SINUMERIK 840/840C
SINUMERIK 850
SINUMERIK 880/880 GA2
Measuring Cycles Version 20 and higher

Start-up Guide

08.96 Edition

Service Documentation

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SINUMERIK 880/880 GA2
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Version 20 and higher

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Valid for:

Control	*Software Version*
SINUMERIK 840	from SW 01
SINUMERIK 840C	from SW 01
SINUMERIK 850	from SW 04
SINUMERIK 880	from SW 04
SINUMERIK 880 GA2	from SW 01

08.96 Edition

SINUMERIK® documentation

Printing history

Brief details of this edition and previous editions are listed below.

The status of each edition is shown by the code in the "Remarks" column.

Status code in "Remarks" column:

A . . . New documentation
B . . . Unrevised reprint with new Order No.
C . . . Revised edition with new status.
If factual changes have been made on a page since the last edition, this is indicated by a new edition coding in the header on that page.

Edition	Order No.	Remarks
07.90	6ZB5 410-0EM02-0AA0	**A**
10.91	6ZB5 410-0EM02-0AA1	**C**
01.93	6FC5 197-0AB60-0BP0	**C**
08.96	6FC5 197-0AB60-0BP1	**C**

Siemens quality for software and training
to DIN ISO 9001, Reg. No. 2160-01

Other functions not described in this documentation might be executable in the control. This does not, however, represent an obligation to supply such functions with a new control or when servicing.

This publication was produced on the Siemens 5800 Office System.

We have checked that the contents of this publication agree with the hardware and software described herein. The information given in this publication is reviewed at regular intervals and any corrections that might be necessary are made in the subsequent printings. Suggestions for improvement are welcome at all times.

Subject to change without prior notice.

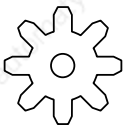
Order No. 6FC5 197-0AB60-0BP1
Printed in the Federal Republic of Germany

Preliminary Remarks

Technical Comments

Other functions not described in this documentation might be executable in the control. This does not, however, represent an obligation to supply such functions with a new control or when servicing.

The symbol shown on the left appears in this documentation whenever the machine tool manufacturer has the possibility of influencing/modifying the functional behaviour described by changing a cycle machine data (MDC).



Since the cycle machine data range and the cycle setting data range can be set up in different ways, the relevant data in the examples are explained on the basis of the standard settings.

This User's Guide applies to:
SINUMERIK 850/880 control as from Software Version 4,
SINUMERIK 880 GA2 as from Software Version 1,
SINUMERIK 840 as from Software Version 1,
SINUMERIK 840C as from Software Version 1,
measuring cycles as from version 20!

Contents

1 General Preconditions

Option: B78

Software versions: For measuring cycles Version 20 and higher, the following software versions are required:

SINUMERIK 840	software version 1 and higher
SINUMERIK 840C	software version 1 and higher
SINUMERIK 850	software version 4 and higher
SINUMERIK 880	software version 4 and higher
SINUMERIK 880 GA2	software version 1 and higher

PLC program: No PLC program is required for the measuring cycle function. The measuring function is activated in the cycles by means of command @720....

FB 116 (850) or FB 121 (840/880) is required when using the function package "Tool management".

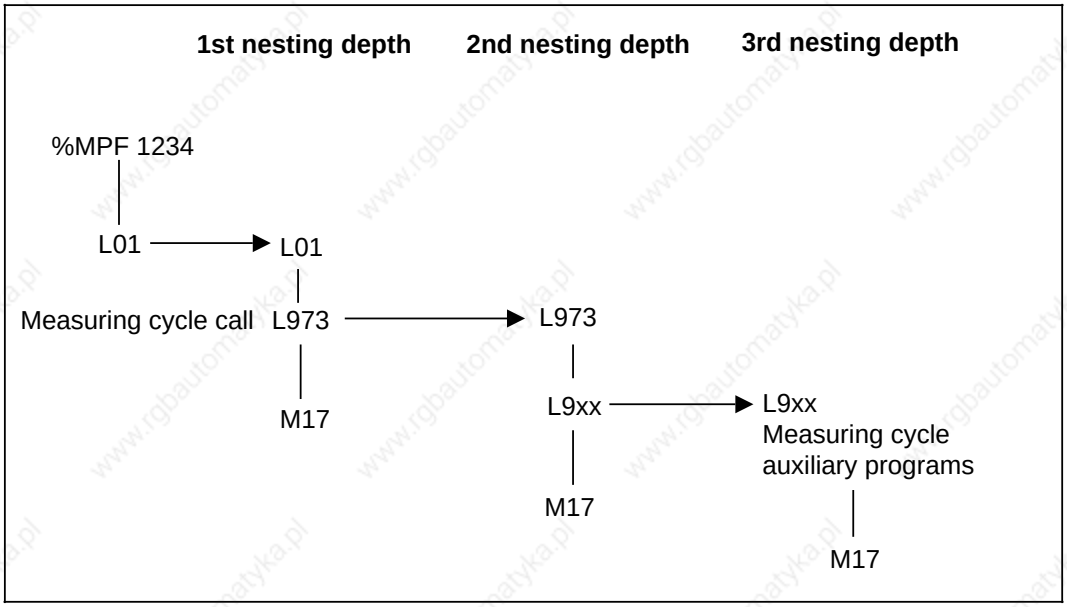
Axis arrangement: For proper operation of measuring cycles it is necessary for the machine axes to be arranged in accordance with **DIN 66217**.

1.1 Notes to ensure smooth running of the measuring cycles

1. To ensure that the measuring cycles operate correctly it is imperative that the machine axes are set up according to **DIN 66217**.
2. Reference point approach must already have been performed.
3. GRC**/**CRC, (coordinate rotation) and scale modification must be deselected before a measuring cycle is called.
4. Inch**/**metric switchover.

   Measurements must be performed in the input system defined in MD 5002 bit 4, i.e. switchover with G70**/**G71 is not permitted.
5. Before the cycles are called, the axes must be positioned in such a way that they do not change direction when they move from the current position to approach the set position. Nor must the tool collide with the sensor or the workpiece probe collide with other machine parts when approaching the starting position with linear interpolation.
6. The parameters of the individual cycles must be defined before the cycles are called.
7. The cycles are automatically skipped in operating modes "Block search", "Dry run" and simulation.
8. All cycles can be exited with the following initial settings:

   T version G01, G90, G95
   M version G01, G90, G94
9. The cycle must be called no later than the 1st nesting depth.
10. Call cycle **L965**. This cycle must be started at least **once** after start-up and it must always be programmed when the measuring plane is changed.



Nesting depth when calling measuring cycles

END OF SECTION

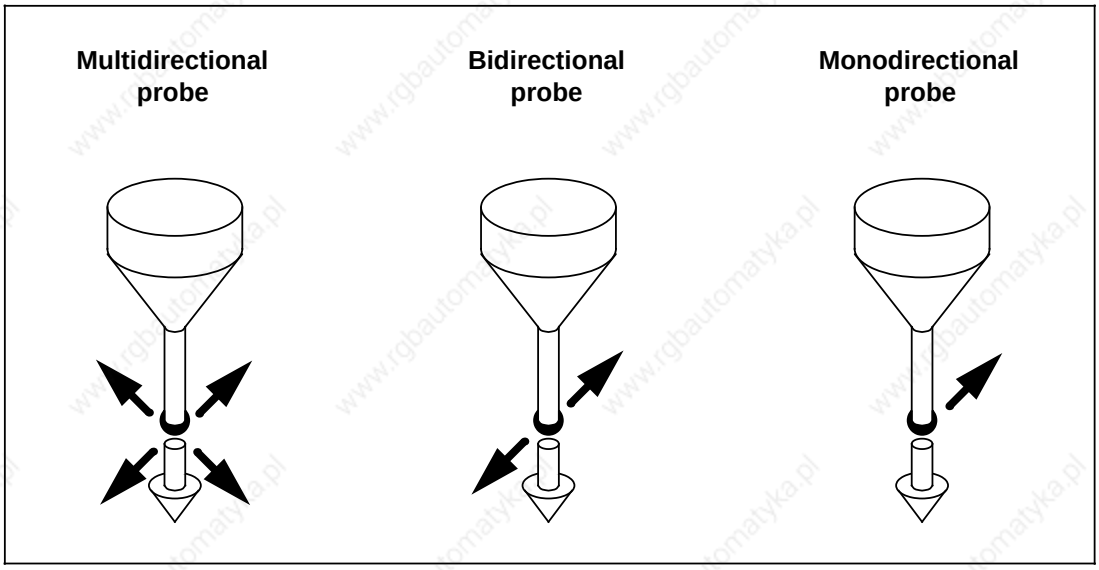
2 Hardware

2.1 Probe

For determining tool and workpiece dimensions, a touch trigger probe is required which supplies a constant signal (no pulse) when deflected.

The probe must switch with almost no bounce. This is generally achieved by adjusting the probe mechanically. In addition, "Software debouncing" is carried out in the NC.

Various types of probe of different make are available on the market. Probes are therefore classified in three groups according to the number of directions in which the probe can be deflected (see Fig. below).



Types of probe

	Turning machines		**Milling machines and machining centres**	
	Tool measure-ment	Workpiece measurement	Tool measurement	Workpiece measurement
Multidirectional probe	yes	yes	yes	yes
Bidirectional probe	—	yes	—	yes
Monodirectional probe	—	—	—	yes

While on turning machines a bidirectional probe can be used, milling machines and machining centres also permit the use of a monodirectional probe for workpiece measurement. In the cycles for milling machines and machining centres, the probe type is to be specified by an R parameter.

2.1.1 Multidirectional probe (3D)

With this type of probe, tool and workpiece measuring cycles can be used without restriction.

2.1.2 Bidirectional probe

This type of probe can be used on turning machines for workpiece measurement. When performing workpiece measurement on milling machines and machining centres, this probe type is treated as a monodirectional probe.

2.1.3 Monodirectional probe

This type cannot be used on turning machines. It can be used for workpiece measurement on milling machines and machining centres with some few restrictions (more information is given in the respective cycles).

It must be possible to position the spindle with the NC function "M19" and to transmit the probe switching signal through 360° to the receiving station (on the machine column).

The probe must be mechanically aligned in the spindle in such a way that measurements can be performed in the following directions with the spindle being positioned to 0 degrees.

	Measurement with 0 degr. spindle position
X-Y plane (G17)	Positive X direction
Z-X plane (G18)	Positive Z direction
Y-Z plane (G19)	Positive Y direction

Measurement takes longer with a monodirectional probe because the spindle must be positioned in the cycle several times with M19.

2.2 Jumpering/connection

Jumpering on the interface module depends on the probe/probe interface used.

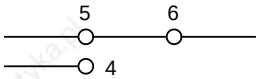
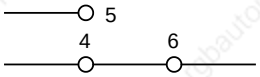
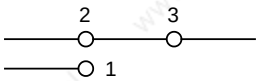
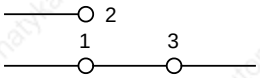
SINUMERIK 850/880/880 GA2			S1.1	S1.2	S2.1	S2.2	S1.3	S1.4	S3.1	S3.2
SINUMERIK 840			S3.1-3	S3.1-4	S1-1	S1-2	S3.3-1	S3.3-2	S2-1	S2-2
Type of operation	**Edge**	**Level**	**Probe 1**				**Probe 2**			
”Open collector” relay contact		open (+5 V)								
		closed (0 V)								
TTL (5 V)		+5 V								
		0 V								
24 V		+24 V								
		0 V								

Dip-fix closed

	SINUMERIK 840	**SINUMERIK 850**	**SINUMERIK 880/880 GA2**	
Module	6FX 1144-0BA	6FX 1121-8BA	6FX 1124-0BA	6FX 1136-8BA
Terminal strip	X131	X121	X111	X121

Terminal strip	
1	
2	Measuring pulse probe 1
3	Ground probe 1
4	Measuring pulse probe 2
5	Ground probe 2
6	

Jumpering on module CSB 6FC5 114-0AA02

SINUMERIK 840C		
S4		SENS 0 active at 24 V input signal or active o. c. transistor sensor 1
S4		SENS 0 active at 0 V input signal or passive o. c. transistor sensor 1
S4		SENS 1 active at 24 V input signal or active o. c. transistor sensor 2
S4		SENS 0 active at 0 V input signal or passive o. c. transistor sensor 2

Jumpering in cable distributor which is connected to X121 on the CSB

The electrical potentials P24 and MEXT can be switched to the inputs MEPUC0, MEPUC1 and MEPUS0, MEPUS1 via switches S1 ... S5 (dip fix) and can thus be used as a ”sensor connection” or ”rapid NC input”.

Table showing state of switches S1 ... S5

Measuring pulse inputs as NC inputs	S1	S2	S3	S4	S5
Measuring pulse inputs	0	0	1	1	1
Level (24 V)	0	0	0	0	0
Open collector	1	1	0	0	0
Relay to earth	1	1	0	0	0
Relay to P24	0	0	1	1	0

0: open
1: closed

Sensor connection to cable distributor 6FC5147-0AA01

Cable connector	Pin	Switch	
X4	1	S1	Measuring pulse sensor 1 (MEPUS0)
	3	S3	Earth sensor 1 (MEPUC0)
X1	1	S2	Measuring pulse sensor 2 (MEPUS1)
	3	S4	Earth sensor 2 (MEPUC1)

END OF SECTION

3 Functional Test

3.1 Service display

The measuring signal can be checked via the diagnostics menu "PLC status".

	Status display
Probe 1 deflected	F 24.7
Probe 2 deflected	F 24.6

3.2 Test program

With the following example of a test program, the measuring function (repeatability of the machine and the probe) can be checked without using the measuring cycle subroutines.

Example:

```
% 1
N5    G00 G94 Z... F150          Pre-positioning approx. 1 mm in front of measuring point
N10   G01 @720 R1 K1 Z...        Move onto probe;
                                 set value approx. 1 mm behind measuring point
N15   @714                       Stop decoding
N20   R0=R1                      Reload actual value of measuring point in parameter R0
N25   G04 F2                     Note value of parameter R0
N30   @100 K-5                   Return to N5
N35   M30
```

In addition, the program can be used to determine the scattering of measured values (repeat accuracy) for the entire measuring system (machine-probe-signal transmission to NC). In other words, the random dimensional deviations can be determined that follow no trend.

END OF SECTION

4 Machine Data for Measuring Cycles

4.1 Cycle machine data memory (MDC)

The machine data for measuring cycles are stored in the cycle machine data memory (MDC).

The MDC memory is subdivided in the following areas:

4.1.1 Channel-oriented values, overview

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
0 . . . 49	Siemens (Measuring Cycles)	—	—	—	—
400 . . . 449	User	—	—	—	—

4.1.2 Channel-oriented bits, overview

MDC No.	Bit No. 7	6	5	4	3	2	1	0
800 . . . 819	Siemens (Measuring Cycles)							
820 . . . 849	Siemens							
900 . . . 949	User							

4.1.3 Central values, overview

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
1000 . . . 1149	Siemens (Measuring Cycles)	—	—	—	—
4000 . . . 4149	User	—	—	—	—

4.1.4 Central bits, overview

SDC No.	Bit No. 7	6	5	4	3	2	1	0
7000 . . . 7009	Siemens (Measuring Cycles)							
7010 . . . 7049	Siemens							
8000 . . . 8049	User							

4.2 NC machine data

4.2.1 MD 18 Zero offset group

Considering the fact that the 800 systems have just one ZO group while several users require more than just one group, this need has been met by the use of a cycle "ZO groups L960".

When starting up the measuring cycles, MD 18 must be preset with "1", otherwise an alarm would be issued on ZO determination.

Cycle L960 stores the current ZO group number in DB 18 to enable the ZO memory to be transferred to the ZO group memory (R240 - R299 or MIB 200 - MIB 399) on completion of ZO determination (by the measuring cycles).

MD 18 is a "System cell" and must not be modified manually after completion of start-up.

4.2.2 MD 19 P number (SINUMERIK 850 only)

The NC machine data 19 (MD 19) is only significant when the PLC function package "Tool management" is used and if the tools are to be compensated by workpiece measuring cycles. In MD 19 the P number (5-32) is to be stated under which the G number of the next cutting edge is to be found.

		Minimum number of P memories settable with NC MD 13									Quantity is determined with NC MD 13	
		Fixed allocation by NC software			Determination by NC MD 5007.6[1])			Determination by NC MD 5007.3[2])			Reference to next cutting edge	User-assignable
		T No. P0	Type P1	Geometry P2 P3 P4	Wear P5	Wear P6	Wear P7	Add. TO P8	Add. TO P9		P10	P11-P32[3])
MD211	D1	TOA area 1										
	Dn											
MD212	D1											
MD216	D1	TOA area m										
	Dn											

TOA areas are determined via NC MD210 (max. 16)
Start address of TOA areas in NC MD211-216

1) Addition to geometry values with NC MD5007.6="0"(with standard machine data "0")
2) Addition to geometry values with NC MD5007.3="1"
3) Depending on NC MD

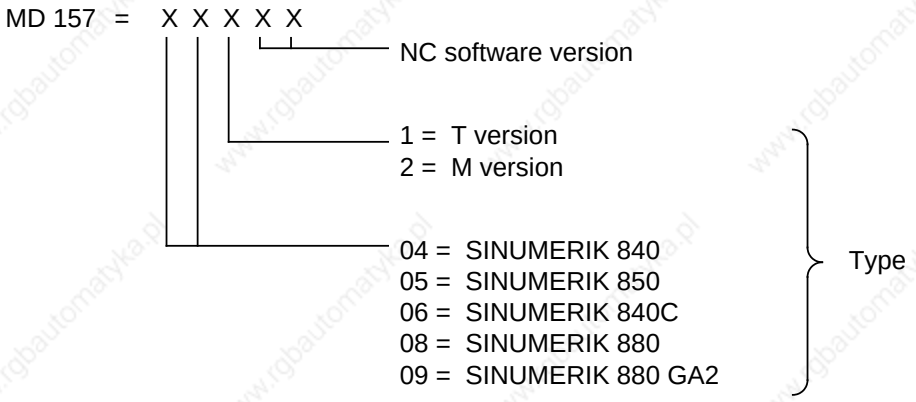
Formula for TOA memory

$$W_{NUMB} = INT \frac{k1}{P_{NUMB} \cdot K2}$$

W_{NUMB} = Number of single-edged tools
k1 = Total capacity of TOA memory 8192 bytes
K2 = Width of one P memory 4 bytes
P_{NUMB} = Number of desired P memories

4.2.3 MD 157 Type/software version

NC MD 157 is always evaluated in the measuring cycles.
The type of control and the NC software version are stored in MD 157.



4.2.4 MD 208/209 Max. tool wear (parameters P5/P6/P7)

These measuring cycles are used to check the maximum wear when performing tool offset.

When the maximum wear is exceeded, no offset is made but an alarm is output.

MD 208:	Wear L1/L2
MD 209:	Wear radius
Max. input value:	99999 ≙ 9.99999

4.2.5 NC transverse axis bits MD 5011 and MD 572*

The NC transverse axis bits are taken into account in all measuring cycles with the following combinations.

