HEIDENHAIN

Technical Manual

iTNC 530

NC software 340 420-01
340 421-01

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Visual display unit **BF 120**

10.4-inch color flat panel display (640 x 480 pixels) with the following keys:

- 8 soft keys
- 2 x soft keys for switching soft-key rows
- Screen layout
- Operating-mode switchover

Id. Nr. 313 506-02

BTS 1x0 Screen-Keyboard Switching Unit

With the BTS 1x0, it is possible to connect two monitors and two operating panels to an MC 422.

Id. Nr. 353 544-01 BTS 150 (2 x BF 150)
Id. Nr. 329 965-02 BTS 120 (2 x BF 120)

TS 632 Touch Probe

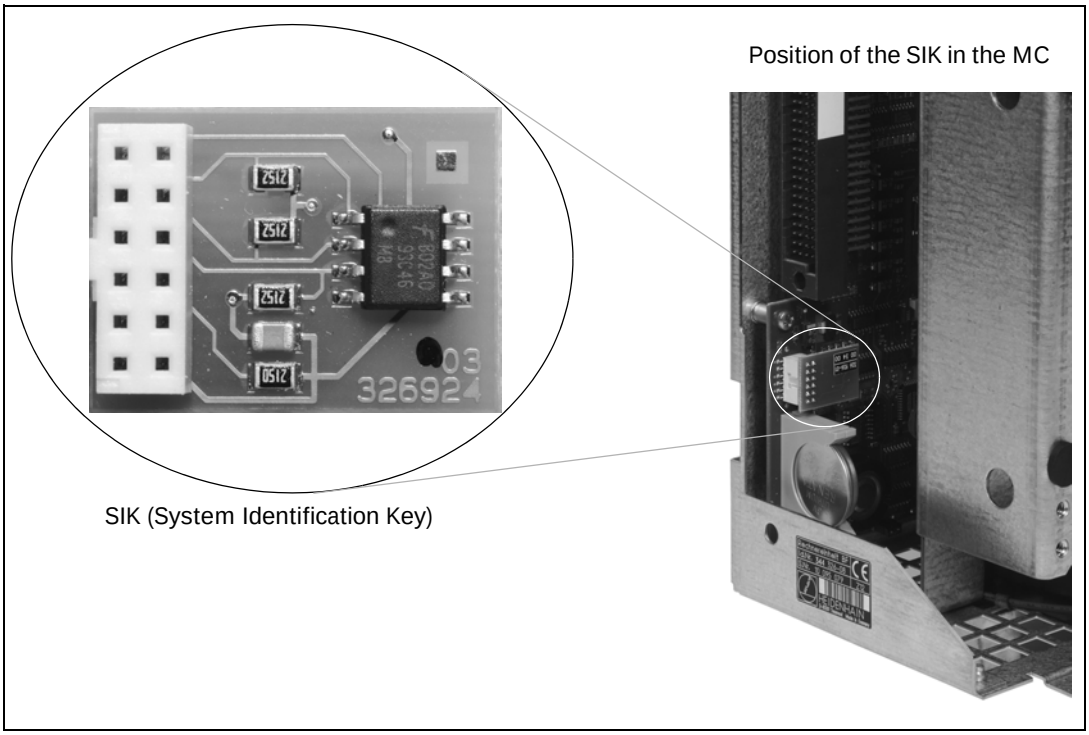
Touch-trigger probe with infrared transmission, for workpiece setup and measurement during machining.

Id. Nr. 331 397-xx	TS 632
Id. Nr. 346 322-xx	EA 632 receiver unit
Id. Nr. 346 323-xx	EA 652 receiver unit
Id. Nr. 354 656-xx	APE 652 Interface Electronics for connecting two EA 652 to the MC 422
Id. Nr. 310 197-xx	Adapter cable for connecting the EA 632 or the APE 511 to the MC 422

2.4.3 Enabling Additional Control Loops

For each MC 422, only the minimum number of control loops is enabled. If you need additional control loops, you must enable them by entering a code number. These additional control loops are not bound to a certain machine parameter index.. The definition as to whether a control loop is used is entered as a value ≠ 0 in MP120.x (nominal speed value outputs to the axes) and MP121.x (nominal speed value outputs to the spindles).

Each MC 422 can be clearly identified by the SIK (System Identification Key).



If you wish to enable additional control loops, please contact HEIDENHAIN for the code number. After you have informed us of the SIK number, we can give you the required code number.

You will find the SIK number on the outside of the MC 422 housing (below the ID label) and on the SIK board.

Note

If you replace the MC 422, you must also replace the SIK in order to ensure that the enabled control loops will also be enabled on the new MC 422.

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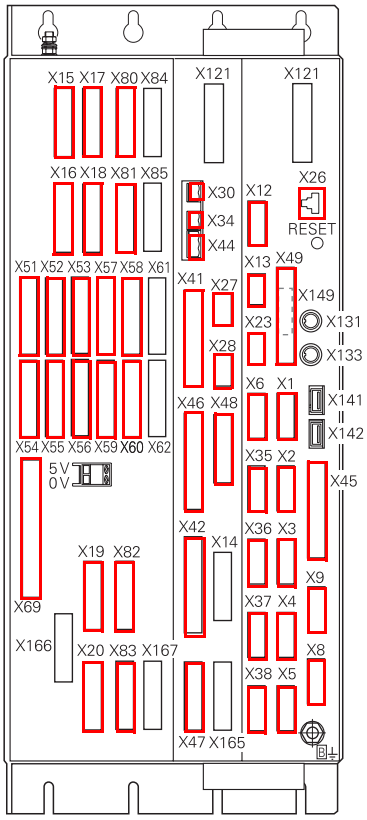


X150, X151 at bottom of housing

X1 to X6	Position encoder 1 V_{PP}
X35 to X38	Position encoder 1 V_{PP}
X15 to X20	Speed encoder 1 V_{PP}
X80 to X83	Speed encoder 1 V_{PP}
X84, X85	Vacant
X51 to X60	PWM output (power stage of motor)
X61, X62	Vacant
X8, X9	Nominal value output, analog
X12	TS touch trigger probe
X13	TT 130 touch trigger probe
X23	Handwheel
X26	Ethernet data interface
X27	RS-232-C/V.24 data interface
X28	RS-422/V.11 data interface
X30	24 V reference signal for spindle
X34	24 V for control-is-ready signal output
X41	PLC output
X42	PLC input
X44	24 V PLC supply voltage
X45	Keyboard unit (TE 4xx)
X46	Machine operating panel
X47	PLC expansion (PL 4xxB)
X48	PLC analog input
X149 (X49)	BF 150 (BF 120) visual display unit
X69	Power supply
X121, X125	Reserved
X127, X128	Reserved
X131, X133	Reserved
X141, X142	Reserved
X165, X166, X167	Reserved
5V/0V	Power supply for processor
X150	Axis-specific drive release 1 to 6
X151	Axis-specific drive release 7 to 10
B	Signal ground
⏚	Equipment ground (YL/GN)

Warning

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

3.10 Drive Controller Enable

A drive controller can be enabled by the NC software only if the controller is enabled with 24 V on X150/X151 **and** on X42, pin 33.

X150, X151: Drive controller enabling for axis groups

The connecting terminals X150 and X151 are located on the bottom of the CC 422.

Pin layout:

Terminal X150/X151	Assignment of X150	Assignment of X151
1	+24 V[a]; drive controller enabling for axis group 1	Reserved, do not assign
2	+24 V[a]; drive controller enabling for axis group 2	Reserved, do not assign
3	+24 V[a]; drive controller enabling for axis group 3	Reserved, do not assign
4	Reserved, do not assign	Reserved, do not assign
5	Reserved, do not assign	Reserved, do not assign
6	Reserved, do not assign	Reserved, do not assign
7	Reserved, do not assign	Reserved, do not assign
8	Reserved, do not assign	Reserved, do not assign
9	0 V	Reserved, do not assign

a. Maximum current consumption 10 mA.

X42/33: Global drive controller enable

Pin layout:

D-sub connctn. (male) 37-pin	Assignment
..	..
33	+24 V (drive controller enable)
..	..

3.13 Motor Power Stage Connection

The iTNC 530 is connected with HEIDENHAIN or non-HEIDENHAIN inverters through a PWM interface.
For a description of the HEIDENHAIN inverter systems, refer to the Technical Manual "Inverter Systems and Motors". The components required for operation of the iTNC 530 with non-HEIDENHAIN inverter systems are described in the manual "Technical Information for the Operation of SIMODRIVE and POWER DRIVE Inverter Systems".

The individual PWM outputs are assigned to different controller groups, See "Maximum spindle speed" on page 6 – 14 and "PWM Frequency" on page 6 – 223.

The following applies for the output signals to the power stage:

Logic level: 5 V
Analog signals I_{ACTL}: ±7.5 V
PWM frequency: MP2180 can be used to set it at 3.33 kHz, 4.16 kHz or 5 kHz

X51 to X62: PWM-Output

Pin layout:

Ribbon cable connector 20-pin	Assignment
1a	PWM U1
1b	0 V U1
2a	PWM U2
2b	0 V U2
3a	PWM U3
3b	0 V U3
4a	$\overline{SH2}$
4b	0 V (–SH2)
5a	$\overline{SH1B}$
5b	0 V ($\overline{SH1B}$)
6a	+IIST 1
6b	–IIST 1
7a	0 V (analog)
7b	+IIST 2
8a	–IIST 2
8b	0 V (analog)
9a	Do not assign
9b	Do not assign
10a	$\overline{Temp.\ warning}$
10b	Ready

Note

The interface complies with the requirements of EN 50 178 for "low voltage electrical separation."

3.16 Touch Probe Systems

The following touch probes can be connected to the iTNC 530:

- TS 220, a touch-trigger probe with cable connection for workpiece setup and measurement during machining.
- TS 632, a touch-trigger probe with infrared transmission for workpiece setup and measurement during machining
- TT 130, a touch probe for workpiece measurement

For suitable connecting cables, see “Cable Overview” at end of chapter.

3.16.1 Triggering Touch Probe for Workpiece Measurement

X12: Touch probe connection

Note

The interface complies with the requirements of EN 50 178 for “low voltage electrical separation.”

Pin layout for TS 220:

MC 422		Adapter cable 274 543-xx			TS 220	
Female	**Assignment**	**Male**	**Color**	**Pin**	**Pin**	**Color**
1	0 V (internal shield)	1				
2	Do not assign	2				
3	Ready	3	Pink	4	4	
4	Start	4				
5	+ 15 V ± 10% (U_P), max. 100 mA	5	Gray	3	3	
6	+5 V ±5% (U_P), max. 100 mA	6	Brown/ Green	2	2	Brown
7	$\overline{\text{Battery warning}}$	7	Gray			
8	0 V (U_N)	8	White/Green	1	1	White
9	Trigger signal	9	Green	5	5	Green
10	$\overline{\text{Trigger signal}}$[a]	10	Yellow	6	6	Yellow
11 to 15	Do not assign	11 to 15				
Hsg.	External shield	Hsg.	External shield	Hsg.		

a. Stylus at rest means logic level HIGH.

3.18.2 HR 130 Panel-Mounted Handwheel

Standard cable length for the HR 130 is 1 meter.

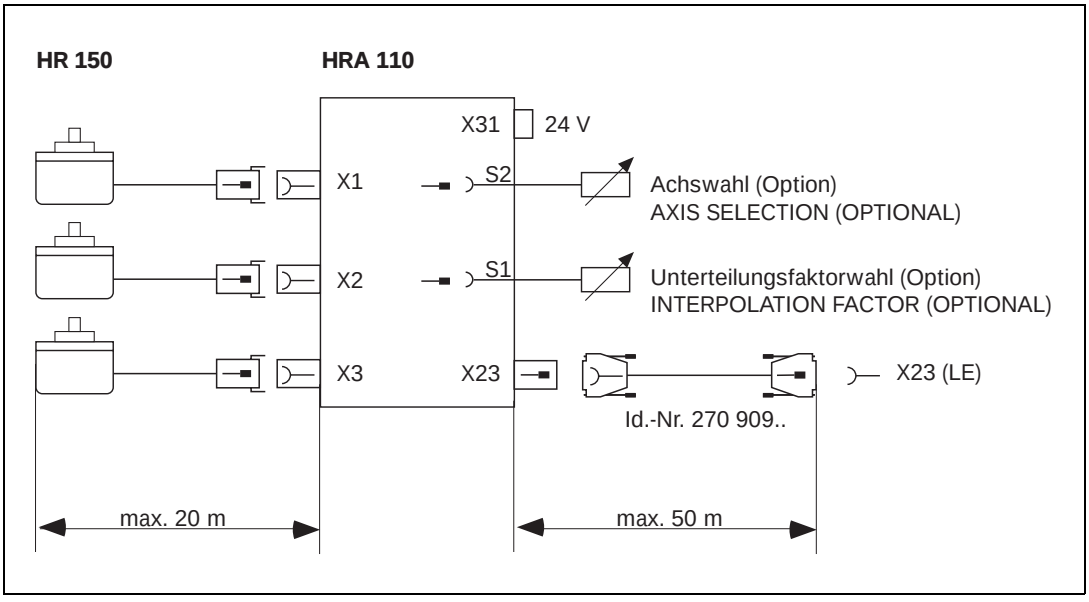
Pin layout for extension cable and handwheel:

Extension cable Id. Nr. 281 429-xx			**HR 130 Id. Nr. 254 040-xx**	
D-sub connctr. (male) 9-pin		**D-sub connctr. (female) 9-pin**	**D-sub connctr. (male) 9-pin**	
Housing	Shield	Housing	Housing	Shield
2	White	2	2	White
4	Brown	4	4	Brown
6	Yellow	6	6	Yellow
8	Green	8	8	Green
7	Gray	7		

3.18.3 HRA 110 Handwheel Adapter

With the handwheel adapter you can connect two or three HR 150 panel-mounted handwheels to the TNC.

