Description of Functions 10.2003 Edition

motion control information system

SINUMERIK 840D/840Di/810D
Machine Data Management
MDA Machine

SIEMENS

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Standard Software for
Production Automation

MCIS MDA Machine

Description of
Functions

10.2003 Edition

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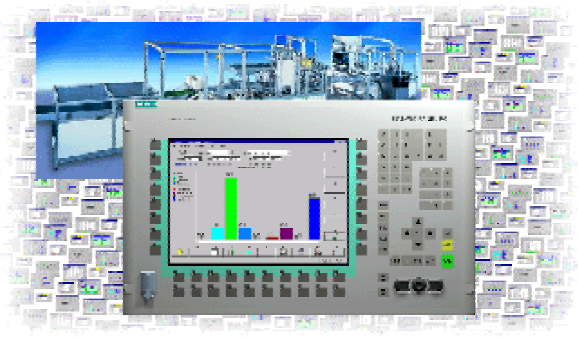
1 Concept

1.1 Why MCIS MDA Machine?

Operator Panel Information Center

MCIS MDA Machine makes an operator panel the central unit for machine data acquisition and operator control at your workstation. Integration into the control level obviates the needs for additional acquisition hardware such as terminals or mechanical recording instruments.



Transparent Machine Data

Individually generated graphic evaluations permit detailed disturbance analyses and diagnostics (ABC analysis, status analysis) directly at the machine level.
This transparency not only allows you to perform weak-point analyses. It also enables you to quickly respond to any disturbances, thereby increasing machine utilization times.

Integration in the SINUMERIK

As an integrated PDA solution on CNC controllers, **MCIS MDA Machine** provides an acquisition and evaluation platform for production. Complete integration in the controller refers, on the one hand, to operation of the dialogs and their layout that run directly on the NC operator panel, and on the other, to data acquisition with access to the NC kernel and the PLC.

The acquired data is also used to verify the availability of individual production facilities or units.

Operating status conditions are acquired automatically directly from the appropriate controller. The following OPC Servers can be used: ProTool/Pro, WinCC und SIMATIC Computing

This provides you with the basis for determining objective data on machine performance and availability, and displaying it online on the operator panel at any time.

You can also acquire and comment on machine information manually on the operator panel.

- Operation directly from operator panel
- No additional hardware
- Transparency directly on machine
- Increased machine utilization times
- Weak-point analysis
- Verification of machine performance
- Acquisition via OPC™ server

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Machine Status Conditions

You can easily define relevant machine status conditions, disturbances, and manual confirmations, as well.

- Manual acquisition of machine information
- Definition of machine status conditions and disturbances, as well as manual confirmations

User-Friendly Machine Data Evaluation

Flexible filter functions allow you to define which machine status conditions and disturbances are displayed or evaluated. These definitions are stored automatically, and can thus be used again and again. This enables you to carry out individual analyses according to criteria of your choice.

- Individual evaluations
- Flexible filter functions

Die Auswertung „Zustandsanalyse“ gibt in grafischer Form eine Übersicht der Maschinenzustände und Störungen mit ihrem exakten zeitlichen Verlauf.

- Display of current machine information and status conditions
- Status analysis with duration and distribution of operating status conditions over time

The disturbance analysis provides a summary of machine status conditions and disturbances for the specified period according to their duration and frequency.

- Disturbance analysis with duration and frequencies

Machine performance is verified via the machine availability calculation for a specific period of time.

- Representation and verification of machine availability and Machine utilization

You can also carry out comprehensive machine-based or unit-based evaluations (i.e. evaluations on the basis of individual machine components) depending on license. During an evaluation, you can, of course, compare the activity of individual units with other units. Documenting or verifying analysis results is facilitated by hard-copy functions, tabular printouts and export of analysis results to Excel.

- User-friendly evaluations of units or machines depending on license
- Evaluation comparisons
- Hard-copy functions, tabular printouts and export to Excel for documentation

The quantities for individual machines and periods or evaluation groups of machines depending on license can be displayed using machine counters.

- Event archive maintenance
- Evaluation of absolute quantities for machines and periods

The acquired messages are archived and summarized in a local database, enabling long-term observations to be made. MSDE is used as a standard database for **MCIS MDA Machine**. Further database management systems can be used in projects, for example MS-ACCESS, SQL Server 2000 or Oracle.

- Data summaries
- Flexible Database interface

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Convenient part type evaluations

A convenient user interface makes it possible to define and manage part types. These part types can be assigned to individual machines or units. Several part types can also be combined into part type filters.

Depending on license it is possible to combine machines and units into evaluation groups. This allows you to combine comprehensive evaluations in a flexible way: the quantities can be displayed according to part types or part type filters for individual machines/units and evaluation groups. You are not just given a good overview of the quality of the manufactured work pieces (good, scrap, rework) but also of the required cycle times compared to the target cycle time.

It is also possible to display the OEE indicators for individual machines or – depending on license - units and evaluation groups. The calculation and display of OEE indicators takes availability, utilization, capacity and quality into consideration, as well as Mean Time To Repair (MTTR) and Mean Time Between Failures (MTBF).

If you prefer graphics, you can have the progress of the OEE indicators displayed as a table rather than of graphics.

- Part type master data
- Assignment of part types to machines
- Part type filter
- Part type-related evaluation
- Acquisition of quality of manufactured items
- Acquisition and evaluation of cycle times
- Calculation of OEE indicators
- Calculation of capacity/quality
- Calculation of availability/utilization
- Calculation of MTTR/MTBF
- Selectable period and period types
- Display as table or graphics

Online-Help

Extensive, context-sensitive online help supplies the information and support you require for operating **MCIS MDA Machine** and for online Customizing.

- Extensive, context-sensitive online Help for **MCIS MDA Machine** and online customizing

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Alarm Acquisition and Evaluation with **MCIS MDA Machine**

MCIS MDA Machine can also carry out acquisitions of SINUMERIK alarms and messages.

The alarm texts matching alarm numbers on the SINUMERIK are transferred to **MCIS MDA Machine**

An alarm acquisition filter can be applied, specifying what alarms and messages are to be transferred to **MCIS MDA Machine**.
The alarms are acquired directly from the SINUMERIK loop alarm and message buffer.

An alarm log and alarm statistics are available for alarm evaluation.

- User-friendly transfer of alarm texts from the SINUMERIK
- Optional alarm acquisition filter
- Automatic transfer of current alarms and messages from the SINUMERIK
- Alarm log and alarm statistic evaluations

Works Calendar

The **MCIS MDA Machine** license for several machines / units provides a works calendar that is also available for evaluations.

Working time models can be defined from shifts and day types. A working time model is assigned to each machine.

A day type is assigned to each day of week.

Data is acquired for each shift with the works calendar option and can be evaluated for each machine operated in a shift.

- Day types, shift types, working time models
- Day type – calendar day assignment
- Machines operate according to working time models
- Shift-specific data acquisition and summary

Customizing and Enhancements

MCIS MDA Machine can be customized to meet a large number of special requirements for machine data acquisition and evaluation.

The modular design of the system and the open database interface allow you to carry out customer-specific enhancements and individual evaluations at any time.

Once the acquisition data has been written to a database, it can be made available to other Microsoft applications across a networked hard drive using Windows data management tools. This also ensures that long-term archiving can be maintained.

- Centralized configuration
- User-friendly customizing
- Customer-specific enhancements
- Data export to Microsoft environment
- Archiving of acquired data

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1.2 Functions

Machine Data Acquisition

- Productive times
- Machine disturbances
- Maintenance and unproductive times
- Setup times
- Manual and automatic acquisition of machine status conditions
- Automatic acquisition of alarms and messages (only for SINUMERIK)

Machine Data Evaluation

- Status analysis – representation of operating status conditions for a selected period of time
- Disturbance analysis – representation of operating status conditions and disturbances according to duration and frequency
- Machine Availability *and Utilization* for user-definable periods
- Alarm evaluations and messages by duration and frequency
- Evaluation of absolute quantities for machines and periods
- Calculation of OEE indicators based on machine counters

Lists

- Logbook
- Log
- Prioritized Log

Archiving and Summarizing Acquired Data

- Shift (only with the works calendar)
- Daily, weekly, monthly, yearly

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Part Type Evaluations

- Part type management
- Evaluation of part type quantities for machines/units or evaluation groups
- Calculation of OEE indicators for machines/units or evaluation groups for any compression period
- Display of OEE indicators in graphical or tabular format

Customizing Options

- Language selection
- Definition of additional languages
- Screens can be customized for user requirements
- Layout of user interface can be customized, e.g. menus
- Screen contents can be customized, e.g. fields, their sequence, and sort order
- Screen and message texts
- Buttons
- User management and authorizations
- Definition of machine status conditions and disturbances, as well as their priorities, from the PLC
- Machine designations and evaluation groups
- Archiving periods for logs and logbooks

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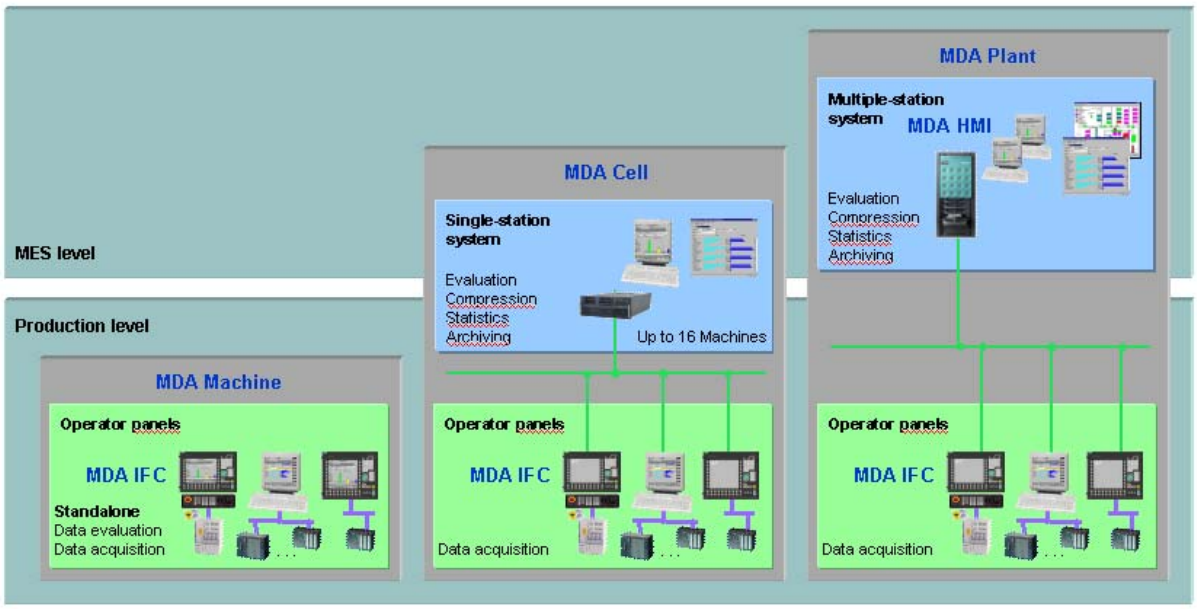
1.3 System Architecture

A variety of industry applications requires a flexible graduation for products and solutions in the environment of **MCIS MDA Machine**. Thus MCIS MDA is available as a three tiered upgrade solution.



System Architecture

MCIS MDA Machine is an introduction solution without any server system. MCIS MDA Machine is installed on every machine for local evaluation purposes. It contains the mere acquisition module **MCIS MDA IFC**. With MCIS MDA Machine the operator panel performs the function of a machine data collection terminal. The information acquired automatically from the machine is complemented by manually entered machine status conditions including disturbance cause and comments (e.g. organizational disturbances).

MCIS MDA Machine is fully integrated in the operator panel. This applies to the operation and layout of the dialogs as well as to the connection for acquisition of the NC/PLC data.

MCIS MDA Machine licenses are available for acquisition and evaluation of one machine and furthermore for up to 8 machines or one machine and up to 7 machine units.

MCIS MDA IFC is necessary at the machine site for the server based systems **MCIS MDA Cell** and **MCIS MDA Plant** for centralized and comparative evaluations. Local evaluations as provided by MCIS MDA Machine may then be abandoned for normal use of the facility.

The combination of the server based systems with MCIS MDA Machine for local evaluations is very convenient during commissioning without server system at the machine manufacturer or as further user interface in special situations (e.g. for emergency strategies).

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The upgrade solution **MCIS MDA Cell** is a single user system at the production or MES level dedicated for central information and evaluation of machines and evaluation groups, e.g. machine groups where disturbances of one machine may affect the following ones. All machine data will be stored in a database system at the server, which can act as an application server and a database server at the same time. A connection breakdown between operator panel (e.g. OP 012) and the server system results in automatically buffering the data directly in the corresponding panel.

Compared with MCIS MDA Cell the multi user system **MCIS MDA Plant** is the MES solution with improved and extended functionality. The significantly extended monitoring of machines provides an ideal control for single machines, machine groups or production lines. Beyond there are many evaluations over time (evaluation history) which provide precise in-depth analyses of the production process.

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2 Machine Data Evaluations

You can access machine data evaluations directly from the operator panel. Results are output in graphical form to facilitate interpretation. Easy-to-use evaluation definitions help you create selection criteria and allow you to carry out individual analyses. You can also document your evaluations by outputting them on a network printer or exporting to Excel.

Subject to the corresponding license a machine can be subdivided into logical units for data acquisition and evaluation purposes. Examples of units include transportation facilities, tool portals, and drilling head magazines.

The illustrations in this chapter and the following chapters are of user interfaces for the **MCIS MDA Machine**. The PC version of the software has been used for each illustration. When using the MCIS MDA Machine application on special operator panels, such as the PC 670, OP031, OP012, the MCIS MDA Machine user interface is modified at setup time to match the respective panel.

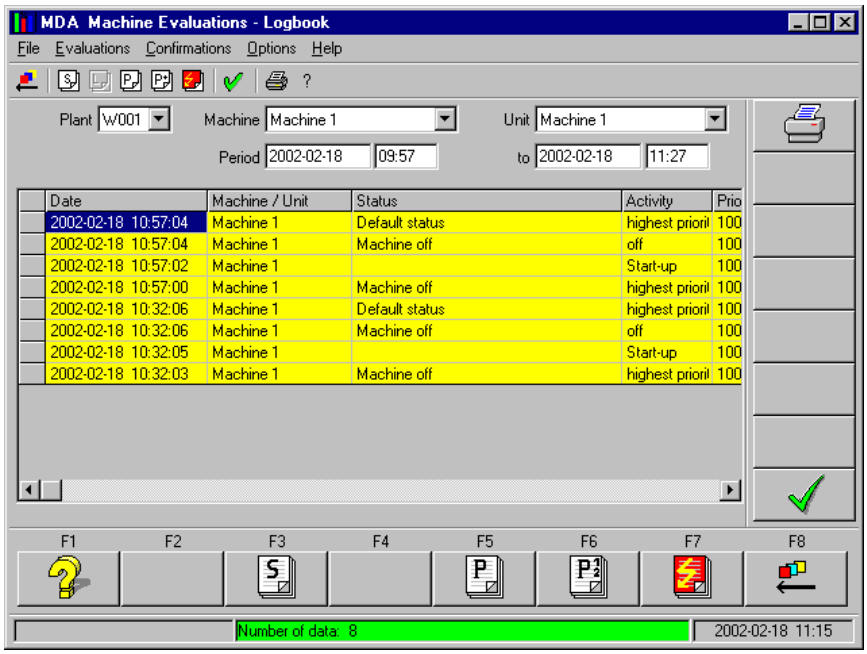
ATTENTION:

The evaluations for evaluation groups taken as examples in the following chapters are not available with MCIS MDA Machine on the SINUMERIK due to reduced resources (only OP031/MMC103).

