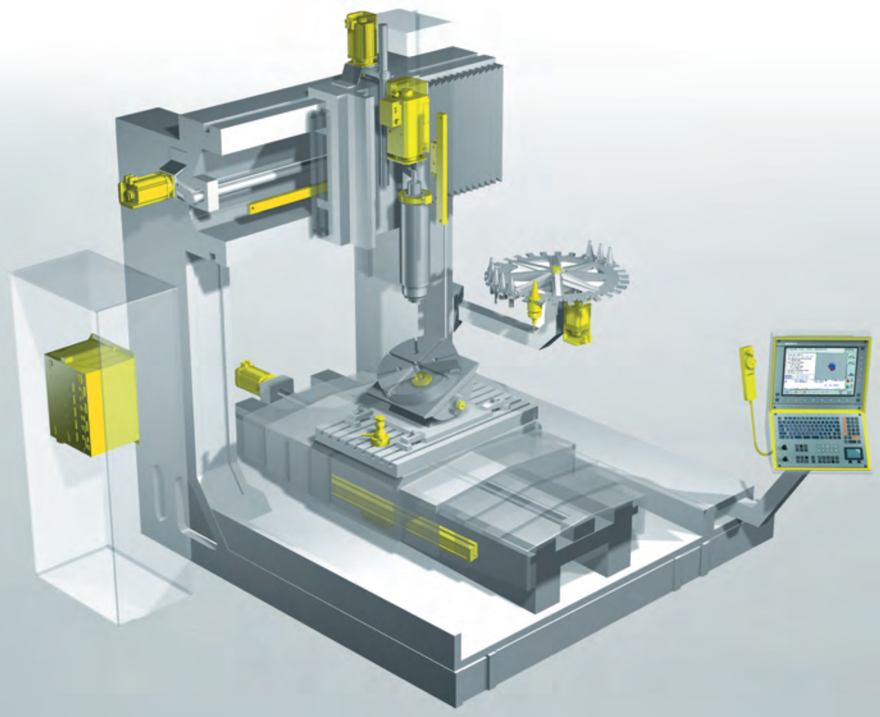
HEIDENHAIN



Service Manual

iTNC 530

July 2010

1 How to Use this 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

This Service Manual assists **service personnel** in the field in **diagnosing and correcting errors** on **machine tools controlled by iTNC 530.**

It includes:

- **Error messages and types of errors that indicate technical defects**
- **Information on possible error causes**
- **Descriptions of 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 – 29 and the "Overview of Possible Error Patterns" on page 5 – 55 include many references to the descriptions for error diagnosis. You will find these descriptions in the chapters of this Service Manual sorted by topics.

The Service Manual does not provide any commissioning support!

It comprises the service possibilities with the current hardware and software at the editing date of this manual. The service possibilities of your devices may differ from those described here. The descriptions also provide information on any peculiarities of the hardware or software.

This manual is valid for:

- iTNC 530, single-processor with NC software 340420 / 421
- iTNC 530, single-processor with NC software 340422 / 423
- iTNC 530, dual-processor with NC software 340480 / 481
- iTNC 530, single-processor with NC software 340490 / 491
- iTNC 530, dual-processor with NC software 340492 / 493

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

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

☞ **Note**

Basic knowledge in Windows is required for some descriptions in this Service Manual concerning the handling of the dual-processor control iTNC 530 and the use of a service laptop or PC.

Udpate service

This Service Manual is updated at irregular intervals.
You find the current printable version on our website -->
http://www.heidenhain.de/ ... /SHB iTNC 530

If you take part in a service training, you receive also a paper version of the Service Manual.

1.3 Other Service Manuals

- Service Manual for Inverter Systems and Motors

1.4 Other Documentation

For more 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
- HEIDENHAIN TNCguide on DVD
- Mounting instructions by HEIDENHAIN
- Brochures of the respective HEIDENHAIN products
- PWM 9 User's Manual
- PWT Operating Instructions
- IK 215 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

Caution

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 Seminars for iTNC 530 for the technician who works 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 Seminars 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.

Caution

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 chapter 2 before you start servicing!
See “Safety Precautions” on page 2 – 15.

2 Safety Precautions

2.1 Overview

Ground

> **DANGER**
>
> Ensure that the equipment grounding conductor is continuous!
> Interruptions in the equipment grounding conductor may cause damage to persons or property.

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.
>
> Improper use can result in serious injury to persons and damage to equipment.

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

> **Caution**
>
> 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 prevent-ion 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** dc voltage mean value 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 the machine manufacturer or after consulting 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

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

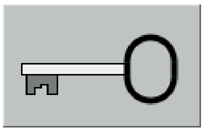
3 Code Numbers

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	Delete the code numbers entered so far –> Code-number softkeys, such as MP EDIT or PLC EDIT are deleted.	In this chapter
123	Edit subset of machine parameters for the machine operator	See page 30 - 571
75368	Offset adjustment for analog axes	See page 20 – 349
79513	Info menu (U[BATT], U[ACCU], U[VCC], TEMP, T[CPU1]),	See page 17 – 267
95148	Call the active machine parameter list	See page 30 – 572
531210	Reset non-volatile PLC markers and PLC words in the RAM	See page 11 – 133
688379	Integrated oscilloscope	See page 10 – 99
807667	Call the PLC area	See page 11 – 115
857282	Reset the operating times	-
LOGBOOK	Call and save the internal log of the TNC	See page 8 – 81
NET123	Network settings for the single-processor control	See page 13 – 172
SETUP	Call for loading of service packs and NC software for the single-processor control	See page 15 – 219
SIK	Display of the number of the system identification key and of the enabled options	See page 28 – 525
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

The machine manufacturer can define 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 manufacturer!

3.3 Input of Code Numbers

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

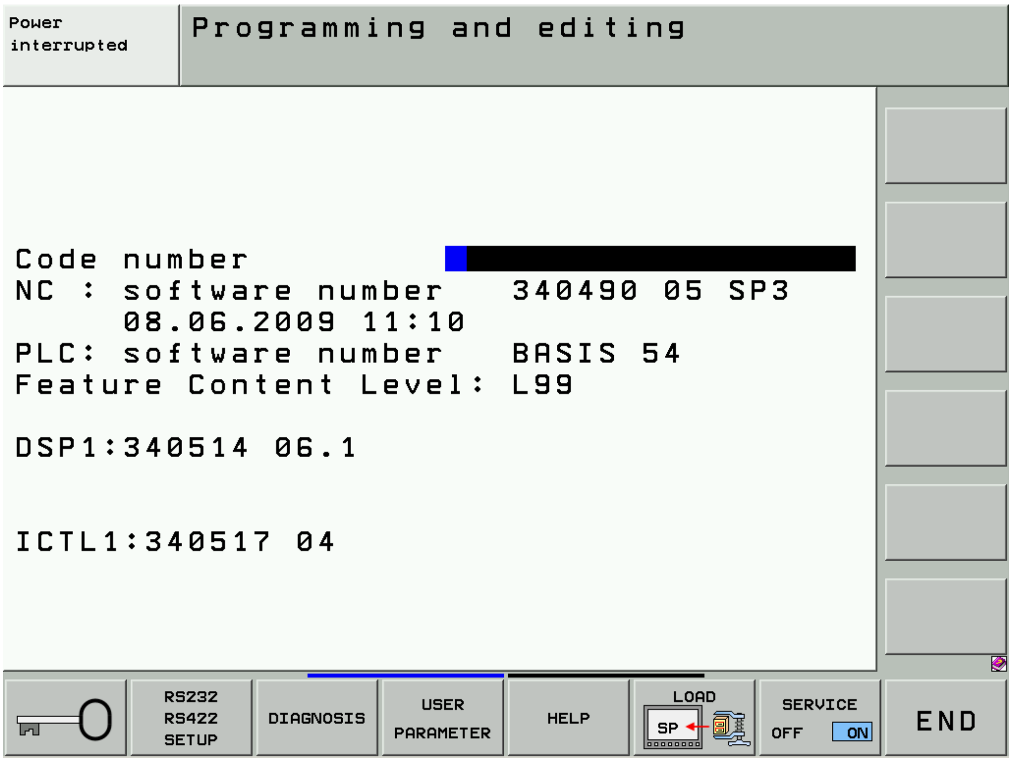
▶ If open: Close the program management by pressing the END button.

Note

Pressing the MOD key while the program manager is open calls the interface settings.

MOD

▶ Call the code number window.



9 5 1 4 8 ENT

▶ Enter the code number and press ENT to confirm.

Note

When certain code numbers are entered, **new soft keys** are displayed, MP 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 notes

- As long as the **machine parameter list is in the editor, no further code number** can be entered. First close the MP editor if you want to enter a new code number
- After you have entered the **code number for the machine parameters** the **PLC tree** can be seen in the program manager.
  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, the soft key MP EDIT needs to be pressed first**.

4 Error Messages

4.1 Introduction

iTNC 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.

The effect of the monitoring functions is described in the annex – .> See “Annex: Monitoring Functions” on page 3 – 661.

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?**

Display	PLC error message	NC error message
ERR window in the column **"Group"**. Call –> See “ERR Key” on page 4 – 26.	**PLC**	**GENERAL** or **OPERATION** or **PROGRAMMING**
Log Call –> See “Log” on page 8 – 81.	**P-** (number and text of error message)	**N-** (number and text of error message)

Note

There are no error numbers 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 the 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).

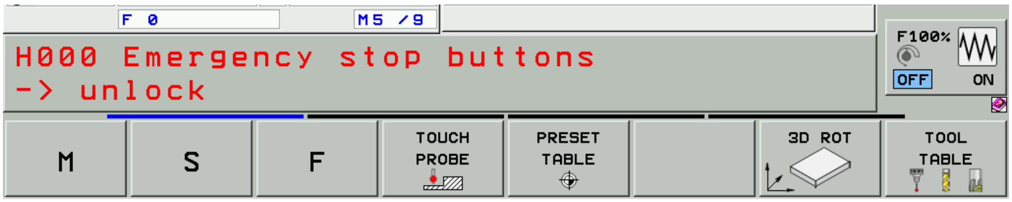


Figure: Additional information in the small PLC window

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

- are displayed **in a red or gray window** (depending on the NC software version) in the center of the screen.
- are made known through a plain-language message.

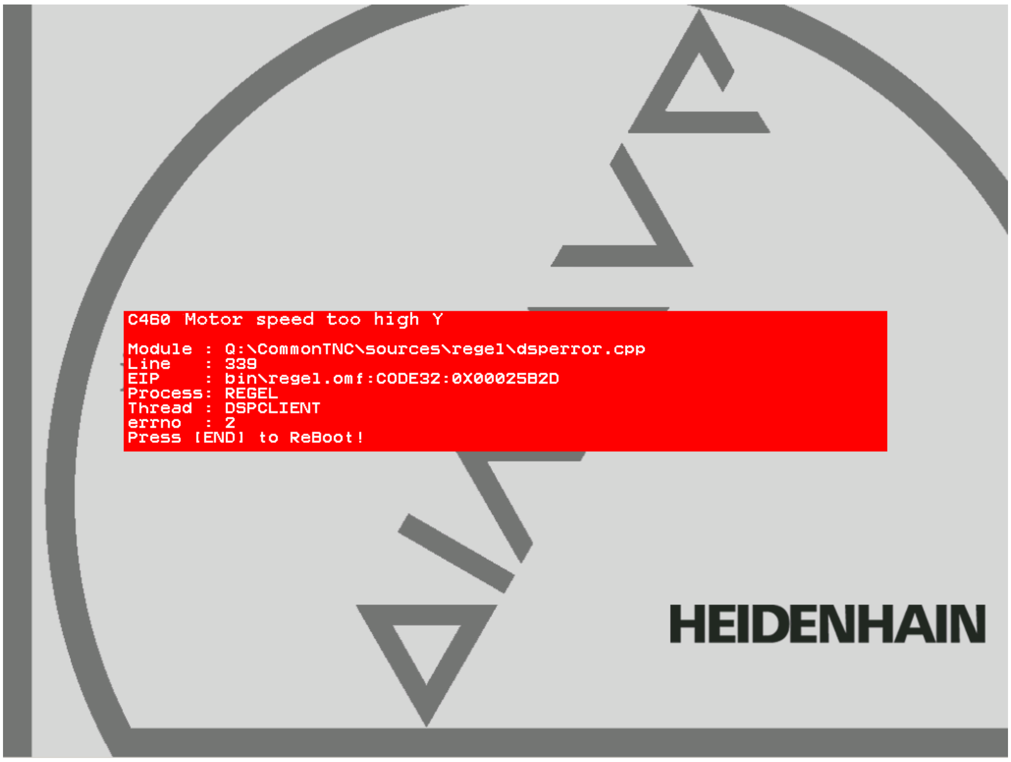


Figure: Red error window

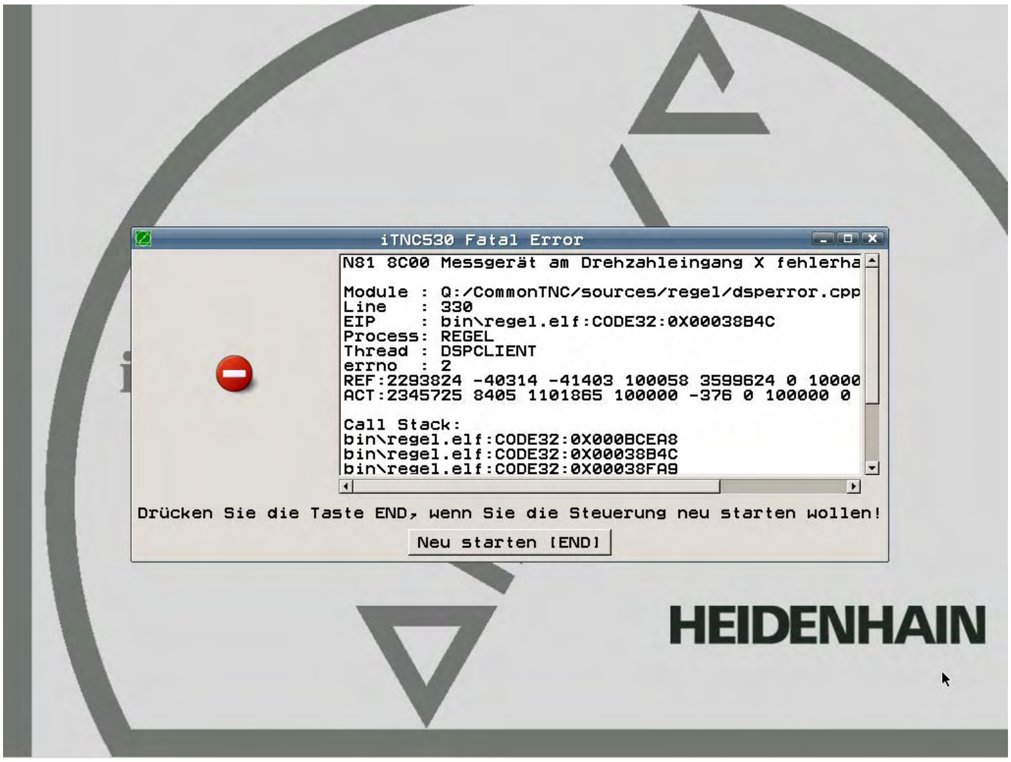


Figure: Gray error window

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.
  The contour of the workpiece is usually not damaged.
- Once the error message is acknowledged, the machine continues to operate at the set feed rate.

Program cancellation

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

NC stop

- The running NC progam is stopped. The star **"*" (STIB)** flashes.
- The axes are braked at the nominal-value characteristic.
  The contour of the workpiece is usually not damaged.
- After the error message was acknowledged, the NC program can be restarted at the position where it was interrupted (NC-START key).

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

As of NC software version 340 49x-04:

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

See “Creating and Downloading of Service Files” on page 7 – 77.

4.2 HELP Key

HELP

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

If the service technician presses the HELP key a window is shown that describes **the cause of error and possibilities of corrective action** in addition to the displayed error message. This support can also be realized for PLC error messages by the machine manufacturer!

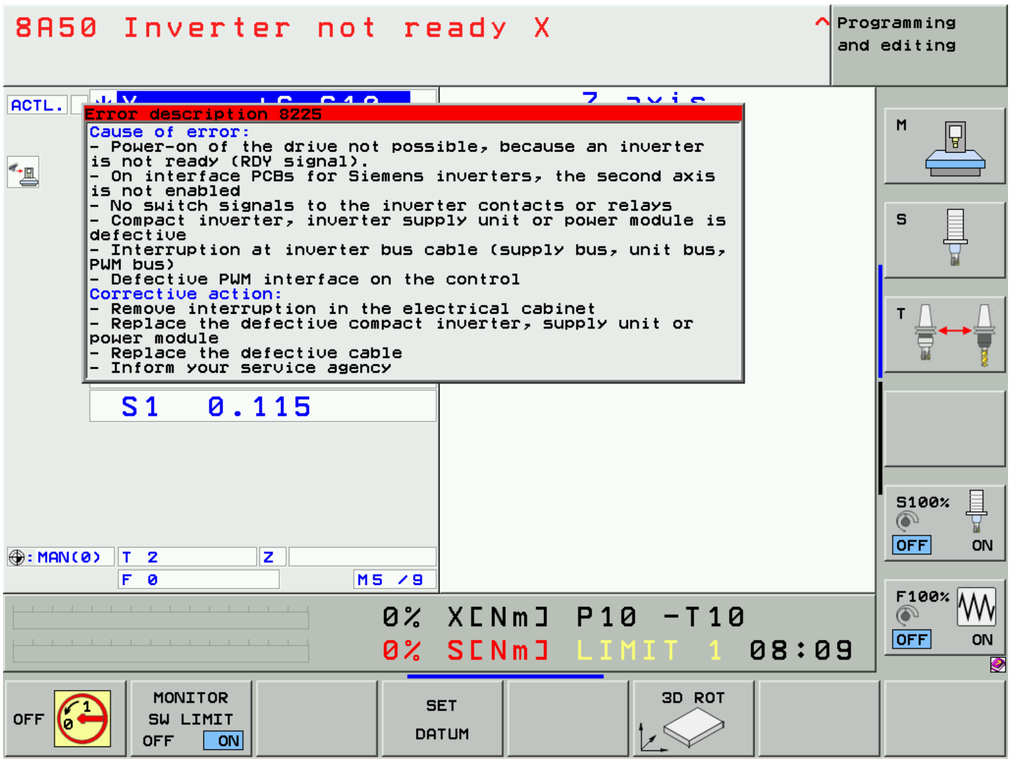


Figure: HELP window

Note

HELP texts cannot be displayed for error messages in red or gray windows. The control must be rebooted.
Information on these errors can be found in the list of NC error messages, See “List of NC Error Messages” on page 4 – 29.

4.3 ERR Key

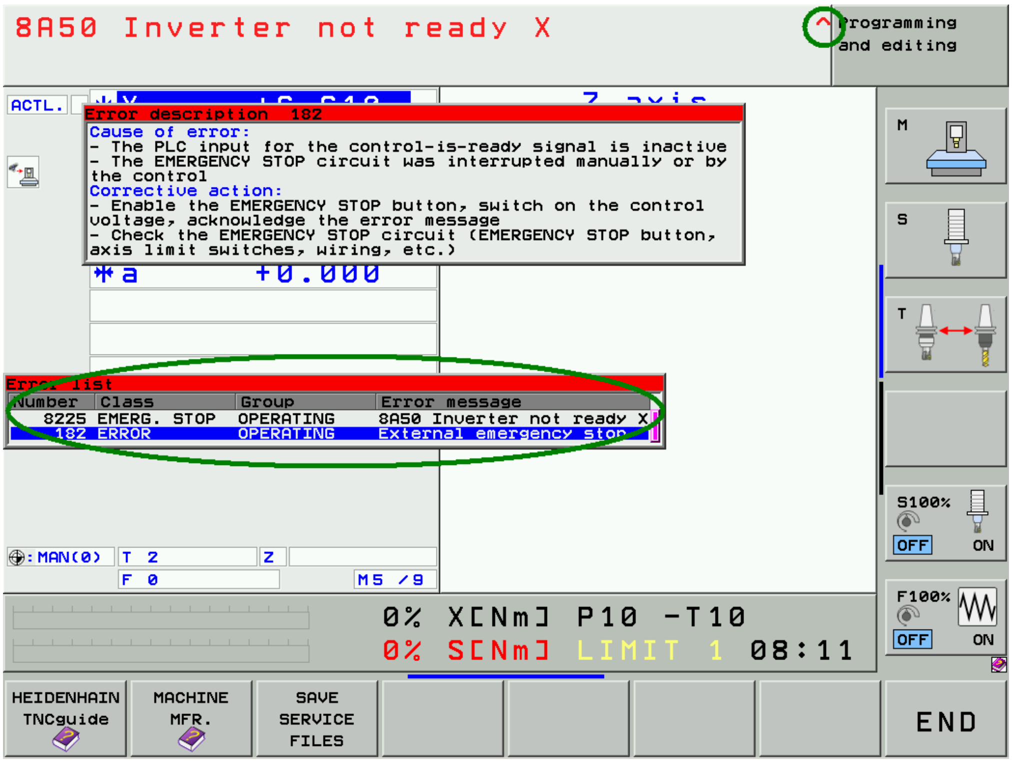
▶ Display all pending error messages in a list
(If you press this key again, the window will close.)

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

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

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

In addition, the help window can be called with the HELP key.



Note

If your machine still features an old keyboard without an ERR key over the HELP key, press the respective "space key" over the HELP key. --> If the NC software of the iTNC 530 supports the function of the ERR key, it can also be used to call the ERR list!

The columns in the ERR window have the following meanings:

Column	Description
`Number`	Error number (–1: no error number defined), issued by HEIDENHAIN or your machine tool builder
`Class`	Error class. Defines the reaction of the control: ■ **ERROR** Program run is interrupted by the iTNC ■ **FEED HOLD** The feed-rate release is canceled ■ **PGM HOLD** The program run is interrupted (the control-in-operation symbol blinks) ■ **PGM ABORT** The program run is interrupted (INTERNAL STOP) ■ **EMERG. STOP** EMERGENCY STOP is set off ■ **RESET** iTNC executes a system restart ■ **WARNING** Warning message, program run resumes ■ **INFO** Info message, program run resumes
Group	Error source. ■ **GENERAL** General error ■ **OPERATING** Error during machining and machine traverse ■ **PROGRAMMING** Error during programming ■ **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 appertaining text.

4.4 CE Key

CE

▶ Clear error message (**C**lear **E**rror)

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

Note

Messages regarding very fatal errors, cannot be confirmed with the CE key.
The control must be rebooted.--> Press the END key.
If this does not work --> Switch the power switch of the machine off and wait for several seconds before you switch 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 is the official list of NC error messages which contains all possible errors 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 subsequently in alphabetical order.

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

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**
8040 Heat-sink temp. UV 1xx	■ Heat-sink temperature of UV 1xx power supply unit is 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 "Status of HEIDENHAIN inverters" on page 3 – 682.	■ 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 "Status of HEIDENHAIN inverters" on page 3 – 682.	■ 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 to restart. ■ Check the wiring (master contactor). ■ Check the PLC program. ■ Exchange the inverter (supply unit).
	■ See "Status of HEIDENHAIN inverters" on page 3 – 682.	■ See "Checking the readiness of the inverter system" on page 16 – 243. ■ See Service Manual Inverter Systems and Motors.
8060 Leakage current in UV 1xx	■ Insulation problem (e.g. defective motor).	■ Check the motor. ■ Check the wiring.
	■ See "Status of HEIDENHAIN inverters" on page 3 – 682.	■ 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 to restart. ■ Check the wiring (master contactor). ■ Check the PLC program. ■ Exchange the inverter (supply unit).
	■ See "Status of HEIDENHAIN inverters" on page 3 – 682.	■ See "Checking the readiness of the inverter system" on page 16 – 243. ■ 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 configuration datum (braking of the spindle). ■ Check the braking resistor. ■ Replace the power supply unit.
	■ See "Status of HEIDENHAIN inverters" on page 3 – 682.	■ See Service Manual Inverter Systems and Motors.
8092 Pos. contr. cyc. time error	■ MC is outputting erroneous cycle time for CC position controller. ■ Hardware error	■ Check machine parameter 7600.x. ■ Exchange the 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 "Controlling the motor brakes" on page 3 – 684. ■ 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 STR column of the motor table. ■ Check the speed encoder connection. ■ Check the motor connection. ■ Release brakes during orientation.
	■ See "Speed Encoders" on page 18 – 293.	■ See "Sequence for Finding Errors in the Control Loop" on page 6 – 62. ■ See "Speed Encoders" on page 18 – 293. ■ 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 "Controlling the motor brakes" on page 3 – 684. ■ 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 "Controlling the motor brakes" on page 3 – 684. ■ 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**
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 stage table and configuration data. ■ Check whether the motor and power module are designed for the load.
	■ See "I2t monitoring" on page 3 – 676.	■ See Service Manual Inverter Systems and Motors.
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 stage 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 – 62. ■ 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 "I2t monitoring" on page 3 – 676.	■ 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 "I2t monitoring" on page 3 – 676.	■ 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 "Status of HEIDENHAIN inverters" on page 3 – 682.	■ 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 "Status of HEIDENHAIN inverters" on page 3 – 682.	■ 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 18 – 293.

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**
8830 EnDat: No field angle <axis>	■ Field angle of the motor with unaligned speed encoder with EnDat interface has not been ascertained. ■ The transferred EnDat serial number does not match the stored EnDat serial number. ■ Connected EnDat encoder or encoder cable is defective.	■ Run a field orientation. ■ Check the motor table (column SYS).
		■ See “Speed Encoders” on page 18 – 293.
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 18 – 308.
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 18 – 308.
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 “Checking the readiness of the inverter system” on page 16 – 243. ■ 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
8A30 Drive enabling (I32) %.2s	■ Power-on of the drive not possible due to missing drive enabling via I32.	■ Check the wiring of the emergency-stop loop.
		■ See “Checking the global drive enable I32, connector X42 / pin 33” on page 16 – 239.

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**
8A40 Enabling of axis group %.2s	■ Because of missing drive enabling for axis groups (X150/X151), the drive cannot be switched on.	■ Check the connector on X150/X151 for correct fit. ■ Check the wiring of X150/X151. ■ Check MP2040.x.
		■ See “Checking the drive enabling for the axis groups via connector X150 and X151 (if wired)” on page 16 – 242.
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 “Checking the readiness of the inverter system” on page 16 – 243. ■ See Service Manual Inverter Systems and Motors.
8AF0 Encoder <axis> defective	■ Contamination of the position encoder ■ Encoder cable defective ■ Motor control board defective	■ Exchange position encoder. ■ Check encoder cable. ■ Exchange the motor drive control board.
	■ See “Position Encoders” on page 18 – 277.	■ See “Position Encoders” on page 18 – 277.
8B00 <Achse> 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 18 – 293.	■ See “Speed Encoders” on page 18 – 293.
8B00 Zn track %.2s error	■ Contamination of the motor encoder (Zn track) ■ Motor encoder cable is defective. ■ Motor control board is defective.	■ Exchange the motor. ■ Check the motor encoder cable. ■ Exchange the motor drive control board.
	■ See “Speed Encoders” on page 18 – 293.	■ See “Speed Encoders” on page 18 – 293.
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.

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**
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 18 – 293.	■ See “Sequence for Finding Errors in the Control Loop” on page 6 – 62. ■ See “Speed Encoders” on page 18 – 293. ■ 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 encoder cable. ■ Check the entry in the motor table. ■ Measure the temperature sensor (576 [Ohm] at 20 [°C]).
	■ See “Speed Encoders” on page 18 – 293. ■ See Service Manual Inverter Systems and Motors.	■ See “Speed Encoders” on page 18 – 293. ■ 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 nonexistent 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” on page 16 – 229. ■ 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 not ready for operation ■ Motor control board defective ■ PWM cable defective ■ Noise pulses	■ Check the control and cabling of the pulse release. ■ Check Uz. ■ If the power supply is not regenerative: 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” on page 16 – 229. ■ 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**
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 – 62. ■ See Service Manual Inverter Systems and Motors.
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 encoder cable. ■ Exchange the motor.
		■ See "Speed Encoders" on page 18 – 293. ■ 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 encoder input PCB.
		■ See "Speed Encoders" on page 18 – 293. ■ 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 control 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 – 62. ■ 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**
8BD0 Excessive servo lag in <axis>	■ The following error of a moving axis is greater than the value given in machine parameter MP1720.x (in lag mode) or MP 1420.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 – 62. ■ Carry out offset adjustment (See “Adjusting the electrical offset (drift adjustment)” on page 20 – 349). ■ Carry out speed adjustment (See “Speed adjustment at the servo amplifier (tachometer adjustment)” on page 20 – 352).
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 18 – 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 18 – 308.
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 18 – 308.
8C10 <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 18 – 293. ■ 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.

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**
AC00 CC amplitude too high %.2s	■ The amplitude of the encoder signal is too high or the signal for contamination is 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 18 – 277.
8B00 <Achse> 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 18 – 293.
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 18 – 293.
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 encoder signal amplitude. ■ Inform your service agency.
		■ See "Encoder Interface" on page 18 – 277.
AC50 CC freq. too high %.2s (position)	■ The maximum input frequency was exceeded at a position encoder input. ■ Noise on the 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 18 – 308.

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**
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 17 – 251
BA00 CC%d operating temperature %d	■ The temperature inside the LE was out of the permissible range. (-128... 0...+127 = Measured temperature value [°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 17 – 267 ■ See “Annex: Monitoring Functions” on page 3 – 661 ■ See “Temperature” on page 6 – 75
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“
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.

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**
C00B Too little main memory	■ Internal software error	■ Check the software version.
C00D Program checksum error	■ Internal software or hardware error	■ Check the software version. ■ Exchange drive control board.
C00E Controller software timeout	■ Internal software or hardware error	■ Check the software version. ■ Exchange drive control board. ■ Inform your service agency.
C012 Pos. control err. Cycle time	■ MC is outputting erroneous cycle time for CC position controller. ■ Hardware error	■ Check machine parameter 7600.0 ■ 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 18 – 293	■ See “Speed Encoders” on page 18 – 293
C310 Z1 track %.2s error	■ Contamination of the motor encoder (Z1 track) ■ Motor encoder cable is defective. ■ Motor control board is defective.	■ Exchange the motor. ■ Check the motor encoder cable. ■ Exchange the motor drive control board.
	■ See “Speed Encoders” on page 18 – 293	■ See “Speed Encoders” on page 18 – 293

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**
C330 Motor temp. too high %.2s	■ Measured motor temperature is too high. ■ No temperature sensor ■ Motor encoder cable is defective. ■ Entry in motor table is incorrect. ■ Incorrect or defective temperature sensor was installed.	■ Let the motor cool down. ■ Check the motor encoder cable. ■ Check the entry in the motor table. ■ Measure the temperature sensor.
	■ See “Speed Encoders” on page 18 – 293. ■ See Service Manual Inverter Systems and Motors.	■ See “Speed Encoders” on page 18 – 293. ■ See Service Manual Inverter Systems and Motors.
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.
Axis module %.2s not ready	■ No pulse release for the power axis module ■ Uz too high ■ 5-V power supply too weak ■ Inverter not ready for operation ■ Motor control board defective ■ PWM cable defective ■ Noise pulses	■ Check the control and cabling of the pulse release. ■ Check Uz. ■ If the power supply is not regenerative: 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” on page 16 – 229. ■ 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 18 – 293.
C380 Motor %.2s not controllable	■ Motor cables crossed (e.g. X with Y). ■ Motor encoder cables crossed ■ 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 cabling. ■ Check motor table entry. ■ Check I2t monitoring (MP2302.x).
	■ See “Speed Encoders” on page 18 – 293. ■ See Service Manual Inverter Systems and Motors.	■ See “Speed Encoders” on page 18 – 293. ■ See Service Manual Inverter Systems and Motors.
C390 Error in 3-D touch probe %.2s	■ Software error ■ Hardware error in drive control board	■ Exchange the motor drive control board. ■ Check the software version.
		■ See “Touch Probe” on page 25 – 413.

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**
C3A0 Incorrect ref. position %.2s	■ Incorrect motor selected (MP2200) ■ Grounding error on motor encoder cable (disturbance on reference signal line) ■ Motor encoder defective	■ Check the motor selection (MP2200) ■ Check the cabling of the motor encoder (grounding). ■ Exchange the motor.
		■ See “Speed Encoders” on page 18 – 293.
C3B0 Motor %.2s: is not turning	■ Inverter is not ready for operation. ■ 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 cables crossed ■ 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 – 62. ■ 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 control 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 – 62 ■ 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 drive control board. ■ Check speed encoder cable (defective or too long). ■ Check speed encoder. ■ Check the grounding and shielding of the cable.
		■ See “Speed Encoders” on page 18 – 293.

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**
C400 Line count error <axis>	■ Line count from the motor table does not match the downloaded values.	■ Check machine parameter (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 18 – 293.	■ See "Speed Encoders" on page 18 – 293.
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 drive control board.
	■ See "Speed Encoders" on page 18 – 293.	■ See "Speed Encoders" on page 18 – 293.
C430 Ctrlr parameters incorrect %s	■ Feedforward-control parameters are set incorrectly (acceleration, friction). ■ Excessive acceleration. ■ Controller parameters are set incorrectly (Ki, Kp, Kd). ■ Filters set incorrectly (band rejection, low pass). ■ Inverter defective (IGBT). ■ Incorrect motor selected in motor table.	■ Check the adjustment of the axes. ■ Check the inverter.
		■ See "Sequence for Finding Errors in the Control Loop" on page 6 – 62. ■ 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 position encoder input.
		■ See "Position Encoders" on page 18 – 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 drive control board.
	■ See "Speed Encoders" on page 18 – 293.	■ See "Speed Encoders" on page 18 – 293.
C460 Motor speed too high <axis>	■ Motor not controllable	■ Check the software version. ■ Inform your service agency.

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**
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.
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: CC4xx/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
E130 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 – 62.
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 18 – 277.	■ See “Encoder Interface” on page 18 – 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**
Operating parameters erased	■ This error message is displayed if the machine parameters are deleted and the PLC program is missing.	■ Enter new operating parameters.
		■ See “Restoring Data” on page 13 – 197.
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 1140.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 – 62.
Movement monitoring error in <axis> B	■ The motor is moving while the axis slides are 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 – 62.
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 17 – 251. ■ See “Error Localization by Process of Exclusion” on page 6 – 66. ■ 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 18 – 308.
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 17 – 267. ■ See “Temperature monitoring” on page 3 – 674. ■ See “Temperature” on page 6 – 75.

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 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 axis 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" on page 16 – 229. ■ See Service Manual Inverter Systems and Motors.
CC%d inverter for axis 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" on page 16 – 229. ■ See Service Manual Inverter Systems and Motors.
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" on page 16 – 229. ■ See Service Manual Inverter Systems and Motors.
CC%d inverter for spindle RDY=1	■ The power module of the spindle is ready for operation although it should actually be switched off.	■ Inform your service agency.
		■ See "Checking the Enables on the iTNC 530" on page 16 – 229. ■ See Service Manual Inverter Systems and Motors.
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 – 62
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 18 – 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**
Ext. In-/output not ready	■ The interface is not connected. ■ The external device is not switched on or is not ready. ■ The transmission cable is defective or incorrect.	■ Check the data transmission line.
		■ See “Connection Setup” on page 13 – 172.
External EMERGENCY STOP	■ The "control-is-ready" PLC input is not active.	■ Release the EMERGENCY STOP switch ■ Retract axis ■ Check the EMERGENCY STOP chain (See “Checking the "Control is ready" output and input (EMERGENCY STOP chain)” on page 16 – 233). ■ If "Control is ready“ output is defective --> Replace MC 320 (See “Exchange of the MC 422 B, MC 422 C, MC 420” on page 28 – 542).
	■ 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 320 defective.	■ Release the EMERGENCY STOP switch ■ Retract axis ■ Check the EMERGENCY STOP chain (See “Checking the "Control is ready" output and input (EMERGENCY STOP chain)” on page 16 – 233). ■ If "Control is ready“ output is defective --> Replace MC (See “Exchange of HEIDENHAIN Components” on page 28 – 523). ■ See “Checking the Enables on the iTNC 530” on page 16 – 229
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 18 – 293.
Error: Profibus configuration	■ An error occurred during evaluation of the Profibus configuration.	■ 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 MP 7640 ■ The transmission line is defective or incorrect.	■ Connect the handwheel via cable adapter. ■ Check machine parameter MP 7640. ■ Inspect the data transfer line for damage.
		■ See “Handwheel” on page 24 – 399.

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 MP 7640 ■ C: x Contamination (x = axis) ■ D: Transmission error during receipt ■ E: Received BCC check sum incorrect ■ F: Handwheel recognized wrong identification ■ G: Handwheel recognized wrong BCC checksum ■ 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 24 – 399.
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 18 – 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 17 – 251. ■ See “Error Localization by Process of Exclusion” on page 6 – 66. ■ 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 18 – 308.
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 is active.	■ Check the amplitude of the encoder signal.
		■ See “Position Encoders” on page 18 – 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 18 – 277.
%.2s-measuring system defective	■ Contradiction apparent from comparison of absolute and incremental positions	■ Inform your service agency.
		■ See “Encoder Interface” on page 18 – 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 18 – 308.
NC: Pprogram 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 13 – 197.
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 permanently at 24 V. ■ MC defective	■ Check input I3 (See “Checking the "Control is ready" output and input (EMERGENCY STOP chain)” on page 16 – 233). ■ Replace relays, safety contactor combinations. ■ See “Error message: EMERGENCY STOP defective” on page 16 – 236.
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 Command Interface” on page 20 – 344.

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**
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 it.
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.
Positioning error	■ The following error of a moving axis is greater than the value given in machine parameter MP1710 (in following error mode) or MP 1410 (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 – 62 ■ Carry out offset adjustment (See “Adjusting the electrical offset (drift adjustment)” on page 20 – 349) ■ Carry out speed adjustment (See “Speed adjustment at the servo amplifier (tachometer adjustment)” on page 20 – 352).
Profibus: File-/memory error	■ A file access error or an error in the error mangement occurred with Profibus functions.	■ Inform your service agency.
Profibus: Hardware error	■ An error occurred during access to the Profibus hardware.	■ You can find more diagnostic information in the diagnostics menu.
		■ See “PROFIBUS diagnosis” on page 11 – 133.
Profibus: Error initialization	■ An error occurred during initialization of the Profibus hardware.	■ You can find more diagnostic information in the diagnostics menu.
		■ See “PROFIBUS diagnosis” on page 11 – 133.
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.

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**
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) recognizes excessive temperature.	■ Check the heat transfer in the electrical cabinet ■ Check the fan of the logic unit.
		■ See “Information Menu” on page 17 – 267. ■ See “Temperature monitoring” on page 3 – 674. ■ See “Temperature” on page 6 – 75.
Processor 2 temperature too high	■ The temperature sensor on processor 2 (processor RTPC) recognizes excessive temperature.	■ Check the heat transfer in the electrical cabinet ■ Check the fan of the logic unit.
		■ See “Information Menu” on page 17 – 267. ■ See “Temperature monitoring” on page 3 – 674. ■ See “Temperature” on page 6 – 75.
Exchange buffer battery	■ The voltage of the buffer battery has dropped below the minimum value.	■ Replace the buffer battery.
		■ See “Buffer Battery” on page 17 – 264.
Ref mark <axis>: incorrect spacing	■ During a reference-mark run on an encoder with distance-coded reference marks a distance of more than 1 000 grating periods was covered without passing over a reference mark.	■ Correct machine parameter MP 1350.
		■ See “Encoder Interface” on page 18 – 277.
Traverse reference points	■ In a part program block you attempted to move an axis that has not yet traversed the reference point.	■ Cross over the reference mark.
		■ See “Reference Run” on page 19 – 317.
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” on page 16 – 229.
Nonvolatile PLC data deleted	■ The code number 531210 was entered.	
		■ See “Non-Volatile PLC Markers and Words” on page 11 – 136.
Excessive following error in <axis>	■ See "8BD0 Excessive servo lag in <axis>"	■ See "8BD0 Excessive servo lag in <axis>".
Current to spindle 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” on page 16 – 229. ■ 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**
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 – 62. ■ Carry out offset adjustment (See "Adjusting the electrical offset (drift adjustment)" on page 20 – 349).
Rely Ext. 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 320 defective.	■ Release the EMERGENCY STOP switch. ■ Retract axis ■ Check the EMERGENCY STOP chain (See "Checking the "Control is ready" output and input (EMERGENCY STOP chain)" on page 16 – 233). ■ If "Control is ready" output is defective --> Replace MC (See "Exchange of HEIDENHAIN Components" on page 28 – 523). ■ See "Checking the Enables on the iTNC 530" on page 16 – 229.
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 Probe" on page 25 – 413.
Exchange touch probe battery	■ Battery dead	■ Replace battery.
		■ See "Touch Probe" on page 25 – 413.

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**
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 the battery. ■ Clean the receiver unit.
	■ Penetration of humidity ■ Touch probe cable defective ■ Cable to transmitter/receiver 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. ■ It is possible, that several touch probes are within the receiving range of a 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 obstacle from infrared connection. ■ Readjust receive range of SE. ■ If the interface to touch probe or transmitter/ receiver unit on the MC is defective –> Replace MC (See "Exchange of HEIDENHAIN Components" on page 28 – 523). ■ See "Touch Probe" on page 25 – 413.
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 17 – 267. ■ See "Temperature monitoring" on page 3 – 674. ■ See "Temperature" on page 6 – 75.
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 17 – 267. ■ See "Temperature monitoring" on page 3 – 674. ■ See "Temperature" on page 6 – 75.
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. ■ Expand the tolerance in machine parameter 6171.
		■ See "Touch Probe" on page 25 – 413.
5-V power supply too high	■ The 5V supply voltage of the control is too high.	■ Check the power supply. ■ Inform your service agency.
		■ See "Power Supply" on page 17 – 251. ■ See "Error Localization by Process of Exclusion" on page 6 – 66. ■ 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**
5-V power supply too low	■ The 5V 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 17 – 251. ■ See “Error Localization by Process of Exclusion” on page 6 – 66. ■ 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 “Power Supply for PLC Outputs” on page 17 – 268.
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” on page 16 – 229. ■ See Service Manual Inverter Systems and Motors.
Insufficient system memory	■ There are too many NC software versions on the control.	■ Delete NC programs that are no longer required.
		■ See “Reloading the NC Software Used” on page 14 – 209.

5 Errors Patterns

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.

Static and nonstatic errors

Errors can also be defined in the categories of static errors (e.g., interruption in the electrical cabinet, defective unit) and nonstatic errors (e.g., loose connection, shielding problems, interferences).
Naturally, static errors can be found more easily.

Sporadic and nonsporadic errors

Check whether you can reproduce a certain error on the machine at any time (nonsporadic error). This assists you in troubleshooting.
The integrated log or the PLC logic diagram are some possibilities to investigate sporadic errors, as well as the integrated oscilloscope.

5.2 Overview of Possible Error Patterns

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 afterwards.

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 visual display unit BC ■ Check power supply to MC ■ Disconnect defective or suspicious units or cables,	■ See “Visual Display Unit” on page 21 – 355 ■ See “Power Supply” on page 17 – 251 ■ See “Error Localization by Process of Exclusion” on page 6 – 66
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 28 – 523.
The **`Power interrupted`** message cannot be confirmed or the login password cannot be entered in a dual-processor control.	■ The key gets caught.	■ Check the keyboard.	■ See “Keyboard Unit” on page 22 – 359.

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 (connector) X34 missing ■ MC defective	■ Check output "Control is ready" and acknowledgment I3	■ See “Checking the Enables on the iTNC 530” on page 16 – 229.
When the machine is switched on, the error message "**EMERGENCY STOP** defective"	■ Wiring defective, contactors defective or too slow ■ MC defective	■ Check the related components	■ See “Error message: EMERGENCY STOP defective” on page 16 – 236.
iTNC monitor is "frozen". The control has locked up. The main switch has to 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 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) ■ Check the wiring of the inverter system, see circuit diagrams of the machine manufacturer. ■ Check the function of the inverter system or the motors.	■ See “Power Supply” on page 17 – 251. ■ See "Service Manual for Inverter Systems and Motors".
During switch-on or operation DSP errors are generated. A mechanical reason or a defective unit can be ruled out.	■ Data loss on the hard disk in the range of the SYS partition	■ Check the hard disk. ■ Activate the NC software again.	■ See “Test of Hard Disk” on page 12 – 153. ■ See “Reloading the NC Software Used” on page 14 – 209.
There are repeated hard disk errors.	■ Defects on the hard disk ■ Defective unit connected to the control (short circuit, etc.)	■ Check the hard disk. ■ Disconnect suspicious units.	■ See “Test of Hard Disk” on page 12 – 153. ■ See “Notes and Tips” on page 6 – 72.
NC functions do not function any more. (The control may have reported that the corresponding files have been deleted.)	■ Data loss on the hard disk in the range of the SYS partition	■ Check the hard disk. ■ Activate the NC software again.	■ See “Test of Hard Disk” on page 12 – 153. ■ See “Reloading the NC Software Used” on page 14 – 209.
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 (short circuit, etc.) Probe or handwheel that were exposed to humidity (coolant, etc.) or have been damaged --> Supply voltages (5V, 12V, 15V) are impaired. A variety of error messages are possible.	■ Disconnect defective or suspicious units or cables.	■ See “Error Localization by Process of Exclusion” on page 6 – 66.
Various error messages are generated which, however, are not substantive.	■ Connection (short circuit) of shielding potential (chassis, cable shielding) with 0V voltage 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” on page 6 – 72.
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 23 – 389.

Error	Possible cause of error	Measures for error diagnosis and/or corrective action	Descriptions in this manual
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 "Checking the readiness of the inverter system" on page 16 – 243.
During reference run, the machine moves to the limit switch.	■ The trip dogs for direction reversal during reference run are defective.	■ Check the motor load.	■ See "Reference Run" on page 19 – 317.
During reference run, the machine moves to the mechanical stop (for machines without limit switch). An error message is sometimes displayed, e.g. **8640 I2T value of motor is too high ...**	■ The machine was switched off at the wrong position.	■ Referencing with axis-direction keys (no automatic reference mark traverse)!	■ See "Reference Run" on page 19 – 317.
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 switching signal is too close to the requested reference mark. ■ A magnet of scale is shifted or defective. ■ The ref. mark selector plate of a scale is shifted. ■ The enamel over a ref. mark of a scale was removed or is damaged.	■ Readjust the trip dog for reference end position. ■ Readjust the magnet (outside or inside the scale housing) and fix it with distance holders. ■ Readjust ref. mark selector inside the scale housing with special slider. ■ Lacquer the ref. mark not to be evaluated again or replace the scale.	■ See "Readjusting the trip dog for reference end position" on page 18 – 305.
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 gets caught up.	■ Axis did not reach the positioning window. ■ Excessive drift of analog axes ■ Approach behavior of axis not optimized.	■ Perform drift adjustment ■ Reoptimization or new optimization of the axis by the machine manufacturer	■ See "Interface to the Drives" on page 20 – 323.
"Vibrating" axes, sometimes connected with loud noises	■ Poor shielding or grounding ■ Connectors on grounding terminal X131 of infeed/regenerative module (Simodrive 611D) not properly wired ■ Grounding terminal X131 of power supply 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 or the covers.	■ See "Notes and Tips" on page 6 – 72. ■ See "Exchange of HEIDENHAIN Components in the SIMODRIVE System" on page 28 – 554.
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 20 – 349.

Error	Possible cause of error	Measures for error diagnosis and/or corrective action	Descriptions in this manual
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 LEDs SH2 of all HEIDENHAIN drive modules light up (or the red LEDs SH2 or RESET of the HEIDENHAIN interface cards for the SIMODRIVE system)	■ Drive release missing	■ Check the releases.	■ See "Checking the Enables on the iTNC 530" on page 16 – 229.
During processing the motors run (axes, spindle) down out of loop.	■ Defective braking resistor (conversion of electrical energy to 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) ■ Check the function of the inverter system or the motors. ■ Check the wiring of the inverter system, see circuit diagrams of the machine manufacturer.	■ See "Power Supply" on page 17 – 251. ■ See "Service Manual for Inverter Systems and Motors".
When operating the iTNC 530 single-processor it becomes slower and slower until it becomes inoperable.	■ Defective USB unit is connected to the control.	■ Disconnect all USB units (e.g., touchpad) from the control and boot again.	

6 Procedures and Tips for Error Diagnosis

6.1 Introduction

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

The modifications are described in the following section:

Note

Make use of the **extensive diagnosis options** of iTNC 530!

Diagnostic possibility	Description in this manual
Integrated drive diagnosis	See "Integrated Diagnostic Functions and DriveDiag" on page 9 – 89.
Integrated oscilloscope	See "Integrated Oscilloscope" on page 10 – 99.
PLC diagnosis	See "PLC Diagnosis" on page 11 – 115.
General log	See "Log" on page 8 – 81.

Note

Refer also to the notes and tips in chapter 6.9!

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 – 60.

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 elimiated before further investigation is possible.

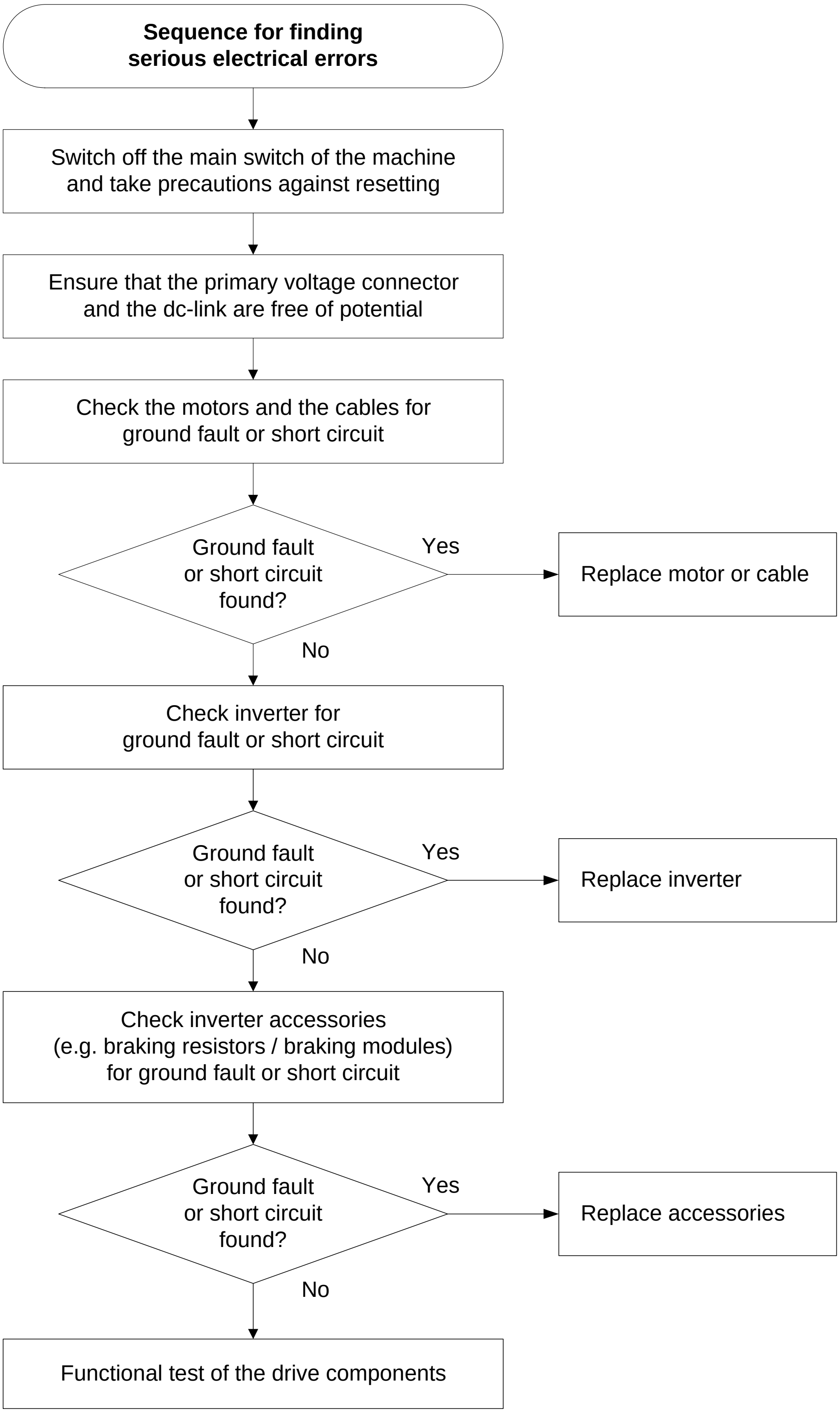
A **ground fault or short circuit** may be suspected in case of:

- 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 on HEIDENHAIN drives, 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 the primary voltage connector and the dc-link are free of potential
Check the motors and the cables for ground fault or short circuit
Ground fault or short circuit found?
Yes
Replace motor or cable
No
Check inverter for ground fault or short circuit
Ground fault or short circuit found?
Yes
Replace inverter
No
Check inverter accessories (e.g. braking resistors / braking modules) for ground fault or short circuit
Ground fault or short circuit found?
Yes
Replace accessories
No
Functional test of the drive components

6.4 Sequence for Finding Errors in the Control Loop

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

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

or in case of errors, for example:

- 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 is a handy tool for analyzing errors in the control loop.

Activation and operation --> See “Integrated Oscilloscope” on page 10 – 99.

Error message	Recommended signals	Additional signal
`Positioning error`	`s diff`	`I (nominal)`, `I2-t (mot.)`, `I2-t (p.m.)`, `Utilization`
`Excessive servo lag`	`s diff`	`I (nominal)`, `I2-t (mot.) I2-t (p.m.)`, `Utilization`
`Nominal speed value too high`	`v nominal, v (nom rpm), v actual, v (act rpm)`	`I (nominal)`, `I2-t (mot.) I2-t (p.m.)`, `Utilization`
`Movement monitoring`	`v nominal, v (nom rpm), v actual, v (act rpm), Pos. diff.`	`I (nominal)`, `I2-t (mot.) I2-t (p.m.)`, `Utilization`
`Standstill monitoring`	`s diff`	`I (nominal)`, `I2-t (mot.) I2-t (p.m.)`, `Utilization`

Note

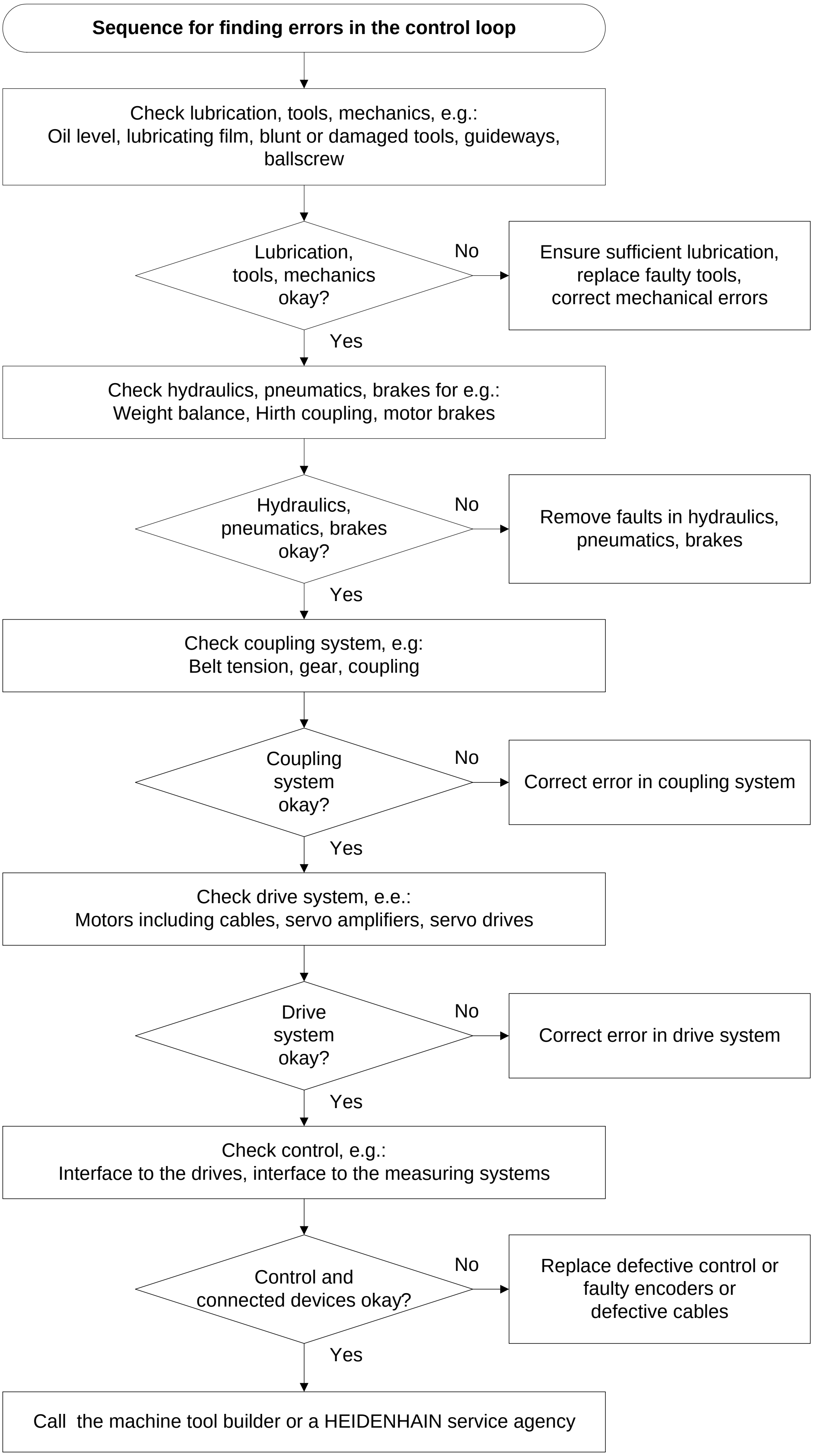
The torque-determining current **`I nominal`** in particular is an important characteristic for the mechanics of the axis concerned (stiffness, blunt tool, lubrication, utilization, etc.)

Other signals, such as **`I2-t (mot.)`**, **`I2-t (Lt.)`** und **`Utilization`** are calculated from the current.

See also:

- “Finding Position Differences of Direct and Indirect Encoder” on page 6 – 68
- “Error Localization by Switching from Direct to Indirect Position Measurement” on page 6 – 70

Flowchart


Sequence for finding errors in the control loop
Check 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 brakes
Hydraulics, pneumatics, brakes okay?
No
Remove faults in hydraulics, pneumatics, brakes
Yes
Check coupling system, e.g:
Belt tension, gear, coupling
Coupling system okay?
No
Correct error in coupling system
Yes
Check drive system, e.e.:
Motors including cables, servo amplifiers, servo drives
Drive system okay?
No
Correct error in drive system
Yes
Check control, e.g.:
Interface to the drives, interface to the measuring systems
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 **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 not longer connected firmly.

In exceptional cases, due to defective electronics or a damaged cable, constant voltage values are supplied to the control that are within the tolerance range of the encoder specifications. Consequently, also here **no encoder error message** is generated!

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

- Increase the monitoring limits (e.g. for the servo lag, See “Position or servo lag monitoring” on page 3 – 664). -- > A longer distance may be traversed before an error is generated.

DANGER

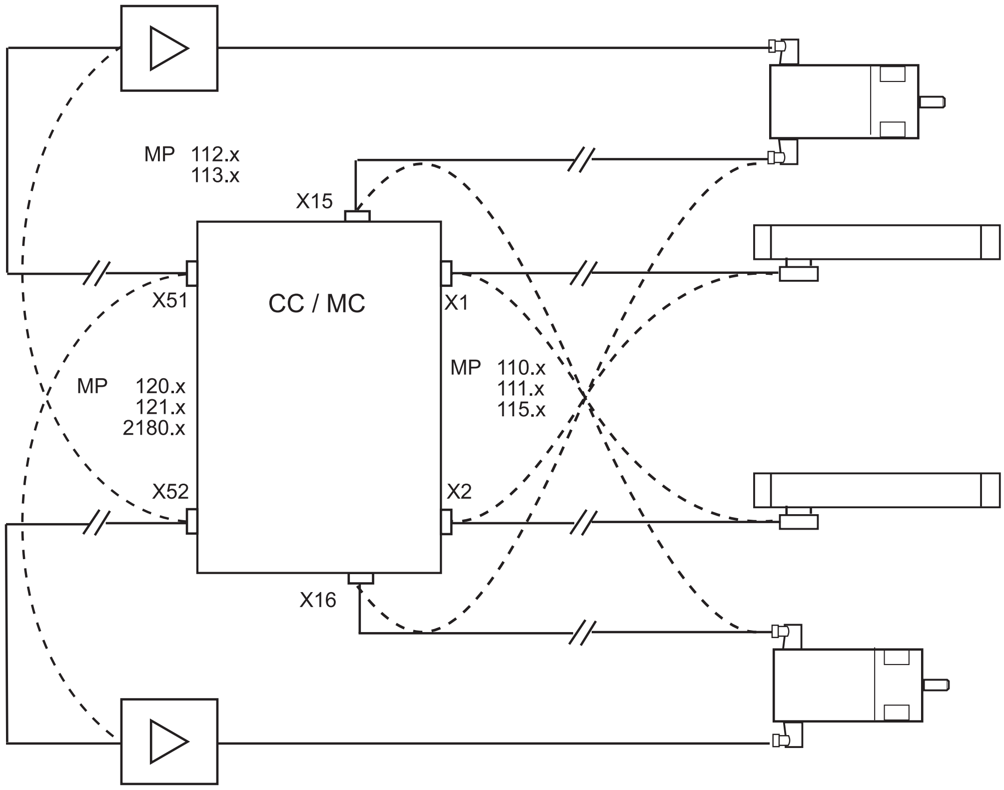
Increasing the monitoring limits reduces the safety of the machine!

- Now inspect the encoder signals with an appropriate measuring device (e.g. PWM 9, See “PWM 9 Encoder Diagnostic Set” on page 29 – 566). --> 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



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.

- Interchange of position encoders -->
  See “Position Encoders” on page 18 – 277.
- Interchange of speed encoders -->
  See “Speed Encoders” on page 18 – 293.
- Interchanging PWM interfaces -->
  See “Digital PWM Interface” on page 20 – 323.
- Interchanging expansion boards –>
  See “Troubleshooting: Interchanging the HEIDENHAIN interface boards for the SIMODRIVE 611 system” on page 20 – 342.
- Interchanging inverters, motors -->
  See "Service Manual for Inverter Systems and Motors".

Caution

For trouble shooting do not connect obviously defective controls (e.g., position encoder with short circuit after entering of humidity) to other interfaces (e.g., X1-X6, X35-X38) of the control.

6.6 Error Localization by Process of Exclusion

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

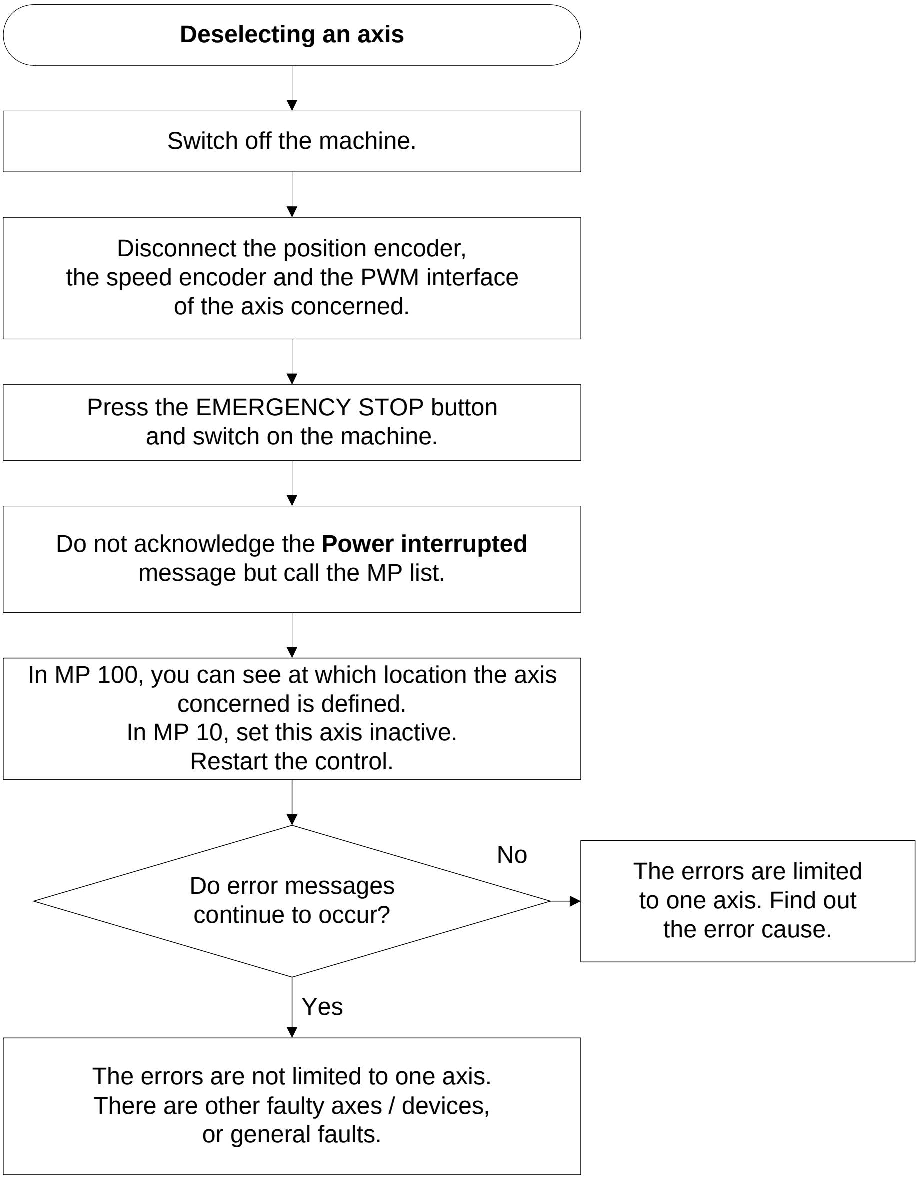
The "exclusion method" is useful in the following events:

- The monitor remains dark after the machine is switched on -->
  See “Troubleshooting” on page 21 – 356.
- Errors occur that concern the handwheel -->
  See “Deselecting and Disconnecting the Portable Handwheel” on page 24 – 409.
- Errors occur that concern the touch probe -->
  See “Deselecting and Disconnecting the Touch Probe” on page 25 – 426.
- 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 is possible that individual axes cannot be deselected when the machine kinematics is active or that the PLC program prohibits that the machine can be moved when axes are missing. --> Ask the machine manufacturer!

Caution

It is not sufficient to deactivate a suspicious axis with machine parameter 10 (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 Finding Position Differences of Direct and Indirect Encoder

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.

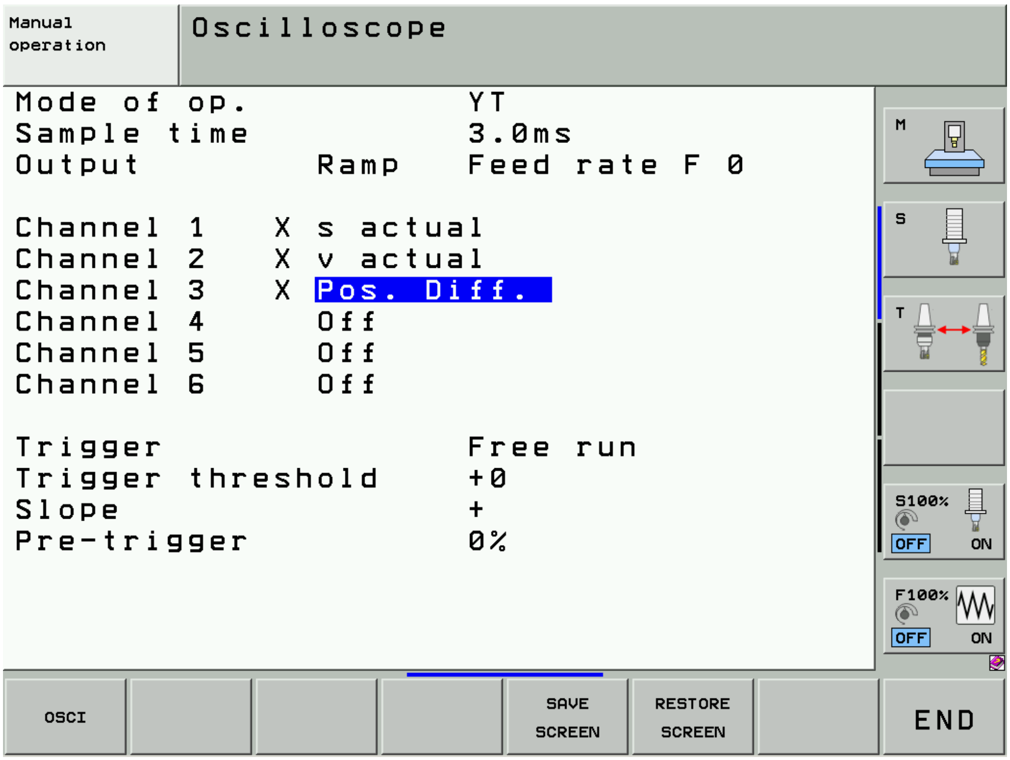
Integrated oscilloscope

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

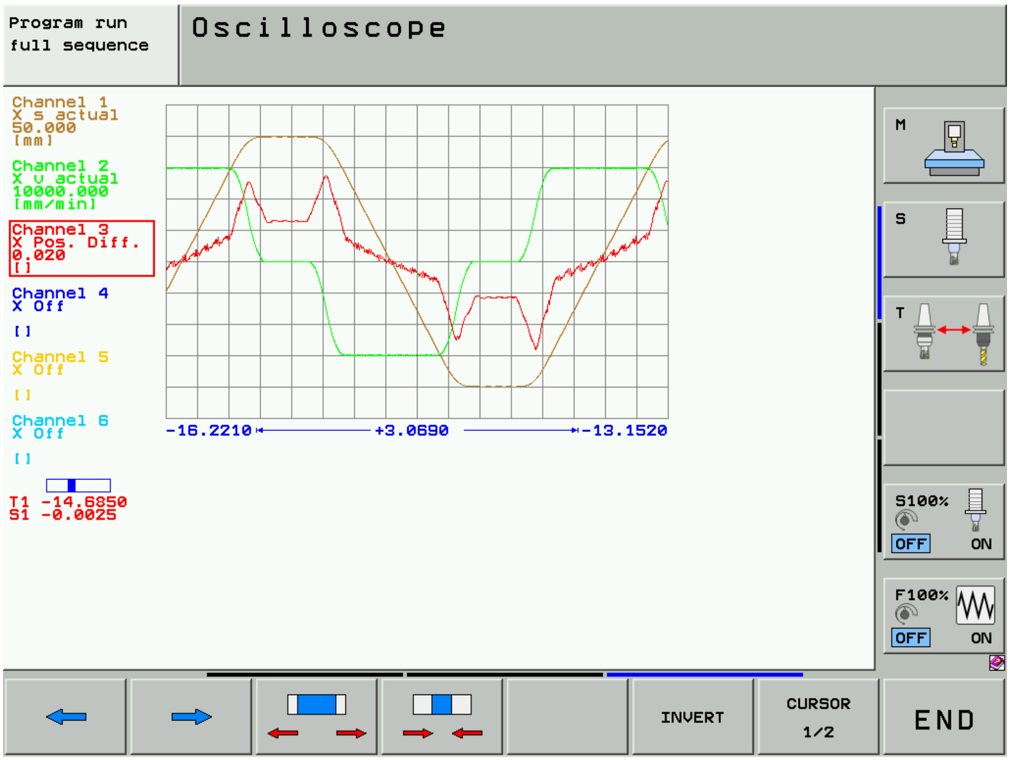
Activation and operation --> See "Integrated Oscilloscope" on page 10 – 99.

An example of recording a position difference:

- Make the following settings:



- Use a NC program which moves the X-axis back and forth several times. (Ask the machine operator.)
- Start the 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 **rectifications of the mechanics or the coupling system** are required.

6.8 Error Localization by Switching from Direct to Indirect Position Measurement

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

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

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

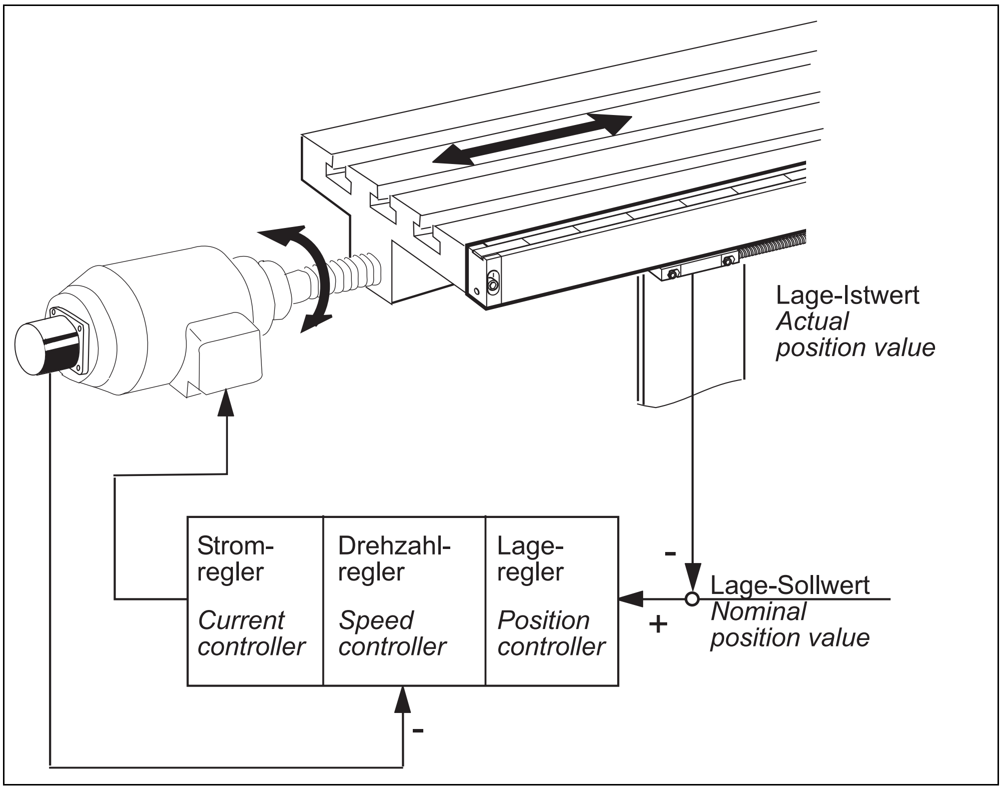
Prerequisite

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.

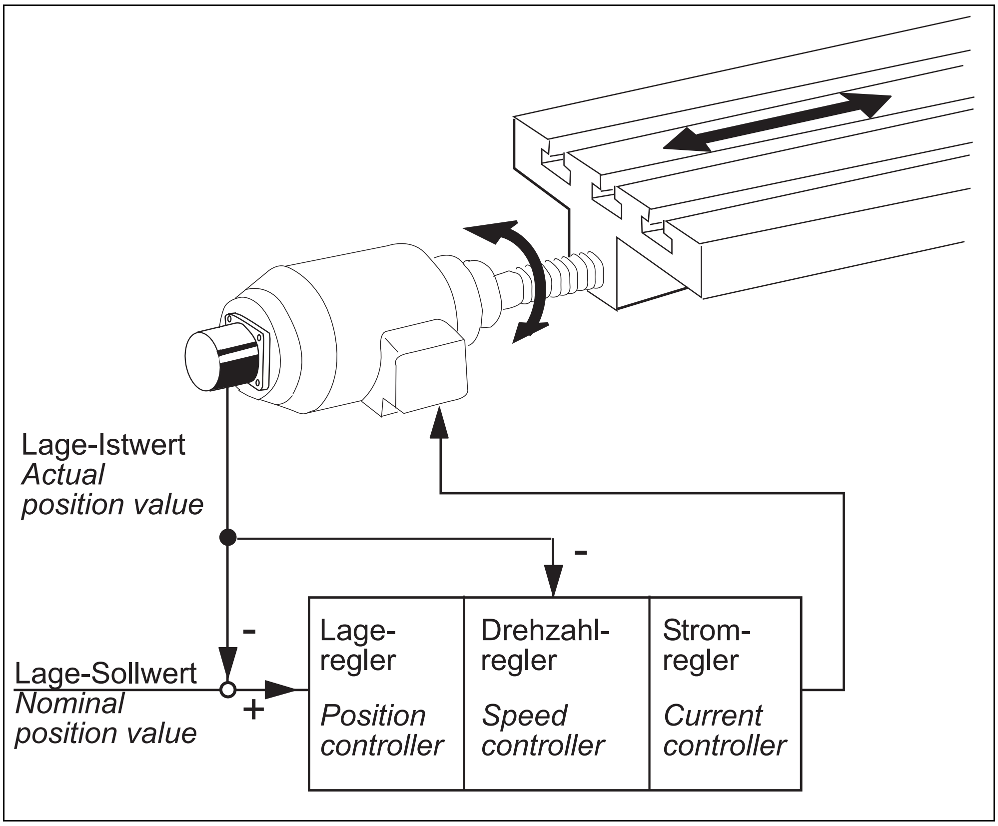
Direct position measurement

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



Flowchart

See "Position Measurement via Motor Encoder (Indirect Position Measurement)" on page 18 – 311.

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.

6.9 Notes and Tips

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.

Have there been any particular incidences, 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 machining program
- Tool breakage
- Collision
- Power failure
- Etc.

Have there been repeated error messages indicating an 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 also supplied by the control** (encoders with long cables are maybe provided with voltage amplifiers).
It is thus possible that **defective connected units or also 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, error messages related to the respective device are ideally displayed. 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 powering unit. --> See “Error Localization by Process of Exclusion” on page 6 – 66.

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.

Connectors and females

Observe the following instructions for connecting or disconnecting any connectors:

D-Sub connectors 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 females

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

Signal socket at the motor

- 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.

Caution

If HEIDENHAIN expansion boards are used for the SIMODRIVE system, please check whether the grounding is implemented as prescribed. --> See “Exchange of HEIDENHAIN Components in the SIMODRIVE System” on page 28 – 554.

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 equipment 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 MC 42x(B), CC 42x and its leads to interfering equipment.
- There is a minimum distance of 10 cm from the MC 42x(B), CC 42x 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

Caution

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 fan
- 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 the operating safety!

Caution

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.

Caution

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 Downloading of Service Files

7.1 Introduction

Service files can be created **as of NC software version 340 49x-04**.

- Files selected by HEIDENHAIN and the machine manufacturer are thus stored in a ZIP file.
- The selected files can be located on the TNC as well as on the PLC partition.
- The compressed service files are stored unter `TNC:\service\Service<xxxxxxxx>.zip.`
- The name of the file is generated automatically, whereby <xxxxxxxx >is the system time shown as an unambiguous character string in hexadecimal code.
- The most up-to-date ZIP file is identified in the program manager in the date and time columns.

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

- General 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 PLC memory
- NC macros defined in PLC:\NCMACRO.SYS
- Information about the hardware

Caution

The compressed service files also include the **milling program the customer used** in the event of an error or at the time of the manual creation of the service files!

Note

Files that are saved on an encrypted PLC partition `PLCE:` cannot be written to the service file.

Service files can **only partially be evaluated by the service engineer himself**. They serve primarily to provide the machine manufacturer or a HEIDENHAIN service agency with extensive information on an error occurred on a machine.

After consultation the respective ZIP file can thus be downloaded from the control and sent to the OEM or HEIDENHAIN.

Caution

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

7.2 Automatic Generation of Service Files

Service files are created automatically ...

- in the event of serious NC error messages that make necessary a reset of the control.
- in the event of PLC error messages for which the machine manufacturer has defined the creation of service files.

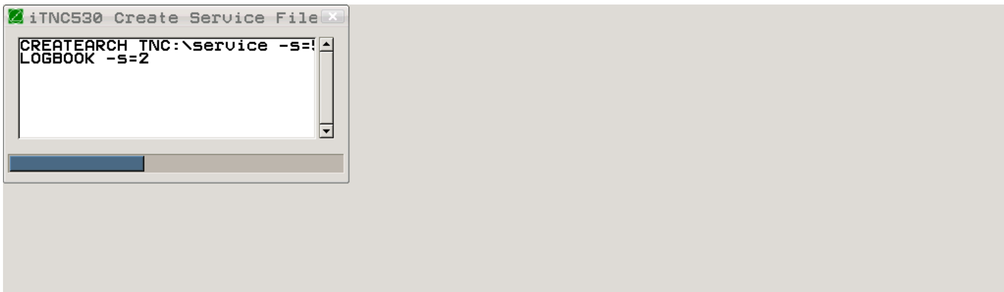


Figure: A service file is created automatically in the event of a serious error

7.3 Manual Generation of Service Files

Service files are created automatically at any time:

▶ Press the ERR key.

▶ Press the SAVE SERVICE FILES soft key.

.

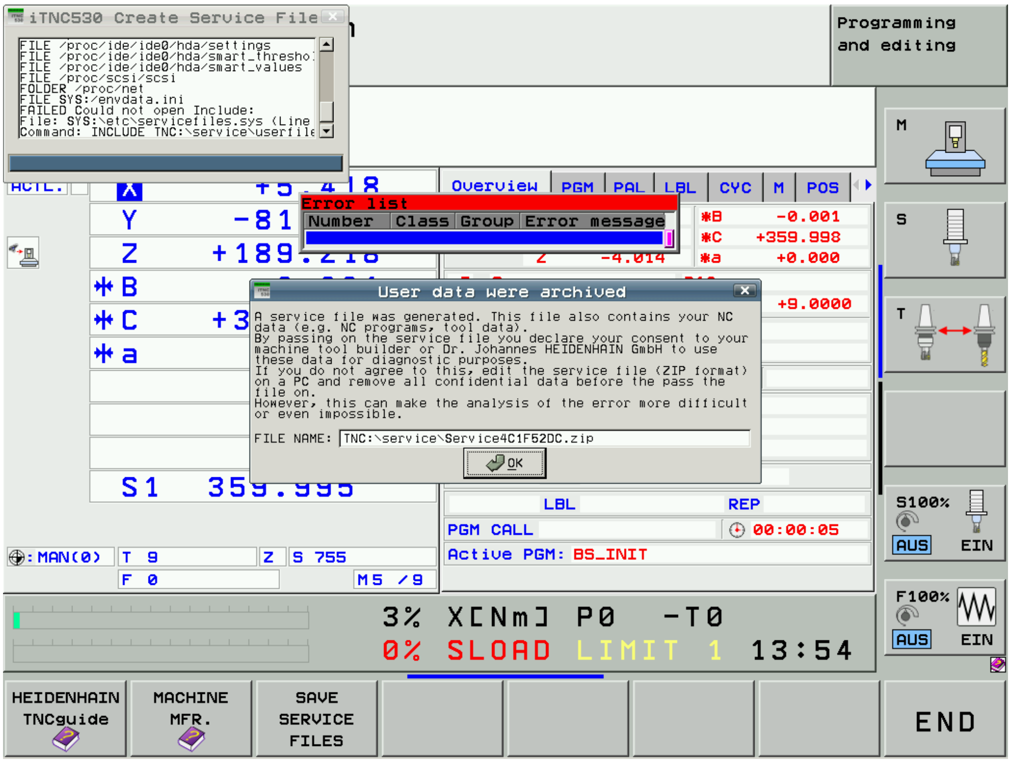
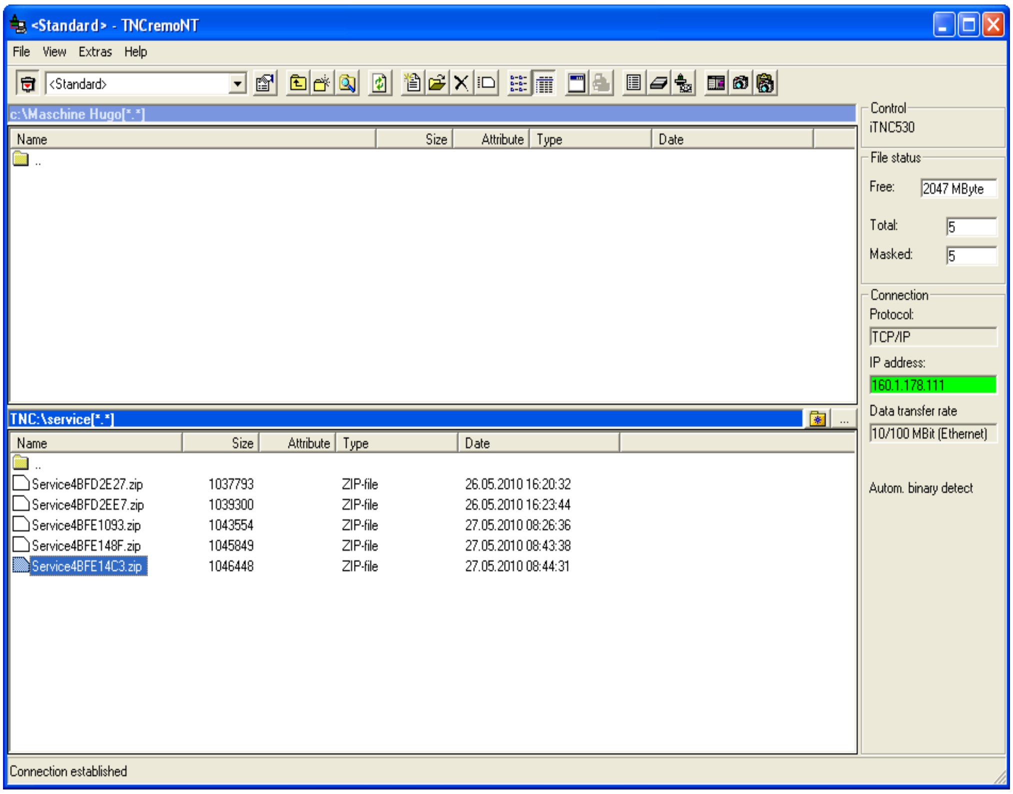


Figure: Service file is generated manually

7.4 Downloading of Service Files

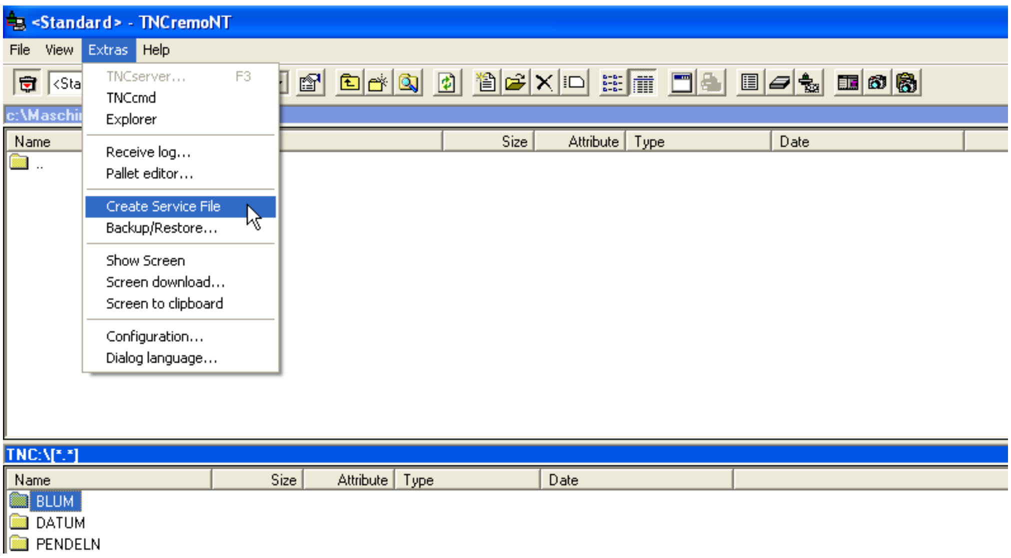
If service files were created automatically or manually on the control, they can be downloaded with TNCremoNT:

- Connect the control to the laptop/PC with TNCremoNT.
- Open the path **`TNC:\service\`** on the hard disk of the control.
- Download the service file:

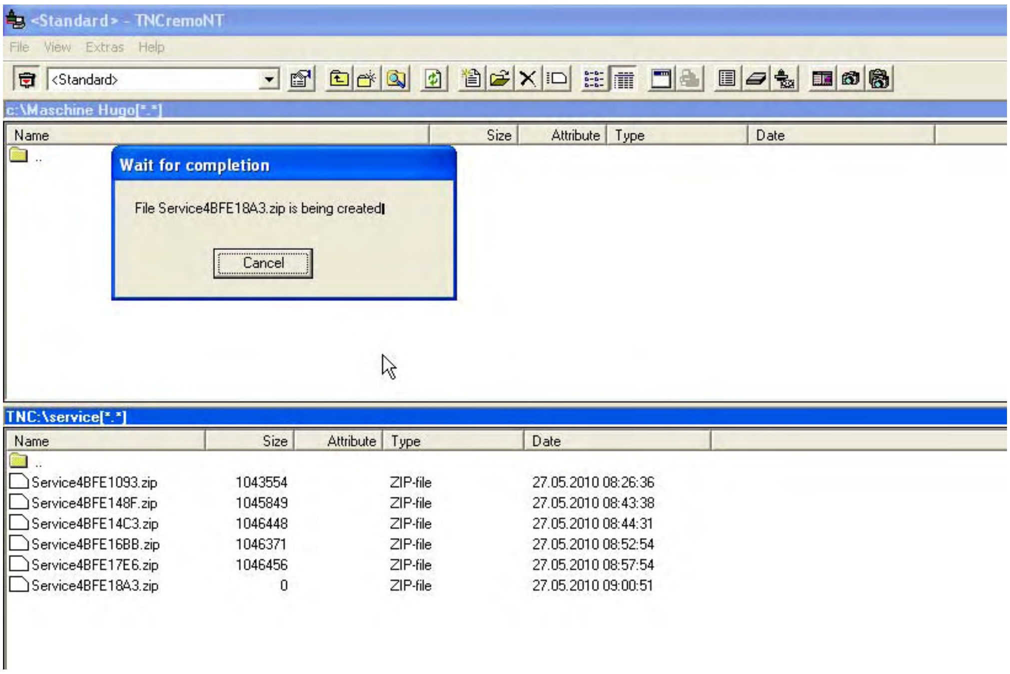


With the current program **TNCremoNT** it is also possible **to create and download service files directly from the laptop/PC**:

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



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



▶ Download the new service file:

Caution

The compressed service files also include the milling program the customer used in the event of an error or at the time of the manual creation of the service files!
If the customer does not wish the milling program to be forwarded, it can be removed from the **Service.zip** file.

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 a process memory.
- When the code number **`LOGBOOK`** is entered and the soft key EXECUTE is pressed, log entries are copied from the process memory into an ASCII file on the control's hard disk and are displayed.

> **Note**
>
> If you intend to perform tests and to see the entries in the log, you have to call it each time again.

- The 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 keystrokes are entered in **`INFO: MAIN KEYSOURCE: <source>`**.
  <source> may include following entries:
  - KEYBOARD
  - PLC
  - PLCNCSTART
  - HANDWHEEL
  - LSV2

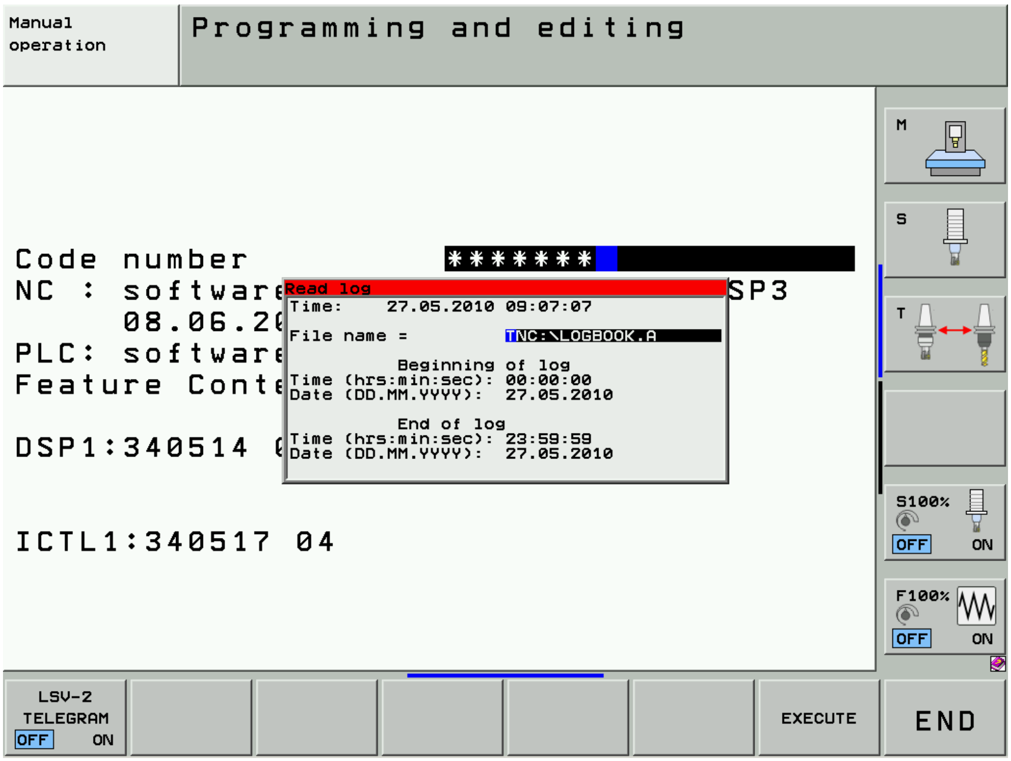
> **Note**
>
> The first horizontal soft key (down left on the screen) is recorded in the log as soft key 0, the second soft key as soft key 1, etc.
> The first vertical soft key (top right on the screen) is recorded in the log as V soft key 0, the second soft key as V soft key 2, etc.
> The **soft keys** are **numbered from left to right and from top to bottom.**
> The arrow keys for the switching of the soft-key rows are recorded.
> Any newly called soft-key row starts again 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 are used and which information is available for the service technician.

> **Note**
>
> Following messages are not shown in the log:
> **`File system error x`**
> Reason: In case of a write or read error all write activities on the hard disk are always interrupted 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. This is an information, not an error message. An entry in the log is not made.

8.2 Calling the Log

- Enter the code number **LOGBOOK.** –> Siehe “Input of Code Numbers” on page 3 – 18
  The following window appears:



- If you wish, you can change the path and the file name here.
  Default: **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!

> **Note**
>
> The log can be read out directly from the PC/laptop with the software tool TNCremoNT from HEIDENHAIN. The code number **LOGBOOK** has not to be entered on the control.
> The local time on the control and the PC/laptop should be identical!

8.3 Overview of Log Entries

Entry		Description
RESET		Restart the control.
ERR		Error messages ■ **P** --> PLC error message with line number in the PLC error text file ■ **N** --> NC error message with number ■ **Power fail interrupt ! -->** 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 in the log for **"dosfsck"**
INFO	MAIN ERRCLEARED	Confirmation of an error message
INFO	MAIN ERR_RECURED	Error message entered several times
KEY		Key strokes
INFO	MAIN SOFTKEY	Path with associated image file of a pressed soft key
STIB[a]	ON	"Control-in-operation" on
	OFF	"Control-in-operation" off
	BLINK	"Control-in-operation" blinking
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. Nr. 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 bodies 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

a. STIB (control-in-operation symbol) = "* " in the screen display

Entry		Description
INFO	MAIN PGMEND	Information about the program end in program run (you can find byte 0 and 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: NC program, line number, actual position, datum, datum shifts, tool number

Entry			Description
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)
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 WARNING ERROR	PLC <log identifier>		Entries through PLC modules 9275 and 9276
INFO	SYS	SHUTDOWN	Control was shut down
		REBOOT-TNC	Reboot the control
INFO[a]	REMO A_LG		Log in with LSV2 protocol
	REMO A_LO		Log out with LSV2 protocol
	REMO C_LK		LSV2 protocol: Locking and releasing the keyboard; the key codes between locking and releasing are sent via LSV2 protocol

a. For testing 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 via LSV2 protocol, the IP address of the external unit is entered in addition to the entry REMO A_LG.

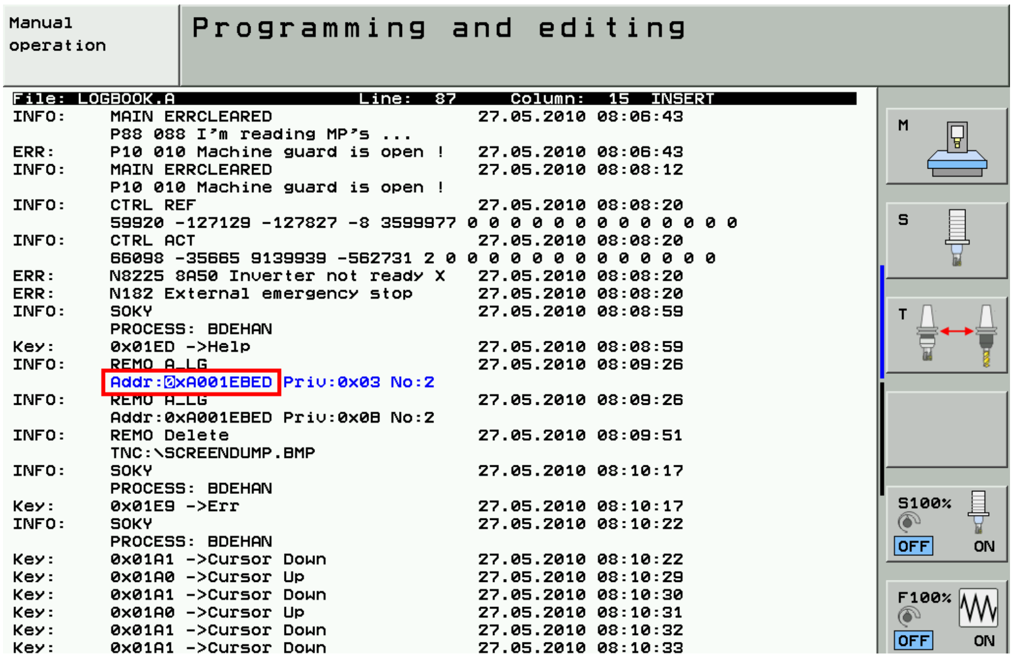


Figure: Entry of IP address of accessing unit (laptop/PC) in the log

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

Example for the IP address 0xA001F3B8:

Transformation IP address	
Hexadecimal display	**Decimal display**
B8	184
F3	243
01	1
A0	160

Result IP address	
Hexadecimal display	**Decimal display**
0xA001F3B8	160.1.243.184

Entry of operating system error messages

Operating-system error messages require a rebooting of the control. During rebooting the operating-system error message is entered in the log. The time when the operating-system error message is entered in the log is indicated, i.e., the reboot time. In the headline of the operating-system error message the Greenwich Mean Time (Universal Time) is shown.

Entry of NC programs

Not each 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 end of an NC program**.

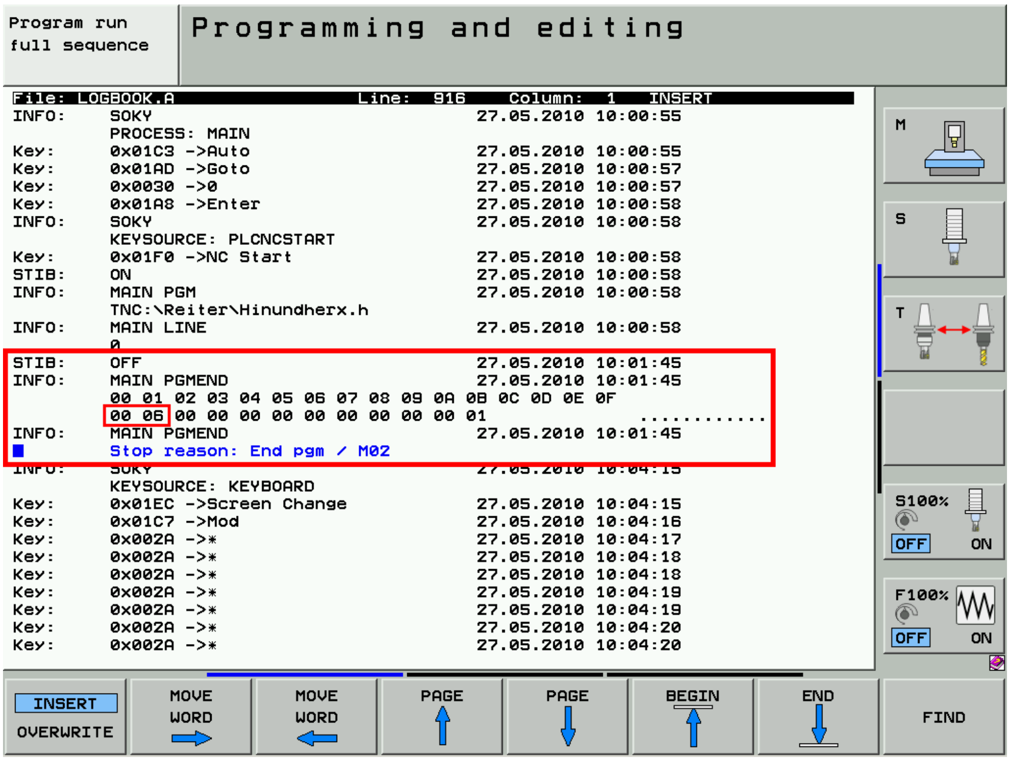


Figure: Example for information at program end

Here an NC program was exited 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 (Siehe “Overview of Log Entries” on page 8 – 83).
- **`INFO: MAIN PGMEND`**
  Information about the program end in conversational format.

8.4 Log Entries at Program Cancelation

If an NC program is not exited properly but aborted ahead of time 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 abortion
- ACTUAL position at program abortion
- Offset values with reference to the machine datum (preset)
- Set datum shift, if available
- Tool number
- Tool length, tool radius, etc.

```
Key:     0x01F0 ->NC Start                27.05.2010 10:10:26
STIB:    ON                               27.05.2010 10:10:26
INFO:    MAIN PGM                         27.05.2010 10:10:26
         TNC:\Reiter\Hinundherx.h
INFO:    MAIN LINE                        27.05.2010 10:10:26
         0
INFO:    CTRL REF                         27.05.2010 10:10:33
         569154 -131224 -138897 -9 3598004 0 0 0 0 0 0 0 0 0 0 0 0 0
INFO:    CTRL ACT                         27.05.2010 10:10:33
         575332 -39760 9128869 -562732 -1971 0 0 0 0 0 0 0 0 0 0 0 0 0
INFO:    CTRL PGM                         27.05.2010 10:10:33
         satznummer=3
ERR:     N41 Standstill monitoring err. in C 27.05.2010 10:10:33
INFO:    CTRL REF                         27.05.2010 10:10:33
         590186 -131224 -138897 -9 3595584 0 0 0 0 0 0 0 0 0 0 0 0 0
INFO:    CTRL ACT                         27.05.2010 10:10:33
         596364 -39760 9128869 -562732 -4391 0 0 0 0 0 0 0 0 0 0 0 0 0
INFO:    CTRL PGM                         27.05.2010 10:10:33
         satznummer=3
ERR:     N38 Excessive servo lag in X     27.05.2010 10:10:33
ERR:     N182 External emergency stop     27.05.2010 10:10:33
INFO:    CTRL REG                         27.05.2010 10:10:33
         Stop Reason: FAST_INPUT
STIB:    OFF                              27.05.2010 10:10:33
INFO:    MAIN PGMEND                      27.05.2010 10:10:33
         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                      27.05.2010 10:10:33
         Stop reason: Emergency stop
         NC program : TNC:\Reiter\Hinundherx.h line 3
INFO:    MAIN PGMEND                      27.05.2010 10:10:33
         Actual pos.:
          X = 59.6314
          Y = -3.9760
          Z = 912.8870
          B = -56.2732
          C = -1.0352
         Preset     : (Range = 0)
          X = 0.6178
          Y = 9.1464
          Z = 926.7766
          B = -56.2723
          C = 0.0025
         Datum shift:
          X = 0.0000
          Y = 0.0000
          Z = 0.0000
          B = 0.0000
          C = 0.0000
         Tool number: 2 (length = 40.0000, radius = 2.0000,
                         DL = 0.0000, DR = 0.0000)
         PalletPreset: no
INFO:    MAIN PGMEND                      27.05.2010 10:10:33
         PGM: SK_2DGER: bewegt: X koordkenz: XY
         Flags: stetig singleend eilgang
         L=300.0000 BESCHL=0.500 PROGF=10000.000 MAXF=10000.000 STARTF=173.000
         ABSCHNITT(X)=300.0000 POS(X)=300.0000
         ABSCHNITT(Y)=0.0000 POS(Y)=-3.9760
STIB:    OFF                              27.05.2010 10:10:33
INFO:    SOKY                             27.05.2010 10:10:37
         KEYSOURCE: KEYBOARD
Key:     0x01EC ->Screen Change           27.05.2010 10:10:37
Key:     0x01C7 ->Mod                     27.05.2010 10:10:38
Key:     0x002A ->*                       27.05.2010 10:10:39
Key:     0x002A ->*                       27.05.2010 10:10:40
Key:     0x002A ->*                       27.05.2010 10:10:40
Key:     0x002A ->*                       27.05.2010 10:10:40
Key:     0x002A ->*                       27.05.2010 10:10:41
Key:     0x002A ->*                       27.05.2010 10:10:41
Key:     0x002A ->*                       27.05.2010 10:10:41
Key:     0x01A8 ->Enter                   27.05.2010 10:10:42
INFO:    MAIN KEYCODE                     27.05.2010 10:10:42
         Valid Key Code: LOGBOOK
Key:     0x0186 ->Softkey 6               27.05.2010 10:10:43
INFO:    SOKY                             27.05.2010 10:10:43
         IDENT:   GRS.S_EXECUTE
         PROCESS: MAIN
         SOFTKEY: /SYS:/resource/sk/1024x768/allg/command.bmx
         OVERLAY: 1
[END]
```

Figure: Excerpt from a log at program abortion

Considering the tool length

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

In this example:
115.5001 - 120.0000 = - 4.4999 (ACTUAL position display of the tool axis Z on the monitor)

Calculating the REF position

Not the ACTUAL values at the time of the program abortion are interesting for the service engineer, but the REF values which represent the positions with reference to the machine datum.

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

In this example:

`Actual pos.`		**`Preset`**		REF position	
76.6001	-	(- 201.7407)	=	278.3408	X axis
1.9861	-	(- 96.7370)	=	98.7231	Y axis
115.5001	-	131.1721	=	- 15.6720	Z axis
0.4139	-	332.4911	=	- 332.0772	A axis

Note

The REF position of the tool axis Z calculated in the example (- 15.6720), is also displayed on the control monitor with the position display setting REF.
This display always refers to the datum of the tool holder.
To determine the REF position of the tool tip, the tool length still has to be subtracted (-15.6720 - 120.0000 = - 135.6720).

9 Integrated Diagnostic Functions and DriveDiag

9.1 Introduction

The iTNC 530 features **numerous diagnostic functions** for finding errors.

These diagnostic functions provide information on:

- Operating states and signals;
  for this purpose, **traffic light symbols** (red, yellow, green) are used.
- Voltage values
- Current values
- Temperature values
- Electronic ID labels
- Motor data

The integrated diagnostic functions can also be used to **test the position encoders**.

The integrated diagnostic functions were **completely revised with the release of NC software version 34049x-04** and are summarized under the term **DriveDiag**.
The features were expanded and the operation and display of the editor were changed.
The application of the integrated diagnostic functions before and as of NC software version 34049x-04 is explained in this manual!

9.2 Activation and Operation

Calling the drive diagnosis

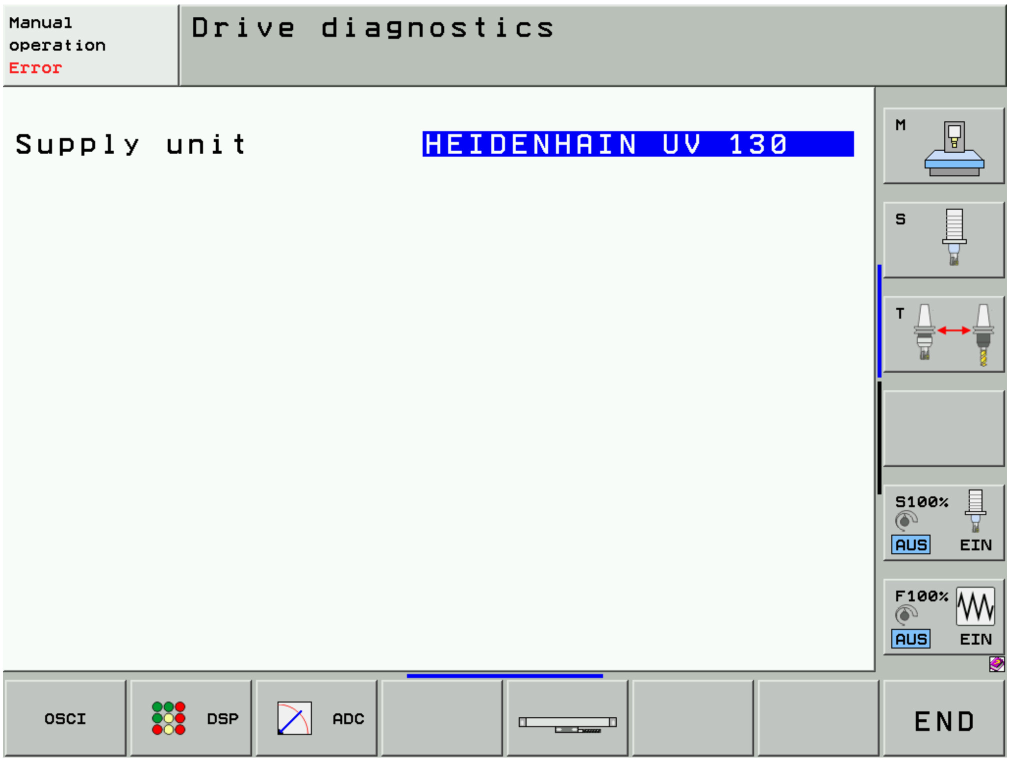
Up to and including NC software version 34049x-03:

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

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

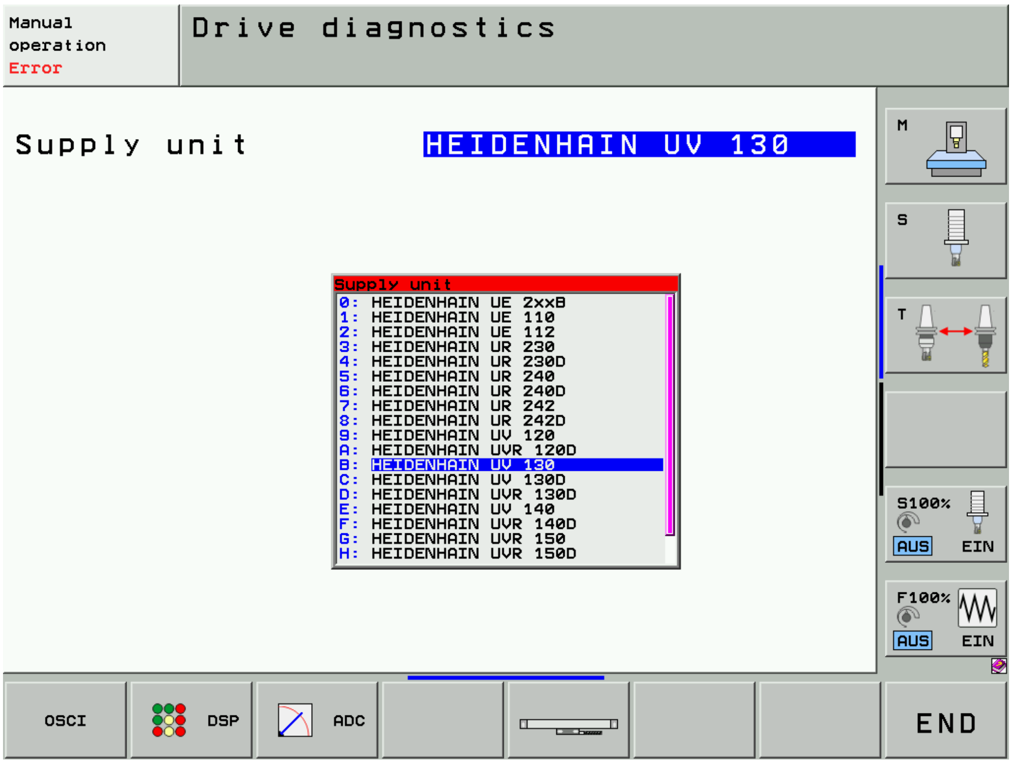
> **Note**
>
> Pressing the MOD key while the program manager is open calls the interface settings.

▶ Press the MOD key.
▶ Press the DIAGNOSIS soft key.
▶ Press the DRIVE DIAGNOSIS soft key. --> A new window opens:



Selecting the supply device

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



- Select the inverter used on the machine.

Note

To ensure that all information of the selected inverter are made available for the diagnostic functions, exit the diagnosis completely and open it again. –> All pages will be refreshed.

Operating the drive diagnosis

- The diagnostic functions can be called by activating the displayed soft keys.

> **Note**
>
> OSCI soft key. --> See "Integrated Oscilloscope" on page 10 – 99.

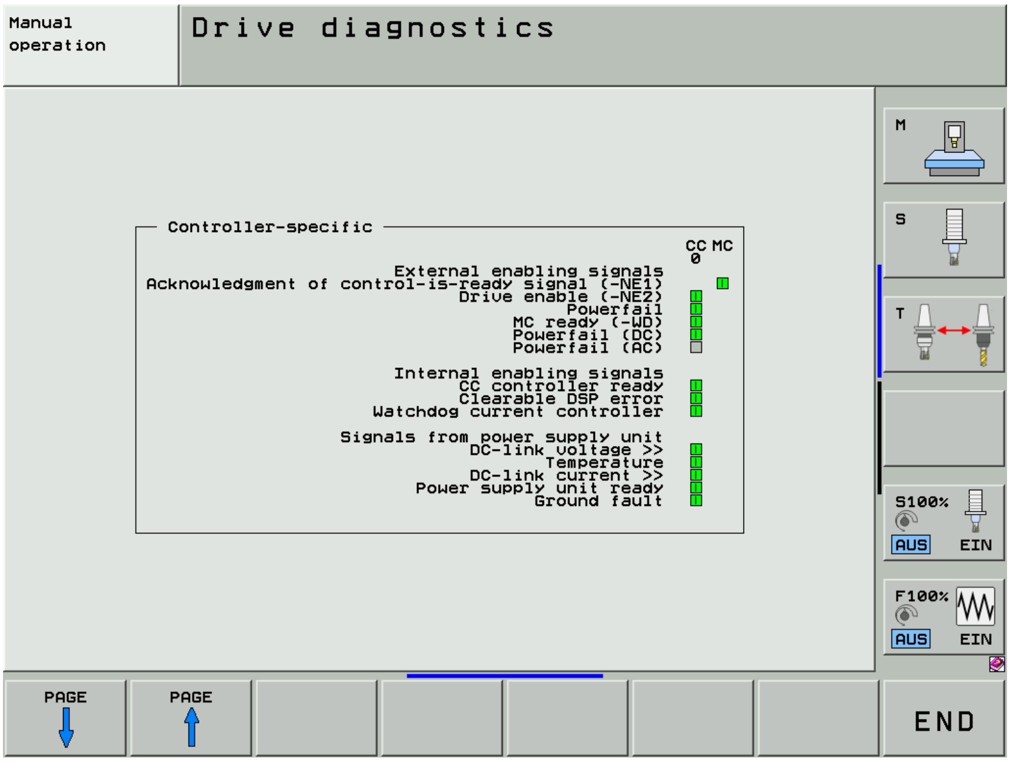


Figure: DSP diagnosis, first page

> **Note**
>
> Use the PAGE soft key to move between both DSP diagnosis pages.

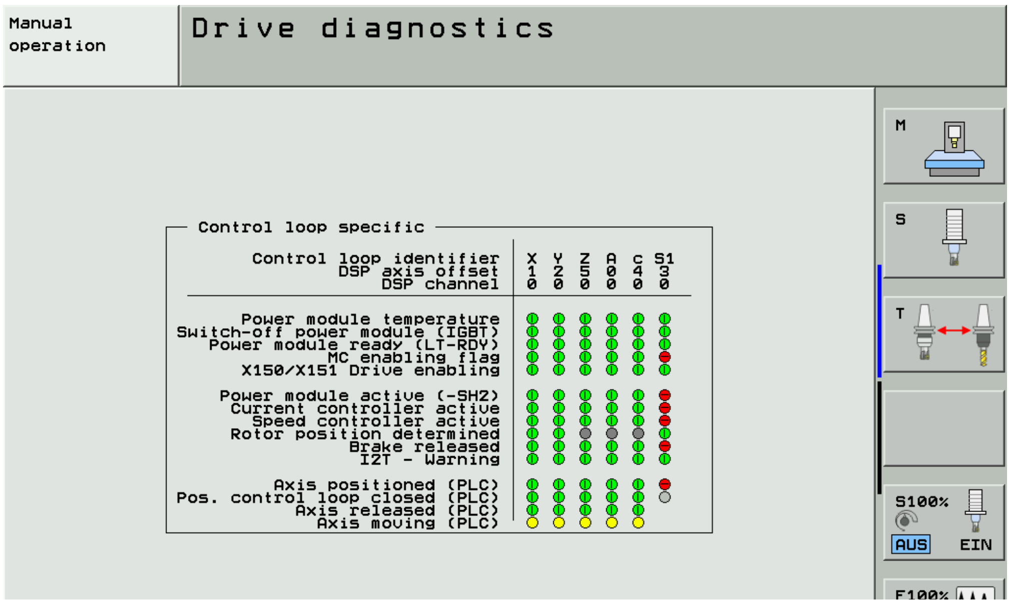


Figure: DSP diagnosis, second page

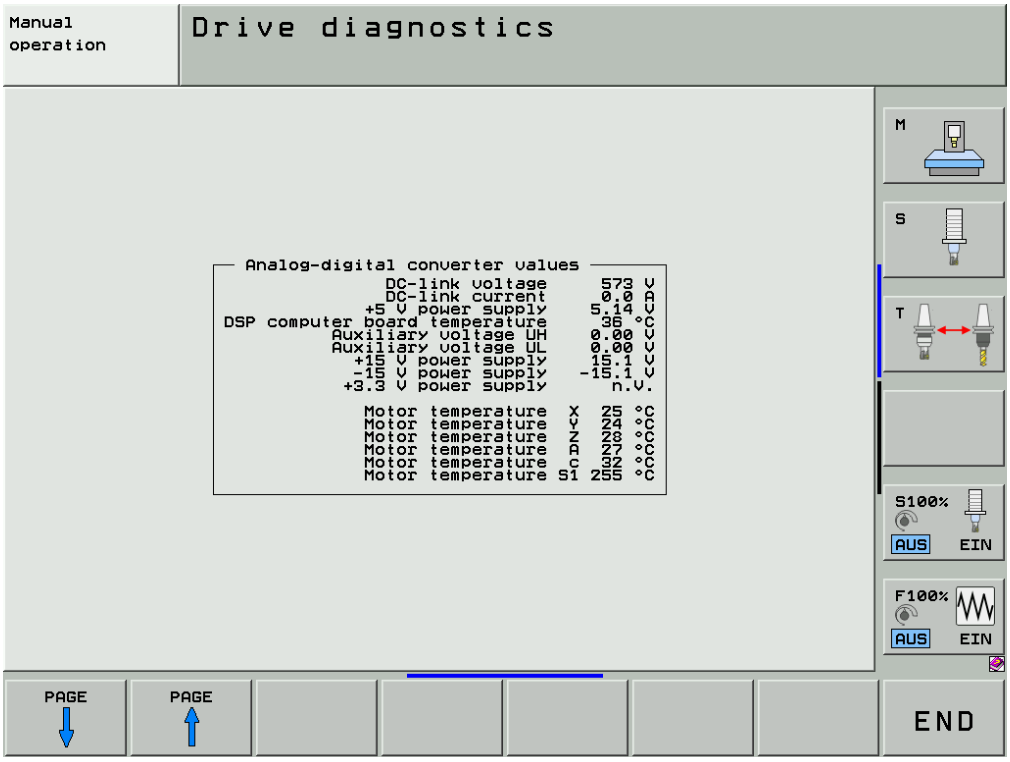


Figure: ADC diagnosis

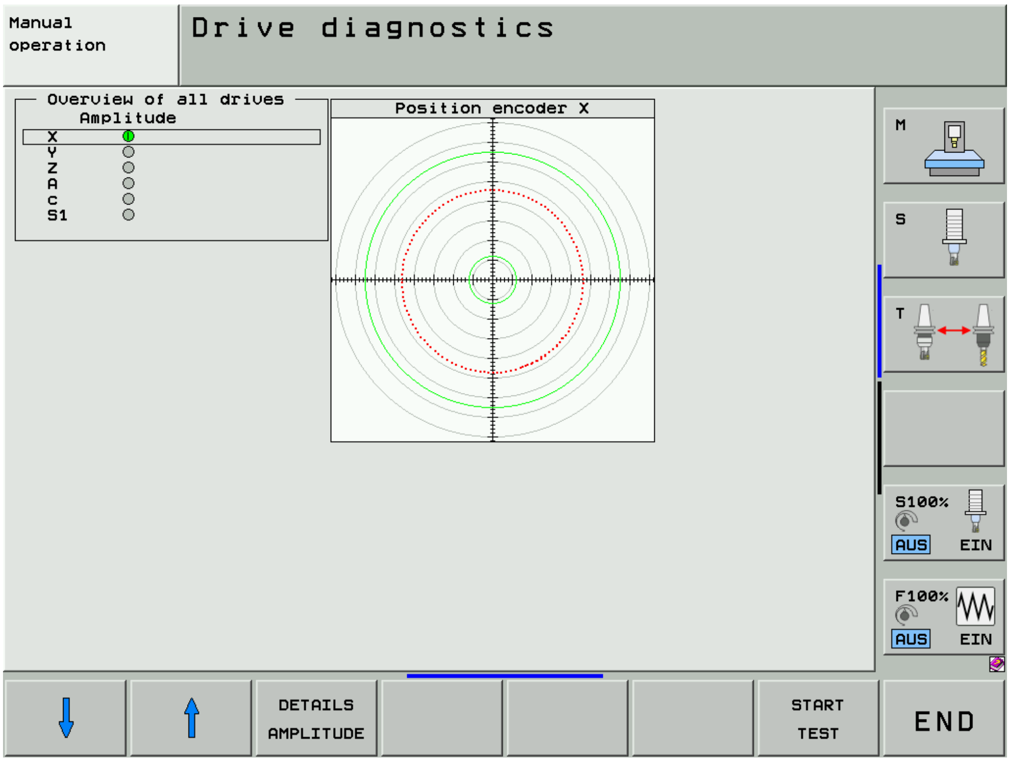


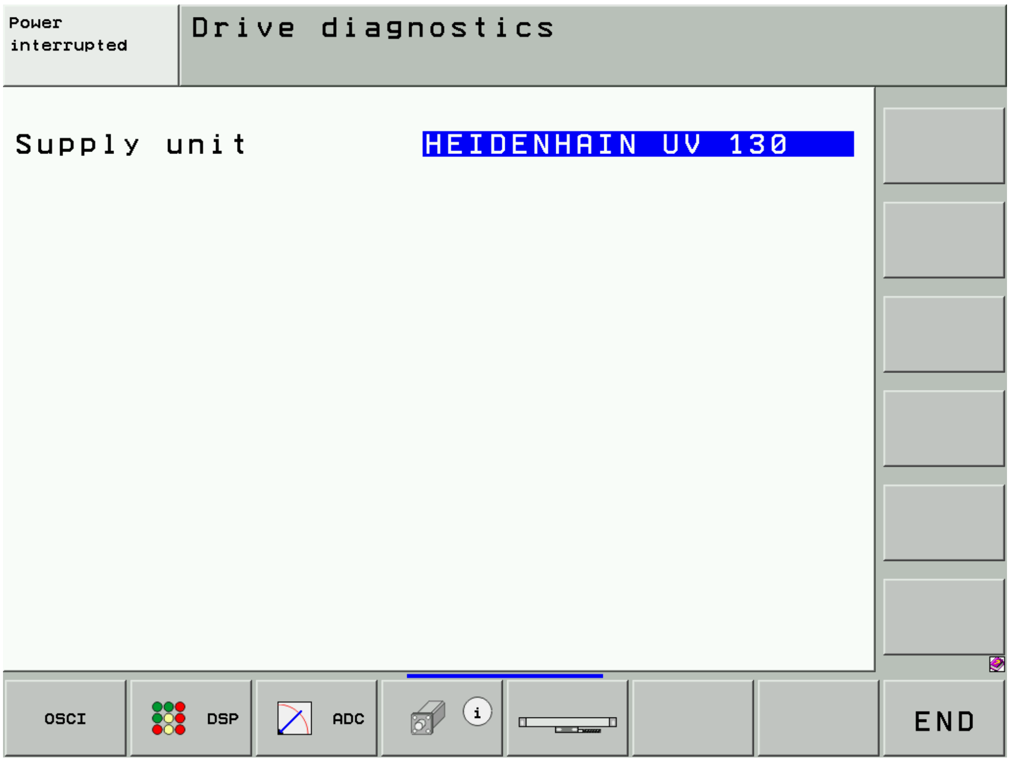
Figure: Test of position encoder

- Press the END soft key to leave the individual pages and the drive diagnosis.

Calling the drive information

Up to and including NC software version 34049x-03:

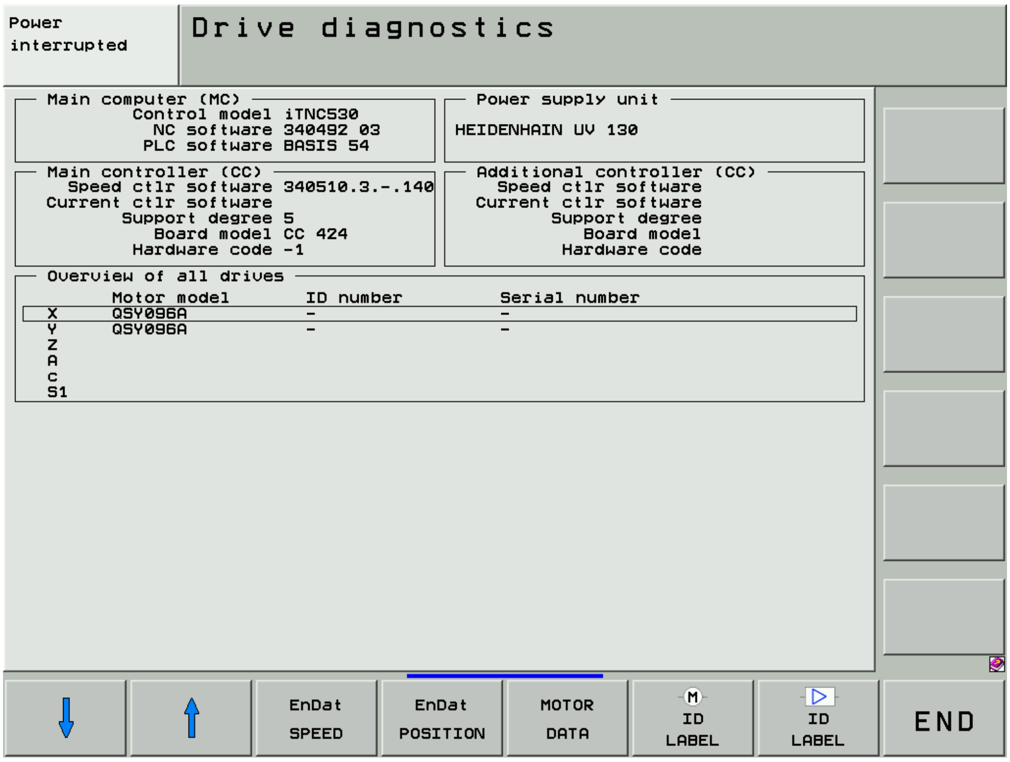
- Shut down and switch off the machine.
- Switch on the machine; do not confirm the **`Power interrupted`** message.
- Select the **`Programming and Editing mode of operation`** (the program manager must not be open).
- Press the MOD key.
- Press the DIAGNOSIS soft key.
- Press the DRIVE DIAGNOSIS soft key. --> A new window opens:



Note

The DRIVE DIAGNOSIS soft key is only visible until the **`Power interrupted`** is confirmed.

▶ Press the DRIVE INFORMATION soft key. --> A new window opens:



▶ Available information can be called by activating the displayed soft keys.

The following information is available:

Soft key	Function
	In **`Overview of all drives`** you use these soft keys to select a drive. The following soft keys display more detailed information.
	
	If an absolute speed encoder with EnDat interface is connected, a detailed display of the encoder information appears.
	If an absolute position encoder with EnDat interface is connected, a detailed display of the encoder information appears.
	The motor data for the selected motor is displayed from the motor table.
	If a HEIDENHAIN motor with an electronic ID label is connected, a display of the information stored in the ID label appears.
	If a HEIDENHAIN power module with an electronic ID label is connected, a display of the information stored in the ID label appears.

▶ Press the END soft key to leave the individual pages and the drive information.

Calling DriveDiag

As of NC software version 34049x-04:

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

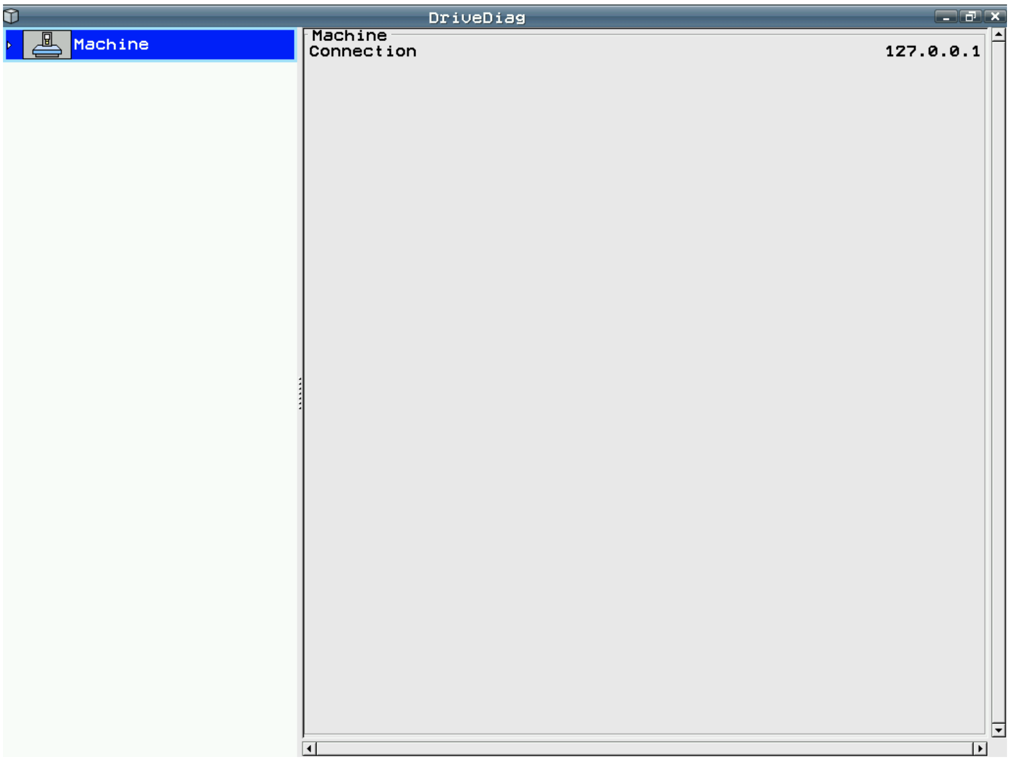
▶ If open: Close the program management by pressing the END button.

Note

Press the MOD key while the program manager is open calls the interface settings.

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

▶ Press the DRIVEDIAG soft key. --> A new window (in addition to the window for the machine operating modes and the window for the programming modes) is opened:



How to operate DriveDiag

- You can open and close the tree structure on the left side of theDriveDiag 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.

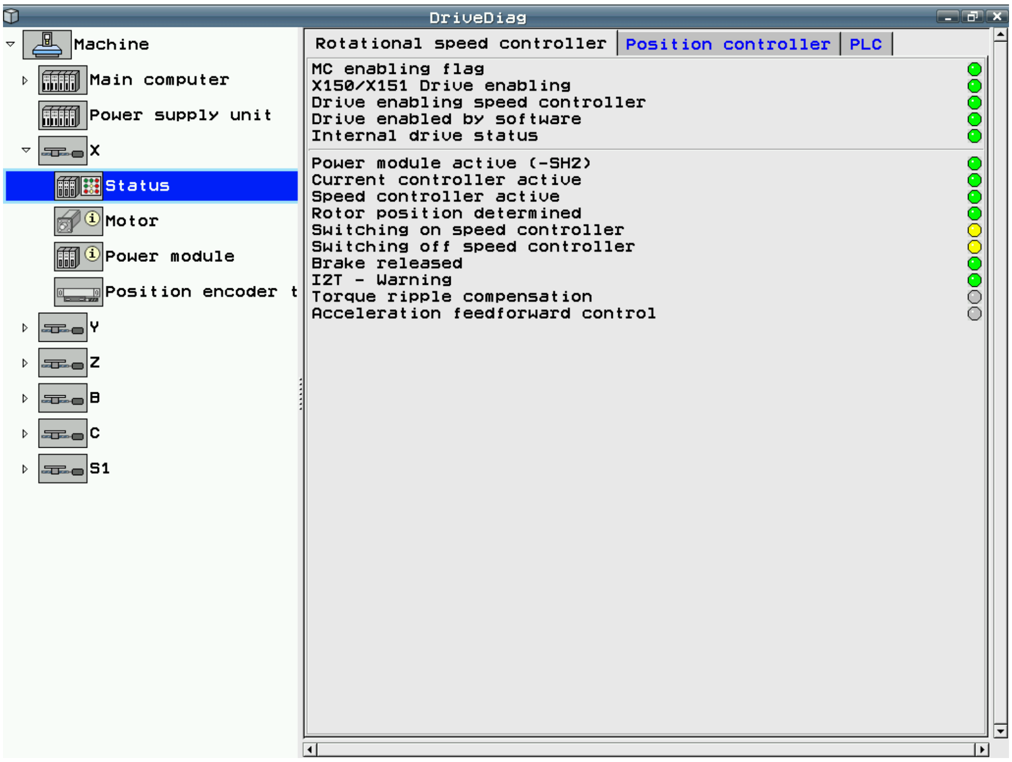
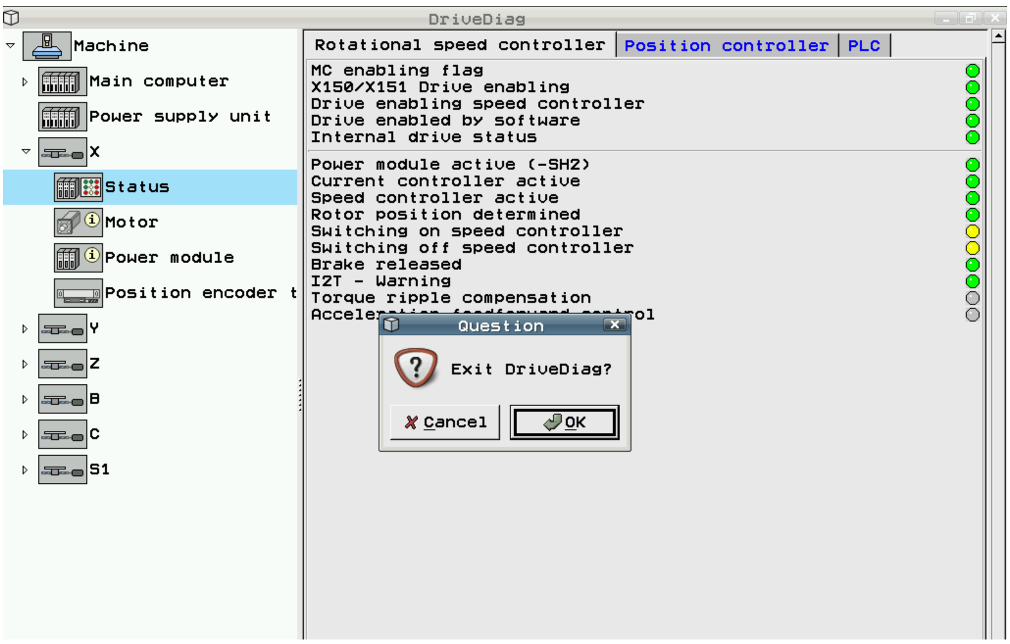


Fig: DriveDiag with open tree structure

> **Note**
>
> We recommend to use the mouse to navigate in DriveDiag.

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

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



9.3 For Error Diagnosis

The use of the intetgrated diagnostic functions or of DriveDiag for error diagnosis is **described in the respective chapters** of this Service Manual.

10 Integrated Oscilloscope

10.1 Introduction

The iTNC 530 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 are to be displayed from the current and speed controller, the error message `Channel <number> cannot be displayed`.

Advantages 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(nominal)` 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**.
- With the respective hardware and software version **signals of encoders** (position encoders, motor encoders) can be recorded.

10.2 Activation and Settings

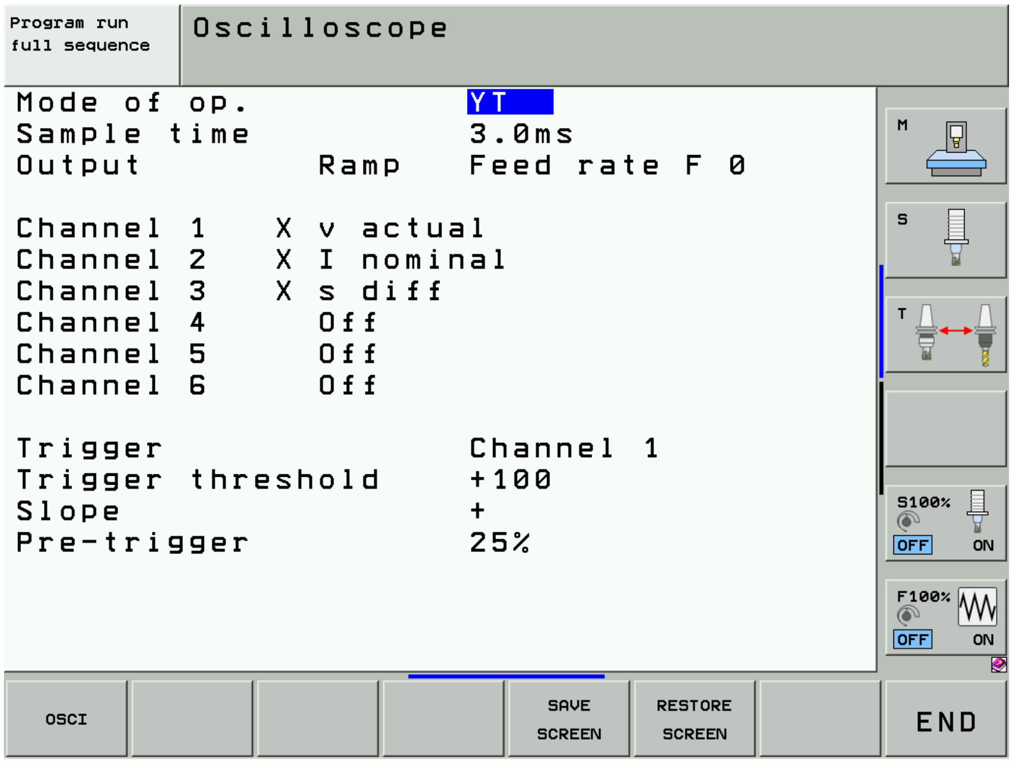
▶ Select the **`Programming and Editing`** operating mode.

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

> **Note**
>
> Pressing the MOD key while the program manager is open calls the interface settings.

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

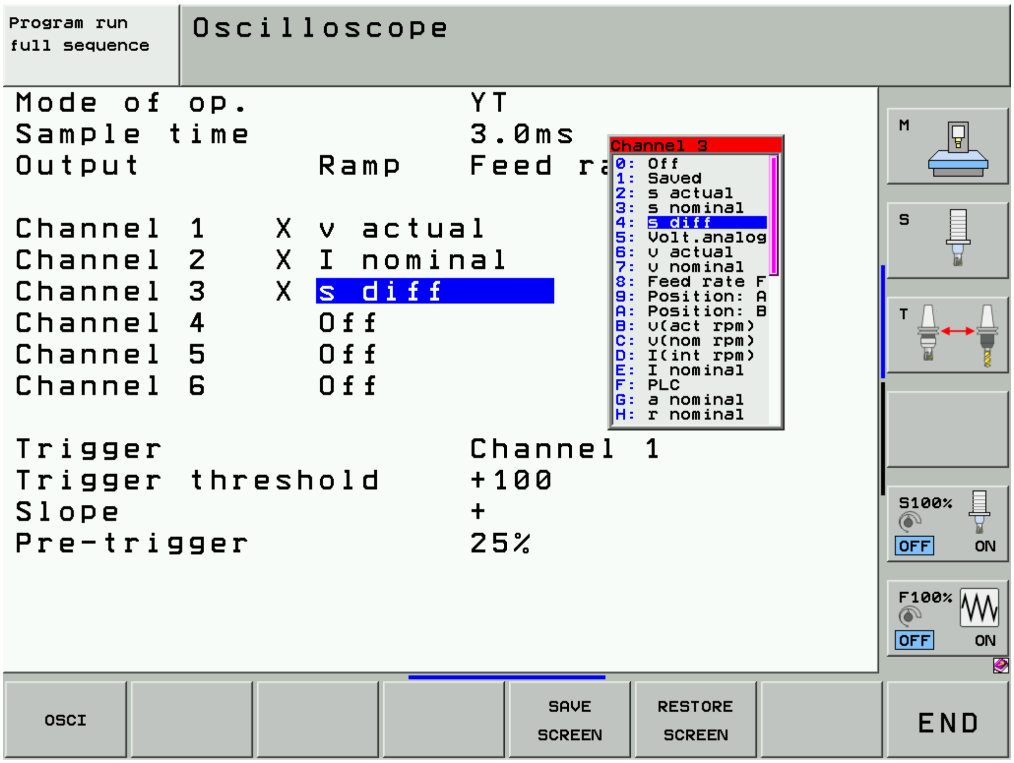
▶ Press the OSCI soft key. --> The setup menu appears.



> **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 selection windows.

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



Mode of operation

▶ 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 form test

Sample time

▶ Set the time interval for recording the signals.

Enter, e.g., 0.6 ms, 1.8 ms and 3.6 ms (depending on the set cycle times).
4096 grid points are saved. The time interval determines the duration of recording.

Example:

0.6 ms	x	4096	=	2.4576 s
1.8 ms	x	4096	=	7.3728 s
3.6 ms	x	4096	=	14.7456 s

Output

- ▶ Select whether the nominal speed value is to be output as a jump or a 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.` During output, the position control loop is open. For safety reasons the step response is only possible after entering a code number.

DANGER

With the step function the machine can be accelerated with maximum force.

- When the step function is used improperly, machine damage or even **personal injury** can be caused!
- Recordings made with the step function in the integrated oscilloscope are mainly used for the optimization of control loops on the machine. The optimazation may only be performed by trained specialists of machine tool builders.
- The indicated 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

- ▶ Define the height of the jump for the nominal speed value (mm/min). If you have defined a ramp as output, this field has no meaning.

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 the recording of 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	As of NC software version
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	Servo lag 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	-	CC 422: xxxxxx-xx CC 424: 34049x-03
Position: B	Signal B of the position encoder	-	CC 422: xxxxxx-xx CC 424: 34049x-03

Signal	Meaning	Unit	As of NC software version
V (act rpm)	Actual speed value; Calculated from rotary speed encoder and standardized with MP1054	[mm/min] or [°/min]	
V (nom 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 422: peak value, CC 424: effective value	[A]	
I nominal	Nominal current value that determines torque CC 422: peak value, CC 424: 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]	
Pos. Diff.	Difference between position and speed encoder	[mm] or [°]	
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]	
I2-t (mot.)	Current value of the I^2-t monitoring of the motor	[%]	340420-02
I2-t (p.m.)	Current value of the I^2t monitoring of the power module	[%]	340420-02
Utilization	Current utilization of the drive	[%]	340420-02
Block no.	Block numbers of the NC program	-	340420-02
Gantry diff.	Difference between synchronized axes	[mm]	340420-02
U nominal	Nominal voltage	[V]	
P mech.	Mechanical power	[W]	
P elec.	Electrical power [W]	[W]	
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	-	
Deviation	Circular form test, contour deviation [mm]	[mm]	340422-03 340480-03
F TCPM	Feed rate at the tool tip with TCPM	-	340422-10 340480-10
Int. diagn.	Reserved for internal purposes	-	340422-10 340480-10
DC-link P	DC-link voltage (if MP 2198.x and MP 2199.x are configured)	-	34049x-04 only with CC 424
Amplitude	Amplitude of the position encoder	-	34049x-04 only with CC 424
Motor: A	Signal A of the speed encoder	-	34049x-04 only with CC 424
Motor: B	Signal B of the speed encoder	-	34049x-04 only with CC 424
CC DIAG	Axis-specific signal with additional input field. Contact your machine manufacturer or a HEIDENHAIN service agency.	-	34049x-04 only with CC 424

Note

The **current signals** in the integrated oscilloscope, when using the controller unit **CC 422, are shown as peak values**, when using the controller unit **CC 424 as effective values**.

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`
    If 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 has been stored in case the pre-trigger is set to 25, 50, 75 or 100%, then correspondingly fewer grid points are recorded.

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.

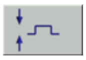
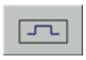
Note

The oscillogram remains stored until you start a new recording.

Vertical resolution

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

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

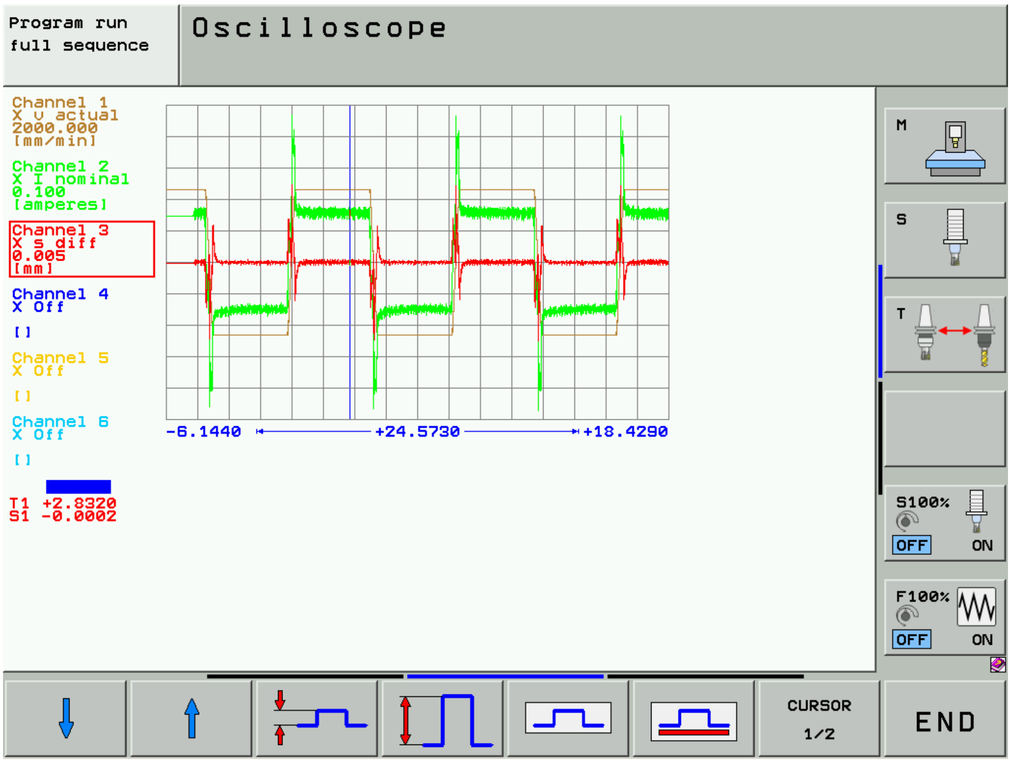
	Shift the signal downward.
	Shift the signal upward.
	Decrease the vertical resolution.
	Increase the vertical resolution.
	Optimum vertical resolution. The signal is centered on the vertical center and always remains in the display area.
	Optimum vertical resolution under consideration of offsets to 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 indicated with 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:



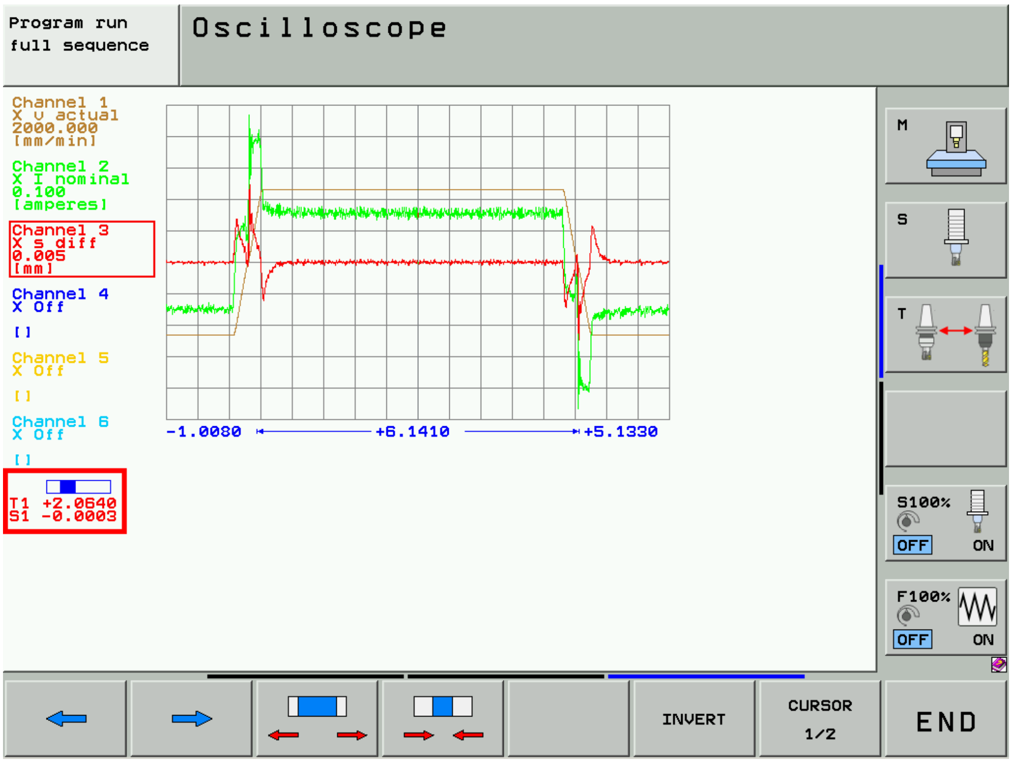
Horizontal resolution

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

The signal details can be made visible:



Note

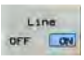
The displayed time detail is shown in a small bar at bottom left.
Every new recording is displayed with this setting.

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:

Meaning of the soft keys:	
	Hide/show gridlines.
	Hide/show connecting lines between measured points.
	Invert the signal.
	Exit the oscilloscope function.

Cursor information

You find the cursor information at the bottom 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.

With the CURSOR 1/2 soft key, you can activate a second cursor.
For the **cursor 2** the signal amplitude and the time (in seconds) are displayed **in relation to cursor 1**. This function allows you for example to measure the acceleration time of an axis.

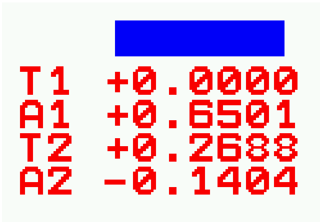


Figure: Cursor information

Cursor information	Comment
T1:	Position of cursor 1 in [s], related to the trigger event
A1:	Signal amplitude at position of cursor 1
T2:	Position of cursor 2 in [s], related to cursor 1 (time difference)
A2:	Signal amplitude at position of cursor 2, related to signal amplitude at position of cursor 1

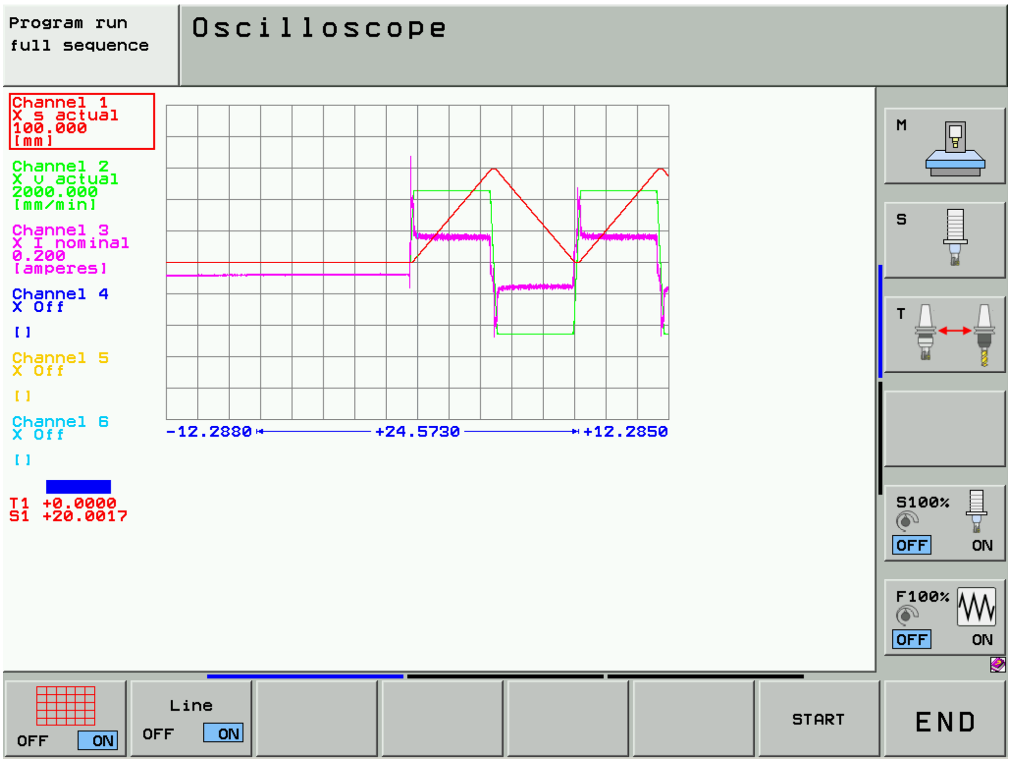
Specific for pre-triggering

See “Pre-trigger” on page 104.

