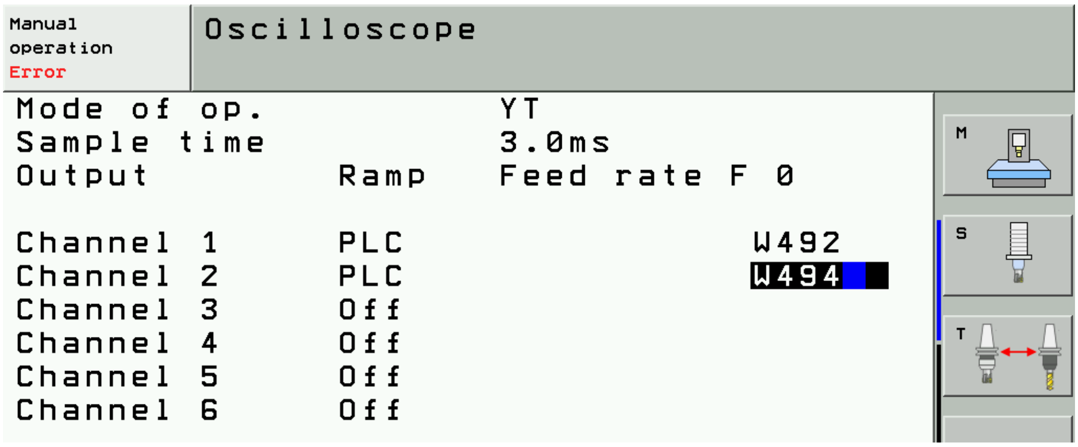
W492 = NP_W492_S_OVERRIDE_NC

Potentiometer values in the integrated oscilloscope

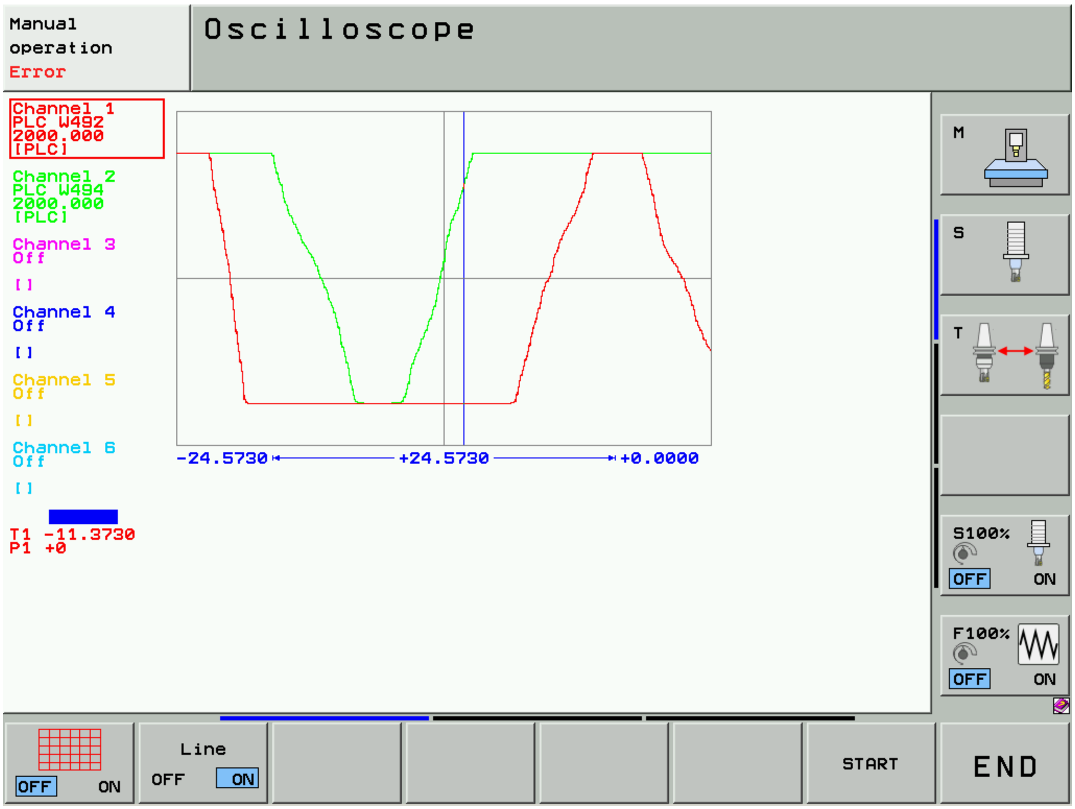
You can also use the integrated oscilloscope to record the states of PLC operands. The advantage of this method is that possible interruptions of the potentiometer wipers can be detected more easily than in the PLC TABLE.

Proceed as follows:

- Switch on the machine.
- Press the EMERGENCY STOP button.
- Call the oscilloscope. --> See "Integrated oscilloscope" on page 10 – 95.
- Make the following settings:



- Start recording.
- Turn the potentiometer to be examined.
- Stop recording and adjust the signals.
- Restart recording. --> Now you can examine the wiper areas of the potentiometers.
- Check, whether the signal of the potentiometer wiper can be changed continuously, or whether it "breaks off" suddenly.



Check TE/MB connection

Via a ribbon cable, the potentiometers of the TE 6xx are powered and evaluated by the MB 620 machine operating panel. The information is transferred to the control via the HSCI bus.

- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Dismount the keyboard.
- Disconnect the ribbon cable from connector X60 of the TE 6xx.
- Press the EMERGENCY STOP button.
- Switch on the machine.
- Measure, whether 5 V are available.
  (Normally, pin 1 is distinguished by a colored strand of the ribbon cable and an arrow on the ribbon connector.)

Connecting terminals	Assignment
6a, 6b	+5 V
7a, 7b	0 V

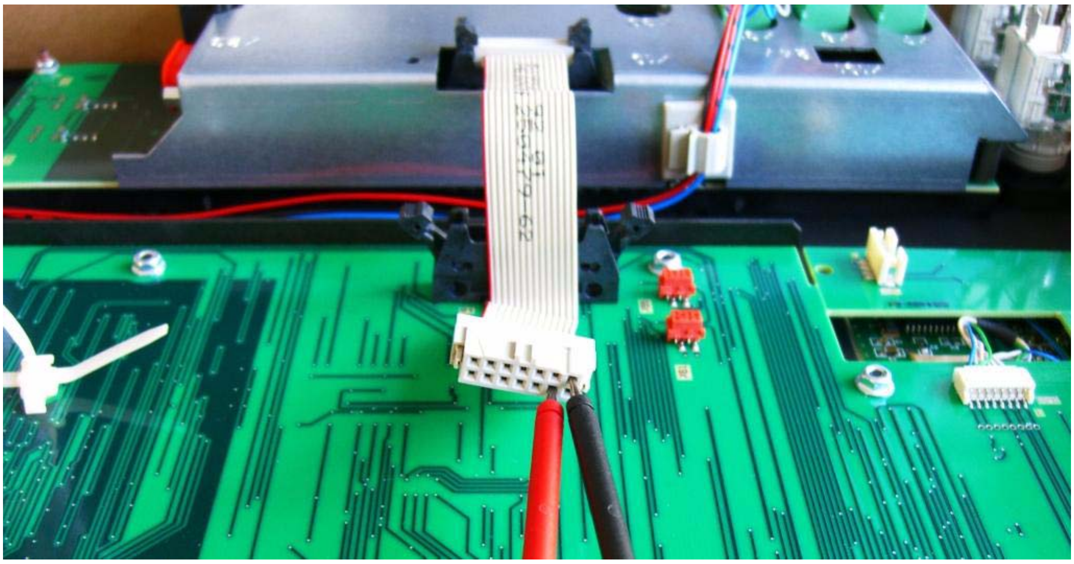
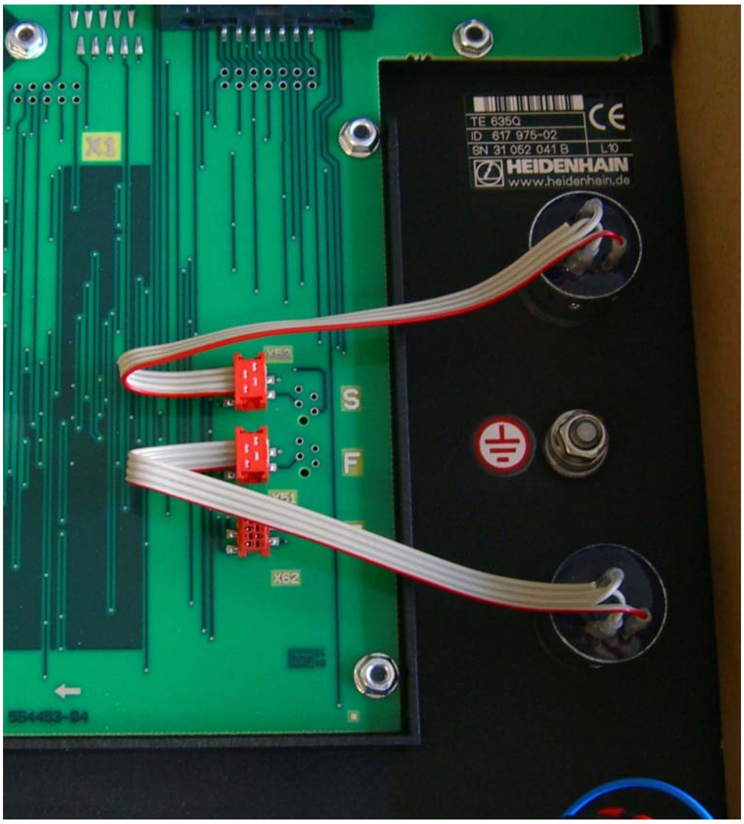


Figure: Measuring the power supply of the potentiometers

- Shut down the control and switch off the machine.
- Reconnect the ribbon cable; make sure that the connection is correct.
- If necessary, check whether the connection on the MB 620 is correct.

Measure potentiometer values directly

- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Dismount the keyboard.
- Disconnect the ribbon-cable connector of the potentiometer.



- Using a multimeter, check the resistances of the potentiometer.
  (Normally, pin 1 is distinguished by a colored strand of the ribbon cable and a notch on the ribbon connector.)

Measurement between the pins	Resistance value
1 - 3	approx. 10 kohms
1 - 2	approx. 0 - 10 kohms

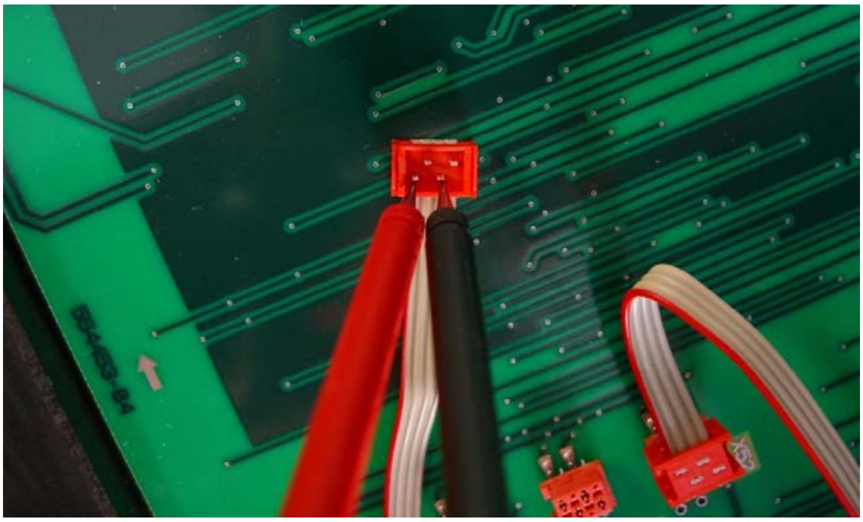


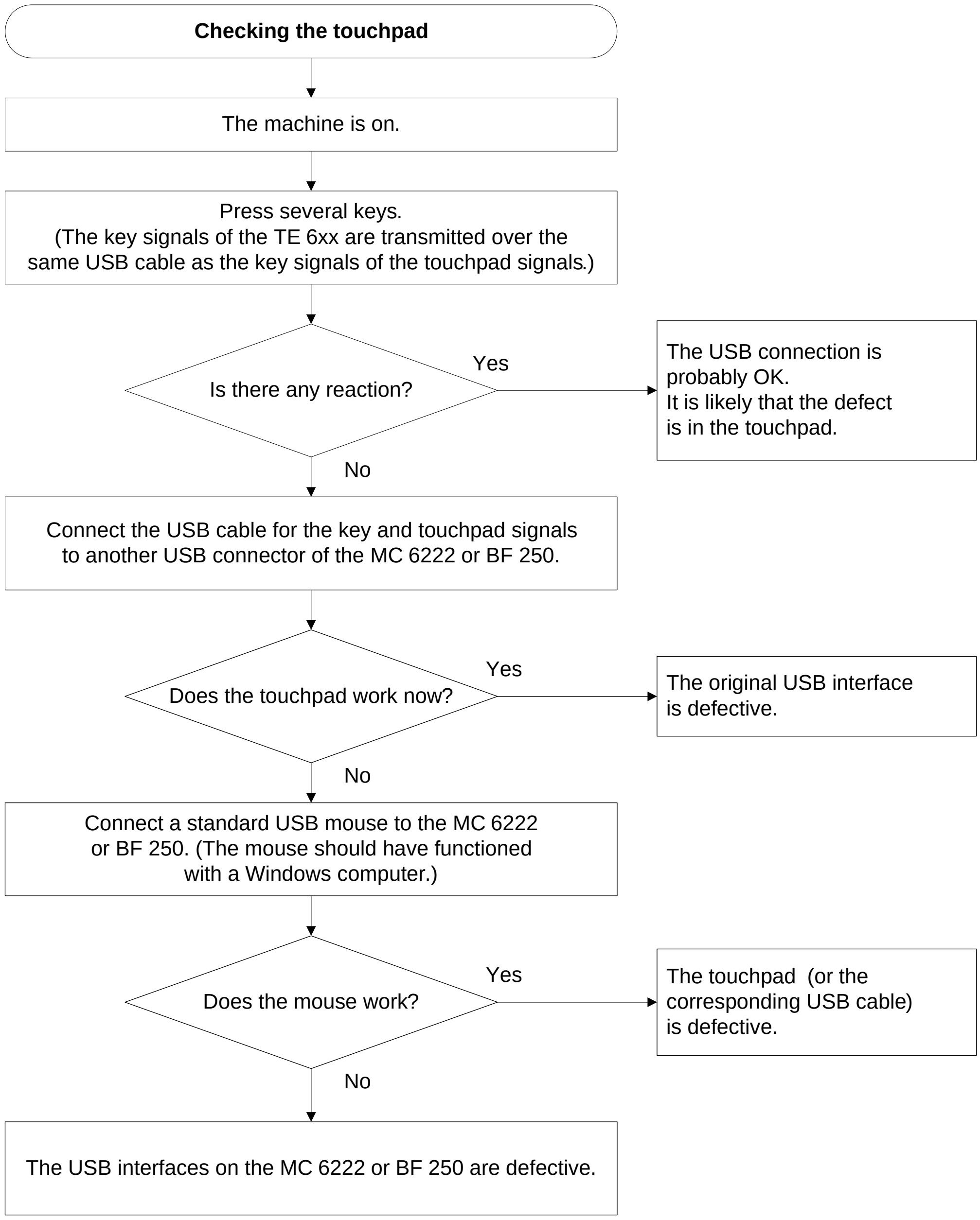
Figure: Measurement between pin 1 and pin 3

23.6 Checking the touchpad

The key and touchpad signals are transferred to the MC 62xx (possibly via a BF 250) with a USB cable.

If the touchpad does not work, carry out the following tests to find out, whether the touchpad, the USB cable or the USB interface of the control component are defective.

Flowchart



Touchpad at laptop

As a crosscheck, you can test the function of the touchpad of TE 6xx with a laptop.

▶ Connect the touchpad of the TE 6xx to a laptop (if required, use expansion for USB cable).

▶ Test the function.

Note

The laptop must feature a Windows operating system with the appropriate mouse driver.
If necessary, adapt the Windows settings. --> "My computer / Control Panel / Mouse ..."

23.7 Corrective action

Pushbuttons

If a key no longer makes contact:

Defective pushbuttons are not replaced individually!
Reason: If individual pushbuttons make bad contact or fail, other keys will also reach the end of their service life soon.

Therefore, only complete boards including the pushbuttons are replaced.

If a key permanently makes contact:

If required, remove chips and clean the keyboard.

- Shut down the control and switch off the machine.

> Attention
>
> Observe the ESD precautions. --> See "Important information" on page 29 – 515.

- Remove the keyboard from the console. (Take care that all connected cables are labeled before you disconnect any.)
- Disassemble the keyboard.
- Clean the components with a standard cleaning agent and a piece of cloth.
- Dry (or let dry) the components.

> DANGER
>
> When liquid cleaning agents were used, the electrical devices must dry completely before they may be operated again.

- Reassemble the equipment.

> Note
>
> Put the rubber mats back into the frame as they were before.

Potentiometers

Replace the defective potentiometer.

Control components

If you have found that the USB interface of the TE 6xx or MC 6222 or BF 250 is defective, replace the control component. --> See "Exchange of HEIDENHAIN components" on page 29 – 515.

23.8 Key matrix of the keyboard units

TE 620
TE 630
TE 635 Q

The keys of the machine operating panel of the TE 635 Q are not included.
--> See "Machine operating panel" on page 24 – 393.

X57 Pin Key		ESC				PRT SC	SCROL	BREAK		INS	DEL	HOME	END	PG UP	PG DN	X
1a	RL0															
2a	RL1															
3a	RL2															
4a	RL3															X
5a	RL4															
6a	RL5															
7a	RL6															
8a	RL7															
9a	RL8															
10a	RL9															
12a	RL11		X	X												
13a	RL12						X	X								
14a	RL13					X										
15a	RL14								X							
16a	RL15															
17a	RL16				X											
18a	RL17															
19a	RL18															
9b	RL19															
10b	RL20											X		X		
12b	RL21															
13b	RL22	X								X					X	
14b	RL23										X		X			
1b	SL0															
2b	SL1															
3b	SL2		X													
4b	SL3	X		X									X			
5b	SL4				X											X
6b	SL5									X	X					
7b	SL6							X	X			X				
8b	SL7					X	X							X	X	

Picture showing the assignment of X57
--> See "Terminal strip X57 for the key matrix" on page 23 – 375.

X57 Pin	Key	7	8	9	~ `	! 1	@ 2	# 3	$ 4	% 5	^ 6	& 7	* 8	(9	) 0	_ -
1a	RL0			X												
2a	RL1		X													
3a	RL2	X														
4a	RL3															
5a	RL4															
6a	RL5															
7a	RL6															
8a	RL7															
9a	RL8															
10a	RL9															
12a	RL11															
13a	RL12															
14a	RL13															
15a	RL14															
16a	RL15															
17a	RL16					X		X								
18a	RL17								X	X						
19a	RL18										X	X				
9b	RL19												X	X		
10b	RL20														X	X
12b	RL21						X									
13b	RL22				X											
14b	RL23															
1b	SL0					X			X		X		X		X	
2b	SL1				X		X	X		X		X		X		X
3b	SL2															
4b	SL3															
5b	SL4	X	X	X												
6b	SL5															
7b	SL6															
8b	SL7															

X57 Pin	Key	+/−	⌫	Y	4	5	6	TAB	Q	W	E	R	T	Y	U	I
1a	RL0						X									
2a	RL1					X										
3a	RL2				X											
4a	RL3			X												
5a	RL4															
6a	RL5															
7a	RL6															
8a	RL7															
9a	RL8															
10a	RL9															
12a	RL11															
13a	RL12															
14a	RL13															
15a	RL14															
16a	RL15															
17a	RL16								X							
18a	RL17									X	X					
19a	RL18											X	X			
9b	RL19													X	X	
10b	RL20															X
12b	RL21	X														
13b	RL22		X					X								
14b	RL23															
1b	SL0	X	X													
2b	SL1															
3b	SL2									X		X		X		X
4b	SL3			X	X	X	X		X		X		X		X	
5b	SL4															
6b	SL5															
7b	SL6							X								
8b	SL7															

X57 Pin	Key	O	P	{ [	}]	¦ \	Z	1	2	3	CAPS LOCK	A	S	D	F	G
1a	RL0									X						
2a	RL1								X							
3a	RL2							X								
4a	RL3						X									
5a	RL4															
6a	RL5															
7a	RL6															
8a	RL7															
9a	RL8															
10a	RL9															
12a	RL11															
13a	RL12															
14a	RL13										X					
15a	RL14															
16a	RL15															
17a	RL16											X				
18a	RL17												X	X		
19a	RL18														X	X
9b	RL19															
10b	RL20	X														
12b	RL21		X			X										
13b	RL22			X												
14b	RL23				X											
1b	SL0															
2b	SL1															
3b	SL2		X				X	X	X	X						
4b	SL3	X														
5b	SL4			X	X								X		X	
6b	SL5											X		X		X
7b	SL6										X					
8b	SL7					X										

X57 Pin	Key	H	J	K	L	:;	",	↵	IV	0	•	-/+	SHIFT	Z	X
1a	RL0											X			
2a	RL1									X					
3a	RL2										X				
4a	RL3								X						
5a	RL4														
6a	RL5														
7a	RL6														
8a	RL7														
9a	RL8														
10a	RL9														
12a	RL11														
13a	RL12														
14a	RL13														
15a	RL14														
16a	RL15														
17a	RL16						X							X	
18a	RL17														X
19a	RL18														
9b	RL19	X	X												
10b	RL20			X	X										
12b	RL21					X									
13b	RL22							X							
14b	RL23												X		
1b	SL0												X		
2b	SL1								X	X	X	X			
3b	SL2						X	X							
4b	SL3														
5b	SL4	X		X		X									
6b	SL5		X		X										
7b	SL6														X
8b	SL7													X	

X57 Pin Key		C	V	B	N	M	< ,	> .	? /	SHIFT	V			Q	CTRL
1a	RL0														
2a	RL1														
3a	RL2												X	X	
4a	RL3														
5a	RL4														
6a	RL5														
7a	RL6											X			
8a	RL7														
9a	RL8										X				
10a	RL9														
12a	RL11														
13a	RL12														
14a	RL13														
15a	RL14														
16a	RL15														X
17a	RL16														
18a	RL17	X													
19a	RL18		X	X											
9b	RL19				X	X									
10b	RL20														
12b	RL21						X	X	X						
13b	RL22														
14b	RL23									X					
1b	SL0													X	
2b	SL1									X					
3b	SL2														
4b	SL3						X								
5b	SL4										X				
6b	SL5							X					X		
7b	SL6		X		X				X			X			X
8b	SL7	X		X		X									

X57 Pin	Key		ALT		ALT			CTRL	CE	DEL	P	I	NO ENT	ENT	END
1a	RL0													X	X
2a	RL1												X		
3a	RL2														
4a	RL3									X	X				
5a	RL4								X			X			
6a	RL5														
7a	RL6														
8a	RL7														
9a	RL8														
10a	RL9														
12a	RL11		X		X										
13a	RL12														
14a	RL13					X									
15a	RL14	X													
16a	RL15							X							
17a	RL16			X											
18a	RL17														
19a	RL18														
9b	RL19														
10b	RL20														
12b	RL21														
13b	RL22														
14b	RL23						X								
1b	SL0		X												X
2b	SL1				X										
3b	SL2						X								
4b	SL3														
5b	SL4														
6b	SL5					X		X	X	X			X	X	
7b	SL6			X											
8b	SL7	X									X	X			

X57 Pin Key		PGM MGT		ERR	APPR DEP	FK		CHF	L	CALC	MOD	HELP	CR	RND	CT	CC
1a	RL0															
2a	RL1											X				
3a	RL2															
4a	RL3															
5a	RL4									X						
6a	RL5			X							X					X
7a	RL6		X										X	X		
8a	RL7	X							X						X	
9a	RL8				X	X	X	X								
10a	RL9															
12a	RL11															
13a	RL12															
14a	RL13															
15a	RL14															
16a	RL15															
17a	RL16															
18a	RL17															
19a	RL18															
9b	RL19															
10b	RL20															
12b	RL21															
13b	RL22															
14b	RL23															
1b	SL0				X											
2b	SL1					X										
3b	SL2						X				X			X	X	
4b	SL3							X	X				X			X
5b	SL4	X	X	X						X						
6b	SL5															
7b	SL6															
8b	SL7											X				

X57 Pin Key		C					TOUCH PROBE	CYCL DEF	CYCL CALL	LBL SET	LBL CALL					STOP
1a	RL0		X	X												
2a	RL1				X							X				
3a	RL2												X		X	
4a	RL3						X							X		
5a	RL4	X				X					X					X
6a	RL5									X						
7a	RL6								X							
8a	RL7							X								
9a	RL8															
10a	RL9															
12a	RL11															
13a	RL12															
14a	RL13															
15a	RL14															
16a	RL15															
17a	RL16															
18a	RL17															
19a	RL18															
9b	RL19															
10b	RL20															
12b	RL21															
13b	RL22															
14b	RL23															
1b	SL0				X		X									
2b	SL1							X	X	X	X					
3b	SL2															X
4b	SL3	X														
5b	SL4															
6b	SL5															
7b	SL6		X			X						X	X	X		
8b	SL7			X											X	

X57 Pin	Key	TOOL DEF	TOOL CALL	SPEC FCT	PGM CALL	↑	←	↓	→	GOTO ☐			
1a	RL0												
2a	RL1												
3a	RL2												
4a	RL3												
5a	RL4				X								
6a	RL5			X			X	X					
7a	RL6		X							X			
8a	RL7	X				X			X				
9a	RL8												
10a	RL9										X	X	X
12a	RL11												
13a	RL12												
14a	RL13												
15a	RL14												
16a	RL15												
17a	RL16												
18a	RL17												
19a	RL18												
9b	RL19												
10b	RL20												
12b	RL21												
13b	RL22												
14b	RL23												
1b	SL0	X	X	X	X						X		
2b	SL1											X	
3b	SL2												X
4b	SL3												
5b	SL4												
6b	SL5					X	X			X			
7b	SL6							X	X				
8b	SL7												

X57: 50-pin terminal strip on the keyboard PCB of the TE 6xx

Note

The two keys left of the touchpad do not belong to the key matrix.
When these keys are pressed, the signal is directly transmitted to the control via USB interface.

23.9 Key matrix of the screen soft keys

Below you find the key matrix of the screen soft keys of BF 250 and MC 6222.

Picture showing the assignment of X57
–> See "Terminal strip X57 for the key matrix" on page 23 – 375.

Vertical soft keys

X57 Pin	13a	14a	15a	16a	1b	2b	3b	4b	5b
Matrix	**RL12**	**RL13**	**RL14**	**RL15**	**SL0**	**SL1**	**SL2**	**SL3**	**SL4**
△			X		X				
MF1		X						X	
MF2	X							X	
MF3				X					X
MF4			X						X
MF5		X							X
MF6	X								X

X57: 50-pin terminal strip on the keyboard PCB of the TE 6xx
MF = Vertical soft keys (MF1 - MF6 from top to bottom)

Horizontal soft keys

X57 Pin	Matrix	⟳	◁	SK1	SK2	SK3	SK4	SK5	SK6	SK7	SK8	▷	⟳
1b	SL0	X											X
2b	SL1		X	X	X	X							
3b	SL2						X	X	X	X			
4b	SL3										X	X	
13a	RL12	X				X				X			
14a	RL13				X				X				X
15a	RL14			X				X				X	
16a	RL15		X				X				X		

X57: 50-pin terminal strip on the keyboard PCB of the TE 6xx
SK = Horizontal soft keys (SK1 - SK8 from left to right)

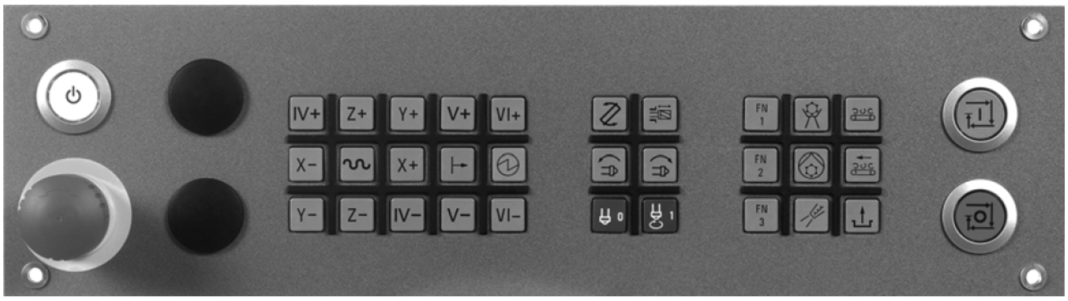
Note

Keys that were pressed are also recorded in the log.
The first horizontal soft key (down left on the screen) is recorded in the log as soft key 0, the second soft key as soft key 1, etc.
The first vertical soft key (top right on the screen) is recorded as V soft key 0, the second soft key as V soft key 2, etc.
The arrow keys for the switching of the soft-key rows are logged.
Any newly called soft-key row starts with soft key 0 or V soft key 0.

24 Machine operating panel

24.1 Introduction

HEIDENHAIN machine operating panel **MB 620** with axis axis-direction keys for up to six axes:



Normally, the MB is installed below or already integrated in the TNC keyboard (as with TE 635 Q).

On the MB 620 machine operating panel there are:

- EMERGENCY STOP button
- CONTROL ON button
- NC START button
- NC STOP button
- Keys for spindle start and spindle stop
- Axis direction keys for 6 axes
- Various function keys
- Two bore holes for additional keys or key switches (shipped blocked with a cover).

Note

The MB 620 keys are easily snapped off and exchanged.

HSCI bus

The **MB 620** is an **HSCI bus device**.

Key and button signals

The **keys and buttons** of the MB are transmitted to the control as **PLC inputs** via the HSCI bus.

Note

With the MB 620 without FS, the EMERGENCY STOP must be wired externally in the EMERGENCY STOP chain.

Emergency stop button

DANGER

HEIDENHAIN recommends checking the function of the EMERGENCY STOP button on the (customized) machine operating panel in regular intervals.

Potentiometers

With a ribbon cable, the **potentiometers of the TE 6xx** are **powered and evaluated by the MB 620 machine operating panel**. The information is transferred to the control via the HSCI bus.

Handwheel

Supply and evaluation of handwheels is effected **via the MB 620**. The information is transferred to the control via the HSCI bus.

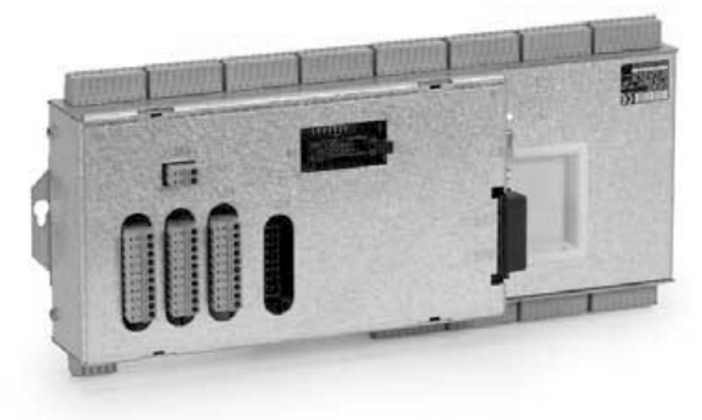
PLC outputs

MB 620 features 8 PLC outputs (which serve, for example, to control the lamps of the buttons).

Customized machine operating panels and PLB 6001

If a customized machine operating panel is used, it is connected to the **HSCI adapter PLB 6001**.

The connection of the machine operating panel to the HSCI bus is thus ensured.



On the PLB 6001 there are:

- HSCI interface
- Connection for handwheel
- Terminals for 64 PLC inputs, 32 PLC outputs for keys and key illumination
- Connection for spindle-speed and feed-rate override potentiometers
- Connection for 24 V power supply

Note

The descriptions for the MB 620 in this chapter also apply for the HSCI adapter PLB 6001.

Signal paths

Overview --> See "Signal paths in the console and to the MC 62xx" on page 23 – 367.

24.2 Possible error causes

- Heavy contamination. --> Key functions may be impaired.
- Jammed chips. --> Key gets stuck.
- Pressure contact defective. --> Key no longer reports actuation.

Note

Defective keys either do not contact any more or are in permanent contact.

- Defective switch (EMERGENCY STOP, CONTROL ON, NC START, NC STOP)

Note

If the NC STOP signal (low-active) between MB and control is interrupted, the machine cannot be traversed any more. The same problem is caused, if the NC STOP key gets stuck.

- HSCI connection error
- Connector defective
- Supply voltage missing
- Defective PLC output
- Lamp in the button burnt out
- Liquid has penetrated
- Board defective
- Interface of a control component defective

24.3 Checking the power supply

The MB 620 is powered with +24 V NC voltage at connector X101.

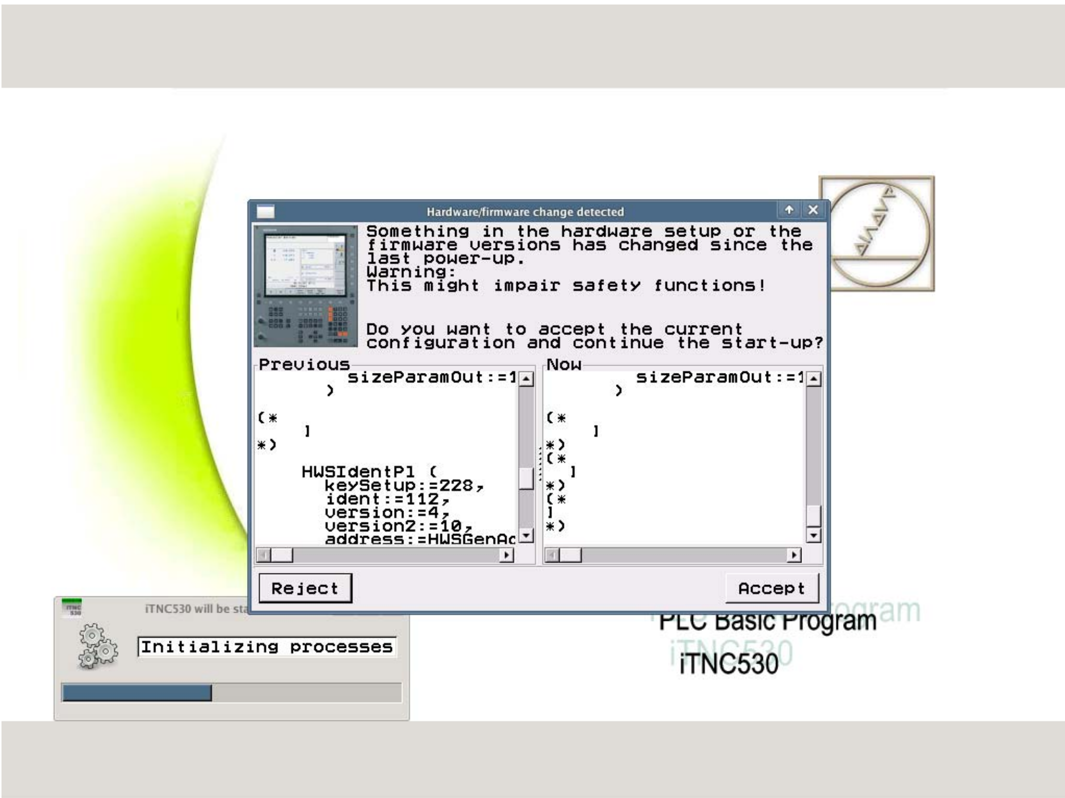
Check, whether the power supply is in order:

- ▶ Switch off the machine.
- ▶ Unfasten the mounting screws of the MB 620.
- ▶ Lift out the MB 620 until you can measure at connector X101.
- ▶ Switch on the machine.
- ▶ Check with a multimeter, if there are +24 V (tolerance 20.4 - 28.8 V) available at connector X101.

> **Note**
>
> The MB 620 features "polyfuses".
> Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., handwheel) from the low voltages of the MB 620.
> Polyfuses have a self-resetting function ("self-healing effect").

24.4 Checking the HSCI connection

If e.g. this message is displayed:



- ▶ Switch off the machine.
- ▶ Unfasten the mounting screws of the MB 620.
- ▶ Lift out the MB 620 as far as necessary and check the HSCI cable and the connection.
- ▶ Switch on the machine.
- ▶ In the window **`Hardware/firmware change detected`**, click **`reject`** and then call the HSCI bus diagnosis. --> See "Bus diagnosis" on page 12 – 147.
- ▶ Check the status of the MB 620.

24.5 Checking the keys

Correct operation?

Ensure that the key really has to function in the selected operating mode.
--> Consult the machine operator or the User's Manual!

Visual inspection

Start with a visual inspection:

- Is the **key heavily contaminated** (grease, dust, oil, etc.)?
- Are there any **jammed chips**?

The key may thus get stuck.

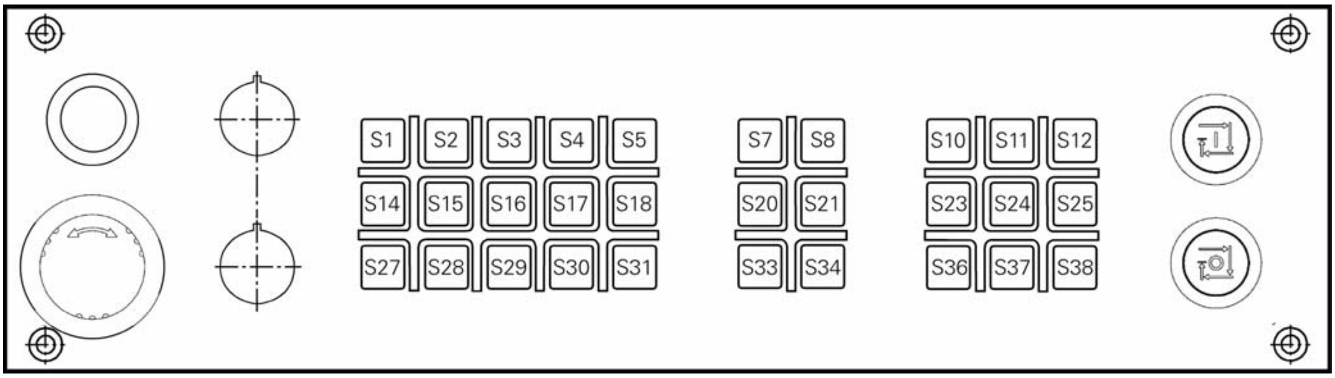
In such events carefully clean the machine operating panel.
--> See "Corrective action" on page 24 – 400.

- Is the **key or the area around it heavily worn?**

This is an indication that the service life of the key has expired and that it does not make contact any longer.

Description of the buttons

The keys of the MB 620 are named as follows:



These names (e.g. S31) also appear in the HSCI bus diagnosis.

Does the control receive the key signal?

The keys and buttons of the MB 620 are assigned to PLC inputs defined by the OEM.

Connectors and pin layouts on MB 620 --> See "Machine operating panel" on page 28 – 500.

The function of the MB keys can be checked with the **HSCI bus diagnosis**:

- Switch on the machine.
- Press the EMERGENCY STOP button.
- Call the HSCI bus diagnosis. –> See "Bus diagnosis" on page 12 – 147.
- Open the path `MB 620 / Digital Input` and place the cursor on the key to be inspected.
- Press the key. --> The **input must change to 1**.
  Exception: **NC STOP --> Changes to 0 when actuated** (failsafe!)

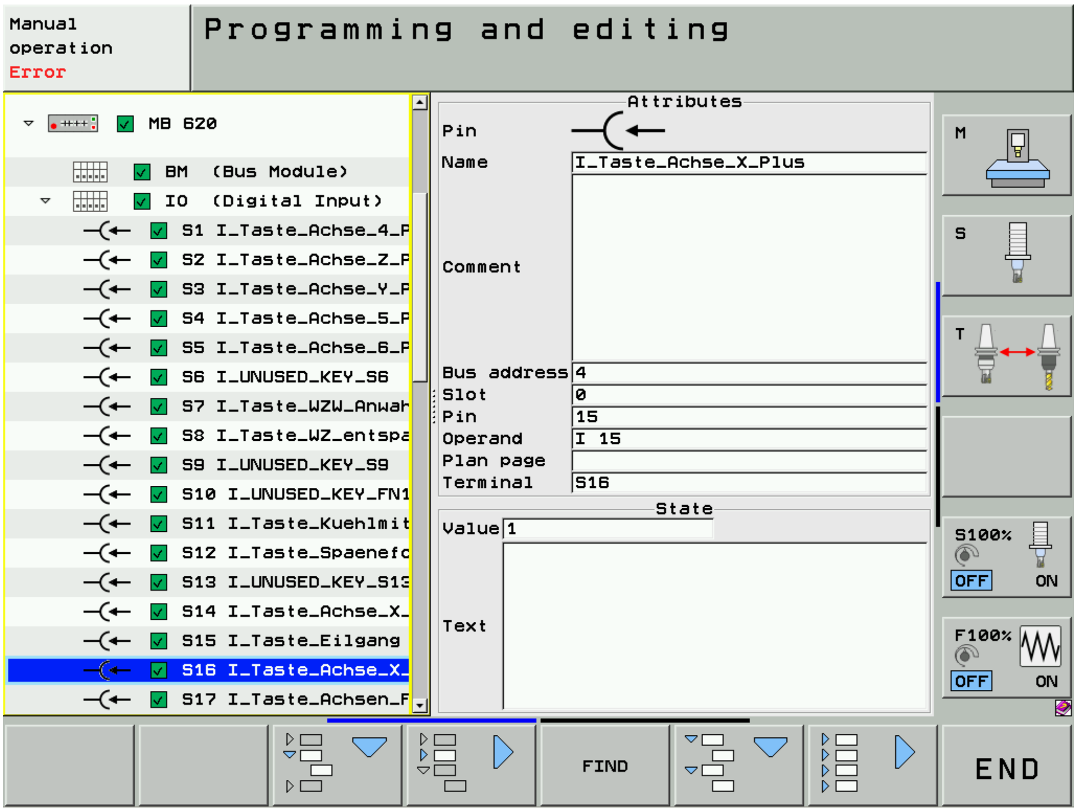


Figure: Inspection of an axis-direction button in the HSCI bus diagnosis

With the **logic diagram** you can check the **chronological switching behavior** of the MB keys:

- Switch on the machine.
- Press the EMERGENCY STOP button.
- Call the logic diagram. --> See "The LOGIC diagram" on page 11 – 124.
- Define the inputs for the recording to follow.
  (The numbers of the inputs can be seen from the Operand line in the HSCI bus diagnosis.)
- Start recording.
- Press the keys or buttons. --> The associated **inputs must change to 1**.
  Exception: **NC STOP --> Changes to 0 when actuated** (failsafe!)

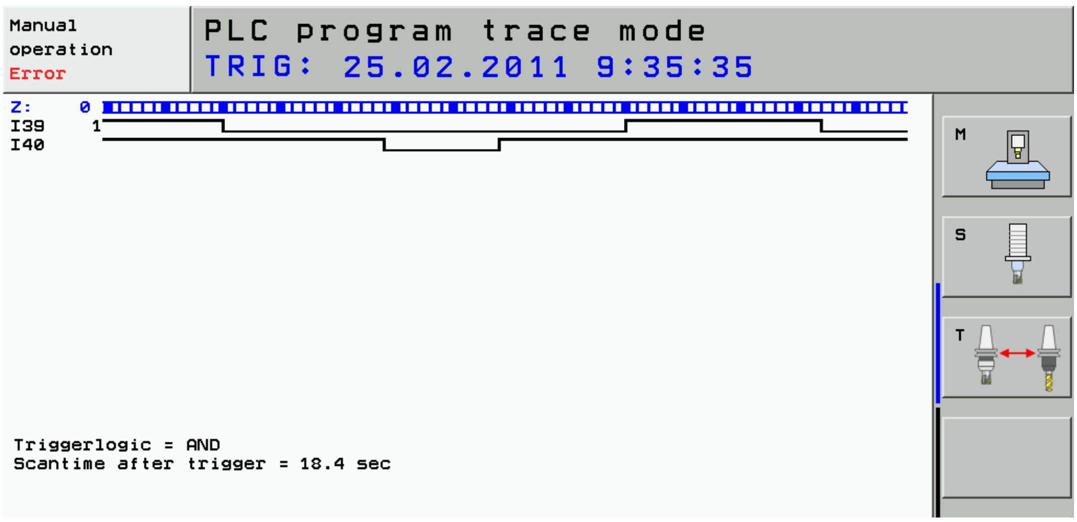


Figure: Recording of NC START and NC STOP keys in the logic diagram

24.6 Checking the outputs

The MB 620 features 8 PLC outputs which serve, for example, to control the lamps of the buttons. These outputs are on the terminal strip X7.

X7: Connecting terminals	Assignment
1	O0 (illumination for the NC Start key)[a]
2	O1 (illumination for the NC Stop key)[a]
3	O2 (illumination for the Control voltage ON key)[a]
4	O3
5	O4
6	O5
7	O6
8	O7
9	+24 V NC
10	0 V

a. With standard wiring

The function of the PLC outputs can be checked with the **HSCI bus diagnosis**:

DANGER

Be sure to ascertain which function of the output to be inspected has on the machine.

- Switch on the machine.
- Call the HSCI bus diagnosis. –> See ”Bus diagnosis” on page 12 – 147.
- Open the path `MB 620 / Digital Output` and place the cursor on the output to be inspected.
- Establish the conditions for setting the output concerned (keystroke, function call, etc.).
  Ask the machine operator.
- The output must change condition.

You can now find out, e.g., whether a lamp is defective or is not controlled correctly.

Note

You can measure the voltage of the outputs at terminal X7 of the MB 620.
The logical state in the HSCI bus diagnosis must be in agreement with the voltage level of the respective outputs.

24.7 Corrective action

Pushbuttons

If a key no longer makes contact:

Defective pushbuttons are not replaced individually!
Reason: If individual pushbuttons make bad contact or fail, other keys will also reach the end of their service life soon.

Therefore, only complete boards including the pushbuttons are replaced.

If a key permanently makes contact:

If required, remove chips and clean the keyboard.

- Shut down the control and switch off the machine.

> Attention
>
> Observe the ESD precautions. --> See "Important information" on page 29 – 515.

- Remove the machine operating panel from the console. (Take care that all connected cables are labeled before you disconnect any.)
- Dismount the board, frames, rubber mats.
- Clean the components with a standard cleaning agent and a piece of cloth.
- Dry (or let dry) the components.

> DANGER
>
> When liquid cleaning agents were used, the electrical devices must dry completely before they may be operated again.

- Reassemble the equipment.

> Note
>
> Put the rubber mats back into the frame as they were before.

Other MB components

Replace defective components, such as the HSCI bus cable, the buttons NC START and NC STOP, the CONTROL ON key, the EMERGENCY STOP button, lamps, etc. with original components!

> DANGER
>
> **Check the function of the EMERGENCY STOP button on the (customized) machine operating panel, if you have replaced the button (and in regular intervals afterwards).**

Control components

If you have found that the HSCI interface of the MB 620 or the MC 62xx or of another control component is defective, replace the control component. --> See "Exchange of HEIDENHAIN components" on page 29 – 515.

25 Handwheel

25.1 Introduction

Figure: HR 520

Portable handwheels and panel-mounted handwheels

An iTNC 530 HSCI can be equipped with the following handwheels:

- HR 520 portable handwheel with display and potentiometers
- HR 410 portable handwheel
- HR 130 panel-mounted handwheel

Cable adapter

Portable handwheels with EMERGENCY stop button are connected to the MB 620 machine operating panel or HSCI adapter PLB 6001 via a **cable adapter**. The circuits for EMERGENCY STOP and for the permissive keys are located in the cable adapter ID 296466-xx.

Pin layouts and wiring (e.g., EMERGENCY STOP key and permissive button on cable adapter)
–> See "Handwheels" on page 28 – 509.

EMERGENCY STOP button

DANGER

HEIDENHAIN recommends checking the function of the EMERGENCY STOP button on the portable handwheel in regular intervals!

Handwheel signals

Supply and evaluation of handwheels is effected **via the MB 620** or the HSCI adapter PLB 6001. The information is transferred to the control via the HSCI bus.

Note

Like the EMERGENCY STOP button of the MB 620 (without FS), the EMERGENCY STOP button of the handwheel (without FS) must be wired externally in the EMERGENCY STOP chain.

Threshold sensitivity

Shock or vibrations can cause a slight motion at the handwheel and produce an unintentional axis movement. The **"threshold sensitivity“** of the handwheel encoder is entered in MP7660.

Note

Refer to the iTNC 530 HSCI User’s Manual for a detailed description on operating the electronic handwheels.

Signal paths

Overview --> See ”Signal paths in the console and to the MC 62xx” on page 23 – 367

25.2 Error messages

The following error messages may be displayed, if there are problems related to handwheels:

- Handwheel?
- Handwheel not ready x
- CC: Handwheel permissive button depressed
- MC: Handwheel permissive depressed

25.3 Possible error causes

- Handwheel not attached
- Connected handwheel does not match the entry in MP7640
- The portable handwheel was dropped down and damaged.
- Heavy contamination --> Key functions are impaired.
- Jammed chips --> Key gets stuck.

Note

If there is an active NC STOP signal (e.g., key is stuck) from the handwheel, the machine cannot be traversed any more.

- Pressure contact defective --> Key no longer reports actuation.

Note

Defective keys either do not contact any more or are in permanent contact.

- EMERGENCY STOP button defective
- Potentiometers defective
- Board defective
- Contaminated or defective handwheel encoder (optical signal evaluation impaired)
- Liquid has penetrated
- Interruption in handwheel cable or connector
- Defective contact in the cable adapter --> Permanent EMERGENCY STOP or permissive keys nonfunctional
- Shock or vibrations --> Unintended traverse movements
- Handwheel interface on MB 620 or on HSCI adapter PLB 6001 defective
- Problems with the +12 V power supply
- Short circuit in cable or handwheel

Note

The MB 620 and the HSCI adapter PLB 6001 feature "polyfuses“.
Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., handwheel) from the low voltages of the MB 620 or the HSCI adapter PLB 6001.
Polyfuses have a self-resetting function ("self-healing effect").

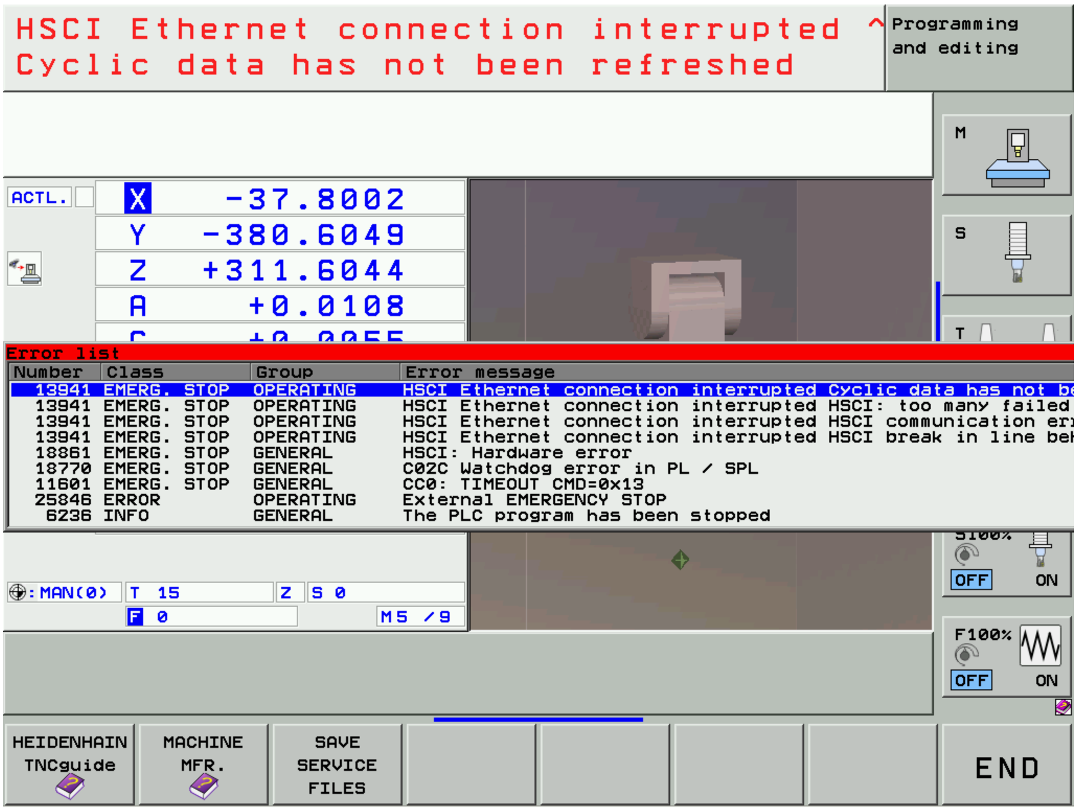


Figure: Error messages that may be displayed if a short circuit occurs in the handwheel during operation

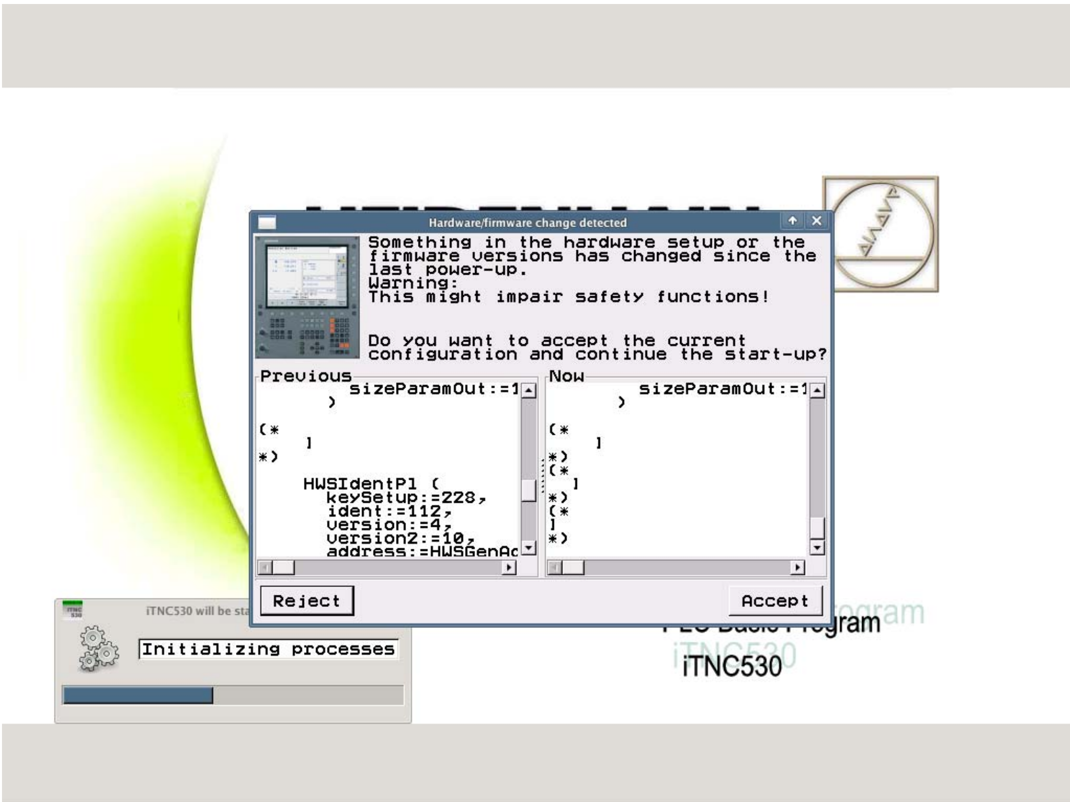


Figure: Error message displayed if a short circuit occurs in the handwheel during start-up of the control

25.4 Error diagnosis of HR 520 portable handwheel with display

Control impaired?

If you suspect that a damaged handwheel or a handwheel into which liquid has penetrated impairs the function of the control:

- Disconnect the handwheel and observe the reaction. --> See "Deselecting and disconnecting the portable handwheel" on page 25 – 412.

Visual inspection

- Visually inspect the HR, EMERGENCY STOP button, keys, potentiometers, cable, contacts, etc.

Examine the device for damage. Are keys heavily contaminated? Are there any jammed chips? Have liquids entered, etc.?

Functional check

- Switch on the machine.
- Select the **`Elec. Handwheel`** operating mode.
- Set the position display of the control to **`NOML`**.
- Observe whether this display changes, while you turn the handwheel.
- Check, whether the EMERGENCY STOP button and all other keys function properly.

> Note
>
> If available, connect an identical handwheel and test its function.

Power supply OK?

The HR 520 is powered by the MB 620 or the HSCI adapter PLB 6001 with +12 V at connector X23.

Connector X23 on MB 620 or HSCI adapter PLB 6001	Assignment
Pin 2	0 V
Pin 4	+12 V

If you have a test adapter, you can use it to check whether the power supply is OK:

- Shut down the control and switch off the machine.
- Unfasten the mounting screws of the machine operating panel.
- Lift out the machine operating panel until you can disconnect the connector X23.
- Connect the test adapter between the handwheel and the connector X23 of the machine operating panel. (See "Test adapter" on page 30 – 560.)
- Switch on the machine.
- Measure, whether there are +12 V between pin 2 (0 V) and pin 4 (+12 V).

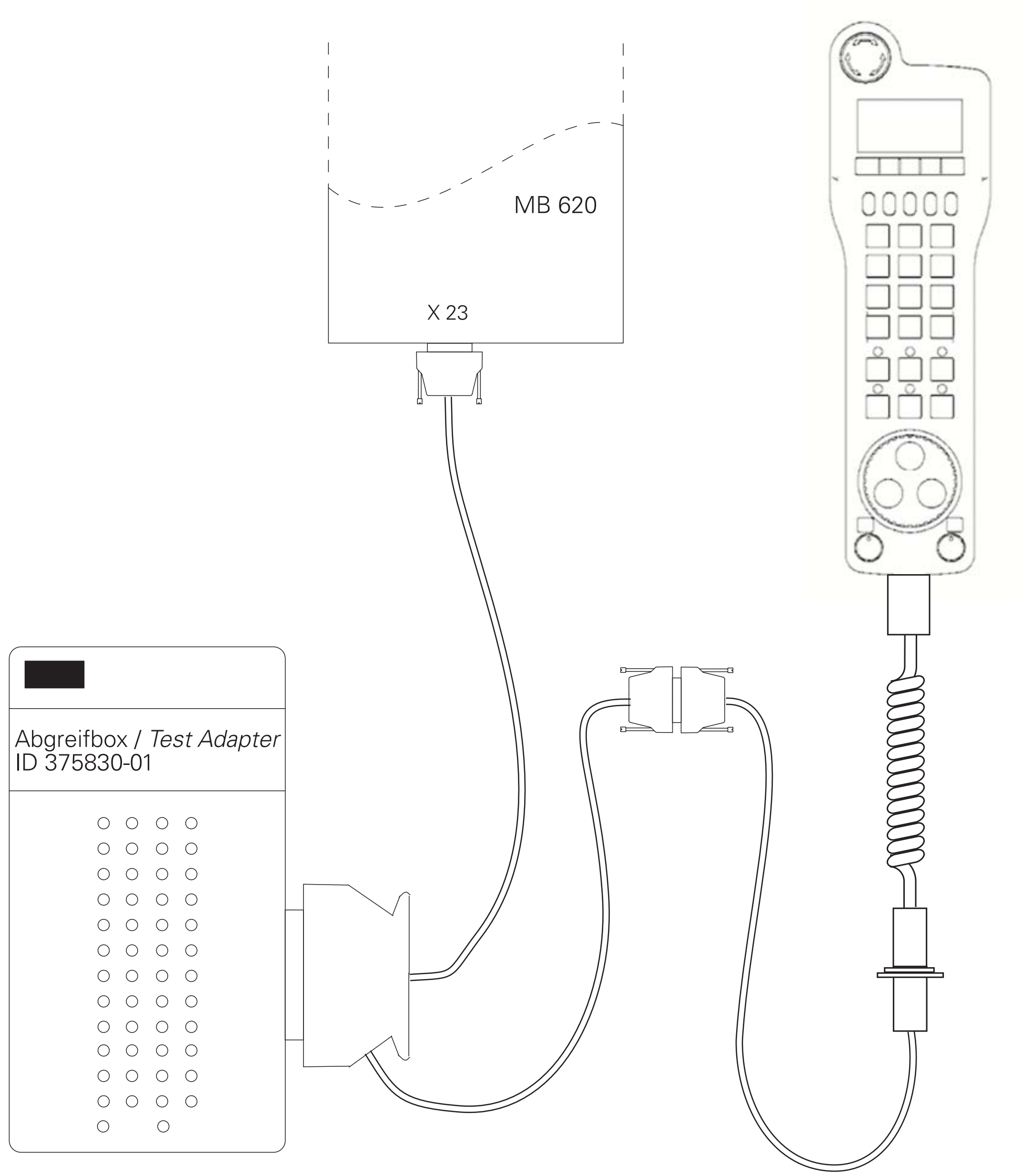


Figure: Test adapter between MB 620 and HR 520

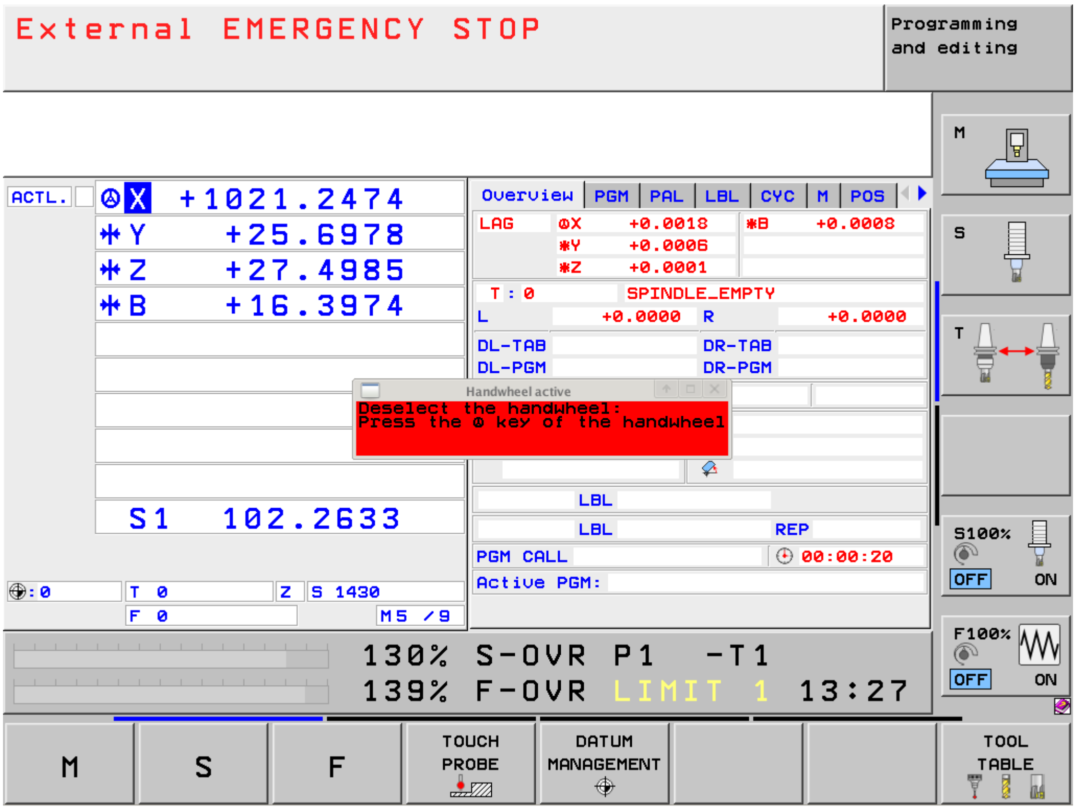
Note

The MB 620 and the HSCI adapter PLB 6001 feature "polyfuses“.
Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., handwheel) from the low voltages of the MB 620 or the HSCI adapter PLB 6001.
Polyfuses have a self-resetting function ("self-healing effect").

Checking the keys

The function of most handwheel keys can be seen from the respective **PLC markers**. Use the PLC diagnostic functions **TABLE** or **LOGIC DIAGRAM** for this purpose:

- Switch on the machine.
- Press the EMERGENCY STOP button.
- Activate the HR 520 (press the handwheel symbol on the HR 520).
  --> The window **Handwheel active** appears on the screen.



- Call the table with the PLC markers or the logic diagram.
  --> See "Diagnosis tools in the PLC mode" on page 11 – 119.
- Press the handwheel keys.
- Check whether the corresponding markers are set (see table).

F1	F2	F3	F4	F5
	X	Y	Z	
	IV	V	VI	
	↑	Handwheel active (M4660)	↓	
	– (M4667)	Rapid traverse (M4663)	+ (M4666)	
	Spindle start (M4664)	Actual position capture	NC start (M4661)	
	Spindle stop (M4665)	CTRL (M4668)	NC stop (M4662)	

All keys are evaluated by the NC. Certain keys are mapped to markers.

Keys that are not mapped to markers can be checked easily by verifying whether a function is called by pressing the corresponding key or whether there is a reaction on the screen.

Checking the potentiometers

The potentiometer setting is shown in the following PLC words:

- W492 (= S override)
- W494 (= F override)

- Switch on the machine.
- Press the EMERGENCY STOP button.
- Activate the HR 520 (press the handwheel symbol on the HR 520).
  –> The window `Handwheel active` appears on the screen.
- Activate the handwheel potentiometers (see next page).
- Call the PLC table for the words. –> See "The TABLE function" on page 11 – 119.
- Place the cursor on W492 or W494.
- Select decimal display (soft key HEX<->DECIMAL).
- Turn the potentiometer to be examined.
- Check whether the display **changes from 0 to 10000 (with nonlinear characteristic curve)** or from **0 to 100 (with linear characteristic curve)**.
  The characteristic curve is defined in MP7620, bit 3.

Note

These PLC words can also be shown in the integrated oscilloscope.
--> See "Checking the potentiometers" on page 23 – 376.

Activating the potentiometers on HR 520:

After selection of the handwheel mode, the potentiometers of the keyboard are still active. To test the handwheel potentiometers, you have to activate them:

- Pick up the handwheel.
- Press and hold the CTRL key, then actuate the HANDWHEEL key.
  --> The menu **`Select override:`** appears in the handwheel display.
- Press the HW soft key to activate the handwheel potentiometers.
  --> The information **`Handwheel override active`** appears on the control screen.

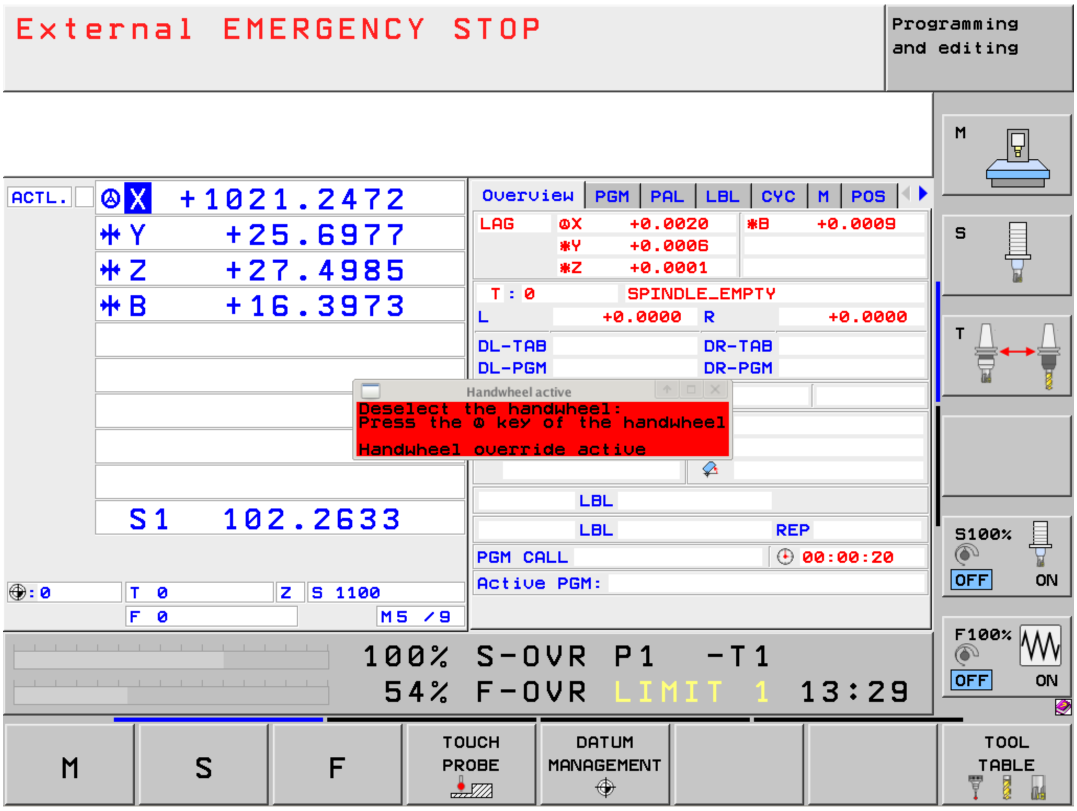


Figure: Active potentiometers on HR 520

Deactivating the potentiometers on HR 520:

If you want to deactivate the HR 520 handwheel after the tests described, first reactivate the potentiometers of the keyboard.
Proceed as follows:

- Pick up the handwheel.
- Press and hold the CTRL key, then actuate the HANDWHEEL key.
  --> The menu **`Select override:`** appears in the handwheel display.
- Press the KBD (keyboard) soft key to activate the potentiometers of the keyboard.
- Press the HANDWHEEL key.
  --> The window **`Handwheel active`** on the control screen is closed, the handwheel is deselected.

25.5 Error diagnosis of HR 410 portable handwheel

Control impaired?

If you suspect that a damaged handwheel or a handwheel into which liquid has penetrated impairs the function of the control:

- Disconnect the handwheel and observe the reaction.
--> See "Deselecting and disconnecting the portable handwheel" on page 25 – 412.

Visual inspection

- Visually inspect the HR, EMERGENCY STOP button, keys, cable, contacts, etc.

Examine the device for damage. Are keys heavily contaminated? Are there any jammed chips? Have liquids entered, etc.?

Functional check

- Switch on the machine.
- Select the **`Elec. Handwheel`** operating mode.
- Set the position display of the control to **`NOML`**.
- Observe whether this display changes, while you turn the handwheel.
- Check, whether the EMERGENCY STOP button and all other keys function properly.

> Note
>
> If available, connect an identical handwheel and test its function.

Power supply OK?

The HR 410 is powered by the MB 620 or the HSCI adapter PLB 6001 with +12 V at connector X23.

Connector X23 on MB 620 or HSCI adapter PLB 6001	Assignment
Pin 2	0 V
Pin 4	+ 12 V

If you have a test adapter, you can use it to check whether the power supply is OK:

- Shut down the control and switch off the machine.
- Unfasten the mounting screws of the machine operating panel.
- Lift out the machine operating panel until you can disconnect the connector X23.
- Connect the test adapter between the handwheel and the connector X23 of the machine operating panel. (See "Test adapter" on page 30 – 560.)
- Switch on the machine.
- Measure, whether there are +12 V between pin 2 (0 V) and pin 4 (+12 V).

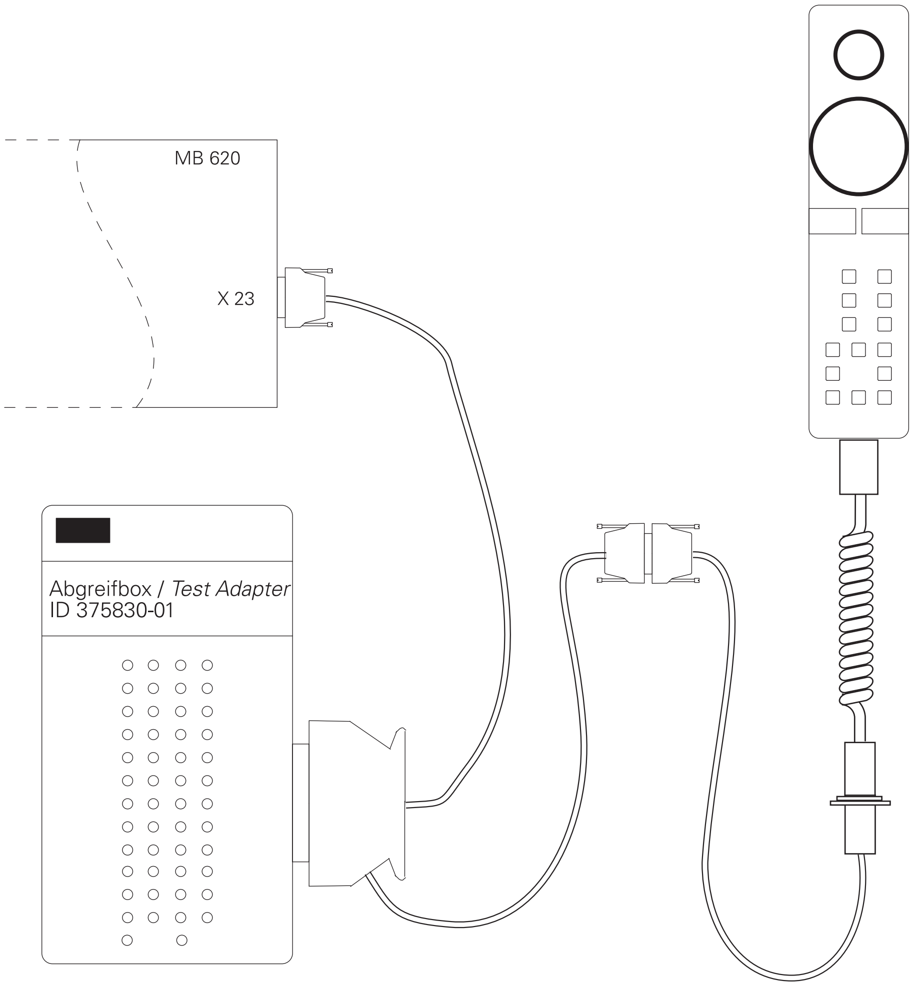


Figure: Test adapter between MB 620 and HR 410

Note

The MB 620 and the HSCI adapter PLB 6001 feature "polyfuses".
Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., handwheel) from the low voltages of the MB 620 or the HSCI adapter PLB 6001.
Polyfuses have a self-resetting function ("self-healing effect").