The evaluations on a shift basis are available with activated works calendar only. Otherwise acquisition and evaluation are on a daily basis.

2.1 Logbook

The acquired machine results are stored in a logbook, which can be used to document the production process (production verification) or to carry out specific evaluations. In the logbook, the individual "in" and "out" entries (start/end of status) are updated with the acquisition time and a unique sequence number.



Selections by:

- Machine / Unit
- Period

You can configure the fields displayed in the logbook, the sequence of the individual columns, as well as the sort order and number of records managed in the logbook.

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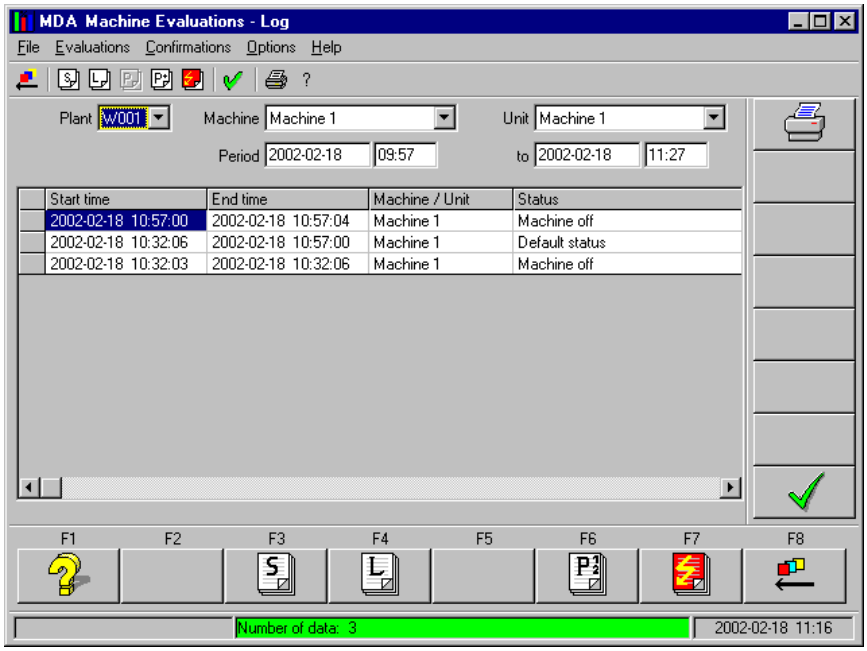
2.2 Log

The acquired machine events are summarized and stored in a log, which can be used to document the production process (production verification) or to carry out specific evaluations. The machine events are entered in the log with their "in" and "out" times. In contrast to the logbook, log entries group together the machine status conditions with their start and end times.

A prioritized log, which has the same structure as the standard log, is also maintained. In the event of parallel machine status conditions (several machine status conditions are present simultaneously), this prioritized log is required for the additional summary levels. The machine status with the highest priority is always entered in the prioritized log. This is necessary to ensure unique 100 % evaluations with respect to duration.



Selections by:

- Machine / Unit
- Period

You can configure the fields displayed in the log, the sequence and width of the individual columns, as well as the sort order and number of records managed in the log.

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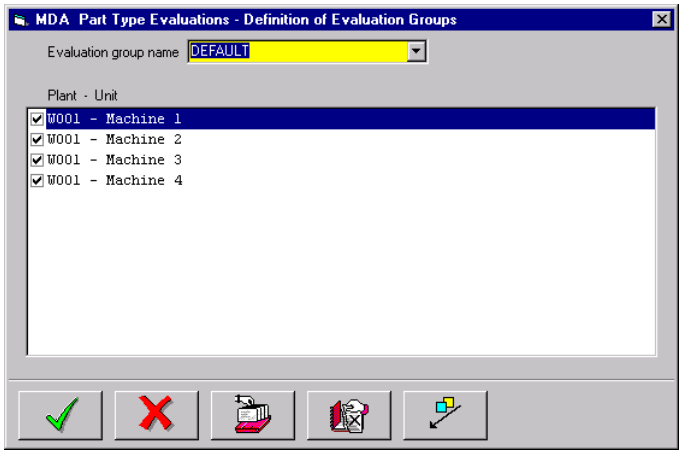
2.3 Defining Evaluation Groups

The evaluations described in the following sections (e.g. status analysis, disturbance analysis, and availability) enable you to analyze individual machines or units and compare them with each other. Depending on the corresponding license you can define any combination as an evaluation group, and store it to carry out repeated analyses.



Evaluation Group Definition

In the dialog for defining evaluation groups, you can specify information for selecting evaluations, assign names to it, and store it.

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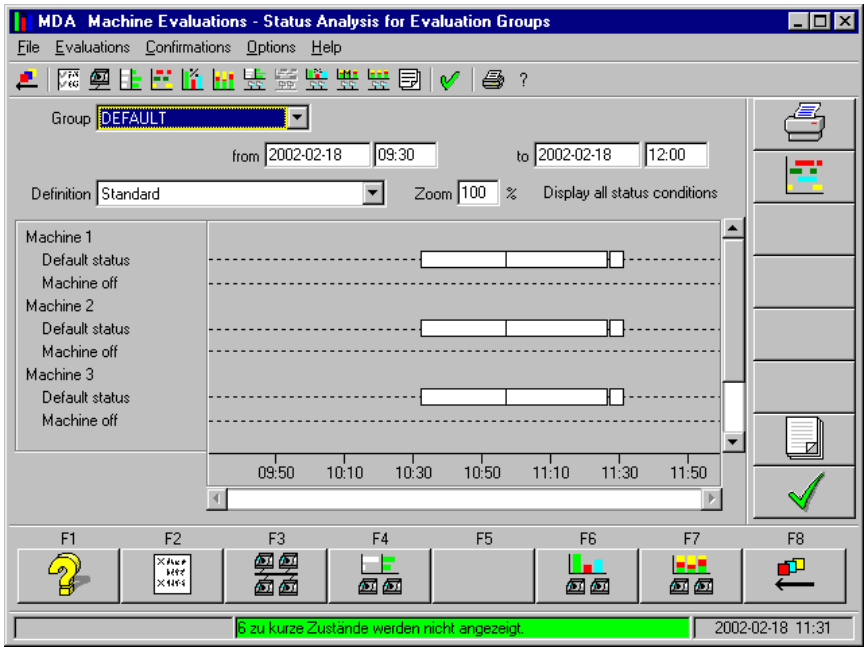
2.4 Status Analysis and Status Analysis for Evaluation Groups

Status analyses display machine status conditions and disturbances in chronological order. The occurrence of parallel machine status conditions (several machine status conditions current at the same time) is also supported. Since several units or machines are displayed simultaneously, direct comparison is possible.

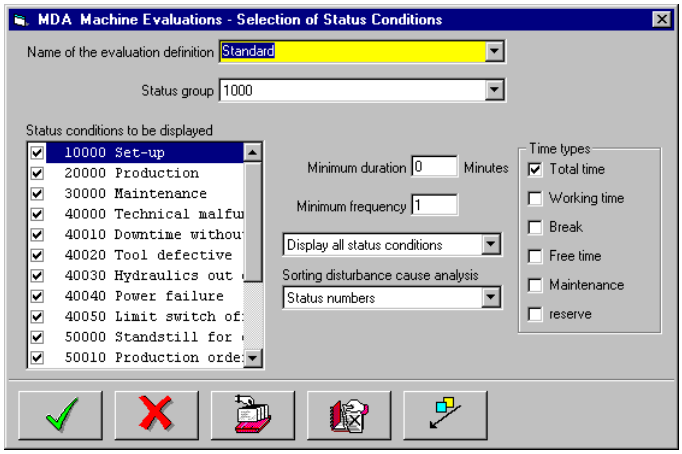


Selections by:

- Machine / Unit resp. Evaluation group
- Period
- Status group
- Individual status
- Duration
- Frequency

You can scroll the screen vertically and horizontally depending on the amount of information displayed.

You can also enter a zoom factor.



Evaluation definition

In the evaluation definition, you can specify and store the status conditions to be included in a specific evaluation (filters). You can also select specific machine status conditions, disturbances, the minimum duration of a machine status, and the minimum frequency and time types.

The machine status conditions and disturbances you can select depend on the status group. This specifies all the possible status conditions of a machine type.

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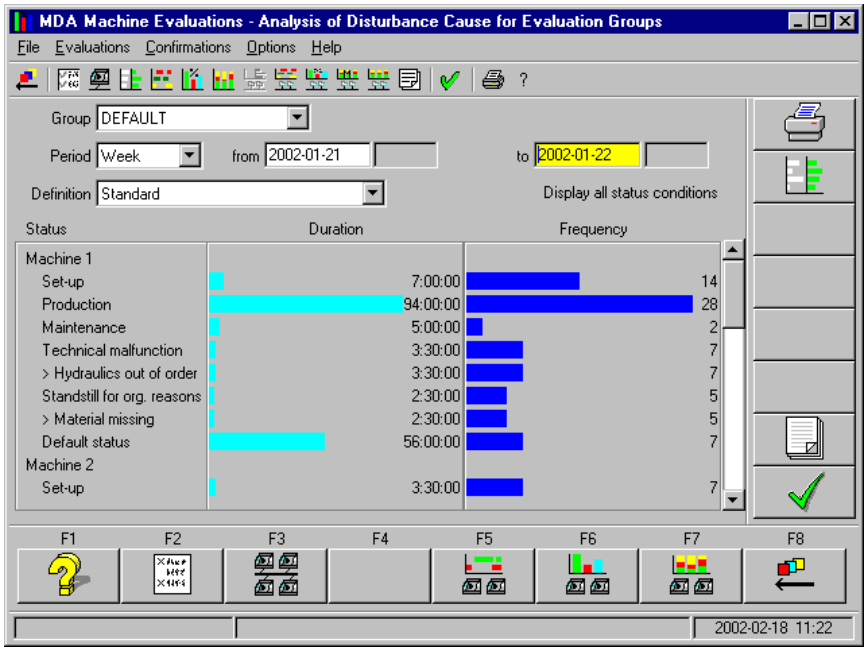
2.5 Disturbance Analysis and Disturbance Analysis for Evaluation Groups

The "Disturbance analysis" menu option displays the duration and frequency of machine status conditions and disturbances for a specific period of time. Since several units or machines are displayed simultaneously, you can compare them directly.

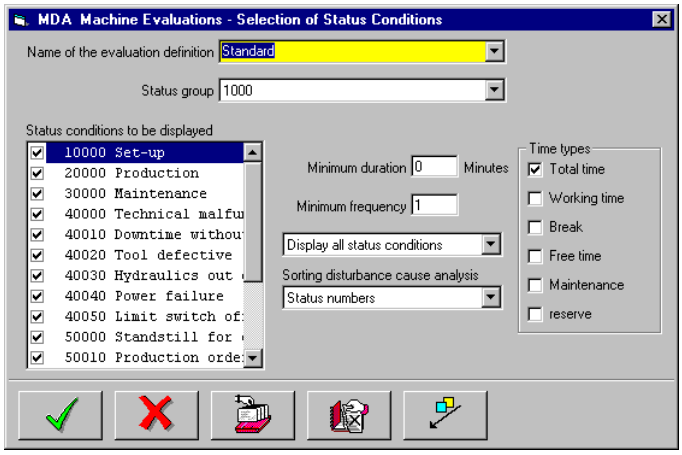


Selections by:

- Machine / Unit resp. Evaluation group
- Period
- Status group
- Individual status
- Duration
- Frequency

You can scroll the screen vertically depending on the amount of information displayed.

You can also enter a zoom factor.



Evaluation definition

As with the status analysis, you can use the filters you have already specified (evaluation definition) or the default filter for the disturbance analysis.

The machine status conditions and disturbances you can select depend on the status group. This specifies all the possible status conditions of a machine type.

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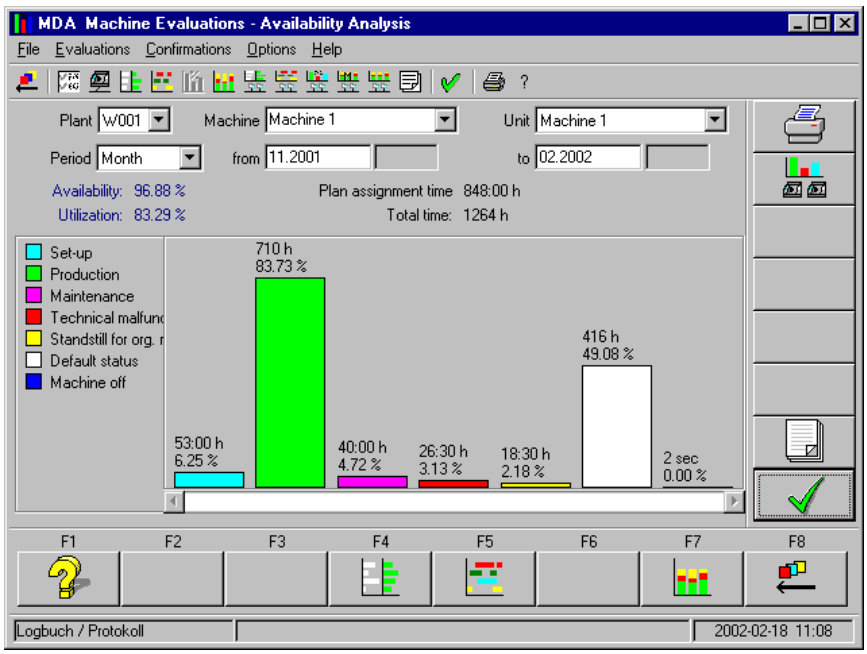
2.6 Availability and Availability for Evaluation Groups

Availability is determined objectively on the basis of the acquired machine data. The calculation for this is described in the following section. The totals of the individual operating status conditions, which form the basis for calculating availability, are displayed as bars. This enables you to verify the calculated result without any difficulty. The group display function offers the following additional options:
The various availability statuses for the main statuses are compressed.

