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MTC200/MT-CNC
Machine Data
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Application Manual

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Indramat

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Purpose of this document

This document describes

- utilization,
- functionality, and
- structure of the machine data;
- the screens of the user interface; and
- the INDRAMAT machine data.

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109-0768-4184-00	04/97	New issue
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Contents

1 Purpose of the Machine Data

Task

The machine data is used

- as alterable machine parameters (controller machine data) for certain control functions, such as setup registers, follower and Gantry axes, and main spindle synchronization;
- as protected data (OEM machine data), such as management of the machine options or for saving measured data;
- as working memory in which the machine manufacturer may store structured data (OEM machine data), e.g. for implementing a pallet management or for saving axis positions; or
- for processing large data quantities (user-related machine data), e.g. for saving geometry data and tolerance values for parts production.

Necessary data structures

The majority of data that is required by the machine manufacturer controller and by the end user, may be represented as

- a structure,
- a one- or two-dimensional array, or as
- a one- or two-dimensional array on a structure.

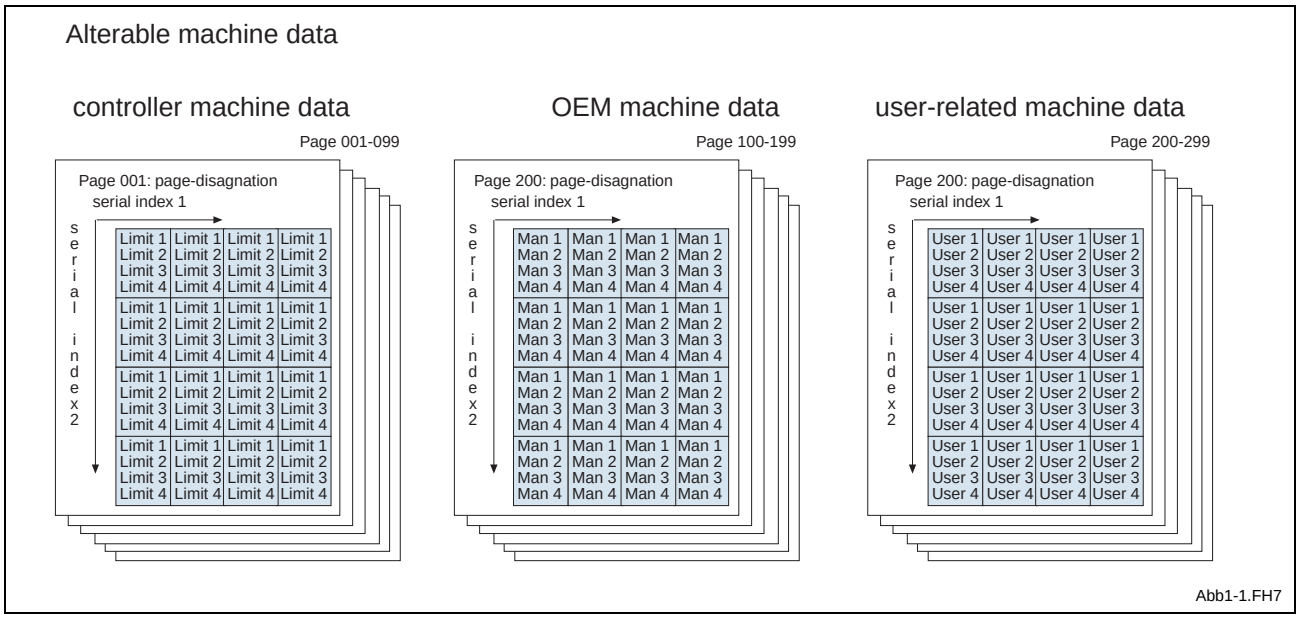

Fig. 1-1: Basic machine data structure

2 Basic Terms

2.1 Page

Definition

A page is the entry of a data structure in the controller, OEM, or user machine data.

Structure of the pages

OEM and user machine data each permit up to 100 pages to be entered in the machine data.

The pages are numbered consecutively:

- Page 001 - 099: controller machine data,
- Page 100 - 199: OEM machine data, and
- Page 200 - 299: user machine data.

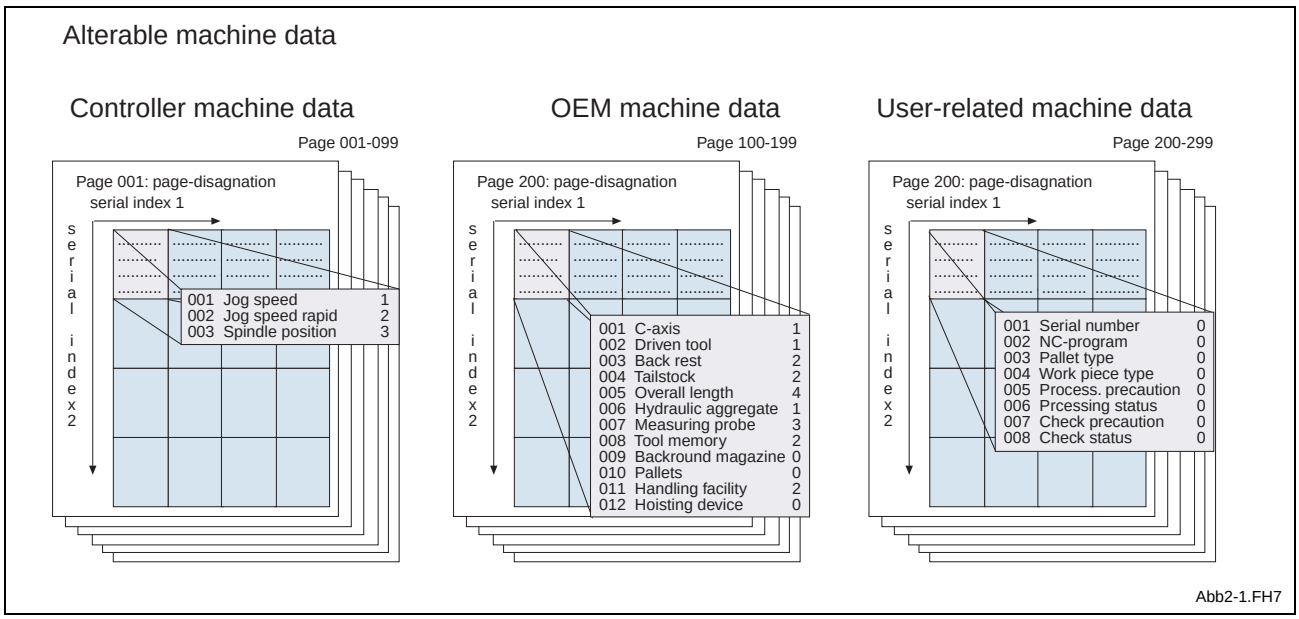

Fig. 2-1: Data structures of the machine data

2.2 Structure

Definition

A structure consists of several data elements that functionally belong together. The individual elements usually belong to different data types.

Machine data structures

Within the machine data, structures of up to 100 data elements can be defined. Each element is characterized by

- its consecutive number;
- its name,
- its data type, and
- its access privileges.

Arrays are not permitted as structure elements.

The data elements of a structure are consecutively counted, starting from ’1’.

No.	Name	Data type	Size [bytes]	Access privileges
1	Jog speed	INT	4	J - J - J - J
2	Spindle position I	SPEED	4	J - J - J - J
3	Spindle position II	DEG	4	J - J - J - J
			Σ = 12	

Fig. 2-1: Typical data structure of a page

2.3 Array

Definition

An array consists of several identical structures that functionally belong together. Depending on its purpose, an array may be uni-dimensional or multi-dimensional.

Machine data arrays

Elementary data types (see Appendix 11.1 ‘Elementary Machine Data Types’, page 11-1) and structures are used as elementary data types.

One- or two-dimensional arrays can be defined in the machine data. Each dimension may contain up to 1000 elements. The index variables of either dimension must be within the range -1000 through 1000.

CAUTION

Maximum size of a page

⇒ The maximum size of a page is limited to 64 kB memory.

2.4 Data Types

Elementary data types

The following pre-defined data types are available for the structure of the machine data:

- BOOL ;Boolean
- BYTE ;Bit string, length 8
- WORD ;Bit string, length 16
- DWORD ;Bit string, length 32
- SINT ;Short integer number (8 bits)
- INT ;Integer number (16 bits)
- DINT ;Double integer number (32 bits)
- USINT ;Unsigned short integer number (8 bits)
- UINT ;Unsigned integer number (16 bits)
- UDINT ;Unsigned double short integer number (32 bits)
- REAL ;Floating pt. number (32 bits, incl. 23 bits mantissa)
- DREAL ;Floating pt. number (64 bits, incl. 52 bits mantissa)
- POS* ;Position (for feed axes)
- VELO* ;Velocity
- ACCEL* ;Acceleration
- DEG ;Spindle position
- SPEED ;Spindle speed
- FEED/REV* ;Velocity per revolution
- CON_SURF_S* ;Cutting speed
- PERI_SPEED* ;Peripheral speed
- AXIS_DES ;Axis meaning

Please refer to the Appendix 11.1 (Elementary Machine Data Types, page 11-1) for further information.

CAUTION

Incorrect interpretation of the pre-defined NC-related data types

⇒ The data types that are marked by an asterisk (*) may only be used if the first control variable (LV1) or the second control variable (LV2) is of the IP_AXIS, SP_AXIS or AXIS_DES control variable type.

2.5 Index Variable Types

Each index variable must have an index variable type allocated during the definition phase. During the subsequent operation, controller and user interface will refer to the related data (e.g. processes and axes) in the parameters.

If, for example, the index variable type PROCESS has been selected for index variable 1, the controller will only take into account the processes that are specified in the current machine parameter set. In the different machine data menus and in the selection of index variable 1 (of a process), the user interface automatically displays the process names that have been stored in the machine parameters,

The following index variable types are available:

- IP_AXIS ;Axes of the feed axis type
- SP_AXIS ;Axes of the spindle type
- PROCESS ;Processes
- AXIS_DES ;Axes of the feed axis type and of the spindle type
- NO_CLASS ;User-defined type with up to 1000 elements in the range between -1000 and +1000

2.6 Machine Data Record

Definition

A machine data record combines the pages 1 through 299 to form a unit. The associated page directory provides the overview of all pages that exist in the machine data record concerned.

Processing machine data records

Up to 99 machine data records can be created and edited within machine data preparation. The individual machine data records may contain completely different OEM and user pages. Merely the control pages always exist. Usually, the machine manufacturer will create only one machine data record for each machine (same as for machine parameters).

3 Functionality - Overview

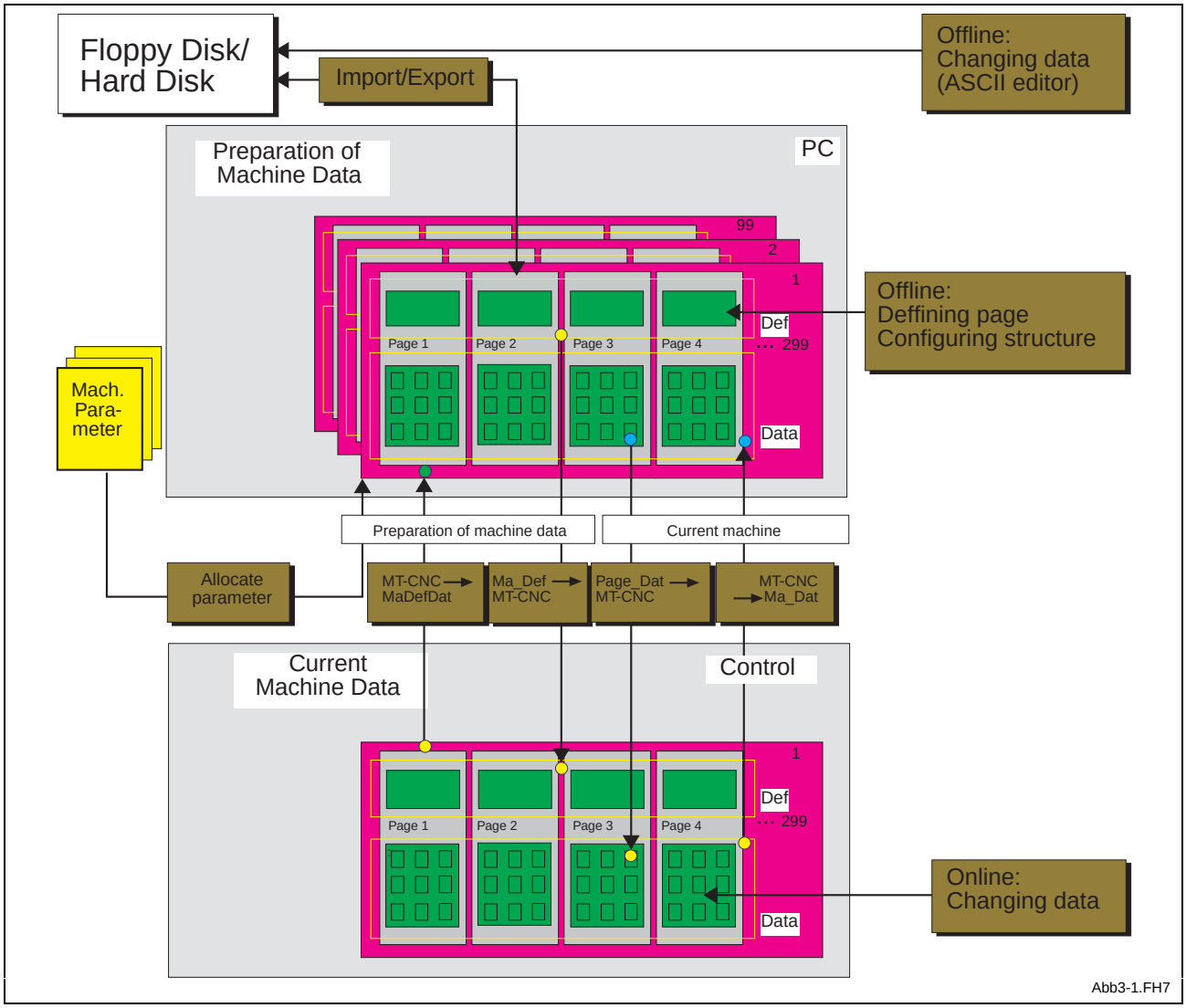

Fig. 3-1: Base functionality

Functions of the current machine data

The current machine data is the last machine data record to have been loaded in the controller.