5011								572*
Bit No.								Bit No.
7	6	5	4	3	2	1	0	1
0	0	0	0	0	0	0	-	0
0	0	0	0	0	0	0	-	1
-	-	0	1	0	0	0	-	1
-	-	0	1	0	0	1	-	1
-	-	0	1	0	1	0	-	1
-	-	0	1	0	1	1	-	1
-	-	0	1	1	0	0	-	1
-	-	0	1	1	0	1	-	1
-	-	0	1	1	1	0	-	1
-	-	0	1	1	1	1	-	1
-	-	1	1	0	0	0	-	1
-	-	1	1	0	0	1	-	1
-	-	1	1	0	1	0	-	1
-	-	1	1	0	1	1	-	1
-	-	1	1	1	0	0	-	1
-	-	1	1	1	0	1	-	1
-	-	1	1	1	1	0	-	1
-	-	1	1	1	1	1	-	1
0	1	-	1	-	-	-	-	1
1	-	-	1	-	-	-	-	1
1	1	-	1	-	-	-	-	1

* - means: 0 for 1st axis
1 for 2nd axis
2 for 3rd axis
3 for 4th axis
:
:
etc.

4.2.6 PLC machine data 6026 bit 2

When the measuring cycle functions

- result display selection
- tool management (840/880)

are used the above-mentioned bit must be ”0”.

FB 89 must be available.

4.3 Channel-oriented values, description

Standard values can be loaded from the measuring cycle diskette.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
0	Start address of empirical values in the setting data (SDC).	1	1 to 99	—	—

Start address of empirical values in the area of the channel-specific cycle setting data (SDC). Here, the value "0" is to be input when no empirical values are required.

The input value must not overlap with the MDC 2 and MDC 3.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
1	Number of empirical values	49	0 to 99	—	—

Here, the number of memories for empirical values in the area of the channel-specific SDC is to be stated. Value "0" is to be input if empirical values are not required.

The input value must not overlap with the MDC 2 and MDC 3.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
2	Start address of empirical values in the setting data (SDC).	51	1 to 99	—	—

Start address of the average values in the area of the channel-specific cycle setting data. Value "0" is to be input when average values are not required.

The input value must not overlap with the MDC 0 and MDC 1.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
3	Number of average values	49	0 to 99	—	—

Here, the number of memories for average values is to be stated in the area of the channel-specific SDC. Value "0" must be input when no average values are required.

The input value must not overlap with the MDC 0 and 1.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
4	Rapid traverse rate Intermediate positioning	100	1 to 100	—	%

The intermediate positions calculated by the measuring cycles are approached at maximum axis speed (NC MD 280*) in percent.

The machine data is only effective with the collision monitor (MDC 800 Bit 0 = 0) switched off.

Example:

MDC 4	80	
MDC 800 bit 0	0	
NC MD 2800	10000	(X axis)
NC MD 2801	8000	(Y axis)
NC MD 2802	10000	(Z axis)

Intermediate positions are approached at a rate of 6400 mm/min (80 % of 8000) when measuring in the X/Y plane.

Intermediate positions are approached at a rate of 8000 mm/min (80 % of 10000) when measuring in the Z/X plane.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
5	Positioning speed with collision monitor active	0	1 to 15.000	—	mm/min

Intermediate positions calculated by measuring cycles are approached at the input speed rate.

The machine data is only effective with activated collision monitoring (MDC 800 bit = 1) and must be > 0; otherwise alarm message 4008 is issued.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
6 . . 13	Reserve			—	—

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
14	PLC number for logging	1	1 to 4	—	—

Here, the number of the PLC must be stated in which the function blocks for the logging function (with CP 315) are called.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
15	PLC number for MDC 16-19	1	1 to 4	—	—

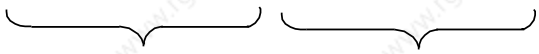
Here, the number of the PLC must be stated in which the measurement abort signal (MDC 16 and MDC 17) or selection of a result display (MDC 18 and MDC 19) is processed.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
16	Meas. abort signal ident. coarse	0	see table	—	—

See MDC 17 for description.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
17	Meas. abort signal ident. fine	0	see below	—	—

	Type	**DB No. DX No.**	**Byte DW**	**Bit**
Input	82	0000	0 : 127	.0 : .7
Flag	84	0000	0 : 255	.0 : .7
DB	87 : 87	0001 : 0255	0 : 2048	.00 : .15
DX	88 : 88	1000 : 1255	0 : 2048	.00 : .15



MDC 16 MDC 17

Use without measurement abort signal

The machining program cannot be continued when a cycle reset alarm (alarm numbers 4000-4039) occurs. It can only be stopped by program abort (reset). Following program abort, further measuring points or measuring or machining operations programmed in the part program can no longer be executed.

To enable these measuring points or machining operations to be likewise executed, first of all, the cause that has led to the reset alarm must be eliminated. Re-entry in the machining program is then possible with block search.

Use with measurement abort signal

The function "Measurement abort signal" provides the possibility of continuing the machining program when cycle reset alarms (4011, 4019, 4020, 4026, 4027, 4030, 4031, 4032, 4033) have occured.

The measurement abort signal is generally released by the operator by pressing a key arranged on the machine control panel.

The signal can be read out by the measuring cycles directly from the PLC input from a flag or a data word.

Example:

a) Measurement abort signal on input: I 15.4

MDC 16 = 820000
MDC 17 = 15.4

b) Measurement abort signal from flag: F 200.2

MDC 16 = 840000
MDC 17 = 200.2

c) Measurement abort signal from data block: DB 200 D 10.9

MDC 16 = 870200
MDC 17 = 10.09

d) Measurement abort signal from DX data block: DX 200 D 10.9

MDC 16 = 881200
MDC 17 = 10.09

The function "Measurement abort signal" is activated as soon as MDC 16 > 0.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
18	Selection result display identifier coarse	0	see table	—	—

See MDC 19 for description.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
19	Selection result display identifier fine	0	see below	—	—

	Type	**DB No. DX No.**	**Byte DW**
Flag	84	0000	0 : 255
DB	87 : 87	0001 : 0255	0 : 2048
DX	88 : 88	1000 : 1255	0 : 2048

MDC 18 MDC 19

The cycle can perform a menu selection (insertion of a result display) on completion of a measuring operation (see MDC 7001 bit 2).

The function "Menu selection" is performed via the PLC, i.e. the cycle enters the relevant menu number directly in the PLC and also triggers menu selection.

The interface area must be determined via MDC 18 and 19 to avoid collision with other "Menu selectors", otherwise alarm 4049, Display cannot be selected, is called.

The following definitions are possible:

a) Measuring Cycles use DB 40 directly
b) " use another DB (image of DB 40)
c) " use a flag area (image of DB 40)

In cases b and c, the PLC user program must take care of data transfer (interface DB 40 assigned interface).

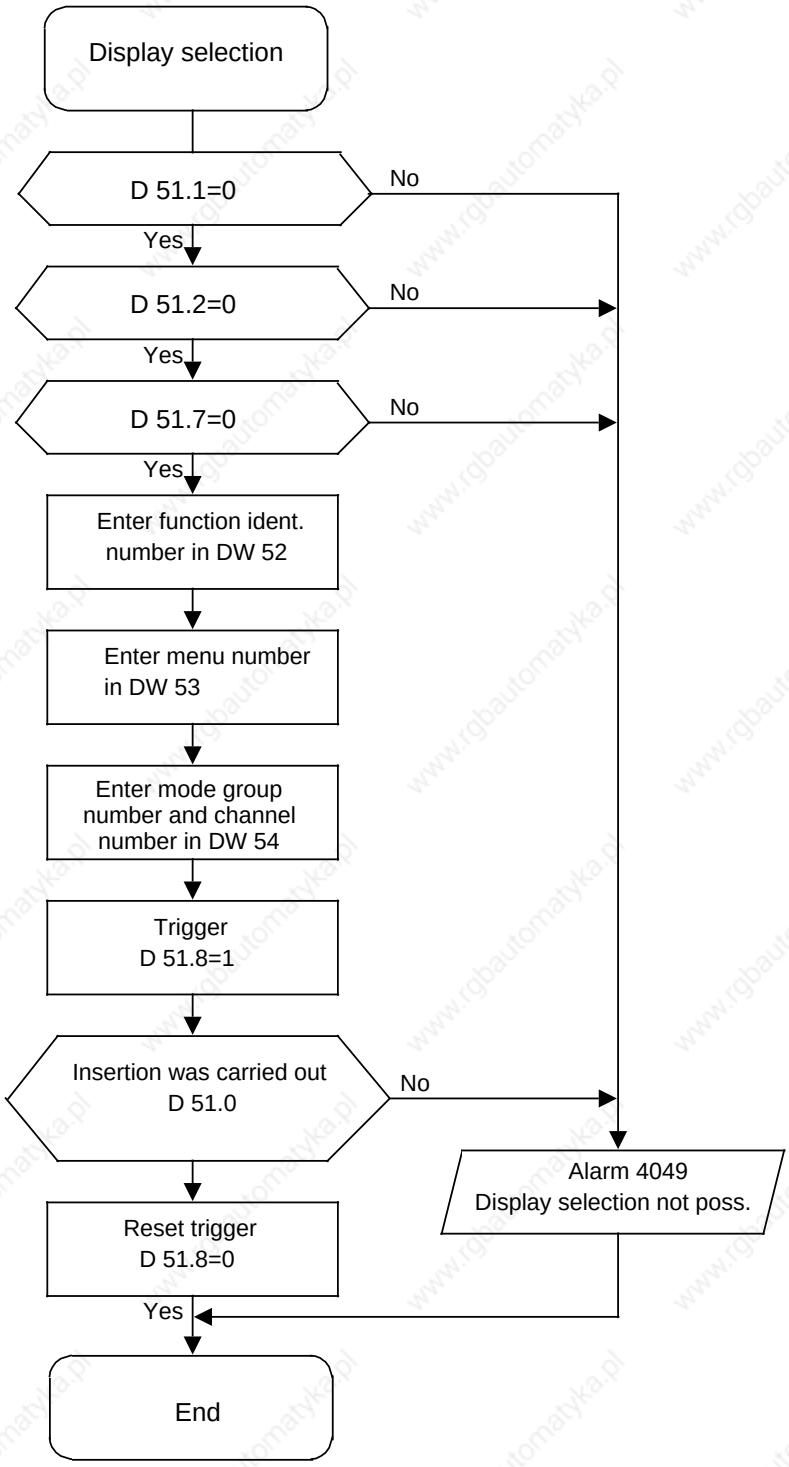
Special case:

If MDC 18=0, the menu selection is performed through DB 40.

Interface for display selection

Byte / Bit	15 7	14 6	13 5	12 4	11 3	10 2	9 1	8 0
DB 40 DL51 (DBm DLn) (M n)								Triggered by user
DB 40 DR51 (DBm DRn) (M n+1)	Insertion from other PLC act.	Insertion own PLC active				Insertion already active	Acknowledgements: Error	Acknowledgements: Insertion carried out
DB40 DL52 (DBm DLn+1) (M n+2)	Function ident No. 1 - 15 1 System area 2 User area						H	
DB40 DR52 (DBm DRn+1) (M n+3)							L	
DB40 DL53 (DBm DLn+2) (M n+4)	Menu number						H	
DB40 DR53 (DBm DRn+2) (M n+5)							L	
DB40 DL54 (DBm DLn+3) (M n+6)	Mode group number 1 - 8							
DB40 DR54 (DBm DRn+3) (M n+7)	Channel number 1 - 8							

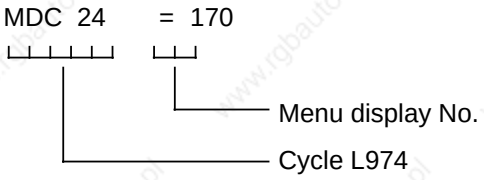
Outline flowchart of insertion by means of measuring cycles via user interface DB40, DW51 - DW54, for example.



MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
2*	Menu No. measurement result (L970 - L979) L97*	170	0 to 254		
3*	Menu No. measurement result (L980 - L989) L98*	170	0 to 254		

The stated display stored in the UMS under the menu number is selected by measuring cycles L97*/L98* on completion of measurement if MDC 7001 bit 2 = 1.

Example: Menu display number 170 is to be called by cycle L974 as measurement result display.



4.4 Channel-oriented bits, description

MDC No.	Bit No. 7	6	5	4	3	2	1	0
800	Meas. input No. 2 with Workpiece measurem.	Tool measurem.						Collision monitoring

Bit 7 = 0: Measuring input 1 is activated by the relevant cycles in the case of workpiece measurement.

Bit 7 = 1: Measuring input 2 is activated by the relevant cycles in the case of workpiece measurement.

Bit 6 = 0: Measuring input 1 is activated by the relevant cycles in the case of tool measurement.

Bit 6 = 1: Measuring input 2 is activated by the relevant cycles in the case of tool measurement.

Bit 0 = 1: Intermediate positioning operations calculated and approached by the measuring cycles are terminated as soon as the probe supplies a switching signal.
Alarm 4012 (probe collision) is displayed in the alarm line in the case of an abort (collision).

See also MDC 5 Positioning speed when collision monitoring is active!

MDC No.	Bit No. 7	6	5	4	3	2	1	0
801	Without average value memory	Inverted inclusion of empirical value	Workpiece probe with 2 D numbers					

Bit 7=0: The average values calculated by the measuring cycles are stored in the defined area (MDC 2, MDC 3) of the channel-oriented SDC.

e.g.: R11 = 12 Empirical value memory 12
Average value memory 12

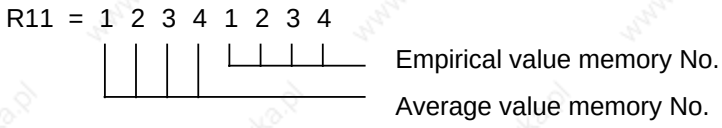
The empirical value memory No. and the average value memory No. are specified via R11.

Bit 7=1: Average value calculation is carried out according to formula with $AV_{old}=0$ (only if difference is > R34). The average value (AV_{new}) is not stored.

Special case: Regardless of bit 7, the fixed relationship
empirical val. memory No. = average val. memory No.
can be cancelled by allocation of

R11 > 9999.

When defining R11 > 9999, R11 is evaluated as follows:



Example: Empirical value memory No. 12
Average value memory No. 9
→ R11=90012

Bit 6 = 0: Empirical value is subtracted from actual value measured.

Bit 6 = 1: Empirical value is added to actual value measured.

Bit 5 = 1: Use of workpiece probe with 2 tool offset memories (possible for T machines only).

When bit 5 is set, measuring with simple workpiece probes is not possible.

MDC No.	Bit No. 7	6	5	4	3	2	1	0
802						Mirror imaging Applicate	Mirror imaging Ordinate	Mirror imaging Abscissa

Bit 2=0: The applicate is not mirror-imaged for tool measurement
Bit 2=1: The applicate is mirror-imaged for tool measurement

Bit 1=0: The ordinate is not mirror-imaged for tool measurement
Bit 1=1: The ordinate is mirror-imaged for tool measurement

Bit 0=0: The abscissa is not mirror-imaged for tool measurement
Bit 0=1: The abscissa is mirror-imaged for tool measurement

The reversal dimensions (m5) stored in the "Central values" area are allowed for by the tool measuring cycle if bit 0, 1 or 2 = 1 (see MDC 1008).

MDC No.	Bit No. 7	6	5	4	3	2	1	0
804								Transfer of ZO groups L960

Bit 0=0: No transfer of ZO groups

Bit 0=1: The measuring cycles activate cycle L960 on ZO determination.

L960 transfers the current ZO memory contents in the relevant R parameter area (R240 - R299) or input buffer area (MIB 200 - MIB 399).

See also NC MD 18 zero offset module!

MDC No.	Bit No. 7	6	5	4	3	2	1	0
806 . . 819				Internal data				

4.5 Central values, description

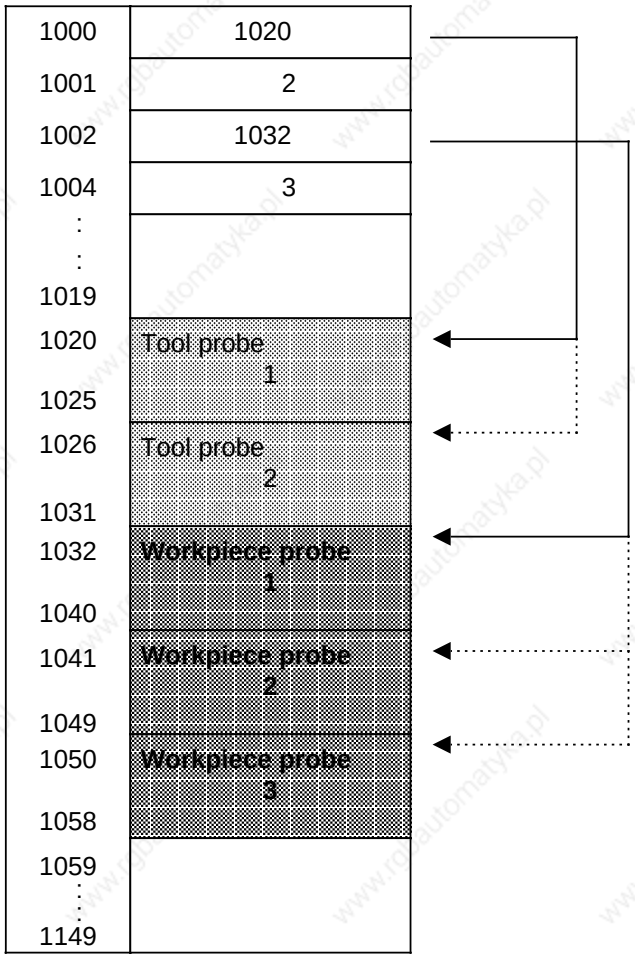
Variable memory organization is provided to put the user in a position of making full use of the memory available for cycles (MDC 1000 - MDC 1149). The number of elements (tool probes, workpiece probes, calibration elements etc.) can be freely chosen within the limits of the memory capacity available.