Note

If the trigger condition is fulfilled **before** the corresponding number of grid points has been stored in case 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. 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. --> There appears a suggestion for the path and name of an oscilloscope file in the header:

> **Note**
>
> You can change the path and name of the oscilloscope file. The file extension must alway 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. --> There appears a suggestion for the path and name of an oscilloscope file in the header:

> **Note**
>
> Enter here whether the oscillogram was filed under another name in another path.

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

10.5 For Error Diagnosis

10.5.1 Triggering on error marker

With the integrated oscilloscope you can record 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).

The advantage of this method is that 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.

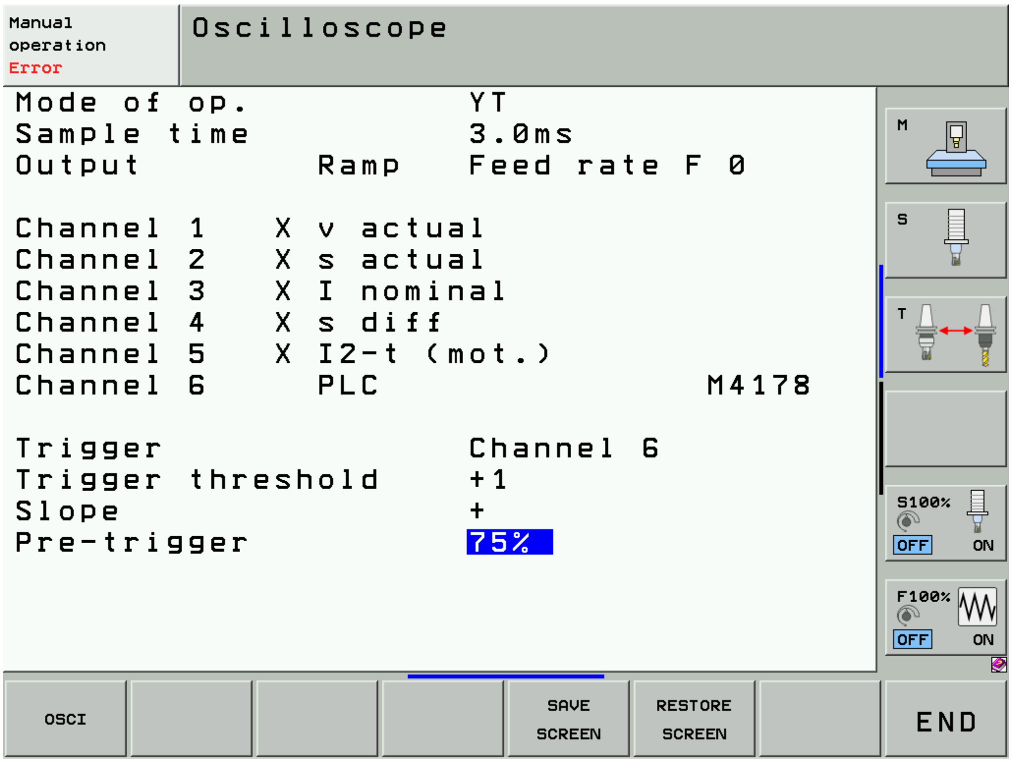


Figure: 75 % triggering on error marker M 4178, channel 6

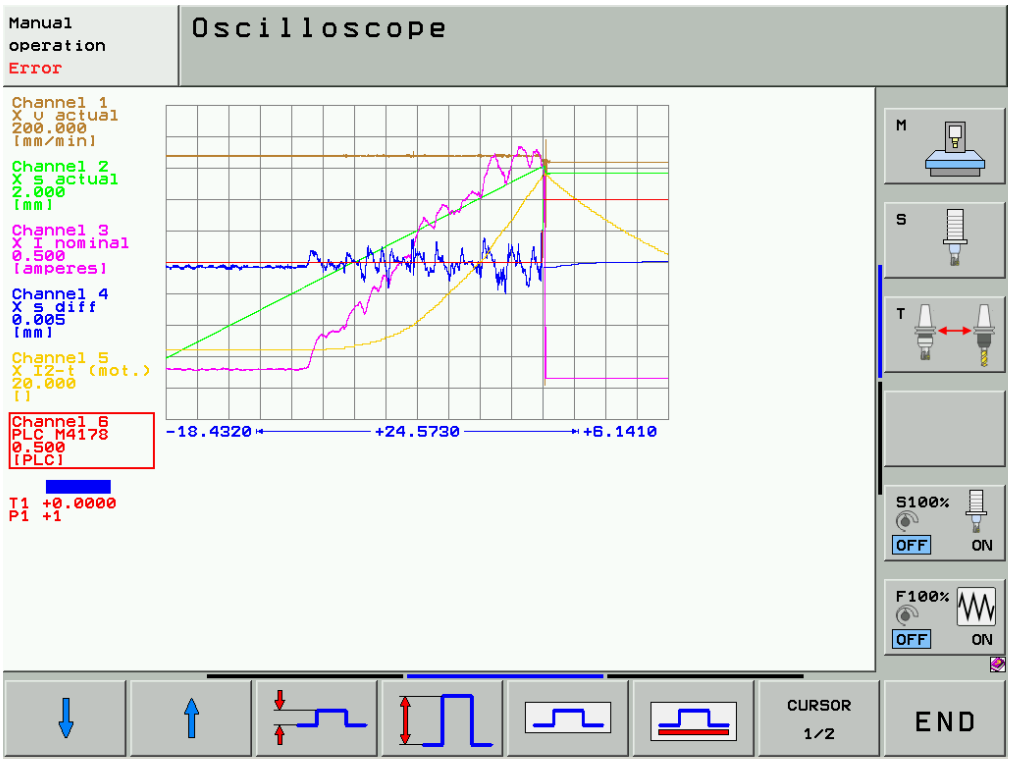


Figure:
An overload generates an I2T error message on the machine, which in turn generates an EMERGENCY STOP. The error marker M 4178 changes from zero to one.
On the time axis, 75 % before the error event are displayed.

10.5.2 Circular interpolation test

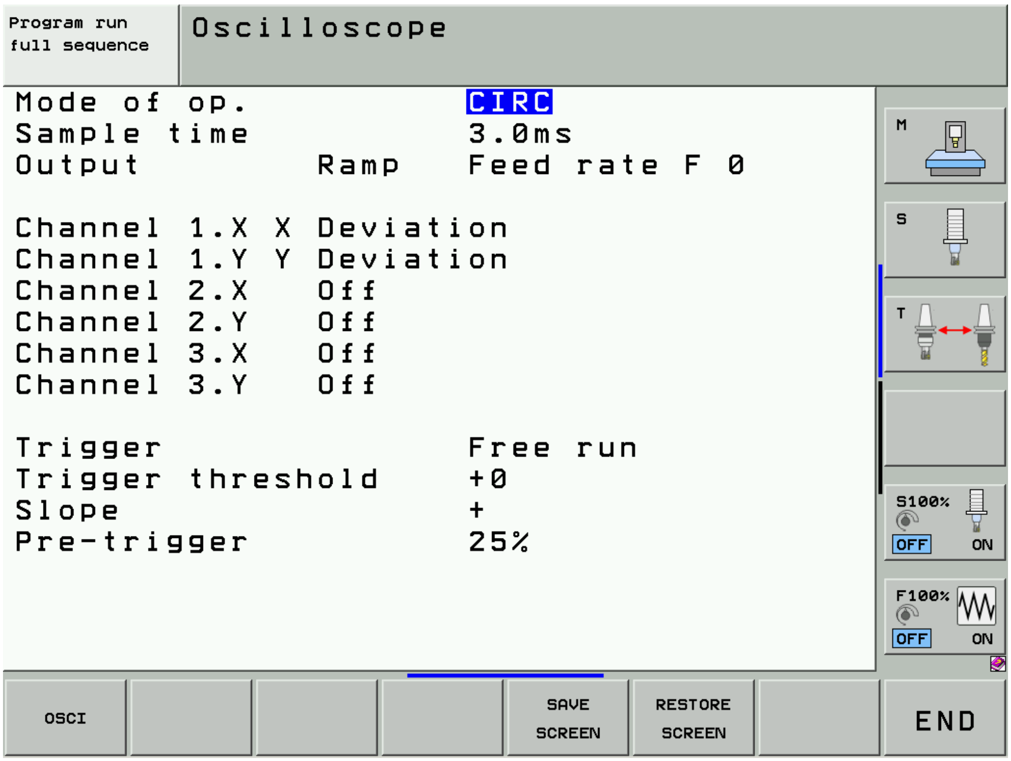
The integrated oscilloscope also contains a circular interpolation test (as of NC software 340422-03, 340480-03).

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., scales) does not serve to test the geometry of the machine!
Here additional measuring equipment (e.g., KGM grid encoder from HEIDENHAIN) is required.

- Choose the **CIRC** operating mode in the oscilloscope.
- Select the **Deviation** setting for the appropriate axes in the two channels.



Example of a circular interpolation test with the integrated oscilloscope:

> **Note**
>
> Ask the machine operator how to operate the machine and how to create and execute the NC program!

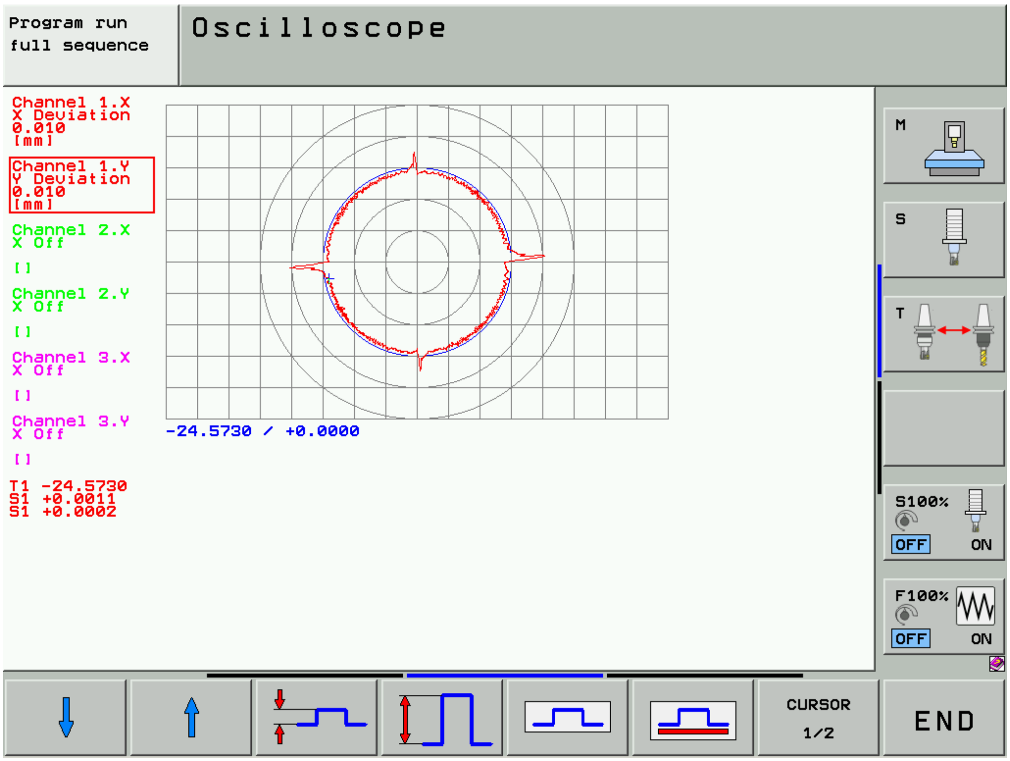
- Position the axes in an area that allows safe traverse of the circle.
- Set the reference points for X and Y as follows:

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 Descriptions in this manual

The 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 is an integral part of a HEIDENHAIN control and is therefore referred to as **Integral 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 in the PLC program or 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

To be in a position to carry out adaptation and control tasks, the PLC has to exchange data with the machine but also 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**.

PLC error messages

See “Error Messages” on page 4 – 21.

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

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 the interface settings.

MOD ▶ Call the code number window.

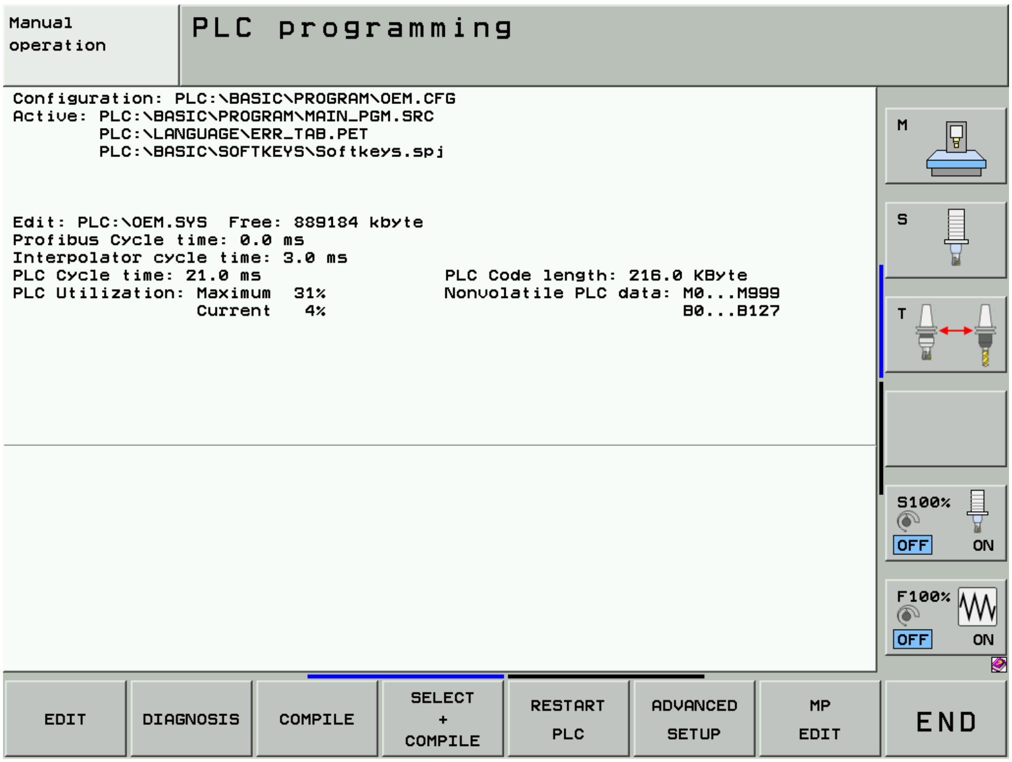
8 0 7 6 6 7 ENT ▶ Enter and confirm the code number.

▶ 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 mode with his own code number.
The diagnosis possibilities with the standard PLC code number 807667 are limited.
--> Ask your machine tool builder!

PLC main page



On this page you see, e.g.:

- Which PLC main program is running
- Which PLC error table is used
- Availability of memory on the PLC partition
- The PLC utilization

Note

The processing time of the PLC (time for one PLC scan) 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, also values considerably higher than 100% may be displayed for the PLC utilization. You do not have to take any measures!
Only when the permissible PLC utilization is superseded, the error message **`PLC: time out`** --> Contact your machine manufacturer!

- The range of non-volatile PLC markers and words (or bytes)

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 “Integrated Diagnostic Functions and DriveDiag” on page 9 – 89.
COMPILE	Compile files registered in OEM.SYS.	
SELECT + COMPILE	Select and compile files to be compiled.	
RESTART PLC	Stop and restart the PLC program (M4173 is supported).	
MP EDIT	Show a list of machine parameters.	See “The Machine Parameter Editor” on page 30 – 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 – 129.
TABLE	Display the logical states of the PLC operands.	See “The TABLE function” on page 11 – 119.
LOGIC DIAGRAM	Show the logic diagram.	See “The LOGIC diagram” on page 11 – 125.
TRACE IN-CODE	Display the TRACE function.	See “The TRACE function” on page 11 – 128.
PROCESS MONITOR	Display the process monitor.	
OSCI	Activate the integrated oscilloscope.	See “Integrated Oscilloscope” on page 10 – 99.
END	End PLC programming.	

11.2 Possible Causes of Errors

General information

- PLC power supply missing
- Overload, short-circuit on an output
- Defective PLC input at the MC or the PLC expansion card
- Defective PLC output at the MC or the PLC expansion card
- Defective cable or connector
- Faulty clamp or screw connection
- Bouncing switches (e.g. mechanical pushbutton switches)
- Poor shielding and grounding
- Electromagnetic fields
- Disturbance 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 the use of PROFIBUS

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

11.3 Diagnosis Tools in the PLC Mode

iTNC 530 provides comprehensive PLC diagnosis options.

▶ Call the PLC mode. --> See “Calling the PLC mode” on page 11 – 115.

Note

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

11.3.1 The TABLE function

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

Call

▶ Scroll through the soft-key row.

TABLE

▶ Soft key to call the TABLE function

▶ The first soft-key row to select the operand types appears:

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

DANGER

Press the SET and RESET soft key 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

Note

The operand type is displayed at top left in the table.

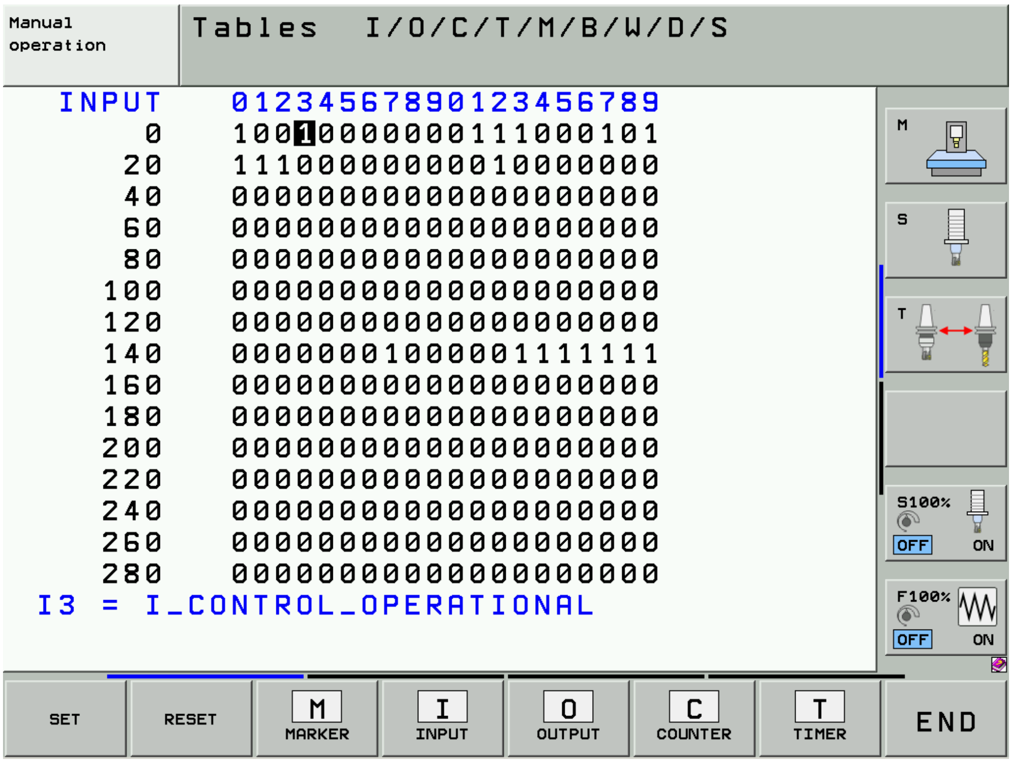
In the tables for **BYTE**, **WORD** and **DOUBLEWORD** the display can be switched by soft key between **HEX** and **DECIMAL**.

With the cursor keys or the GOTO key followed by an entry, the operands can be selected within the table.

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 TABLE.
- Press the INPUT soft key.



- Place the cursor on the input to be examined (e.g. GOTO I3 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, ect.
  - At the terminals (X3) of the machine operating panel
  - At the terminals (X3, X4, X5, X6) of the PL 4xxB input/output unit
  - At the terminals (X4, X5) of the input/output module PLD 16-8

Figure: Measuring at a terminal of the I/O module PLD 16-8 using a needle tip probe

Note

An active input is signalled by a yellow LED at the PLD 16-8.

Assignment --> See "Connector Designation and Layout" on page 27 – 447.

Note

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

Note

If the HEIDENHAIN test adapter is available, you can connect it between the connectors X42 and X45 of the MC to measure the voltage level of the input to be checked. --> See "Measuring circuit with test adapter for PLC inputs and outputs on the MC" on page 11 – 124.

Conclusion

The logic states in the PLC-TABLE must be in agreement with the voltage levels for each input. --> See "Specifications" on page 11 – 147!

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.

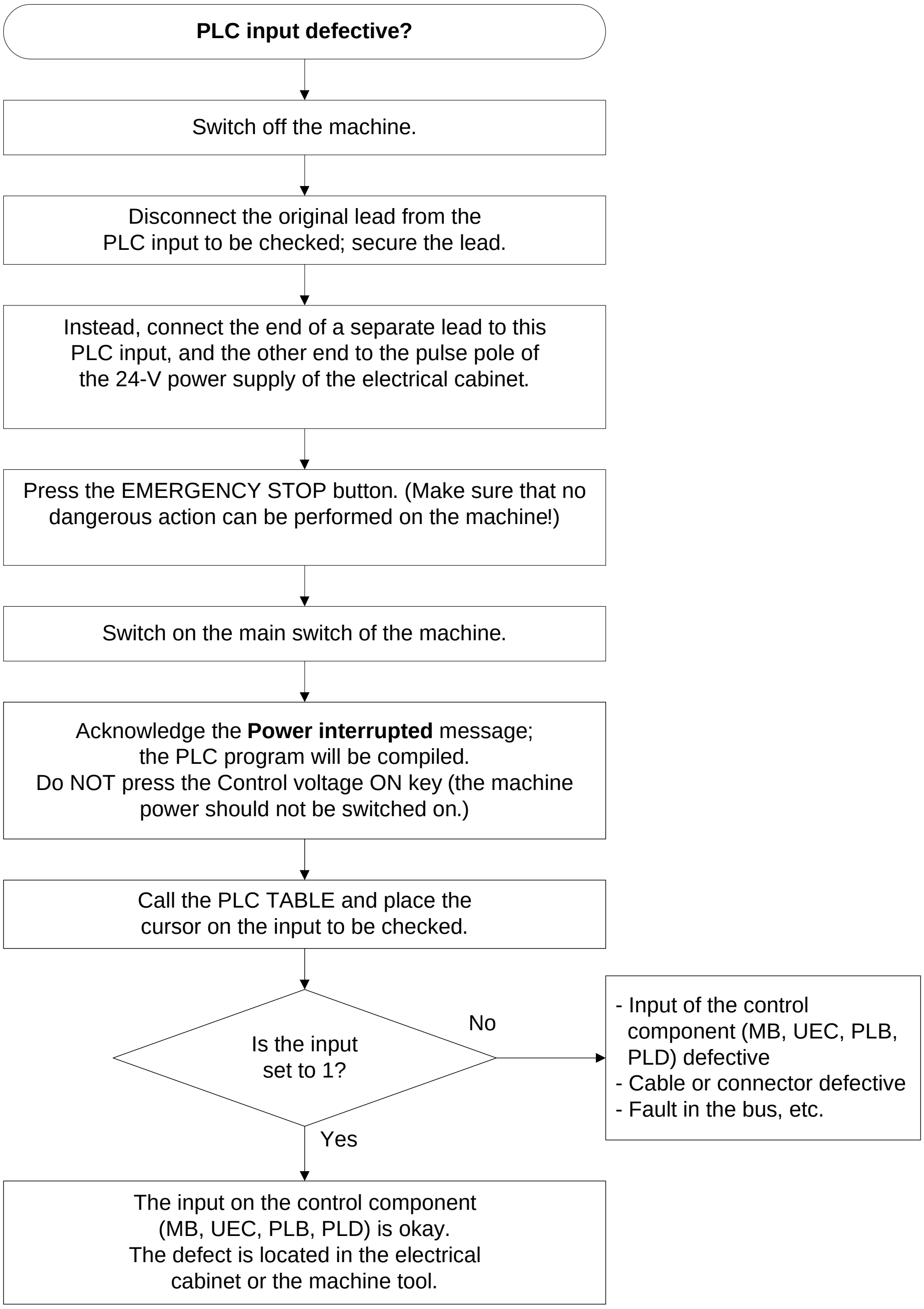
Error localization
PLC input

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.

Caution

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 TABLE.
- Press the OUTPUT soft key.
- Place the cursor on the output to be examined (e.g. GOTO O32 ENTER).
- Observe the logical state of the output to be checked.
- Check whether the connected actor (relay, etc.) has triggered or whether the connected device operates.
- Measure the 24-V supply voltage DC-link voltage (electrical cabinet voltage).
- 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, ect.
  - At the terminals (X4) of the machine operating panel.
  - At the terminals (X7, X8) of the PL 4xxB input/output unit.
  - At the terminals (X6) of the input/output module PLD 16-8.

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 at the PLD 16-8 is indicated by a yellow LED!

A red LED at X4/pin1 indicates a short circuit at the output side of a PLD 16-8.

Assignment --> See “Connector Designation and Layout” on page 27 – 447.

Note

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

Note

If the HEIDENHAIN test adapter is available, you can connect it between the connectors X41 and X46 of the MC to measure the voltage level of the input to be checked. --> See “Measuring circuit with test adapter for PLC inputs and outputs on the MC” on page 11 – 124.

Conclusion

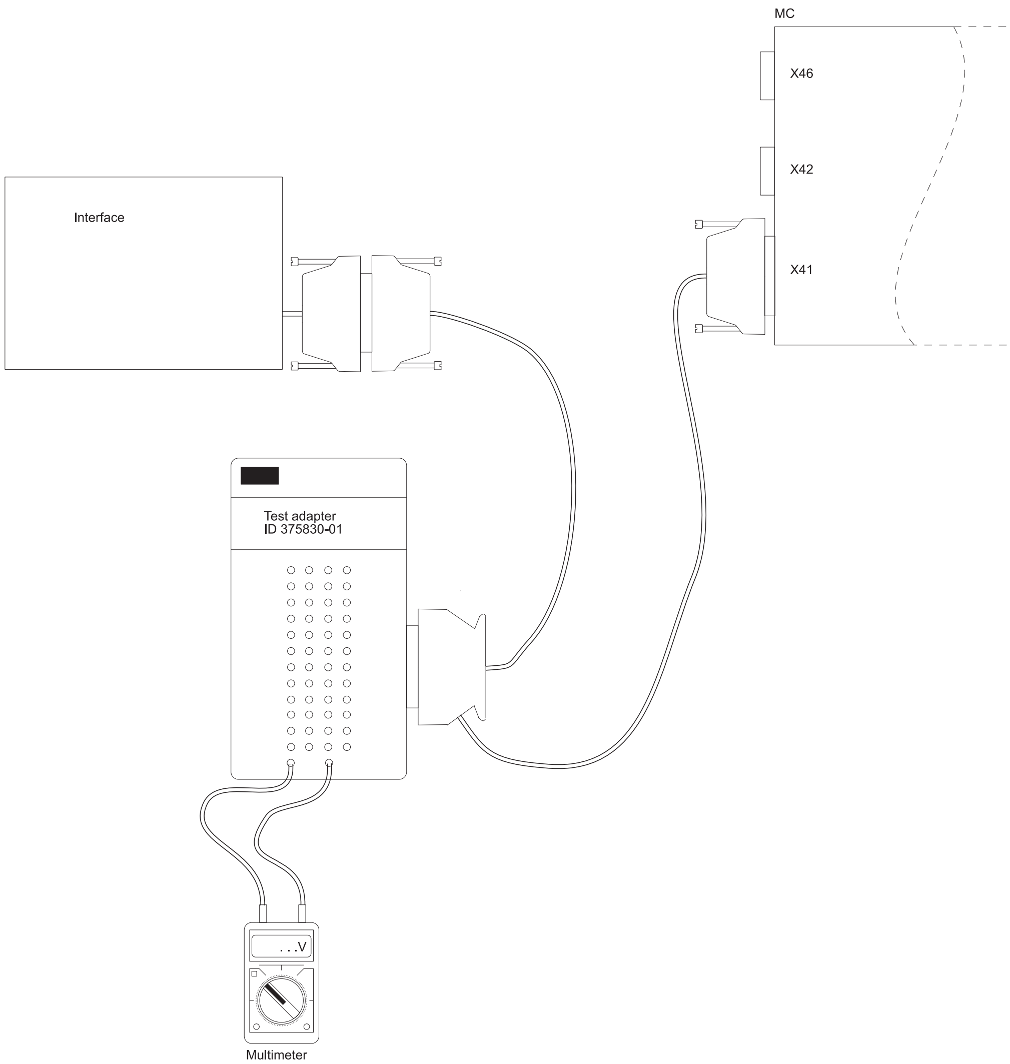
The logic states in the PLC table must be in agreement with the voltage levels for each output. --> See “Specifications” on page 11 – 147.

Meaning of the LEDs on the PLD 16-8

LED	Status	Meaning
Red LED at X4, pin 1	Continuously on	Short circuit of the outputs [a]
Yellow LEDs at X4, X5 and X6	On	Inputs/outputs set
Green LEDs at X6, pin 9 and pin 10	On	24 V power supply of the outputs

a. In case of a short circuit of an output, the output voltage is reset.
The short-circuit monitoring remains in place. It can be reset with the manufacturer's PLC program or by switching the machine on and off.
In order to recognize a short circuit, a current of 20 A must be able to flow for approx. 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.

Measuring circuit with test adapter for PLC inputs and outputs on the MC



DANGER

Do not engage or disengage any connecting elements while the machine is under power!

X41: PLC output
X42: PLC input
X46: Machine operating panel

11.3.2 The LOGIC diagram

With the LOGIC DIAGRAM function, **the time course of the dynamic change of PLC operands (M, I, O, T, C)** can be displayed.

Call

LOGIC DIAGRAM

▶ Soft key to call the LOGIC DIAGRAM function.

Selecting the operands

SELECT M/I/O/T/C

▶ Display selection table.

In the displayed table the desired operands can be selected. The individual positions in the table are interrogated using dialog. Incorrect entries can be deleted with the DEL key. A trigger condition can be set for each operand. 512 states are recorded each before and after a trigger event. The following trigger conditions are possible:

1	Record when operand is logical on (Triggering on positive edge)
0	Record when operand is logical zero (Triggering on negative edge)
NO ENT	No trigger: If no trigger condition is entered for any of the operands, the operand states are traced the operands are recorded continuously. The 1024 most recent states remain saved.

e.g.:	0	I5	1	Trigger on positive edge
	1	O6	0	Trigger on negative edge
	2	M2003		No trigger

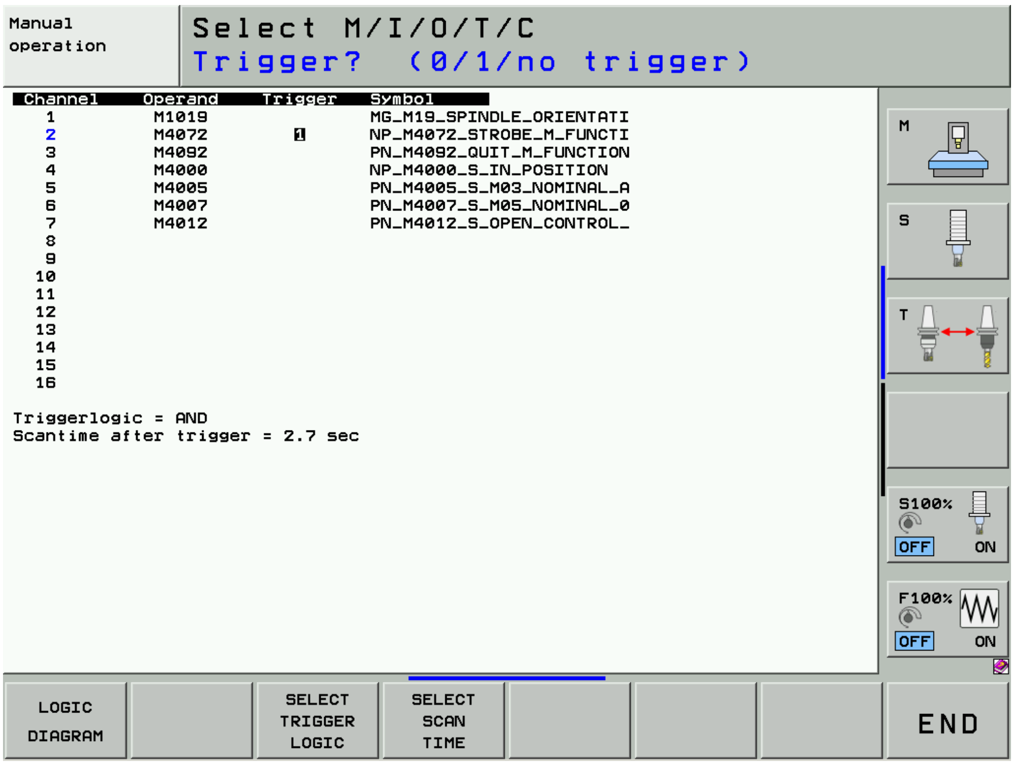
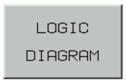


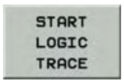
Figure: Example for the operand selection

> **Note**
>
> The **WATCH LIST** can also be called before and with the ADD TO LOGIC DIAGRAM soft key operands can be added to the logic diagram.

Start of recording



▶ Call LOGIC DIAGRAM again.



▶ Start the **LOGIC TRACE** function.

Note

A recording begins with START LOGIC TRACE and ends with STOP LOGIC TRACE soft key with the arrival of a trigger event.
During the recording, **tracing ...** appears over the logic diagram.
If the screen displays a machine operating mode, the signal word **PCTR** is shown during the recording.

▶ Display the Machine mode on the iTNC monitor (key on visual display unit).

PCTR blinking:	Trigger condition has not yet arrived
PCTR not blinking:	Trigger condition has arrived, buffer is written
PCTR not lit:	Buffer full, LOGIC DIAGRAM can be called

The logic states of up to 16 operands (M,I,O,T,C) can be displayed at the same time. A maximum of 1024 PLC cycles are traced.

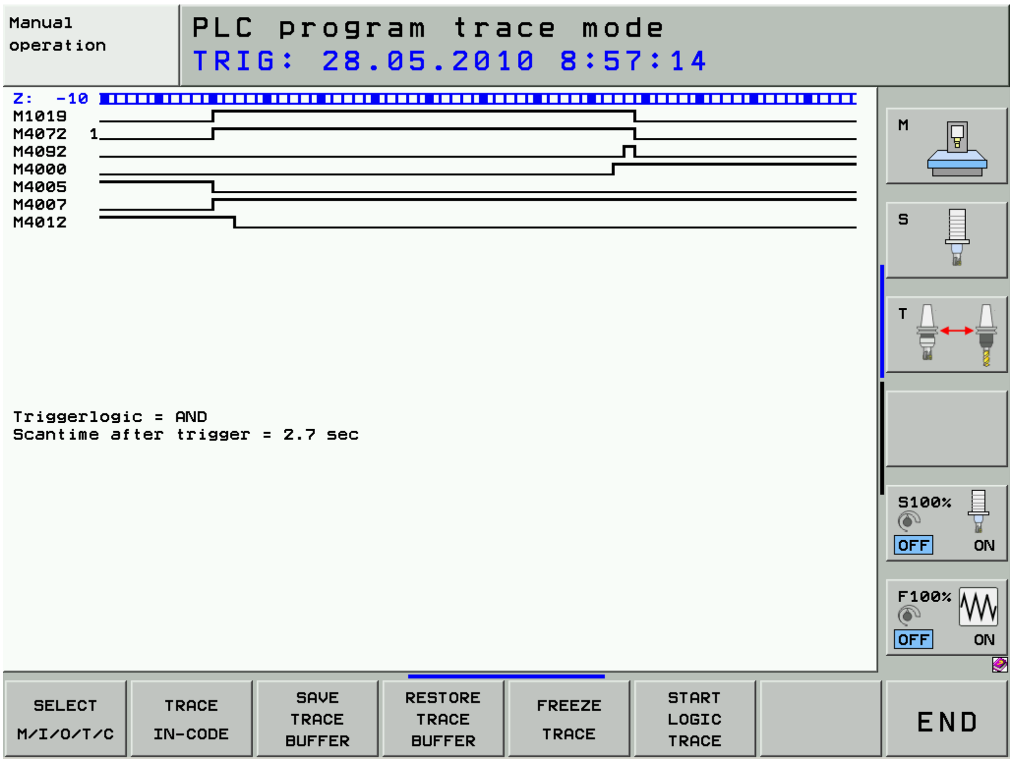


Figure: Recording of PLC markers during spindle orientation

The trigger event is displayed on the left edge of the display with the PLC cycle 0.
It is possible to shift the logic diagram -512 PLC cycles to the left and +512 PLC cycles to the right.

Note

The distance of two narrow bars in the upper line describes the duration of one PLC cycle. According to this, the distance of two thicker bars describes the duration of 5 PLC cycles.

Saving the LOGIC DIAGRAM recording

After having recorded a LOGIC DIAGRAM, you can save it on the hard disk of the control:

▶ Press this soft key.

▶ Confirm with the ENT key.
--> The logic diagram is saved under **PLC:\TRCSAVE.A**.

Calling the LOGIC DIAGRAM recording

A saved LOGIC DIAGRAM recording can be called again:

▶ Press this soft key.

▶ Confirm with the ENT key.
--> The contents of the LOGIC DIAGRAM diagram is saved under **PLC:\TRCSAVE.A**.

Further possibilities with the integrated oscilloscope

Also the **integrated oscilloscope** offers the possibility to record inputs, outputs, markers and the control signals of timer and counter! It is also possible to record bytes, words and double words with 6 channels available.
See “Integrated Oscilloscope” on page 10 – 99!

11.3.3 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.

Call

▶ Soft key to call the TRACE function

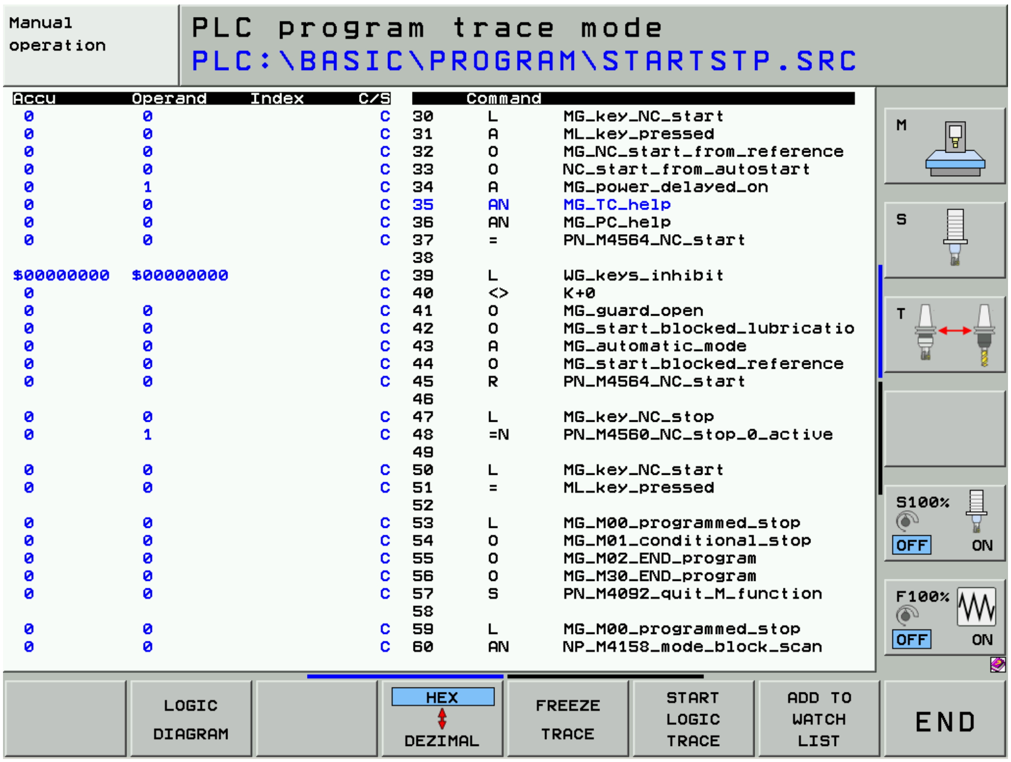
Selecting the PLC

▶ 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.

▶ Set the display to the program part to be checked (e.g., with the GOTO key, the FIND soft key, with the cursor keys, etc.).



The statement list (STL) of the converted 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 an **S** if it is a Submit program part.

Evaluation

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

11.3.4 The WATCH LIST function

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

Call

- Soft key to call the WATCH LIST function.

Selecting symbolic operands in the WATCH LIST

- You have called the WATCH LIST.
- Press the SYMBOL LIST soft key to open a list box with all local and global operands used in the PLC program.
- Use the arrow keys to select the desired operand and press the SELECT soft key or the ENTkey to confirm.
- 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 on the control.
Otherwise the error message **`Selection list is empty`** is displayed.

Note

Create a WATCH LIST, if necessary, with the aid of the machine manufacturer!

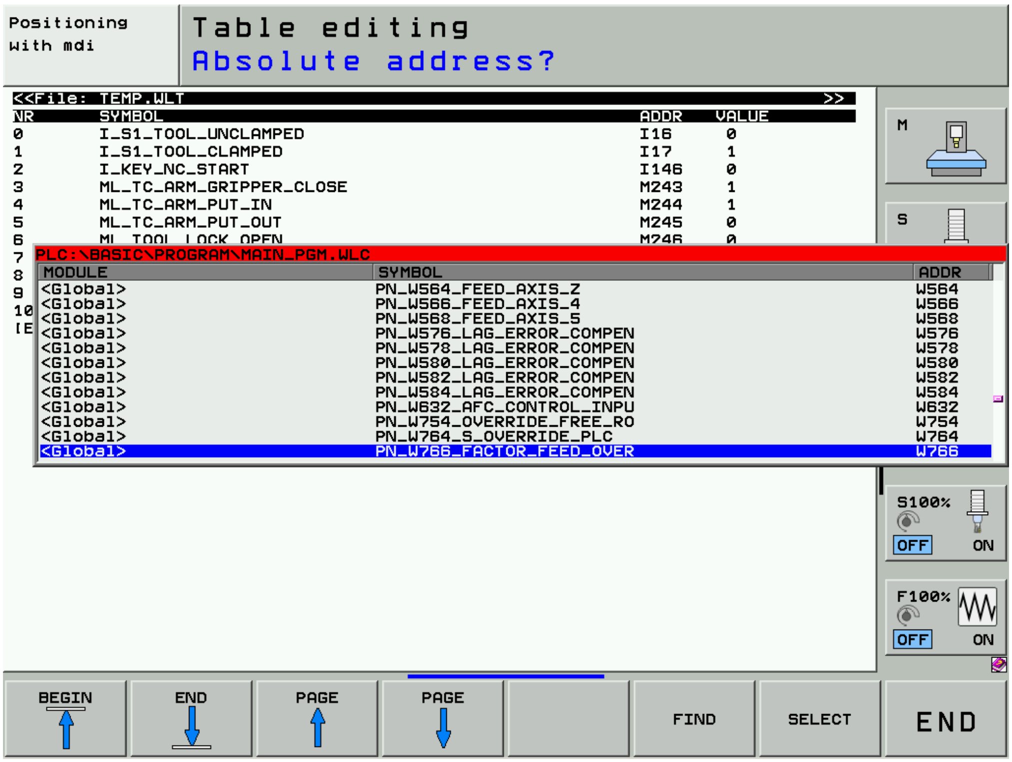


Figure: Example for the selection of symbolic operands

Selecting absolute operands in the WATCH LIST

- You have called the WATCH LIST.
- Now press the INSERT LINE soft key.
- Press the RIGHT ARROW key until the cursor is in the **ADDR** column.
- Enter the absolute address of the operand, e. g. W1022.
- Press the ENT key.

Note

Create a WATCH LIST, if necessary, with the aid of the machine manufacturer!

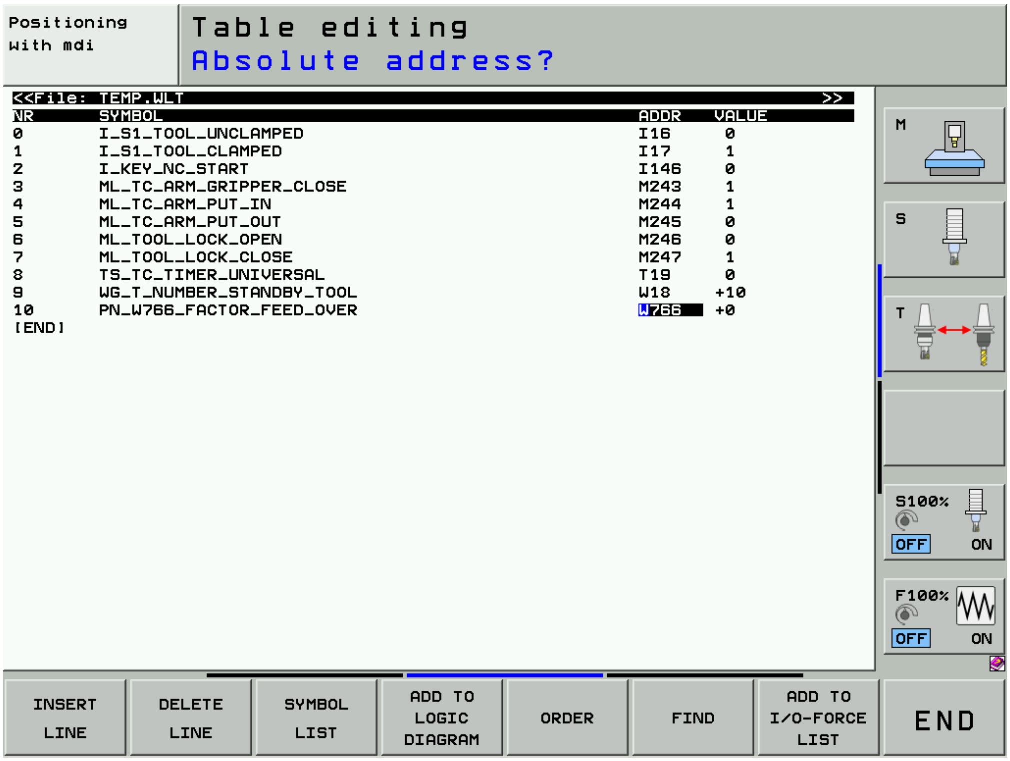


Figure: Example for the selection of absolute operands

Note

You can also call the TABLE or the TRACE IN CODE function before and add to the WATCH LIST with the ADD TO WATCH LIST 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 cursur 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).

Calling a WATCH LIST file

A saved WATCH LIST file can be called again at any time:

- Open the WATCH LIST function.
- Press the PGMMGT key. --> The program management is opened.
- Place the cursor in path **PLC:\DEBUG** on the saved WATCH LIST file (e.g., Watch123.wlt).
- Press the ENT key. --> The file is called in the WATCH LIST function.

11.3.5 The I / O - FORCE LIST

This diagnosis function exists as of NC software 340490-xx (with programming surface smarT.NC),

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.
Make sure that hanging axes are supported!
Consult the machine manufacturer!

Call

- Soft key to call the I / O FORCE LIST function.

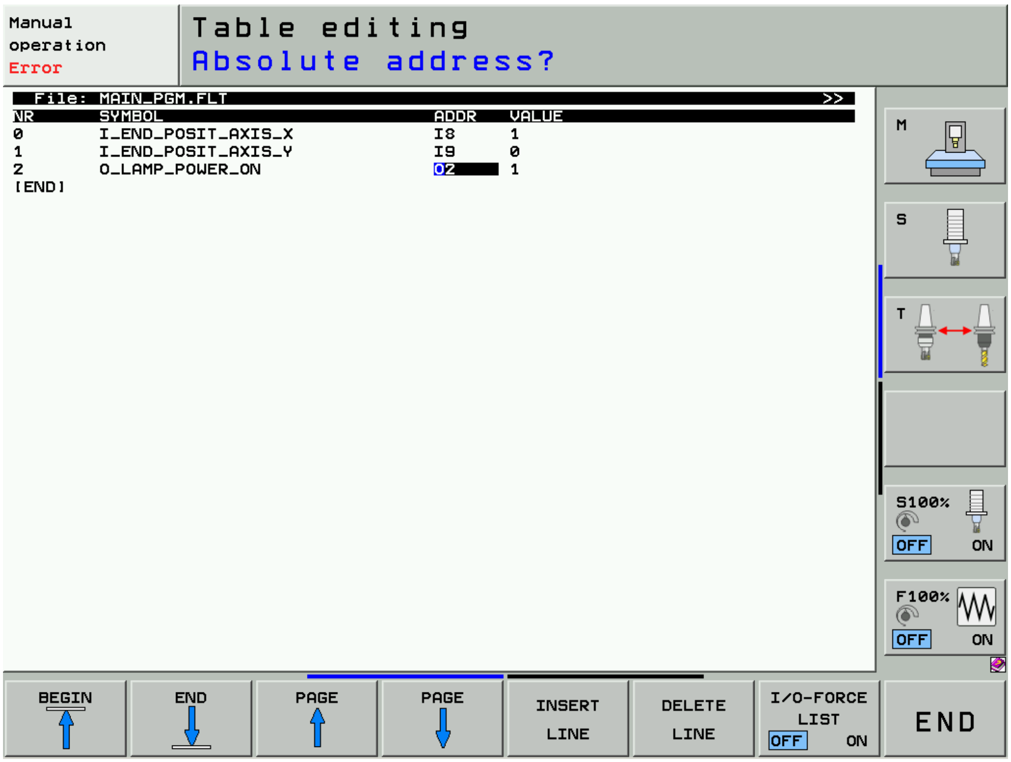
Selecting inputs and outputs for the FORCE LIST

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

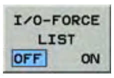
Note

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

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

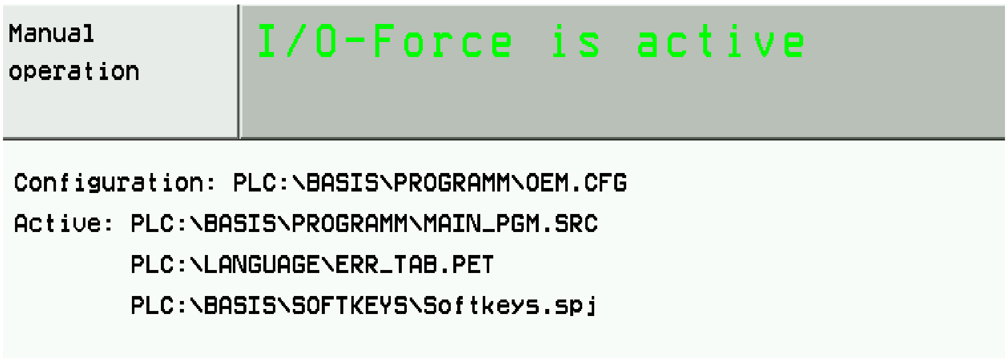


Activating the I/O FORCE LIST



▶ Now 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 is shown:



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 informational text 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:

- ▶ Press the PGMMGT key. --> The program management is opened and the cursor is placed on the file `MAIN_PGM.FLT` in the path where the PLC main program is also located.
- ▶ Press the COPY soft key.
- ▶ Enter a target file (e.g., Force123.flt).

Calling an I/O FORCE LIST file

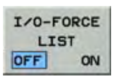
A saved I/O FORCE LIST file can be called again at any time:

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

Deactivating and exiting the I/O FORCE LIST

After having worked with the I/O FORCE LIST function, **it is essential to terminate this function again!**

- ▶ Press the EMERGENCY STOP key.



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

- ▶ As a precaution all PLC operands in the I/O FORCE LIST with the DELETE LINE.
- ▶ Exit the function I/O FORCE LIST with the END soft key.
- ▶ Exit the PLC mode.
- ▶ As a precaution, restart the control!

11.3.6 PROFIBUS diagnosis

- The iTNC 530 also cooperates with PROFIBUS components.
- 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.

Call

▶ 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 interface settings.

MOD

▶ Press the MOD key.

▶ Press the DIAGNOSIS soft key.

▶ Press the PROFIBUS DIAGNOSIS soft key.

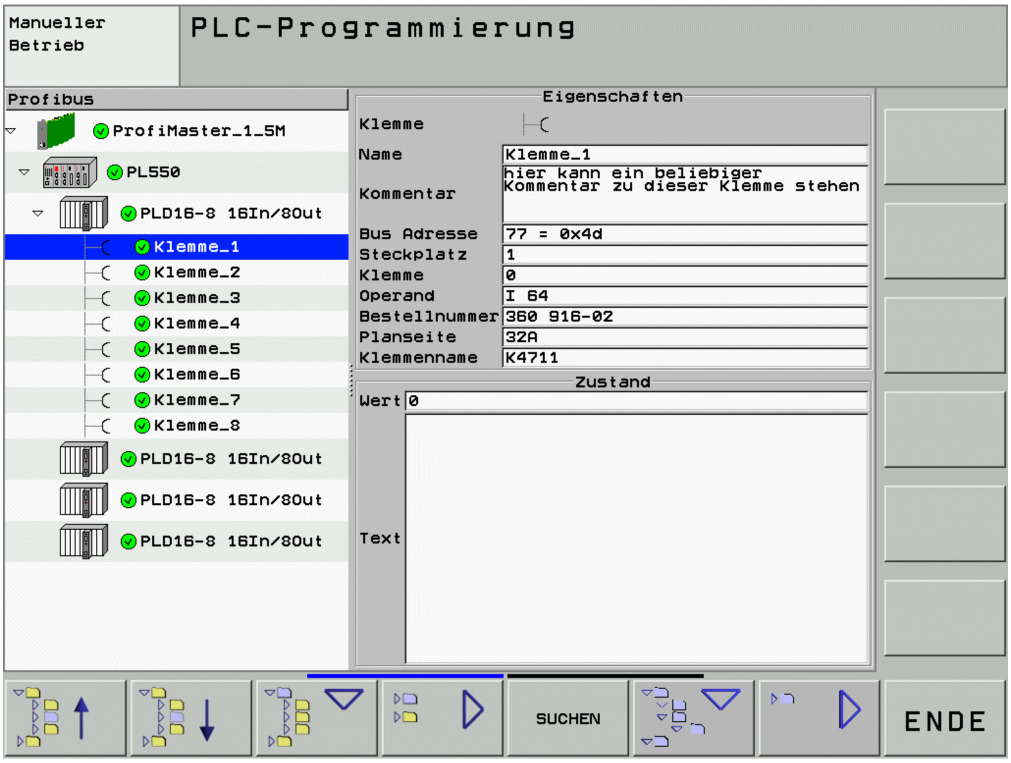


Figure: Profibus diagnosis start page

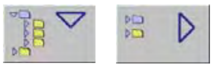
This screen shows the structure of the PROFIBUS system together with details on the PROFIBUS components.
The search function assists you in finding PROFIBUS components whose names are known.

Soft keys for the PROFIBUS diagnosis

You select, open or close the component symbols and open or close the PROFIBUS tree by using the soft keys:

Select a PROFIBUS component.

Open/Close the PROFIBUS tree.
(with complex system the opening can last a few seconds)

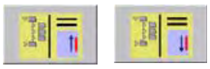


Open/Close the PROFIBUS slaves.

Search a PROFIBUS component
(the search is performed on the level where the cursor is placed: slave, module, terminal)

- Place the cursor on the desired level.
- Press the FIND soft key. --> The iTNC 530 opens a small window above the soft-key row in which you type the name you want to find.
- Enter the name or the beginning of the name of the PROFIBUS component. --> The cursor jumps to the first component with this name.

Move the separating line (enlarge/reduce the window size)



Move the status window.

Note

Also the arrow keys of the operating panel can be used for navigation.

Use for troubleshooting

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 status (further information in the text window)

Log files

The PROFIBUS diagnosis described is mainly suitable for static failures.
An analysis of sporadic failures is thus difficult.
Experience has shown, however, that sporadic failures account for the mayority of PROFIBUS errors.

For the analysis of sporadic failures special PROFIBUS log files are suitable which record important events during start-up and run time.

- **PBCONFIG_FAIL.LOG**
  Protocol of 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 contents is copied to**PBLOGBOOK.LOG.OLD**.
- **REPORT.TXT**
  Protocol of the last PROFIBUS start (will be overwritten during the next HSCI/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`**.

For analysis of a PROFIBUS error **this file** is read out from the control by the TNCremoNT and are sent **to your machine manufacturer or to a HEIDENHAIN service agency**.

11.4 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 menu.

For example: **When replacing controls** this information from the process memory of the control to be replaced are saved on the hard disk in order to load in into the process memory of the new control at a later date.

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

Saving on hard disk

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

- Scroll through the soft-key row.

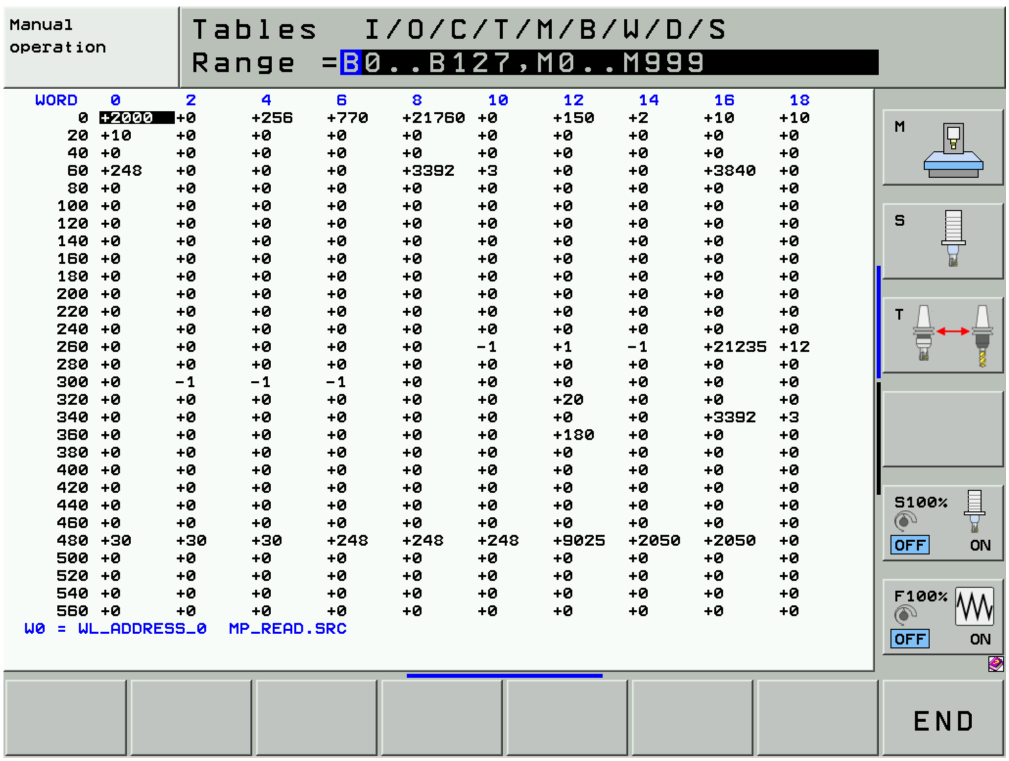
- Call the TABLE function.

- Scroll through the soft-key row.

- Press this soft key. --> A default area is displayed.

Note

The iTNC 530 enters the maximum defined area of the non-volatile PLC markes and words (e.g., B0 ... B127, M0 ... M999) automatically.
This range can be changed after prior 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.



WORD	0	2	4	6	8	10	12	14	16	18
0	+2000	+0	+256	+770	+21760	+0	+150	+2	+10	+10
20	+10	+0	+0	+0	+0	+0	+0	+0	+0	+0
40	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
60	+248	+0	+0	+0	+3392	+3	+0	+0	+3840	+0
80	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
100	+0	+0	+0	+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	+0	+0	+0	+0	+0	+0
320	+0	+0	+0	+0	+0	+0	+20	+0	+0	+0
340	+0	+0	+0	+0	+0	+0	+0	+0	+3392	+3
360	+0	+0	+0	+0	+0	+0	+180	+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	+9025	+2050	+2050	+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: Save non-volatile PLC markers and words

ENT

▶ Confirm the setting. --> The iTNC 530 offers the path and file name **PLC:\PLCMEM.A**.
(If required, you can change the path and file name and also save more than one file on the hard disk.)

ENT

▶ Confirm the file name. -->The states and contents of the PLC markers/words are stored on hard disk in the file specified.

END END

▶ Exit the PLC mode.

Playing back the data into the RAM

▶ Call the PLC mode. --> See “Calling the PLC mode” on page 11 – 115.

▷

▶ Scroll through the soft-key row.

TABLE

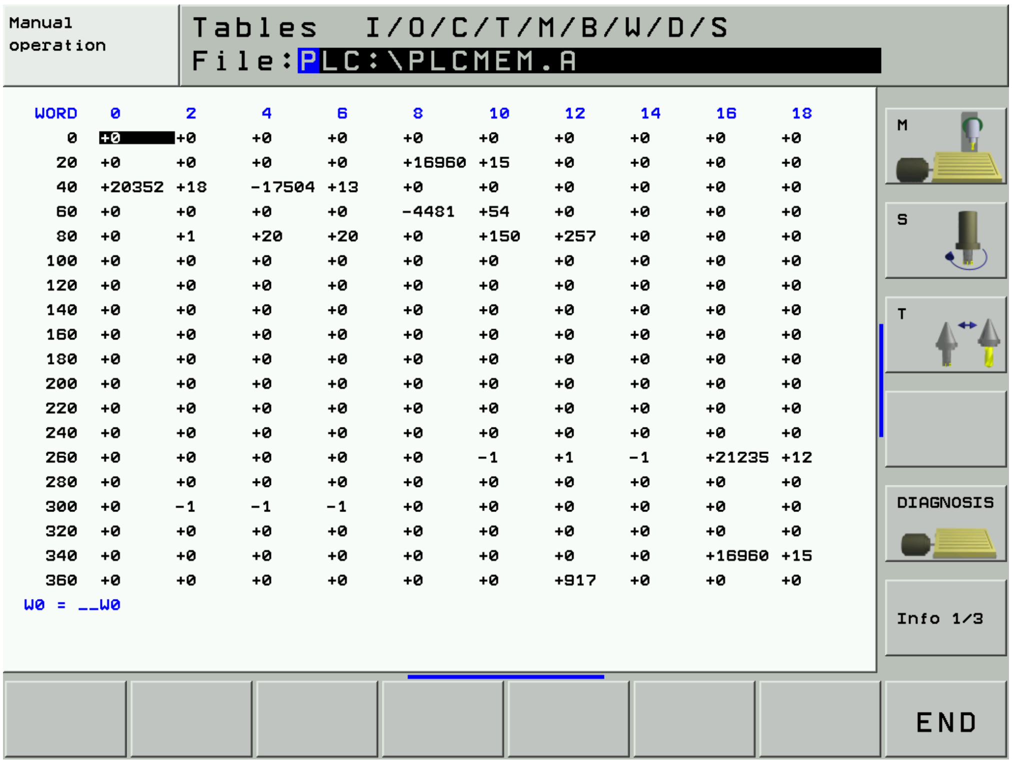
▶ Call the TABLE function.

▷

▶ Scroll through the soft-key row.

RESTORE M/B/W/D

▶ Press this soft key. --> The iTNC 530 offers the path and file name **PLC:\PLCMEM.A**.
(If the remanent PLC markers and words were stored in another file, the file name must be indicated here.)



WORD	0	2	4	6	8	10	12	14	16	18
0	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
20	+0	+0	+0	+0	+16960	+15	+0	+0	+0	+0
40	+20352	+18	-17504	+13	+0	+0	+0	+0	+0	+0
60	+0	+0	+0	+0	-4481	+54	+0	+0	+0	+0
80	+0	+1	+20	+20	+0	+150	+257	+0	+0	+0
100	+0	+0	+0	+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	+0	+0	+0	+0	+0	+0
320	+0	+0	+0	+0	+0	+0	+0	+0	+0	+0
340	+0	+0	+0	+0	+0	+0	+0	+0	+16960	+15
360	+0	+0	+0	+0	+0	+0	+917	+0	+0	+0

Figure: Write back non-volatile PLC markers and words

ENT

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

END END

▶ Exit the PLC mode.

11.5 Overviews

The following tables are excerpts from the iTNC 530 Technical Manual of May 2009.

Overview of markers

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

Operand		Description	Set	Reset	As of SW vers.
M	1900 - 1999	Decoded M function if M4571 is set	NC	NC	

Spindle

Operand		Description	Set	Reset	As of SW vers.
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 rotational direction 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 position encoder on the spindle	PLC	PLC	

Thread cutting

Operand		Description	Set	Reset	As of SW vers.
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	As of SW vers.
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	As of SW vers.
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	

Operand		Description	Set	Reset	As of SW vers.
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	Not supported as of 340 422-03, 340 480-03
M	4055	Enable the probing process	NC	PLC	
M	4056	NC stop in all operating modes if stylus is deflected	PLC	PLC	
M	4057	Touch probe cycles active (FN17: ID990 NR2)	NC	NC	340 422-09, 340 480-09
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 PLC to the NC

Operand		Description	Set	Reset	As of SW vers.
M	4070	Strobe signal for gear code	NC	NC	
M	4071	Strobe signal for S code	NC	NC	
M	4072	Strobe signal for M functions	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	As of SW vers.
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	As of SW vers.
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	Starting and stopping 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	As of SW vers.
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: Reference-Mark Traverse	NC	NC	
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	1. PLC cycle after power on	NC	NC	
M	4173	1. PLC scan after interruption of the PLC program	NC	NC	
M	4174	1. PLC scan 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 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	340 420-06
M	4186	NC program is active in the Test Run mode	NC	PLC	340 49x-01
M	4188	Compilation process of the PLC project active	NC	PLC	340 49x-04
M	4189	EMERGENCY STOP test during control start-up completed	NC	PLC	340 49x-05

Arithmetic or Module Error in the PLC

Operand		Description	Set	Reset	As of SW vers.
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	340 49x-04
M	4211	Error from Python script with NC stop active	NC	NC	340 49x-04
M	4212	Error from Python script with EM. STOP active	NC	NC	340 49x-04
M	4213	Error from Python script with NC Cancel active	NC	NC	340 49x-04
M	4220	Error from PET table with F stop active	NC	NC	
M	4221	Error from PET table with NC stop active	NC	NC	

Operand		Description	Set	Reset	As of SW vers.
M	4222	Error from PET table with EM. STOP active	NC	NC	
M	4223	Error from PET table with NC Cancel active	NC	NC	340 422-10, 340 480-10
M	4225	Activate alternative error reaction			340 49x-04
M	4227	PLC error message with priority 0 (error)	NC	NC	340 422-10, 340 480-10
M	4228	PLC error message with priority 1 (warning)	NC	NC	340 422-10, 340 480-10
M	4229	PLC error message with priority 2 (info)	NC	NC	340 422-10, 340 480-10
M	4230	NC start via LSV2	NC	NC	
M	4231	NC stop via LSV2	NC	NC	

Markers influenceable by machine parameters

Operand		Description	Set	Reset	As of SW vers.
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	As of SW vers.
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	As of SW vers.
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	As of SW vers.
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	Locking the handwheel	PLC	PLC	
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 fast PLC input from MP4130.2	NC	PLC	
M	4591	Status fast PLC input from MP4130.3	NC	PLC	
M	4592	Status fast PLC input from MP4130.4	NC	PLC	
M	4593	Status fast PLC input from MP4130.5	NC	PLC	
M	4600	Faulty internal communication between HeROS and Windows	NC	NC	340 480-06
M	4620	Enable LIFTOFF function	PLC	NC/ PLC	340 422-06, 340 480-06
M	4622	Delay NC macro with `RESETINIT =` from NCMACRO.SYS	PLC	PLC	340 422-10, 340 480-10
M	4623	Disable starting of DNC mode (LSV2 access)	PLC	PLC	340 49x-03
M	4624	Changed axis-traverse limits	NC	PLC	340 49x-04
M	4625	Disable NC axes when velocity semifeedforward control is active	PLC	PLC	340 49x-04
M	4626	Disable all key inputs of the TE keyboard unit, including the soft keys	PLC	PLC	340 49x-05
M	4660	HR 420 assumes control	NC	NC	340 422-09, 340 480-09
M	4661	NC start on HR 420	NC	NC	340 422-09, 340 480-09
M	4662	NC stop on HR 420	NC	NC	340 422-09, 340 480-09
M	4663	Rapid traverse key on HR 420	NC	NC	340 422-09, 340 480-09
M	4664	Spindle start on HR 420	NC	NC	340 422-09, 340 480-09
M	4665	Spindle stop on HR 420	NC	NC	340 422-09, 340 480-09
M	4666	+ key on HR 420	NC	NC	340 422-09, 340 480-09
M	4667	Key – on HR 420	NC	NC	340 422-09, 340 480-09

Operand		Description	Set	Reset	As of SW vers.
M	4668	CTRL key on HR 420	NC	NC	340 422-09, 340 480-09
M	4670	Potentiometer on HR 420/ HR 5x0 active	NC	NC	340 49x-05
M	4680	Disable activation of the HR 420/ HR 5x0	PLC	PLC	340 49x-04
M	4753	Write errors from PLC modules in the PLC log	PLC	PLC	340 422-09, 340 480-09
M	4754	Write diagnostic information in MYDEBUG.LOG	PLC	PLC	340 422-10, 340 480-10

PLC error markers

Operand		Description	Set	Reset	As of SW vers.
M	4800 - 4999	Reserved markers for PLC error messages	PLC	NC/ PLC	

Overview of words

	Operand	Description	Set	Reset	As of SW vers.
W	256	Gear code	NC/PLC	NC/PLC	
W	258	S code	NC	NC	
W	260	Code for M functions	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 operation	NC	NC	expand with 34049x-02
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	34049x-04
W	342	Value from column PLC in table AFC.TAB	NC	NC/PLC	34049x-03
W	348	Current AFC status (0=inactive, 1=learn, 2=control)	NC	NC/PLC	34049x-03
W	350	Error from AFC that led to NC stop	NC	NC/PLC	34049x-05
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 high-speed 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 axis 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	34049x-04
W	754	% function for feed-rate override for free rotation	PLC	PLC	

	Operand	Description	Set	Reset	As of SW vers.
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 override (PLC to NC)	NC/PLC	NC/PLC	
W	766	Percentage for feed-rate override (PLC to NC)	NC/PLC	NC/PLC	
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 erroneously	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	
W	1024	Axis enabling	NC	NC	
W	1026	Axes in position	NC	NC	
W	1028	Axes in motion	NC	NC	
W	1030	Current direction of traverse	NC	NC	
W	1032	Reference marks not yet traversed	NC	NC	
W	1034	Positive software limit switch was approached	NC	NC	
W	1036	Negative software limit switch was approached	NC	NC	
W	1038	Prepare to open the position control loop	PLC	PLC	
W	1040	Axis-specific opening of the position control loop	PLC	PLC	
W	1042	Deactivation of monitoring functions	PLC	PLC	
W	1044	Actual-to-nominal value transfer	PLC	PLC	
W	1046	Manual traverse in positive direction	PLC	PLC	
W	1048	Manual traverse in negative direction	PLC	PLC	
W	1054	Reference end position	PLC	PLC	
W	1056	Lubrication pulse: Value in MP4050.x exceeded	NC	NC	
W	1058	Reset the accumulated distance	PLC	PLC	
W	1060	Axis-specific feed rate enable	PLC	PLC	
W	1062	Lock the handwheel for specific axes	PLC	PLC	

Overview of operands

Operand	Abbreviation	Address range	
Markers	M (marker)	**M0 to M9999** **M0 to M999** free; are deleted only after entry of the code number 531210, not by a reset (non-volatile range). The range can be reduced or enlarged 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 I31** **I128 to I152** **I160 to I175** **I64 to I127** **I192 to I255** **I256 to I319** **I320 to I383**	(MC) (Machine operating panel) (HR 410, HRA 110) (first PL) (second PL) (third PL) (fourth PL)
Output	O (output)	**O0 to O30** **O0 to O7** **O96 to O111** **O32 to O62** **O64 to O94** **O128 to O158** **O160 to O190**	(MC) (via machine operating panel) (HR 410, HRA 110) (first PL) (second PL) (third PL) (fourth PL)
Counter	C (counter)	**C0 to C47** **C48 to C95** **C96 to C143**	Set the counter Counter content Counter pulse release
Timer	T (timer)	**T0 to T47** **T48 to T95 and T96 to T999**	Timer start Timer is running
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

11.6 Specifications

11.6.1 PLC inputs

Input signals of the switching inputs on the MC 42x(B/C), PL 4xxB, and PLD 16-8:

Voltage range	MC 42x (B/C), PL 4xxB	PLD 16-8
"1" signal: U_i	13 V to 30.2 V	13 V to 28.8 V
"0" signal: U_i	–20 V to 3.2 V	–3 V to 2.5 V

Current ranges	MC 42x (B/C)	PL 4xx B	PLD 16-8
"1" signal: I_i	3.8 mA to 8.9 mA	2.5 mA to 6 mA	2.5 mA to 5.8 mA
"0" signal: I_i when U_i =3.2 V	1.0 mA	0.65 mA	0.3 mA

Addresses of the switching inputs:

Address	Quantity	Device
I0 to I31	31 + Acknowledgment **control-is-ready signal**	PLC inputs directly on the MC, connector X42
I64 to I127 I64 to I95	64 32	First PL 410B, PL 510 (PLD 16-8) First PL 405 B
I128 to I152	25	Machine operating panel (MC, connector X46)
I160 to I175	16	Handwheels HR 410, HR 332 and handwheel adapter HRA 110 (MC, X23)
I192 to I255 I192 to I223	64 32	Second PL 410B, PL 510 (PLD 16-8) Second PL 405 B
I256 to I319 I256 to I287	64 32	Third PL 410B, PL 510 (PLD 16-8) Third PL 405 B
I320 to I383 I320 to I351	64 32	Fourth PL 410 B, PL 510 (PLD 16-8) Fourth PL 405 B

Note

If the machine manufacturer uses the basic modules PLB 511 or PLB 512, you can find the address ranges in the circuit diagrams of the machine.
If you have any questions, contact the machine manufacturer or a HEIDENHAIN service agency.

Which PLC input is located on which pin of the connector?
--> See "Connector Designation and Layout" on page 27 – 447!

Note

The transmission of input states of handwheels and PLC input/output units (expansion cards) is performed with HEIDENHAIN serial data transmission busses on the connectors X23 and X47.
On the X42 and X46 connectors, each input has its own wire.

11.6.2 Analog inputs

The MC 42x (B/C), the PLC I/O unit PL 410 B and PLA 4-4 (for PL 510) have analog inputs.

The PL 410B is available with and without analog inputs.

Device	Analog inputs (±10 V)
MC 42x (B/C), X48	3
PL 405 B	–
PL 410 B (ID 263 371-02)	4
PLA 4-4 (PL 510)	4

Voltage range:	–10 V to +10 V
Input resistance:	> 250 kΩ
Resolution (W480, W482, W484):	100 mV
Resolution (Module 9003, 9138):	10 mV (MC 42x (B/C)) 100 mV (PL 410B) 4.9 mV (PLA 4-4)

Which analog input is located on which pin of the connector?
--> See “Connector Designation and Layout” on page 27 – 447!

11.6.3 Inputs for thermistors

The MC 42x (B/C), the PL 410 B PLC I/O unit, and the PLA 4-4 (for PL 510) have inputs for Pt 100 thermistors.

The PL 410B is available with and without analog inputs.

Device	Inputs for Pt 100 thermistors
MC 42x (B/C), X48	3
PL 405 B	–
PL 410 B (ID 263 371-02)	4
PLA 4-4 (PL 510)	4

Constant current:	5 mA
Temperature range:	0 °C to 100 °C
Resolution (W486, W488, W490):	0.5 °C
Resolution (Module 9003, 9138):	0.1 °C (MC 42x (B/C)) 0.5 °C (PL 410B) 0.03 °C (PLA 4-4)

Which thermistor input is located on which pin of the connector?
--> See “Connector Designation and Layout” on page 27 – 447!

11.6.4 PLC outputs

Output signals and addresses

The switching outputs are transistor outputs with current limitation.

Please note:

- Permissible load: Resistive load (inductive load only with quenching diode parallel to inductivity).
- MC 42x (B/C), PL 4xxB: Short circuiting of **one** output is **permissible.**
  No more than one output may be short-circuited **at one time.**
- PLD 16-8: The outputs are short-circuit proof.
- 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).
- The switching outputs need a minimum load of 5 mA.
  They conform to EN 61131-2.

DANGER

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!

Addresses:

Address	Quantity	Device
O0 to O30	31	PLC outputs directly on the MC, connector X41
O0 to O7	8	Machine operating panel (MC, X46)
O32 to O62	31	First PLC input/output unit (MC, X47)
O64 to O94	31	Second PLC input/output unit
O96 to O111	16	Handwheels HR 410, HR 332 and HRA 110 (MC, X23)
O128 to O158	31	Third PLC input/output unit
O160 to O190	31	Fourth PLC input/output unit

Note

The transmission of output states of handwheels and PLC input/output units (expansion cards) is performed with HEIDENHAIN serial data transmission busses on the connectors X23 and X47.
On the X41 and X46 connectors, each output has its own wire.

Which PLC output is located on which pin of the connector?
--> See “Connector Designation and Layout” on page 27 – 447!

Supply voltage for PLC outputs

EN 61 131-2:1994 permits:

- 5% alternating voltage component is permissible
- Minimum absolute value: 20.4 V–
- Maximum absolute value: 28.8 V–

See “Power Supply for PLC Outputs” on page 17 – 268.

12 Hard Disk and File Manager of the iTNC 530

12.1 Introduction

- The TNC data and PLC data are located on the hard disk of the iTNC 530 as well as the **the complete NC software including setup files is located here**.
  With dual-processor controls, the Windows system is located on the hard disk.

Caution

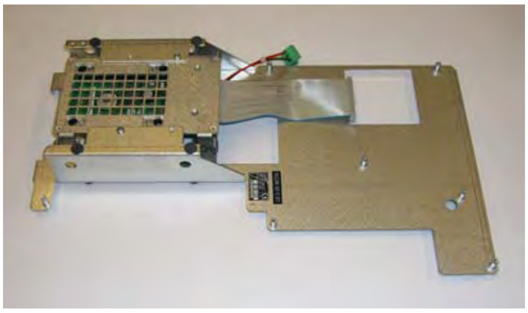
If there are defects on the hard disk, it may be possible that no functions at all can be called.

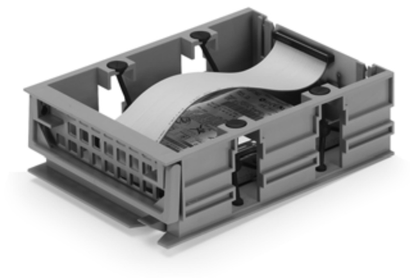
- Depending on the operating conditions (e.g., vibration load, dirt), the hard disk is exposed to higher or lower loads. HEIDENHAIN thus recommends to have the hard disk checked after 3 to 5 years.

Caution

As the entire NC software is located on the hard disk **it is subject to export limitations.**

HDR and drive assembly





	Drive assembly	HDR
	Permanently installed in the MC by means of a holding plate.	= Hard Disk Removeable = Exchanging hard disk Is inserted into the expansion case of the MC and is locked.
Used for:	MC 422	MC 422 B, MC 422 C, MC 420

Removal and insertion of the HDR, shipping brace
--> See "Exchange of the HDR" on page 28 – 544.

Removal and insertion of drive assembly, shipping brace
--> See "Exchange of the Drive Assembly" on page 28 – 537.

12.2 Structure of the Hard Disk

Single-processor control

The hard disk 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. To view the PLC partition, the code number 807667 must be entered.
SYS:	**System-specific data:** The complete NC software including setup files is located here (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.

Caution

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

Dual-processor control

The hard disk is divided into four partitions:

Windows	Drive letter under Windows --> **C:**
TNC:	User-specific data: Drive letter under Windows --> **D:**
PLC:	OEM-specific data: Drive letter under Windows --> **E:**
SYS:	System-specific data: Drive letter under Windows --> **F:**

12.3 Possible Causes of Error

- Mechanical wear
- Vibration
- Contamination
- Humidity
- Crash of hard disk
- Defective cable or connector
- No communcation due to defective processor board
- No power supply
- Manipulation of the hard disk
  (e.g. use of non-permissible programs for refragmentation, hard disk testing, duplication)

12.4 Test of Hard Disk

No communication with the hard disk

When the control is started and there is no communication with the hard disk, normally the following error message is displayed:

`Boot: Giving up`
`Reason is: Load processes failed`
or
`No bootable device available`

- Check, whether the memory card is firmly in the slot, or check the hard disk on a functioning iTNC 530 (if available).

At present no further tests are possible in the field!

Communication with the hard disk

If data are still transferred to the hard disk, some tests could be carried out in the field. --> See following instructions.
Additional and more comprehensive tests can only be performed at HEIDENHAIN agencies!

Caution

Do not use your own hard-disk test or repair programs!
Data recovery at HEIDENHAIN or a specialized company could thereby become more difficult or even impossible.

With the single-processor control (without Windows)

Hard disk test by means of soft keys:

With the NC software version **34049x-05 a simple hard disk test** for the single-processor control was installed.

Note

This test can be called if the NC software still boots 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. --> The file system of the PLC partition (**`hda5`**) and the TNC partition (**`hda6`**) is checked and, if required, repaired automatically.

Note

This test does not check the SYS partition.
The SYS partition is checked each time the control is switched on.

The result is transferred to the log.

- Click OK or press the ENT key. --> The control reboots!

▶ If required, call the log (See “Calling the Log” on page 8 – 82):

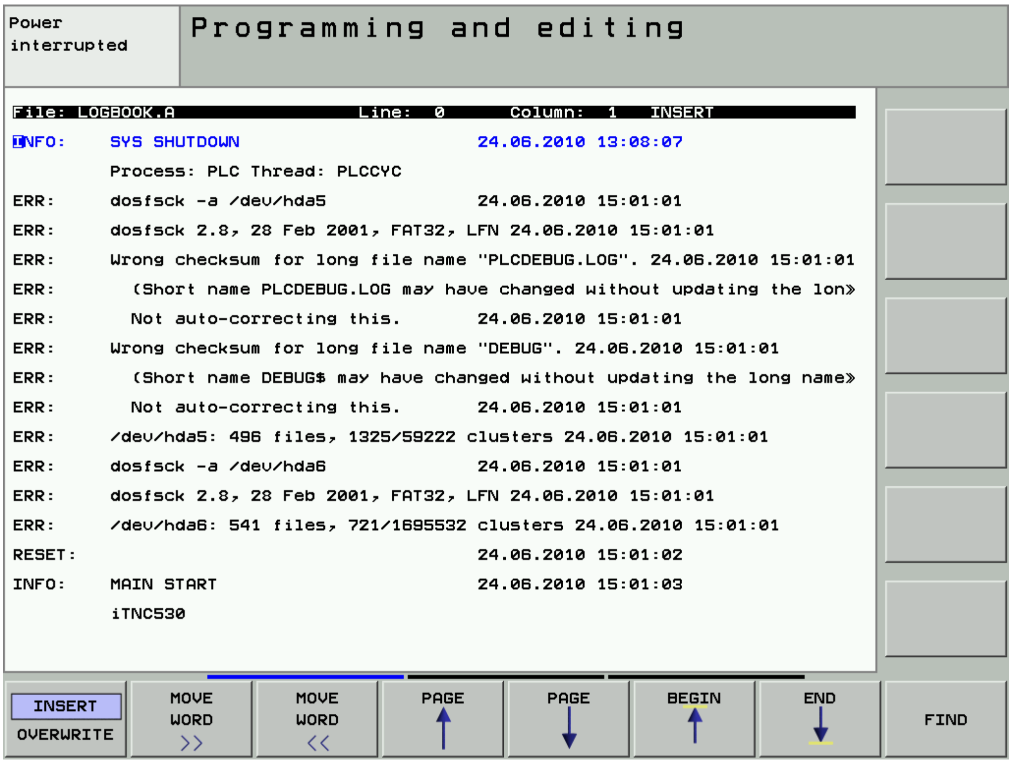


Figure: Excerpt from the log with faulty files after checking the file system

▶ If faulty files or clusters are detected, you should replace the hard disk. --> Contact the machine manufacturer or a HEIDENHAIN service agency!

Hard disk test on the HeROS level:

If the NC software does not boot again completely, hard disk tests can also be perforemed on the HeROS level (HEIDENHAIN Real Time Operating System).

- If possible: Move the machine to its basic position.
- Shut down the control and switch off the machine.
- Press the EMERGENCY STOP key.
- Switch on the control again.
- When the screen of the control turns blue (HeROS start-up procedure), press the DEL key (either on the ASCII keyboard or in the area of the numeric keypad) until the message **`Welcome to HeROS`** is displayed.
- Now release the key.
- As **`User name`** enter "tnc".
- Now type the command **`dosfsck /dev/hda1`** (blank space after dosfsck) and confirm with Enter. --> The SYS partition is checked and the result of the test is displayed.
- Now type the command **`dosfsck /dev/hda5`** (blank space after dosfsck) and confirm with Enter. --> The PLC partition is checked and the result of the test is displayed.
- Now type the command **`dosfsck /dev/hda6`** (blank space after dosfsck) and confirm with Enter. --> The TNC partition is checked and the result of the test is displayed.

Figure: Excerpt of the hard disk test on the HeROS level with faulty files

- If faulty files or clusters are detected, you should replace the hard disk. --> Contact the machine manufacturer or a HEIDENHAIN service agency!
- Enter the command **`exit`** after the test.
- Switch the control off (a shut down is not possible).

With the dual-processor control (with Windows)

Principally, all functions of Windows can be used with the dual-processor control. Windows also includes hard-disk test programs.

Note

To perform this hard disk test Windows must boot completely (not always possible when the hard disk is defective)!
Furthermore, you require certain local administrator rights in Windows. --> Ask the machine manufacturer!

Caution

- First close all programs in Windows before you activate the test programs. This also applies to the iTNC application!
- Changes in Windows may influence the function of the control!
- HEIDENHAIN cannot guarantee the function of Windows applications!

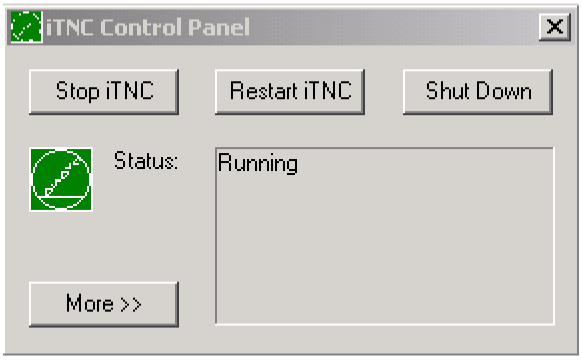
You can use the following test routine:

- If possible: Move the machine to its basic position.

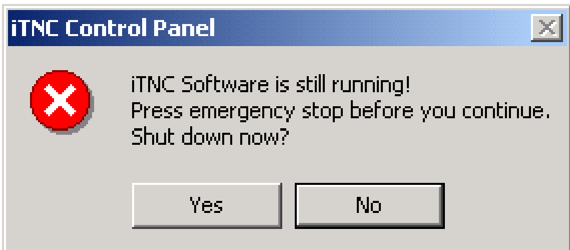
- Press the WINDOWS key.

- Close all programs in Windows.
- Exit the iTNC application as follows:

- Double-click the HEIDENHAIN symbol in the task bar.
  --> The **iTNC Control Panel** is opened.



- Now click on **`Shut Down`**.
- The following window appears:



- Press the EMERGENCY STOP key and click **`Yes`**.

- The following window appears:

- Click **No** --> Windows is not supposed to be shut down!
- You can now see the Windows user interface.
- Click on **My Computer/Control Panel/Administrative Tools/Computer Management/Storage/Disk Management** in succession.
  --> Here the conditon of the data medium (hard disk) is shown, e.g., **Healthy**.
- Click with the right mouse button on the drive to be tested.
- Click on **Properties** in the open window.
- Click now on **Tools** and for **Error-checking** on **Check Now** (in window **Check disk** no additional information has to be selected).
- Click on **Start.**
- If no error has been detected, the error message **Disk Check Complete** is displayed.
- If errors are detected, you should replace the hard disk. --> Contact the machine manufacturer or a HEIDENHAIN service agency!

Note

The same test can also be performed with the Windows **Command Prompt** and the command **chkdsk**, e.g. **chkdsk C:**.

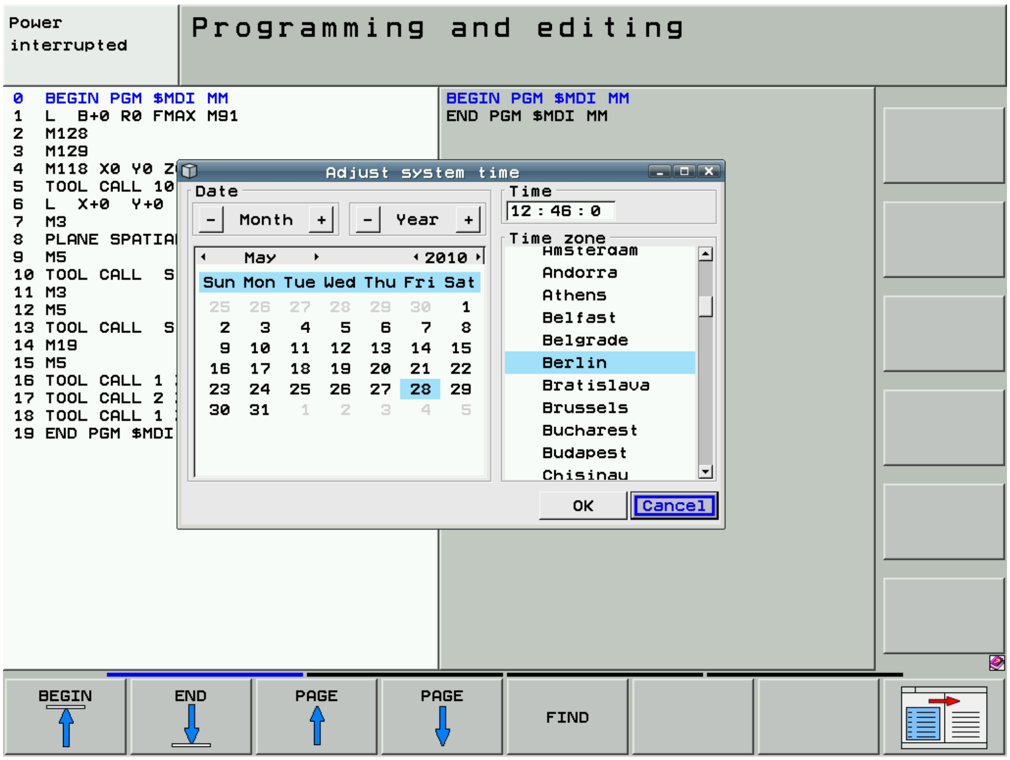
12.5 Setting the System Time

With the single-processor control

NC software versions as of 340 49x-03:

- Select the **`Programming and Editing`** operating mode.
- Press the MOD key.
- If required, switch to the next soft-key row.

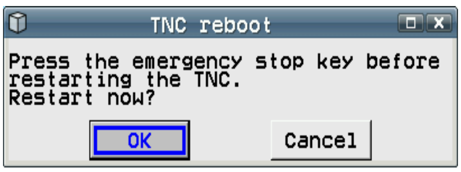
- Press the softkey. --> The following window opens:



- Set the date, the time (**local time**) and the time zone.
  For the navigation you can use the TAB key or the mouse.

> **Note**
>
> Changeover to winter / summer time is automatic.

- If you have made any changes, you will be asked to press the EMERGENCY STOP button and to restart the control.



- Confirm the message with **`OK`**. --> The control boots and transfers the new settings.

NC software versions less than 340 49x-03:

- The setting of the system time to the second is only explained in the HEIDENHAIN service courses.
  If necessary, contact the HEIDENHAIN helpline!
- The machine parameter **MP 7235** is active.
  The **difference of local time to distance time** is entered here.
  The Greenwich Mean Time (GMT) is used as system time.

Note

Changeover to winter / summer time is not automatic.

For this, MP 7235 must/can be adapted.

With the dual-processor control control

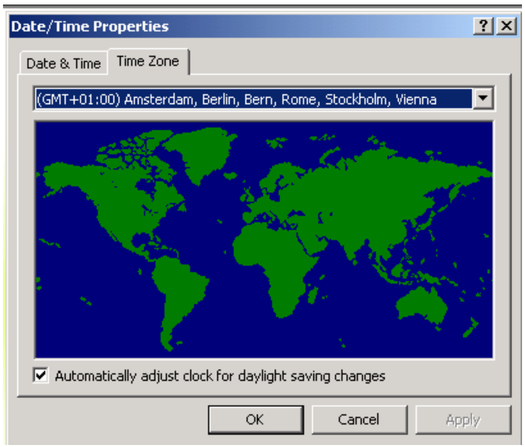
The system time of dual-processor controls is set by means of the Windows clock.

Note

To set the Windows clock, you require certain local administrator rights in Windows. Contact your machine tool builder.

▶ Click on the time display in the Windows task bar (usually at the buttom right corner).

▶ First select the correct time zone.

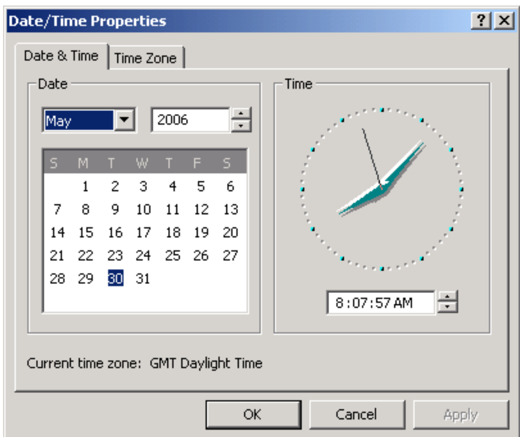


Note

The automatic conversion from summertime to wintertime can be activated.

The difference between local time to Greenwich Mean Time (GMT) is defined with the selected time zone. In dual-processor controls with Windows, MP 7235 does not have any function.

▶ Subsequently, set the current datum and **the local time.**



12.6 Setting the Program Manager

The iTNC 530 offers several possibilities for setting the program manager.

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

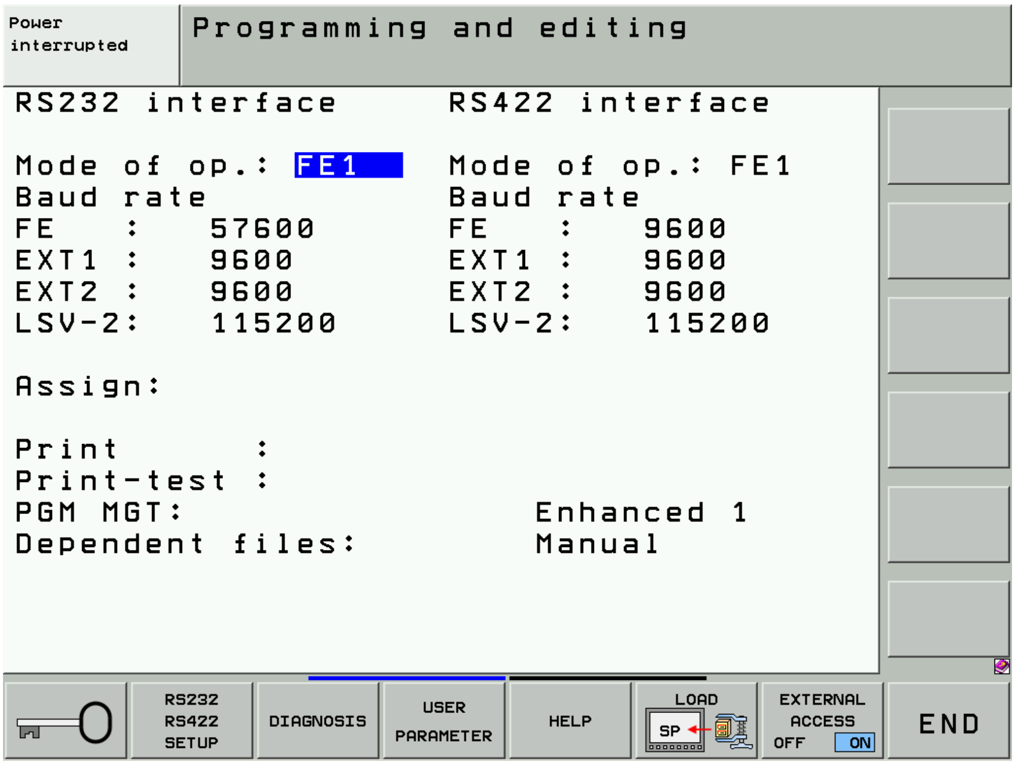
How to change the settings:

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

▶ Call the code number window.

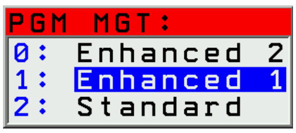
▶ Call the interface setups. Here you can also find the setting for the program manager.

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 setting page with the END soft key or the END key.

Note

Descriptions in this iTNC 530 Service Manual use the program manager with the setting **`Enhanced 1`**.

12.7 File Management of TNC Partition

Calling the TNC partition

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

▶ Call the **`Program Management`**.

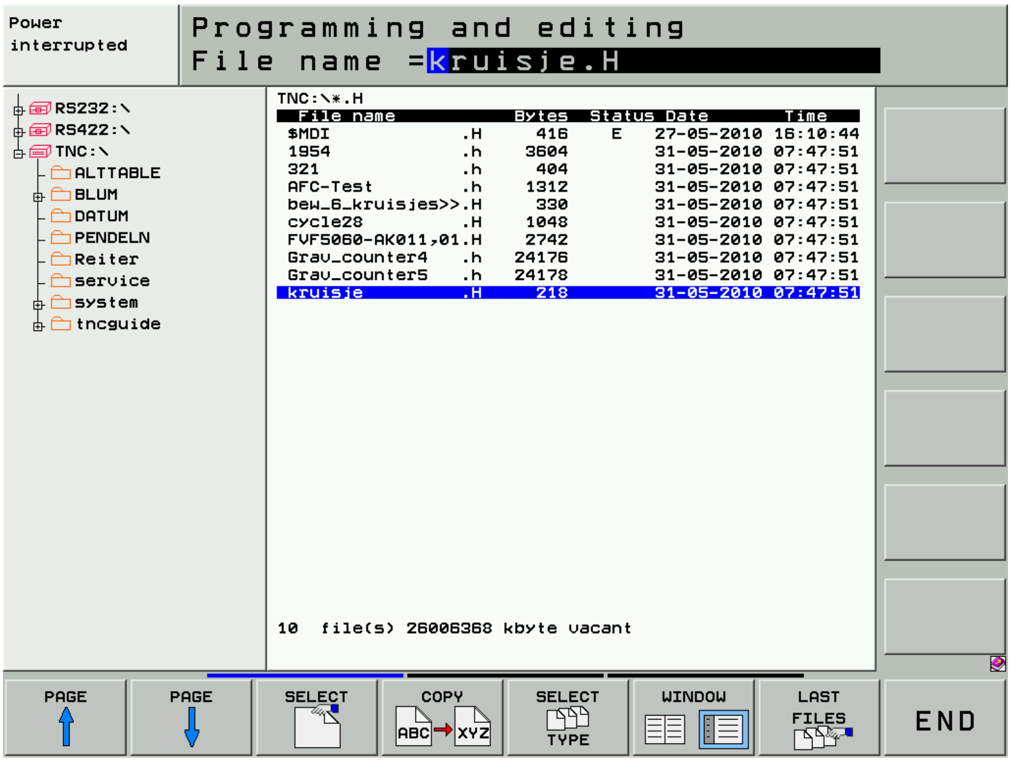


Figure: Program management of iTNC 530

The directory structure is displayed on the left. 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 or 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.

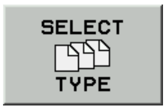
Overview of the most important TNC file types

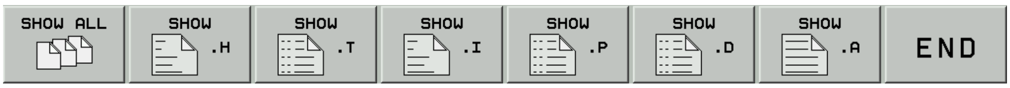
File type	File extension
NC program HEIDENHAIN plain-language	.H
Tool table	.T
NC program in ISO	.I
Pallet table	.P
Datum table	.D
ASCII file (text file)	.A
Point table	.PNT
Pocket table (tool changer)	.TCH
Preset table	.PR
Cutting-data table	.CDT
Freely definable tables (e.g., tables of tool material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

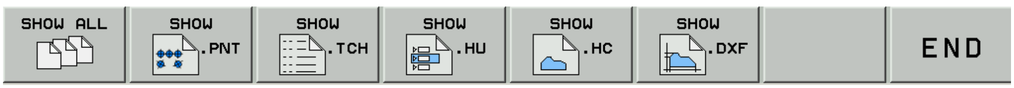
Note

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	File selected in a Program Run mode of operation
	P	Protected file that cannot be deleted or edited
	+	This file has dependent files (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 User's Manual for detailed information about file management!

12.8 File Management of 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 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 cannot be called again. All other PLC files can still be read but cannot be edited any more.

PGM MGT

▶ Call the **`Program Management`**.

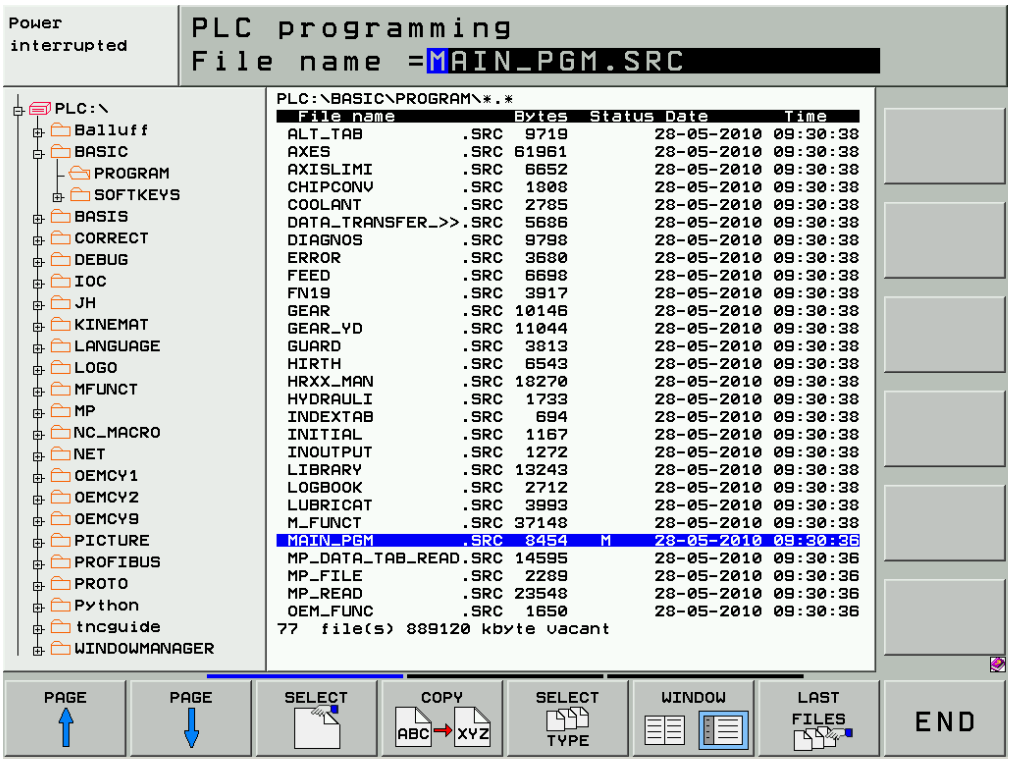


Figure: Program management of iTNC 530

The directory structure is displayed on the left, 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 or 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.

Overview of the most important PLCfile 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:*.PLC**
To remove this filter use the soft keys SELECT TYPE --> SHOW ALL.

Which file type is to be listed?

SELECT TYPE

SHOW ALL	.PLC FILES	SHOW .A	.HLP FILES	.SYS FILES	.COM FILES	.CMA FILES	END
SHOW ALL	.PET FILES	.SRC FILES	.SPJ FILES				END

▷ 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	File selected in a Program Run mode of operation
	P	Protected file that cannot be deleted or edited
	+	This file has dependent files (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 User’s Manual for detailed information about file management!

13 Data Backup

13.1 Introduction

Backup recommended

When servicing it is often necessary or advisable to 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 hard disk of the iTNC 530 without having to transfer data to an external medium.
--> See "Create copy of original MP file" on page 30 – 574.

Moreover, all **PLC data**, i.e. the specific machine data determined by the 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.

Data backup

Caution

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	Connector	
	Single-processor software	Dual-processor software
Ethernet	X26 (managed by HeROS)	X26 (managed by HeROS)
RS-232-C (V.24)	X27 for HeROS	X27 for Windows X127 for HeROS
RS-422 (V.11)	X28 for HeROS	X28 for Windows X128 for HeROS
USB (Universal Serial Bus)	X141 and X142 Exception: MC 420, only X141	X141 and X142 Exception: MC 422C with X141, X142, X143, X144 (X144 is located on the bottom of the housing)

Note

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

Note

Individual or several files and directories can quickly be read in and out with a USB stick without any large effort.

Windows knowledge

Depending on the Windows system of your laptop/PC, there are different proceedings regarding the interrogation and setting of the Ethernet configuration.
The following description contains examples of Windows 2000 and Windows XP.
Windows knowledge is required! If necessary, ask your system administrator.

Authorization

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 2.6 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 service 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**.

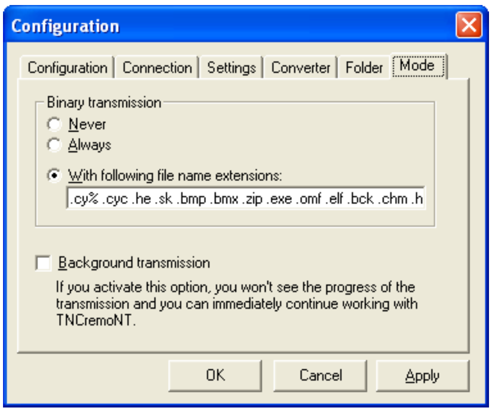
BINARY-to-ASCII conversion

Some files (e.g., NC programs) on the hard disk 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 default setting of the HEIDENHAIN data transfer software TNCremoNT is correct, the downloading of data from the control's hard disk to an external data medium (e.g., laptop/PC) is performed with an automatic conversion from BINARY format to ASCII format.
During transfer of data from an external data medium to the control's hard disk, the data are converted from ASCII format to BINARY format.

The figure shows the correct default setting in the TNCremoNT configuration:



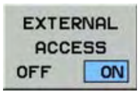
Note

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

Protection from data tampering

It is possible that the machine manufacturer has activated the following soft key on the iTNC 530.
Before data are read from or written to the control's hard disk, such an action must be approved.

- Press the MOD key and subsequently the soft key EXTERNAL ACCESS ON/OFF.
  --> The access must be approved!



Note

The **external access** (via laptop/PC) to partitions on the control's hard disk (e.g., PLC partition) **can be locked with passwords** by the machine manufacturer, like the internal access (on the control).
Contact the machine manufacturer!

13.2 Connection Setup

13.2.1 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-crossed Ethernet cable (patch cable) for connection via your local network (intranet).

> **Note**
>
> Mark your cable as "crossed" or "non-crossed"!

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

Management of the Ethernet interface on the iTNC 530

On the single-processor control, the Ethernet interface is managed by the HEIDENHAIN operating system HeROS. The settings of the Ethernet interface can be interrogated via the **code number NET123**.

With the dual-processor control, the Ethernet interface is managed by Windows. The settings of the Ethernet interface can, for example, be interrogated with the command **ipconfig** in the prompt.

Connection via your local network

Ask your system administrator!

Connection establishment at the customer's (field service)

It is advisable to set up a direct connection between your service 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 a crossed Ethernet cable.

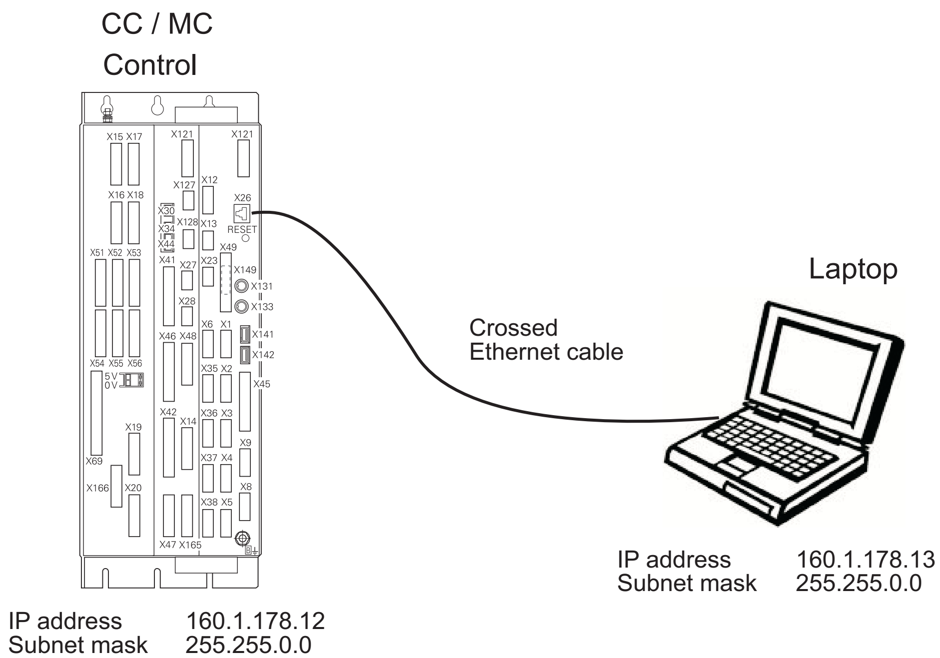


Figure: Example for peer-to-peer connection

▶ 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, or vice versa.

Note

For laptops with Windows XP it is recommended to adapt the Ethernet settings on the laptop ("alternate configuration").

Otherwise, a new Ethernet setting can also be made at the iTNC 530 without having to overwrite the original setting (code number NET123 / soft key DEFINE NET / soft key INSERT LINE).

On the following pages you will find the respective descriptions.

Adjusting Ethernet settings on the laptop

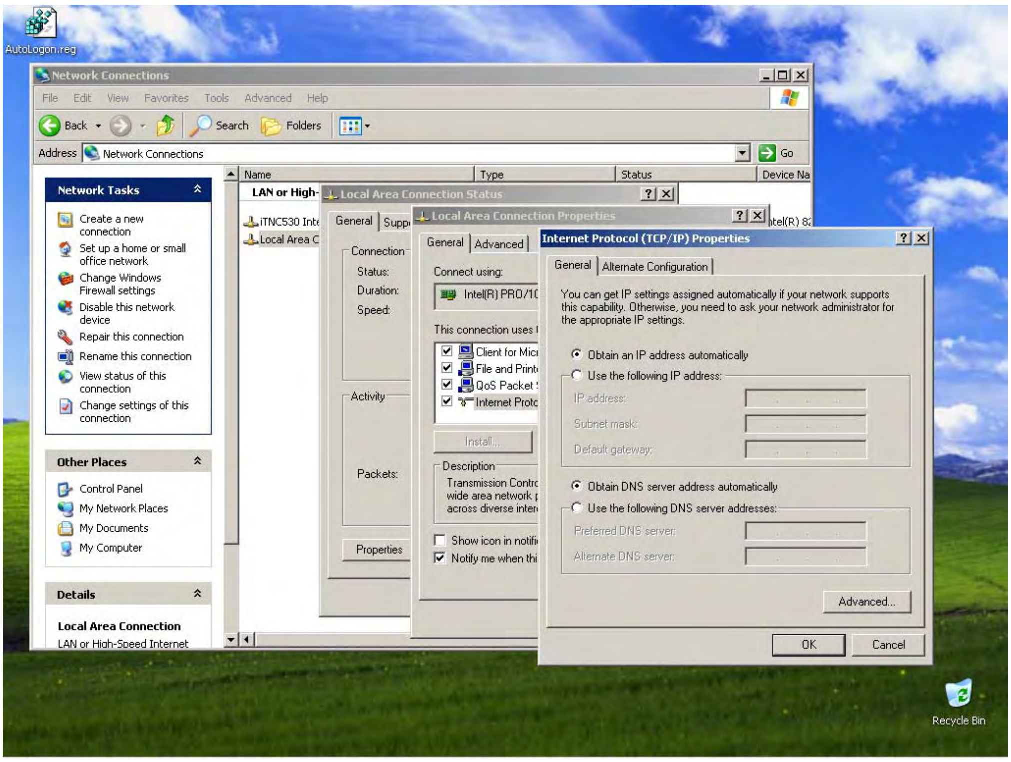
If you want to adapt your laptop to the iTNC 530:

▶ First, write down the Ethernet settings of the control:
Single-processor: Code number NET123. --> DEFINE NET soft key.
Dual-processor control: Ethernet settings in Windows (local area connection).
Details on how to call this information. --> See “Adjusting Ethernet settings on the control” on page 13 – 175.

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

▶ Activate 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 with Windows XP** the characteristics of the TCP/IP protocol are stored in LAN connection --> Characteristics --> Internet protocol (TCP/IP) --> Characteristics.



Note

If the standard configuration of your laptop generates the IP address automatically, click the button "Alternate configuration" of Windows XP.

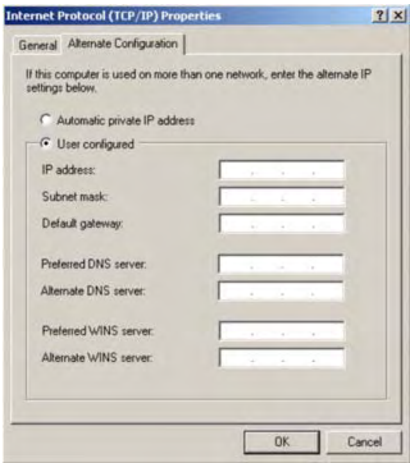


Figure: "Internet Protocol (TCP/IP) Properties, Alternate Configuration"

Caution

In "General" or "Alternate Configuration", write down the original settings 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 IP address.

Note

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

Example:
Address of the iTNC 530: 160.1.180.5
Address of the laptops: 160.1.180.6

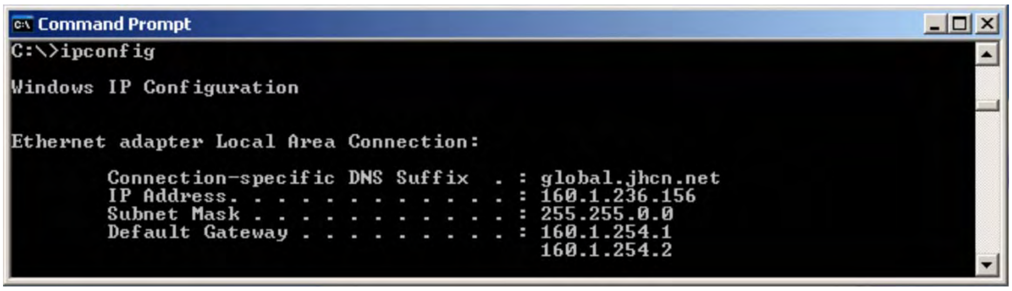
- The subnet mask of your laptop must be identical with that of the iTNC 530.
  Enter this accordingly (the standard gateway is of no significance here).
- Confirm the settings with OK.

Adjusting Ethernet settings on the control

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

▶ Write down the IP address and subnet mask of your laptop:

In the prompt enter, e.g. the **ipconfig** command (or you enter the **winipcfg** command, depending on the Windows version).



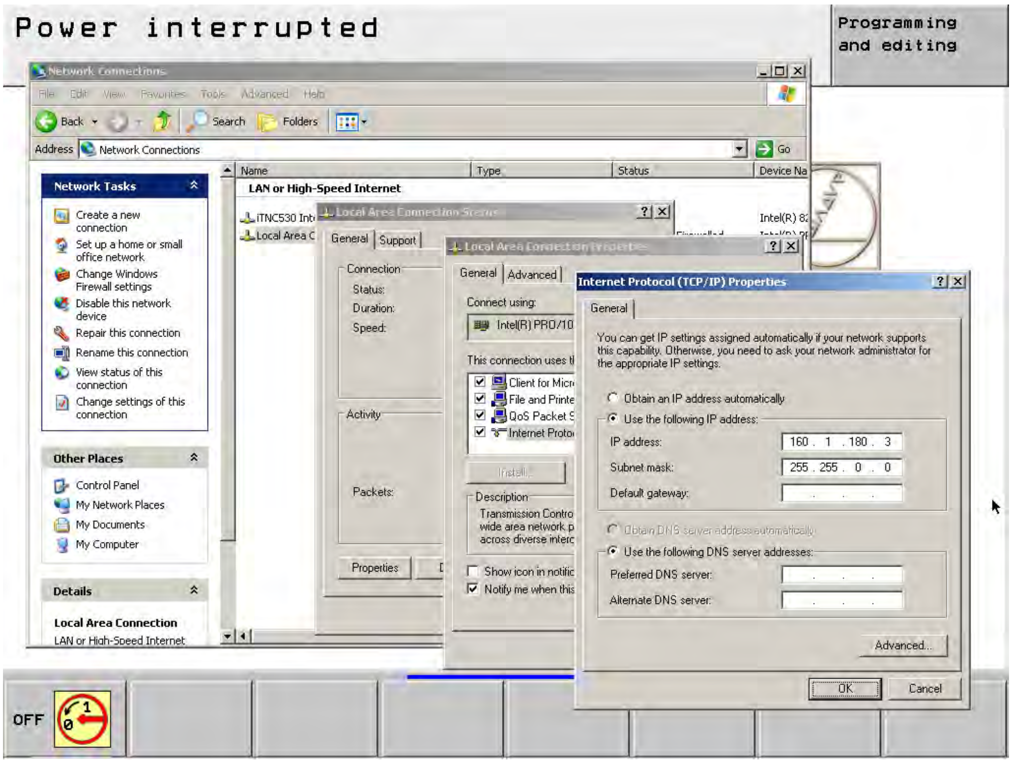
Note

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

Now adapt the network settings of the iTNC 530:

With the **dual-processor control**:

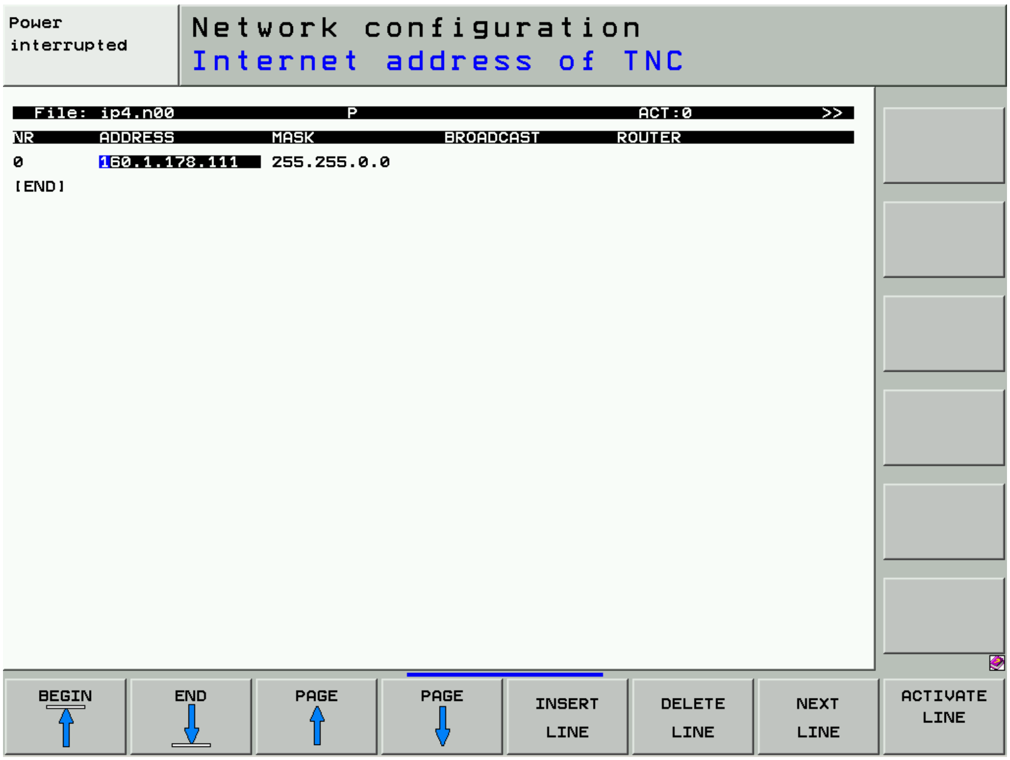
▶ Adapt the network settings in Windows:
Start --> Control Panel --> Network Connections --> Local Area Connection --> Properties --> Internet Protocol (TCP/IP) --> Properties.
Before that write down the original settings.



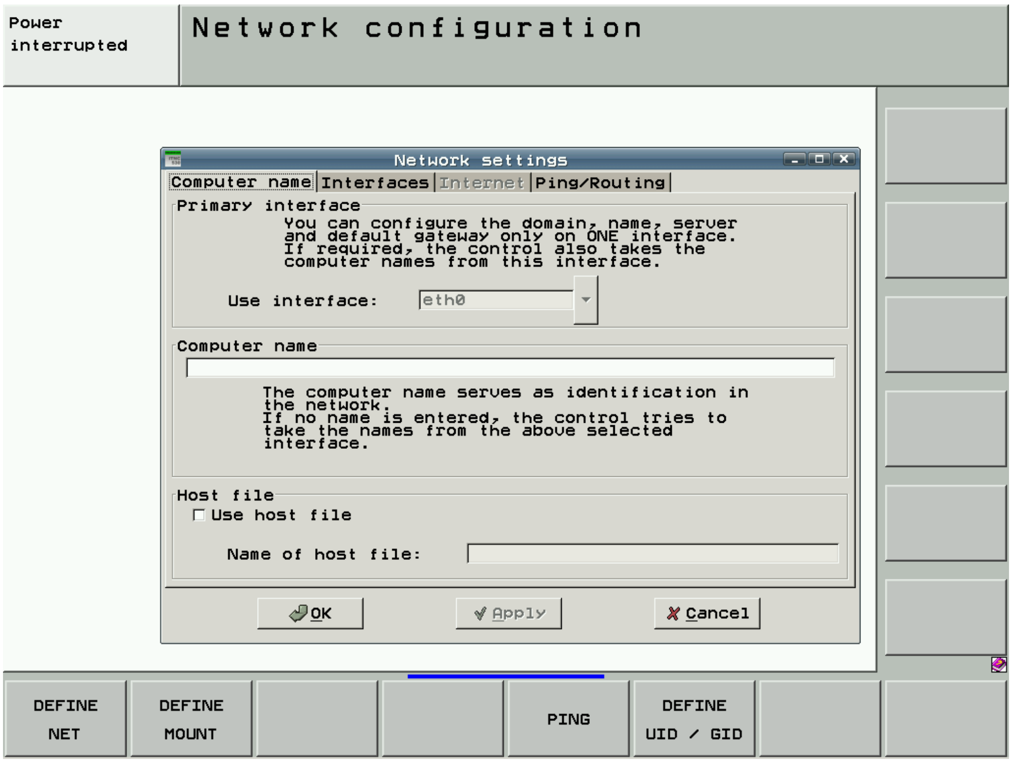
With the **single-processor control**:

▶ Enter the code number **NET123** on the control and press the soft key DEFINE NET.

The following display appears up to NC software version 34049x-04:



The following display appears as of NC software version 34049x-05:



Up to NC software 340 49x-04:

- Press the INSERT LINE soft key.

> **Note**
>
> If the INSERT LINE soft key is not available with older NC software versions -->
> note down the original settings, before you overwrite them or generate a backup copy of the file (ip4n00.a).

- Enter a suitable 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 530 160.1.11.228

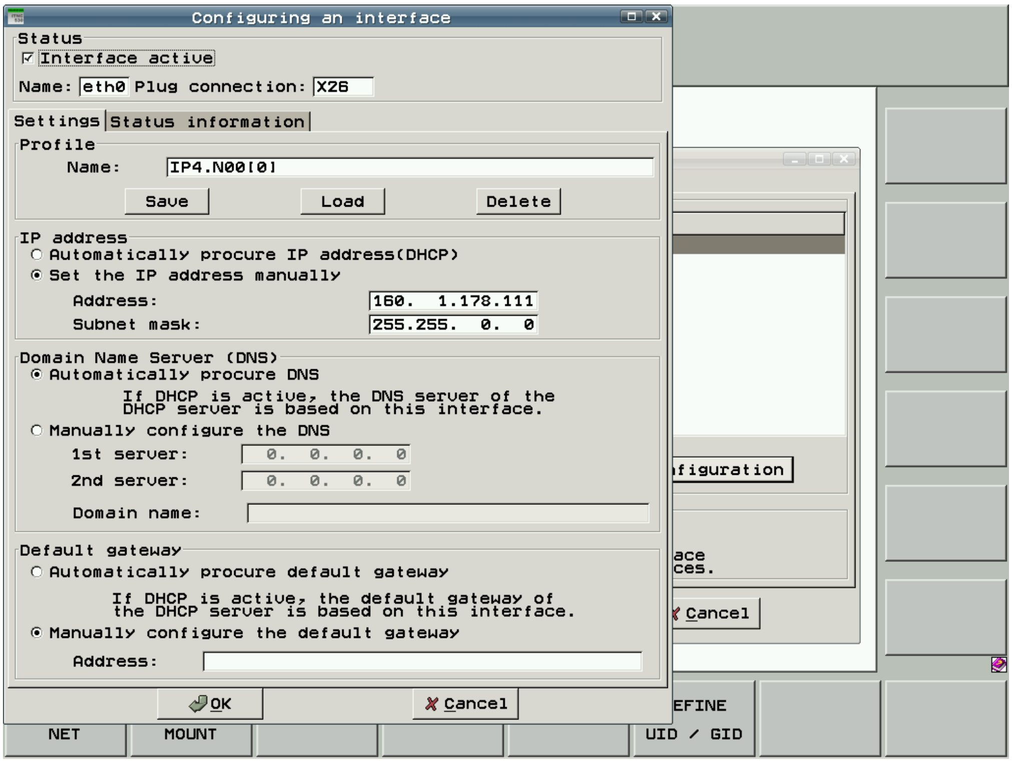
- Enter the same subnet mask as that of your laptop.

> **Note**
>
> If the message **`Protected file!`** appears while entering the new settings, the write protection for the file **ip4.n00** must be disabled:
> Exit network settings --> Enter PLC code number --> Call program management --> Place cursor in the NET folder on file ip4.n00 --> Switch to the next soft-key row --> Press MORE FUNCTIONS soft key --> Cancel locking --> **`P`** (Protected) disappears in the status column.
> Now you can change the network settings.

- Press the INSERT LINE soft key.
- Press the END key twice.
- Now the control reboots, the new settings are active.

As of NC software 34049x-05:

- Click the menu item**Interfaces** in the window **Network settings**.
- Click the **Configuration** button. –> The following window appears:



- Enter a suitable 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	160.1.11.228

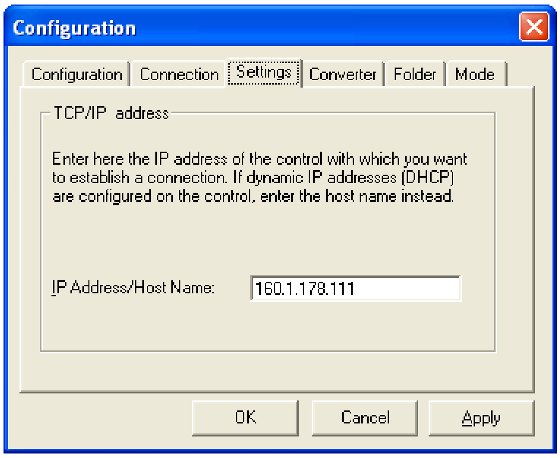
- Enter the same subnet mask as that of your laptop.
- Confirm by clicking **OK** in the window **Configuring an interface**.
- In the window **Network settings** also click **OK**.
- In the window **Activate changes** click **Restart**.
- Now the control reboots, the new settings are active.

TNCremoNT

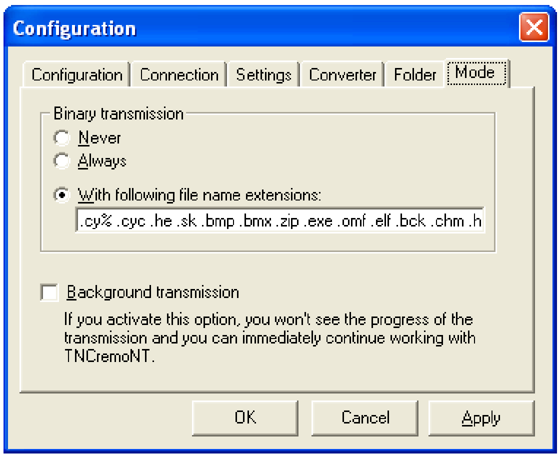
- Start the HEIDENHAIN data transfer program TNCremoNT.

- Click this icon to open the configuration windows.
  (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 transmission mode (BINARY-ASCII conversion). It should be set as follows:



- Confirm with **`Apply`** and **`OK`**.

- Click this icon. --> The connection is set up.

- The TNCremo screen is split and the control's hard disk is 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 during connection establishment, …
>
> 
>
>
> ... the external access to the control is not permitted!
>
> In this case press the MOD key and subsequently theEXTERNAL ACCESS ON/OFF soft key in order to permit access.

„Pinging"

If no TNCremoNT connection is established, 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**, confirm with ENTER and subsequently press the PING soft key.
- Enter the IP address of the iTNC.
- Confirm ENTER. -->If the Ethernet card functions, you receive the answer **HOST RESPOND.**
  If the Ethernet card does not function, the **TIMEOUT** message is displayed.

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 Ethernet card does not function, a timeout message is displayed.

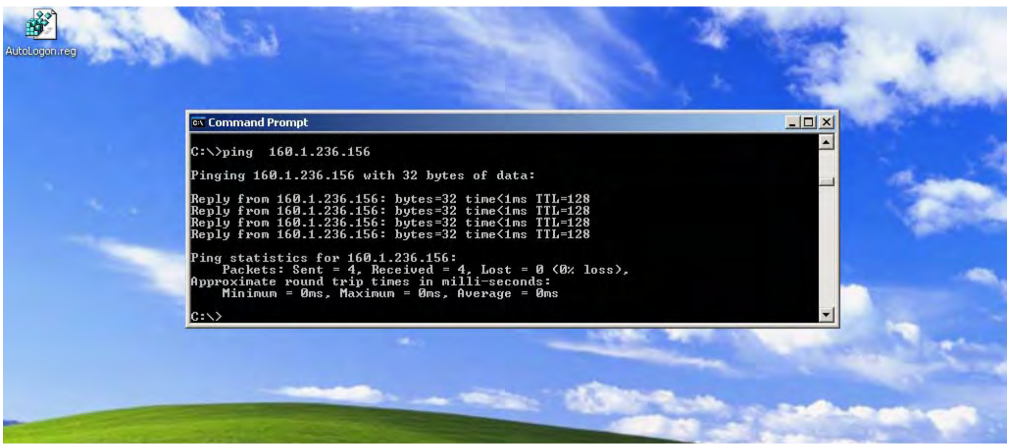


Figure: Pinging from the laptop to the control successful

Pinging from the control to the laptop (test of the connection):

- Enter the code number **NET123**, confirm with ENTER and subsequently press the PING soft key.
- Enter the IP address of the laptop.
- Confirm ENTER. -->If the connection functions, you receive the answer `HOST RESPOND.` If the connection does not function, the `TIMEOUT` message is displayed.

Note

If the "pinging" does not function, you have to check again all settings and the hardware (Ethernet cables, Ethernet cards).
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 Mbit network
	Off	10 Mbit network

Restoring original settings

After having finished data back-up and separated the connection, do not forget to restore the original network settings of your laptop or of the iTNC 530!

On the laptop:

- Activate the original settings with the "General" button on the laptop with Windows XP or enter the original setting noted down and press ENTER to confirm.

On the control:

Up to NC software 340 49x-04:

- Place the cursor in the line with the original network settings and press the ACTIVATE LINE soft key.
- If you have overwritten the original settings on the control, you have to enter them again or copy the back-up file (e.g., ip4n00.a) to file ip4.n00.
- Press the END key twice. --> The control reboots and transfers the new settings.

Note

You can / should protect the file **ip4.n00** with the original network settings.
Enter PLC code number --> Call program manangement --> Place the cursor in the NET folder on file ip4.n00 --> Switch to the next soft-key row --> Press MORE FUNCTIONS soft key --> Set the locking --> `P` (Protected) appears in the status column.

As of NC software 34049x-05:

- Place the cursor in the line with the original network settings and press the ACTIVATE LINE soft key.
- If you have overwritten the original settings on the control, you have to enter them again or copy the back-up file (e.g., ip4n00.a) to file ip4.n00.
- Press the END key twice. --> The control reboots and transfers the new settings.

13.2.2 Via serial interface RS-232-C or RS-422

Requirements

- A laptop/PC with a **RS-232-C** or **RS-422** interface or a **USB interface** (for connection of a USB/RS-232-C adapter).
- A **crossed serial data transfer cable** ("null-modem cable") for the connection of laptop and **D-sub connector on the electrical cabinet** (HEIDENHAIN adapter block).
  Possible configurations, also for direct connection of the laptop to the iTNC 530. -->
  See “Cable Overview” on page 13 – 200.
- An **"opto bridge"**.

Note

Do not use self-made cables (shielding problems, contact problems, short circuits, etc.).
Mark your cable as "crossed" or "non-crossed"!

Caution

HEIDENHAIN recommends using an **"Opto-Bridge".**
This serial adapter connector ensures metallic isolation via optocoupler 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!

Managing the serial data interfaces on the iTNC 530

Data interface	Connector	
	Single-processor software	Dual-processor software
RS-232-C (V.24)	X27 for HeROS	X27 for Windows X127 for HeROS
RS-422 (V.11)	X28 for HeROS	X28 for Windows X128 for HeROS

Use the connector for HeROS!

Connection setup

- Connect your laptop to the adapter connector RS-232-C or RS-422 of the electrical cabinet with a crossed serial data transfer cable (and possibly an opto bridge).

Note

Usually, the machine tool builder mounts the HEIDENHAIN adapter connector RS-232-C or RS-422 to a electrical cabinet wall.
If this is not the case, note that mostly you must use a different data transfer cable for direct connection of the iTNC 530. –> See “Cable Overview” on page 13 – 200.

- Now configure the serial interface on the iTNC 530.

Configuration of the serial interface on the iTNC

- Call –> See “Interface configuration and assignment of mode” on page 13 – 206
- Select the baud rate for the LSV/2 protocol.
  You can select the highest possible baud rate. If there are transmission problems, you can back on lower baud rates.

Note

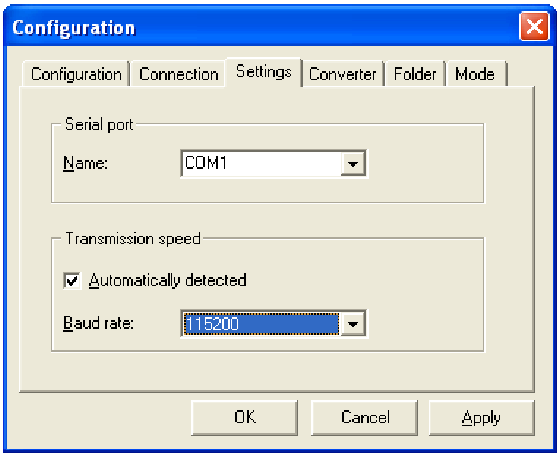
The iTNC 530 recognizes automatically when the LSV-2 protocol is used (e.g., data transfer with TNCremoNT).
A setting in the line **`Operating mode`** is not necessary!

TNCremoNT

- Start the HEIDENHAIN data transfer program TNCremoNT.

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

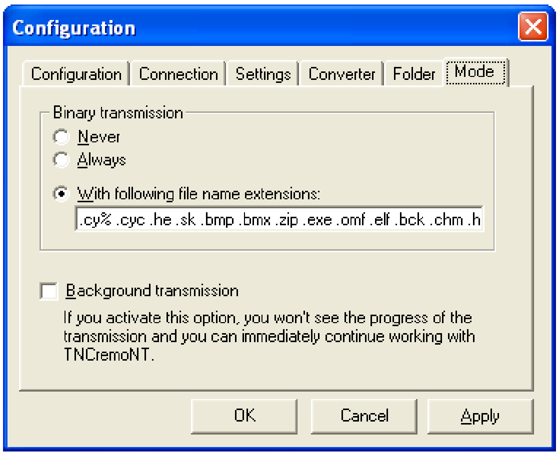
- Click now on **`Connection`** and select the **`LSV-2 (serial connection)`**.
- Then click on **`Settings`** and select the serial interface (e.g. COM1).
- Activate automatic detection of the data transfer rate on connection setup. –> The baud rate you have set on iTNC 530 is activated.



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 transmission mode (BINARY-ASCII conversion). It should be set as follows:



▶ Confirm with **Apply** and **OK**.

▶ Click this icon. --> The connection is set up.

▶ The TNCremo screen is split and the control's hard disk is 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 during connection establishment, …

... the external access to 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.

13.2.3 Via USB

Requirements

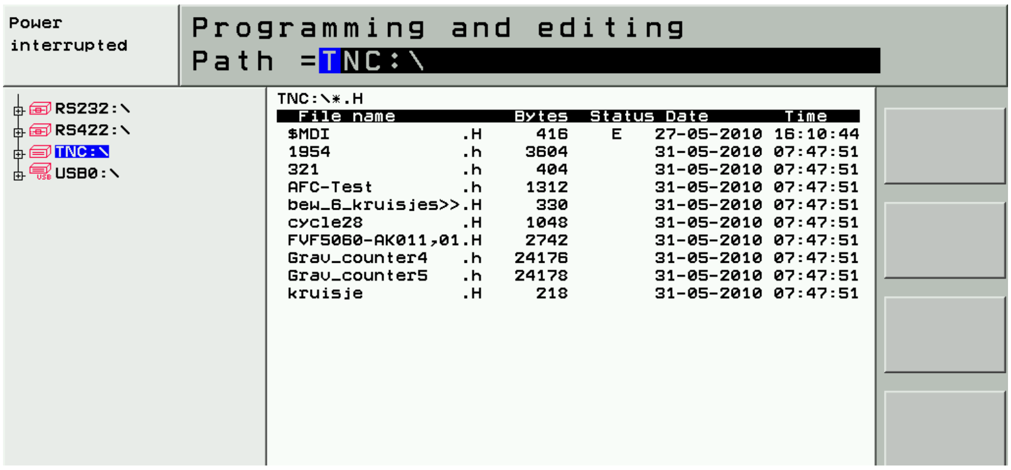
- At least **NC software version 34049x-02 with feature content level L2** on the iTNC 530.
- A **USB device** (e.g. USB stick) with the following characteristics:
  - USB 1.1
  - FAT or VFAT file system or per ISO 9660
  - Current consumption below 0.5 A (otherwise a separate power supply is required)
  - USB cable, max. 6 m (for longer cables amplifiers must be used)

Note

iTNC 530 recognizes standard USB 1.1 sticks.
HEIDENHAIN cannot guarantee that all USB sticks available on the market work with iTNC 530!

Connecting the USB stick

- Call the `Programming and editing` mode of operation and press the PGMMGT key.
- Connect the USB stick to the control (or to a slot provided by the machine manufacturer). --> The USB device appears in the directory tree:



Disconnecting the USB stick

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 and then continue to switch the soft-key row, until the soft keys with the USB-stick symbols appear.

- Press the soft key with the symbol "Remove USB stick". --> The USB device is deleted from the directory tree.
- Remove the USB stick.

Caution

If you remove the USB stick without having pressed the "Remove USB stick" symbol before, you may loose data on the stick!

13.3 Reading In and Out of Individual Files or Directories

There are several possibilities of reading in and downloading files and directories:

- Connection of a USB device; transfer using the dual-window concept in the program management
- Transfer using TNCremoNT
- Transfer using TNCserver

> **Note**
>
> Information on setting data interfaces and reading in and out of data (e.g., **TNCserver** operation) can be found in the User's Manual for the iTNC 530.

Connection setup

▶ Connect a USB stick --> See “Connection Setup” on page 13 – 172
or ...

▶ Establish the connection between the control and the laptop using TNCremoNT. --> See “Connection Setup” on page 13 – 172.

Transferring data to the USB flash drive

> **Caution**
>
> Use the **dual-window concept also on the iTNC 530 processor control with Windows** when transferring control data to a USB stick. Only then the required BINARY-to-ASCII data conversion is ensured.

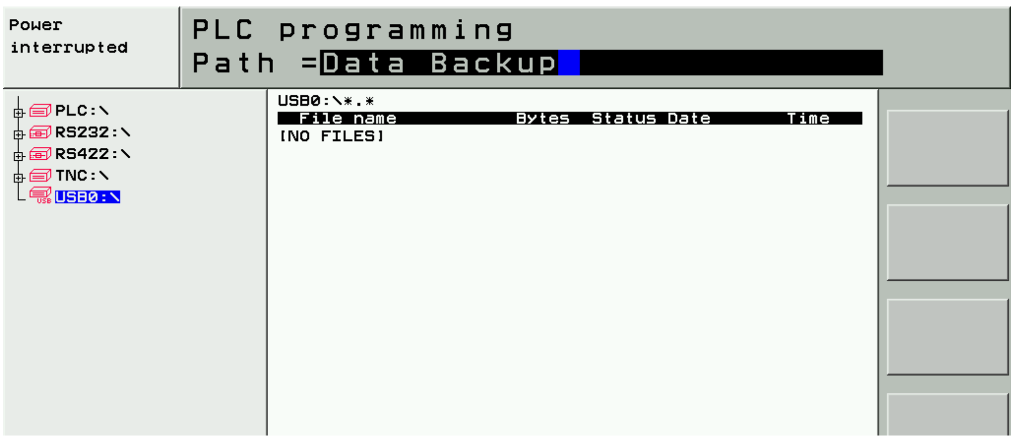
> **Note**
>
> To change to the PLC partition you must have entered the PLC code number before.

> **Note**
>
> The following description uses the program manager with the setting **`Enhanced 1`** --> See “Setting the Program Manager” on page 12 – 162.

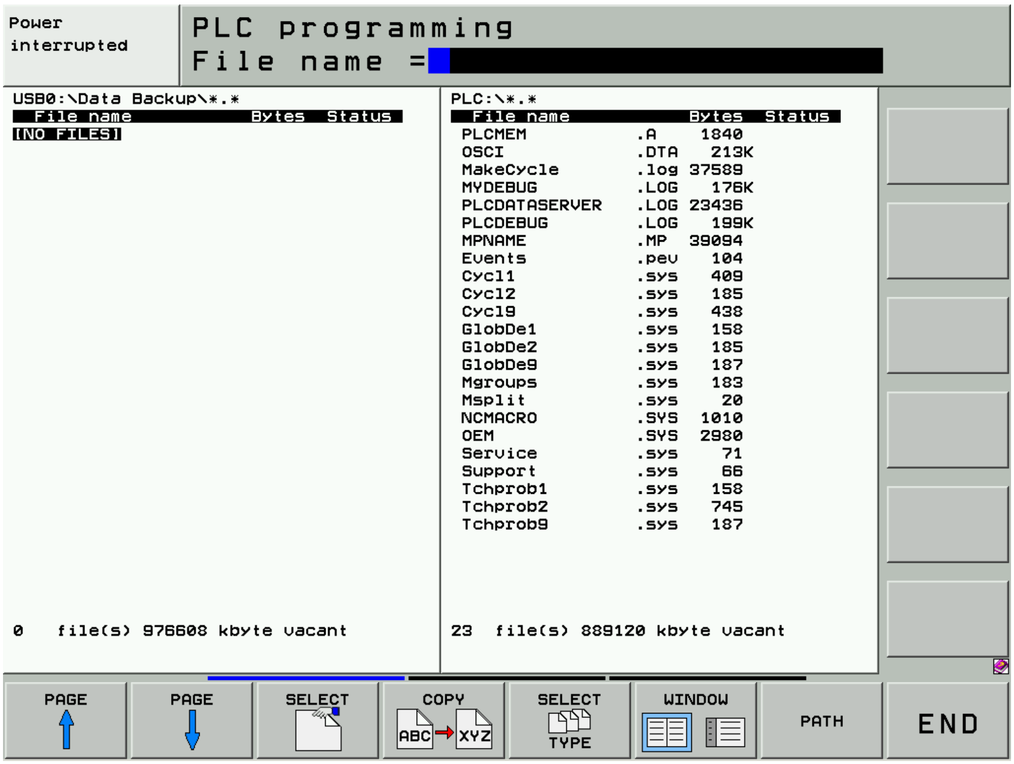
▶ Switch to the **`Programming and Editing`** operating mode (for TNC data) or **`PLC programming`** (for PLC data) and press the PGMMGT key.

▶ 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 and confirm with the ENT key and the YES soft key.



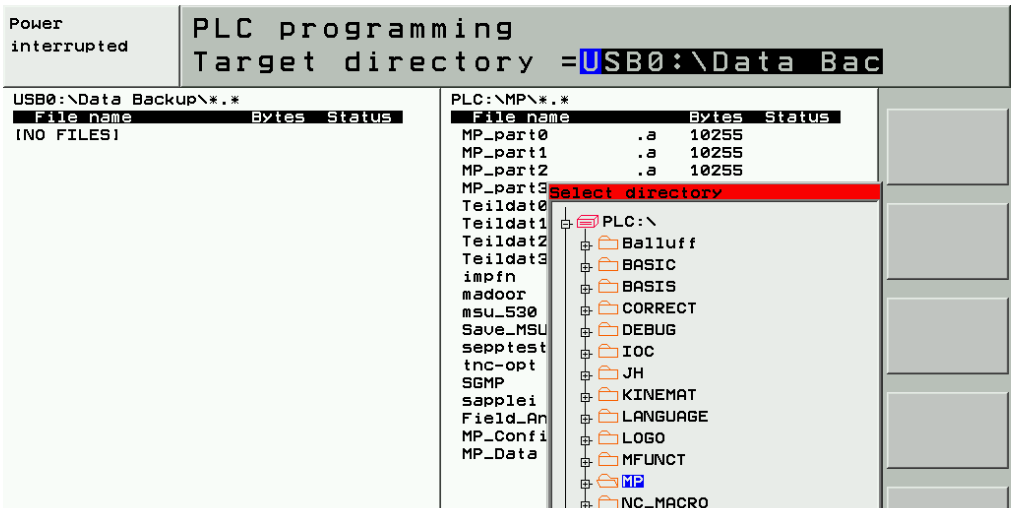
- Place the cursor on the new directory.
- Press the WINDOW soft key (switch to next soft-key row). --> The display changes to the dual-window concept:



- 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 stick.
- Press the WINDOW soft key (switch to next soft-key row). --> Now you exit the dual-window concept.
- Press the soft key "Remove USB stick" before you remove the stick. --> See “Disconnecting the USB stick” on page 13 – 185.

Transferring data from the USB flash drive

Caution

Use the**dual-window conceptalso on the iTNC 530 processor control with Windows** when transferring control data from a USB stick to the control.
Only then the required ASCII-to-BINARY data conversion is ensured.

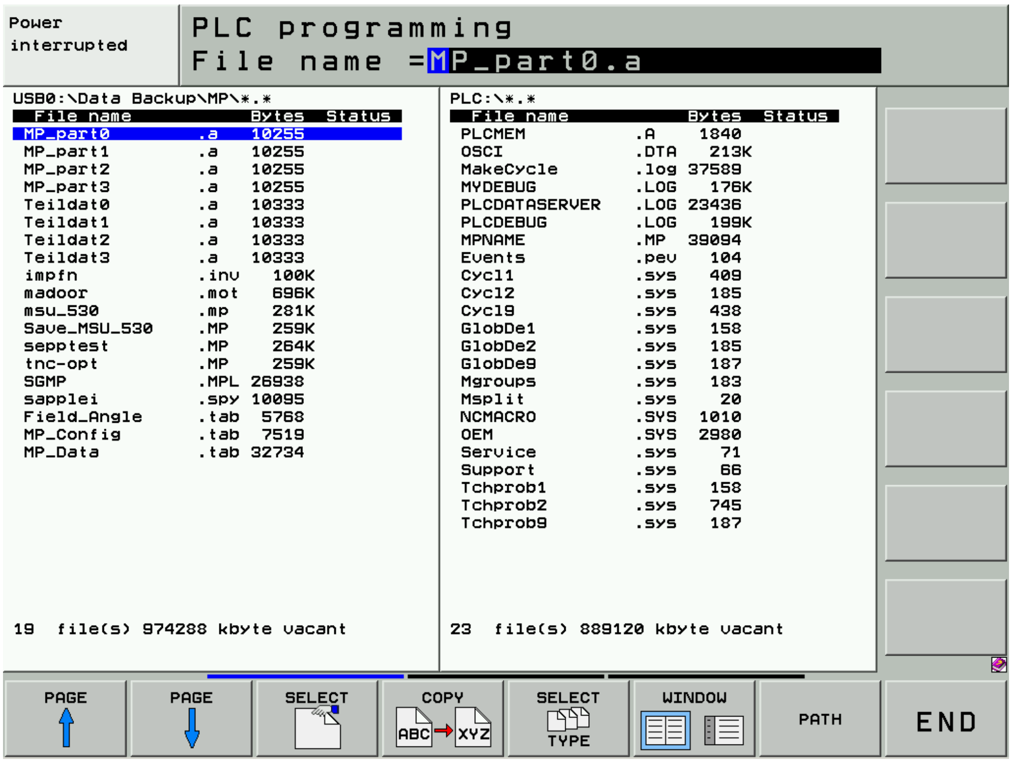
Note

To change to the PLC partition you must have entered the PLC code number before.

Note

The following description uses the program manager with the setting **`Enhanced 1`** --> See "Setting the Program Manager" on page 12 – 162.

- Switch to the **`Programming and Editing`** operating mode (for TNC data) or **`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 (switch to next soft-key row). --> The display changes to the dual-window concept:



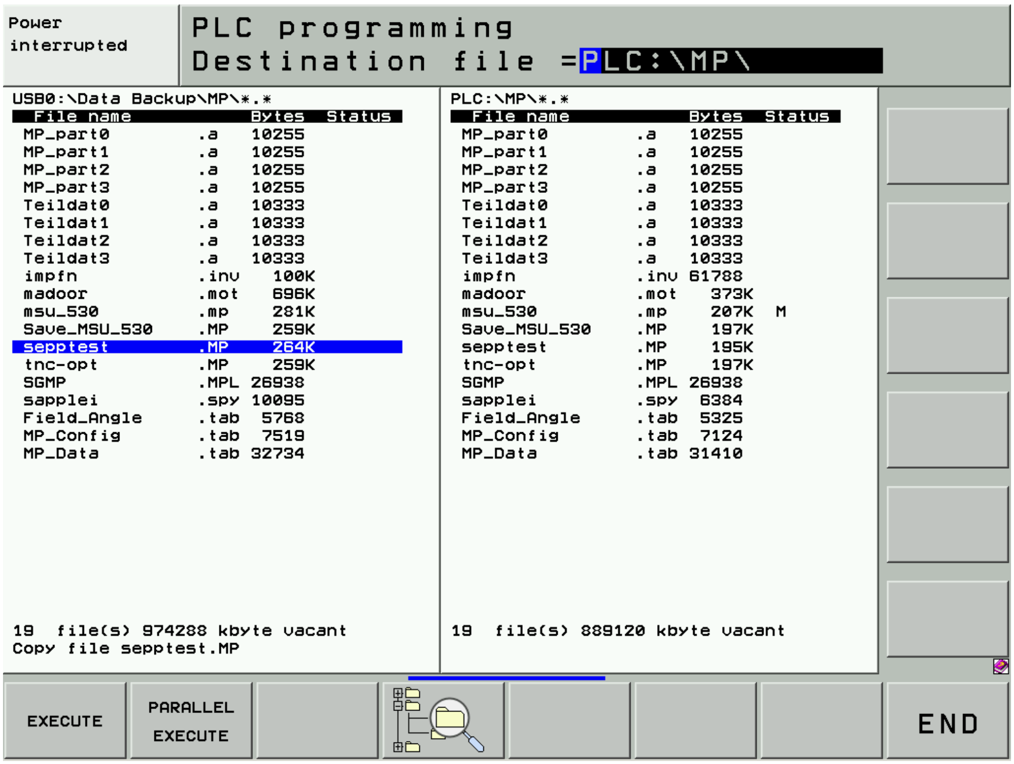
- Place the cursor in the right half on the directory or subdirectory to which you wish to transfer the data.

Note

Press the soft keys PATH and FILES to activate the respective view.

- Return to the other side now.

▶ 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 from the USB stick to the control.

▶ Press the WINDOW soft key (switch to next soft-key row). --> Now you exit the dual-window concept.