Checking the keys

The function of the handwheel keys can be seen from the respective **PLC inputs**. Use the PLC diagnostic functions **TABLE** or **LOGIC DIAGRAM** for this purpose:

- Switch on the machine.
- Press the EMERGENCY STOP button.
- Call the table with the PLC inputs or the logic diagram.
  --> See "Diagnosis tools in the PLC mode" on page 11 – 119.
- Press the handwheel keys.
- Check whether the corresponding inputs change to 1 (see table below).

MP7645 determines whether the handwheel keys are evaluated by the NC or the PLC.

Note

Ask the machine manufacturer whether you may change the MP7645.0 for test purposes. The PLC program may not permit this.

MP7645.0: 0 Evaluation of the keys by the NC (Exception: The function keys A, B and C are evaluated by the PLC.)				MP7645.0: 1 Evaluation of all keys by the PLC		
X		IV		O96 I160		O97 I161
Y		V		O98 I162		O99 I163
Z		Actual position capture		O100 I164		O103 I167
Slow feed rate	Medium feed rate	Fast feed rate		O104 I168	O105 I169	O106 I170
–		+		I171		I172
O109 I173	O110 I174	O111 I175		O109 I173	O110 I174	O111 I175

25.6 Deselecting and disconnecting the portable handwheel

You have found that a portable handwheel is defective and must be exchanged or repaired.

The customer can deselect the handwheel to be able to continue work without it.

- Shut down the control and switch off the machine.
- Unscrew the handwheel from the handwheel adapter at the console.
- Screw the dummy plug onto the handwheel adapter.

Note

The EMERGENCY STOP button on the handwheel is serially connected into the EMERGENCY STOP chain.
The dummy plug bridges the missing handwheel in the EMERGENCY STOP chain.

- Switch on the machine.
- Do not acknowledge the `Power interrupted` message, but call the machine parameter list.
- Enter the value 0 (no handwheel) in the machine parameter MP7640.
- Exit the machine parameter list.
- Switch on the machine and test the function.

Dummy plug

The dummy plug for the handwheel adapter can be purchased from the machine manufacturer or from HEIDENHAIN (ID 271958-03).

.

DANGER

When you connect a new or repaired handwheel to the machine:
You must absolutely check, whether the EMERGENCY STOP button on the handwheel functions properly!

25.7 Error diagnosis of HR 130 panel-mounted handwheel

Control impaired?

If you suspect that a damaged handwheel or a handwheel into which liquid has penetrated impairs the function of the control:

- Disconnect the handwheel and observe the reaction.

Visual inspection

- Start with a visual inspection!

Is there any damage, have liquids penetrated, etc.?

Functional check

- Switch on the machine.
- Select the **Elec. Handwheel** operating mode.
- Set the position display of the control to **NOML**.
- Observe whether this display changes, while you turn the handwheel.

Power supply OK?

The HR 130 panel-mounted handwheel is powered by the MB 620 or the HSCI adapter PLB 6001 with +12 V at connector X23.

Connector X23 on MB 620 or HSCI adapter PLB 6001	Assignment
Pin 2	0 V
Pin 4	+ 12 V

If you have a test adapter, you can use it to check whether the power supply is OK:

- Shut down the control and switch off the machine.
- Unfasten the mounting screws of the machine operating panel.
- Lift out the machine operating panel until you can disconnect the connector X23.
- Connect the test adapter between the handwheel and the connector X23 of the machine operating panel. (See "Test adapter" on page 30 – 560.)
- Switch on the machine.
- Measure, whether there are +12 V between pin 2 (0 V) and pin 4 (+12 V).

Note

The MB 620 and the HSCI adapter PLB 6001 feature "polyfuses".
Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., handwheel) from the low voltages of the MB 620 or the HSCI adapter PLB 6001.
Polyfuses have a self-resetting function ("self-healing effect").

25.8 Corrective action

Keys

If a key no longer makes contact:

Return the handwheel for repair!

> Note
>
> Individual keys, boards and other handwheel components are not exchanged in the field.

If a key permanently makes contact:

If required, remove chips and clean the keyboard.

- Shut down the control and switch off the machine.
- Screw off the handwheel.
- Clean it with a standard cleaning agent and a piece of cloth.
- Dry the handwheel.

> DANGER
>
> When liquid cleaning agents were used, the electrical devices must dry completely before they may be operated again.

Potentiometers

Replace the complete HR 520.

Cables and handwheel adapters

Replace defective parts only by original HEIDENHAIN components.

Control components

If you have found that the handwheel interface on the MB 620 or the HSCI adapter PLB 6001 is defective (connector X23), replace the component.
--> See "Exchange of HEIDENHAIN components" on page 29 – 515.

26 Touch probes

26.1 Introduction

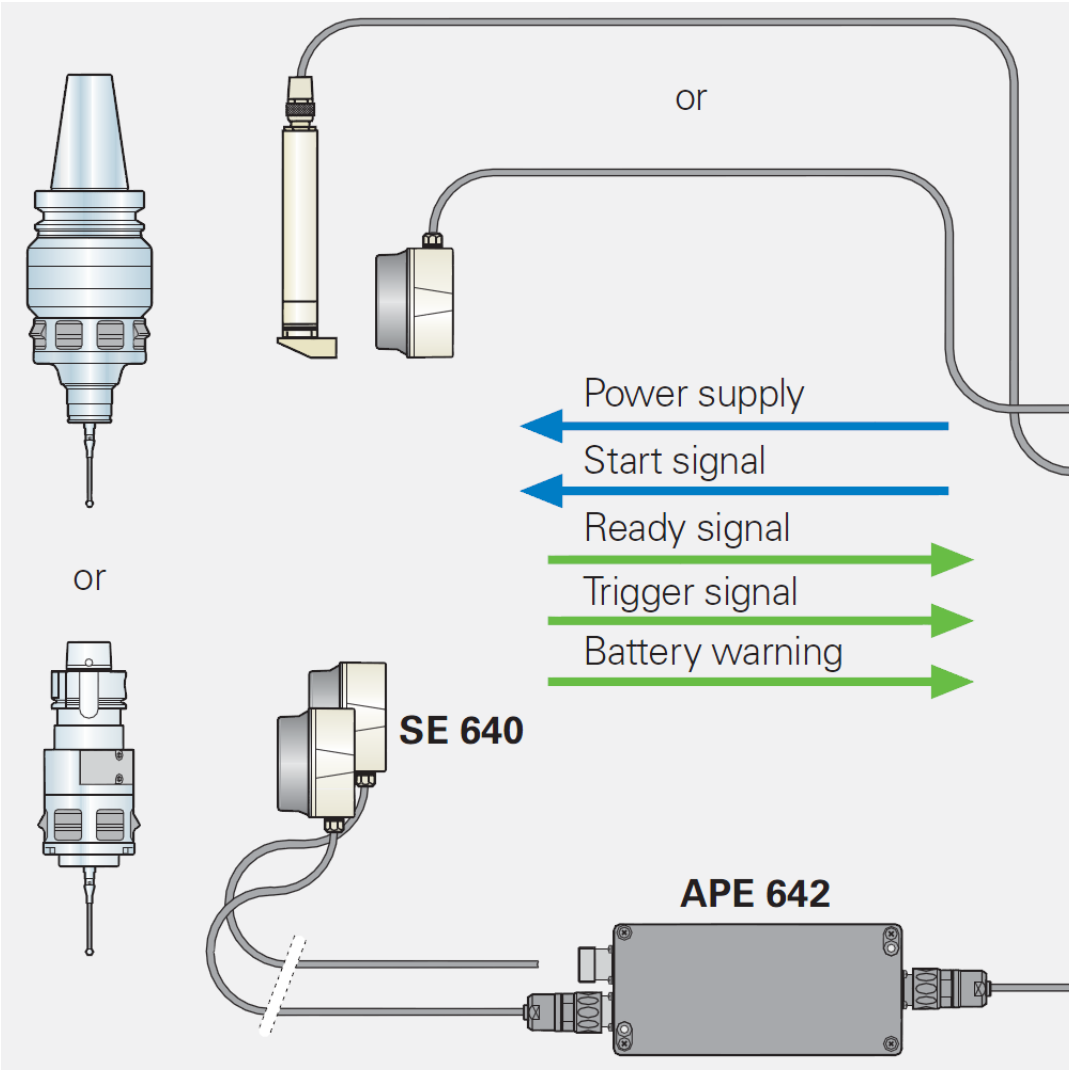
Figure: TS 740

An iTNC 530 HSCI can be equipped with different touch probes (see following pages).

TS touch probes

TS with infrared transmission of the trigger signal (e.g. TS 440, TS 444, TS 640, TS 740)

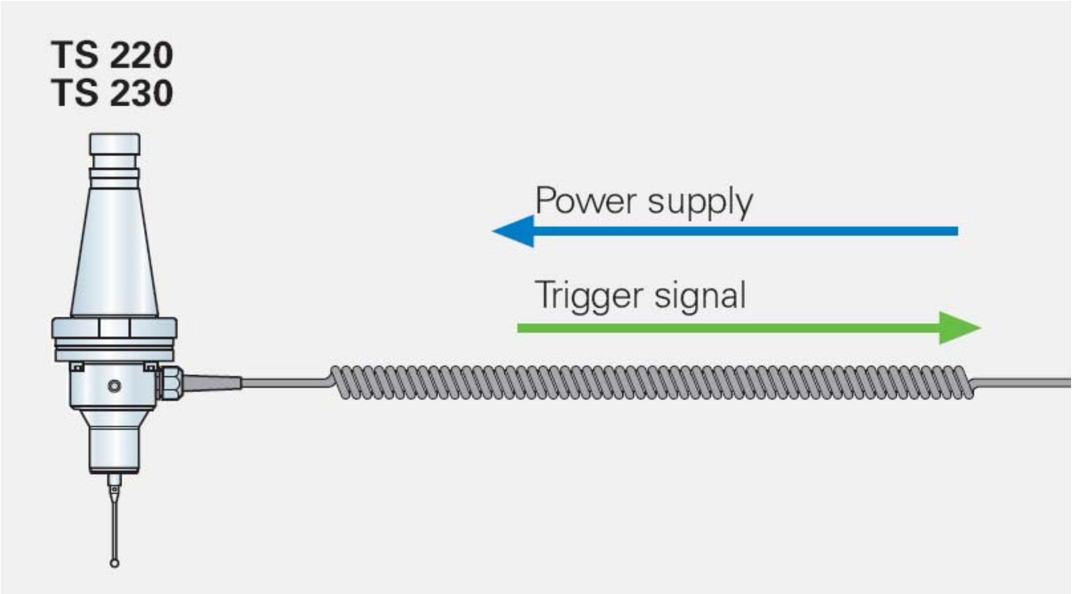
- These touch probes are designed for use on machines with automatic tool changer.
- They serve to align workpieces, set datums and calibrate workpieces.
- The infrared transmission is established between the TS touch probe and the SE transmitter/ receiver unit.
- The infrared transmission is tolerant to noise and even works by reflection.
- The probe is operated with non-rechargeable or rechargeable batteries (except TS 444).
- The TS 640 is equipped with an integrated cleaning blower.
- The TS 444 features an integrated air turbine generator and therefore is battery-free.



Various styli can be inserted into the touch probes. The styli feature a rated break point.

TS with signal transmission via cable (e.g. TS 220)

- The machine operator inserts the touch probes into the spindle by hand.
- They serve to align workpieces, set datums and calibrate workpieces.
- Power supply and signal transmission via the cable.

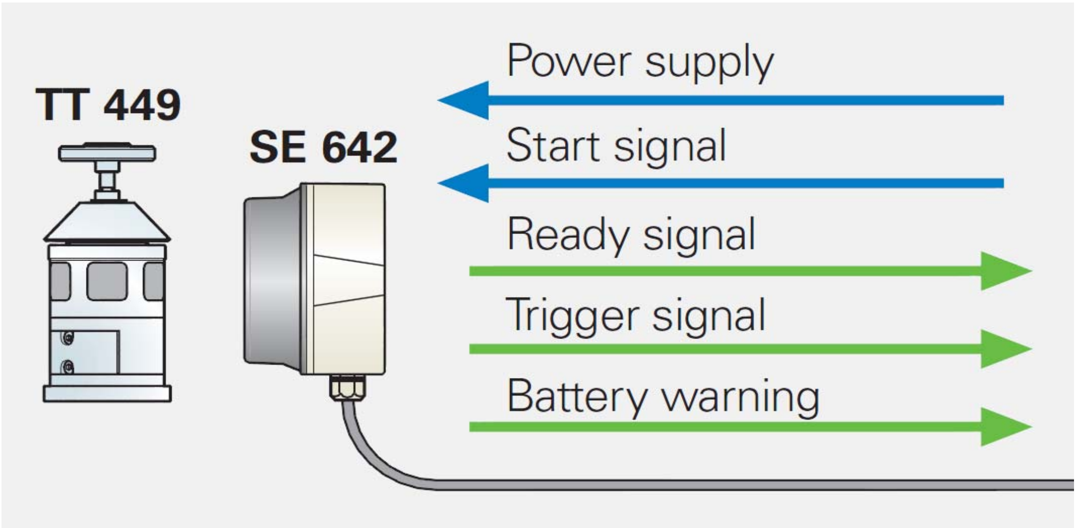


Various styli can be inserted into the touch probes. The styli feature a rated break point.

TT tool touch probe

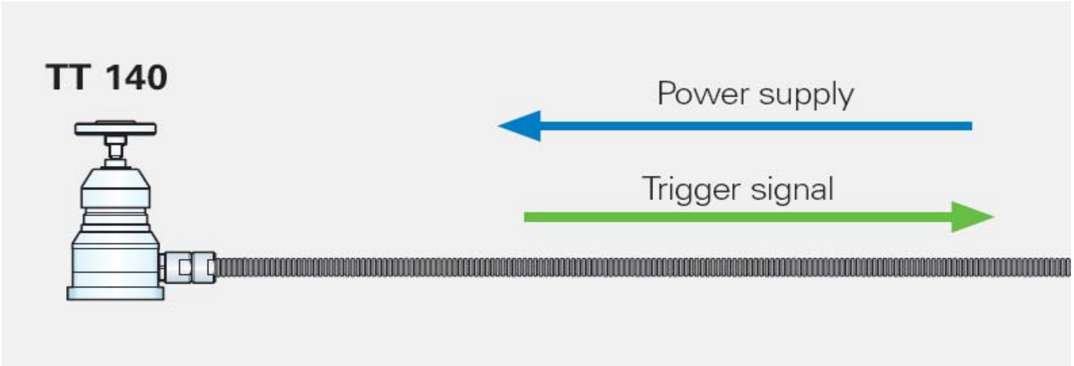
TT with infrared transmission of the trigger signal (e.g. TT 449)

- This touch probe is used to measure tools (length, radius, individual teeth).
- Tools can be examined for breakage.
- Tool wear can be determined.
- The infrared transmission is established between the TT tool touch probe and the SE transmitter/ receiver unit.
- The infrared transmission is tolerant to noise and even works by reflection.
- The probe is normally battery-operated.



TT with signal transmission via cable (e.g. TT 140)

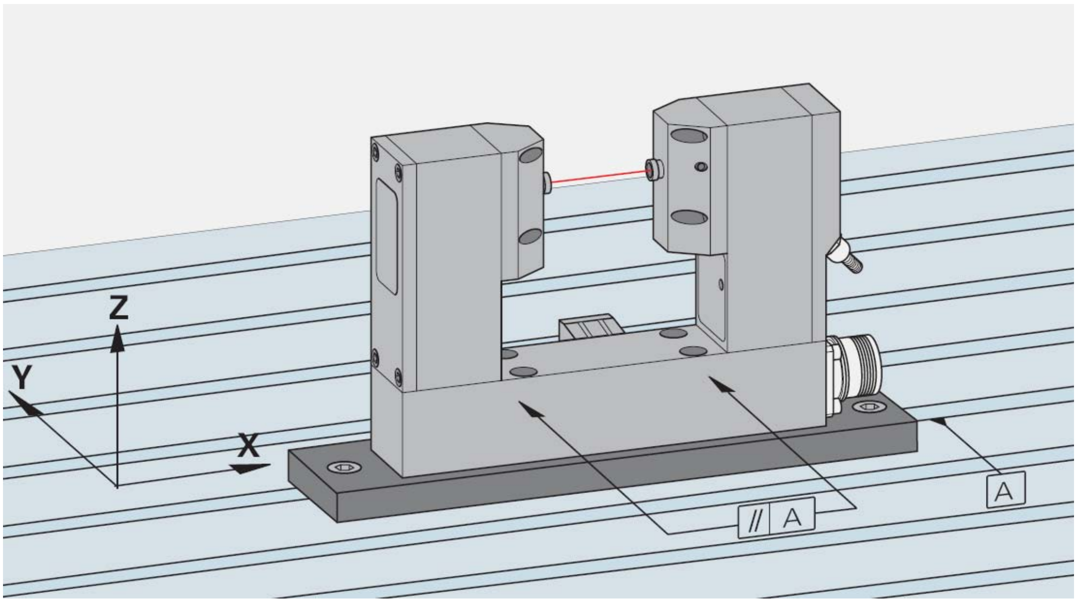
- This touch probe is used to measure tools (length, radius, individual teeth).
- Tools can be examined for breakage.
- Tool wear can be determined.



TL laser touch probe

Laser probe system (e.g., TL Micro 150) for tool measurement

- This laser system is used to measure tools (e.g., length, radius, individual teeth).
- Tools can be examined for breakage.
- Tool wear can be determined.



DANGER

Laser radiation! Do not stare into beam! Laser class 2.

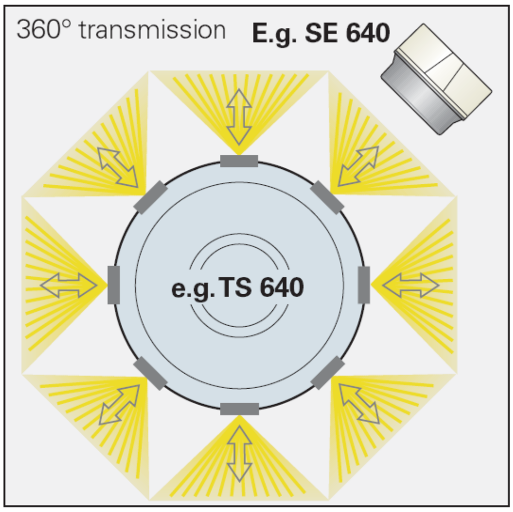
Infrared transmission

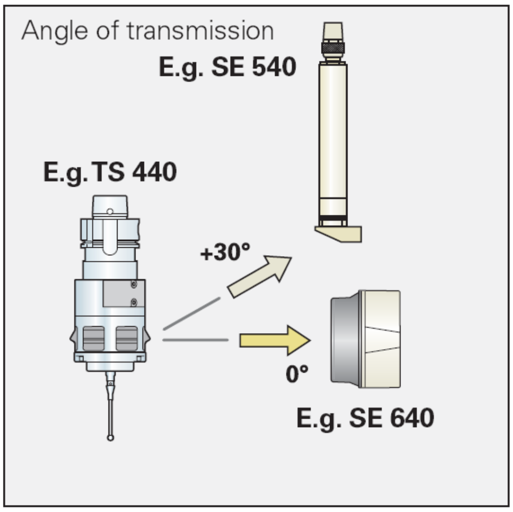
360° range:

The LEDs and receiver modules for infrared transmission are evenly distributed on the circumference of the touch probe. This ensures a 360° transmission range for reliable reception without previous spindle orientation.

Beam angle:

To adapt the touch probes to varying machine designs, the touch probes are available with horizontal transmission elevations of 0° or +30°.





Touch probe cycles

By means of touch probe cycles ...

- Datums can be set in manual and automatic mode.
- Workpiece misalignment can be compensated manually and automatically.
- Workpieces can be measured automatically.
- Tools can be measured automatically.
- Touch probe systems can be calibrated.

Touch probe signals

Touch probes are powered and evaluated via the **PLB 62xx system module** or the **UEC 11x controller unit**.
The information is transferred to the control via the HSCI bus.

Further information

You will find further information on touch probes in the…

- iTNC 530 HSCI User's Manual
- corresponding mounting instructions
- brochure 3-D Touch Probes for Machine Tools

These documents can be downloaded from the HEIDENHAIN website (www.heidenhain.de).

26.2 Error messages

The following error messages may be displayed, if there are problems related to touch probes:

- 8086 Probing already active
- 8AB0 Illegal probing %.2s
- C390 Error in 3-D touch probe %.2s
- No measured value saved %.2s
- Stylus already in contact
- Exchange touch probe battery.
- Touch probe not ready
- TS: Inadequate consistency

26.3 Possible error causes

General

- Touch probe not ready
- Collision (stylus, probe or transmitter/receiver unit damaged)
- Humidity
- Short circuit in the cable, in the transmitter/receiver unit or in the touch probe
- Heavy contamination
- Shocks or vibrations
- Electromagnetic interference
- Touch probe cable or connector defective
- Touch probe defective
- Touch probe interface on PLB 62xx system module or UEC 11x controller unit defective

> Note
>
> The PLB 62xx and the UEC 11x feature "polyfuses."
> Polyfuses are electronic fuses that become highly resistive if an overload occurs and thus separate defective peripherals (e.g., touch probes) from the low voltages of the PLB 62xx or the UEC 11x.
> Polyfuses have a self-resetting function ("self-healing effect").

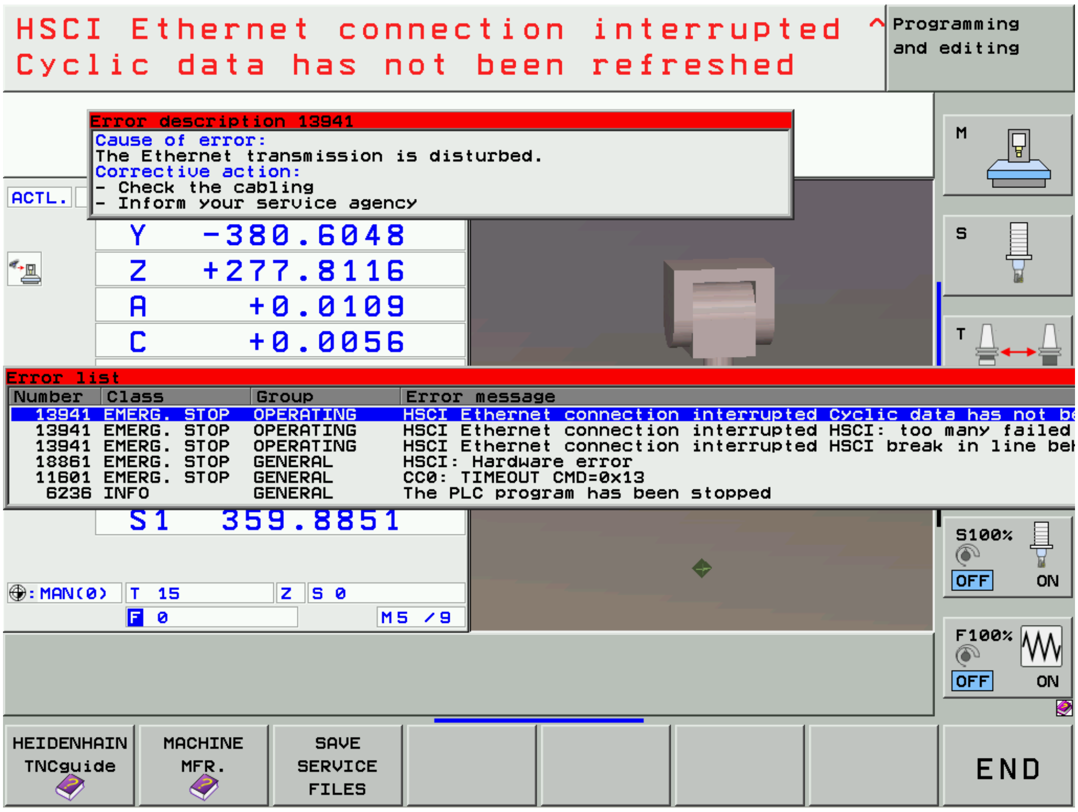


Figure: Error messages that may be displayed if a short circuit occurs in the touch probe during operation

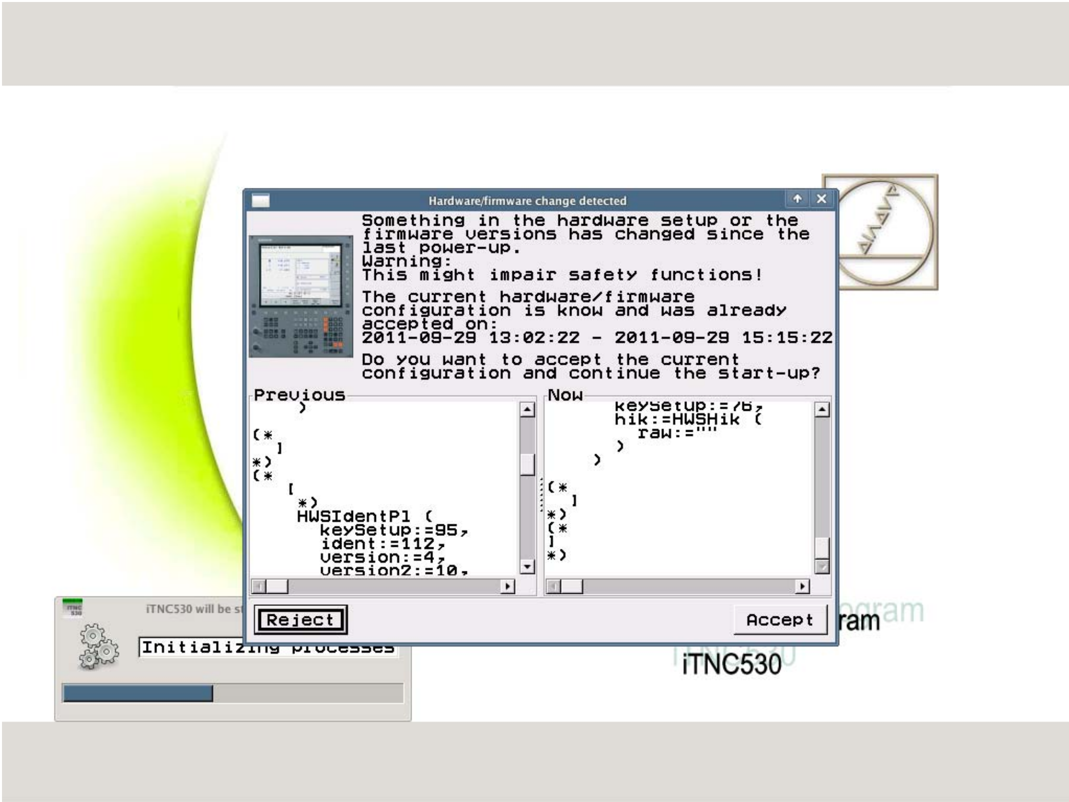


Figure: Error messages that may be displayed if a short circuit occurs in the touch probe during start-up of the control

Specifically for touch probes with infrared transmission:

- Battery flat (capacity below 10 %)
  --> In this case the message **`Exchange touch probe battery`** is output, when a probing operation is started.
- No infrared connection due to contamination of the probe and/or the transmitter/receiver unit
- Obstacle in the infrared connection or strong shading of transmitter or receiver
- Contact on infrared touch probe not closed or defective
- Several touch probes may be within the receiving range of one SE; the infrared signals cannot be allocated any more; faulty operation
- Cable to transceiver unit defective
- Interface to transmitter/receiver unit on PLB 62xx system module or UEC 11x compact controller defective

Specifically for touch probe with air turbine generator (TS 444)

- Compressed air supply for integrated turbine generator missing
- Air turbine generator or capacitors defective

Note

If the capacitors in the TS 444 cannot be sufficiently charged, the touch probe outputs a battery warning. This means that the error message **`Exchange touch probe battery`** is displayed at the control. With the TS 444, this is of course not required. Find the actual error cause!

Specifically for laser systems

- Damage to the housing
- Compressed air supply missing (required to open the shutters of the transmitter and receiver of the laser beam and for the blowing unit)

26.4 Error diagnosis on TS touch probes

Control impaired?

If you suspect that a damaged touch probe or a touch probe into which humidity has penetrated impairs the function of the control:

- Disconnect the touch probe and observe the reaction.
  --> See "Deselecting and disconnecting the touch probe" on page 26 – 433.

Visual inspection

- Visually inspect the stylus, touch probe, transmitter/receiver unit, cable, etc.

Is the stylus broken? Is the touch probe or the cable damaged?
Is the transmitter/receiver unit contaminated, etc.?

Checking the LEDs

Touch probe with infrared interface:

LED	Infrared transmission
Green	OK
Yellow	Acceptable
Red	Not acceptable

LED	Touch Probe
Green	Touch probe is ready Stylus is at rest
Yellow	Touch probe is ready Stylus is deflected
Red	Battery capacity < 10% Change the battery
Off	Touch probe is not ready

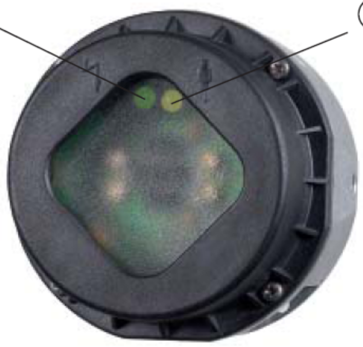


Figure: Optical status indicator of the transceiver units SE 440, SE 640 and EA 632 with two multicolored LEDs

LED	Touch probe
Green	Touch probe is ready Stylus is at rest
Yellow	Touch probe is ready Stylus is deflected
Red	*On continuously:* Battery capacity < 10% Change the battery *Blinking:* Touch probe is not ready

Figure: Optical status indicator of the SE 540 with one multicolored LED

Note

A detailed description of the **optical status indicator**, of the beam direction, of battery exchange, stylus exchange, centering, specifications, etc. can be found in the mounting instructions of the touch probe.

Touch probe with cable:

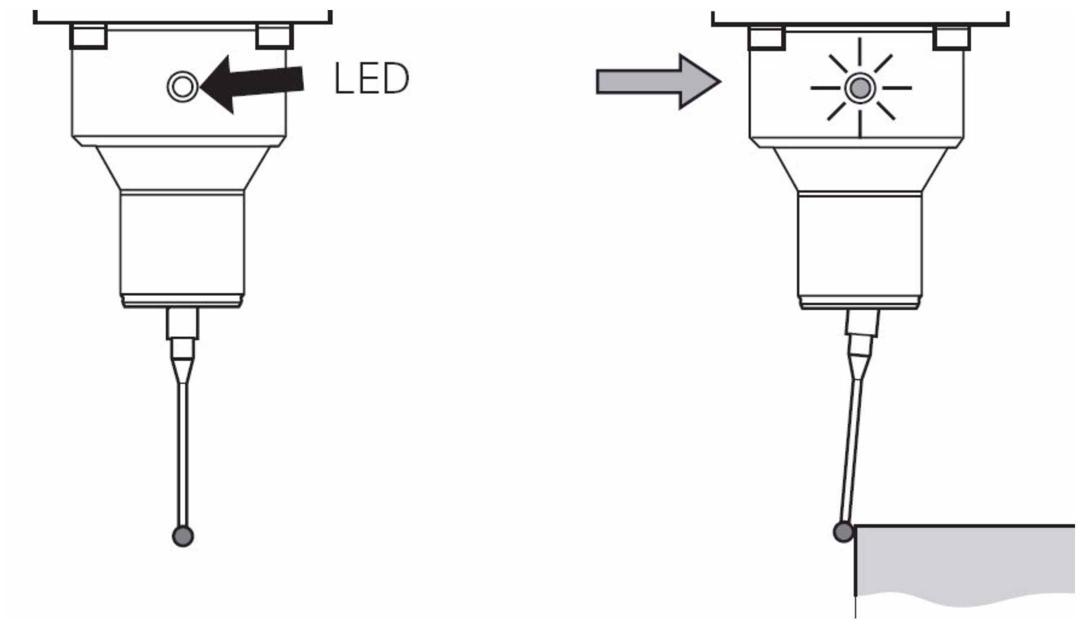


Figure: Two red LEDs (offset by 180°) on the TS 220 indicate that the stylus is deflected

Checking the Ready bridge

In **touch probes with cable** (not in those with infrared interface) the **Ready signal is bridged**. This means that the Ready signal must always be present if a touch probe with cable is connected.

Proceed as follows to check the Ready bridge:

- Shut down the control and switch off the machine.
- Disconnect the touch probe cable from the connector X112 of the UEC 11x controller unit or the PL 62xx system module.
- Use a multimeter which you set to "beep" mode or to ohm measurement.
- Apply the needle tips to the pins **3** and **10** of the **touch probe cable**. --> A beep must be heard or a low ohmic value displayed.

Assignment at the X112 interface (15-pin D-sub, triple-row)

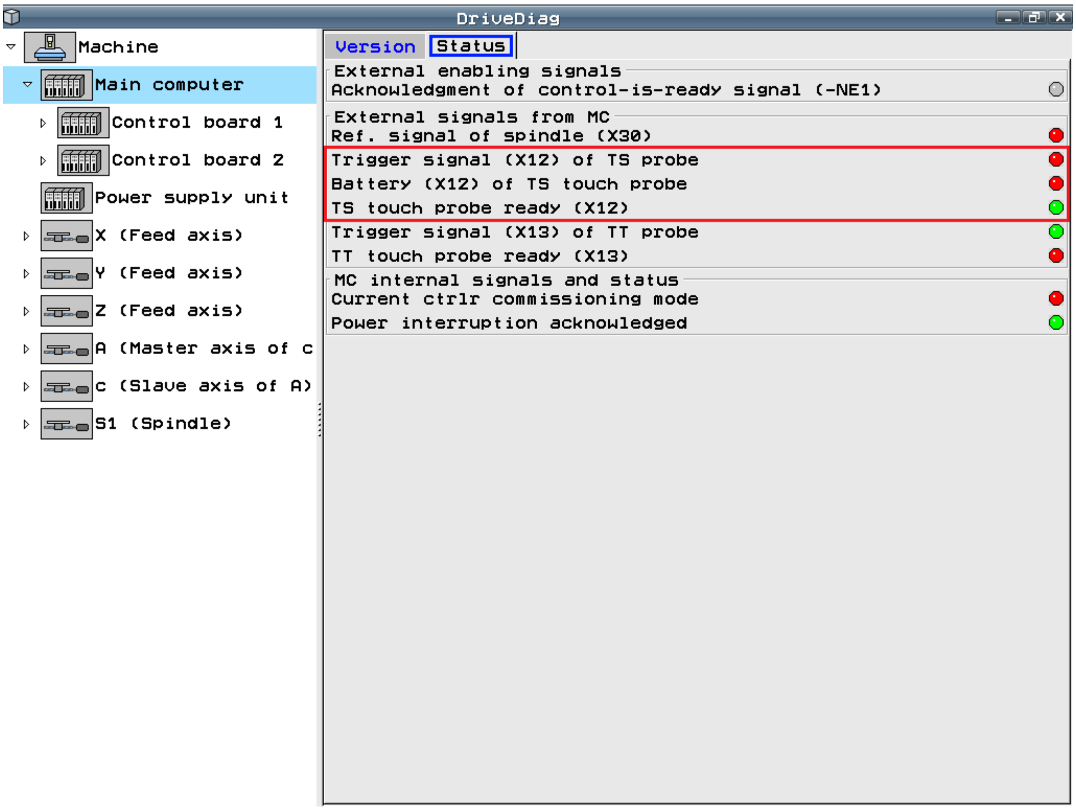
Female	Assignment of X112 (TS)
1	Trigger signal
2	Trigger signal
3	TS ready
4	Battery warning
5	+ 5 V-NC (+/- 5%)
6	TS start
7	Do not assign
8	0 V-NC
9	0 V-NC
10	+ 24 V-NC
11	Do not assign
12	Do not assign
13	Do not assign
14	Do not assign
15	Do not assign

Functional test by means of DriveDiag

DANGER

Ask the machine manufacturer and observe the machine manufacturers's safety precautions (set-up mode, etc.)!

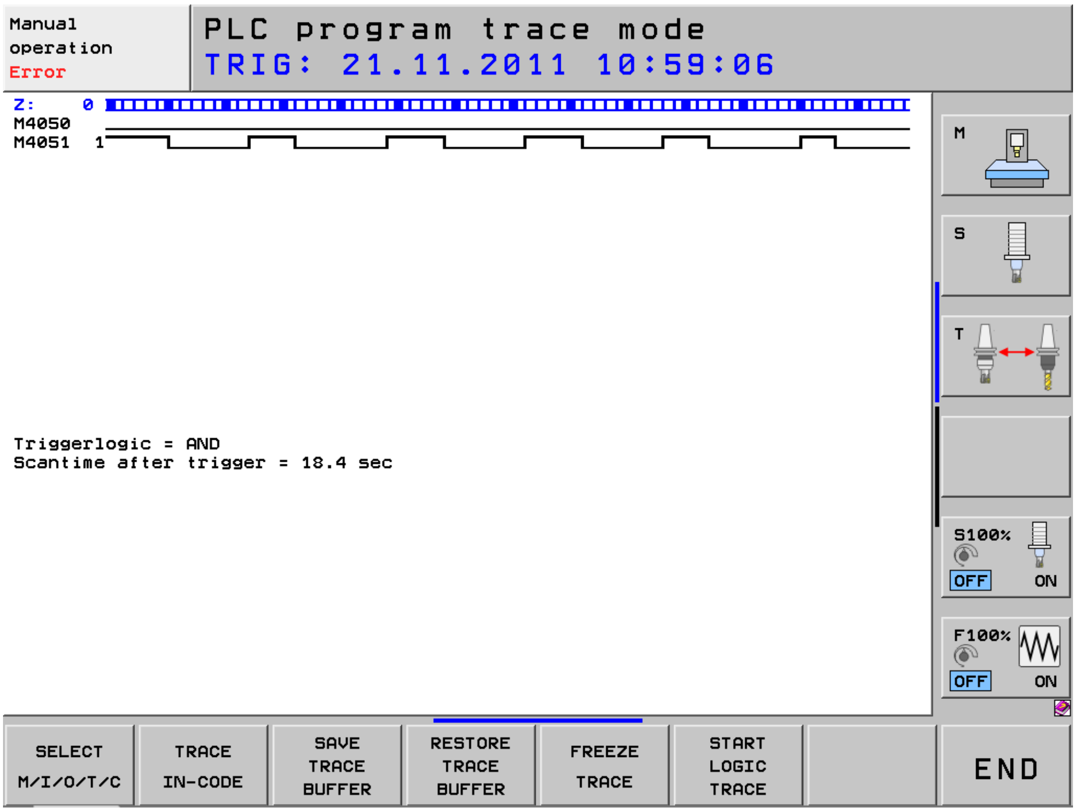
- Switch on the machine.
- Insert the touch probe.
- Press the EMERGENCY STOP button as a precaution.
- Call DriveDiag. --> See "DriveDiag" on page 9 – 91.
- Open the following page:



- Check the lamp at **`TS touch probe ready (X12)`**.
  When the touch probe is ready, the lamp shines green.
- Deflect the stylus by hand.
- Check the lamp at **`trigger signal of TS touch probe (X12)`**.
  When the stylus is deflected, the lamp shines green.
- You can also observe the lamp at **`TS touch probe battery (X12)`**.
  If the battery capacity is sufficient, this lamp shines green.
  With touch probe systems with cable, this lamp shines red.

Functional test by means of the logic diagram

- Switch on the machine.
- Insert the touch probe.
- Press the EMERGENCY STOP button as a precaution.
- Call the logic diagram. –> See "The LOGIC diagram" on page 11 – 124.
- Enter the operands M4050 and M4051 and set the trigger to M4051.
- Start recording.
- Check the marker 4050.
  If the probe is ready, this marker has the status zero.
- Deflect the stylus by hand.
- Check the marker 4051.
  If the stylus is deflected, this marker changes to one.



26.5 Error diagnosis on TT touch probes

Control impaired?

If you suspect that a damaged touch probe or a touch probe into which humidity has penetrated impairs the function of the control:

- Disconnect the touch probe and observe the reaction.
  --> See "Deselecting and disconnecting the touch probe" on page 26 – 433.

Visual inspection

- Visually inspect the touch probe and the cable.

Are the touch probe or the cable damaged?

Checking the LEDs

Two red LEDs (offset by 180°) on the **TT 140** indicate that the stylus is deflected:

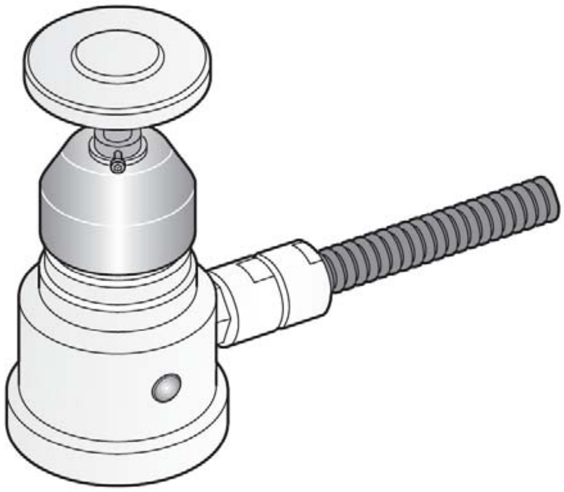


Figure: Optical status indicator on TT 140 with two red LEDs

Checking the Ready bridge

In the **TT** the **Ready signal is bridged**.
This means that the Ready signal must always be present when a tool touch probe is connected.

Proceed as follows to check the Ready bridge:

- Shut down the control and switch off the machine.
- Disconnect the touch probe cable (possibly together with the adapter ID 667674-01) from the connector X113 of the UEC 11x controller unit or the PL 62xx system module.
- Use a multimeter which you set to "beep" mode or to ohm measurement.
- Apply the needle tips to the following pins of the **touch probe cable**:

TT cable ID 633616-xx	Pins to be contacted
Without touch probe adapter ID 667674-01	**10** (+ 24 V NC) and **3** (TT is ready)
With touch probe adapter ID 667674-01	**10** (+ 24 V NC) and **3** (touch probe is ready)

Note

The touch probe adapter ID 667674-01 is required to connect a TT probe to a UEC 11x controller unit or a PLB 62xx system module up to and including variant 02.

- A beep must be heard or a low ohmic value displayed.

PLB 62xx or UEC 11x up to and including variant 02

Pin layout X113 with touch probe adapter ID 667 674-01:

(15-pin D-sub, triple-row)

Female	Assignment of X113 (TT) up to variant 02	Adapter ID 667 674-01	TT cable ID 633 616-xx
1	Trigger signal		Trigger signal
2	$\overline{\text{Trigger signal}}$		$\overline{\text{Trigger signal}}$
3	TS ready		Do not assign
4	$\overline{\text{Battery warning}}$		$\overline{\text{Battery warning}}$
5	+ 5 V-NC (+/- 5%)		+ 5 V-NC (+/- 5%)
6	Start		Do not assign
7	0 V-NC		TT start
8	0 V-NC		0 V-NC
9	0 V-NC		0 V-NC
10	+ 24 V-NC		+ 24 V-NC
11	TT ready		TT ready
12	Do not assign		Do not assign
13	Do not assign		Do not assign
14	Do not assign		Do not assign
15	Do not assign		Do not assign

Figure: TT cable with touch probe adapter

PLB 62xx or UEC 11x as of variant 03:

Pin layout of X113 (touch probe adapter no longer required):

(15-pin D-sub, triple-row)

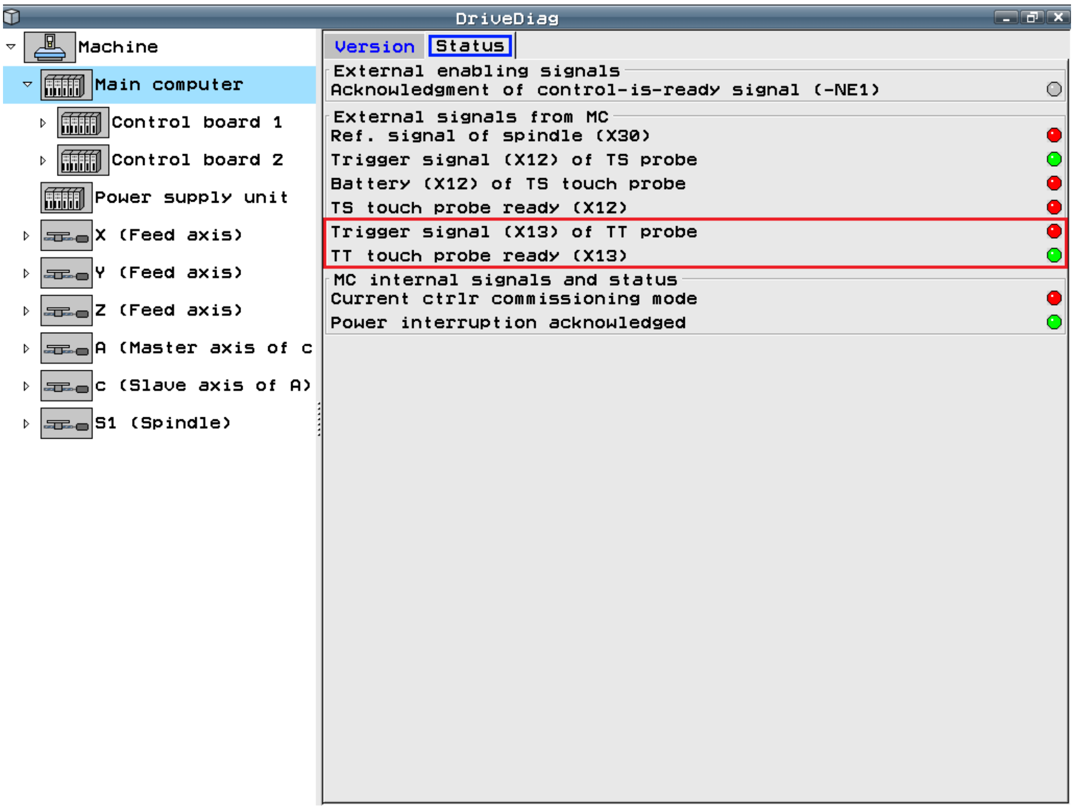
Female	Assignment X113 (TT) as of variant 03
1	Trigger signal
2	$\overline{\text{Trigger signal}}$
3	Do not assign
4	$\overline{\text{Battery warning}}$
5	+ 5 V-NC (+/- 5%)
6	Do not assign
7	TT start
8	0 V-NC
9	0 V-NC
10	+ 24 V-NC
11	TT ready
12	Do not assign
13	Do not assign
14	Do not assign
15	Do not assign

Functional test by means of DriveDiag

DANGER

Ask the machine manufacturer and observe the machine manufacturers's safety precautions (set-up mode, etc.)!

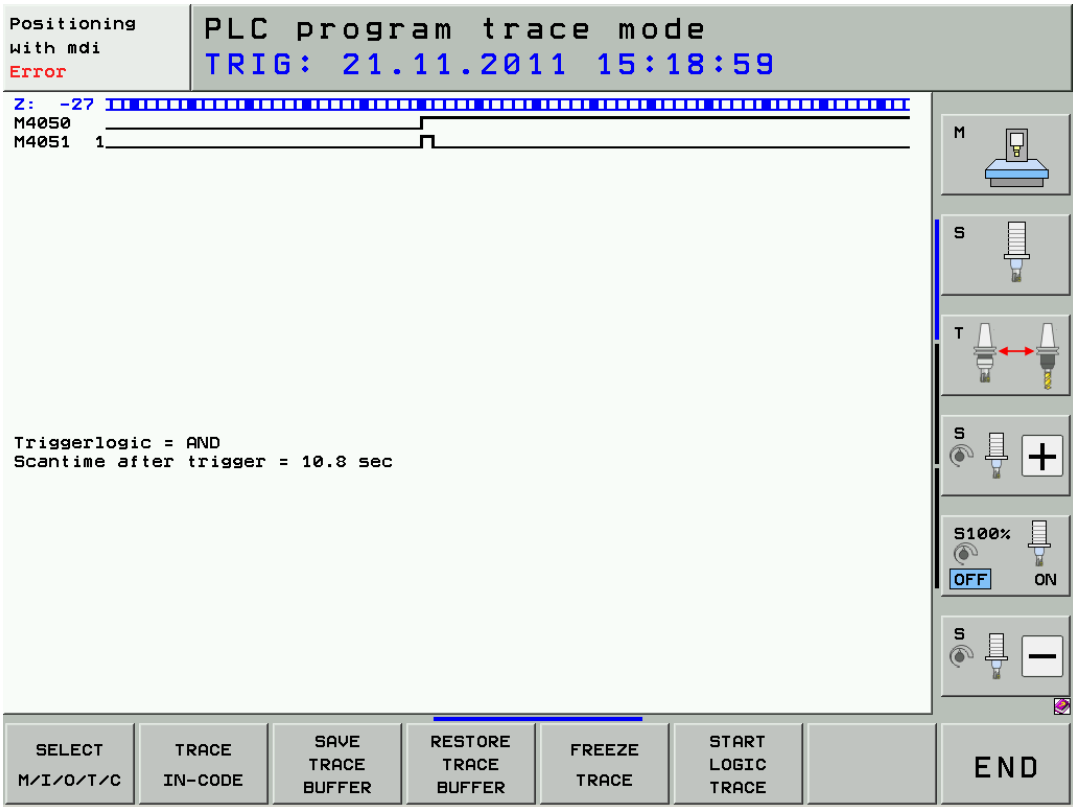
- Switch on the machine.
- Turn the feed-rate potentiometer to a small value.
- Call DriveDiag. --> See “DriveDiag” on page 9 – 91.
- Open the following page:



- Start a probing cycle with the TT.
- Check the lamp at **`TT touch probe ready (X13)`**.
  When the touch probe is ready, the lamp shines green.
- Deflect the tool touch probe by hand.
- Check the lamp at **`trigger signal of TT touch probe (X13)`**.
  When the touch probe is deflected, the lamp shines green.
  The message **`Stylus deflected`** appears in the machine display.

Functional test by means of the logic diagram

- Switch on the machine.
- Turn the feed-rate potentiometer to a small value.
- Call the logic diagram. -->See "The LOGIC diagram" on page 11 – 124.
- Enter the operands M4050 and M4051 and set the trigger to M4051.
- Start recording.
- Start a probing cycle with the TT.
- Check the marker 4050.
  If the probe is ready, this marker has the status zero.
- Deflect the tool touch probe by hand.
- Check the marker 4051.
  If the touch probe is deflected, this marker changes to one.
  The message **Stylus deflected** appears in the machine display.



26.6 Error diagnosis on the laser touch probe

Control impaired?

If you suspect that a damaged laser system or a laser system into which liquid has penetrated impairs the function of the control:

- Disconnect the laser system and observe the reaction.
  --> See ”Deselecting and disconnecting the touch probe” on page 26 – 433.

Visual inspection

> DANGER
>
> Laser radiation! Do not stare into beam! Laser class 2.

- Check whether the laser system or the cable is damaged, etc.
- Is the pressure of the compressed air unit correct (read the display)?

> Note
>
> For descriptions of the wiring, status displays and maintenance (e.g. cleaning and lubrication of components, functional check of the shutter) refer to the mounting instructions of the laser touch probe.

Checking the LEDs

> DANGER
>
> Laser radiation! Do not stare into beam! Laser class 2.

Optical status indicator	LED	Function
Laser ON	Green	Input for enabling transmission
Alignment	Green	Laser adjustment OK (signal > 95 %)
Laser OK	Green	Laser output OK (signal > 75 %)
Output	Red	DYN output (signal > 50 %)
Mode	White	Operating mode 0
	Green	Operating mode 1
	Red	Operating mode 2
	Yellow	Operating mode 3

Checking the Ready bridge

In the **laser touch probe** the **Ready signal is bridged**.
This means that the Ready signal must always be present when a laser touch probe is connected.

Proceed as follows to check the Ready bridge:

- Shut down the control and switch off the machine.
- Disconnect the touch probe cable (possibly together with the adapter ID 667674-01) from the connector X113 of the UEC 11x controller unit or the PL 62xx system module.
- Use a multimeter which you set to "beep" mode or to ohm measurement.
- Apply the needle tips to the following pins of the **touch probe cable**:

Laser touch probe, cable	Pins to be contacted
Without touch probe adapter ID 667674-01	**10** (+ 24 V NC) and **3** (TT is ready)
With touch probe adapter ID 667674-01	**10** (+ 24 V NC) and **3** (touch probe ready)

- A beep must be heard or a low ohmic value displayed.

PLB 62xx or UEC 11x up to and including variant 02

Pin layout X113 with touch probe adapter ID 667 674-01:

(15-pin D-sub, triple-row)

Female	Assignment of X113 (TT) up to variant 02	Adapter ID 667 674-01	TT cable ID 633 616-xx
1	Trigger signal		Trigger signal
2	$\overline{\text{Trigger signal}}$		$\overline{\text{Trigger signal}}$
3	TS ready		Do not assign
4	$\overline{\text{Battery warning}}$		$\overline{\text{Battery warning}}$
5	+ 5 V-NC (+/- 5%)		+ 5 V-NC (+/- 5%)
6	Start		Do not assign
7	0 V-NC		TT start
8	0 V-NC		0 V-NC
9	0 V-NC		0 V-NC
10	+ 24 V-NC		+ 24 V-NC
11	TT ready		TT ready
12	Do not assign		Do not assign
13	Do not assign		Do not assign
14	Do not assign		Do not assign
15	Do not assign		Do not assign

Figure: Laser touch probe, cable with touch probe adapter

PLB 62xx or UEC 11x as of variant 03:

Pin layout of X113 (touch probe adapter no longer required):

(15-pin D-sub, triple-row)

Female	Assignment X113 (TT) as of variant 03
1	Trigger signal
2	$\overline{\text{Trigger signal}}$
3	Do not assign
4	$\overline{\text{Battery warning}}$
5	+ 5 V-NC (+/- 5%)
6	Do not assign
7	TT start
8	0 V-NC
9	0 V-NC
10	+ 24 V-NC
11	TT ready
12	Do not assign
13	Do not assign
14	Do not assign
15	Do not assign

26.7 Deselecting and disconnecting the touch probe

You suspect a defective touch probe (short-circuit, etc.)?
Now, you want to test the control function without touch probe connected.

Proceed as follows:

- Close all active probing cycles.
- Remove the touch probe from the spindle (by hand or automatically).
- Press the EMERGENCY STOP button and shut down the control.
- Switch off the machine.
- Disconnect the touch probes from the PLB 62xx or UEC 11x (connectors X112 and X113).
- Switch the machine back on again.
- Observe, whether error messages are repeated or error conditions recur.

26.8 Corrective action

Cleaning

Use standard cleaning agents to clean transmitter/receiver units.

Realigning the SE

If required, realign the transmitter/receiver unit.

> Note
>
> A detailed description of the visual status check, **of the beam direction**, of battery exchange, stylus exchange, centering, specifications, etc. can be found in the mounting instructions of the touch probe!

Exchange of components

If required, replace the (rechargeable) battery, the broken stylus (of TS), the damaged contact plate (of TT), the defective cable, etc.

> Attention
>
> When you exchange the battery, pay attention that the polarity is correct.

> Attention
>
> After the stylus (of TS) or the contact plate (of TS) has been exchanged, the touch probe must be calibrated again.

> Note
>
> A detailed description of the visual status check, of the beam direction, **of battery exchange, stylus exchange**, centering, specifications, etc. can be found in the mounting instructions of the touch probe!
> If required, follow the instructions of the machine manufacturer!

Recalibration

Check the accuracy of the touch probe system after exchanging the stylus, the contact plate, and of course after a collision. Perform a recalibration.
For this purpose, consult the machine operator, the machine manufacturer or your HEIDENHAIN service agency.

> Note
>
> A detailed description of the visual status check, of the beam direction, of battery exchange, stylus exchange, **centering**, specifications, etc. can be found in the mounting instructions of the touch probe!
> If required, follow the instructions of the machine manufacturer!

> Note
>
> A TL Micro laser touch probe system must/should be recalibrated under the following conditions:
>
> - For initial operation and after cleaning or adjustment
> - Directly before precision measurements

Returning the touch probe

Return defective touch probes and those that impair the function of the control for examination.

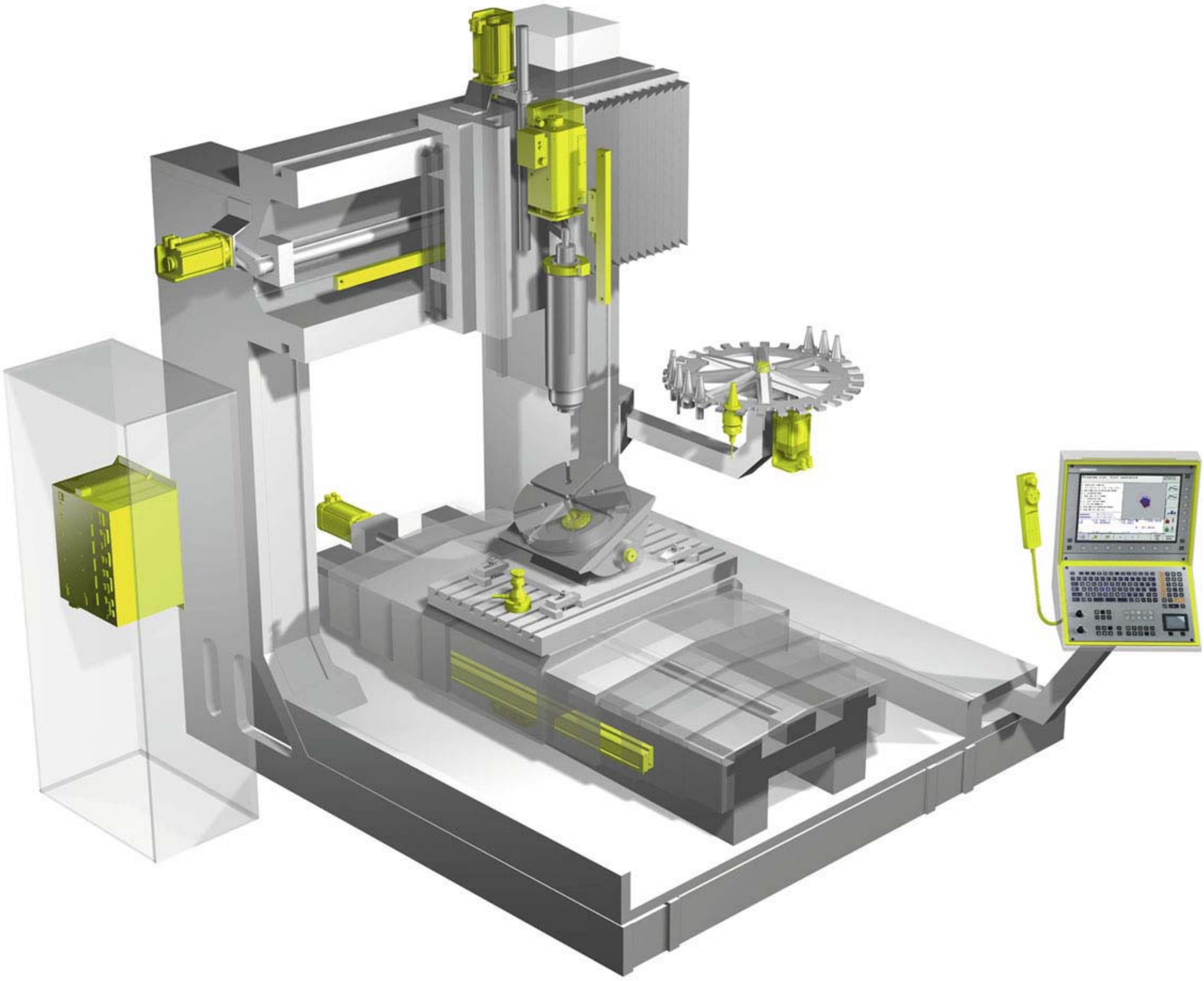
Returning the control component

If the touch probe interface of the PLB 62xx or UE 11x is defective, replace this component.
--> See "Exchange of HEIDENHAIN components" on page 29 – 515

27 Features of HEIDENHAIN components

27.1 HEIDENHAIN components in a machine tool

The picture shows HEIDENHAIN components that may be installed at a machine tool.
The picture is only an example as, of course, there is a great variety of different machine tools and machining centers.
Furthermore, it does not claim to be complete!



Note

On the cover page of this Service Manual and in the PDF file the highlighted HEIDENHAIN components are clear to see.

27.2 Hardware identification

On every HEIDENHAIN product there is an ID label which indicates ...

- Unit designation
- ID number
- Serial number

Thus, each unit is uniquely identified.

ID label

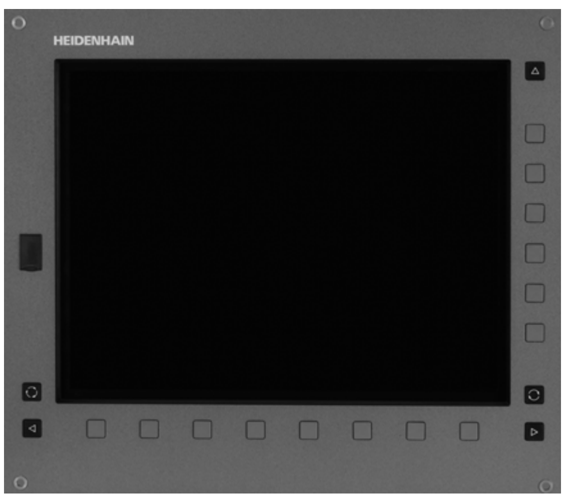
Figure: ID label of an MC 6241

> **Note**
>
> Whenever possible, the ID label is located well visible on the front of a product. Otherwise, you may find it on the side or on the rear of the unit.

ID labels are attached to the following mandatory and optional components of an iTNC 530 HSCI:

Main computer

<table>
<tr><td colspan="2">Main computer MC 4290 (MC = main computer)</td></tr>
<tr><td rowspan="2">Compact main computer for integration in the operating console, with built-in TFT flat-panel display and soft keys.

■ Processor:
Pentium M with 1.8 GHz
■ 1 GB RAM
■ Main computer unit for single-processor version
■ HSCI interface
■ 2 x Ethernet interface 100BaseT
■ 3 x USB 2.0
(1 in the operating panel, 2 on the rear)
■ 1 x RS-232C
■ Optionally with Profibus</td><td></td></tr>
<tr><td>
</td></tr>
</table>

Main computer MC 6241 (MC = main computer)

Main computer for **installation in an electrical cabinet**:

- Processor:
  Pentium M with 1.8 GHz
- 1 GB RAM
- Main computer unit for single-processor version
- HSCI interface
- 2 x Ethernet interface 100BaseT
- 2 x USB 2.0
- 1 x RS-232C
- Optionally with Profibus

Storage medium

SSDR hard disk (SSDR = solid state disk removable)

Additionally required for MC 6222:

- **SSDR** hard disk of the iTNC 530 HSCI
  - Contains the NC software
  - Memory capacity 32 GB, of which 21.4 GB are for the TNC:\ partition and 1 GB for the PLC:\ partition; remaining memory for system data

HDR hard disk (HDR = hard disk removable)

Additionally required for MC 6241:

- **HDR**hard disk of the iTNC 530 HSCI
  - Contains the NC software
  - Memory capacity 160 GB, of which 138 GB are for the TNC:\ partition and 1 GB for the PLC:\ partition. Remaining memory for system data

SIK component

<table>
<tr><td colspan="2">SIK component (SIK = system identification key)</td></tr>
<tr><td>Additionally required for MC 6xxx:

■ SIK System Identification Key
• Contains the NC software license for enabling control loops and software options.
• The SIK number provides the control with a unique identification.</td><td></td></tr>
</table>

Controller unit

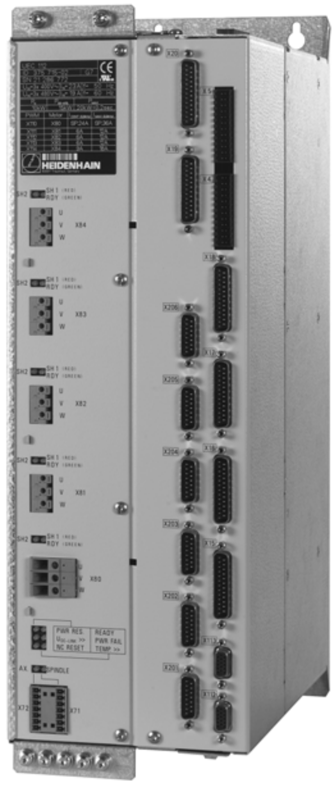
<table>
<tr><td colspan="2">Controller unit CC 61xx (CC = controller computer)</td></tr>
<tr><td>CC 6106 with 6 control loops
consists of:

1 drive-control motherboard and
2 drive-control expansion boards

It is equipped with:
■ 6 PWM outputs
■ 6 speed encoder inputs (1 Vpp or EnDat 2.2)
■ 6 position encoder inputs (1 Vpp or EnDat 2.2)
■ 2 SPI expansion slots
■ Power supply through UV(R) power supply unit

Available as:
■ CC 6106 with 6 control loops
■ CC 6108 with 8 control loops
■ CC 6110 with 10 control loops</td><td></td></tr>
</table>

Controller unit with integrated inverter

UEC 11x controller unit (UEC = **U**mrichter**e**inheit - inverter unit - with **c**ontroller computer)	
Controller unit with integrated inverter and PLC for up to 5 control loops for providing line voltage. Compact unit for machines with limited number of axes and low power demands. This controller unit features: ■ HSCI interface ■ 4 (UEC 111) or 5 (UEC 112) speed encoder inputs ■ 4 (UEC 111) or 5 (UEC 112) position encoder inputs ■ Connection for 3 axes plus spindle (UEC 111) or Connection for 4 axes plus spindle (UEC 112) ■ Braking resistor ■ 38 PLC inputs, 23 PLC outputs (expandable via PL 61xx) ■ Integrated power supply unit 24 V NC / 3.5 A for supplying the HSCI components Available as: ■ UEC 111 with 4 digital control loops ■ UEC 112 with 5 digital control loops	

System PL

PL 62xx	
System PL, consisting of PLB 620x basic module and I/O modules. ■ One module must be in the HSCI system if no UEC 11x is used. ■ HSCI interface ■ Connections for TS and TT touch probes ■ Safety-relevant PLC inputs/outputs Mounted on standard NS 35 rails (DIN 46 227 or EN 50 022) Available as: ■ PLB 6204 with 4 slots for I/O modules ■ PLB 6206 with 6 slots for I/O modules ■ PLB 6208 with 8 slots for I/O modules	

Expansion PL

PL 61xx

Expansion PL, consisting of PLB 610x basic module and I/O modules

- HSCI interface
- Up to 7 PL 61xx can be present in the HSCI system.

Mounted on standard NS 35 rails (DIN 46 227 or EN 50 022)

Available as:

- PLB 6104 with 4 slots for I/O modules
- PLB 6106 with 6 slots for I/O modules
- PLB 6108 with 8 slots for I/O modules

I/O modules

PLD-H xx–xx–xx (PLD-H = PLC I/O module digital HSCI)

Digital I/O module:

- **PLD-H 16-08-00:**
  I/O module with 16 digital inputs and 8 digital outputs
- **PLD-H 08-16-00**
  I/O module with 8 digital inputs and 16 digital outputs

PLA-H xx–xx–xx (PLA-H = PLC I/O module analog HSCI)

Analog I/O module:

- **PLA-H 08-04-04:**
  Analog module with eight analog inputs ± 10 V, four analog outputs ± 10 V and four inputs for Pt 100 thermistors.

SPI expansion module

<table>
<tr><td colspan="2">Expansion module for analog axes/spindles in the HSCI system
CMA-H 04-04-00 (CMA-H = controller module analog HSCI)</td></tr>
<tr><td>Expansion module for analog axes/spindles in the HSCI system:

■ CMA-H 04-04-00:
Module for controlling analog axes or spindles.
The CMA-H is inserted in one of the SPI slots on the bottom of the controller units. The analog control loop outputs are accessed only via the NC. Interpolated movements of analog axes with other axes are not possible.</td><td></td></tr>
</table>

PSL13x low-voltage power supply unit

PSL 130

PSL 130 power supply unit for HSCI components with +24 V power supply when using a HEIDENHAIN inverter system

The **PSL 130** power supply unit was conceived in order to be able to provide the HSCI components of the iTNC 530 HSCI with +24 V NC voltage and +24 V PLC voltage.

The output voltages of the **PSL 130** fulfill the requirements for Protective Extra Low Voltage (PELV) according to EN 50178. The power supply unit is powered with line voltage (L1, L2) and the DC-link voltage Uz.
This is used to produce the +24 V NC and +24 V PLC output voltages.

PSL 135

PSL135 power supply unit for supplying the HSCI components in a multi-row configuration or for using a non-HEIDENHAIN inverter system

The **PSL 135** power supply unit was conceived in order to be able to provide the HSCI components of the iTNC 530 HSCI with +24-V NC voltage, + 24-V PLC voltage and +5 V.

The output voltages of the **PSL 135** fulfill the requirements for Protective Extra Low Voltage (PELV) according to EN 50178. The power supply unit is powered with line voltage (L1, L2) and the DC-link voltage Uz.
This is used to produce the +24 V NC, +24 V PLC, and +5 V output voltages.

Visual display unit

BF 250

- 15-inch design
- Resolution: 1024 x 768 pixels
- 8 horizontal soft keys, 6 vertical soft keys for PLC
- 3 soft keys for switching soft-key rows
- Key for screen layout and operating mode switching
- Additional USB interface (USB 2.0) on the front of the visual display unit
- Integrated USB hub with (USB 2.0) with 4 USB interfaces on the back of the display unit
- HDL connection
- Fulfills IP54 degree of protection when installed

Keyboards

TE 620

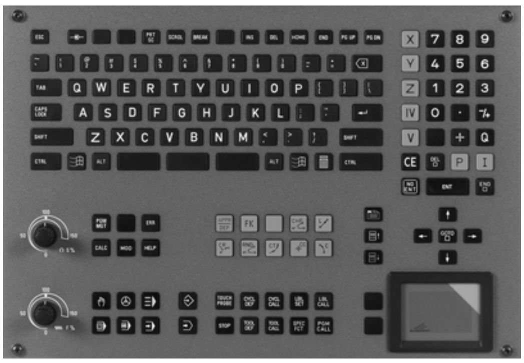
NC control panel

- The IV and V keys, the blank key to the left of V and the blank key above MOD in the operating panel are snap-ons.
- USB interface
- Fulfills IP54 degree of protection when installed

TE 630

NC control panel:

- The IV and V keys, the blank key to the left of V and the blank key above MOD in the operating panel are snap-ons.
- USB interface
- Touchpad
- Fulfills IP54 degree of protection when installed



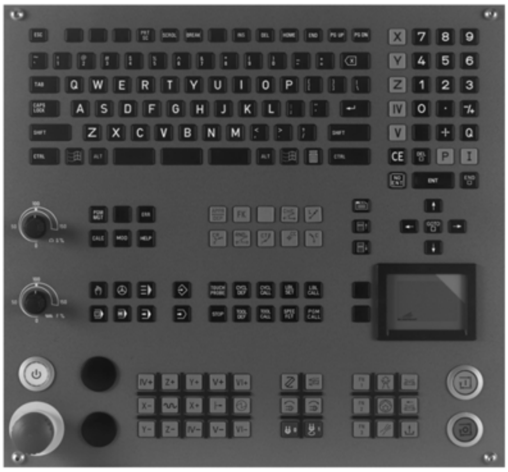
<table>
<tr><th colspan="2">TE 635Q</th></tr>
<tr><td>

NC control panel:
Same features as TE 630

Machine operating panel:

- 15-inch design
- 6 axis-direction keys
- 16 function keys
- Keys for NC start and NC stop (illuminated)
- Keys for spindle start and spindle stop
- All keys in the machine operating panel are snap-on keys.
- EMERGENCY STOP key
- Key for control voltage ON (RAFI key, illuminated)
- Two bore holes (22 mm) for additional RAFI buttons (shipped blocked with a cover) or detachable key switches
- HSCI interface
- Fulfills IP54 degree of protection when installed

</td><td>



</td></tr>
</table>

Machine operating panel

<table>
<tr><th colspan="2">MB 620</th></tr>
<tr><td>

The MB 620 is equipped with:

- 15-inch design
- HSCI interface
- Handwheel connection X23
- 21 snap-on (exchangeable) keys
  The key functions are freely definable via the PLC.
- 8 PLC inputs and 8 PLC outputs
- Two bore holes for additional keys or keylock switches
- Fulfills IP54 degree of protection when installed

</td><td>

</td></tr>
</table>

HSCI adapter for PLB 6001 OEM-specific machine operating panel

<table>
<tr><th colspan="2">PLB 6001</th></tr>
<tr><td>

The PLB 6001 is equipped with:

- HSCI interface
- Handwheel connection X23
- 64 PLC inputs, 32 PLC outputs for keys / key illumination
- Connection for spindle-speed and feed-rate override potentiometer
- Screw fastening or top-hat-rail mounting

</td><td>

</td></tr>
</table>

Handwheels

HR 410

Portable electronic handwheel with snap-on (exchangeable) keys.

