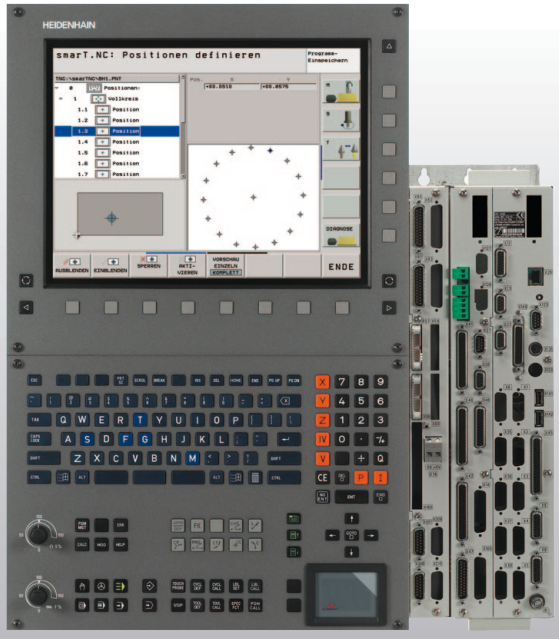
HEIDENHAIN

Technical Manual



iTNC 530

NC Software
340 490-06
340 491-06
340 492-06
340 493-06

February 2011

10 Data Interfaces

Module 9132 Selection of override potentiometer

In a control system with more than one HSCI machine operating panel or keyboard unit, you can use Module 9132 to define which potentiometers are to be active. The selected operating panel or keyboard unit uses the potentiometer values to calculate the override.

If you use more than one operating station or machine operating panel, the PLC program must ensure that only one of the two operating devices is active at any one time so as to avoid danger to the operator.

Condition:

- The override potentiometers are selected by selecting the machine operating panel to which the potentiometers are connected.
- The numbering of the machine operating panels starts with the number 0 and is based on the arrangement or sequence in the IOC configuration or the HSCI string. A machine operating panel or PLB 6001 at connector X501 of the MC always receives the last, i.e. the highest number of the machine operating panels in the HSCI system.
- After the control has been restarted and the PLC has been restarted/ compiled, the potentiometers on the machine operating panel with the number 0 are active. If you want the previously active operating panel to be active again, the PLC program must write the corresponding information to the nonvolatile memory and evaluate it during a restart of the PLC.
- Basically, there is no switchover of operation between the machine operating panels or the keyboard units. Only the evaluation of the potentiometers is switched.

Call:

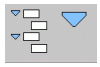
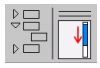
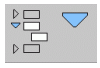
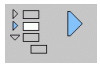
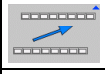
```
PS    K/B/W/D  <Number of machine operating panel>
                 0 ... n
PS    K/B/W/D  <Reserved>
PS    K/B/W/D  <Reserved>
CM    9132
```

Error recognition:

Marker	Value	Meaning
M4203	0	No error
	1	Error code in W1022
W1022	2	Programmed MB machine operating panel does not exist

Soft keys for HSCI/ PROFIBUS diagnostics

The following soft keys are available in the main menu for bus diagnosis:

Soft key	Submenu	Function
HSCI		Select the HSCI or PROFIBUS bus system
PROFIBUS		
		Open the HSCI/PROFIBUS tree
		Shrink the HSCI/PROFIBUS tree
		Move the separating line (enlarge/reduce the window size)
		
MORE FUNCTIONS		Opens the submenu with additional functions
		Move the state window up or down
		
		Open/Close HSCI/PROFIBUS slaves
		
	FIND	Find an HSCI/PROFIBUS component
		Return to the previous soft key row
END		Exit the BUS diagnostics

Navigation with the arrow keys of the operating panel:

- ↓, ↑ Select an HSCI/PROFIBUS component
- → (or + key) Open the HSCI/PROFIBUS component for the connected modules or terminals to appear
- ← (or – key) Close the HSCI/PROFIBUS component

If filtered air is blown into the electrical cabinet for cooling purposes, the standard EN 61800-5-1 applies.

Danger

Be sure to take the measures required for preventing dust or water from entering the electrical cabinet or the housing.
Dust depositing inside electrical devices may cause them to fail and impair the safety of the system. Max. contamination level 2 is permitted for the components.

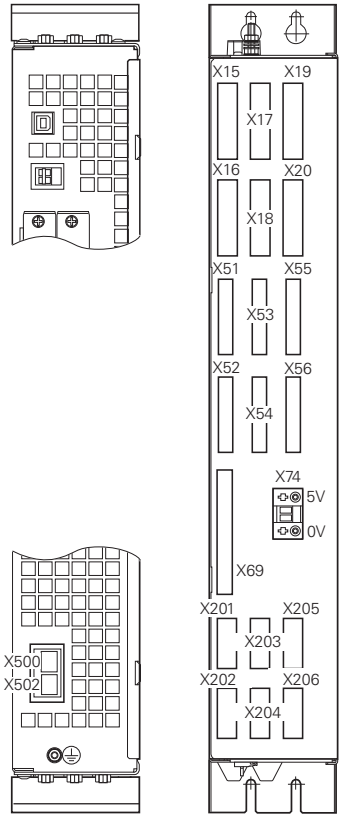
All electric and electronic control components must be installed in an environment (e.g. electrical cabinet, housing) that fulfills the requirements of protection class IP54 (dust and splash-proof protection) in order to fulfill the requirements of contamination level 2.

1.6 Storage and Operating Temperatures

1.6.1 Limit values

Device	Air approaching the device in the panel / electrical cabinet	Temperature range outside the panel / electrical cabinet
MC 6xxx in panel without HDR	0°C to +50°C	0°C to +45°C (no direct exposure to sunlight)
MC 6110, MC 6120	0°C to +50°C	0°C to +45°C (no direct exposure to sunlight)
MC 6210	0°C to +50°C	0°C to +45°C (no direct exposure to sunlight)
MB 6xx, TE 6xx, PLB 6001	0°C to +50°C	0°C to +45°C
HR 4xx, HR 5xx		0°C to +45°C
MC 6x41	+5°C to +40°C	
PLB 61x, PLB 62x, PLD-H, PLA-H	+5°C to +40°C	
BF 2xx	0°C to +50°C	0°C to +45°C (no direct exposure to sunlight)
HDR hard disk	+5°C to +55°C	0°C to +45°C (no direct exposure to sunlight)
CompactFlash card	0°C to +70°C	0°C to +45°C (no direct exposure to sunlight)

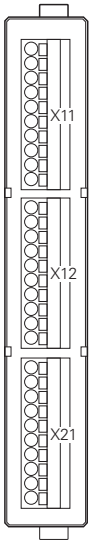
Function	CC 61xx	CC 424
Following error in the jerk phase (MP2606.x)	Same as CC 424	Typical input values: 0.001 to 0.005
Stick-slip friction compensation (MP2610.x, MP2612.x, MP2614.x)	Same as CC 424	Feed-rate independent; MP2610.x same meaning as previously (effective values, readjustment necessary), MP2612 has new meaning MP2614.x is new
Stick-slip friction compensation (MP1511.x, MP1512.x)	Same as CC 424	MP1511.x and MP1512.x can only be used for analog axes. MP2610.x, MP2612.x and MP2614.x should be used for digital axes.
Multiplication factor for k_V factor and kink point	Same as CC 424	MP1820.x and MP1830.x are only supported for analog axes.
Filter in the speed control loop	Same as CC 424	MP2530.x, MP2540.x, MP2550.x and MP2560.x removed, New machine parameters MP2542.x to MP2546.x, MP2552.x to MP2556.x, MP2562.x to MP2566.x, MP2572.x to MP2576.x, MP2560.x has new meaning
Master-slave torque control	In master-slave-torque mode, the PWM outputs of the master and slave axes must always be operated on the same DSP (meaning the same drive-control motherboard for the CC 61xx), i.e. the master and slave axes must be operated with the same power. More slave axes are possible for the CC 61xx than before, e.g. up to five slave axes are possible for a CC for six axes.	As of 340 422-06: The PWM outputs of the master and slave axes must always be operated on the same DSP ("Single speed" setting).
Gantry axes and master-slave-torque control	The PWM outputs of the master and slave axes in gantry mode of operation do not need to be operated on the same DSP (with CC 61xx, they can therefore be distributed to different CCs).	
Reading the absolute value of encoders with EnDat interface	Same as CC 424	The absolute value can be read out again via the **PASS OVER REFERENCE** soft key or via Module 9220 (i.e. after the exchange of milling heads).

CC 6106, controller unit with 6 control loops and HSCI interface			
Pin layout	**Connector**	**Function**	**Page**
	X15 to X20	Speed encoder	
	X51 to X56	PWM output	
	X69	Supply bus	
	X201 to X206	Position encoder	
	X500	HSCI output	50
	X502	HSCI input	50
	–	SPI slot 1 (on bottom, reserved for expansion modules)	
	–	SPI slot 2 (on bottom, reserved for expansion modules)	
	X74	+ 5 V supply	112
	X7	Bridge for signal ground (on bottom)	112
	⏚	Protective ground	

Attention

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

PLD-H 16-08-00

Pin layout	Connector	Function	Page
	X11	PLC inputs	136
	X12	PLC inputs	136
	X21	PLC outputs	137

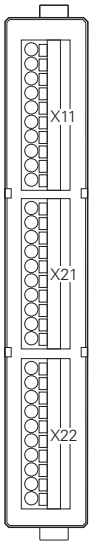
Diagnosis (meanings of the LEDs):

- Red (X11/pin 1) status LED
  - Flashes: status of I/O module OK
  - Permanently on or off: error on I/O module
- Yellow (per output): Status of the output

Error recognition:

- **Short circuit:** A short circuit is reported when a current >= 20 A flows for approximately 3 ms. Both the output-specific message and the group message are modal.
  After the short circuit has been removed, the PLC must reset the output before it can be activated again.
- **Open circuit operation (line break):** With load currents <= 300 mA, the PLD 16-8 reports a line breakage.

PLD-H 08-16-00

Pin layout	Connector	Function	Page
	X11	PLC inputs	136
	X21	PLC outputs	137
	X22	PLC outputs	137

Diagnosis (meanings of the LEDs):

- Red (X11/pin 1) status LED
  - Flashes: status of I/O module OK
  - Permanently on or off: error on I/O module
- Yellow (per output): Status of the output

Error recognition:

- **Short circuit:** A short circuit is reported when a current >= 20 A flows for approximately 3 ms. Both the output-specific message and the group message are modal.
  After the short circuit has been removed, the PLC must reset the output before it can be activated again.
- **Open circuit operation (line break):** With load currents <= 300 mA, the PLD 08-16 reports a line breakage.

1.12 PSL13x Low-Voltage Power Supply Unit

1.12.1 General information

PSL 130 power supply unit for HSCI components with +24-V power supply when using a HEIDENHAIN inverter system. The **PSL 130** power supply unit was conceived in order to be able to provide the HSCI components of the iTNC 530 with +24-V NC voltage and +24-V PLC voltage. The output voltages of the **PSL 130** fulfill the requirements for Protective Extra Low Voltage (PELV) according to EN 50178. The power supply unit is powered with line voltage (L1, L2) and the DC-link voltage Uz. This is used to produce the +24-V NC and +24-V PLC output voltages. ID 575 047-xx PSL 130	
PSL 135 power supply unit for supplying the HSCI components in a double-row configuration. The **PSL 135** power supply unit was conceived in order to be able to provide the HSCI components of the iTNC 530 with +24-V NC voltage, + 24-V PLC voltage and +5 V. The output voltages of the **PSL 135** fulfills the requirements for Protective Extra Low Voltage (PELV) according to EN 50178. The power supply unit is powered with line voltage (L1, L2) and the DC-link voltage Uz. This is used to produce the +24-V NC, +24-V PLC and +5-V output voltages. ID 627 032-xx PSL 135	

X79: Unit bus Connection:

40-pin ribbon connector	Pin layout	
1a to 3b	0 V *1	These voltages must not be linked with other voltages (only basic insulation)!
4a	+24 V *1	
4b	+24 V *1	
5a	+15 V *1	
5b	+24 V *1	
6a	+15 V *1	
6b	+15 V *1	
7a to 8b	Do not assign	
9a	Reserved (SDA)	
9b	Do not assign	
10a	Reserved (SCL)	
10b	$\overline{\text{ERR.TEMP}}$	
11a	$\overline{\text{PF.PS}}$	
11b	0 V	
12a	$\overline{\text{RES.PS}}$	
12b	0 V	
13a	$\overline{\text{PWR.OFF}}$	
13b	0 V	
14a	5 V FS (spindle enable)	
14b	0 V	
15a	5 V FA (axis enable)	
15b to 16b	0 V	
17a and 17b	–15 V	
18a and 18b	+15 V	
19a to 20b	+5 V	

Danger

The interface complies with the requirements of EN 61800-5-1 for low voltage electrical separation (except for 1a to 6b).

1.18 TE 635Q Keyboard Unit

General information

The new operating panel is the TE 630 plus the machine operating keys.

Technical characteristics:

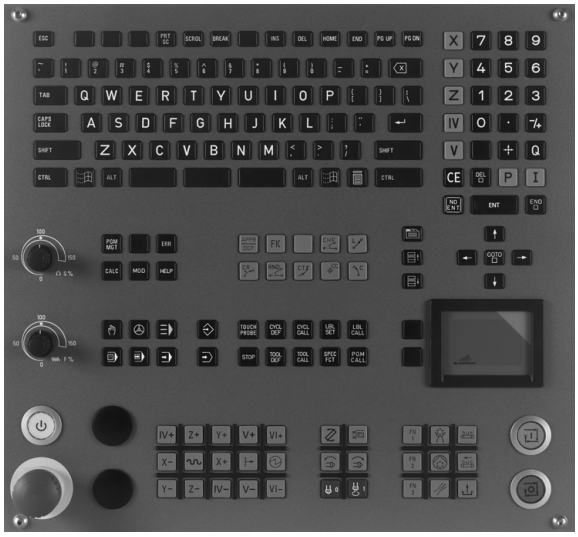
- Weight: 3.3 kg
- Fulfills IP54 degree of protection when installed

NC operating panel:
Same features as TE 630

Machine operating panel:

- 6 axis-direction keys
- 16 function keys
- Keys for NC start and NC stop (illuminated)
- Keys for spindle start and spindle stop
- All keys in the machine operating panel are snap-on keys.
- EMERGENCY STOP key
- Key for control voltage ON (RAFI key, illuminated)
- Two bore holes (22 mm) for additional RAFI buttons (shipped blocked with a cover) or keylock switches
- HSCI interface

ID 617 975-xx TE 635Q



Machine operating panel

The description of the TE 635Q machine operating panel is the same as that of the MB 620, see page 166.

Danger

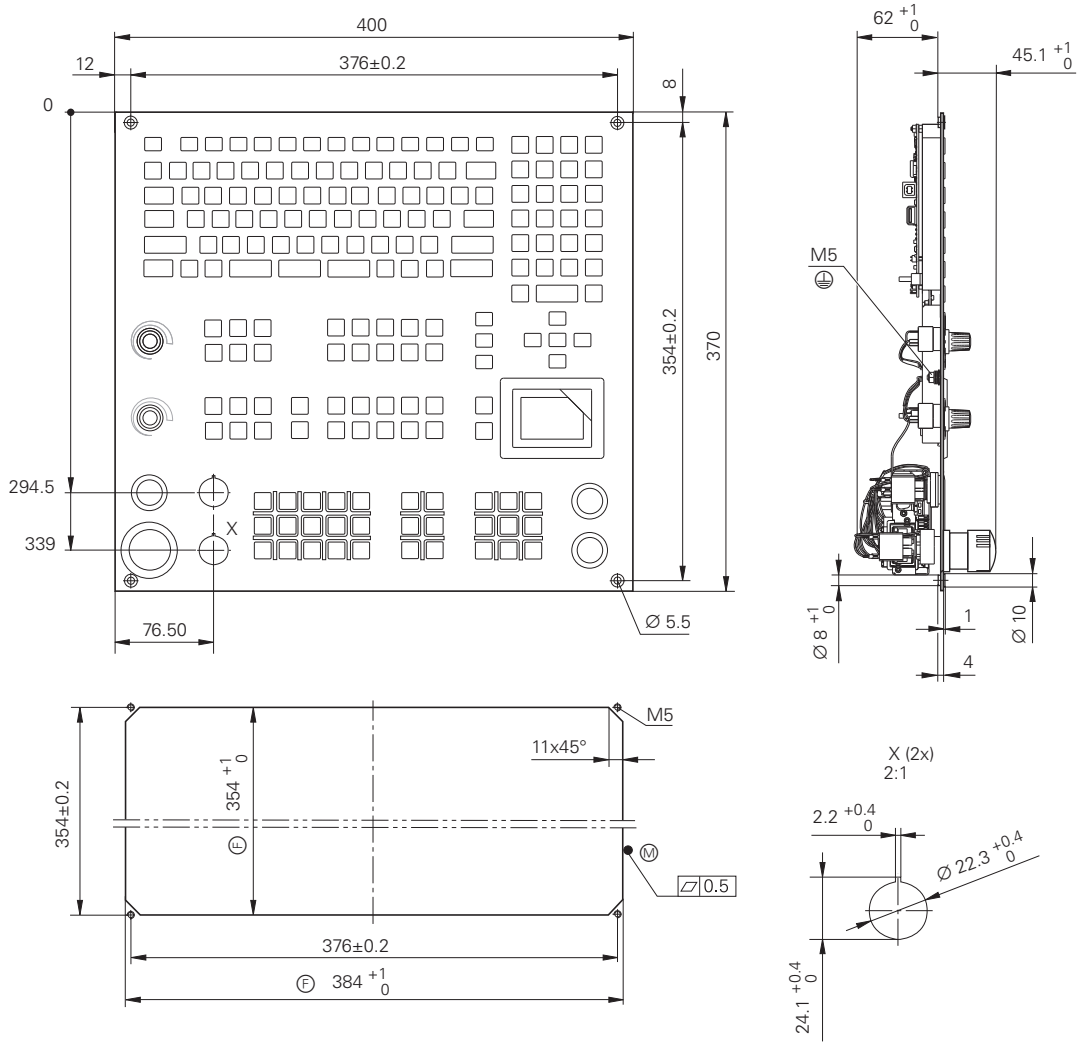
Please note that the TE 635Q is powered by +24-V NC.

For the entire HSCI system, the +24 V NC supply voltage is required to be safely separated voltage. The +24 V NC supply voltage must not, under any circumstances, be connected with the +24 V PLC supply voltage, because this removes the double basic insulation.

Keyboard unit

The description of the TE 635Q control panel corresponds to the description of the TE 630, see page 179.

1.21.12 TE 535Q



1.2.3 New Functions

HEIDENHAIN will introduce the described, new functions only with the following service packs:

- NC software 606 42x-01 SP 02 (December 2010)
- NC software 340 49x-06 SP 02 (December 2010)
- NC software 340 49x-05 SP 07 (December 2010)

Profibus telegram repetitions

With the above-mentioned software versions, the HEIDENHAIN Profibus master can execute telegram repetitions if there are errors in the Profibus communication. This function is activated via the entry **__JHDP_RETRY=x** in MP4000.x. To do so, the x must be replaced by the required maximum number of telegram repetitions, e.g. **__JHDP_RETRY=5**. The permissible range for x is 0 to 15. If a number above 15 is entered, it is automatically limited to 15. Previously, the occurrence of telegram repetitions immediately triggered an Emergency Stop. This is still the default setting.

When activating Profibus telegram repetitions it must be noted, however, that the occurrence of telegram repetitions influences the time response of the entire Profibus data transfer. This can have massive effects on the time response of the PLC program, as the updating times of the inputs and outputs can vary considerably.

Attention

Do not activate telegram repetitions in PLC programs that depend on fixed update intervals for the inputs and outputs.
Repetitions of Profibus telegrams can cause delays of one or more PLC cycles while reading PLC inputs.

The PLC program does not recognize the occurrence of telegram repetitions below the set maximum number.

If the number of required telegram repetitions exceeds the configured maximum number, an error message with an Emergency Stop reaction is triggered.

1.2.7 Important notes on the radio network of the wireless handwheel system

The HEIDENHAIN wireless handwheel system uses the ISM band in the frequency range of 2.405 GHz to 2.480 GHz up to a maximum transmission power of 10 mW. As the ISM band generally is a freely accessible frequency range worldwide (country-specific restrictions must be checked individually for the country of destination), many radio systems have been developed for this range. As other radio systems can disturb the radio transmission of the wireless handwheel system, a vacant radio channel (ZigBee channels 11 to 26) is always required to ensure noise-free radio communication between the HR 550FS and HRA 551FS.