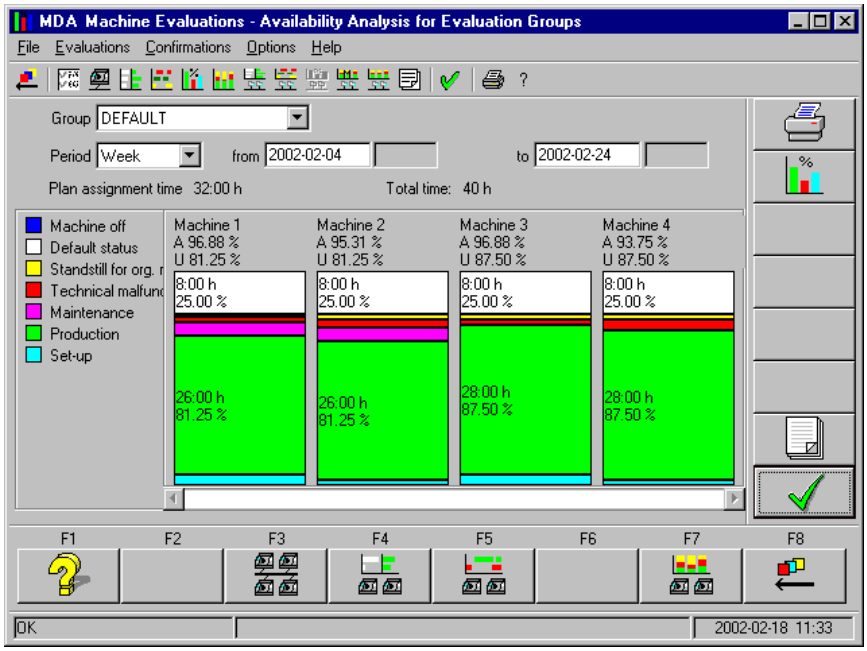


Selections by:

- Machine / Unit
- Period

You can scroll the screen horizontally depending on the amount of information displayed.

The fact that they are displayed in different colors makes it easy to differentiate between the possible statuses.



Selections by:

- Evaluation group
- Period

The machines / units already defined in the selected evaluation group are displayed next to each other, which enables you to compare them directly.

The letters “A” and “U” above the bar graph stand for machine “availability” and “utilization”.

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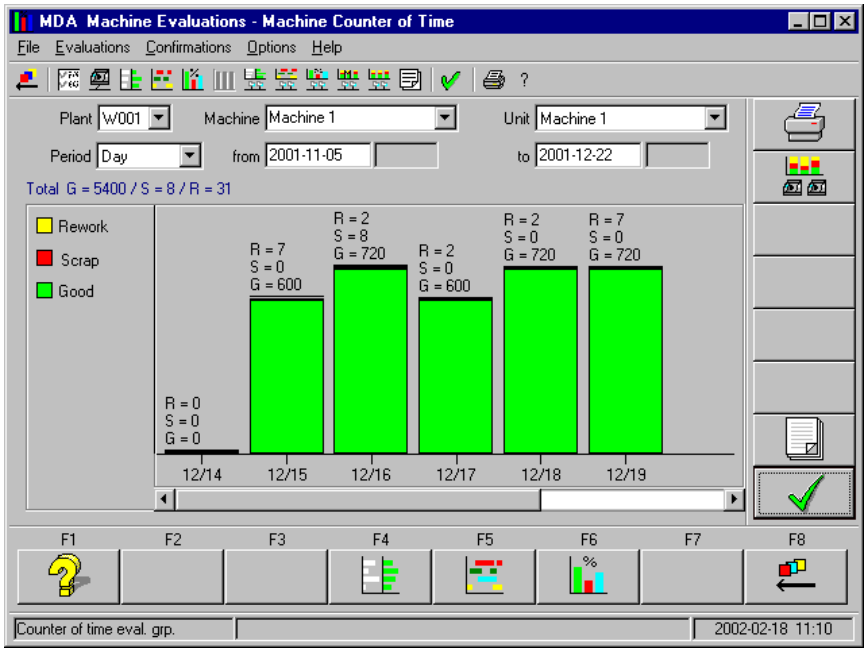
2.7 Machine Counters for Periods

Quantities can be output for a selectable period for individual machines and machine aggregates. The absolute quantities are displayed as histograms in different configurable compression levels (e.g. days, shifts etc.). The quantities are displayed in different colors depending on the quality.



Selections by:

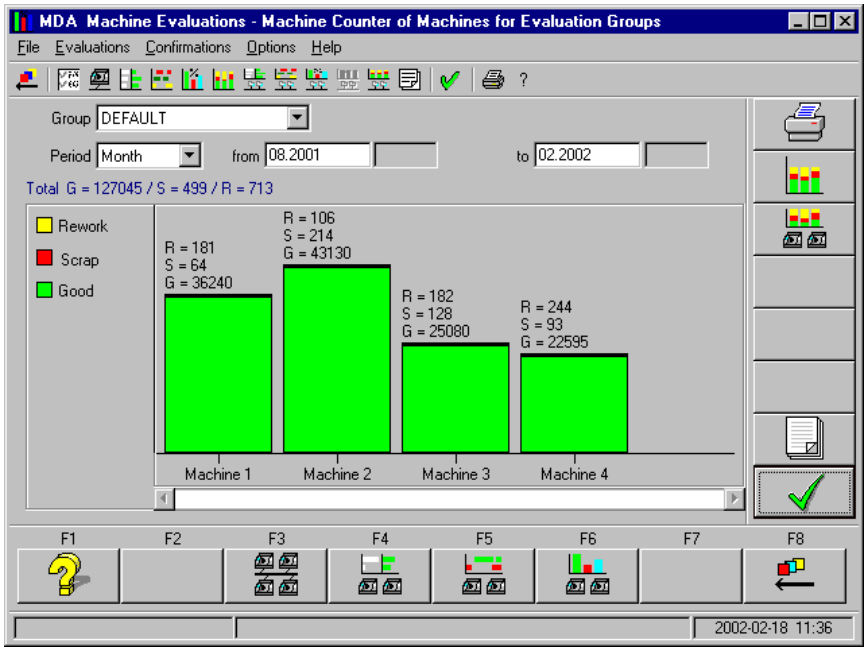
- Machine / Unit
- Period
- Period type

A bar showing the quantities is displayed for the selected machines / units for each time unit.

The total (G), waste (A) and rework (N) quantities are displayed above the bars.

2.8 Machine Counters for Machines of Evaluation Groups

Quantities can be displayed for evaluation groups for a configurable period. The absolute quantities are displayed in the form of a histogram per machine/unit. The quantities are displayed indifferent colors depending on the quality.



Selections by:

- Evaluation group
- Period
- Period type

A bar showing the quantities is displayed for the selected machines/ units per time unit.

The total (G), waste (A) and rework (N) quantities are displayed above the bars.

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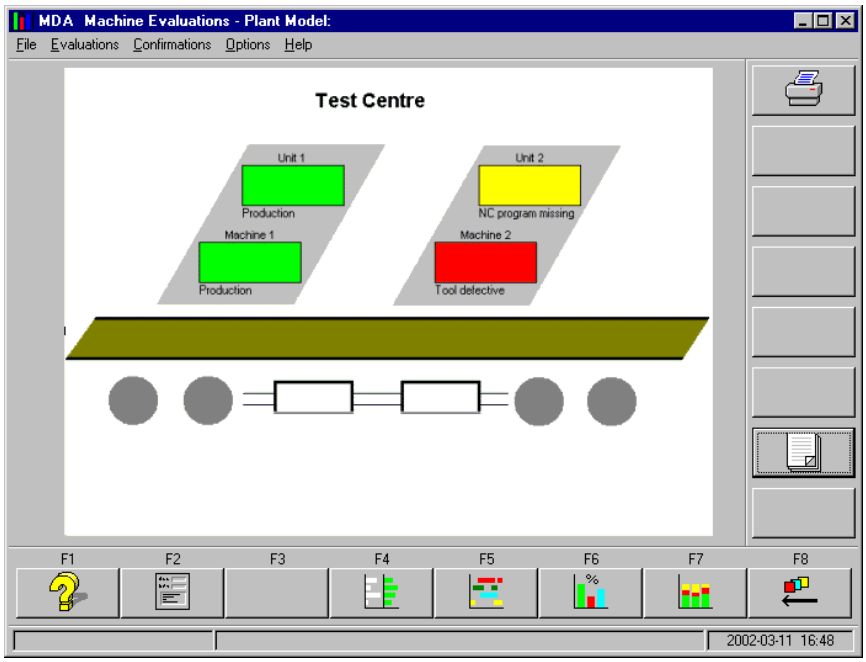
2.9 Plant Model

MCIS MDA Machine allows the creation of a simple plant model with one or more machines both on the acquisition stations and on the supervisor PC.

ACHTUNG:

This function is not available on the SINUMERIK due to resource problems.



- Background bitmap
- One symbol for each machine and unit
- Description of the machine/unit above the symbol
- Color-coded status conditions
- Status texts

The current status condition of the machine or unit is represented in the plant model by a given color in the display. The status text can optionally be output below the symbol.

The position and size of each machine and unit symbol in the plant model is determined when customizing the stations.
You can also draw a background bitmap to display further statistical details about the plant. This background bitmap is loaded into the plant model by the system so that the machine and unit symbols can be drawn.

The plant model is one-dimensional, i.e. there is no picture hierarchy. These functionality is provided in a detailed manner by the server based components **MCIS MDA Cell** and **MCIS MDA Plant**.

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3 Part Type Evaluations

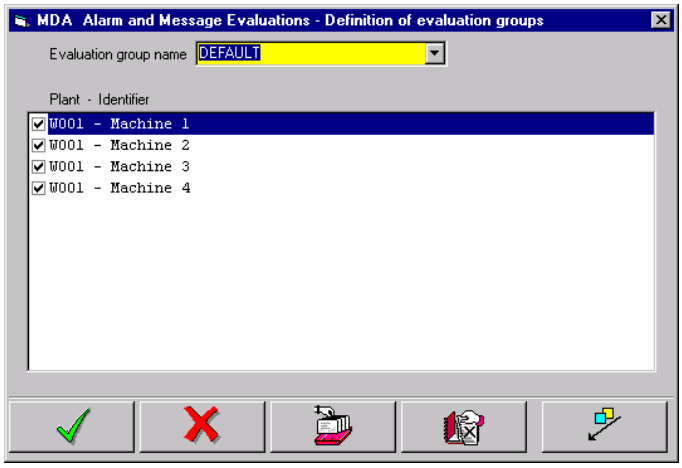
MCIS MDA Machine part type evaluations provide a user interface that can be used to conveniently evaluate manufactured quantities on machines and units. Comprehensive selection and combination facilities are provided: You can define and filter the part types in accordance with your individual preferences, combine machines and aggregates to form selection groups and determine the period type that is being examined.

It is also possible to display OEE indicators for individual machines/units and evaluation groups. The calculation and display of the OEE indicators takes availability, utilization, performance and quality into consideration, and also Mean Time To Repair (MTTR) and Mean Time Between Failures (MTBF). If you prefer graphics, the progress of the OEE indicators can be displayed in graphical format rather than in a table.

The results of the product data acquisition and evaluations can also be clearly shown in the log, logbook and statistics and, like other evaluations, exported or printed for documentation purposes.

3.1 Evaluation Group Definition

The evaluations described in the following sections allow individual machines and units to be analyzed and direct comparisons of these components made. Any combination of machines and units can be defined in the form of evaluation groups and stored for repeated analyses.



Evaluation Group Definition

Machines and units for selecting evaluations are combined, named and saved in the group definition.

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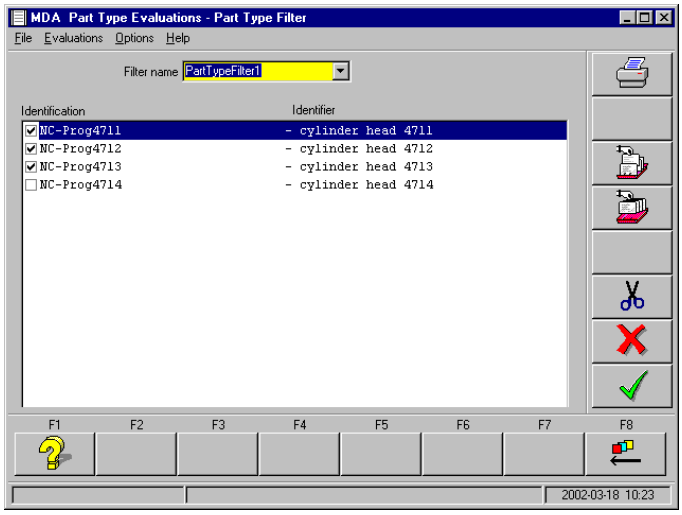
3.2 Part Type Filter Definition

Filters containing a number of part types can be defined. These filters are used in the part type list, the quantity evaluations and the logs and statistics.



Part Type Filter Definition

The list contains the part types. The part types belonging to the filter have a check mark in the check box.

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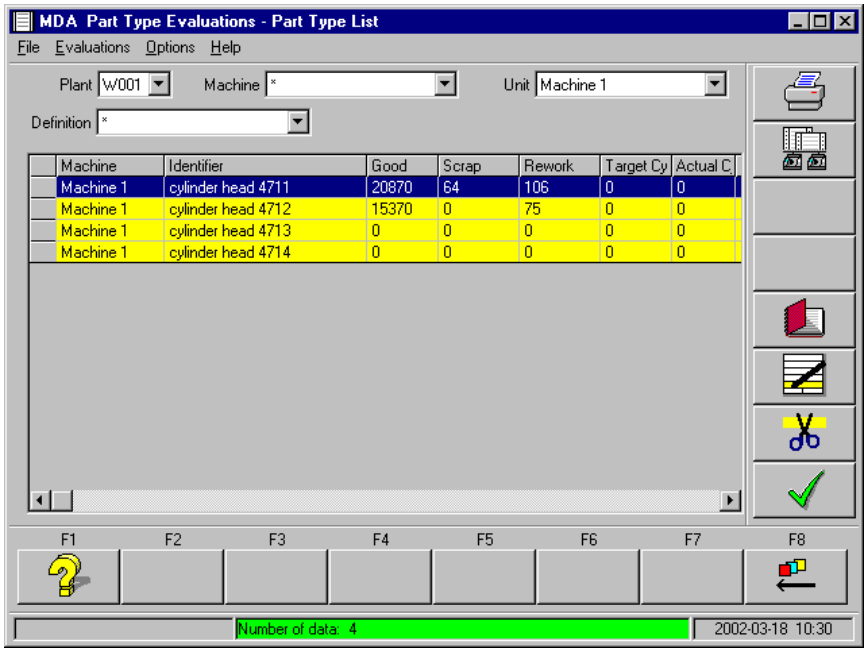
3.3 Part Type List

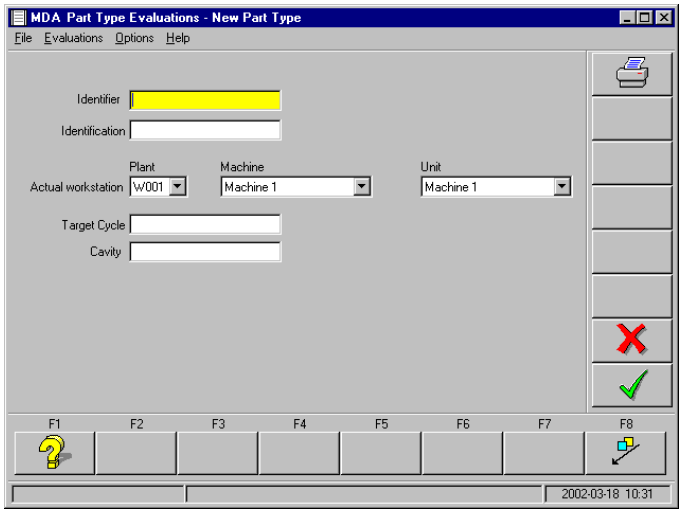
The **Part Type List** screen form allows you to display the quantities and evaluations for certain part types for individual machines or units. You can also switch to the screen form for creating and editing the part type master data or delete a part type in the screen form.