No fixed memory location has been provided for any element (m). Only the sequence of the elements used has been determined (see table). The start address of an element (A_{mn}) results from the end address of the previously entered element. The MDC memory can therefore be set up without a gap and can be fully adapted to the relevant measuring tasks of the machine.

m1	MDC 1000	Start address tool probe
m2	MDC 1002	Start address workpiece probe
m3	MDC 1004	Start address calibration element
m4	MDC 1007	Start address tool change position
m5	MDC 1008	Start address reversal dimension

Sequence of elements

Example:



MDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
1000	Start address (m1) tool probe 6 data (d)	1020 (A_{m1})	1020 to 1144	—	—

MDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
1001	Number (a) of tool probes	3 (a)	0 to 21	—	—

End address $E_{m1} = A_{m1} + d \cdot a - 1 = 1020 + 6 \cdot 3 - 1 = 1037$

MDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
1002	Start address (m2) workpiece probe 9 data (d)	1038 (A_{m2})	1020 to 1141	—	—

Start address $A_{m2} = E_{m1} + 1$

MDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
1003	Number (a) workpiece probe	7 (a)	0 to 14	—	—

End address $E_{m2} = A_{m2} + d \cdot a - 1 = 1038 + 9 \cdot 7 - 1 = 1100$

MDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
1004	Start address (m3) calibration element 7 data (d)	1101 (A_{m3})	1020 to 1143	—	—

Start address $A_{m3}=E_{m2}+1$

MDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
1005	Number (a) calibration element	3 (a)	0 to 18	—	—

End address $E_{m3} = A_{m3} + d \cdot a - 1 = 1101 + 7 \cdot 3 - 1 = 1121$

MDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
1006	Maximum axis number on machine which is used for measurement	12 (a)	1 to 24	—	—

MDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
1007	Start address (m4) tool change position 1 data	1122 (A_{m4})	1126	—	—

Start address $A_{m4}=E_{m3}+1$
End address $E_{m4} = A_{m4} + MDZ1006 - 1 = 1133$

MDC No.	Designation	Standard value	maximaler Eingabewert	Ref. system	Input unit
1008	Start address (m5) reversal dimension 1 data	1134 (A_{m5})	1126	—	—

Start address $A_{m5}=E_{m4}+1$
End address $E_{m5}= A_{m5} + MDZ1006 - 1=1145$

MDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
1009 . . 1011	Reserved			—	—

MDC No.	Designation	Standard value	maximaler Eingabewert	Ref. system	Input unit
1012	M function for triggering FB 116 SINUMERIK 850	0		—	—

The tool offset memory number (D number) is to be indicated to the measuring cycle via R10 for workpiece measurement.

When using the PLC function package "Tool management" (PLC package 1), only the T number of the tool to be compensated is known. The associated D number must be determined via the PLC (FB 116).

When using FB 116 (SINUMERIK 850), the number of the M function by means of which FB 116 is to be triggered must be input in MDC 1012. MDC 7000 bit 3 and MDC 7000 bit 4 must be "zero".

Triggering itself is performed automatically via the measuring cycles.

Effect of M function in the PLC (FB 116):

- Read R98 and R99
- R98 = 1 Enter in R79 the number of the TO range belonging to the tool (R99) and the D number in R80.
  = 2 Lock tool (R99)
- R99 = . . . Tool number (T number)

PLC program (FB116)

```
      :
      :Q          DB10
      :L          DL28        } e.g. M function M85
      :T          FY170
      :
      :L          KB1
      :T          FY100
      :
      :
      :JU         FB116
NAME  :WZAUS:ME
MANR  :           FY100       (Entry of magazine number)
DBRP  :           DB100       (DB No. for data transfer in R98, R99)
KAN   :           FY100       (Number of NC channel)
R-KE  :           KF+98       (Fixed identifiers in parameters R98, R99)
R-TO  :           KF+79       (Fixed TO range number to R79)
                              (Fixed D No. to R80)
M-ST  :           F170.5      (M85)
AUSP  :           F0.1        (Criterion for locking)
IST   :           FY102       (Actual magazine location)
NSBY  :           DR22        (Interface byte in DB36)
WF    :           F162.1      (Output signal: No tool)
      :
      :BE
```

MDC No.	Designation	Standard value	maximaler Eingabewert	Ref. system	Input unit
1013	R parameter for scrap detection	0	999	—	—

The codes for scrap detection are stored in this R parameter.
(See MDC 7001.4)

MDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
1014 . . 1019	Reserved			—	—

4.5.1 Tool probe (m1)

The trigger points are always stored as radius dimensions, even for a transverse axis.

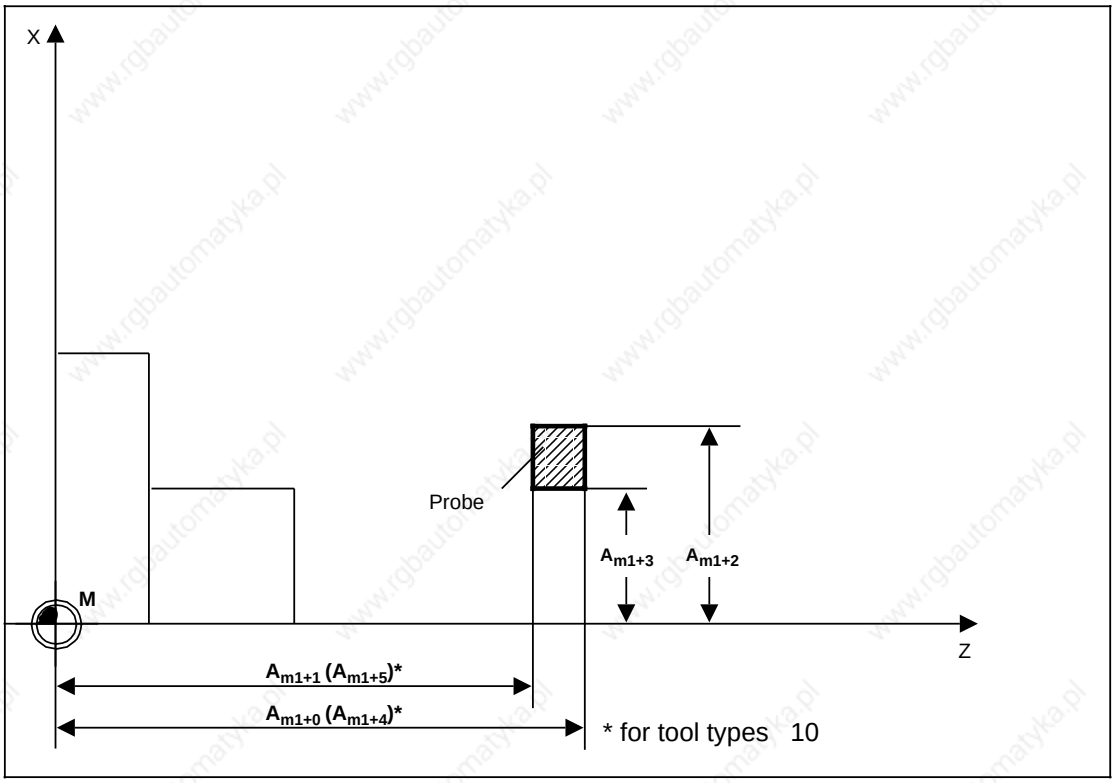
MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
A_{m1+0} : A_{m1+n+5}	Tool probe (m1)			—	—

The start address A_{m1} is stored in MDC 1000.

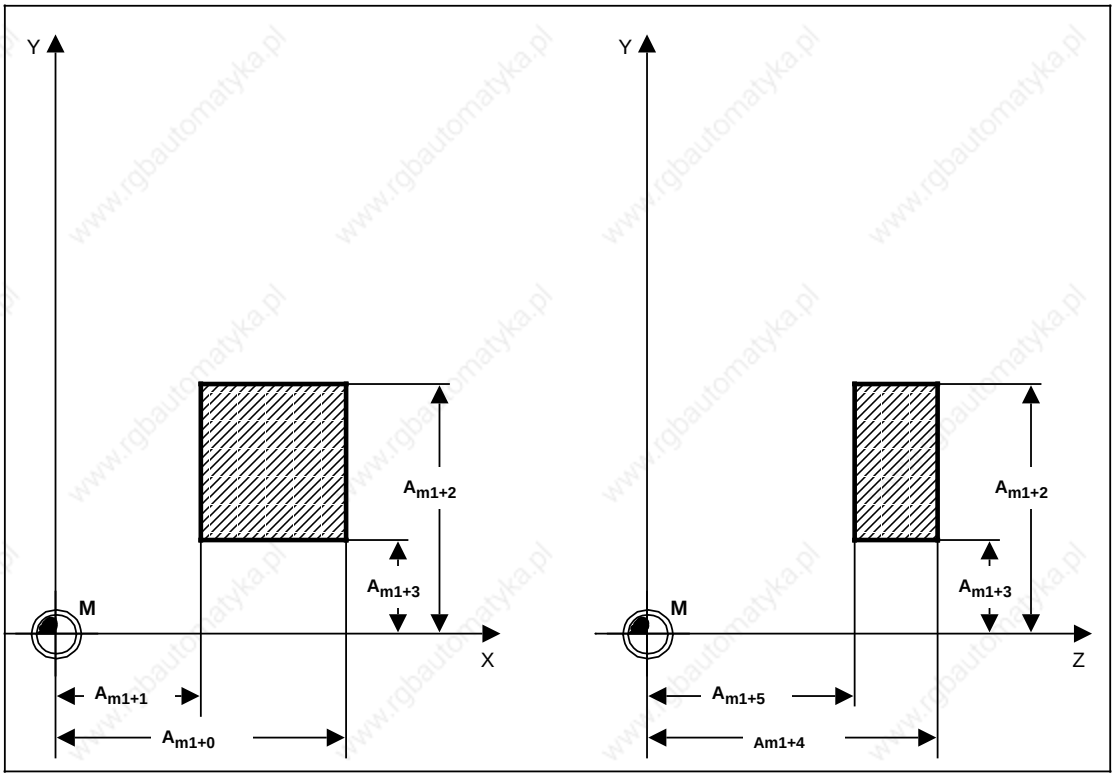
The number of tool probes specified in MDC 1001 must be stored in the MDC memory as follows:

MD No.	**Designation**	**Max. input value**
A_{m1+0}	Tool probe 1 Trigger point - Direction of abscissa	± 99 999.999
A_{m1+1}	Trigger point + Direction of abscissa	± 99 999.999
A_{m1+2}	Trigger point - Direction of ordinate	± 99 999.999
A_{m1+3}	Trigger point + Direction of ordinate	± 99 999.999
A_{m1+4}	Trigger point - Direction of applicate	± 99 999.999
A_{m1+5}	Trigger point + Direction of applicate	± 99 999.999
A_{m1+6}	Tool probe 2	± 99 999.999
: A_{m1+11}		± 99 999.999
A_{m1+n}	Tool probe (k)	± 99 999.999
: A_{m1+n+5}		± 99 999.999

Here n=6 · MDC 1001



Tool probe on turning machine



Tool probe on milling machine

4.5.2 Workpiece probe (m2)

MDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
A_{m2+0} : A_{m2+n+8}	Workpiece probe (m2)			—	mm

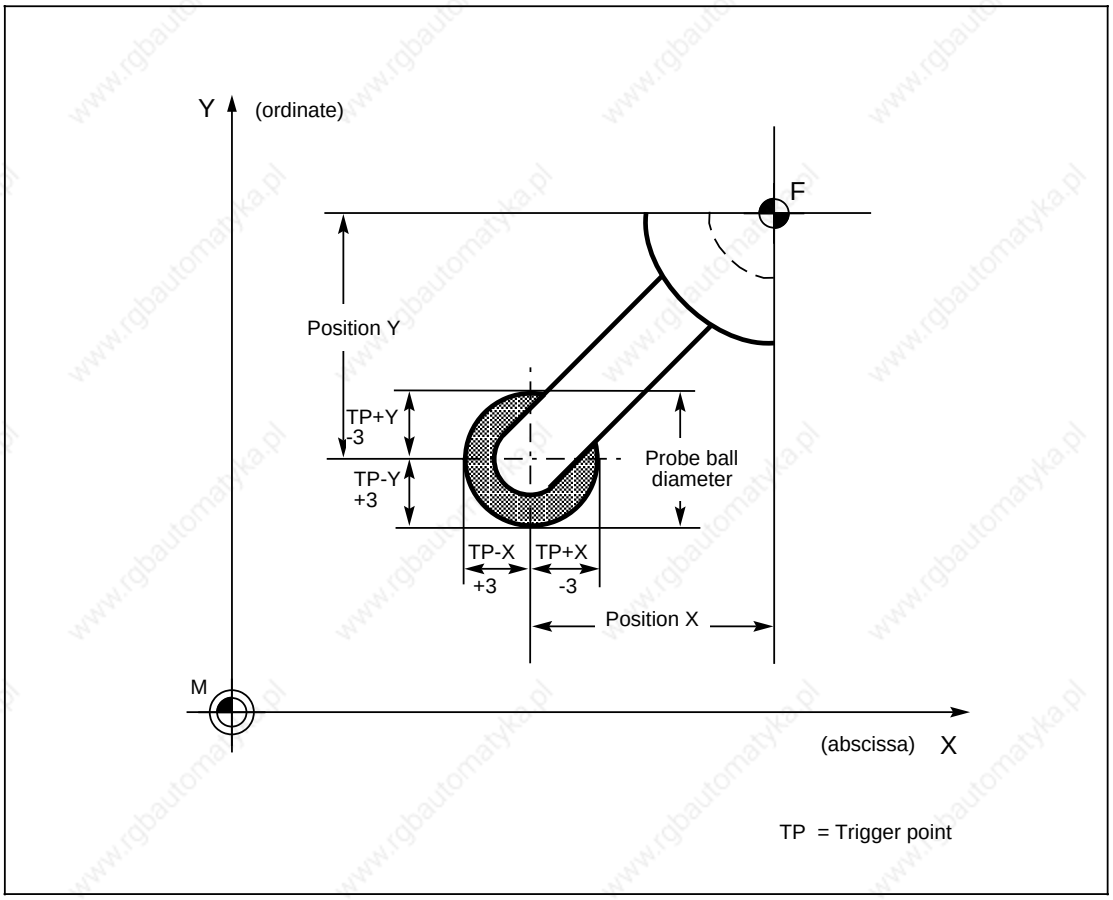
The start address A_{m2} is stored in MDC 1002.

The number of workpiece probes specified in MDC 1003 must be stored in the MDC memory as follows:

MD No.	Designation	Max. input value
A_{m2+0}	Workpiece probe Ball diameter	± 99 999.999
A_{m2+1}	Trigger point - Direction of abscissa	± 99 999.999
A_{m2+2}	Trigger point + Direction of abscissa	± 99 999.999
A_{m2+3}	Trigger point - Direction of ordinate	± 99 999.999
A_{m2+4}	Trigger point + Direction of ordinate	± 99 999.999
A_{m2+5}	Trigger point - Direction of applicate	± 99 999.999
A_{m2+6}	Trigger point + Direction of applicate	± 99 999.999
A_{m2+7}	Position of abscissa (deviation)	± 99 999.999
A_{m2+8}	Position of ordinate (deviation)	± 99 999.999
A_{m2+9} : A_{m2+17}	Workpiece probe 2	± 99 999.999 ± 99 999.999
A_{m2+n} : A_{m2+n+8}	Workpiece probe (k)	± 99 999.999 ± 99 999.999

Here n=9 · MDC 1003

When using workpiece probes with 2 D numbers, no ”Position of abscissa or ordinate” is allowed to be entered.



MDC overview: Workpiece probe

4.5.3 Calibration element (m3)

Only radius dimensions are to be used, even for a transverse axis.

MDC No.	Designation	Standard value	Input limits	Ref. system	Input unit
A_{m3+0} : A_{m3+n+6}	Calibration element (m3)			—	—

The start address A_{m3} is stored in MDC 1004.

The number of calibration elements specified in MDC 1005 must be stored in the MDC memory as follows:

MD No.	**Designation**	**Max. input value**
A_{m3+0}	Calibration element 1	± 99 999.999
A_{m3+1}		± 99 999.999
A_{m3+2}		± 99 999.999
A_{m3+3}		± 99 999.999
A_{m3+4}		± 99 999.999
A_{m3+5}		± 99 999.999
A_{m3+6}		± 99 999.999
A_{m3+7} : A_{m3+13}	Calibration element 2	± 99 999.999 ± 99 999.999
A_{m3+n} : A_{m3+n+6}	Calibration element (k)	± 99 999.999 ± 99 999.999

Here n = 7 · MDC 1005.

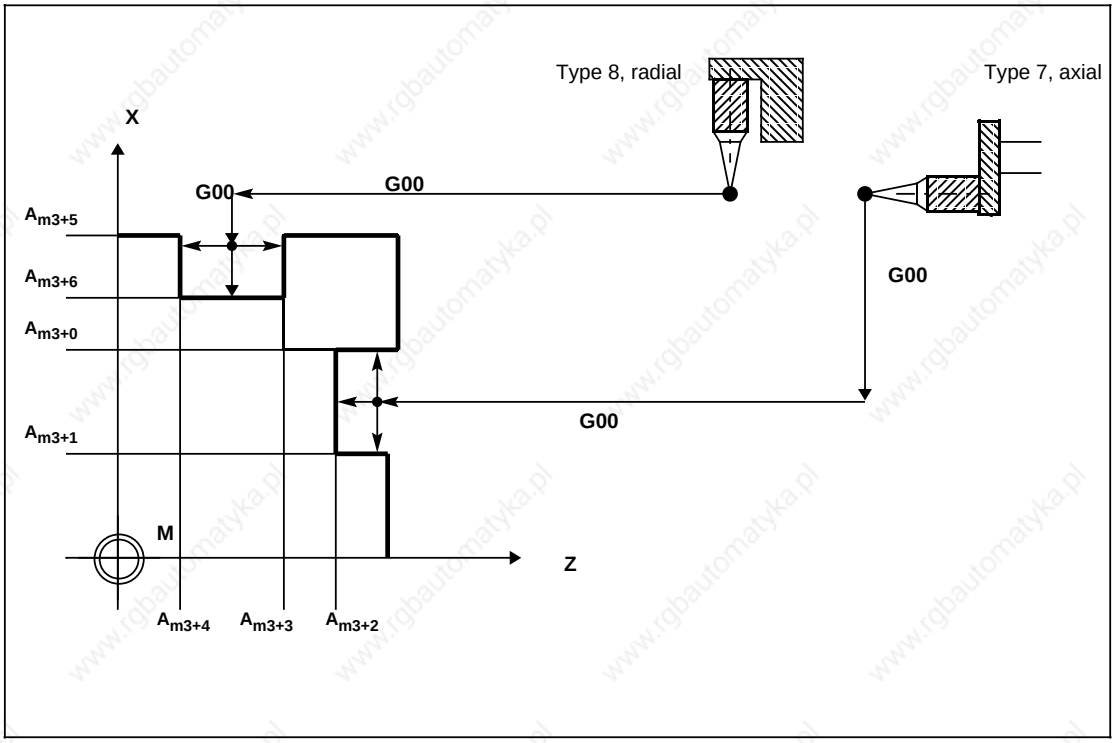
The following elements can be stored in the MDC area A_{m3}+0 to A_{m3}+n+6:

a) Pairs of calibration grooves
b) Calibration surfaces
c) Calibration balls
d) Reference bores