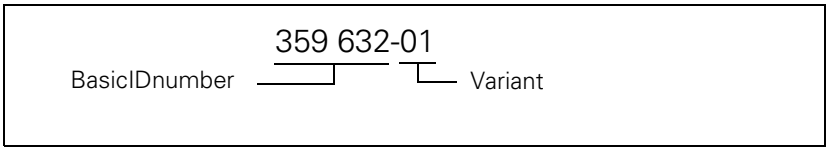
Since a handwheel is always connected with the movement of axes, the operator must be able to trigger an emergency stop of the machine by means of the handwheel at any time. This results in a special situation for the emergency stop switch of the HR 550FS wireless handwheel system. An unsafe situation in the radio communication must always trigger a safe reaction from the control. Therefore, an interference in the radio communication also means an emergency stop at the HRA 551FS as reaction. An unexpected emergency stop of the machine is undesirable and may cause damage to the contour of the workpiece being machined. It is therefore essential to ensure a noise-free radio communication. Reliable operation of the wireless handwheel always requires planning the coexistence of the radio users active in the frequency and radio range concerned. If this cannot be guaranteed because there is no free radio channel available, we advise against using the wireless handwheel system.

HEIDENHAIN cannot guarantee noise-free radio communication of the HR 550FS wireless handwheel system with the HRA 551FS. Even if an available radio channel has been found and the proper functioning of the system has been ascertained, it is possible that the availability situation of the 2.4 GHz ISM band will change later on. If this situation cannot be corrected by changing the wireless handwheel system or the competing radio system to another channel, it may become necessary to revert to using a handwheel with cable. HEIDENHAIN therefore offers the HR 520 handwheel with cable as an alternative.

If a wireless handwheel is to be operated in an unsafe radio environment anyway, the HR 550FS mobile part must be placed into the charging position of the HRA 551FS if a critical situation occurs, in which a workpiece could be damaged through an emergency stop. The contacts on the HR 550FS and the HRA 551FS provide a direct contact between the mobile part and the base station, and therefore communication is independent of the radio connection.

Designation of MC 42x(B,C) and CC 42x

ID numbers of MC 42x(B,C) and CC 42x:



The basic ID number indicates hardware differences.
This first digit of the variant number indicates hardware changes.

Variant	Changes to the MC 422
xxx xxx-y1	Initial version
xxx xxx-y2	Main computer revised (not for dual-processor version)

Variant	Changes to the MC 420
xxx xxx-01	Initial version

Variant	Changes to the MC 422B
xxx xxx-01	Initial version

Variant	Changes to the CC 422
xxx xxx-01	Initial version (speed controller → SH1, current controller → SH2)
xxx xxx-02	Modified controller (MC → SH1, speed controller → SH2)

Variant	Changes in the CC 424(B)
xxx xxx-01	Initial version

Variant	Changes to the MC 422C
xxx xxx-01	Initial version

Variant	Changes to the MC 422C DP
xxx xxx-01	Initial version

HRA 110 handwheel adapter

For connecting up to three **HR 150** handwheels to the TNC.
The axes and the subdivision factor are selected via rotary switch.

The most important characteristics of the HR 150 are:

- 11 μA_{PP} signals, line count 5000
- 1 m cable with 9-pin connector (male)
- Cable outlet for axial and radial use
- Ergonomic knurled control knob
- Version with mechanical detent, 100 positions per 360°

ID 261 097-03	HRA 110
ID 540 940-06	HR 150 with mechanical detent
ID 540 940-07	HR 150 without mechanical detent
ID 270 908-01	HRA selector switch

Machine interfacing	iTNC 530
Feedback control with CC 422	
Position control resolution	$\frac{\text{Signal period}}{1024}$
Path interpolation	1.8ms
Fine interpolation	–
Cycle time of position controller	Minimum 1.8 ms
Cycle time of speed controller	600 µs
Cycle time of current controller	PWM frequency / Cycle time 3333 Hz / 150 µs 4166 Hz / 120 µs 5000 Hz / 100 µs 6666 Hz / 75 µs 8333 Hz / 60 µs 10000 Hz / 50 µs
Maximum motor speed	$n_{max} = \frac{f_{PWM} \cdot 60000\ min^{-1}}{p \cdot 5000\ Hz}$ n_{max}: Maximum motor speed [min^{-1}] f_{PWM}: PWM frequency [Hz] p: Number of pole pairs The following PWM frequencies are available: 3333 Hz, 4000 Hz, 5000 Hz, 6666 Hz, 8000 Hz, 10000 Hz
or by way of:	Maximum signal frequency of the motor encoder = 400 kHz $n_{max} = \frac{f_{max} \cdot 60000\ [s/min]}{ELC}$ n_{max}: Maximum motor speed [min^{-1}] f_{max}: Maximum signal frequency of the motor encoder [kHz] ELC: Encoder line count Example: $n_{max} = \frac{400kHz \cdot 60000\ [s/min]}{2048}$ $n_{max} = 11718.75\ min^{-1}$

Status of options that have been set

Module 9067 Status of software settings

PLC Module 9067 enables you to request status information about software settings. Module 9067 can currently be used to interrogate the software options set in the SIK.

Call:

PS	B/W/D/K	<Mode> 0: Interrogate whether SW option is set in the SIK
PS	B/W/D/K	<Number> If mode is 0: Number of SIK option
CM	9067	
PL	B/W/D	<Status> Status of SIK option (if mode is 0): 0: Not set 1: Set

Error recognition:

Marker	Value	Meaning
M4203	0	Function was performed correctly
	1	Error code in W1022
W1022	1	Invalid value for number
	2	Invalid value for mode

Deleting the packed files of existing NC software

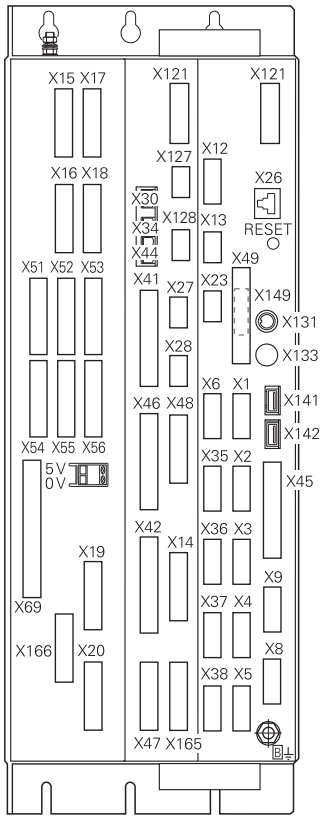
- While in the **Programming and Editing** operating mode, press the MOD key.
- Enter the code number 95148 and confirm your entry with the ENT key.
- While in the **Machine-parameter programming** mode, press the MOD key.
- Press the **UPDATE DATA** soft key.
- Press the **SELECT** soft key.
- All NC software versions that exist in the control are shown in the following options display.
- Select the NC software to be deleted with the arrow keys and press the **DELETE** soft key to delete all packed NC software files. The currently active NC software is marked with an asterisk (*) in the **Sel** column. Confirm your selection with the **YES** soft key. Press the **NO** soft key or the **END** soft key to exit the list box without deleting an NC software.

Note

If the packed files of an NC software, including the currently active software, are deleted, the respective software cannot be activated via the selection window any longer. The software concerned must then again be transferred to the control (See "Procedure for exchanging the NC software up to and including 340 422-12" on page 321).
The deletion of the packed files of the currently active NC software has no other effects.

MC 422B / 5 position encoder inputs and CC 422 with 6 control loops

Connection overview



Connector	Function	Page
X1 to X5	Position encoder	376
X35 to X38	Not occupied	–
X15 to X20	Speed encoder	378
X51 to X60	PWM output	386
X8, X9	Nominal value output, analog	391
X12	TS touch-trigger probe	395
X13	TT touch-trigger probe	397
X23	Handwheel	404
X26	Ethernet data interface	400
X27	RS-232-C/V.24 data interface	401
X28	RS-422/V.11 data interface	403
X127	RS-232-C/V.24 data interface (only for Windows 2000)	401
X128	RS-422/V.11 (only for Windows 2000)	403
X141, X142	USB interface	461
X30	24 V spindle reference signal	410
X34	24 V for control-is-ready signal output	370
X41	PLC output	418
X42	PLC input	412
X44	24 V PLC supply voltage	366
X45	Control panel	445
X46	Machine operating panel	438
X47	PLC expansion	424
X48	PLC analog input	388
X149 (X49)	BF 150 (BF 120) visual display unit	447
X131	Reserved	–
X69	Power supply	354
X121, X125	Reserved	–
X165, X166	Reserved	–
X74	5 V power supply	355
X150	Axis-specific drive enabling (at bottom of housing)	373
B	Signal ground	–
⏚	Ground lead (YL/GN)	–

3.5.3 UV106B power supply unit

General information

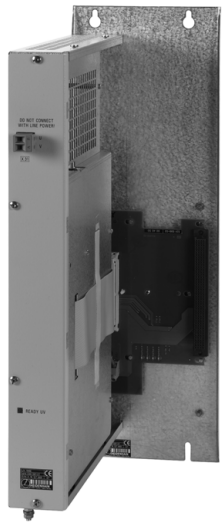
UV 106B power supply unit for analog HEIDENHAIN contouring controls

The **UV 106B** power supply unit was designed so that the iTNC 530 could be used with a compact, coordinated system for analog nominal shaft-speed interfaces (+/–10 V).

It supplies the iTNC 530 with the supply voltages necessary for operation.

The **UV 106B** (ID 546 581-01) is being introduced as a replacement for the **UV 106** (ID 366 572-11).

ID 546 581-01 UV 106B



Specifications

Specifications	UV 106B
Power supply (at X31)	400 V~ ± 10%[a] 50 Hz
Protection	6.3 A (gR) Siemens Sitor type or 6.3 A (gRL) Siba type
Load capacity (5 V)	20 A
Power consumption	Max. 400 W
Degree of protection	IP 20
Module width	159 mm
Weight	4 kg
ID number	546 581-xx

a. An isolating transformer is not necessary when the UV 106B is connected.

X15 to X20, X80 to X85: Speed encoder with EnDat interface

Pin layout:

CC 42x		Adapter cable 336 376-xx				Connecting cable 340 302-xx		
Male	**Assignment**	**Female**	**Color**	**Female**		**Male**	**Color**	**Female**
1	+5 V (U_P)	1	Brown/Green	10	Line drop compensator ID 370 224-01, if required	10	Brown/Green	10
2	0 V (U_N)	2	White/Green	7		7	White/Green	7
3	A+	3	Green/Black	1		1	Green/Black	1
4	A–	4	Yellow/Black	2		2	Yellow/Black	2
5	0 V							
6	B+	6	Blue/Black	11		11	Blue/Black	11
7	B–	7	Red/Black	12		12	Red/Black	12
8	0 V	8	Internal shield	17		17	Internal shield	17
9	Do not assign							
10	Clock	10	Green	5		5	Green	5
11	Do not assign							
12	$\overline{\text{Clock}}$	12	Brown	14		14	Brown	14
13	Temperature +	13	Yellow	8		8	Yellow	8
14	+5 V (sensor)	14	Blue	16		16	Blue	16
15	Data	15	Red	3		3	Red	3
16	0 V (sensor)	16	White	15		15	White	15
17	Do not assign							
18	Do not assign							
19	Do not assign							
20	Do not assign							
21	Do not assign							
22	Do not assign							
23	$\overline{\text{Data}}$	23	Black	13		13	Black	13
24	0 V							
25	Temperature –	25	Violet	9		9	Violet	9
Hsg.	Housing	Hsg.	Ext. shield	Hsg.		Hsg.	Ext. shield	Hsg.

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage (PELV)."

Danger

Only units that comply with the requirements of EN 61800-5-1 for "protective extra-low voltage (PELV)" may be connected.

3.16.2 Triggering touch probe for tool measurement

X13: Connection of the touch probe

Pin layout on the MC 422(B,C):

Note

The interface complies with the requirements of EN 61800-5-1 for "protective extra-low voltage (PELV)."

Pin layout on adapter cable and touch probe:

MC 42x(B,C)		Adapter cable 335 332-xx			TT130 296 537-xx	
Female	**Assignment**	**Male**	**Color**	**Female**	**Male**	**Color**
1	Readiness	1	Pink	6	6	
2	0 V (U_N)	2	White/Green	1	1	White
3	Do not assign	3				
4	+15 V ±5% (U_P)	4	Brown/Green	2	2	Brown
5	Do not assign	5		5	5	
6	Do not assign	6				
7	+5 V ±5% (U_P)	7				
8	Trigger signal	8	Brown	3	3	Green
9	$\overline{\text{Trigger signal}}$[a]	9	Green	4	4	Yellow
–	–	–	–	7	7	
Hsg.	Ext. shield	Hsg.	Ext. shield	Hsg.	Hsg.	

a. Stylus at rest means logic level HIGH.

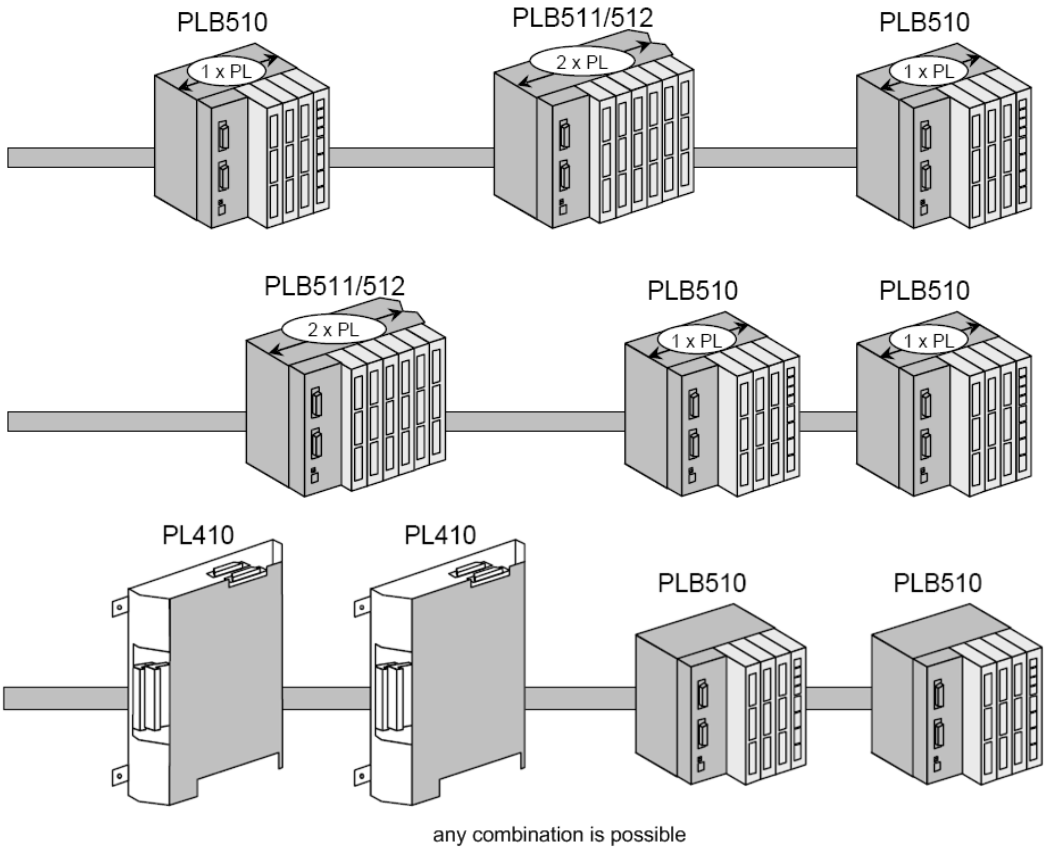
3.20.3 PLC inputs on the PL 405B

X3, X4: PLC inputs Pin layout on the PL:

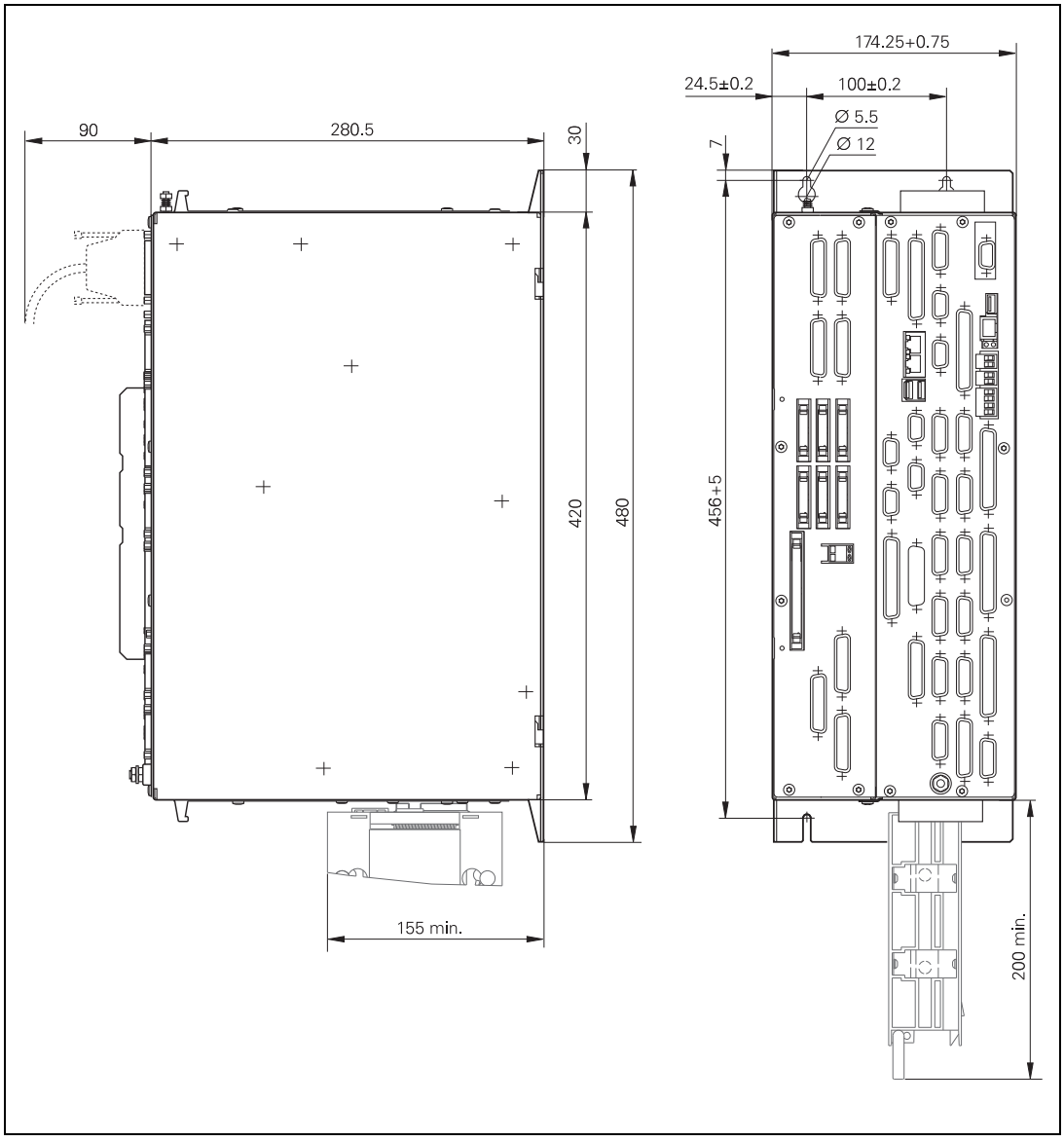
X3				
Terminal	**Pin layout**			
	PL 1	**PL 2**	**PL 3**	**PL 4**
1	I64	I192	I256	I320
2	I65	I193	I257	I321
3	I66	I194	I258	I322
4	I67	I195	I259	I323
5	I68	I196	I260	I324
6	I69	I197	I261	I325
7	I70	I198	I262	I326
8	I71	I199	I263	I327
9	I72	I200	I264	I328
10	I73	I201	I265	I329
11	I74	I202	I266	I330
12	I75	I203	I267	I331
13	I76	I204	I268	I332
14	I77	I205	I269	I333
15	I78	I206	I270	I334
16	I79	I207	I271	I335

