



HEIDENHAIN

Technical Information

TNC 370



This Technical Information is for the HEIDENHAIN TNC 370 control with NC software version 280 60x 07 (x = dialog language) and is intended for use in conjunction with the Technical Manual for the TNC 360. The information in this document is subject to change without notice.

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1 Introduction

The TNC 370 is an easy-to-program contouring control for boring and milling machines with 3 or 4 axes and spindle orientation. The hardware design is the same as for TNC 360. However, the TNC 370 is driven by a 32-bit CPU for high processing speeds. Its newly designed TE 370 operating panel includes an ASCII keypad, machine operating keys and an HR 130 handwheel. The TNC 370 is equipped with the BF 370 flat panel display with soft keys and other TNC keys integrated in its frame.

Some of the connector designations on the LE 370 and their pin layouts have changed from those on the TNC 360. Connector X13 is provided for an additional touch probe system, the TT 120 for tool presetting. The PL 410 I/O unit is not compatible with the LE 370. A new PL 410B I/O unit is available for the LE 370.

This document describes only the differences of the TNC 370 from the TNC 360 and should be used in conjunction with the Technical Manual for the TNC 360.

2 Features and Specifications

Components	<ul style="list-style-type: none">• LE 370 logic unit• TE 370 keyboard with QWERTY keyboard, machine operating keys, HR130 handwheel• BF 370 flat luminescent screen (192 mm x 120 mm, 640 x 400 pixels) with soft keys
Optional components	<ul style="list-style-type: none">• Electronic handwheel one HR 330 or HR 410 portable handwheel or up to three HR 150 panel-mounted handwheels via HRA 110 instead of HR130• Floppy disk unit FE 401• 3D touch probe TS 120/TS 220/TS 630• Tool touch probe TT120
Control modes	<ul style="list-style-type: none">• Contouring control for 4 axes and spindle orientation• Linear interpolation in 3 of 4 axes• Circular interpolation in 2 of 4 axes
Program memory	<ul style="list-style-type: none">• Buffered RAM memory (approx. 70 KB) for 64 NC programs• Central tool file, PLC program (if not filed in EPROM)• EPROM memory (128 KB) for PLC program, PLC error messages
Tool memory	99 tools
Operating modes	<ul style="list-style-type: none">• Manual operation• Electronic handwheel /jog positioning• Positioning by manual data input• Program run/single block• Program run/full sequence• "Blockwise transfer" via data interface, with simultaneous execution• Programming and editing• Test run (logical and graphical)
Programming	<ul style="list-style-type: none">• In HEIDENHAIN conversational mode and according to ISO• Manually via TNC keyboard unit• Externally via data interface
Entry and display resolution	1 μm , 5 μm , 10 μm , 50 μm , 100 μm

Programmable functions	<ul style="list-style-type: none"> • Nominal position (absolute or incremental dimensions) in Cartesian or polar coordinates • Straight lines • Circular arcs • Helical interpolation • Corner rounding, chamfering • FK programming • Tangential approach and departure from a contour • Tool number, tool length and radius compensation • Spindle speed • Rapid traverse • Feed rate • Program call from inside other programs • Subprograms and repetition of program sections • Machining cycles for peck drilling, tapping (without floating tap holder), slot milling, rectangular pocket milling, circular pocket milling • Cycles for milling pockets with a free contour (SL cycles) • Shifting and rotation of the coordinate system, mirroring, scaling, dwell time, miscellaneous functions M, program stop • Spindle orientation
Parameter programming	Mathematical functions (=, +, -, x, :, sin, cos, angle α of $r \sin \alpha$ and $r \cos \alpha$, $\sqrt{\quad}$, $\sqrt{a^2 + b^2}$), parameter comparison (=, \neq , >, <), output of parameter values via the data interface
Digitizing	<ul style="list-style-type: none"> • With TS 120 and TNC software expansion option • Optional evaluation software SUSA for PCs
Maximum traverse	$\pm 30\,000$ mm (1181 in.)
Maximum traversing speed	300 m/min (11 810 ipm)
Data interfaces	RS-232-C/V.24; data transfer rates up to 115 200 baud
Cycle times	<ul style="list-style-type: none"> • Block processing time: 10 ms (3D straight line without radius compensation) • Control loop cycle time: 6 ms • PLC cycle time: 24 ms
Position feedback	Incremental HEIDENHAIN linear encoders with distance-coded reference marks and with one reference mark Graduation period 0.01/0.02/0.1 mm or equivalent line counts for rotary encoders

Control inputs	<ul style="list-style-type: none"> • 4 inputs for position measuring systems (4 sinusoidal inputs) • 1 measuring system input for spindle orientation (square-wave input signal) • 1 input for electronic handwheel • 2 inputs for 3D touch probe system • 55 PLC inputs + 1 PLC input for EMERGENCY OFF monitoring • Additionally 64 PLC inputs on optional PLC I/O board PL 410B
Control outputs	<ul style="list-style-type: none"> • 5 analog outputs for the spindle and axes • 31 PLC outputs + 1 PLC output for EMERGENCY OFF • Additionally 31 PLC outputs on optional PLC I/O board PL 410B
Integrated PLC	Programming in the form of a list of instructions, 4000 PLC commands, Entry by HEIDENHAIN keyboard or data interface
Supply voltage	LE 370: 24 Vdc BF 370: 24 Vdc
Power consumption	NC: approx. 17 W PLC: approx. 48 W PL 410B: approx. 25 W BF 370: approx. 25 W
Environmental temperature	Operating: LE 0 to 45° C (32 to 113° F); BF 370 0 to 40° C (32 to 104° F) Storage: -30 to 70° C (-22 to 158° F)
Weight	LE 370: 6 kg TE 370: 2.7 kg BF 370: 2.1 kg PL 410B: 1.5 kg

3 Hardware Components TNC 370

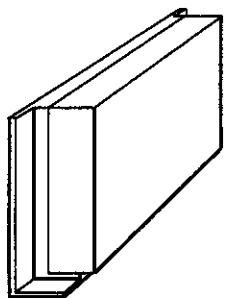
The TNC 370 consists of the following hardware components:

- LE 370 (Logic unit)
- TE 370 (TNC keyboard)
- BF 370 (Visual display unit with keyboard)
- PL 410B (optional PLC I/O board)

The TNC 370 is not subject to export restrictions. An export version is not necessary.

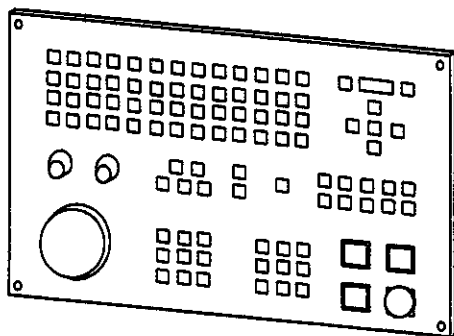
Logic unit LE370

Id.-Nr. 288 711 49



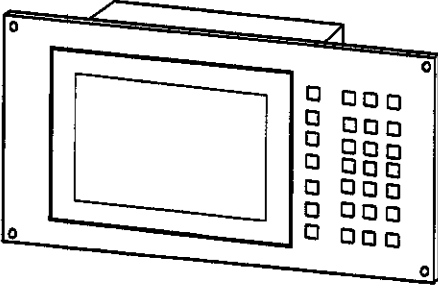
TNC keyboard TE370

Id.Nr. 288 713 02 (keyboard with handwheel and machine operating keys)



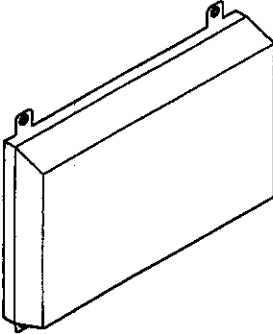
Visual display unit BF 370

Id.-Nr. 288 708 01

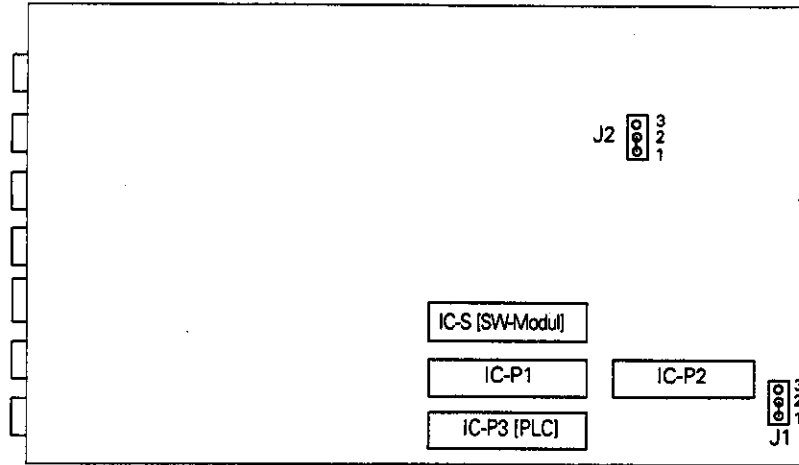


PLC I/O board PL 410B

Id.-Nr. 263 371 12



4 EPROM Sockets



The NC software is located in sockets IC P1 and IC P2 (two 4-MB EPROMs)

The jumper J1 is set to position 1–2 for two 4-MB EPROMs.

The jumper J2 is set to position 1–2 for connecting the BF 370.

NC Software number: 280 60x

Software module (EPROM): Id. Nr. 246 051 01

Logic units that have already been delivered can be retrofitted with the software module.

Id.Nr. to order the module for retrofitting: Id.Nr. 286 405 01

4.1 Software Exchange



When the software is exchanged with the software version 07, the change in the internal representation of Q parameters causes the erasure of all NC programs. Be sure to save a backup copy of your NC programs before you exchange the software. Because they are no longer recognized by the new software, user cycles in the PLC EPROM are not functional.

5 Power Supply

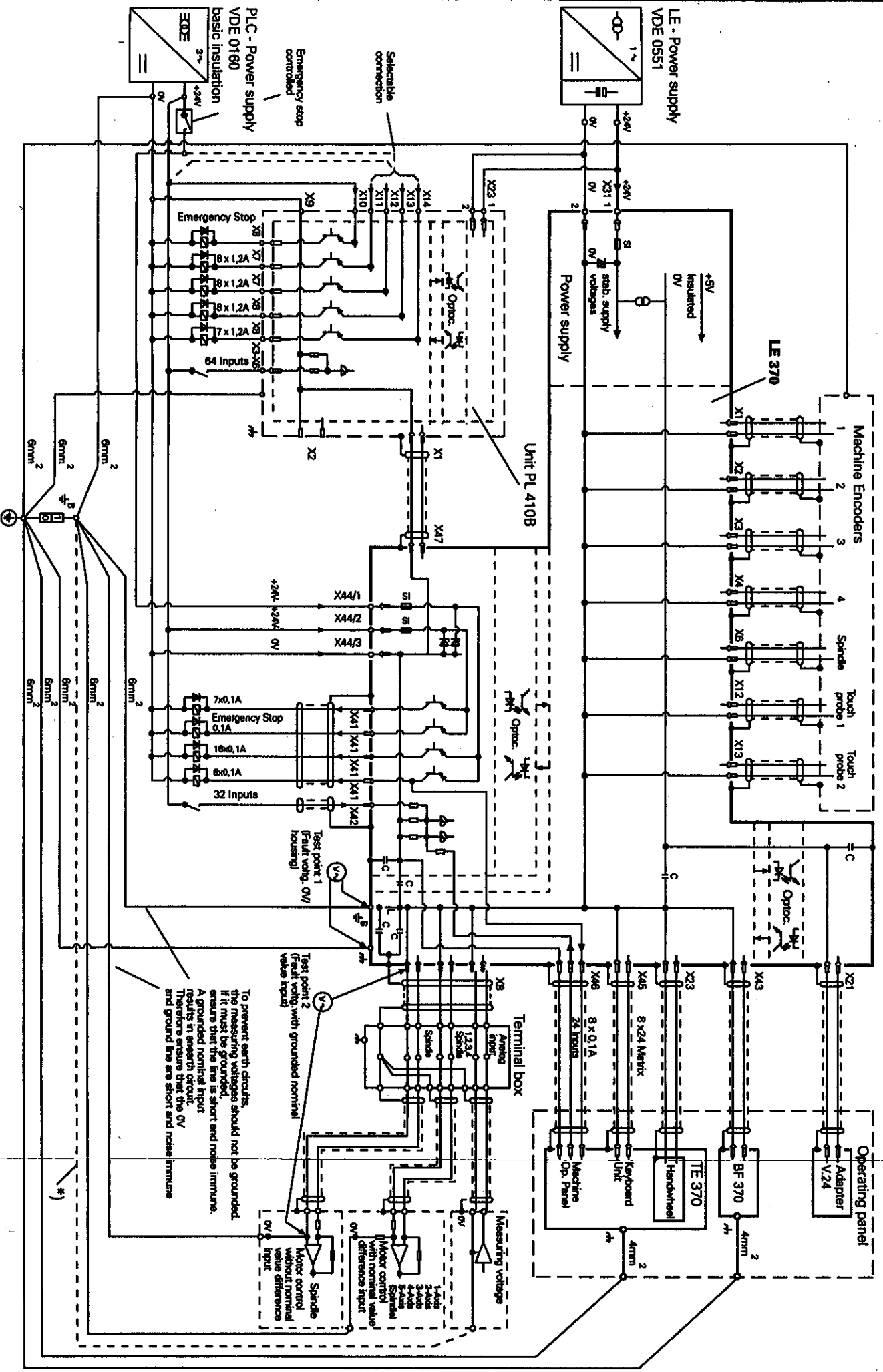
The supply voltages must meet the following specifications:

Unit	Supply voltage	Voltage range DC average	Max. current consumption	Power consumption
LE	NC	24 V – (VDE 0551)	LE 370 0.7 A	17 W
	PLC	24 V – (base insulation according VDE0160)	≈ 2.0 A when half of the outputs ³⁾ are switched on simultaneously	≈ 48 W when half of the outputs ³⁾ are switched on simultaneously
PL 410B	≈ 20 A when half of the outputs ³⁾ are switched on simultaneously		≈ 480 W when half of the outputs ³⁾ are switched on simultaneously	
BF 370²⁾			Approx. 1 A with full display	25 W typical

¹⁾ Voltage surges up to 36 V $\overline{\text{---}}$ for $t < 100$ ms are permissible.

²⁾ The BF 370 has its own connection for the power supply, through which the internal ventilation is also supplied

³⁾ No more than half of the outputs may be driven at once



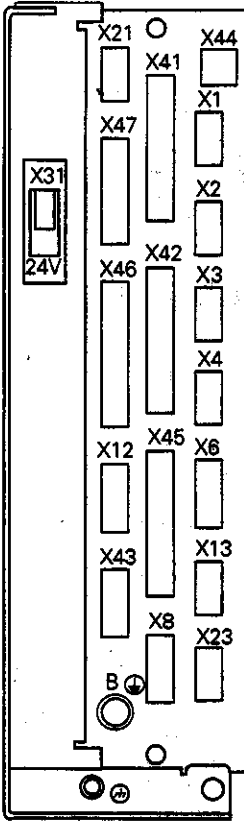
To prevent earth circuits, the measuring voltages should not be grounded, if it must be grounded, ensure that the line is short and noise immune. A grounded nominal input results in error in circuit. Therefore ensure that the 0V and ground line are short and noise immune

Test point 2 (fault voltage, grounded nominal value input)

Spindle Major control without normal value difference input

Major control with normal value difference input

7 Connections



- X1 = Measuring system 1 (~)
- X2 = Measuring system 2 (~)
- X3 = Measuring system 3 (~)
- X4 = Measuring system 4 (~)
- X6 = Measuring system S (□)

X8 = Nominal value outputs 1,2,3,4,S

- X12 = Touch probe system 1
- X13 = Touch probe system 2
- X21 = Data interface RS-232-C/V.24
- X23 = Handwheel HR130

- X41 = PLC output
- X42 = PLC input
- X43 = VDU
- X45 = TNC keyboard
- X46 = Machine operating panel
- X47 = PLC I/O board PL 410B

- X31 = Power supply 24 V for NC
- X44 = Power supply 24 V for PLC

B = Signal ground

m

8 Connector Assignment

X1, X2, X3, X4, measuring systems

(sine-wave signal input)

D-sub connector
(9-pin female insert)

Pin No.	Assignment
1	I1-
2	0 V (U _N)
3	I2-
4	Inner screen
5	I ₀ -
6	I1+
7	+ 5 V (U _p)
8	I2+
9	I ₀ +
Housing	Outer screen



The interfaces comply with the recommendations in VDE 0160, 5.88 for separation from line power.

X6 measuring system S

(square-wave signal input)

D-sub connector
(15-pin female insert)

Pin No.	Assignment
1	U _{a1}
2	0 V (U _N)
3	U _{a2}
4	+ 5 V (U _p)
7	U _{a0}
9	U _{a1}
10	0 V (U _N)
11	U _{a2}
12	+ 5 V (U _p)
13	U _{a3}
14	U _{a0}
5, 6, 8, 15	not assigned
Housing	Outer screen = device chassis



The interfaces comply with the recommendations in VDE 0160, 5.88 for separation from line power.

X8 nominal value output

D-sub connector
(15-pin female insert)

Pin No.	Assignment
1	Analog output 1
2	Analog input
3	Analog output 2
4	<i>Not used</i>
5	Analog output 3
6	<i>Not used</i>
7	Analog output 4
8	Analog output S
9	0 V Analog output 1
10	0 V Analog input
11	0 V Analog output 2
12	<i>Not used</i>
13	0 V Analog output 3
14	0 V Analog output 4
15	0 V Analog output S
Housing	Screen



The interfaces comply with the recommendations in VDE 0160, 5.88 for separation from line power.

X12 Touch probe 1

D-sub connector
(15-pin female insert)

Pin No.	Assignment
1	Inner screen
2	<i>Not used</i>
3	Ready/standby
4	Start
5	+ 15 V
6	+ 5 V (UP)
7	Battery warning
8	0 V (UN)
9	Trigger signal (signal low in rest position)
10	Trigger signal (signal high in rest position)
11	<i>Not used</i>
12	<i>Not used</i>
13	<i>Not used</i>
14	<i>Not used</i>
15	<i>Not used</i>
Housing	Screen



The interfaces comply with the recommendations in VDE 0160, 5.88 for separation from line power.

X13 Touch probe 2

D-sub connector
(9-pin female insert)

Pin No.	Assignment	Color
1	Ready	Pink
2	0 V (UN)	White/Green
3	<i>Not used</i>	-
4	+ 15 V	Gray
5	<i>Not used</i>	-
6	<i>Not used</i>	-
7	+ 5 V (UP)	Brown/Green
8	Trigger signal	Green
9	Trigger signal	Yellow
Housing	Screen	-



The interfaces comply with the recommendations in VDE 0160, 5.88 for separation from line power.

X21 RS-232-C / V.24

D-sub connector
(9-pin female insert)

Pin No.	Assignment	Color
1	<i>Not used</i>	-
2	TxD	Yellow
3	RxD	Green
4	DSR	Brown
5	GND	Red
6	DTR	Blue
7	CTS	Gray
8	RTS	Pink
9	<i>Not used</i>	-
Housing	Screen	-



The interfaces comply with the recommendations in VDE 0160, 5.88 for separation from line power.

X23 Handwheel

D-sub connector
(9-pin female insert)

Pin No.	Assignment
1	<i>Not used</i>
2	0 V
3	<i>Not used</i>
4	+ 12 V \pm 0.6 V (U _v)
5	<i>Not used</i>
6	DTR
7	TxD
8	RxD
9	DSR
Housing	Screen



The interfaces comply with the recommendations in VDE 0160, 5.88 for separation from line power.

X 31 NC power supply

Pin Number	Assignment
1	+ 24 V –
2	0 V

X44 PLC power supply ¹⁾

Pin Number	Assignment
1	+ 24 V – switched off by EMERGENCY STOP
2	+ 24 V – not switched off by EMERGENCY STOP
3	0 V

¹⁾ If the TNC is working as a programming station, the connector X44 must also be supplied with 24 V!

X42 PLC inputD-sub connector
(37-pin female insert)

Pin Number	Assignment
1	I0
2	I1
3	I2
4	I3 Acknowledgment for test "control operational"
5	I4
6	I5
7	I6
8	I7
9	I8
10	I9
11	I10
12	I11
13	I12
14	I13
15	I14
16	I15
17	I16
18	I17
19	I18
20	I19
21	I20
22	I21
23	I22
24	I23
25	I24
26	I25
27	I26
28	I27
29	I28
30	I29
31	I30
32	I31
33, 34	<i>Do not use</i>
35, 36, 37	0 V (PLC) test output; <i>Do not use</i>
Housing	Outer screen

X41 PLC outputD-sub connector
(37-pin female insert)

Pin Number	Assignment
1	O0
2	O1
3	O2
4	O3
5	O4
6	O5
7	O6
8	O7
9	O8
10	O9
11	O10
12	O11
13	O12
14	O13
15	O14
16	O15
17	O16
18	O17
19	O18
20	O19
21	O20
22	O21
23	O22
24	O23
25	O24 ¹⁾
26	O25 ¹⁾
27	O26 ¹⁾
28	O27 ¹⁾
29	O28 ¹⁾
30	O29 ¹⁾
31	O30 ¹⁾
32	<i>Do not use</i>
33	0 V (PLC) test output; <i>Do not use</i>
34	Control operational
35, 36, 37	24 V (PLC) test output; <i>Do not use</i>
Housing	Outer screen

1) Not switched off by EMERGENCY STOP

**X46 Machine
control panel**

D-sub connector
(37-pin female insert)

Pin Number	Assignment
1	I128 Coolant ON
2	I129 Coolant OFF
3	I130 Spindle OFF
4	I131 NC STOP
5	I132 NC START
6	I133 Axis direction key X-
7	I134 Axis direction key Y-
8	I135 Axis direction key Z-
9	I136 Axis direction key Z+
10	I137 Axis direction key Y+
11	I138 Axis direction key X+
12	I139 Axis direction key 4+
13	I140 Axis direction key 4-
14	I141 Rapid traverse
15	I142 Spindle ON
16	I143
17	I144
18	I145
19	I146
20	I147 Key F5
21	I148 Key F1
22	I149 Key F2
23	I150 Key F3
24	I151 Key F4
25	-
26	O0
27	O1
28	O2
29	O3
30	O4
31	O5
32	O6
33	O7
34, 35	0 V (PLC) ¹⁾
36, 37	+ 24 V (PLC) ²⁾
Housing	Outer screen

¹⁾ Externally available PLC reference potential for the outputs O0–O7

²⁾ Externally available (via fuse) PLC supply voltage for the inputs.