- Five axis selection keys
- Keys for traverse direction
- Keys for preset feeds
- Actual-position-capture key
- Three keys for machine functions (definable via PLC)
  - Spindle right/left/stop
  - NC start/stop, spindle start; for HEIDENHAIN basic PLC program
- Two permissive buttons (24 V)
- Emergency stop button (24 V)
- Magnetic holding pads

HR 520

Portable electronic handwheel with snap-on (exchangeable) keys.

- Display for operating mode, actual position value, programmed feed rate and spindle speed, error messages
- Graphic display; resolution: 128 x 64 pixels, 6-line display
- Spindle speed and feed-rate override
- Selection of axes via keys or soft keys
- Actual position capture
- NC start/stop, spindle start/stop
- 6 freely programmable PLC keys with LED
- Keys for traverse direction
- Exchangeable snap-on keys for PLC functions and maintenance
- Integrated permissive key and emergency stop button (24 V)
- Magnetic holding pads
- Mount for attaching the handwheel to the machine

HR 130

Panel-mounted handwheel	With ergonomic knob
	Radial cable outlet
	With or without detent

Touch probes

TS 740, TS 640, TS 642, TS 444, TS 440

Touch-trigger probe with infrared transmission, for workpiece setup and measurement during machinin; for machines with automatic tool changer

- TS 440 with compact dimensions
- TS 444 with alternative battery-free power supply via compressed air through the spindle head
- TS 640 with wide-range infrared transmission and long operating time
- TS 642 with mechanical activation switch in the clamping shank
- TS 740 with high probing accuracy and repeatability, and low probing forces

The infrared transmission is established between the TS touch probe and the SE transceiver unit. The following SE units can be combined with the TS touch probes:

- SE 640 for integration in the machine workspace
- SE 642 for mounting in the workspace, for operation of a TS 44x, TS 64x, TS 74x infrared workpiece touch probe and the TT 449 infrared tool touch probe
- SE 540 for integration in the spindle head

TS 740
TS 640
TS 642
TS 440
TS 444

SE 640
transmitter-receiver unit

SE 642
transmitter-receiver unit

SE 540
transmitter-receiver unit

TS 640, TS 740

TS 440, TS 444

SE 640

SE 540

TS 220

Triggering touch probe with signal transmission over cable connection for machines with manual tool change; for workpiece setup and measurement during machining TS 220 Adapter cable for connection to the system PL or the UEC	

TT 140

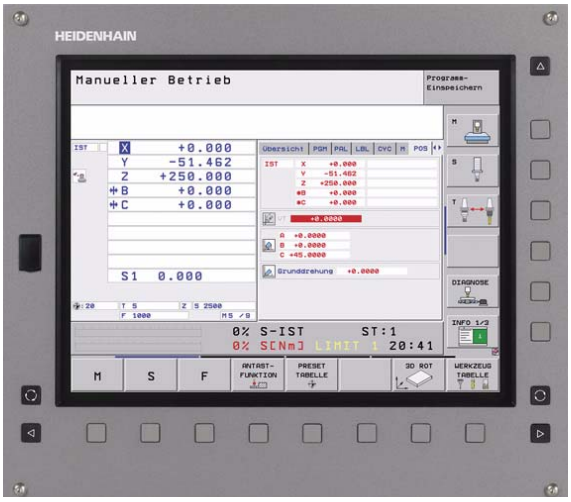
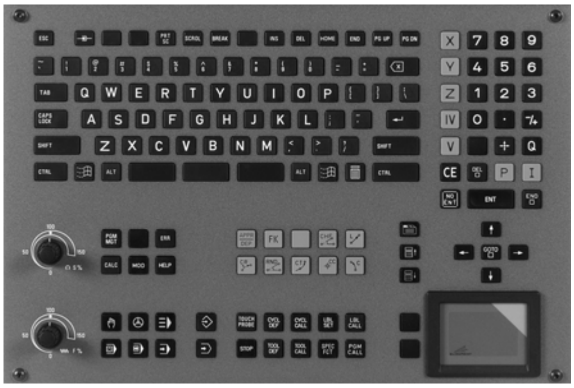
Tool touch probe Touch trigger probe with rated break point of the connection pin for the probe head and optical deflection display. An additional connection pin is delivered with the touch probe. TT 140 Connection pin Adapter cable for connection to the PL 62xx	

TT 449

Tool touch probe Touch trigger probe with rated break point of the connection pin for the probe head and optical deflection display. An additional connection pin is delivered with the touch probe. The TT 449 is wireless and communicates over infrared beam with the SE 642. TT 449 Connection pin	

Industrial PC

IPC 6110	
	■ Main computer ■ Integrated ASCII keyboard with additional keypad ■ 15-inch screen with soft keys ■ 3 USB connections ■ Slot for CompactFlash memory card, types I and II ■ Ethernet connection ■ RS-232-C/V.24 data interface ■ Power supply connection
Controls on the IPC 6110 ■ English ASCII keyboard with function keys ■ 24-key keyboard block with snap-on keys ■ 8 horizontal soft keys ■ 6 vertical soft keys ■ 2 keys for switching the horizontal soft-key row ■ Key for switching the vertical soft-key row ■ Key for view change ■ Key for changing screen layout	

IPC 6120 package	
"IPC 6120 Advanced" package (with TE 630 and CFR) "IPC 6120 Basic" package (with TE 620 and CFR)	■ Main computer ■ Separate TNC operating panel TE 630 or TE 620 ■ 15-inch screen ■ 3 USB connections ■ Slot for CompactFlash memory card, types I and II ■ Ethernet connection ■ RS-232-C/V.24 data interface ■ Power supply connection ■ CFR TNCterm
Controls on the IPC 6120 (can be used only as a package with TE 6xx) ■ Complete TNC operating panel with programming keys ■ Two override potentiometers (can be accessed for switching with analog inputs, not included in delivery) ■ Mouse pad with keys (only "IPC 6120 adv. package") ■ 8 horizontal soft keys ■ 6 vertical soft keys ■ 2 keys for switching the horizontal soft-key row ■ Key for switching the vertical soft-key row ■ Key for view change ■ Key for changing screen layout	 

Encoders

For information on position and speed encoders refer to the respective sales literature and mounting instructions.

Inverters and motors

For information on these components refer to the Service Manual "Inverter Systems and Motors".

Interface boards for the SIMODRIVE system 611D

For information on these components refer to the Service Manual "Inverter Systems and Motors".

27.3 Display of important system information

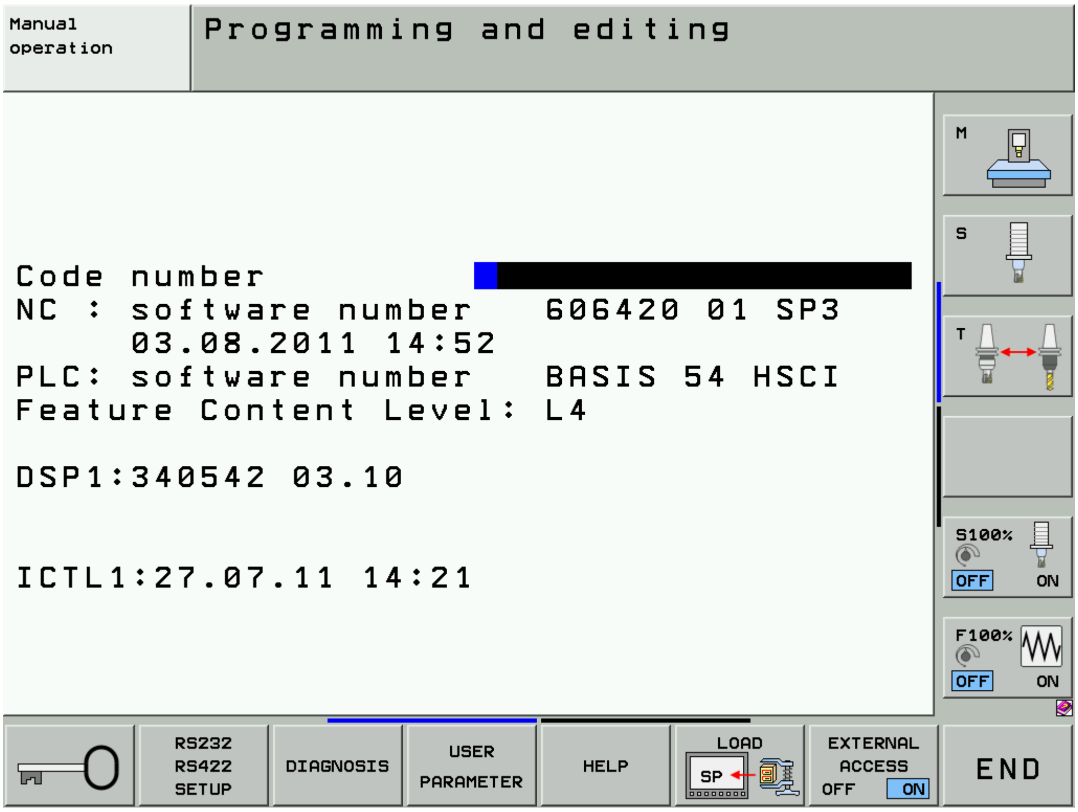
When you consult your machine manufacturer or HEIDENHAIN in the event of an error or a malfunction of your machine, it is important that you know which NC and PLC software is installed on the iTNC 530 HSCI.

Calling the display

- Select the `Programming and Editing` operating mode.
- If open: Close the program management by pressing the END button.

> Note
>
> Pressing the MOD key while the program manager is open calls screen where you can make the interface settings.

- Call the code number window.



NC software

```
NC : software number   606420 01 SP3
```

606420 Program number of the NC software
01 Version of the NC software
SP 3 Version of the service pack

> Note
>
> Below the NC software number, there is the date and time when the NC software was last loaded.

Currently, the following NC software versions may be installed on an iTNC 530 HSCI:

Hardware	Standard SW	Export SW	Comment
Single-processor	606 420-xx	340 421-xx	iTNC 530 HSCI and HeROS 5

As the NC software of the iTNC 530 HSCI is subject to export licensing, HEIDENHAIN can also supply a special export version (until now all odd-numbered NC software versions).

HEIDENHAIN releases a new program number for the NC software whenever it introduces extensive new functions.

PLC software

```
PLC: software number   BASIS 54 HSCI
```

BASIC 54 HSCI Random character sequence which the machine manufacturer uses to identify his PLC software

Feature Content Level

```
Feature Content Level: L4
```

L4 "L" is the abbreviation of "level"; "1" stands for the "feature content".

When a new NC software version is released, error fixes and improvements in functions are managed separately.
When the NC software is updated to a new version, only the included error fixes will initially be effective.
If the new features of this NC software version are also required, they can be enabled by entering a code number. --> Ask the machine manufacturer!

DSP software

```
DSP1:340542 03.3
```

340542 Program number of DSP software
03.3 Version of the DSP software

Note

The DSP software is the operating system for the **d**igital **s**ignal **p**rocessors (DSP) that are responsible for the speed control of digital axes/spindles:
DSP1: Software for the main controller board
DSP2: Software for the add. controller board

Current controller software

```
ICTL1:1.02.11 9:35
```

1.02.11 Program number of current controller software
9:35 Date and time of installation

Note

The ICTL software is the operating system for the **d**igital **s**ignal **p**rocessors (DSP) that are responsible for the speed control of digital axes/spindles:
ICTL1: Software for the main controller board
ICTL2: Software for the add. controller board

28 Connector designations and pin layouts

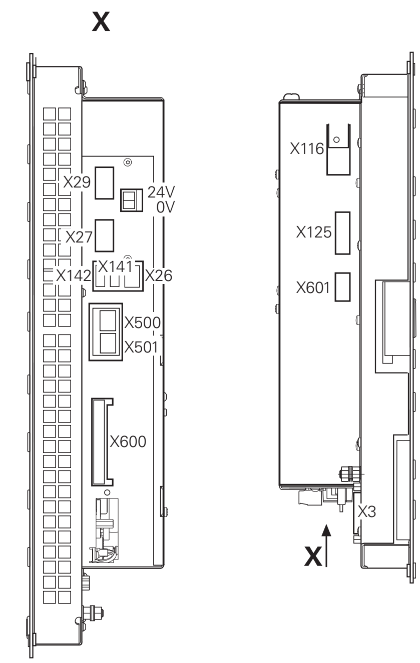
28.1 Important note

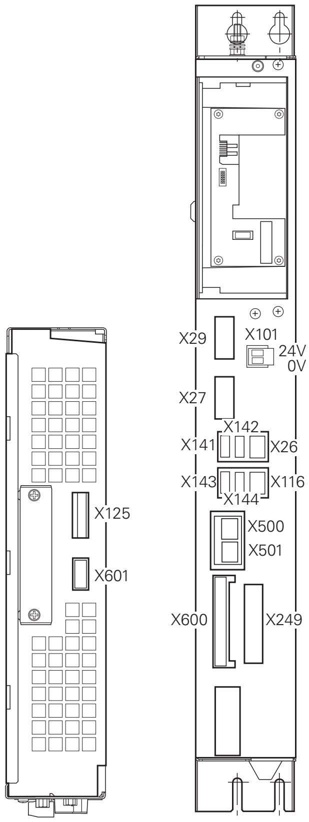
Attention

Do not engage or disengage any connecting elements while the unit is under power!
See “Safety precautions” on page 2 – 15.

28.2 MC main computer

28.2.1 Designations and positions of connectors

MC 6222: Main computer for installation in the operating panel		
Positions of the connectors	**Connector**	**Function**
	X29	Reserved
	X26, X116	Ethernet data interface
	X27	RS-232-C/V.24 data interface
	X141, X142, X143, X144	USB 2.0 interface (Type A)
	X101	+24 V NC power supply
	X500	HSCI output 1 (synchronized) to CC, PL, MB (not with MC 6x5x)
	X501	HSCI output 2, only to MB or PLB 6001(not with MC 6x5x)
	X600	Reserved
	X601	Reserved
	X116	Reserved
	X121	MC 6222: Profibus (option)
	X125	SIK (System Identification Key)
	X3	Connection for screen soft keys
	⏚	Protective ground

<table>
<tr><td colspan="3">MC 6241: Main computer for installation in electrical cabinet</td></tr>
<tr><th>Positions of the connectors</th><th>Connector</th><th>Function</th></tr>
<tr><td rowspan="14">
</td><td>X29</td><td>Reserved</td></tr>
<tr><td>X26, X116</td><td>Ethernet data interface</td></tr>
<tr><td>X27</td><td>RS-232-C/V.24 data interface</td></tr>
<tr><td>X141, X142,
X143, X144</td><td>USB 2.0 interface (Type A)</td></tr>
<tr><td>X101</td><td>+24 V NC power supply</td></tr>
<tr><td>X500</td><td>HSCI output 1 (synchronized) to CC, PL, MB (not with MC 6x5x)</td></tr>
<tr><td>X501</td><td>HSCI output 2, only to MB or
PLB 6001 (not with MC 6x5x)</td></tr>
<tr><td>X600</td><td>Reserved</td></tr>
<tr><td>X249</td><td>HDL interface for visual display unit</td></tr>
<tr><td>X121</td><td>MC 6x4x: Profibus (option)</td></tr>
<tr><td>X125</td><td>SIK (System Identification Key)</td></tr>
<tr><td>X601</td><td>Reserved</td></tr>
<tr><td>⏚</td><td>Protective ground</td></tr>
</table>

28.2.2 Pin layouts

X3: Connection for screen soft keys

Screen soft keys from X3 to TE via ribbon cable

Screen soft keys		
BF 250 visual display unit	**TE 6xx keyboard unit**	
X3 **D-sub connector, 15-pin**	**X1** **Plug connector, 10-pin**	**X57** **Plug connector, 50-pin**
1	1a	1b
2	2a	2b
3	3a	3b
4	4a	4b
5	5a	5b
9	1b	16a
10	2b	15a
11	3b	14a
12	4b	13a

X26, X116: Ethernet interface

Connection	Maximum cable length	Maximum data transfer rate	Network topology
RJ45, 8-pin	Unshielded: 100 m	For integration into the company network via NFS or SMB protocol: 10 or 100 Mbps	Star configuration
	Shielded: 400 m	For **LSV2 protocol** (in conjunction with e.g. TNCremoNT): 2 to 5 Mbps (depending on file type and network utilization)	

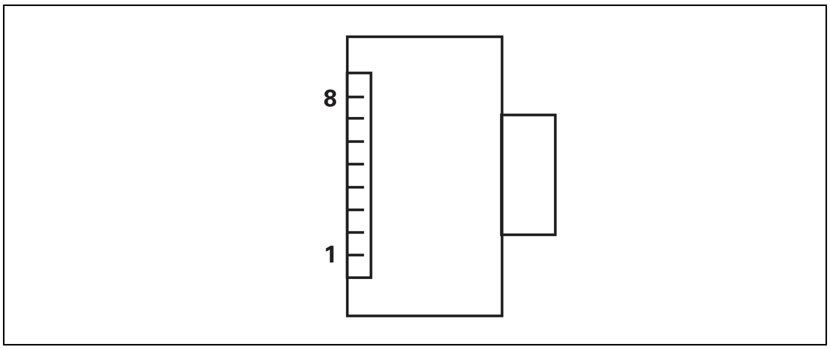
A hub serves as a central node that establishes the connection to the other participants.

RJ45 connection (female) 8-pin	Assignment
1	TX+
2	TX–
3	REC+
4	Do not assign
5	Do not assign
6	REC–
7	Do not assign
8	Do not assign
Housing	External shield

DANGER

The Ethernet interfaces of the MC 6xxx comply with the requirements of PELV ("low voltage electrical separation") according to EN 61800-5-1 and are powered internally by 24 V NC.
All devices connected to these Ethernet interfaces must comply with the requirements of SELV or PELV according to EN 61800-5-1.

Face of the connector:



Meanings of the LEDs on the Ethernet data interface:

LED	Condition	Meaning
Green	Blinking	Interface active
	Off	Interface inactive
Yellow	On	100 Mb network
	Off	10 Mb network

X27: RS-232-C/V.24 data interface

Maximum cable length: 20 m

25-pin adapter block:

MC 6xxx		Connecting cable 365 725-xx			Adapter block 310 085-01		Connecting cable 274 545-xx		
Male	**Assignment**	**Female**	**Color**	**Female**	**Male**	**Female**	**Male**	**Color**	**Female**
1	Do not assign	1		1	1	1	1	White/ Brown	1
2	RXD	2	Yellow	3	3	3	3	Yellow	2
3	TXD	3	Green	2	2	2	2	Green	3
4	DTR	4	Brown	20	20	20	20	Brown	8
5	Signal GND	5	Red	7	7	7	7	Red	7
6	DSR	6	Blue	6	6	6	6		6
7	RTS	7	Gray	4	4	4	4	Gray	5
8	CTS	8	Pink	5	5	5	5	Pink	4
9	Do not assign	9					8	Violet	20
Hsg.	External shield	Hsg.	Ext. shield	Hsg.	Hsg.	Hsg.	Hsg.	Ext. shield	Hsg.

9-pin adapter block:

MC 6xxx		Connecting cable 355 484-xx			Adapter block 363 987-02		Connecting cable 366 964-xx		
Male	**Assignment**	**Female**	**Color**	**Male**	**Female**	**Male**	**Female**	**Color**	**Female**
1	Do not assign	1	Red	1	1	1	1	Red	1
2	RXD	2	Yellow	2	2	2	2	Yellow	3
3	TXD	3	White	3	3	3	3	White	2
4	DTR	4	Brown	4	4	4	4	Brown	6
5	Signal GND	5	Black	5	5	5	5	Black	5
6	DSR	6	Violet	6	6	6	6	Violet	4
7	RTS	7	Gray	7	7	7	7	Gray	8
8	CTS	8	White/ Green	8	8	8	8	White/ Green	7
9	Do not assign	9	Green	9	9	9	9	Green	9
Hsg.	External shield	Hsg.	Ext. shield	Hsg.	Hsg.	Hsg.	Hsg.	Ext. shield	Hsg.

Note

The interface complies with the requirements of EN50178 for "low voltage electrical separation."

X101: NC power supply

The MC is supplied with +24 V NC (control voltage) of the machine, for example by the PSL 130, or by the integrated 24 V power supply unit of the UEC 11x.

Protective Extra Low Voltage (PELV) according to EN 61800-5-1 must be complied with for the +24 V NC power supply.

Power supply: Minimum absolute value: +20.4 V–
Maximum absolute value +28.8 V–

Pin layout:

Connecting terminals at X101	Assignment
+	+24 V NC
–	0 V NC

Attention

Ensure that either the DC-link power supply unit is switched off or the line power is disconnected before connecting the power cables!

Power consumption and efficiency:

Device	Power consumption	Efficiency
MC 6241	40 W	85 %
MC 6222	60 W	

Note

If USB components that are connected to X141/X142 require more than 0.5 A, a separate power supply becomes necessary for these components. One possibility is the USB hub from HEIDENHAIN.

X121: PROFIBUS connection

Pin layout on X121 of the MC main computer or IPC and on X1 of the PLB 550 PROFIBUS slave

Main computer X121		Connecting cable 515 845-01			PLB 550 X1	
D-sub connctn. (female) 9-pin	Assignment	D-sub cnnctr. (male) 9-pin		D-sub cnnctr. (male) 9-pin	X1 D-sub cnnctn. (female) 9-pin	Assignment
1	Do not assign	1	–	1	1	Do not assign
2	Do not assign	2	–	2	2	Do not assign
3	B line	3	B line	3	3	B line
4	RTS (signal type: TTL)	4	–	4	4	RTS (signal type: TTL)
5	GND	5	–	5	5	GND
6	+5 V	6	–	6	6	+5 V
7	Do not assign	7	–	7	7	Do not assign
8	A line	8	A line	8	8	A line
9	Do not assign	9	–	9	9	Do not assign
Housing	External shield	Housing	External shield	Housing	Housing	External shield

All signals on the PL 550 are electrically isolated.

All signals are electrically isolated at X121 of the MC 6xxx main computer or the IPC 6xxx.

The +5 V and GND pins supply the terminating resistor in the connector.

X125: Slot for SIK

The system identification key is located in slot X125.

X141, X142, X143, X144: USB interface

Pin layout for USB connection (type A):

USB connection (female) 4-pin	Assignment
1	+5 V
2	USBP–
3	USBP+
4	GND

Note

If USB components that are connected to one of the USB ports require more than 0.5 A, a separate power supply becomes necessary for these components. One possibility is the USB hub (USB 2.0) from HEIDENHAIN.

If a USB hub is connected to one of the USB ports, the maximum permissible length of the USB cable is reduced to 20 m.

USB hub

The power supply for the USB hub must comply with EN 50 178, 5.88 requirements for "low voltage electrical separation."

X249: Visual display unit

Pin layout:

MC 6xxx, X249		Connecting cable ID 625 901-xx	BF 2xx, X2	
25-pin connection	Assignment		25-pin connection	Assignment
1	TD2+		1	TD2+
2	TD2–		2	TD2–
3	TD1+		3	TD1+
4	TD1–		4	TD1–
5	TD0+		5	TD0+
6	TD0–		6	TD0–
7	TC+		7	TC+
8	TC–		8	TC–
9	Do not assign		9	Do not assign
10	Do not assign		10	Do not assign
11	+ 5 V		11	Do not assign
12	TxD+		12	RxD+
13	TxD–		13	RxD–
14	TD2S		14	TD2S
15	Do not assign		15	EQSEL1
16	TD1S		16	TD1S
17	Do not assign		17	GND for EQSEL
18	TD0S		18	TD0S
19	Do not assign		19	EQSEL0
20	TCS		20	TCS
21	Do not assign		21	Do not assign
22	Do not assign		22	Do not assign
23	GND		23	GND
24	RxD+		24	TxD+
25	RxD–		25	TxD–

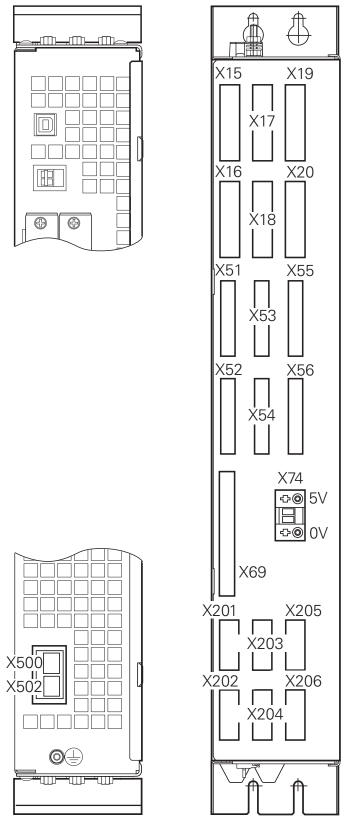
X500, X501:
HSCI interfaces

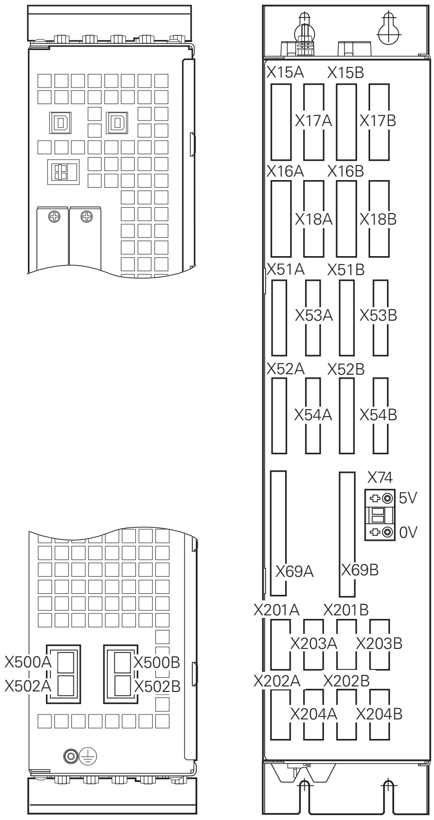
HSCI connection X500, output 1 synchronized	
RJ45 connection (female) 8-pin	**Assignment**
1	TD0+
2	TD0–
3	RD0+
4	Do not assign
5	Do not assign
6	RD0–
7	Do not assign
8	Do not assign

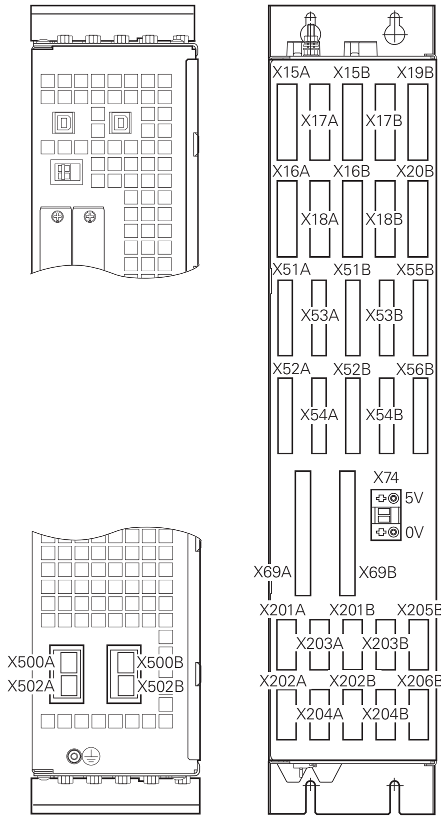
HSCI connection X501, output 2	
RJ45 connection (female) 8-pin	**Assignment**
1	TD1+
2	TD1–
3	RD1+
4	Do not assign
5	Do not assign
6	RD1–
7	Do not assign
8	Do not assign

28.3 CC controller unit

28.3.1 Designations and positions of connectors

CC 6106, controller unit with 6 control loops and HSCI interface		
Positions of the connectors	**Connector**	**Function**
	X15 to X20	Speed encoder
	X51 to X56	PWM output
	X69	Supply bus
	X201 to X206	Position encoder
	X500	HSCI output
	X502	HSCI input
	–	SPI slot 1 (on bottom, reserved for expansion modules)
	–	SPI slot 2 (on bottom, reserved for expansion modules)
	X74	+ 5 V supply
	X7	Bridge for signal ground (= functional ground) (on bottom)
	⏚	Protective ground

<table>
<tr><td colspan="3">CC 6108 controller unit with 8 control loops and HSCI interface</td></tr>
<tr><th>Positions of the connectors</th><th>Connector</th><th>Function</th></tr>
<tr><td rowspan="17">
</td><td>X15A - X18A</td><td>Speed encoder
Drive-control motherboard A</td></tr>
<tr><td>X15B - X18B</td><td>Speed encoder
Drive-control motherboard B</td></tr>
<tr><td>X51A - X54A</td><td>PWM output
Drive-control motherboard A</td></tr>
<tr><td>X51B - X54B</td><td>PWM output
Drive-control motherboard B</td></tr>
<tr><td>X69A</td><td>Supply bus
Drive-control motherboard A</td></tr>
<tr><td>X69B</td><td>Supply bus
Drive-control motherboard B</td></tr>
<tr><td>X201A - X204A</td><td>Position encoder
Drive-control motherboard A</td></tr>
<tr><td>X201B - X204B</td><td>Position encoder
Drive-control motherboard B</td></tr>
<tr><td>X500A</td><td>HSCI output
Drive-control motherboard A</td></tr>
<tr><td>X502A</td><td>HSCI input
Drive-control motherboard A</td></tr>
<tr><td>X500B</td><td>HSCI output
Drive-control motherboard B</td></tr>
<tr><td>X502B</td><td>HSCI input
Drive-control motherboard B</td></tr>
<tr><td>X74</td><td>+ 5 V supply</td></tr>
<tr><td>–</td><td>SPI slot 1 (on bottom, reserved for expansion modules)</td></tr>
<tr><td>–</td><td>SPI slot 2 (on bottom, reserved for expansion modules)</td></tr>
<tr><td>X7</td><td>Bridge for signal ground
(= functional ground)
(on bottom)</td></tr>
<tr><td>⏚</td><td>Protective ground</td></tr>
</table>

CC 6108 / CC 6110 controller unit with 8 / 10 control loops and HSCI interface		
Positions of the connectors	**Connector**	**Function**
	X15A - X18A	Speed encoder Drive-control motherboard A
	X15B - X20B	Speed encoder Drive-control motherboard B
	X51A - X54A	PWM output Drive-control motherboard A
	X51B - X56B	PWM output Drive-control motherboard B
	X69A	Supply bus Drive-control motherboard A
	X69B	Supply bus Drive-control motherboard B
	X201A - X204A	Position encoder Drive-control motherboard A
	X201B - X206B	Position encoder Drive-control motherboard B
	X500A	HSCI output Drive-control motherboard A
	X502A	HSCI input Drive-control motherboard A
	X500B	HSCI output Drive-control motherboard B
	X502B	HSCI input Drive-control motherboard B
	X74	+ 5 V supply
	–	SPI slot 1 (on bottom, reserved for expansion modules)
	–	SPI slot 2 (on bottom, reserved for expansion modules)
	X7	Bridge for signal ground (= functional ground) (on bottom)
	⏚	Protective ground

28.3.2 Pin layouts

X7: Bridge for signal ground (= functional ground)

Connecting terminal X7	Assignment
1	Connection for signal ground (= functional ground)
2	Connection on housing

In shipping condition, the CC 61xx is connected over an external bridge (pin 1) with the housing (pin 2). If only one CC 61xx is in the system, it ensures the correct signal-ground connection of the CC.

If there are two or more CC 61xx units in the system that are connected over a UV power module to the same supply bus (X69), this external signal-ground bridge can stay connected with only one CC 61xx. To avoid ground loops, these signal ground bridges from any more CCs must be removed.

If there are two or more CC 61xx units powered over more than one UV power module and are therefore connected with different supply bus systems (X69), then the external signal-ground bridge is connected with only one CC 61xx of the respective supply bus. This bridge for the signal ground on all other CC 61xx units that are on a common supply bus (X69) must be disengaged in order to prevent ground loops.

> **Attention**
>
> If you connect angle or linear encoders from HEIDENHAIN to the speed encoders (such as for torque motors), you must pay attention to the different connector layouts!
> HEIDENHAIN offers special cables and line-drop compensators for such applications.
> More information is in the Cable overviews.

X15 to X20: 1 Vpp speed encoder

Pin layout:

CC 61xx		Adapter cable 289 440-xx				Connecting cable 336 847-xx		
Male	**Assignment**	**Female**	**Color**	**Female**		**Male**	**Color**	**Female**
1	+5 V (U_P)	1	Brown/Green	10	Possibly voltage controller ID 370 226-01	10	Brown/Green	10
2	0 V (U_N)	2	White/Green	7		7	White/Green	7
3	A+	3	Green/Black	1		1	Green/Black	1
4	A–	4	Yellow/Black	2		2	Yellow/Black	2
5	0 V							
6	B+	6	Blue/Black	11		11	Blue/Black	11
7	B–	7	Red/Black	12		12	Red/Black	12
8	0 V	8	Internal shield	17		17	Internal shield	17
9	Do not assign							
10	Do not assign							
11	Do not assign							
12	Do not assign							
13	Temperature+	13	Yellow	8		8	Yellow	8
14	+5 V (sensor)	14	Blue	16		16	Blue	16
15	Do not assign							
16	0 V (sensor)	16	White	15		15	White	15
17	R+	17	Red	3		3	Red	3
18	R–	18	Black	13		13	Black	13
19	C+	19	Green	5		5	Green	5
20	C–	20	Brown	6		6	Brown	6
21	D+	21	Gray	14		14	Gray	14
22	D–	22	Pink	4		4	Pink	4
23	Do not assign							
24	0 V							
25	Temperature –	25	Violet	9		9	Violet	9
Hsg.	Housing	Hsg.	External shield	Hsg.		Hsg.	External shield	Hsg.

> **Note**
>
> The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

X15 to X20: Speed encoder with EnDat interface

Pin layout:

CC 61xx		Adapter cable 336 376-xx				Connecting cable 340 302-xx		
Male	**Assignment**	**Female**	**Color**	**Female**		**Male**	**Color**	**Female**
1	+5 V (U_P)	1	Brown/Green	10	Possibly voltage controller ID 370 224-01	10	Brown/Green	10
2	0 V (U_N)	2	White/Green	7		7	White/Green	7
3	A+	3	Green/Black	1		1	Green/Black	1
4	A–	4	Yellow/Black	2		2	Yellow/Black	2
5	0 V							
6	B+	6	Blue/Black	11		11	Blue/Black	11
7	B–	7	Red/Black	12		12	Red/Black	12
8	0 V	8	Internal shield	17		17	Internal shield	17
9	Do not assign							
10	Clock	10	Green	5		5	Green	5
11	Do not assign							
12	$\overline{\text{Clock}}$	12	Brown	14		14	Brown	14
13	Temperature+	13	Yellow	8		8	Yellow	8
14	+5 V (sensor)	14	Blue	16		16	Blue	16
15	Data	15	Red	3		3	Red	3
16	0 V (sensor)	16	White	15		15	White	15
17	Do not assign							
18	Do not assign							
19	Do not assign							
20	Do not assign							
21	Do not assign							
22	Do not assign							
23	$\overline{\text{Data}}$	23	Black	13		13	Black	13
24	0 V							
25	Temperature –	25	Violet	9		9	Violet	9
Hsg.	Housing	Hsg.	External shield	Hsg.		Hsg.	External shield	Hsg.

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

DANGER

Only units that comply with the requirements of EN 61800-5-1 for "protective extra-low voltage (PELV)" may be connected.

Pin layout (for the LC or RCN):

CC 61xx		**Adapter cable 336 376-xx**				**Adapter cable 369 124-xx Adapter cable 369 129-xx**	
Male	**Assignment**	**Female**	**Color**	**Female**		**Male**	**Color**
1	+5 V (U_P)	1	Brown/Green	10	Possibly voltage controller ID 368 210-02	7	Brown/Green
2	0 V (U_N)	2	White/Green	7		10	White/Green
3	A+	3	Green/Black	1		15	Green/Black
4	A–	4	Yellow/Black	2		16	Yellow/Black
5	0 V						
6	B+	6	Blue/Black	11		12	Blue/Black
7	B–	7	Red/Black	12		13	Red/Black
8	0 V	8	Internal shield	17		11	Internal shield
9	Do not assign						
10	Clock	10	Green	5		8	Violet
11	Do not assign						
12	$\overline{\text{Clock}}$	12	Brown	14		9	Yellow
13	Temperature+	13	Yellow	8			
14	+5 V (sensor)	14	Blue	16		1	Blue
15	Data	15	Red	3		14	Gray
16	0 V (sensor)	16	White	15		4	White
17	Do not assign						
18	Do not assign						
19	Do not assign						
20	Do not assign						
21	Do not assign						
22	Do not assign						
23	$\overline{\text{Data}}$	23	Black	13		17	Pink
24	0 V						
25	Temperature –	25	Violet	9			
Hsg.	Housing	Hsg.	External shield	Hsg.		Hsg.	External shield
					1		
					2 Temp.+		
					3 Temp.–		
					4		

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

Pin layout (for the LC or RCN):

CC 61xx		**Adapter cable 509 667-xx**			**Adapter cable 369 124-xx Adapter cable 369 129-xx or RCN**	
Male	**Assignment**	**Female**	**Color**	**Female**	**Male**	**Color**
1	+5 V (U_P)	1	Brown/Green	7	7	Brown/Green
2	0 V (U_N)	2	White/Green	10	10	White/Green
3	A+	3	Green/Black	15	15	Green/Black
4	A–	4	Yellow/Black	16	16	Yellow/Black
5	0 V					
6	B+	6	Blue/Black	12	12	Blue/Black
7	B–	7	Red/Black	13	13	Red/Black
8	0 V	8	Internal shield	11	11	Internal shield
9	Do not assign					
10	Clock	10	Green	8	8	Violet
11	Do not assign					
12	$\overline{\text{Clock}}$	12	Brown	9	9	Yellow
13	Temperature+	13	Yellow	5		
14	+5 V (sensor)	14	Blue	1	1	Blue
15	Data	15	Red	14	14	Gray
16	0 V (sensor)	16	White	4	4	White
17	Do not assign					
18	Do not assign					
19	Do not assign					
20	Do not assign					
21	Do not assign					
22	Do not assign					
23	$\overline{\text{Data}}$	23	Black	17	17	Pink
24	0 V					
25	Temperature –	25	Violet	6		
Hsg.	Housing	Hsg.	External shield	Hsg.	Hsg.	External shield

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

X51 to X56: PWM-output

Pin layout:

Ribbon connector, 20-pin	Assignment
1a	PWM U1
1b	0 V U1
2a	PWM U2
2b	0 V U2
3a	PWM U3
3b	0 V U3
4a	$\overline{\text{SH2}}$
4b	0 V ($\overline{\text{SH2}}$)
5a	$\overline{\text{SH1}}$
5b	0 V ($\overline{\text{SH1}}$)
6a	+IACTL 1
6b	–IACTL 1
7a	0 V (analog)
7b	+IACTL 2
8a	–IACTL 2
8b	0 V (analog)
9a	Do not assign
9b	$\overline{\text{BRK}}$
10a	$\overline{\text{ERR}}$
10b	RDY

> Note
>
> The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

X69: CC supply voltage and control signals

Pin layout:

50-pin ribbon connector	Assignment	50-pin ribbon connector	Assignment
1a to 5b	+5 V	16b	GND
6a to 7b	+ 12 V	17a	RDY.PS
8a	+5 V (low-voltage separation)	17b	GND
8b	0 V (low-voltage separation)	18a	$\overline{\text{ERR.ILEAK}}$
9a	+15 V	18b	GND
9b	–15 V	19a	$\overline{\text{PF.PS.AC}}$ (only regenerative HEIDENHAIN inverters)
10a	UZAN	19b	GND
10b	0 V	20a	Do not assign
11a	IZAN	20b	GND
11b	0 V	21a	Do not assign
12a	$\overline{\text{RES.PS}}$	21b	GND
12b	0 V	22a	Do not assign
13a	$\overline{\text{PF.PS.ZK}}$	22b	GND
13b	GND	23a	Reserved (SDA)
14a	$\overline{\text{ERR.UZ.GR}}$	23b	GND
14b	GND	24a	Reserved (SLC)
15a	$\overline{\text{ERR.IZ.GR}}$	24b	GND
15b	GND	25a	RES.LE
16a	$\overline{\text{ERR.TMP}}$	25b	GND

X74: +5 V power supply for CC

Maximum wire cross section: 2.5 mm^2

Connecting terminal at X74	Assignment
1	+5 V from the UV supply module (X74)
2	0 V

Attention

The +5 V supply via X74 from the supply module is mandatory for the CC 61xx!

If the system includes several CCs 61xx that are connected to the same supply bus (X69) via a UV supply module, only the last CC 61xx (usually the rightmost unit) must be connected to the UV via X74. The other CC 61xx units are then supplied via supply bus X69.

If several CC 61xx units are supplied by more than one UV supply module, which means that they are connected to different supply bus systems (X69), then the last CC 61xx (usually the unit at the extreme right) of the respective supply bus must also be supplied with the additional +5 V of the UV via X74.

Check whether the +5 V supply of all drive-control motherboards is present. The voltage is displayed in the DriveDiag diagnosis tool. On the "Voltages and currents" tab for the drive control boards, you will find the +5 V supply voltage. The value of this voltage should not be below +4.90 V.

X201 to X206: Position encoder 1 Vpp

Pin layout:

CC 61xx		Adapter cable 309 783-xx Adapter cable 310 199-xx			Measuring system	
Male	**Assignment**	**Female**	**Color**	**Female**	**Male**	**Color**
1	+5 V (U_P)	1	Brown/Green	12	12	Brown/Green
2	0 V (U_N)	2	White/Green	10	10	White/Green
3	A+	3	Brown	5	5	Brown
4	A–	4	Green	6	6	Green
5	Do not assign	5				
6	B+	6	Gray	8	8	Gray
7	B–	7	Pink	1	1	Pink
8	Do not assign	8				
9	+5 V (sensor)	9	Blue	2	2	Blue
10	R+	10	Red	3	3	Red
11	0 V (sensor)	11	White	11	11	White
12	R–	12	Black	4	4	Black
13	0 V	13				
14	Do not assign	14	Violet	7	7	Violet
15	Do not assign	15				
Hsg.	External shield	Hsg.	External shield	Hsg.	Hsg.	External shield

Note

The interface complies with the requirements of EN50178 for "low voltage electrical separation."

X201 to X206: Position encoder with EnDat interface

Pin layout:

CC 61xx		Adapter cable 332 115-xx			Connecting cable 323 897-xx				Adapter cable 313 791-xx		
Male	**Assignmt.**	**Female**	**Color**	**Fem.**	**Male**	**Color**	**Fem.**		**Male**	**Color**	**Fem.**
1	+5 V (U_P)	1	Brown/ Green	7	7	Brown/ Green	7	Evtl. Spannungsregler ID 336 697-02	7	Brown/ Green	5b
2	0 V (U_N)	2	White/ Green	10	10	White/ Green	10		10	White/ Green	6a
3	A+	3	Green/ Black	15	15	Green/ Black	15		15	Green/ Black	2a
4	A–	4	Yellow/ Black	16	16	Yellow/ Black	16		16	Yellow/ Black	2b
5	Data	5	Gray	14	14	Gray	14		14	Gray	3b
6	B+	6	Blue/ Black	12	12	Blue/ Black	12		12	Blue/ Black	1a
7	B–	7	Red/ Black	13	13	Red/ Black	13		13	Red/ Black	1b
8	$\overline{\text{Data}}$	8	Pink	17	17	Pink	17		17	Pink	3a
9	+5 V (sensor)	9	Blue	1	1	Blue	1		1	Blue	5a
10	Vacant	10		3	3	Red	3		3		
11	0 V (sensor)	11	White	4	4	White	4		4	White	6b
12	free	12		2	2	Black	2		2		
13	Internal shield	13	Internal shield	11	11	Internal shield	11		11	Internal shield	
14	Clock	14	Violet	8	8	Violet	8		8	Violet	4a
15	$\overline{\text{Clock}}$	15	Yellow	9	9	Yellow	9		9	Yellow	4b
Hsg.	Housing	Hsg.	Ext. shield	Hsg.		Ext. shield			Hsg.	Ext. shield	

Note

The interface complies with the requirements of EN50178 for "low voltage electrical separation."

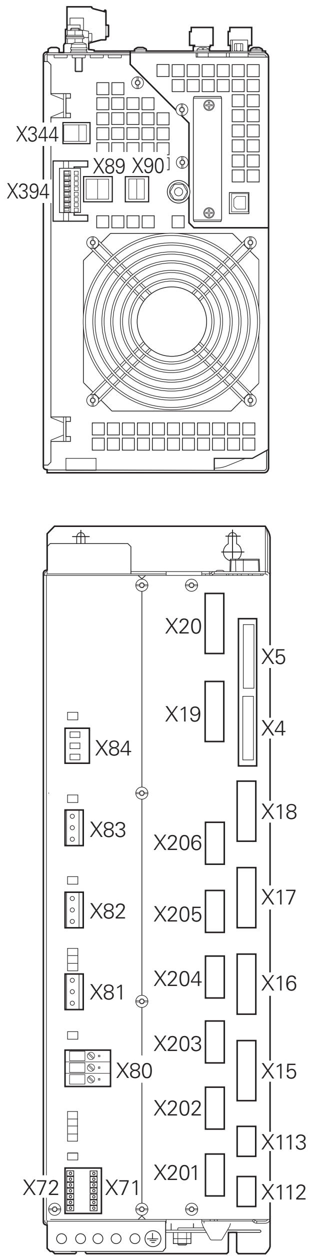
X500, X502:
HSCI interfaces

HSCI connection X500, output	
RJ45 connection (female) 8-pin	**Assignment**
1	TD0+
2	TD0–
3	RD0+
4	Do not assign
5	Do not assign
6	RD0–
7	Do not assign
8	Do not assign

HSCI connection X502, input	
RJ45 connection (female) 8-pin	**Assignment**
1	RD0+
2	RD0–
3	TD0+
4	Do not assign
5	Do not assign
6	TD0–
7	Do not assign
8	Do not assign

28.4 Controller unit with integrated UEC inverter

28.4.1 Designations and positions of connectors

<table>
<tr><td colspan="3">UEC 11x: Compact controller unit with integrated inverter and PLC I/Os</td></tr>
<tr><th>Positions of the connectors</th><th>Connector</th><th>Function</th></tr>
<tr><td rowspan="25">
</td><td>X4, X5</td><td>PLC inputs</td></tr>
<tr><td>X6</td><td>PLC outputs</td></tr>
<tr><td>X15 to X19</td><td>Speed encoder</td></tr>
<tr><td>X31</td><td>Supply voltage for UEC 11x (3 x 400 V ± 10 %)</td></tr>
<tr><td>X71</td><td>Spindle safety relay (pulse inhibitor for spindle)</td></tr>
<tr><td>X72</td><td>Safety relay of axes (pulse inhibitor for axes)</td></tr>
<tr><td>X80</td><td>Motor connection for spindle
(24 A rated current at 3.3 kHz)</td></tr>
<tr><td>X81</td><td>Motor connection axis 1
(6 A rated current at 3.3 kHz)</td></tr>
<tr><td>X82</td><td>Motor connection axis 2
(6 A rated current at 3.3 kHz)</td></tr>
<tr><td>X83</td><td>Motor connection axis 3
(9 A rated current at 3.3 kHz)</td></tr>
<tr><td>X84</td><td>Motor connection axis 4
(6 A rated current at 3.3 kHz)</td></tr>
<tr><td>X89</td><td>Braking resistor</td></tr>
<tr><td>X90</td><td>24 V NC output / 3.5 A</td></tr>
<tr><td>X112</td><td>TS triggering touch probe</td></tr>
<tr><td>X113</td><td>TT triggering touch probe</td></tr>
<tr><td>X201 to X205</td><td>Position encoder</td></tr>
<tr><td>X344</td><td>24 V supply for motor holding brake</td></tr>
<tr><td>X394</td><td>Motor holding brake 1 to 4</td></tr>
<tr><td>X500</td><td>HSCI output</td></tr>
<tr><td>X502</td><td>HSCI input</td></tr>
<tr><td>⏚</td><td>Protective ground M5</td></tr>
</table>

28.4.2 Pin layouts

Type of terminals on the UEC 11x

Socket connectors X4, X5, X6 on UEC 11x	
Connection	Socket connector with tension clamp connection, type: Weidmüller B2L 3.5/24 SN SW 2-row, 24-pin
Connectable conductors	Usable conductor cross sections without wire-end sleeve: 0.08 mm^2 to 1.0 mm^2 Usable conductor cross sections with wire-end sleeve: 0.14 mm^2 0.34 mm^2 0.5 mm^2 (only with Weidmüller PZ 6/5 crimping pliers)

Note

HEIDENHAIN recommends:

Preferably use a conductor cross section of 0.34 mm^2 if you use stranded wires with wire-end sleeves. This cross section can be clamped appropriately and ensures a reliable terminal connection.

If you use stranded wires with wire-end sleeves and a conductor cross section of 0.5 mm^2, the Weidmüller PZ 6/5 crimping pliers (setting 0.25–0.5 mm^2) must be used for crimping.
In this case, orient the crimped wire-end sleeve before inserting it into the socket connector.
If crimping pliers from other manufacturers are used for crimping conductors with a cross section of 0.5 mm^2, the crimped wire-end sleeves cannot be inserted into the socket connector and clamped appropriately, and therefore do not result in a reliable terminal connection.

X4: Single-channel PLC inputs

Connections on the front of the UEC 11x:

- 18 single-channel PLC inputs are freely available:
  I0 to I17

Terminal	Signal designation	Assignm. / Function
1a	+24 V PLC.01	24 V supply of the outputs MC.RDY, O16 to O22
2a	+24 V PLC.02	24 V supply of the outputs O8 to O15
3a	+24 V PLC.03	24 V supply of the outputs O0 to O7
4a	0 V PLC	0 V for all I/Os
5a	–REF.SP	Reserved, do not assign
6a	0 V PLC	0 V for all I/Os
7a	I12	24 V inputs
8a	I13	
9a	I14	
10a	I15	
11a	I16	
12a	I17	
1b	I0	24 V inputs
2b	I1	
3b	I2	
4b	I3	
5b	I4	
6b	I5	
7b	I6	
8b	I7	
9b	I8	
10b	I9	
11b	I10	
12b	I11	

X5: Single-channel PLC inputs

Connections on the front of the UEC 11x:

- 20 single-channel PLC inputs are freely available: I18 to I37

Terminal	Signal designation	Assignm. / Function
1a	I30	24 V inputs
2a	I31	
3a	I32	
4a	I33	
5a	I34	
6a	I35	
7a	I36	
8a	I37	
9a	–ES.A	+24 V input for "Control is ready" acknowledgment
10a	–ES.B	24 V input "Drive enable"
11a	Do not assign	
12a	Do not assign	
1b	I18	24 V inputs
2b	I19	
3b	I20	
4b	I21	
5b	I22	
6b	I23	
7b	I24	
8b	I25	
9b	I26	
10b	I27	
11b	I28	
12b	I29	

X6: Single-channel PLC outputs

Connections on the top of the UEC 11x:

- 23 single-channel PLC outputs
  O0 to O22

Terminal	Signal designation	Assignm. / Function
1a	O4	24 V outputs, can be switched off via terminal X4.3a (+24 V PLC.03)
2a	O5	
3a	O6	
4a	O7	
5a	O12	24 V outputs, can be switched off via terminal X4.2a (+24 V PLC.02)
6a	O13	
7a	O14	
8a	O15	
9a	O20	24 V outputs, cannot be switched off
10a	O21	
11a	O22	
12a	MC.RDY	24 V for control-is-ready signal output
1b	O0	24 V outputs, can be switched off via terminal X4.3a (+24 V PLC.03)
2b	O1	
3b	O2	
4b	O3	
5b	O8	24 V outputs, can be switched off via terminal X4.2a (+24 V PLC.02)
6b	O9	
7b	O10	
8b	O11	
9b	O16	24 V outputs, cannot be switched off
10b	O17	
11b	O18	
12b	O19	

Note

Each output of the UEC 11x may be loaded with a maximum current of 150 mA.

Note

If the integrated PLC outputs do not suffice for the machine, you can connect up to 7 additional external PL 61xx to the UEC 11x via the HSCI interface.

X15 to X19: Speed encoder

See “X15 to X20: 1 Vpp speed encoder” on page 28 – 465.

X31:
UEC power supply

Note

EN 61800-5-1 requires a non-detachable connection to the line power supply.

Note

If the power supply is other than 400 V, an autotransformer is required. It must comply at least with the connection specifications of the UEC 11x.

With a power supply of 400 V, the inverter voltage U_Z is 565 Vdc, and with a power supply of 480 V it is 678 Vdc.

Connecting terminals	UEC 111, UEC 112
Operation on 400 V~	
L1 L2 L3	400 V~ ± 10 % 50 Hz to 60 Hz
	Cable / single conductor (HT wire): 6 mm^2 (AWG 10) Single conductor H07 V2-K: 4 mm^2 (AWG 10) Line fuse: 25 A (gR) semiconductor fuse, Siemens Sitor type Grounding terminal: ≥ 10 mm^2 (AWG 6)
	Tightening torque for connecting terminals: 0.7 Nm (6.5 to 7 psi)
Operation on 480 V~	
L1 L2 L3	480 V~ ± 10 % 50 Hz to 60 Hz
	Cable / single conductor (HT wire): 6 mm^2 (AWG 10) Single conductor H07 V2-K: 4 mm^2 (AWG 10) Line fuse: 25 A (gR) semiconductor fuse, Siemens Sitor type Grounding terminal: ≥ 10 mm^2 (AWG 6)
	Tightening torque for connecting terminals: 0.7 Nm (6.5 to 7 psi)

X71: Safety relay for spindle
X72: Safety relay for axes

For information on the wiring and function, see the circuit diagram for your machine.

Connecting terminals X71 to X72	Assignment
1	+24 V pulse release output (max. 250 mA) for control of the relays at X71.3 and X72.3 for drive enabling (Axis ON, Spindle ON).
2	0 V for pulse release output
3	+24 V pulse release input for Axis ON, Spindle ON
4	Do not assign
5	Do not assign
6[a]	Normally closed contact (OE1, OE1A or OE1S)
7[a]	Normally closed contact (OE2, OE2A or OE2S)

a. Max. 125 V

Note

The +24 V pulse release voltage at terminals X71.1 and X72.1 is generated internally by a separate power supply unit of the UEC 11x. This voltage may only be used for drive enabling (for supplying the relay coils that are internally connected to X71.3 and X72.3).

Attention

The +24 V pulse release voltage must not be linked with other voltages (e.g. +24 V NC or +24 V PLC) of the HEIDENHAIN control system.

Attention

A recovery diode is required in the proximity of inductive loads, e.g. relay or contactor coils.

X80: Spindle motor
X81: Axis motor 1
X82: Axis motor 2
X83: Axis motor 3
X84: Axis motor 4

Connecting terminals	Assignment
U	Motor connection U
V	Motor connection V
W	Motor connection W

X89: Braking resistor

Connecting terminal X89 UE 11x	Assignment	PW 21x	PW 1x0(B); Connecting terminal X1
1	$+U_Z$	RB1	1
2	Switch to $–U_Z$	RB2	2

X90: 24 V output

Connecting terminal X90	Assignment
+	+24 V (max. 3.5 A)
–	0 V

X112, X113: Triggering touch probe

> **Note**
>
> The touch probes are connected to the PLB 62xx PLC system module or UEC 11x controller unit at X112 (TS) and X113 (TT).

> **Note**
>
> For the PLB 62xx up to variant 02, please note:
>
> The touch probe adapter ID 667674-01 is required to connect a TT touch probe to the connector X113.

X112/X113 pin layout on PLB 62xx as of variant-03 and UEC 11x:

(15-pin D-sub, triple-row)

Female	Assignment of X112 (TS)	Assignment of X113 (TT)
1	Trigger signal	Trigger signal
2	$\overline{\text{Trigger signal}}$[a]	$\overline{\text{Trigger signal}}$[a]
3	TS ready	Do not assign
4	$\overline{\text{Battery warning}}$	$\overline{\text{Battery warning}}$
5	+ 5 V-NC (+/- 5%)	+ 5 V-NC (+/- 5%)
6	TS start	Do not assign
7	Do not assign	TT start
8	0 V-NC	0 V-NC
9	0 V-NC	0 V-NC
10	+ 24 V-NC	+ 24 V-NC
11	Do not assign	TT ready
12	Do not assign	Do not assign
13	Do not assign	Do not assign
14	Do not assign	Do not assign
15	Do not assign	Do not assign

a. Stylus at rest means logic level HIGH.

> **Note**
>
> The interface complies with the requirements of EN 60204-1:2006 for protective extra-low voltage (PELV).

Adapter for connecting the TT touch probe to a PLB 62xx up to variant 02:

This adapter makes the Start and Ready signals available on the correct pins of X113.

Pin layout of adapter with ID 667 674-01:

(15-pin D-sub, triple-row)

Female	Assignment of X113 (TT) up to variant 02	Adapter ID 667 674-01	TT adapter cable ID 633 616-xx
1	Trigger signal		Trigger signal
2	$\overline{\text{Trigger signal}}$[a]		$\overline{\text{Trigger signal}}$[a]
3	TS ready		Do not assign
4	$\overline{\text{Battery warning}}$		$\overline{\text{Battery warning}}$
5	+ 5 V-NC (+/- 5%)		+ 5 V-NC (+/- 5%)
6	Start		Do not assign
7	0 V-NC		TT start
8	0 V-NC		0 V-NC
9	0 V-NC		0 V-NC
10	+ 24 V-NC		+ 24 V-NC
11	TT ready		TT ready
12	Do not assign		Do not assign
13	Do not assign		Do not assign
14	Do not assign		Do not assign
15	Do not assign		Do not assign

X344:
24 V power supply for motor holding brakes

Connecting terminals	Assignment
1	+24 V PLC
2	0 V PLC

X394:
Motor holding brakes

Connecting terminals	Assignment
1	Holding brake 1 (X81)
2	0 V PLC
3	Holding brake 2 (X82)
4	0 V PLC
5	Holding brake 3 (X83)
6	0 V PLC
7	Holding brake 4 (X84)
8	0 V PLC

X201 to X205:
Position encoder

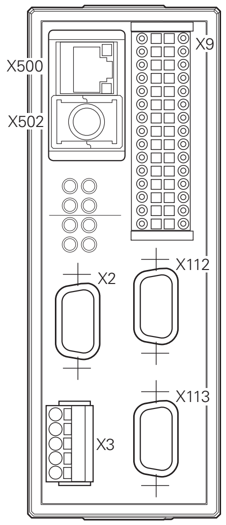
See “X201 to X206: Position encoder 1 Vpp” on page 28 – 470.

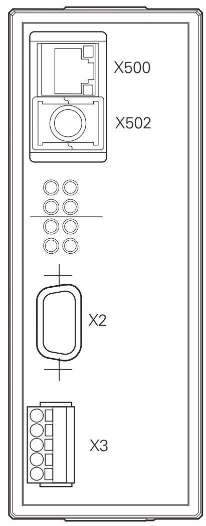
X500, X502:
HSCI interfaces

See “X500, X502: HSCI interfaces” on page 28 – 472.

28.5 PLB basic modules

28.5.1 Designations and positions of connectors

PLB 62xx, PLC system module		
Connection overview	**Connector**	**Function**
	X500	HSCI output
	X502	HSCI input
	X9	Safety-related PLC inputs/outputs
	X2	Reserved, do not assign
	X3	+24 V NC, +24 V PLC power supply
	X112	TS triggering touch probe
	X113	TT triggering touch probe

PLB 61xx, PLC expansion module		
Connection overview	**Connector**	**Function**
	X500	HSCI output
	X502	HSCI input
	X2	Reserved, do not assign
	X3	+24 V NC, +24 V PLC power supply

Meaning of the LEDs on PLB 6xxx:

PLB 6xxx, meaning of the LEDs		
LED	**LED status**	**Meaning**
PL green (right)	■ Off ■ On ■ Slow blinking	■ PL not ready ■ PL ready ■ PL initialization
PL yellow (left)	■ Off ■ Fast blinking ■ Blinking twice	■ No error ■ Error with SS1F reaction is present ■ Error with SS2 reaction is present
HSCI green (right)	■ Off ■ On	■ PL not ready for HSCI communication ■ PL ready for HSCI communication
HSCI yellow (left)	■ Off ■ Fast blinking ■ Blinking twice	■ No HSCI communication error ■ No HSCI communication ■ Error in HSCI communication

28.5.2 Pin layouts

X3:
+24 V NC, +24 V PLC power supply

Power consumption of the PL 6xxx via X3, +24 V NC: max. 48 W

Power consumption of the PL 6xxx via X3, +24 V PLC: max. 21 W

The power to the PLC outputs is also supplied via the corresponding terminals on the respective I/O module connectors for PLC outputs. The power consumption of the +24 V PLC via X3 and the power consumption of the PLC outputs add to each other.

Pin layout of X3:
Supply voltage for logic and PLC outputs

Connecting terminal	Assignment
1 (top terminal)	+ 24 V NC
2	0 V NC (ground + 24 V NC)
3	⏚ Protective ground Minimum wire cross section of the power cables for 24 V PLC
4	+24 V PLC
5 (bottom terminal)	0 V PLC (ground +24 V PLC)

Type of terminal X9 on PLB 62xx

Socket connector X9 on PLB 62xx	
Connection	Socket connector with tension clamp connection, type: Weidmüller B2L 3.5/30 SN SW 2-row, 30-pin
Connectable conductors	Usable conductor cross sections without wire-end sleeve: 0.08 mm^2 to 1.0 mm^2 Usable conductor cross sections with wire-end sleeve: 0.14 mm^2 0.34 mm^2 0.5 mm^2 (only with Weidmüller PZ 6/5 crimping pliers)

Note

HEIDENHAIN recommends:

Preferably use a conductor cross section of 0.34 mm^2 if you use stranded wires with wire-end sleeves. This cross section can be clamped appropriately and ensures a reliable terminal connection.

If you use stranded wires with wire-end sleeves and a conductor cross section of 0.5 mm^2, the Weidmüller PZ 6/5 crimping pliers (setting 0.25–0.5 mm^2) must be used for crimping.
In this case, orient the crimped wire-end sleeve before inserting it into the socket connector.
If crimping pliers from other manufacturers are used for crimping conductors with a cross section of 0.5 mm^2, the crimped wire-end sleeves cannot be inserted into the socket connector and clamped appropriately, and therefore do not result in a reliable terminal connection.

X9: Safety-relevant PLC inputs/outputs

Pin layout of PLB 62xx:

The triggering outputs at X9 each supply up to 150 mA of output current. The only exceptions are the two outputs –STOS.A.G and -STO.A.G with max. 2 A of output current.

Seven outputs and twelve inputs are available at X9 of a PLB 62xx for free use.
Further PLC inputs/outputs must be realized by means of I/O modules.

Terminal	NEW signal designation	OLD connector/signal design. (MC 42xC)	Assignm. / Function
1a	24 V.A	X34	24 V supply of the outputs MC.RDY, O.0 to O.2
2a	Do not assign	–	–
3a	MC.RDY[a]	–SH1A (safe stop) X41.34 / O33	24 V output: (safe torque off) “Control is ready”
4a	O0		24 V outputs (high-side driver)
5a	O1		
6a	O2		
7a	–ES.A	–NE1 / X42.4 / I3 Acknowledgment: "Control is ready"	24 V input EMERGENCY STOP input 1
8a	I0		24 V inputs (PLC)
9a	I1		
10a	I2		
11a	I3		
12a	I4		
13a	I5		
14a	–PF.PS.AC	–PF.PS.AC (signal at X69)	24 V outputs for powerfail
15a	–PF.PS.DC	–PF.PS.ZK (signal at X69)	
1b	24 V.B	X44	24 V supply of the outputs O.3 to O.6
2b	0 V		0 V PLC for all I/Os
3b	O3[a]		24 V outputs (high-side driver)
4b	O4		
5b	O5		
6b	O6		
7b	–ES.B	–NE2 / X42.33 / I32 "Drive enabling"	24 V input EMERGENCY STOP input 2
8b	I6		24 V inputs (PLC)
9b	I7		
10b	I8		
11b	I9		
12b	I10		
13b	I11		
14b	–SP.REF+	X30	Optocoupler input, Spindle ref.
15b	–SP.REF–	X30	

a. 2 A outputs

X112, X113: Triggering touch probe

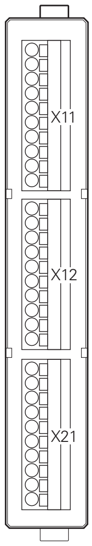
See “X112, X113: Triggering touch probe” on page 28 – 479.

X500, X502: HSCI interfaces

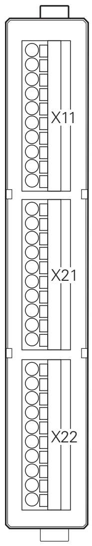
See “X500, X502: HSCI interfaces” on page 28 – 472.

28.6 Digital I/O modules

28.6.1 Designations and positions of connectors

<table>
<tr><td colspan="3">PLD-H 16-08-00</td></tr>
<tr><th>Positions of the connectors</th><th>Connector</th><th>Function</th></tr>
<tr><td rowspan="4">
</td><td>X11</td><td>PLC inputs, channel A</td></tr>
<tr><td>X12</td><td>PLC inputs, channel A</td></tr>
<tr><td>X21</td><td>PLC outputs, channel A</td></tr>
<tr><td colspan="2">Diagnosis (meanings of the LEDs):
■ Red (X11/pin 1) status LED
• Flashes: status of I/O module OK
• Continuously on or off: error on I/O module
■ Yellow (per output): Status of the output

Error recognition:
■ Short circuit: A short circuit is reported when a current >= 20 A flows for approximately 3 ms. Both the output-specific message and the group message are modal.
After the short circuit has been removed, the PLC must reset the output before it can be activated again.</td></tr>
</table>

<table>
<tr><td colspan="3">PLD-H 08-16-00</td></tr>
<tr><th>Positions of the connectors</th><th>Connector</th><th>Function</th></tr>
<tr><td rowspan="4">
</td><td>X11</td><td>PLC inputs, channel A</td></tr>
<tr><td>X21</td><td>PLC outputs, channel A</td></tr>
<tr><td>X22</td><td>PLC outputs, channel A</td></tr>
<tr><td colspan="2">Diagnosis (meanings of the LEDs):
■ Red (X11/pin 1) status LED
• Flashes: status of I/O module OK
• Continuously on or off: error on I/O module
■ Yellow (per output): Status of the output

Error recognition:
■ Short circuit: A short circuit is reported when a current >= 20 A flows for approximately 3 ms. Both the output-specific message and the group message are modal.
After the short circuit has been removed, the PLC must reset the output before it can be activated again.</td></tr>
</table>

28.6.2 Pin layouts

X11, X12: PLC inputs

Note

The 0 V terminals of X11 and X12 of the PLD-H are connected internally. These connections are used for connecting the potential of the electronics and for operating the LEDs.
Since only a low current is required (max. 50 mA), it is sufficient to establish only one 0 V connection (preferably at X11).

X11: PLC inputs on the PLD-H										
Assignment	**Terminal**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
PL 6xxx Slot 1	0 V PLC	0 V PLC	I0	I1	I2	I3	I4	I5	I6	I7

X12: PLC inputs on the PLD-H										
Assignment	**Terminal**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
PL 6xxx Slot 1	0 V PLC	0 V PLC	I8	I9	I10	I11	I12	I13	I14	I15

Only the first four slots of a PL 6xxx can be used for **fast PLC inputs**. The fifth slot and the successive slots (on PL 6x06, PL 6x08) must not be defined as fast PLC inputs.

The configuration of fast PLC inputs in the HSCI system corresponds to the previous configuration using machine parameters.

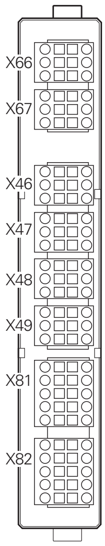
X21, X22: PLC outputs

X21: PLC outputs on the PLD-H										
Assignment	**Terminal**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
PL 6xxx Slot 1	O0	O1	O2	O3	O4	O5	O6	O7	24 V PLC for O0 to O3	24 V PLC for O4 to O7

X22: PLC outputs on the PLD-H										
Assignment	**Terminal**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
PL 6xxx Slot 1	O8	O9	O10	O11	O12	O13	O14	O15	24 V PLC for O8 to O11	24 V PLC for O12 to O15

28.7 Analog I/O modules

28.7.1 Designations and positions of connectors

PLA-H 08-04-04		
Positions of the connectors	**Connector**	**Function**
	X66 to X67	Analog outputs +/- 10 V
	X46 to X49	Analog inputs +/- 10 V
	X81 to X82	Analog inputs Pt 100

The PLA-H 08-04-04 has analog inputs, analog outputs and inputs for PT 100 thermistors.

	Analog inputs (±10 V)	Analog outputs (±10 V)	Inputs for Pt 100 thermistors
PLA-H 08-04-04	8	4	4

28.7.2 Pin layouts

Type of terminals on the PLA-H 08-04-04

Socket connectors on the PLA-H 08-04-04	
Connection:	Socket connector with tension clamp connection, X81, X82: Type: Weidmüller B2L 3.5/10 SN SW 2-row, 10-pin X66, X67, X46, X47, X48, X49: Weidmüller B2L 3.5/6 SN SW 2-row, 6-pin
Connectable conductors:	Usable conductor cross sections without wire-end sleeve: 0.08 mm^2 to 1.0 mm^2 Usable conductor cross sections with wire-end sleeve: 0.14 mm^2 0.34 mm^2 0.5 mm^2 (only with Weidmüller PZ 6/5 crimping pliers)

Note

HEIDENHAIN recommends:

Preferably use a conductor cross section of 0.34 mm^2 if you use stranded wires with wire-end sleeves. This cross section can be clamped appropriately and ensures a reliable terminal connection.

If you use stranded wires with wire-end sleeves and a conductor cross section of 0.5 mm^2, the Weidmüller PZ 6/5 crimping pliers (setting 0.25–0.5 mm^2) must be used for crimping.
In this case, orient the crimped wire-end sleeve before inserting it into the socket connector.
If crimping pliers from other manufacturers are used for crimping conductors with a cross section of 0.5 mm^2, the crimped wire-end sleeves cannot be inserted into the socket connector and clamped appropriately, and therefore do not result in a reliable terminal connection.

X46 to X49: Analog input

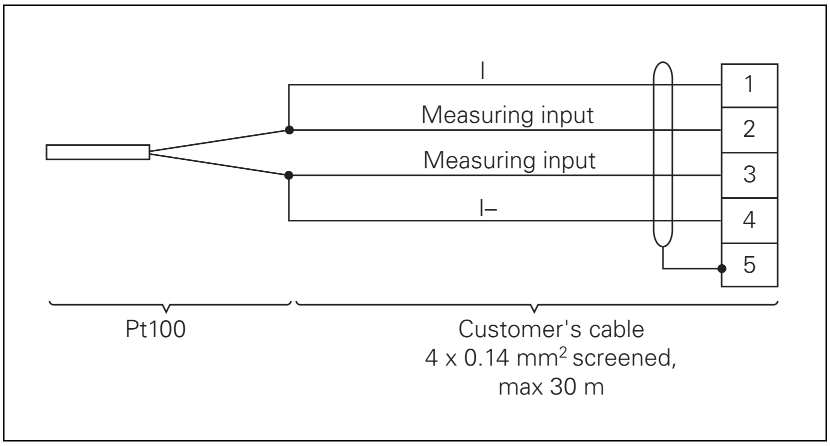
Connecting terminals	Assignment
1a/1b	–10 V to +10 V (input)
2a/2b	0 V (reference potential)
3a/3b	Shield

X66 to X67: Analog output

Connecting terminals	Assignment
1a/1b	–10 V to +10 V (output)
2a/2b	0 V (reference potential)
3a/3b	Shield

X81 to X82: Connection for PT 100

Normally, the thermistor connection is configured as a "four-conductor circuit":



Connecting terminals	Assignment
1a/1b	I+ Constant current for PT 100
2a/2b	U+ Measuring input for PT 100
3a/3b	U– Measuring input for PT 100
4a/4b	I– Constant current for Pt 100
5a/5b	Shield

28.8 SPI expansion module

28.8.1 Designations and positions of connectors

28.8.2 Pin layouts

In the HSCI system, analog nominal-value outputs are available via the CMA-H 04-04-00, e.g. for controlling spindles and auxiliary axes.

The CMA-H 04-04-00 is an optional SPI expansion module. It adds four analog nominal-value outputs to the CC 61xx controller unit or the UEC 1xx.

Controller unit	Number of CMA-H 04-04-00 modules per unit	Max. number of nominal value outputs
CC 61xx	2	8
UEC 11x	1	4

Note

- The analog nominal-value outputs can only be accessed via the NC, and not via the PLC. The PL 6xxx provides PLC analog outputs.
- It is not possible to control interpolating axes; only spindles and auxiliary axes that are not interpolated together with other digital axes can be controlled.