X4				
Terminal	**Pin layout**			
	PL 1	**PL 2**	**PL 3**	**PL 4**
1	I80	I208	I272	I336
2	I81	I209	I273	I337
3	I82	I210	I274	I338
4	I83	I211	I275	I339
5	I84	I212	I276	I340
6	I85	I213	I277	I341
7	I86	I214	I278	I342
8	I87	I215	I279	I343
9	I88	I216	I280	I344
10	I89	I217	I281	I345
11	I90	I218	I282	I346
12	I91	I219	I283	I347
13	I92	I220	I284	I348
14	I93	I221	I285	I349
15	I94	I222	I286	I350
16	I95	I223	I287	I351

Examples of possible combinations:

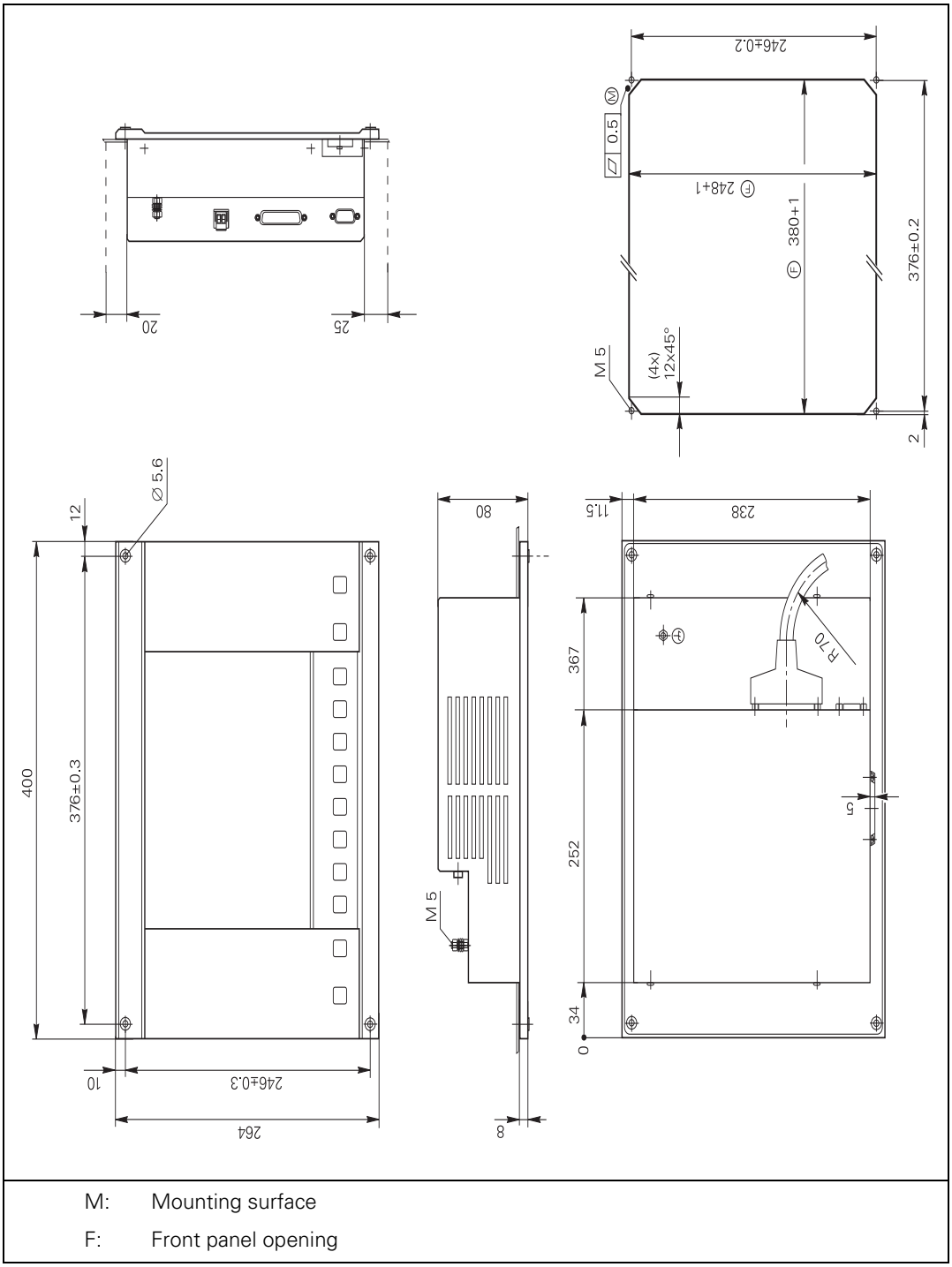


3.32.4 MC 422C DP/CC 422 with 6 control loops



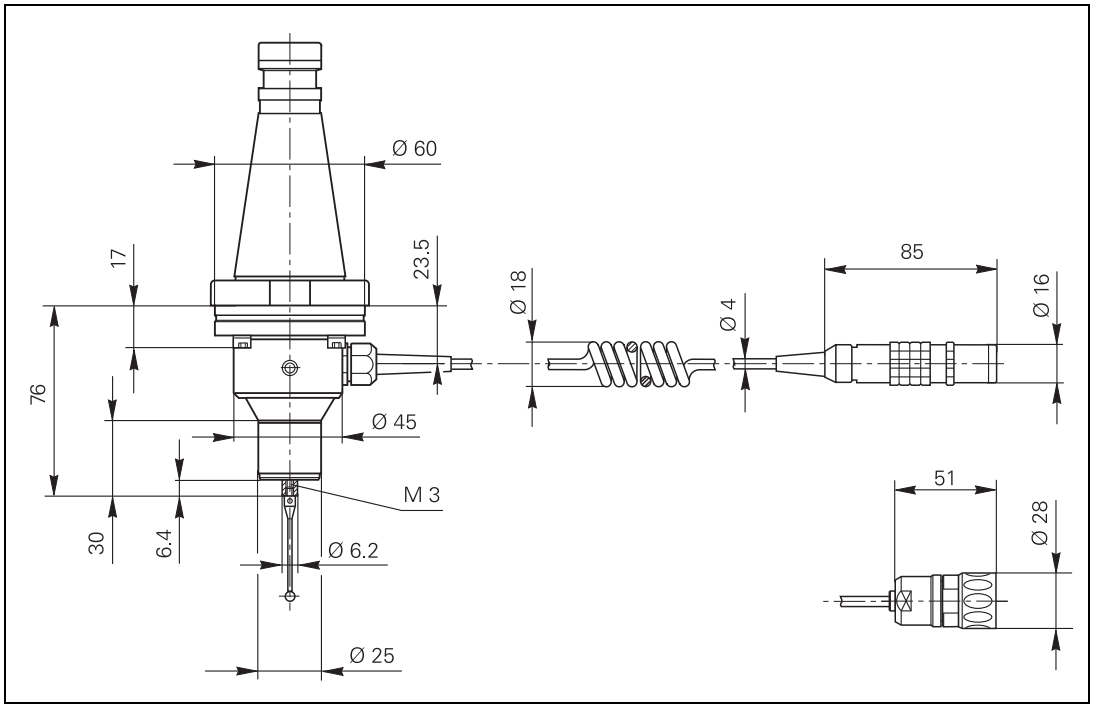
3.32.22 BF 120

Weight: 3 kg

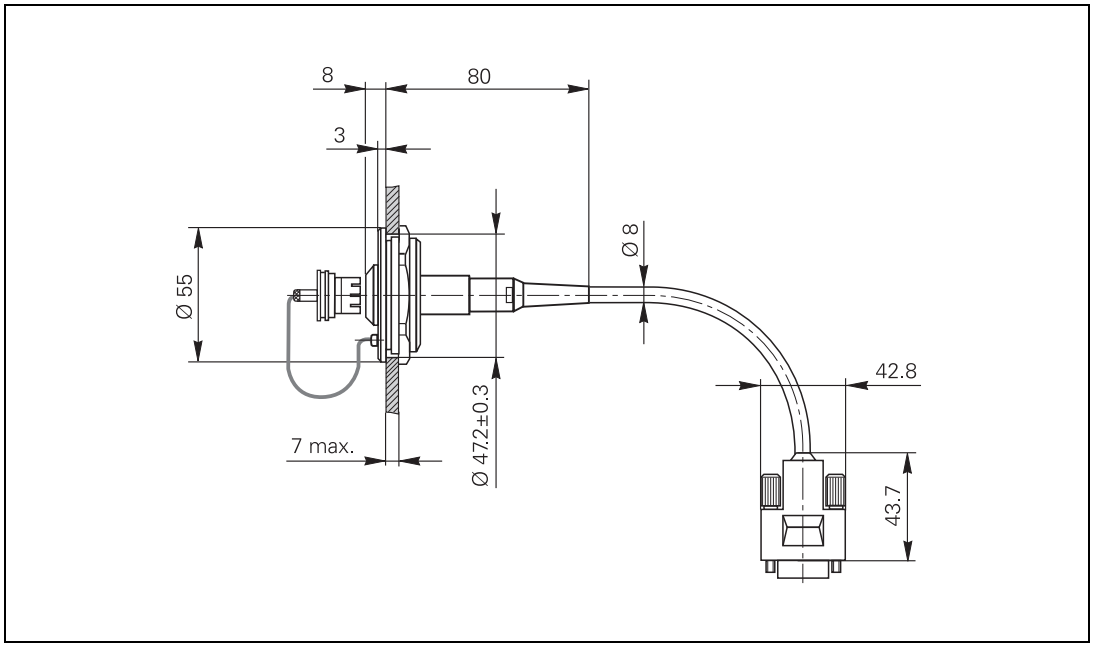


M: Mounting surface

F: Front panel opening



Adapter cable for
TS 120/TS 220



▶ Enter the code number 95148 to access the **Machine Parameter Programming** mode of operation

Meaning of the soft keys in the **Machine Parameter Programming** mode of operation:

Meaning of the soft keys:	
	Switch between insertion and overwrite modes
	Jump to the beginning of the next word in the line
	Jump to the beginning of the previous word in the line
	Go back one page in the machine parameter file
	Go forward one page in the machine parameter file
	Jump to the beginning of the machine parameter file
	Jump to the end of the machine parameter file
	Search the machine parameter file for a text string
	Delete the character covered by the cursor
	Delete the word that the cursor is in
	Delete the line that the cursor is in
	Reinsert last deleted word or line
	Open the selection list for power modules
	Open the selection list for motors
	Open the selection list for power supply modules

MP	Function and input	Software version & behavior	Page
MP120.x	Nominal speed command outputs of the axes Input: 0: No servo-controlled axis 1 to 6: Analog outputs 1 to 6 at terminal X8 7 to 12: Analog outputs 7 to 12 at terminal X9 51 to 62: Digital output X51 to X62	RESET	655
MP121.0	Nominal speed command output of the first spindle Input: 0: No servo-controlled axis 1 to 6: Analog outputs 1 to 6 at terminal X8 7 to 12: Analog outputs 7 to 13 at terminal X9 51 to 62: Digital output X51 to X62	RESET	657
MP121.1	Nominal speed command output of the second spindle Input: 0: No servo-controlled axis 1 to 6: Analog outputs 1 to 6 at terminal X8 7 to 12: Analog outputs 7 to 13 at terminal X9 51 to 62: Digital output X51 to X62	RESET	
MP130.x	Y index of the machine parameters MP2xxx.y for the axes Input: 0 to 12	PLC RUN	655
MP131.x	Y index of the machine parameters MP2xxx.y for the spindle(s) in operating mode 0 Input: 0 to 12	PLC RUN	657
MP131.0	Index for the first spindle		
MP131.1	Index for the second spindle		
MP132.x	Y index of the machine parameters MP2xxx.y for the spindle(s) in operating mode 1 Input: 0 to 12	PLC RUN	657
MP132.0	Index for the first spindle		
MP132.1	Index for the second spindle		
MP210	Counting direction of position encoder output signals Format: %xxxxxxxxxxxxxx Input: Bits 0 to 13 represent axes 1 to 14 0: Positive 1: Negative	REF	651

MP	Function and input	Software version & behavior	Page
MP2202.x	Overwrite "Line count" from the motor table Input: *: Input from the motor table active 0: No speed encoder (volts-per-hertz control mode) 1 to 999 999	340 420-05 PLC RUN	1001
MP2204.x	Overwrite "Counting direction" from the motor table Input: *: Input from the motor table active +: Positive counting direction –: Negative counting direction	340 420-05 RESET	1001
MP2206.x	Overwrite "Type of encoder" from the motor table Input: *: Input from the motor table active 0: No speed encoder (volts-per-hertz control mode) 1: Incremental rotary encoder with Z1 track 2: Absolute rotary encoder with EnDat interface (aligned) 3: Absolute linear encoder with EnDat interface 4: Linear motor with one reference mark (CC424(B)) 5: Absolute rotary encoder with EnDat interface (not aligned) 6: Incremental rotary encoder without Z1 track 7: Incremental rotary encoder with distance-coded reference marks (nonaligned) 8: Incremental linear encoder with distance-coded reference marks (not aligned)	340 420-05 RESET 340 490-03	1001
MP2208.x	Inductance of the series reactor Input: * = Input from the motor table active Value of the series reactor in [µH]	340 490-03	1008
MP2209.x	Mass moment of inertia of a drive motor Input: * = Input from the motor table active Value of the mass moment of inertia in [kgm^2]	340 490-03	1138
MP2210.x	Only CC 424(B): Reduction of the nominal voltage (and, as a result, the nominal magnetizing current) at the rpm for field weakening during idle running. Input: 0 to 60 [%] 0 = Function inactive	340 490-01	1097

MP	Function and input	Software version & behavior	Page
MP6010	Selection of the touch probe Input: 0: Touch probe with cable transmission (TS 120, TS 220) 1: Touch probe with infrared transmission (TS 632) 2: Touch probe with infrared transmission (TS 440, TS 640) 3: Battery-free TS 444 touch probe	PLC CN123 340 490-04	1481
MP6120	Probing feed rate (triggering touch probe) Input: 1 to 10 000 [mm/min]	PLC RUN CN123 340 490-05	1486
MP6130	Maximum measuring range Input: 0.001 to 99 999.9999 [mm]	PLC RUN CN123	1486
MP6140	Setup clearance above measuring point Input: 0.001 to 99 999.9999 [mm]	PLC RUN CN123	1486
MP6150	Rapid traverse in probing cycle Input: 10 to 20 000 [mm/min]	PLC RUN CN123	1486
MP6151	Pre-positioning in probing cycle with rapid traverse Input: 0: Pre-position with speed from MP6150 1: Pre-positioning at rapid traverse	340 490-02 PLC RUN CN123	1485
MP6160	M function for probing from opposite directions Input: –1: Spindle orientation directly by NC 0: Function inactive 1 to 999: Number of the M function for spindle orientation through PLC	PLC RUN CN123	1490
MP6161	M function for orienting the touch probe before every measuring process Input: –1: Spindle orientation directly by the NC 0: Function inactive 1 to 999: Number of the M function	PLC RUN CN123	1488

MP	Function and input	Software version & behavior	Page
MP7317	M function for graphic simulation	PLC	1511
MP7317.0	Beginning of graphic simulation Input: 0 to 88	RUN CN123	
MP7317.1	Interruption of the graphic simulation Input: 0 to 88		
MP7330.0-15	Specification of user parameters 1 to 16 Input: 0 to 9999.00 (no. of the user parameter)	PLC RUN	1246
MP7340.0-15	Dialog messages for user parameters 1 to 16 Input: 0 to 4095 (line number of the PLC dialog message file)	PLC RUN	1246

MP	Function and input	Software version & behavior	Page
MP7645	Initializing parameter for handwheel	PLC	1454, 1461
MP7645.0	Assignment of the keys on handwheel 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 Third handwheel axis IV Switch position 5 3rd handwheel axis V 2: Switch position 3 3rd handwheel axis Z Switch position 4 Third handwheel axis IV Switch position 5 3rd handwheel axis V		
MP7645.1	Fixed assignment of third handwheel if MP7645.2 = 1 Input: 1: Axis X 2: Y axis 4: Z axis 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		

Module	Function	SW version	Page
9282	Tool usage test for pallet table	340 422-10, 340 480-10	1544
9285	Set the access level	340 490-05	1158
9290	Select a file		1356
9291	Call an NC macro		1645
9300	Lock/release the pocket table		1535
9301	Find the number of an entry in the pocket table		1537
9302	Search for a vacant pocket in the tool magazine		1537
9304	Copy columns P1 to P5 to the pocket table	340 420-03, 340 490-03	1530
9305	Tool exchange in the pocket table		1536
9306	Exchange tools between tool magazines		1538
9310	Read the machine parameter from the run-time memory		531
9311	Dynamically change values for friction compensation	340 490-03	1100
9312	Change machine parameters in the current machine parameter file	340 490-03	532
9313	Read machine parameters from current machine parameter file	340 490-03	534
9314	Activate/Deactivate machine-parameters	340 490-06	534
9320	Status of the NC program end		1200
9321	Find the current block number	340 420-06	1197
9322	Information of the current NC program	340 422-09, 340 480-09	1198
9340	Search for a pocket depending on magazine rules	340 420-03	1531
9341	Edit a pocket table depending on magazine rules	340 420-03	1532
9342	Find magazine and pocket number	340 420-06	1533
9343	Compile and activate magazine rules	340 422-10, 340 480-10	1534
9350	Read data from the tool table	340 422-07, 340 480-07	1513
9351	Write data to tool table	340 422-07, 340 480-07	–
9390	Open the online help window with the control's browser	340 490-03	1191
9391	Display an error message with additional offset	340 490-03	1192
9392	Display PLC error message with help offset	340 490-05	1171

HEIDENHAIN offers incremental linear encoders with **distance-coded reference marks.** The nominal increment between two fixed reference marks depends on the encoder being used:

- In MP334.x, enter for each axis the nominal increments between two fixed reference marks.

If the number of grating periods between the reference end position and the first reference mark exceeds the value from MP334.x, the error message **`Ref mark <axis>: incorrect spacing`** appears. This monitoring is turned off with MP334.x = 0.

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 +1.797693135E+308 [mm] or [°]

MP332.x **Number of signal periods for the distance in MP331**
Input: 1 to +1.797693135E+308

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

Special function M150

If NC blocks were used in the Positioning with Manual Data Input, Program Run Single Block, and Program Run Full Sequence operating modes to program positions that are outside of the traverse ranges, then normally the blocks containing this violation are not performed, and an error message is output.

With M150 the block is traversed to at least shortly before the limit of the traverse range, despite this programming violation. Positioning is performed as close to the limit of the traverse range as possible. For example, if the limit is –600.000 and the programmed position is –700.000, M150 traverses to –599.999. This means that the limit switch information for the PLC via W1045 and W1036 is not set, since the limit switch is not traversed to.

6.1.8 Lubrication Pulse

You can define the traverse distance for each axis after which the PLC commands lubrication:

- In MP4050.x you define the traverse distance at which the lubrication pulse is to be output. The NC reports in W1056 when the entered distance in an axis has been exceeded.
- With W1058 you reset the distance counter to 0 after lubrication.

The summation of the path traversed always occurs in MP4050.x, regardless of the operating mode and how the axis was moved.

MP4050.0-8 Path-dependent lubrication of axes 1 to 9
Input: 0 to 99 999.999 [m or 1000°]

		Set	Reset
W1056	**Lubrication pulse: Value in MP4050.x exceeded** Bits 0 to 8 represent axes 1 to 9	NC	NC
W1058	**Reset the accumulated distance** Bits 0 to 8 represent axes 1 to 9	PLC	PLC

PLC positioning through markers and words

To ensure compatibility, a PLC positioning command is permissible for axes 1 to 9 with M4120 to M4128, D528 to D544 and W560 to W568.

Attention

Software limit switches are ignored!

Programming:

- Enter the target position in the double words D528 to D544 in the unit [0.0001 mm].
- Enter the feed rate in words W560 to W568 [mm/min].
- To start the PLC positioning movement: Set markers M4120 to M4124 for the desired axis.