Depending on the access privilege, the current machine data can be written by the NC program (using the MTD command), from the SPS program (using the MTD_RD and MTD_WR) function blocks), and by the user via the user interface. Reading the machine data is always possible.

Within the user interface, the user may select a different page of the current machine data. Furthermore, the index variables 1 and 2 may be changed in order to select a different structure within a page.

A backup function is available that permits the data of the machine data record (in the controller) to be saved on the hard disk.

Another function enables the user to load the data of a single page from the PC in the controller.

Functions within machine data preparation

Machine data preparation permits new machine data records to be prepared for the user. The following functions are available:

- Create machine data record,
- Clear machine data record,
- Edit machine data record names,
- Copy machine data record
- Load definitions
- Save data and definitions

The subsequent page level permits

- pages to be created,
- pages to be cleared,
- page names to be edited,
- page data to be cleared,
- pages to be imported / exported,
- pages to be printed,
- pages to be copied,
- page definitions to be modified.

The import/export function permits an entire page to be imported/exported between the existing directories on the hard disk and a diskette (or hard disk or network). Besides the page data, the page definition are transferred, too.

Using an external ASCII editor, the data of a page may be modified and re-imported into the existing directories.

Within machine data preparation, the user may save all definitions and data of the current machine data record (in the controller) in the specified directories on the hard disk.

In the opposite direction, the definitions of previously defined machine data records may be loaded into the controller. The controller merely initializes the modified pages if the machine data record concerned has already been stored in the controller.

Production planning, who must provide the machine data for several machines (with different parameter records) may allocate the necessary parameter record to the individual machine data records that are to be processed.

4 Menus of the User Interface

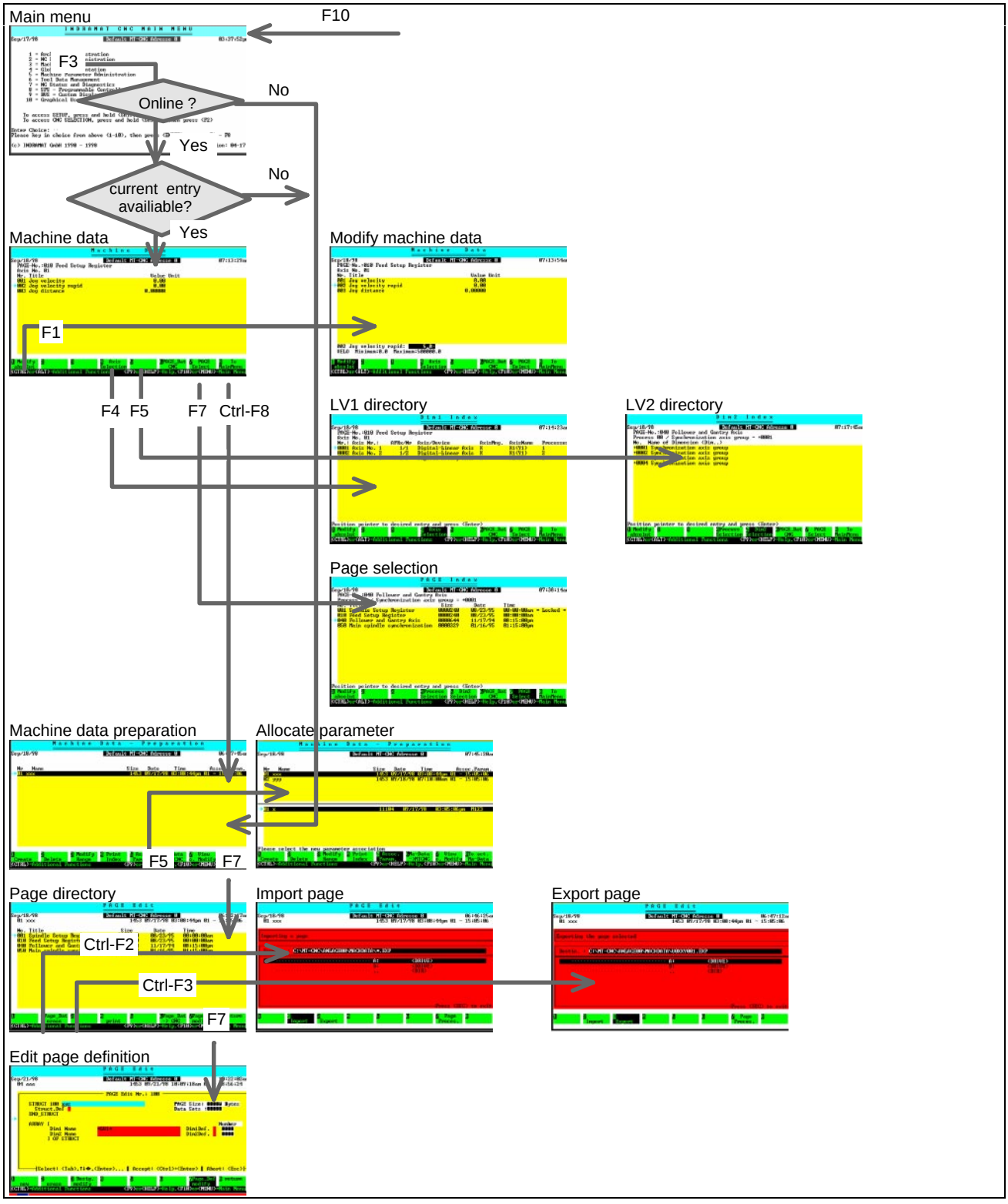

Fig. 4-1: Menu structure of the machine data

4.1 Current Machine Data

The following section describes the individual menus of the current machine data.

General

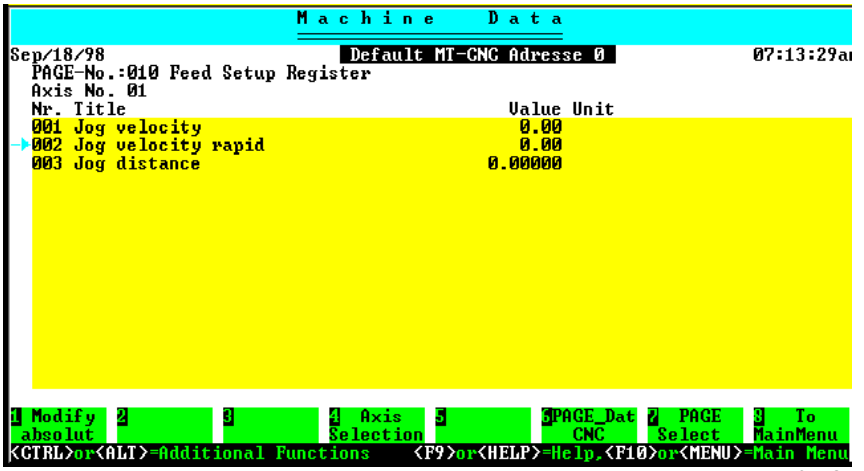

Fig. 4-2: Current machine data

Notes: When the current machine data is invoked, the user interface shows the last selected data record of the machine data record that is currently in the controller. If data has not yet been invoked, the user interface displays the machine data preparation.

When it represents the current machine data, the user interface cyclically requests the values of the displayed data elements, and continually updates those values.

If the user interface is in off line mode, it displays the machine data preparation instead of the (current) machine data.

The following functions are accessible to the user:

<F1> Edit - absolute

Select a data element with the cursor and press the <F1> or <Enter> key to edit a data element. During the editing process, the user interface displays the name, the value range (min, max), and the value of the data element concerned above the soft keys.

Pressing the <Enter> key terminates the editing process and enters the edited values in the controller.

Pressing the <Esc> key cancels the modifications, and the controller retains the old value.

Some data elements may require a password to be entered before they can be edited.

<F4> Select index variable 1

<Ctrl><F4> up

<Alt><F4> down

<F5> Select index variable 2

<Ctrl><F5> up

<Alt><F5> down

Selecting the <F4> or <F5> key displays an index variable list that permits the index variable 1 or 2, respectively, to be selected. The <Cursor> keys can be used for selecting a new value for the index variable, that is entered when the <Enter> key is pressed. The user interface immediately displays the related current machine data.

Press additionally the <Ctrl> or <Alt> key to change the index variable by ‘1’ or ‘-1’ respectively.

<F6> Load page data in controller

Pressing the <F6> key permits the data of a single page to be loaded into the controller.

Note: This function must always be used for loading the data of a page into the controller.

Pressing the <F6> key takes you to the page directory of the current machine data record. In that menu, use the cursor to select the page whose data shall be loaded into the controller, and press the <Enter> key to start the data transfer.

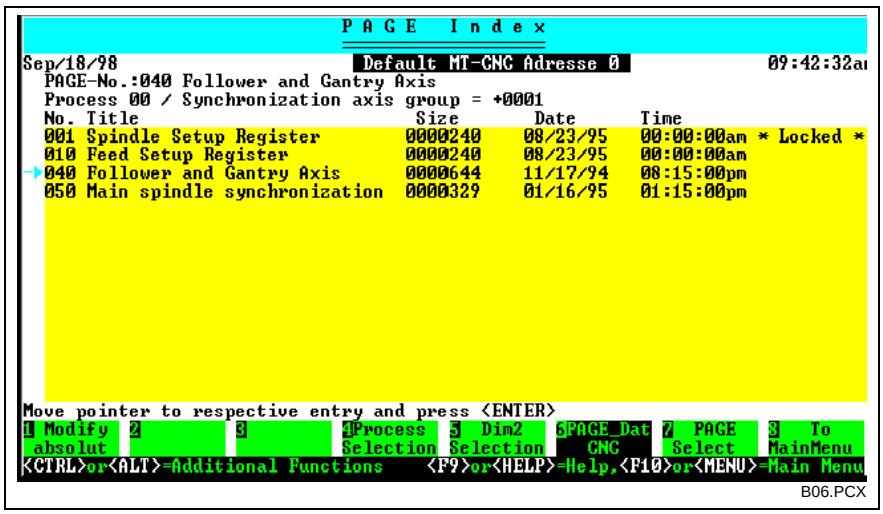

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Fig. 4-3: Page directory used for loading page data into the controller

<F7> Select page

<Ctrl><F7> up

<Alt><F7> Down

When the <F7> function key is selected, the user interface displays the page directory that permits a new page to be selected. Within the page directory, use the cursor keys to select a new page, and press the <Enter> key to display the associated machine data.
The next page up or down can be selected by additionally pressing the <Ctrl> or <Alt> key, respectively.

<F8> Return to the main menu

Select the <F8> key to return to the calling menu.

<Ctrl><F6> Save the data of the current machine data record

Selecting the <Ctrl>+<F6> key combination permits the ‘Save data of the current machine data record’ function to be started. The user interface saves all data items of the machine data record in the controller onto the PC.

Note: The ‘Save data of the current machine data record’ function should particularly be used once the setup phase has been completed and, from time to time, during regular operation to perform a backup of the machine data that is held in the controller.

<Ctrl><F8> Machine data preparation

Pressing these keys takes the user to machine data preparation.
The user interface displays all existing machine data records. A machine data record can be created and/or modified (see page 4-4, ‘Machine Data Preparation’). Furthermore, data and definitions of a page can be edited.

