Service Manual

TNC 415B/425

11/06

Kundendienst/Service

HEIDENHAIN

* SERVICE MANUAL *
TNC 415B / 425

Changes/Developments
We are constantly working on technical improvements of our products.
For this reason, details described in this manual may differ slightly from your control. In this case, please order a revised service manual from us.

Issue 11/2006

valid for the software versions	TNC 415B/425:	NC Software 259 93*	(Standard)
	TNC 415F/425E:	NC Software 259 94*	(Export)
	TNC 415B/425:	NC Software 280 54*	(Special Software)
	TNC 415F/425E:	NC Software 280 56*	(Export)

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1. How to Use this Service Manual

The service manual TNC 415B/425 can be used to diagnose, locate and eliminate errors on machine tools controlled by TNC.

In order to correctly judge the problems in an NC-controlled machine tool, fundamental knowledge of the machine tool and its drives as well as their interaction with the control and the measuring systems is required. Incorrect behaviour of the machine tool can also result from improper use of the control, NC-programming errors and incorrect or not properly optimized machine parameters.

For further information in this respect please refer to the

- **Documentation of the machine tool manufacturer**
- **Operating Manual** (HEIDENHAIN)
- **Technical Manual** (HEIDENHAIN).

The Technical Manual is not enclosed with every control. In general, it is only supplied to the machine tool manufacturer and is updated by HEIDENHAIN, Traunreut. Therefore, it is absolutely necessary to contact the machine tool manufacturer, if errors occur that are due to a machine parameter or to the interface of the control. Support will, however, also be provided by the HEIDENHAIN service department and agencies. Telephone numbers, addresses and telex/fax numbers can be found on the back side of the cover page and the back side of the service manual.

2. Minor Error Messages

TNC 415B/425 features a comprehensive integral monitoring system to avoid input and operation errors, to locate errors and technical defects of the entire equipment (TNC, measuring systems, machine tool, cables etc.). The monitoring system is a fixed component of the TNC hardware and software; it is always active when the control is switched on. If a technical defect or an operation error is detected, an error message in plain language is displayed on the screen.

To erase **minor error messages**, press CE .

Further error messages are described in the

- **Operating Manual TNC 407/415B/425**
- **Technical Manual TNC 407/415/425**
- **Documentation by the machine tool manufacturer**
- **Operating Instructions FE 401 B**.

Error Message	**Sec.**
AXIS DOUBLE PROGRAMMED	15.2
START POSITION INCORRECT	15.2
TOUCH POINT INACCESSIBLE	15.2
RANGE EXCEEDED	15.2
OPERATING PARAMETERS ERASED	2.1
BAUD RATE NOT POSSIBLE	16.3
CYCL PARAMETER INCORRECT	15.2
FAULTY RANGE DATA	15.2
ROTATION NOT PERMITTED	15.2
DATA MEDIUM MISSING	16.3
DATA MEDIUM EMPTY	16.3
DATA MEDIUM WRITE-PROTECTED	16.3
LIMIT SWITCH <AXIS>	2.1
PLANE WRONGLY DEFINED	15.2
EMERGENCY STOP	19.6
EXT. IN-/OUTPUT NOT READY	16.3
ERR: 001	16.3
ERR: 002	16.3
ERR: 003	16.3
ERR: 004	16.3
ERR: 005	16.3
ERR: 006	16.3
ERR: 007	16.3
ERR: 010	16.3
ERR: 011	16.3
ERR: 012	16.3
ERR: 013	16.3
ERR: 014	16.3
ERR: 015	16.3
ERR: 016	16.3
ERR: 017	16.3
ERR: 018	16.3
ERR: 100	16.3
ERR: 101	16.3

Error Message	**Sec.**
ERR: 102	16.3
ERR: 103	16.3
ERR: 104	16.3
ERR: 105	16.3
ERR: 106	16.3
ERR: 107	16.3
ERR: 108	16.3
ERR: 109	16.3
PROGRAM DATA ERRONEOUS	16.3
WRONG OPERATING MODE	16.3
WRONG AXIS PROGRAMMED	15.2
HANDWHEEL ?	14.3
HANDWHEEL DEFECTIVE	14.3
ME: TAPE END	16.3
SCALING FACTOR NOT PERMITTED	15.2
PLC PROGRAM NOT TRANSLATED	2.1
PLC: ERROR <00 to 99>	2.1
POSITIONING ERROR	2.1
PROGRAM INCOMPLETE	16.3
POWER INTERRUPTED	2.1
INTERFACE ALREADY ASSIGNED	16.3
RELAY EXT. DC VOLTAGE MISSING	19.6
STYLUS ALREADY IN CONTACT	15.2
PROBE SYSTEM NOT READY	15.2
EXCHANGE TOUCH PROBE BATTERY	15.2
TRANSFERRED VALUE ERRONEOUS X	16.3
TRANSFERRED DATA INCORRECT X	16.3
TIME LIMIT EXCEEDED	15.2

2.1 Causes of Minor Error Messages

OPERATING PARAMETERS ERASED

- With new and exchange controls, the machine parameters are always erased
- Defective buffer batteries, accumulator or capacitor
- RAM error on the processor board
- Software exchanged

LIMIT SWITCH <AXIS>

- "Manual" Operating Mode
  The preset **software limit** switch has been reached during traverse with the axis address keys.
- "Automatic" Operating Mode
  The **calculated position** of the current block is beyond the software limit switch range or beyond the additional limit (set with the MOD function <AXIS LIMIT>). The positioning is not performed.

Machine Parameters for the Software Limit Switches

	X+	X-	Y+	Y-	Z+	Z-
Default setting	910.0	920.0	910.1	920.1	910.2	920.2
Activation via PLC [1]	911.0	921.0	911.1	921.1	911.2	921.2
Activation via PLC [1]	912.0	922.0	912.1	922.1	912.2	922.2

	IV+	IV-	V+	V-
Default setting	910.3	920.3	910.4	920.4
Activation via PLC [1]	911.3	921.3	911.4	921.4
Activation via PLC [1]	912.3	922.3	912.4	922.4

[1] PLC markers M 2816 and M 2817

POWER INTERRUPTED

- After a reset signal of the power supply (e.g. line voltage drops)
- Important machine parameters may have been changed:
  e.g. MP 210, MP 410.3, MP 730, MP 3240.1, MP 7210, MP 7310

POSITIONING ERROR

- The servo lag monitor set in the machine parameters 1410.X or 1710.X has responded.
  (Check the run-in behaviour of the axis; readjust, if necessary.)

PLC PROGRAM NOT TRANSLATED

- After editing, the PLC program must be compiled (translated) anew.

PLC: ERROR 00	marker	2924	
to	to		— set
PLC: ERROR 99	marker	3023	

- Instead of PLC: ERROR 00 to 99 another dialogue may be displayed with customized PLC programs. For further information please contact your machine tool manufacturer.

NOTES

3. Major Error Messages and their Causes

The integrated monitoring system distinguishes between minor and gross errors. Gross errors are characterized by a **blinking display** (e.g. malfunctions of the encoders, of the drives and data processing errors).
If a gross error occurs, the control opens the contact **"Control Ready for Operation"**. This causes an emergency stop of the machine tool.

By switching off the main switch or by pressing END, the emergency stop state can be reset, provided that the error cause has been eliminated.

Display (blinking)	**Error Cause**
PROCESSOR CHECK ERROR YX	X = 0 CRC sum control data incorrect 1 CRC sum machine parameters incorrect 2 Check sum NC-memory incorrect 3 Test plane incomplete / will not run 4 Crosstalk between data bits in RAM 5 Crosstalk between addresses in RAM 6 Stack overflow 7 CRC sum PLC program ASCII 8 CRC sum PLC program OP-Code 9 CRC sum test section A Software error B Wrong interrupt Differentiation with register V0: 08 bus error 0C address error 10 illegal instruction 14 division by 0 18 error output for CHK command (check range) 20 error output for TRAPV command (trap on overflow) 24 privilege infringement (supervisor command in the user mode) 28 emulator trap 2C emulator trap 30 - 34 - 38 - 3C interrupt vector not initialized 40 interrupt vector not initialized 44 interrupt vector not initialized 48 interrupt vector not initialized 4C - 50 - 54 - 58 - 5C - 60 false interrupt (with priority 0) 64-7C interrupt auto-vector 4-7, user interrupt \$100-\$3FC 94-BC TRAP #5 - #15

Display (blinking)	**Error Cause**
PROCESSOR CHECK ERROR YX (continued)	C Time slice overflow D Command stack overflow control loop E Wrong command main processor F Wrong display mode main processor G Wrong boot command H Verify error with boot command "load" I Wrong supplementary command with boot command "test" J Boot logon not successful K EPROM comparison CLP L Wrong command CLP processor M Operating voltage beyond tolerance range N No PLC texts in PLC chip O Axis 4 and/or 5 paraxial with export version P Inhibited software function activated (function without software enable module) Q TNC 415 without CLP or geometry CPU R The control attempted to start a PLC positioning (M2704 to M2708), a datum shift (M2716) or to switch the range (M2816 and M2817), although MP7440/bit 2 was set or MP3030 ≤ 1. Y = CPU number 1 = main processor 2 = geometry processor 3 = CLP processor

If the error message **PROCESSOR CHECK ERROR XY** (XY = code; see above) comes up repeatedly, send the **complete logic unit** to HEIDENHAIN for repair. Please indicate the **error message and the code.**

Display (blinking)	Error Cause
ERROR IN PLC-PROGRAM XX	XX = 1A NC start — complement missing 1B Rapid traverse — complement missing 1C Axis address key latch — complement missing 1D Feed enable — complement missing 1E PLC positioning X [1)] — complement missing 1F PLC positioning Y [1)] — complement missing 1G PLC positioning Z [1)] — complement missing 1H PLC positioning IV [1)] — complement missing 1I Axis address key X+ — complement missing 1J Axis address key X- — complement missing 1K Axis address key Y+ — complement missing 1L Axis address key Y- — complement missing 1M Axis address key Z+ — complement missing 1N Axis address key Z- — complement missing 1O Axis address key IV+ — complement missing 1P Axis address key IV- — complement missing 1Q More than one of the markers M2485...M2487 (M03, M04, M05) are set simultaneously 1R More than one of the functions "PLC Positioning" (M2704 to M2708), "Datum Shift" (M2716) or "Q-Parameter Transfer" are activated simultaneously. 2A Jog increment pos. X+ — complement missing 2B Jog increment pos. X- — complement missing 2C Jog increment pos. Y+ — complement missing 2D Jog increment pos. Y- — complement missing 2E Jog increment pos. Z+ — complement missing 2F Jog increment pos. Z- — complement missing 2G Jog increment pos. IV+ — complement missing 2H Jog increment pos. IV- — complement missing 2I Jog increment pos. V+ — complement missing 2K Jog increment pos. V- — complement missing 2L — complement missing 2M Axis address key V+ — complement missing 2N Axis address key V- — complement missing 2P PLC positioning V — complement missing 50 Excessive nesting (too many modules nested inside one another) 51 Stack underflow (an attempt to acquire data from the STACK, although it was empty) 52 Stack overflow (an attempt to load too many data onto the STACK) 53 Time-out (the permissible program run-time has been exceeded by more than twice. Check the structure of the subprogram) 54 CASE arguments are larger than the number of entries in the table 55 No access to error texts / dialogue texts

1) Only active with compatibility mode TNC 355

Display (blinking)	Error Cause
ERROR IN PLC-PROGRAM X	X = 7 Called label not defined 8 No end-program condition found (the program does not contain an EM instruction, or it contains a JP instruction without a LBL instruction following.) 9 Program is too long (RAM overflow) (insufficient memory for the program code to be generated.)
ERROR IN PLC-PROGRAM XX	XX = 10 Assign with parenthesis (an =, S, SN, R, RN or PS instruction has been programmed, although arithmetic parenthesis are open) 11 Excessive nesting of parentheses (more than 16 parentheses are open) 12 Jump within a gating sequence (unconditional jump has been programmed, although the gating sequence was not closed with an Assign) 13 "Close Parenthesis" without "Open Parenthesis" (a "Close Parenthesis" command was programmed, although no parentheses were open) 14 Label within parentheses (a LBL instruction has been programmed, although parentheses are open) 15 Label within a gating sequence (a LBL instruction has been programmed, although the previous gating was not closed with an Assign) 16 Jump within parentheses (a jump instruction has been programmed, although parentheses are open) 17 Parentheses open at the end of a block (an EM instruction has been programmed, although parentheses are open) 18 Label defined twice 19 Logic Assign missing (a Word Assign or gating has been programmed, although the previous Logic-gating was not closed with a Assign) 20 Logic Assign missing (a Word instruction has been programmed, although the previous Logic-gating was not closed with an Assign) 21 Word accumulator not loaded (a Word Assign or gating has been programmed, although the Logic accumulator does not contain a definite value) 22 Logic accumulator not loaded (a Logic has been programmed, although the Logic accumulator does not contain a definite value)

Display (blinking)	**Error Cause**
ERROR IN PLC-PROGRAM XX (continued)	23 Accumulators not loaded on "Open Parentheses" (an A[, AN[, O[, ON[, XON[command has been programmed, although neither the word nor the logic accumulator has been gated or loaded) 24 Incorrect type of parentheses result (a different type has been calculated in the parentheses from that which was defined in the "Open Parentheses" command, i.e. logic instead of word or vice versa) 25 Conditional jump with incorrect logic accumulator (a conditional jump has been programmed, although the logic accumulator does not contain a definite value) 26 Empty CASE instruction 27 "END-CASE" missing

NOTES

Error Messages GROSS POSITIONING ERROR: Axes with Analogue Speed Controller

Display (blinking)	Error Cause
GROSS POSITIONING ERROR <AXIS> YA	**Positioning (Servo Lag) Monitoring** - Operation with feed forward control: position monitoring range exceeded (range defined in MP1420.X) - Operation with servo lag: servo lag monitoring range exceeded (range defined in MP1720.X) - Operation with gantry axes: positions of master and slave axes deviate by more than the value set in MP855.X. (displayed axis = slave axis)
GROSS POSITIONING ERROR <AXIS> YB	**Monitoring of the Analogue Voltage Limit** - The nominal voltage calculated by the control has reached its limit of ± 10 V (± 20 V for spindle). (only with feed forward control)
GROSS POSITIONING ERROR <AXIS> YC	**Movement Monitoring** - The path actually traversed in a certain time is less than ¼ of or more than 4x the nominal value calculated by the control. (can be influenced via MP1140.x)
GROSS POSITIONING ERROR <AXIS> YD	**Standstill Monitoring** - The deviation from the nominal position of an axis in standstill has exceeded the value programmed in the machine parameter MP1110.x.
GROSS POSITIONING ERROR <AXIS> YE	**Monitoring of the Offset Voltage** - The offset voltage limit of 100mV has been reached during an automatic offset adjustment with MP1220. (see section 18.5) Y = CPU number: 1 = main processor, 2 = geometry processor, 3 = CLP processor

Error Location

When the error message GROSS POSITIONING ERROR is displayed, the error may be located in any element of the closed loop.

e.g.- Error in control (e.g. CLP board)
- Excessive offset voltage at the servo amplifier
- Incorrect speed adjustment at the servo amplifier
- Monitoring function of servo amplifier has responded (e.g. monitoring of current intensity)
- Electrical defect at the servo amplifier
- Mechanical error (bearing, spindle, guides)
- Excessive mechanical forces on a drive

Error Messages GROSS POSITIONING ERROR: Axes with Integrated Digital Speed Controller

Display (blinking)	Error Cause
GROSS POSITIONING ERROR <AXIS> YA	**Positioning (Servo Lag) Monitoring** - Operation with feed forward control: position monitoring range exceeded (range defined in MP1420.X) - Operation with servo lag: servo lag monitoring range exceeded (range defined in MP1720.X) - Operation with gantry axes: positions of master and slave axes deviate by more than the value set in MP855.X. (displayed axis = slave axis)
GROSS POSITIONING ERROR <AXIS> YB	**Monitoring of the Analogue Voltage Limit** - The nominal voltage calculated by the control has reached its limit of ± 10 V (± 20 V for spindle). (only with feed forward control)
GROSS POSITIONING ERROR <AXIS> YC	**Movement Monitoring** - The difference between the path information of the position encoder (LS) and that of the speed encoder (ROD) has reached the tolerance limit defined in MP1970.x.
GROSS POSITIONING ERROR <AXIS> YD	**Standstill Monitoring** - The deviation from the nominal position of an axis in standstill has exceeded the value programmed in the machine parameter MP1110.x.
GROSS POSITIONING ERROR <AXIS> YE	**Monitoring of the Offset Voltage** - The offset voltage limit of 100mV has been reached during an automatic offset adjustment with MP1220. (see section 18.5)
GROSS POSITIONING ERROR <AXIS> YF	**Monitoring of the Integrated Digital Speed Controller** - The monitoring limit of the integrated speed controller (MP1910.x) has responded.
	Y = CPU number: 1 = main processor 2 = geometry processor 3 = CLP processor

Error Location

When the error message GROSS POSITIONING ERROR is displayed, the error may be located in any element of the closed loop.

e.g.:
- Error in control (e.g. CLP board)
- Excessive offset voltage at the servo amplifier
- Monitoring function of servo amplifier has responded (e.g. monitoring of current intensity)
- Electrical defect at the servo amplifier
- Motor, tachometer, encoder or cabling defective
- Mechanical error (bearing, spindle, guides)
- Excessive mechanical forces on a drive

Display (blinking)	Error Cause	
ENCODER <AXIS> DEFECTIVE YA	Signal amplitude error	position encoder
ENCODER <AXIS> ` DEFECTIVE YA	Signal amplitude error	speed encoder
ENCODER <AXIS> DEFECTIVE YB	Signal frequency error	position encoder
ENCODER <AXIS> ` DEFECTIVE YB	Signal frequency error	speed encoder
ENCODER <AXIS> DEFECTIVE YC	Error with distance-coded scale	position encoder
ENCODER <AXIS> `DEFECTIVE YC	Error with distance-coded scale	speed encoder
	Y = CPU number	1 = main processor 2 = geometry processor 3 = CLP processor
	Error Causes: - Encoder not connected - Cable damaged - Glass scale contaminated or damaged - Scanning head defective - Encoder monitoring system defective Checking the encoders: see section 13	
WRONG REFERENCE POINT	Wrong reference mark spacing entered with distance-coded linear encoders (counting error caused by the measuring system or the logic unit)	
TNC OPERATING TEMP. EXCEEDED	Temperature inside the logic unit has exceeded + 70°C	
EMERG. STOP DEFECTIVE YX	YX = 1(1. emergency stop test 1) 2. emergency stop test 1. 3. emergency stop test - Error during the test routine "Control ready for operation" when the machine is switched on (see section 19.4)	
EMERGENCY STOP PLC	This error message is only generated, if the marker 2815 is set without additional marker (M2924 - M3023).	

Display (blinking)	Error Cause
PLC: Error 00 [1)]	marker 2924
to	to — and marker 2815 set
PLC: Error 99 [1)]	marker 3023
CHECK SUM ERROR YX	TNC 407: 1A CRC sum main processor EPROM chips 1/2 1B CRC sum main processor EPROM chips 3/4 1D CRC sum PLC chip 1X Check sum calculation TNC 415A: YA CRC sum main processor EPROM chips 1 to 4 YC CRC sum geometry processor EPROM chips 5/6 YD CRC sum PLC chip YE CRC sum GEM chip 7 YR CRC sum CLP boot chip 1X Check sum calculation TNC 415B, TNC 425: YA CRC sum main processor EPROM chips 1/2 YB CRC sum main processor EPROM chips 3/4 YC CRC sum geometry processor EPROM chips 5/6 YD CRC sum PLC chip YE CRC sum GEM chip 7 YR CRC sum CLP boot chip 1X Check sum calculation Y = CPU number 1 = main processor 2 = geometry processor 3 = CLP processor

[1)] Instead of PLC: ERROR 00 ... 99 another dialogue may be displayed with customized PLC programs. For further information, please contact your machine tool manufacturer.

CRC = Cyclic Redundancy Check (during data transfer)

If the error message CHECK SUM ERROR YX comes up repeatedly, send the **complete logic unit** to HEIDENHAIN for repair. Please indicate the **check sum error**.

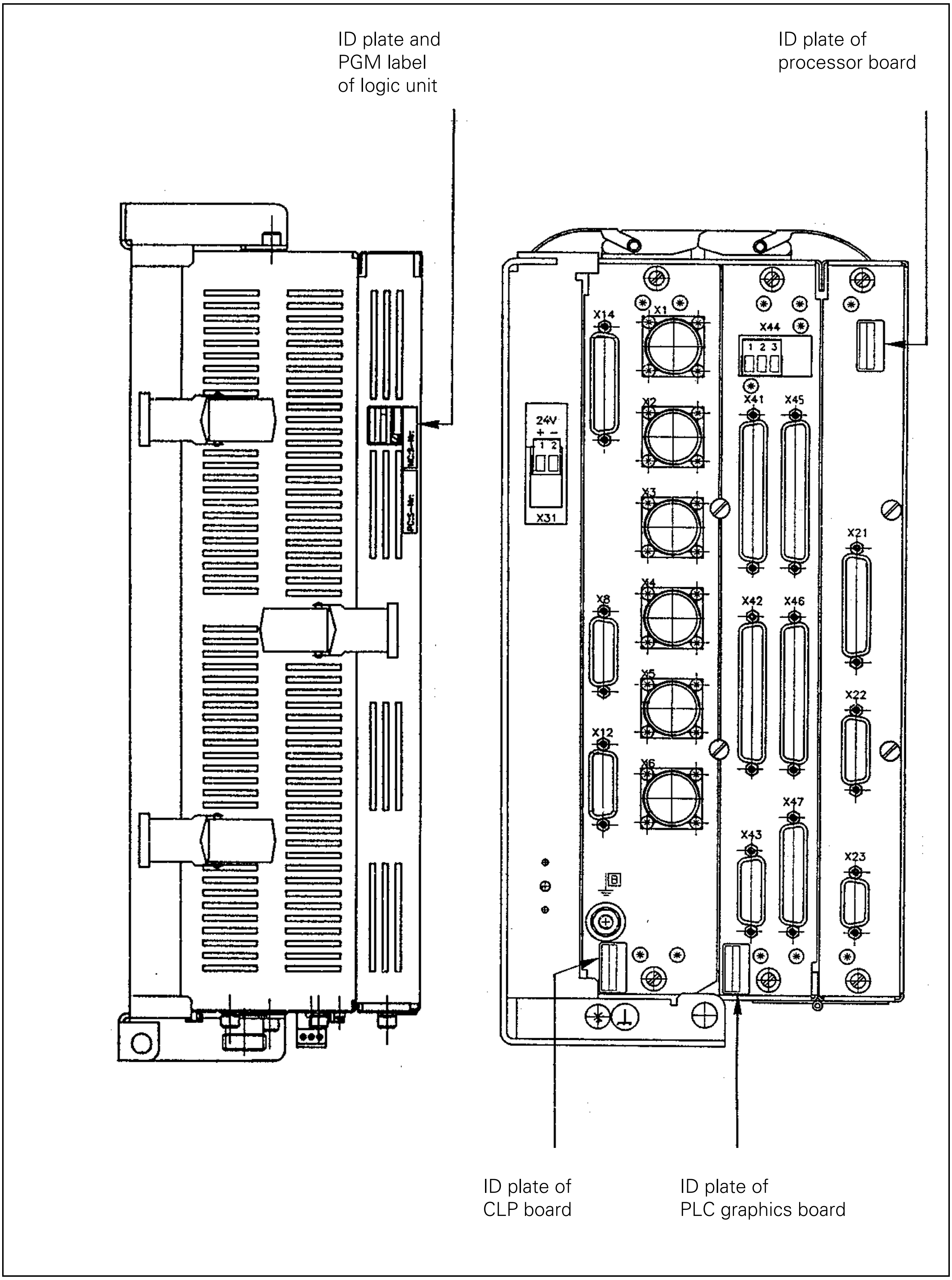
4. Hardware Components TNC 415B/425

TNC Component	TNC 415 B	TNC 425
LOGIC UNIT LE 415 B/F[6]		
Id.No. 267 223 --	x	
LOGIC UNIT LE 425/E[6(7)]		
Id.No. 267 214 --		x
VISUAL DISPLAY UNIT BC 110/B		
Id.No. 260 520 -- (BC 110B)	x	x
Id.No. 254 740 -- (BC 110)	x [5)]	x [5)]
KEYBOARD UNIT TE 400		
Id.No. 250 517 --	x	x
KEYBOARD UNIT TE 410 (customized version)		
Id.No. 258 645 --	x	x
Id.No. 264 105 --	x	x
PLC I/O BOARD PA 110 (option)[2)]		
Id.No. 262 651 --	x	x
PLC I/O BOARD PL 400 (option)[1)]		
Id.No. 255 855 --	x	x
PLC I/O BOARD PL 405 (option)[4)]		
Id.No. 263 371 21	x	x
PLC I/O BOARD PL 410 (option)[3)]		
Id.No. 263 371 --	x	x

1) only digital part (64 PLC inputs / 32 PLC outputs)
2) only analogue part
3) version 01: 64 PLC inputs / 23 PLC outputs and analogue part
version 11: 64 PLC inputs / 23 PLC outputs, no analogue part
4) only digital part: (32 PLC inputs / 16 PLC outputs)
5) superseded by BC 110B
6) F/E: export versions of the controls (different software; hardware identical)
7) TNC 425: control with integral digital speed controller (see section 18.2)

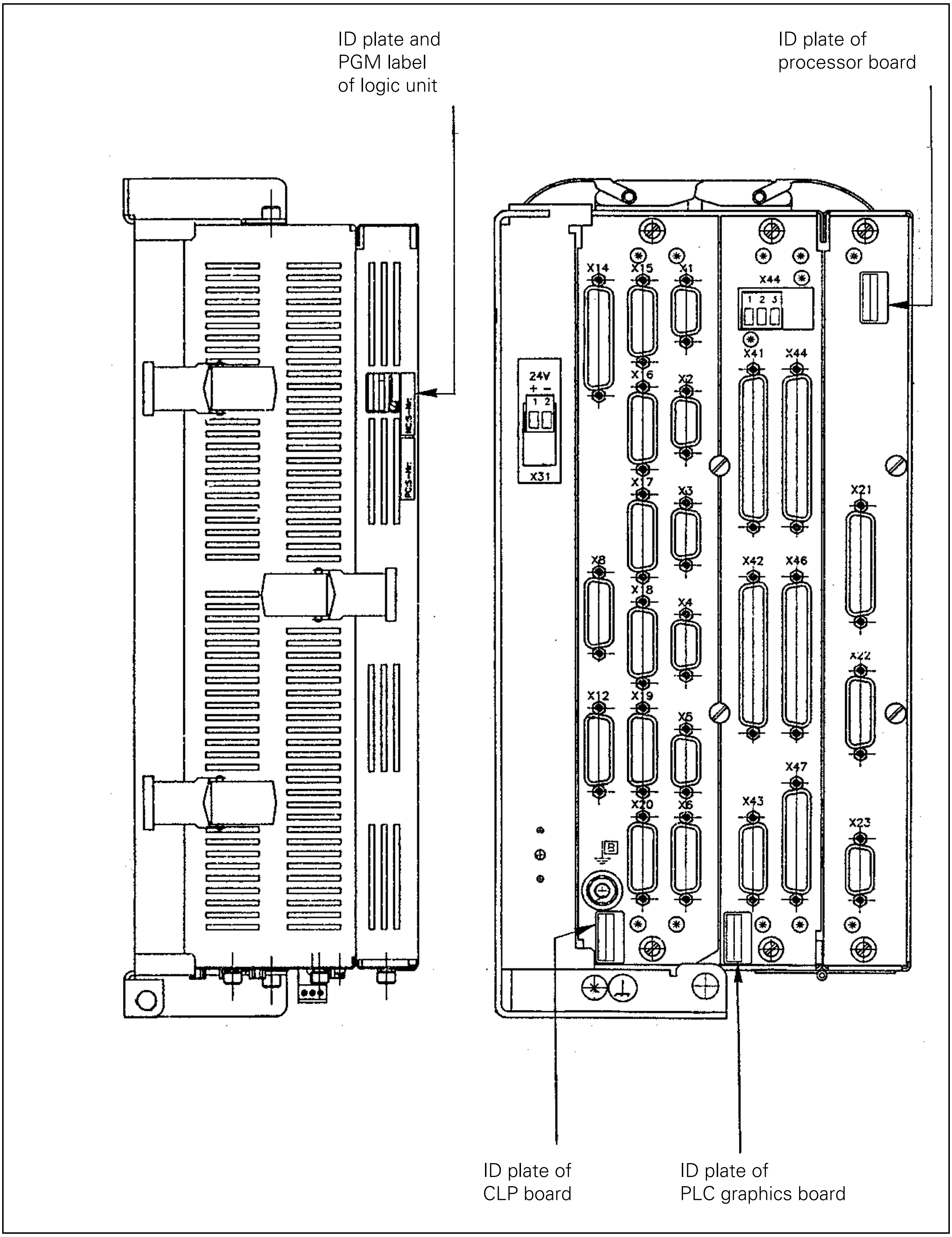
5. LOGIC UNIT LE 415B/425

5.1 Designation of the Logic Unit LE 415B/F



LE 415F = export version of LE 415B

5.2 Designation of the Logic Unit LE 425/E



LE 425E= export version of LE 425

5.3 Hardware Components of the LOGIC UNIT LE 415B/425

Board Overview LE 415B/F

Board	TNC 415B/F		
	LE 415B/F 267 223 --	**LE 415B/F 267 223 3-**	**LE 415B/F 267 223 4-**
PROCESSOR BOARD			
Id.No. 268 553 01	x	x	x
PLC GRAPHICS BOARD			
Id.No. 257 954 02	x	x	
Id.No. 257 954 03*			x
CLP BOARD			
Id.No. 275 705 01	x		
Id.No. 275 705 02		x	x

Board Overview LE 425/E

Board	TNC 425/E				
	LE 425/E 267 214 1-	**LE 425/E 267 214 2-**	**LE 425/E 267 214 3-**	**LE 425/E 267 214 4-**	**LE 425/E 267 214 5-**
PROCESSOR BOARD					
Id.No. 268 553 01	x	x	x	x	x
PLC GRAPHICS BOARD					
Id.No. 257 954 02	x	x	x	x	
Id.No. 257 954 03*					x
CLP BOARD					
Id.No. 265 401 01	x				
Id.No. 268 927 01		x			
Id.No. 275 711 01			x		
Id.No. 275 711 02				x	x

* +24V supply voltage of the operating panel (routed via X46) cannot be switched off with EMERG. STOP.

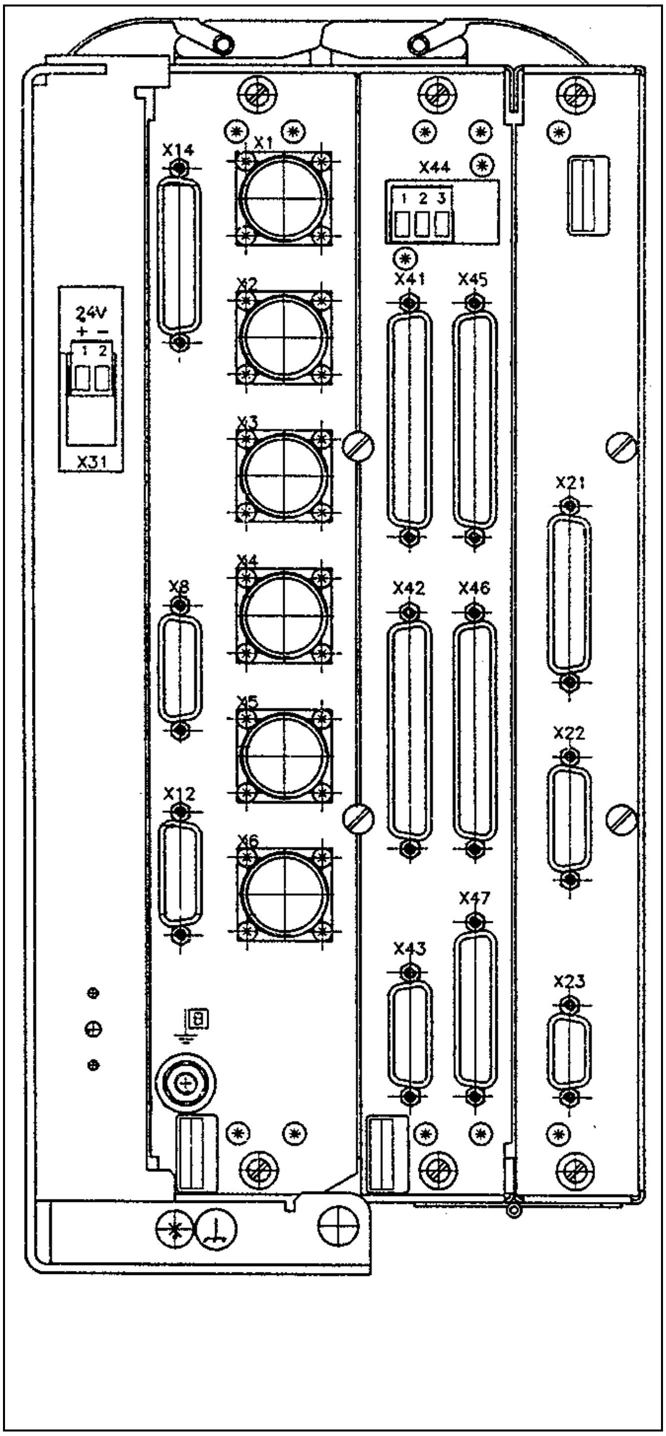
6. Connector Designation and Pin Layout

6.1 Connectors on the LOGIC UNIT LE 415B/425

6.1.1 Connector Designation LOGIC UNIT LE 415B/425

LE 415B

Power Supply | CLP Board | PLC Graphics Board | Processor Board



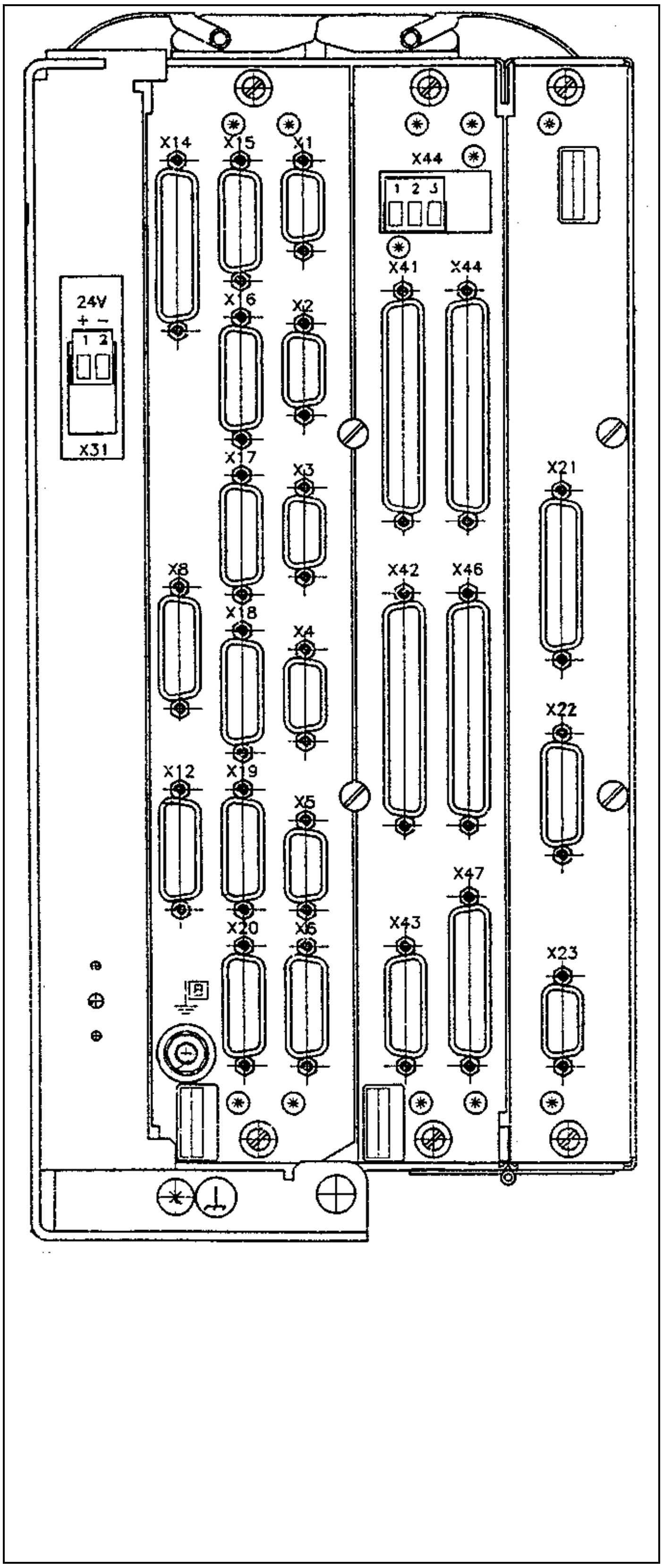
CLP board
X1 = measuring system 1 (~)
X2 = measuring system 2 (~)
X3 = measuring system 3 (~)
X4 = measuring system 4 (~)
X5 = measuring system 5 (~)
X6 = measuring system S ( )
X8 = nominal value output 1, 2, 3, 4, 5, S
X12 = triggering touch probe
X14 = measuring touch probe
B = signal ground

PLC graphics board
X41 = PLC output
X42 = PLC input
X43 = visual display unit (BC)
X44 = 24V power supply for PLC
X45 = TNC keyboard unit (TE)
X46 = machine operating panel
X47 = PLC I/O board

Processor board
X21 = RS-232-C data interface
X22 = RS-422 data interface
X23 = electronic handwheel
X31 = 24V- power supply for NC

LE 425

Power Supply | CLP Board | PLC Graphics Board | Processor Board



CLP Board
X1 = encoder 1 (~)
X2 = encoder 2 (~)
X3 = encoder 3 (~)
X4 = encoder 4 (~)
X5 = encoder 5 (~)
X6 = encoder S (⎍)
X8 = nominal value output 1, 2, 3, 4, 5, S
X12 = touch trigger probe
X14 = measuring touch probe
X15 = encoder / speed
X16 = encoder / speed
X17 = encoder / speed
X18 = encoder / speed
X19 = encoder / speed
X20 = reserved
B = signal ground

PLC Graphics Board
X41 = PLC output
X42 = PLC input
X43 = visual display unit (BC)
X44 = 24 V power supply for PLC
X45 = TNC operating panel (TE)
X46 = machine operating panel
X47 = PLC I/O interface

Processor Board
X21 = V.24/RS-232-C data interface
X22 = V.11/RS-422 data interface
X23 = electronic handwheel
X31 = 24V- power supply for NC

6.1.2 Pin Layout: POWER SUPPLY LE 415B/425

X31 Power Supply (NC)
terminal strip (pluggable) 2-pin

Pin No.	Assignment
1	+ 24 V
2	0V

6.1.3 Pin Layout: CLP Board LE 415 B

X1,X2,X3,X4,X5 Encoders 1,2,3,4,5 (Position)
sinusoidal input,
current interface 7-16µA
flange socket with female insert (9-pin, Conei)

Pin No.	Assignment
1	0°+
2	0°-
5	90°+
6	90°-
7	RP+
8	RP-
3	+ 5 (Up)
4	0 V ($U_{\text{usable comp.}}$)
9	internal shield
housing	external shield = housing

X6 Spindle Encoder (Position)

square-wave encoder (TTL)
flange socket with female insert (12-pin, Conei)

Pin No.	Signal Designation
5	Ua1
6	-Ua1
8	Ua2
1	-Ua2
3	Ua0
4	-Ua0
7	-UaS
(2)	+ 5V (sense)
12	+ 5V (Up)
(11)	0 V (sense)
10	0 V ($U_{\text{usable comp.}}$)
9 (via spring)	shield = housing

X8 Nominal Value Output 1,2,3,4,5,S
flange socket with female insert
(15-pin, D-SUB)

Pin No.	Signal Designation
1	analogue output 1
3	analogue output 2
5	analogue output 3
7	analogue output 4
4	analogue output 5
8	analogue output spindle
9	0V analogue output 1
11	0V analogue output 2
13	0V analogue output 3
14	0V analogue output 4
6	0V analogue output 5
15	0V analogue output spindle
housing	external shield = housing
2,10,12	do not assign

X12 Touch Trigger Probe
flange socket with female insert
(15-pin, D-SUB)

Pin No.	Signal Designation
1	internal shield
3	standby
4	start
5	+ 15V
6	+ 5V (Up)
7	-battery warning
8	0 V ($U_{\text{usable comp.}}$)
9	trigger signal
10	-trigger signal 1)
2, 11 to 15	not assigned

1) stylus at rest = high level

X14 Measuring Touch Probe
flange socket with female insert (25-pin, D-SUB)

Pin No.	Assignment
17	0° +
4	0° -
16	90° +
3	90° -
14	RP +
2	RP -
15	+ 5V
1	0V
21	0° +
8	0° -
20	90° +
7	90° -
18	RP +
6	RP -
19	+ 5V
5	0 V
25	0°+
12	0°-
24	90°+
11	90°-
22	RP +
10	RP -
23	+ 5V
9	0V
13	shield

6.1.4 Pin Layout: CLP Board LE 425

X1, X2, X3, X4, X5 Encoder 1, 2, 3, 4, 5 (Position)
sinusoidal input
current interface 7 - 16µA
flange socket with female insert (9-pin, D-SUB)

Pin No.	Assignment
6	0° +
1	0° -
8	90° +
3	90° -
9	RP +
5	RP -
7	+ 5V (U_P)
2	0V (U_N)
3	internal shield
housing	external shield = housing

X6 Spindle Encoder (Position)
square-wave input (TTL)
flange socket with female insert (15-pin, D-SUB)

Pin No.	Assignment
1	U_{a1}
9	$-U_{a1}$
3	U_{a2}
11	$-U_{a2}$
14	U_{a0}
7	$-U_{a0}$
13	$-U_{aS}$
12	+ 5V sense
10	0V sense
4	+ 5V (U_P)
2	0V (U_N)
5, 6, 8, 15	not assigned
housing	external shield = housing

X8 Nominal Value Output 1, 2, 3, 4, 5, S
see CLP board LE 415 B

X14 Measuring Touch Probe
see CLP board LE 415 B

X12 Touch Trigger Probe
see CLP board LE 415 B

X15, X16, X17, X18, X19 Encoder 1,2,3,4,5 (Speed)

sinusoidal input,
voltage interface 1Vpp
flange socket with female insert (15-pin, D-SUB)

Pin No.	Assignment
1	A+
9	A-
3	B+
11	B-
14	R +
7	R -
4	+ 5V (U_P)
2	0V (U_N)
(12)	+ 5V sense
(10)	0V sense
5,6,8,13,15	do not assign
housing	external shield = housing

6.1.5 Pin Layout: PLC Graphics Board LE 415B/425

X44 Power Supply (PLC)

terminal strip (pluggable) 3-pin

Pin No.	Assignment
1	+ 24V_A can be switched off via EMERG. STOP
2	+ 24V cannot be switched off via EMERG. STOP
3	0V

X41 PLC Output

flange socket with female insert (37-pin, D-SUB)

Pin No.	Assignment
1	O0
2	O1
3	O2
4	O3
5	O4
6	O5
7	O6
8	O7
9	O8
10	O9
11	O10
12	O11
13	O12
14	O13
15	O14
16	O15
17	O16
18	O17
19	O18
20	O19

Pin No.	Assignment
21	O20
22	O21
23	O22
24	O23
25	O24 2)
26	O25 2)
27	O26 2)
28	O27 2)
29	O28 2)
30	O29 2)
31	O30 2)
32	do not assign
33	0V (PLC) 1)
34	control ready for operation 2)
35,36,37	+24V_A PLC 3)
housing	external shield

1) 0 V PLC reference potential for testing
2) cannot be switched off with ext. EMERG. STOP
3) + 24V_A PLC power supply for testing
(can be switched off)

X42 PLC Input

flange socket with female insert (37-pin, D-SUB)

X45 TNC Operating Panel (TE)

flange socket with female insert (37-pin, D-SUB)

Pin No.	Assignment
1	I0
2	I1
3	I2
4	I3 acknowledgement for test "control ready for operation"
5	I4
6	I5
7	I6
8	I7
9	I8
10	I9
11	I10
12	I11
13	I12
14	I13
15	I14
16	I15
17	I16
18	I17
19	I18
20	I19
21	I20
22	I21
23	I22
24	I23
25	I24
26	I25
27	I26
28	I27
29	I28
30	I29
31	I30
32	I31
33,34	do not assign
35,36,37	0V PLC [1)]
housing	external shield = housing

[1)] external reference potential for PLC supply

Pin No.	Assignment
1	RL0
2	RL1
3	RL2
4	RL3
5	RL4
6	RL5
7	RL6
8	RL7
9	RL8
10	RL9
11	RL10
12	RL11
13	RL12
14	RL13
15	RL14
16	RL15 key matrix
17	RL16
18	RL17
19	RL18
20	SL0
21	SL1
22	SL2
23	SL3
24	SL4
25	SL5
26	SL6
27	SL7
28	RL19
29	RL20
30	do not assign
31	RL21
32	RL22 key matrix
33	RL23
34	spindle override (wiper)
35	feed override (wiper)
36	- 5V override potentiometer
37	0V override potentiometer
housing	external shield = housing

X43 Visual Display Unit (BC 110/B)
flange socket with female insert (15-pin, D-SUB)

Pin No.	Assignment
1,8,11	GND
2 to 6,12,13	do not assign
7	R signal
9	V SYNC
10	H SYNC
14	G signal
15	B signal

X46 Machine Operating Panel
flange socket with female insert (37-pin, D-SUB)

Pin No.	Assignment
1	I128
2	I129
3	I130
4	I131
5	I132
6	I133
7	I134
8	I135
9	I136
10	I137
11	I138
12	I139
13	I140
14	I141
15	I142
16	I143
17	I144
18	I145
19	I146
20	I147
21	I148
22	I149
23	I150
24	I151
25	I152
26	O0 [1)]
27	O1 [1)]
28	O2 [1)]
29	O3 [1)]
30	O4 [1)]
31	O5 [1)]
32	O6 [1)]
33	O7 [1)]
34	0 V (PLC) [2)]
35	0 V (PLC) [2)]
36	+ 24V PLC [3)] [4)]
37	+ 24V PLC [3)] [4)]

X47 PLC Expansion Interface
12V interface
flange socket with male insert(25-pin, D-SUB)

Pin No.	Assignment
1,2,3	0 V * 1
4	serial IN 2
5,6,17,18	not assigned
7	-RESET
8	-WRITE EXTERN
9	WRITE EXTERN
10	-O5
11	-O3
12	-O1
13	shield
14,15,16	+ 12V * 1
19	serial IN 1
20	EMERGENCY STOP
21	-serial OUT
22	serial OUT
23	-O4
24	-O2
25	-O0

1) O0...O7 simultaneously at X21 (PLC output)
2) 0V PLC reference potential for testing
3) + 24 V PLC supply voltage routed via fuse for the inputs I128 to I152
4) PLC board version 01/02: + 24V_A can be switched off
PLC board version 03: + 24V cannot be switched off

6.1.6 Pin Layout: Processor Board LE 415B/425

X21 V.24/RS-232 Data Interface
flange socket with female insert (25-pin, D-SUB)

Pin No.	Assignment
1	shield
2	RxD
3	TxD
4	CTS
5	RTS
6	DTR
7	GND (0 V * 2)
8 to 19	not assigned
20	DSR
21 to 25	not assigned
housing	external shield = housing

X22 V.11/RS-422 Data Interface
flange socket with female insert (15-pin, D-SUB)

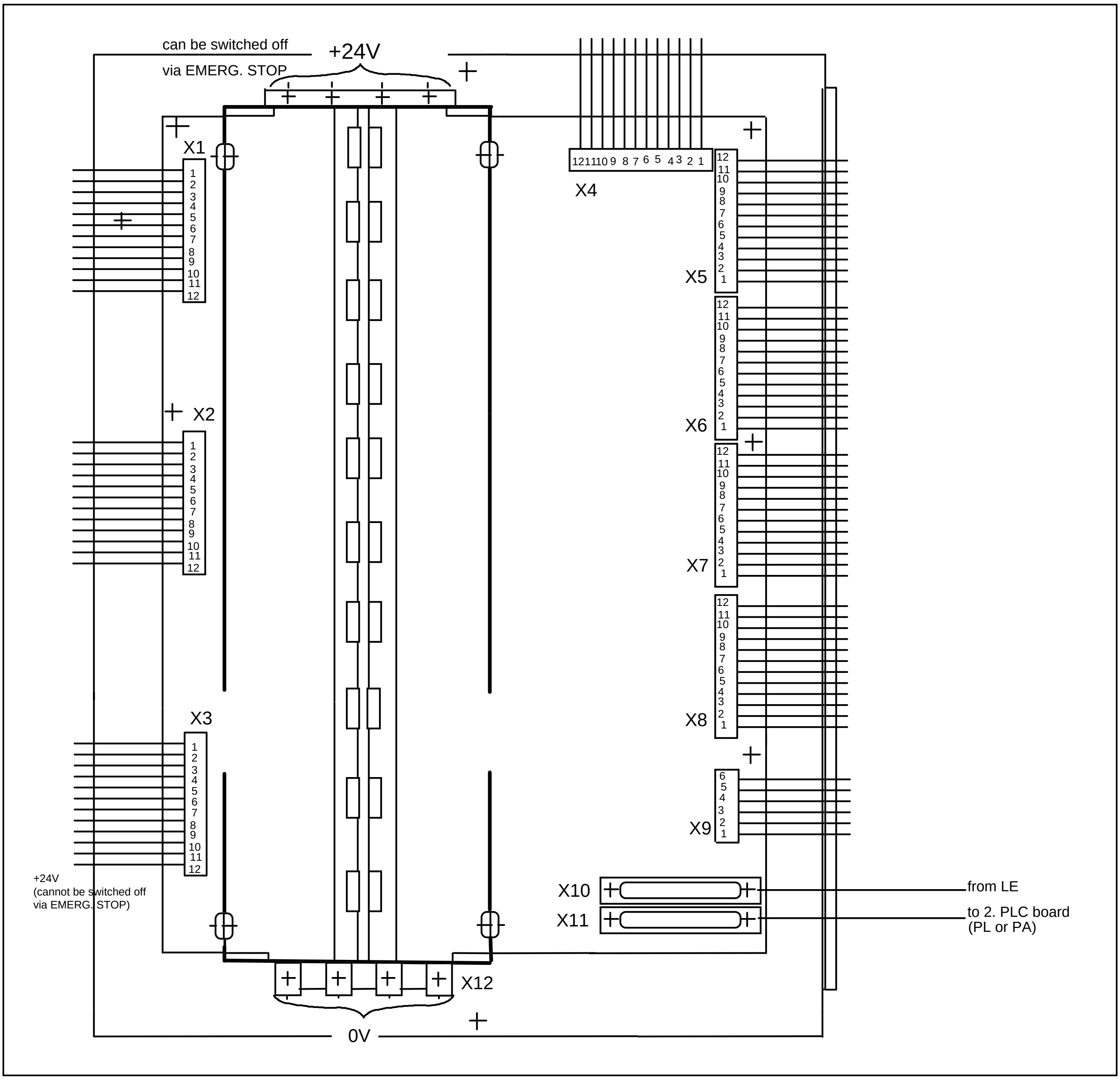
Pin No.	Assignment
1	shield
2	RxD
3	CTS
4	TxD
5	RTS
6	DSR
7	DTR
8	GND
9	-RxD
10	-CTS
11	-TxD
12	-RTS
13	-DSR
14	-DTR
15	do not assign

X23 Handwheel Interface (serial)
flange socket with female insert (9-pin, D-SUB)

Pin No.	Assignment HR 130/330	Assignment HR 332
1,3,5	not assigned	not assigned
4	+ 12V	+ 12V
2	0 V	0 V
6	DTR	DTR
9	not assigned	not assigned
8	RXD	RXD
7	do not assign	TXD
housing	external shield = housing	external shield = housing

6.2 Connectors on the PLC I/O Boards

6.2.1 Connectors on PL 400



6.2.2 Pin Layout: PL 400

X1 Pin No.	Assignment as 1. PL	as 2. PL
1	O32	064
2	O33	065
3	O34	066
4	O35	067
5	O36	068
6	O37	069
7	O38	070
8	O39	071
9	O40	072
10	O41	073
11	O42	074
12	do not assign	

X4 Pin No.	Assignment as 1. PL	as 2. PL
1	I126	I254
2	I74	I202
3	I73	I201
4	I72	I200
5	I71	I199
6	I70	I198
7	I69	I197
8	I68	I196
9	I67	I195
10	I66	I194
11	I65	I193
12	I64	I192

X2 Pin No.	Assignment as 1. PL	as 2. PL
1	O43	075
2	O44	076
3	O45	077
4	O46	078
5	O47	079
6	O48	080
7	O49	081
8	O50	082
9	O51	083
10	O52	084
11	O53	085
12	do not assign	

X5 Pin No.	Assignment as 1. PL	as 2. PL
1	I86	I214
2	I85	I213
3	I84	I212
4	I83	I211
5	I82	I210
6	I81	I209
7	I80	I208
8	I79	I207
9	I78	I206
10	I77	I205
11	I76	I204
12	I75	I203

X3 Pin No.	Assignment as 1. PL	as 2. PL
1	O54	086
2	O55	087
3	O56 [1)]	088 [1)]
4	O57 [1)]	089 [1)]
5	O58 [1)]	090 [1)]
6	O59 [1)]	091 [1)]
7	O60 [1)]	092 [1)]
8	O61 [1)]	093 [1)]
9	O62 [1)]	094 [1)]
10	control ready for operation	
11	do not assign	
12	+24V cannot be switched off via ext. EMERG. STOP	

X6 Pin No.	Assignment as 1. PL	as 2. PL
1	I98	I227
2	I97	I226
3	I96	I225
4	I95	I224
5	I94	I223
6	I93	I221
7	I93	I220
8	I91	I219
9	I90	I218
10	I89	I217
11	I88	I216
12	I87	I215

[1)] outputs cannot be switched off via ext. EMERG. STOP

X7 Pin No.	Assignment as 1. PL	 as 2. PL
1	I110	I238
2	I109	I237
3	I108	I236
4	I107	I235
5	I106	I234
6	I105	I233
7	I104	I232
8	I103	I231
9	I102	I230
10	I101	I229
11	I100	I228
12	I99	I227

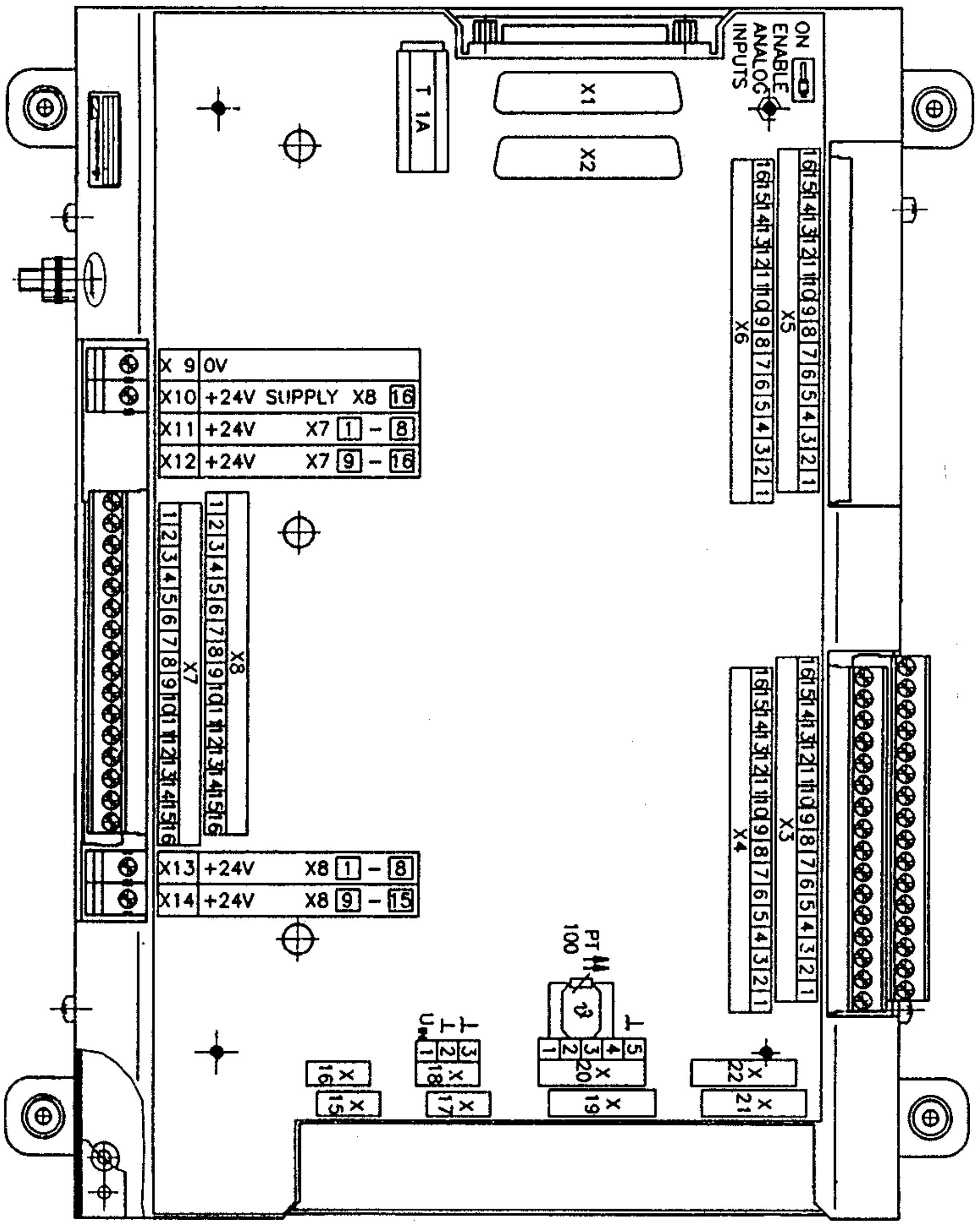
X8 Pin No.	Assignment as 1. PL	 as 2. PL
1	I122	I250
2	I121	I249
3	I120	I248
4	I119	I247
5	I118	I246
6	I117	I245
7	I116	I244
8	I115	I243
9	I114	I242
10	I113	I241
11	I112	I240
12	I111	I239

X9 Pin No.	Assignment as 1. PL	 as 2. PL
1	do not assign	
2	do not assign	
3	do not assign	
4	I125	I253
5	I124	I252
6	I123	I251

X10 Connection to LE or to 1. PL	
Pin No.	**Assignment**
1,2,3	0 V
4	serial IN 2
5,6,17,18	not assigned
7	-RESET
8	-WRITE EXTERN
9	WRITE EXTERN
10	-O5
11	-O3
12	-O1
13	shield
14,15	+ 12 V
16	board ID (PK)
19	serial IN 1
20	control ready for operation
21	-SERIAL OUT
22	SERIAL OUT
23	-O4
24	-O2
25	-O0

X11 Connection of 2. PL or PA	
Pin No.	**Assignment**
1,2,3	0V
4-6, 14-18	do not assign
7	-RESET
8	-WRITE EXTERN
9	WRITE EXTERN
10	-O5
11	-O3
12	-O1
13	shield
19	serial IN 2
20	control ready for operation
21	-serial OUT
22	serial OUT
23	-O4
24	-O2
25	-O0

6.2.3 Connectors on PL 405



6.2.4 Pin Layout: PL 405

X1 Connection to Logic Unit or to 1. PL	
Pin No.	**Assignment**
1,2,3	0V
5.6.17.18	do not assign
4	serial IN 2
7	-RESET
8	WRITE EXTERN
9	-WRITE EXTERN
10	-O5
11	-O3
12	-O1
13	shield
14, 15	+12V
16	board ID (PK)
19	serial IN 1
20	control ready for operation
21	-serial OUT
22	serial OUT
23	-O4
24	-O2
25	-O0

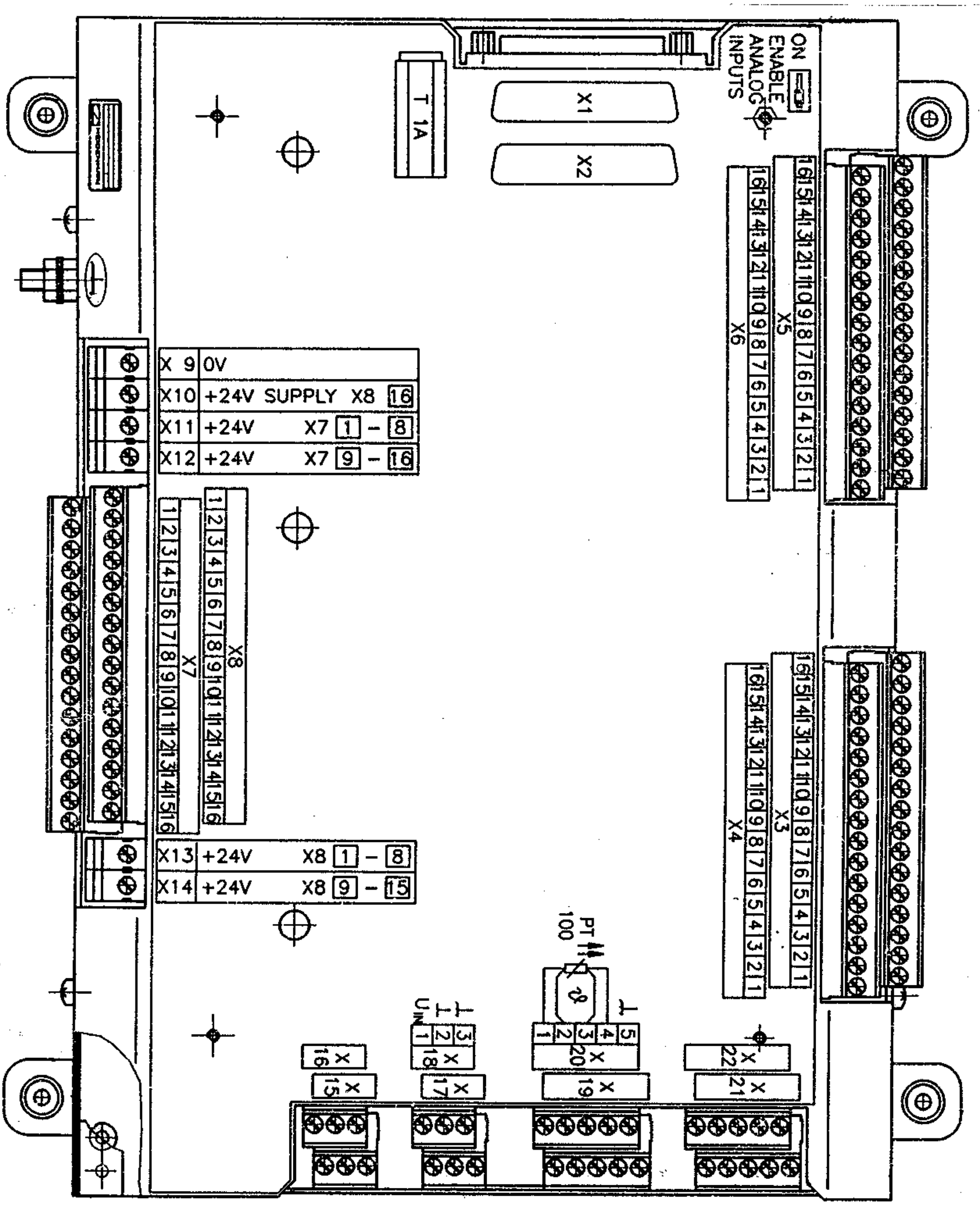
X3 PLC Inputs		
	Assignment	
Pin No.	**as 1. PL**	**as 2. PL**
1	I64	I192
2	I65	I193
3	I66	I194
4	I67	I195
5	I68	I196
6	I69	I197
7	I70	I198
8	I71	I199
9	I72	I200
10	I73	I201
11	I74	I202
12	I75	I203
13	I76	I204
14	I77	I205
15	I78	I206
16	I79	I207

X4 PLC Inputs		
	Assignment	
Pin No.	**as 1. PL**	**as 2. PL**
1	I80	I208
2	I81	I209
3	I82	I210
4	I83	I211
5	I84	I212
6	I85	I213
7	I86	I214
8	I87	I215
9	I88	I216
10	I89	I217
11	I90	I218
12	I91	I219
13	I92	I220
14	I93	I221
15	I94	I222
16	I95	I223

X8 PLC Outputs and "Control Ready for Operation"		
	Assignment	
Pin No.	**as 1. PL**	**as 2. PL**
1	O48	O80
2	O49	O81
3	O50	O82
4	O51	O83
5	O52	O84
6	O53	O85
7	O54	O86
8	O55	O87
9	O56	O88
10	O57	O89
11	O58	O90
12	O59	O91
13	O60	O92
14	O61	O93
15	O62	O94
16	control ready for operation	

X9, X10, X13, X14 PL 405 Power Supply			
Terminal	Assignment	as 1. PL	as 2. PL
X9	0V		
X10	+24 V- logic supply and "Control Ready for Operation"		
X13	+24 V- output supply	O48 - O55	O80 - O87
X14	+24 V- output supply	O56 - O62	O88 - O94

6.2.5 Connectors on PL 410



6.2.6 Pin Layout: PL 410

X1 Connection to Logic Unit or to 1. PL	
Pin No.	**Assignment**
1,2,3	0V
5, 6, 17, 18	do not assign
4	serial IN 2
7	-RESET
8	-WRITE EXTERN
9	WRITE EXTERN
10	-O5
11	-O3
12	-O1
13	shield
14, 15	+12V
16	board ID (PK)
19	serial IN 1
20	control ready for operation
21	-serial OUT
22	serial OUT
23	-O4
24	-O2
25	-O0

X2 Connection of 2. PL or PA	
Pin No.	**Assignment**
1,2,3	0V
4-6, 14 - 18	do not assign
7	RESET
8	-WRITE EXTERN
9	WRITE EXTERN
10	-O5
11	-O3
12	-O1
13	shield
19	serial IN 2
20	control ready for operation
21	-serial OUT
22	serial OUT
23	-O4
24	-O2
25	-O0

X3 PLC Inputs		
	Assignment	
Pin No.	**as 1. PL**	**as 2. PL**
1	I64	I192
2	I65	I193
3	I66	I194
4	I67	I195
5	I68	I196
6	I69	I197
7	I70	I198
8	I71	I199
9	I72	I200
10	I73	I201
11	I74	I202
12	I75	I203
13	I76	I204
14	I77	I205
15	I78	I206
16	I79	I207

X4 PLC Inputs		
	Assignment	
Pin No.	**as 1. PL**	**as 2. PL**
1	I80	I208
2	I81	I209
3	I82	I210
4	I83	I211
5	I84	I212
6	I85	I213
7	I86	I214
8	I87	I215
9	I88	I216
10	I89	I217
11	I90	I218
12	I91	I219
13	I92	I220
14	I93	I221
15	I94	I222
16	I95	I223

X5 PLC Inputs		
Pin No.	**Assignment as 1. PL**	**as 2. PL**
1	I96	I224
2	I97	I225
3	I98	I226
4	I99	I227
5	I100	I228
6	I101	I229
7	I102	I230
8	I103	I231
9	I104	I232
10	I105	I233
11	I106	I234
12	I107	I235
13	I108	I236
14	I109	I237
15	I110	I238
16	I111	I239

X6 PLC Inputs		
Pin No.	**Assignment as 1. PL**	**as 2. PL**
1	I112	I240
2	I113	I241
3	I114	I242
4	I115	I243
5	I116	I244
6	I117	I245
7	I118	I246
8	I119	I247
9	I120 1)	I248 1)
10	I121 1)	I249 1)
11	I122 1)	I250 1)
12	I123 1)	I251 1)
13	I124 1)	I252 1)
14	I125 1)	I253 1)
15	I126 1)	I254 1)
16	I127 1)	I255 1)

X7 PLC Outputs		
Pin No.	**Assignment as 1. PL**	**as 2. PL**
1	O32	O64
2	O33	O65
3	O34	O66
4	O35	O67
5	O36	O68
6	O37	O69
7	O38	O70
8	O39	O71
9	O40	O72
10	O41	O73
11	O42	O74
12	O43	O75
13	O44	O76
14	O45	O77
15	O46	O78
16	O47	O79

X8 PLC Outputs and "Control Ready for Operation"		
Pin No.	**Assignment as 1. PL**	**as 2. PL**
1	O48	O80
2	O49	O81
3	O50	O82
4	O51	O83
5	O52	O84
6	O53	O85
7	O54	O86
8	O55	O87
9	O56	O88
10	O57	O89
11	O58	O90
12	O59	O91
13	O60	O92
14	O61 1)	O93 1)
15	O62 1)	O94 1)
16	control ready for operation	

1) With active analogue inputs (depend on the position of the ENABLE ANALOGUE INPUTS switch on PL140) these PLC inputs and outputs are not available (see section 21.7.2).