		Set	Reset
D528-544	**Target position for PLC positioning**	PLC	PLC
W560-568	**Feed rate for PLC positioning**	PLC	PLC
M4120	**PLC positioning axis 1 active**	NC/PLC	NC/PLC
M4121	**PLC positioning axis 2 active**	NC/PLC	NC/PLC
M4122	**PLC positioning axis 3 active**	NC/PLC	NC/PLC
M4123	**PLC positioning axis 4 active**	NC/PLC	NC/PLC
M4124	**PLC positioning axis 5 active**	NC/PLC	NC/PLC
M4125	**PLC positioning axis 6 active**	NC/PLC	NC/PLC
M4126	**PLC positioning axis 7 active**	NC/PLC	NC/PLC
M4127	**PLC positioning axis 8 active**	NC/PLC	NC/PLC
M4128	**PLC positioning axis 9 active**	NC/PLC	NC/PLC

6.4.7 Compensation of Sliding Friction (Only for Digital Axes)

Sliding friction is compensated within the range of the speed controller:

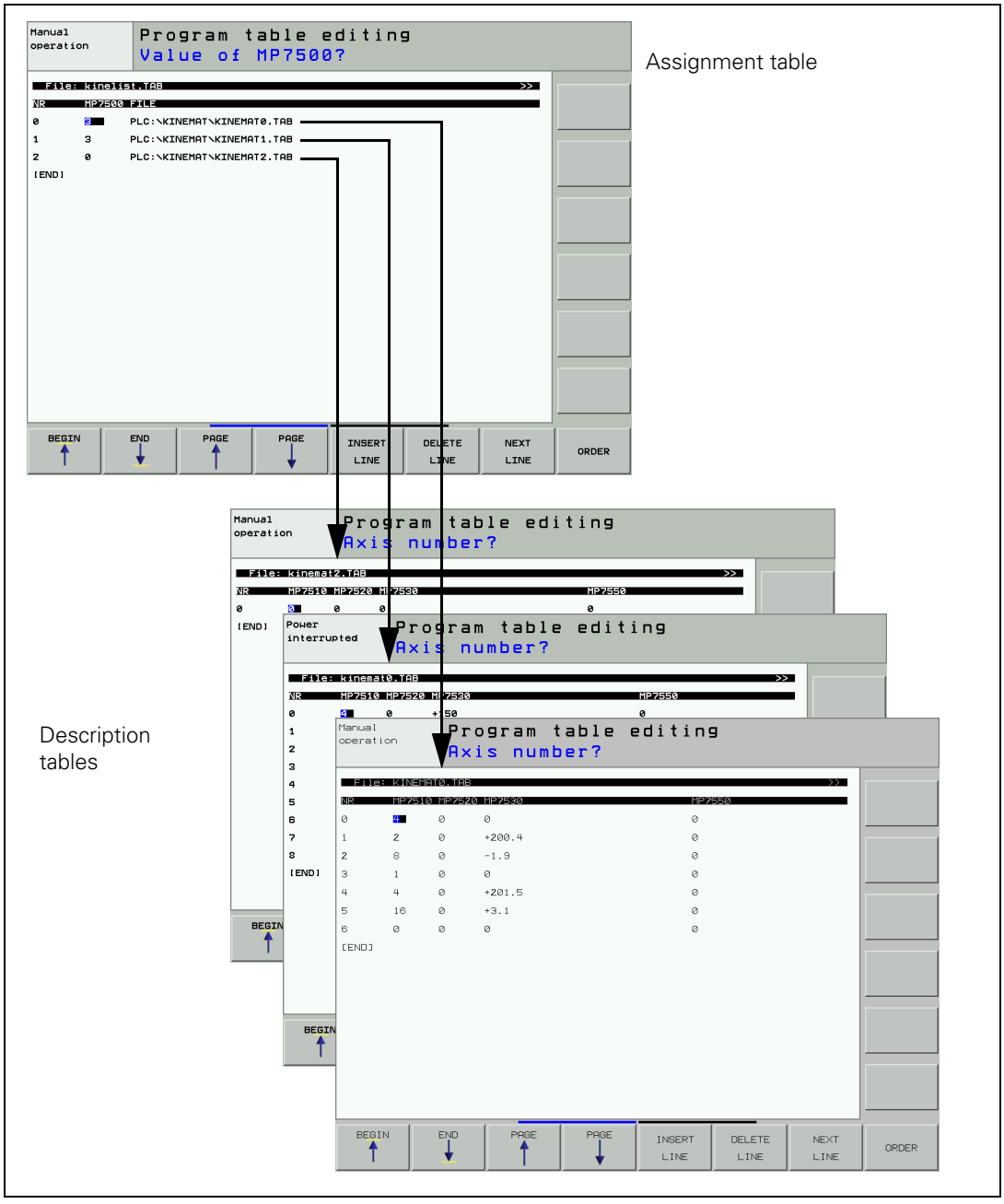
- With the integrated oscilloscope of the iTNC, define the nominal current value (I NOMINAL) at a very low speed of approx. 10 rpm.
- Enter the value for current in MP2610.x. At every change in direction, this amount is fed forward to the speed controller to compensate the sliding friction at low speeds.
- Measure the nominal value for current (I NOMINAL) at rated speed and enter it in MP2620.x. Depending on the nominal speed value, a certain current is fed forward to the speed controller and causes a sliding friction that depends on the speed.

When the traverse direction is reversed at high feed rates, the sliding friction might be overcompensated. In a circular interpolation test, such overcompensation appears in the form of reversal spikes that jut inward. With MP2612.x you can prevent overcompensation by delaying the compensation.

MP2610.x **Friction compensation at low speeds (effective only with velocity feedforward control)**
Input: 0 to 100.0000 [A]
0: No friction compensation (or axis is analog)

MP2612.x **Delay of the friction compensation (effective only with velocity feedforward control)**
Input: 0.0000 to 1.0000 [s] (typically: 0.015 s)
0: No friction compensation (or axis is analog)

MP2620.x **Friction compensation at rated speed**
Input: 0 to 100.000 [A]
0: No friction compensation (or axis is analog)


Manual operation
Program table editing
Value of MP7500?
File: kinelist.TAB
NR MP7500 FILE
0 2 PLC:\KINEMAT\KINEMAT0.TAB
1 3 PLC:\KINEMAT\KINEMAT1.TAB
2 0 PLC:\KINEMAT\KINEMAT2.TAB
[END]
BEGIN
END
PAGE
PAGE
INSERT LINE
DELETE LINE
NEXT LINE
ORDER
Assignment table
Manual operation
Program table editing
Axis number?
File: kinemat2.TAB
NR MP7510 MP7520 MP7530 MP7550
[END]
Power interrupted
File: kinemat0.TAB
File: KINEMAT0.TAB
0 4 0 0 0
1 2 0 +200.4 0
2 8 0 -1.9 0
3 1 0 0 0
4 4 0 +201.5 0
5 16 0 +3.1 0
6 0 0 0 0
Description tables

Kinematics – reading and editing

The READ KINEMATICS and WRITE KINEMATICS functions are used to read and modify elements of the currently active kinematics in the NC program. In the NC program you cannot define these function FN17 (soft keys: program functions, kinematic functions) until you have entered the code number 555 343. With the iTNC 530, transformations and geometry axes are elements of the transformation chain.

READ KINEMATICS

Syntax:

```
READ KINEMATICS NOTE_QS0 MODE Q0 RESULT_Q1 KEX "KEY;AXIS" TO QS1
```

- NOTE:
  The function saves a "pointer" in this string variable. You need this pointer if you want to use WRITE KINEMATICS to describe these transformation elements again.
- MODE:
  0: Increment read-pointer
  1: Set the read-pointer to the beginning of the transformation chain
- RESULT:
  In "Result", the function provides information about possible errors.
  0: No error
  1: Error
- KEY:
  The key words whose entries are to be read are transferred in "Key." With the iTNC 530, the key words match the column names of the transformation table. The individual key words are separated by a semicolon.
- TO:
  Keys are returned, separated by a semicolon. The sequence depends on the sequence of the "KEY" key words.

WRITE KINEMATICS

Syntax:

```
WRITE KINEMATICS NOTE_QS0 MODE Q0 RESULT_Q1 KEY "COORD" = QS50
```

- NOTE:
  Pointer to a certain transformation element. This pointer must first be determined with READ KINEMATICS.
- MODE:
  0: Increment read-pointer
  1: Set the read-pointer to the beginning of the transformation chain
- RESULT:
  In "Result", the function provides information about possible errors.
  0: No error
  1: Error
- KEY:
  The key words whose entries are to be overwritten are transferred in "Key." The individual key words are separated by a semicolon.
- =:
  A string that contains the new entries is to be transferred as value. The entries are separated by a semicolon. The sequence depends on the sequence of the "KEY" key words.

6.5.6 KinematicsOpt

Accuracy requirements are becoming increasingly stringent, particularly in the area of 5-axis machining. Complex parts are required to be manufactured with precision and reproducible accuracy even over long periods.

KinematicsOpt (software option #48) is an important component that helps you meet these complex requirements: A 3-D touch probe cycle measures the rotary axes on your machine fully automatically, regardless of whether they are used in rotary-table or head configurations. A calibration sphere is fixed at any position on the machine table, and measured with a resolution that you define. In the cycle definition, you only have to define for each rotary axis the area that you want to measure.

From the measured values, the TNC calculates the static tilting accuracy. The software minimizes the spatial error arising from the tilting movement and, at the end of the measurement process, automatically saves the machine geometry in the respective machine constants of the kinematics table.

When using the cycles for KinematicsOpt, please also refer to the Touch Probe Cycles User's Manual.

Functions

- Testing the static tilting accuracy by probing different points on a calibration sphere with a 3-D workpiece touch probe.
- Optimizing the static tilting accuracy by adjusting the kinematics description.
- Backing up and restoring the kinematics data that can be changed with this software.

Prerequisites

- The software options #48 (KinematicsOpt) and #8 (software option 1) must be enabled.
- Feature Content Level (FCL) 3 or higher must be enabled.
- The 3-D touch probe used for the measurement must be calibrated.
- A calibration sphere with an exactly known radius and sufficient rigidity must be attached to the machine table.
- The kinematics must be described in the new table format (columns: **KEY**, **AXIS**, **COORD**, ...)
- The kinematics description of the machine must be complete and correct. The transformation values must be entered with an accuracy of approx. 1 mm.
- All machine axes involved must have adequate positioning accuracy.
- The geometry of the machine must have been measured.
- The machine datum (MP960.x) must be defined for the rotary axes (is not measured in the cycle).
- The machine parameters MP6600 to MP6602 must be defined.
- The cycles use the value entered in MP420 or MP430 to determine whether the respective axis is a rotary axis or a Hirth axis.
- Option #52 KinematicsComp, if rotational position errors of the rotary axes are to be compensated

Interrogating the 3-D ROT data via PLC

PLC Module 9045 makes the relevant data for the "Tilt working plane" function available to the integrated PLC as well. The following data are available:

- Tilt angles (A, B, C)
- Tilted axes (A, B, C)
- In which operating mode the "Tilt working plane" function is active

When the 3-D ROT data are interrogated via Module 9045, the data are entered in four sequential double words beginning from the given starting address [n]. The returned bit mask indicates which tilt angles are possible as a result of the currently active kinematics configuration.

Note

Ensure that the addresses are available on the control, and that the given target address is a double word address.

The data are output in the following format:

- D[n+0]: Tilt angle A (unit 0.0001°)
- D[n+4]: Tilt angle B (unit 0.0001°)
- D[n+8]: Tilt angle C (unit 0.0001°)
- W[n+12]: Currently tilted axes (bit-encoded)
  Bit 0: Axis A tilted
  Bit 1: Axis B tilted
  Bit 2: Axis C tilted
- W[n+14]: "Tilt working plane" is active in operating mode
  Bit 0: Tilting active in **Program Run** operating mode
  Bit 1: Tilting active in **Manual** operating mode

Module 9045 Reading the 3-D ROT data

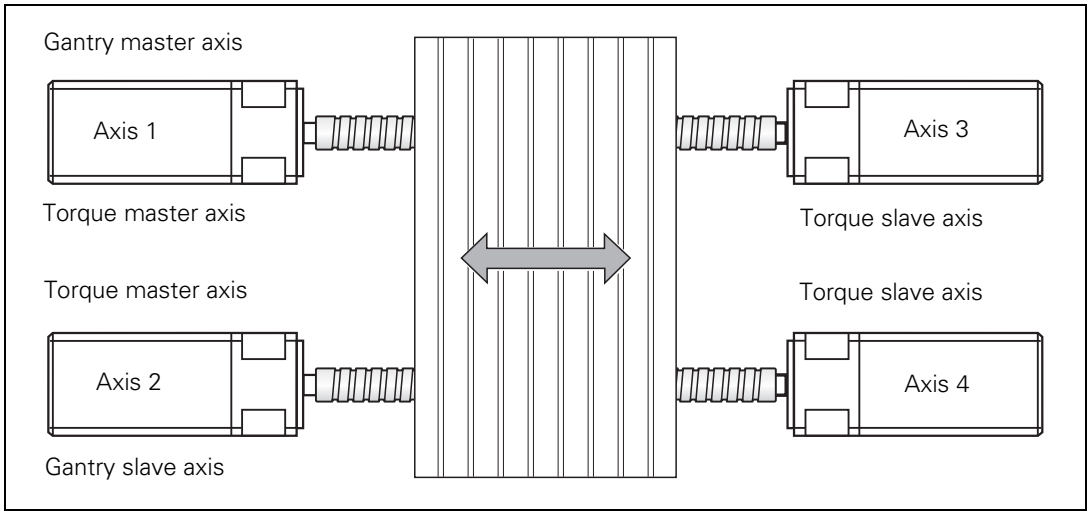
Call:
PS B/W/D/K <>Starting address as double-word number [n]>
CM 9045

Error recognition:

Marker	Value	Meaning
M4203	0	3-D ROT data read
	1	3-D ROT data was not read

Gantry axes in master-slave torque control

It is possible to run gantry axes in master-slave torque control. The gantry master and gantry slave axes are at the same time torque master axes and have one torque slave axis each.



Example for the MP entries:

MP850.0 = 0
Axis 1 is master axis

MP850.1 = 1
Axis 2 is slave to axis 1

MP850.2 = 1
Axis 3 is slave to axis 1

MP850.3 = 2
Axis 4 is slave to axis 2

MP860.0 = 0 or 1
Axis 1: Datum for synchronous control

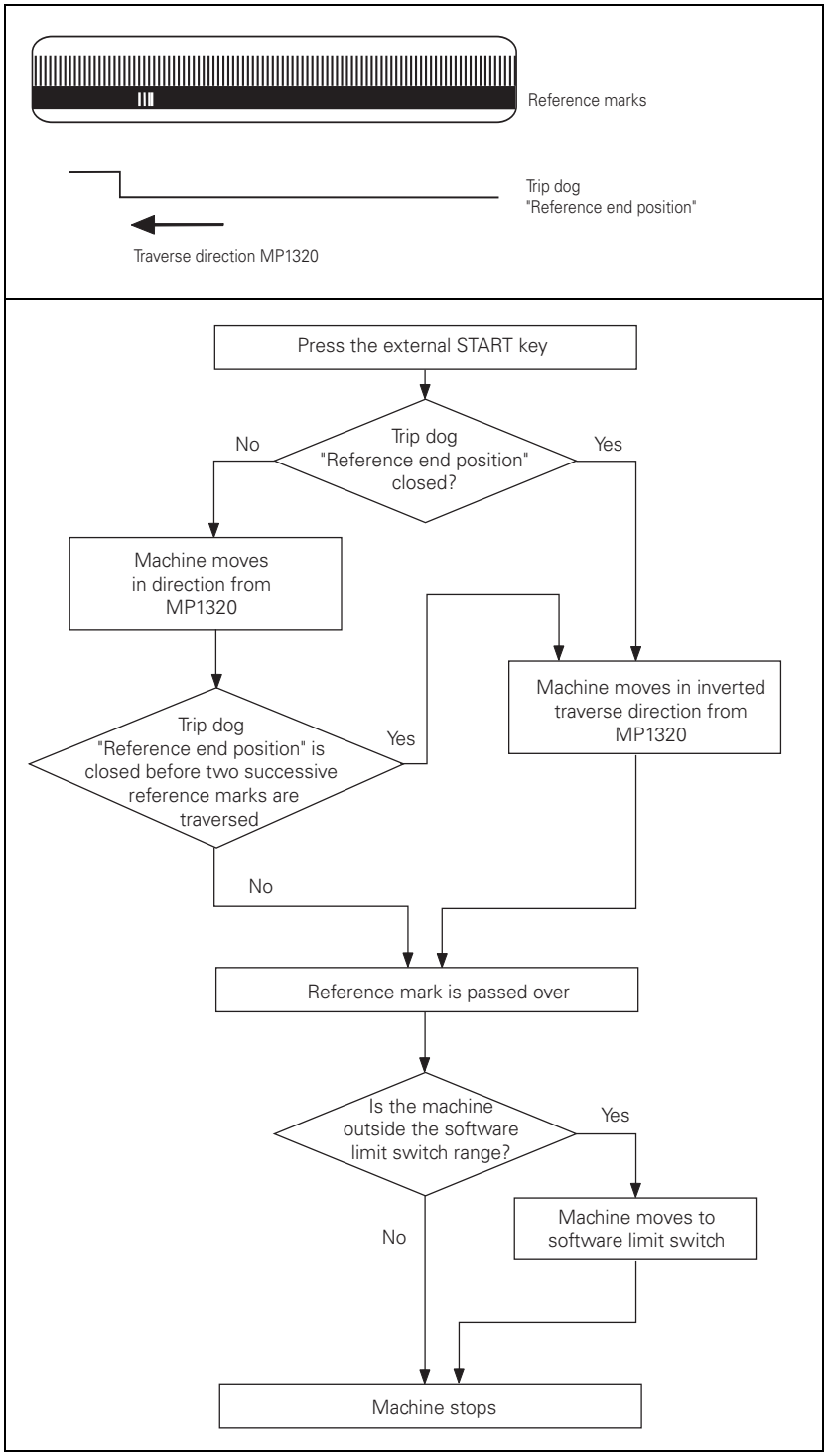
MP860.1 = 0 or 1
Axis 2: Datum for synchronous control

MP860.2 = 2
Axis 3 is torque slave axis

MP860.3 = 2
Axis 4 is torque slave axis

Position encoder with one reference mark

Function when MP1350.x = 1



If the HSC filter does not need to be used to limit the bandwidth, very brief machining times can be achieved by setting high limit frequencies with high jerk values. Of course, requirements for this are increased jerk (MP1232.x, MP1242.x, MP1250.x) and acceleration values (MP1060, MP1070). since starting at certain limit frequencies, the jerk and acceleration values increasingly limit the feed rate. The machining time is briefest at a certain value in MP1212. The following rule of thumb is used to find the optimum value:

MP1212 = 23 + MP1232 *0.2 (however, MP1212 should be ≥ 30)

If the tolerance is increased, the optimum value for MP1212 is shifted to smaller frequencies.

List of the nominal position value filters

The settings for the nominal position value filters are listed below by the MP number.

MP1200 **Nominal position value filter**
Input: 0: Single filter
1: Double filter
2: HSC filter
3: Advanced HSC filter

MP1201 **Nominal position value filter in the Manual, Handwheel, Jog Increment, and Pass Over Reference Point operating modes**
Input: 0: Single filter
1: Double filter

MP1202 **Predefined tolerance for Cycle 32**
Input: 0.0000 to 3.0000 [mm]
MP1202.0 Tolerance at corners for movements at machining feed rate
MP1202.1 Tolerance at corners for movements at rapid traverse

MP1205 **Reduction of the starting feed rate**
Input: 0: Not active (fast, but somewhat less precise)
1: Active (slow, but likely more precise)

MP1210 **Limit frequency for single filter**
Input: 0.0 to 166.0 [Hz]

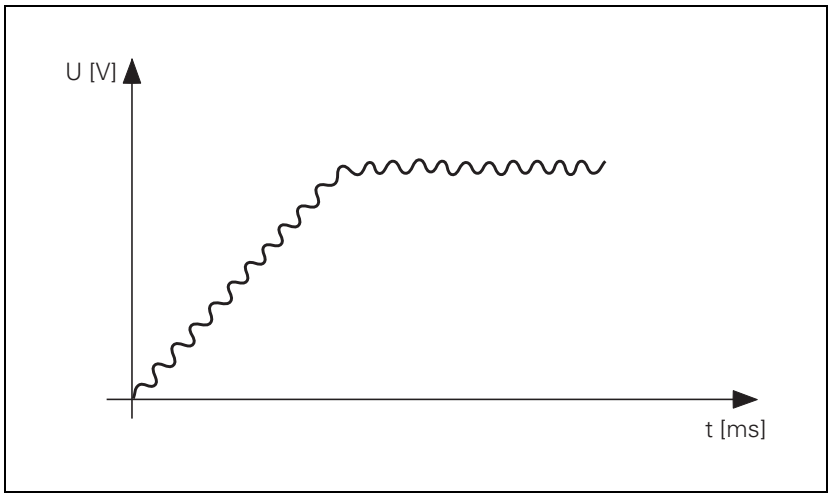
MP1211 **Limit frequency for double filter**
Input: 0.0 to 166.0 [Hz]

MP1212 **Limit frequency for HSC filter**
Input: 0.0 to 166.0 [Hz]

MP1213 **Limit frequency for advanced HSC filter**
Input: 0.0 to 166.0 [Hz]

MP1222 **Tolerance at curvature changes with HSC filter**
Input: (only effective if MP7640 bit 4 = 0)
0: Do not include the tolerance
1: Include the tolerance

MP1223 **Tolerance at curvature changes with advanced HSC-filter**
Input: (only effective if MP7640 bit 4 = 0)
0: Do not include the tolerance
1: Include the tolerance



Attention

If the k_V factor that you select is too large, the system will oscillate around the forward-fed nominal velocity value.