Central values calibration element (m3)

a) Assignment of MDC memory with calibration groove pair

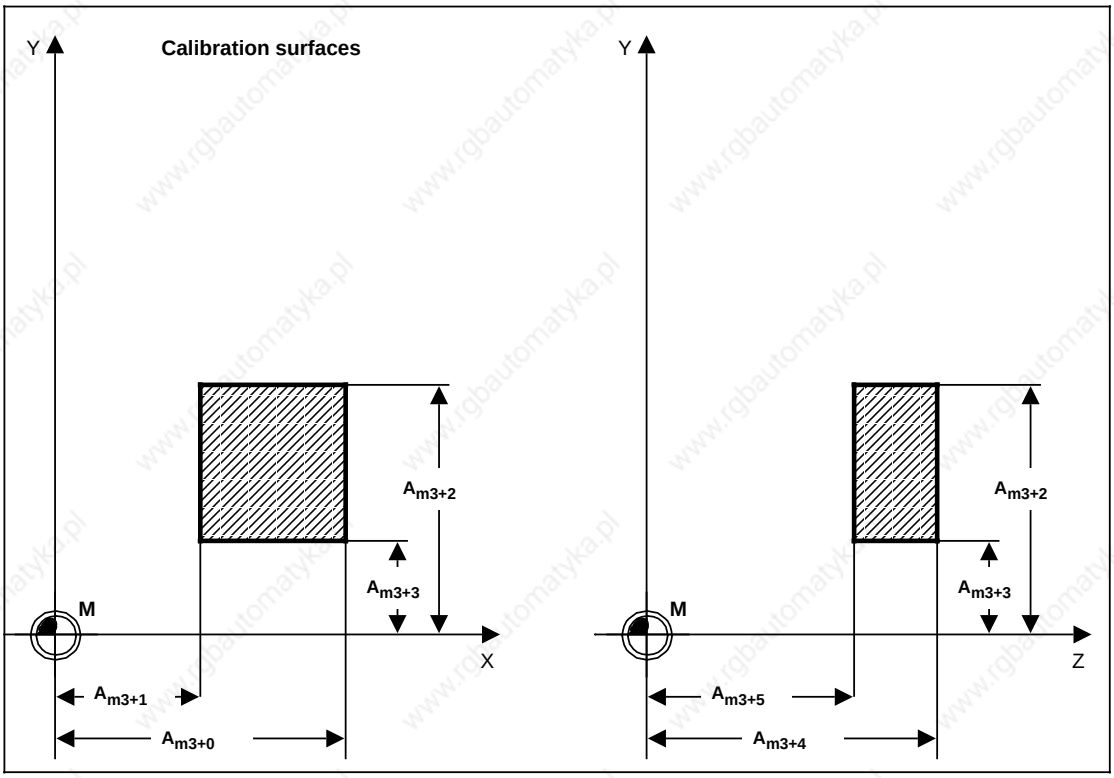
MD No.	Designation	Max. input value
A_{m3+0}	Calibration groove pair a	± 99 999.999
A_{m3+1}	b	± 99 999.999
A_{m3+2}	c	± 99 999.999
A_{m3+3}	d	± 99 999.999
A_{m3+4}	e	± 99 999.999
A_{m3+5}	f	± 99 999.999
A_{m3+6}	g	± 99 999.999



MDC overview: Calibration groove pair

b) Assignment of MDC memory with calibration surfaces

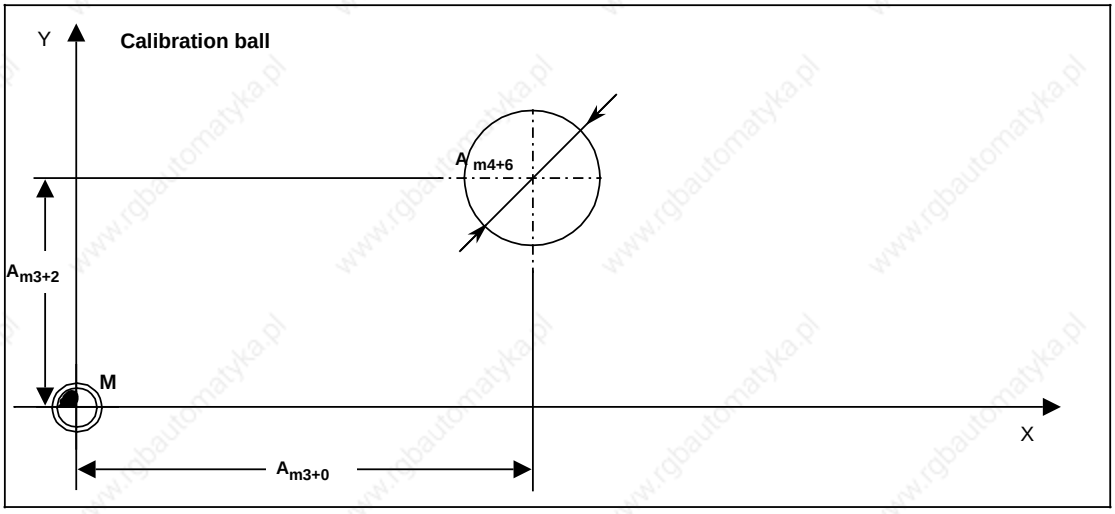
MD No.	Designation	Max. input value
A_{m3+0}	Calibration surface - Abscissa	± 99 999.999
A_{m3+1}	+Abscissa	± 99 999.999
A_{m3+2}	- Ordinate	± 99 999.999
A_{m3+3}	+Ordinate	± 99 999.999
A_{m3+4}	- Applicate	± 99 999.999
A_{m3+5}	+Applicate	± 99 999.999
A_{m3+6}	---	± 99 999.999

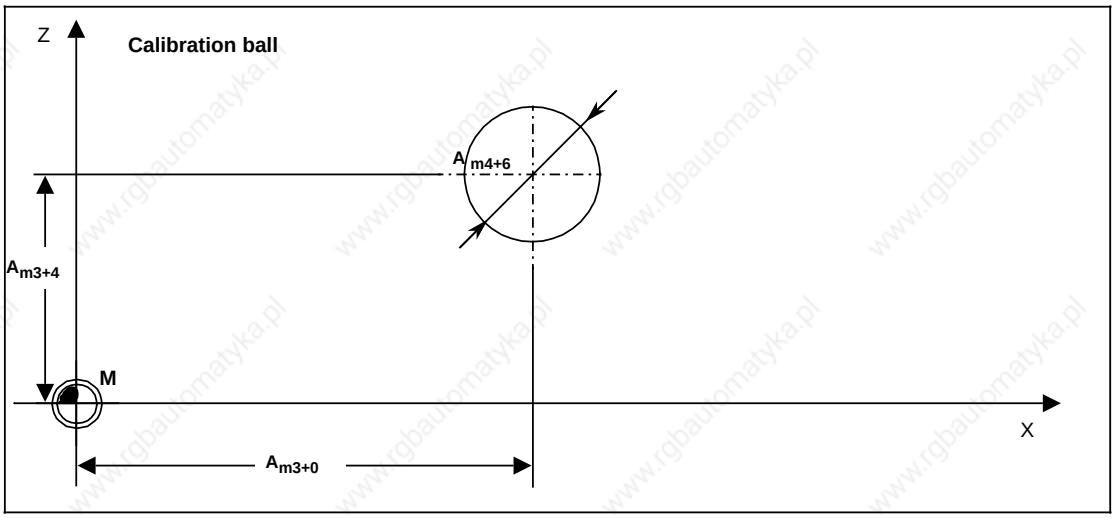


MDC overview: Calibration surfaces

c) Assignment of MDC memory with calibration balls

MD No.	Designation	Max. input value
A_{m3+0}	Calibration ball Centre point abscissa	± 99 999.999
Am3+1	---	± 99 999.999
A_{m3+2}	Centre point ordinate	± 99 999.999
A_{m3+3}	---	± 99 999.999
A_{m3+4}	Centre point applicate	± 99 999.999
A_{m3+5}	---	± 99 999.999
A_{m3+6}	Diameter ball	± 99 999.999

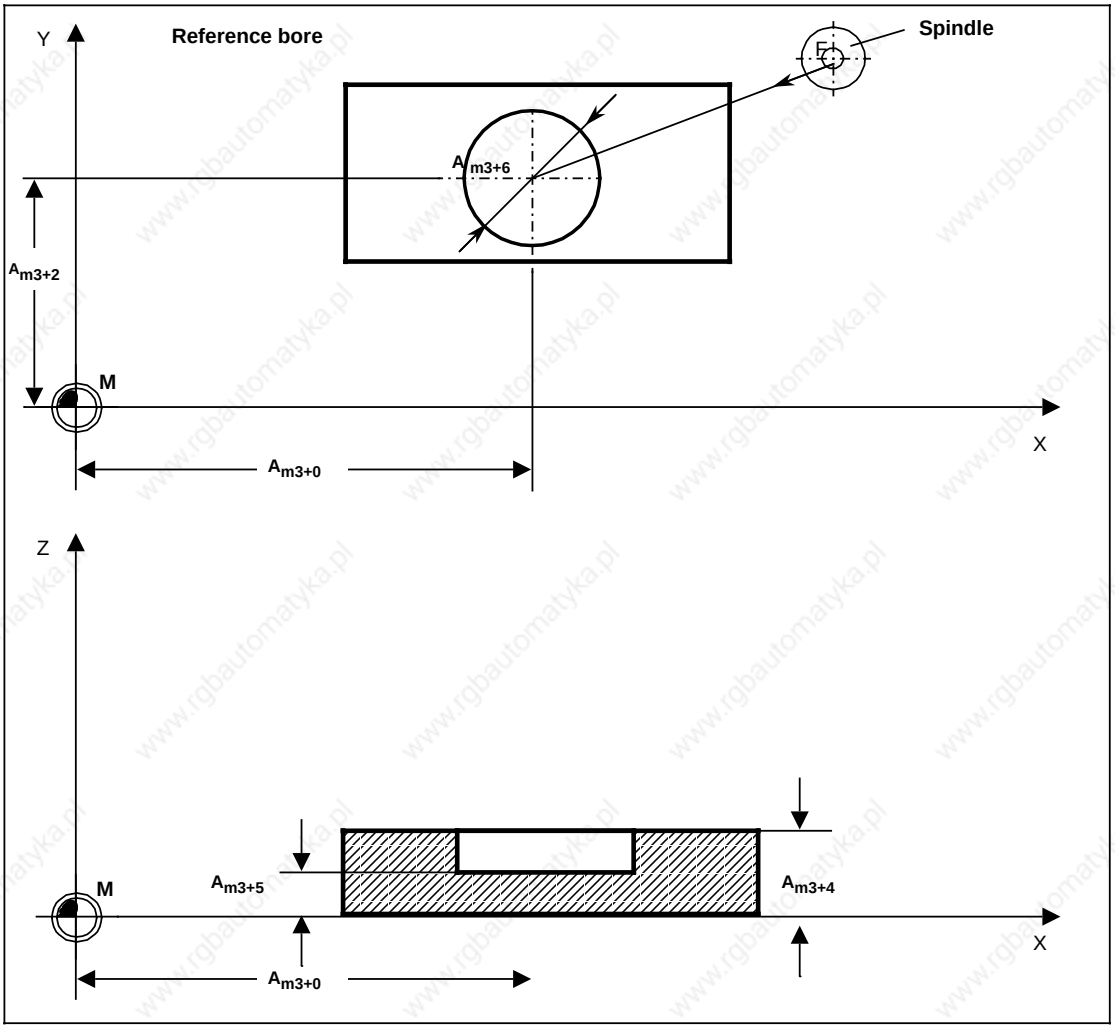




MDC overview: Calibration ball

d) Assignment of MDC memory with reference bores

MD No.	Designation	Max. input value
A_{m3+0}	Reference bore Centre point abscissa	± 99 999.999
A_{m3+1}	---	± 99 999.999
A_{m3+2}	Centre point ordinate	± 99 999.999
A_{m3+3}	---	± 99 999.999
A_{m3+4}	Upper edge of bore	± 99 999.999
A_{m3+5}	Lower edge of bore	± 99 999.999
A_{m3+6}	Bore diameter	± 99 999.999



MDC overview: Reference bore

4.5.4 Tool change position (m4)

MDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
A_{m4+0} : A_{m4+n}	Tool change position (m4)			—	mm

The start address A_{m4} is stored in MDC 1007.

n = MDC 1006

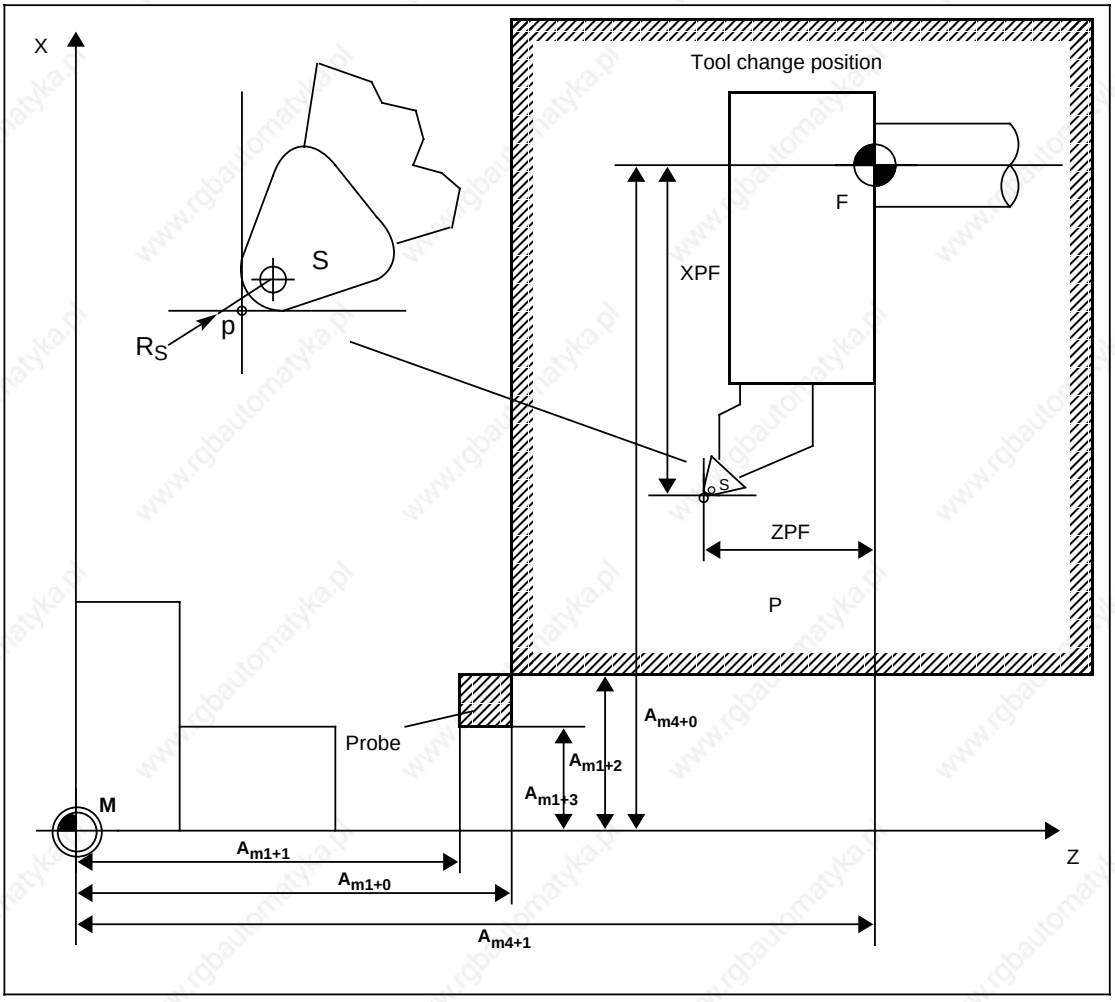
The cycle positions the tool reference point "F" to the specified tool change position (m4) before and after measurement when the function "Tool measurement automatic" (R23 = 2) has been selected for tool measurement.

The tool change position should be a position from which all tools that can possibly be used on the machine can be changed without collision.

The tool tips are only allowed to be located in the shaded area (see graphics: Tool change position).

The tool change positions must be stored in the MDC memory as follows.

MD No.	Designation	Max. input value
	Tool change position	
A_{m4+0}	Axis No. 1	± 99 999.999
:	:	
A_{m4+n}	Axis No. n	± 99 999.999



MDC overview: Tool change position

4.5.5 Reversal dimension (m5)

MDC No.	Designation	Standard value	Input values	Ref. system	Input unit
A_{m5+0} : A_{m5+n}	Reversal dimension (m5)			—	mm

The start address A_{m5} is stored in MDC 1008.

n = MDC 1006 Largest axis number at the machine which is used for measuring

A special application of tool measurement is the so-called "mirror-imaged measuring". Here, the probe is located outside the machine work area. The tools are measured in the opposite working direction (turned by 180 degrees).

This kind of measurement offers the advantage that the machine work area is fully available despite the stationary-mounted tool probe.

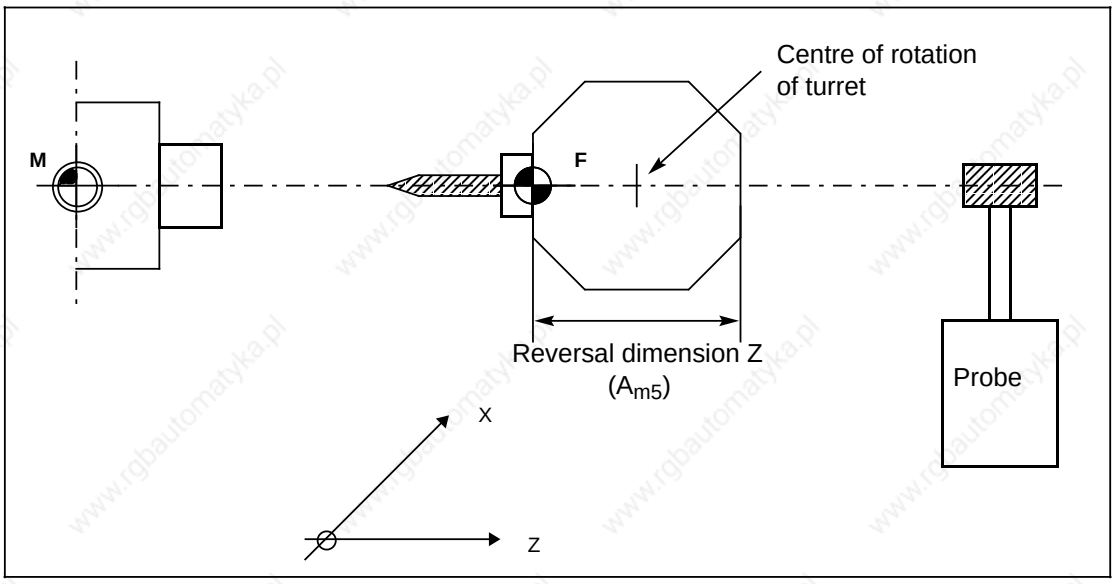
The tools must be positioned in the turret turned by 180 degrees under PLC control.

Axis-specific "mirror-imaging" is activated via MDC 802 bits 0, 1 and 2.

A reversal dimension must be input in MDC m5 if the tool reference dimension "F" is not precisely located in the centre of rotation of the turret.

The reversal dimensions must be stored in the MDC memory as follows.

MD No.	**Designation**	**Max. input value**
A_{m5+0}	Axis number 1 Reversal dimension axis No. 1	± 99 999.999
:	:	
A_{m5+n}	Reversal dimension axis No. n	± 99 999.999



4.6 Central bits, description

MDC No.	Bit No.							
	7	6	5	4	3	2	1	0
7000	Result not in R43-R49	Logging (R39)	Tool measure-ment via tool managem. 880/840	Tool mana-gement SINUMERIK 880/840	D No. (TO range) R10		Logging module	Extended T address

Bit 7 = 0: The measurement results are entered in parameters R43 - R49 and R200 - R219 (for workpiece measurement only).