X9, X10, X11, X12, X13, X14 PL Power Supply			
Terminal	**Assignment**	**as 1. PL**	**as 2. PL**
X9	0V		
X10	+24 V- supply of LE and "Control Ready for Operation"		
X11	+24 V- output supply	O32 - O39	O64 - O71
X12	+24 V- output supply	O40 - O47	O72 - O79
X13	+24 V- output supply	O48 - O55	O80 - O87
X14	+24 V- output supply	O56 - O62	O88 - O94

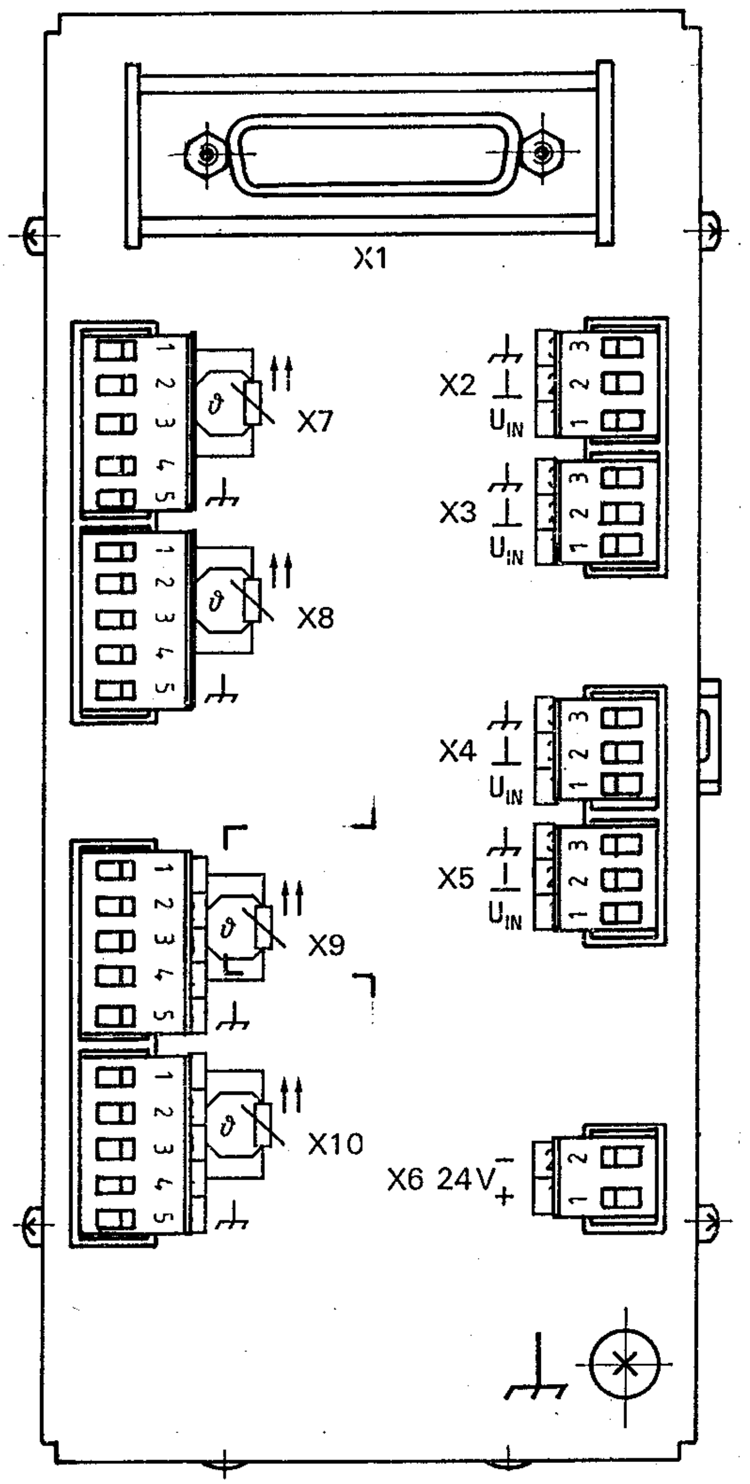
X15 [1], X16 [1], X17 [1], X18 [1] Analogue Inputs ± 10V	
Pin No.	**Assignment**
1	voltage input (± 10V)
2	0V
3	shield

X19 [1], X20 [1], X21 [1], X22 [1] Inputs for PT 100 Thermistors **Four-wire Connector with constant current source**	
Pin No.	**Assignment**
1	I+ constant current for PT 100
2	U+ measuring input
3	U- measuring input
4	I- constant current for PT 100
5	shield

Allocation of Analogue Inputs to Internal PLC Memory Addresses		
Input	**Internal Memory Address**	
	1. PL 410	2. PL 410
X15	W496	W464
X16	W498	W466
X17	W500	W468
X18	W502	W470
X19	W504	W472
X20	W506	W474
X21	W508	W476
X22	W510	W478

[1] not with version 11 of PL 410

6.2.7 Connectors on PA 110



6.2.8 Pin Layout: PA 110

X1 Connection to Logic Unit or 1.PL	
Pin No.	**Assignment**
1, 2, 3	0 V
4	serial IN 2
5, 6, 17, 18	do not assign
7	-RESET
8	-WRITE EXTERN
9	WRITE EXTERN
10	-O5
11	-O3
12	-O1
13	shield
14, 15	+ 12V
16	board ID (PK)
19	serial IN 1
20	control ready for operation
21	-serial OUT
22	serial OUT
23	-O4
24	-O2
25	-O0

X2, X3, X4, X5 Analogue Inputs ± 10V	
Pin No.	**Assignment**
1	voltage input (+/- 10 V)
2	0 V
3	shield

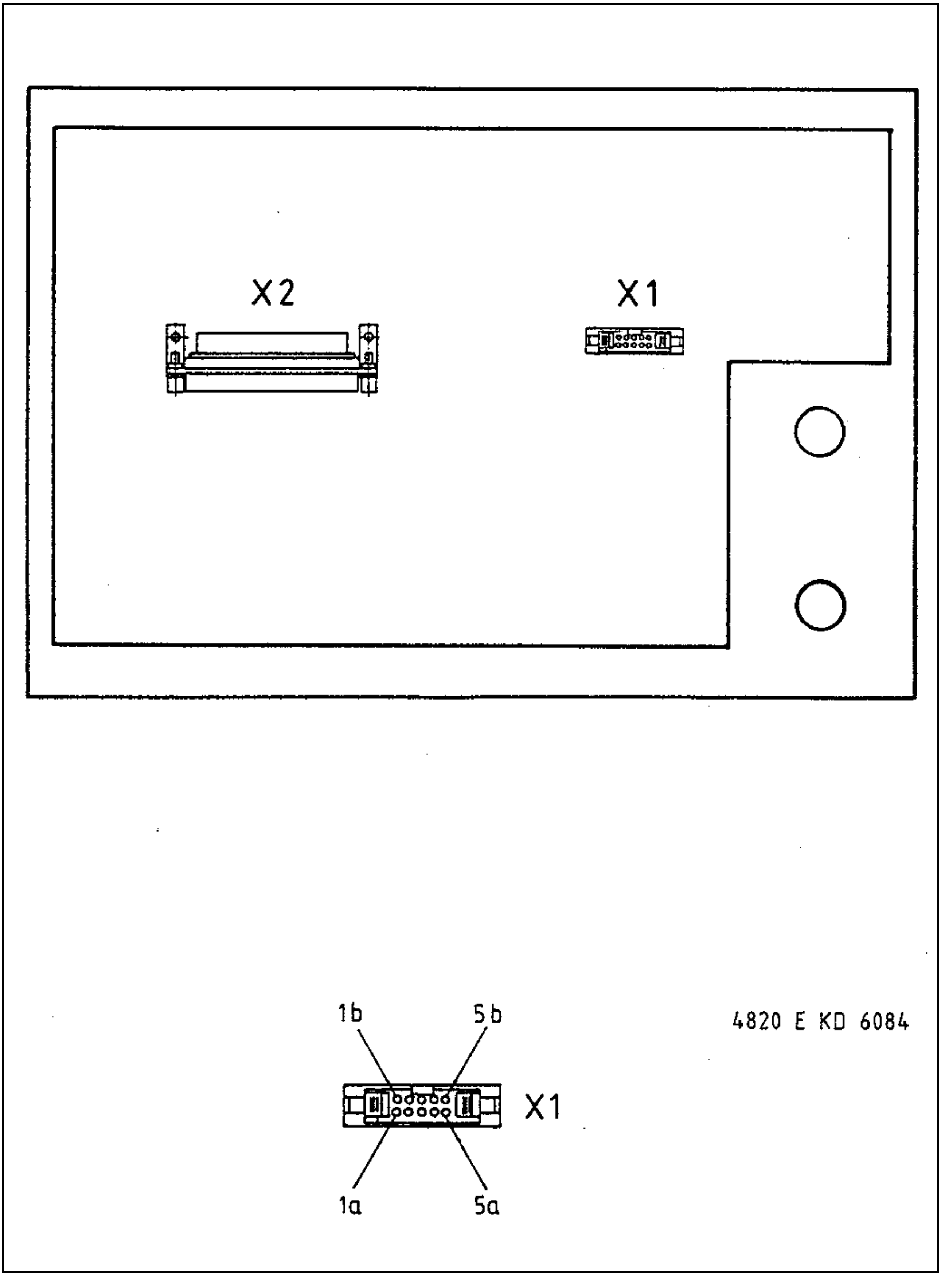
X6 PA 110 Power Supply	
Pin No.	**Assignment**
1	+24 V
2	0V

X7, X8, X9, X10 Inputs for PT 100 Thermistors Four-wire connector with const. current source	
Pin No.	**Assignment**
1	I+ constant current for PT100
2	U+ measuring input
3	U- measuring input
4	I- constant current for PT100
5	shield

Allocation of Analogue Inputs to Internal PLC Memory Addresses		
Input	**Internal Memory Address**	
	PA as 1. expansion	PA as 2. expansion
X2	W496	W464
X3	W498	W466
X4	W500	W468
X5	W502	W470
X7	W504	W472
X8	W506	W474
X9	W508	W476
X10	W510	W478

6.3 Connectors on the Keyboard Units

6.3.1 Connectors on TE 400



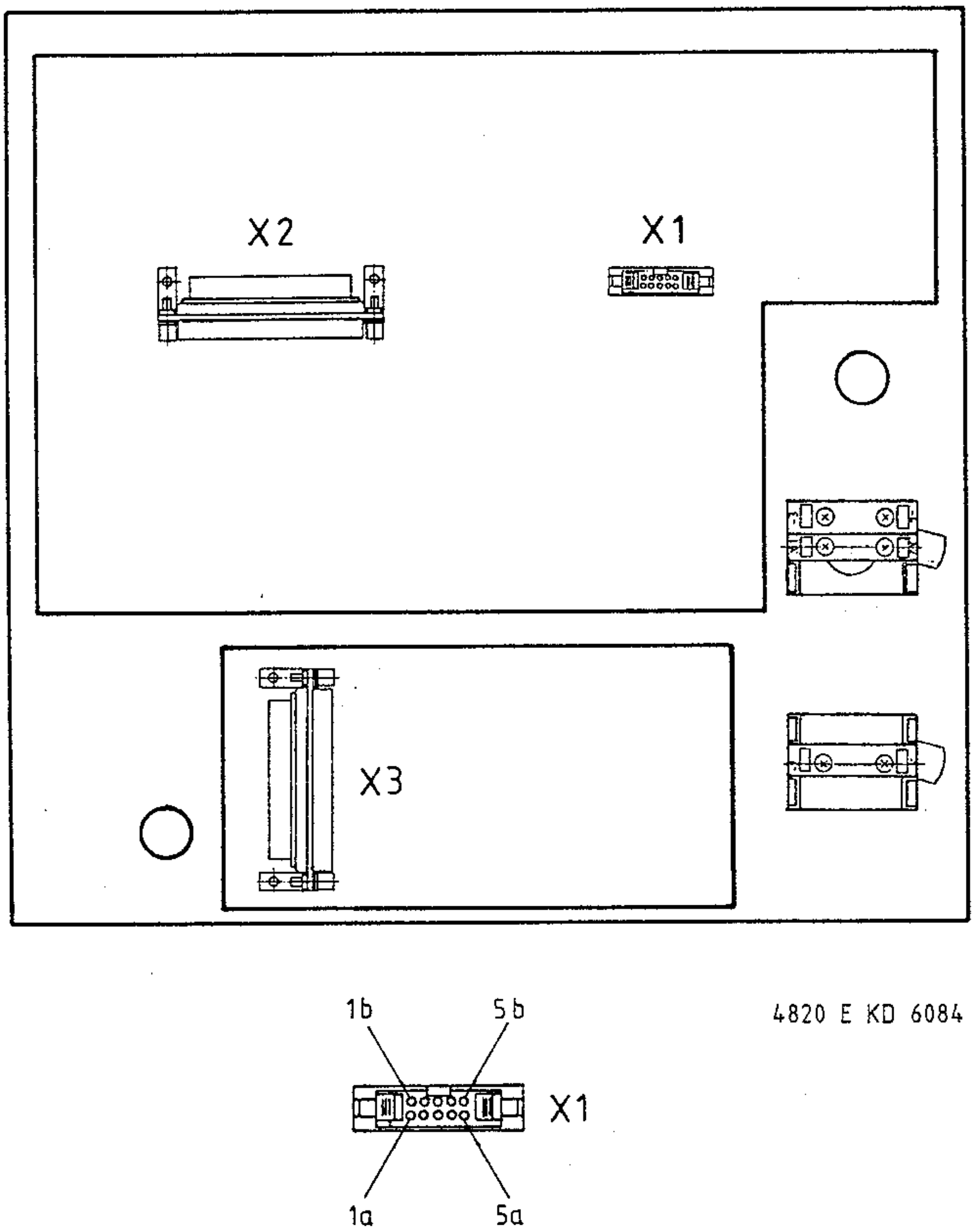
6.3.2 Pin Layout: TE 400

X1 Connection of the Soft Keys of the VDU Plug-type connector with female insert (9-pin)	
Pin No.	**Assignment**
1	SL0
2	SL1
3	SL2
4	SL3
5	do not assign
6	RL15
7	RL14
8	RL13
9	RL12

X2 Connection to Logic Unit (LE) flange socket with male insert (37-pin)	
Pin No.	**Assignment**
1	RL0
2	RL1
3	RL2
4	RL3
5	RL4
6	RL5
7	RL6
8	RL7
9	RL8
10	RL9
11	RL10
12	RL11
13	RL12
14	RL13
15	RL14
16	RL15
17	RL16
18	RL17
19	RL18
20	SL0
21	SL1
22	SL2
23	SL3
24	SL4
25	SL5
26	SL6
27	SL7
28	SL19
29	SL20
30	do not assign
31	RL21
32	RL22
33	RL23
34	spindle override (wiper)
35	feed override (wiper)
36	+ 5V
37	0V

(shaded) = key matrix

6.3.3 Connectors on TE 410



6.3.4 Pin Layout: TE 410

X1 Connection of the Soft Keys of the Logic Unit
flange socket with female insert (9-pin)

Pin No.	Assignment
1	SL0
2	SL1
3	SL2
4	SL3
5	do not assign
6	RL15
7	RL14
8	RL13
9	RL12

X2 Connection to the Logic Unit
flange socket with male insert (37-pin)

Pin No.	Assignment
1	RL0
2	RL1
3	RL2
4	RL3
5	RL4
6	RL5
7	RL6
8	RL7
9	RL8
10	RL9
11	RL10
12	RL11
13	RL12
14	RL13
15	RL14
16	RL15
17	RL16
18	RL17
19	RL18
20	SL0
21	SL1
22	SL2
23	SL3
24	SL4
25	SL5
26	SL6
27	SL7
28	RL19
29	RL20
30	do not assign
31	RL21
32	RL22
33	RL23
34	spindle override (wiper)
35	feed override (wiper)
36	+ 5V
37	0V

X3 Connection to the Logic Unit

flange socket with male insert (37-pin)

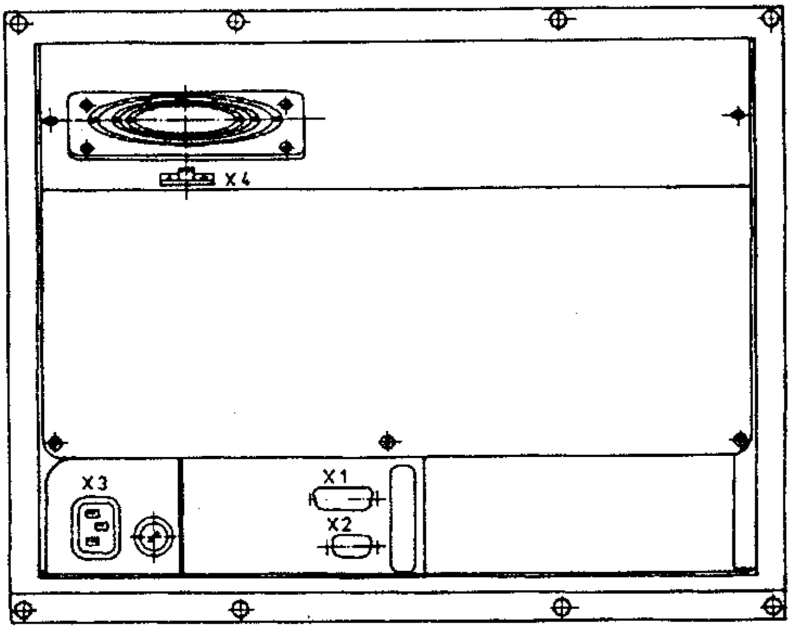
Pin No.	Assignment
1	I 128 unlock shelter door 3)
2	I 129 coolant ON/OFF
3	I 130 spindle OFF
4	I 131 NC OFF
5	I 132 NC ON
6	I 133 axis address key X- 1) X+ 2)
7	I 134 axis address key Y- 1) Z- 2)
8	I 135 axis address key Z- 1) Y- 2)
9	I 136 axis address key Z+ 1) Y+ 2)
10	I 137 axis address key Y+ 1) Z+ 2)
11	I 138 axis address key X+ 1) X- 2)
12	I 139 axis address key IV+
13	I 140 axis address key IV-
14	I 141 rapid traverse
15	I 142 spindle ON
16	do not assign
17	do not assign
18	do not assign
19	I 146 axis address key V+
20	I 147 axis address key V-
21	I 148 spindle probing operation
22	do not assign
23	do not assign
24	do not assign
25	do not assign
26	do not assign
27	do not assign
28	do not assign
29	do not assign
30	do not assign
31	do not assign
32	do not assign
33	do not assign
34	do not assign
35	do not assign
36	+ 24V - PLC
37	+ 24V - PLC

(shaded) = key matrix

1) = TE versions 01/03
2) = TE versions 02/04
3) = TE Id.Nos. 264 105 05/06

6.4 Connectors on the Visual Display Units

6.4.1 Connectors on the Visual Display Unit BC 110



6.4.2 Pin Layout: Visual Display Unit BC 110

X1 Connection to the Logic Unit
flange socket with male insert (15-pin)

Pin No.	Assignment
7	R analogue
9	V-SYNC
10	H-SYNC
11	0V
14	G analogue
15	B analogue

X2 Connection of the soft keys to the Keyboard Unit
flange socket with male insert (9-pin)

Pin No.	Assignment
1	SL0
2	SL1
3	SL2
4	SL3
6	RL15
7	RL14
8	RL13
9	RL12

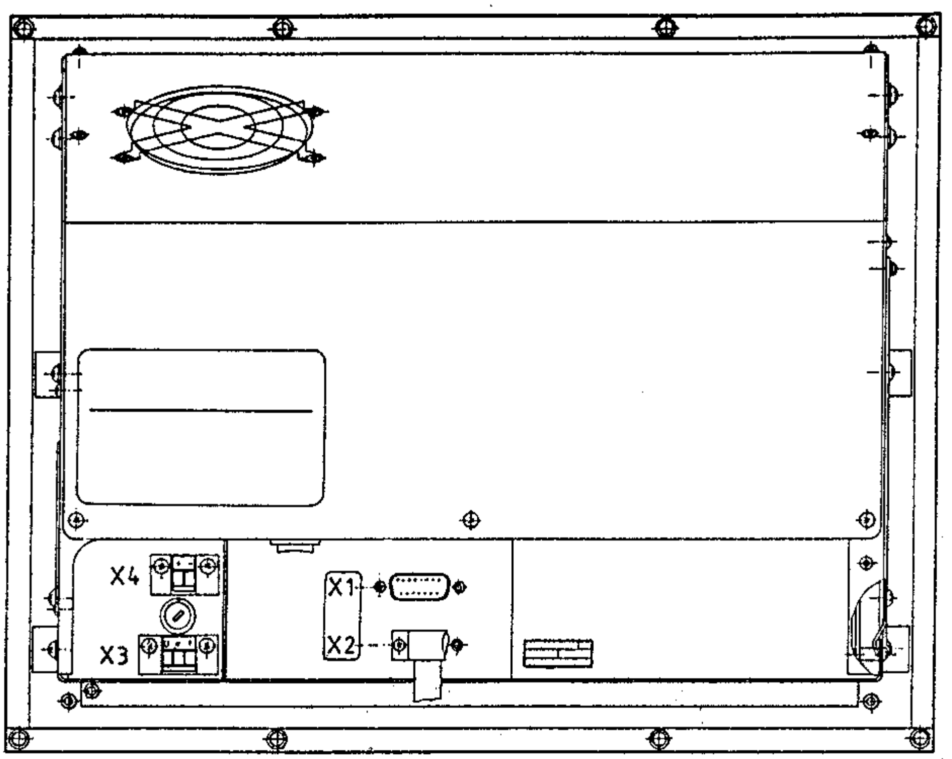
X3 Power Connection
Euro connector

X4 DC Connection for Integral Fan
terminal strip (2-pin)

Pin No.	Assignment
1	+24V
2	0V

(shaded) = key matrix

6.4.3. Connectors on the Visual Display Unit BC 110 B



6.4.4 Pin Layout: Visual Display Unit BC 110 B

X1 Connection to the Logic Unit
flange socket with male insert (15-pin)

Pin No.	Assignment
7	R analogue
9	V-SYNC
10	H-SYNC
11	0V
14	G analogue
15	B analogue

X2 Connection of the Soft Keys to the Keyboard Unit
flange socket with male insert (9-pin)

Pin No.	Assignment
1	SL0
2	SL1
3	SL2
4	SL3
6	RL15
7	RL14
8	RL13
9	RL12

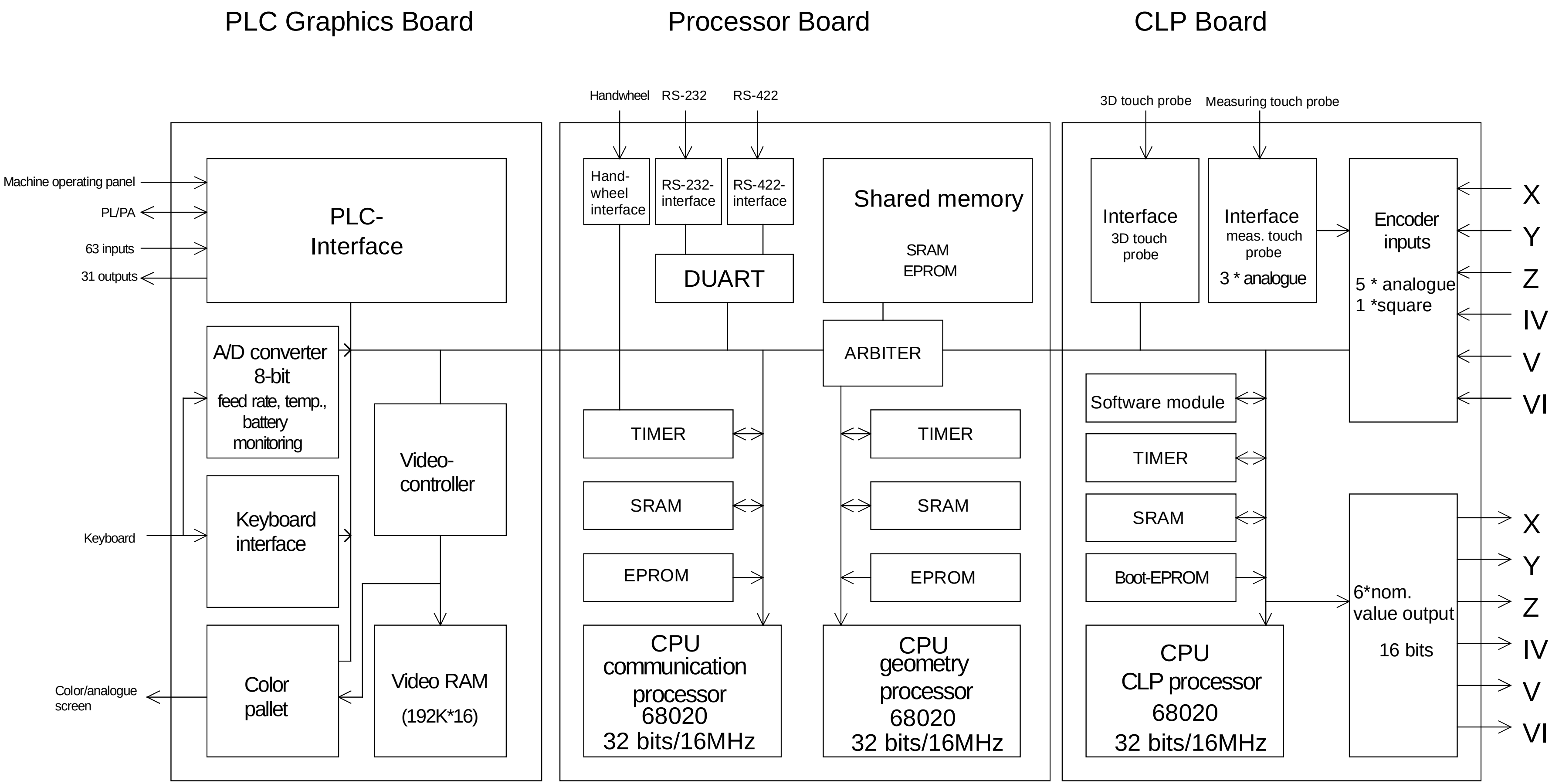
X3 Power Connection
terminal strip (3-pin)
Assignment as labelled

X4 Test Output
terminal strip (2-pin)

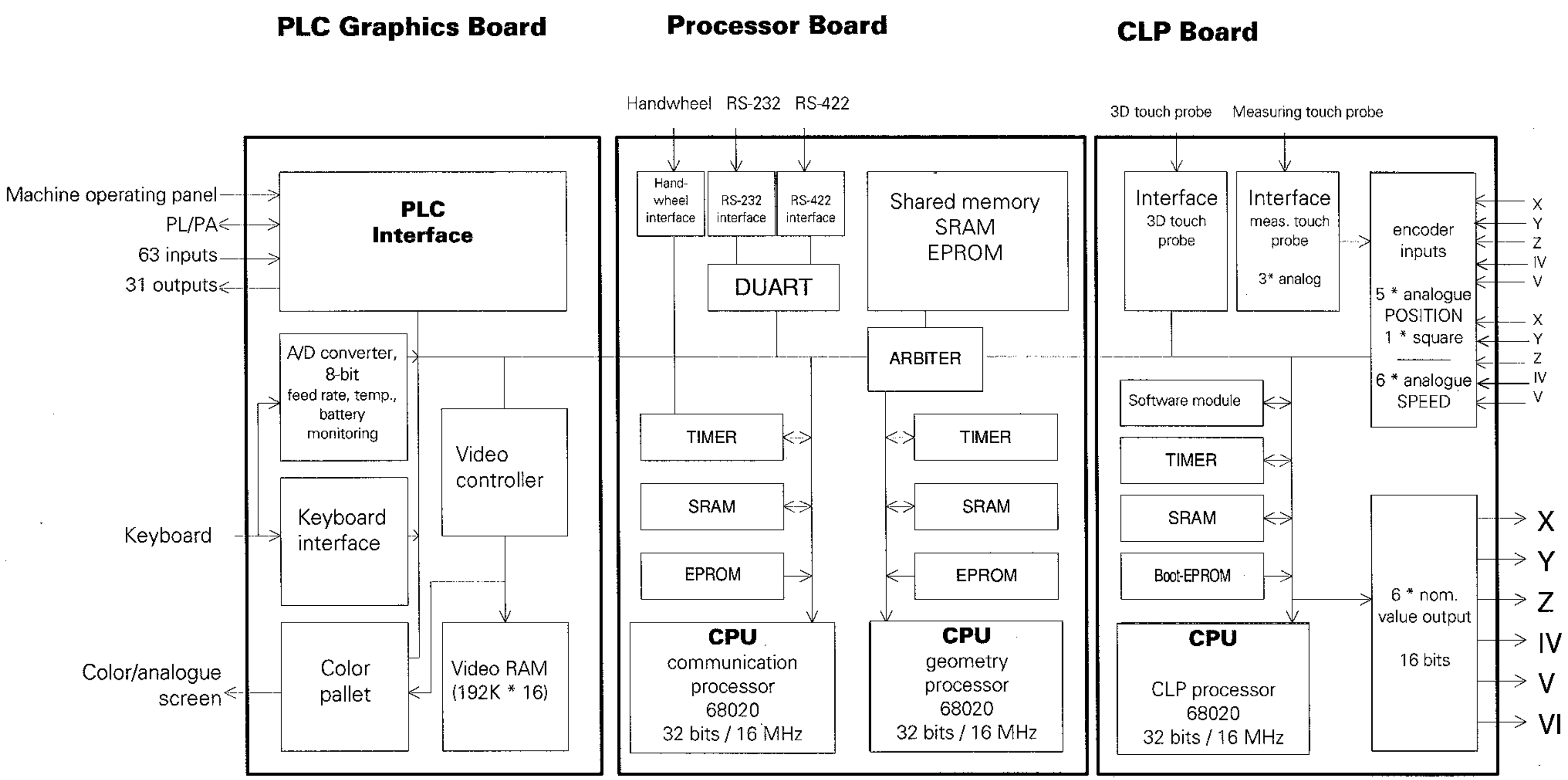
Pin No.	Assignment
+	6V
-	0V

= key matrix

TNC 415 Block Diagram



TNC 425 Block Diagram



8. Board Description

LE 415B/425

PROCESSOR BOARD

- Interfaces
V.24/RS-232-C data interface
V.11/RS-422 data interface
HR 130/330 handwheel

- Monitoring function
EMERGENCY STOP

- Storage
Operating program (NC software)
PLC programs
Machine parameters
Compensation value lists
NC program (customized programs)

CLP BOARD

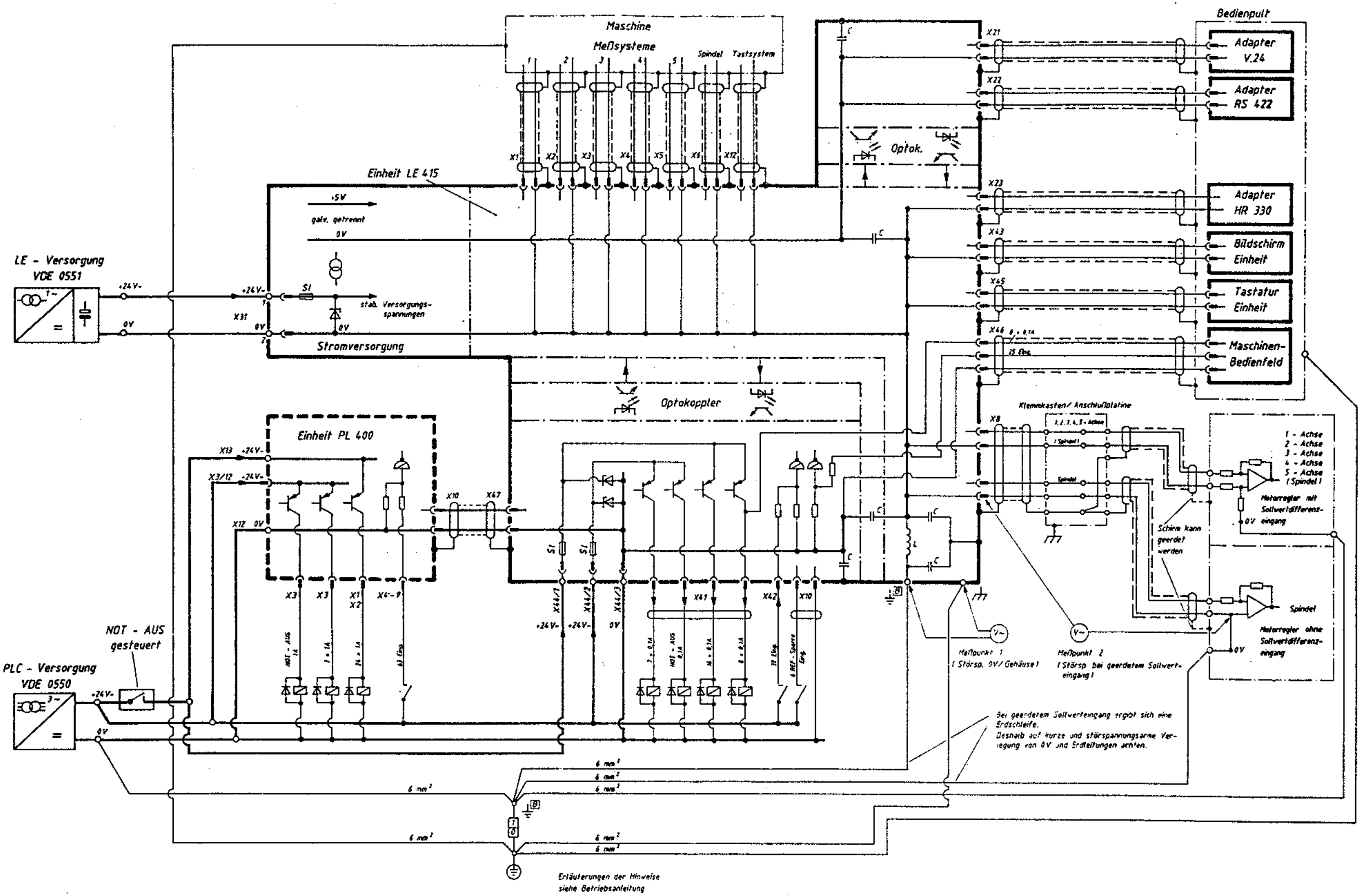
- Interfaces
Encoder inputs
3D touch probe

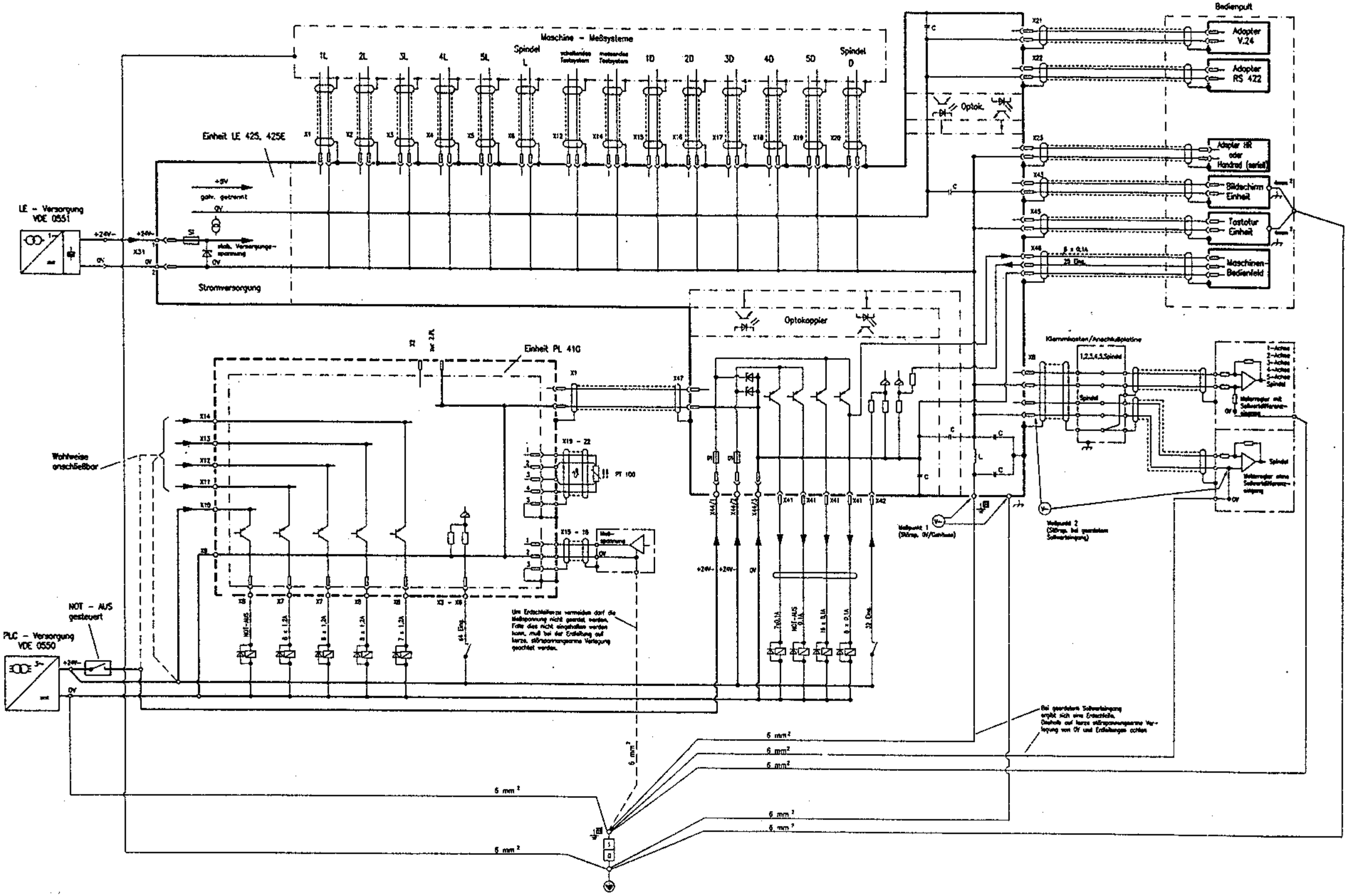
- Monitoring functions
Encoder inputs
Axis position
Program memory
Data processing
EMERGENCY STOP

PLC GRAPHICS BOARD

- Interfaces
57 PLC inputs
31 PLC outputs
Visual display unit
Keyboard unit
Machine operating panel
PLC I/O boards

- Monitoring functions
Temperature
Voltages
Buffer battery


Maschine
Meßsysteme
Spindel
Tastsystem
Bedienpult
Adapter V.24
Adapter RS 422
Optok.
Adapter HR 330
Bildschirm Einheit
Tastatur Einheit
Maschinen-Bedienfeld
Einheit LE 415
+5V
galv. getrennt
0V
LE - Versorgung
VDE 0551
+24V
S1
stab. Versorgungsspannungen
X31
Stromversorgung
Optokoppler
Einheit PL 400
Klemmkasten/Anschlußplatine
1 - Achse
2 - Achse
3 - Achse
4 - Achse
5 - Achse
(Spindel)
Motorregler mit Sollwertdifferenzeingang
Schirm kann geerdet werden
Spindel
Motorregler ohne Sollwertdifferenzeingang
Meßpunkt 1
(Störsp. 0V/Gehäuse)
Meßpunkt 2
(Störsp. bei geerdetem Sollwerteingang)
NOT - AUS gesteuert
PLC - Versorgung
VDE 0550
Bei geerdetem Sollwerteingang ergibt sich eine Erdschleife.
Deshalb auf kurze und störspannungsarme Verlegung von 0V und Erdleitungen achten.
6 mm²
Erläuterungen der Hinweise siehe Betriebsanleitung


Maschine - Meßsysteme
1L
2L
3L
4L
5L
Spindel L
1D
2D
3D
4D
5D
Spindel D
Bedienpult
Adapter V.24
Adapter RS 422
Optok.
Bildschirm Einheit
Tastatur Einheit
Maschinen-Bedienfeld
Einheit LE 425, 425E
LE - Versorgung VDE 0551
Stromversorgung
Optokoppler
Einheit PL 410
Wahlweise anschließbar
PT 100
NOT - AUS gesteuert
PLC - Versorgung VDE 0550
6 mm²

NOTES

10. Power Supply

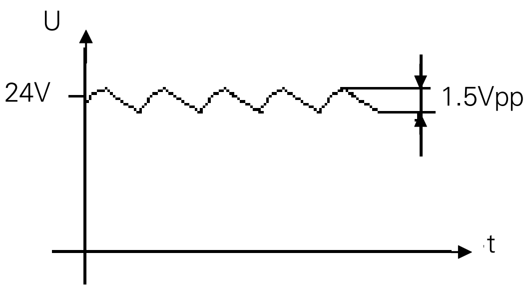
10.1 External Power Supply Requirements

The voltages must correspond to the following definitions:

Assembly		Power Supply	Voltage Range DC Mean Value	Max. Current Consumption	Power Consumption
LE	NC	24V - (VDE 0551)	lower limit 20.4V ⎓ upper limit 31V ⎓ [1]	LE 415/425: 1.5A	LE 415/425: approx. 36W
	PLC	24V - (VDE 0550)		1.8A if half of the inputs/outputs are active simultaneously	approx. 6W if approx. 1/3 of the inputs/outputs are active simultaneously
PL 400 **PL 410**				21A if half of the inputs/outputs are active simultaneously	approx. 25W if approx. 1/3 of the inputs/outputs are active simultaneously
PA 110				approx. 100mA	approx. 2.9W

[1] Voltages up to 36V ⎓ are permissible with $t < 100$ms.

10.1.1 NC Power Supply

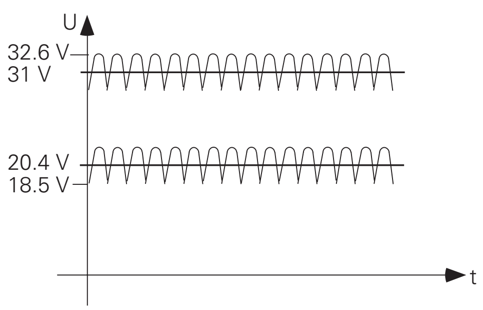


The NC part of the LE must not be connected to the control voltage of the machine tool. It requires its own external power supply generated separately according to the German standard VDE 0551.
24V DC voltage with a permissible AC component (ripple voltage) of 1.5Vpp (recommended filtering capacitor 10 000µF/40V -).

10.1.2 PLC Power Supply

The PLC part (PLC inputs and outputs) of the LE, PL and PA is operated with a control voltage of 24V- of the machine tool (generated according to VDE 0550).

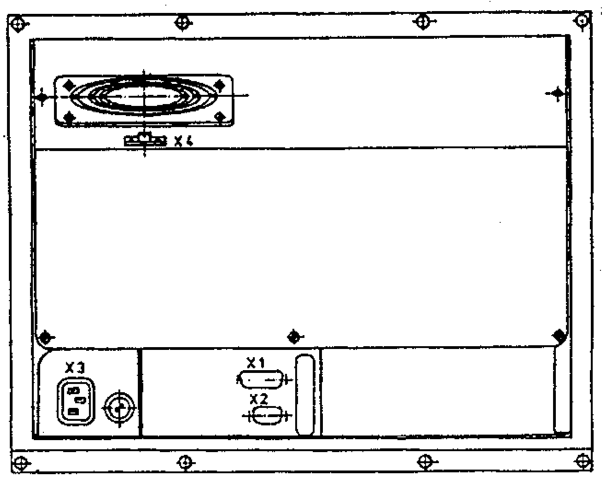
The installation and connection of the measuring resistors and the analogue inputs (PL 410, PA 110) must be safe from contact according to VDE 0160 (section 5.5.1).
If this cannot be ensured, PLC and PL 410 (PA 110) have to be powered according to VDE 0551.
Superimposed AC voltage components arising from a non-controlled three-phase bridge connection with a ripple factor of 5% (see German standard DIN 40110/10.75, section 1.2) are permissible. Thus the highest absolute value for the upper voltage limit is 32.6V; the smallest value for the lower voltage limit is 18.5V.



The 0V line of the PLC power supply must be connected to the central signal ground (line ∅ ≥ $6mm^2$) of the machine tool. The ground connector on the PL410 housing must be connected to the protective ground (line ∅ ≥ $6mm^2$). To avoid ground loops the measuring voltage at the analogue inputs must not be grounded.

10.1.3 Power Supply of the Visual Display Units

BC 110

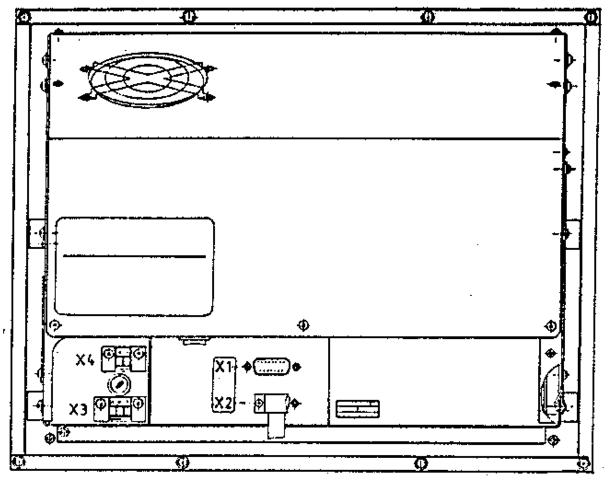


X1 = connection of logic unit
X2 = keyboard connection (for soft keys)

X3 = Line connection		
Line voltage	110 V~	220 V~
Voltage range	85 ... 132 V~	170 ... 264 V~
Line fuse	F 3.15 A	F 3.15 A
Frequency	49 ... 61 Hz	
Power consumption	60 W	

X4 = DC connection for fan	
Pin designation	Assignment
1	+ 24 V
2	0 V

BC 110B



X1 = connection of logic unit
X2 = keyboard connection (for soft keys)

X3 = Line connection		
Line voltage	110 V~	220 V~
Voltage range	85 ... 132 V~	170 ... 264 V~
Line fuse	T 2.0 A	T 2.0 A
Frequency	49 ... 61 Hz	
Power consumption	60 W	

X4 = Voltage output for testing	
Pin designation	Assignment
+	6 V
-	0 V

Note: The fan of BC 110B is supplied internally with + 24V.

10.2 Power Supply of the NC

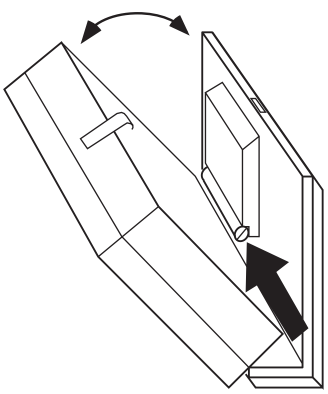
The power supply line of the NC is connected to the terminals of X31.

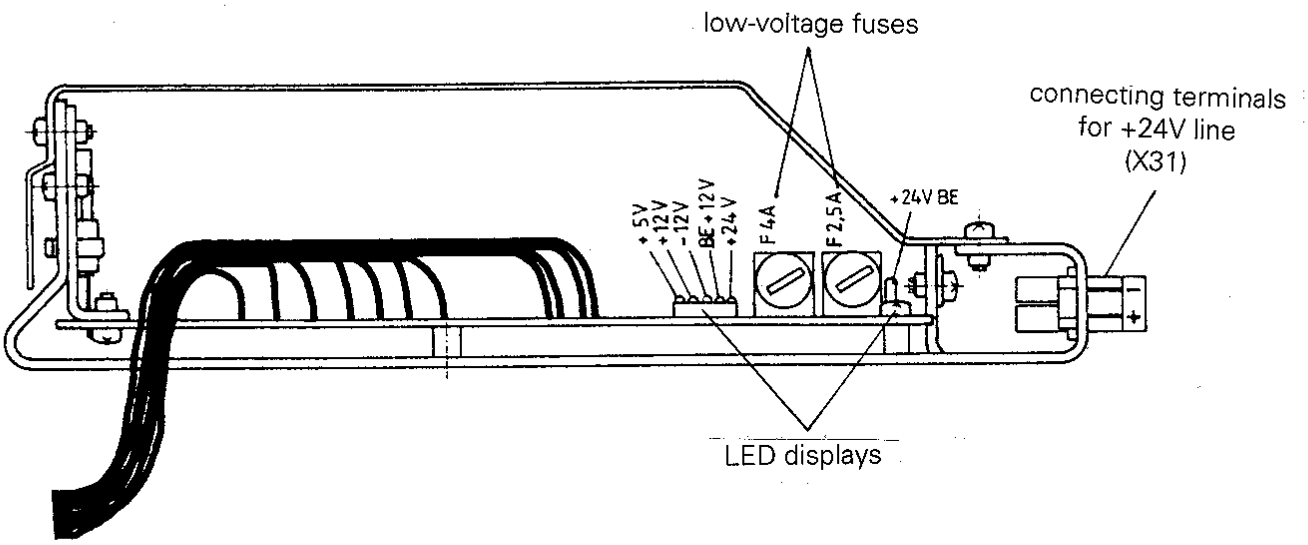
X31 NC power supply

Pin No.	Assignment
1	+ 24 V
2	0 V

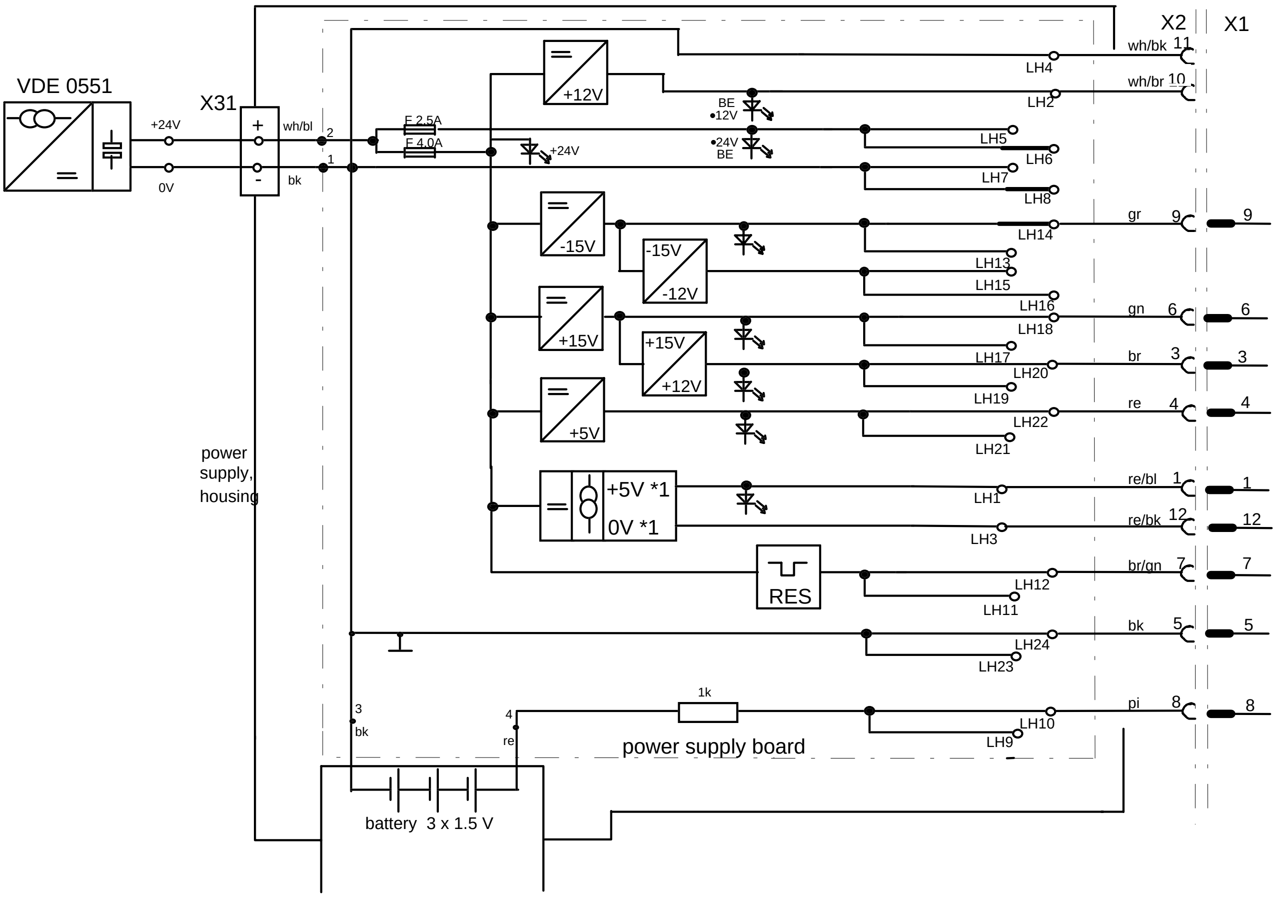
The different voltages for the LE are transformed from the voltage fed (+24V) in the POWER SUPPLY assembly (see block diagrams in section 10.2.1).

The input and output voltages are displayed by LEDs. The states of the individual voltages are only displayed approximately by the LEDs. The exact values must be measured; the measured values must correspond to the table in section 10.2.1.