Selections by:

- Machine / Unit
- Part type / Part type filter

The table then shows you the quantities for the selected part types, categorized according to quality, target and actual cycle time, cavity and processing status.



Part Type Definition

This is where the name, identification, target cycle time and cavity of the new part type are defined and assigned to a machine/unit.

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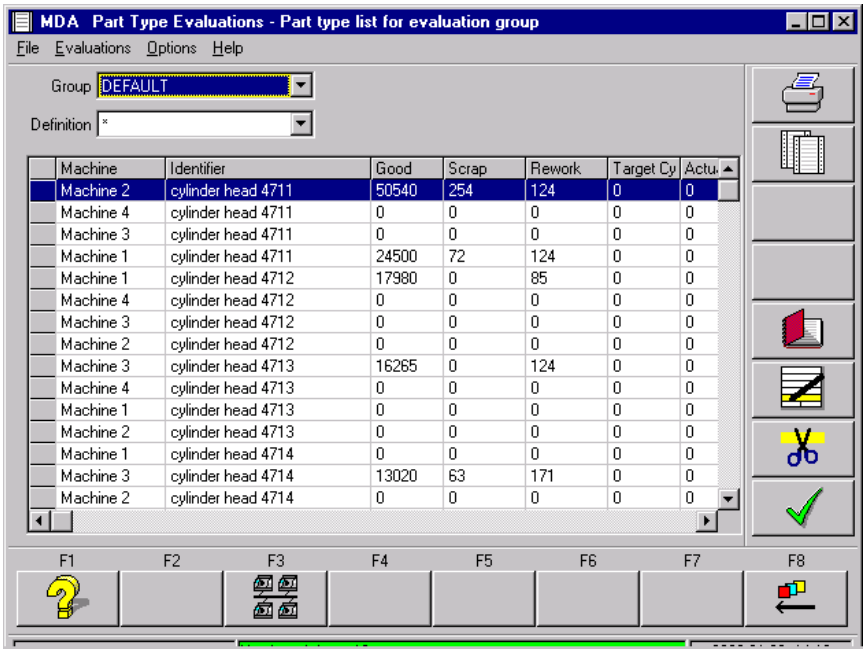
3.4 Part Type List for Evaluation Groups

The **Part Type List for Evaluation Groups** screen form can be used to display the quantity evaluations for a group of machines depending on the license. This allows a direct comparison to be made between several machines.



Selections by:

- Evaluation group
- Part type / Part type filter

The table shows you the quantities for the part type or part types in the selected filter, categorized according to quality, target and actual cycle time, cavity and processing status for all machines in the selected evaluation group.

3.5 OEE Indicators and OEE Indicators for Evaluation Groups

OEE indicators for individual machines/units or evaluation groups can be displayed in graphical or tabular format for any compression period. The OEE indicators are calculated using an external program, which calculates the utilization, availability, capacity, quality, OEE indicator, MTBF (Mean Time Between Failures) and MTTR (Mean Time To Repair).

If part type acquisition has not been enabled in your **MCIS MDA Machine** configuration, the OEE indicators may still be displayed in part type evaluations. The calculation is being done based on the machine data.

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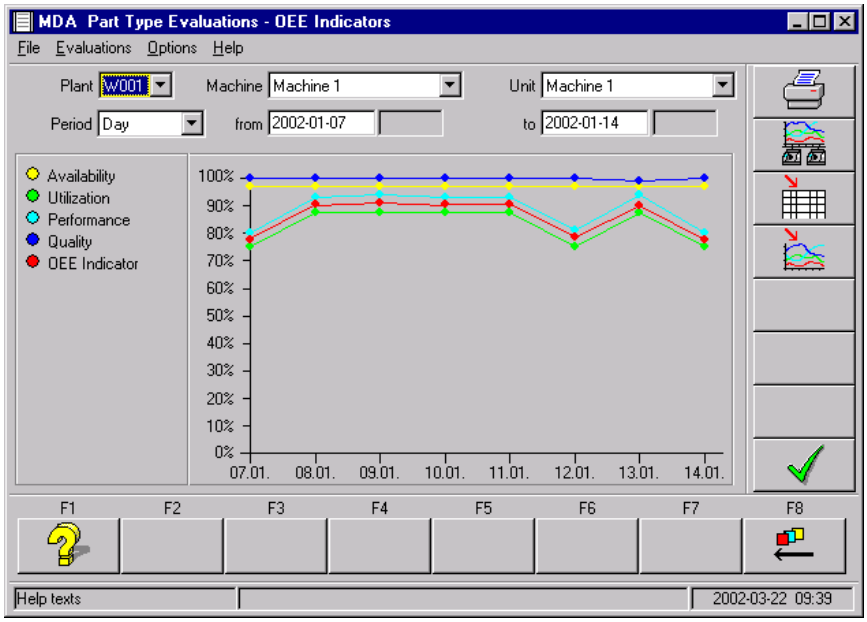
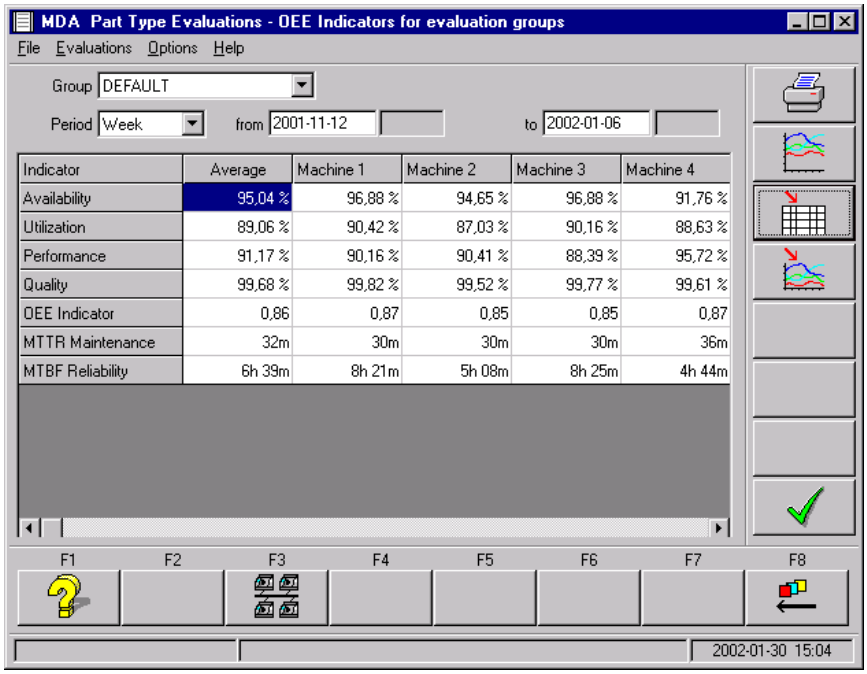


Selections by:

- Machine / Unit
- Period
- Period type

The graphical display shows the chronological progress of availability, utilization, capacity, quality and OEE indicator for the selected machine in percent. The unit of measurement on the x-axis corresponds to the selected period type.

The table for the graphical display also displays the Mean Time To Repair (MTTR) and Mean Time Between Failures (MTBF).



Selections by:

- Evaluation group
- Period
- Period type

The tabular representation shows the OEE indicator evaluation group for each machine/unit over the time period. The averages are also displayed.

The graphical representation shows the chronological progress of the OEE indicators. The OEE indicators are calculated for each period over all machines/units in the evaluation group, entered in the graphical display and connected to the previous value by a line.

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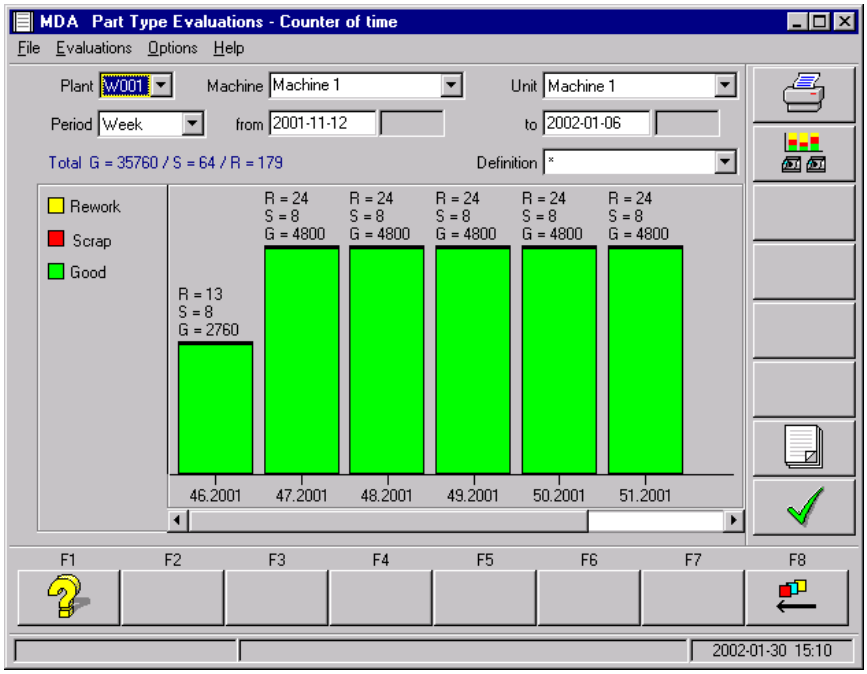
3.6 Part Type Counters for Time Intervals

Quantities can be displayed for individual machines or units for a configurable period. The absolute quantities are displayed in a histogram in different configurable compression levels (e.g. in days, shifts etc.). The quantities appear in different colors depending on the quality thereof.



Selections by:

- Machine / Unit
- Period
- Period type
- Part Type / Part Type Filter

A bar is displayed for the selected machines/units per time unit together with the quantities.

The total (G), waste (A) and rework (N) quantities are displayed above the bars.

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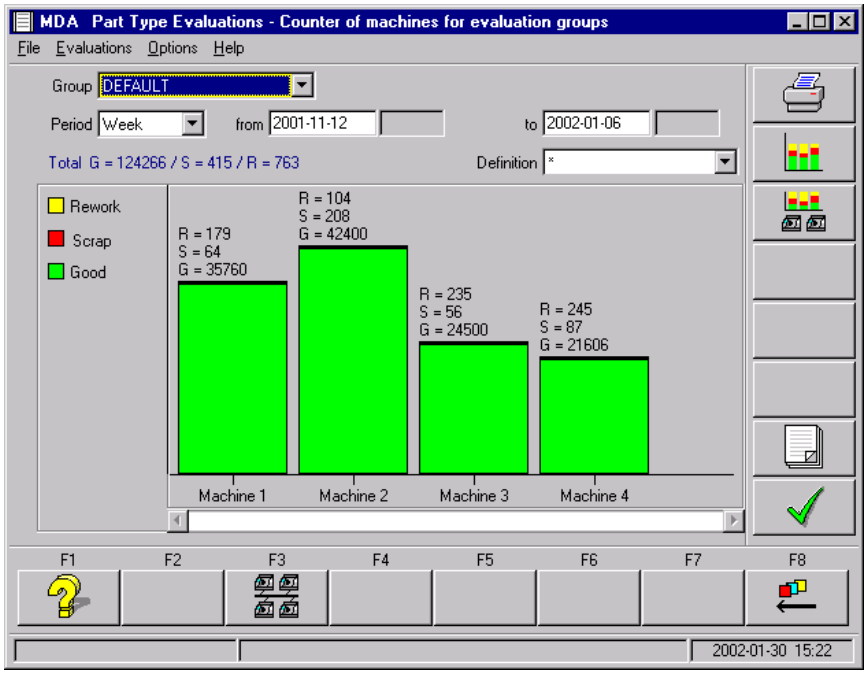
3.7 Part Type Counters for Machines of Evaluation Groups

Quantities can be displayed for evaluation groups for a configurable period. The absolute quantities are displayed in a histogram in different configurable compression levels (e.g. in days, shifts etc.). The quantities appear in different colors depending on the quality thereof.



Selections by:

- Evaluation Group
- Period
- Period type
- Part Type / Part Type Filter

A bar is displayed for the selected evaluation group per machine/unit together with the quantities.

The total (G), waste (A) and rework (N) quantities are displayed above the bars.

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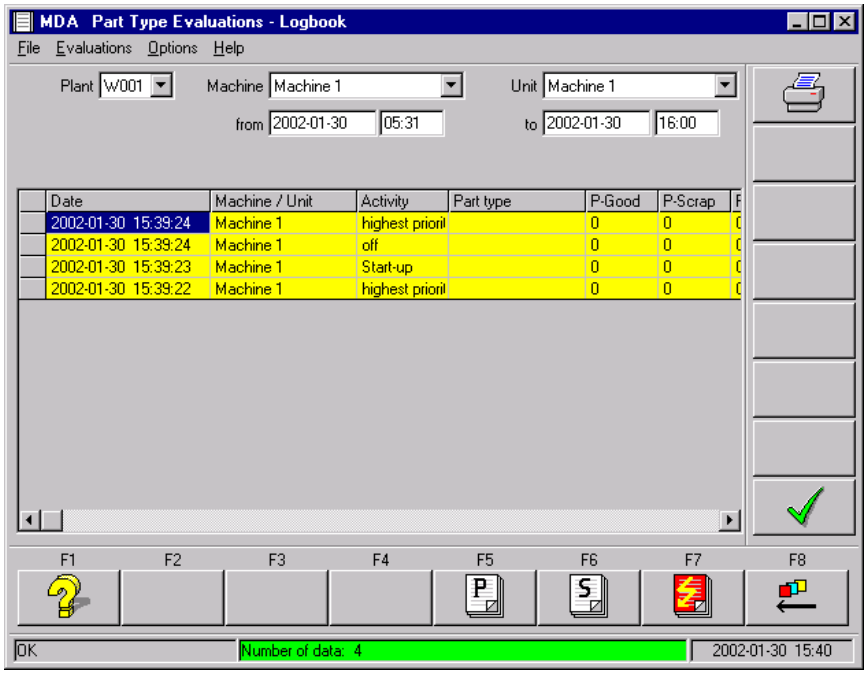
3.8 Logbook

The actions, the number of manufactured items according to quality, the target cycle time, the actual cycle time, the status and the priority are recorded in the logbook for all machines/units and part types. The logbook can be viewed in the **Logbook** screen form, in which the entries for individual machines/units can be displayed in tabular format for a selected period.



Selections by:

- Machine / Unit
- Period

The table contains a record for each action for the selected machine.

The width and order of the columns can be configured according to requirements.

The sorting order and number of records in the log are also configurable.