▶ Press the soft key "Remove USB stick" before you remove the stick. --> See “Disconnecting the USB stick” on page 13 – 185.

Reading out data using TNCremoNT

In the **upper half of the screen** (laptop/PC contents), select the **target drive** and the **target directory**:

- Click the bar with the drive information. --> Its color changes from gray to blue, 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. --> The path is displayed in the blue bar.

Note

For the data zu 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 screen half** (iTNC 530 contents), select the **source drive** and the **source directory**:

- Click the bar with the drive information. --> Its color changes from gray to blue, 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. --> The path is displayed in the blue bar.

Note

For changing to the PLC: und SYS: control partitions, the respective code numbers are interrogated.

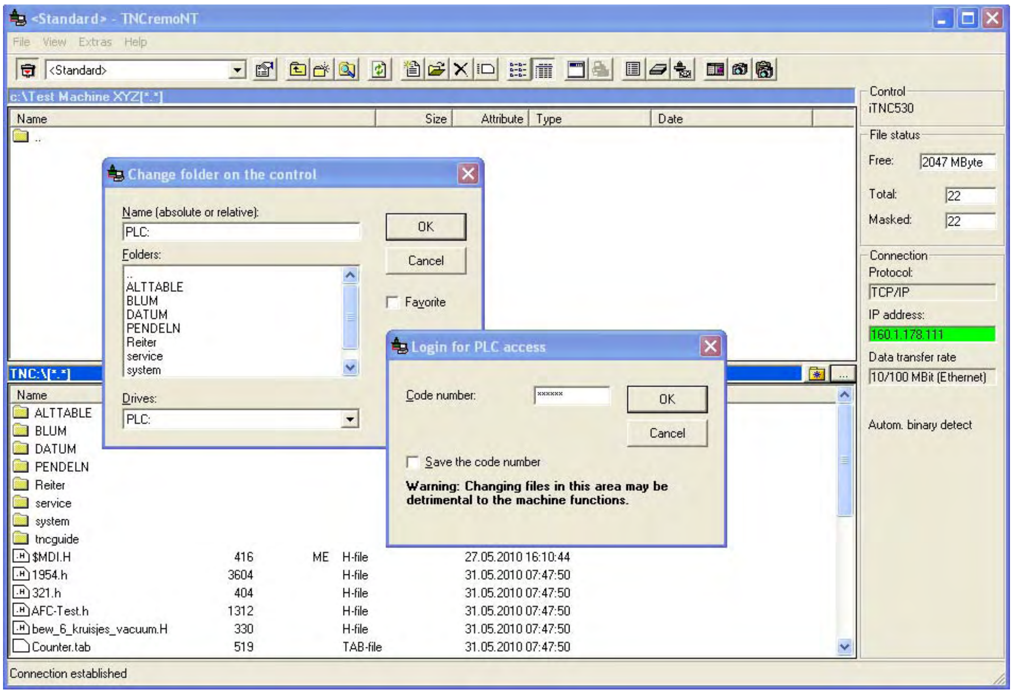


Figure: Changing to the PLC partition

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 file is being transferred.

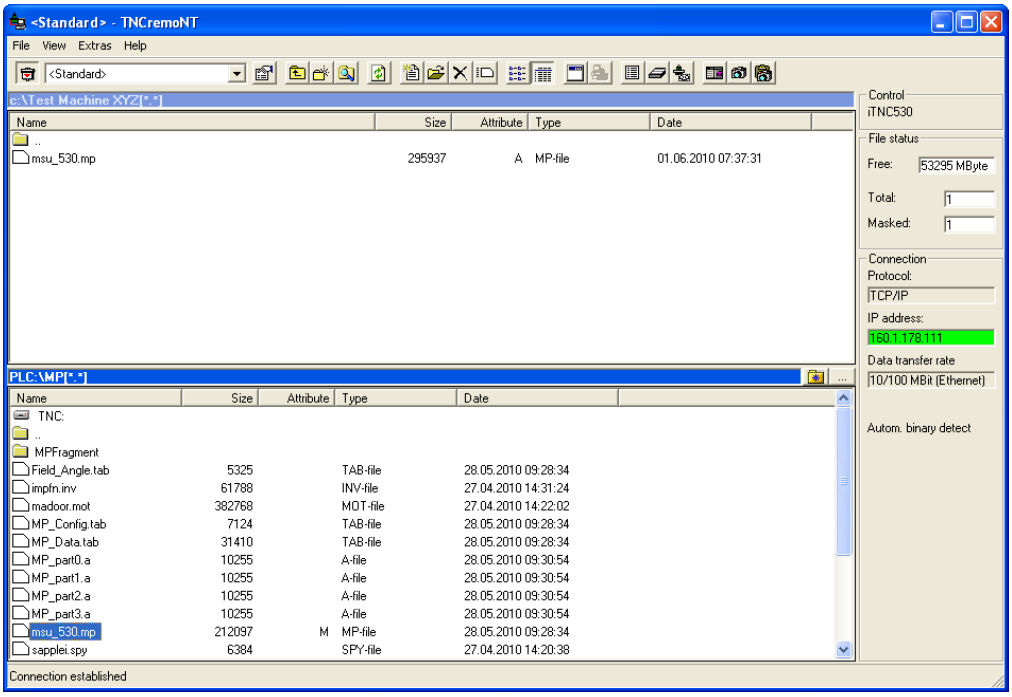


Figure: Read-out file

Note

During downloading the data format is automatically converted from BINARY (control) to ASCII (laptop/PC) via TNCremoNT.

Reading in data using TNCremoNT

In the **lower screen half** (iTNC 530 contents), select the **target drive** and the **target directory**:

- Click the bar with the drive information. --> Its color changes from gray to blue, 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. --> The path is displayed in the blue bar.

Note

For changing to the PLC: und SYS: control partitions, the respective code numbers are interrogated.

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 from gray to blue, 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. --> The path is displayed in the blue 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 file is being transferred.

Note

During uploading the data format is automatically converted from ASCII (laptop/PC) to BINARY (control) via TNCremoNT.

13.4 Backup on an External Data Medium

During backup the data of the control's hard disk are stored on an external data medium (e.g. service laptop).

Either the contents of the control partitions PLC:\ and TNC:\ are archived for long periods or all available data of the control's hard disk (full backup) are used for, e.g., an exchange of the control.

Note

If possible the control should be in **`Power interrupted`** state while the backup is run.

Connection setup

- Set up a connection to iTNC 530 via TNCremoNT.
  --> See “Connection Setup” on page 13 – 172.

Selecting the target drive on the laptop

In the **upper screen half** (laptop/PC contents), select the **target drive**:

- Click the bar with the drive information. --> Its color changes from gray to blue, 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 blue bar.

Creating target folder on laptop

- Click the icon **`Create folder`** or select **`File / Create folder ...`** from the menu. --> A new window opens.
- Enter the name of the new directoy (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 blue bar.

Selecting the control partition

In the **lower screen half** (iTNC 530 contents), select the **source drive**:

- Click the bar with the drive information. --> Its color changes from gray to blue, 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 blue bar.

Note

For changing to the PLC control partition, the respective code number is interrogated.

- Ensure that your are in the root directory of the selected partition (in the example PLC:).

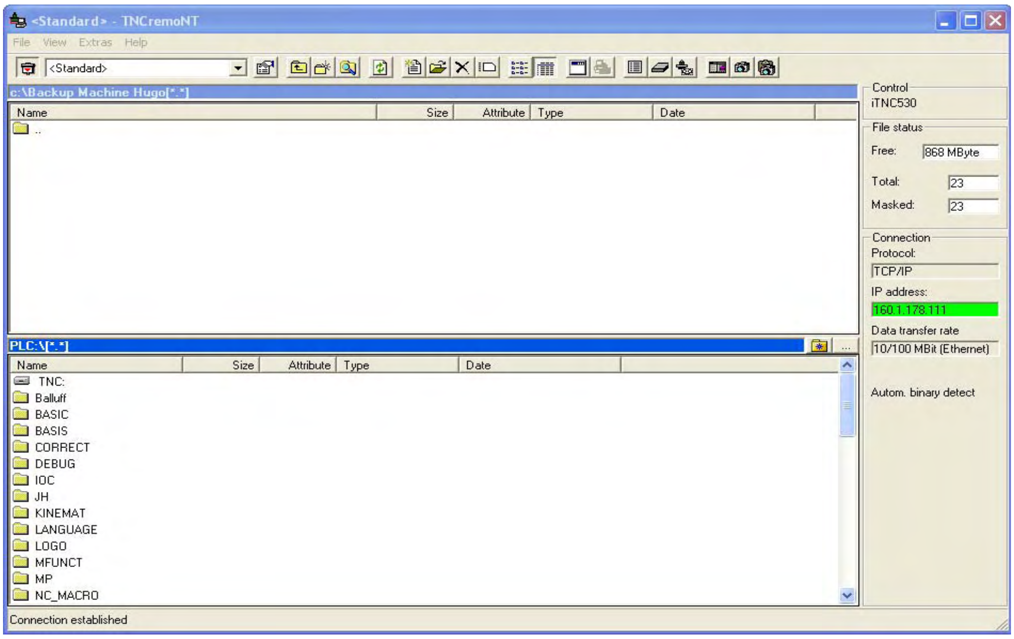
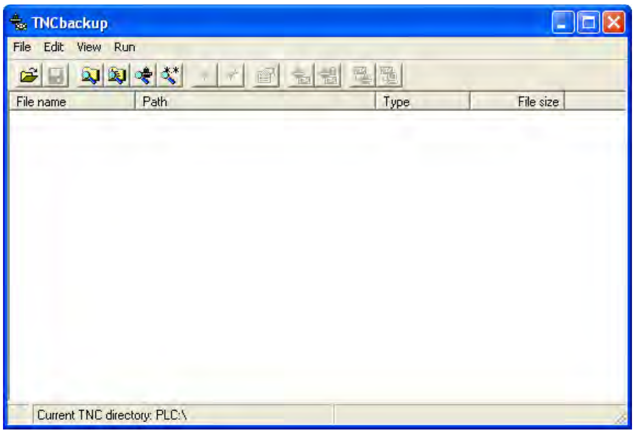


Figure: PLC partition selected for data back-up

Call the back-up 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 on **`Scan directory tree`**. --> All files of the selected partition are listed.

▶ The backup should have an identifying name (for example the machine number).

Note

HEIDENHAIN recommends to create 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 are up-to-date. Experience has shown that customer data (NC programs, etc.) are changed more frequently.
There is no information on operating hours or the calibration of touch probes or overflows of Multiturn-EnDat encoders in these archives.

If you have to **replace the MC 422 tauschen**:

- Select **`Scan everything`** ("full backup") or ...

- **`Scan system and machine files`** (Ask the customer if the TNC data have already been backed up or the source files are stored on an external data medium.)

Caution

The machine time (TIMES.SYS), the calibration data of the touch probes, possible overflows of multiturn EnDat encoders, traverse range settings, etc. (NCDATA.SYS) are included in this backup so that they can subsequently be transferred to the new control or hard disk. These backup types are **not intended for an archive**, since machine time, calibration data, overflows of multiturn EnDat encoders etc. continue to change.

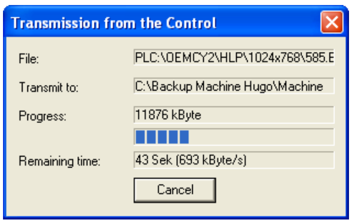
Note

For these backup types the settings of date and time on control and laptop must match. Otherwise the error message **`Wrong password!`** is displayed.

Starting the backup

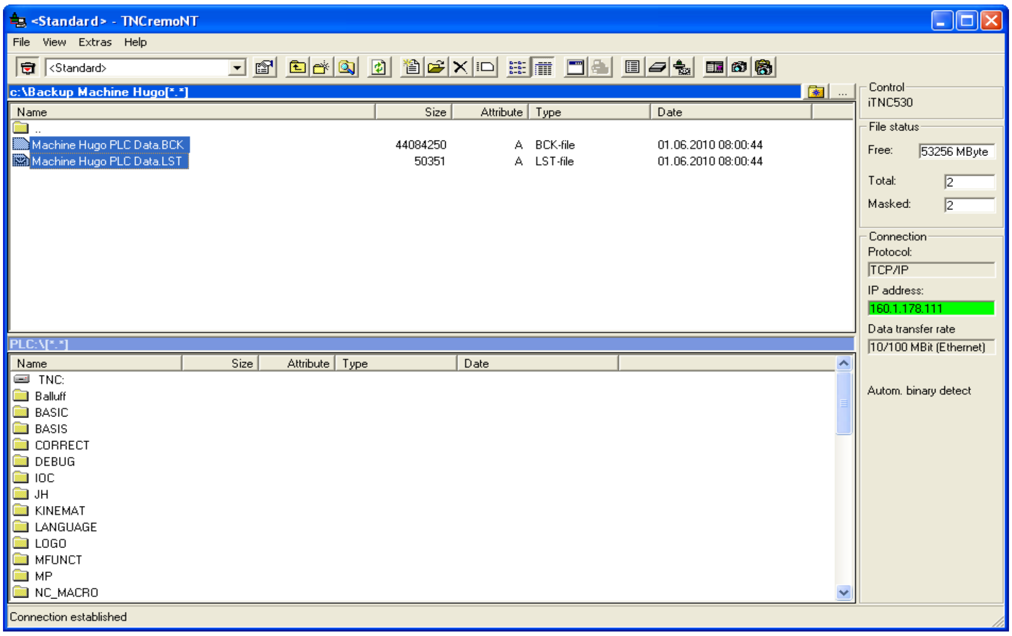
- Click on **`Run/Backup`** (or the corresponding icon).
  The following window appears:

- Enter an identifiying name for the backup file in the **`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.



Caution

The backup is only complete and can be restored at a later date, if both files are available:
***.BCK**: backup file with the files in compressed format
***.LST**: reference list containing the directories and the files

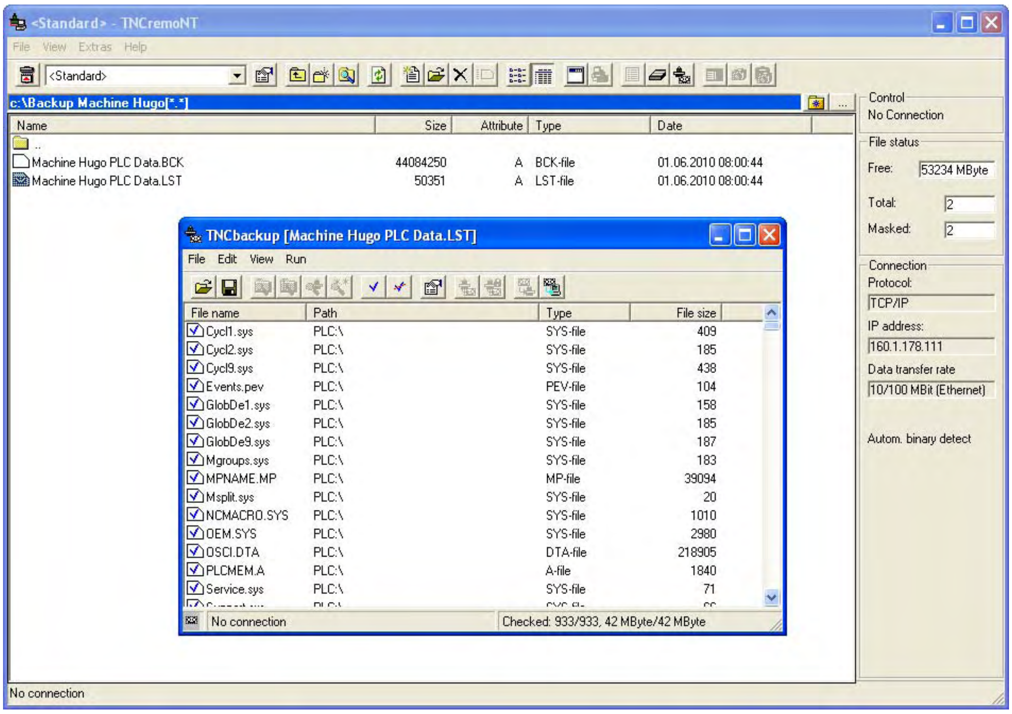
▶ Separate the connection.

▶ Close the **TNCremoNT** window.

13.5 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) and 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 before 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 changes regarding the blue ticks.

Caution

If your store the set marks your *.LST file after extraction, only the marked files of this backup will be restored in a later process!

13.6 Restoring Data

When restoring the backup of a machine, the data (e.g., PLC data, TNC data, "full backup") are restored from an external data medium (e.g. service laptop) to the control's hard disk.

Caution

- When restoring the hard-disk data, the machine must not operate!
- The control should be in **`Power interrupted`** state.
- 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 13 – 172.
Tip: For the original settings for DEFINE NET, refer to file **`IP4.N00`** which you have extracted, e.g., from the backup file of the corresponding machine. --
--> See “Extracting Files from the Backup File” on page 13 – 196.

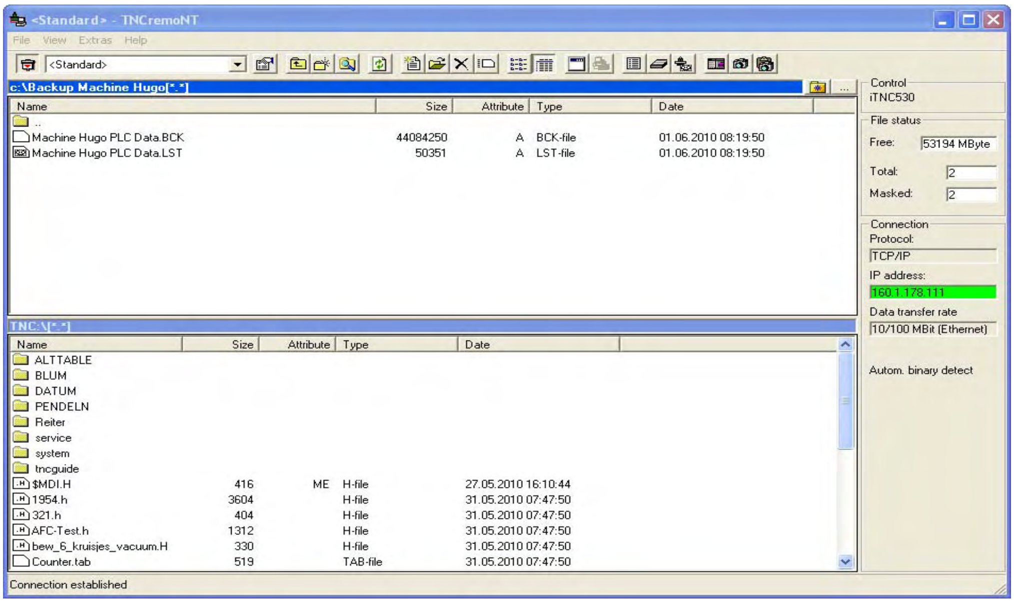
Connection setup

- Set up a connection to iTNC 530 via TNCremoNT.
  --> See “Connection Setup” on page 13 – 172.

Backup file

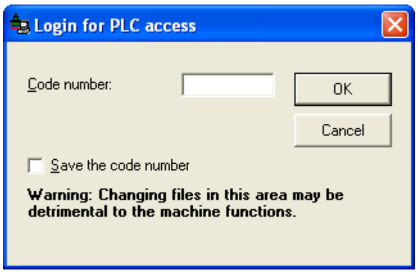
In the **upper screen half** (laptop/PC contents), select the **drive** and the **directory** where you have stored the backup file:

- Click the bar with the drive information. --> Its color changes from gray to blue, 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 blue bar.

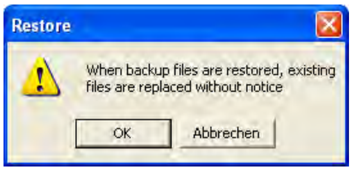


Starting the restoring procedure

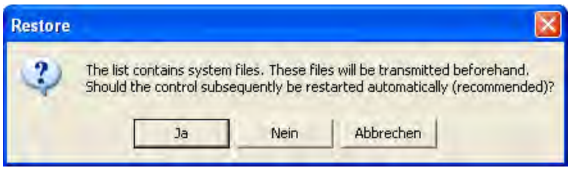
- Double-click on the **LST file** to open it. --> The **`TNCbackup`** window appears.
- Start the data transfer with the menu item **`Run/Restore`** or the corresponding icon.
- To restore PLC data (PLC archive, full backup) you need to know the PLC code number:



- Enter and confirm the code number.
- Confirm the following warning with **`OK`**:



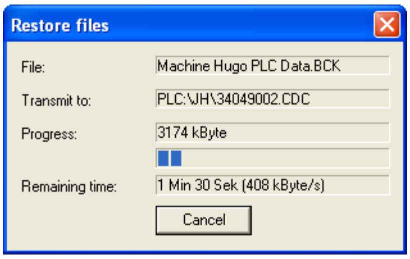
- Confirm the message regarding an automatic control reset with **`Yes`**!



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 12 – 159.

- The data are 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.

Note

The network settings of the control should be saved.
They can be found under PLC:\NET\ ...
Move the cursor to the corresponding filed, press the soft keys AUX. FUNCTIONS and PROTECT. A **P** is shown in the status column for "protected".

Note

After restoring the machine backup and subsequently booting the control, **the following problem can occur with older NC software versions**:
In the original MP list the control requires additional parameters (e.g. as of index xxx.5).

Background:
In the OEM.SYS there is the entry AXISNUMBER.
This serves to specify the number of axes for which indices are to be created in the MP file (e.g. indices xxx.0 to xxx.8 for 9 axes).
If a control boots without PLC data, the MP list is added to the hardware configuration (i.e. on controls with 5 axes only up to parameter xxx.4).
The same is true if the PLC data of a control were lost and for new or exchange controls.
The number of axis indices exceeds the hardware configuration for example if the spindle drives more than one axis (C-axis mode, etc.).
I.e., when booting the first time during data restoration the original MP list is truncated and therefore no longer useful.

Solution:

1. Load MP_NAME.MP into the editor.
   (as long as the original MP list is open for editing, it cannot be restored).
2. Load the entire backup on the control again.
3. Reboot the control.

13.7 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
RS-422 (V.11)	Up to 1000 m

☞ **Note**

Do not use self-manufactured cables (shielding problems, contact problems, short circuits, etc.).
Mark your cable as "crossed" or "non-crossed".

13.7.1 Ethernet interface RJ45 connection

For the direct connection of laptop and control (**"peer-to-peer"**) you require a **crossed Ethernet cable ("crossover cable").**

☞ **Note**

Mark your Ethernet cable as "crossed" in order to avoid confusion.

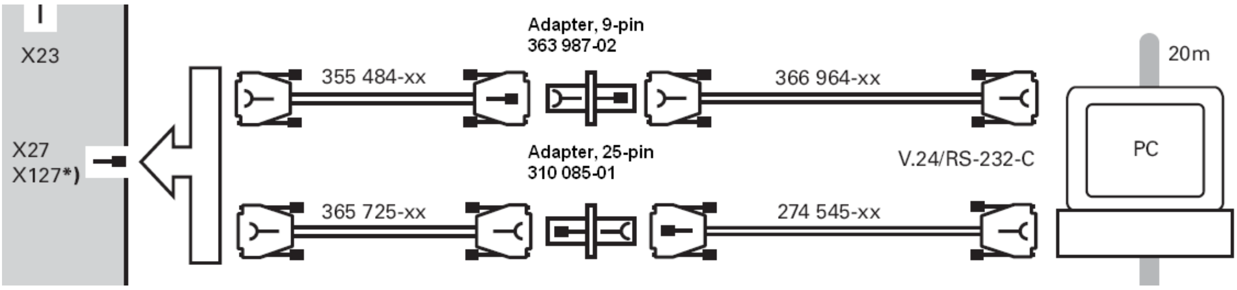
If you establish the connection via your local network (intranet), normally use a non-crossed Ethernet cable (patch cable).

13.7.2 RS-232-C (V.24)

Note

The RS-232-C has different pin layouts at the iTNC 530 (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.

Some possible combinations are:



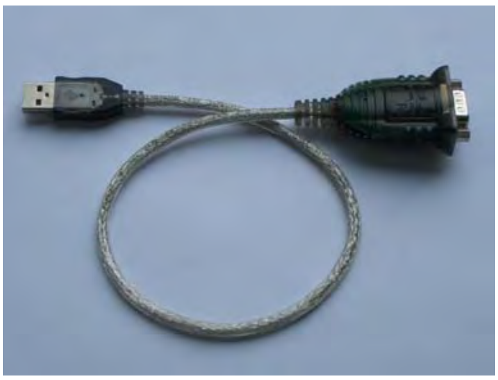
Note

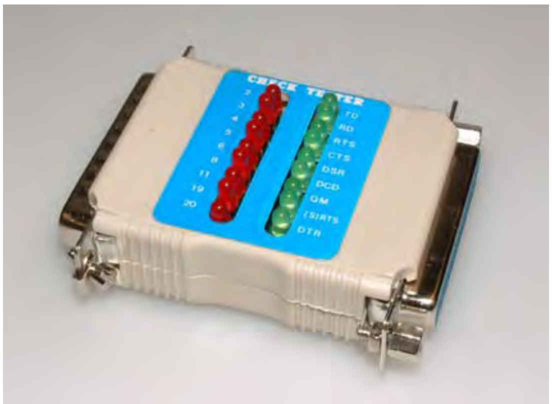
You find detailed information on cables and cable layouts for serial data transfer in the **help menu of TNCremoNT** under the catchword **"Cable assembly"**.

Caution

For data transfer via RS-232-C or RS-422 HEIDENHAIN recommends using an **"Opto Bridge".**
This serial adapter connector ensures metallic isolation via optocoupler 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!

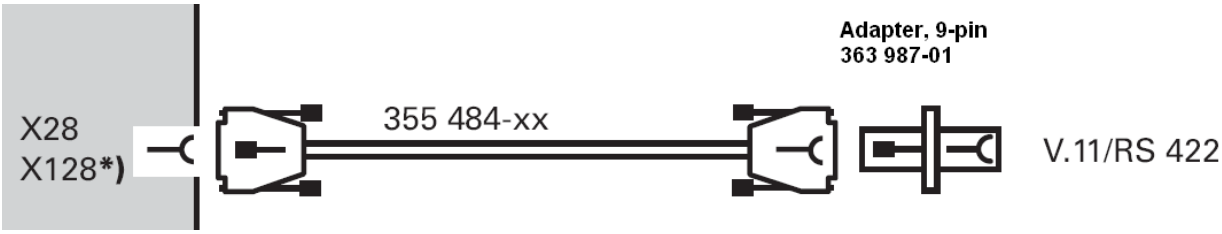
Accessories The following accessories can be helpful; they are available in specialized computer stores:

	D-sub adapter connector 25-pin "Opto Bridge" Metallically isolates the serial interface by means of integrated opto couplers and thus protects from: - Overvoltages - Different load potentials by different main current 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

	D-sub adapter connector 25-pin To test the data transfer lines; display by LEDs
	D-sub adapter connector 25-pin To cross the data transfer lines
	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.

13.7.3 RS-422 (V.11)

The RS-422-/V.11 data interface has the same pin layout at the iTNC (connector X28, X128) and at the V.11 adapter block (D-sub connector on the switch cabinet).



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"**.

Caution

For data transfer via RS-232-C or RS-422 HEIDENHAIN recommends using an **"Opto Bridge".**
This serial adapter connector ensures metallic isolation via optocoupler 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!

13.8 Operating Modes of the Data Interfaces

13.8.1 Overview of operating modes

The iTNC can be set for data transfer according to the following interface operating modes:

FE1

For connection of the HEIDENHAIN floppy-disk unit FE 401B or other peripheral units.
This operating mode is supported by TNCRemoNT.

Protocol:	Blockwise transfer
Data format:	7 data bits, 1 stop bit, even parity
Baud rate:	110 - 115 200 baud
Interface parameters:	Firmly adapted
Transfer stop:	Software handshake with DC3

Data format and protocol adjusted to suit FE 401/B!

EXT 1, EXT 2

For adjusting data transfer to external peripheral units.

Protocol:	Standard data format or blockwise transfer Adjusting via machine parameters from MP5000
Data format:	Adjusting via machine parameters from MP5000
Baud rate:	110 - 115 200 baud
Interface parameters:	Adjusting via machine parameters from MP5000
Transfer stop:	Software handshake with DC3 or hardware handshake with RTS, set via machine parameter from MP 5000

LSV-2:

The LSV2 protocol allows various functions such as file management and diagnosis of the iTNC 530 to be executed from the PC.
This operating mode is supported by TNCRemoNT.

Protocol:	Bidirectional data transfer in accordance with DIN 66019
Data format:	8 data bits, 1 stop bit, none parity
Baud rate:	110 - 115 200 baud
Interface parameters:	Firmly adapted
Transfer stop:	Software handshake via protocol

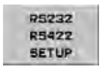
13.8.2 Interface configuration and assignment of mode

Calling the interface setup

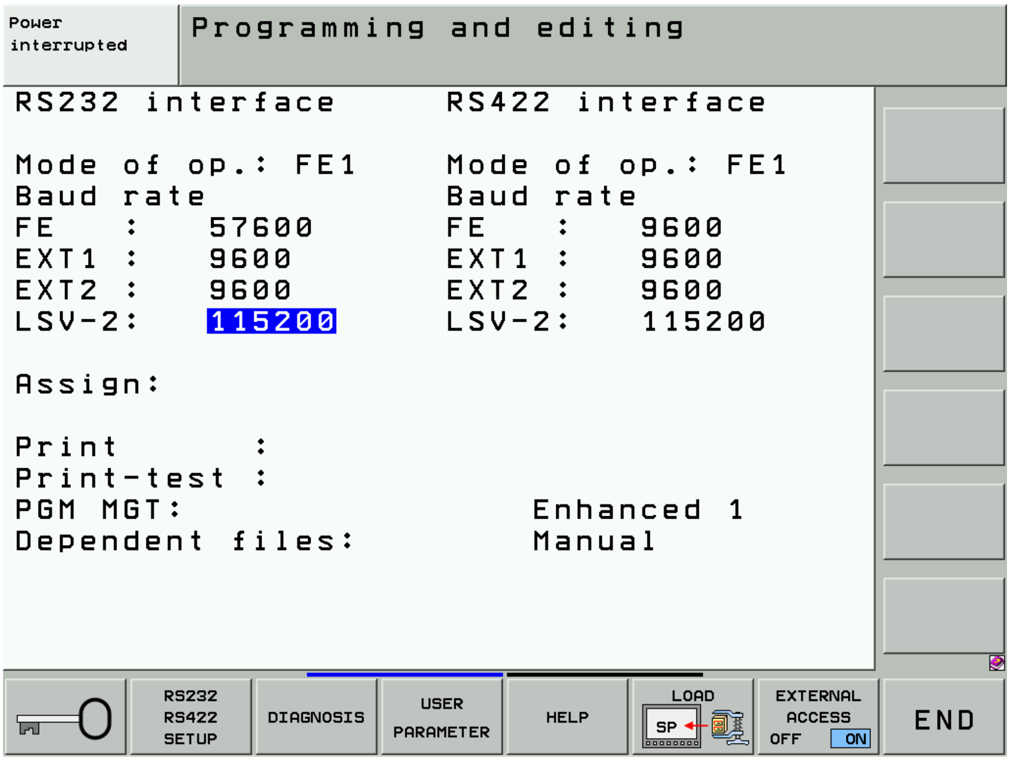
Press the following key combination to call the main screen for interface configuration:

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

▶ Press the MOD key.



▶ Call the setup menu for the serial data interfaces.



Operating mode / baud rate

The data interface RS-232-C (V.24) is configured on the left side 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 the operating mode, baud rate and assignment of interfaces:

- ▶ Move the cursor to the entry you wish to edit.
- ▶ Press the GOTO key to display a popup window. Place the cursor on the desired value.
- ▶ Confirm with ENT.
- ▶ Use END to exit the interface settings.

Note

The iTNC 530 recognizes automatically when the LSV-2 protocol is used (e.g., data transfer with TNCremoNT). It is not necessary to set the line **`Operating mode`**!

13.9 Drive Symbols

The different drives are shown in the program management of the HEIDENHAIN control:

RS-232-C:\ V.24 data interface (X27)
RS-422:\ V.11 data interface (X28)
TNC:\ TNC partition (user data)
PLC:\ PLC partition (machine data via code number)

Depending on the operating mode, a symbol is displayed next to the external drive symbol:

Mode of operation	Drive symbol with PGM MGT
FE1	
EXT1, EXT2	
Ethernet	

14 Reloading the NC Software Used

14.1 Introduction

It can be helpful for servicing to reload the NC software used on the machine on the iTNC 530 if **data of the SYS partition were lost**.
For example:

- 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.

Each NC software version and each service pack installed are archived on the control's hard disk. With the single-processor version of the iTNC 530, this is done in path **`SYS:\zip`** and with the dual-processor version in path **`C:\Program Files\Install`**. These archives can be called on the control as described in the following desciptions.

The NC software used can be downloaded from the states archives. The associated data are extracted again. It might thus be possible to restore destroyed files on the hard disk.

14.2 Preparations

Test of Hard Disk

- Before loading again the NC software used, run a hard disk test for the SYS partition. The **`Test for bad clusters`** must be activated. Contact a HEIDENHAIN service agency if you wish to carry out this special hard disk test.

> **Note**
>
> Defective areas on the hard disk detected by the hard disk test are "disabled".
> I.e., that these areas are not used any more in the event of a new loading of data.

Active NC software version and service pack

- Check which NC software version and which service pack is active on the control. Press the MOD key.If the NC software number is followed by **`SP`** (e.g., **`340490 04 SP6`**), 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 loaded again and subsequently the associated service pack.

Preparing the machine

- If still possible:
  Move 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.

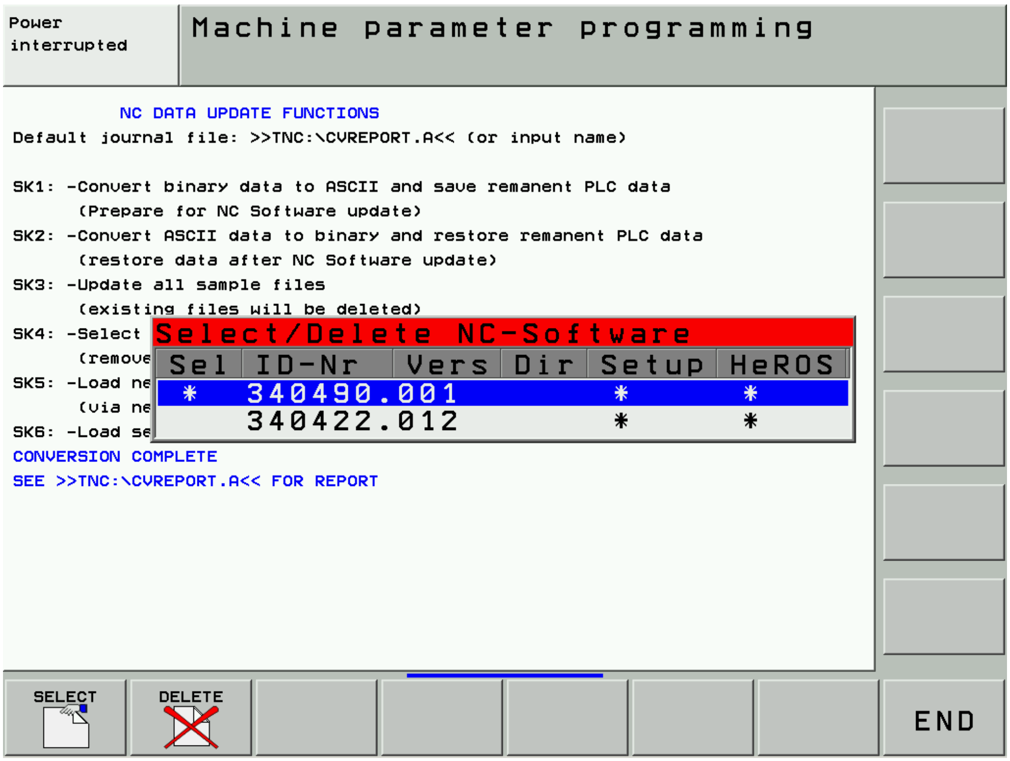
> **Note**
>
> HEIDENHAIN recommends backing up the control data before reloading the NC software used. –> See "Backup on an External Data Medium" on page 13 – 192.

14.3 Proceeding up to NC Software 34049x-01 (Single-Processor Version)

- Call the **machine parameter list** with the corresponding code number.
- Now press the MOD key.
- Press the UPDATE DATA soft key.
- Press the BIN --> ASC softkey to convert the files on the hard disk from binary to ASCII format.

Equivalent file name extensions in binary and ASCII format					
.H	.H%	.I	.I%	.T	.T%
.TCH	.TC%	.D	.D%	.P	.P%
.PNT	.PN%	.COM	.CO%	.CMA	.CM%

- Press the soft key NCVER --> All NC software versions on the control now appear in the following selection window.



- The currently used software version is distinguished by an asterisk in the first column `Sel`. Place the cursor to the marked NC software version!

DANGER

You may only activate the NC software currently used by the machine!

A change to another NC software version is not described in this Service Manual and must only be made in agreement with the machine manufacturer.

- Press the SELECT soft key.

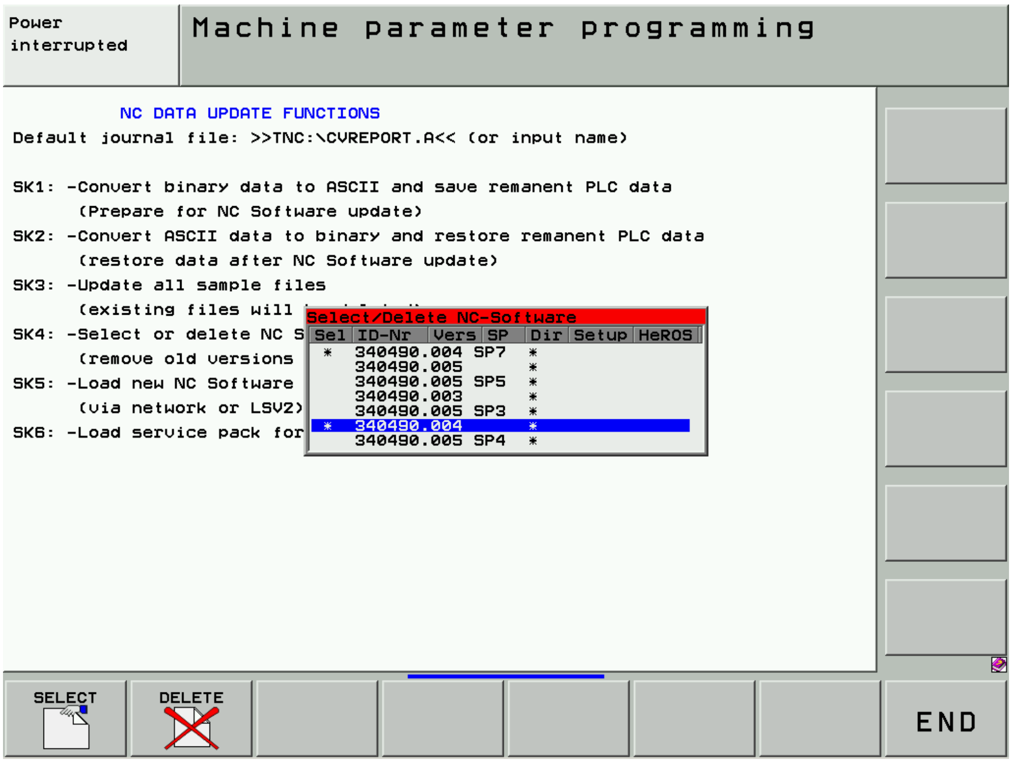
- Confirm your selection with the YES soft key.

> **Note**
>
> If now the error message `Not enough space on SYS:` is generated, packed NC software versions must be deleted from the SYS partition. This is done in the mentioned selection window with the DELETE soft key.
> Ask the machine manufacturer which NC software versions may be deleted!

- The control activates the selected NC software again and performs a reset.
- Call again the **machine parameter list**.
- Press the MOD key.
- Press the UPDATE DATA soft key.
- Press the ASC --> BIN soft key to convert the files on the hard disk from ASCII to binary format.
- If a service pack was active on the machine (what you have noted down), you must now load it. --> See “Loading of Service Packs” on page 15 – 219 .
- Check the NC software version incl. related Service Pack. --> Press the MOD key.
- Finally, check the machine functions!

14.4 Proceeding as of NC Software 34049x-02 (Single-Processor Version)

- Call the **machine parameter list** with the corresponding code number.
- Now 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 following selection window.



- The currently used software version is distinguished by a asterisk in the first column **Sel**. Place the cursor to the marked NC software version!

Note

Do not confuse NC software versions and service packs!
NC software versions do **not** have the extension **SP** (e.g., **340490.004**).
The preceding NC software version helps to assign the service packs. Then follows **SP** with the number of the pack (e.g., **340490.004 SP6**).

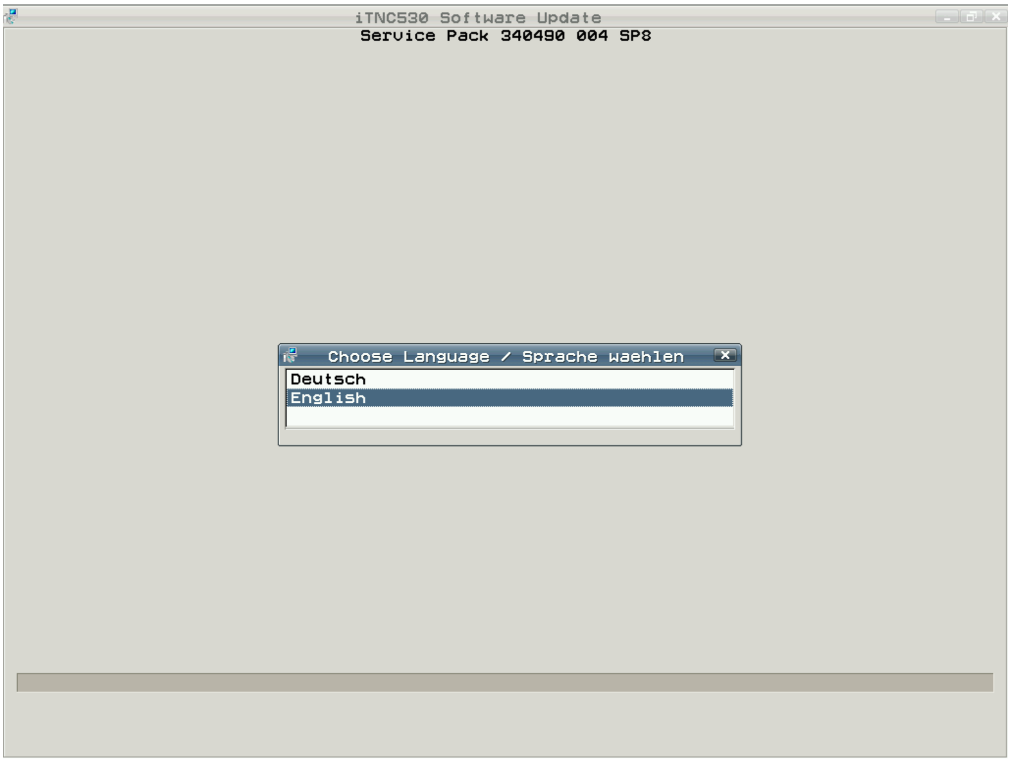
DANGER

You may only activate the NC software currently used by the machine!

A change to another NC software version is not described in this Service Manual and must 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.

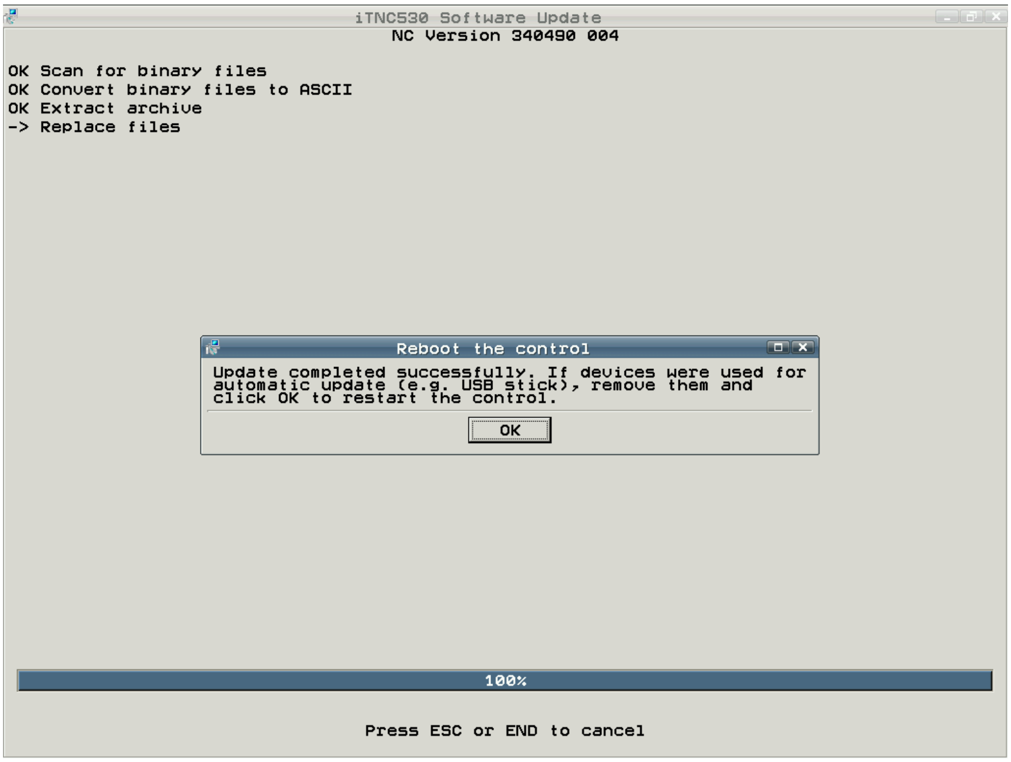


▶ Select a language and confirm the following questions by pressing ENT or by mouse click. --> The NC software is loading.

Note

If now the error message **Not enough space on SYS:** is generated, packed NC software versions and service packs must be deleted from the SYS partition. This is done in the mentioned selection window with the DELETE soft key.
Ask the machine manufacturer which NC software versions and service packs may be deleted!

▶ When the NC software has been successfully loaded, the following message is displayed:



▶ Click OK or press the ENT key. --> The control reboots!

▶ 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. related Service Pack. --> Press the MOD key.

▶ Finally, check the machine functions!

14.5 Proceeding for the Dual-Processor Version

DANGER

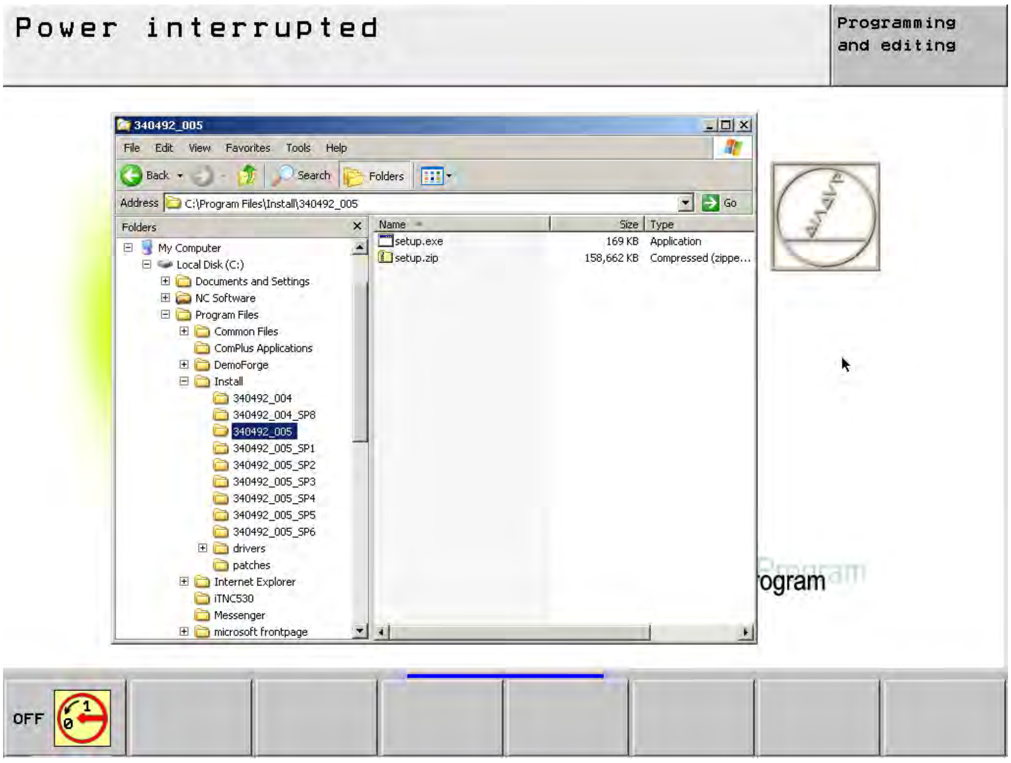
You may only activate the NC software currently used by the machine!

A change to another NC software version is not described in this Service Manual and must only be made in agreement with the machine manufacturer.

Caution

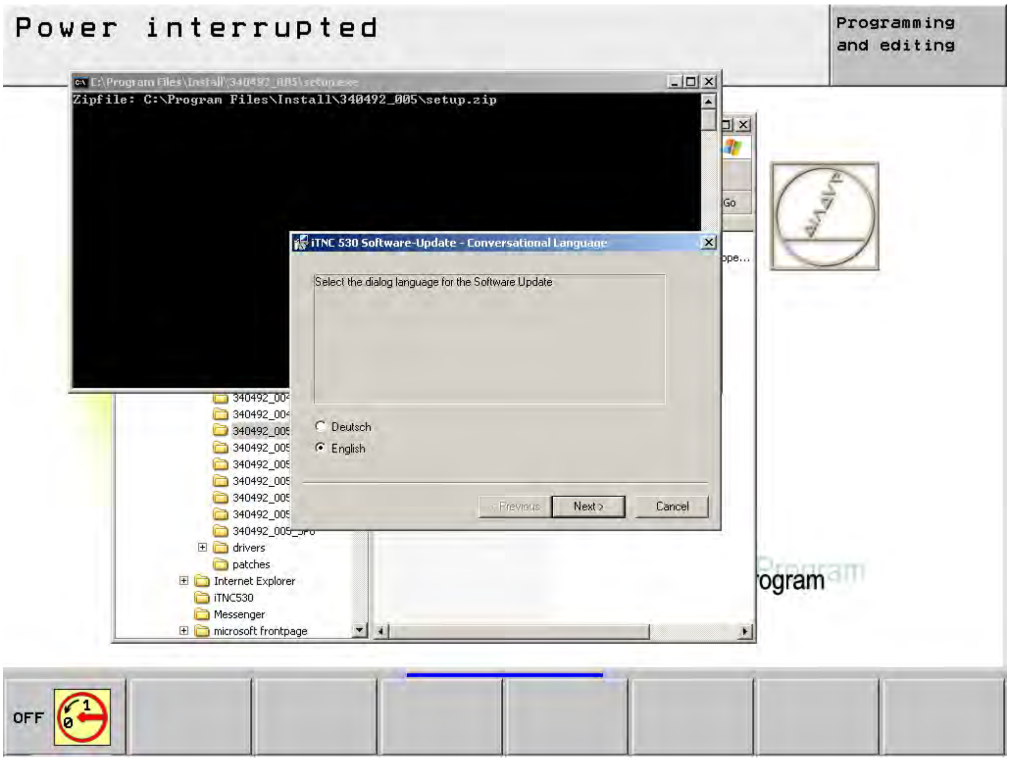
With the dual-processor version of the iTNC 530 as of NC software 34049x-02, **NC software is installed with Windows**.
A corresponding Windows authorization is required.
If necessary, ask the machine manufacturer!

- Press the Windows key to display the taskbar.
- Open the folder C:\Program Files\Install with, e.g., the Windows explorer.



- Click the folder with the current NC software version on the machine.

- Double-click setup (symbol on the left)
  --> The control now displays the **iTNC530 software update** menu.

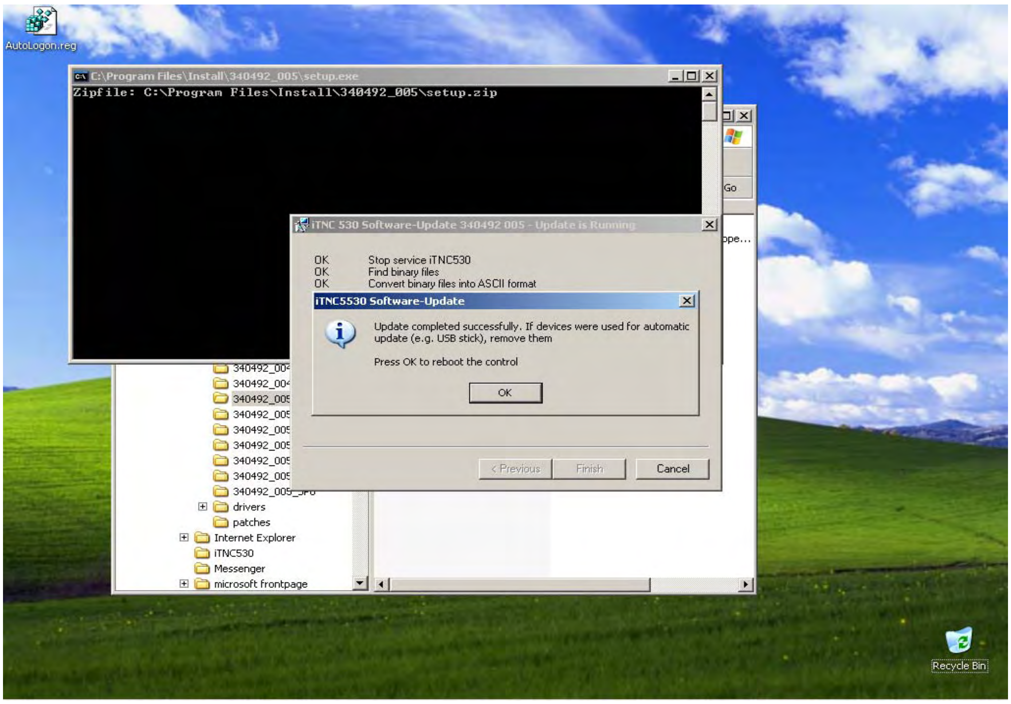


Note

Before a new installation under Windows, please always close all other applications. This also applies for the HEIDENHAIN NC software! In this case you do not have to stop the NC software via the control panel manually as this is made automatically by the update procedure.

- Select a language and confirm the following information and questions by mouse click. --> The NC software is loading.

- When the NC software has been successfully installed, the following message is displayed:



- Click OK. --> The control reboots!
- 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. related Service Pack. --> Press the MOD key.
- Finally, check the machine functions!

15 Loading of Service Packs

15.1 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 the machine parameter with the control file **setup.ini**.

Caution

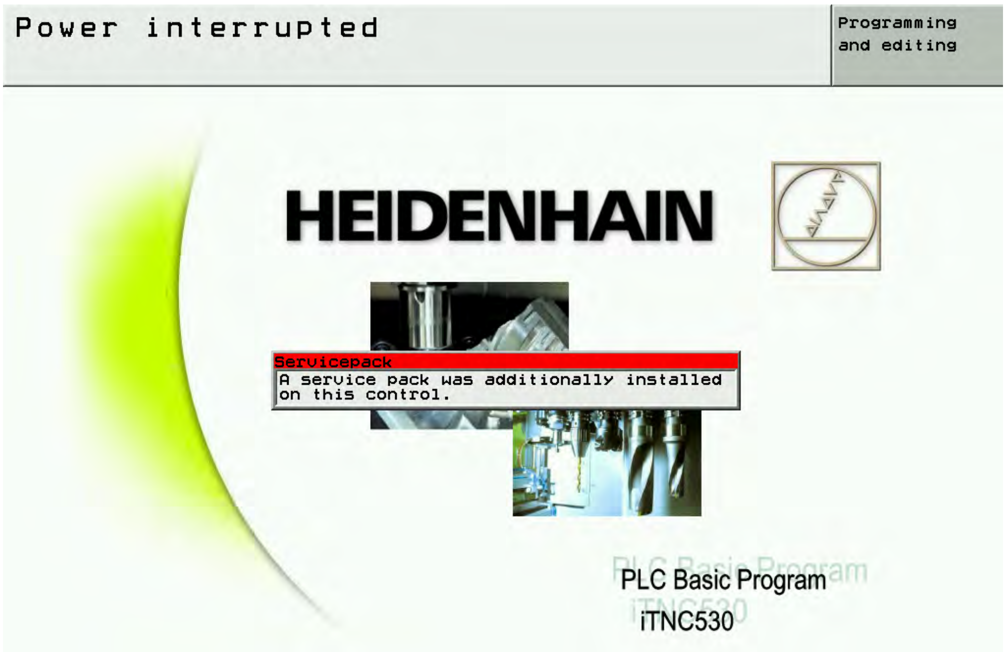
Normally a service pack must be loaded by or in agreement with the machine tool builder.

Caution

If a service pack has already been installed, it will not be possible to install a service pack with a lower version number. As of NC software 340 490-02, this is checked during the installation of a service pack, and a message will be displayed if an error is found.

Display on the screen

If a service pack is installed on the iTNC 530, a corresponding message is shown after the control is booted (before confirming the the **Power interrupted** message).



The machine manufacturer, however, may overlap this message window.

If you press the MOD key while the machine is switched on, you can see whether a service pack is active. In this case you find the letters **SP** followed by the version number (e.g., **340490 04 SP6**) after the ID number of the NC software.

There are different proceedings for the loading of service packs, depending on the NC software version. On the following pages you will find the respective descriptions.

15.2 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

- Move 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 13 – 192.

15.3 Execution up to NC Software 34049x-01 (Single and Dual Processor Version)

Unzipping the ZIP File

The provided ZIP file, e.g., **`34049001sp2.zip`**) has still to be unzipped on a data medium (PC/laptop)!
A folder with the number of the NC software (e.g., **`34049001`**) is created.
It includes the service pack in compressed format (e.g., **`340490_001_SP2.zip`**).

Access to the service pack files via the customer network

If the control is connected to the company network and the service pack files were filed on a released folder of the network, you have access to these data. --> If necessary, ask the system administrator.

Otherwise, you may also transfer the service pack from your service laptop to the control.

Transferring files service packs from the laptop to the control

- Reboot the control; the **`Power interrupted`** message is displayed.
- Establish the connection between the laptop and the control. --> See “Connection Setup” on page 13 – 172.
- Select the PLC partition of the iTNC 530 and create a new folder (e.g., PLC:\servicepacks).
- Open the folder.
- Transfer the folder with the service pack from your laptop to the iTNC 530.
- Separate the connection to TNCremoNT.

Loading the service pack

- 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 interface settings.

MOD

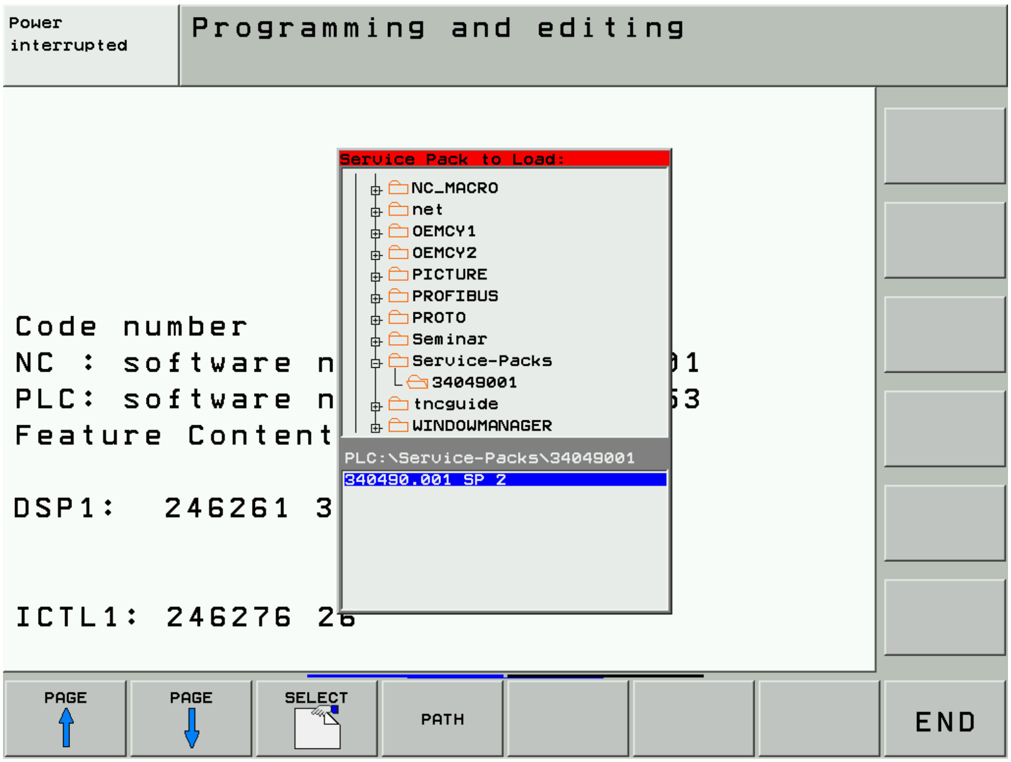
- Press the MOD key.

- Press the SP --> ITNC soft key.
  A pop-up window is opened.
- In the upper part of the window, set the cursor to the folder that contains the zip file of the service pack.

> **Note**
>
> With the +/- key you may open and close the directory trees.

- Press the ENT key. --> All ZIP files of available service packs are shown in the lower part of the window.
- Press the FILES soft key . --> The cursor changes to the lower part of the window.

▶ Place the cursor on the latest service pack (e.g., **340490.001 SP 2**).



▶ Press the SELECT soft key.The service pack is automatically archived on the SYS partition of the iTNC 530. The service pack is now loaded and the control restarts automatically.

▶ Check the NC software version incl. related service pack. --> Press the MOD key.

Functional test

▶ Finally, check the machine functions!

15.4 Execution as of NC Software 34049x-02 (Single-Processor Version)

Unzipping the ZIP File

The provided ZIP file (e.g., **34049004sp6.zip**) has still to be unzipped on a data medium (PC/laptop/USB stick)!
A folder with the number of the NC software (e.g., **34049004**) is created.
This folder contains a subdirectory (e.g., **340490_004_SP6**), of the following files:

- **setup.elf** (previously **setup.omf**)
- **setup.ini** (optional)
- **setup.zip**

Access to the service pack files via the customer network

If the control is connected to the company network and the service pack files were filed on a released folder of the network, you have access to these data. --> If necessary, ask the system administrator.

Otherwise, you can also use a USB stick as data medium (or transfer the service pack from your service laptop to the control).

Loading the service pack

▶ Connect the USB stick to X141 or X142 (USB interfaces of the iTNC 530).

Note

When connecting, USB memory devices that use the file system VFAT or ISO 9660 (not NTFS, or similar), are recognized automatically **as of NC software version 34049x-02 with feature content level L2**.
If level 2 is not set, you can transfer the service pack with TNCremoNT to the control's hard disk See “Transferring files service packs from the laptop to the control” on page 15 – 221.

▶ 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 interface settings.

MOD ▶ Press the MOD key.

▶ Enter the code number **SETUP**. --> A pop-up window appears.

▶ In the upper part of the window, set the cursor to the USB data medium (or to the partition of the control's hard disk where you have transferred the service pack with TNCremoNT).

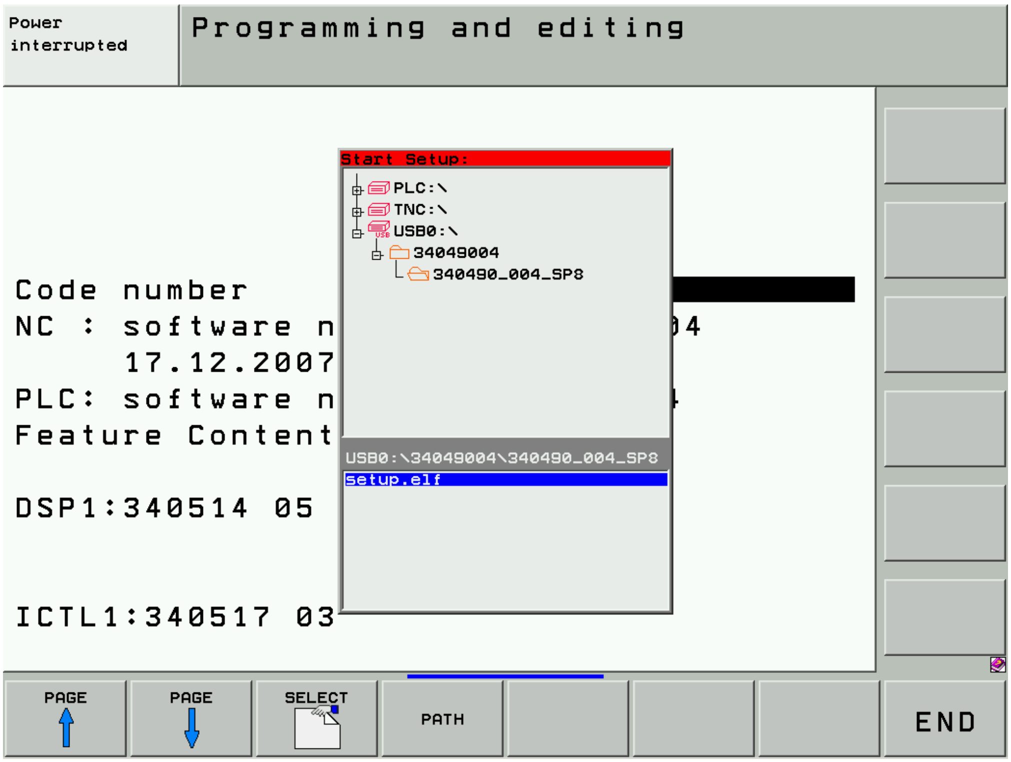
Note

With the +/- key you may open and close the directory trees.

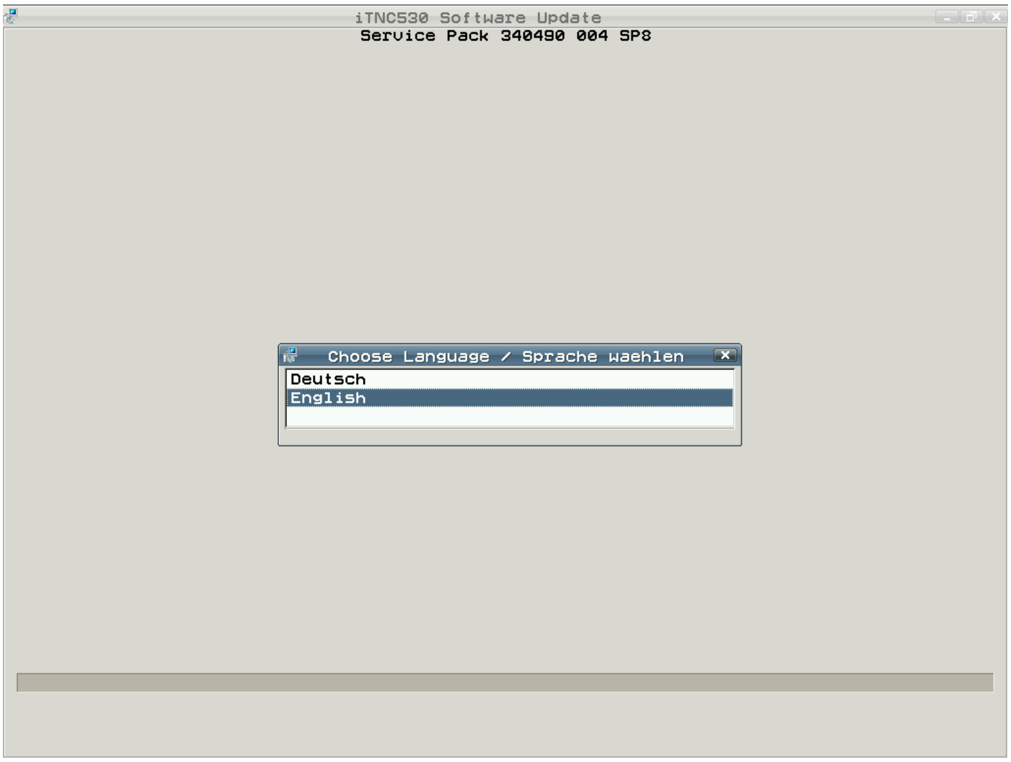
▶ Now set the cursor to the folder with the designation of the NC software + service pack (e.g., **340490_004_SP6**).

▶ Press ENT. --> The file **setup.elf** (previously **setup.omf**) is shown in the lower part of the window.

▶ Press the FILES soft key. --> The cursor changes 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 loaded.

▶ When the service pack has been successfully loaded, the following message is displayed:

▶ Disconnect the USB stick and click OK or press the ENT key. --> The control restarts.
▶ Check the NC software version incl. related service pack. --> Press the MOD key.

Note

If you have transferred the service pack from your laptop to the control (e.g., on PLC:\servicepack), it can be deleted here again. Thus making space again on the hard disk. The service pack is automatically archived on the SYS partition of the iTNC 530 and can be called at any time.

Functional test

▶ Finally, check the machine functions!

15.5 Execution as of NC Software 34049x-02 (Dual-Processor Version)

Unzipping the ZIP File

The provided ZIP file (e.g., **`34049204sp6.zip`**) has still to be unzipped on a data medium (PC/laptop/USB stick)!
A folder with the number of the NC software (e.g., **`34049204`**) is created.
This folder contains a subdirectory (e.g., **`340492_004_SP6`**), of the following files:

- **`setup.exe`**
- **`setup.ini`** (optional)
- **`setup.zip`**

Access to the service pack files via the customer network

If the control is connected to the company network and the service pack files were filed on a released folder of the network, you have access to these data. –> If necessary, ask the system administrator.

You may also use a USB stick as data medium.

Loading the service pack

Caution

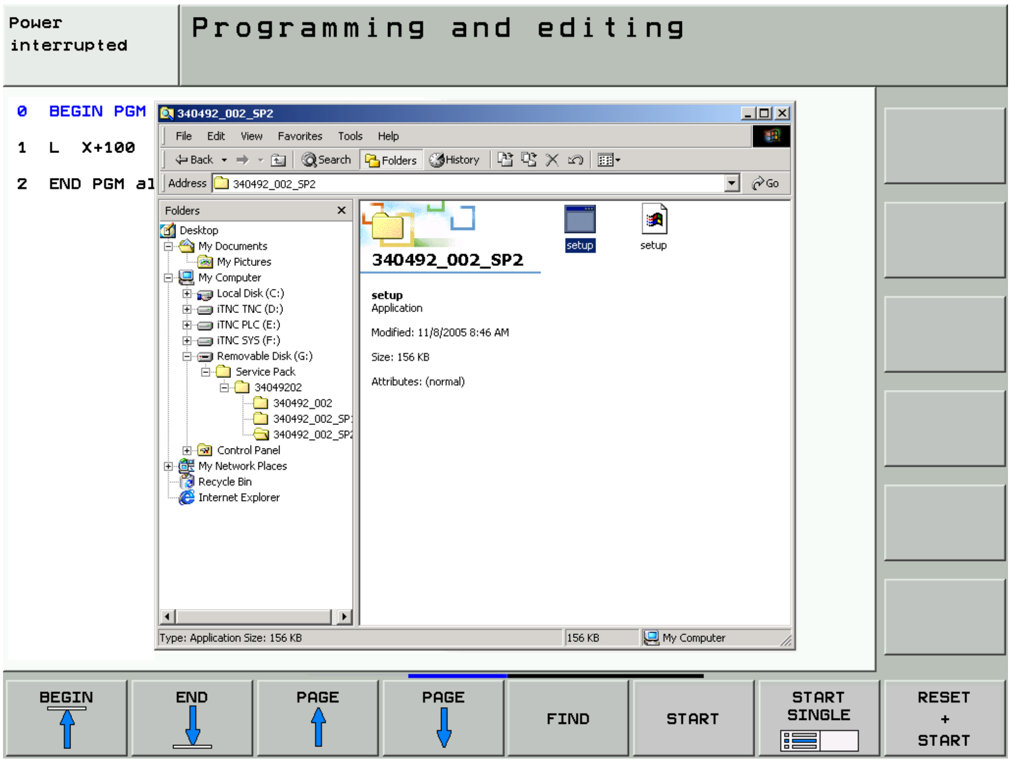
With the dual-processor version of the iTNC 530 as of NC software 34049x-02, **service packs are installed with Windows**.
A corresponding Windows authorization is required.
If necessary, ask the machine manufacturer!

- Connect the USB stick to X141 or X142 (USB interfaces of the iTNC 530).

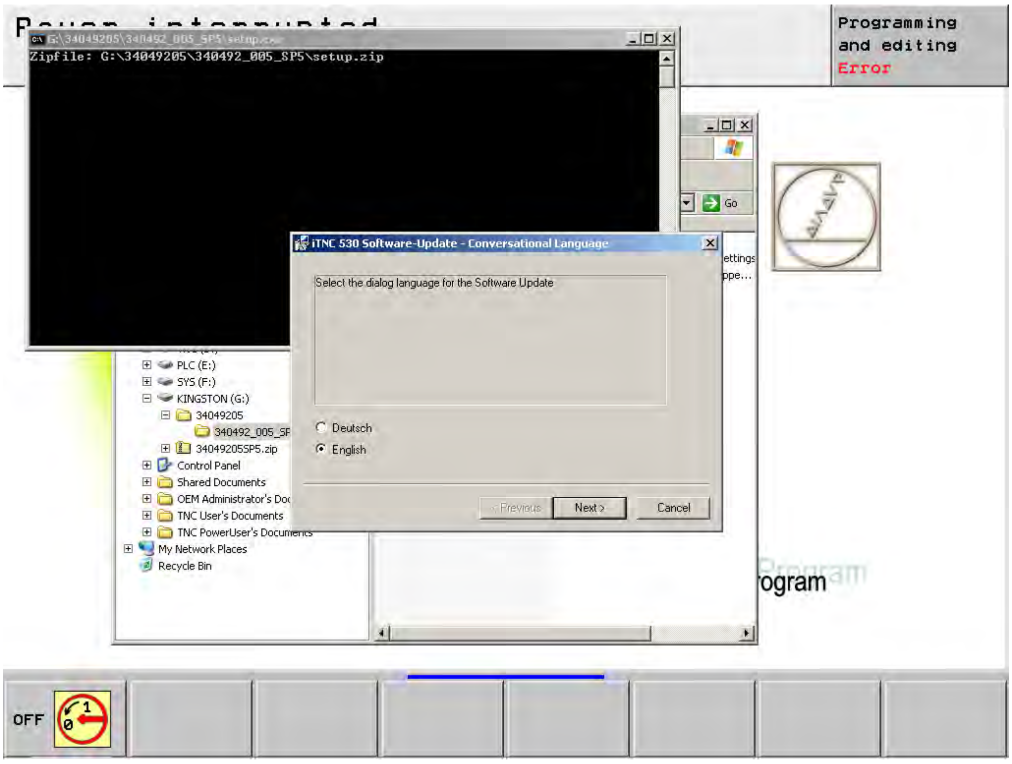
Note

When connecting, USB memory devices that use the file system VFAT or ISO 9660 (not NTFS or similar) are detected automatically.

- Press the Windows key to display the taskbar.
- With the Windows explorer, e.g., open the folder on the USB stick, that contains the service pack.



▶ Double-click setup (symbol on the left)
--> The control now displays the **iTNC530 Software Update** menu.

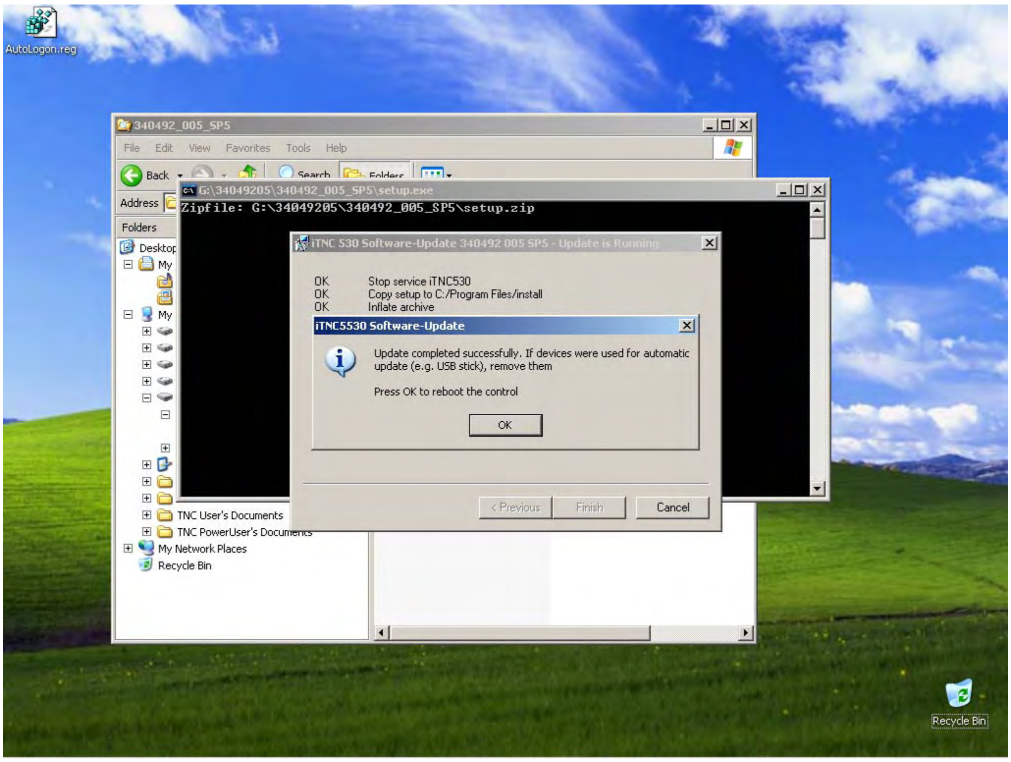


Note

Before a new installation under Windows, please always close all other applications. This also applies for the HEIDENHAIN NC software. In this case you do not have to stop the NC software via the control panel manually as this is made automatically by the update procedure.

▶ Select a language and confirm the following information and questions by mouse click. --> The service pack is loaded.

▶ When installation of the service pack was successful, the following message is displayed:



▶ Click the symbol for the USB memory device in the Windows taskbar and log off.

▶ Disconnect the USB stick and click on OK --> The control reboots!

▶ Check the NC software version incl. related service pack. --> Press the MOD key.

Functional test

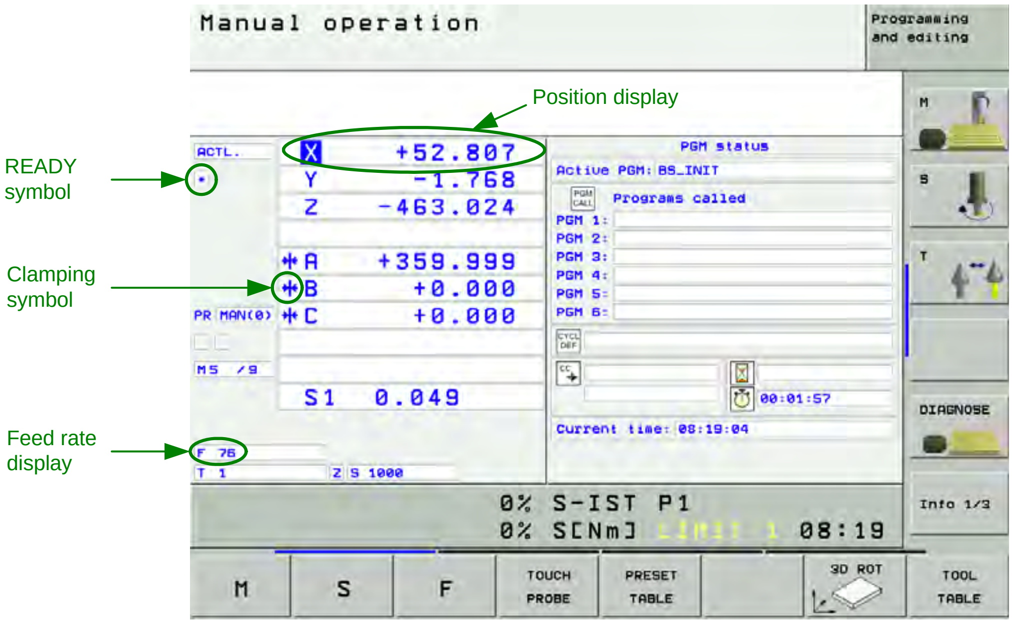
▶ Finally, check the machine functions!

16 Checking the Enables on the iTNC 530

16.1 Introduction

For an operating axis (axis in control loop) ...

- no "Axis clamped" symbol is shown.
- the "STIB" star (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**:

Closed EMERGENCY-STOP chain

The **EMERGENCY-STOP chain** must be closed!

The EMERGENCY STOP chain involves ...

- the EMERGENCY STOP button on the machine operating panel
- the EMERGENCY STOP button on the handwheel (if available)
- Hardware axis limit switch (if available)
- the control itself (alternatively also PL module)

The "Control is ready" output switches, e.g., a relay whose contacts are part of the EMERGENCY-STOP chain.

In the event of severe errors, the control resets the "Control is ready" output and thus interrupts the EMERGENCY STOP chain.

A prerequisite is that the machine machine manufacturer has integrated the "Control is ready" output and input correctly in the EMERGENY-STOP chain. --> See “Annex: Principle of Function of the iTNC 530 Control” on page 2 – 657.

Integration of the control in the EMERGENCY-STOP chain	**MC**
Supply of "Control is ready" output	X34, pin 1 = 24 V, pin 2 = 0 V
"Control is ready" output	X41, pin 34
"Acknowledgement of Control is ready" input	X42, pin 4 = PLC input 3

Acknowledgment control is ready

I3 must be set.

- PLC input of the control: **X42/4**
- Designation: **Acknowledgment control is ready**
- Designation in the circuit diagrams: **NE1**

Global drive enabling

I32 must be set.

- PLC input of the control: **X42/33**
- Designation: **Global drive enabling** (the function is defined in the MP 2050)
- Designation in the circuit diagrams: **NE2**

Drive enabling for axis groups

24 V must be available at the connectors **X150 / 151** for the related axis group.

- Connector on the bottom of the CC: **X150 and X151**
- Designation: **Axis-specific drive enabling**
- Definition in machine parameter **MP 2040**.

Note

The use of the axis-specific drive enable is optional, i.e. not implemented on all machines.

Drives ready for operation

The **drives must be ready for operation** and report this condition.

- On the HEIDENHAIN inverter system the green **LEDs READY** at the drive modules UM xxx or at the output stages of a compact inverter must be lit.
- When non-HEIDENHAIN inverter systems are used, the counterpart displays must be lit.

Note

If a drive is taken in control, the READY signal must be transmitted via the PWM cable to the control after a defined time. For this purpose the corresponding relays must have triggered.
The iTNC monitors the time between 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 trigger too slowly or the drive be defective.
The permissible waiting time is entered in **MP 2170** .

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 “Checking the readiness of the inverter system” on page 16 – 243.

Note

Many **analog servo drives** provide a ready signal that can be evaluated by the PLC program of the iTNC 320. 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 controller active

The **PLC module 9161** must be called.

- This module serves to activate the current and speed controllers for digital control loops. (If necessary ask the machine manufacturer, in which program part this module is called.)

Note

The word W1024 contains the axes enabled by the NC.

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 (use either W1060 or M4563).

The word W1040 contains the axes in which the control loop is opened by the PLC (e.g., with. clamping axes).

The PLC module 9169 serves to call those axes for which I32 does not switch off the drives.

Some machine parameters

MP2040 **Axis groups for drive enabling through X150/X151**

Format: %xxxxxxxxxxxxxx

Input: 0: Axis not assigned
1: Axis assigned

MP2040.0-5 Group 1 to 6

MP2040.6-7 reserved, enter %00000000000000

MP2050 **Functionality of drive enabling I32 (X42/33)**

Input: 0: Emergency stop for all axes, Module 9169 not effective
1: Emergency stop for all axes that are not excepted with Module 9169
2: I32 and Module 9169 have no function

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]

16.2 Examination

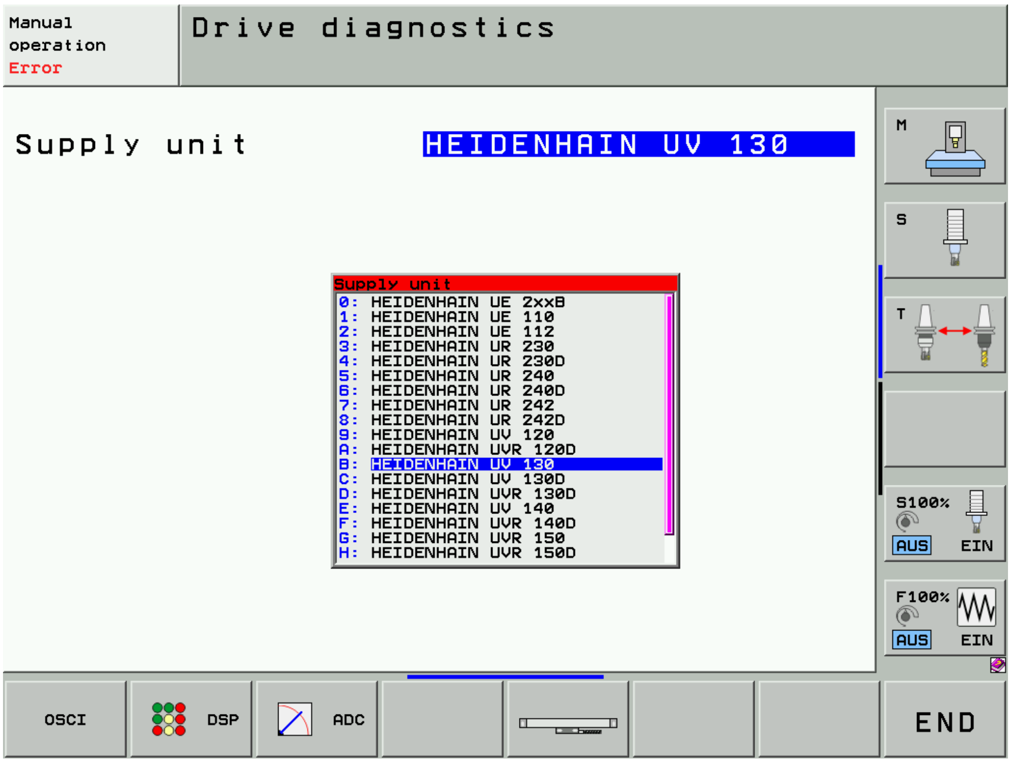
The iTNC 530 features comprehensive diagnosis tools, such as DriveDiag, PLC-TRACE or PLC-TABLE.

These **diagnosis tools** are suitable for checking the enables on the iTNC 530.

Moreover, the service engineer requires **measuring equipment**, such as a mulitmeter, etc.

Selecting the supply device

▶ Select the power supply unit used. --> See "Integrated Diagnostic Functions and DriveDiag" on page 9 – 89:



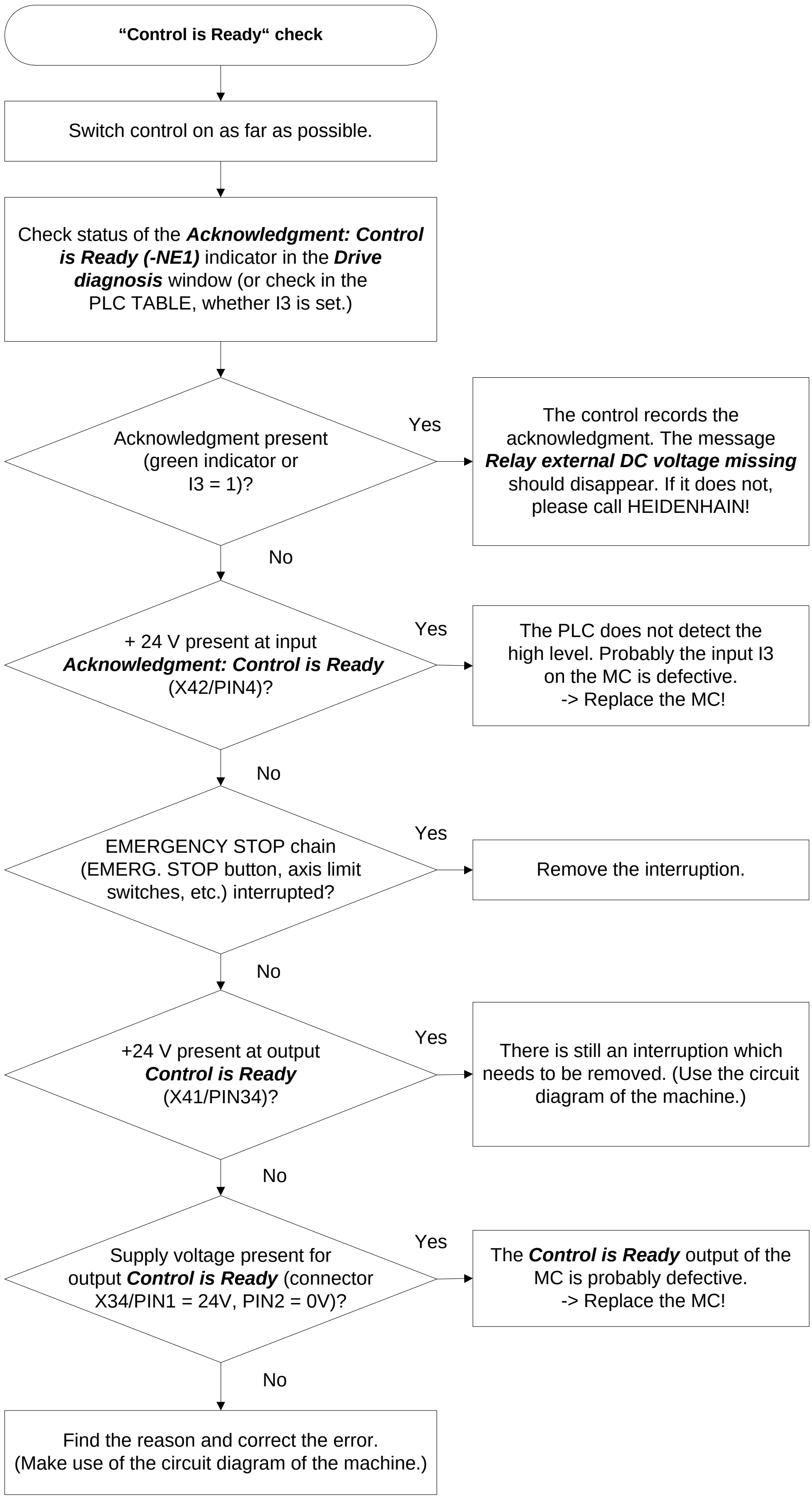
Note

Not all status information of non-HEIDENHAIN inverters can mostly be used.

16.2.1 Checking the "Control is ready" output and input (EMERGENCY STOP chain)

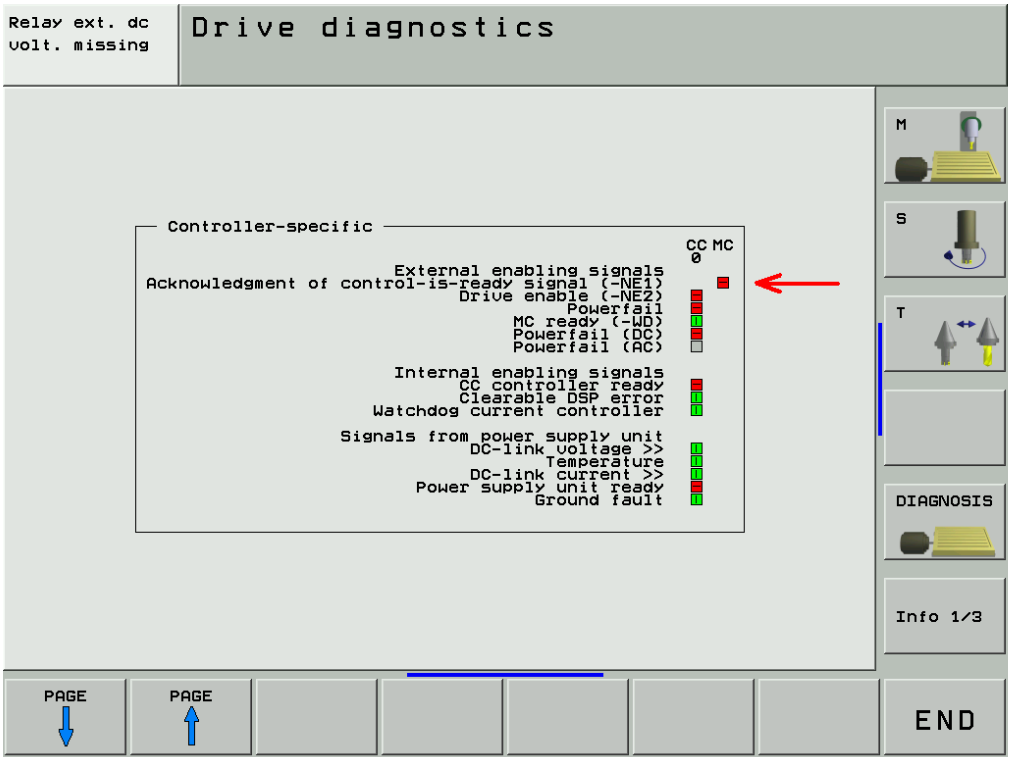
Fault:
Message "Relay external DC voltage missing" permanently displayed

If the message **`Relay external DC voltage missing`** does not disappear after pressing the key CONTROL ON, carry out the folllowing fault diagnosis:



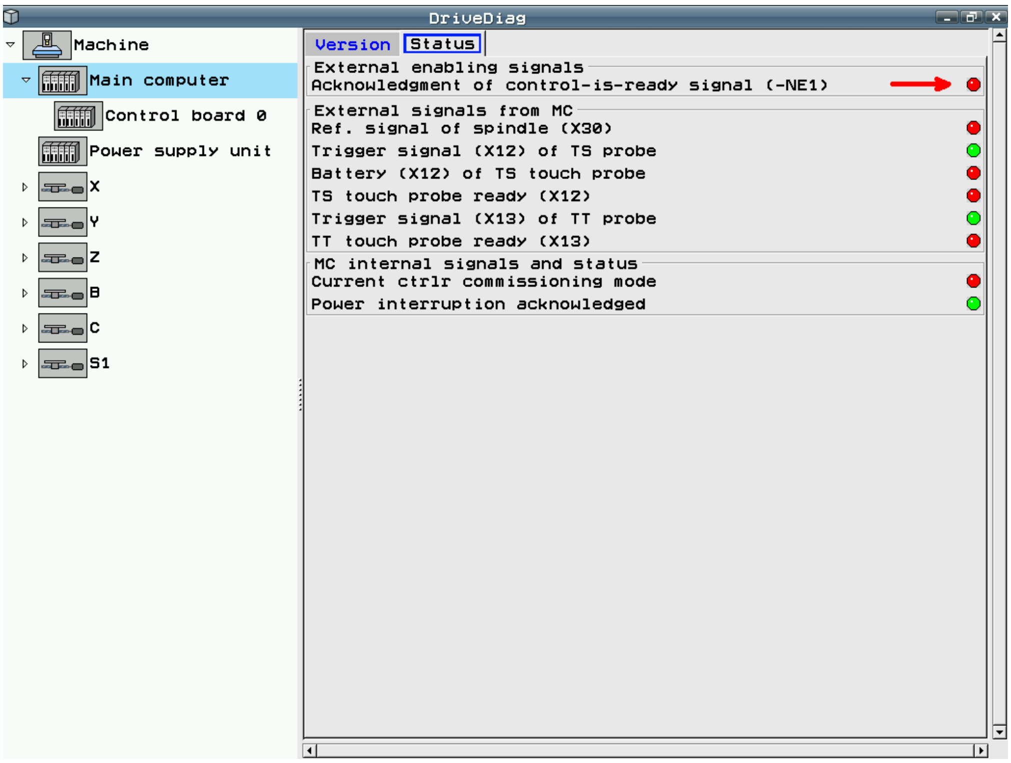
Page from the integrated drive diagnosis

Call via the soft keys DIAGNOSIS --> DRIVE DIAGNOSIS --> DSP
See “Integrated Diagnostic Functions and DriveDiag” on page 9 – 89.



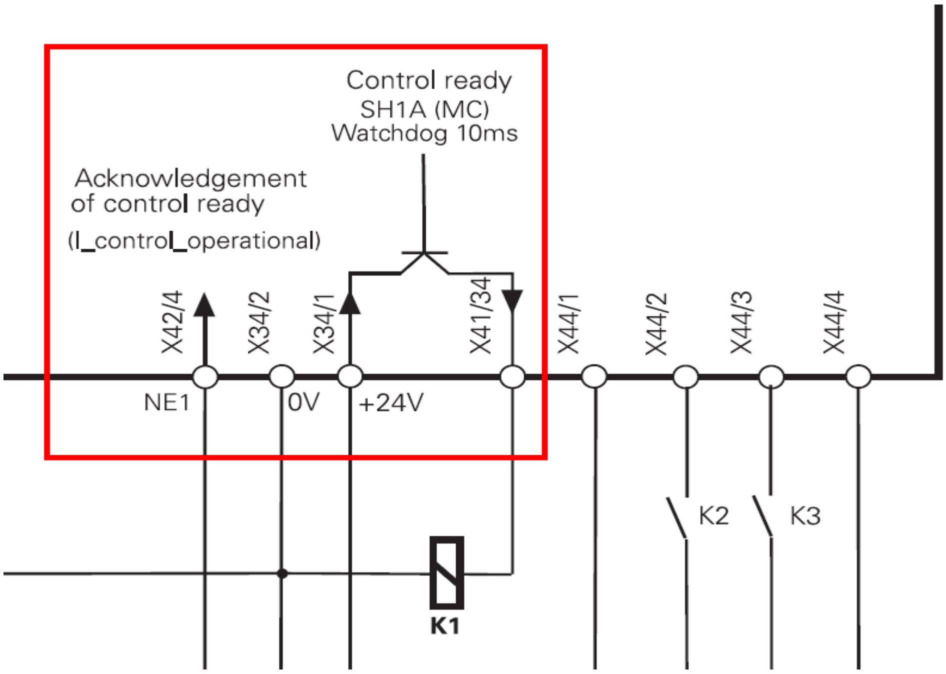
Page from DriveDiag

Call via the soft keys DIAGNOSIS --> DRIVE DIAGNOSIS --> DRIVEDIAG
See “Integrated Diagnostic Functions and DriveDiag” on page 9 – 89.



Excerpt from the basic circuit diagram

Here you can see the terminals that can be measured (the PLC inputs and outputs are mostly connected to a strip in the electrical cabinet):



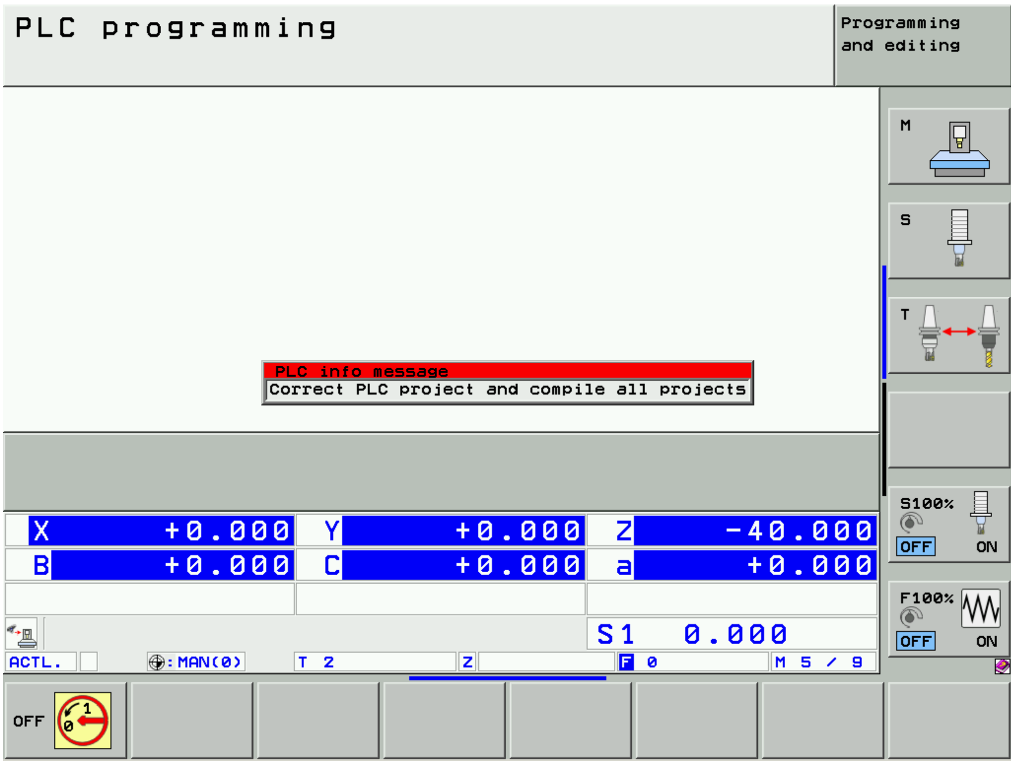
> **Note**
>
> If the **Control-is-ready output** on the MC is defective, you can use the **Control-is-ready output** of a PLC expansion board for test purposes:
>
> - PL 405 B or PL 410 B: X8 / pin16
> - PL 510, input/output module PLD 16-8: X6 / terminal 8
>
> (The function of this terminal can be set with a sliding switch on the rear side of the I/O module concerned, setting 1 = "Control is ready", See "X6: PLC outputs on the PL 510" on page 27 – 518)

Sliding switch on I/O module

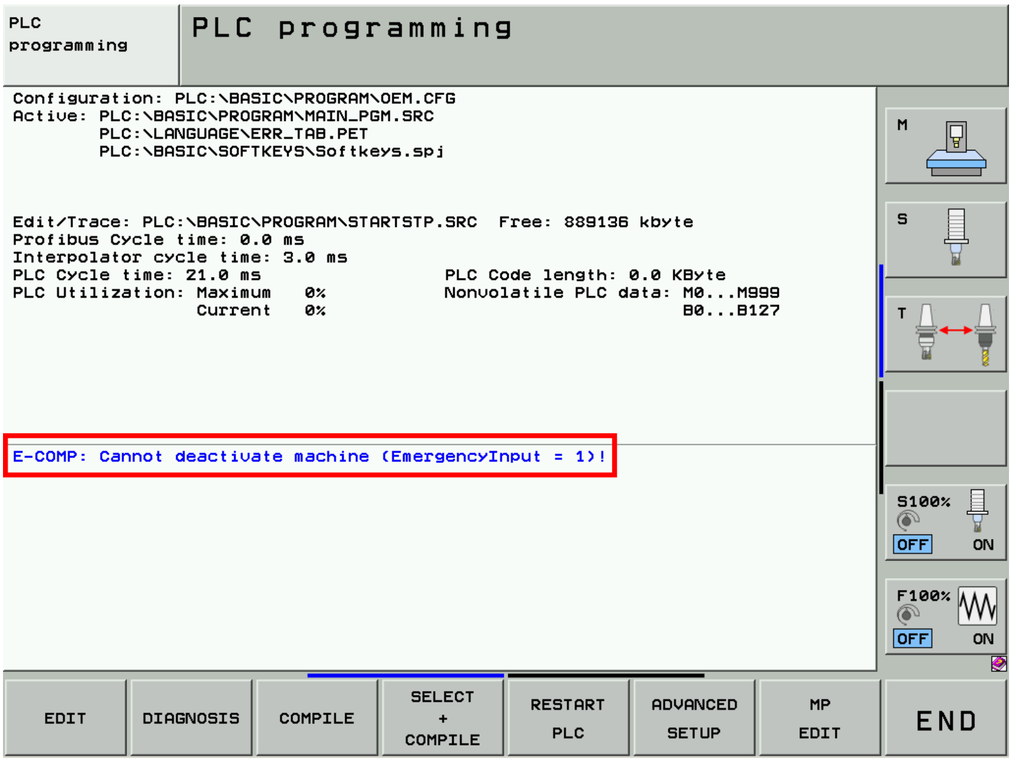
> **Caution**
>
> For permanent operation with a different wiring contact the machine tool builder and add the changes to the circuit diagrams of the machine.

Error message: EMERGENCY STOP defective

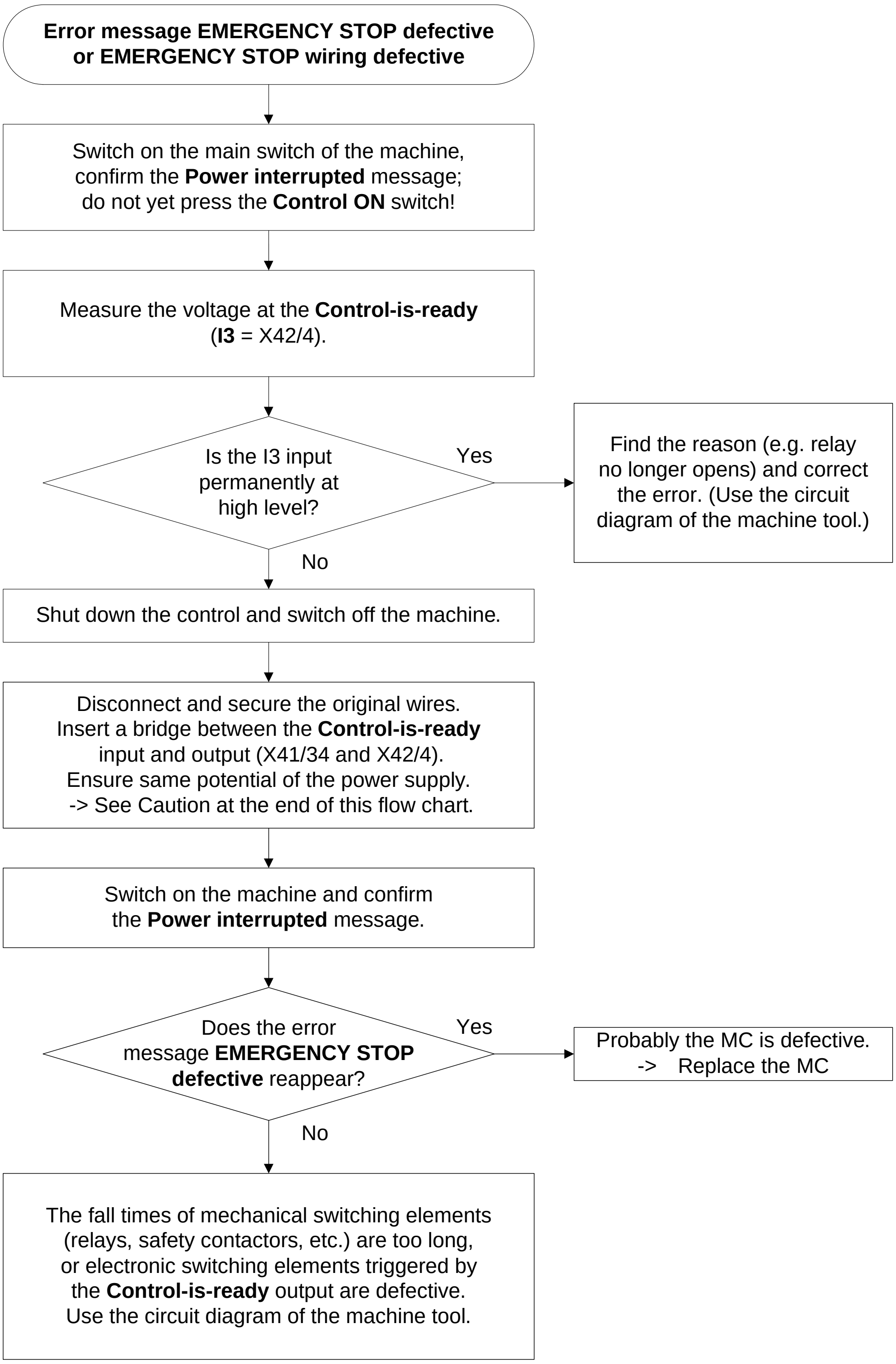
If the error message `EMERGENCY STOP defective` is displayed ...
or the following display appears ...



... providing the following information after entering the PLC code number ...



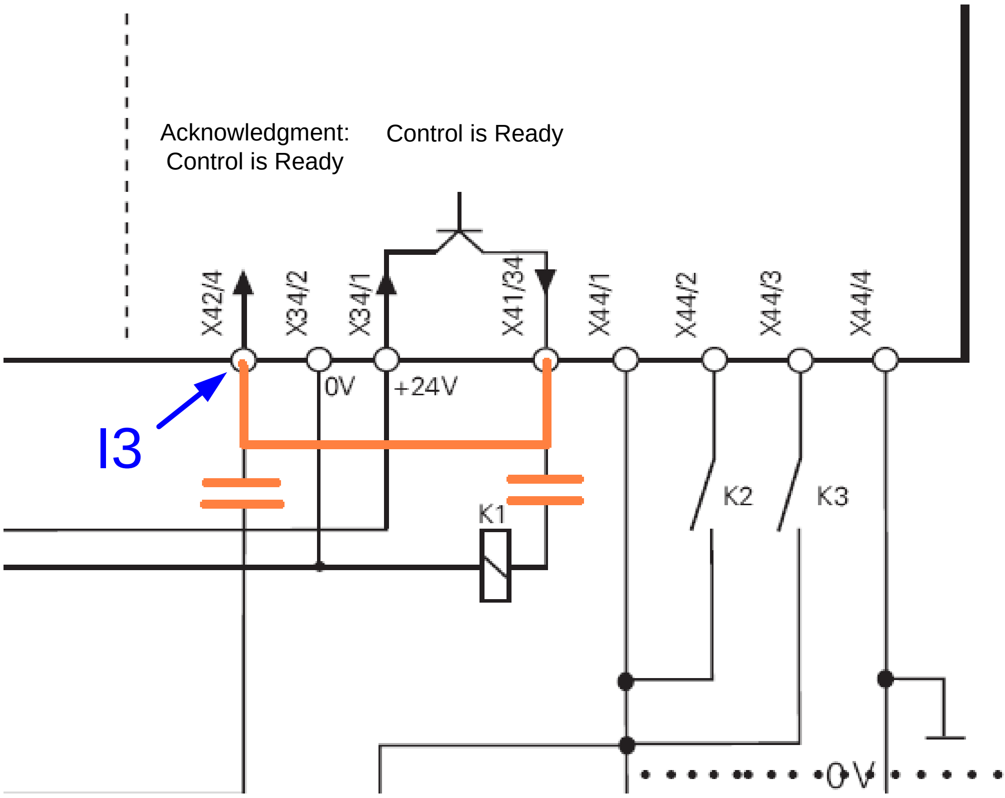
... carry out the error diagnosis as follows:



Caution

If 24 V is supplied to the **Control is ready** output from the HEIDENHAIN inverter system via connector X34, potential differences between the machine voltage and the 24 V from the inverter can result in compensating currents.
Therefore it is preferable to supply X34 with machine voltage before you insert a bridge between the **Control is ready** input and output during the following investigation!

Bridge inserted



Note

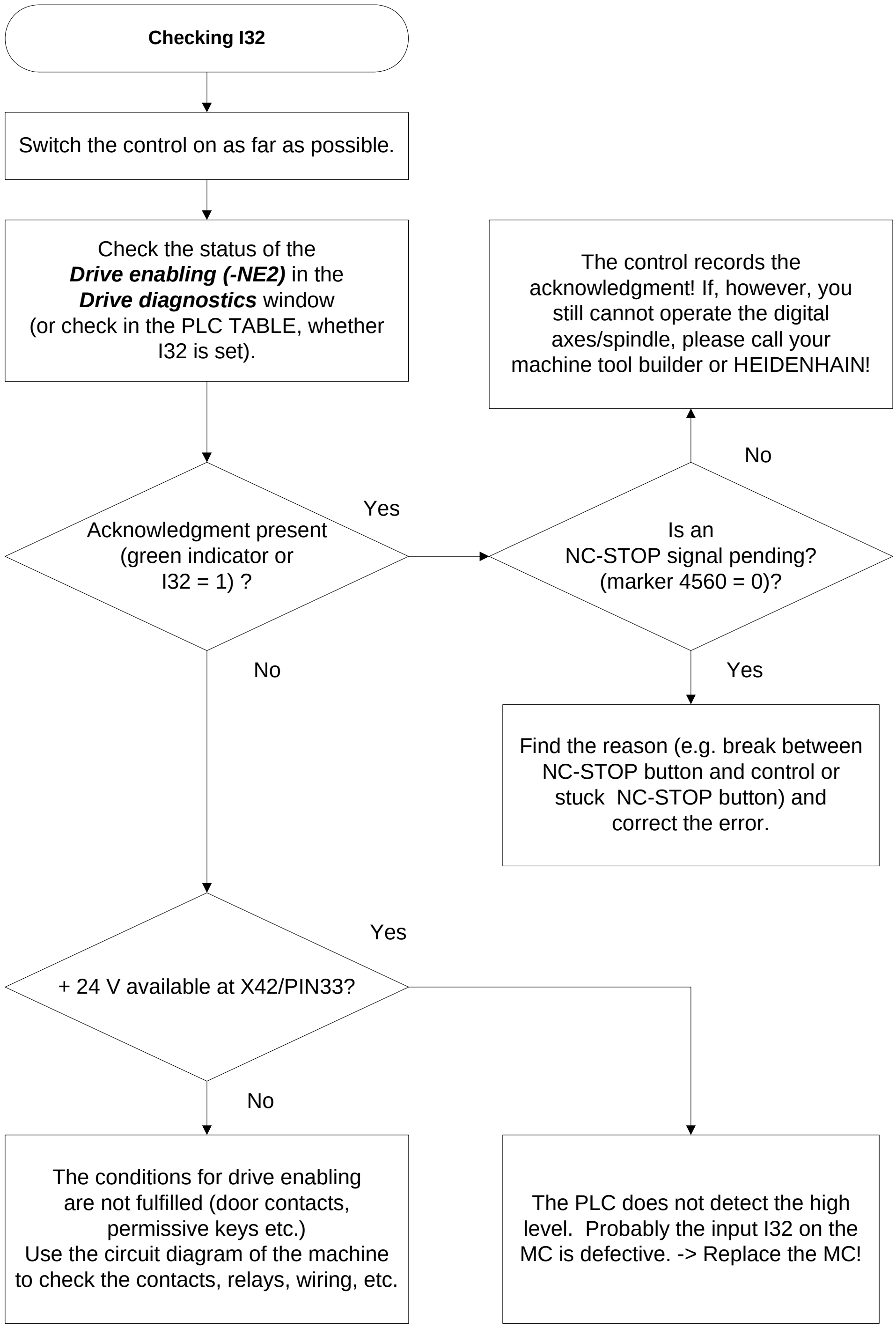
The function of the **`Control-is-ready`** output of a PLD expansion card (e.g., PLD 16-8 I/O module) can also be tested with this method.

Note

Procedure for the EMERGENCY STOP test --> See "Annex: Monitoring Functions" on page 3 – 661.

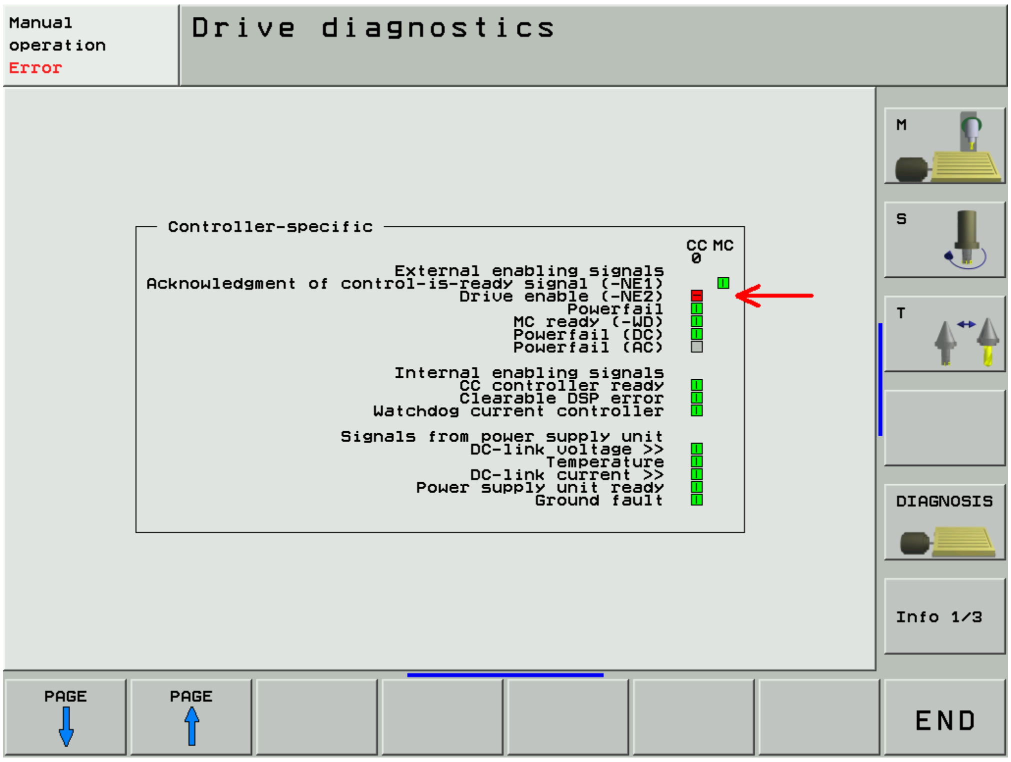
16.2.2 Checking the global drive enable I32, connector X42 / pin 33

If you can switch on the machine but cannot move with an axis/spindle, check the following:



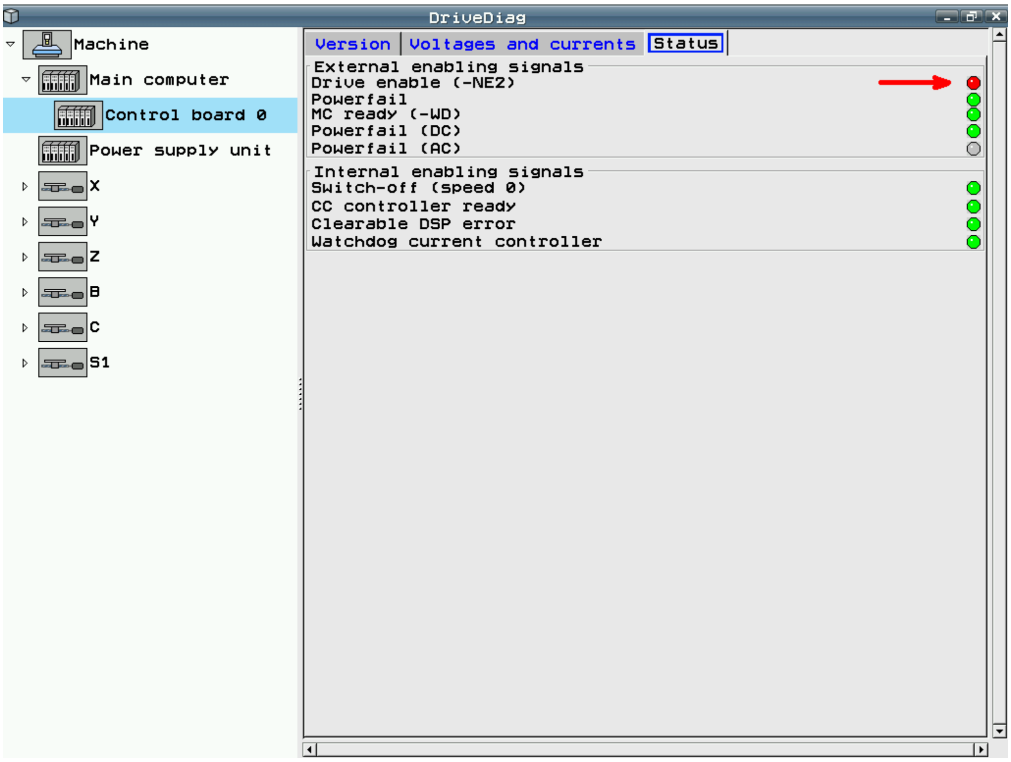
Page from the integrated drive diagnosis

Call via the soft keys DIAGNOSIS --> DRIVE DIAGNOSIS --> DSP
See “Integrated Diagnostic Functions and DriveDiag” on page 9 – 89.



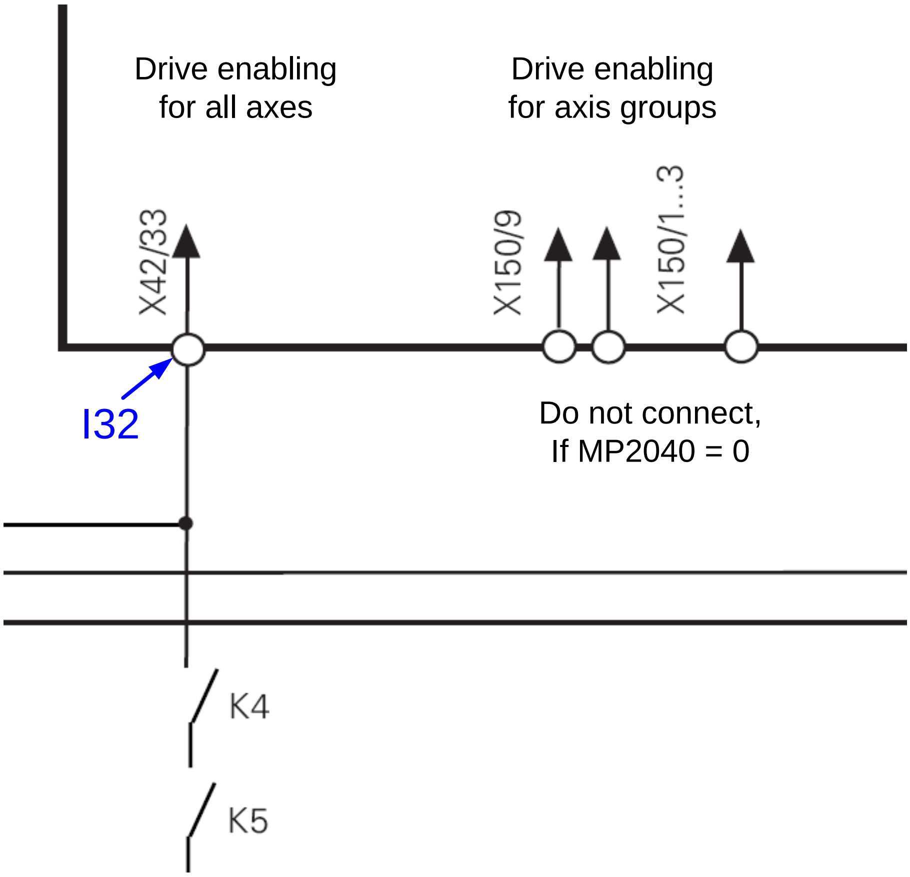
Page from DriveDiag

Call via the soft keys DIAGNOSIS --> DRIVE DIAGNOSIS --> DRIVEDIAG
See “Integrated Diagnostic Functions and DriveDiag” on page 9 – 89.



Excerpt from the basic circuit diagram

Here you can see the terminal that can be measured (the PLC inputs and outputs are mostly connected to a strip in the electrical cabinet).



16.2.3 Checking the drive enabling for the axis groups via connector X150 and X151 (if wired)

The axis groups for the drive enabling via X150 (main DCB) and X151 (auxiliary DCB) are defined in MP2040.

- Check whether 24V are available for the axis group to be traversed.
- Check according to the integrated drive diagnosis or DriveDiag whether the corresponding axis groups are released:

Page from the integrated drive diagnosis

Call via the soft keys DIAGNOSIS --> DRIVE DIAGNOSIS --> DSP.
See “Integrated Diagnostic Functions and DriveDiag” on page 9 – 89.

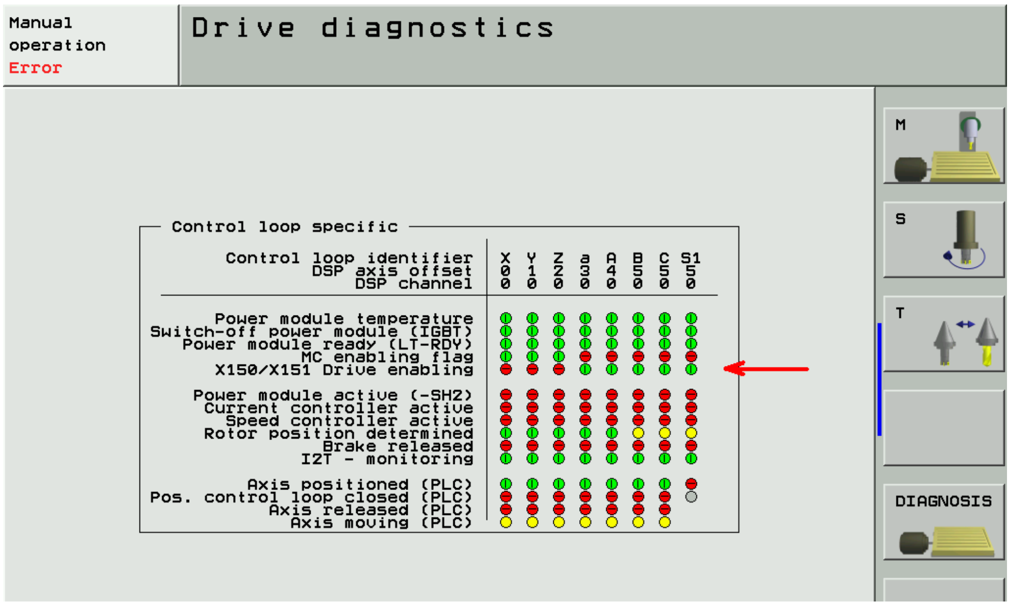


Figure: The axes are displayed next to each other.

Page from DriveDiag

Call via the soft keys DIAGNOSIS --> DRIVE DIAGNOSIS --> DRIVEDIAG.
See “Integrated Diagnostic Functions and DriveDiag” on page 9 – 89.

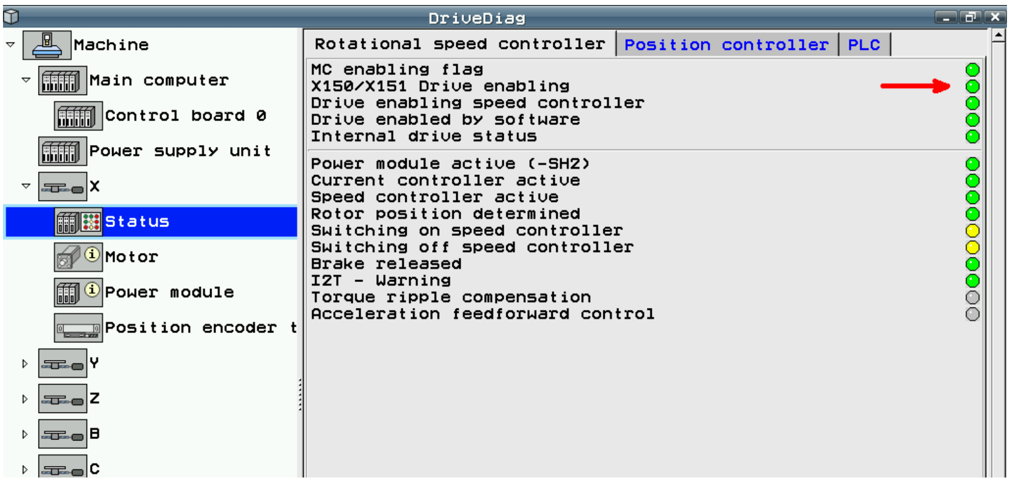


Figure: Here each axis is shown on an individual page.

Note

If no axis groups are defined in MP 2040, the default setting of the drive release is active (via X150 / X151).

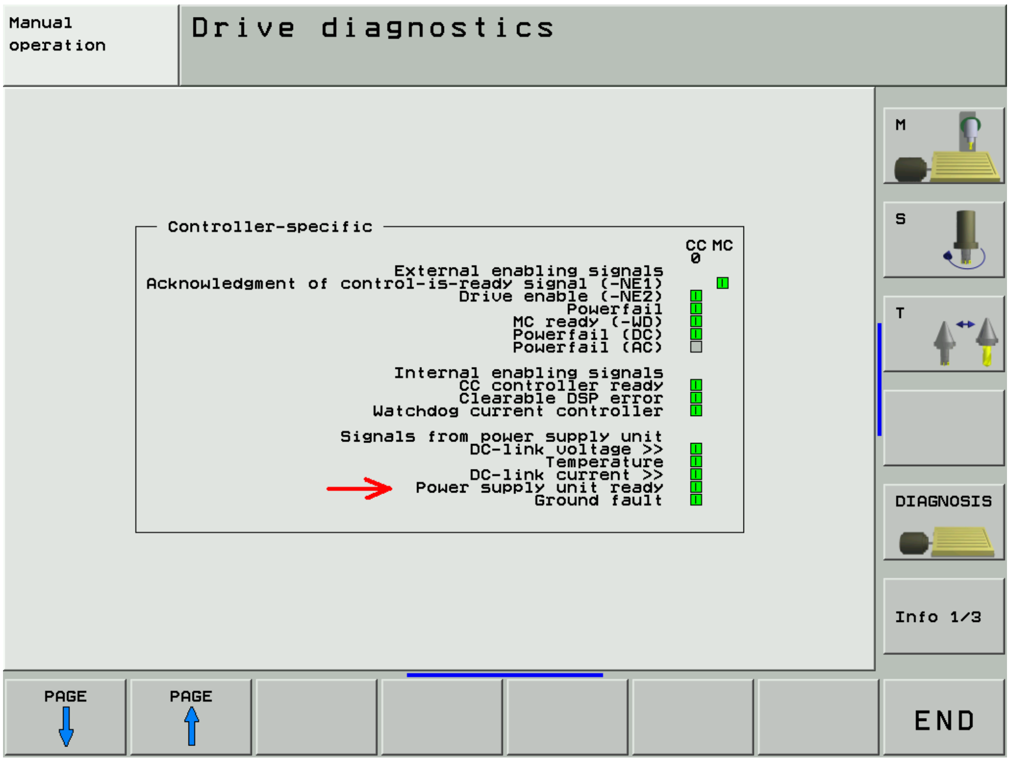
16.2.4 Checking the readiness of the inverter system

- Switch on the machine.
- Check according to the integrated drive diagnosis or DriveDiag whether the power supply unit is ready and the dc-link voltage built up:

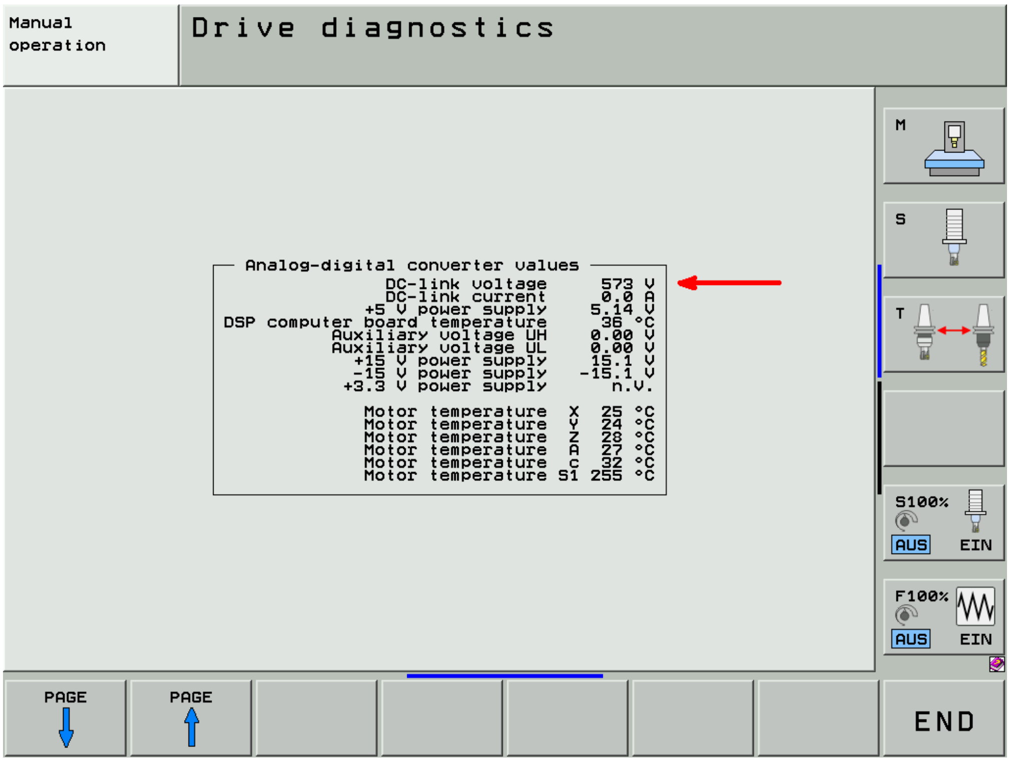
Pages from the integrated drive diagnosis

Call via the soft keys DIAGNOSIS --> DRIVE DIAGNOSIS --> DSP

See "Integrated Diagnostic Functions and DriveDiag" on page 9 – 89.

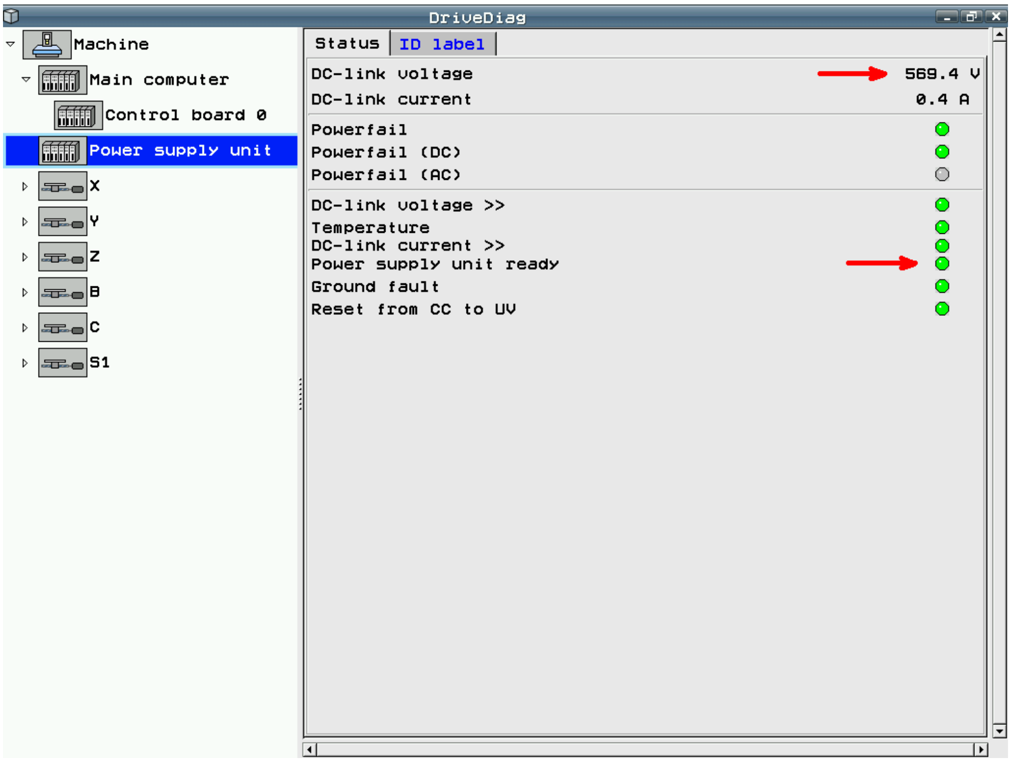


Press the ADC soft key (previously AMP) to obtain information on the height of the dc-link voltage:



Page from DriveDiag

Call via the soft keys DIAGNOSIS --> DRIVE DIAGNOSIS --> DRIVEDIAG.
See "Integrated Diagnostic Functions and DriveDiag" on page 9 – 89.



- Check according to the integrated drive diagnosis or DriveDiag whether the power modules are ready:

Page from the integrated drive diagnosis

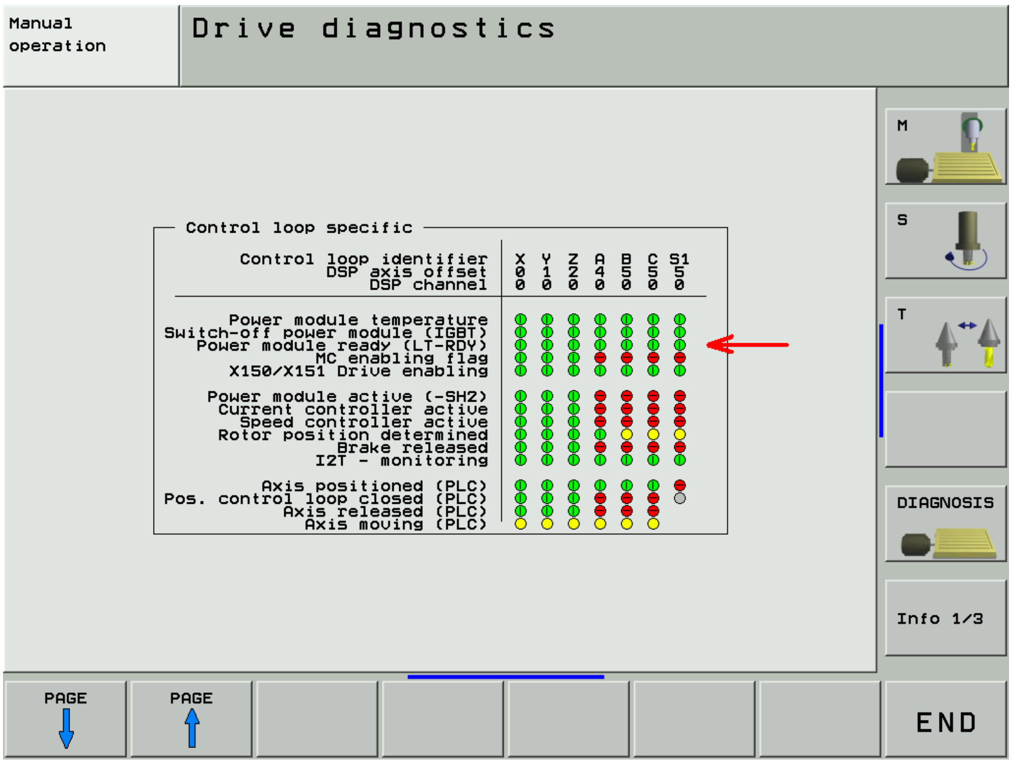


Figure: The axes are displayed next to each other.

Page from DriveDiag

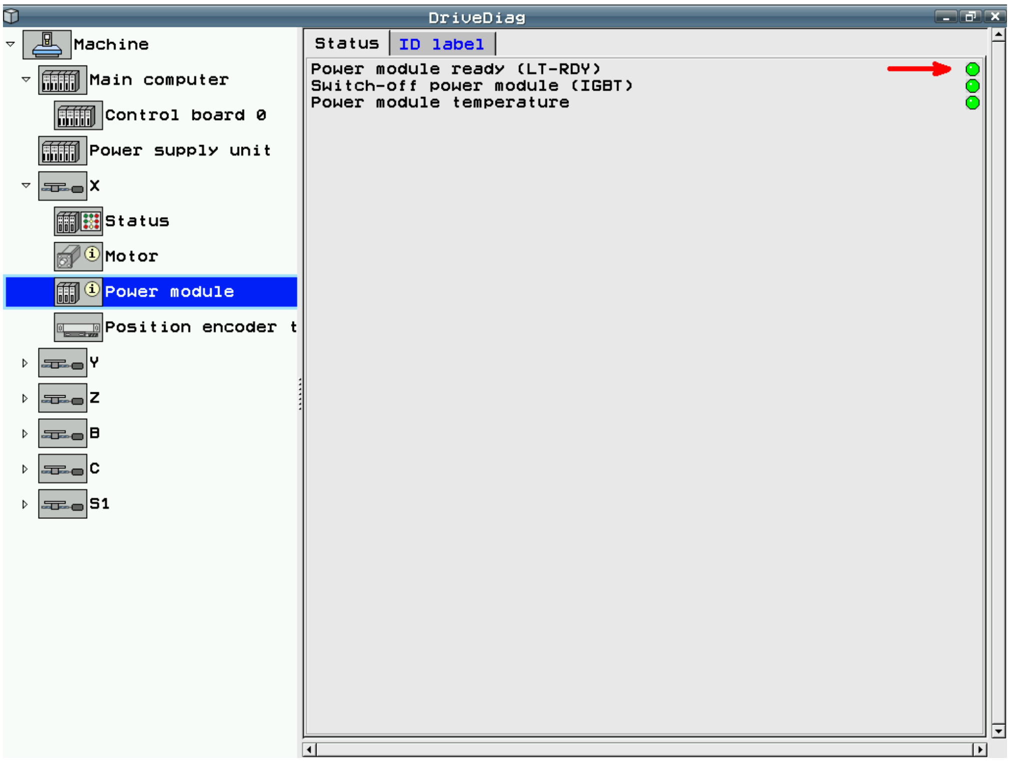


Figure: Here each axis is shown on an individual page.

Green READY LEDs on the drives

- Open the electrical cabinet and check whether the **compact inverter or the power supply unit** are **ready** (green READY LEDs).
  (A non-HEIDENHAIN inverter is probably also equipped with a corresponding LED or display.)

Inverters	Green LED
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

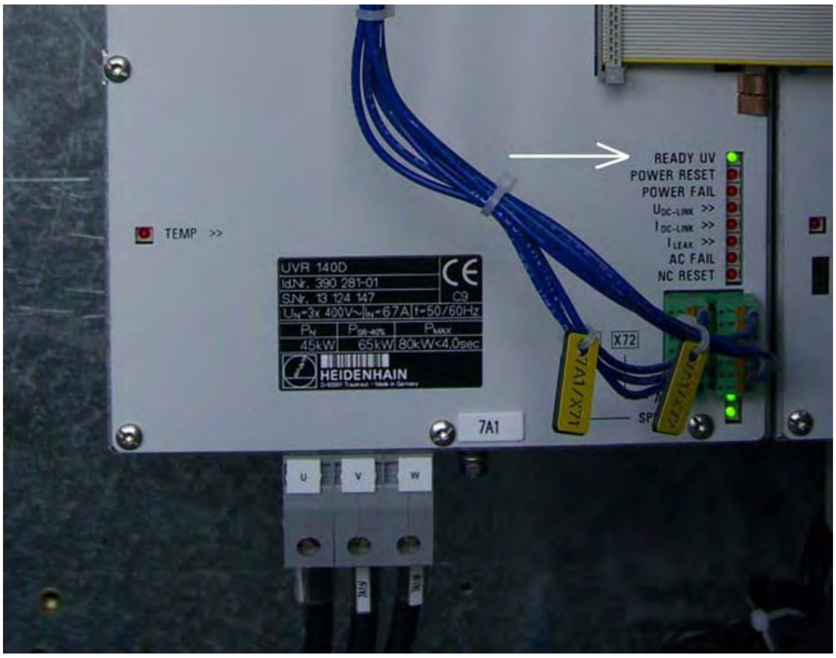


Figure: Green LED READY UV on UVR 140 D (the green LED POWER MODULE READY at top left must also be lit)

- Check if the **green READY LED** lights up on, e.g.

- the compact inverter
- the UM axis module
- the HEIDENHAIN interface 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.)

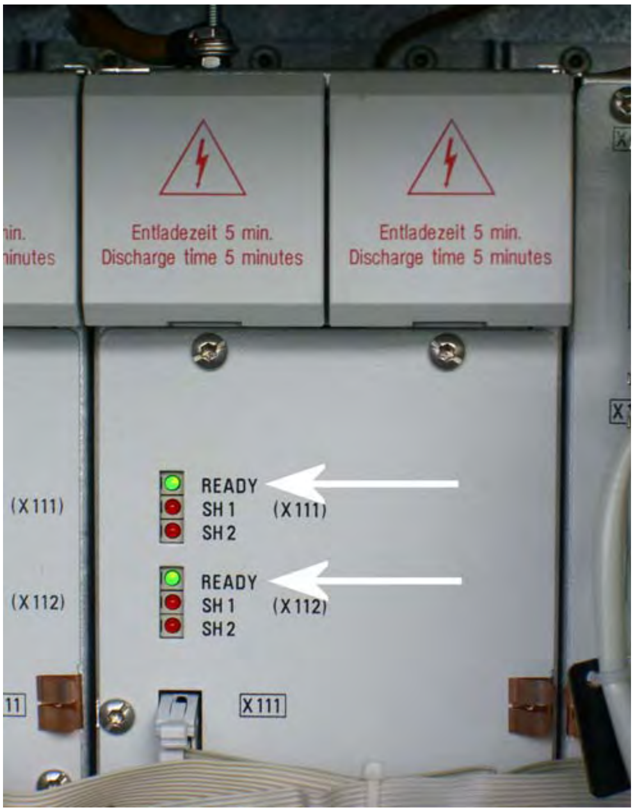


Figure: READY LEDs on a two-axis module

> **Note**
>
> When the axis or the spindle are still operating, the red LEDs **SH1** and **SH2** 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.

Red LED SH1

The signal **SH1** ...

- means "safe stop 1"
- is indicated by a red LED on the inverter system
- is created by the **controller (MC) of the iTNC 530**
- is low-active, i.e. failsafe

If the processor is not ready for operation or if an error is pending, SH1 is output. The red SH1 LED and the green READY LED at the inverter can never be lit a the same time. They are mutually locked.

Red LED SH2

The signal **SH2** ...

- means "safe stop 2"
- is indicated by a red LED on the inverter system
- is created by the **processor (CC) of the iTNC 530**
- is low-active, i.e. failsafe

If an axis or spindle is not controlled, SH2 is pending and the red LED is on.
This is for example the case with clamped axes or if a spindle is not controlled.
SH2 and READY are on simultaneously.

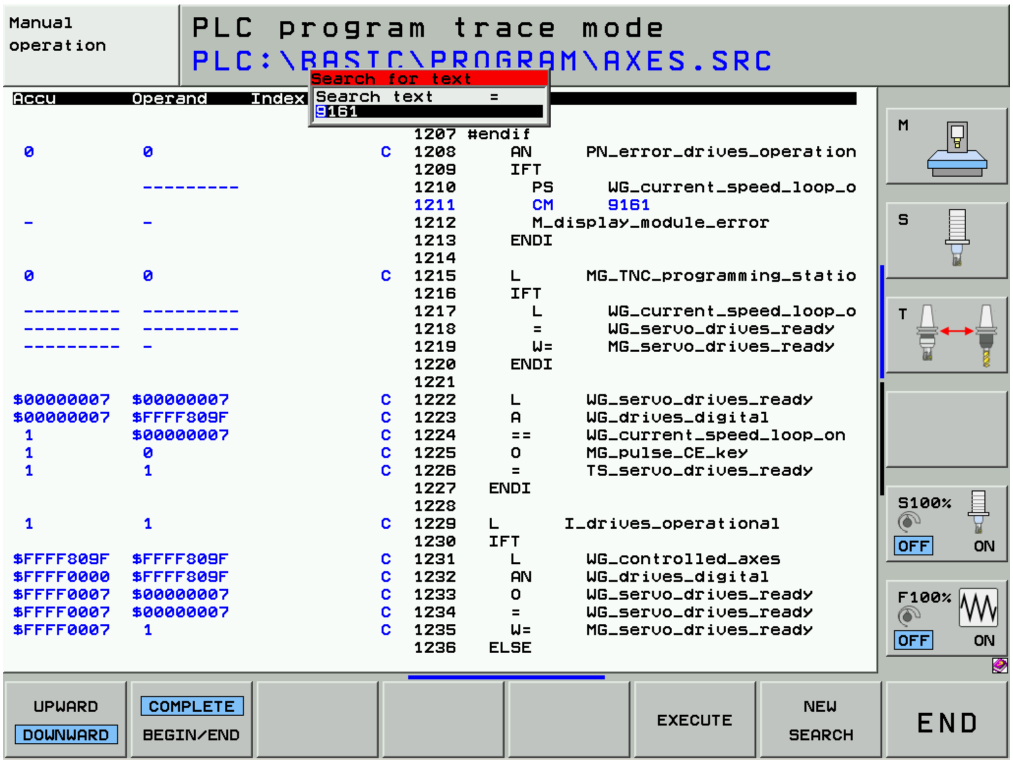
> **Note**
>
> **HEIDENHAIN interface cards for the SIMODRIVE system:**
> The cards for the plug-type connectors (ribbon cables) are equipped with the green **READY** LED and the red LEDs **SH1** and **SH2**.
> The cards with D-Sub connectors are equipped with the green **READY** LED and the red **RESET X1** and **RESET X2** LEDs for the respective axis.
> RESET X1, RESET X2 correspond to the SH2 signal.
> The first generation of the cards with D-Sub connectors feature a green **IF** LED and a red **NB** LED.
> IF stands for "pulse enable" (German: Impulsfreigabe) and means that the axis module is ready.
> NB means that the axis module is "not ready" (nicht bereit).
> For further information on the drives please refer to the service manual "Inverter Systems and Motors".

16.2.5 Checking PLC modules, markers and words

For the following investigations, the PLC diagnosis functions are used.
--> See “PLC Diagnosis” on page 11 – 115.

> **Note**
>
> For these PLC analyses it might be helpful or often even necessary to contact the machine manufacturer for support.

- Check whether the **PLC module 9161** is **called** in the corresponding PLC program (ask the machine manufacturer in which program block this PLC module is called).
  For this purpose enter the PLC TRACE mode.
  The PLC module 9161 serves to activate the current and speed controllers individually for each axis.



- Check the value in the **word W1024**.
  For this purpose enter the PLC TABLE.
  The word W1024 contains the axes enabled by the NC.

- Check the value in the **word W1060** or whether the marker 4563 is set.
  For this purpose enter the PLC TABLE.
  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.)

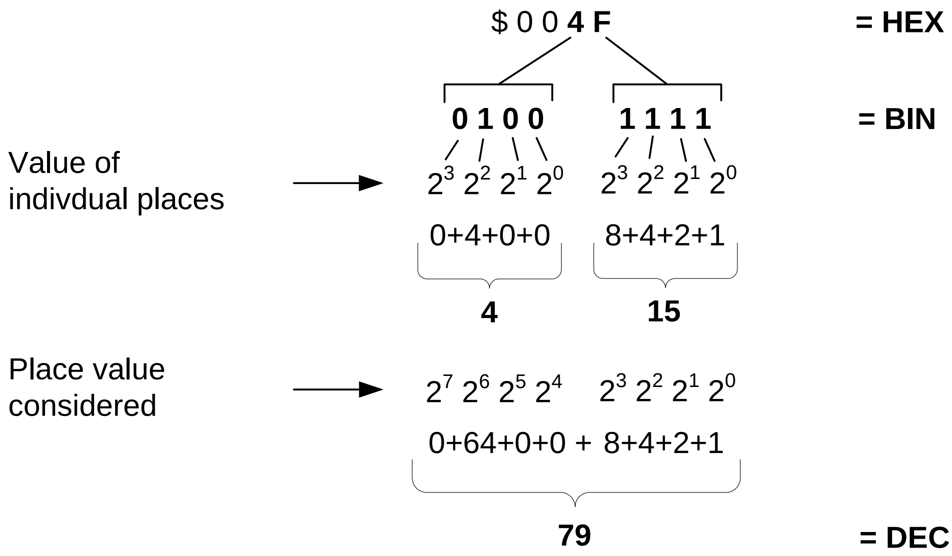
- Check the value in the **word W1040**.
  For this purpose enter the PLC TABLE.
  The word W1040 contains the axes in which the control loop is opened by the PLC (e.g., clamping axes).

Note

The value of the words is displayed in hexadecimal or decimal format.
The hexadecimal format is distinguished by a leading $.
A hexadecimal digit comprises 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, that is 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 the binary format this is 0100 1111 and in the decimal format this is the value 79.



17 Power Supply

17.1 Power Supply for the iTNC 530

17.1.1 Introduction

The iTNC 530 is powered by …

- HEIDENHAIN compact inverter (UE, UR) or
- HEIDENHAIN power supply units (UV, UVR) or
- HEIDENHAIN power supply units UV 105 (B), UV 106 (B)

The CC 42x is powered via the 50-pin ribbon cable connection and additionally via a 5 V terminal, if required.
The CC 42x in turn powers the connected MC 42x (B/C) via a connecting board with connector.
When using the UV 106 (B), the CC is not required. --> The MC is directly connected to the UV 106 (B).
This makes it possible to operate analog axes and spindles exclusively.

Note

The iTNC 530 (MC/CC) powers the connected units, such as scales, motor encoders, touch probes, handwheel, transmitter-receiver units.

Exceptions:

- The screen has its own connection for power supply.
- The PLC outputs are powered with 24 V machine voltage.
- Infra-red touch probes have a battery.

Damaged units that are powered by the iTNC may affect the supply voltages and thus the entire system.