Type of terminals on the CMA-H 04-04-00

Properties	Socket connectors on CMA-H 04-04-00
Output:	±10 V
Maximum load capacity of the outputs:	10 mA
Maximum capacity:	3 nF
Connection:	4 socket connectors with tension spring connection, type: Weidmüller B2L 3.5/6 SN SW 2-row, 6-pin
Connectable conductors:	Usable conductor cross sections without wire-end sleeve: 0.08 mm^2 to 1.0 mm^2 Usable conductor cross sections with wire-end sleeve: 0.14 mm^2 0.34 mm^2 0.5 mm^2 (only with Weidmüller PZ 6/5 crimping pliers)

Note

HEIDENHAIN recommends:

Preferably use a conductor cross section of 0.34 mm^2 if you use stranded wires with wire-end sleeves. This cross section can be clamped appropriately and ensures a reliable terminal connection.

If you use stranded wires with wire-end sleeves and a conductor cross section of 0.5 mm^2, the Weidmüller PZ 6/5 crimping pliers (setting 0.25–0.5 mm^2) must be used for crimping.
In this case, orient the crimped wire-end sleeve before inserting it into the socket connector.
If crimping pliers from other manufacturers are used for crimping conductors with a cross section of 0.5 mm^2, the crimped wire-end sleeves cannot be inserted into the socket connector and clamped appropriately, and therefore do not result in a reliable terminal connection.

X66 to X67: Analog outputs

X66: Analog outputs 1 and 2			
Function	**Analog output 1**		
Connecting terminal	**1a**	**2a**	**3a**
Assignment	±10 V	0 V	Shield
Function	**Analog output 2**		
Connecting terminal	**1b**	**2b**	**3b**
Assignment	±10 V	0 V	Shield

X67: Analog outputs 3 and 4			
Function	**Analog output 3**		
Connecting terminal	**1a**	**2a**	**3a**
Assignment	±10 V	0 V	Shield
Function	**Analog output 4**		
Connecting terminal	**1b**	**2b**	**3b**
Assignment	±10 V	0 V	Shield

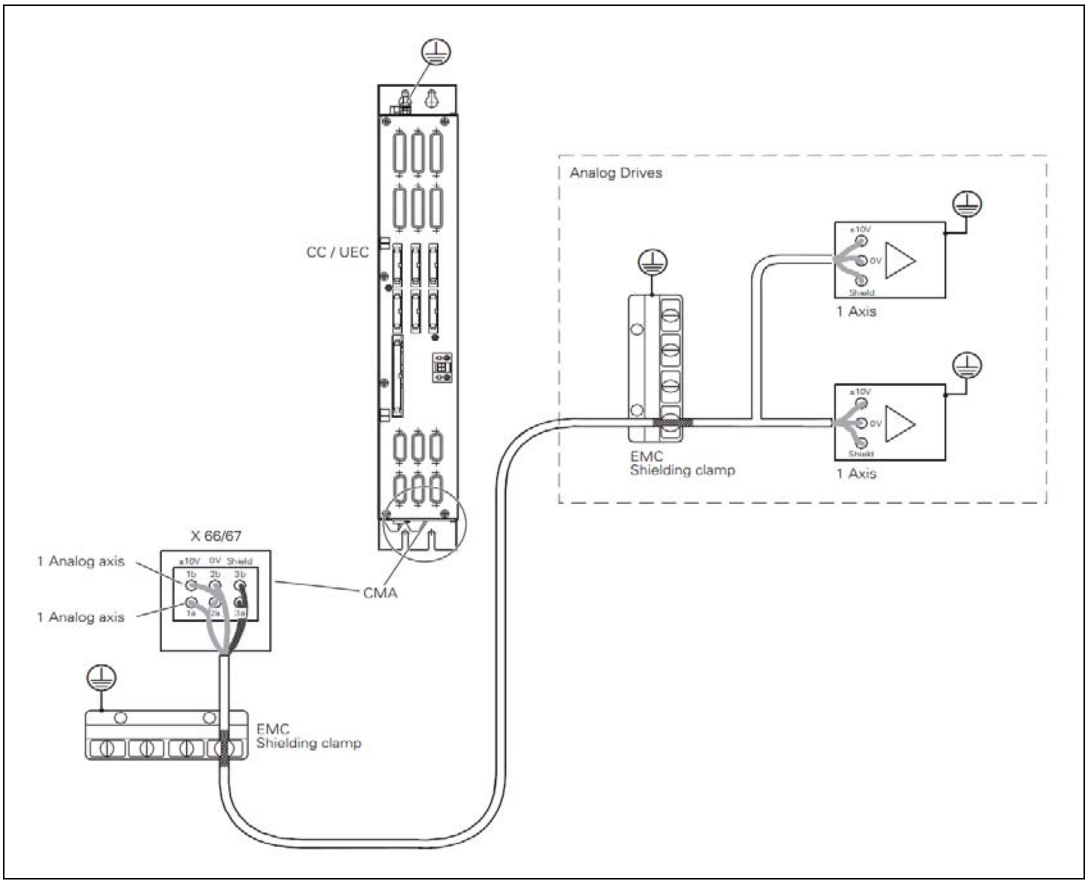
Note

Please note:

- Connect the shield of the connecting cable leading to the nominal-value output both to pin 3 a/b on the CMA-H and to the ground potential of the housing of the CC 61xx or UEC 11x. HEIDENHAIN recommends using EMC shielding terminals. The max. distance between the CMA-H and the ground point is 500 mm.
- On the analog servo amplifier, you also connect the shield of the connecting cable to the ground potential of the housing via an EMC shielding terminal.
- Use only shielded twisted-pair connecting cables.
- The connecting cables to the nominal-value outputs must not have more than one intermediate terminal.

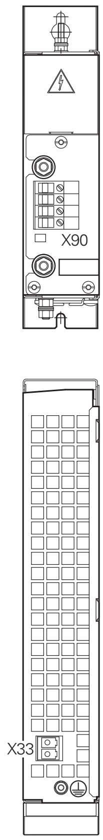
Wiring overview

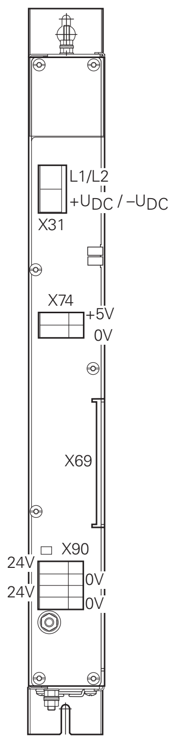
CMA-H 04-04-00: Schematic wiring diagram



28.9 PSL low-voltage power supply unit

28.9.1 Designations and positions of connectors

PSL 130 pin layout	Connector	Function
	Conductor bar	Connection of DC-link voltage Uz
	B – Signal ground (= functional ground)	Signal ground (0 V signal of the +24 V NC signal connected internally to protective ground)
	X90	Output for supply voltages: ■ Terminal 1: +24 V NC ■ Terminal 2: 0 V NC (ground +24 V NC) ■ Terminal 3: + 24 V PLC ■ Terminal 4 0 V PLC (ground +24 V– PLC)
	X33	Input voltages L1, L2
	⏚	Protective ground

PSL 135 pin layout	Connector	Function
	X31	Input voltages L1, L2 and connection of the DC-link voltage Uz
	B – Signal ground (= functional ground)	Signal ground (0 V signal of the +24 V NC signal connected internally to protective ground)
	X74	Output for supply voltages: ■ Terminal 1: +5 V ■ Terminal 2: 0 V
	X69	Power supply and control signals for CC 61xx (for X69 on CC)
	X90	Output for supply voltages: ■ Terminal 1: +24 V NC ■ Terminal 2: 0 V NC (ground +24 V NC) ■ Terminal 3: + 24 V PLC ■ Terminal 4 0 V PLC (ground +24 V– PLC)
	⏚	Protective ground

28.9.2 Pin layouts

X31:
Input voltage of the PSL 135

Supply voltage: 400 V ± 10 % or 400 V– to 750 V–

Connecting terminal	Assignment
L1	Phase 1 / 400 V~ ±10 % / 50 Hz to 60 Hz
L2	Phase 2 / 400 V~ ±10 % / 50 Hz to 60 Hz
$+U_{DC}$	400 V– to 750 V–
$–U_{DC}$	0 V–
	Equipment ground (YL/GN), ≥ 10 mm^2
	Connecting lead: Wire cross section: at least 1.5 mm^2 (AWG 16) **Conductor protection:** Fuses or a motor protection switch of 6.3 A or greater depending on the wire cross section used. **Line fuse:** Internal protection of the PSL (4 A).
Tightening torque: for the connecting terminals 0.5 - 0.6 Nm **Grounding terminal:** ≥ 10 mm^2 (AWG 6) **Strain relief:** Ensure that the connecting cables are not subject to excessive strain.	

Through the connection to the 400 V AC line voltage (L1, L2) via X31, the output voltages of the PSL 135 are available as soon as the machine's main switch has been turned on.
This is necessary to boot the control.

> Note
>
> HEIDENHAIN recommends connecting the PSL 135 power supply unit to the U_Z DC-link voltage and the 400 V supply voltage (X31).

Conductor bars:
Supply of the PSL 130 with U_Z

Connecting terminals	Assignment
$–U_Z$	DC-link voltage –
$+U_Z$	DC-link voltage +

X33:
Input voltage of the PSL 130

Supply voltage: 400 V ± 10 %

Connecting terminal	Assignment
L1	Phase 1 / 400 V~ ±10 % / 50 Hz to 60 Hz
L2	Phase 2 / 400 V~ ±10 % / 50 Hz to 60 Hz
⏚	Equipment ground (YL/GN), ≥ 10 mm^2
	Connecting lead: Wire cross section: at least 1.5 mm^2 (AWG 16) **Conductor protection:** Fuses or a motor protection switch of 6.3 A or greater depending on the wire cross section used. **Line fuse:** Internal protection of the PSL (4 A).
Tightening torque: for the connecting terminals 0.5 - 0.6 Nm **Grounding terminal:** ≥ 10 mm^2 (AWG 6) **Strain relief:** Ensure that the connecting cables are not subject to excessive strain.	

Through the connection to the 400 V AC line voltage (L1, L2) via X33, the output voltages of the PSL 130 are available as soon as the machine's main switch has been turned on.
This is necessary to boot the control.

Note

HEIDENHAIN recommends connecting the PSL 130 power supply unit to the U_Z DC-link voltage and the 400 V supply voltage (X33).

X69:
CC supply voltage and control signals

See “X69: CC supply voltage and control signals” on page 28 – 469.

X74:
Output voltage of the PSL 135

Connecting terminal	Assignment
Terminal 1 (top)	+ 5 V NC
Terminal 2	0 V NC (also ground +24 V NC)
Tightening torque: for the connecting terminals 0.5 to 0.6 Nm **Strain relief:** Ensure that the connecting cables are not subject to excessive strain.	

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

X90:
Output voltage of the PSL 13x

Connecting terminal	Assignment
Terminal 1 (top)	+ 24 V NC
Terminal 2	0 V NC (ground + 24 V NC)
Terminal 3	+ 24 V PLC
Terminal 4 (bottom)	0 V PLC (ground + 24 V PLC)
Tightening torque: for the connecting terminals 0.5 - 0.6 Nm **Strain relief:** Ensure that the connecting cables are not subject to excessive strain.	

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

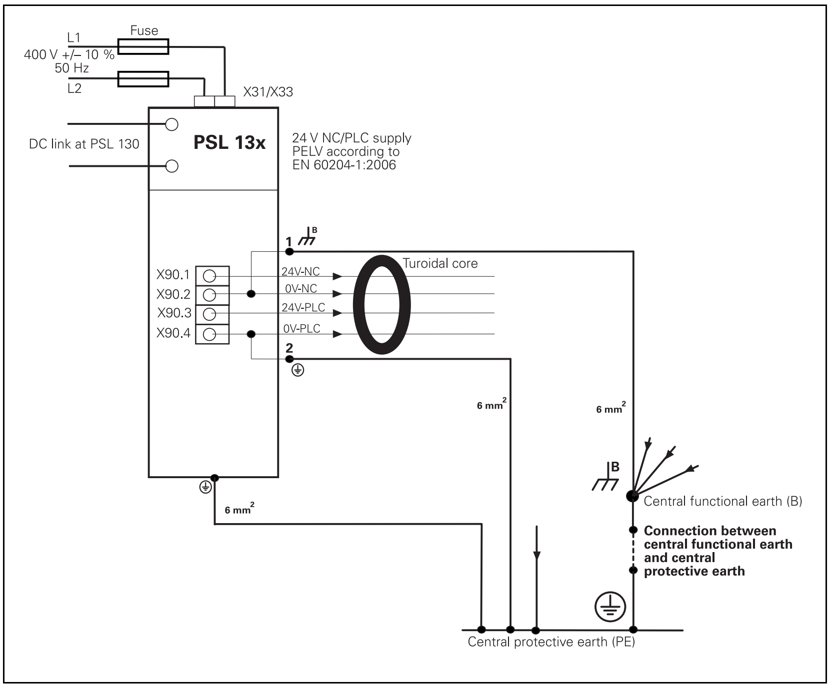
Signal ground (= functional ground)

Connections for signal ground, which are connected internally in the PSL 13x to 0 V NC and 0 V PLC signals.

Note

Conductor cross section of at least 6 mm^2 for connecting to signal ground (= central functional ground).

Power connection

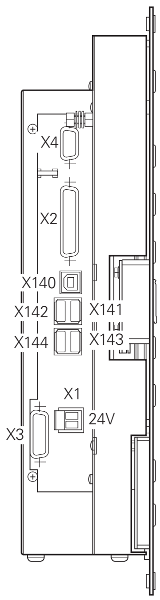


Note

PSL 130: As of variant 04 the toroidal core is integrated in the unit.
PSL 135: As of variant 02 the toroidal core is integrated in the unit.

28.10 Display unit

28.10.1 Designations and positions of connectors

<table>
<tr><td colspan="3">BF 250 15-inch TFT screen</td></tr>
<tr><th>Positions of the connectors</th><th>Connector</th><th>Function</th></tr>
<tr><td rowspan="7">
</td><td>X4</td><td>Reserved</td></tr>
<tr><td>X2</td><td>HDL connection
(HEIDENHAIN display link)</td></tr>
<tr><td>X140</td><td>USB input (type A)</td></tr>
<tr><td>X141 to X144</td><td>USB 2.0 output (type A)</td></tr>
<tr><td>X1</td><td>+24 V power supply</td></tr>
<tr><td>X3</td><td>Connection of the screen soft keys to the keyboard unit</td></tr>
<tr><td></td><td></td></tr>
</table>

28.10.2 Pin layouts

X1:
+24 V power supply

Connection for the +24 V power supply of the BF 2xx. The screen can be powered by +24 V NC or +24 V PLC through the integrated power supply unit of the BF 2xx.

Connecting terminal X1	Assignment
1	+24 V
2	0 V

Power supply: Minimum absolute value: +20.4 V–
Maximum absolute value: +28.8 V–

Power consumption of the BF 250: 50 W

X2:
HDL connection

Port for the HEIDENHAIN display link (HDL) connection to the MC 6xxx connector X249.
--> See "X249: Visual display unit" on page 28 – 459.

X3:
Connection of the screen soft keys

See "X3: Connection for screen soft keys" on page 28 – 455.

X140:
USB input

Connection for the integrated USB hub to the MC 6xxx connector X141 or X142.
The USB hub of the BF 2xx supports USB 2.0.

X141 to X146:
USB output

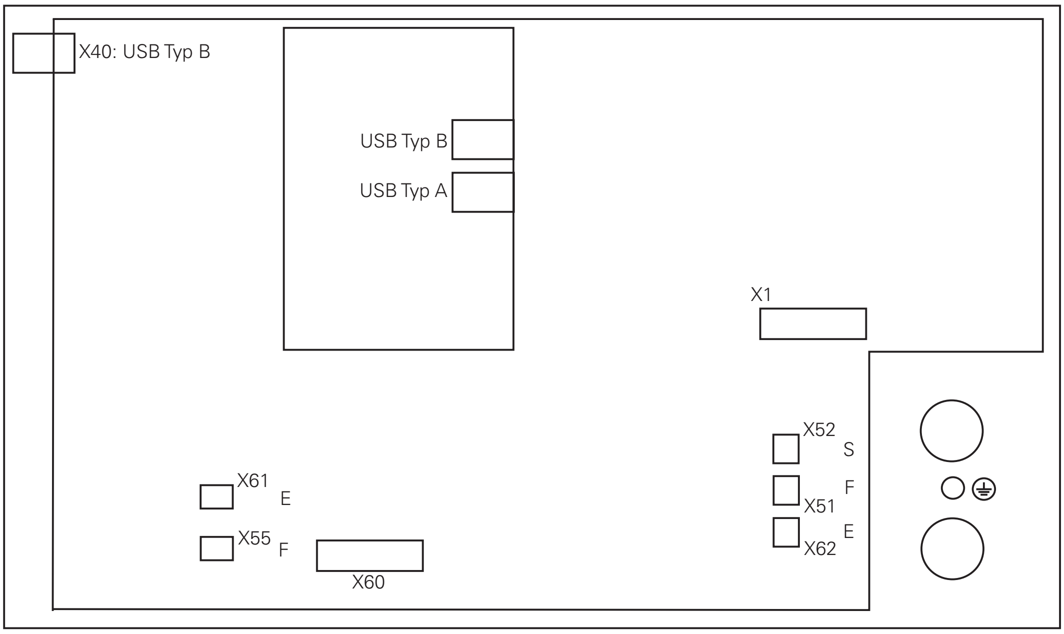
BF 250: Five freely available connections for additional USB devices.
One of them on the front of the BF 250.

Maximum load of the five USB outputs of the BF 250:
4 x 500 mA, 1 x 100 mA, distributed as desired

28.11 Keyboard units

28.11.1 Designations and positions of connectors

TE 620
TE 630



Connector	Function
USB type B	USB connection to BF 2xx. The TE 6xx is connected to the USB hub of the BF 2xx. The maximum permissible cable length for this USB connection is 3 m. The USB hub of the TE 6xx only supports USB 1.1.
USB type A	Freely available USB connection (USB 1.1) Maximum load capacity of USB output: 1 x 100 mA
X1	Screen soft keys of BF 2xx X3 via ribbon cable to keyboard unit X1
X60	Potentiometer of keyboard unit via ribbon cable to machine operating panel X10
X52 (S)	Connection for spindle-speed override potentiometer
X51 (F)	Connection for feed-rate override potentiometer
X62 (E)	Connection for rapid-traverse override potentiometer, alternative to X61 (not with TE 63x)
X55	Connection for feed-rate override potentiometer, alternative to X51 (not with TE 63x)
X61	Connection for rapid-traverse override potentiometer
⏚	Protective ground (M5)

The TE keyboard units are supplied with power via the USB port.

TE 635Q The TE 635Q is the same as the TE 630 with the operating panel keys of the MB 620 integrated.

28.11.2 Pin layouts

X1: Connection of the screen soft keys

See "X3: Connection for screen soft keys" on page 28 – 455.

X51: Feed rate override potentiometer

Connection for feed-rate override potentiometer

X52: Spindle override potentiometer

Connection for spindle-speed override potentiometer

X55: Feed rate override potentiometer

Connection for feed-rate override potentiometer; alternative to X51 (not with TE 63x)

X60: Potentiometer values for MB 620

Potentiometer values		
TE 6xx keyboard unit	**MB 620**	**Assignment**
X60 **Plug connector, 14-pin**	**X10** **Plug connector, 14-pin**	
1a	1a	Potentiometer 1
2a	2a	Potentiometer 3
3a	3a	Do not assign
4a	4a	Do not assign
5a	5a	Do not assign
6a	6a	+ 5 V
7a	7a	0 V
1b	1b	Potentiometer 2
2b	2b	- - -
3b	3b	Do not assign
4b	4b	Do not assign
5b	5b	- - -
6b	6b	+ 5 V
7b	7b	0 V

X61: Rapid traverse override potentiometer

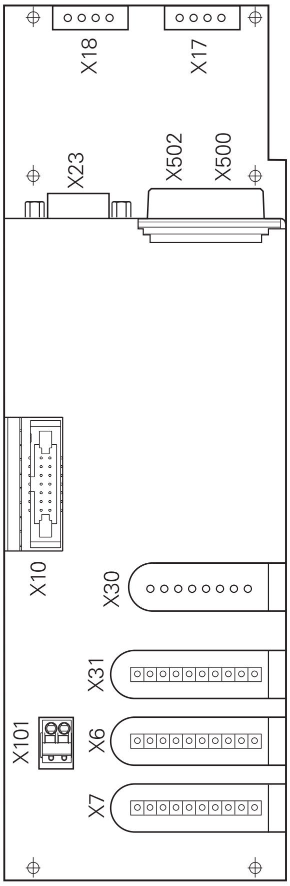
Connection for rapid-traverse override potentiometer

X62: Rapid traverse override potentiometer

Connection for rapid-traverse override potentiometer, alternative to X61 (not with TE 63x)

28.12 Machine operating panel

28.12.1 Designations and positions of connectors

Pin layout for MB 620	Connector	Function
	X17	EMERGENCY STOP (MB) (reserved for functional safety)
	X18	EMERGENCY STOP (MB) (reserved for functional safety)
	X500	HSCI output
	X502	HSCI input
	X6	PLC inputs
	X7	PLC outputs
	X10	Interface to keyboard and potentiometers
	X23	Handwheel connection
	X30	Connection for handwheel adapter (reserved for functional safety)
	X31	Permissive key, NC Start, NC Stop
	X101	24 V NC power supply
	⏚	Protective ground

28.12.2 Pin layouts

X6:
PLC inputs

Connecting terminals	Assignment
1	I0
2	I1
3	I2 (Control Voltage ON, CVO)[a]
4	I3
5	I4
6	I5
7	I6
8	I7
9	Reserved (do not assign)
10	Reserved (do not assign)

a. With standard wiring

DANGER

Please note that the MB 620 is powered by +24 V NC.

For the entire HSCI system, the +24 V NC power supply voltage is required to be safely separated voltage. It must also be safely separated from the +24 V PLC!

X7:
PLC outputs

Connecting terminals	Assignment
1	O0 (illumination for the NC Start key)[a]
2	O1 (illumination for the NC Stop key)[a]
3	O2 (illumination for the Control Voltage ON key)[a]
4	O3
5	O4
6	O5
7	O6
8	O7
9	+24 V NC (available here)
10	0 V NC (available here)

a. With standard wiring

Current load of the outputs: Maximum 150 mA per output

DANGER

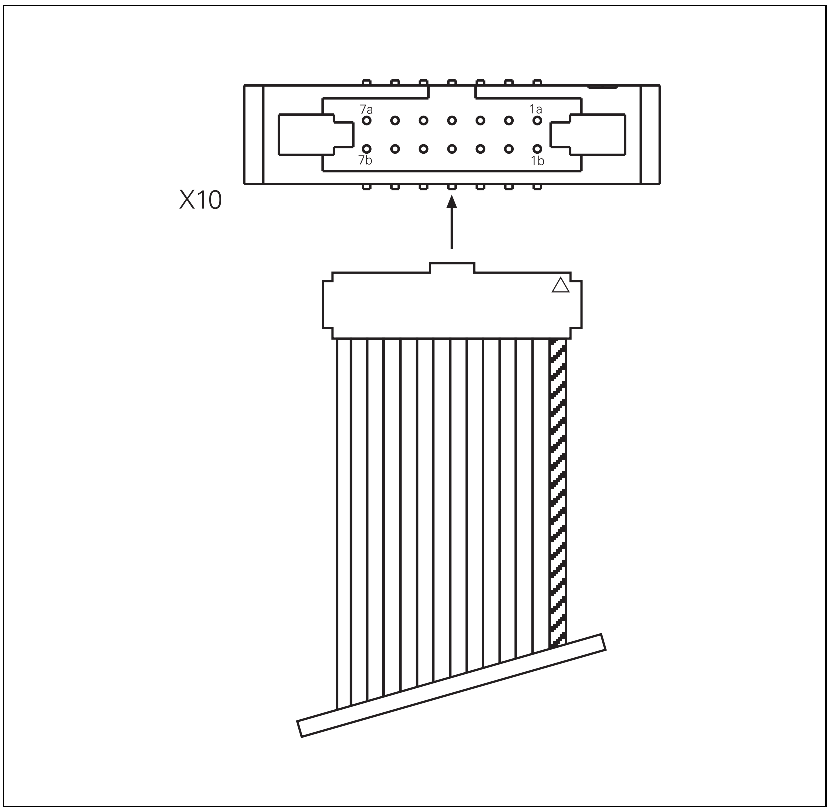
Please note that the outputs of connector X7 are powered internally by +24 V NC, and therefore supply +24 V NC at HIGH level.

For the entire HSCI system, the +24 V NC supply voltage is required to be safely separated voltage. The +24 V NC supply voltage must not, under any circumstances, be connected with the +24 V PLC supply voltage, because this removes the double basic insulation.

Each of the switching outputs at X7 supplies up to 150 mA of output current and are provided for driving the lamps on the MP620.

X10: Interface to keyboard and potentiometers

Designation of the terminals:



See "X60: Potentiometer values for MB 620" on page 28 – 499.

X17 and X18: EMERGENCY STOP on MB

Only for machine operating panels with FS (functional safety).

Not for use with MB 620 without FS!
With the MB 620 without FS, the EMERGENCY STOP must be wired externally in the EMERGENCY STOP chain!

X23: Handwheel input

D-sub connector (female) 9-pin	Assignment
1	CTS
2	0 V
3	RTS
4	+12 V
5	Do not assign
6	DTR
7	TxD
8	RxD
9	DSR
Housing	External shield

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

DANGER

The connector for the handwheel on the machine operating panel, as well as the connector on the handwheel itself, may be removed only by trained and qualified personnel, even if it can be removed without using a tool.
If the handwheel connector is removed, only basic insulation from line power (230 V) is provided!

X30: Handwheel connection, permissive button / EMERGENCY STOP

Only for machine operating panels with FS (functional safety).

Not for use with MB 620 without FS!
With the MB 620 without FS, the EMERGENCY STOP and the permissive keys must be wired externally in the EMERGENCY STOP chain and in the safety circuits!

X31: NC Start / NC Stop

Connecting terminals	Assignment
1	Reserved (do not assign)
2	Reserved (do not assign)
3	Reserved (do not assign)
4	Reserved (do not assign)
5	NC Start[a]
6	Reserved (do not assign)
7	NC Start power supply (+24 V NC)[a]
8	NC Stop[a]
9	Reserved (do not assign)
10	NC Stop power supply (+24 V NC)[a]

a. With standard wiring

NC Start and NC Stop are normally-open contacts on the MB 620.

DANGER

Please note that the MB 620 is powered by +24 V NC.

For the entire HSCI system, the +24 V NC supply voltage is required to be safely separated voltage. The +24 V NC supply voltage must not, under any circumstances, be connected with the +24 V PLC supply voltage, because this removes the double basic insulation.

X101: Power supply

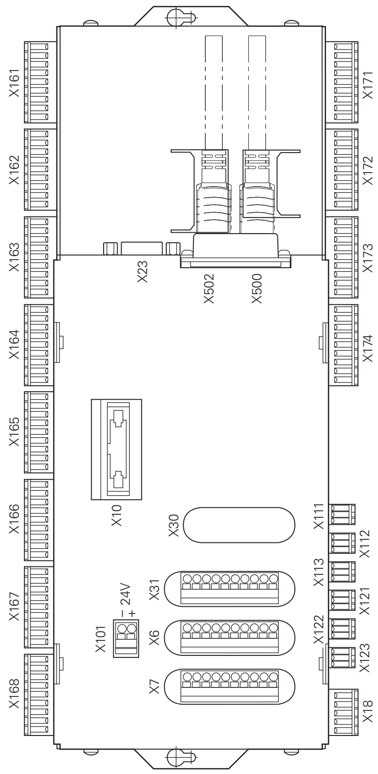
Connecting terminals	Assignment
1	+24 V-NC
2	0 V-NC

X500, X502: HSCI interfaces

Assignment –> See ”X500, X502: HSCI interfaces” on page 28 – 472.

28.13 HSCI adapter PLB 6001

28.13.1 Designations and positions of connectors



PLB 6001 pin layout	Connector	Function
	X500	HSCI output
	X502	HSCI input
	X6	PLC inputs
	X7	PLC outputs
	X10	Interface to keyboard and potentiometers
	X18	Reserved
	X23	Handwheel connection
	X30	Reserved
	X31	Permissive key, NC Start, NC Stop
	X101	24 V NC power supply
	X111	Potentiometer connection 1
	X112	Potentiometer connection 2
	X113	Potentiometer connection 3
	X121	Potentiometer connection 4
	X122	Potentiometer connection 5
	X123	Potentiometer connection 6
	X161	PLC inputs I0 to I7
	X162	PLC inputs I8 to I15
	X163	PLC inputs I16 to I23
	X164	PLC inputs I24 to I31
	X165	PLC inputs I32 to I39
	X166	PLC inputs I40 to I47
	X167	PLC inputs I48 to I55
	X168	PLC inputs I56 to I63
	X171	PLC outputs O0 to O7
	X172	PLC outputs O8 to O15
	X173	PLC outputs O16 to O23
	X174	PLC outputs O24 to O31
	⏚	Protective ground

28.13.2 Pin layouts

X6:
PLC inputs

Connecting terminals	Assignment
1	I0
2	I1
3	I2 (Control Voltage ON, CVO)[a]
4	I3
5	I4
6	I5
7	I6
8	I7
9	Reserved (do not assign)
10	Reserved (do not assign)

a. With standard wiring

DANGER

Please note that the PLB 6001 is supplied with +24 V NC.

For the entire HSCI system, the +24 V NC power supply voltage is required to be safely separated voltage. It must also be safely separated from the +24 V PLC!

X7:
PLC outputs

Connecting terminals	Assignment
1	O0 (illumination for the NC Start key)[a]
2	O1 (illumination for the NC Stop key)[a]
3	O2 (illumination for the Control Voltage ON key)[a]
4	O3
5	O4
6	O5
7	O6
8	O7
9	+24 V NC (available here)
10	0 V NC (available here)

a. With standard wiring

Current load of the outputs: Maximum 150 mA per output

DANGER

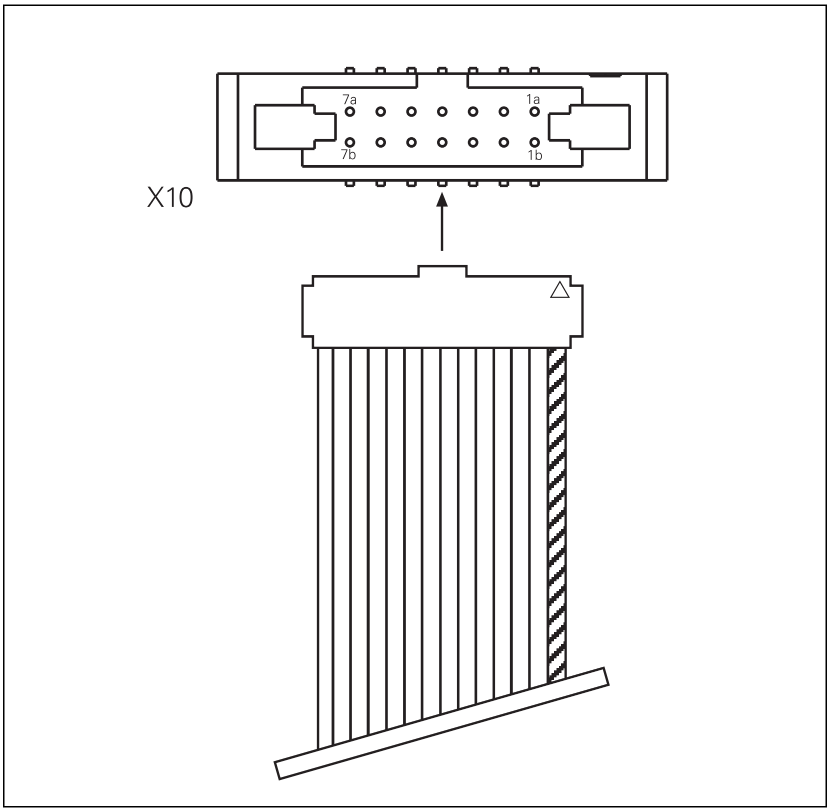
Please note that the outputs of connector X7 are powered internally by +24 V NC, and therefore supply +24 V NC at HIGH level.

For the entire HSCI system, the +24 V NC supply voltage is required to be safely separated voltage. The +24 V NC supply voltage must not, under any circumstances, be connected with the +24 V PLC supply voltage, because this removes the double basic insulation.

Each of the switching outputs at X7 supplies up to 150 mA of output current. They are provided for driving the lamps on the machine operating panel.

X10: Interface to keyboard and potentiometers

Designation of the terminals:



See “X60: Potentiometer values for MB 620” on page 28 – 499.

X23: Handwheel input

D-sub connector (female) 9-pin	Assignment
1	CTS
2	0 V
3	RTS
4	+ 12 V
5	Do not assign
6	DTR
7	TxD
8	RxD
9	DSR
Housing	External shield

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

DANGER

The connector for the handwheel on the machine operating panel, as well as the connector on the handwheel itself, may be removed only by trained and qualified personnel, even if it can be removed without using a tool.
If the handwheel connector is removed, only basic insulation from line power (230 V) is provided!

X31:
NC Start / NC Stop

Connecting terminals	Assignment
1	Reserved (do not assign)
2	Reserved (do not assign)
3	Reserved (do not assign)
4	Reserved (do not assign)
5	NC Start
6	Reserved (do not assign)
7	NC Start power supply (+24 V NC)
8	NC Stop
9	Reserved (do not assign)
10	NC Stop power supply (+24 V NC)

DANGER

Please note that the PLB 6001 is supplied with +24 V NC.

For the entire HSCI system, the +24 V NC supply voltage is required to be safely separated voltage. The +24 V NC supply voltage must not, under any circumstances, be connected with the +24 V PLC supply voltage, because this removes the double basic insulation.

X101:
Power supply

Connecting terminals	Assignment
1	+24 V-NC
2	0 V-NC

X111 to X113,
X121 to X123:
Potentiometer connection

Connecting terminals	Assignment
1	0 V potentiometer
2	Potentiometer arm
3	+5 V potentiometer

X161 to X168:
PLC inputs

X161: PLC inputs									
Assignment	Terminal								
	1	2	3	4	5	6	7	8	9
PL 6001	0 V PLC	I0	I1	I2	I3	I4	I5	I6	I7

X162: PLC inputs									
Assignment	Terminal								
	1	2	3	4	5	6	7	8	9
PL 6001	0 V PLC	I8	I9	I10	I11	I12	I13	I14	I15

X163: PLC inputs									
Assignment	Terminal								
	1	2	3	4	5	6	7	8	9
PL 6001	0 V PLC	I16	I17	I18	I19	I20	I21	I22	I23

X164: PLC inputs									
Assignment	Terminal								
	1	2	3	4	5	6	7	8	9
PL 6001	0 V PLC	I24	I25	I26	I27	I28	I29	I30	I31

X165: PLC inputs									
Assignment	**Terminal**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
PL 6001	0 V PLC	I32	I33	I34	I35	I36	I37	I38	I39

X166: PLC inputs									
Assignment	**Terminal**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
PL 6001	0 V PLC	I40	I41	I42	I43	I44	I45	I46	I47

X167: PLC inputs									
Assignment	**Terminal**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
PL 6001	0 V PLC	I48	I49	I50	I51	I52	I53	I54	I55

X168: PLC inputs									
Assignment	**Terminal**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
PL 6001	0 V PLC	I56	I57	I58	I59	I60	I61	I62	I63

X171 to X174: PLC outputs

X171: PLC outputs									
Assignment	**Terminal**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
PL 6001	24 V PLC for O0 to O7	O0	O1	O2	O3	O4	O5	O6	O7

X172: PLC outputs									
Assignment	**Terminal**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
PL 6001	24 V PLC for O8 to O15	O8	O9	O10	O11	O12	O13	O14	O15

X173: PLC outputs									
Assignment	**Terminal**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
PL 6001	24 V PLC for O16 to O23	O16	O17	O18	O19	O20	O21	O22	O23

X174: PLC outputs									
Assignment	**Terminal**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
PL 6001	24 V PLC for O24 to O31	O24	O25	O26	O27	O28	O29	O30	O31

Please note that the outputs of connectors X171 to X174 are metallically isolated internally from the +24 V24 VNC supply voltage supplied via X101. The outputs can therefore be supplied with +24 V PLC or +24 V NC.

For the entire HSCI system, the +24 V NC supply voltage is required to be safely separated voltage. The +24 V NC supply voltage must not, under any circumstances, be connected with the +24 V PLC supply voltage, because this removes the double basic insulation.

X500, X502: HSCI interfaces

Assignment --> See "X500, X502: HSCI interfaces" on page 28 – 472.

28.14 Handwheels

X23: Handwheel input

Handwheels are connected to the MB 620 machine operating panel. –> See ”X23: Handwheel input” on page 28 – 502.

28.14.1 HR 4xx or HR 5xx portable handwheel

Pin layout for the various extension cables, adapter cables, connecting cables, and the handwheel:

Extension cable ID281429xx			**Adapter cable ID296466xx**			**Connecting cable**			**HR 4xx HR 5xx**	
D-sub connector (male) 9-pin		**D-sub cnnctr. (female) 9-pin**	**D-sub connector (male) 9-pin**		**Cplg. on mntg. base (female) (5+7)-pin**	**Cnnctr. (male) (5+7)-pin**		**Cnnctr. (female) (5+7)-pin**	**Connctr. (male) (5+7)-pin**	
Hsg.	Shield	Housing	Hsg.	Shield	Housing	Hsg.	Shield	Housing	Hsg.	Shield
2	White	2	2	White	E	E	White	E	E	
4	Brown	4	4	Brown	D	D	Brown	D	D	
6	Yellow	6	6	Yellow	B	B	Yellow	B	B	
7	Gray	7	7	Gray	A	A	Gray	A	A	
8	Green	8	8	Green	C	C	Green	C	C	
					6	6	Black	6	6	
					7	7	RD/BL	7	7	
					5	5	Red	5	5	
					4	4	Blue	4	4	
					2	2	WH/GN	2	2	
					3	3	BN/GN	3	3	
					1	1	GY/PK	1	1	
				WH/BN	3	Contacts 1 + 2				
				WH/YL	2	Contact 2 (left) permissive button				
				WH/GN	1	Contact 1 (right)				
				WH/BL	1	Contact 1				
				WH/RD	2	Contact 1 EMERGENCY STOP				
				YL/BK	3	Contact 2				
				WH/BK	4	Contact 2				

Note

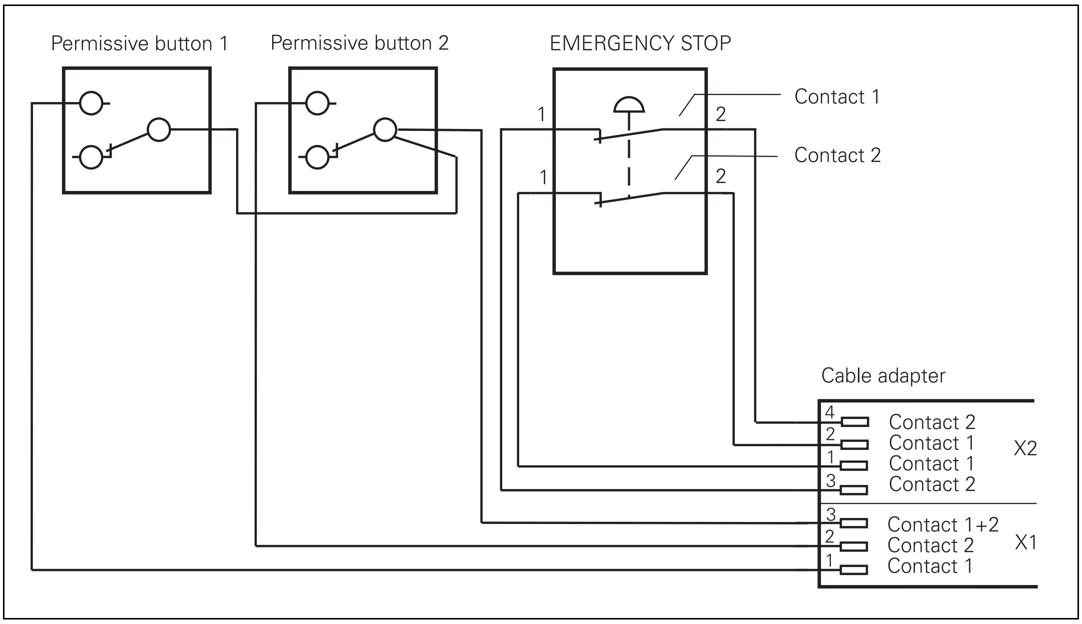
The interfaces comply with the requirements of EN 61800-5-1 for “protective extra-low voltage (PELV).”

DANGER

Only units that comply with the requirements of EN 61800-5-1 for "protective extra-low voltage (PELV)" may be connected.

The adapter includes plug-in terminal strips for the contacts of the EMERGENCY STOP button and permissive button (max. load 24 V; 1.2 A).

Internal wiring of the contacts for the EMERGENCY STOP button and permissive button:



Additional components		ID
Dummy plug for EMERGENCY STOP circuit		271 958-03
Connecting cables		
	Spiral cable	312 879-01
	Normal cable	296 467-xx
	Metal armor tubing	296 687-xx
Plug-in terminal strips for advance ordering		
	3-pin terminal block	266 364-06
	4-pin terminal block	266 364-12

28.14.2 HR 130 panel-mounted handwheel

The standard cable length for the HR 130 is 1 meter.

Pin layout for extension cable and handwheel:

Extension cable, ID 281 429-xx			HR 130, ID 254 040-xx	
D-sub cnnctr. (male) 9-pin		**D-sub cnnctr. (female) 9-pin**	**D-sub cnnctr. (male) 9-pin**	
Housing	Shield	Housing	Housing	Shield
2	White	2	2	White
4	Brown	4	4	Brown
6	Yellow	6	6	Yellow
8	Green	8	8	Green
7	Gray	7		

28.15 Touch probes

Touch probes for workpiece measurement

See “X112, X113: Triggering touch probe” on page 28 – 479.

Touch probes for tool measurement

See “X112, X113: Triggering touch probe” on page 28 – 479.

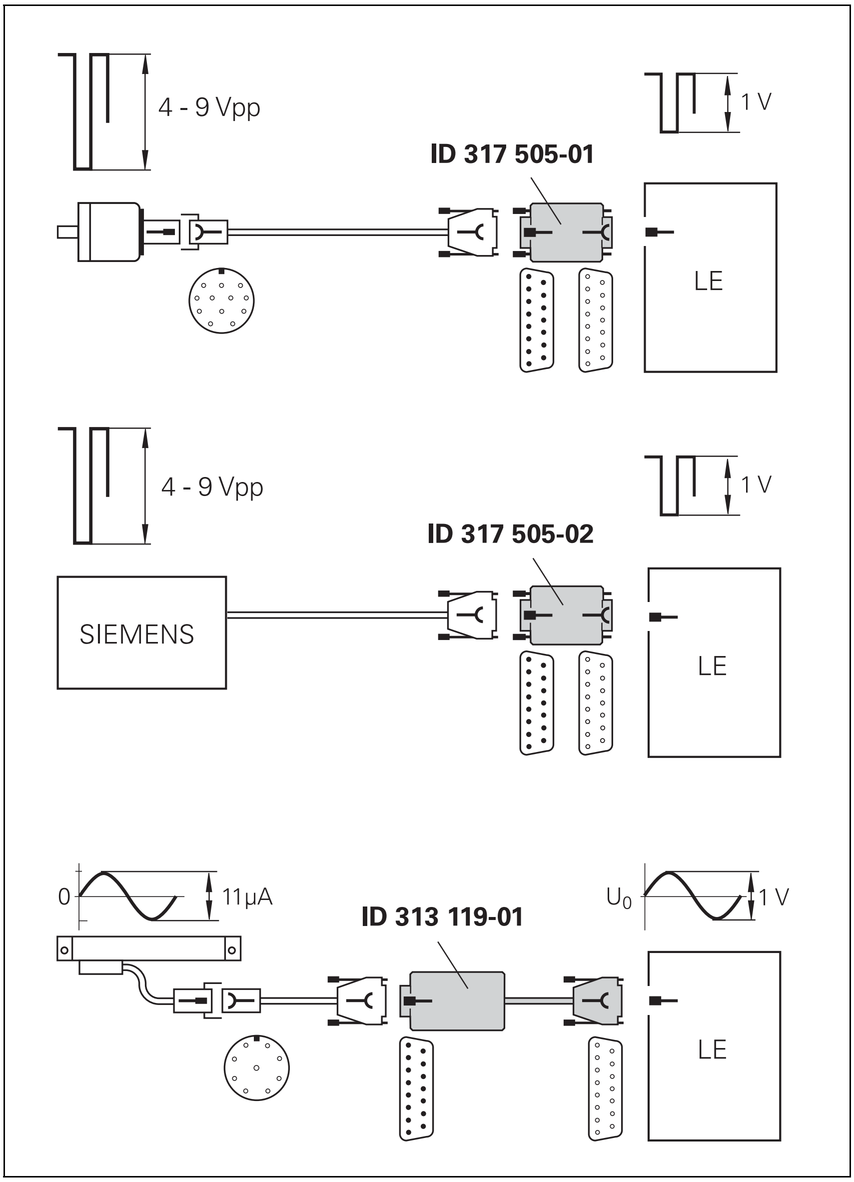
28.16 Encoders

28.16.1 Position encoders

See “X201 to X206: Position encoder 1 Vpp” on page 28 – 470.

Especially for machine retrofits, the use of adapters for encoder signal adjustment can be of interest.

Encoder signals with 11 μA_{PP} or TTL level can be adapted to the 1 V_{PP} interface with HEIDENHAIN adapter connectors.



Adapters for encoder signals	ID
TTL (HEIDENHAIN layout)/1 V_{PP}	317 505-01
TTL (SIEMENS layout)/1 V_{PP}	317 505-02
11 μA_{PP} to MC 6xxx	317 505-05
11 μA_{PP} /1 V_{PP}	313 119-01

Note

Please note:

- The adapters adjust only the levels, not the signal shape.
- The contamination signal of the square-wave encoder cannot be evaluated.
- A square-wave signal can be subdivided no more than 4-fold.
- If encoders with TTL signals are connected to a CC 61xx via an adapter (ID 317505-xx), then the phase position of the reference pulse is not correct. In order to deactivate monitoring, set bit 9 of MP2220.

Adapter TTL (HEIDENHAIN)/ 1 Vpp

Pin layout of D-sub connector (female) and D-sub connector (male):

D-sub connector (female), 15-pin	Assignment	D-sub connection (male), 15-pin	Assignment
1	+5 V (U_P)	1	+5 V (U_P)
2	0 V (U_N)	2	0 V (U_N)
3	A+	3	U_{a1}
4	A–	4	$–U_{a1}$
5	Not assigned	5	Not assigned
6	B+	6	U_{a2}
7	B–	7	$–U_{a2}$
8	Not assigned	8	Not assigned
9	+5 V	9	+5 V
10	R+	10	U_{a0}
11	0 V	11	0 V
12	R–	12	$–U_{a0}$
13	Not assigned	13	Not assigned
14	**Do not assign**[a]	14	**Do not assign**[a]
15	Not assigned	15	Not assigned

a. The control assigns the EnDat clock to pin 14. Therefore, you must not assign any signals to this pin when using the TTL adapter connector.

Adapter TTL (SIEMENS) 1 Vpp

Pin layout of D-sub connector (female) and D-sub connector (male):

D-sub connector (female), 15-pin	Assignment	D-sub connection (male), 15-pin	Assignment
1	Not assigned	1	Not assigned
2	0 V	2	0 V
3	A+	3	U_{a1}
4	A–	4	$–U_{a1}$
5	Not assigned	5	Not assigned
6	B+	6	U_{a2}
7	B–	7	$–U_{a2}$
8	Not assigned	8	Not assigned
9	Not assigned	9	Not assigned
10	R+	10	Not assigned
11	Not assigned	11	Not assigned
12	R–	12	U_{a0}
13	Not assigned	13	$–U_{a0}$
14	Not assigned	14	Not assigned
15	Not assigned	15	Not assigned

Adapter 11 µApp / 1 Vpp

Pin layout of D-sub connector (female) and D-sub connector (male):

D-sub connector (female), 15-pin	Assignment	D-sub connection (male), 15-pin	Assignment
1	+5 V (U_P)	1	+5 V (U_P)
2	0 V (U_N)	2	0 V (U_N)
3	A+	3	0°+
4	A–	4	0°–
5	0 V	5	0 V
6	B+	6	90°+
7	B–	7	90°–
8	0 V	8	0 V
9	+5 V	9	+5 V
10	R+	10	R+
11	0 V	11	0 V
12	R–	12	R–
13	0 V	13	0 V
14	Not assigned	14	Not assigned
15	Not assigned	15	Not assigned

28.16.2 Speed encoders

See “X15 to X20: 1 Vpp speed encoder” on page 28 – 465.

28.17 Inverters and motors

Inverter systems are powered via PWM outputs of the control.
--> See ”X51 to X56: PWM-output” on page 28 – 469.

The motor encoders are connected to the speed encoder interface of the control.
--> See ”X15 to X20: 1 Vpp speed encoder” on page 28 – 465.

Note

For further information, refer to the Service Manual "Inverter Systems and Motors".

28.18 Interface boards for the SIMODRIVE 611D drive system

The HEIDENHAIN interface boards for the SIMODRIVE system receive PWM signals from the control and convert them.
--> See ”X51 to X56: PWM-output” on page 28 – 469.

Note

For further information, refer to the Service Manual "Inverter Systems and Motors".

29 Exchange of HEIDENHAIN components

29.1 Important information

DANGER

Observe the safety precautions to avoid injury or damage to persons or machines.
--> See "Safety precautions" on page 2 – 15.

Attention

Always use original HEIDENHAIN components as replacements!

Which components can be exchanged in the field?

- **MC**
  (Main computer)
- **HDR**
  (Hard disk removable)
- **SSDR**
  (Solid state disk removable)
- **SIK**
  (System identification key)
- **CC**
  (Controller computer)
- **UEC 11x**
  (Controller unit with integrated inverter)
- **PLB 6xxx** and **PLD-H** and **PLD-A**
  (PLC basic modules and I/O modules)
- **PSL 13x**
  (Low-voltage power supply unit)
- **Fuses**
- **Buffer battery in the MC**
- **Fan**
- **Potentiometers**
  (for feed rate and spindle speed)
- **Rechargeable or non-rechargeable batteries in the touch probe**
- **Stylus, contact plate**
- **Connected HEIDENHAIN peripherals**
  (monitors, keyboards, encoders, inverters, motors, handwheels, probes, etc.)
- **Cables and accessories**
- **HEIDENHAIN interface boards**
  (for the Simodrive system)

What could be exchanged in addition?

- **VDU components**
- **Components of the keyboard**
- **Components of the machine operating panel**

Export restrictions

If an iTNC 530 HSCI operates with an NC software where **more than four axes** can **interpolate** with each other, (contouring with calculation of more than 4 axes), it is subject to **export licensing**.

The NC software for path interpolation is stored on the data medium.

Export licenses are thus required for:

- The **NC software** of iTNC 530 HSCI for interpolation of more than four axes
- Associated **service packs**
- The **HDR** (Hard Disk Removable) on which this NC software is stored
- The **SSDR** (Solid State Disk Removable) on which this NC software is stored
- The **SIK** (on which the NC software version of iTNC 530 HSCI is stored)

High-accuracy and high-resolution encoders may also require an export license.

Attention

Contact your OEM, if you suspect conflicts!

Attention

NC software and service packs for path interpolation of more than four axes that are on your laptop or a USB flash drive also require an export permit!

NC software update

An NC software update is performed by the **machine manufacturer** or in coordination with him.

The PLC program, the machine parameters or the data in the PLC partition may also be updated, according to the OEM's specific instructions.

DANGER

The HEIDENHAIN NC software for iTNC 530 HSCI must be released by the OEM for the respective machine!

Note

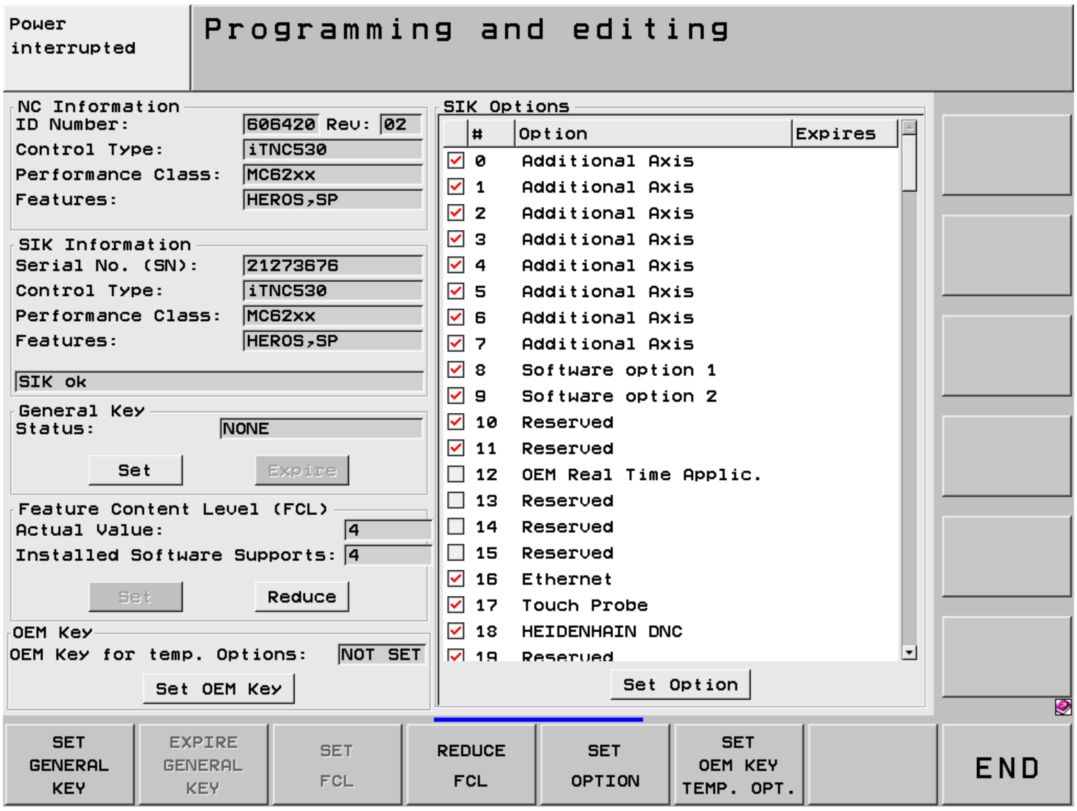
The NC software update is described in the iTNC 530 HSCI Technical Manual which is available to the machine tool builder.

SIK

The SIK (= **S**ystem **I**dentification **K**ey) ...

- is located in a slot on the side of the MC 6222 housing (slot X125).
- is located in a slot on the bottom of the MC 6241 housing (slot X125).
- contains the NC software license (standard or export version).
- stores enabled control loops and software options (e.g, tilting operation, HSC milling, TCPM, cylindrical surface interpolation, synchronized axes, etc.)
- contains the Feature Content Level (of the NC software version).
- is inserted in the replacement control, if the control needs to be exchanged.
  --> Thus all enabled options are still available!

After you have entered the code word **SIK**, the SIK number and the enabled options are displayed on the screen.



The SIK number is also printed on the ID label applied onto the board of the SIK.

Feature Content Level

When a new NC software version is released, error fixes and improvements in functions are managed separately.
When the NC software is updated to a new version, only the included error fixes will initially be effective.

If the **new features** of this NC software version are also required, these can be **ordered** and subsequently **be enabled with a code number**. --> Ask the machine manufacturer!

The `Feature Content Level` is now numbered consecutively:

- The `Feature Content Level` is shown in the code number window. --> See "Display of important system information" on page 27 – 451.
- The `Feature Content Level` is also displayed in the SIK window (see previous illustration).
- A higher `Feature Content Level` always includes the features of the previous versions.

Electronic ID label

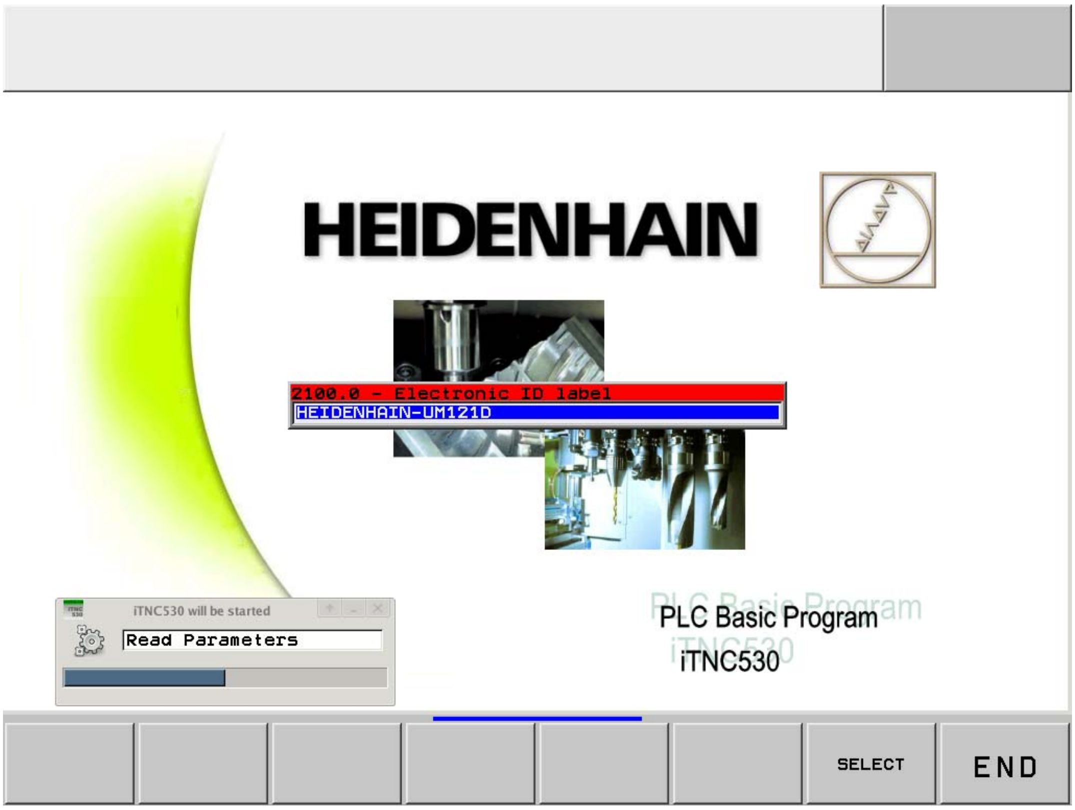
Some HEIDENHAIN units feature an electronic ID label.
The product name, the ID number and the serial number are saved in this ID label.

Prerequisite for the evaluation of the electronic ID labels of the iTNC 530 HSCI:

Machine parameters	Current units with electronic ID label
MP7690 is active	HEIDENHAIN inverters with "D" in the device name, e.g., UM 112D
	HEIDENHAIN synchronous motors with EnDat motor encoders

Under these conditions, the devices are automatically detected when the control is started.

During every control restart, the control checks whether the connected units with electronic ID label match the entries in MP2100.x or MP2200.x.



Attention

If a unit with electronic ID label generates a pop-up window when the control is restarted, …

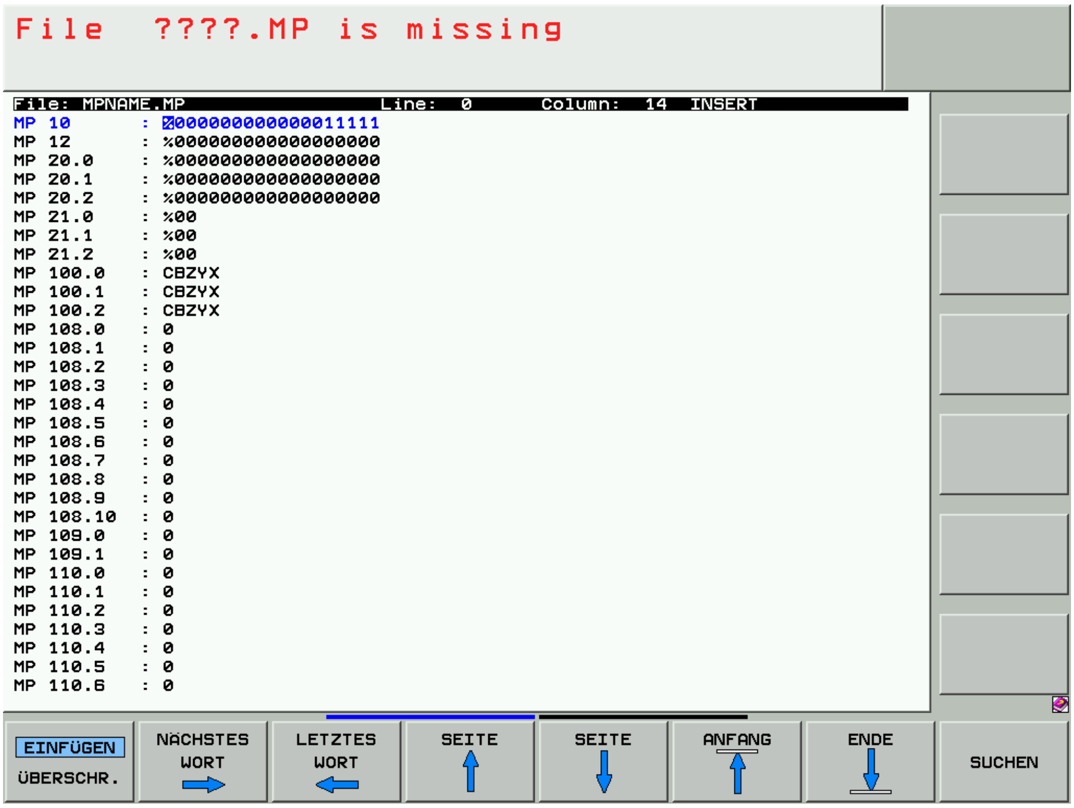
- the active MP list does not match the connected unit.
  (E.g., if a backup was restored that does not fit exactly to the machine.)
- the connected unit does not match the active MP list.
  (E.g., the replacement unit is not exactly the same.)
- you have switched the rotary encoder inputs or PWM outputs for troubleshooting without deactivating the evaluation of the electronic ID labels before.

The evaluation of the electronic ID labels should be deactivated via MP7690 before switching the rotary encoder inputs (motor encoder) or PWM outputs (interface to the power modules).

MP7690 **Evaluation of the electronic ID labels**
Input: %xxx
Bit 0 – HEIDENHAIN power modules
0: Active
1: Inactive
Bit 1 – HEIDENHAIN synchronous motors
0: Active
1: Inactive
Bit 2 – Reserved

MPNAME.MP

If machine data is missing (data loss, data medium new or replaced) the control opens the file MPNAME.MP, the **"default setting" of the machine parameters** when booting for the first time:



Note

If the control was already started several times, the logo of the default setting appears in the `Power interrupted` status. MPNAME.MP is active.

- The file MPNAME.MP is generated by the HEIDENHAIN operating system.
- Axes cannot be traversed, spindles not switched on, and the control is set to Programming Station.
- The HEIDENHAIN standard display colors are used.
- There are no comments in MPNAME.MP.
- Each parameter of the MPNAME.MP could now be set by the machine manufacturer.
- In this case, the service engineer will restore the backup of the machine data.
  --> See "Restoring data" on page 14 – 207.

ESD protection

ESD = Electrostatic discharge

Attention

When you exchange HEIDENHAIN components, you might come into direct or indirect contact with electronic components.

Always assume that **all electronic components and assemblies are endangered by electrostatic discharge (ESD)** and may be **damaged by incorrect handling**.

These ESD-sensitive components could also come into contact with a statically charged object (tool, workbench, packaging, etc.)

Therefore observe the ESD protective measures, when you exchange MC, CC, HDR, buffer battery and all devices with accessible electronic components!

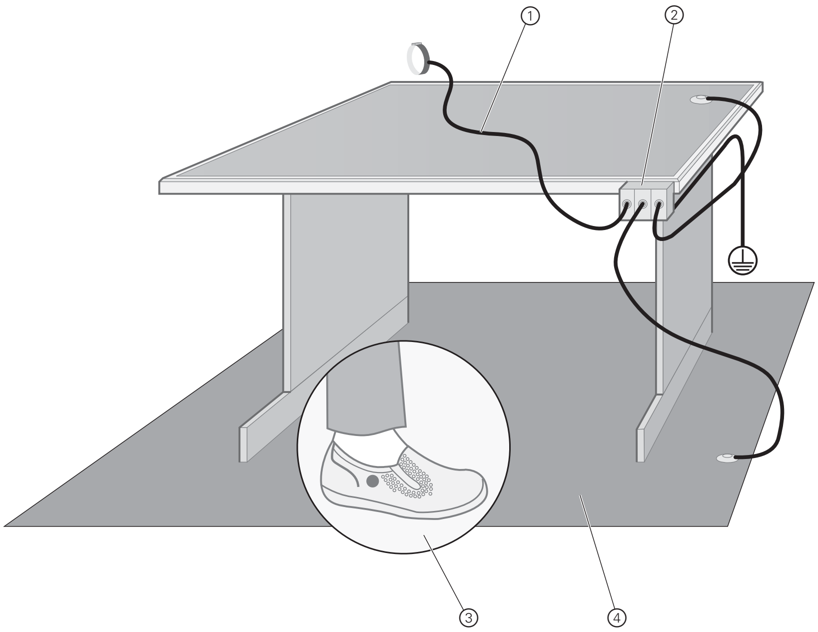
Keep in mind that you can damage components that are not accessible simply by touching the pins in connectors.

To ensure protection from ESD, follow the precautionary measures described in **IEC 61340-5-1**, **IEC 61340-5-2** and **IEC 61340-4-1**!

The following are some points covered in the above mentioned standards:

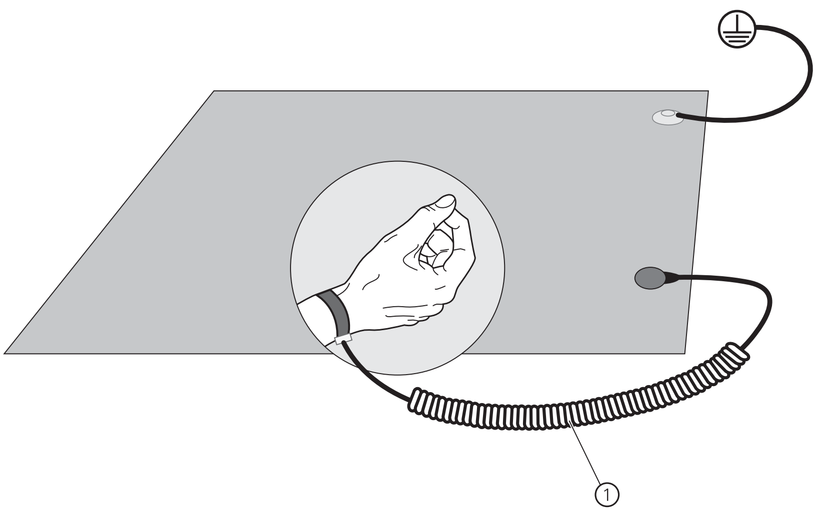
- When handling electrostatically endangered components or assemblies (e.g. exchange, installation, shipping), **always comply with** the **precautionary measures in these standards**.
- Store and transport ESD-sensitive components in **ESD protective containers**.
- Ensure during handling the **proper grounding of the working area** (e.g. tool, workbench, packaging) **and the person**.
- **Inspect the ESD protection system regularly.**

The following figure shows how a suitable working area could look in accordance with IEC 61340.



1.	Wristband with 1 Mohm grounding cable for grounding the person
2.	Grounded connection for wristbands, floor mats, table mats etc. for equipotential bonding
3.	Dissipative shoes
4.	Dissipative flooring or floor mat

An important part of the working area is a suitable working surface with a wristband with 1 Mohm grounding resistance for grounding the person:



Information about errors

If possible, write the assumed error or circumstances that caused the failure of the unit on a slip of paper and apply it to the outside of the unit.

> Note
>
> Replacement controls are delivered with a form which you can use to provide information on the error of the defective control.

ID number for service order

When placing a service order, always indicate the ID number of the HEIDENHAIN device concerned.

Serial number for traceability

For reasons of **traceability** also indicate the serial number of the HEIDENHAIN device. The serial number as well as the ID number can be found on the ID label of the device.

Replacement units and spare parts

For replacement units and spare parts, ask your **machine manufacturer**!
This also applies for the NC software!

Please observe:

- Always use original HEIDENHAIN components as replacements!
- HDR and SSDR are normally equipped with the **most recent NC software**.
  If you wish to keep the previously installed - older - NC software version, contact your OEM.
  He can restore this version.

> Note
>
> If you purchase the NC software directly from HEIDENHAIN and require an older NC software version, this software can be ordered in writing. Only then can/may HEIDENHAIN provide an older - no longer up-to-date - NC software version!

- Please send the defective unit in its original packaging to your machine manufacturer or your HEIDENHAIN agency.

Repair

Many HEIDENHAIN units are not repaired on site but are exchanged or replaced. These devices are exclusively repaired by the specialists of the HEIDENHAIN workshops. The devices are also updated to the latest state-of-the-art and subjected to tests.

Packaging

- If possible, use the original packaging from HEIDENHAIN.

Inspection after replacement of electrical components

According to **DIN VDE 0113 part 1 / EN 60204-1**, the following inspections are required after an electrical component has been exchanged:

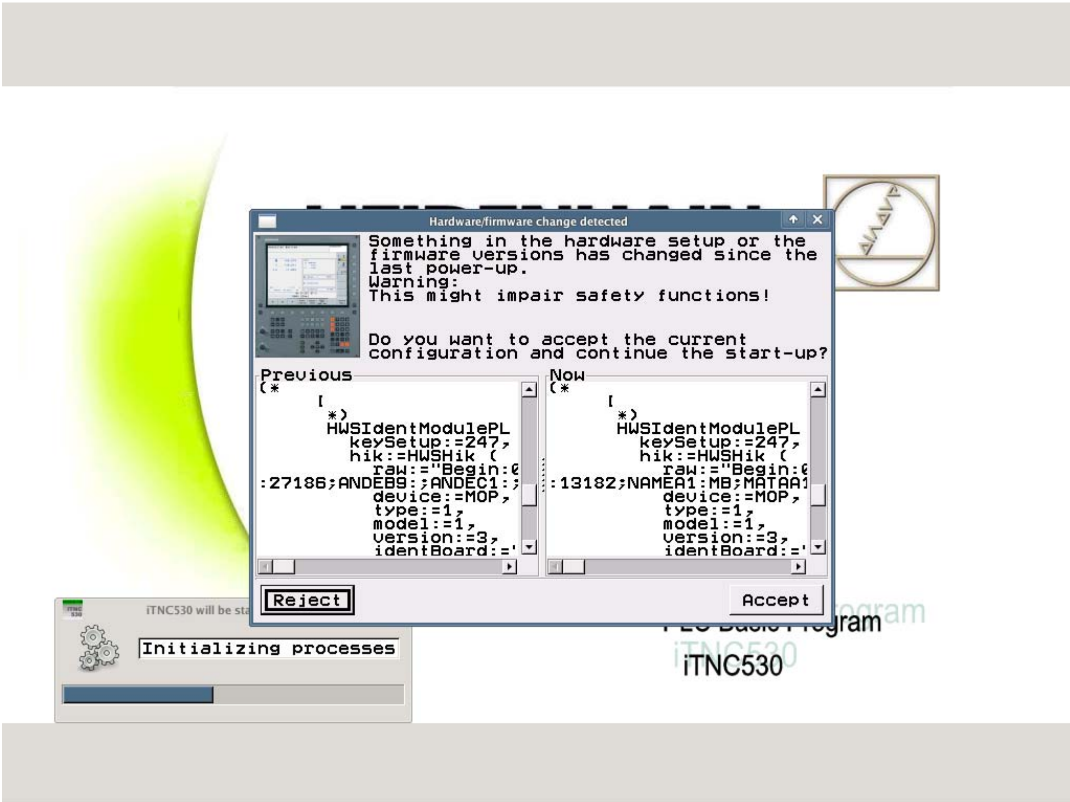
- Check whether the electrical equipment corresponds to the technical documentation.
- Check whether the protective ground system is continuous.
- Perform a functional check.

29.2 Recognizing and accepting hardware updates

The iTNC 530 HSCI automatically monitors and checks whether hardware changes (including different serial numbers of otherwise identical units) to control components were implemented.

I.e., the control detects, if a hardware component was exchanged.

After startup and initializing of the hardware (message **`Hardware is being initialized`** with progress bar) a dialog window appears:



▶ Accept these changes. --> The control will start up completely.

> **Note**
>
> If you pressed **`Reject`** here, the control would start in the **Programming station** mode. It would not be possible to operate the machine tool.

▶ Switch on the machine and test the functions.

> **Note**
>
> If an exchanged HSCI device requires a **firmware update**:
> After the firmware update has been loaded, the above dialog window **`Hardware/firmware change detected`** is displayed.
> The firmware is either loaded automatically, or a window appears informing on the required firmware update. The technician must confirm the loading of the firmware.
> --> See "Detecting and loading firmware updates" on page 29 – 524.

29.3 Detecting and loading firmware updates

HSCI components have their own firmware which must match the currently installed NC software version. Every time the control is started, the NC software checks the firmware versions of the individual HSCI components.