10.2.1 NC Power Supply: Block Diagram



X2: connector (12-pin) of connecting cable "power supply <-> processor board"
X1: socket (12-pin) on processor board

Voltage Table

Test point on power supply board	Reference point on power supply board	Output	UNOM [V]	UMIN [V]	UMAX [V]	INOM [A]
LH22	LH24 (0V)	+ 5V (UP)	+ 5.05	+ 5.00	+ 5.10	2.5
LH20	LH24 (0V)	+ 12V	+ 12	+ 11.4	+ 12.6	0.1
LH18	LH24 (0V)	+ 15V	+ 15.0	+ 14.4	+ 15.6	0.15
LH14	LH24 (0V)	- 15V	- 15.0	- 14.4	- 15.6	0.08
LH10	LH24 (0V)	+ UBATT	+ 4.5	+ 3.9	-	approx. 20 µA
LH1	LH3 (0V*1)	+ 5V * 1 [1]	+ 5	+ 4.75	+ 5.25	0.3
LH12 (reset) [2]						

[1] potential-free voltage
[2] reset U_{Lmax} = 0.4 V, U_{Hmin} = 3.9 V

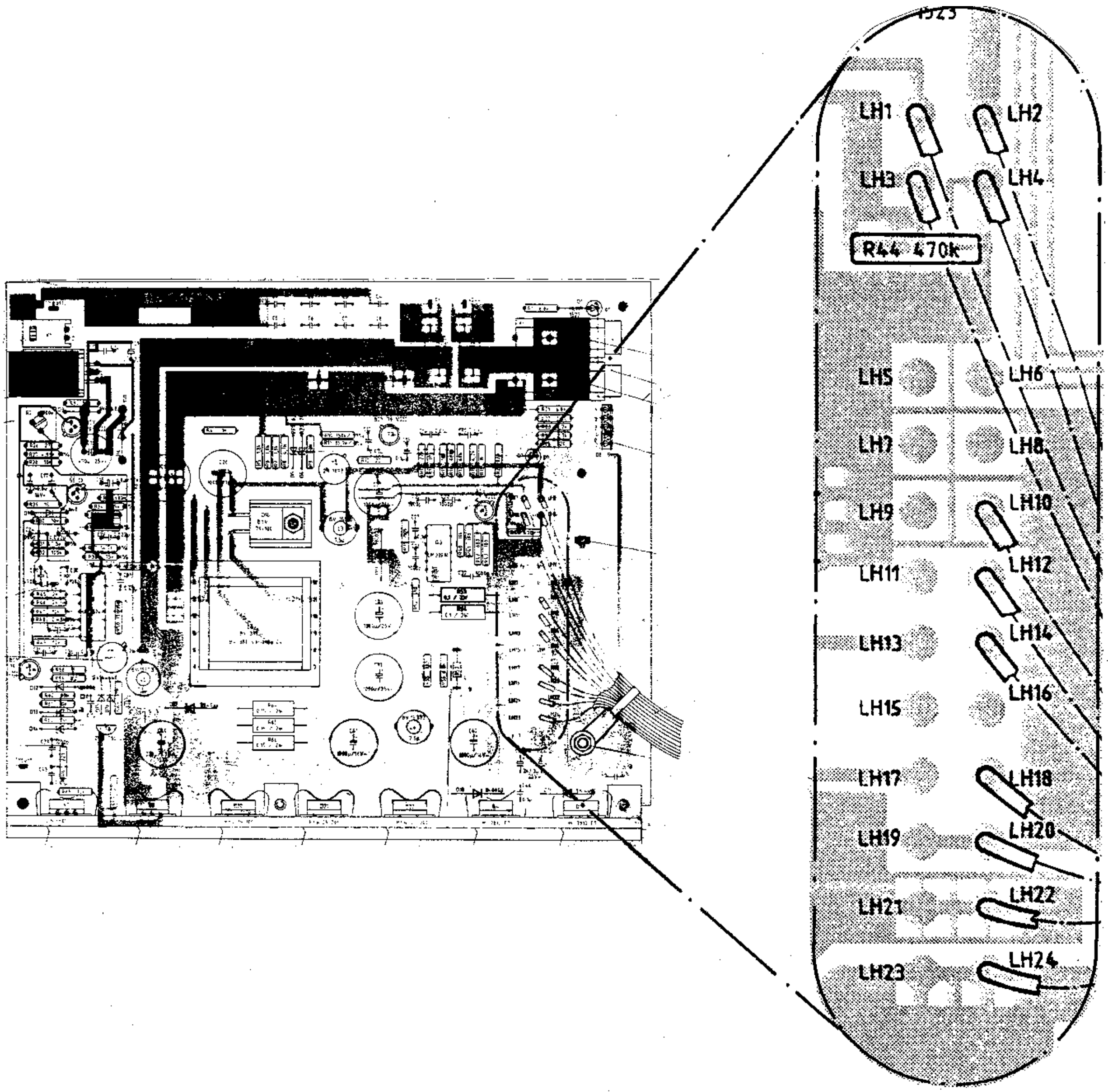
10.3 Checking the Power Supply Unit

Two low-voltage fuses are located on the POWER SUPPLY assembly. The fuse F 2.5A protects the output voltage of +24V BE (not required for TNC 415B/425), and the fuse F 4.0A protects the remaining voltages (see block diagram in section 10.2.1). If an error occurs in the power supply (all voltages missing), first check the +24V at the supply line (2-pin terminal strip X31) and then the low-voltage fuse F 4.0A.

The voltages can be measured directly on the power supply board, the processor board and the CLP board (sections 10.3.1 and 10.3.2).
The values and their tolerances can be seen from the corresponding tables. If the measured values deviate distinctly from the values in the table, the power supply assembly is defective.

Observe the safety instructions!
The power supply unit does not work without load.
(Basic load is required)

10.3.1 Test Points on the Power Supply Board



Voltage Table

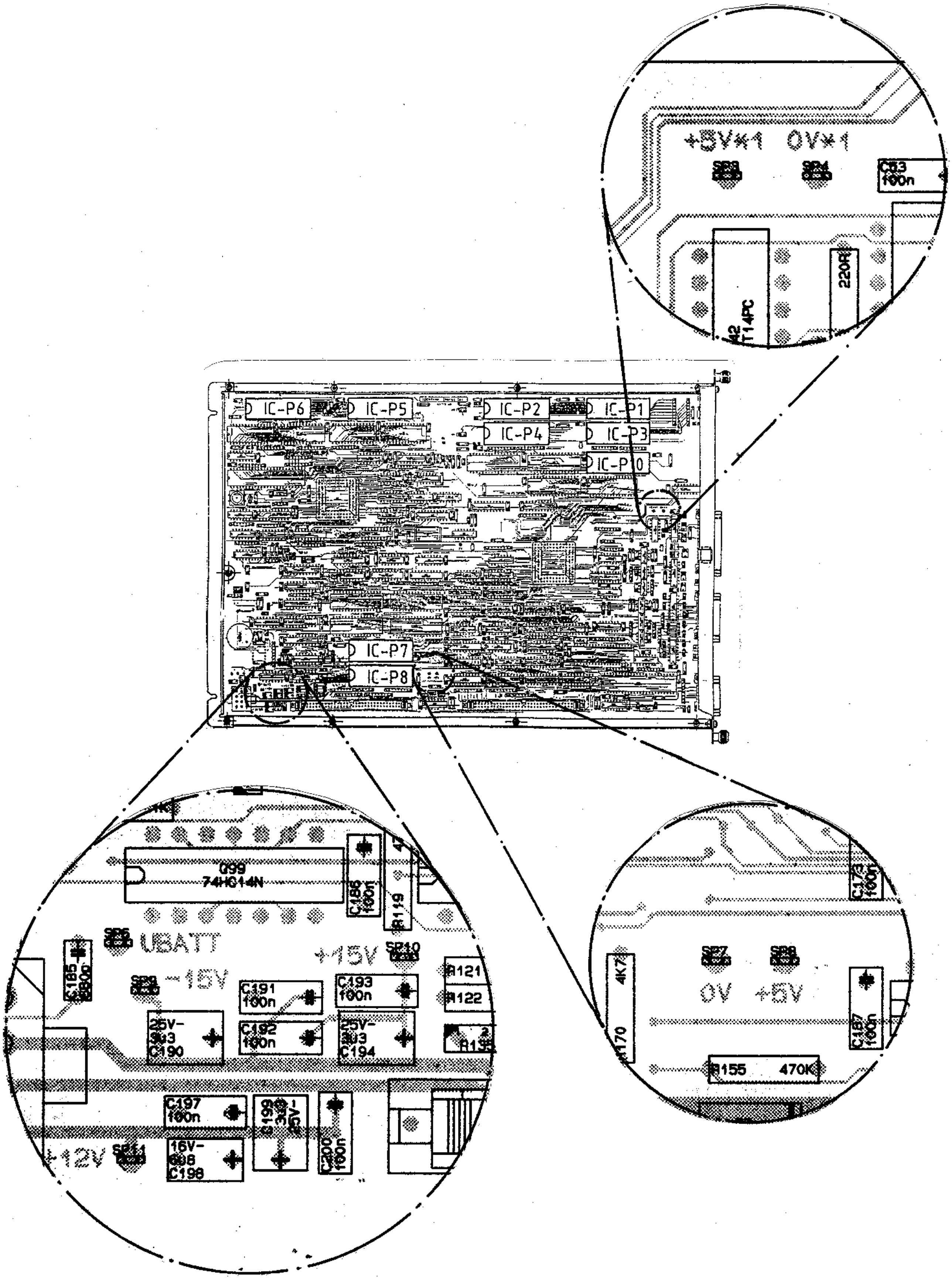
Test point on power supply board	Reference point on power supply board	Output	U_{NOM} [V]	U_{MIN} [V]	U_{MAX} [V]	I_{NOM} [A]
LH22	LH24 (0V)	+ 5V (UP)	+ 5.05	+ 5.00	+ 5.10	2.5
LH20	LH24 (0V)	+ 12V	+ 12	+ 11.4	+ 12.6	0.1
LH18	LH24 (0V)	+ 15V	+ 15.0	+ 14.4	+ 15.6	0.15
LH14	LH24 (0V)	- 15V	- 15.0	- 14.4	- 15.6	0.08
LH10	LH24 (0V)	+ U_{BATT}	+ 4.5	+ 3.9	-	approx. 20 µA
LH1	LH3 (0V*1)	+ 5V * 1 [1)]	+ 5	+ 4.75	+ 5.25	0.3
LH12 (reset) [2)]						

1) potential-free voltage

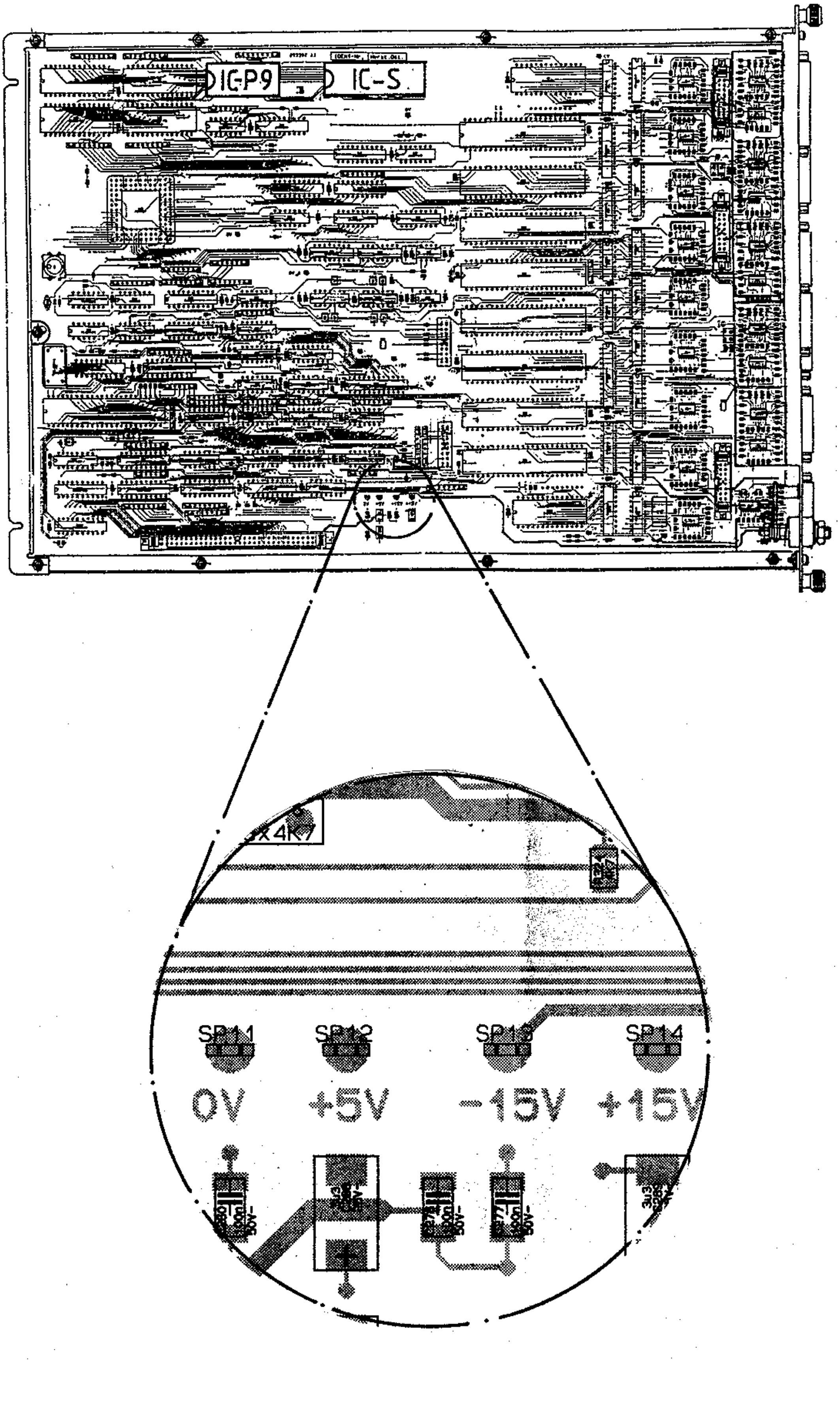
2) reset U_{Lmax} = 0.4 V, U_{Hmin} = 3.9 V

10.3.2 Test Points on the Boards

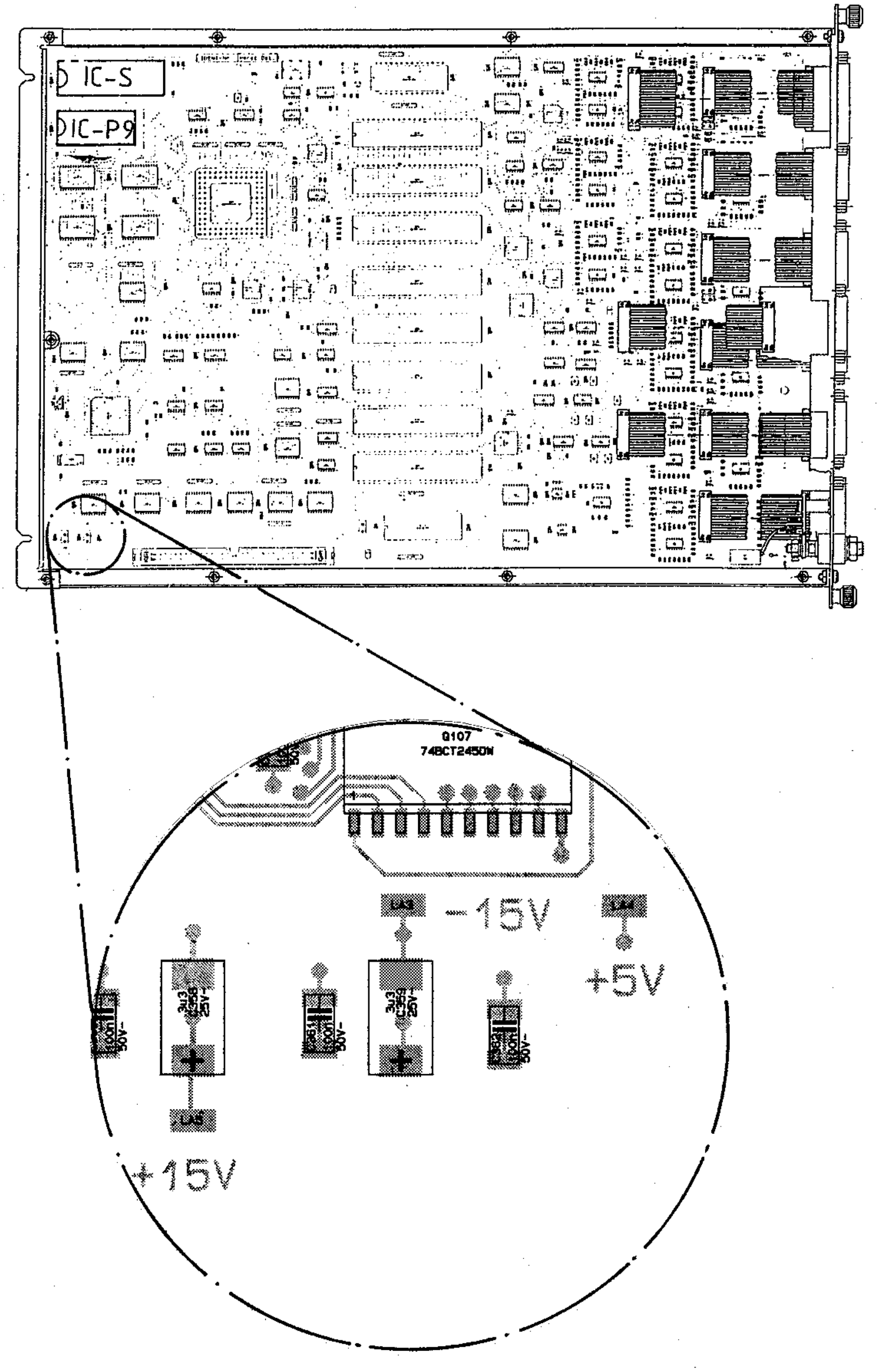
Processor board TNC 415B/425 Id.No. 268 553 –



CLP board TNC 425 Id.No. 265 401 – and Id.No. 268 927 –



CLP Board TNC 415B/425 Id.No. 275 705 -- and Id.No. 275 911 --



10.4 Power Supply of the PLC

The power supply line for the internal PLC of LE 415B/425 is connected to the terminal strip X44.

X44 PLC power supply of LE 415B/425

Terminal strip (pluggable) 3-pin

Pin No.	**Assignment**
1	+ 24 V_A, can be switched off via EMERGENCY STOP
2	+ 24 V , cannot be switched off via EMERGENCY STOP
3	0V

Fuses: F1: 3.15A (+ 24V_A, can be switched off)
F2: 1.0A (+ 24V, cannot be switched off)

The PLC power supply of PL 400, PL 405, PL 410 or PA 110 is connected to the following terminal strips:

Power supply of PA 110

Pin No.	**Assignment**
1	+ 24 V - can be switched off via EMERGENCY STOP
2	0V

Power supply of PL 400

Terminal	**Assignment**
X13	+ 24 V can be switched off via EMERGENCY STOP
X12	0V
X3, pin 12	+ 24V_A cannot be switched off via EMERGENCY STOP

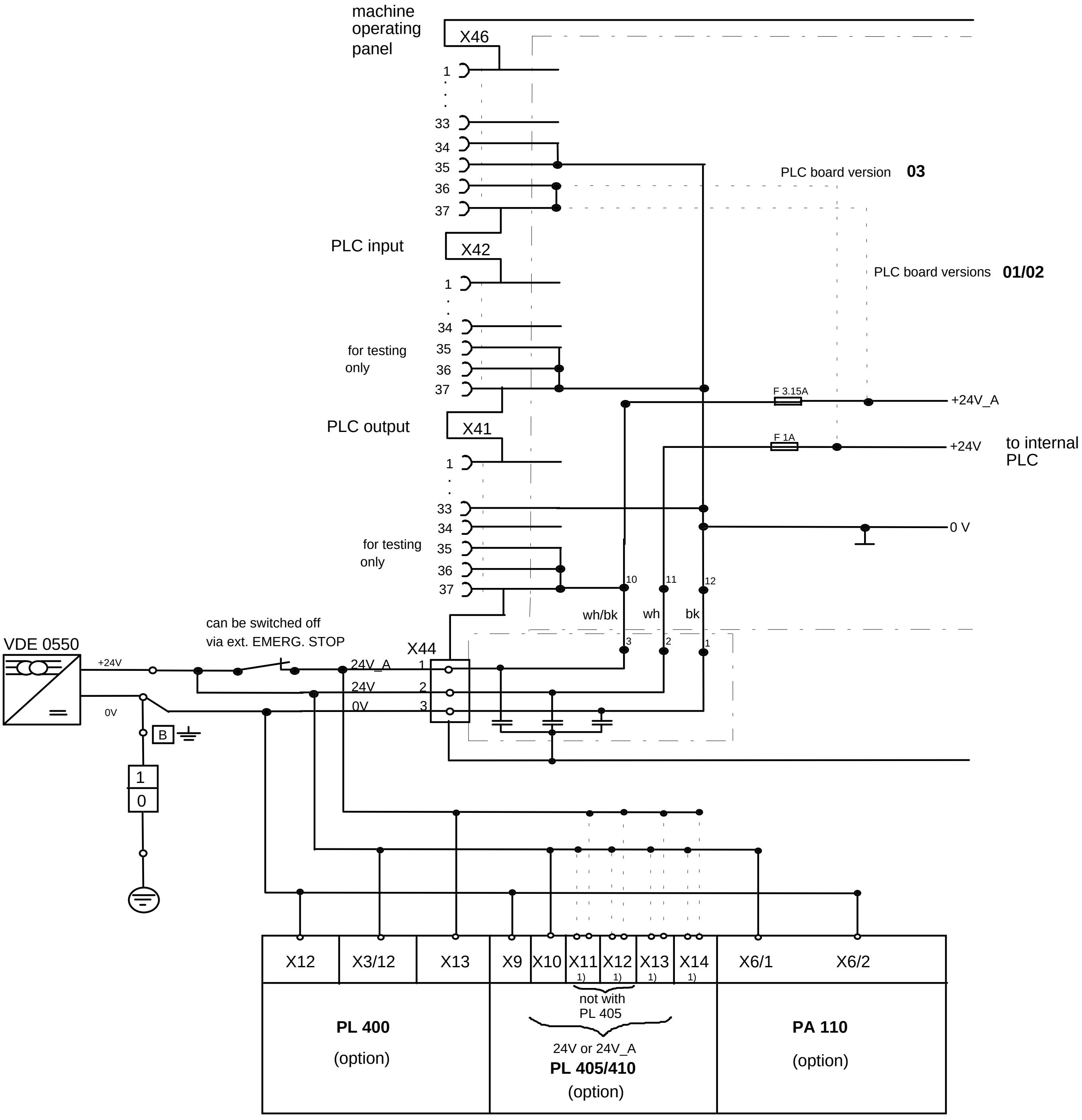
Power supply of PL 405 / 410

X9, X10, X11, X12, X13, X14 Power supply of PL			
Terminal	Assignment	1.PL	2.PL
X9	0V		
X10	+ 24V- logic unit and "control ready for operation"		
X11 [1)]	+ 24V- logic unit for outputs	O32 - O39	O64 - O71
X12 [1)]	+ 24V- logic unit for outputs	O40 - O47	O72 - O79
X13	+ 24V- logic unit for outputs	O48 - O55	O80 - O87
X14	+ 24V- logic unit for outputs	O56 - O62	O88 - O94

Fuse: - F2: T1A (+ 24V- supply for logic unit)

[1)] not with PL 405

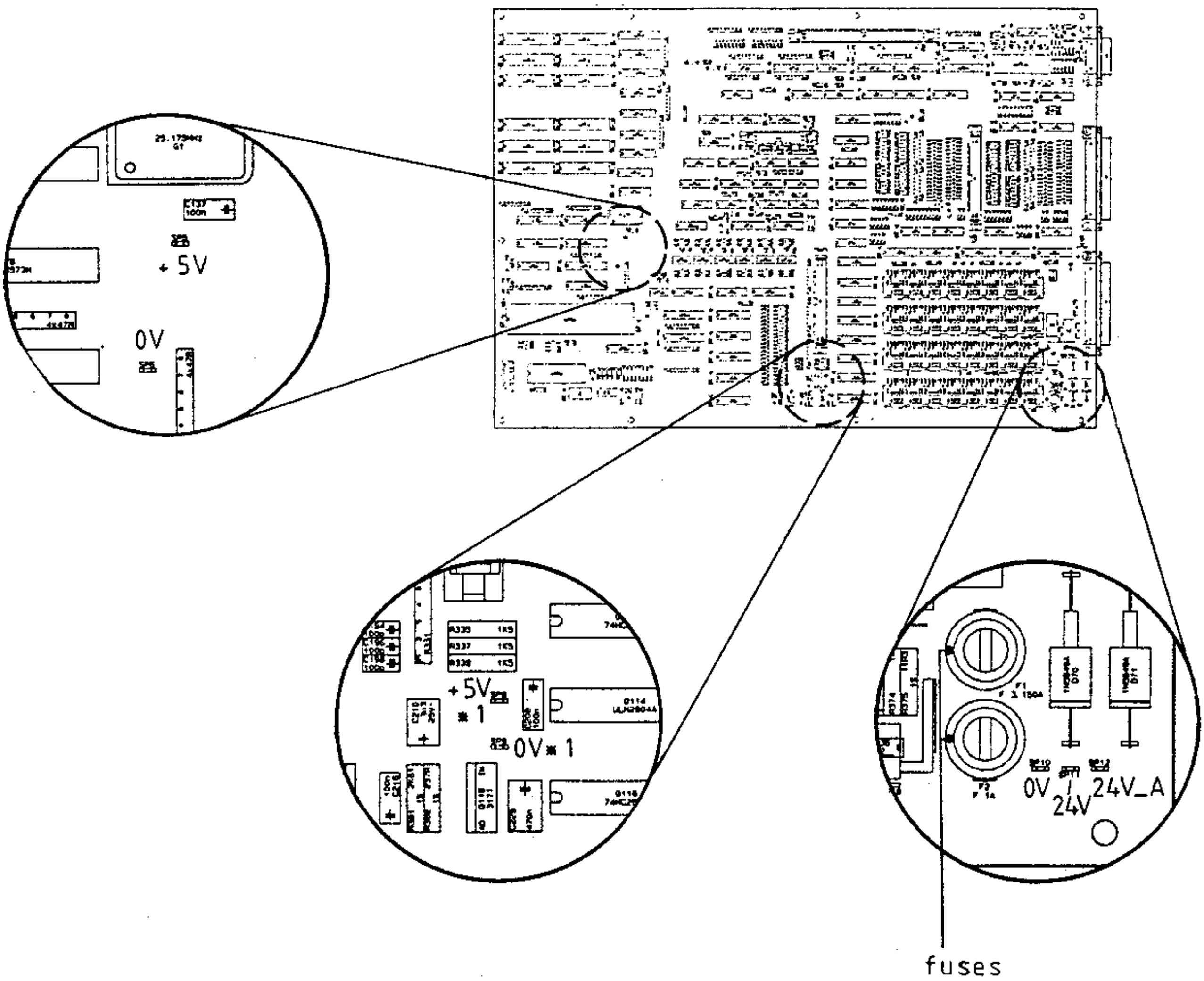
10.4.1 PLC Power Supply: Block Diagram



[1] can be powered with 24V or 24V_A

X44 Pin 1, +24V_A (PLC can be switched off): power supply for the PLC outputs O0 - O23.
X44 Pin 2, +24V (PLC cannot be switched off): power supply for the PLC outputs O24 - O30 and output "control ready for operation"; power supply for PLC graphics board.

10.4.2 Test Points on the PLC Graphics Boar



10.5 Buffer Battery

The buffer battery is the voltage source for the program memory when the machine tool is switched off.

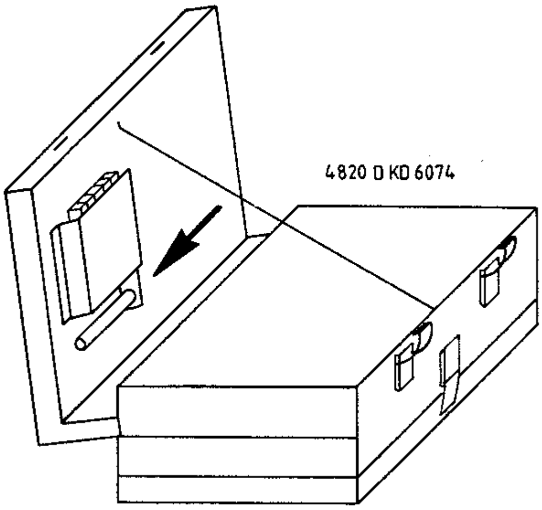
If the error message

EXCHANGE BUFFER BATTERY

is generated, the batteries must be exchanged within one week.

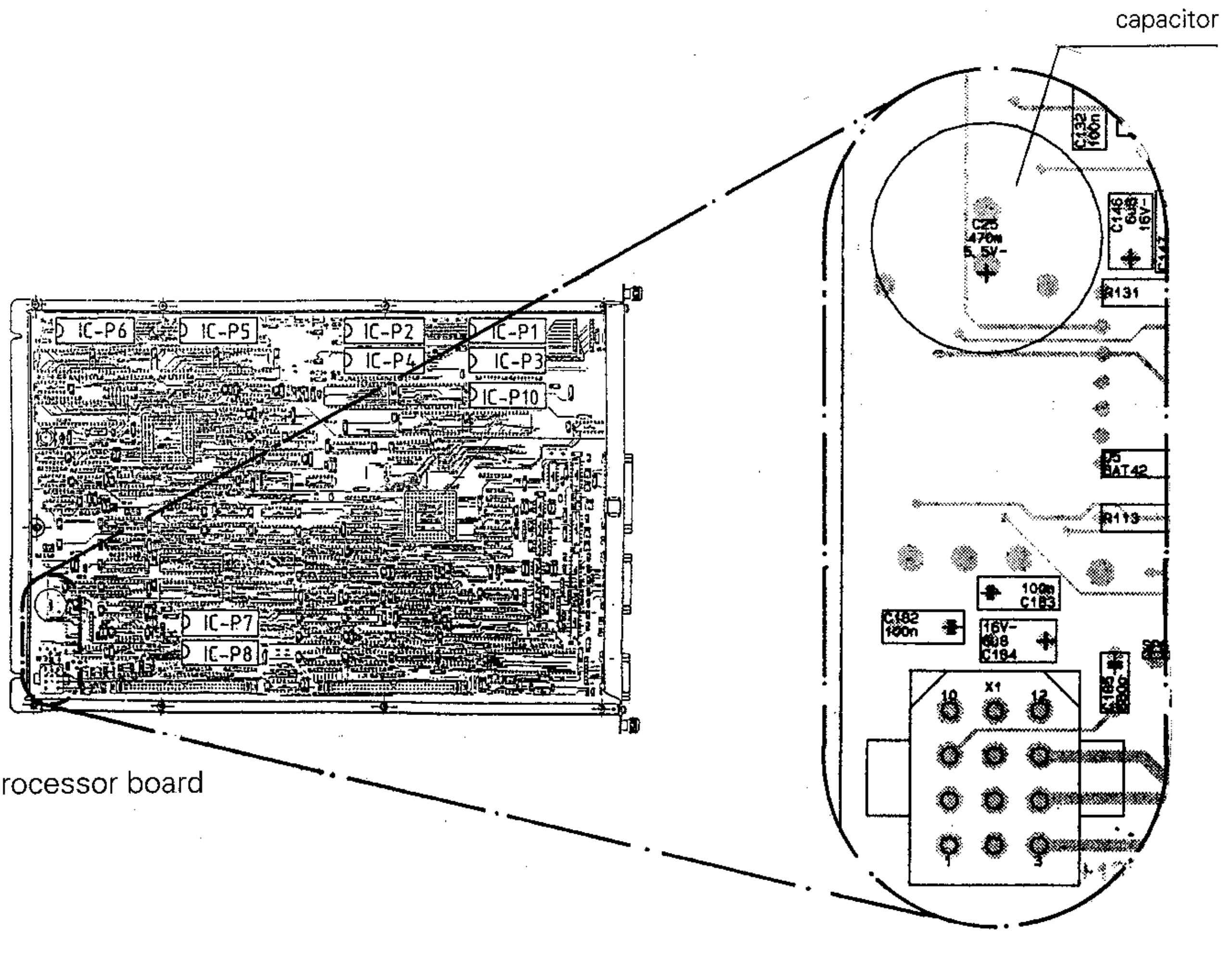
The buffer batteries are located behind a screw fitting in the power supply of the LE. To exchange the batteries, open the LE by undoing the snaps.

In order to protect the program memory of TNC 415B/425, a capacitor (on the processor board) is used in addition to the batteries. Thus, the line voltage may be switched off during battery exchange.
Without the batteries the capacitor is capable of maintaining the memory contents for about one day.



3 AA-size batteries
leak-proof
IEC designation "LR6"

The capacitor is only being charged when the TNC is switched on.

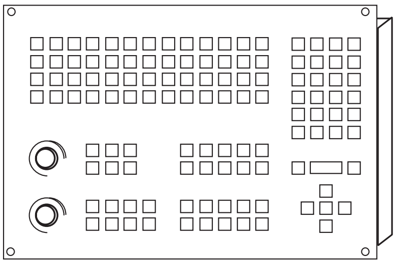


Processor board

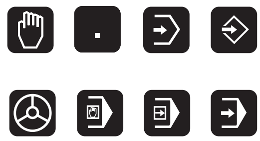
11. Keyboard Unit TE 400/410

11.1 Overview

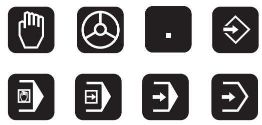
TE 400 Id.No. 250 517 ..



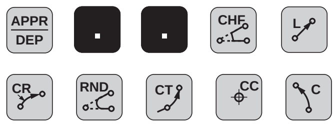
Version **01**



Version **02**



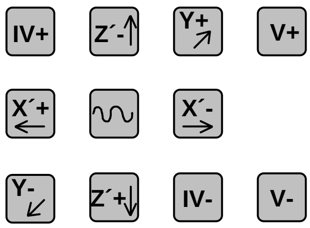
Version **03**



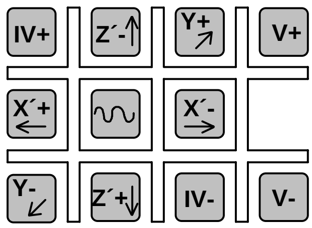
(remaining keys as version 01)

TE 410 Id.No. 258 645 ..

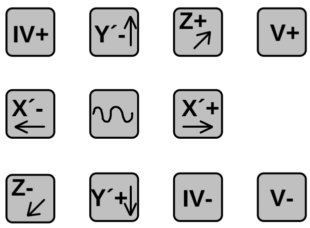
Version **01**
(without protective frame)



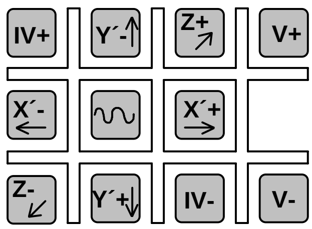
Version **03**
(with protective frame)



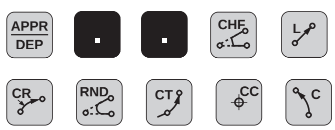
Version **02**
(without protective frame))



Version **04**
(with protective frame)



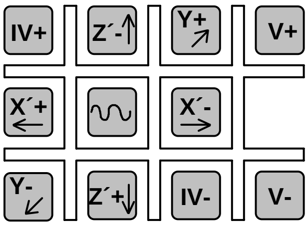
Version **05** (remaining keys as version 03)
Version **06** (remaining keys as version 04)



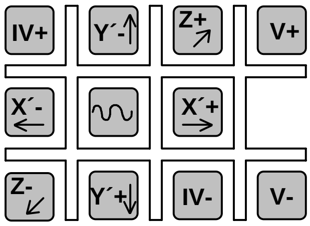
(remaining keys as version 01)

TE 410 Id.No. 264 105 ..

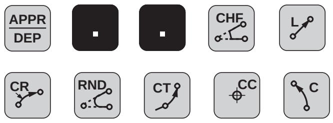
Version **01**



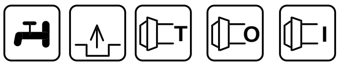
Version **02**



Version **03** (remaining keys as version 01)
Version **04** (remaining keys as version 02)



Version **05** (remaining keys as version 03)
Version **06** (remaining keys as version 04)



11.2 Checking the Keyboard Unit

The keyboard unit can be checked fast and reliably with the measuring adapter.

11.2.1 Checking the Key Functions

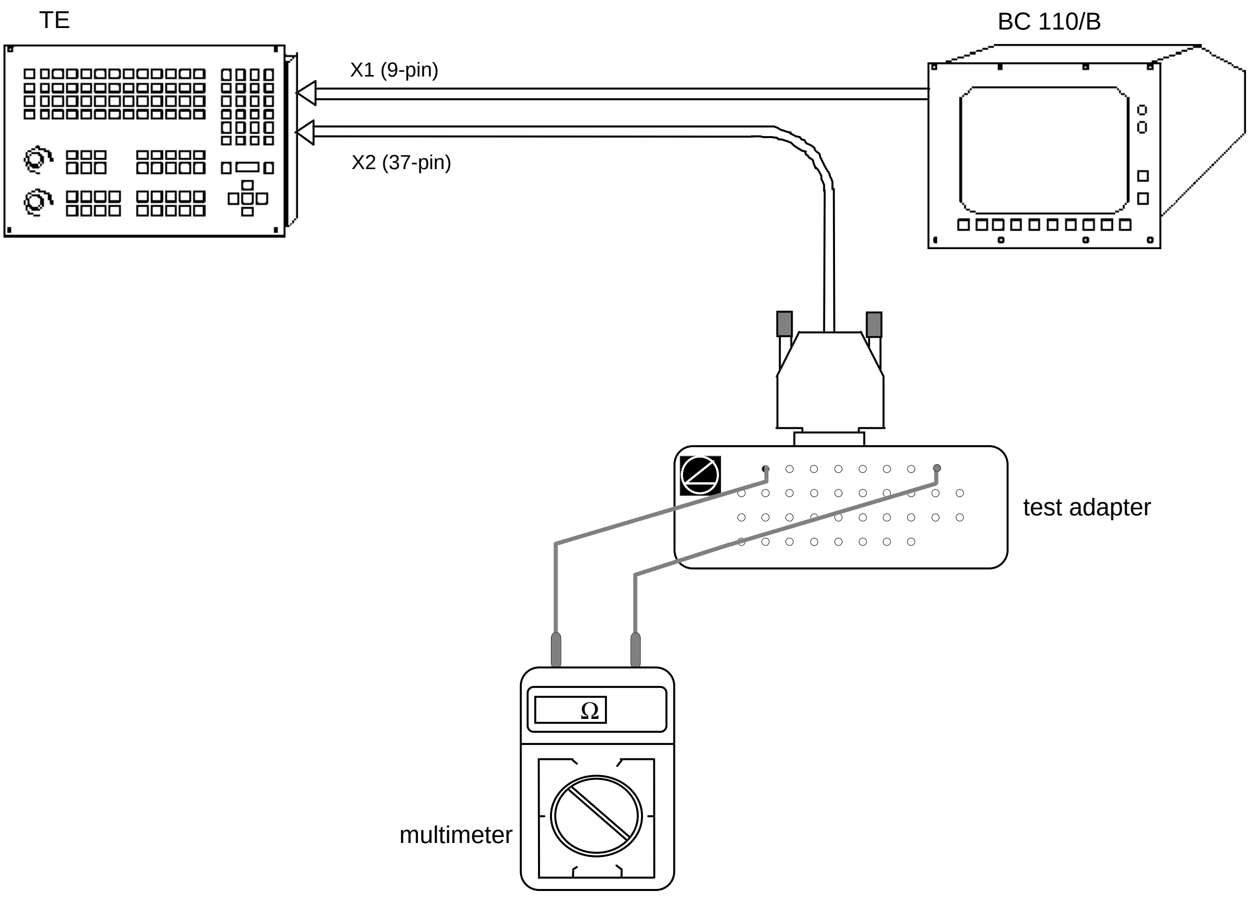
Proceeding:

Observe the safety instructions!

- Switch off the main switch.
- Disconnect the keyboard unit from the LE and connect the measuring adapter (see section 20) to the keyboard unit.
  Now the contacts of the keys can be measured at the measuring adapter with an Ohmmeter.

If e.g. PGM NR is pressed at the TNC operating panel, approx. 1 Ω can be measured at the adapter between PIN 8 and PIN 24 (see key matrix, section 11.2.3 and 11.2.4); consider the resistance of the testing wires.

11.2.2 Measuring Setup for Checking the Functions of the NC-Keys



11.2.3 Key Matrix of the Keyboard Unit

X2 Pin	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
Key	RL0	1	2	3	4	5	6	7	8	16	17	18	19	20	21	22	SL0	1	2	3	4	5	6	7
!										x							x							
#										x								x						
$											x						x							
%											x							x						
^												x					x							
&												x						x						
*													x				x							
(													x					x						
)														x			x							
−														x				x						
+															x		x							
=															x			x						
⌫																x	x							
"										x								x						
Q										x										x				
W											x								x					
E											x									x				
R												x							x					
T												x								x				
Y													x						x					
U													x							x				
I														x					x					
O														x						x				
P															x				x					

X2 Pin	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
Key	**RL0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**SL0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
<															x					x				
RET																x			x					
CTRL										x											x			
A										x												x		
S											x										x			
D											x											x		
F												x									x			
G												x										x		
H													x								x			
J													x									x		
K														x							x			
L														x								x		
;															x						x			
>															x							x		
:																x					x			
SPACE										x													x	
Z										x														x
X											x												x	
C											x													x
V												x											x	
B												x												x
N													x										x	
M													x											x
,														x									x	

X2 Pin	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
Key	**RL0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**SL0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
.														x										x
?															x								x	
/															x									x
SPACE																x							x	
PGM NAME								x													x			
CL PGM							x														x			
PGM CALL						x															x			
EXT					x																x			
						x													x					
MOD		x																						x
	x																						x	
.		x															x							
			x																					x
					x																		x	
	x																							x
		x																					x	
			x																				x	
				x																			x	
APPR DEP									x								x							
									x									x						
									x										x					

X2 Pin	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
Key	**RL0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**SL0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
CHF									x											x				
L								x												x				
CR							x													x				
RND							x												x					
CT								x											x					
CC						x														x				
C					x															x				
TOUCH PROBE				x													x							
CYCL DEF								x										x						
CYCL CALL							x											x						
LBL SET						x												x						
LBL CALL					x													x						
STOP					x														x					
TOOL DEF								x									x							
TOOL CALL							x										x							
R L –						x											x							
R R +					x												x							
X				x																	x			
7			x																		x			
8		x																			x			
9	x																				x			
Y				x																x				
4			x																	x				

X2 Pin	1	2	3	4	5	6	7	8	9	17	18	19	28	29	31	32	20	21	22	23	24	25	26	27
Key	RL0	1	2	3	4	5	6	7	8	16	17	18	19	20	21	22	SL0	1	2	3	4	5	6	7
5		x																		x				
6	x																			x				
Z				x															x					
1			x																x					
2		x																	x					
3	x																		x					
IV				x														x						
0		x																x						
.			x															x						
−/+	x																	x						
V									x												x			
									x													x		
			x																			x		
Q			x														x							
CE					x																	x		
DEL				x																		x		
P				x																				x
I					x																			x
NO ENT		x																				x		
ENT	x																					x		
END	x																x							
↑								x														x		
←						x																x		
GOTO							x															x		
→								x															x	
↓						x																	x	

11.2.4 Key Matrix of the VDU Keys

X1 Pin [1]	4b	3b	2b	1b	1a	2a	3a	4a
X2 Pin [1]	**13**	**14**	**15**	**16**	**20**	**21**	**22**	**23**
Key [2]	**RL12**	**RL13**	**RL14**	**RL15**	**SL0**	**SL1**	**SL2**	**SL3**
◁				x		x		
SK1			x			x		
SK2		x				x		
SK3	x					x		
SK4				x			x	
SK5			x				x	
SK6		x					x	
SK7	x						x	
SK8				x				x
▷			x					x
	x				x			
		x			x			

[1] connector on keyboard unit
[2] VDU key

X1: connector for flat cable VDU ⇨ keyboard unit (plug-type connector)
X2: connector for cable keyboard unit ⇨ logic unit (D-SUB, 37-pin)

SK = **s**oft **k**ey (SK1...SK8 from left to right)

11.2.5 Checking the Potentiometers

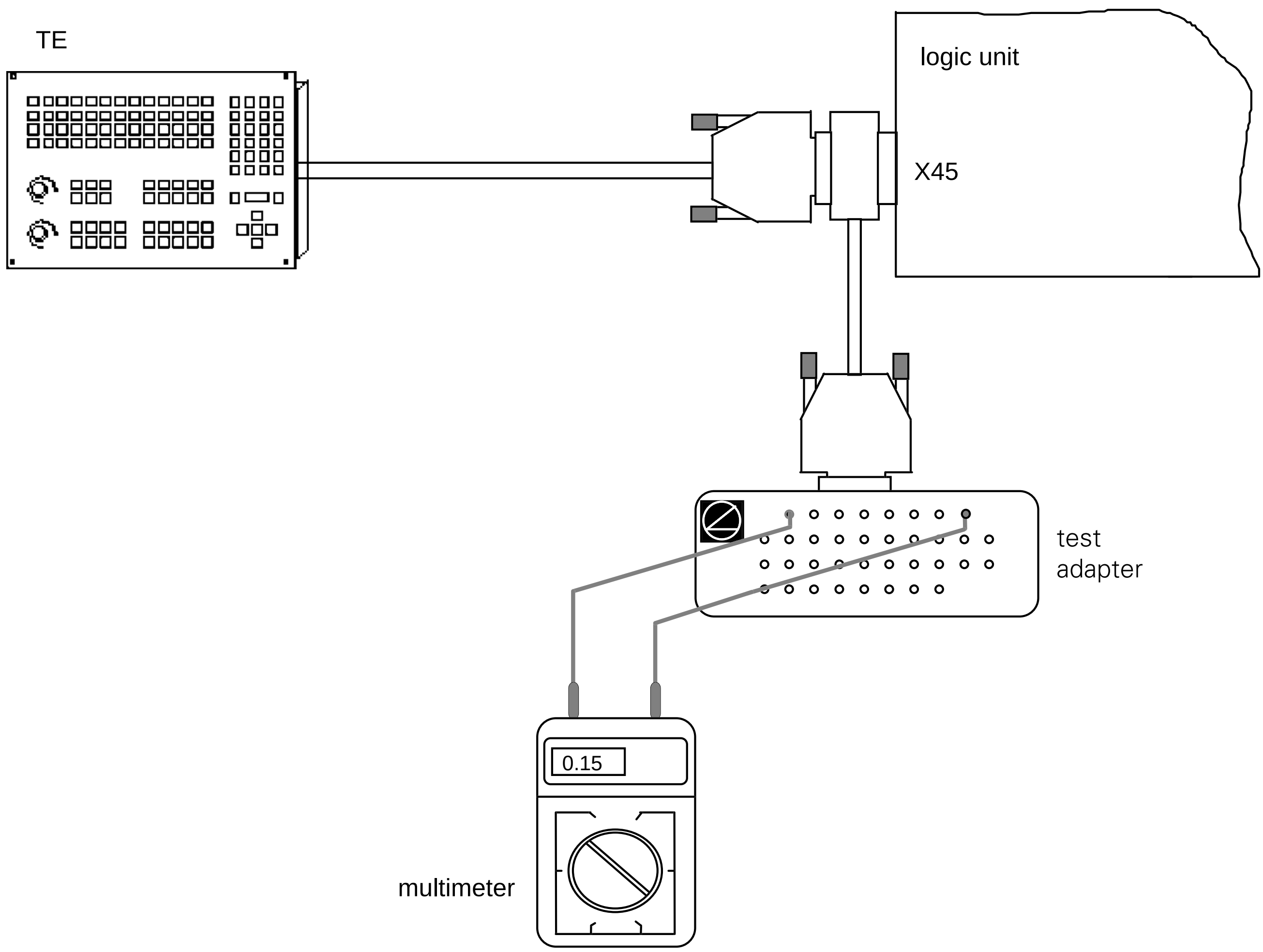
Proceeding:

Observe the safety instructions!

Connect the measuring adapter to X45 of the logic unit. Now the wiper voltages of the potentiometers can be measured with a multimeter.

Potentiometer	PIN	Voltage
override F%	37 = 0V / 35 = + pot.	(0 to approx. 4.95)V
spindle S%	37 = 0V / 34 = + pot.	(0 to approx. 4.95)V

11.2.6 Measuring Setup for Checking the Potentiometers



11.2.7 Machine Operating Panel of TE 410

The PLC inputs of the machine operating panel of TE 410 (I128 - I148) can be tested at the flange socket X3 (37-pin) on the keyboard unit TE 410 or at the flange socket X46 (connection of machine control panel) of the TNC 415B/425.

For this purpose the TABLE function (see section 19.4) in the PLC mode is helpful as well.

KEY of version		Flange socket X3 on KEYBOARD UNIT		PLC
01/03	02/04	PIN	PIN	Input
IV+	IV+	12	36.37	I139
Z´-↑	Y´-↑	8	36.37	I135
Y+ ↗	Z+ ↗	10	36.37	I117
V+	V+	19	36.37	I146
X´+ ←	X´- ←	11	36.37	I138
∿	∿	14	36.37	I141
X´- →	X´+ →	6	36.37	I133
Y- ↙	Z- ↙	7	36.37	I134
Z´+↓	Y´+↓	9	36.37	I136
IV-	IV-	13	36.37	I140
V-	V-	20	36.37	I147

KEY of version		Flange socket X3 on KEYBOARD UNIT		PLC
05/06	[1]	PIN	PIN	Input
O	O	3	36.37	I130
I	I	15	36.37	I142
T	T	21	36.37	I148
		1	36.37	I128
		2	36.37	I129
NC 0	NC 0	4	36.37	I131
NC I	NC I	5	36.37	I132

[1] remaining versions

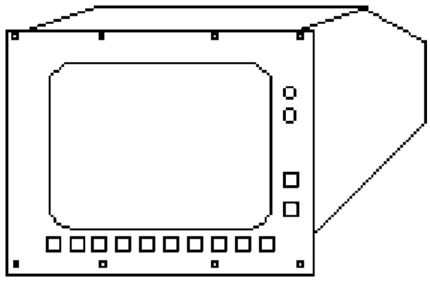
pin 36/37 = + 24V_PLC

12. Visual Display Unit BC 110/B

12.1 Overview

BC 110 Id.No. 254 740 01

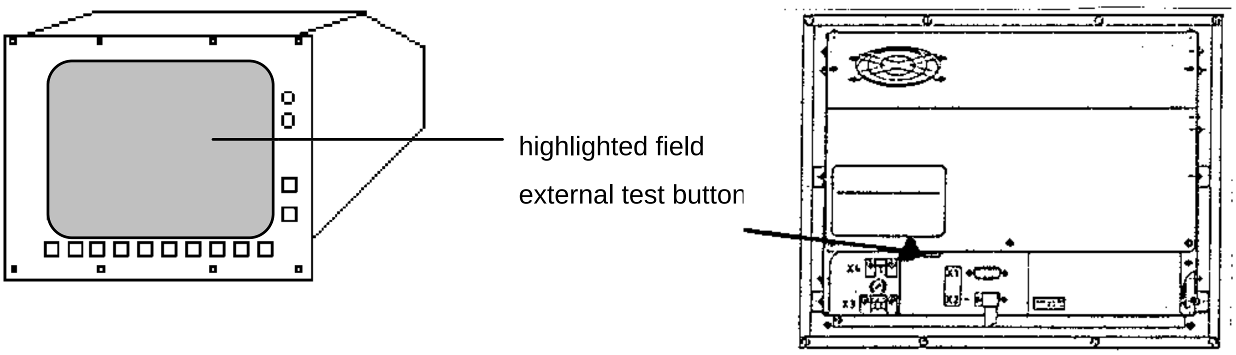
BC 110 B Id.No. 260 520 01



12.2 Checking the Visual Display Unit

BC 110 B, Id.No. 260 520 01

If the screen remains dark when the machine is switched on, first check the power supply (line voltage) of the VDU. If the voltage supply is functioning properly, a square highlighted filed can be generated on the screen of the VDU (which must be switched on) by pressing the external test button on the back side of the unit.



If the VDU generates this highlighted field, the PLC graphics board in the logic unit is probably defective.
If however, the VDU remains dark after the test button was pressed, the VDU is defective and must be exchanged.

BC 110, Id.No. 254 740 01

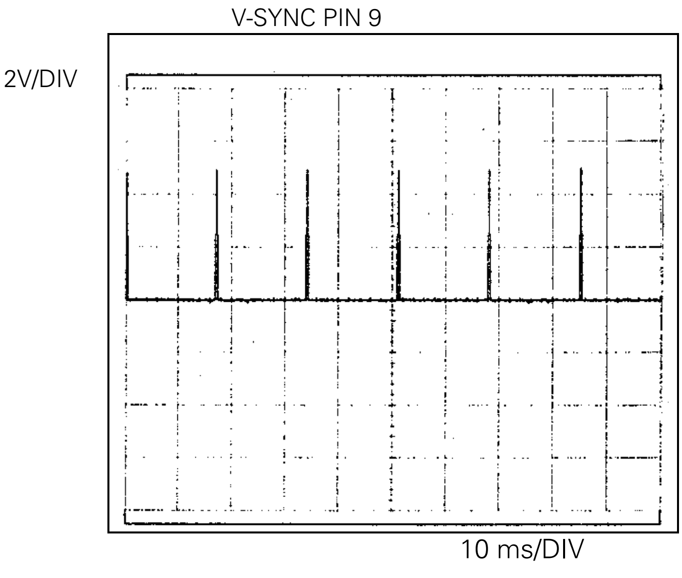
If the screen remains dark when the machine is switched on, first check the power supply (line voltage) of the VDU. The control signals for the screen can only be checked with an oscilloscope.

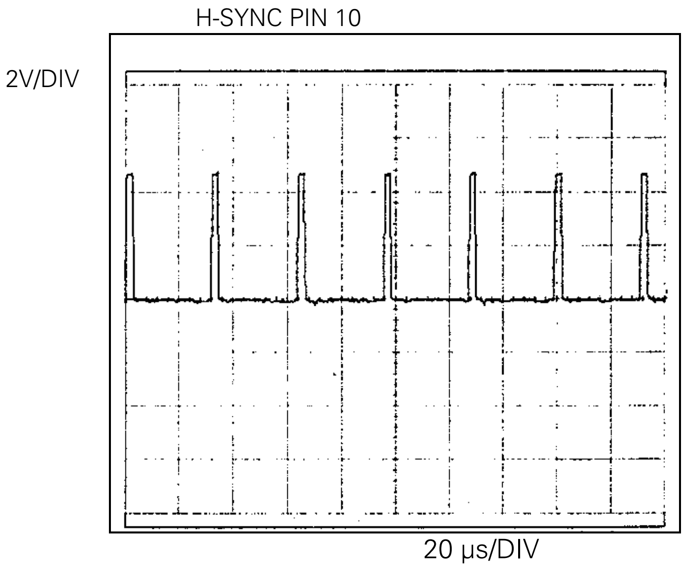
The following diagrams were generated with the VISUAL DISPLAY UNIT connected. Depending on machine parameters and image depicted, the colour signals R-analog, Y-analog and B-analog may differ from those on page 75.

X43 Visual Display Unit (BC 110)
flange socket with female insert (15-pin)

Pin No.	Assignment
1, 8, 11	GND
2 to 6, 12, 13	do not assign
7	R signal
9	V SYNC
10	H SYNC
14	Y signal
15	B signal

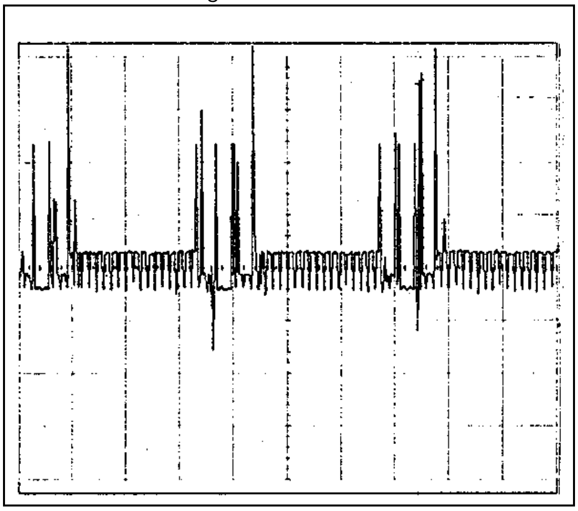
Diagrams





R-analog PIN 7 [1)]

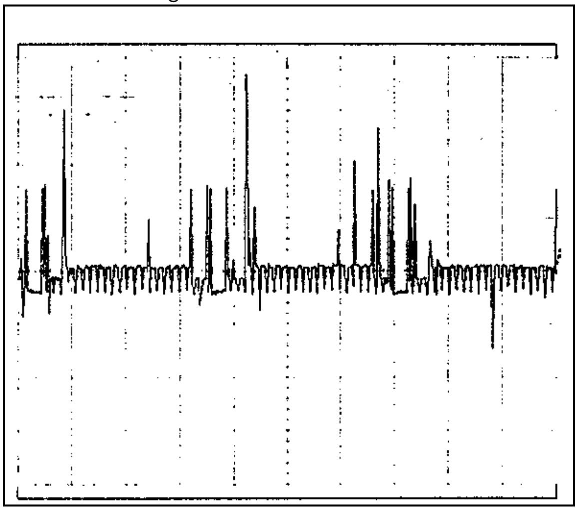
0,2V/DIV



5 ms/DIV

Y-analog PIN 14 [1)]

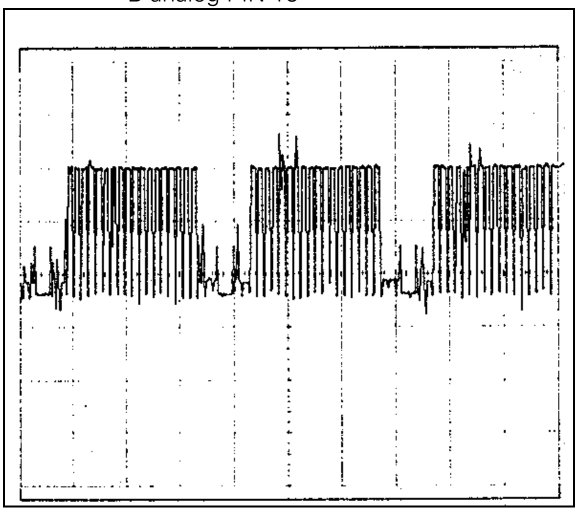
0,2V/DIV



5 ms/DIV

B-analog PIN 15 [1)]

0,2V/DIV



5 ms/DIV

[1] When measuring the colour signals directly at the output of the logic unit (without the VISUAL DISPLAY UNIT connected), the amplitudes are twice as large.