X45 TNC keyboard

D-sub connector
(37-pin female insert)

Pin Number	Assignment
1	RL0
2	RL1
3	RL2
4	RL3
5	RL4
6	RL5
7	RL6
8	RL7
9	RL8
10	RL9
11	RL10
12	RL11
13	RL12
14	RL13
15	RL14
16	RL15
17	RL16
18	RL17
19	RL18
20	SL0
21	SL1
22	SL2
23	SL3
24	SL4
25	SL5
26	SL6
27	SL7
28	RL19
29	RL20
30	<i>Do not use</i>
31	RL21
32	RL22
33	RL23
34	Spindle override (wiper)
35	Feed override (wiper)
36	+ 5 V override potentiometer
37	0 V override potentiometer
Housing	External screen

**X 43 Flat screen
BF370**

D-sub connector
(15-pin female insert)

Pin Number	Assignment
1	-
2	-
3	<i>Not used</i>
4	-
5	<i>Not used</i>
6	<i>Not used</i>
7	Video
8	-
9	V SYNC
10	-
11	0 V Signal
12	-
13	-
14	H SYNC 2
15	CLOCK
Housing	Screen

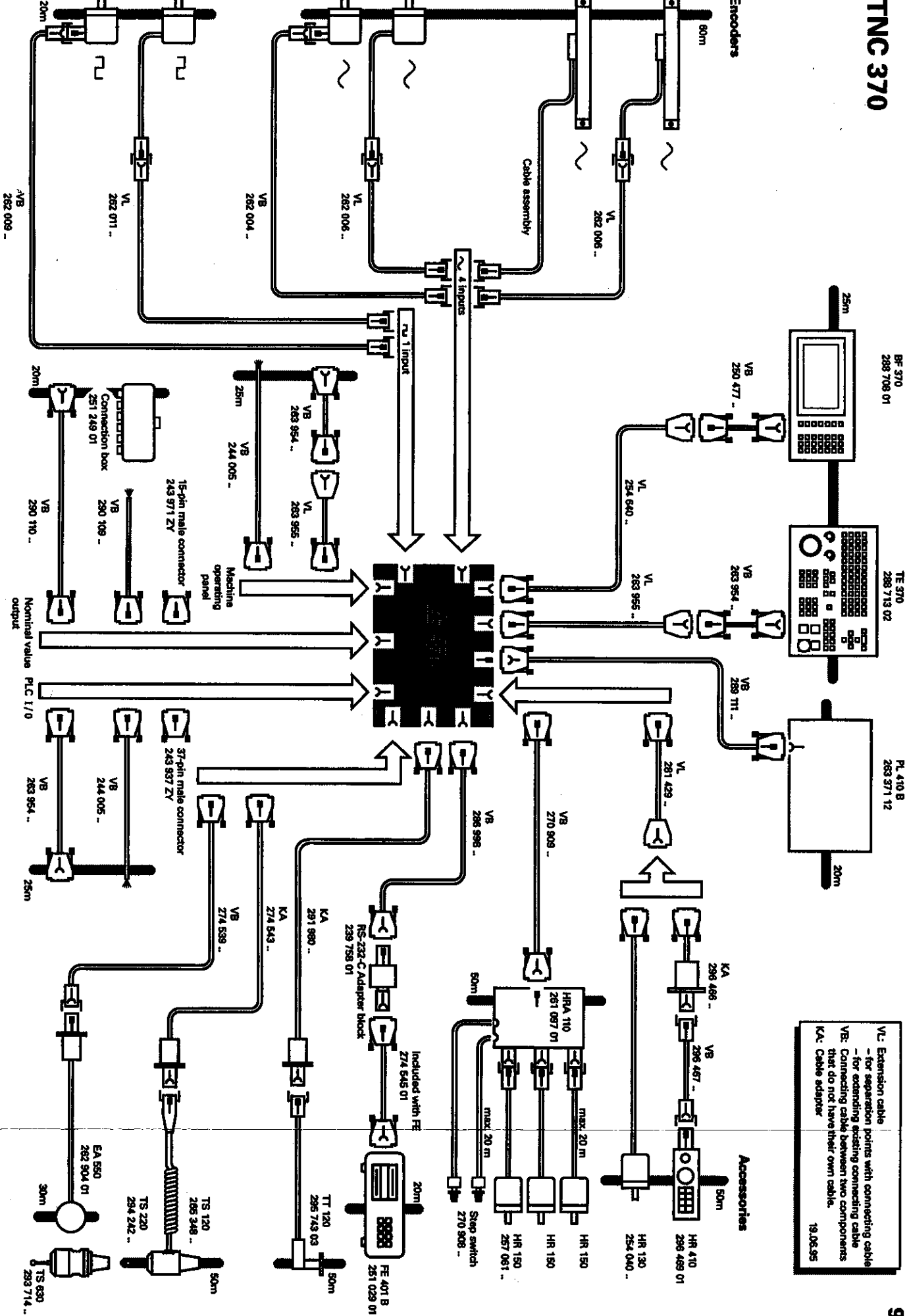


The interfaces comply with the recommendations in VDE 0160, 5.88 for separation from line power.

**X 47 PLC I/O board
PL 410B**

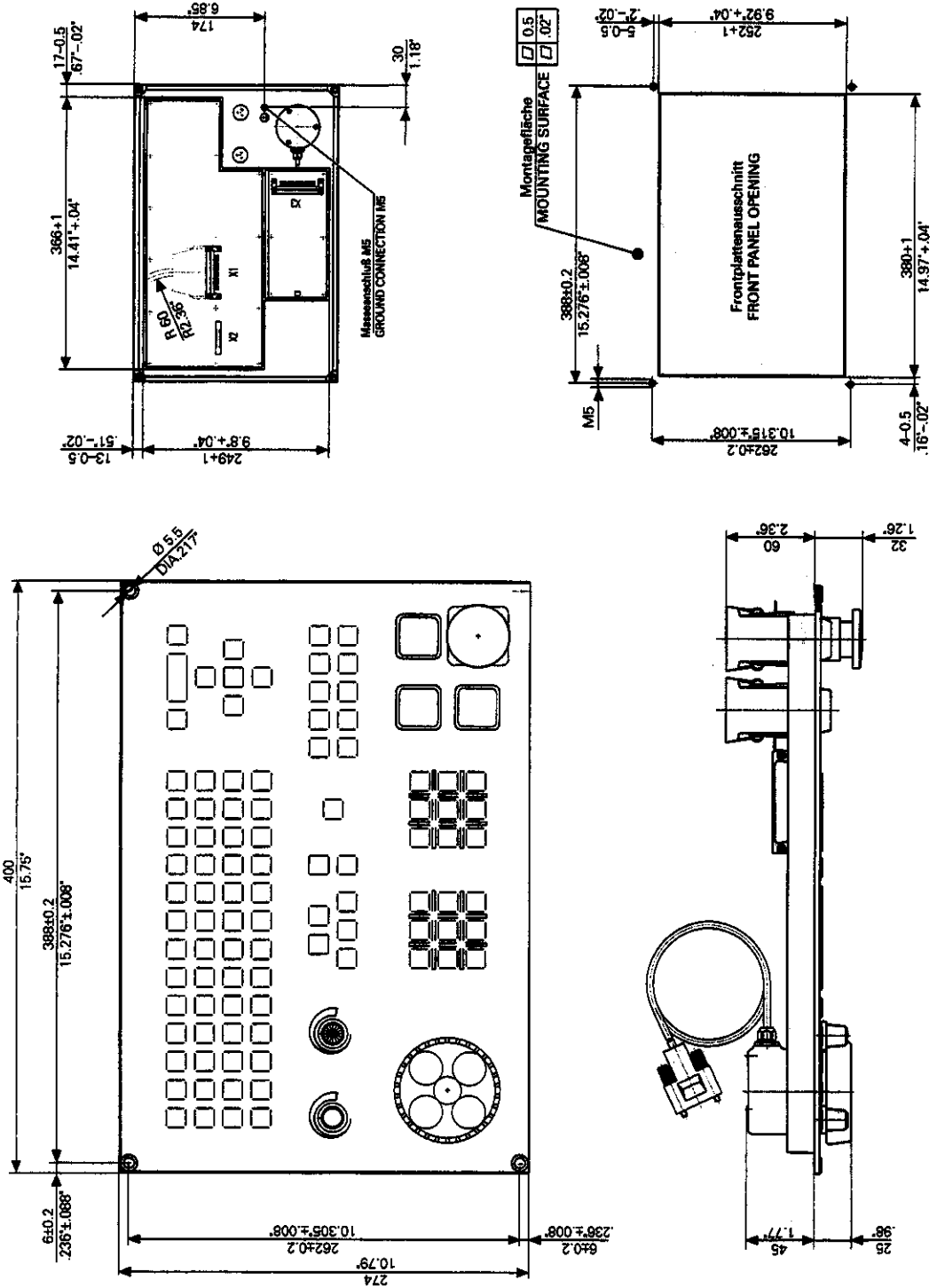
D-sub connector
(25-pin male insert)

Pin Number	Assignment
1	0 V
2	0 V
3	0 V
4	<i>Not used</i>
5	$\overline{A6}$
6	INTERRUPT
7	\overline{RESET}
8	$\overline{WRITE\ EXTERN}$
9	WRITE EXTERN
10	$\overline{A5}$
11	$\overline{A3}$
12	$\overline{A1}$
13	<i>Not used</i>
14	PLC board signifier 4
15	PLC board signifier 3
16	<i>Not used</i>
17	<i>Not used</i>
18	$\overline{A7}$
19	SERIELL IN 1
20	EMERGENCY STOP
21	$\overline{SERIELL\ OUT}$
22	SERIELL OUT
23	$\overline{A4}$
24	$\overline{A2}$
25	A0
Housing	Screen



VL Extension cable
 - for separation points with connecting cable
 - for extending existing connecting cable
 VB: Connecting cable between two components
 that do not have their own cable.
 KA: Cable adapter
 19.06.95

10.3 TE 370



Machine parameter	Function and input	Reaction/ Code Nr.
MP120.0 to MP120.3	Assignment of the analog outputs Input range: 0 to 5 0 = output 1 1 = output 2 2 = output 3 3 = output 4 5 = output S	RESET
MP210	Count direction of the measuring system signals Input range: 0 to 15 Bit 0 X axis +0 = positive +1 = negative Bit 1 Y axis +0 = positive +2 = negative Bit 2 Z axis +0 = positive +4 = negative Bit 3 4th axis +0 = positive +8 = negative	RESET
MP330.0 to MP330.3	Signal period Input range: 1 to 1000 in [μm] or $\left[\frac{1^\circ}{1000} \right]$	REF
MP340.0 to MP340.4	Interpolation factor of the EXE or IBV at X6 Input: 0 to 5 0 = no measuring system on X6 or EXE without interpolation 1 = EXE without interpolation 2 = Spindle encoder with 2048 pulses 4 = Spindle encoder with 4096 pulses 5 = EXE with 5 fold interpolation	
MP410.3	Axis designation for axis 4 Input range: 0 to 5 0 = A 1 = B 2 = C 3 = U 4 = V 5 = W	RESET
MP710.0 to MP710.3	Backlash compensation Input range: -1.000 to +1.000 [mm]	
MP711.0 to MP711.3	Size of the reversal peaks in circular motion Input range: 0.000 to 1.000 [mm]	
MP712.0 to MP712.3	Compensation value per control loop cycle time Input range: 0.0000 to 1.0000 [mm]	

Machine parameter	Function and Input	Reaction/ Code Nr.
MP720.0 to MP720.3	Linear axis-error compensation Input range: - 1.000 to + 1.000 in [mm/m] or [1°/1000°]	
MP730	Non-linear axis-error compensation Input range: 0 to 15 Bit 0 X axis +0 = not active +1 = active Bit 1 Y axis +0 = not active +2 = active Bit 2 Z axis +0 = not active +4 = active Bit 3 4th axis +0 = not active +8 = active	
MP910.0 to MP910.3	Traverse range 1: Maximum value Input range: -99 999.999 to +99 999.999 [mm] or [°]	
MP911.0 to MP911.3	Traverse range 2: Maximum value Input range: -99 999.999 to +99 999.999 [mm] or [°]	
MP912.0 to MP912.3	Traverse range 3: Maximum value Input range: -99 999.999 to +99 999.999 [mm] or [°]	
MP920.0 to MP920.3	Traverse range 1: Minimum value Input range: -99 999.999 to +99 999.999 [mm] or [°]	
MP921.0 to MP921.3	Traverse range 2: Minimum value Input range: -99 999.999 to +99 999.999 [mm] or [°]	
MP922.0 to MP922.3	Traverse range 3: Minimum value Input range: -99 999.999 to +99 999.999 [mm] or [°]	
MP950.0 to MP950.3	Datum point for positioning blocks with M92 Input range: -99 999.999 to +99 999.999 [mm] or [°] Values referenced to machine datum	

11.2 Positioning

Machine parameter	Function and input	Reaction/ Code-Nr.
MP1010.0 to MP1010.3	Rapid traverse Input range: 80 to 300 000 [mm/min]	
MP1020.0 to MP1020.3	Manual feed Input range: 80 to 300 000 [mm/min]	

Machine parameter	Function and input	Reaction/ Code-Nr.
MP1330.0 to MP1330.3	Feed rate for traversing the reference marks Input range: 80 to 30 000 [mm/min]	
MP1331.0 to MP1331.3	Feed rate for leaving the reference end-position (only for rotary encoders MP1350 = 2) Input range: 80 to 500 [mm/min]	
MP1340.0 to MP1340.3	Sequence for traversing reference marks Input range: 0 to 4 0 = no evaluation of the reference marks 1 = axis X 2 = axis Y 3 = axis Z 4 = 4th axis	REF
MP1350.0 to MP1350.3	Type of reference mark approach Input range: 0 to 2 0 = measuring system with distance-coded reference marks 1 = measuring system with one reference mark 2 = special sequence (linear measurement via rotary encoder)	REF
MP1390	Control with lag or feed forward control Input range: 0 or 1 0 = operation with feed forward control 1 = operation with lag	