The first and second handwheels are assigned to the X and Y axes. The third handwheel can be assigned either through a selection switch (option) or with MP7645.



An additional switch enables you to select, for example, the interpolation factor for the handwheel. In the PLC you must evaluate the current position of the handwheel selection switch and activate the corresponding interpolation factor with Module 9036.

X41: PLC outputs on the MC 422

Pin layout:

MC 422		**Connecting cable Id. Nr. 244 005-xx Id. Nr. 263 954-xx**	
D-sub connctn. (female) 37-pin	**Assignment**	**D-sub connctr. (male) 37-pin**	
Power via X44, pin 3; can be switched off with EMERGENCY STOP			
1	O0	1	Gray/Red
2	O1	2	Brown/Black
3	O2	3	White/Black
4	O3	4	Green/Black
5	O4	5	Brown/Red
6	O5	6	White/Red
7	O6	7	White/Green
8	O7	8	Red/Blue
9	O8	9	Yellow/Red
10	O9	10	Gray/Pink
11	O10	11	Black
12	O11	12	Pink/Brown
13	O12	13	Yellow/Blue
14	O13	14	Green/Red
15	O14	15	Yellow
16	O15	16	Red
Power via X44, pin 2; can be switched off with EMERGENCY STOP			
17	O16	17	Gray
18	O17	18	Blue
19	O18	19	Pink
20	O19	20	White/Gray
21	O20	21	Yellow/Gray
22	O21	22	Green/Red
23	O22	23	White/Pink
24	O23	24	Gray/Green
Power via X44, pin 1; **cannot** be switched off with EMERGENCY STOP			
25	O24	25	Yellow/Brown
26	O25	26	Gray/Brown
27	O26	27	Yellow/Brown
28	O27	28	White/Yellow
29	28	29	Gray/White

3.24 TNC Keyboard Unit

X1: Connection of soft keys on the visual display unit with the TNC keyboard

Pin layout:

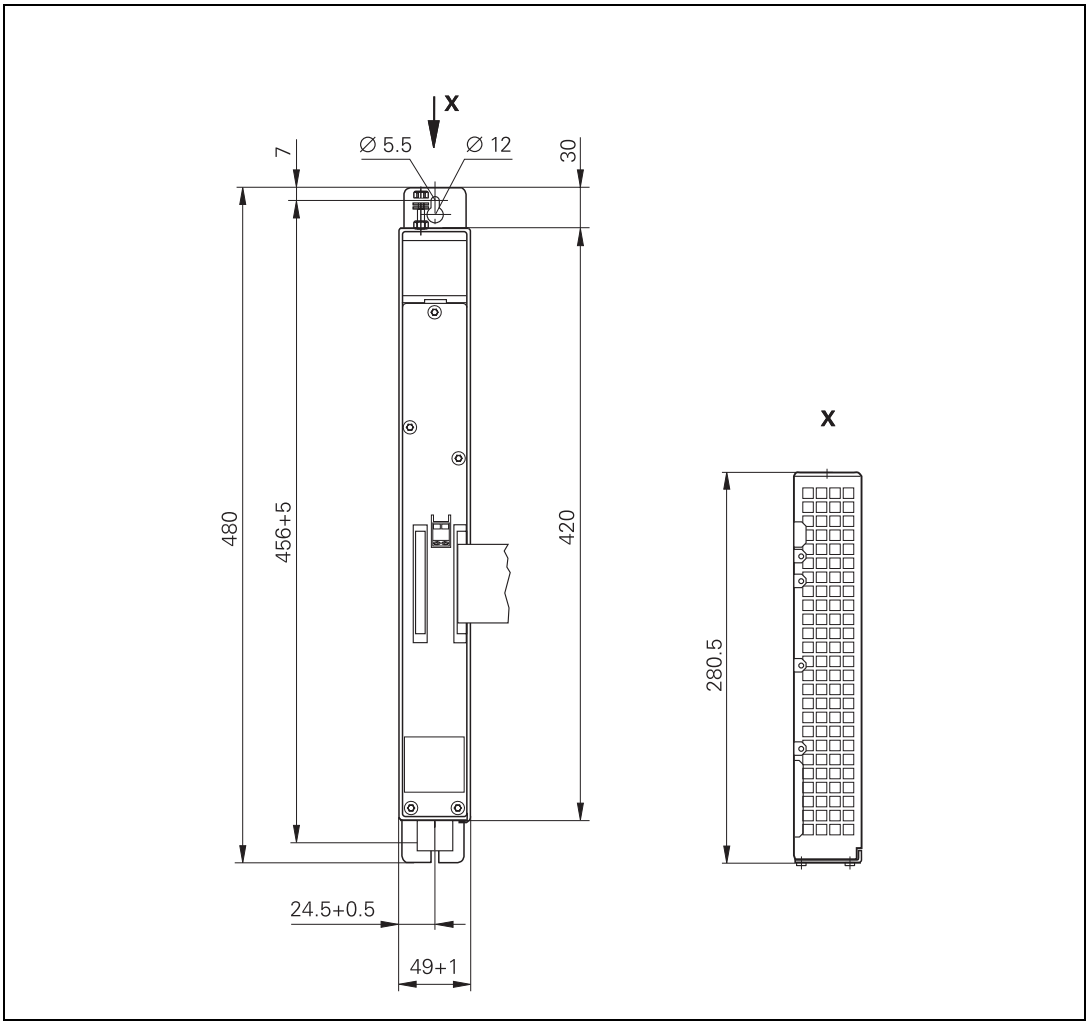
Connector (male) 9-pin	Assignment
1	SL0
2	SL1
3	SL2
4	SL3
5	Do not assign
6	RL15
7	RL14
8	RL13
9	RL12

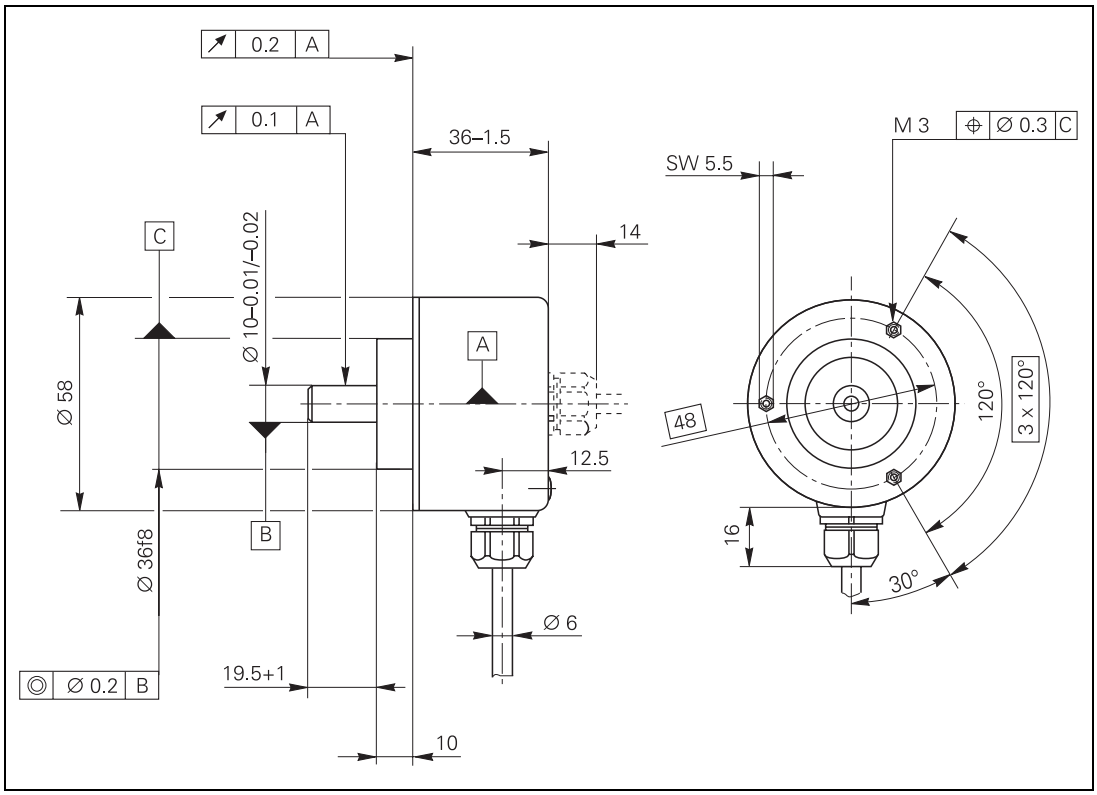
X45: TNC Keyboard (TE 420)

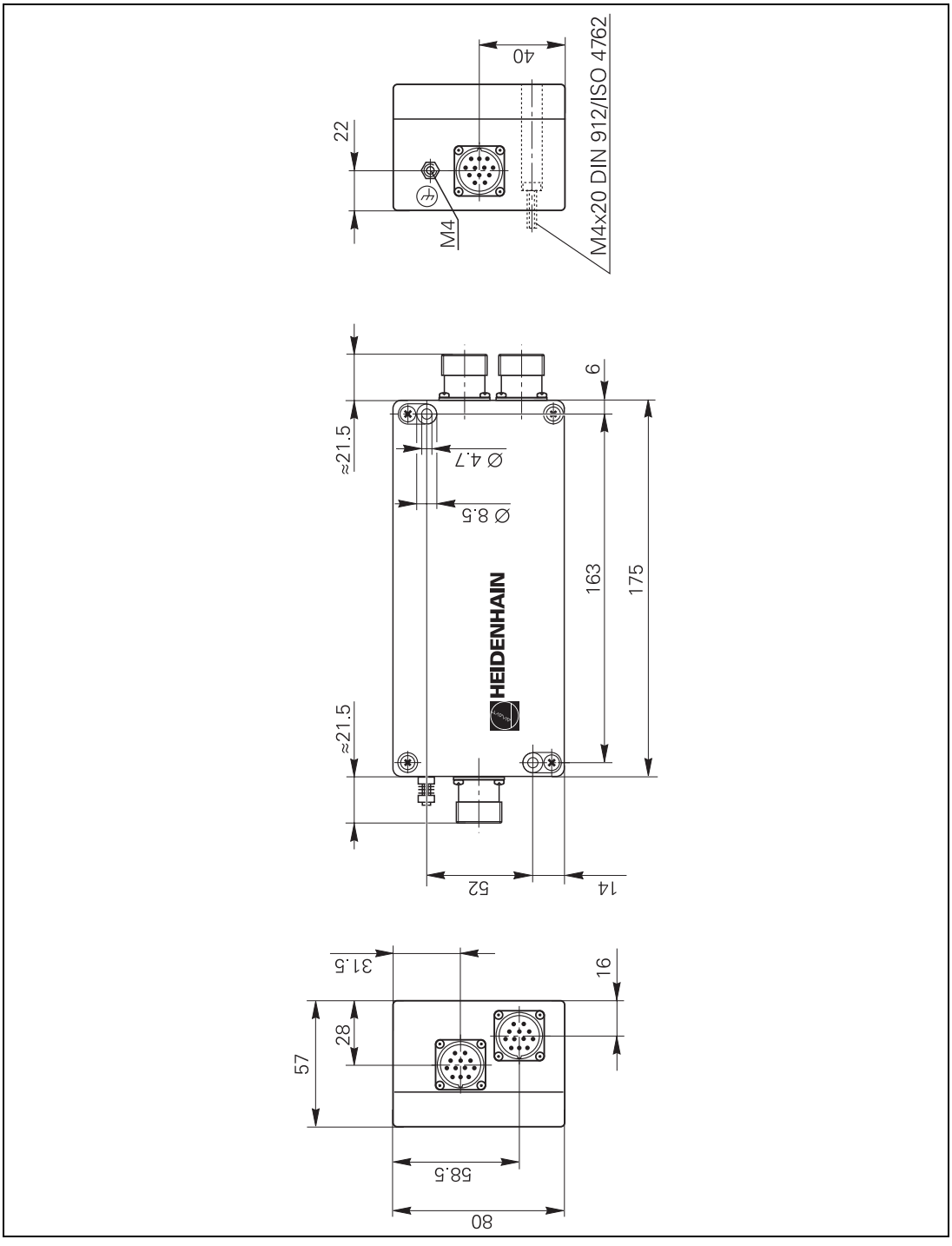
Pin layout:

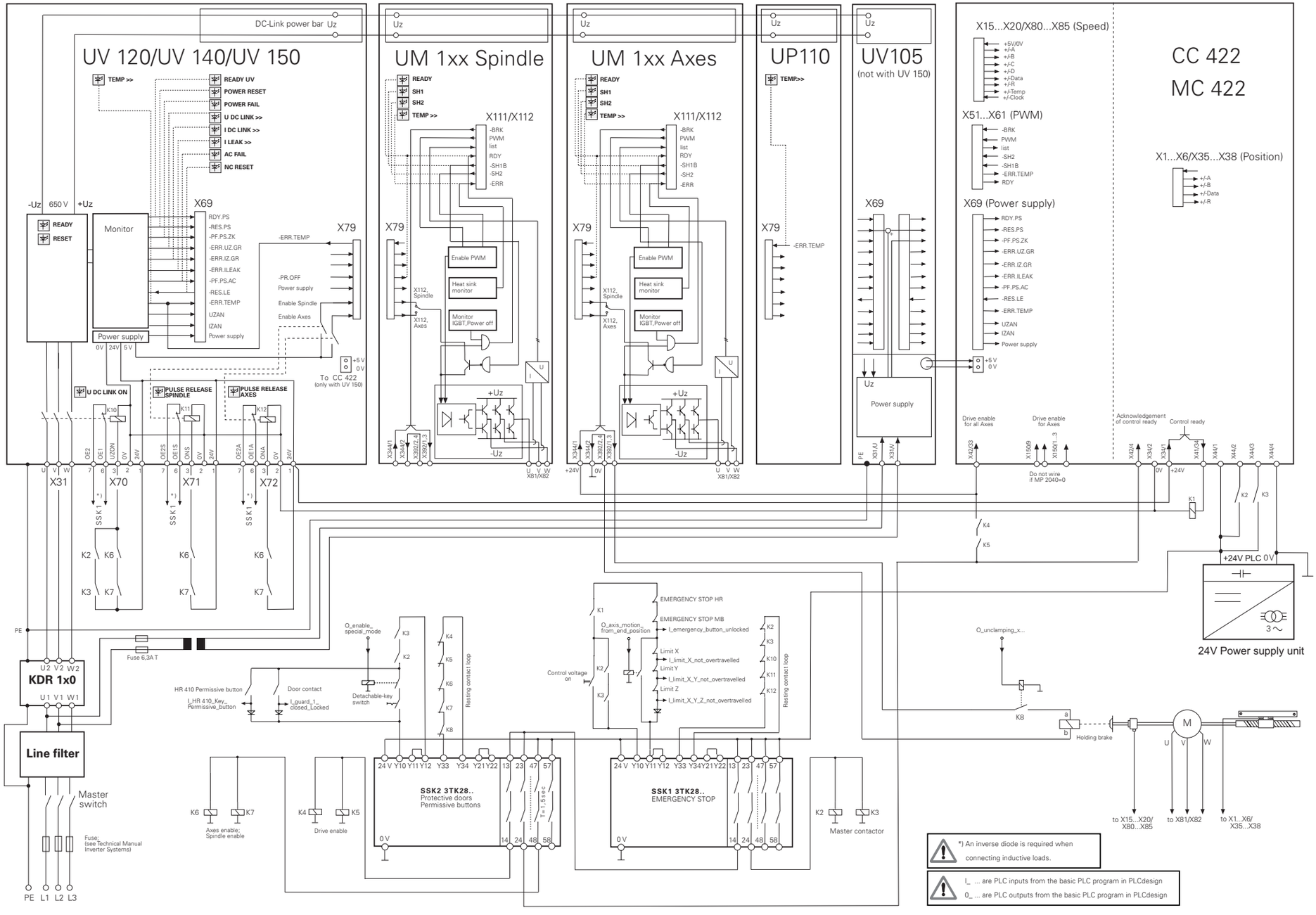
MC 422		Connecting cable Id. Nr. 263 954-xx			TE 420 313 038-xx
D-sub connctn. (female) 37-pin	Assignment	D-sub cnnctr. (male) 37-pin		D-sub cnnctr. (female) 37-pin	X2: D-sub connctn. (male) 37-pin
1	RL0	1	Gray/Red	1	1
2	RL1	2	Brown/Black	2	2
3	RL2	3	White/Black	3	3
4	RL3	4	Green/Black	4	4
5	RL4	5	Brown/Red	5	5
6	RL5	6	White/Red	6	6
7	RL6	7	White/Green	7	7
8	RL7	8	Red/Blue	8	8
9	RL8	9	Yellow/Red	9	9
10	RL9	10	Gray/Pink	10	10
11	RL10	11	Black	11	11
12	RL11	12	Pink/Brown	12	12
13	RL12	13	Yellow/Blue	13	13
14	RL13	14	Green/Blue	14	14
15	RL14	15	Yellow	15	15
16	RL15	16	Red	16	16
17	RL16	17	Gray	17	17
18	RL17	18	Blue	18	18
19	RL18	19	Pink	19	19
20	SL0	20	White/Gray	20	20
21	SL1	21	Yellow/Gray	21	21

3.27.3 UV 105




0.2 A
0.1 A
36–1.5
14
C
Ø 10–0.01/–0.02
A
Ø 58
12.5
B
Ø 36f8
Ø 6
19.5+1
10
Ø 0.2 B
M 3
Ø 0.3 C
SW 5.5
48
120°
3 x 120°
16
30°


40
22
M4
M4x20 DIN 912/ISO 4762
6
≈21.5
Ø 4.7
Ø 8.5
HEIDENHAIN
163
175
≈21.5
52
14
31.5
16
28
57
58.5
80


UV 120/UV 140/UV 150
UM 1xx Spindle
UM 1xx Axes
UP110
UV105
(not with UV 150)
CC 422
MC 422
DC-Link power bar Uz
X15...X20/X80...X85 (Speed)
X51...X61 (PWM)
X1...X6/X35...X38 (Position)
X69 (Power supply)
TEMP >>
READY UV
POWER RESET
POWER FAIL
U DC LINK >>
I DC LINK >>
I LEAK >>
AC FAIL
NC RESET
READY
RESET
Monitor
Power supply
-Uz 650 V +Uz
X69
X79
-ERR.TEMP
-PR.OFF
Power supply
Enable Spindle
Enable Axes
To CC 422
(only with UV 150)
READY
SH1
SH2
TEMP >>
X111/X112
-BRK
PWM
list
RDY
-SH1B
-SH2
-ERR
Enable PWM
Heat sink monitor
Monitor IGBT,Power off
X112, Spindle
X112, Axes
+Uz
-Uz
U DC LINK ON
PULSE RELEASE SPINDLE
PULSE RELEASE AXES
K10
K11
K12
X31
X70
X71
X72
PE
Fuse 6,3A T
KDR 1x0
Line filter
Master switch
Fuse; (see Technical Manual Inverter Systems)
PE L1 L2 L3
HR 410 Permissive button
I_HR 410_Key_ Permissive_button
Door contact
I_guard_1_ closed_Locked
Detachable-key switch
O_enable_ special_mode
Resting contact loop
EMERGENCY STOP HR
EMERGENCY STOP MB
O_axis_motion_ from_end_position
I_emergency_button_unlocked
Limit X
I_limit_X_not_overtravelled
Limit Y
I_limit_X_Y_not_overtravelled
Limit Z
I_limit_X_Y_Z_not_overtravelled
Control voltage on
SSK2 3TK28..
Protective doors
Permissive buttons
SSK1 3TK28..
EMERGENCY STOP
Axes enable; Spindle enable
Drive enable
Master contactor
Drive enable for all Axes
Drive enable for Axes
Acknowledgement of control ready
Control ready
Do not wire if MP 2040=0
+24V PLC 0V
24V Power supply unit
O_unclamping_x...
Holding brake
to X15...X20/ X80...X85
to X81/X82
to X1...X6/ X35...X38
*) An inverse diode is required when connecting inductive loads.
I_ ... are PLC inputs from the basic PLC program in PLCdesign
O_ ... are PLC outputs from the basic PLC program in PLCdesign

4 Machine parameters

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Module 9034 Load a machine parameter subfile

With this module you load the contents of the given machine parameter into the main memory. All MPs not listed in this file remain unchanged.

The MP file to be selected is checked. A faulty file is not loaded. If the MP file contains parameters that require a system reset, the file is not loaded.

The file name is transferred in a string that must contain the complete path, name and file extension. Further characters, even space characters, are not permitted.

If the PLC program is created externally, ensure that lower-case letters are not used for the file name!

Once the NC program has started, the module operates only during the output of an M/S/T/Q strobe.

Call only in a submit job.

Call:

PS	B/W/D/K	<>String number> 0 to 3
CM	9034	
PL	B/W/D	<>Error code> 0: No error 1: String does not contain a valid file name, or the name (including the path) is too long. 2: File not found 3: File is faulty / contains reset parameters 4: Incorrect string number was transferred (0 to 3) 5: Call was not in a submit job 6: Call during running program without strobe

MP	Function and input	Software version and behavior	Page
MP1356.x	Difference between speed and position encoder, if MP1355 = 1 Input: -99 999.999 to +99 999.999 [mm] or [°]	PLC RUN REF 340 420-02	6 – 101
MP1360.x	Fast PLC input for reference pulse Input: 0: No fast PLC input for reference pulse 1 to 5: Fast PLC input 1 to 5 (MP4130.x)	PLC RUN REF	6 – 101
MP1391	Velocity feedforward control in the MANUAL and HANDWHEEL operating modes Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 correspond to axes 1 to 14 0: Operation with following error (lag) 1: Operation with velocity feedforward control	PLC RUN	6 – 47, 6 – 120
MP1392	Velocity feedforward in the POSITIONING WITH MANUAL DATA INPUT, PROGRAM RUN SINGLE BLOCK and PROGRAM RUN FULL SEQUENCE operating modes Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 correspond to axes 1 to 14 0: Operation with following error (lag) 1: Operation with velocity feedforward control	PLC RUN	6 – 120
MP1396.x	Feedback control with velocity semifeedforward Input: 0.001 to 0.999 1: Velocity feedforward control	PLC RUN	6 – 126

MP	Function and input	Software version and behavior	Page
MP3450.0-7	Number of spindle position-encoder revolutions for gear ranges 1 to 8 Input: 0 to 65 535 0: No transmission	PLC RUN	6 – 180
MP3451.0-7	Number of spindle revolutions for gear ranges 1 to 8 Input: 0 to 65 535 0: No transmission	PLC RUN	6 – 180
MP3510.0-7	Rated speed for the gear ranges 1 to 8 Input: 0 to 99 999.999 [rpm]	PLC RUN	6 – 186
MP3515.0-7	Maximum spindle speed for gear ranges 1 to 8 Input: 0 to 99 999.999 [rpm]	PLC RUN	6 – 189
MP3520.0 MP3520.1	Speed activation through marker M4011 Input: 0 to 99 999.999 [rpm] Spindle speed for oriented stop Input: 0 to 99 999.999 [rpm]	PLC RUN	6 – 195, 6 – 198

MP	Function and input	Software version and behavior	Page
MP6570	Max. permissible surface cutting speed at the tooth edge Input: 1.0000 to 129.0000 [m/min]	PLC RUN CN123	
MP6572	Maximum permissible speed during tool measurement Input: 1 to 1000 [rpm] 0: 1000 [rpm]	PLC RUN CN123	
MP6580.0-2	Coordinates of the TT 130 probe contact center with respect to the machine datum (traverse range 1) Input: -99 999.9999 to +99 999.9999 [mm]	PLC RUN CN123	
MP6581.0-2	Coordinates of the TT 130 probe contact center with respect to the machine datum (traverse range 2) Input: -99 999.9999 to +99 999.9999 [mm]	PLC RUN CN123	
MP6582.0-2	Coordinates of the TT 130 probe contact center with respect to the machine datum (traverse range 3) Input: -99 999.9999 to +99 999.9999 [mm]	PLC RUN CN123	
MP6585	Monitoring the position of the rotary and additional linear axes during the tool measurement cycles Format: %xxxxxx Input: 0: Axis is not monitored 1: Axis is monitored Bit 0 – A axis Bit 1 – B axis Bit 2 – C axis Bit 3 – U axis Bit 4 – V axis Bit 5 – W axis	PLC RUN CN123	
MP6586 MP6586.0-5	Ref. coordinate for monitoring the position of the rotary and additional linear axes during the tool measurement cycles Input: -99 999.9999 to +99 999.9999 [mm or °] Axes A to W	PLC RUN CN123	

4.3.13 Colors

MP	Function and input	Software version and behavior	Page
MP7350	Window frames	PLC RUN	7 – 5
MP7351	Error messages	PLC RUN	7 – 5
MP7352 MP7352.0 MP7352.1 MP7352.2	"Machine" operating mode display Background Text for operating mode Dialog	PLC RUN	7 – 5
MP7353 MP7353.0 MP7353.1 MP7353.2	"Programming" operating mode display Background Text for operating mode Dialog	PLC RUN	7 – 5
MP7354 MP7354.0 MP7354.1 MP7354.2 MP7354.3	"Machine" program text display Background General program text Active block Background of inactive window	PLC RUN	7 – 6
MP7355 MP7355.0 MP7355.1 MP7355.2 MP7355.3	"Programming" program text display Background General program text Active block Background of inactive window	PLC RUN	7 – 6
MP7356 MP7356.0 MP7356.1 MP7356.2	Status window and PLC window Background Axis positions in the status display Status display other than axis positions	PLC RUN	7 – 6
MP7357 MP7357.0 MP7357.1	"Machine" soft-key display Background Symbols	PLC RUN	7 – 6
MP7358 MP7358.0 MP7358.1	"Programming" soft-key display Background Symbols	PLC RUN	7 – 6

MP	Function and input	Software version and behavior	Page
MP7645	Initializing parameter for handwheel	PLC	
MP7645.0	Layout of the handwheel keypad for HR 410 Input: 0: Evaluation of the keys by NC, including LEDs 1: Evaluation of the keys by PLC	RUN	
MP7645.0	Assignment of a third handwheel via axis selector switch S2, when MP7645.2 = 0 Input: 0: Switch position 1 (at the left stop) 3rd handwheel axis Z Switch position 2 3rd handwheel axis IV Switch position 3 3rd handwheel axis V 1: Switch position 1 3rd handwheel axis X Switch position 2 3rd handwheel axis Y Switch position 3 3rd handwheel axis Z Switch position 4 3rd handwheel axis IV Switch position 5 3rd handwheel axis V 2: Switch position 3 3rd handwheel axis Z Switch position 4 3rd handwheel axis IV Switch position 5 3rd handwheel axis V		
MP7645.1	Fixed assignment of third handwheel if MP7645.2 = 1 Input: 4: Axis Z 8: Axis IV (MP410.3) 16: Axis V (MP410.4)		
MP7645.2	Assignment of a third handwheel via axis selector switch or MP7645.1 Input: 0: Assignment by axis selection switch according to MP7645.0 1: Assignment by MP7645.1		
MP7645.3-7	No function		
MP7650	Counting direction for handwheel Format: %xxxxxxxxx Input: 0: Negative counting direction 1: Positive counting direction	PLC RUN	
MP7660	Threshold sensitivity for electronic handwheel Input: 0 to 65 535 [increments]	PLC RUN	