13. Encoders

13.1 Error Messages for Axes with Analogue Speed Controller

ENCODER <AXIS> DEFECTIVE YA

A = signal amplitude error

ENCODER <AXIS> DEFECTIVE YB

B = signal frequency error

ENCODER <AXIS> DEFECTIVE YC

C = error with distance-coded scales

Y = CPU number 1 = main processor
2 = geometry processor
3 = CLP processor

13.1.1 Error Causes

- Glass scale contaminated or damaged
- Scanning head contaminated or defective
- Cable damaged
- Encoder input of the logic unit (LE) defective

13.1.2 Error Location

In order to determine whether the encoder or the encoder input of the logic unit is defective, the encoders can be switched at the logic unit. For this purpose the corresponding machine parameters must be altered as well:

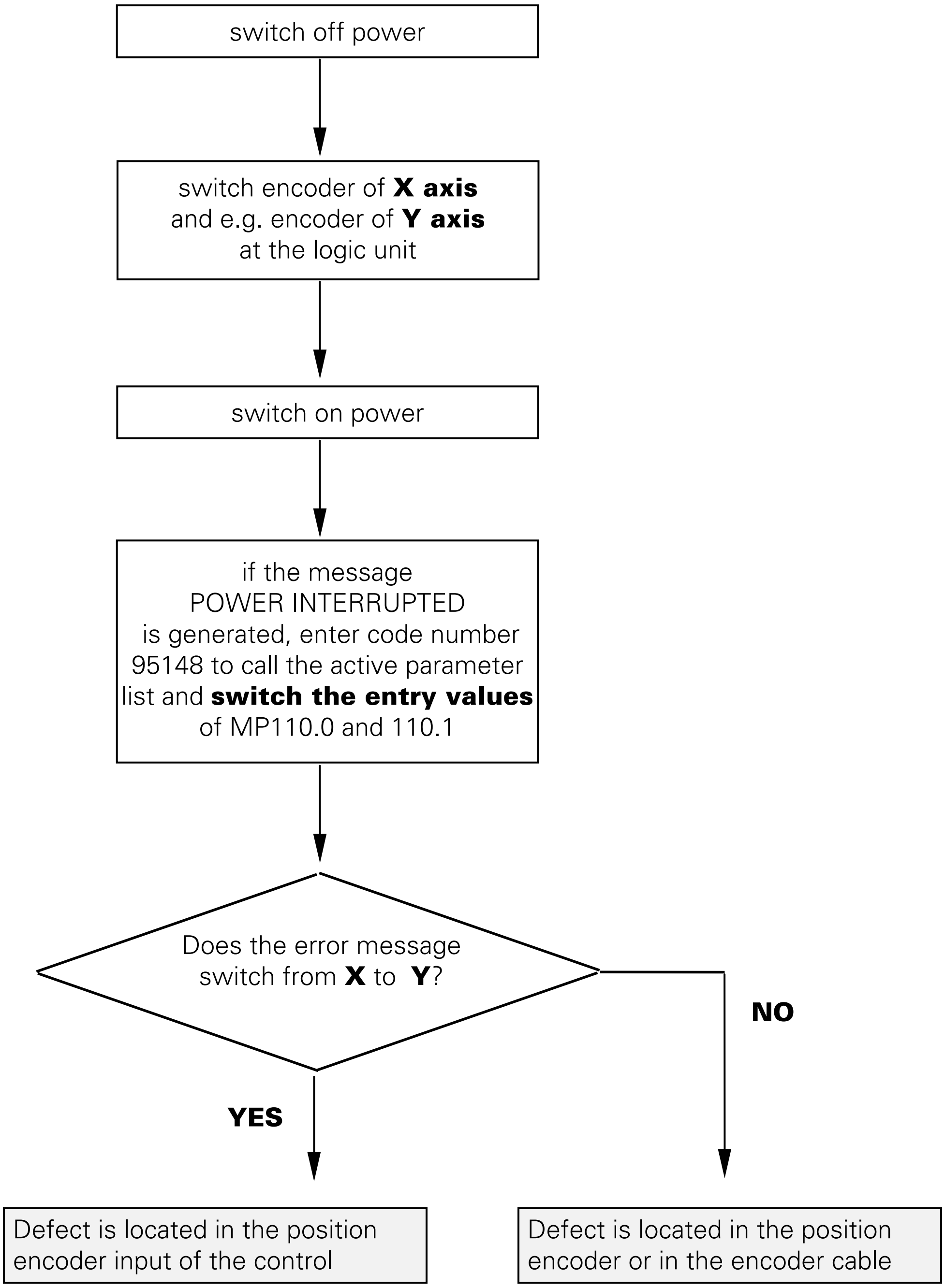
Function		**MP**	**Entry Value**
Allocation of the axes	X	110.0	0 = X1
to the encoder inputs	Y	110.1	1 = X2
	Z	110.2	2 = X3
	IV	110.3	3 = X4
	V	110.4	4 = X5
			5 = X6[1)]

1) X6 may be used for a machine axis, if no oriented spindle stop is required.

Flow-Chart for Error Location

ENCODER X DEFECTIVE 3B

(Example)



Observe the safety instructions!

13.2 Error Messages for Axes with Integral Digital Speed Controller

With the integral digital speed controller there are **two** encoder inputs for each axis:

Encoder inputs for the actual position:

encoder 1:	input X1
encoder 2:	input X2
encoder 3:	input X3
encoder 4:	input X4
encoder 5:	input X5
encoder S:	input X6

Encoder inputs for the actual speed:

encoder 1:	input X15
encoder 2:	input X16
encoder 3:	input X17
encoder 4:	input X18
encoder 5:	input X19

Therefore, there are **two** groups of error messages:

Monitoring of actual position capture (X1, X2, X3, X4, X5, X6)

ENCODER <AXIS> DEFECTIVE YA

A = signal amplitude error, position encoder

ENCODER <AXIS> DEFECTIVE YB

B = signal frequency error, position encoder

ENCODER <AXIS> DEFECTIVE YC

C = error with distance-coded scales, position encoder

Y = CPU number
1 = main processor
2 = geometry processor
3 = CLP processor

Monitoring of actual speed capture (X15, X16, X17, X18, X19)

ENCODER <AXIS>` DEFECTIVE YA

A = signal amplitude error, speed encoder

ENCODER <AXIS>` DEFECTIVE YB

B = signal frequency error, speed encoder

ENCODER <AXIS>` DEFECTIVE YC

C = error with distance-coded scales (speed encoder)

Y = CPU number
1 = main processor
2 = geometry processor
3 = CLP processor

13.2.1 Error Causes

- Glass scale contaminated or damaged
- Scanning head contaminated or defective
- Cable damaged
- Encoder input of the logic unit (LE) defective

13.2.2 Error Location

In order to determine whether the one of the encoders of an axis or one of the encoder inputs on the logic unit is defective, the encoders can be switched at the logic unit. For this purpose the corresponding machine parameters must be altered as well (always change **both** parameters!):

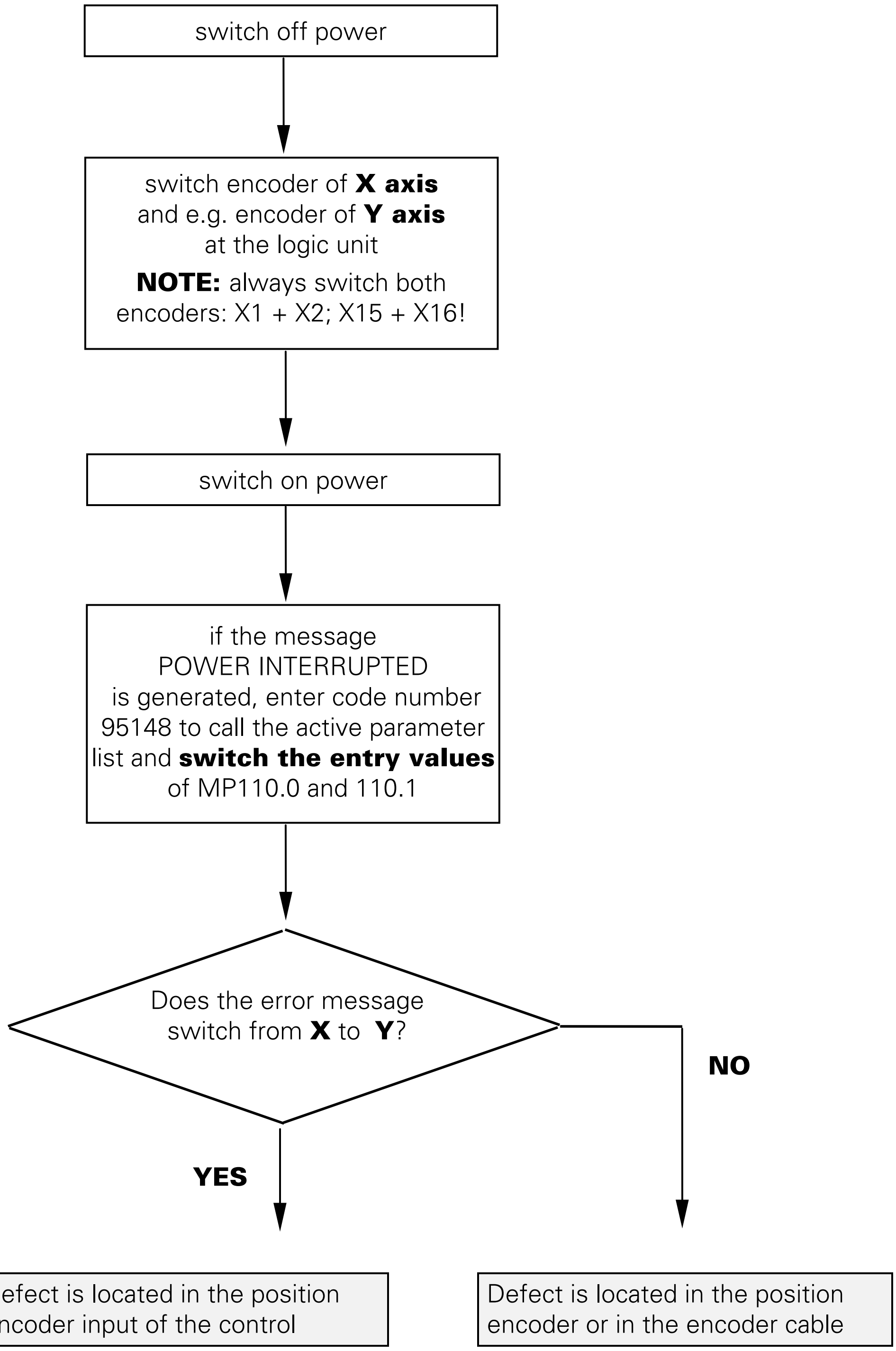
Function		MP	Entry value
Allocation of the axes	X	110.0	0 = X1 (pos.) / X15 (speed)
to the encoder inputs	Y	110.1	1 = X2 (pos.) / X16 (speed)
	Z	110.2	2 = X3 (pos.) / X17 (speed)
	IV	110.3	3 = X4 (pos.) / X18 (speed)
	V	110.4	4 = X5 (pos.) / X19 (speed)
			5 = X6[1)] (pos.)

1) X6 can be used for a machine axis, if no oriented spindle stop is required.

Flow-Chart for Error Location

ENCODER X` DEFECTIVE 3B

(Example)



Observe the safety instructions!

13.3 Electrical Inspection of an Encoder

In order to give a precise statement on the electrical function of an encoder, it must be measured with a phase angle measuring unit (PWM), an oscilloscope and a leak tester. (see operating instructions of encoder diagnostic set)

If no phase angle measuring unit is available, the electrical state of the cable, the lamp and the photocells of an encoder can be checked with an ohmmeter. The following resistances must be measured at the connector of the encoder:

Possible measurements at an encoder with current interface (7 - 16µA)

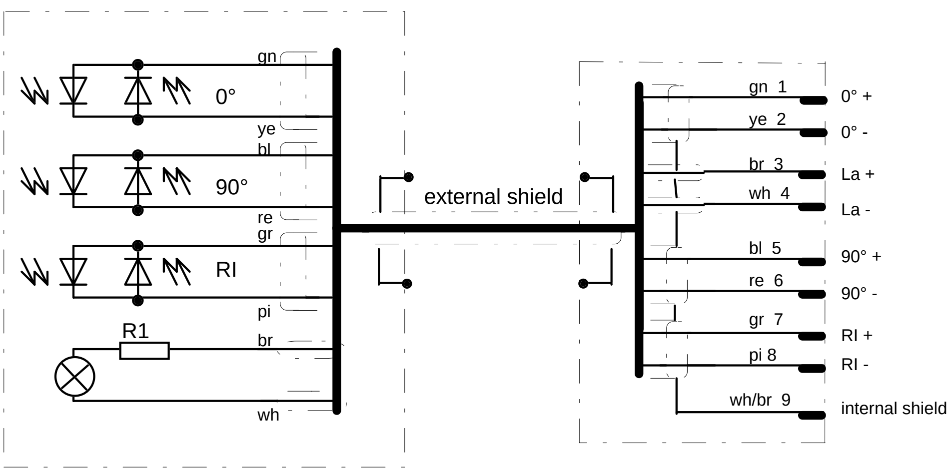
- encoder connector housing against machine chassis < 1 Ω (external shield)
- encoder connector housing against PIN 9 (internal shield - external shield) R = ∞
- encoder connector housing against PIN 1 to PIN 8 (external shield - signal lines) R = ∞
- PIN 9 against PIN 1 to PIN 8 (internal shield - signal line) R = ∞

• pin 1 against pin 2	0°		
• pin 2 against pin 1	0°	(switch poles of ohmmeter)	
• pin 5 against pin 6	90°		The measured values should approximately equal.
• pin 6 against pin 5	90°	(switch poles of ohmmeter)	
• pin 7 against pin 8	RP[1)]		
• pin 8 against pin 7	RP[1)]	(switch poles of ohmmeter)	
• pin 3 against pin 4[2)]		(approx. 5 - 30 Ω)	

1) If encoders with selectable reference mark are used, different resistance values can be measured (or no resistance), depending on the type of activation.

2) The encoder check (pin 3 against pin 4) can only be carried out, if the encoder light unit is a lamp. If the encoder features an amplifier section, the light unit cannot be checked at all. With encoders with infrared diodes, a resistance in the conducting direction can be measured between pin 3 (+) and pin 4 (-).

Basic Circuit Diagram with Sinusoidal Signals (7 - 16µA)

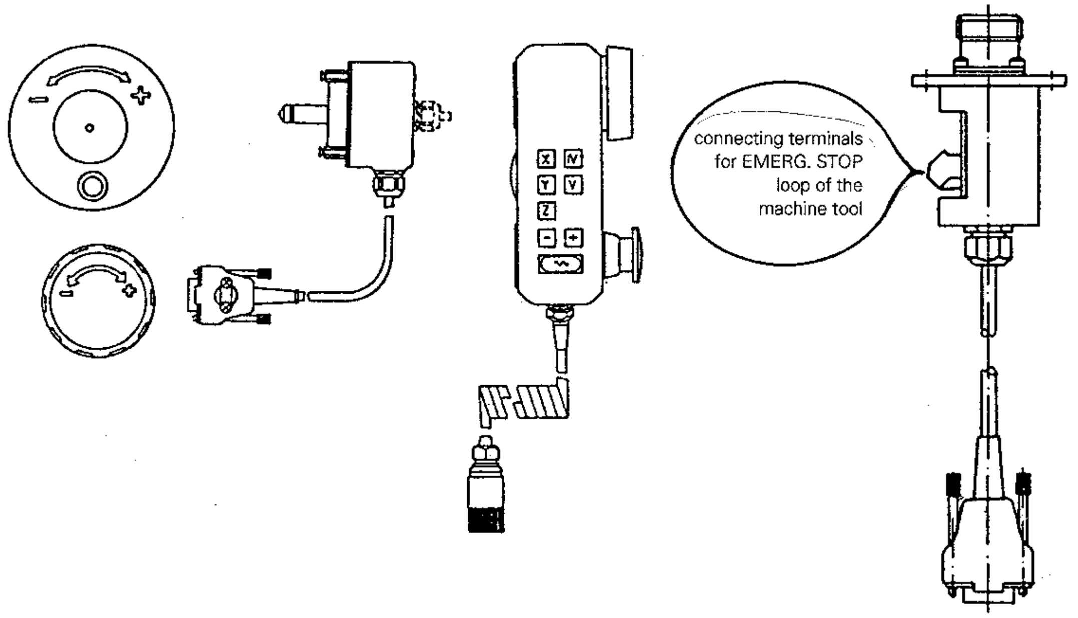


Encoders with square-wave signals can only be tested with a phase angle measuring unit (PWM).

14. Electronic Handwheels

14.1 Handwheel HR 130/330

HR 130	Id.No. 254 040 –	HR 330	Adapter cable for HR 330
HR 130.001	Id.No. 249 371 –	Id.No. 251 534 –	Id.No. 249 889 –

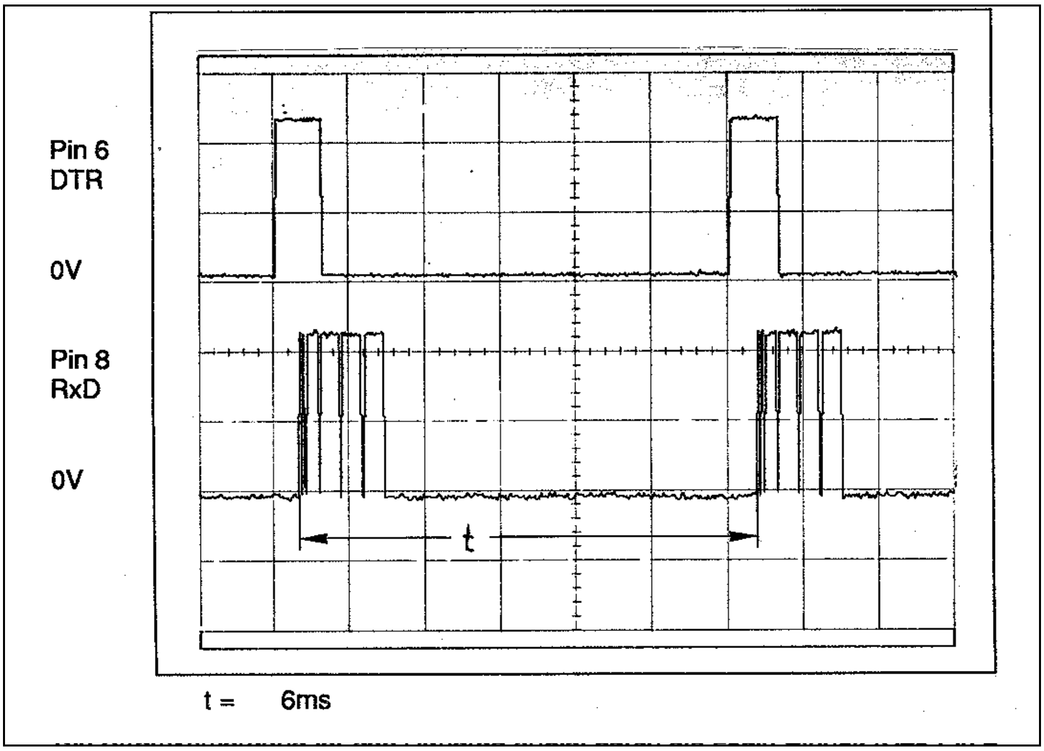


pin	color	signal
1	bl	EMG.
2	bl	STOP
3	gn	RxD
4	ye	DTR
5	bn	+12V
6	wh	0V

pin	color	signal
2	wh	0V
4	bn	+12V
6	ye	DTR
8	gn	RxD

14.1.1 Checking the Handwheel HR 130/330

The serial handwheel HR 130 (without auxiliary keys) and HR 330 (with auxiliary keys) can be checked with an oscilloscope. The following signals can be measured at the handwheel input X23 of LE 415B/425. The signals have to correspond to the diagram below.



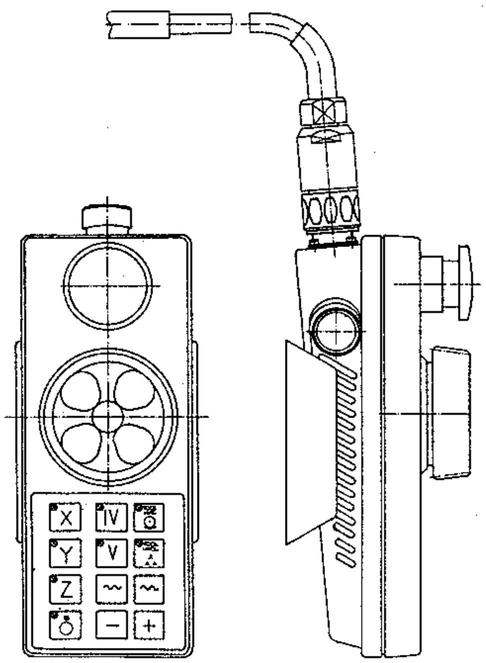
The supply voltage for the handwheel is fed via the logic unit (X23 pin 2 = 0V, pin 4 = + 12V).

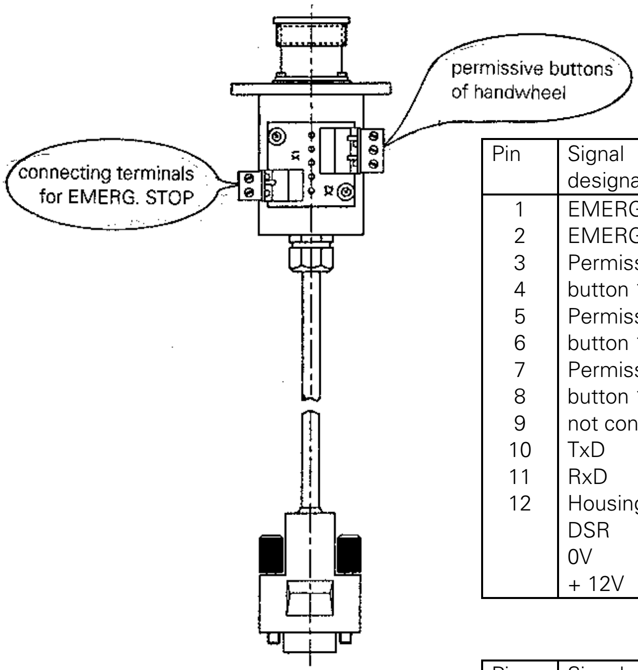
14.2 Handwheel HR 332

HR 332 Id.No. 266 064 –

Connecting cable Id.No. 272 292 –

Adapter cable Id.No. 274 556 01 (12-pin to 9-pin)





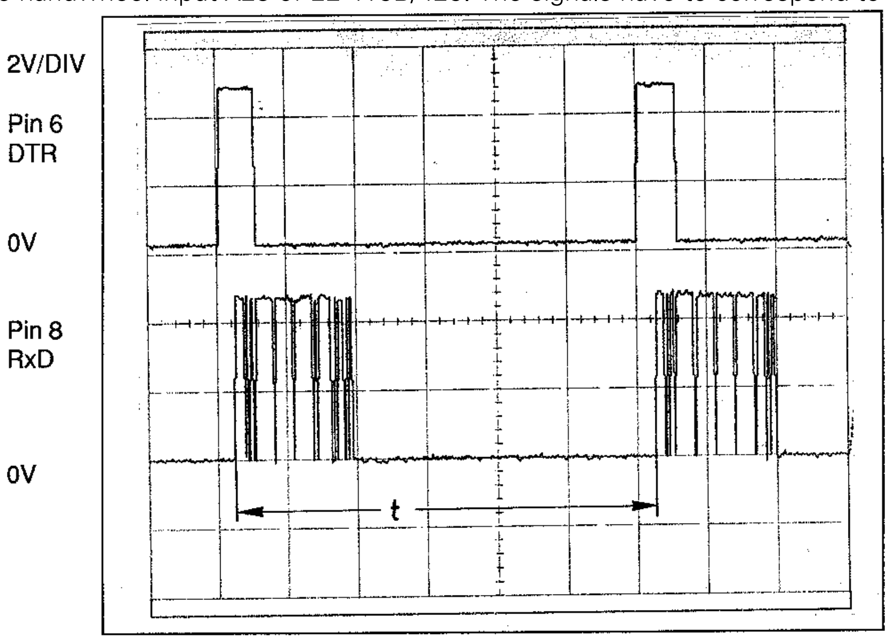
Pin	Signal designation
1	EMERG. STOP
2	EMERG. STOP
3	Permissive
4	button *
5	Permissive
6	button *
7	Permissive
8	button *
9	not connected
10	TxD
11	RxD
12	Housing shield
	DSR
	0V
	+ 12V

Pin	Signal designation
2	0V
4	+ 12V
6	DTR
7	TxD
8	RxD

The assignment of the handwheel keys depends on the version.
* The number of the permissive buttons and the internal wiring depends on the version of HR 332.

14.2.1 Checking the Handwheel HR 332

The serial handwheel HR 332 can be checked with an oscilloscope. The following signals can be measured at the handwheel input X23 of LE 415B/425. The signals have to correspond to the diagram below.



t = 6ms

The supply voltage for the handwheel is fed via the logic unit (X23 pin 2 = 0V, pin 4 = + 12V).

14.3 Error Messages

HANDWHEEL ?

- Data transfer (cable) has been interrupted
- Incorrect value entered in MP 7640.

HANDWHEEL DEFECTIVE

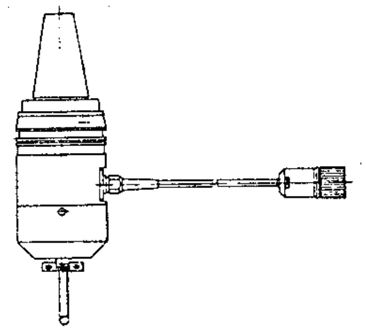
The light unit in the electronic handwheel is not emitting enough light, with the result that the signals in the handwheel become too small. An error signal is sent over the serial interface of the handwheel.

15. 3D-Touch Probes

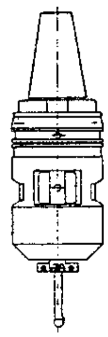
15.1 Overview

15.1.1 Touch Probes with External Interface Electronics (APE)

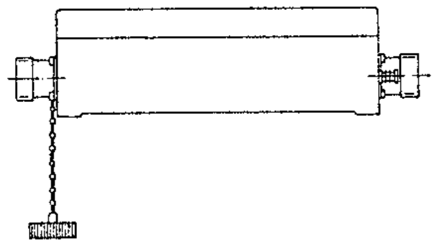
TS 111 Id.No. 237 400 –
Transmission via cable



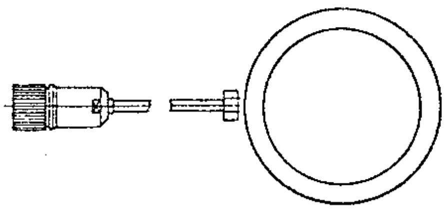
TS 511 Id.No. 237 402 –
Infra-red transmission



APE 110 Id.No. 230 465 – for **TS 111**
APE 510 Id.No. 227 590 – for **TS 511**
APE 511 Id.No. 237 586 – for **TS 511** with additional connector for a second **SE 510**

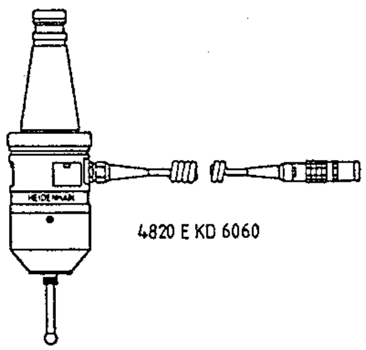


SE 510 Id.No. 230 473 –

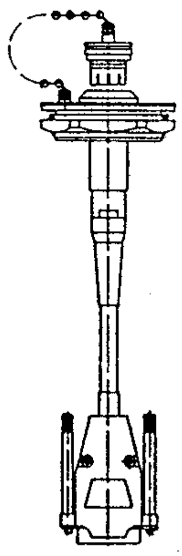


15.1.2 Touch Probe with Integral Interface Electronics (APE)

TS 120 Id.No. 243 614 –



Adapter cable for TS 120 Id.No. 244 891 –



15.2 Error Messages

15.2.1 Error Messages in the Probing Mode

TOUCH POINT INACCESSIBLE

- After the start of a probing function, the scanning point was not reached within the measuring range defined in the machine parameter MP6130.

EXCHANGE TOUCH PROBE BATTERY

- The battery voltage of the touch probe system with infrared transmission is below the minimum value.

STYLUS ALREADY IN CONTACT

- The stylus was already deflected when the probing function was started.

PROBE SYSTEM NOT READY

- The infrared transmission between the "Touch Probe" and the "Transmitter/Receiver Unit" is faulty (e.g. caused by contamination) or interrupted. The two windows of the touch probe system must be oriented to the transmitter/receiver unit.
- The battery is dead.
- The TM 110 is not connected.
- An error has been detected at one of the encoders of the TM110 (contamination).

15.2.2 Error Messages during Digitizing of 3D-Contours

WRONG AXIS PROGRAMMED

- The touch probe axis in the scanning cycle **RANGE** is not identical with the calibrated touch probe axis.

FAULTY RANGE DATA

- A MIN coordinate value in the scanning cycle **RANGE** is larger than or equal to the corresponding MAX coordinate value.
- One or more coordinates are beyond the limit switch range of the scanning cycle **RANGE**.
- No scanning cycle **RANGE** was defined when calling the scanning cycles **MEANDER** or **CONTOUR LINES**.

MIRRORING NOT PERMITTED

ROTATION NOT PERMITTED

SCALING FACTOR NOT PERMITTED

- Mirroring, rotation or scaling factor were active when the scanning cycles **RANGE**, **MEANDER** or **CONTOUR LINES** were called.

RANGE EXCEEDED

- The range has been exceeded during probing, i.e. a part of the 3D-contour is outside the range.

CYCL PARAMETER INCORRECT

- The programmed travel or the distance between lines or points is negative or larger than 56 535 mm. (only possible with Q-parameter programming)

TOUCH POINT INACCESSIBLE

- The stylus was deflected before the range was reached during approach.
- In the cycle CONTOUR LINES, the stylus was not deflected within the probing range.

STYLUS ALREADY IN CONTACT

- The stylus is not at rest, although it is not touching the contour.

PLANE WRONGLY DEFINED

- One of the coordinates of the starting point in the cycle CONTOUR LINES is identical with the touch probe axis.

START POSITION INCORRECT

- The starting point coordinate that is identical with the starting probe-axis is beyond the range.

AXIS DOUBLE PROGRAMMED

- The same axis has been programmed for both starting point coordinates in the cycle CONTOUR LINES.

TIME LIMIT EXCEEDED

- In the scanning cycle CONTOUR LINES the first point of the scanned line was not reached within the programmed time limit.

STYLUS DEFLECTION EXCEEDS MAX.

- The stylus was deflected by more than the value programmed in the machine parameter MP6330 (TM110).

16. Data Interfaces

16.1 Operating Modes of the Data Interfaces

For data transfer the TNC 415B/425 can be switched to the following 6 interface modes:

ME: For connection of the HEIDENHAIN Magnetic Tape Unit ME 101/102 or other peripheral units (e.g. printer).

Data format and protocol adapted to ME!

Protocol:	standard transfer
Data format:	7 data bits, 1 stop bit, even parity
Baud rate:	110 - 2400 Baud
Interface parameter:	fixed
Transmission stop:	DC3 (software handshake)

FE 1: For connection of the HEIDENHAIN Floppy Disk Unit FE 401 B (or the Floppy Disk Unit FE 401, from software 230 626 **03**) or other peripheral units.

Data format and protocol adapted to FE 401/B!

Protocol:	blockwise transfer
Data format:	7 data bits, 1 stop bit, even parity
Baud rate:	110 - 38400 Baud (FE 401B) 9600 Baud (FE 401)
Interface parameter:	fixed
Transmission stop:	DC3 (software handshake)

FE 2: For connection of the HEIDENHAIN Floppy Disk Unit FE 401 or other peripheral units.

Data format and protocol adapted to FE 401/B!

Protocol:	blockwise transfer
Data format:	7 data bits, 1 stop bit, even parity
Baud rate:	110 - 38400 Baud 9600 Baud (FE 401)
Interface parameter:	fixed
Transmission stop:	DC3 (software handshake)

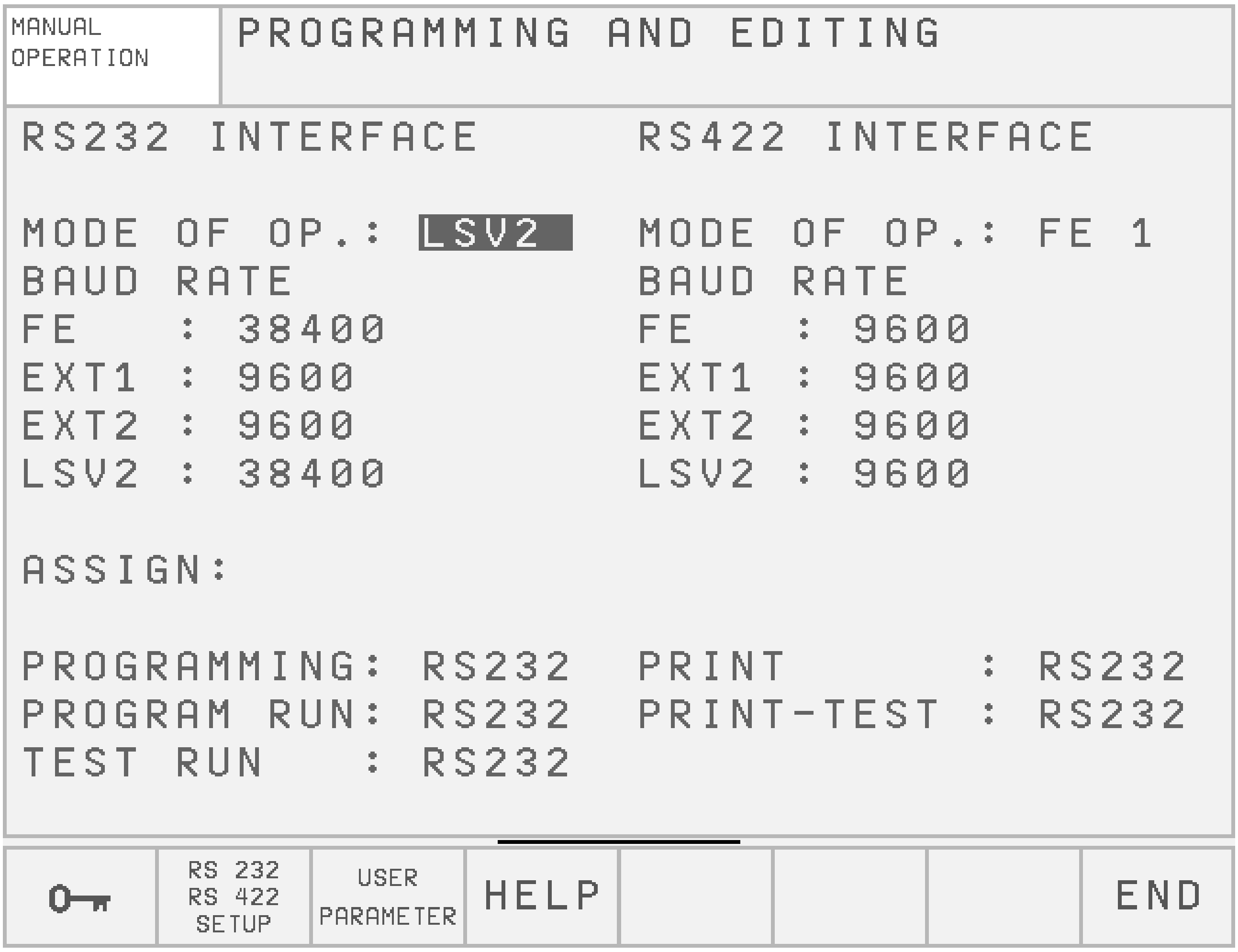
EXT 1: To adapt the transfer of data to external units in standard data format
EXT 2: and for blockwise transfer.

Protocol:	standard or blockwise transfer adaptation from machine parameter MP 5000
Data format:	adaptation from machine parameter MP 5000
Baud rate:	110 - 38400 Baud
Interface parameters :	adaptation from machine parameter MP 5000
Transmission stop:	DC3 (software handshake) or RTS (hardware handshake) selectable as of MP5000

LSV/2: With the LSV/2 protocol several functions (such as file management, remote control and TNC diagnosis from a PC) can be performed with the appropriate software (TNC REMOTE or LSV/2 TOOLBOX).

16.1.1 Interface Configuration and Allocation of the Operating Modes

In the operating modes PROGRAMMING AND EDITING and TEST RUN the setup menu for the data interfaces is called after pressing MOD and the soft key RS 232 RS 422 SETUP.

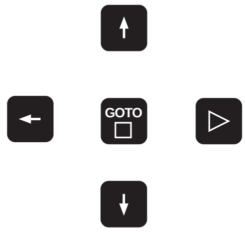


On the left half of the screen the RS-232-C interface is configured, on the right half the RS-422-C. On the lower left of the screen the operating modes PROGRAMMING/EDITING, PROGRAM RUN and TEST RUN can be allocated to either RS-232-C or RS-422-C. (If the MOD function "RS 232/RS 422 SETUP" is called in the PLC editor or the MP editor, the editor can be allocated to one of the interfaces.)

On the lower right of the screen the user can define via PRINT or PRINT TEST, whether outputs with FN15 and digitized positions are to be output via one of the interfaces or into a file in the memory of the control.

- RS 232 means: Data are output via the data interface RS-232-C.
- RS 422 means: Data are output via the data interface RS-422-C.
- FILE means: Data are filed in the TNC.

Note:
In the machine parameter MP5000 individual interfaces can be disabled.

With the arrow keys  the desired settings

(operating mode, baud rate, interface allocation) can be selected and set according to your requirements by pressing ENT.

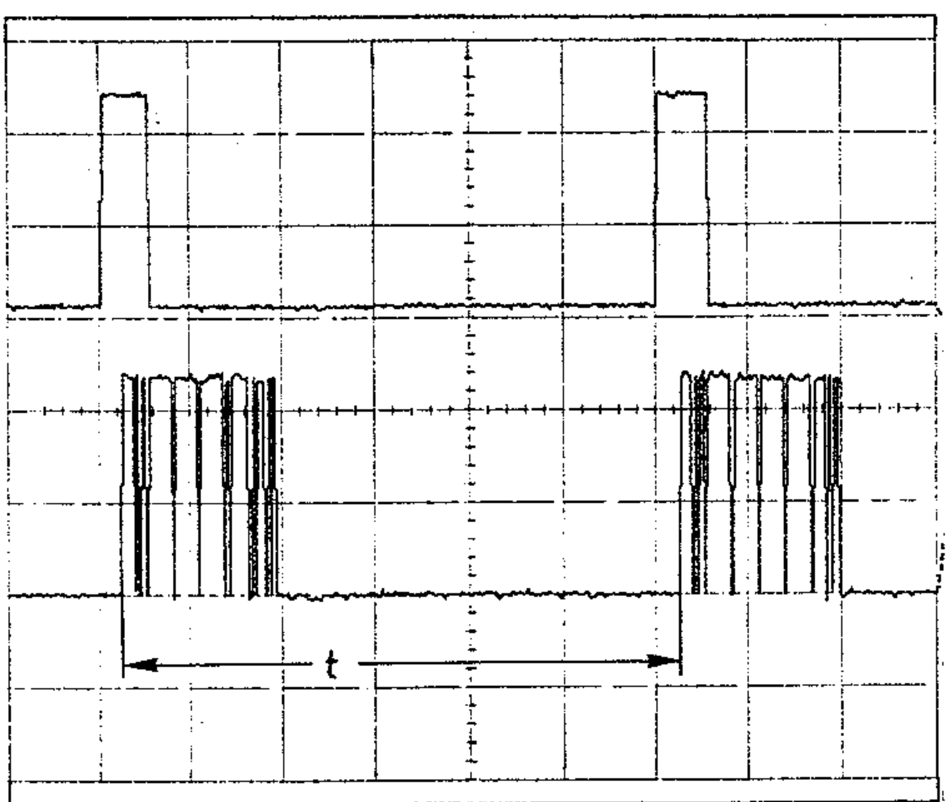
To exit the MOD function RS 232/RS 422 SETUP, press the soft key END.

16.2 Machine Parameters for the Data Interfaces

In the operating modes ME, FE 1, FE 2 and LSV/2 the interface parameters cannot be changed.

In the operating modes EXT 1 and EXT2 the interface parameters can be set via machine parameter (starting with MP5000).

The detailed functions of the individual machine parameters please see from the "Technical Manual" or from the "Description of the Data Interfaces TNC 407/415" (Id.No. 275 931 –).



16.3 Error Messages

16.3.1 Error Messages at the TNC in the ME Mode

WRONG OPERATING MODE

The wrong operating mode or no operating mode was selected on the external data medium.

WRONG PROGRAM DATA

Wrong program data have been detected during data transfer. The control attempted three times to read the data from the magnetic tape before interrupting the process.

DATA MEDIUM MISSING

No cassette has been inserted into the drive.

DATA MEDIUM EMPTY

No programs are stored on the data medium (cassette).

DATA MEDIUM WRITE-PROTECTED

The write-enable plug on the cassette is missing.

PROGRAM INCOMPLETE

Data transfer was interrupted before the program was transferred completely.

EXT. INPUT/OUTPUT NOT READY

The DSR-signal is missing at the TNC.
- ME not connected.
- Defective or wrong transfer cable.
- Wrong interface assignment.

ME: TAPE END

The cassette is full. To continue data transfer, turn over or exchange the cassette.

16.3.2 Error Messages at the ME

In the ME the electronics is tested, and the external operating conditions are checked. If an error is detected, the lamps of the operating mode display start blinking. In the following table the error types are listed:

○ LED off ✷ LED blinking

Indicator Lamp	Error Message
○○○✷ ○○○○	Faulty data during transfer
○○✷○ ○○○○	No cassette inserted
○○✷✷ ○○○○	Write-enable plug in cassette missing
○✷○○ ○○○○	Wrong operating mode selected
○✷○✷ ○○○○	Data of magnetic tape faulty
○✷✷○ ○○○○	Magnetic tape empty
✷○○○ ○○○○	Errors in ME electronics
✷○○✷ ○○○○	
✷○✷○ ○○○○	
✷○✷✷ ○○○○	
✷✷○○ ○○○○	
✷✷○✷ ○○○○	
✷✷✷✷ ○○○○	End of tape
○✷✷✷ ○○○○	Peripheral unit not connected
✷✷✷○ ○○○○	Data transfer between TNC and ME or peripheral unit was interrupted with DEL

By pressing STOP the error messages can be cleared.

16.3.3 Error Messages at the FE in the ME-Mode

In the ME-mode, errors are displayed by blinking indicator lamps (LEDs).

○ LED off ● LED on ✱ LED blinking

Indicator Lamp	Error Message
○○○● ○✱○○	Disk missing or error in the ME electronics
○○○✱ ○✱○○	Disk cannot be formatted, as it is currently being used
✱○○● ✱○○○	Disk missing or not formatted
✱○○✱ ✱○○○	Disk cannot be copied, as a read/write process is active
●○✱● ○○○○	External unit not ready or not connected
✱○●● ○○○○	Disk missing or not formatted
✱○○● ○○●○	Disk missing or not formatted or no program available
✱○●✱ ○○○○	Program cannot be output, as a transfer is active via the TNC interface
✱○○✱ ○○●○	Program cannot be output, as a transfer is active via the PRT interface
○○✱● ●○○○	External unit not ready or not connected
○○●● ✱○○○	Disk missing or not formatted
○○○● ✱○●○	Disk missing or not formatted
○○●✱ ✱○○○	Program cannot be output, as a transfer is active via the TNC interface
○○○✱ ✱○●○	Program cannot be output, as a transfer is active via the PRT interface
○●○● ○○✱○	External unit not ready or not connected
○✱○● ○○●○	Disk missing or error in the ME electronics
○✱○✱ ○○●○	Table of contents cannot be output, as a transfer is active via the PRT interface
○○○✱ ○○●○	No interface coupling possible, as a transfer is active via the TNC interface
○○●✱ ○○○○	No interface coupling possible, as a transfer is active via the PRT interface
○○✱● ○○○○	External unit not ready or not connected

By pressing STOP the error messages can be cleared.

16.3.4 Error Messages at the TNC in the FE Mode

In this operating mode, the floppy disk unit outputs errors in the following format:

(SOH) ERR: (SP) (SP) (SP) [XXX] (ETB) (BCC)
XXX = error number

The following errors can be displayed on the screen:

Input/Output Errors

ERR: 001 = wrong command code
ERR: 002 = illegal program name
ERR: 003 = faulty data transfer
ERR: 004 = program incomplete
ERR: 005 = receiving buffer overflow
ERR: 006 = function currently disabled
ERR: 007 = data-buffer overflow

Errors during Program Write or Read

ERR: 010 = program not on disk
ERR: 011 = program erase-protected
ERR: 012 = program is being written to
ERR: 013 = program directory is full
ERR: 014 = disk is full
ERR: 015 = text not found
ERR: 016 = program name already exists
ERR: 017 = disk access active
ERR: 018 = program currently being read

Disk / Drive / Controller Errors

ERR: 100 = disk not initialized
ERR: 101 = sector number too large [1)]
ERR: 102 = drive not ready [2)]
ERR: 103 = disk is write-protected
ERR: 104 = faulty data on disk [1)]
ERR: 105 = sector cannot be found[1)]
ERR: 106 = check sum incorrect [1)]
ERR: 107 = disk controller defective [3)]
ERR: 108 = DMA defective [3)]
ERR: 109 = disk exchanged during program loading

1) These error messages indicate that the disk is defective; in most cases, they can only be eliminated by formatting the disk anew.

2) If this error message comes up while the disk is inserted, the drive is probably defective.

3) Hardware defect

16.3.5 Error Messages during Data Transfer

TRANSFERRED VALUE ERRONEOUS X

X = A faulty character frame
B character overflow
C faulty character frame or character overflow
D parity error
E faulty character frame or parity error
F character overflow or parity error
G faulty character frame or character overflow or parity error
H receiving-buffer overflow
K
L } incorrect ESC sequence (only in ME mode)

TRANSFERRED DATA INCORRECT X

X = A faulty character frame
D parity error
M control has received the character for "negative acknowledgement" (NAK) more than 3 times
N control has sent the character for "negative acknowledgement" (NAK) more than 3 times

BAUD RATE NOT POSSIBLE

If both data interfaces (RS 232 / RS 422) are activated simultaneously, the baud rates of **both** interfaces must be the same.

INTERFACE ALREADY ASSIGNED

A data interface cannot be used for two operating modes simultaneously. (e.g. DNC mode and programming at the same time is not possible with one data interface.)

EXT. IN-/OUTPUT NOT READY

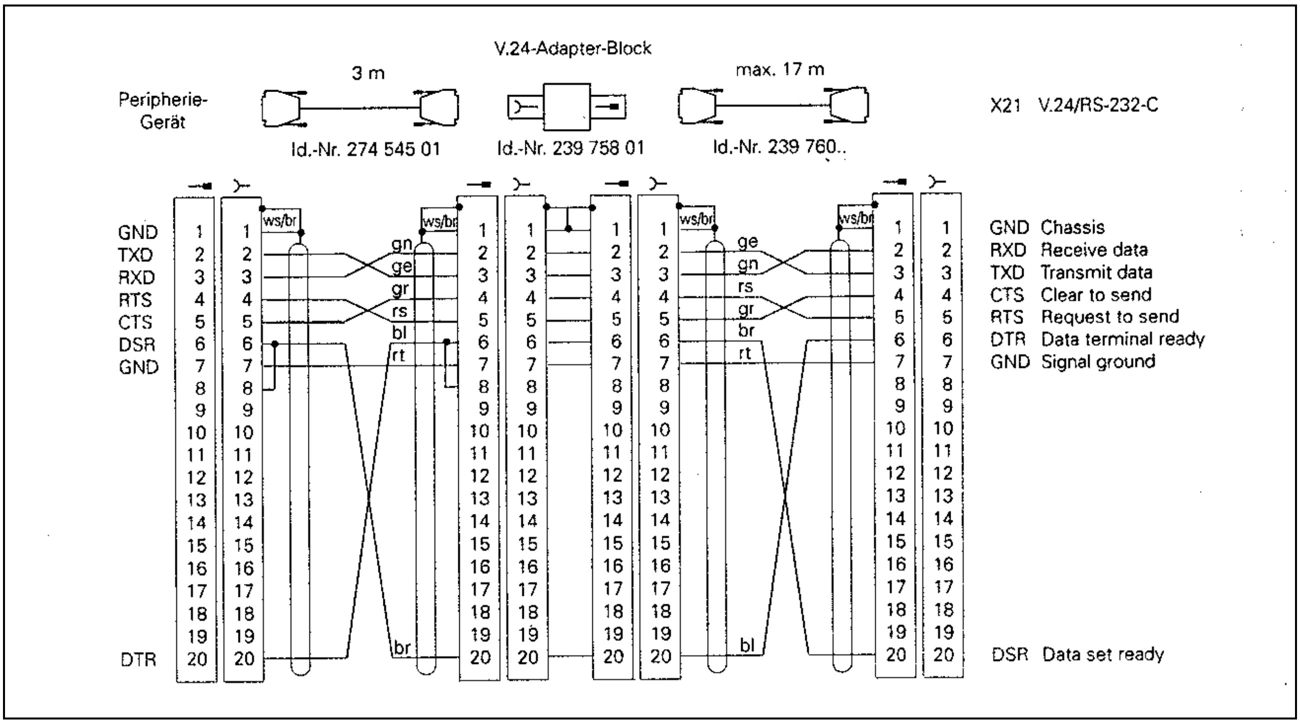
- DSR signal at the TNC missing
- Defective or wrong transfer cable
- Wrong interface assignment

PROGRAM INCOMPLETE

Data transfer was interrupted before the program was completely loaded.

16.4 Wiring Diagrams of the Data Interfaces

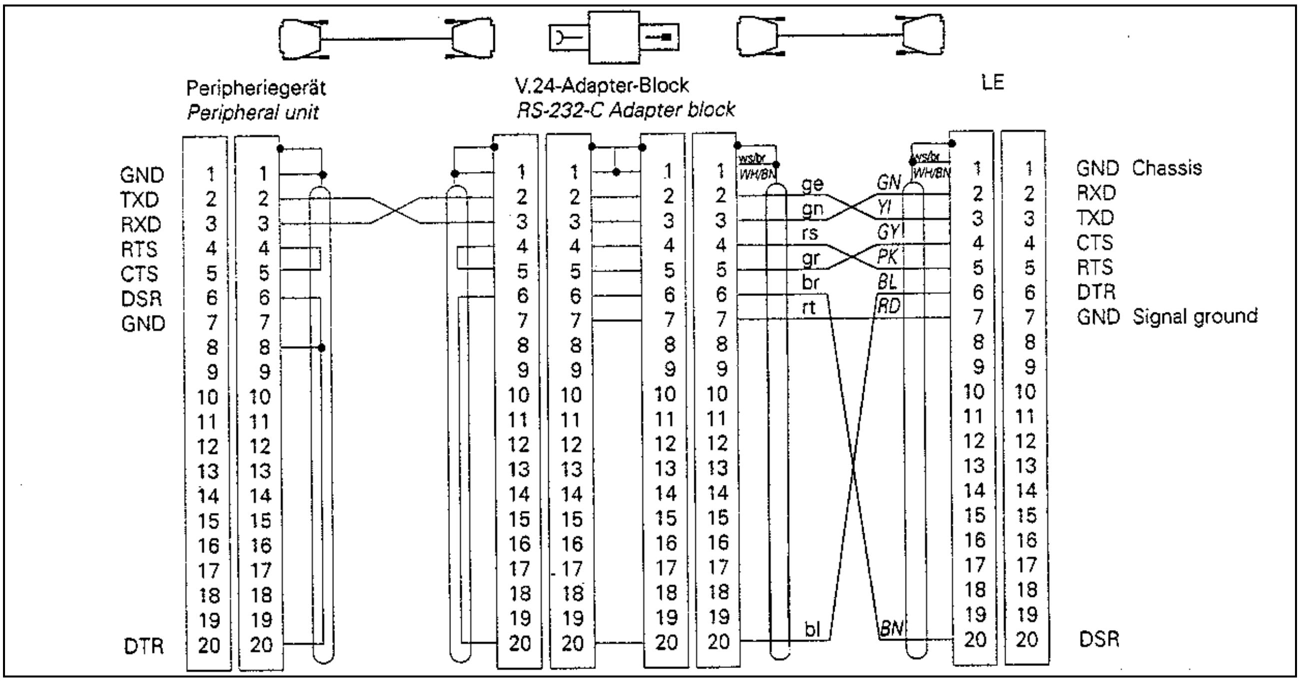
16.4.1 RS-232-C Data Interface with RS-232-C Adapter Block (full wiring)



If the pin layout of your peripheral unit differs from the above layout, the HEIDENHAIN connecting cable may not be used.

16.4.2 RS-232C Data Interface with RS-232C Adapter Block (simplified wiring)

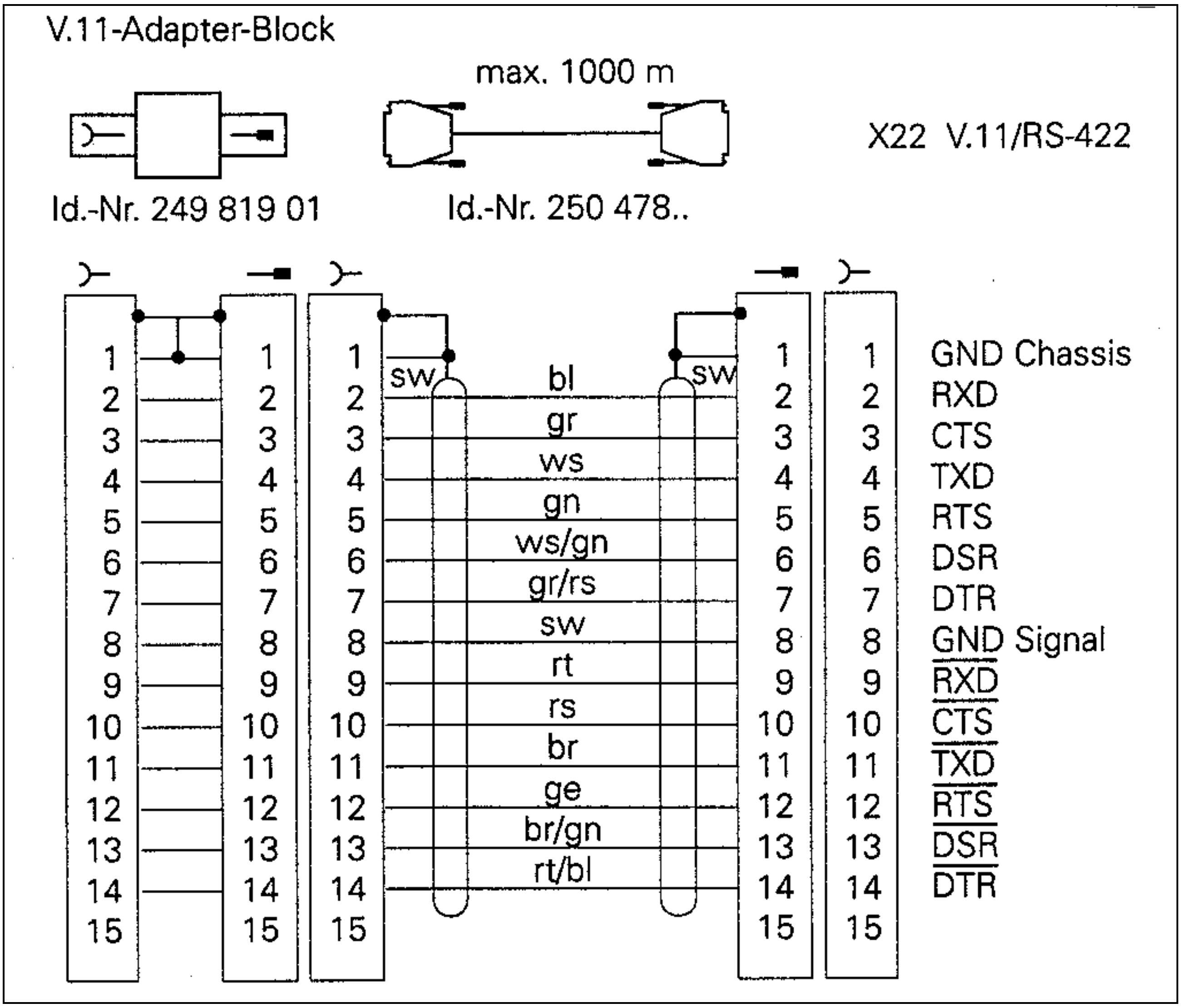
Example:



With this wiring, only transfer stop with DC3 is possible (software handshake).

The RS-232-C data interface has **different** pin layouts at the logic unit X21 and the RS-232-C adapter block.

16.4.3 RS-422 Data Interface

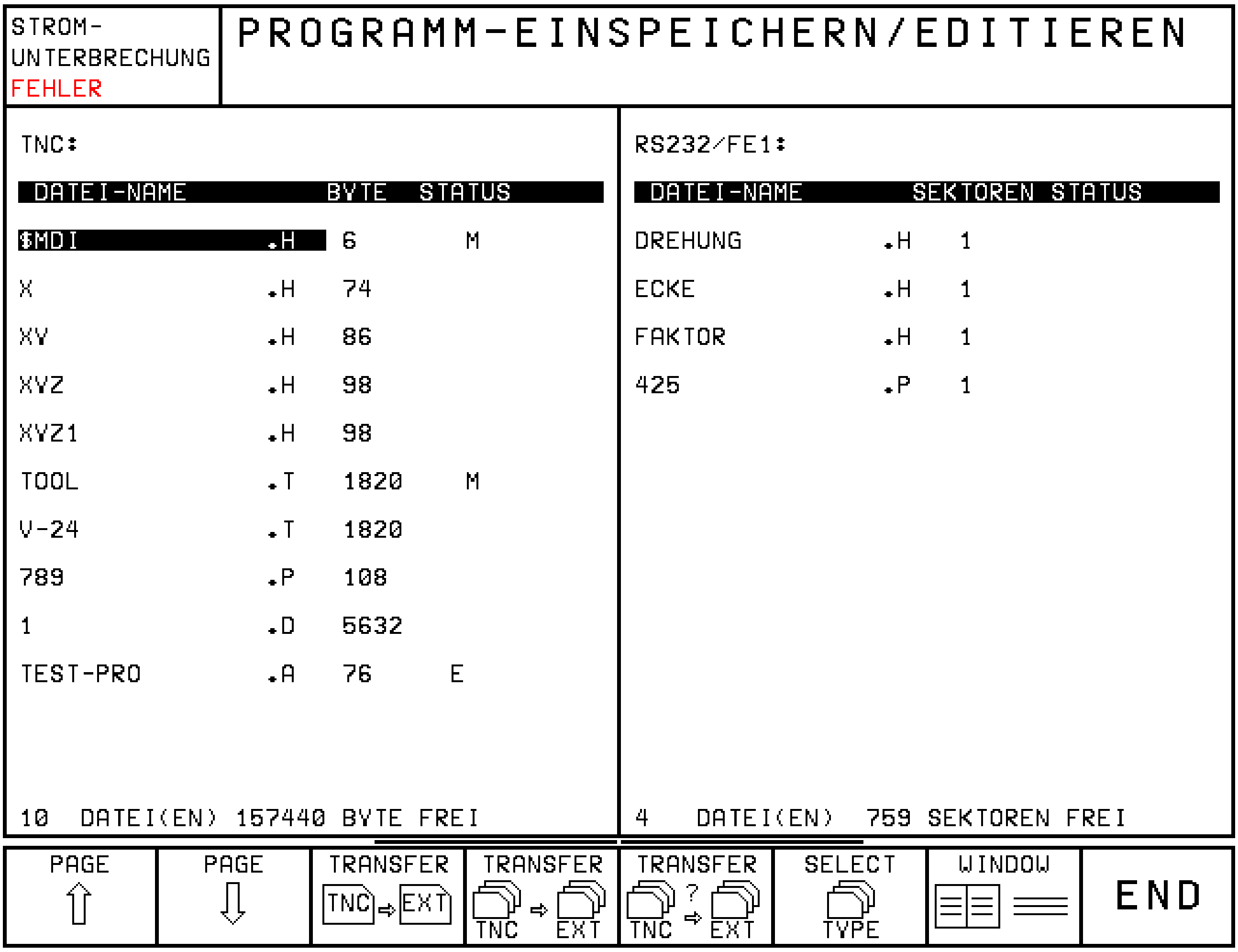


The RS-422 data interface has **identical** pin layouts at the logic unit X22 and at the RS-422 adapter block.

17. Data Input and Output

17.1 Data Transfer Menu

In the operating mode PROGRAMMING/EDITING (press), the data transfer menu is activated by pressing .



On the left half of the screen the memory contents of the TNC is displayed; on the right half the memory contents of the peripheral unit.
The memory contents of the peripheral unit is only displayed automatically in the interface mode FE1. In all other operating modes it can be loaded by means of the soft key SHOW EXT. DIRECTORY.

To switch between the screen halves press the arrow keys and .
By switching the screen half the **direction** of data transfer is changed.

Explanation of the soft keys:

PAGE ⇧	PAGE ⇩	TRANSFER TNC ⇨ EXT	TRANSFER TNC ⇨ EXT	TRANSFER TNC ? ⇨ EXT	SELECT TYPE	WINDOW	END

TRANSFER TNC ⇨ EXT	The program **selected** with ↑ or ↓ is read in or out.
TRANSFER TNC ⇨ EXT	All programs are read in or out **without confirmation**.
TRANSFER TNC ? ⇨ EXT	All programs are read in or out **after confirmation**.
SELECT TYPE	The following soft keys may be offered depending on the interface mode:

FE1 mode (external directory is loaded automatically):

SHOW ALL	SHOW .H	SHOW .T	SHOW .I	SHOW .P	SHOW .D	SHOW .A	END

SHOW ALL	All file types are displayed.
SHOW .H	Only the files with this extension are displayed. e.g. (.H = NC program in HEIDENHAIN plain language)

FE2 / EXT1 / EXT2 mode:

SHOW EXT. DIRECTORY	SHOW .H	SHOW .T	SHOW .I	SHOW .P	SHOW .D	SHOW .A	END

SHOW .H	Only the files with this extension are displayed. e.g. (.H = NC program in HEIDENHAIN plain language)
SHOW EXT. DIRECTORY	The external directory is loaded.
WINDOW	This soft key cancels the split screen display. Afterwards several settings can be made in the screen half selected before. After pressing the soft key once again, the screen is split again.

PAGE ⇧	PAGE ⇩	SELECT	COPY ABC ⇨ XYZ		SELECT TYPE	WINDOW	END

17.2 Overview of Files for TNC 415B/425

Depending on the subordinate mode (NC, PLC MODE, MP MODE etc.) in which the transfer menu is activated, only certain file types are offered to be downloaded or output.