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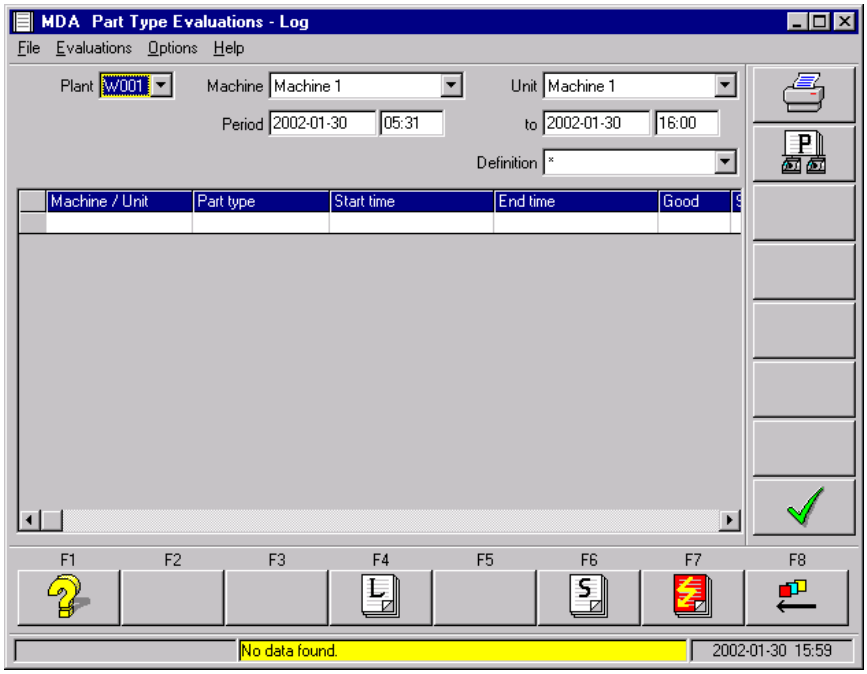
3.9 Log and Log for Evaluation Groups

The part types manufactured on a particular machine or evaluation group can be viewed in the **Log** and **Evaluation Groups Log** screen form. By default, it contains a summary of the start and end of processing, the processing time, the number of manufactured parts according to the quality, target cycle time and actual cycle time for the selected part types.



Selections by:

- Machine / Unit resp. Evaluation group
- Period
- Part Type / Part Type Filter

The table contains a record per part type and start / end of processing for the machine / unit.

The fields displayed in the log, the order and width of the individual columns, the sorting order and the number of records kept in the log are configurable.

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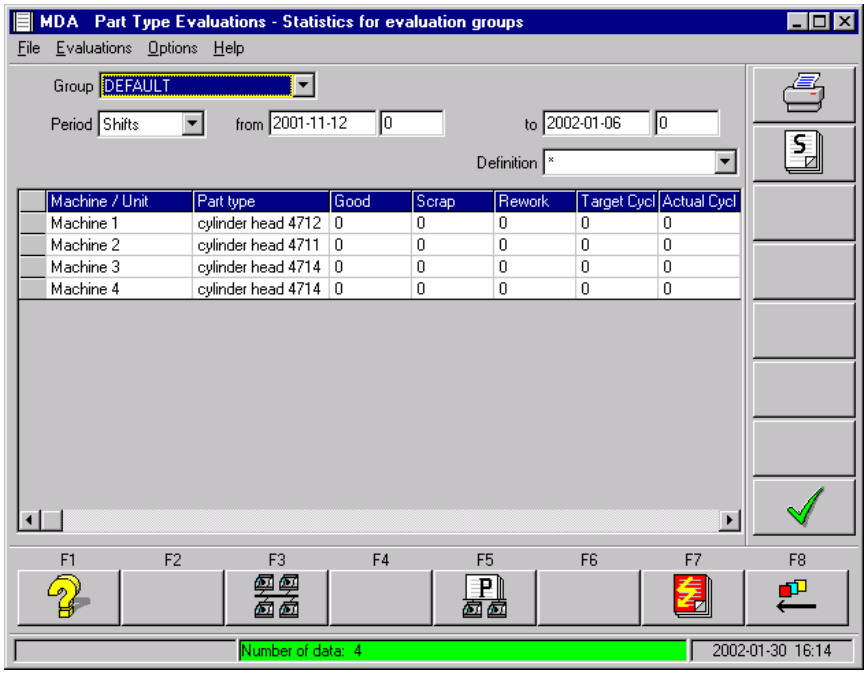
3.10 Statistics and Statistics for Evaluation Groups

Statistics for part types manufactured on a certain machine or evaluation group (depending on license) can be displayed. By default, these statistics compress the processing time and the number of manufactured parts according to quality, target cycle time and actual cycle tine for the selected part types.



Selections by:

- Machine resp. Evaluation group
- Period
- Period Type
- Part Type / Part Type Filter

The table contains a record per part type and start/end of processing for the machine/unit.

The fields that are displayed, the order and width of the individual columns and the sorting order of the records are configurable.

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4 Alarm Evaluation

ATTENTION:

The following functions and user interfaces mentioned in the following chapters are ONLY available on SINUMERIK, not on standard PCs, SIMATIC panel PCs and so on.

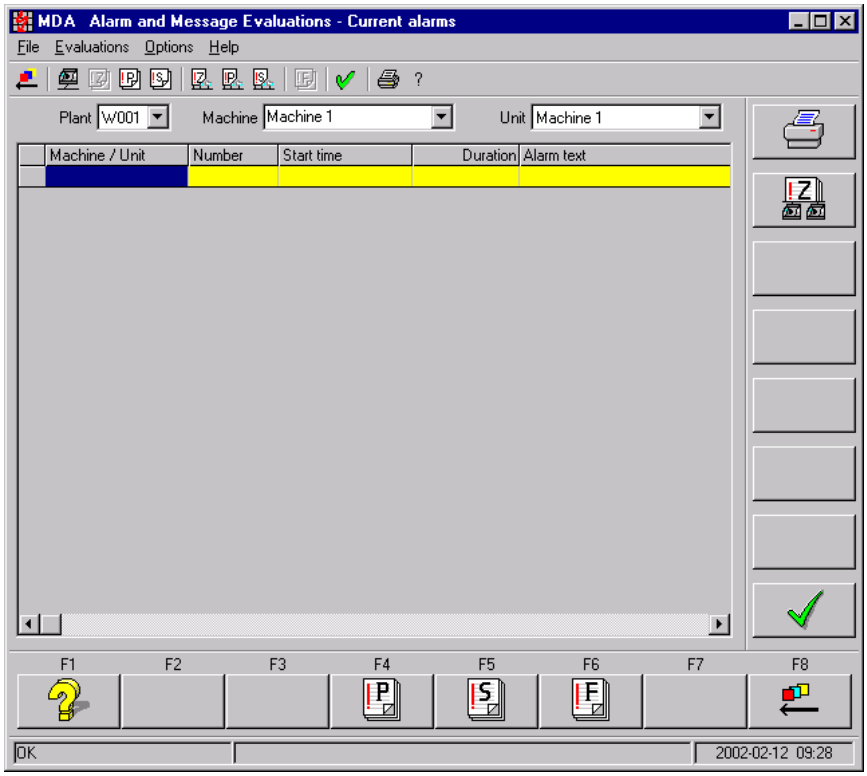
There is an optional feature in **MCIS MDA Machine** to acquire and evaluate alarms and messages automatically.
The alarms and messages are not acquired by means of a data block, but instead are tapped directly from the alarm/message buffer (proto.txt) by the SINUMERIK system.

Customizing allows you to apply the general and user-specific alarm texts from the SINUMERIK to the alarm numbers of MCIS MDA Machine; a configurable alarm acquisition filter specifies which alarm and message numbers are to be acquired from SINUMERIK in the MCIS MDA Machine system.

You can access machine data evaluations directly from the operator panel. Easy-to-use evaluation definitions help you create selection criteria and allow you to carry out individual analyses. For documentation purposes it is possible to send the evaluations to a printer configured under Windows such as a network printer or export the evaluations to Excel.

4.1 Current Alarms and Current Alarms for Evaluation Group

Acquired alarms and messages are stored in the database. The current alarms and messages can be displayed for individual machines or for evaluation groups (depending on license).



Selections by:

- Machine resp. Evaluation group

The fields to be displayed and the column order can be configured.

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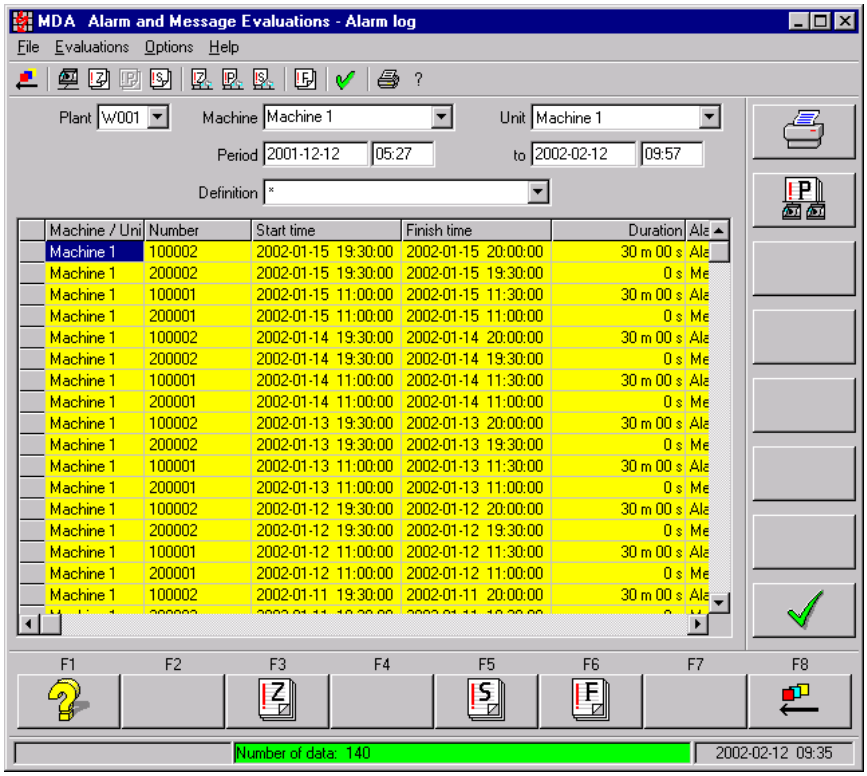
4.2 Alarm Log and Alarm Log for Evaluation Groups

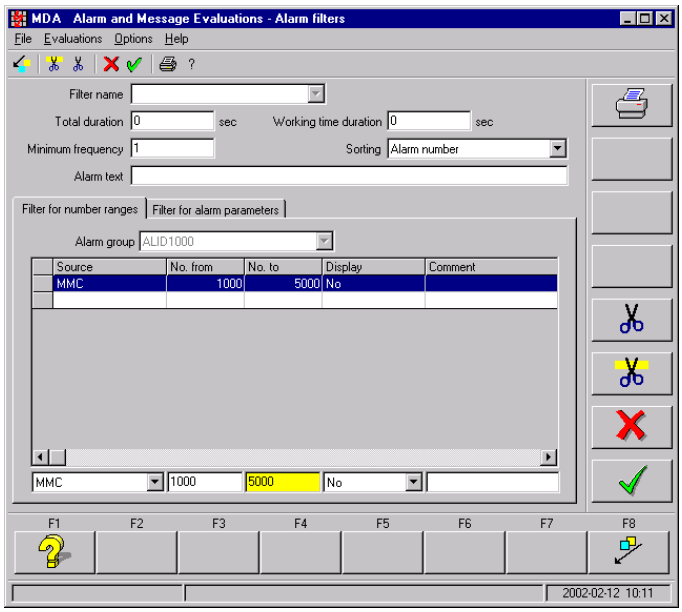
The acquired machine events are stored in a log, which can be used to document the production process (production verification) or to carry out specific evaluations. The machine events are entered in the log with their "in" and "out" times.



Selections by:

- Machine resp. Evaluation group
- Period
- Alarm Filter

You can configure the fields displayed in the log, the sequence and width of the individual columns, as well as the sort order and number of records managed in the log.



Customizing an alarm filter

You can create several alarm filters.
You specify the criteria for selecting alarms and messages in the alarm filters and also specify how data is sorted in the screen form.

The alarms can be filtered by minimum duration, minimum frequency, alarm text, number ranges and also based on parameter values.

Sorting can be carried out by alarm duration, alarm frequency, alarm start time and alarm number.

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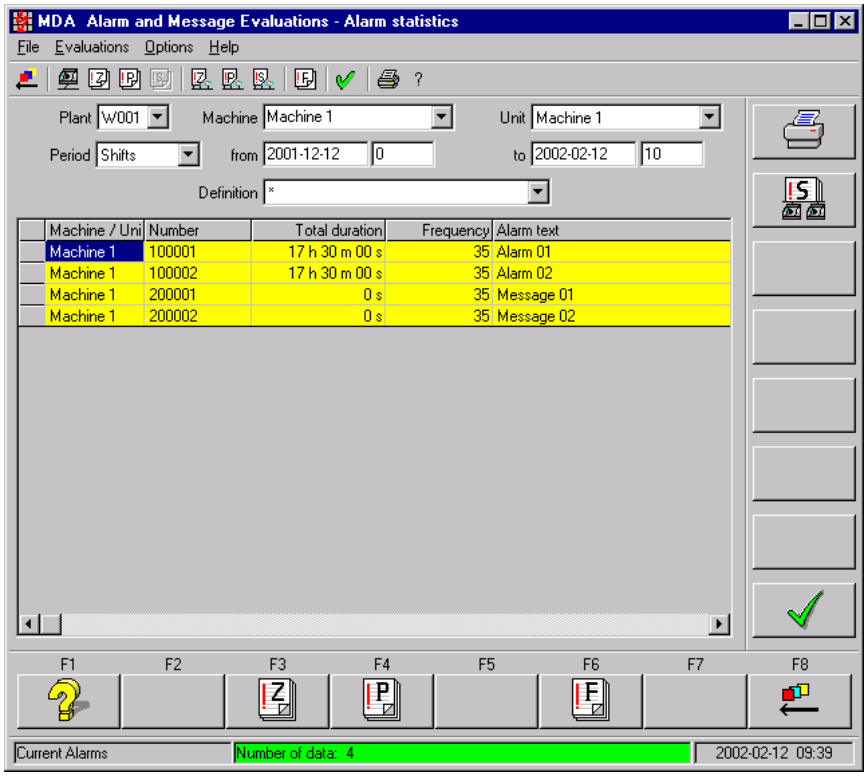
4.3 Alarm Statistics and Alarm Statistics for Evaluation Group

The alarms and messages in the log are summarized as shift, day, week, month and year tables. The summarized data is displayed as totals in the alarm statistics for individual machines and units or for evaluation groups. Per alarm/message the total duration and total frequency is output for the evaluation period.



Selections by:

- Machine resp. Evaluation group
- Period
- Filter name

You can configure the fields displayed, the sequence and width of the individual columns, the number of records maintained in the log per summary period.

The same alarm filters can be applied as in the alarm log.

ATTENTION:

An evaluation by shifts is only available if the software includes the works calendar.