Module	Function	SW Vers.	Page
9160	Status request for temperature monitoring and I^2t monitoring		6 – 173
9161	Enabling the drive controller		6 – 143
9162	Status request of the drive controller		6 – 144
9163	Wye/delta connection switchover		6 – 205
9164	Reading the actual speed value of the motor		6 – 134
9165	Sampling the current motor temperature		6 – 170
9166	Momentary utilization of the drive motor		6 – 174
9167	Supply voltage monitoring		6 – 169
9168	Interrogating the commissioning status		6 – 230
9169	Axes for which I32 does not switch off the drives		6 – 144
9171	Oriented spindle stop		6 – 196
9175	Spindle switchover		6 – 207
9180	Simulation of NC keys		
9181	Disable individual NC keys		
9182	Re-enabling individual NC keys		
9183	Disabling groups of NC keys		
9184	Re-enabling groups of NC keys		
9186	Call a soft-key function		
9187	Status of a soft-key function call		
9189	Shutting down the control		7 – 4
9190	Starting the operating times		
9191	Stopping the operating times		
9192	Reading the operating times		
9193	Setting the operating times		
9194	Alarm when operating time exceeded		
9195	System time		
9196	Finding the PLC cycle time		8 – 2
9197	Start cycle timer		8 – 42
9200	Display/delete PLC soft-key row		7 – 14
9201	Display/delete PLC soft key		7 – 15
9202	Select/deselect PLC soft keys and PLC windows		7 – 15
9203	Activate PLC soft-key resource file		7 – 19
9204	Update the PLC soft keys		7 – 20
9205	Define the setup parameters for the PLC soft keys		7 – 21
9206	Change setting of the PLC soft keys		7 – 22
9207	Replace PLC soft keys		7 – 23
9208	Status information of PLC soft-key structure		7 – 24
9210	Opening or erasing screen mask for the PLC window		
9211	Status of the large PLC window		

	Marker	Description	Set	Reset	SW Vers.	Page
D	528-544	Target position for PLC positioning	PLC	PLC		6 – 33
D	528	Datum shift for axis 1	PLC	PLC		
D	532	Datum shift for axis 2	PLC	PLC		
D	536	Datum shift for axis 3	PLC	PLC		
D	540	Datum shift for axis 4	PLC	PLC		
D	544	Datum shift for axis 5	PLC	PLC		
W	560 - 568	Feed rate for PLC positioning	PLC	PLC		6 – 33
W	576 - 584	Lag-tracking axis error compensation	PLC	PLC		6 – 42
D	592	Nominal position for spindle orientation	PLC	PLC		6 – 198
D	596	Max. feed rate from PLC [mm/min]	NC/ PLC	PLC		6 – 127
D	604	Maximum possible spindle speed	PLC	NC/ PLC		6 – 183
W	754	% function for feed-rate override for free rotation	PLC	PLC		
D	756	Programmed rotational speed or rotational speed of the PLC [0.001 rpm]	NC/ PLC	NC/ PLC		6 – 188
D	760	Offset in tilting axes touch probe center offset [1/10 000°]	PLC	PLC		
W	764	Percentage for spindle override (PLC to NC)	NC/ PLC	NC/ PLC		6 – 189
W	766	Percentage for feed rate override (PLC to NC)	NC/ PLC	NC/ PLC		
D	768 - 956	Values from MP4210.0 to MP4210.47	NC	NC		8 – 34
W	960 - 968	Value from MP4220.0 to MP4220.4	NC	NC		8 – 35
W	976 - 988	Value from MP4310.3 to MP4310.6	NC	NC		8 – 35
W	1008	S code for minimum speed	NC	NC		6 – 191
W	1018	Number of files opened by the PLC	NC	NC		
W	1020	Number of open files	NC	NC		
W	1022	Error status of the module last called	NC	NC		
W	1024	Axis release	NC	NC		6 – 129
W	1026	Axes in position	NC	NC		6 – 166
W	1028	Axes in motion	NC	NC		6 – 167
W	1030	Current direction of traverse	NC	NC		6 – 9
W	1032	Reference marks not yet traversed	NC	NC		6 – 102
W	1034	Positive software limit switch was traversed	NC	NC		6 – 23
W	1036	Negative software limit switch was traversed	NC	NC		6 – 23
W	1038	Preparing opening of the position control loop	PLC	PLC		6 – 130
W	1040	Axis-specific opening of the position control loop	PLC	PLC		6 – 130
W	1042	Deactivation of monitoring functions	PLC	PLC		6 – 161

Example:
LS 486C:
Incremental linear encoder with distance-coded reference marks, grating period 20 µm (= one signal period covers 0.02 mm), nominal increment between reference marks is 20 mm.

MP331.x = 0.02
MP332.x = 1

$$MP334.x = \frac{20\ mm}{0.02\ mm} = 1000\ (or\ 0)$$

MP331.x **Distance for the number of signal periods in MP332**
Input: 0.0001 to 99 999.9999 [mm] or [°]

MP332.x **Number of signal periods for the distance in MP331**
Input: 1 to 16 777 215

MP334.x **Nominal increment between two fixed reference marks on encoders with distance-coded reference marks**
Input: 1 to 65 535
0: 1 000

External interpolation

If you connect encoders with TTL signals and an external interpolation unit through the TTL/1 V_{PP} adapter to the control:

▶ In MP340.x, enter the interpolation factor of the external interpolation unit.

MP340.x **Interpolation factor for external interpolation**
Input: 0 to 99
0 = 1: No external interpolation

6.1.6 Reading Axis Information

Module 9038 Reading general axis information

With Module 9038 you can interrogate the general status information of the axes. You can ask for the status of a specific axis or of all axes at once. Bit 0 to Bit 8 correspond to axes 1 to 9. Bit 15 corresponds to the spindle. If status information is read for only one axis, only bit 0 is changed. The following table shows the meanings of the return codes:

Status information	Meaning
0	0: Axis (spindle) not active (MP10 or MP3010 or no encoder) 1: Axis (spindle) active
1	Depending on the current traverse range: 0: NC axis or not active 1: PLC axis
2	0: No servo-controlled axis (spindle), only display or not active 1: Servo-controlled axis (spindle)
3	Maximum temperature of the motor [°C]
4	0: No Hirth axis 1: Hirth axis (MP420)
5	Hirth grid [1/10 µm] (MP430)
6	Modulo value (MP810)
7	0: Linear axis or not active 1: Rotary axis in at least one of the traverse ranges
8	0: Analog axis (spindle) or not active 1: Digital axis (spindle)

Call:

PS	B/W/D/K	<>Axis> Axis specific: 0 to 8 represent axes 1 to 9, 15 represents the spindle Bit-coded output for all axes: –1
PS	B/W/D/K	<>Status information> See table above
CM	9038	
PL	B/W/D	<>Information>

Error detection:

Marker	Value	Meaning
M4203	0	Information was read
	1	Error code in W1022
W1022	1	Status information not available on this iTNC
	2	Axis does not exist

Module 9120 Starting a PLC axis

This module starts positioning a PLC axis regardless of other processes in the control.

Conditions:

- Status changes through a PLC positioning command are not detected until the next PLC scan.
- The axis must be activated in MP10 and identified in MP100 as a PLC axis.
- Traverse over the software limit switches is not checked.
- The axis must be stationary before positioning. Interrupt a running positioning movement with Module 9121.
- The feed-rate override is disabled. To change the feed rate, use module 9124.
- If no reference mark has been traversed, the positioning process builds on the counter value as it was upon switch-on.

Call:

PS	B/W/D/K	<>Axis> 0 to 8 correspond to axes 1 to 9
PS	B/W/D/K	<>Target position> Input unit: [0.0001 mm]
PS	B/W/D/K	<>Feed rate> Input unit: [mm/min]
PS	B/W/D/K	<>Mode> Bit 0: Type of target position input 0: Absolute, i.e. relative to the machine datum 1: Incremental
CM	9120	
PL	B/W/D	<>Error code> 0: No error. Positioning was started. 1: Axis does not exist 2: Not a PLC axis 3: Axis is already being positioned 4: Absolute position is outside of modulo range 5: Programmed axis not in closed loop 6: Feed rate not permitted

Module 9121 Stopping a PLC axis

Stops a running PLC positioning process in an axis.

Condition:

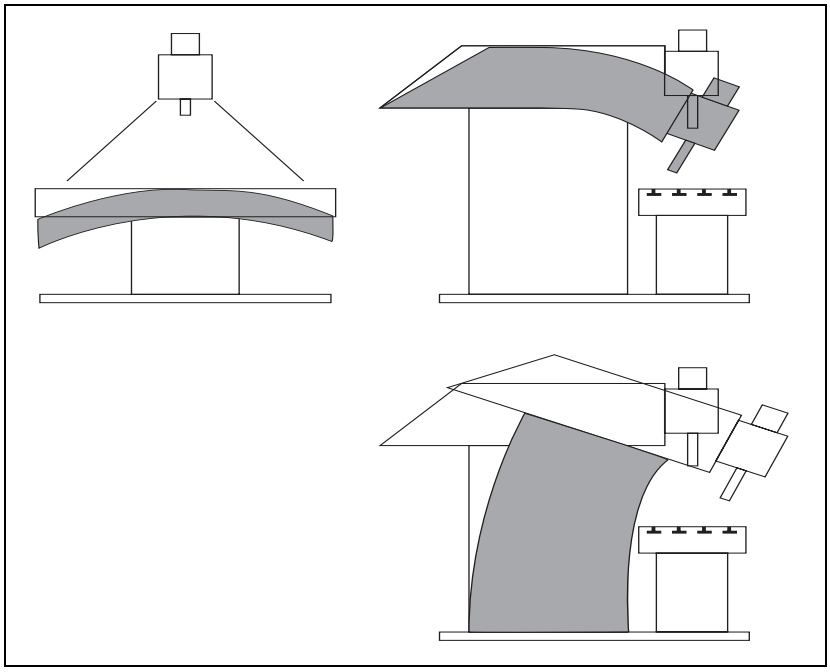
- Status changes through a PLC positioning command are not detected until the next PLC scan.

Call:

PS	B/W/D/K	<>Axis> 0 to 8 correspond to axes 1 to 9
CM	9121	
PL	B/W/D	<>Error code> 0: Positioning is canceled 1: Axis does not exist 2: Not a PLC axis 3: Axis was already stationary

6.4.3 Nonlinear Axis Error Compensation

Errors in machine geometry (e.g. an error in one axis caused by the sagging of another axis) or external influences (e.g. temperature) can cause nonlinear axis errors. These graphics show typical nonlinear axis errors:



The best way to measure nonlinear axis error is with a comparator measuring system such as the HEIDENHAIN VM 101.

Note

The iTNC can compensate screw-pitch error and axis sag simultaneously.

Compensation

The compensation must be effective only at low feed rates, otherwise the nominal value increase will cause vibration at high velocity:

- In MP1511.x, enter a factor for static friction compensation (approximate value: 5000 to 10 000).
- In MP1512.x, enter a limit for the amount of the static friction compensation (approx. value: < 50).
- In MP1513.x, limit the maximum feed rate up to which the static friction compensation remains in effect.

MP1511.x **Factor for static friction compensation**
Input: 0 to 16 777 215 [µs]

MP1512.x **Limitation of the amount of the static friction compensation**
Input: 0 to 16 777 215 [counting steps]

MP1513.x **Feed-rate limitation for static friction compensation**
Input: 0 to 300 000 [mm/min]

MP1391 **Velocity feedforward control in the MANUAL and HANDWHEEL operating modes**
Format: %xxxxxxxxxxxxxx
Input: Bits 0 to 13 correspond to axes 1 to 14
0: Operation with following error (lag)
1: Operation with velocity feedforward control

Digital axes: Limit to the integral factor

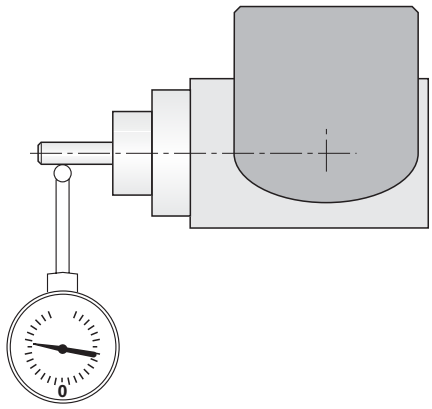
In machines with very high static friction, a position deviation at standstill can lead to the accumulation of a very high integral factor. This can lead to a jump in the position value when the axis "tears loose." In such cases you can limit the integral-action component of the speed controller with MP2512.x.