A firmware update may be required ...

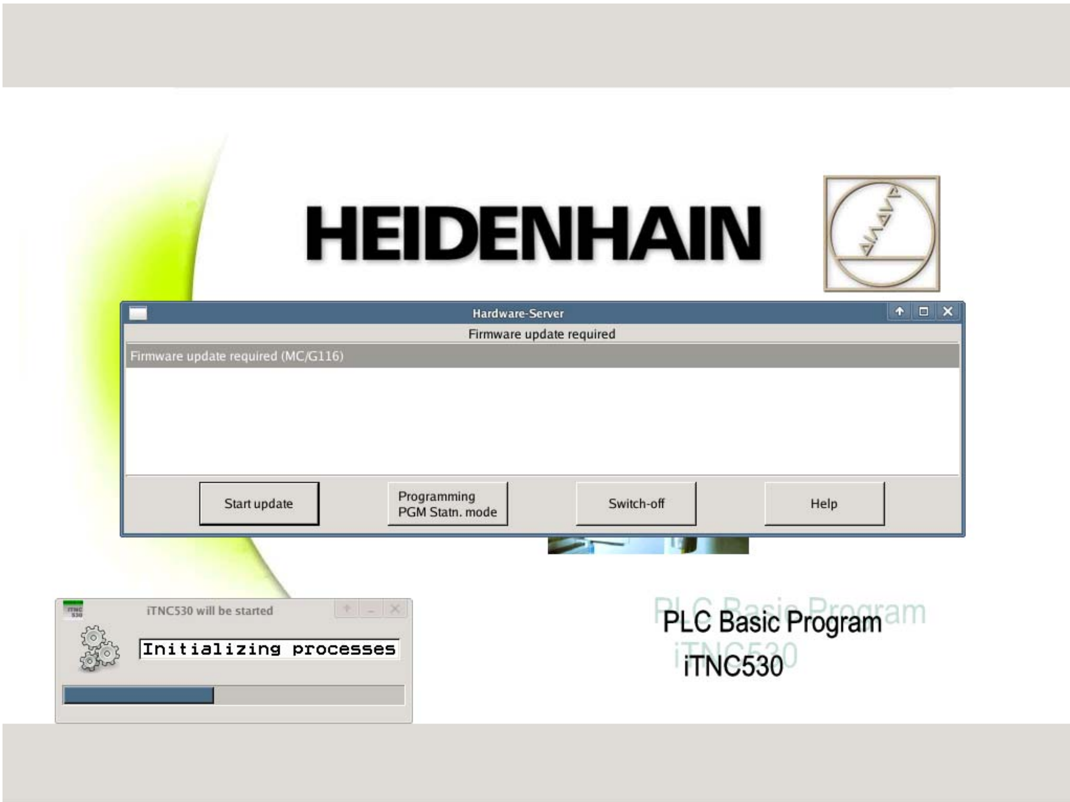
- when a hardware component was exchanged.
- after an NC software update.
- when a service pack was loaded.

Some firmware updates need to be confirmed by the technician before they are loaded, others are loaded automatically.

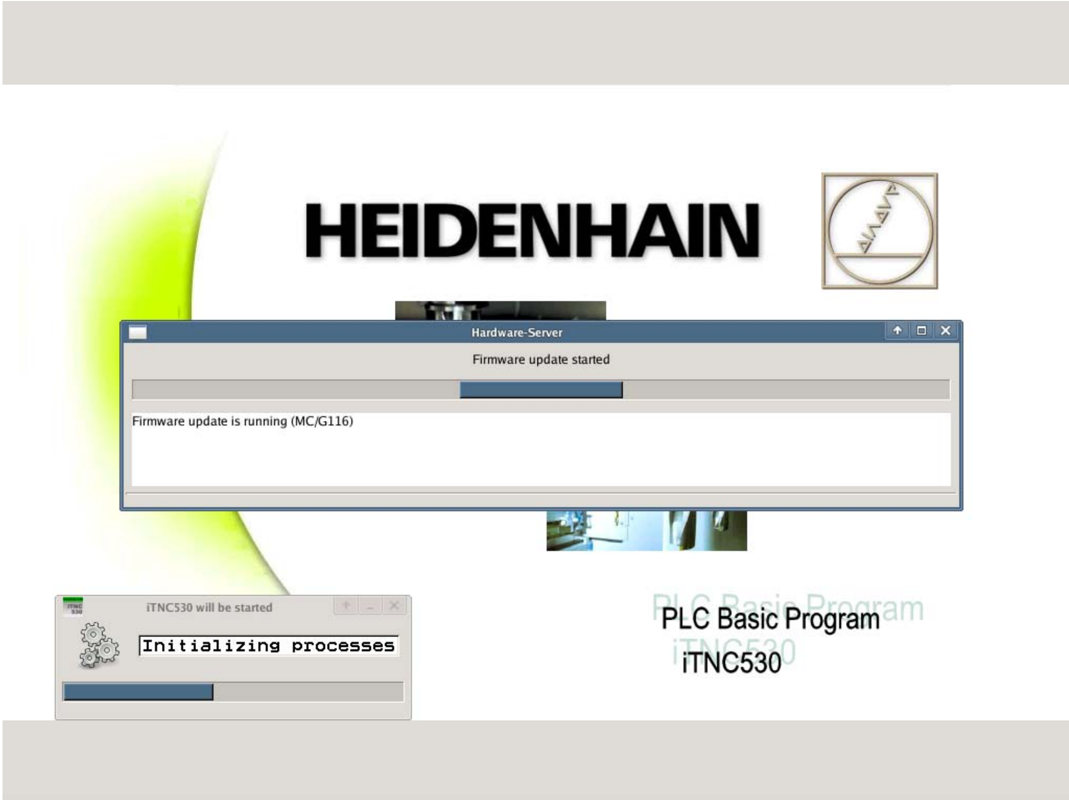
Firmware update with prior confirmation

- The firmware update is not loaded until the button **`Start update`** was pressed in the window **`Firmware update required`**.
- These firmware updates **cannot be repeated** after a **loading attempt has failed** (e.g. interruption caused by power failure). The HSCI component requires servicing.
- This can happen with MC, CC units, etc.

After startup, the control displays the following message:



- Click the **`start update`** button or use the TAB key to place the cursor there and press ENT to confirm.
--> The firmware will be loaded:



Attention

The control and the HSCI component must not be switched off during this firmware update! Otherwise, it will require servicing!

- If the firmware update was loaded without error, a corresponding message is displayed.

Attention

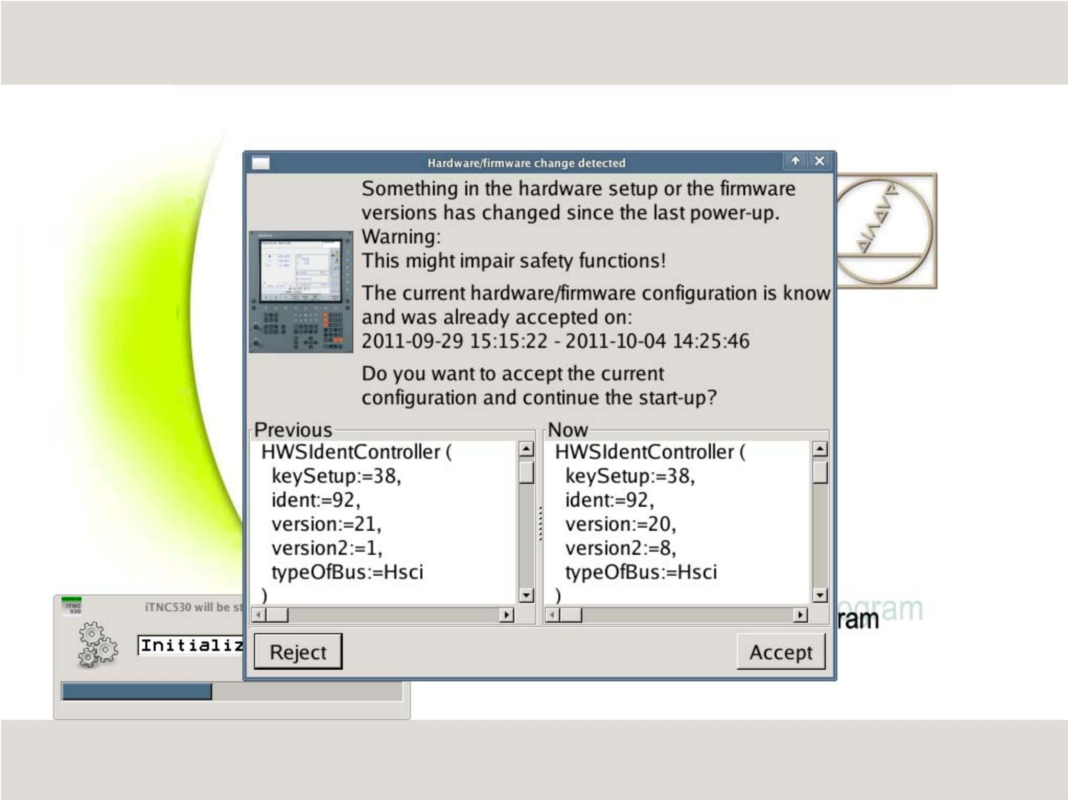
If a message appears saying that the firmware of older HSCI devices could not be updated (See "Special case: Firmware update cannot be loaded" on page 29 – 530.)
--> Contact your OEM or a HEIDENHAIN service agency.

- Switch off the main switch of the machine.
- **Wait at least 1 minute!**
It must be ensured that the affected HSCI device is fully reset.
- Switch the main switch back on again.

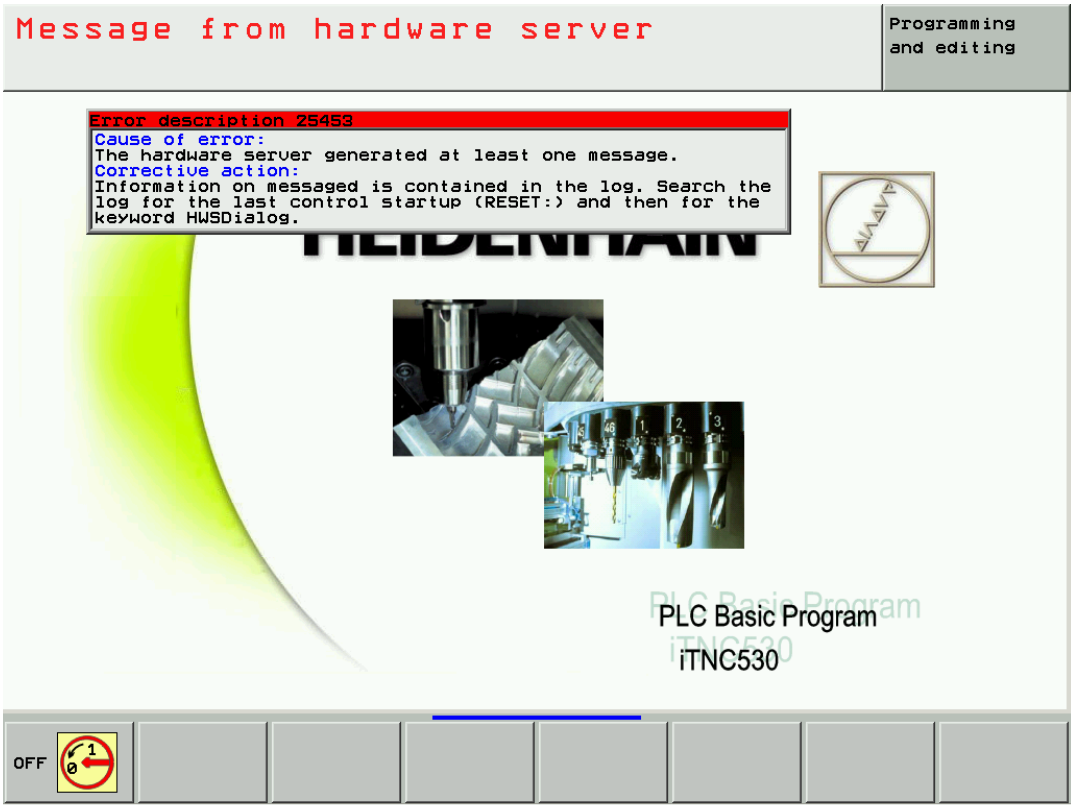
Note

If further firmware updates are required, the control will report these successively. Run all firmware updates as described.

- After the last firmware update, the window **Hardware/firmware change detected** appears:

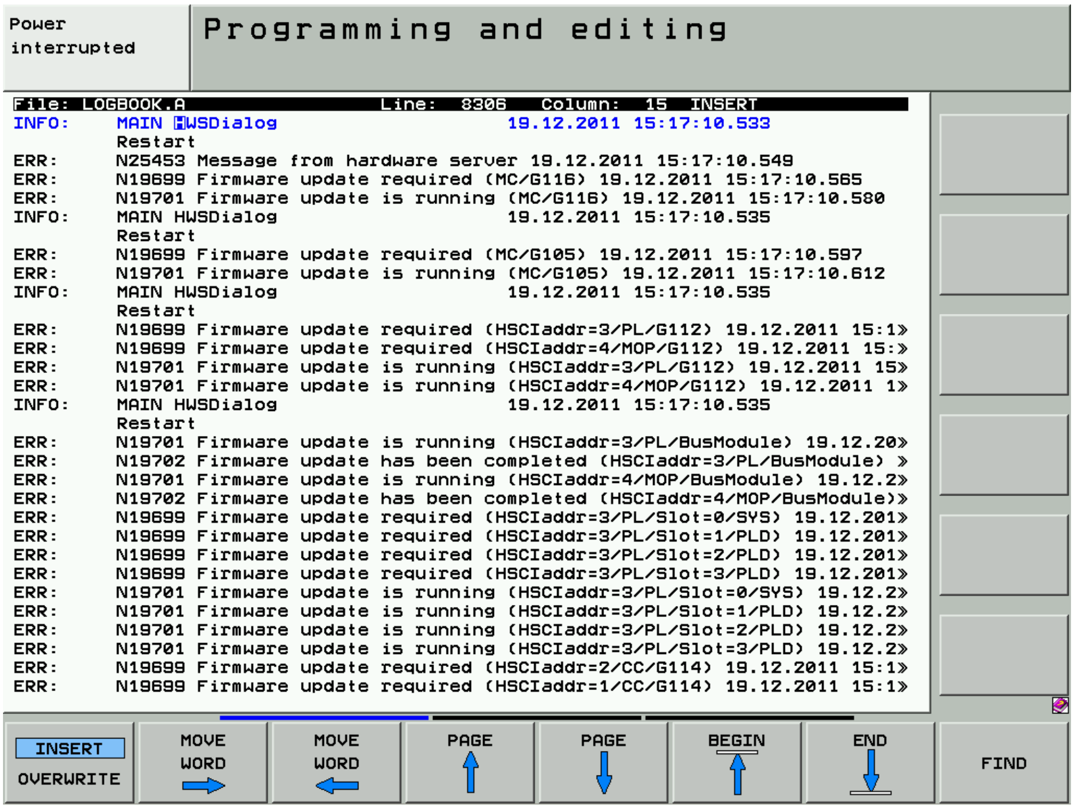


- Accept these changes. --> The control will start up completely and display the following message (press the HELP key for this purpose):



- Acknowledge the message.
- Call the log. --> See "Log" on page 8 – 79.

▶ Search for the string **HWSDialog** in the log.



▶ Here you can see for which HSCI devices the firmware was updated (in the example: firmware for the component G116 in the MC).

▶ Press SEARCH and EXECUTE until all updated HSCI devices are listed.

Attention

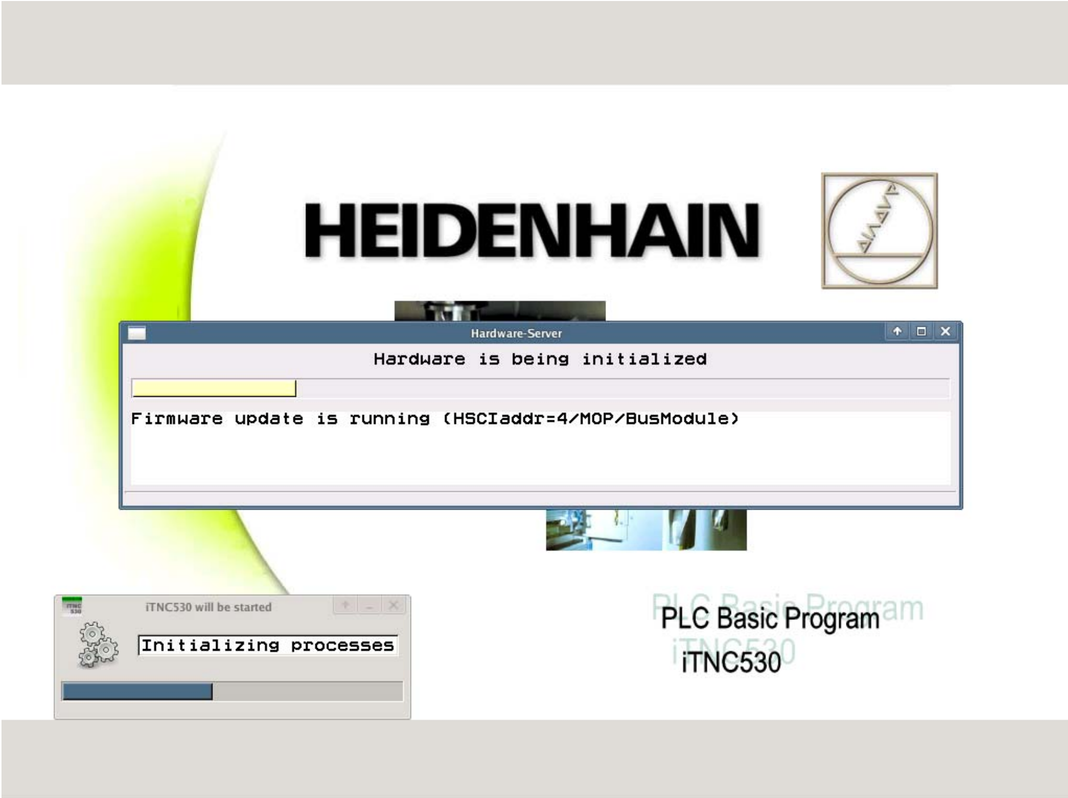
If you find the message **Exchange the peripheral device** in the log, or a similar message indicating that the firmware of older HSCI devices could not be updated
--> Contact your OEM or a HEIDENHAIN service agency!

▶ Switch on the machine and test the functions.

Firmware update without prior confirmation

- The firmware update is loaded automatically without requiring prior confirmation by the technician.
- These firmware updates **can be repeated after a loading attempt has failed**.
- This can happen with PL, MB, etc.

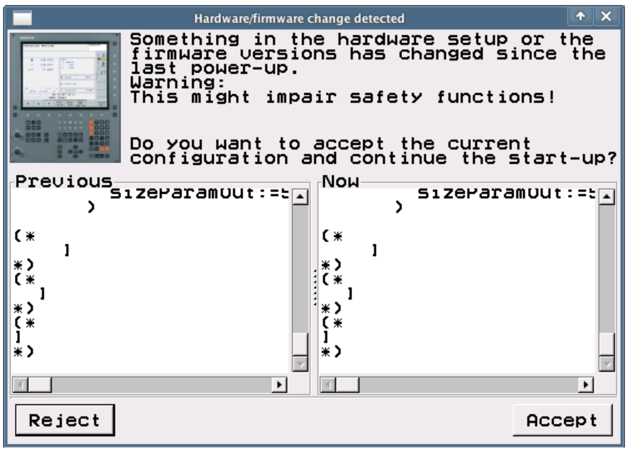
While the firmware updated is being loaded automatically, the control displays this window:



Attention

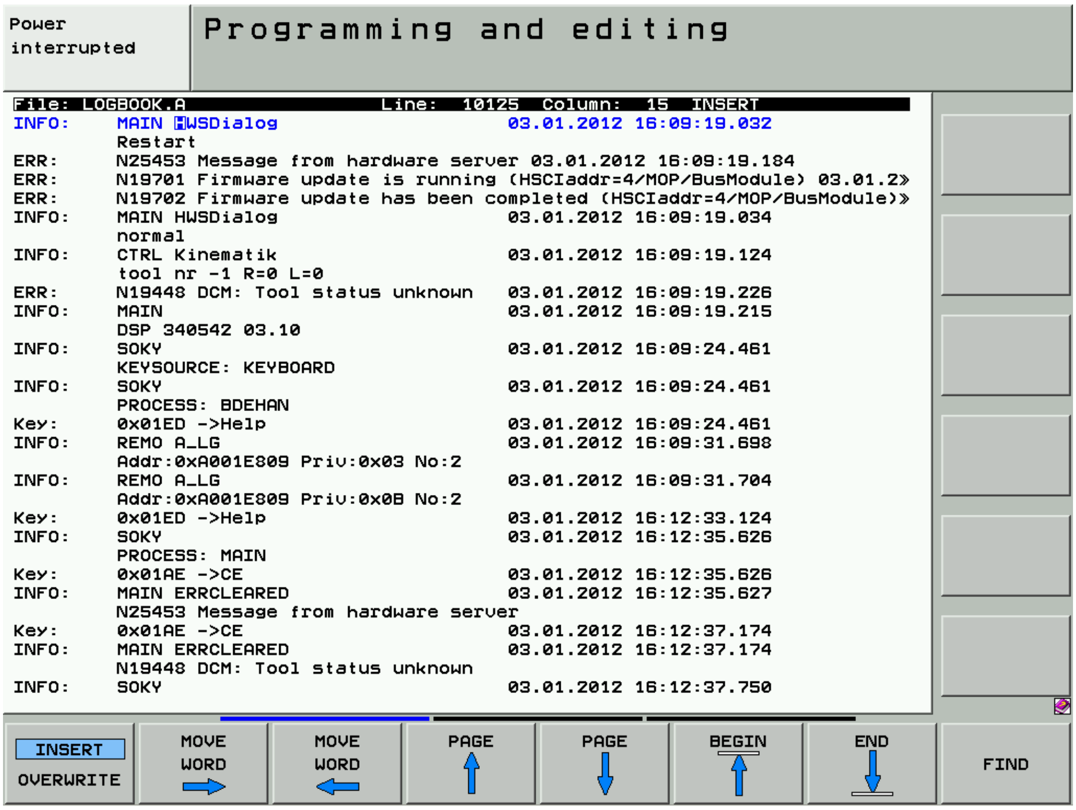
If a message appears saying that the firmware of older HSCI devices could not be updated (See "Special case: Firmware update cannot be loaded" on page 29 – 530.)
--> Contact your OEM or a HEIDENHAIN service agency.

After the firmware updated was loaded automatically, the control displays this message:



- Accept these changes. --> The control will start up completely and display the following message (press the HELP key for this purpose):

- Acknowledge the message.
- Call the log. --> See "Log" on page 8 – 79.
- Search for the string **HWSDialog** in the log.



- Here you can see which new HSCI devices were found and which firmware was updated. (In the example: the machine operating panel MOP)
- Press SEARCH and EXECUTE until all updated HSCI devices are listed.

> **Attention**
>
> If you find the message **Exchange the peripheral device** in the log, or a similar message indicating that the firmware of older HSCI devices could not be updated
> --> Contact your OEM or a HEIDENHAIN service agency!

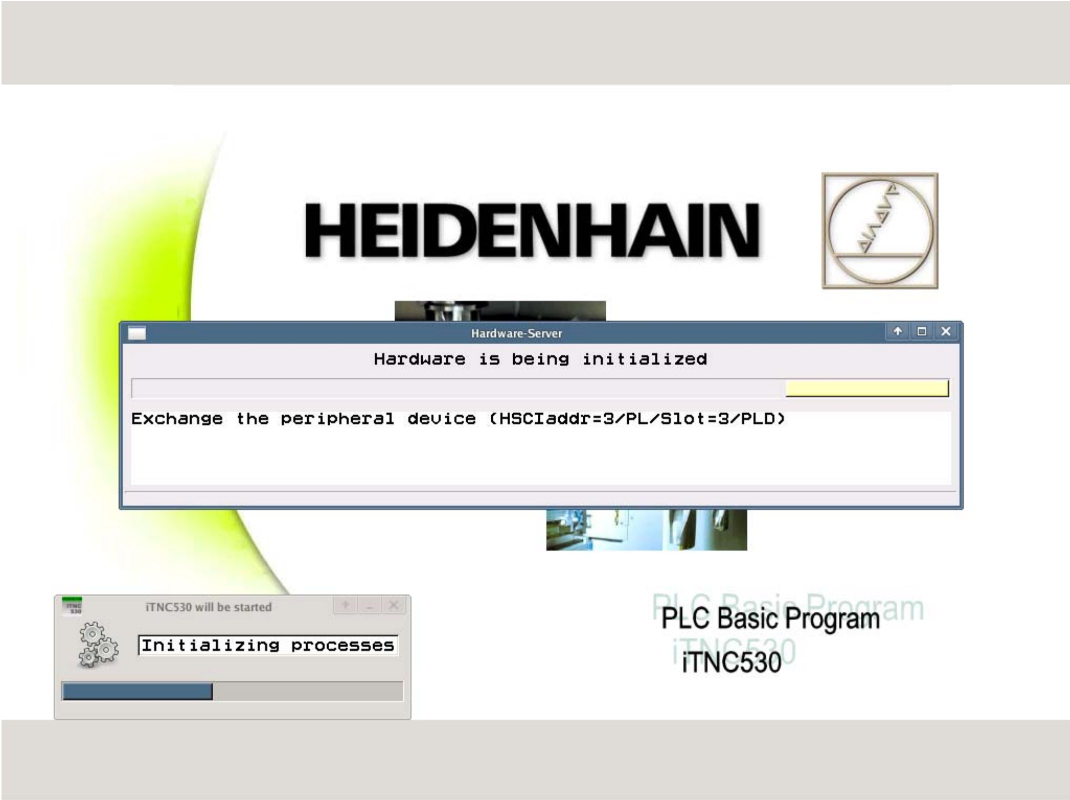
- Switch on the machine and test the functions.

Special case: Firmware update cannot be loaded

On some older HSCI components the firmware update cannot be loaded onto the machine in the field.

Example:
An up-to-date PLD-H 16-08-00 is to be replaced by an older PLD-H 16-08-00:

While booting, the control displays this window:



Attention

If this or a similar message appears, a firmware update cannot be performed for the older HSCI device. --> Contact your OEM or a HEIDENHAIN service agency.

Note

The message **`Exchange the peripheral device`** or similar messages indicating that a firmware update could not be loaded are also entered in the log of the control.

29.4 Exchanging the MC 6222

Preparing the machine tool

If still possible:

- Move the machine to home position (axes, tool changer, tilting head, etc.)
  Ask the machine operator!
- Press EMERGENCY STOP.

Backup of non-volatile PLC markers and words

- Back up the condition of non-volatile PLC markers and words from the RAM to the data medium.
  --> See "Non-volatile PLC markers and words" on page 11 – 134.

Removing the defective MC 6222

- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Open the console.
- Label all lines and cables and disconnect them from the MC.
- Screw off the ground lead.
- Dismount the MC from the console.

> Attention
>
> Observe the ESD precautions. --> See "Important information" on page 29 – 515!

- **Remove the SSDR**. --> See "Exchanging the SSDR" on page 29 – 537.
- **Remove the SIK** (slot X125 on side).

> Attention
>
> - The SIK (System Identification Key) remains with the machine.
>   It must be inserted into the new or replacement MC; i.e. all enabled options are still available.
> - Only defective SIKs are exchanged.
>   If options were enabled on the defective SIK, you will receive the code numbers to enable these on your new SIK after giving us the number of your defective SIK.
>   The SIK number is displayed on the screen after you have entered the **SIK** code number. The SIK number is also printed on the ID label applied onto the board of the SIK.
>   The defective SIK must be returned!

Mounting the new MC 6222

- **Insert the SSDR into the new MC 6222 and fix it.**
  --> See "Exchanging the SSDR" on page 29 – 537.
- **Insert the SIK into the new MC 6222.**
- Mount the MC 6222 in the console.
- Screw on the ground lead.
- If required, remove the red protective caps from the MC connectors.
- Reconnect and attach all lines and cables.

> Attention
>
> Do not forget the grounding screw! Do not confuse any of the connectors!

- Close the console.
- Switch on the power switch of the machine.

Accepting hardware updates

After start-up, the control may display the window **Hardware/firmware change detected**.

- Accept these changes. --> See "Recognizing and accepting hardware updates" on page 29 – 523.

Running firmware updates

Firmware updates may be required for the exchange MC. The NC software automatically detects, whether this is required.

- Run these firmware updates. --> See "Detecting and loading firmware updates" on page 29 – 524.

Restoring non-volatile PLC markers and words

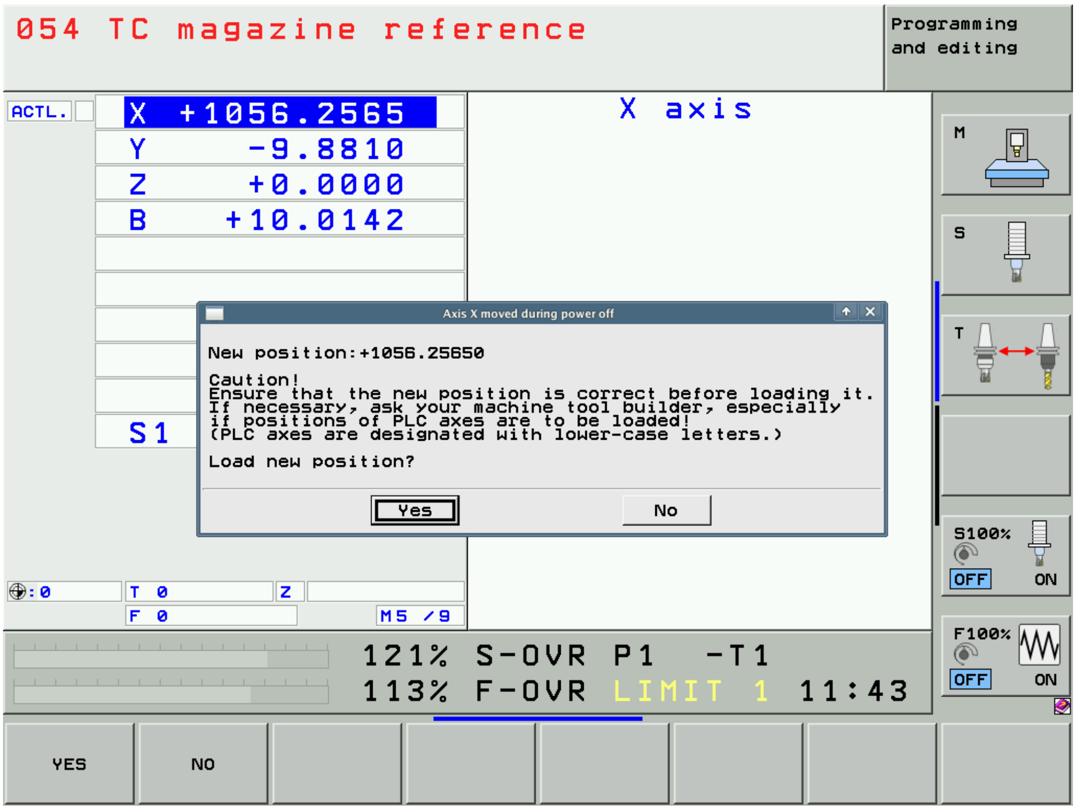
- After restarting the control you must not acknowledge the **Power interrupted** message.
- Write the non-volatile PLC markers and words from the data medium to the RAM of the new control. --> See "Non-volatile PLC markers and words" on page 11 – 134.

Setting date and time on the new MC 6222

- Check the date and time of the control and reset it, if necessary. --> See "Setting the system time" on page 13 – 173.

Accepting axis positions

- Switch on the machine.
  Regarding the axis positions, the following window may be displayed:



- Check whether the "new" positions are correct and then confirm them.

Note

Background:
The axis positions of EnDat encoders are saved to the RAM of the control when the machine is switched off. The actual axis positions of the machine are not identical with the values in the RAM of the exchange MC.

Restoring the original state of the machine

If necessary, you may ...

- recalibrate the touch probes.
- initialize the swivel head again.
- initialize the tool changer again.

Contact the machine manufacturer for information!

> Note
>
> On machines with analog axes, an offset fine adjustment should be performed with the HEIDENHAIN code number after the control was exchanged.
> --> See "Adjusting the electrical offset (drift adjustment)" on page 21 – 355.

Functional test

- Check the machine functions (with the aid of the machine operator).

Returning the defective MC 6222

- Replacement controls are delivered with a form which you can use to provide information on the error of the defective control.
  Please fill in this form and attach it to the housing of the MC 6222.
- Use the original packaging of the new MC 6222 to package the defective MC 6222.
- Return the defective MC 6222 to the machine manufacturer or to your HEIDENHAIN service agency.

29.5 Exchanging the MC 6241

Preparing the machine tool

If still possible:

- Move the machine to home position (axes, tool changer, tilting head, etc.)
  Ask the machine operator!
- Press EMERGENCY STOP.

Backup of non-volatile PLC markers and words

- Back up the condition of non-volatile PLC markers and words from the RAM to the data medium.
  --> See "Non-volatile PLC markers and words" on page 11 – 134.

Removing the defective MC 6241

- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Label all lines and cables and disconnect them from the MC.
- Unscrew the ground wire or the ground bar.
- Dismount the MC.

> Attention
>
> Observe the ESD precautions. --> See "Important information" on page 29 – 515!

- **Remove the HDR**. --> See "Replacing the HDR" on page 29 – 543.
- **Remove the SIK** (slot X125 on bottom).

> Attention
>
> - The SIK (System Identification Key) remains with the machine.
>   It must be inserted into the new or replacement MC; i.e. all enabled options are still available.
> - Only defective SIKs are exchanged.
>   If options were enabled on the defective SIK, you will receive the code numbers to enable these on your new SIK after giving us the number of your defective SIK.
>   The SIK number is displayed on the screen after you have entered the **SIK** code number.
>   The SIK number is also printed on the ID label applied onto the board of the SIK.
>   The defective SIK must be returned!

Mounting the new MC 6241

- **Insert the HDR into the new MC 6241and fix it.** --> See "Replacing the HDR" on page 29 – 543.
- **Insert the SIK into the new MC 6241.**
- Mount the MC 6241.
- Screw on the ground wire or the ground bar.
- If required, remove the red protective caps from the MC connectors.
- Reconnect and attach all lines and cables.

> Attention
>
> Do not forget the grounding screw! Do not confuse any of the connectors!

- Switch on the power switch of the machine.

Accepting hardware updates

After start-up, the control may display the window `Hardware/firmware change detected`.

- Accept these changes. --> See "Recognizing and accepting hardware updates" on page 29 – 523.

Running firmware updates

Firmware updates may be required for the exchange MC. The NC software automatically detects, whether this is required.

- Run these firmware updates. --> See "Detecting and loading firmware updates" on page 29 – 524.

Restoring non-volatile PLC markers and words

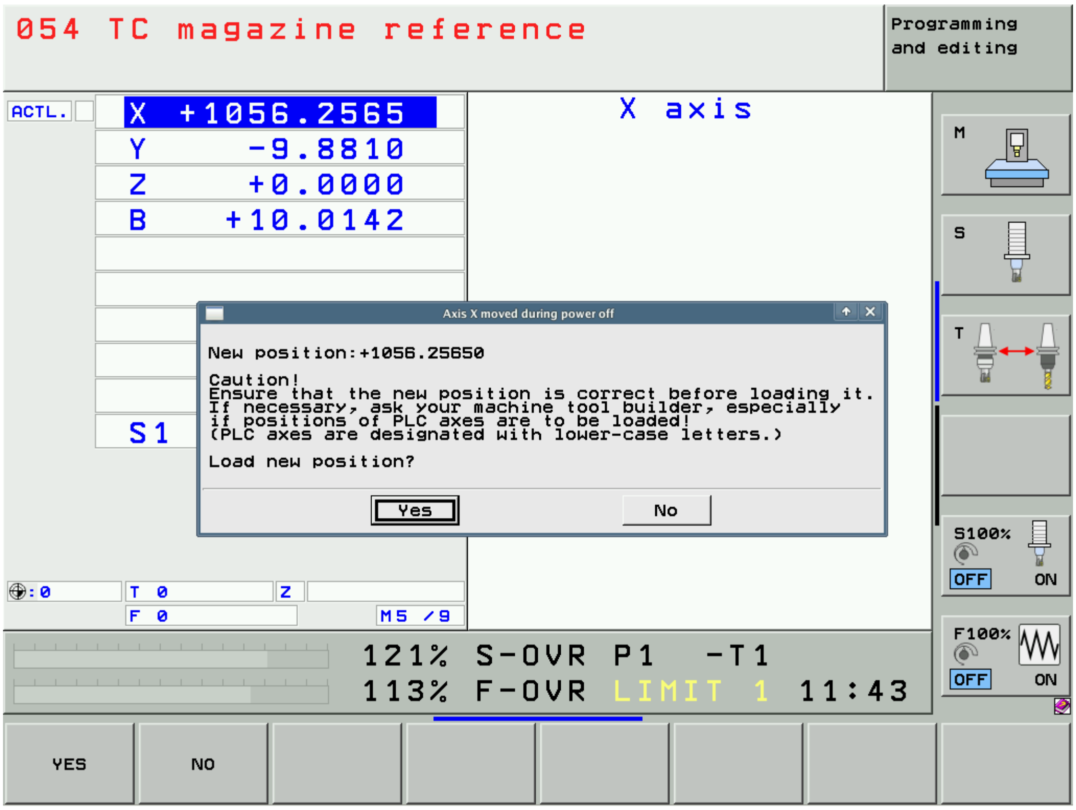
- After restarting the control you must not acknowledge the `Power interrupted` message.
- Write the non-volatile PLC markers and words from the data medium to the RAM of the new control. --> See "Non-volatile PLC markers and words" on page 11 – 134.

Setting date and time on the new MC 6241

- Check the date and time of the control and reset it, if necessary. --> See "Setting the system time" on page 13 – 173.

Accepting axis positions

- Switch on the machine.
  Regarding the axis positions, the following window may be displayed:



- Check whether the "new" positions are correct and then confirm them.

> **Note**
>
> Background:
> The axis positions of EnDat encoders are saved to the RAM of the control when the machine is switched off. The actual axis positions of the machine are not identical with the values in the RAM of the exchange MC.

Restoring the original state of the machine

If necessary, you may ...

- recalibrate the touch probes.
- initialize the swivel head again.
- initialize the tool changer again.

Contact the machine manufacturer for information!

> Note
>
> On machines with analog axes, an offset fine adjustment should be performed with the HEIDENHAIN code number after the control was exchanged.
> --> See "Adjusting the electrical offset (drift adjustment)" on page 21 – 355.

Functional test

- Check the machine functions (with the aid of the machine operator).

Returning the defective MC 6241

- Replacement controls are delivered with a form which you can use to provide information on the error of the defective control.
  Please fill in this form and attach it to the housing of the MC 6241.
- Use the original packaging of the new MC 6241 to package the defective MC 6241.
- Return the defective MC 6241 to the machine manufacturer or to your HEIDENHAIN service agency.

29.6 Exchanging the SSDR

Attention

The SSDR may only be exchanged in consultation with the machine manufacturer or by the machine manufacturer!

SSDRs that you receive in exchange and new SSDRs are already partitioned and formatted. The HeROS operating system and the NC software are installed. The SSDRs are normally equipped with the most recent NC software.
This NC software must be released by the machine manufacturer!

If the machine manufacturer has not released the latest NC software, or if you wish to keep the "old" NC software version that was installed on your defective SSDR, this version must be installed. For this purpose you also require support from the machine manufacturer.

Preparing the machine tool

If still possible:

- Move the machine to home position (axes, tool changer, tilting head, etc.)
  Ask the machine operator!
- Press EMERGENCY STOP.

If possible ...

Back up the non-volatile PLC markers and words.

It is likely that no data can be written any more to a defective SSDR.
However, if this is still possible:

- Back up the condition of non-volatile PLC markers and words from the RAM to the data medium.
  --> See "Non-volatile PLC markers and words" on page 11 – 134.

Backup

It is likely that the data on a defective SSDR cannot be backed up any more.
However, if this is still possible:

- Establish a connection between your laptop and the control.
  --> See "Connection setup" on page 14 – 183.
- Back up all control data on the SSDR.
  In the program TNCremoNT select the icon `Scan all`. --> See "Backup on an external data medium" on page 14 – 202.

Note

If an external archive for the TNC data is already available, you need not back up the TNC partition. This saves time; ask your customer!
In this case, select the icon `Scan system and machine files`.

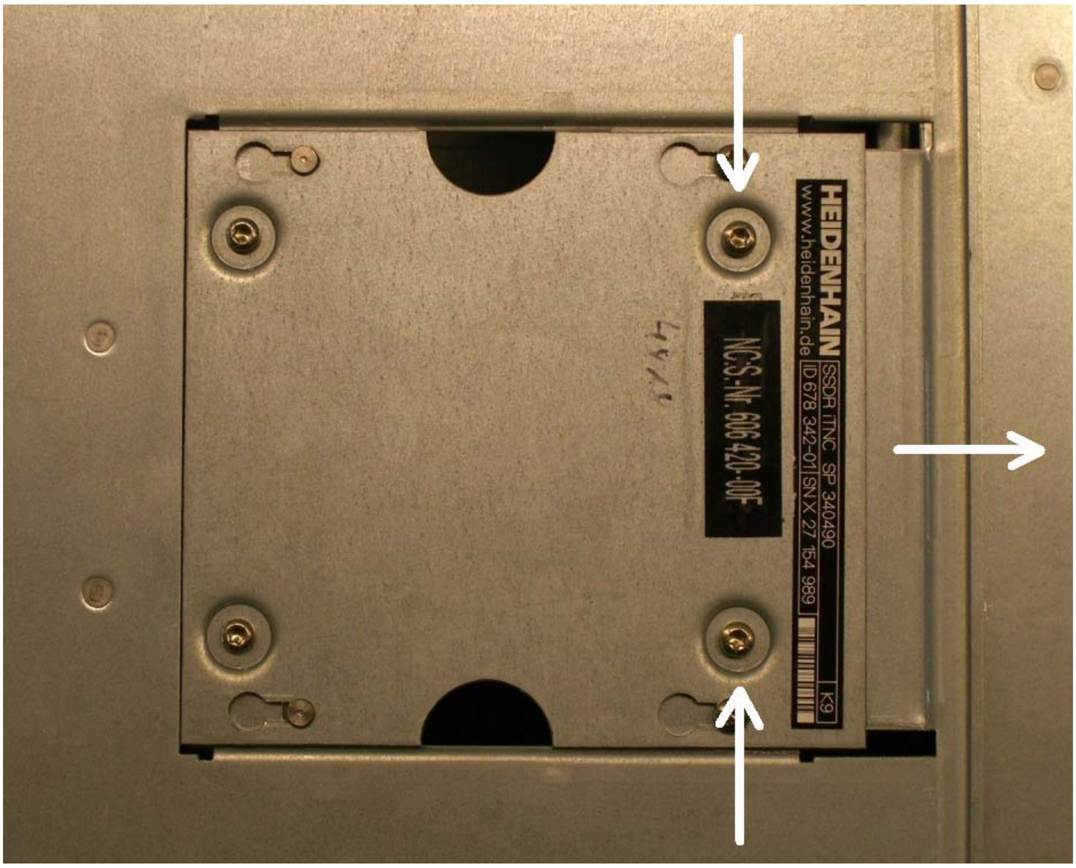
Removing the defective SSDR

- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Open the console.

> Note
>
> The MC 6222 normally may remain in the console for exchanging the SSDR.

> Attention
>
> Observe the ESD precautions. --> See "Important information" on page 29 – 515!

- Loosen the two screws that hold the SSDR holding plate (do not remove the screws).



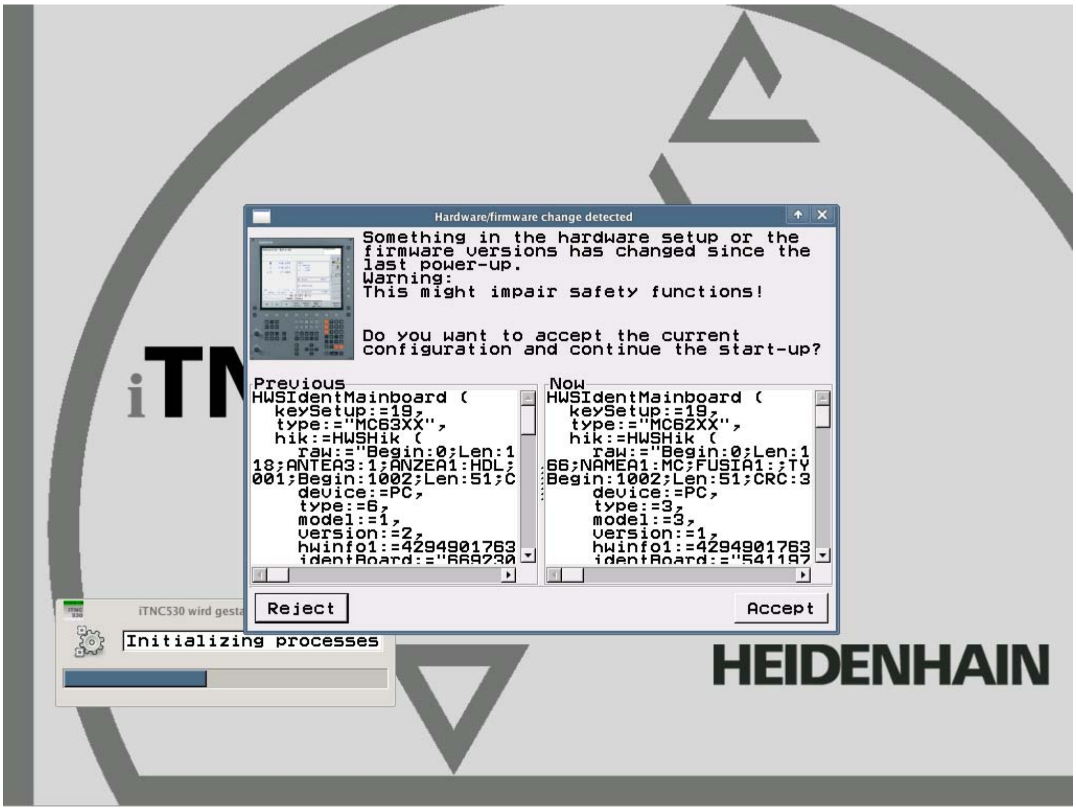
- Slide the SSDR to the right and remove it.

Mounting the new SSDR

- Insert the new SSDR and slide it left as far as it will go.
- Tighten the two mounting screws.
- Close the console.
- Switch on the power switch of the machine.

Detecting hardware updates

The control may display the following window:



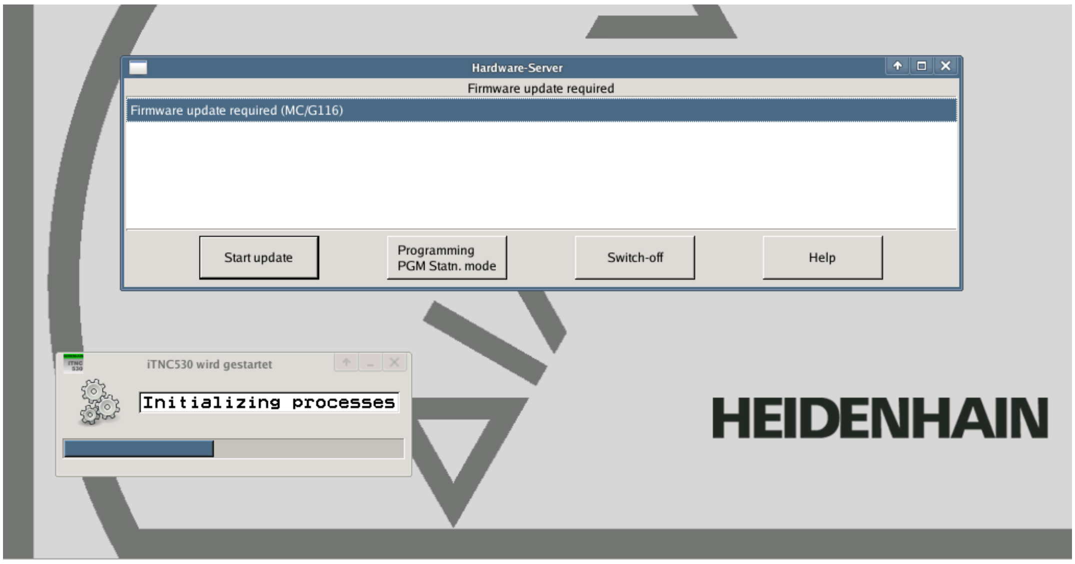
Note

In the plant, the SSDR was configured with a hardware (e.g. an MC 63xx) your machine does not feature. The NC software now detects the changes to the hardware.

- Accept these changes. --> The control will continue booting.

Detecting firmware updates

The control may display the following window:



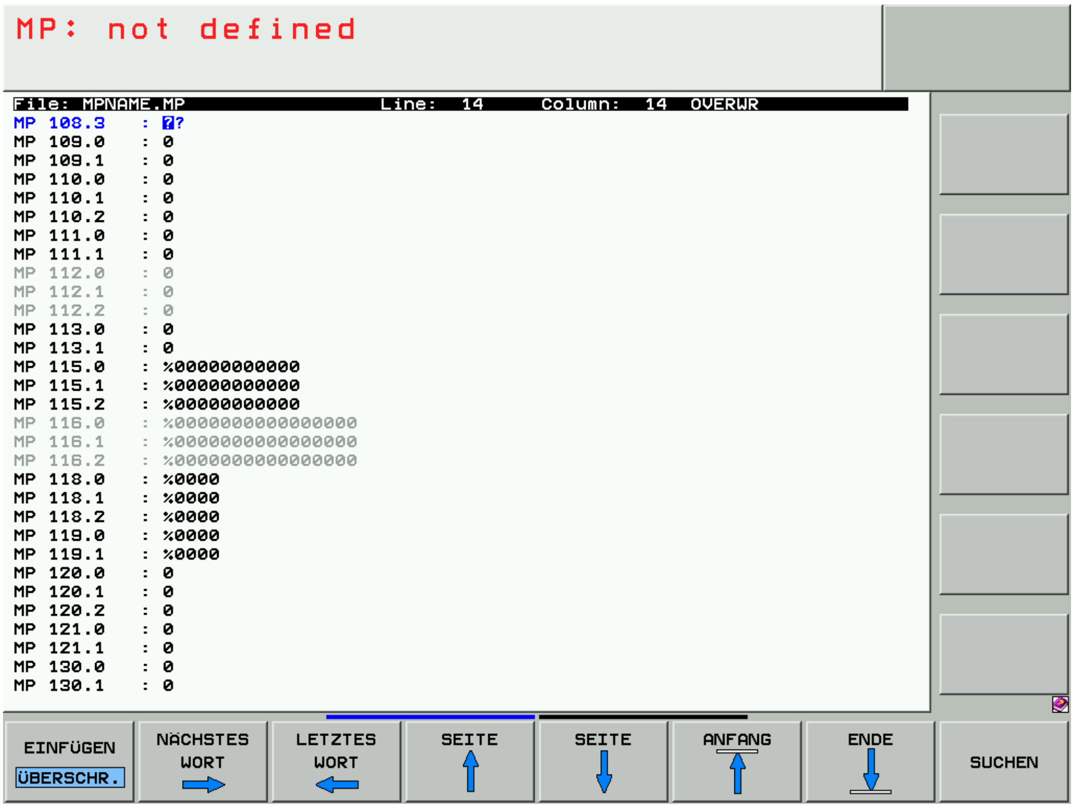
Note

The current NC software on the new SSDR detects that the firmware of HSCI devices needs to be updated.

- Run all firmware updates. --> See "Detecting and loading firmware updates" on page 29 – 524.

Adapting MPNAME.MP

Now the control may require entries in MPNAME.MP.

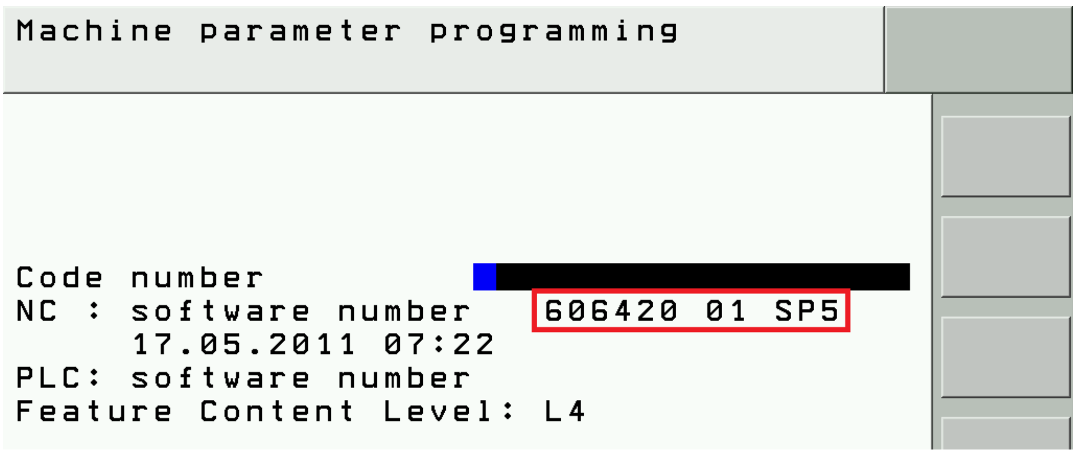


- Do **not enter** any data here. With the MOD key, you can open the code number window, set date and time, set up the Ethernet interface and load the appropriate backup for the machine. Continue as described!

Defining the NC software version

Check the currently active NC software version:

- Call the code number window.



Note

If you require a different software version, load it now. --> Contact your machine tool builder. Open the program manager and delete the incomplete MPNAME.MP file. --> A suitable MPNAME.MP will be created automatically. Only now can you exit the `Machine parameter programming` mode; the `Setup` key word is accepted.

Setting date and time on the control

- Check the date and time of the control and reset it, if necessary.
  --> See "Setting the system time" on page 13 – 173.

Setting up the data interface

- Make the settings for Ethernet transmission on the control.
  --> See "Via Ethernet" on page 14 – 183.
- Or define the settings for the RS 232 interface.
  --> See "Via RS-232-C/V.24 serial interface" on page 14 – 192.

Restoring the data

As you could probably not save any data from the defective SSDR, you must use available archives (PLC data, TNC data) to restore the data on the new SSDR.

> Note
>
> If required, you can obtain PLC and machine data from the machine manufacturer.

- Establish a connection between your laptop and the control.
  --> See "Connection setup" on page 14 – 183.
- Load the correct backup on the new SSDR.
  --> See "Restoring data" on page 14 – 207.

> Note
>
> In the LST file, delete the blue check marks for the files **LIES_MP.A** and **READ_MP.A**.
>
> Background:
> The files **LIES_MP.A** and **READ_MP.A** that contain the comments (in German and English) to the current machine parameters belong to every NC software version (can be found under **PLC:\JH\...**).
> As the replacement SSDRs are normally supplied with the latest NC software version, the **LIES_MP.A/READ_MP.A** in your backup file possibly belongs to an older NC software version. If you have deleted the check marks in your LST file, the current **LIES_MP.A/READ_MP.A** is not overwritten by the old **LIES_MP.A/READ_MP.A**.
>
> It is not recommended to protect the **LIES_MP.A** and **READ_MP.A** files on the control as protected files cannot be updated during an NC software update!

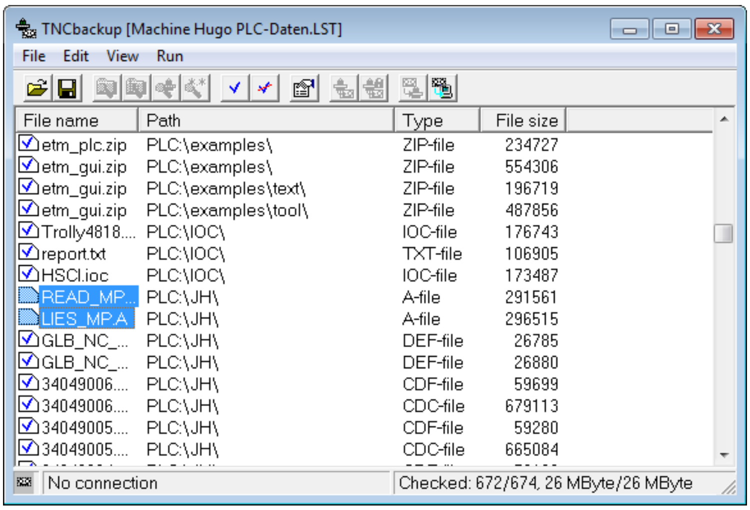


Figure: Check marks for LIES_MP.A and READ_MP.A removed

Updating the machine parameter list

If the control opens the machine parameter list after you have restored the backup, new machine parameters are added with the current NC software of the replacement SSDR or older MPs are removed.

END

▶ Press the END key.

The following messages may be generated:

Power interrupted	MP: not defined

▶ Enter a value for the new machine parameter.

Note

Comments on the new MPs can be found in the text file **READ_MP.A** or **LIES_MP.A** in the path **PLC:\JH\ ...**
Contact the machine manufacturer for information on the values to be entered!
If required you can add comments on the functions of new parameters in the MP list.

Power interrupted	MP: incorrect number

▶ The parameter no longer exists. --> Delete this MP or mark the parameter as a comment so it remains in the list.

END

▶ After each change, try to activate the machine parameter list with END.
If the MP list is complete, the iTNC 530 HSCI restarts.

If possible ...

If you could still transfer the **non-volatile PLC markers and words** from the RAM to the defective SSDR and subsequently create a backup:

▶ After restarting the control you must not acknowledge the **Power interrupted** message.

▶ Write the non-volatile PLC markers and words from the SSDR to the RAM of the control.
--> See "Non-volatile PLC markers and words" on page 11 – 134.

Restoring the original state of the machine

If necessary, you may ...

- recalibrate the touch probes.
- initialize the swivel head again.
- initialize the tool changer again.

Contact the machine manufacturer for information!

Note

On machines with analog axes, an offset fine adjustment should be performed with the HEIDENHAIN code number after the control was exchanged.
--> See "Adjusting the electrical offset (drift adjustment)" on page 21 – 355.

Functional test

▶ Check the machine functions (with the aid of the machine operator).

Creating a machine backup

If changes were made to the machine or control (e.g., new machine parameters added), you should create a backup of the current machine data.
--> See "Backup on an external data medium" on page 14 – 202.

Returning the defective SSDR

▶ Attach a note with the error description to the SSDR.

▶ Use the original packaging of the new SSDR to package the defective SSDR.

▶ Return the defective SSDR to the machine tool builder or to your HEIDENHAIN service agency.

29.7 Replacing the HDR

> Attention
>
> **The HDR may only be exchanged in consultation with the machine manufacturer or by the machine manufacturer!**
>
> HDRs that you receive in exchange and new HDRs are already partitioned and formatted.
> The HeROS operating system and the NC software are installed. The HDRs are normally equipped with the most recent NC software.
> **This NC software must be released by the machine manufacturer!**
>
> If the machine manufacturer has not released the latest NC software, or if you wish to keep the "old" NC software version that was installed on your defective HDR, this version must be installed.
> For this purpose you also require support from the machine manufacturer.

Preparing the machine tool

If still possible:

- Move the machine to home position (axes, tool changer, tilting head, etc.)
  Ask the machine operator!
- Press EMERGENCY STOP.

If possible ...

Back up the non-volatile PLC markers and words.

It is likely that no data can be written any more to a defective HDR.
However, if this is still possible:

- Back up the condition of non-volatile PLC markers and words from the RAM to the data medium.
  --> See "Non-volatile PLC markers and words" on page 11 – 134.

Backup

It is likely that the data on a defective HDR cannot be backed up any more.
However, if this is still possible:

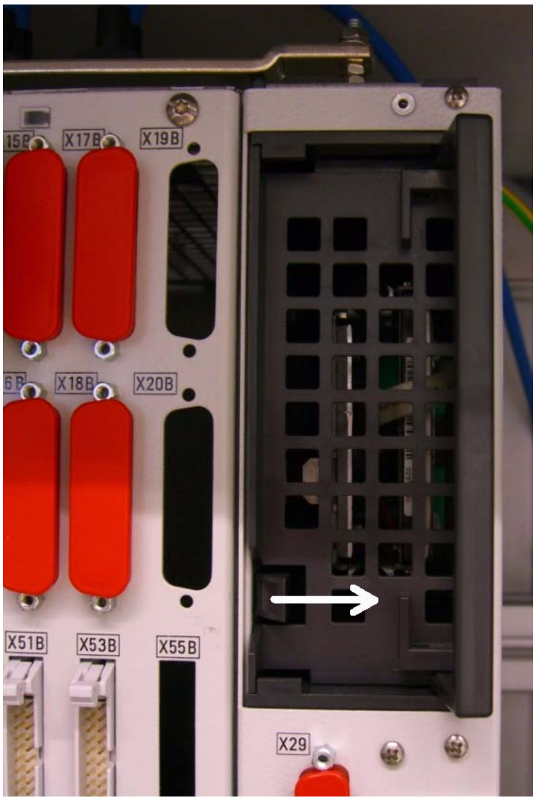
- Establish a connection between your laptop and the control.
  --> See "Connection setup" on page 14 – 183.
- Back up all control data of the HDR.
  In the program TNCremoNT select the icon `Scan all`.
  --> See "Backup on an external data medium" on page 14 – 202.

> Note
>
> If an external archive for the TNC data is already available, you need not back up the TNC partition.
> This saves time; ask your customer!
> In this case, select the icon `Scan system and machine files`.

Removing the defective HDR

- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Press the handle in the HDR housing upwards to open the locking mechanism.

- Press the looking hook in the HDR housing upwards and remove the HDR.



Attention

Observe the ESD precautions. --> See "Important information" on page 29 – 515!

Shipping brace of the HDR

▶ **Secure the HDR for transport!**
(The hard disk is mounted on a steel plate that is inserted into the guideways of the plastic housing. --> See sticker "Locking the hard disk" on the HDR.)

Figure: Sticker on the HDR housing informing on the shipping brace

Installing the new HDR

▶ Loosen the shipping brace; the HDR must be unimpeded! --> See sticker "Unlocking the hard disk" on the HDR.

> Attention
>
> Do not overextend the locking hook; just lift it slightly.

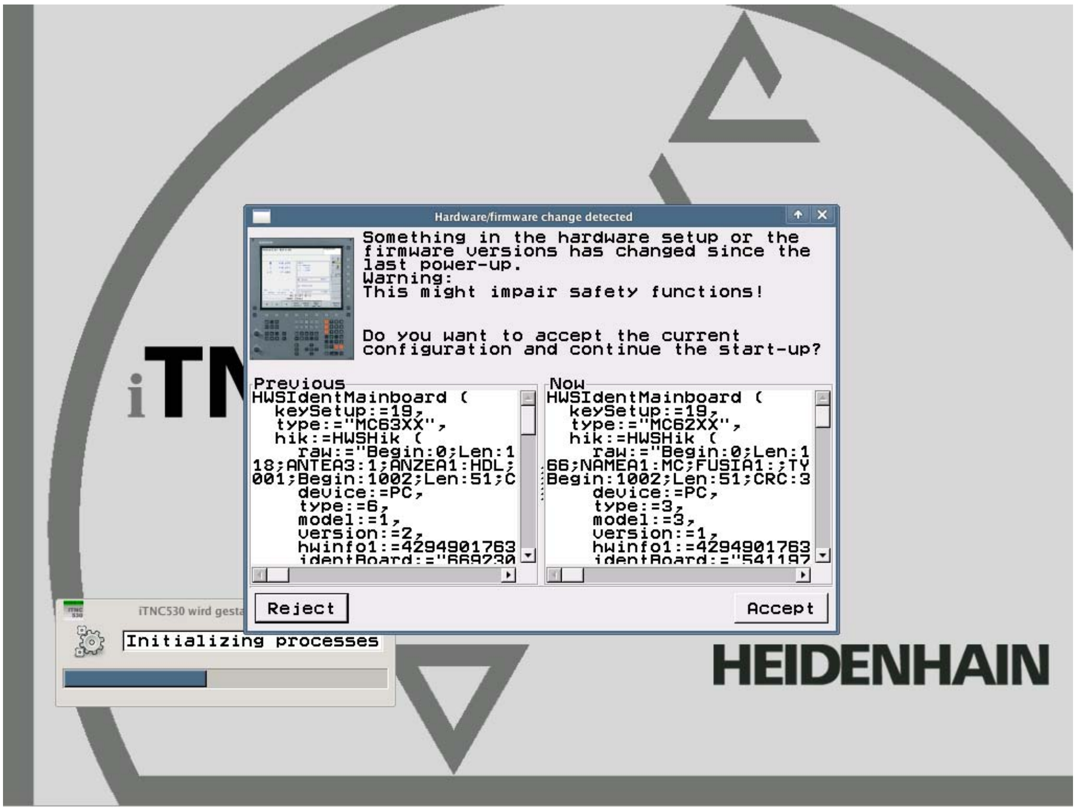
▶ Check whether all plug connections at the HDR are seated firmly.

▶ Insert and lock (by pressing down the handle) the new HDR.

▶ Switch on the power switch of the machine.

Detecting hardware updates

The control may display the following window:



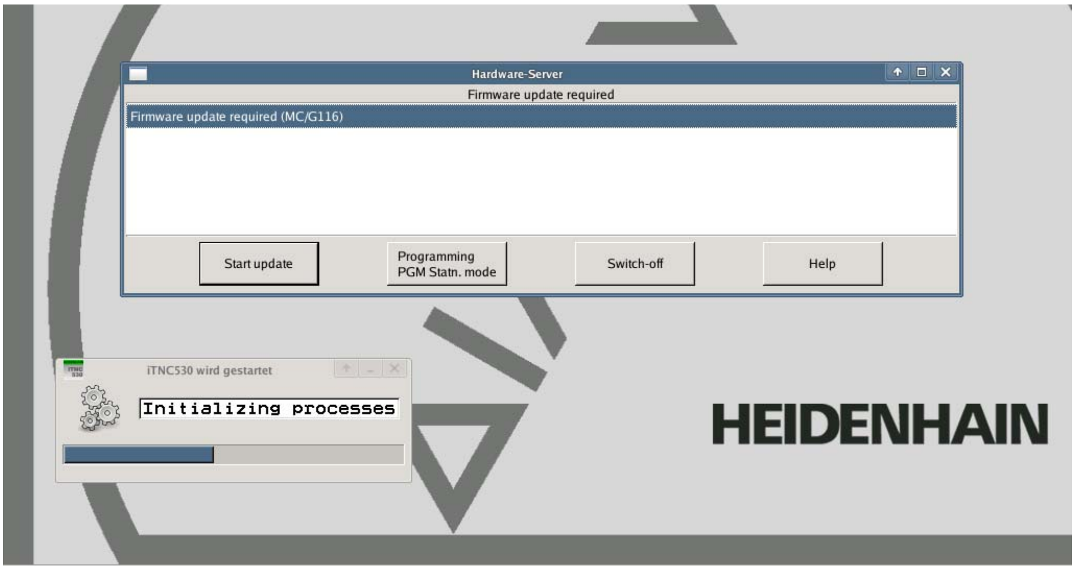
Note

In the plant, the HDR was configured with a hardware (e.g. an MC 63xx) your machine does not feature. The NC software now detects the changes to the hardware.

- Accept these changes. --> The control will continue booting.

Detecting firmware updates

The control may display the following window:



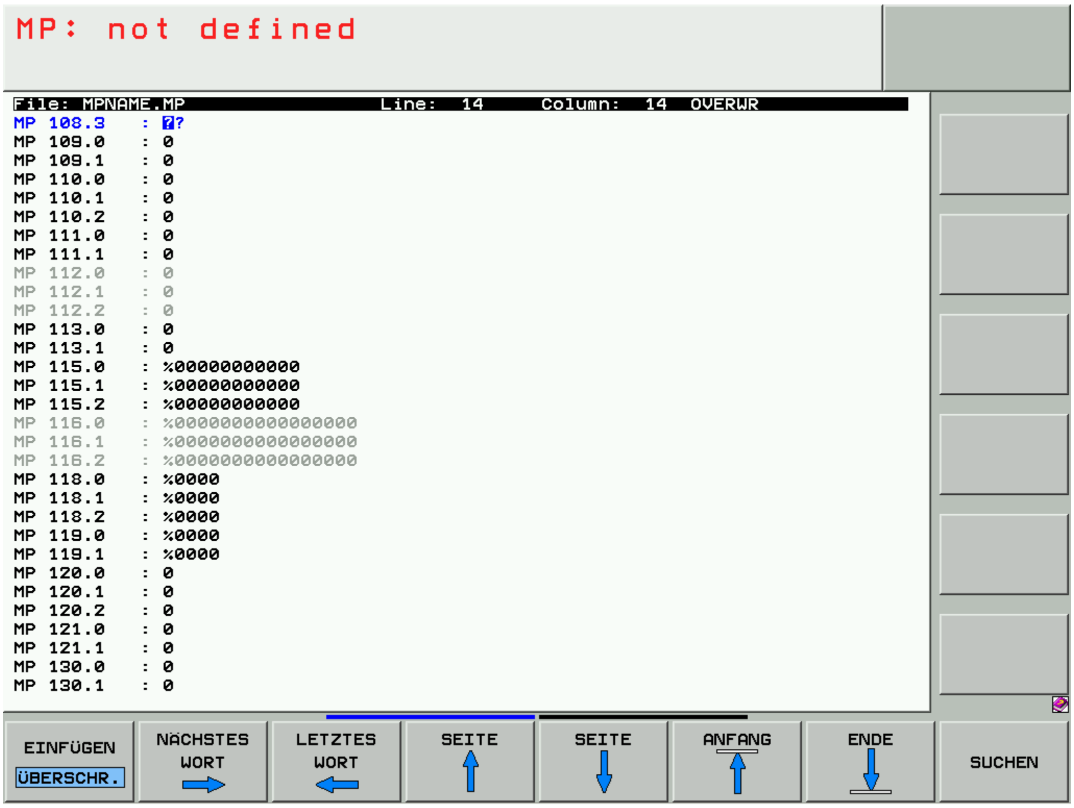
Note

The current NC software on the new HDR detects that the firmware of HSCI devices needs to be updated.

- Run all firmware updates. --> See ”Detecting and loading firmware updates” on page 29 – 524.

Adapting MPNAME.MP

Now the control may require entries in MPNAME.MP.

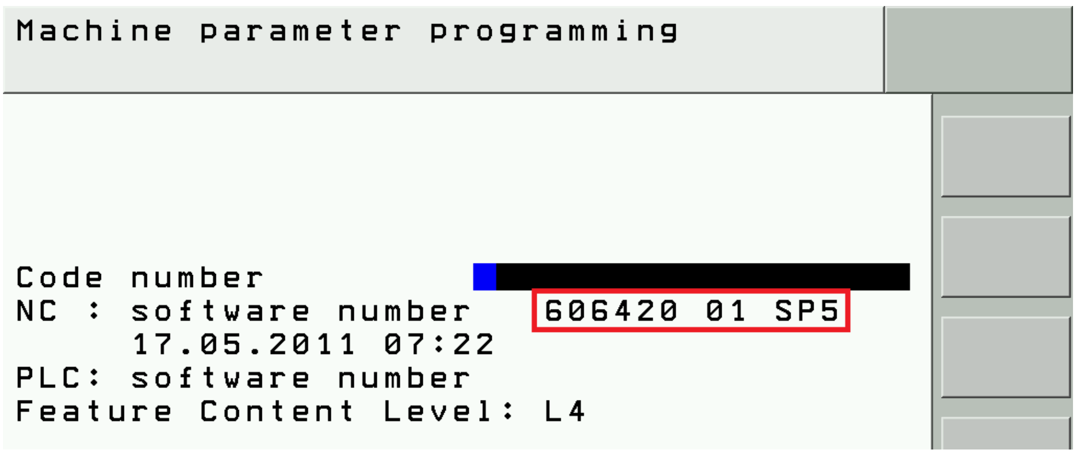


- Do **not enter** any data here. With the MOD key, you can open the code number window, set date and time, set up the Ethernet interface and load the appropriate backup for the machine. Continue as described!

Defining the NC software version

Check the currently active NC software version:

- Call the code number window.



Note

If you require a different software version, load it now. --> Contact your machine tool builder. Open the program manager and delete the incomplete MPNAME.MP file. --> A suitable MPNAME.MP will be created automatically. Only now can you exit the `Machine parameter programming` mode; the `Setup` key word is accepted.

Setting date and time on the control

- Check the date and time of the control and reset it, if necessary.
  --> See "Setting the system time" on page 13 – 173.

Setting up the data interface

- Make the settings for Ethernet transmission on the control.
  --> See "Via Ethernet" on page 14 – 183.
- Or define the settings for the RS 232 interface.
  --> See "Via RS-232-C/V.24 serial interface" on page 14 – 192.

Restoring the data

As you could probably not save any data from the defective HDR, you must use available archives (PLC data, TNC data) to restore the data on the new HDR.

> Note
>
> If required, you can obtain PLC and machine data from the machine manufacturer.

- Establish a connection between your laptop and the control.
  --> See "Connection setup" on page 14 – 183.
- Load the correct backup on the new HDR.
  --> See "Restoring data" on page 14 – 207.