11.3 Operation with feed forward control

Machine parameter	Function and input	Reaction/ Code-Nr.
MP1410	Position monitoring in operation with pre-control (cancelable) Input value: 0.001 to 30 [mm]	
MP1420	Position monitoring in operation with pre-control (EMERGENCY STOP) Input value: 0.001 to 30 [mm]	
MP1510.0 to MP1510.3	k_v -factor for feed forward control Input value: 0.1 to 10 [1/min]	
MP1520	Position approach speed Input value: 0.1 to 10 [m/min]	

11.4 Operation with servo lag

Machine parameter	Function and input	Reaction/ Code-Nr.
MP1710	Position monitoring for operation with lag (cancelable) Input value: 0.001 to 1000 [mm]	
MP1720	Position monitoring for operation with lag (EMERGENCY STOP) Input value: 0.001 to 1000 [mm]	
MP1810.0 to MP1810.3	k_v -factor for operation with lag Input range: 0.1 to 10 [1/min]	
MP1820	Multiplication factor for the k_v -factor Input value: 0.001 to 1	
MP1830	Kink point Input value: 0 to 100 [%]	

11.5 Spindle

Machine parameter	Function and input	Reaction/ Code-Nr.
MP3010	Spindle-speed output, Spindle orientation Input value: 0 to 8 0 = No spindle-speed output 1 = BCD-coded output of the spindle speed, only if the spindle speed changes 2 = BCD-coded output of the spindle-speed at every TOOL CALL 3 = Analog output of the spindle speed, but gear-change signal only if the gear range changes 4 = Analog output of the spindle speed and gear-change signal at every TOOL CALL 5 = Analog output of the spindle speed and no gear-change signal 6 = As for input value 3, but with controlled spindle for orientation 7 = As for input value 4, but with controlled spindle for orientation 8 = As for input value 5, but with controlled spindle for orientation The input values 6, 7 and 8 also enable Cycles 17 and 202.	RESET

Machine parameter	Function and input	Reaction/ Code-Nr.
MP3020	Definition of the spindle speed range Input value: 0 to 01991	
MP3030	Axis halt on TOOL CALL with only a spindle speed output Input value: 0 or 1 1 = No axis-halt on TOOL CALL 0 = Axis-halt on TOOL CALL	
MP3120	Zero spindle speed permitted Input value: 0 or 1 0 = 0 rpm permitted 1 = 0 rpm not permitted	
MP3130	Polarity of the S-analog voltage Input value: 0 to 3 0 = M03 positive voltage M04 negative voltage 1 = M03 negative voltage M04 positive voltage 2 = M03 and M04 positive voltage 3 = M03 and M04 negative voltage	
MP3140	Count direction of the measuring system signals for the spindle Input value: 0 or 1 0 = Positive count direction with M03 1 = Negative count direction with M03	
MP3210.0 to MP3210.7	S-analog voltage for gear range Input value: 0 to 9.999 [V]	
MP3240.0	Maximum S-analog voltage output input: 0 to 9.000 [V]	
MP3240.1	Minimum S-analog voltage output Input value: 0 to 9.999 [V]	
MP3240.2	Jog-voltage for gear change Input value: 0 to 9.999 [V]	
MP3310.0	Limit with S-override (maximum) Input value: 0 to 150 [%]	
MP3310.1	Limit with S-override (minimum) Input value: 0 to 150 [%]	
MP3410.0	Ramp gradient for spindle for M03, M04, M05 Input range: 0,001 to 1.999 [V/ms]	
MP3410.1	Ramp gradient of the analog voltage for Spindle orientation Input value: 0.001 to 1.999 [V/ms]	
MP3410.2	Ramp gradient for tapping Input value: 0.001 to 1.999 [V/ms]	

Machine parameter	Function and input	Reaction/ Code-Nr.
MP3410.3	Acceleration ramp for rigid tapping Input value: 0,001 to 1.999 [V/ms]	
MP3420	Positioning window for spindle Input range: 0 to 65 535 [increments] 1 increment is equivalent to about 0.088°	
MP3430	Reference mark deviation from the desired position (Spindle preset) Input value: 0 to 360 [°]	
MP3440.0 to MP3440.7	k_v -factor for spindle orientation Input range: 0.1 to 10 [1/min]	
MP3510.0 to MP3510.7	Spindle speed for gear ranges Input value: 0 to 99 999.999 [rpm]	
MP3520.0	Spindle speed activated by marker M2501 Input value: 0 to 99 999.999 [rpm]	
MP3520.1	Spindle speed for spindle orientation Input value: 0 to 99 999.999 [rpm]	

11.6 Integrated PLC

Machine parameter	Function and input	Reaction/ Code-Nr.
MP4010	PLC program from RAM or from EPROM Input: 0 or 1 0 = EPROM operation 1 = RAM operation	RESET
MP4060.0 to MP4060.3	Path dependent lubrication Input range: 0 to 65 535 (units of 65 536 μm)	
MP4110.0 to MP4110.47	Time for timers Input range: 0 to 65 535 [PLC-cycles] (one cycle 24 ms)	
MP4120.0 to MP4120.31	Preset value for counters C0 to C31 input range: 0 to 65 535 [PLC cycles]	
MP4130	Fast PLC input to suppress the monitoring functions Input value: 0 to 255 [No. of the PLC input]	
MP4131	Activation condition for fast PLC input from MP4130 Input value: 0 or 1	
MP4210.0 to MP4210.47	Set a number in the PLC (D768 to W 988) Input range: -99 999.9999 to +99 999.9999 [mm] or [°]	

Machine parameter	Function and input	Reaction/ Code-Nr.
MP4220.0 to MP4220.3	Feed rate for PLC positioning Input range: 80 to 30 000 – Set a number in the PLC in the word range W960 to W968	
MP4310.0 to MP4310.6	Set a number in the PLC, in the Word range W976 to W988 Input range: 0 to 65 535	

11.7 Setting the data interfaces

Machine parameter	Function and input	Reaction/ Code-Nr.
MP5010.0	Control characters for "blockwise transfer" Input range: 0 to 32 382 Character for program end and beginning The character for program end also applies for "Standard data interface"	123
MP5010.1	ASCII characters for data input	123
MP5010.2	ASCII characters for data output	123
MP5010.3	ASCII characters for beginning and end of the command block	123
MP5010.4	ASCII characters for positive acknowledgment or negative acknowledgment	123
MP5010.5	ASCII character for data transmission ended	123

Machine parameter	Function and input	Reaction/ Code-Nr.															
MP5020	<p>Operating mode EXT: interface configuration Input range: 0 to 255</p> <p>Bit 0 7 or 8 Data bits +0 = 7 Data bits +1 = 8 Data bits</p> <p>Bit 1 Block-Check-Character +0 = BCC character optional +2 = BCC character not control character</p> <p>Bit 2 Transmission stop through RTS +0 = not active +4 = active</p> <p>Bit 3 Transmission stop through DC3 +0 = not active +8 = active</p> <p>Bit 4 Character parity +0 = even +16 = odd</p> <p>Bit 5 Character parity +0 = not required +32 = required</p> <p>Bit 6/7 Stop bits</p> <table data-bbox="264 833 683 985"> <thead> <tr> <th></th> <th><u>Bit 6</u></th> <th><u>Bit 7</u></th> </tr> </thead> <tbody> <tr> <td>+0 = 1½ Stop bits</td> <td>0</td> <td>0</td> </tr> <tr> <td>+64 = 2 Stop bits</td> <td>1</td> <td>0</td> </tr> <tr> <td>+128 = 1 stop bit</td> <td>0</td> <td>1</td> </tr> <tr> <td>+192 = 1 stop bit</td> <td>1</td> <td>1</td> </tr> </tbody> </table> <p>Bit 8 RTS low in when not transmitting +0 = not active +256 = active</p> <p>Bit 9 Do not transmit EOT after reception of ETX +0 = not active + 512 = active</p>		<u>Bit 6</u>	<u>Bit 7</u>	+0 = 1½ Stop bits	0	0	+64 = 2 Stop bits	1	0	+128 = 1 stop bit	0	1	+192 = 1 stop bit	1	1	
	<u>Bit 6</u>	<u>Bit 7</u>															
+0 = 1½ Stop bits	0	0															
+64 = 2 Stop bits	1	0															
+128 = 1 stop bit	0	1															
+192 = 1 stop bit	1	1															
MP5030	<p>Operating mode EXT: data transmission protocol Input: 0 or 1</p> <p>0 = "Standard data transmission" 1 = "Blockwise transfer"</p>	123															

11.8 Measuring with a 3D touch probe

Machine parameter	Function and input	Reaction/ Code Nr.
MP6010	Selection of the touch probe system Input: 0 or 1 0 = TS 120 / TS220 1 = TS 630	123
MP6120	Probing feed rate Input range: 80 to 30 000 [mm/min]	123
MP6130	Maximum measuring range Input range: 0.001 to 30 000.000 [mm]	123
MP6140	Safety clearance above measuring point Input range: 0.001 to 30 000.000 [mm]	123
MP6150	Rapid traverse for probe cycle Input range: 80 to 30 000 [mm/min]	123

11.9 Digitizing with TS 120 (only with digitizing option)

Machine parameter	Function and input	Reaction/ Code Nr.
MP6210	Number of oscillations per second in normal direction Input range: 0 to 65.535 [1/s]	
MP6230	Feed rate in normal direction Input range: 0 to 10 000 [mm/min]	
MP6240	Maximum deflection of stylus Input range: 0 to 10.000 [mm]	
MP6250	Numerical value for M function for transferring modal values Input 0 to 89 0 = no transfer 1 ... 89 number of the M function	
MP6260	Output of M90 for NC blocks with digitized data Input: 0 or 1 0 = no output of M90 1 = output of M90 in every NC block	
MP6270	Rounding of trailing zeros Input: 0 or 1 0 = Output in 0.001 mm increments (1 μ m) 1 = Output in 0.01 mm increments (10 μ m)	

11.10 Tool calibration with TT 120

Machine parameter	Function and input	Reaction/ Code Nr.
MP6500	Tool Calibration with TT 120 Input: 0 or 1 0 = Cycles for tool calibration inhibited 1 = Cycles for tool calibration not inhibited	
MP6505	Probing direction for tool measurement Input: 0 to 3 0 = Positive probing direction in the angle reference axis (0°axis) 1 = Positive probing direction in the +90° axis 2 = Negative probing direction in the angle reference axis (0° axis) 3 = Negative probing direction in the +90° axis	123
MP6507	Calculation of the probing feed rate Input: 0 to 2 0 = Calculation of the probing feed rate with constant tolerance 1 = Calculation of the probing feed rate with variable tolerance 2 = Constant probing feed rate	123
MP6510	Max. permissible measuring error for tool measurement with rotating tool Input: 0.002 to 0.999 [mm]	123
MP6520	Probing feed rate for tool measurement with non-rotating tool Input: 10 to 3000 [mm/min]	123
MP6530	Distance from tool lower edge to probe contact upper edge for tool radius measurement Input: 0.001 to 99.9999 [mm]	123
MP6531	Diameter or edge length of TT 120 probe contact Input: 0.001 to 99 999.9999 [mm]	
MP6540	Safety zone around the probe contact TT 120 for pre-positioning Input: 0.001 to 99 999.9999 [mm]	
MP6550	Rapid traverse in the probing cycle for TT 120 Input: 10 to 10 000 [mm/min]	123
MP6560	M-function for spindle orientation for measuring individual teeth Input: 0 to 88	123
MP6570	Max. permissible surface cutting speed at the tool cutting edge Input: 1.0000 to 120.0000 [m/min]	123

Machine parameter	Function and input	Reaction/ Code Nr.
MP6580.0 to MP6580.2	Coordinates (X, Y, Z) of the TT 120 stylus center referenced to the machine datum Input: -99 999.9999 to 99 999.9999 [mm]	