MP2512.x **Limiting the integral factor of the speed controller**
Input: 0.000 to 30.000 [s] (realistically: 0.1 to 2.0)

Step 1b

Determining the Y offset:

- Position A = +90
- Offset = 0.5 * determined value
- If the determined value > 0, then MP7530.1 = **–** offset
- If the determined value < 0, then MP7530.1 = **–** offset



Step 1c

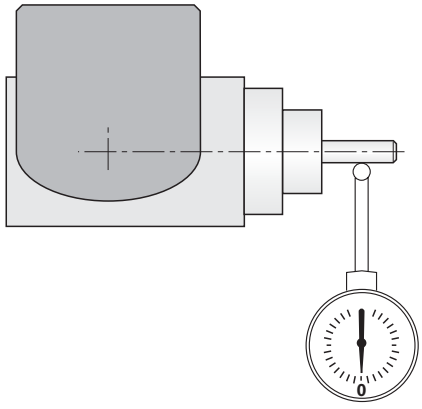
Checking the settings:

- Activate 3-D ROT
- Position A = +90
- Set dial indicator to 0
- Datum setting
- Position A = –90
- Probe same position again
- Display and dial indicator must read 0

Step 2a

Determining the Z offset:

- Position A = –90
- Set dial indicator to 0



```
MP 7510.0   : %000100   ;Shift in Z axis (Z1)
MP 7510.1   : %000010   ;Shift in Y axis (Y1)
MP 7510.2   : %001000   ;Free tilting axis A
MP 7510.3   : %000001   ;Shift in X axis (X1)
MP 7510.4   : %000100   ;Shift in Z axis (Z2)
MP 7510.5   : %010000   ;Free tilting axis B
MP 7510.6   : %000000   ;End of the transformation chain

MP 7520.0   : %00       ;Incremental dimensions, swivel head
MP 7520.1   : %00       ;Incremental dimensions, swivel head
MP 7520.2   : %00       ;Incremental dimensions, swivel head
MP 7520.3   : %00       ;Incremental dimensions, swivel head
MP 7520.4   : %00       ;Incremental dimensions, swivel head
MP 7520.5   : %00       ;Incremental dimensions, swivel head

MP 7530.0   : +200.4    ;Dimension Z1
MP 7530.1   : -1.9      ;Dimension Y1
MP 7530.2   : +0        ;Variable dimension (free tilting axis A)
MP 7530.3   : +201.5    ;Dimension X1
MP 7530.4   : +3.1      ;Dimension Z2
MP 7530.5   : +0        ;Variable dimension (free tilting axis B)
```

MP7500 bit 7 = 1 (recommended)
During “datum setting” for X, Y and Z, the tilting angles entered in 3-D ROT are used to calculate the datum if “tilted working plane” is **active.**
During “datum setting” for X, Y and Z, the reference points of the tilting axes are used to calculate the datum if “tilted working plane” is **inactive.** This allows a workpiece to be aligned, a datum to be set, “tilt working plane” to be activated, and a new datum to be set in the “tilted working plane.”

With MP7682 bit 1 you define whether the nominal or the actual values are used to calculate the presets during “datum setting” (is valid for MP7500 bit 3, bit 5, bit 7, bit 8).

No servo-controlled axes:

The user must enter the current positions of the tilting axes by using the 3-D ROT soft key.

Note

In the combination of coordinate transformation cycles, note the sequence of activation and deactivation.

Datum at position after switch-on (MP860.x = 0)

Entry for the slave axis

With MP860.x you can select whether the position after switch-on should be used as a synchronization reference. Master and slave axes must be at identical positions. If the defined datums are to be reproduced, then only the master needs to be moved over the reference mark.

Monitoring of synchronized axes begins immediately upon switch-on.

Datum at reference marks (MP860.x = 1)

Entry for the slave axis

With MP860.x you can select whether the position should be ascertained by traversing the reference marks. After crossing over the reference mark, the master and slave axes are positioned to the same value. The default setting can be corrected with MP960.x (machine datum). In order for MP960.x to be set, the axes must traverse the reference marks with MP860.x = 0, so that no compensation movements are made. An offset in the axes is corrected after both reference marks are traversed. Reference mark traverse is ended as soon as a reference mark is traversed in both axes. The monitoring function is not active until after the compensation movement. The monitoring function is not active before the reference marks are traversed.

Conditions:

- The same type of reference mark traverse must be set for both the master and slave axes (MP1350.x).
- The velocity with which an offset (after traversing a reference mark or emergency stop) is compensated for is defined in MP1330.x for the slave axis.
- In the sequence for traversing the reference marks (MP1340.x), the master axis must be defined before the slave axis.
- The compensation movement can **not** be stopped with an NC stop (only with an emergency stop).
- The compensation movement is **not** considered in the following words:
  - W1026 (Axes in position)
  - W1028 (Axes in motion)
- If the master axis has traversed the reference mark at the time of an NC stop or an emergency stop, but the slave axis has not yet crossed it, then the slave axis can only be moved across it by using the axis-direction keys.
- Using a linear encoder: it is sufficient if the master axis has one reference end position.
- Using the speed encoder for linear measurement: One reference end position is enough, but the NC needs a reference end position signal for both axes (W1054).

6.7 Reference Marks

6.7.1 Definition

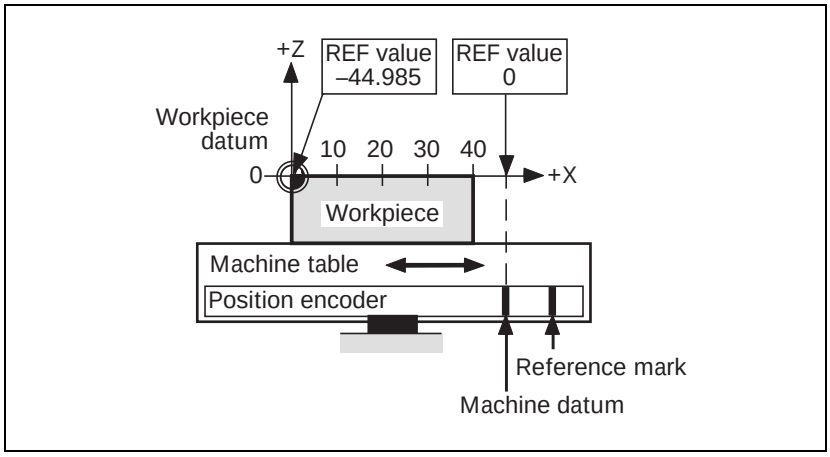
The position value (coordinates) of an axis position is defined with respect to a freely selectable datum. When the axes are moved, the ACTUAL position is calculated incrementally. If there is an interruption in power, the reference between the axis position and the position value is lost.

Reference marks

HEIDENHAIN linear encoders are designed with one or more reference marks. The reference marks identify an axis position at a known distance from the machine datum. The position of the freely selectable datum is defined with respect to the machine datum.

The datum and the actual position can be reproduced as soon as the reference marks are traversed.

HEIDENHAIN recommends position encoders with distance-coded reference marks. With distance-coded reference marks, the position value can be reestablished after traverse of a short distance over any two reference marks.



6.7.2 Traversing the reference marks

The reference marks must be traversed after any interruption in power:

- Press the machine START button: The reference marks are automatically traversed. The sequence of axes is predetermined.

or:

- Press the machine axis-direction button. The user determines the sequence of the axes.

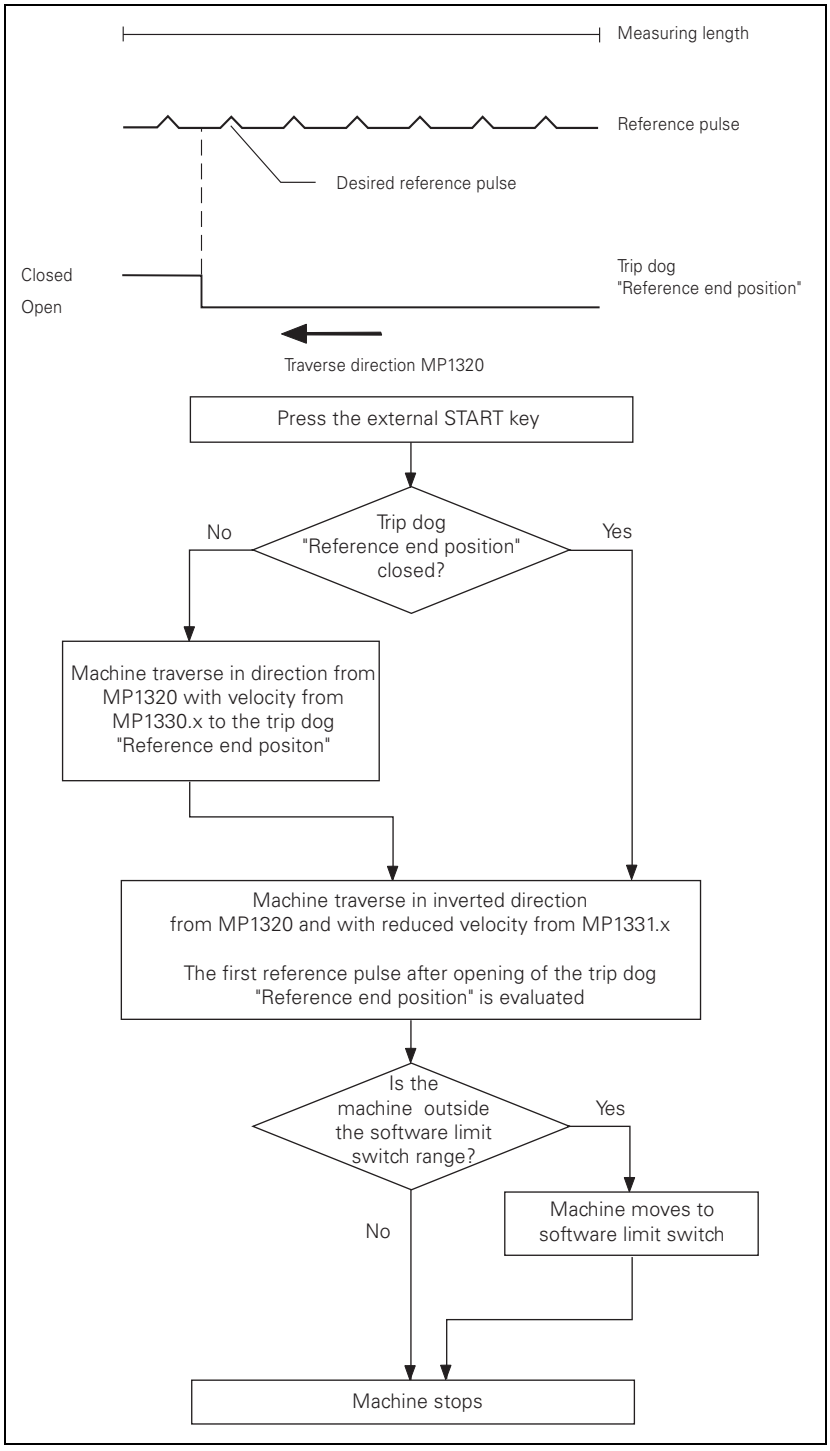
After the reference marks have been traversed:

- The software limit switches are activated.
- The most recently saved datum and machine datum are reproduced.
- PLC positioning and positioning with M91 and M92 become possible.
- The counter is set to zero for axes in an open loop.

Linear measurement through rotary encoder

Function when MP1350.x = 2

For linear measurement using a rotary encoder, a reference pulse is produced on each revolution of the encoder. Ensure that during referencing the same reference pulse is always evaluated. This can be realized with the trip dog for reference end position.



MP1060.x **Acceleration**
Input: 0.001 to 100.0 [m/s^2 or 1000°/s^2]

MP1087.x **Max. permissible axis-specific jerk for Manual mode**
Input: 0.1 to 1000.0 [m/s^3 or 1000°/s^3]

MP1089.x **Max. permissible axis-specific jerk for Pass Over Reference Point mode**
Input: 0.1 to 1000.0 [m/s^3 or 1000°/s^3]

MP1090 **Maximum permissible jerk on the tool path**
Input: 0.1 to 1000.0 [m/s^3 or 1000°/s^3]
MP1090.0 With machining feed rate
MP1090.1 Beginning with feed rate from MP1092

MP1092 **Feed rate threshold from which MP1090.1 becomes effective**
Input: 10 to 300 000 [mm/min]

MP1094 **HSC filter**
Input: 0: HSC filter inactive
0.1 to 166.0: Cutoff frequency for HSC filter

MP1095 **Nominal position value filter**
Input: 0: Single filter
1: Double filter
MP1095.0 In the Program Run, Full Sequence; Program Run, Single Block; and Positioning With Manual Data Input operating modes
MP1095.1 In the Manual, Handwheel, Jog Increment and Pass Over Reference Point operating modes

MP1096 **Tolerance for contour transitions**
Input: 0: No nominal position value filter
0.001 to 3.000 [mm]: Permissible tolerance at contour transitions

MP1097.x **Max. permissible axis-specific jerk (single/HSC filter)**
Input: 0.1 to 1000.0 [m/s^3 or 1000°/s^3]

MP1098.x **Max. permissible axis-specific jerk (double/HSC filter)**
Input: 0.1 to 1000.0 [m/s^3 or 1000°/s^3]

MP1099 **Minimum filter order**
Input: 0 to 20
MP1099.0 Minimum filter configuration for single filter (MP1095 = 0)
MP1099.1 Minimum filter configuration for double filter (MP1095 = 1)

MP1521 **Transient response during acceleration and deceleration**
Input: 1 to 255 [ms]
0: Function inactive

Digital axes:
For digital axes, the maximum feed rate also depends on the number of pole pairs in the drive motor and the pitch of the ballscrew.

$$v_{max}\,[mm/min] = \frac{30\,000}{\text{No. of pole pairs}}\ [1/min] \cdot \text{ballscrew pitch [mm]}$$

Analog axes:

- In MP1050.x, enter the desired analog voltage for rapid traverse.
- Adjust the rapid traverse feed rate (v_{max}) with the analog voltage at the servo amplifier.