> Note
>
> In the LST file, delete the blue check marks for the files **LIES_MP.A** and **READ_MP.A**.
>
> Background:
> The files **LIES_MP.A** and **READ_MP.A** that contain the comments (in German and English) to the current machine parameters belong to every NC software version (can be found under **PLC:\JH\...**).
> As the replacement SSDRs are normally supplied with the latest NC software version, the **LIES_MP.A/READ_MP.A** in your backup file possibly belongs to an older NC software version. If you have deleted the check marks in your LST file, the current **LIES_MP.A/READ_MP.A** is not overwritten by the old **LIES_MP.A/READ_MP.A**.
>
> It is not recommended to protect the **LIES_MP.A** and **READ_MP.A** files on the control as protected files cannot be updated during an NC software update!

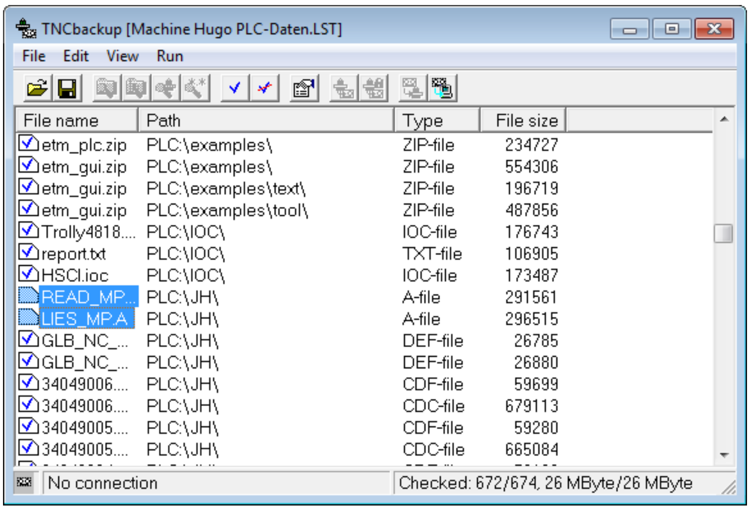


Figure: Check marks for LIES_MP.A and READ_MP.A removed

Updating the machine parameter list

If the control opens the machine parameter list after you have restored the backup, new machine parameters are added with the current NC software of the replacement HDR or older MPs are removed.

- Press the END key.

The following messages may be generated:

Power interrupted	MP: not defined

- Enter a value for the new machine parameter.

> Note
>
> Comments on the new MPs can be found in the text file **READ_MP.A** or **LIES_MP.A** in the path **PLC:\JH\ ...**
> Contact the machine manufacturer for information on the values to be entered!
> If required you can add comments on the functions of new parameters in the MP list.

Power interrupted	MP: incorrect number

- The parameter no longer exists. --> Delete this MP or mark the parameter as a comment so it remains in the list.

- After each change, try to activate the machine parameter list with END.
  If the MP list is complete, the iTNC 530 HSCI restarts.

If possible ...

If you could still transfer the **non-volatile PLC markers and words** from the RAM to the defective HDR and subsequently create a backup:

- After restarting the control you must not acknowledge the **Power interrupted** message.
- Write the non-volatile PLC markers and words from the HDR to the RAM of the control.
  --> See "Non-volatile PLC markers and words" on page 11 – 134.

Restoring the original state of the machine

If necessary, you may ...

- recalibrate the touch probes.
- initialize the swivel head again.
- initialize the tool changer again.

Contact the machine manufacturer for information!

> Note
>
> On machines with analog axes, an offset fine adjustment should be performed with the HEIDENHAIN code number after the control was exchanged.
> --> See "Adjusting the electrical offset (drift adjustment)" on page 21 – 355.

Functional test

- Check the machine functions (with the aid of the machine operator).

Creating a machine backup

If changes were made to the machine or control (e.g., new machine parameters added), you should create a backup of the current machine data.
--> See "Backup on an external data medium" on page 14 – 202.

Returning the defective HDR

- Attach a note with the error description to the HDR.
- **Check whether the hard disk is secured by a shipping brace.**
- Use the original packaging of the new HDR to package the defective HDR.
- Return the defective HDR to the machine manufacturer or to your HEIDENHAIN service agency.

29.8 Exchanging the CC

Preparing the machine tool

If still possible:

- Move the machine to home position (axes, tool changer, tilting head, etc.)
  Ask the machine operator!
- Press EMERGENCY STOP.

Removing the defective CC

- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Screw off the shielding plate.
- Label all lines and cables and disconnect them from the CC.
- Unscrew the ground wire or the ground bar.
- Dismount the CC.

> Attention
>
> Observe the ESD precautions. --> See "Important information" on page 29 – 515!

Mounting the new CC

- Install the new CC in the electrical cabinet.
- Screw on the ground wire or the ground bar.
- If required, remove the red protective caps from the CC connectors.
- Reconnect and attach all lines and cables.

> Attention
>
> Do not forget the grounding screw! Do not confuse any of the connectors!

- Screw on the shielding plate.
- Switch on the power switch of the machine.

Accepting hardware updates

After start-up, the control may display the window `Hardware/firmware change detected`.

- Accept these changes. --> See "Recognizing and accepting hardware updates" on page 29 – 523.

Running firmware updates

Firmware updates may be required for the exchange CC. The NC software automatically detects, whether this is required.

- Run these firmware updates. --> See "Detecting and loading firmware updates" on page 29 – 524.

Functional test

- Check the machine functions (with the aid of the machine operator).

Returning the defective CC

- Replacement controls are delivered with a form which you can use to provide information on the error of the defective control.
  Fill in this form and attach it to the housing of the CC.
- Use the original packaging of the new CC to package the defective CC.
- Return the defective CC to the machine manufacturer or to your HEIDENHAIN service agency.

29.9 Exchanging the UEC

Preparing the machine tool

If still possible:

- Move the machine to home position (axes, tool changer, tilting head, etc.) Ask the machine operator!
- Press EMERGENCY STOP.

Removing the defective UEC

- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Label all lines and cables and disconnect them from the UEC.
- Unscrew the ground wire or the ground bar.
- Dismount the UEC.

> Attention
>
> Observe the ESD precautions. --> See "Important information" on page 29 – 515!

Mounting the new UEC

- Install the new UEC in the electrical cabinet.
- Screw on the ground wire or the ground bar.
- If required, remove the red protective caps from the UEC connectors.
- Reconnect and attach all lines and cables.

> Attention
>
> Do not forget the grounding screw! Do not confuse any of the connectors!

- Switch on the power switch of the machine.

Accepting hardware updates

After start-up, the control may display the window **`Hardware/firmware change detected`**.

- Accept these changes. --> See "Recognizing and accepting hardware updates" on page 29 – 523.

Running firmware updates

Firmware updates may be required for the exchange UEC. The NC software automatically detects, whether this is required.

- Run these firmware updates. --> See "Detecting and loading firmware updates" on page 29 – 524.

Functional test

- Check the machine functions (with the aid of the machine operator).

Returning the defective UEC

- Replacement controls are delivered with a form which you can use to provide information on the error of the defective control.
  Fill in this form and attach it to the housing of the UEC.
- Use the original packaging of the new UEC to package the defective UEC.
- Return the defective UEC to the machine manufacturer or to your HEIDENHAIN service agency.

29.10 Exchanging the buffer battery

See "Buffer battery" on page 18 – 257.

29.11 Exchanging other HEIDENHAIN components

HSCI components

- When you exchange HEIDENHAIN components of the iTNC 530 HSCI, messages related to **firmware or hardware updates** may be issued.
  - Accept these changes.
    --> See "Recognizing and accepting hardware updates" on page 29 – 523.
  - Run the required firmware updates.
    --> See "Detecting and loading firmware updates" on page 29 – 524.

Encoders

- Many HEIDENHAIN products (encoders, scanning heads, etc.) are supplied with **mounting aids** (metal forks, spacer plates, etc.)
- **Mounting Instructions** and **Mounting Information** are also included in delivery.
- The HEIDENHAIN testing devices PWM 9 (See "PWM 9 encoder diagnostic kit" on page 30 – 564) or PWT (See "PWT 10/17/18 test unit" on page 30 – 566) are good aids for **adjusting scanning heads**.

> Attention
>
> When you exchange motors or encoders for drives that determine the field angle (normally linear and torque motors) the function `Field orientation` must be executed again.
> Contact your machine manufacturer!

- When HEIDENHAIN encoders (e.g. linear encoders) are exchanged, in most cases the machine datum needs to be reset. --> See "Encoder interface" on page 19 – 277.
- If a HEIDENHAIN motor encoder for a spindle was exchanged, it may be necessary to reset the spindle preset. --> See "Encoder interface" on page 19 – 277.

Drive components and mechanics

- If HEIDENHAIN motors for axes or spindles were exchanged, it may be necessary to readjust the trip dog for reference end position, to reset the machine datum and to determine the spindle preset. --> See "Encoder interface" on page 19 – 277.
- Some **successor models** (e.g., inverters, motors) are supplied with **replacing instructions** describing, e.g., changes required in the MP list or in motor or power module tables.
- When you exchange **electrical original components** (inverters, motors, etc.) normally no **readjustment of the control loops** of axes and spindle is required.
  Exception: When exchanging a CMA-H 04-04-00 additional module for analog axes and spindles, an offset adjustment with the code number for fine compensation should be performed.
  --> See "Adjusting the electrical offset (drift adjustment)" on page 21 – 355.
- **For information on the exchange of drive components**, refer to the **Service Manual "Inverter Systems and Motors"**.
- When you exchange **mechanical components**, **readjustment of the control loops** of axes and spindles **may be necessary.** --> Contact the machine manufacturer!

Cables

- Always use **original HEIDENHAIN cables** as replacements! Do not exceed any maximum lengths!

Shielding and grounding

- If required, ensure **proper shielding and grounding** of cables and components.

Packaging

- If possible, use the **original HEIDENHAIN packaging**.

> Note
>
> If you have any **questions**, contact the **machine tool builder** or a **HEIDENHAIN service agency**:

29.12 Exchanging HEIDENHAIN interface boards in the SIMODRIVE system

Version with D-sub connector

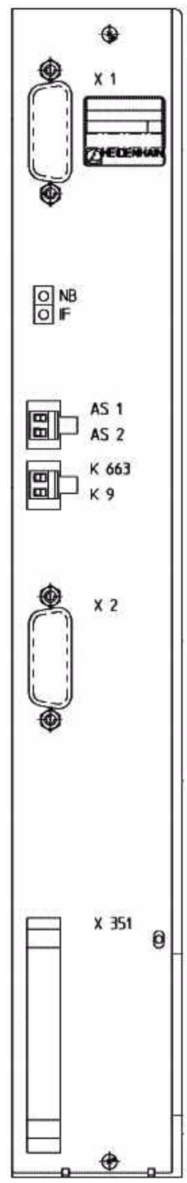
HEIDENHAIN interface boards for the SIMODRIVE system in the version with D-Sub connector are available **with or without metallic isolation** of HEIDENHAIN PWM signals to the Siemens interface.

<table>
<tr>
<td>
Interface boards without metallic isolation are identified as follows:

■ On the front panel, there are the LEDs NB (not ready) and IF (pulse release).

■ There is no grounding screw on the front panel.

■ There is no transformer on the board.

■ These boards have the ID numbers 291070-01, 324952-01, 02, 03 and 10 without index A.
</td>
<td>


</td>
</tr>
</table>

Attention

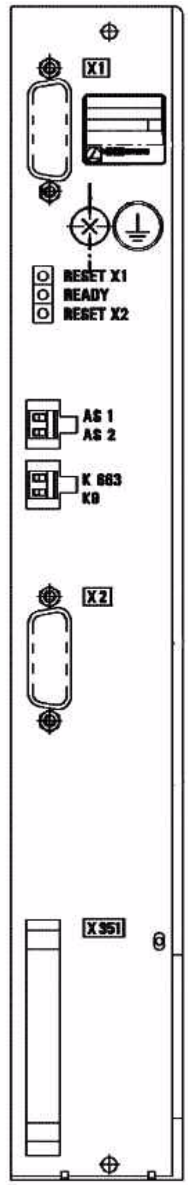
The terminal X131 of the Siemens E/R module of boards without metallic isolation must not be connected to the central signal ground of the machine!

Note

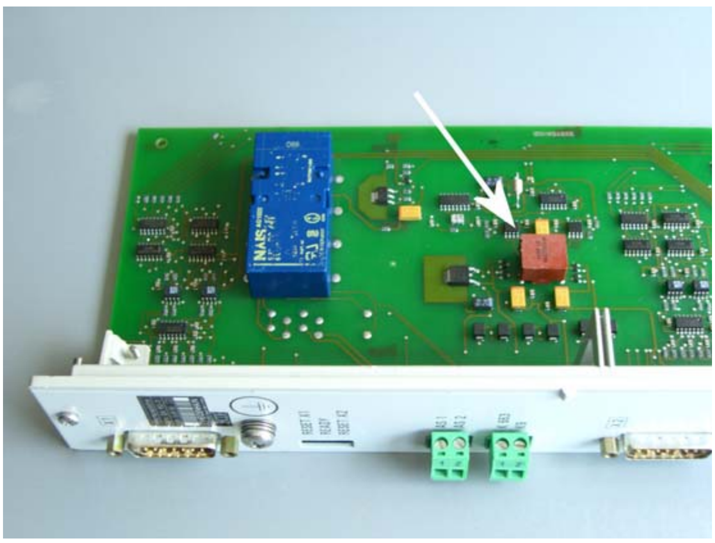
The HEIDENHAIN interface boards of the first generation were produced without metallic isolation.

Interface boards **with metallic isolation** are identified as follows:

- On the front panel, there are the LEDs **RESET X1, READY** and **RESET X2**.
- There is a grounding screw on the front panel.
- There is a transformer on the board.
- These boards have the ID number 324952-10 with index A, 11, 12, ...



Transformer component on board



Grounding screw on front panel	

Attention

The terminal X131 of the Siemens E/R module of boards with metallic isolation has to be connected to the central signal ground of the machine!
The individual expansion boards must also be connected to the central signal ground of the machine via the grounding screw on the front panel.

Attention

Interface boards **with and without metallic isolation must not be used together**!
Either all boards are metallically isolated and X131 is wired, or all boards are not metallically isolated and X131 is not wired!

Photo: Siemens E/R module with terminal X131

> **Attention**
>
> If a Siemens E/R module is used together with a "monitoring module" (UEB module), the terminal X131 of this module must be wired exactly like on the E/R module.

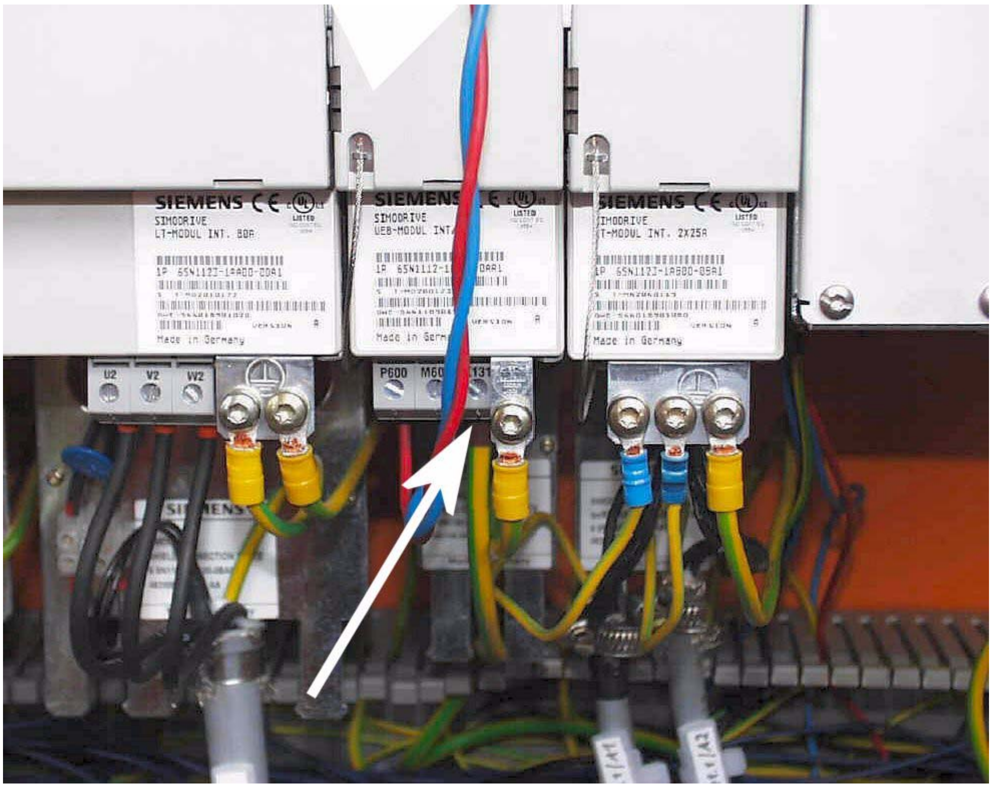


Photo: Siemens UEB module with terminal X131

Version with ribbon cable connector

HEIDENHAIN interface boards for the SIMODRIVE system in the version with ribbon cable feature metallic isolation of the HEIDENHAIN PWM signals to the Siemens interface.

Thus, the terminal X131 must be available at the SIEMENS drive system!

The individual expansion boards must also be connected to the central signal ground of the machine via the grounding screw on the front panel.

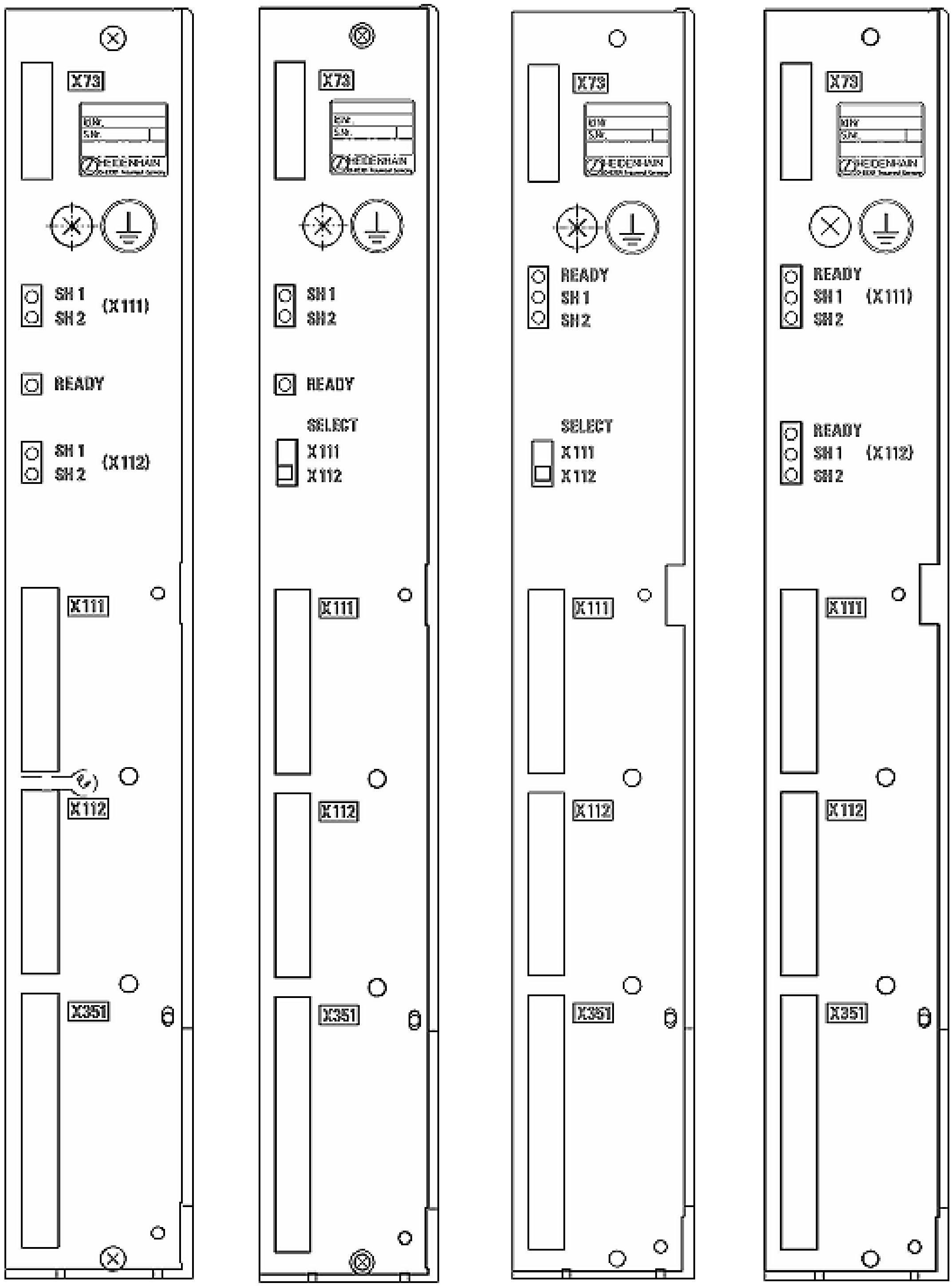


Figure: Various HEIDENHAIN interface boards with ribbon cable connectors

Compatibility of HEIDENHAIN expansion boards to SIMODRIVE power modules

SIEMENS has revised the SIMODRIVE power modules.
Among other things interference suppression circuits have been added.

In 2007, the HEIDENHAIN expansion boards for the modified SIMODRIVE power modules were also revised:

Modified SIMODRIVE power modules	Matching HEIDENHAIN expansion boards	Version
At the end of the SIEMENS ordering designation of the revised power modules you find the **code A2 or A3**.	324952-03, index A	2 axes, D-sub
	324952-12, index D	2 axes, D-sub
	324955-17	1 axis, ribbon cable
	359002-05	2 axes, ribbon-cable
	515012-03	1 axis, ribbon cable

The HEIDENHAIN expansion boards listed in the above table replace the previous variants.
This means that they may also be inserted in "older" SIMODRIVE power modules.

Attention

"Older" HEIDENHAIN expansion boards must not be operated with modified SIMODRIVE power modules.
Possible errors and error messages –> See ”Overview of possible errors” on page 5 – 51.

30 Measuring, testing and inspection equipment

30.1 Important notes

DANGER

Observe the safety precautions in chapter 2 of this manual.
--> See "Safety precautions" on page 2 – 15!

Attention

The following inspection, measuring and testing equipment is **only** intended **for testing** machines!

Attention

Encoder cables, etc., are no longer continuously shielded when the test adapter is connected.

Attention

When using grounded measuring equipment (e.g., oscilloscope with power connection), always use the socket of the machine's electrical cabinet for power supply.
Compensating currents caused by different earth potentials can thus be avoided!

Attention

For measuring voltages, first connect to 0 V and only then to the voltage to be measured!

Attention

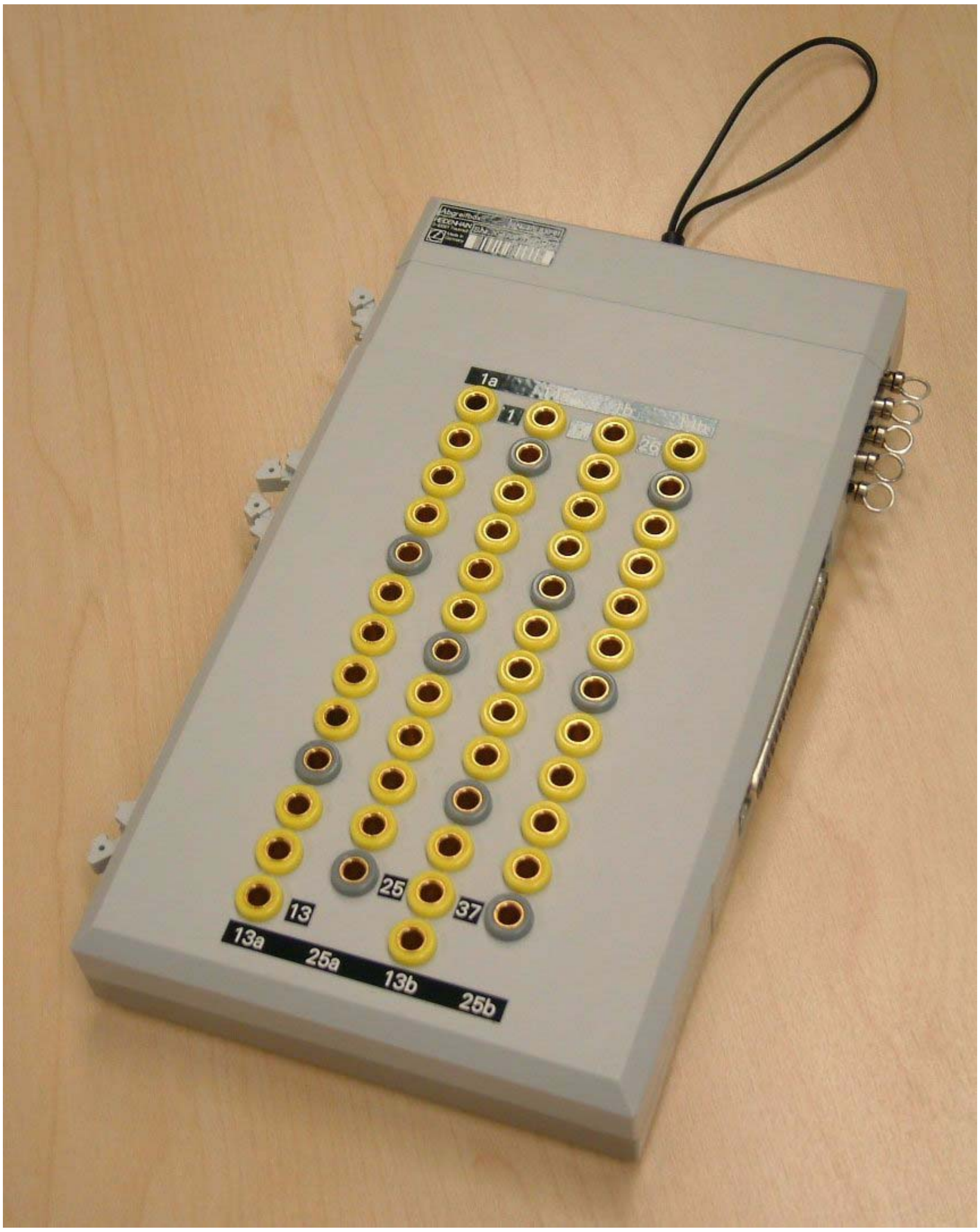
Always observe the **User's Manual** of PWM 9 as well as the **Operating Instructions** of PWT 10/17/18 and PWM 20 / IK 215!

30.2 Test adapter

Brief description

The test adapter ...

- currently has the ID 375830-01.
- can be connected to all D-Sub and ribbon-cable connectors of HEIDENHAIN devices.
- requires adapter cables.
- has numbered banana jacks to which, e.g., a multimeter can be connected.
- permits signal and voltage measurement during the operation of HEIDENHAIN devices.
- has five prepared banana plugs with eyes to be clipped on the measuring lines.
  These banana plugs are located at the upper right; if required, they can be plugged into the numbered banana jacks.

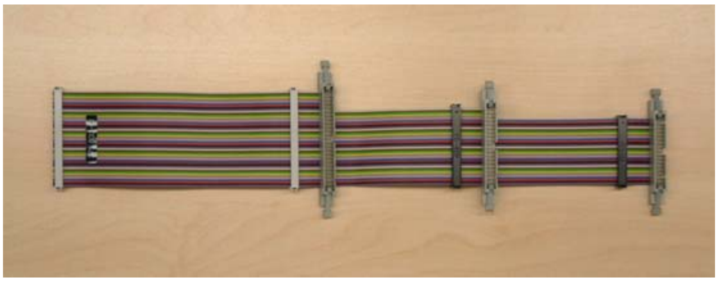
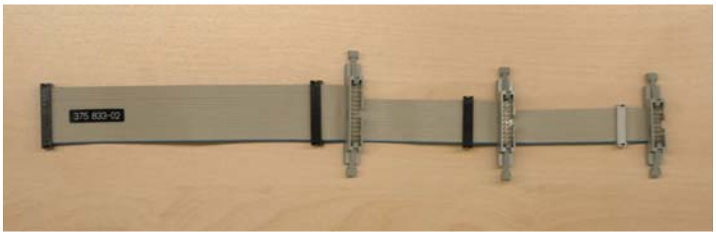


DANGER

Only **one** interface at a time may be inspected on the test adapter!

Adapter cable to the test adapter

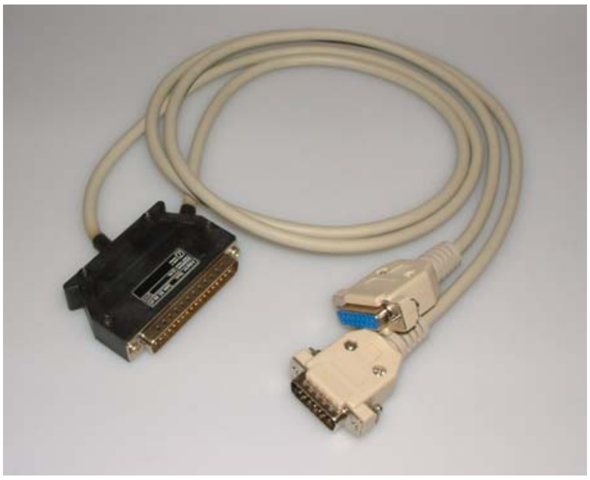
Each ribbon cable and D-sub connector requires its own adapter cable.

	Connecting cable, ribbon type 50, 40, 34-pin ID 375833-01
	Connecting cable, ribbon type 26, 20, 16-pin ID 375833-02

A new and an old version of the D-sub adapter cables are available.
The older version has some disadvantages:

- The oval-head screws on the D-sub connector reduce the insertion depth. An adapter connector can/must be used.
- More space is required as the adapter connector has a lateral cable outlet and the original connector must be connected directly to the adapter connector.

	D-sub adapter cable 9-pin ID 255481-01 New version
	D-sub adapter cable 9-pin ID 255481-01 Older version

	D-sub adapter cable 15-pin ID 255482-01 New version
	D-sub adapter cable 15-pin ID 255482-01 Older version
	D-sub adapter cable 25-pin ID 255483-01 New version
	D-sub adapter cable 25-pin ID 255483-01 Older version

	D-sub adapter cable 37-pin ID 255484-01 New version
	D-sub adapter cable 37-pin ID 255484-01 Older version

30.3 PWM 9 encoder diagnostic kit

Brief description

- The PWM 9 set currently has the ID 512134-01.
- The **PWM 9** phase angle measuring unit is a universal testing device for inspecting and adjusting HEIDENHAIN **incremental** encoders (linear , rotary and angle encoders).
- There are different **expansion modules** available for checking the different encoder signals (11 µApp, 1 Vpp, TTL, HTL).
- The PWM 9 can be connected **in series between the encoder and the control**. Inspections at "operating speed" are possible.

DANGER

If the PWM 9 is connected in the signal path between the encoder and the control:
Do not change the settings of the PWM 9 (e.g., parameters, encoder voltages) and do not switch it off while the machine tool is operating.
Ignoring this may cause machine damage or personal injury!
Read the **PWM 9 User's Manual**, before you use the device.

- The signal amplitude is also measured when the encoder has stopped.
- Three BNC sockets (A/B/C) are available for checking the encoder signals on an oscilloscope (recommended by HEIDENHAIN).
- For inspecting and adjusting HEIDENHAIN measuring systems **in the workshop** the PWM 9 can also be used without subsequent electronics (e.g., control, position display).

Available functions The PWM 9 functionality consists of the PWT MODE and the PWM MODE.

The most important functions of the PWM MODE:

- Display of phase angle and on-to-off ratio
- Display of scanning frequency
- Measurement of signal amplitude, current consumption and supply voltage of the measuring system
- Display of internal universal counter and of encoder signal periods (pulse count)
- Display of reference signal, fault-detection signal and counting direction
- Output of the amplified scanning signals (11 µApp, 1 Vpp interface boards) or of the original scanning signals (TTL, HTL interface boards) via 3 BNC sockets (e.g. to an oscilloscope)

The most important functions of the PWT MODE:

Graphic bar display of ...

- Signal amplitude
- Signal quality
- Width of reference signal
- Position of reference signal

Check-Ref function

- Adjusting aid for mounting scanning heads of exposed encoders
- Checking distance-coded reference marks

Note

Every **PWM 9** is delivered with a detailed **User's Manual**.
This User's Manual is available on the Internet in German and other languages and can be downloaded from www.heidenhain.de/...
During our **training courses on measuring systems** or special **PWM 9 trainings** the PWM 9 is explained in detail.
We recommend that you participate in a HEIDENHAIN service training course so that you can use the PWM 9 correctly and efficiently.
Contact HEIDENHAIN Traunreut or your regional agency.

30.4 PWT 10/17/18 test unit

Brief description

- The **PWT** phase angle test unit is a mounting and adjusting aid for the **scanning heads of exposed incremental encoders**.
  However, it is also possible to check signals (A track, B track, reference mark) of **sealed linear and angular encoders** and of **motor encoders**.
- Three different PWT versions are available:

Encoder diagnostic kit	Signal type	ID	Suited for:
PWT 10	11 µApp	325411-xx	Exposed and sealed encoders
PWT 17	TTL	325412-xx	Exposed encoders
PWT 18	1 Vpp	325413-xx	Exposed and sealed encoders, motor encoders

Note

The PWT 17 can only be used for exposed encoders!
The electronic circuit of an exposed encoder converts the TTL signals to 11 µApp signals which the PWT 17 requires for evaluation.
Sealed encoders do not feature such electronic conversion.

- For HEIDENHAIN motor encoders, the PWT 18 for 1 Vpp signals is used.
- The PWT **cannot** be connected in series between motor encoder and control.
- The encoder is connected to and powered by the PWT 18.
- The signals of scales or scale tapes can be observed during traverse with indirect position measurement (i.e. the motor encoder is used for positioning).
  This means that the signals of the position encoder could also be checked at "operating speed".
- For inspecting a motor encoder, the encoder or the motor shaft must be rotated externally (e.g., manually). Thus, motor encoder signals can hardly be checked at operating speed.
- The signal amplitude is also measured when the encoder has stopped.
- For a detailed assessment of the signal quality, an inspection of the position or speed encoder with the PWM 9 is recommended.

Available functions

Graphic bar display of ...

- Signal amplitude
- Signal quality
- Width of reference signal
- Position of reference signal

Check-Ref function:

- Adjusting aid for mounting the scanning heads of exposed encoders
- Check of distance-coded reference marks

Note

Every **PWT** is delivered with **operating instructions**.
These instructions are available on the Internet in German and other languages. They can be downloaded from www.heidenhain.de/...
A detailed explanation of the PWT is part of our **training courses on measuring systems**.
We recommend that you participate in a HEIDENHAIN service training course so that you can use the PWT correctly and effectively.
Contact HEIDENHAIN Traunreut or your regional agency.

30.5 IK 215 adjusting and testing package

- The IK 215 is a **hardware platform for the HEIDENHAIN ATS Software** (Adjusting and Testing Software).
- The above package currently has the ID 547858-01.
- The IK 215 is an adapter card for PCs (PCI bus) for inspecting and testing absolute HEIDENHAIN encoders with EnDat or SSI interface.
- The incremental signals of linear and angle encoders are also displayed.
- With the SA 100 service adapter, the IK 215 can be connected **in series between encoder and control**. Inspections at "operating speed" are possible.
- Parameters (e.g. datum shift), the electronic ID label and OEM information can be read and written via the EnDat interface.

Note

The **IK 215 Adjusting and Testing Package** is delivered with detailed **operating instructions**. These instructions are also available on the Internet in German and English. They can be downloaded from www.heidenhain.de/...
A detailed explanation of the **IK 215 Adjusting and Testing Package** is part of our **training courses on measuring systems**.
We recommend that you participate in a HEIDENHAIN service training course so that you can use the IK 215 Adjusting and Testing Package correctly and efficiently.
Contact HEIDENHAIN Traunreut or your regional agency.

30.6 PWM 20 encoder diagnostic kit

- Like the IK 215, the **PWM 20** phase angle measuring unit is a **hardware platform for the HEIDENHAIN ATS software** (adjusting and testing software).
- The above kit currently has the ID 759251-01.
- The PWM 20 can directly be connected to a PC or laptop via the **USB interface**.
- It serves to inspect and test HEIDENHAIN absolute encoders with EnDat or SSI interface.
- The incremental signals of linear and angle encoders are also displayed.
- With the SA 100 service adapter, the PWM 20 can be connected **in series between encoder and control**. Inspections at "operating speed" are possible.
- Parameters (e.g. datum shift), the electronic ID label and OEM information can be read and written via the EnDat interface.

Note

The **PWM 20 encoder diagnostic kit** is delivered with detailed **operating instructions**.
These instructions are also available on the Internet in German and English. They can be downloaded from www.heidenhain.de/...
A detailed explanation of the **PWM 20 encoder diagnostic kit** is part of our **training courses on measuring systems**.
We recommend that you participate in a HEIDENHAIN service training course so that you can use the PWM 20 correctly and efficiently.
Contact HEIDENHAIN Traunreut or your regional agency.

31 Machine parameters

31.1 Explanation

A contouring control must have access to **specific data** (e.g., traverse distances, acceleration, shaft speeds) before it can execute its programmed instructions.
You define these data in what are known as **machine parameters**.

The list of machine parameters is structured according to **topic groups**.

Machine parameters	Topics
10 to 999	Encoders and machines
1000 to 1399	Positioning
1400 to 1699	Operation with velocity feedforward control
1700 to 1999	Operation with following error
2000 to 2999	Integrated speed and current control
3000 to 3999	Spindle
4000 to 4999	Integrated PLC
5000 to 5999	Data interface
6000 to 6199	3-D touch probe
6500 to 6599	Tool measurement with triggering touch probe
7100 to 7199	Tapping
7200 to 7349	Programming and display
7350 to 7399	Colors
7400 to 7599	Machining and program run
7600 to 7699	Hardware
13000 to 13999	Second spindle

If there is more than one input value for a single function (e.g., a separate input for each axis), the parameter number is extended by **indices**.
Index zero is always axis 1, index one is axis 2, etc.

Example:

MP1010.0-8	Rapid traverse
MP1010.0	Rapid traverse for axis 1
MP1010.1	Rapid traverse for axis 2
MP1010.2	Rapid traverse for axis 3
MP1010.3	Rapid traverse for axis 4
MP1010.4	Rapid traverse for axis 5
MP1010.5	Rapid traverse for axis 6
MP1010.6	Rapid traverse for axis 7
MP1010.7	Rapid traverse for axis 8
MP1010.8	Rapid traverse for axis 9

In the **OEM.SYS** system file, the number of axes used or intended is entered after the term `AXISNUMBER` in order that only the necessary index parameters are displayed.

With other machine parameters you can **activate specific functions**. In this case, the **parameters serve as on/off switches for these functions**. These parameters are bit-encoded. Each bit is assigned either to an axis or a function.

Example:

MP10 : %00000000011111 ; active axes

31.2 The machine parameter editor

Important notes

For service purposes, the service engineer must not only look up values set in the MP list, but he must also be able to edit them, if required. The MP list is protected against unauthorized editing with a code number.
Please note the following:

DANGER

- **Machine parameters may only be changed after consultation with the machine manufacturer.**
  (For this reason some OEMs also determine their own MP code numbers.)
- Only edit machine parameters while the control is in "Power interrupted" status or if EMERGENCY STOP is pressed.
  Machine parameters that concern the control loops may only be edited **when EMERGENCY STOP is pressed**!

Note

- Extensive changes should be made in a test MP list and not in the original MP list.
- It is advisable to create a backup of the machine data on an external data medium, if you intend to make comprehensive changes to the machine settings.
  --> See "Backup on an external data medium" on page 14 – 202.

Changes by the operator

The machine operator can alter machine settings, for example via FN17 commands, NC macros, cycles or special soft keys.
He will mostly increase safety, e.g., he can reduce the traverse range or the maximum speed.

Only the values in the run-time memory are overwritten, however. The values in the original MP list on the control's data medium do not change!

Subgroups of the MP List

It is also possible to call subgroups of the original MP list:

Call	Contents
USER PARAMETERS soft key	Up to 16 parameters released by the machine manufacturer
Code number 123	Parameters defined by HEIDENHAIN

Changes by the PLC

The **PLC program** of the machine manufacturer can **read machine parameters** and **overwrite** most of them!

Normally however, only the values in the run-time memory are overwritten. The values in the original MP list on the control's data medium do not change!

Another MP file (which of course must exist on the control's data medium) can also be selected by the PLC.

MP subfiles (subgroups of the original MP file, sometimes with different values) can also be activated by the PLC. The MP subfile contents are loaded into the run-time memory. All MP values that are not in this file remain unchanged in the run-time memory.

Examples of changed machine parameters:

- Adaptation to achieve special accuracy, speed, surface quality
- Different loads

Note

So it is possible that the values in the original MP list (basic data) are not valid at any rate.
It is possible that values in the MP list have been changed for testing purposes; with special machine functions, however, these values in the run-time memory are overwritten by the PLC!
If necessary, ask the machine manufacturer which MP files or MP subfiles are active in which special mode of the machine, or which parameters are overwritten by the PLC!

Calling the machine parameter editor

- Select the **Programming and Editing** operating mode.
- If open: Close the program management by pressing the END button.

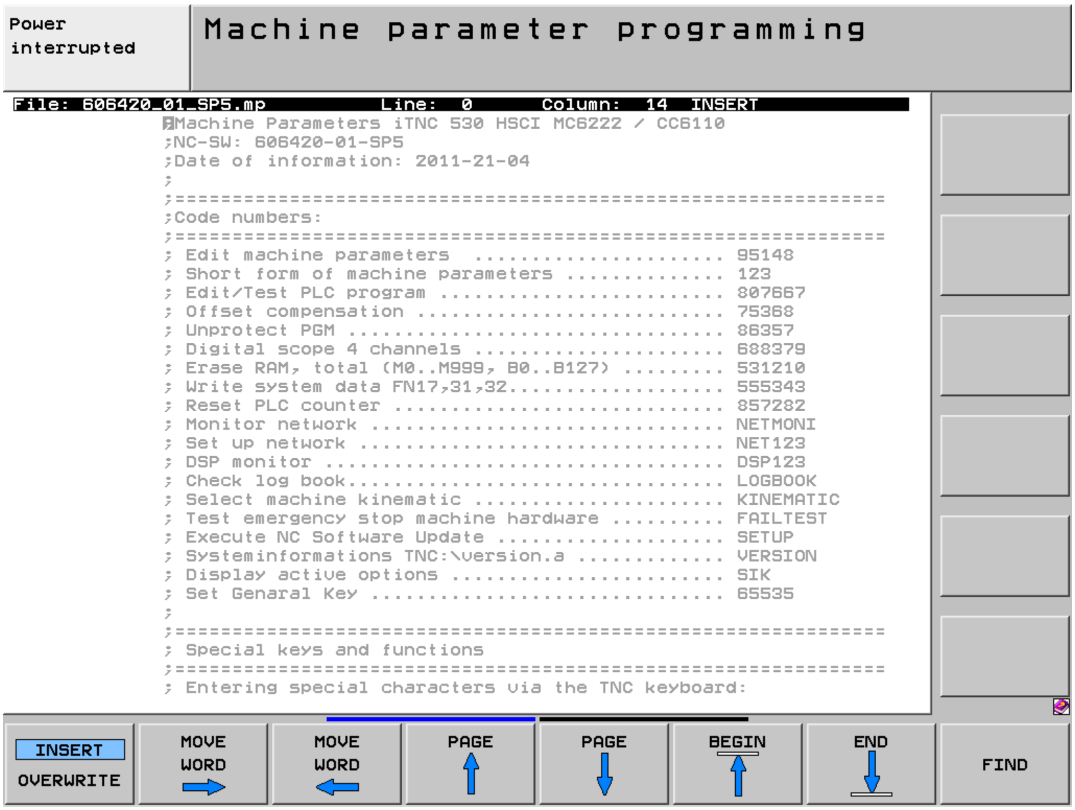
> **Note**
>
> Pressing the MOD key while the program manager is open calls screen where you can make the interface settings.

- Call the code number window.

9 5 1 4 8 ENT

- Enter the code number and press ENT to confirm.

The active machine parameter list appears on the screen in the **Machine Parameter Programming** mode:



> **Note**
>
> If the message **Line is write-protected** is displayed when you try to edit a machine-parameter value, individual machine parameters or the entire MP list is protected against editing.
> The machine manufacturer has defined his own MP code number. --> Please contact your machine manufacturer!

- Press the END key to exit the machine parameter mode list.

Input format

MP values can be shown in different formats:

- **Decimal:**
  There is no identifier before the value.
  Example: MP910.0 : +1000 ; traverse range
- **Binary:**
  The identifier **%** is displayed before the value.
  Binary input is recommended for machine parameters that activate individual functions bit-encoded.
  Example: MP10 : %00000000011111 ; active axes
- **Hexadecimal:**
  The identifier **$** is displayed before the value.
  The hexadecimal input is suitable, e.g. for large numerical values.
  Example: MP7350 : $0808080 ; color mixture in red-green-blue for the window frame

For MP1054.x (linear distance of one motor revolution) and MP7530.x (type of dimension for transformation) also a **formula** may be indicated instead of a fixed value.

Comments on the MPs

See “Meaning of the machine parameters” on page 31 – 579.

Creating a copy of the original MP file

If **changes** to the machine parameters are required for for servicing (troubleshooting, testing), these should not be made in the **original MP list**!
Create a copy of the original MP file and activate this copy.

▶ Call the active machine parameter list (see previous page).

PGM MGT ▶ Call the program management.

▶ The cursor automatically is on the active machine parameter file (status **M**).
If not, place the cursor on the active file.

COPY ABC → XYZ ▶ Press this soft key.

▶ Enter the name of the working copy in the header, e.g., TEST.MP.

EXECUTE ▶ Press this soft key or the OK soft key (or the ENTER key) to start copying.

▶ The copy is created. It is stored in the same directory as the original MP file.

> **Note**
>
> You can also protect the original MP file against editing or overwriting --> soft keys MORE FUNCTIONS / PROTECT.
> The letter **P** (for "protected") is displayed in the status column of the program management.
>
> Of course, you can also back up important data on an external data medium beforeyou start servicing!

Activating a copy of the original MP file for testing

- Place the cursor on the working copy, e.g., TEST.MP.
- Load this file into the editor.
- Press the END key to activate the selected MP file. (The iTNC 530 HSCI may carry out a reset.) The original MP file is reactivated in the same way.

> **Note**
>
> In the program management, the active MP file is distinguished by the letter `M` in the status column.

Searching machine parameters

In case the **number of the parameter is known**:

- Press the GOTO key and enter the number (without dot or blanks).
- Confirm with ENTER. --> The editor places the cursor on the desired parameter.

In case the **name of the parameter is known** (but not its number):

- Press the SEARCH soft key and enter the name.

> **Note**
>
> The name does not have to be written in full.

- With the corresponding soft key, select whether case sensitivity is to be considered.
- Press the EXECUTE soft key. --> The editor places the cursor on the required text. If the associated parameter is not the one you have been looking for, just press SEARCH and EXECUTE until it is found.

If you have **marked parameters**:

- Press the SEARCH soft key and enter the identification word.
- With the corresponding soft key, select whether case sensitivity is to be considered.
- Press the EXECUTE soft key. --> The editor places the cursor on identification word.

Editing and marking machine parameters

- Place the cursor on the machine parameter to be edited

INSERT OVERWRITE

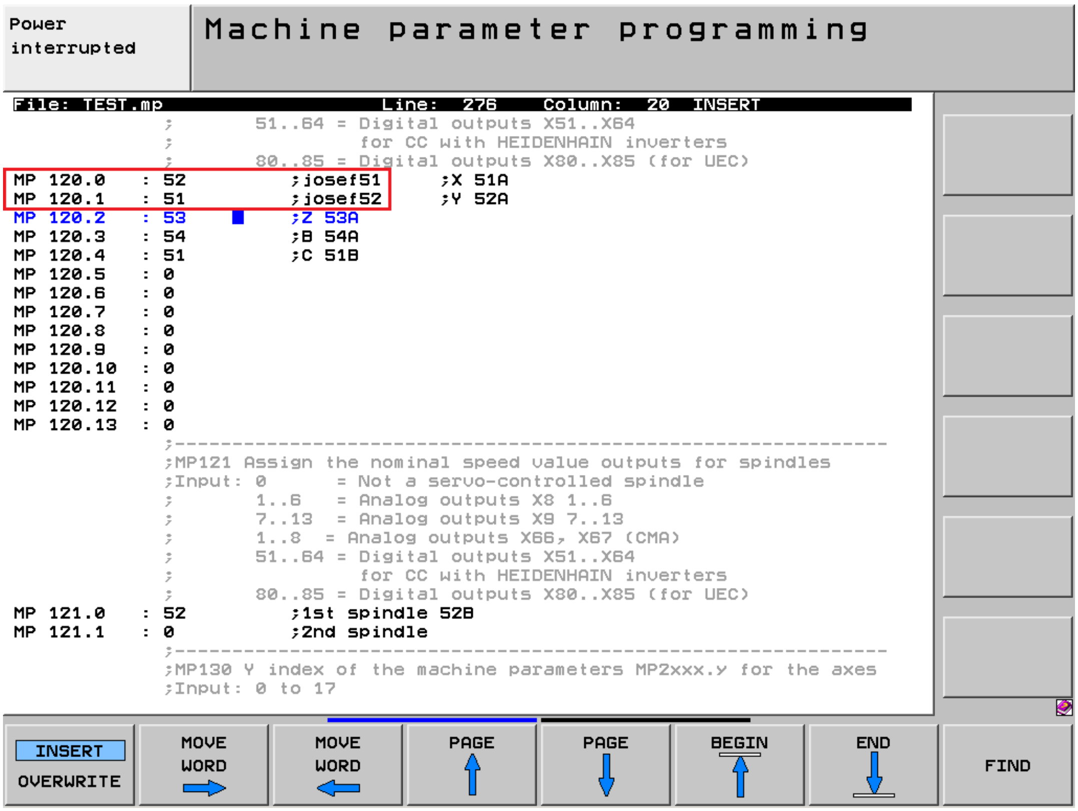
- Set the editing mode to Insert or Overwrite, as it makes sense.

> **Note**
>
> `INSERT` is preset; the original values are thus retained.
> For bit-encoded parameters, however, the editing mode `OVERWRITE` is useful.

- Edit the parameter.

> **Note**
>
> Mark the modified machine parameters so that later you can find them quickly.

- Enter a semicolon after the edited parameter and subsequently an identification word (e.g., your name, company name).
- Place the cursor with the arrow key in the next line. --> The modified line is structured.



Deleting entries and markings

If you want to **delete from right to left** :

▶ Press this key.

If you want to **delete from left to right**:

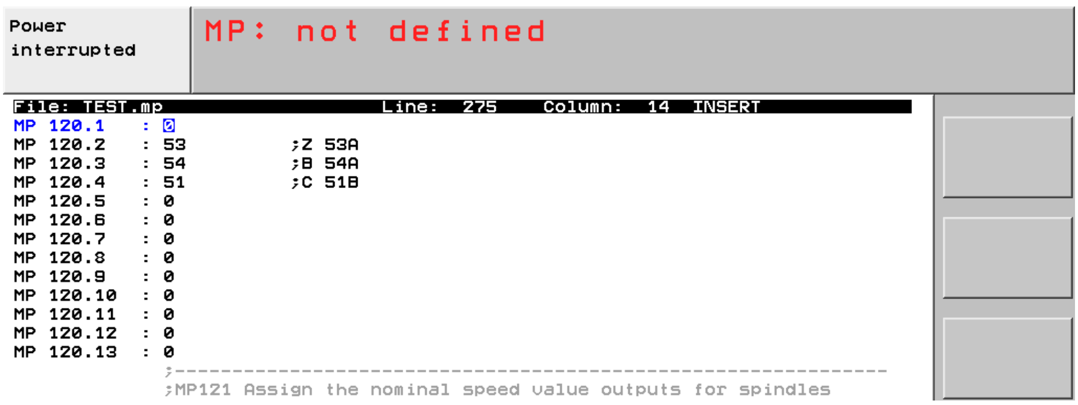
▶ Press the CE key.

Attention

Do not press the DEL key if you want to delete individual letters, words, numbers, etc. DEL will delete the entire line.

If you have deleted an entire line:

▶ Press the END key. --> The machine parameter editor generates the deleted parameter again and asks you for information.



▶ Enter the correct value (if required, look it up in the original MP list).

Activating modified values

After you have modified parameter values for service purposes:

- Place the cursor in the line after the parameter edited last. --> The entire MP list is restructured.
- Exit the machine parameter list by pressing the END key.

Missing or incorrect entries result in error messages from the control that prompt you to correct your entry.

The following errors are displayed:

Input error	Meaning
0	No MP number found
1	Invalid MP number
2	No separator (:) found
3	Input value incorrect
4	MP defined twice
6	MP cannot be saved

If the control does not detect any errors, it automatically exits the machine parameter editor and is ready for operation after a defined reaction.

Attention

Most machine parameters cannot be saved while an NC program is running. The error message `Parallel operation not possible` appears.
In this event you must wait until workpiece machining is finished, or you stop and abort the program. Then the modified machine parameters can be saved.

Attention

If you have edited **machine parameters for the spindle** (MP3000 - MP3999, MP13000 - MP13999), these new values do not go into effect until after leaving the machine parameter list a **new speed** is **commanded** for the spindle concerned.
For example: Press S soft key. --> Enter spindle speed. --> Confirm with NC START button.

Reaction to change

If parameter values were changed and confirmed with END, the control may react as follows:

- Modified values are immediately adopted without reset or new reference run (e.g., changed color settings).
- Axes must be referenced (e.g., changed axis parameters).
- The control is reset (e.g., changes to certain control-loop parameters).

Note

This behavior is defined by HEIDENHAIN and cannot be influenced!

If you have reason to doubt that a changed parameter value was adopted, the control should be restarted manually.

Operating the machine with the new values

If **the machine manufacturer agrees** that the machine should be operated with the new settings...

- transfer the new parameter values to the original MP list and activate it (or activate an MP list agreed upon with the machine manufacturer). Write your name (or the name of the responsible person) and the date of change in the header of the list as a comment.
- **create a new backup of the machine data.** --> See "Backup on an external data medium" on page 14 – 202.

Restoring original settings

When you have finished error diagnosis or certain tests at the machine, you will normally restore the original settings.

▶ You are in the **`Machine parameter programming`** mode.

PGM MGT

▶ Call the program management.

▶ Place the cursor on the original MP list.

ENT

▶ Load this file into the editor.

END

▶ Press the END key. (The iTNC 530 HSCI activates the selected original MP file and performs a reset, if necessary.)

> **Note**
>
> In the program management, the active MP file is distinguished by the letter **`M`** in the status column.

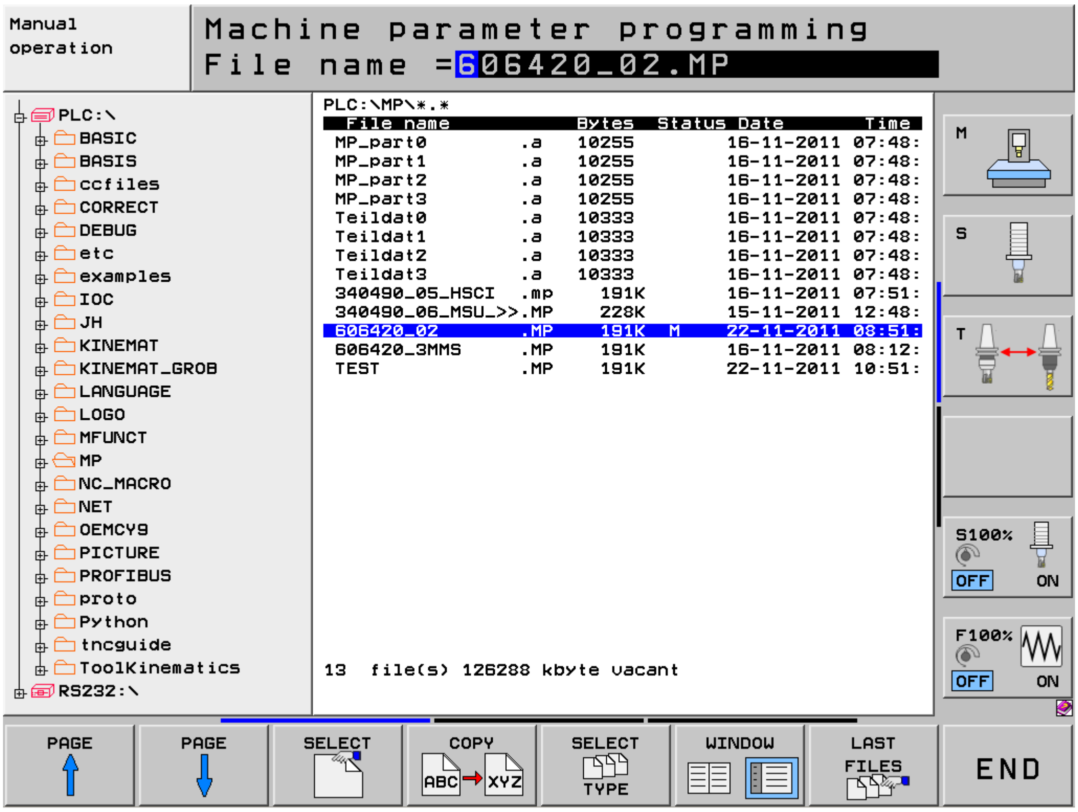


Figure: Active MP list in the program manager

31.3 Meaning of the machine parameters

Machine parameter lists often contain **original HEIDENHAIN comments**.
Semicolons "**;**" identify comments.
Entries behind semicolons are not evaluated by the NC software.

Your can enter your own comments, beginning with a semicolon, **in the MP list**. For this purpose you need have write permission (enter correct code number).

Text file READ_MP.A

If the machine manufacturer has removed the original HEIDENHAIN comments in full or in part:

- Enter the PLC code number.
- Open the program manager.
- Open one of the following **text files**:

Path	File	Meaning
PLC:\JH\ ...	LIES_MP.A	HEIDENHAIN comments on the MPs in German
	READ_MP.A	HEIDENHAIN comments on the MPs in English

Note

Tip:
Transfer the **READ_MP.A** text file to your service laptop. Now you can easily look up the meaning of the parameters, while the original MP list of the manufacturer is open on the control.

Attention

LIES_MP.A and **READ_MP.A** also contain the default values of the parameters. However, these are not valid for your machine; only the values in the original MP list are relevant.

The text files **LIES_MP.A** and **READ_MP.A** are components of an NC software update.
This means that these text files are updated together with the NC software.
Thus, you always have the appropriate comments on the MPs of the installed NC software.

Searching MP numbers in READ_MP.A

Do not use the keys GOTO and ENT like in an MP list. The editor would place the cursor on the line with the specified number and not on the desired parameter.
You are dealing with a text file and not with an MP list!

Use the soft keys FIND and EXECUTE to navigate to the desired MP numbers.

31.4 List of machine parameters

(Excerpt from the iTNC 530 HSCI Technical Manual of May 2011)

31.4.1 Format: Encoders and machines

MP	Function and input	Software version and behavior
MP10	Active axes	PLC
	Input: %xxxxxxxxxxxxxxxxxx Input: Bits 0 to 17 represent axes 1 to 18 0: Axis not active 1: Axis active	RUN
MP12	Axis-specific demo operation for NC axes	PLC
	Format: %xxxxxxxxxxxxxxxxxx Input: Bits 0 to 17 represent axes 1 to 18 0: Demo operation not active 1: Demo operation active	RUN
MP20	Monitoring functions for the axes	PLC
	Format: %xxxxxxxxxxxxxxxxxx Input: Bits 0 to 17 represent axes 1 to 18 0: Monitoring not active 1: Monitoring active	RUN
MP20.0	Absolute position of the distance-coded reference marks	
MP20.1	Amplitude of encoder signals	
MP20.2	Edge separation of encoder signals	
MP21	Monitoring functions for the spindle	PLC
	Format: %xx Input: Bit 0 – Spindle 1 0: Monitoring not active 1: Monitoring active Bit 1 – Spindle 2 0: Monitoring not active 1: Monitoring active	RUN
MP21.0	Absolute position of the distance-coded reference marks	
MP21.1	Amplitude of encoder signals	
MP21.2	Edge separation of encoder signals	
MP100	Designation of axes	PLC
	Format: -wvucbazyxWVUCBAZYX Input: Characters 1 to 9 from the right represent axes 1 to 18	RUN
MP100.0	Traverse range 1	
MP100.1	Traverse range 2	
MP100.2	Traverse range 3	
MP108.x	Assignment of axes to drive-control motherboards Input: 0 to 4: Number of drive-control motherboard in the HSCI chain	
MP109.x	Assignment of spindle(s) to drive-control motherboards Input: 0 to 4: Number of drive-control motherboard in the HSCI chain	RESET
MP110.x	Assignment of position encoder inputs to the axes Input: 0: No position encoder input 1 to 6: Position encoder inputs X1 to X6 35 to 38: Position encoder inputs X35 to X38 201 to 214: Position encoder inputs X201 to X214	RESET

MP	Function and input	Software version and behavior
MP111.x	Position encoder input for the spindle/spindles Input: 0: No position encoder input 1 to 6: Position encoder inputs X1 to X6 35 to 38: Position encoder inputs X35 to X38 201 to 214: Position encoder inputs X201 to X214	REF
MP111.0	Position encoder input for the first spindle	
MP111.1	Position encoder input for the second spindle	
MP112.x	Assignment of speed encoder inputs to the axes Input: 0: No speed encoder input 15 to 20: Speed encoder inputs X15 to X20 80 to 85: Speed encoder inputs X80 to X85	RESET
MP113.x	Speed encoder for the spindle/spindles Input: 0: No speed encoder input 15 to 20: Speed encoder inputs X15 to X20 80 to 85: Speed encoder inputs X80 to X85	REF
MP113.0	Speed encoder for the first spindle	
MP113.1	Speed encoder for the second spindle	
MP118.x	Position encoder input for axes Format: %xxxx Input: Bit 0: Position encoder input 1 V_{PP} 0: 1 V_{PP} 1: Reserved Bit 1: Reserved Bit 2: Input frequency of the position encoder input at 1 V_{PP}: 0: 27 kHz 1: 400 kHz Bit 3: Analog or digital position encoder input: 0: Analog encoder signal control (1 V_{PP}) 1: Digital encoder signal control (EnDat 2.2)	
MP119.x	Position encoder input for the spindle/spindles Format: %xxxx Input: Bit 0: Position encoder input 1 V_{PP} 0: 1 V_{PP} 1: Reserved Bit 1: Reserved Bit 2: Input frequency of the position encoder input at 1 V_{PP}: 0: 27 kHz 1: 400 kHz Bit 3: Analog or digital position encoder input: 0: Analog encoder signal control (1 V_{PP}) 1: Digital encoder signal control (EnDat 2.2)	
MP120.x	Nominal speed command outputs of the axes Input: 0: No servo-controlled axis 1 to 8: Analog CMA output X66, X67 51 to 56: Digital CC outputs X51 to X56 80 to 85: Digital UEC outputs X80 to X85	RESET
MP121.0	Nominal speed command output of the first spindle Input: 0: No servo-controlled axis 1 to 8: Analog CMA output X66, X67 51 to 56: Digital CC outputs X51 to X56 80 to 85: Digital UEC outputs X80 to X85	RESET
MP121.1	Nominal speed command output of the second spindle Input: 0: No servo-controlled axis 1 to 4: Analog CMA output X66, X67 51 to 56: Digital CC outputs X51 to X56 80 to 85: Digital UEC outputs X80 to X85	RESET

MP	Function and input	Software version and behavior
MP130.x	y index of the machine parameters MP2xxx.y for the axes Input: 0 to 12	PLC RUN
MP131.x	Y index of the machine parameters MP2xxx.y for the spindle(s) in operating mode 0 Input: 0 to 12	PLC RUN
MP131.0	Index for the first spindle	
MP131.1	Index for the second spindle	
MP132.x	Y index of the machine parameters MP2xxx.y for the spindle(s) in operating mode 1 Input: 0 to 12	PLC RUN
MP132.0	Index for the first spindle	
MP132.1	Index for the second spindle	
MP210	Counting direction of position encoder output signals Format: %xxxxxxxxxxxxxxxxxx Input: Bit 0 to Bit 17 represent axis 1 to 18 0: Positive 1: Negative	REF
MP331.x	Distance for the number of signal periods in MP332 Input: 0.0001 to +1.797693135E+308 [mm] or [°]	PLC RUN REF
MP332.x	Number of signal periods for the distance in MP331 Input: 1 to +1.797693135E+308	PLC RUN REF
MP334.x	Nominal increment between two fixed reference marks on encoders with distance-coded reference marks Input: 1 to 65 535 0: 1 000	PLC RUN REF
MP340.x	Interpolation factor for external interpolation Input: 0 to 99 0 = 1: No external interpolation	RESET
MP410	Assignment of axis keys IV, V and VI Input: Axis labels A/B/C/U/V/W/T	PLC RUN
MP410.3	IV axis key	
MP410.4	V axis key	
MP410.5	VI axis key (only HR 5xx)	
MP420.x	Hirth coupling Input: 0: No Hirth coupling 1: Hirth coupling	PLC RUN
MP430.x	Prescribed increment for Hirth coupling Input: 0.0000 to 30.0000 [°]	PLC RUN
MP708.x	Traverse distance for acceleration-dependent backlash compensation Input: 0.0001 to 1.000 [mm] 0: Function inactive	PLC RUN
MP709.x	Time constant for backlash compensation Input: 1 to 1000 [ms]	PLC RUN
MP710.x	Backlash compensation Input: –9.9999 to +9.9999 [mm] or [°]	PLC RUN
MP711.x	Height of peaks during circular movement (analog only) Input: –1.0000 to +1.0000 [mm] (digital: 0)	PLC RUN
MP712.x	Compensation value per control loop cycle time Input: 0.000000 to 99.999999 [mm] (digital: 0)	PLC RUN

MP	Function and input	Software version and behavior
MP715.x	Height of peaks during circular movement (analog only) with M105 Input: –1.0000 to +1.0000 [mm] (digital: 0)	PLC RUN
MP716.x	Compensation value per control loop cycle time with M105 Input: 0.000000 to 99.999999 [mm] (digital: 0)	PLC RUN
MP720.x	Linear axis error compensation Input: –1.000 to +1.000 [mm/m]	PLC RUN
MP730	Selection of linear/nonlinear axis error compensation Format: %xxxxxxxxxxxxxxxxxx Input: Bit 0 to Bit 17 represent axis 1 to 18 0: Linear axis error compensation 1: Nonlinear axis error compensation	PLC RUN
MP732	Nonlinear axis-error compensation for rotary axes Format: %xxxxxxxxxxxxxxxxxx Input: Bit 0 to Bit 17 represent axis 1 to 18 0: Not active (usual compensation) 1: Active (mapped to traverse range)	
MP750.x	Reversal error (backlash compensation) Input: –9.9999 to +9.9999 [mm] or [°]	PLC RUN
MP752.x	Compensation time for reversal error Input: 0 to 1000 [ms]	PLC RUN
MP810.x	Display mode for rotary axes and PLC auxiliary axes Input: 0.0000 to 99 999.9999 [°] 0: Display +/–99 999.9999 1: Modulo value for display	PLC RUN REF
MP812	Activate software limit switches for rotary axes with modulo display, M94 and encoders with EnDat interface Format: %xxxxxxxxxxxxxxxxxx Input: Bit 0 to Bit 17 represent axis 1 to 18 0Input: : Software limit switch not active 1: Software limit switch active	RESET
MP850.x	Synchronized axes Input: 0: Master axis 1: Slave axis to axis 1 2: Slave axis to axis 2 3: Slave axis to axis 3 4: Slave axis to axis 4 5: Slave axis to axis 5 6: Slave axis to axis 6 7: Slave axis to axis 7 8: Slave axis to axis 8 9: Slave axis to axis 9 10: Slave axis to axis 10 11: Slave axis to axis 11 12: Slave axis to axis 12 13: Slave axis to axis 13 14: Slave axis to axis 14 15: Slave axis to axis 15 16: Slave axis to axis 16 17: Slave axis to axis 17	PLC RUN
MP855.x	Synchronization monitoring Input: 0 to 100.0000 [mm] 0: Monitoring not active	PLC RUN

MP	Function and input	Software version and behavior
MP860.x	Datum for synchronous control Format: %xxx Input: Bit 0 – Datum position for synchronous control 0: Datum at position after switch-on 1: Datum at reference marks (machine datum) Bit 1 – Master-slave torque control 0: Axis is not slave axis in master-slave torque control 1: Axis is slave axis in master-slave torque control Bit 2 – Brake test of slave axis 0: Test the brakes of a synchronized axis simultaneously 1: Test the brakes of a synchronized axis successively	PLC RUN
MP910.x	Positive software limit switches, traverse range 1 (default setting after power on) Input: –99 999.9999 to +99 999.9999 [mm] or [°]	PLC RUN
MP911.x	Positive software limit switches, traverse range 2 Input: –99 999.9999 to +99 999.9999 [mm] or [°]	PLC RUN
MP912.x	Positive software limit switches, traverse range 3 Input: –99 999.9999 to +99 999.9999 [mm] or [°]	PLC RUN
MP920.x	Negative software limit switches, traverse range 1 (default setting after power on) Input: –99 999.9999 to +99 999.9999 [mm] or [°]	PLC RUN
MP921.x	Negative software limit switches, traverse range 2 Input: –99 999.9999 to +99 999.9999 [mm] or [°]	PLC RUN
MP922.x	Negative software limit switches, traverse range 3 Input: –99 999.9999 to +99 999.9999 [mm] or [°]	PLC RUN
MP950.x	Datum for positioning blocks with M92 for axes 1 to 9 Input: –99 999.9999 to +99 999.9999 [mm] or [°] Values with respect to the machine datum	PLC RUN
MP951.x	Simulated tool-change position for TOOL CALL during mid-program startup (block scan) Input: –99 999.9999 to +99 999.9999 [mm] or [°]	PLC RUN
MP960.x	Machine datum Input: –1.79769313486E+308 to +1.79769313486E+308 [mm] or [°] Values with respect to the scale reference point	PLC RUN

31.4.2 Positioning

MP	Function and input	Software version and behavior
MP1010.x	Rapid traverse Input: 10 to 1 000 000 [mm/min or °/ min]	PLC RUN
MP1011	Limit of rapid traverse on the path Input: 10 to 1 000 000 [mm/min or °/ min]	PLC RUN
MP1012.x	Second axis-specific rapid traverse Input: 10 to 1 000 000 [mm/min or °/ min]	
MP1020.x	Manual feed Input: 10 to 300 000 [mm/min]	PLC RUN
MP1030.x	Positioning window Input: 0.0001 to 2.0000 [mm]	PLC RUN
MP1040	Analog axes: Polarity of nominal value voltage Digital axes: Algebraic sign of the nominal speed value Format: %xxxxxxxxxxxxxxxxxx Input: Bit 0 to Bit 17 represent axis 1 to 18 0: Positive 1: Negative	
MP1050.x	Analog axes: Analog voltage at rapid traverse Input: 1.000 to 9.000 [V] Digital axes: without function Input: 1	PLC RUN
MP1054.x	Distance of one motor revolution [mm or °] Input: Analog axes: Without function Digital axes: A formula can be entered.	PLC RUN
MP1060.x	Acceleration Input: 0.001 to 500 [m/s^2] or [1000°/s2]	PLC RUN
MP1061	Limitation of the path acceleration Input: 0.001 to 500 [m/s^2]	PLC RUN
MP1070	Radial acceleration Input: 0.001 to 500 [m/s^2]	PLC RUN
MP1080.x	Analog axes: Integral factor for offset adjustment Input: Enter 0 to 65 535 Digital axes: No function Input: 0	PLC RUN
MP1085.x	Maximum permissible axis-specific jerk for path movements in the operating modes Program Run Full Sequence, Program Run Single Block, and Positioning with Manual Data Input Input: 0.0 to 9999.9 [m/s^3 or °/s3]	
MP1086.x	Maximum permissible axis-specific jerk for rapid traverse movements in the operating modes Program Run Full Sequence, Program Run Single Block, and Positioning with Manual Data Input Input: 0: Function inactive 0.0 to 9999.9 [m/s^3 or °/s^3]	PLC RUN
MP1087.x	Maximum permissible axis-specific jerk for Manual operating mode Input: 0.1 to 1000.0 [m/s^3 or 1000° /s3]	PLC RUN
MP1088.x	Axis-specific jerk limiting for unfiltered positioning movements Input: 0.1 to 9999.9 [m/s^3]	
MP1089.x	Max. permissible axis-specific jerk for Pass Over Reference Point mode Input: 0.1 to 1000.0 [m/s^3 or 1000°/s^3]	PLC RUN