11.11 Tapping

Machine parameter	Function and input	Reaction/ Code Nr.
MP7110.0	Minimum for feed override when tapping Input range: 0 to 150 [%]	
MP7110.1	Maximum for feed override when tapping Input range: 0 to 150 [%]	
MP7120.0	Dwell time for change of direction of spindle rotation Input range: 0 to 65.535 [s]	
MP7120.1	Advanced switch time of spindle for "tapping" cycle (only active with BCD output of spindle rpm) Input range: 0 to 65.535 [s]	
MP7120.2	Spindle run-on time after reaching total hole depth Input range: 0 to 65.535 [s]	
MP7130	Spindle run-in characteristic Input range: 0.001 to 10 [°/min] (matching MP1520)	
MP7140	Transient response of spindle on acceleration Input range: 0.001 to 1 (matching MP1530)	
MP7150	Positioning window for tool axis Input range: 0.001 to 2 [mm]	
MP7160	Spindle orientation with cycle 17 Input: 0 or 1 0 = Spindle orientation before execution of cycle 17 1 = No spindle orientation before execution of cycle 17	

11.12 Display and operation

Machine parameter	Function and input	Reaction/ Code Nr.
MP7210	Programming station Input values: 0 to 2 0 = Control and programming 1 = Programming station, "PLC active" 2 = Programming station "PLC inactive"	123 RESET
MP7212	Acknowledgment of display "Power interruption" 0 = manual with "CE" 1 = automatic after 3 sec	
MP7220	Block-number step size for ISO programs Input range: 0 to 255	123
MP7222	Programming language selection: dialog or ISO Input: 0 to 2 0 = Selection via MOD 1 = Only dialog 2 = Only ISO	
MP7230	Switching the dialogue language Input: 0 or 1 0 = First dialog language 1 = Basic language (English)	123
MP7235	Resetting the timing Input: 0 to 4 0 = No resetting 1 = Reset switch-on duration 2 = Reset run time of automatic operation 4 = Reset run time of spindle	
MP7240 (dropped in version 07)	Inhibit program input for [Program name] = [OEM-cycle number in EPROM]. Input: 0 or 1 0 = Inhibit 1 = Do not inhibit	123
MP7245.0 (dropped in version 07)	Inhibit the HEIDENHAIN cycles 1 to 15 Input range: 0 to 65 534	
MP7245.1 (dropped in version 07)	Inhibit the HEIDENHAIN standard cycles 16 to 30 Input range: 0 to 65 535	
MP7250 (dropped in version 07)	Difference between Q-parameter number for "CALL-active" and "DEF-active" block in OEM cycles Input range: 0 to 50	
MP7251	Number of global Q parameters Input range: 0 to 40	
MP7260	Number of tools in the tool table Input range: 0 to 99 0 = No central tool file 1 to 99 = Activate central tool file for entered number of tools	123 RESET

Machine parameter	Function and input	Reaction/ Code Nr.
MP7261	Number of pockets in tool magazine Input range: 0 to 99	123
MP7266	Items in tool table Input: 0 to 99 0 = No display 1 to 99 = Position in tool table MP7266.0 Tool name (NAME) MP7266.1 Tool length (L) MP7266.2 Tool radius (R) MP7266.3 not active MP7266.4 Oversize tool length (DL) MP7266.5 Oversize tool radius (DR) MP7266.6 not active MP7266.7 Tool locked? (TL) MP7266.8 Replacement tool (RT) MP7266.9 TIME 1 MP7266.10 TIME 2 MP7266.11 CURRENT TIME MP7266.12 Commentary on the tool (DOC) MP7266.13 Number of tool teeth (CUT) MP7266.14 Tolerance for tool length (LTOL) MP7266.15 Tolerance for tool radius (RTOL) MP7266.16 Cutting direction of the tool (DIRECT) MP7266.17 PLC status (PLC) MP7266.18 Tool offset: length (TT:L-OFFS) MP7266.19 Tool offset: radius (TT:R-OFFS) MP7266.20 Breakage tolerance: length (LBREAK) MP7266.21 Breakage tolerance: radius (RBREAK)	123
MP7267	Items in pocket table Input: 0 to 99 0 = No display 1 to 99 = Position in pocket table MP7267.0 Tool number (T) MP7267.1 Special tool (ST) MP7267.2 Fixed pocket (F) MP7267.3 Locked pocket (L) MP7267.4 PLC status (PLC)	123

Machine parameter	Function and input	Reaction/ Code Nr.
MP7270	Machine parameter with multiple function Input: 0 to 3 Bit 0 +0 = Display of the axis feed rate in manual mode only when an axis-direction key is pressed (axis-specific feed from MP1020.X) +1 = Display of the axis feed rate before operating an axis-direction key (smallest value from MP1020.X for all axes) Bit 1 +2 = NC stop in Manual mode stops the execution of an M function	123
MP7274	Expanded spindle display Input: 0 to 3 Bit 0 Display of current gear range +0 No display +1 Display Bit 1 Display of spindle power +0 Acquisition via analog input +2 Acquisition via PLC word W600	
MP7275	Reference value of displayed spindle power for acquisition via analog input Input: 0 to 4.999 [V] for acquisition via word W600 Input: 0 to 43 690 Input value is equivalent to 100%	
MP7280	Decimal sign Input: 0 or 1 0 = Decimal comma 1 = Decimal point	123
MP7285	Calculation of the tool length in the position display of the tool axis Input: 0 or 1 0 = Tool length ignored 1 = Tool length taken into account	123
MP7290	Position-display step Input: 0 to 4 0 = 0.001 mm or 0.001° 1 = 0.005 mm or 0.005° 2 = 0.010 mm or 0.01° 3 = 0.050 mm or 0.05° 4 = 0.100 mm or 0.1°	123

Machine parameter	Function and input	Reaction/ Code Nr.
MP7300	Cancel status display, Q-parameters, and tool data Input: 0 or 7 0 = Status display, Q parameters and tool data canceled through program selection 1 = Status display, Q parameters and tool data canceled through M02, M30, END PGM and program selection 2 = Status display and tool data canceled through program selection 3 = Status display and tool data canceled through M02, M30, END PGM and program selection 4 = Status display and Q parameters canceled through program selection 5 = Status display and Q parameters canceled through M02, M30, END PGM and program selection 6 = Status display canceled through program selection 7 = Status display canceled through M02, M30, END PGM and program selection	123
MP7310	Graphics display Input range: 0 to 3 Bit 0 Changeover of 3-plane display + 0 = European preferred + 1 = American preferred Bit 1 Rotation of the coordinate system in the machining plane + 90° + 0 = no rotation + 2 = coordinate system rotated by +90°	123
MP7330.0 to MP7330.15	Determination of the User Parameters Input range: 0 to 9999.00 (Number of the desired machine parameter)	
MP7340.0 to MP7340.15	Dialogues for User Parameters Input range: 0 to 199 0 to 99 from PLC error messages 100 to 199 from dialogue texts	

11.13 Machining and program run

Machine parameter	Function and input	Reaction/ Code Nr.
MP7410	<p>"Scaling factor" cycle active in two or three axes Input: 0 or 1</p> <p>0 = Cycle "Scaling factor" operates in all three principle axes 1 = Cycle "Scaling factor" only operates in the machining plane</p>	123
MP7411	<p>Tool data in touch probe block Input: 0 or 1</p> <p>0 = With the touch probe block the current tool data are overwritten with the calibrated data of the probe system 1 = The current tool data are retained even with a touch probe block</p>	123
MP7420	<p>Cycles for milling pockets with free-programmed contours Input range: 0 to 15</p> <p>Bit 0 Slot milling direction for + 0 = Anti-clockwise slot milling of the pocket contours, clockwise for islands + 1 = Clockwise slot milling of the pocket contours, anti-clockwise for islands</p> <p>Bit 1 Sequence for clearing out and – slot milling + 0 = First slot milling, then clear out pocket + 2 = First clear out pocket, then slot milling</p> <p>Bit 2 Merge programmed contours + 0 = Contours merged only if the tool center paths intersect + 4 = Contours merged if the programmed contours overlap</p> <p>Bit 3 Clear out and slot milling to pocket depth, or for each feed + 0 = Clearing out and slot milling performed in one operation for all feeds + 8 = For each peck, first perform slot milling and then feed clearing out (depending on Bit 1) before next peck</p>	123

Machine parameter	Function and input	Reaction/ Code Nr.
MP7430	Overlap factor for pocket milling Input range: 0.1 to 1.414	123
MP7440	Output of M functions Input range: 0 to 7 Bit 0 Program stop on M06 + 0 = Program halt on M06 + 1 = No program stop on M06 Bit 1 modal cycle call M89 + 0 = normal code transfer of M89 at beginning of block + 2 = modal cycle call M89 at end of block Bit 2 Program stop on M functions + 0 = Program stop until acknowledgment of M function + 4 = No program stop (does not wait for acknowledgment) Bit 3 + 0 = reserved Bit 4 + 0 = reserved Bit 5 Axis-in-position marker is set if a dwell time is programmed two between two positioning blocks. + 0 = not active + 32 = active	123
MP7460	Constant feed rate in corners Input value: 0.001 to 179.999 [°]	123
MP7470	Display mode for rotary axis Input: 0 to 3 Bit 0 Display mode +0 = 0 to + 359.999 [°] (no software limit switch) +1 = -30 000.000 to + 30 000.000 (software limit switch active)	123

Machine parameter	Function and input	Reaction/ Code Nr.
MP7480.0	Output of tool number or pocket number with TOOL CALL block Input range: 0 to 3 0 = No output 1 = Output of tool number only when tool number changes (W262) 2 = Output of tool number with every TOOL CALL block (W262) 3 = Output of pocket number (W262) and tool number (W264) only when tool number changes	
MP7480.1	Output of tool number or pocket number with TOOL DEF block Input range: 0 to 3 0 = No output 1 = Output of tool number only when tool number changes (W262) 2 = Output of tool number with every TOOL DEF block (W262) 3 = Output of pocket number (W262) and tool number (W264) only when tool number changes	

11.14 Hardware

Machine parameter	Function and input	Reaction/ Code Nr.
MP7620	Feed rate and spindle override Input range: 0 to 15 Bit 0 Feed rate override if rapid traverse button is pressed in "program run" +0 = Override not active +1 = Override active Bit 2 Feed rate override if rapid traverse buttons and machine direction buttons are pressed in "manual" operating mode +0 = Override not active +4 = Override active Bit 3 Spindle and feed rate override in 1% increments or according to a non-linear characteristic curve +0 = 1% increments +8 = non-linear characteristic curve	123

Machine parameter	Function and input	Reaction/ Code Nr.																						
MP7640	Handwheel Input: 0 to 6 0 = No handwheel 1 = HR 330 2 = HR 130 3 = HR 330 with evaluation of keys via PLC 4 = HR 332 with evaluation of keys via PLC 5 = Up to three HR 150 via HRA 110 6 = HR410	123																						
MP7641	Entry of interpolation factor for HR 332 or HRA 110 Input: 0 to 15 Bit 0 = +0 Via TNC keyboard +1 Via PLC module 9036 Bit 1 = +0 disable HR in programming mode +2 enable HR in programming mode Bit 2 = +4 Via TNC keyboard and PLC module 9036 Bit 3 = +8 = Transfer handwheel keys to the PLC in all operating modes																							
MP7645.0	Assignment of handwheel keys for HR 332 if MP7640 = 4: Input value: 0 or 1 0 = All keys and LEDs, except axis selection keys and their LEDs, are selectable via PLC 1 = All 12 keys and LEDs are selectable via PLC If MP 7640 = 5: Assignment of 3rd handwheel via axis selection switch Input value: 0 to 2 <table data-bbox="189 1191 751 1451"> <thead> <tr> <th></th> <th><u>Switch</u></th> <th><u>3rd handwheel</u></th> </tr> </thead> <tbody> <tr> <td rowspan="2">0 =</td> <td>1 (left stop)</td> <td>Z axis</td> </tr> <tr> <td>2</td> <td>4th axis</td> </tr> <tr> <td rowspan="4">1 =</td> <td>1 (left stop)</td> <td>X axis</td> </tr> <tr> <td>2</td> <td>Y axis</td> </tr> <tr> <td>3</td> <td>Z axis</td> </tr> <tr> <td>4</td> <td>4th axis</td> </tr> <tr> <td rowspan="2">2 =</td> <td>3</td> <td>Z axis</td> </tr> <tr> <td>4</td> <td>4th axis</td> </tr> </tbody> </table>		<u>Switch</u>	<u>3rd handwheel</u>	0 =	1 (left stop)	Z axis	2	4th axis	1 =	1 (left stop)	X axis	2	Y axis	3	Z axis	4	4th axis	2 =	3	Z axis	4	4th axis	
	<u>Switch</u>	<u>3rd handwheel</u>																						
0 =	1 (left stop)	Z axis																						
	2	4th axis																						
1 =	1 (left stop)	X axis																						
	2	Y axis																						
	3	Z axis																						
	4	4th axis																						
2 =	3	Z axis																						
	4	4th axis																						
MP7645.1	Assignment of 3rd handwheel via machine parameter Input: 0 to 8 0 = Assignment of 3rd handwheel via MP7645.0 1 = 3rd handwheel X axis 2 = 3rd handwheel Y axis 4 = 3rd handwheel Z axis 8 = 3rd handwheel 4th axis																							