Unlike operation with following error, you must also enter the optimum k_V factor for each axis when operating with interpolated axes.

You can selectively increase the contour accuracy with a higher k_V factor. This k_V factor is activated with M105:

- In MP1515.x, define a second set of k_V factors and activate them with M105.

M105 also influences compensation of reversal spikes during circular motion. With M106 you can switch back to the original set of k_V factors:

- Enable the M functions M105/M106 with MP7440, bit 3.

MP1510.x **k_V factor for velocity feedforward control**
Input: 0.100 to 1000.000 [(m/min)/mm]

MP1515.x **k_V factor for velocity feedforward control effective after M105**
Input: 0.100 to 1000.000 [(m/min)/mm]

MP7440 **Output of M functions**
Format: %xxxxx
Input: Bit 3 – Switching the k_V factors with M105/M106:
0: Function is not in effect
1: Function is effective

For calculation of the acceleration feedforward, the integral-action component of the nominal current value I (int 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.

$$\text{MP2600.x} = \frac{\text{I (N INT) [A]} \cdot \text{t [s]} \cdot 60\ \text{[s/min]} \cdot \text{MP1054.x [mm]}}{\Delta\text{V (N IST) [mm/min]}}$$

I (int rpm) = integral-action component of the nominal current value

t = acceleration time in which I (int rom) remains constant

ΔV (ACT RPM)=actual-speed-value change

MP1054.x = Traverse distance per motor revolution

MP2600.x Acceleration feedforward control
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 Limit of integral factor of the speed controller
Input: 0.000 to 30.000 [s]

Integral Phase Compensation IPC

An *I* factor can be set in the speed controller of the iTNC (MP2510.x). This *I* factor is needed to attain a short setting time. However, the *I* factor has a negative influence on the position controller, i.e. the position controller tends to oscillate more easily, and it is often impossible to set the k_V factor (MP1510.x) high enough.
The IPC (Integral Phase Compensation) compensates the negative influence of the I factors on the speed controller, and makes it **possible** to increase the k_V factor (MP1510.x).

The IPC is beneficial on the following types of machines:

- Machine type 1: Machines with a dominant natural frequency between 15 Hz and 80 Hz, for which it is not possible to set a sufficiently high k_v factor.
- Machine type 2: Small-to-medium size machines that are driven directly.

Note

- The acceleration feedforward (MP2600.x) must already have been carefully adjusted for both types of machines.
- If after commissioning the IPC you wish to optimize the speed controller again, you must switch off the IPC beforehand, because the IPC influences the curve form.
- Use the same test program to commission the IPC as is used to measure the jerk and the k_v factor.

6.8.8 Power and Torque Limiting

You can limit the power of your spindle motor to achieve wider gear ranges. Wide-range motors are characterized by a larger speed range with higher torque at low speed.
One solution for bringing about this behavior is to use an oversized motor, and to limit the maximum power. However, power limiting does not reduce the high torque to the speed at which power limiting becomes effective. This high torque (until power limiting takes effect) can be reduced with torque limiting, in order to keep the mechanics of the machine from becoming overloaded.

As of software version 340 49x-05, the maximum spindle power is always limited in order to avoid overloading the power supply module. If MP2392 is set to zero and a power supply module is defined in MP2198, the maximum spindle power is limited to the value S6-40 from the power supply module table (Supply.spy). For applications requiring a higher spindle power (i.e. the spindle should be able to take up the maximum power P-Max from Supply.spy), the desired maximum power must be entered in MP2393.

With torque limiting you can also limit the torque of the axis motors, in order to keep the mechanics of the machine from becoming overloaded. Power limiting is not useful for axis motors.

For **axes and spindles**, the torque is limited to the value taken from either the table of power modules or the motor table, whichever is lower.

On supply units where the $\overline{\text{ERR.IZ.GR}}$ signal is available, the power of the spindle is limited via MP2392.x in case of error (not for axes).

HEIDENHAIN recommends activating this monitoring function via MP2220.x bit 2 (not with UE 2xx).

The torque can be calculated for any speed:

$$M = \frac{P \cdot 60}{n \cdot 2 \cdot \pi}$$

M: Torque [Nm]
P: Power [W]
n: Speed [min^{-1}]

Note

The power and torque limiting can have an effect on the braking of the spindle in an emergency stop.

- Enter the maximum power for the spindle in MP2392.x.
- Enter the maximum torque for the spindle or axis in MP2396.x.
- Activate the power limiting of the spindle at $\overline{\text{ERR.IZ.GR}}$ via MP2220.x bit 2 = 0 (not for UE 2xx)

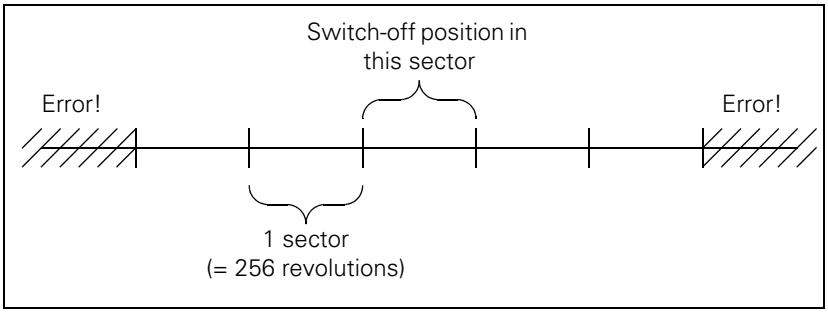
Difference between position at switch-on and shutdown

When the control is switched off, the actual position of the axes is saved with an absolute encoder. During switch-on it is compared with the position values read by the encoder.

If the positions differ by more than the difference defined in MP1146.x, a pop-up window appears with both positions. The new position must be confirmed with a soft key. If it is not confirmed, the error message **Check the position encoder <axis>** appears.

Special case: Absolute multiturn rotary encoder

The control stores an overflow (more than 4096 revolutions of the encoder) internally. Additionally, the number of traversed sectors (1 sector = 256 revolutions) is stored. After the drives are switched on, the current sector is compared to the stored sector.



If at switch-on the motor is more than two complete sectors away from the switch-off position (more than the sector after next), then immediately after the drives are switched on the **Switch-off pos. <axis> unequal ENDAT** error message appears.

Attention

The error must then be corrected!

After the control has been restarted, it is assumed that the number of revolutions is correct again.

The pop-up window may appear, stating that the positions at switch-on and shutdown differ by more than MP1146.x. If the motor is located at the correct position, you can confirm the message with the **YES** soft key.

MP1146.x	**Difference between the position at shutdown and the position read in via the EnDat interface**
Input:	0.0000 to 300.0000 [mm] or [°] 0: No difference permitted

Temperature model, second order

The following values (entries in the motor table or power module table) are required for the second-order temperature model to calculate the temperature (default values [axis/spindle] are valid for the entry "0"):

- **F-DC** [Hz]:
  This parameter is not evaluated for the CC 422.
  Lower limit frequency for the transition of traverse to standstill with the CC 424(B).
  F-DC = 0 – Default value (0 Hz) is active
  F-DC > 0 – Input value in Hz is active
- **T-DC** [s]:
  Thermal time constant for operation at standstill (not evaluated at present)
- **F-AC** [Hz]:
  Upper limit frequency for the transition from standstill to traverse.
  F-AC = 0 – Default value (0 Hz) is active
  F-AC > 0 – Input value in Hz is active
- **Tth_1** [s]:
  Thermal time constant for the transition from winding to housing
  Tth_1 = 0 – Default value (0 s) is active
  Tth_1 > 0 – Input value in [s] is active
- **Rth_1** [K/W]
  Thermal resistance for the transition from winding to housing.
  Rth_1 = 0 – Default value: 0 K/W
  Rth_1 > 0 – Input value in [K/W] is active
- **Tth_2** [s]:
  Thermal time constant for the transition from housing to coolant
  Tth_2 = 0 – Default value: 10 s for axes, 150 s for ball screw
  Tth_2 > 0 – Input value in [s] is active
- **Rth_2** [K/W]:
  Thermal resistance for the transition from winding to coolant
  Rth_2 = 0 – Default value: 0 K/W
  Rth_2 > 0 – Input value in [K/W] is active
- When the CC starts up, the current motor temperature (KTY sensor) is taken into the calculation model in order, for example, to compensate any excessive temperatures.

Note

- All parameters have to be entered for the model to become active. If a parameter is missing, the first-order temperature model becomes active, either with the thermal time constant "Tth2" or with "T-AC."

Module 9144 Safety self-test / Emergency-stop test

PLC module 9144 is used to activate special functions regarding the safety self-test or emergency-stop test, as well as the Functional Safety (FS) of a HEIDENHAIN control system.

The test can be started directly through the PLC module. Also, a PLC soft key can be made available through the PLC program if all minimum requirements are fulfilled so that the user can start the emergency stop test directly by soft key.

It must be ensured by the PLC program that the following minimum requirements are met before the self-test is started:

- All guard doors must be closed and, if possible, locked.
- No active machining operation is allowed.
- All servo drives must be switched off.

Further constraints may apply, depending on the control model used:

- **Safety self-test and emergency-stop test for controls with or without HSCI and without Functional Safety (FS)**
  The PLC program decides whether and at what time a repeated test is to be run or suggested after the control has been switched on. The PLC program can use Module 9144 to start the test immediately, taking the minimum requirements (mode 0) into account.
  If the PLC program wants to test the brakes beforehand, it must command the brake test through PLC module 9143. Before the repeated self test begins, the PLC program must switch off the drives.
- The marker M4190 is set and the marker M4189 is reset when a test is started.
- The marker M4189 is set and the marker M4190 is reset when the entire test cycle has been completed.
- The marker M4192 is set when there is a request for the control voltage to be switched on.

Module 9144 and the PLC markers are used to start the repeated self-test through the PLC and to fully automate the self-test. The test is started by Module 9144 and at first triggers an external emergency stop through the signals MC.RDY and STO.A.G. Then the test continues up to the point at which the control voltage must be switched on again. This can be done by the user on request by the NC, or the procedure can be automated in such a way that marker 4192 is evaluated and the control voltage is switched on by the PLC. As soon as the control voltage has been switched on again, the self-test continues up to completion.

Disable speed output for spindle

With M4008 you can block the speed output for the spindle. At the same time, M03, M04 or M05 are highlighted. The nominal speed value is zero.

		Set	Reset
M4008	**Disable speed output for spindle**	PLC	PLC

Gear ranges

You can define up to eight gear ranges:

- In MP3510.x, enter for each gear range the rated speed for "S-override 100%."
  Enter the value zero for unnecessary gear ranges.
- In MP3210.x, enter for every gear range the S analog voltage or motor revolutions at rated speed.
- In MP3240.1, define the minimum nominal speed value for the motor.
- In MP3120, define whether zero is permitted as a programmed speed.

If an impermissible speed is programmed, M4004 is set and the error message **WRONG RPM** is displayed.

Note

The gear range from W256 is output when the spindle speed is 0.

MP3510.0-7 Rated speed for the gear ranges 1 to 8
Input: 0 to 99 999.999 [min^{-1}]

MP3210.0-7 Analog nominal spindle voltage at rated speed for the gear ranges 1 to 8
Input: 0 to 100.000 [V]

MP3210.0-7 Digital spindle motor revolutions at rated speed for the gear ranges 1 to 8
Input: 0 to 100.000 [1000 min^{-1}]

MP3240.1 Analog spindle: Minimum nominal value voltage
Input: 0 to 9.999 [V]

MP3240.1 Digital spindle: Minimum motor speed
Input: 0 to 9.999 [1000 min^{-1}]

MP3120 Zero speed permitted
Input: 0: S = 0 permitted
1: S = 0 not allowed

		Set	Reset
M4004	**Impermissible speed was programmed**	NC	NC

6.12.9 Rigid tapping

Cycle 17

- Define the rigid tapping process in the NC program with Cycle 17. While Cycle 17 is running, the iTNC automatically switches the tool axis to velocity feedforward mode.
- Define the dynamic response of the spindle and the machine tool axes in machine parameters. See "The Control Loop" on page 813 and „Spindle" on page 941.

With Cycle 17 the spindle can also be feedback-controlled. This results in a better speed curve:

- Set MP7160 bit 2 = 1 to drive the spindle under position feedback control with Cycle 17.

The tool axis can track the spindle or it can be interpolated with the spindle. Interpolation can result in higher speed stability of the tool axis. The path jerk (spindle and tool axis) can be set via MP3415.3:

$$r = \frac{a}{MP3415.3}$$

Whichever value is smaller from this formula and from MP1090.0 is valid.

- In MP7160, set bit 4 = 1 to interpolate the tool axis with the spindle.

With small thread depths and excessive spindle speeds it is possible that the programmed spindle speed may not be attained. The immediate transition from the acceleration phase to the braking phase can diminish the quality of the thread:

- Set MP7160 bit 1 = 1 in order to limit the spindle speed so that the spindle runs for about 1/3 of the tapping time at a constant speed.

During tapping, the position of the tool axis tracks the actual position of the spindle.

Please note that the use of acceleration feedforward control for the tool axis makes the tool axis sensitive to fluctuations in spindle speed caused, for example, by gear transmission. If this happens, the tool axis starts to run rough:

- In MP7160, set bit 3 = 1 to switch off acceleration feedforward control for Cycle 17.

Before tapping, the axes (e.g. Z and S) are synchronized through an oriented spindle stop, i.e., every Z position is assigned to a certain spindle angle. The NC orients the spindle. The NC sets M4017. The position control loop must be closed (M4012). Also see „Oriented Spindle Stop" on page 964.

Synchronization makes it possible to cut the same thread more than once. The assigned spindle angle depends on the thread pitch entered in the cycle. You can deselect this function to save machining time:

- Set MP7160 bit 0 = 1
  In this case you cannot cut the thread more than once.

Sample time:

▶ Set the time interval for recording the signals.
Possible entries: 0.6 ms, 1.8 ms and 3.6 ms
4096 samples are stored. The signals are therefore stored for the following duration:

- 0.6 ms · 4096 = 2.4576 s
- 1.8 ms · 4096 = 7.3728 s
- 3.6 ms · 4096 = 14.7456 s

Output:

▶ Select whether the nominal speed value is to be issued as a step or ramp.

- If you select ramp output, then the programmed feed rate, k_V factors, and acceleration values that you have specified with machine parameters go into effect.
- If you select step output, a step will be output as nominal velocity value when you press the axis-direction buttons in the **Manual operating mode.** During output, the position control loop is open. A step can be output only if code number 688379 or 807667 has been entered.

Feed rate:

▶ Enter the height of the step for the nominal velocity value (in mm/min). If you have defined a ramp as output, this field has no meaning.

Channel 1 to channel 6:

▶ Assign the channels of the recorded signals to the respective axes.

Trigger:

▶ Define the type of recording.
You have the following possibilities:

- **Free run:** The recording is started and ended by soft key. When you press the STOP soft key, the last 4096 events are saved.
- **Single shot**: When you press the START soft key, the next 4096 events are saved.
- **Channel 1** to **channel 6**: Recording begins as soon as the trigger threshold for the set channel is crossed.

Trigger threshold:

▶ Enter the trigger threshold (you will find the appropriate units in the signals table on 987):

Slope:

▶ Define whether recording will be triggered with the rising (positive) or falling (negative) edge.

Determining data for synchronous motors

The motor data for synchronous motors are entered in the motor table after some conversions using the values from the motor data sheet of the respective manufacturer (here using the example of a SIEMENS motor).

Values in the HEIDENHAIN motor table	Values from the motor data sheet
TYPE: SM	Permanently excited synchronous motor
NAME: 1FT6044-4AF7	1FT6044-4AF7
MODE: 0	
Rated current I-N in [A_{eff}] winding I-N: 2.9	Data sheet value Inoml (100 K) IN = 2.9 A
Rated voltage U-N in [V_{eff}] interlinked U-N: 341	Calculation from data sheet values n_{noml}, k_E, R_{Str}, $I_{noml\ (100\ K)}$, L_D: $U\text{-}N = \sqrt{3} \cdot \sqrt{(U_e + U_r)^2 + U_x^2}$ $U_e = (n_{noml} / 1000) \cdot (k_E / \sqrt{3})$ $U_e = (3000 / 1000) \cdot (108 / \sqrt{3})$ $U_e = 187.06\ V_{eff\ L,N}$ $U_r = RStr \cdot I_{noml\ (100\ K)}$ $U_r = 3.05 \cdot 2.9$ $U_r = 8.85\ V_{eff\ L,N}$ $U_x = 2 \cdot \pi \cdot (n_{noml} / 60) \cdot PZ \cdot (LD / 1.5) \cdot I_{noml\ (100\ K)}$ $U_x = 2 \cdot \pi \cdot (3000 / 60) \cdot 2 \cdot (0.016 / 1.5) \cdot 2.9$ $U_x = 19.44\ V_{eff\ L,N}$ $U\text{-}N = \sqrt{3} \cdot \sqrt{(187{,}06 + 8{,}85)^2 + 19{,}44^2}$ $U\text{-}N = 341\ V_{eff\ L,L}$
Rated speed N-N in [min^{-1}] N-N: 3000	Data sheet value n_{noml} $N\text{-}N = 3000\ min^{-1}$
Rated frequency F-N in [Hz] F-N: 100	Calculation from data sheet value n_{noml} $F\text{-}N = (n / 60) \cdot PZ$ $F\text{-}N = (3000 / 60) \cdot 2$ F-N = 100 Hz
No-load voltage at rated speed U0 in [V_{eff}] interlinked U0: 324	Calculation from data sheet value n_{noml} and k_Et $U0 = (n_{noml} / 1000) \cdot k_E$ $U0 = (3000 / 1000) \cdot 108$ $U0 = 324\ V_{eff\ L,L}$
No-load current I0 in [A_{eff}] winding I0: 3	Data sheet value $I_{0\ (100\ K)}$ $I0 = 3\ A_{eff}$
Stator resistance at 20 °C R1 in [mΩ] at 20° C R1: 3050	Data sheet value R_{Str} R1 = 3050 mΩ
Rotor resistance at 20 °C R2 in [mΩ] at 20° C R2: 0	

Adjusting the current controller:

- 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 code number 688379 or 807667 (followed by the DIAGNOSIS and DRIVE DIAGNOSTICS soft keys) to switch to the **Drive Diagnostics** mode of operation.
- 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 axis to be adjusted.
- With the FACTOR P/I soft key, select the I factor and set MP2430.x = 0.
- With the FACTOR P/I soft key, select the P factor.
- Calculate the starting value of the P factor with the following formula:

$$\text{Starting value} = \frac{100\,000 \cdot L}{T_a}$$

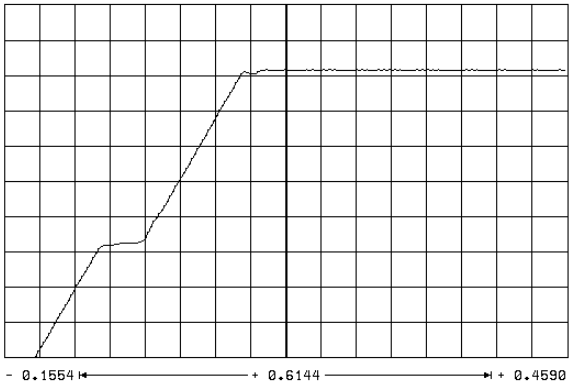
T_a	f_{PWM} **(MP2180.x)**
150	3 333 Hz
120	4 166 Hz
100	5 000 Hz
75	6 666 Hz
60	8 333 Hz
50	10 000 Hz

Synchronous motor: $$L = \frac{XH}{2 \cdot \pi \cdot (F\text{-}N) \cdot 1000}$$

Asynchronous motor: $$L = \frac{XStr1 + XStr2}{2 \cdot \pi \cdot (F\text{-}N) \cdot 1000}$$

The values for XH (magnetizing reactance), F-N (rated frequency), XStr1 (stator leakage reactance) and XStr2 (rotor leakage reactance) can be found in the motor table. Switch to the editing mode of the motor table (APPEND MOTOR soft key).
The values for XH, XStr1 and XStr2 are specified in [mΩ] in the motor table. Use these values in the formulas. The formula already contains the conversion factor.