4.2 Machine Data Preparation

Editing Machine Data Records

The following section describes the menus that are used for editing a machine data record within the scope of machine data preparation.

- Create machine data record
- Clear machine data record
- Modify machine data record name
- Print directory of machine data records
- Assign parameters
- Load machine data definitions into the controller
- View or edit definitions and data
- About the current machine data
- Copy machine data record
- Locate text
- Save definitions and data on the hard disk

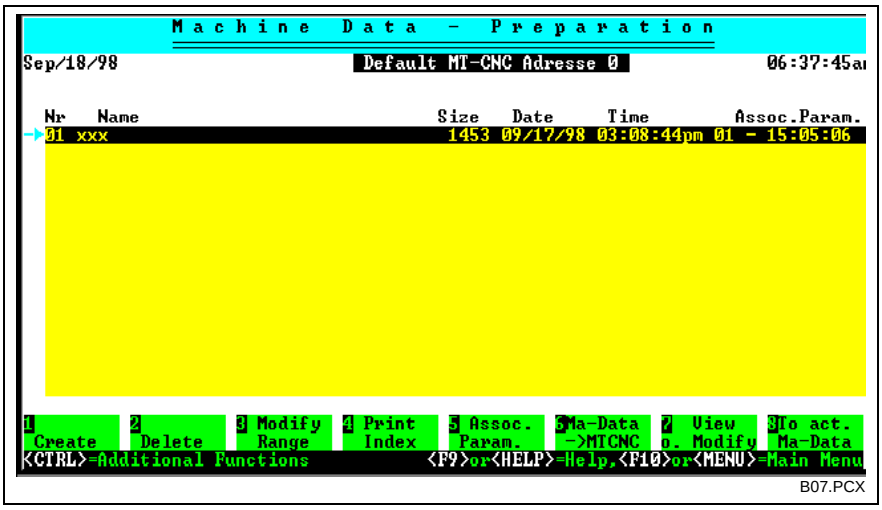


Fig. 4-4: Editing machine data records

Notes: The user interface displays the last machine data record to have been loaded into the controller with a gray background. The gray background disappears as soon as the user modifies the definitions or the enhanced selection texts of a page of that machine data record during machine data preparation or using the import/export function.
If the current parameter record has been modified and/or does no longer agree with the assigned parameter record of the current machine data record, the user interface issues a corresponding message and provides the current machine data record with a green background.
Modifying data within the current machine data via the user interface or the NC and/or SPS user program does not influence the gray background.

<F1> Create new machine data record

When the <F1> key is pressed, the user interface starts a dialog that permits a new machine data record to be entered. The user is asked to enter the machine data record number (any number between 1 and 99) and the machine data record name. The user interface automatically generates the other data items (such as length, date, time, and allocated parameters).

<F2> Clear machine data record

Use the cursor to select the machine data record that shall be cleared, and press <Enter> to confirm the selection. Prior to clearing the data record, the user interface displays a safety prompt that must be confirmed by entering <J>.

Note: The current entry cannot be cleared.

<F3> Change the machine data record name

Selecting the <F3> key permits the machine data record name to be edited.

Use the cursor to select the machine data record that shall be renamed, and press <Enter> to confirm the selection. Next, the user interface displays the old name of the selected machine data record in a line editor above the soft keys. Edit the name and select the <Enter> key to cause the user interface to close the editor. The new name will then be used within the directory.

Note: The current entry cannot be modified.

<F4> Print the machine data record directory

After the <F4> key has been selected, the user interface displays a window of the following contents:

- Print file: Machine data editing
- Start print on page: 1
- Print to: File
- Printer driver: IBMPRO
- Print directory name: D:\MT-CNC\ANLAGE00\PRINT\

Once the print parameters have been selected, press the <Ctrl>+<Enter> key combination to confirm the selection and to start the print process.

<F5> Assign parameters

Using that function enables the user to assign a machine data record a parameter record.

Note: The ‘Assign parameters’ function must be used when the user interface provides the machine data record that has been loaded into the controller with a green bar. This is the case if the current parameter record has been edited, or if machine data records for different machines and with different parameter records shall be created, modified, and managed in the PC concerned.
Since those parameters influence the access to the data of a page when axis- and process-related control variables are used, they are of fundamental significance to the machine data.

If machine data records are to be created for another machine with another parameter record, the associated parameter records must be transferred to the PC concerned, using parameter storage.

Within the machine data, the user interface takes parameter data into account (such as number and names of the axes and processes for the employed control variables).

When a new machine data record is created, the user interface automatically assigns it the current parameter record (see last column ‘assigned parameter record’ in the directory). If you want to assign a different parameter record, press the <F5> function key. Use the <Cursor> and <Enter> keys to select and confirm a machine data record. The user in-

terface then displays the list of machine parameters in the lower half of the screen. Use the <Cursor> and <Enter> keys to select and confirm the new parameter record you wish to assign. The user interface then updates the parameter record number and the related date in the last column of the list.

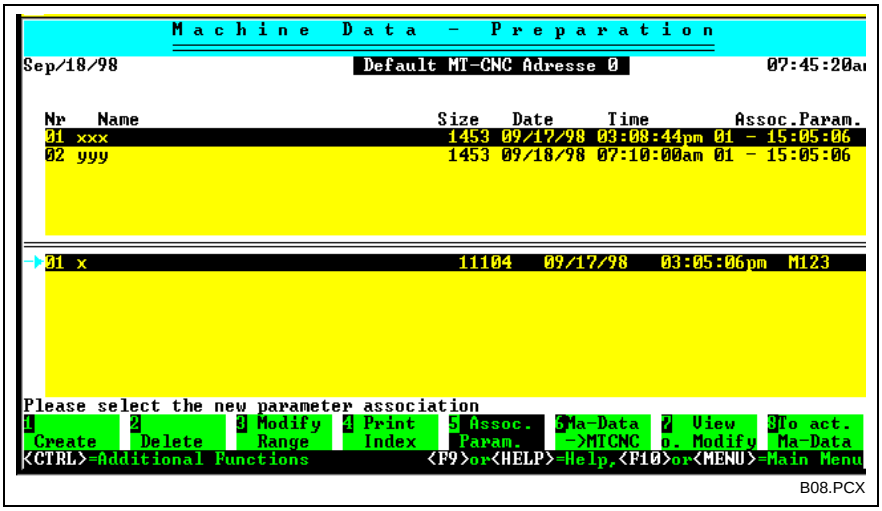


Fig. 4-5: Assigning a different parameter record to a machine data record

<F6> Load machine data definitions into the controller

When the <F6> key is pressed, the user interface loads the definitions of the selected machine data record in on line mode into the controller.

Note: This function must be used when the definitions of a machine data record that is different than the machine data record in the controller shall be loaded into the controller or if at least one page of the current machine data record has been modified by modifying the page definitions or using the import function.

Use the cursor to select the machine data record whose definitions shall be transferred to the controller; and confirm with the <Enter> key.

Prior to transferring the definitions the user interface displays a safety prompt that must be confirmed by entering <J>.

Notes: Once the user interface has transferred all modified page definitions, the controller initializes the data elements of all pages whose definitions have been modified with the value ‘0’.

The user interface displays a green bar if it detects during machine data definition loading that the parameter record in the controller is different than the one that was used during creation.

CAUTION

Machine data is initialized.

⇒ Whenever machine data definitions have been transferred, the data of the pages whose definitions have been changed is newly initiated.

<F7> Viewing or modifying definitions and data

Press the <F7> key to get to the menus that permit pages to be edited.

Use the cursor to select the required machine data record, and press the <Enter> key to confirm the selection. Next, the user interface displays the page directory with all the pages that belong to the machine data record concerned (see next chapter).

<F8> To the current machine data

Pressing that function key takes the user to the current machine data (see preceding chapter).

When the current machine data is invoked, the user interface shows the last data record to have been selected of the machine data record in the controller. If data has not yet been invoked, the user interface displays the page directory that permits a page to be selected.

<Ctrl><F1> Copy machine data record

The selected machine data record is copied onto a new entry.

Press the <Ctrl>+<F1> key combination and use the cursor to select the machine data record that is to be copied. Press the <Enter> key to confirm. The user interface prompts the user to enter the machine data record number (a free number between 1 and 99), and the machine data record name. This procedure is the same as for entering a new machine data record.

Note: The 'copy machine data record' function copies the definitions, types and data of all pages of the selected machine data record.

<Ctrl><F3> Find text

The 'Find text' function permits a machine entry to be found within the machine data record directory that contains a specific search text.

When the <Ctrl>+<F3> key combination is pressed, the user interface displays a window in which the string that is to be found can be entered.

Note: The search function starts from the directory entry that follows the entry under the cursor position.
The search function can also look for parts names.
The search function is case-insensitive.

<Ctrl><F6> Save definitions and data on the hard disk

Using the <Ctrl>+<F6> key combination in on line mode permits the structures and data of all pages to be saved from the controller onto the hard disk.

Notes: This function permits definitions, types, and data of the machine data record in the controller to be saved onto the hard disk.
All names are saved in the language that has been selected on the user interface.

Additional text (selection text) of the control variables cannot be loaded from the controller.

CAUTION

Text is overtyped

⇒ Existing translations may be overwritten if definitions and data are saved after the language selection has been changed.

After the <Ctrl>+<F6> key combination has been pressed, the machine data record number (a free number between 1 and 99) and the machine data record name must be entered. This procedure is the same as for entering a new machine data record.

Editing Pages

The following section describes the menus that are available for editing a page within the machine data preparation:

- Create a new page
- Clear a page
- Rename a page
- Print definitions and data of a page
- Clear the data of a page
- Change the page definitions
- To the machine data directory
- Copy a page
- Page import
- Page export

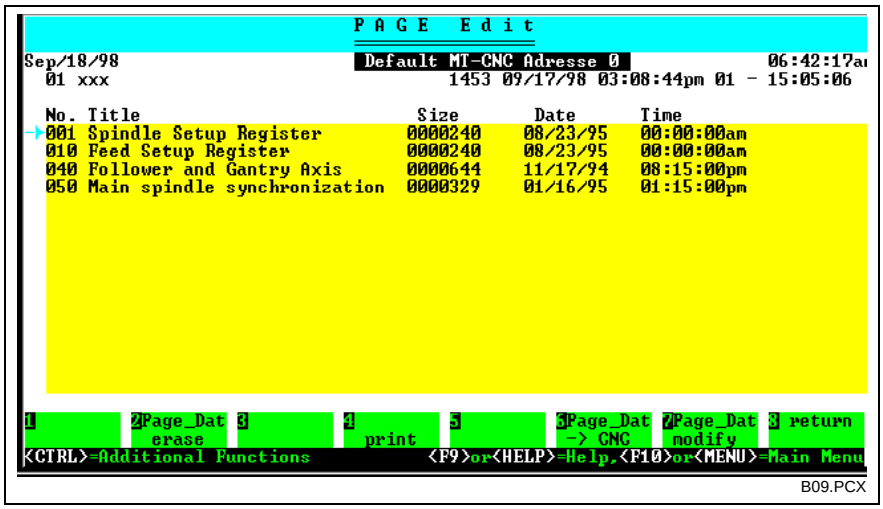


Fig. 4-6: Edit pages

<F1> Create a new page

When the <F1> key is selected, the user interface starts a dialog to enter a new page. The page number (a free number between 100 and 299) and the page name must be entered. The user interface automatically generates the other data items (such as size, date, and time).

<F2> Clear a page

Pressing the <F2> key permits a page to be cleared.
Use the cursor to select the page that is to be cleared, and press the <Enter> key to confirm the selection. Before the user interface clears the associated definitions and dates of a page, it displays a safety prompt that must be confirmed by entering <J>.

<F3> Renaming a page

Selecting the <F3> key permits a page to be renamed.
Use the cursor to select the page that shall be renamed, and press the <Enter> key to confirm the selection. The user interface than displays the old name of the selected machine data record in a line editor above the soft keys. Once editing has been completed and the <Enter> key pressed, the user interface closes the editor and enters the new name in the directory.

<F4>Printing definitions and data of a page

Selecting <F4> permits the definitions and data of a page to be printed.
After the key has been selected, the user interface displays a window of the following contents:

- Print file: Machine data editing
- Start print on page: 1
- Print to: File
- Printer driver: IBMPRO
- Print directory name: D:\MT-CNC\ANLAGE00\PRINT\

Once the print parameters have been selected, press the <Ctrl>+<Enter> key combination to confirm the selection and to start the print process.

<F5> Clear the data of a page

Select the <F5> key to clear the data of a page within machine data preparation (in the PC). The definitions of the page are not affected.
Use the cursor to select the page that shall be cleared, and press the <Enter> key to confirm the selection. Please remember that the user interface subsequently clears the page-related data without any further prompt.

Note: Deleting data is particularly necessary after page definitions have been modified, and the data of an earlier structure no longer tallies with the new structure. This happens if, for example, new elements are inserted in a structure.