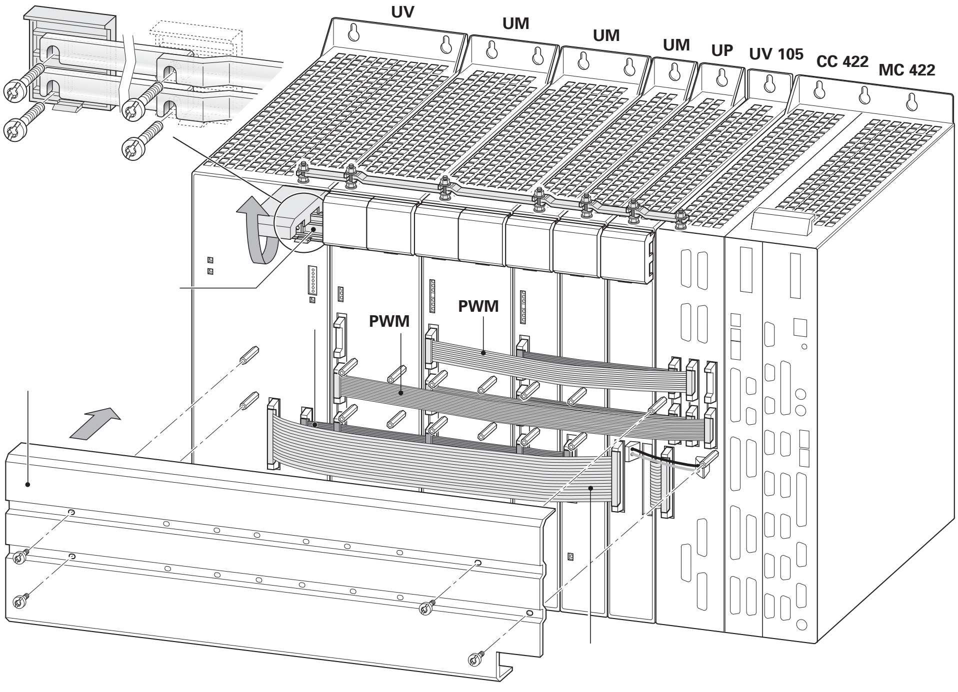
Note

The central voltage for powering the electronics is the 5 V supply voltage.
The control monitors this 5 V supply voltage.
If it falls below 4.75 V, the error message **`5-V power supply too low`** is displayed.
If it rises above 5.40 V, the error message **`5-V power supply too high`** is displayed.

Pin layout --> See "Power Supply Units" on page 27 – 487.

Power supply by UV 105

Power is supplied through the 50-line ribbon-cable connector X69 and in addition through a 5 V terminal on the UV 105.
The UV xxx does not have an additional 5 V terminal and thus cannot power the iTNC 530 sufficiently. The 50-line ribbon cable X69 of the UV xxx is connected to the UV 105 so that the status signals of the UV xxx can be transmitted to the iTNC.



Note

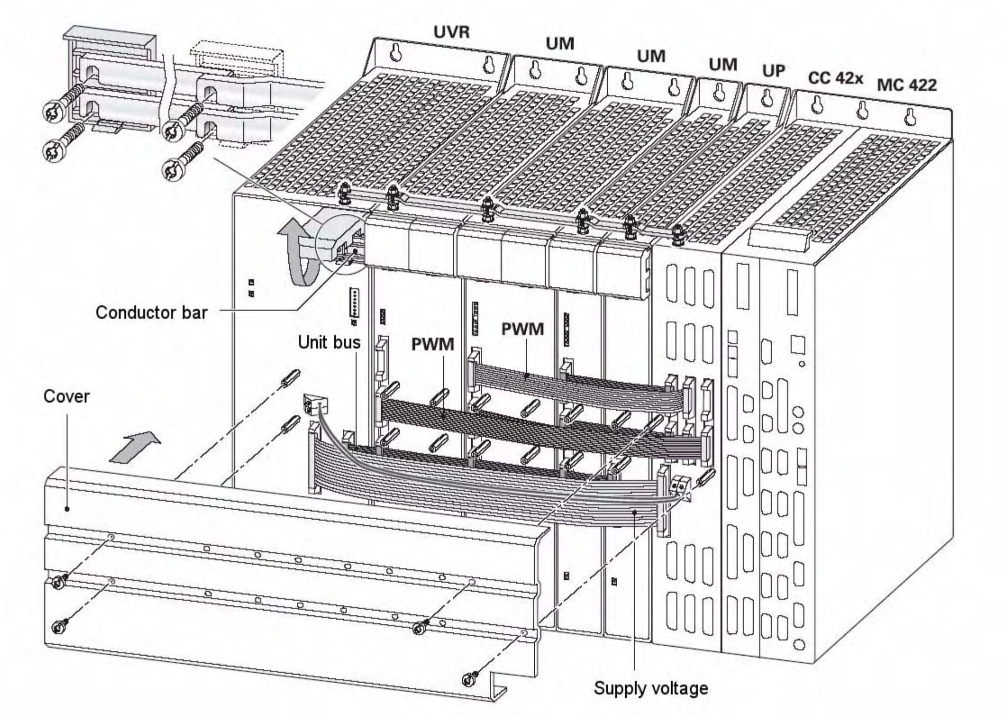
When using HEIDENHAIN inverters that are not provided with the additional 5 V terminal on the front panel (e.g. UE xxx, UE xxx B, UR xxx, UV xxx), normally the UV 105 is required. In case of a low current consumption of the iTNC 530 (e.g., single processor with low clock frequency, only few peripheral units are connected) it is possible that the machine manufacturers have not used the UV 105.

The UV 105 can also be used if the iTNC 530 is combined with non-HEIDENHAIN inverters to power the HEIDENHAIN control.

Since status signals from non-HEIDENHAIN inverters are not available or are not compatible to HEIDENHAIN systems, the adapter (ID 349 211-01) is then connected to X69 of the UV 105.

Power supply by UVR

Power is supplied through the 50-line ribbon-cable connector X69 and in addition through a 5 V terminal on the UVR.
A more powerful switching power supply and an additional 5 V terminal is built into the UVR.
--> The iTNC can be powered correspondingly.
The UV 105 is not required!



Note

When using HEIDENHAIN inverters that are provided with the additional 5 V terminal on the front panel (e.g., UR xxx D, UV xxx D, UVR xxx, UVR xxx D), an accessory unit for the power supply of the iTNC 530 is not required.

Note

For information on HEIDENHAIN compact inverters and power supply units refer to the **Service Manual for Inverter Systems and Motors.**

Power supply by UV 105 B

The **UV 105 B** was designed solely for the use on HEIDENHAIN controls **in connection with non-HEIDENHAIN inverter systems**.
The phases U/V and the dc-link voltage ± U_{DC} are connected via a connector on the front panel.
The LED **READY UV** on the front panel indicates the readiness of the unit.

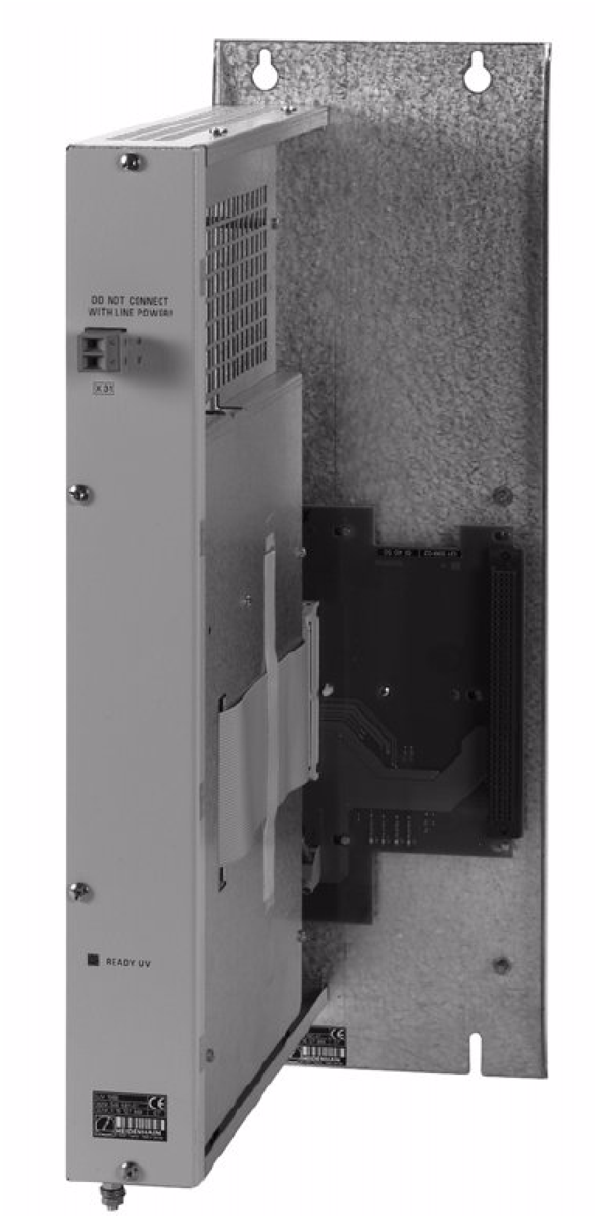
Power is supplied through the 50-line ribbon-cable connector and in addition through a 5 V terminal on the UV 105 B.

Power supply by UV 106 (B)

An MC 42x (B/C) can also be connected to a UV 106 (B/C) instead of a CC 42x controller unit. Thus the control loops for digital axes and spindles are not required. --> This combination is solely destined **for analog axes and spindles**.

The phases U and V are connected via a connector on the front panel.
The LED **READY UV** on the front panel indicates the readiness of the unit.

The MC is powered by means of a connecting board on the rear side of the unit.



17.1.2 UV 105, UV 105 B

Possible causes of error

- Supply voltage to U and V missing
- Fan has failed
- Fuse on board of the UV 105 (B) released
- UV 105 (B) defective
- DC-link voltage missing
- Fuse on the protective PCB has blown
  (connected to the conductor bar of a Simodrive system)

Troubleshooting UV 105 (B)

DANGER

Danger of electrical shock!

High voltages and currents

When checking the UV 105 (B) power supply unit, proceed as follows:

Control of the LED READY UV

The LED READY UV on the front panel of the UV 105 B indicates the readiness of the unit.

5 V on auxiliary terminal

▶ Measure whether the 5 V voltage on the auxiliary terminal of the UV 105 (B) is available.

Note

If you have the HEIDENHAIN test adapter with the corresponding ribbon cable, you can connect it parallel to the 50-line ribbon cable of the UV 105 (B) and measure the corresponding low voltages.
See “Test Adapter” on page 29 – 562.
See “X69: NC power supply and control signals” on page 27 – 481.

Function of the fan

▶ Check, whether the fan of the UV 105 (B) is running.

If it does not, this might indicate that ...

- No supply voltage for the UV 105 (B) is available.
- Fuses in the UV 105 (B) have released.
- The UV 105 (B) is defective.

The fan itself might be defective.

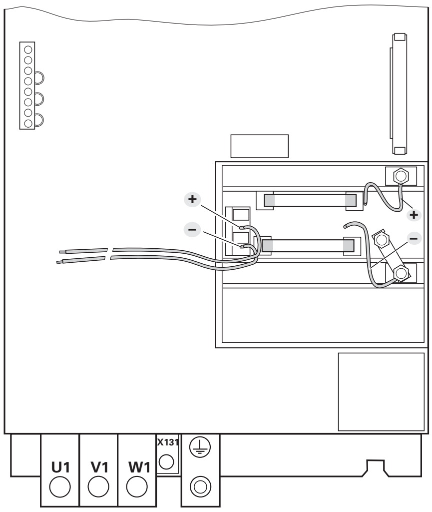
Checking the supply voltages

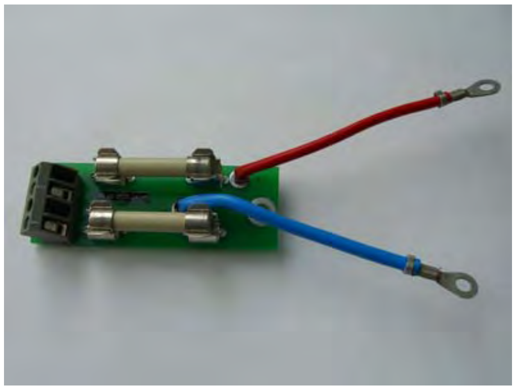
▶ Measure carefully, whether 400 Vac ±10 % are available on U and V of connector X31 (on the bottom of the UV 105) or the connector on the front panel (UV 105 B).

▶ If connected:
Measure carefully, whether a dc-link voltage on the conductor bars of the UV 105 or on the connector on the front panel of the UV 105 B is available (the voltage depends on the inverter system).

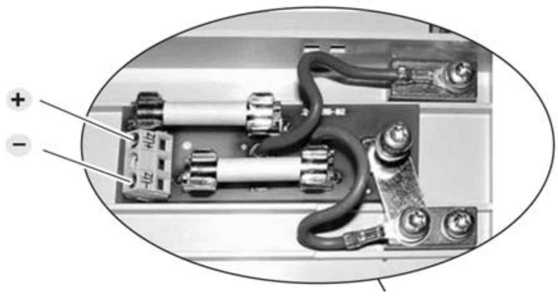
U_Z of a non HEIDENHAIN inverter system

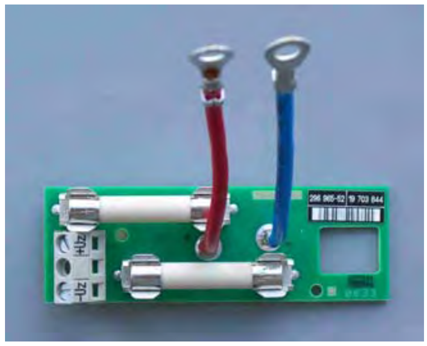
When using a non-HEIDENHAIN inverter system (e.g., Simodrive 611), the power supply from the dc link is mostly lead via a protective PCB. This is secured to the conductor bar on the non-HEIDENHAIN inverter.





Figures: Protective PCB "old"





Figures: Protective PCB "new"

> **DANGER**
>
> **Danger of electrical shock!**
>
> High voltages and currents

- Shut down the control and switch off the machine.
- Take precautions against restart.
- Check whether there is zero potential at the conductor bars.
- Check the fuses on the protective PCB and exchange them, if necessary.

Fuses in UV 105 (B)

- Shut down the control and switch off the machine.
- Take precautions against restart.
- Check whether there is zero potential on the connections.
- Dismantle the UV 105 (B) power supply unit.
- Ensure that the unit is not under power.
- Remove the side plate.
  Caution: On the UV 105, one screw is located under the cover of the connector of the conductor bar.
- Check the fuses on the power supply board.

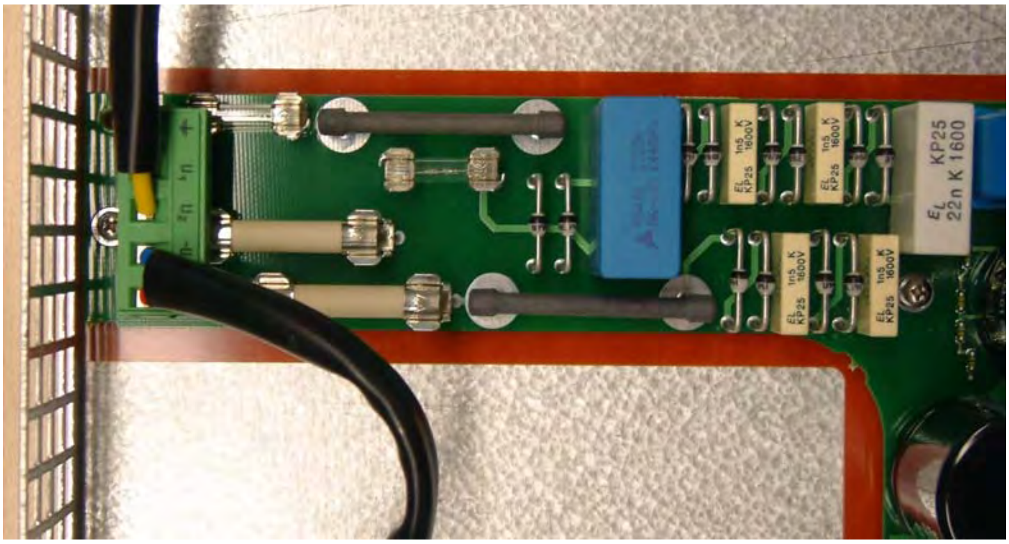
DANGER

Danger of electrical shock!
A switching power supply is located in the UV 105 (B). This switching power supply may still be under voltage although it is seperated from the power source (without current consuming unit, the voltage on the board is only reduced slowly).
Do not touch the board or the fuses with bare hands!
Use insulated pincers when removing the fuses!

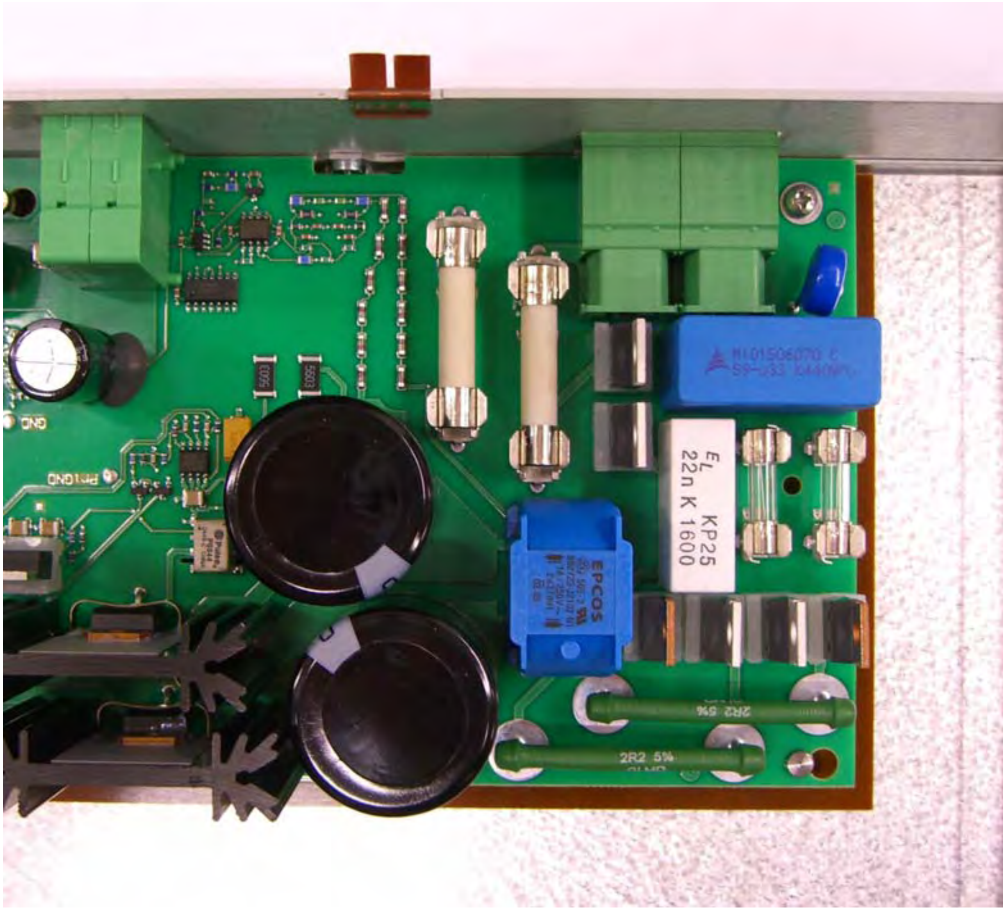
Caution

Be careful not to touch any components on the power supply board sensitive to electrostatic discharge and observe the ESD regulations!

Position of the fuses in the UV 105:



Position of the fuses in the UV 105 B:



> **Note**
>
> If any of the fuses is defective, the UV 105 (B) power supply unit must be replaced. Replacing the fuses is not advised.

Corrective action

A defective UV 105 (B) must be replaced.

Mounting the UV 105 (B)

> **DANGER**
>
> For mounting the UV 105 (B), the additional 5V lines must be connected with the correct polarity!
> Otherwise there will be a short circuit of these lines on the 5V ribbon wires.
>
> Restore the ground by means of lines and conductor bars!

17.1.3 UV 106, UV 106 B

Possible causes of error

- Supply voltage to U and V missing
- Fan has failed
- Fuse on board of the UV 106 (B) released
- UV 106 (B) defective

Troubleshooting UV 106 (B)

> **DANGER**
>
> **Danger of electrical shock!**
>
> High voltages and currents

When checking the UV 106 (B) power supply unit, proceed as follows:

Control of the LED READY UV

The LED READY UV on the front panel of the UV 106 (B) indicates the readiness of the unit.

Function of the fan

▶ Check, whether the fan of the UV 106 (B) is running.

If it does not, this might indicate that ...

- no supply voltage for the UV 106 (B) is available
- fuses in the UV 106 (B) have released
- the UV 106 (B) is defective.

The fan itself might be defective.

Checking the supply voltages

▶ Measure carefully, whether 400 Vac ±10 % are available on U and V of connector X31 on the front panel.

> **Note**
>
> It is not useful to measure the low voltages on the 50-line ribbon cable of the UV 106 (B) (e.g., with the HEIDENHAIN test adapter).
> The MC cannot be connected. The low voltages, however, must be measured while under load.

Fuses in UV 106 (B)

- Shut down the control and switch off the machine.
- Take precautions against restart.
- Check whether there is zero potential on the connections.
- Dismantle the UV 106 (B) power supply unit.
- Ensure that the unit is not under power.
- Remove the side plate.
- Check the fuses on the power supply board.

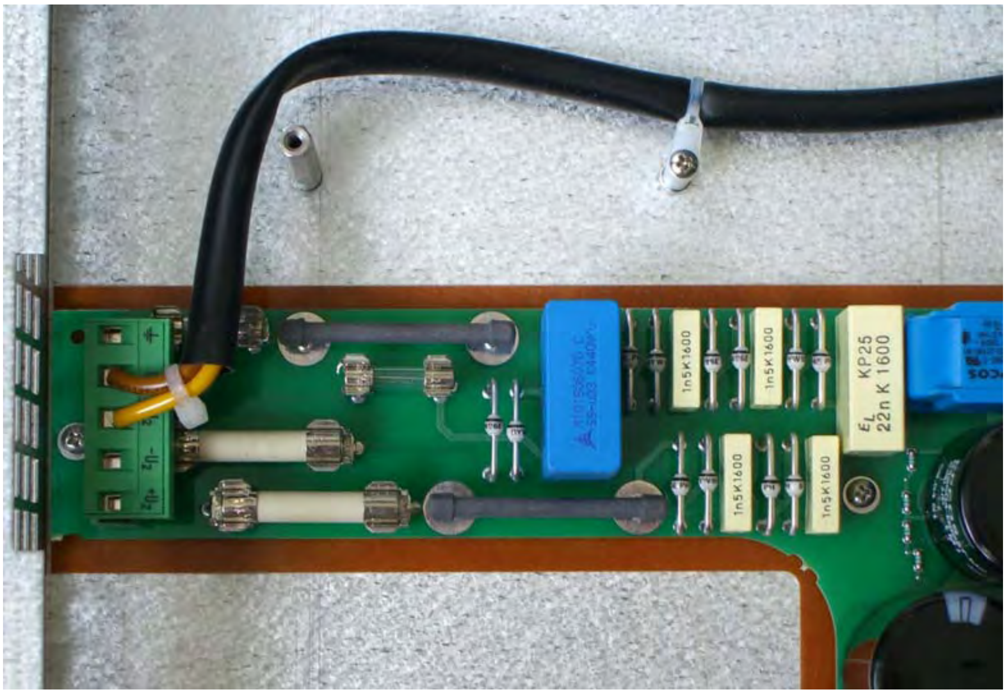
DANGER

Danger of electrical shock!
A switching power supply is located in the UV 106 (B). This switching power supply may still be under voltage although it is seperated from the power source (without current consuming unit, the voltage on the board is only reduced slowly).
Do not touch the board or the fuses with bare hands!
Use insulated pincers when removing the fuses!

Caution

Be careful not to touch any components on the power supply board sensitive to electrostatic discharge and observe the ESD regulations!

Position of the fuses in the UV 106:



Note

If any of the fuses is defective, the UV 106 (B) power supply unit must be replaced. Replacing the fuses is not advised.

Corrective action

A defective UV 106 (B) must be replaced.

Mounting the UV 106 (B)

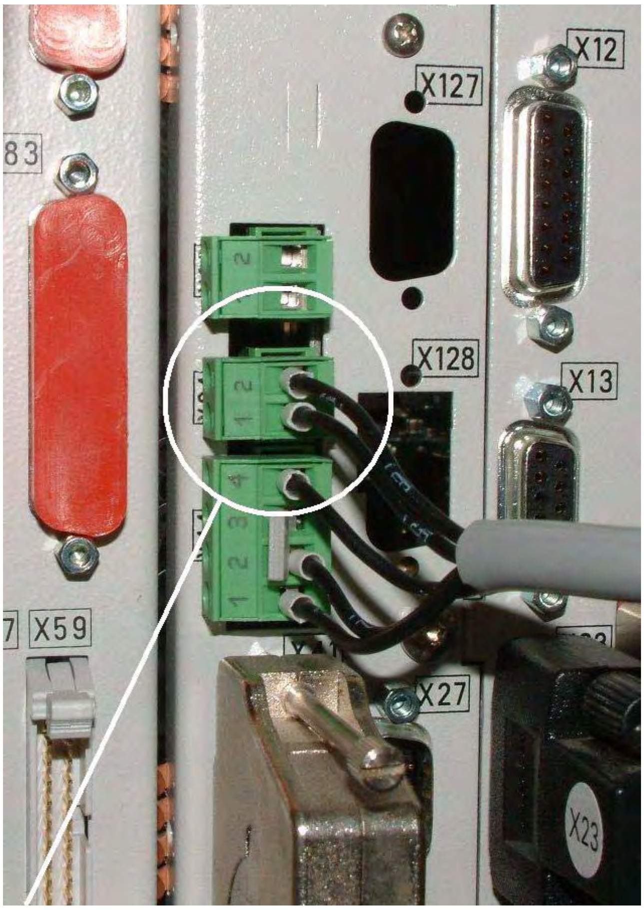
DANGER

Restore the ground!

17.2 Power Supply for "Control-Is-Ready Signal"

X34: Power supply for "Control-Is-Ready" signal output

The control-is-ready signal output is powered with 24 Vdc provided by the compact inverter or the power supply unit. The voltage is connected to terminal X34 of the MC.
Pin layout:



Connecting terminal X34 on the MC	Pin layout
1	+24 V
2	0 V

If a HEIDENHAIN inverter system is located in the electrical cabinet, connector X72 generally supplies the 24 V from the inverter. See "Annex: Principle of Function of the iTNC 530 Control" on page 2 – 657).

If there is a non-HEIDENHAIN inverter system in the electrical cabinet, the power supply unit in the electrical cabinet supplies the 24 V.

Error messages

If the 24 V supply on X34 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 **EXTERNAL EMERGENCY STOP** error message is displayed:

Note

For this purpose the Control-Is-Ready signal output must be integrated correctly into the EMERGENCY STOP chain. --> See "Annex: Principle of Function of the iTNC 530 Control" on page 2 – 657, See "During Start-Up" on page 3 – 661!

Troubleshooting

- Measure the voltage on X34.
- Check the wiring. (Use the circuit diagram of the machine tool for this purpose.)
- Examine the power supply units.

17.3 Buffer Battery

Introduction

The buffer battery ...

- Is the power source for the RAM when the machine is switched off.
- Is located inside the MC.
- Has a rated voltage of 3 V.
- Has a typical service life of 3 to 5 years.

For safeguarding the RAM, an additional capacitor (Gold cap) was integrated onto the PCB of the iTNC. This capacitor stores the RAM content for approx. one day without batteries.

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

Caution

If the voltage of the buffer battery falls below 2.6 V the error message **`Exchange buffer battery`** appears.
The error message is activated every 30 minutes.
Exchange the buffer battery as soon as possible!

Figure: "Exchange 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 code number 79513. --> See “Information Menu” on page 17 – 267.
- 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 loaded sufficiently, wait a few seconds and enter the code number 79513 again to read the updated voltage value.
If the voltage of the Gold cap does not reach 3 V or more, the MC must be replaced.

Replacing the buffer battery

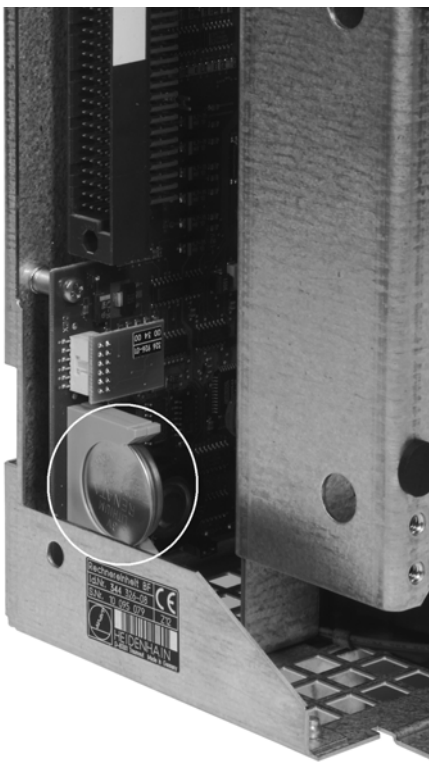
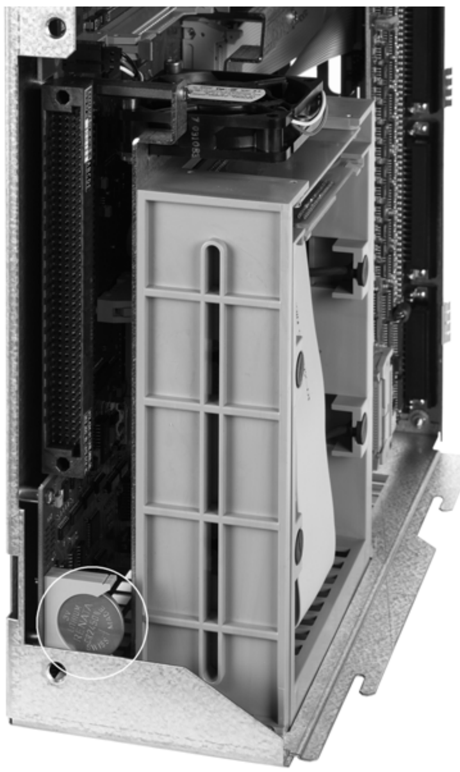
When replacing the buffer battery, proceed as follows:

- As a precaution back up the condition of non-volatile PLC markers and words from RAM to the hard disk. --> See “Non-Volatile PLC Markers and Words” on page 11 – 136.
- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Dismount the MC.
- Exchange the battery.
  Due to the non-symmetric shape of the battery there is only one possibility of inserting.
  Battery type: 1 lithium battery, type CR 2450N (Renata), ID 315878-01

Caution

Be careful not to touch any components sensitive to electrostatic discharge
and observe the ESD regulations!

Position of the buffer battery

MC 422	MC 422 B/C
	

Were any data lost?

If the battery was exchanged although the Gold cap was not loaded sufficiently, the battery-buffered areas of the working memory are deleted. The non-volatile PLC markers and words belong to this range.

If you have backed up the non-volatile PLC markers and words from the RAM to the hard disk before replacing the battery, you can now restore them. --> See “Non-Volatile PLC Markers and Words” on page 11 – 136.

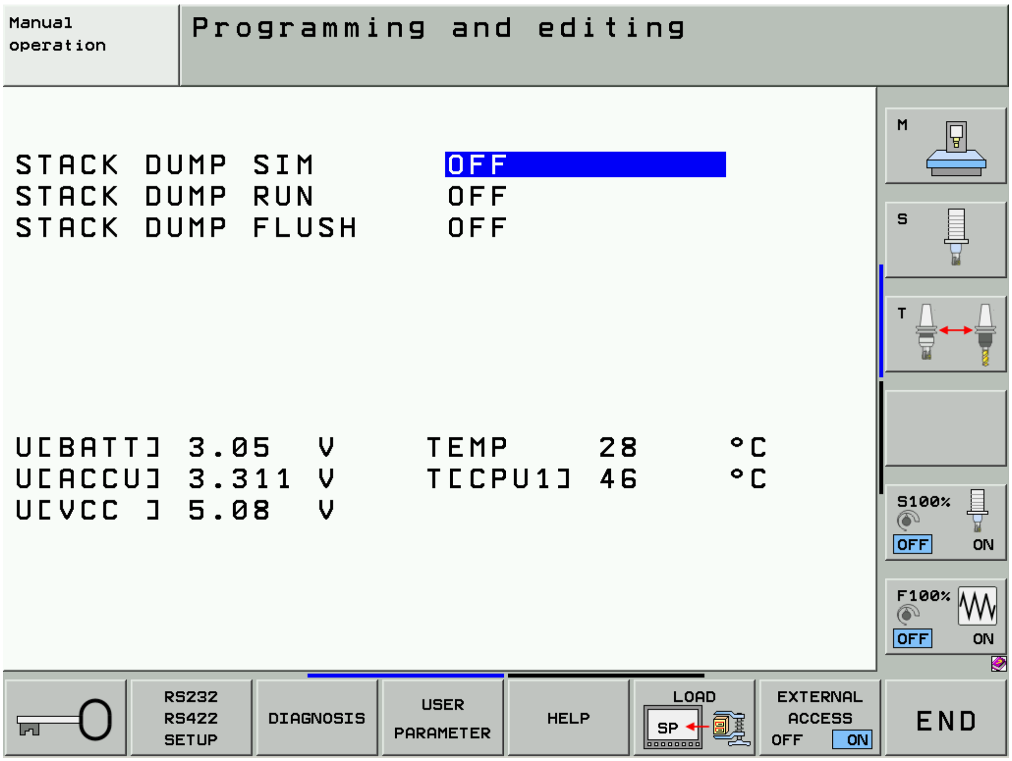
If not, this may mean that several components of the machine must be set again (tool changer, swivel head, etc.) --> Ask the machine tool builder!

It is possible, the datum and the time of the BIOS settings were lost. Set these values again. --> See “Setting the System Time” on page 12 – 159.

17.4 Information Menu

Call

- Enter the code number **79513**. --> See "Code Numbers" on page 3 – 17.
- Confirm with ENTER. --> 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]	**3.05 V**	Voltage of buffer battery
U [ACCU]	**3.311 V**	Charge status of the capacitor ("Goldcap")
U [VCC]	**5.08 V**	Supply voltage 5 V
TEMP	**28 °C**	Temperature in the housing of the MC/CC
T [CPU1]	**46 °C**	Temperature of the CPU1

Note

These values are updated internally in the minutes cycle.
The display is only updated with the new call of the Info menu. I.e., the code number **79513** must be entered again.

17.5 Power Supply for PLC Outputs

17.5.1 Introduction

The PLC of the iTNC 530 as well as the PL 4xx B / PL 510 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/A rated, at least however with 1000 µF/A. At a current load of 15 A, for example, this corresponds to a capacity of 2250 µF.

EN 61 131-2:1994 permits:

- 5% alternating voltage component is permissible
- Minimum absolute value: 20.4 Vdc
- Maximum absolute value: 28.8 Vdc

Power consumption

If half of the outputs are switched at the same time, the following are the values for power consumption:

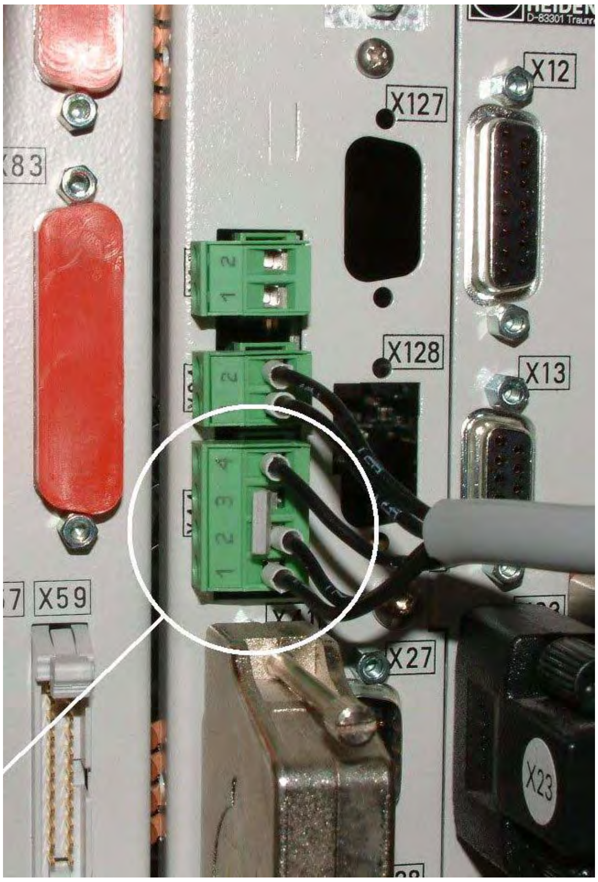
MC 42x (B/C):	48 W
PL 410 B:	Approx. 460 W
PL 405B:	Approx. 235 W
PL 510:	Approx. 485 W

Nominal operating current per output

MC 42x (B/C): 0.150 A
PL 410 B: 2 A (with max. current consumption of 20 A)
PL 405 B: 2 A (with max. current consumption of 20 A)
PLD 16-8: 2 A
Simultaneity:
2 outputs with 2 A each
4 outputs with 1 A each
8 outputs with 0.5 A each
Total current:
Out0 to Out7: ≤ 4 A
Out0 to Out3: ≤ 2 A
Out4 to Out7: ≤ 2 A

17.5.2 Supply voltage for PLC outputs on the MC

X44:
PLC supply voltage



Pin layout on the MC 42x (B/C):

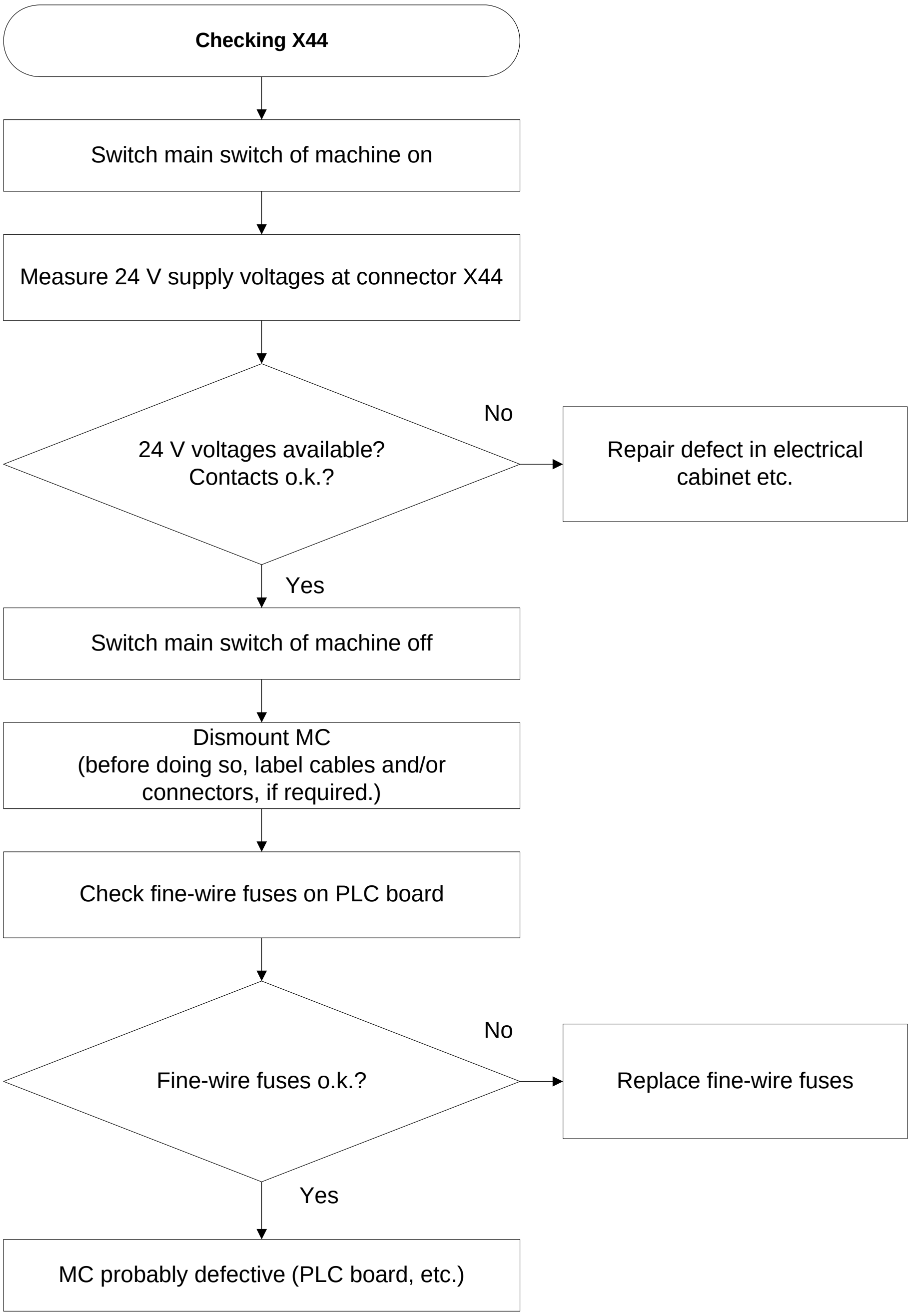
Connecting terminal	Pin layout	PLC outputs
1	+24 V cannot be switched off via EMERGENCY STOP	O24 to O30
2	+24 V can be switched off via EMERGENCY STOP	O16 to O23
3		O0 to O15
4	0 V	

Error message

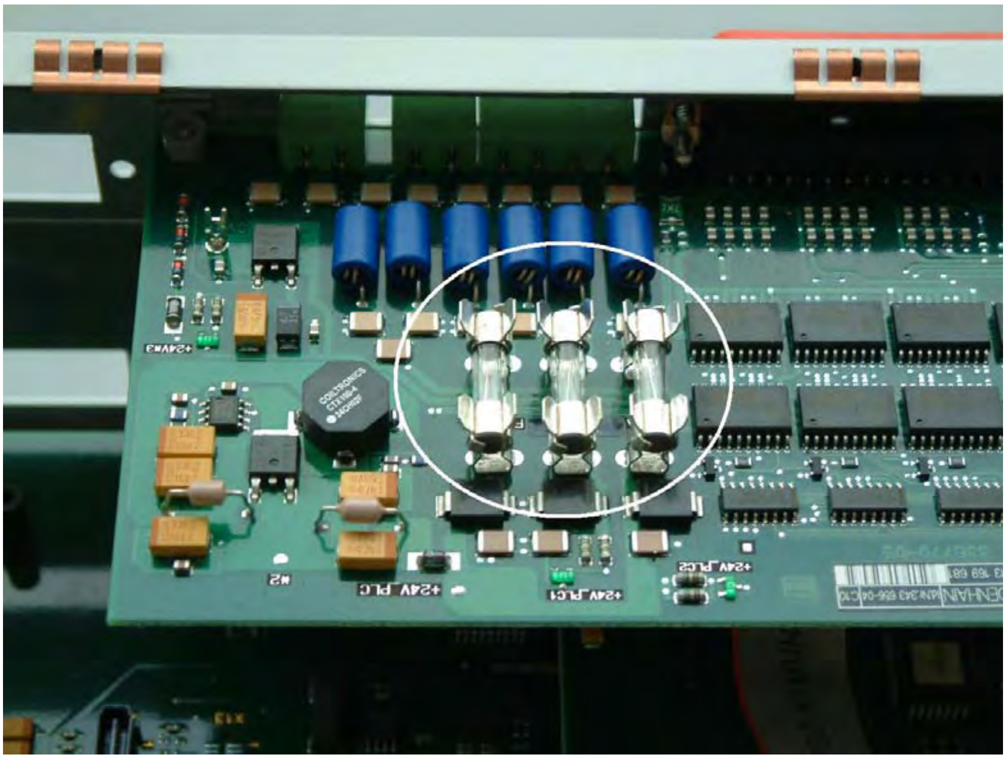
If the 24 V power supply (which cannot be shut off via emergency stop) is missing at X44, the error message **`Supply voltage missing at X44`** appears.

The corresponding PLC outputs do not function. Depending on the PLC program of the machine manufacturer, PLC error messages are displayed.

Troubleshooting X44



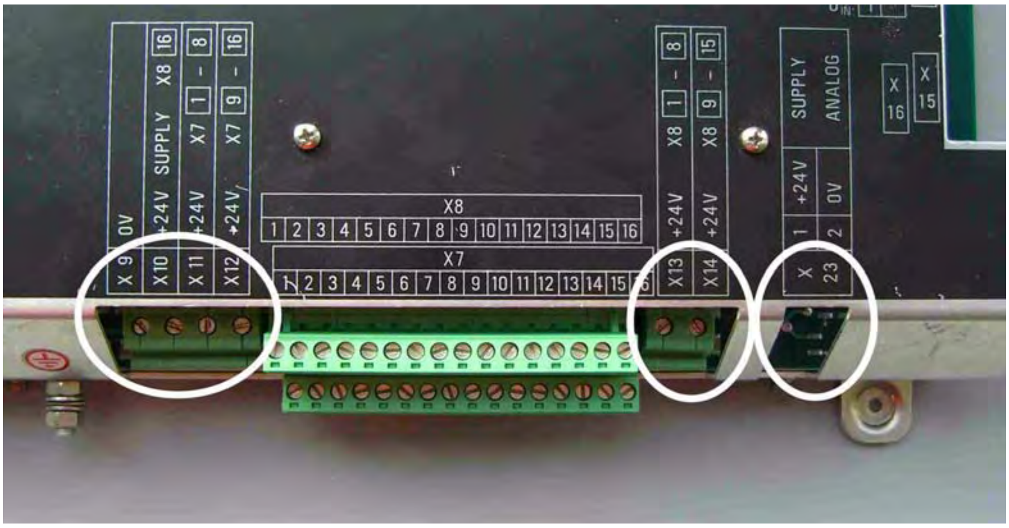
Fine wire fuses



> **Caution**
>
> Use only original replacement fuses.
> Be careful not to touch any components sensitive to electrostatic discharge and observe the ESD regulations!

17.5.3 Supply voltage for PLC outputs on the PL 4xx B

Connection



X9 to X14: Power supply

Pin layout on the PL 410 B:

Terminal	Pin layout	PL 1	PL 2	PL 3	PL 4
X9	0 V				
X10	+24 Vdc logic power supply and for control-is-ready signal[a]				
X11	+24 Vdc power supply for outputs[a]	O32 – O39	O64 – O71	O128 – O135	O160 – O167
X12	+24 Vdc power supply for outputs[a]	O40 – O47	O72 – O79	O136 – O143	O168 – O175
X13	+24 Vdc power supply for outputs[a]	O48 – O55	O80 – O87	O144 – O151	O176 – O183
X14	+24 Vdc power supply for outputs[a]	O56 – O62	O88 – O94	O152 – O158	O184 – O190

a. 20.4 V to 28.8 V

Pin layout on the PL 405B:

Terminal	Pin layout	PL 1	PL 2	PL 3	PL 4
X9	0 V				
X10	+24 Vdc logic power supply and for control-is-ready signal[a]				
X13	+24 Vdc power supply for outputs[a]	O48 – O55	O80 – O87	O144 – O151	O176 – O183
X14	+24 Vdc power supply for outputs[a]	O56 – O62	O88 – O94	O152 – O158	O184 – O190

a. 20.4 V to 28.8 V

X23: Supply voltage of the analog inputs of the PL 410 B

The PL 410B input/output unit is also available with additional analog inputs and inputs for Pt 100 thermistors. The power supply must comply with EN 50 178, 5.88 requirements for ”low voltage electrical separation.”

Connecting terminal	Pin layout
1	+24 Vdc as per EN 50 178, 5.88
2	+0 V

Error

The corresponding PLC outputs do not function. Depending on the PLC program of the machine manufacturer, PLC error messages are displayed.

Note

Monitoring the PLC outputs --> See “The TABLE function” on page 11 – 119.

Functional check

- Observe, whether the green LED near the bus connectors X1/X2 is on.

If this is not the case.

- Measure whether the 24 V supply voltage is available at X9/X10.

Note

If LED is not lit up, despite available power supply, the PL board is probably defective.

- Measure all other power supply connections.

Note

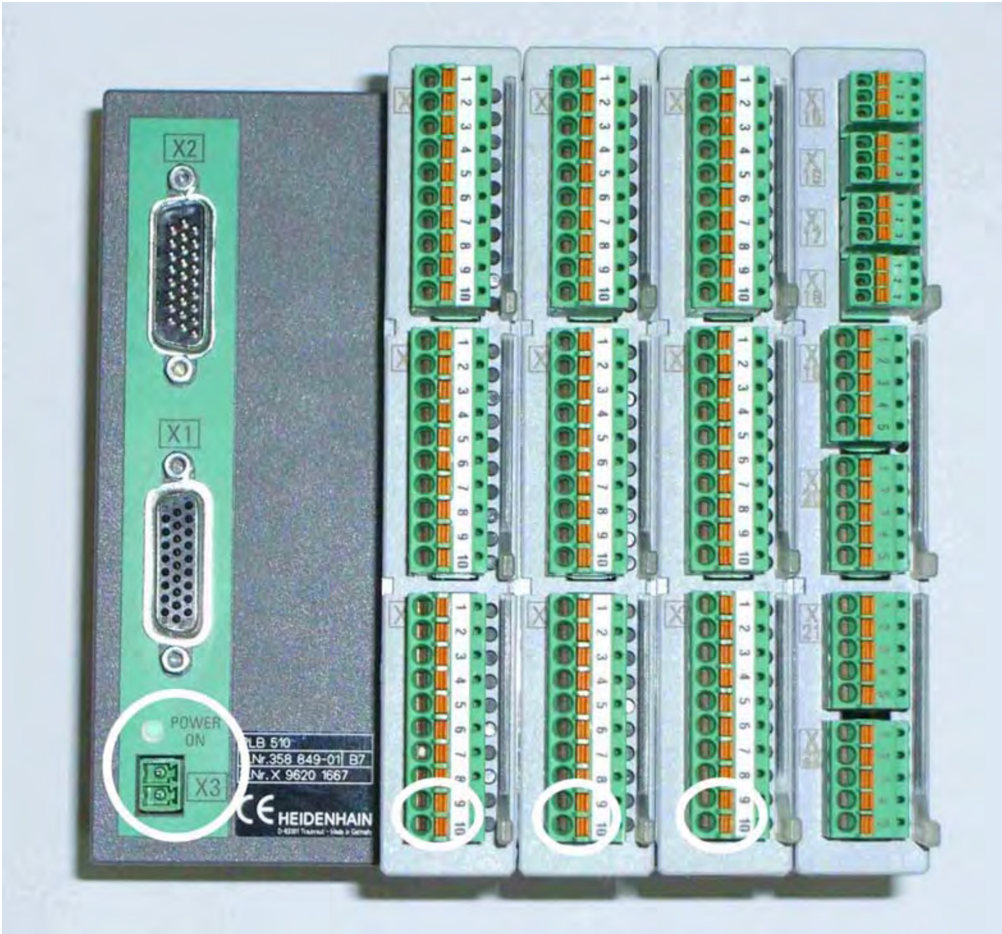
On older PLC expansion boards PL 4xx B, you may still find fine-wire fuses (glass fuses) on the board. These may be replaced, if necessary:
On newer PL 4xx B, the glass fuse has been replaced by an SMD fuse.
The SMD fuse has been soldered onto the board. Contact your HEIDENHAIN service agency.

17.5.4 Supply voltage for PLC outputs on the PL 510

Note

The iTNC 530 cyclically monitors the supply voltage and short circuits of the PLC outputs of a PL 510.

Connection



PLB 510 basic module

Pin layout for X3 (power supply for logic circuit):

Connecting terminal	Pin layout
1	+24 Vdc (20.4 V to 28.8 V)
2	+0 V

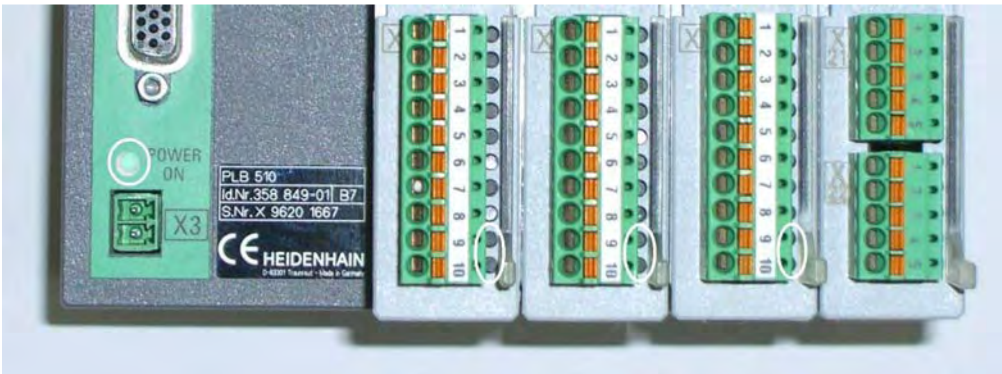
PLD 16-8 input/ output module

Pin layout at X6 (power supply for PLC outputs):

Connecting terminal	Pin layout
9	+24 Vdc (20.4 V to 28.8 V) for group 1 (terminal 1 - 4)
10	+24 Vdc (20.4 V to 28.8 V) for group 2 (terminal 5 - 8)

LED display

The green LEDs indicate the correct supply:



Error

The corresponding PLC outputs do not function. Depending on the PLC program of the machine manufacturer, PLC error messages are displayed.

> **Note**
>
> Monitoring the PLC outputs --> See “The TABLE function” on page 11 – 119.

Functional check

- Observe, whether the green LEDs on X6 pin 9 and pin 10 of the PLD16-8 input/output modules are lit.
- Observe, whether the green LED POWER ON on the basic module PLB 510 is lit.

If this is not the case.

- Measure whether the 24 V supply voltages are available as indicated above.

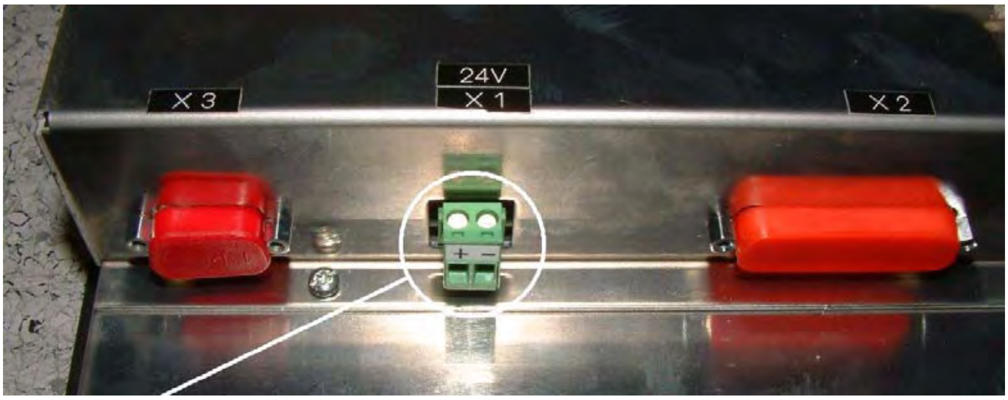
> **Note**
>
> If the LEDs are not lit, despite available power supply, the basic module PLB 510 or the corresponding I/O module PLD 16-8 is probably defective.

17.6 Power Supply for the Display Units

Power supply with basic insulation in accordance with EN 50 178:

Connecting terminal X1	Pin layout
1	+24 V
2	0 V

Power consumption: BF 120: 15 W
BF 150: 45 W



Errors

- The fan does not run.
- The screen remains black.

Troubleshooting

See "Visual Display Unit" on page 21 – 355.

18 Encoder Interface

18.1 Position Encoders

18.1.1 Introduction

Position encoders are also referred to as **linear encoders**.
They report positions and movements of the machine to the control.
iTNC 530 operates with **incremental** and **absolute** encoders.
Encoders with one reference mark or distance-coded reference marks and with EnDat interface are permissible.

Encoders 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 18 – 293.

Position encoder inputs

MC 420	MC 422 (B/C)	CC 424 (B)
■ **X1 to X5**	■ **X1 to X6** ■ **X35 to X38** (depending on the expansion stages)	■ **X201 to X206** ■ **X207 to X214** (depending on the expansion stages)

For example, **scales for linear axes** or **angular encoders for rotary axes/spindles** can be connected here.

Monitoring of the position encoders

The monitoring functions for the position encoders are activated in **MP 20.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 AMPLITUDE TOO LOW <AXIS>
Edge separation of encoder-signals	Position encoder <AXIS>: FREQUENCY TOO HIGH

DANGER

The monitoring functions for the position encoders (MP 20.x) must always be active!
Safe machine operation is not ensured without these monitoring functions.
Exception:
MP 20.0 is only active for position encoders with distance-coded reference marks.

Assignment of the position encoders

MP 100 is read from the right to the left and contains the information which axis is the first, the second, the third axis, etc.

Caution

MP 100 must not be changed!

Assignment of speed encoder inputs in the machine parameters	Axes	Spindles
Machine parameters	**MP 110.x**	**MP 111.x**

Assignment of the position encoder inputs to the drive-control boards of the CC 424 (B)	Position encoder inputs
1 (main DCB)	X201 - X206
2 (auxiliary DCB)	X207 - X214

Note

On the CC 424 (B) with 8 and with 14 control loops, X207 and X208 are still located on the main DCB.

EnDat encoders

It is possible to connect **EnDat encoders** to all position encoder inputs of an MC or CC!

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.

Signal type and input frequency

	MC 420 and MC 422 (B/C)	CC 424 (B)
Connector	X1 - X6, X35 - X38	X201 - X214
Signal type and associated MP	1 Vpp or 11 µApp	1 Vpp or 11 µApp
	MP 115.0	**MP 116.0**
Input frequency and associated MP	With 1 Vpp: 27 kHz or 400 kHz With 11 µApp: 27 kHz or 140 kHz	With 1 Vpp: 27 kHz or 400 kHz With 11 µApp: 27 kHz or 140 kHz
	MP 115.2	**MP 116.2**

For other signal types (TTL, etc.) adapters can be used.
--> See “Position encoders” on page 27 – 520.

Polyfuses

Note

Current MCs and CCs feature so-called **"Polyfuses"**. These are electronic fuses that separate defective peripheral devices from the low voltages in the control in the event of an error. This is also true for the encoders!

If a defective encoder draws too much current, it is "separated" from the control component. Corresponding error messages are displayed.

18.1.2 Possible causes of errors

- Contamination of the position encoder
- Chips in the scale
- 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
- Interface on the control defective

Caution

The amplitude of the reference marks is not monitored!
For example, if a reference mark is contaminated and thus cannot be evaluated, with distance-coded encoders a corresponding error message (e.g., **`Reference marks: 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.

18.1.3 Troubleshooting

To find out, whether **the connected encoder** or **the interface of the control** is defective, the interchange method can be used. Use the interface of a working axis for this purpose.

Caution

For trouble shooting do not connect obviously defective controls (e.g., position encoder with short circuit after entering of humidity) to other interfaces (e.g., X1-X6, X35-X38) of the control.

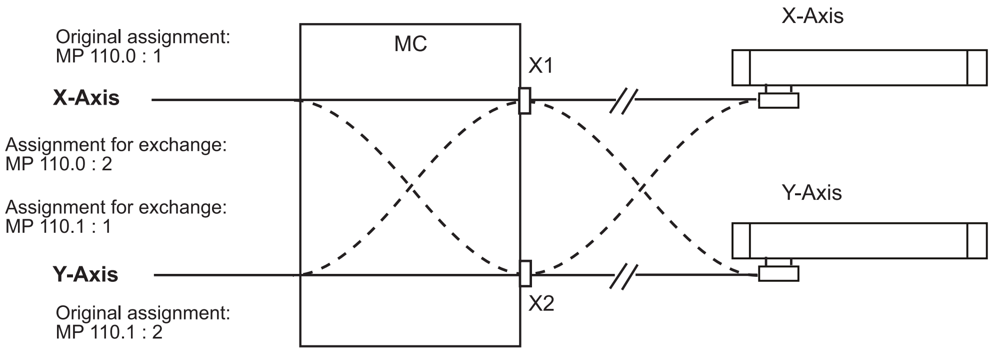
Example

Error in X axis. position encoders connected to MC

Example machine parameters

MP 100.x = CZYX (X = 1st axis, Y = 2nd axis, Z = 3rd axis, C = 4th axis)
MP 110.0 = 1 (X-axis at X1 input)
MP 110.1 = 2 (Y-axis at X2 input)
MP 110.2 = 3 (Z-axis at X3 input)
MP 110.3 = 4 (C-axis at X4 input)
MP 115.0 = %0000000000 (all inputs 1 Vpp)
MP 115.1 = %0000000000
MP 115.2 = %0000000000 (all inputs 50 kHz)

Block diagram



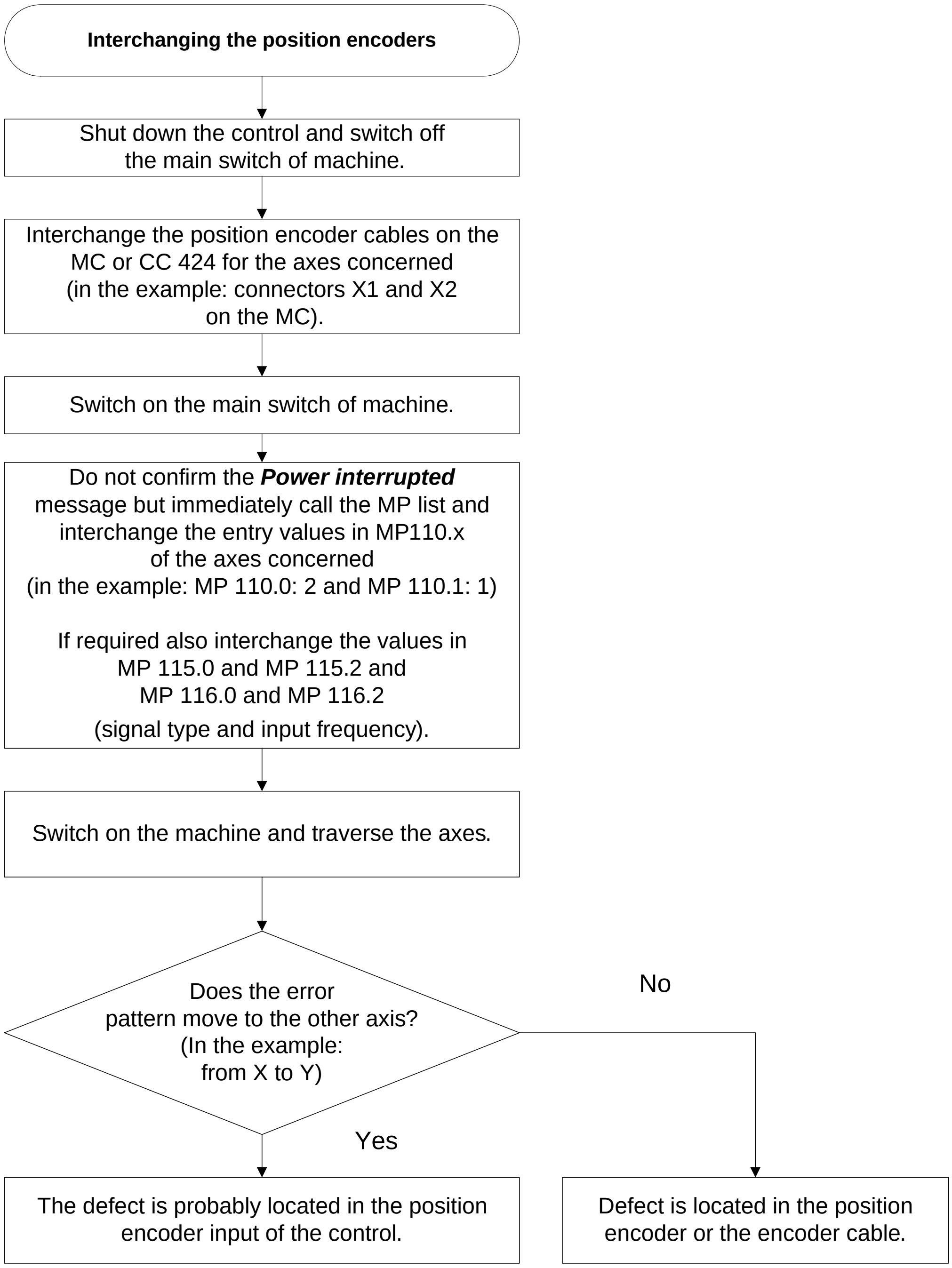
Note

Always switch both the cable and the interface assignment by machine parameter!

Note

MC:
Position encoder inputs can be assigned in any order.
CC 424 (B):
On the main DCB and on the auxiliary DCB the position encoder inputs can be assigned in any order.

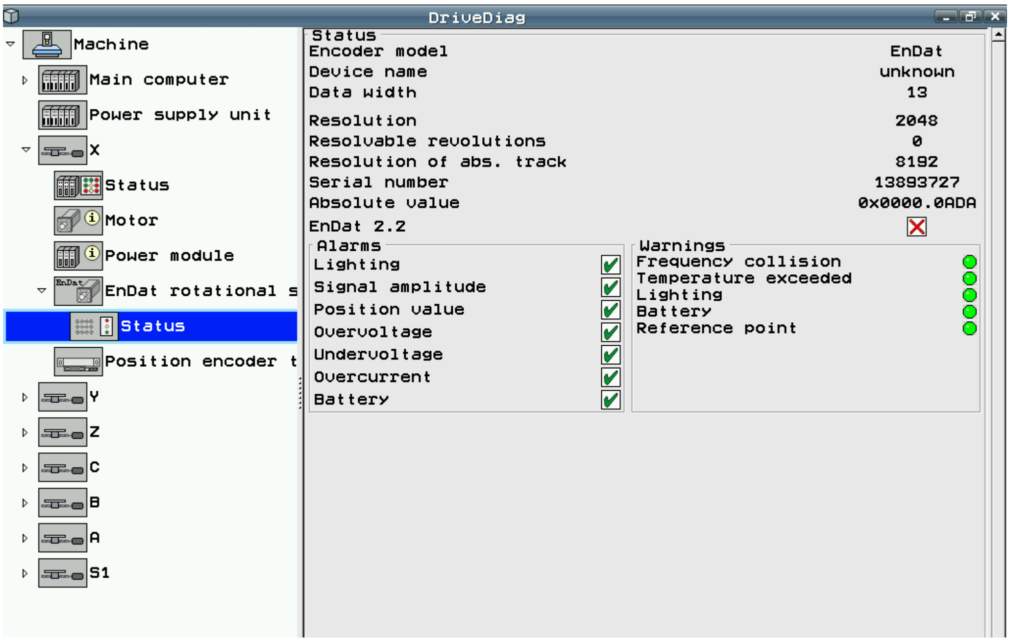
Flowchart


Interchanging the position encoders
Shut down the control and switch off the main switch of machine.
Interchange the position encoder cables on the MC or CC 424 for the axes concerned (in the example: connectors X1 and X2 on the MC).
Switch on the main switch of machine.
Do not confirm the ***Power interrupted*** message but immediately call the MP list and interchange the entry values in MP110.x of the axes concerned (in the example: MP 110.0: 2 and MP 110.1: 1)
If required also interchange the values in MP 115.0 and MP 115.2 and MP 116.0 and MP 116.2 (signal type and input frequency).
Switch on the machine and traverse the axes.
Does the error pattern move to the other axis? (In the example: from X to Y)
No
Yes
The defect is probably located in the position encoder input of the control.
Defect is located in the position encoder or the encoder cable.

18.1.4 Possibilities with the integrated diagnosis or DriveDiag

EnDat position encoder

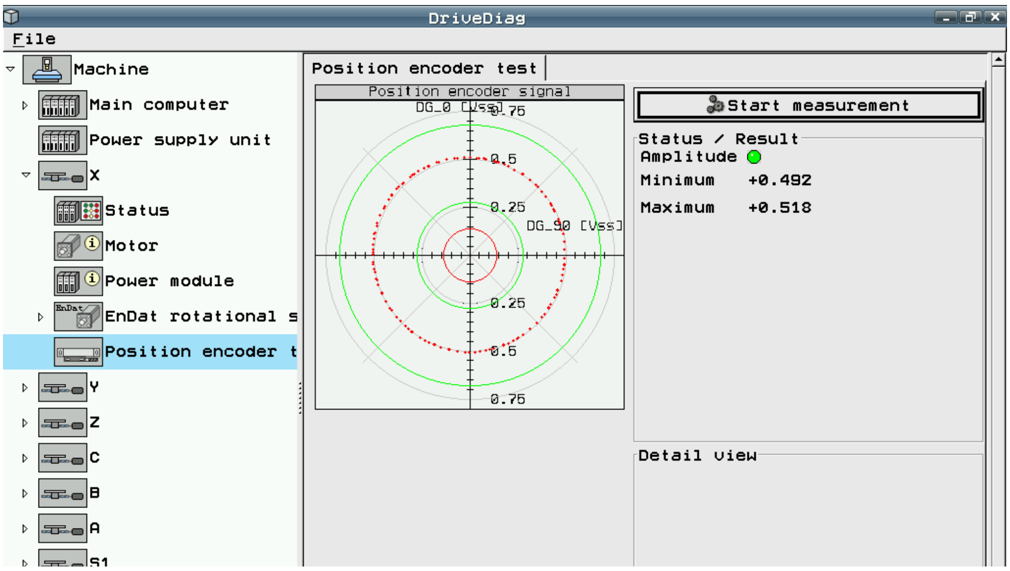
On the info screen "EnDat Position Encoder" you can see, whether alarm bits are set:



Calling the screen. --> See “Integrated Diagnostic Functions and DriveDiag” on page 9 – 89.

Position encoder test

The integrated diagnosis functions or DriveDiag also offer a simple position encoder test:



Calling the screen. --> See “Integrated Diagnostic Functions and DriveDiag” on page 9 – 89.

The signal quality is evaluated at the current position of the scanning head.
This test can be run with stationary or traversing axis.
If the axis is stationary, the measuring points are at a fixed place; if it moves, they are arranged on a circle. The measuring points must be located between the two green tolerance circles.

Note

As of NC software version 340 49x-05 the circular diagram has been removed.

18.1.5 Possibilities with the integrated oscilloscope

The integrated oscilloscope is used to record the incremental signals (A, B or I1, I2) of position encoders.

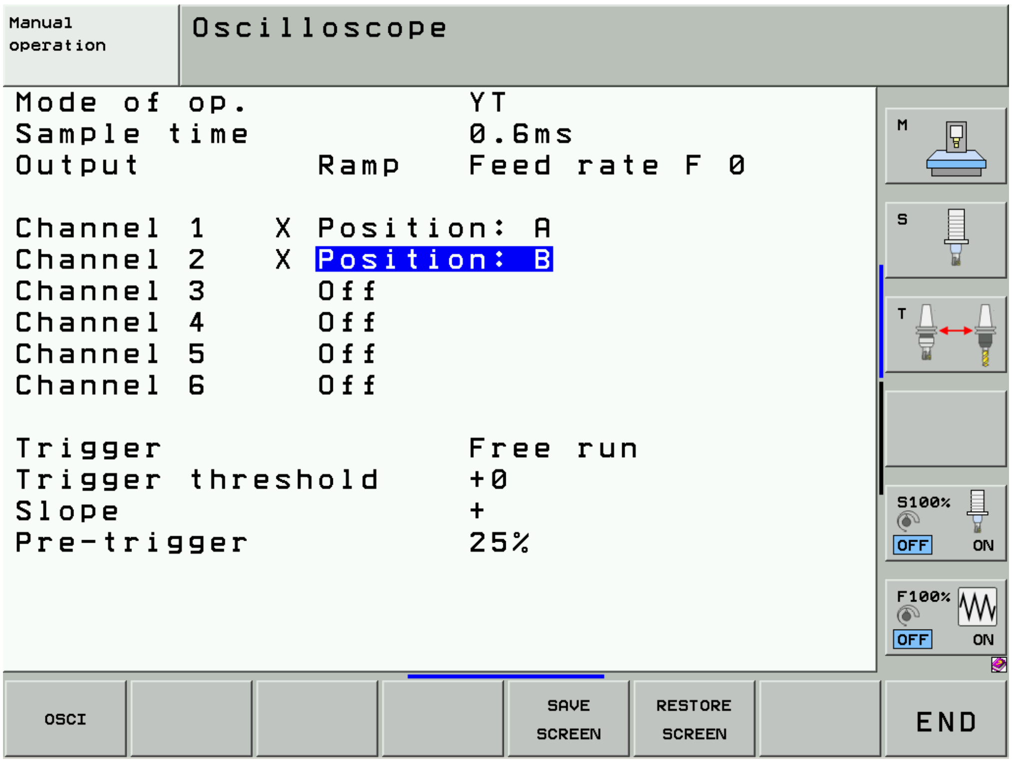
Activation and operation --> See "Integrated Oscilloscope" on page 10 – 99.

Note

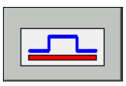
Reference signals and EnDat signals cannot be displayed!
A phase angle measuring unit should be used for an accurate tracing of the signals (e.g., PWM 9)!

Example for an oscilloscope recording of position encoder signals:

- Define the following settings (depending on the NC software version, either **`position: A`** and **`position: B`** or **`position: I1`** and **`position: I2`** is offered):

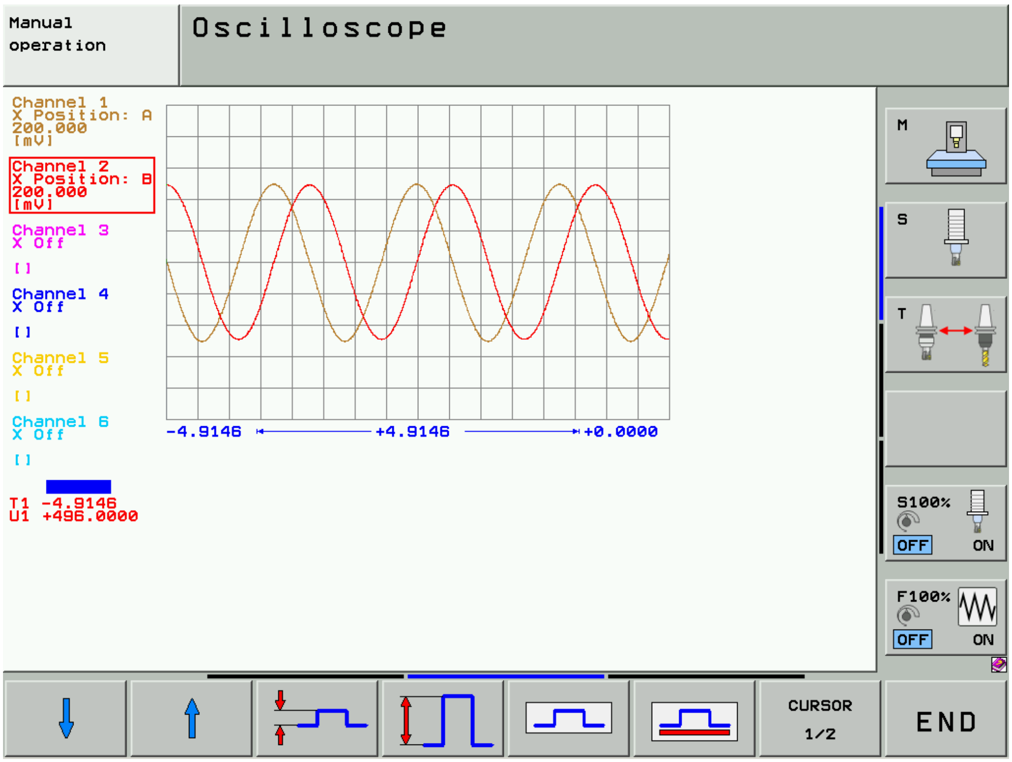


- Move the X-axis at very low speed in the manual mode.
- Start the oscilloscope recording.
- Stop recording.



- Adapt the signals under consideration of the zero line.

- Adapt the time axis for a more detailed representation.



A and B signal must be of equal size and move symmetrically around the same vertical axis **(no vertical offset)!**

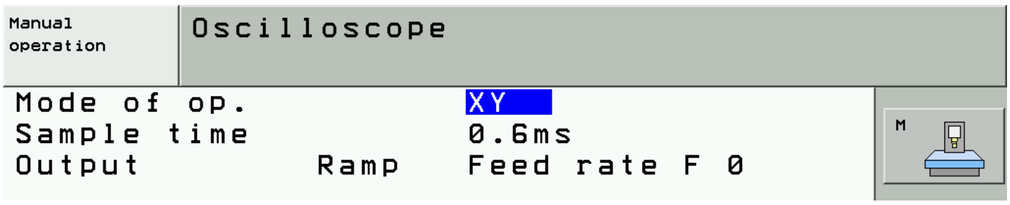
The **90° offset of the A and B-signal** on the horizontal axis can be clearly seen.
A drop of the amplitudes during traverse could e.g. be an indicator for a contaminated scale section. If the amplitude during standstill is too low, e.g., the scanning head could be contaminated.

The signals in the integrated oscilloscope are always displayed in the **unit mV**, independent of the type of encoder connected (1 Vpp or 11 µApp).

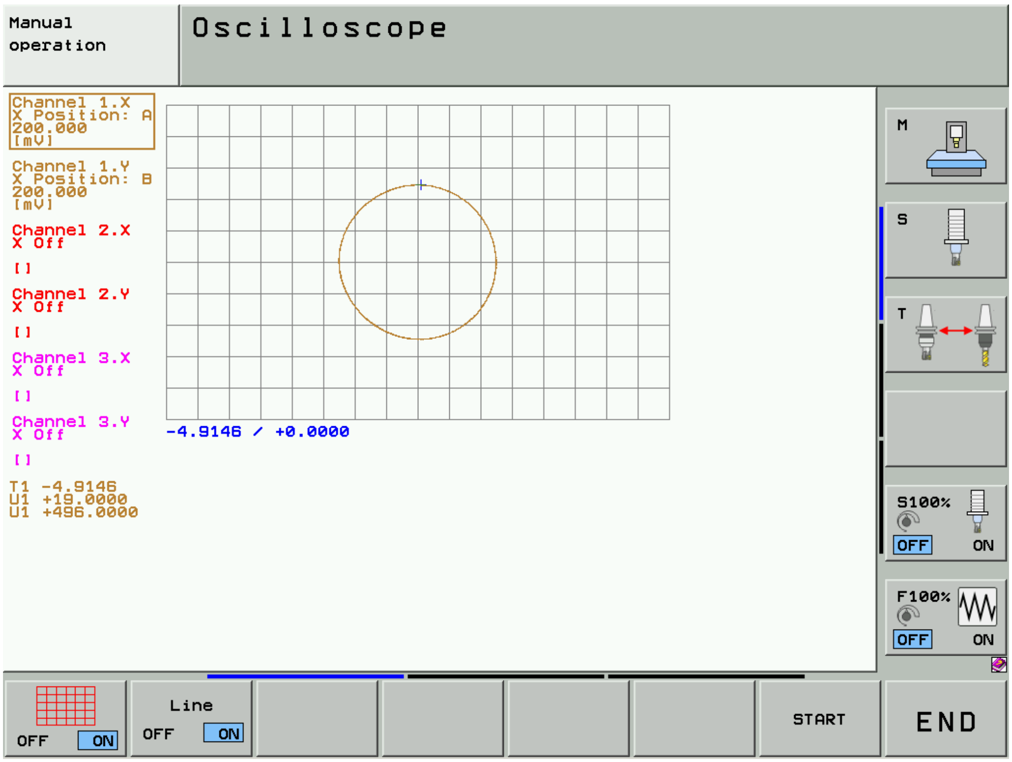
If you find that the sinusoidal signals have an **offset (2.5 V)** and do not correspond to 1 Vpp or 11 µApp, the signals **must** be **converted** using specified formulae.

Current signals 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 the 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.

18.1.6 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., cleaning of 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 manufacturer whether and which information has been written to the EnDat encoder. Ensure that the replacement unit also contains this information!

Failure to do so may result in machine damage or personal injury!

Control

If you have found that the encoder interface on the control is defective:

- Replace the MC or CC. --> See "Exchange of HEIDENHAIN Components" on page 28 – 523.

18.1.7 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.

Caution

The method to define the field angle of the respective axis / spindle is defined by the machine manufacturer.
Follow the instructions of the machine manufacturer!

18.1.8 Resetting the machine datum

As the machine datum (machine reference) refers to the positon 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. 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!

Caution

Setting the machine datum is absolutely essential on most machine tools with 5-axis machining and with tool changers.
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, but have to be reactivated and reset afterwards.
Thus consult the machine manufacturer!
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 MP 7290.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 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

If you traverse 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 MP 910.x. It is also possible that the operator has limited the traverse range even further.)

- Write down the displayed REF value (if necessary, abstract the value defined by the machine manufacturer).
- Invert the REF value displayed (or the result).
- Add this value to the value in MP 960.x for the axis concerned and enter the result.

Example 1: Positioning to the machine datum (e.g., by probing)

A: REF value displayed	-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 MP 960.x	+630.500 mm
F: D + E = **New entry in MP 960.x**	**630.623 mm**

Example 2: Positioning to a reference mark defined by the OEM (e.g., by probing)

A: REF value displayed	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 MP 960.x	+630.500 mm
F: D + E = **New entry in MP 960.x**	**630.623 mm**

- **Check, whether the reset 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 function of the tool changer.
- Set the display to **ACTL**.
- If necessary, instruct the customer to mill a work piece and check it for dimensional accuracy.

Further information --> See “Reference Run” on page 19 – 317.

Gantry axes with two position encoders

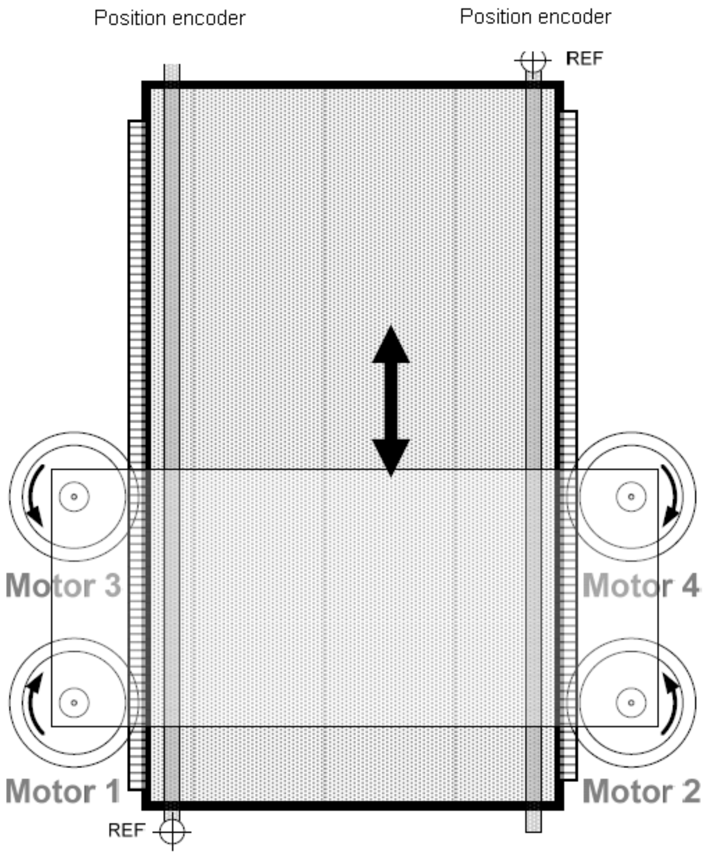


Figure: Example for a combination of gantry and master-slave torque drive

Note

If a position encoder with gantry axes fails, the machine datum remains the same because of the second position encoder.
The MP 960.x for the axis to be reset can be derived from the unchanged axis via the rigidity of the mechanical construction (portal, etc.).

- Always try to mount the encoder as exactly as possible to its original position!
- Ask the machine manufacturer which MP list is active.

Note

If required, machine manufacturers use special MP lists or MP subfiles for the operation of gantry axes, See “Changes by the PLC” on page 30 – 572.

- Set MP 860.x (datum for synchronous control) to 0 for the slave axis.
  --> After the reference marks have been traversed, no compensating motion is made.
- The slave axis must be displayed. Enter the slave axis in MP 7291.x.
- Set the display to **REF**. --> Now you can see the **current actual positions of the axis referenced to the machine datum**.
- Set the position display step in MP 7290.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. These values differ slightly.
- Add the difference of the displayed values to the value entered in MP 960.x for the axis with the remounted encoder.
- Enter the result.

Example 1: New position encoder of the slave axis was remounted.

A: REF value for master axis displayed	500.000 mm
A: REF value for slave axis displayed	500.345 mm
C: Display difference of A and B	+0.345 mm
D: Original entry in MP 960.x for the slave axis	+2000.000 mm
F: C + D = **New entry in MP 960.x**	**2000.345 mm**

Example 2: New position encoder of the master axis was remounted

A: REF value for master axis displayed	499.678 mm
A: REF value for slave axis displayed	500.000 mm
C: Display difference of A and B	+0.322 mm
D: Original entry in MP 960.x for the master axis	+0.000 mm
F: C + D = **New entry in MP 960.x**	**0.322 mm**

- **Check, whether the new axis has been reset correctly (master or slave):**
  If the algebraic sign is wrong, the display difference is twice as large.
  There is no display difference if the calculation is performed correctly (the position values of master and slave axis are equal).
- Reset MP 860.x to the 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 control the geometry of the gantry axes.

- Check the function of the tool changer.
- Set the display to **ACTL**.
- If necessary, instruct the customer to mill a work piece and check it for dimensional accuracy.

Further information --> See “Reference Run” on page 19 – 317.

18.1.9 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

Consult the machine operator and observe the machine manufacturers's safety precautions (setup mode, etc.)!

- Set MP 3430 to zero.
- Run the spindle at low speed.
- Orient the spindle to zero position.

Caution

It is possible that the machine manufacturer has defined several spindle positions. Orient to the spindle zero position which refers to MP 3430!
If necessary, contact the machine manufacturer!

- Observe the position that is established.
- Stop spindle orientation (M5); the spindle must be free to rotate.

DANGER

Press the EMERGENCY STOP key.
It must be ensured that the spindle cannot be switched on!

- Set the display to **REF** --> Now you can read 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 MP 3430 (spindle preset).
- **Check, whether spindle orientation is correct!**
- Set the display to **ACTL**.

Further information --> See “Reference Run” on page 19 – 317.

18.2 Speed Encoders

18.2.1 Introduction

Speed encoders in motors are also referred to as **motor encoders**.
They report positions and movements of the axes and spindles to the control.
iTNC 530 operates with **incremental** and **absolute** encoders.
Encoders with one reference mark or distance-coded reference marks and with EnDat interface are permissible.

Speed encoder inputs

Following **speed encoder inputs** are located on the CC 422 or CC 424 (B):

- **X15 to X20**
- **X80 to X87** (depending on the expansion stage)

Monitoring of rotary encoders

For digital axes the speed encoders are always monitored!

Assignment of speed encoders

MP 100 is read from the right to the left and contains the information which axis is the first, the second, the third axis, etc.

Caution

MP 100 must not be changed!

The inputs of the speed encoders for the CC 422 and the CC 424 (B) are assigned in different machine parameters.

Note

MP 112.x is not active for the CC 424 (B)!
The encoder inputs and PWM outputs are exclusively selected via MP120.x/MP121.x.!
(In the special case that a second spindle is used on a power module, MP 113.x is still applicable).

Assignment of speed encoder inputs in the machine parameters		**Axes**	**Spindles**
CC422	Machine parameter	**MP 112.x**	**MP 113.x**
CC 424 (B)	Machine parameter	**MP 120.x**	**MP 121.x**

Note

CC 422:
As of MP 112.6 (7th axis) the connectors as of X80 can be allocated but not MP 112.0 to MP 112.5.

Assignment of the speed encoder outputs to the drive-control boards of the CC 422	Speed encoder input
1 (main DCB)	X15 - X20
2 (auxiliary DCB)	X80 - X87

Fixed assignment of PWM output and speed encoder input **of the CC 424 (B)**:

Drive-control board of the CC 424 (B)	PWM output (MP120.x/MP121.x)	Speed encoder input
1 (main DCB)	X51	X15
1 (main DCB)	X52	X16
1 (main DCB)	X53	X17
1 (main DCB)	X54	X18
1 (main DCB)	X55	X19
1 (main DCB)	X56	X20
2 (auxiliary DCB)	X57	X80
2 (auxiliary DCB)	X58	X81
2 (auxiliary DCB)	X59	X82
2 (auxiliary DCB)	X60	X83
2 (auxiliary DCB)	X61	X84
2 (auxiliary DCB)	X62	X85
2 (auxiliary DCB)	X63	X86
2 (auxiliary DCB)	X64	X87

Note

On the CC 424 (B) with 8 and with 14 control loops, X57/X80 und X58/X81 are still located on the main DCB.

EnDat encoders

All speed encoder inputs operate with **1 Vpp** and are **EnDat-compatible**.

Memory areas in the EnDat encoder

Motor encoders with EnDat interface can feature a so-called **electronic ID label**. It contains the **motor data**, such as device name, ID number, serial number, etc.

Furthermore, the machine manufacturer has the possibility of storing **machine or system-specific data**.

Temperature sensor lines

The signal cable for the motor encoder also includes the **temperature sensor lines of the motor**.

Polyfuses

Note

Current CCs feature so-called **"Polyfuses"**. These are electronic fuses that separate defective peripheral devices from the low voltages in the control in the event of an error. This is also true for the encoders!

If a defective encoder draws too much current, it is "separated" from the control component. Corresponding error messages are displayed.

Different servicing

Caution

The service on the CC 422 and CC 424 (B) is different.
Ensure to use the correct instructions!

18.2.2 Possible causes of errors

- 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
- Interface on the control defective

18.2.3 Trouble shooting on the CC 422

To find out, whether **the connected encoder** or **the interface of the control** is defective, the interchange method can be used. Use the interface of a working axis for this purpose.

Caution

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

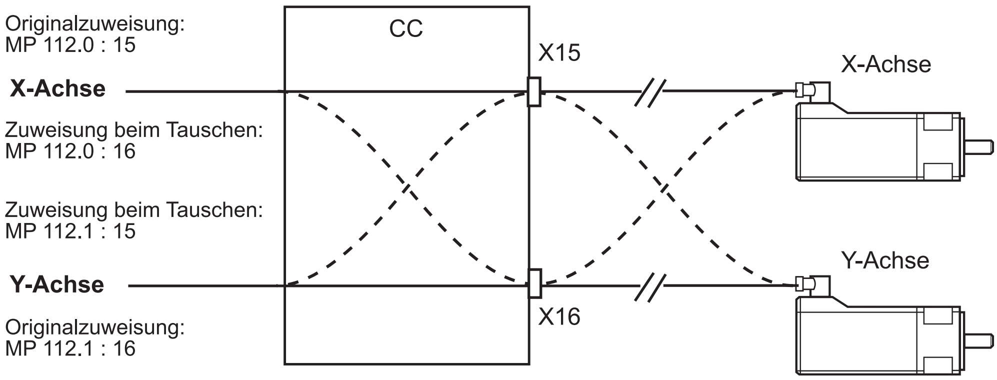
Example

Error in X-axis

Example machine parameters

MP 100.x = CZYX (X = 1st axis, Y = 2nd axis, Z = 3rd axis, C = 4th axis)
MP 112.0 = 15 (X-axis at X15 input)
MP 112.1 = 16 (Y-axis at X16 input)
MP 112.2 = 17 (Z-axis at X17 input)
MP 112.3 = 18 (C-axis at X18 input)

Block diagram



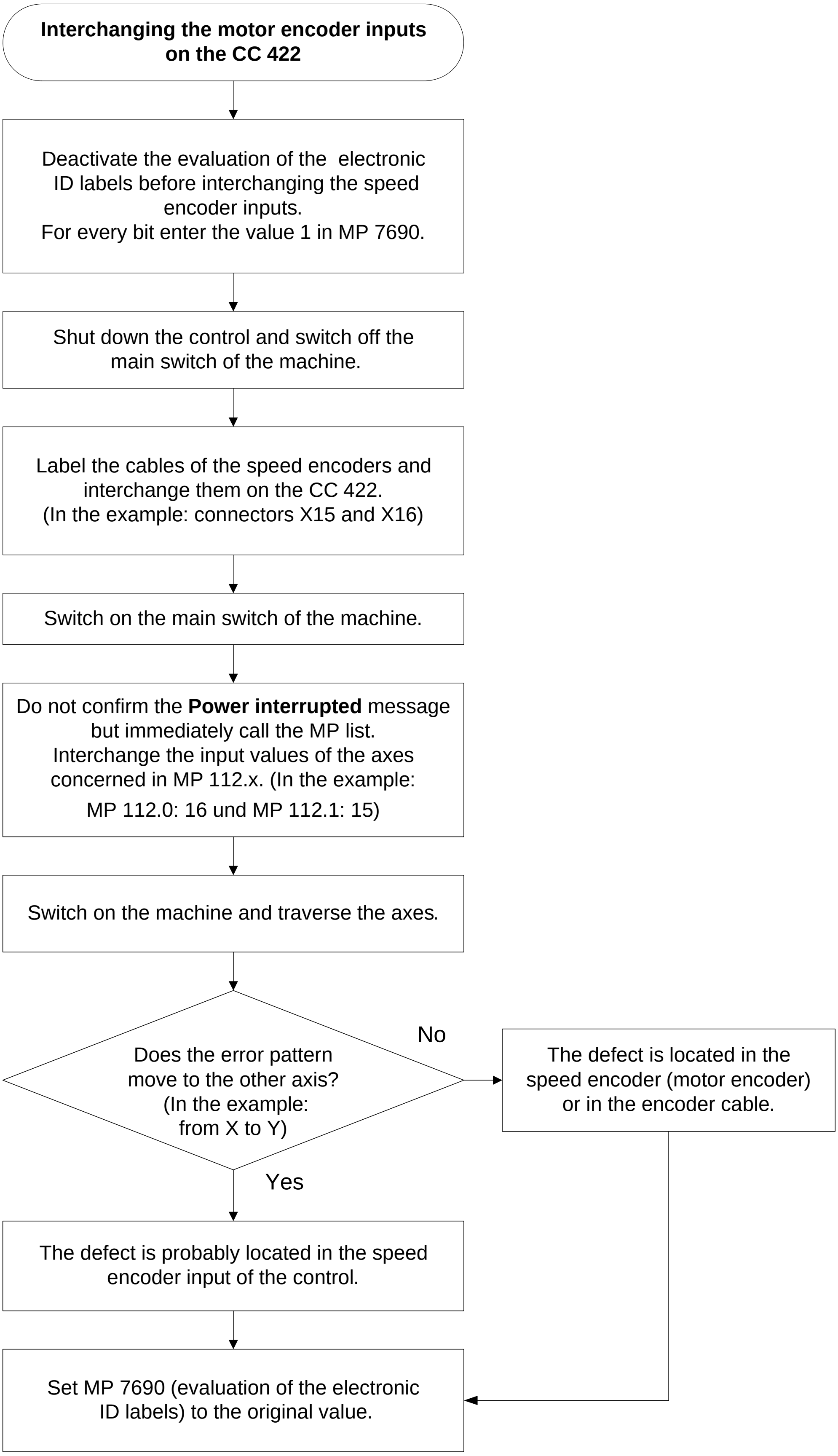
Note

Always switch both the cable and the interface assignment by machine parameter!

Note

Encoders can only be switched within the main DCB and the auxiliary DCB!
Master and slave axes must always be connected to the same drive-control board.

Flowchart



Interchanging the motor encoder inputs on the CC 422
Deactivate the evaluation of the electronic ID labels before interchanging the speed encoder inputs.
For every bit enter the value 1 in MP 7690.
Shut down the control and switch off the main switch of the machine.
Label the cables of the speed encoders and interchange them on the CC 422.
(In the example: connectors X15 and X16)
Switch on the main switch of the machine.
Do not confirm the **Power interrupted** message but immediately call the MP list.
Interchange the input values of the axes concerned in MP 112.x. (In the example:
MP 112.0: 16 und MP 112.1: 15)
Switch on the machine and traverse the axes.
Does the error pattern move to the other axis? (In the example: from X to Y)
No
The defect is located in the speed encoder (motor encoder) or in the encoder cable.
Yes
The defect is probably located in the speed encoder input of the control.
Set MP 7690 (evaluation of the electronic ID labels) to the original value.

18.2.4 Trouble shooting on the CC 424 (B)

To find out, whether **the connected encoder** or **the interface of the control** is defective, the interchange method can be used. Use the interface of a working axis for this purpose.

Caution

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

Example

Error in X-axis

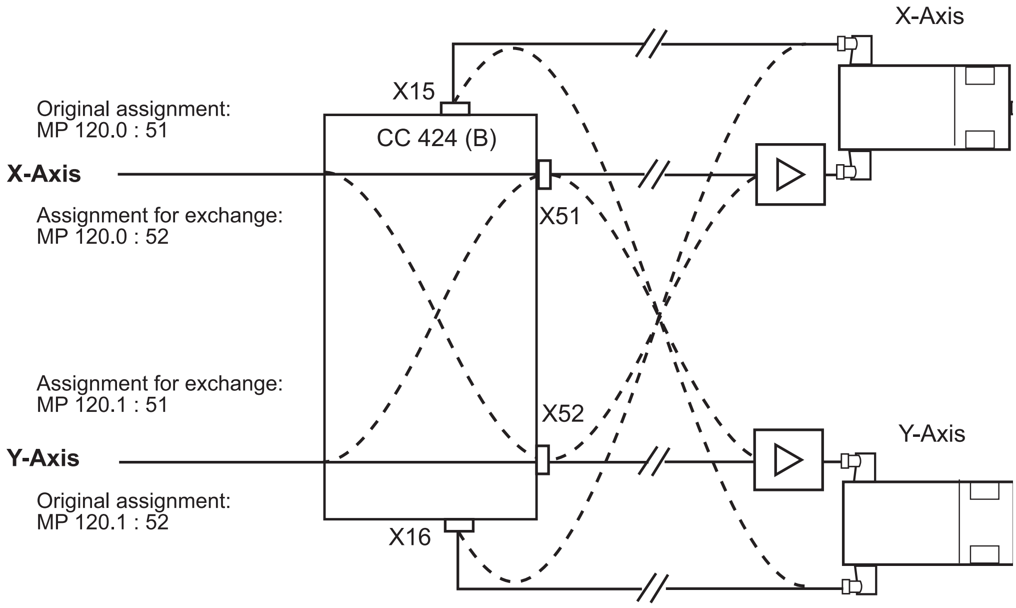
Example machine parameters

MP 100.x = CZYX (X = 1st axis, Y = 2nd axis, Z = 3rd axis, C = 4th axis)
MP 120.0 = 51 (X-axis on PWM output X51 and speed input X15)
MP 120.1 = 52 (Y-axis on PWM output X52 and speed input X16)
MP 120.2 = 53 (Z-axis on PWM output X53 and speed input X17)
MP 120.3 = 54 (C-axis on PWM output X54 and speed input X18)

Notes and preliminary action

- Use the motor encoder input of a functioning axis.
  (The firmly assigned PWM output must be connected as unassigned PWM outputs might not be active, depending on so-called single-speed and double-speed outputs.)
- Encoders can only be switched within the main DCB and the auxiliary DCB!
- **The firmly assigned PWM output must also be exchanged!**
- Axes in master-slave torque control are only permitted at X15/X17 or X16/X18.
  When using a CC 424 (B) with 8 and 14 control loops starting with NC software 34049x-03, master-slave torque axes also function on X19/X80 or X20/X81.
- The **same PWM frequency** must be set for the axes to be switched!

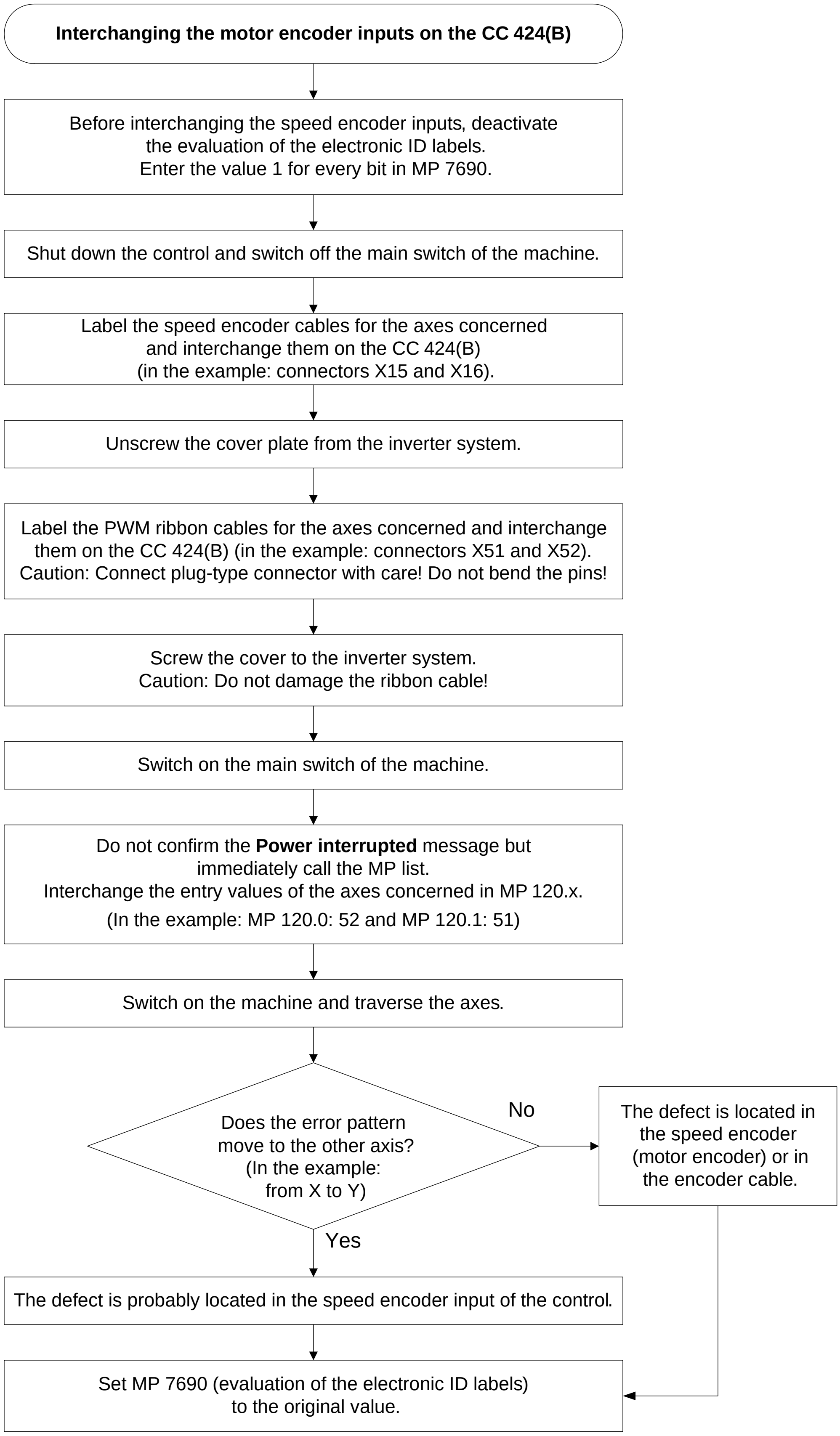
Block diagram



Note

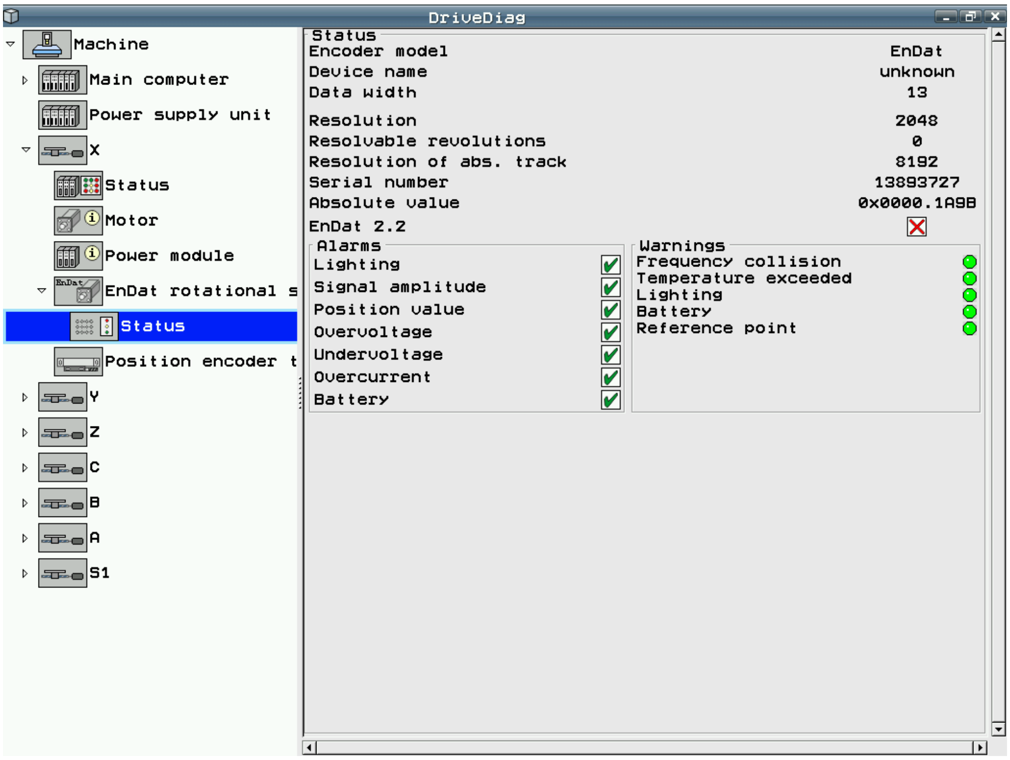
Always switch both the cable and the interface assignment by machine parameter!

Flowchart


Interchanging the motor encoder inputs on the CC 424(B)
Before interchanging the speed encoder inputs, deactivate the evaluation of the electronic ID labels. Enter the value 1 for every bit in MP 7690.
Shut down the control and switch off the main switch of the machine.
Label the speed encoder cables for the axes concerned and interchange them on the CC 424(B) (in the example: connectors X15 and X16).
Unscrew the cover plate from the inverter system.
Label the PWM ribbon cables for the axes concerned and interchange them on the CC 424(B) (in the example: connectors X51 and X52). Caution: Connect plug-type connector with care! Do not bend the pins!
Screw the cover to the inverter system. Caution: Do not damage the ribbon cable!
Switch on the main switch of the machine.
Do not confirm the Power interrupted message but immediately call the MP list. Interchange the entry values of the axes concerned in MP 120.x. (In the example: MP 120.0: 52 and MP 120.1: 51)
Switch on the machine and traverse the axes.
Does the error pattern move to the other axis? (In the example: from X to Y)
No
The defect is located in the speed encoder (motor encoder) or in the encoder cable.
Yes
The defect is probably located in the speed encoder input of the control.
Set MP 7690 (evaluation of the electronic ID labels) to the original value.

18.2.5 Possibilities with the integrated diagnosis or DriveDiag

On the info screen "EnDat rotational speed encoder" you can see, whether alarm bits are set:



Calling the screen. --> See “Integrated Diagnostic Functions and DriveDiag” on page 9 – 89.

18.2.6 Possibilities with the integrated oscilloscope

As of NC software version 34049x-04 in combination with the CC 424 (B), the incremental signals (A, B) can be recorded with the integrated oscilloscope.

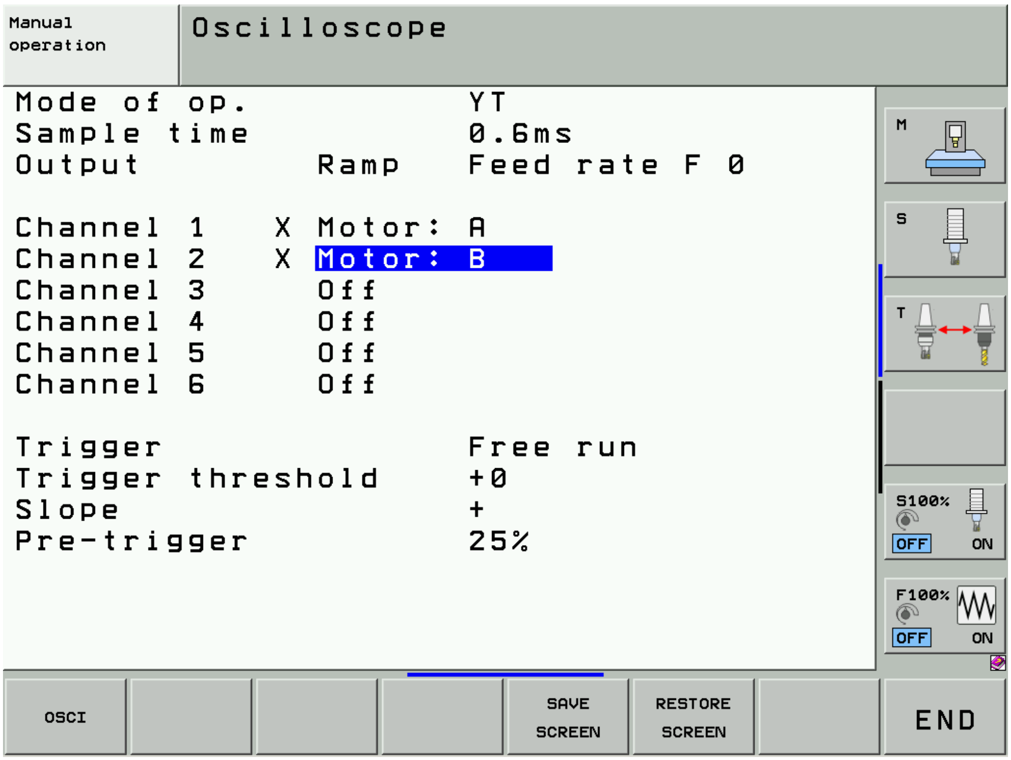
Activation and operation --> See "Integrated Oscilloscope" on page 10 – 99.

Note

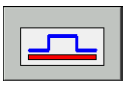
Reference signals and EnDat signals cannot be displayed!
A phase angle measuring unit should be used for an accurate tracing of the signals (e.g., PWM 9)!

Example for an oscilloscope recording of motor encoder signals:

- Make the following settings:

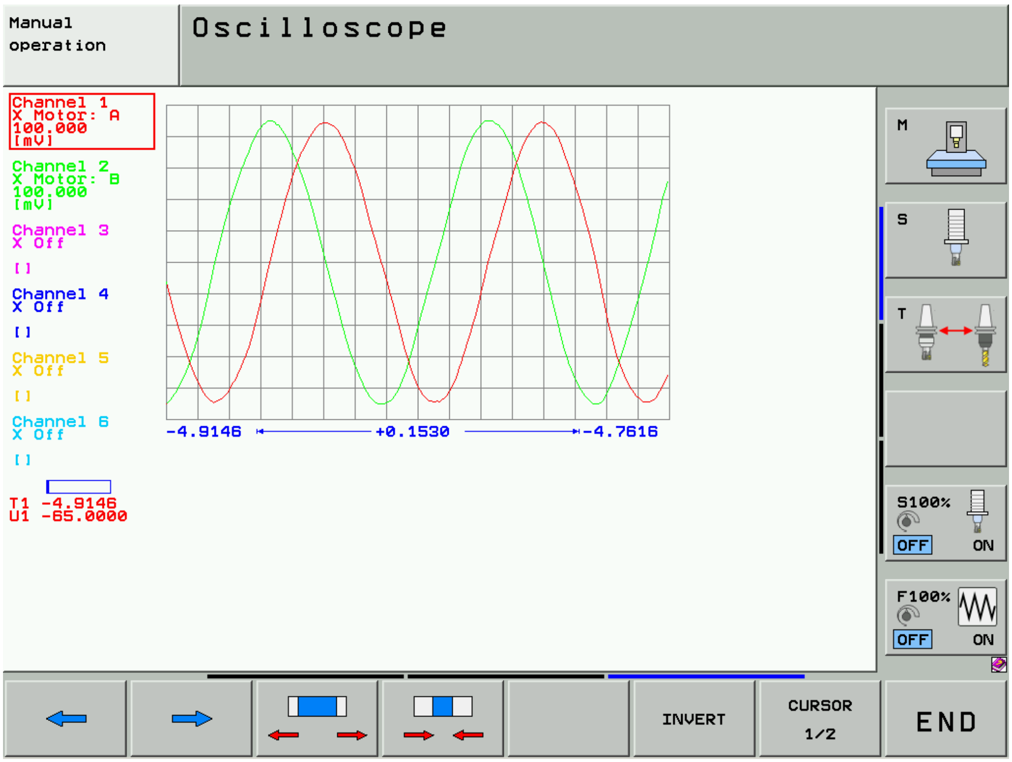


- Move the X-axis at very low speed in the manual mode.
- Start the oscilloscope recording.
- Stop recording.



- Adapt the signals under consideration of the zero line.

- Adapt the time axis for a more detailed representation.

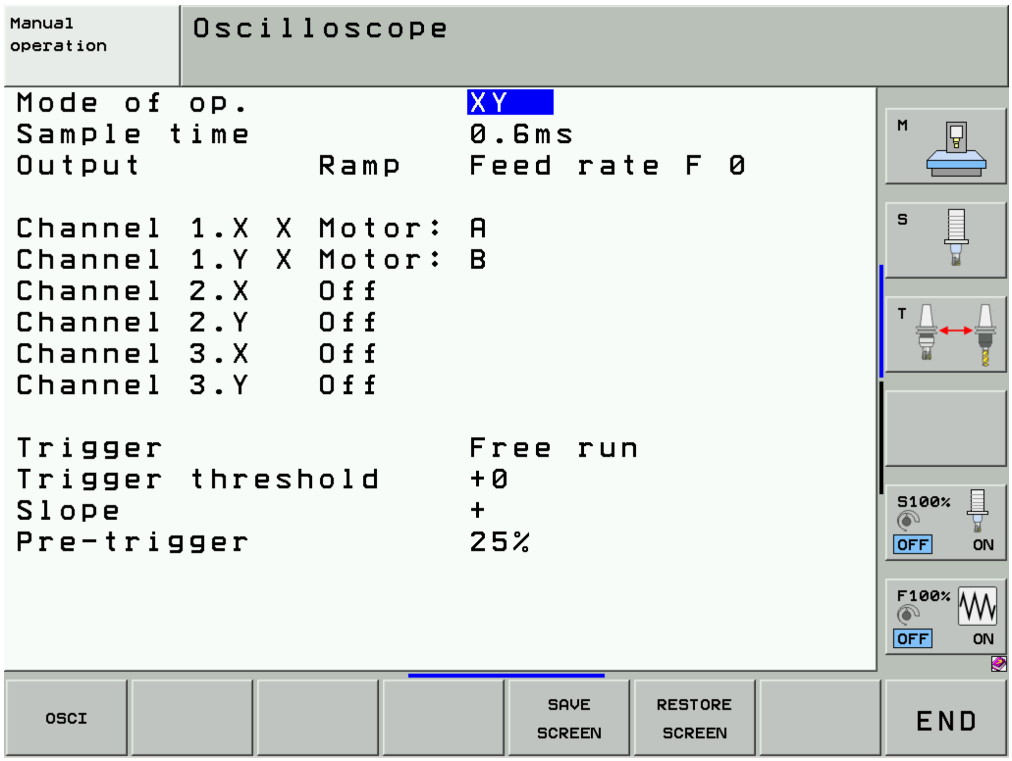


A and B signal must be of equal size and move symmetrically around the same vertical axis **(no vertical offset)!**

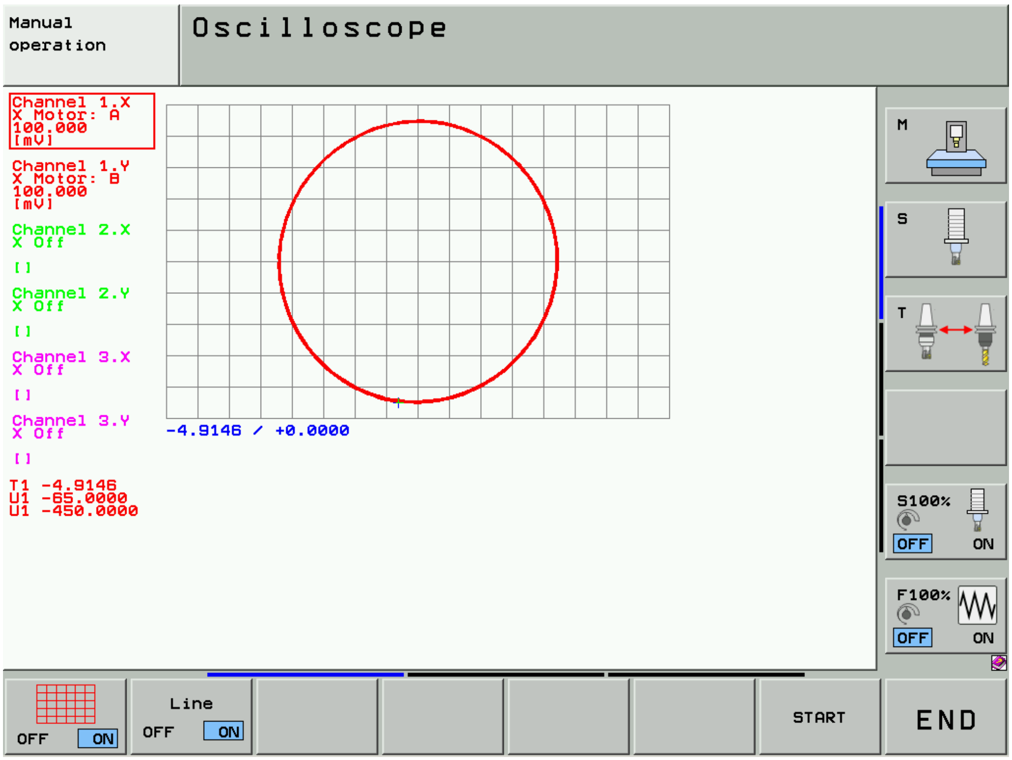
The **90° offset of the A and B-signal** on the horizontal axis can be clearly seen.

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 the signal evaluation is correct, a circle will be displayed!

18.2.7 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!

Caution

Motor encoders in synchronous motors must be adjusted to a certain position.
The **adjustment** is made by the motor manufacturer.

In addition, new motors can have an **electronic ID label**. This electronic ID label for the motor is stored in the EnDat motor encoder. When exchanging the motor encoder, the electronic ID label must be written again.
This is done by 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 manufacturer whether and which information has been written to the EnDat encoder. Ensure 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).

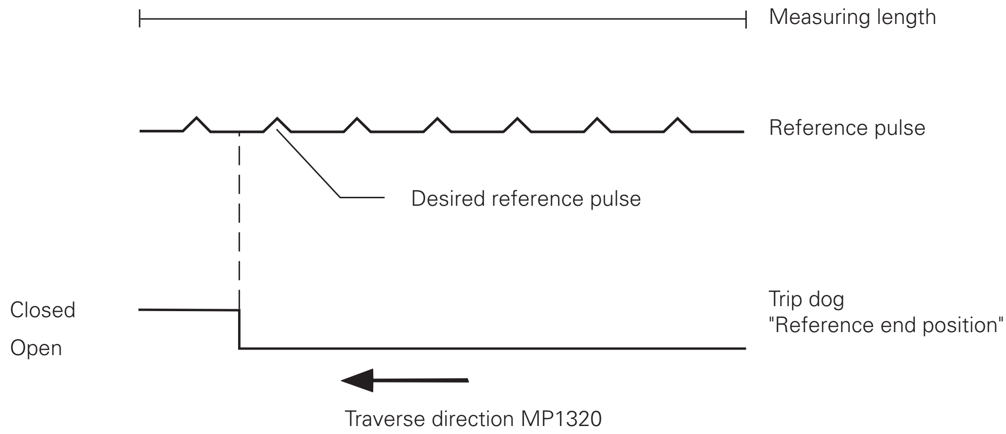
Control

If you have found out that the motor encoder interface on the control is defective:

- Replace the CC. --> See "Exchange of the CC" on page 28 – 551.

18.2.8 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 evaluted when the machine is switched on, a trigger signal is used (PLC input).
The trigger signal should be at the corrcect axis position, as precisely as possible 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**. --> Now you can see the **current actual position of the axis referenced to the machine datum**.
- Reference the axis concerned at a low speed of the remounted motor.
- Read the display and compare the value for this axis with the value in MP 960.x.
- Position the axis with M91 to the value of MP 960.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 18 – 306.)
  Ask the machine operator.
- Starting from this point, position the axis with M91 by half the value in MP 1054.x (linear distance of one motor revolution) in the traverse direction specified in MP 1320.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 MP 910.x. It is also possible that the operator has 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 oscillscope 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 Set" on page 29 – 566

Further information --> See "Reference Run" on page 19 – 317.

18.2.9 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 18 – 288.

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 have been made to the position encoder!)

DANGER

Ask the machine manufacturer for the reason why a double reference run of the machine axis was configured! It is possible that the double reference run is used for avoiding a collision. Follow the **instructions of the machine manufacturer** for readjusting the double reference run!

General procedure:

- Reset MP 1355.x for the respective axis to 1 (= double reference run) and MP 1356.x (distance between speed and position encoder for double reference run) to 0.
- Reboot the control.
- Confirm the position report of the EnDat motor encoder.
- You may have to expand the traverse range.
- Move slowly and carefully over the reference mark of the position encoder.
- Now the message **`Set MP 1356.x to <value>`** appears.
- Note down this value.
- Enter this value in MP 1356.x.
- Reset the traverse range to the original value.
- **Test the entire reference run of the machine again!**

Further information --> See “Reference Run” on page 19 – 317.

18.2.10 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 18 – 292.

18.3 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 add themselves together.

There are two possible 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
0x00008000	Reserved

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

18.4 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 following HEIDENHAIN measuring equipment 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 Set" on page 29 – 566.

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.
This could lead to damage or injury to the machine or persons!
Read the **operating manual** of the PWM 9 in detail, before you use the device.

Photo: Example of a recording with the PWM 9

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 Testing Unit" on page 29 – 568.

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 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

Each **PWT** is delivered with **operating instructions**.

Photo: Example of a recording with the PWT 18:
A scale (1 Vpp) is connected to the PWT 18 with the signal cable and the adapter connector ID 324555-01. The axis is traversed by a motor encoder with indirect path measurement (See "Position Measurement via Motor Encoder (Indirect Position Measurement)" on page 18 – 311).

IK 215 Use the IK 215 interface card for inspecting and testing an EnDat encoder. --> See “IK 215 Adjusting and Testing Package” on page 29 – 570

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.
This could lead to damage or injury to the machine or persons!
Read the **operating instructions** of the IK 215 in detail, before you use the unit.

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.

18.5 Position Measurement via Motor Encoder (Indirect Position Measurement)

Switching position measurement from the linear encoder to the motor encoder may be helpful to ...

- **Facilitate dismounting of a defective position encoder**
  (e.g. if the axis is at a position in which you cannot dismount the scale)
- **Analyze errors in the control loop**
  (See "Error Localization by Switching from Direct to Indirect Position Measurement" on page 6 – 70)
- **Analyze the quality of the encoder signals from the position encoder with a PWT**
  (See "Further Examination of Position and Speed Encoders" on page 18 – 308)

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 to work with the machine tool!

Reasons:

- No reference point for the axis concerned is evaluated.
  You could move to the limit switches or the mechanical stops.
  An 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** (MP 210.x) or the **sign of the nominal speed value** (MP 1040.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.

Furthermore, an automatic **plausibility test** for the MP 1040.x (algebraic sign of the nominal speed value) has been introduced with the NC software version 34049x-02 in combination with a CC 424 (B). Error message `Incorrect entry in MP 1040.x` states that MP 1040 must now be inverted.

For older software versions and the use of CC 422 it is recommended ...

- to check the tolerance limits for the monitoring of following error, movement and standstill and to reduce the set values, if necessary (See "Annex: Monitoring Functions" on page 3 – 661).
- to reduce the kv factor for the position control loop (MP 1510.x, MP 1810.x).
- to reduce the proportional factor (MP 2500.x) and the integral factor (MP 2510.x) of the speed controller equally.

Contact your machine tool builder.

DANGER

Always secure vertical axes to prevent them from falling down before you switch to position capture via motor encoder!

With axes with **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 with master-slave torque control” on page 18 – 314.

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 axis can also be operated with only one drive ("service function", e.g., a portal is only moved with one drive).

Note

Please clarify with the machine tool builder, whether the axis concerned is operated as individual axis, with master-slave torque control, as gantry axis or gantry axis with master-slave torque control!

Preliminary action

- A defective scale or scanning head or a defective encoder cable could influence the low voltages of the control. This could affect the overall function!
  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 (not in the original MP list)!
- You may have to expand the traverse range limits.
  This is done in the machine parameters MP 910.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.

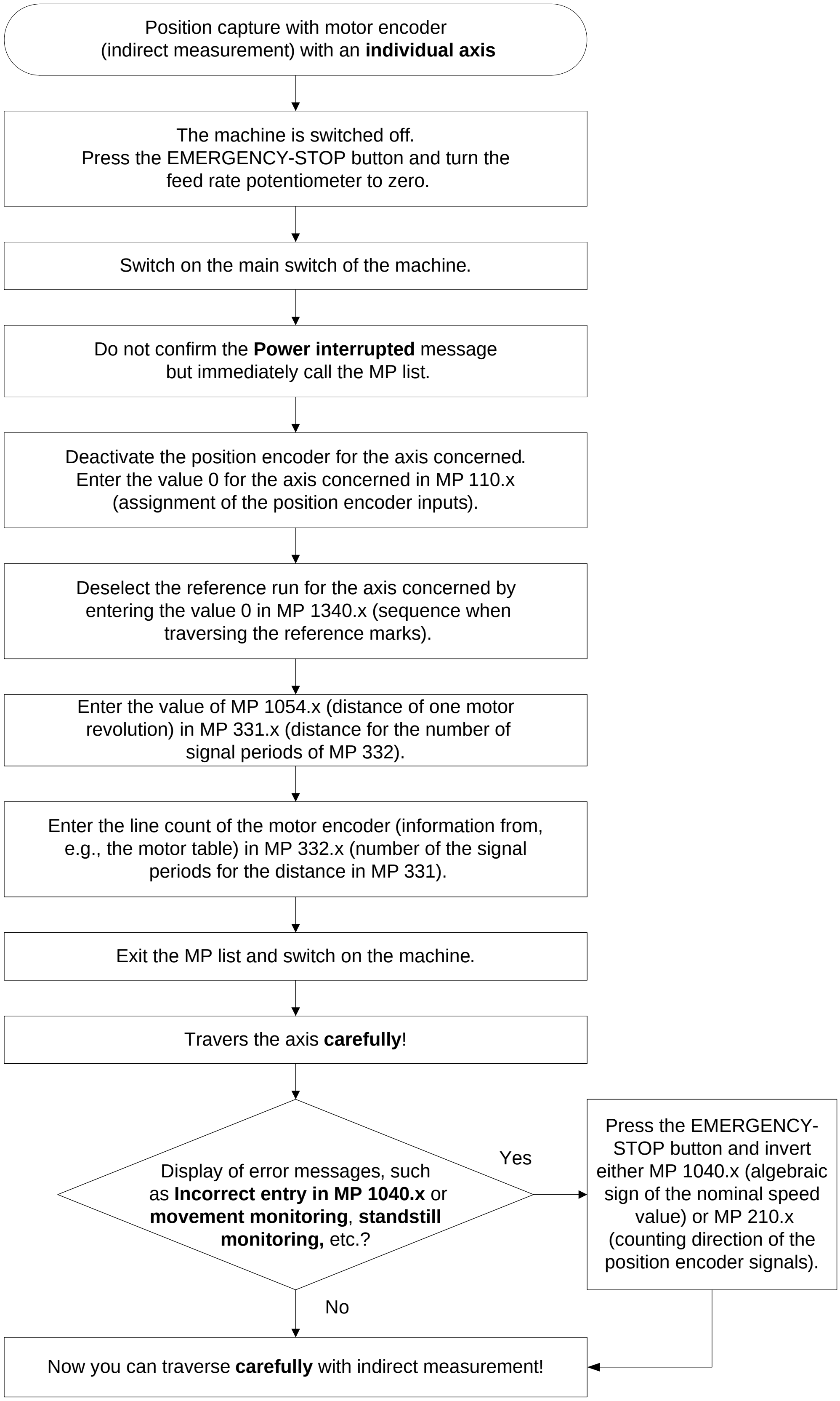
Line count of the motor encoder

For traverse with indirect position measurement the line count of the encoder must be known.

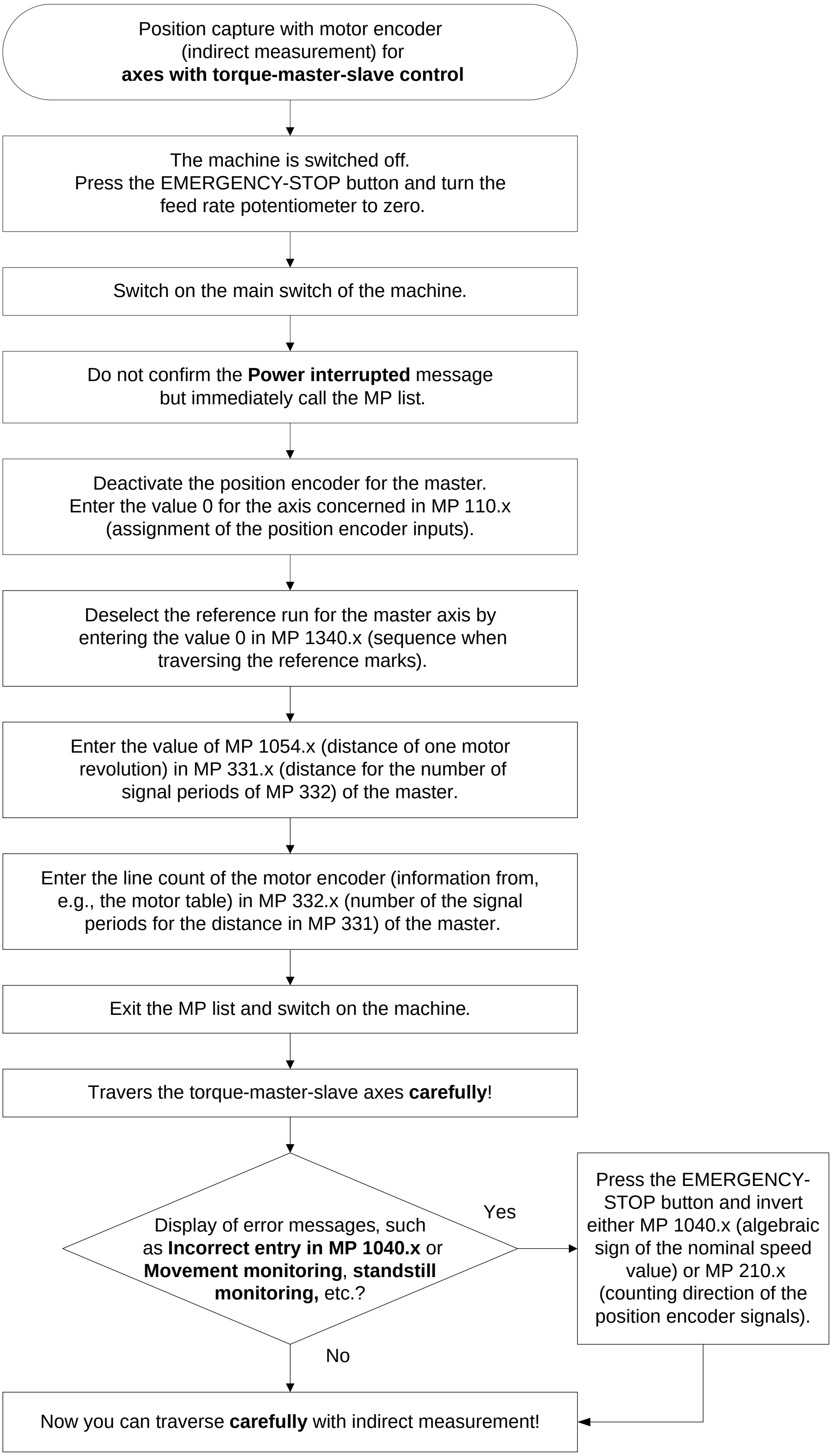
The motor table contains this information:

- Call the machine parameter list.
- Place the cursor on MP 2200.x for the motor concerned.
- Switch to the next soft-key row.
- Press the soft key with the motor symbol.
- Now press the SHOW ACTIVE 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).

Flowchart for individual axis



Flowchart for axes with master-slave torque control



18.6 Switching over the Position Display for Servicing

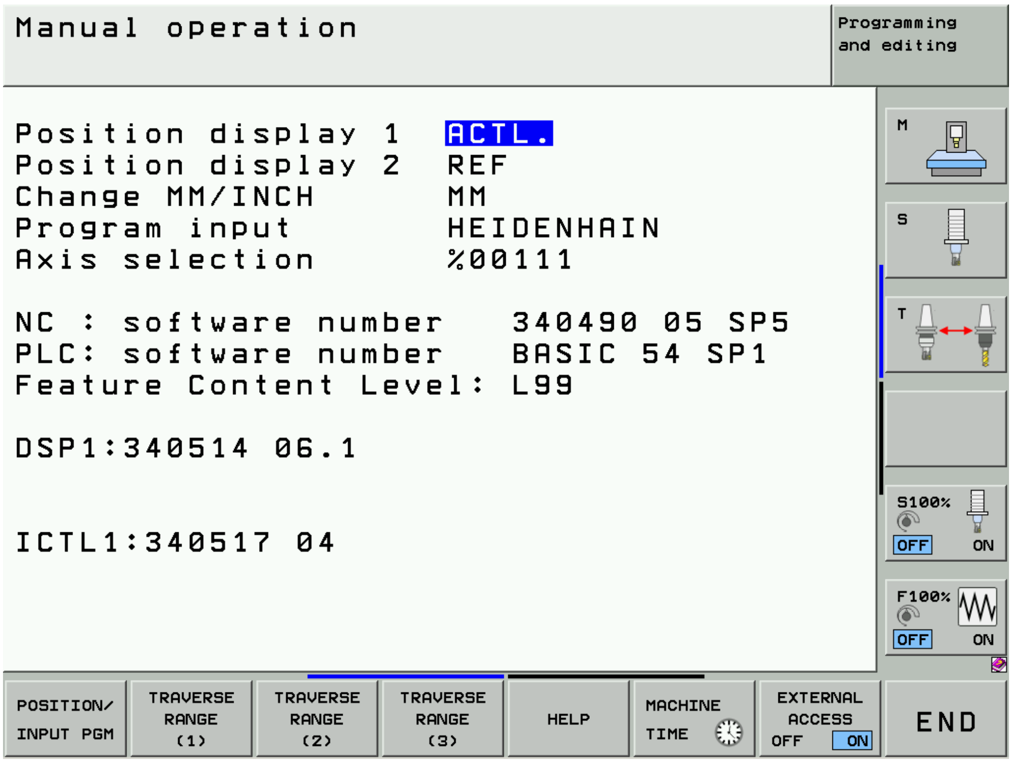
When servicing it is often important to switch over the position display (e.g., to **REF** when resetting the machine datum).

Call

- 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.

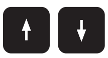


- Press GOTO. --> A selection window is opened.

Description of the settings

Possible position displays:

ACTL.	Actual position
REF	Distance to machine datum
LAG	Current following error
SOLL	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 window.

19 Reference Run

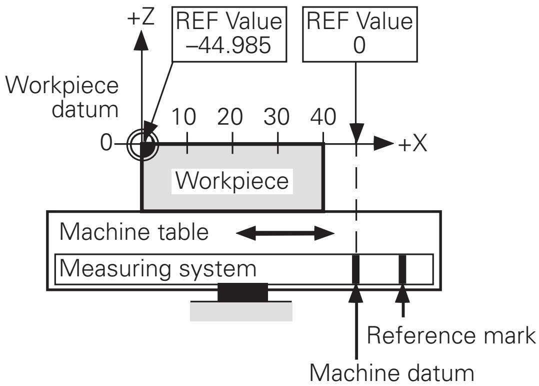
19.1 Definition

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. When the machine is switched off, the reference between the axis position and the position value is lost.

Reference marks

HEIDENHAIN linear encoders (except EnDat) are designed with 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 mark of your machine tool.
It is defined by the machine tool builder.
The machine datum is required for ...

- Defining the limits of traverse (software limit switches)
- Moving to machine-referenced positions (such as tool change positions)
- Setting the workpiece datum

Distance between the scale reference point and the machinedatum

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.

- **MP 960.x** contains the distance between scale reference point and machine datum.

Note

After removing and remounting a measuring system MP 960.x may have to be altered. See “Resetting the machine datum” on page 18 – 288.

Spindle preset

A corresponding angle encoder or also the motor encoder in the spindle motor may be used for spindle orientation.

- **MP 3430.x** contains the deviation of the reference mark from the desired position.

19.2 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 MP 960.x.

19.3 Possible Causes of Errors

The causes of error of encoders also apply here. --> See "Possible causes of errors" on page 18 – 279; See "Possible causes of errors" on page 18 – 279.

Especially for the referencing, the following causes of error are possible:

- Defective trip dog
  (the reference end position is not recognized)
- Switch signal of the trip dog is too close to the reference pulse
  (During reference run via the motor encoder --> The reference mark signal is recognized too early or too late but not at the requested axis position.)

With old position encoders:

- Magnet inside or outside scale housing shifted or defective
  (wrong or no reference mark is evaluated)
- Ref. mark selector plate shifted
  (inside the scale housing, at the position of the ref. mark label outside the scale housing)
- Removed or damaged enamel
  (On some scales the ref. marks were deactivated with enamel; if it is removed by cleaning with unsuitable cleaning agents and equipment, these marks are "reactivated".)

19.4 Troubleshooting

Examining the encoders

- See "Encoder Interface" on page 18 – 277.

Examining the reference mark

- See "Further Examination of Position and Speed Encoders" on page 18 – 308.

Examining the switch signal of the trip dog

- Move the axis to the presumed position of the trip dog.
- Ask the machine manufacturer for the PLC input for the switch signal.
- Observe the switch signal, e.g. in the integrated oscillocope or in the PLC logic diagram.

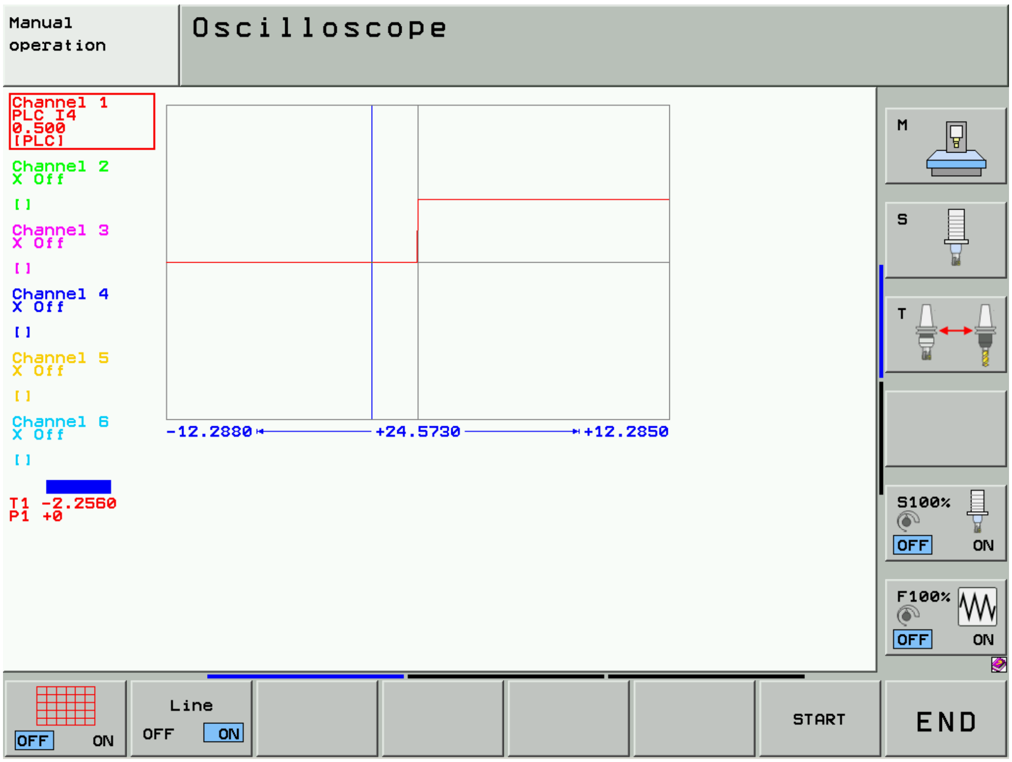


Figure: Switch signal of the trip dog in the integrated oscilloscope

19.5 Corrective Action

- Repair the trip dogs.
- Replace the encoder, See “Encoder Interface” on page 18 – 277.
- Readjust shifted magnet or replace damaged magnet. Do not forget spacer plates (filler pieces)!
- Readjust shifted ref. mark selector plate.
  Use a special slider. --> Ask a HEIDENHAIN service agency!
- Have the removed or damaged enamel repainted. --> Ask a HEIDENHAIN service agency!
- Adjust the trip dogs relative to the motor encoder ref. pulse. --> See “Readjusting the trip dog for reference end position” on page 18 – 305.

19.6 Deselecting the Reference Run for Axes

For axis examinations it is possible to deselect the referencing in **MP 1340.x** .

▶ Enter value 0 (= no evaluation of the reference mark) for the corresponding axis or for all axes.

Note

In MP1340.x the **sequence for the reference mark run** is listed.

With following entries, i.e.:

- 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 must enter MP1340.2 = 0!

However, the reference run is normally deselected for all axes.

19.7 Retraction after an Error with Control Reset

General information

> **DANGER**
>
> **It is the machine operator's task to retract the tool!**
> If you have any questions, contact the machine manufacturer!

- The sequence of the axes to be referenced can be defined by the operator if the machine manufacturer permits the axes to be moved with the external axis direction keys.
- If necessary, the referencing can also be deselected, See “Deselecting the Reference Run for Axes” on page 19 – 320.

Tilted axes

If the tool is tilted, it should be retracted in the respective angular position.

As of NC software version 34049x-02 with feature content level L2 it is possible to define the current tool axis direction as the only traverse direction:

> **Note**
>
> The manufacturer can enable this function in MP 7503 with value 1.

- Perform a warm or cold start of the control.
- Acknowledge the `Power interrupted` message. --> The message `Relay ext. dc voltage missing` is displayed.
- Press the button Control ON.

- Press the 3-D ROT soft key and a new window `Tilt the Working Plane` appears.
- Place the cursor on the line `Manual operation`.

- Press the TOOL AXIS soft key.

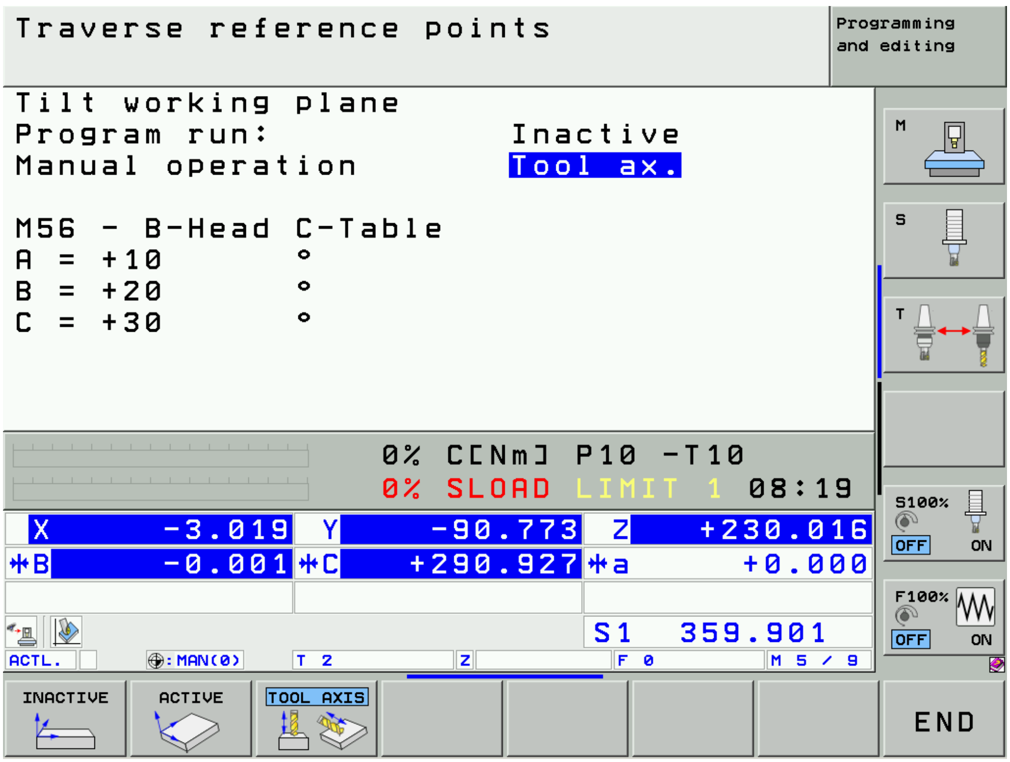
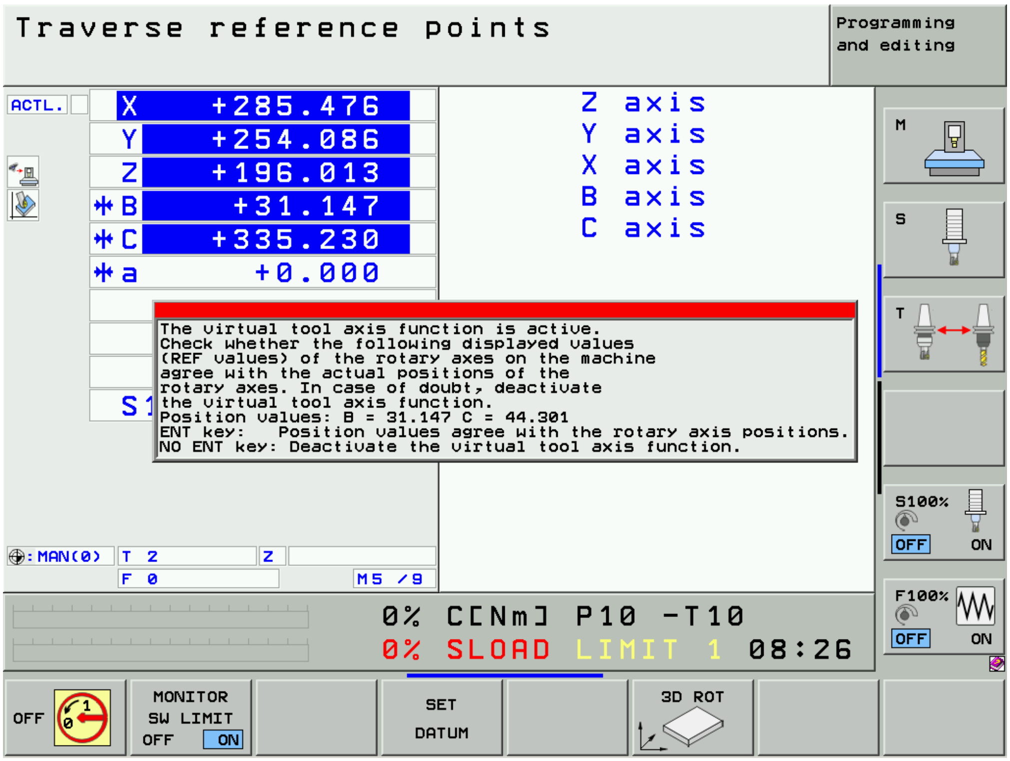


Figure: Setting the tool axis for retracting in a tilted system

- Use the END soft key to exit the page.
- Read the following informational text carefully and press ENT or NO ENT.



Note

The last position of the rotary axes before power-off is stored in non-volatile memory for incremental encoders. These non-volatilely stored axis values are shown in a pop-up window when 3D ROT / TOOL AXIS is called before referencing, and must be acknowledged by the machine operator with ENT (confirmation of the values) or NO ENT (values deviate, reference run must be performed first).
Starting with NC software version 340 49x-04, handwheel superimposed traverse in the active tool axis system (Virtual Tool Axis VT) is now also possible when the TCPM is active.
--> Ask the machine operator or the machine manufacturer.

DANGER

The machine axes must not have been moved after the error with control reset has occured!

DANGER

It depends on the tool used (e.g., tap) whether a retraction is possible.

- If you have acknowledged the position values of the axes, you can retract the tool axis (e.g., Z axis) in a tilted system.
  Please proceed **carefully**!

20 Interface to the Drives

20.1 Digital PWM Interface

20.1.1 Introduction

The position, speed and current controllers are located in the HEIDENHAIN control.
The "result" of the position, speed and current control is pulse-width modulated.
Via **PWM interfaces** (PWM = pulse-width-modulation) digital servo amplifiers are controlled.

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

Following **PWM interfaces** are located on the CC 422 or CC 424 (B)
(every digital axis/spindle has its own PWM ribbon-cable connector):

- **X51 to X56**
- **X57 to X64** (depending on the expansion stage)

Assignment of the PWM outputs

MP 100 is read from the right to the left and contains the information which axis is the first, the second, the third axis, etc.

Caution

MP 100 must not be changed!

Assignment of the PWM outputs in the machine parameters	Axes	Spindles
Machine parameters	**MP 120.x**	**MP 121.x**

Note

The connectors as of X57 can be assigned as of MP 120.6 (7th axis), but not those before!

Assignment of the PWM outputs to the drive-control boards of the CC 422	PWM output
1 (main DCB)	X51 - X56
2 (auxiliary DCB)	X57 - X62

Fixed assignment of PWM output and speed encoder input **of the CC 424 (B)**:

Drive-control board of the CC 424 (B)	PWM output (MP120.x/MP121.x)	Speed encoder input
1 (main DCB)	X51	X15
1 (main DCB)	X52	X16
1 (main DCB)	X53	X17
1 (main DCB)	X54	X18
1 (main DCB)	X55	X19
1 (main DCB)	X56	X20
2 (auxiliary DCB)	X57	X80
2 (auxiliary DCB)	X58	X81
2 (auxiliary DCB)	X59	X82
2 (auxiliary DCB)	X60	X83
2 (auxiliary DCB)	X61	X84
2 (auxiliary DCB)	X62	X85
2 (auxiliary DCB)	X63	X86
2 (auxiliary DCB)	X64	X87

Note

On the CC 424 (B) with 8 and with 14 control loops, X57/X80 und X58/X81 are still located on the main DCB.

PWM frequency

On the CC 422 higher PWM frequencies (> 5000 Hz) can be set for controller groups with **MP 2180.x**. This means, that not all PWM outputs of a controller group can be used.
With the respective configuration **individual PWM outputs are not active!**

Different PWM frequencies in **MP 2180.x** can be assigned also to the CC 424 (B).

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 und 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.

With the respective configuration **individual PWM outputs are not active!**

Single and double-speed control loops

With CC 424 (B) 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 controller cycle times.
If **double-speed control loops are configured** on a CC 424 (B), **several PWM outputs or motor outputs are not active**, since in this case the DSP (digital signal processor) only requires one double-speed channel instead of two single speed channels.

Power supply modules, power stages and motors

Assignment in the machine parameters	Supply modules	Power modules	Motors
Machine parameters	**MP 2198.x**	**MP 2100.x**	**MP 2200.x**

Different servicing

Caution

The service on the CC 424 and CC 422 (B) is different.
Ensure to use the correct instructions!

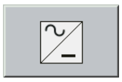
20.1.2 Tables for power supply modules, power stages and motors

Via the name of the power supply module (MP 2198.x), the power stage used (MP 2100.x) and the motor (MP 2200.x), the control can access the values in the respective power supply module, power stage and motor tables.

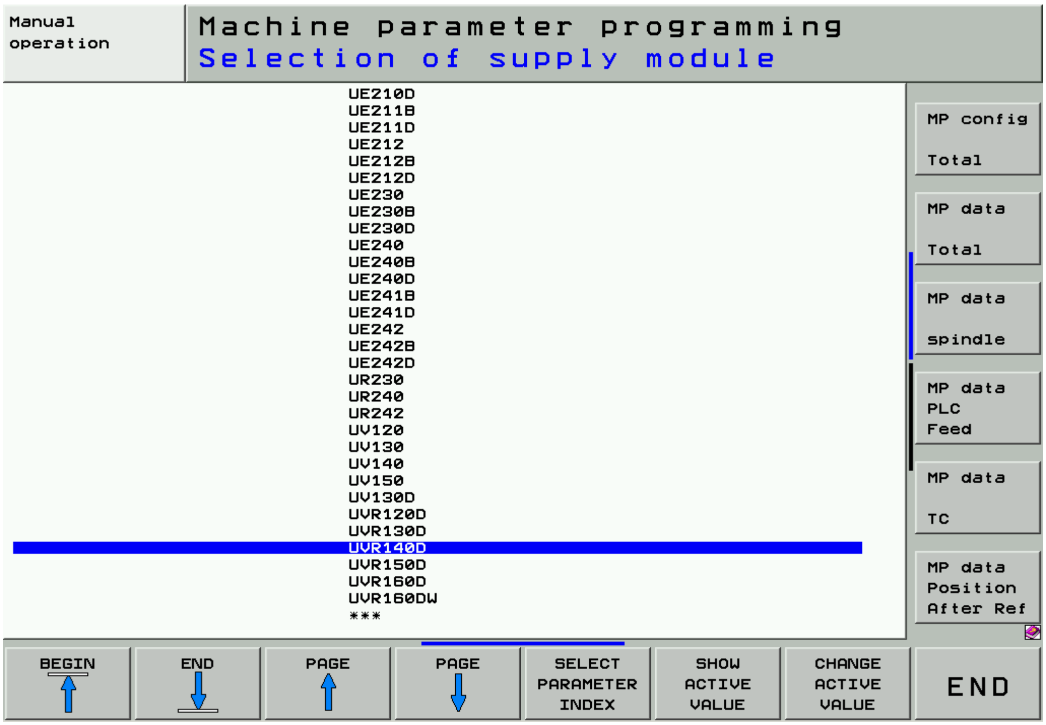
How to access the tables:

Table of power supply modules

- Open the machine parameter list.
- Place the cursor on the respective power supply module (e.g.,GOTO2198).
- 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 power supply modules of various manufacturers as well as HEIDENHAIN compact inverters.