The following data may be in the RAM:

NC Memory Management	**Extension (TNC)**	**Extension (external)**
NC program: HEIDENHAIN language	.H	.H
NC program: ISO	.I	.D
Active tool file	TOOL.T	TOOL.T
Tool data (table)	.T	.T
Pocket number table		TOOL_P.R
Pallet table	.P	.L
Datum table	.D	.N
Text file (ASCII)	.A	.A
Measuring point table (digitizing)	.PNT	.U
PLC Memory Management (RAM)		
PLC program	.PLC	.P
Error messages 1. language	.ER1	.A
Error messages English	.ERE	.A
Dialogues 1. language	.DI1	.A
Dialogues English	.DIE	.A
ASCII file	.A	.A
Help texts	.HLP	.J
Data for axis error compensation	.COM	.V
Data for axis error compensation	.CMA	.S
Machine Parameter Mode		
Machine parameter lists	.MP	.M
Compensation value table selectable via code number	.KOR	.S

Additional information on the files or programs is provided by letters in the status field.

E: The file/program has been selected in the PROGRAMMING mode.
S: The file/program has been selected and activated in the TEST RUN mode.
M: The file/program has been selected and activated in either PROGRAM RUN / FULL SEQUENCE or in PROGRAM RUN / SINGLE BLOCK.
P: The file/program is protected against erasing and editing.
IN: The table/program was programmed in Inch.
W: The file/program was not completely transferred to an external memory and thus is no longer available.

17.3 External Data Output

Preparations:

- Connect the external data medium (FE, ME or other peripheral unit, e.g. personal computer with HEIDENHAIN data transfer software) to the TNC.
- Prepare the external data medium for data transfer:

  Press STOP , TNC and  at the ME

  Press STOP at the FE.
- Select the operating mode, the baud rate and the interface assignment at the TNC (see section 16.1).

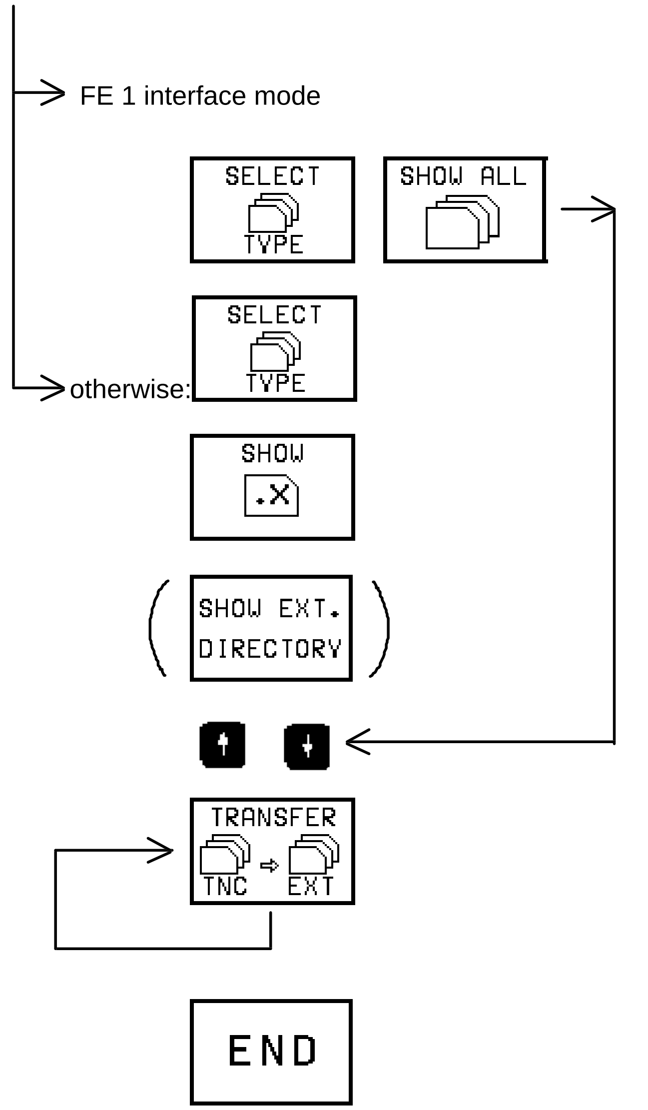
17.3.1 Output of Files with the Extensions .H, .I, .T, .D, .P, .A, .PNT

Press Key	Function
	Operating mode PROGRAMMING/EDITING Activate data transfer menu

The different file types are distinguished by the file name and the extension.

In the TNC there are the following six different file types that can be selected via soft key:

- HEIDENHAIN dialogue programs <file name> .**H**
- ISO programs <file name > .**I**
- Tool tables <file name > .**T** 1)
- Datum tables <file name > .**D**
- Pallet tables <file name > .**P**
- Text files (ASCII) <file name > .**A**
- Point files <file name > .**PNT**



Soft keys to display all file types

Select file type

Soft key to confirm desired file type

Call external directory

Select file by pressing arrow keys

Start data transfer 2)

Output further files

Soft key to exit data transfer

TNC in operating mode PROGRAMMING/EDITING

1) The file **TOOL.T** (active tool table) must be read out in another operating mode (see section 17.3.2)

2) see section 17.2

17.3.2 Output of TOOL.T File (Active Tool Table) and of POCKET-TABLE

Press Key	Function
	TNC in MANUAL operating mode
TOOL TABLE	Call tool table
	Activate data transfer menu
TRANSFER TNC ⇒ EXT	Read out tool table
	The active tool table is output to the external data medium; filename: **TOOL.T**
POCKET TABLE	Call pocket table
	Activate data transfer menu
TRANSFER TNC ⇒ EXT	Read out pocket table
	The POCKET TABLE is output to the external data medium; filename: **TOOL_P.R**
END	Exit subprogram

17.3.3 Output of the Machine Parameter List <NAME>.MP

NOTE:
The TNC only displays the external directory in the FE1 mode.

Press Key	Function
	TNC in operating mode PROGRAMMING AND EDITING
MOD	Prepare TNC for entry of code number
9 5 1 4 8 ENT	Enter code number and confirm with ENT
MOD	Here an interface can be allocated to the MP editor
END	
EXT	Activate data transfer menu

There may be **several** files with the extension .MP in the TNC. The active machine parameter list is distinguished by the STATUS **M**.

Press Key	Function
TRANSFER TNC ⇒ EXT	Soft key for data transfer
END	Exit data transfer menu
END	TNC in operating mode PROGRAMMING AND EDITING

17.3.4 Output of the Compensation Value List for Multipoint Axis Error Compensation <NAME>.KOR

NOTE:
The TNC only displays the external directory in the FE1 mode.

Until NC software 259 93x.**07** and 259 94x.**07** the compensation values and the axis relations were filed in **one** table (file with extension **.KOR**). This file is stored in the RAM of the TNC and can be read out.

Press Key	Function
	TNC in operating mode PROGRAMMING AND EDITING
MOD	Prepare TNC for entry of code number
1 0 5 2 9 6 ENT	Enter code number and confirm with ENT
EXT	Activate data transfer menu
TRANSFER TNC ⇒ EXT	Press soft key
	The file <NAME>.**KOR** is stored on the external data medium as <NAME>.**S**
END	Exit data transfer menu
END	TNC in operating mode PROGRAMMING AND EDITING

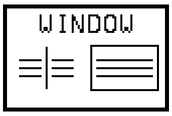
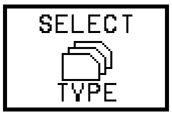
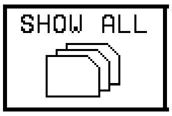
NOTE:
The TNC only displays the external directory in the FE1 mode.

As of NC software 259 93x.**08** and 259 94x.**08** the compensation values and axis relations can be stored as files with the extensions .**COM** and .**CMA**.

Press Key	**Function**
	TNC in operating mode PROGRAMMING AND EDITING
MOD	Prepare TNC for entry of code number
8 0 7 6 6 7 ENT	Enter code number and confirm with ENT
EXT	Activate data transfer menu
MOD	Here the PLC editor can be assigned to an interface
END	
	Press arrow key to select the TNC directory
SELECT TYPE	Soft key and arrow key on VDU
.COM FILES	List <NAME>.COM
TRANSFER TNC ⇒ EXT	Read out <NAME>.COM
SELECT TYPE	Soft key and arrow key on VDU
.CMA FILES	List <NAME>.CMA
TRANSFER TNC ⇒ EXT	Read out NAME>.CMA

If no .CMA file is defined and multipoint axis error compensation selected via MP730, the compensation value tables of the code number 105296 are valid.

17.3.5 PLC File Management

Press Key	Function
	TNC in operating mode PROGRAMMING AND EDITING
MOD	Prepare TNC for entry of code number
8 0 7 6 6 7 ENT	Enter code number and confirm with ENT
PGM NAME	Call file manager
	Split screen
	Press soft key
	Press soft key

The PLC is subdivided into two **internal** drives.
Drive TNC: PLC files in RAM [1)]
Drive TNC/EPROM: PLC files in PLC EPROM [1)]

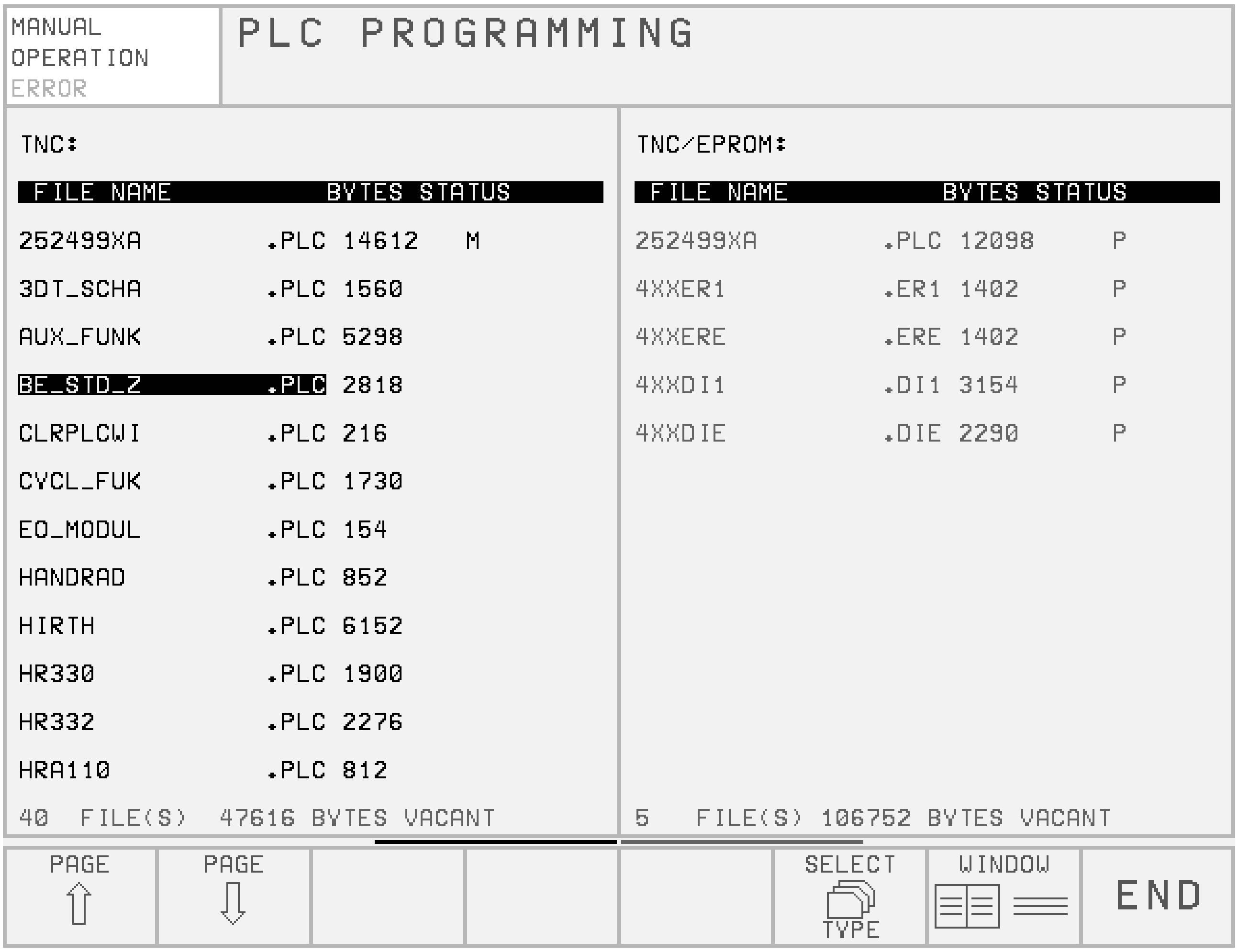
The following files may be stored:

PLC programs		.PLC
Error messages	1. language	.ER1
Error messages	English	.ERE
Dialogues	1. language	.DI1
Dialogues	English	.DIE
ASCII files		.A
Help texts		.HLP
Data for axis error compensation		.COM
Data for axis error compensation		.CMA

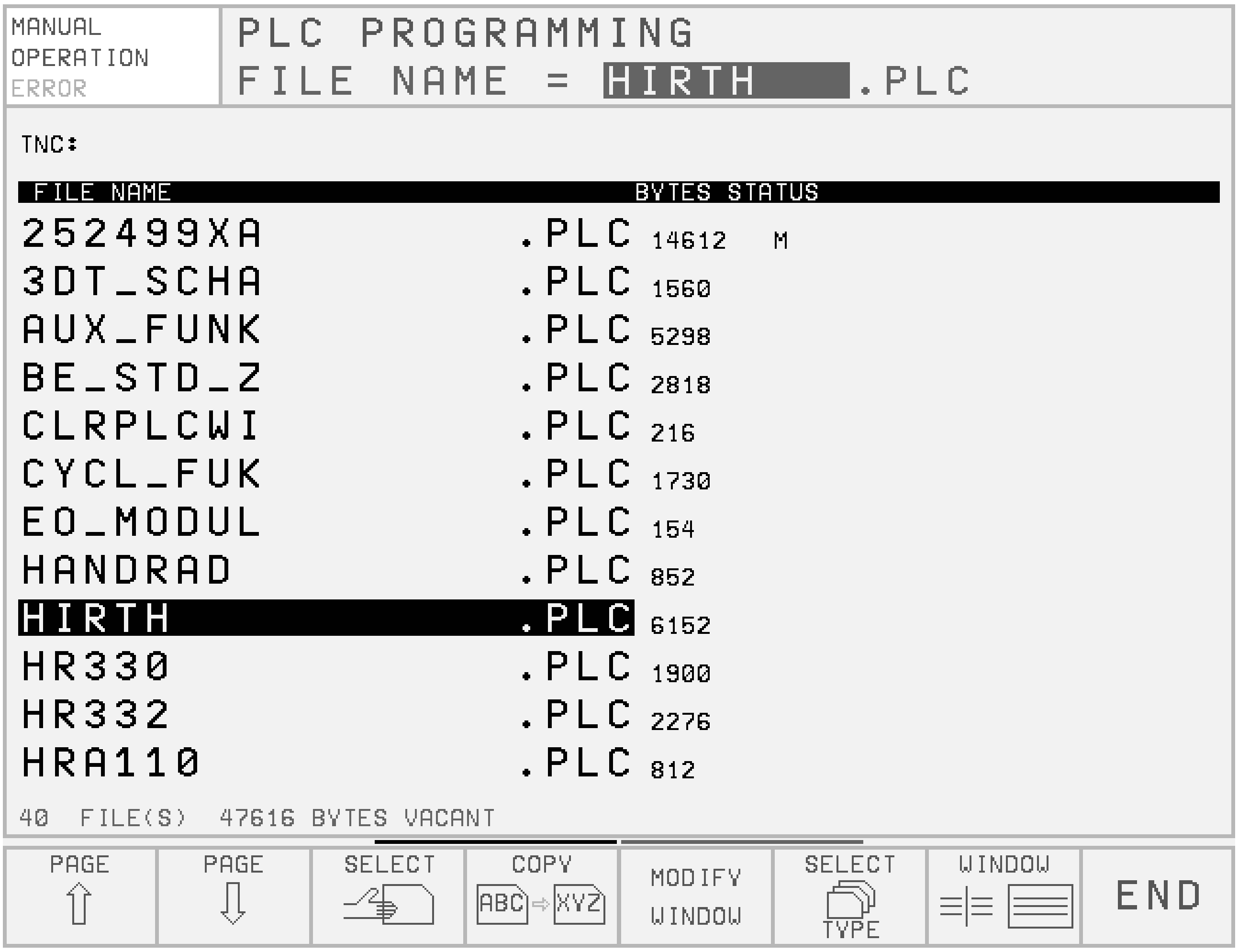
For each half of the screen the required "drive" can be selected by soft key.

[1)] Between the PLC RAM and the PLC EPROM similar functions are possible as between the RAM and external data medium.

Selecting the Drives



Press Key	Function
← or →	Select the window to be modified
◁ or ▷	Switch soft key row
MODIFY WINDOW	Press soft key



Press Key	**Function**
SELECT XXX	Assign the "drive" by pressing a soft key
END	Press soft key
◁ or ▷	Switch soft key row back

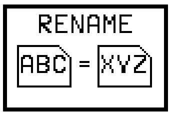
17.3.6 Output of Files from PLC Memory

NOTE:
The TNC only displays the external directory in the FE1 mode.

Overview of the Files

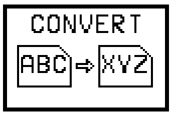
PLC programs		.PLC
Error messages	1. language	.ER1 [1]
Error messages	English	.ERE [1]
Dialogues	1. language	.DI1 [1]
Dialogues	English	.DIE [1]
ASCII files		.A [1]
Help texts		.HLP
Files for axis error compensation		.COM [2]
Files for axis error compensation		.CMA [2]

[1] **Note:**
The error messages, dialogues and ASCII files are output as ASCII files with the extension **.A**. Therefore, the files to be output must have different filenames so that they will not be overwritten on the external data medium.

(to rename a files, press the soft key 

.)

Note down filename and the extension!

After having downloaded the files, the extension **.A** must be reconverted to the **original** extension by pressing the soft key 

.

[2] see section 17.3.4

There may be several files with the same extension in RAM.
Note down status information (see section 17.2).

Press Key	Function
	TNC in operating mode PROGRAMMING AND EDITING
MOD	Prepare TNC for entry of code number
8 0 7 6 6 7 ENT	Enter code number and confirm with ENT
EXT	Activate data transfer menu
in interface mode FE 1	
SELECT TYPE SHOW ALL	Soft keys to display all file types
otherwise: SELECT TYPE	
.XXX FILES	List desired file type
↑ ↓	Select desired file with arrow keys (if necessary)
RENAME ABC = XYZ	Rename file with soft key (if necessary)
TRANSFER TNC ⇒ EXT	Start data transfer 1)
	Output further file, if desired
END	Soft key to exit the data transfer menu
END	TNC in operating mode PROGRAMMING AND EDITING

1) see section 17.1

17.4 Downloading External Data

Preparations:

- Connect the external data medium (ME, FE or other peripheral unit) to the TNC.
- Prepare the external data medium for data transfer:

  press STOP, TNC and →8 at the ME,

  press STOP at the FE.
- Select the operating mode, the baud rate and the interface assignment (see 16.1) at the TNC.

17.4.1 Downloading files with the Extensions .H, .I, .D, .P, .T, .A

Press Key	**Function**
	TNC in operating mode PROGRAMMING AND EDITING
EXT	Activate data transfer menu
	Press arrow key to select screen of external data medium
in interface mode FE 1	
SELECT TYPE / SHOW ALL	Soft keys to display all file types
otherwise:	Press arrow key on the VDU to switch the soft key row to display of all file types
SHOW .X	List desired file type
SELECT TYPE / SHOW EXT. DIRECTORY	Call directory of external data medium
	Select file with arrow key, if required
TRANSFER TNC ⇐ EXT	Start data transfer
	Download further files, if required
END	Soft key to exit data transfer menu
END	TNC in operating mode PROGRAMMING AND EDITING

The TOOL.T file (active tool table) must be downloaded in another operating mode (see section 17.4.2).

17.4.2 Downloading TOOL.T Files (Active Tool Table) and the POCKET TABLE

Press Key	Function
	TNC in MANUAL operating mode.
TOOL TABLE	
EDIT OFF / ON	EDIT on!
EXT	Activate data transfer menu.
TRANSFER TNC ⇐ EXT	Press soft key.
DELETE/ENT IGNORE/NOENT — NO ENT	Downloading is not started.
ENT	The **TOOL.T** file is downloaded from the external data medium. The existing file is **overwritten**!
POCKET TABLE	
EDIT OFF / ON	EDIT on!
EXT	Activate data transfer menu.
TRANSFER TNC ⇐ EXT	Press soft key-
DELETE/ENT IGNORE/NOENT — NO ENT	Downloading is not started.
ENT	The **TOOL_P.R** file is downloaded from the external data medium. The existing file is **overwritten**!
END	Exit the subordinate mode.

17.4.3 Machine Parameter Input <NAME>.MP

Press Key	Function
	TNC in operating mode PROGRAMMING AND EDITING.
MOD	Prepare TNC for input of code number.
9 5 1 4 8 ENT	Enter code number, confirm with ENT.
MOD	Here, the MP editor can be assigned to an interface.
END	
EXT	Activate data transfer menu.
	Press arrow key to enter the directory of the external data medium.
interface mode FE1	
otherwise:	If necessary: select the desired MP file by pressing the arrow keys.
...	Enter name of MP file (ASCII or numerical keys).
TRANSFER TNC ⇐ EXT	Soft key for data input.
END	Exit the data transfer menu [1]
END	The machine parameter file loaded in the editor is activated (receives the status **M**, see section 17.3.3).

[1] If several MP files are downloaded after each other, the TNC activates the MP list downloaded last.

When the error message

OPERATING PARAMETERS ERASED

is displayed, enter the machine parameter file <NAME>.MP as follows:

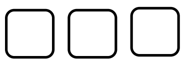
(see section 2.1)

Press Key	**Function**
CE	Clear the error message OPERATING PARAMETERS ERASED
MOD	Configure the interface (see section16.1)
END	
EXT	Activate the data transfer menu.
interface mode FE1	
↓ ↑	If necessary: select the desired MP file by pressing the arrow keys.
otherwise ☐ ☐ ☐ ...	Enter the name of the MP file (ASCII or numerical keys).
TRANSFER TNC ⇐ EXT	Start data transfer.
END	Exit the data transfer menu.
END ☐	The machine parameter file loaded in the editor is activated (receives the status **M**, see section 17.3.3).

17.4.4 Input of the Compensation Value List for Multipoint Axis Error Compensation <NAME>.KOR

NOTE:
The TNC displays the external directory only in the FE1 mode.

Until NC-software 259 93x.**07** and 259 94x.**07** the compensation values and the relations are filed in **one** table (file with extension **.KOR**).

Press key	**Function**
	TNC in operating mode PROGRAMMING AND EDITING.
MOD	Prepare TNC for input of code number.
1 0 5 2 9 6 ENT	Enter code number, confirm with ENT.
 EXT	Activate data transfer menu.
	Press arrow key to enter the directory of the external data medium.
interface mode FE1	
	If necessary: select desired compensation value list by pressing an arrow key.
otherwise:  ...	Enter the file name of the compensation value list (ASCII or numerical keys).
TRANSFER TNC ⇐ EXT	Start data transfer.
END	Exit the data transfer menu.
END □	TNC in operating mode PROGRAMMING AND EDITING

From NC-software 259 93x.**08** and 259 94x.**08** the compensation values and the relations can be stored in files with the extensions .**COM** and .**CMA**.

If there is no <NAME>.**CMA** file on the external data medium, the compensation value tables from the code number 105 296 are valid. These files can be read in as described in section 17.4.4.

Press key	**Function**
	TNC in operating mode PROGRAMMING AND EDITING.
MOD	Prepare TNC for input of code number.
8 0 7 6 6 7 ENT	Enter code number, confirm with ENT.
EXT	Activate the data transfer menu.
MOD	Here, the PLC editor can be assigned to an interface.
END	Press soft key.
→	Press arrow key to enter the directory of the external data medium.
SELECT TYPE ▷	Soft key and arrow key on VDU.
.COM FILES	Press soft key.
interface mode FE1	
↓ or ↑	If necessary: press arrow key to select the desired <NAME>.COM file.
otherwise: ...	Enter the name of the <NAME>.COM file (ASCII or numerical keys).
TRANSFER TNC ⇐ EXT	Start data transfer [1] (continued on page 116)

[1] **Caution**: Until the software version 12 the dimensions "MM" must be contained after the file name in the header of a <NAME>.COM file; otherwise the file cannot be read in (if required, use a text editor to insert MM)

Example of a header: **`BEGIN X-AXIS.COM MM DATUM:+90 DIST:2`**

Press key	Function
SELECT TYPE ▷	Press soft key and arrow key on VDU.
.CMA FILES	Press soft key.
interface mode FE1	
↓ or ↑	If necessary: press arrow key to select the desired <NAME>.CMA file.
otherwise: ☐ ☐ ☐ ...	Enter the name of the <NAME>.CMA file (ASCII or numerical keys).
TRANSFER TNC ⇐ EXT	Start data transfer.
END	Exit the data transfer menu after data transfer.

17.4.5 Downloading PLC Program, Error Messages, Dialogues and Help Texts

NOTE:
The TNC displays the external directory only in the FE1 mode.

The error messages and the dialogues are downloaded as **ASCII** files (<NAME>.A). They need to be converted to their original file types afterwards.

Press key	Function
	TNC in operating mode PROGRAMMING AND EDITING.
MOD	Prepare TNC for input of code number.
8 0 7 6 6 7 ENT	Enter code number, confirm with ENT.
EXT	Activate the data transfer menu.
→	Press arrow key to enter the directory of the external data medium.
interface mode FE1	
SELECT TYPE / SHOW ALL	Press soft keys.
↑ ↓	If necessary: Press arrow key to select the desired file.
TRANSFER TNC ⇐ EXT	Start data transfer.
	Download further files if required.
otherwise: SELECT TYPE	
.XXX FILES ▷	Press soft key to select the desired file extension.
...	Enter the name of the file to be downloaded. (ASCII or numerical keys)
TRANSFER TNC ⇐ EXT	Press soft key.
	Download further files if required.

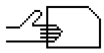
After reading in the files, the error messages and dialogues need to be reconverted into their original file types.

Error messages	1. language:	<NAME>.**A** ⇒	<NAME>.**ER1**
Error messages	English:	<NAME>.**A** ⇒	<NAME>.**ERE**
Dialogues	1. language:	<NAME>.**A** ⇒	<NAME>.**DI1**
Dialogues	English:	<NAME>.**A** ⇒	<NAME>.**DIE**

Press key	**Function**
←	Press arrow key to select the TNC directory.
SELECT TYPE / SHOW ALL	Soft keys to display all file types.
↑ or ↓	Select the file to be converted.
WINDOW / ▷	Soft key and arrow key on VDU.
CONVERT ABC ⇒ XYZ	Start conversion.
.XXX FILES	Soft key for desired file extension.
	Convert further files if required.
After the conversion into the original file types, the ASCII files that were converted must be deleted.	
CL PGM	
↑ or ↓	Select desired file.
DELETE	Delete file.
	Delete further files if required.
PGM NAME	
END	Press soft key.

If the PLC program is run from RAM (MP 4010 = 1) and several files of the type <NAME>.PLC are contained in RAM, the PLC program that had the status **M** before it was transferred, must be loaded into the process memory. (see section 19.5)

If there are several dialogue or error message files in RAM, the desired file can be selected via soft key.

Press key	**Function**
 ...	TNC in PLC menu.
SELECT .DI1/.ER1 FILES	Press soft key.
 or 	Select desired file.
SELECT 	Press soft key.
END	Press soft key.

18. Analogue Outputs

18.1 Specifications

6 outputs 1, 2, 3, 4, 5 and S

Load capacity: $R_{Lmin} \geq 5\ k\Omega$
$C_{Lmax} \leq 2\ nF$

Voltage range: $U_{amax} = \pm\ 10V \pm 100\ mV$
$U_{amin} = 0V \pm 3\ mV$

Machine parameters for the analogue outputs

Analogue outputs	MP	Entry values
X	120.0	0 = output 1
Y	120.1	1 = output 2
Z	120.2	2 = output 3
IV	120.3	3 = output 4
V	120.4	4 = output 5
		5 = output S

Resolution:	16 Bit = 65 536 steps
Smallest step	$\frac{10\ V}{65\ 536} = 0.153\ mV$

18.2 Checking the Analogue Outputs

18.2.1 Axes with Analogue Speed Controller

Proportionally to the traversing speed, the control generates an analogue voltage of 0V to 9V (rapid traverse). The easiest way to determine this voltage is to connect the test adapter directly to the logic unit or to the connecting terminals of the servo-amplifiers and to measure with a multimeter.

If however, the axis does not move due to a defect, and you want to test whether the error is inside or outside the control, the following steps are recommended:

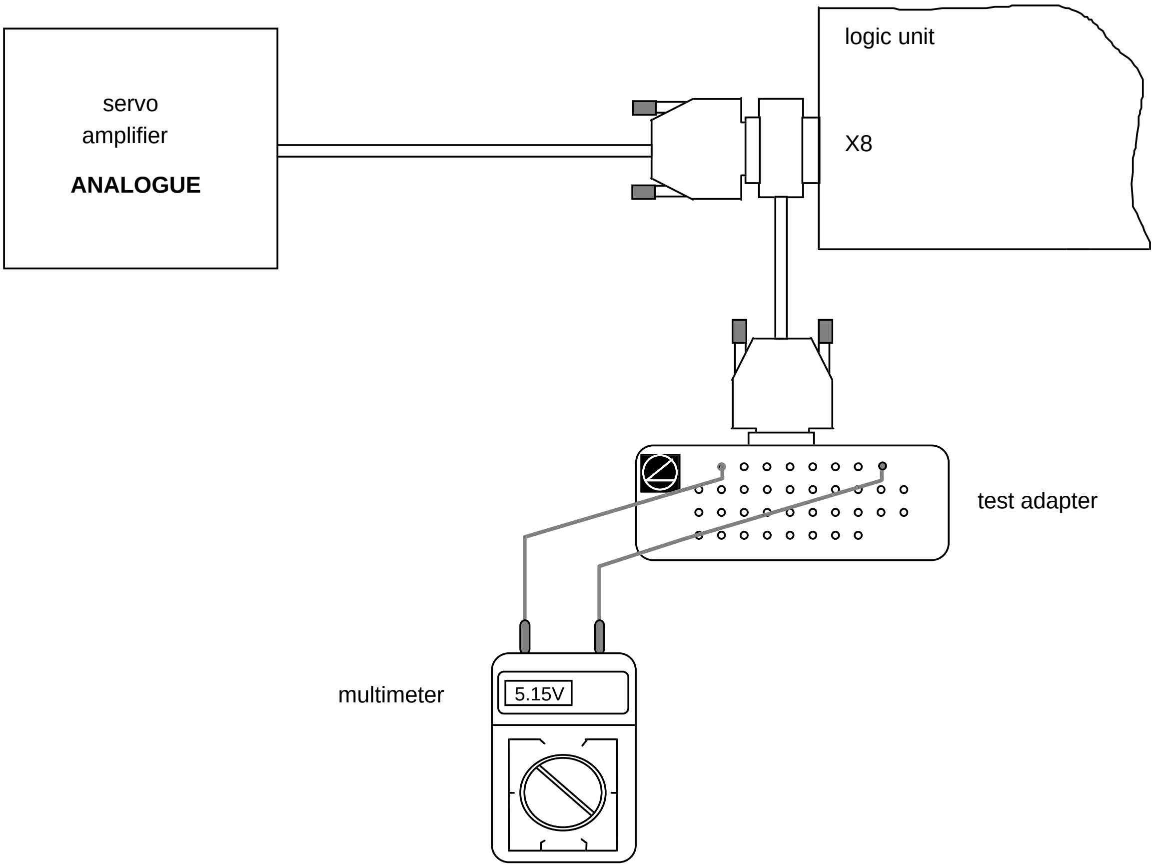
- Switch off the main switch at the machine tool.
- Connect the test adapter to the connector X8 (nominal value output) of the LE and connect a multimeter to the test adapter sockets for the defective axis. If no test adapter is available, connect a multimeter directly to the nominal value output of the servo-amplifier.
- Switch on the main switch and the control voltage.
- Switch the position display to LAG (servo lag) (see section 18.3).
- Check and adjust the following machine parameters:
  (If you alter a machine parameter, note down the original value and enter it again after finishing the test.)

MP	Entry Value	Function	Original Value
1410.X	30 [mm]	Servo-lag monitoring (erasable), feed forward	
1420.X	30 [mm]	Servo-lag monitoring (EMERG. STOP), feed forward	
1140.X	9.99 [V]	Movement monitoring	
1710.X	300 [mm]	Servo lag monitoring (erasable), trailing mode	
1720.X	300 [mm]	Servo lag monitoring (EMERG. STOP), trailing mode	

- Traverse the reference points that need to be traversed before those of the defective axis.
- Turn the override potentiometer of the keyboard unit completely to the left and start reference mark traverse for the defective axis.
- Check the axis enable for the defective axis at the servo amplifier.
- Check the screen display.
  ***** (Control ready for operation) must be ON, the **F** of the feed rate display must be normally lit (if the display is inverse, the feed rate enable is missing), and the symbol for "Axis not in the position loop" (e.g. →|← **X**) should not follow the position display.
- Turn the override potentiometer slowly to the right and turn it back left again before the servo lag display reaches the limit of the position monitoring.

When the override potentiometer is turned to the right, the control outputs an analogue voltage which is increased proportionally to the servo lag up to a maximum value of 10V. The control operates correctly, if a voltage of 10V ± 0.1V can be measured at the test adapter with the multimeter. If no voltage can be measured, switch off the main switch, unplug the connector X8 from the logic unit, disconnect the nominal value line from the servo amplifier and test this line for short-circuit. If the nominal value line is in order, connect X8 to the logic unit again (leave the nominal value line disconnected), switch on the main switch and repeat the measurement with reference mark traverse. If an analogue voltage can be measured now, the control operates correctly. If no voltage can be measured, the analogue output of the logic unit is probably defective.

Measuring Setup to Check the Analogue Outputs



X8 Nominal value output for 1, 2, 3, 4, 5, S

flange socket with female insert (15-pin

Pin No.	Signal
1	analogue output 1
3	analogue output 2
5	analogue output 3
7	analogue output 4
4	analogue output 5
8	analogue output S axis
9	0V analogue output 1

Pin No.	Signal
11	0V analogue output 2
13	0V analogue output 3
14	0V analogue output 4
6	0V analogue output 5
15	0V analogue output S axis
housing	external shield = housing
2, 10, 12 do not assign	

Observe the safety instructions!

18.2.2 Axes with Integral Digital Speed Controller

Depending on the machine parameter MP1900 the driving axes of TNC 425/E are individually defined as **analogue axes** (as TNC 415 B/F) or as **digital axes**.
With axes with **integral digital speed controller** (corresponding bit of MP1900 = 1) a TTL voltage is output at the analogue output.

If however, the axis does not move due to a defect, and if you want to test whether the error is inside or outside the control, the following steps are recommended:

- Switch off the main switch.
- Disconnect the **nominal value line** from the connector X8 and check for short-circuit and line disconnection.
- If the **nominal value line** is in order, leave it disconnected and connect the test adapter to the connector X8.
- Switch on main switch and machine control voltage.
- Switch the position display to LAG (servo lag); see section 18.3.
- Define the axis to be checked as **analogue** controlled axis (MP1900, corresponding bit = 0)

Function		**MP No.**	**Bit**	**Entry range**	**Original [1)] Entry Values**
Axes with digital speed controller		1900		0 to 31 0 = analogue-controlled axis	
	X		0	+1 = X-axis digital controlled	
	Y		1	+2 = Y-axis digital controlled	
	Z		2	+4 = Z-axis digital controlled	
	IV		3	+8 = IV. axis digital controlled	
	V		4	+16 = V. axis digital controlled	

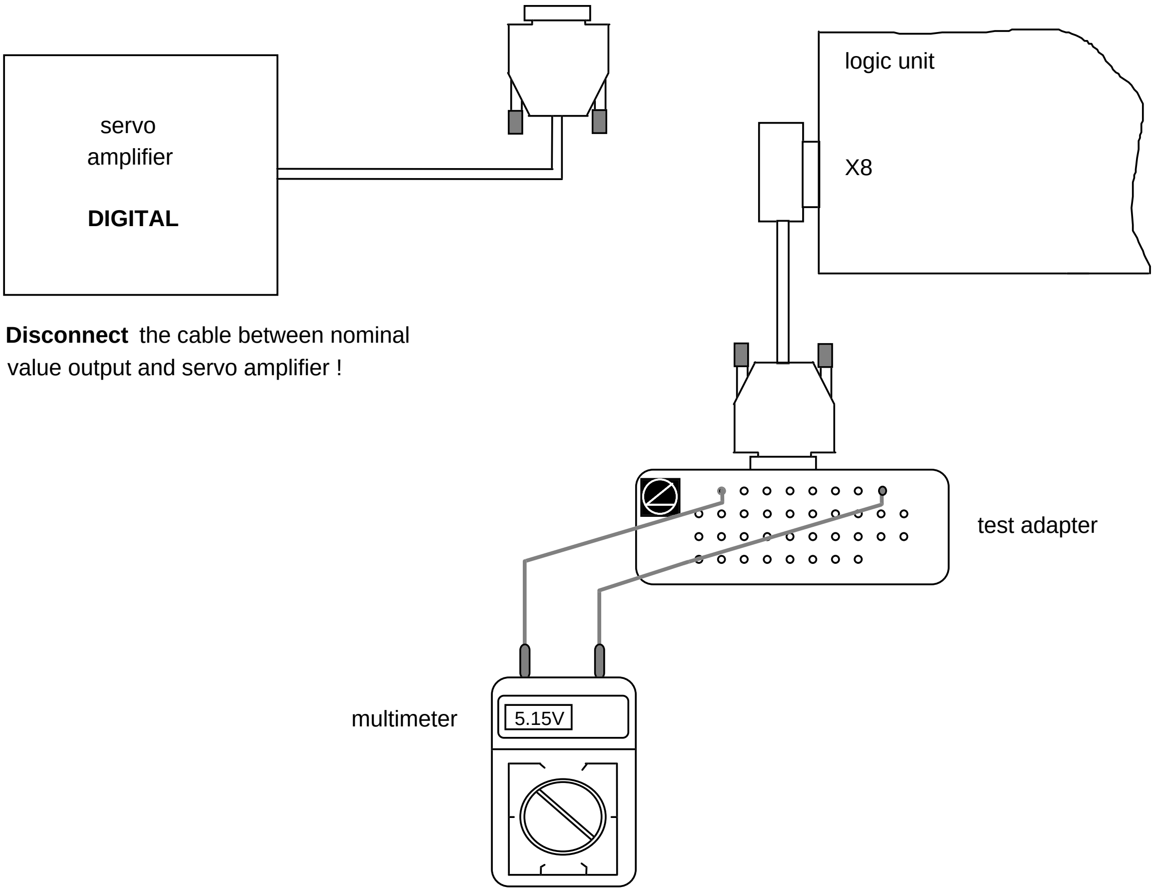
- The following machine parameters need to be checked and adapted. (Do not forget to re-enter the original values after having finished the test!)

MP	Entry Value	Function	Original Entry Values
1410.X	30 [mm]	Servo lag monitoring (cancellable), feed forward control	
1420.X	30 [mm]	Servo lag monitoring (EMERG. STOP), feed forward control	
1140.X	9.99 [V]	Movement monitoring	
1710.X	300 [mm]	Servo lag monitoring (cancellable), trailing operation	
1720.X	300 [mm]	Servo lag monitoring (EMERG. STOP), trailing operation	

- Turn the override potentiometer of the keyboard unit completely to the left and start reference mark traverse for the defective axis.
- Check the axis enable for the defective axis at the servo amplifier.
- Check the screen display
  ***** (control ready for operation) must be switched on, the **F** of the feed rate display must be lit normally (if the display is inverse the feed rate enable is missing) and the symbol for "axis not in position loop" (e.g. →|← **X**) must not follow the position display.
- Turn the override potentiometer slowly to the right and turn it back left before the servo lag display reaches the limit of the position monitoring.

When the override potentiometer is turned to the right, the control outputs an analogue voltage which is increased proportionally to the servo lag up to a maximum value of 10V. The control operates correctly, if a voltage of 10V ± 0.1V can be measured at the test adapter with the multimeter. If no voltage can be measured, the analogue output of the logic unit is probably defective.

Measuring Setup to Check the Analogue Outputs



X8 Nominal value output for 1, 2, 3, 4, 5, S

flange socket with female insert (15-pin)

Pin No.	Signal
1	analogue output 1
3	analogue output 2
5	analogue output 3
7	analogue output 4
4	analogue output 5
8	analogue output S axis
9	0V analogue output 1

Pin No.	Signal
11	0V analogue output 2
13	0V analogue output 3
14	0V analogue output 4
6	0V analogue output 5
15	0V analogue output S axis
housing	external shield = housing
2, 10, 12 do not assign	

Observe the safety instructions!

18.3 Switching Over the Position Display

Press Key	Function
	TNC in operating mode MACHINE (manual, full sequence etc.)
MOD	Activate MOD function

```
MANUAL OPERATION                              PLC
                                              PROGRAMMING

POSITION DISPLAY      ACTL.
                      REF
CHANGE MM/INCH        MM
PROGRAM INPUT         HEIDENHAIN
AXIS SELECTION        %00000



NC : SOFTWARE NUMBER 280540 04
PLC: SOFTWARE NUMBER 252499 01
OPT:                   1

POSITION/  | AXIS      | AXIS      | AXIS      | HELP |  |  | END
INPUT PGM  | LIMIT (1) | LIMIT (2) | LIMIT (3) |      |  |  |
```

Press Key	Function
↓ or ↑	Select dialogue POSITION DISPLAY
ENT	Switch to desired display mode NOML: nominal position DIST: distance-to-go ACTL: actual position REF: distance to reference mark (machine datum); with distance-coded measuring system zero REF mark LAG: current servo lag
END	Exit the subprogram

18.4 Adjustment of the Feed Rate
18.4.1 Axes with Analogue Speed Controller

Check and adapt the machine parameters (note down the original entry values).

MP	Entry Value	Function	Original Entry Value
1390	0	feed forward control [1] ON in automatic operating modes	
7290.X	6	display step = 0.1 µm	

• Switch position display to LAG (servo lag).

• Enter the following test program (e.g. for X axis)

```
0   BEGIN PGM  X  MM
1   LBL 1
2   X + 0  F  MAX
3   X + 100  F  MAX      (select a larger traverse range if possible!)
4   CALL LBL  1  REP  100/100
5   END PGM  X  MM
```

• Run the test program in the operating mode "PROGRAM RUN / FULL SEQUENCE".

• Adjust the feed rate at the servo amplifier (tachometer) until the servo lag display is approximately zero for positioning in both directions.

• Repeat the adjustment for all axes.

• Reset the machine parameters and the position display to the original values.

[1] The operating mode "feed forward control" must be optimized.

18.4.2 Axes with Integral Digital Speed Controller

Depending on the machine parameter MP1900 the driving axes of TNC 425/E are individually defined as **analogue axes** (as TNC 415 B/F) or as **digital axes**.

With axes with **integral digital speed controller** (corresponding bit of MP1900 = 1) the feed adjustment of the servo amplifier as described in section 18.4.1 is not required.

18.5 Offset Adjustment

18.5.1 Axes with Analogue Speed Controller

a) Offset Adjustment with Code Number

Press Key	Function
	TNC in operating mode PROGRAMMING AND EDITING
MOD	Prepare TNC for entry of code number
7 5 3 6 8 ENT	Enter code number for offset adjustment and confirm with ENT

Now the contents of the offset memory is displayed on the screen in converter steps (1 conv. step = 0.153 mV).
From left to right: X, Y, Z, IV, V.

```
MANUAL      PROGRAMMING AND EDITING
OPERATION   -44   -12   -59   -31   -8



CODE NUMBER


NC : SOFTWARE NUMBER 280540 04
PLC: SOFTWARE NUMBER 252499 01
OPT:                 1


CONTINUE | QUIT | | | | | | END
```

Press Key	Function
CONTINUE	Offset compensation is executed
QUIT	Offset is not executed or is cancelled

The offset adjustment with code number only compensates the **current** offset. Subsequent offset modifications are **not** compensated.

b) Cyclic Offset Adjustment via Machine Parameters

In the machine parameter MP1220 the cycle time is defined [1s] after which an offset is compensated by one converter step.
To switch off the automatic offset adjustment, enter the value 0 in the machine parameter MP1220.

NOTE:
If an offset voltage of 100 mV is reached with automatic offset adjustment, the control switches off, generating the error message

GROSS POSITIONING ERROR <axis><CPU number> E

c) Offset Adjustment at the Servo Amplifier

• Check and adjust the following machine parameters. (Note down the original values before changing.)

MP	Entry Value	Function	Original Entry Value
1080.0 1080.1 1080.2 1080.3 1080.4	0 0 0 0 0	integral factor	
1220	0	cycle time for automatic offset adjustment	
1390	0	feed forward control ON	
1510.0 1510.1 1510.2 1510.3 1510.4	≥ 1 ≥ 1 ≥ 1 ≥ 1 ≥ 1	KV factor for feed forward control	
7290.X	6	display step = 0.1 µm	

• Switch position display to LAG (display of servo lag); see section 18.3.

• Cancel the offset compensation with code number (see item a)

• Adjust the offset at the servo amplifier until the values of the individual axes are zero or oscillate symmetrically about zero.

• Reset the machine parameter values and the position display to their original values.

18.5.2 Axes with Integral Digital Speed Controller

With axes with **integral digital speed controller** (TNC 425, corresponding bit of MP1900 = 1) the offset adjustment as described in section 18.5.1 is not required.

.

NOTES

18.6 Oscilloscope Function

TNC 415B/425 features an integral oscilloscope. To activate the OSCILLOSCOPE mode, enter the code number 688 379.

```
MANUAL      OSCILLOSCOPE
OPERATION

OUTPUT                  RAMP
NOML. FEED RATE         0

SAMPLE TIME             0,6 MS

CHANNEL 1 X             VOLT.ANLOG
CHANNEL 2 Y             OFF
CHANNEL 3 Z             VOLT.ANLOG
CHANNEL 4 X             OFF

TRIGGER                 FREE RUN
TRIGGER THRESHOLD       +0
SLOPE                   +
PRE-TRIGGER             0  %

OSCI |  |  |  |  |  | MP EDIT | END
```

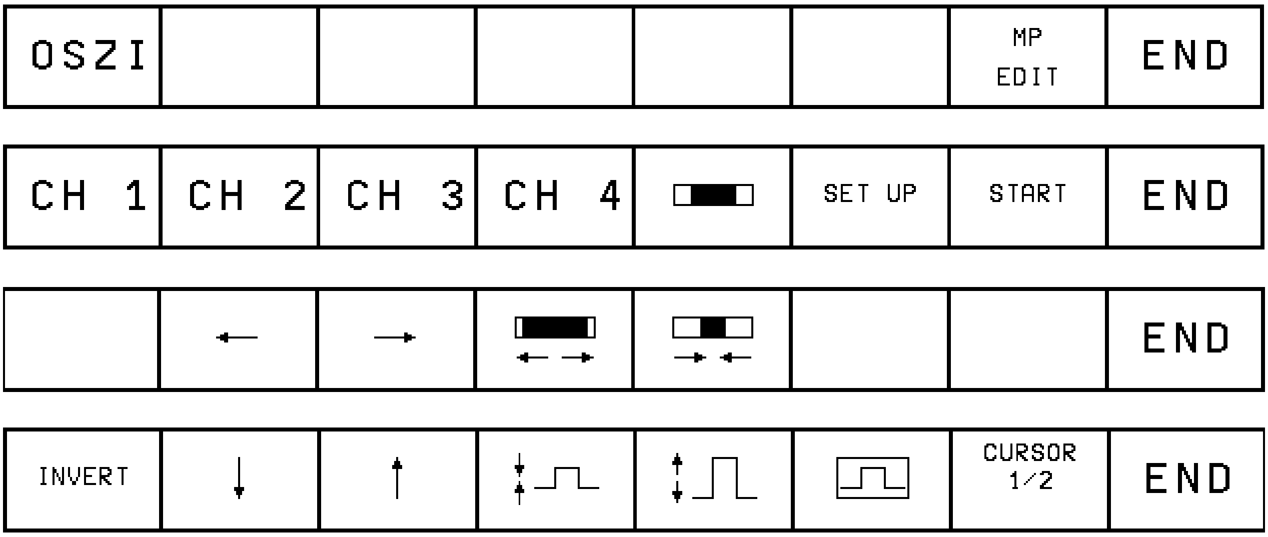
The axes, parameters and trigger conditions to be recorded are selected by pressing the cursor keys which move the cursor to the desired position.

The following characteristic curves can be displayed:

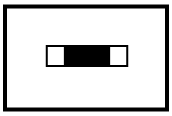
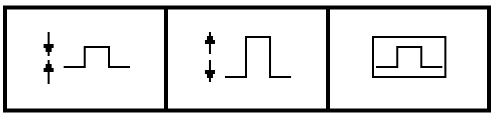
Feed rate	F ACTL	actual value (mm/min)
	F NOML	nominal value (mm/min)
Shaft speed [1)]	N ACTL	actual value (mm/min)
	N NOML	nominal value (mm/min)
Speed controller [1)]	N INT	difference of nominal and actual for speed controller (mm/min)
Position	S ACTL	actual value (mm)
	S NOML	nominal value (mm)
Servo lag	S DIFF	servo lag for position control (mm)
Analogue voltage	U ANALOG	analogue voltage output (V)

[1)] only for digital controlled driving axes

18.6.1 Soft Key Rows



Explanation of the soft keys:

START	start recording
	horizontal zoom
CURSOR 1/2	activate cursor
	optimum vertical resolution, centered on screen

18.6.2 Trigger

The following possibilities are available:

• FREE RUN	Recording is terminated by hand.
• SINGLE SHOT	Recording of a memory contents; started by trigger condition
• CHANNEL ...	Recording starts when the trigger threshold of the selected channel is exceeded.

Trigger Threshold

The trigger threshold for the selected channel is indicated as a numerical value; the units are as follows:
- feed rate (mm/min)
- position (mm)
- shaft speed (mm/min)
- servo lag (µm)
- analogue voltage (mV)

Edges

Triggering with rising (positive) and falling (negative) edge.

Pre-Trigger

Definition of recording start in % of the total recording time; possible entry values are 0%, 25%, 50%, 75%, 100%; selectable by pressing ENT.

18.6.3 Recording

The recording parameters to be edited are selected via arrow keys. The values for the feed rate threshold and the trigger threshold are entered via the numerical keys. The entry values for all other recording parameters are selected by pressing ENT.

Output

To output a nominal value in the MANUAL mode, it is possible to chose between a pre-set ramp and a jump function. The jump function (only possible with digital controlled axes) is required for the adjustment of the speed encoder. Moreover, if the preliminary entry value is unknown, the maximum acceleration can be determined from jump function and recording with the oscilloscope. In MDI and AUTOMATIC the axes are always accelerated following the selected ramp.

Feed Rate

If a jump function is selected as output signal, the feed rate is entered in mm/min. The programmed feed rate is valid for the acceleration subsequent to the ramp.

Time Resolution

The recording time is between 2.4576 seconds and 24.576 seconds (selected time x 4096). The selected time (0.6 ms to 6 ms) is the clock time for recording the characteristic lines. The recording time is displayed below the grating. Beginning and end of display (relative to the trigger point; cursor line T1) are displayed as well.

Channel 1 to Channel 4

Four channels can be selected for recording. The assignment of the axes to the channels is variable; select the axis to be changed, press ENT to switch the channel.

For each channel a characteristic line is selected. It consists of the following values:

Feed rate	V ACTL	actual value (mm/min)
	V NOML	nominal value (mm/min)
Shaft speed	N ACTL	actual value (mm/min)
	N NOML	nominal value (mm/min)
Speed controller	N INT	difference of nominal/actual value for the speed controller (mm/min)
Position	S ACTL	actual value (mm)
	S NOML	nominal value(mm)
Servo lag	S DIFF	servo lag for position controller (mm)
Analogue voltage	U ANALOG	analogue voltage output (V)
Channel	OFF	channel is displayed
	SAVED	channel is stored

Recording is started by pressing the START soft key. A soft key row is displayed which only contains a STOP key. The process can be interrupted at any time.
During recording the stored channels cannot be displayed simultaneously, since it is not possible to synchronise the stored channels and the newly recorded channels.

Evaluation of the recorded channels via cursor

Whereas the entire memory contents is displayed after start, the time window selected before the start is displayed after re-setup of the screen.
On the left side of the screen the time T1 (time of trigger event) is displayed. Below there is the absolute value in [mm/min], [mm] or [mV].
If an additional cursor with the time T2 is displayed by means of the key CURSOR 1/2, it can be shifted with the arrow keys on the TNC operating panel. The time T2 is the difference to T1; the numerical value displayed below is the difference to the value belonging to T1.
The T2 display and the additional cursor can be erased by pressing the soft key END or "Cursor 1/2".

Vertical Zoom

For the display of each selected channel the vertical grid can be changed in steps via soft key. The vertical grid size is displayed on the left side of the screen below the designations of the channel and the recording.

Centering the Display

The vertical resolution is selected such that an optimum display is ensured.

Returning to the original vertical resolution:
By pressing NOENT the original display of the stored data is re-established.

Horizontal Zoom

The recording comprises 4096 evaluated data. The time resolution (i.e. the clock time of the recorded data) can be set between 0.6 and 6 ms. The range for extension and compression is limited as follows:

	evaluated data	data: pixels
minimum display	4096	8 : 1
max. extended display	64	1 : 8

The length of the displayed detail and its starting point as absolute position within the duration of the recorded data is depicted as scroll bar in the status window.

19. PLC Inputs and Output

19.1 PLC Inputs

19.1.1 PLC Inputs on LE

Connector X42: I0 to I31 and acknowledgement "control ready for operation"
Connector X46: I128 to I152

"0" signal U_e = - 20V to 3.2V
I_e = 1.0mA with U_e = 3.2V

"1" signal U_e = 13V to 30.2V
I_e = 3.8mA to 8.9mA

19.1.2 PLC Inputs on PL 400

Terminal strips X4 to X9: I64 (I192) to I126 (I254)

"0" signal U_e = - 20V to 4V
I_e = 1.6mA with U_e = 4V

"1" signal U_e = 16.5V to 30V
I_e = 6.2mA to 12.6mA

19.1.3 PLC Inputs on PL 405/410

PL 405, terminal strips X3 to X4: I64 (I192) to I95 (I223)
PL 410, terminal strips X3 to X6: I64 (I192) to I127 (I255)

"0" signal U_e = - 20V to 4V
I_e = 1.6mA with U_e = 4V

"1" signal U_e = 16.5V to 30V
I_e = 6.2mA to 12.6mA

19.2 PLC Outputs

19.2.1 PLC Outputs on LE

Connector X41: O0 to O30 and output "control ready for operation"
Connector X46: O0 to O7 [1)]

[1)] outputs available at X46 or X41

"1" signal $U_{a\,min}$ = U_B - 3V
$I_{a\,NOML}$ = 0.1A

19.2.2 PLC Outputs on PL 400

Terminal strips X1 to X3: O32 (O64) to O62 (O94) and output "control ready for operation"

"1" signal $U_{a\,min}$ = U_B - 3V
$I_{a\,NOML}$ = 1.2A

19.2.3 PLC Outputs on PL 405/410

PL 405, terminal strip X8: O48 (O80) to O62 (O94) and output "control ready for operation"
PL 410, terminal strips X7 to X8: O32 (O64) to O47 (O79) and output "control ready for operation"

"1" signal $U_{a\,min}$ = U_B - 3V
$I_{a\,NOML}$ = 1.2A

Pin layout: see section 6

19.3 Checking the PLC Inputs and Outputs

The test unit (see section 20) can be used to check the PLC inputs and outputs on the logic unit (X41, X42, X46). The voltage level of the PLC inputs and the output current of the PLC outputs on the PL 400/405/410 can be measured directly at the terminals.

19.3.1 PLC Inputs

The PLC inputs can be checked as follows:

• Connect the test unit between LE and PLC (measure directly at the PL boards).

Press Key	Function
(Programming/Editing key)	TNC in operating mode PROGRAMMING/EDITING
MOD	Prepare TNC for input of code number
8 0 7 6 6 7 ENT	Enter code number, confirm with ENT
TABLE	Call TABLE function
INPUT	Display of input table

Now the logic states of the inputs are displayed on the screen. They must correspond to the voltage levels of the corresponding inputs (voltage levels: see section 19.1). If there is a difference and the input voltage is correct, the input board of the PLC graphics board or the PLC I/O board PL 400/405/410 is defective.

Press Key	Function
END	Exit the TABLE function
END	TNC in operating mode PROGRAMMING/EDITING

Observe the safety instructions!

19.3.2 PLC Outputs

The PLC outputs can be checked as follows:
• Connect the test unit between the PLC and the LE (measure directly at the PL boards).

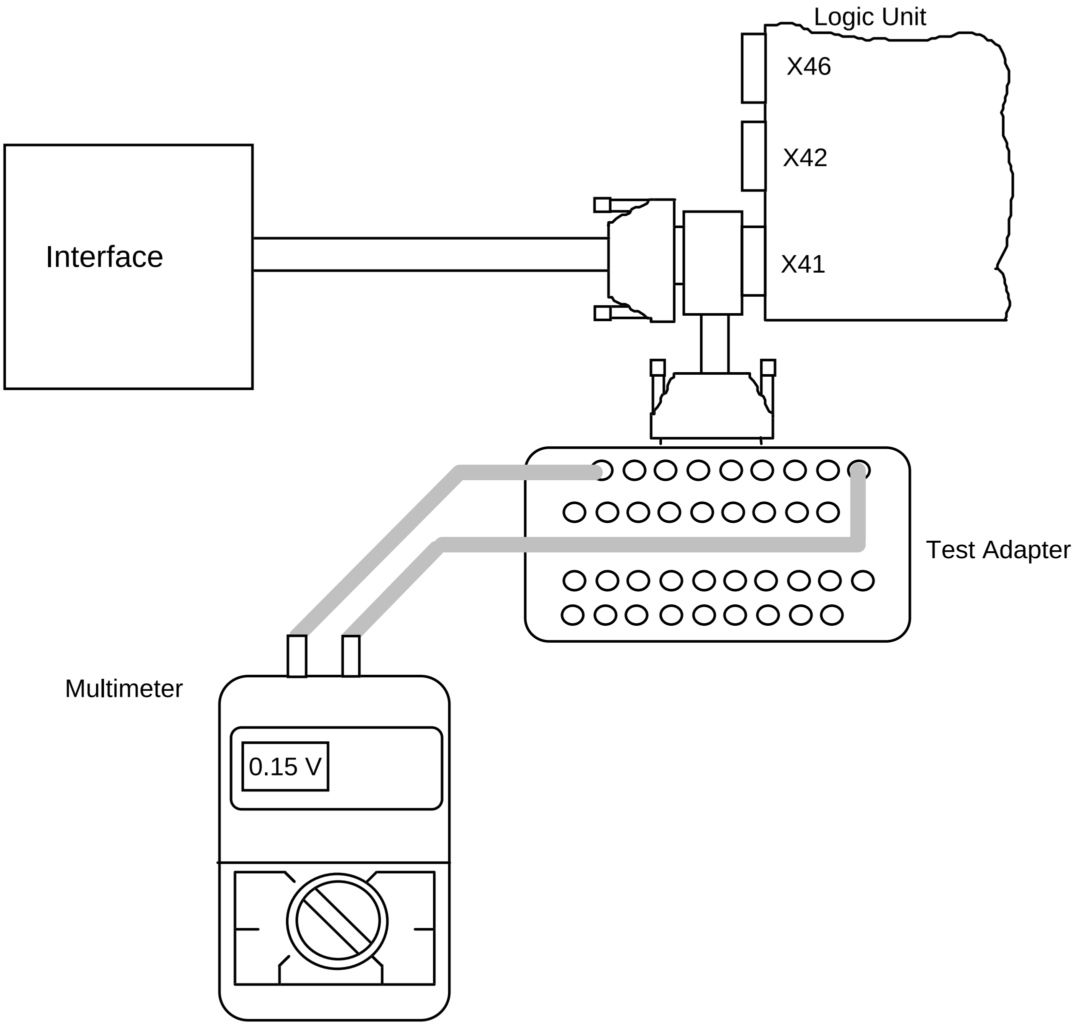
Press Key	Function
	TNC in operating mode PROGRAMMING/EDITING
MOD	Prepare TNC for input of code number
8 0 7 6 6 7 ENT	Enter code number, confirm with ENT
TABLE	Call TABLE function
OUTPUT	Display of output table

Now the logic states of the outputs are displayed on the screen. They must correspond to the voltage levels of the corresponding outputs. If there is a difference, check the output cable for short circuit and measure the output current at the interface (max. 100 mA for LE outputs, max. 1.2 A for PL outputs). If the output current is not exceeded and connecting cable is in order, the output board of the PLC graphics board or the PLC I/O board PL 400/405/410 is defective.

Press Key	Function
END	Exit the TABLE function
END	TNC in operating mode PROGRAMMING/EDITING

Observe the safety instructions!

19.3.3 Measurement Setup for PLC Inputs and Outputs at the LE



X41 : PLC output
X42 : PLC input
X46 : machine operating panel

Observe the safety instructions!