<F7> Change page-definitions

Select the <F7> key to get into the menu in which the individual pages can be modified.
Use the cursor to select the page that shall be modified, and press the <Enter> key to confirm the selection. The user interface then displays the definitions of the selected page (see Chapter ‘Modify Page Definitions’ on page 4-13).

<F8> Back to machine data preparation

Select the <F8> key to return to the ‘Machine data preparation’ menu.

<Ctrl><F1> Copy a page

The selected page is copied onto a new entry.
Select the <Ctrl>+<F1> key combination and use the cursor to select the page that shall be copied. Press the <Enter>Y key to confirm the selection. The user interface prompts the user to enter the page number (a free number between 100 and 299) and the page name. This procedure is the same as for entering a new page.

Note: The ‘Copy page’ function copies the definitions, the types, and the data of the selected page.

<Ctrl><F2> Page import

This function permits data to be read from an external medium.
The user interface displays two windows when the <Ctrl>+<F2> key combination is pressed. The top window shows the name of the target file and the related path name. The bottom window is subdivided into two areas. The upper area shows the name of the source file and the related path. Here, you may edit the complete path and the file name.
Alternatively, the file selection window in the lower area permits the cursor to be moved within the directory structures and the file that shall be read to be selected. When the <Enter> key is pressed, the user interface updates the path and/or file name in the upper area. The user interface starts the reading process after the name has been selected (using the <Enter> key).
Pressing the <Tab> key moves the cursor between the upper and the lower area of the second window.

Notes: When a page is imported, the user interface takes the definitions and the data from the file concerned. To the internal data file it only transfers the values of the data elements that are listed within the file that shall be read. The user interface does not affect any other data elements for which values have not been stored within the file that is to be imported.

The user interface removes the gray background of the active machine data record if structure definitions, control variable definitions, or enhanced selection texts of the page that is to be read are different than the ones of the existing page. If the definitions of a page have been modified, reloading the definitions of the machine data record can re-establish the access to the current machine data. Next, the modified and/or imported pages may be loaded into the controller within the active machine data.

In contrast to OEM and user pages, the user interface does not take on the structure and control variable definitions of INDRAMAT pages (1 through 99).
During import, the user interface always interprets the page number and the page name that follow the STRUCT key word, and transfers definitions and data to the page that is specified here. Existing pages (with the same page number) are overwritten. If a page with the specified number does not yet exist, the user interface creates one and enters it in the related page directory.

<Ctrl><F3> Page-Export

This function can be used for storing a page under any file name in an existing path on an external medium (or on the same medium).
Select the <Ctrl>+<F3> key combination and use the cursor to select the page that shall be exported. Press the <Enter> key to confirm the selection.
The user interface then displays two windows. The top window shows the name of the source file and the related path name. The bottom window is subdivided into two areas. The upper area shows the name of the target file and the related path. Here, you may edit the complete path and the file name. Alternatively, the file selection window in the lower area permits the cursor to be moved within the directory structures and the file that shall be read to be selected. When the <Enter> key is pressed, the user interface updates the path and/or file name in the upper area. The user interface starts the reading process after the name has been selected (using the <Enter> key).
Pressing the <Tab> key moves the cursor between the upper and the lower area of the second window.

Note: When a page is exported, the user interface transfers the definitions and the data from the file concerned. The user interface transfers the last data to have been saved on the hard disk. There will be no data export if data has not yet been saved.

Structure and explanation of an export file

The example below shows a typical export file. On the right-hand side, there is the printout of an export file for *pallet management*. The text in the left-hand column explains the structure of the export file.

Information for the internal management

```
%IND:0:XX:Y:051
!01.00
#51 Turning/milling center I    2629 13.05.97 13:19:38   01 - 07:46:58
$
$
$
$
*100 Pallet management
%IND
```

Current type list

```
; ------------------------------------------------------------------------------
; 09.06.1997 08:34:34
; ------------------------------------------------------------------------------
; 001 : BOOL
; 002 : BYTE
; 003 : WORD
; 004 : DWORD
; 006 : SINT
; 007 : INT
; 008 : DINT
; 009 : USINT
; 010 : UINT
; 011 : UDINT
; 012 : REAL
; 013 : DREAL
; 014 : POS
; 015 : VELO
; 016 : ACCEL
; 017 : DEG
; 018 : SPEED
; 019 : FEED/REV
; 020 : CON_SURF_S
; 021 : PERI_SPEED
; 022 : AXIS_DES
; 023 : IP_AXIS
; 024 : SP_AXIS
; 025 : PROCESS
; 026 : AXIS_DES
; 027 : NO_CLASS
; ------------------------------------------------------------------------------
```

Page definition

```
[START]
STRUCT 100 Pallet management
  Serial number                UDINT       NoNC,NoSPS,BOF,PwBOF
  NC program                   UINT        NoNC,SPS,BOF,PwBOF
  Pallet type                  USINT       NoNC,SPS,BOF,PwBOF
  Workpiece type               USINT       NoNC,SPS,BOF,PwBOF
END_STRUCT
ARRAY [
        *Process                      PROCESS    0..6
         #+0000 0000  *Process* 0:  turning machine
         #+0001 0001  *Process* 1:  milling machine
        *Pallet*                      NO_CLASS   1..10 <LV2> <selection>
] OF STRUCT
```

Description of the data representation

```
; ------------------------------------------------------------------------------
; No. <-Data name --------------->\Ty\<LV1>\<LV2>\value unit
;0001 <-Name                    ->\02\+0000\+0000\55 mm
;No--Data name ------------------Type-LV1---LV2--value  unit-------------------
```

Data

```
0001 Serial number              \11\+0000\+0001\0
0002 NC program                 \10\+0000\+0001\0
0003 Pallet type                \09\+0000\+0001\0
0004 Workpiece type             \09\+0000\+0001\0
```

Comment line and separating line

```
;No--Data name ------------------Type-LV1---LV2--value unit-------------------
```

Data

```
0001 Serial number              \11\+0000\+0002\0
0002 NC program                 \10\+0000\+0002\0
0003 Pallet type                \09\+0000\+0002\0
0004 Workpiece type             \09\+0000\+0002\0

.
.
.
```

Comment line and separating line

```
;No--Data name------------------Type-LV1---LV2--value unit------------------
```

Data

```
0001 Serial number              \11\+0006\+0010\0
0002 NC program                 \10\+0006\+0010\0
0003 Pallet type                \09\+0006\+0010\0
0004 Workpiece type             \09\+0006\+0010\0
```

End mark

```
[END]
```

Notes: A line that begins with a semicolon is a comment line that is not mandatory.

The parts written in bold type and in italics are program-related key words that must not be removed. All other components may be modified as required.

The file entries must be adjusted accordingly when the page definitions are modified.

Recommendation: Only data should be modified within an export file.

Modify Page Definitions

The following section describes the menus within machine data preparation that permit the page definitions to be modified:

- Structure definitions
- Insert a data element
- Remove a data element
- Enter or modify a data type
- Enter or modify access privileges
- Terminate structure definitions
- Definition of the control variables
- Selection of the control variable type
- Specification of the range of a control variable
- Soft key label
- Enter enhanced selection texts
- Enter selection text
- Remove selection text
- Remove selection text entries
- Remove control variable

Basics

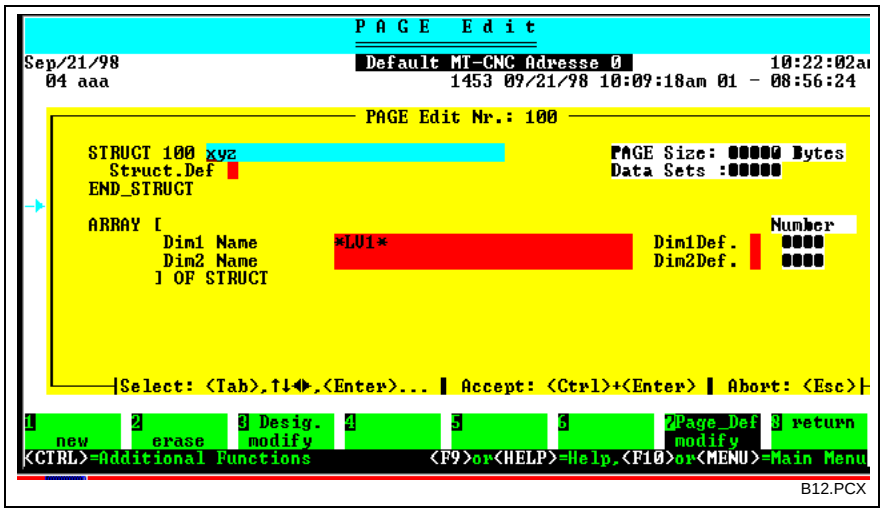


Fig. 4-7: Enter or modify page definition

The base screen used for defining a page contains the key words STRUCT and END_STRUCT. The page structure is defined within that range. Furthermore, the key words ARRAY [LV1 name, LV2 name] OF STRUCT can be found there. Within that range, the array to the previously defined structure is specified.

Within the array, the page name is available for editing after the STRUCT key word. If necessary, it may be modified here. Correspondingly, the LV1 names may directly be entered in the fields that follow ‘LV1/LV2 name’.

To reach the structure definition, use the cursor or the <Tab> key to move to the field behind ‘Struct. def.’, and press the <Enter> key. Use the same procedure to reach the definitions of the control variables. Use the <Cursor> or the <Tab> key to place the cursor on the field after ‘LV1 def.’ or ‘LV2 def.’ and press the <Enter> key.

Structure definitions

The structure definition is reached if, within the base screen, the cursor is positioned on the field behind ‘Struct. def.’ and the <Enter> key is pressed. The user interface then displays a new window and a new soft key line.

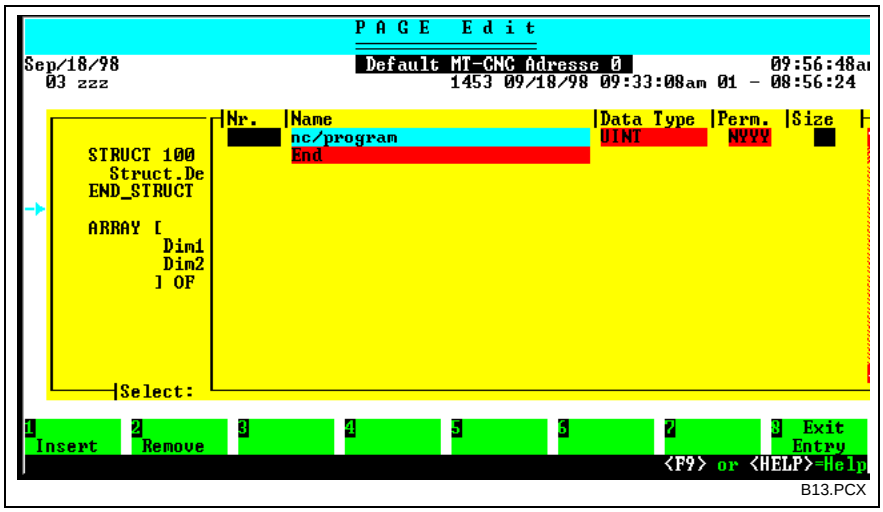


Fig. 4-8: Specification of the structure definition

Note: The structure is empty if the page has newly been created.

<F1> Insert a data element

When the <F1> key is selected, the user interface inserts a new entry before the currently selected entry.

At the beginning, repeatedly selecting the <F1> key inserts the required number of data element entries that may later be edited. Alternatively, name, data type and access privileges can be entered step by step and immediately after a data element entry has been inserted and before the next one is inserted.

Use the <Tab> key to move within the table from left to right and from top to bottom. Using <Shift>+<Tab> permits movements in the opposite direction. Alternatively, the <Cursor> keys may be used for moving through the table.

Note: Inserting data elements within a structure requires existing data to be cleared. In such a situation, the user interface displays an information window that permits the page data to be cleared immediately. The data may as well be cleared later within machine data preparation.

Enter or modify the data type

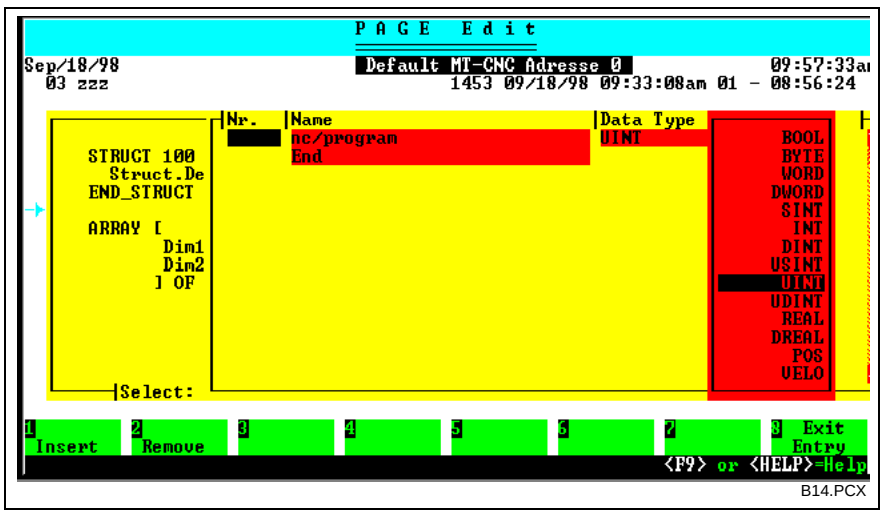


Fig. 4-9: Enter or modify the data type

To enter or edit the data type of an element, move to the line concerned and the ‘data type’ column (using the <Tab> key),and press the <Enter> key.