- Set this P factor (MP2420.x) with the ↑ soft key.
- Press the START STEP soft key.
  This sends a step function to the current controller and measures the step response. The height and length of the step function are automatically calculated by the iTNC.
- With the ↑ soft key, increase the P factor (MP2420.x) step by step until just barely no undershoot is visible.



MP1820.x too large

Step 4: Switch-on the nominal position value filter

▶ In MP1096.x, enter a defined tolerance (e.g. 0.02 mm).

5. Activate monitoring functions:

Note

To ensure that the monitoring functions become effective at the right moment, you must enter meaningful values.

HEIDENHAIN recommends the following input values. You must change these values slightly to adapt them to the design of the machine.

MP	Temporary input value	Meaning
MP1030.x	0.01 mm	Positioning window
MP1110.x	2 · MP1030.x	Standstill monitoring
MP1140.x	0.03 [1000 min^{-1}]	Movement monitoring
MP1144.x	0.5 mm	Motion monitor for position and speed
MP1410.x	0.5 mm	Position monitoring in operation with velocity feedforward control (erasable)
MP1420.x	2 mm	Position monitoring in operation with velocity feedforward control (EMERGENCY STOP)
MP1710.x	1.2 · following error in rapid traverse	Position monitoring in operation with following error (erasable)
MP1720.x	1.4 · following error in rapid traverse	Position monitoring in operation with following error (EMERGENCY STOP)

Step 2: Set the traverse range
Same procedure as for digital axes.

Step 3: Specify the type of control
For control with following error, same procedure as for digital axes.

For control with velocity feedforward control, same procedure as for digital axes.

Step 4: Perform an offset adjustment
At the iTNC: "The Control Loop" on page 813.

5. Activate monitoring functions:

- Enter the following temporary input values when you begin: see "Commissioning of digital axes" on page 1026

Step 6: Compensate the backlash
Same procedure as for digital axes.

Step 7: Compensate the static (stick-slip) friction
Same procedure as for digital axes.

6.14.9 Commissioning the analog spindle

Adjusting the servo amplifier
Same procedure as for analog axes.

Acceleration
Same procedure as for digital spindle. You measure the signals directly at the servo amplifier with an external oscilloscope.

Direction of rotation
Same procedure as for digital spindle.

Position controller
Same procedure as for digital spindles.

Summary:

- The speed is switched at the intersection of the two current curves (Imax of motor, Imax of power module) so that no inconsistencies in the torque behavior of the motor occur.
- For better controllability (no harmonics at higher PWM frequencies), it might already make sense to switch at lower speeds.
- The best speed to switch at must be determined by experimenting. The value above should serve as an initial value.

MP2186.x **Speed-dependent switching of the PWM frequency**

Input: 0 to 100 000 [rpm]
MP2186.x specifies the shaft speed at which the PWM frequency is switched to twice the PWM frequency

MP2188.x **Speed-dependent switching of the PWM frequency**

Input: 0 to 100 000 [rpm]
MP2188.x specifies the shaft speed at which the original PWM frequency is returned to from the doubled PWM frequency (as the result of MP2186.x).
MP2188.x must be < MP2186.x

Module 9311 Dynamically change values for friction compensation

Module 9311 is used at run-time to prescribe other values for the friction compensation. The original values from MP2610.x, MP2612.x and MP2614.x are temporarily overwritten in the DSP. The MP file remains unchanged.

Conditions:

- This function is supported as of the DSP hardware CC 424(B).

Call:

PS B/W/D/K <Axis number>
PS B/W/D/K <Current in [mA]>
0 to 30000 replaces the value in MP2610.x
PS B/W/D/K <Path in [0.1 µm]>
0 to 10000 replaces the value in MP2612.x
PS B/W/D/K <Path in [0.1 µm]>
0 to 10000 replaces the value in MP2614.x
CM 9311

Error recognition:

Marker	Value	Meaning
M4203	0	New values assumed for axis number
	1	Error code in W1022
W1022	1	Invalid value as replacement for machine parameter
	2	Invalid axis number programmed
	19	Function is not supported by the DSP board (CC 422)
	24	Call was not from a cyclic program

Temperature sensor

Linear motors usually have a KTY and several PTC thermistors or thermoswitches for temperature measurement.

Attention

The PTC thermistors or thermoswitches must be **galvanically isolated** and evaluated by the PLC.

The KTY requires **double insulation** to the motor windings, which must be provided by the motor manufacturer. Otherwise, do **not** connect the KTY to the control!

The KTY is monitored by the control (NC). The temperature signal is conducted to the control together with the encoder signals (X15 to X20, X80 to X83). If the KTY is not to be evaluated, this function must be deactivated over MP2220.x bit 4 = 1 (See "Monitoring Functions" on page 1084).

For linear and torque motors, the conductor for the temperature signal of the KTY is frequently in the motor power cable, which can cause interference. Since the conductor for the temperature signal is then led into the conductor of the speed encoder, the interference causes noise in the encoder signals. HEIDENHAIN therefore recommends conducting the temperature signals over the line drop compensator, so that the interference signals are filtered.

Note

HEIDENHAIN recommends the additional temperature monitoring of the PTC thermistors or thermoswitches via the PLC, since these are distributed over the entire length (linear motors) or circumference (torque motors) (as opposed to the KTY, for which there are only spot measurements).

For example, PTC thermistors can be connected to a PLC input via the securely grounded 3RN1013-1BW10 thermistor motor-protection device from SIEMENS.

Values in the HEIDENHAIN motor table	Values from the motor data sheet
Stator leakage reactance at F-N Xstr1 in [mΩ] Xstr1: 0	If nothing given, then zero.
Rotor leakage reactance at F-N Xstr2 in [mΩ] Xstr2: 0	
Magnetizing reactance XH for F-N at rated conditions XH in [mΩ] XH: 2295	Calculation from data sheet value $L1_{L-L}$, *n* and 2p XH = $2 \cdot \pi \cdot (n / 60) \cdot (2p / 2) \cdot (L1_{L,L} / 2)$ = $2 \cdot \pi \cdot (180 / 60) \cdot (66 / 2) \cdot (0.00738 / 2)$ = 2295 mΩ
Desaturation speed N-XH in [min^{-1}] N-XH: 0	
Rotational speed of beginning field weakening range N-FS [min^{-1}] N-FS: 0	
Maximum speed (mechanical) N-MAX in [min^{-1}] N-MAX: 180	Data sheet value *n* N-MAX = 180 min^{-1}
Saturation factor %-XH in % %XH: 100	
Stalling torque reduction factor %-K in % %-K: 100	
No. of pole pairs (half pole no. of motor) PZ PZ: 33	From data sheet value 2p PZ = 2p/2 PZ = 66/2 = 33
Temperature coefficient of the stator winding TK in 1/K TK: 0.004	
Line count of the speed encoder STR STR: 32768	
Type of encoder SYS: 5	Incremental encoder with Z1 track: 1 Aligned absolute encoder with EnDat interface: 2 Unaligned absolute encoder with EnDat interface: 5 Unaligned incremental encoder with distance-coded reference marks: 7
Counting direction DIRECT. DIRECT.: +	
Max. temperature of motor at temperature sensor T-MAX in [°C] T-MAX: 120	
Maximum motor current I-MAX in [A_{eff}] winding I-MAX: 53	Data sheet value Ip I-MAX = 53.0 A_{eff}

Transferred number		Return Value
	Handwheel subdivision factor	0 to 10
31	Axis 1	
32	Axis 2	
33	Axis 3	
34	Axis 4	
35	Axis 5	
36	Axis 6	
37	Axis 7	
38	Axis 8	
39	Axis 9	
	Tool change	
50	Tool change sequence (see **FN18: SYSREAD ID61 NR0**)	
51	Pocket number for reserve	
52	Magazine number for reserve	
53	Pocket number for insertion	
54	Magazine number for insertion	
100	Number of the tool axis	
1000	Table editor (only in a spawn job or submit job)	>= 0: Active line in the table editor –1: Table editor not active
1001	Pallet table (only in a spawn job or submit job)	>= 0: Active line in the pallet table –1: Pallet table not active
1002	Status of pallet machining	–1: Main program is not a pallet table 0: Machining was not started 1: NC program is selected but not started 2: NC program was started 3: Pallet-change macro was started 4: Macro from the **PALEPILOG** entry in NCMAKRO.SYS was started 5: Pallet-change macro was started by the PLC (Module 9280)

Call:
PS B/W/D/K <Number of the desired status information>
CM 9035
PL B/W/D <Status information>

Error recognition:

Marker	Value	Meaning
M4203	0	No error
	1	Error code in W1022
W1022	1	Status information invalid
	20	Call was not in a submit or spawn job

Condition:

- The .CHM help file must be stored language-sensitive in the TNC:\tncguide\de directory, or in TNC:\tncguide\en etc.
- An OEM-specific OEMx.CHM file is necessary.
- If no OEMx.CHM file is indicated, the online help is not called. All other reactions that are saved for this error in the .PET table are performed.

Call:

```
PS    K/B/W/D  <Line number in the .PET error table>>
PS    K/B/W/D  <Additional text from S0 to S99 or constant string>
PS    K/B/W/D  <Variable 1>
PS    K/B/W/D  <Variable 2>
PS    K/B/W/D  <Offset for the help number in .PET>
CM    9392
```

Error recognition:

Marker	Value	Meaning
M4203	0	No error
	1	Error code in W1022
W1022	1	Transferred parameter outside of value range or error number is not in .PET table
	2	Invalid parameter
	3	String address outside of value range
	8	Incorrect operating mode, compatibility error marker set
	23	Overflow of PLC error message queue

Example:

```
PS    K10              ; Error 10 from .PET
PS    S"ERROR-ERROR"   ; %s
PS    K9000            ; %d
PS    W100             ; %.1f
PS    K2               ; Offset for the help number in .PET
CM    9392
```

Assumption: Text in .PET "%s error in module %d, W100 = %.1f" and W100 = 1234

Therefore, the following output text results:
"ERROR-ERROR error in module 9000, W100 = 123.4"

Including an OEM-specific online help file

Once you have created a valid *.chm file, proceed as follows in order to display your own OEM-specific help file in the HEIDENHAIN TNCguide:

- You may need to rename your ***.chm** file. You must use one of the names reserved by HEIDENHAIN for OEM help files.
  e.g. **OEM1.CHM**
- Use TNCremo to transfer the help file to the control.
- Store your help file in the appropriate language directory:
  TNC:\tncguide\de, TNC:\tncguide\en, etc. If you have created only an English help file, HEIDENHAIN recommends placing it in the other language directories as well.
- Press the HELP key to call the TNCguide. Your help file should now automatically be included in the TNCguide directory tree.

National languages

CHM files will not be available for all possible TNC dialog languages at the time the NC software is released. We are planning on delivering the German and English languages with the software, and the CHM files in other languages will be made available for free downloading (for unregistered users as well, of course) from our FileBase. The user then simply downloads the appropriate file(s) for the respective language(s), and stores them in the directory defined by us on the TNC hard disk: **TNC:\tncguide\de** or the appropriate language subdirectory.

A **readme.a** file is located in the respective language directories on the TNC hard disk under **TNC:\tncguide**. This file describes the procedure for loading the CHM files from our FileBase.

Online help files and TNCremoNT

The online help files (with file name extension .chm) can be managed with TNCremoNT:

- **Transfer of *.chm files:**
  Online help files are binary files. If TNCremoNT is updated to version 2.5, the file extension .chm is automatically added to the list of binary file types. Otherwise the list of binary file types must be amended manually under Extras > Configuration on the Mode tab in order to transfer them correctly.
- **Performing a backup of the TNC via TNCremoNT:**
  Online help files are automatically untagged during creation of the scan list used for the backup. This also applies to CHM files that the machine manufacturer has saved on the control.
  Reason:
  The *.chm files saved on the control require a large amount of memory, and do not need to be backed up, since they are freely available from the HEIDENHAIN homepage.
  Please note that only online help files from HEIDENHAIN are available here. This setting can be applied to other file types as well in TNCbackup under Edit > Settings, if necessary.

Automatic selection of the Learning / Controlling status

If an NC program is selected for machining and started, and if AFC is active, then it is first checked whether an associated **<name>.AFC.DEP** file exists in the same directory as the NC file. If this is the case, then the data in this file are immediately used as control parameters, and machining is performed with adaptive feed control. If this file does not exist, the first machining run is used as the learning phase and the file is created. If the AFC file is determined to be incomplete during machining, the missing steps are automatically performed in the Learning mode, thereby generating the missing data.
When Learning is deactivated (M05, manually via soft key, or with FN 17), the learned data are saved and the status of this data block is set to "Controlling." During Controlling, the data blocks are read in the same sequence they were learned, the step numbers are evaluated and other parameters (tool number, index) are checked to see if they match.

The current status or mode of AFC is stored in PLC Word W348 (inactive = 0, learning phase = 1, controlling = 2).

- W348 = 0: AFC inactive (OFF)
- W348 = 1: AFC in learning phase
- W348 = 2: AFC is controlling

Additional FN functions

Further FN 17 functions are available for software option #45 "AFC - Adaptive Feed Control":

- Definition of reference power. The learning phase can therefore be omitted. The reference power is specified in percent with respect to the rated power of the spindle. Example:
  FN 17:SYSWRITE ID 622 NR0 IDX 3.0 = 85
- Activating cut-based tool-wear monitoring.
  The monitoring limit is specified in percent of the reference power. If the spindle power exceeds the monitoring limit, the PLC marker M4510 will be set. In this way, the PLC can initiate the desired reactions, such as setting the tool life of a tool to "expired". Example:
  Monitoring limit at 20% with a reference power of 50%. In this way, 60% of the rated power output of the spindle is monitored:
  FN 17:SYSWRITE ID 622 NR0 IDX 4.0 = 20
- Activating cut-based spindle-load monitoring.
  The monitoring limit is specified in percent of the reference power. If the spindle power exceeds the monitoring limit, an NC stop is triggered.
  Monitoring limit at 40% with a reference power of 50%. In this way, the system monitors for 70% of the rated power output of the spindle:
  FN 17:SYSWRITE ID 622 NR0 IDX 5.0 = 20

  The PLC can read in word W350 why the NC stop was triggered:
  - (W350 = 1 or 2:
    NC stop due to falling below the permissible minimum power
  - W350 = 3:
    NC stop due to detected cutter breakage (FN17 function ID 622 IDX 6.0)
  - W350 = 4:
    NC stop because the spindle load was exceeded (FN17 function ID 622 IDX 5.0)

During the block scan, PLC positioning commands are included in calculation only if they are also executed. The TOOL CALL block normally initiates PLC positioning commands for tool change. If you want these positioning commands to be calculated in the block scan:

- In MP951.x, enter the absolute position with respect to the machine datum. The values for MP951.x can be assumed with the "actual position capture" key.
- Activate the calculation for the specific axes with MP7450.

With flexible tool-pocket coding in the central tool file (see "Tool Changer" on page 1513), the change of pocket number in the tool file must be prevented during block scan if the TOOL CALL blocks are not collected:

- Set M4542.

The block scan can be interrupted by a programmed STOP or with M06, whereby you can have the programmed dwell time included:

- With MP7680, bits 3 and 4, select the parameters for the block scan.
- With MP7451.x, define the feed rate for returning to the contour.

If an NC program block is interrupted in **`Single Block mode`** or by a **`STOP`** block and the positions of NC axes are changed, the NC program can be restarted at the changed positions. If in OEM.SYS **`STRICTREPOS = YES,`** the function for restoring the position is activated (see "OEM.SYS" on page 1637).

Note

If you change the tool data in the PLC, update them with M4538, or change or update them with an NC macro, then the new tool data cannot be correctly offset in the block scan.

Module 9279 Shut down control (configurable)
With Module 9279 the control can be

- Shut down
- Shut down and restarted (reset)
- Shut down, and then a PLC output specified in MP4040, MP4041 and MP4042 is set.

In each case the PLC is not executable after shutting down, and no message appears on the screen that the control is being shut down.

Call:
PS B/W/D/K <Mode>
0: Shut down the control
1: Shut down and restart the control
2: Shut down the control depending on MP4040, MP4041 and MP4042
CM 9279

Error recognition:

Marker	Value	Meaning
M4203	0	Control reset was carried out
	1	Error code in W1022
W1022	2	Invalid mode
	20	Module was not called in a spawn job or submit job

Module 9189 Shut down the control
Module 9189 shuts down the control. The PLC is not executable after shutdown. The message windows, which appear during shutdown via soft key, do not appear.

Call:
CM 9189

Error recognition:

Marker	Value	Meaning
M4203	0	Control was shut down
	1	Error code in W1022
W1022		Module was not called in a spawn job or submit job

Message for power interruption

After the control powers up, the **`Power interrupted`** message appears.

▶ Press the CE key to acknowledge this message and compile the PLC program.

With MP7212 you can suppress this message, e.g. for unattended operation.

MP7212 Power interrupted message
Input: 0: Acknowledge the **`Power interrupted`** message with CE key
1: **`Power Interrupted`** message does not appear

8.1.28 Conversational language

The TNC is delivered with all NC-dialog human languages already loaded:

- In MP7230.0 select the conversational language in which you wish to work.

If the NC dialog messages for the selected language are not on the hard disk, the error message **LANGUAGE LOAD ERROR** appears. You can continue working in the default language English.

You can write your own dialog messages and save them in several languages:

- Save your dialog messages in permanently defined directories in the PLC partition.

These directories are:

PLC:\LANGUAGE\
- CHINESE\
- CZECH\
- DANISH\
- DUTCH\
- ENGLISH\
- ESTONIA\ (Option #41 – ID 530 184-01)
- FINNISH\
- FRENCH\
- GERMAN\
- HUNGARIA\
- ITALIAN\
- KOREAN\ (Option #41 – ID 530 184-01)
- LATVIAN\ (Option #41 – ID 530 184-011)
- LITHUANIAN\ (Option #41 – ID 530 184-01)
- NORWEGIAN\ (Option #41 – ID 530 184-01)
- POLISH\
- PORTUGUE\
- ROMANIAN\ (Option #41 – ID 530 184-01)
- RUSSIAN\
- SLOVAK\ (Option #41 – ID 530 184-01)
- SLOVENIAN\ (Option #41 – ID 530 184-01)
- SPANISH\
- SWEDISH\
- TURKISH\ (Option #41 – ID 530 184-01)

- With MP7230.1–3, switch to the desired language.

You can store PLC dialog message files, PLC error message files, and help files with identical file names in the different languages and in UNICODE (e.g. with PLCtext V3.1):

Note

If texts from these files are also used in the PLC window, then they cannot be in UNICODE, but must rather use UTF8-coding.

- In the system file OEM.SYS, enter only the file names with the commands **PLCDIALOG =** and **PLCERROR =**. The NC looks for the paths given in MP7230.1 or MP7230.2. The entry behind **MODEHELP =** is overwritten with the selected path whenever MP7230.3 is changed.