Bit 7 = 1: The result is not entered in R43 - R49 but only in parameters R200 - R219. This bit must be set when logging with preset measuring point via R45.

Bit 6 = 1: R39 is set with the format required for the logging module. Activation of logging function.

Bit 5 = 0: Tool is always measured

Bit 5 = 1: Tool is only measured if the identifier bit for measurement is set in the PLC (see outline flowchart). Bit 5 is only effective in conjunction with bit 4.

Bit 4 = 0: Tool management SINUMERIK 850 (FB116).

Bit 4 = 1: Tool management SINUMERIK 840/880.

Bit 3 = 0: D number unknown; for workpiece measurement the tool cutting edge number is output via R10, the D number is not. The cycle determines the relevant D number of the tool via FB116 or FB121 (dependent on MDC 7000 bit 4) from the tool cutting edge number (R10) and the associated T number (R8 and R9).

Bit 3 = 1: D number known; D number to be specified via R10 in which the offset is to be allowed for.

Bit 1 = 0: Logging via P-PCB.

Bit 1 = 1: Logging via CP 315. (observe MDC0, 14).

The following additional functions must be performed to configure the ”Logging via CP 315” function:

- Configuring of the FB package subfunctions ”Logging of measurement results” and ”PLC controlled data output”.

  More detailed information is contained in the following documentation:

  SINUMERIK 840/880
  PLC 135 WB Function Blocks
  Package 8: PLC controlled data input/output
  Planning Guide

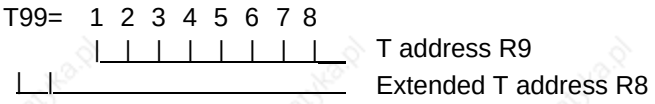
- Configuring of computer link via CP 315

  More detailed information is contained in the following documentation:

  SINUMERIK 840/880
  Computer Link with CP 231 A, CP 315/373 ...
  Planning Guide

Bit 0 = 0: No extended T address, only R9 is evaluated in the cycle.

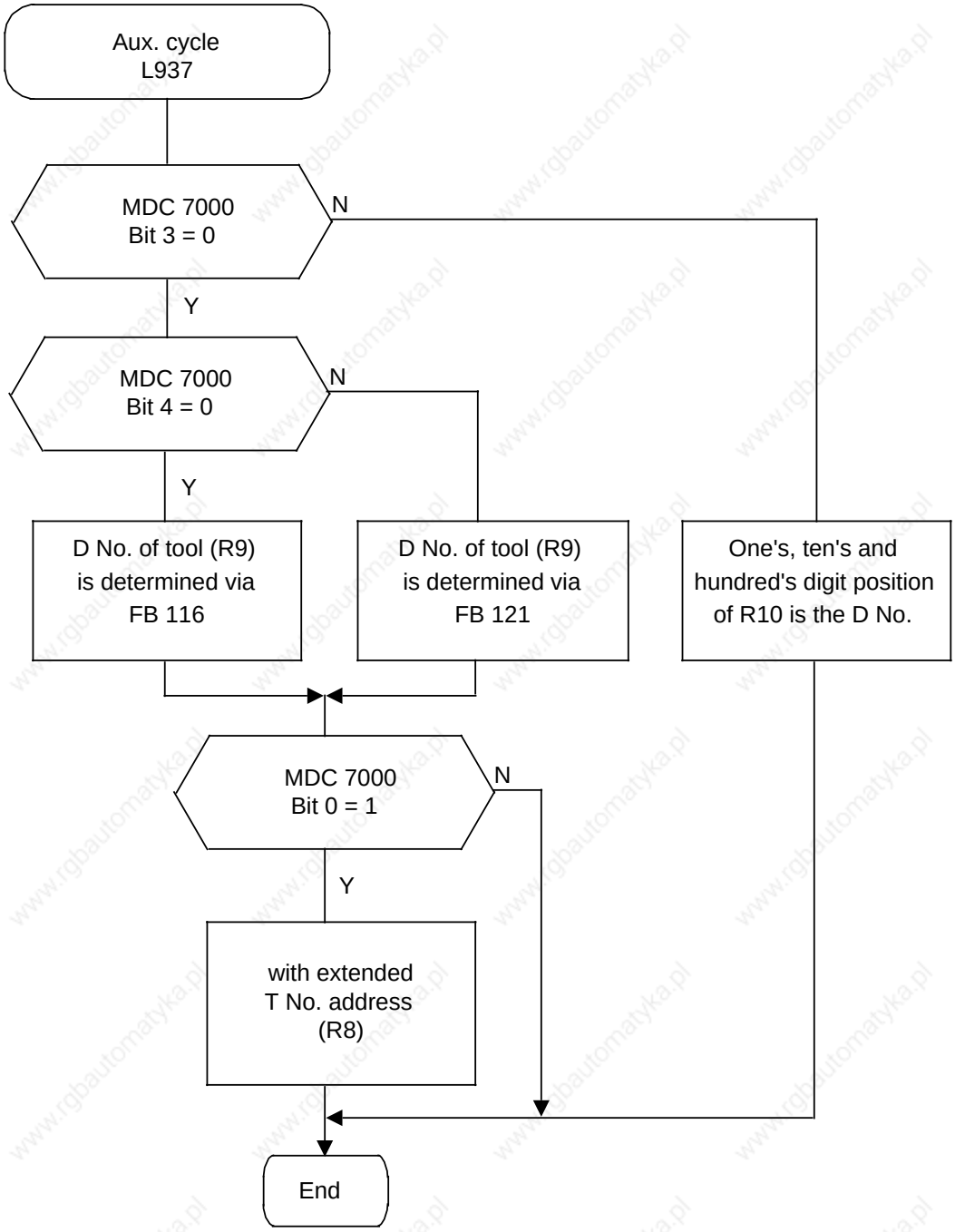
Bit 0 = 1: Extended T address. The extended T address has been introduced to increase the number of tools that can be selected.



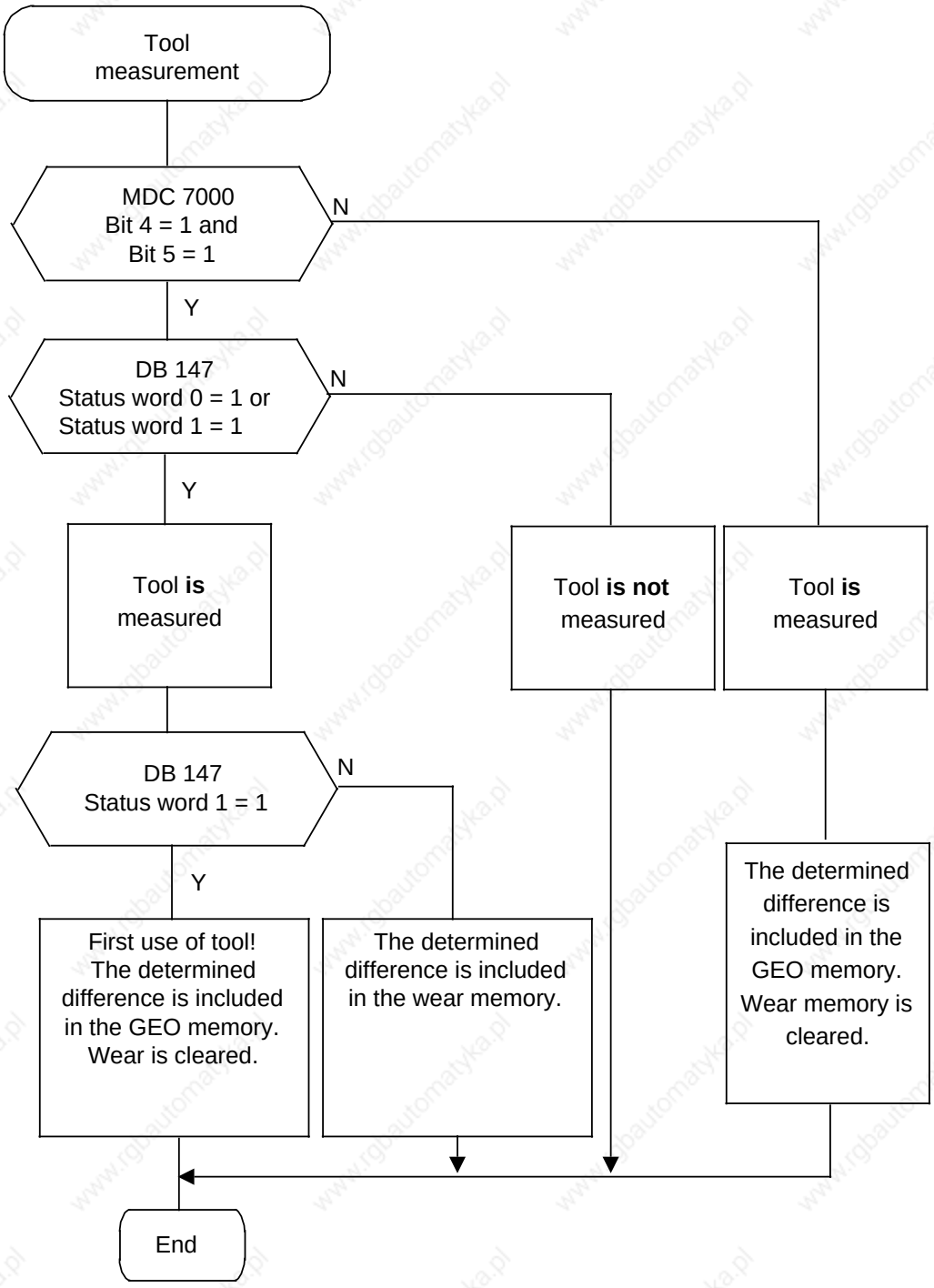
The extended T address must be defined with parameter R8.

e.g. R8 = 99 R9 = 12345678

Outline flowchart of bits 0, 3 and 4 of MDC 7000 with workpiece measurement



Outline flowchart of MDC 7000 bit 4 and bit 5 (tool measurement)



MDC No.	Bit No.							
	7	6	5	4	3	2	1	0
7001	R parameter assignment partly via L967		No M00 with alarms "Oversize", "Undersize", "Permis. dim. difference exceeded"	Automatic scrap detection	Aut. selection auto-display after 5 s.	Aut. selection measurem. result displ.	M00 in the case of measurem. repitition	Measurem. repit. after exceeding R36/R37

Bit 7=1: Auxiliary cycle L967 is called by the measuring cycles, which must be programmed by the user.

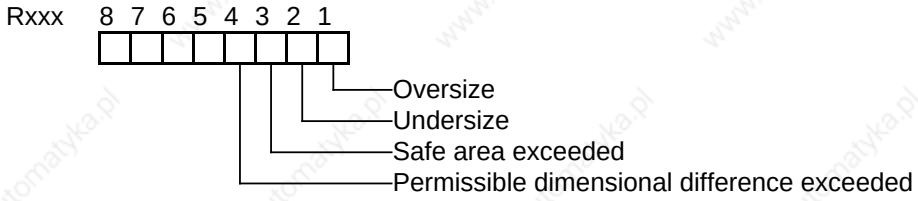
In the cycle L967 R parameters can be defined which can have the same value for all measuring cycles (simpler programming).

Example :

```
L967
R11 = 0   R22 = 1   R25 = 0   R29 = 1   R33 = 0.004   LF
M17  LF
```

Bit 5 = 1: No M00 is performed when the alarms "Oversize", "Undersize" or "Permissible dimensional difference exceeded" occur, if no result display has been selected (MDC 7001 bit 2 = 0).

Bit 4 = 1: If the bit is set, the following identifiers are stored in the R parameter defined by MDC 1013.



"Safe area exceeded" is set only after preceding measurement abort.

Bit 3=1: The display shown before the measurement result display is selected after approx. 5 seconds without NC start if MDC 7001 bit 2 is set.

Bit 2=1: A measurement result display is automatically shown on the screen on completion of the measuring operation (MDC 18 to MDC 39).

The cycle comes to a standstill with programmed STOP (M00). The display shown before the measurement result display is selected with NC START and the cycle is continued.

Bit 1=1: Repeat measurement must be started with NC START if the MDC 7001 bit 0 is set and the limits (R36 or R37) have been exceeded. An alarm is displayed in the alarm line which need not be acknowledged.

Bit 0 = 1: Measurement is repeated if the determined diffference exceeds the values of R36 or R37. The new result is averaged with the preceding one. This averaged result is now used to check the limits (R36 or R37).

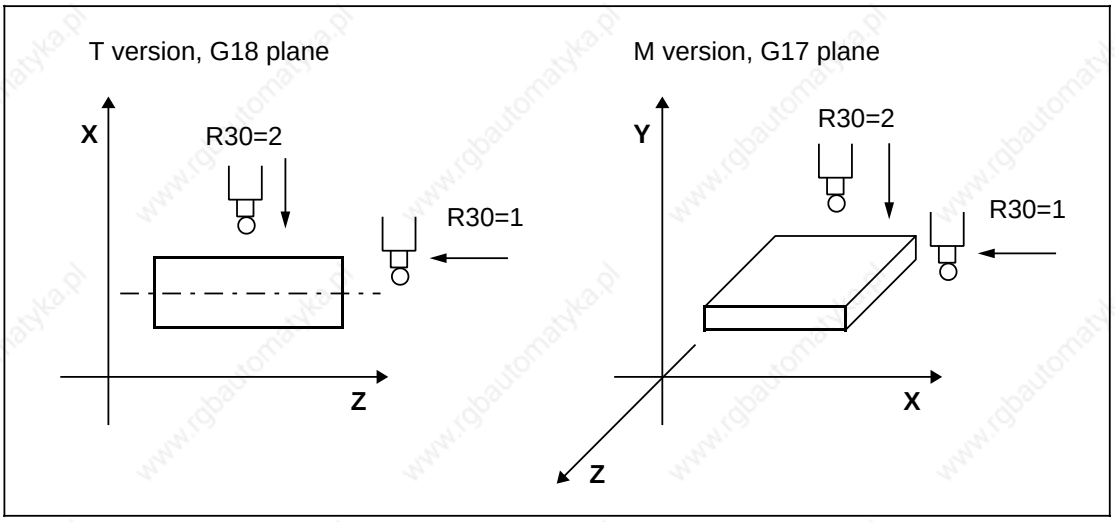
The repeat measurement (up to 5 times) can be stopped (MDC 16 and 17) by an abort signal (e.g.: by the operator).

In the case of a repeat measurement an alarm is only displayed in the alarm line if MDC 7001 bit 1 is set.

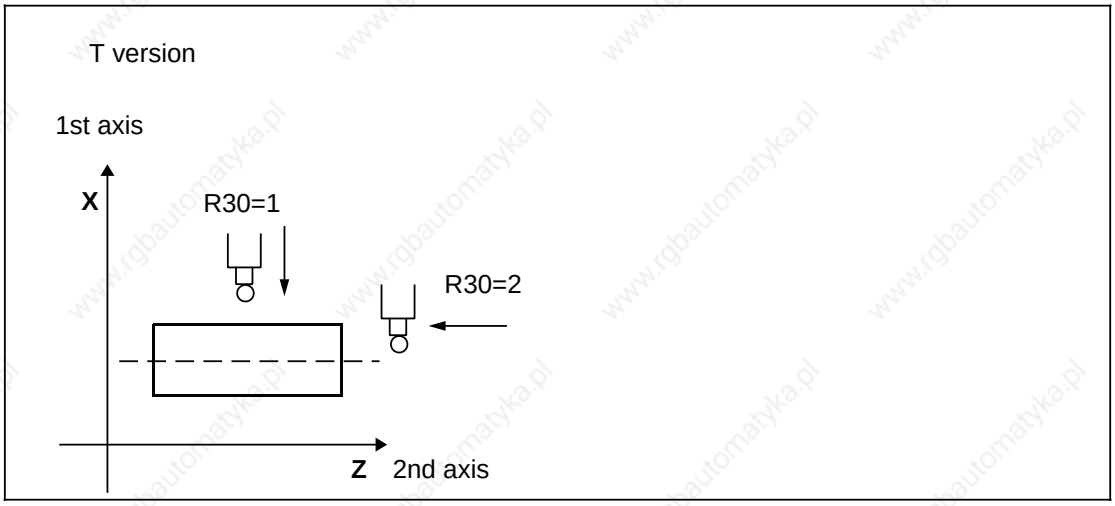
MDC No.	Bit No.							
	7	6	5	4	3	2	1	0
7002							Axes not changed R30	

The axis definitions of R30 are evaluated as shown below only if MD 157 defines a T version (MD 157 = x1x1):

Axis definition via R30 in accordance with DIN 66217:



Axis definition via R30 (MDC 7002.1=0, axes changed):



MDC No.	Bit No. 7	6	5	4	3	2	1	0
7004			L1 to end of probe				Coordinate rotation	Spindle offset (R13)

Bit 0 = 0: The position of the spindle is not offset.

Bit 0 = 1: When using a mono probe the position of the spindle is additionally offset by parameter R13 (offset angle position). In normal cases, R13 = 0. If R13 = -360 the direction of rotation of the spindle can be changed.
When measuring with **L979**, R13 is also taken into account if a **multi probe** is used.
Here, the following applies:
R13 = 0: Positioning direction of the spindle according to M3
R13 =-360: Opposite positioning direction

Bit 1 = 0: Coordinate rotation is not permitted during measurement

Bit 1 = 1: With measurement type L977, Measure hole**/**shaft, selected coordinate rotation is permitted.

Bit 5 = 0: L1 of probe type 30 to centre of probe ball

Bit 5 = 1: L1 of probe type 30 to end of probe

MDC No.	Bit No. 7	6	5	4	3	2	1	0
7005 . . 7009				Reserved				

END OF SECTION

5 Setting Data for Measuring Cycles

5.1 Cycle setting data memory (SDZ)

Empirical values and average values of the measuring cycles are stored in the cycle setting data memory (SDC).

The SDC memory is subdivided into the following areas:

5.1.1 Channel-oriented values, overview

SDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
0 ... 99	Siemens (Measuring cycles)	–	–	–	–
400 ... 499	User	–	–	–	–

5.1.2 Channel-oriented bits, overview

SDC No.	Bit No. 7	6	5	4	3	2	1	0
800 ... 819	Siemens (Measuring cycles)							
820 ... 849	Siemens							
900 ... 949	User							

5.2 Channel-oriented values, description

SDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
0	Internal data	–	–	–	–

SDC No.	Designation	Standard value	Max. input value	Ref. system	Input unit
1 . . . 99	Empirical values/average values	0	0 to +/– 99999999	–	–

The classification must be determined via MDC 0 - MDC 3.

5.3 Channel-oriented bits, description

SDC No.	Bit No. 7	6	5	4	3	2	1	0
800	Workpiece measure-ment second probe	Tool measure-ment second probe			Display in workpiece coordinates when measuring in JOG 840/840C		Check of cycle MD	Check of transfer parameters

Bit 1 Bit 1=1: Cycle MD are checked (L932).
Bit 0 Bit 0=1: Transfer parameters are checked (L932).