The user interface then displays all existing data types in another window. Move the cursor to the required data type and press the <Enter> key to select it.

Enter or modify access privileges

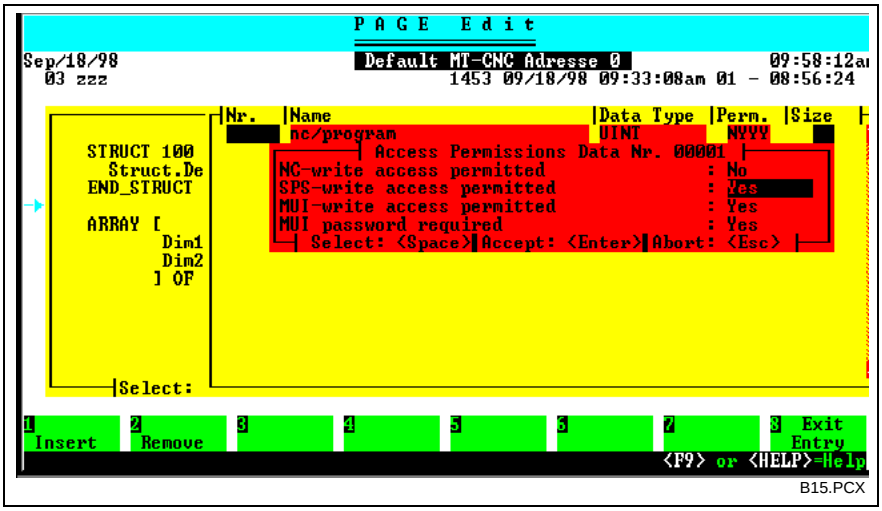


Fig. 4-10: Enter or modify access privileges

The access privileges of pages of the NC, the SPS, and the user interface may, for a data element, newly be entered or modified. To do this, move to the line concerned and the column ‘privileges’ (using the <Tab> key), and press the <Enter> key for confirmation. The user interface then displays another window of the following contents:

- NC write access permitted Yes / No
- SPS write access permitted Yes / No
- BOF write access permitted Yes / No
- BOF password required Yes / No

Use the <Space> key to change the selections for write access and/or user interface password. Press the <Enter> key to enter all changes and to close the window. Press the <Esc> key to abort the process.

Besides specifying the write access, the user can request a password protection for each data element by selecting ‘Yes’.

If, within the structure definition for a data element, a specification is not made, the NC grants all subsystem a write access; and the user interface requests a password entry for editing.

<F2> Remove a data element

Select the<F2> key to clear the entry of a data element.

Note: Please remember that the user interface does not display any further safety prompt.

<F8> Terminate structure definitions

Select the <F8> key to terminate the structure definitions and to close the associated window.

Definition of the control variables

To get to the definition of a control variable, move the cursor within the base screen to ‘LV1 def.’ or ‘LV2 def.’ and press the <Enter> key. The user interface then displays the ‘LV Definitions’ window and a new soft key line.

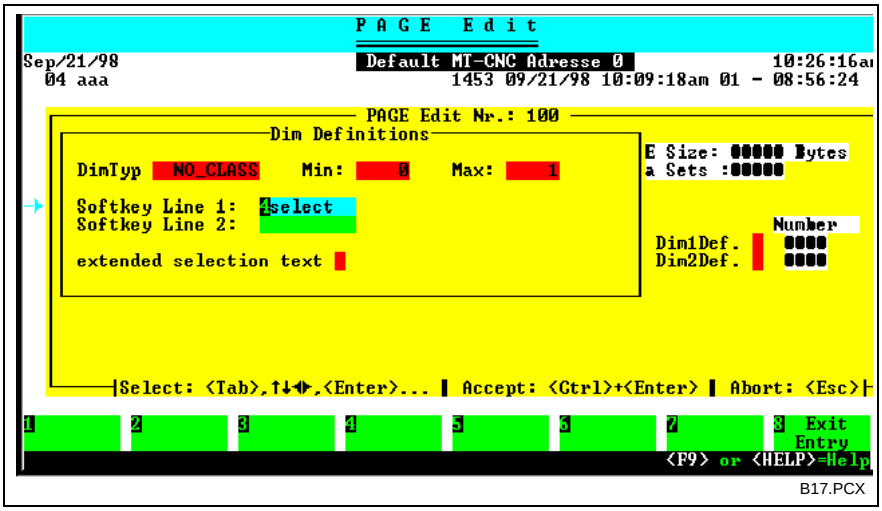


Fig. 4-11: Definition of a control variable

The following data must be entered in the LV definition window:

- the control variable type,
- the range of the control variable,
- the related soft key labels, and
- the enhanced selection texts.

The enhanced selection texts enable the machine manufacturer to store additional text, that may be used by the end user, to each value or to several values of a control variable. The user interface displays the enhanced selection text when the control variable is selected.

Note: Additional text cannot be loaded into the controller. The texts no longer exist when the data is loaded back into a new machine data record.

Selecting the control variable type

Move to the corresponding column (using the <Tab> key and, subsequently, pressing the <Enter> key) to enter or modify the control variable type. The user interface then opens a new window and displays all existing control variable types. Move the cursor onto the required data type, and press the <Enter> key to confirm the selection.

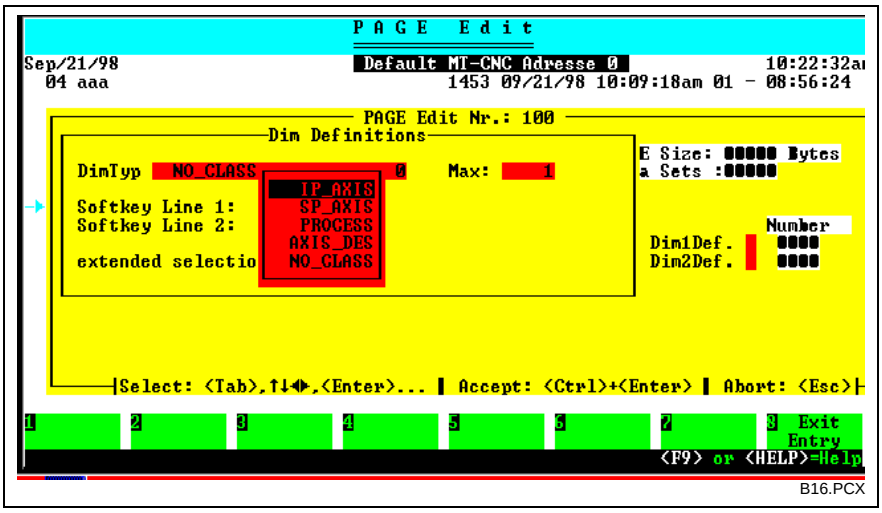


Fig. 4-12: Selecting the control variable type

The following control variable types are available:

Control variable type	Soft key label	Comment
IP_AXIS	Axis selection	Axes of the feed axis type
SP_AXIS	Axis selection	Axes of the spindle type
PROCESS	Process selection	Any existing process
AXIS_DES	Axis selection	Axes of the feed axis or spindle type
NO_CLASS	Any label	no type

Note: The control variable types IP_AXIS, SP_AXIS and AXIS_DES are orientated towards the axis meaning.

Specifying the range of a control variable

The range of a control variable of the NO_CLASS type can be between -1000 and 1000. Thus, the following minimum and maximum values can be specified:

- min. = -1000 ... 1000
- max. = -1000 ... 1000

A control variable can contain a maximum of 1000 elements. The following applies:

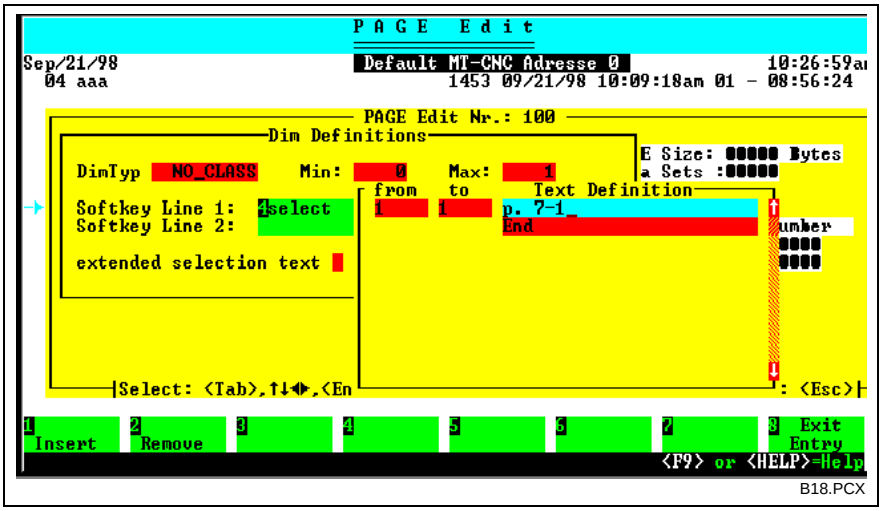
$$maximum\ value\ -\ minimum\ value\ \leq\ 1000$$

Soft key labels

Move to the related fields to edit the soft key labels. The top line may contain a maximum of 8 characters, the bottom line can hold a maximum of 9 characters.

Entering enhanced selection texts

Move the cursor to the field concerned to specify the enhanced selection text. When the <Enter> key is pressed, the user interface displays a new window and the related soft key bar.



B18.PCX

Fig. 4-13: Extended selection texts

<F1> Insert selection text

When the <F1> key is pressed, the user interface inserts a new line before the selected entry.

At the beginning, repeatedly selecting the <F1> key inserts the required number of lines that may later be edited. Alternatively, the allocated control variable number (e.g. from 1 to 1) or the control variable range (e.g. from 1 through 10) and the selection text can be entered immediately after a line has been inserted and before the next one is inserted.

Use the <Tab> key to move within the table from left to right and from top to bottom. Using <Shift>+<Tab> permits movements in the opposite direction. Alternatively, the <Cursor> keys may be used for moving through the table.

<F2> Removing selection text

Press the <F2> key to delete the entry of a selection text.

Note: Please remember that the user interface does not display any further safety prompt**.**

<F8> Terminating the selection text entry

Select the <F8> key to terminate the text definitions.
In the event of a malfunction, the user interface immediately generates an error message at this point.

Notes: The page definitions of the controller machine data are not accessible to the user.
The range of the control variables, the labels of the associated soft keys, and the enhanced selection texts have been defined for the control variable types that are pre-defined by the controller.
The enhanced selection texts are not transferred to the controller. Consequently, a machine data record that has been created by uploading the machine data and definitions from the controller does not contain any enhanced selection texts.

Removing a control variable

Follow this procedure to remove a control variable:

- Specify a value range ‘0’ in the LV definition window (min = 0, max =0).
- Clear the related name of the control variable concerned.

After these steps have been completed, the value ‘0000’ must be displayed for the ‘Number’ item that appears after the control variable.

Note: There must be at least one control variable defined; the page would be invalid otherwise.

<Esc> Aborting the page definition

Press the <Esc> key to cancel the previously made definitions. If you are in another window, the user interface first closes that window when you press the <Esc> key. Page definition is aborted when you press the <Esc> key again.

<Esc><Enter> Terminating structure definition

Press the <Ctrl>+<Enter> key combination to enter the modifications. New and enhanced texts are entered in all available languages of the user interface if they have not yet been defined there. (Subsequently, the new and/or modified texts must be translated. To do this, select the required language in the pop up menu and translate the texts concerned.)