19.4 Diagnosis Possibilities in the PLC Mode

19.4.1 TRACE Function

Activation via soft key TRACE

MANUAL OPERATION — PLC PROGRAM TRACE MODE

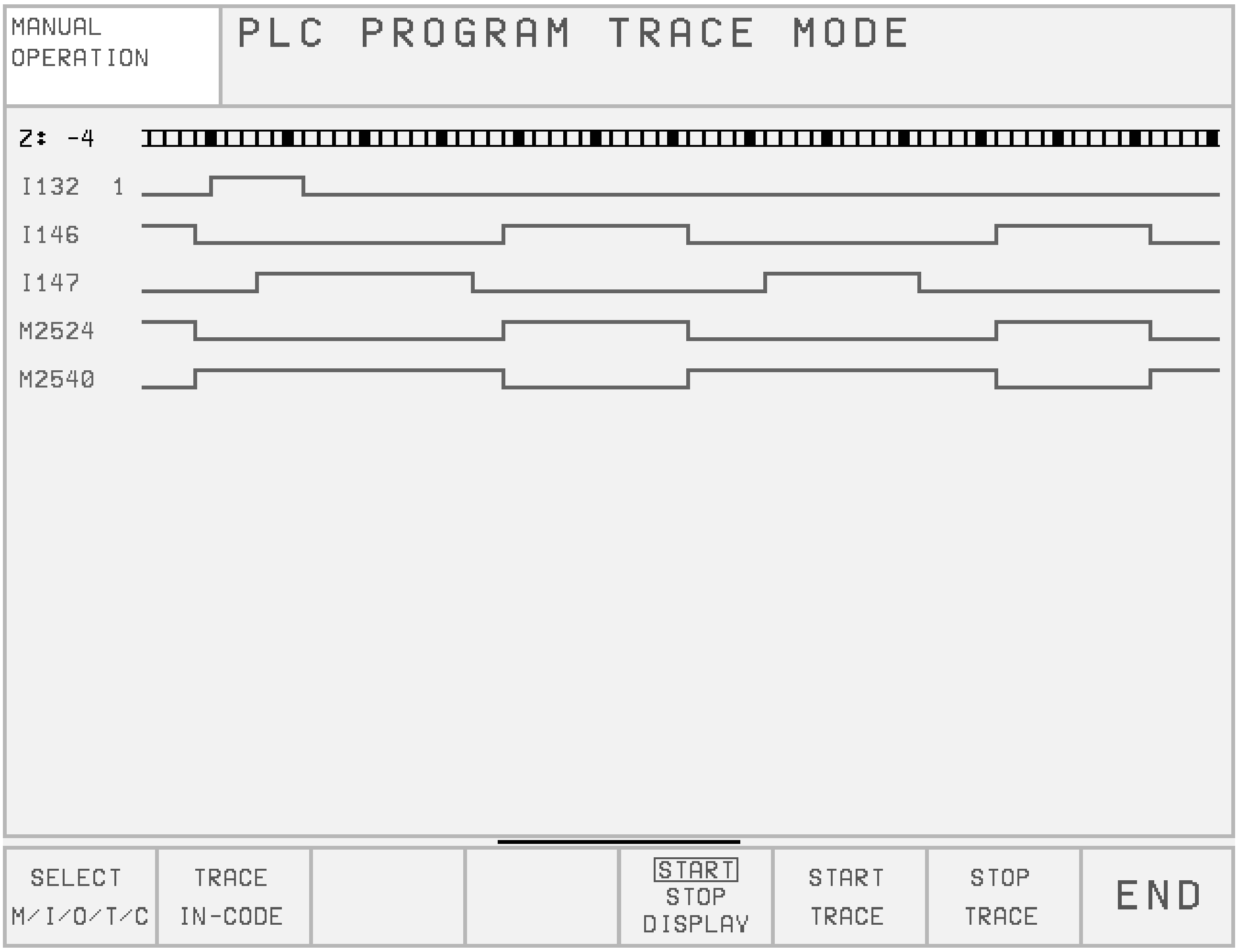
OPERAND	ACCU	ACTIVE	LINE	COMMAND		COMMENT
0	0	*	40	XON	M2207	
0	0	*	41	=	M902	
1	1	*	42	XO	I131	
0	0	*	43	XON	M2207	
0	0	*	44	=	M903	
			45	; FREIGABEN DER WERKZEUGACHSEN		
0	0	*	46	A	M2000	
0	0	*	47	=	O0	
0	0	*	48	A	M2001	
0	0	*	49	=	O1	
0	0	*	50	A	M2002	
0	0	*	51	=	O2	
0	0	*	52	A	M2003	
0	0	*	53	=	O3	

SELECT M/I/O/T/C	LOGIC DIAGRAM	FIND	HEX ⇕ DECIMAL	START STOP DISPLAY	START TRACE	STOP TRACE	END

The TRACE function provides the possibility of controlling the logic states of the markers, inputs, outputs, timers and counters; it also serves to check the contents of bytes, words and double words of the compiled PLC program.

An instruction list (AWL) of the compiled program is displayed. In addition, the contents of the operand and of the accumulator is displayed in HEX code or decimal code. All active commands of the instruction list are marked by "*". Use the cursor keys or the GOTO function to display the requested program part.

19.4.2 LOGIC Diagram



The logic states of up to 16 operands (M, I, O, T, C) can be depicted simultaneously on the screen.
1024 PLC scans can be traced.

Activation of the Logic Diagram:

Press Key	Function
TRACE	Press soft key
LOGIC DIAGRAM	Press soft key

Selecting the Operands and Starting the Logic Diagram

Press Key	Function
SELECT M/I/O/T/C	

A table is displayed from which the operands can be selected. The control requests the positions of the table in a dialogue. Wrong inputs can be cleared by pressing DEL. It is possible to enter a trigger condition for each operand. 512 states are traced before and after a trigger event. The following trigger conditions are possible:

"1" ⇒ trace if the operand is a logical "1"
(trigger on positive edge)

"0" ⇒ trace if the operand is a logical "0"
(trigger on negative edge)

NO ENT ⇒ no trigger
If no trigger condition is entered for any of the operands, the operand states are traced continuously and the last 1024 states are stored.

e.g.:	0	I5	1	⇒ trigger on positive edge
	1	O6	0	⇒ trigger on negative edge
	2	M2003		⇒ no trigger

Press Key	Function
START TRACE	Start TRACE function
	TNC in operating mode "MACHINE" (key on VDU)

The trace function is started with START TRACE; END TRACE or a trigger event terminate the tracing.

PCTR blinking : trigger condition has not occurred yet
PCTR on : trigger condition has occurred; write access to buffer memory
PCTR off : buffer memory is full; LOGIC DIAGRAM can be called

Press Key	Function
	Switch to TRACE mode
LOGIC DIAGRAM	Call logic diagram

19.4.3 TABLE Function

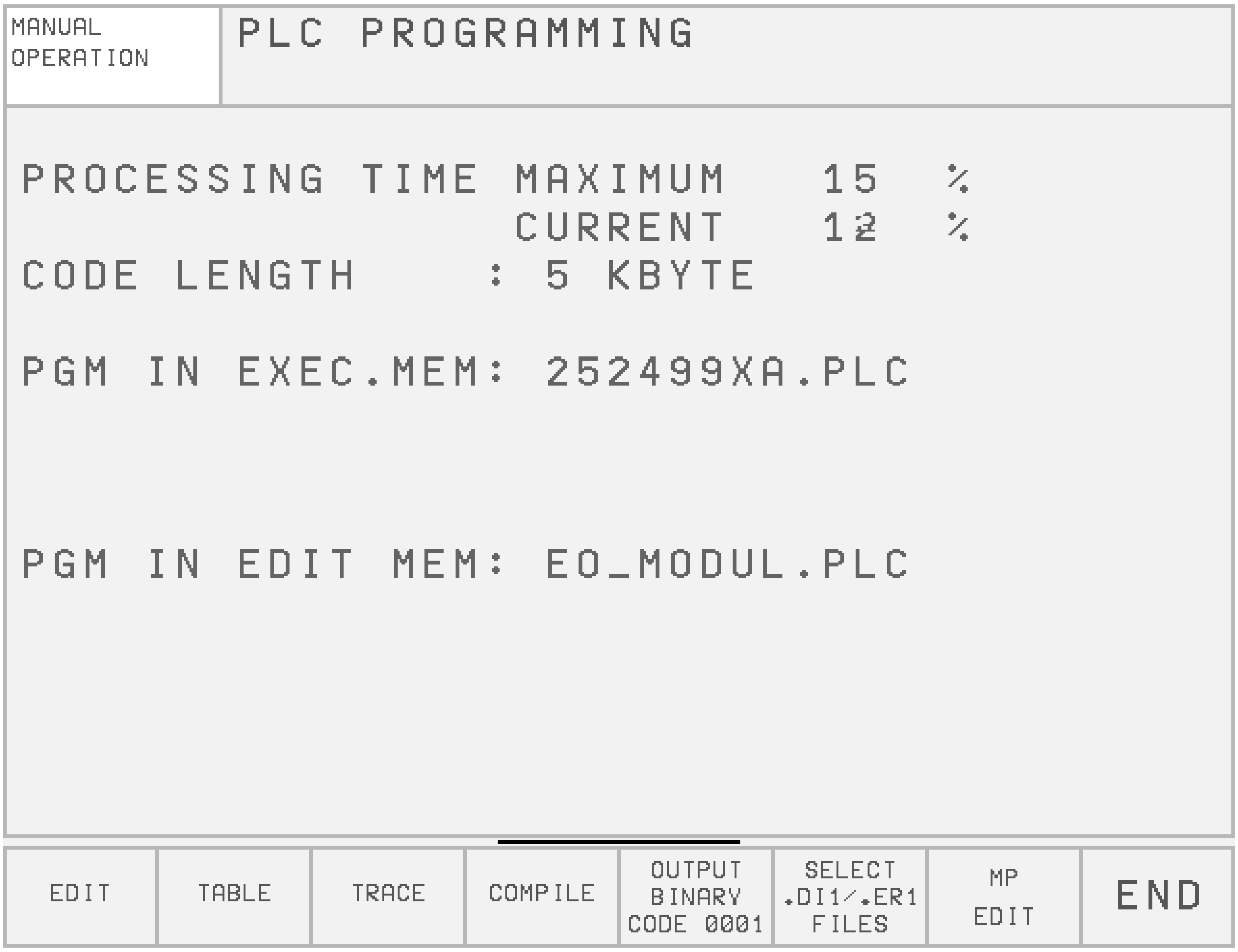
Press Key	Function
TABLE	Call TABLE function
SET | RESET | MARKER | INPUT | OUTPUT | COUNTER | TIMER | END	
▷	Key on VDU
BYTE | WORD | DOUBLE | HEX ⇕ DECIMAL | | | | END	

After pressing a soft key, the corresponding table is activated.
The logic states of the markers, inputs, outputs, counters and timers are dynamically displayed.
In the tables for bytes, words and double words, the display can be switched between HEX and DECIMAL.

With the cursor keys or the GOTO key, positions of a table can be selected.

Notes

19.5 Compiling the PLC Program



Selecting a File as EDITOR PGM:

Press Key	Function
PGM NAME	Call file overview
SELECT	Select desired program

The file is no in the **editor** and can be called any time by pressing the soft key EDIT.

Loading <NAME.PLC> into the Process Memory:

COMPILE	Press soft key
SELECT	Press soft key

The selected PLC PGM is compiled and loaded into the process memory.

19.6 Output "Control Ready for Operation" and Acknowledgement for Test " Control Ready for Operation "

Important functions are monitored by the TNC 415B/425 by way of a self-diagnosis system (electronic assemblies such as micro-processor, EPROM, RAM, positioning systems, encoders etc.).

If an error is detected, a blinking error message in plain language is displayed in the dialogue line. As soon as this error message is generated, the control opens the output "Control Ready for Operation".

The output "Control Ready for Operation" is available via:

Logic unit,	connector X41	pin 34
PL 400,	terminal strip X3	pin 10
PL 405,	terminal strip X8	pin 16
PL 410,	terminal strip X8	pin 16

By switching off the power switch or by pressing END this state can be cancelled, provided that the error cause has been eliminated.

The output "Control Ready for Operation" is to switch off the +24V control voltage in the machine tool interface. Since this is an important safety function, the switch-off function of the output "Control Ready for Operation" is tested via the input "Acknowledgement Control Ready for Operation" each time the control is switched on.

TNC 415B/425 features three monitoring systems (main processor, geometry processor and CLP processor) which are also tested when the machine tool is switched on.

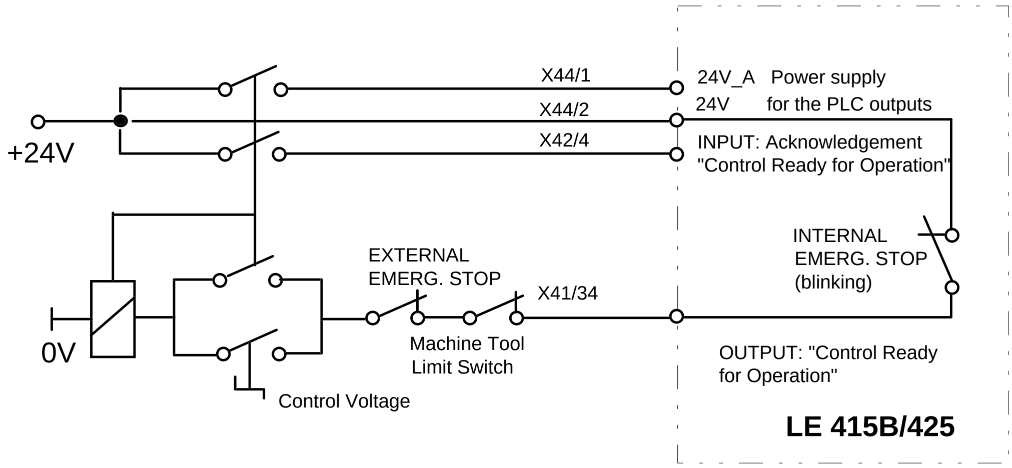
If the +24V at the input "Acknowledgement Control Ready for Operation" are missing during the test routine after power-on, the error message " RELAY EXT. DC VOLTAGE MISSING" is displayed. If however, the acknowledgement is switched off too late (or not at all) after the output has been switched off, the blinking error message "EMERGENCY STOP DEFECTIVE" is generated. This error message is also displayed, if the power supply of the PLC is missing (power supply of the PLC: see section 10).

If the control detects an error during the power-on test routine, a bridge can be inserted between the output "Control Ready for Operation" and the input "Acknowledgement Control Ready for Operation" (disconnect the wires) in order to determine whether the defect is due to the control or to the interface. If the error is still present after inserting the bridge and with correct PLC power supply, the defect is located in the logic unit. If however, the error does not occur with the bridge being inserted, the defect is located in the interface.

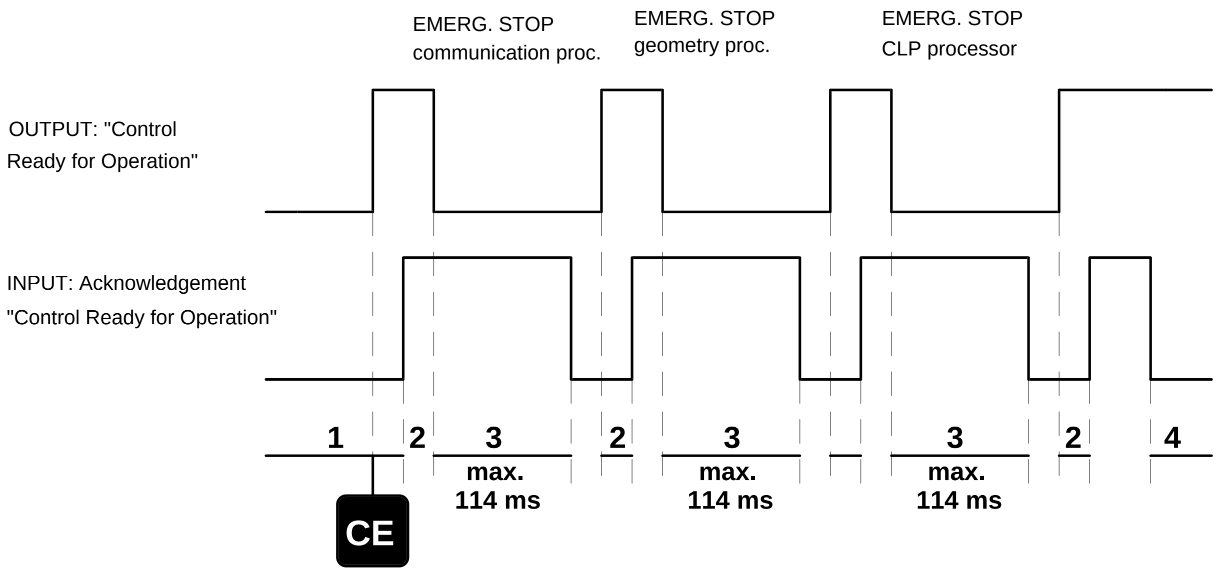
Warning!
Do not forget to remove the bridge and to install the standard operating state after the test.

Observe the safety instructions!

19.6.1 Wiring of the EMERGENCY STOP Interface



19.6.2 TNC 415B/425 Flow Diagram



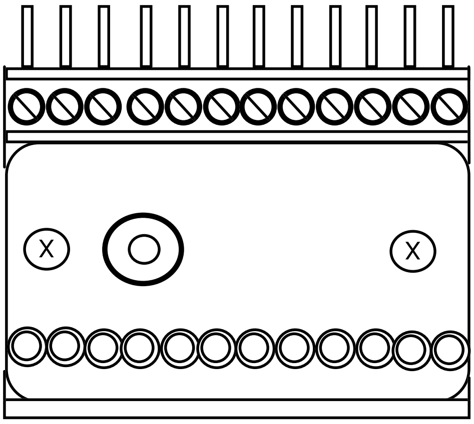
Time	Remarks	Error Message
1		**POWER INTERRUPTED**
2	Waiting for control voltage	**RELAY EXT. DC VOLTAGE MISSING**
3	After switching off the output "Control Ready for Operation", the "Acknowledgement Control Ready for Operation" must be switched off within 114 ms; otherwise the blinking error message is generated.	**EMERGENCY STOP DEFECTIVE YX** YX = 1(= Communication processor 1) = Geometry processor 1. = CLP processor
4	If the acknowledgement is switched off during operation, the error message is displayed.	**EMERGENCY STOP**

20. Test Units

20.1 Test Unit for the PLC Inputs and Outputs

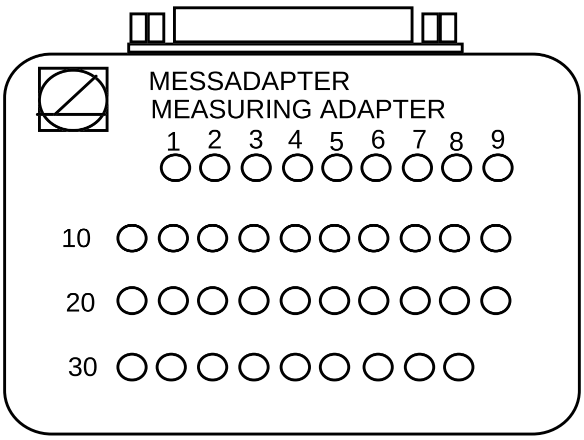
PL Test Unit, Id.No. 247 359 01

to test the PLC inputs and outputs on PL 400

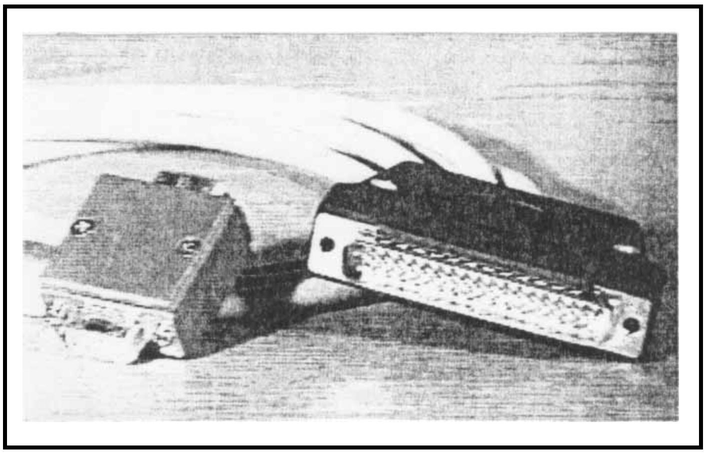


20.2 Universal Measuring Adapter

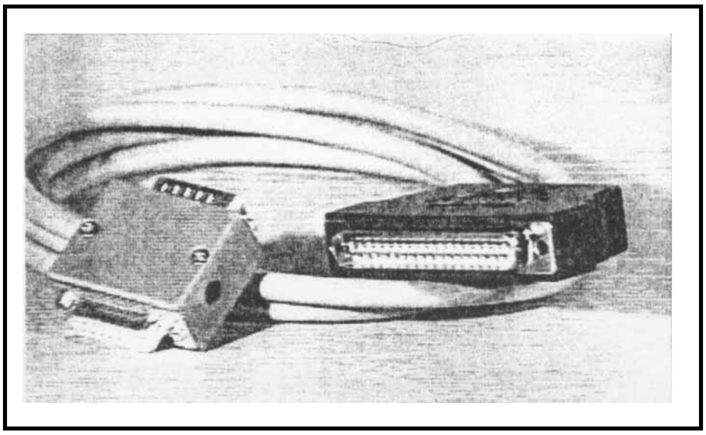
Used:
as universal test unit for D-Sub connectors, 9-pin to 37-pin (Id.No. 255 480 01)



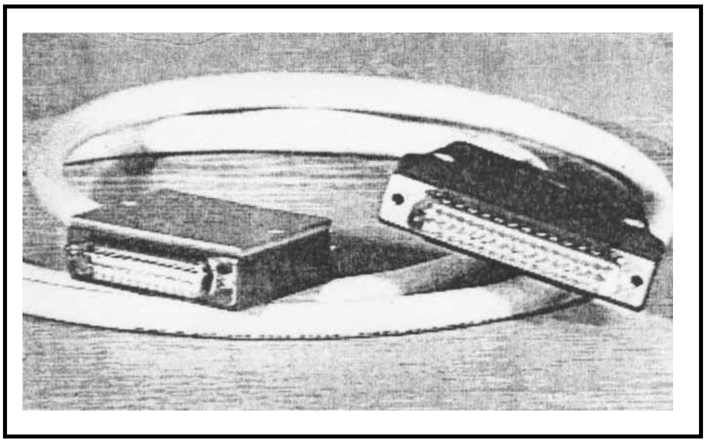
The measuring adapter can be used to test the inputs and outputs of D-Sub connectors (9-pin to 37-pin).
On the following page the adapter cables are shown that are required for the different connectors.



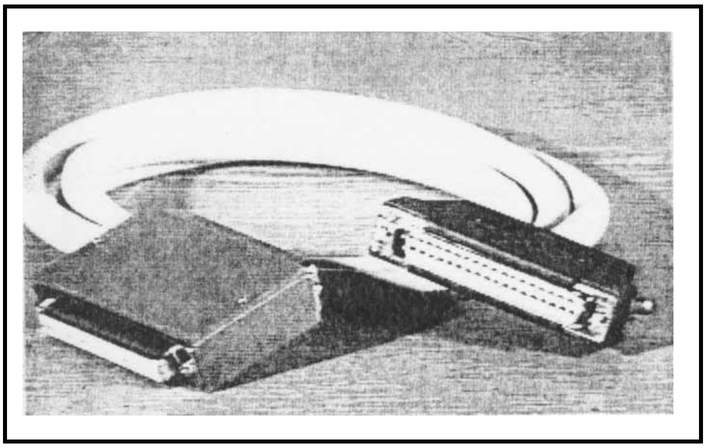
Adaptor Cable,9pin
Id.No. 255 481 01



Adaptor Cable, 15pin
Id.No. 255 482 01



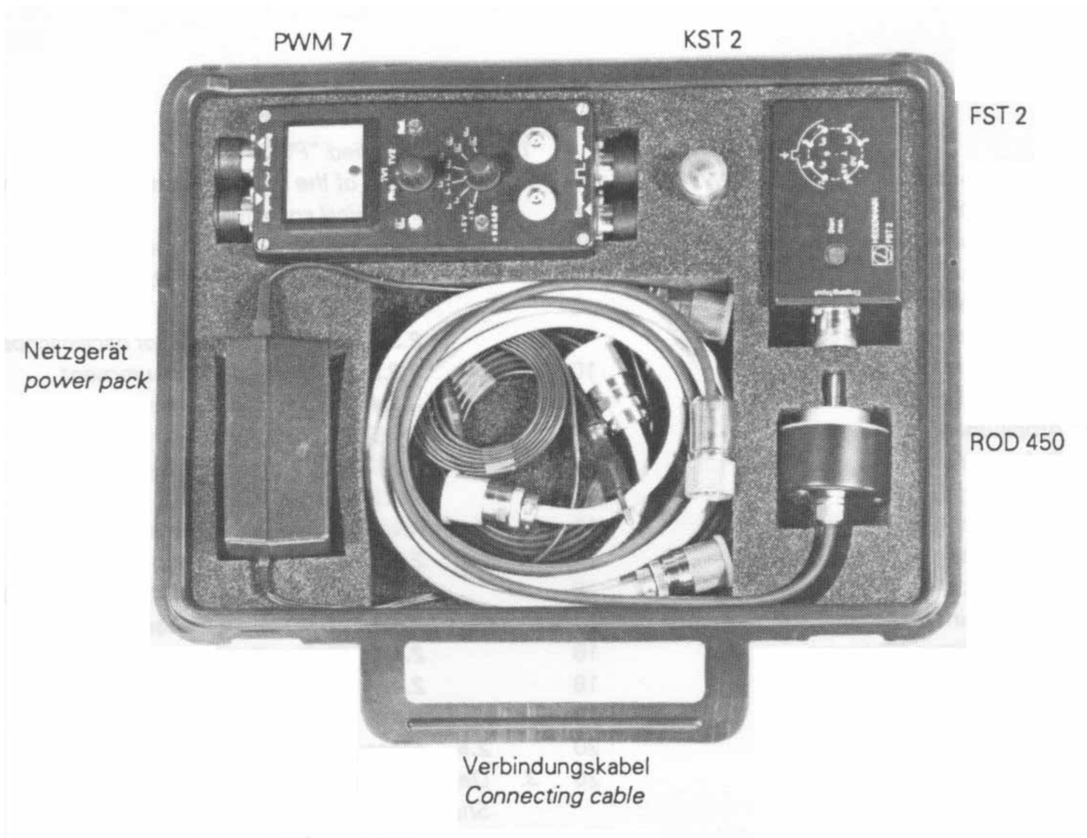
Adaptor Cable, 25pin
Id.No. 255 483 01



Adaptor Cable, 37pin
Id.No. 255 484 01

20.3 Encoder Diagnostic Set, Id.No. 254 599 01

Used:
to test the electrical functions of an encoder
(Further information please see from the operating instructions of the Diagnostic Set.)



21. Exchange Instructions

21.1 Important Notes

Observe the safety instructions!

21.1.1 Required Equipment

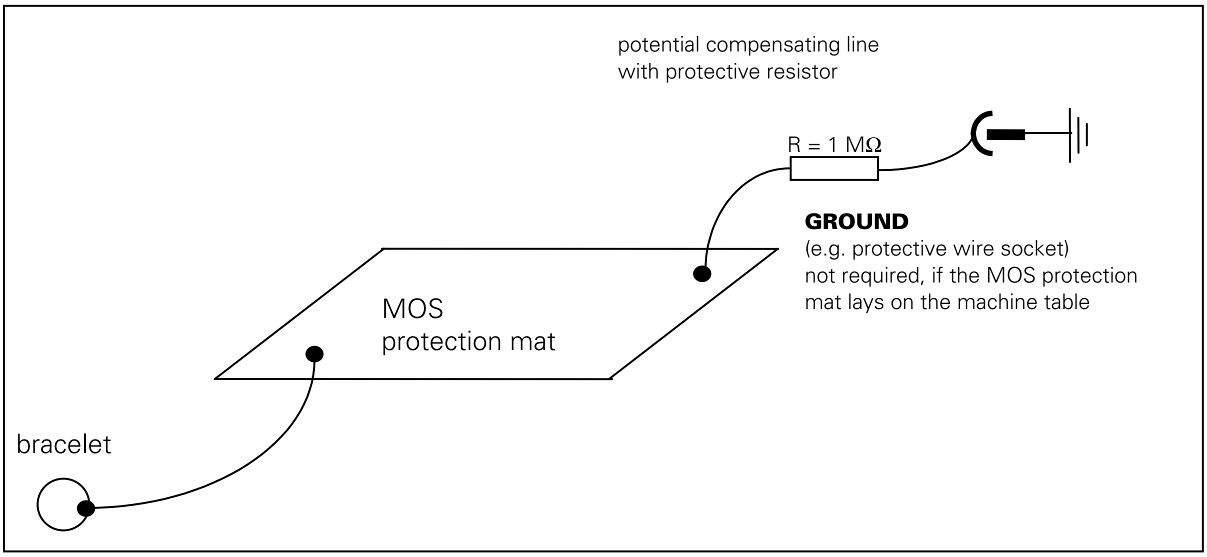
1 external data medium, e.g. FE 401/B or PC with connecting cable
1 tool set (screw driver, socket wrench etc.)
1 MOS protection device (only required for exchanging boards or EPROMs)

21.1.2 MOS Protection

If the processor board, the PLC graphics board, the CLP boards or EPROMs are to be exchanged, a MOS protection is definitely required, since otherwise MOS components on the boards or the EPROMs may be destroyed.

Caution!
Avoid any unprotected handling of the boards or EPROMs with statically charged objects (packaging material, storage etc.).

MOS Protection



21.1.3 Software Compatibility

Exchange units (LOGIC UNIT) are always supplied with the most recent software version. Exchange boards, however, are delivered **without** software and without software enable module. Therefore, the EPROMs and the software enable module of the defective board must be inserted into the exchange board at site. Always remove the EPROMs and the software enable module before sending us boards for repair!)

21.1.4 Backing up RAM Data

Before the LOGIC UNIT, an assembly (e.g. processor board, power supply etc.) or the NC software are exchanged, all RAM data (files, settings etc.) must be backed up.

The following files may be stored in RAM and must be backed up on a external data medium:

NC memory management		**Extension in TNC**	**Extension on external medium**
NC program, HEIDENHAIN dialogue		.H	.H
NC program, ISO		.I	.I
Active tool table		TOOL.T	TOOL.T
Tool data (table)		.T	.T
Pocket table			TOOL_P.R
Pallet table		.P	.L
Datum table		.D	.N
Text file (ASCII)		.A	.A
Point table (digitizing)		.PNT	.U
PLC memory management (RAM)			
PLC program		.PLC	.P
Error messages	1. language	.ER1	.A
Error messages	English	.ERE	.A
Dialogues	1. language	.DI1	.A
Dialogues	English	.DIE	.A
ASCII files		.A	.A
Help texts		.HLP	.J
Data for axis error compensation		.COM	.V
Data for axis error compensation		.CMA	.S
Machine parameter mode			
Machine parameter list		.MP	.M
Compensation value table (accessible via code number)		.KOR	.S

Letters representing additional information on the files and programs are displayed in the status display:

E: The file or the program was selected in PROGRAMMING.
S: The file or the program was selected and activated in TEST RUN.
M: The file or the program was selected and activated in PROGRAM RUN/FULL SEQUENCE or in PROGRAM RUN/SINGLE BLOCK.
P: The file or the program is protected against deleting and editing.
IN: The file or the program was programmed in inches.
W: The file or the program was not completely transferred to the external medium and thus is no longer available.

The data can be read out as described in section 17.3.
The **BACKUP routine** is a very useful function to read out all data.
After pressing MOD in the operating mode "Machine Parameter Editing" (code number 95148) the menu for interface configuration is displayed, comprising the soft keys

[BACKUP DATA] and [RESTORE DATA].

```
MANUAL       MACHINE PARAMETER PROGRAMMING
OPERATION

RS232 INTERFACE          RS422 INTERFACE

MODE OF OP.: LSV2        MODE OF OP.: FE 1
BAUD RATE                BAUD RATE
FE   : 38400             FE   : 9600
EXT1 : 9600              EXT1 : 9600
EXT2 : 9600              EXT2 : 9600
LSV2 : 38400             LSV2 : 9600

ASSIGN:

PROGRAMMING: RS232       PRINT        : RS232
PROGRAM RUN: RS232       PRINT-TEST   : RS232
TEST RUN   : RS232       PLC EDITOR   : RS232
                         MP EDITOR    : RS232

RS 232 | BACKUP | RESTORE |  |  |  |  | END
RS 422 | DATA   | DATA    |  |  |  |  |
SETUP  |        |         |  |  |  |  |
```

With [BACKUP DATA] all operating parameters and the data of all file types are transferred via the data interface and filed in $BACKUP.A. To reload the data into the TNC, press the soft key [RESTORE DATA].

Moreover, the pre-set values and the entry values for the supplementary operating modes must be determined so that they can be re-entered after the exchange.

Switch off and on the main switch of the machine tool.

TNC Dialogue	Press Key	Notes
MEMORY TEST		
POWER INTERRUPTED	CE	
RELAY EXT. DC VOLTAGE MISSING		Switch on control voltage
MANUAL OPERATION TRAVERSE REF. POINT AXIS TRAVERSE REF. POINT AXIS TRAVERSE REF. POINT AXIS TRAVERSE REF. POINT AXIS	MOD	**Do not yet traverse the reference points!**
POSITION DISPLAY (upper) ACTL REF LAG NOML DIST		Mark the selected position display with a cross and then switch the upper POSITION DISPLAY to ACTL by pressing ENT if necessary.
POSITION DISPLAY (lower) ACTL REF LAG NOML DIST The lower position display can be activated with the soft key STATUS ON (only in the split screen mode)		
UNIT MM INCH		Mark the unit
PROGRAM INPUT HEIDENHAIN ISO		Mark the type of program input
Software number: NC PLC		Note down NC and PLC software number

TNC Dialogue			**Press Key**	**Notes**
SIGN of LIMIT X-	=		AXIS LIMIT	Press soft key, note down the values. (do not forget the sign!) If MP7490 = 1, three different limits may be active. In this case, note down all three values.
LIMIT X+	=			
LIMIT Y-	=			
LIMIT Y+	=			
LIMIT Z-	=			Note down the values (do not forget the sign!)
LIMIT Z+	=			
LIMIT IV-	=			
LIMIT IV+	=			
LIMIT V-	=			
LIMIT V+	=		END	
ACTL X				Note down the pre-set values (do not forget the sign!)
ACTL Y				
ACTL Z				
ACTL IV				
ACTL V				

TNC Dialogue	Press Key	Notes
		(key on VDU)
	MOD	
	RS 232 RS 422 SETUP	
OPERATING MODE ME FE1 FE2 EXT1 EXT2 LSV2 BAUD RATE FE: BAUD EXT 1: BAUD EXT 2: BAUD LSV 2: BAUD		Mark the operating mode of the RS 232 interface Mark the baud rate of the RS 232 interface
OPERATING MODE ME FE1 FE2 EXT1 EXT2 LSV2 BAUD RATE FE: BAUD EXT 1: BAUD EXT 2: BAUD LSV 2: BAUD		Mark the operating mode of the RS 422 interface Mark the baud rate of the RS 422 interface
ASSIGNMENT LATCH RS232 RS422 TEST RUN RS232 RS422 PROGRAM RUN RS232 RS422 PRINT RS232 RS422 PRINT TEST RS232 RS422	END	Mark the assignment of the interfaces to the operating modes

21.1.5 Labelling the Connecting Cables

If the connecting cables are labelled incompletely or not at all, they have to be marked such that the correct plug connections can be re-established after having exchanged the logic unit or another assembly.
Pin layout: see section 6

WARNING:
Switching the connecting cables may destroy the unit!

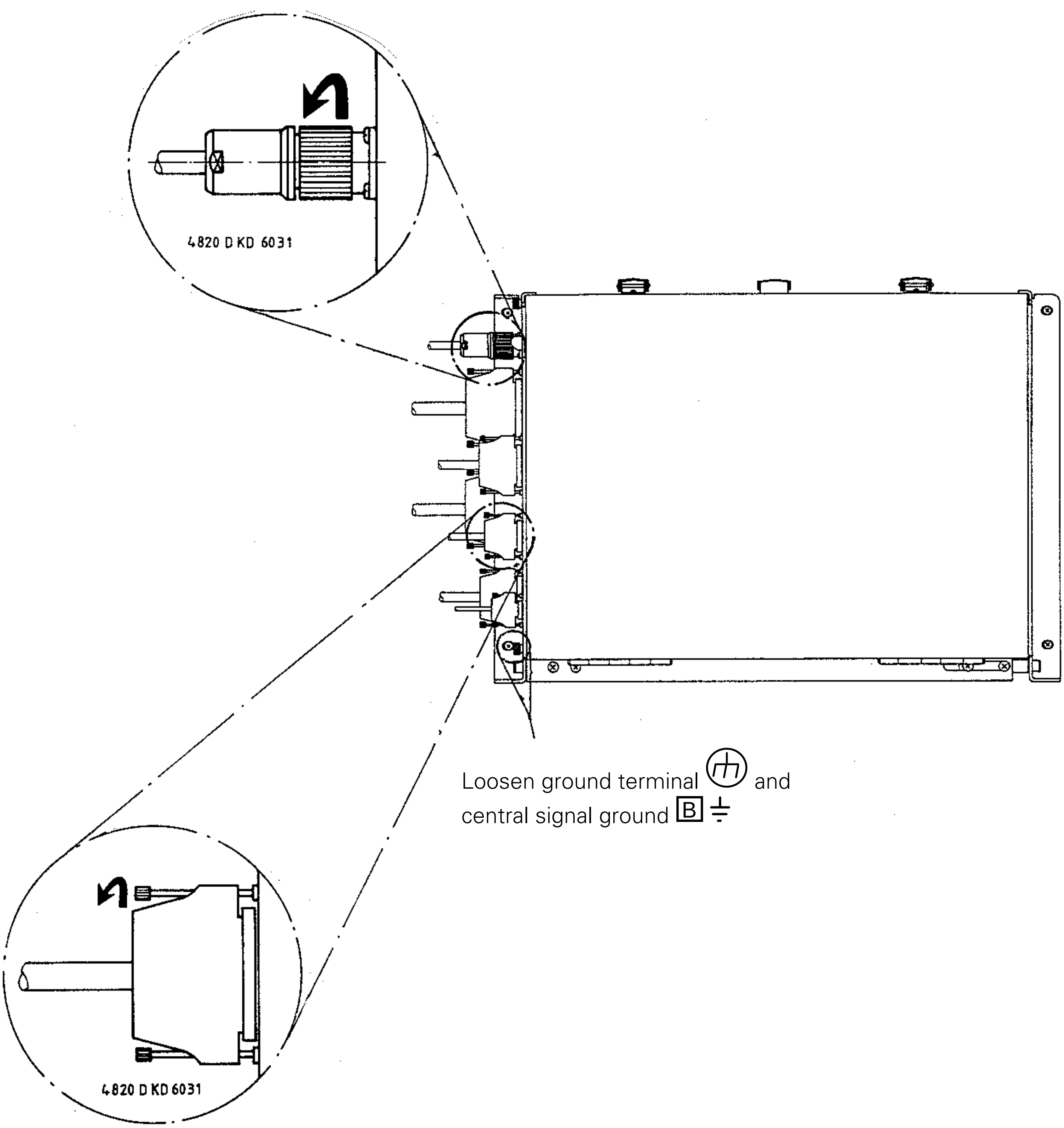
21.2 Exchanging the Logic Unit

21.2.1 Observe the exchange instructions (section 21.1) !

21.2.2 Dismounting the Logic Unit

a) Switch off the main switch.
b) Loosen all plug connections and clamped joints at the logic unit.

Round connector
Loosen knurled coupling rings (TNC 415B/F only)

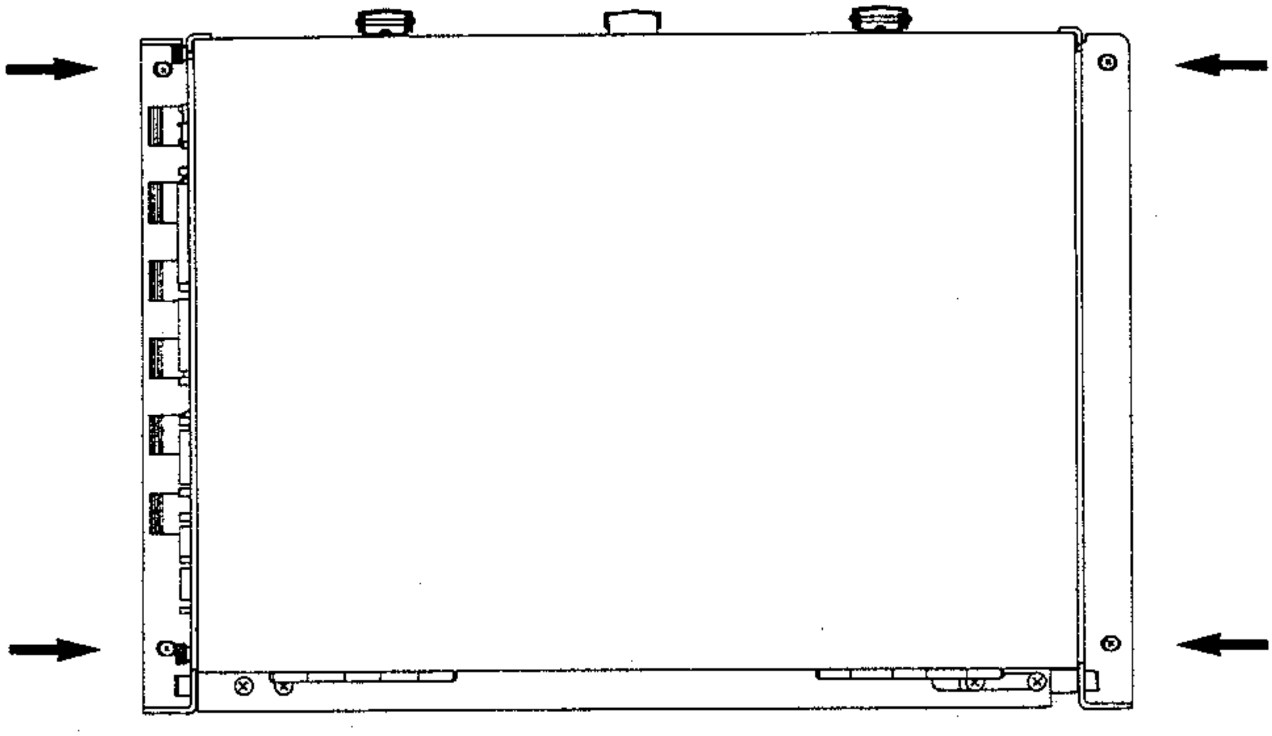


Loosen ground terminal ⏚ and
central signal ground B ⏚

D-Sub connector
Loosen knurled screws

NOTE:
If a PL400/410 is mounted on the upper side of the housing, it must be removed before dismounting the logic unit.

c) Loosen the 4 mounting screws on the logic unit



d) Remove the old logic unit and insert the new logic unit.

21.2.3 Mounting the Logic Unit

The logic unit is mounted in the reverse order that is was dismounted.

a) Insert and secure the logic unit.
b) Engage the connectors.

Observe that no connectors are switched!

c) Switch on the main switch.
d) Read in the machine tool data (machine parameters, PLC program, NC programs and tables) that have been backed up before the exchange.
e) Enter the pre-set values and the supplementary operating modes from the table in section 21.1.4 (**before** traversing the reference marks).
f) Offset adjustment with code number (see section 18.5).

Exchange is now finished.

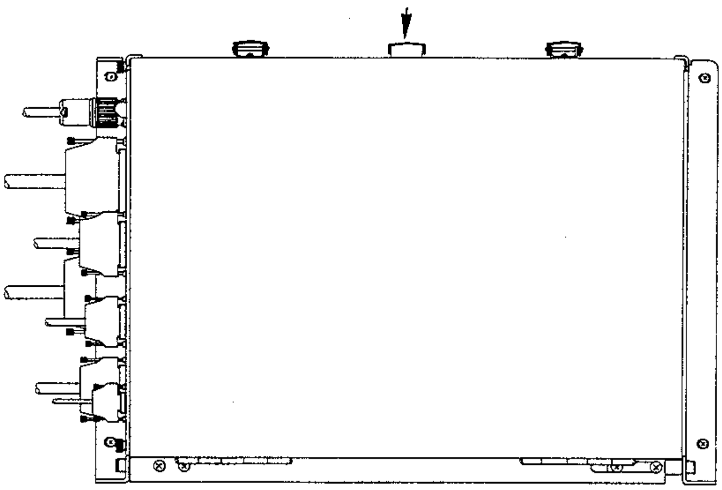
21.3 Exchanging the Processor Board

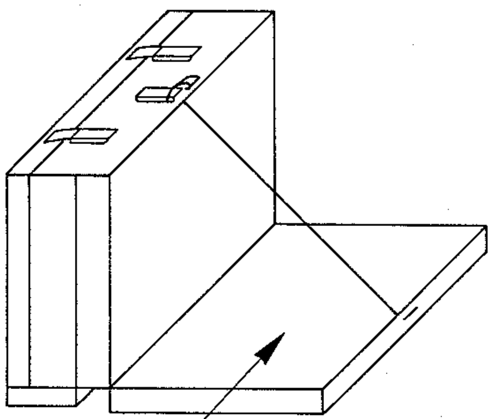
21.3.1 Observe the exchange instructions (section 21.1)!

21.3.2 Dismounting the Processor Board

a) Switch off the main switch on the machine tool.
b) Disengage the connectors on the processor board (X21, X22, X23).
c) Undo the lock and open the logic unit.

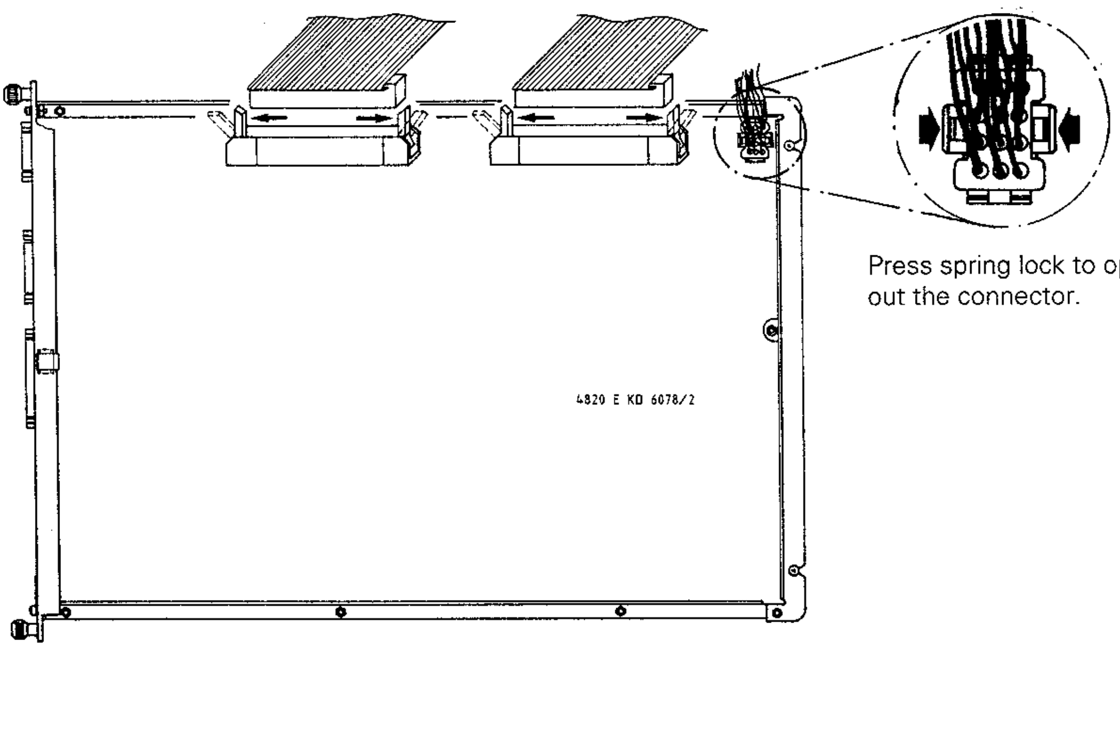
Undo lock





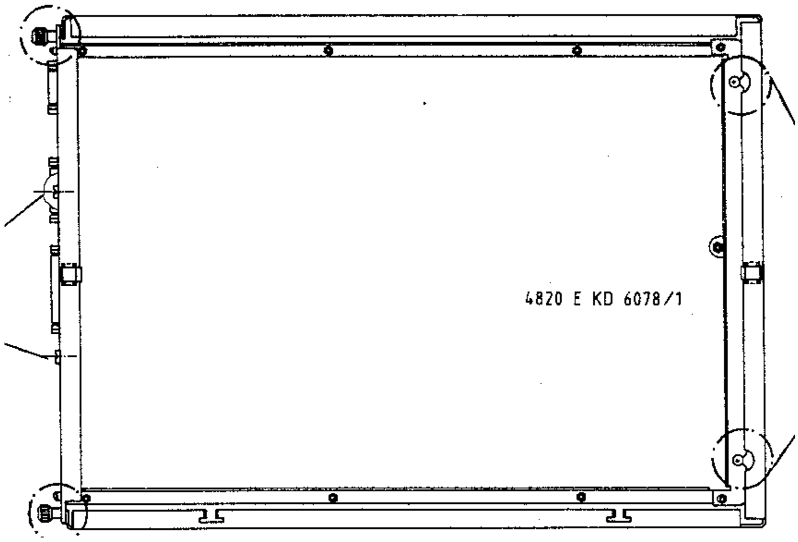
Processor board TNC 415B/425

d) Disengage internal connectors



Press spring lock to open it and pull out the connector.

e) Loosen/remove fixing screws



f) Lift out the processor board; exchange the EPROMs, if required
(see section 21.8). Insert the new board.

21.3.3 Mounting the Processor Board

The processor board is mounted in the reverse order that is was dismounted.

a) Insert and secure the processor board.
b) Engage the connectors.

Observe that no connectors are switched!

c) Close the logic unit and the lock.
d) Switch on the main switch.
e) Read in the machine data (machine parameters, PLC program, NC programs and tables) that have been backed up before the exchange.
f) Enter the pre-set values and the supplementary operating modes from the table in section 21.1.4 (**before** traversing the reference marks).
g) Offset adjustment with code number (see section 18.5).

Exchange is now finished.

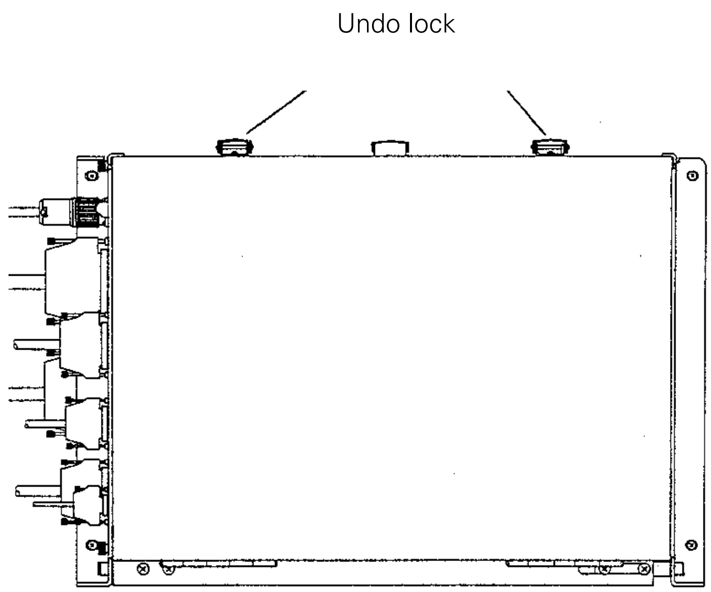
Warning!
Send and store the boards **only** in the **original packaging** that protects them from acquiring static charge. Never use conventional plastics to wrap the boards in.

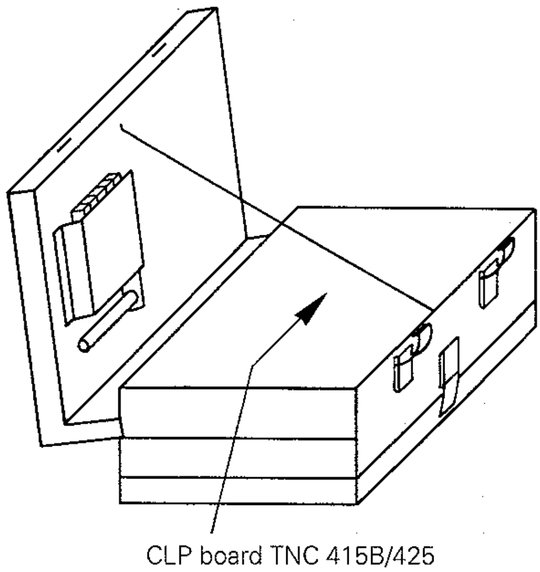
21.4 Exchanging the CLP Board

21.4.1 Observe the exchange instructions (section 21.1)!

21.4.2 Dismounting the CLP Board

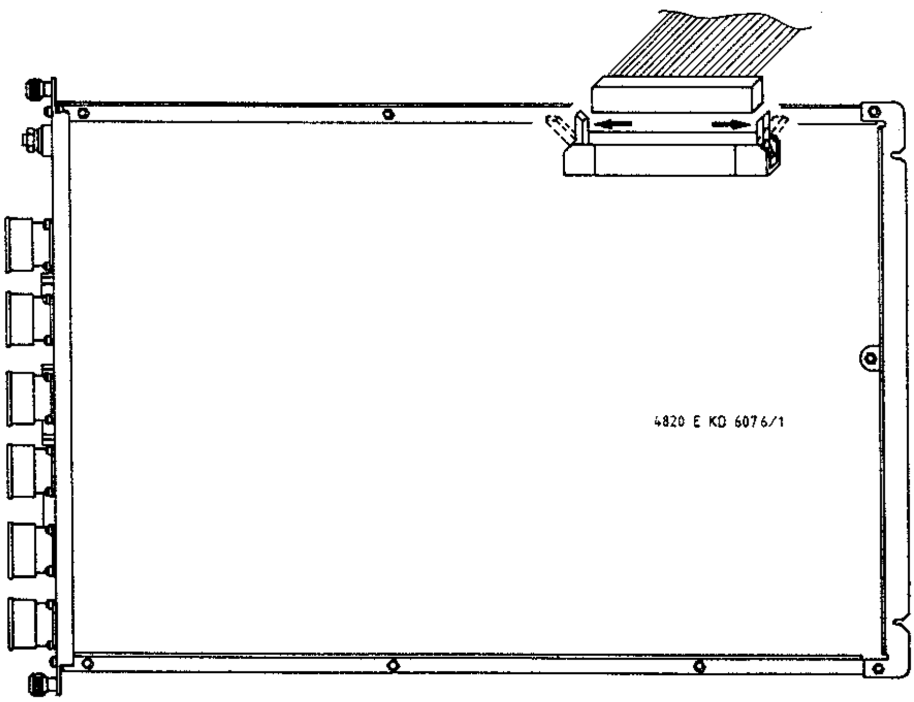
a) Switch off the main switch at the machine tool.
b) Disengage the connectors at the CLP board.
c) Undo the locks and open the logic unit.



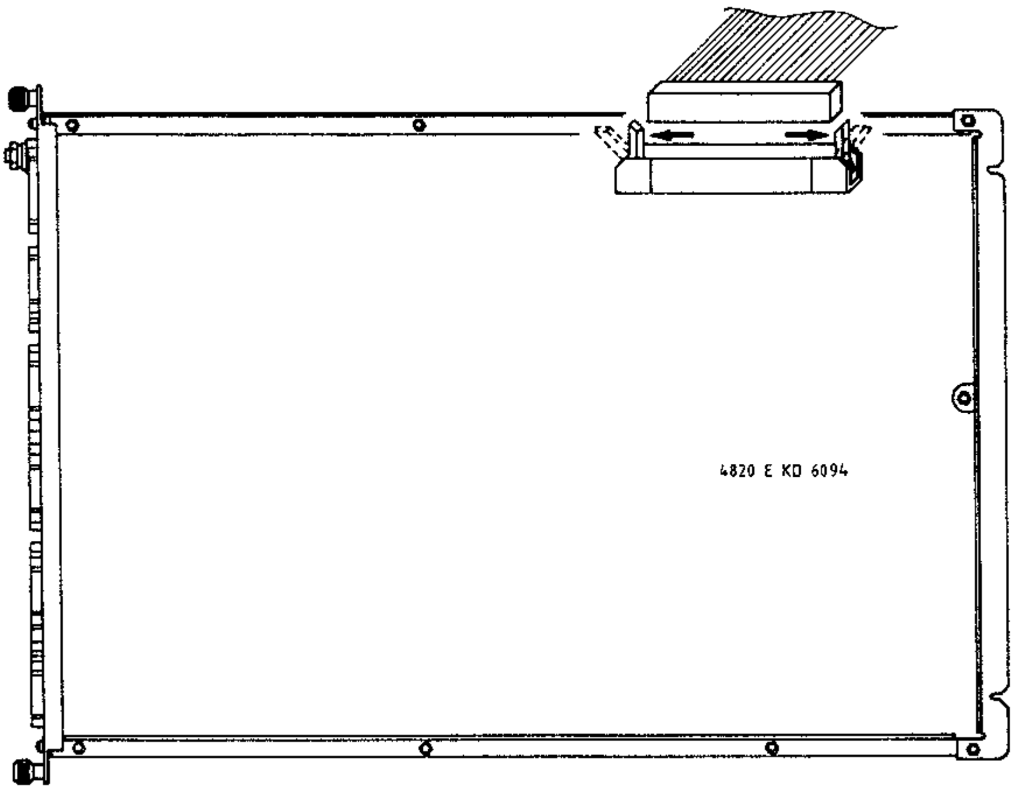


d) Disengage internal connectors

CLP board TNC 415B

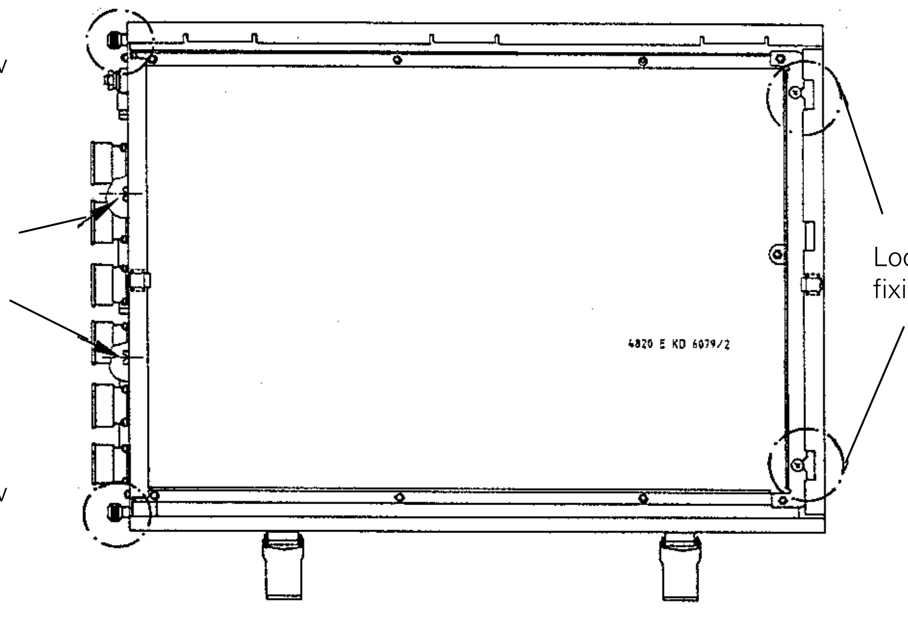


CLP board TNC 425

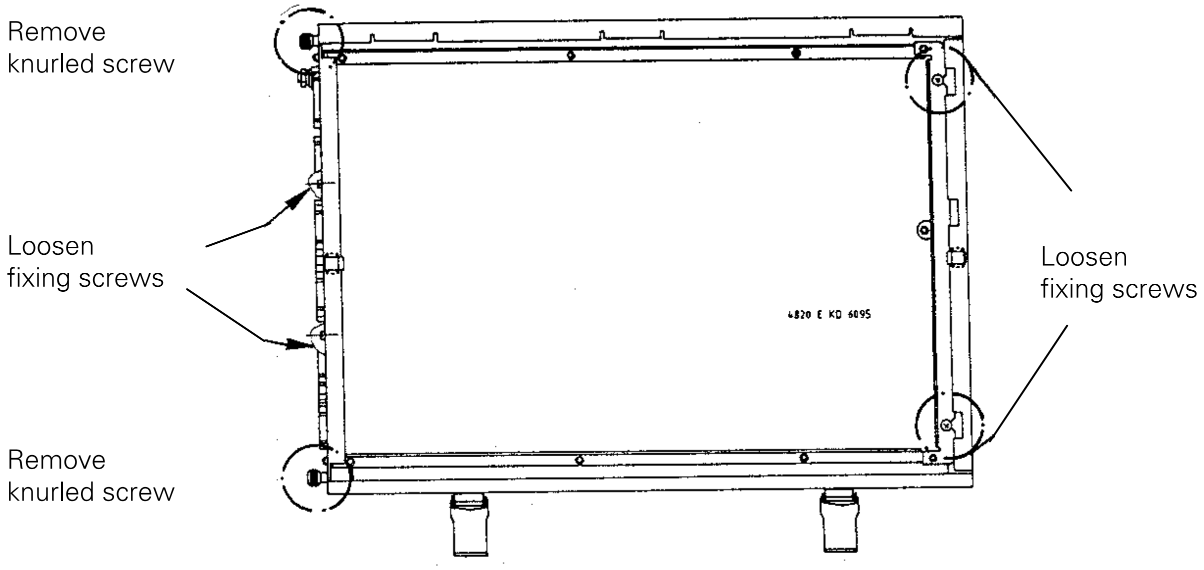


e) Loosen/remove the fixing screws.