SDC No.	Bit No. 7	6	5	4	3	2	1	0
801 . . . 809	Reserved							

END OF SECTION

6 Auxiliary Cycles for Start-up

6.1 Auxiliary cycle L898

Subroutine L898 is offered to facilitate setup of the variable MDC memory (MDC 1000 - MDC 1149) at start-up.

Cycle L898 contains a basic set of the possible element types. Elements of the same type are combined in blocks for clear organisation of the cycle.

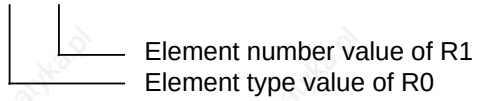
The cycle is to be modified according to the elements used.

To begin with, the start address of the first element is determined. Next, the number of elements used must be input. The cycle calculates the relevant start addresses and stores the data in this memory area without a gap.

The following blocks can be stored.

1st block	(starting at N0)	:	Start address and number of blocks
2nd block	(N100X)	:	Data of tool probe (6 data)
3rd block	(N200X)	:	Data of workpiece probe (9 data)
4th block	(N300X)	:	Calibration element (7 data)
5th block	(N400X)	:	Tool change position (for each axis)
6th block	(N500X)	:	Reversal dimensions (for each axis)

Signification of block number: N X00X



e.g.: N 2003 R0 = 2 Workpiece probe
R1 = 3 Number 3

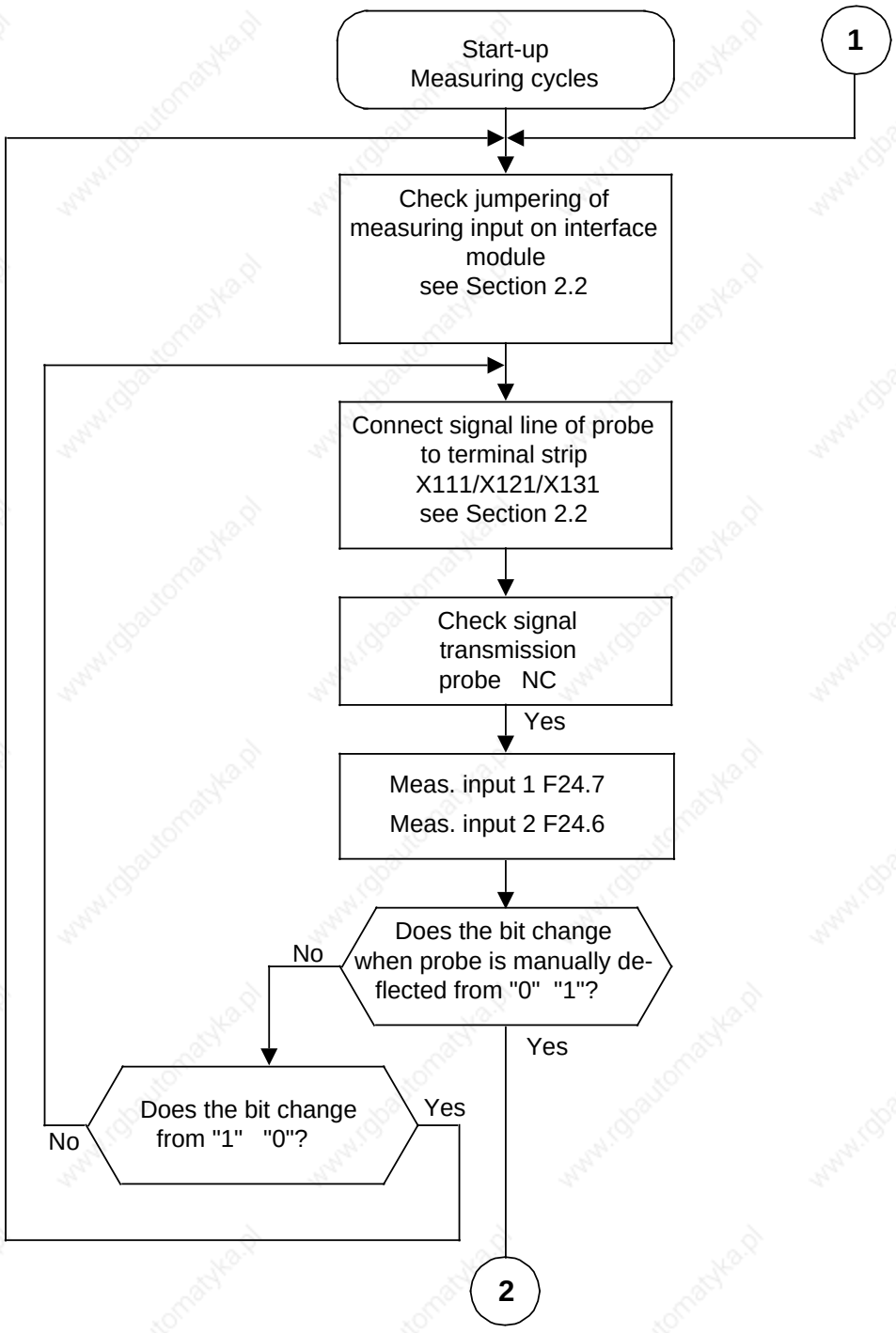
The precise definition of the various elements can be derived from the MDC central values (Section 4.4).

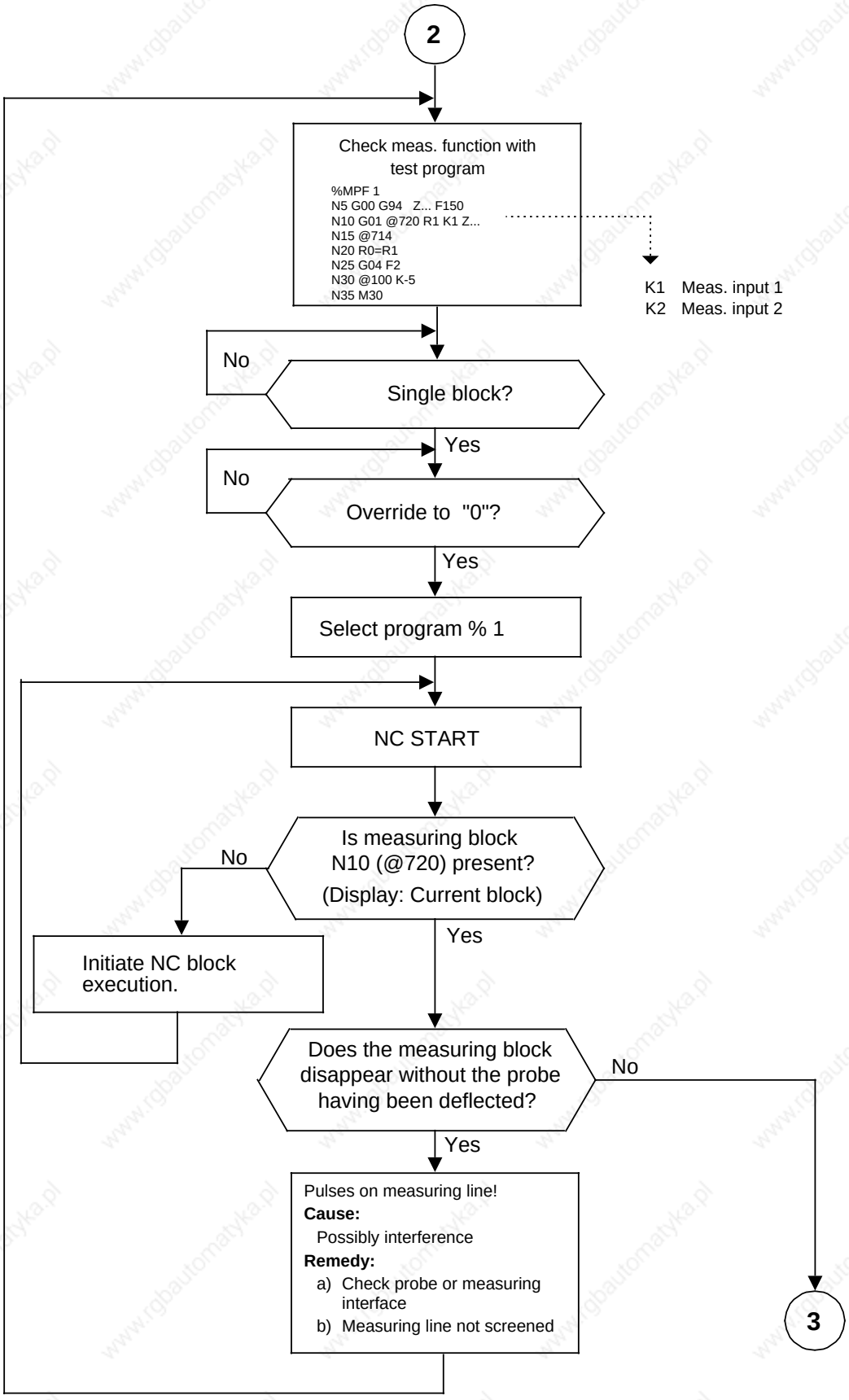
The cycle can be modified on a PG675, PG685 or PG750 with the aid of a text processing system or directly on the control.

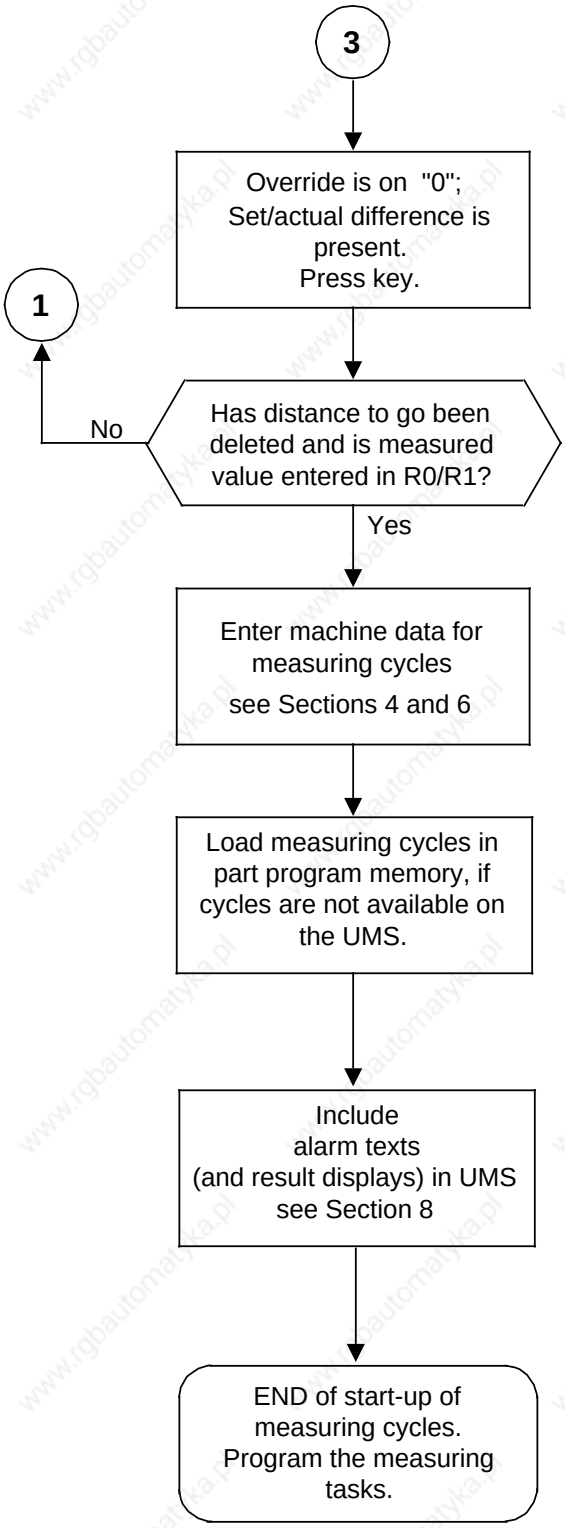
For being run, cycle L898 requires cycle L969 (designation on the diskette: L969IBN.ZPL). Both cycles are only required at start-up for setting up the MDC memory. They must not be included in the UMS and should be removed from the part program memory on completion of start-up. The MDC same as the NC MD can be filed on an external device (diskette) via the RS232C (V.24) interface for data protection.

END OF SECTION

7 Start-up Flowchart







END OF SECTION

8 User Memory Submodule (UMS)

8.1 Measuring cycle overview

Cycle	Function	T version			M version			T/M version		
		A	To	Wp	A	To	Wp	A	To	Wp
L931	Internal	V			V			V		
L932	Check MDC and transfer parameters	C			C			C		
L933	Internal	V			V			V		
L934	Internal	V			V			V		
L935	Measurement result display selection	C			C			C		
L936	Measurement abort	C			C			C		
L937	Internal	V			V			V		
L938	Internal	V			V			V		
L939	Auxiliary program for tool measurement	V			V			V		
L960	Transfer of ZO data blocks			Z			Z			Z
L961	Additive input of EV	C			C			C		
L962	Erase program EV/AV	C			C			C		
L963	Internal	–			V			V		
L964	Calibrate workpiece probe using reference data			V			V			V
L965	Measurement plane	V			V			V		
L966	Auxil. program for operator guidance macro	C			C			C		
L967	Presetting of transfer parameters	C			C			C		
L969	Coordinate rotation	–			V			V		
L970	Prepositioning	C			C			C		
L971	Tool measurement		C			C			C	
L972	Tool measurement		V							
L973	Calibrate workpiece probe			V						
L974	Workpiece measurement			V						

A - Auxiliary programs
V - Existing programs
C - Additional programs
To - Tool measurement
Wp - Workpiece measurement

Cycle	Function	T version			M version			T/M version		
		A	To	Wp	A	To	Wp	A	To	Wp
L976	Calibrate workpiece probe						V			V
L978	Workpiece measurement						V			V
L977	Workpiece measurement BWN						C			C
L979	Workpiece measurement 2D BWN						C			C
L980	Auxil. program for L981							V		
L981	Search for bore									V
L982	Tool measurement		V							
L988	Auxiliary program for workpiece measurement			V			V			V
L989	Internal						V			V

From measuring cycle version 3.2 and higher the tool measuring cycles L972 and L982 are available in two versions, stored on the supplied diskette as L9721, L9722 and L9821, L9822. Depending on individual requirements either L9721**/**L9821 or L9722**/**L9822 can be stored under program number L972**/**L982.

A - Auxiliary programs
V - Existing programs
C - Additional programs
To - Tool measurement
Wp - Workpiece measurement

The table shows which auxiliary programs (A cycles) are used by the measuring cycles (M cycles)

A Cycle \ M Cycle	L970	L972	L973	L974	L976	L977	L978	L979	L981	L982			
L931		◢	◢	◢	◢	◢	◢	◢	◢	◢	◢		
L932		◢	◢	◢	◢	◢	◢	◢	◢	◢	◢		
L933		◢	◢	◢	◢	◢	◢	◢	◢	◢	◢		
L934		◢	◢	◢	◢	◢	◢	◢	◢	◢	◢		
L935		◢	◢	◢	◢	◢	◢	◢	◢	◢	◢		
L936		◢		◢	◢		◢	◢	◢	◢	◢		
L937				◢			◢	◢	◢	◢			
L938		◢		◢	◢		◢	◢	◢		◢		
L939		◢			◢						◢		
L960				◢			◢	◢	◢				
L961													
L962													
L963									◢				
L964			◢			◢							
L965													
L966													
L967		◢	◢	◢	◢	◢	◢	◢	◢	◢	◢		
L969								◢					
L971		◢									◢		
L980										◢			
L988				◢			◢	◢	◢				
L989									◢				

Additional auxiliary programs (comfort programs)

8.2 Result displays, alarm texts

8.2.1 Result displays

Result displays are available for displaying measurement results. The displays are automatically inserted on completion of the cycle (see MDC 7001).

The relevant displays are to be included in the UMS depending on the scope of measurement.

The numbers in the fields show the R parameters in which the respective data is entered.

Result display for tool measurement: (File name: MESS128.??D):

AUTOMATIC - K1

Tool measurement:	Measurement result	Cycle 215

Input data

Measurement option	23
Memory D No.	212
Tool type	216
Empir. val. memory No.	213
Empirical value	214
Confidence interval	36
Perm. meas. difference	37
Meas. probe No.	218
Data	217

Output data

meas.	(calibration)	Actual value	Difference
L1 1.S	(Abscissa - dir.)	200	201
L2 ”	(Abscissa +dir.)	202	203
D/R ”	(Ordinate - dir.)	204	205
L1 2.S	(Ordinate +dir.)	206	207
L2 ”	(Applicate - dir.)	208	209
D/R ”	(Applicate+dir.)	210	211

Alarm No. 219

Result display for tool measurement

Measurement result display for calibration of workpiece probe (File name: MESS169M.??D):

AUTOMATIC - K1

Workpiece measurement: Measurement result Cycle 215

Input data		Output data			
				Actual value	Difference
Measurement option	23				
Confidence interval	36	Probe-ball		200	201
Lower confidence limit	33				
		Abscissa	- direction	202	203
Meas. probe No.	218	Abscissa	+direction	204	205
Data	217	Ordinate	- direction	206	207
		Ordinate	+direction	208	209
		Applicate	- direction	210	211
		Applicate	+direction	212	213
		Position	Abscissa	214	
		Position	Ordinate	216	
		Alarm No.		219	

Result display for workpiece measurement

Measurement result display for workpiece measurement (File name: MESS170M.??D):

AUTOMATIC - K1

Workpiece measurement: Measurement result Cycle 215

Input data		Output data			
		Diameter/width		1st axis	2nd axis
Measurement option	23				
Confidence interval	36	Set value	206	207	208
Perm. meas. difference	37	Actual value	209	210	211
		Upper tolerance limit	200	201	202
D/ZO memory No.	216	Lower tolerance limit	203	204	205
		Difference	212	213	214
Meas. probe No.	218				
Data	217	Correction value	50		
		Alarm No.		219	

Result display for workpiece measurement

8.2.2 Include result displays and alarm list in UMS

Measuring cycles, alarm texts and result displays are supplied on a diskette (format: MS-DOS, WS800A).

The alarm texts and result displays are available in the following languages:

- German
- English
- French
- Italian
- Spanish

The following projects are contained on the diskette:

- README?.TXT — Information for start-up and use of measuring cycles
- PAK?_?? — Cycles and alarm texts (from Version 3.5)
  - MESAL840.TTS — Alarm texts: Standard and measuring cycles (840/840C)
  - MESAL880.TTS — Alarm texts: Standard and measuring cycles (850/880)
- ERGBI840 — Result displays for SINUMERIK 840/840C
- ERGBI880 — Result displays for SINUMERIK 850/880
  - MESEGANW.MB — User menu tree for result displays
  - MESS128.FCD — Result display: Tool measurement
  - MESS169M.FCD — Result display: Calibrate workpiece probe
  - MESS170M.FCD — Result display: Workpiece measurement
- MESSM840 — Menus, texts, displays, programs, OGMs and link lists
- MESSM880 — Menus, texts, displays, programs, OGMs and link lists
- MESST840 — Menus, texts, displays, programs, OGMs and link lists
- MESST880 — Menus, texts, displays, programs, OGMs and link lists
- WSM_M840 — Measuring cycles for measuring in JOG, alarm texts and selection displays
  - FX34 — Module in S5-DOS format, PG685 for measuring in JOG

8.3 Input displays for measuring cycles

8.3.1 Input displays for cycles package 3 (measuring cycles for turning machines)

8.3.1.1 General

The measuring cycles can be entered in the part program either by direct programming of R parameters or by menu displays with operator guidance.