5 Important Additional Information

5.1 New Installation

Procedure

After a new installation, the following sequence in using the machine data should be followed:

⇒ Create the parameter record

⇒ Load the parameter record into the controller

⇒ Create the machine data record with the required pages

⇒ Load the definitions of the machine data record into the controller

⇒ Enter the data within the current machine data

5.2 Software Update

Procedure

Use the following procedure for a software update in which the data (including the machine data) that is contained in the controller shall be saved due to a firmware exchange:

⇒ <F1> Storage

⇒ <Ctrl>+<F6> MT-CNC ⇒ NC data
(saving all controller data)

⇒ <F10> Exit the menu

⇒ Replace firmware

⇒ <F1> Storage

⇒ <F6> NC data ⇒ MT-CNC
(load all previously saved data into the controller)

⇒ <F10> Exit the menu

⇒ <F3> Machine data
(the following error message appears:
'No directory-related machine data in the controller')

⇒ <Del> Acknowledge error message

⇒ <Ctrl>+<F6> MT-CNC ⇒ MaDefDat
(Save the definitions and data of the machine data record in the controller)

5.3 Entering a Password

Recommended access interlocking

Three keys are available for processing the machine data:

- Modify system parameters
- Modify machine data definitions
- Modify machine data

These keys should be allocated to the user passwords according to the competence of the users:

The following basic distinction should be made:

Machine manufacturers with the keys	Setup personnel with the keys	End users with the keys
• Modify system parameters • Modify machine data definitions • Modify machine data	• Modify machine data definitions • Modify machine data	• Modify machine data

The following tables show the individual functions and the keys that are required for execution those functions.

Password key for the functions of the current machine data

Function	Soft key	Key required
Edit - absolute	<F1>	-: if an MUI password has not been requested for the data element Modify MaDat: if an MUI password has been requested for the data element
LV1/LV2 selection	<F4>, <F5>, <Ctrl>+<F4>, <Ctrl>+<F5>, <Alt>+<F4>, <Alt>+<F5>	-
Page_Dat ⇒ MT-CNC (load page data)	<F6>	Modify MaDat
Page selection	<F7>, <Ctrl>+<F7>, <Alt>+<F7>	-
To the main menu	<F8>	-
MT-CNC ⇒ Ma_Dat (save machine data)	<Ctrl>+<F6>	Modify MaDat
Preparation	<Ctrl>+<F8>	-

Fig. 5-1: Password key for the functions of the current machine data

Password key for the functions required for processing a machine data record within preparation

Function	Soft key	Key required
New	<F1>	Modify MaDef
Clear	<F2>	Modify MaDef
Rename	<F3>	Modify MaDef
Print directory	<F4>	-
Assign parameter	<F5>	Modify MaDat
Ma_Def ⇒ MT-CNC (load definitions)	<F6>	Modify MaDef
Modify MaDefDat (access to def.)	<F7>	-
Current machine data	<F8>	-
Copy	<Ctrl>+<F1>	Modify MaDef
Find text	<Ctrl>+<F3>	-
MT-CNC ⇒ MaDefDat (Save data and definitions)	<Ctrl>+<F6>	-

Fig. 5-2: Password key for the functions required for processing a machine data record within preparation

Password key for the functions required for processing a page within preparation

Function	Soft key	Key required
New	<F1>	Page 1-99: Locked Page 100-199: Modify system parameters Page 200-299: Modify MaDef
Clear	<F2>	Page 1-99: Locked Page 100-199: Modify system parameters Page 200-299: Modify MaDef
Rename	<F3>	Page 1-99: Locked Page 100-199: Modify system parameters Page 200-299: Modify MaDef
Print	<F4>	-
Clear Page_Dat	<F5>	Modify MaDat
Edit Page_Def	<F7>	Page 1-99: Locked Page 100-199: Modify system parameters Page 200-299: Modify MaDef
Return	<F8>	-
Copy	<Ctrl>+<F1>	Page 1-99: Locked Page 100-199: Modify system parameters Page 200-299: Modify MaDef
Page import	<Ctrl>+<F2>	if only data was modified: Modify MaDat if definitions have also been modified: Page 1-99: not possible Page 100-199: Modify system parameters Page 200-299: Modify MaDef
Page export	<Ctrl>+<F3>	Modify MaDat

Fig. 5-3: Password key for the functions required for processing a page within preparation

5.4 Preparing Page Data

Example

Using the machine data, a machine manufacturer has implemented a pallet management. For that function, the end user wants, within the scope of production planning, to prepare the related page data for a new job, and transfer the data to the machine.

Working steps

1. Fetch the data and definitions of a page from the machine:

⇒ <F3> Machine data

⇒ <Ctrl>+<F6> MT-CNC ⇒ Ma_Dat
(Save the data of the machine data record in the controller)

⇒ <Ctrl>+<F8> Preparation

⇒ <F7> Modify MaDefDat
(select the current machine data record)

⇒ <Ctrl>+<F3> Page export

⇒ <F10> Exit the machine data

2. Use an ASCII editor to edit the data in production planning:

⇒ Perform the necessary data modifications.

3. Return the data and definitions to the machine:

⇒ <F3>	Machine data
⇒ <Ctrl>+<F8>	Preparation
⇒ <F7>	Modify MaDefDat (select the current machine data record)
⇒ <Ctrl>+<F2>	Page import
⇒ <F8>	Return
⇒ <F8>	Current machine data
⇒ <F6>	Page_Dat ⇒ MT-CNC (load page data into the controller)
⇒ <F10>	Exit machine data

5.5 Modifying Page Definitions

Boundary conditions for modifying page definitions within the user interface

After the user has modified the structure definition via the user interface, the user interface asks whether or not the data of that page shall be cleared. Enter <N> to retain the existing data; or enter <J> to remove the data. (The data may also be deleted later. To do this, select the <F5> 'Clear page data' function from the 'Edit page' menu.)

The user interface always retains the data if the user modifies the range of the control variables LV1 or LV2.

Boundary conditions for modifying page definitions outside the user interface

During export, all data items (including the ones that are outside the definition range) are written to the file concerned. Missing data items are not completed.

During import, the user interface shows the following behavior:

- Data is not cleared at the beginning of the import process
- Existing data is overwritten
- Data that has not existed is inserted at the corresponding locations
- Data that is outside the definition range is also accepted

Notes: Only the user can clear or overwrite data that is outside the definition range.

The following options are available:

1. Clear page data
   <F5> 'Clear Page_Dat in the 'Edit page' menu

then

2a. Save data
   <Ctrl>+<F6> 'MT-CNC ⇒ Ma_Dat' in the 'actual machine data' menu

or

2b. Save data and definitions
   <Ctrl>+<F6> 'MT-CNC ⇒ MaDefDat' in the 'Preparation' menu

or

2c. Import complete data record
   <F5> 'Page import' in the 'Edit page' menu

Boundary conditions for reloading definitions and data

If the machine data definitions are loaded later (<F6> ‘Ma_Def ⇒ MT-CNC’ in the ‘Preparation’ menu), the controller initializes data elements whose definitions have changed with a value of ‘0’.

If the page data is loaded later (<F6> ‘Page_Dat ⇒ MT-CNC’ in the ‘Current machine data’ menu), the user interface loads the data from the hard disk into the controller.

The following boundary conditions must be taken into account:

- The user interface only transfers the data that have been stored on the hard disk.
- Data that is outside the definition range is not transferred to the controller.

The user interface does not transfer missing data, so that the value in the controller is not overwritten.

6 Access to Machine Data

6.1 NC Syntax

MTD command Use the 'MTD' (Machine Table Data) command to read and write individual machine data elements from the NC (provided that write access to the element is permitted).

Syntax **MTD ([Page no.], [control variable 1], [control variable 2], [element-No.])**

Name	Range	Comment
Page No.	1 ... 299	001 .. 099: Pages of the controller machine data 100 .. 199: Pages of the OEM machine data 200 .. 299: Pages of the user machine data
Control variable 1	min. value ... max. value	min. value: 1st value of the structure definition (≥ -1000) max. value: 2nd value of the structure definition (≤ 1000) additionally: greatest value - smallest value ≤ 1000
Control variable 2	min. value ... max. value	min. value: 1st value of the structure definition (≥ -1000) max. value: 2nd value of the structure definition (≤1000) additionally: greatest value - smallest value ≤ 1000
Element no..	1 ... 100	consecutive numbering, starting from 1

Fig. 6-1: Names and ranges of the parameters of the MTD command

Notes:

The individual numbers must be separated by commas.

A variable can be used instead of a constant.

Using an arithmetic calculation instead of a constant or a variable is not permitted.

All above-mentioned parameters must always be specified.

The NC checks the validity of the parameters at the execution time, not before. If a parameter specification is outside the valid range, the NC interrupts program execution and issues an error message.

The NC reacts in the same way if the user performs a write access from the NC program to a write-protected data element.

If the user assigns a data element a value outside the valid range, the NC automatically (without error message) delimits that value to the smallest or greatest value of the data element.

Using the MTD command, any number of data elements may be read from the machine data within an NC block; but only one data element can be written to at any one time.

6.2 SPS Syntax

MTD_RD and MTD_WR

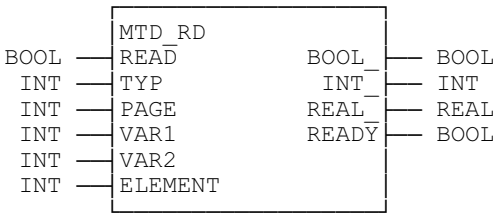
The ‘MTD_RD’ function block permits individual machine data elements to be read from the SPS program.

Provided that the access from the SPS program is permitted, the ‘MTD_WR’ function block permits machine data to be written to. The machine data is kept in the CNC. The SPS must therefore access this information as required, i.e. in serial mode. Consequently, the machine data will be available after one SPS cycle at the earliest.

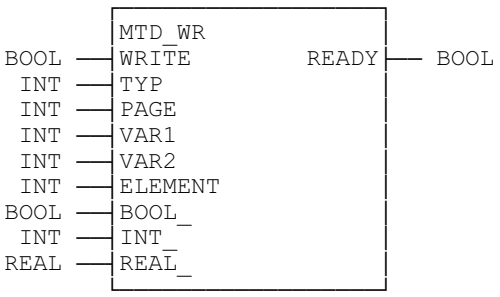
The function block interfaces have been exactly defined. When a function block is invoked, the programmer merely ‘interconnects’ the corresponding signals. An assembler program performs the handling of the function blocks. The inner structure of the function blocks can therefore not be represented by the IL, LAD, or LOP programming languages.

Interfaces of the ‘MTD_RD’ and ‘MTD_WR’ function blocks

Reading machine data ‘MTD_RD’



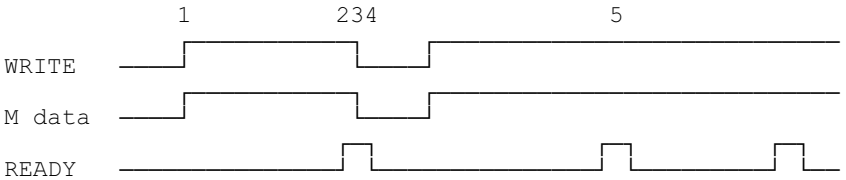
Writing machine data ‘MTD_WR




```
READ:         BOOL;
                       0  -    FB not active
                       1  -    Initiate reading machine data
WRITE:        BOOL;
                       0  -    FB not active
                       1  -    Initiate writing machine data
TYP:          INT;     Data type that shall be read/written
                        0 -    BOOL
                        7 -    INT
                       10 -    REAL
PAGE:         INT;     Page number (1...299)
VAR1:         INT;     Control variable 1
                       (min. value ... max. value according
                        to page definition)
VAR2:         INT;     Control variable 2
                       (min. value ... max. value according
                        to page definition)
ELEMENT:      INT;     Data element (1...100)
BOOL_:        BOOL;    Machine data that shall be read and/or
INT_:         INT;     written
REAL_:        REAL;
READY:        BOOL;Reading machine data
                       0 - Data invalid
                       1 - Data valid
                       Writing machine data
                       0 - Data transfer active or FB not
                           active
                       1 - Data transferred
```

Method of operation

Timing of writing machine data:



(1) Setting the WRITE input initiates machine data transfer. The machine data that is to be accessed is defined by the inputs PAGE, VAR1, VAR2 and ELEMENT. The TYP input defines the data type of the machine data. Conversion is automatically performed if the data is not available in the specified data format.

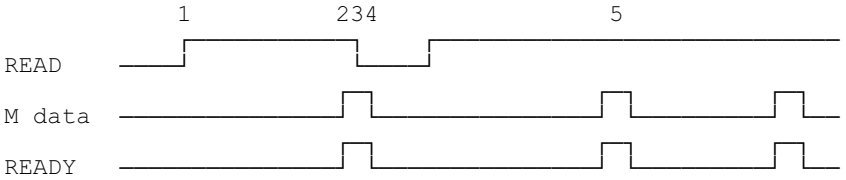
(2) The activated READY output shows that the machine data transfer is completed. In a write process, the READY output indicates the completion of the data transfer.

(3) The WRITE input may be cleared after a single data exchange.

(4) Clearing the WRITE input also clears the READY output of the function block.

(5) If the WRITE input remains statically ON, a new data transfer is automatically initiated after the previous one has been completed. This permits the machine data to be written cyclically.

Timing of reading machine data:



(1) Setting the READ input initiates machine data transfer. The machine data that is to be accessed is defined by the inputs PAGE, VAR1, VAR2 and ELEMENT. The TYP input defines the data type of the machine data. Conversion is automatically performed if the data is not available in the specified data format.