CLP board TNC 415B



CLP board TNC 425



f) Lift out the CLP board; exchange the EPROM, if required (see section 21.8).
Insert the new board.

21.4.3 Mounting the CLP Board

The CLP board is mounted in the reverse order that is was dismounted.

a) Insert and secure the CLP board.
b) Engage the connectors.

Observe that no connectors are switched!

c) Close the logic unit and the locks.
d) Switch on the main switch.
e) Offset adjustment with code number (see section 18.5).

Exchange is now finished.

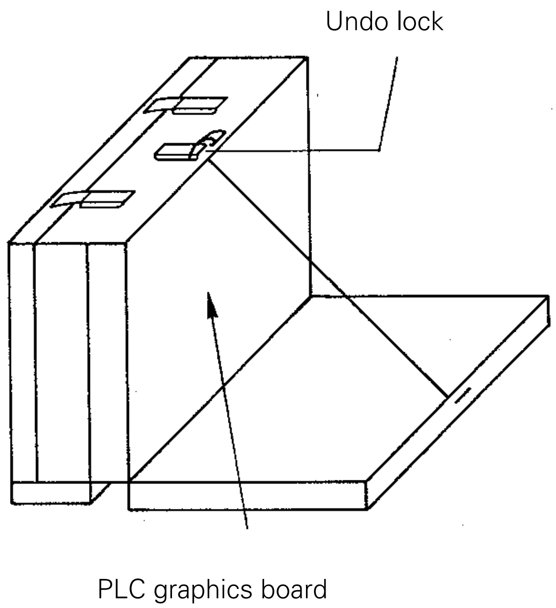
Warning!
Send and store the boards **only** in the **original packaging** that protects them from acquiring static charge. Never use conventional plastics to wrap the boards in.

21.5 Exchanging the PLC Graphics Board

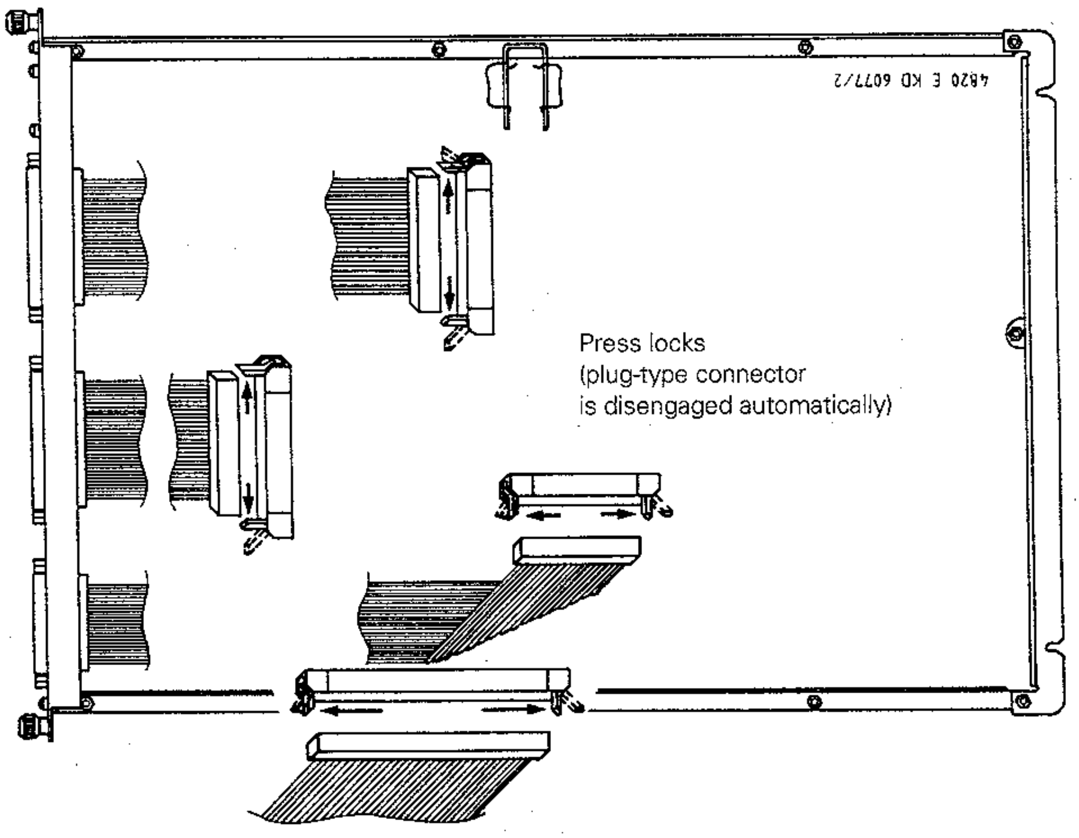
21.5.1 Observe the exchange instructions in section 21.1!

21.5.2 Dismounting the PLC Graphics Board

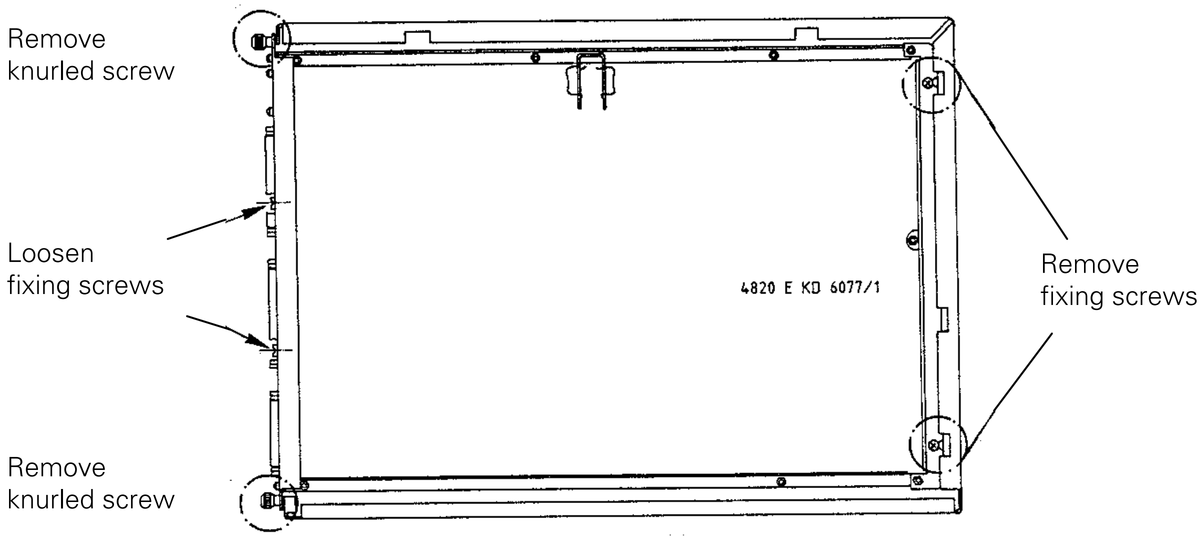
a) Switch off the main switch of the machine tool.
b) Disengage the connectors on the PLC graphics board.
c) Undo the lock and open the logic unit.



d) Disengage internal connectors.



e) Loosen/remove fixing screws



f) Lift out the PLC graphics board and insert the new board.

21.5.3 Mounting the PLC Graphics Board

The PLC graphics board is mounted in the reverse order that it was dismounted.

a) Insert and secure the PLC graphics board.
b) Engage the connectors.

Observe that no connectors are switched!

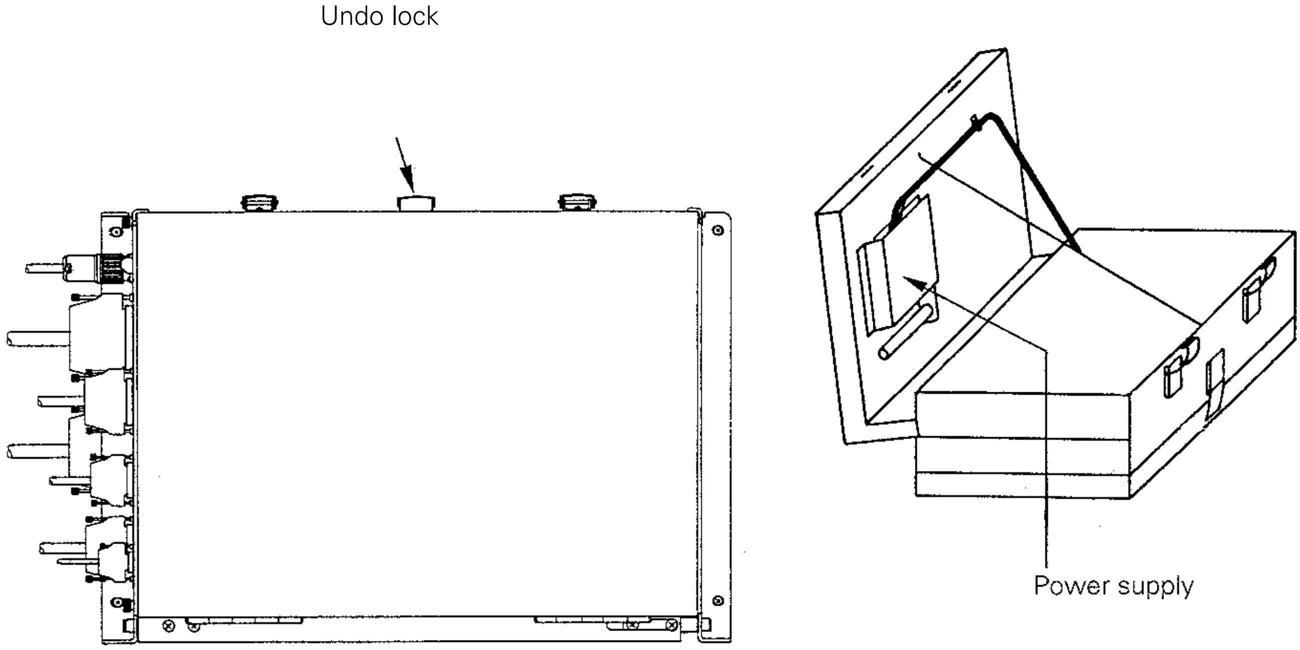
c) Close the logic unit and the lock.
d) Switch on the main switch.
e) Carry out offset adjustment with code number (see section 18.5).

Exchange is now finished.

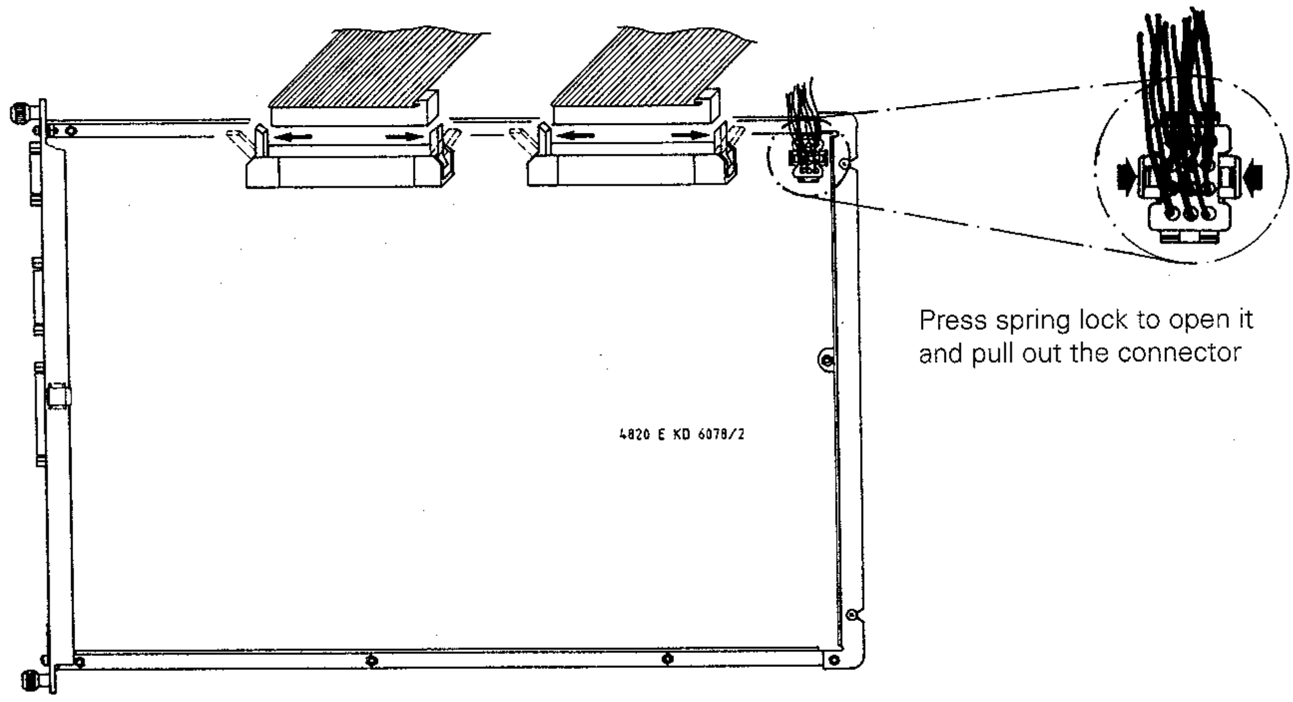
Warning!
Send and store the boards **only** in the **original packaging material** that protects them from acquiring static charge. Never use conventional plastics to wrap the boards in.

21.6 Exchanging the POWER SUPPLY Unit

a) **Observe the exchange instructions in section 21.1!**
b) Switch off the main switch on the machine tool.
c) Undo the lock and open the logic unit.



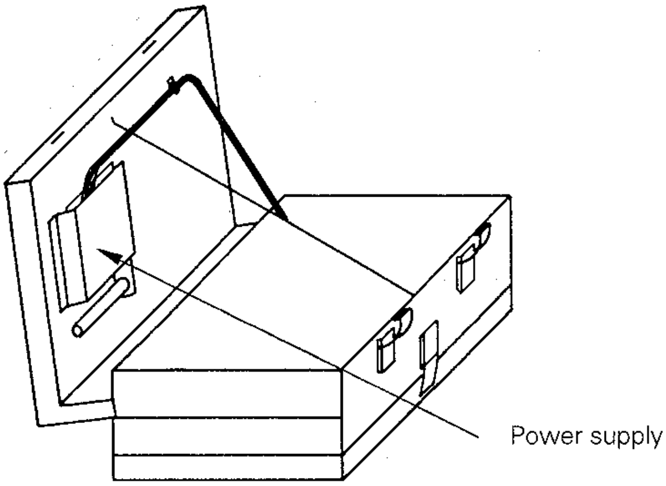
d) Disengage the connection to the power supply unit at the processor board.

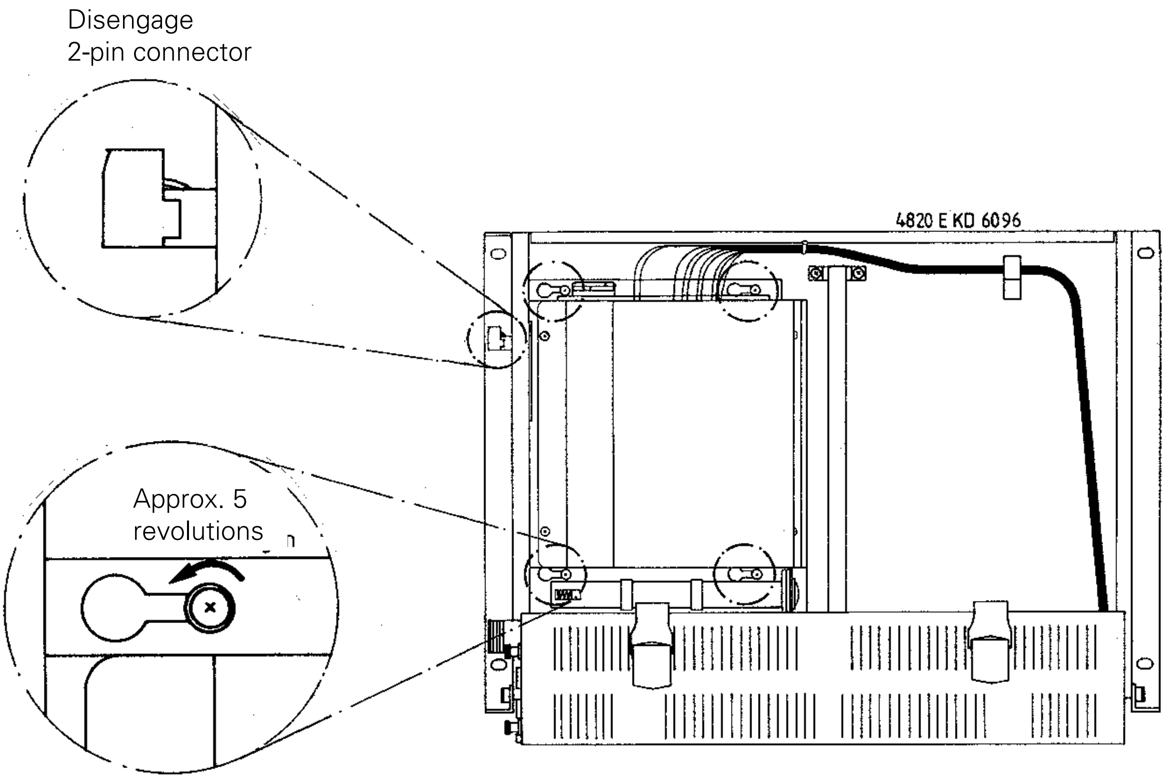


e) Pull the cable harness to the power supply through the housing.

To pull the cable harness the PLC graphics board and the CLP board must be removed.
(see sections 21.4 and 21.5)

f) Disengage the connector of the NC power supply and loosen the mounting screws.





Slide out the power supply unit to the right and insert the new power supply unit.

g) • Fasten the mounting screws.
• Pull the cable harness through the housing again.
• Engage the connectors.
• Close the logic unit, switch on the main switch.

Exchange is now finished.

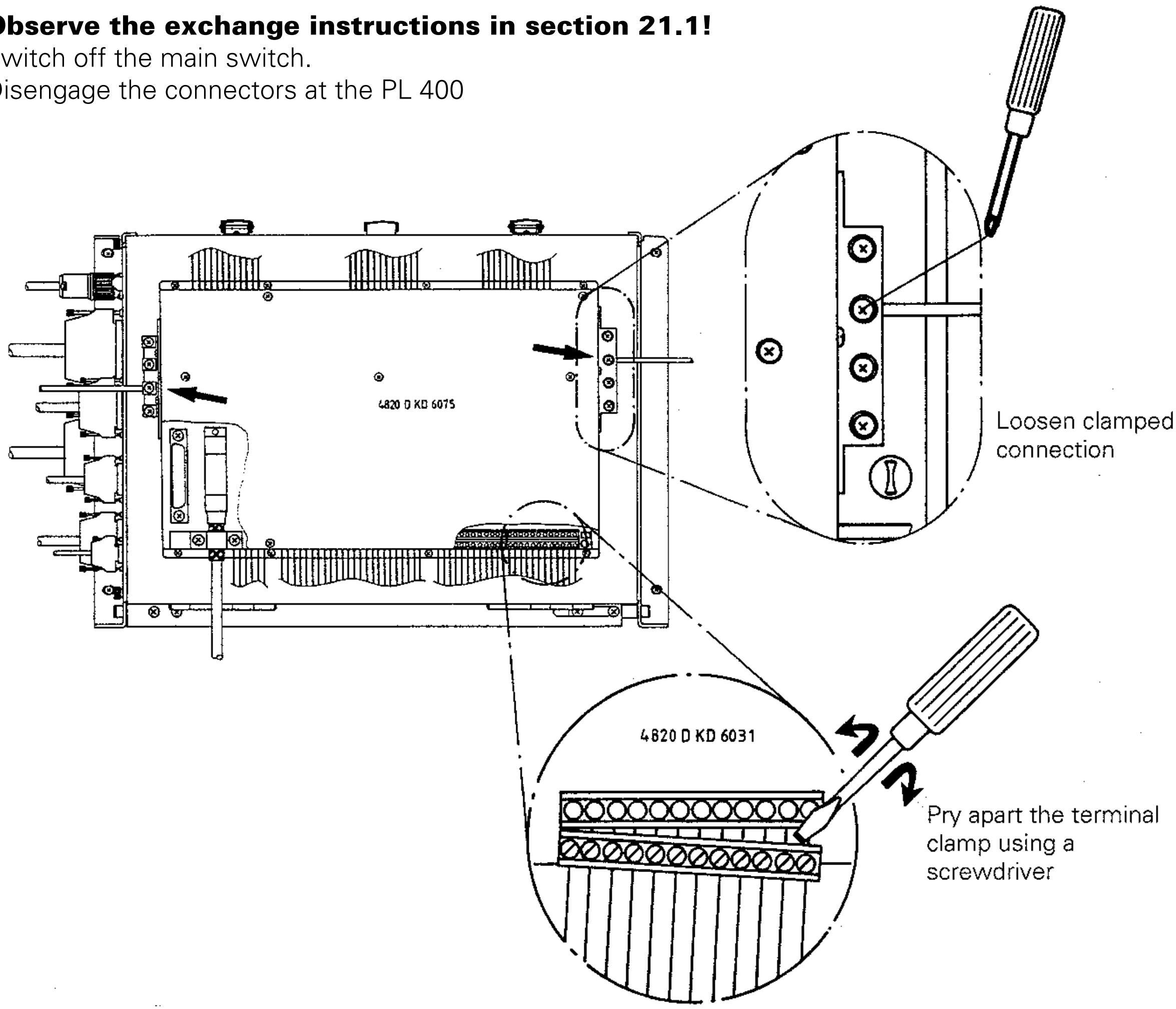
Observe that no connectors are switched!

Warning!
Send and store the boards **only** in the **original packaging material** that protects them from acquiring static charge. Never use conventional plastics to wrap the boards in.

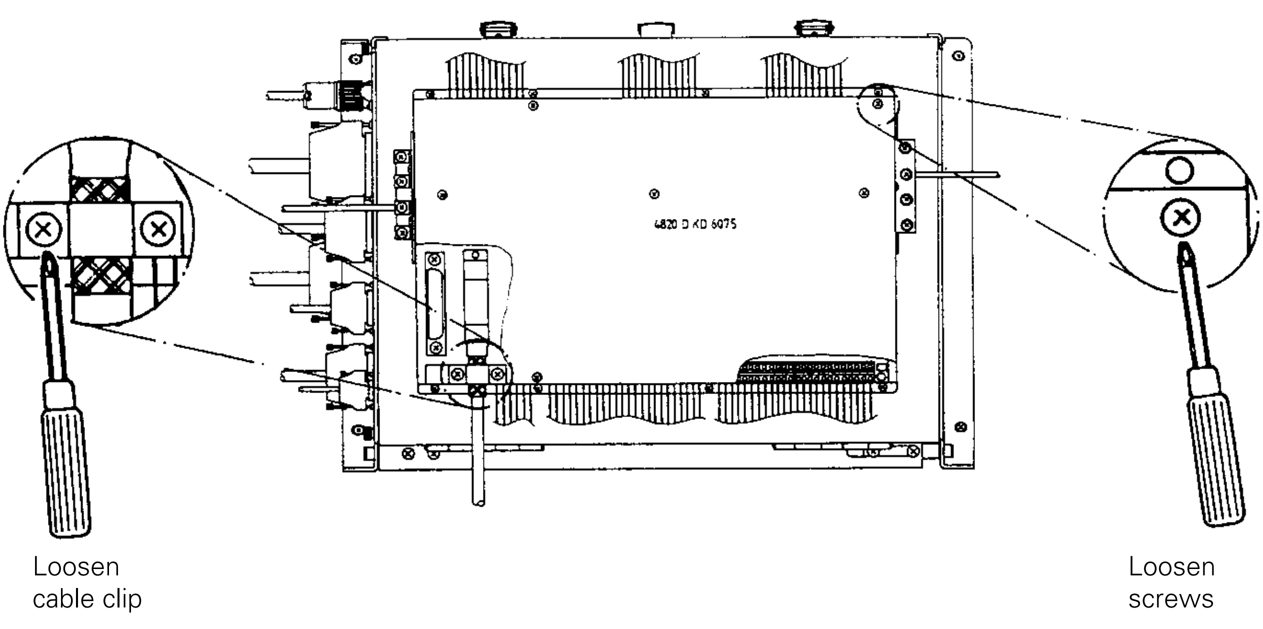
21.7 Exchanging the PLC I/O Boards

21.7.1 Exchanging the PLC I/O Board PL 400

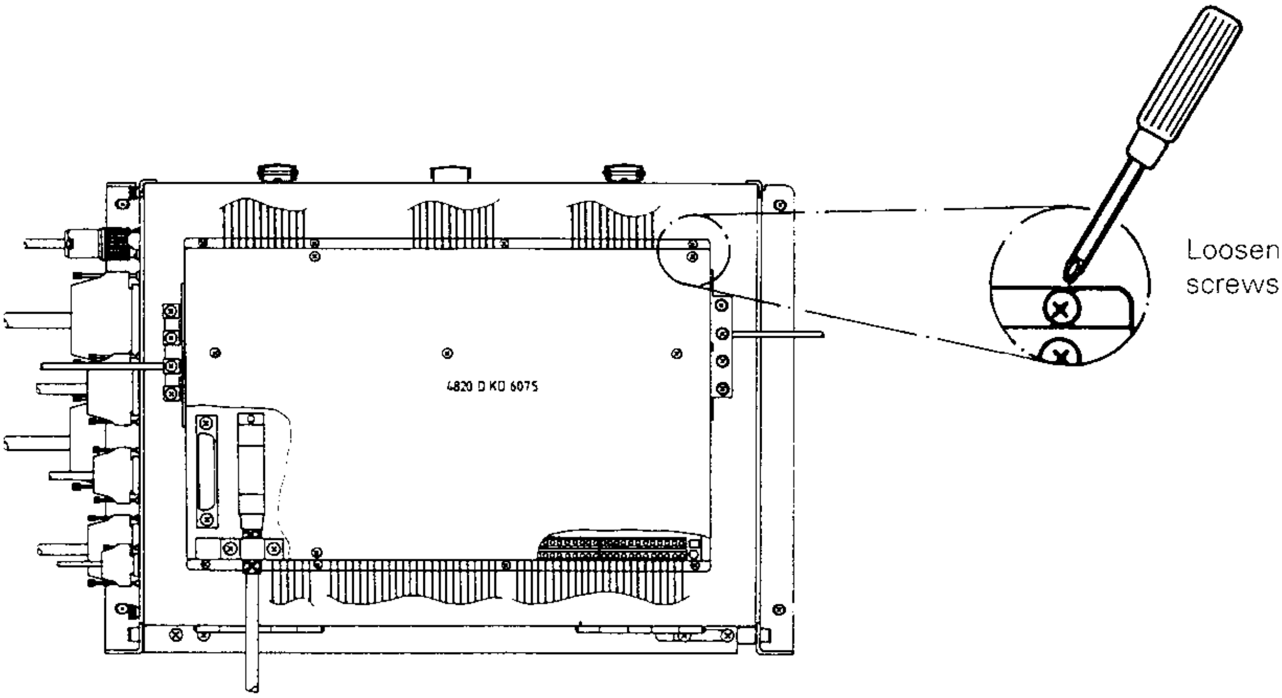
a) Observe the exchange instructions in section 21.1!
b) Switch off the main switch.
c) Disengage the connectors at the PL 400



d) Unscrew the cover of the PL 400 and disconnect the cable to the PLC graphics board from the PL 400.



e) Unscrew the PL 400 from the logic unit. [1]



f) The new PLC I/O board PL 400 is mounted in reverse order:
- Mount the PL 400 to the logic unit. [1]
- Engage the connectors.
- Switch on the main switch.

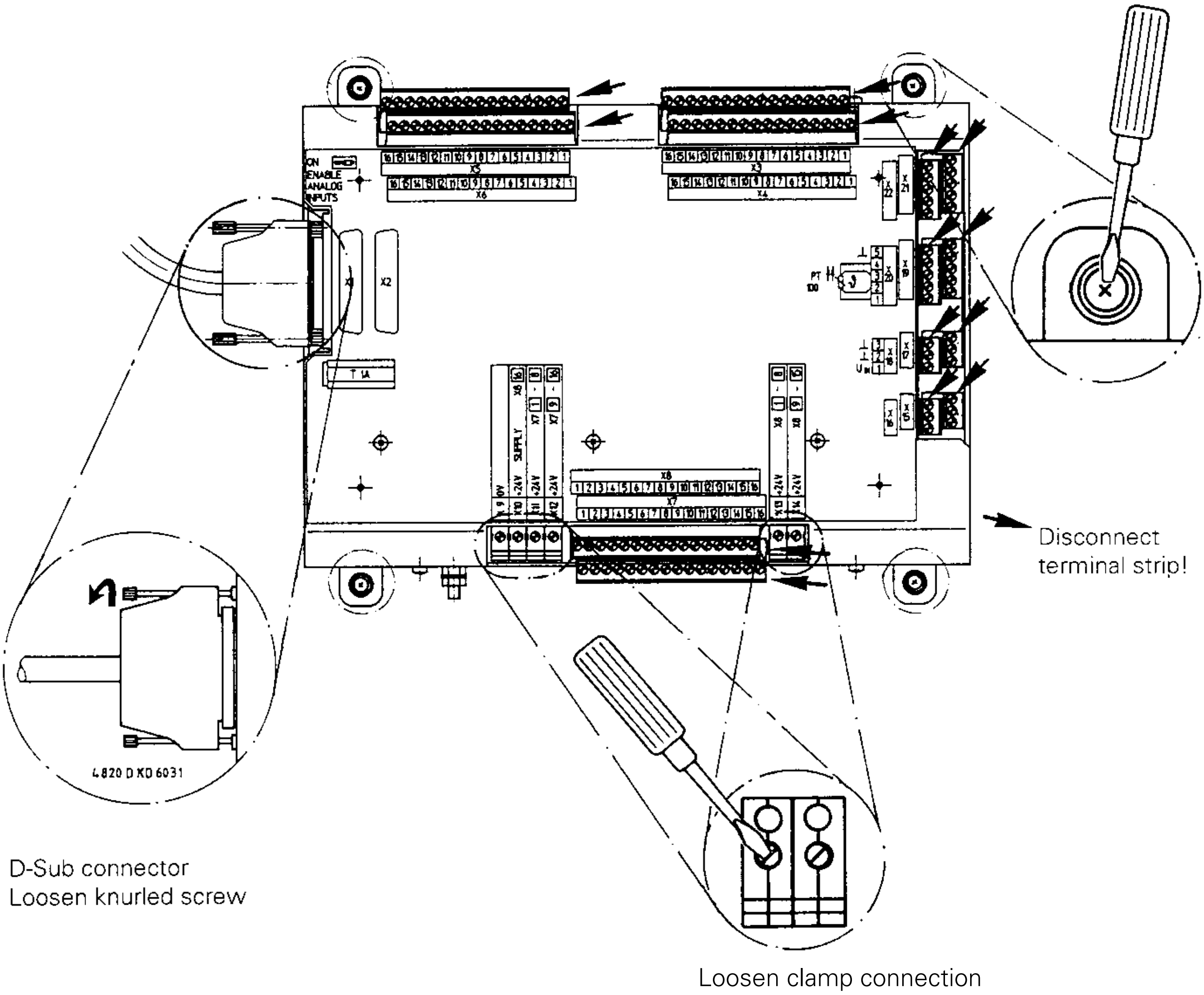
Exchange is now finished.

Warning!
Send and store the boards **only** in the **original packaging material** that protects them from acquiring static charge. Never use conventional plastics to wrap the boards in.

[1] The PL 400 may also be located in the switch cabinet.

21.7.2 Exchanging the PLC I/O Board PL 410

a) Observe the exchange instructions in section 21.1!
b) Switch off the main switch.
c) Loosen the connectors at the PL 410.



d) Loosen the PL 410 mounting screws

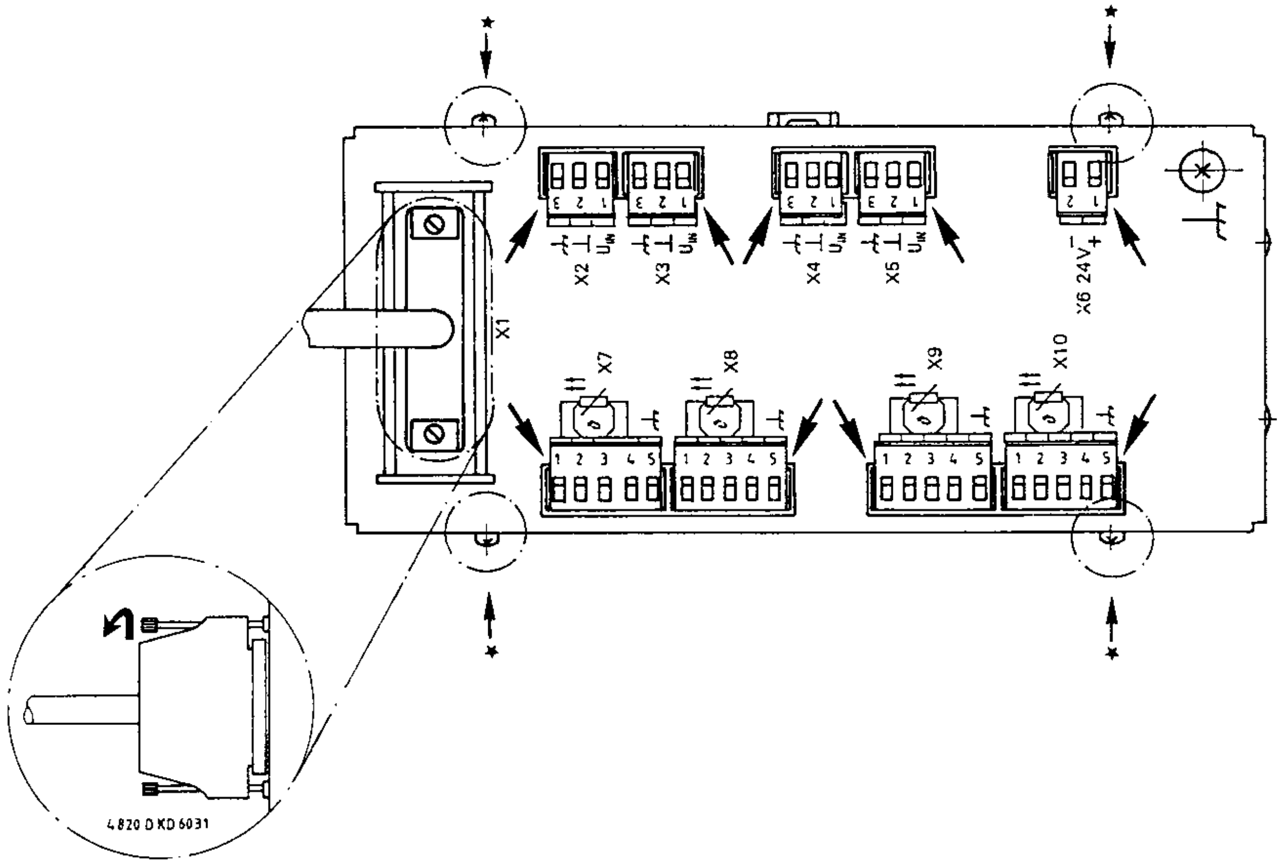
e) The new PLC I/O board PL 410 is mounted in reverse order:
- Engage all connectors.
- Check the correct position of the switch ENABLE ANALOGUE INPUTS.
  (ON position: analogue part activated, other position: analogue part not activated)
- Switch on the main switch.

Exchange is now finished.

Warning!
Send and store the boards **only** in the **original packaging material** that protects them from acquiring static charge. Never use conventional plastics to wrap the boards in.

21.7.3 Exchanging the Analogue Board PA 110

a) Observe the exchange instructions in section 21.1!
b) Switch off the main switch.
c) Disengage the connectors at the PA 110.



→ Disconnect terminal strip!

D-Sub connector
Loosen knurled screw

d) Dismounting the PA 110
The PA 110 may be fixed in two ways:
1) via fixing bar
Dismounting: Use a screwdriver to pry the lock upwards and remove the PA 110 from the bar.
2) via four mounting screws:
Dismounting:
• Loosen the mounting screws in the housing (* →)
• Unscrew the base plate and reassemble the PA for shipping.

e) The new PA 110 is mounted in reverse order:
• Engage the connectors.
• Switch on the main switch.

Exchange is now finished.

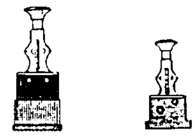
Warning!
Send and store the boards **only** in the **original packaging material** that protects them from acquiring static charge. Never use conventional plastics to wrap the boards in.

21.8 Exchanging the EPROMs

21.8.1 MOS Protection

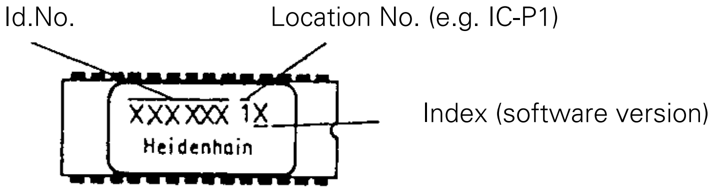
To exchange the EPROMs MOS protection is indispensable, as otherwise the EPROMs could be destroyed by static charge.

e.g. IC drawing punch and insertion tool

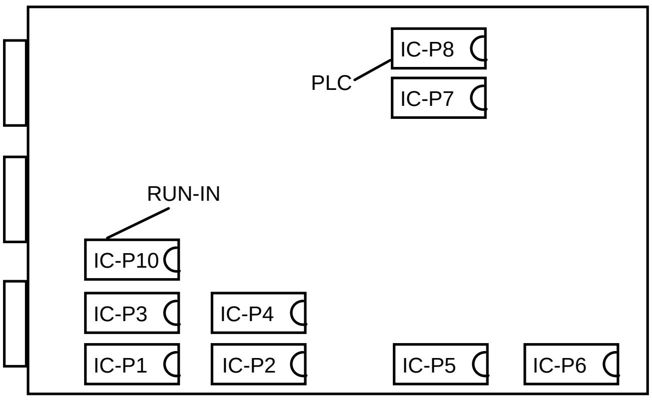


Observe the mark on the EPROMs (do not turn them by 180°); be sure not to damage any components during the exchanged. Use an appropriate tool. After the software exchange the logic unit must be marked with the new NC-software number (see sections 5.1 and 5.2).

21.8.2 EPROM Designation



PROCESSOR Board Id.No. 268 553 01

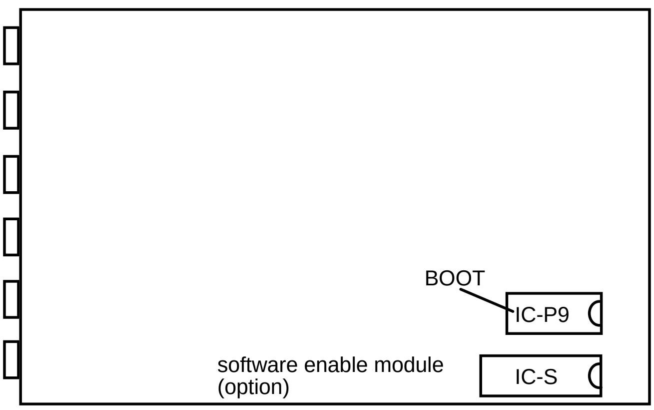


Note:

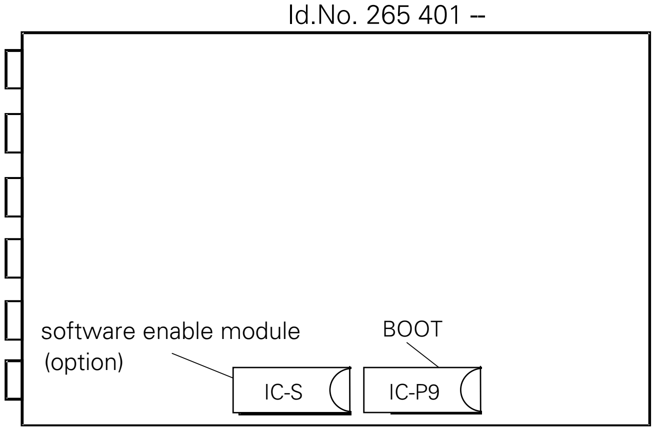
With the current software version IC-P3 / IC-P4 are not inserted.

RUN-IN: Internal test program (does not have to be exchanged together with the software)

CLP Board Id.No. 275 711 --
Id.No. 275 705 --



CLP Board Id.No. 268 927 --
Id.No. 265 401 --



22. Machine Parameter List

MACHINE PARAMETER LIST

(Excerpt from R.H. 1.0 TNC 415B/425, sections 5.1 and 5.2)

Code Numbers

123	MACHINE PARAMETER EDITING FOR END USERS (marked by *)
75368	OFFSET ADJUSTMENT
79513	VOLTAGE AND TEMPERATURE DISPLAY
86357	REMOVE EDIT/ERASE PROTECTION
95148	MP MODE
105296	COMPENSATION VALUE LIST
531210	RESET M 1000 TO M 2000 AND BYTES 0 - 127
620159	DOWNLOAD RUN-IN PROGRAM VIA INTERFACE
807667	PLC MODE
688379	INTERNAL OSCILLOSCOPE
951026	START RUN-IN PROGRAM FROM EPROM

Machine Parameters

In the following list the machine parameters for all software versions are listed.
Since however, certain machine parameters are only valid for a certain software version, or are only active from a certain software version on, columns with symbols for differentiation have been introduced after the machine parameter number.

Explanation of the Symbols:

◆ = The machine parameter applies for all software versions of this control.
04 = The machine parameter has been introduced with a certain software version (e.g. 04 means: introduced with software version 04).
I04 = The machine parameter is inactive.
- = The machine parameter is not available with this control.

Explanation of the Columns:

A = TNC 415B/F/BR/FR and TNC 425/E with NC software 259 93* -- or 259 94*
B = TNC 415B/F/BR/FR and TNC 425/E with NC software 280 54* -- or 280 56* -- (special software)
C = reserved
AE6 = entry values for operation with HEIDENHAIN test unit

User Parameters

By means of the MOD function "User Parameters" certain machine parameters can be altered easily (e.g. adaptation of the data interface). The user parameters that are accessible via this MOD function are determined in machine parameters by the machine tool manufacturer.

Input Values

Input values are e.g.

- the numbers 0 and 1 to select functions, algebraic signs or the counting direction or
- numerical values for feed rates, displacement etc.
- decimal input values that can be calculated by combining several functions (bit-coded)
- bit patterns (selectable with %)
  e.g. MP 10 : % 00111
  i.e. X,Y,Z with encoder (1)
  IV, V without encoder (0)
- hexadecimal values (selectable with $)
  e.g. MP 7353.0: $ 0F818A0

Structure

The machine parameters are subdivided into groups.
The parameter numbers are structured such that the list can be expanded easily.

0-999	Encoders and machine tool axes: allocation, evaluation, compensation
1000	Positioning
1400	Operation with feed precontrol
1700	Operation with servo lag
1900	Integral digital speed control (TNC 425)
2000	Integral speed and current control (TNC 426 PA)
3000	Spindle
4000	Integral PLC
5000	Adaptation of the data interface
6000	3D-touch probe (general parameters)
6200	Connection of measuring touch probe or touch trigger probe
6210	Digitizing with 3D-touch probe
6500	Tool calibration with TT 110
7100	Tapping
7200	Display and programming
7330	User parameters
7350	Colours, general display and FK graphics
7400	Operation and program run
7500	Tilting the working plane
7600	Hardware

Function		MP No.	Bit	A	B	C	Input		AE-6 Entry value
Axes with encoder		10		◆	◆	◆	0 =	no encoder	
	X		0				+1 =	X axis with encoder	% 11111
	Y		1				+2 =	Y axis with encoder	
	Z		2				+4 =	Z axis with encoder	
	IV		3				+8 =	IV. axis with encoder	
	V		4				+16 =	V. axis with encoder	
Encoder monitoring		30		◆	◆	◆	0 =	no axis monitored	
Absolute position of distance-coded	X		0				+1 =	X axis monitored	% 111111
reference marks	Y		1				+2 =	Y axis monitored	
	Z		2				+4 =	Z axis monitored	
	IV		3				+8 =	IV. axis monitored	
	V		4				+16 =	V. axis monitored	
	S		5				+32 =	S axis monitored	
Signal amplitude		31		◆	◆	◆	0 =	no axis monitored	
	X		0				+1 =	X axis monitored	% 111111
	Y		1				+2 =	Y axis monitored	
	Z		2				+4 =	Z axis monitored	
	IV		3				+8 =	IV. axis monitored	
	V		4				+16 =	V. axis monitored	
	S		5				+32 =	S axis monitored	
Edge separation		32		◆	◆	◆	0 =	no axis monitored	
	X		0				+1 =	X axis monitored	% 111111
	Y		1				+2 =	Y axis monitored	
	Z		2				+4 =	Z axis monitored	
	IV		3				+8 =	IV. axis monitored	
	V		4				+16 =	V. axis monitored	
	S		5				+32 =	S axis monitored	

Function		MP No.	Bit	A	B	C	Input		AE-6 Entry value
VDU display		40					0 =	no axis displayed	
	X		0	◆	◆	◆	+1 =	X axis displayed	% 111111
	Y		1	◆	◆	◆	+2 =	Y axis displayed	
	Z		2	◆	◆	◆	+4 =	Z axis displayed	
	IV		3	◆	◆	◆	+8 =	IV. axis displayed	
	V		4	◆	◆	◆	+16 =	V. axis displayed	
	S		5	08	◆	◆	+32 =	position of regulated spindle (not with M03/M04)	
Controlled axes		50		◆	◆	◆	0 =	no axis controlled	
	X		0				+1 =	X axis controlled	% 11111
	Y		1				+2 =	Y axis controlled	
	Z		2				+4 =	Z axis controlled	
	IV		3				+8 =	IV. axis controlled	
	V		4				+16 =	V. axis controlled	
PLC auxiliary axes		60		◆	◆	◆	0 =	no auxiliary axis	
	X						+1 =	X axis is auxiliary axis	% 00000
	Y						+2 =	Y axis is auxiliary axis	
	Z						+4 =	Z axis is auxiliary axis	
	IV						+8 =	IV. axis is auxiliary axis	
	V						+16 =	V. axis is auxiliary axis	
Assignment of the encoder inputs to the machine axes							0 to 5		
							TNC 415B/426CA:	TNC 425: / TNC 426PA:[2]	
	X	110.0		◆	◆	◆	0 = X1	0 = X1/X15 / 0 = X1	0
	Y	110.1		◆	◆	◆	1 = X2	1 = X2/X16 / 1 = X2	1
	Z	110.2		◆	◆	◆	2 = X3	2 = X3/X17 / 2 = X3	2
	IV	110.3		◆	◆	◆	3 = X4	3 = X4/X18 / 3 = X4	3
	V	110.4		◆	◆	◆	4 = X5	4 = X5/X19 / 4 = X5	4
							5 = X6[1]	5 = X6[1] / 5 = X6[1]	

[1] X6 may only be used for a machine axis, if no regulated spindle (GS) is required.
[2] The input assignment for the speed encoders (X15 - X20) is fixed: X15 = X axis, X16 = Y axis etc.

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Assignment of the nominal value							0 to 5	
outputs to the machine axes	X	120.0		◆	◆	◆	0 = output 1	0
(no function, if MP 2000.X ≠ 0)	Y	120.1		◆	◆	◆	1 = output 2	1
	Z	120.2		◆	◆	◆	2 = output 3	2
	IV	120.3		◆	◆	◆	3 = output 4	3
	V	120.4		◆	◆	◆	4 = output 5	4
							5 = output S [1]	
Count direction of the encoder		210		◆	◆	◆	0 = positive	
signals	X		0				+1 = X axis negative	(% 00000)
	Y		1				+2 = Y axis negative	
	Z		2				+4 = Z axis negative	
	IV		3				+8 = IV. axis negative	
	V		4				+16 = V. axis negative	
Signal period							0.1 to 1000[µm]	
(displacement per grating period; consider	X	330.0		◆	◆	I02		20
the screw pitch when using a rotary	Y	330.1		◆	◆	I02		20
encoder.)	Z	330.2		◆	◆	I02		20
With square-wave input signals the	IV	330.3		◆	◆	I02		20
displacement per square-wave period	V	330.4		◆	◆	I02		20
must be entered. (Consider external interpolation.)								
Calculation of the signal period								
Path for counting pulses from	X	331.0		-	-	02	0 to 99 999.9999 [mm]	0.02
MP 332.X	Y	331.1		-	-	02		0.02
	Z	331.2		-	-	02		0.02
	IV	331.3		-	-	02		0.02
	V	331.4		-	-	02		0.02
Number of counting pulses from	X	332.0		-	-	02	1 to 16 177 215 [counting pulses]	1
MP 331.X	Y	332.1		-	-	02	The TNC automatically calculates the signal period.	1
	Z	332.2		-	-	02		1
	IV	332.3		-	-	02	signal period [mm] = $\frac{MP331}{MP332}$	1
	V	332.4		-	-	02		1

[1] S-analogue may only be used for a machine axis, if no analogue output of the spindle speed is required.

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Interpolation factor of the EXE							0, 1, 5	
at the encoder input	X	340.0		◆	◆	-		0
(TNC 415BR/FR only)	Y	340.1		◆	◆	-	0 = no EXE	0
	Z	340.2		◆	◆	-	1 = 1-fold EXE	0
	IV	340.3		◆	◆	-	5 = 5-fold EXE	0
	V	340.4		◆	◆	-		0
Axis designation								
	IV	410.3		◆	◆	◆	0 = A 1 = B 2 = C	4
	V	410.4		◆	◆	◆	3 = U 4 = V 5 = W	5
Hirth coupling								
Activation	IV	420.3		◆	◆	◆	0 = inactive	0
	V	420.4		◆	◆	◆	1 = active	0
Prescribed step	IV	430.3		◆	◆	◆	0 to 30.0000 [°]	1
	V	430.4		◆	◆	◆		1

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Axis correction:								
Backlash compensation	X	710.0		◆	◆	◆	-1.0000 to +1.0000 [mm]	0
	Y	710.1		◆	◆	◆		0
	Z	710.2		◆	◆	◆		0
	IV	710.3		◆	◆	◆		0
	V	710.4		◆	◆	◆		0
Compensation of reversal spikes in circular interpolation								
• magnitude of reversal spike	X	711.0		◆	◆	◆	0 to 1 [mm]	0
	Y	711.1		◆	◆	◆		0
	Z	711.2		◆	◆	◆		0
	IV	711.3		◆	◆	◆		0
	V	711.4		◆	◆	◆		0
• feed rate to compensate the reversal spike	X	712.0		◆	◆	◆	0 to 1 [mm per CLP cycle time]	0
	Y	712.1		◆	◆	◆		0
	Z	712.2		◆	◆	◆		0
	IV	712.3		◆	◆	◆		0
	V	712.4		◆	◆	◆		0
• magnitude of reversal spike (only effective with M05)	X	715.0		08	◆	◆	0 to 1 [mm]	0
	Y	715.1		08	◆	◆		0
	Z	715.2		08	◆	◆		0
	IV	715.3		08	◆	◆		0
	V	715.4		08	◆	◆		0
• feed rate to compensate the reversal spike (only effective with M05)	X	716.0		08	◆	◆	0 to 1 [mm per CLP cycle time]	0
	Y	716.1		08	◆	◆		0
	Z	716.2		08	◆	◆		0
	IV	716.3		08	◆	◆		0
	V	716.4		08	◆	◆		0

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Factor for multipoint axis error compensation	X	720.0		◆	◆	◆	-1.0000 to +1.0000 [mm/m]	0
	Y	720.1		◆	◆	◆		0
	Z	720.2		◆	◆	◆		0
	IV	720.3		◆	◆	◆		0
	V	720.4		◆	◆	◆		0
Multipoint axis error compensation		730		◆	◆	◆	0 = linear compensation active	% 00000
	X		0				+1 = X axis, multipoint compensation active	
	Y		1				+2 = Y axis, multipoint compensation active	
	Z		2				+4 = Z axis, multipoint compensation active	
	IV		3				+8 = IV. axis, multipoint compensation active	
	V		4				+16 = V. axis, multipoint compensation active	
Display mode							0 to ± 99 999.9999 [mm] or [°]	
for rotary axes and PLC auxiliary axes	X	810.0		◆	◆	◆	0 = display ± 99 999.9999	0
	Y	810.1		◆	◆	◆	(software limit switch active)	0
	Z	810.2		◆	◆	◆	≠ 0 modulo value for display	0
	IV	810.3		◆	◆	◆	(software limit switch inactive)	0
	V	810.4		◆	◆	◆		0

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Gantry axes							0 to 5	
Configuration	X	850.0		08	◆	◆		0
	Y	850.1		08	◆	◆	0 = main axis	0
	Z	850.2		08	◆	◆	1 = tracked to X axis	0
	IV	850.3		08	◆	◆	2 = tracked to Y axis	0
	V	850.4		08	◆	◆	3 = tracked to Z axis	0
							4 = tracked to IV. axis	
							5 = tracked to V. axis	
Monitoring the synchronized movement of							0 to 100.0000 [mm]	
the coupled axes	X	855.0		-	02	06	0 = monitoring inactive	0
	Y	855.1		-	02	06	≠ 0 maximum deviation of master	0
	Z	855.2		-	02	06	and slave axes	0
	IV	855.3		-	02	06		0
	V	855.4		-	02	06		0
Defining the relationship between the axes							0, 1	
	X	860.0		08	◆	◆	0 = referenced to position after power-on	0
	Y	860.1		08	◆	◆	1 = referenced to REF marks (machine datum)	0
	Z	860.2		08	◆	◆		0
	IV	860.3		08	◆	◆		0
	V	860.4		08	◆	◆		0

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
Software limit switch ranges							
Range 1	X+	910.0	◆	◆		linear axis:	+99 999.9999
Default setting after power-on:	Y+	910.1	◆	◆		-99 999.9999 to +99 999.9999 [mm]	"
	Z+	910.2	◆	◆			"
Activation by PLC:	IV+	910.3	◆	◆		rotary axis:	"
M2817 = 0, M2816 = 0	V+	910.4	◆	◆		-99 999.9999 to +99 999.9999 [°]	"
strobe marker M2824	X-	920.0	◆	◆			-99 999.9999
	Y-	920.1	◆	◆			"
	Z-	920.2	◆	◆			"
	IV-	920.3	◆	◆			"
	V-	920.4	◆	◆			"
Range 2							
	X+	911.0	◆	◆			+99 999.9999
Activation by PLC:	Y+	911.1	◆	◆			"
M2817 = 0, M2816 = 1	Z+	911.2	◆	◆			"
strobe marker M2824	IV+	911.3	◆	◆			"
	V+	911.4	◆	◆			"
	X-	921.0	◆	◆			-99 999.9999
	Y-	921.1	◆	◆			"
	Z-	921.2	◆	◆			"
	IV-	921.3	◆	◆			"
	V-	921.4	◆	◆			"
Range 3							
	X+	912.0	◆	◆			+99 999.9999
Activation by PLC:	Y+	912.1	◆	◆			"
M2817 = 1, M2816 = 1	Z+	912.2	◆	◆			"
strobe marker M2824	IV+	912.3	◆	◆			"
	V+	912.4	◆	◆			"
	X-	922.0	◆	◆			-99 999.9999
	Y-	922.1	◆	◆			"
	Z-	922.2	◆	◆			"
	IV-	922.3	◆	◆			"
	V-	922.4	◆	◆			"

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Datum for positioning blocks with M92 (referenced to the machine datum)	X	950.0		◆	◆	◆	linear axis:	0
	Y	950.1		◆	◆	◆	-99 999.9999 to +99 999.9999 [mm]	0
	Z	950.2		◆	◆	◆		0
	IV	950.3		◆	◆	◆	rotary axis:	0
	V	950.4		◆	◆	◆	-99 999.9999 to +99 999.9999 [°]	0
Target position for simulated tool change for TOOL CALL with block scan	X	951.0		08	◆	◆	linear axis:	0
	Y	951.1		08	◆	◆	-99 999.9999 to +99 999.9999 [mm]	0
	Z	951.2		08	◆	◆		0
	IV	951.3		08	◆	◆	rotary axis:	0
	V	951.4		08	◆	◆	-99 999.9999 to +99 999.9999 [°]	0
Shifting the machine datum (referenced to the REF mark of the encoder)	X	960.0		◆	◆	◆	linear axis:	0
	Y	960.1		◆	◆	◆	-99 999.9999 to +99 999.9999 [mm]	0
	Z	960.2		◆	◆	◆		0
	IV	960.3		◆	◆	◆	rotary axis:	0
	V	960.4		◆	◆	◆	-99 999.9999 to +99 999.9999 [°]	0

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Rapid traverse	X	1010.0		◆	◆	◆	linear axis:	10000
	Y	1010.1		◆	◆	◆	10 to 30 000 [mm/min]	"
	Z	1010.2		◆	◆	◆	rotary axis:	"
	IV	1010.3		◆	◆	◆	10 to 30 000 [°/min]	"
	V	1010.4		◆	◆	◆		"
Manual feed	X	1020.0		◆	◆	◆	linear axis:	10000
	Y	1020.1		◆	◆	◆	10 to 30 000 [mm/min]	"
	Z	1020.2		◆	◆	◆	rotary axis:	"
	IV	1020.3		◆	◆	◆	10 to 30 000 [°/min]	"
	V	1020.4		◆	◆	◆		"
Positioning window	X	1030.0		◆	◆	◆	linear axis:	0.05
	Y	1030.1		◆	◆	◆	0.0001 to 2.0000 [mm]	"
	Z	1030.2		◆	◆	◆	rotary axis	"
	IV	1030.3		◆	◆	◆	0.0001 to 2.0000 [°]	"
	V	1030.4		◆	◆	◆		"
Polarity		1040		◆	◆	◆	0 = positive	
of the nominal value voltage	X		0				+1 = X axis negative	% 00000
(TNC 415B/425 [1)]/426CA)	Y		1				+2 = Y axis negative	
or of the nominal shaft speed	Z		2				+4 = Z axis negative	
(TNC 425/426PA)	IV		3				+8 = IV. axis negative	
with positive traverse direction	V		4				+16 = V. axis negative	
Analogue voltage for rapid traverse	X	1050.0		◆	◆	◆	4.5 to 9 [V]	9
	Y	1050.1		◆	◆	◆		9
	Z	1050.2		◆	◆	◆	no function with TNC 426 PA	9
	IV	1050.3		◆	◆	◆	(entry value: 1)	9
	V	1050.4		◆	◆	◆		9

[1)] analogue controlled

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
Acceleration	X	1060.0	◆	◆	◆	0.001 to 3.0 [m/s²]	1
	Y	1060.1	◆	◆	◆		1
	Z	1060.2	◆	◆	◆		1
	IV	1060.3	◆	◆	◆		1
	V	1060.4	◆	◆	◆		1
Radial acceleration		1070	◆	◆	◆	0.0001 to 3.0 [m/s²]	1.5
Integral factor [1]	X	1080.0	◆	◆	◆	0 to 65 535	0
	Y	1080.1	◆	◆	◆		0
	Z	1080.2	◆	◆	◆		0
	IV	1080.3	◆	◆	◆		0
	V	1080.4	◆	◆	◆		0
Standstill monitoring	X	1110.0	◆	◆	◆	0.0001 to 30 [mm]	0.1
	Y	1110.1	◆	◆	◆		0.1
	Z	1110.2	◆	◆	◆		0.1
	IV	1110.3	◆	◆	◆		0.1
	V	1110.4	◆	◆	◆		0.1
							0.1
Movement monitoring	X	1140.0	◆	◆	◆	0.03 to 10 [V] for TNC 415B/425 [1]	1
	Y	1140.1	◆	◆	◆	0.03 to 10 [1000/min] for TNC 426 PA	1
	Z	1140.2	◆	◆	◆	**Note:** entry value 10 ⇨ monitoring **inactive**	1
	IV	1140.3	◆	◆	◆		1
	V	1140.4	◆	◆	◆		1
							1
Time out to switch off the residual voltage on error message "Positioning Error"		1150	◆	◆	◆	0 to 65 535 [s]	0
Automatic cyclical [2] **offset adjustment**		1220	◆	◆	◆	1 to 65 535 [s] 0 = no automatic adjustment	1

[1] analogue controlled
[2] no function with TNC 425 (MP 1900 ≠ 0) and TNC 426 PA (MP 2000 ≠ 0): entry value = 0

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Reference mark evaluation		1320		◆	◆	◆	0 = positive	
Direction for traversing the reference marks	X		0				+1 = X axis negative	% 00000
	Y		1				+2 = Y axis negative	
	Z		2				+4 = Z axis negative	
	IV		3				+8 = IV. axis negative	
	V		4				+16 = V. axis negative	
Feed rate for traversing the reference marks								
	X	1330.0		◆	◆	◆	linear axis:	10 000
	Y	1330.1		◆	◆	◆	10 to 30 000 [mm/min]	"
	Z	1330.2		◆	◆	◆		"
	IV	1330.3		◆	◆	◆	rotary axis:	"
	V	1330.4		◆	◆	◆	10 to 30 000 [°/min]	"
Feed rate for leaving the reference end-								
position	X	1331.0		◆	◆	◆	linear axis:	200
(only if MP1350 = 2)	Y	1331.1		◆	◆	◆	10 to 500 [mm/min]	"
	Z	1331.2		◆	◆	◆		"
	IV	1331.3		◆	◆	◆	rotary axis:	"
	V	1331.4		◆	◆	◆	10 to 500 [°/min]	"
Axis sequence for reference mark traverse							0 = no ref. mark traverse	
	1. axis	1340.0		◆	◆	◆	1 = X	1
	2. axis	1340.1		◆	◆	◆	2 = Y	2
	3. axis	1340.2		◆	◆	◆	3 = Z	3
	4. axis	1340.3		◆	◆	◆	4 = IV	4
	5. axis	1340.4		◆	◆	◆	5 = V	5
Type of reference mark approach	X	1350.0		◆	◆	◆	0 = position encoder with distance-coded	1
	Y	1350.1		◆	◆	◆	reference marks (1. mode)	1
	Z	1350.2		◆	◆	◆	1 = position encoder without distance-coded	1
	IV	1350.3		◆	◆	◆	reference marks	1
	V	1350.4		◆	◆	◆	2 = special function (linear measurement	1
							with rotary encoder)	
							3 = position encoder with distance-coded	
							reference marks (2. mode)	

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Feed forward control or trailing mode in the operating modes "Positioning with MDI" "Program Run / Single Block" "Program Run / Full Sequence"		1390		◆	◆	◆	0 = feed forward control 1 = trailing mode	0
Feed forward control in all operating modes	X Y Z IV V	1391	0 1 2 3 4	-	02	02	bit not set: control in the operating modes "Positioning with MDI", "Program Run / Single Block" and "Program Run / Full Sequence" according to MP1390 bit set: feed forward control in all operating modes	% 00000

Operation with Feed Forward Control

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Position monitoring in operation with feed forward control								
cancellable (POSITIONING ERROR)	X	1410.0		◆	◆	◆	0.0001 to 30.0000 [mm]	3
	Y	1410.1		◆	◆	◆		3
	Z	1410.2		◆	◆	◆		3
	IV	1410.3		◆	◆	◆		3
	V	1410.4		◆	◆	◆		3
EMERGENCY STOP (GROSS POSITIONING ERROR)	X	1420.0		◆	◆	◆	0.0001 to 30.0000 [mm]	4
	Y	1420.1		◆	◆	◆		4
	Z	1420.2		◆	◆	◆		4
	IV	1420.3		◆	◆	◆		4
	V	1420.4		◆	◆	◆		4

Cams for "Reference End Position":
The reference marks can either be traversed manually using the axis direction keys or automatically with the start key. It is not necessary to enter a code number for the manual traverse as was the case with preceding TNC models. The traverse direction for automatic traverse of the reference marks is defined in MP1320.
In order to reverse the traverse direction at the end of the traverse range, a cam for "reference end position" is required. The trigger signals "ref. end position" are assigned to free PLC inputs. By the PLC software these PLC inputs are connected to the PLC markers M2506 and M2556 to M25599. Depending on the entry value of MP1350 the TNC behaves differently.