MP1010.x **Rapid traverse**
Input: 10 to 300 000 [mm/min]

MP1020.x **Manual feed**
Input: 10 to 300 000 [mm/min]

MP1050.x **Analog axes: Analog voltage at rapid traverse**
Input: 1 000 to 9 000 [V]
Digital axes: without function
Input: 1

		Set	Reset
M4587	**Feed rate limit exceeded F MAX**	PLC	PLC
D596	**Max. feed rate from PLC [mm/min]**	NC/PLC	PLC
D360	**Programmed feed rate**	NC	NC
D388	**Current tool feed rate [mm/min]**	NC	NC

Position loop resolution

The encoder signals are interpolated 1024-fold.

$$\text{Position loop resolution [µm]} = \frac{\text{Signal period [µm]}}{1024}$$

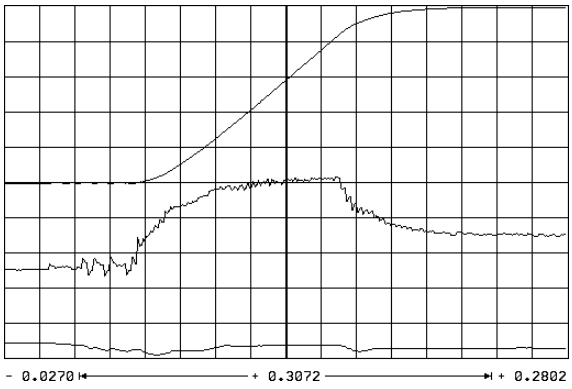
Analog axes

The iTNC outputs a voltage per position error. The 10-V analog voltage is subdivided 65536-fold with a 16-bit D/A converter. This results in a smallest voltage step of 0.15 mV.

Rapid traverse (MP1010.x) is attained at a certain voltage (MP1050.x). This results in the voltage ΔU per position error or following error s_a:

$$\Delta U = \frac{\text{MP1050.x [mV]}}{S_a\text{[µm]}}$$

If ΔU is divided by the smallest possible voltage step (0.15 mV), the result is the number *n* of the possible voltage steps per position error.



MP2600.x at optimum setting

For calculation of the acceleration feedforward, the integral-action component of the nominal current value INTEG. RPM is recorded with the internal oscilloscope. The actual speed value V (ACT RPM) and nominal current value I NOMINAL are also recorded for better illustration.

$$MP2600.x = \frac{I\ (N\ INT)\ [A] \cdot t\ [s] \cdot 60\ [s/min] \cdot MP2020.x\ [mm]}{\Delta V\ (ACT\ RPM)\ [mm/min]}$$

I (N INT) = integral-action component of the nominal current value

t = acceleration time in which I (N INT) remains constant

ΔV (ACTUAL RPM) = actual speed value during change

MP1054.x = traverse distance per motor revolution

MP2600.x **Acceleration feedforward**
Input: 0 to 100.0000 [A/(rev/s^2)]

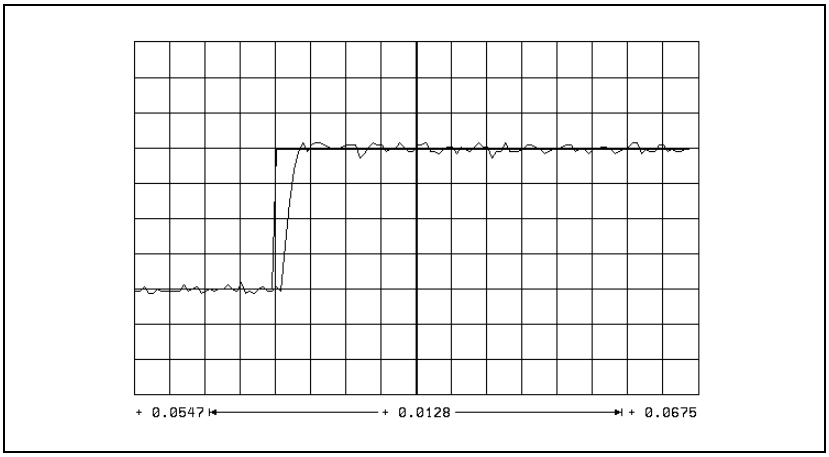
Limiting the integral factor

In machines with a great deal of stiction, a high integral-action component can accumulate if there is a position error at standstill. This can result in a jump in position when the axis begins moving. In such cases you can limit the integral-action component of the speed controller:

- Enter a limit in MP2512.x.
  Realistic input values: 0.1 to 2.0

MP2512.x **Limiting the integral factor of the speed controller**
Input: 0.000 to 30.000 [s]

You adjust the current controller to attain the optimum result, with the position and speed controller switched off.



The step response is adjusted such that there is no overshoot and the rise time is as small as possible:

- In MP2420.x, define the P factor of the current controller.
- In MP2430.x, define the I factor of the current controller.

MP2420.x **P factor of the current controller**
Input: 0 to 9999.99 [V/A]

MP2430.x **I factor of the current controller**
Input: 0 to 9 999 999 [Vs/A]

6.9 Offset Adjustment

Digital axes:

An offset adjustment at the output of the current controller is automatically compensated.

Analog axes:

The maximum permissible offset voltage in the control is 100 mV. If this voltage is exceeded, the error message **EXCESSIVE OFFSET IN <AXIS>** appears.

With the integral factor you can adjust an offset automatically:

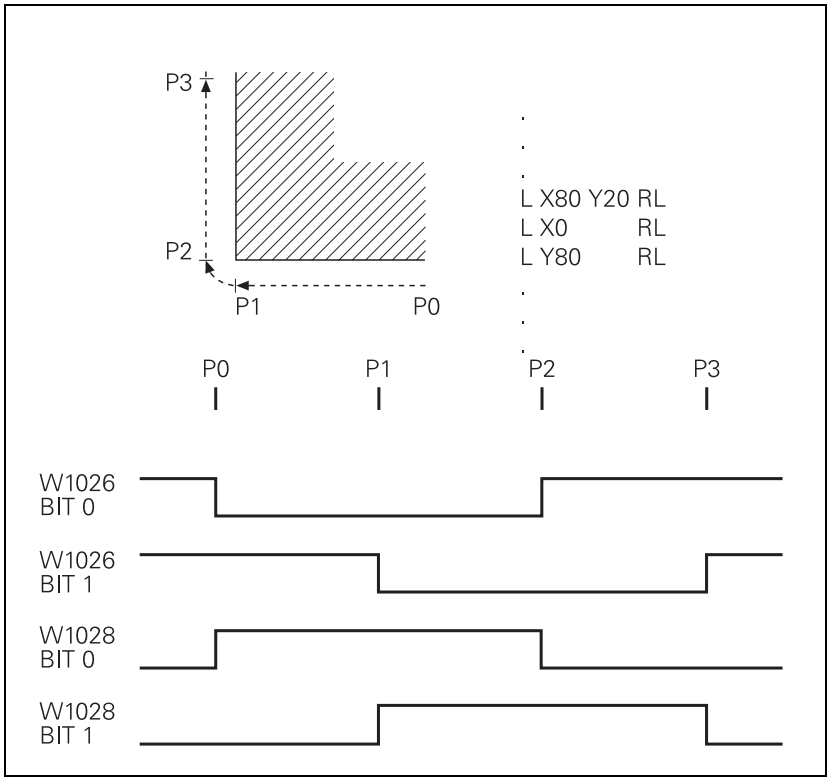
- Enter an integral factor in MP1080.x. The speed with which the offset is eliminated depends on the size of the factor.
- Play in the drives can result in instability in the control loop. In this case, enter the factor zero.

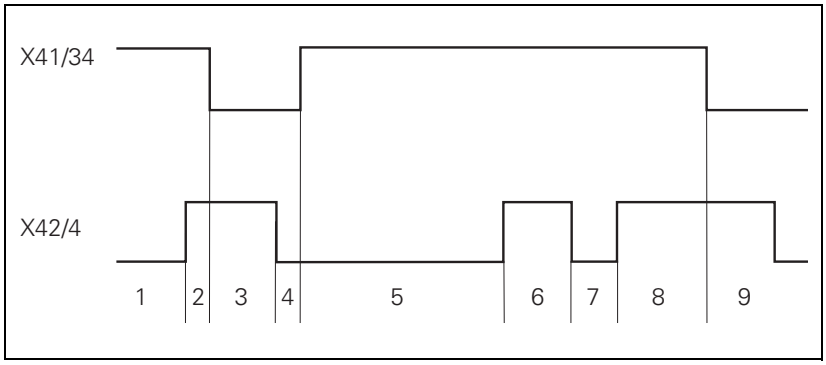
MP1080 is effective only at a standstill.

MP1080.x **Analog axes: Integral factor for offset adjustment**
Input: Input 0 to 65 535
Digital axes: nonfunctional
Input: 0

Axes in motion During axis movement, the NC sets the corresponding bits in W1028.

		Set	Reset
W1028	**Axes in motion** Bits 0 to 8 correspond to axes 1 to 9 0: Axis not in motion 1: Axis in motion	NC	NC





Step	Function	Screen display
1	Waiting for machine control voltage	**RELAY EXTERNAL DC VOLTAGE MISSING**
2	Recognition of the machine control voltage on X42/4 and switch-off of the control-is-ready signal on X41/34 by host computer (t < 66 ms)	
3	Maximum time within which the control-is-ready acknowledgment on X42/4 must go to zero (t < 1 s)	If exceeded **EMERGENCY STOP DEFECTIVE**
4	Recognition of the acknowledgment and setting of X41/34 (t < 20 ms)	
5	Waiting for machine control voltage	**RELAY EXTERNAL DC VOLTAGE MISSING**
6	Normal control operation. Control-is-ready output and acknowledgment are high.	
7	Control voltage is switched off externally.	**EMERGENCY STOP**
8	After switching on again, the machine control voltage can be switched off, and then the control operates normally.	
9	After detecting a fault, the control switches off the control-is-ready output (X41/34).	Blinking error message

Gear shifting

You control the gear shifting through PLC outputs. The NC enters the current gear range according to the programmed speed in W256. The gear range is calculated with MP3510.x. The output of the gear range is defined in MP3010. MP3030 bit 1 determines if the speed should be reduced to 0 when shifting between gears.

When the gear range is changed, the NC uses the G strobe (M4070). As soon as you confirm the gear shift with M4090, the program resumes and the G strobe (M4070) is reset by the NC.
If a TOOL CALL block is followed by the output of a T strobe and G strobe, then M4547 is set by the output of the T strobe and reset by output of the G strobe. If there is no output of either the T or G strobe, M4547 is not set.

In the PLC program you can change the programmed speed and the gear range that is calculated by the NC. This may be necessary, for example, for horizontal/vertical spindles. The programmed speed is saved by the NC in D356 and D756:

- Enter a speed in D756 and a gear range in W256. The speed must lie within the speed range of the gear.
- With M4134, activate your entries in D756 and W256.
- After the NC has reset M4134, change the gear and report with M4090 that the gear shift has been completed.

A changing nominal speed value can be output to shift gears by alternately setting and resetting M4009 and M4010. This can be realized by interrogating the timers in the PLC program. This function also works if you have used M4008 to disable the speed output for the spindle:

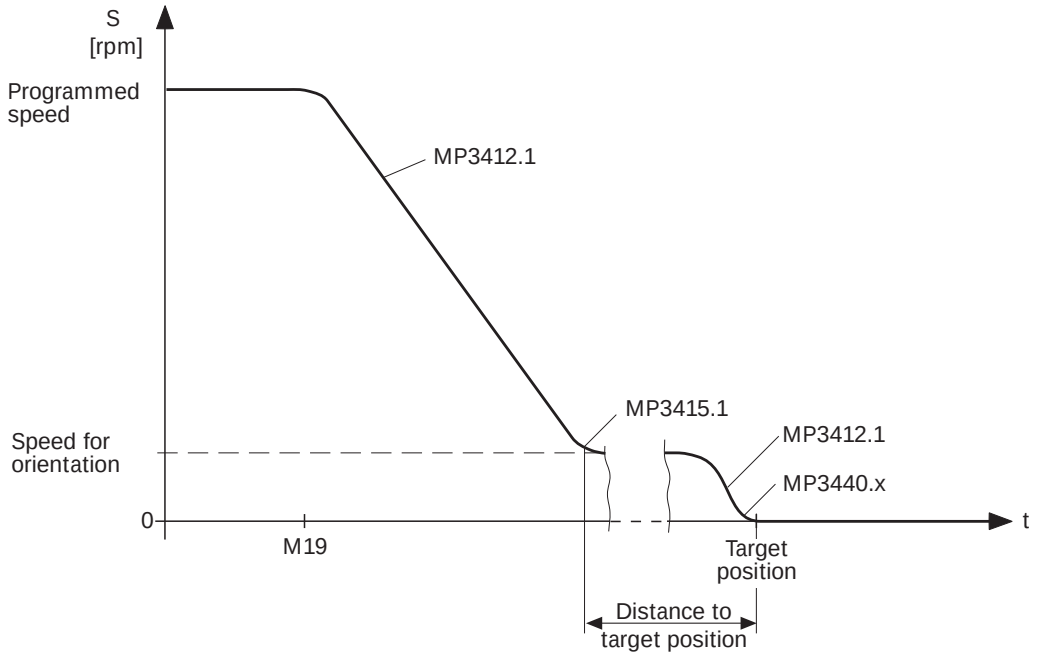
- In MP3240.2, define the nominal speed value that is output with M4009/ M4010 to the spindle motor.