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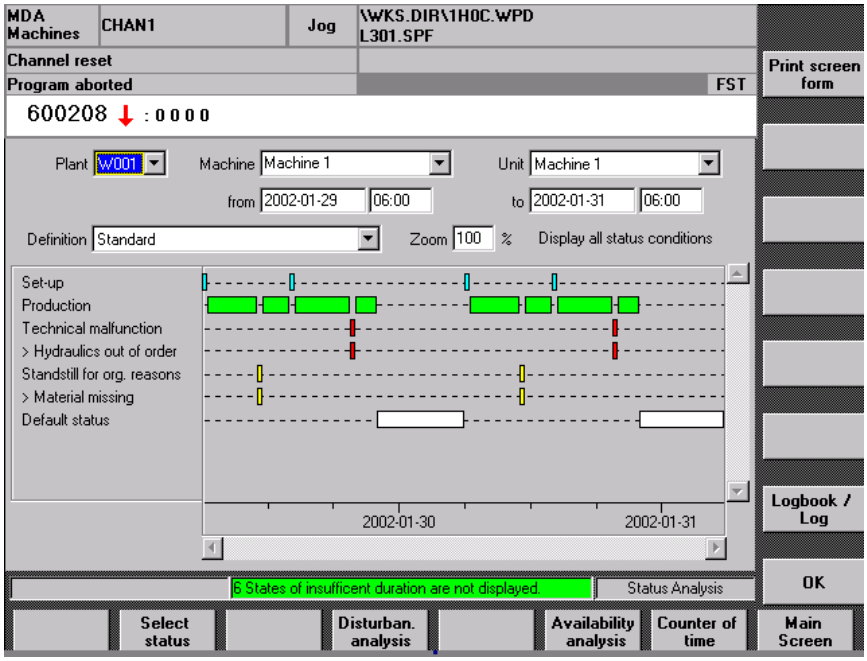
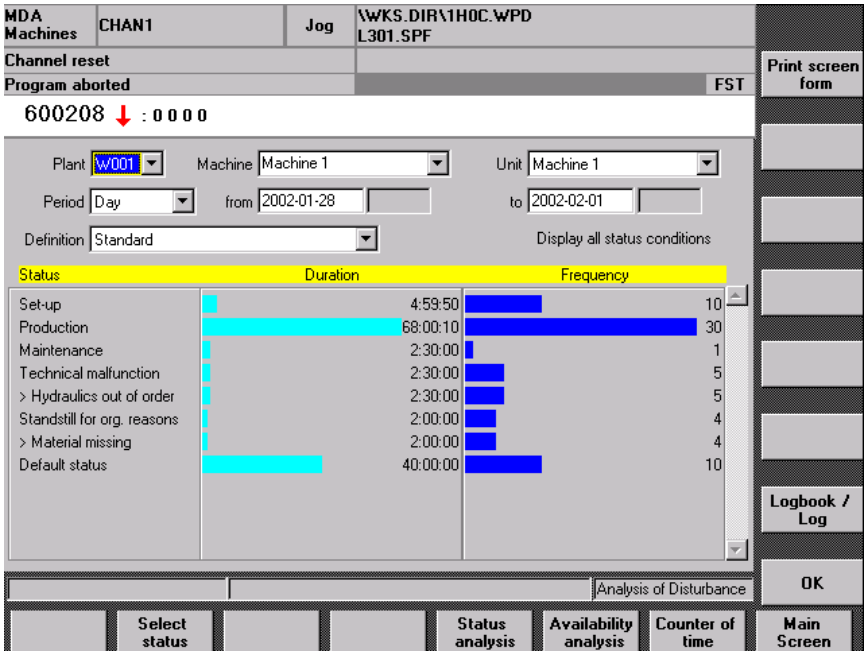
5 Screen Form Layout on the SINUMERIK

Previous chapters show the screen forms with the layout available on standard PCs, SIMATIC panel PCs etc. These screen forms are also integrated in the SINUMERIK Human Machine Interface (HMI) and convey the “look and feel” of this interface. Because of specific design rules on the SINUMERIK (windows, button texts etc.) the layout there differs in some kind as you see in the following examples.



Example:

Status analysis



Example:

Disturbance analysis

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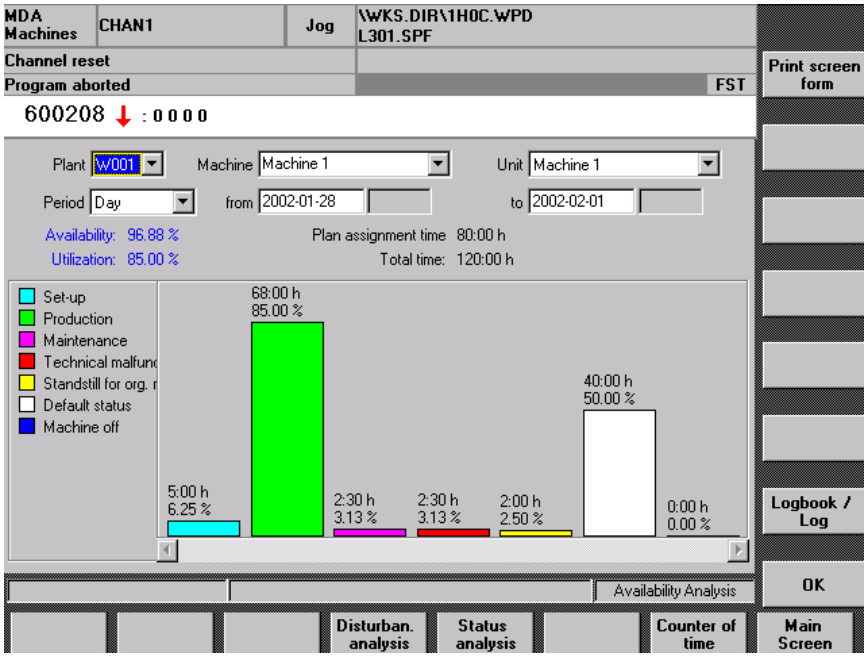
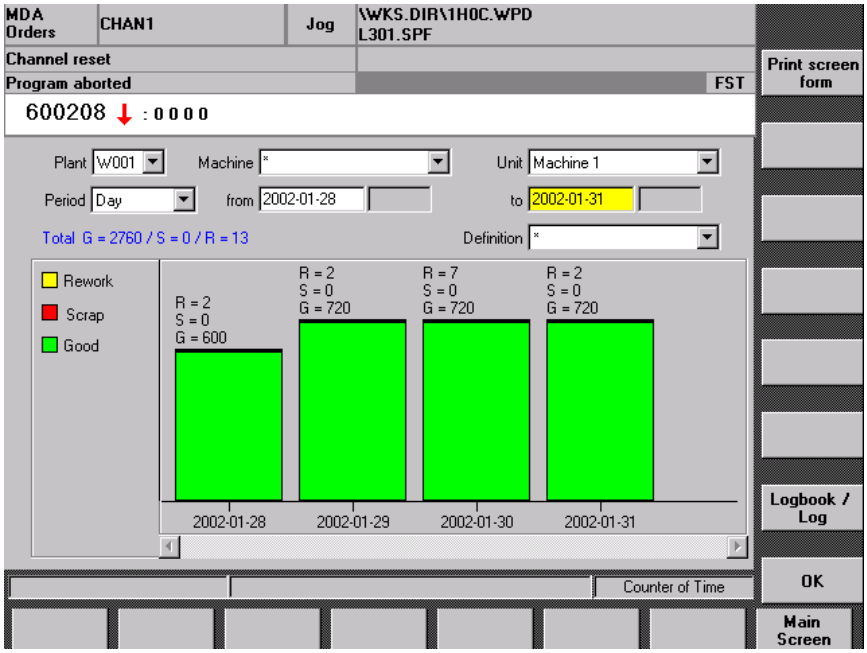


Example:

Availability analysis



Example:

Machine counter

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6 Data Acquisition

Both machine data and production data is acquired.

6.1 Machine Data Acquisition

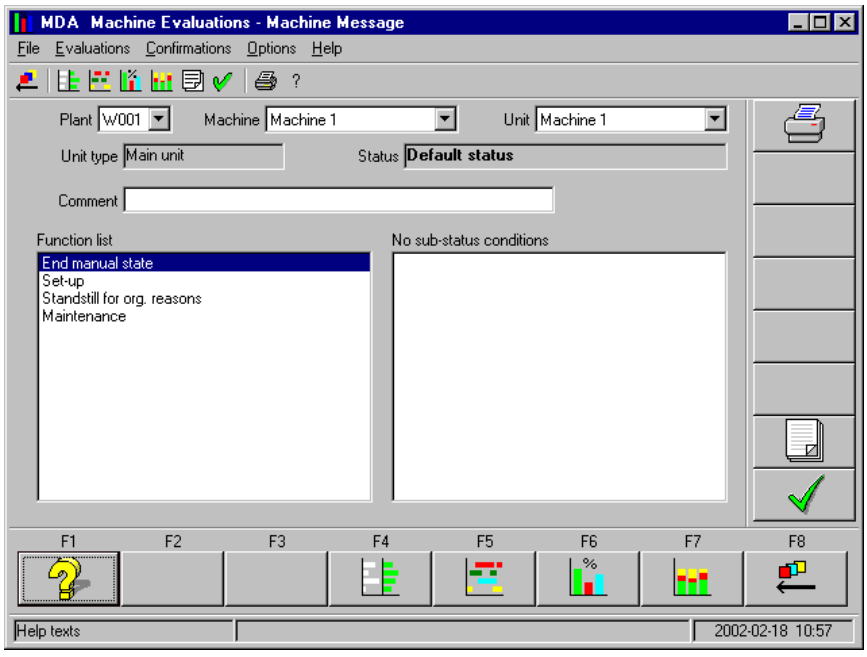
You can acquire machine data both manually and automatically.

Acquiring machine data manually allows you to enter machine status conditions and disturbances that cannot be acquired automatically (e.g. maintenance). This is the only case in which you have to enter information manually for machine data acquisition.

Automatic machine data acquisition extracts machine information from the PLC via an OPC interface. A standard interface (e.g. data block 13) is available in the PLC for this purpose. This data block must be supplied individually by the PLC program depending on the information required.

6.1.1 Manual Machine Data Acquisition

The "Machine message" dialog enables you to enter machine status conditions and disturbances manually that cannot be acquired automatically. These include organizational disturbances, and operating status conditions such as maintenance or setup. You can enter an explanatory comment for each action, which is also recorded in the logbook.



Selections by:

- Machine / Unit
- Machine status

You can select the machine status or disturbance from a list.

You can use a status group to configure the machine status conditions and disturbances that can be entered.

You can assign the status group to individual machines, thereby minimizing the time and effort required for configuration.

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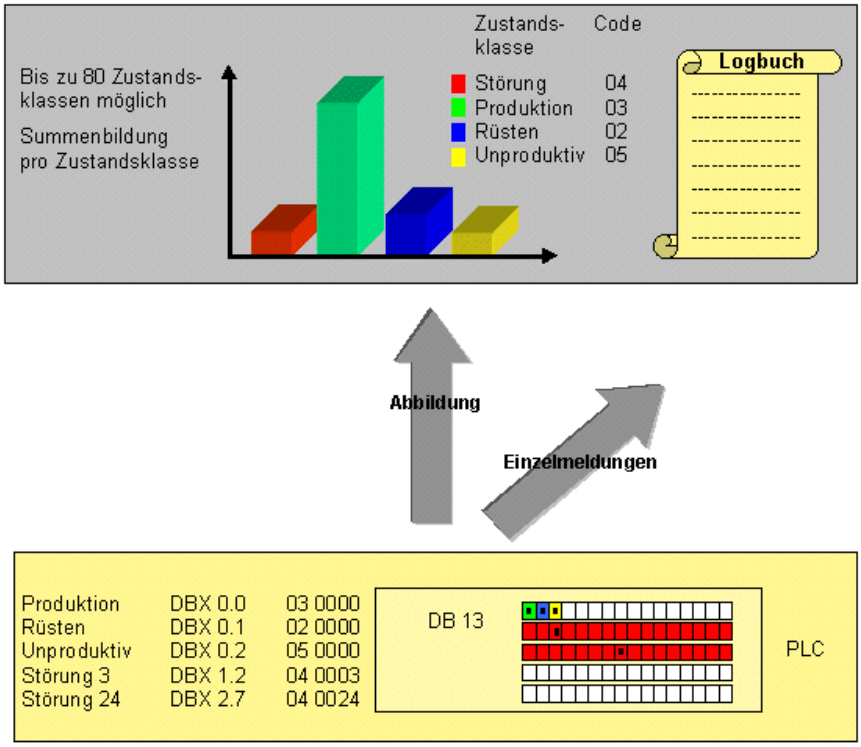
6.1.2 Automatic Machine Data Acquisition

With automatic machine data acquisition, the PLC interface is used to carry out detailed disturbance diagnostics and evaluations. In data block 13, you can define individual machine status conditions and disturbances. In this connection, a bit corresponds to a machine status or a disturbance. The DB13 designation naturally only serves as an example.

Dependent on license the bit strip in the data block can be subdivided according to logical units of a machine. You can define up to 128 machine status conditions and disturbances for each unit.

For implementation with ProTool/Pro, an interface optimized to have the right size for an MDC (machine data cluster) data block that only contains a machine without a unit.

The data block is supplied by the machine manufacturer's PLC program. This enables parallel machine status conditions and disturbances to be acquired, thus supporting disturbance analyses. **MCIS MDA Machine** reads out and logs the data block cyclically. The cycle time can be configured as required.



Picture: principle of mapping of status conditions to log and status class

Using the configuration functions, you can assign a six-digit numeric code to each bit used in the data block. This numeric code can be used to form a two-digit status group (e.g. disturbance). At the same time, the status remains coded in a unique four-digit form. Refer to the Commissioning Guide for a detailed description.
If of one of the configured bits in data block 13 changes, a single message is entered in the logbook (start or end of status).

In the graphic evaluation, you can total the time at the status class level (e.g. disturbance, production, setup, unproductive), or at the individual status level (e.g. disturbance 3).

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6.1.3 Standard Acquisition on the SINUMERIK

When deploying **MCIS MDA Machine** on the SINUMERIK, you can determine a machine status condition from the following standard control variables.

- Operating mode
- Program status
- NCU alarm
- Number of alarms

The following machine status conditions can be derived from these variables:

- JOG mode
- MDA mode (MDA: Machine Data Acquisition)
- Production
- Organizational disturbance
- Disturbance (PLC)
- Disturbance (NC/PLC)

The automatic machine data acquisition is part of the standard configuration and can be deployed without additional customizing or programming effort (similar to Plug and Play).

An advantage of this interface is the fact that the machine manufacturer has not the need of supplying data in a data block by the PLC. This results on the other hand in the abandonment of the acquisition of other machine-specific status conditions.

6.2 Product Data Acquisition

All production data is acquired automatically for example in a data block (DB14).

The PDC cluster (PDC = Production Data Cluster) contains the part type-specific data for exactly one machine.

Only one PDC cluster can be defined for **MCIS MDA Machine** on the SINUMERIK.

Up to 8 PDC clusters for up to 8 machines can be defined for **MCIS MDA Machine** for ProTool/Pro, WinCC and SIMATIC Computing on SIMATIC panel-PCs or standard PCs, all depending on the current license.

MCIS MDA Machine evaluates the coordination word, the order ID, the counters (good, waste and rework) and the cycle time counters (target and actual processing times) in the PDC cluster and records these data in the database to obtain the corresponding part type-specific evaluations.
You will find this principle in the following diagram.