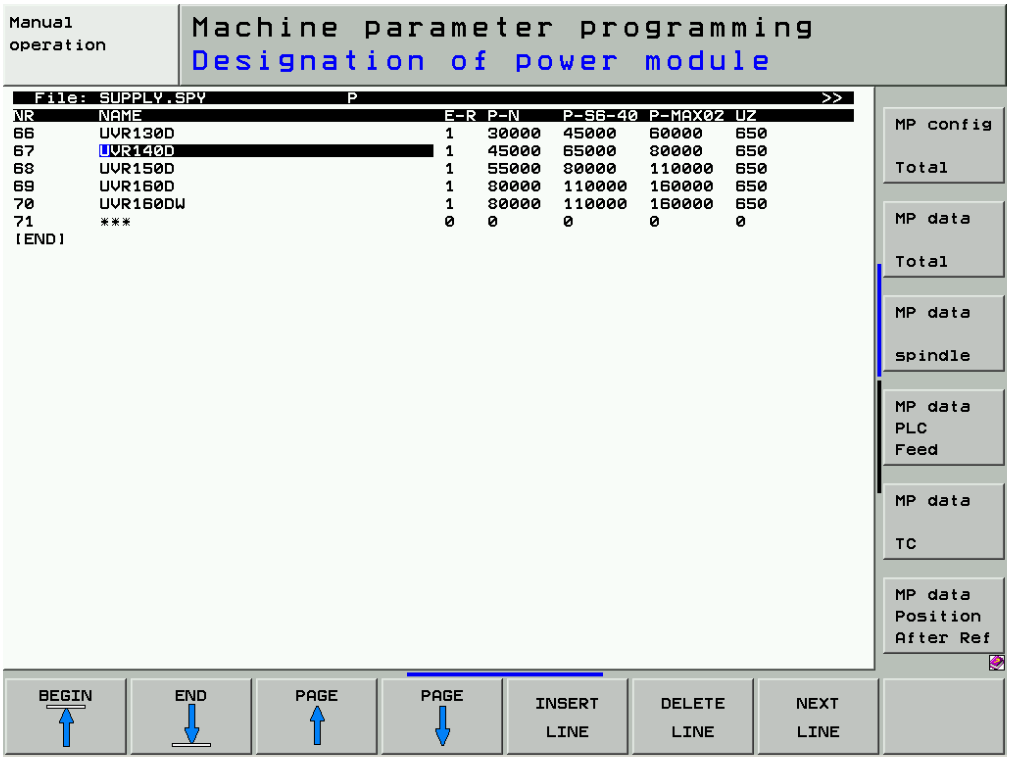
Note

The original table of power supply modules by HEIDENHAIN is stored in the SYS partition of the hard disk.
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 hard disk.
If the designation of supply module tables (**SUPPLY.SPY**) is the same, the data of the OEM table 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 technical data of the selected power supply module are displayed:



▶ You can now move the cursor in the line of the marked power supply module and read all available specifications.

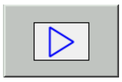
Note

The meaning of the selected column is shown in the header (e.g., **`Rated power [W]`**).

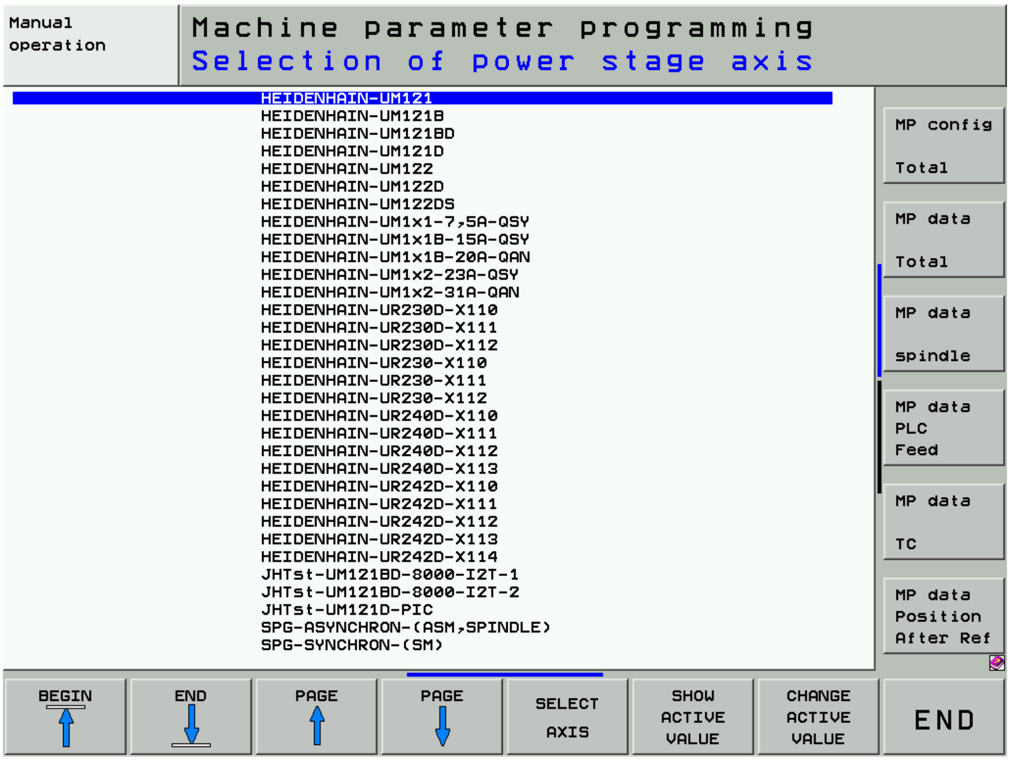
▶ Exit the supply module table by pressing the END key.

Power module table

- Open the machine parameter list.
- Place the cursor on the machine parameter for the axis/spindle concerned.
  MP 2100.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 supply modules of various manufacturers as well as end stages of HEIDENHAIN compact inverters.

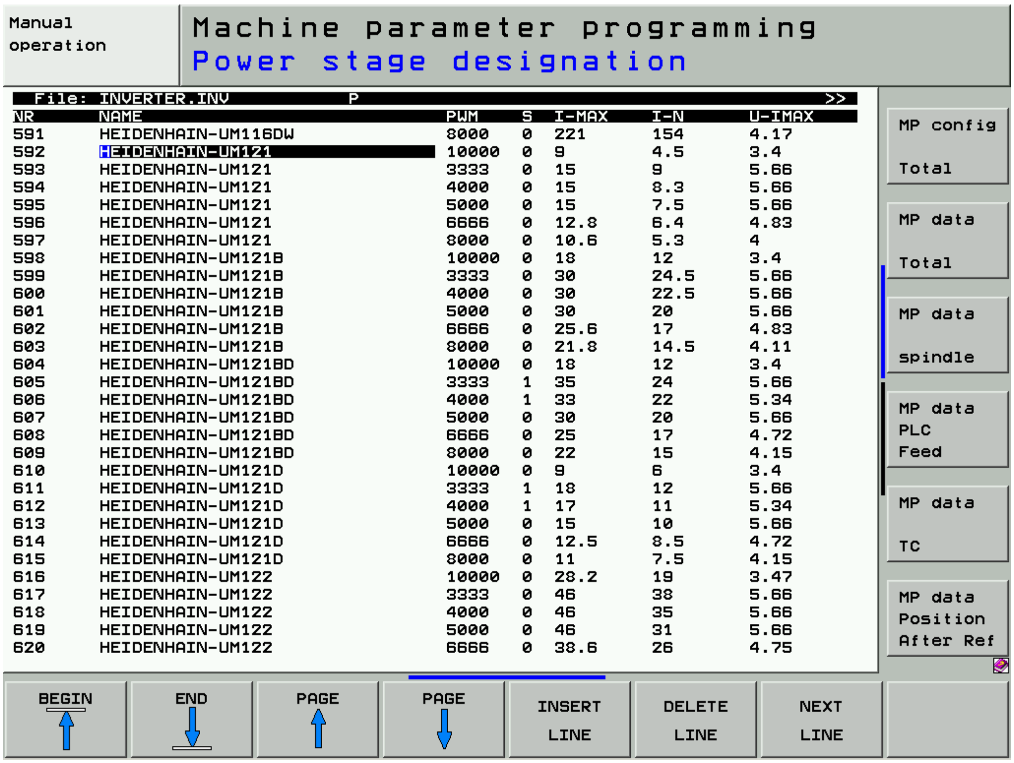
Note

The original power stage table by HEIDENHAIN is stored in the SYS partition of the hard disk.
The OEM can create his own power stage table (with additional power stages and/or edited data) which is stored in the PLC partition of the hard disk.
If the designation of power stage tables (**INVERTER.INV**) is the same, the data of the OEM table have priority.

DANGER

Do not change any values in the power module table!
This could lead to damage to property or persons!

- Press the SHOW ACTUAL VALUE soft key. --> The technical data of the selected power stage are displayed:



NR	NAME	PWM	S	I-MAX	I-N	U-IMAX
591	HEIDENHAIN-UM116DW	8000	0	221	154	4.17
592	HEIDENHAIN-UM121	10000	0	9	4.5	3.4
593	HEIDENHAIN-UM121	3333	0	15	9	5.66
594	HEIDENHAIN-UM121	4000	0	15	8.3	5.66
595	HEIDENHAIN-UM121	5000	0	15	7.5	5.66
596	HEIDENHAIN-UM121	6666	0	12.8	6.4	4.83
597	HEIDENHAIN-UM121	8000	0	10.6	5.3	4
598	HEIDENHAIN-UM121B	10000	0	18	12	3.4
599	HEIDENHAIN-UM121B	3333	0	30	24.5	5.66
600	HEIDENHAIN-UM121B	4000	0	30	22.5	5.66
601	HEIDENHAIN-UM121B	5000	0	30	20	5.66
602	HEIDENHAIN-UM121B	6666	0	25.6	17	4.83
603	HEIDENHAIN-UM121B	8000	0	21.8	14.5	4.11
604	HEIDENHAIN-UM121BD	10000	0	18	12	3.4
605	HEIDENHAIN-UM121BD	3333	1	35	24	5.66
606	HEIDENHAIN-UM121BD	4000	1	33	22	5.34
607	HEIDENHAIN-UM121BD	5000	0	30	20	5.66
608	HEIDENHAIN-UM121BD	6666	0	25	17	4.72
609	HEIDENHAIN-UM121BD	8000	0	22	15	4.15
610	HEIDENHAIN-UM121D	10000	0	9	6	3.4
611	HEIDENHAIN-UM121D	3333	1	18	12	5.66
612	HEIDENHAIN-UM121D	4000	1	17	11	5.34
613	HEIDENHAIN-UM121D	5000	0	15	10	5.66
614	HEIDENHAIN-UM121D	6666	0	12.5	8.5	4.72
615	HEIDENHAIN-UM121D	8000	0	11	7.5	4.15
616	HEIDENHAIN-UM122	10000	0	28.2	19	3.47
617	HEIDENHAIN-UM122	3333	0	46	38	5.66
618	HEIDENHAIN-UM122	4000	0	46	35	5.66
619	HEIDENHAIN-UM122	5000	0	46	31	5.66
620	HEIDENHAIN-UM122	6666	0	38.6	26	4.75

- You can now move the cursor in the line of the marked power stage and read all available specifications.

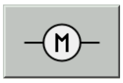
Note

The meaning of the selected column is shown in the header (e.g., **Peak current [A]**).

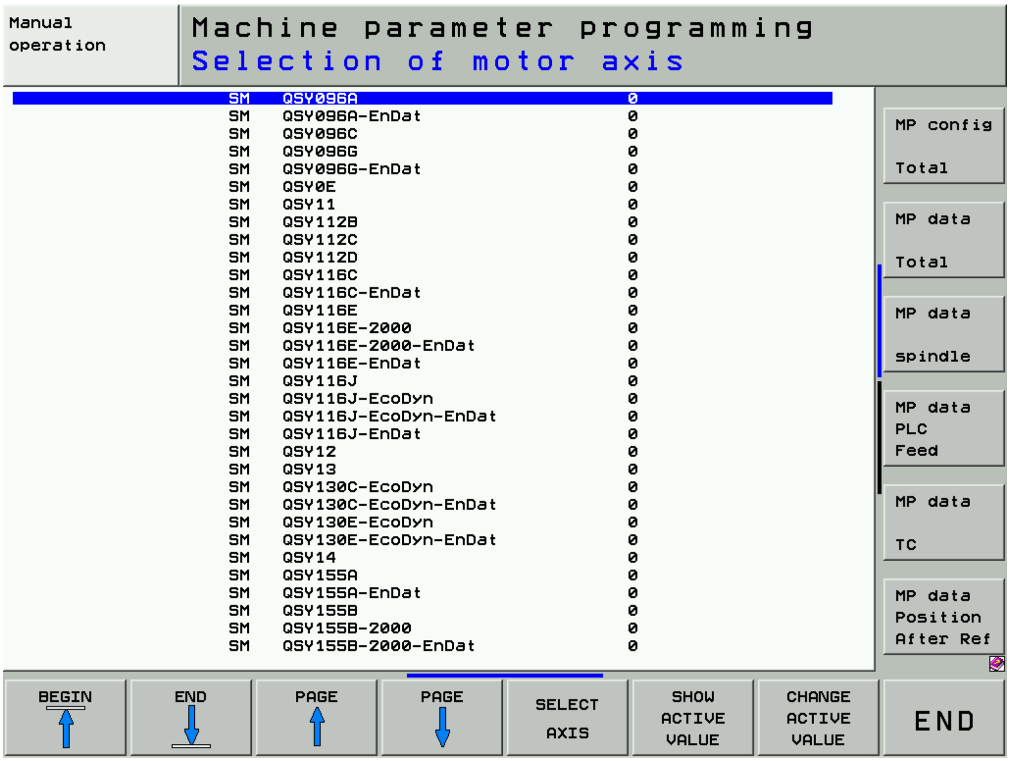
- Exit the power stage table by pressing the END key.

Motor table

- Open the machine parameter list.
- Place the cursor on machine parameter MP 2200.x for the axis/spindle concerned.
- 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.

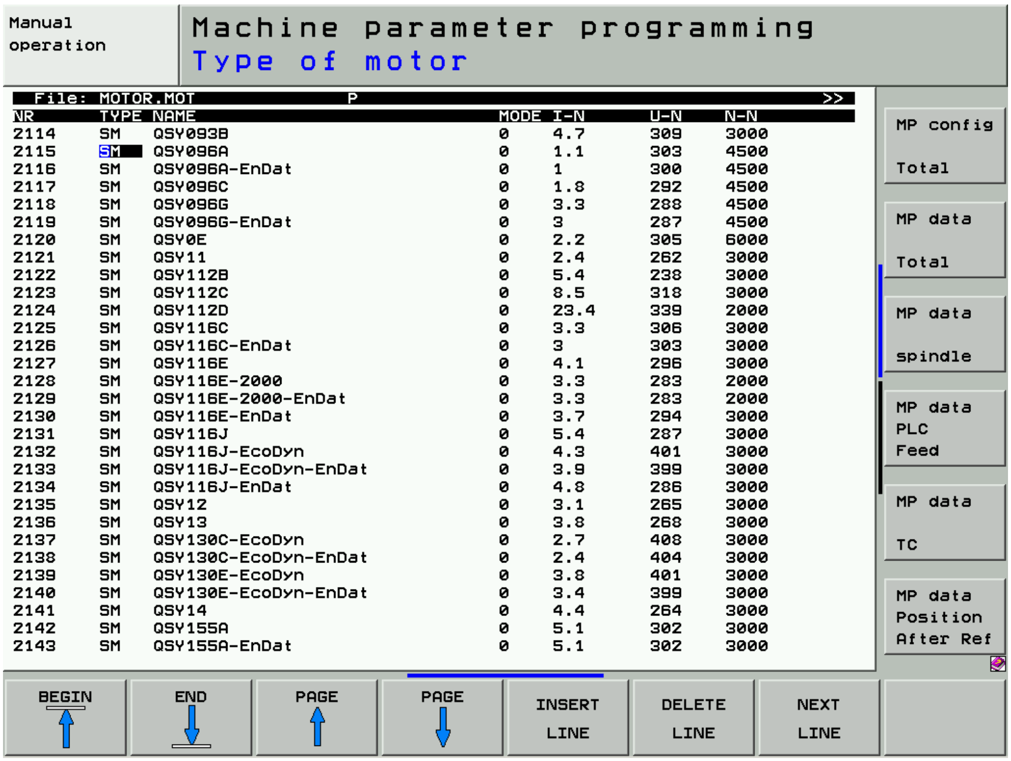
Note

The original motor table by HEIDENHAIN is stored in the SYS partition of the hard disk. The OEM can create his own motor table (with additional motors and/or edited data) which is stored in the PLC partition of the hard disk.
If the designation of motor tables (**MOTOR.MOT**) is the same, the data of the OEM table 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 technical data of the selected module are displayed:



NR	TYPE	NAME	MODE	I-N	U-N	N-N
2114	SM	QSY093B	0	4.7	309	3000
2115	SM	QSY096A	0	1.1	303	4500
2116	SM	QSY096A-EnDat	0	1	300	4500
2117	SM	QSY096C	0	1.8	292	4500
2118	SM	QSY096G	0	3.3	288	4500
2119	SM	QSY096G-EnDat	0	3	287	4500
2120	SM	QSY0E	0	2.2	305	6000
2121	SM	QSY11	0	2.4	262	3000
2122	SM	QSY112B	0	5.4	238	3000
2123	SM	QSY112C	0	8.5	318	3000
2124	SM	QSY112D	0	23.4	339	2000
2125	SM	QSY116C	0	3.3	306	3000
2126	SM	QSY116C-EnDat	0	3	303	3000
2127	SM	QSY116E	0	4.1	296	3000
2128	SM	QSY116E-2000	0	3.3	283	2000
2129	SM	QSY116E-2000-EnDat	0	3.3	283	2000
2130	SM	QSY116E-EnDat	0	3.7	294	3000
2131	SM	QSY116J	0	5.4	287	3000
2132	SM	QSY116J-EcoDyn	0	4.3	401	3000
2133	SM	QSY116J-EcoDyn-EnDat	0	3.9	399	3000
2134	SM	QSY116J-EnDat	0	4.8	286	3000
2135	SM	QSY12	0	3.1	265	3000
2136	SM	QSY13	0	3.8	268	3000
2137	SM	QSY130C-EcoDyn	0	2.7	408	3000
2138	SM	QSY130C-EcoDyn-EnDat	0	2.4	404	3000
2139	SM	QSY130E-EcoDyn	0	3.8	401	3000
2140	SM	QSY130E-EcoDyn-EnDat	0	3.4	399	3000
2141	SM	QSY14	0	4.4	264	3000
2142	SM	QSY155A	0	5.1	302	3000
2143	SM	QSY155A-EnDat	0	5.1	302	3000

▶ You can now move the cursor in the line of the marked motor and read all available specifications.

Note

The meaning of the selected column is shown in the header (e.g., **Line count of the rotary encoder**).

▶ Exit the motor table by pressing the END key.

20.1.3 Possible causes of error

- Mechanical defects
- Wear and tear of mechanical parts
- Aging of the machine
- Motor defective
- Power module defective
- Defective power supply module
- Defective cables
- Poor shielding and grounding
- HEIDENHAIN interface board for the SIMODRIVE 611 drive system defective
- Old HEIDENHAIN interface board in a modified SIMODRIVE 611 power module
- Wrong grounding in connection with the HEIDENHAIN interface boards
- PWM interface or CC 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 error elimination.

20.1.4 Sequence for finding errors in the control loop

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

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

or in case of errors, for example:

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

... machine components can be checked in a certain sequence for finding errors. –>
See “Sequence for Finding Errors in the Control Loop” on page 6 – 62.

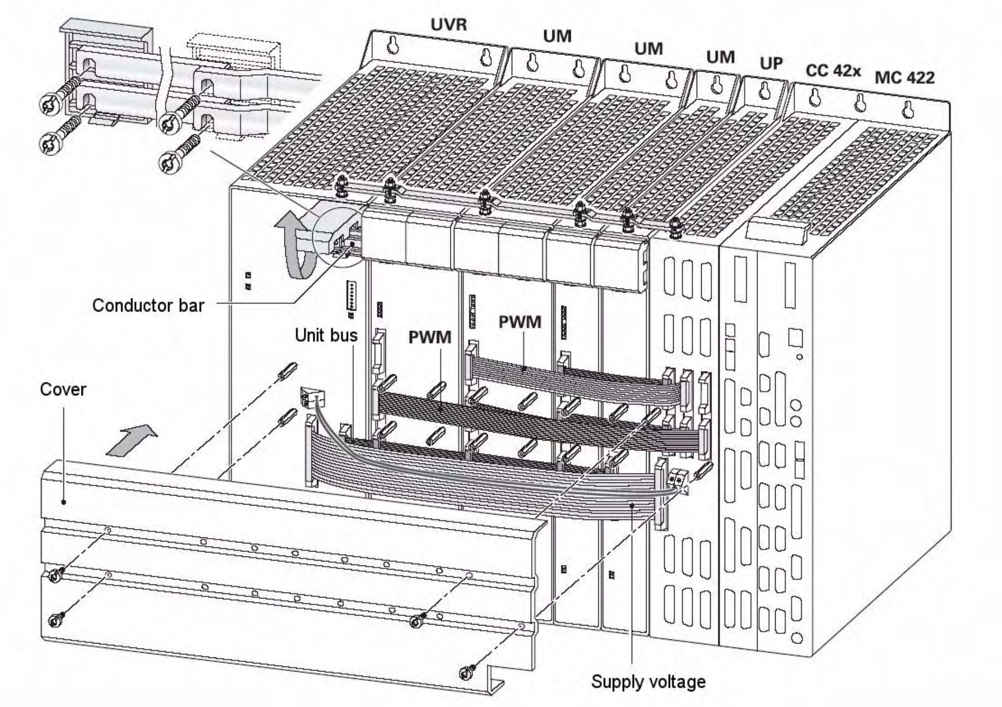
20.1.5 Troubleshooting: Interchanging PWM outputs on the CC 422

To find out whether **the connected drive system** or **the PWM interface on the CC** is defective, the interchange method can be used.
Use the interface of a functioning axis.

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".

Modular setup with CC 422



Example

Error in X-axis

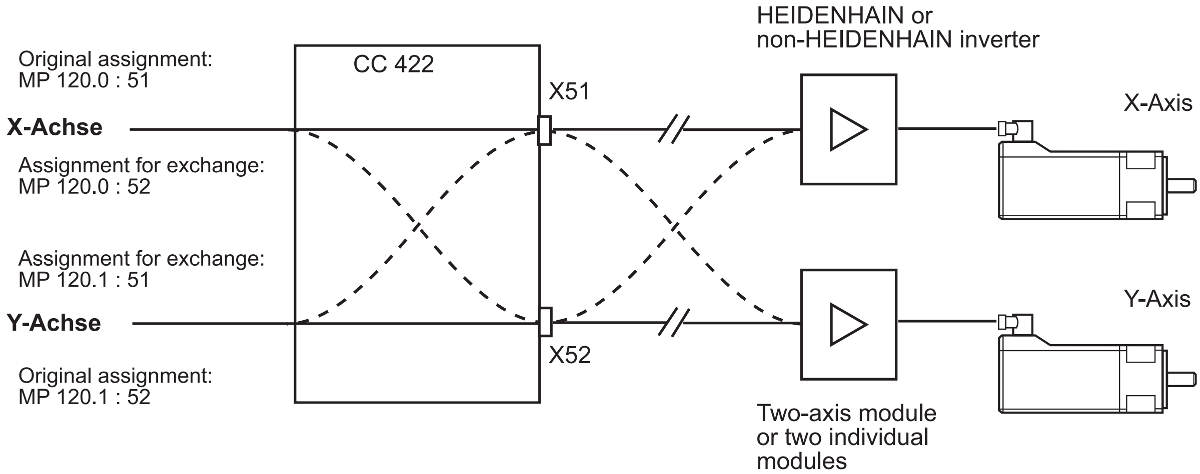
Example machine parameters

MP 100.x	= - - - - -CZYX (X = 1st axis, Y = 2nd axis, Z = 3rd axis, C = 4th axis)
MP 2180.x	= 0 (PWM frequency = 5 kHz for all axes)
MP 120.0	= 51 (X axis on PWM output X51)
MP 120.1	= 52 (Y axis on PWM output X52)
MP 120.2	= 53 (Z axis on PWM output X53)
MP 120.3	= 54 (C axis on PWM output X54)

Notes and preliminary action

- Switch the PWM output with that of a functioning axis.
  (depending on the configuration of the PWM frequencies, unassigned PWM outputs can be inactive).
- The outputs can only be switched within the main DCB and the auxiliary DCB.
- The **same PWM frequency** must be set for the axes to be switched!

Block diagram



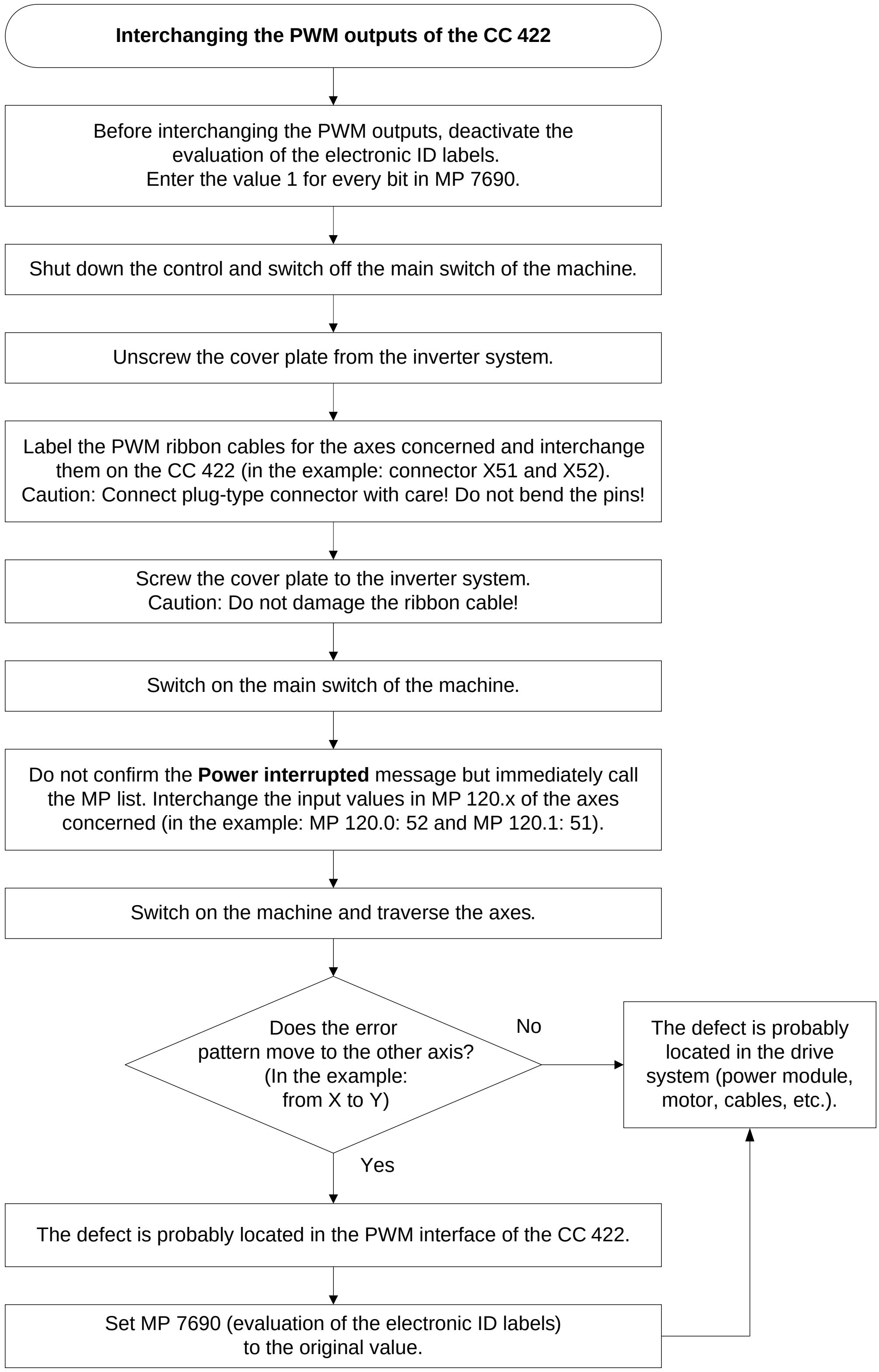
Note

Always switch both the cable and the interface assignment by machine parameter!

Note

It is not relevant for this test routine which drive modules are connected.

Flowchart



Next test

If you have detected that the error is outside the control (servo amplifier, motor, cables, etc.), run this routine --> See "Troubleshooting: Interchanging power modules or output stages of the same type" on page 20 – 339.

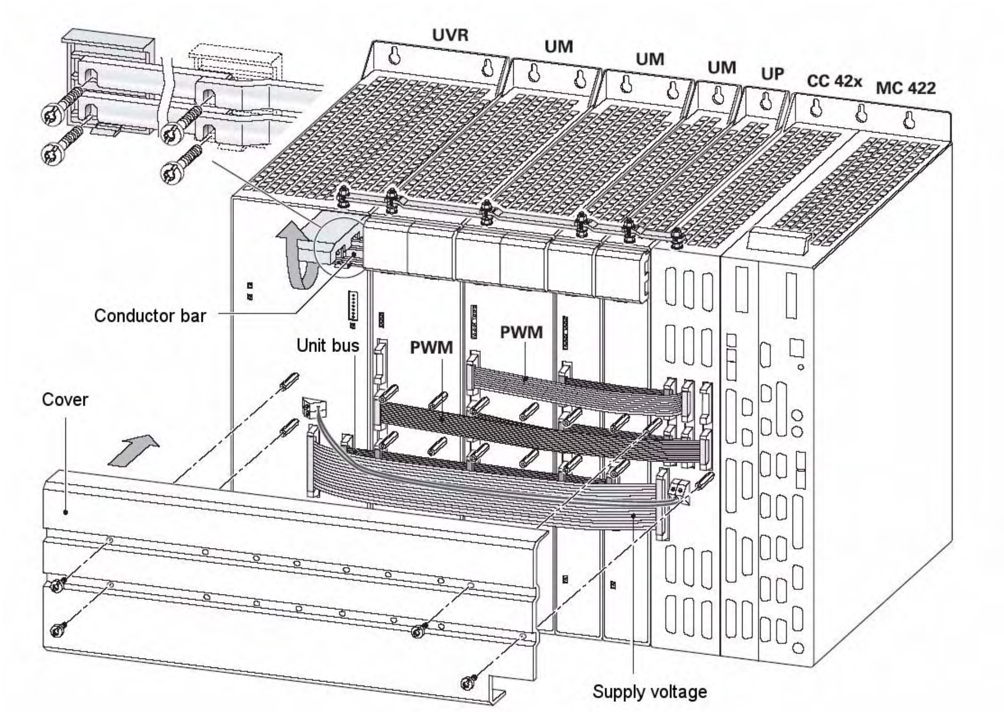
20.1.6 Troubleshooting: Interchanging PWM outputs on the CC 424 (B)

To find out whether **the connected drive system** or **the PWM interface on the CC** is defective, the interchange method can be used.
Use the interface of a working axis for this purpose.

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".

Modular setup with CC 424 (B)



Example

Error in X-axis

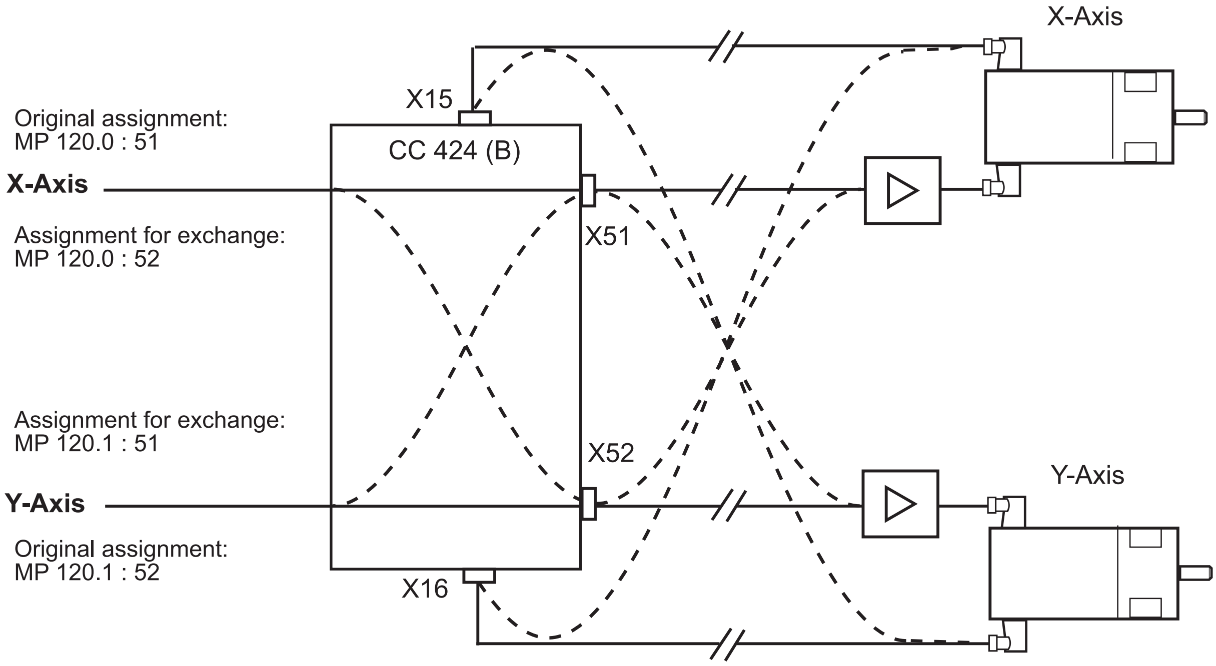
Example machine parameters

MP 100.x	= - - - - -CZYX (X = 1st axis, Y = 2nd axis, Z = 3rd axis, C = 4th axis)
MP 2180.x	= 0 (PWM frequency = 5 kHz for all axes)
MP 120.0	= 51 (X axis on PWM output X51)
MP 120.1	= 52 (Y axis on PWM output X52)
MP 120.2	= 53 (Z axis on PWM output X53)
MP 120.3	= 54 (C axis on PWM output X54)

Notes and preliminary action

- Switch the PWM output with that of a functioning axis.
  (Depending on the configuration of single-speed and double-speed control loops, unassigned PWM outputs may not be active.)
- Single-speed and double-speed PWM outputs with equal PWM frequency can be interchanged for test purposes.
- The outputs can only be switched within the main DCB and the auxiliary DCB.
- **The firmly assigned motor encoder input must also be interchanged!**
- The **same PWM frequency** must be set for the axes to be switched!
- Axes in master-slave torque control are only permitted on X51/X53 or X52/X54.
  When using a CC 424 (B) with 8 and 14 control loops starting with NC software 34049x-03, master-slave torque axes also function on X55/X57 or X56/X58.

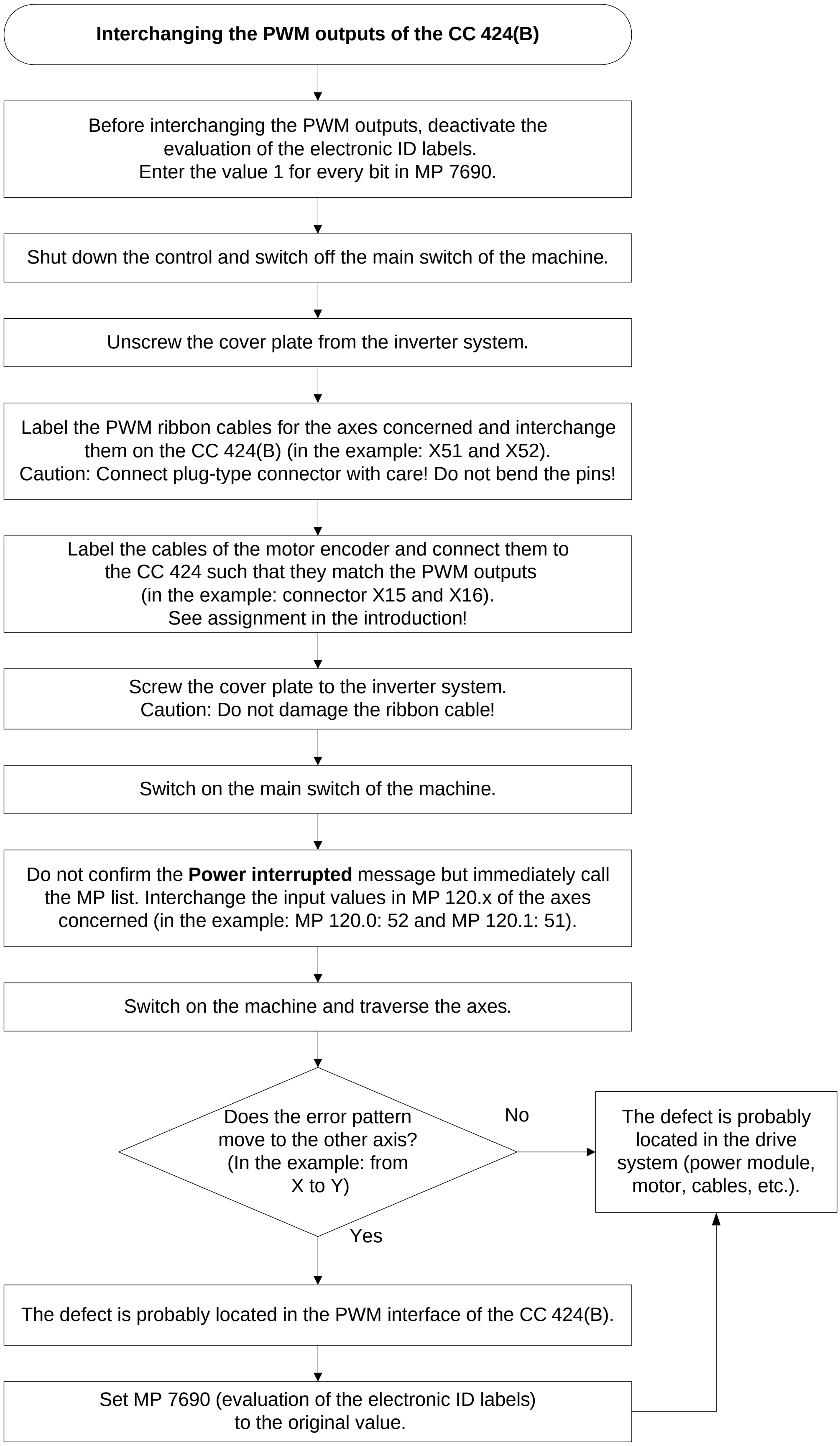
Block diagram



> **Note**
>
> Always switch both the cable and the interface assignment by machine parameter!

> **Note**
>
> It is not relevant for this test routine which drive modules are connected.

Flowchart



Next test

If you have detected that the error is outside the control (servo amplifier, motor, cables, etc.), run this routine --> See “Troubleshooting: Interchanging power modules or output stages of the same type” on page 20 – 339.

20.1.7 Troubleshooting: Interchanging power modules or output stages of the same type

If you have found out that the PWM interface on the CC 422 oder CC 424 (B) 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 strongly 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 exchange a machine parameter 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 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 modules

UM 11x: **X111** (PWM connection of channel 1) connected with **X51** (iTNC, X axis)
X81 (motor connection of channel 1) connected with motor **X axis**

UM 11x: **X111** (PWM connection of channel 1) connected with **X52** (iTNC, Y axis)
X81 (motor connection of channneel 1) connected with motor **Y axis**

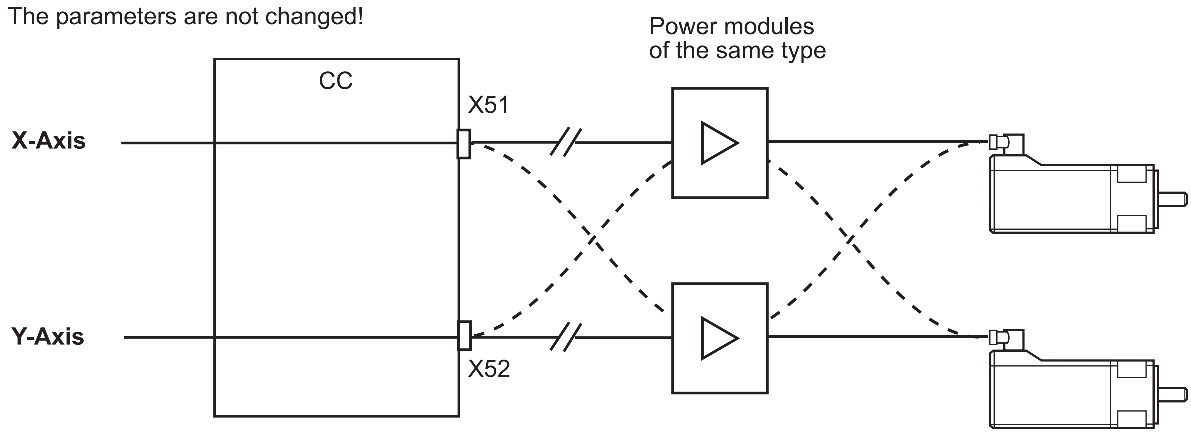
Assumed configuration for one 2-axis module

UM 12x: **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**

Example

Error in X axis.
Two 1-axis modules are available.

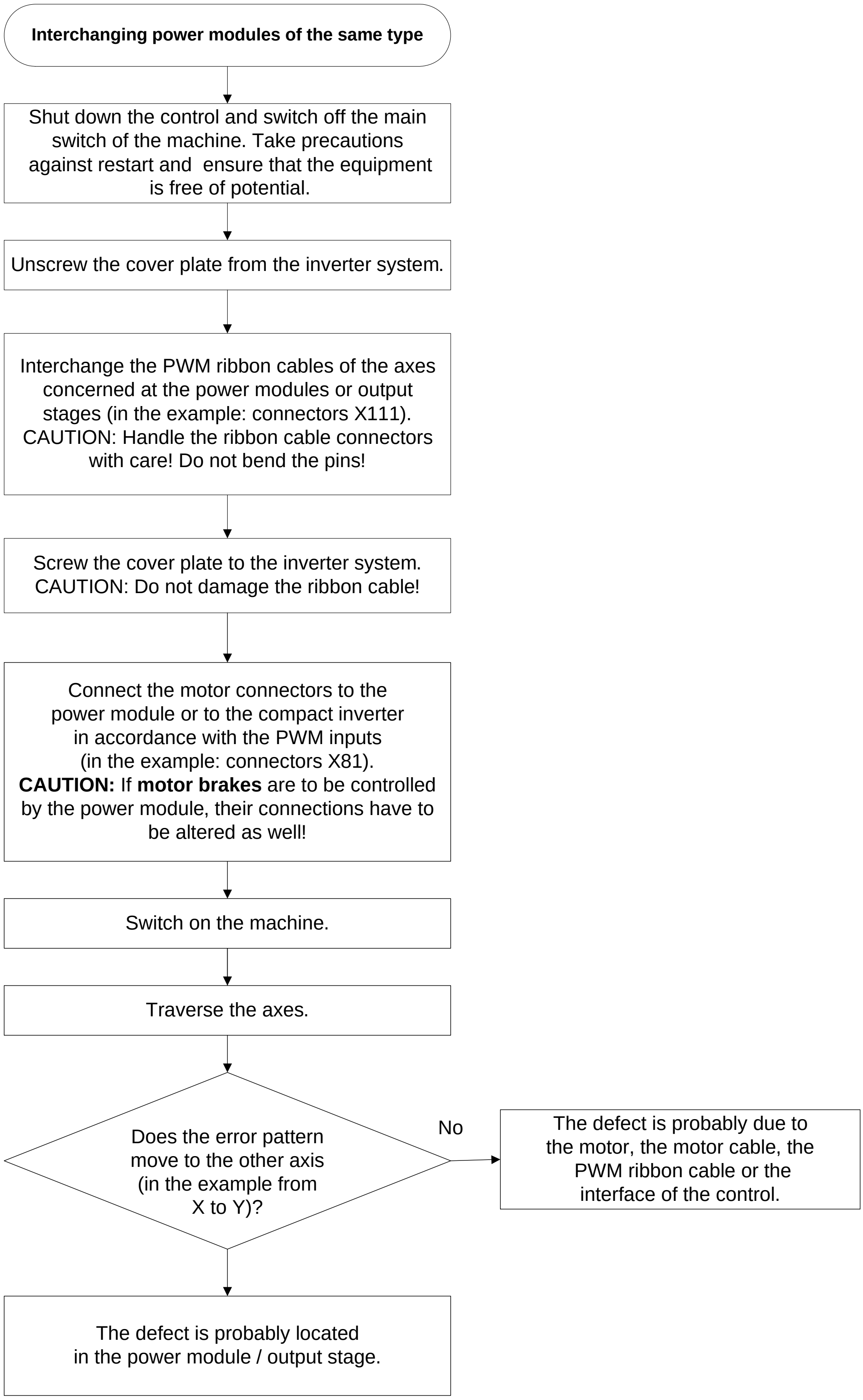
Block diagram for two 1-axis modules



DANGER

If **motor brakes** are connected to the power modules, they **must** be **exchanged as well** (X344, X392, X393, X394, depending on the model. --> See Service Manual for Inverter Systems and Motors)!
Motor brakes can be connected to current HEIDENHAIN 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 two 1-axis modules



20.1.8 Troubleshooting: Interchanging the HEIDENHAIN interface boards for the SIMODRIVE 611 system

If a SIMODRIVE 611 system is used in combination with the HEIDENHAIN control, there are HEIDENHAIN interface boards in the SIEMENS drive modules to adapt the PWM signals.

Caution

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 exchange **dimensionally identical expansion boards**.
Please observe:

- Exchange the boards while the machine is switched off.
- Exchange boards of the same type (1-axis module or 2-axis module, metallically isolated or not metallically isolated. --> See ”Exchange of HEIDENHAIN Components in the SIMODRIVE System” on page 28 – 554).
- The grounding must be correct. --> See ”Exchange of HEIDENHAIN Components in the SIMODRIVE System” on page 28 – 554.

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.
Difficulties can 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 MP 10.
  With some machines this might be difficult.
  --> Ask your machine tool builder!

Caution

Boards with metallic isolation of HEIDENHAIN PWM signals and SIEMENS interface must not be replaced by boards without metallic isolation and vice versa. --> See “Overview of Possible Error Patterns” on page 5 – 55.

Caution

"Older" HEIDENHAIN expansion cards must not be operated with modified SIMODRIVE power modules. --> See “Compatibility of HEIDENHAIN interface boards and SIMODRIVE power modules” on page 28 – 559.

20.1.9 Corrective action

Control

If you have found that the interface on the CC is defective:

- Exchange the CC. --> See ”Exchange of the CC” on page 28 – 551.

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".

Mechanics

If you have found that the fault is due to the mechancis of the machine tool:

- Replace mechanical components. --> Ask your machine tool builder.

20.2 Analog Speed Command Interface

20.2.1 Introduction

For the operation of analog axes and spindles, the position controller is located in the MC, the speed and current controller in the servo amplifier.
The "result" of the position control is transferred to the analog servo amplifier via the **± 10 V speed command interface**.

For analog drives **DC motors** are often used.

Analog speed value outputs

Following **analog speed command outputs** are located on the **MC 42x (B/C)**:

- **X8**
- **X9**

On each of these D-Sub connectors there are several analog channels.

Assignment of the speed value outputs

MP 100 is read from the right to the left and contains the information which axis is the first, the second, the third axis, etc.

Caution

MP 100 must not be changed!

Assignment of the speed command outputs in the machine parameters	Axes	Spindles
Machine parameters	**MP 120.x**	**MP 121.x**

20.2.2 Possible causes of error

- Mechanical defects
- Wear and tear of mechanical parts
- Aging of the machine
- Motor (carbon brushes, tachometer brushes, winding, etc.) defective
- Servo amplifier defective
- Defective cables
- Poor shielding and grounding
- Errors in the NC or PLC software
- Defective nominal speed value interface of the MC (X8, X9)

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 error elimination.

20.2.3 Sequence for finding errors in the control loop

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

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

or in case of errors, for example:

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

... machine components can be checked in a certain sequence for finding errors. -->
See “Sequence for Finding Errors in the Control Loop” on page 6 – 62.

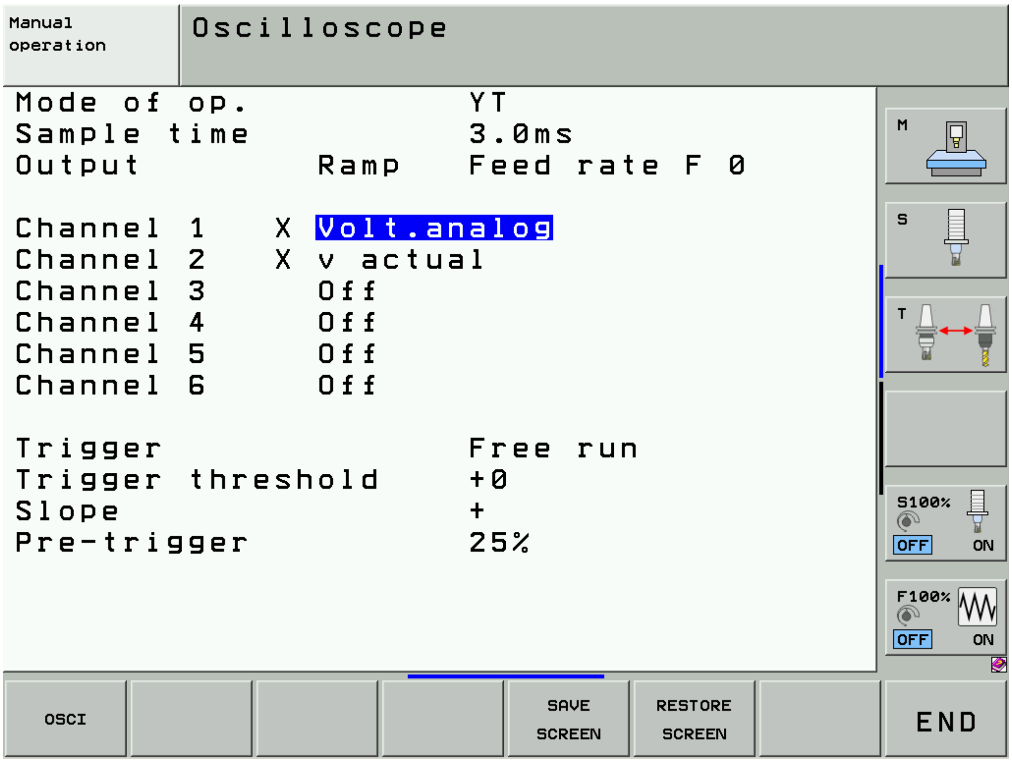
20.2.4 Checking the analog speed command interface

The control outputs an analog voltage of 0 V to maximum ± 10 V (the analog voltage is entered in MP 1050.x).

This voltage can be measured at the connecting terminals of the servo amplifier or directly at the MC with the HEIDENHAIN test adapter.

Observation with the integrated oscilloscope

With the integrated oscilloscope the **Volt. analog** voltage can also be observed:



Activation and operation --> See “Integrated Oscilloscope” on page 10 – 99.

Error:
No axis movement!

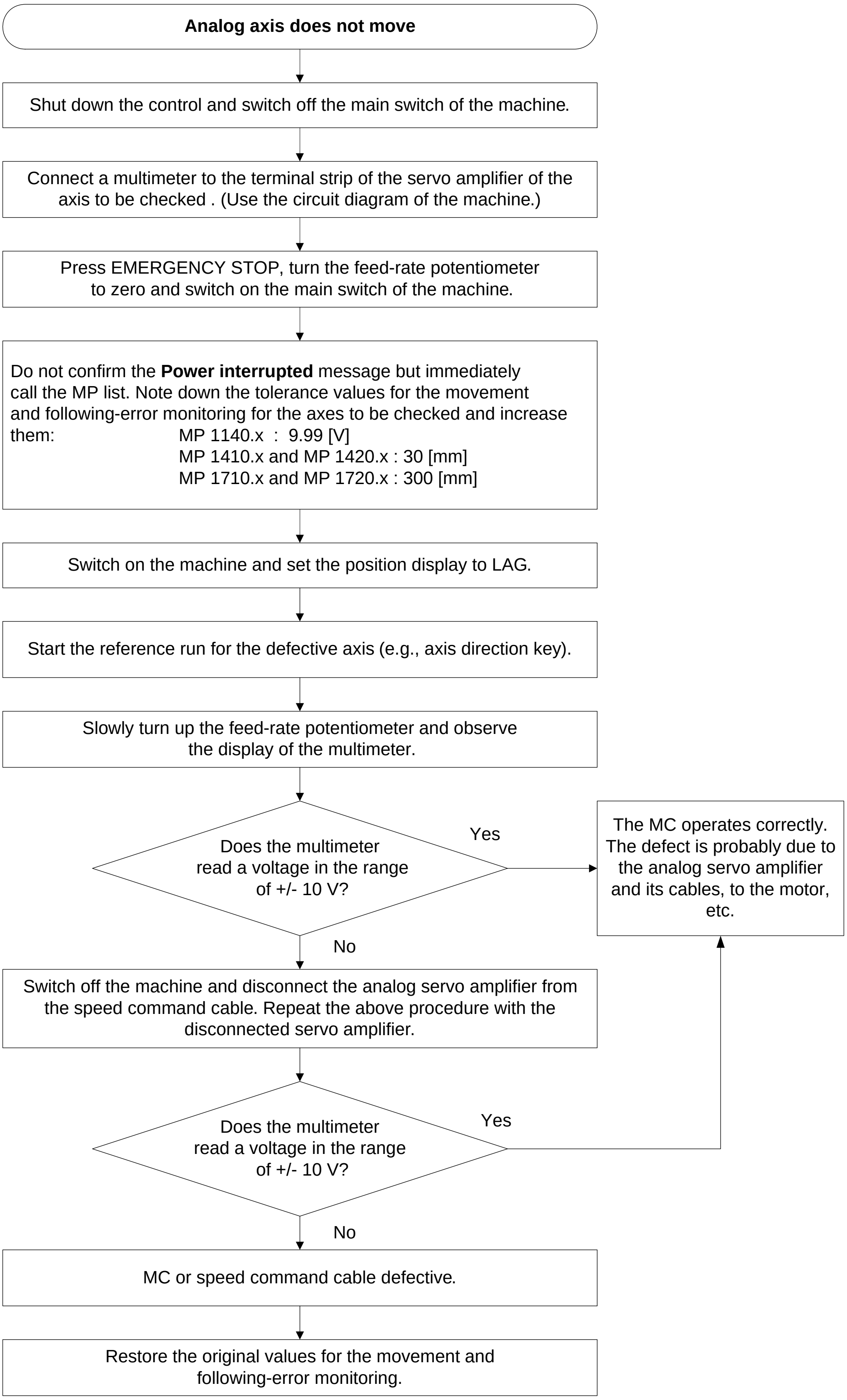
It is a **prerequisite** that the **release conditions** (e.g., door contacts, permissive buttons) for the axis movements are **given**.

for the axes to be traversed ...

- no "Axis clamped" symbol must be shown.
- the "STIB" star (control-in-operation) must be visible
- 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

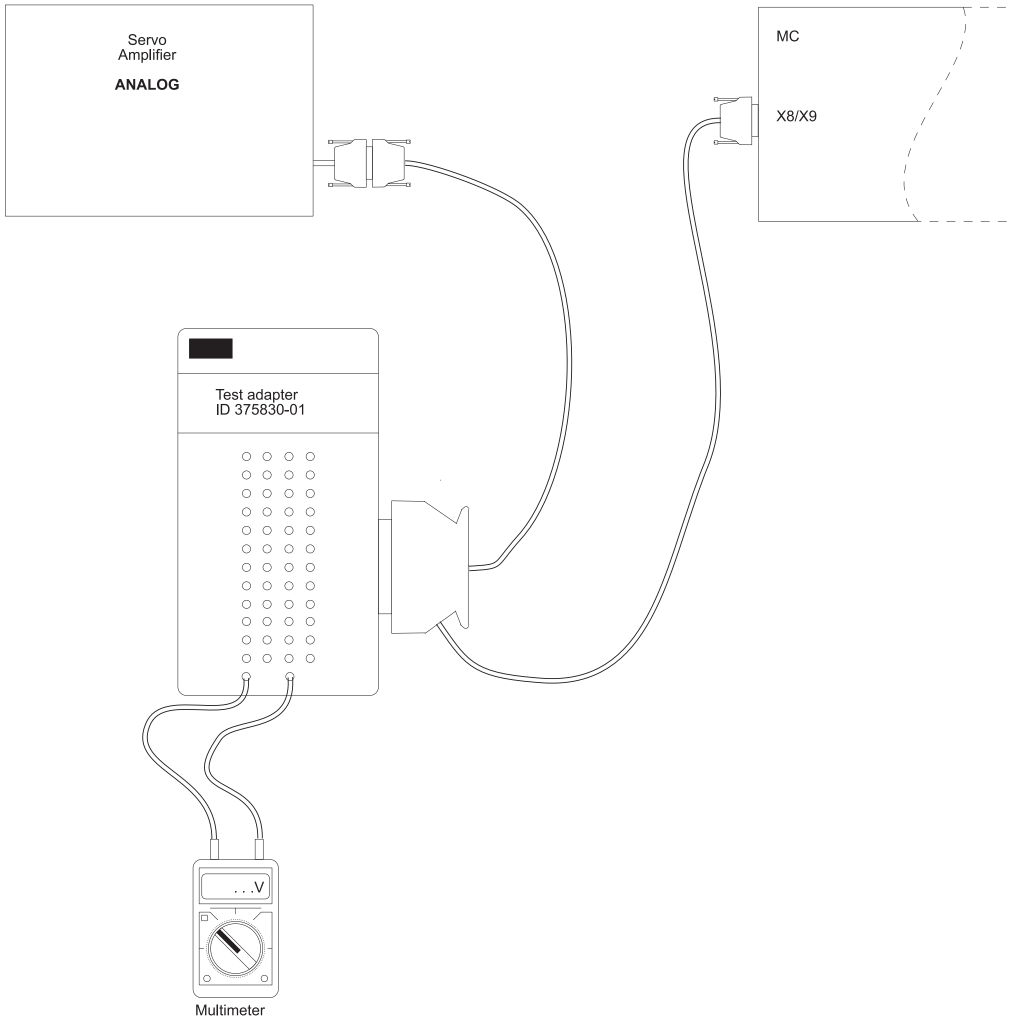
If the control operates properly, a nominal speed command voltage can be read with the above routine until the monitoring values (movement, following error, etc.) are reached.

Battery box

If available, you can investigate whether the analog servo amplifier can be operated with a **"Battery box"** (not a HEIDENHAIN unit).
This battery box replaces the control and provides the analog servo amplifier with a nominal speed value of ±10 V.
(The controller enabling on the servo amplifier must be available. --> If necessary, ask the machine manufacturer!)

Measuring setup with test adapter

If available, you can connect the test adapter between connection X8 or X9 of the MC and the nominal speed value cable. Connect a multimeter to the corresponding banana jacks of the test adapter.
Assignment for the analog channels. --> See "X8: Analog output 1 to 6" on page 27 – 459, See "X9: Analog output 7 to 13" on page 27 – 459.



Specifications of the analog channels

Load capacity:	$R_L \geq 5$ kΩ, I ≤2 mA, $C_L \leq 2$ nF
Short-circuit stability:	One output short-circuit proof at a time
Voltage range:	U_{amax} = +10 V ± 100 mV
	U_{amin} = -10 V ± 100 mV
Resolution:	14 bit = 16 384 steps
Smallest step:	$\frac{10V}{16384} = 0{,}610$ mV

20.2.5 Adjusting the electrical offset (drift adjustment)

An offset adjustment is required or recommendable, in case of the following:

- You receive the error message **EXCESSIVE OFFSET <AXIS>**.
- The axis drifts.
- The servo lag of the axis at standstill is impermissibly high.
- You have exchanged the motor.
- You have replaced the motor brushes.
- You have exchanged the analog servo amplifier.
- You have replaced cables or electrical lines on the machine.
- You have exchanged the MC.

Note

The offset adjustment has only to be performed with analog axes.
First the analog servo amplifier is adjusted, subsequently the fine adjustment in the HEIDENHAIN control is carried out.

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.)!

Here are two proposals.

Proposal 1:

- Set the following machine parameters (note down the original values):
  - MP 1080.x (integral factor for offset) **:** **0** (switched off)
  - MP 1391.x, 1392.x (velocity feedforward control) **:** **1** (switched on)
  - MP 7290.x (display step) **:** **6** (0.1 µm)
- Switch on the machine. The axis concerned must be in the position control loop.
  --> If necessary, ask the machine manufacturer!

- 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 interface settings.

MOD
- Call the code number window.

7 5 3 6 8 ENT
- Enter and confirm the code number.

CANCEL
- End compensation.

Note

Before the adjustment on the servo amplifier, the fine compensation is cancelled via the control.

- Switch the position display to **LAG** and observe the display.
- Adjust the offset at the servo amplifier until the individual axes either display the value 0 or oscillate around 0 (approximate value ± 3-5 µm).

Note

You can use the integrated oscilloscope with the settings **s actl.**, **s noml.**, **s diff**. --> See "Integrated Oscilloscope" on page 10 – 99.

- Reset the machine parameters and 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 20 – 351.

Proposal 2:

- Shut down the control and switch off the machine.
- Disconnect the nominal speed cable from the control.
- 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 concerned).

Note

You can also produce a D-Sub connector for every analog nominal value interface X8 and X9. There is a bridge between ± 10 V and 0 V (See "X8: Analog output 1 to 6" on page 27 – 459, See "X9: Analog output 7 to 13" on page 27 – 459) for every channel in these connectors. Connect the corresponding connector to the nominal speed value cable that you have disconnected from the control (X8, X9).
Advantage of this method: The nominal speed cable is included in the offset adjustment of the servo amplifier.

- Switch on the main switch of the machine.
- Do not acknowledge the **Power interrupted** message, but call the machine parameter list immediately.
- Set parameter 120.x to zero. --> No nominal value output, only display of axes.
(If necessary, deselect the reference point traverse in MP 1340.x).
- Switch on the machine.
- Check the controller enabling on the servo amplifier and establish it, if required.
(If necessary, ask the machine manufacturer)!
- Select **Manual operation**, set the display to the actual value and set the axis to zero.
- Adjust the servo amplifier to standstill as close as possible. The axis movement can be seen on the actual value display and possibly on a pulley.
- 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 20 – 351.

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!
> The control can compensate only ± 100 mV with the offset fine adjustment by code number! This corresponds to 1% of the ± 10 V interface!
> An insufficient offset adjustment on the servo amplifier can thus not be compensated any more with the code number adjustment.

The axes to be compensated must be in the position control loop. --> If necessary, ask the machine manufacturer!

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

MOD

- Call the code number window.

7 5 3 6 8

- Enter the code number.

ENT

- Confirm.

The iTNC displays the offset values of the analog axes 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 servo amplifier and in the control.

- Press the corresponding soft key in order to …

CONTINUE

Carry out an offset compensation.
The values are stored in the nonvolatile memory. By the offset adjustment with the code number, the current offset of the entire control loop is compensated. Later changes in offset are not compensated.

CANCEL

Do not carry out an offset compensation, or end a previous compensation.

END

Exit the menu without making any changes.

20.2.6 Speed adjustment at the servo amplifier (tachometer adjustment)

Speed adjustment at servo amplifier needs to be carried out in case of the following:

- You have updated the mechanics of the axis.
  (e.g., guideway, bearing, belt, coupling, ball screw, etc.)
- You have exchanged the analog servo amplifier or the motor.
- You have replaced the motor 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 the speed adjustment, the offset adjustment for the axis concerned should be performed. --> See “Adjusting the electrical offset (drift adjustment)” on page 20 – 349.

Suggestion how to perform 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 following machine parameter (note down the original value):
  - MP 7290.x (display step) **: 6** (0.1 µm)
- In the machine parameters MP 1391.x and MP 1392.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 X axis, choose a larger traverse range if necessary):

```
0    BEGIN PGM tacho_adjustment X MM
1    LBL 1
2    L      X + 0   F MAX
3    L      X + 300   F MAX
4    CALL  LBL 1  REP 100
5    END PGM tacho_adjustment X MM
```

> **DANGER**
>
> Enter this test program together with the machine operator. Please be careful to prevent a 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 turn the feed rate potentiometer slowly to 100 %.

- Adjust tachometer generator at the servo amplifier using the servo lag display as follows:

Operation with ...	Servo-lag displayed
Velocity with feedforward control	Ideally 0
Following error	According to the following formula: $$\text{LAG [mm]} = \frac{\text{Traversing speed}\left[\frac{\text{m}}{\text{min}}\right]}{\text{kv factor}}$$

Note

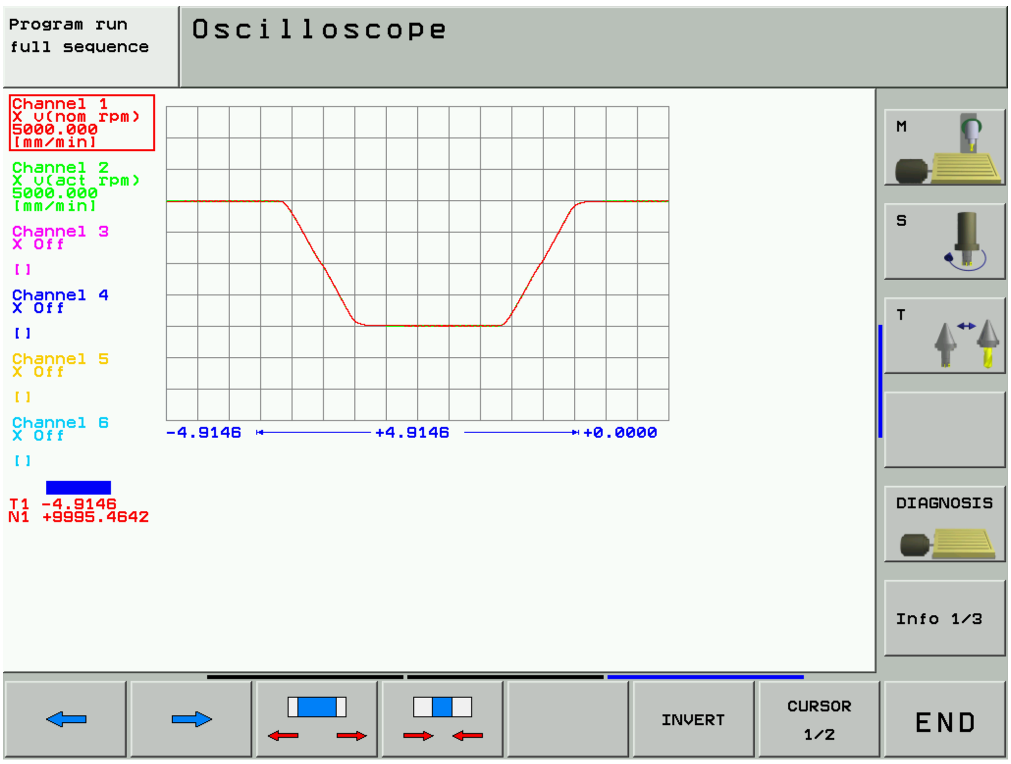
Read the traverse speed from the display.
The kv factor for the lag mode is defined in MP 1810.x.
It is possible that a multiplication factor for the kv factor is active for the displayed traverse speed (MP 1820.x). A characteristic curve kink point is entered in MP 1830.x. Contact the machine manufacturer!

- Repeat the adjustment for all axes.
- Reset machine parameter MP 7290.x to its original value.

Note

It might be helpful to use the integrated oscilloscope. The signals **V (nom rpm) and V (act rpm) can be recorded and compared**. The quality of the speed adjustment can thus be controlled and improved, if required.

Comparison of noml. and actl. speed in the integrated oscilloscope



20.2.7 Corrective action

Control

If you have found that the analog interface on the MC is defective:

- Replace the MC. --> See "Exchange of HEIDENHAIN Components" on page 28 – 523.

Drive components

If you have found that the analog servo amplifier or the motor is defective:

- Replace the drive component. --> Ask the respective manufacturer!

Mechanics

If you have found that the fault is due to the mechancis of the machine tool:

- Replace mechanical components. --> Ask your machine tool builder.

21 Visual Display Unit

21.1 Introduction

One of the two flat-panel displays are connected to the iTNC 530:

Flat-Panel Display	Soft Keys	Screen Diagonal	Pixels
BF 150	horizontal and vertical	15.1 inch	1024 x 768
BF 120	only horizontal	10.4 inch	640 x 480

The BF …

- is supplied with **24 V dc voltage from the electrical cabinet power supply unit**
- receives **display signals from the control**

The screen interface ...

- connector **X49** on the MC for the BF 120
- connector **X149** on the MC for the BF 150

... is HEIDENHAIN-specific.

A conventional flat-panel screen cannot be connected.

21.2 Possible Causes of Errors

- Defective monitor
- Faulty 24 Vdc power supply
- Defective monitor cable
- No display signals from the control
- Defective device or cable that is connected to the control and impairs it
- Defective screen soft keys
- Defective fan
- Defective cover glass

21.3 Troubleshooting

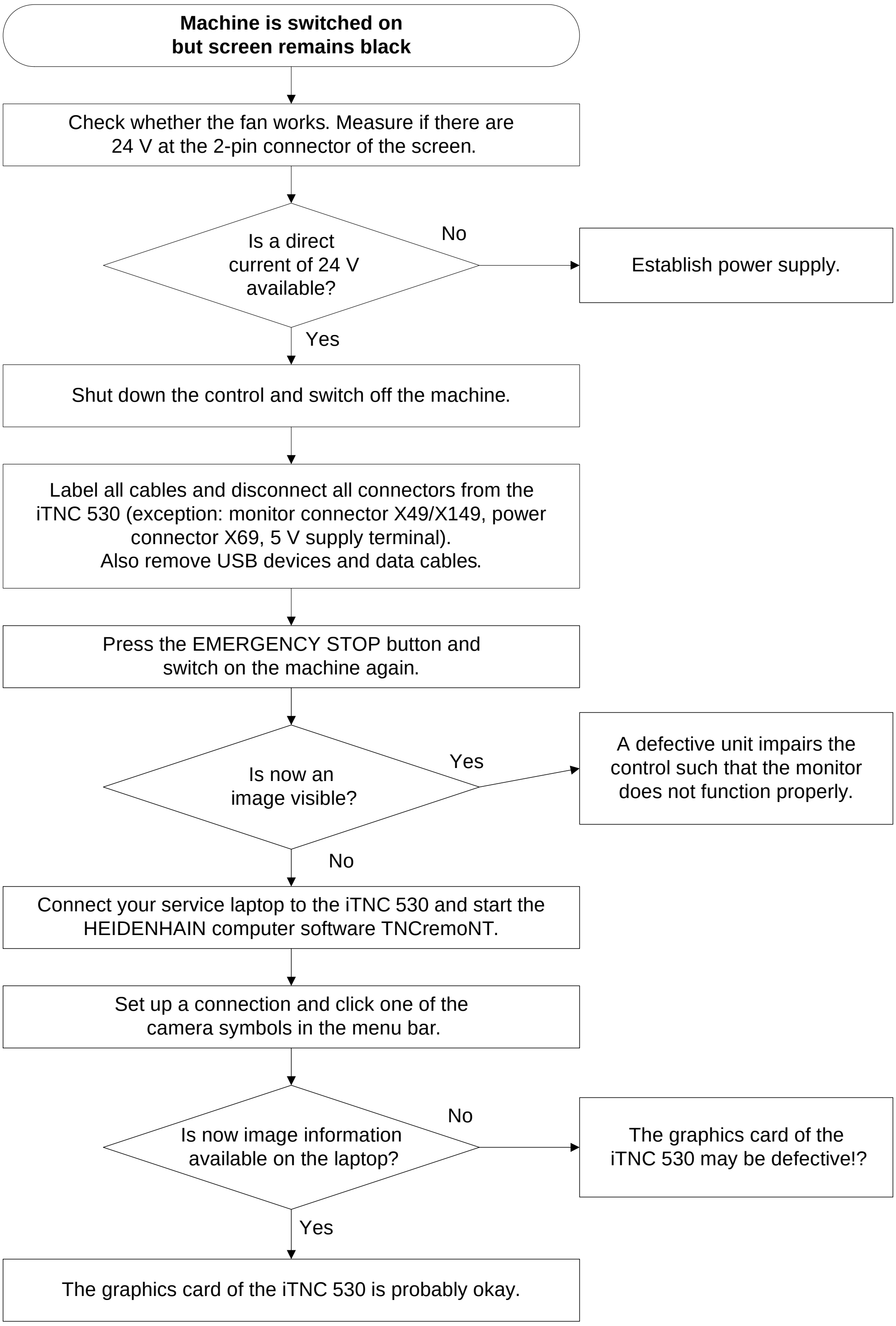
VDU soft keys

The soft-key rows of the BF screens are connected with the keypad board of the TE via ribbon cable.

Troubleshooting --> See “Checking the Keys” on page 22 – 363.

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 part of the menu bar, next to the camera symbols.
> The dongle can be ordered from HEIDENHAIN.

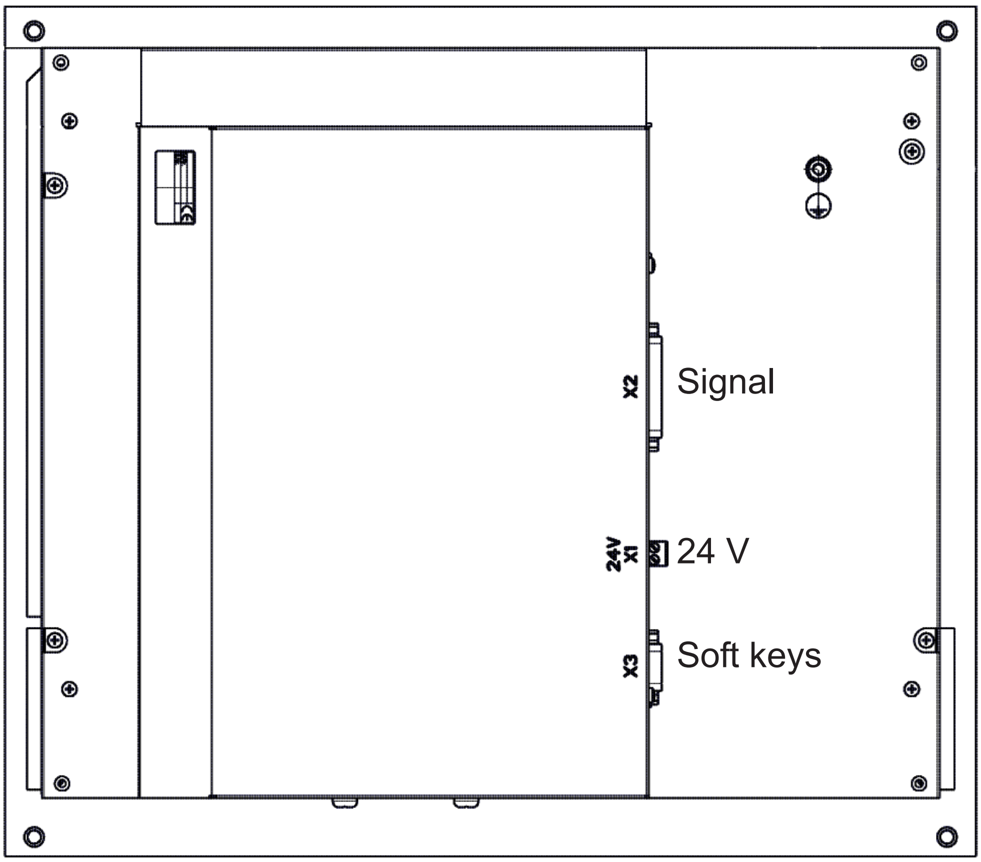
> **Note**
>
> If you can see the display information with TNCremoNT, it is still not 100% sure that all areas of the graphics card are in good order!

If a defective unit or cable is the reason for the black screen:

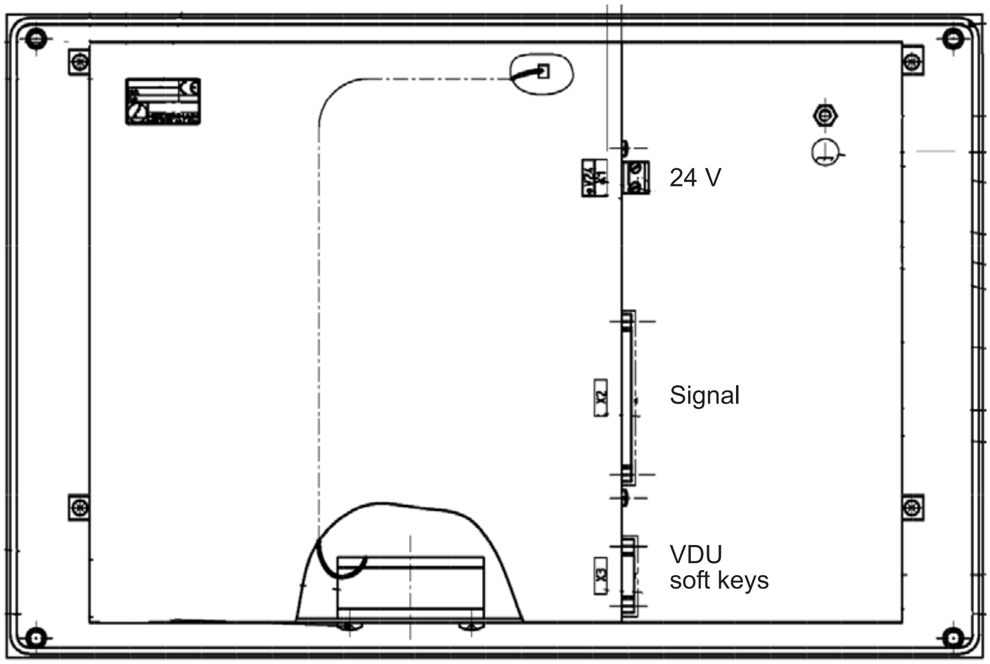
- Connect all connectors to the MC and CC one after the other (the machine must always be switched off) and observe when the error occurs again (in this case the black screen).
- Subsequently, search the error of the connected device including its cable.

> **Note**
>
> If you have found out that the screen itself is defective, then a further inspection of the flat-panel display is not possible without special test equipment.

Rear view BF 150



Rear view BF 120



21.4 Corrective Action

VDU soft keys	Exchange the soft-key rows.
Fan	Replace the fan.
Front glass	Replace the front panel with cover glass.
Monitor	Replace the complete visual display unit.
Control	If you have found that the VDU interface on the control is defective (connector X49, X149), replace the MC. -->See "Exchange of HEIDENHAIN Components" on page 28 – 523.

22 Keyboard Unit

22.1 Introduction

- The keyboard units are available with individual keys and as membrane keyboard.
- The screen soft keys are connected to the keypad board.
- The key signals on the control are transferred by a matrix. With every crosspoint of a **ScanLine (SL)** being assigned to a certain key via a **ReturnLine (RL)**.
- If HR 420 electronic handwheel is active, the operation of the machine via keypad is locked.

Keyboards currently used:

Keyboard Unit	Windows Keys	smarT.NC keys	Touchpad
TE 420	-	-	-
TE 520 B	X	X	-
TE 530	X	-	X
TE 530 B	X	X	X
TE 535 Q	X	X	X

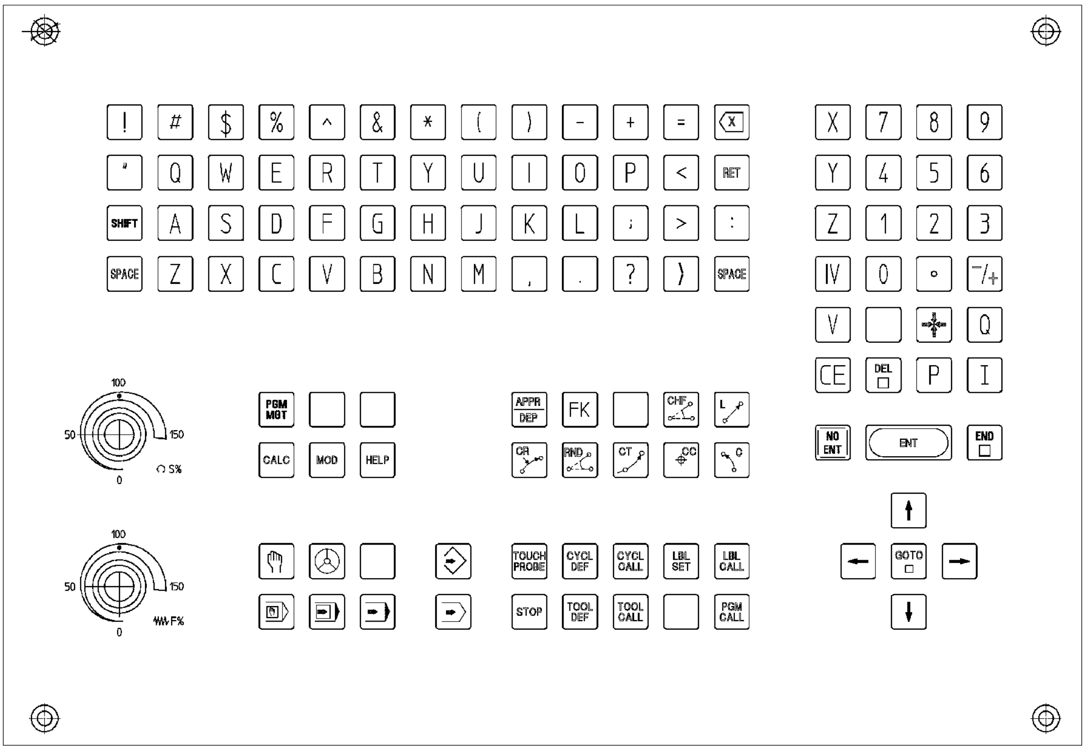
Note

The **TE 420** was **conceived for** the use on a **TNC 426/430**. It can also be used for an iTNC 530 single-processor control.
The **TE 535 Q** is a **keyboard unit including a machine operating panel**.

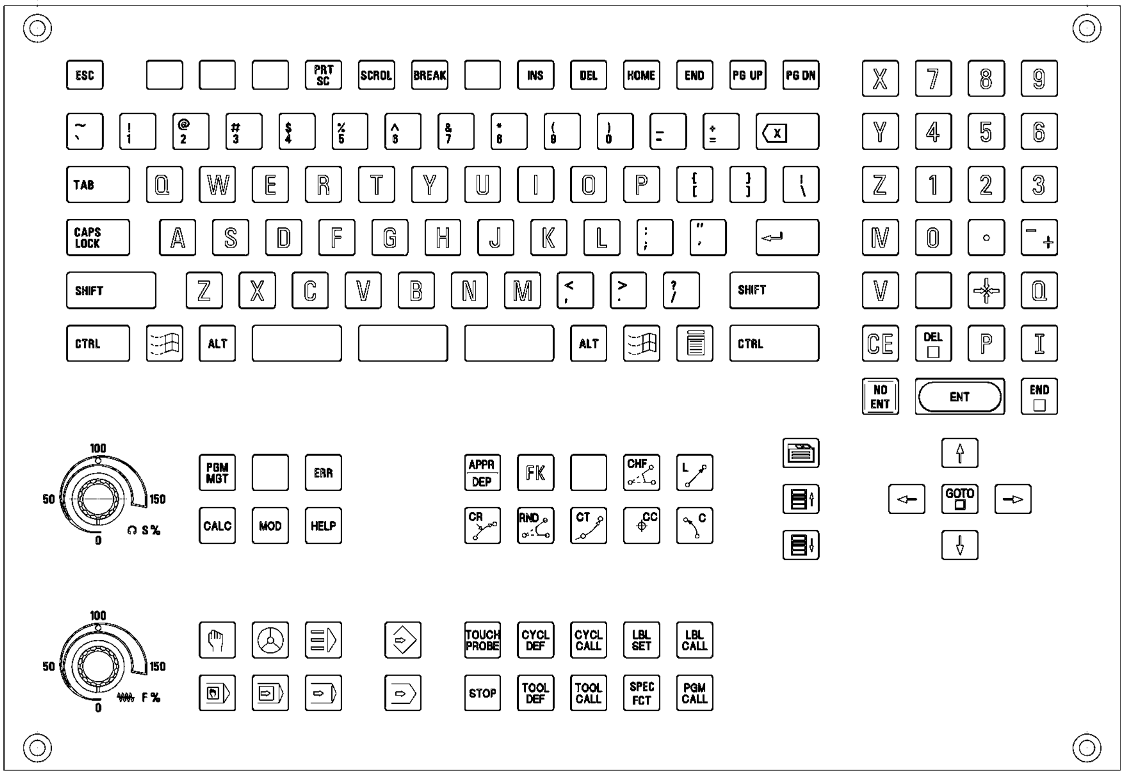
Machine-specific keyboards are also used, which however work according to the same principle.

22.2 Front View of the Keyboard Units

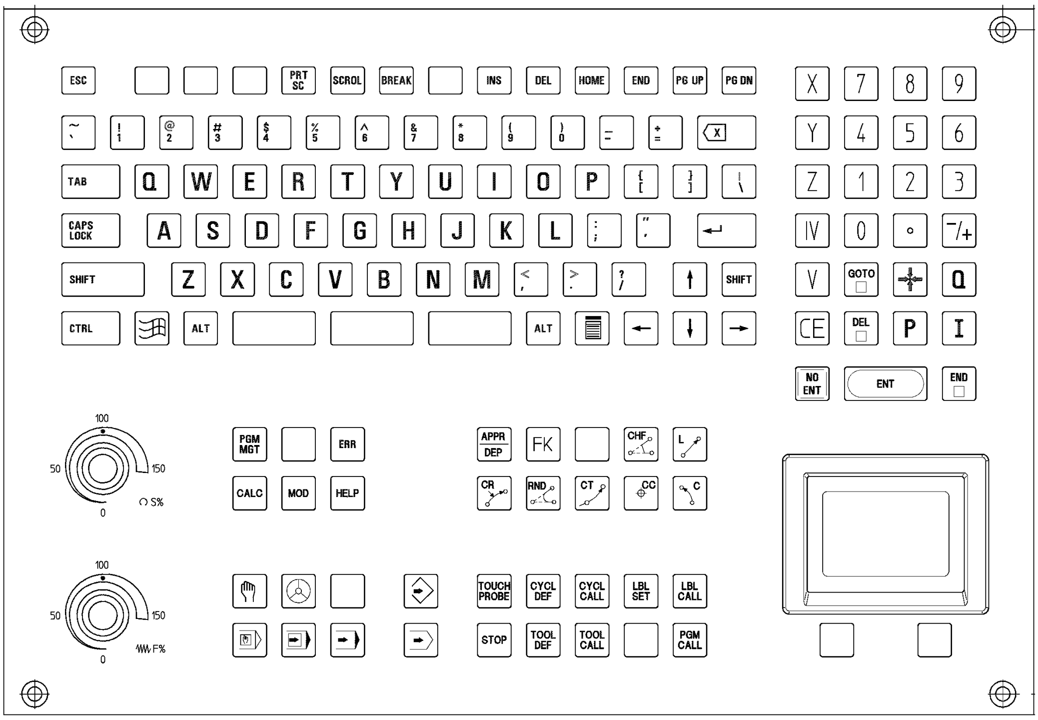
TE 420



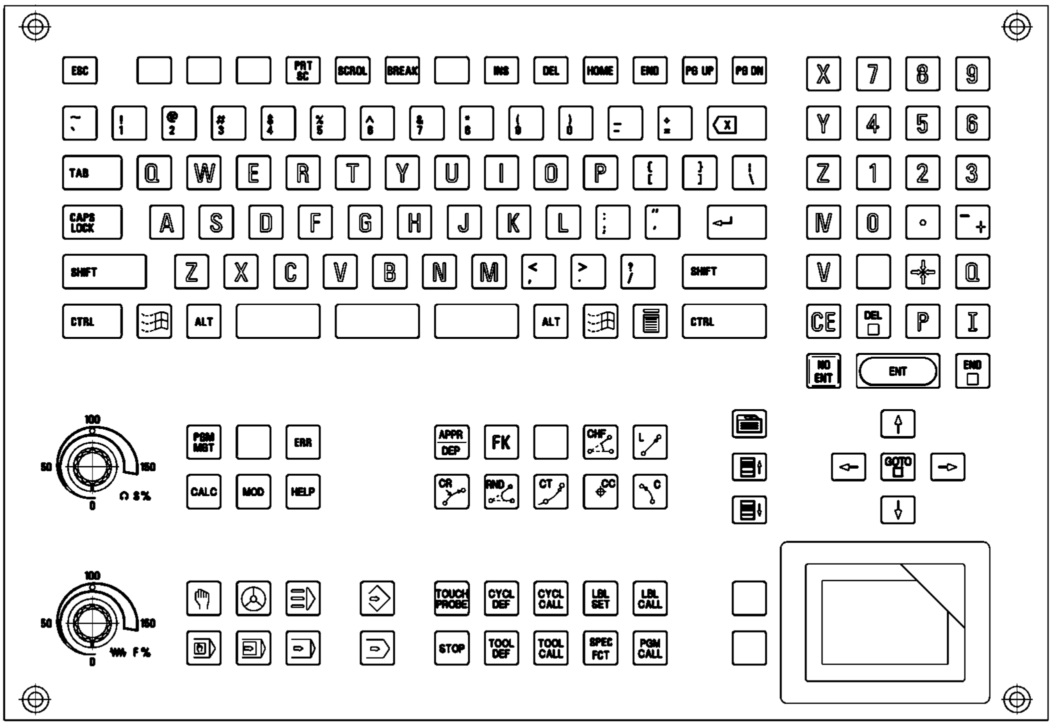
TE 520 B



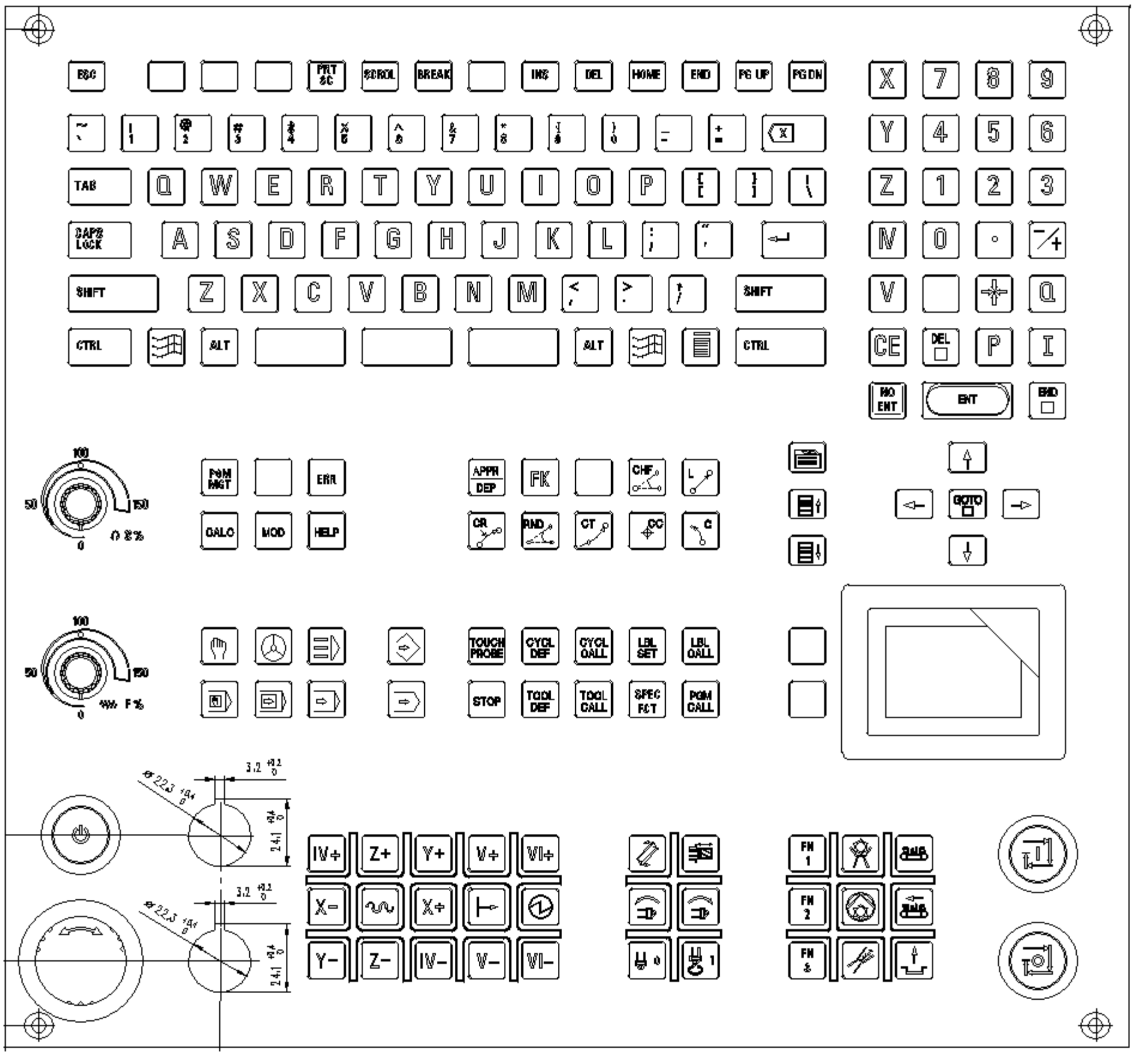
TE 530



TE 530 B



TE 535 Q



22.3 Possible Causes of Error

- Strong contramination --> Key functions are possibly damaged.
- 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 keypad board
- Defective cable between screen and keypad (screen softkeys)
- Defective cable between keypad and control
- Potentiometer wiper worn
- Defective touchpad
- Defective interface on the control

22.4 Checking the Keys

This includes the **hard keys on the TE keypad unit** and the **soft keys on the BF flat-panel display**. The soft-keys rows of the screen are connected by ribbon cable with the keypad board.

> **Note**
>
> See the chapter "Machine Operating Panel" how to check the machine operating panel keys on the TE 535 Q.

Correct operation?

Make sure that the key really functions in the selected operating mode. –> Consult the machine operator or see user's manual!

Visual inspection

First check the keypad visually!

- 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 22 – 371.

- Is the **key or the area around it heavily worn out?**

This is an indication that the service life of the tool has expired and that is 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:

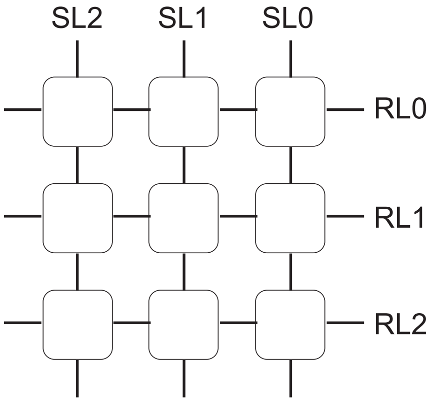
- Switch on the machine.
- Press the EMERGENCY STOP key.
- Call the table with the PLC words. –> See "The TABLE function" on page 11 – 119.
- Place the cursor on word 274.
- Press the key to be examined and check if the display changes to a **key code** or if the key **reacts accordingly**!

> **Note**
>
> The key code is secondary. 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 keyboard cable or the control is defective. Further tests are required. --> See following descriptions!

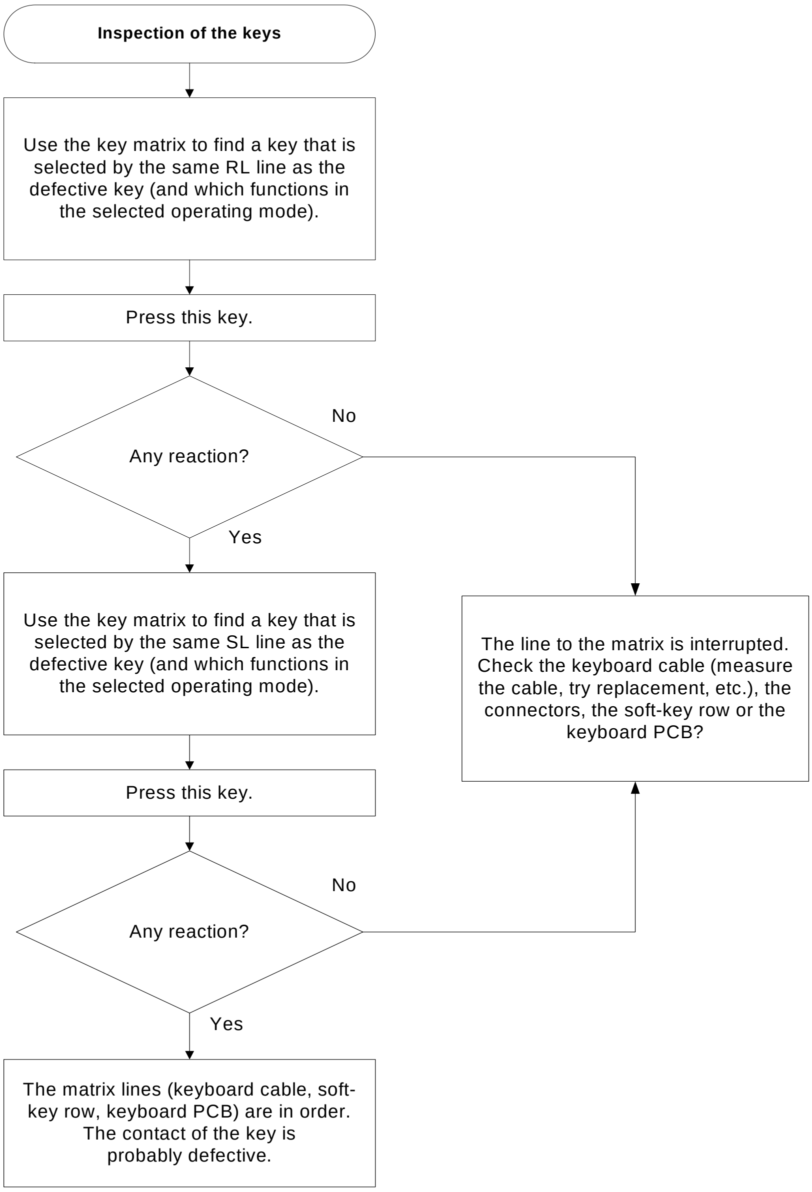
Principle of the key matrix

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 22 – 372 or See “Key Matrix of the Visual Units” on page 22 – 388.



Flowchart

Is a line (cable, board), the key element of the keyboard or the soft-key row of the screen?



Measuring setup with test adapter

The setup described below allows to make an almost complete statement about the condition of the connected keypad.
However, a special appliance is required. --> See “Test Adapter” on page 29 – 562.

Note

If no test adapter is available, you can measure directly at the contacts of the keyboard cable or the keyboard.
However, this is very cumbersome, since you must contact the right pins precisely while pressing the key to be inspected!

Test inclusive keyboard cable:

- Shut down the control and switch off the machine.
- Disconnect the keypad cable on connector X45 of the MC.
- Connect the keypad cable to the test adapter.

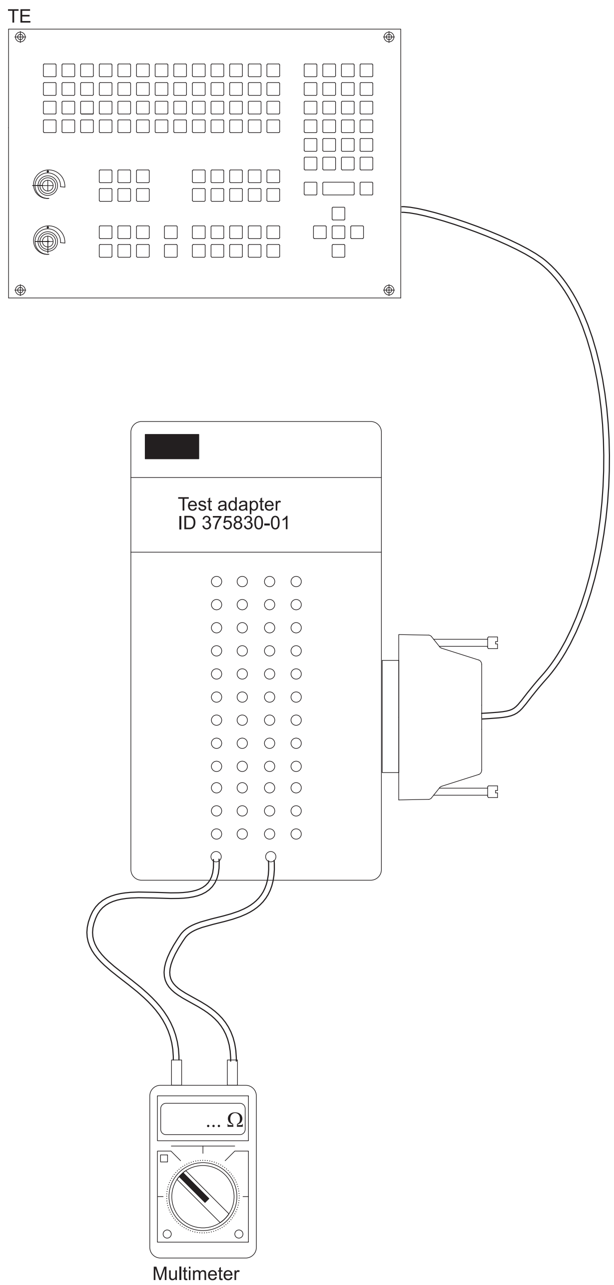


Figure: Keyboard test with test adapter and multimeter

- Connect the measuring lines of a multimeter to the banana jacks of the test adapter. Use the respective key matrix with the pin layout. --> See “Key Matrix of the Keyboard Units” on page 22 – 372.
- Set the multimeter to "alarm" (acoustic signal) or to ohm measurement.
- Press the key to be examined. If the key functions, the multimeter will "ring". If you use ohm measurement, the measured resistance is approx. 1 ohm (consider the resistances of the measuring lines and the test adapter).

Note

Limitations for keypads as of TE 5xx:
A continuity test of the cross points of scan lines (SL) and the **return line 0** (RL 0) is not possible.
There are logical gates between RL 0 and the corresponding keys. These gates serve as keypad identifier as of TE 5 xx.
Direct ohm measurement is thus not possible here.

Test without keyboard cable:

- Shut down the control and switch off the machine.
- Dismount the keyboard from the console.
- Disconnect the keyboard cable.
- Instead connect the test adapter with the respective adapter cable.
- Executions and restrictions. --> See test incl. keyboard cable.

Test adapter replaces keyboard

The **functioning of the keypad interface** on the MC can also be tested with the test adapter as well as the functioning of the keyboard:

- Shut down the control and switch off the machine.
- Disconnect the keypad from the MC.
- Connect the test adapter instead to connector X45 of the MC.
- Switch on the machine.
- **Press the EMERGENCY STOP key.**
- You can now simulate the pressing of keys by bridging the corresponding pin sockets on the test adapter (see key matrix which sockets must be connected).

Caution

Do not cause a short circuit of the potentiometer voltage (pin 36 and 37)!

- Observe the keys, e.g. in the PLC-TABLE.

Note

As the keypad interface X45 on the MC is designed as female, you can also connect the pins with a bridge and thus conduct a simulation by pressing the keys.

22.5 Checking the Potentiometers

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.

The potentiometer setting is shown in the following **PLC words**:

- **W492** (=S override)
- **W494** (= F override)

Proceed as follows:

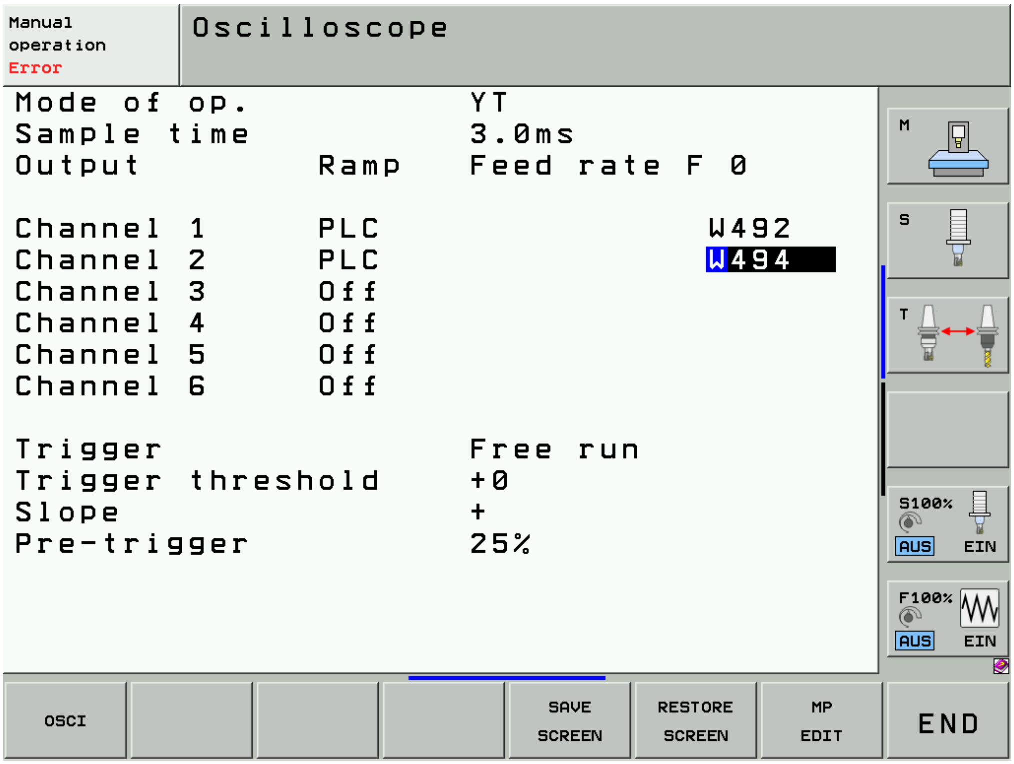
- Switch on the machine.
- Press the EMERGENCY STOP button.
- Call the table with the PLC words. --> See “The TABLE function” on page 11 – 119.
- Place the cursor on W492 or W494 (e.g., GOTO 492).
- Select the decimal display (soft key).
- Turn the potentiometer to be examined.
- Check if the display can be changed from 0 to 15000 (with nonlinear characteristic curve) or 0 to 150 (with linear characteristic curve).
  The characteristic curve is defined in MP 7620 bit 3.

Potentiometer values in the integrated oscilloscope

With the integrated oscilloscope you can record the states of PLC words as well.
The advantage of this method is that possible wiper interruptions of the potentiometers can be recognized better than in the PLC TABLE.

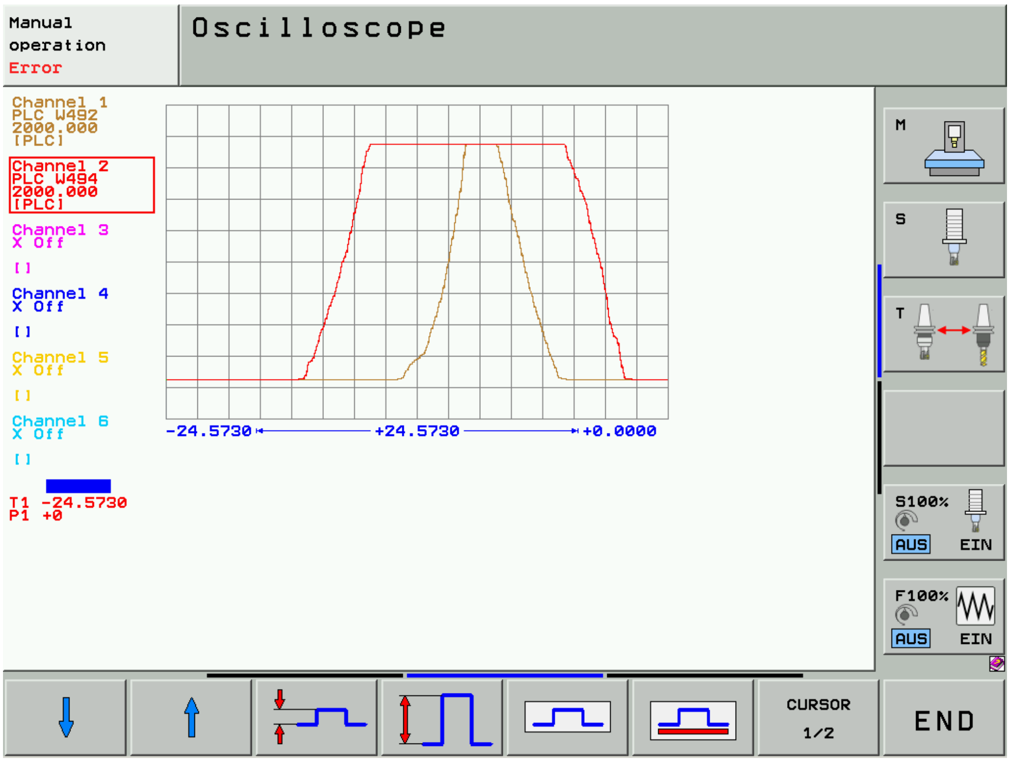
Proceed as follows:

- Switch on the machine.
- Press the EMERGENCY STOP key.
- Call the oscilloscope. --> See “Integrated Oscilloscope” on page 10 – 99.
- Make the following settings:



- Start the 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.



Measuring setup with test adapter

Procedure:

- ▶ Shut down the control and switch off the machine.
- ▶ Insert the measuring adapter on the MC connector X45 between MC and TE cable.
- ▶ Switch the machine back on again.
- ▶ Using a multimeter, check the collector voltages of the potentiometers.

Potentiometers	Pins		Voltage range
Feedrate override F%	37 = 0V	35 = wiper potentiometer	0 ... approx. + 5V
Spindle override S%	37 = 0V	34 = wiper potentiometer	0 ... approx. + 5V

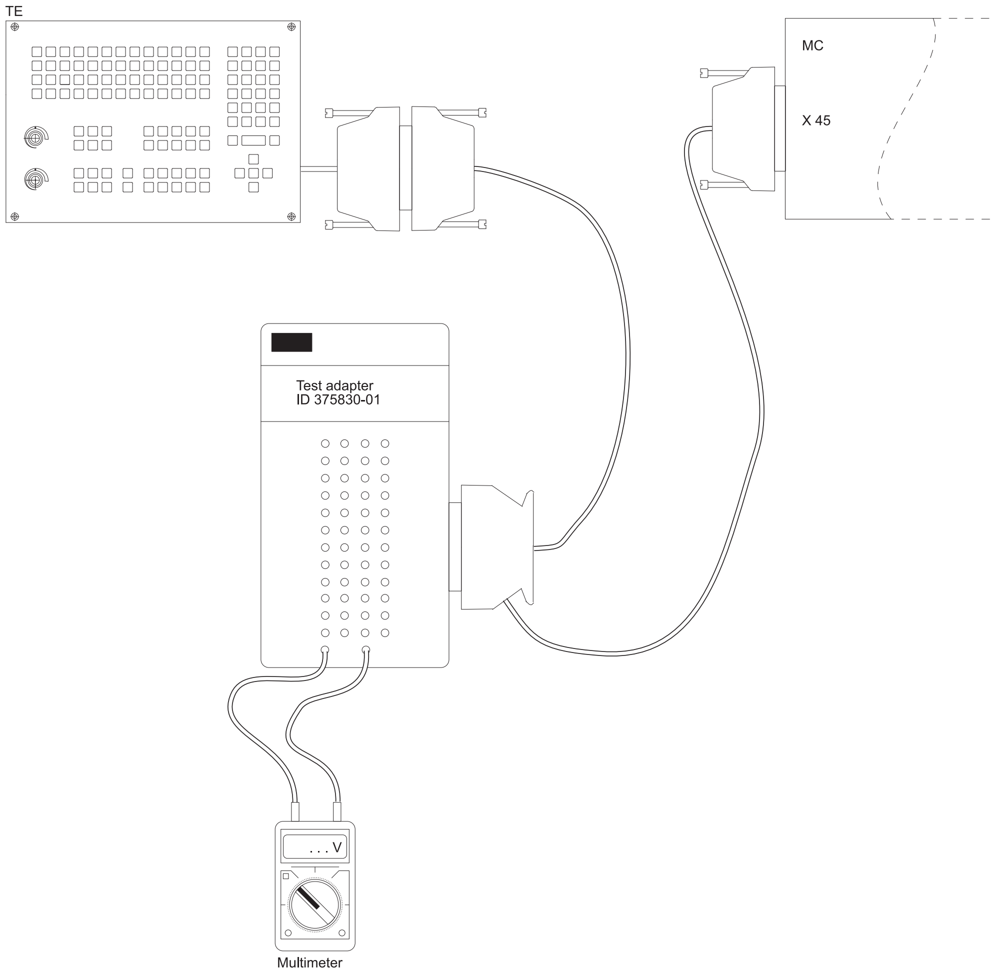


Figure: Potentiometer test with test adapter and multimeter

22.6 Checking the Touchpads

The touchpad (= mousepad) on the keyboards TE 530, TE 530 B and TE 535 Q is required and functions with:

- iTNC 530 dual-processor control with Windows
- iTNC 530 single-processor control as of NC software 34049x-xx (smarT.NC)

This touchpad is not connected to the MC via keypad connector X45 but with a USB cable to one of the two USB interfaces of the MC (X141, X142).

If the touchpad does not function, carry out the following test to find out if the touchpad itself or the interface on the control is defective:

Second USB interfaces

- Connect the touchpad to the second USB connection of the control (X141 or X142).
- Reboot the control.
- Test the function of the touch pad.

Other mouse

- Connect a commercially available mouse to the USB connectors of the control (the mouse should function on a PC with Windows).
- Reboot the control.
- Now test whether the mouse functions.

Touchpad on laptop

- Connect the touchpad of the control to a laptop (if required, use expansion for USB cable).
- Test the function.

Note

The laptop must feature a Windows operating system with the respective mouse driver. If necessary, adapt the respective Windows settings. --> "My computer/Control Panel/ Mouse ..."

22.7 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.

> **Caution**
>
> Observe the ESD precautions. --> See "Important Information" on page 28 – 523!

- 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 have been used, the electrical devices must dry completely before they may be operated again.

- Reassemble the keyboard.

> **Note**
>
> Put the rubber mats back into the frame as they were before.

Potentiometer

Replace the defective potentiometer.

Control

If you have found that the TE interface of the control is defective (connector X45), replace the MC. --> See "Exchange of HEIDENHAIN Components" on page 28 – 523.

22.8 Key Matrix of the Keyboard Units

TE 520 B
TE 530
TE 530 B
TE 535 Q

The keys of the range of the machine operating panel of the TE 535 Q are not listed. --> See “Machine Operating Panel” on page 23 – 389.

X2 Pin key		ESC				PRT SC	SCROL	BREAK		INS	DEL	HOME	END	PG UP	PG DN
1	RL0														
2	1														
3	2														
4	3														
5	4														
6	5														
7	6														
8	7														
9	8														
10	9														
12	11		X	X											
13	12						X	X							
14	13					X									
15	14								X						
16	15														
17	16				X										
18	17														
19	18														
28	19														
29	20											X		X	
31	21														
32	22	X								X					X
33	23										X		X		
20	SL0														
21	1														
22	2		X												
23	3	X		X									X		
24	4				X										
25	5									X	X				
26	6							X	X			X			
27	7					X	X							X	X

X2 Pin key		X	7	8	9	~ `	! 1	@ 2	# 3	$ 4	% 5	^ 6	& 7	* 8	(9	) 0
1	RL0				X											
2	1			X												
3	2		X													
4	3	X														
5	4															
6	5															
7	6															
8	7															
9	8															
10	9															
12	11															
13	12															
14	13															
15	14															
16	15															
17	16						X		X							
18	17									X	X					
19	18											X	X			
28	19													X	X	
29	20															X
31	21							X								
32	22					X										
33	23															
20	SL0						X			X		X		X		X
21	1					X		X	X		X		X		X	
22	2															
23	3															
24	4	X	X	X	X											
25	5															
26	6															
27	7															

X2 Pin	key	– –	+ =	⌫ X	Y	4	5	6	TAB	Q	W	E	R	T	Y
1	RL0							X							
2	1						X								
3	2					X									
4	3				X										
5	4														
6	5														
7	6														
8	7														
9	8														
10	9														
12	11														
13	12														
14	13														
15	14														
16	15														
17	16									X					
18	17										X	X			
19	18												X	X	
28	19														X
29	20	X													
31	21		X												
32	22			X					X						
33	23														
20	SL0		X	X											
21	1	X													
22	2										X		X		X
23	3				X	X	X	X		X		X		X	
24	4														
25	5														
26	6								X						
27	7														

X2 Pin key		U	I	O	P	{ [	}]	¦ \	Z	1	2	3	CAPS LOCK	A	S	D
1	RL0											X				
2	1										X					
3	2									X						
4	3								X							
5	4															
6	5															
7	6															
8	7															
9	8															
10	9															
12	11															
13	12															
14	13												X			
15	14															
16	15															
17	16													X		
18	17														X	X
19	18															
28	19	X														
29	20		X	X												
31	21				X			X								
32	22					X										
33	23						X									
20	SL0															
21	1															
22	2		X		X				X	X	X	X				
23	3	X		X												
24	4					X	X								X	
25	5													X		X
26	6												X			
27	7							X								

X2 Pin key		F	G	H	J	K	L	: ;	" ,	↵	IV	0	.	-/+	SHIFT
1	RL0													X	
2	1											X			
3	2												X		
4	3										X				
5	4														
6	5														
7	6														
8	7														
9	8														
10	9														
12	11														
13	12														
14	13														
15	14														
16	15														
17	16								X						
18	17														
19	18	X	X												
28	19			X	X										
29	20					X	X								
31	21							X							
32	22									X					
33	23														X
20	SL0														X
21	1										X	X	X	X	
22	2								X	X					
23	3														
24	4	X		X		X		X							
25	5		X		X		X								
26	6														
27	7														

X2 Pin	key	Z	X	C	V	B	N	M	< ,	> .	? /	SHIFT	V		
1	RL0														
2	1														
3	2														X
4	3														
5	4														
6	5														
7	6													X	
8	7														
9	8												X		
10	9														
12	11														
13	12														
14	13														
15	14														
16	15														
17	16	X													
18	17		X	X											
19	18				X	X									
28	19						X	X							
29	20														
31	21								X	X	X				
32	22														
33	23											X			
20	SL0														
21	1											X			
22	2														
23	3								X						
24	4												X		
25	5									X					X
26	6		X		X		X				X			X	
27	7	X		X		X		X							

X2 Pin	key	Q	CTRL		ALT		ALT			CTRL	CE	DEL	P	I
1	RL0													
2	1													
3	2	X												
4	3											X	X	
5	4										X			X
6	5													
7	6													
8	7													
9	8													
10	9													
12	11				X		X							
13	12													
14	13							X						
15	14			X										
16	15		X							X				
17	16					X								
18	17													
19	18													
28	19													
29	20													
31	21													
32	22													
33	23								X					
20	SL0	X			X									
21	1						X							
22	2								X					
23	3													
24	4													
25	5							X		X	X	X		
26	6		X											
27	7			X		X							X	X

X2 Pin	key	NO ENT	ENT	END □	PGM MGT		ERR	APPR DEP	FK		CHF	L	CALC	MOD	HELP
1	RL0		X	X											
2	1	X													X
3	2														
4	3														
5	4												X		
6	5						X							X	
7	6					X									
8	7				X							X			
9	8							X	X	X	X				
10	9														
12	11														
13	12														
14	13														
15	14														
16	15														
17	16														
18	17														
19	18														
28	19														
29	20														
31	21														
32	22														
33	23														
20	SL0			X				X							
21	1								X						
22	2									X				X	
23	3										X	X			
24	4				X	X	X						X		
25	5	X	X												
26	6														
27	7														X

X2 Pin	key	CR	RND	CT	CC	C					TOUCH PROBE	CYCL DEF	CYCL CALL	LBL SET	LBL CALL
1	RL0						X	X							
2	1								X						
3	2														
4	3										X				
5	4					X				X					X
6	5				X									X	
7	6	X	X										X		
8	7			X								X			
9	8														
10	9														
12	11														
13	12														
14	13														
15	14														
16	15														
17	16														
18	17														
19	18														
28	19														
29	20														
31	21														
32	22														
33	23														
20	SL0								X		X				
21	1											X	X	X	X
22	2		X	X											
23	3	X			X	X									
24	4														
25	5														
26	6						X			X					
27	7							X							

X2 Pin key						STOP	TOOL DEF	TOOL CALL	SPEC FCT	PGM CALL					GOTO
1	RL0														
2	1	X													
3	2		X		X										
4	3			X											
5	4					X				X					
6	5								X			X	X		
7	6							X							X
8	7						X				X			X	
9	8														
10	9														
12	11														
13	12														
14	13														
15	14														
16	15														
17	16														
18	17														
19	18														
28	19														
29	20														
31	21														
32	22														
33	23														
20	SL0						X	X	X	X					
21	1														
22	2					X									
23	3														
24	4														
25	5										X	X			X
26	6	X	X	X									X	X	
27	7				X										

X2 Pin key				
1	RL0			
2	1			
3	2			
4	3			
5	4			
6	5			
7	6			
8	7			
9	8			
10	9	X	X	X
12	11			
13	12			
14	13			
15	14			
16	15			
17	16			
18	17			
19	18			
28	19			
29	20			
31	21			
32	22			
33	23			
20	SL0	X		
21	1		X	
22	2			X
23	3			
24	4			
25	5			
26	6			
27	7			

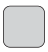
Note

The two keys under or left to the touchpad do not belong to the key matrix!
If these keys are pressed, the signal is transmitted to the control via USB interface.

TE 420

X2 Pin	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
key	RL0	1	2	3	4	5	6	7	8	16	17	18	19	20	21	22	SL0	1	2	3	4	5	6	7
!										X							X							
#										X								X						
$											X						X							
%											X							X						
^												X					X							
&												X						X						
*													X				X							
(													X					X						
)														X			X							
−														X				X						
+															X		X							
=															X			X						
⌫																X	X							
"										X									X					
Q										X										X				
W											X								X					
E											X									X				
R												X							X					
T												X								X				
Y													X						X					
U													X							X				
I														X					X					
O														X						X				
P															X				X					
<															X					X				
RET																X			X					

X2 Pin	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
key	RL0	1	2	3	4	5	6	7	8	16	17	18	19	20	21	22	SL0	1	2	3	4	5	6	7
SHIFT										X											X			
A										X												X		
S											X										X			
D											X											X		
F												X									X			
G												X										X		
H													X								X			
J													X									X		
K														X							X			
L														X								X		
;															X						X			
>															X							X		
:																X					X			
SPACE										X													X	
Z										X														X
X											X												X	
C											X													X
V												X											X	
B												X												X
N													X										X	
M													X											X
,														X									X	
.														X										X
?															X								X	
)															X									X
SPACE																X							X	
PGM MGT								X													X			

X2 key Pin	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
	RL0	1	2	3	4	5	6	7	8	16	17	18	19	20	21	22	SL0	1	2	3	4	5	6	7
							X														X			
						X															X			
CALC					X																X			
MOD						X													X					
HELP			X																					X
	X																						X	
	X																							X
		X															X							
					X																		X	
		X																					X	
			X																				X	
				X																			X	
			X																					X
APPR DEP									X								X							
FK									X									X						
									X										X					
CHF									X											X				
L								X												X				
CR							X													X				
RND							X												X					
CT								X											X					
CC						X														X				
C					X															X				
TOUCH PROBE				X													X							
CYCL DEF								X										X						
CYCL CALL							X											X						
LBL SET						X												X						

X2 Pin key	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
	RL0	1	2	3	4	5	6	7	8	16	17	18	19	20	21	22	SL0	1	2	3	4	5	6	7
LBL CALL					X													X						
STOP					X														X					
TOOL DEF								X									X							
TOOL CALL							X										X							
						X											X							
PGM CALL					X												X							
X				X																	X			
7			X																		X			
8		X																			X			
9	X																				X			
Y				X																X				
4			X																	X				
5		X																		X				
6	X																			X				
Z				X															X					
1			X																X					
2		X																	X					
3	X																		X					
IV				X														X						
0		X																X						
.			X															X						
-/+	X																	X						
V									X												X			
									X													X		
			X																			X		
Q			X														X							
CE					X																	X		

X2 Pin key	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
	RL0	1	2	3	4	5	6	7	8	16	17	18	19	20	21	22	SL0	1	2	3	4	5	6	7
DEL				X																		X		
P				X																				X
I					X																			X
NO ENT		X																				X		
ENT	X																					X		
END	X																X							
↑								X														X		
←						X																X		
GOTO							X															X		
→								X															X	
↓						X																	X	

22.9 Key Matrix of the Visual Units

BF 150

Vertical soft keys:

X1 Pin	**9**	**8**	**7**	**6**	**1**	**2**	**3**	**4**	**5**
X2 Pin	**13**	**14**	**15**	**16**	**20**	**21**	**22**	**23**	**24**
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

X1 and X2 are the connections to the keyboard unit

X1: Connection for ribbon cable display unit=> keyboard unit (plug-type connector)
X2: Connection for cable keyboard unit => MC (D-Sub 37-pin)
MF = Vertical soft keys (MF1..MF6 from top to bottom)

BF120
BF 150

Horizontal soft keys:

X1 Pin	X2 Pin	Matrix	↺	◁	SK1	SK2	SK3	SK4	SK5	SK6	SK7	SK8	▷	↻
1	20	SL0	X											X
2	21	SL1		X	X	X	X							
3	22	SL2						X	X	X	X			
4	23	SL3										X	X	
9	13	RL12	X				X				X			
8	14	RL13				X				X				X
7	15	RL14			X				X				X	
6	16	RL15		X				X				X		

X1 and X2 are the connections to the keyboard unit

X1: Connection for ribbon cable display unit=> keyboard unit (plug-type connector)
X2: Connection for cable keyboard unit => MC (D-Sub 37-pin)
SK = Horizontal soft keys (SK1..SK8 from left to right)

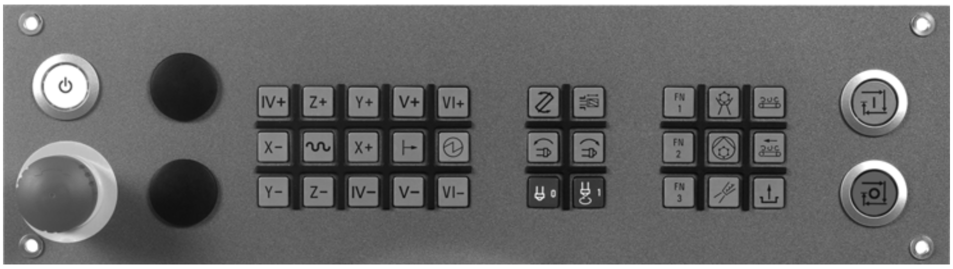
Note

The keys 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 in the log 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 recorded.
Any newly called soft-key row starts again with soft key 0 or V soft key 0.

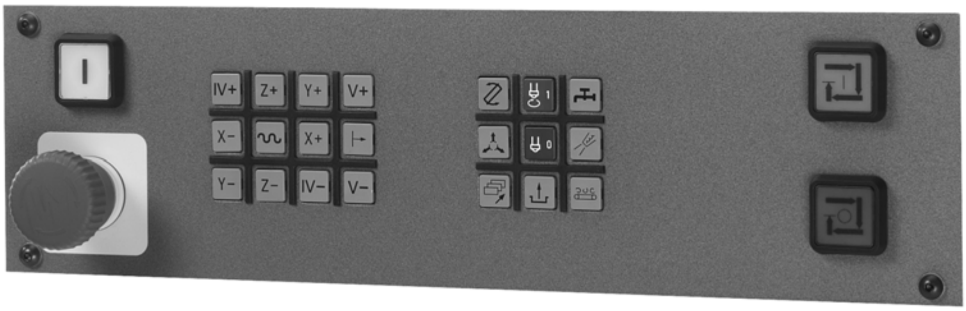
23 Machine Operating Panel

23.1 Introduction

HEIDENHAIN machine operating panel **MB 520** with axis-direction keys for up to 6 axes.



HEIDENHAIN machine operating panel **MB 420** with axis-direction keys for up to 5 axes.



The MB is normally mounted below the TNC keyboard.

You can find the following on the machine operating panels:

MB 520	MB 420
■ 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 buttons or key switches (blocked with a cover when shipped).	■ EMERGENCY STOP button ■ CONTROL ON button ■ NC START button ■ NC STOP button ■ Keys for spindle start and spindle stop ■ Axis direction keys for 5 axes ■ Various function keys

Note

The MB keys are snap-ons, and can be switched.

The machine operating panel is connected to **connector X46** of the MC.

The **keys and buttons** of the MB are transmitted as **PLC inputs** to the control.

The MB is provided with 8 PLC outputs (e.g., the lamps of the buttons can be controlled).

If a machine operating panel from the machine tool builder is used, please refer to its circuit diagram from which you can see the wiring of the keys.

DANGER

HEIDENHAIN recommends to check the function of the EMERGENCY STOP button on the machine operating panel or operating tableau in regular intervals!

Note

The TE 535Q features an integrated machine operating panel.

23.2 Possible Causes of Errors

- Severe contamination --> Key functions are possibly damaged.
- 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.

- Defective cable between MB and control
- Connector defective
- Supply voltage missing
- Defective PLC output
- Lamp in the button has burn through
- Liquid has penetrated
- Board defective
- Defective interface on the control

23.3 Checking the Power Supply

Power is supplied on the following connectors and pins:

MB 420	MB 520	Pin layout
Connector X1 (or connector X46 on the MC)	**Connector X3 (or connector X46 on the MC)**	
Pin 34, 35	Pin 34, 35	0 V
Pin 36, 37	Pin 36, 37	24 V (PLC)

Check whether the power supply is in order:

Measuring setup with test adapter

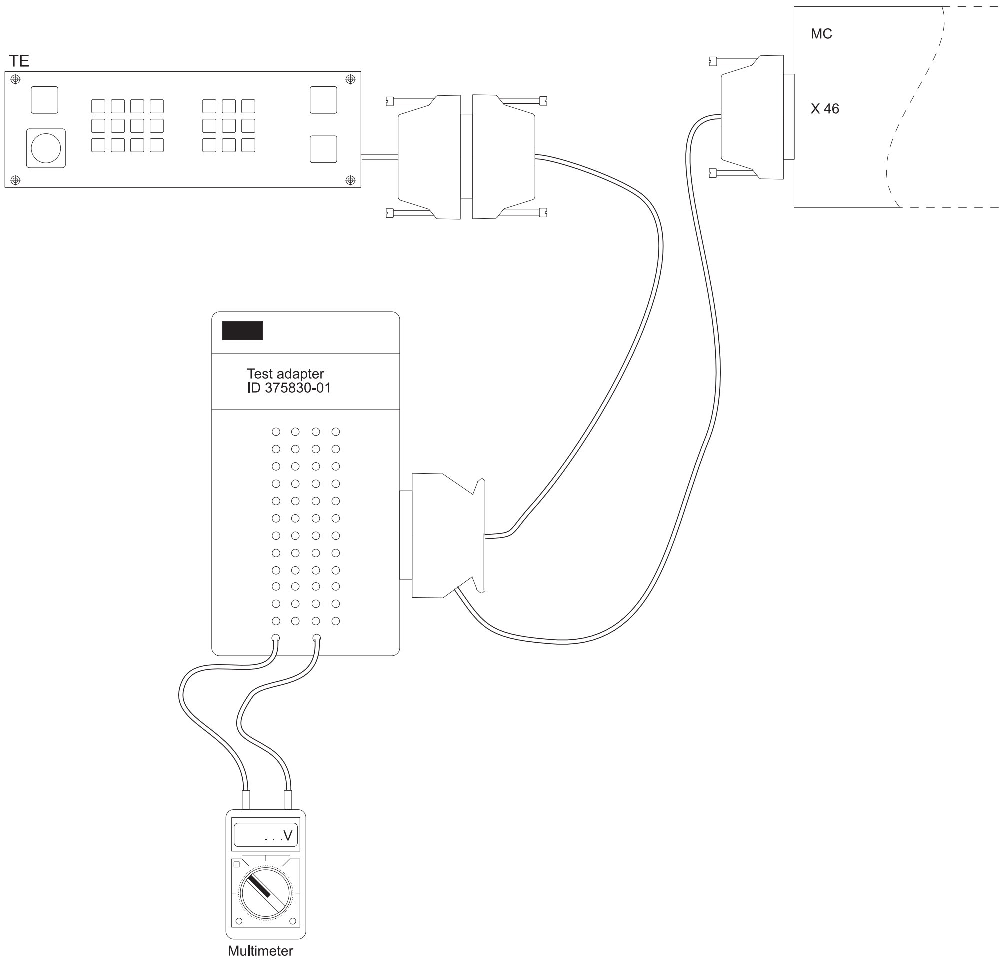


Figure: Voltage management with test adapter

Procedure:

- Shut down the control and switch off the machine.
- Connect the test adapter between MB and control (See “Test Adapter” on page 29 – 562).
- Switch the machine back on again.
- Check the supply voltage at the pins concerned with a multimeter.

23.4 Checking the Keys

Correct operation?

▶ Make sure that the key really functions in the selected operating mode. --> Consult the machine operator or see user's manual!

Visual inspection

▶ First check the keypad visually!

- 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 23 – 398.

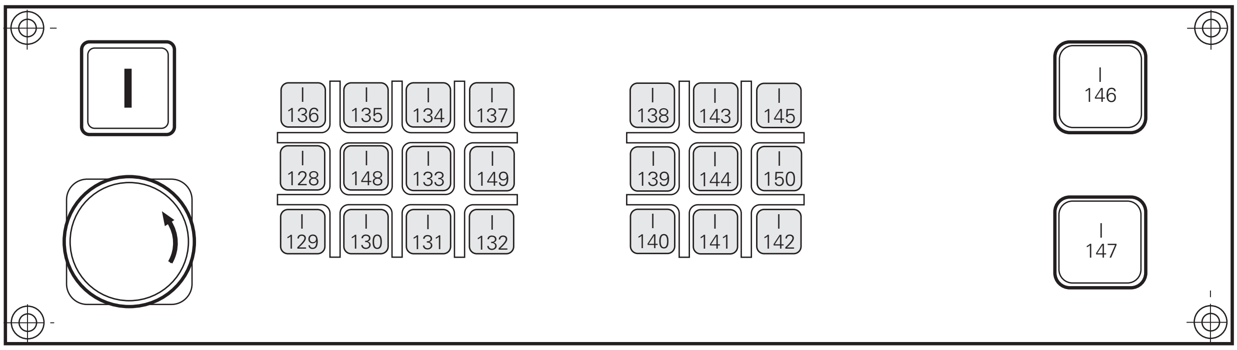
- Is the **key or the area around it heavily worn out?**

This is an indication that the service life of the tool has expired and that it does not make contact any longer.

Does the control receive the key signal?

The keys and buttons of the MB are assigned to PLC inputs:

Assignment of the **PLC inputs** to the keys of the **MB 420**:

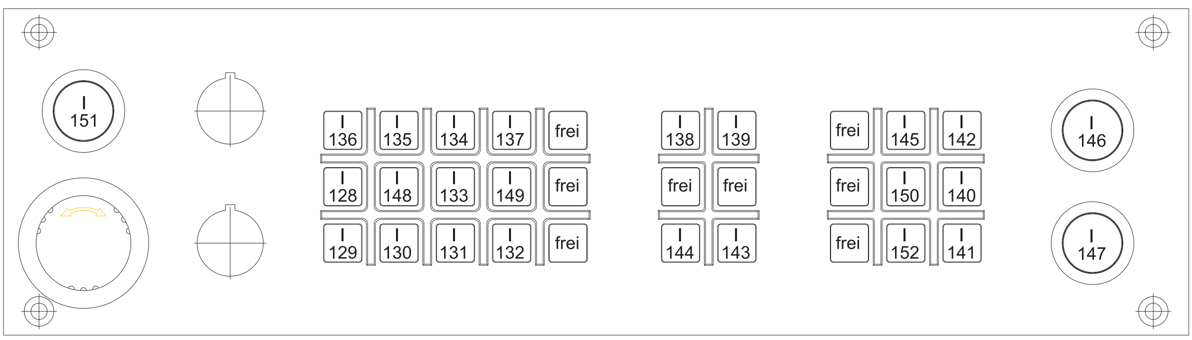


Two further inputs (I151 and I152) may be wired via terminal block X3:

Terminal X3	Pin layout
1	I151
2	I152
3	+24 V

Here, for example, the CONTROL ON button is interrogated. --> See circuit diagram of the machine.

Assignment of the **PLC inputs** to the keys of the **MB 520**:



The machine manufacturer can assign the keys marked with "free" to any PLC input. --> See circuit diagrams of the machine.

With the **table for the PLC inputs** you can check the **condition of the MB keys** (pressed or not):

- Switch on the machine.
- Press the EMERGENCY STOP button.
- Call the table with the PLC inputs. –> See “The TABLE function” on page 11 – 119.
- Press the keys. --> The respective **inputs must change to 1**!
  Exception: **I147 = NC STOP, changes to 0 when actuated** (broken wire interlock!)

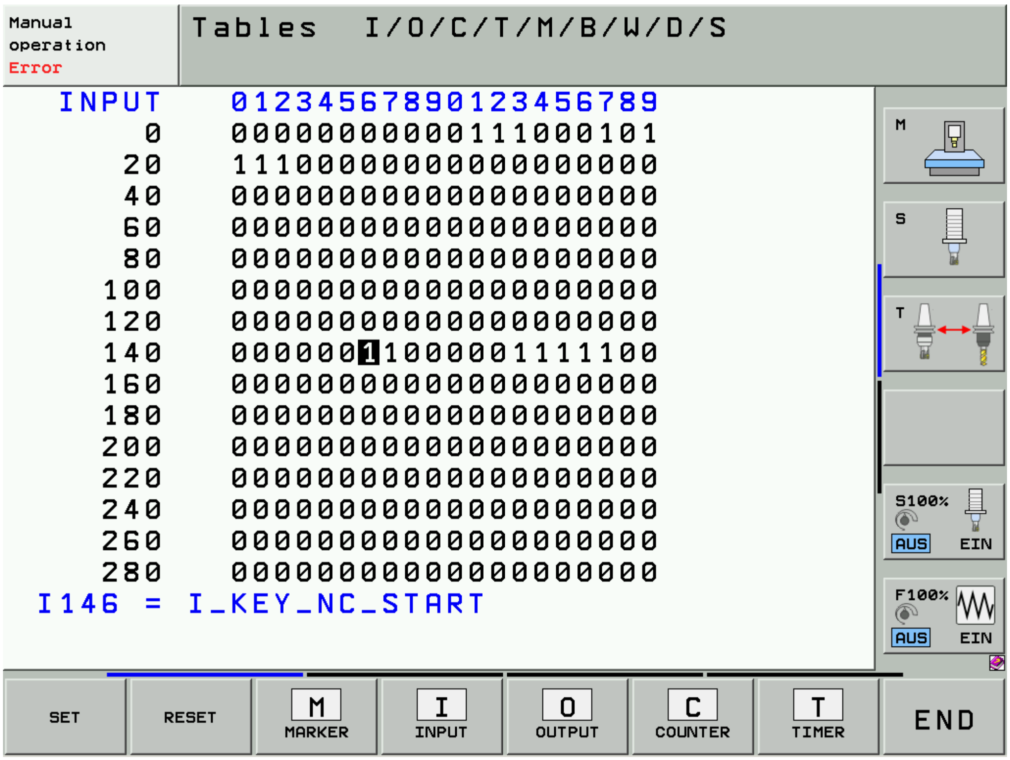


Figure: Observation of the NC-START button in the PLC table

> **Note**
>
> You can measure the voltage of the inputs, e.g., with a connected test adapter.
> The logic state in the PLC-TABLE must be in agreement with the voltage level of each input!

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 – 125.
- Define the INPUTs for the following recording.
- Start the recording.
- Press the keys. --> The respective **inputs must change to 1**!
  Exception: **I147 = NC STOP, changes to 0 when actuated** (broken wire interlock!)

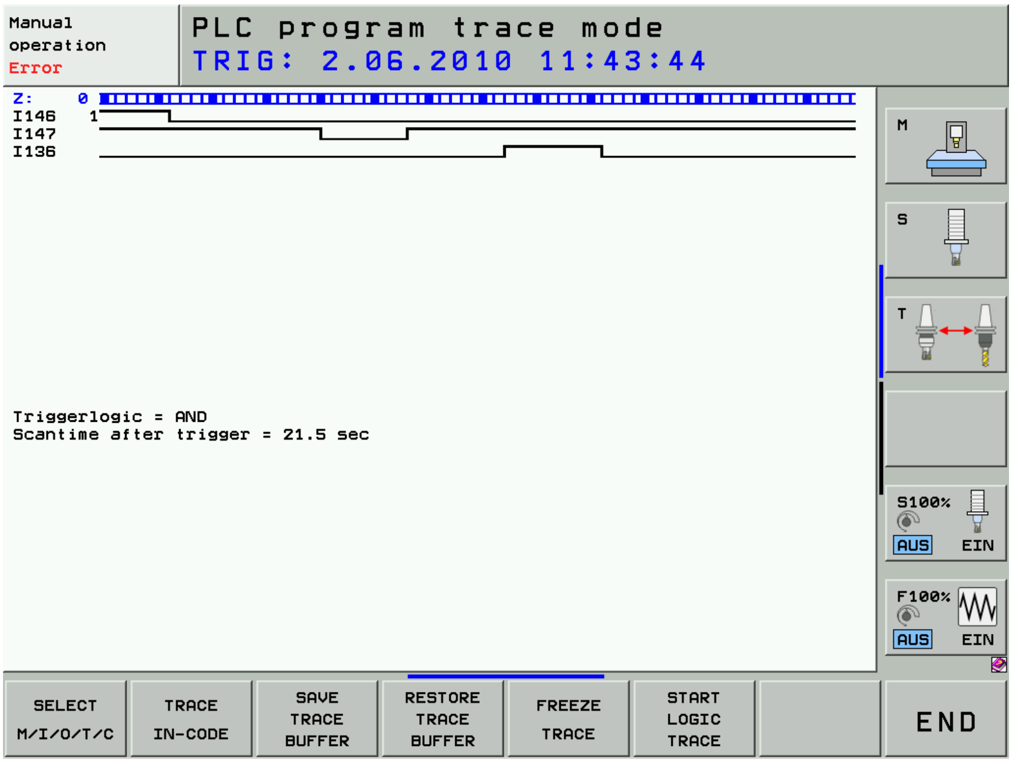


Figure: Recording of NC START and NC STOP buttons in the logic diagram

Note

If a key does not produce a reaction of the control, one does not know, whether the pushbutton itself or the machine operating panel PCB, the MB cable or the control is defective.
If required, further tests can be performed. --> See following descriptions!

Measuring setup with test adapter

You require a special appliance for the following setup. --> See “Test Adapter” on page 29 – 562.

Note

If no test adapter is available, you can measure directly at the contacts of the MB cable or the machine operating panel.
However, this is very cumbersome, since you must contact the right pins precisely while pressing the key to be inspected!

Test inclusive MB cable:

- Shut down the control and switch off the machine.
- Disconnect the MB cable on connector X46 of the MC.
- Connect the MB cable to the test adapter.
- Connect the measuring lines of a multimeter to the banana jacks of the test adapter.
  Insert one line into socket 37 (or 36) and connect the other line with the socket for the respective key.
  Use the respective table with the pin layout. --> See “Machine Operating Panel” on page 27 – 499.
- Set the multimeter to "alarm" (acoustic signal) or to ohm measurement.
- Press the key to be examined. If the key functions, the multimeter will "ring". If you use ohm measurement, the measured resistance is approx. 1 ohm (consider the resistances of the measuring lines and the test adapter).

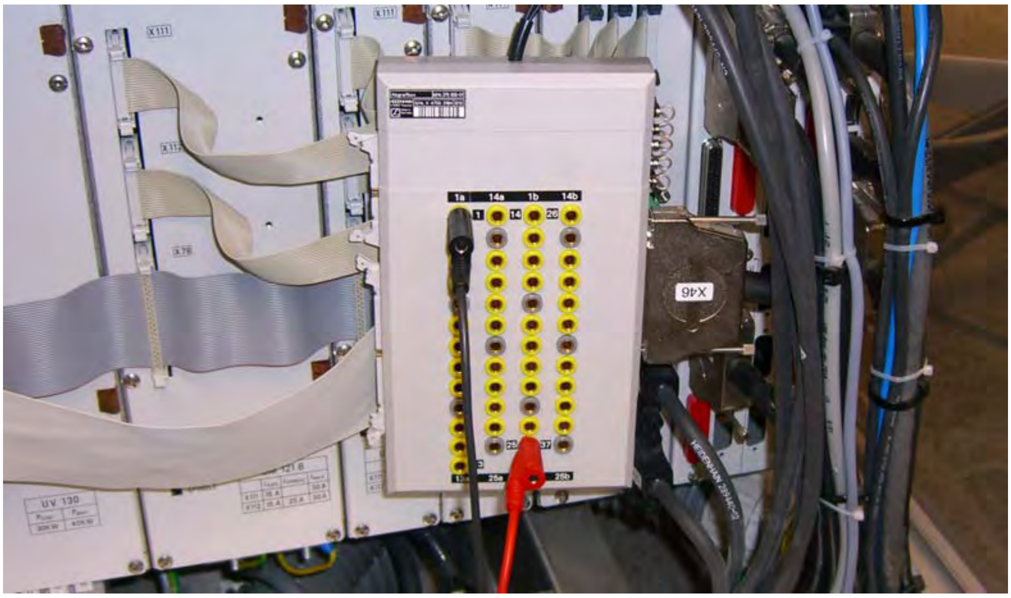


Figure: Keyboard test incl. cable with test adapter and multimeter

Test without MB cable:

- Shut down the control and switch off the machine.
- Dismount the machine operating panel from the console.
- Disconnect the MB cable.
- Instead connect the test adapter with the respective adapter cable.
- Execution. --> See test incl. MB cable.

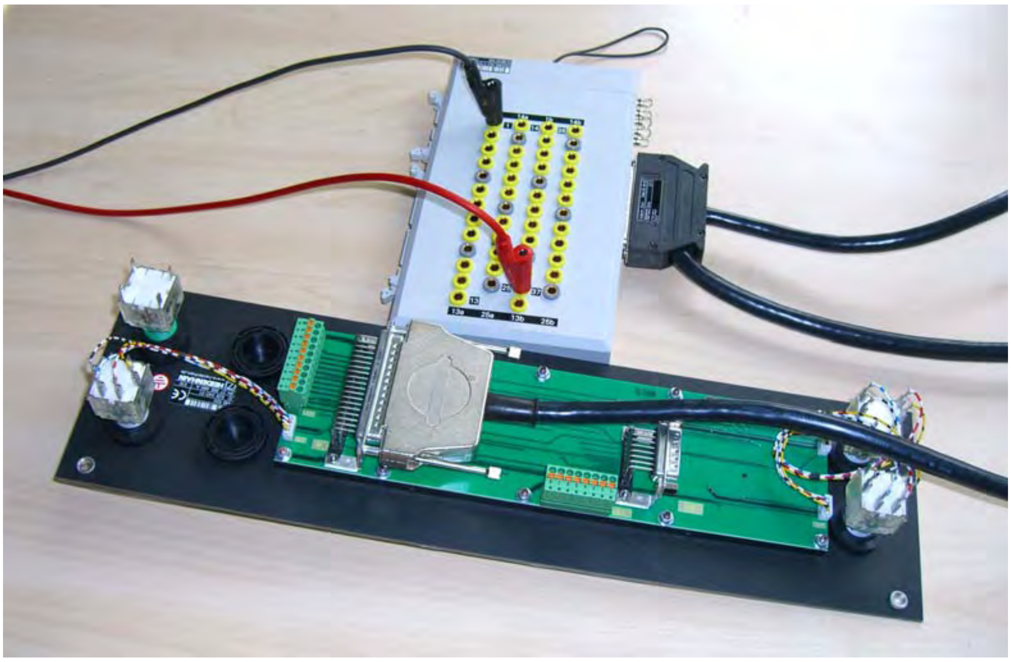


Figure: Keyboard test with test adapter and multimeter

Test adapter replaces MB

With the test adapter you can test the function of the machine operating panel as well as the **function of the MB interface** on the MC:

- Shut down the control and switch off the machine.
- Disconnect the MB cable from the MC.
- Connect the test adapter instead to connector X46 of the MC.
- Switch on the machine.
- **Press the EMERGENCY STOP button.**
- Use a line that you then insert into the socket 37 (or 36) of the test adapter.
- Insert the other end of the line into the socket for the respective key.
  Use the respective table with the pin layout. --> See “Machine Operating Panel” on page 27 – 499.
- You can simulate the pressing of keys by bridging the respective banana jacks on the test adapter.

Caution

Do not cause a short circuit of the voltage (pin 36/37 and pin 34/35)!

- Observe the keys, e.g. in the PLC-TABLE.

Note

As the MB interface X46 on the MC is designed as female, you can also connect the pins with a bridge and thus conduct a simulation by pressing the keys.

23.5 Checking the Outputs

The MB 420 and the MB 520 features 8 PLC outputs which serve, for example, to control the lamps of the buttons.
These outputs are located on the connecting line of the MB control and also on the following terminal blocks:

MB 420	MB 520	Pin layout
Terminal X4	**Terminal X12**	
1	1	O0
2	2	O1
3	3	O2
4	4	O3
5	5	O4
6	6	O5
7	7	O6
8	8	O7
9	9	0 V
-	10	+ 24 V

With the **table for the PLC outputs** you can check the condition of the outputs:

DANGER

Be sure to ascertain which function of the output to be inspected has on the machine.

- Call the table with the PLC outputs. --> See “The TABLE function” on page 11 – 119.
- 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.

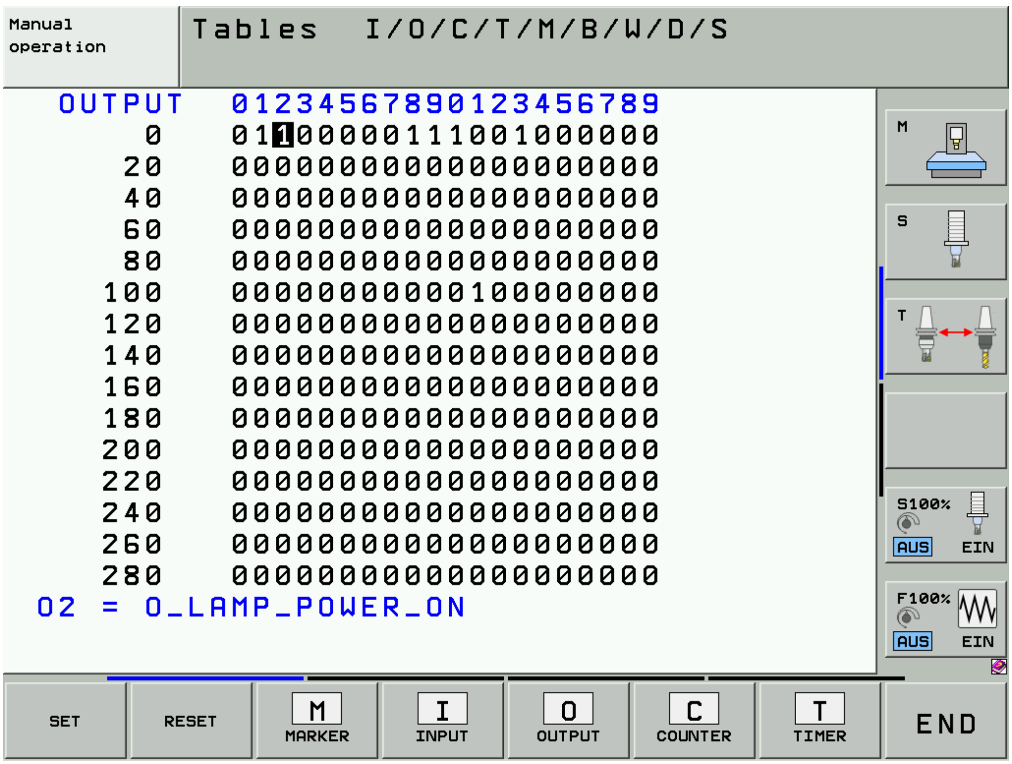


Figure: Observation of the lamp for the button "Control On" in the PLC table

> **Note**
>
> Measure the output voltages, e.g. at terminal X4 of MB 420 at terminal X12 of the MB 520 or with a connected test adapter.
> The logic state in the PLC-TABLE must be in agreement with the voltage level of each output!

23.6 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.

> **Caution**
>
> Observe the ESD precautions. --> See "Important Information" on page 28 – 523!

- Remove the MB 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 have been used, the electrical devices must dry completely before they may be operated again.

- Reassemble the MB.

> **Note**
>
> Put the rubber mats back into the frame as they were before.

Other MB components

Replace defective components, such as the cable between MB and control, the board, the buttons NC START, NC STOP and EMERGENCY STOP, CONTROL ON, lamps, etc. with original components!

Control

If you have found that the MB interface of the control is defective (connector X46), replace the MC. --> See "Exchange of HEIDENHAIN Components" on page 28 – 523.

24 Handwheel

24.1 Introduction

A iTNC 530 can be equipped with the following handwheels:

- One HR 420 portable handwheel with display
- One HR 410 portable handwheel
- One HR 130 panel-mounted handwheel
- Three HR 150 panel-mounted handwheels via the HRA 110 handwheel adapter

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 MP 7660!

Portable handwheels with EMERGENCY STOP button are connected to the control via a **cable adapter**. The EMERGENCY STOP wiring and the wiring for the permissive keys are located in cable adapter Id.Nr. 296466-xx.

Pin layouts and wiring (e.g., EMERGENCY STOP key and permissive key on cable adapter). --> See “Handwheels” on page 27 – 503.

Note

Refer to the iTNC 530 User’s Manual for a detailed description on operating the electronic handwheels.

DANGER

HEIDENHAIN recommends to check the function of the EMERGENCY STOP button on the portable handwheel in regular intervals!