MP3030 **Behavior of the spindle**
Input: Bit 1– Zero spindle speed when shifting to another gear range
0: Reduce speed to 0
1: Do not reduce speed to 0

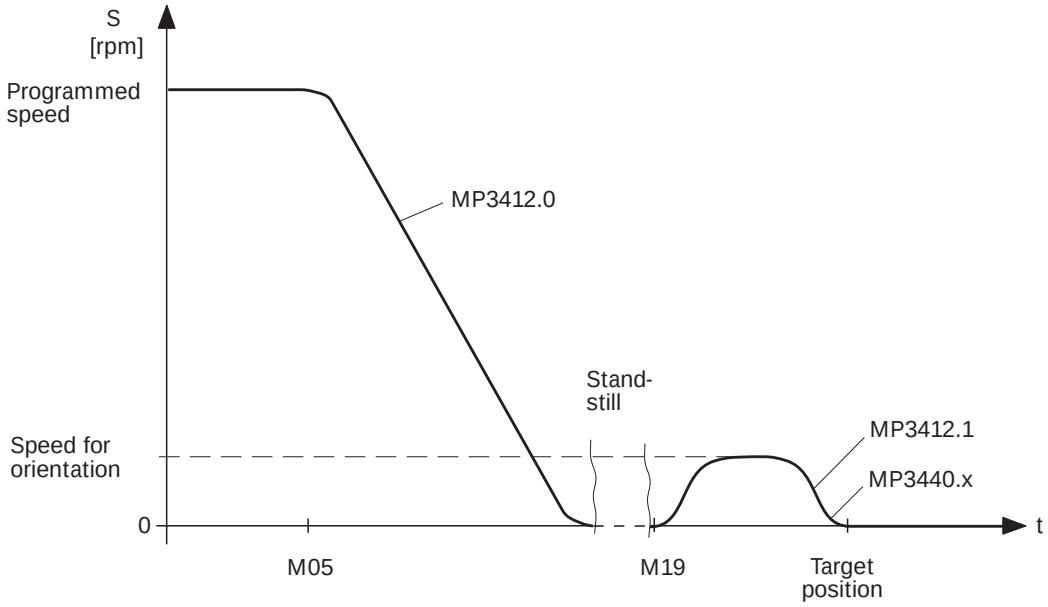
MP3240.2 **Analog spindle: Spindle jog voltage for gear shifting (M4009/M4010)**
Input: 0 to 9.999 [V]

MP3240.2 **Digital spindle: Motor speed for gear shifting (M4009/ M4010)**
Input: 0 to 9.999 [1000 rpm]

Orienting a moving spindle



Orienting a stationary spindle



Module 9175 Spindle switchover

With this module you can switch between spindle 1 and spindle 2. When switching via an M strobe, MP7440 bit 2 must not be set. When switching via an S or G strobe, MP3030 or MP13030, respectively, must not be set. The module only needs to be called once.

Call:

PS B/W/D/K <>Spindle number>
0: First spindle
1: Second spindle

CM 9175

Error detection:

Marker	Value	Meaning
M4203	0	Specified spindle active
	1	Error code in W1022
W1022	2	Invalid spindle number
	6	M4157 = 1 (RESTORE POSITION active)
	20	Module was called in a spawn job or submit job
	21	Missing strobe in M4176 = 1

Saving the recording

You can display the signal last recorded for a channel again by selecting the Saved signal.

With the SAVE SCREEN soft key in the Set up menu you can save the recorded signals with all settings in a file on the hard disk. The file must have the extension *.DTA. You can recall this file with the PLC development software PLCdesign.

6.14.4 Field Orientation

If a synchronous spindle is used along with an encoder without Z1 track or a nonaligned encoder with EnDat interface, there is no assignment between the encoder and rotor magnets.
With the FIELD ORIENTATION function, which must be run once during commissioning, the iTNC 530 automatically determines the assignment between the encoder and the rotor magnets (field angle) and saves this information on the hard disk. Of the FIELD ORIENTATION function is not run, the following error message appears:

- Encoder with EnDat interface: **8830 EnDat: no field angle <axis>**
- Encoder without Z1 track: **8820 field angle unknown <axis>**

Encoder with EnDat interface	Encoder without Z1 track
As soon as the absolute position of the encoder has been read, the assignment between absolute position and field angle is determined from the file.	After the drive has been switched on, the spindle is oriented automatically. Following that, the drive is ready for operation. As soon as the reference mark is traversed during the first movement of the spindle, the assignment of the field angle is determined from the file.

- Switch on the control.
- Do **not** acknowledge the **Power Interrupted** message. In the **Programming and Editing** mode of operation, use the MOD key to enter the coder number **688379.** The oscilloscope is started.
- Press the I CONTROL soft key.
- In the **Manual mode of operation,** acknowledge the **Power Interrupted** message.
- Use the CHOOSE AXIS soft key in the oscilloscope to select the corresponding axis.
- Press the FIELD ORIENT. soft key.
  The PLC must
  - switch the drive on/off.
  - release and lock the brakes

The spindle rotates with rated speed for the duration of approx. 2 s. During this period the field angle at the reference mark or datum is determined and automatically saved in a file on the hard disk.

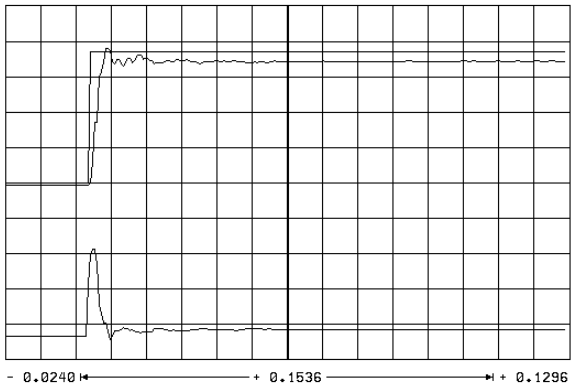
- Press the END soft key.

The control carries out a reset. Then the assignment of the field angle is available.
If an encoder with EnDat interface is used, the field angle is assigned to the zero position of the encoder.
If an encoder without Z1 track is used, the spindle is first roughly oriented after it has been started. Then the field angle can be assigned to the reference mark and the spindle starts, taking the field angle into account.

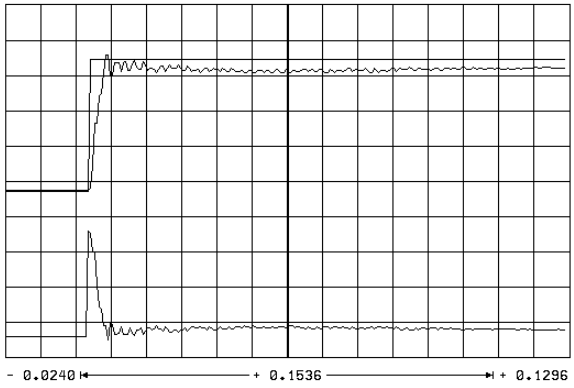
Note

If the speed encoder is exchanged, the field orientation function must be rerun.

- Compensate high-frequency interference oscillations (> 400 Hz) with MP2530.x or MP2560.x.



MP2530 optimum



MP2530 too small

▶ Test the three filter settings using a test part made of short line segments.

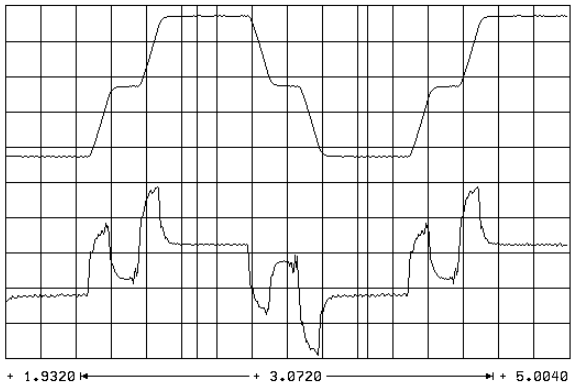
- Single filter
- Double filter
- HSC filter

Single filter (MP1099.0)

Damping [dB]	Frequency to be damped [Hz]										
	10	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
3	10	–	–	–	3	2	2	–	–	–	1
4	12	7	5	4	–	–	–	2	–	–	–
5	13	8	6	–	–	3	–	–	2	–	–
6	14	9	–	5	4	–	–	–	–	2	–
7	15	10	7	–	–	–	3	–	–	–	-
8	16	–	–	6	–	4	–	3	–	–	2
9	17	11	8	–	5	–	–	–	–	–	–
10	18	–	–	–	–	–	–	–	–	–	–
11	19	12	–	–	–	–	4	–	3	–	–
12	–	–	9	7	–	–	–	–	–	–	–

Double filter (MP1099.1)

Damping [dB]	Frequency to be damped [Hz]										
	10	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
3	7	4	3	2	–	–	1	1	–	–	–
4	8	5	–	–	2	–	–	–	1	–	–
5	9	6	4	3	–	2	–	–	–	1	–
6	10	–	–	–	–	–	–	–	–	–	1
7	11	7	5	–	3	–	2	–	–	–	–
8	–	–	–	4	–	–	–	–	–	–	–
9	12	8	–	–	–	–	–	2	–	–	–
10	13	–	6	–	–	3	–	–	–	–	–
11	–	–	–	–	–	–	–	–	2	–	–
12	14	9	–	5	4	–	–	–	–	–	–



▶ Calculate MP2620.x:

$$MP2620.x = \frac{I\,NOML_1 - I\,NOML_2}{2}$$

In the event that the motor cannot be driven at the rated speed:

▶ Measure I NOMINAL at maximum speed (rapid traverse) and calculate the current at rated speed as follows:

$$MP2620.x = \frac{(I_{max} - MP2610.x) \cdot \text{<rated speed>}}{n_{max}} + MP2610.x$$

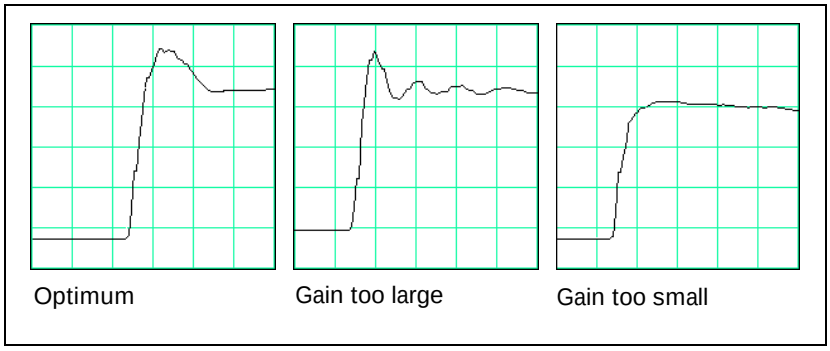
I_{nmax}: Current at rapid traverse

n_{max}: Shaft speed at rapid traverse

▶ Perform a coarse velocity adjustment:

- Set MP1010.x (rapid traverse) and MP1050.x (analog voltage at rapid traverse).
- With the internal oscilloscope functions, output the nominal value step at the height for rapid traverse.
- Record U ANALOG and check the voltage.
- Use a tachometer to measure the rotational speed of the motor and a tacho-potentiometer at the servo amplifier to adjust the nominal speed for rapid traverse.
- Connect an oscilloscope to the tachometer of the motor.
- Test the step response on the tachometer during the step output.

▶ Adjust the proportional (P) component and the integral-action (I) component of the speed controller at the servo amplifier



Determining the acceleration

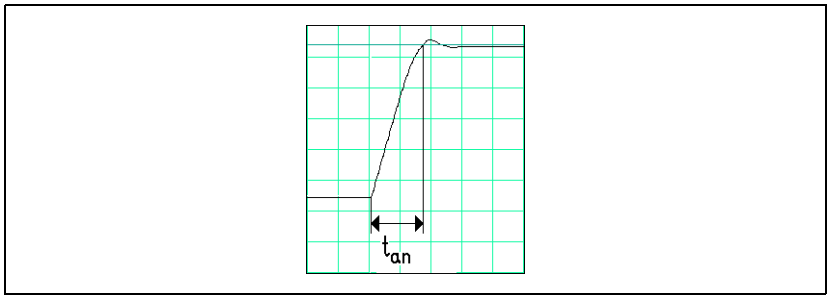
After adjusting the servo amplifier, you can determine from the step response the maximum possible acceleration:

$$a = \frac{F_{max}}{t_{an} \cdot 60\,000}$$

a: Acceleration [m/s^2]

F_{max}: Maximum machining feed rate (MP1010.x) [mm/min]

t_{an}: Rise time [s]



▶ Enter the maximum possible acceleration in MP1060.x.

MP7354 "Machine" program text display
MP7354.0 Background
MP7354.1 General program text
MP7354.2 Active block
MP7354.3 Background of inactive window

MP7355 "Programming" program text display
MP7355.0 Background
MP7355.1 General program text
MP7355.2 Active block
MP7355.3 Background of inactive window

MP7356 Status window and PLC window
MP7356.0 Background
MP7356.1 Axis positions in the status display
MP7356.2 Status display other than axis positions

MP7357 "Machine" soft-key display
MP7357.0 Background
MP7357.1 Symbols

MP7358 "Programming" soft-key display
MP7358.0 Background
MP7358.1 Symbols

MP7360 Graphics: 3-D view
MP7360.0 Background
MP7360.1 Top surface
MP7360.2 Front face
MP7360.3 Text display in the graphics window
MP7360.4 Lateral face
MP7360.5 Lowest point of blank form
MP7360.6 Highest point of blank form (below surface)

MP7361 Graphics: Projection in three planes
MP7361.0 Background
MP7361.1 Top view
MP7361.2 Front and side view
MP7361.3 Axis cross and text in the graphic display
MP7361.4 Cursor

MP7362 Additional text display in the graphic window and pocket calculator
MP7362.0 Background of graphic window and pocket calculator
MP7362.1 Background of status display and keys of the pocket calculator
MP7362.2 Status symbols and symbols of the pocket calculator (c in "cos")
MP7362.3 Status values and texts of the pocket calculator (os in "cos")

MP7363 Programming graphics
MP7363.0 Background
MP7363.1 Resolved contour
MP7363.2 Subprograms and frame for zooming
MP7363.3 Alternative solutions
MP7363.4 Unresolved contour

7.2.2 Vertical PLC soft keys (only on BF 150)

To display the vertical PLC soft keys on the BF 150, a resource file is required. The PLC soft-key structure is defined in the resource file. The number of submenus depends only on the iTNC memory.