Symbol	Symbol	Function
		**Drive control board x** **Version** tab: ■ **Speed controller software:** Installed speed-controller software version ■ **Current-controller software:** Installed current-controller software version ■ **Hardware code:** Additional information for identifying the hardware (only CC 422). ■ **Version of additional info:** Date and time of installation ■ **Degree of support:** Degree of support for controller software ■ **SG software available:** Information about whether the installed software supports functional safety ■ **SG software active:** Functional safety is activated/deactivated
		Drive control board x **Voltages and currents** tab: ■ **Supply voltage +5V:** Current value of voltage in [V] ■ **DC-link voltage:** Current value of voltage in [V] ■ **DC-link current:** Current value of current in [A] ■ **DSP computer board temp.**: Current temperature value on the DSP computer board in [°C] ■ **Supply voltage +15V:** Current value of voltage in [V] ■ **Supply voltage –15V:** Current value of voltage in [V] ■ **Supply voltage +3.3V:** Current value of voltage in [V] ■ **Auxiliary voltage UL:** Current value of voltage in [V] ■ **Auxiliary voltage UH:** Current value of voltage in [V]
		Drive control board x **Status** tab: ■ Status information about various signals, see page 1283

8.1.31 Window Manager

The XFCE Window Manager for the graphic interface of the control was introduced with software version 340 49x-04. The XFCE Window Manager is a standard window manager for UNIX-based operating systems. It provides the following functions:

- Optional taskbar for switching between various applications (user interfaces).
- Additional desktop on which the machine tool builder's applications can be run.
- Controlling the focus between NC-software applications and those of the machine tool builder.
- The size and position of pop-up windows can be changed. It is also possible to close, minimize and restore the pop-up windows.

Basic configuration

The window manager is supplied with two default configurations (FULL and SIMPLE). The configuration of the window manager can be changed at any time by using the XFCE configuration dialog.

The SIMPLE configuration neither has a taskbar, nor a background image for the third desktop. As a result, the TNC software with window manager differs only very slightly from the NC software version without window manager. The FULL configuration has a taskbar, however.

HEIDENHAIN recommends using the taskbar of the window manager only on controls equipped with a mouse or a touch pad.

If a software version with the window manager is installed on a control for the first time, the **PLC:\WINDOWMANAGER** directory does not exist. It is created when the NC software is started up for the first time, and the SIMPLE configuration is active.

If you delete the **PLC:\WINDOWMANAGER** directory, the directory is created again during the next startup of the NC software and the SIMPLE configuration is active.

If TNCremoNT is used to transfer the PLC partition between the programming station and a single-processor or dual-processor version, the configuration of the Window Manager (**PLC:\WINDOWMANAGER** directory) is also transferred. The configuration is portable, except for the position of the XFCE taskbar (also called TNC taskbar).
On a dual-processor control, the TNC taskbar is moved to the opposite side of the screen if it displayed at the same position as the Windows taskbar, which is usually at the bottom of the screen.

If a window manager configuration exists, it is retained when the NC software is reinstalled (software update).

Input fields

With the switches **/e** and **/i** you can assign input fields to the variables:

/e: shows the current value that can be overwritten.

/i: shows an empty field in which a new value can be entered.

In addition, both switches **/e** and **/i** can be given an identifier **xxx** (**/e = xxx**, **/i = xxx**), where **xxx** is a positive whole number. With Module 9211 you can then ascertain whether the cursor is located in this field.

The switch **/s = xxx** is used to created a field in which no entries can be made. By entering the identifier **xxx** it is possible to ascertain with Module 9211 whether the cursor is located in this field.

If the switches **/e**, **/i** or **/s** are used, the cursor keys function as jump commands from input field to input field. The current page is scrolled if necessary. Any text between the input fields might no longer be shown.

Note

Do not edit any text before the first input field or after the last.

The C command "printf" requires a format that defines the length of the numerical field:

- Save this format in the mask file. Otherwise the length of the input field depends on the coincidental content of the associated variable.

For the input function this format instruction is converted internally into a form suitable for the C command "scanf":

printf: %[flags][digits1][.[digits2]][1]conversion_char

scanf: %[digits1] [size]conversion_char

Note

Special characteristics

- %d, %e
  The size information "1" can be omitted. Floating-point variables are of the double type and automatically add to this information.
- %g
  Do not use. Causes errors.
- %i
  Do not use. Any number entered with leading zeros would be interpreted as an octal number.
- %u
  Works correctly only in the definition range for the respective variables.
- The size indicator **h** (short integer) of the "scanf" function cannot be written. All integer variables are automatically expanded to 32 bits for input and output.

The following definitions are possible:

Entries for the menu definition and type of soft key in the HR 420 menu:

Entry	Parameter	Description
;		Comment
SKMENU <menu name> **ENDSKMENU**		Beginning or end of the definition of a soft-key menu. The name of the menu must be given for **SKMENU** (e.g. "HRRootMenu"—see the example). The soft keys are aligned on the HR 420 in the sequence in which they appear in the file. Also note the additional parameters for this keyword.
	HRROOT	Freely-definable root menu when called from the basic handwheel menu via the **FCT** (Function) soft key
	HRMENU	Freely-definable submenu, called via the keyword **NODE ...**
	TITLE:<name>	Menu title: Freely definable text in the third line of the HR 420 The parameter **TITLE:** can also be surrounded by quotation marks. This permits blank spaces in the menu title.
NODE <submenu name>	Soft key jumps to a submenu. Is confirmed via W306 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 W306 to the PLC. The soft-key name and the name of the submenu must be indicated.	
BLANK	Empty soft key, is shown as "**..**". You can also specify a soft-key name.	
ACTION <soft-key name>		Function soft key. Is confirmed via W306 to the PLC. The soft-key name must be indicated.
	STATUS:<marker or word>	An operand is assigned to the soft key (in addition to W306). If a **marker** is indicated and the soft key is pressed, the marker is set. If a **word** is indicated, the soft key number is entered (index number in the *.sys file, e.g. Softkey.sys).
PULSE <soft-key name>	The soft key is reported to the PLC via W306 for the duration of the PLC cycle. A soft-key name must be indicated.	
The soft-key types **RADIO, CHECK** and **STATE** may not be used. Other parameters, such as **ENABLE, HIDE, REPEAT,** etc. are not yet available.		

8.4.2 Machine operating panel

At connection X46 there are 25 PLC inputs (I128 to I152) and eight PLC outputs (O0 to O7) for evaluating the keys on the machine operating panel.

You can activate specific functions by linking the PLC inputs with the corresponding markers and words.

You can store the pressing of an axis-direction button:

- With MP7680 bit 0, enable the memory function.
- Use M4562 to save a depressed axis direction key. This means that the axis will move until there is an NC STOP.

If the LSV2 connection is active, the NC Start and NC Stop commands can be transmitted. PLC Marker M4230 functions like NC Start, and M4231 like NC Stop, unless the PLC markers are reset by the PLC program. The two markers for NC Start (M4564, M4230) are OR-gated in the PLC run-time system. The two markers for NC Stop (M4560, M4231) are AND-gated (if one marker = 0, then an NC Stop is triggered). After evaluating the states, the two markers of the LSV2 connection are set to their original state again (M4230=0, M4231=1).

MP7680 **Machine parameter with multiple function**
Input: Bit 0 – Memory function for axis-direction keys with M4562:
0: Not saved
1: Saved if M4562 is set

		Set	Reset
W1046	**Manual traverse in positive direction** Bits 0 to 13 correspond to axes 1 to 14: 0: Do not move axis 1: Move axis	PLC	PLC

		Set	Reset
W1048	**Manual traverse in negative direction** Bits 0 to 13 correspond to axes 1 to 14: 0: Do not move axis 1: Move axis	PLC	PLC

		Set	Reset
M4230	**NC start via LSV2**	NC	NC
M4231	**NC stop via LSV2**	NC	NC
M4560	**NC stop (0: stop)**	PLC	PLC
M4561	**Rapid traverse**	PLC	PLC
M4562	**Memory function for axis direction keys (MP7680 bit 0 = 1)**	PLC	PLC
M4564	**NC start**	PLC	PLC

Module 9242 Positioning in a file

With this module you change the position of the cursor in a file opened with Module 9240. The new position is provided as result from Module 9242.
If the file was opened in the "record oriented" mode (tables), the cursor is positioned line by line.
If the file was opened in the "buffered" mode, the cursor is positioned character by character.
If you indicate a position before the beginning or after the end of the file, the cursor is positioned to the beginning or end of the file, respectively. The addressing of the new position is relative to the beginning or end of the file, or to the current position. You can interrogate the current position by transferring the position value zero relative to the current position.

Call only in a submit job or spawn job.

Call:

PS	D	<File handle> Number from Module 9240
PS	B/W/D/K	<Desired position>
PS	B/W/D/K	<Mode> 0: Position relative to the file beginning 1: Position relative to the current position 2: Position relative to the file end
CM	9242	
PL	B/W/D/K	<New position> –1: Error code in W1022

Error recognition:

Marker	Value	Meaning
M4203	0	Cursor was positioned
	1	Error code in W1022
W1022	1	Impermissible mode
	2	Incorrect file handle
	7	File system error
	20	Module was not called in a spawn job or submit job

Activating and deactivating monitoring

There are various methods for activating and deactivating collision monitoring.

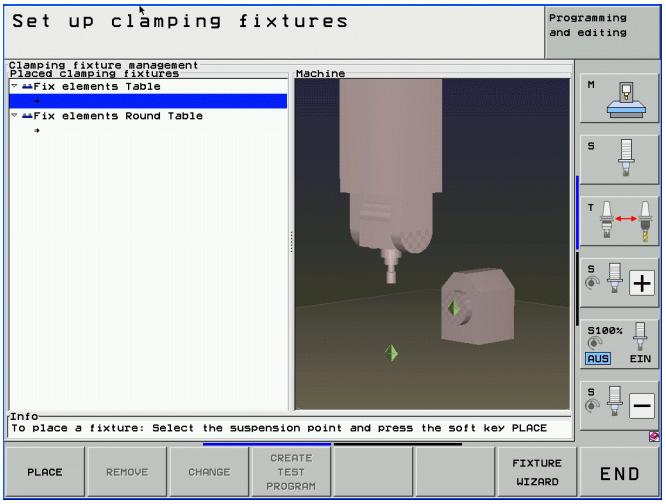
- **Manually**
  In the **Manual** operating mode, press the **Collision** soft key to open the "Collision monitoring (DCM)" menu, and activate or deactivate DCM for the **Manual** and **Program Run** operating modes (active/inactive).
- **PLC module or FN17**
  - It is always possible to create two kinematics tables with the same kinematics description on the control for each application. One of these tables would not contain any descriptions of collision objects (CMOs). Depending on your needs, you can activate the kinematics with or without collision monitoring via the PLC (Module 9097) or with **FN17: SYSWRITE ID290 NR1.**
  - PLC Module 9063 is used to activate and deactivate collision monitoring (DCM) for the Program Run modes.
  - Bit 3 of Module 9221 is used to deactivate collision monitoring for PLC positioning movements. This means that it is possible to position an axis when DCM is active and the reference marks have not yet been traversed in all axes. A PLC positioning command can only be executed if collision monitoring is deactivated for all axes involved in the positioning movement. The deactivation of collision monitoring for the PLC positioning movement does not affect the status information provided by Module 9064.
- **WRITE TO KINEMATIC**
  At the same time, monitoring of these CMOs can be switched off by entering "1" in the **ON/OFF** column of the **active** description table. This can also be during program run in the active description table using the **WRITE TO KINEMATIC** function.

Example:
Deactivation of an active COM table so that collision monitoring is deactivated for a certain action, such as a tool change.

Table in the new kinematics description format before overwriting:

NR	KEY	AXIS	COORD	ON/OFF	FILE	DONTTEST
:						
1	CMO				CMO_Head	PLC:\Kinemat\...
2	MachAxis	B				
3	CMO				CMO_Portal	PLC:\Kinemat\...
4	MachAxis	X				
:						
[END]						

The location points defined by you can be selected by the user after pressing the FIXTURE MANAGEMENT soft key in the 3rd soft-key row.



Several different or identical fixtures can be inserted at any location in the description. The automatic assignment of an index to every fixture is used to distinguish between identical fixtures that are inserted at the same location in the description. (e.g. vise.001, vise.002, vise.003)

Test point

You use probing cycles of the type **Test point** to define probing points in the fixture kinematics, which are used after the fixture has been placed in order to verify the position and orientation of the fixture. If the fixture kinematics contains test points, then once the fixture has been placed and its position and orientation ascertained, the CREATE TEST PROGRAM soft key will be offered to the operator. It is used to create a test program that automatically probes all test points in order to check the position and orientation of the fixture.

Attention

HEIDENHAIN recommends assigning test points to all fixture kinematics. In this way, the operator can check the position and orientation of the fixture.

Input possibilities for variables:

Entry	Input	Description
Description (DOC)	Any text	Designation or name of the object, used in the fixture description.
Model (KEY)	■ Test point	Defines a number variable, whose value must be entered when placing the workpiece via the control's user interface. The value can be changed by the operator without FixtureWizard and without ascertaining the position and orientation of the workpiece again (e.g., the distance between jaws changes, but the vise remains at the same position on the table).
Name (NAME)	Any text	Name for the probing cycle. The entry of a name is mandatory for the creation of a test program. It is used internally by the test program.
Axis (AXIS)	Axis identifier	Indication of the main axis for the probing cycle.
X, Y, Z	Position value	Entry of the position at which the fixture is to be probed.
Label text (LABELID)	Any text	For test points without function.

		Set	Reset
M4160	**Pallet table selected**	NC	NC

MP7683 **Executing pallet tables and NC programs**

Format: %xxxxx

Input: Bit 0 – PROGRAM RUN, SINGLE BLOCK operating mode:
0: During the start, a line of the NC program is run. The pallet change macro is executed completely.
1: During the start, a complete NC program is run.
Bit 1 – PROGRAM RUN, FULL SEQUENCE operating mode:
0: During the start, a complete NC program is run.
1: At the start all NC programs are executed up to next pallet.
Bit 2 – PROGRAM RUN, FULL SEQUENCE operating mode:
0: As defined in bit 1
1: All NC programs and pallets up to the end of the table are executed.
Bit 3 – When the end of the table is reached, the process begins again with the first line.
0: Function is not in effect
1: Function is effective (bit 2=1)
Bit 4 – Editing the active pallet table
0: Active pallet table cannot be edited.
1: The active pallet can be edited in the PROGRAM RUN, FULL SEQUENCE and PROGRAM RUN, SINGLE BLOCK modes.
Bit 6 – Display of pallet table and NC program
0: Both simultaneously in a split screen
1: Pallet table or NC program individually
Bit 7 – AUTOSTART function
0: AUTOSTART by the NC
1: AUTOSTART by the PLC
Bit 8 – Procedure for tool-oriented machining in the **Program Run** operating modes
0: NC start machines all workpieces on the pallet until the next tool change
1: NC start executes all NC programs until the end of the pallet
Bit 9 – Editing of pallet tables
0: EDIT PALLET soft key is not displayed
1: EDIT PALLET soft key is displayed

The six LEDs of the HR 5x0 can be controlled by the specified PLC markers.

F1	F2	F3	F4	F5
	X	Y	Z	
	IV	V	VI	
	↑	Handwheel active/ inactive	↓	
	– (M4667)	Rapid traverse (M4663)	+ (M4666)	
	Spindle Start (M4664) LED (M4684)	Actual position capture LED (M4689)	NC start (M4661) LED on (M4681)	
	Spindle Stop (M4665) LED (M4685)	Ctrl (M4668) LED (M4688)	NC stop (M4662) LED (M4682)	

8.11 Hirth coupling

Hirth coupling describes a type of clamping of rotary axes and swivel heads. Finely splined disks mesh together in order to create a rigid connection.

During datum setting, the NC rounds off according to the grid spacing from MP430.x:

- Configure the exact positioning in the Hirth grid as PLC positioning.

After positioning an axis with Hirth coupling, Module 9148 can use the nominal position value of the axis as its actual position value. This affects the actual-value display and other internal calculations, such as for the transformation chain for tilting axes.

MANUAL operating mode

As soon as an axis direction key is pressed, the NC resets the corresponding bit in W1026 (axis in position).

- As soon as the axis-in-position bit is set again, you check the nominal position with the Hirth grid and derive from it a PLC positioning command to the next grid point.

ELECTRONIC HANDWHEEL operating mode

For the current handwheel axis, the corresponding bit is reset in W1026 (axis in position).

As soon as you select another handwheel axis, "axis in position" is set for the previous axis.

The Hirth axis can be positioned with the handwheel:

- Check the actual position with the Hirth grid and derive from it a PLC positioning to the next grid point.

Controlled positioning

The positions of the Hirth axis must be programmed in the grid:

- Check the positions in the PLC during program run.
- As soon as "axis in position" is reset, check the target position with the Hirth grid.
  - If the target position is not in the Hirth grid, output a PLC error message.

MP420.x Hirth coupling
Input: 0: No Hirth coupling
1: Hirth coupling

MP430.x Prescribed increment for Hirth coupling
Input: 0.0000 to 30.0000 [°]

Module 9148 Use nominal value as actual value
With Module 9148 you can use the nominal value as actual value for selected axes when the position loop is open. This makes it possible to use the nominal value for certain internal functions such as the actual value display and calculations such as transformation chains of tilting axes.

Example

Here you see the print mask of Cycle 421 for English and German.

```
L_ENGLISH;
"-------------------------------------------------------------------
-----"; "************ Measuring Log for Probing Cycle 421: Hole
Measuring **********";
"Date: %02.2d-%02.2d-%4d",DAY,MONTH,YEAR4;
"Time: %2d:%02.2d:%02.2d",HOUR,MIN,SEC;
"Measuring program: %S",CALL_PATH;
"-------------------------------------------------------------------
-------";
" ";
"Nominal values:   Center in 1st axis: %6.4LF", Q273;
"                  Center in 2nd axis: %6.4LF", Q274;
"                  Diameter: %6.4LF", Q262;
"";
"-------------------------------------------------------------------
--------";
"";
"Given limit values:Maximum dimension for center in 1st axis: %6.4LF",
Q31;
"                  Minimum dimension for center in 1st axis: %6.4LF",
Q32;
"";
"                  Maximum dimension for center in 2nd axis: %6.4LF",
Q33;
"                  Minimum dimension for center in 2nd axis: %6.4LF",
Q34;
"";
"                  Maximum dimension for hole: %6.4LF", Q275;
"                  Maximum dimension for hole: %6.4LF", Q276;
"";
"*******************************************************************
********";
"";
"Actual values:    Center in 1st axis: %6.4LF", Q151;
"                  Center in 2nd axis: %6.4LF", Q152;
"                  Diameter: %6.4LF", Q153;
"";
"-------------------------------------------------------------------
--------";
"";
"Deviations: Center in 1st axis: %6.4LF", Q161;
"            Center in 2nd axis: %6.4LF", Q162;
"            Diameter: %6.4LF", Q163;
"";
"*******************************************************************
********";
"";
"Further measuring results: measuring height: %6.4LF", Q261;
"";
"*************************** End of Measuring Log
***************************";
L_GERMAN;
"-------------------------------------------------------------------
--------"; "************** Messprotokoll Antastzyklus 421 Bohrung
```

With MP7263 bit 1 you configure the output of the column in the pocket table during backup and during conversion from binary format to ASCII.
By setting MP7263 bit 2, the "Edit ON/OFF" soft key can be hidden when the pocket table is displayed. This makes it possible to prevent manual editing of the pocket table.
MP7263 bit 3 can be used to hide the RESET POCKET TABLE and RESET COLUMN T soft keys.

MP7260 to MP7267 can also be overwritten by the PLC or the LSV2 protocol.

The bits #4, #5 and #6 of machine parameter MP7263 are used to define settings for deleting tools and their index entries. These settings apply to tools in the pocket table.

As of software version 340 49x-05, during control start-up the prototype pocket table **PLC:\PROTO\PROTOTYP.TCH** is used when a pocket table is created. The previous standard pocket table is only created if no prototype pocket table exists.

If bit #12 is set in MP7682, the error message "Tool radius too large" is suppressed if R2 > R for a tool in the tool table. This might be necessary if barrel cutters are used. Please keep in mind that the cutter form compensation with LN blocks does not work with this cutter shape.

Module 9341 Editing a pocket table depending on magazine rules

Module 9341 reserves, releases, or makes pockets unavailable in the pocket table, in accordance with the magazine rules.

The module affects the columns **RSV, LOCKED_ABOVE, LOCKED_BELOW, LOCKED_LEFT,** and **LOCKED_RIGHT.** Therefore these columns may not be changed manually nor by the PLC program.