Machine parameter	Function and input	Reaction/ Code Nr.
MP7645.2	Assignment of 3rd handwheel via axis selection switch or MP7645.1 Input: 0 to 1 0 = Assignment via axis selection switch according to MP 7645.0 1 = Assignment via MP 7645.1	
MP7645.3-7	reserved for handwheel	
MP7650	Count direction for handwheel Input: 0 or 1 0 = Positive count direction 1 = Negative count direction	
MP7660	Threshold sensitivity for electronic handwheel Input value: 0 to 65 535 [increments]	
MP7670.0	Minimum interpolations factor for HR 410 at medium speed range Input range: 0 to 10	
MP7670.1	Minimum interpolations factor for HR 410 at smallest speed range Input range: 0 to 10	
MP7670.2	Minimum interpolations factor for HR 410 at greatest speed range Input range: 0 to 10	
MP7671.0	% Factor from MP1020.x for feed rate with smallest speed range for HR410 Input range: 0 to 1000%	
MP7671.1	% Factor from MP1020.x for feed rate with medium speed range for HR410 Input range: 0 to 1000%	
MP7671.2	% Factor from MP1020.x for feed rate with greatest speed range for HR410 Input range: 0 to 1000%	
MP7680	Memory function for axis-direction keys 0 = not stored 1 = stored	
MP7690	Memory test at switch-on Input range: 0 to 3 Bit 0 RAM test + 0 = Memory test at switch-on + 1 = No memory test at switch-on Bit 1 EPROM test + 0 = Memory test at switch-on + 2 = No memory test at switch-on	

12 PLC

12.1 List of markers

Marker	Function	Set	Reset
M2000	Axis enable X	NC	PLC
M2001	Axis enable Y	NC	PLC
M2002	Axis enable Z	NC	PLC
M2003	Axis enable 4	NC	PLC
M2004	S-analog voltage not on ramp	NC	NC
M2005	S-analog voltage = 0 V	NC	NC
M2007	Spindle in position	NC	NC
M2008	X axis in position	NC	NC
M2009	Y axis in position	NC	NC
M2010	Z axis in position	NC	NC
M2011	4th axis in position	NC	NC
M2012	Lubrication pulse X axis, since value of MP4060.0 was exceeded	NC	NC
M2013	Lubrication pulse Y axis, since value of MP4060.1 was exceeded	NC	NC
M2014	Lubrication pulse Z axis, since value of MP4060.2 was exceeded	NC	NC
M2015	Lubrication pulse 4th axis, since value of MP4060.3 was exceeded	NC	NC
M2022	Touch probe not ready (no standby signal at connector X12)	NC	NC
M2023	Stylus deflected before start of probing cycle	NC	NC
M2025	Stylus deflected (probing sequence is executed)	NC	PLC
M2026	Probe operation ended or interrupted	NC	NC
M2027	Battery voltage too low (battery warning on connector X12); evaluated only during the probe operation	NC	NC
M2032	T Code 1st bit (lsb)	NC	NC
M2033	T Code 2nd bit	NC	NC
M2034	T Code 3rd bit	NC	NC
M2035	T Code 4th bit	NC	NC
M2036	T Code 5th bit	NC	NC
M2037	T Code 6th bit	NC	NC
M2038	T Code 7th bit	NC	NC
M2039	T Code 8th bit (msb)	NC	NC
M2042	Analog output of the spindle speed	NC	NC
M2043	Change signal for gear code	NC	NC
M2044	Change signal for S code	NC	NC
M2045	Change signal for M function	NC	NC
M2046	Strobe signal T code (P code) with TOOL CALL	NC	NC
M2047	Strobe signal 2nd T code (2nd P code) with TOOL DEF	NC	NC
M2048	Tapping cycle called	NC	NC
M2051	Operating mode: Manual	NC	NC
M2052	Operating mode: Electronic handwheel	NC	NC
M2053	Operating mode: Positioning with manual data input	NC	NC
M2054	Operating mode: Program run/single block	NC	NC
M2055	Operating mode: Program run/full sequence	NC	NC

Marker	Function	Set	Reset
M2057	Operating mode: Traversing the reference marks	NC	NC
M2061	END PGM, M02 or M30 has been executed	NC	NC
M2064	S Code 1st bit (lsb)	NC	NC
M2065	S Code 2nd bit	NC	NC
M2066	S Code 3rd bit	NC	NC
M2067	S Code 4th bit	NC	NC
M2068	S Code 5th bit	NC	NC
M2069	S Code 6th bit	NC	NC
M2070	S Code 7th bit	NC	NC
M2071	S Code 8th bit (msb)	NC	NC
M2072	M Code 1st bit (lsb)	NC	NC
M2073	M Code 2nd bit	NC	NC
M2074	M Code 3rd bit	NC	NC
M2075	M Code 4th bit	NC	NC
M2076	M Code 5th bit	NC	NC
M2077	M Code 6th bit	NC	NC
M2078	M Code 7th bit	NC	NC
M2079	M Code 8th bit (msb)	NC	NC
M2080	Minimum rpm from MP3020 1st bit (lsb)	NC	NC
M2081	Minimum rpm from MP3020 2nd bit	NC	NC
M2082	Minimum rpm from MP3020 3rd bit	NC	NC
M2083	Minimum rpm from MP3020 4th bit	NC	NC
M2084	Minimum rpm from MP3020 5th bit	NC	NC
M2085	Minimum rpm from MP3020 6th bit	NC	NC
M2086	Minimum rpm from MP3020 7th bit	NC	NC
M2087	Minimum rpm from MP3020 8th bit (msb)	NC	NC
M2088	Increment from MP3020 1st bit (lsb)	NC	NC
M2089	Increment from MP3020 2nd bit	NC	NC
M2090	Increment from MP3020 3rd bit	NC	NC
M2091	Increment from MP3020 4th bit (msb)	NC	NC
M2092	Illegal spindle speed	NC	NC
M2093	Another T code (P code) follows with TOOL CALL	NC	NC
M2094	Tool service life expired	NC	NC
M2095	Rigid tapping is active	NC	NC
M2096	X key last pressed	NC	NC
M2097	Y key last pressed	NC	NC
M2098	Z key last pressed	NC	NC
M2099	Key IV last pressed	NC	NC
M2100	X axis is tool axis	NC	NC
M2101	Y axis is tool axis	NC	NC
M2102	Z axis is tool axis	NC	NC
M2103	4th axis is tool axis	NC	NC
M2104	G Code S-Analog 1st bit (lsb)	PLC	PLC
M2105	G Code S-Analog 2nd bit	PLC	PLC
M2106	G Code S-Analog 3rd bit (msb)	PLC	PLC
M2112	T Number (P Number) 1st decade (lsb)	NC	NC
M2113	T Number (P Number) 1st decade	NC	NC
M2114	T Number (P Number) 1st decade	NC	NC

Marker	Function	Set	Reset
M2115	T Number (P Number) 1st decade (msb)	NC	NC
M2116	T Number (P Number) 2nd decade (lsb)	NC	NC
M2117	T Number (P Number) 2nd decade	NC	NC
M2118	T Number (P Number) 2nd decade	NC	NC
M2119	T Number (P Number) 2nd decade (msb)	NC	NC
M2127	Spindle in motion	NC	NC
M2128	X axis in motion	NC	NC
M2129	Y axis in motion	NC	NC
M2130	Z axis in motion	NC	NC
M2131	4th axis in motion	NC	NC
M2136	Reference mark in X axis not yet traversed	NC	NC
M2137	Reference mark in Y axis not yet traversed	NC	NC
M2138	Reference mark in Z axis not yet traversed	NC	NC
M2139	Reference mark in 4th axis not yet traversed	NC	NC
M2149	Transfer with FN19 active	NC	NC
M2150	Unit of measure for transfer with FN19 (0=mm,1=inch)	NC	NC
M2160	Traverse direction X axis 0 = positive 1 = negative	NC	NC
M2161	Traverse direction Y axis 0 = positive 1 = negative	NC	NC
M2162	Traverse direction Z axis 0 = positive 1 = negative	NC	NC
M2163	Traverse direction 4th axis 0 = positive 1 = negative	NC	NC
M2180	1st PLC scan after switch-on	NC	NC
M2182	Inhibited key was operated	NC	PLC
M2183	Program interruption ("Control operational" display flashes)	NC	NC
M2184	Control operational ("Control operational" display goes on or flashes)	NC	NC
M2185	1st PLC scan after interruption of the PLC program	NC	NC
M2186	Code number 84159 entered	NC	PLC
M2190	Non-flashing error message is displayed	NC	NC
M2191	*External EMERGENCY STOP* message is displayed	NC	NC
M2192 to M2239	Markers controllable by MP4310.0, MP 4310.1 and MP 4310.2	NC	NC
M2390	Tool measuring cycle active	NC	NC
M2391	Inspect tool	NC	NC
M2392	Tool is outside of wear tolerance	NC	NC
M2393	Tool is outside of break tolerance	NC	NC
M2400	Tool number 0 programmed	NC	NC
M2401	Active tool with pocket number (MP7260/MP7261)	NC	NC
M2402	Active tool without pocket number (MP7260/MP7261)	NC	NC
M2403	Active tool = special tool	NC	NC
M2448	NC start (edge evaluation)	PLC	PLC
M2449	Rapid traverse	PLC	PLC
M2450	Memory function for axis-direction keys	PLC	PLC
M2451	Feed release for all axes	PLC	PLC
M2452	Activate PLC-positioning axis X	PLC	NC
M2453	Activate PLC-positioning axis Y	PLC	NC
M2454	Activate PLC-positioning axis Z	PLC	NC
M2455	Activate PLC-positioning axis 4	PLC	NC

Marker	Function	Set	Reset
M2456	Manual traverse X+	PLC	PLC
M2457	Manual traverse X-	PLC	PLC
M2458	Manual traverse Y+	PLC	PLC
M2459	Manual traverse Y-	PLC	PLC
M2460	Manual traverse Z+	PLC	PLC
M2461	Manual traverse Z-	PLC	PLC
M2462	Manual traverse 4+	PLC	PLC
M2463	Manual traverse 4-	PLC	PLC
M2464	Complement - NC start	PLC	PLC
M2465	Complement - rapid traverse	PLC	PLC
M2466	Complement - memory function for axis-direction keys	PLC	PLC
M2467	Complement - feed release	PLC	PLC
M2468	Complement activate PLC-positioning axis X	PLC	NC
M2469	Complement activate PLC-positioning axis Y	PLC	NC
M2470	Complement activate PLC-positioning axis Z	PLC	NC
M2471	Complement activate PLC-positioning axis 4	PLC	NC
M2472	Complement - manual traverse X+	PLC	PLC
M2473	Complement - manual traverse X-	PLC	PLC
M2474	Complement - manual traverse Y+	PLC	PLC
M2475	Complement - manual traverse Y-	PLC	PLC
M2476	Complement - manual traverse Z+	PLC	PLC
M2477	Complement - manual traverse Z-	PLC	PLC
M2478	Complement - manual traverse 4+	PLC	PLC
M2479	Complement - manual traverse 4-	PLC	PLC
M2480	Acknowledgment "Gear change completed"	PLC	PLC
M2481	S code acknowledgment	PLC	PLC
M2482	Acknowledgment of M function	PLC	PLC
M2483	Acknowledgment T code (P code) with TOOL CALL	PLC	PLC
M2484	Acknowledgment T code (P code) with TOOL DEF	PLC	PLC
M2485	Status display and sign of S analog for M03	PLC	PLC
M2486	Status display and sign of S analog for M04	PLC	PLC
M2487	Status display for M05 and spindle stop	PLC	PLC
M2488	NC stop ("0" signifies stop)	PLC	PLC
M2489	Change direction of spindle rotation	PLC	PLC
M2490	Spindle rotation left (for gear change)	PLC	PLC
M2491	Spindle rotation right (for gear change)	PLC	PLC
M2492	Await open control loop X axis	PLC	PLC
M2493	Await open control loop Y axis	PLC	PLC
M2494	Await open control loop Z axis	PLC	PLC
M2495	Await open control loop 4th axis	PLC	PLC
M2496	Enable marker for the decoded M code transfer to markers M1900 to M1999	PLC	PLC
M2498	Release jog positioning	PLC	PLC
M2499	Open spindle control loop	PLC	PLC
M2501	Activates spindle speed MP3520.0 and direction of rotation from marker M2656	PLC	PLC
M2502	NC STOP in all operating modes if stylus is deflected	PLC	PLC
M2503	Enable marker for probing functions	NC	PLC