In the OEM.SYS file, the PLC soft-key project file *.SPJ is entered through the keyword **SOFTKEYPROJECT =.** After acknowledgment of **Power interruption** the resource file of the same name *.SYS is generated from this file. The resource file is activated with PLC Module 9203. The resource handle returned by this module must be transferred to Modules 9204 to 9208.

The soft-key structure is displayed with Module 9204. This is necessary after a resource file has been activated (also after it has been activated for the first time) and after soft-key setup parameters have been edited (with Module 9205).

In the standard setting the soft-key number is transferred to the PLC via W304 after the NODE, BACK and ACTION soft keys have been pressed. When the key is released, –1 is confirmed. PULSE, CHECK and RADIO soft keys are not reported via W304 to the PLC. With Module 9205, you can also select a word address other than W304. BLANK soft keys are not reported to the PLC.

Entry in the *.SPJ	Meaning
;	Comment
SKPATH	Path of the soft-key graphic files
SOFTKEY	Soft-key definition. The name of the soft-key graphic file and the name of the soft key must be specified. The maximum permissible length of the soft-key name is 23 characters. First entry = soft-key number 0, Second entry = soft-key number 1, etc. With ACTION soft keys, the soft-key number is confirmed via W304 (unless changed by Module 9205) to the PLC.
SKMENU	Beginning of the definition of a soft-key menu. The name of the menu must be specified.
ENDSKMENU	End of the definition of a soft-key menu
NODE	Soft key jumps to a submenu. Is confirmed via W304 (unless changed by Module 9205) to the PLC. The soft-key name and the name of the submenu must be indicated.
BACK	Soft key jumps to a submenu. Is confirmed via W304 (unless changed by Module 9205) to the PLC. The soft-key name and the name of the submenu must be indicated.
BLANK	Vacant soft key. You can also specify a soft-key name.
ACTION	Function soft key. Is confirmed via W304 (unless changed by Module 9205) to the PLC. A soft-key name must be indicated.

Entry			Description
INFO	MAIN PGM		Started NC program or NC macro
INFO	MAIN LINE		Line number of the started NC program or NC macro
INFO	MAIN PATH	PLCEDIT	File for PLC Editor
		NCEDIT	File for NC Editor
		RUNPGM	Main program for program run
		RUNPALET	Pallet table for program run
		RUNDATUM	Datum table for program run
		RUNTOOL	Tool table for program run
		RUNTCH	Pocket table for program run
		SIMPGM	Main program for program test
		SIMDATUM	Datum table for program test
		SIMTOOL	Tool table for program test
		RUNBRKPGM	Stopping point for block scan
		SIMBRKPGM	Stopping point for program test
		RUNPRINT	Path for FN15: PRINT for program run
		SIMPRINT	Path for FN15: PRINT for program test
		MDIPGM	File for positioning with manual data input
		NCFMASK	Mask for file management in the NC area
		PLCFMASK	Mask for file management in the PLC area
		EASYDIR	Paths for standard file management
		TCHPATH	Datum table for manual measurement
		SIMTAB	Freely definable table in program test
		RUNTAB	Freely definable table in program run
		KINTAB	Active kinematic table
		PGMEND	Information about the program end in program run Byte 0/1 00 01 Emergency stop 00 02 Positioning error 00 03 Programmed stop 00 04 Block end in single block mode 00 05 Geometry error 00 06 END PGM, M02 00 07 TNC STOP button 00 08 Data transmission error (V.24/V.11) Byte 2/3 xx xx Internal error class Byte 4...7 xx xx xx xx Internal error code
INFO WARNING ERROR	PLC <log identifier>		Entries through PLC Modules 9275 and 9276

8.1.4 The TRACE Function

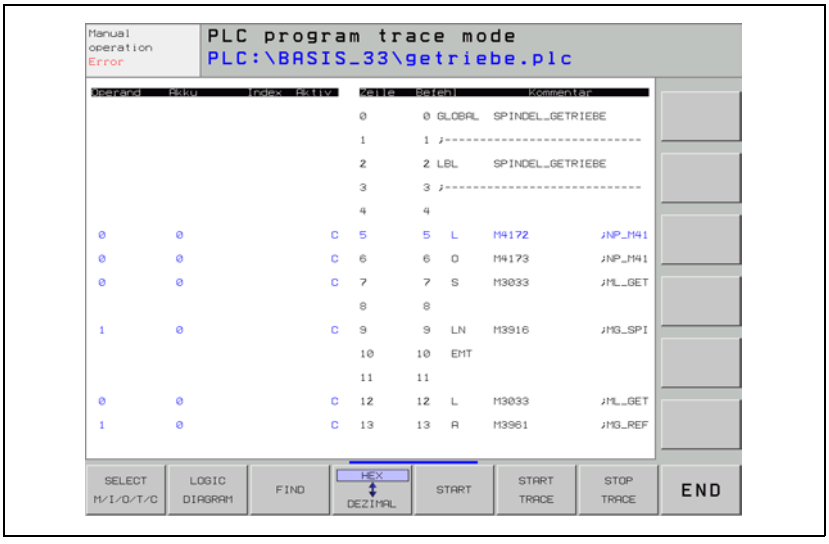
With the TRACE function you can:

- Control the logical states of markers, inputs, outputs, timers, and counters
- Check the content of bytes, words and double words

Select the TRACE function through the TRACE soft key in the PLC main menu. The TNC displays:

- The statement list (STL) of the selected PLC program
- For every program line, the content of the operand and the accumulator in HEX or decimal code (selectable by soft key)

The TNC identifies every cyclically executed command with an asterisk **(*)**. With the arrow keys or the GOTO function you can select the program section that you would like to see on the screen.
The PLC program to be selected is chosen with PGM MGT, and must be the currently active main program or a file integrated with USES.



KINEMATIC =

Path for the assignment table of the tilting-axis geometry description.

Input example: **KINEMATIC = PLC:\KINELIST.TAB**

REMOTE. LOCKSOFTKEY VISIBLE =

Display **External access ON/OFF** soft key.

Input example: **REMOTE.LOCKSOFTKEYVISIBLE = YES**

REMOTE. PLCPASSWORD NEEDED =

Access to the PLC partition using the LSV2 protocol only with the password from **PLCPASSWORD =**

Input example: **REMOTE.PLCPASSWORDNEEDED = YES**

REMOTE. PLCPASSWORD FORCED =

Setup, machine backup and full backup only with the password from **PLCPASSWORD =**

Input example: **REMOTE.PLCPASSWORDFORCED = YES**

AXISNUMBER =

Number of the indexes of the machine parameters (except MP2xxx.y) in the machine-parameter file.

Input example: **AXISNUMBER = 6**

PWM PARAMETER =

Number of the indexes of machine parameters MP2xxx.y (for the current and speed controller) in the machine-parameter file.

Input example: **PWMPARAMETER = 6**

NUMBERMP4111 =

Number of required timers > 96. The corresponding number of machine parameters MP4111.96 to MP4111.x is created.

Input example: **NUMBERMP4111 = 10**
(machine parameters MP4111.96 to MP4111.105 are created)

LOGO =

Path for customer-specific company logo during control power-up

Input example: **LOGO = PLC:\LOGO\OEM-LOGO.BMP**

SOFTKEY PROJECT =

Path for PLC soft-key project file *.SPJ with the structure of the vertical PLC soft key

Input example: **SOFTKEYPROJECT = PLC:\SOFTKEY.SPJ**

Group name	Group number ID....	System data number NR....	System data index IDX....	System data item
Coordinate transformation				
		4	1	Transformation of the manual mode coordinate system into the active coordinate system (e.g. rotated, shifted).
			2	Transformation of the active coordinate system (e.g. rotated, shifted) into the manual mode coordinate system.
		5	5	Ask if due to a tilt motion, an axis is shown in an untilted coordinate system on top of another axis. The number of the first of two sequential Q parameters must be given. It contains the axis to be asked (0 = X, 1 = Y, 2 = Z). The second Q parameter should return the corresponding image (0 = X, 1 = Y, 2 = Z, –1 = Axis has no image).
		8	–	Spindle orientation including the angle
PLC data				
	2000	10	Marker no.	PLC markers

MP4210.0-47 Setting a number in the PLC (D768 to D956)
Input: -99 999.9999 to +99 999.9999

MP4220.0-4 Setting a number in the PLC (W960 to W968)
Input: 10 to 30 000

MP4230.0-31 Setting a number in the PLC (Module 9032)
Input: -99 999.9999 to +99 999.9999

MP4231.0-31 Setting a number in the PLC (Module 9032)
Input: -99 999.9999 to +99 999.9999

MP4310.0-6 Setting a number in the PLC (W976 to W988, M4300 to M4411)
Input: 10 to 30 000

Module 9032 Read machine parameters
With this module you can read the value of the given machine parameter from the active machine parameter file. The input value is transferred as a natural number with the decimal point shifted by the number of possible decimal places.

Only the value from the editable machine parameter file is read, not any value modified in the run-time memory by PLC Module 9031.

For non-indexed machine parameters, zero must be transferred as the index.

Call only in a submit job.

Call:

PS	B/W/D/K	<MP number>
PS	B/W/D/K	<MP index>
CM	9032	
PL	B/W/D	<MP value / Error code>
		1: MP number does not exist
		2: No separator (:)
		3: MP value out of range
		4: MP not found in file
		5: No MP file found
		6: Call was not in a submit job
		7: MP is of the “string” type
		8: No system memory

9 Data Interfaces

9.1 Ethernet Interface

9.1.1 Software

The TNC requires an NFS server (Network File System) as the remote station. The NFS server must work according to the TCP/IP protocol principle. The remote station must be an NFS server.

OSI 7-layer model		TNC
7	Application layer	NFS
6	Presentation layer	
5	Communications layer	
4	Transport layer	TCP protocol
3	Network layer	IP protocol
2	Data link layer	Ethernet card
1	Physical layer	

Before networking, the TNC must be properly configured. Please discuss the required settings with your network supervisor.

Error message	Cause	Corrective action	As of NC SW
8B70 External drive lock <axis>	■ The drive switch-on is blocked by one or more external signals: • EMERGENCY STOP (TNC 4xx P and M) • PFAIL (TNC 4xx P and M) • NO (TNC 4xx P)	■ Check the external enabling signals. ■ Check the PLC program. ■ Check the external wiring. ■ Inform your service agency.	340 420-01
8B80 External drive stop <axis>	■ The drive is switched off through an external signal: • EMERGENCY STOP (TNC 4xx P and M) • PFAIL (TNC 4xx P and M) • NO (TNC 4xx P)	■ Check the external enabling signals. ■ Check the PLC program. ■ Check the external wiring. ■ Inform your service agency.	340 420-01
8B90 No field orientation <axis>	■ No field orientation was performed. ■ Serial number has changed. ■ Field orientation was not possible.	■ Run a field orientation. ■ Inform your service agency.	340 420-01
8BA0 Incorrect line count <axis>	■ Incorrect entry in motor table. ■ Faulty reference signal. ■ Noise pulses. ■ Encoder cable is defective.	■ Inform your service agency. • Check the entry in the motor table. • Check the motor encoder cable. • Exchange the motor encoder cable. • Exchange the motor.	340 420-01
8BC0 Motor current <axis> too high	■ Incorrect current controller parameters. ■ Incorrect parameters in the motor table. ■ Power module defective. ■ Motor cable defective. ■ Motor defective. ■ Motor control board defective.	■ Inform your service agency. • Are the correct motor and power module selected? • Check the current control adjustment. • Check the motor and motor cable for a short circuit. • Exchange the power module or drive control board.	340 420-01

Error message	Cause	Corrective action	As of NC SW
C450 Incorrect encoder <axis>	■ Incorrect encoder selected in the motor table, e.g. linear encoder instead of rotary encoder, EnDat encoder instead of encoder with Z1 track. ■ Motor encoder cable is defective. ■ Motor encoder defective. ■ Motor control board defective.	■ Inform your service agency. • Correct the encoder entry in the motor table. • Check the motor encoder cable. • Exchange the motor. • Exchange the motor drive control board.	340 420-01
C460 Motor speed too high <axis>	■ The selected contouring feed rate (MP1010.x) is greater than the maximum motor speed.	■ Inform your service agency. • Check the entry in MP1010.x.	340 420-01
E120 Safe function call error	■ Internal software error.	■ Inform your service agency. • Check software version.	340 420-01
E140 Current to axis <axis> not equal 0	■ Motor current was determined during cutout channel test (24-hour test).	■ Inform your service agency. • Check the inverter.	340 420-01
E150 Inverter <axes> ready	■ RDY status of the inverter is HIGH instead of LOW.	■ Inform your service agency. • Check the inverter. • Check the cabling of the cutout channels.	340 420-01
E160 Inverter <axis> not ready	■ RDY status of the inverter is LOW instead of HIGH.	■ Inform your service agency. • Check the inverter. • Check the cabling of the cutout channels.	340 420-01
E130 Position error too large <axis>	■ MP650 too small. ■ Incorrect mounting of position encoder. ■ Incorrect temperature compensation, linear or nonlinear compensation, or reversal error.	■ Inform your service agency. • Correct MP640. • Check the encoder mounting. • Check the compensation.	340 420-01