Call:

PS B/W/D/K <Magazine number>
PS B/W/D/K <Pocket number>
PS B/W/D/K <Tool number>
PS B/W/D/K <Mode>

- 0: Release pocket (depending on magazine and tool number)
- 1: Release pocket (depending on magazine and pocket number)
- 2: Reserve pocket (depending on magazine, pocket and tool number)
- 3: Make pocket unavailable (depending on magazine and pocket number)
- 4: Reserve pocket if previously unavailable (depending on magazine and pocket number)

CM 9341

Error recognition:

Marker	Value	Meaning
M4203	0	Pocket table edited
	1	Error code in W1022
W1022	1	Invalid pocket number
	2	Invalid magazine number
	3	Invalid mode
	4	Invalid tool number
	6	Reservation not possible
	7	Magazine rules not compiled or not present
	20	Module was not called in a spawn job or submit job
	36	File error in pocket table
	45	Module cancellation, error evaluation using return value
	55	Pocket table could not be locked

Calling an NC program with TOOL CALL

With the NC block TOOL CALL you can call an NC program of your own definition:

- With the keyword **TC = <path name>\<file name>** in the PLC:\NCMACRO.SYS file, define the name of the NC program to be called.

To synchronize the current machine status and the look-ahead calculation with an NC macro call, see "NCMACRO.SYS" on page 1644.
The tool geometry is not taken over then. You must program a TOOL CALL at another place to update the tool data.

NC functions that must be reset at the beginning of a tool-change macro:

The tool-change macro requires non-radius-compensated movements with M91 (coordinates refer to the machine datum) or M92 (coordinates refer to a position defined by the machine manufacturer):

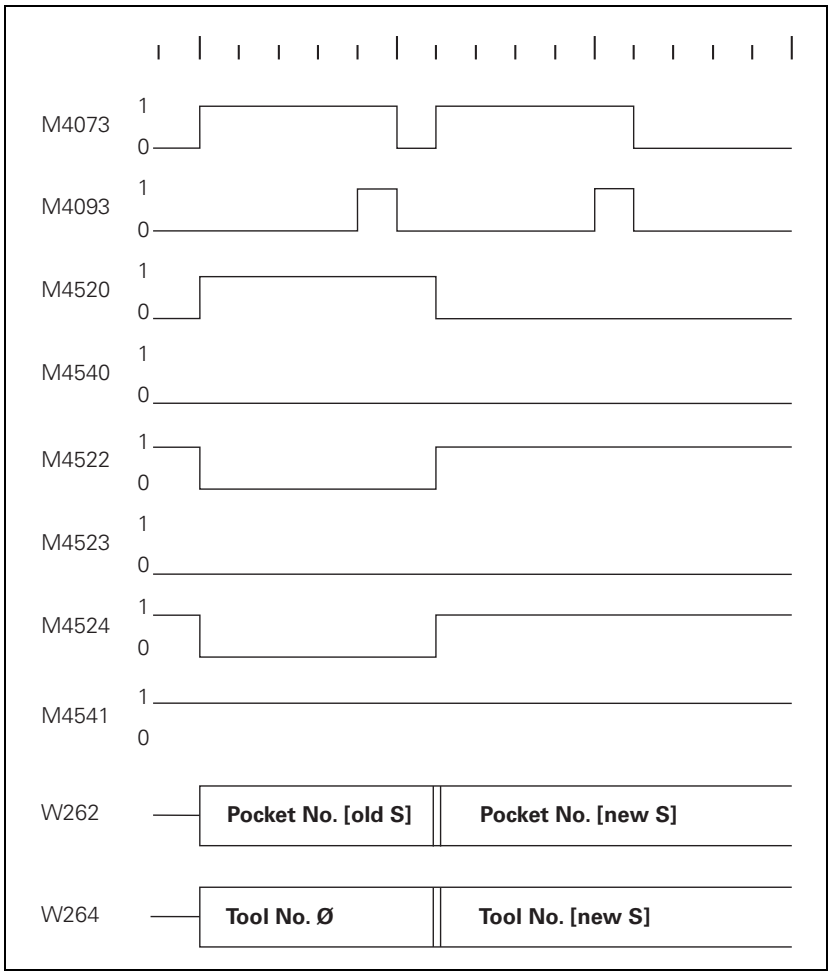
- M103 (Reduce feed rate during plunging to factor F)
- M112 (Insert rounding radius between nontangential straight lines)
- M114 (Automatic correction of machine geometry when machining with tilting axes)
- M118 (Superimpose handwheel positioning during program run)
- M124 (Ignore points when machining non-radius compensated straight line blocks)
- M128 (Retain position of tool tip when positioning tilting axes) or **FUNCTION TCPM**
- Cycle19 **(WORKING PLANE)** or **PLANE**
- Possibly M126 (Permit zero crossover on 360° rotary axes), if rotary axes are moved and their traverse ranges permit multiple paths.
- Possibly M136 (Feed rate F in millimeters per spindle revolution), if feed rates other than **FMAX** are used.
- Possibly M144 (Compensating the machine's kinematics configuration for ACTUAL/NOMINAL positions at end of block), if this function is activated via MP7502.
- Possibly Cycle 32 **(TOLERANCE),** if a certain tolerance (MP1096.x) is required in the tool-change macro.

S → S, Single changing arm, M4540 = 0 or MP7481.x, bit x = 0

First the pocket number of the old tool and the tool number zero are transferred.

Zero means clear the spindle!

▶ Acknowledge with M4093.
Then the pocket number and tool number of the new tool are transferred.



You activate the enhanced tool management function through the PYTHON.SYS system file. The PLC:\PYTHON.SYS file links soft-key functions with a Python script, among other things. You will find a more detailed description of the PYTHON.SYS file in the "Python in the iTNC" supplement to the Technical Manual on the HEIDENHAIN FileBase.

The standard PYTHON.SYS provides three options (A, B, C). Each of them activates a different variant of the new tool management function:

- Variant A
  The new tool management function is started/activated directly through the TOOL TABLE soft key
  This always activates the new tool management. The previous tables (tool table, pocket table) are no longer available to the user.
- Variant B
  The new tool management function is started directly through the TOOL TABLE soft key after a reset/activation
  Same as variant A, but the tables of the new tool management function are already loaded in the background when the **Power interrupted** message is acknowledged. The time required for opening the new tables after pressing the TOOL TABLE soft key is reduced, especially for large tool tables and pocket tables.
- Variant C
  The new tool management function is started through the TOOL MANAGEMENT soft key from the tool table, pocket table and the Program Run, Full Sequence mode of operation after a reset/activation
  The known soft keys TOOL TABLE and POCKET TABLE can continue to be used to activate the previous tables. The new tool management function can be started by pressing the TOOL MANAGEMENT soft key in the third soft-key row that appears after pressing the TOOL TABLE, POCKET TABLE soft key in the **Program Run, Full Sequence** mode of operation.

You do not need to activate software option #46 (Python OEM Process) if you want to use one of the above-mentioned standard features.

Note

If the enhanced tool management function is active, a TNC backup can only be restored before the **Power interrupted** message has been acknowledged.
Later the tool table and the pocket table are constantly exchanging data with the Python scripts and are therefore locked for the restore process.

9.1.1 Selecting the PLC mode

To select the PLC mode:

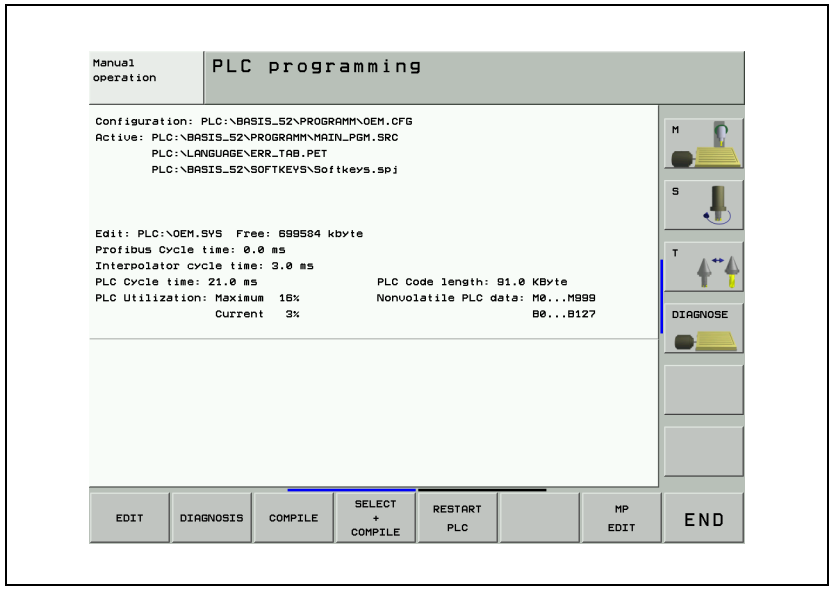
- Select the **Programming and Editing** operating mode.
- Press the MOD key.
- Enter the code number 807667 and confirm your entry with the ENT key, or if you already entered the code number, press the PLC EDIT soft key.

Exit PLC mode:

- Press the END soft key or the END key.

9.1.2 PLC main menu

After you have entered the code number (or pressed the PLC EDIT soft key) the iTNC displays the PLC main menu:



Keyword	Description		Example
REMMARKERMIN	Start address of the markers whose data remains stored after a power interruption (remanence). Default value: 0		REMMARKERMIN = 0
REMMARKERMAX	End address of the bytes, words or double words whose data remains stored after a power interruption (remanence). The range defined by REMMARKERMIN and REMMARKERMAX may not consist of more than 2048 markers. Default value: –1 = Deactivated		REMMARKERMAX = 150
MARKERS	A total of 100 000 bytes is available for all keywords, timers, counters and strings combined	Number of markers available. Default value: 10000	MARKERS = 15000
BYTES		Size in bytes for the byte/word/double word memory. Default value: 10000	BYTES = 20000
INPUTS		Number of input markers available. Default value: 384	INPUTS = 450
OUTPUTS		Number of output markers available. Default value: 192	OUTPUTS = 250
INPUTBYTES		Size in bytes for the byte/word/double word memory range used by the Profibus inputs. Default value: 1000	
OUTPUTBYTES		Size in bytes for the byte/word/double word memory range used by the Profibus outputs. Default value: 1000	

OEMCYC. ZIPNAME =

The possibility of machining with or without preset tables can also be used in OEM cycles. A separate directory is created on the PLC partition for each cycle project (PLC:\OEMCYC_ZIP\, PLC:\OEMCY2_ZIP\, etc.). In OEM.SYS, enter after the keyword the name of the *.ZIP file to be unpacked, e.g. **OEMCYC.ZIPNAME = ABC.ZIP**, **OEMCY2.ZIPNAME = DEF.ZIP**, etc. The *.ZIP files contain all information for the cycles, including the directory structure. When the control is started up, the appropriate *.ZIP files are unpacked in the folders. The documentation for CycleDesign contains more detailed information.

PALETTPRESET =

Activate pallet preset table in order to manage reference points for pallets, see page 1441

Input example: **PALLETPRESET = TNC:\Palletpreset.pr**

PLCCOMPCFG =

Configuration file for conditional compiling.

Input example: **PLCCOMPCFG = PLC:\OEM\OEM.CFG**

PLCDIALOG =

Name for text file with PLC dialogs; the path for the text file is permanently defined.

Input example: **PLCDIALOG = DIALOG.A**

PLCERRFIX =

Path for "Corrective action" help text.

Input example: **PLCERRFIX = FIX.A**

PLCERROR =

Name for text file with PLC error messages; the path for the text file is permanently defined.

Input example: **PLCERROR = PLC_ERR.A**

PLCERRREASON =

Path for "Cause of error" help text.

Input example: **PLCERRREASON = REASON.A**

PLCERRTAB =

(Mandatory entry for PLC error messages): Path for PLC error message table. If you compile a PLC program, the iTNC automatically enters it in the OEM.SYS file.

Input example: **PLCERRTAB = PLC:\ PLC_PGM \ERR_TAB.PET**

PLCEVENTS =

Path for event list (SPAWN command).

Input example: **PLCEVENTS = PLC:\EVENTS.PEV**

PLCMAIN =

(Mandatory entry): Path for the active PLC program. If you compile a PLC program, the iTNC automatically enters it in the OEM.SYS file.

Input example: **PLCMAIN = PLC:\PLC_PGM\MAIN_530.PLC**

Group name	Group number ID....	System data number NR....	System data index IDX....	System datum
PLC data				
PLC data Block transfer of up to 8 variables possible Example, "Writing Q parameters to PLC markers": **FN 17: SYSWRITE ID2000 NR10 IDX880 = BLOCK Q1620 - Q1627**				
	2000	10	Marker no.	PLC marker
		60	Byte no.	PLC byte
		70	Word no.	PLC word
		80	Double-word no.	PLC double word
The function **FN 17: SYSWRITE ID 2001** is identical to the function FN 17: SYSWRITE ID 2000, but it makes it possible to exchange data between the NC program and the PLC without synchronization. However, there are many constraints on using the function FN 17: SYSWRITE ID 2001, which are difficult to estimate. This new FN function (FN 17: SYSWRITE ID 2001) may only be used after consultation with HEIDENHAIN.				
	2001	10	Marker no.	PLC marker
		60	Byte no.	PLC byte
		70	Word no.	PLC word
		80	Double-word no.	PLC double word
		90	Output marker no.	Profibus operand output marker
		100	Output byte no.	Profibus operand output byte
		110	Output word no.	Profibus operand output word
		120	Output double word no.	Profibus operand output double word
Set PLC markers for tapping				
	2020	1	–	Set PLC markers 4030 and 4031 for tapping.

9.6.2 Operand addressing (byte, word and double word)

The memory for operands B (8 bits), W (16 bits), and D (32 bits) is only 8 bits wide. Since the operands can be 8, 16 or 32 bits wide, an overlap of the memory areas will occur, which you must take into account when addressing the memory.

Double word	Word	Byte	Memory	Word address	Double-word address
D0	W2	B3	8 bits	High byte	Highest byte
		B2	8 bits	Low byte	
	W0	B1	8 bits	High byte	
		B0	8 bits	Low byte	Lowest byte
D4	W6	B7	8 bits	High byte	
		B6	8 bits	Low byte	
	W4	B5	8 bits		
		B4	8 bits		
•	•	•	•	•	•
•	•	•	•	•	•
•	•	•	•	•	•
D9996	W9998	B9999	8 bits	High byte	Highest byte
		B9998	8 bits	Low byte	
	W9996	B9997	8 bits	High byte	
		B9996	8 bits	Low byte	Lowest byte

For byte addressing, every address is accessible; for word addressing, every second address; and for double word addressing, every fourth from 0 to 9996. The address parameter indicates the low byte of the word address (W) and the lowest byte of the double-word address (D).

Markers, timers and counters are addressed with the corresponding code letters M, T or C followed by the operand number (e.g. M500, T7, C18).

9.8.4 LOAD TWO'S COMPLEMENT (L–)

Syntax: L– (LOAD MINUS)

Operands: B, W, D, K

Action:

Load the two's complement of the addressed operand, or of a constant, into the word accumulator. If necessary, the iTNC fills the accumulator with the correct algebraic sign. The two's complement allows negative numbers to be stored, i.e., a number loaded with the L command appears in the accumulator with an inverted sign. This command can be used only with word processing.

Example:

Negate the content of byte B5 and then add it to the content of byte B6. Assign the result to byte B8.
Initial state:
Byte B5 = 15 (dec)
Byte B6 = 20 (dec)
Byte B8 = ?

Function	STL	Accumulator content	Operand content
Load byte B5 into the word accumulator, invert the algebraic sign.	L– B5	–15	+15
Add the contents of the word accumulator and byte B6.	+B6	+5	+20
Assign the gating result to byte B8.	= B8	+5	+5

9.8.22 EXCLUSIVE OR (XO)

Logic processing with the EXCLUSIVE OR command

Syntax: XO (EXCLUSIVE OR)

Operands: M, I, O, T, C

Action:

- At the beginning of a logic sequence, this command functions like an L command, i.e., the logical state of the operand is loaded into the logic accumulator. You should always begin a sequence of logical gating operations with a load command (see L, LN, L–).
- Within a logic sequence, gate the content of the logic accumulator and the logical state of the operand with EXCLUSIVE OR. The iTNC saves the result of the operation in the logic accumulator.

Example:

Gate the inputs I4 and I5 with EXCLUSIVE OR, and assign the result to output O2.
Initial state:
Input I4 = 1
Input I5 = 1
Output O2 = ?

Function	STL	Accumulator content	Operand content
Load the operand content into the logic accumulator.	L I4	1	1
Gate the content of logic accumulator and input I5 with EXCLUSIVE OR.	XO I5	0	1
Assign the gating result to output O2.	= O2	0	0

9.8.38 AND NOT [ ] (AN[ ])

Syntax: AN[ ] (AND NOT [ ])

Operands: None

Action:

See example of command A[ ] (AND [ ])

9.8.39 OR [ ] (O[ ])

Syntax: O[ ] (OR [ ])

Operands: None

Action:

See example of command A[ ] (AND [ ])

9.8.40 OR NOT [ ] (ON[ ])

Syntax: ON[ ] (OR NOT [ ])

Operands: None

Action:

See example of command A[ ] (AND [ ])

9.8.41 EXCLUSIVE OR [ ] (XO[ ])

Syntax: XO[ ] (EXCL: OR [ ])

Operands: None

Action:

See example of command A[ ] (AND [ ])

9.8.42 EXCLUSIVE OR NOT [ ] (XON[ ])

Syntax: XON[ ] (EXCL: OR NOT [ ])

Operands: None

Action:

See example of command A[ ] (AND [ ])

Example

Entry in the OEM.SYS file:

PLCEVENTS=PLC:\EXAMPLE.PEV

Content of the file PLC:\EXAMPLE.PEV:

JOB_1;I5==1;$0010; Event $0010 to process JOB_1, if I5==1
JOB_1;B20==5;$0004; Event $0004 to process JOB_1, if B20==5
AUXJOB;W6 <10;$0100; Event $0100 to process AUXJOB, if W6 <10

The iTNC triggers an event if a particular condition is met after one run of the cyclic PLC program and if this condition was not met after the previous run of the cyclic PLC program (edge formation). The number of events of this type that can be activated simultaneously is limited to 15.

If you produce a PLC process with the spawn command, the iTNC searches the event file for entries for this process. It places all relevant entries in a list that is run after every cycle of the cyclic PLC program. If a PLC process terminates itself, or if you terminate the process by recompiling the PLC program, the iTNC then deletes all entries in the list.

The iTNC does not monitor the entries in the event file. This means that syntactically incorrect entries of incorrect job names do not result in an error message.

The iTNC issues a blinking error message if

- A non-existent event file is listed in the OEM.SYS file (when the first spawn command is executed).
- Due to the number of entries in the event file, more events need to be monitored than the run-time list permits. Maximum number of entries in the run-time list: 15

Process monitor

In the PLC programming mode you can use the PROCESS MONITOR soft key to open a status screen in which the iTNC displays all parallel processes, including the process for the submit queue. In a time interval, which can be set with the "+" and "–" soft keys, the iTNC displays

- the name of the process (**TASKNAME**)
- the current status of the process (**STATE**)
  - executable (**SCHED**)
  - running (**RUN+**)
  - waiting for event (**EVWAIT**)
  - waiting for time period (**TMWAIT**)
  - AND-gating of the bits in the event mask (**AND**)
  - OR-gating of the bits in the event mask (**OR**)
- the event mask (**EVMASK**)
- the PLC module letting the process wait (**MOD**)
- how often the process has changed contexts in the last time interval (**SCHED**).
- how much CPU time the processor has used from the defined time interval (**CPU(ms)**). The iTNC also shows the distribution of CPU time in a bar chart (**RATIO**).

Module 9054 Conversion from ASCII/hexadecimal → Binary

Module 9054 converts strings of ASCII-coded hexadecimal values into a block of binary values in the word-marker range. The string in the specified string memory is interpreted as a sequence of ASCII-coded hexadecimal numbers and converted into a block of corresponding binary bytes. Two ASCII characters produce one binary byte. The iTNC saves the binary block beginning at the specified address in the word-marker range.

Call:

PS B/W/D/K <String address in which the hexadecimal value is saved>
PS B/W/D/K <Word address from which the iTNC saves the binary values>
CM 9054

Error recognition:

Marker	Value	Meaning
M4203	0	Number was converted
	1	See W1022 for error code
W1022	2	Invalid string address
	11	Invalid word address
		Odd number of characters in the string or a character that cannot be interpreted as hexadecimal

Example

Initial state:
SO = "63"
BO = 99

Function	STL	String accu. (characters), data stack [bits]
Push string address S0 onto the data stack.	PS K+0	63
Push word address B0 onto the data stack.	PS B0	99
Conversion of the two ASCII characters 6 and 3 into the binary number 99.	CM 9054	01100011