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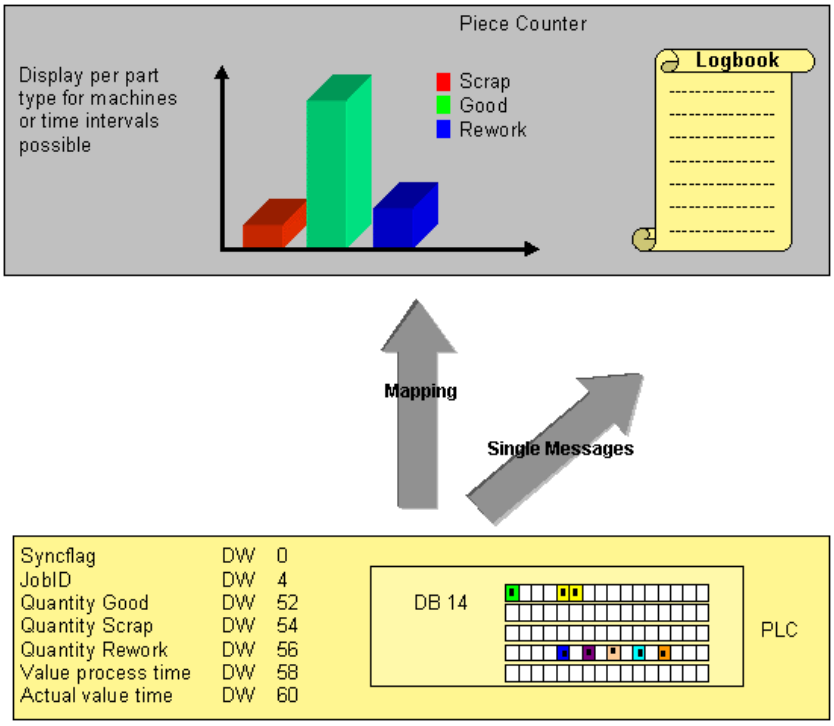

Picture: principle of the mapping from counters to log and total quantities

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7 Works Calendar

MCIS MDA Machine can be optionally used with a works calendar.

You can define working time models with shifts and assign every machine to the appropriate working time model with the works calendar. The data is acquired for each shift and summarized by **MCIS MDA Machine** per shift. Without works calendar the summary is done on a daily basis.

ATTENTION:

The works calendar user interface is not available for single machine licenses.

The basic elements of the works calendar are shift types and day types.

The shift types allow you to specify various shift patterns, i.e. the sequence of work periods and breaks as well as free shifts.

The following is defined for each day type in the working time model:

- the number of shifts and
- the shift type of each shift

The calendar defines on what days of the year what day type is valid.

By assigning a day type to each calendar day and assigning a working time model to each machine, you can determine what machine is working in what shift at any time.

- Working day
- Free day
- ...

- Early shift
- Late shift
- Night shift
- ...

- Standard 3 shifts
- Standard 2 shifts
- ...

Each day in the calendar is assigned a day type.

The definition of the works calendar can be carried out locally on the acquisition stations if available, or centrally from the supervisory level with MCIS MDA Cell or MCIS MDA Plant.

If the works calendar is managed centrally, there is a menu function to download the current works calendar data to the acquisition stations.

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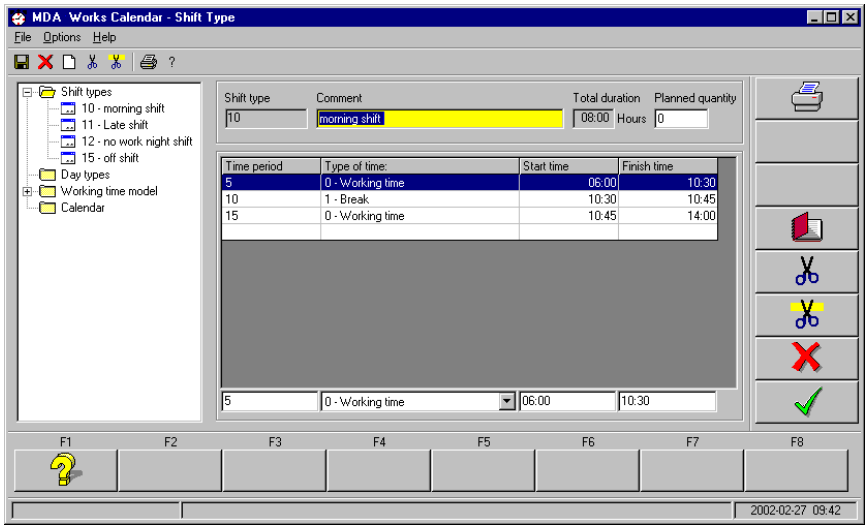
7.1 Shift Types

Every shift type consists of one or more time periods. Each period can be working time, a break period or free time.



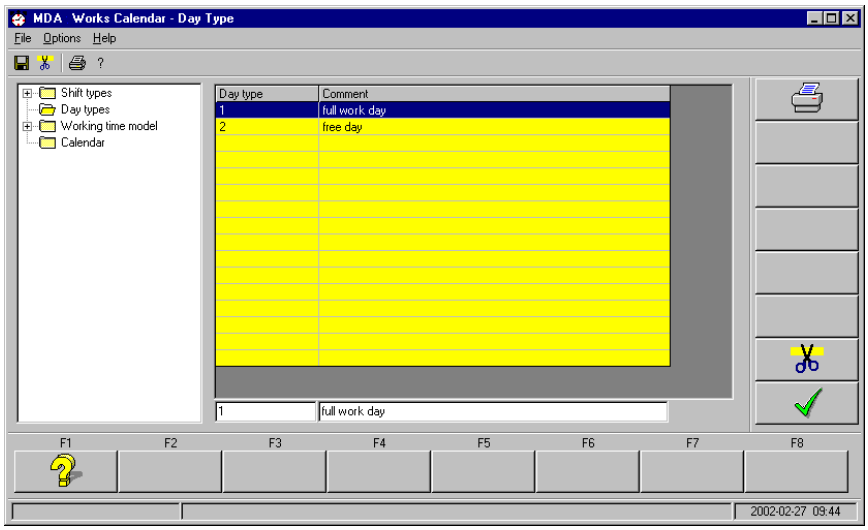
You can specify a planned quantity for each shift.

Time types:

- Working time
- Break times
- Free time

7.2 Day Types

The types of day connect the calendar with the working time model.



Each date in the calendar is assigned a day type and--in the working time model--each day type is defined according to the shift pattern which corresponds to this day type assigned to it.

You can define up to 16 different day types.

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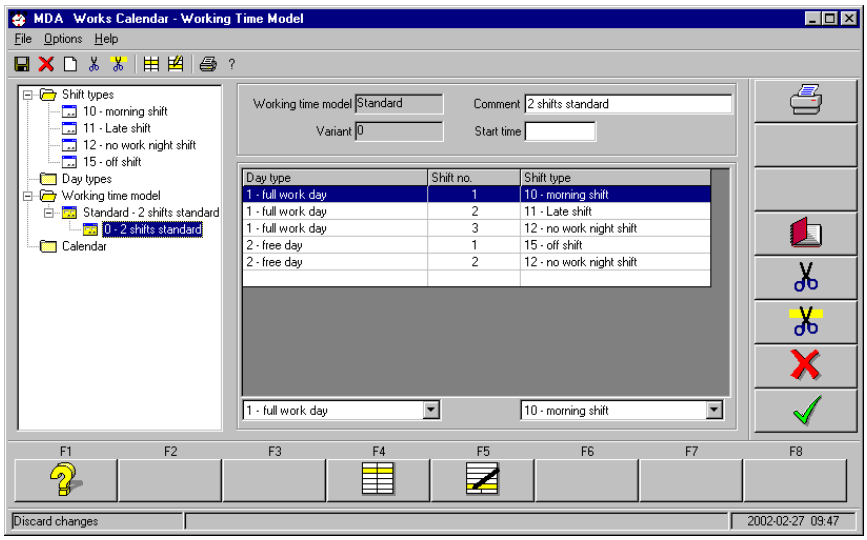
7.3 Working Time Model

The following is defined for each day type in the working time model:

- the number of shifts and
- the shift type of each shift



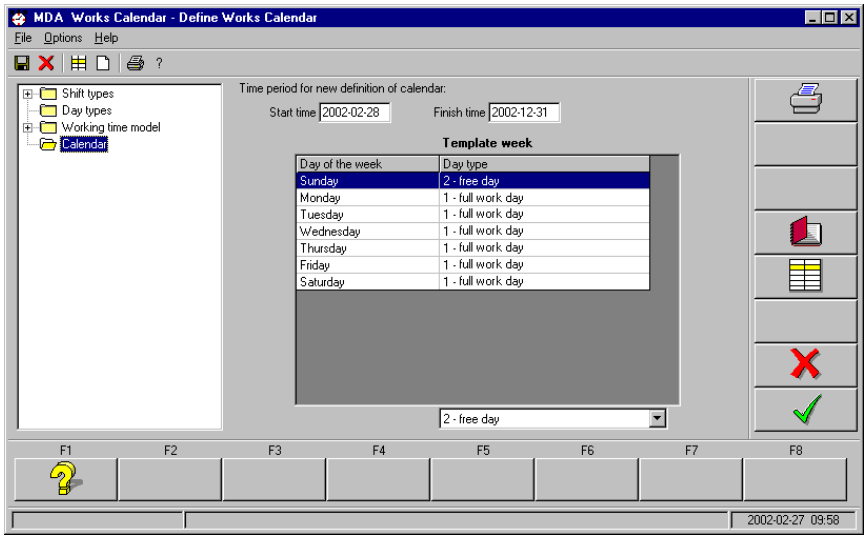
You specify the sequence of shifts for each day type in the working time model.

A check is run to see if the shifts are scheduled back-to-back, because time gaps are not allowed.

Variants can be defined for all working time models.

7.4 Calendar – Template Week

For assigning day types to the calendar days, define a template week and create a time interval in the calendar using this template week.



The template week specifies the day type normally valid on every weekday.

Each weekday in the time interval is assigned to the appropriate day type of the template week.

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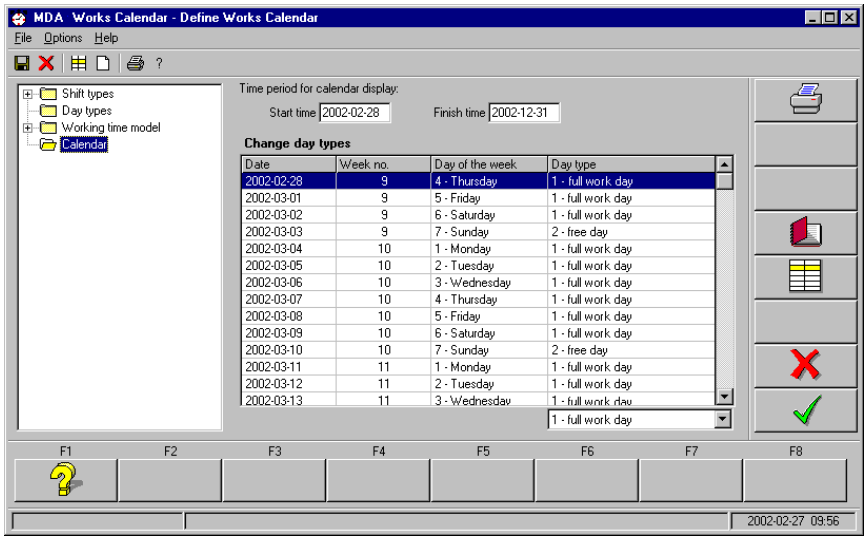
7.5 Calendar – Customizing Day Types

The template week was used to assign the appropriate day type to each calendar day. You can additionally make manual changes to the day type for individual calendar days such as for holiday or days when the company is closed.



Each calendar day is assigned a day type.

If required, the day type can be modified for individual days.

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8 Customizing

8.1 Overview

You can configure many aspects of **MCIS MDA Machine** to meet your individual requirements. Two user-friendly configuration environments are available for this purpose. The configuration data is as the acquired data stored in a local database (ACCESS or MSDE).

The two configuration environments are the **OEM-Customizing** and the Online-Customizing.

8.2 OEM-Customizing

MCIS MDA Customizing is individually licensed as a separate program and not part of **MCIS MDA Machine**. First of all it is intended for machine manufacturers to customize individual menus or screen form texts for the end customer.

Here comes a short overview of the functions of OEM-Customizing:

You can customize the menus: which button starts what function. Which functions are available for the user per menu.

All screen from texts and message texts are fully customizable to your means.

New languages e.g. Polish or Hungarian can be added or existing ones can be replaced. You can toggle between all languages online.

You can configure the layout of the screens (e.g. where which fields are displayed), as required.

You can also configure the layout of lists as regards their content, the sequence of fields, and their sort order.

The bitmaps for buttons or starting screens provided by MCIS MDA Machine can be replaced with your own ones.

- Menu structure
- Screen form texts and message texts
- New languages with online toggle
- Layout and fields of screens
- Fields, sequence and sort order of lists
- Individual “Look and Feel”, individual starting screens

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8.3 Online-Customizing

A separate, user-friendly Customizing interface is available, enabling you to customize **MCIS MDA Machine** online. You can use this interface to specify basic settings, such as machine designation, status groups, priorities, user authorizations, etc. You can carry out changes online at any time (for example, changes to the default language setting for the user interfaces). You can carry out changes online at any time (for example, changes to the default language setting for the user interfaces).

This enables you to configure the system centrally, and to implement customer-specific enhancements quickly and easily.

The software includes a user authorization management system. This enables you to specify the particular evaluations and screens that specific user groups may access.

If you do not define user authorizations, any user can define the menu structure and release evaluations.

The language of the user interface can be specified. German, English, French, Spanish and Italian are currently available

The machine status conditions need to be defined in order to automatically acquire machine data based on detailed values from the PLC. This also enables you to generate status classes and uniquely define the machine status together with its address in the PLC. If concurrent machine status conditions occur, you must specify their priorities within these status conditions. You can also choose the color in which the machine status is displayed.

The software components have got several global parameters to control their functions like a trace level for debugging, a bitmap path, windows properties (fixed or variable window size) up to the INI-files for the acquisition details.

Summarized archives are generated to enable evaluations and analyses to be carried out over a prolonged period of time. You can configure the periods for which the acquired and summarized data (logbook, log, and archives) is to be stored.