Graphic input displays are available for all measurement versions included in measuring cycle package 3 (measuring cycles for turning machines) (in German only).

User menu numbers 102 to 122 have been used to configure the menu tree of the measuring cycle displays.

The existing menu tree file for measuring cycles (standard and measuring cycles) can be used as a basis for configuring the complete user menu tree.

Check whether files with identical names and versions already exist before transferring the files to the WS 800A.

8.3.1.2 Diskette

The following files are contained on the supplied diskette:

SINUMERIK 850T/880T

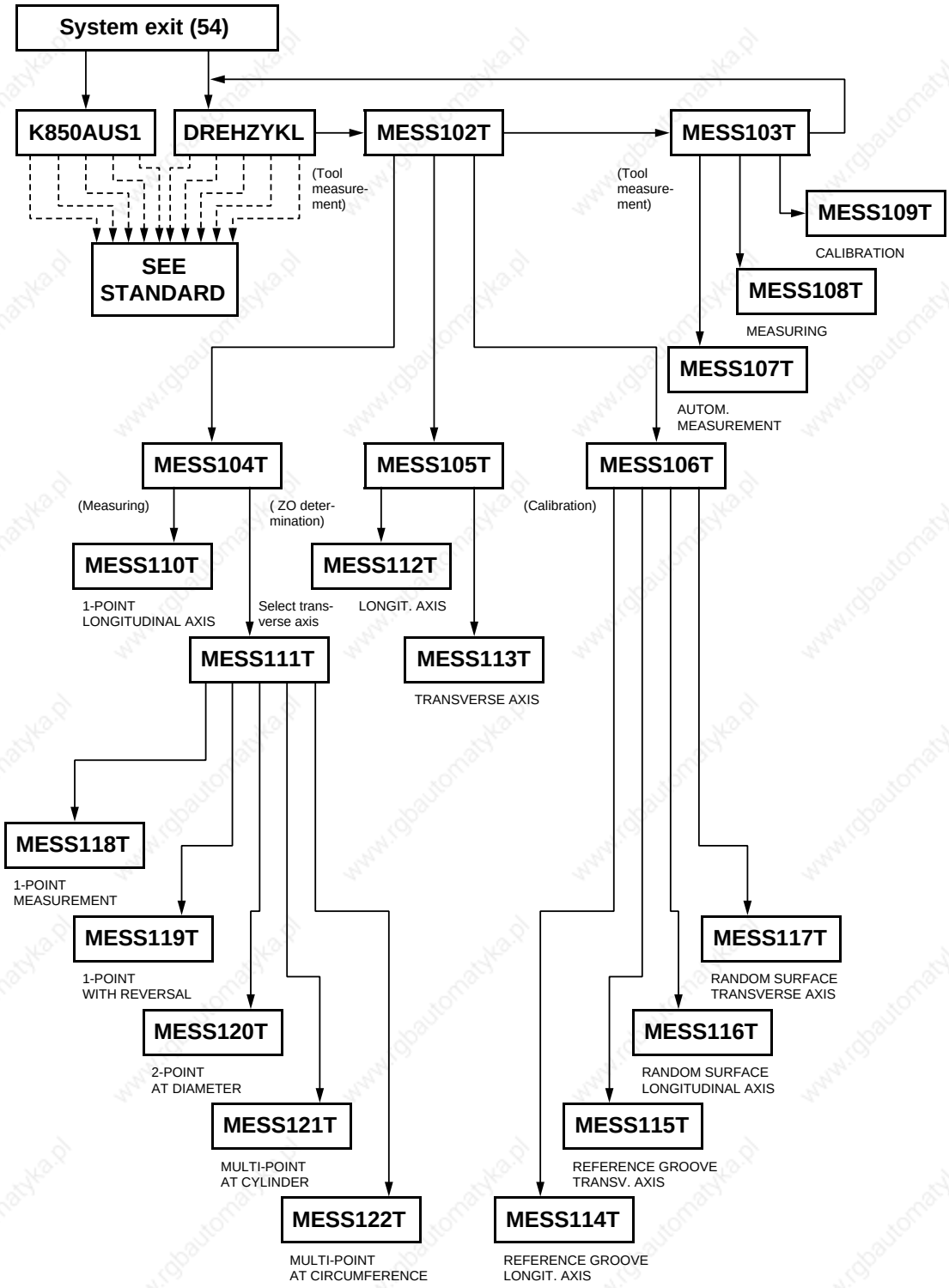
Project:	MESST880	
Menus:	ANWM880T.MB	Modified standard menu tree
	MESSANWT.MB	User menu tree for measuring cycles
Texts:	MESAL880.TTS	Alarm texts for standard and measuring cycles
Displays:	MES1??T.FCD	Measuring cycle displays
Programs:	L966.ZPL	Auxiliary program for OGM
UGM files:	BFM0???.BFM	Operator guidance macros for measuring cycles
Linkage lists:	MESST880.LBD	Link list for standard and measuring cycles

SINUMERIK 840T/840C T

Project:	MESST840	
Menus:	840.MB	Modified standard menu tree
	MESSANWT.MB	User menu tree for measuring cycles
Texts:	MESAL840.TTS	Alarm texts for standard and measuring cycles
Displays:	MES1??T.FCD	Measuring cycle displays
Programs:	L966.ZPL	Auxiliary program for OGM
UGM files:	BFM0???.BFM	Operator guidance macros for measuring cycles
Linkage lists:	MESST840.LBD	Link list for standard and measuring cycles

8.3.1.3 Outline and branching displays package 3

SINUMERIK 850T/880T



8.3.2 Input displays for cycle package 4 (measuring cycles for milling machines and machining centres)

8.3.2.1 General

The measuring cycles can be entered in the part program either by direct programming of R parameters or by menu displays with operator guidance.

Graphic input displays are available for all measurement versions included in measuring cycle package 4 (measuring cycles for milling machines and machining centres) (in German only).

User menus 131 to 167 have been used to configure the menu tree of the measuring cycle displays.

The existing menu tree file for measuring cycles (standard and measuring cycles) can be used as a basis for configuring the complete user manual tree.

It should be checked whether files with identical names and versions already exist before transferring the files to the WS800A.

8.3.2.2 Diskette

The following files are contained on the supplied diskette 1/2:

SINUMERIK 850M/880M

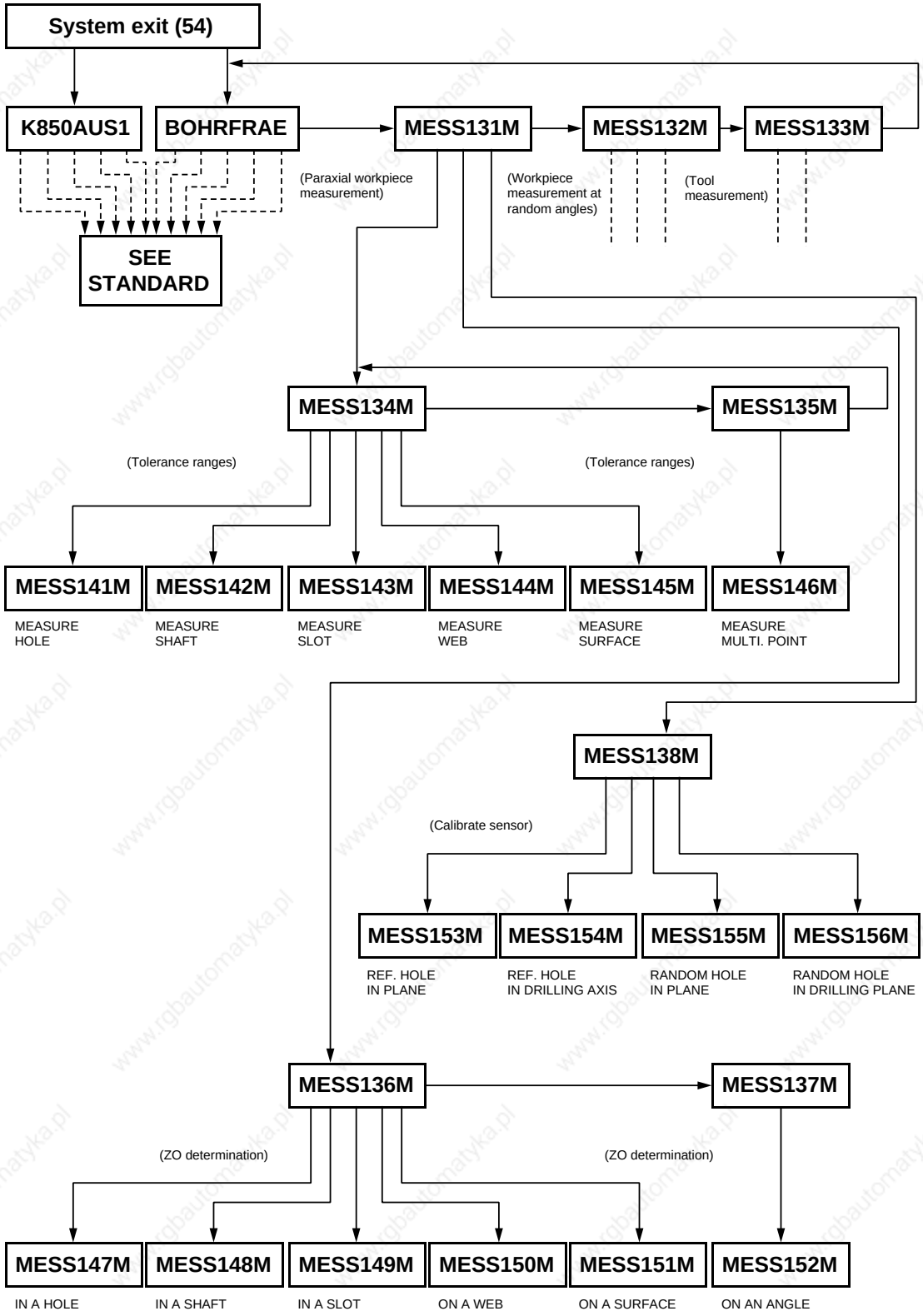
Project:	MESSM880	
Menus:	ANWM880M.MB	Modified standard menu tree
	MESSANWM.MB	User menu tree for measuring cycles
Texts:	MESAL880.TTS	Alarm texts for standard and measuring cycles
Displays:	MES1??M.FCD	Measuring cycle displays
Programs:	L966.ZPL	Auxiliary program for OGM
OGM files:	BFM0???.BFM	Operator guidance macros for measuring cycles
Linkage lists:	MESSM880.LBD	Linkage list for standard and measuring cycles

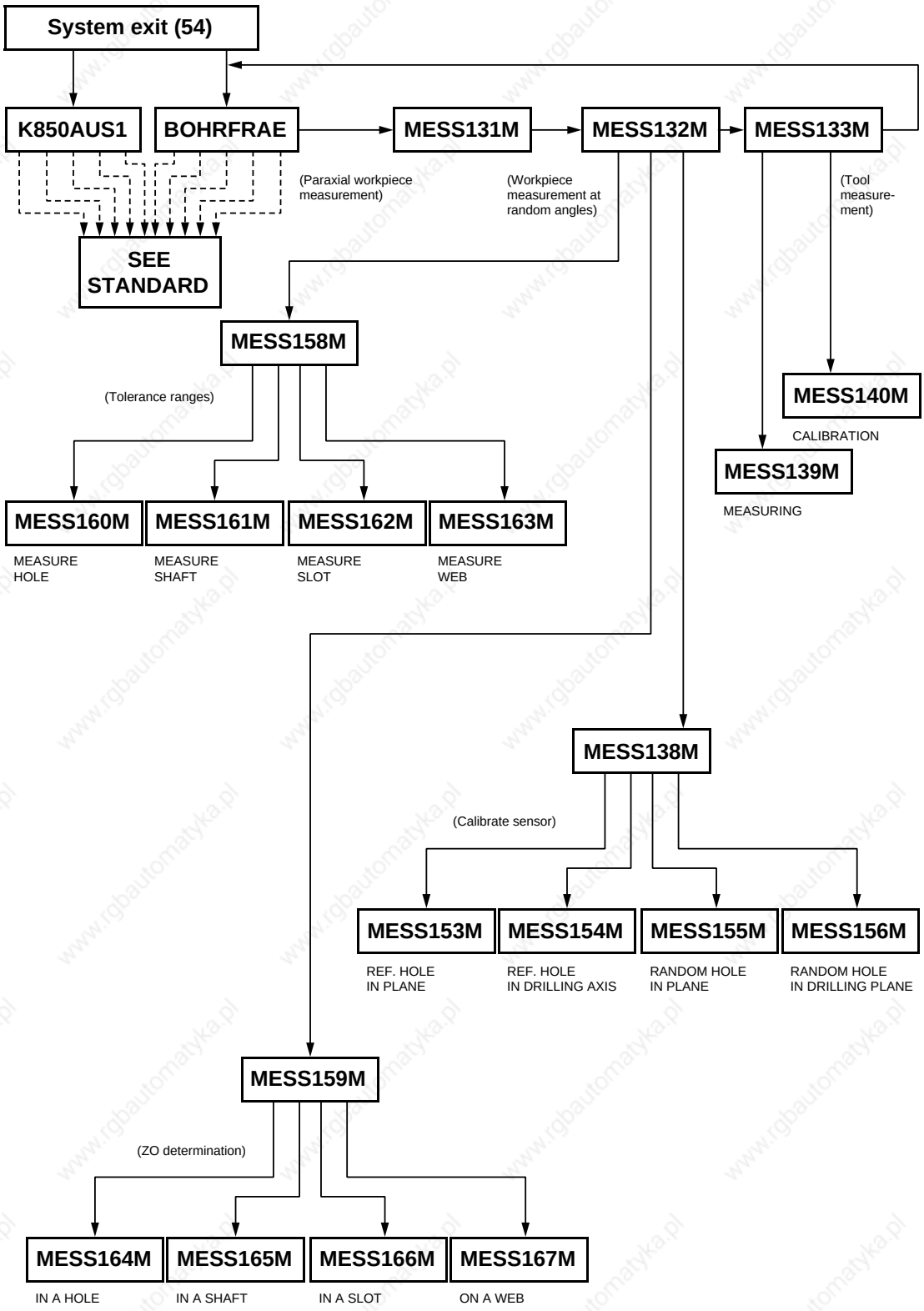
SINUMERIK 840M/840C M

Project:	MESSM840	
Menus:	840.MB	Modified standard menu tree for 840 SW 1
	840SW21.MB	Modified standard menu tree for 840 SW > 2
	840_CS??.MB	Modified standard menu tree for 840C
	MESSANWM.MB	User menu tree for measuring cycles
Texts:	MESAL840.TTS	Alarm texts for standard and measuring cycles
Displays:	MES1??M.FCD	Measuring cycle displays
Programs:	L966.ZPL	Auxiliary program for OGM
OGM files:	BFM0???.BFM	Operator guidance macros for measuring cycles
Linkage lists:	MESSM840.LBD	Linkage list for standard and measuring cycles

8.3.2.3 Outline and branching package 4

SINUMERIK 850M/880M

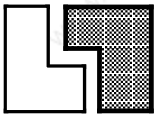




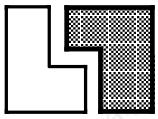
END OF SECTION

9 Tool and Workpiece Measurement in JOG Mode (SINUMERIK 880)

9.1 General conditions



The function "Tool measurement in JOG" is available as from Software Version 4, the function "Workpiece measurement in JOG" is available as from Software Version 5 as an option for SINUMERIK 880.



The functions are operated via softkeys and input displays.

The function MEASURING IN JOG mode offers the following functions:

- Semi-automatic determination of tool lengths and their storage in the tool offset memory,
- Semi-automatic determination of the workpiece zero and its storage in the zero offset memory.

9.2 Necessary machine data

The machine data used for measuring via measuring cycles are also used for the function MEASURING IN JOG mode.

In addition, MD 158 MEASURING SPEED and MD 159 RETRACTION PATH are also used. Please refer to Section 4 for a description of these machine data.

END OF SECTION

10 Workpiece Measurement in JOG Mode (SINUMERIK 840 SW2)

10.1 General conditions

Software versions: The following NC software version is required for workpiece measurement: SINUMERIK 840M Software Version 2.1 or higher.

PLC program: FX 34 is required for the automatic selection of measuring cycles L885, L886 and L887 in JOG mode.

Axis arrangement: The axes must be arranged according to DIN 66217 to ensure correct operation of the measuring cycles.

Installation must be carried out according to Sections 1 to 7 paying special attention to the following:

- **2.1 Probe**

  Only multi-directional probes must be used.

- **4.3 Channel-oriented values**

  MDC 0, 1, 2, 3 for empirical values and average values are not required and can therefore be assigned with ”0”.

  MDC 16 and 17 for the measurement abort signal identifier must be assigned with ”0”.

  MDC 18 and 19 are not taken into account. This also applies to MDC 2* and 3* because FX 34 calls its own selection display after completing the measuring operation.

- **4.4 Channel-oriented bits**

  MDC 801 - 804 are not taken into account.

- **4.5 Central values**

  Only

  – MDC 1002 - start address workpiece probe,
  – MDC 1003 - number of workpiece probes,
  – MDC 1013

  have to be defined for workpiece measurement in JOG mode.

- **4.6 Central bits**

  Bit 7 must not be set in MDC 7001 as the measuring cycles are preset by L887.

10.2 User Memory Submodule (UMS)

10.2.1 Diskette

The measuring cycles for measuring in JOG mode, alarms texts and selection displays are supplied on diskette (format: MS DOS, WS 800A).

Project:	WSM_M840
Menus:	MESJ840M.MB User menu tree for measuring in JOG mode 840 MESJ840C.MB User menu tree for measuring in JOG mode 840C
Texts:	MESJAL840.TTS Alarm texts (English)
Displays:	MESJ132M.FCD, MESJ134M.FCD MESJ137M.FCD, MESJ141M.FCD - MESJ147M.FCD MESJ153M.FCD, MESJ161M.FCD - MESJ167M.FCD MESJ128.FCD
Programs:	L885.ZPL store PRESET L886.ZPL store ZO L887.ZPL JOG MEASURING
Link lists:	WSM_M840.LBD for 840 WSM_M840C.LBD for 840C

10.2.2 Link lists

SINUMERIK 840M		SINUMERIK 840C
File name:	WSM_M840.LBD	WSM_M840C.LBD
MESJ840M.MB	MESJ840C.MB	
MESJAL840.TTS	MESJAL840.TTS	
L885.ZPL	L885.ZPL	
L886.ZPL	L886.ZPL	
L887.ZPL	L887.ZPL	

The measuring cycles of package 4 must also be linked. The following programs are required for measuring in JOG mode:

L931.ZPL	L933.ZPL	L934.ZPL
L935.ZPL	L937.ZPL	L938.ZPL
L963.ZPL	L965.ZPL	L967.ZPL
L977.ZPL	L978.ZPL	L988.ZPL

10.3 FX 34: Measuring for SINUMERIK 840M

The block is supplied on diskette in the project FX34 (format S5 DOS; PG 685) and supports the cycle package ”Automatic workpiece measurement with operation in JOG mode”.