(2) The activated READY output shows that the machine data transfer is completed. In a read process, the READY output indicates that the requested data is present.

(3) The READ input may be cleared after a single data exchange.

(4) Clearing the READ input also clears the READY output of the function block.

(5) If the READ input remains statically ON, a new data transfer is automatically initiated after the previous one has been completed. This permits the machine data to be read cyclically.

Error handling

Programming errors prevent the ‘MTD_RD’ and ‘MTD_WR’ function blocks from being executed correctly. In this case, fault handling informs about the cause of the malfunction.

Error type for the function blocks	
Reading machine data	*Writing machine data*
MTD_RD: 178	MTD_WR: 177

Error no.	
1	Invalid input parameter The values of the ‘PAGE’, ‘VAR1’, ‘VAR2’ and ‘ELEMENT’ inputs are negative. The ‘PAGE’ input is outside the range 1 ... 299. The ‘VAR1’ input is outside the range -1000 ... 1000. The ‘VAR2’ input is outside the range -1000 ... 1000. The ‘ELEMENT’ input is outside the range 1 ... 100.
6	Internal transfer error
?	CPU reports error (e.g. machine data not found; data write-protected)

7 Spindle Setup Register

7.1 Jog Speed

Name Jog speed

Number 1

Purpose Jog speed is used in manual mode as the speed that is used for continuous turning (AxxCM3 / AxxCM4: 0→1 and AxxCRAPID = 0) and for continuous or incremental jogging.

Unit 1/min

Range 10.0 ... 100 000.0

Requirements

- 'Manual mode' (setup) has been selected.
- The axis is operational (AxxCREADY = 1) and the controller enable signal is active (AxxSRF = 1).
- The axis enabling signal is applied (AxxCENABL = 1).
- Motion inhibit is inactive (AxxCMHOLD = 0).
- The spindle-related RAPID input has not been set (AxxCRAPID = 0).
- Besides the spindle counter-clockwise/clockwise rotation request, the SPS does not issue a spindle clockwise/counter-clockwise rotation, spindle stop, or spindle positioning request at the same time.

Notes: The process-related RAPID input does not have an effect on spindles.
For spindle movement, the NC will employ the related value from the axis parameters instead of the setup register if the user assigns the value '0' to the jog speed of a spindle.

7.2 Rapid Jog Speed

Name Rapid jog speed

Number 2

Purpose The 'Rapid jog speed' is use in manual mode as the rapid jog speed for continuous turning (AxxCM3/AxxCM4: 0→1 and AxxCRAPID = 1), and for continuous and incremental jogging.

Unit [1/min]

Range 10.0 ... 100 000.0

Requirements

- 'Manual mode' (setup) has been selected.
- The axis is operational (AxxCREADY = 1) and the controller enable signal is active (AxxSRF = 1).
- The axis enabling signal is applied (AxxCENABL = 1).
- Motion inhibit is inactive (AxxCMHOLD = 0).
- The spindle-related RAPID input has been set (AxxCRAPID = 1).
- Besides the spindle counter-clockwise/clockwise rotation request, the SPS does not issue a spindle clockwise/counter-clockwise rotation, spindle stop, or spindle positioning request at the same time.

Notes: The process-related RAPID input does not have an effect on spindles.

For spindle movement, the NC will employ the related value from the axis parameters instead of the setup register if the user assigns the value '0' to the rapid jog speed of a spindle.

7.3 Spindle Position Jogging

Name Spindle position jogging

Number 3

Purpose 'Spindle position jogging' is used in manual mode for positioning (AxxCM19: 0→1) the spindle.

Unit °

Range 0.0001 ... 10 000.000 0

Requirements

- 'Manual mode' (setup) has been selected.
- The axis is operational (AxxCREADY = 1) and the controller enable signal is active (AxxSRF = 1).
- The axis enabling signal is applied (AxxCENABL = 1).
- Motion inhibit is inactive (AxxCMHOLD = 0).
- Besides the spindle positioning request, the SPS does not issue a spindle clockwise/counter-clockwise rotation, or spindle stop request at the same time.

Notes: With analog spindles, the 'reference speed' (Cxx.051) that is stored in the axis parameters is used for positioning.

With digital spindles, the drive automatically positions, taking the positioning speed from the SERCOS parameter 'Spindle positioning speed' (S-0-0222) into account.

The NC takes 'spindle position jogging' from the axis parameters if jog speed and rapid jog speed of the spindle concerned have both a value assigned that is different from '0'.

7.4 Peculiarities

Incremental jogging of spindles

Provided that a spindle is moved by incremental jogging with 'variable jog distance', activating the AxxCJGPOS interface signal causes the NC to move to the position that is stored in the 'spindle position jogging' setup register.

Spindle with rotary axis capability

A spindle with rotary axis capability possesses all spindle-related functions in spindle mode, and all functions of a feed axis in rotary axis mode.

CAUTION

⇒ Prior to changing the 'Default System of Units for Programming' (Bxx.001) and 'Programmable Decimal Places for Distances' (Bxx.002) process parameters, the setup registers must be saved in the machine data in the PC and be loaded back into the controller after the parameters have been modified. To check that the values have been converted as required is mandatory.

8 Setup Registers of the Feed Axes

8.1 Jog Speed

Name Jog speed

Number 1

Purpose The NC employs the 'jog speed' in manual mode for continuous and incremental axis jogging.

Unit Linear axes: mm/min or inch/min
Rotary axes: units/min

Range 10.0 ... 100 000.0 mm or units/min
1.00 ... 10 000.00 inch/min

Requirements

- 'Manual mode' (setup) has been selected.
- The axis is operational (AxxCREADY = 1) and the controller enable signal is active (AxxSRF = 1).
- The axis enabling signal is applied (AxxCENABL = 1).
- Motion inhibit is inactive (AxxCMHOLD = 0).
- The process-related RAPID input has not been set (PxxCRAPID = 0).

Notes: The axis-related RAPID input does not have an effect on feed axes (axis meaning X, Y, Z, U, V, W, A, B, C).

For axis movement, the NC will employ the related value from the axis parameters instead of the setup register if the user assigns the value '0' to the jog speed of a feed axis.

8.2 Rapid Jog Speed

Name Rapid jog speed

Number 2

Purpose The NC employs the 'rapid jog speed' in manual mode for continuous and incremental axis jogging.

Unit Linear axes: mm/min or inch/min
Rotary axes: units/min

Range 10.0 ... 100 000.0 mm/min or units/min
1.00 ... 10 000.00 inch/min

Requirements

- 'Manual mode' (setup) has been selected.
- The axis is operational (AxxCREADY = 1) and the controller enable signal is active (AxxSRF = 1).
- The axis enabling signal is applied (AxxCENABL = 1).
- Motion inhibit is inactive (AxxCMHOLD = 0).
- The spindle-related RAPID input has been set (PxxCRAPID = 1).

Notes: The axis-related RAPID input does not have an effect on feed axes (axis meaning X, Y, Z, U, V, W, A, B, C).

For axis movement, the NC will employ the related value from the axis parameters instead of the setup register if the user assigns the value '0' to the rapid jog speed of a feed axis.

8.3 Variable Jog Distance

Name Variable jog distance

Number 3

Purpose In manual mode, 'variable jog distance' permits any distance to be specified that the NC moves along in incremental jogging at the variable jog distance (AxxCJGPOS / AxxCJGNEG: 0→1, PxxCJOGM0 = PxxCJOGM1 = PxxCJOGM2 = 1).

Unit Linear axes: mm or inch
Rotary axes: units

Range 0.000 1 ... 10 000.000 0 mm or units
0.000 01 ... 1 000.000 00 inch

Requirements

- 'Manual mode' (setup) has been selected.
- The axis is operational (AxxCREADY = 1) and the controller enable signal is active (AxxSRF = 1).
- The axis enabling signal is applied (AxxCENABL = 1).
- Motion inhibit is inactive (AxxCMHOLD = 0).
- Incremental jogging with variable jog distance has been pre-selected (PxxCJOGM0 = PxxCJOGM1 = PxxCJOGM2 = 1).

Notes: In incremental jogging with variable jog distance, the NC moves the axes at jog speed or at rapid jog speed, depending on the state of the process-related RAPID input.

For axis movement, the NC will employ the related value from the axis parameters instead of the setup register if the user assigns the value '0' to 'variable jog distance' of a feed axis.

8.4 Peculiarities

Tool magazine axis With NC-controlled tool magazines, the NC does not take the 'variable jog distance' from the machine data into account. In incremental jogging, it always employs the 'Parametric jogging distance' (Cxx.022) from the axis parameters to move the tool magazine axis from location to location.

Handwheel If, in handwheel mode and using the jog mode signals, the SPS selects incremental jogging with 'variable jog distance' (PxxCJOGM0 = PxxCJOGM1 = PxxCJOGM2 = 1), the NC employs the 'Parametric jogging distance' (Cxx.022) value that is stored in the axis parameters divided by 100 (variable jog distance per handwheel revolution) to interpret the graduation marks on the handwheel.

CAUTION

⇒ Prior to changing the 'Default System of Units for Programming' (Bxx.001) and 'Programmable Decimal Places for Distances' (Bxx.002) process parameters, the setup registers must be saved in the machine data in the PC and be loaded back into the controller after the parameters have been modified. To check that the values have been converted as required is mandatory.

9 Slave and Gantry Axes

9.1 Synchronous Axes Compound is Activated

Name Synchronous axes compound is activated

Number 1

Purpose The data element indicates whether or not the related synchronous axes compound has been activated.

Unit -

Range
0: Synchronous axes compound has not been switched on
1: Synchronous axes compound has been switched on

Modifications Only the NC operating system updates the ‘Synchronous axes compound’ status information. All other subsystems may only read that data element.

9.2 Axis Meaning of the Master Axis

Name Axis meaning of the master axis

Number 2

Purpose Specifying the associated axis meaning permits each linear axis, rotary axis, or spindle with rotary axis capability to be declared as the master axis.

Unit -

Range 0 - 9

0: No master axis
1: Axis meaning X
2: Axis meaning Y
3: Axis meaning Z
4: Axis meaning U
5: Axis meaning V
6: Axis meaning W
7: Axis meaning A
8: Axis meaning B
9: Axis meaning C

Default value 0 (there is no master axis for the synchronous axes compound concerned)

Interpretation The NC interrupts machining and generates an error message if the ‘axis meaning of the master axis’ data element has the value ‘0’ assigned when the related synchronous axes compound is switched on.

9.3 Axis Meaning of the Slave Axis

Name Axis meaning of the slave axis 1/2/3

Number 3, 8, 13

Purpose Specifying the associated axis meaning permits each linear axis, rotary axis, or spindle with rotary axis capability to be declared as a slave axis.

Unit -

Range 0 - 9

0: No slave axis
1: Axis meaning X
2: Axis meaning Y
3: Axis meaning Z
4: Axis meaning U
5: Axis meaning V
6: Axis meaning W
7: Axis meaning A
8: Axis meaning B
9: Axis meaning C

Default value 0 (there is no slave axis 1/2/3 for the synchronous axes compound concerned)

Interpretation The NC interrupts machining and generates an error message if a slave axis has not been entered when the related synchronous axes compound is switched on.

9.4 Gearing Ratio of the Slave Axis

Name Gearing ratio

$$Gearing\ ratio := \frac{Revolutions\ of\ master\ axis}{Revolutions\ of\ slave\ axis}$$

$j \in \{1, 2, 3\}$

Number 4/5, 9/10, 14/15

Purpose To avoid rounding errors, the gearing ratios (i_LA/FA1, i_LA/FA2 and i_LA/FA3) are specified on the basis of the machine data:

- revolutions of the master axis, and
- revolutions of the slave axis 1/2/3.

Unit -

Range 1 - 65535 (revolutions of master and slave axes)

CAUTION

⇒ The gearing ratios (i_LA/FA1, i_LA/FA2 and i_LA/FA3) must be in the range between 0.01 and 100.

Default value 0 (revolutions of master and slave axes)

9.5 Sense of Rotation of the Slave Axis

Name Sensor of rotation of the slave axis 1/2/3

Number 6, 11, 16

Purpose 'Sense of rotation of the slave axis 1/2/3' enables the sense of rotation of slave axis 1/2/3 to be reversed with respect to the master axis.

Range
0: No change in the sense of rotation
1: Sense of rotation reversed

Default value 0

9.6 Slave Axis = Gantry Axis

Name Slave axis 1/2/3 = Gantry axis

Number 7, 12, 17

Purpose The NC does not interpret this data element.

Unit -

Range 0/1

Default value 0

9.7 Peculiarities

Modifying the machine data

Provided that the synchronous axes compound concerned is not active, the individual data elements may be modified from the user interface, the SPS or the NC at any time. An error message will be issued if a user makes an attempt to access the data of an active synchronous axes compound from the SPS or from the user interface. An error message will be issued and the NC stops machining if the user makes that attempt in the NC program.