Marker	Function	Set	Reset
M2508	Status display M08 or M09 0 = Status display M09 1 = Status display M08	PLC	PLC
M2510	S Override = 100%	PLC	PLC
M2511	F Override = 100%	PLC	PLC
M2527	Activate spindle orientation	PLC	NC
M2543	Complement activate spindle orientation	PLC	NC
M2544	Open control loop X axis	PLC	PLC
M2545	Open control loop Y axis	PLC	PLC
M2546	Open control loop Z axis	PLC	PLC
M2547	Open control loop 4th axis	PLC	PLC
M2548	Reset of accumulated distance for lubrication X axis	PLC	PLC
M2549	Reset of accumulated distance for lubrication Y axis	PLC	PLC
M2550	Reset of accumulated distance for lubrication Z axis	PLC	PLC
M2551	Reset of accumulated distance for lubrication 4th axis	PLC	PLC
M2552	Actual – nominal value transfer X axis	PLC	PLC
M2553	Actual – nominal value transfer Y axis	PLC	PLC
M2554	Actual – nominal value transfer Z axis	PLC	PLC
M2555	Actual – nominal value transfer 4 axis	PLC	PLC
M2556	Reference end position for X axis	PLC	PLC
M2557	Reference end position for Y axis	PLC	PLC
M2558	Reference end position for Z axis	PLC	PLC
M2559	Reference end position for axis 4	PLC	PLC
M2560 to M2589	BCD values for PLC positioning, tool number, spindle orientation and Q parameters	PLC	PLC
M2600	Sequence of tool number or pocket number transfer (M2093 = 1)	PLC	PLC
M2601	Return special tool to its original pocket in spite of variable pocket coding	PLC	PLC
M2608	Inverse display of M03, M04, M05 and S analog = 0 V	PLC	PLC
M2609	Status display M08, M09 inverse	PLC	PLC
M2610	Tool number shown inverted in status display	PLC	PLC
M2611	Acknowledgment of transfer with FN19	PLC	PLC
M2612	Do not update pocket number in the pocket table	PLC	PLC
M2614	Inhibit input (after acknowledgment with M/S/T/Q strobe the following blocks are not run)	PLC	PLC
M2624	Limit switch X+	NC	NC
M2625	Limit switch X-	NC	NC
M2626	Limit switch Y+	NC	NC
M2627	Limit switch Y-	NC	NC
M2628	Limit switch Z+	NC	NC
M2629	Limit switch Z-	NC	NC
M2630	Limit switch 4+	NC	NC
M2631	Limit switch 4-	NC	NC
M2656	Spindle orientation from stop	PLC	PLC
M2657	Status display M07/M09	PLC	PLC
M2688	No monitoring X axis	PLC	PLC
M2689	No monitoring Y axis	PLC	PLC

Marker	Function	Set	Reset
M2690	No monitoring Z axis	PLC	PLC
M2691	No monitoring axis 4	PLC	PLC
M2704	Activate PLC positioning X axis	PLC	NC
M2705	Activate PLC positioning Y axis	PLC	NC
M2706	Activate PLC positioning Z axis	PLC	NC
M2707	Activate PLC positioning 4th axis	PLC	NC
M2712	Activate PLC positioning for spindle orientation	PLC	NC
M2713	Activate the transfer of the value from D528 to the Q Parameter defined in W516	PLC	NC
M2716	Strobe marker for datum correction	PLC	NC
M2719	Deactivate the TNC 355 mode	PLC	PLC
M2814	Activation of a gear range and spindle speed via PLC	PLC	NC
M2815	Flashing PLC error message	PLC	PLC
M2816	Select traverse range	PLC	PLC
M2817	Select traverse range	PLC	PLC
M2824	Activation of the selected traverse range (M2816/M2817)	PLC	NC
M2826	Suppress handwheel pulses	PLC	PLC
M2924 to M3023	Activate PLC error messages	PLC	NC; PLC
M3168	Overflow during multiplication	NC	PLC
M3169	Division by 0	NC	PLC
M3170	MODULO incorrectly executed	NC	PLC
M3171	Transfer incorrectly executed	NC	NC
M3172	Reserved for errors that the PLC programmer would like to intercept	NC	NC
M3200 to M3263	Values from MP4310.3 to MP4310.6	NC	NC

12.2 List of words

Words	Function
W256	G code for S analog
W258	S code
W260	M code
W262	Pocket number when MP7480 = 3 Tool number when MP7480 = 1 or 2
W264	Tool number when MP7480 = 3
W272	Operating mode 0 = Programming and editing 1 = Manual operation 2 = Electronic handwheel 3 = Positioning with manual entry 4 = Program run/single block 5 = Program run/full sequence 6 = Test run 7 = Pass over reference point
W274	Key code for the operated, inhibited key, Signal via M2182
D276	Code of the last code number entered through MOD
D280	1st numerical value from FN19
D284	2nd numerical value from FN19
W320	Nominal spindle speed
W322	Actual spindle speed
D356	Programmed spindle speed (NC → PLC)
D360	Programmed feed rate (NC → PLC)
D388	Current feed rate
W492	%-factor – spindle override (NC → PLC)
W494	%-factor – feed rate override (NC → PLC)
W516	Key code for simulation of TNC keys Number of the Q parameter (Q100 to Q107) to be overwritten with M2713
W522	Monitoring functions suppressed if PLC input from MP4130 is activated
D528	Value to be transferred to the Q parameter Datum correction for X axis PLC Position of X axis [1/1000 mm]
D532	Datum correction for Y axis PLC Position Y axis
D536	Datum correction for Z axis PLC Position Z axis
D540	Datum correction for 4th axis PLC Position 4th axis
W560	Feed rate PLC-positioning X axis [mm/min]
W562	Feed rate PLC-positioning Y axis
W564	Feed rate PLC-positioning Z axis
W566	Feed rate PLC-positioning 4th axis

Words	Function
	Follow-up axis error compensation Input range: +32 767 to -32 768 [µm]
W576	Axis X
W578	Axis Y
W580	Axis Z
W582	Axis 4
D592	Position spindle orientation (Strobe M2712)
D596	Maximum feed rate
D604	Maximum spindle speed (not yet active)
D756	Set spindle speed from the PLC; programmed spindle speed
W764	%-factor – spindle override
W766	%-factor – feed rate override (PLC → NC)
D768 to D956	Value from MP4210.0 to MP4210.47
W960 to W966	Value from MP4220.0 to MP4220.3
W976 to W988	Value from MP 4310.0 to MP4310.6
W1008	S code for minimum rpm

12.3 PLC Modules

Module 9000 Copy Marker Range

Module 9001 Copy Word Range

Module 9010 Read in Byte Range

Module 9011 Read in Word Range

Module 9012 Read in Doubleword Range

Module 9020 Write in Byte Range

Module 9021 Write in Word Range

Module 9022 Write in Doubleword Range

Module 9030 Read Machine Parameter

Module 9031 Write Machine Parameter

Module 9032 Read Machine Parameter

Module 9035 Read Status Information

Module 9036 Write Status Information

Module 9040 Read axis coordinates

Module 9150 Inserting an NC block

Module 9170 Setting the ramp gradient of the spindle

The modules are described (except for module 9031 and module 9170) in the Technical Manual TNC 360.

12.4 Submit Programs

Submit programs are subprograms which the PLC submits to the NC for processing. This allows tasks to be performed which are very processor-intensive, require program loops or must wait for external results. It is assumed, however, that these programs are not bound by a particular time frame. Depending on processor loading, each Submit program is allocated a certain computing power, but always at least 5% of the total power. Submit programs are started from the PLC program and can access all the same data memories (M/B/W/D) as can the main program. This can lead to problems in certain circumstances. Such problems can be avoided if the data processed by the PLC program are clearly separated from the data processed by the Submit program.

Up to eight Submit programs can be entered in a queue (Submit Queue). Each receives an "Identifier," a number between 1 and 255 allocated by the NC, which is transferred into the Word Accumulator. With this "Identifier" and the REPLY function, it can be interrogated whether or not the program is in the queue, is being processed, or is already complete. The Submit programs are executed in the order of their placement in the queue. Should an error occur during the execution of the Submit programs, the following Markers are set:

- M3168: Overflow during multiplication
- M3169: Division by 0
- M3170: MODULO incorrectly executed
- M3171: Error status for PLC module
- M3172: Reserved for errors, which the PLC programmer would like to intercept

These markers are listed separately in the submit job. This means that the same markers can be edited as those in the PLC run program without changing the original markers.

Exact times cannot be given for the commands for the management of the Submit queue. The execution times denote maximum values.

12.4.1 Call up of the Submit Program (SUBM)

Abbreviation for PLC Editor: SUBM (SUBMIT)

Execution time [μ s] < 30

Number of bytes 10

Operands: jump address (LBL)

Operation:

The SUBM command allots an "Identifier" (1 to 255) to the subprogram, designated by the jump address (LBL). Simultaneously, the allocated number is written to the Word Accumulator. If there are already programs transferred into the Submit queue, the addressed program will not be processed until the program immediately prior to it is finished. A submission to the queue may only take place from a PLC program, a SUBM command in a Submit program is not possible.

If no location is free in the queue, or if the SUBM command is programmed in a Submit program (nesting), a "0" will be returned to the Word Accumulator.

12.4.2 Status Interrogation of a Submit Program (RPLY)

Abbreviation for PLC Editor: RPLY (REPLY)

Execution time [μ s] < 5
Number of bytes 10

Operands: B, W, D

Operation:

With the RPLY command the Status of the Submit program is interrogated with the specified Identifier. This Identifier must already be stored in a Byte, Word or Doubleword prior to the calling up of the Submit program. With the RPLY command and the memory address specified above, which contains the Identifier, one of the following messages about the status is transferred to the Word Accumulator:

Word Accumulator 0: Program complete/not in the queue

Word Accumulator 1: Program running

Word Accumulator 2: Program in the queue

12.4.3 Cancellation of a Submit Program (CAN)

Abbreviation for PLC Editor: CAN (CANCEL)

Execution time [μ s] < 40
Number of bytes 10

Operands: B, W, D

Operation:

With the CAN command the Submit-Program with the specified Identifier is removed from the queue. This Identifier must already be stored in a Byte, Word or Doubleword prior to the calling up of the Submit-Program. After the cancellation of the Program, the next Submit program in the queue will immediately be processed.

The following PLC modules cannot be canceled with CANCEL at any desired point:

- PLC module for access to the screen (908X).
- PLC module for reading NC files (909X).

In these cases, the RPLY command must be used to check whether or not the CAN command may be used.

13 New Functions

13.1 Tool calibration with the TT 120

The HEIDENHAIN TT 120 touch probe serves for measuring and inspecting tools. HEIDENHAIN provides standard cycles for automatic tool measurement and calibration with the TT 120 (see User's Manual).

Technical Prerequisites

- TT 120
- TNC 370 as of software version 280 60x 07
- Central tool file TOOL.T must be active via machine parameter
- The machine must feature a controlled spindle for spindle orientation

Interfacing the TT 120

MP6500 enables the cycles for tool measurement. The cycles should only be enabled when a TT 120 is mounted and interfaced.

MP6505 defines the probing direction for tool radius measurement. For tool radius measurement, MP6530 defines the distance from the tool bottom to the top of the probe contact. MP6540 defines a safety zone around the probe contact of the TT 120. When a cycle for tool measurement is started the tool moves automatically from the "clearance height" entered in the cycle at the feed rate defined in MP6550 to the limit of the safety zone.

The probe disk diameter or the cube edge length is entered in MP6531. The coordinates of the probe contact center referenced to the machine datum is entered in MP6580.