MP	Function and input	Software version and behavior
MP1090	Maximum permissible jerk on the tool path	PLC
	Input: 0: Not active 0.0 to 9999.9 [m/s^3 or °/s^3]	RUN
MP1090.0	For movements not at rapid traverse or feed rate < MP1092	
MP1090.1	For movements at rapid traverse or feed rate > MP1092	
MP1092	Feed rate threshold for MP1085.x and MP1086.x	PLC
	Input: 1 to 300 000 [mm/min] (previous behavior) 0: Not active	RUN
MP1094	HSC filter (no longer recommended with HSCI, improved nominal position value filters as of MP12xx)	Only through **MPMODE = 340422** in OEM.SYS
	Input: 0: HSC filter inactive 0.1 to 166.0: Cutoff frequency for HSC filter	
MP1095	Nominal position value filter (no longer recommended with HSCI, improved nominal position value filters as of MP12xx)	PLC RUN
	Input: 0: Single filter 1: Double filter	Only through **MPMODE = 340422** in OEM.SYS
MP1095.0	In the Program Run Full Sequence, Program Run Single Block, and Positioning With Manual Data Input operating modes	
MP1095.1	In the Manual, Handwheel, Jog Increment and Pass Over Reference Point operating modes	
MP1096	Tolerance for contour transitions at corners (no longer recommended with HSCI, improved nominal position value filters as of MP12xx)	PLC RUN
	Input: 0: No nominal position value filter 0.001 to 3.000 [mm]	Only through **MPMODE = 340422** in OEM.SYS
MP1096.0	With machining feed rate	
MP1096.1	With rapid traverse	
MP1097.x	Max. permissible axis-specific jerk (single filter / HSC filter) (no longer recommended with HSCI, improved nominal position value filters as of MP12xx)	PLC RUN
	Input: 0.1 to 1000.0 [m/s^3 or 1000°/s^3]	Only through **MPMODE = 340422** in OEM.SYS
MP1098.x	Max. permissible axis-specific jerk (double filter / HSC filter) (no longer recommended with HSCI, improved nominal position value filters as of MP12xx)	PLC RUN
	Input: 0.1 to 1000.0 [m/s^3 or 1000°/s^3]	Only through **MPMODE = 340422** in OEM.SYS
MP1099	Minimum filter order (no longer recommended with HSCI, improved nominal position value filters as of MP12xx)	PLC RUN
	Input: 0 to 20	Only through **MPMODE = 340422** in OEM.SYS
MP1099.0	Minimum filter order for single filter (MP1095 = 0)	
MP1099.1	Minimum filter order for double filter (MP1095 = 1)	
MP1110.x	Standstill monitoring	PLC
	Input: 0.0010 to 30.0000 [mm]	RUN
MP1120.x	Standstill monitoring when determining the field angle	PLC
	Input: 0.0000 to 300.0000 [mm] or [°]	RUN

MP	Function and input	Software version and behavior
MP1140.x	Threshold above which the movement monitoring functions Input: Analog axes: 0.030 to 10.000 [V] Digital axes: 0.030 to 10.000 [1000 min] Recommended: 0.030 [1000 min]	PLC RUN
MP1144.x	Motion monitor for position and speed Input: Analog axes: Without function Digital axes: 0 to 99 999.999 [mm] 0: No monitoring	PLC RUN
MP1146.x	Difference between the position at shutdown and the position read in via the EnDat interface Input: 0.0000 to 300.0000 [mm] or [°] 0: No difference permitted	PLC RUN
MP1150.0	Delay time for erasing the nominal velocity value with the erasable error message **EXCESSIVE SERVO LAG IN <AXIS>** Input: 0 to 65.535 [s] Recommended: 0	PLC RUN
MP1150.1	Time period for which the monitoring function is to remain off after the fast PLC input defined in MP4130.0 is set. With HSCI, this must be realized via the PLC program. Input: 0 to 65.535 [s] 0: Monitoring functions on Recommended: 0.2 to 0.5	
MP1150.2	Minimum time period for which the monitoring functions are to remain effective after expiration of the time from MP1150.1. With HSCI, this must be realized via the PLC program. Input: 0 to 65.535 [s]	
MP1160	LIFTOFF at powerfail Input: 0 to 30.0000 [mm] Default: 0.1 [mm]	PLC RUN
MP1200	Selection of the nominal position value filter used Input: 0: Single filter 1: Double filter 2: HSC filter 3: Advanced HSC filter	PLC RUN
MP1201	Nominal position value filter in manual operation Input: 0: Single filter 1: Double filter	PLC RUN
MP1202	Predefined tolerance for Cycle 32 Input: 0.0000 to 3.0000 [mm]	PLC RUN
MP1202.0	Tolerance at corners for movements at machining feed rate	
MP1202.1	Tolerance at corners for movements at rapid traverse	
MP1205	Reduction of the contouring feed rate at the beginning of a contour element Input: 0: Not active (fast, possibly less precise) 1: Active (slow but likely more precise)	
MP1210	Limit frequency for single filter Input: 0: Filter is switched off 0.0 to 166.0 [Hz]	PLC
MP1211	Limit frequency for double filter Input: 0: Filter is switched off 0.0 to 166.0 [Hz]	PLC
MP1212	Limit frequency for HSC filter Input: 0: Filter is switched off 0.0 to 166.0 [Hz]	PLC

MP	Function and input	Software version and behavior
MP1213	Limit frequency for advanced HSC filter Input: 0: Filter is switched off 0.0 to 166.0 [Hz]	PLC
MP1222	Tolerance for curvature changes with HSC filter (only effective if MP7684 bit 4 = 0) Entry:0: Do not include the tolerance 1: Include the tolerance	PLC RUN
MP1223	Tolerance for curvature changes with advanced HSC filter (only effective if MP7684 bit 4 = 0) Entry:0: Do not include the tolerance 1: Include the tolerance	PLC RUN
MP1230.x	Max. permissible axis-specific jerk at corners for single filter Input: 0.1 to 1000.0 [m/s³]	PLC RUN
MP1231.x	Max. permissible axis-specific jerk at corners for double filter Input: 0.1 to 1000.0 [m/s³]	PLC RUN
MP1232.x	Max. permissible axis-specific jerk at corners for HSC filter Input: 0.1 to 1000.0 [m/s³]	PLC RUN
MP1233.x	Max. permissible axis-specific jerk at corners for advanced HSC filter Input: 0.1 to 1000.0 [m/s³]	PLC RUN
MP1240.x	Max. permissible axis-specific jerk at curvature changes for single filter Input: 0.1 to 1000.0 [m/s³]	PLC RUN
MP1241.x	Max. permissible axis-specific jerk at curvature changes for double filter Input: 0.1 to 1000.0 [m/s³]	PLC RUN
MP1242.x	Max. permissible axis-specific jerk at curvature changes for HSC filter Input: 0.1 to 1000.0 [m/s³]	PLC RUN
MP1243.x	Max. permissible axis-specific jerk at curvature changes for advanced HSC filter Input: 0.1 to 1000.0 [m/s³]	PLC RUN
MP1250.x	Factor for axis-specific jerk at corners at rapid traverse (from value in MP123x.x) Input: 0.0000 to 30.0000 1: No change at rapid traverse	PLC RUN
MP1262	Filter order used for HSC filters Input: 0 to 31 [filter order] 31: Default	PLC RUN
MP1263	Filter order used for advanced HSC filters Input: 0 to 31 [filter order] 31: Default	PLC RUN
MP1290	Only with option #40: Maximum angle tolerance for DCM (Dynamic Collision Monitoring) Input: 0.0000° to 3.0000° 3: Default	PLC RUN
MP1292	Only with option #40: Manual oversize for DCM (Dynamic Collision Monitoring) Input: 0 to 1000 [mm] 0: Default	PLC RUN
MP1294	Only with option #40: Higher traversing speed for Dynamic Collision Monitoring (DCM) through movement of only a single axis Input: 0: Function inactive 1: Function active	PLC RUN
MP1320	Direction for traversing the reference marks Format: %xxxxxxxxxxxxxxxxxx Input: Bit 0 to Bit 17 represent axis 1 to 18 0: Positive 1: Negative	PLC RUN

MP	Function and input	Software version and behavior
MP1330.x	Velocity for traversing the reference marks Input: 80 to 1 000 000 [mm/min]	PLC RUN
MP1331.x	Velocity for leaving the reference mark end position for axes 1 to 18 (only for rotary encoders MP1350 = 2) Input: 10 to 1 000 000 [mm/min]	PLC RUN
MP1340.x	Sequence for traversing the reference marks Input: 0: No evaluation of reference marks 1 to 18: Axis 1 to 18	PLC RUN REF
MP1350.x	Sequence for finding the reference mark Input: 0: Linear encoder with distance-coded reference marks (old routine) 1: Position encoder with one reference mark 2: Special type (length measurement with ROD) 3: Linear encoder with distance-coded reference marks (new routine) 4: Same as 3 except that two reference marks are evaluated 5: Encoder with EnDat interface 6: Reference pulse via fast PLC input 7: Speed encoder with EnDat interface at the position and speed encoder inputs	PLC RUN REF
MP1352	Activate the software limit switches before traversing the reference marks Format: %xxxxxxxxxxxxxxxxxx Input: Bit 0 to Bit 17 represent axis 1 to 18 0: Software limit switch not active 1: Software limit switch active	
MP1355	Double reference run Format: %xxxxxxxxxxxxxxxxxx Input: Bit 0 to Bit 17 represent axis 1 to 18 0: Reference run as defined in MP1350.x 1: Double reference run	PLC RUN REF
MP1356.x	Distance between speed and position encoder for double reference run. Input: –99 999.999 to +99 999.999 [mm] or [°]	PLC RUN REF
MP1357.x	W1032 for double reference run Input: 0: Reset W1032 if the reference run has been over the EnDat interface of the speed encoder 1: Reset W1032 if the reference mark was traversed with the position encoder	PLC RUN
MP1360.x	Fast PLC input for reference pulse Input: 0: No fast PLC input for reference pulse 1 to 5: Fast PLC inputs 1 to 5 (MP4130.x)	PLC RUN REF
MP1391 MP1391.0 MP1391.1	Velocity and acceleration feedforward control in the MANUAL and HANDWHEEL operating modes Format: %xxxxxxxxxxxxxxxxxx Velocity feedforward control Input: Bit 0 to Bit 17 represent axis 1 to 18 0: Inactive 1: Active Acceleration feedforward control Input: Bit 0 to Bit 17 represent axis 1 to 18 0: Inactive 1: Active	PLC RUN

MP	Function and input	Software version and behavior
MP1392	Velocity feedforward in the operating modes Program Run Single Block, Program Run Full Sequence and Positioning with Manual Data Input Format: %xxxxxxxxxxxxxxxxxx Input: Bit 0 to Bit 17 represent axis 1 to 18 0: Operation with following error (lag) 1: Operation with velocity feedforward control	PLC RUN
MP1396.x	Feedback control with velocity semifeedforward Input: 0.001 to 0.999 1: Velocity feedforward control	PLC RUN

31.4.3 Operation with velocity feedforward control

MP	Function and input	Software version and behavior
MP1410.x	Position monitoring for operation with velocity feedforward control (erasable) Input: 0.0010 to 30.0000 [mm] Recommended: 0.5 mm	PLC RUN
MP1420.x	Position monitoring for operation with velocity feedforward control (emergency stop) Input: 0.0010 to 30.0000 [mm] Recommended: 2 mm	PLC RUN
MP1510.x	k_V factor for velocity feedforward control Input: 0.100 to 1 000.000 [(m/min)/mm]	PLC RUN
MP1511.x	Factor for stick-slip friction compensation Input: 0 to 16 777 215 [s]	PLC RUN
MP1512.x	Limitation of the amount of the stick-slip friction compensation Input: 0 to 16 777 215 [counting steps]	PLC RUN
MP1513.x	Feed-rate limitation for stick-slip friction compensation Input: 0 to 300 000 [mm/min]	PLC RUN
MP1515.x	k_V factor for velocity feedforward control effective after M105 Input: 0.100 to 1000.000 [m/(min*mm)]	PLC RUN
MP1516.x	k_V factor for velocity semifeedforward control Input: 0.100 to 20.000 [(m/min)/mm]	PLC RUN
MP1521	Transient response during acceleration and deceleration Input: 1 to 255 [ms] 0: Function inactive	PLC RUN
MP1522	Feed-rate smoothing Input: 0 to 60 [ms] 0: Function inactive	PLC RUN

31.4.4 Operation with following error

MP	Function and input	Software version and behavior
MP1710.x	Position monitoring for operation with following error (erasable) Input: 0.0000 to 300.0000 [mm] Recommended: 1.2 · following error	PLC RUN
MP1720.x	Position monitoring for operation with following error (emergency stop) Input: 0.0000 to 300.0000 [mm] Recommended: 1.4 · following error	PLC RUN
MP1810.x	k_V factor for control with following error Input: 0.100 to 20.000 [(m/min)/mm]	PLC RUN
MP1815.x	k_V factor for control with following error effective after M105 Input: 0.100 to 20.000 [(m/min)/mm]	PLC RUN
MP1820.x	Multiplier for the k_v factor Input: 0.001 to 1.00000	PLC RUN
MP1830.x	Characteristic curve kink point Input: 0.000 to 100.000 [%]	PLC RUN

31.4.5 Integrated speed and current control

MP	Function and input	Software version and behavior
MP2000.x	Performance of control loop (software option 49) Input: 0: Single-speed axis 1: Double-speed axis	RESET
MP2040 MP2040.0-7	Axis groups (for drive enabling through MP4132) Format: %xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (Bit 31 = spindle) Input: 0: Axis/spindle not assigned (switching only through emergency-stop inputs) 1: Axis/spindle assigned Axis group 1 to 8	PLC RUN
MP2100.x	Type of axis power modules (change possible without automatic restart) Input: Name from file <Motor.amp>	PLC RUN
MP2160.x	Field weakening with synchronous motors Input: 0: No voltage-protection module 1: Voltage-protection module present 2: Limited field weakening without voltage-protection module for EcoDyn motors 9: Weakened-field operation permitted, alternative to 1 10: Feed axis in EcoDyn mode, alternative to 2	
MP2170	Waiting time between the switch-on of the drive and the drive's standby signal Input: 0.001 to 4.999 [s] 0: 2 [s]	
MP2172	Delay of the STO.A.x signal (inverter enable) at internal emergency stop (e.g. standstill monitoring, PLC via error table...) Input: 0 to 60 [s] as an integer 0: 3 [s] Default	
MP2173.x	Pulse switch-off of the power modules Input: 0.2 to 100.000 [s] 0: 3 [s] Default	
MP2180.x	PWM frequency Input: 0: f_{PWM} = 5000 Hz 3200 to 3999: f_{PWM} = 3333 Hz 4000 to 4999: f_{PWM} = 4000 Hz 5000 to 5999: f_{PWM} = 5000 Hz 6000 to 7999: f_{PWM} = 6666 Hz 8000 to 9999: f_{PWM} = 8000 Hz 10000: f_{PWM} = 10000 Hz	PLC, RUN
MP2182.x	Cycle time of current controller at double the fundamental PWM frequency Input: 0: Standard case: MP2180 = [3333 Hz to 5000 Hz] with single-speed axes MP2180 = [3333 Hz to 10000 Hz] with double-speed axes (current controller cycle time = 1 / (2 * MP2180)) 1: Reserved 2: Special case 2, CC61xx: MP2180 = [3333 Hz to 5000 Hz] with speed-dependent doubling (MP2186, MP2188) of the fundamental PWM frequency from MP2180 with double speed axes (current controller cycle time = 1 / (4 * MP2180))	PLC RUN
MP2184.x	Only CC424(B) (not CC61xx): Reserved Input: 0	

MP	Function and input	Software version and behavior
MP2186.x	Shaft speed at which the factor 1 PWM frequency is switched to a factor 2 (twice the PWM frequency) Input: 0 to 100 000 [rpm]	
MP2188.x	Shaft speed at which the factor 2 PWM frequency is switched to a factor 1 Input: 0 to 100 000 [rpm]	
MP2190.x	DC-link voltage U_Z of the power supply module Input: 0 to 3000 [V] *: Entry from the power supply module table HEIDENHAIN inverters: Non-regenerative: 565 V Regenerative: 650 V	
MP2195	Handling of status signals from HEIDENHAIN power supply units. MP2195 can also be overwritten by the PLC and the LSV2 protocol. Input: Bit 0 – Status signals that are already active during control power-up 0: Missing signals are ignored 1: Missing signals are evaluated Bit 1– $\overline{\text{ERR.UZ.GR}}$ signal 0: Error message is not suppressed 1: Error message is suppressed Bit 2 – $\overline{\text{ERR.TMP}}$ signal 0: Error message is not suppressed 1: Error message is suppressed Bit 3 – Reserved Bit 4 – $\overline{\text{ERR.IZ.GR}}$ signal 0: Error message is not suppressed 1: Error message is suppressed Bit 5 – RDY.PS signal 0: Error message is not suppressed 1: Error message is suppressed Bit 6 – $\overline{\text{ERR.ILEAK}}$ signal 0: Error message is not suppressed 1: Error message is suppressed Bit 7 - PF.PS.AC 0: Error message is not suppressed 1: Error message is suppressed Bit 8 - PF.PS.DC 0: Error message is not suppressed 1: Error message is suppressed Bit 9 – Monitoring the DC-link voltage Uz or LIFT-OFF function 0: Uz monitoring and LIFTOFF function are active 1: Uz monitoring and LIFTOFF function are not active	PLC
MP2196.x	Identifier for power supply module in MP2198.x Input: P, Q, R or T	PLC RUN
MP2198.x	Type of power supply module Input: Name from file SUPPLY.SPY Default setting: Empty string	PLC RUN
MP2199.x	Assignment of the drive to the power supply module Input: 0: The axis/spindle is assigned to the UV in MP2198.0 1: The axis/spindle is assigned to the UV in MP2198.1	PLC RUN
MP2200.x	Motor Input: Name of the selected motor (is entered by the iTNC)	PLC RUN
MP2202.x	Overwrite "Line count" from the motor table Input:*: Input from the motor table active 0: No speed encoder (volts-per-hertz control mode) 1 to 999 999	PLC RUN

MP	Function and input	Software version and behavior
MP2204.x	Overwrite "Counting direction" from the motor table Input:*: Input from the motor table active +: Positive counting direction –: Negative counting direction	RESET
MP2206.x	Overwrite "Type of encoder" from the motor table Input:*: Input from the motor table active 0: No speed encoder (volts-per-hertz control mode) 1: Incremental rotary encoder with Z1 track 2: Absolute rotary encoder with EnDat interface (aligned) 3: Absolute linear encoder with EnDat interface 4: Linear motor with one reference mark (CC424(B)) 5: Absolute rotary encoder with EnDat interface (not aligned) 6: Incremental rotary encoder without Z1 track 7: Incremental rotary encoder with distance-coded reference marks (nonaligned) 8: Incremental linear encoder with distance-coded reference marks (not aligned) 9: Aligned rotary encoder with EnDat 2.2 interface 10: Nonaligned rotary encoder with EnDat 2.2 interface 11: Linear encoder with EnDat 2.2 interface 12: Reserved	RESET
MP2208.x	Inductance of the series reactor Input:* = Entry from the motor table active Value of the series reactor in [μH]	RESET
MP2209.x	Mass moment of inertia of a drive motor Input:* = Entry from the motor table active Value of the mass moment of inertia in [kgm^2]	RESET
MP2210.x	Reduction of the nominal voltage (and, as a result, the nominal magnetizing current) at the rpm for field weakening during idle running. Input: 0 to 60 [%] 0 = Function inactive	

MP	Function and input	Software version and behavior
MP2220.x	Monitoring functions Format: %xxxxxxxxxxxxxxxx Input: Bit 0 – Monitoring the reference mark 0: Monitoring active 1: Monitoring inactive Bit 1 – Monitoring the direction of rotation 0: Monitoring active 1: Monitoring inactive Bit 2 – Power limit of spindle with $\overline{\text{ERR.IZ.GR}}$ (only for HEIDENHAIN inverters, except UE 2xx) 0: Power limit active 1: Power limit inactive (All HEIDENHAIN inverters except UE 2xx) Bit 3 – Switching off the controller when the motor brakes are activated 0: Suppress oscillations 1: Oscillations are allowed Bit 4 – Monitoring for excessive temperature 0: Active 1: Inactive Bit 5 – Monitoring for insufficient temperature 0: Active 1: Inactive Bit 6 – Reserved Bit 7 – Monitoring of encoder input frequency 0: Active 1: Inactive Bit 8 – Adjust mechanical offset by gradually increasing the k_V factor 0: Active 1: Inactive Bits 9 to 15 – Reserved	PLC RUN
MP2221.x	Bit 7 – Switch-on time of the drive Input: 0: Reduction of the switch-on time is active 1: Reduction of the switch-on time is not active Bit 10 – Handling of linear and synchronous motors to attain higher milling power with AFC Input: 0: Handling for attaining higher milling power is active 1: Handling for attaining higher milling power is not active	PLC RUN
MP2222.x	Reserved	
MP2223.x	Reserved	
MP2230.x	Multiplier for motor standstill current during test of motor brake Input: 0.1 to 30.0 [· motor standstill current] 0: No test of motor brakes, or motor without brake	
MP2232.x	Maximum permissible path during test of motor brakes Input: 0 to 10.0000 [mm] or [°]	
MP2250.x	Determining the field angle without motor motion Input: 0: Same as input value 2 1: Reserved 2: Method 2 (brakes applied) 3: Method 3 (same as Method 2, but motor brake is not applied) 4: Method 4 (if there is a lot of noise in the encoder signals)	PLC RUN
MP2252.x	Reserved Input: Enter 0	PLC RUN

MP	Function and input	Software version and behavior
MP2254.x	Field-angle determination Input: 0: Field angle is determined during operation; soft key has no function (without plausibility test) 1: Reserved 2: Field angle determination via soft key, motor motion is permitted (with plausibility test) 3: Same as 2, but the drive no longer has to be be switched on by the PLC. The drive is moved immediately!	PLC RUN
MP2256.x	Determined field angle Input: 0: Field angle does not need to be determined, or has not been determined	PLC RUN
MP2257.x	Control or encoder identification for the field angle from MP2256.x Input: 0: Field angle does not need to be determined, or has not been determined	PLC RUN
MP2260.x	"TRC – Torque Ripple Compensation" File name for the torque-ripple-compensation file Input: xx_<MotorNamefromMotorTable>.TRC (generated in TNCopt) No input: No compensation	PLC RUN
MP2261.x	Deactivate compensation Bit 0: Torque ripple compensation Bit 1: Gear error compensation Input: %0000000000000000 1: Compensation not active	PLC RUN
MP2302.x	Reference value for I^2t monitoring of motor Input: 0 to 1000.000 [· rated current of motor] 0: I^2t monitoring of motor switched off 1: Rated current of motor as reference value	PLC
MP2304.x	Reference value for I^2t monitoring of power module Input: 0 to 1000.000 [· rated current of power module] 0: I^2t monitoring of power module switched off 1: Rated current of power module as reference value	PLC
MP2308.x	Time between output of the braking signal $\overline{\text{BRK}}$ and switching off of the controller (overlap time) Input: 0.001 to 5.000 [s] 0: 0.200 s	
MP2309.x	Controller parameters adjusted to closed brake Input: 0: Not active 0.001 to 5.000 [s]	
MP2312.x	Factor for utilization of motors Input: 0 to 1 000.000 0: Factor = 1	
MP2390.x	Maximum braking power Input: 0.1 to 3000.000 [kW] 0: Braking power is not limited	
MP2392.x	Power limit Input: 0: No power limit 0.1 to 3 000.000 [kW]	
MP2393.x	Power limiting after PLC request Input: 0: No power limit 0.001 to 3000.000 [kW]	
MP2394.x	Maximum brake power for power failure Input: 0.1 to 3000.000 [kW] 0: Braking power is not limited	

MP	Function and input	Software version and behavior
MP2396.x	Maximum torque Input: 0.1 to 30 000.0 [Nm] 0: Torque is not limited	PLC
MP2420.x	Proportional factor of the current controller Input: 0.00 to 9999.99 [V/A] * = automatic calculation of the P factor	PLC
MP2430.x	Integral factor of the current controller Input: 0.00 to 9999 999 [Vs/A] * = automatic calculation of the I factor	PLC
MP2440.x	Cutoff frequency of the feedforward current controller Input: 0.1 to 5000.0 [Hz] 0: Feedforward control not active	PLC
MP2450.x	Dead-time compensation Input: 0: Dead-time compensation not active 1: Dead-time compensation active	PLC
MP2500.x	Proportional factor of the speed controller Input: 0 to 1 000 000.000 [As]	PLC RUN
MP2510.x	Integral factor of the speed controller Input: 0 to 100 000 000 [A]	PLC RUN
MP2512.x	Limit of integral factor of the speed controller Input: 0.000 to 30.000 [s] (realistic values: 0.1 to 2.0)	PLC RUN
MP2520.x	Differential factor of the speed controller Input: 0 to 1.0000 [As]	PLC RUN
MP2530.x	PT_2 element of the speed controller (second-order time delay element) Input: 0 to 1.0000 [s]	PLC RUN
MP2540.x	Reserved	PLC RUN
MP2542.x	Damping/phase increase for filter 1 Input: 0 to 99.0 [dB]	PLC RUN
MP2543.x	Damping/phase increase for filter 2 Input: 0 to 99.0 [dB]	PLC RUN
MP2544.x	Damping/phase increase for filter 3 Input: 0 to 99.0 [dB]	PLC RUN
MP2545.x	Damping/phase increase for filter 4 Input: 0 to 99.0 [dB]	PLC RUN
MP2546.x	Damping/phase increase for filter 5 Input: 0 to 99.0 [dB]	PLC RUN
MP2550.x	Reserved	PLC RUN
MP2552.x	Center/cutoff frequency for filter 1 Input: 0 to 30000.0 [Hz]	PLC RUN
MP2553.x	Center/cutoff frequency for filter 2 Input: 0 to 30000.0 [Hz]	PLC RUN
MP2554.x	Center/cutoff frequency for filter 3 Input: 0 to 30000.0 [Hz]	PLC RUN
MP2555.x	Center/cutoff frequency for filter 4 Input: 0 to 30000.0 [Hz]	PLC RUN

MP	Function and input	Software version and behavior
MP2556.x	Center/cutoff frequency for filter 5 Input: 0 to 30000.0 [Hz]	PLC RUN
MP2560.x	Low-pass filter Input: 0: No low-pass filter 1: 1st-order low-pass filter 2: 2nd-order low-pass filter	PLC RUN
MP2560.x	Filter order of the low-pass filter Input: 0 to 20	PLC RUN
MP2561.x	Maximum input frequency for motor encoders Format: %xxxxxxxxxxxxxxxxxx Input: Bit 0 – Maximum input frequency for motor encoders 0: 400 kHz 1: 800 kHz	PLC RUN
MP2562.x	Filter type for filter 1 Input: 0: No filter 1: PT2 low-pass filter (speed controller) 2: Band-rejection filter (speed controller) 3: Phase increase (speed controller) 11: PT2 low-pass filter (position controller) 12: Band-rejection filter (position controller) 13: Phase increase (position controller)	PLC RUN
MP2563.x	Filter type for filter 2 Input: 0: No filter 1: PT2 low-pass filter (speed controller) 2: Band-rejection filter (speed controller) 3: Phase increase (speed controller) 11: PT2 low-pass filter (position controller) 12: Band-rejection filter (position controller) 13: Phase increase (position controller)	PLC RUN
MP2564.x	Filter type for filter 3 Input: 0: No filter 1: PT2 low-pass filter (speed controller) 2: Band-rejection filter (speed controller) 3: Phase increase (speed controller) 11: PT2 low-pass filter (position controller) 12: Band-rejection filter (position controller) 13: Phase increase (position controller)	PLC RUN
MP2565.x	Filter type for filter 4 Input: 0: No filter 1: PT2 low-pass filter (speed controller) 2: Band-rejection filter (speed controller) 3: Phase increase (speed controller) 11: PT2 low-pass filter (position controller) 12: Band-rejection filter (position controller) 13: Phase increase (position controller)	PLC RUN
MP2566.x	Filter type for filter 5 Input: 0: No filter 1: PT2 low-pass filter (speed controller) 2: Band-rejection filter (speed controller) 3: Phase increase (speed controller) 11: PT2 low-pass filter (position controller) 12: Band-rejection filter (position controller) 13: Phase increase (position controller)	PLC RUN
MP2572.x	Bandwidth for filter 1 Input: 0 to 30000.0 [Hz]	PLC RUN

MP	Function and input	Software version and behavior
MP2573.x	Bandwidth for filter 2 Input:0 to 30000.0 [Hz]	PLC RUN
MP2574.x	Bandwidth for filter 3 Input:0 to 30000.0 [Hz]	PLC RUN
MP2575.x	Bandwidth for filter 4 Input:0 to 30000.0 [Hz]	PLC RUN
MP2576.x	Bandwidth for filter 5 Input:0 to 30000.0 [Hz]	PLC RUN
MP2590.x	Braking ramp in an emergency stop Input: 0.001 to 999.999 [min^{-1}/ms] 0: Function inactive	PLC RUN
MP2600.x	Acceleration feedforward control Input: 0 to 100.0000 [A/(rev/s2)]	PLC
MP2602.x	IPC time constant T_1 Input: 0.0001 to 1.0000 [s] 0: IPC inactive	PLC RUN
MP2604.x	IPC time constant T_2 Input: 0.0001 to 1.0000 [s] 0: IPC inactive	PLC RUN
MP2606.x	Jerk feedforward control. Minimizing the following error (due to mechanical deformation) during the jerk phase Input: 0.000 to 10.000	PLC RUN
MP2610.x	Friction compensation at low speeds (effective only with velocity feedforward control) Input: 0 to 100.0000 [A] 0: No friction compensation (or axis is analog)	PLC RUN
MP2610.x	Friction compensation at low speed Input: 0 to 30.0000 [A] (effective value) 0: No friction compensation	PLC RUN
MP2612.x	Delay of friction compensation (effective only during operation with velocity feedforward control) Input: 0.0000 to 1.0000 [s] (typically: 0.015 s) 0: No friction compensation (or axis is analog)	PLC RUN
MP2612.x	Input: 0.000 to 1.000 [mm] or [°] 0: No friction compensation 0.1: Typical input value Distance before the reversal point from which a reduction of the current from MP2610.x is to go into effect	PLC RUN
MP2614.x	Distance after the reversal point from which a reduction of the current from MP2610.x is to go into effect Input: 0.000 to 1.000 [mm] or [°] 0: Friction compensation same as CC 422 0.1: Typical input value	PLC RUN
MP2620.x	Friction compensation Input: 0 to 100.000 [A] 0: No friction compensation (or axis is analog)	PLC RUN
MP2630.x	Holding current Input: –100.000 to +100.000 [A]	PLC RUN
MP2640.x	Torsion compensation between position encoder and speed encoder Input: 0.001 to 100.000 [μm/A] 0: Not active	

MP	Function and input	Software version and behavior
MP2900.x	Tensioning torque between master and slave for master-slave torque control (entry for the slave axis) Input: –100.00 to +100.00 [Nm]	PLC
MP2910.x	P factor of the torque controller for master-slave torque control (entry for the slave axis) Input: 0.00 to 999.99 [1/(Nm · min)]	PLC
MP2912.x	Setting for master-slave torque control Input: 0: The output of the torque adjustment controller (= speed compensation value) is distributed evenly to master and slave. 1: The output of the torque-adjustment controller (= speed compensation value) is only distributed to the slave.	PLC

31.4.6 Spindle

MP	Function and input	Software version and behavior
MP3010	Output of speed, gear range Input: 0: No output of spindle speed 1: Speed code if the speed changes 2: Speed code at every TOOL CALL 3: Nominal speed value always, G code if the gear range shifts 4: Nominal speed value always, G code at every TOOL CALL 5: Nominal speed value always, no G code 6: Same as 3, but with controlled spindle for orientation 7: Same as 4, but with controlled spindle for orientation 8: Same as 5, but with controlled spindle for orientation	PLC RUN
MP3011	Function of analog output S, if MP3010 < 3 Input: 0: No special function 1: Voltage is proportional to the current contouring feed rate, depending on MP3012 2: Voltage is defined as through Module 9130 3: Voltage is defined through M functions (M200 to M204)	
MP3012	Feed rate from output of an analog voltage of 10 V, MP3011 = 1 Input: 0 to 300 000 [mm/min]	
MP3013.x	Characteristic curve kink points (velocity) for output of the analog voltage with M202 Input: 10 to 300 000 [mm/min]	PLC RUN
MP3014.x	Characteristic curve kink points (voltage) for output of the analog voltage with M202 Input: 0.000 to 9.999 [V]	PLC RUN
MP3020	Speed range for S code output Format: xxyyz xx: S code for minimum speed yy: S code for maximum speed z: Speed increment Input: 0 to 99 999	PLC RUN
MP3030	Behavior of the spindle Input: Bit 0 – 0: Axis stop for TOOL CALL S 1: No axis stop for TOOL CALL S Bit 1: Zero spindle speed when switching to another gear range 0: Reduce speed to 0 1: Do not reduce speed to 0	PLC RUN
MP3120	Zero speed permitted Input: 0: S = 0 allowed 1: S = 0 not permitted	PLC RUN
MP3130	Polarity of the nominal spindle speed Input: 0: M03 positive, M04 negative 1: M03 negative, M04 positive 2: M03 and M04 positive 4: M03 and M04 negative	PLC RUN
MP3140	Counting direction of spindle position encoder output signals Input: 0: Positive counting direction with M03 1: Negative counting direction with M03	PLC RUN
MP3142	Line count of the rotary encoder on the spindle Input: 100 to 100 000 [lines]	PLC RUN

MP	Function and input	Software version and behavior
MP3143	Mounting configuration of the spindle position encoder Input: 0: Position encoder directly on the first spindle 1: Position encoder via transmission (ratio in MP3450.x and MP3451.x); X30 pin 1: reference pulse 2: Position encoder via transmission (ratio in MP3450 and MP3451); X30 pin 1: reference pulse release 3: Same as input value 1, except that the second reference pulse is evaluated. 4: Reference-mark evaluation of the spindle via EnDat. The encoder must be mounted directly (without transmission). No reference pulse is necessary. A new reference-mark evaluation via marker M4015 may only be performed at standstill. 5: The position encoder is mounted directly (same as input value 0) and the transmission ratio is also evaluated. (rigid tapping will also be possible without a spindle position encoder!)	PLC RUN
MP3210.0-7	Analog nominal spindle voltage at rated speed for the gear ranges 1 to 8 Input: 0 to 100.000 [V] Digital spindle motor revolutions at rated speed for the gear ranges 1 to 8 Input: 0 to 100.000 [1000 min^{-1}]	PLC RUN
MP3240.1	Analog spindle: Minimum nominal value voltage Input: 0 to 9.999 [V] Digital spindle: Minimum motor speed Input: 0 to 9.999 [1000 min^{-1}]	PLC RUN
MP3240.2	Analog spindle: Spindle jog voltage for gear shifting (M4009/M4010) Input: 0 to 9.999 [V] Digital spindle: Motor speed for gear shifting (M4009/M4010) Input: 0 to 9.999 [1000 min^{-1}]	
MP3310	Limitation for spindle speed override Input: 0 to 150 [%]	PLC RUN
MP3310.0	Upper limit	
MP3310.1	Lower limit	
MP3350	Maximum permissible overshoot of the spindle speed in percent of the nominal spindle speed Input: 0 to 100 [%]	PLC RUN
MP3351	Entry of an absolute value for the permissible overshoot of the spindle speed Input: 0.001 to 100000.000 [rpm] 0 = Monitoring off	PLC RUN
MP3411.0-7	Ramp gradient of the spindle with M03 and M04 for gear ranges 1 to 8 Input: Analog axes: 0 to 1.999 [V/ms] Digital axes: 0 to 1.999 [1000 min^{-1}/ms]	PLC RUN
MP3412	Multiplication factor for MP3411.x Input: 0.000 to 1.999	PLC RUN
MP3412.0	With M05	
MP3412.1	With oriented spindle stop	
MP3412.2	With tapping with floating tap holder	
MP3412.3	With rigid tapping	
MP3415	Overshoot behavior of the spindle with M03, M04 and M05 Input: 0 to 1000 [ms]	PLC RUN
MP3415.0	With M03, M04 and M05	
MP3415.1	For oriented spindle stop	
MP3415.2	With tapping	
MP3415.3	With rigid tapping	

MP	Function and input	Software version and behavior
MP3420	Spindle positioning window Input: 0 to 360.0000 [°]	PLC RUN
MP3430	Deviation of the reference mark from the desired position (spindle preset) Input: 0 to 360 [°]	PLC RUN
MP3440.0-7	k_V factor for spindle orientation for gear ranges 1 to 8 Input: 0.1 to 10 [(1000°/ min) /°]	PLC RUN
MP3450.0-7	Number of spindle position-encoder revolutions for gear ranges 1 to 8 Input: 0 to 65 535 0: No transmission	PLC RUN
MP3451.0-7	Number of spindle revolutions for gear ranges 1 to 8 Input: 0 to 65 535 0: No transmission	PLC RUN
MP3510.0-7	Rated speed for the gear ranges 1 to 8 Input: 0 to 99 999.999 [min^{-1}]	PLC RUN
MP3515.0-7	Maximum spindle speed for gear ranges 1 to 8 Input: 0 to 99 999.999 [min^{-1}]	PLC RUN
MP3520.0 MP3520.1	Speed activation through marker M4011 Input: 0 to 99 999.999 [min^{-1}] Spindle speed for oriented stop Input: 0 to 99 999.999 [min^{-1}]	PLC RUN
MP3530	Increased spindle power for roughing Input: 0 = Not active 1 = Increased spindle power for roughing	
MP3540	Permissible spindle speed shortfall Input: 0.001 to 0.999 0: Monitoring not active	
MP3542	Minimum spindle speed as of which the monitoring in MP3540 becomes active Input: 0.001 to 0.999 0: Monitoring not active	
MP3550	Delay of emergency-stop reaction of spindles Input: 0.001 to 0.100 [s] 0: Delay not active	

31.4.7 Integrated PLC

MP	Function and input	Software version and behavior
MP4000.0-63	Options for the conditional compilation of the PLC program	
MP4020	PLC functions Format: %xxxxxxxxxxxxxx Input: Bit 0 to bit 4: Reserved Bit 5: Single or double spindle operation 0: Single-spindle operation 1: Double-spindle operation Bit 6 – Reserved Bit 7 – Reserved Bit 8 – Behavior after an ext. emergency stop 0: "Approach position" is not automatically activated 1: "Approach position" is automatically activated Bit 9 – Behavior of a simulated key 0: Simulated key is transferred immediately to the NC 1: Simulated key is processed first by an active PLC window before being transferred to the NC Bit 10 – Behavior of a locked key 0: Locked key only works on the active PLC window 1: Locked key works on neither the active PLC window nor on the NC Bit 11 – PLC counter in MP4120.x 0: Input in PLC cycles 1: Input in seconds Bit 12 – Font size in PLC window 0: Automatic adaptation of font size to screen 1: Font size for BF 120 Bit 13 – Reserved, set to 0 Bit 14 – PLC module interface for 18 axes 0: PLC module interface for 14 axes plus spindle (axes = bit 0 to bit 14, spindle = bit 15). 1: PLC module interface for 18 axes plus spindle (axes = bit 0 to bit 17, spindle = bit 31). Bit 15 – Saving the changes to tables to memory medium 0: Cyclic saving of tables (behavior same as up to and including 606 42x-01 SP 04) 1: Save tables each time they are closed Bit 16 – Time at which strobe markers are reset 0: Do not reset strobe markers until the action triggered by acknowledgment of the strobe is concluded by the NC 1: Reset strobe markers immediately upon acknowledgment (behavior same as up to and including 606 42x-01 SP 04)	RESET
MP4030.x	Assignment of physical/logic PL (not required for HSCI systems)	
MP4031	Monitoring of number of PLs (not required for HSCI systems)	
MP4040	Set PLC output after shutdown	PLC RUN
MP4041	Time after shutdown until setting of the PLC output from MP4044 Input: 0 to 1000 [s]	PLC RUN
MP4043	Delay during shutdown for the PLC to execute final actions Input: 1 to 60 [s] 0: No delay	PLC RUN
MP4044	PLC output to be set after shutdown Input: Symbolic name of PLC output 0: Cannot be evaluated, results in an error message	PLC RUN
MP4045	Reserved	
MP4050.0-8	Traverse distance for lubrication of axes 1 to 18 Input: 0 to 99 999.999 [m or 1000°]	PLC RUN

MP	Function and input	Software version and behavior
MP4070	Compensation amount per PLC cycle for lagged-tracking axis error compensation Input: 0.0001 to 0.5000 [mm]	PLC RUN
MP4110.0-47	Run time PLC timer T0 to T47 Input:0 to 1 000 000.000 [s]	PLC RUN
MP4111.96-x	Run time PLC timer T96 to x (defined in OEM.SYS) Input: 0 to 1 000 000.000 [s]	PLC RUN
MP4120.0-47	PLC counter preset value Input: 0 to 1 000 000.000 [s or PLC cycles, depending on MP4020, bit 11]	PLC RUN
MP4130.0 MP4130.1 MP4130.2-5	Fast PLC input for switching the monitoring functions off (with HSCI, this is also possible via MP4132.x) Reserved Fast PLC inputs Input: 0 to 20 000 [Number of the PLC input or symbolic PLC operand] -1: Function inactive	
MP4131.0 MP4131.1 MP4131.2-5	Activation criterion for the fast PLC input for switching the monitoring functions off (with HSCI, this is also possible via MP4132.x) Reserved Activation criterion for fast PLC inputs Input: 0: Activation at low level 1: Activation at high level	
MP4132.0-7	Axis-specific drive enable, switch-off of monitoring functions Input: 0 to 20000 [Number of the PLC input or symbolic PLC operand] –1: Function not active	
MP4210.0-47	Setting a number in the PLC (D768 to D956) Input: –99 999.9999 to +99 999.9999	
MP4220.0-4	Setting a number in the PLC (W960 to W968) Input: 10 to 30 000	
MP4230.0-31	Setting a number in the PLC (Module 9032) The number of indexes can be increased via an entry in OEM.SYS. Input: –99 999.9999 to +99 999.9999	
MP4231.0-31	Setting a number in the PLC (Module 9032) Input: –99 999.9999 to +99 999.9999	
MP4310.0-9	General parameters in the PLC (W976 to W994, M4300 to M4459) Format: Number, $xxxx [Hex], %xxxxxxxxxxxxxxxx [Bin] Input: 0 to 65535	

31.4.8 Configuration of the data interface

MP	Function and input	Software version and behavior
MP5000	Disable data interfaces	PLC
	Input: 0: No interface disabled 1: RS-232-C/V.24 interface disabled 2: RS-422/V.11 interface disabled 3: RS-232-C/V.24 and RS-422/V.11 interfaces disabled	RUN
MP5020	Configuration of the data interface	PLC
	Format: %xxxxxxxx Input: Bit 0 – 0: 7 data bits 1: 8 data bits Bit 1 – 0: Any BCC character 1: BCC not control character Bit 2 – 0: Transmission stop by RTS not active 1: Active Bit 3 – 0: Transmission stop by DC3 not active 1: Active Bit 4 – 0: Character parity even 1: Odd Bit 5 – 0: Character parity not desired 1: Desired Bit 6 = 0, Bit 7 = 0: 1.5 stop bits Bit 6 = 1, Bit 7 = 0: 2 stop bits Bit 6 = 0, Bit 7 = 1: 1 stop bit Bit 6 = 1, Bit 7 = 1: 1 stop bit Bit 8, 9 – Reserved Bit 10 – Check for missing connection 0: Active 1: Not active	RUN CN123
MP5020.0	Operating mode EXT1	
MP5020.1	Operating mode EXT2	
MP5020.2	Operating mode EXT3 (PLC)	
MP5020.3	Operating mode EXT4 (PLC)	
MP5030	Communications protocol	PLC
	Input: 0 = Standard data transfer 1 = Blockwise transfer 2 = Without protocol (only for MP5030.2)	RUN CN123
MP5030.0	Operating mode EXT1	
MP5030.1	Operating mode EXT2	
MP5030.2	Operating mode EXT3 (PLC)	
MP5030.3	Operating mode EXT4 (PLC)	

MP	Function and input	Software version and behavior
MP5040	Data transfer rate in operating mode EXT3 or EXT4 (data transfer through PLC)	PLC
	Input: 0: 110 bps 1: 150 bps 2: 300 bps 3: 600 bps 4: 1200 bps 5: 2400 bps 6: 4800 bps 7: 9600 bps 8: 19200 bps 9: 38400 bps 10: 57600 bps 11: 115200 bps	RUN
MP5040.0	Operating mode EXT3 (PLC)	
MP5040.1	Operating mode EXT4 (PLC)	

31.4.9 3-D touch probe

MP	Function and input	Software version and behavior
MP6010	Selection of the touch probe Input: 0: Touch probe with cable transmission (TS 120, TS 220) 1: Touch probe with infrared transmission (TS 632) 2: Touch probe with infrared transmission (TS 440, TS 640) 3: Battery-free TS 444 touch probe	PLC CN123
MP6120	Probing feed rate (triggering touch probe) Input: 1 to 10 000 [mm/min]	PLC RUN CN123
MP6130	Maximum measuring range Input: 0.001 to 99 999.9999 [mm]	PLC RUN CN123
MP6140	Setup clearance above measuring point Input: 0.001 to 99 999.9999 [mm]	PLC RUN CN123
MP6150	Rapid traverse in probing cycle Input: 10 to 20 000 [mm/min]	PLC RUN CN123
MP6151	Pre-positioning in probing cycle with rapid traverse Input: 0: Pre-position with speed from MP6150 1: Pre-positioning at rapid traverse	PLC RUN CN123
MP6160	M function for probing from opposite orientations Input: –1: Spindle orientation directly by NC 0: Function inactive 1 to 999: Number of the M function for spindle orientation by the PLC	PLC RUN CN123
MP6161	M function for orienting the touch probe before every measuring process Input: –1: Spindle orientation directly by the NC 0: Function inactive 1 to 999: Number of the M function	PLC RUN CN123
MP6162	Orientation angle Input: 0 to 359.9999 [°]	PLC RUN CN123
MP6163	Minimum difference between the current spindle angle and MP6162 before executing an oriented spindle stop Input: 0 to 3.0000 [°]	PLC RUN CN123
MP6165	Orient the probe before approaching with Cycle 0 or 1, or with manual probing Input: 0: Probe is not oriented before each probing 1: Probe is oriented and always deflected in the same direction	PLC RUN CN123
MP6166	Probing direction of the touch probe with consideration of an active basic rotation (only manual measuring cycles) Input: 0: Inactive 1: Active	PLC RUN CN123
MP6170	Number of measurements in a programmed measurement (touch probe block) Input: 1 to 3	PLC RUN CN123
MP6171	Confidence range for programmed measurement (MP6170 > 1) Input: 0.002 to 0.999 [mm]	PLC RUN CN123

MP	Function and input	Software version and behavior
MP6180	Coordinates of the ring gauge center for automatic calibration (Probing Cycle 2) with respect to the machine datum (traverse range 1) Input: 0 to +99 999.9999 [mm]	PLC CN123
MP6180.0	X coordinate	
MP6180.1	Y coordinate	
MP6180.2	Z coordinate	
MP6181	Coordinates of the ring gauge center for automatic calibration (Probing Cycle 2) with respect to the machine datum (traverse range 2) Input: 0 to +99 999.9999 [mm]	PLC CN123
MP6181.0	X coordinate	
MP6181.1	Y coordinate	
MP6181.2	Z coordinate	
MP6182	Coordinate of the ring gauge center for Probing Cycle 2 with respect to the machine datum (traverse range 3) Input: 0 to +99 999.9999 [mm]	PLC CN123
MP6182.0	X coordinate	
MP6182.1	Y coordinate	
MP6182.2	Z coordinate	
MP6185	Distance of probing point below ring top surface during calibration Input: +0.001 to +99 999.9999 [mm]	PLC CN123

31.4.10 Tool measurement with TT

MP	Function and input	Software version and behavior
MP6500	Tool measurement with TT 130 Format: %xxxxxxxxxxxxxxx Input: Bit 0 – Cycles for tool measurement 0: Disabled 1: Not disabled Bit 1 – 0: Tool radius measurement allowed. Tool length measurement with rotating spindle 1: Tool radius measurement and individual tooth measurement disabled Bit 2 – 0: Tool length measurement with stationary spindle (bit 1=1) 1: Tool length measurement with rotating spindle, only if a tool radius offset (**TT: R-OFFS**) has been entered in the tool table Bit 3 – 0: Tool measurement with spindle orientation 1: Tool measurement without spindle orientation. Individual tooth measurement not possible. Tool radius measurement possibly faulty Bit 4 – 0: Automatically determine speed 1: Always use minimum spindle speed Bit 5 – NC stop during **tool checking** 0: The NC program is not stopped when the breakage tolerance is exceeded 1: If the breakage tolerance is exceeded, the NC program is stopped and the error message **Tool broken** is displayed. Bit 6 – NC stop during **tool measurement** 0: The NC program is not stopped when the breakage tolerance is exceeded 1: If the breakage tolerance is exceeded, the NC program is stopped and the error message **Touch point inaccessible** is displayed.	PLC RUN
MP6500	Tool measurement with TT 130 Format: %xxxxxxxxxxxxxxx Input: Bit 7 – Reserved Bit 8 – Probing routine 0: Probe contact is probed from several directions 1: Probe contact is probed from one direction Bit 9 – Automatic measurement of the direction of the probe contact basic rotation (bit 8 = 1) 0: Basic rotation is not measured 1: Basic rotation of the probe element is automatically measured Bit 10 – Probing routine (bit 8 = 1) 0: Pre-positioning to starting point in all three principal axes 1: Pre-positioning to starting point in the tool axis and in the axis of the probing direction (MP6505) (bit 9 = 0) Bit 11 – **Tool checking** and changing in the tool table 0: After **Tool checking** the tool table is changed 1: After **Tool checking** the tool table is not changed Bit 12 – PLC datum shift 0: Do not include 1: Include Bit 13 – 0: Tool is measured in the tilt position in which the tool touch probe was also calibrated 1: Tool is measured in another tilt position Bit 14 – Tool measurement with number of teeth = 0 0: Tool measurement with rotating spindle 1: Tool measurement with stationary spindle	PLC RUN

MP	Function and input	Software version and behavior
MP6505	Probing direction for tool radius measurement for 3 traverse ranges Input: 0: Positive probing direction of the angle reference axis (0° axis) 1: Positive probing direction in the +90° axis 2: Negative probing direction in the angle reference axis (0° axis) 3: Negative probing direction in the +90° axis	PLC RUN CN123
MP6505.0	Traverse range 1	
MP6505.1	Traverse range 2	
MP6505.2	Traverse range 3	
MP6507	Calculation of the probing feed rate Input: 0: Calculation of the probing feed rate with constant tolerance 1: Calculation of the probing feed rate with variable tolerance 2: Constant probing feed rate	PLC RUN CN123
MP6510	Maximum permissible measuring error for tool measurement with rotating tool Input: 0.002 to 0.999 [mm]	PLC RUN CN123
MP6510.0	First measurement error	
MP6510.1	Second measurement error	
MP6520	Probing feed rate for tool measurement with non-rotating tool Input: 1 to 10 000 [mm/min]	PLC RUN CN123
MP6530	Distance from the tool end to the top of the probe contact during tool radius measurement for 3 traverse ranges Input: 0.001 to 99.9999 [mm]	PLC RUN CN123
MP6530.0	Traverse range 1	
MP6530.1	Traverse range 2	
MP6530.2	Traverse range 3	
MP6531	Diameter or edge length of the TT 130 probe contact for 3 traverse ranges Input: 0.001 to 99.9999 [mm]	PLC RUN
MP6531.0	Traverse range 1	
MP6531.1	Traverse range 2	
MP6531.2	Traverse range 3	
MP6540	Safety zone around the probe contact of the TT 130 for pre-positioning Input: 0.001 to 99 999.9999 [mm]	PLC RUN CN123
MP6540.0	Safety clearance in tool axis direction	
MP6540.1	Safety clearance in the plane perpendicular to the tool axis	
MP6550	Rapid traverse in probing cycle for TT 130 Input: 10 to 1 000 000 [mm/min]	PLC RUN CN123
MP6560	M function for spindle orientation during individual tooth measurement Input: –1: Spindle orientation directly by NC 0: Function inactive 1 to 999: Number of the M function for spindle orientation by PLC	PLC RUN CN123
MP6562	M function before and after tool measurement cycle (TT cycle) Input: –1: Function inactive 0 to 999: Number of the M function	349 490-06 PLC RUN CN123
MP6562.0	M function before the cycle start	
MP6562.1	M function after cycle end	

MP	Function and input	Software version and behavior
MP6570	Max. permissible surface cutting speed at the tooth edge Input: 1.0000 to 129.0000 [m/min]	PLC RUN CN123
MP6572	Maximum permissible speed during tool measurement Input: 1 to 1000 [min^{-1}] 0: 1000 [min^{-1}]	PLC RUN CN123
MP6580.0-2	Coordinates of the TT 130 probe contact center with respect to the machine datum (traverse range 1) Input: –99 999.9999 to +99 999.9999 [mm]	PLC RUN CN123
MP6581.0-2	Coordinates of the TT 130 probe contact center with respect to the machine datum (traverse range 2) Input: –99 999.9999 to +99 999.9999 [mm]	PLC RUN CN123
MP6582.0-2	Coordinates of the TT 130 probe contact center with respect to the machine datum (traverse range 3) Input: –99 999.9999 to +99 999.9999 [mm]	PLC RUN CN123
MP6585	Monitoring the position of the rotary and additional linear axes during the tool measurement cycles Format: %xxxxxx Input: 0: Axis is not monitored 1: Axis is monitored Bit 0 – A axis Bit 1 – B axis Bit 2 – C axis Bit 3 – U axis Bit 4 – V axis Bit 5 – W axis	PLC RUN CN123
MP6586	Ref. coordinate for monitoring the position of the rotary and additional linear axes during the tool measurement cycles Input: –99 999.9999 to +99 999.9999 [mm or °]	PLC RUN CN123
MP6586.0	A axis	
MP6586.1	B axis	
MP6586.2	C axis	
MP6586.3	U axis	
MP6586.4	V axis	
MP6586.5	W axis	
MP6600	KinematicsOpt: Maximum permitted change value Input: 0.010 to 1.000 [mm]	PLC RUN CN123
MP6601	KinematicsOpt: Radius deviation of the calibration sphere Input: 0.010 to 0.100 [mm]	PLC RUN CN123
MP6602	KinematicsOpt: M-function macro for positioning the rotary axes Input: 0 to 999 -1: Function inactive	PLC RUN CN123

31.4.11 Tapping

MP	Function and input	Software version and behavior
MP7110.0	Minimum for feed-rate override during tapping Input: 0 to 150 [%]	PLC RUN
MP7110.1	Maximum for feed-rate override during tapping Input: 0 to 150 [%]	
MP7120.0	Dwell time for reversal of spindle rotational direction Input: 0 to 65.535 [s]	PLC RUN
MP7120.1	Advanced switching time of the spindle during tapping with coded spindle-speed output Input: 0 to 65.535 [s]	
MP7120.2	Spindle slow-down time after reaching the hole depth Input: 0 to 65.535 [s]	
MP7130	Run-in behavior of the spindle during rigid tapping Input: 0.001 to 10 [°/min]	PLC RUN
MP7150	Positioning window of the tool axis during rigid tapping Input: 0.0001 to 2 [mm]	PLC RUN
MP7160	Spindle response during Cycles 17, 207 and 18 Format: %xxxxx Input: Bit 0 – Oriented spindle stop with Cycles 17 and 207 0: Oriented spindle stop before execution of the cycle 1: No oriented spindle stop before execution of the cycle Bit 1 – Spindle speed 0: Spindle speed is not limited 1: Spindle speed is limited so that it runs with constant speed approx. 1/3 of the time Bit 2 – Spindle in position feedback control 0: Spindle operated without position feedback control 1: Spindle operated with position feedback control Bit 3 – Acceleration feedforward control 0: Active 1: Not active Bit 4 – 0: Tool axis tracks the spindle 1: Tool axis and spindle interpolated	PLC RUN CN123

31.4.12 Display and operation

MP	Function and input	Software version and behavior
MP7210	Programming station Input: 0: Controlling and programming 1: Programming station with PLC active 2: Programming station with PLC inactive 3: Programming station with PLC and emergency stop active	CN123
MP7212	Power interrupted message Input: 0: Acknowledge message **Power interrupted** with CE key 1: **Power Interrupted** message does not appear	PLC RUN CN123
MP7220	Block number increment for DIN/ISO programs Input: 0 to 250	PLC RUN CN123
MP7224	Lock specific file types Input: 0: Do not disable 1: Disable Bit 0 – HEIDENHAIN programs *.H Bit 1 – ISO programs *.I Bit 2 – Tool tables *.T Bit 3 – Datum tables *.D Bit 4 – Pallet tables *.P Bit 5 – Text files *.A Bit 6 – HELP files *.HLP Bit 7 – Point tables *.PNT	PLC RUN CN123
MP7224.0	Disabling soft keys for file types	
MP7224.1	Protect file types	
MP7224.2	Disable the EDIT ON/OFF soft key	
MP7225	Reserved	PLC RUN
MP7226.0 MP7226.1	Reserved Size of the datum table Input: 0 to 255 [lines]	PLC RUN CN123
MP7229 MP7229.0	Properties of the NC program Line number for program testing Input: 100 to 9999	PLC RUN CN123
MP7229.1	Program length up to which FK blocks are permitted Input: 100 to 9999	

MP	Function and input	Software version and behavior
MP7230.x	Dialog language Input: 0: English 1: German 2: Czech 3: French 4: Italian 5: Spanish 6: Portuguese 7: Swedish 8: Danish 9: Finnish 10: Dutch 11: Polish 12: Hungarian 13: Reserved 14: Russian (Cyrillic characters) 15: Chinese (simplified) 16: Chinese (traditional) 17: Slovenian (option #41) 18: Norwegian (option #41) 19: Slovak (option #41) 20: Latvian (option #41) 21: Korean (option #41) 22: Estonian (option #41) 23: Turkish (option #41) 24: Romanian (option #41) 14, 15, 16 and 17 only in connection with BF 150	PLC RUN CN123
MP7230.0	NC conversational language, soft keys for OEM cycles, operating-system language	
MP7230.1	PLC conversational language (user parameters)	
MP7230.2	PLC error messages	
MP7230.3	Help files	

MP	Function and input	Software version and behavior
MP7237	Display and reset the operating times	PLC
MP7237.0	Display PLC operating times Input: Bits 0 to 12 represent PLC operating times 1 to 13 0: Do not display 1: Display	RUN
MP7237.1	Reset PLC operating times with code number 857282 Input: Bits 0 to 12 represent PLC operating times 1 to 13 0: Do not reset 1: Reset	
MP7237.2	Reset NC operating times with code number 857282 Input: Bit 0 – No function Bit 1 – "Machine on" operating time Bit 2 – "Program run" operating time 0: Do not reset 1: Reset	
MP7238.0-12	Dialog messages for PLC operating times 1 to 13 Input: 0 to 4095 Dialog no. from the file (OEM.SYS)	PLC RUN
MP7245	Disable auxiliary cycles Input: 0: Auxiliary cycles disabled 1: Auxiliary cycles permitted	PLC RUN
MP7246	Machine parameter with multiple function Input: %xxxx Bit 0 – Paraxial positioning blocks 0: Permitted 1: Locked Bit 1 – Clear with DEL key 0: Does not need confirmation 1: Must confirm via soft key Bit 2 – Tool usage file 0: Do not generate 1: Generate Bit 3 – Settings file for AFC 0: Do not generate 1: Generate Bit 4 – ASCII file for machining time per NC block 0: Do not create ASCII file for machining time per NC block 1: Create ASCII file for machining time per NC block	PLC RUN
MP7251	Number of global Q parameters starting from Q99 (up to Q60) that are transferred from the OEM cycle to the calling program. Input: 0 to 40	PLC RUN
MP7260	Number of tools in the tool table MP7260 can also be overwritten by the PLC and the LSV2 protocol. Input: 0 to 30 000	CN123
MP7261.0-7	Number of pockets in the tool magazine 1 to 8 MP7261 can also be overwritten by the PLC and the LSV2 protocol. Input: 0 to 9999	CN123
MP7262	Maximum tool index number for indexed tools MP7262 can also be overwritten by the PLC and the LSV2 protocol. Input: 0 to 9	CN123

MP	Function and input	Software version and behavior
MP7263	Pocket table MP7263 can also be overwritten by the PLC and the LSV2 protocol. Format: %xxxxxxx Input: Bit 0 – 0: Show POCKET TABLE soft key 1: Hide POCKET TABLE soft key Bit 1 – Output of the columns for file functions 0: Output only the displayed columns 1: Output all columns Bit 2 – Show the "Edit ON/OFF" soft key in the pocket table 0: Display soft key 1: Do not display soft key Bit 3 – Soft keys "Reset pocket table" and "Reset column T" 0: Display soft keys 1: Do not display soft keys Bit 4 - Deletion possible for a tool that is in the pocket table. Deletion must be confirmed. 0: Deletion impossible 1: Deletion possible (with confirmation) Bit 5 – Deletion of a tool possible even without confirmation (if bit #4 = 1) 0: Deletion not possible without confirmation 1: Deletion possible without confirmation Bit 6 – Deletion of index entries of a tool behaves like deletion of a tool. The settings of bits 4 and 5 also apply to the index entries if bit 6 is set. 0: Deletion always impossible 1: Deletion possible depending on settings in bits 4 and 5	CN123

MP	Function and input	Software version and behavior
MP7266	Elements of the tool table MP7266 can also be overwritten by the PLC and the LSV2 protocol. Input: 0: No display 1 to 99: Position in the tool table	CN123
MP7266.0	16-character alphanumeric tool name (NAME)	
MP7266.1	Tool length L	
MP7266.2	Tool radius R	
MP7266.3	Tool radius 2 for toroidal cutter (R2)	
MP7266.4	Oversize in tool length (DL)	
MP7266.5	Oversize in tool radius (DR)	
MP7266.6	Oversize in tool radius 2 (DR2)	
MP7266.7	Locked tool? (TL)	
MP7266.8	Replacement tool (RT)	
MP7266.9	Maximum tool age, M4543 (TIME1)	
MP7266.10	Maximum tool age, TOOL CALL (TIME2)	
MP7266.11	Current tool age (CUR.TIME)	
MP7266.12	Comment on the tool (DOC)	
MP7266.13	Number of tool teeth (CUT)	
MP7266.14	Wear tolerance for tool length (LTOL)	
MP7266.15	Wear tolerance for tool radius (RTOL)	
MP7266.16	Cutting direction of the tool (DIRECT)	
MP7266.17	Additional information for PLC, module 9093 (PLC)	
MP7266.18	Tool offset for tool length (TT:LOFFS)	
MP7266.19	Tool offset for tool radius (TT:ROFFS)	
MP7266.20	Breakage tolerance for tool length (LBREAK)	
MP7266.21	Breakage tolerance for tool radius (RBREAK)	
MP7266.22	Tooth length (LCUTS)	
MP7266.23	Plunge angle (ANGLE)	
MP7266.24	Tool type (TYP)	
MP7266.25	Tool material (TMA)	
MP7266.26	Cutting-data table (CDT)	
MP7266.27	PLC value (PLC-VAL)	
MP7266.28	Probe center offset in reference axis (CAL-OF1)	
MP7266.29	Probe center offset in minor axis (CAL-OF2)	
MP7266.30	Spindle angle during calibration (CAL-ANG)	
MP7266.31	Tool type for pocket table (PTYP)	
MP7266.32	Maximum shaft speed [rpm] (NMAX)	
MP7266.33	Retract tool (LIFTOFF)	

MP	Function and input	Software version and behavior
MP7266.34	PLC value (P1)	
MP7266.35	PLC value (P2)	
MP7266.36	PLC value (P3)	
MP7266.37	Additional kinematics description (KINEMATIC)	
MP7266.38	Point angle for DRILL and CSINK (T-ANGLE)	
MP7266.39	Thread pitch for TAP (PITCH)	
MP7266.40	Control strategy name for AFC (Adaptive Feed Control)	
MP7266.41	Tolerance value or tool radius R2 (R2TOL)	
MP7266.42	Compensation value table for 3DToolComp (DR2TABLE)	
MP7266.43	Time stamp during tool changing (LAST_USE)	
MP7267	Elements of the pocket table MP7267 can also be overwritten by the PLC and the LSV2 protocol. Input: 0: No display 1 to 99: Position in the pocket table	CN123
MP7267.0	Tool number (T)	
MP7267.1	Special tool (ST)	
MP7267.2	Fixed pocket (F)	
MP7267.3	Locked pocket (L)	
MP7267.4	PLC status (PLC)	
MP7267.5	Tool name (TNAME)	
MP7267.6	Comment on the tool (DOC)	
MP7267.7	Tool type for pocket table (PTYP)	
MP7267.8	Value 1 (P1)	
MP7267.9	Value 2 (P2)	
MP7267.10	Value 3 (P3)	
MP7267.11	Value 4 (P4)	
MP7267.12	Value 5 (P5)	
MP7267.13	Reserve pocket (RSV)	
MP7267.14	Pocket above locked (LOCKED_ABOVE)	
MP7267.15	Pocket below locked (LOCKED_BELOW)	
MP7267.16	Pocket at left locked (LOCKED_LEFT)	
MP7267.17	Pocket at right locked (LOCKED_RIGHT)	
MP7267.18	S1 value (P6)	
MP7267.19	S2 value (P7)	
MP7270	Feed rate display in the operating modes MANUAL OPERATION and ELECTRONIC HANDWHEEL Input: 0: Display of axis feed rate through pressing an axis direction key (axis-specific feed rate from MP1020) 1: Display of axis feed rate also before an axis direction key is pressed (smallest value from MP1020 for all axes)	PLC RUN CN123
MP7280	Decimal character Input: 0: Decimal comma 1: Decimal point	PLC RUN CN123
MP7281	Depiction of the NC program Input: 0: All blocks completely 1: Current block completely, others line by line 2: All blocks line by line; complete block when editing	PLC RUN CN123
MP7285	Tool length offset in the tool-axis position display Input: 0: Tool length is not offset 1: Tool length is offset	PLC RUN CN123

MP	Function and input	Software version and behavior
MP7289	Position display step for the spindle Input: 0: 0.1° 1: 0.05° 2: 0.01° 3: 0.005° 4: 0.001° 5: 0.0005° 6: 0.0001°	PLC RUN CN123
MP7290.0-8	Position display step for axes 1 to 18 Input: 0: 0.1 mm or 0.1° 1: 0.05 mm or 0.05° 2: 0.01 mm or 0.01° 3: 0.005 mm or 0.005° 4: 0.001 mm or 0.001° 5: 0.0005 mm or 0.0005° 6: 0.0001 mm or 0.0001°	PLC RUN CN123
MP7291	Display of axes on the screen Format: SXYZABCUVWxyzabcuvw- Input: Characters 1 to 9 from the right represent lines 1 to 9 Character 10 is spindle S which is always output in line 10.	PLC RUN
MP7291.0	Display in traverse range 1	
MP7291.1	Display in traverse range 2	
MP7291.2	Display in traverse range 3	
MP7294	Disable axis-specific "Datum setting" in the preset table Format: %xxxxxxxxxxxxxxxxxx Input: Bits 0 to 17 represent axes 1 to 18 0: Not disabled 1: Disabled	PLC RUN CN123
MP7295	Disable "Datum setting" Format: %xxxxxxxxxxxxxxxxxx Input: Bits 0 to 17 represent axes 1 to 18 0: Not disabled 1: Disabled	PLC RUN CN123
MP7296	"Datum setting" through axis keys Input: 0: Datum can be set by axis keys and soft key 1: Datum can be set only by soft key	PLC RUN CN123
MP7300	Erasing the status information, tool data and Q parameters Input: 0: Erase the status information, Q parameters and tool data if a program is selected. 1: Erase the status information, Q parameters and tool data if a program is selected and in the event of M02, M30, and END PGM. 2: Erase the status information and tool data if a program is selected. 3: Erase the status information and tool data if a program is selected and in the event of M02, M30, END PGM. 4: Erase the status information and Q parameters if a program is selected. 5: Erase the status information and Q parameters if a program is selected and in the event of M02, M30, END PGM. 6: Erase the status information if a program is selected and in the event of M02, M30, END PGM. 7: Erase the status information when a program is selected and in the event of M02, M30, END PGM.	PLC RUN CN123

MP	Function and input	Software version and behavior
MP7310	Graphic display mode Format: %xxxxxxxx Input: Bit 0 – Projection in three planes: 0: German-preferred projection 1: US-preferred projection Bit 1 – Rotating the coordinate system in the working plane by 90°: 0: No rotation 1: Rotation by +90° Bit 2 – BLK form after datum shift: 0: Shifted 1: Not shifted Bit 3 – Display of the cursor position: 0: Not displayed 1: Displayed Bit 4 – Reserved Bit 5 – 3-D graphics during program test 0: 2,5 D and 3 D (only with MC 420 or MC 422B and higher) 1: 2,5 D Bit 6 – Stock removal with an inclined tool 0: Not active 1: Active Bit 6 – Exact evaluation of the column LCUTS (cutting length) from the TOOL.T table in order to display special tools (e.g. saw blade). 0: Free evaluation 1: Exact evaluation for special tools	PLC RUN CN123
MP7312	Limitation of the tool tooth length LCUTS if no value was given for the tooth length in the tool table Input: = 0: No limitation, infinitely long tooth length > 0: Tooth length = 2 * tool radius * MP7312	PLC RUN
MP7315	Tool radius for graphic simulation without TOOL CALL Input: 0.0000 to 99 999.9999 [mm]	PLC RUN CN123
MP7316	Penetration depth of the tool Input: 0.0000 to 99 999.9999 [mm]	PLC RUN CN123
MP7317 MP7317.0 MP7317.1	M function for graphic simulation Beginning of graphic simulation Input: 0 to 88 Interruption of the graphic simulation Input: 0 to 88	PLC RUN CN123
MP7330.0-15	Specification of user parameters 1 to 16 Input: 0 to 9999.00 (no. of the user parameter)	PLC RUN
MP7340.0-15	Dialog messages for user parameters 1 to 16 Input: 0 to 4095 (line number of the PLC dialog message file)	PLC RUN

31.4.13 Colors

MP	Function and input	Software version and behavior
MP7350	Window frames	PLC RUN
MP7351 MP7351.0 MP7351.1 MP7351.2	Error messages Priority 0 (error) Priority 1 (warning) Priority 2 (information)	PLC RUN
MP7352 MP7352.0 MP7352.1 MP7352.2	"Machine" operating mode display Background Text for operating mode Dialog	PLC RUN
MP7353 MP7353.0 MP7353.1 MP7353.2	"Programming" operating mode display Background Text for operating mode Dialog	PLC RUN
MP7354 MP7354.0 MP7354.1 MP7354.2 MP7354.3 MP7354.4	"Machine" program text display Background General program text Active block Color of the comments and unused machine parameters in the machine parameter file Background of inactive window	PLC RUN
MP7355 MP7355.0 MP7355.1 MP7355.2 MP7355.3 MP7355.4	"Programming" program text display Background General program text Active block Color of the comments and unused machine parameters in the machine parameter file Background of inactive window	PLC RUN
MP7356 MP7356.0 MP7356.1 MP7356.2	Status window and PLC window Background Axis positions in the status display Status display other than axis positions	PLC RUN
MP7357 MP7357.0 MP7357.1 MP7357.2 MP7357.3	"Machine" soft-key display Background Text color Inactive soft-key row Active soft-key row	PLC RUN
MP7358 MP7358.0 MP7358.1 MP7358.2 MP7358.3	"Programming" soft-key display Background Text color Inactive soft-key row Active soft-key row	PLC RUN
MP7360 MP7360.0 MP7360.1 MP7360.2 MP7360.3 MP7360.4 MP7360.5 MP7360.6	Graphics: 3-D view and plan view Background Surface 3-D: Front face Text display in the graphics window 3-D: Lateral face Lowest point of blank form Highest point of blank form (below surface)	PLC RUN

MP	Function and input	Software version and behavior
MP7361	Graphics: Projection in three planes	PLC
MP7361.0	Background	RUN
MP7361.1	Top view	
MP7361.2	Front and side view	
MP7361.3	Axis cross and text in the graphic display	
MP7361.4	Cursor	
MP7362	Additional status display in the graphics window	PLC
MP7362.0	Background of graphic window	RUN
MP7362.1	Background of status display	
MP7362.2	Status symbols	
MP7362.3	Status values	
MP7362.4	Color of the unselected tabs in the graphics window	
MP7362.5	AFC tab – Background color	
MP7362.6	AFC tab – Color of actual override factor	
MP7362.7	AFC tab – Color of actual spindle factor	
MP7363	Interactive programming graphics	PLC
MP7363.0	Background	RUN
MP7363.1	Resolved contour	
MP7363.2	Subprograms and frame for zooming	
MP7363.3	Alternative solutions	
MP7363.4	Unresolved contour	
MP7363.5	Rapid traverse movements	
MP7364	Color of the help illustrations for cycles	PLC
MP7364.0-6	Colors 1 to 7 of the graphic program used	RUN
MP7364.7	Line color (color 8 of the graphic program)	
MP7364.8	Color for highlighted graphic elements if defined in the help illustration	
MP7364.9	Background	
MP7365	Oscilloscope	PLC
MP7365.0	Background	RUN
MP7365.1	Grid	
MP7365.2	Cursor and text	
MP7365.3	Selected channel	
MP7365.4-9	Channel 1 to 6	
MP7366	Pop-up window (HELP key, pop-up menus etc.)	PLC
MP7366.0	Background	RUN
MP7366.1	Text or foreground	
MP7366.2	Active line	
MP7366.3	Title bar	
MP7366.4	Scroll-bar field	
MP7366.5	Scroll bar	
MP7366.6-14	Reserved	
MP7367	Large PLC window	PLC
MP7367.0	Background	RUN
MP7367.1-7	Colors 1 to 7 (Color 8: MP7350)	
MP7367.8-14	Colors 9 to 15	
MP7368	Calculator	PLC
MP7368.0	Background	RUN
MP7368.1	Background of displays and keys	
MP7368.2	Key texts ("os" in "cos")	
MP7368.3	Key symbols	