24.2 Possible Causes of Errors

- The portable handwheel was dropped down and damaged.
- Severe contamination –> Key functions are possibly damaged.
- Jammed chips. --> Key gets stuck.

Note

If there is an active NC STOP signal (e.g., gets stuck) from the handwheel, the machine cannot be traversed any more.

- 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
- Potentiometer defective
- Board defective
- Handwheel encoder defective
- Liquid has penetrated
- Handwheel cable or connector defective
- Defective contact in cable adapter. --> Continuous EMERGENCY STOP or permissive keys nonfunctional.
- Short circuit in cable or handwheel
- Shock or vibrations. --> Unintended traverse movements.
- Problems with the +12 V power supply

Caution

The power supply of the handwheels is not monitored.

A defective handwheel or a handwheel into which liquid has penetrated, can influence the 12 Vdc supply voltage of the control. This can lead to various disturbances of the control, even to a black screen. It is possible that also error messages are displayed that do not immediately refer to a defective handwheel.

In this case try to operate the control without handwheel (See “Deselecting and Disconnecting the Portable Handwheel” on page 24 – 409) to find out whether the disturbances and error messages mentioned still are generated on the machine.

- Handwheel interface on MC defective

24.3 Error Location on Portable Handwheel with HR 420 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 24 – 409.

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 `El. Handwheel` operating mode.
- Set the control display to `NOML`.
- Observe whether this display changes, while turning 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 420 is powered by the MC with +12 V voltage at connector X23.

Connector X23 on the MC	Pin layout
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 okay:

- Shut down the control and switch off the machine.
- Connect the test adapter between connector X23 of the MC and handwheel (See "Test Adapter" on page 29 – 562).
- Switch on the machine.
- Measure, whether there are +12 V between pin 2 and pin 4.

Caution

The power supply of the handwheels is not monitored.

A defective handwheel or a handwheel with penetrated humidity may influence the 12 Vdc supply voltage of the control. This can lead to various disturbances of the control, even to a black screen. It is possible that also error messages are displayed that do not immediately refer to a defective handwheel.

In this case try to operate the control without handwheel (See "Deselecting and Disconnecting the Portable Handwheel" on page 24 – 409) to find out whether the disturbances and error messages mentioned still are generated on the machine.

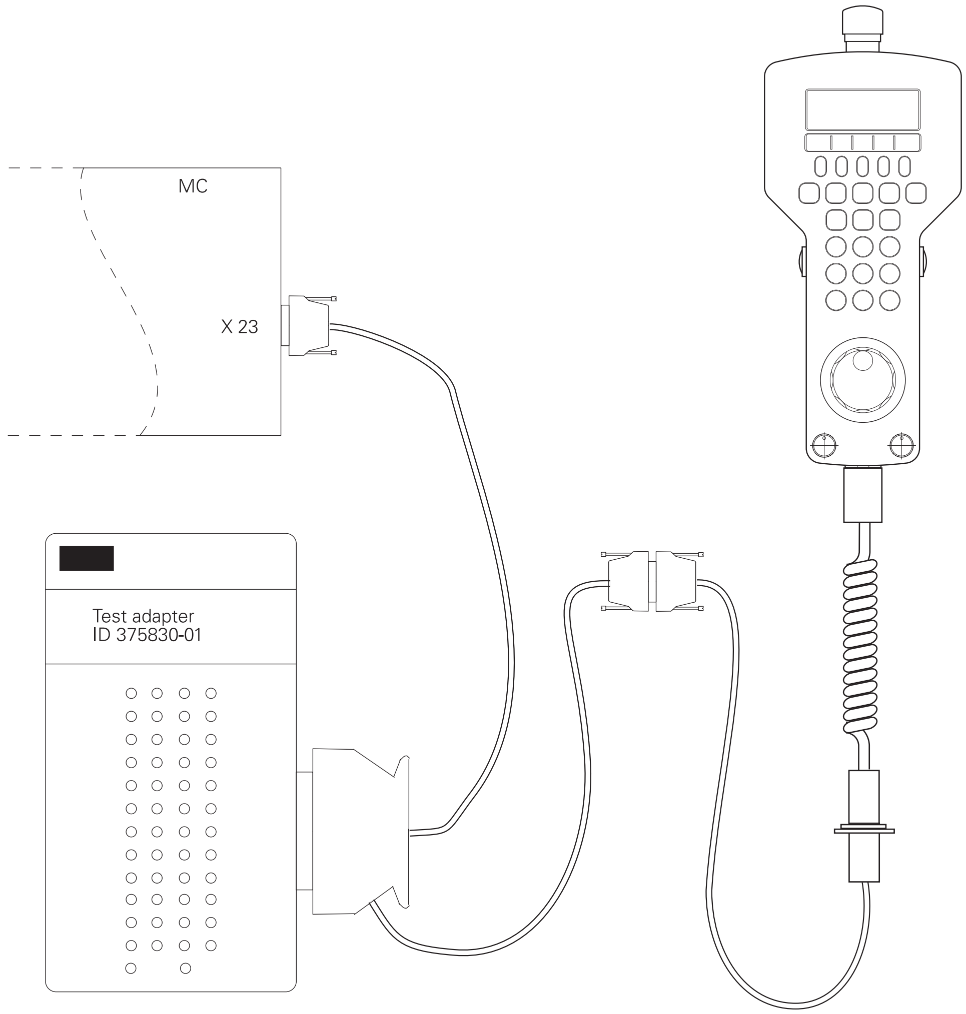
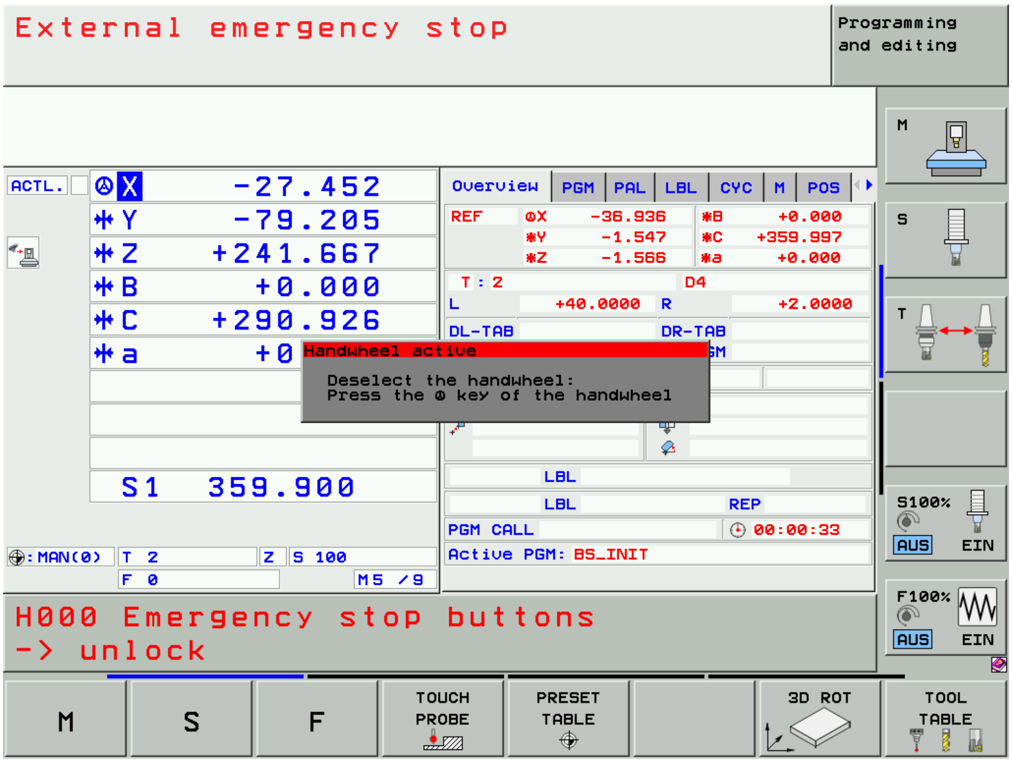


Figure: Test adapter between MC and handwheel

Checking the keys

The function of most handwheel keys can be checked with the respective **PLC marker**. Use the PLC diagnosis functions **TABLE** or **LOGIC DIAGRAM**:

- Switch on the machine.
- Press the EMERGENCY STOP key.
- Activate the HR 420 (press the handwheel symbol on the HR 420). --> 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 (following table).

F1	F2	F3	F4	F5
X	Y	Z	IV	V
	↑	Hand-wheel 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 in markers can be checked easily by controlling if a function is called by pressing the corresponding key or if there is a reaction on the screen.

Checking the potentiometers

By means of **W494** you can check the function of the **feed-rate override potentiometer,** and by means of **W492** the function of the **spindle-override potentiometer**:

- Switch on the machine.
- Press the EMERGENCY STOP key.
- Activate the HR 420 (press the handwheel symbol on the HR 420). --> The window `Handwheel active` appears on the screen.
- Activate the handwheel potentiometers (as of NC software version 34049x-xx, 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 (e.g., GOTO 492).
- Select the decimal display (soft key).
- Turn the potentiometer to be examined.
- Check if the display can be changed from 0 to 10000 (with nonlinear characteristic curve) or 0 to 100 (with linear characteristic curve). The characteristic curve is defined in MP 7620 bit 3.

Note

These PLC words can also be shown in the integrated oscilloscope.
--> See "Checking the Potentiometers" on page 22 – 367.

Activate potentiometer on HR 420:

The override potentiometers of the HR 420 are active up to NC software version 34049x-xx as soon as the handwheel operation was selected!
The potentiometers of the keyboard are then inactive.

DANGER

By switching from the keyboard to the HR 420 and vice versa, the feed rate or the spindle speed can change depending on the corresponding potentiometer setting.

As of NC software version 34049x-xx (with smarT.NC programming surface), the potentiometers of the keyboard are still active after selecting the handweel operating mode. For testing the handwheel potentiometers, you must switch over correspondingly:

- On HR 420: Press and hold the CTRL key, then activate the HANDWHEEL key.
  --> In the handwheel display appears the menue **`Select override:`**
- On HR 420: Press the soft key HW in order to activate the handwheel potentiometer.
  --> The information **`Handwheel override active`** appears on the control screen.

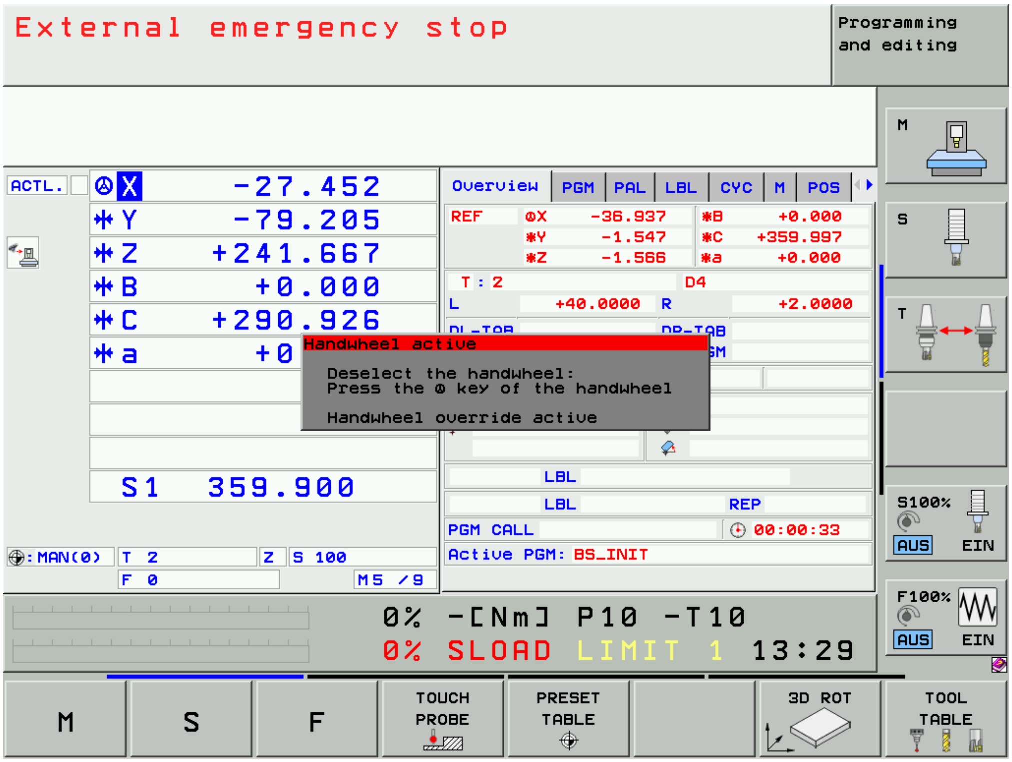


Figure: Active potentiometers on HR 420

Deactivating potentiometer on HR 420:

As of NC software version 34049x-xx (with smarT.NC programming interface).

If you want to deactivate the HR 420 handwheel after the tests described, reactivate the potentiometers of the keyboard.
Proceed as follows:

- On HR 420: Press and hold the CTRL key, then activate the HANDWHEEL key.
  --> In the handwheel display appears the menu **`Select override:`**
- On HR 420: Press the soft key KBD in order to activate the potentiometers on the keyboard.
- On HR 420: Press the HANDWHEEL key. --> The window **`Handwheel active`** on the control screen is closed, the handwheel is deselected.

24.4 Error Diagnosis at 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 24 – 409.

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 **El. Handwheel** operating mode.
- Set the control display to **NOML**.
- Observe whether this display changes, while turning 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 MC with +12 V voltage at connector X23.

Connector X23 on the MC	Pin layout
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 okay:

- Shut down the control and switch off the machine.
- Connect the test adapter between connector X23 of the MC and handwheel (See “Test Adapter” on page 29 – 562).
- Switch on the machine.
- Measure, whether there are +12 V between pin 2 and pin 4.

Caution

The power supply of the handwheels is not monitored.

A defective handwheel or a handwheel with penetrated humidity may influence the 12 Vdc supply voltage of the control. This can lead to various disturbances of the control, even to a black screen. It is possible that also error messages are displayed that do not immediately refer to a defective handwheel.

In this case try to operate the control without handwheel (See “Deselecting and Disconnecting the Portable Handwheel” on page 24 – 409) to find out whether the disturbances and error messages mentioned still are generated on the machine.

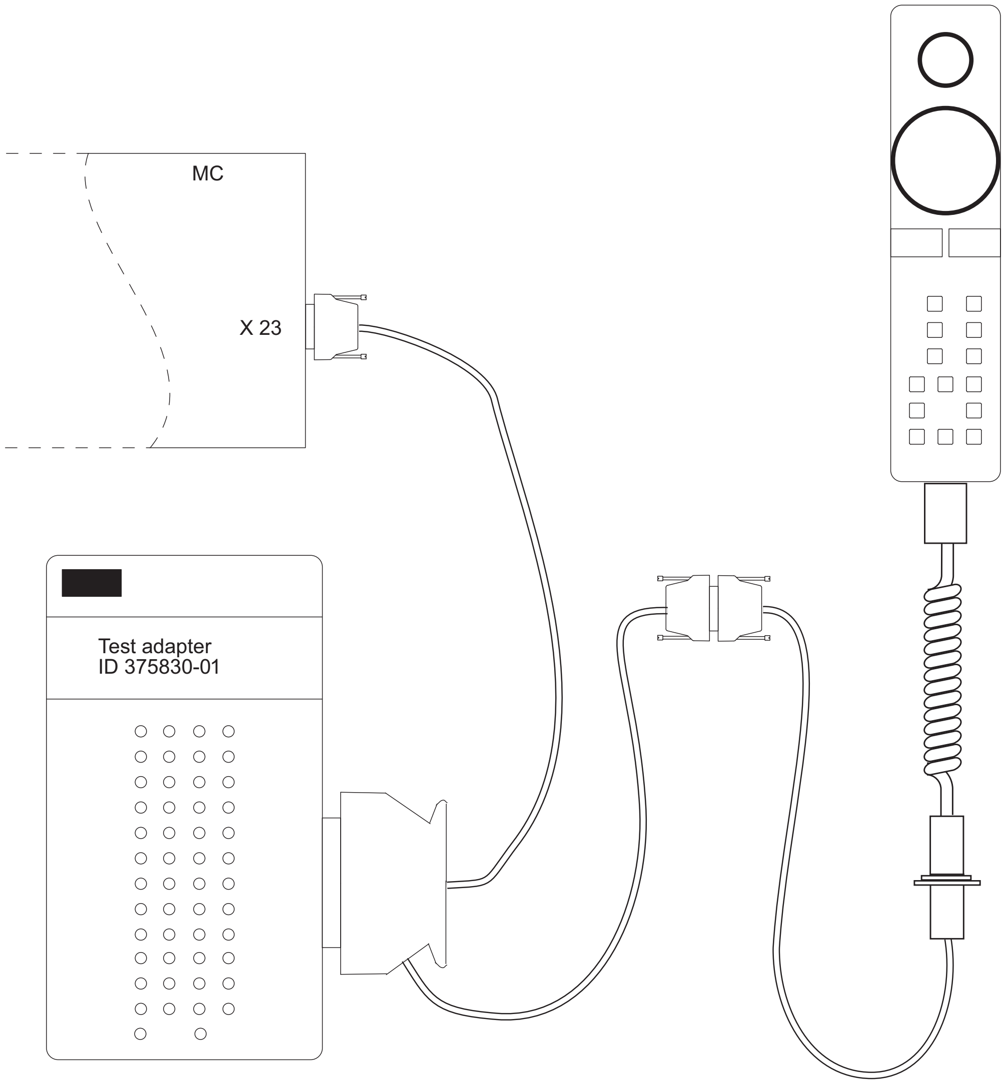


Figure: Test adapter between MC and handwheel

Checking the keys

The function of the handwheel keys can be checked with the respective **PLC inputs**. Use the PLC diagnosis functions **`TABLE`** or **`LOGIC DIAGRAM`**:

- Switch on the machine.
- Press the EMERGENCY STOP key.
- 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.

MP7645 determines whether the handwheel keys are evaluated by the NC or the PLC.

Note

Ask the machine manufacturer if MP 7645.0 can be changed for test purposes. The PLC program may not permit this.

MP7645.0: 0 Evaluation of keys via 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

24.5 Deselecting and Disconnecting the Portable Handwheel

You have found that an 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.

- 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 machine parameter MP7640.
- Exit the machine parameter list.
- Switch on the machine and perform functional testing.

Dummy plug

The dummy plug for the handwheel adapter can be purchased from the machine manufacturer or from HEIDENHAIN (ID 271958-03).

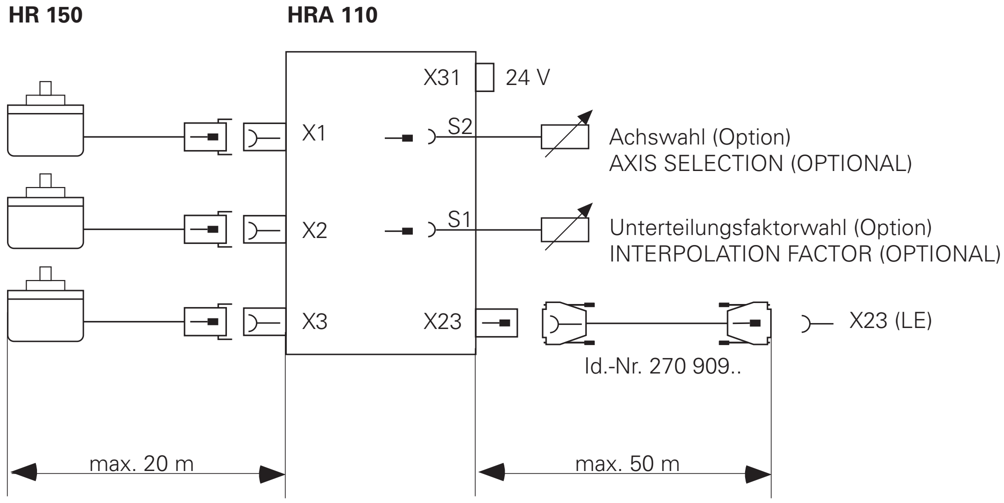
DANGER

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!

24.6 Error Diagnosis at Panel-Mounted Handwheels

With the HRA 110 handwheel adapter you can connect two or three HR 150 panel-mounted handwheels to iTNC 530.

The first and second handwheels are assigned to the X and Y axes. The third handwheel can be assigned either through a selection switch (option) or with MP 7645.



An additional switch enables you to select, for example, the subdivision factor for the handwheel. The current position of the step switch is evaluated by the PLC.

Power supply OK?

The HRA 410 handwheel adapter is powered by the MC with +12 V voltage at connector X23.

Connector X23 on the MC	Pin layout
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 okay:

- Shut down the control and switch off the machine.
- Connect the test adapter between connector X23 of the MC and handwheel adapter (See "Test Adapter" on page 29 – 562).
- Switch on the machine.
- Measure, whether there are +12 V between pin 2 and pin 4.

Caution

The power supply of the handwheels is not monitored.

A defective handwheel adapter or a handwheel adapter with penetrated humidity may influence the 12 Vdc supply voltage of the control. This can lead to various disturbances of the control, even to a black screen. It is possible that also error messages are displayed that do not immediately refer to a defective handwheel adapter.

In this case try to operate the control without handwheel adapter to find out whether the disturbances and error messages mentioned still are generated on the machine.

The HRA 110 handwheel adapter is powered in addition with **+24 V voltage** at connector **X31**.

- Measure, whether there are +24 V between pin 1 (+24 V) and pin 2 (0 V).

Checking the switches

The function of the selection switches can be checked with the respective **PLC inputs**. Use the PLC diagnosis functions **TABLE**:

- ▶ Switch on the machine.
- ▶ Press the EMERGENCY STOP key.
- ▶ Call the table with the PLC inputs. –> See “The TABLE function” on page 11 – 119.
- ▶ Turn the selection switches.
- ▶ Check whether the corresponding inputs change to 0.
  (Assignments --> See tables below)

Assignment of the switch positions to the PLC inputs

The tables below list the assignments of switch positions of S1 and S2 to the PLC inputs I160 to I175.

The two switches work with a 0 V logic circuit.

Example:
If switch S1 is set to position 3, input I162 is logically 0; all other inputs are logically 1.

Step switch 1: Step switch for choosing the subdivision factor

Switch position	PLC input
1 (at the left stop)	I160
2	I161
3	I162
4	I163
5	I164
6	I165
7	I166
8 (at the right stop)	I167

Step switch 2: Axis selection switch

Switch position	PLC input
1 (at the left stop)	I168
2	I169
3	I170
4	I171
5	I172
6	I173
7	I174
8 (at the right stop)	I175

24.7 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 have been used, the electrical devices must dry completely before they may be operated again.

Cables and handwheel adapters

Replace defective parts only by original HEIDENHAIN components!

Control

If you have found that the HR interface of the control is defective (connector X23), replace the MC. –> See “Exchange of HEIDENHAIN Components” on page 28 – 523.

25 Touch Probe

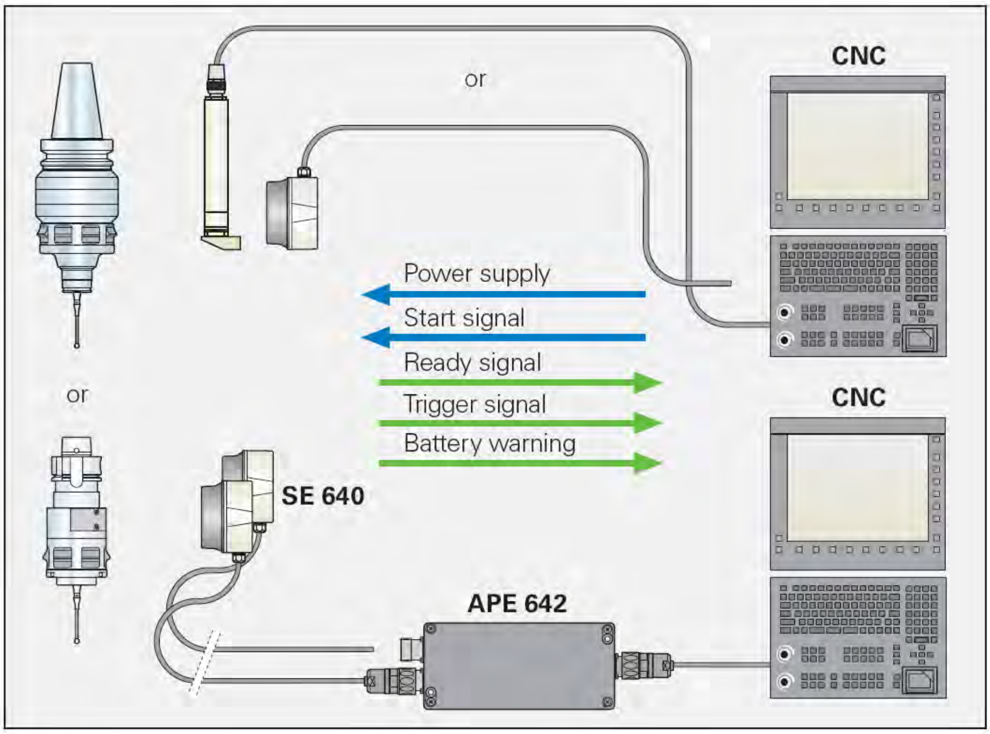
25.1 Introduction

Different touch probes

An iTNC 530 can be equipped with different touch probes.

Touch probes with infrared transmission of the trigger signal (e.g. TS 740, TS 640, TS 444, TS 440)

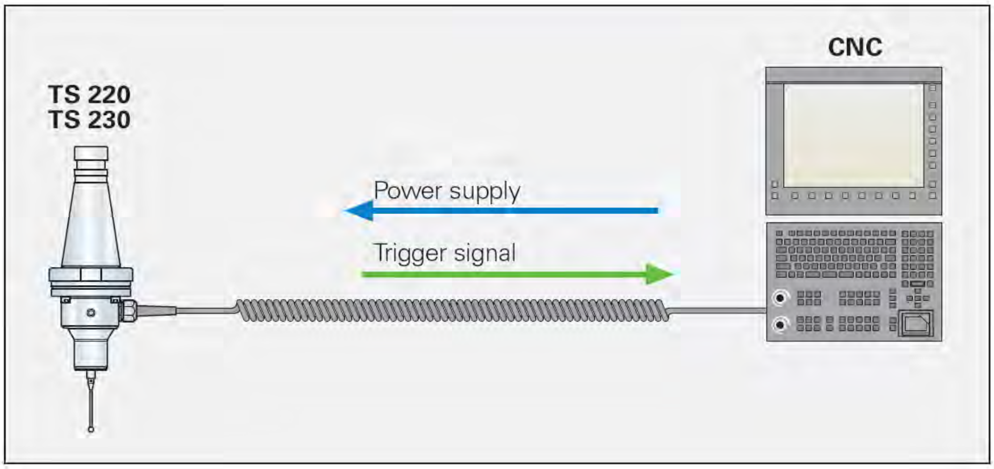
- These touch probes are designed for use on machines with automatic tool changer.
- They serve to align workpieces, set datums and calibrate workpieces.
- The infrared transmission is established between the TS touch probe and the SE transmitter/receiver unit.
- The infrared transmission is tolerant to noise and even works by reflection.
- The probe is operated with nonrechargeable or rechargeable batteries (exept TS 444).
- The TS 640 is equipped with an integrated cleaning blower.
- The TS 444 features an integrated turbine generator and therefore is battery-free.



Various styli can be inserted into the touch probes. The styli feature a rated break point.

Touch probe with signal transmission via cable (e.g. TS 220)

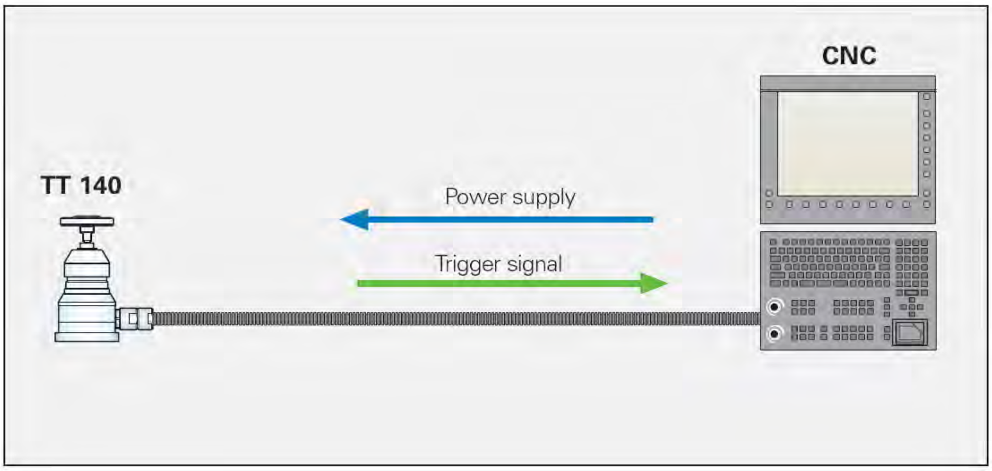
- The machine operator inserts the touch probes by hand into the spindle.
- They serve to align workpieces, set datums and calibrate workpieces.
- Power supply and signal transmission via the cable.



Various styli can be inserted into the touch probes. The styli feature a rated break point.

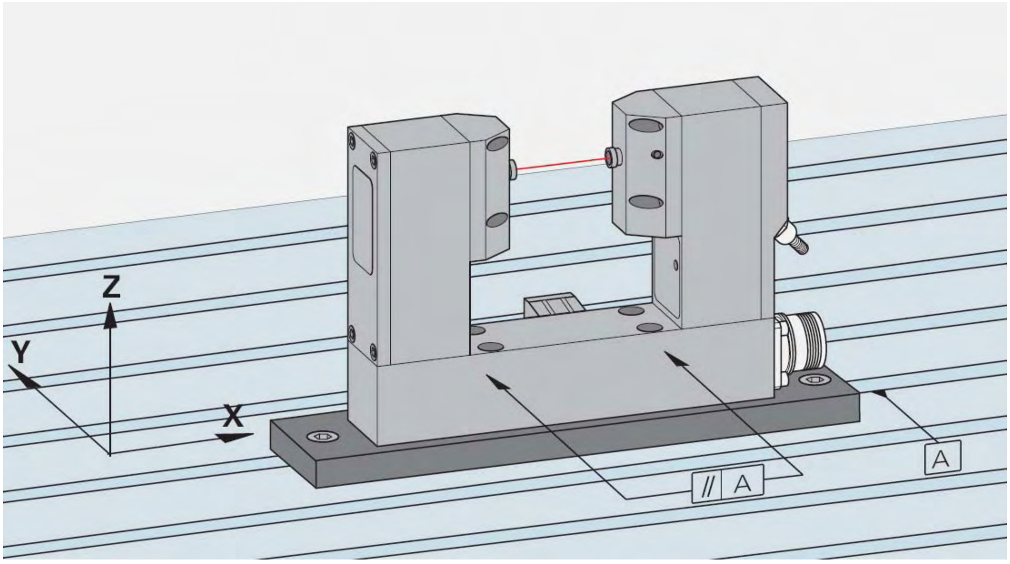
Touch probe for tool measurement (e.g. TT 140)

- This touch probe is used to measure tools (length, radius, individual teeth).
- Tools can be examined for breakage.
- Tool wear can be determined.



Laser 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 the beam! Laser class 2.

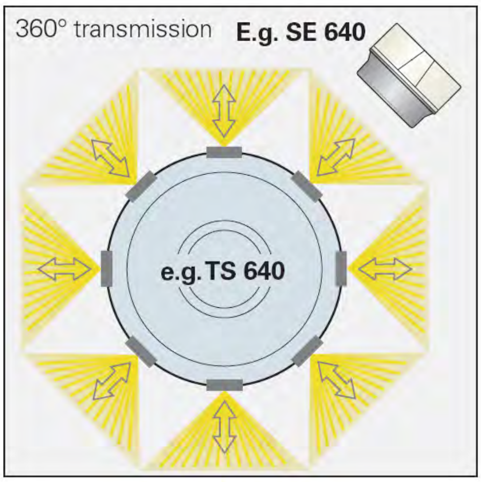
Infrared transmission

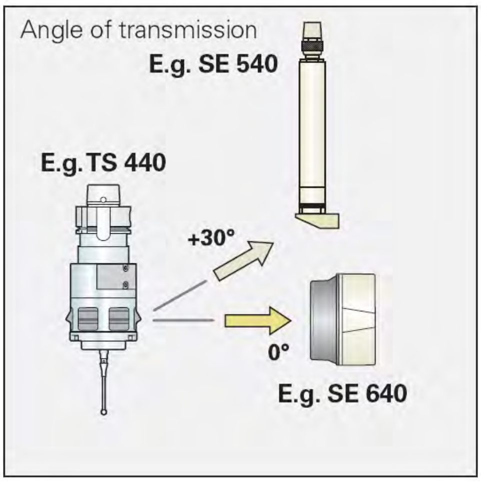
360° range:

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.

Pin layout

See “Touch Probes” on page 27 – 507.

Other information

You will find further information on touch probes in …

- The iTNC 530 User's Manual
- The corresponding mounting instructions
- The brochure 3-D Touch Probes for Machine Tools

These documents can be downloaded from the HEIDENHAIN website (www.heidenhain.de).

25.2 Possible Causes of Errors

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
- Interface of probe on MC defective

Caution

The power supply of the touch probes is not monitored.

A defective probe or a probe with penetrated humidity may influence the 5 Vdc and 15 Vdc supply voltages of the control. This also applies for a defective or wet transmitter/receiver unit.
This can lead to various disturbances of the control, even to a black screen. It is possible that also error messages are displayed that do not immediately refer to a defective touch probe or transceiver unit.

In this case try to operate the control without touch probe (See "Deselecting and Disconnecting the Touch Probe" on page 25 – 426) to find out whether the disturbances and error messages mentioned still are generated on the machine.

Specifically for touch probes with infrared transmission:

- Battery flat (capactiy 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 or the transceiver 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 transceiver unit on the MC is 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.` With the TS 444, this is of course not required. Find the actual error cause!

Especially for laser systems:

- Damage to the housing
- Compressed air missing
  (for opening the protective cover for the transmitting and receiving of the laser beam and for the blowing unit)

25.3 Error Diagnosis on TS Touch Probes

Control impaired?

If you suspect that a damaged touch probe or a touch probe into which liquid 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 25 – 426.

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 transceiver unit contaminated? etc.

Checking the LEDs

Touch probe with infrared interface:

By means of two multicolor LEDs, a visual status check of SE 440, SE 640 and EA 632 transmitter/receiver units is possible:

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

On the SE 540, there is a multicolor LED with the following meaning:

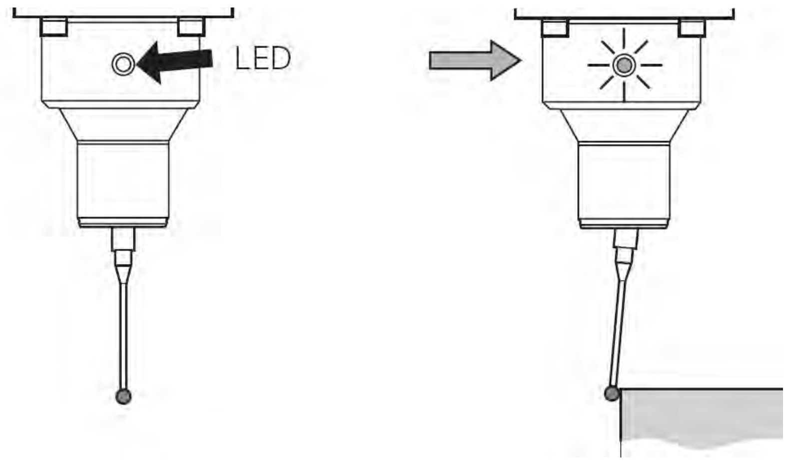
LED	Touch probe
Green	Touch probe is ready Stylus is at rest
Yellow	Touch probe is ready Stylus is deflected
Red	*On continuously:* Battery capacity < 10% Change the battery *Blinking:* Touch probe is not ready

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!

Touch probe with cable:

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 keypad cable on connector X12 from the MC.
- Use a multimeter which you set to "beep" mode or to ohm measurement.
- Apply the needle tips to the pins **3** and **5** of the touch probe cable. --> A beep must be heard or a low ohmic value displayed.

Assignment at the interface X12 (D-SUB, 15-pin, 2-row):

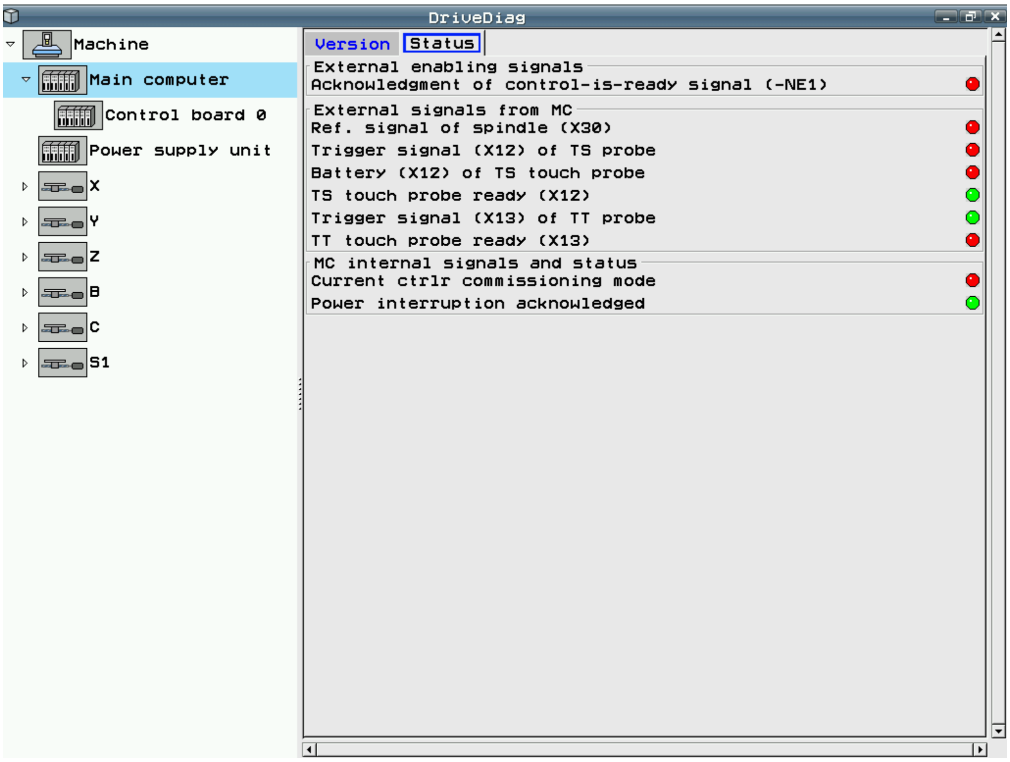
MC 42x(B)	
Female	**Assignment X12 (TS)**
1	0 V (internal shield)
2	Do not assign
3	**Readiness**
4	Start
5	**+15 V ±10% (U_P), max. 100 mA**
6	+5 V ± 5% (U_P), max. 100 mA
7	$\overline{\text{Battery warning}}$
8	0 V (U_N)
9	Trigger signal
10	$\overline{\text{Trigger signal}}$
11 to 15	Do not assign
Hsg.	External shield

Functional test

> **DANGER**
>
> Consult the machine operator and observe the machine manufacturers's safety precautions (setup mode, etc.)!

By means of DriveDiag:

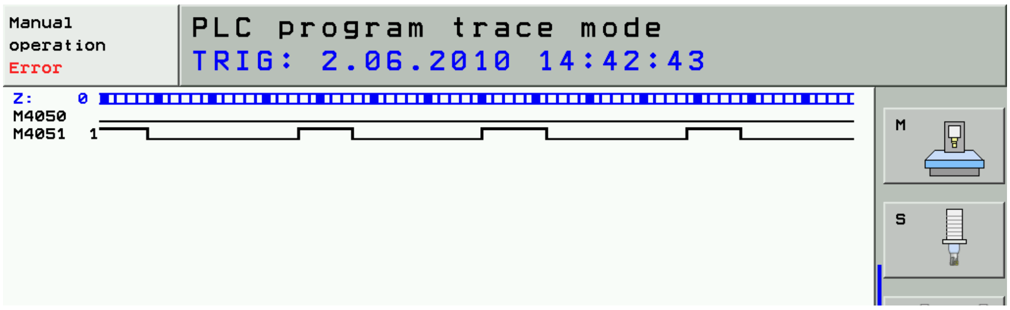
- Switch on the machine.
- Insert the touch probe.
- As a precaution press the EMERGENCY STOP button.
- Call the DriveDiag. --> See “Integrated Diagnostic Functions and DriveDiag” on page 9 – 89.
- Open the following page:



- 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 (X12) of TS touch probe`**.
  When the stylus is deflected, the lamp shines green.
- You can also check the lamp at **`Battery (X12) of TS touch probe`**.
  If the battery capacity is sufficient, this lamp shines green.
  With touch probe systems with cable, this lamp shines red.

By means of logic diagram:

- Switch on the machine.
- Insert the touch probe.
- As a precaution press the EMERGENCY STOP button.
- Call the logic diagram. -->See "The LOGIC diagram" on page 11 – 125.
- Enter the operands M4050 and M4051 and place the trigger on M4051.
- Start the recording.
- Check the marker 4050.
  If the probe is ready, this marker has the status zero!
- Deflect the stylus by hand.
- Check marker 4051.
  If the stylus is deflected, this marker changes to one!



By means of test adapter:

- Switch off the machine.
- Connect the test adapter between MC (connector X12) and touch probe cable.
  --> See "Test Adapter" on page 29 – 562.
- Switch on the machine.
- Insert the touch probe.
- As a precaution press the EMERGENCY STOP button.
- Deflect the stylus by hand.
- Measure the respective voltage:

Signal	Connector X12	Voltage	Meaning
-	Pin 5	+15 V	Power supply
-	Pin 6	+ 5 V	Power supply
Ready signal	Pin 3	+15 V	Probe is ready
Negated trigger signal	Pin 10	+ 5 V	Probe is ready, stylus at rest
Negated trigger signal	Pin 10	0 V	Probe is ready, stylus deflected

The 0 V reference potential (U_N) is on pin 8. --> See "X12: Connection of the touch probe for workpiece measurement" on page 27 – 460.

Note

If available, you can also connect an identical touch probe to test the functionality!

25.4 Error Diagnosis on TT Touch Probes

Control impaired?

If you suspect that a damaged touch probe or a touch probe into which liquid 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 25 – 426.

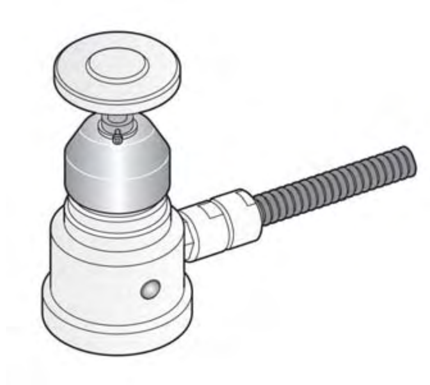
Visual inspection

- Visually inspect the touch probe and 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:



Checking the "Ready" bridge

In the **TT** the **Ready signal is bridged**.
This means that the Ready signal must always be present if a TT probe is connected.

Proceed as follows to check the Ready bridge:

- Shut down the control and switch off the machine.
- Disconnect the keypad cable on connector X13 from the MC.
- Use a multimeter which you set to "beep" mode or to ohm measurement.
- Apply the needle tips to the pins **1** and **4** of the touch probe cable. --> A beep must be heard or a low ohmic value displayed.

Assignment at the interface X13 (D-SUB, 9-pin, 2-row):

MC 42x(B)	
Female	**Assignment X13 (TT)**
1	**Readiness**
2	0 V (U_N)
3	Do not assign
4	**+15 V ±5% (U_P)**
5	Do not assign
6	Do not assign
7	+5 V ±5% (U_P)
8	Trigger signal
9	$\overline{\text{Trigger signal}}$
–	–
Hsg.	External shield

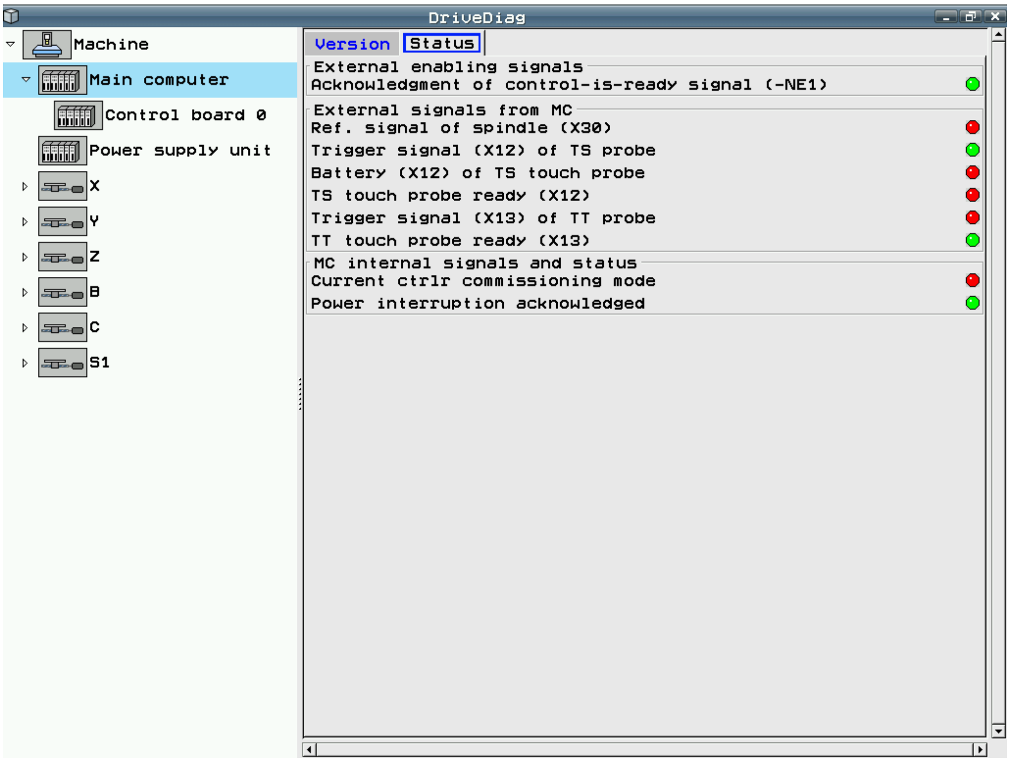
Functional test

DANGER

Consult the machine operator and observe the machine manufacturers's safety precautions (setup mode, etc.)!

By means of DriveDiag:

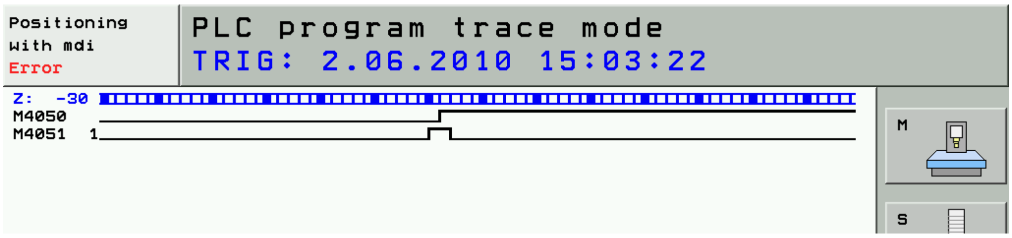
- Switch on the machine.
- Turn the feed-rate potentiometer to a low value.
- Call the DriveDiag. --> See "Integrated Diagnostic Functions and DriveDiag" on page 9 – 89.
- Open the following page:



- Start the probing cycle with the TT (table touch probe).
- 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 (X13) of TT touch probe`** .
  When the touch probe is deflected, the lamp shines green.
  In the machine display appears the message **`Stylus deflected`**.

By means of logic diagram:

- Switch on the machine.
- Turn the feed-rate potentiometer to a low value.
- Call the logic diagram. --> See “The LOGIC diagram” on page 11 – 125
- Enter the operands M4050 and M4051 and place the trigger on M4051.
- Start the recording.
- Start the probing cycle with the TT (tool touch probe).
- Check the marker 4050.
  If the probe is ready, this marker has the status zero!
- Deflect the tool touch probe by hand.
- Check marker 4051.
  If the touch probe is deflected, this marker changes to one!
  In the machine display appears the message **Stylus deflected**.



By means of test adapter:

- Switch off the machine.
- Connect the test adapter between MC (connector X13) and touch probe cable.
  --> See “Test Adapter” on page 29 – 562.
- Switch on the machine.
- Turn the feed-rate potentiometer to zero.
- Start the probing cycle with the TT (tool touch probe).
- Deflect the tool touch probe by hand.
- Measure the respective voltage:

Signal	Connector X13	Voltage	Meaning
	Pin 4	+15 V	Power supply
	Pin 7	+ 5 V	Power supply
Ready signal	Pin 1	+15 V	Probe is ready
Negated trigger signal	Pin 9	+ 5 V	Probe is ready, at rest
Negated trigger signal	Pin 9	0 V	Probe already deflected.

The 0 V reference potential (U_N) is on pin 2. --> See “X13: Connection of the touch probe for tool measurement” on page 27 – 462

Note

If available, you can also connect an identical TT probe to test the functionality!

25.5 Error Diagnosis on 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 touch probe and observe the reaction. --> See “Deselecting and Disconnecting the Touch Probe” on page 25 – 426.

Visual inspection

> **DANGER**
>
> Laser radiation! Do not stare into the beam! Laser class 2.

Check whether the laser system or the cable is damaged, etc.

Checking the LEDs

> **DANGER**
>
> Laser radiation! Do not stare into the 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 if 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 keypad cable on connector X13 from the MC.
- Use a multimeter which you set to "beep" mode or to ohm measurement.
- Apply the needle tips to the pins **1** and **4** of the touch probe cable. --> A beep must be heard or a low ohmic value displayed.

Assignment at the interface X13 (D-SUB, 9-pin, 2-row):

MC 42x(B)	
Female	**Assignment X13 (TT)**
1	**Readiness**
2	0 V (U_N)
3	Do not assign
4	**+15 V ±5% (U_P)**
5	Do not assign
6	Do not assign
7	+5 V ±5% (U_P)
8	Trigger signal
9	$\overline{\text{Trigger signal}}$
–	–
Hsg.	External shield

25.6 Deselecting and Disconnecting the Touch Probe

You assume that a defective touch probe impairs the low voltages of the control. 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 probe systems from the control (connector X12 and X13).
- ▶ Switch the machine back on again.
- ▶ Observe, whether error messages are repeated or error conditions recur.

25.7 Corrective Action

Cleaning

Use standard cleaning agents to clean transmitter/receiver units.

Readjusting 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.

> **Caution**
>
> When you exchange the battery, pay attention that the polarity is correct.

> **Caution**
>
> 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.
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:
>
> - After a commissioning, cleaning or adjustment
> - Directly before precise measurements

Returning the touch probe

Return defective touch probes and those that impair the function of the control for examination.

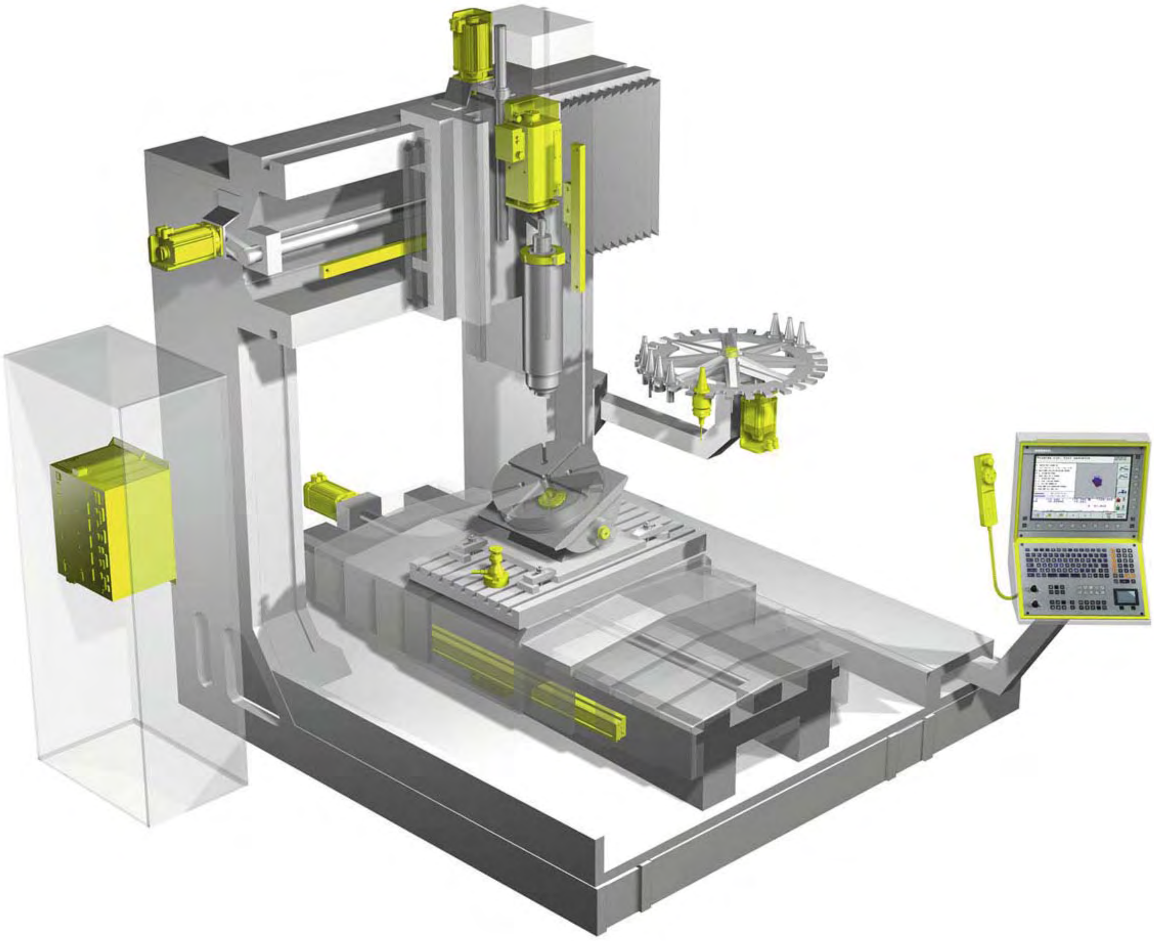
Returning the control

If you have found that the touch probe interface of the control is defective (connector X12, X13), replace the MC. --> See “Exchange of HEIDENHAIN Components” on page 28 – 523.

26 Important Features of HEIDENHAIN Components

26.1 HEIDENHAIN Components in a Machine Tool

The picture shows possible HEIDENHAIN components on a machine tool.
The picture is only an example as, of course, there exists a large selection 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 well visible.

26.2 Hardware Identification

On every HEIDENHAIN product there is an ID label which indicates ...

- Device designation
- ID number
- Serial number

Thus, each unit is uniquely identified.

ID label

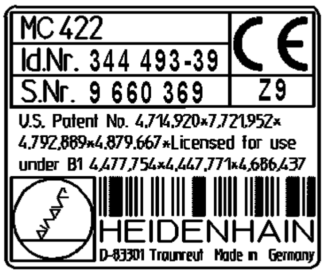


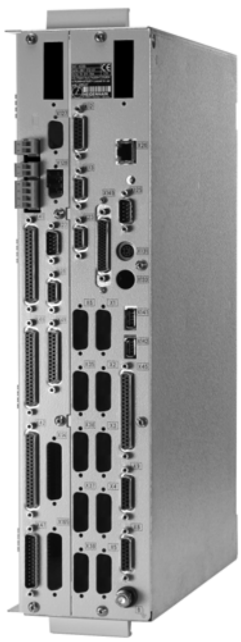
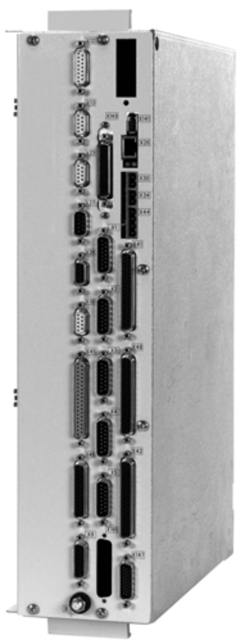
Figure: ID label of an MC 422

Note

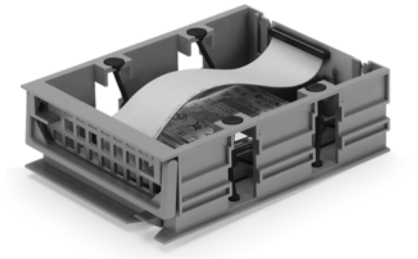
Whenever possible, the ID label is located well visible on the front of a product. Otherwise, you may find it on the side or on the rear of the unit.

The ID label is attached to the following mandatory and optionals iTNC 530 components:

Main computer

MC main computer	
The iTNC 530 comprises 2 components: ■ **MC 42x (B/C) main computer** (MC = Main Computer) ■ CC 42x(B) controller unit (CC = Controller Computer) The MC main computer is available in two versions: ■ Standard version MC 422 B/C ■ MC 420 basic version with 5 position encoder inputs and reduced performance range. However, these functions can be activated with two code numbers.	 MC 422 B  MC 420

HDR hard disk,
SIK

The main computer consists of three components: ■ MC 42x (B/C) main computer ■ **HDR hard disk** ■ **SIK system identification key**	  HDR SIK

Controller units

CC controller unit	
CC 422 with 6 (figure), 10 or 12 control loops It is equipped with: ■ 6 PWM outputs ■ 6 speed encoder inputs	**CC 424 (B)** with 6 (figure), 8, 10, 12 or 14 control loops It is equipped with: ■ 6 PWM outputs ■ 6 speed encoder inputs ■ 6 position encoder inputs
	

Power supply units

UV 106 B power supply unit for analog HEIDENHAIN contouring controls

The UV 106 B power supply unit was designed so that the iTNC 530 could be used with a compact, coordinated system for analog nominal shaft-speed interfaces (+/–10V).

It supplies the iTNC 530 with the supply voltages necessary for operation.

UV 105 B power supply unit for the operation of HEIDENHAIN controls with non-HEIDENHAIN inverter systems.

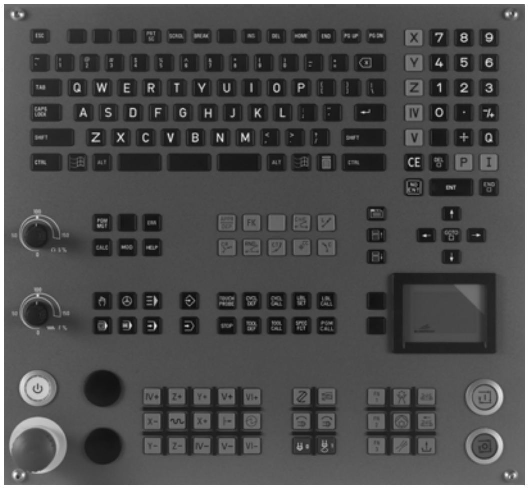
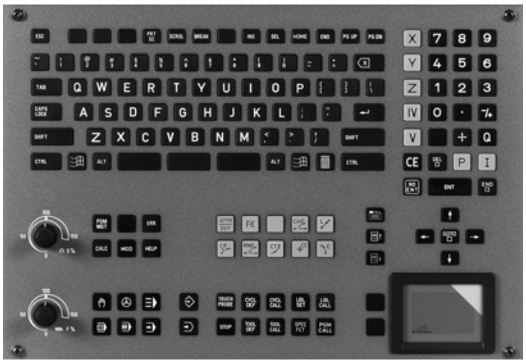
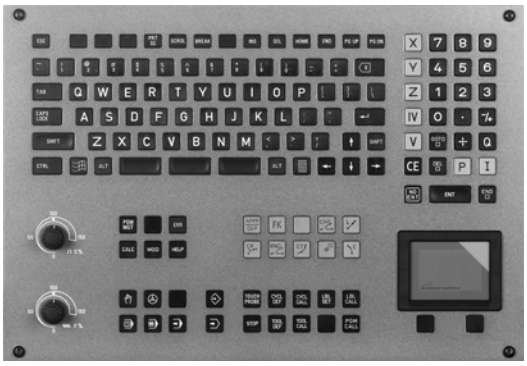
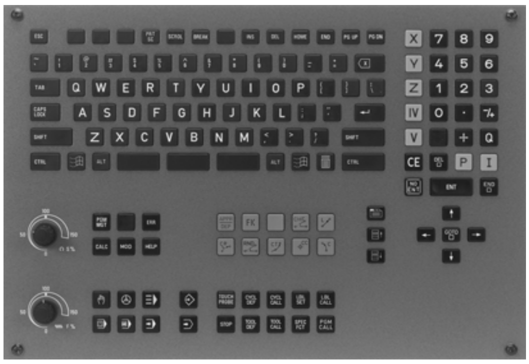
An LED showing the readiness of the power supply is located on the front of the UV 105 B.

UV 105 power supply unit The UV 105 power supply unit serves to supply the power to the CC42x if a non-HEIDENHAIN inverter is used, or, if required, to supply additional power if a HEIDENHAIN inverter is used. If a non-HEIDENHAIN inverter system is used, the adapter connector is connected to X69 of the UV 105 power supply unit.	

Visual display units

BF 150 visual display unit 15.1-inch color flat panel display (1024 x 768 pixels) with horizontal and vertical soft keys.	
BF 120 visual display unit 10.4-inch color flat panel display (640 x 480 pixels) with horizontal soft keys.	

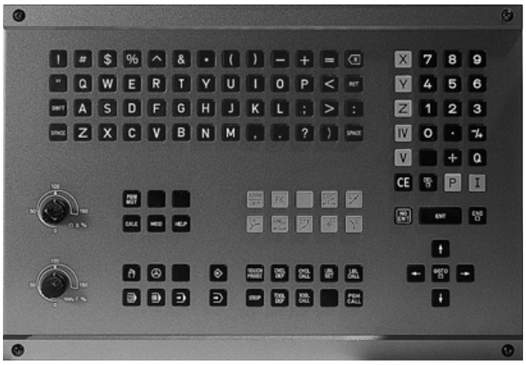
Keyboards

TE 535 Q operating panel The operating panel corresponds to the TE 530 B in the NC sector. In addition, machine operating keys were integrated.	
TE 530 B operating panel with ... ■ Touchpad ■ Function keys for the smarT.NC operating mode ■ SPEC FCT key to call special TNC functions The IV and V keys are snap-ons, and can be switched.	
TE 530 operating panel with touchpad	
TE 520 B operating panel with ... ■ Function keys for the smarT.NC operating mode ■ SPEC FCT key to call special TNC functions This operating panel corresponds to the TE 530 B without the touchpad. The IV and V keys are snap-ons, and can be switched.	

TE 420 operating panel

Only used for the iTNC 530 single-processor control.

The IV and V keys are snap-ons, and can be switched.



Switching unit

BTS 1x0 screen-keyboard switching unit

With the BTS 1x0, it is possible to connect two monitors and two operating panels to an MC 42x (B/C).

Machine operating panel

MB 520 machine operating panel

Machine operating panel with snap-on (switchable) keys.

There is an EMERGENCY STOP button on the machine operating panel.

MB 420 machine operating panel

Machine operating panel with snap-on (switchable) keys.

There is an EMERGENCY STOP button on the machine operating panel.

Handwheels

HR 410 handwheel

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 with 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 420 handwheel

Portable electronic handwheel with ...

- Display for operating mode, actual positon value, programmed feed rate and spindle speed, error message
- Spindle speed and feed-rate override
- Selection of axes via keys or soft keys
- Actual position capture
- NC start/stop
- Spindle start/stop
- Keys for traverse direction
- Two permissive buttons (24 V)
- EMERGENCY STOP button (24 V)
- Magnetic holding pads
- Mount for attaching the handwheel to the machine

HR 130 handwheel

Panel-mounted handwheel

With ergonomic knob, radial
cable outlet
with or without detent

HRA 110 handwheel adapter

For connecting up to three **HR 150** handwheels to the TNC.
The axes and the subdivision factor are selected via rotary switch.

HRA 110

HR 150 cable outlet
radial, with or without detent

Handwheel selection switch

Touch probes

TT 130 tool touch probe

Triggering touch probe for measuring tools.

TT 130

Adapter cable for connection to the MC 42x (B/C)

TT 140 tool touch probe

Triggering touch probe for measuring tools.
With rated break point of the connection pin for the probe head and optical deflection display.

TT 140

Connection pin

Adapter cable for connection to the MC 42x (B/C)

TS 220 touch probe

Touch trigger probe with cable connection for signal transmission for machines with manual tool change. For workpiece setup and measurement during machining.

TS 740, TS 640, TS 444, TS 440 touch probes

Triggering touch probe with infrared transmission, for workpiece setup and measurement during machining. 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 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 540 for integration in the spindle head

TS 640, TS 740 TS 440, TS 444

SE 640 SE 540

PLC Expansion

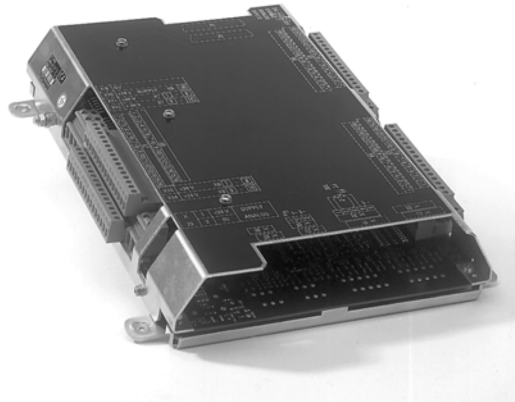
PL 410 B input/output unit
For the expansion of PLC inputs and outputs

64 inputs
31 outputs or ...

64 inputs
31 outputs
4 analog inputs ± 10 V
4 inputs for PT 100 thermistors

PL 405 B input/output unit

32 inputs
15 outputs



PL 510 input/output board
Modular I/O system for the expansion of PLC inputs and outputs. The PL 510 consists of the **PLB 510** basic module and the following components:

- **PLD 16-8** I/O module with 16 digital inputs and 8 digital outputs
- **PLA 4-4** analog module with 4 analog inputs for Pt 100 thermistors and 4 ±10 V analog inputs
- Empty housing for partial assembly

The PL 510 can be mounted on a top hat rail (NS 35 EN 50022). The PL 510 equipped (completely or partially) with PLD 16-8 is compatible with PL 410 B/PL 405 B.

PLB 510 basic module
with 4 slots

PLB 510 basic module with 6 slots	
PLB 512 basic module with 8 slots	

PLD 16-8 input/output module PLA 4-4 analog module	 PLD 16-8 PLA 4-4

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".

26.3 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.

Calling the display

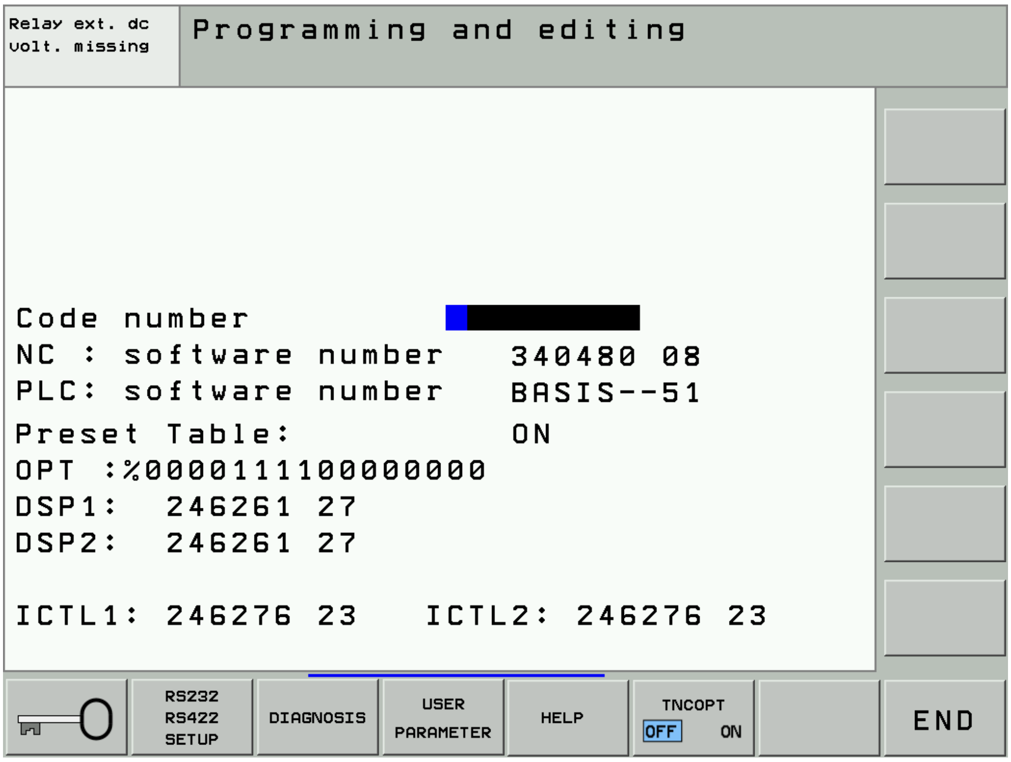
▶ Select the **Programming and Editing** operating mode.

▶ Press the MOD key.

Note

Which information is now displayed depends on the NC software installed!

Display for NC software 340420-xx to 340480-xx



NC software

```
NC : software number 340480 08
```

340480 Program number of the NC software
08 Version of the NC software

Note

Additionally, a service pack can be installed which is then displayed after the NC software version, e.g., 340480 08 **SP1**.

The iTNC 530 is currently equipped with the following NC software versions:

Hardware	Standard SW	Export SW	Comment
Single-processor	340 420-xx	340 421-xx	without preset tables
	340 422-xx	340 423-xx	with preset tables
	340 490-xx	340 491-xx	with preset tables and smarT.NC programming surface
Dual-processor (with Windows 2000 or Windows XP)	340 480-xx	340 481-xx	with preset tables
	340 492-xx	340 493-xx	with preset tables and smarT.NC programming surface

Due to restrictions on the export of the iTNC 530, HEIDENHAIN can also supply a special export version (until now all NC software versions with odd character parity).

HEIDENHAIN releases a new program number for the NC software whenever it introduces extensive new functions.

PLC software

```
PLC: software number   BASIS--51
```

BASIS--51 Random character sequence which the machine manufacturer uses to identify his PLC software

Preset table

```
Preset Table:          ON
```

ON Preset table active
OFF Preset table not active

Options

```
OPT :%0000111100000000
```

% Identifier of binary format
0000111100000000 Options enabled in the SIK (e.g. auxiliary axes, tilting operation, HSC milling etc.)

DSP software

```
DSP1:  246261 27
```

246261 Program number of DSP software
27 Version of the DSP software

Note

The DSP software designates 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

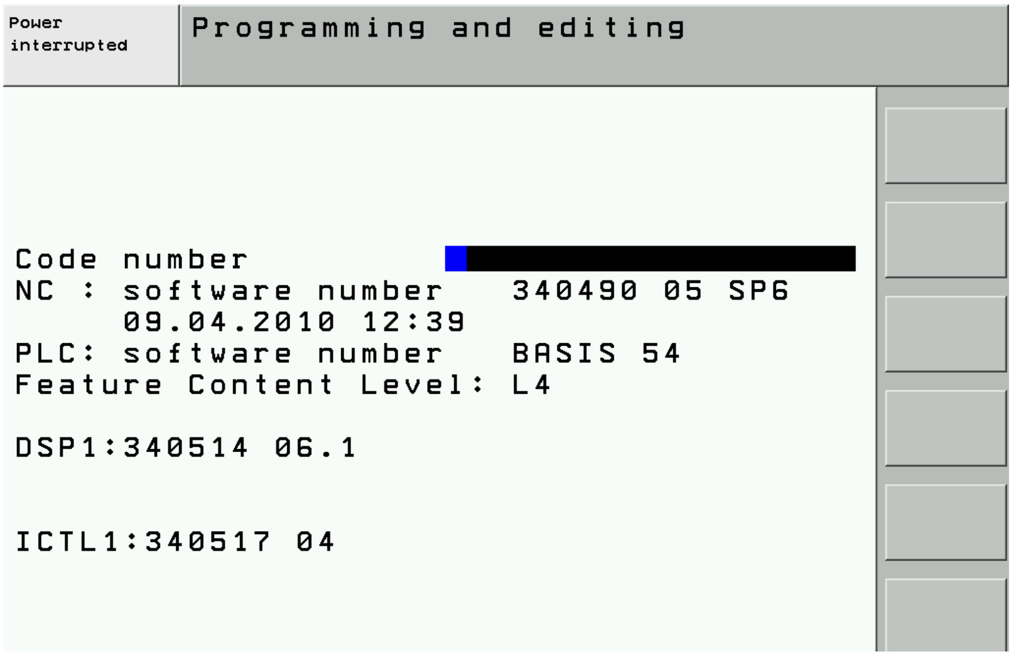
Current controller software

```
ICTL1: 246276 23
```

246276 Program number of current controller software
23 Version of current controller software

> **Note**
>
> The ICTL software designates 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

Display for NC Software as of 340490-xx (smarT.NC programming interface)



> **Note**
>
> As opposed to the display for the NC software types of 340420-xx to 340480-xx , the "feature content level" is displayed. (The display for "preset table" and "OPT" is no longer required.)
> Please see previous picture for explanations of "NC: software number" etc.!

Feature Content Level

```
Feature Content Level: L4
```

L4 "L" is the abbreviation of "level"; "4" stands for "feature content level".

When a new version is released as of NC software 340490-xx, the ranges for error fixes and expanded functions are managed separately.
When the NC software is updated to a new version, first only the included error fixes will be effective.
If the new features of this NC software version are also required, they can be enabled by a code number. --> Ask the machine manufacturer!

27 Connector Designation and Layout

27.1 Important Note

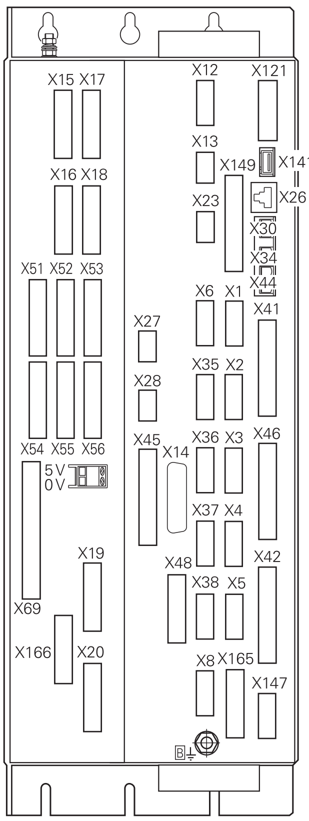
Caution

Do not engage or disengage any connecting elements while the unit is under power!
See “Safety Precautions” on page 2 – 15.

27.2 MC and CC

27.2.1 Designation and position of connectors

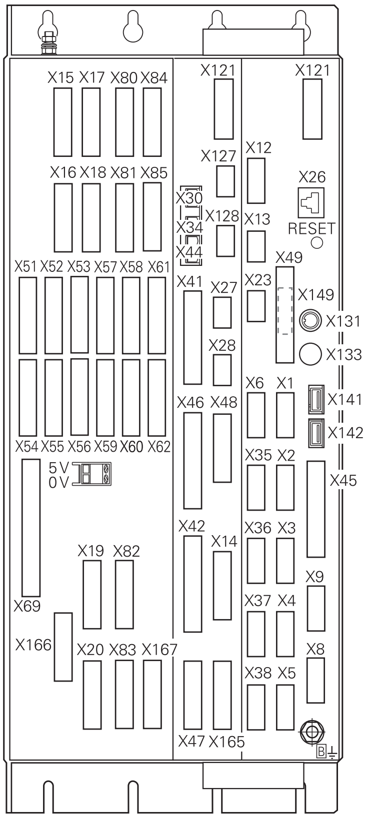
MC 422 (B) with 5 position encoder inputs and CC 422 with 6 control loops



X150 at bottom of housing

X1 to X5	Encoder for position
X35 to X38	Vacant
X15 to X20	Encoder for speed
X51 to X60	PWM output
X8, X9	Nominal value output, analog
X12	TS touch trigger probe
X13	TT touch trigger probe
X23	Handwheel
X26	Ethernet data interface
X27	RS-232-C/V.24 data interface
X28	RS-422/V.11 data interface
X127	V.24/RS-232-C (only for Windows)
X128	V.11/RS-422 (only for Windows)
X141, X142	USB interface
X30	24 V reference signal for spindle
X34	24 V for "control-is-ready" output
X41	PLC output
X42	PLC input
X44	24 V PLC supply voltage
X45	Keyboard unit
X46	Machine operating panel
X47	PLC expansion
X48	PLC analog input
X149 (X49)	BF 150 (BF 120) visual display unit
X131	Reserved
X69	Power supply
X121, X125	Reserved
X165, X166	Reserved
X74	5-V power supply
X150	Axis-specific drive release
B	Signal ground
⏚	Equipment ground (YL/GN)

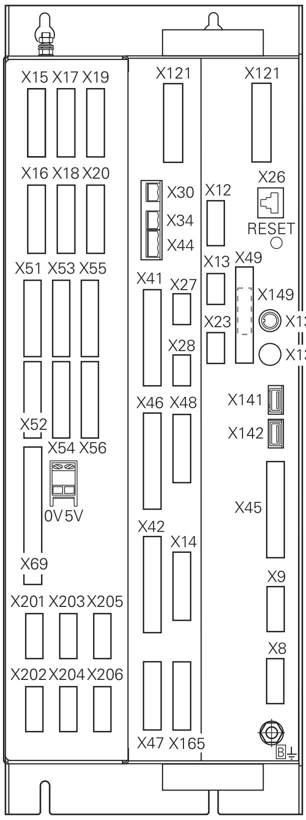
MC 422 (B) with 10 position encoder inputs and CC 422 with 10 or 12 control loops



X150, X151 at bottom of housing

X1 to X6	Encoder for position
X35 to X38	Encoder for position
X15 to X20	Encoder for speed
X80 to X83	Encoder for speed
X84, X85	Encoder for speed (12 control loops)
X51 to X60	PWM output
X61, X62	PWM output (12 control loops)
X8, X9	Nominal value output, analog
X12	TS touch trigger probe
X13	TT touch trigger probe
X23	Handwheel
X26	Ethernet data interface
X27	RS-232-C/V.24 data interface
X28	RS-422/V.11 data interface
X127	V.24/RS-232-C (only for Windows)
X128	RS-422/V.11 (only for Windows)
X141, X142	USB interface
X30	24 V reference signal for spindle
X34	24 V for "control-is-ready" output
X41	PLC output
X42	PLC input
X44	24 V PLC supply voltage
X45	Keyboard unit
X46	Machine operating panel
X47	PLC expansion
X48	PLC analog input
X149 (X49)	BF 150 (BF 120) visual display unit
X131	Reserved
X69	Power supply
X121, X125	Reserved
X165, X166, X167	Reserved
X74	5-V power supply
X150/X151	Axis-specific drive release
B	Signal ground
⏚	Equipment ground (YL/GN)

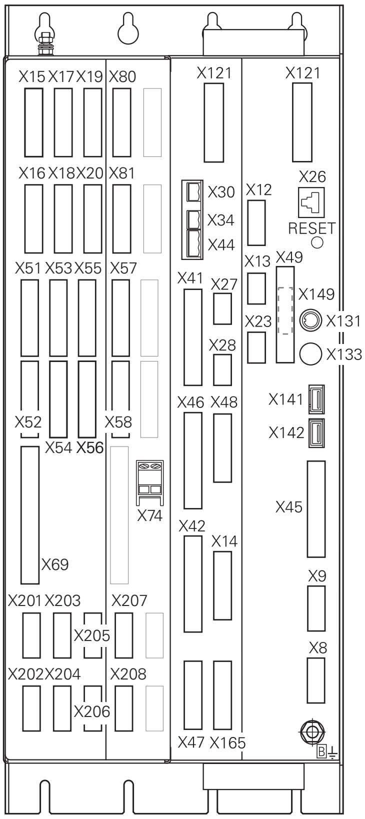
MC 422 B and CC 424 (B) with 6 control loops



X150 at bottom of housing

X201 to X206	Encoder for position
X15 to X20	Encoder for speed
X51 to X56	PWM output
X8, X9	Nominal value output, analog
X12	TS touch trigger probe
X13	TT touch trigger probe
X23	Handwheel
X26	Ethernet data interface
X27	RS-232-C/V.24 data interface
X28	RS-422/V.11 data interface
X127	V.24/RS-232-C (only for Windows)
X128	V.11/RS-422 (only for Windows)
X141, X142	USB interface
X30	24 V reference signal for spindle
X34	24 V for "control-is-ready" output
X41	PLC output
X42	PLC input
X44	24 V PLC supply voltage
X45	Keyboard unit
X46	Machine operating panel
X47	PLC expansion
X48	PLC analog input
X149 (X49)	BF 150 (BF 120) visual display unit
X131	Reserved
X69	Power supply
X121, X125	Reserved
X165	Reserved
X74	5-V power supply
X150	Axis-specific drive release
B	Signal ground
⏚	Equipment ground (YL/GN)

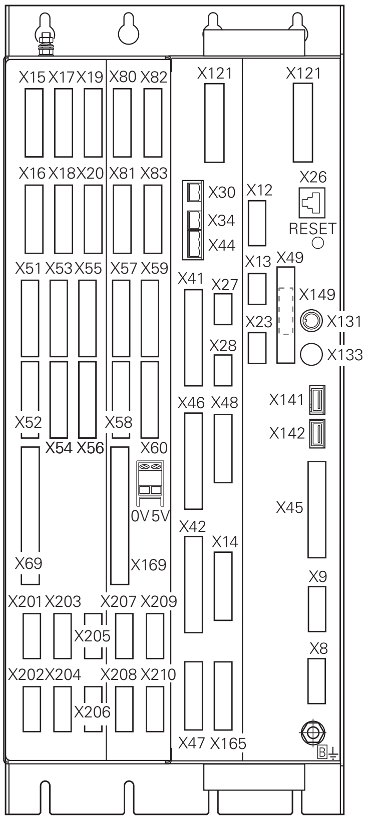
MC 422 B and CC 424 (B) with 8 control loops



X150 at bottom of housing

X201 to X208	Encoder for position
X15 to X20	Encoder for speed
X80 to X81	Encoder for speed
X51 to X58	PWM output
X8, X9	Nominal value output, analog
X12	TS touch trigger probe
X13	TT touch trigger probe
X23	Handwheel
X26	Ethernet data interface
X27	RS-232-C/V.24 data interface
X28	RS-422/V.11 data interface
X127	V.24/RS-232-C (only for Windows)
X128	V.11/RS-422 (only for Windows)
X141, X142	USB interface
X30	24 V reference signal for spindle
X34	24 V for "control-is-ready" output
X41	PLC output
X42	PLC input
X44	24 V PLC supply voltage
X45	Keyboard unit
X46	Machine operating panel
X47	PLC expansion
X48	PLC analog input
X149	BF 150 monitor
X131	Reserved
X69	Power supply
X121, X125	Reserved
X165	Reserved
X74	5-V power supply
X150	Axis-specific drive release
B	Signal ground
⏚	Equipment ground (YL/GN)

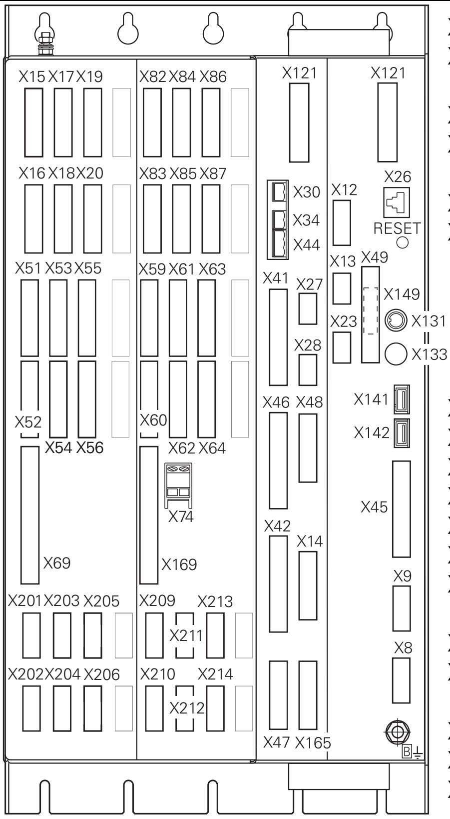
MC 422 B and CC 424 (B) with 10 control loops



X150, X151 at bottom of housing

X201 to X210	Encoder for position
X15 to X20	Encoder for speed
X80 to X83	Encoder for speed
X51 to X60	PWM output
X8, X9	Nominal value output, analog
X12	TS touch trigger probe
X13	TT touch trigger probe
X23	Handwheel
X26	Ethernet data interface
X27	RS-232-C/V.24 data interface
X28	RS-422/V.11 data interface
X127	V.24/RS-232-C (only for Windows)
X128	RS-422/V.11 (only for Windows)
X141, X142	USB interface
X30	24 V reference signal for spindle
X34	24 V for "control-is-ready" output
X41	PLC output
X42	PLC input
X44	24 V PLC supply voltage
X45	Keyboard unit
X46	Machine operating panel
X47	PLC expansion
X48	PLC analog input
X149 (X49)	BF 150 (BF 120) visual display unit
X131	Reserved
X69, X169	Power supply
X121, X125	Reserved
X165	Reserved
X74	5-V power supply
X150/X151	Axis-specific drive release
B	Signal ground
⏚	Equipment ground (YL/GN)

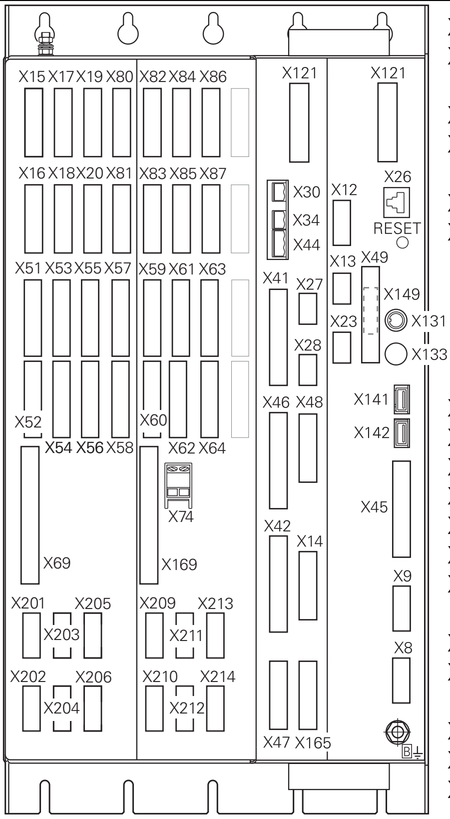
MC 422 B and CC 424 (B) with 12 control loops



X150, X151 at bottom of housing

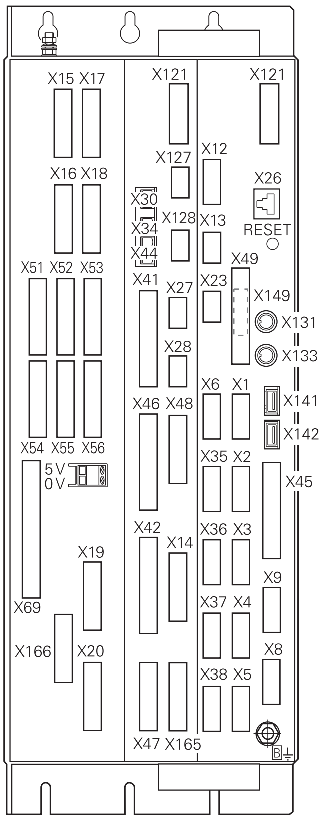
X201 to X206	Encoder for position
X209 to X214	Encoder for position
X15 to X20	Encoder for speed
X82 to X87	Encoder for speed
X51 to X56	PWM output
X59 to X64	PWM output
X8, X9	Nominal value output, analog
X12	TS touch trigger probe
X13	TT touch trigger probe
X23	Handwheel
X26	Ethernet data interface
X27	RS-232-C/V.24 data interface
X28	RS-422/V.11 data interface
X127	V.24/RS-232-C (only for Windows)
X128	V.11/RS-422 (only for Windows)
X141, X142	USB interface
X30	24 V reference signal for spindle
X34	24 V for "control-is-ready" output
X41	PLC output
X42	PLC input
X44	24 V PLC supply voltage
X45	Keyboard unit
X46	Machine operating panel
X47	PLC expansion
X48	PLC analog input
X149	BF 150 monitor
X131	Reserved
X69, X169	Power supply
X121, X125	Reserved
X165	Reserved
X74	5-V power supply
X150, X151	Axis-specific drive release
B	Signal ground
⏚	Equipment ground (YL/GN)

MC 422 B and CC 424 (B) with 14 control loops



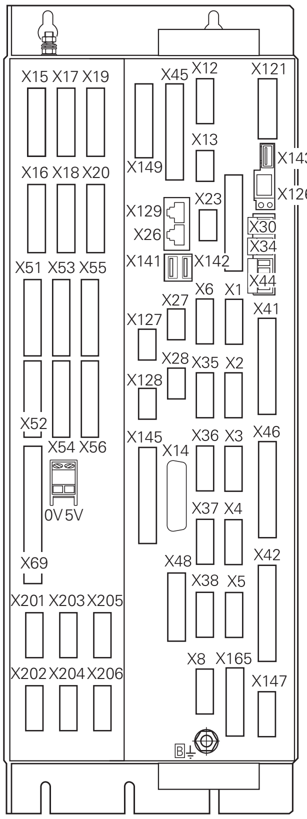
X150, X151 at bottom of housing

X201 to X206	Encoder for position
X209 to X214	Encoder for position
X15 to X20	Encoder for speed
X80 to X87	Encoder for speed
X51 to X58	PWM output
X59 to X64	PWM output
X8, X9	Nominal value output, analog
X12	TS touch trigger probe
X13	TT touch trigger probe
X23	Handwheel
X26	Ethernet data interface
X27	RS-232-C/V.24 data interface
X28	RS-422/V.11 data interface
X127	V.24/RS-232-C (only for Windows)
X128	V.11/RS-422 (only for Windows)
X141, X142	USB interface
X30	24 V reference signal for spindle
X34	24 V for "control-is-ready" output
X41	PLC output
X42	PLC input
X44	24 V PLC supply voltage
X45	Keyboard unit
X46	Machine operating panel
X47	PLC expansion
X48	PLC analog input
X149	BF 150 monitor
X131	Reserved
X69, X169	Power supply
X121, X125	Reserved
X165	Reserved
X74	5-V power supply
X150, X151	Axis-specific drive release
B	Signal ground
⏚	Equipment ground (YL/GN)

MC 422C / 5 position encoder inputs and CC 422 with 6 control loops		
Connection overview	**Connector**	**Function**
	X1 to X5	Position encoder
	X35 to X38	Not occupied
	X15 to X20	Speed encoder
	X51 to X60	PWM output
	X8	Nominal value output, analog
	X12	TS triggering touch probe
	X13	TT triggering touch probe
	X23	Handwheel
	X26	Ethernet data interface
	X27	RS-232-C/V.24 data interface
	X28	RS-422/V.11 data interface
	X141, X142	USB interface (X142 at bottom of unit)
	X30	24 V spindle reference signal
	X34	24 V for control-is-ready signal output
	X41	PLC output
	X42	PLC input
	X44	24 V PLC supply voltage
	X45	Operating panel
	X46	Machine operating panel
	X147	PLC expansion
	X48	PLC analog input
	X149	BF 150 (BF 120) visual display unit
	X69	Power supply
	X121	Reserved
	X165, X166	Reserved
	X74	5 V power supply
	X150	Axis-specific drive enabling (at bottom of housing)
	B	Signal ground
	⏚	Ground lead (YL/GN)

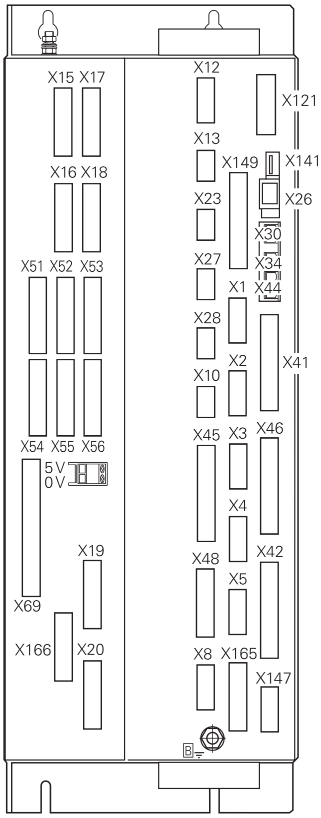
MC 422C DP without position encoder inputs and CC 424(B) with 6 control loops

Connection overview



Connector	Function
X1 to X5	Not occupied
X35 to X38	Not occupied
X15 to X20	Speed encoder
X51 to X60	PWM output
X8	Nominal value output, analog
X12	TS triggering touch probe
X13	TT triggering touch probe
X23	Handwheel
X26	Ethernet data interface
X27	RS-232-C/V.24 data interface
X28	RS-422/V.11 data interface
X127	RS-232-C/V.24 data interface (only for Windows)
X128	RS-422/V.11 (only for Windows)
X141, X142	USB interface
X143, X144	USB interface
X30	24 V spindle reference signal
X34	24 V for control-is-ready signal output
X41	PLC output
X42	PLC input
X44	24 V PLC supply voltage
X45	Operating panel
X46	Machine operating panel
X147	PLC expansion
X48	PLC analog input
X149	BF 150 display unit
X126, X129	Reserved for Ethernet
X69	Power supply
X121	Reserved
X165	Reserved
X74	5 V power supply
X150	Axis-specific drive enabling (at bottom of unit)
B	Signal ground
⏚	Ground lead (YL/GN)

MC 420 and CC 422 with 6 control loops



X142 and X150 on bottom of housing

X1 to X5	Encoder for position
X15 to X20	Encoder for speed
X51 to X56	PWM output
X8	Nominal value output, analog
X12	TS touch trigger probe
X13	TT touch trigger probe
X23	Handwheel
X26	Ethernet data interface
X27	RS-232-C/V.24 data interface
X28	RS-422/V.11 data interface
X141	USB interface
X142	USB Interface
X30	24 V reference signal for spindle
X34	24 V for "control-is-ready" output
X41	PLC output
X42	PLC input
X44	24 V PLC supply voltage
X45	Keyboard unit
X46	Machine operating panel
X147	PLC expansion
X48	PLC analog input
X149	BF 150 monitor
X69	Power supply
X10	Reserved
X121	Reserved
X165, X166	Reserved
X74	5-V power supply
X150	Axis-specific drive release
B	Signal ground
⏚	Equipment ground (YL/GN)

27.2.2 Pin Layouts on the MC and CC

X1 to X6,
X35 to X38,
X201 to X214:
Position encoder
1 V_{PP}

D-sub connector, 15-pin

MC 42x (B/C), CC 424 (B)		Adapter cable ID 309 783-xx Adapter cable ID 310 199-xx			Measuring system	
Male	**Pin layout**	**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 EN 61800-5-1 for "protective extra-low voltage" (PELV).

X1 to X6, X35 to X38, X201 to X214: Position encoders with EnDat interface

D-sub connector, 15-pin

MC 42x(B,C), CC 424(B)		Adapter cable ID 332 115-xx			Connecting cable ID 323 897-xx				Adapter cable ID 313 791-xx		
Male	**Pin layout**	**Female**	**Color**	**Female**	**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	Vacant	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 EN 61800-5-1 for "protective extra-low voltage" (PELV).

X8: Analog output 1 to 6

D-sub connector, 15-pin

MC 42x (B/C)		Connecting cable	
Female	**Pin layout**	**Male**	**Color**
1	Analog output 1: ±10 V	1	Brown
2	Do not assign	2	Brown/Green
3	Analog output 2: ±10 V	3	Yellow
4	Analog output 5: ±10 V	4	Red/Blue
5	Analog output 3: ±10 V	5	Pink
6	Analog output 5: 0 V	6	GY/PK
7	Analog output 4: ±10 V	7	Red
8	Analog output 6: ±10 V	8	Violet
9	Analog output 1: 0 V	9	White
10	Do not assign	10	WH/GY
11	Analog output 2: 0 V	11	Green
12	Do not assign	12	
13	Analog output 3: 0 V	13	Gray
14	Analog output 4: 0 V	14	Blue
15	Analog output 6: 0 V	15	Black
Housing	External shield	Housing	External shld.

X9: Analog output 7 to 13

D-sub connector, 15-pin
There is no connector X9 on the MC 422 C.

MC 42x (B)		Connecting cables	
Female	**Pin layout**	**Male**	**Color**
1	Analog output 7: ±10 V	1	Brown
2	Analog output 13 [a]: ±10 V	2	Brown/Green
3	Analog output 8: ±10 V	3	Yellow
4	Analog output 11: ±10 V	4	Red/Blue
5	Analog output 9: ±10 V	5	Pink
6	Analog output 11: 0 V	6	GY/PK
7	Analog output 10: ±10 V	7	Red
8	Analog output 12: ±10 V	8	Violet
9	Analog output 7: 0 V	9	White
10	Analog output 13[a]: 0 V	10	WH/GY
11	Analog output 8: 0 V	11	Green
12	Do not assign	12	
13	Analog output 9: 0 V	13	Gray
14	Analog output 10: 0 V	14	Blue
15	Analog output 12: 0 V	15	Black
Housing	External shield	Housing	External shld.

a. Only for MC 422 B, but not for MC 422

Note

X8, X9: The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

DANGER

X8, X9: Only units that comply with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV) may be connected.

X12: Connection of the touch probe for workpiece measurement

D-sub connector, 15-pin

Note

The interface complies with the requirements of EN 61800-5-1 for “protective extra-low voltage" (PELV).

Pin layout for TS 220:

MC 42x (B/C)		Adapter cable ID 274 543-xx			TS 220	
Female	**Pin layout**	**Male**	**Color**	**Pin**	**Pin**	**Color**
1	0 V (internal shield)	1				
2	Do not assign	2				
3	Readiness	3	Pink	4	4	
4	Start	4				
5	+15 V ± 10% (U_P), max. 100 mA	5	Gray	3	3	
6	+5 V ± 5% (U_P), max. 100 mA	6	Brown/Green	2	2	Brown
7	$\overline{\text{Battery warning}}$	7	Gray			
8	0 V (U_N)	8	White/Green	1	1	White
9	Trigger signal	9	Green	5	5	Green
10	$\overline{\text{Trigger signal}}$[a]	10	Yellow	6	6	Yellow
11 to 15	Do not assign	11 to 15				
Hsg.	External shield	Hsg.	External shield	Hsg.		

a. Stylus at rest means logic level HIGH.

Pin layout for TS 440, TS 640 with SE 640:

MC 42x (B/C)		Adapter cable ID 310 197-xx			SE 640		TS 440, TS 640
Female	**Pin layout**	**Male**	**Color**	**Female**	**Male**	**Color**	
1	0 V (internal shield)	1	White/ Brown	7			
2	Do not assign						
3	Readiness	3	Gray	5	5	Gray	
4	Start	4	Yellow	3	3		
5	+15 V ± 10% (U_P), max. 100 mA	5	Brown	2	2	Brown	
6	+5 V ± 5% (U_P), max. 100 mA						
7	$\overline{\text{Battery warning}}$	7	Blue	6	6	Blue	
8	0 V (U_N)	8	White	1	1	White	
9	Trigger signal						
10	$\overline{\text{Trigger signal}}$[a]	10	Green	4	4	Green	
11 to 15	Do not assign						
Hsg.	External shield	Hsg.	Ext. shield	Hsg.	Hsg.		

a. Stylus at rest means logic level HIGH.

Pin layout for TS 440, TS 640 with SE 540:

MC 42x (B)		**Adapter cable ID 310 197-xx**			**Adapter cable ID 517 375-xx**			**SE 540**
Female	**Pin layout**	**Male**	**Color**	**Female**	**Male**	**Color**	**Female**	
1	0 V (internal shield)	1	White/ Brown	7	7	Internal shield	7	**TS 440**, **TS 640**
2	Do not assign							
3	Readiness	3	Gray	5	5	Gray	5	
4	Start	4	Yellow	3	3	Yellow	3	
5	+15 V ± 10% (U_P), max. 100 mA	5	Brown	2	2	Brown	2	
6	+5 V ± 5% (U_P), max. 100 mA							
7	Battery warning	7	Blue	6	6	Blue	6	
8	0 V (U_N)	8	White	1	1	White	1	
9	Trigger signal							
10	Trigger signal[a]	10	Green	4	4	Green	4	
11 to 15	Do not assign							
Hsg.	External shield	Hsg.	Ext. shield	Hsg.	Hsg.	Ext. shield	Hsg.	

a. Stylus at rest means logic level HIGH.

Pin layout for TS 632 with EA 632:

MC 422		**Adapter cable ID 310 197-xx**			**EA 632 346 322-xx**		**TS 632**
Female	**Pin layout**	**Male**	**Color**	**Female**	**Male**	**Color**	
1	0 V (internal shield)	1	White/ Brown	7	7	White/ Brown	
2	Do not assign						
3	Readiness	3	Gray	5	5	Gray	
4	Start	4	Yellow	3	3		
5	+15 V ± 10% (U_P), max. 100 mA	5	Brown	2	2	Brown	
6	+5 V ± 5% (U_P), max. 100 mA						
7	Battery warning	7	Blue	6	6	Blue	
8	0 V (U_N)	8	White	1	1	White	
9	Trigger signal						
10	Trigger signal[a]	10	Green	4	4	Green	
11 to 15	Do not assign						
Hsg.	External shield	Hsg.	Ext. shield	Hsg.	Hsg.		

a. Stylus at rest means logic level HIGH.

Two EA 652 can be connected to the MC 422 via the APE 652. This is necessary for example on large machines or on machines with swivel heads.

Pin layout for TS 632 with 2 EA 652 via the APE 652:

MC 422	Adapter cable 310 197-xx	APE 652 354 656-xx		Conneacting cable ID 336 157-xx			EA 652 346 322-xx		TS 632
		Male	Female	Male	Color	Female	Male	Color	
Assignment see above!		7	7	7	White/ Brown	7	7	White/ Brown	
		5	5	5	Gray	5	5	Gray	
		3	3	3	Yellow	3	3		
		2	2	2	Brown	2	2	Brown	
		6	6	6	Blue	6	6	Blue	
		1	1	1	White	1	1	White	
		4	4	4	Green	4	4	Green	
		Hsg.	Hsg.	Hsg.	Ext. shield	Hsg.	Hsg.		

X13: Connection of the touch probe for tool measurement

D-sub connector, 9-pin

Pin layout on the MC 42x (B/C):

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

Pin layout on adapter cable and touch probe:

MC 42x (B/C)		Adapter cable ID 335 332-xx			TT 130 296 537-xx	
Female	Pin layout	Male	Color	Female	Male	Color
1	Readiness	1	Pink	6	6	
2	0 V (U_N)	2	White/Green	1	1	White
3	Do not assign	3				
4	+15 V ±5% (U_P)	4	Brown/Green	2	2	Brown
5	Do not assign	5		5	5	
6	Do not assign	6				
7	+5 V ±5% (U_P)	7				
8	Trigger signal	8	Brown	3	3	Green
9	$\overline{\text{Trigger signal}}$[a]	9	Green	4	4	Yellow
–	–	–	–	7	7	
Hsg.	External shield	Hsg.	Ext. shield	Hsg.	Hsg.	

a. Stylus at rest means logic level HIGH.

X15 to X20, X80 to X87: Speed encoder 1 V_{PP}

D-sub connector, 25-pin

CC 42x (B)		Adapter cable 289 440-xx				Connecting cable 336 847-xx		
Male	Pin layout	Female	Color	Female		Male	Color	Female
1	+5 V (U_P)	1	Brown/Green	10	Line drop compensator 370 226-01, if required	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, X80 to X87: Speed encoder with EnDat interface

D-sub connector, 25-pin

CC 42x (B)		Adapter cable 336 376-xx				Connecting cable 340 302-xx		
Male	Pin layout	Female	Color	Female		Male	Color	Female
1	+5 V (U_P)	1	Brown/Green	10	Line drop compensator 370 224-01, if required	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 42x (B)		Adapter cable 336 376-xx				Adapter cable 369 124-xx Adapter cable 369 129-xx	
Male	**Pin layout**	**Female**	**Color**	**Female**		**Male**	**Color**
1	+5 V (U_P)	1	Brown/Green	10	Line drop compensator 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 Temperature+		
					3 Temperature–		
					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 42x (B)		Adapter cable 509 667-xx			Adapter cable 369 124-xx Adapter cable 369 129-xx or RCN	
Male	**Pin layout**	**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).

X23: Handwheel input

D-sub connector, 9-pin

Female	Pin layout
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).

X26: Ethernet interface RJ45 connection

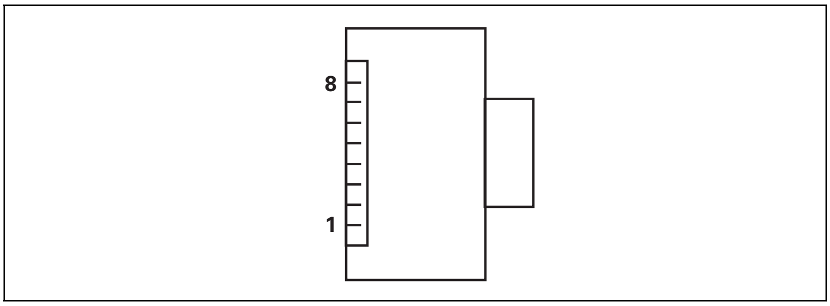
RJ45 connection, 8-pin

Maximum data transfer rate:
Approx. 2 to 5 Mbps (depending on file type and network utilization)

Maximum cable length if shielded: 100 m

RJ45 connection (female) 8-pin	Pin layout
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

Face of the connector:



Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

Meanings of the LEDs on the Ethernet data interface X26:

LED	Condition	Meaning
Green	Blinking	Interface active
	Off	Interface inactive
Yellow	On	100 Mb net
	Off	10 Mb net

X27: RS-232-C/V.24 data interface

D-sub connector, 9-pin

Single-processor control: Connection to HEIDENHAIN HeROS operating system
Dual-processor control: Connection to Windows

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

25-pin adapter block:

MC 42x (B/C)		Connecting cable ID 365 725-xx			Adapter block 310 085-01		Connecting cable ID 274 545-xx		
Male	**Pin layout**	**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	6
									8
5	Signal GND	5	Red	7	7	7	7	Red	7
6	DSR	6	Blue	6	6	6	6	Violet	20
							8		
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							
Hsg.	External shield	Hsg.	Ext. shield	Hsg.	Hsg.	Hsg.	Hsg.	Ext. shield	Hsg.

9-pin adapter block:

MC 42x (B/C)		Connecting cable ID 355 484-xx			Adapter block 363 987-02		Connecting cable ID 366 964-xx		
Male	**Pin layout**	**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.

X28: RS-422/V.11 Data interface

D-sub connector, 9-pin

Single-processor control: Connection to HEIDENHAIN HeROS operating system
Dual-processor control: Connection to Windows

MC 42x (B)		Connecting cable ID 355 484-xx			Adapter block 363 987-01	
Female	**Pin layout**	**Male**	**Color**	**Female**	**Male**	**Female**
1	RTS	1	Red	1	1	1
2	DTR	2	Yellow	2	2	2
3	$\overline{\text{RXD}}$	3	White	3	3	3
4	$\overline{\text{TxD}}$	4	Brown	4	4	4
5	0 V	5	Black	5	5	5
6	CTS	6	Violet	6	6	6
7	DSR	7	Gray	7	7	7
8	RxD	8	White/ Green	8	8	8
9	TxD	9	Green	9	9	9
Hsg.	External shield	Hsg.	Ext. shield	Hsg.	Hsg.	Hsg.

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

X30: Reference signal spindle

Terminal, 2-pin

Connecting terminal	Pin layout
1	+24 V
2	0 V

X34: Power supply for “Control is ready”

Terminal, 2-pin

The "Control-is-ready" output is powered with 24 Vdc provided by the UE 2xxB inverter or the UV1xx power supply unit.
The voltage is connected with terminal X34.

Connecting terminal X34	Pin layout	Connection when using a HEIDENHAIN inverter
1	+24 V	X72/1
2	0 V	X72/2

X41:
PLC outputs
on the MC 42x (B/C)

D-sub connector, 37-pin

MC 42x (B/C)		**Connecting cable ID 244 005-xx ID 263 954-xx**	
Female	**Pin layout**	**Male**	
Supply via X44, pin 3; can be switched off with EMERGENCY STOP			
1	O0[a]	1	Gray/Red
2	O1[a]	2	Brown/Black
3	O2 [a]	3	White/Black
4	O3[a]	4	Green/Black
5	O4[a]	5	Brown/Red
6	O5[a]	6	White/Red
7	O6[a]	7	White/Green
8	O7[a]	8	Red/Blue
9	O8	9	Yellow/Red
10	O9	10	GY/PK
11	O10	11	Black
12	O11	12	Pink/Brown
13	O12	13	Yellow/Blue
14	O13	14	Green/Red
15	O14	15	Yellow
16	O15	16	Red
Supply via X44, pin 2; can be switched off with EMERGENCY STOP			
17	O16	17	Gray
18	O17	18	Blue
19	O18	19	Pink
20	O19	20	WH/GY
21	O20	21	Yellow/Gray
22	O21	22	Green/Red
23	O22	23	White/Pink
24	O23	24	Gray/Green
Supply via X44, pin 1; **cannot** be switched off with EMERGENCY STOP			
25	O24	25	Yellow/Brown
26	O25	26	Gray/Brown
27	O26	27	Yellow/Black
28	O27	28	White/Yellow
29	O28	29	Gray/Blue
30	O29	30	Pink/Blue
31	O30	31	Pink/Red
32, 33	Do not assign	32	Brown/Blue; Pink/Green
34	Control-is-ready signal	34	Brown
35, 36, 37	Do not assign	35	Yellow/Pink; Violet; White
Housing	External shield	Housing	External shield

a. Also via X46 (PLC inputs/outputs)

X42: PLC inputs on the MC 42x (B/C)

D-sub connector, 37-pin

MC 42x (B/C)		Connecting cable ID 244 005-xx, ID 263 954-xx	
Female	**Pin layout**	**Male**	
1	I0	1	Gray/Red
2	I1	2	Brown/Black
3	I2	3	White/Black
4	I3 Control-is-ready signal acknowledgement	4	Green/Black
5	I4	5	Brown/Red
6	I5	6	White/Red
7	I6	7	White/Green
8	I7	8	Red/Blue
9	I8	9	Yellow/Red
10	I9	10	GY/PK
11	I10	11	Black
12	I11	12	Pink/Brown
13	I12	13	Yellow/Blue
14	I13	14	Green/Blue
15	I14	15	Yellow
16	I15	16	Red
17	I16	17	Gray
18	I17	18	Blue
19	I18	19	Pink
20	I19	20	WH/GY
21	I20	21	Yellow/Gray
22	I21	22	Green/Red
23	I22	23	White/Pink
24	I23	24	Gray/Green
25	I24	25	Yellow/Brown
26	I25	26	Gray/Brown
27	I26	27	Yellow/Black
28	I27	28	White/Yellow
29	I28	29	Gray/Blue
30	I29	30	Pink/Blue
31	I30	31	Pink/Red
32	I31	32	Brown/Blue
33	I32 Drive enable	33	Pink/Green
34	Do not assign	34	Brown
35	0 V (PLC) test output; do not assign	35	Yellow/Pink
36	0 V (PLC) test output; do not assign	36	Violet
37	0 V (PLC) test output; do not assign	37	White
Housing	External shield	Housing	External shield

X44: PLC supply voltage

Terminal, 4-pin

Pin layout on the MC 42x (B/C):

Connectiont erminal	Pin layout	PLC outputs
1	+24 V cannot be switched off via EMERGENCY STOP	O24 to O30
2	+24 V can be switched off via EMERGENCY STOP	O16 to O23
3		O0 to O15
4	0 V	

☞ **Note**

If the +24-V power supply (which cannot be shut off via emergency stop) is missing at X44, the error message **`Supply voltage missing at X44`** appears.

X45: D-sub connector, 37-pin
iTNC control panel

MC 42x (B/C)		Connecting cable ID 263 954-xx			TE
Female	**Pin layout**	**Male**		**Female**	**X2: Male**
1	RL0	1	Gray/Red	1	1
2	RL1	2	Brown/Black	2	2
3	RL2	3	White/Black	3	3
4	RL3	4	Green/Black	4	4
5	RL4	5	Brown/Red	5	5
6	RL5	6	White/Red	6	6
7	RL6	7	White/Green	7	7
8	RL7	8	Red/Blue	8	8
9	RL8	9	Yellow/Red	9	9
10	RL9	10	GY/PK	10	10
11	RL10	11	Black	11	11
12	RL11	12	Pink/Brown	12	12
13	RL12	13	Yellow/Blue	13	13
14	RL13	14	Green/Blue	14	14
15	RL14	15	Yellow	15	15
16	RL15	16	Red	16	16
17	RL16	17	Gray	17	17
18	RL17	18	Blue	18	18
19	RL18	19	Pink	19	19
20	SL0	20	WH/GY	20	20
21	SL1	21	Yellow/Gray	21	21
22	SL2	22	Green/Red	22	22
23	SL3	23	White/Pink	23	23
24	SL4	24	Gray/Green	24	24
25	SL5	25	Yellow/ Brown	25	25
26	SL6	26	Gray/Brown	26	26
27	SL7	26	Yellow/Black	27	27
28	RL19	28	White/Yellow	28	28
29	RL20	29	Gray/Blue	29	29
30	Do not assign	30	Pink/Blue	30	30
31	RL21	31	Pink/Red	31	31
32	RL22	32	Brown/Blue	32	32
33	RL23	33	Pink/Green	33	33
34	Spindle override (wiper)	34	Brown	34	34
35	Feed-rate override (wiper)	35	Yellow/Pink	35	35
36	+5 V override potentiometer	36	Violet	36	36
37	0 V override potentiometer	37	White	37	37
Housing	External shield	Housing	External shield	Housing	Housing

X46: Machine operating panel

D-sub connector, 37-pin

PLC inputs I128 to I152 and PLC outputs O0 to O7 are on connection X46 of the machine operating panel. The reference potential (PLC) for outputs O0 to O7 is connected to pins 34 and 35.

Pin layout on the MC 42x (B/C), connecting cables and machine operating panel:

Caution

PLC inputs I128 to I152 must be switched only with the power supply from pins 36 and 37, since this power supply is internally protected for this purpose (PLC supply voltage from X44 connection 2).

MC 42x (B/C), X48		Connecting cable ID 263 954-xx			MB 420, X1	
Female	Pin layout	Male		Female	Male	Key
1	I128	1	Gray/Red	1	1	X –
2	I129	2	Brown/Black	2	2	Y –
3	I130	3	White/Black	3	3	Z–
4	I131	4	Green/Black	4	4	IV–
5	I132	5	Brown/Red	5	5	V–
6	I133	6	White/Red	6	6	X +
7	I134	7	White/Green	7	7	Y +
8	I135	8	Red/Blue	8	8	Z +
9	I136	9	Yellow/Red	9	9	IV+
10	I137	10	GY/PK	10	10	V +
11	I138	11	Black	11	11	Tool change
12	I139	12	Pink/Brown	12	12	Unlock tool
13	I140	13	Yellow/Blue	13	13	Menu select.
14	I141	14	Green/Blue	14	14	Unlock door
15	I142	15	Yellow	15	15	Chip removal
16	I143	16	Red	16	16	Spindle on
17	I144	17	Gray	17	17	Spindle off
18	I145	18	Blue	18	18	Coolant
19	I146	19	Pink	19	19	NC start
20	I147	20	WH/GY	20	20	NC stop
21	I148	21	Yellow/Gray	21	21	Rapid trav.
22	I149	22	Green/Red	22	22	Retract axis
23	I150	23	White/Pink	23	23	Rinse water jet
24	I151	24	Gray/Green	24	24	Via X3
25	I152	25	Yellow/Brown	25	25	Via X3
26	O0[a]	26	Gray/Brown	26	26	Via X4
27	O1[a]	26	Yellow/Black	27	27	Via X4
28	O2 [a]	28	White/Yellow	28	28	Via X4
29	O3[a]	29	Gray/Blue	29	29	Via X4
30	O4[a]	30	Pink/Blue	30	30	Via X4
31	O5[a]	31	Pink/Red	31	31	Via X4
32	O6[a]	32	Brown/Blue	32	32	Via X4
33	O7[a]	33	Pink/Green	33	33	Via X4
34, 35	0 V (PLC)	34, 35	Brown, Yellow/Pink	34, 35	34, 35	
36, 37	+24 V (PLC)	36	Violet, White	36, 37	36,37	
Housing	Ext. shield	Housing	External shield	Housing	Housing	

a. Also via X41 (PLC outputs on the MC 42x(B))

X47:
PLC expansion for PL 4xx B on the MC 422 (B/C)

D-sub connector, 25-pin

MC 42x (B/C)		Connecting cable ID 289 111-xx / ID 317 788-xx			1. PL 410 B/PL405 B	
Male	**Pin layout**	**Female**		**Male**	**X1 Socket**	**Pin layout**
1	0 V	1	Brown, Yellow, Pink, Red, Violet	1	1	0 V
2	0 V	2	Red/Blue, Brown/Green, Yellow/Brown, Gray/Brown, Pink/Brown	2	2	0 V
3	0 V	3	Brown/Blue, Brown/Red, Brown/Black, Yellow/Gray, Yellow/Pink	3	3	0 V
4	Do not assign	4	Gray/Green	4	4	Serial IN 2
5	$\overline{\text{Address 6}}$	5	White/Green	5	5	$\overline{\text{Address 6}}$
6	INTERRUPT	6	Pink/Green	6	6	INTERRUPT
7	$\overline{\text{RESET}}$	7	Green/Blue	7	7	$\overline{\text{RESET}}$
8	$\overline{\text{WRITE EXTERN}}$	8	White/Blue	8	8	$\overline{\text{WRITE EXTERN}}$
9	WRITE EXTERN	9	White/Red	9	9	WRITE EXTERN
10	$\overline{\text{Address 5}}$	10	GY/PK	10	10	$\overline{\text{Address 5}}$
11	$\overline{\text{Address 3}}$	11	Blue	11	11	$\overline{\text{Address 3}}$
12	$\overline{\text{Address 1}}$	12	Green	12	12	$\overline{\text{Address 1}}$
13	Do not assign	13		13	13	Do not assign
14	PCB identifier 3	14	Yellow/Blue, Pink/Blue, Yellow/Black	14	14	+ 12 V
15	PCB identifier 4	15	Yellow/Red, Gray/Red, Pink/Red	15	15	+ 12 V
16	Do not assign	16	Gray/Blue	16	16	PCB identifier 2
17	Do not assign	17	Green/Black	17	17	PCB identifier 1
18	$\overline{\text{Address 7}}$	18	White/Yellow	18	18	$\overline{\text{Address 7}}$
19	Serial IN 1	19	White/Black	19	19	Serial IN 1
20	EM. STOP	20	Green/Red	20	20	EM. STOP
21	$\overline{\text{Serial OUT}}$	21	WH/GY	21	21	$\overline{\text{Serial OUT}}$
22	Serial OUT	22	White/Pink	22	22	Serial OUT
23	$\overline{\text{Address 4}}$	23	Black	23	23	$\overline{\text{Address 4}}$
24	$\overline{\text{Address 2}}$	24	Gray	24	24	$\overline{\text{Address 2}}$
25	$\overline{\text{Address 0}}$	25	White	25	25	$\overline{\text{Address 0}}$
Housing	External shield	Housing	External shield	Housing	Housing	External shield

X47:
PLC expansion for PL 510 to the MC 422 (B/C)

D-sub connector, 25-pin

MC 42x (B/C)		Connecting cable ID 371 045-xx			1. PL 510	
Male	**Pin layout**	**Female**		**Male**	**X1 Socket**	**Pin layout**
1	0 V	1	Black	1	1	0 V
2	0 V	2	Violet	2	2	0 V
3	0 V	3		3	3	0 V
4	Do not assign	4		4	4	Do not assign
5	$\overline{\text{Address 6}}$	5	Yellow	5	5	$\overline{\text{Address 6}}$
6	INTERRUPT	6	Blue	6	6	INTERRUPT
7	$\overline{\text{RESET}}$	7	Red	7	7	$\overline{\text{RESET}}$
8	$\overline{\text{WRITE EXTERN}}$	8	Gray	8	8	$\overline{\text{WRITE EXTERN}}$
9	WRITE EXTERN	9	Pink	9	9	WRITE EXTERN
10	$\overline{\text{Address 5}}$	10	Green	10	10	$\overline{\text{Address 5}}$
11	$\overline{\text{Address 3}}$	11	White	11	11	$\overline{\text{Address 3}}$
12	$\overline{\text{Address 1}}$	12	Brown	12	12	$\overline{\text{Address 1}}$
13	Do not assign	13		13	13	Do not assign
14	+5 V (output)	14	White/Blue	14	14	
15	+5 V (feedback)	15	Brown/Blue	15	15	
16	Do not assign	16	White/Pink	16	16	PCB identifier 2
17	Do not assign	17	Pink/Brown	17	17	PCB identifier 1
18	$\overline{\text{Address 7}}$	18	Brown/Green	18	18	$\overline{\text{Address 7}}$
19	Serial IN 1	19	WH/GY	19	19	Serial IN 1
20	EM. STOP	20	Gray/Brown	20	20	EM. STOP
21	$\overline{\text{Serial OUT}}$	21	White/Yellow	21	21	$\overline{\text{Serial OUT}}$
22	Serial OUT	22	Yellow/Brown	22	22	Serial OUT
23	$\overline{\text{Address 4}}$	23	White/Green	23	23	$\overline{\text{Address 4}}$
24	$\overline{\text{Address 2}}$	24	GY/PK	24	24	$\overline{\text{Address 2}}$
25	$\overline{\text{Address 0}}$	25	Red/Blue	25	25	$\overline{\text{Address 0}}$
				26	26	
Housing	External shield	Housing	External shield	Housing	Housing	External shield

X48: Analog input (PLC) on the MC 42x (B/C)

D-sub connector, 25-pin

Caution

Remember to connect the analog inputs with the correct polarity!

Female	Pin layout
1	I_1+ Constant current for Pt 100
2	I_1– Constant current for Pt 100
3	U_1+ Measuring input for Pt 100
4	U_1– Measuring input for Pt 100
5	I_2+ Constant current for Pt 100
6	I_2– Constant current for Pt 100
7	U_2+ Measuring input for Pt 100
8	U_2– Measuring input for Pt 100
9	I_3+ Constant current for Pt 100
10	I_3– Constant current for Pt 100
11	U_3+ Measuring input for Pt 100
12	U_3– Measuring input for Pt 100
13	Do not assign
14	Analog input 1: –10 V to +10 V
15	Analog input 1: 0 V (reference potential)
16	Analog input 2: –10 V to +10 V
17	Analog input 2: 0 V (reference potential)
18	Analog input 3: –10 V to +10 V
19	Analog input 3: 0 V (reference potential)
20 to 25	Do not assign
Housing	External shield

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

X49:
BF 120 flat-panel display

D-sub connector, 62-pin

MC 42x(B/C), X49		Connecting cable ID 340 300-xx			BF 120, X2
Female	**Assignment**	**Male**		**Female**	**Male**
1	0 V	1	Gray/Black	1	1
2	CLK.P	2	Brown/Black	2	2
3	HSYNC	3	Green/Black	3	3
4	$\overline{\text{BLANK}}$	4	Orange/Black	4	4
5	VSYNC	5	Blue/Black	5	5
6	0 V	6	Green/White	6	6
7	R0	7	Orange/White	7	7
8	R1	8	Brown/White	8	8
9	R2	9	Gray/White	9	9
10	R3	10	Blue/White	10	10
11	0 V	11	Violet/White	11	11
12	G0	12	Violet/Brown	12	12
13	G1	13	Violet/Green	13	13
14	G2	14	Violet/Orange	14	14
15	G3	15	Violet/Blue	15	15
16	0 V	16	Red/Gray	16	16
17	B0	17	Red/Brown	17	17
18	B1	18	Yellow/Gray	18	18
19	B2	19	Yellow/Brown	19	19
20	B3	20	Yellow/Green	20	20
21	0 V	21	Vacant	21	21
22	0 V	22	Black/Gray	22	22
23	$\overline{\text{CLP.P}}$	23	Black/Brown	23	23
24	$\overline{\text{HSYNC}}$	24	Black/Green	24	24
25	BLANK	25	Black/Orange	25	25
26	$\overline{\text{VSYNC}}$	26	Black/Blue	26	26
27	0 V	27	White/Green	27	27
28	$\overline{\text{R0}}$	28	White/Orange	28	28
29	$\overline{\text{R1}}$	29	White/Brown	29	29

MC 42x(B/C), X49		Connecting cable ID 340 300-xx			BF 120, X2
Female	**Assignment**	**Male**		**Female**	**Male**
30	$\overline{R2}$	30	WH/GY	30	30
31	$\overline{R3}$	31	White/Blue	31	31
32	0 V	32	Gray/Violet	32	32
33	$\overline{G0}$	33	Brown/Violet	33	33
34	$\overline{G1}$	34	Green/Violet	34	34
35	$\overline{G2}$	35	Orange/Violet	35	35
36	$\overline{G3}$	36	Blue/Violet	36	36
37	0 V	37	Gray/Red	37	37
38	$\overline{B0}$	38	Brown/Red	38	38
39	$\overline{B1}$	39	Gray/Yellow	39	39
40	$\overline{B2}$	40	Brown/Yellow	40	40
41	$\overline{B3}$	41	Green/Yellow	41	41
42	0 V	42	Vacant	42	42
43	$\overline{\text{DISP.}}$ $\overline{\text{LOW}}$	43	Red/Blue	43	43
44	DISP. LOW	44	Blue/Red	44	44
45	$\overline{\text{DISP.ON}}$	45	Red/Orange	45	45
46	DISP.ON	46	Orange/Red	46	46
47	C0	47	Green/Red	47	47
48	C1	48	Red/Green	48	48
49	C2	49	Orange/Yellow	49	49
50	C3	50	Yellow/Orange	50	50
51	C4	51	Yellow/Blue	51	51
52	C5	52	Blue/Yellow	52	52
53 to 56	Do not assign	53 to 56	Vacant	53 to 56	53 to 56
57 to 62	0 V	57 to 62	Vacant	57 to 62	57 to 62
Housing		Housing		Housing	Housing

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.

X51 to X64: PWM-output

Ribbon cable connector, 20-pin

Ribbon cable connector, 20-pin	Pin layout
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	+/actl 1
6b	–/actl 1
7a	0 V (analog)
7b	+Iactl 2
8a	–/actl 2
8b	0 V (analog)
9a	$\overline{\text{BRK}}$
9b	Do not assign
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:
NC power supply and control signals

Ribbon cable connector, 50-pin, same assignment as X169.

50-pin ribbon connector	Pin layout	50-pin ribbon connector	Pin layout
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 UV 120, UV 140, UV 150, UR 2xx)
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 supply

Terminal, 2-pin

Wire color of 5 V connection	5 V terminal on CC 42x (B)
Black	0 V
Red	+5 V

X127: RS-232-C/V.24 data interface

D-sub connector, 9-pin

Dual-processor control: Connection to HEIDENHAIN HeROS operating system

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

25-pin adapter block:

MC 42x (B/C)		Connecting cable ID 365 725-xx			Adapter block 310 085-01		Connecting cable ID 274 545-xx		
Male	**Pin layout**	**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	6
									8
5	Signal GND	5	Red	7	7	7	7	Red	7
6	DSR	6	Blue	6	6	6	6	Violet	20
							8		
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							
Hsg.	External shield	Hsg.	Ext. shield	Hsg.	Hsg.	Hsg.	Hsg.	Ext. shield	Hsg.

9-pin adapter block:

MC 42x (B/C)		Connecting cable ID 355 484-xx			Adapter block 363 987-02		Connecting cable ID 366 964-xx		
Male	**Pin layout**	**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	WH	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.

X128: RS-422/V.11 data interface

D-sub connector, 9-pin

Dual-processor control:Connection to HEIDENHAIN HeROS operating system

MC 42x (B/C)		Connecting cable ID 355 484-xx			Adapter block 363 987-01	
Female	Pin layout	Male	Color	Female	Male	Female
1	RTS	1	Red	1	1	1
2	DTR	2	Yellow	2	2	2
3	$\overline{RXD}$	3	White	3	3	3
4	$\overline{TxD}$	4	Brown	4	4	4
5	0 V	5	Black	5	5	5
6	CTS	6	Violet	6	6	6
7	DSR	7	Gray	7	7	7
8	RxD	8	White/Green	8	8	8
9	TxD	9	Green	9	9	9
Hsg.	External shield	Hsg.	External shield	Hsg.	Hsg.	Hsg.

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

X141, X142: USB connection

USB connection

USB connection (female) 4-pin	Pin layout
1	+5 V
2	USBP–
3	USBP+
4	GND

Note

When connecting, USB memory devices that use the file system VFAT or ISO 9660 (not NTFS or similar) are detected automatically.

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.

USB hub

Connections on the USB hub (368 735-01):

Connection designation	Function
X1	24-V power supply
X32	5-V output
X140	USB input (to the MC 42x(B))
X141	USB output 1
X142	USB output 2
X143	USB output 3
X144	USB output 4

> **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.

X147: PLC Expansion for PL 510 on the MC 420

D-sub connector, 26-pin

MC 420		Connecting cable ID 371 046-xx			First PL 510	
Male	**Pin layout**	**Female**		**Male**	**X1 female**	**Pin layout**
1	0 V	1	Black	1	1	0 V
2	0 V	2	Violet	2	2	0 V
3	0 V	3		3	3	0 V
4	Do not assign	4		4	4	Do not assign
5	$\overline{\text{Address 6}}$	5	Yellow	5	5	$\overline{\text{Address 6}}$
6	INTERRUPT	6	Blue	6	6	INTERRUPT
7	$\overline{\text{RESET}}$	7	Red	7	7	$\overline{\text{RESET}}$
8	$\overline{\text{WRITE EXTERN}}$	8	Gray	8	8	$\overline{\text{WRITE EXTERN}}$
9	WRITE EXTERN	9	Pink	9	9	WRITE EXTERN
10	$\overline{\text{Address 5}}$	10	Green	10	10	$\overline{\text{Address 5}}$
11	$\overline{\text{Address 3}}$	11	White	11	11	$\overline{\text{Address 3}}$
12	$\overline{\text{Address 1}}$	12	Brown	12	12	$\overline{\text{Address 1}}$
13	Do not assign	13		13	13	Do not assign
14	+5 V (output)	14	White/Blue	14	14	
15	+5 V (feedback)	15	Brown/Blue	15	15	
16	PCB identifier 2	16	White/Pink	16	16	PCB identifier 2
17	PCB identifier 1	17	Pink/Brown	17	17	PCB identifier 1
18	$\overline{\text{Address 7}}$	18	Brown/Green	18	18	$\overline{\text{Address 7}}$
19	Serial IN 1	19	WH/GY	19	19	Serial IN
20	EM. STOP	20	Gray/Brown	20	20	EM. STOP
21	$\overline{\text{Serial OUT}}$	21	White/Yellow	21	21	$\overline{\text{Serial OUT}}$
22	Serial OUT	22	Yellow/Brown	22	22	Serial OUT
23	$\overline{\text{Address 4}}$	23	White/Green	23	23	$\overline{\text{Address 4}}$
24	$\overline{\text{Address 2}}$	24	GY/PK	24	24	$\overline{\text{Address 2}}$
25	$\overline{\text{Address 0}}$	25	Red/Blue	25	25	$\overline{\text{Address 0}}$
26		26		26	26	
Housing	External shield	Housing	External shield	Housing	Housing	External shield

X149: BF 150 flat-panel display

D-sub connector, 44-pin

MC 42x (B/C), X149		Connecting cable ID 353 545-xx			BF 150, X2
Female	Pin layout	Male		Female	Male
1	A7M	1		1	1
2	A6M	2	White/Brown	2	2
3	A5M	3	White/Green	3	3
4	A4M	4	Red/Gray	4	4
5	A3M			5	5
6	CLKM	6	Red/Blue	6	6
7	A2M	7	White/Orange	7	7
8	A1M	8	Red/Brown	8	8
9	A0M	9	Red/Green	9	9
10	LVDSGND	10	Red/Orange	10	10
11	HWK_GND	11	Orange/Red	11	11
12	HWK0	12	White/Blue	12	12
13	HWK1	13	Blue/White	13	13
14	HWK2	14	White/Blue	14	14
15	HWK3	15	Gray/White	15	15
16	A7P	16		16	16
17	A6P	17	Brown/White	17	17
18	A5P	18	Green/White	18	18
19	A4P	19	Gray/Red	19	19
20	A3P			20	20
21	CLKP	21	Blue/Red	21	21
22	A2P	22	Orange/White	22	22
23	A1P	23	Brown/Red	23	23
24	A0P	24	Green/Red	24	24
25 to 30	Not assigned			25 to 30	25 to 30
31 to 39	LVDSGND			31 to 39	31 to 39
40 to 44	Not assigned			40 to 44	40 to 44
Housing		Housing		Housing	Housing

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.

X150, X151: Drive controller enable for axis groups

Terminal, 9-pin

The connecting terminals X150 and X151 are located on the bottom of the CC 42x (B).

- X150 controls drive enabling for the axis groups on the first controller board (PWM outputs X51 to X56).
- X151 controls drive enabling for the axis groups on the second controller board (PWM outputs X57 to X60 or X62).

Note

The pin of an axis group must always be wired to the connector on whose PCB the control loop is located.
If an axis group contains control loops located on both PCBs, then the pins of both connectors must be wired.

Terminal X150/X151	Assignment of X150	Assignment of X151
1	+24 V[a]; drive controller-enabling for axis group 1	+24 V[a]; drive controller enabling for axis group 1
2	+24 V[a]; drive controller enabling for axis group 2	+24 V[a]; drive controller enabling for axis group 2
3	+24 V[a]; drive controller enabling for axis group 3	+24 V[a]; drive controller enabling for axis group 3
4	Only CC 424: +24 V[a]; drive controller enabling for axis group 4	Only CC 424: +24 V[a]; drive controller enabling for axis group 4
5	Only CC 424: +24 V[a]; drive controller enabling for axis group 5	Only CC 424: +24 V[a]; drive controller enabling for axis group 5
6	Only CC 424: +24 V[a]; drive controller enabling for axis group 6	Only CC 424: +24 V[a]; drive controller enabling for axis group 6
7	Reserved, do not assign	Reserved, do not assign
8	Reserved, do not assign	Reserved, do not assign
9	0 V	0 V

a. maximum current consumption 10 mA

X169: NC supply voltage and control signals

Ribbon cable connector, 50-pin, same assignment as X69.

See “X69: NC power supply and control signals” on page 27 – 481.

27.3 Power Supply Units

The iTNC 530 is supplied via connector X69 (X169) on the CC,
See “X69: NC power supply and control signals” on page 27 – 481.

Exception: An MC can be connected directly to a UV 106 (B), the CC is not required. This constellation is intended for machines with analog axes and spindle(s).

The power supply units include:

- UV 105, UV 105 B and UV 106, UV 106 B power supply units

Note

Further information --> See “Power Supply” on page 17 – 251.

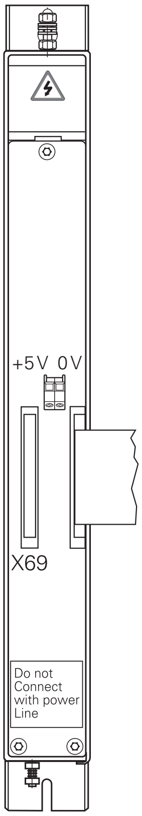
- UV and UVR power supply units
- UE and UR compact inverters

Note

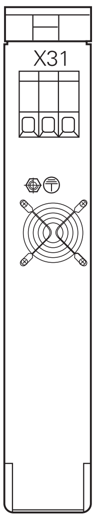
For detailed information, refer to the Service Manual "Inverter Systems and Motors".

27.3.1 UV 105 power supply unit

Connection overview UV 105



Conductor bar	Power supply with U_Z
X74	5-V power supply for CC 42x
Free ribbon cable	Power supply for CC 42x (B) (to X69 on CC 42x (B))
X69	Status signals from UV 1x0



X31	Power supply

Variant	Changes to UV 105
344980-01	Initial version
344980-02	Version only for non-HEIDENHAIN inverters
344980-12	Version only for HEIDENHAIN inverters
344980-13	Version for HEIDENHAIN and non-HEIDENHAIN inverters
344980-14	Leads / ribbon cables elongated for double-row configuration

X31: Power supply unit for UV 105

Supply voltage: 400 V ± 10%

Pin layout:

Connecting terminal	Pin layout
U	U[a]
V	V[a]
⏚	Equipment ground (YL/GY), ≥ 10 mm^2

a. Connecting cable 1.5 mm^2

Note

If you are using non-HEIDENHAIN inverter systems or regenerative HEIDENHAIN inverter systems, you must connect the supply voltage to the terminals U and V via an isolating transformer (300 VA, basic insulation as per EN 50 178 and VDE 0550).

There is no need for an isolating transformer if non-regenerative HEIDENHAIN inverter systems are used.

DANGER

Do not ground this isolating transformer on the secondary side!

The isolating transformer decouples the dc-link voltage from ground. Grounding the isolating transformer on the secondary side leads to an addition of the dc-link voltage and the supply voltage. This would overload and thus destroy the UV 105.

Power supply of the UV 105 with U_Z

The UV 105 is powered with dc-link voltage U_Z through

- the conductor bars (for HEIDENHAIN inverter systems).
- a cable which is connected instead of the conductor bar (for non-HEIDENHAIN inverter systems).

X69: NC supply voltage and control signals

Connection to connector X69/X169 of the CC, See “X69: NC power supply and control signals” on page 27 – 481.

Note

Operation with HEIDENHAIN inverters:
For the NC to be able to evaluate the status signals of the compact inverters or the power supply units, connector X69 must be connected by ribbon cable with X69 of the UV 105.
Operation with non-HEIDENHAIN inverters:
Since status signals from non-HEIDENHAIN inverters are not available or are not compatible to HEIDENHAIN systems, the adapter (Id. Nr. 349 211-01) must be connected to X69 on the UV 105.

X74: 5 V connection of the UV 105

Pin layout:

Wire color of 5-V connection	5 V terminal on CC 42x (B)
Black	0 V
Red	+5 V

DANGER

For mounting the UV 105, the additional 5V lines must be connected with the correct polarity!
Otherwise there will be a short circuit of these lines on the 5V ribbon wires of X69.

27.3.2 UV 105 B power supply unit

Connection overview UV 105 B

Connector on the front panel

Supply voltage: 400 V ± 10%

Pin layout:

Connecting terminal	Pin layout
U	U[a]
V	V[a]
$+U_{DC}$	DC-link voltage of the non-HEIDENHAIN inverster system
$-U_{DC}$	DC-link voltage of the non-HEIDENHAIN inverster system

a. Connecting cable 1.5 mm^2

Equipment ground (YL/GY) ≥ 10 mm^2

Note

You must connect the supply voltage to the terminals U and V via an isolating transformer (300 VA, basic insulation as per EN 50 178 and VDE 0550).

Caution

Do not ground this isolating transformer on the secondary side!

The isolating transformer decouples the dc-link voltage from ground. Grounding the isolating transformer on the secondary side leads to an addition of the dc-link voltage and the supply voltage. This would overload and thus destroy the UV 105 B.

50-pin ribbon cable

For connection to connector X69/X169 of the CC, See “X69: NC power supply and control signals” on page 27 – 481.

5V terminal on the front panel

Pin layout:

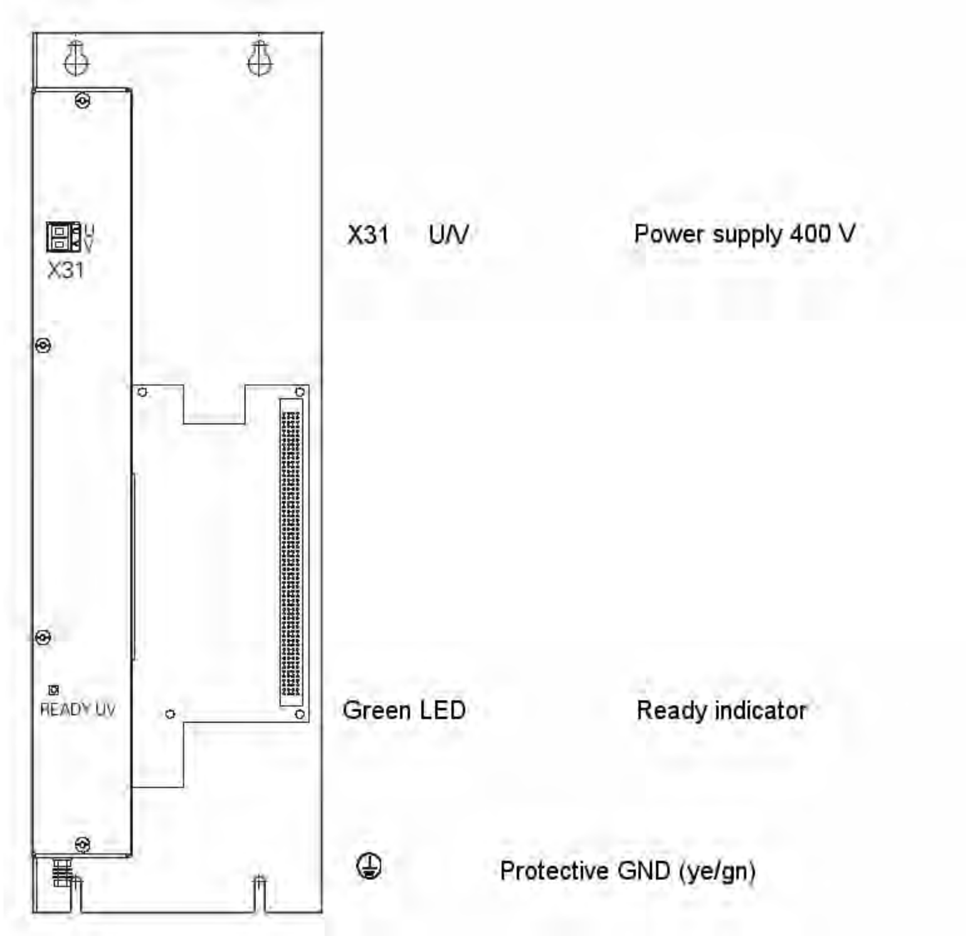
Wire color of 5-V connection	5 V terminal on CC 42x (B)
Black	0 V
Red	+5 V

Caution

For mounting the UV 105 B, the additional 5V lines must be connected with the correct polarity!
Otherwise there will be a short circuit of these lines on the 5V ribbon wires.

27.3.3 UV 106 (B) power supply unit

Connection overview UV 106 (B)



X31: Power supply of the UV 106 (B)

Supply voltage: 400 V ± 10%

Pin layout:

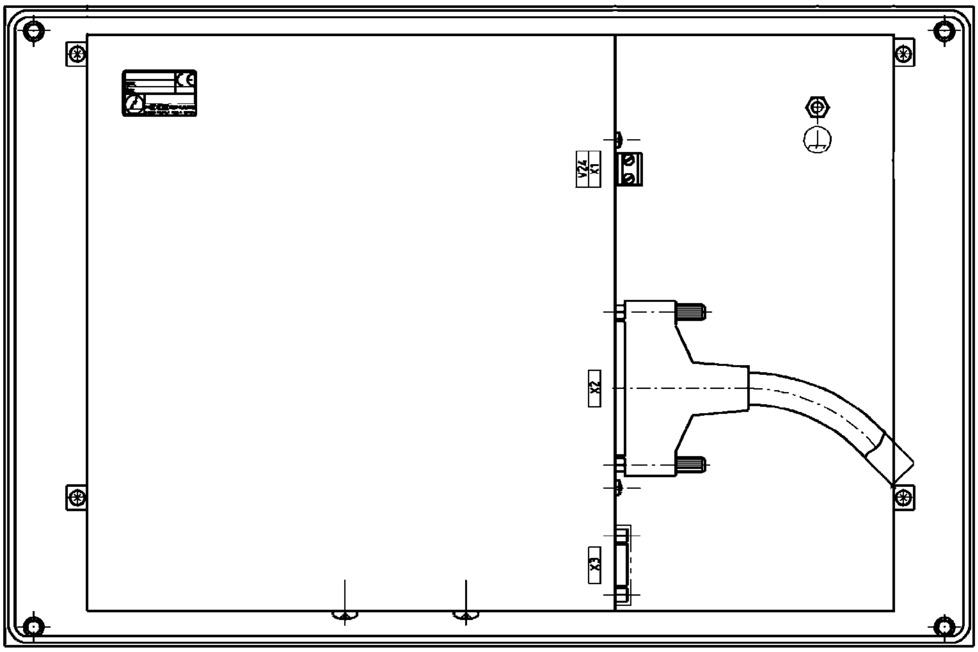
Connecting terminal	Pin layout
U	Phase 1 / 400 Vac ±10% / 50 Hz to 60 Hz
V	Phase 2 / 400 Vac ±10% / 50 Hz to 60 Hz
	Protective ground (YL/GN), ≥ 10 mm^2
	Connecting leads Wire cross section: 1.5 mm^2 (AWG 16)
Tightening torque: for the connecting terminals 0.7 Nm (6.5 to 7 lb-ibn) **Grounding terminal:** ≥ 10 mm^2 (AWG 6) **Strain relief:** Ensure that the connecting cables are not subject to excessive strain.	

Equipment ground (YL/GY) ≥ 10 mm^2

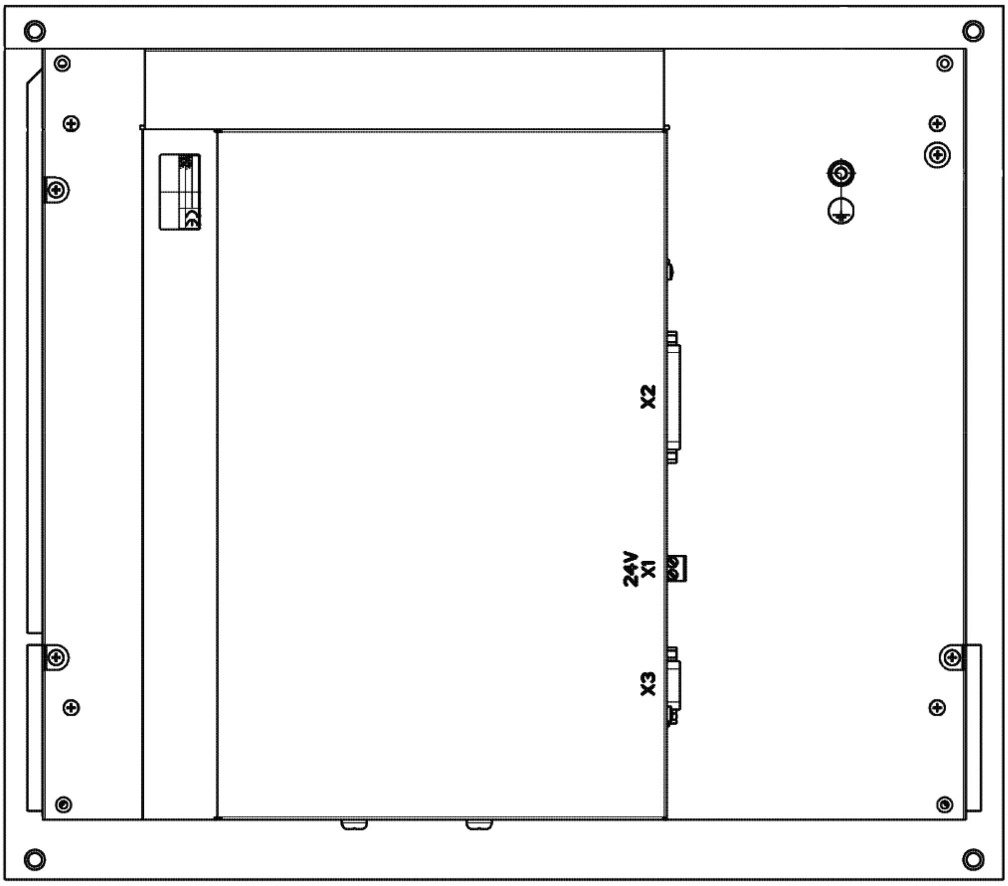
27.4 Monitors

27.4.1 Designation and position of connectors

BF 120



BF 150



27.4.2 Pin layouts

X1:
Power supply

Connecting terminal X1	Pin layout
1	+24 V
2	0 V

Power consumption:BF 120: 15 W
BF 150: 45 W

DANGER

The power supply must have basic insulation as per EN 61800-5-1.

X2:
Connection of the BF 120 to the MC

See "X49: BF 120 flat-panel display" on page 27 – 478.

X2:
Connection of the BF 150 to the MC

See "X149: BF 150 flat-panel display" on page 27 – 485.

X3:
Connection of the VDU soft keys to the iTNC operating panel

Connector (male) 9-pin	Pin layout
1	SL0
2	SL1
3	SL2
4	SL3
5	Do not assign
6	RL15
7	RL14
8	RL13
9	RL12

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

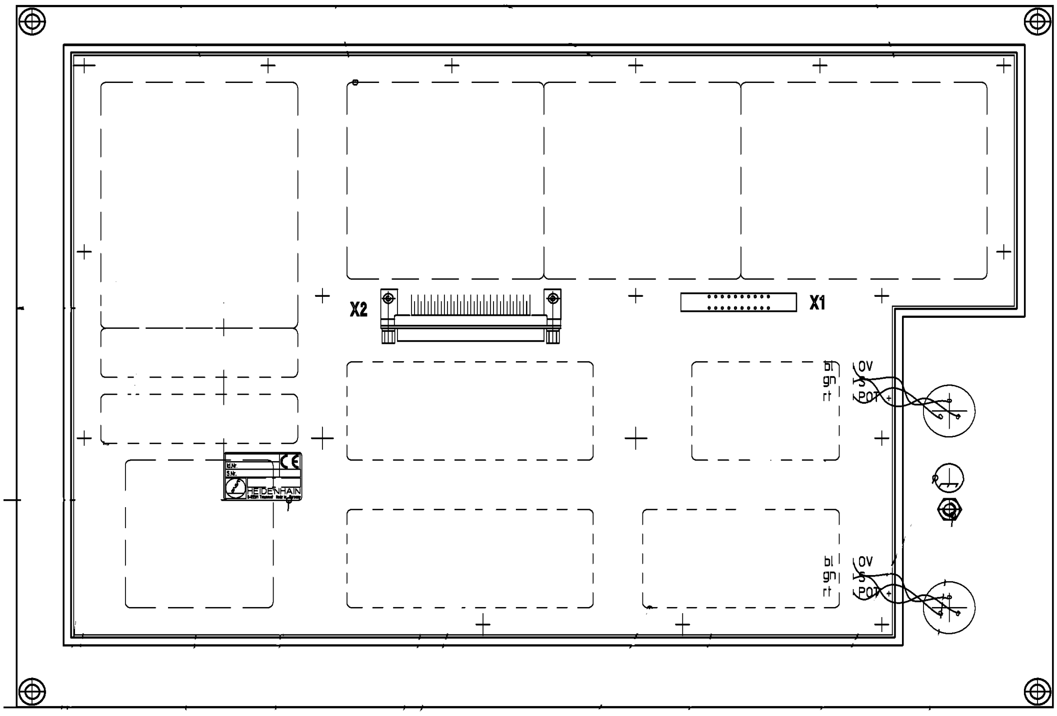
DANGER

Only units that comply with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV) may be connected.