For measuring individual teeth, an M function for spindle orientation for positioning the individual edges must be transferred to the PLC. The number of this M function is entered in MP6560. The respective positions are transferred as in the "Spindle orientation" cycle.

Probing feed rate and spindle speed

For tool measurement of a non-rotating tool the probing feed rate is taken from MP6520.

For tool measurement of a rotating tool the probing feed rate and the spindle speed are automatically calculated by the TNC. The rotational speed is calculated from the maximum permissible surface cutting speed (MP6570) and the tool radius from the tool table. The rotational speed is limited to a maximum of 1000 rpm.

$$n = \frac{MP6570}{2 \times \pi \times r \times 10^3}$$

n =	Rotational speed [rev./min]
MP6570 =	Maximum permissible surface cutting speed of the tool edge [m/min]
r =	Tool radius [mm]

The probing feed rate is calculated from the calculated rotational speed and the measuring tolerance given in MP6510.

$$v = \frac{\text{Measuring tolerance}}{n} \quad \text{Meas. tolerance} = \quad \text{Meas. tolerance [mm] depending on MP6507}$$

$$n = \quad \text{Rotational speed [rpm]}$$

MP6507 defines the method of calculating the probing feed rate:

MP6507=0: Calculation of the feed rate with constant tolerance

This setting guarantees that the measuring tolerance remains constant regardless of the tool radius (MP6510). If the tool is very large, however, the necessary probing feed rate comes so close to zero that it falls below the lowest programmable increment. The smaller the maximum surface cutting speed and the permissible measuring error, the sooner this effect becomes noticeable.

MP6507=1: Calculation of the feed rate with variable tolerance

In this setting the permissible measuring tolerance changes depending on the tool radius. This ensures that there is a probing feed rate even for large tool radii. The measuring tolerance changes according to the following table:

Tool radius	Measuring tolerance
up to 30 mm	MP6510
30 to 60 mm	2 × MP6510
60 to 90 mm	3 × MP6510
90 to 120 mm	4 × MP6510

etc.

MP6507=2: Constant probing feed rate

The probing feed rate remains constant regardless of the tool. The absolute measuring error grows linearly with increasing tool radius.

$$\text{Meas. tolerance} = \frac{r}{5 [\text{mm}]} \times \text{MP6510} \quad r = \quad \text{Tool radius [mm]}$$

$$\text{MP6510} = \quad \text{Max. permissible measuring error [mm]}$$

Markers in the PLC

Marker M2390 is set when a tool measuring cycle is started. Marker M2391 indicates whether a cycle for tool measurement or tool inspection was activated. If a cycle for tool inspection was called call, marker M2392 indicates whether the tolerance entered in the tool table (RTOL or LTOL) was exceeded.

Markers M2502, M2503, M2022, M2023, M2025 and M2026 function as in the standard probing cycles. The cycles for tool measurement must therefore also be released by the PLC with Marker M2503.

- MP6500 Tool Calibration with TT 120
 Input: 0 or 1
 0 = Cycles for tool calibration inhibited
 1 = Cycles for tool calibration not inhibited
- MP6505 Probing direction for tool measurement
 Input: 0 to 3
 0 = Positive probing direction in the angle reference axis (0°axis)
 1 = Positive probing direction in the +90° axis
 2 = Negative probing direction in the angle reference axis (0° axis)
 3 = Negative probing direction in the +90° axis
- MP6507 Calculation of the probing feed rate
 Input: 0 to 2
 0 = Calculation of the probing feed rate with constant tolerance
 1 = Calculation of the probing feed rate with variable tolerance
 2 = Constant probing feed rate
- MP6510 Max. permissible measuring error for tool measurement with rotating tool
 Input: 0.002 to 0.999 [mm]
- MP6520 Probing feed rate for tool measurement with non-rotating tool
 Input: 10 to 3000 [mm/min]
- MP6530 Distance from tool lower edge to probe contact upper edge for tool radius
 measurement
 Input: 0.001 to 99.9999 [mm]
- MP6531 Diameter or edge length of the TT 120 probe contact
 Input: 0.001 to 99 999.9999 [mm]
- MP6540 Safety zone around the probe contact TT 120 for pre-positioning
 Input: 0.001 to 99 999.9999 [mm]
- MP6550 Rapid traverse in the probing cycle for TT 120
 Input: 10 to 10 000 [mm/min]
- MP6560 M function for spindle orientation for measuring individual teeth
 Input: 0 to 88
- MP6570 Max. permissible surface cutting speed at the tool cutting edge
 Input: 1.0000 to 120.0000 [m/min]

MP6580 Coordinates of the TT 120 stylus center referenced to the machine datum
 Input: -99 999.9999 to 99 999.9999 [mm]

MP6580.0 Axis X
 MP6580.1 Axis Y
 MP6580.2 Axis Z

		Set	Reset
M2390	Cycle for tool calibration started	NC	NC
M2391	0 = Tool measurement	NC	NC
	1 = Tool inspection		
M2392	0 = Tolerance not exceeded	NC	NC
	1 = Tolerance exceeded		

13.2 Tool table, Pocket table

The operator is able to edit the tool table TOOL.T and the pocket table TOOLP.TCH in the "Edit" mode (see User's Manual).

The operator can upload or download the tool or pocket table with the EXT key. Identifiers T and R are assigned for the tool table and pocket table respectively on the external memory.

The following fields can be edited in the tool table:

NAME : 16 character alphanumeric tool name
 L : Tool length
 R : Tool radius
 DL : Oversize for tool length
 DR : Oversize for tool radius
 TL : Tool locked?
 RT : Replacement tool
 TIME1 : Max. tool life (M2094)
 TIME2 : Max. tool life (TOOL CALL)
 CUR. TIME: Current tool life
 DOC : Comment on the tool
 CUT : Number of tool teeth
 LTOL : Tolerance for tool length
 RTOL : Tolerance for tool radius
 DIRECT : Cutting direction of the tool
 PLC : Additional information for PLC (not yet active)
 TT: L-OFFS: Length offset of TT
 TT: R-OFFS: Radius offset of TT
 LBREAK: Length tolerance for breakage
 RBREAK: Radius tolerance for breakage

The elements in the table and the sequence in which they appear are defined in machine parameters MP7266.x.

The following fields can be edited in the pocket table:

T: Tool number
 ST: Special tool
 F: Fixed pocket
 L: Locked pocket
 PLC: Additional information for PLC (not yet active)

The elements in the table and the sequence in which they appear are defined in machine parameters MP7267.x.

The number of tools in the tool table is defined in machine parameter MP7260. If MP7260 contains a zero value, then the system will run without a tool table ("TOOL.T" does not exist). Tool length and tool radius are programmed in the NC program with TOOL DEF (see User's Manual). Automatic tool management is not possible when operating with no tool table.

The number of pockets in the tool magazine is defined in machine parameter MP7261. No pocket table is generated if MP7261 is defined as zero.

MP7260	Number of tools in tool table Input: 0 to 99	
MP7261	Number of pockets in pocket table Input: 0 to 99	
MP7266	Elements of the tool table Input: 0 to 20 0 = no display 1 to 20 = position in tool table	
MP7266.0	Tool name	(NAME)
MP7266.1	Tool length	(L)
MP7266.2	Tool radius	(R)
MP7266.3	not active	
MP7266.4	Oversize tool length	(DL)
MP7266.5	Oversize tool radius	(DR)
MP7266.6	not active	
MP7266.7	Tool locked?	(TL)
MP7266.8	Replacement tool	(RT)
MP7266.9	TIME 1	
MP7266.10	TIME 2	
MP7266.11	CURRENT TIME	
MP7266.12	Comment on the tool	(DOC)
MP7266.13	Number of tool teeth	
MP7266.14	Tolerance for tool length	
MP7266.15	Tolerance for tool radius	(RTOL)
MP7266.16	Cutting direction of the tool	(DIRECT)
MP7266.17	PLC status	(PLC)
MP7266.18	Length offset of TT	TT: L-OFFS
MP7266.19	Radius offset of TT	TT: R-OFFS
MP7266.20	Length tolerance for breakage	LBREAK
MP7266.21	Radius tolerance for breakage	RBREAK

MP7267	Elements of pocket table Input: 0 to 6 0 = no display 1 to 6 = position in pocket table	
MP7267.0	Tool number	(T)
MP7267.1	Special tool	(ST)
MP7267.2	Fixed pocket	(F)
MP7267.3	Locked pocket	(L)
MP7267.4	PLC-Status	(PLC)

13.3 Handwheel HR 410

Machine parameter MP7640=6 activates the functions for the HR410 handwheel.

When the control transfers the initializing parameters, it transmits to the handwheel a code that depends on the value entered in MP7640. After initialization is completed, the handwheel must answer with a corresponding code. If the code is incorrect, the error message "HANDWHEEL NOT READY B" appears. If no handwheel is connected the error message "HANDWHEEL NOT READY A" appears.

The TNC user interface provides no possibility for entering or displaying the handwheel interpolation factor. MP7645.0 bit 1 defines whether the handwheel keys will be evaluated by the NC or the PLC.

Evaluation by the NC (MP7645.0 = 0)

All keys except for the function keys A, B, and C are evaluated by the NC. All outputs except O109 to O111 are driven by the NC. The function keys A, B, and C, and the outputs O109 to O111 must therefore still be evaluated or controlled by the PLC.

Machine parameters MP7670.0 to MP7670.2 determine which subdivision factors are in effect for low, medium and high speed.

The machine parameters MP7671.0 to MP7671.2 define the speed of the speed levels (low, medium, high) with the percentage factor from MP1020. The last adjusted speed level (the key last pressed) remains stored even if power is interrupted.

If the handwheel is active, that is, if the handwheel symbol is shown for one of the axes, the NC will use the value entered in MP7671.x to calculate the feed rate when the HR 410 axis keys are pressed. For this reason the axis direction keys on the machine control panel are inhibited whenever the handwheel axis direction keys are being used. The feed rate override potentiometer is disabled. It is not possible to influence the handwheel interpolation factor or to select of the handwheel axis with module 9036.

Evaluation by the PLC (MP7645.0 = 1)

All keys (I160 ... I175) must be evaluated by the PLC, and all LEDs (O96... O111) driven by the PLC. This means that a special PLC program must be written. PLC module 9036 can set the handwheel axis and the handwheel interpolation factor. The PLC Word W766 can influence the feed rate of the direction keys.

Assignment of handwheel inputs/outputs:

X axis	I160	O96
4th axis	I161	O97
Y axis	I162	O98
V axis	I163	O99
Z axis	I164	O100
Actual position capture	I167	
Slow feed rate	I168	O104
Medium feed rate	I169	O105
Fast feed rate	I170	O106
Axis direction -	I171	
Axis direction +	I172	
Function key A	I173	O109
Function key B	I174	O110
Function key C	I175	O111

13.4 Read and write system data

Reading the system data

With function FN18: READ SYSDAT you can read certain system data and store them in Q parameters. The system data is selected by group number and an index.

FN18: SYSREAD Qxxx = Idxxxxx NRxxxxx IDXxxxxx ; Comment

The input range for the Q parameter number is 0 to 99.

The input range for ID (System data group), NR (System data number) and IDX (index of the system data number) is 0 to 65535.

The IDX data and the comment are optional.

At present the following data can be read:

	System data group	System data number	System data index
Active mirror axis	210	3	-

Writing the system data

You can write system data with function FN17: WRITE SYSDAT. The system data is selected by group number and an index.

FN17: SYSWRITE Idxxxxx NRxxxxx IDXxxxxx = Qxxx or numerical value ; Comment

The input range for ID (system data group), NR (system data number) and IDX (index of the system data number) is 0 to 65535. The input range for the Q parameter number is 0 to 99, for the numerical value it is -99 999.999 to +99 999.999.

The data for IDX and the comment are optional.

At present the following data can be written:

	System data group	System data number	System data index
Active mirrored axis	210	3	-
Active tool axis from TOOL CALL	212	4	-

13.5 New fixed cycles

New fixed cycles (cycle numbers 200 to 231) have been integrated in software version 07. For an exact description of these cycles, refer to the User's Manual of the control.

With this software version it is no longer possible to create one's own OEM cycles through the NC program numbers 999 999 68 to 99. Previously written OEM cycles are no longer functional. The machine parameters MP7240, MP7250, 7245.0 and 7245.1 have been dropped.