- User authorization management
- Selection of standard language
- Machine designations and evaluation groups
- Priorities for parallel status conditions
- Machines status conditions and disturbances
- Alarms and messages
- Status classes for machines
- OEE indicators
- Global parameters of the software components
- Trace level for debugging
- Window properties
- Toolbars
- Parameters for archiving time intervals and length of log

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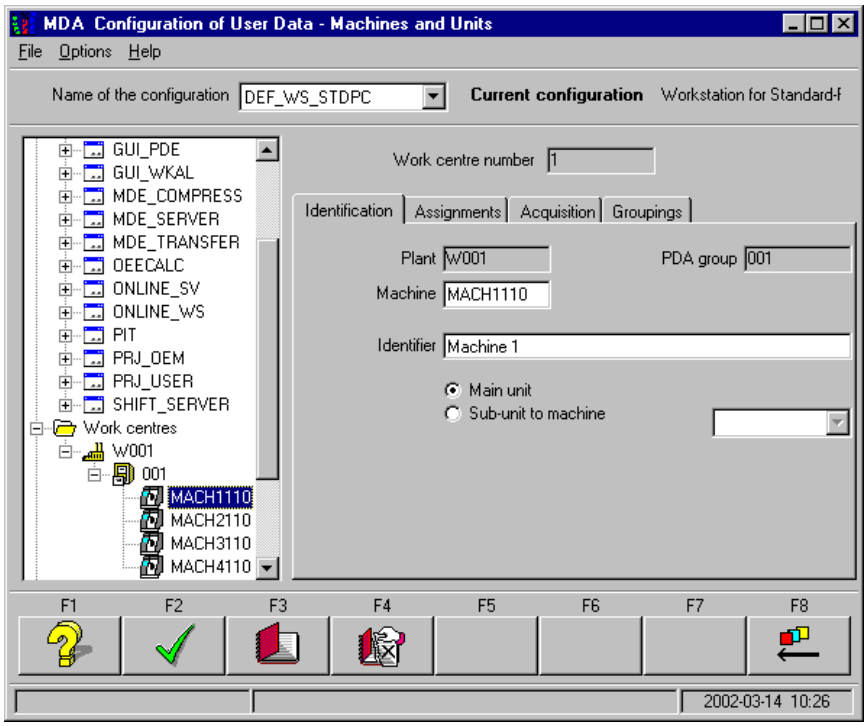
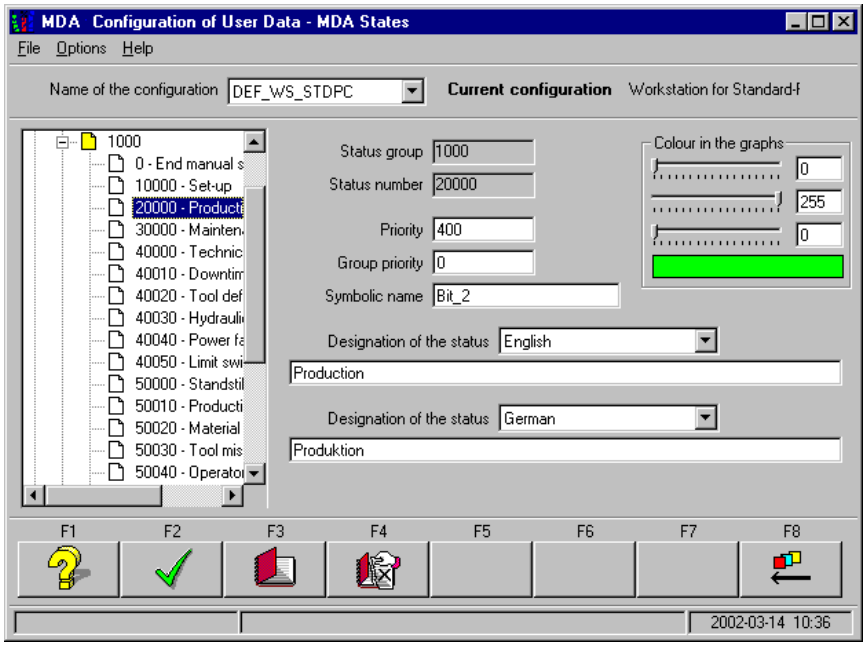
The examples below show you how to define machines and units, as well as how to specify machine status conditions:



Selection grouped by

- General parameters
- Work centers
- MDA status conditions
- User groups
- User names
- Data synchronization
- OEE Indicators
- Screen forms
- Screen texts
- Message texts
- Languages



All data is stored in a local database.

To avoid problems with the current acquisition any changes carried out are effective when the user interface or the concerning software component is restarted.

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8.4 Customizing the Calculation

The OEE indicators are calculated using an external program. The following formulas (similar to the German VDI definition) are used.

OEE Indicator Formula:

The standard OEE indicators are calculated using the following formulas:

Utilization = T_{PROD} / T_{TARG} * 100 %

Availability = (T_{TARG} – T_{ST}) / T_{TARG} * 100 %

Capacity = ($\sum_{Material}$ (Total-$Qty_{Material}$ * Targ-Cycle $Time_{Material}$)) / (T_{Targ} - T_{ST}) * 100 %

Quality = ($\sum_{Material}$ (Total-$Num_{Material}$ – $Waste\text{-}Qty_{Material}$)) / ($\sum_{Material}$ Total-$Qty_{Material}$) * 100 %

$OEE_{Machine}$ = Availability * Capacity * Quality / 1.000.000

MTBF = T_{PROD} / Number of Failures

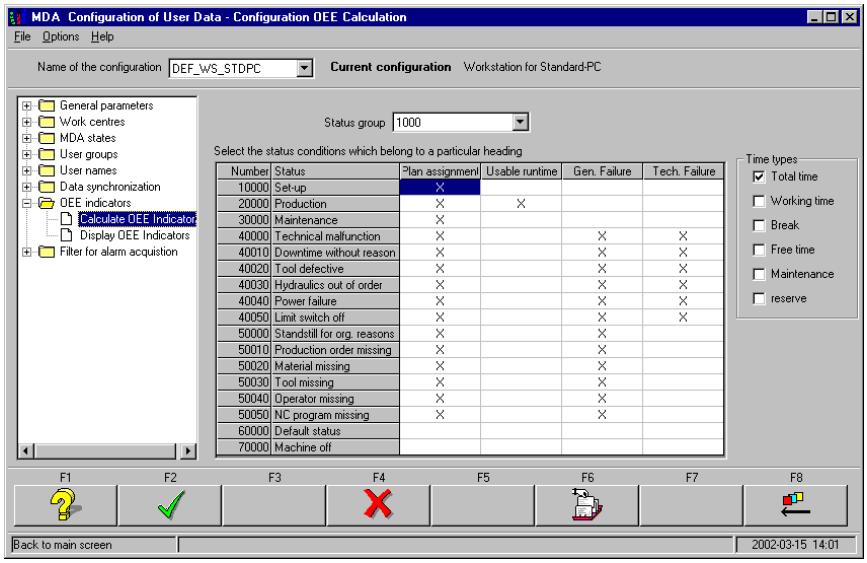
MTTR = Meantime to Repair

T_{PROD} Useful operating time: productive operating time of machine/unit.

T_{TARG} Planned operating time: planned machine/unit operating time according to works calendar.

T_{ST} time during which machine/unit had technical problems.

The machine statuses that were involved and the respective periods (T_{PROD}, T_{TARG}, T_{ST}) are configured when the calculations are being customized. This configuration must be performed separately for each status group.



Selections by:

- Status group
- Time types

Selecting the time types defines the works calendar time types to which the evaluation relates.

The table contains all the defined statuses for the status group. “X“ means that this status belongs to this duration.

It can also be defined which OEE indicators are displayed in the table and the graphics.

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9 Scope of Supply

MCIS MDA Machine provides several license models for different use cases. In particular these are different licenses for connection of a different number of machines or machine units.

The scope of supply includes the data medium (CD) containing the software and documentation, which consists of the Commissioning Guide, the Description and the extensive online help for **MCIS MDA Machine**, as well as the associated customization interface.

The documentation is supplied in electronic form (PDF files) on the license CD only. You will find an appropriate Reader attached on the CD.

Attached on the CD you will also find the software packet **MCIS MDA IFC** to be used with MCIS MDA Cell and MCIS MDA Plant. You will find more details in the corresponding description.

Licenses MCIS MDA Machine

Licenses for connection of

- 1 machine
- 8 machines
- 1 machine and up to 7 machine units

Contents of the CD-ROM:

- **MCIS MDA Machine**
- Customizing
- User interfaces in the following languages:
  - German
  - English
  - French
  - Spanish
  - Italian
- Electronic documentation in:
  - German
  - English
- **MCIS MDA IFC** to be used with MCIS MDA Cell and MCIS MDA Plant

The fully-integrated system solution also includes the option of using digital inputs/outputs to acquire status signals from conventional machines that do not fulfill the hardware requirements for **MCIS MDA Machine**.

Other means of connection and solutions are available on request.

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10 Technical Data

10.1 Requirements for operating on panel-PCs etc.

Target system	➢ SIMATIC Panel PC 670 with keyboard, or ➢ SIMATIC PC FI45, or ➢ Standard-PC, Pentium 200 MHz, Pentium II recommended
Memory	➢ At least 128 MByte RAM
Display	➢ VGA, 256 colors; XGA recommended For customizing: at least XGA
Operating System	➢ Windows NT 4.0 SP 6 ➢ Windows 2000
Type of PLC	➢ SIMATIC S7-300 ➢ SIMATIC S7-400 ➢ SIMATIC C7-6xx
PLC	Feeding of one or several data blocks (e.g. DB13, DB14) with predefined structure by a PLC program ➢ Machine data acquisition 84 Bytes per machine ➢ Production data acquisition 132 Bytes per machine
OPC-Server	The following OPC Servers are supported: ➢ ProTool/Pro V5.2 SP3 or V6.0 ➢ WinCC V5.1 ➢ SIMATIC Computing V3.0 SP1 ➢ Other OPC server and interfaces upon request
Interface to PLC	All supported interfaces to the PLC provided by the above OPC server e.g.: ➢ PROFIBUS DP / MPI (with SIMATIC PC 670 and SIMATIC PC FI45 onboard) ➢ Industrial Ethernet
Link to MCIS MDA Cell and MCIS MDA Plant	➢ Network card for Ethernet with TCP/IP ➢ LAN connection to supervisory level

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10.2 Requirements for operating on SINUMERIK

Target System	➢ SINUMERIK 810D, 840D and FM-NC ➢ Operator panels OP 010, OP 012, OP 015 with PCU 50 and HMI-version 6.0, 6.1 or 6.2 ➢ Operator panels OP 031, OP 032, OP 032S with MMC 103 and HMI version 4.3, 4.4, 5.1, 5.2 5.3 project-specific upon request
Memory	➢ At least 128 MByte RAM on PCU 50
Operating System	➢ Windows NT 4.0 SP 6 on PCU 50
Type of PLC	➢ All SINUMERIK PLCs
PLC	➢ Machine data acquisition PnP interface for 1 machine or Feeding of one or several data blocks (e.g. DB13, DB14) with predefined structure by a PLC program ➢ Machine data acquisition 84 Bytes per machine ➢ Production data acquisition 132 Bytes per machine
Interface to PLC	➢ Internal system interfaces of SINUMERIK
Link to MCIS MDA Cell and MCIS MDA Plant	➢ Network card for Ethernet with TCP/IP ➢ LAN connection to supervisory level

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10.3 Technical Data for MCIS MDA Machine

Number of machines or machine units that can be connected	**MCIS MDA Machine**: connections depending on license: ➢ 1 machine ➢ 8 machines ➢ 1 machine and up to 7 machine units
Operating System	➢ Windows NT 4.0 SP6 ➢
Memory Required for Installation	➢ Approx. 100 MB on hard disk, depending on standard components already installed
Supported displays	➢ All resolutions with at least VGA (640x480)
Poll Cycle PLC Interface	➢ 5 sec. (standard), configurable from 1 sec.
Max. Memory Required for Database Entries (MS-ACCESS)	➢ Logbook: 280 Bytes per entry ➢ **Machine data** • Log: 200 Bytes per entry • (Priorisiertes) Log: 240 Bytes per entry • Shift total: 160 Byte ∗ N ∗ Number of shifts • Daily total: 160 Byte ∗ N ∗ Number of days • Weekly total: 160 Byte ∗ N ∗ Number of weeks • Monthly total: 160 Byte ∗ N ∗ Number of months • Annual total: 160 Byte ∗ N ∗ Number of years N: Number of machine statuses over all work centers ➢ **Part type data** • Log: 280 Bytes per entry • Shift total: 220 Byte ∗ M ∗ Number of shifts • Daily total: 220 Byte ∗ M ∗ Number of days • Weekly total: 220 Byte ∗ M ∗ Number of weeks • Monthly total: 220 Byte ∗ M ∗ Number of months • Annual total: 220 Byte ∗ M ∗ Number of years M: Number of part types that were actually manufactured within the time unit for all work centers ➢ **Alarms** • Log: 350 Bytes per entry • Shift total: 210 Byte ∗ ε ∗ Number of shifts • Daily total: 210 Byte ∗ ε ∗ Number of days • Weekly total: 210 Byte ∗ ε ∗ Number of weeks • Monthly total: 210 Byte ∗ ε ∗ Number of months • Annual total: 210 Byte ∗ ε ∗ Number of years ε: Anticipated number of different alarms within time unit

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<table>
<tr><td>Max. Memory Required for Database Entries (MS-ACCESS)</td><td>
Maximum memory requirement is calculated as follows:
☞ Define number of logbook and log entries
☞ Estimate value of N, M und ε parameters
☞ Select time unit
☞ Use the relevant formula, add up the results and add 20% to the total. This percentage represents the average size difference between a compressed database and a non-compressed database.
☞ Multiply the result by 3. This takes the two backup files produced during DB compression into consideration
</td></tr>
<tr><td>Max. Memory Required for Database Entries (MSDE)</td><td>
➢ Logbook: 440 Bytes per entry
➢ Machine data
• Log: 340 Bytes per entry
• (Priorisiertes) Log: 360 Bytes per entry
• Shift total: 200 Byte ∗ N ∗ Number of shifts
• Daily total: 200 Byte ∗ N ∗ Number of days
• Weekly total: 200 Byte ∗ N ∗ Number of weeks
• Monthly total: 200 Byte ∗ N ∗ Number of months
• Annual total: 200 Byte ∗ N ∗ Number of years
N: Number of machine statuses over all work centers
➢ Part type data
• Log: 500 Bytes per entry
• Shift total: 260 Byte ∗ M ∗ Number of shifts
• Daily total: 260 Byte ∗ M ∗ Number of days
• Weekly total: 260 Byte ∗ M ∗ Number of weeks
• Monthly total: 260 Byte ∗ M ∗ Number of months
• Annual total: 260 Byte ∗ M ∗ Number of years
M: Number of part types that were actually manufactured within the time unit for all work centers
➢ Alarms
• Log: 720 Bytes per entry
• Shift total: 420 Byte ∗ ε ∗ Number of shifts
• Daily total: 420 Byte ∗ ε ∗ Number of days
• Weekly total: 420 Byte ∗ ε ∗ Number of weeks
• Monthly total: 420 Byte ∗ ε ∗ Number of months
• Annual total: 420 Byte ∗ ε ∗ Number of years
➢ ε: Anticipated number of different alarms within time unit
Maximum memory requirement is calculated as follows:
☞ Define number of logbook and log entries
☞ Estimate value of N, M und ε parameters
☞ Select time unit
☞ Use the relevant formula and add up the results
</td></tr>
</table>

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11 Further Information

Further information is available in the following descriptions:

- MCIS MDA Machine Commissioning Guide

And the following descriptions (online help):

- MDA Part Type Evaluations
- MDA Machine Evaluations
- MDA Alarm and Message Evaluations
- MDA Customizing
- MDA Works Calendar

Moreover a set of descriptions and short descriptions of reference installations are available. Please ask your sales representative for further information.

You will find further information on:

http://www.is.siemens.de/itps/openshopfloor/

For further information to MCIS MDA Machine
In connection with ProTool/Pro, WinCC, SIMATIC Computing or SINUMERIK
Please contact the A&D Customer Support:

Phone: +49 (0) 180 5050 222
Email: techsupport@ad.siemens.de

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