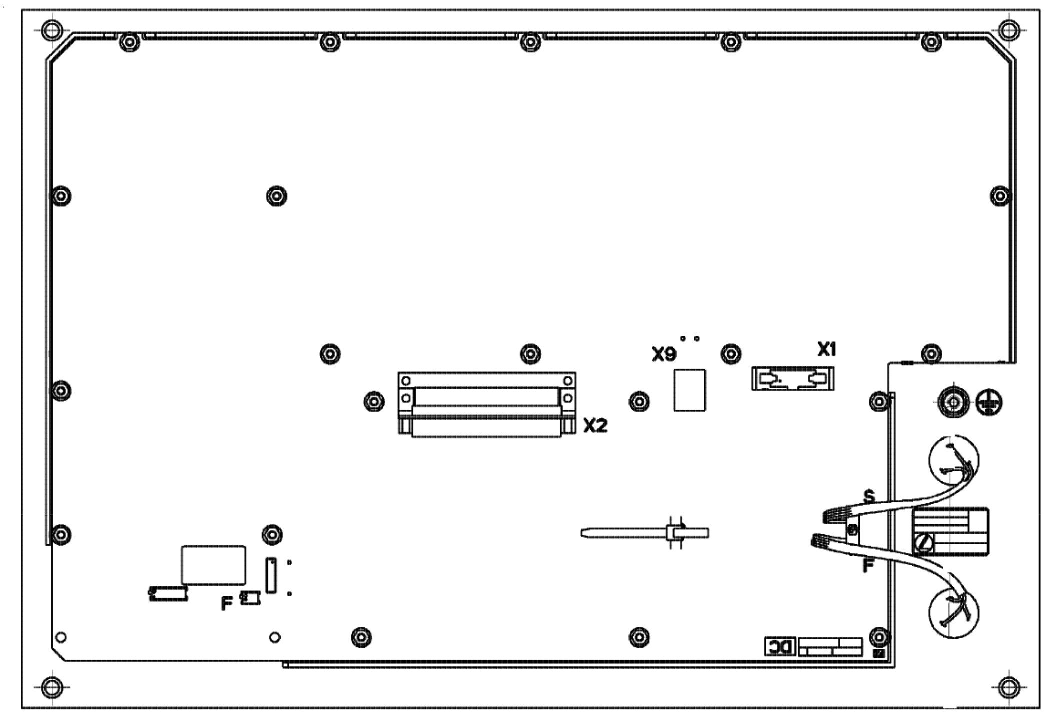
27.5 Keyboard Units

27.5.1 Designation and position of connectors

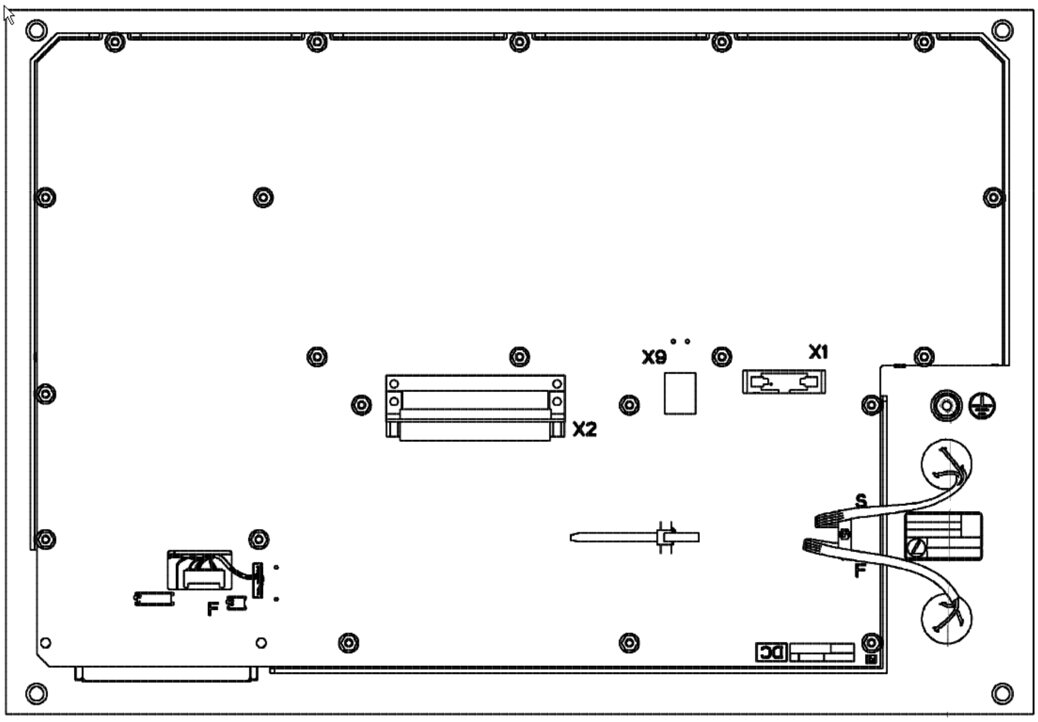
TE 420



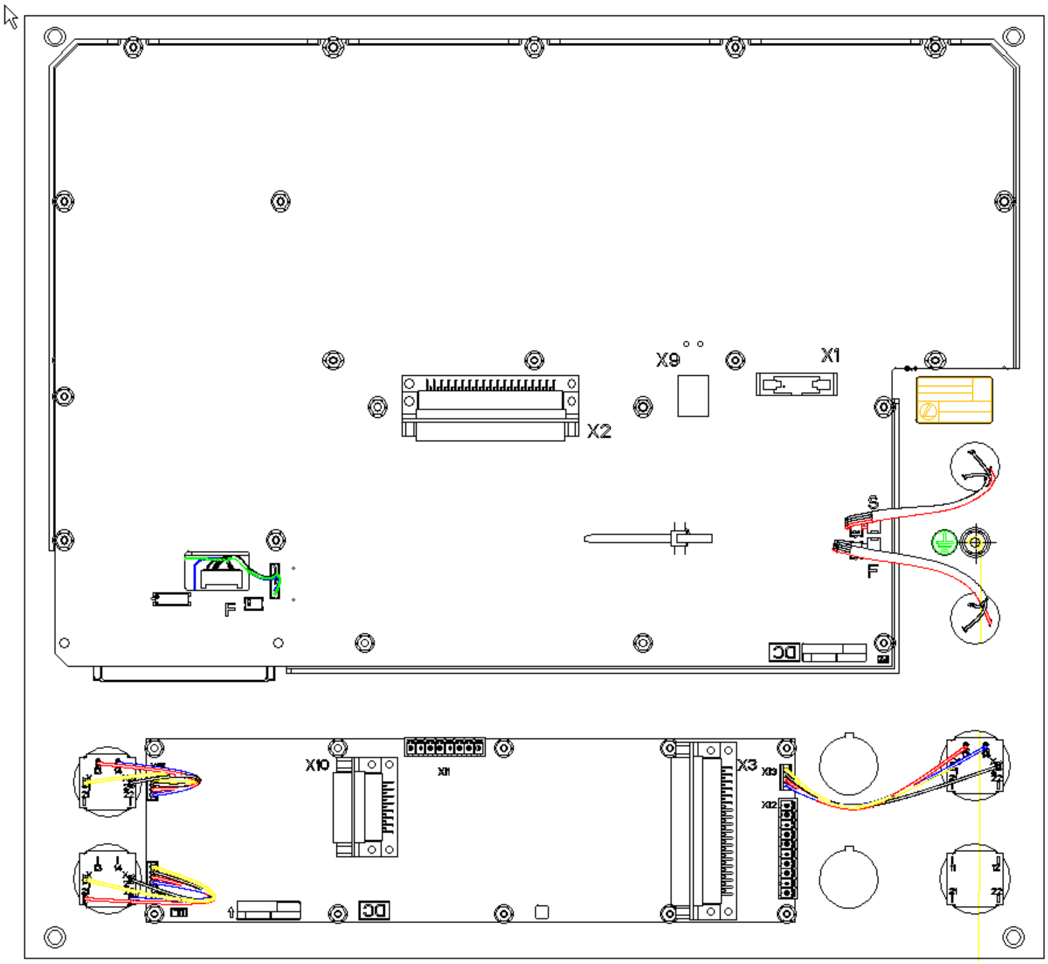
TE 520 B



TE 530 (B)



TE 535 Q



27.5.2 Pin layouts

X1: Connection of the VDU soft keys to the iTNC operating panel

Pin layout of the iTNC keyboard:

Connecting element (male) 9-pin	Pin layout
1	SL0
2	SL1
3	SL2
4	SL3
5	Do not assign
6	RL15
7	RL14
8	RL13
9	RL12

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.

X2: iTNC keyboard

See “X45: iTNC control panel” on page 27 – 473.

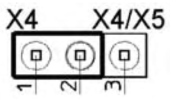
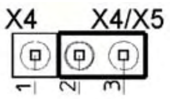
X9: USB interface for the mousepad

See “X141, X142: USB connection” on page 27 – 483.

27.6 BTS 1x0 Monitor/Keyboard Switch

Two monitors (BTS 110: 2 x BF 120, BTS 150: 2 x BF 150) and two TE keyboards can be connected to an MC 42x(B) with the BTS 1x0.

The two monitors are always active. Switchover between the two keyboard units is realized by a 24 V switching input on the BTS 1x0.
A jumper on the PCB is used to determine which potentiometer should be active. The jumper is on the upper PCB next to the ID plate.

Jumper setting	Active potentiometers
	Always keyboard 1 (at X4)
	Currently active keyboard

Note

You cannot switch between the two touchpads on the TE 53x with the BTS 1x0.
You must connect both touchpads to the MC 42x (B/C) (possibly via the USB hub).

X1, X2, X4, X5 to X7: Monitor and keyboard connections

Assignment of the individual connections:
--> See “Keyboard Units” on page 27 – 495
--> See “Monitors” on page 27 – 493

Connection designation	Monitor/Keyboard
X1	Input BF 120 or BF 150
X2	TE input
X4	First TE output
X5	Second TE output
X6	First BF 120 or BF 150 output
X7	Second BF 120 or BF 150 output

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

X3: Switchover between the keyboards

Depending on the signal at X3, one of the keyboards at X4 or X5 is activated:

Signal at X3		Active keyboard
Terminal 1	Terminal 2	
0 V	0 V	At X4
+24 V	0 V	At X5

X8: Supply voltage for BTS 1x0

Power supply with double insulation in accordance with EN 61800-5-1.

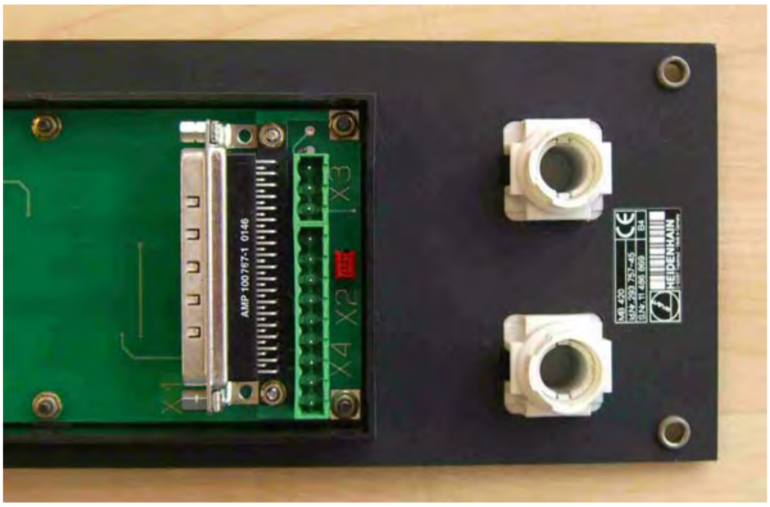
Connecting terminal	Pin layout
1	+24 V
2	0 V

Current consumption: Max. 100 mA.

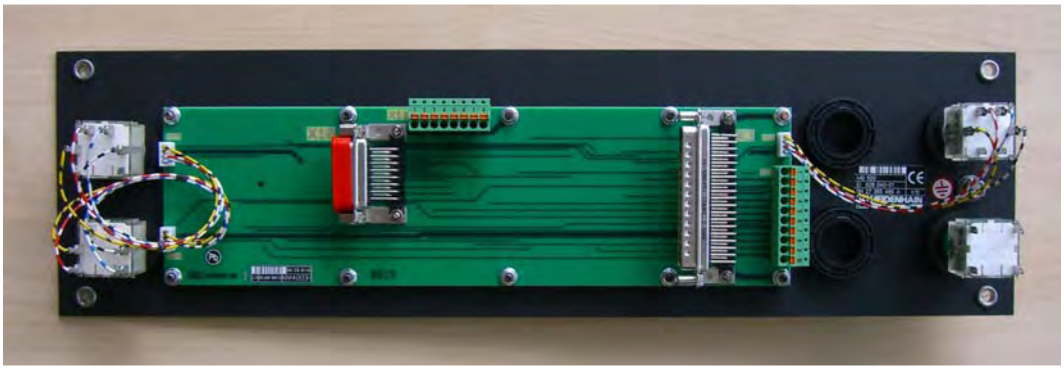
27.7 Machine Operating Panel

27.7.1 Designation and position of connectors

MB 420



MB 520



27.7.2 Pin Layouts on MB 420

X1:
Connection to MC

See “X46: Machine operating panel” on page 27 – 474.

X2:
Connection of NC start and NC stop key

The NC start key and the NC stop key are connected with the MB 420 via X2.

X3:
PLC Inputs

Terminal	Pin layout
1	I151
2	I152
3	+24 V

Note

These PLC inputs are connected to the control via the D-Sub connector X1 (MC, connector X46).

X4:
PLC outputs

Terminal	Pin layout
1	O0
2	O1
3	O2
4	O3
5	O4
6	O5
7	O6
8	O7
9	0 V

Note

These PLC outputs are connected to the control via the D-Sub connector X1 (MC, connector X46).

27.7.3 Pin layouts on MB 520

X3:
Connection to MC

D-sub connector, 37-pin

Connecting cable ID 263 954-xx:

X3	PLC input	Meaning of the keys	SN/Signal
1	I128	X minus	S14
2	I129	Y minus	S27
3	I130	Z minus	S28
4	I131	IV minus	S29
5	I132	V minus	S30
6	I133	X plus	S16
7	I134	Y plus	S3
8	I135	Z plus	S2
9	I136	IV plus	S1
10	I137	V plus	S4
11	I138	Select tool change	S7
12	I139	Unclamp tool	S8
13	I140	Chip conveyor back	S25
14	I141	Unlock working space	S38
15	I142	Chip conveyor	S12
16	I143	Spindle start	S34
17	I144	Spindle stop	S33
18	I145	Coolant, external (M08)	S11
19	I146	NC start	STRT from terminal strip X15
20	I147	NC stop	STP from terminal strip X14
21	I148	Rapid traverse	S15
22	I149	Retract axis	S17
23	I150	Coolant, internal (M07)	S24
24	I151	Control voltage ON	STSP from terminal strip X13
25	I152	Additional coolant	S37
26	O0	NC start lamp	From terminal strip X15
27	O1	NC stop lamp	From terminal strip X14
28	O2	Control voltage lamp On	From terminal strip X13
29	O3	Vacant	
30	O4	Vacant	

X3	PLC input	Meaning of the keys	SN/Signal
31	O5	Vacant	
32	O6	Vacant	
33	O7	Vacant	
34	0 V		
35	0 V		
36	+24 V		
37	+24 V		

X10:
To a transfer unit

D-sub connector, 15-pin

Connecting cable ID 629 663-xx:

X10	PLC Input	Meaning of the keys	SN/Signal	Color
1	Vacant	VI plus	S5	White
2	Vacant	VI minus	S31	Brown
3	Vacant	Jog spindle to left	S20	Green
4	Vacant	Jog spindle to right	S21	Yellow
5	Vacant	Permissive mode	S18	Violet
6	Vacant	FN1	S10	Brown/Green
7	Vacant	FN2	S23	Gray
8	Vacant	FN3	S36	Pink
9	Vacant	Not assigned	Vacant input X11/1	Blue
10	Vacant	Not assigned	Vacant input X11/2	Red
11	Vacant	Not assigned	Vacant input X11/3	Black
12	Vacant	Not assigned	Vacant input X11/4	White/Green
13	Vacant	Not assigned	Vacant input X11/5	Red/Black
14	Vacant	Not assigned	Vacant input X11/6	Yellow/Black
15	Vacant	Not assigned	Vacant input X11/7	Blue/Black

X11:
Vacant PLC inputs

Terminal X11	PLC operand	Meaning	Signal
1	Ixxx	Vacant	Vacant input to X10/9
2	Ixxx	Vacant	Vacant input to X10/10
3	Ixxx	Vacant	Vacant input to X10/11
4	Ixxx	Vacant	Vacant input to X10/12
5	Ixxx	Vacant	Vacant input to X10/13
6	Ixxx	Vacant	Vacant input to X10/14
7	Ixxx	Vacant	Vacant input to X10/15
8		+24 V	

Note

These PLC inputs are connected to the control via the D-Sub connector X10.

X12:
PLC outputs

Terminal X12	PLC operand	Meaning	Signal
1	O0	NC start lamp	From terminal strip X15
2	O1	NC stop lamp	From terminal strip X14
3	O2	Control voltage lamp On	From terminal strip X13
4	O3	Vacant	Vacant output X3
5	O4	Vacant	Vacant output X3
6	O5	Vacant	Vacant output X3
7	O6	Vacant	Vacant output X3
8	O7	Vacant	Vacant output X3
9	0 V		
10	+24 V		

Note

These PLC outputs are connected to the control via the D-Sub connector X3 (MC, connector X46).

X13, X14, X15:
Key connections

- X13: Terminal strip for the '"machine control voltage ON" key
- X14: Terminal strip for the "NC stop" key
- X15: Terminal strip for the "NC start" key

27.8 Handwheels

X23: Handwheel input See “X23: Handwheel input” on page 27 – 467.

27.8.1 HR 4xx portable handwheel

The HR 4xx is a portable electronic handwheel.

Assignment of the keys of the HR 420 to the PLC inputs and outputs. --> See “Error Location on Portable Handwheel with HR 420 Display” on page 24 – 401.

Assignment of the keys of the HR 410 to the PLC inputs and outputs --> See “Error Diagnosis at HR 410 Portable Handwheel” on page 24 – 406.

Pin layout for the various extension cables, adapter cables, connecting cables, and the handwheel:

Extension cable Id. Nr. 281 429-xx			**Adapter cable Id. Nr. 296 466-xx**			**Connecting cable**			**HR 4xx**	
D-sub connector (male) 9-pin		**D-sub connctr. (female) 9-pin**	**D-sub connector (male) 9-pin**		**Coupling on mounting base (female) (5+7)-pin**	**Cnnctr. (male) (5+7)-pin**		**Cnnctr. (female) (5+7)-pin**	**Connector (male) (5+7)-pin**	
Housing	Shield	Housing	Housing	Shield	Housing	Housing	Shield	Housing	Housing	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	Red/Blue	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	Gray/Pink	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

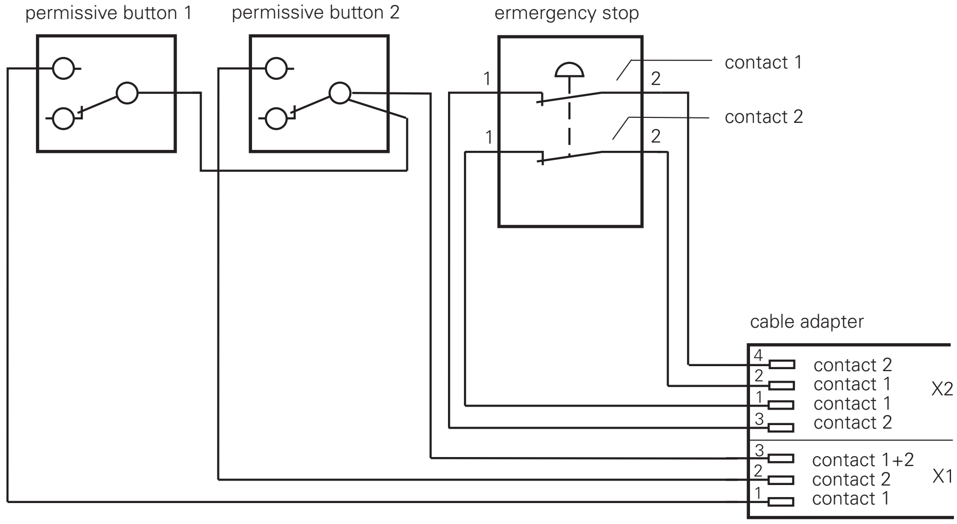
The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

DANGER

Only units that comply with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV) may be connected.

The cable adapter Id.Nr. 296466-xx includes plug-in terminal strips for the contacts of the EMERGENCY STOP button and permissive button (maximum load 24 V DC / 1.2 A).

Internal wiring of the contacts for the EMERGENCY STOP and permissive buttons:



Additional components		ID
Dummy plug for EMERGENCY STOP circuit		271 958-03
Connecting cable		
	Spiral cable	312 879-01
	Normal cable	296 467-xx
	With metal armor tubing	296 687-xx
Plug-in terminal strips		
	3-pin terminal block	266 364-06
	4-pin terminal block	266 364-12

27.8.2 HR 130 panel-mounted handwheel

The standard cable length for the HR 130 is 1 meter.

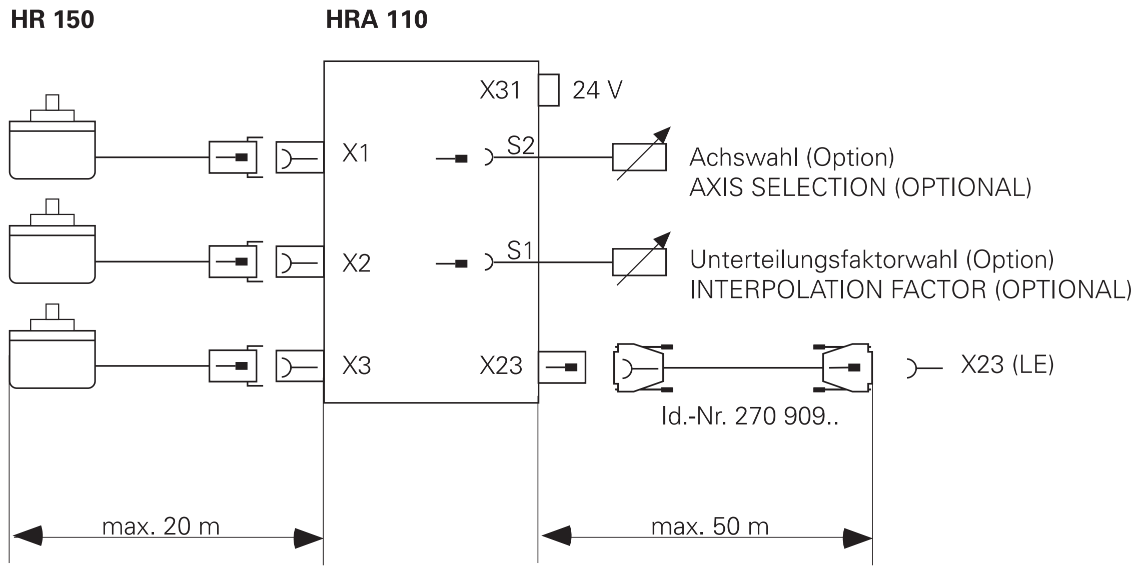
Pin layout for extension cable and handwheel:

Extension cable ID 281 429-xx			HR 130 ID 254 040-xx	
D-sub connector (male) 9-pin		**D-sub connector (female) 9-pin**	**D-sub connector (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		

27.8.3 HRA 110 handwheel adapter

With the HRA 110 handwheel adapter you can connect two or three HR 150 panel-mounted handwheels to iTNC 530.

The first and second handwheels are assigned to the X and Y axes. The third handwheel can be assigned either through a selection switch (option) or with MP7645.



An additional switch enables you to select, for example, the subdivision factor for the handwheel. The current position of the step switch is evaluated by the PLC.

X1 to X3: Inputs on the HRA 110 for the HR 150 handwheels

HRA 110	
Connection (female) 9-pin	**Pin layout**
1	I_1 +
2	I_1 –
5	I_2 +
6	I_2 –
7	I_0 –
8	I_0 +
3	+ 5 V
4	0 V
9	Internal shield
Housing	External shield

X23: Connection to MC 42x (B/C)

Pin layout on the HRA 110:

HRA 110	
D-sub connection (female) 9-pin	**Pin layout**
1	RTS
2	0 V
3	CTS
4	+12 V +0.6 V (U_V)
5	Do not assign
6	DSR
7	RxD
8	TxD
9	DTR
Housing	External shield

X31: HRA 110 supply voltage

Pin layout on the HRA 110:

Caution

The power supply of the PLC must not be used simultaneously for the HRA110, otherwise the metallic isolation of the PLC inputs/outputs would be bridged.

HRA 110	
Connecting terminal	**Pin layout**
1	+ 24 Vdc as per IEC 742 (VDE 551)
2	0 V

Maximum current consumption 200 mA.

27.9 Touch Probes

Touch probes for workpiece measurement

See “X12: Connection of the touch probe for workpiece measurement” on page 27 – 460.

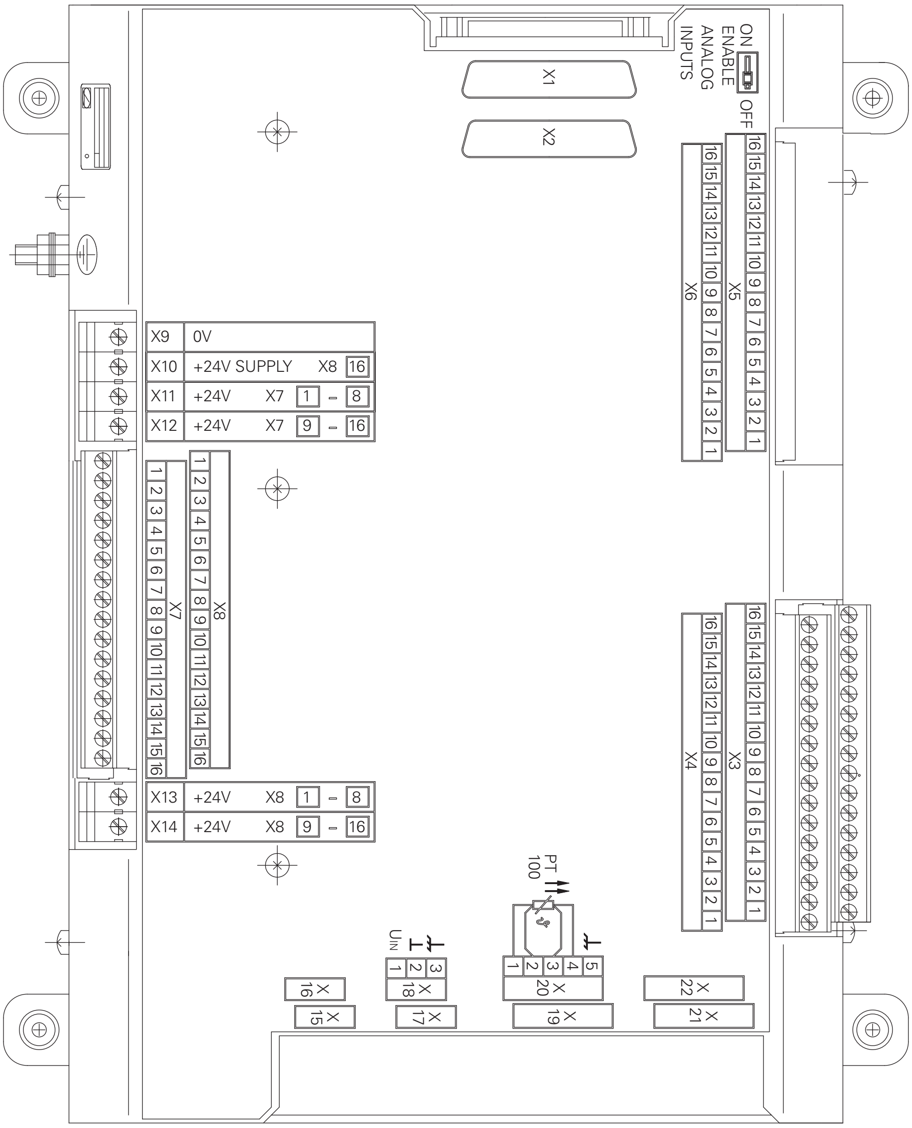
Touch probe for tool measurement

See “X13: Connection of the touch probe for tool measurement” on page 27 – 462.

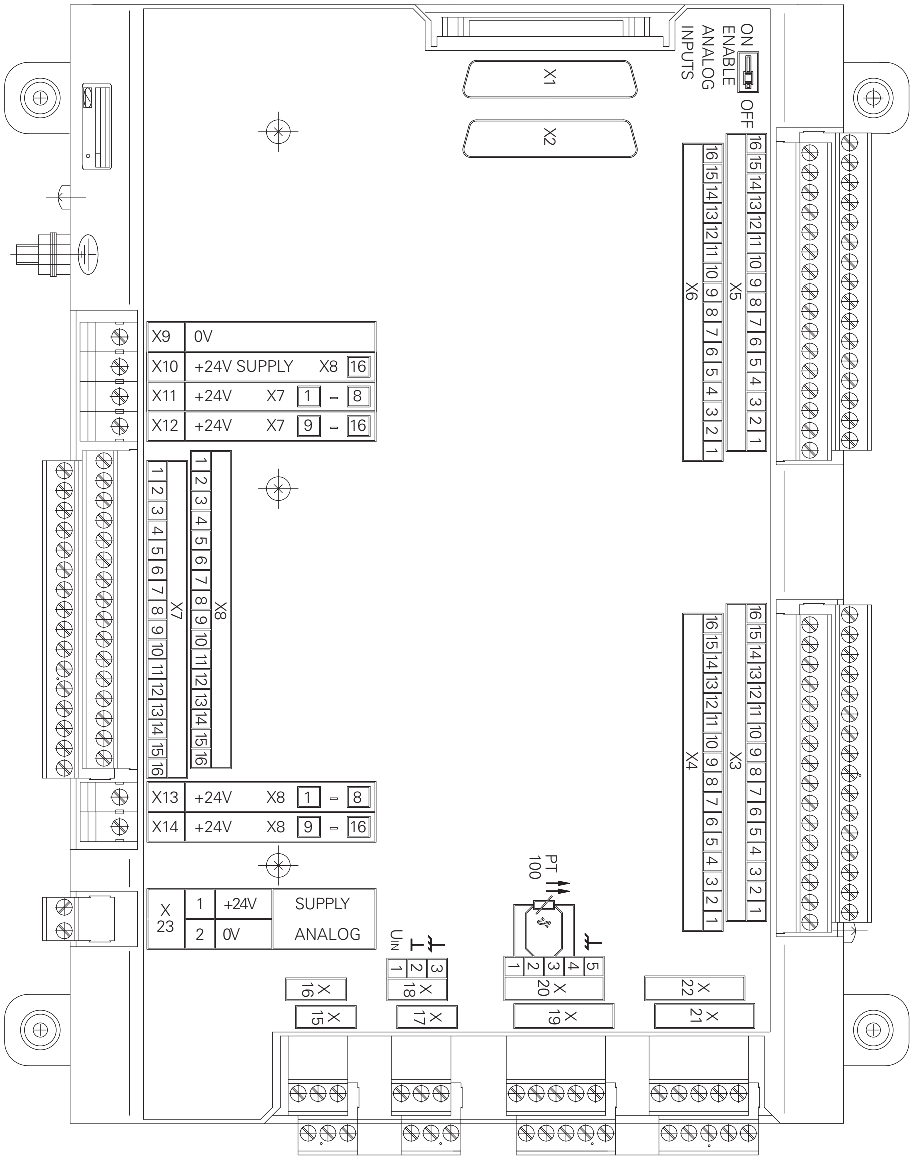
27.10 PLC Input/Output Units

27.10.1 Designation and position of connectors

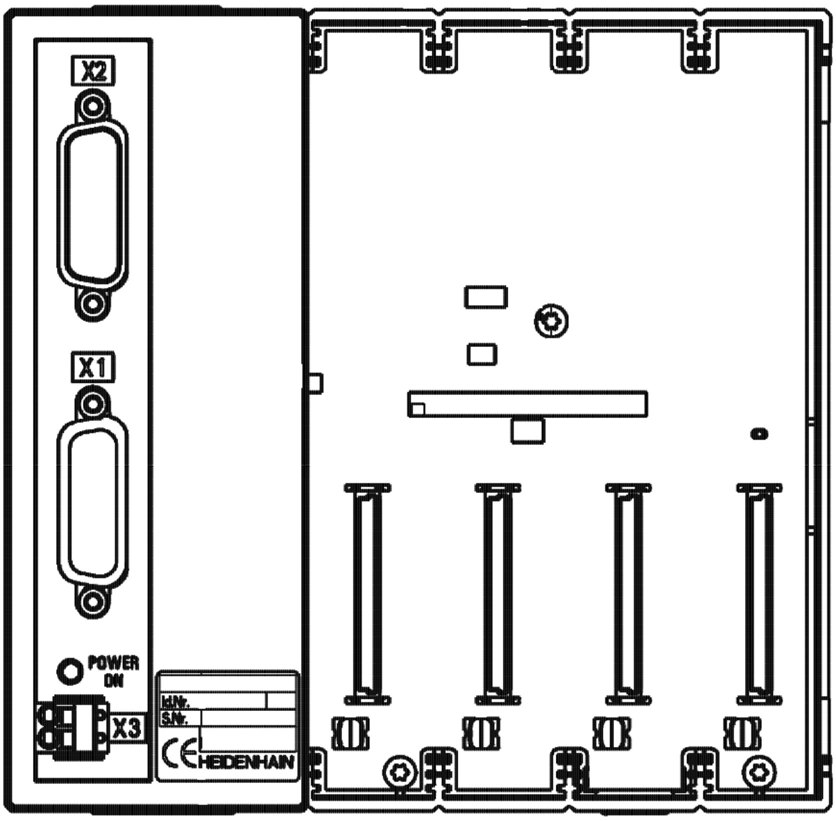
PL 405 B

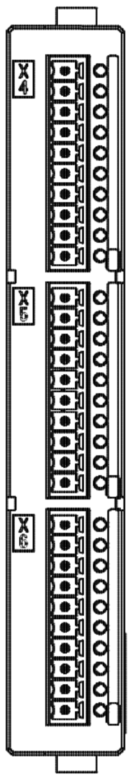
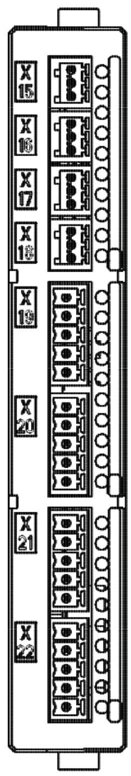


PL 410 B


ON
ENABLE
ANALOG
INPUTS
OFF
X1
X2
X5
X6
X9 0V
X10 +24V SUPPLY X8 16
X11 +24V X7 1 – 8
X12 +24V X7 9 – 16
X7
X8
X3
X4
X13 +24V X8 1 – 8
X14 +24V X8 9 – 16
PT 100
X 23
1 +24V SUPPLY
2 0V ANALOG
X 15
X 16
X 17
X 18
X 19
X 20
X 21
X 22

PL 510 PLB 510 Basic Module



PLD 16-8 input/output module	PLA 4-4 analog module
	

27.10.2 PL 4xxB Pin Layouts

X1:
PLC expansion on the MC

See “X47: PLC expansion for PL 4xx B on the MC 422 (B/C)” on page 27 – 475.

X2:
PLC expansion PL 4xx B on the PL 410 B

D-sub connector, 25-pin

PL 410 B		**Connecting cable ID 289 111-xx / ID 317 788-xx**			**PL 410 B PL 405B on the PL 410B**	
Male	**Pin layout**	**Female**		**Male**	**X1 female**	**Pin layout**
1	0 V	1	Brown, Yellow, Pink, Red, Violet	1	1	0 V
2	0 V	2	Red/Blue, Brown/ Green, Yellow/Brown, Gray/Brown, Pink/ Brown	2	2	0 V
3	0 V	3	Brown/Blue, Brown/ Red, Brown/Black, Yellow/Gray, Yellow/ Pink	3	3	0 V
4	Do not assign	4	Gray/Green	4	4	Serial IN 2
5	$\overline{\text{Address 6}}$	5	White/Green	5	5	$\overline{\text{Address 6}}$
6	INTERRUPT	6	Pink/Green	6	6	INTERRUPT
7	$\overline{\text{RESET}}$	7	Green/Blue	7	7	$\overline{\text{RESET}}$
8	$\overline{\text{WRITE EXTERN}}$	8	White/Blue	8	8	$\overline{\text{WRITE EXTERN}}$
9	WRITE EXTERN	9	White/Red	9	9	WRITE EXTERN
10	$\overline{\text{Address 5}}$	10	GY/PK	10	10	$\overline{\text{Address 5}}$
11	$\overline{\text{Address 3}}$	11	Blue	11	11	$\overline{\text{Address 3}}$
12	$\overline{\text{Address 1}}$	12	Green	12	12	$\overline{\text{Address 1}}$
13	Do not assign	13		13	13	Do not assign
14	PCB identifier 4	14	Yellow/Blue, Pink/Blue, Yellow/Black	14	14	+12 V
15	PCB identifier 3	15	Yellow/Red, Gray/Red, Pink/Red	15	15	+12 V
16	PCB identifier 2	16	Gray/Blue	16	16	PCB identifier 2
17	PCB identifier 1	17	Green/Black	17	17	PCB identifier 1
18	$\overline{\text{Address 7}}$	18	White/Yellow	18	18	$\overline{\text{Address 7}}$
19	Serial IN 1	19	White/Black	19	19	Serial IN 1
20	EM. STOP	20	Green/Red	20	20	EM. STOP
21	$\overline{\text{Serial OUT}}$	21	WH/GY	21	21	$\overline{\text{Serial OUT}}$
22	Serial OUT	22	White/Pink	22	22	Serial OUT
23	$\overline{\text{Address 4}}$	23	Black	23	23	$\overline{\text{Address 4}}$
24	$\overline{\text{Address 2}}$	24	Gray	24	24	$\overline{\text{Address 2}}$
25	$\overline{\text{Address 0}}$	25	White	25	25	$\overline{\text{Address 0}}$
Housing	External shield	Housing	External shield	Housing	Housing	External shield

X3:
PLC input
PL 410 B and
PL 405 B

Terminal X3	Pin layout			
	1. PL	2. PL	3. PL	4. PL
1	I64	I192	I256	I320
2	I65	I193	I257	I321
3	I66	I194	I258	I322
4	I67	I195	I259	I323
5	I68	I196	I260	I324
6	I69	I197	I261	I325
7	I70	I198	I262	I326
8	I71	I199	I263	I327
9	I72	I200	I264	I328
10	I73	I201	I265	I329
11	I74	I202	I266	I330
12	I75	I203	I267	I331
13	I76	I204	I268	I332
14	I77	I205	I269	I333
15	I78	I206	I270	I334
16	I79	I207	I271	I335

X4:
PLC input
PL 410 B and
PL 405 B

Terminal X4	Pin layout			
	1. PL	2. PL	3. PL	4. PL
1	I80	I208	I272	I336
2	I81	I209	I273	I337
3	I82	I210	I274	I338
4	I83	I211	I275	I339
5	I84	I212	I276	I340
6	I85	I213	I277	I341
7	I86	I214	I278	I342
8	I87	I215	I279	I343
9	I88	I216	I280	I344
10	I89	I217	I281	I345
11	I90	I218	I282	I346
12	I91	I219	I283	I347
13	I92	I220	I284	I348
14	I93	I221	I285	I349
15	I94	I222	I286	I350
16	I95	I223	I287	I351

X5:
PLC input
PL 410 B

Terminal X5	Pin layout			
	1. PL	**2. PL**	**3. PL**	**4. PL**
1	I96	I224	I288	I352
2	I97	I225	I289	I353
3	I98	I226	I290	I354
4	I99	I227	I291	I355
5	I100	I228	I292	I356
6	I101	I229	I293	I357
7	I102	I230	I294	I358
8	I103	I231	I295	I359
9	I104	I232	I296	I360
10	I105	I233	I297	I361
11	I106	I234	I298	I362
12	I107	I235	I299	I363
13	I108	I236	I300	I364
14	I109	I237	I301	I365
15	I110	I238	I302	I366
16	I111	I239	I303	I367

X6:
PLC input
PL 410 B

Terminal X6	Pin layout			
	1. PL	**2. PL**	**3. PL**	**4. PL**
1	I112	I240	I304	I368
2	I113	I241	I305	I369
3	I114	I242	I306	I370
4	I115	I243	I307	I371
5	I116	I244	I308	I372
6	I117	I245	I309	I373
7	I118	I246	I310	I374
8	I119	I247	I311	I375
9	I120	I248	I312	I376
10	I121	I249	I313	I377
11	I122	I250	I314	I378
12	I123	I251	I315	I379
13	I124	I252	I316	I380
14	I125	I253	I317	I381
15	I126	I254	I318	I382
16	I127	I255	I319	I383

X7:
PLC output
PL 410 B

Terminal X7	Pin layout			
	1. PL	2. PL	3. PL	4. PL
1	O32	O64	O128	O160
2	O33	O65	O129	O161
3	O34	O66	O130	O162
4	O35	O67	O131	O163
5	O36	O68	O132	O164
6	O37	O69	O133	O165
7	O38	O70	O134	O166
8	O39	O71	O135	O167
9	O40	O72	O136	O168
10	O41	O73	O137	O169
11	O42	O74	O138	O170
12	O43	O75	O139	O171
13	O44	O76	O140	O172
14	O45	O77	O141	O173
15	O46	O78	O142	O174
16	O47	O79	O143	O175

X8:
PLC output
PL 410 B and
PL 405 B

Terminal X8	Pin layout			
	1. PL	2. PL	3. PL	4. PL
1	O48	O80	O144	O176
2	O49	O81	O145	O177
3	O50	O82	O146	O178
4	O51	O83	O147	O179
5	O52	O84	O148	O180
6	O53	O85	O149	O181
7	O54	O86	O150	O182
8	O55	O87	O151	O183
9	O56	O88	O152	O184
10	O57	O89	O153	O185
11	O58	O90	O154	O186
12	O59	O91	O155	O187
13	O60	O92	O156	O188
14	O61	O93	O157	O189
15	O62	O94	O158	O190
16	Control-is-ready signal			

X9 to X14: Power supply

Pin layout on the PL 4xx B:

Terminal	Pin layout	1. PL	2. PL	3. PL	4. PL
X9	0 V				
X10	+24 Vdc logic power supply and supply for "control-is-ready" signal				
X11	+24 Vdc power supply for outputs	O32 – O39	O64 – O71	O128 – O135	O16O – O167
X12	+24 Vdc power supply for outputs	O40 – O47	O72 – O79	O136 – O143	O168 – O175
X13	+24 Vdc power supply for outputs	O48 – O55	O80 – O87	O144 – O151	O176 – O183
X14	+24 Vdc power supply for outputs	O56 – O62	O88 – O94	O152 – O158	O184 – O190

Note

The power supply must have a value of at least 20.4 V and maximum 28.8 V!
The terminals X11 and X12 do not exist on the PL 405 B.

X15 to X18: Analog input on the PL 410 B

Connecting terminals	Pin layout
1	–10 V to +10 V
2	0 V (reference potential)
3	Shield

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

Characteristics of the connecting cable:

- Shielding
- 2 conductors with 0.14 mm²
- Maximum length: 50 m

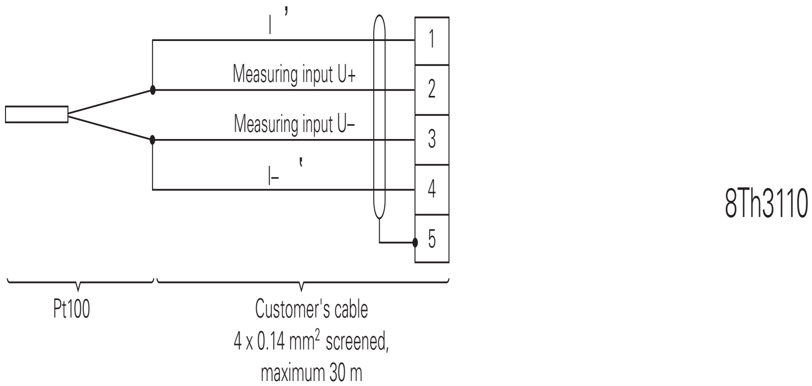
X19 to X22: Connection for Pt 100 on the PL 410 B

Connecting terminals	Pin layout
1	I+ Constant current for Pt 100
2	U+ Measuring input for Pt 100
3	U– Measuring input for Pt 100
4	I– Constant current for Pt 100
5	Shield

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

Normally, the thermistor connection is a "four-conductor circuit":



X23:
Supply voltage for analog inputs of the PL 410 B

The PL 410B input/output unit is also available with additional analog inputs and inputs for Pt 100 thermistors.

Connecting terminal	Pin layout
1	+24 V– (safety extra-low voltage as per EN 61800-5-1)
2	+0 V

DANGER

The power supply must correspond to a safety extra-low voltage (SELV) as per EN 61800-5-1.

27.10.3 Pin layouts for PL 510

**X1:
PLC expansion on the MC 422 (B)**

See "X47: PLC expansion for PL 510 to the MC 422 (B/C)" on page 27 – 476.

**X1:
PLC expansion on the MC 420**

See "X147: PLC Expansion for PL 510 on the MC 420" on page 27 – 484.

**X2:
PLC expansion PL 510 on the PL 510**

D-sub connector, 26-pin

Pin layout on PLB 510 basic module:

PL 510		Connecting cable ID 371 046-xx			PL 510 on PL 510	
Male	**Pin layout**	**Female**		**Male**	**X1 Socket**	**Pin layout**
1	0 V	1	Black	1	1	0 V
2	0 V	2	Violet	2	2	0 V
3	0 V	3		3	3	0 V
4	Do not assign	4		4	4	Do not assign
5	$\overline{\text{Address 6}}$	5	Yellow	5	5	$\overline{\text{Address 6}}$
6	INTERRUPT	6	Blue	6	6	INTERRUPT
7	$\overline{\text{RESET}}$	7	Red	7	7	$\overline{\text{RESET}}$
8	$\overline{\text{WRITE}}$ $\overline{\text{EXTERN}}$	8	Gray	8	8	$\overline{\text{WRITE}}$ $\overline{\text{EXTERN}}$
9	WRITE EXTERN	9	Pink	9	9	WRITE EXTERN
10	$\overline{\text{Address 5}}$	10	Green	10	10	$\overline{\text{Address 5}}$
11	$\overline{\text{Address 3}}$	11	White	11	11	$\overline{\text{Address 3}}$
12	$\overline{\text{Address 1}}$	12	Brown	12	12	$\overline{\text{Address 1}}$
13	Do not assign	13		13	13	Do not assign
14	+5 V (output)	14	White/Blue	14	14	
15	+5 V (feedback)	15	Brown/Blue	15	15	
16	PCB ident. 2	16	White/Pink	16	16	PCB ident. 2
17	PCB ident. 1	17	Pink/Brown	17	17	PCB ident. 1
18	$\overline{\text{Address 7}}$	18	Brown/Green	18	18	$\overline{\text{Address 7}}$
19	Serial IN 1	19	WH/GY	19	19	Serial IN
20	EM. STOP	20	Gray/Brown	20	20	EM. STOP
21	$\overline{\text{Serial OUT}}$	21	White/Yellow	21	21	$\overline{\text{Serial OUT}}$
22	Serial OUT	22	Yellow/Brown	22	22	Serial OUT
23	$\overline{\text{Address 4}}$	23	White/Green	23	23	$\overline{\text{Address 4}}$
24	$\overline{\text{Address 2}}$	24	GY/PK	24	24	$\overline{\text{Address 2}}$
25	$\overline{\text{Address 0}}$	25	Red/Blue	25	25	$\overline{\text{Address 0}}$
26		26		26	26	
Housing	External shld.	Housing	External shield	Housing	Housing	External shld.

**X3:
Supply voltage for logic**

Pin layout on PLB 510 basic module:

Connect. terminal	Pin layout
1	+24 Vdc (20.4 V to 28.8 V)
2	+0 V

X4 to X5: PLC inputs on the PL 510

Pin layout on the PLD 16-8 input/output module:

Note

The 0-V terminals of X4 and X5 of the PLD 16-8 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 X4).

X4											
Pin layout		**Terminal**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
First PL 510	Socket 1	0 V	0 V	I64	I65	I66	I67	I68	I69	I70	I71
	Socket 2	0 V	0 V	I80	I81	I82	I83	I84	I85	I86	I87
	Socket 3	0 V	0 V	I96	I97	I98	I99	I100	I101	I102	I103
	Socket 4	0 V	0 V	I112	I113	I114	I115	I116	I117	I118	I119
Second PL 510	Socket 1	0 V	0 V	I192	I193	I194	I195	I196	I197	I198	I199
	Socket 2	0 V	0 V	I208	I209	I210	I211	I212	I213	I214	I215
	Socket 3	0 V	0 V	I224	I225	I226	I227	I228	I229	I230	I231
	Socket 4	0 V	0 V	I240	I241	I242	I243	I244	I245	I246	I247
Third PL 510	Socket 1	0 V	0 V	I256	I257	I258	I259	I260	I261	I262	I263
	Socket 2	0 V	0 V	I272	I273	I274	I275	I276	I277	I278	I279
	Socket 3	0 V	0 V	I288	I289	I290	I291	I292	I293	I294	I295
	Socket 4	0 V	0 V	I304	I305	I306	I307	I308	I309	I310	I311
Fourth PL 510	Socket 1	0 V	0 V	I320	I321	I322	I323	I324	I325	I326	I327
	Socket 2	0 V	0 V	I336	I337	I338	I339	I340	I341	I342	I343
	Socket 3	0 V	0 V	I352	I353	I354	I355	I356	I357	I358	I359
	Socket 4	0 V	0 V	I368	I369	I370	I371	I372	I373	I374	I375

X5											
Pin layout		**Terminal**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
First PL 510	Socket 1	0 V	0 V	I72	I73	I74	I75	I76	I77	I78	I79
	Socket 2	0 V	0 V	I88	I89	I90	I91	I92	I93	I94	I95
	Socket 3	0 V	0 V	I104	I105	I106	I107	I108	I109	I110	I111
	Socket 4	0 V	0 V	I120	I121	I122	I123	I124	I125	I126	I127
Second PL 510	Socket 1	0 V	0 V	I200	I201	I202	I203	I204	I205	I206	I207
	Socket 2	0 V	0 V	I216	I217	I218	I219	I220	I221	I222	I223
	Socket 3	0 V	0 V	I232	I233	I234	I235	I236	I237	I238	I239
	Socket 4	0 V	0 V	I248	I249	I250	I251	I252	I253	I254	I255
Third PL 510	Socket 1	0 V	0 V	I264	I265	I266	I267	I268	I269	I270	I271
	Socket 2	0 V	0 V	I280	I281	I282	I283	I284	I285	I286	I287
	Socket 3	0 V	0 V	I296	I297	I298	I299	I300	I301	I302	I303
	Socket 4	0 V	0 V	I312	I313	I314	I315	I316	I317	I318	I319
Fourth PL 510	Socket 1	0 V	0 V	I328	I329	I330	I331	I332	I333	I334	I335
	Socket 2	0 V	0 V	I344	I345	I346	I347	I348	I349	I350	I351
	Socket 3	0 V	0 V	I360	I361	I362	I363	I364	I365	I366	I367
	Socket 4	0 V	0 V	I376	I377	I378	I379	I380	I381	I382	I383

X6: PLC outputs on the PL 510

Pin layout on the PLD 16-8 input/output module:

X6											
Pin layout		**Terminal**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
First PL 510	Socket 1	O32	O33	O34	O35	O36	O37	O38	O39[a]	+24 V[b]	+24 V[c]
	Socket 2	O40	O41	O42	O43	O44	O45	O46	O47[a]	+24 V[b]	+24 V[c]
	Socket 3	O48	O49	O50	O51	O52	O53	O54	O55[a]	+24 V[b]	+24 V[c]
	Socket 4	O56	O57	O58	O59	O60	O61	O62	O63[a]	+24 V[b]	+24 V[c]
Second PL 510	Socket 1	O64	O65	O66	O67	O68	O69	O70	O71[a]	+24 V[b]	+24 V[c]
	Socket 2	O72	O73	O74	O75	O76	O77	O78	O79[a]	+24 V[b]	+24 V[c]
	Socket 3	O80	O81	O82	O83	O84	O85	O86	O87[a]	+24 V[b]	+24 V[c]
	Socket 4	O88	O89	O90	O91	O92	O93	O94	O95[a]	+24 V[b]	+24 V[c]
Third PL 510	Socket 1	O128	O129	O130	O131	O132	O133	O134	O135[a]	+24 V[b]	+24 V[c]
	Socket 2	O136	O137	O138	O139	O140	O141	O142	O143[a]	+24 V[b]	+24 V[c]
	Socket 3	O144	O145	O146	O147	O148	O149	O150	O151[a]	+24 V[b]	+24 V[c]
	Socket 4	O152	O153	O154	O155	O156	O157	O158	O159[a]	+24 V[b]	+24 V[c]
Fourth PL 510	Socket 1	O160	O161	O162	O163	O164	O165	O166	O167[a]	+24 V[b]	+24 V[c]
	Socket 2	O168	O169	O170	O171	O172	O173	O174	O175[a]	+24 V[b]	+24 V[c]
	Socket 3	O176	O177	O178	O179	O180	O181	O182	O183[a]	+24 V[b]	+24 V[c]
	Socket 4	O184	O185	O186	O187	O188	O189	O190	O191[a]	+24 V[b]	+24 V[c]

a. The function of this terminal can be set with a sliding switch on the rear side of the PLD 16-8 I/O modules:
Setting 1: Control-is-ready signal
Setting 2: PLC output
b. Group 1 (terminals 1 to 4)
c. Group 2 (terminals 5 to 8)

☞ **Note**

If you use only the outputs at X6 for a PLD 16-8 I/O unit (and no inputs), the 0-V connection for supplying the electronics and for operating the LEDs must be established at X4 or X5.

☞ **Note**

The iTNC 530 cyclically monitors the PLC outputs of the PL 510 for a short-circuit.

X6: Power supply for the PLC outputs on PLD 16-8 input/ output module

Pin layout at X6 (power supply for PLC outputs):

Connecting terminal	Pin layout
9	+24 Vdc (20.4 V to 28.8 V) for group 1 (terminal 1 - 4)
10	+24 Vdc (20.4 V to 28.8 V) for group 2 (terminal 5 - 8)

X15 to X18: Analog input on the PLA 4-4 analog module

Connecting terminals	Pin layout
1	–10 V to +10 V
2	0 V (reference potential)
3	Shield

Note

The interfaces comply with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

Characteristics of the connecting cable:

- Shielding
- 2 conductors with 0.14 mm²
- Maximum length: 50 m

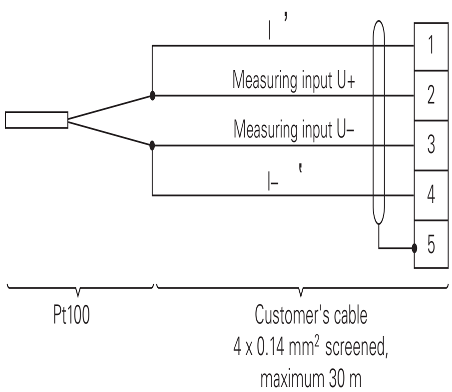
X19 to X22: Connection for Pt 100 on the PLA 4-4 analog module

Connecting terminals	Pin layout
1	I+ Constant current for Pt 100
2	U+ Measuring input for Pt 100
3	U– Measuring input for Pt 100
4	I– Constant current for Pt 100
5	Shield

Note

The interfaces comply with the requirements of EN 61800-5-1 for "protective extra-low voltage" (PELV).

Normally, the thermistor connection is a "four-conductor circuit":



8Th3110

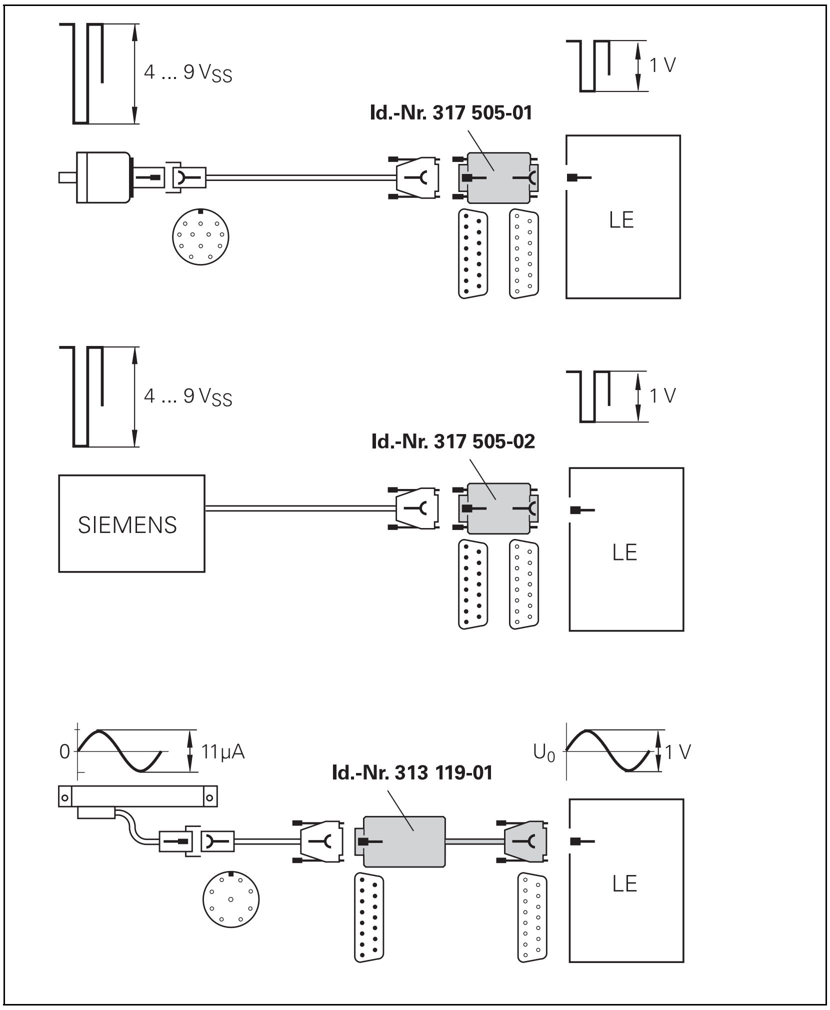
27.11 Encoders

27.11.1 Position encoders

See “X1 to X6, X35 to X38, X201 to X214: Position encoder 1 VPP” on page 27 – 457.

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 42x (B/C)	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 424 (B) 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 MP 2220.

Adapter connector TTL (HEIDENHAIN)/ 1 V_{PP}

Pin layout of D-sub connector (female) and D-sub connector (male):

D-sub connector (female) 15-pin	Pin layout	D-sub connection (male) 15-pin	Pin layout
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	0 V	5	0 V
6	B+	6	U_{a2}
7	B–	7	$-U_{a2}$
8	0 V	8	0 V
9	+5 V	9	+5 V
10	R+	10	U_{a0}
11	0 V	11	0 V
12	R–	12	$-U_{a0}$
13	0 V	13	0 V
14	$-U_{aS}$	14	$-U_{aS}$
15	Not assigned	15	Not assigned

Adapter connector TTL (SIEMENS) / 1 V_{PP}

Pin layout of D-sub connector (female) and D-sub connector (male):

D-sub connctr. (female) 15-pin	Pin layout	D-sub connection (male) 15-pin	Pin layout
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 connector 11 µA$_{PP}$ / 1 V$_{PP}$

Pin layout of D-sub connector (female) and D-sub connector (male):

D-sub connector (female) 15-pin	Pin layout	D-sub connection (male) 15-pin	Pin layout
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

27.11.2 Speed encoders

See “X15 to X20, X80 to X87: Speed encoder 1 VPP” on page 27 – 463.

27.12 Inverters and Motors

Inverter systems are powered via PWM outputs of the control. --> See “X51 to X64: PWM-output” on page 27 – 480.

The motor encoders are connected to the speed encoder interface of the control. --> See “X15 to X20, X80 to X87: Speed encoder 1 VPP” on page 27 – 463.

Note

For further information, refer to the Service Manual "Inverter Systems and Motors".

27.13 Interface Boards for the SIMODRIVE System 611D

The HEIDENHAIN expansion boards for the SIMODRIVE system receive PWM signals from the control and converts them. --> See “X51 to X64: PWM-output” on page 27 – 480.

Note

For further information, refer to the Service Manual "Inverter Systems and Motors".

28 Exchange of HEIDENHAIN Components

28.1 Important Information

DANGER

Observe the safety precautions to avoid injury or damage to persons or machines.
--> See "Safety Precautions" on page 2 – 15.

Caution

Always use original HEIDENHAIN components as replacements!

Which components may be exchanged in the field?

- **MC**
  (Main Computer = housing part with the computer)
- **CC**
  (Controller Computer = housing part with controller)
- **Drive assembly**
  (Hard disk with adapter board and holding plate in the MC 422)
- **HDR**
  (Hard Disk Removable for the MC 422 B/C and the MC 420)
- **SIK**
  (System Identification Key)
- **Fuses**
- **Buffer battery in the control**
- **Fan**
- **Potentiometers**
  (for feed rate and spindle speed)
- **Chargeable or nonrechargeable batteries in the touch probe**
- **Stylus, contact plate**
- **Connected HEIDENHAIN units**
  (e.g., monitors, keyboards, encoders, inverters, motors, handwheels, probes, etc.)
- **Cables and accessories**
- **HEIDENHAIN expansion cards**
  (for the Simodrive system)

What could be exchanged in addition?

- **VDU components**
- **Components of the keyboard**
- **Components of the machine operating panel**

NC software update

An NC software update is performed by the **machine manufacturer** or in coordination with him.

As per special prescriptions of the OEM, the PLC program, the machine configuration or the data in the PLC partition may also be updated.

DANGER

The HEIDENHAIN NC software for iTNC 530 must be released by the OEM for the respective machine!

Note

The NC software update for the single-processor and dual-processor control is described in the Technical Manual iTNC 530 which is available to the machine manufacturer!

Export restrictions

As iTNC 530 features more than 4 axes interpolating with each other (contouring with calculation of more than 4 axes), it is subject to **export licensing**!

The NC software for the path interpolation is located on the corresponding hard disk.

Export licenses are thus required for:

- The **NC software** of the iTNC 530
- The **drive assembly** (as spare part)
- The **MC 422** (the drive assembly is a fixed component of the MC 422)
- The **HDR** (Hard Disk Removable)
- The **SIK** (on which the NC software version of iTNC 530 is stored)

High-accuracy and high-resolution encoders may also require an export license.

Caution

Contact your OEM, if you suspect conflicts!

Caution

NC software that may be on your service laptop is also subject to an export license!

Windows license

The corresponding Windows license is required for the dual-processor controls iTNC 530 with Windows.

The Windows license is applied to **...**

- to the housing of the MC 422
- to the HDR for the MC 422 B, MC 422 C, MC 420

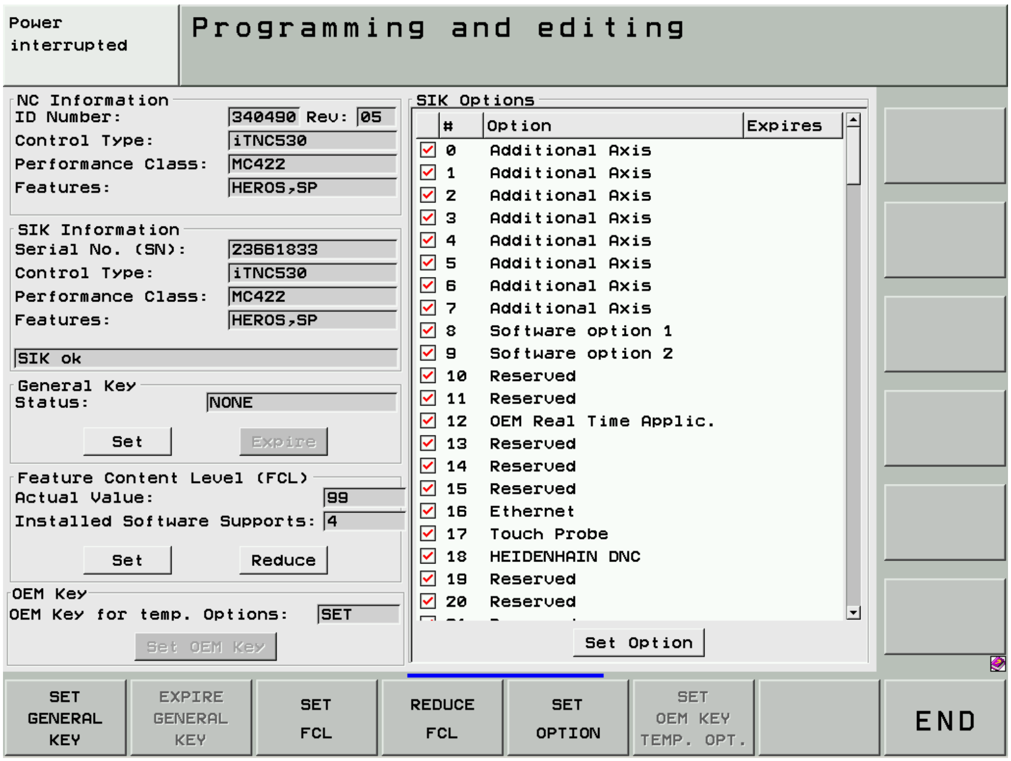
SIK

SIK for MC 422	SIK for HDR
	

The SIK (= **S**ystem **I**dentification **K**ey) ...

- Is located in a base on the processor board of MC 422 (left figure).
- Is located in a slot on the HDR for the MC 422 B/C und MC 420 (right figure).
- Includes the NC software license (standard or export version, with or without Windows, with a various number of enabled control loops, etc.)
- Stores enabled control loops and software options (e.g, tilting operation, HSC milling, TCPM, cylindrical surface interpolation, etc.)
- Includes the Feature Content Level (of NC software version)
- Is inserted in the replacement control, if the control needs to be exchanged. --> Thus all enabled options are still available!

The number is displayed on the screen after entering the code **SIK**.



The SIK number can also be found on the SIK housing or on a sticker below the ID label of the MC.

Feature Content Level

When a new version is released as of NC software 340490-xx (with smarT.NC programming surface), the ranges for error fixes and expanded 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 **ordered** and subsequently **be enabled by 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 "Important Features of HEIDENHAIN Components" on page 26 – 429.
- The number shown cannot be higher than the NC software version (i.e., for NC software 340490-04, the highest possible Feature Content Level is 4).
- A higher `Feature Content Level` always includes the features of the previous versions.

Electronic ID label

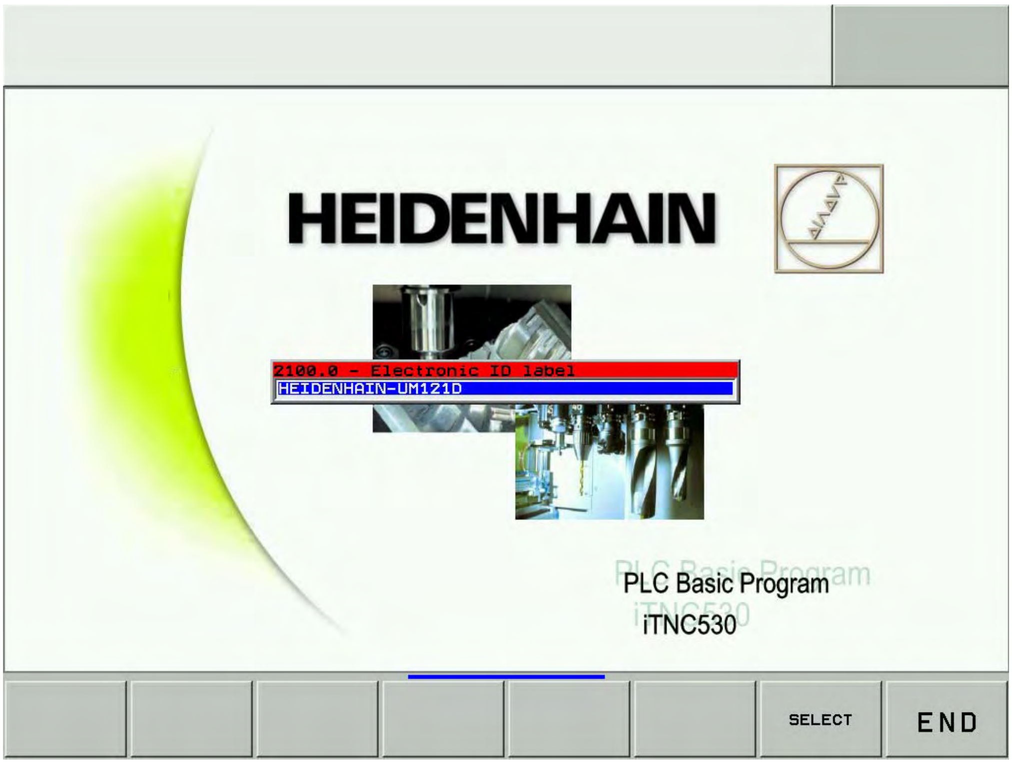
Some HEIDENHAIN units feature an electronic ID label.
The product name, the ID number and the serial number are saved in this ID label.

Prerequisite for the evaluation of the electronic ID labels of the iTNC 530:

As of NC software version	Machine parameters	Current units with electronic ID label
340422-06	MP 7690 is active	HEIDENHAIN inverter with "D" in the device name, e.g., UM 112D
340480-06		HEIDENHAIN synchronous motors with rotary encoders with EnDat interface

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.



Caution

If a unit with electronic ID label responds with the corresponding message window when the control is restarted ...

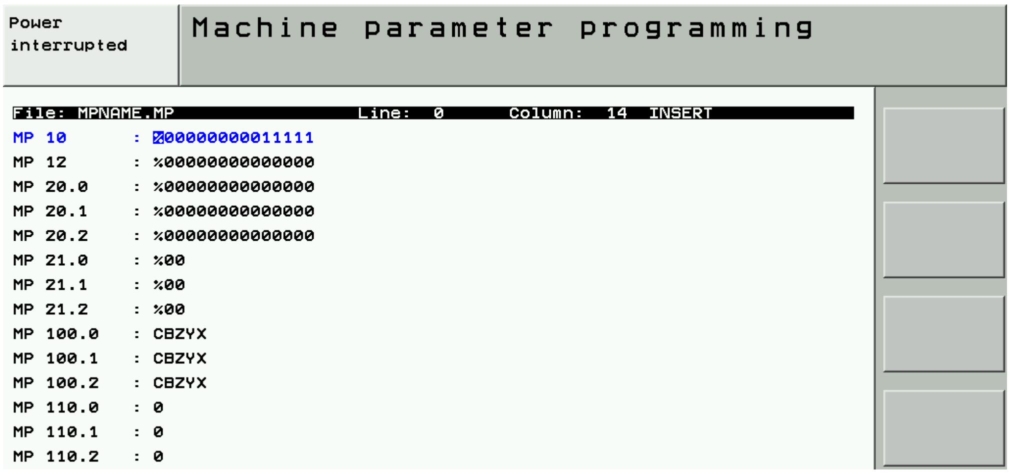
- The active MP list does not correspond to the connected unit (e.g., if a backup was restored before, that does not fit exactly to the machine).
- The connected unit does not correspond to the active MP list (e.g., the mounted replacement unit is not exactly the same).
- You have exchanged the rotary 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 exchanging the rotary encoder inputs (motor encoder) or PWM outputs (interface to the power modules).

MP7690	**Evaluation of the electronic ID labels**
Input:	%xx
	Bit 0 – HEIDENHAIN power modules 0: Active 1: Inactive Bit 1 – HEIDENHAIN synchronous motors 0: Active 1: Inactive

MPNAME.MP

If the machine data are missing (data loss, replacement control, new control) the control opens with the **machine parameter "default setting"** MPNAME.MP when booting the first time:



Note

If the control has already booted several times, the logo of the default setting appears in the `Power interrupted` status. This is based on MPNAME.MP.

- The file MPNAME.MP is generated by the HEIDENHAIN operating system.
- The axes cannot be traversed, and the control is set to programming station.
- The colors is set to the HEIDENHAIN standard colors.
- 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 restores the backup of the machine data. --> See “Backup on an External Data Medium” on page 13 – 192.

ESD protection

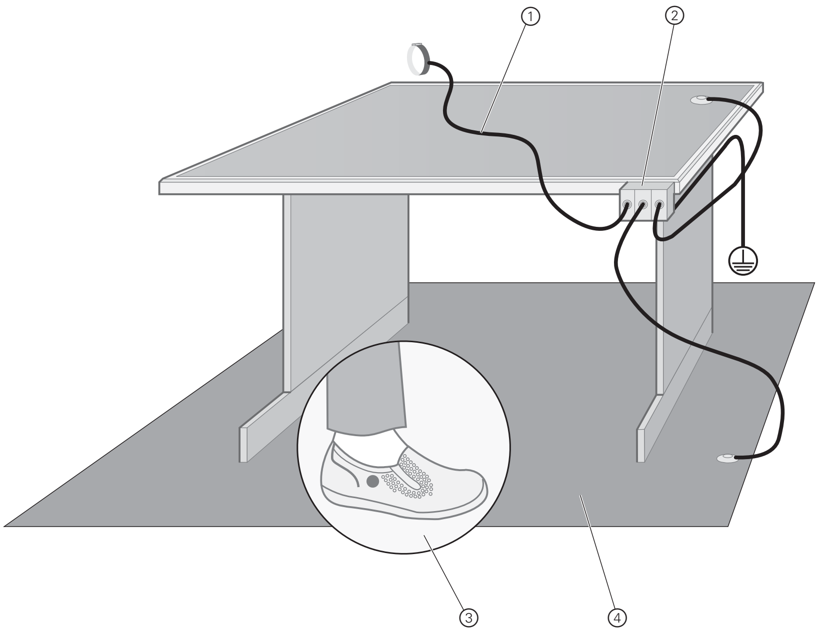
> **Caution**
>
> When exchanging HEIDENHAIN components, you might come into contact with electronic components.
>
> Always assume that **all electronic components and assemblies are endangered by electrostatic discharge (ESD)** and may be **damaged by incorrect handling**.
>
> These ESD-sensitive components could also come into contact with a statically charged object (tool, workbench, packaging, etc.)
>
> Therefore, when exchanging MC, CC, HDR, drive assembly, buffer battery and all units with openly accessible electronic components, observe the ESD measures!

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:

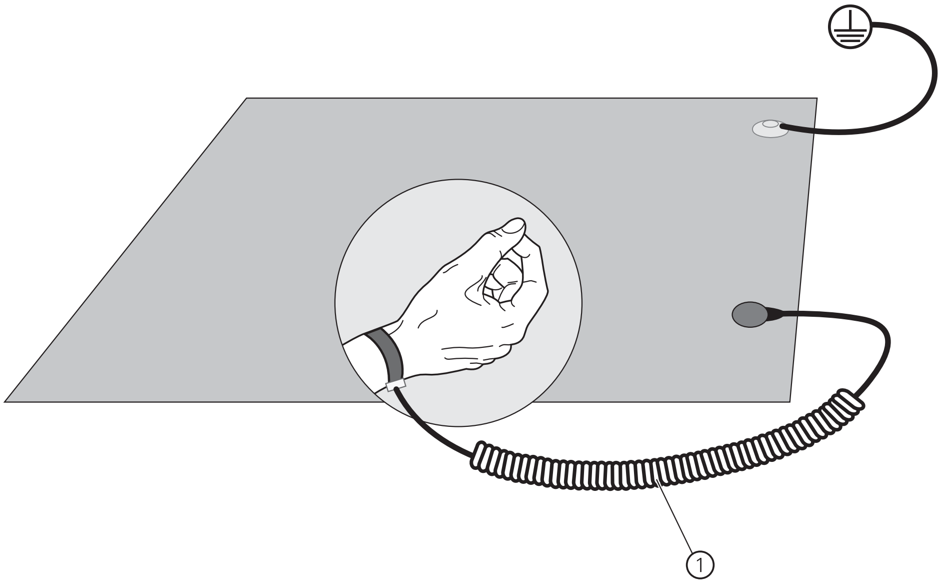
- When handling electrostatically endangered components or assemblies (e.g. exchange, installation, shipping), always **comply with the precautionary measures described in IEC61340-5-1, IEC 61340-5-2 and IEC 61340-4-1**.
- Store and transport ESD-sensitive components in **ESD protective containers**.
- 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.	Wrist strap 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 wrist strap with 1 MOhm grounding resistance for grounding the person:



Information on possible 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 numbers for service order

When placing a service order, always indicate the ID number of the HEIDENHAIN device concerned.

Note

Since the iTNC 530 consists of two components (MC and CC) you can exchange each component individually or both together.
When sending us both components, do not forget to state both ID numbers.
The ID number of the MC can be found on the front panel or on the right side of the housing.
The ID number of the CC can be found on the underside of the base plate of the housing.

Serial number for traceability

To ensure **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!**
- MC, HDR and drive assembly are normally **equipped with the current NC software**. If you wish to keep the previously installed - older - NC software version, contact your OEM. He can restore this 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 HEIDENHAIN agencies. The devices are also updated to the latest state-of-the-art and subjected to tests.

Checking after replacement of electrical components

According to **DIN VDE 0113 part 1 / EN 60204-1**, the following must be checked after an electrical component has been exchanged:

- Check whether the electrical equipment corresponds to the technical documentation.
- Check whether the connections of the grounding conductor system are continuous.
- Perform a functional check.

28.2 Exchange of the MC 422

Caution

The MC 422 may only be exchanged in consultation with the machine manufacturer or by the machine manufacturer!

MCs received for exchange and new MCs are normally equipped with the most recent NC software.
This NC software must be released by the machine manufacturer!

If the latest NC software has not been released by the machine manufacturer or if the NC software version of your defective control should also run on the replacement control, it must be loaded. For this purpose you also require support from the machine manufacturer.

Note: Dual-processor MCs have already loaded Windows.

Preparing the machine

If still possible:

- Move 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 RAM to the hard disk. --> See "Non-Volatile PLC Markers and Words" on page 11 – 136.

Data backup

- Establish a connection between your laptop and the control. --> See "Connection Setup" on page 13 – 172.
- Back up all control data from the hard disk. Select the icon `Scan everything`. --> See "Backup on an External Data Medium" on page 13 – 192.

Note

If an external archive for the TNC data is already available, you need not to back up the TNC partition. Thus you save time!
Contact the customer!
In this case, select the icon `Scan system and machine files`.

Note

If you cannot back up data on the defective MC 422 anymore, you must go back to available archives (PLC data, TNC data) to back up the data on the new control.
If required, you may obtain the machine data also from the machine manufacturer.

Removing the Defective MC 422

- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Label and remove all of the connections on the MC.
- Loosen two torx screws at the top and two at the bottom of the housing (do not screw off completely).
- Remove the defective MC by drawing it towards you by the handles until the MC disengages from the CC. Now you can pull out the MC at a slight angle to the right.

Caution

Observe the ESD precautions. --> See "Important Information" on page 28 – 523!

Shipping brace of the hard disk

▶ **Secure the hard disk of the defective control for the transport!**
(See sticker on the housing of the MC 422.)

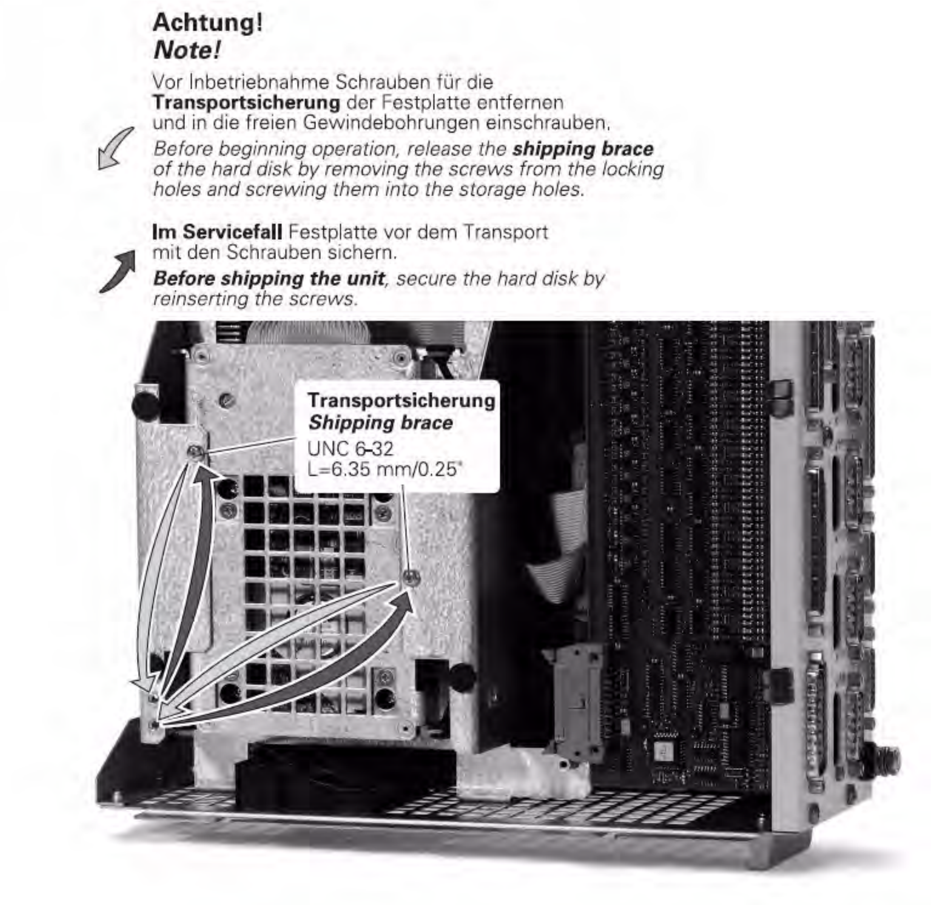


Figure: Sticker regarding the shipping brace of the hard disk on the housing of the MC 422

SIK

Caution

Observe the ESD precautions. --> See "Important Information" on page 28 – 523!

▶ Remove the SIK from the defective MC 422 and insert it into the new MC 422.

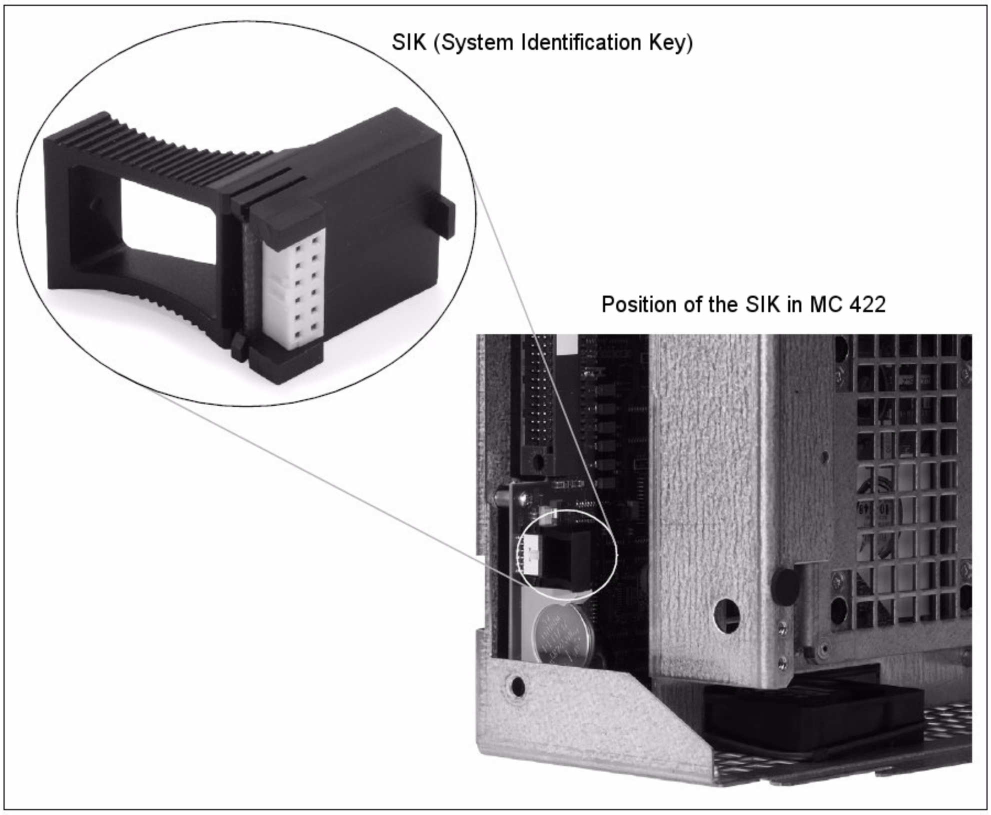


Figure: Position of SIK in the MC 422

Caution

- The SIK (System Identification Key) will remain 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 number is displayed on the screen after entering the code **SIK**. It can also be found on the SIK housing or on a sticker below the ID label of the MC.
  The defective SIK has to be returned.

▶ Remove the label with the SIK number (over the ID plate) from the MC and apply it on the new MC 422 (over the ID plate).

Integrating the New MC 422

- The original SIK must be inserted in the new MC 422 and the SIK sticker must be applied over the ID label
- **Remove the transportation lock of the hard disk before mounting the new MC 422.** See sticker on the housing of the MC 422. The hard disk must oscillate freely!
- Insert the new MC 422 and screw it into place.
- If required, remove the protective caps from the MC connectors.
- Reestablish and screw into place all the connections.

> **Caution**
>
> Do not confuse any of the connectors! Do not forget the grounding screw!

- Switch on the main switch of the machine.

Adapting the MPNAME.MP

Only necessary if you want to transfer the backup files by means of Ethernet interface and the **NC software version of the control is lower than 340420-08**!

If the file MPNAME.MP is now displayed on the screen:

- Press END to restart the control.

> **Note**
>
> If entries for additional control-loop indexes are now required in the machine parameter list (error message `MP: not defined)` or there seem to be too many control-loop indexes (error message `MP: incorrect number),` then ...
>
> - Delete the MPNAME.MP. -->
>   An adapted MPNAME.MP is generated automatically.
> - Press END. -->
>   The control boots and generates the `Power interrupt` message.

> **Note**
>
> As of NC software version 340420-08, the code number NET 123 for setting up the Ethernet configuration is also accepted with open MP list.

Setting date and time on the new MC 422

- Check the date and time of the control and reset it, if necessary. --> See "Setting the System Time" on page 12 – 159.

Setting up the data interface

- Make the settings for Ethernet transmission on the control.
  --> See "Via Ethernet" on page 13 – 172.
  Subsequently, protect the `IP4.N00` file to make sure it is not overwritten!
- Or define the settings for the RS 232 interface.
  --> See "Via serial interface RS-232-C or RS-422" on page 13 – 182.

Defining the NC software version

- Check the currently active NC software version. --> See "Display of Important System Information" on page 26 – 443.
  If you need another software version, it must be loaded now. --> Contact the machine manufacturer!

Restoring the data

- Establish a connection between your laptop and the new control.
  --> See "Connection Setup" on page 13 – 172.
- Load the backup on the new MC 422. --> See "Restoring Data" on page 13 – 197.

Note

Delete the blue check mark for **READ_MP.A**.

Background:
To each NC software version belongs a **READ_MP.A** file which includes the comments on the current machine parameters (to be found under **PLC:\JH\READ_MP.A**). As the replacement control is normally supplied with the latest NC software version, the **READ_MP.A** in your backup file possibly belongs to an older NC software version. If you have deleted the check mark in your LST file, the current **READ_MP.A** is not overwritten by the old **READ_MP.A**.

It is not recommended to protect the **READ_MP.A** file on the control as otherwise the file cannot be updated during an NC software update!

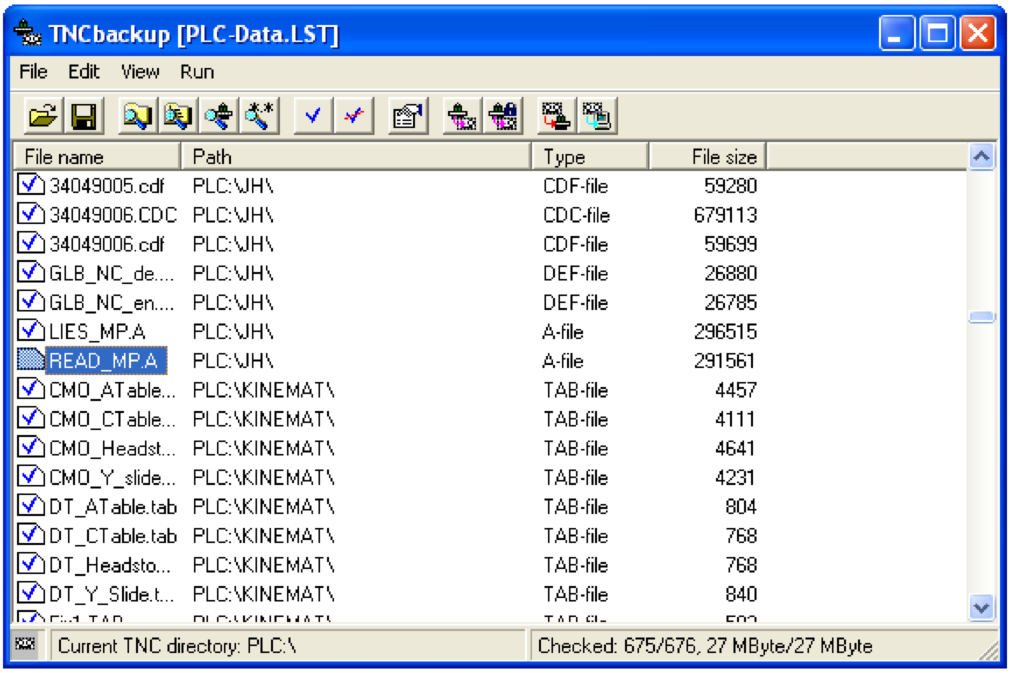


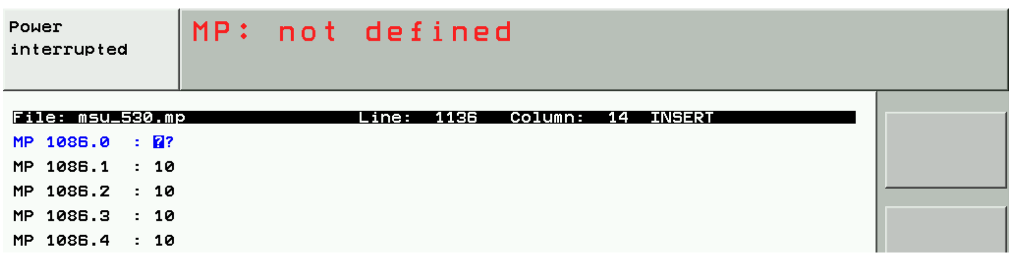
Figure: Check mark with READ_MP.A has been removed

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 control or older MPs are removed.

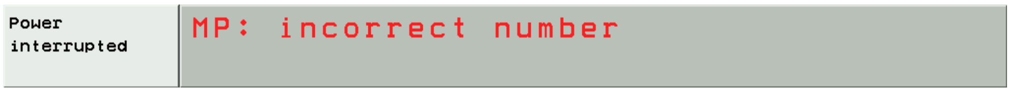
- Press the END key.

The following messages may be generated:



▶ 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 **`READ_MP.A`** in path **`PLC:\JH\ ...`**
> Contact the machine manufacturer for more information!
> If required you can add comments on the function of the new parameters in the MP list.



▶ The parameter is not required. --> Delete this MP or mark the parameter as comment so it remains in the machine parameter list.

END ▶ After each change, try to activate the machine parameter list with END. If the MP list is complete, the iTNC 530 restarts.

Reset non-volatile PLC markers and words

▶ Restart the control, do not acknowledge the **`Power interrupted`** message.
▶ Write the non-volatile PLC markers and words from the hard disk to the RAM of the new control. --> See “Non-Volatile PLC Markers and Words” on page 11 – 136.

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 exchange of the control.
> --> See “Adjusting the electrical offset (drift adjustment)” on page 20 – 349.

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 have been added), you should create a current machine backup. --> See “Backup on an External Data Medium” on page 13 – 192.

Removing the defective MC 422

▶ 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 422.
▶ **Check whether the hard disk is secured by a shipping brace.**
▶ Pack the defective MC 422 in the original packaging of the new MC 422.
▶ Return the defective MC 422 to the machine manufacturer or to your HEIDENHAIN service agency.

28.3 Exchange of the Drive Assembly

Caution

The drive assembly must only be exchanged by or in consultation with the machine manufacturer!

Drives that you receive in exchange and new drives are already partitioned and formatted. The HeROS operating mode and the NC software are installed. The hard disks are normally equipped with the most recent NC software.
This NC software must be released by the machine manufacturer!

If the latest NC software has not been released by the machine manufacturer or if the NC software version of your defective control should also run on the replacement control, it must be loaded. For this purpose you also require support from the machine manufacturer.

Note: Dual-processor controls have loaded Windows.

Preparing the machine

If still possible:

- Move machine to home position (axes, tool changer, tilting head, etc.).
  Ask the machine operator!
- Press EMERGENCY STOP.

If possible ...

Backup the non-volatile PLC markers and words.

It is likely that no data can be written on a defective hard disk.
If this is still possible:

- Back up the condition of non-volatile PLC markers and words from RAM to the hard disk. --> See "Non-Volatile PLC Markers and Words" on page 11 – 136.

Backup

It is likely that no data can be backed up from a defective hard disk.
If this is still possible:

- Establish a connection between your laptop and the control.
  --> See "Connection Setup" on page 13 – 172.
- Back up all control data from the hard disk.
  Select the icon `Scan everything`. --> See "Backup on an External Data Medium" on page 13 – 192.

Note

If an external archive for the TNC data is already available, you need not to back up the TNC partition. Thus you save time!
Contact the customer!
In this case, select the icon `Scan system and machine files`.

Removing the defective drive assembly

- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Label and remove all of the connections on the MC.
- Loosen two torx screws at the top and two at the bottom of the MC housing (do not screw off completely).
- Remove the MC by drawing it towards you by the handles until the MC disengages from the CC. Now you can pull out the MC at a slight angle to the right.

Caution

Observe the ESD precautions. --> See "Important Information" on page 28 – 523!

- Dismount the hard disk together with the holding plate (drive assembly)

Shipping brace of the hard disk

▶ **Secure the hard disk for the transport!**
(See sticker on the housing of the MC 422.)

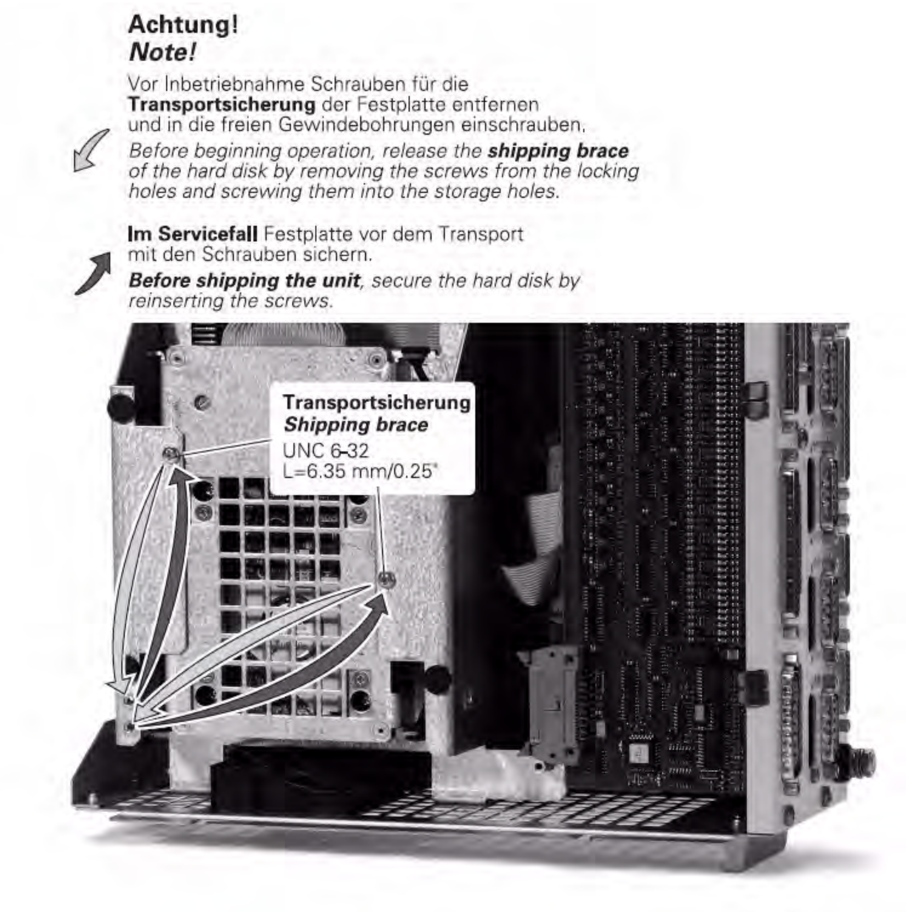


Figure: Sticker regarding the shipping brace of the hard disk on the housing of the MC 422

Integrating the new drive assembly

▶ **Remove the shipping braces before mounting the hard disk!**
See sticker on the housing of the MC 422. The hard disk must oscillate freely!

▶ Insert the new drive assembly in the MC 422.

▶ Connect MC 422 to the CC and screw it into place.

▶ Re-establish and screw into place all the connections.

Caution

Do not confuse any of the connectors! Do not forget the grounding screw!

▶ Switch on the main switch of the machine.

Adapting the MPNAME.MP

Only necessary if you want to transfer the backup files by means of Ethernet interface and the **NC software version of the control is lower than 340420-08**!

If the file MPNAME.MP is now displayed on the screen:

- Press END to restart the control.

Note

If entries for additional control-loop indexes are now required in the machine parameter list (error message **`MP: not defined)`** or there seem to be too many control-loop indexes (error message **`MP: incorrect number),`** then ...

- Delete the MPNAME.MP. -->
  An adapted MPNAME.MP is generated automatically.
- Press END. -->
  The control boots and generates the **`Power interrupt`** message.

Note

As of NC software version 340420-08, the code number NET 123 for setting up the Ethernet configuration is also accepted with open MP list.

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 12 – 159.

Setting up the data interface

- Make the settings for Ethernet transmission on the control.
  --> See "Via Ethernet" on page 13 – 172.
  Subsequently, protect the **`IP4.N00`** file to make sure it is not overwritten!
- Or define the settings for the RS 232 interface.
  --> See "Via serial interface RS-232-C or RS-422" on page 13 – 182.

Defining the NC software version

- Check the currently active NC software version. --> See "Display of Important System Information" on page 26 – 443.
  If you need another software version, it must be loaded now. --> Contact the machine manufacturer!

Restoring the data

As you could probably not store data from the defective hard disk, you must now go back to available archives (PLC-data, TNC-data) to restore data on the new hard disk; if required, the machine manufacturer can also provide you with PLC or machine data.

- Establish a connection between your laptop and the control.
  --> See "Connection Setup" on page 13 – 172.
- Load the backup on the new hard disk of the MC 422.
  --> See "Restoring Data" on page 13 – 197.

Note

Delete the blue check mark for **`READ_MP.A`** in the LST file.

Background:
To each NC software version belongs a **`READ_MP.A`** file which includes the comments on the current machine parameters (to be found under **`PLC:\JH\READ_MP.A`**). As the replacement drives are normally supplied with the latest NC software version, the **`READ_MP.A`** in your backup file possibly belongs to an older NC software version. If you have deleted the check mark in your LST file, the current **`READ_MP.A`** is not overwritten by the old **`READ_MP.A`**.

It is not recommended to protect the **`READ_MP.A`** file on the control as otherwise the file cannot be updated during an NC software update!

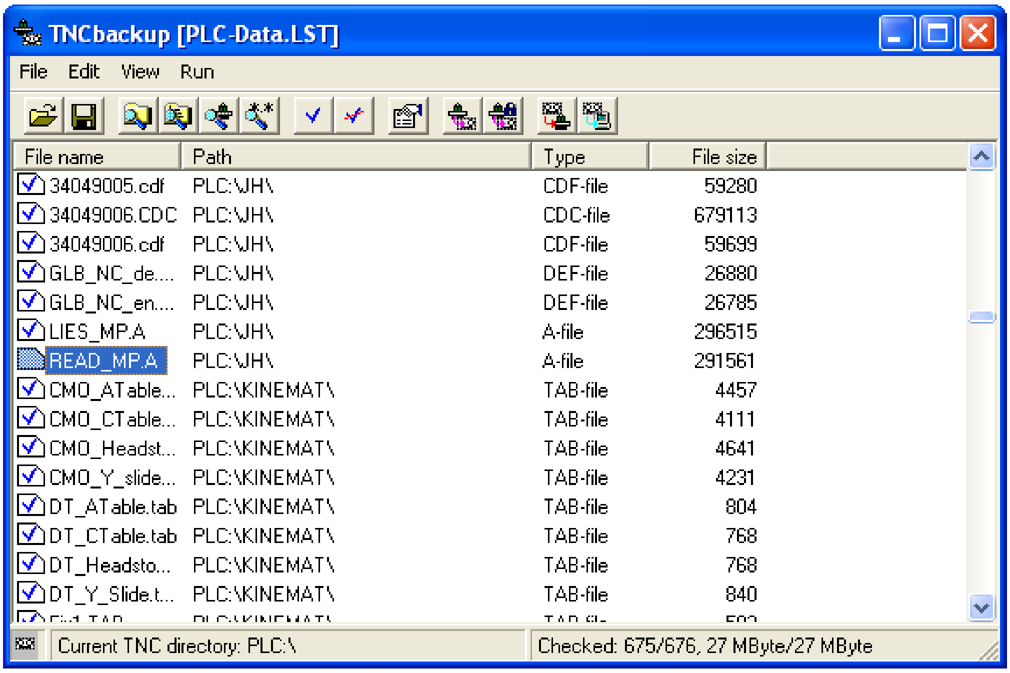


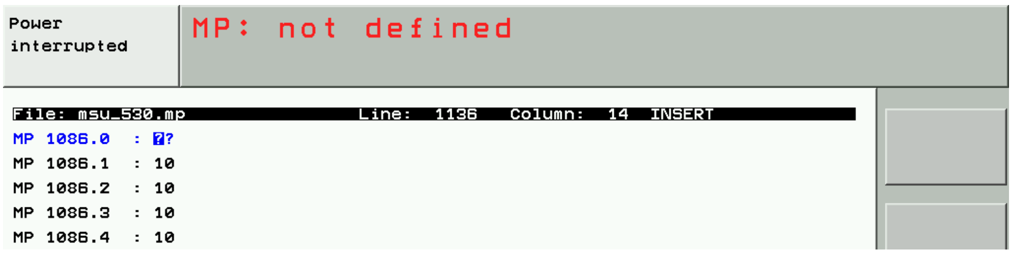
Figure: Check mark with READ_MP.A has been removed

Updating the machine parameter list

If the control opens the machine parameter list after you have restored the back up, new machine parameters are added with the current NC software of the replacement hard disk or older MPs are removed.

▶ Press the END key.

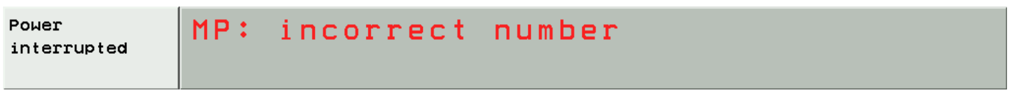
The following messages may be generated:



▶ 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 **READ_MP.A** in path **PLC:\JH\ ...**
Contact the machine manufacturer for more information!
If required you can add comments on the function of the new parameters in the MP list.



▶ The parameter is not required. --> Delete this MP or mark the parameter as comment so it remains in the machine parameter list.

▶ After each change, try to activate the machine parameter list with END.
If the MP list is complete, the iTNC 530 restarts.

If possible ...

If you could still store the **non-volatile PLC markers and words** from RAM to the defective hard disk and subsequently create a backup:

- Restart the control, do not acknowledge the **`Power interrupted`** message.
- Write the non-volatile PLC markers and words from the hard disk to the RAM of the control. --> See “Non-Volatile PLC Markers and Words” on page 11 – 136.

Restoring the default settings on the machine

If necessary, you must ...

- 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 exchange of the control.
> --> See “Adjusting the electrical offset (drift adjustment)” on page 20 – 349.

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 have been added), you should create a current machine backup. --> See “Backup on an External Data Medium” on page 13 – 192.

Removing the defective drive assembly

- Apply a note with the error description on the sheet metal of the drive assembly.
- **Check whether the hard disk is secured by a shipping brace.**
- Pack the defective drive assembly in the original packaging of the new drive assembly.
- Return the defective drive assembly to the machine manufacturer or to your HEIDENHAIN service agency.

28.4 Exchange of the MC 422 B, MC 422 C, MC 420

Preparing the machine

If still possible …

- Move machine to home position (axes, tool changer, tilting head, etc.).
  Ask the machine operator!
- Press the EMERGENCY STOP button.

Backup of Non-Volatile PLC Markers and Words

- Back up the condition of non-volatile PLC markers and words from RAM to the HDR. --> See “Non-Volatile PLC Markers and Words” on page 11 – 136.

Removing the defective MC 422 B (MC 422 C, MC 420)

- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Label and remove all of the connections on the MC.
- Loosen two torx screws at the top and two at the bottom of the housing (do not screw off completely).
- Remove the defective MC by drawing it towards you by the handles until the MC disengages from the CC. Now you can pull out the MC at a slight angle to the right.

Caution

Observe the ESD precautions. --> See “Important Information” on page 28 – 523!

- Remove the HDR incl. SIK (hard disk removable).
  --> See “Exchange of the HDR” on page 28 – 544.
  (The SIK to the machine is located in a plug-in slot in the HDR housing.)

Mounting the new MC 422 B (MC 422 C, MC 420)

- Insert the SIK into the new MC 422 B and lock it. --> See “Exchange of the HDR” on page 28 – 544.
- Insert the new MC 422 B and screw it into place.
- If required, remove the protective caps from the MC connectors.
- Reestablish and screw into place all the connections.

Caution

Do not confuse any of the connectors! Do not forget the grounding screw!

- Switch on the main switch of the machine.

Setting date and time on the new MC 422 B (MC 422 C, MC 420)

- Check the date and time of the control and reset it, if necessary. --> See “Setting the System Time” on page 12 – 159.

Reset non-volatile PLC markers and words

- Restart the control, do not acknowledge the `Power interrupted` message.
- Write the non-volatile PLC markers and words from the HDR to the RAM of the new control.
  --> See “Non-Volatile PLC Markers and Words” on page 11 – 136.

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 exchange of the control. -> See “Adjusting the electrical offset (drift adjustment)” on page 20 – 349.

Functional test

- Check the machine functions (with the aid of the machine operator).

Returning the defective MC 422 B (MC 422 C, MC 420)

- 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 422 B.
- Pack the defective MC 422 B in the original packaging of the new MC 422 B.
- Return the defective MC 422 B to the machine manufacturer or to your HEIDENHAIN service agency.

Caution

If you want to send us the HDR for investigation or repair, it must be secured for the transport and packed separately. --> See “Exchange of the HDR” on page 28 – 544!
Remove the SIK before (it remains "with the machine")!
If possible, use the original packaging for the HDR.
Do not transport the HDR when mounted in the MC 42x (B)!

28.5 Exchange of the HDR

Caution

The drive assembly 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 mode 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 latest NC software has not been released by the machine manufacturer or if the NC software version of your defective HDR should also run on the replacement HDR, it must be loaded. For this purpose you also require support from the machine manufacturer.

Note: HDRs supporting dual-processor controls have loaded Windows.

Note

As of NC software version 34049x-04, the MC 420 or MC 422 B/C must feature a main memory of minimum 256 MB.
With less working memory, the boot procedure is not completed!
If necessary, the main memory must be upgraded.

Preparing the machine

If still possible:

- Move machine to home position (axes, tool changer, tilting head, etc.).
  Ask the machine operator!
- Press the EMERGENCY STOP button.

If possible ...

Backup the non-volatile PLC markers and words.

It is likely that no data can be written on a defective HDR.
If this is still possible:

- Back up the condition of non-volatile PLC markers and words from RAM to the HDR. --> See "Non-Volatile PLC Markers and Words" on page 11 – 136.

Data backup

It is likely that no data can be backed up from a defective hard disk.
If this is still possible:

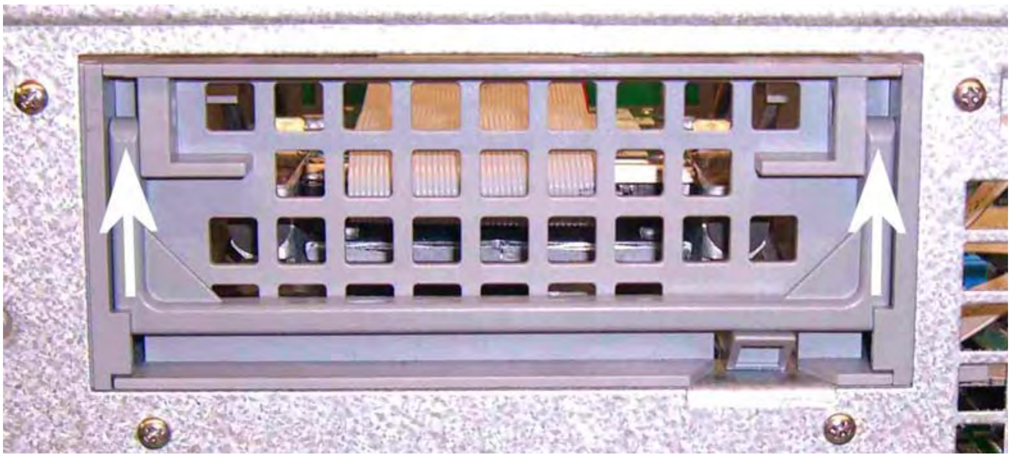
- Establish a connection between your laptop and the control.
  --> See "Connection Setup" on page 13 – 172.
- Back up all control data from the HDR.
  Select the icon `Scan everything`. --> See "Backup on an External Data Medium" on page 13 – 192.

Note

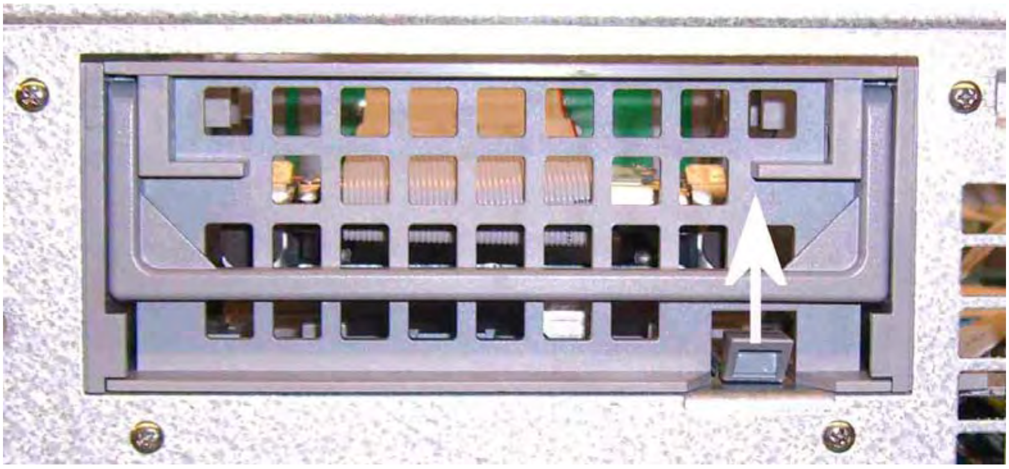
If an external archive for the TNC data is already available, you need not to back up the TNC partition. Thus you save time!
Contact the customer!
In this case, select the icon `Scan system and machine files`.

Removing the defective HDR

- Switch off the machine, take precautions against resetting, ensure that the equipment is free of potential.
- Press the handle of the HDR upwards to loosen the locking.



- Press the locking hook upwards and remove the HDR.



Caution

Observe the ESD precautions. --> See "Important Information" on page 28 – 523!

Shipping brace of the HDR

▶ **Secure the HDR for the transport!**
(The hard disk is mounted to a steel plate that is inserted into the guideways of the plastic housing. --> See sticker on the HDR.)

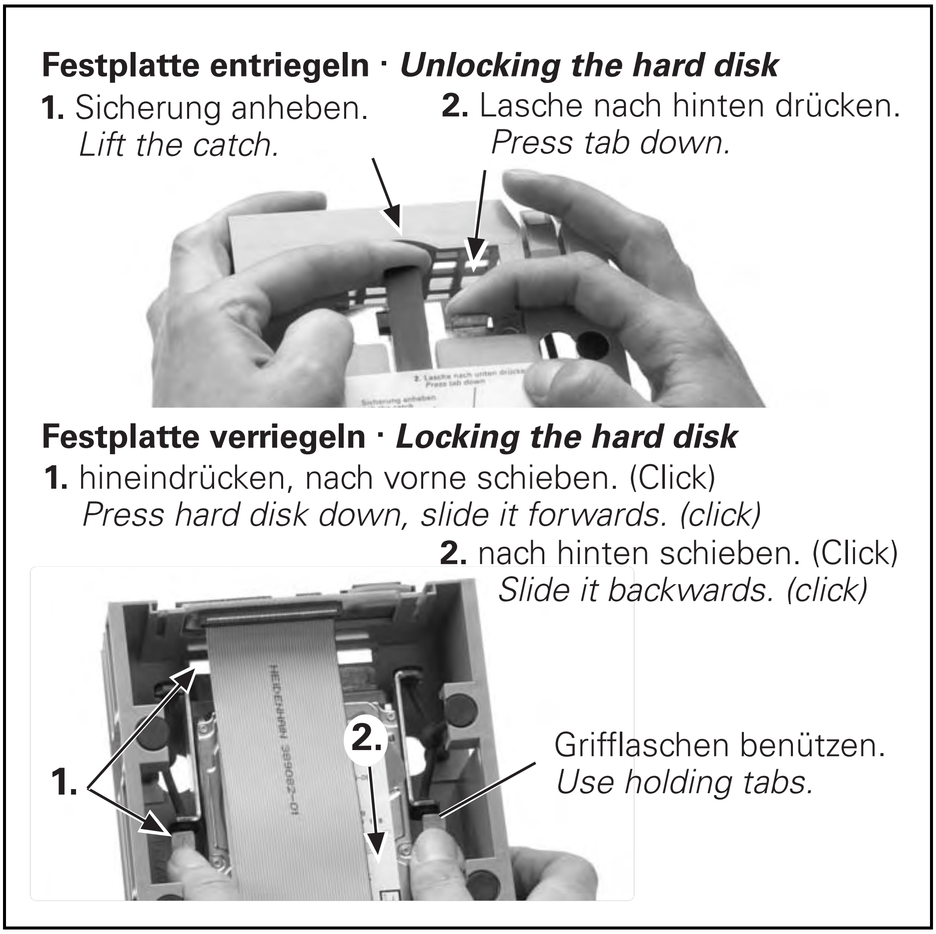


Figure: Sticker regarding the shipping brace on the housing of the HDR

SIK

> **Caution**
>
> Observe the ESD precautions. --> See "Important Information" on page 28 – 523!

▶ Remove the SIK from the defective HDR and insert it into the new HDR.

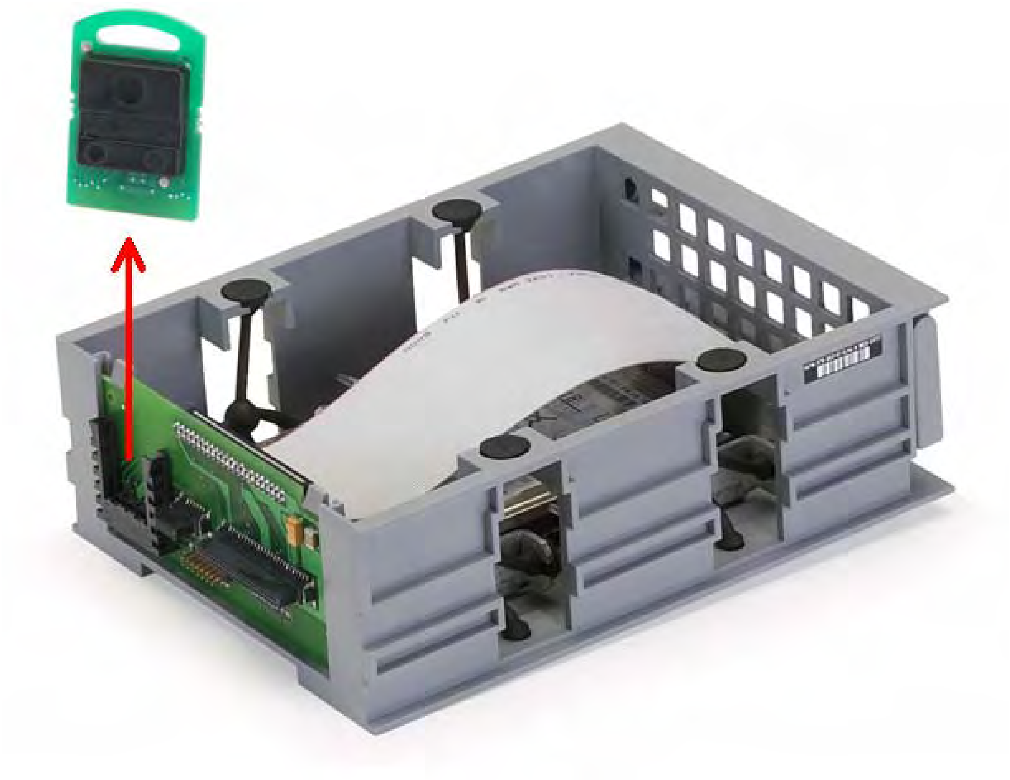


Figure: Position of SIK in the HDR

> **Caution**
>
> - The SIK (System Identification Key) will remain with the machine.
>   It must be inserted into the new or replacement HDR; 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 entering the **SIK** code. It can also be found on the SIK housing.
>   The defective SIK has to be returned.

Installing the new HDR

▶ The original SIK must be inserted into the new HDR.

▶ Loosen the shipping brace; the HDR must oscillate freely! --> See sticker on the HDR.

> **Caution**
>
> Do not overexpand the locking hook but just lift it slightly.

▶ Insert and lock new HDR (also press the handle down).

▶ Switch on the main switch of the machine.

Upgrading the main memory

Only necessary if the HDR features an NC software as of 34049x-04 and the main memory of the MC is less than 256 MB.
With less working memory, the boot procedure is not completed!

- Clarify the NC software version of the HDR and the main memory of the MC.
- Upgrade the main memory of the MC. Use the enclosed mounting instructions.

Adapting the MPNAME.MP

Only necessary if you want to transfer the backup files by means of Ethernet interface and the **NC software version of the control is lower than 340420-08**!

If the file MPNAME.MP is now displayed on the screen:

- Press END to restart the control.

Note

If entries for additional control-loop indexes are now required in the machine parameter list (error message **`MP: not defined)`** or there seem to be too many control-loop indexes (error message **`MP: incorrect number),`** then ...

- Delete the MPNAME.MP. -->
  An adapted MPNAME.MP is generated automatically.
- Press END. -->
  The control boots and generates the **`Power interrupt`** message.

Note

As of NC software version 340420-08, the code number NET 123 for setting up the Ethernet configuration is also accepted with open MP list.

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 12 – 159.

Setting up the data interface

- Make the settings for Ethernet transmission on the control.
  --> See “Via Ethernet” on page 13 – 172.
  Subsequently, protect the **`IP4.N00`** file to make sure it is not overwritten!
- Or define the settings for the RS 232 interface.
  --> See “Via serial interface RS-232-C or RS-422” on page 13 – 182.

Defining the NC software version

- Check the currently active NC software version. --> See “Display of Important System Information” on page 26 – 443.
  If you need another software version, it must be loaded now. --> Contact the machine manufacturer!

Restoring the data

As you could probably not store data from the defective HDR, you must now go back to available archives (PLC-data, TNC-data) to restore data on the new HDR; if required, the machine manufacturer can also provide you with PLC or machine data.

- Establish a connection between your laptop and the control.
  --> See “Connection Setup” on page 13 – 172.

▶ Load the backup on the new HDR. --> See “Restoring Data” on page 13 – 197.

Note

Delete the blue check mark for **READ_MP.A** in the LST file.

Background:
To each NC software version belongs a **READ_MP.A** file which includes the comments on the current machine parameters (to be found under **PLC:\JH\READ_MP.A**). As the replacement HDR is normally supplied with the latest NC software version, the **READ_MP.A** in your backup file possibly belongs to an older NC software version. If you have deleted the check mark in your LST file, the current **READ_MP.A** is not overwritten by the old **READ_MP.A**.

It is not recommended to protect the **READ_MP.A** file on the control as otherwise the file cannot be updated during an NC software update!

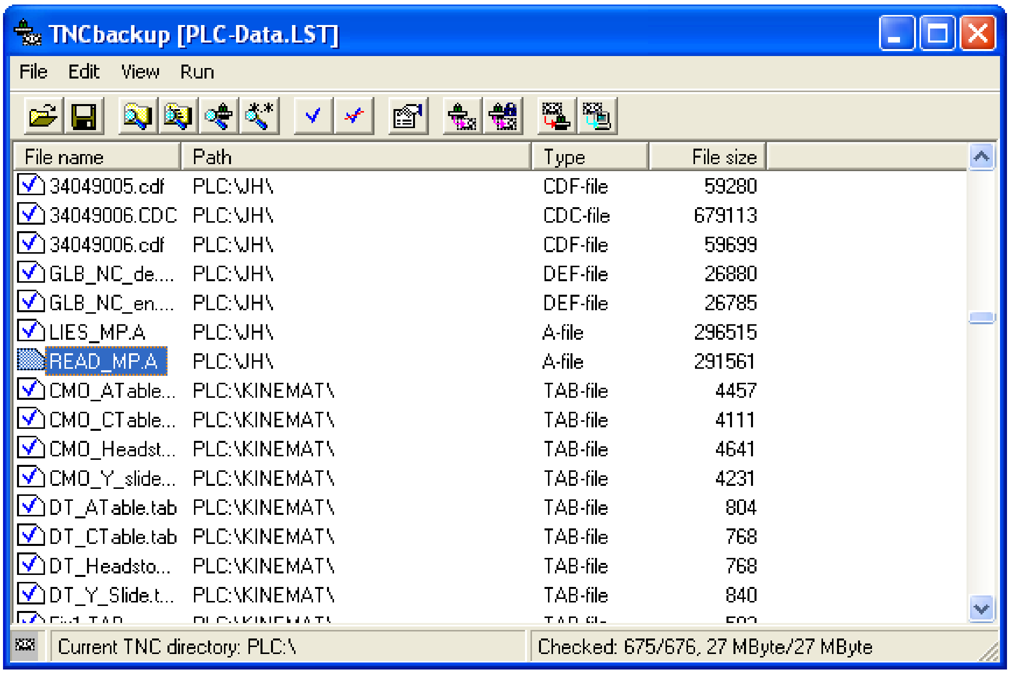


Figure: Check mark with READ_MP.A has been removed

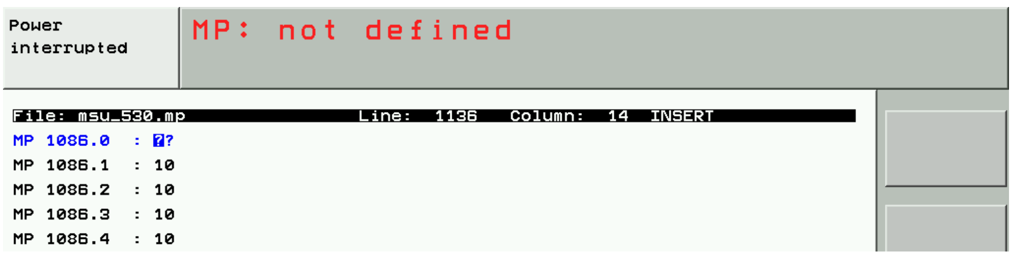
Updating the machine parameter list

If the control opens the machine parameter list after you have restored the back up, new machine parameters are added with the current NC software of the replacement HDR or older MPs are removed.

END

▶ Press the END key.

The following messages may be generated:



▶ Enter a value for the new machine parameter.

Note

Comments on the new MPs can be found in the text file **`READ_MP.A`** in path **`PLC:\JH\ ...`**
Contact the machine manufacturer for more information!
If required you can add comments on the function of the new parameters in the MP list.

`Power interrupted`	`MP: incorrect number`

▶ The parameter is not required. --> Delete this MP or mark the parameter as comment so it remains in the machine parameter list.

▶ After each change, try to activate the machine parameter list with END.
If the MP list is complete, the iTNC 530 restarts.

If possible ...

If you could still store the **non-volatile PLC markers and words** from RAM to the defective HDR and subsequently create a backup:

▶ Restart the control, do 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 – 136.

Restoring the original state of the machine

If necessary, you must ...

- 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 exchange of the control.
--> See “Adjusting the electrical offset (drift adjustment)” on page 20 – 349.

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 have been added), you should create a current machine backup. --> See “Backup on an External Data Medium” on page 13 – 192.

Returning the defective HDR

▶ Apply a note with the error description on the HDR.
▶ **Check whether the hard disk is secured by a shipping brace.**
▶ Pack the defective HDR in the original packaging of the new HDR.
▶ Return the defective HDR to the machine manufacturer or to your HEIDENHAIN service agency.

28.6 Exchange of the CC

Preparing the machine

If still possible:

- Move machine to home position (axes, tool changer, tilting head, etc.). Ask the machine operator!
- Press EMERGENCY STOP button.

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 and remove all of the connections on the CC and the MC.
- Dismount the CC component together with the MC from the electrical cabinet.
- Separate the MC from the defective CC.
  Loosen two torx screws at the top and two at the bottom of the housing (do not unscrew completely). Remove the MC by drawing it towards you by the handles until the MC disengages from the CC.
  Now you can pull out the MC at a slight angle to the right.

> **Caution**
>
> Observe the ESD precautions. --> See “Important Information” on page 28 – 523!

Mounting the new CC

- Connect the MC with the new CC.
- Mount the new CC together with the MC in the electrical cabinet.
- Re-establish all of the connections on the CC and the MC.

> **Caution**
>
> Do not confuse any of the connectors!
>
> Do not forget to connect the grounding screw at bottom right of the MC and the grounding screw above the CC housing!

- Screw on the shielding plate.
- Switch on the main switch of the machine.

Functional test

- Check the machine functions (with the aid of the machine operator).

Returnings 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.
- Pack the defective CC in the original packaging of the new CC.
- Return the defective CC to the machine manufacturer or to your HEIDENHAIN service agency.

28.7 Exchange of the Buffer Battery

See "Buffer Battery" on page17 – 264.

28.8 Exchange of Other HEIDENHAIN Components

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 Set" on page 29 – 566) or PWT (See "PWT 10/17/18 Testing Unit" on page 29 – 568) are good aids for **adjusting scanning heads**.

Caution

When you exchange motors or encoders for drives with field angle determination (normally linear and torque motors) the function `Field orientation` must be executed again. Contact your machine manufacturer!

- If HEIDENHAIN measuring devices (e.g., scale) were exchanged, in most cases the machine datum had to be set again. --> See "Encoder Interface" on page 18 – 277.
- If a HEIDENHAIN motor encoder for a spindle was exchanged, it can be necessary to set the spindle preset again. --> See "Encoder Interface" on page 18 – 277.

Drive components and mechanics

- If HEIDENHAIN motors for axes or spindles were exchanged, it might be necessary to readjust the trip dog for reference end position, to reset the machine datum and to find the spindle preset again. --> See "Encoder Interface" on page 18 – 277.
- Some **successor spare parts** (e.g., inverters, motors) are supplied with **replacing instructions** describing, e.g., necessary changes in the MP list or in motor or power module tables.
- When exchanging **electrical original components** (inverters, motors, etc.) a **new adjustment of control loops** of axes and spindle **is normally not necessary.**
  Exception: When exchanging an MC that also (or exclusively) controls analog axes, an offset adjustment with the code number for the fine compensation should be performed. --> See "Adjusting the electrical offset (drift adjustment)" on page 20 – 349.
- **For information on the exchange of drive components**, refer to the **Service Manual "Inverter Systems and Motors"**.
- When exchanging **mechanical components, readjustment of the control loops** of axes and spindles **may be necessary.** --> Contact the machine manufacturer!

Cables

- Exchange cables only for **original cables**! Do not exceed any maximum lengths!

Shielding and grounding

- If required, ensure **proper shielding and grounding** of cables and components.

Packaging

- If possible, use **original packagings** from HEIDENHAIN.

Note

If you have any questions, contact the **machine tool builder** or a **HEIDENHAIN service agency.**

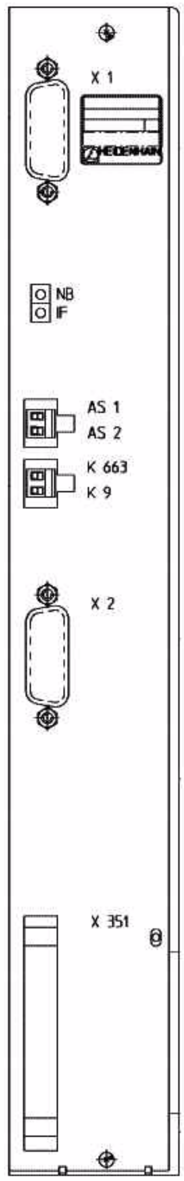
28.9 Exchange of HEIDENHAIN Components in the SIMODRIVE System

Version with D-sub connector

HEIDENHAIN expansion 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.

Interface boards **without metallic isolation** are recognized 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 front panel.
- These board have the Id.Nr. 291070-01, 324952-01, -02, -03 and -10 without index A.

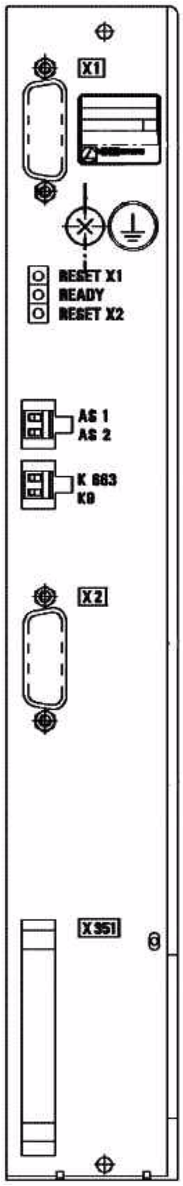


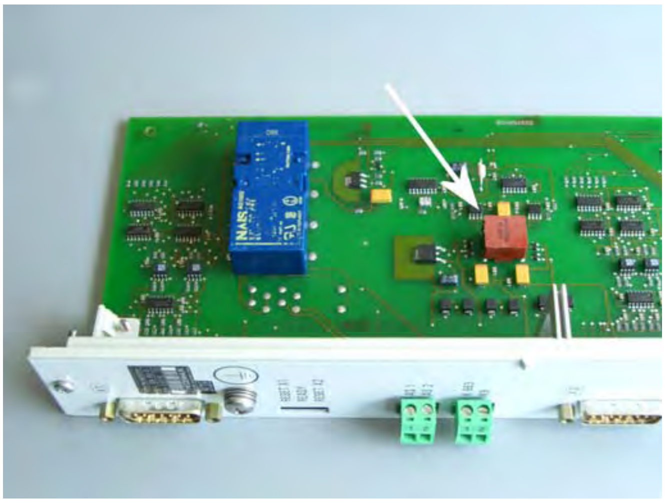
Caution

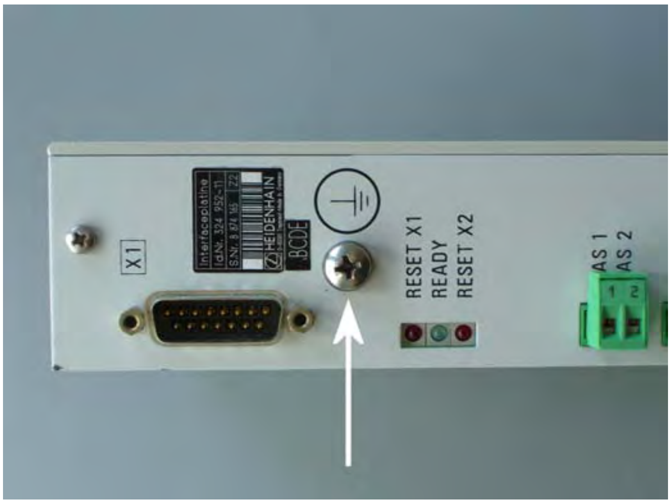
The terminal X131 of the Siemens E/R module of boards without metallic isolation may not be connected to the central signal ground of the machine!

Note

The HEIDENHAIN interface boards of the first generation were built without metallic insulation.

Expansion boards **with metallic isolation** are recognized 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 transformer on the front panel. ■ These boards have the ID 324952-10 with index A, -11, -12, ...	

Transformer component on the board	

Grounding screw on the front panel	

Caution

The terminal X131 of the Siemens E/R module of boards with metallic isolation must be connected to the central signal ground of the machine!
The individual interface boards must also be connected to the central signal ground of the machine via the grounding screw on the front panel.

Caution

Interface boards **with and without metallic isolation** may **not be used together**!
Either all boards are galvanically isolated and X131 is wired or all boards are not galvanically isolated and X131 is not wired!

Photo: Siemens E/R module with terminal X131

Caution

If a Siemens E/R module is used together with a so-called monitoring module (UEB module), the terminal X131 on this module has to be wired as on the E/R module!

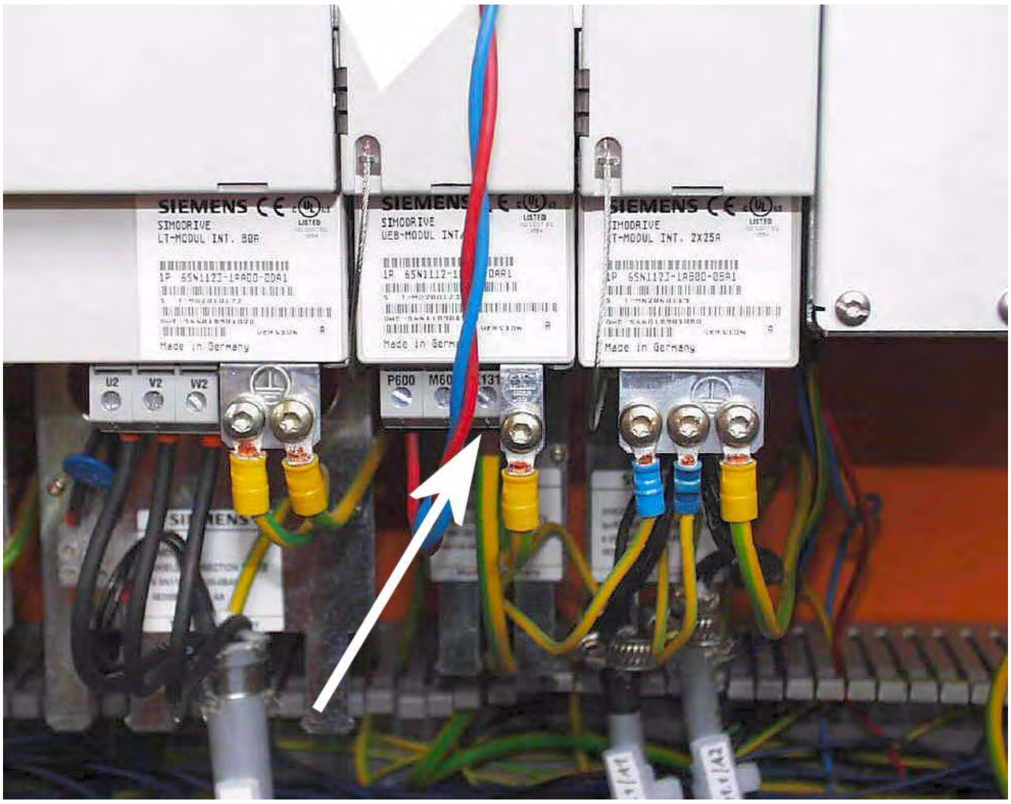


Photo: Siemens UEB module with terminal X131

Version with ribbon cable connector

HEIDENHAIN interface boards for the SIMODRIVE system in the version with ribbon cable have a 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 interface boards must also be connected to the central signal ground of the machine via the grounding screw on the front panel.

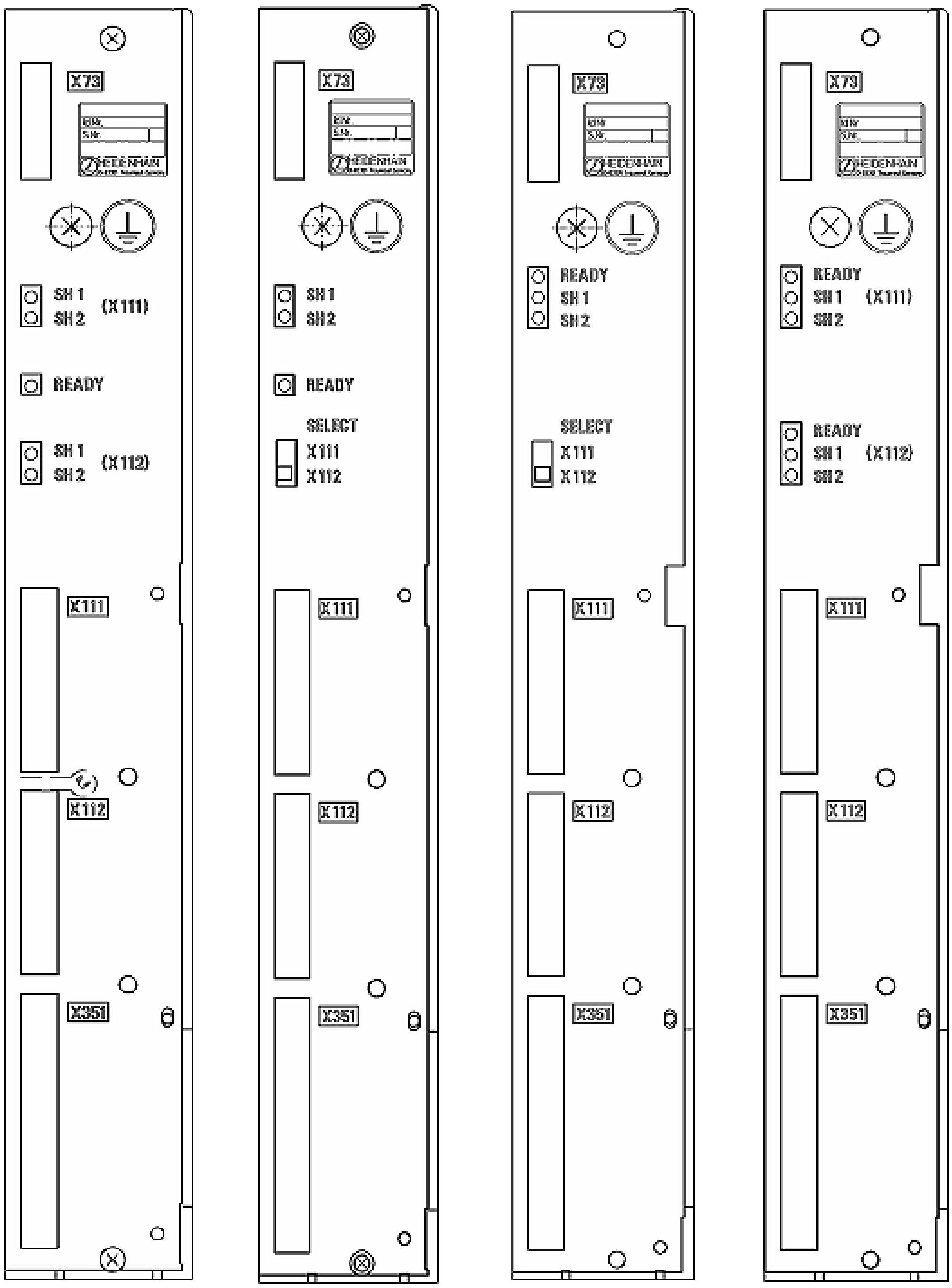


Figure: Various HEIDENHAIN interface boards with ribbon cable connectors

Compatibility of HEIDENHAIN interface boards and SIMODRIVE power modules

SIEMENS has revised the SIMODRIVE power modules.
Among other things the interference suppression circuits have been supplemented.

In 2007, the HEIDENHAIN interface boards suitable for the modified SIMODRIVE power modules were also improved:

Modified SIMODRIVE power modules	**Matching HEIDENHAIN interface boards**	**Description**
At the end of the SIEMENS ordering designation of the improved power modules you find the **code A2 or A3**	324952-03, index A	2-axis version, D-sub connector
	324952-12, index D	2-axis version, D-sub connector
	324955-17	1-axis version, ribbon-cable connector
	359002-05	2-axis version, ribbon-cable connector
	515012-03	1-axis version, ribbon-cable connector

The HEIDENHAIN interface boards listed in the above table replace the previous variants. This means that they may also be inserted in "older" SIMODRIVE power modules.

Caution

"Older" HEIDENHAIN interface boards may not be operated with modified SIMODRIVE power modules.
Possible errors and error messages --> See “Overview of Possible Error Patterns” on page 5 – 55.

29 Measuring, Testing and Inspection Equipment

29.1 Important Notes

DANGER

Observe the safety precautions in chapter 2 of this manual. --> See "Safety Precautions" on page 2 – 15!

Caution

The following inspection, measuring and testing equipment is **only** intended **for testing** machines!

Caution

Encoder cables, etc., are no longer continuously shielded when the test adapter is connected.

Caution

When using grounded measuring equipment (e.g., oscilloscope with power connection), always the socket of the machine's electrical cabinet should be used for power supply. Compensating currents caused by different earth potentials can thus be avoided!

Caution

For measuring voltages, first connect to 0 V and only then to the voltage to be measured!

Caution

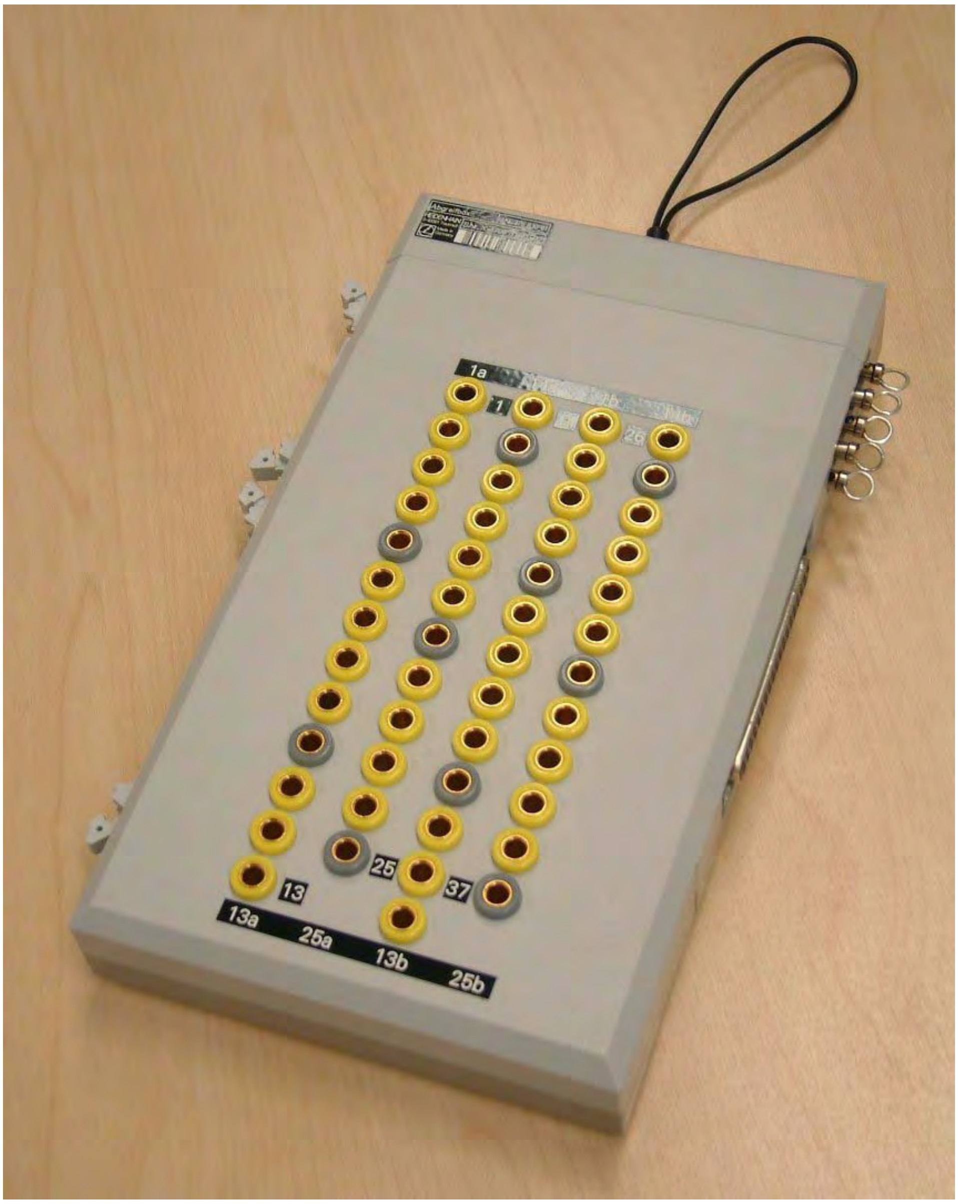
Always observe the **Operating Instructions** of PWM 9 as well as the **Operating Instructions** of PWT 10/17/18 and IK 215!

29.2 Test Adapter

Brief description

The test adapter ...

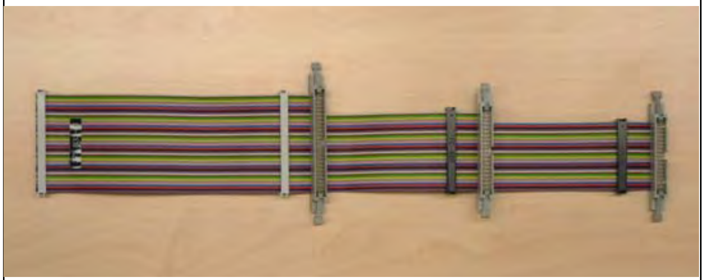
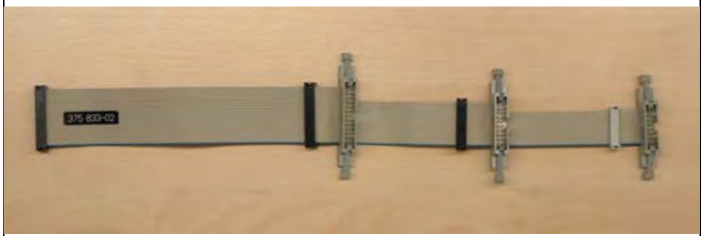
- Currently has the ID 375830-01.
- Can be connected to all D-Sub and ribbon-cable connectors of HEIDENHAIN devices.
- Requires adapter cables.
- Has numbered banana jacks to which, e.g., a multimeter can be connected.
- Permits signal and voltage measurement during the operation of HEIDENHAIN devices.
- Has 5 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 may be inspected on the test adapter!

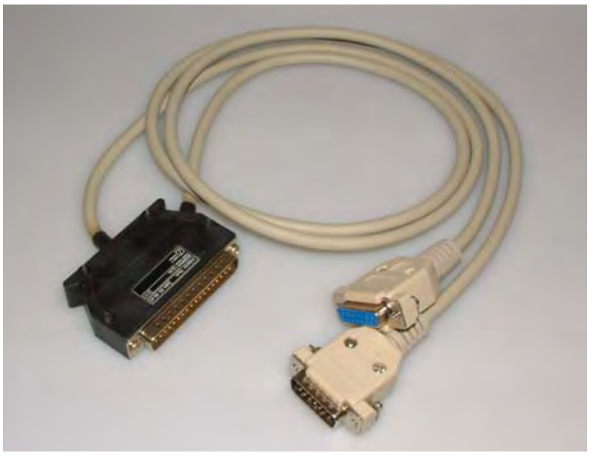
Adapter cable to the test adapter

Each ribbon cable and D-sub connector requires its own adapter cable.

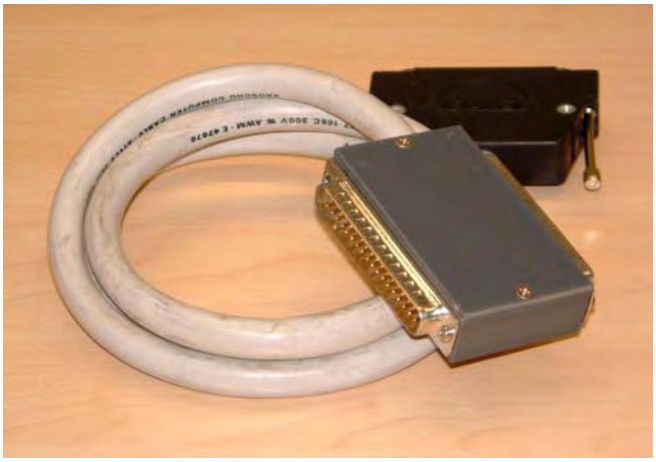
	Connecting cable, ribbon type 50-, 40-, 34-pin ID 375833-01
	Connecting cable, ribbon type 26-, 20-, 16-pin ID 375833-02

A new and an old version of the D-sub adapter cables are available.
The older version has 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

29.3 PWM 9 Encoder Diagnostic Set

Brief description

- The PWM 9 set currently has the ID 512134-01.
- The **PWM 9** phase angle measuring unit for inspecting and adjusting HEIDENHAIN **incremental** linear 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.
This could lead to damage or injury to the machine or persons!
Read the **User's Manual** of the PWM 9 in detail, before you use the device.

- The signal amplitude is also measured when the encoder has stopped.
- For inspecting and adjusting HEIDENHAIN measuring systems **in the workshop** PWM 9 can also be used without subsequent electronics (e.g., control, position display).

Available functions

The PWM 9 functions consist 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 amplified scanning signals (interface board: 11 µApp, 1 Vpp) or of the original scanning signals (TTL, HTL interface board) 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

Each **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 effectively.
Contact HEIDENHAIN Traunreut or your regional agency.

29.4 PWT 10/17/18 Testing Unit

Short description

- The PWT testing unit was originally designed as mounting aid for **scanning heads**. However, it is also possible to check signals (A track, B track, reference mark) of **motor ecncoders**!
- Three different PWT versions are available:

Encoder diagnostic set	Signal type	ID
PWT 10	11 µApp	325411-xx
PWT 17	TTL	325412-xx
PWT 18	1 Vpp	325413-xx

- For HEIDENHAIN motor encoders, the PWT 18 is used for 1 Vpp signals.
- The PWT 18 **cannot** be connected in series between 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 scanning heads of exposed encoders
- Checking distance-coded reference marks

☞ **Note**

Each **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.

29.5 IK 215 Adjusting and Testing Package

- Current ID number 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.
- Parameters (e.g. datum shift) and the electronic ID label and OEM information can be read and written via the EnDat interface.

Note

Each **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 effectively.
Contact HEIDENHAIN Traunreut or your regional agency.

30 Machine Parameter

30.1 Explanation

A contouring control must have access to **specific data** (e.g., traverse distances, acceleration, shaft speeds) before it can execute its programmed instructions.
These data are defined in **machine parameters**.

The list of machine parameters is divided into **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 (servo lag)
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	Color
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 system file **OEM.SYS**, using the code word **AXISNUMBER**, the number of axes used or entered, so that only the necessary indices of the machine 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:

MP 10 : %00000000011111 ; active axes

30.2 The Machine Parameter Editor

Important notes

For service purposes, the service technician 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 many 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 13 – 192.

Changes by the operator

The machine operator may change the machine settings.
He will mostly increase the security, e.g., he can reduce the traverse range or the maximum speed.

But only the values in the run-time memory are overwritten. The values of the original MP list on the control's hard disk do not change!

Subgroups of the MP list

It is also possible to call subgroups of the original MP list:

Call	Contents
USER PARAMETER soft key	Up to 16 parameters which have been 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!

But normally only the values in the run-time memory are overwritten. The values of the original MP list on the control's hard disk do not change!

Another MP file (that of course must exist on the control's hard disk) can also be selected by means of the PLC.

MP subfiles (subgroups of the original MP file, sometimes with different values) can also be activated by the PLC. The MP subfile content is loaded into the process memory. All MP values that are not in this file remain unchanged.

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 are overwritten in the run-time memory 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 editors

- 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 interface settings.

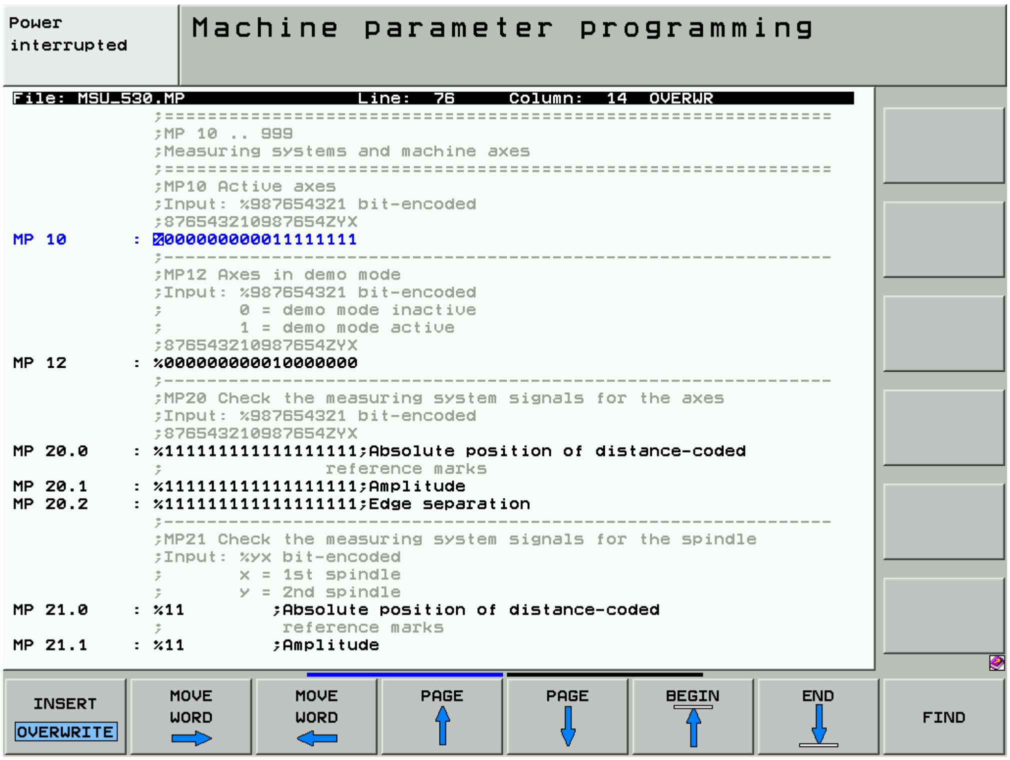
MOD

- 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 trying to edit a machine-parameter value, individual machine parameters or the complete MP list is protected against editing.
> The machine manufacturer has defined an own MP code number. --> Please contact your machine manufacturer!

END

- Press the END key to exit the MP list.

Input format

MP values can be shown in different formats:

- **Decimal:**
  There is no identifier before the value.
  Example: MP 910.0 : +1000 ; traverse range
- **Binary:**
  The identifier **%** stands before the value.
  The binary input is recommended for machine parameters for a bit-encoded activation of individual functions.
  Example: MP 10 : %00000000011111 ; active axes
- **Hexadecimal:**
  The identifier $ stands before the value.
  The hexadecimal input is suitable, e.g., to show great numerical values.
  Example: MP 7350 : $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 30 – 579.

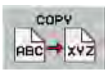
Create copy of original MP file

Extensive changes in the machine parameters for servicing (troubleshooting, testing) should not be made in the **original MP list**!
Copy the original MP file and activate it!

- Enter the active machine parameter list (see previous page).

- Call the program management.

- The cursor automatically stands on the active machine parameter file (status **M**). Otherwise set the cursor on the active file.



- Press this soft key.

- Enter the name of the working copies in the header, e.g., TEST.MP.

- Press this soft key (or the RUN soft key or ENTER) to start the copying process.

- The copy is made. It is stored in the same directory as the original MP file.