10.3.1 Description

FX 34 makes automatic selection of cycle L885 (Preset), L886 (Zero point offset) or L887 (Measuring) possible by pressing the relevant softkey. Operating mode JOG must be active in the measuring channel. In the case of cycles L886 and L885, the start bit is automatically set in the measuring channel by FX 34 and remains active for one cycle only. To start L886 and L885 and while they are running, FB 78 is disabled and ”AUTOMATIC” mode is preset by FX 34 in the measuring channel.

In the case of measuring cycle L887, FX 34 switches to operating mode ”AUTOMATIC” in the measuring channel. The user must execute NC Start via the machine control panel because traversing paths must not be commenced via the softkey. If the measuring cycle is not started within 30 seconds FX 34 again displays the starting menu on the screen.

When cycles L885 and/or L886 have been completed, the JOG basic display is displayed on the operator panel.

After measuring cycle L887 has been completed operating mode JOG is again selected and the selection menu ”WORKPIECE MEASUREMENT” is displayed. Cycle L887 can only be started in its own mode group. In other words, if the measuring channel is in mode group 1 while the current operating mode group is mode group 2, the cycle cannot be started.

Note:

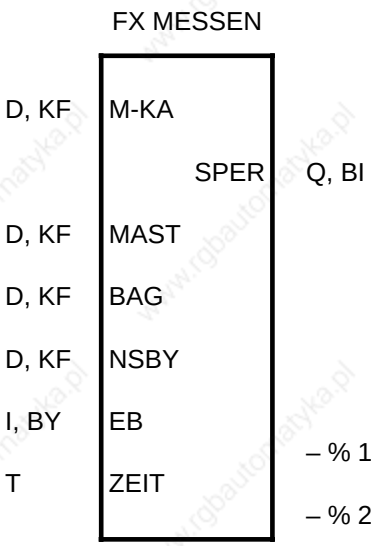
When FX 34 is used, FB 78 (transfer machine control panel to NC channel) must be called conditionally with flag ”SPER” from the parameter field of FX 34 as otherwise ”AUTOMATIC” mode cannot be set and the cycles in the measuring channel cannot be started (see Section 10.3.5 ”Programming example”).

After FX 34 has been called for the first time in cyclic mode the PLC must be restarted.

10.3.2 Additional information

Lib. No.	E88530-B 6234-A-50
FBs to be loaded:	none
FXs to be loaded:	FX 34
DBs to be loaded:	none
DXs to be loaded:	none
Type of FX call:	unconditional
DBs to be entered:	none
Error messages:	ACCU 1 (FX No.) = 34
	% 1 Measuring channel is 0 or greater than 4 % 2 Master channel is greater than measuring channel

10.3.3 Block call



10.3.4 Signal description

M-KA: Number of measuring channel (1 - 4)

MAST: Master channel of mode group in which the measuring channel is located

BAG: Mode group in which the measuring channel is located

NSBY: Interface byte (1 - 65) in DB 36 for selection with FB 62

EB: Number of first input byte (64, 72, 80, 88) with which the machine control panel is assigned

SPER: Flag (F 100.0 - F 199.7) from user area to disable FB 78

ZEIT: Time cell to check whether Start is initated via machine control panel 30 seconds after measuring cycle L887 has been selected.
(T 0 - T 127 with 135 WB)
(T 0 - T 255 with 155 U)

10.3.5 Programming example

```
        OB 1

        :
        :
        : AN F 120.0              Unassigned flag from user area
        : JC FB78
NAME    : T:MS      KN            Conditional call of FB 78
E-BY    :           IB64
K-NR    :           KF+1
SPIN    :           KF+0
        :
        : DO FX34
NAME    : MESSEN
M-KA    :           KF+2          Measuring channel is channel 2
MAST    :           KF+1          Master channel for measuring
BAG     :           KF+1          Mode group with measuring channel is mode group 1
NSBY    :           KF+2          Unassigned interface byte
EB      :           IB64          IB with which machine control panel is assigned
SPER    :           F 120.0       Unassigned user flag bit
ZEIT    :           T 3           Unassigned time cell
        :
        : BE
```

10.3.6 Block data list

FX No.	Name	Block length words	Call length words	Lib. No. E88530-B	Processing time ms
34	MESSEN	410	10	6234-A-50	

Nesting depth	Called FBs	Assigned variables
1	FB 11, FB 62	FW 224 - FW 231, FW 238 - FW 254

END OF SECTION

11 Lists

11.1 Cycle machine data

11.1.1 Channel-oriented values

MDC No.	Designation	Max. input value	Input unit	Standard value
0	Start address of empirical values in cycle setting data	99	1	1
1	Number of empirical values	99	1	49
2	Start address of average values in cycle setting data	99	1	51
3	Number of average values	99	1	49
4	Max. positioning speed (percentage value of rapid traverse)	100	1 in %	100
5	Positioning speed with effective collision monitoring	1500	mm/min	0
6	Reserved			0
7	Reserved			0
8	Reserved			0
9	Reserved			0
10 : 13	Reserved			0 : 0
14	PLC number for logging	4		1
15	PLC number for MDC 16-19	4		1
16	Measurement abort signal Identifier coarse			0
17	Measurement abort signal Identifier fine			0
18	Select result display Identifier coarse			0
19	Select result display Identifier fine			0
20 : 35	Menu No. Measurement result display L970 : Menu No. Measurement result display L985			170 : 170
36 . . . 49	Internal Data			0 . . . 0

11.1.2 Channel-oriented bits

MDC No.	Bit No. 7	6	5	4	3	2	1	0
800	Meas. input No. 2 with Workpiece measurem.	Tool measurem.						Collision monitoring
801	Without average val. memory	Reverse allowance for empirical values	Workpiece probe with 2D numbers					
802						Mirror-imaging Applicate	Mirror-imaging vert. ordinate	Mirror-imaging hor. abscissa
803								
804								Transfer of ZO groups L960
805								
806 : 819			Internal data					
820								
821 : 849								

11.1.3 Central values

MDC No.	Designation	Max. input value	Input unit	Standard value
1000	Start address (m1) Tool probe e.g.: A_{m1}=1020 6 data (d)	1144		1020
1001	Number(a) Tool probe $E_{m1}=A_{m1}+6a-1$	21		3
1002	Start address (m2) Workpiece probe $A_{m2}=E_{m1}+1$ 9 data (d)	1141		1038
1003	Number(a) Workpiece probe $E_{m2}=A_{m2}+9a-1$	14		7
1004	Start address (m3) Cal. groove/surf./ball/bore $A_{m3}=E_{m2}+1$ 7 data (d)	1143		1101
1005	Number8a) Calibration element $E_{m3}=A_{m3}+7a-1$	18		3
1006	Max. axis number on machine for measurement	24		12
1007	Start address (m4) Tool change position 1 data (d) $A_{m4}=E_{m3}+1$ $E_{m4}=A_{m4}$+MDC 1006-1	1126		1122
1008	Start address (m5) Reversal dimension 1 data (d) $A_{m5}=E_{m4}+1$ $E_{m5}=A_{m5}$+MDC 1006-1	1126		1134
1009	Reserved			
1010	Reserved			
1011	Reserved			
1012	M function for triggering FB116 only if MDC 7000/3=0 and MDC 7000/4=0			
1013	R parameter for scrap detection	999		0
1014 : 1019	Reserved			

A=Start address
E=End address

MDC No.	Designation	Max. input value	Input unit
$A_{m1}+0$	Tool probe 1 Trigger point in minus direction (abscissa)	+-99 999.999	mm
$A_{m1}+1$	Trigger point in plus direction (abscissa)	+-99 999.999	mm
$A_{m1}+2$	Trigger point in minus direction (ordinate)	+-99 999.999	mm
$A_{m1}+3$	Trigger point in plus direction (ordinate)	+-99 999.999	mm
$A_{m1}+4$	Trigger point in minus direction (applicate)	+-99 999.999	mm
$A_{m1}+5$	Trigger point in plus direction (applicate)	+-99 999.999	mm
$A_{m1}+6$	Tool probe 2	+-99 999.999	mm
: $A_{m1}+11$		+-99 999.999	mm
$A_{m1}+n$	Tool probe (k)	+-99 999.999	mm
: $A_{m1}+n+5$		+-99 999.999	mm
$A_{m2}+0$	Workpiece probe 1 Ball diameter	+-99 999.999	mm
$A_{m2}+1$	Trigger point in minus direction (abscissa)	+-99 999.999	mm
$A_{m2}+2$	Trigger point in plus direction (abscissa)	+-99 999.999	mm
$A_{m2}+3$	Trigger point in minus direction (ordinate)	+-99 999.999	mm
$A_{m2}+4$	Trigger point in plus direction (ordinate)	+-99 999.999	mm
$A_{m2}+5$	Trigger point in minus direction (applicate)	+-99 999.999	mm
Am2+6	Trigger point in plus direction (applicate)	+-99 999.999	mm
Am2+7	Position (abscissa) (deviation)	+-99 999.999	mm
Am2+8	Position (ordinate) (deviation)	+-99 999.999	mm
$A_{m2}+6$	Tool probe 2	+-99 999.999	mm
: $A_{m2}+11$		+-99 999.999	mm
$A_{m2}+n$	Tool probe (k)	+-99 999.999	mm
: $A_{m2}+n+8$		+-99 999.999	mm

A_{m1} = [MD 1000] *d Number of data of one element*
A_{m2} = [MD 1002] *k Number of element*
A_{m3} = [MD 1004]
A_{m4} = [MD 1007] *$n=d \cdot k$*
A_{m5} = [MD 1008]

MDC No.	Designation	Max. input value	Input unit
$A_{m3}+0$	Cal. gr. pair 1 / cal. surf. 1 / cal. ball 1 / cal. bore 1 a / - abscissa / cp. abscissa / cp.abscissa	+-99 999.999	mm
$A_{m3}+1$	b / + abscissa	+-99 999.999	mm
$A_{m3}+2$	c / - ordinate / cp. ordinate / cp. ordinate	+-99 999.999	mm
$A_{m3}+3$	d / + ordinate	+-99 999.999	mm
$A_{m3}+4$	e / -applicate / cp. applicate / upp. edge B.	+-99 999.999	mm
$A_{m3}+5$	f / +applicate / low. edge B	+-99 999.999	mm
$A_{m3}+6$	g / / D ball / D bore	+-99 999.999	mm
$A_{m3}+7$	Cal. gr. pair 2 / cal. surf. 2 / cal. ball 2 / cal. bore 2	+-99 999.999	mm
:			
$A_{m3}+13$		+-99 999.999	mm
$A_{m3}+n$	Cal. gr. pair (k) / cal. surf.(k) / cal. ball(k) /cal. bore (k)	+-99 999.999	mm
:			
$A_{m3}+n+6$		+-99 999.999	mm
$A_{m4}+0$	Tool change position axis No. 1	+-99 999.999	mm
:			
$A_{m4}+23$	Tool change position axis No. 24	+-99 999.999	mm
$A_{m5}+0$	Reversal dimension axis No. 1	+-99 999.999	mm
:			
$A_{m5}+23$	Reversal dimension axis No. 24	+-99 999.999	mm
:			
1149			

A_{m1} = [MD 1000]
A_{m2} = [MD 1002]
A_{m3} = [MD 1004]
A_{m4} = [MD 1007]
A_{m5} = [MD 1008]

d Number of data of one element
k Number of element

$n = d \cdot k$

11.1.4 Central bits

MDC No.	Bit No. 7	6	5	4	3	2	1	0
7000	Result not in R43 - R49	Logging (R39)	Tool measure-ment via tool management 880/840	Tool management 880/840	D number(TO area) R10		Logging module	Extended T address
7001	R parameter assignment partly via L967		No M00 with alarms "Oversize", "Undersize", "Permis. dim. dif. exceeded"	Automatic scrap detection on workpiece measure-ment	Auto select auto-display after 5 s.	Auto select measurem. result display	M00 with repeated measurem.	Repeated measure-ment after exceeding R36/R37
7002							Axes not changed	
7003								
7004			L1 to end of probe				Coordinate rotation	Spindle offset (R13)
7005				Reserved				
7006 : 7009				Reserved				

11.2 Cycle setting data

11.2.1 Channel-oriented values

SD No.	Designation	Max. input value	Input unit
0	Internal data	---	---
1	Empirical values/average values		
2	" "		
3	" "		
4	" "		
4 : 99	" " " "		

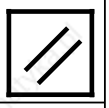
11.2.2 Channel-oriented bits

MDC No.	Bit No.							
	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
800					Display in workpiece coordinates		Check cycle MD	Check transfer parameters
801 : 809	Reserved							

END OF SECTION

12 Alarms

12.1 Alarm overview

Alarm number	Alarm group	Alarm is removed by ...
4000	Measuring cycles	Press acknowledgement key 
4001 ... 4039	Measuring cycles	Press RESET key 
4040 ... 4049	Measuring cycles	Press acknowledgement key 
4050 ... 4099	Mould making cycles	Press RESET key 
4100 ... 4299	Standard cycles partly measuring cycles	Press RESET key 
5000 ... 5299	User	

The table shows which alarms can occur in the various cycles and can be output

Alarm \ Cycle	L 8 8 5	L 9 3 1	L 9 3 2	L 9 3 3	L 9 3 4	L 9 3 5	L 9 3 6	L 9 3 7	L 9 3 8	L 9 3 9	L 9 6 1	L 9 6 2	L 9 6 3	L 9 6 4	L 9 6 5	L 9 6 7	L 9 6 8	L 9 6 9	L 9 7 0	L 9 7 1	L 9 7 2	L 9 7 3	L 9 7 4	L 9 7 6	L 9 7 7	L 9 7 8	L 9 7 9	L 9 8 0	L 9 8 1	L 9 8 2	L 9 8 8	L 9 8 9
4000																																
4001			◢																													
4002			◢																													
4003			◢																													
4004																																
4005																																
4006		◢													◣				◣													
4007																					◣	◣	◣	◣	◣	◣	◣		◣	◣		
4008			◣	◣															◣												◣	
4009		◢																					◣		◣	◣	◣					
4010					◢														◣													◢
4011					◢																											◢
4012					◢									◢					◣	◢	◣	◣	◣	◣	◣	◣	◣	◢		◣		◢
4013		◢																			◣									◣		
4014		◢						◢		◢																						
4015																																
4019													◣																			
4020								◢																								
4021								◢		◢																						
4025																					◣									◣		
4026																					◣									◣		
4027																																
4030								◢		◢											◣	◣	◣	◣	◣	◣	◣		◣	◣		

◣ Alarm is output directly by the cycle

◢ Alarm is set and output by the calling cycle

Alarm \ Cycle	L8855	L8855	L9331	L9332	L9333	L9334	L9335	L9336	L9337	L9338	L9339	L9361	L9362	L9363	L9364	L9365	L9367	L9368	L9369	L9370	L9371	L9372	L9373	L9374	L9376	L9377	L9378	L9379	L9380	L9381	L9382	L9388
4031																																
4032																													◢			
4033																																
4038																					◢		◢	◢	◢	◢	◢		◢	◢		
4039			◢	◢		◢			◢						◢				◢		◢	◢	◢	◢	◢	◢	◢		◢	◢		
4040																									◢	◢	◢					
4041																									◢	◢	◢					
4042								◢																	◢	◢	◢			◢		
4048								◢																								
4049						◢																										
4100		◢																														
4121					◢																											◢
4180																					◢	◢	◢	◢	◢	◢	◢		◢	◢		
4200			◢					◢	◢																							
4219	◢																															
4220	◢																															

◢ Alarm is output directly by the cycle

◢ Alarm is set and output by the calling cycle

12.2 Measuring cycle alarms

The following alarm texts are stored in the UMS (see Section 8.1). They appear in the alarm line on the screen when an alarm occurs.

In addition, the alarm numbers are entered in the R parameter R219 permitting "listening in" to the alarms from the PLC when necessary.

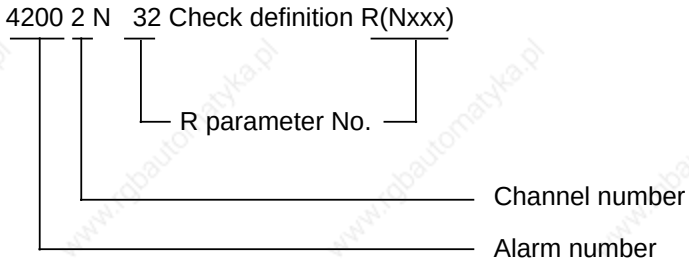
Alarm number	Alarm text	Remove alarm by ...
4000	Remove alarm	
4001	Check MDC 0 / 1	
4002	Check MDC 2 / 3	
4003	Check MDC 1000 - 1019	
4004	Loading MDC locked	
4005	MDC area overrun	
4006	NC type or SW version wrong	
4007	Wrong MC programs loaded	
4008	Check MDC (Nxxxx)	
4009	Measurement not possible	
4010	Probe fault	
4011	Probe does not switch	
4012	Probe collision	

Alarm number	Alarm text	Remove alarm by ...
4013	Check type in TO memory	
4014	STACK overflow	
4015	Check ZO number	
4019	Calculation not possible	
4020	No D number received from PLC	
4021	PLC interface not ready	
4025	Wrong pos. of tool tip	
4026	Tool point direct. 9 defined	
4027	Tool pt. dir. <1 or > 10 def.	
4030	Safe area overrun	
4031	Applicate not within tolerance	
4032	Ordinate not within tol.	
4033	Appl. A. ordin. not within tol.	
4038	Stop measurement / RESET	
4039	Program RESET required	

Alarm number	Alarm text	Remove alarm by ...
4040	Oversize	
4041	Undersize	
4042	Permissible dim. diff. exceeded	
4048	No active tool available	
4049	Display selection not possible	
4100	No D number active	
4121	Spindle not within tol. zone	
4153	Thread length too short	
4180	Option not available	
4200	Check definition R (Nxxxx)	
4219	Call cycle again	
4220	Parallel lines	

Explanation of alarm 4200

Example of an alarm line



It has been detected in the cycle running in channel 2 that parameter R32 is incorrectly defined.

END OF SECTION

13 Abbreviations

AV	Average value	
EV	Empirical value	
MDC	Machine data for cycles	(Cycle machine data)
M version	Milling machine control	
NC MD	NC machine data	
SDC	Setting data for cycles	(Cycle setting data)
SW	Software version	
T version	Turning machine control	
UMS	User memory submodule	
To	Tool	

END OF SECTION