The data may only be modified via the user interface if the user possesses the necessary password and if the compound concerned is not active.

Note: If there is incorrect data (e.g. axis meaning of master axis = 0) when a synchronous axes compound is activated, the NC genertes an error message and sets the 'Error' (PxxSERROR) interface signals until the activation of the compound is canceled. If the operator does not eliminate that error before the next activation, the NC will generate another error message and will set the 'Error' interface signal again upon the next activation.

10 Master Spindle Synchronization

10.1 Synchronous Operation OK

Name Synchronous operation of synchronous spindle 1/2 OK

Number 1, 2

Purpose The 'Synchronous operation of synchronous spindle 1 / 2 OK' data elements indicate whether or not the synchronous spindle concerned has been activated and follows the master spindle, taking the 'Synchronous spindle 1/2 synchronous operation window' into account.

Unit -

Range 0: Synchronous operation of synchronous spindle 1/2 not OK
1: Synchronous operation of synchronous spindle 1/2 OK

Modifications Only the NC operating system updates the 'Synchronous operation of synchronous spindle 1 / 2 OK' status information. All other subsystems may only read that data element.

10.2 Axis Meaning of the Master Spindle

Name Axis meaning of the master spindle

Number 3

Purpose This data item can be used for declaring any main spindle or main spindle with rotary axis capability to be the master spindle.

Unit -

Range 0, 10, 11, 12

0: No master spindle
10: Axis meaning spindle S1
11: Axis meaning spindle S2
12: Axis meaning spindle S3

Default value 0 (no master spindle)

Interpretation The NC interrupts machining and generates an error message if the axis meaning of the master spindle has the value '0' assigned when synchronous operation is activated.

10.3 Axis Meaning of the Synchronous Spindle

Name Axis meaning of the synchronous spindle 1/2

Number 4, 12

Purpose This data item can be used for declaring any main spindle or main spindle with rotary axis capability to be a synchronous spindle.

Unit -

Range 0, 10, 11, 12

0: No synchronous spindle
10: Axis meaning spindle S1
11: Axis meaning spindle S2
12: Axis meaning spindle S3

Default value 0 (no synchronous spindle)

Interpretation The NC interrupts machining and generates an error message if the axis meaning of synchronous spindle 1/2 has the value '0' assigned when the synchronous spindle concerned is activated.

10.4 Angular Offset

Name Angular offset of synchronous spindle 1/2

Number 5, 13

Purpose 'Angular offset of synchronous spindle 1/2' enables the user to select any angular offset between the master spindle and the synchronous spindle concerned during synchronous operation.

Unit °

Range 0.0000° - 359.9999° (the NC performs a Modulo computation for values outside the range).

Default value 0 (no offset)

Modifications 'Angular offset of synchronous spindle 1/2' can be written during synchronous operation. The NC immediately carries out the modifications if the user modifies the angular offset during synchronous operation.

10.5 Position Offset

Name Position offset of synchronous spindle 1/2

Number 6, 14

Purpose During synchronous operation, 'position offset of synchronous spindle 1/2' enables the user to additively modify the offset between master and synchroous spindle that has been specified by the 'angular offset' data element.

Unit °

Range 0.0000° - 359.9999° (the NC performs a Modulo computation for values outside the range).

Default value 0 (no offset)

Modifications Writing to 'position offset of synchronous spindle 1/2' during synchronous operation is possible. The NC immediately executes the changes if the user modifies the position offset during synchronous operation.

Note: In contrast to the other data elements, a separate password input is not required here.

10.6 Gearing Ratio

Name Gearing ratio

$$\text{Gearing ratio:} = \frac{\text{Master spindle revolutions}}{\text{Revolutions of synchronous spindle}}$$

$j \in \{1, 2\}$

Number 7/8, 15/16

Purpose To avoid rounding errors, the gearing ratio (i_LS/SS1) of synchronous spindle 1 is specified on the basis of the machine data

- master spindle revolutions i_LS/SS1 and
- revolutions i_LS/SS1 of synchronous spindle 1; and

the gearing ratio (i_LS/SS2) of synchronous spindle 2 is specified on the basis of the machine data

- master spindle revolutions i_LS/SS2 and
- revolutions i_LS/SS2 of synchronous spindle 2.

Unit -

Range 1 - 65536 (for master and synchronous spindle revolutions)

Note: The gearing ratios (i_LS/SS1 and i_LS/SS2) must be inside the range between 0.01 and 100.

Default value 0 (for master and synchronous spindle revolutions)

10.7 Sense of Rotation

Name Sense of rotation of synchronous spindle 1/2

Number 9, 17

Purpose 'Sense of rotation of synchronous spindle 1/2' permits the sense of rotation of synchronous spindle 1 or 2 to be reversed.

Unit -

Range 0: no change in the sense of rotation
1: sense of rotation changed (defined sense of rotation reversed)

Default value 0

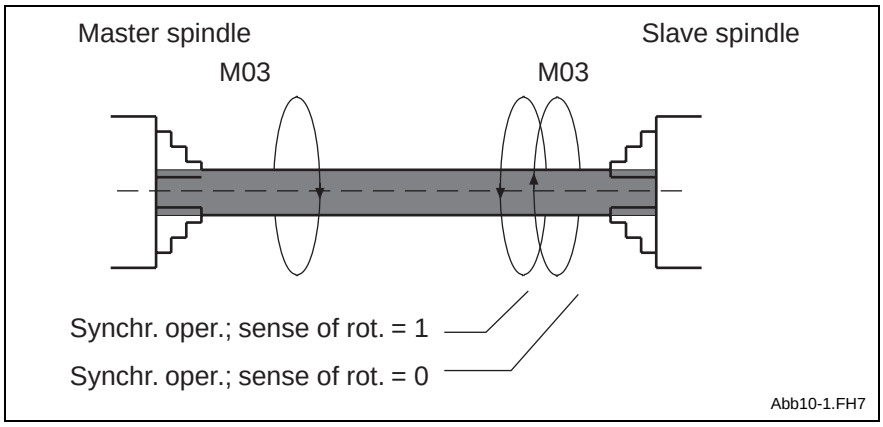


Fig. 10-1: Synchronous operation - sense of rotation

10.8 Synchronous Operation Window

Name Synchronous operation window of synchronous spindle 1/2

Number 10, 18

Purpose 'Synchronous operation window of synchronous spindle 1/2' is used for continuously monitoring the synchronous operation of synchronous spindle 1/2'. The NC monitors the actual position values of master spindle and synchronous spindle 1/2, taking the selected gearing ratio into account. If the two actual values diverge during operation to the extent that they exceed the synchronous operation window of synchronous spindle 1/2, the NC resets the 'synchronous operation OK' signal that is related to synchronous spindle 1/2.

Unit °

Range 0.0000° -359.9999° (the NC performs a Modulo computation for values outside the range).

Default value 0°

Note: Exceeding the synchronous operation window does not have any effect in the NC. Any reaction mechanisms or diagnoses messages that may be required must be programmed in the SPS.

10.9 Error Limit

Name Error limit of synchronous spindle 1/2

Number 11, 19

Purpose Like ‘synchronous window of synchronous spindle 1/2’, ‘error limit of synchronous spindle 1/2’ is used for continuously monitoring the synchronous operation of synchronous spindle 1/2. The NC monitors the actual position values of synchronous spindle 1/2, taking the existing gearing ratio into account. If the two actual values diverge during operation to the extent that they exceed the error limit of synchronous spindle 1/2, the NC resets the ‘synchronous operation OK’ signal that is related to the synchronous axis.

Note: Exceeding the synchronous operation window does not have any effect in the NC. Any error handling mechanisms or diagnoses messages that may be required must be programmed in the SPS.

Unit °

Range 0.0000° - 359.9999° (the NC performs a Modulo computation for values outside the range).

Default value 0°

10.10 Peculiarities

Modifying the machine data Provided that the related master spindle or synchronous spindle is not active, the individual data elements may be modified from the user interface, the SPS or the NC at any time. An error message will be issued if a user makes an attempt to access the data of a spindle that participates in synchronous operation from the SPS or from the user interface. An error message will be issued and the NC stops machining if the user makes that attempt in the NC program. The data elements ‘angular offset of synchronous spindle 1/2’ and ‘position offset of synchronous spindle 1/2’ are the only exception. During synchronous operation, the user may modify those elements at any time from the SPS, the NC, or the user interface.

Data can only be modified via the user interface if the user enters the correct password.

Note: If there is incorrect data (e.g. master spindle speed = 0), the NC generates an error message and sets the ‘Error’ (PxxSERROR) interface signals until the activation of the synchronous spindle concerned is canceled. If the operator does not eliminate that error before the next activation, the NC will generate another error message and will set the ‘Error’ interface signal again upon the next activation.

11 Appendix

11.1 Elementary Machine Data Types

Key word	Size	Unit	VK	NK	VZ	VN	MIN	MAX	Resolution	INIT	PROC
BOOL	1	-	1	0	0	0	0	1	1	0	0
BYTE	1	-	8	0	0	1	Bit string	Bit string	1	0	0
WORD	2	-	16	0	0	1	Bit string	Bit string	1	0	0
DWORD	32	-	32	0	0	1	Bit string	Bit string	1	0	0
SINT	1	-	3	0	1	0	-128	127	1	0	0
INT	2	-	5	0	1	0	-32768	32767	1	0	0
DINT	4	-	10	0	1	0	-2147483648	2147483647	1	0	0
USINT	1	-	3	0	0	0	0	255	1	0	0
UINT	2	-	5	0	0	0	0	65535	1	0	0
UDINT	4	-	10	0	0	0	0	4294967296	1	0	0
REAL	4	-	0	0	1	0	$-3.4*10^{38}$	$3.4*10^{38}$	$1.2*10^{-38}$	0	0
DREAL	8		0	0	1	0	$-18*10^{307}$	$18*10^{307}$	$2.2*10^{-308}$	0	0
POS*	4	LA: mm, inch RA: units HS: °	PN=4: 6 PN=5: 5	PN=4: 4 PN=5: 5	1	0	PN=4: -100000.0000 PN=5: -10000.00000	PN=4: 100000.0000 PN=5: 10000.00000	PN=4: 0.0001 PN=5: 0.00001	0	0
VELO*	4	LA: mm, inch inch/min RA: units/min HS: 1/min	PN=4: 6 PN=5: 5	PN=4: 1 PN=5: 2	0	0	PN=4: 0.0 PN=5: 0.00	PN=4: 500000.0 PN=5: 50000.00	PN=4: 0.1 PN=5: 0.01	0	0
ACCEL*	4	LA: mm/s^2, $inch/s^2$ RA: units/s² HS: rad/s²	PN=4: 6 PN=5: 5	PN=4: 0 PN=4: 1	1	0	PN=4: 0.0 PN=5: 0.00	PN=4: 100000 PN=5: 10000.0	PN=4: 0 PN=5: 0.1	0	0
DEG	4	°	3	2	0	0	0.00	359.99		0	0
SPEED	4	1/min	5	2	1	0	0.00	96000.00		0	0
FEED/REV*	4	mm/inch	PN=4: 6 PN=5: 5	PN=4: 4 PN=5: 5	0	0	PN=4: 0.0000 PN=5: 0.00000	PN=4: 999999.9999 PN=5: 99999.99999	PN=4: 0.0001 PN=5: 0.00001	0	0
CON_SURF_S*	4	m/min, inch/min	5	2	0	0	0.00	99999.99	0.01	0	0
PERI_SPEED*	4	m/s, feet/s	PN=4: 6 PN=5: 5	PN=4: 2 PN=5: 3	0	0	PN=4: 0.00 PN=5: 0.000	PN=4: 99999.99 PN=5: 9999.999	PN=4: 0.01 PN=5: 0.001	0	0
AXIS_DES	1	-	2	0	0	0	0	12	1	0	0

Fig. 11-1: Elementary machine data types

CAUTION

Incorrect interpretation of the pre-defined NC-related data types

⇒ The data types that are marked by an asterisk (*) may only be used if the first control variable (LV1) or the second control variable (LV2) is of the IP_AXIS, SP_AXIS or AXIS_DES control variable type.

Explanation of the table

Key word:	Name of the data type
Size:	Number of bytes assigned in the memory
Unit:	mm or inch
VK:	Integer part digits
NK:	Fractional part digits
VZ:	Sign exists 0: No 1: Yes
VN:	Show leading zeros 0: No 1: Yes
MIN:	Minimum value
MAX:	Maximum value
Resolution:	Smallest representable value
INIT:	Initialization value
PR:	Number of the procedure that shall be performed
PN:	Programmable fractional part digits for distances (process parameter: Bxx.002)
LA:	Linear axis
RA:	Rotary axis
HS:	Master spindle drive

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