MP	Function and input	Software version and behavior
MP7369	Directory tree in PGM MGT	PLC
MP7369.0	Text background	RUN
MP7369.1	Text	
MP7369.2	Text background of the active folder	
MP7369.3	Line color of the tree structure	
MP7369.4	Folders	
MP7369.5	Drives	
MP7369.6	Text background of the heading in the browser window	
MP7370	Small PLC window	PLC
MP7370.0	Background	RUN
MP7370.1-15	Colors 1 to 15	
MP7371.0	Status window and PLC window; background window	PLC
MP7371.1	Background elements	RUN
MP7371.2	Values except positions	
MP7371.3	Positions	
MP7375.0	smarT.NC; background: Input forms	PLC
MP7375.1	Background: Unselected tab	RUN
MP7375.2	Background: Tree view and input fields	
MP7375.3	Background: Inactive input field	
MP7375.4	Background: Help graphic	
MP7375.5	Cursor: Tree view and background of current field	
MP7375.6	Cursor: Tree view if the input focus is in the form	
MP7375.7	Text color: Inactive input field	
MP7375.8	Text color: Active input field	
MP7375.9	Text color: Radio buttons	
MP7375.10	Text color: Inactive label	
MP7375.11	Background: Radio/check buttons during "mouse-over"	
MP7375.12	PREDEF global data: Background	
MP7375.13	PREDEF global data: Text	
MP7375.14	Changed global data: Background	
MP7375.15	Changed global data: Text	
MP7375.16	Tool tip: Background	
MP7375.17	Tool tip: Text	
MP7375.18	Dialog title: Background	
MP7375.19	Dialog title: Text	
MP7375.20	Pattern generator: Points of the same height	
MP7375.21	Pattern generator: Currently active points	
MP7375.22	Pattern generator: Deleted points	
MP7375.23	Pattern generator: Hidden points	
MP7375.24	Pattern generator: Rectangle for zoom	

31.4.14 Machining and program run

MP	Function and input	Software version and behavior
MP7400	Look-ahead – Number of NC blocks for advance calculation of the path Input: 0: 256 [blocks] (default) 1: 512 [blocks] 2: 1024 [blocks]	PLC RUN
MP7410	Scaling cycle in two or three axes Input: 0: Scaling cycle is effective in all three principal axes 1: Scaling cycle is effective only in the working plane	PLC RUN CN123
MP7411	Tool data in the touch probe block Input: Bit 0 – 0: Use the calibrated data of the touch probe 1: Use the current tool data from the last TOOL CALL Bit 1 – 0: Only one set of touch probe calibration data 1: Use the tool table to manage more than one set of touch probe calibration data; display the tool name and tool number	PLC RUN CN123
MP7420	Cycles for milling pockets with combined contours Format: %xxxxx Input: Bit 0 – Milling direction for channel milling: 0: Counterclockwise for pockets, clockwise for islands 1: Clockwise for pockets, counterclockwise for islands Bit 1 – Sequence for rough-out and channel milling (only for SL 1): 0: First channel milling, then pocket rough-out 1: First pocket rough-out, then channel milling Bit 2 – Merging of listed contours: 0: Contours are merged only if the tool-center paths intersect 1: Contours are merged if the programmed contours intersect Bit 3—Rough-out and channel milling to pocket depth or for every infeed 0: Each process uninterrupted to pocket depth 1: Both processes for each pecking depth before proceeding to the next depth Bit 4 – Position after completion of the cycle 0: Tool moves to the same position as before the cycle was called 1: iTNC retracts the axis to the "clearance height"	PLC RUN CN123
MP7430	Overlap factor for pocket milling Input: 0.001 to 1.414	PLC RUN CN123
MP7431	Arc end-point tolerance Input: 0.0001 to 0.016 [mm]	PLC RUN CN123
MP7432	Limit-switch tolerance for M140 / M150 Input: 0.0001 to 1.0000 [mm] 0: Limit-switch tolerance not active	

MP	Function and input	Software version and behavior
MP7440	Output of M functions Format: %xxxxxxx Input: Bit 0 – Program stop with M06 0: Program stop with M06 1: No program stop with M06 Bit 1 – Modal cycle call M89 0: Normal code transfer of M89 at beginning of block 1: Modal cycle call M89 at end of block Bit 2 – Program stop with M functions 0: Program stop until acknowledgment of the M function 1: No program stop. No waiting for acknowledgment. Bit 3 – Switching of k_v factors with M105/M106: 0: Function is not in effect 1: Function is effective Bit 4—Reduced feed rate in the tool axis with M103: 0: Function is not in effect 1: Function is effective Bit 5 – Reserved Bit 6 – Automatic activation of M134 0: M134 must be activated in the NC program 1: M134 is automatically activated when an NC program is selected	PLC RUN CN123
MP7441	Error message during cycle call Format: %xxx Input: Bit 0 – 0: Error message **Spindle ?** is not suppressed 1: Error message **Spindle ?** is suppressed Bit 1: Reserved, enter 0 Bit 2 – 0: Error message **Enter depth as negative** is suppressed 1: Error message **Enter depth as negative** is not suppressed	PLC RUN CN123
MP7442	Number of the M function for spindle orientation in the fixed cycles Input: 1 to 999: Number of the M function 0: No oriented spindle stop –1: Oriented spindle stop by the NC	PLC RUN CN123
MP7444	Delay time for the change signals (M/S/T) Input: 0, 1, 2 0: Change signal after complete filter run time (previous behavior) 1: Change signal if the nominal feed rate reached the value 0 before the actual value (formed by the filters) did. 2: Change signal if the nominal feed rate reached the value 0 before the actual value (formed by the filters) did, and an additional delay until the actual value reaches the time window the first time.	PLC RUN
MP7450	Offsetting the tool change position from MP951.x in block scan Format: %xxxxxxxxxxxxxxxxxx Input: Bits 0 to bit 17 represent axes 1 to 18 0: Do not offset 1: Offset	PLC RUN
MP7451.x	Feed rate for returning to the contour for axes 1 to 18 Input: 10 to 1 000 000 [mm/min]	PLC RUN
MP7460.x	Reserved	PLC RUN CN123
MP7461.x	Reserved	PLC RUN CN123

MP	Function and input	Software version and behavior
MP7470	*Maximum contouring tool feed rate at 100% override Input: 0 to 300 000 [mm/min] 0: No limitation	PLC RUN CN123
MP7471	Maximum velocity of the principal axes during compensating movements through M128 or TCPM Input: 0 to 300 000 [mm/min]	PLC RUN CN123
MP7475	Reference for datum table Input: 0: Reference is workpiece datum 1: Reference is machine datum (MP960.x)	PLC RUN CN123
MP7480	Output of the tool or pocket number	PLC RUN
MP7480.0	With TOOL CALL block Input: 0: No output 1: Tool number output only when tool number changes 2: Tool number output for every TOOL CALL block 3: Pocket number and tool number output only when tool number changes 4: Output of the pocket number and tool number for every TOOL CALL block 5: Pocket number and tool number output only when tool number changes. Pocket table is not changed. 6: Pocket number and tool number output for every TOOL CALL block. Pocket table is not changed.	
MP7480.1	With TOOL DEF block Input: 0: No output 1: Tool number output only when tool number changes 2: Tool number output for every TOOL DEF block 3: Pocket number and tool number output only when tool number changes 4: Pocket number and tool number output for every TOOL DEF block	
MP7481.x	Sequence for new and returned tool when changing tools Format: %xxxxxxxx 0: First, output the pocket of the tool to be returned 1: First, output the pocket of the new tool Input: Bit 0: New tool from magazine 1 Bit 1: New tool from magazine 2 Bit 2: New tool from magazine 3 Bit 3: New tool from magazine 4 Bit 4: New tool from magazine 5 Bit 5: New tool from magazine 6 Bit 6: New tool from magazine 7 Bit 7: New tool from magazine 8	PLC RUN
MP7481.0	Tool from magazine 1 to be returned	
MP7481.1	Tool from magazine 2 to be returned	
MP7481.2	Tool from magazine 3 to be returned	
MP7481.3	Tool from magazine 4 to be returned	
MP7481.4	Tool from magazine 5 to be returned	
MP7481.5	Tool from magazine 6 to be returned	
MP7481.6	Tool from magazine 7 to be returned	
MP7481.7	Tool from magazine 8 to be returned	

MP	Function and input	Software version and behavior
MP7482	Pocket coding of the tool magazines Format: %xxxxxxxx 0: Variable pocket coding 1: Fixed pocket coding Input: Bit 0: Magazine 1 Bit 1: Magazine 2 Bit 2: Magazine 3 Bit 3: Magazine 4 Bit 4: Magazine 5 Bit 5: Magazine 6 Bit 6: Magazine 7 Bit 7: Magazine 8	PLC RUN
MP7483	Tool name/number for TOOL CALL / TOOL DEF Input: 0: Names and numbers are permitted (as before) 1: Only names are permitted 2: Only numbers are permitted	
MP7484.x	Search sequence in tool magazines Input: 0 to 7 [index from MP7261] -1: Abort	
MP7485	Add usage time for tool selection Input: 0 to 100 [%] Default setting: 10	
MP7490	Functions for traverse ranges Format: %xxxx Input: Bit 0 – 0: Display one traverse range with MOD 1: Display three traverse ranges with MOD Bit 1 – 0: Each traverse range has its own datum (and 3 memories for the positions of the swivel head) 1: One datum for all traverse ranges Bit 2 – Calibration data: Touch probe for workpiece measurement: 0: One set of calibration data for all traverse ranges 1: Every traverse range has its own set of calibration data Bit 3 – Calibration data: Touch probe for tool measurement: 0: One set of calibration data for all traverse ranges 1: Every traverse range has its own set of calibration data	PLC RUN
MP7492.x MP7492.0 MP7492.17	Number of axis in which the same datum is to be set during Datum Setting (with active preset table) Input: 0 to 17 –1: Do not set a datum Datum set in the first axis to Datum set in the 18th axis	PLC RUN
MP7493	Maximum deviation of the current tool orientation relative to the tool axis when setting a reference point with M114 Input: 0.0000 to 30.0000 [degrees] Default: 0.005	PLC RUN
MP7494	Axes for which an exact stop is to occur after positioning Format: %xxxxxxxxxxxxxxxxxx Input: Bits 0 to 17 represent axes 1 to 18 0: No exact stop 1: Exact stop	PLC RUN
MP7500 (is set via the kinematics table)	Reserved	

MP	Function and input	Software version and behavior
MP7502	Functionality of M144/M145 Input: %xxx Bit 0 – 0: M144/M145 not active 1: M144/M145 active Bit 1 – M144/M145 in the automatic modes 0: M144/M145 active 1: M144 is activated automatically at the start of an NC program. It can only be deactivated with M145 during an NC program. Bit 2 – M144/M145 in the manual modes 0: M144/M145 not active 1: M144/M145 active	PLC RUN
MP7503	Virtual tool axis – Reapproaching the contour and manual traverse in the current tool-axis direction (FCL2 upgrade function) Input: 0: Inactive 1: Active	PLC RUN
MP7506	Selection of kinematics at booting of the control Input: 0 to 999 -1: Function inactive	PLC RUN
MP7507	Selecting the kinematics for the operating mode Input: %xxx Bit 0 0: Kinematics cannot be selected in Editing operating modes 1: Kinematics can be selected in Editing operating modes for simulation in Test Run mode Bit 1 0: Kinematics cannot be selected in Program Run operating modes 1: Kinematics of the real machine can be selected in Program Run operating modes Bit 2 0: 3D ROT soft key is not available in Test Run mode 1: 3D ROT soft key is available in Test Run mode	PLC RUN
MP7510 (only possible via the old kinematics table)	Reserved	
MP7520 (only possible via the old kinematics table)	Reserved	
MP7530 (only possible via the old kinematics table)	Reserved	
MP7550 (only possible via the old kinematics table)	Reserved	

31.4.15 Hardware

MP	Function and input	Software version and behavior
MP7602	PLC cycle time Input: 0 to 60 [ms] 0 to 12: 12 ms	
MP7610.x	Reserved	
MP7620	Feed-rate override and spindle speed override Format: %xxxxxxx Input: Bit 0 – Feed-rate override if rapid traverse key is pressed in **Program Run** mode. 0: Override not effective 1: Override effective Bit 1 – No function Bit 2 – Feed-rate override if rapid traverse key and machine direction button are pressed in **Manual Operation** mode 0: Override not effective 1: Override effective Bit 3 – Feed-rate override and spindle-speed override in 1 % increments or according to a nonlinear characteristic curve 0: 1% steps 1: Nonlinear characteristic curve Bit 4 – No function Bit 5 – Rapid traverse override instead of spindle override 0: Potentiometer is used for spindle override 1: Potentiometer is used for rapid-traverse override Bit 6 – Feed-rate smoothing 0: Not active 1: Active Bit 7 – Reserved Bit 8 – Informational text if feed-rate or rapid-traverse override is set to 0 % 0: Informational text inactive 1: Informational text active Bit 9 – HSCI keyboard with three potentiometers 0: Keyboard unit with two potentiometers 1: Keyboard unit for HSCI with three potentiometers	PLC RUN
MP7621	Reserved	
MP7630	Recovery time after emergency stop test can be configured Input: 1 to 999 [ms] 0: 200 ms	PLC RUN
MP7640	Handwheel Input: 0: No handwheel 1: Reserved 2: HR 130 3: Reserved 4: Reserved 5: Up to three HR 150 via HRA 110 6: HR 410 7 to 10: Reserved 11: HR420/HR520 without LED activation 12: In future for HR 550FS wireless handwheel 13: HR520 with LED activation	PLC RUN

MP	Function and input	Software version and behavior
MP7641	Handwheel settings Format: %xxxxxxxxxxxxxx Input: Bit 0 – HR 410: Entry of subdivision factor 0: Through iTNC keyboard 1: Through PLC Module 9036 Bit 1 – HR 420/HR 5xx: With detent positions 0: Without detent positions 1: With detent positions Bit 2 – HR 420/HR 5xx: Axis direction keys and rapid traverse 0: By the NC 1: By the PLC Bit 3 – HR 420/HR 5xx: NC start / NC stop 0: By the NC 1: By the PLC Bit 4 – Handwheel superimposition in the active tool-axis direction 0: Behavior as before 1: VT axis can be selected Bit 5 – Inactive behavior of HR 420/HR 5xx 0: Report the keys of the HR to the PLC only when the HR is active 1: Report the keys of the HR to the PLC even if the HR is not active Bit 6 – Selecting and traversing auxiliary axes with HR 420/HR 5xx 0: Traversing auxiliary axes not possible 1: Traversing auxiliary axes is possible Bit 7 – Teach-In button on HR 5xx 0: By the NC 1: By the PLC Bit 8 – CTRL button on HR 5xx 0: By the NC 1: By the PLC Bit 9 – PLC soft keys with active HR 420/HR 5xx 0: PLC soft keys are not active when HR is active 1: PLC soft keys are active when HR is active	PLC RUN

MP	Function and input	Software version and behavior
MP7645	Initializing parameter for handwheel	PLC
MP7645.0	Assignment of the keys on handwheel HR 410 Input: 0: Evaluation of the keys by NC, including LEDs 1: Evaluation of the keys by PLC	RUN
MP7645.0	Assignment of a third handwheel via axis selector switch S2, when MP7645.2 = 0 Input: 0: Switch position 1 (at the left stop) 3rd handwheel axis Z Switch position 2 3rd handwheel axis IV Switch position 3 3rd handwheel axis V 1: Switch position 1 3rd handwheel axis X Switch position 2 3rd handwheel axis Y Switch position 3 3rd handwheel axis Z Switch position 4 3rd handwheel axis IV Switch position 5 3rd handwheel axis V 2: Switch position 3 3rd handwheel axis Z Switch position 4 3rd handwheel axis IV Switch position 5 3rd handwheel axis V	
MP7645.1	Fixed assignment of third handwheel if MP7645.2 = 1 Input: 1: X axis 2: Y axis 4: Z axis 8: Axis IV (MP410.3) 16: Axis V (MP410.4)	
MP7645.2	Assignment of a third handwheel via axis selector switch or MP7645.1 Input: 0: Assignment by axis selection switch according to MP7645.0 1: Assignment by MP7645.1	
MP7645.3	HRA 55xFS: Behavior of the permissive buttons Input: 0: Permissive buttons not pressed --> Relay contacts A and B are open, but not cross-circuit proof. 1: Handwheel permissive buttons are cross-circuit proof	
MP7645.4-7	No function	
MP7650	Handwheel counting direction (for HRA 110: for each axis) Input: Bit 0 0: Negative counting direction 1: Positive counting direction Axis-specifically only for HRA 110: Bits 0 to 17 represent axes 1 to 18 0: Negative counting direction 1: Positive counting direction	PLC RUN
MP7660	Sensitivity for electronic handwheel Input: 0 to 65 535 [increments]	PLC RUN

MP	Function and input	Software version and behavior
MP7670	Subdivision factor for handwheel	PLC
	Input: 0 to 10	RUN
MP7670.0	Subdivision factor for slow speed	
MP7670.1	Subdivision factor for medium speed (only HR 410)	
MP7670.2	Subdivision factor for fast speed (only HR 410)	
MP7671	Handwheel feed rate in the Handwheel operating mode with HR 410	PLC
	Input: 0 to 1000 [% of MP1020]	RUN
MP7671.0	Low speed	
MP7671.1	Medium speed (only HR 410)	
MP7671.2	Fast speed (only HR 410)	
MP7672	HR 410, distance per handwheel step	
	Input: 0.0000 to 1.0000 [mm]	
MP7672.0	Low speed	
MP7672.1	Medium speed	
MP7672.2	Fast speed	
MP7674.x	Handwheel, axis-specific subdivision factor	PLC
	Input: 1 to 10 0: No limitation	RUN
MP7675.x	Handwheel, axis-specific maximum path	PLC
	Input: 0.0001 to 10.0000 [mm] 0: No limitation	RUN
MP7680	Machine parameter with multiple function	PLC
	Format: %xxxxxxxxxxxxxxx Input: Bit 0 – Memory function for axis-direction keys with M4562 0: Not saved 1: Saved if M4562 is set Bit 1 – Returning to the contour 0: Not active 1: Active Bit 2 – Block scan 0: Not active 1: Active Bit 3 – Interruption of block scan for STOP or M06 0: Interruption 1: No interruption Bit 4 – Inclusion of programmed dwell time during the block scan 0: Include the dwell time 1: Do not include the dwell time Bit 5 – Start of calculation for block scan 0: Start from block with cursor 1: Start from beginning of program Bit 6 – Tool length in blocks with normal vectors 0: Without R2 from tool table (south pole) 1: With R2 from tool table (center of sphere) Bit 7 – Inserting a defined rounding arc or spline 0: Defined rounding arcs are always inserted 1: Defined rounding arcs are always inserted if the acceleration from MP1060.x or MP1070 was exceeded	RUN

MP	Function and input	Software version and behavior
MP7680	Machine parameter with multiple function Bit 8 – Insertion of rounding arc or cubic spline 0: Rounding arc is inserted 1: A cubic spline is inserted instead of a rounding arc Bit 9 – Constant jerk on spline (bit 8 = 1) 0: No constant jerk 1: Constant jerk Bit 10 – Cutter-radius-compensated outside corners 0: Insertion of a circular arc 1: Insertion of a spline curve Bit 11 – Behavior of M116 0: Rotary axis is parallel to linear axis 1: Any position of rotary axis to linear axis Bit 12 – Behavior of Cycle 28 0: Standard behavior 1: The slot wall is approached and departed tangentially; at the beginning and end of the slot a rounding arc with a diameter equal to the slot width is cut Bit 13 – Behavior during program interruption with axis movement 0: Automatic activation of **APPROACH POSITION** 1: Do not automatically activate **APPROACH POSITION** Bit 14 – Behavior of NC start after NC stop and internal stop 0: NC start permitted 1: NC start only permitted after block scan (GOTO) Bit 15 – NC Start if program is aborted 0: NC start permitted 1: NC Start not permitted (message window) Bit 16 – Behavior of Cycle 39 0: Approach/departure movement on an arc is active 1: Approach/departure movement on an arc is not active Bit 17 – Behavior of Markers M4175 and M4176 0: Clear M4175 and M4176 upon internal stop 1: M4176 remains set during RUNCANCEL macro	PLC RUN
MP7681	M/S/T/Q transfer to the PLC during block scan Format: %xxxx Input: Bit 0 – 0: Transfer M functions to the PLC during block scan 1: Collect M functions and transfer them to the PLC after block scan. Bit 1 – 0: Transfer T code to the PLC during block scan 1: Transfer last T code to the PLC after block scan Bit 2 – 0: Transfer S or G code to the PLC during block scan 1: Transfer S or G code to the PLC after block scan. Bit 3 – 0: Transfer FN19 outputs to the PLC during block scan 1: Transfer last FN19 outputs to the PLC after block scan. Bit 4 – MP subfiles during block scan 0: MP subfiles are not activated during block scan 1: MP subfiles are activated during block scan	PLC RUN

MP	Function and input	Software version and behavior
MP7682	Machine parameter with multiple function Format: %xxxxxxxxxxxxxxx Input: Bit 0 – Incremental block after TOOL CALL 0: With length compensation 1: Without length compensation Bit 1 – Reference value for calculating the preset during datum setting 0: Actual value is calculated 1: Nominal value is calculated Bit 2 – Traverse path of rotary axes with modulo display 0: Positioning without passing over zero 1: Positioning on the shortest path Bit 3 – Reserved, enter 0 Bit 4 – Tolerance for compensating movements with tilting axes (M114) 0: Tolerance will be included 1: Tolerance will not be included Bit 5 – Feed rate with M128 or TCPM 0: Feed rate refers to tool tip 1: Feed rate from interpolation of all axes involved Bit 6 – Behavior with TOOL DEF strobe 0: Depending on the NC program, the TOOL DEF strobe must be acknowledged by the PLC (TOOL DEF within a continuous contour) 1: TOOL DEF strobe must always be acknowledged by the PLC Bit 7 – Block elements TOOL CALL and S in ISO blocks 0: Machine as programmed 1: Machine at beginning of block (block display does not change) Bit 8 – Behavior of M8 at the end of Cycles 202 and 204 0: At the end of Cycles 202 and 204, the status of M8 is restored to that before the cycle call (behavior until now). 1: At the end of Cycles 202 and 204, the status of M8 is not restored automatically.	PLC RUN
MP7682	Bit 9 – Loading of "Tilted working plane" status 0: The "tilted working plane" status is not applied to the Manual Operation mode after a program interruption (behavior until now). 1: The "Tilted working plane" status is loaded into the Manual Operation mode after a program interruption Bit 10 – Peripheral milling active/inactive 0: Peripheral milling allowed 1: Peripheral milling inactive Bit 11 – Reserved Bit 12 – Error message "Tool radius too large" is suppressed if R2 > R 0: Error message is displayed 1: Error message is suppressed Bit 13 – No program interruption upon invalid TOOL DEF 0: Error message and NC stop upon invalid TOOL DEF 1: Only warning upon invalid TOOL DEF Bit 14 – No insertion of the tool if TIME2 has expired 0: Tool is inserted even if TIME2 has expired 1: TOOL CALL for a tool where TIME2 has expired leads to an error message and NC stop	

MP	Function and input	Software version and behavior
MP7683	Executing pallet tables and NC programs Format: %xxxxxxxxx Input: Bit 0 – No function Bit 1 – **Program Run, Full Sequence** mode 0: NC start executes a complete NC program. 1: NC start executes all NC programs up to the next pallett. Bit 2 – **Program Run, Full Sequence** mode 0: As defined in bit 1 1: All NC programs and pallets up to the end of the table are executed. Bit 3 – When the end of the table is reached, the process begins again with the first line. 0: Function is not in effect 1: Function is effective (bit 2 = 1) Bit 4 – Editing the active pallet table 0: Active pallet table cannot be edited. 1: In the **Program Run, Full Sequence** and **Program Run, Single Block** modes, the current pallet table can be edited. Bit 5 – AUTOSTART soft key 0: Do not display soft key 1: Display soft key Bit 6 – Display of pallet table and NC program 0: Both simultaneously in a split screen 1: Pallet table or NC program individually Bit 7 – AUTOSTART function 0: AUTOSTART function by NC 1: AUTOSTART function by PLC Bit 8 – Procedure for tool-oriented machining in the **Program Run** operating modes 0: NC start machines all workpieces on the pallet until the next tool change 1: NC start executes all NC programs until the end of the pallet	PLC RUN
MP7683	Executing pallet tables and NC programs Bit 9 – EDIT PALLET soft key 0: EDIT PALLET soft key is not displayed 1: EDIT PALLET soft key is displayed	PLC RUN

MP	Function and input	Software version and behavior
MP7684	Nominal position value filter (bit 0 to bit 4) and path control with M128 or TCPM (bit 5 to bit 7) Format: %xxxxxxxx Input: Bit 0 – Nominal position value filter 0: Include acceleration 1: Do not include the acceleration Bit 1 – Nominal position value filter 0: Include the jerk 1: Do not include the jerk Bit 2 – Nominal position value filter 0: Include the tolerance 1: Do not include the tolerance Bit 3 – Nominal position value filter 0: Include the radial acceleration 1: Do not include the radial acceleration Bit 4 – Nominal position value filter 0: Include jerk and tolerance limit at changes in the curvature 1: Do not include jerk and tolerance limit at changes in the curvature Bit 5 – Reserved Bit 6 – Reserved Bit 7 – Reserved Bit 8 – Reserved Bit 9 – Accelerated 5-axis machining with M128 with many rotary axis motions that are less than 2° per positioning block (not with handwheel superimpositioning with M118) 0: Inactive 1: Active Bit 10 - Modification of the calculation of the contouring feed rate at the beginning of a contour element 0: Active 1: Inactive	PLC RUN
MP7690	Evaluation of the electronic ID labels Input: %xxx Bit 0 – HEIDENHAIN power modules 0: Active 1: Inactive Bit 1 – HEIDENHAIN synchronous motors 0: Active 1: Inactive Bit 2 – HEIDENHAIN power supply units 0: Active 1: Inactive	

31.4.16 Spindle, second

MP	Function and input	Software version and behavior
MP13010 to MP13530	Machine parameter block for the second spindle Input: Function and input range are identical with MP3010 to MP3530.	

1 Annex: Principle of function of the iTNC 530 HSCI control

1.1 Introduction

This chapter gives you block diagrams and brief explanations of the principle of function of the iTNC 530 HSCI control.

Fundamental knowledge about controls, encoders, drives, electronics and mechanics simplifies error diagnosis and is often indispensible for successful servicing.

Ask your machine manufacturer for detailed or special explanations (e.g., machine functions, circuit diagram of the machine).

1.2 The control loop

Cascade control

Machine tools normally function on the principle of **cascade control**.
Here the position control loop is prior to the speed and current control loops.

Benefits of cascade control:

- Transparent structure of the individual control loops
- Disturbances can be compensated through the subsequent controllers.
  This relieves the prior controller.
- The respective outer control loop protects the inner control loop by limiting the command variable.

The position, speed and current controllers are integrated in the iTNC 530 HSCI control.
The power output stage is driven over PWM signals.
PWM is the abbreviation of pulse-width modulation. The information content in this signal is the ratio of pulse duration and pause duration.

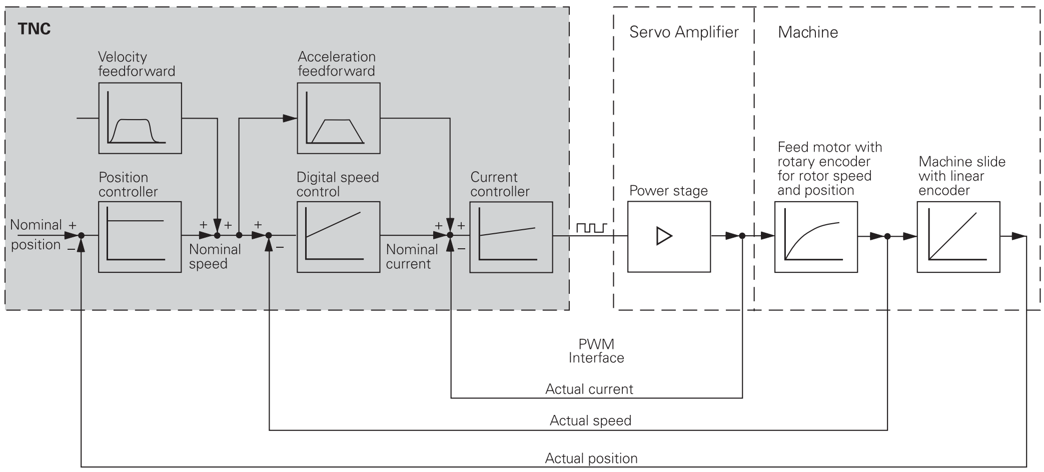


Figure: Simplified representation of cascade control for the digital control loop with a modular inverter system

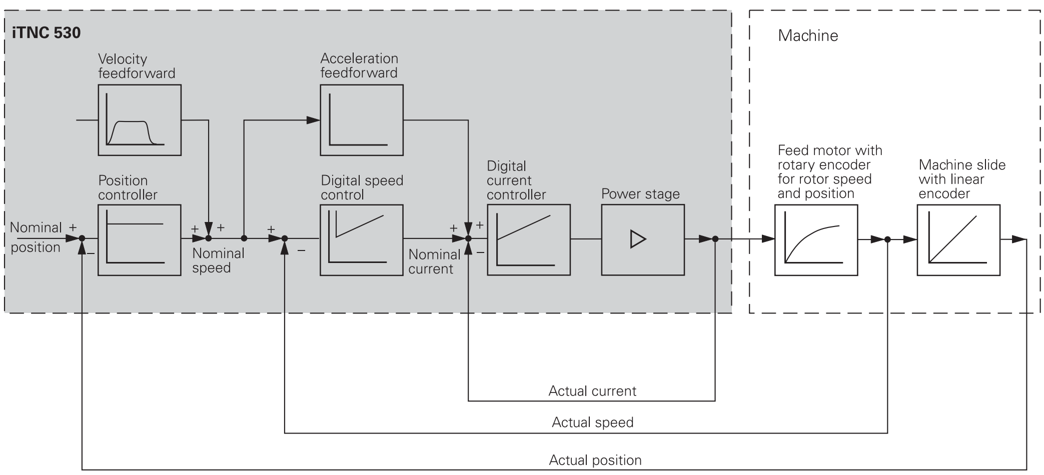


Figure: Simplified representation of cascade control for the digital control loop with a UEC 11x compact controller

Nominal and actual values for the controllers

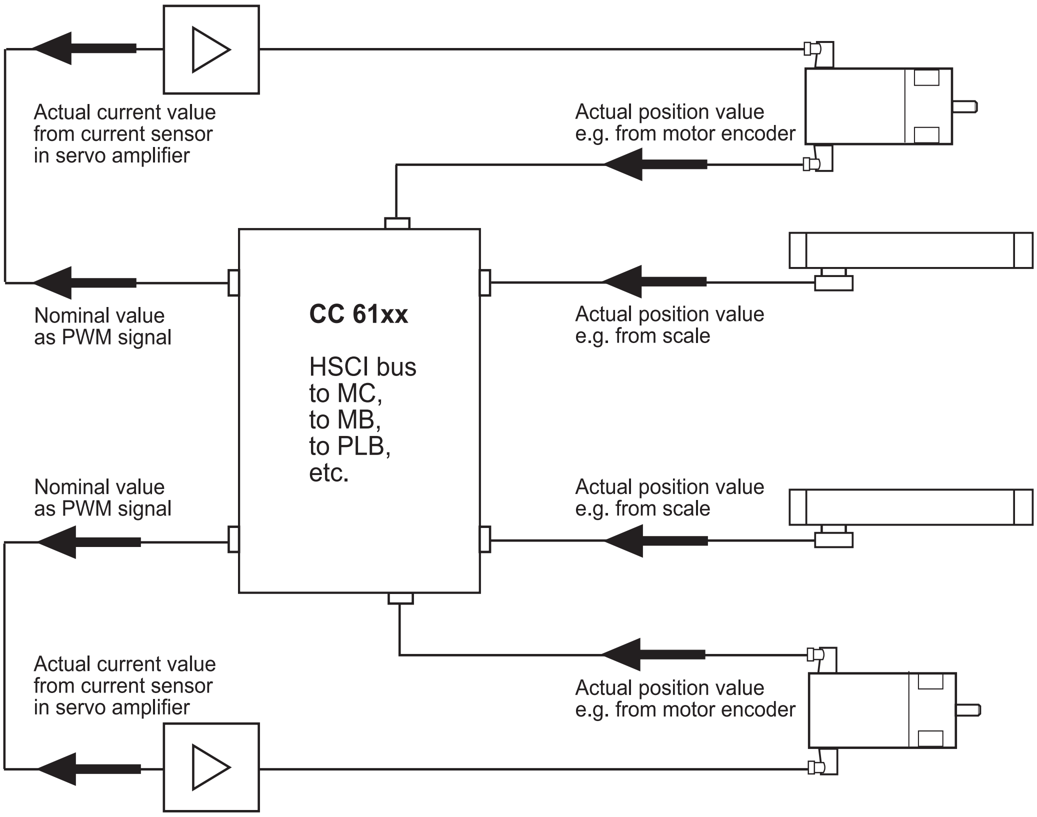


Figure: CC 61xx: Nominal values, actual values and connected devices

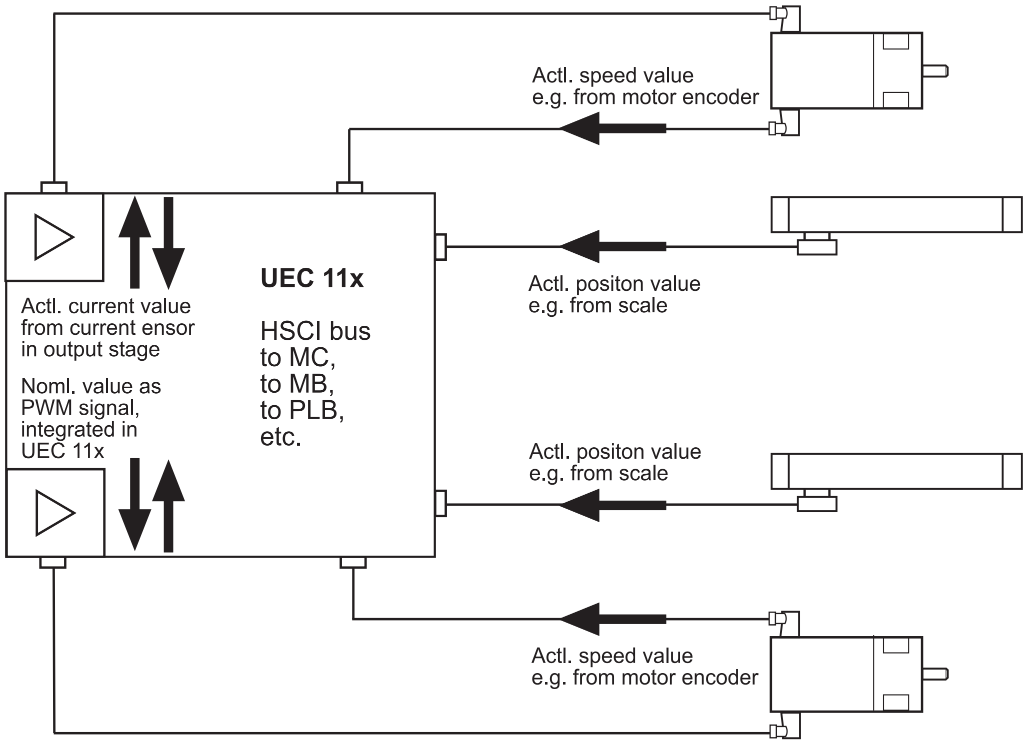


Figure: UEC 11x: Nominal values, actual values and connected devices

The **position controller** receives its nominal value, e.g., from the NC program; the actual value is normally provided by a linear encoder (scale). The actual position value can also be provided by a motor encoder instead of a scale. The position of the machine table depending on the number of counting pulses or revolutions of the motor encoder is set in the machine parameters (e.g., one revolution of the encoder changes the table position by 10 mm).

The **speed controller** receives its nominal value from the position encoder. Thus the output quantity of the position controller is the input quantity of the speed controller. This is why this interface is also referred to as "nominal speed value interface". With analog axes, the control leads the nominal speed command interface (±10 V) "to the outside" to the analog servo amplifier. With digital axes, this interface is "inside" the control.
The actual value for the speed controller is supplied by the motor encoder.

The **current controller** receives its nominal value from the speed controller. The actual value is provided by current sensors in the power module or in the output stage.

Cycle times

There is a separate time interval for each control loop:

- **Position controller cycle time**
  Time interval during which the interpolation points on the path are calculated
- **Speed controller cycle time**
  Time interval in which the actual speed value is compared to the calculated nominal speed value
- **Current controller cycle time**
  Time interval in which the actual current value is compared to the calculated nominal current value

The cycle times that apply vary depending on the control unit (CC, UEC) and on its settings.

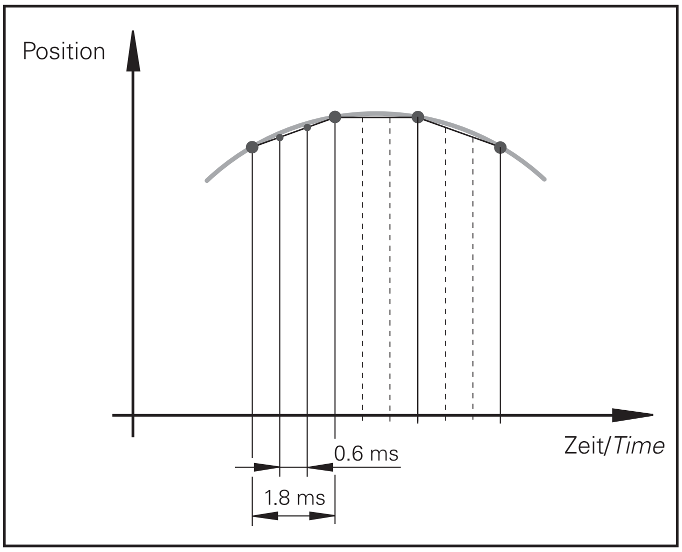


Figure: Cycle times

Look ahead

In order to adapt the feed rate to the machining process, the iTNC 530 HSCI calculates the geometry ahead of time. This way changes in directions (corners, curvatures, and changes in curvatures) are detected in time, and the participating NC axes can be braked or accelerated accordingly.

The number of NC blocks calculated ahead of time can be set by the machine manufacturer (default setting = 256 blocks).

Interpolator

The interpolator operates at a prescribed clock rate, the position controller cycle time.

The interpolator calculates a velocity from the programmed feed rate. In the CC61xx it makes this calculation every 3 ms. The value is also dependent on the acceleration curve and the end position.

If more than one axis is moved simultaneously, the path acceleration a_{path} is formed from the appropriate axis components. The same applies to rapid traverse in the path.

Position controller

With the iTNC 530 HSCI the user can choose between two types of feedback control:

- Feedback control with following error (servo lag)
- Feedback control with velocity feedforward

Machine parameter	Following error	Velocity feedforward	For the operating modes
MP1391.0	0	1	Manual and handwheel
MP1392	0	1	Positioning with Manual Data Input, Program Run Single Block, Program Run Full Sequence

> Note
>
> The machine should be adjusted for both types of control.

Position feedback control with following error

Feedback control with following error means that there is a certain lag, i.e. a distance between the nominal position commanded by the NC and the actual axis position.

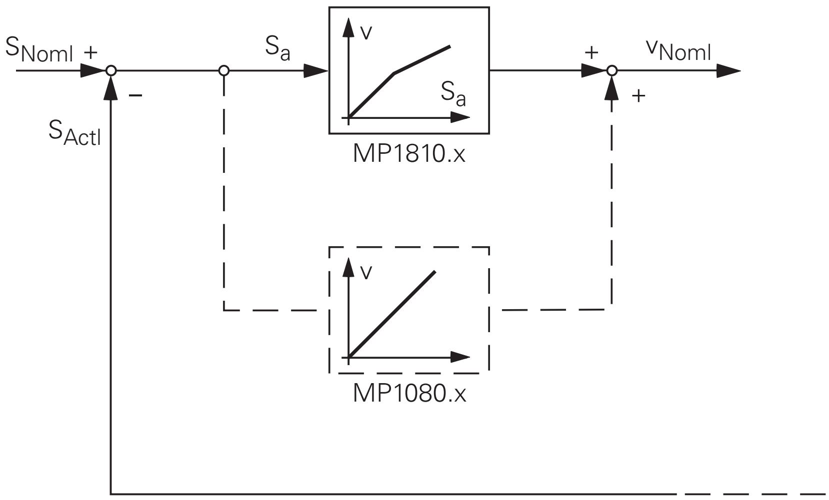


Figure: Simplified representation of feedback control with following error

> Note
>
> Analog axes (control via CMA-H): For stationary axes, the integral factor has an additional effect (MP1080.x). It produces an offset adjustment.
> Digital axes: There is no offset. MP1080.x has no function.

The nominal position value s_{noml} for a given axis is compared with the actual position value s_{actl} and the resulting difference is the following error s_a:

s_a = $s_{noml} - s_{actl}$

s_a = Following error

s_{noml} = Nominal position value

s_{actl} = Actual position value

The following error is multiplied by the k_v factor and passed on as nominal velocity value:

v_{noml} = $k_v \cdot s_a$

v_{noml} = Nominal velocity value

k_v factor for feedback control with following error

The control loop gain - the k_v factor - defines the amplification of the position control loop.

The k_v factor is defined by the machine tool builder.

For axes that are interpolated with each other, the k_v factors must be equal to prevent contour deviations.

DANGER

Control-loop parameters may only be changed by the machine manufacturer or after consultation with the machine manufacturer!
An increase of the k_v factor could lead to damage or injury to the machine or to persons!

Interrelation of k_v factor, feed rate, and following error

The following formula shows the interrelation of k_v factor, feed rate, and following error:

$$k_v = \frac{v_e}{s_a} \quad \text{or} \quad s_a = \frac{v_e}{k_v}$$

k_v	=	Loop gain (m/min)/mm]
v_e	=	Rapid traverse [m/min]
s_a	=	Following error [mm]

Position control with velocity feedforward

The nominal velocity value consists of an open-loop and a closed-loop component.

With velocity feedforward control, the machine-adjusted nominal velocity value is the open-loop controlled component. The closed-loop velocity component is calculated through the following error. The following error is small (for example, several µm).

From the value in MP1392 (for the operating modes `Positioning with manual data input`, `Programs run / single block` and `Program run full sequence`) and MP1391 (for the operating modes `Manual operation` and `El. handwheel`) you can see, whether the machine is operated with following error or velocity feedforward (for velocity feedforward control the bits are set to 1).

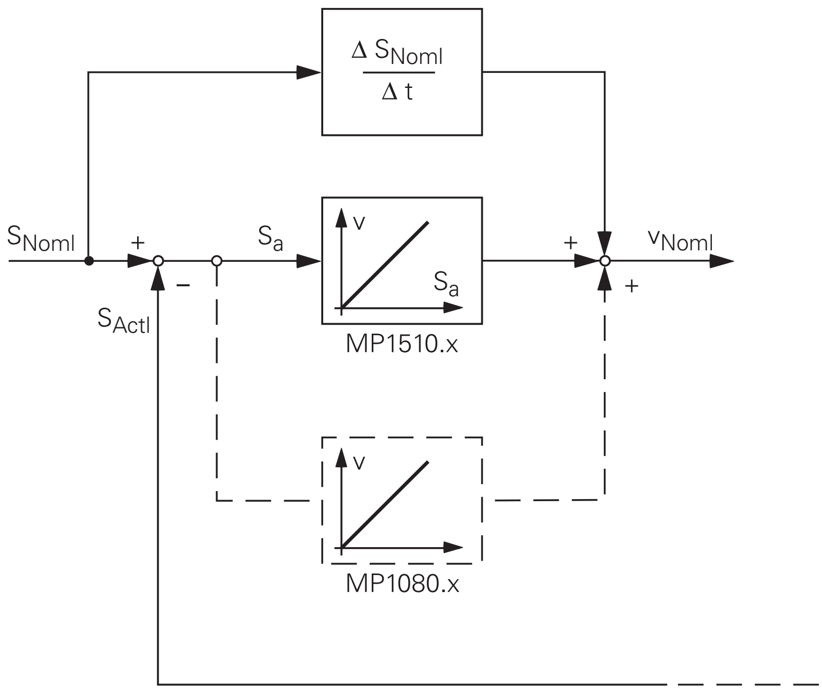


Figure: Simplified representation of velocity feedforward control

Note

Analog axes (control via CMA-H): For stationary axes, the integral factor has an additional effect (MP1080.x). It produces an offset adjustment.
Digital axes: There is no offset. MP1080.x has no function.

Unlike operation with following error, the machine manufacturer sets the optimum k_v factor for each axis for operation with interpolating axes.

Position control with velocity semifeedforward control

MP1396.x allows the operator to switch to velocity semifeedforward control.
Normally, work will be carried out using velocity feedforward. Velocity semifeedforward is activated, for example, by an OEM cycle before roughing, in order to permit a higher following error and thereby a higher velocity, combined with a lowered accuracy, in order to traverse corners.
Before finishing, another OEM cycle can be used to switch back to velocity feedforward, in order to finish with the highest accuracy possible.

In order to use velocity semifeedforward, a factor must be entered for every axis in MP1396.x, where values toward 0 control the following error more, and values toward 1 control the velocity feedforward more.

As soon as a factor between 0.001 and 0.999 has been entered in MP1396.x, the k_V factor from MP1516.x becomes effective.

Note

For axes that are interpolated with each other, the k_v factors must be equal. In this case the smaller k_v factor determines the input value for these axes.

The values for position monitoring are interpolated according to the factor in MP1396.x between the values for servo lag (MP1710.x, MP1720.x) and the values for velocity feedforward control (MP1410.x, MP1420.x).

Feedback control with following error (servo lag)	Feedback control with velocity semifeedforward	Feedback control with velocity feedforward
MP1391 bit x = 0 MP1392 bit x = 0 MP1396.x = nonfunctional	MP1391 bit x = 1 MP1392 bit x = 1 MP1396.x = 0.001 ⟷ MP1396.x = 0.999	MP1391 bit x = 1 MP1392 bit x = 1 MP1396.x = 1

Speed controller

Up to 20 digital speed controllers for the axes and spindles are integrated in the iTNC 530 HSCI.

The actual speed values are measured directly at the motors with HEIDENHAIN rotary encoders. The position controller provides the nominal speed value. The speed controller is driven by the difference between nominal and actual speed values. It provides the nominal current value as output.

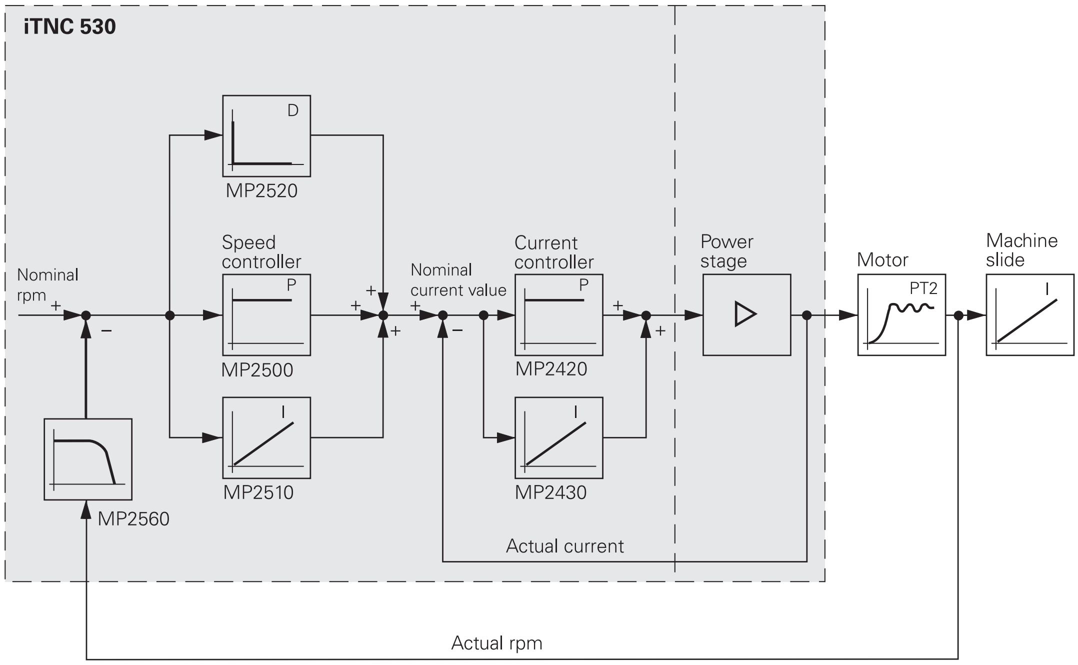


Figure: Simplified representation of the speed controller

Current controller

Up to 20 digital current controllers for the axes and spindles are integrated in the iTNC 530 HSCI.

The nominal values for magnetizing current I_{dnom} and torque current I_{qnom} are divided into the PWM signals U_1, U_2 and U_3 through a PI controller and vector rotator VD+, and are transferred to the power module through X51 to X60.

Principle of PWM signal generation

The actual current values I_{1act} and I_{2act} are determined by the power module and are transferred to vector rotator VD– through X51 to X60. The vector rotator determines the actual values of magnetizing current I_{dActl} and torque current I_{qActl}.

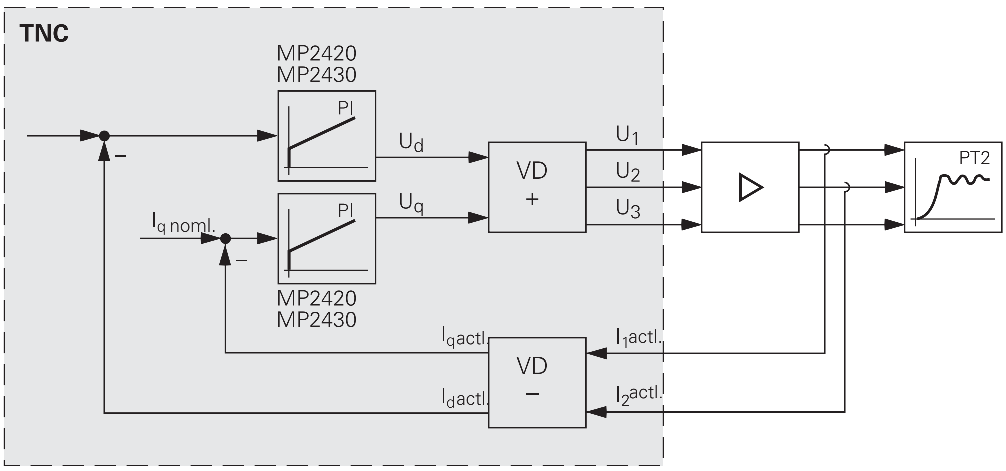


Figure: Simplified representation of the current controller

Double-speed control loops

Double speed control loops operate with shorter controller cycle times.
This makes higher control performance possible, e.g., for high frequency spindles, linear and torque motors.

1.3 The HSCI bus

Connection of HEIDENHAIN components

The main computer (MC 62xx), the controller unit (CC 61xx, UEC 11x) and other control components (PLB 6xxx, MB 620) are connected to each other via the HSCI, the **H**EIDENHAIN **S**erial **C**ontroller **I**nterface.

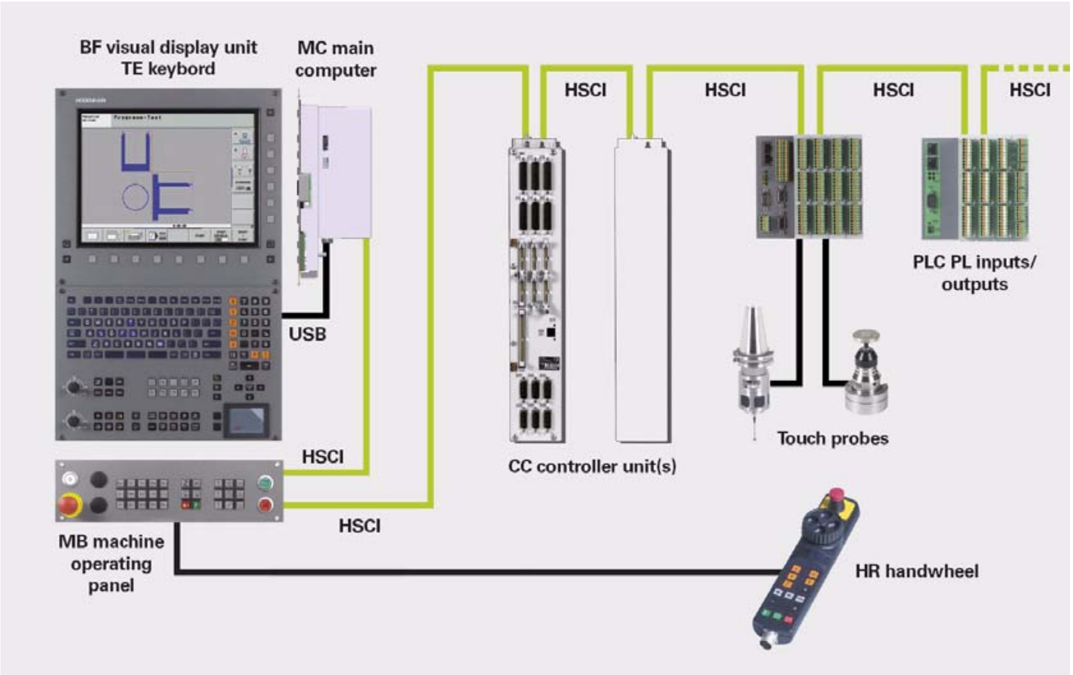


Figure: Example of HSCI connections

The HSCI components are connected via special shielded HSCI cables adapted for the increased demands of machine tool environments.
Terminating resistors are not required in the HSCI system.

Attention

The HSCI connecting cable may only be installed in a protected manner (e.g. within the electrical cabinet, cable ducts).

HSCI inputs and outputs

The HSCI slaves are connected in series to connector X500 of the MC 62xx main computer. Connector X502 is always the HSCI input to the HSCI slaves and X500 the HSCI output to the next HSCI slave.

HSCI output	HSCI input
X 500 The MC 62xx also features a second, non-synchronized output to which, e.g., the MB 620 may be connected.	X 502

Note

The last HSCI participant in the line detects its position automatically (X500 remains open) and internally and independently closes the HSCI network.

Maximum number of devices

The following table shows the maximum permissible number of individual HSCI participants for the iTNC 530 HSCI:

<table>
<tr><th>HSCI component</th><th colspan="2">Maximum quantity in the system</th></tr>
<tr><td>MC (HSCI master)</td><td colspan="2">1 in the system</td></tr>
<tr><td>CC, UEC, UMC (HSCI slave)</td><td colspan="2">4 controller motherboards
(distributed to CC, UEC, UMC as desired)</td></tr>
<tr><td>MB 6xx (FS), PLB 6001 (FS) (HSCI slave)</td><td>2 in the system</td><td rowspan="3">Total number of 9 components must not be exceeded here.</td></tr>
<tr><td>PLB 62xx (FS) (HSCI slave)</td><td>1 in the system
(not with UEC 11x)</td></tr>
<tr><td>PLB 61xx (FS), PLB 62xx (FS) (HSCI slave)</td><td>7 in the system</td></tr>
<tr><td>HR handwheel (FS) (at MB 6xx or PLB 6001)</td><td colspan="2">1 in the system</td></tr>
<tr><td>PLD-H xx-xx FS (in PLB 6xxx FS)</td><td colspan="2">8 in the system</td></tr>
<tr><td>PLD-H xx-xx (in PLB 6xxx (FS))</td><td colspan="2">64 in the system</td></tr>
</table>

DANGER

If you use more than one operating station or machine operating panel, the PLC program must ensure that only one of the operating devices is active at any one time so as to avoid danger to the operator.

Some features

The following features characterize the HSCI connection:

- Based on standard 100BaseT Ethernet hardware
- Linear structure ("open ring"; closed ring or star configuration are not possible)
- Only one master in the system (MC), all other devices are HSCI slaves

Benefits

The HSCI connection has several benefits:

- Hardware platform for flexible and scalable control system (e.g. local axis systems)
- High noise immunity due to digital communication between components
- Greater permissible cable lengths of the complete system
- More PLC inputs and outputs
- Simple wiring
- Comprehensive yet straightforward possibilities for diagnostics

Address assignment

Different addresses are assigned to the individual participants in the HSCI network. The addresses are assigned dynamically during booting of the MC. The addresses of the participants are formed from an HSCI address (8 bits) and a device type address (6 bits).

The following applies to the assignment of the HSCI address:

- The master (MC) always has the HSCI address 0.
- The HSCI addresses of the slaves result from their position in the bus:
  - First device after the master (MC): Bus address 1
  - Second device after the master (MC): Bus address 2
  - etc.

The device-type address is for internally distinguishing between connected HSCI participants.
Each device type (MC, CC, PL, MB, etc.) is assigned a type specification that is used to address all HSCI participants of this type.

Particularity of the HSCI addresses for the controller basic boards:

In the machine parameters MP108.x (axes) and MP109.x (spindles) the numbers (HSCI addresses) of the controller basic boards are entered. These numbers result from the position of the controller basic boards in the HSCI system.

However, the HSCI address to be entered only depends on the controller basic boards in the system. PLs and MBs are not taken into account.
This means that for the first controller basic board, you have to enter the address 0 in MP108/MP109, regardless of whether I/O units or machine operating panels are located before the CC in the HSCI chain.

Comparison of nominal and actual configuration

The nominal configuration defined by the machine tool builder is saved in an IOC file on the data medium of the control. This nominal configuration contains the assignment of the device-type address and serial number of the device to the individual HSCI addresses. The momentary configuration is ascertained during startup of the system by requesting the serial numbers.
The momentary configuration is compared with the nominal configuration. If there is a deviation, the machine operator is prompted to check the configuration.

+24 V-NC power supply ... 244
+24 V-PLC power supply ... 244

A

Actual values ... 642
Adjustment, scanning head ... 552
Adjustment, synchronous motor ... 310
Ambient temperature ... 74
Analog input ... 144
Analog interface ... 349
Analog output ... 146
Analog speed value interface, inspection ... 352
Asynchronous motor ... 327
ATS software ... 568, 569
Axis clamped symbol ... 225, 352
Axis limit switches ... 225

B

Backup ... 181, 202
Backup archive ... 204
Backup type ... 204
Basic circuit diagram ... 229
Battery ... 261, 416, 417
Battery box ... 354
Battery, touch probe ... 416, 417, 425
Battery-buffered memory ... 134, 257
Baud rate ... 192, 213
BINARY-to-ASCII conversion ... 182
Buffer battery ... 257
Bus diagnosis ... 147

C

Cables ... 72, 552
Calibration data ... 204
Cascade control ... 641
CC, exchange ... 550
CE Key ... 26
Circular interpolation test ... 109
Clear error message ... 26
Code number window ... 18
Code Numbers ... 17
Compensation values ... 111
Connection Setup ... 183
Connector designation ... 453
Connectors ... 72
Contamination ... 73
Control in operation ... 225, 352
Control is ready ... 225, 228, 240
Control loop ... 58, 227, 641
Control-in-operation ... 83, 225, 352
Control-is-ready acknowledgement ... 226, 240
Control-is-ready, bridge ... 232
Controller unit ... 438
Controller unit with integrated inverter ... 439
Counting direction, position encoder signals ... 317
current ... 327
Current controller ... 227, 327, 349, 643, 647
Current-controller software ... 452
Cycle time ... 330, 643

D

Data interface ... 181, 213
Data medium ... 167
Data transfer software ... 182, 189
Date ... 204, 208
Datum ... 323
DC motors ... 349
Default setting of the machine parameters ... 519
Deselect handwheel ... 412
Deselect referencing ... 326
Deselecting the touch probe ... 433
Diagnostic functions ... 55
Digital interface ... 327
Direct position measurement ... 69
Display, ACTL ... 296, 321, 352
Display, LAG ... 321, 356, 358
Display, NOML. ... 321, 352
Display, REF ... 295, 321
Double-speed control loop ... 330, 647
Drift adjustment ... 355
Drive enable, axis-specific ... 226
Drive enabling, axis groups ... 232
Drive Symbols ... 214
DriveDiag ... 91
DriveDiag, EnDat position encoder ... 289
DriveDiag, EnDat speed encoder ... 306
DriveDiag, position encoder test ... 289
DriveDiag, power module ... 233
DriveDiag, power supply unit ... 233
DriveDiag, touch probe ... 425, 429
Drives ... 327
Drives ready for operation ... 226
DSP software ... 452
Dual-window concept ... 197
Dummy plug for the handwheel adapter ... 412

E

Electrical errors ... 56
Electronic ID label ... 301, 310, 518
Emergency stop button ... 225, 393, 401, 412, 572
Emergency stop defective, error message ... 230
EMERGENCY STOP test ... 240
EMERGENCY-STOP chain ... 225, 228, 240
Enables ... 225
EnDat encoder, error code ... 313
EnDat encoder, memory area ... 279, 301, 310
EnDat encoders ... 279, 301
EnDat, position encoder ... 289
ERR Key ... 25
Error diagnosis in the field ... 55
Error diagnosis, comparison ... 71
Error diagnosis, electrical errors ... 56
Error diagnosis, process of exclusion ... 63
Error diagnosis, process of interchange ... 61
Error finding, first steps ... 71
Error messages ... 21
Errors ... 51
ES.A ... 240
ES.B ... 240
ESD protection ... 520
Ethernet ... 181, 183, 209
Ethernet cable, crossed ... 209
Exchange of HEIDENHAIN components ... 515
Expansion PL ... 440
Export restrictions ... 220, 516
External access ... 182, 189, 194
Extracting files ... 206

F

F override ... 376, 407
Feature Content Level ... 518
Feature content level ... 452

Feed rate ... 645
Feed rate display ... 225, 352
Females ... 72
Field angle ... 294
Field orientation ... 552
Field-angle determination ... 552
File information ... 176, 179
File management ... 167, 175, 177
File type ... 176, 178
Finding errors in the control loop ... 58
Firmware update ... 524
Following error ... 317, 644
Friction, sliding ... 109
Functional principle, control loop ... 641
Functional principle, HSCI bus ... 648
Fuses in the PSL 130 ... 249
Fuses in the PSL 135 ... 254

G

Gantry axes ... 297, 318
Gold cap ... 257, 261
Ground fault ... 56
Grounding ... 72, 552

H

Handwheel ... 401, 445
Handwheel signals ... 401
Handwheel, cable adapter ... 401
Handwheel, supply and evaluation ... 393
Handwheel, threshold sensitivity ... 402
Hardware/firmware change detected ... 396, 523, 526
HDL display interface ... 362
HDR, replacement ... 543
HEIDENHAIN components ... 435
HEIDENHAIN expansion boards, compatibility ... 558
HEIDENHAIN interface boards, exchange ... 553
HELP Key ... 24
Help menu ... 210
Help texts ... 24
HSCI adapter ... 394, 444
HSCI Bus ... 648
HSCI bus diagnosis ... 397, 399
HSCI connections ... 648
HSCI system, power supply ... 243
HSCI, address assignment ... 649
Humidity ... 74
HWSDialog ... 527, 529

I

I/O modules ... 440
I/O-FORCE LIST ... 131
ID ... 522
ID label ... 436
ID number ... 522
If ... 187
IK 215 ... 316, 568
IK 215 Adjusting and Testing Package ... 568
Index y of the MP 2xxx.y group ... 330
Indirect position measurement ... 70
Industrial PC ... 448
Information menu ... 261
Infrared transmission ... 419
Input frequency ... 280
Inspection Equipment ... 559
Instructions, machine manufacturer ... 294, 295, 311, 312, 355, 358, 434
Interchange method, HEIDENHAIN expansion boards ... 347
Interchange method, power stages and output stages ... 343
Interface boards ... 347, 450
Interpolator ... 643
Inverter system ... 12, 226, 327, 450
Inverter system, readiness ... 233
IP address ... 183

K

Key code ... 370
Key element ... 374
Key matrix ... 374, 382, 392
Key signal ... 366, 370, 397
Key, checking ... 370, 397, 406
Key, corrective action ... 381, 400, 414
Keyboard ... 365, 443
Kinematics ... 85
kv factor ... 645

L

LED (PULSE RELEASE) SPINDLE / AXES, inverter system ... 234
LED ON, PSL 130 ... 247
LED ON, PSL 135 ... 250
LED READY, inverter system ... 234
LED SH 1 / STO A, inverter system ... 236
LED SH 2 / STO B, inverter system ... 236
LED U DC-LINK ON, inverter system ... 234
LED, CC 61xx ... 262
LED, Ethernet data interface ... 191
LED, inverter system ... 226
LED, MC 62xx ... 255
LED, PLB 62xx ... 272
LED, PLD-H ... 120, 123, 276
LED, touch probe ... 419, 422, 423, 427, 431
LED, UEC 11x ... 267
LIES_MP.A ... 579
Line count, motor encoder ... 318
Linear motor ... 294, 327
Lissajous figure ... 291
List of error messages ... 27
Log ... 79
LOGIC diagram ... 124
Logic diagram recording, MB keys ... 398
Look ahead ... 643

M

Machine data ... 181
Machine datum ... 295, 311, 312, 323
Machine Operating Panel ... 393, 444
Machine parameter editor ... 572
Machine parameter list ... 580
Machine parameters ... 571
Main computer ... 436
Master-slave torque control ... 318
MC 6222, exchange ... 531
MC 6241, exchange ... 534
MC.RDY ... 240
Measuring Equipment ... 559
Measuring system ... 60, 450, 552
Message from hardware server ... 526, 529
Metallic isolation ... 347, 553, 554
Monitoring functions ... 279
Motor ... 12

Motor brake ... 344
Motor encoder ... 300
Motor encoder, asynchronous motor ... 310
Motor encoder, synchronous motor ... 310
Motor outputs ... 328
Motor table ... 318, 336
Motors ... 450
Mounting aids ... 552
Mounting information ... 552
Mounting instructions ... 552
MP subfiles ... 572
MPNAME.MP ... 519
Multiturn EnDat encoder ... 204

N

NC error messages ... 21
NC software ... 215, 451
NC software update ... 516
NC software version ... 215
Nominal speed value, algebraic sign ... 317
Nominal values ... 642
Non-Volatile PLC Markers and Words ... 134, 257
Non-volatile PLC markers and words ... 116
Notes for the field service ... 71

O

OEM.SYS ... 117, 177, 571
OEM.SYS system file ... 117, 177, 571
Offset adjustment ... 355
Operand, absolute ... 129
Operand, symbolic ... 128
Operands ... 143
Operating hours ... 204
Operating-system error messages ... 21
Opto bridge ... 192, 210, 211
Original HEIDENHAIN components ... 515
Original parts ... 11
Oscilloscope ... 95
Oscilloscope recording, circular interpolation test ... 110
Oscilloscope recording, essential values ... 65
Oscilloscope recording, key code ... 371
Oscilloscope recording, motor encoder signals ... 307
Oscilloscope recording, position difference ... 67
Oscilloscope recording, position encoder signals ... 290
Oscilloscope recording, potentiometer values ... 377
Oscilloscope recording, speed adjustment ... 359
Oscilloscope recording, triggering on error marker ... 107
Oscilloscope recording, U analog ... 352
Overview of components ... 435

P

Packaging ... 522, 552
Partition ... 168
Password ... 204, 208
Peer-to-peer ... 183, 209
Pin layout ... 453
Pinging ... 190
PLC cycle time ... 116
PLC diagnosis ... 115
PLC error markers ... 140
PLC error messages ... 21
PLC input ... 144, 393
PLC input, check ... 120, 411
PLC input, error localization ... 122
PLC main page ... 116
PLC marker ... 136, 238, 406
PLC mode ... 115
PLC modules ... 238
PLC output ... 145, 393
PLC output, check ... 123
PLC partition ... 116, 168, 177
PLC software ... 452
PLC TABLE ... 376
PLC utilization ... 116
PLC word ... 141, 238
PLC, supply voltage ... 274
Polyfuses ... 72, 277, 300, 396, 402, 405, 410, 413
Position controller ... 327, 349, 643, 644
Position differences of direct and indirect encoder ... 67
Position display ... 225, 321, 352
Position encoder datum ... 295
Position encoder inputs ... 277
Position encoder, replacement ... 293
Position encoders ... 277
Position encoders, monitoring ... 279
Position measurement via motor encoder ... 317
Potentiometers ... 366, 376, 393, 407
Power distribution switches ... 361, 366
Power module ... 331
Power modules, reading out data ... 338
Power off and on ... 55
Power supply ... 243
Power supply module ... 331
Power supply unit ... 442
Preventive maintenance ... 314
Principle of function, control ... 641
Procedures for error diagnosis in the field ... 55
Process of exclusion ... 63
Process of interchange ... 61
Process of interchange, motor outputs ... 341
Process of interchange, position encoders ... 281
Process of interchange, PWM outputs ... 341
Process of interchange, speed encoders ... 304
PROFIBUS diagnosis ... 162
Program manager ... 174
PSL13x low-voltage power supply unit ... 246, 250, 442
PWM ... 569
PWM 20 ... 316, 569
PWM 20 encoder diagnostic kit ... 569
PWM 9 ... 314, 564
PWM 9 Encoder Diagnostic Kit ... 564
PWM frequency ... 330
PWM interface ... 327
PWT ... 315, 566
PWT 10/17/18 test unit ... 566

R

RAM ... 135
READ_MP.A ... 579
Readjustment of the control loops ... 552
Ready signal ... 227
Recording of logic diagram, touch probe ... 426, 430
Reference ... 295
Reference end position, trigger signal ... 311
Reference mark ... 323, 324
Reference pulse ... 311
Reference run ... 323
Relay external DC voltage missing ... 228
Release conditions ... 352
Repair ... 522
Replacement of electrical components, prescribed

inspections ... 522
Replacement units ... 522
Replacing instructions ... 552
Restore ... 207
Restoring ... 207
ReturnLine (RL) ... 366
RJ45 ... 209
RS-232-C ... 181, 192, 210

S

S override ... 376, 407
Safety Precautions ... 15
Scale reference point ... 323
ScanLine (SL) ... 366
Screen ... 361, 443
Screen soft keys ... 363, 366
Screen switchover key ... 92
Serial interface ... 192
Serial number ... 522
Service files ... 75
Service pack ... 215, 219
Servo amplifier, analog ... 349
Servo amplifier, digital ... 327
Servo, analog ... 349
Shielding ... 72, 552
Shipping brace of the hard disk ... 74
Shipping brace, HDR ... 545
Short circuit ... 56
Signal type ... 280
SIK component ... 438, 517
Single-speed control loop ... 330
Soft-key row, screen ... 374
Software limit switches ... 323
Sources of interference ... 73
Spare parts ... 522
Specify error ... 522
Speed adjustment ... 358
Speed controller ... 227, 327, 349, 643, 647
Speed encoders ... 300
Speed value interface, analog ... 349
SPI expansion module ... 441
Spindle orientation ... 299, 312
Spindle preset ... 299, 312, 323
SSDR, exchange ... 537
Stiction ... 109
STO.A.G ... 240
Storage medium ... 437
Stylus already in contact ... 429, 430
Subnet mask ... 183
Successor models ... 552
Supply module table ... 332
Supply voltage, 5 V ... 261
Support for error diagnosis ... 12
Surface temperature ... 74
Switching from direct to indirect position measurement ... 69
Synchronous motor ... 327
Synchronous spindle ... 294
SYS partition ... 168
system ... 173
System information ... 451
System PL ... 439
System time ... 173, 208

T

TABLE function ... 119
Table of power stages ... 334
Tachometer adjustment ... 358
TCP/IP protocol ... 186
Temperature ... 74
Temperature sensor lines ... 301
Temperature, CPU ... 261
Temperature, MC ... 261
Terminals ... 72
Test adapter ... 560
Test of the data medium ... 169, 215
Testing equipment ... 559
the motor ... 331
Thermistor ... 144
Three-phase ac motors ... 327
Tips for error diagnosis in the field ... 55, 71
TNC partition ... 168, 175
TNCremoNT ... 165, 182, 189
TNCremoPlus ... 363
Torque motor ... 294, 327
Touch probe ... 415, 446
Touch probe signals ... 419
Touch probe, ready ... 425, 429
Touch probe, Ready bridge ... 424, 427, 431
Touch probe, Ready signal ... 431
Touch probe, trigger signal ... 425, 429
Touchpad ... 380
Touchpad signals ... 366
TRACE function ... 127
Traceability ... 522
Traffic light symbols ... 91
Traverse range ... 323
Trigger signal, reference end position ... 325
Trip dog, reference end position ... 311, 325

U

UEC, exchange ... 551
UPDATE DATA ... 216
USB interface ... 181, 195, 366
User parameters ... 572

V

Velocity feedforward control ... 645
Velocity semifeedforward control ... 646
Visual inspection ... 71
Visual inspection, handwheel ... 404, 409, 413
Visual inspection, key ... 370, 397
Visual inspection, touch probe ... 422, 427, 431

W

WATCH LIST function ... 128
Windows ... 11
Windows authorization ... 187
Windows knowledge ... 181

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