Note

You can also protect the original MP file against changes or overwriting. --> Soft keys AUX: FUNCTIONS / PROTECT.
A **P** is shown for "protected" in the status column in program management.

Of course, you can also backup important data on an external data medium before servicing!

Activate the copy of the original MP file for test purposes

- Place the cursor on the working copy, e.g., TEST.MP.
- Load this file into the editor.
- When the END key is pressed, the selected MP file is activated (the iTNC 530 performs a reset, if necessary).
  Later on the original MP file is reactivated in the same way.

Note

In the program management, the active MP file has the entry **M** in the status column.

Search machine parameters

In case the **number of the parameter is known**:

- Press the GOTO key and enter the number (without index).
- Confirm with ENTER. --> The editor places the cursor at the requested parameter.

In case the **name of the parameter is known** (but not the number):

- Press the SEARCH soft key and enter the name.

Note

The name has not to be written as a whole.

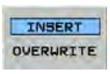
- With the corresponding soft key, select whether capitalization shall be of importance or not.
- Press the EXECUTE soft key. --> The editor places the cursor on the required text. If the associated parameter is not the one you have been looking for, just press SEARCH and EXECUTE until it is found.

If you have **marked the parameter**:

- Press the SEARCH soft key and enter the marking word.
- With the corresponding soft key, select whether capitalization shall be of importance or not.
- Press the EXECUTE soft key. --> The editor places the cursor to the marking word.

Edit and mark machine parameters

- Place the cursor on the machine parameter to be changed.



- Where it makes sense, set the editing mode to Insert or Overwrite.

Note

INSERT is preset. The original values are thus retained.
For bit-coded parameters, however, the editing mode **OVERWRITE** is a possibility.

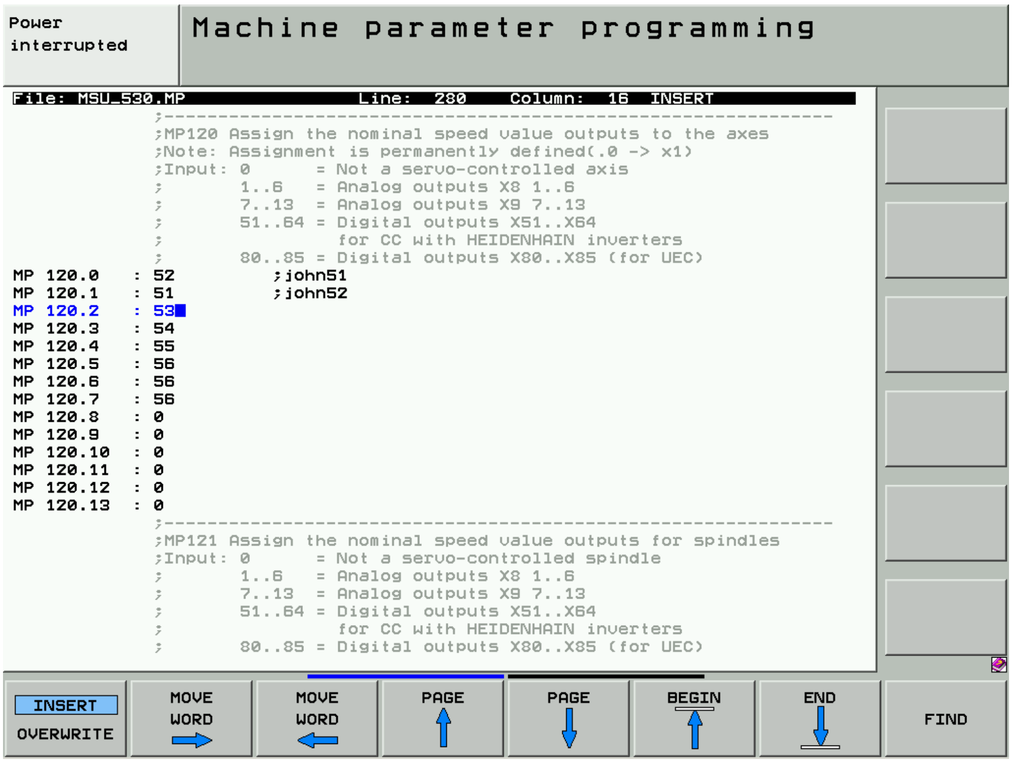
- Change the parameter.

Note

Mark the modified machine parameters so that later you can find them quickly again.

- Enter a semicolon after the modified 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 records and marks

If you want to **delete from right to left** :

▶ Press this key.

If you want to **delete from left to right**:

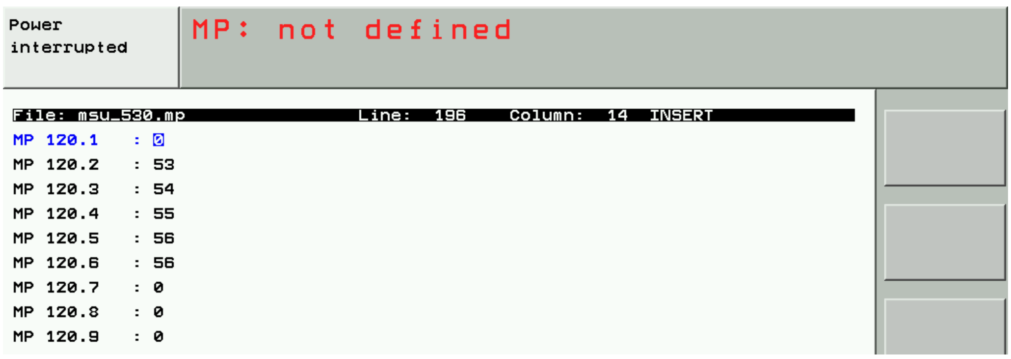
▶ Press the CE key.

Caution

Do not press the DEL key if you want to delete individual letters, words, numbers, etc. Press DEL to delete a complete line!

If you have deleted a complete 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).

Activate the modified values

After you have modified parameter values for service purposes:

- Place the cursor after the last modified parameter in the next line. --> The MP list is structured completely.
- 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	Entry value incorrect
4	MP defined twice
6	MP cannot be stored

If the control does not recognize any errors, it automatically exits the machine parameter editor and is ready for operation after a defined reaction.

Caution

Most machine parameters cannot be stored while an NC program is running.
The error message `Parallel operation not possible` appears.
The program must be stopped and exited. Then the modified data can be saved.

Reaction to change

If parameter values were changed and confirmed with END, the control can react as follows:

- Modified values are immediately confirmed without reset and new referencing (e.g., when changing color settings).
- Axes must be referenced anew (e.g., when changing axis parameters).
- A reset is started (e.g., when changing 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 was transferred or not, the control can be rebooted manually.

Operating the machine with the new values

If **the machine manufacturer agrees** that the machine should be operated with the new settings...

- Transmit the changed parameter values in the original MP list (or activate an agreed MP list), write your name (or owner's name) and modification date as a comment into the header of the list.
- **Create a new backup of the machine data.** --> See “Backup on an External Data Medium” on page 13 – 192.

Restoring original settings

When you have finished error diagnosis or various tests at the machine, you will normally restore the original settings.

- Your 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 activates the selected original MP file and performs a reset, if necessary).

Note

In the program management, the active MP file has the entry **`M`** in the status column.

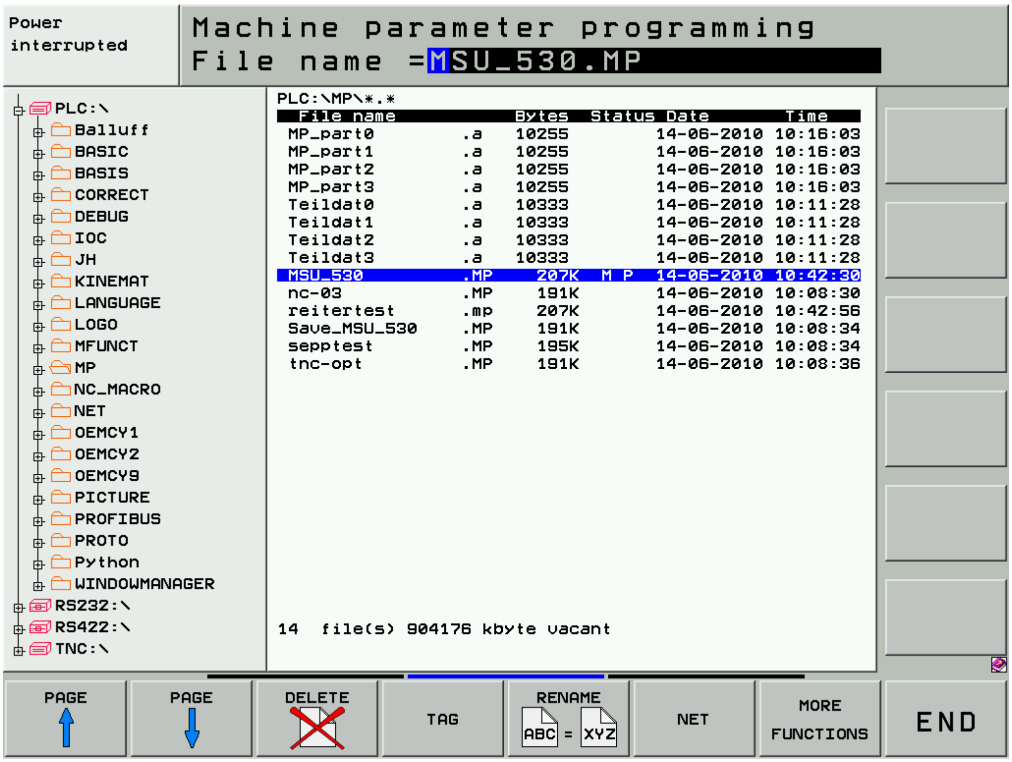


Figure: Active MP list in the program manager

30.3 Meaning of the Machine Parameters

Machine parameter lists often contain **original HEIDENHAIN comments**.
Semicolons "**;**" designate comments.
Entries after semicolons are not evaluated by the NC software.

Your can enter comments, beginnig with a semicolon, **yourself in the MP list**. You must have a write permission for this purpose (correct code number).

Text file READ_MP.A

If the machine manufacturer has removed the original HEIDENHAIN comments in full or in parts:

- 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

Hint:
Transfer the **READ_MP.A** text file to your service laptop. You can easily refer to the meaning of the parameters, while the original MP list of the manufacturer is open on the control.

Caution

LIES_MP.A or **READ_MP.A** also includes the default values for the parameters. They 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 a component of an NC software update.
This means that these text files are also updated with an NC software update.
Thus you always have the suitable comments on the MPs of your installed NC software!

Search MP numbers in READ_MP.A.

Do not use the keys GOTO and ENT like in an MP list. Otherwise the editor places the cursor on the line with the indicated number and not on the requested parameter.
You are concerned with a text file and not with an MP list!

Use the soft keys FIND and EXECUTE for navigation to the requested MP numbers.

30.4 List of Machine Parameters

(excerpt from the Technical Manual of iTNC 530 of May 2009)

30.4.1 Encoders and machines

MP	Function and input	SW version and behavior
MP10	Active axes Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 0: Axis not active 1: Axis active	PLC RUN
MP12	Axis-specific demo operation for NC axes Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 0: Demo operation not active 1: Demo operation active	PLC RUN
MP20	Monitoring functions for the axes Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 0: Monitoring not active 1: Monitoring active	PLC 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 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	PLC 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 Format: -wvucbazyxWVUCBAZYX Input: Characters 1 to 9 from the right represent axes 1 to 9	PLC RUN
MP100.0	Traverse range 1	
MP100.1	Traverse range 2	
MP100.2	Traverse range 3	
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	SW version and behavior
MP111.x	Position encoder input for the spindle(s) 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	
MP115.0	Position encoder input 1 Vpp or 11 µApp Format: %xxxxxxxxxxx Input: Bit 0 to bit 5: Position encoder inputs X1 to X6 Bit 6 to bit 9: Position encoder inputs X35 to X38 Bit 10: No function 0: 1 Vpp 1: 11 µApp	RESET
MP115.1	Reserved Format: %xxxxxxxxxxx Input: Enter %00000000000	
MP115.2	Input frequency of position encoder inputs Format: %xxxxxxxxxxx Input: Bit 0 to bit 5: Position encoder inputs X1 to X6 Bit 6 to bit 9: Position encoder inputs X35 to X38 Bit 10: No function With 1 Vpp: 0: 27 kHz 1: 400 kHz With 11 µApp: 0: 27 kHz 1: 140 kHz	

MP	Function and input	SW version and behavior
MP116.0 MP116.1 MP116.2	Only CC 424(B): Position encoder input 1 Vpp or 11 µApp Format: %xxxxxxxxxx Input: Bit 0 to bit 9: Linear encoder inputs X201 to X210 Bit 10: No function 0: 1 Vpp 1: 11 µApp CC 424(B) only: Reserved Format: %xxxxxxxxxxx Input: Enter %00000000000 Only CC 424(B): Input frequency of the position encoder inputs Format: %xxxxxxxxxxx Input: Bit 0 to bit 9: Linear encoder inputs X201 to X210 Bit 10: No function With 1 Vpp: 0: 27 kHz 1: 400 kHz With 11 µApp: 0: 27 kHz 1: 140 kHz	RESET 340 420-08, 340 422-02, 340 480-02
MP120.x	Nominal speed command outputs of the axes Input: 0: No servo-controlled axis 1 to 6: Analog outputs 1 to 6 at terminal X8 7 to 12: Analog outputs 7 to 12 at terminal X9 51 to 62: Digital output X51 to X62	RESET
MP121.0 MP121.1	Nominal speed command output of the first spindle Input: 0: No servo-controlled axis 1 to 6: Analog outputs 1 to 6 at terminal X8 7 to 12: Analog outputs 7 to 13 at terminal X9 51 to 62: Digital output X51 to X62 Nominal speed command output of the second spindle Input: 0: No servo-controlled axis 1 to 6: Analog outputs 1 to 6 at terminal X8 7 to 12: Analog outputs 7 to 13 at terminal X9 51 to 62: Digital output X51 to X62	RESET RESET
MP130.x	Y index of the machine parameters MP2xxx.y for the axes Input: 0 to 12	PLC RUN
MP131.x MP131.0 MP131.1	Y index of the machine parameters MP2xxx.y for the spindle(s) in operating mode 0 Input: 0 to 12 Index for the first spindle Index for the second spindle	PLC RUN
MP132.x MP132.0 MP132.1	Y index of the machine parameters MP2xxx.y for the spindle(s) in operating mode 1 Input: 0 to 12 Index for the first spindle Index for the second spindle	PLC RUN
MP210	Counting direction of position encoder output signals Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 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

MP	Function and input	SW version and behavior
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 340 490-05
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
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 340 490-05
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
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: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14: 0: Linear axis error compensation 1: Nonlinear axis error compensation	PLC RUN
MP732	Nonlinear axis-error compensation for rotary axes Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 0: Not active (usual compensation) 1: Active (mapped to traverse range)	340 490-03

MP	Function and input	SW version and behavior
MP750.x	Reversal error (backlash compensation) Input: -9.9999 to +9.9999 [mm] or [°]	PLC RUN 340 490-04
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 tilting axes with modulo display, M94 and encoders with EnDat interface Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 0: 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	PLC RUN
MP855.x	Synchronization monitoring Input: 0 to 100,0000 [mm] 0: Monitoring not active	PLC RUN
MP860.x	Datum for synchronous control Input: 0: Datum at position after switch-on 1: Datum at reference marks 2: Axis is torque slave axis	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

MP	Function and input	SW version and behavior
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 REF

30.4.2 Positioning

MP	Function and input	SW version and behavior
MP1010.x	Rapid traverse Input: 10 bis 300 000 [mm/min or °/ min]	PLC RUN
MP1011	Limit of rapid traverse on the path Input: 10 bis 300 000 [mm/min or °/ min]	340 420-05 PLC RUN
MP1012.x	Second axis-specific rapid traverse Input: 10 bis 300 000 [mm/min or °/ min]	340 490-03
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: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 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 a 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/s²]	PLC RUN 340 490-04
MP1061	Limitation of the path acceleration Input: 0.001 to 500 [m/s²]	340 490-04 PLC RUN
MP1070	Radial acceleration Input: 0.001 to 500 [m/s²]	PLC RUN 340 490-04
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 bis 9999.9 [m/s³ or °/s³]	340 490-04
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/s³ or °/s³]	340 490-04 PLC RUN

MP	Function and input	SW version and behavior
MP1087.x	Maximum permissible axis-specific jerk for "Manual mode" Input: 0.1 to 1000.0 [m/s³ or 1000 °/s³]	PLC RUN
MP1088.x	Axis-specific jerk limiting for unfiltered positioning movements Input: 0.1 to 9999.9 [m/s³]	340 490-05
MP1089.x	Max. permissible axis-specific jerk for "Pass Over Reference Point" mode Input: 0.1 to 1000.0 [m/s³ or 1000 °/s³]	PLC RUN
MP1090 MP1090.0 MP1090.1	Maximum permissible jerk on the tool path Input: 0: Not active 0.0 to 9999.9 [m/s³ or °/s³] For movements not at rapid traverse or feed rate < MP1092 For movements at rapid traverse or feed rate > MP1092	PLC RUN 340 490-04
MP1092	Feed rate threshold for MP1085.x and MP1086.x Input: 1 to 300 000 [mm/min] (previous behavior) 0: Not active	PLC RUN 340 490-03
MP1094	HSC filters Input: 0: HSC filter inactive 0.1 to 166.0: Cutoff frequency for HSC filter	As of 340 490-01, 340 492-01 only via MPMODE = 340422 in OEM.SYS
MP1095 MP1095.0 MP1095.1	Nominal position value filter Input: 0: Single filter 1: Double filter In the Program Run Full Sequence, Program Run Single Block, and Positioning With Manual Data Input operating modes In the Manual, Handwheel, Jog Increment and Pass Over Reference Point operating modes	PLC RUN As of 340 490-01, 340 492-01 only via MPMODE = 340422 in OEM.SYS
MP1096 MP1096.0 MP1096.1	Tolerance for contour transitions at corners Input: 0: No nominal position value filter 0.001 to 3.000 [mm] With machining feed rate With rapid traverse	PLC RUN As of 340 490-01, 340 492-01 only via MPMODE = 340422 in OEM.SYS
MP1097.x	Maximum permissible axis-specific jerk (single/HSC filter) Input: 0.1 to 1000.0 [m/s³ or 1000 °/s³]	PLC RUN As of 340 490-01, 340 492-01 only via MPMODE = 340422 in OEM.SYS

MP	Function and input	SW version and behavior
MP1098.x	Maximum permissible axis-specific jerk (double/HSC filter) Input: 0.1 to 1000.0 [m/s³ or 1000 °/s³]	PLC RUN As of 340 490-01, 340 492-01 only via MPMODE = 340422 in OEM.SYS
MP1099 MP1099.0 MP1099.1	Minimum filter order Input: 0 to 20 Minimum filter configuration for single filter (MP1095 = 0) Minimum filter configuration for double filter (MP1095 = 1)	PLC RUN As of 340 490-01, 340 492-01 only via MPMODE = 340422 in OEM.SYS
MP1110.x	Standstill monitoring Input: 0.0010 to 30.0000 [°]	PLC RUN
MP1120.x	Standstill monitoring when determining the field angle Input: 0.0000 to 300.0000 [mm] or [°]	340 422-03, 340 480-03 PLC RUN
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	340 420-05 PLC RUN
MP1150.0 MP1150.1 MP1150.2	Delay time for deleting the nominal velocity value with the erasable error message **EXCESSIVE SERVO LAG IN <AXIS>** Input: 0 to 65.535 [s] Recommended: 0 Time period for which the monitoring function is to remain off after the fast PLC input defined in MP4130.0 is set. Input: 0 to 65.535 [s] 0: Monitoring functions on Recommended: 0.2 to 0.5 Minimum time period for which the monitoring functions are to remain effective after expiration of the time from MP1150.1. Input: 0 to 65.535 [s]	PLC RUN
MP1160	As of CC 424(B): LIFTOFF at powerfail Input: 0 to 30.0000 [mm] Default: 0.0000 [mm]	340 490-04 PLC RUN

MP	Function and input	SW version and behavior
MP1200	Selection of the nominal position value filter used Input: 0: Single filter 1: Double filter 2: HSC filter 3: Advanced HSC filter	340 490-01 PLC RUN
MP1201	Nominal position value filter in manual operation Input: 0: Single filter 1: Double filter	340 490-01 PLC RUN
MP1202	Predefined tolerance for Cycle 32 Input: 0.0000 to 3.0000 [mm]	340 490-01 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)	340 490-03
MP1210	Limit frequency for single filter Input: 0: Filter is switched off 0.0 to 166.0 [Hz]	340 490-01 PLC
MP1211	Limit frequency for double filter Input: 0: Filter is switched off 0.0 to 166.0 [Hz]	340 490-01 PLC
MP1212	Limit frequency for HSC filter Input: 0: Filter is switched off 0.0 to 166.0 [Hz]	340 490-01 PLC
MP1213	Limit frequency for advanced HSC filter Input: 0: Filter is switched off 0.0 to 166.0 [Hz]	340 490-01 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	340 490-01 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	340 490-01 PLC RUN
MP1230.x	Max. permissible axis-specific jerk at corners for single filter Input: 0.1 to 1000.0 [m/s³]	340 490-01 PLC RUN
MP1231.x	Max. permissible axis-specific jerk at corners for double filter Input: 0.1 to 1000.0 [m/s³]	340 490-01 PLC RUN
MP1232.x	Max. permissible axis-specific jerk at corners for HSC filter Input: 0.1 to 1000.0 [m/s³]	340 490-01 PLC RUN
MP1233.x	Max. permissible axis-specific jerk at corners for advanced HSC filter Input: 0.1 to 1000.0 [m/s³]	340 490-01 PLC RUN

MP	Function and input	SW version and behavior
MP1240.x	Max. permissible axis-specific jerk at curvature changes for single filter Input: 0.1 to 1000.0 [m/s³]	340 490-01 PLC RUN
MP1241.x	Max. permissible axis-specific jerk at curvature changes for double filter Input: 0.1 to 1000.0 [m/s³]	340 490-01 PLC RUN
MP1242.x	Max. permissible axis-specific jerk at curvature changes for HSC filter Input: 0.1 to 1000.0 [m/s³]	340 490-01 PLC RUN
MP1243.x	Max. permissible axis-specific jerk at curvature changes for advanced HSC filter Input: 0.1 to 1000.0 [m/s³]	340 490-01 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	340 490-02 PLC RUN
MP1262	Only CC 424(B): Filter order used for HSC filter Input: 0 to 31 [filter order] 31: Default	340 490-02 PLC RUN
MP1263	Only CC 424(B): Filter order used for advanced HSC filter Input: 0 to 31 [filter order] 31: Default	340 490-02 PLC RUN
MP1290	Only with option #40: Maximum angle tolerance for DCM (Dynamic Collision Monitoring) Input: 0.0000 to 30.0000 [°] 3: Default	340 490-02 PLC RUN
MP1292	Only with option #40: Manual oversize for DCM (Dynamic Collision Monitoring) Input: 0 to 1.000 [mm] 0: Default	340 490-02 PLC RUN
MP1320	Direction for traversing the reference marks Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 0: Positive 1: Negative	PLC RUN
MP1330.x	Velocity for traversing the reference marks Input: 80 to 300 000 [mm/min]	PLC RUN
MP1331.x	Velocity for leaving the reference mark end position for axes 1 to 9 (only for rotary encoders MP1350 = 2) Input: 10 to 300 000 [mm/min]	PLC RUN
MP1340.x	Sequence for traversing the reference marks Input: 0: No evaluation of reference marks 1 to 14: Axes 1 to 14	PLC RUN REF

MP	Function and input	SW version and behavior
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	PLC RUN REF
MP1352	Activate the software limit switches before traversing the reference marks Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 0: Software limit switch not active 1: Software limit switch active	340 490-04
MP1355	Double reference run Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 0: Reference run as defined in MP1350.x 1: Double reference run	340 420-05 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 [°]	340 420-05 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	340 422-05, 340 480-05 PLC RUN
MP1360.x	Fast PLC input for reference pulse Input: 0: No fast PLC input for reference pulse 1 to 5: Fast PLC input 1 to 5 (MP4130.x)	PLC RUN REF
MP1391	Velocity and acceleration feedforward control in the MANUAL and HANDWHEEL operating modes Format: %xxxxxxxxxxxxxx	340 490-01 PLC RUN
MP1391.0	Velocity feedforward control Input: Bits 0 to 13 represent axes 1 to 14 0: Inactive 1: Active	
MP1391.1	Acceleration feedforward Input: Bits 0 to 13 represent axes 1 to 14 0: Inactive 1: Active	
MP1392	Velocity feedforward in the POSITIONING WITH MANUAL DATA INPUT, PROGRAM RUN SINGLE BLOCK and PROGRAM RUN FULL SEQUENCE operating modes Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 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

30.4.3 Operation with Velocity Feedforward Control

MP	Function and input	SW version and behavior
MP1410.x	Position monitoring for operation with velocity feedforward control (erasable) Input: 0.0010 to 30.0000 [°] Recommended: 0.5 mm	PLC RUN
MP1420.x	Position monitoring for operation with velocity feedforward control (EMERGENCY STOP) Input: 0.0010 to 30.0000 [°] Recommended: 2 mm	PLC RUN
MP1510.x	kv factor for velocity feedforward 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 static 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	kV factor for velocity feedforward control effective after M105 Input: 0.100 to 1000.000 [m/(min*mm)]	PLC RUN 340 490-04
MP1516.x	kVFactor for velocity semifeedforward 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	340 422-10, 340 480-10 PLC RUN

30.4.4 Operation with following error (servo lag)

MP	Function and input	SW version and behavior
MP1710.x	Position monitoring for operation with following error (erasable) Input: 0.0000 to 3.0000 [mm] Recommended: 1.2 · following error	PLC RUN
MP1720.x	Position monitoring for operation with following error (EMERGENCY STOP) Input: 0.0000 to 3.0000 [mm] Recommended: 1.4 · following error	PLC RUN
MP1810.x	kv factor for operation with following error Input: 0.100 to 20.000 [(m/min)/mm]	PLC RUN
MP1815.x	kV 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 kV factor (as of 340 49x-03 also for CC424(B)) Input: 0.001 to 1.00000	PLC RUN
MP1830.x	Characteristic curve kink point (as of 340 49x-03 also for CC424(B)) Input: 0.000 to 100.000 [%]	PLC RUN

30.4.5 Integrated speed and current control

MP	Function and input	SW version and behavior
MP2040	Axis groups (for drive enabling through X150/X151) Format:%xxxxxxxxxxxxxx Input: 0: Axis not assigned (disabling only through I32) 1: Axis assigned	PLC RUN
MP2040.0-2	Axis group 1 to 3	
MP2040.3-7	Reserved, enter %00000000000000	
MP2050	Functionality of drive enabling I32 (X42/33) MP2050 can also be overwritten by the PLC and the LSV2 protocol. Input: 0: Emergency stop for all axes, Module 9169 not effective 1: Emergency stop for all axes that are not excepted with Module 9169 2: I32 and Module 9169 have no function	340 490-03
MP2100.x	Type of axis power modules (change possible without automatic restart) Input: Name from file <Motor.amp>	PLC RUN 340 490-03
MP2150	Signal for powerfail MP2150 can also be overwritten by the PLC and the LSV2 protocol. Input: 0: AC fail 1: Powerfail and AC fail 2: Reserved 3: Powerfail	340 490-03
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	
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 SH1Bsignal (inverter enable) at internal emergency stop (e.g. standstill monitoring, PLC via error table...) Input: 0 to 6 [s] as an integer 0: 3 [s] Default	340 490-02
MP2173.x	Pulse switch-on of the power stage Input: 0.2 to 100.000 [s] 0: 3 [s] Default	340 490-05
MP2180.x	PWM frequency Input: 0: fPWM = 5000 Hz 3200 to 3999: fPWM = 3333 Hz 4000 to 4999: fPWM = 4166 Hz (CC 424(B): 4000 Hz) 5000 to 5999: fPWM = 5000 Hz 6000 to 7999: fPWM = 6666 Hz 8000 to 9999: fPWM = 8333 Hz (CC 424(B): 8000 Hz) 10000: fPWM = 10000 Hz	CC 422: RESET CC 424(B): PLC, RUN

MP	Function and input	SW version and behavior
MP2182.x	Only CC 424(B): Cycle time of current controller at double the fundamental PWM frequency Input: 0: Cycle time = 1 / (2 · fPWM) 1: Cycle time = 1 / fPWM (not for CC61xx) 2: Cycle time = 1 / (2 · fPWM)	340 490-03 PLC RUN
MP2184.x	Only CC424(B) (not CC61xx): Reserved Input: 0	340 490-03
MP2186.x	As of CC424(B): Specifies the shaft speed at which the PWM frequency is switched to twice the PWM frequency Input: 0 to 100 000 [U/min]	340 490-03
MP2188.x	As of CC424(B): Specifies the shaft speed at which the factor 2 PWM frequency is switched to a factor 1 Input: 0 to 100 000 [U/min]	340 490-03
MP2190.x	As of CC424(B): dc-link voltage UZ 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	340 490-05
MP2192	As of CC424(B): Threshold sensitivity for LIFTOFF Input: 0 to 100 [%]	340 490-03
MP2194	As of CC 424(B): DC-link voltage as of which the spindle is braked in a powerfail Input: 0 to 3000 [V]	340 490-03
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	340 490-04
MP2198.x	As of CC 424(B): Type of the power supply module Input: Name from file SUPPLY.SPY Default setting: Empty string	340 490-04

MP	Function and input	SW version and behavior
MP2199.x	As of CC 424(B): 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	340 490-04
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	340 420-05 PLC RUN
MP2204.x	Overwrite "Counting direction" from the motor table Input: *: Input from the motor table active +: Positive counting direction –: Negative counting direction	340 420-05 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)	340 420-05 RESET 340 490-03
MP2208.x	Inductance of the series reactor Input: * = Input from the motor table active Value of the series reactor in [µH]	340 490-03
MP2209.x	Mass moment of inertia of a drive motor Input: * = Input from the motor table active Value of the mass moment of inertia in [kgm2]	340 490-03
MP2210.x	Only CC 424(B): 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	340 490-01

MP	Function and input	SW 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: Vibrations are allowed CC 422: Bit 4 to bit 8 reserved Bit 4 – Only CC 424(B): Monitoring for excessive temperature 0: Active 1: Inactive Bit 5 – Only CC 424(B): Monitoring for insufficient temperature 0: Active 1: Inactive Bit 6 – Reserved Bit 7– Only CC 424(B): Monitoring of encoder input frequency 0: Active 1: Inactive Bit 8 – Only CC 424(B): Adjust mechanical offset by gradually increasing the kV 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	340 490-04
MP2222.x	Reserved	340 490-04
MP2223.x	Reserved	340 490-04
MP2230.x	Factor 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	340 420-08
MP2232.x	Maximum permissible path during test of motor brakes Input: 0 to 10.0000 [mm] or [°]	340 420-08
MP2234.x	Internal triggering of the motor brakes via the PWM interface Format: %xx Input: Bit 0 – 0: Signal is transmitted 1: Signal is not transmitted Bit 1– reserved	340 422-06, 340 480-06 PLC RUN
MP2250.x	As of CC 424(B): 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)	340 490-04 PLC RUN

MP	Function and input	SW version and behavior
MP2252.x	CC 424(B) only: Reserved Input: Enter 0	340 422-03, 340 480-03 PLC RUN
MP2254.x	Determining the field angle Input: 0: Field angle is determined during operation; soft key has no function (without plausibility test) 1: Only CC 422: Field angle is determined via soft key; motor motion is permitted 2: Only CC 424(B): Field angle is determined via soft key; motor motion is permitted (with plausibility test) 3: Only CC 424(B): Same as 2, but the drive must no longer be switched on via the PLC. The drive is moved immediately!	340 420-09 PLC RUN 340 490-01
MP2256.x	Determined field angle Input: 0: Field angle does not need to be determined, or has not been determined	340 422-03, 340 480-03 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	340 422-03, 340 480-03 PLC RUN
MP2260.x	Only CC 424(B): "TRC – Torque Ripple Compensation" File name for the torque-ripple-compensation file Input: xx_<MotorNamefromMotorTable>.TRC (generated in TNCopt) No entry: No compensation	340 490-02 PLC RUN
MP2261.x	As of CC424(B): Deactivate compensation Bit 0: Torque ripple compensation Bit 1: Gear error compensation Input: %0000000000000000 1: Compensation not active	340 490-05
MP2302.x	Reference value for I^2t monitoring of the motor Input: 0 to 1 000.000 [· rated current of motor] 0: I2t monitoring of motor switched off 1: Rated current of motor as reference value	PLC
MP2304.x	Reference value for I^2t monitoring of the power module Input: 0 to 1000.000 [· rated current of power module] 0: I2t monitoring of power module switched off 1: Rated current of power module as reference value	340 420-06 PLC
MP2308.x	Time between output of the braking signal $\overline{BRK}$ and switching off of the controller (overlap time) Input: 0.001 to 0.500 [s] 0: 0.200 s	340 420-06
MP2309.x	Controller parameters adjusted to closed brake Input: 0: Not active 0.001 to 1.999 [s]	340 490-04
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 3 000.000 [kW] 0: Braking power is not limited	

MP	Function and input	SW version and behavior
MP2392.x	Power limit Input: 0: No power limit 0.1 to 3 000.000 [kW]	
MP2394.x	Maximum brake power for power failure Input: 0.1 to 3 000.000 [kW] 0: Braking power is not limited	
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 340 490-03
MP2430.x	Integral factor of the current controller Input: 0.00 to 9 999 999 [Vs/A] * = automatic calculation of the I factor	PLC 340 490-03
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	PT2 element of the speed controller (2nd order time delay) Input: 0 to 1.0000 [s]	PLC RUN
MP2540.x	Only CC 422: Band-rejection filter damping Input: 0.0 to 18.0 [dB]	PLC RUN
MP2542.x	Only CC 424(B): Damping/phase increase for filter 1 Input: 0 to 99.0 [dB]	PLC RUN
MP2543.x	Only CC 424(B): Damping/phase increase for filter 2 Input: 0 to 99.0 [dB]	PLC RUN
MP2544.x	Only CC 424(B): Damping/phase increase for filter 3 Input: 0 to 99.0 [dB]	PLC RUN
MP2545.x	Only CC 424(B): Damping/phase increase for filter 4 Input: 0 to 99.0 [dB]	PLC RUN
MP2546.x	Only CC 424(B): Damping/phase increase for filter 5 Input: 0 to 99.0 [dB]	PLC RUN
MP2550.x	Only CC 422: Band-rejection filter center frequency Input: 0.0 to 999.9 [Hz]	PLC RUN
MP2552.x	Only CC 424(B): Center/corner frequency for filter 1 Input: 0 to 30000.0 [Hz]	PLC RUN
MP2553.x	Only CC 424(B): Center/corner frequency for filter 2 Input: 0 to 30000.0 [Hz]	PLC RUN
MP2554.x	Only CC 424(B): Center/corner frequency for filter 3 Input: 0 to 30000.0 [Hz]	PLC RUN

MP	Function and input	SW version and behavior
MP2555.x	Only CC 424(B): Center/corner frequency for filter 4 Input: 0 to 30000.0 [Hz]	PLC RUN
MP2556.x	Only CC 424(B): Center/corner 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	Only CC 424(B): Filter order of the low-pass filter Input: 0 to 20	340 420-09 PLC RUN
MP2562.x	Only CC 424(B): 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	Only CC 424(B): 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	Only CC 424(B): 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	Only CC 424(B): 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	Only CC 424(B): 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	Only CC 424(B): Bandwidth for filter 1 Input: 0 to 30000.0 [Hz]	PLC RUN

MP	Function and input	SW version and behavior
MP2573.x	Only CC 424(B): Bandwidth for filter 2 Input: 0 to 30000.0 [Hz]	PLC RUN
MP2574.x	Only CC 424(B): Bandwidth for filter 3 Input: 0 to 30000.0 [Hz]	PLC RUN
MP2575.x	Only CC 424(B): Bandwidth for filter 4 Input: 0 to 30000.0 [Hz]	PLC RUN
MP2576.x	Only CC 424(B): Bandwidth for filter 5 Input: 0 to 30000.0 [Hz]	PLC RUN
MP2590.x	Braking ramp in an emergency stop Input: 0.1 to 999.9 [rpm/ms] 0: Function inactive	PLC RUN
MP2600.x	Acceleration feedforward Input: 0 to 100.0000 [mm]	PLC
MP2602.x	IPC time constant T1 Input: 0.0001 to 1.0000 [s] 0: IPC inactive	PLC RUN
MP2604.x	IPC time constant T2 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
MP2607.x	Damping factor for active damping Input: 0 to 30.000 0: No damping 1.5: Typical damping factor	340 422-03, 340 480-03 PLC RUN
MP2608.x	Damping time constant for active damping Input: 0.000 to 0.9999 [s] 0: No damping 0.005 to 0.02: Typical damping time constant	340 422-03, 340 480-03 PLC RUN
MP2610.x	Friction compensation at low speeds (effective only with velocity feedforward control) Input: 0 to 30.0000 [A] 0: No friction compensation (or axis is analog)	PLC RUN
MP2610.x	Only CC 424(B): Low-speed friction compensation Input: 0 to 30.0000 [A] (effective value) 0: No friction compensation	PLC RUN
MP2612.x	Delay of the friction compensation (effective only 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 Only CC 424(B): Distance before the reversal point from which a reduction of the current from MP2610.x is to go into effect.	PLC RUN

MP	Function and input	SW version and behavior
MP2614.x	Only CC 424(B): 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 424 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 340 490-03
MP2640.x	As of CC424(B): Torsion compensation between position encoder and speed encoder 0.001 to 30.000 [µm/A] 0: Not active	340 490-03
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
MP2920.x	Factor for variable torque distribution of the master-slave torque control (entry for the slave axis) Input: 0.000 to 100.000 1: Master and slave axes have identical motors	PLC
MP2930.x	Speed compensation ratio for master-slave torque control (entry for the slave axis) Input: –100.00 to +100.00 [%]	PLC

30.4.6 Spindle

MP	Function and input	SW 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 allowed	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 340 490-03

MP	Function and input	SW 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.	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 rpm]	PLC RUN
MP3240.1	Analog spindle: Minimum nominal value voltage Input: 0 to 9.999 [V] Digital spindle: Minimum motor speed Input: 0 to 100,000 [1000 rpm]	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 100,000 [1000 rpm]	
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 [%]	340 490-03
MP3351	Entry of an absolute value for the permissible overshoot of the spindle speed Input: 0.001 to 100000.000 [U/min] 0 = Monitoring off	340 490-03
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 rpm)/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	
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

MP	Function and input	SW version and behavior
MP3440.0-7	k 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 340 490-05
MP3451.0-7	Number of spindle revolutions for gear ranges 1 to 8 Input: 0 to 65 535 0: No transmission	PLC RUN 340 490-05
MP3510.0-7	Rated speed for the gear ranges 1 to 8 Input: 0 to 99 999.999 [rpm]	PLC RUN
MP3515.0-7	Maximum spindle speed for gear ranges 1 to 8 Input: 0 to 99 999.999 [rpm]	PLC RUN
MP3520.0 MP3520.1	Speed activation through marker M4011 Input: 0 to 99 999.999 [rpm] Spindle speed for oriented stop Input: 0 to 99 999.999 [rpm]	PLC RUN
MP3530	Increased spindle power for roughing Input: 0 = Not active 1 = Increased spindle power for roughing	340 490-03
MP3540	As of CC424(B): Permissible lower spindle speed limit Input: 0.001 to 0.999 0: Monitoring not active	340 490-05
MP3542	As of CC 424(B): Minimum spindle speed as of which the monitoring in MP3540 becomes active Input: 0.001 to 0.999 0: Monitoring not active	340 490-05
MP3550	As of CC424(B): Delay of EMERGENCY STOP reaction of spindles Input: 0.001 to 0.100 [s] 0: Delay not active	340 490-05

30.4.7 Integrated PLC

MP	Function and input	SW version and behavior
MP4000.0-31	Options for the conditional compilation of the PLC program	
MP4020	PLC Functions Format: %xxxxxxxxxxxxxxx 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 – Transferring the values of the Pt 100 inputs 0: Accept values at a change rate of 1 K/s 1: Accept results immediately 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 – Monitoring the housing fan 0: Monitoring active 1: Inactive Bit 14 – Reserved	RESET340 490-05
MP4030	Assignment of physical to logical PL Input: 0: First logical PL 1: Second logical PL 2: Third logical PL 3: Fourth logical PL	PLC RUN
MP4030.0	First physical PL	
MP4030.1	Second physical PL	
MP4030.2	Third physical PL	
MP4030.3	Fourth physical PL	
MP4031	Monitoring of number of PLs Input: -1: Monitoring not active 0 to 4: Number of PLs being monitored	340 490-04
MP4040	Set PLC output after shutdown	340 420-03 PLC RUN
MP4041	Time after shutdown until setting of the PLC output from MP4042 Input: 0 to 1000 [s]	340 420-03 PLC RUN

MP	Function and input	SW version and behavior
MP4042	PLC output to be set after shutdown Input: 0 to 31	340 420-03 PLC RUN
MP4043	Delay during shutdown for the PLC to execute final actions Input: 1 to 60 [s] 0: No delay	340 490-04 PLC RUN
MP4044	Switch off outputs that cannot be switched off by emergency stop after 250-ms delay Input: %xxxxxxxx Bits 0 to 7 correspond to O16 to O23 0: Do not switch off output with delay 1: Switch off output with delay	340 422-07, 340 480-07 Only until 340 422-09, 340 480-09 PLC RUN
MP4045	Switch off outputs that cannot be switched off by emergency stop after 250-ms delay Input: % xxxxxxx Bits 0 to 6 correspond to O24 to O30 0: Do not switch off output with delay 1: Switch off output with delay	340 420-08 Only until 340 422-09, 340 480-09 PLC RUN
MP4050.0-8	Traverse distance for lubrication of axes 1 to 9 Input: 0 to 99 999.999 [m or 1000°]	PLC RUN
MP4060.0-3	Outputs that are to be switched off with the delay from MP4061.x when all outputs are switched off Input: 0 to 30 [no. of the output] –1: Do not switch off any outputs with delay	340 422-09, 340 480-09 PLC
MP4061.0-3	Delay time for switching off the outputs in MP4060.x Input: 0 to 5.000 [s]	340 422-09, 340 480-09 PLC
MP4070	Compensation amount per PLC cycle for lagged-tracking axis error compensation Input: 0.0001 to 2.0000 [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	Number of the high-speed PLC input for switching off the monitoring functions Reserved Numerical designation for fast PLC inputs Input: 0 to 255 [no. of the PLC input]	

MP	Function and input	SW version and behavior
MP4131.0 MP4131.1 MP4131.2-5	Activation criterion for fast PLC input for switching off the monitoring functions Reserved Activation criterion for fast PLC inputs Input: 0: Activation at low level 1: Activation at high level	
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	340 490-03

30.4.8 Configuration of the Data Interface

MP	Function and input	SW version and behavior
MP5000	Disable data interfaces 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	PLC RUN
MP5020	Configuration of the data interface 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	PLC RUN CN123 340 490-05
MP5020.0	Operating mode EXT1	
MP5020.1	Operating mode EXT2	
MP5020.2	Operating mode EXT3 (PLC)	
MP5020.3	Operating mode EXT4 (PLC)	
MP5030	Data transmission protocol Input: 0 = Standard data transfer protocol 1 = Blockwise transfer 2 = Without protocol (only for MP5030.2)	PLC 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	SW 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)	

30.4.9 3-D touch probe

MP	Function and input	SW 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: TS 444 touch probe, battery free	PLC CN123 340 490-04
MP6120	Probing feed rate (triggering touch probe) Input: 1 to 10 000 [mm/min]	PLC RUN CN123 340 490-05
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	340 490-02 PLC RUN CN123
MP6160	M function for probing from opposite directions Input: –1: Spindle orientation directly by NC 0: Function inactive 1 to 999: Number of the M function for spindle orientation through 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

MP	Function and input	SW version and behavior
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
MP6180 MP6180.0 MP6180.1 MP6180.2	Coordinates of the ring gauge center for automatic calibration (Probing Cycle 2) with respect to the machine datum (traverse range 1) Input: 0.0000 to 99 999.9999 [mm] X coordinate Y coordinate Z coordinate	PLC CN123
MP6181 MP6181.0 MP6181.1 MP6181.2	Coordinates of the ring gauge center for automatic calibration (Probing Cycle 2) with respect to the machine datum (traverse range 2) Input: 0.0000 to +99 999.9999 [mm] X coordinate Y coordinate Z coordinate	PLC CN123
MP6182 MP6182.0 MP6182.1 MP6182.2	Coordinate of the ring gauge center for Probing Cycle 2 with respect to the machine datum (traverse range 3) Input: 0.0000 to +99 999.9999 [mm] X coordinate Y coordinate Z coordinate	PLC CN123
MP6185	Distance of probing point below ring top surface during calibration Input: +0.001 to +99 999.9999 [mm]	PLC CN123

30.4.10 Tool Measurement with TT

MP	Function and input	SW version and behavior
MP6500	Tool measurement with TT 130 Format: %xxxxxxxxxxxxxxx Input: Bit 0 – Cycles for tool measurement 0: Locked 1: Not locked 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 rotating 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 the tool check, the tool table is changed. 1: After the tool check, 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	SW 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 of 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	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 340 490-05
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 300 000 [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
MP6570	Max. permissible surface cutting speed at the tooth edge Input: 1.0000 to 129.0000 [m/min]	PLC RUN CN123

MP	Function and input	SW version and behavior
MP6572	Maximum permissible speed during tool measurement Input: 0 to 100,000 [1000 rpm] 0: 1000 [rpm]	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: 0.000 to 1.000 [mm]	340 490-04
MP6601	KinematicsOpt: Radius deviation of the calibration sphere Input: 0.010 to 0.100 [mm]	340 490-04

30.4.11 Tapping

MP	Function and input	SW 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

30.4.12 Display and operation

MP	Function and input	SW 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 340 49x-02
MP7212	Power interrupted message Input: 0: Acknowledge the Power interrupted message with CE key 1: Power Interrupted message does not appear	PLC RUN CN123
MP7220	Block number increment for 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	Protecting file types	
MP7224.2	Disable the EDIT ON/OFF soft key	340 422-07, 340 480-07
MP7225	Disable Windows drives in the TNC file manager Format: ABCDEFGHIJKLMNOPQRSTUVWXYZ Input: If there are more than one drive, they are entered without spaces, e.g. MP7225 = CDE	340 480-06 PLC RUN
MP7226.0 MP7226.1	Reserved Size of the datum table Input: 0 to 255 [lines]	PLC RUN CN123
MP7229 MP7229.0 MP7229.1	Properties of the NC program Line number for program testing Input: 100 to 9999 Program length up to which FK blocks are permitted Input: 100 to 9999	PLC RUN CN123

MP	Function and input	SW 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 340 490-04
MP7230.0	NC conversational language, soft keys for OEM cycles	
MP7230.1	PLC conversational language (user parameters)	
MP7230.2	PLC error messages	
MP7230.3	Help files	
MP7235	Time difference to Universal Time (Greenwich Mean Time) Input: –23 to +23 [hours] MP REMOVED as of 340 490-03	No longer used as of 340 480-03, 340 49x-03 CN123 RESET
MP7237	Displaying and resetting the operating times	PLC RUN
MP7237.0	Display PLC operating times Input: Bits 0 to 12 represent PLC operating times 1 to 13 0: Do not display 1: Display	
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

MP	Function and input	SW version and behavior
MP7245	Disabling 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 340 490-04
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 340 490-03
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 340 490-05
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 340490-03
MP7263	Pocket table MP7263 can also be overwritten by the PLC and the LSV2 protocol. Format: %xx 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 key 1: Do not display soft key	CN123 340490-05

MP	Function and input	SW 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	SZ123 **340490-03**
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)	340 420-02
MP7266.32	Maximum shaft speed [rpm] (NMAX)	340 422-03, 340 480-03
MP7266.33	Retract tool (LIFTOFF)	340 422-06, 340 480-06
MP7266.34	PLC value (P1)	340 490-01
MP7266.35	PLC value (P2)	340 490-01
MP7266.36	PLC value (P3)	340 490-01
MP7266.37	Additional kinematics description (KINEMATIC)	340 490-01
MP7266.38	Point angle for DRILL and CSINK (T-ANGLE)	340 490-01
MP7266.39	Thread pitch for TAP (PITCH)	340 490-01
MP7266.40	Control strategy name for AFC (Adaptive Feed Control)	340 490-03
MP7266.41	Tool value or tool radius R2 (R2TOL)	340 490-05

MP	Function and input	SW version and behavior
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	SZ123 340 490-03
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)	340 420-02
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)	340 490-05
MP7267.19	S2 value (P7)	340 490-05
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 period	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
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

MP	Function and input	SW version and behavior
MP7290.0-8	Position display step for axes 1 to 9 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: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 0: Not disabled 1: Disabled	340 422-01, 340 480-02 PLC RUN CN123
MP7295	Disable “Datum setting” Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 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 when 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 when 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	SW 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 – Reserved Bit 7 – Reserved	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

30.4.13 Color

MP	Function and input	SW 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 340 422-06, 340 480-06
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 340490-05
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 340490-05
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

MP	Function and input	SW version and behavior
MP7360	Graphics: 3-D view and plan view	PLC
MP7360.0	Background	RUN
MP7360.1	Surface	
MP7360.2	3-D: Front face	
MP7360.3	Text display in the graphics window	
MP7360.4	3-D: Lateral face	
MP7360.5	Lowest point of blank form	
MP7360.6	Highest point of blank form (below surface)	
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	340 490-04
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	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	340 420-02
MP7365.2	Cursor and text	
MP7365.3	Selected channel	
MP7365.4-9	Channel 1 to 6	

MP	Function and input	SW version and behavior
MP7366 MP7366.0 MP7366.1 MP7366.2 MP7366.3 MP7366.4 MP7366.5 MP7366.6-14	Pop-up window (HELP key, pop-up menus etc.) Background Text or foreground Active line Title bar Scroll-bar field Scroll bar Reserved	PLC RUN
MP7367 MP7367.0 MP7367.1-7 MP7367.8-14	Large PLC window Background Colors 1 to 7 (Color 8: MP7350) Colors 9 to 15	PLC RUN
MP7368 MP7368.0 MP7368.1 MP7368.2 MP7368.3	Calculator Background Background of displays and keys Key texts (“os” in “cos”) Key symbols	PLC RUN
MP7369 MP7369.0 MP7369.1 MP7369.2 MP7369.3 MP7369.4 MP7369.5 MP7369.6	Directory tree in PGM MGT Text background Text Text background of the active folder Line color of the tree structure Folders Drives Text background of the heading in the browser window	PLC RUN
MP7370 MP7370.0 MP7370.1-15	Small PLC window Background Colors 1 to 15	340 420-05 PLC RUN
MP7392 MP7392.0 MP7392.1	Settings for screensaver Time after which the screensaver is activated Input: 1 to 99 [min] 0: No screen saver Type of screensaver Input: 0: No screensaver 1: Default screensaver of the X server 2: 3-D line graphics	PLC RUN CN123 340 490-03

30.4.14 Machining and Program Run

MP	Function and input	SW 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]	340 490-02 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	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: Tool only moves in the tool 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	340 490-03

MP	Function and input	SW 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 kv 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 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.	340 490-05
MP7450	Offsetting the tool change position from MP951.x in block scan Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 0: Do not offset 1: Offset	PLC RUN
MP7451.0-8	Feed rate for returning to the contour for axes 1 to 9 Input: 10 to 300 000 [mm/min]	PLC RUN
MP7460.x	Reserved	340 422-10, 340 480-10 PLC RUN CN123

MP	Function and input	SW version and behavior
MP7461.x	Reserved	340 422-10, 340 480-10 PLC RUN CN123
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 MP7480.0	Output of the tool or pocket number 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.	PLC RUN
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	

MP	Function and input	SW version and behavior
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 2: 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	340 490-05 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	
MP7482	Pocket coding of the tool magazine Format: %xxxx 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	340 420-06 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	340 490-03
MP7484	Search sequence in tool magazines Input: 0 to 7 [index from MP7261] -1: Abort	340 490-05
MP7485	Add usage time for tool selection Input: 0 to 100 [%] Sstandard setting: 10	340 490-05
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

MP	Function and input	SW version and behavior
MP7492.x MP7492.0 MP7492.13	Number of axis in which the same datum is to be set during Datum Setting (with active preset table) Input: 0 to 9 –1: Do not set a datum Datum set in the first axis to Datum set in the 14th axis	340 422-03, 340 480-03 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	340 490-02 PLC RUN
MP7494	Axes for which an exact stop is to occur after positioning Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 0: No exact stop 1: Exact stop	340 422-06, 340 480-06 PLC RUN
MP7500 (is set via the kinematics table)	Tilt working plane (inactive preset table) Format: %xxxxxxxxx Input: Bit 0 – "Tilted working plane" 0: Off 1: On Bit 1 – 0: Angles correspond to the position of the tilting axes of the head/table 1: Angles correspond to the spatial angle (the iTNC calculates the position of the tilted axes of the head/table) Bit 2 – 0: The tilting axes are not positioned with Cycle 19 1: The tilting axes are positioned with Cycle 19 Bit 3 – 0: The current tilting-axis position is taken into account with respect to the machine datum 1: The 0° position is assumed for the first rotary axis Bit 4 – 0: Compensate mechanical offset during exchange of the spindle head when calling M128, M114, TCPM or "tilted working plane" 1: Compensate mechanical offset during PLC datum shift Bit 5 – 0: The current tilting-axis position is taken into account with respect to the machine datum 1: The tilting-axis position that was entered with the 3-D ROT soft key applies. Bit 6 – 0: Spatial angle C is realized through a rotation of the coordinate system. 1: Spatial angle C is realized through a rotation of the table	PLC RUN
	Bit 7 – 0: The current tilting-axis position is taken into account with respect to the machine datum 1: The active tilting-axis position is a) derived from the tilting angles in the 3D ROT window if manual tilting is active b) derived from the reference coordinates of the rotary axes if tilting is inactive Bit 8 – 0: The tilting axis positioning is considered depending on bit 3, bit 5 and bit 7 1: If manual tilting is active, the datum to be set for the principal axes X, Y and Z is recalculated back to the home position of the tilting element	

MP	Function and input	SW version and behavior
MP7500 (is set via the kinematics table)	Tilt working plane (active preset table) Format: %xxxxxxxxx Input: Bit 0 – “Tilted working plane” 0: Off 1: On Bit 1 – 0: Angles correspond to the position of the tilting axes of the head/table 1: Angles correspond to the spatial angle (the iTNC calculates the position of the tilted axes of the head/table) Bit 2 – 0: The tilting axes are not positioned with Cycle 19 1: The tilting axes are positioned with Cycle 19 Bit 3 – No function Bit 4 – No function Bit 5 – Test of the tilting axis during "datum setting" in X, Y and Z 0: Current tilting-axis position must fit to the defined tilting angles 1: No test Bit 6 – 0: Spatial angle C is realized through a rotation of the coordinate system. 1: Spatial angle C is realized through a rotation of the table Bit 7 – No function Bit 8 – No function Bit 9 – Reserved	340 422-01, 340 480-02 PLC RUN
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	340 490-03
MP7507	Selecting the kinematics for the operating mode Input: %xx 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 Machining operating modes 1: Kinematics of the real machine can be selected in Machining operating modes	340 490-05

MP	Function and input	SW version and behavior
MP7510 (only possible via the old kinematics table)	Transformed axis Format: %xxxxxx Input: 0: End of the transformation sequence Bit 0 corresponds to axis X Bit 1 corresponds to axis Y Bit 2 corresponds to axis Z Bit 3 corresponds to axis A Bit 4 corresponds to axis B Bit 5 corresponds to axis C	PLC RUN
MP7510.0-14	Transformation 1 to transformation 15	
MP7520 (only possible via the old kinematics table)	Additional code for transformation Format: %xx Input: Bit 0 – Tilting axis 0: Swivel head 1: Tilting table Bit 1 – Type of dimension in MP7530.x 0: Incremental dimension for swivel head 1: Absolute with respect to the machine datum for tilting table	PLC RUN
MP7520.0-14	Transformation 1 to transformation 15	
MP7530 (only possible via the old kinematics table)	Type of dimension for transformation Entry: Entry of a formula is possible 0: Free tilting axis	PLC RUN
MP7530.0-14	Transformation 1 to transformation 15	
MP7550 (only possible via the old kinematics table)	Home position of the tilting element Input: -99 999.9999 to +99 999.9999	PLC RUN
MP7550.0	A axis	
MP7550.1	B axis	
MP7550.2	C axis	

30.4.15 Hardware

MP	Function and input	SW version and behavior
MP7600.0	Only CC 422: Position controller cycle time = MP7600.0 · 0.6 ms Input: 1 to 20 Proposed input value: 3 (= 1.8 ms) Proposed input value for basic version: 6 (= 3.6 ms)	RESET
MP7600.1	Only CC 422: PLC cycle time = MP7600.1 ·Position controller cycle time = MP7600.0 · MP7600.1 · 0.6 ms Input: 1 to 20 Proposed input value: 6 (= 10.8 ms) Proposed input value for basic version: 3 (= 10.8 ms)	
MP7602	Only CC 424(B): PLC cycle time Input: 0 to 60 [ms] 0 to 10: 10.8 ms	340 422-03, 340 480-03
MP7610.x	Only CC 424(B): Definition of the control loops as single or double speed Input: %xxxx	340 490-01, 340 492-01
MP7610.0	Control loop of the 1st controller PCB	
MP7610.1	Control loop of the 2nd controller PCB	
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 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	PLC RUN 340 490-05
MP7621	Reserved	
MP7630	Recovery time after EMERGENCY STOP test can be configured Input: 1 to 999 [ms] 0: Previous behavior (through 340 49x-03)	340 490-03

MP	Function and input	SW version and behavior
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: HR 420	PLC RUN
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: With detent positions 0: Without detent positions 1: With detent positions Bit 2 – HR 420: Axis direction keys and rapid traverse 0: Controlled by the NC 1: Controlled by the PLC Bit 3 – HR 420: NC Start / NC Stop 0: Controlled by the NC 1: Controlled 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 0: Report the keys of the HR 420 to the PLC only when the HR is active 1: Report the keys of the HR 420 to the PLC even if the HR is not active Bit 6 – Selecting and traversing auxiliary axes with HR 420 0: Traversing auxiliary axes not possible 1: Traversing auxiliary axes is possible Bit 7 – Teach-In button on HR 550 0: Controlled by the NC 1: By the PLC Bit 8 – CTRL button on HR 550 0: Controlled by the NC 1: By the PLC Bit 9 – PLC soft keys with active HR 420 0: PLC soft keys are not active when HR is active 1: PLC soft keys are active when HR is active	PLC RUN 340 490-05

MP	Function and input	SW version and behavior
MP7645	Initializing parameter for handwheel	PLC
MP7645.0	Assignment of the keys on handwheel HR 410	RUN
	Input: 0: Evaluation of the keys by NC, including LEDs 1: Evaluation of the keys by PLC	
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: Axis X 2: Axis Y 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	
MP7645.3-7	No function	
MP7650	Handwheel counting direction (for HRA 110: for each axis)	PLC
	Input: Bit 0 0: Negative counting direction 1: Positive counting direction Axis-specifically only for HRA 110: Bits 0 to 13 represent axes 1 to 14 0: Negative counting direction 1: Positive counting direction	RUN
MP7660	Sensitivity for electronic handwheel	PLC
	Input: 0 to 65 535 [increments]	RUN
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 high speed (only HR 410)	

MP	Function and input	SW version and behavior
MP7671	Handwheel feed rate in the Handwheel operating mode with HR 410 Input: 0 to 1000 [% of MP1020]	PLC RUN
MP7671.0	Low speed	
MP7671.1	Medium speed (only HR 410)	
MP7671.2	High speed (only HR 410)	
MP7672	HR 410, distance per handwheel step Input: 0.0000 to 1.0000 [mm]	340 490-03
MP7672.0	Low speed	
MP7672.1	Medium speed	
MP7672.2	Fast speed	
MP7674.x	Handwheel, axis-specific subdivision factor Input: 1 to 10 0: No limitation	PLC RUN 340 490-03
MP7675.x	Handwheel, axis-specific maximum path Input: 0.0001 to 1.0000 [mm] 0: No limitation	PLC RUN 340 490-03
MP7680	Machine parameter with multiple function 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.	PLC RUN

MP	Function and input	SW 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 RESTORE POSITION 1: Do not automatically activate RESTORE 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)	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 340 490-05

MP	Function and input	SW version and behavior
MP7682	Machine parameter with multiple function Format: %xxxxxxxx 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 unit now). 1: At the end of Cycles 202 and 204, the status of M8 is not restored automatically.	PLC RUN 340 490-05
MP7682	Bit 9 – Loading of "Tilted working plane" status 0: The "tilted working plane" status is not applied to the Manual operating mode after a program interruption (behavior until now). 1: The "Tilted working plane" status is loaded into the Manual operating mode after a program interruption. Bit 10 – Peripheral milling active/inactive 0: Peripheral milling allowed 1: Peripheral milling inactive Bit 11 – Reserved	

MP	Function and input	SW 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: During the start, a complete NC program is run. 1: At the start all NC programs are executed up to next pallet. 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: The active pallet can be edited in the PROGRAM RUN, FULL SEQUENCE and PROGRAM RUN, SINGLE BLOCK modes. 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 5 – EDIT PALLET soft key 0: EDIT PALLET soft key is not displayed 1: EDIT PALLET soft key is displayed	PLC RUN 340 490-05

MP	Function and input	SW 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 permitted) 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: Previous behavior (through 340 490-02)	PLC RUN 340 490-03
MP7690	Evaluation of the electronic ID labels Input: %xx Bit 0 – HEIDENHAIN power modules 0: Active 1: Inactive Bit 1 – HEIDENHAIN synchronous motors 0: Active 1: Inactive Bit 2 – HEIDENHAIN power supply unit 0: Active 1: Inactive	340 422-06, 340 480-06 340 490-05
MP7691.x	Size of internal diagnostics files (FILO memory) for error searching. Can only be evaluated by HEIDENHAIN. Set MP7691.x = 0.	

MP	Function and input	SW version and behavior
MP7691.0	OS trace Log file with reports from the operating system (keystroke capture/selected programs, operating mode, external connections, etc.) **`TNC:\trace.dmp (file saved before switch-off)`** **`TNC:\trace.act (current recording)`** Input: 1 to 10 [megabytes] 0: Inactive (default)	340 420-05
MP7691.1	TCP trace Log files with reports of the network traffic (TCP/IP). 10 files are created with the size from MP7691.1 in [megabytes]. **`TNC:\tcpdump\capture1 - capture10`** Input: Each file with 1 to 10 [megabytes] 0: Inactive (default)	340 490-02
MP7691.2	NC trace Size of the log file with reports from the NC software. 10 files are created that are 10 · [MP7691.2] megabytes large **`TNC:\ncpdump\capture1 - capture10`** Input: Each file with 1 to 10 [10KB] 0: Inactive (default)	
MP7691.3	Kernel trace Size of the log file with reports from the NC kernel. 10 files are created that are 10 · [MP7691.3] megabytes large **`TNC:\klog\0.log - 9.log`** Input: Each file with 1 to 10 [10KB] 0: Inactive (default)	

30.4.16 Second spindle

MP	Function and input	SW 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 Control

1.1 Introduction

This chapter gives you block diagrams and brief explanations of the principle of function of the iTNC 520 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

The control loop for analog axes/ spindles

The iTNC 530 can also control analog axes / spindles.

The position controller is located in the control, speed and current controller in the analog servo amplifier.

The analog servo amplifiers are supplied with voltage values of - 10 V and + 10 V (speed command interface).

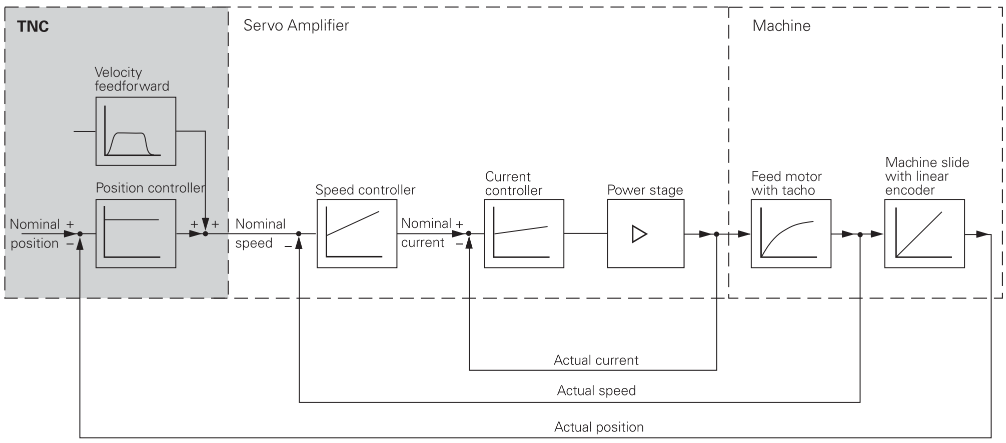


Figure: Simplified illustration for the analog control loop

The control loop for digital axes/ spindles

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 located in the iTNC 530.
The power module is driven by the CC 42x (B) through PWM signals.
PWM is the abbreviation for pulse-width modulation. The information content in this signal depends on the relation of pulse duration to pulse-off duration.

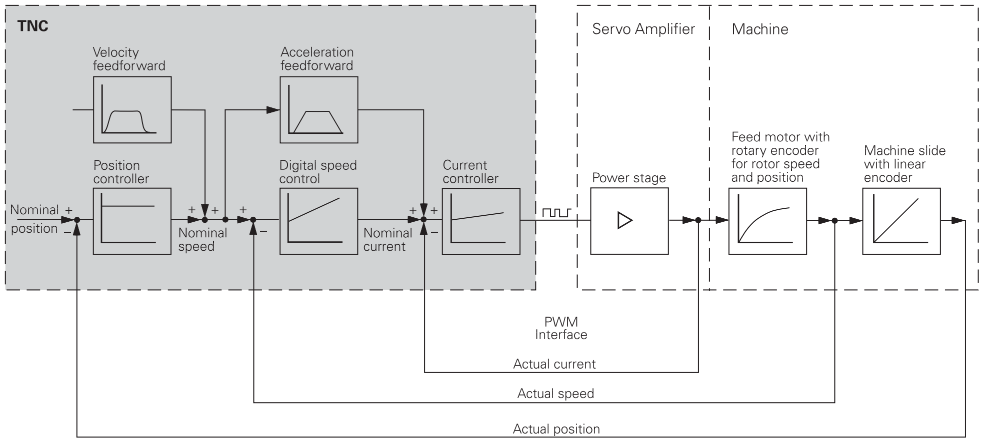


Figure: Simplified illustration of a cascade control for the digital control loop

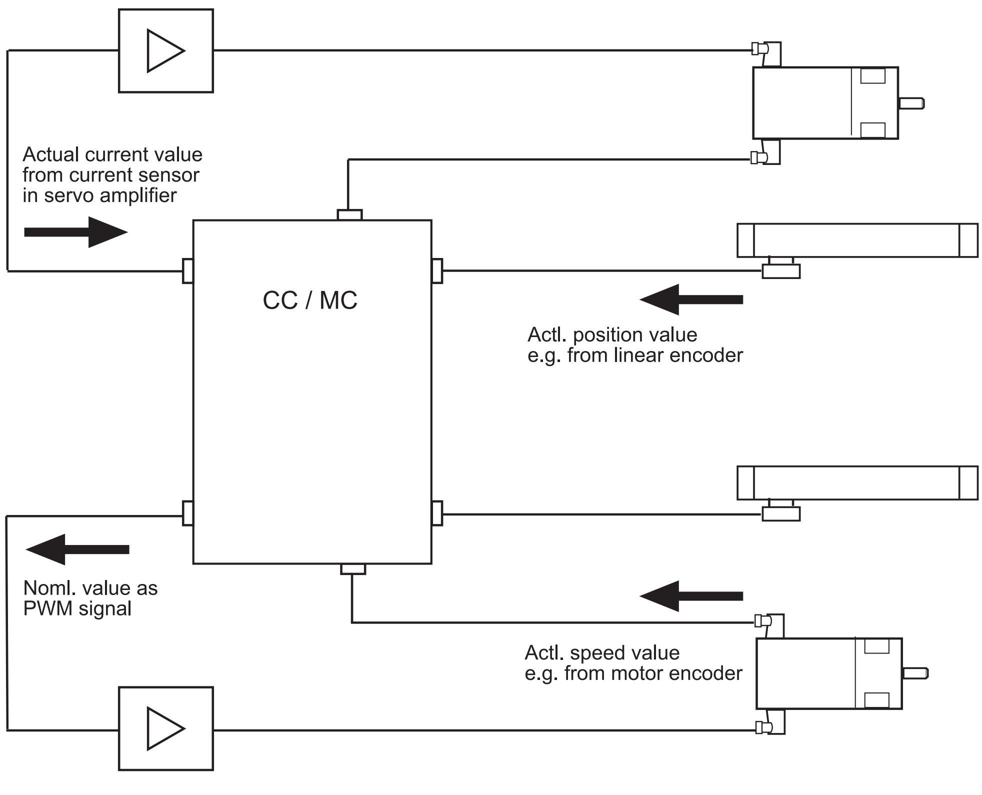


Figure: Nominal values, actual values and connected devices

Nominal and actual values for the controllers

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 designated as "nominal speed value interface". With analog axes, the control leads the nominal speed value interface (± 10V) "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 CC used or the CC’s settings.

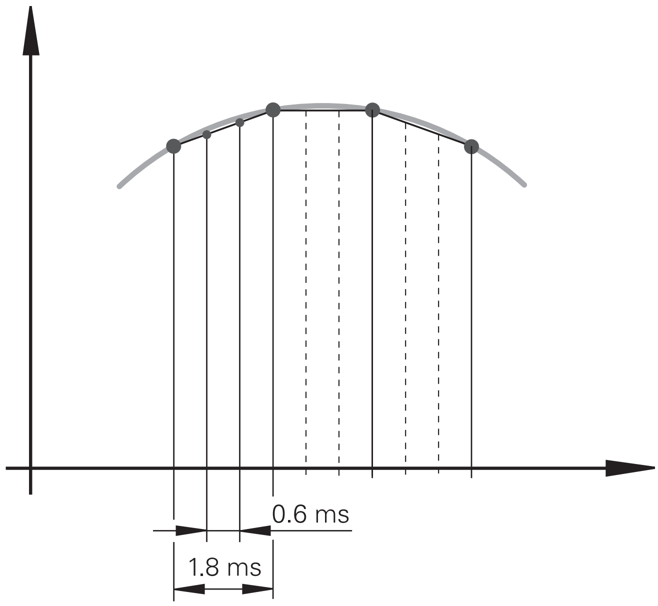


Figure: Cycle times

Look ahead

In order to adapt the feed rate to the workpiece machining process, the iTNC 530 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).

The interpolator

The interpolator operates at a prescribed clock rate, the position controller cycle time.

The interpolator calculates a velocity from the programmed feed rate. With the CC 424 (B) this calculation occurs every 3 ms, and with the CC 422 the frequency of the calculation depends on the time in MP 7600.x. 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.

The position controller

With the iTNC 530 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	Feed forward control	For the operating modes
MP 1391.0	0	1	Manual and handwheel
MP 1392	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.

Operation with following error

Following error (also known as servo lag) is a gap that remains between the nominal position commanded by the NC and the actual-position.

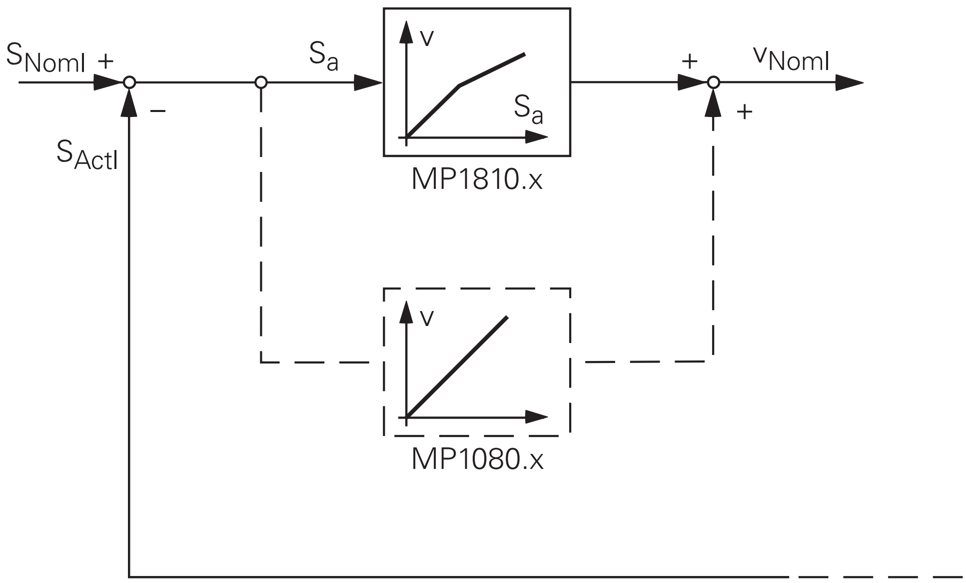


Figure: Simplified illustration of feedback control with following error

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 during control with following error

The control loop gain, known as 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 parameter 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 of property or 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 control

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.

Using MP 1392 (for the operating modes **Positioning with manual data input, Programs run, single block** and **Program run full sequence**) and MP 1391 (for the operating modes **Manual operation** and **El. handwheel**) you can find out whether the traverse is performed in the following error mode or feedforward mode (with velocity feedforward control the bits are set to 1).

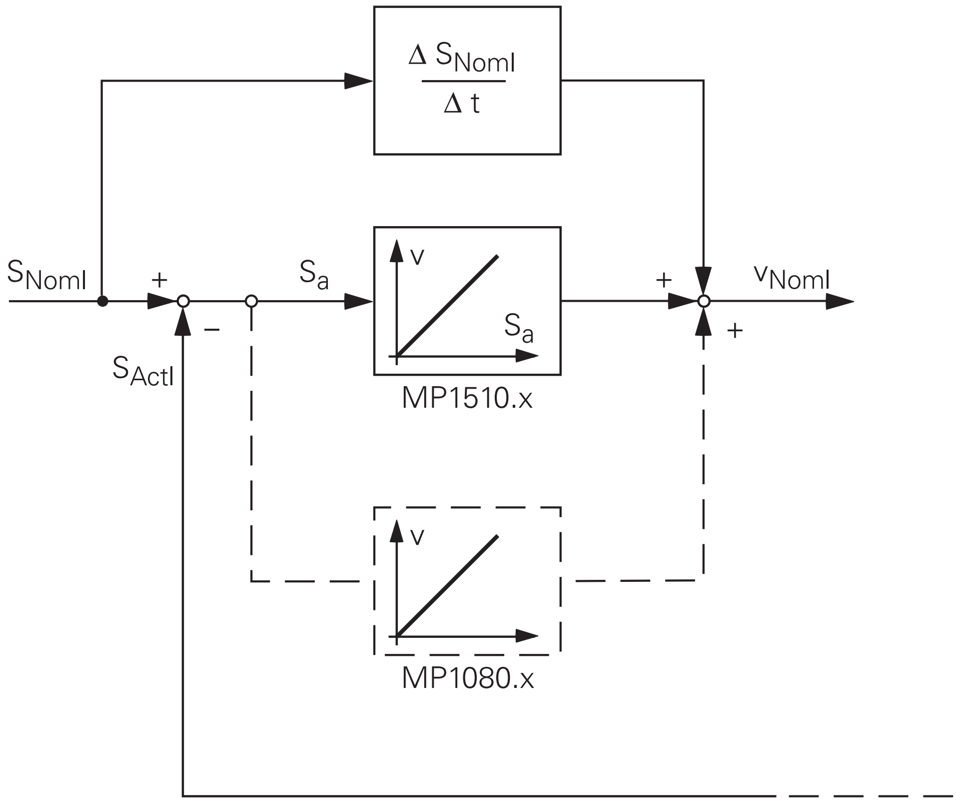


Figure: Simplified illustration of velocity feedforward control

Unlike operation with following error, the machine manufacturer **sets the optimum k_v factor** 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

The speed controller

6, 10 or 12 digital speed controllers for the axes and spindles are integrated in the iTNC 530:

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.

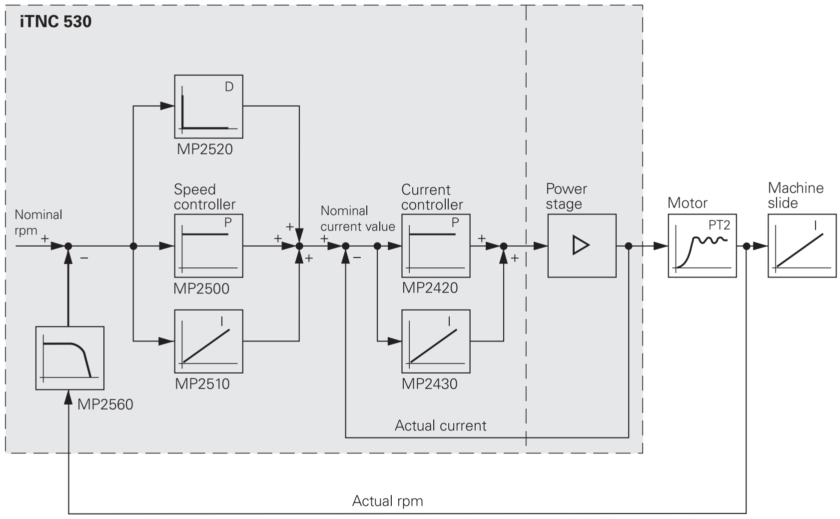


Figure: Simplified illustration of the speed controller

The current controller

6, 10 or 12 digital current controllers for the axes and spindles are integrated in the iTNC 530:

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 the generation of PWM signals --> See “PWM Signals” on page 1 – 654.

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_{dist} and torque current I_{qnom}.

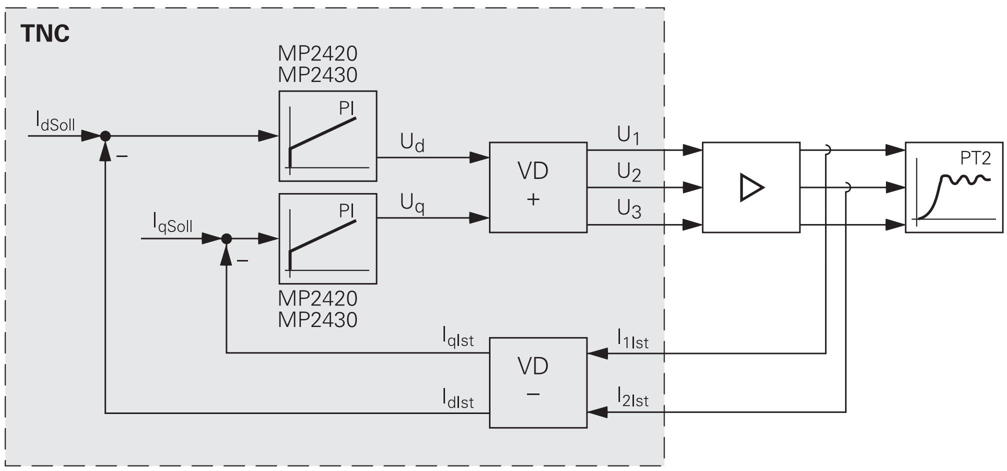


Figure: Simplified illustration of the current controller

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.

☞ **Note**

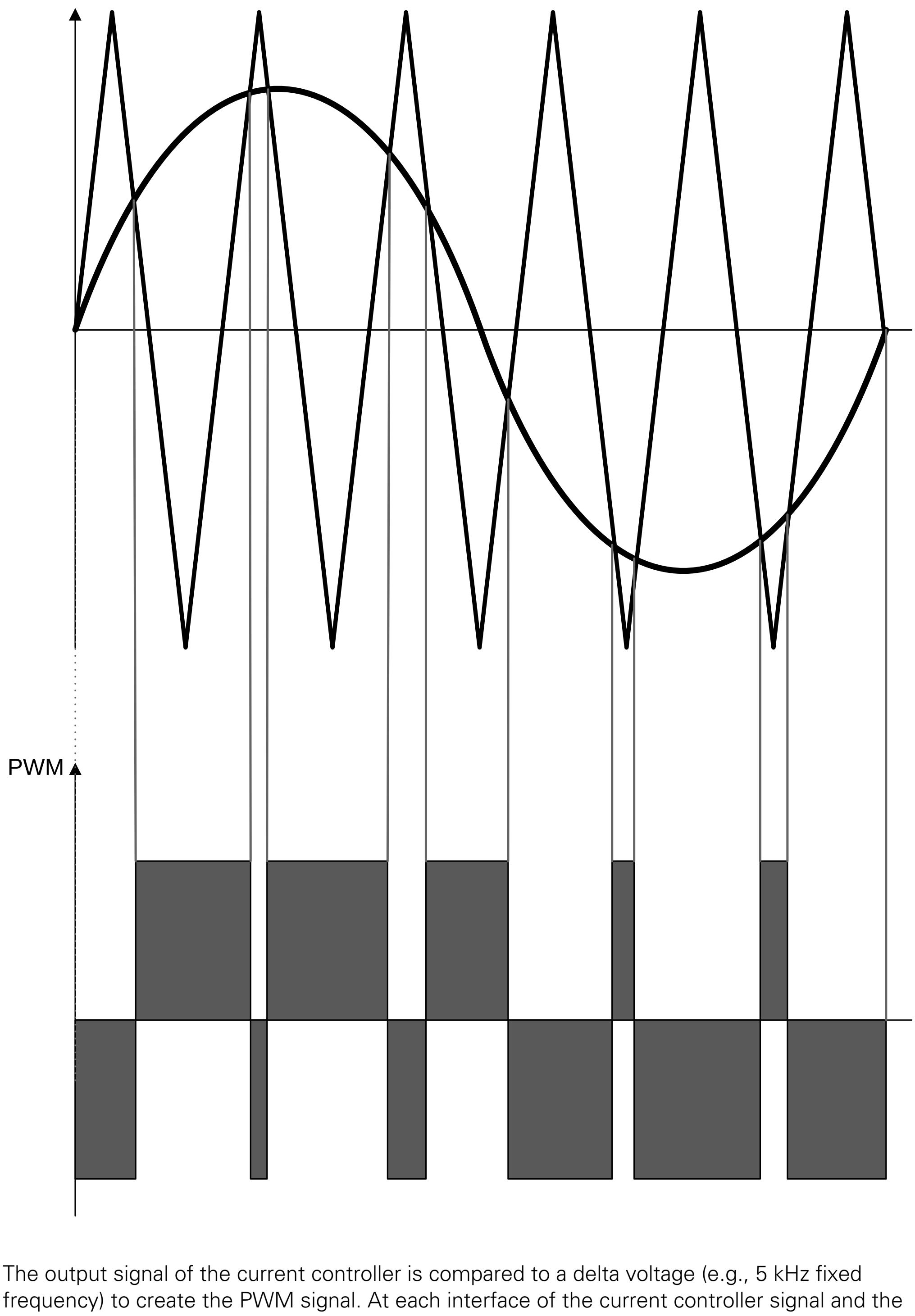
When using a CC 424 (B), the machine manufacturer can set double speed control loops.

1.3 PWM Signals

Digital axes and spindles are driven with PWM signals.

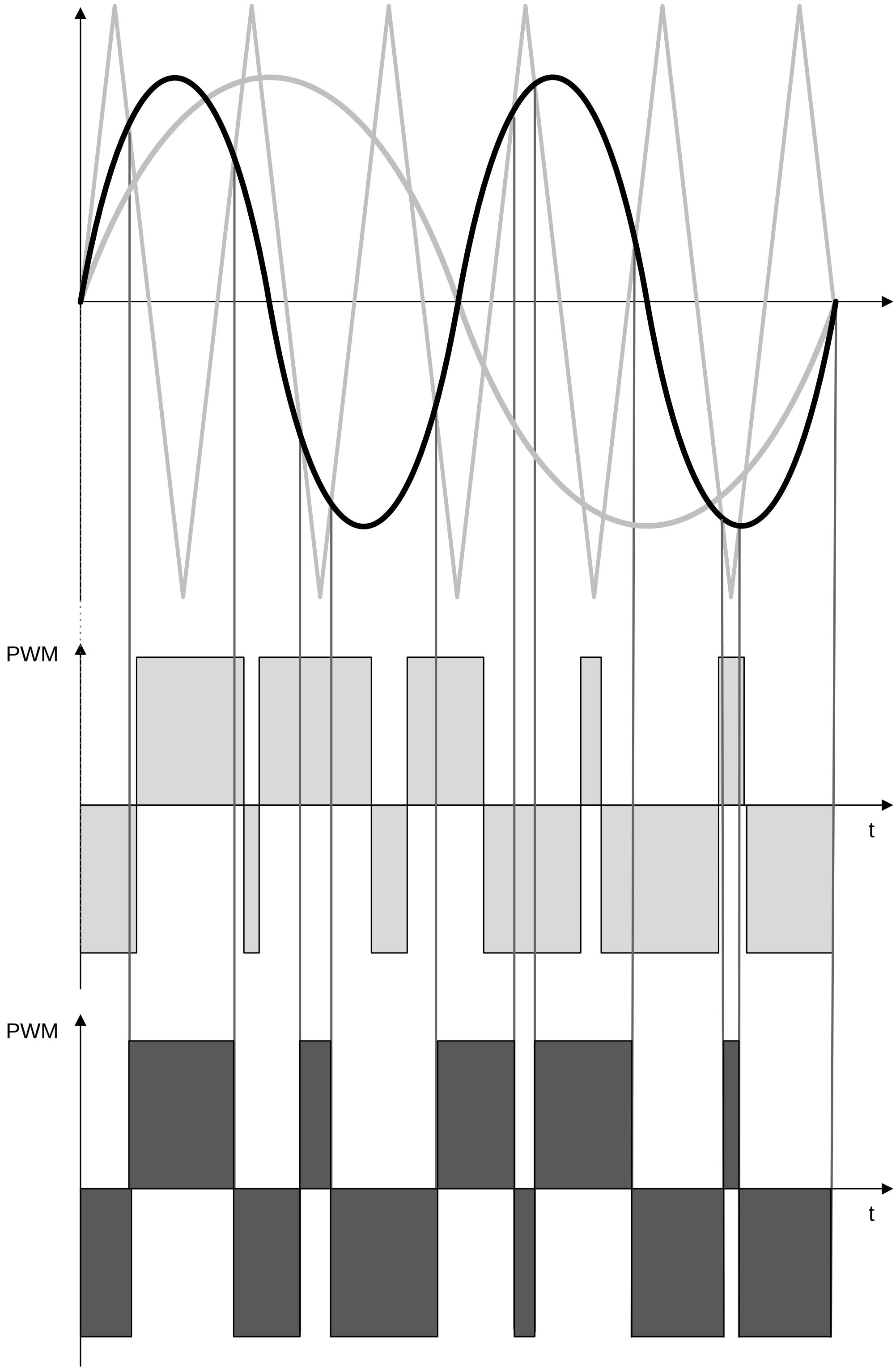
PWM is the abbreviation **"Pulse Width Modulation"**. The information (speed, torque) for the output stages is converted into a pulse and pause ratio.

The PWM signal is generated in the HEIDENHAIN control and is transferred to the inverter via PWM interfaces.

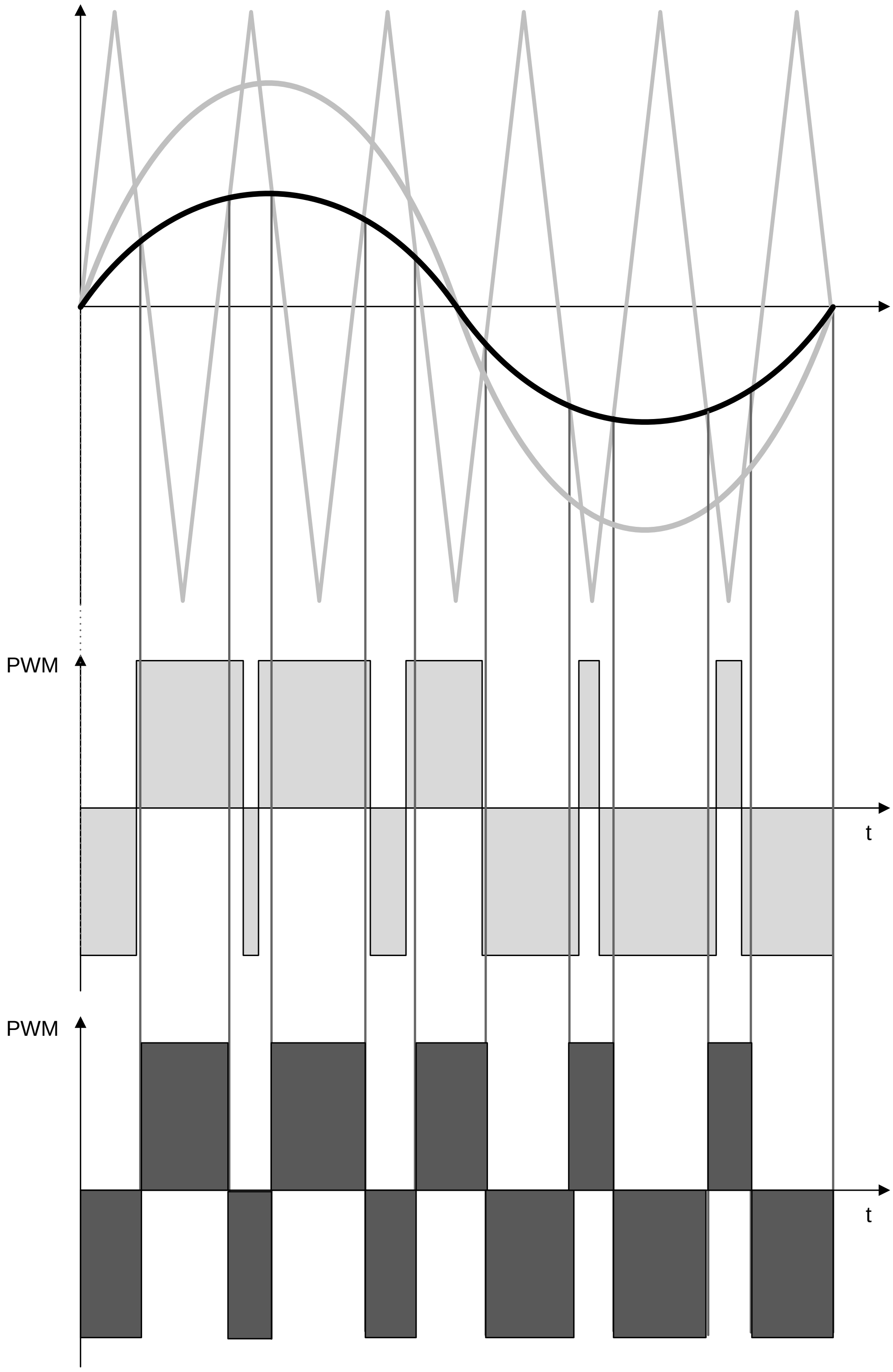


The output signal of the current controller is compared to a delta voltage (e.g., 5 kHz fixed frequency) to create the PWM signal. At each interface of the current controller signal and the delta voltage there is a switchover from pulse to pause.

"Scanning" a signal with higher frequency (higher motor speed) effects a more frequent change of pulses and pauses.



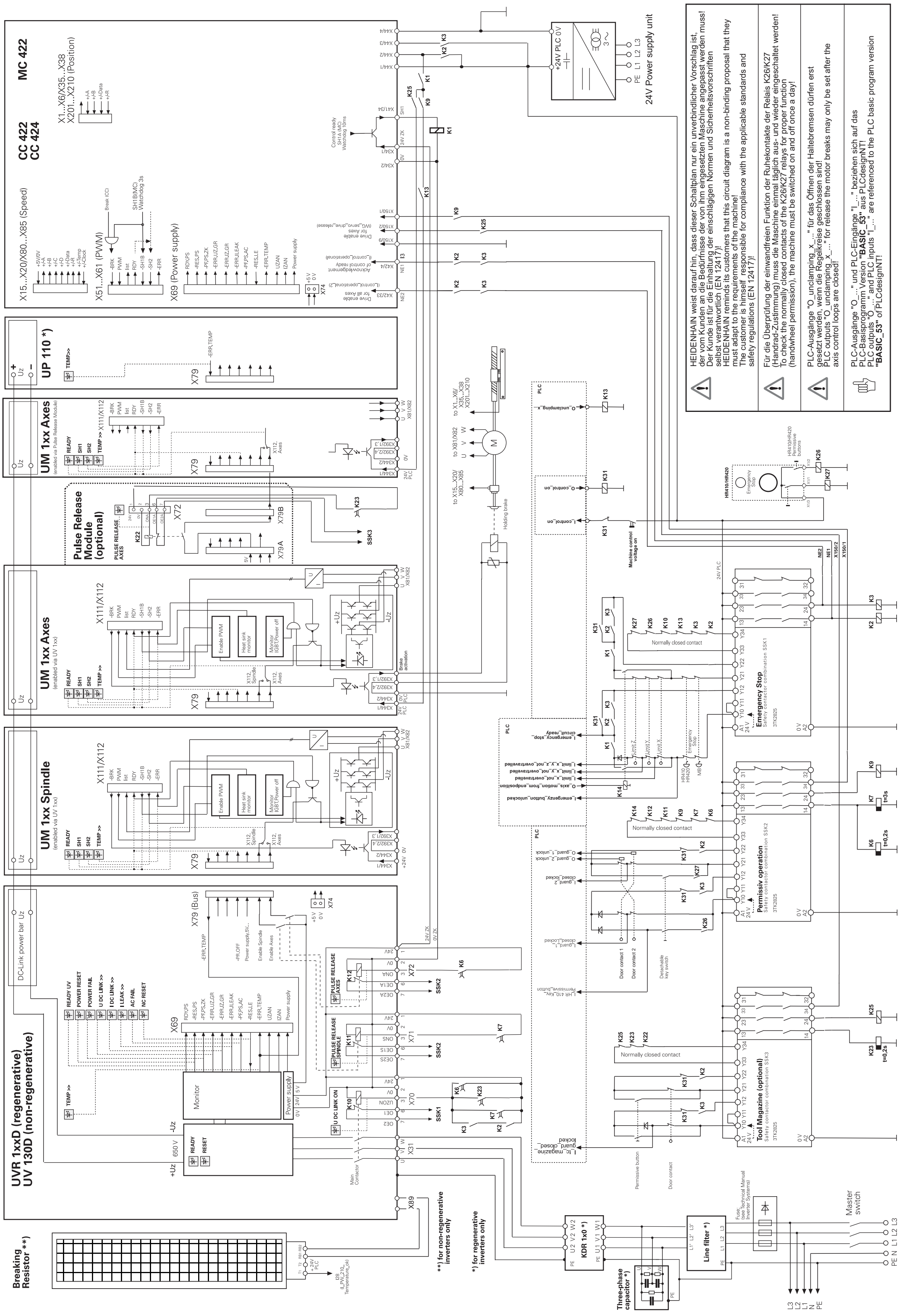
"Scanning" a signal with a lower amplitude (low motor torque) results in a smaller difference between pulses and pauses.



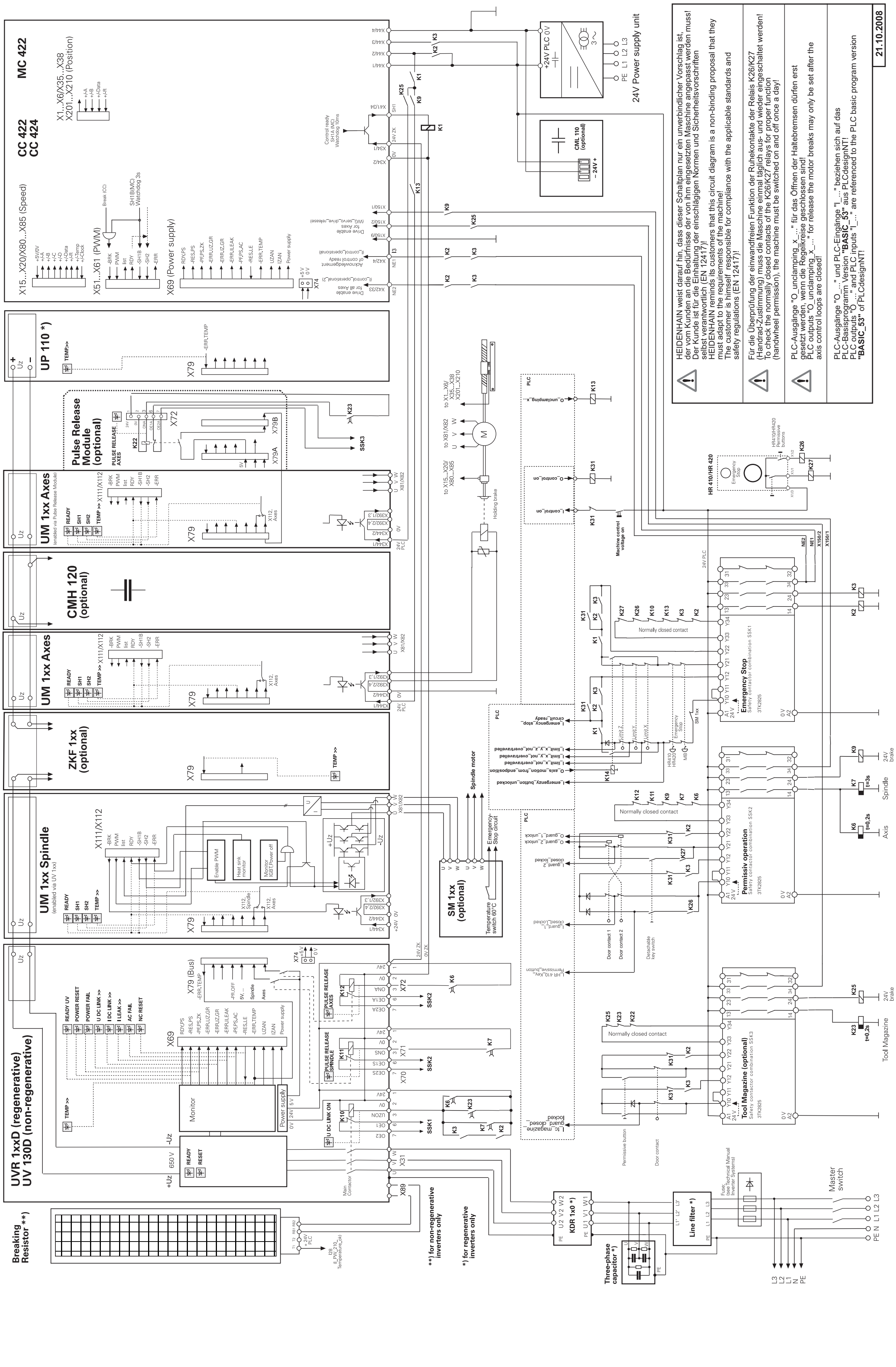
An infinite low or missing signal effects a ratio of pulse to pause of 50:50!
The torque on the motor is zero.

2 Annex: Principle of Function of the iTNC 530 Control

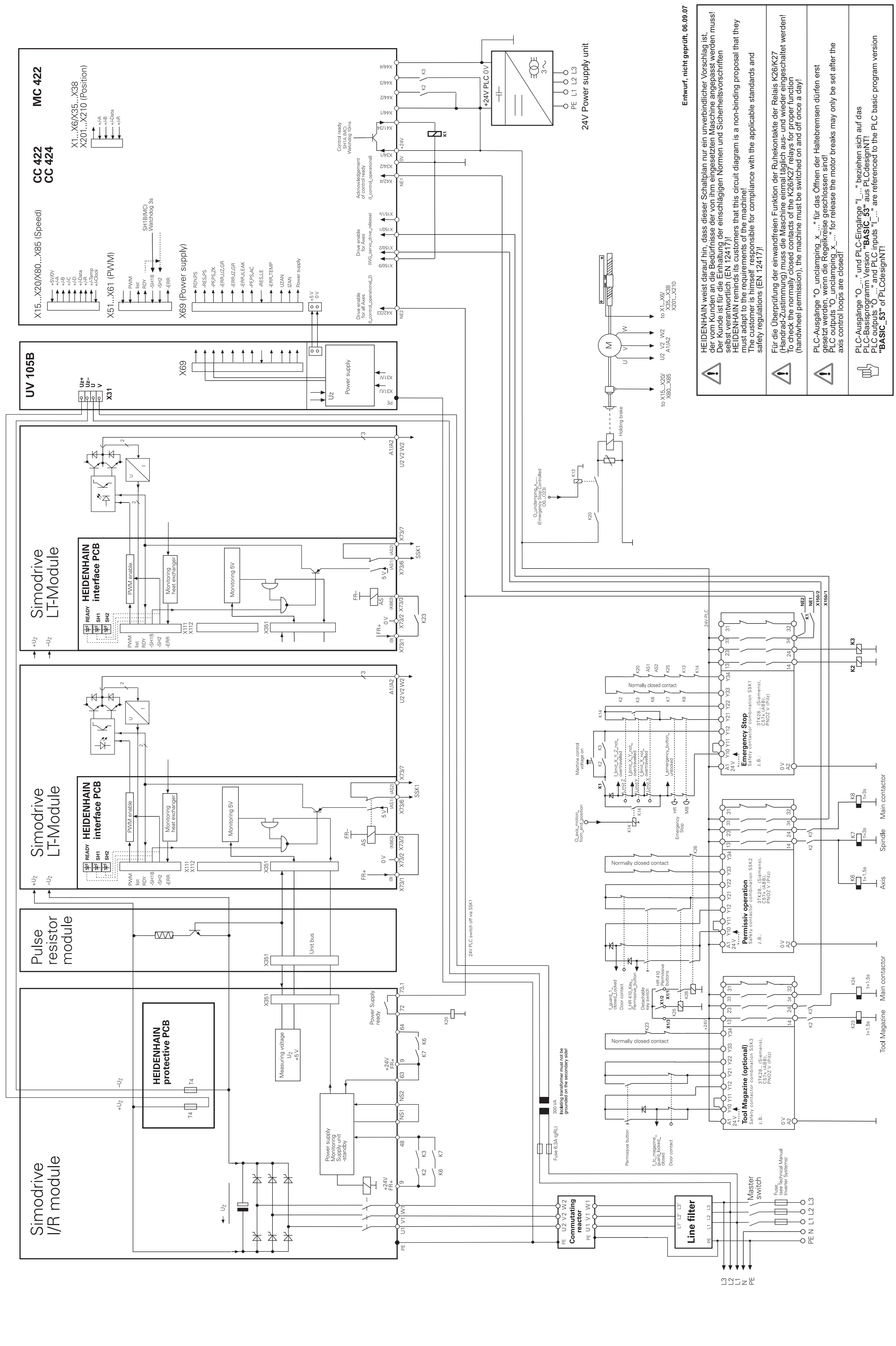
iTNC 530 with modular HEIDENHAIN inverter system



iTNC 530 with modular HEIDENHAIN inverter system with optional ZKF, CMH, CML, SM and parallel NE 1 / NE 2



iTNC 530 with SIMODRIVE inverter system



3 Annex: Monitoring Functions

3.1 Introduction

iTNC 530 features comprehensive monitoring functions.

Values are defined for axis positions and dynamic response of the machine. If the specified values are exceeded, the control displays an error message and stops the machine.

DANGER

Active monitoring functions are essential for safe machine operation!
Safe machine operation is not possible if the monitoring functions are switched off.
Uncontrolled axis movements are not detected.

- Deactivated monitoring functions or changed tolerance values may result in damage to persons or equipment.
- You must not switch off any of the monitoring functions!

In this chapter you can look up which monitoring functions exist on iTNC 530 and how they are defined.

3.2 During Start-Up

EMERGENCY STOP test

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.

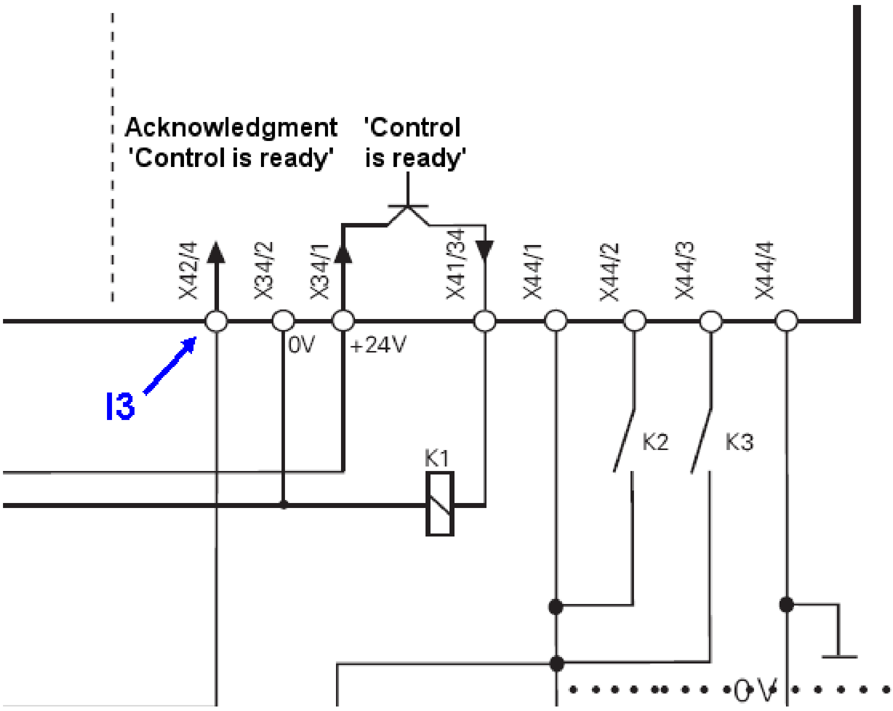
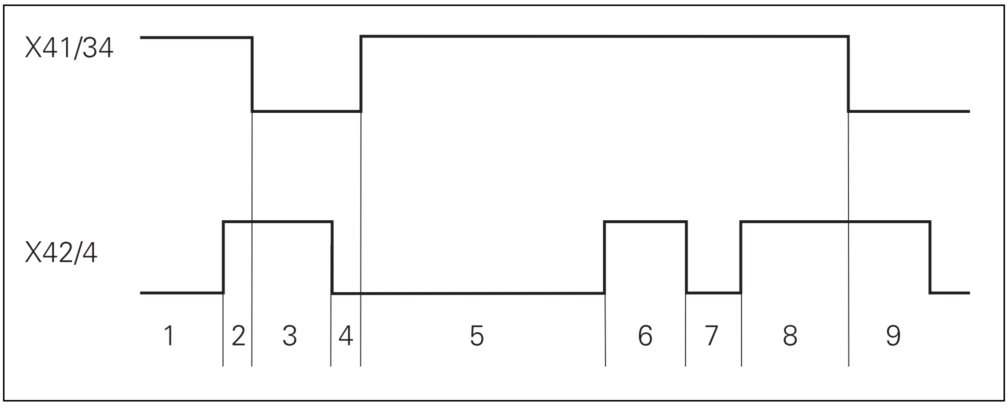


Figure: Excerpt from the basic circuit diagram

Note

For the wiring recommended by HEIDENHAIN, refer to the circuit diagram; --> See “Annex: Principle of Function of the iTNC 530 Control” on page 2 – 657.
The **Control-is-ready signal acknowledgment** has to occur within 1 s.

Time diagram



X41/34 = Control is ready output = O33
X42/4 = Control-is-ready signal acknowledgement = I3

Step	Function	Screen display
1	Waiting for machine control voltage	**`RELAY EXTERNAL DC VOLTAGE MISSING`**
2	Recognition of the machine control voltage on X42/4 and switch-off of the control-is-ready signal on X41/34 by host computer (t < 66 ms)	
3	Maximum time within which the control-is-ready acknowledgment on X42/4 must go to zero (t < 1 s)	If exceeded, **`EMERGENCY STOP defective`**
4	Recognition of the acknowledgment and setting of X41/34 (t < 20 ms)	
5	Waiting for machine control voltage	**`RELAY EXTERNAL DC VOLTAGE MISSING`**
6	Normal operation of control. Control-is-ready output and acknowledgment are high.	
7	Control voltage is switched off externally.	**`EXTERNAL EMERGENCY STOP`**
8	After switching on again, the machine control voltage can be switched off, and then the control operates normally.	
9	After detecting a fault, the control switches off the control-is-ready output (X41/34).	Error message

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 power supply from connector X 34 is missing
- MC defective
- Wiring defective, contactors defective or too slow

Troubleshooting

See “Checking the "Control is ready" output and input (EMERGENCY STOP chain)” on page 16 – 233.

3.3 During Operation

During operation, the iTNC 530 monitors the following positions:

- Amplitude of encoder signals
- Edge separation of encoder signals
- Absolute position for encoders with distance-coded reference marks
- Current position (position or servo-lag monitoring)
- Actual path traversed (movement monitoring)
- Position deviation at standstill (standstill monitoring)
- Nominal speed value
- Checksum of safety-related functions
- Power supply
- Buffer battery voltage
- Operating temperature of MC and CPU
- Run time of PLC program

With digital axes, the iTNC 530 also monitors:

- Motor current
- Motor temperature
- Temperature of power module
- Dc-link voltage
- I^2t of power module and motor

Depending on the PLC program, the following can be evaluated:

- Actual utilization of drive motors
- Status of HEIDENHAIN Inverters

If the **Control is ready** signal output and the **Control is ready signal acknowledgment** input are correctly connected to the **emergency-stop loop**, the control interrupts the loop via the **Control is ready** signal output as soon as a hazardous error occurs.

3.3.1 Position or servo lag monitoring

The axis positions are monitored by the iTNC as long as the control loop is closed.

The input values for position monitoring depend on the maximum possible following error (servo lag). Therefore the input ranges for operation with following error and velocity feedforward are separate.

For both modes of operation there are two range limits for position monitoring.

If the first limit is exceeded, the error message **`Positioning error`** is generated: The machine stops.
You can clear this message with the CE key. An actual-to-nominal value transfer is then executed for the respective axis.

If the second limit is exceeded, the error message **`Excessive servo lag in <axis>`** appears. The control-is-ready signal output is reset. The EMERGENCY STOP chain is interrupted.

MP1410.x **Position monitoring for the operation with velocity feedforward control (NC stop)**

MP1420.x **Position monitoring for the operation with velocity feedforward control (EMERGENCY STOP)**

MP1710.x **Position monitoring for the operation with following error (NC stop)**

MP1720.x **Position monitoring for the operation with following error (EMERGENCY STOP)**

Possible causes of error

The list does not claim to be complete; ask your machine tool builder!
You may add your own experiences!

- Blunt tool
- Excessive machining feed rate
- Spindle speed too low
- Insufficient lubrication
- General mechanical stiffness
- Vibration load on the machine
- With analog axes: excessive offset (drift), faulty tachometer or carbon brushes
- Hardware error in the control loop
- Scanning head loose
- Encoder defective
- Encoder cable defective

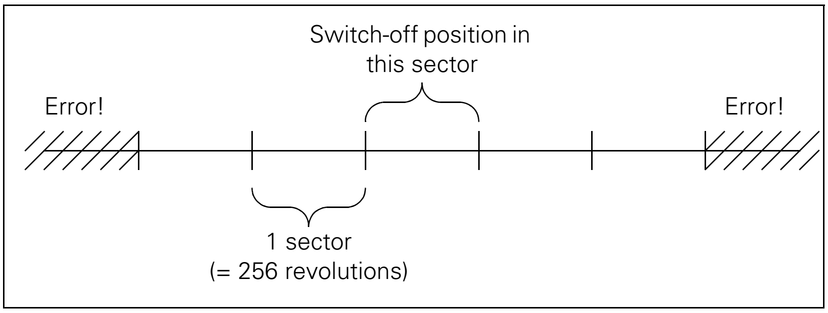
Difference between position at switch-on and shutdown

When the control is switched off, the actual position of the axes is saved with an absolute encoder. During switch-on it is compared with the position values read by the encoder.

If the positions differ by more than the difference defined in MP 1146.x, a pop-up window appears with both positions. The new position can be confirmed with a soft key. If it is not confirmed, the error message **`Check the position encoder <axis>`** appears.

Special case: Absolute multiturn rotary encoder

The control stores an overflow (more than 4096 revolutions of the encoder) internally. Additionally, the number of traversed sectors (1 sector = 256 revolutions) is stored. After the drives are switched on, the current sector is compared to the stored sector.



If at switch-on the motor is more than two complete sectors away from the switch-off position (more than the sector after next), then immediately after the drives are switched on the **`Switch-off pos. <axis> unequal ENDAT`** error message appears.

Caution

The error must then be corrected!

It is assumed that after restarting the control the number of revolutions is correct again.

It is possible that a pop-up window appears with the information that there is a difference between switch-on and switch-off position by more than the value in MP1146.x. If the motor is located at the correct position, you can confirm the message with the YES soft key.

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

Possible causes of error

The list does not claim to be complete; ask your machine tool builder!
You may add your own experiences!

- Shock load on the machine while it is not under power
- An axis was moved while the machine was switched off
- Contamination of the encoder
- Scanning head loose
- Encoder defective
- Encoder cable defective

3.3.2 Nominal speed value monitoring

For the axes, the nominal speed value monitoring is effective only in operation with velocity feedforward.

For the spindle, it is effective in operation with following error as long as the position control loop is closed (orientation).

If the nominal speed value calculated by the position controller is greater than the maximum possible nominal value, the error message **NOMINAL SPEED VALUE TOO HIGH <AXIS>** appears and the control-is-ready output is reset.

Maximum nominal value		
Analog Axes	**Analog Spindles**	**Digital axes**
10 V	20 V	Maximum motor speed from the motor table

Caution

Entries in the motor table must not be changed!

Problem or error

The machine does not reach the set acceleration and braking ramps.
It has lost its dynamic!

Possible remedies

The list does not claim to be complete; ask your machine tool builder!
You may add your own experiences!

- For analag axes: Check the tachometer and carbon brushes, adjust the servo amplifier again
- For digital axes: New adjustment of the control loops by the machine manufacturer
- Overhaul the mechanics
- Eliminate the hardware error in the control loop

3.3.3 Movement monitoring

Movement monitoring is possible during operation both with velocity feedforward and with following error.

During movement monitoring, the actual path traveled is compared at short intervals (several servo cycles) with the nominal path calculated by the NC. If during this period the actual path traveled differs from the calculated path, the blinking error message **MOVEMENT MONITORING <AXIS> A** is displayed.

Analog axes:
An existing offset during a standstill may cause a potential at the analog output without any resulting positioning movement:

- In MP1140.x, enter a threshold from which the movement monitoring should go into effect.

Digital axes:
There is no offset.

- In MP1140.x, enter a speed from which the movement monitoring should go into effect.

For digital axes, in addition to the comparison of actual and nominal values, the calculated position from the pulses of the position encoder are compared with the pulses of the speed encoder:

- Enter in MP332.x the number of signal periods and in MP331.x the path for the number of signal periods.
- MP1054.x contains the displacement per motor revolution. A formula can also be entered.
- MP1144.x contains the value for this position difference. If no position encoder is used, the value 0 must be entered as position difference.

If the difference is greater than the input value from MP1144.x, the error message **MOVEMENT MONITORING IN <AXIS> B** appears.

DANGER

If you enter the maximum value in MP1140.x or MP1144.x, no movement monitoring is active.
Safe machine operation is not possible without movement monitoring!

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^{-1}]
MP1054.x	**Distance of a motor revolution [mm or °]**
Input:	Analog axes: Nonfunctional
	Digital axes: A formula can be entered.
MP1144.x	**Motion monitor for position and speed**
Input:	Analog axes: Nonfunctional
	Digital axes: 0 to 99 999.999 [mm] 0: No monitoring

Possible causes of error

The list does not claim to be complete; ask your machine tool builder!
You may add your own experiences!

- Large backlash (ball screw, gear, belt, coupling, etc.)
- Blunt tool
- Excessive machining feed rate
- Spindle speed too low
- Insufficient lubrication
- General mechanical stiffness
- Vibration load on the machine
- With analog axes: excessive offset (drift), faulty tachometer or carbon brushes
- Hardware error in the control loop
- Scanning head loose
- Encoder defective
- Encoder cable defective

Possible causes of error for movement monitoring ... B

The list does not claim to be complete; ask your machine tool builder!
You may add your own experiences!

- Large backlash (ball screw, gear, belt, coupling, etc.)
- Belt torn
- Coupling defective
- Gear defective

3.3.4 Standstill monitoring

Standstill monitoring is effective during operation both with velocity feedforward and with following error, as soon as the axes have reached the positioning window.

If the position deviation is greater than the value defined in MP1110.x, the error message **STANDSTILL MONITORING <AXIS>** is displayed. The message also appears if, while moving to a position, an overshoot occurs that is larger than the input value in MP1110.x, or if the axis moves in the opposite direction when beginning a positioning movement:

▶ In MP1110.x, enter a threshold from which the standstill monitoring should go into effect.

MP1110.x **Standstill monitoring**

Input: 0.0010 to 30.0000 [mm]

Possible causes of error

The list does not claim to be complete; ask your machine tool builder!
You may add your own experiences!

- Analog axes: Excessive offset (drift)
- Vertical axes: Poor brake or defective weight balance
- Clamped axes: Great mechanical effects during machining

3.3.5 Positioning window

The positioning window defines the limits within which the control considers a position to have been reached. After the position has been reached, the control begins running the next block. The position controller can correct a disturbance inside this window without activating the "Return to the Contour" function.

▶ The size of the positioning window is defined in MP1030.x.

MP1030.x **Positioning window**

Input: 0.0001 to 2.0000 [mm]

Possible error

The NC program gets caught up in an NC block.

Possible causes of error

The list does not claim to be complete; ask your machine tool builder!
You may add your own experiences!

- Excessive static and sliding friction ("slip & stick")
- Chip in the thread during tapping, thread milling or forming (The spindle "vibrates" to the left and right without leaving the hole.)
- Analog axes: Excessive drift
- Digital axes: Insufficient controller adjustment (The axis "oscillates" and "jitters" around the positioning window.)
- Missing acknowledgment of M, S, T, G, Q strobe signals (strobe acknowledgments, PLC)
- Defective motor coil: No exact positioning can be performed at this place.

Test for troubleshooting

Slightly increase the value for the positioning window and observe the machine behavior. Restore the original value afterwards.

Axes in position

Once the axes have moved into the positioning window, the corresponding bits are set in W1026. This also applies to the status after the machine control voltage is switched on. Axes that are not used are considered to be in position.

The NC resets the bits as soon as you start a positioning movement or traverse the reference marks.

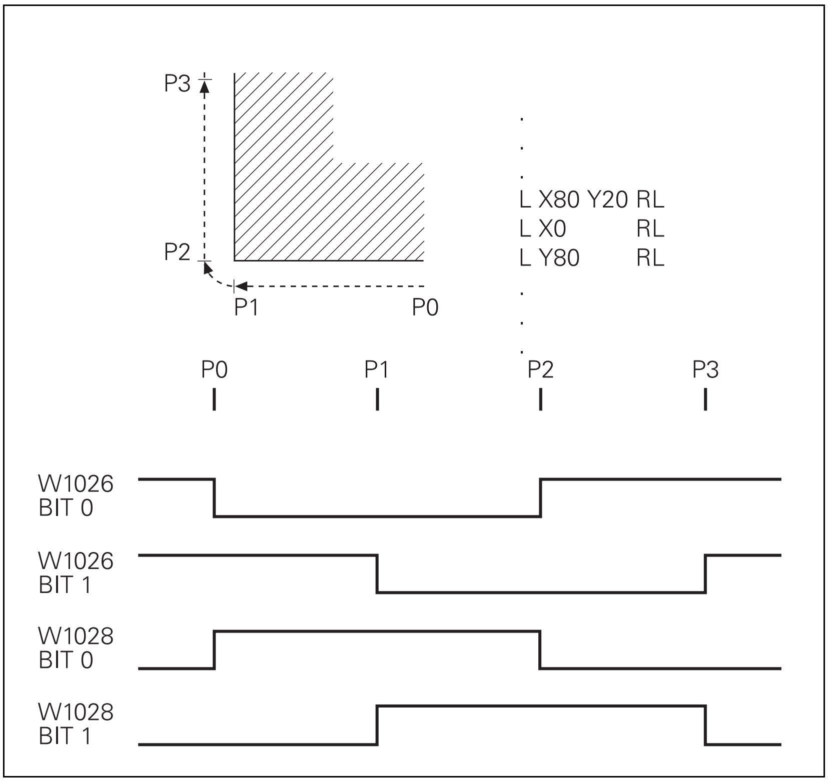
In the **Electronic Handwheel** mode of operation the bit for the current handwheel axis is reset.

W1026 is not set for contours that can be machined with constant surface speed.

		Set	Reset
W1026	**Axes in position** Bits 0 to 8 represent axes 1 to 9 0: Axis not in positioning window 1: Axis in positioning window	NC	NC

Axes in motion During axis movement, the NC sets the corresponding bits in W1028.

		Set	Reset
W1028	**Axes in motion** Bits 0 to 8 represent axes 1 to 9 0: Axis not in motion 1: Axis in motion	NC	NC



3.3.6 Monitoring of the power supply unit

The rectified supply voltage of the power supply unit is monitored. The supply voltage must lie within a defined range (400 V ± 10%). If this is not the case the power supply unit reports an AC fail ($\overline{\text{PF.PS.AC}}$).

At the same time, the dc-link voltage is monitored.

Excessive voltage

If approx. 760 V- (UV 120, UV 140, UV 150, UR 2xx: approx. 800 V) is exceeded, the NC revokes the pulse release (reset) for the IGBT (end stage) of the power stage. **The motors run out non-controlled**. No energy is returned to the dc link.

Possible causes of error

The list does not claim to be complete; ask your machine tool builder!
You may add your own experiences!

- Defective braking resistor (conversion of electrical energy to 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)

Too low voltages

- If the dc-link voltage falls below approx. 385 Vdc (UV 120, UV 140, UV 150, UR 2xx: approx. 410 V), the power supply unit reports a **powerfail** (signal $\overline{\text{PF.PS.ZK}}$)
- If the dc-link voltage falls below approx. 155 Vdc (UV 120, UV 140, UV 150, UR 2xx, UV 105: approx. 200 V), the control is reset (signal $\overline{\text{RES.PS}}$).
- Below approx. 135 Vac (UV120, UV140, UV150, UR2xx, UV105: approx. 180V), the power supply unit switches off.

The UV 105 power supply unit reports a powerfail if the dc-link voltage is < approx. 385 V and the supply voltage is < approx. 330 V.

▶ With MP2150, you can define which inverter signal is to trigger **`powerfail`** on the control.

Inverter signal	Meaning
AC fail ($\overline{\text{PF.PS.AC}}$)	Failure of supply voltage for inverter
Powerfail ($\overline{\text{PF.PS.ZK}}$)	DC-link voltage failure

Since the AC fail is reported to the control before the powerfail, the control has more time to react to the subsequent dc-link voltage failure.

Note

Only the regenerative HEIDENHAIN inverters provide the AC-fail signal.

If a power fail is triggered on the control, all drives are brought to a controlled stop. The PLC -outputs are switched off and the control freezes to ensure that the hard disk can no longer be accessed.

The control must be turned off and on again.

MP2150 **Powerfail signals on the control**

Input: 0: AC fail
1: Power fail and AC fail
2: Reserved
3: Powerfail

Note

Using module 9167, the machine manufacturer can switch the dc-link voltage monitoring on or off.

Possible causes of error

The list does not claim to be complete; ask your machine tool builder!
You may add your own experiences!

- Power failure
- Failure of one or several phases in the supply line
- Supply voltage fallen below minimum
- Interruption in the electrical cabinet
- Inverter (power supply module) defective
- Short circuit of drives (drive modules, motors)

3.3.7 Temperature monitoring

Temperature of the MC 42x (B/C)

The internal temperature of the MC 42x (B/C) is continuously monitored. At approx. 55 °C the message **`TNC temperature warning`** is displayed. If the temperature does not fall below 55° C any more, the warning is reactivated after two minutes. Beginning at about 60 °C the error message **`Temperature too high <temperature> °C`** appears and an EMERGENCY STOP is triggered. If the temperature does not fall below 60 °C when the machine is switched on again, the error message reappears after 10 to 20 seconds.

Motor temperature

To measure the motor temperature, a KTY 84 must be connected at pins 13 and 25 of X15 to X20, X80 to X83. The temperature value is ascertained at least once per second. The maximum permissible motor temperature is taken from the motor table.

If this voltage is exceeded, it results in the error message **`MOTOR TEMPERATURE <AXIS> TOO HIGH`** and the drives are automatically switched off.

Caution

Entries in the motor table must not be changed!

Heat sink temperature of the power module

At X51 to X60 the temperature warning signal is available at pin 10a.

If the permissible temperature of the heat sink on the power module is exceeded, this signal is reset.

The temperatur warning signal is not evaluated in the NC. This information is made available via the modules 9610 or 9066.

Caution

To avoid destroying the power module, the drives must be brought to a standstill immediately after a temperature warning.

The OEM should provide for correspondingly!

Data on maximum permissible temperatures are available from the manufacturer of your power supply unit.

Possible causes of error

No claim for completeness; contact your machine manufacturer!
You may add your own experiences!

- Device (motor, power module, etc) overloaded
- Clogged filter pads
- Climate control unit in electrical cabinet defective
- Defective fan
- Unfavorable mounting of components
- Defective temperature sensor
- Defective encoder cable

3.3.8 Internal power supply and housing fan

Via the PLC you can capture and evaluate the current values of the internal power supply and the speed of the housing fan.

The permanent speed monitoring (speed > 1500 min^{-1}) of the housing fan of the MC/CC can be switched off with MP4020 bit 13.

Module 9133 Output of hardware information

Call:
PS B/W/D/K <>Mode>
0: Internal temperature sensor in [°C]
1: Temperature CPU1 (basic PCB) in [°C]
2: Temperature CPU2 (additional PCB) in [°C]
3: Voltage of buffer battery in [mV]
4: 5-V supply voltage of main board in [mV]
5: 3.3-V supply voltage in [mV]
6: Rotational speed of the housing fan in [min^{-1}]
CM 9133
PL B/W/D <>Value>

Error recognition:

Markers	Markers	Markers
M4203	0	Value was determined
	1	Error code in W1022
W1022	2	Invalid number given
	8	No second CPU present (for code 2)

MP4020 **PLC Functions**

Format: %xxxxxxxxxxxxxx

Input: Bit 13 – Monitoring the housing fan of the MC/CC

0: Monitoring active
1: Inactive

3.3.9 I^2t monitoring

General information

HEIDENHAIN inverter systems feature individual I^2t monitors, one for each power module and motor.

Function

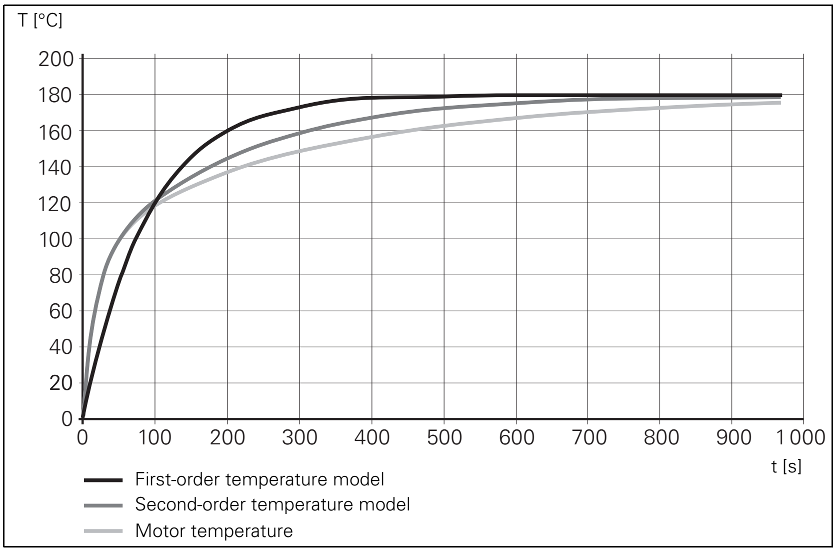
An I^2t monitor calculates and supervises the temperature pattern in a thermal motor or power-stage model during operation.

The calculation is based on:

- The momentary current
- The rated or standstill current
  (with motors multiplied by `MP 2302.x` and with power stages multiplied by `MP 2304.x`)
- A device-specific temperature model

A first-order temperature model is available for monitoring power modules, first and second-order models are available for motors. These models make it possible to permanently calculate the temperature of the stator winding in the motor or the semiconductor in the power module.

Temperature model in an example comparison (motor)



The I^2t monitor responds if this calculated temperature exceeds a certain limit.

Because temperature increase and heat dissipation are uneven when the motor is stationary or moving slowly, the I^2t monitor distinguishes between standstill and traversing mode.

This limit range is defined in a motor table or power module table.
The following entries are important:

- F-AC **`(transition frequency in traversing mode [Hz])`**
- F-DC **`(transition frequency at standstill [Hz]; only CC 424(B))`**

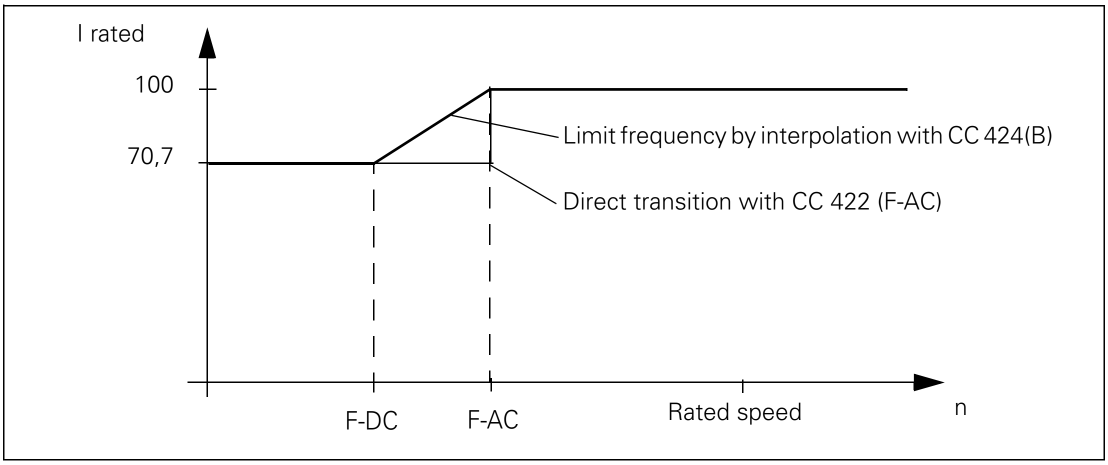
Basics

The following graphics illustrate these parameters in relation to the reference current. Remember here that CC 422 and CC 424(B) may have different parameters.

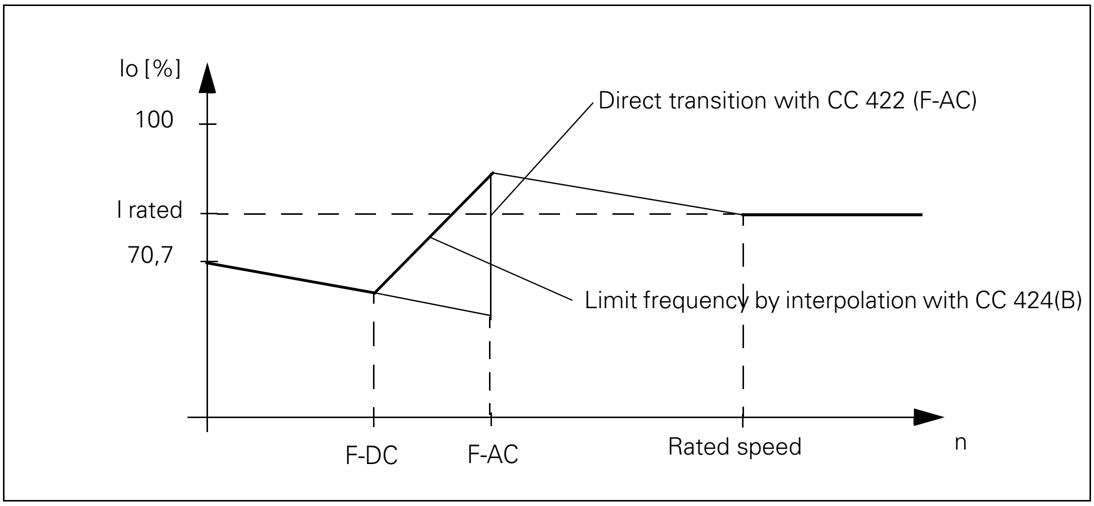
For the CC 422, no difference is made between F-DC and F-AC. Instead, F-AC is used as a rigid limit frequency for the transition between standstill and traversing mode.

With the CC 424 (B) it is possible to use an interpolated current range for the transition from standstill to traverse. This allows a more exact calculation of the temperature model.

If there is no stall torque value given in the motor table, the following model of current (with respect to the rated current) is used to calculate the temperature in the motor. The factors for MP 2302.x and MP 2304.x are not yet taken into account.



If the stall current value is given in the motor table, the following model of current (with respect to the stall current) is used to calculate the temperature in the motor. This is only used for synchronous motors, however. For asynchronous motors the above model of current applies, which is used if no stall current is given. For synchronous motors, the factors from MP 2302.x and MP 2304.x are not yet taken into account in the following description.



Settings and evaluation

- **MP 2302.x** contains the factor for the I^2t monitoring of the motor.
  The input value is a factor for the reference current (1 = 100% of the motor's standstill current or rated current).
  Values smaller than 1 provide increased protection (I^2t cause the monitor to respond), values higher than 1 less protection for the motor.

Note

If you enter zero, the I^2t monitoring for the motor (not for the power module) is switched off.

- **MP 2304.x** contains the factor for the I^2t monitoring of the power module.
  The input value is a factor of the power module's rated current (1 = 100 % of the power module's rated current).
  Values smaller than 1 provide increased protection (I^2t cause the monitor to respond), values higher than 1 causes less protection for the power module.

Note

If you enter zero, the I^2t monitoring for the power module (not for the motor) is switched off.

- All required entries for calculation of a temperature model have to be available in the motor table or power module table.
- The OEM should use module 9160 to interrorgate the I^2t monitoring and take suitable measures (See "Interrogation through PLC module" on page 3 – 679).

Limit values

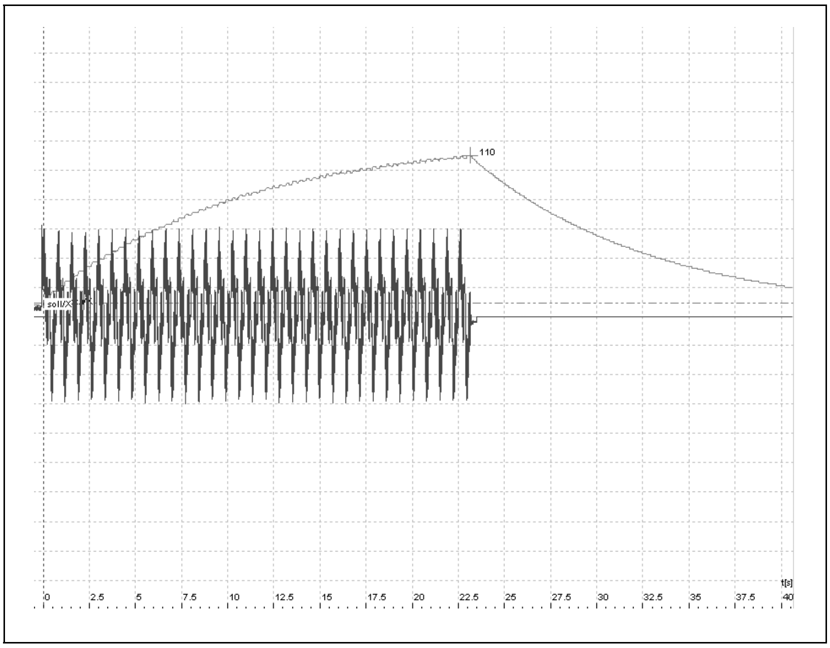
The limit values for the I^2t value (dimension for the permissible temperature in the device [%]) are handled by the NC side of the control and are composed of the following:

- Value exceeds 100 %:
  An axis-specific I^2t early warning is sent to the PLC (for evaluation and possible countermeasures such as reduction of the feed rate with error message by PLC program with the aid of PLC Module 9160).
  If the value does not exceed 110% and falls below 90%, the axis-specific early warning is reset.
- 110%:
  An NC stop is triggered and the drives are switched off.

Note

In the oscilloscope you can display the current value of the I^2t monitoring of the motor and power module, as well as the current load of the drive.

Motor overload with I^2t monitoring



Machine parameters

MP2302.x Factor for I^2t monitoring of motor

Input: 0 to 1 000.000 [· rated current of motor or standstill current]

0: I^2t monitoring of motor switched off
1: Rated current of motor or standstill current is reference value

MP2304.x Factor for I^2t monitoring of the 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 is reference value

Interrogation through PLC module

Module 9160 Status request from temperature monitoring and I^2t-monitoring.

The I^2t monitoring reported by the module is given with respect to the first I^2t monitor response (power stage or motor), if both I^2t monitors are activated (MP2302.x, MP2304.x). This early warning is withdrawn as soon as the limit for reset is reached.

Call:

```
CM    9160
PL    D        <>Temperature monitoring>
               Bit 15876543210
               Axis:Sxxxxx987654321
PL    D        <> I2t monitoring   I2t early warning>
               Bit 15876543210  15       876543210
               Axis Sxxxxx987654321  Sxxxxx987654321
```

Error recognition:

Markers	Value	Meaning
M4203	0	No error
	1	Control has no current controller

Temperature models

The temperature model of the motor or power module is defined by the entries in the motor table or power module table, respectively (motor.mot, inverter.inv). Remember that calculation of which temperature model to use depends exclusively on the availability or nonavailability of the parameters. In addition, the parameters for motors and power modules are to be evaluated separately.

Compatibility

Old motor tables of the iTNC 530 are also usable in newer NC software versions. If the columns/parameters in the temperature models are missing, however, it is impossible to calculate a second-order temperature model.

In such a case the entries **`F-DC, T-DC, F-AC, T-AC`** are used for a first-order temperature model. If this model, too, has no entries (entries "0"), the default values apply.

Possible causes of error

The list does not claim to be complete; ask your machine tool builder!
You may add your own experiences!

- Overload of the drives (power module, motor)
- Axis traverses as far as it will go
- Mechanical stiffness

3.3.10 Actual utilization of drive motors

The PLC module 9166 provides the momentary utilization of the given drive motor as a percentage value.

Ask your machine tool builder, whether he evaluates this PLC module and how the information is displayed.

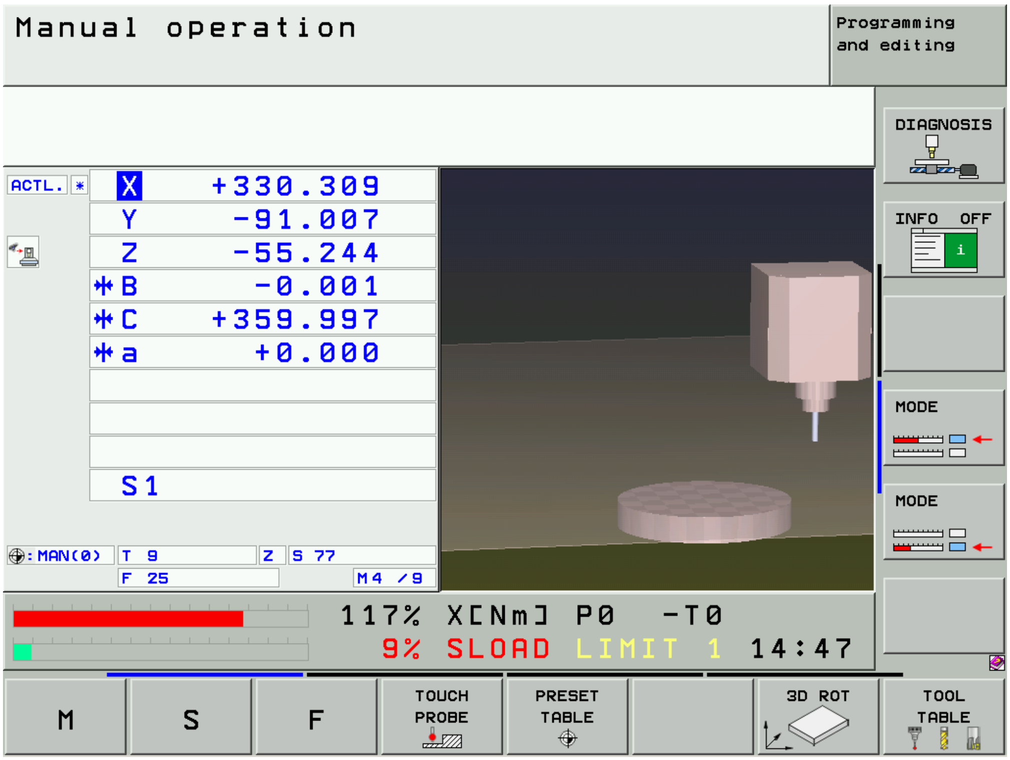


Figure: Example for a utilization display in the small PLC window

3.3.11 Status of HEIDENHAIN inverters

The HEIDENHAIN power supply units have several status signals which lead to error messages on the control:

Status Signal	Associated Error Message	Possible Causes of Error
DC-link voltage too high (ERR.UZ.GR)	8080 Uz UV 1xx too high	■ Defective braking resistor (conversion of electrical energy to 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)
Heat sink temperature too high (ERR.TEMP)	8040 Heat sink temperature UV 1xx	■ Excessive load of the power supply unit ■ Temperature in the electical cabinet too high ■ Fan defective ■ Temperature sensor defective ■ Unfavorable mounting of components
Excessive DC-link current (ERR.IZ.GR)	8041 Excessive Iz in UV 1xx	■ Overload of the machine while machining a workpiece ■ Tool is worn
Power supply unit not ready (RDY.PS)	8061 No inverter-ready signal	■ Inverter defective ■ Control of inverter defective (load and main contactor)
Excessive leakage current (ERR.ILEAK)	8060 Leakage current in UV 1xx too high	■ Insulating problems (motor, cable, etc.) ■ Humidity has entered the motor

MP2195 is used to suppress the error message for each status signal.

In general these errror messages should not be suppressed!
Exception: If you are using a UE 2xx, the signals must be suppressed because this compact inverter does not provide these signals.

☞ **Note**

Status information of the HEIDENHAIN inverters can also be read with PLC module 9066 --> Ask your machine tool builder whether this PLC module is evaluated and how the information is displayed.

Status signals that are already low-active or not available during control start-up

Warning and danger signals are low-active; i.e., line-break proof!

The handling of status signals of the HEIDENHAIN power supply unit that are already low-active or not available during control start-up, varies depending on MP2195 bit 0.

MP2195 bit 0 = 0:
Missing signals cannot be detected with Module 9066 and do not result in an error message when the drive is switched on.

MP2195 bit 0 = 1:
After the PLC program has been compiled, missing signals can be detected with Module 9066 and trigger an error message when the drive is switched on. Signals that are not provided by the power supply unit (e.g. non-HEIDENHAIN inverter system, "older" HEIDENHAIN inverters) must be suppressed with MP2195 (bit 1 to bit 6), because non-existent signals are always identified as errors.

The SUPPLY.SPY table for the power supply modules contains the STATUS-SIG column for the status signals of the power supply module. This column informs you, among other things, whether the PF.PS.AC and PF.PS.DC is supported by the power supply module. This information in SUPPLY.SPY is evaluated by the CC424 (B) and higher.

Bits 7 and 8 of MP2195 enable you to deactivate the error messages that may be triggered by the evaluation of these signals (PF.PS.AC, PF.PS.DC), without changing the SUPPLY.SPY table.

Note

Signals that change their status during operation are always identified as errors.

Only as of CC424 (B): Errors of the supply module (e.g. excessive Uz temp.) lead to an NC stop (if M148 then LIFTOFF) with a subsequent emergency stop.

MP2195 Handling of status signals from HEIDENHAIN power supply units

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 - $\overline{\text{PF.PS.AC}}$
0: Previous behavior; Error message is not suppressed
1: Error message is suppressed
Bit 8 - $\overline{\text{PF.PS.DC}}$
0: Previous behavior; Error message is not suppressed
1: Error message is suppressed

3.3.12 Controlling the motor brakes

The motor brakes are controlled with the $\overline{\text{BRK}}$ braking signal, which is transmitted to the **HEIDENHAIN inverters** via the PWM interface (X51 to X62). The corresponding outputs are activated there. See the basic circuit diagrams.
Control of the motor brakes via the PWM interface must be deactivated for non-HEIDENHAIN inverters that do not support this function:

- MP2234.x bit 0 = 1

The motor brakes are opened no later than 50 ms after the speed controller is switched on. For safety reasons, the controller is not switched off until the braking signal has been output.

- Enter in MP2308.x the time (overlap time) after which the controller is to be switched off after the braking signal has been output.

If the inverter sends the $\overline{\text{RES.PS}}$ reset signal, then the $\overline{\text{BRK}}$ braking signals are output immediately upon switch-off of the controllers, i.e. without any overlap time.

Activated brakes cause a change in the controlled system. The motor with the changed controlled system is controlled during the overlap time. This can lead to oscillations when the controller is switched off. These oscillations are suppressed by the NC software. MP2220 bit 3 can be used to deactivate the suppression of vibrations. HEIDENHAIN does not recommend switching off the suppression of the oscillations.

In MP2309.x you can define a time period in which the speed and position controller parameters are adjusted to values for controlling a closed brake when the drive is switched on. This parameter can be used to avoid oscillations in the drive during switch-on when the brake is still closed and the controller is already active.

MP2220	**Monitoring functions**
Input:	Bit3 - Switching off the controller when the motor brakes are activated
	0: Suppress oscillations 1: Vibrations are allowed
MP2234	**Internal triggering of the motor brakes via the PWM interface**
Format:	%xx
Input:	Bit 0
	0: Signal is transmitted 1: Signal is not transmitted Bit 1– reserved
MP2308.x	**Time between output of the braking signal $\overline{\text{BRK}}$ and switching off of the controller (overlap time)**
Input:	0.001 to 0.500 [s]
	0: 0.200 s
MP2309.x	**Controller parameters adjusted to closed brake**
Input:	0: Previous behavior; not active
	0.001 to 1.999 [s]

Automatic test of the motor brakes at switch-on

You can carry out an automated functional test of the motor brake after switching on the drive, either before traversing the reference mark or through activation by PLC Module 9143.

This brake test only functions in combination with HEIDENHAIN inverter systems and only when using the brake output on X392/X393 if it is wired according to the basic circuit diagram from HEIDENHAIN.

For the period of one second, a current is output while the brake is applied. The path that the axis has moved is then measured. If the permissible path is exceeded, the error message **`8130 Motor brake defective <axis>`** appears, and the axis remains controlled. The test is carried out simultaneously for all affected axes.

DANGER

If the machine were switched off in case of an error, vertical axes could fall down!
This could lead to damage to property or persons!
In case of an error, the axis must be moved to a safe position, and physically supported, if necessary. Only then may the machine be switched off so that the defect can be corrected!

If no motor current flows while testing the motor brakes, the error message **`8310 No current for brake test <axis>`** appears.

▶ MP2230.x contains a factor for the motor current with which the test of the motor brake should be performed. MP2230.x = 0 if the test is not to be performed or for motors without brakes.

The **`I0`** standstill current is used as motor current entered in the motor table. If **`I0`** in the motor table equals 0, then the rated current **`I-N`** from the motor table is used.

Recommended input value for MP2230.x:

$$\text{MP2230.x} \geq 1{,}3 \cdot \frac{M_L}{M_0}$$

M_L: Maximum torque of the axis
M_0: Standstill torque of the motor

Always keep in mind:

- Torque for motor test ≥ 1.3 · maximum load torque of the axis
- Stall torque of the motor ≥ maximum load torque of the axis
- Holding torque of the motor brake ≥ torque for the motor test

Note

- Please note that when reading the current via the internal oscilloscope, on the CC 422 you are seeing the peak value, and on the CC 424 (B) you are seeing the effective value of the current.
- Please note that the test torque can only be generated with a certain factor of uncertainty. Factors of influence here are the accuracy of the current sensors and the torque constant of the motor.

▶ MP2232.x contains the permissible path that the motor is allowed to move against the brake. MP2232.x = 0 if the test is not to be performed or for motors without brakes.

MP2232.x must be < MP1110.x so that the standstill monitoring does not activate!

Recommended input value for MP2232.x:

$$\text{MP2232.x} = 2 \cdot \alpha \cdot \frac{\text{MP1054.x}}{360°}$$

α: Permissible braking angle: Backlash of the motor brake as per the manufacturer specifications (for HEIDENHAIN motors, $\alpha \leq 1°$)

Example:
QSY 155B-EcoDyn: M_0 = 13 Nm, M_{Br} = 40 Nm
M_L = 11 Nm

$$\text{MP2230.x} \geq 1{,}3 \cdot \frac{11\ \text{Nm}}{13\ \text{Nm}} = 1{,}1$$

MP1054.x = 20 mm
α = 1°

$$\text{MP2232.x} = 2 \cdot 1° \cdot \frac{20\ \text{mm}}{360°} = 0{,}111\ \text{mm}$$

MP2230.x	**Factor for motor current during test of motor brake**
Input:	0.1 to 30.0 [· motor current]
	0: No test of motor brakes, or motor without brake 1.3: Recommended input value
MP2232.x	**Maximum permissible path during test of motor brakes**
Input:	0 to 10.0000 [mm] or [°]

3.3.13 EMERGENCY STOP monitoring during operation

On the control there is a PLC output (X41/34) with the designation control-is-ready, and the associated PLC-input for the MC (X42/4; I3) with the designation control-is-ready-acknowledgement for the EMERGENCY STOP routine.

Internal EMERGENCY STOP

If a functional error (e.g., standstill monitoring) is recognized, the iTNC generates an **internal EMERGENCY STOP**.
The iTNC ...

- switches off the "Control is ready" output.
  (SH1A; responsible watchdog reacts after 10 ms at the latest)
- switches off the inverter enables, and thus the inverters are without power.
  (SH1B; responsible watchdog reacts after the time set in MP2172 of 1 to 6 s).

An error message appears and the PLC program is stopped.
Depending on the error class, it might be possible that cannot be cleared with the CE key:

- Correct the error and restart the switch-on routine.
  --> See “During Start-Up” on page 3 – 661!

MP2172 Delay for the SH1B signal (inverter enable)

Input: 0 to 6 [s] as an integer

0: 3 [s] Default

External EMERGENCY STOP via MC (I3)

If an **external EMERGENCY STOP** is triggered via input I3 ("acknowledgment of control-is-ready signal"),

- the nominal speed value "null" is output via the MC, braking the drives on the intended braking ramp (usually at the limit of current).
- the **EMERGENCY STOP** error message is displayed.
- markers M4177 and M4178 are set by the NC.

You can clear the error message with CE after switching the machine control voltage back on.

The input I3 ("control-is-ready signal acknowledgment") is passed directly onto the NC; it can **not** be manipulated by the PLC (I3).

Resetting the “control-is-ready signal acknowledgment” inputs leads to position monitoring being shut off for the time defined in MP1150.1, and to an actual-to-nominal value transfer. After the time defined in MP1150.1 has expired, position monitoring is again active, for at least the time defined in MP1150.2.

If marker M4580 is set, then instead of the external emergency stop ("control-is-ready signal acknowledgment" input), the control loops of all axes and of the spindle are opened, and an NC stop is performed.

		Set	Reset
M4177	**Clearable error message displayed**	NC	NC
M4178	**Error message EMERGENCY STOP is displayed**	NC	NC
M4580	**Suppress EMERGENCY STOP, open all position control loops, NC stop**	PLC	PLC

External EMERGENCY STOP via CC (axis releases)

At the same time, HEIDENHAIN recommends using the "global axis enabling" of the controller unit (CC) via (X42/33; I32) or the axis-specific "axis enables" of the CC via X150/X151, which are also integrated in the **external emergency stop.**
If these are switched off, then when there is an emergency stop of the controller unit (CC) ...

- the nominal speed value "null" is output, braking the drives on the intended braking ramp (usually at the limit of current).
- The pulses of the power stages are normally switched off after the braking process and the overlap time (MP2308). MP2173.x serves to monitor the braking of the drives. The monitoring time for the braking process is defined in MP2173.x. After the monitoring time has expired, the control checks whether the servo drive is at a standstill. If this is not the case, the control assumes that a serious error has occurred and switches off (via SH2) the pulses of the power stages. This ensures that, after a request to switch off the servo drives (e.g. EMERGENCY STOP, X150, PLC or alarm), the pulses are safely switched off (via SH2) at the latest after the time specified in MP2173.x expires. If the standstill is detected right before expiration of the time defined in MP2173.x, the active braking process is continued and the pulses are not switched off until after the overlap time.
  The time for switching off the pulses (entry in MP2173.x) must be greater than the maximum possible braking time of the axis/spindle that can occur through electrical braking. Especially for axes/spindles without mechanical braking, you must ensure that the pulses are not switched off until after the maximum possible braking time for the axis/spindle that can occur through electrical braking. Undecelerated axes/spindles coast to a stop after pulse switch-off. In the worst case, this can cause damage to the machine. Specific operating conditions of the machine, such as maximum feed rate, overload on the axes, etc., must also be taken into account.

☞

Note

The time for switching off the pulses (via SH2, entry in MP2173.x) must always be greater than the maximum possible braking time of the axis/spindle that can occur through electrical braking.
However, the time in MP 2173 should not be too large so that the safety function of the machine parameter is still ensured.

MP2173.x	**Pulse switch-on of the power stage**
Input:	0.2 to 100.000 [s]
	0 = 3 seconds (default value)

A

B

C

D

E

F

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Especially if you need **technical support** the HEIDENHAIN Helpline team can provide detailed advice and information on measuring systsems, controls as well as NC and PLC programming.

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