Linear Encoder with Distance-Coded Reference Marks (MP 1350.X = 0), Mode 1
If the trigger signal "ref. end position" is set when starting reference mark traverse, the axis moves in the direction opposite to that set in the MP1320. If the trigger signal "ref. end position" is only set during automatic traverse, the TNC ignores this signal. Thus, there must be at least two reference marks within the range of the "reference end position". Ref. mark evaluation takes place either in the range of the "ref. end position" or else beyond this range. In case of an evaluation beyond the software limit switch range, the axis automatically moves to the software limit switch after evaluation.

Linear Encoder without Distance-Coded Reference Marks (MP 1350.X = 1)
The traverse direction is automatically reversed, if the axis traverses the cam for "ref. end position". If the axis is already in the range of the "reference end position" range when starting, it moves immediately in the opposite direction. For this reason the reference mark has to be outside the "ref. end position" range.

Special Operation: Linear Measurement with a Rotary Encoder (MP1350.X = 2)
The axis automatically moves to the cam for "reference end position" at the defined feed rate (MP1330). This axis is started again at a reduced feed rate (MP1331) in the opposite direction; the first reference mark is evaluated after the end of the "reference end position" range has been reached. Then the axis is stopped. If the axis is already in the "reference end position" range when starting, it moves immediately at the reduced feed rate (MP1331) in the direction opposite to that indicated in MP1320.

Linear Encoder with Distance-Coded Reference Marks (MP1350.X = 3), Mode 2
If the trigger signal "reference end position" is set during reference mark traverse, the axis moves opposite to the direction defined in MP1320. The signal "ref. end position" is not ignored by the NC. it is only set during automatic traverse. The traverse direction is reversed immediately. Thus, no reference marks are required in the "ref. end position" range.

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
1. block of Kv factors	X	1510.0	◆	◆		0.1 to 20	1
for operation with feed forward	Y	1510.1	◆	◆			1
control	Z	1510.2	◆	◆			1
	IV	1510.3	◆	◆			1
	V	1510.4	◆	◆			1
Stiction compensation	X	1511.0	◆	◆		0 to 16 777 215 [µs]	0
Duration of stiction compensation	Y	1511.1	◆	◆			0
(differential part)	Z	1511.2	◆	◆			0
	IV	1511.3	◆	◆			0
	V	1511.4	◆	◆			0
Limit of extent of stiction compensation	X	1512.0	◆	◆		0 to 16 777 215 [counting steps]	0
(differential part)	Y	1512.1	◆	◆			0
	Z	1512.2	◆	◆			0
	IV	1512.3	◆	◆			0
	V	1512.4	◆	◆			0
Feed rate for stiction compensation	X	1513.0	◆	◆		0 to 300 000 [mm/min]	0
(differential part)	Y	1513.1	◆	◆			0
	Z	1513.2	◆	◆			0
	IV	1513.3	◆	◆			0
	V	1513.4	◆	◆			0
2. block of Kv factors	X	1515.0	◆	◆		0.1 to 10	1
for operation with feed forward	Y	1515.1	◆	◆			1
control	Z	1515.2	◆	◆			1
M105: enable	IV	1515.3	◆	◆			1
M106: inhibit	V	1515.4	◆	◆			1
Approach speed and transient behaviour when accelerating		1520	◆	◆		0.1 to 10 [m/min]	1
Feed rate below which the						0.1 to 10.000 [mm/min]	
positioning window is monitored	X	1525.0	-	02			0
	Y	1525.1	-	02		recommended value: 0.5 mm/min	0
	Z	1525.2	-	02			0
	IV	1525.3	-	02			0
	V	1525.4	-	02			0

Operation with Servo Lag

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Position monitoring during operation with servo lag							0 to 300 [mm]	
cancellable (POSITIONING ERROR)	X	1710.0		◆	◆	◆		20
	Y	1710.1		◆	◆	◆		20
	Z	1710.2		◆	◆	◆		20
	IV	1710.3		◆	◆	◆		20
	V	1710.4		◆	◆	◆		20
EMERGENCY STOP (GROSS POSITIONING ERROR)	X	1720.0		◆	◆	◆	0 to 300 [mm]	30
	Y	1720.1		◆	◆	◆		30
	Z	1720.2		◆	◆	◆		30
	IV	1720.3		◆	◆	◆		30
	V	1720.4		◆	◆	◆		30
1. block of Kv factors for the trailing mode	X	1810.0		◆	◆	◆	0.1 to 10	1
	Y	1810.1		◆	◆	◆		1
	Z	1810.2		◆	◆	◆		1
	IV	1810.3		◆	◆	◆		1
	V	1810.4		◆	◆	◆		1
2. block of Kv factors for the trailing mode	X	1815.0		◆	◆	◆	0.1 to 10	1
M105: enable	Y	1815.1		◆	◆	◆		1
M106: inhibit	Z	1815.2		◆	◆	◆		1
	IV	1815.3		◆	◆	◆		1
	V	1815.4		◆	◆	◆		1

Function		**MP No. Bit**	**A**	**B**	**C**	**Input**	**AE-6 Entry value**
Multiplication factor for Kv	X	1820.0	◆	◆	◆	0.001 to 1.000	
(not effective with M105)	Y	1820.1	◆	◆	◆		1
	Z	1820.2	◆	◆	◆		1
	IV	1820.3	◆	◆	◆		1
	V	1820.4	◆	◆	◆		1
							1
Kink point	X	1830.0	◆	◆	◆	0 to 100.000 [%]	
	Y	1830.1	◆	◆	◆		100
	Z	1830.2	◆	◆	◆		100
	IV	1830.3	◆	◆	◆		100
	V	1830.4	◆	◆	◆		100
							100

Integral Digital Speed Control (TNC 425)

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Selecting the axes		1900		◆	◆		0 to 31	% 11111
with digital speed controller	X		0				0 = axis with analogue controller	
	Y		1				+1 = X axis with digital controller	
	Z		2				+2 = Y axis with digital controller	
	IV		3				+4 = Z axis with digital controller	
	V		4				+8 = IV. axis with digital controller	
							+16 = V. axis with digital controller	
Speed controller monitoring	X	1910.0		◆	◆		1 to 167 215 [counting steps]	5000
	Y	1910.1		◆	◆			5000
	Z	1910.2		◆	◆			5000
	IV	1910.3		◆	◆			5000
	V	1910.4		◆	◆			5000
Integral component for the speed	X	1920.0		◆	◆		0 to 65 535	100
controller	Y	1920.1		◆	◆			100
	Z	1920.2		◆	◆			100
	IV	1920.3		◆	◆			100
	V	1920.4		◆	◆			100
Limitation of the integral factor for							0 to 30.000 [s]	
the speed controller (PT1 element)	X	1925.0		-	◆		0 = inactive (normal case)	0
	Y	1925.1		-	◆		Standard value: 0.1 to 2.0 [s]	0
	Z	1925.2		-	◆		entry value 2: → normal effect	0
	IV	1925.3		-	◆		entry value 0.1: → **very strong** effect	0
	V	1925.4		-	◆		This function should only be used, if the drive jogs	0
							during standstill due to stiction.	
							The larger the entry value, the more the behavior	
							resembles that of a PI controller.	
Proportional component for the							0 to 65 535	
speed controller	X	1940.0		◆	◆			250
	Y	1940.1		◆	◆			250
	Z	1940.2		◆	◆			250
	IV	1940.3		◆	◆			250
	V	1940.4		◆	◆			250

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Factor for acceleration feedforward							0 to 9.999 [V/(m/s²)]	
control of the speed controller	X	1945.0			◆			0
	Y	1945.1			◆			0
	Z	1945.2			◆			0
	IV	1945.3			◆			0
	V	1945.4			◆			0
Polarity of torque signal		1950		◆	◆		0 to 31	% 00000
	X		0				0 = positive	
	Y		1				+1 = X axis negative	
	Z		2				+2 = Y axis negative	
	IV		3				+ 4 = Z axis negative	
	V		4				+ 8 = IV. axis negative	
							+ 16 = V. axis negative	
Selecting the measuring systems		1951		◆	◆		0 to 31	% 00000
							0 = 2 measuring systems for each axis:	
							- linear encoder for position	
							- rotary encoder for speed	
	X		0				+1 = 1 measuring system (rotary encoder) for both position and speed (X axis)	
	Y		1				+2 = Y axis	
	Z		2				+4 = Z axis	
	IV		3				+8 = IV. axis	
	V		4				+16 = V. axis	
Ratio of grating period								
LS to ROD	X	1955.0		◆	◆		0.1 to 100	1
	Y	1955.1		◆	◆			1
	Z	1955.2		◆	◆		(the entry values should be >5)	1
	IV	1955.3		◆	◆			1
	V	1955.4		◆	◆			1

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
Compensation for reversal spikes with digitally controlled driving axes	X	1960.0	◆	◆		-1.0000 to +1.0000 [mm]	0
	Y	1960.1	◆	◆			0
	Z	1960.2	◆	◆			0
	IV	1960.3	◆	◆			0
	V	1960.4	◆	◆			0
Movement monitoring for position and speed (only for digitally controlled driving axes)	X	1970.0	◆	◆		0 to 1 [mm]	0,5
	Y	1970.1	◆	◆			0,5
	Z	1970.2	◆	◆		**Note**: entry value 0 ⇨ monitoring **inactive**	0,5
	IV	1970.3	◆	◆			0,5
	V	1970.4	◆	◆			0,5
Delayed shutdown of speed controller in EMERGENCY STOP		1980	◆	◆		0 to 1.999 [s]	0

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
Maximum current [1]	X	2110.0	-	-	◆	0 to 999.999[Ap]	0
of the power stage	Y	2110.1	-	-	◆	e.g. with SIEMENS power stage 6SN1123-1AA00-	0
	Z	2110.2	-	-	◆	0BA0:	0
	IV	2110.3	-	-	◆	6SN1123-1AA00-0BA0:	0
	V	2110.4	-	-	◆	$18\ A \cdot \sqrt{2} = 25.45$ Ap	0
	S	2110.5	-	-	◆	see MP2310	0
Nominal current [1]	X	2120.0	-	-	◆	0 to 999.999[Ap]	0
(reference value for I^2t monitoring)	Y	2120.1	-	-	◆	e.g.with SIEMENS power stage 6SN1123-1AA00-0BA0:	0
	Z	2120.2	-	-	◆	6SN1123-1AA00-0BA0:	0
	IV	2120.3	-	-	◆	$9\ A \cdot \sqrt{2} = 12.72$ Ap	0
	V	2120.4	-	-	◆		0
	S	2120.5	-	-	◆		0
Voltage of the current sensor	X	2130.0	-	-	◆	0 to 99.999[V]	0
with peak current	Y	2130.1	-	-	◆	with HEIDENHAIN interface card: 7.5V	0
	Z	2130.2	-	-	◆		0
	IV	2130.3	-	-	◆		0
	V	2130.4	-	-	◆		0
	S	2130.5	-	-	◆		0
Motor type [2]	X	2200.0	-	-	◆	0 to 5	0
	Y	2200.1	-	-	◆	0 = synchronous motor	0
	Z	2200.2	-	-	◆	1 = asynchronous motor	0
	IV	2200.3	-	-	◆	2 to 5 = reserved	0
	V	2200.4	-	-	◆		0
	S	2200.5	-	-	◆		0

[1] entry values depending on the power stage: see table 1 on page 21.1
[2] entry values depending on the motor: see table 2 on page 21.1

Table 1: Entry values depending on the power stage

The following SIEMENS power stages can be connected to TNC 426 PA:

	6SN1123-1AA00										6SN1123-1AB00		
	0AA0	0BA0	0CA0		0DA0		0EA0		0FA0		0AA0	0BA0	0CA0
			VSA	HSA	VSA	HSA	VSA	HSA	VSA	HSA			
MP2110	14.14	25.45	50.91	50.91	79.2	79.2	158.4	158.4	198	198	14.14	25.45	50.91
MP2120	7.07	12.72	25.45	33.94	39.6	42.42	79.2	84.85	99	120.2	7.07	12.72	25.45

When using non-SIEMENS power stages, please contact HEIDENHAIN.

Table 2: Entry values depending on the motor

The following SIEMENS drives can be connected to TNC 426 PA:

	1FT6064 6AC71	1FT6084 8AC71	1FT6086 8AC71	1FT6062 6AH71	1FT6082 8AH71	1PH6103 4NG4	1PH6107 4NG4
MP2200	0	0	0	0	0	1	1
MP2210	2 000	2 000	2 000	4 500	4 500	2 000	2 000
MP2220	2 915	3 080	2 970	6 435	6 930	9 900	9 900
MP2230	3	4	4	3	4	2	2
MP2280	0	0	0	0	0	14.0	22.1
MP2290	0	0	0	0	0	162	189
MP2300	5.4	11.8	15.4	5.5	11.5	28.3	43.8
MP2310	21.5	46.95	61.7	22.06	62.2	45.3	70.1

When using non-SIEMENS drives, please contact HEIDENHAIN.

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
Nominal speed (synchronous motor) [1)]	X	2210.0	-	-	◆	0 to 10 000[rpm]	0
Kink point rpm (asynchronous motor) [1)]	Y	2210.1	-	-	◆		0
	Z	2210.2	-	-	◆		0
	IV	2210.3	-	-	◆		0
	V	2210.4	-	-	◆		0
	S	2210.5	-	-	◆		0
Maximum shaft speed [1)]	X	2220.0	-	-	◆	0 to 99 999[rpm]	0
	Y	2220.1	-	-	◆	(value from table plus 10%)	0
	Z	2220.2	-	-	◆	When operating with servo lag, the speed is limited to	0
	IV	2220.3	-	-	◆	the value of MP 2220. When operating with feed for-	0
	V	2220.4	-	-	◆	ward control, the error message GROSS POSITIONING	0
	S	2220.5	-	-	◆	ERROR <Axis> B is generated when the value of	0
						MP 2220 is reached.	
Number of pairs of poles [1)]	X	2230.0	-	-	◆	1 to 4	1
	Y	2230.1	-	-	◆		1
	Z	2230.2	-	-	◆		1
	IV	2230.3	-	-	◆		1
	V	2230.4	-	-	◆		1
	S	2230.5	-	-	◆		1
Line count of rotary encoder	X	2240.0	-	-	◆	0 to 10 000 [lines per revolution]	0
(speed encoder)	Y	2240.1	-	-	◆	0 = non-controlled axis (no encoder monitoring)	0
	Z	2240.2	-	-	◆		0
	IV	2240.3	-	-	◆		0
	V	2240.4	-	-	◆		0
	S	2240.5	-	-	◆		0

[1)] entry values depending on the motor: see table 2 on page 21.1

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
Counting direction of the signals of the rotary encoder	X	2250.0	-	-	◆	0 = not inverted	0
	Y	2250.1	-	-	◆	1 = inverted	0
	Z	2250.2	-	-	◆		0
	IV	2250.3	-	-	◆		0
	V	2250.4	-	-	◆		0
	S	2250.5	-	-	◆		0
Motor constant	X	2260.0	-	-	◆	0 to 99.999[Nm/A]	0
	Y	2260.1	-	-	◆	with SIEMENS drives: 0	0
	Z	2260.2	-	-	◆		0
	IV	2260.3	-	-	◆		0
	V	2260.4	-	-	◆		0
	S	2260.5	-	-	◆		0
Max. motor temperature	X	2270.0	-	-	◆	0 to 255[°C]	0
	Y	2270.1	-	-	◆	255 = no monitoring	0
	Z	2270.2	-	-	◆	with SIEMENS drives: 150	0
	IV	2270.3	-	-	◆		0
	V	2270.4	-	-	◆		0
	S	2270.5	-	-	◆		0
Magnetising current [1)]	X	2280.0	-	-	◆		0
	Y	2280.1	-	-	◆	0 to 99.999[Ap]	0
	Z	2280.2	-	-	◆	e.g. with SIEMENS motor 1PH6103/... :	0
	IV	2280.3	-	-	◆	9.9 A $\cdot \sqrt{2}$ = 12.72 Ap	0
	V	2280.4	-	-	◆		0
	S	2280.5	-	-	◆		0

[1)] entry values depending on the motor: see table 2 on page 21.1

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Time constant of armature [1]	X	2290.0		-	-	◆	0 to 10 000[ms]	0
	Y	2290.1		-	-	◆	**Example:** Calculation of time constant of the armature from the motor parameters of the SIEMENS spindle motor 1PH6107-4GN4	0
	Z	2290.2		-	-	◆	SIEMENS motor parameters:	0
	IV	2290.3		-	-	◆	P164 = nom. frequency = 68.9 Hz	0
	V	2290.4		-	-	◆	P168 = resistance of armature (cold) = 157 mΩ	0
	S	2290.5		-	-	◆	P170 = leakage reactance of armat. = 785 mΩ	0
							P171 = reactance of main field = 12 090 mΩ	
							$MP2290 = \frac{(P171[m\Omega] + P170[m\Omega] \cdot 1000}{2 \cdot \Pi \cdot P164[Hz] \cdot P168[m\Omega]} [ms] =$	
							$= \frac{(12090 + 785) \cdot 1000}{2 \cdot \Pi \cdot 68{,}9 \cdot 157} [ms] = 189 [ms]$	
Nominal value of motor [1]	X	2300.0		-	-	◆	0 to 100.000[A]	0
(reference value for "utilization"	Y	2300.1		-	-	◆	MP 2300 is used to calculate the I²t monitoring and the utilization	0
display and for I²t monitoring)	Z	2300.2		-	-	◆	display (modules 9160 and 9166)	0
	IV	2300.3		-	-	◆		0
	V	2300.4		-	-	◆		0
	S	2300.5		-	-	◆		0
Maximum current [1]	X	2310.0		-	-	◆	0 to 100.000[A_p]	0
of motor	Y	2310.1		-	-	◆		0
	Z	2310.2		-	-	◆	The speed controller limits the maximum current to the minimum	0
	IV	2310.3		-	-	◆	value of MP2110 and MP2310.	0
	V	2310.4		-	-	◆		0
	S	2310.5		-	-	◆		0
reserved		2320.x		-	-	◆	entry value 0	0
reserved		2330.x		-	-	◆	entry value 0	0

[1] entry values depending on the motor: see table 2 on page 21.1

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
Amplification for current controller	X	2400.0	-	-	◆	0 to 30 000 [1/V]	0
	Y	2400.1	-	-	◆	0 = controller inhibited	0
	Z	2400.2	-	-	◆		0
	IV	2400.3	-	-	◆		0
	V	2400.4	-	-	◆		0
	S	2400.5	-	-	◆		0
reserved	X	2410.0	-	-	◆	0	0
	Y	2410.1	-	-	◆		0
	Z	2410.2	-	-	◆		0
	IV	2410.3	-	-	◆		0
	V	2410.4	-	-	◆		0
	S	2410.5	-	-	◆		0
Proportional factor of the current controller	X	2500.0	-	-	◆	0 to 100 000[Ap]	0
	Y	2500.1	-	-	◆		0
	Z	2500.2	-	-	◆		0
	IV	2500.3	-	-	◆		0
	V	2500.4	-	-	◆		0
	S	2500.5	-	-	◆		0
Integral factor of the current controller	X	2510.0	-	-	◆	0 to 100 000[A]	0
	Y	2510.1	-	-	◆		0
	Z	2510.2	-	-	◆		0
	IV	2510.3	-	-	◆		0
	V	2510.4	-	-	◆		0
	S	2510.5	-	-	◆		0
reserved	X	2520.0	-	-	◆	0	0
	Y	2520.1	-	-	◆		0
	Z	2520.2	-	-	◆		0
	IV	2520.3	-	-	◆		0
	V	2520.4	-	-	◆		0
	S	2520.5	-	-	◆		0
reserved	X	2530.0	-	-	02	0	0
	Y	2530.1	-	-	02		0
	Z	2530.2	-	-	02		0
	IV	2530.3	-	-	02		0
	V	2530.4	-	-	02		0
	S	2530.5	-	-	02		0

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
reserved	X	2600.0	-	-	◆	0	0
	Y	2600.1	-	-	◆		0
	Z	2600.2	-	-	◆		0
	IV	2600.3	-	-	◆		0
	V	2600.4	-	-	◆		0
	S	2600.5	-	-	◆		0
reserved	X	2610.0	-	-	◆	0	0
	Y	2610.1	-	-	◆		0
	Z	2610.2	-	-	◆		0
	IV	2610.3	-	-	◆		0
	V	2610.4	-	-	◆		0
	S	2610.5	-	-	◆		0
reserved	X	2620.0	-	-	◆	0	0
	Y	2620.1	-	-	◆		0
	Z	2620.2	-	-	◆		0
	IV	2620.3	-	-	◆		0
	V	2620.4	-	-	◆		0
	S	2620.5	-	-	◆		0
Holding current for height axes	X	2630.0	-	-	06	0 to ± 30 [A]	0
	Y	2630.1	-	-	06		0
	Z	2630.2	-	-	06		0
	IV	2630.3	-	-	06		0
	V	2630.4	-	-	06		0
	S	2630.5	-	-	06		0
Movement monitoring	X	2800.0	-	-	02	0 to 99 999.999[mm]	0
position and speed	Y	2800.1	-	-	02	0 = no monitoring	0
	Z	2800.2	-	-	02	The position is calculated from the pulses of the	0
	IV	2800.3	-	-	02	position encoder and from the pulses of the speed	0
	V	2800.4	-	-	02	encoder. If the difference of the results exceeds the	0
						value of MP2800, the error message GROSS	0
						POSITIONING ERROR <Axis> C is generated.	

Spindle

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Output of the spindle speed	3010	◆	◆	◆	0 = spindle speed not output	6
coded					1 = only if speed changes 2 = with every TOOL CALL	
analogue					3 = gear switching signal only if gear range changes 4 = gear switching signal with every TOOL CALL 5 = no gear switching signal	
controlled spindle for orientation					6 = gear switching signal only if gear range changes 7 = gear switching signal with every TOOL CALL 8 = no gear switching signal	
Output of an analogue voltage at the analogue output of the spindle (only if MP3010 < 3)	3011	◆ ◆ ◆ -	◆ ◆ ◆ ◆	◆ ◆ ◆ ◆	0 = no function 1 = voltage is proportional to the current feed rate 2 = voltage defined via PLC (module 9130) 3 = voltage defined via M-function (M200 - M204)	0
Feed rate that corresponds to an analogue voltage of 10V (only if MP3011 = 1)	3012	◆	◆	◆	0 to 300 000 [mm/min]	0

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
LASER function with M202					10 to 300 000 [mm/min]	
Characteristic curve kink points						
Speed	3013.0	-	◆	◆		0
	3013.1	-	◆	◆		0
	3013.2	-	◆	◆		0
	3013.3	-	◆	◆		0
	3013.4	-	◆	◆		0
	3013.5	-	◆	◆		0
	3013.6	-	◆	◆		0
	3013.7	-	◆	◆		0
	3013.8	-	◆	◆		0
	3013.9	-	◆	◆		0
	3013.10	-	◆	◆		0
	3013.11	-	◆	◆		0
Characteristic curve kink points	3014.0	-	◆	◆	0 to 9.999 [V]	0
Voltage	3014.1	-	◆	◆		0
	3014.2	-	◆	◆		0
	3014.3	-	◆	◆		0
	3014.4	-	◆	◆		0
	3014.5	-	◆	◆		0
	3014.6	-	◆	◆		0
	3014.7	-	◆	◆		0
	3014.8	-	◆	◆		0
	3014.9	-	◆	◆		0
	3014.10	-	◆	◆		0
	3014.11	-	◆	◆		0
Definition of the spindle speed range	3020	04	◆	◆	0 to 99 999 00991 = no limitation	00991

Function			MP No. Bit	A	B	C	Input	AE-6 Entry value
Axis halt on TOOL CALL with only a spindle speed output			3030	◆	◆	◆	0 = axis halt 1 = no axis halt	0
Programming the spindle speed **S = 0** (if MP3240.1 ≠ 0)			3120	◆	◆	◆	0 ⇒ S = 0 permitted 1 ⇒ S = 0 not permitted	0
Polarity • of S-analogue voltage (TNC 415B/425/426CA) • of nominal spindle speed (TNC 426 PA)			3130	◆	◆	◆	0 = M03: positive M04: negative 1 = M03: negative M04: positive 2 = M03 and M04: positive 3 = M03 and M04: negative	0
Count direction of the spindle encoder			3140	◆	◆	◆	0 = positive 1 = negative	0
Line count of the spindle encoder			3142	-	-	◆	0 = 1024 lines 1 = 2048 lines	0
S-analogue voltage with								
nominal speed	gear range	1	3210.0	◆	◆	◆	0 to 9.999 [V]	9
	gear range	2	3210.1	◆	◆	◆		9
	gear range	3	3210.2	◆	◆	◆		9
	gear range	4	3210.3	◆	◆	◆		9
	gear range	5	3210.4	◆	◆	◆		9
	gear range	6	3210.5	◆	◆	◆		9
	gear range	7	3210.6	◆	◆	◆		9
	gear range	8	3210.7	◆	◆	◆		9
Revolutions of the motor with								
nominal speed							0 to 9.999 [1000/min]	
(TNC 426 PA)	gear range	1	3210.0	-	-	◆		9
	gear range	2	3210.1	-	-	◆		9
	gear range	3	3210.2	-	-	◆		9
	gear range	4	3210.3	-	-	◆		9
	gear range	5	3210.4	-	-	◆		9
	gear range	6	3210.5	-	-	◆		9
	gear range	7	3210.6	-	-	◆		9
	gear range	8	3210.7	-	-	◆		9

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Controlled range for S-analogue output						
Min. S-analogue voltage that can be output	3240.1	◆	◆	◆	0 to 9.999 [V]	0
Jog voltage for gear switching (markers for direction of rotation: M2490/M2491)	3240.2	◆	◆	◆	0 to 9.999 [V]	0.1
Controlled range for S-speed output (TNC 426 PA)						
Min. motor speed that can be output	3240.1	-	-	◆	0 to 9.999 [1000/min]	0
Motor speed for gear switching (markers for direction of rotation: M2490/M2491)	3240.2	-	-	◆	0 to 9.999 [1000/min]	0.1
Limit with S-override max.	3310.0	◆	◆	◆	0 to 150 [%]	150
min.	3310.1	◆	◆	◆		0
Ramp gradient of the spindle:					0 to 1.999 [V/ms]	
• Spindle ON/OFF, M03, M04, M05;	3410.0	◆	◆	◆		0.1
• Oriented spindle stop	3410.1	◆	◆	◆		0.1
• "Tapping" cycle	3410.2	◆	◆	◆		0.1
• Tapping without floating tap holder (Rigid Tapping)	3410.3	◆	◆	◆		0.1
Ramp gradient of the spindle: (TNC 426 PA)					0 to 1.999 [$\frac{1000 / min}{ms}$]	
• Spindle ON/OFF, M03, M04, M05;	3410.0	-	-	◆		0.1
• Oriented spindle stop	3410.1	-	-	◆		0.1
• "Tapping" cycle	3410.2	-	-	◆		0.1
• Tapping without floating tap holder (Rigid Tapping)	3410.3	-	-	◆		0.1

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
Transient response of the spindle:						0 to 1000[ms]	
• Spindle ON/OFF, M03, M04, M05;		3415.0	-	-	◆		1
• Oriented spindle stop		3415.1	-	-	◆		1
• "Tapping" cycle		3415.2	-	-	◆		1
• "Rigid Tapping" cycle		3415.3	-	-	◆		1
Positioning window for the spindle		3420	◆	◆	◆	0 to 65 535 [increments]	10
Spindle pre-set		3430	◆	◆	◆	0 to 360 [°]	0
Kv factor for the spindle							
(per gear range)	gear range 1	3440.0	◆	◆	◆	0.1 to 10	1
	gear range 2	3440.1	◆	◆	◆		1
	gear range 3	3440.2	◆	◆	◆		1
	gear range 4	3440.3	◆	◆	◆		1
	gear range 5	3440.4	◆	◆	◆		1
	gear range 6	3440.5	◆	◆	◆		1
	gear range 7	3440.6	◆	◆	◆		1
	gear range 8	3440.7	◆	◆	◆		1

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
Nominal spindle speed							
	gear range 1	3510.0	◆	◆	◆	0 to 99 999.999 [rpm]	1000
	gear range 2	3510.1	◆	◆	◆		2000
	gear range 3	3510.2	◆	◆	◆		3000
	gear range 4	3510.3	◆	◆	◆		4000
	gear range 5	3510.4	◆	◆	◆		5000
	gear range 6	3510.5	◆	◆	◆		6000
	gear range 7	3510.6	◆	◆	◆		7000
	gear range 8	3510.7	◆	◆	◆		8000
Maximum spindle speed						0 to 99 999 [rpm]	1200
	gear range 1	3515.0	◆	◆	◆		2400
	gear range 2	3515.1	◆	◆	◆		3600
	gear range 3	3515.2	◆	◆	◆		4800
	gear range 4	3515.3	◆	◆	◆		6000
	gear range 5	3515.4	◆	◆	◆		7200
	gear range 6	3515.5	◆	◆	◆		8400
	gear range 7	3515.6	◆	◆	◆		9600
	gear range 8	3515.7	◆	◆	◆		
Spindle speed activated by marker 2501		3520.0	◆	◆	◆	0 to 99 999.999 [rpm] direction of rotation is always positive	200
Spindle speed for oriented spindle stop		3520.1	◆	◆	◆	0 to 99 999.999 [rpm]	100

Integral PLC

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
PLC program from RAM or from EPROM		4010		◆	◆	-	+ 0 = EPROM operation + 1 = RAM operation	0
PLC compatibility to TNC 415/425		4020		-	-	◆	0 to 31	%00000
convert axis words W1024ff to markers			0				corresponding bit = 0 ⇒ function inactive corresponding bit = 1 ⇒ function active	
convert new markers into old markers			1					
convert configuration bits from MP4210 into markers			2					
error markers are available			3					
non-volatile markers in the range M1000 to M1999			4					
Automatic lubrication	X	4060.0		◆	◆	◆	0 to 65 535 [65 536 µm]	100
	Y	4060.1		◆	◆	◆		200
	Z	4060.2		◆	◆	◆		300
	IV	4060.3		◆	◆	◆		400
	V	4060.4		◆	◆	◆		0
Maximum change of the temperature compensation per PLC scan in the PLC words W576 - W584		4070		◆	◆	◆	0.0001 to 0.005 [mm]	0.0001

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
PLC: Time for T 0 - T 29	4110.0	◆	◆	◆	0 to 65 535 [PLC cycles]	100
	4110.1	◆	◆	◆		22
	4110.2	◆	◆	◆		50
	4110.3	◆	◆	◆		100
	4110.4	◆	◆	◆		4
	4110.5	◆	◆	◆		5
	4110.6	◆	◆	◆		6
	4110.7	◆	◆	◆		7
	4110.8	◆	◆	◆		8
	4110.9	◆	◆	◆		9
	4110.10	◆	◆	◆		10
	4110.11	◆	◆	◆		11
	4110.12	◆	◆	◆		12
	4110.13	◆	◆	◆		13
	4110.14	◆	◆	◆		14
	4110.15	◆	◆	◆		15
	4110.16	◆	◆	◆		25
	4110.17	◆	◆	◆		0
	4110.18	◆	◆	◆		0
	4110.19	◆	◆	◆		0
	4110.20	◆	◆	◆		0
	4110.21	◆	◆	◆		0
	4110.22	◆	◆	◆		0
	4110.23	◆	◆	◆		0
	4110.24	◆	◆	◆		0
	4110.25	◆	◆	◆		0
	4110.26	◆	◆	◆		0
	4110.27	◆	◆	◆		0
	4110.28	◆	◆	◆		0
	4110.29	◆	◆	◆		0

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
PLC: Time for T 30 - T 47					0 to 65 535 [PLC cycles]	
	4110.30	◆	◆	◆		0
	4110.31	◆	◆	◆		0
	4110.32	◆	◆	◆		0
	4110.33	◆	◆	◆		0
	4110.34	◆	◆	◆		0
	4110.35	◆	◆	◆		0
	4110.36	◆	◆	◆		0
	4110.37	◆	◆	◆		0
	4110.38	◆	◆	◆		0
	4110.39	◆	◆	◆		0
	4110.40	◆	◆	◆		0
	4110.41	◆	◆	◆		0
	4110.42	◆	◆	◆		0
	4110.43	◆	◆	◆		0
	4110.44	◆	◆	◆		0
	4110.45	◆	◆	◆		0
	4110.46	◆	◆	◆		0
	4110.47	◆	◆	◆		0
					0 to 65 535 [PLC cycles]	
PLC: Pre-set values for counters 0 - 10	4120.0	◆	◆	◆		0
	4120.1	◆	◆	◆		1
	4120.2	◆	◆	◆		2
	4120.3	◆	◆	◆		3
	4120.4	◆	◆	◆		4
	4120.5	◆	◆	◆		5
	4120.6	◆	◆	◆		6
	4120.7	◆	◆	◆		7
	4120.8	◆	◆	◆		8
	4120.9	◆	◆	◆		9
	4120.10	◆	◆	◆		10

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
PLC: Pre-set values for counters 11 - 31	4120.11	◆	◆	◆		11
	4120.12	◆	◆	◆		12
	4120.13	◆	◆	◆		13
	4120.14	◆	◆	◆		14
	4120.15	◆	◆	◆		15
	4120.16	◆	◆	◆		16
	4120.17	◆	◆	◆		17
	4120.18	◆	◆	◆		18
	4120.19	◆	◆	◆		19
	4120.20	◆	◆	◆		20
	4120.21	◆	◆	◆		21
	4120.22	◆	◆	◆		22
	4120.23	◆	◆	◆		23
	4120.24	◆	◆	◆		24
	4120.25	◆	◆	◆		25
	4120.26	◆	◆	◆		26
	4120.27	◆	◆	◆		27
	4120.28	◆	◆	◆		28
	4120.29	◆	◆	◆		29
	4110.30	◆	◆	◆		30
	4110.31	◆	◆	◆		31
Fast PLC input Defining the fast input	4130	◆	◆	◆	0 to 254	0
Defining the active level of the fast input	4131	◆	◆	◆	0 = activation with LOW level 1 = activation with HIGH level	0

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
Setting a number	D768	4210.0	◆	◆	◆	-99 999.9999 to +99 999.9999 [mm] or [°]	+10
	D772	4210.1	◆	◆	◆		+1
	D776	4210.2	◆	◆	◆		+2
	D780	4210.3	◆	◆	◆		+3
	D784	4210.4	◆	◆	◆		+4
	D788	4210.5	◆	◆	◆		+5
	D792	4210.6	◆	◆	◆		+6
	D796	4210.7	◆	◆	◆		+7
	D800	4210.8	◆	◆	◆		+8
	D804	4210.9	◆	◆	◆		+9
	D808	4210.10	◆	◆	◆		+10
	D812	4210.11	◆	◆	◆		+11
	D816	4210.12	◆	◆	◆		+12
	D820	4210.13	◆	◆	◆		+13
	D824	4210.14	◆	◆	◆		+14
	D828	4210.15	◆	◆	◆		+15
	D832	4210.16	◆	◆	◆		+16
	D836	4210.17	◆	◆	◆		+17
	D840	4210.18	◆	◆	◆		+18
	D844	4210.19	◆	◆	◆		+19
	D848	4210.20	◆	◆	◆		+20
	D852	4210.21	◆	◆	◆		+21
	D856	4210.22	◆	◆	◆		+22
	D860	4210.23	◆	◆	◆		+23
	D864	4210.24	◆	◆	◆		+24
	D868	4210.25	◆	◆	◆		+25
	D872	4210.26	◆	◆	◆		+26
	D876	4210.27	◆	◆	◆		+27
	D880	4210.28	◆	◆	◆		+28
	D884	4210.29	◆	◆	◆		+29
	D888	4210.30	◆	◆	◆		+30
	D892	4210.31	◆	◆	◆		+31

Function			MP No.	Bit	A	B	C	Input	AE-6 Entry value
Setting a number		D896	4210.32		◆	◆	◆		+0
		D900	4210.33		◆	◆	◆		+0
		D904	4210.34		◆	◆	◆		+0
		D908	4210.35		◆	◆	◆		+0
		D912	4210.36		◆	◆	◆		+0
		D916	4210.37		◆	◆	◆		+0
		D920	4210.38		◆	◆	◆		+0
		D924	4210.39		◆	◆	◆		+0
		D928	4210.40		◆	◆	◆		+0
		D932	4210.41		◆	◆	◆		+0
		D936	4210.42		◆	◆	◆		+0
		D940	4210.43		◆	◆	◆		+0
		D944	4210.44		◆	◆	◆		+0
		D948	4210.45		◆	◆	◆		+0
		D952	4210.46		◆	◆	◆		+0
		D956	4210.47		◆	◆	◆		+0
Machine parameters with	W960	X	4220.0		◆	◆	◆	10 to 30 000	1800
multiple function	W962	Y	4220.1		◆	◆	◆	- setting a number in PLC	1800
	W964	Z	4220.2		◆	◆	◆	or	1800
	W966	IV	4220.3		◆	◆	◆	- feed rate for reapproaching the contour	1800
	W968	V	4220.4		◆	◆	◆	[mm/min] or [°/min]	1800
Setting a number			4230.0		◆	◆	◆	-99 999.9999 to +99 999.9999 [mm]	0
(readable with module9032)			.		.	.	.		-
			.		.	.	.		-
			.		.	.	.		-
			4230.31		◆	◆	◆		0

Function	MP No.	Bit	A	B	C	Input	AE-6 Entry value
PLC: setting a number (readable with module 9032)	4231.0		◆	◆	◆	-99 999.9999 to +99 999.9999	0
	.		.	.	.		-
	.		.	.	.		-
	.		.	.	.		-
	4231.31		◆	◆	◆		0
PLC: setting a number						-99 999.9999 to +99 999.9999	
W976 (M2192 to 2207)	4310.0		◆	◆	◆		20480
W978 (M2208 to 2223)	4310.1		◆	◆	◆		0
W980 (M2224 to 2239)	4310.2		◆	◆	◆		0
W982 (M3200 to 3215)	4310.3		◆	◆	◆		0
W984 (M3216 to 3231)	4310.4		◆	◆	◆		0
W986 (M3232 to 3247)	4310.5		◆	◆	◆		0
W990 (M3248 to 3263)	4310.6		◆	◆	◆		0
Adaptation of the PLC extension interface (X47)	4410		◆	◆	◆ [1]		0
		0				+0 = no analogue inputs activated on 1. extension +1 = analogue inputs on 1. extension (PA 100 or analogue inputs activated on PL 410)	
		1				+0 = no analogue inputs activated on 2. extension +2 = analogue inputs on 2. extension (PA 100 or analogue inputs activated on PL 410)	

[1] reserved, entry value 0

Adaptation of the Data Interface

Function	**MP No.**	**Bit**	**A**	**B**	**C**	**Input**	**AE-6 Entry value**
Inhibiting a data interface	5000		◆	◆	◆	0 = no interface inhibited 1 = RS-232 inhibited 2 = RS-422 inhibited	0
Data format and transfer stop operating mode **EXT1** operating mode **EXT2** operating mode **EXT3 (PLC)**	 5020.0* 5020.1* 5020.2*		 ◆ ◆ ◆	 ◆ ◆ ◆	 ◆ ◆ ◆	 0 to 255	 168 168 168
7 or 8 data bits		0				**+0** = 7 data bits, bit 8 = parity +1 = 8 data bits, bit 8 = 0, bit 9 = parity	
Block check character		1				**+0** = BCC character optional +2 = control character not BCC	
Transmission stop through RTS		2				**+0** = inactive +4 = active	
Transmission stop through DC3		3				+0 = inactive **+8** = active	
Character parity even/odd		4				**+0** = even +16 = odd	
Character parity on/off		5				+0 = off **+32** = on	
Number of stop bits		6 7				+ 64 → bit 6 = 1 **+128** → bit 7 = 1 bit 6 bit 7 0 1 = 1½ stop bits 1 0 = 2 stop bits 0 1 = 1 stop bit 1 1 = 1 stop bit	

* accessible via code number 123

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Operating mode for						
EXT1	5030.0*	◆	◆	◆		1
EXT2	5030.1*	◆	◆	◆	0 = "standard data transfer"	1
EXT3 (PLC)	5030.2*	◆	◆	◆	1 = "blockwise transfer"	1
Data transfer rate for PLC coupling (EXT3)	5040	◆	◆	◆	0 to 9 0 = 110 Bd 5 = 2400 Bd 1 = 150 Bd 6 = 4800 Bd 2 = 300 Bd 7 = 9600 Bd 3 = 600 Bd 8 = 19200 Bd 4 = 1200 Bd 9 = 38400 Bd	7
Control characters for "Blockwise Transfer"						
ASCII character for beginning of					0 to 127	
program (STX)	5200.0*	◆	◆	I02		0
EXT1	5200.1*	◆	◆	I02		0
EXT2	5200.2*	◆	◆	I02		0
EXT3 (PLC)						
ASCII character for end of program					0 to 127	
EXT1 (ETX)	5201.0*	◆	◆	I02		0
EXT2	5201.1*	◆	◆	I02		0
EXT3 (PLC)	5201.2*	◆	◆	I02		0
ASCII character for file type (for data transfer)					0 to 127	
EXT1	5202.0*	◆	◆	I02		0
EXT2	5202.1*	◆	◆	I02		0
EXT3 (PLC)	5202.2*	◆	◆	I02		0

* accessible via code number 123

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
ASCII character for input						0 to 127	
identification	(E)	5203.0*	◆	◆	I02		0
EXT1		5203.1*	◆	◆	I02		0
EXT2		5203.2*	◆	◆	I02		0
EXT3 (PLC)							
ASCII character for file type							
(for data output)						0 to 127	
EXT1		5204.0*	◆	◆	I02		0
EXT2		5204.1*	◆	◆	I02		0
EXT3 (PLC)		5204.2*	◆	◆	I02		0
ASCII character for output						0 to 127	
identification		5205.0*	◆	◆	I02		0
EXT1	(A)	5205.1*	◆	◆	I02		0
EXT2		5205.2*	◆	◆	I02		0
EXT3 (PLC)							
ASCII character for beginning of							
command block						0 to 127	
EXT1	(SOH)	5206.0*	◆	◆	I02		0
EXT2		5206.1*	◆	◆	I02		0
EXT3 (PLC)		5206.2*	◆	◆	I02		0
ASCII character for end of							
command block						0 to 127	
EXT1	(ETB)	5207.0*	◆	◆	I02		0
EXT2		5207.1*	◆	◆	I02		0
EXT3 (PLC)		5207.2*	◆	◆	I02		0

* accessible via code number 123

Function		MP No. Bit	A	B	C	Input	AE-6 Entry value
ASCII character for positive acknowledgement						0 to 127	
EXT1	(ACK)	5208.0*	◆	◆	I02		0
EXT2		5208.1*	◆	◆	I02		0
EXT3 (PLC)		5208.2*	◆	◆	I02		0
ASCII character for negative acknowledgement						0 to 127	
EXT1	(NAK)	5209.0*	◆	◆	I02		0
EXT2		5209.1*	◆	◆	I02		0
EXT3 (PLC)		5209.2*	◆	◆	I02		0
ASCII character for end of transfer							
EXT1	(EOT)					0 to 127	
EXT2		5210.0*	◆	◆	I02		0
EXT3 (PLC)		5210.1*	◆	◆	I02		0
		5210.2*	◆	◆	I02		0

* accessible via code number 123

3D-Touch Probe (General Parameters)

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Selection of touch trigger probe	6010*	◆	◆		0 = transmission via cable (TS 120) 1 = infrared transmission (TS 510)	0
Probing feed rate	6120*	◆	◆		10 to 3 000 [mm/min]	80
Maximum measuring range	6130*	◆	◆		0.001 to 99 999.9999 [mm]	1
Safety clearance over measure-ment point for automatic measurement	6140*	◆	◆		0.001 to 99 999.9999 [mm]	1
Rapid traverse for probe cycle	6150*	◆	◆		10 to 10 000 [mm/min]	2000
M-function for 180° spindle rotation to compensate the center misalignment of the stylus	6160*	◆	◆		0 = function inactive 1 to 88 = number of M-function for probing	0
		-	04		1 = oriented spindle stop via NC 0 = function inactive +1 to 88 = number of M function for oriented spindle stop via PLC	0

Connection of Measuring Touch Probe or Touch Trigger Probe

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Selecting the touch probe (probing and digitizing cycles)	6200 *	10	◆		0 = touch trigger probe 1 = measuring touch probe	0

* accessible via code number 123

Digitizing with 3D-Touch Probe

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Number of oscillations in normal direction	6210	◆	◆	◆	0 to 65.535 [1/sec]	0
Lubrication of touch probe axis • displacement for lubrication at the end of a line	6220	-	◆	◆	0.000 to 999.999 [mm]	0
• time intervals for lubrication	6221	-	◆	◆	0 to 65 535 [min]	0
Feed rate in normal direction	6230	◆	◆	◆	0 to 1 000 [mm/min]	0
Maximum deflection of the stylus	6240	◆	◆	◆	0 to 10 [mm]	0
Output of M90 on NC blocks of digitized data	6260	◆	◆	◆	0 = no output 1 = output	0
Rounding of decimal places (NC blocks)	6270	◆	◆	◆	0 = output in 0.001 mm (1 µm) 1 = output in 0.01 mm (10 µm) 2 = output in 0.0001 mm (0.1 µm)	0

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Deflection depth of stylus	6300 [1]	10	-	-	0.1 to 2.0000 [mm]	1
Deflection depth of stylus	6310	-	◆	◆	0.1 to 2.0000 [mm]	1
Counting direction of the encoders in the touch probe X Y Z	6320 0 1 2	10	10	◆	0 = positive +1 = X axis negative +2 = Y axis negative +4 = Z axis negative	0
Calculating the center offset when calibrating the TM 110	6321	-	◆	◆	0 = calibrate and measure center offset 1 = calibrate without measuring center offset	0
Allocation of the touch probe axes to the machine axes machine axis X machine axis Y machine axis Z	 6322.0 6322.1 6322.2	 - - -	 ◆ ◆ ◆	 ◆ ◆ ◆	 0 = touch probe axis X 1 = touch probe axis Y 2 = touch probe axis Z	 0 1 2
Maximum deflection of the stylus	6330	10	10	◆	0.1 to 4 [mm]	3
Minimum deflection of the stylus	6340	I12	I12	-	0.001 to 0.5 [mm]	0.005
Feed rate for positioning to the MIN point and contour approach	6350	10	◆	◆	10 to 3 000 [mm/min]	300
Feed rate for probing in measuring cycles	6360	10	◆	◆	10 to 3 000 [mm/min]	1000
Rapid traverse for probing	6361	10	◆	◆	10 to 10 000 [mm/min]	2000
Feed rate reduction if the stylus (TM 110) is deflected away from its path	6362	-	◆	◆	0 = feed reduction inactive 1 = feed reduction active	0

[1] with special software and for TNC 426 this function has been shifted to MP 6310!

Function	MP No.	Bit	A	B	C	Input	AE-6 Entry value
Kv factor for column control	6370		10	-	-	0.1 to 10	1
Factor for friction compensation	6380		10	-	-	0 to 0.999	0.1
Target window for contour lines	6390		10	◆	◆	0.1 to 4.0	1

Tool Calibration with TT 110

Function	MP No.	Bit	A	B	C	Input	AE-6 Entry value
Tool calibration cycles	6500		-	◆	◆	0 = cycles inhibited 1 = cycles not inhibited	0
Probing direction for tool calibration	6505		-	◆	◆	0 = pos. probing direction in the angle reference axis (0° axis) 1 = pos. probing direction in the +90° axis 2 = neg. probing direction in the angle reference axis (0° axis) 3 = neg. probing direction in the +90° axis	0
Calculating the probing feed rate	6507		-	◆	◆	0 = calculation of probing feed rate with constant tolerance 1 = calculation of probing feed rate with variable tolerance 2 = constant probing feed	0
Maximum permissible measuring error for measurement with a rotating tool	6510		-	◆	◆	0.002 to 0.999 [mm]	0.005
Probing feed rate for measurement with a non-rotating tool	6520		-	◆	◆	10 to 3 000 [mm/min]	10
Distance between lower edge of tool and upper edge of stylus for tool radius measurement	6530		-	◆	◆	0.001 to 99.9999 [mm]	10
Diameter or edge length of the TT 110 stylus	6531		-	◆	◆	0.001 to 99 999.9999 [mm]	10

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Safety zone around the stylus of TT 110 for pre-positioning	6540	-	◆		0.001 to 99 999.9999 [mm]	10
Rapid traverse in the probing cycle	6550	-	◆		10 to 10 000 [m/min]	10
M function for oriented spindle stop for measuring individual cutting edges	6560	-	◆		-1 = oriented spindle stop via NC 0 = function inactive 1 to 88 = number of M function for oriented spindle stop via PLC	10
Maximum permissible surface cutting speed at the cutting edges of the tool	6570	-	◆		1.0000 to 120.0000 [m/min]	100
Center coordinates of the TT 110 stylus referenced to the machine datum					- 99 999.9999 to + 99 999.9999 [mm]	
X	6580.0	-	◆			0
Y	6580.1	-	◆			0
Z	6580.2	-	◆			0

Tapping

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Minimum feed override when tapping	7110.0	◆	◆	◆	0 to 150 [%]	95
Maximum feed override when tapping	7110.1	◆	◆	◆	0 to 150 [%]	105
Dwell time for change of direction of spindle rotation in a tapping cycle	7120.0	◆	◆	◆	0 to 65.535 [s]	0
Spindle run-on time in a tapping cycle (only effective with BCD output of the spindle speed)	7120.1	◆	◆	◆	0 to 65.535 [s]	0
Spindle slow-down time after reaching the boring depth	7120.2	◆	◆	◆	0 to 65.535 [s]	0
Tapping without floating tap holder • run-in behaviour of the spindle	7130	◆	◆	◆	0.001 to 10 [°/min]	0.5
• transient response of the spindle during acceleration	7140	◆	◆	-	0.01 to 0.999	0.15
Positioning window for tool axis	7150	◆	◆	◆	0.0001 to 2 [mm]	0.05
Oriented spindle stop at the beginning of cycle 17 "Rigid Tapping"	7160	◆	◆	◆	0 = spindle orientation is executed 1 = spindle orientation is not executed	1

Display and Programming

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Programming station		7210*		◆	◆	◆	0 = control 1 = programming station: PLC active 2 = programming station: PLC inactive	0
POWER INTERRUPTED		7212		◆	◆	◆	0 = press [CE] to confirm the message 1 = message is confirmed automatically	1
Block number increment size (for ISO programming)		7220*		◆	◆	◆	0 to 250 0 = no generation	0
Maximum length of file names when opening a file		7222*		◆	◆	I02	0 = max. 8 characters 1 = max. 12 characters 2 = max. 16 characters	
Disabling file types (for selection, table of contents and ext. data transfer)		7224.0*		◆	◆	◆	0 = no file type disabled	% 00000000
HEIDENHAIN programs	(**.H**)		0	◆	◆	◆	+ 1 = disabled	
ISO programs	(**.I**)		1	◆	◆	◆	+ 2 = disabled	
Tool tables	(**.T**)		2	◆	◆	◆	+ 4 = disabled	
Datum tables	(**.D**)		3	◆	◆	◆	+ 8 = disabled	
Pallet tables	(**.P**)		4	◆	◆	◆	+16 = disabled	
ASCII (text) files	(**.A**)		5	◆	◆	◆	+32 = disabled	
PLC help files	(**.HLP**)		6	08	◆	◆	+64 = disabled	
Measuring point tables	(**.PNT**)		7	08	◆	◆	+128 = disabled	

* accessible via code number 123

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Protecting file types		7224.1*		◆	◆	◆	0 = no file type protected	% 00000000
HEIDENHAIN programs	(**.H**)		0	◆	◆	◆	+ 1 = protected	
ISO programs	(**.I**)		1	◆	◆	◆	+ 2 = protected	
Tool tables	(**.T**)		2	◆	◆	◆	+ 4 = protected	
Datum tables	(**.D**)		3	◆	◆	◆	+ 8 = protected	
Pallet tables	(**.P**)		4	◆	◆	◆	+16 = protected	
ASCII (text) files	(**.A**)		5	◆	◆	◆	+32 = protected	
PLC help files	(**.HLP**)		6	08	◆	◆	+64 = protected	
Measuring point tables	(**.PNT**)		7	08	◆	◆	+128 = protected	
Preset size								
Pallet table	(**.P**)	7226.0*		◆	◆	◆	0 to 255 = number of reserved entries	10
Datum table	(**.D**)	7226.1*		◆	◆	◆	(can be expanded via soft key)	10
Size of NC memory for								
DNC mode	Minimum	7228.0		08	◆	◆	1 to 1024 [kBytes]	1
	Maximum	7228.1		08	◆	◆	1 to 1024 [kBytes]	100
Length of program								
- to check the program		7229.0		-	-	◆	100 to 9999	100
- up to which FK blocks are permitted		7229.1		-	-	◆		
Changing the dialog language		7230*		◆	◆	-	0 = 1. language 1 = 2. language	0
Changing the dialog language							0 = English 6 = Portuguese	
NC dialog		7230.0		-	-	◆	1 = German 7 = Swedish	1
PLC dialog (OEM cycles, USER parameters)		7330.1		-	-	◆	2 = Czech 8 = Danish 3 = French 9 = Finnish	1
PLC error messages		7230.2		-	-	◆	4 = Italian 10 = Dutch 5 = Spanish	1
Deviation from Greenwich time		7235		-	-	◆	-23 to +23 [hours] 0 = Greenwich time 1 = CET 2 = Central European summer time The factory setting of the internal clock of the control is Greenwich time. To adapt the time of the program manager to the local time, the difference between local time and Greenwich time must be entered in MP 7235.	

* accessible via code number 123

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Inhibiting program entry if PGM No. = No. of OEM cycle	7240*	◆	◆	◆	0 = inhibited 1 = not inhibited	1
Inhibiting HEIDENHAIN cycles	7245.0	◆	◆	◆	0 to 65 535 Bit = 0 ⇒ cycle not inhibited Bit = 1 ⇒ cycle inhibited	$ 0000
cycle 1	1					
cycle 2	2					
cycle 3	3					
cycle 4	4					
cycle 5	5					
cycle 6	6					
cycle 7	7					
cycle 8	8					
cycle 9	9					
cycle 10	10					
cycle 11	11					
cycle 12	12					
cycle 13	13					
cycle 14	14					
cycle 15	15					
	7245.1	◆	◆	◆	0 to 65 535 Bit = 0 ⇒ cycle not inhibited Bit = 1 ⇒ cycle inhibited	$ 0000
cycle 16	0					
cycle 17	1					
cycle 18	2					
cycle 19	3					
cycle 20	4					
cycle 21	5					
cycle 22	6					
cycle 23	7					
cycle 24	8					
cycle 25	9					
cycle 26	10					
cycle 27	11					
cycle 28	12					
cycle 29	13					
cycle 30	14					
cycle 31	15					

Function	**MP No. Bit**	**A**	**B**	**C**	**Input**	**AE-6 Entry value**
Disable paraxial positioning blocks with R+/R- compensation	7246	◆	◆	◆	0 = enabled 1 = disabled	0
Difference between Q-parameter numbers for DLG-DEF block and DLG-CALL block in OEM cycle	7250	◆	◆	◆	0 to 50 0 if only "DLG-CALL" blocks	0
Number of global Q-parameters transferred form OEM cycle to calling program	7251	◆	◆	◆	0 to 100 40 = the Q-parameters Q60 to Q90 are global	0
Central tool file	7260*	◆	◆	◆	0 to 254: central tool file entry value = number of tools 0 = no central tool file	254
Number of tools with pocket number	7261*	◆	◆	◆	0 to 254	254

* accessible via code number 123

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Items in the tool table (.T file) that can be displayed and output via interface:					0 = not displayed 1 - 99 = position of the element in the tool table	
NAME (tool name)						
L (tool length)	7266.0	◆	◆		smallest value = first position	1
R (tool radius 1)	7266.1	◆	◆		highest value = last position	2
R2 (tool radius 2)	7266.2	◆	◆			3
DL (oversize tool length)	7266.3	◆	◆			4
DR (oversize tool radius 1)	7266.4	◆	◆			5
DR2 (oversize tool radius 2)	7266.5	◆	◆			6
TL (tool locked)	7266.6	◆	◆			7
RT (replacement tool)	7266.7	◆	◆			8
TIME1 (max. tool life)	7266.8	◆	◆			9
TIME2 (max. tool life with TOOL CALL)	7266.9	◆	◆			10
CUR.TIME current tool life)	7266.10	◆	◆			11
DOC (commentary on tool)	7266.11	◆	◆			12
CUT (number of cutting edges)	7266.12	◆	◆			13
LTOL (tolerance for tool length)	7266.13	-	◆			14
RTOL (tolerance for tool radius)	7266.14	-	◆			15
DIRECT (cutting direction of the tool)	7266.15	-	◆			16
PLC (PLC status)	7266.16	-	◆			17
TT: L-OFFS (tool offset, length)	7266.17	-	02			18
TT: R-OFFS (tool offset, radius)	7266.18	-	04			19
LBREAK (breakage tolerance, tool length)	7266.19	-	04			20
RBREAK (breakage tolerance, tool radius)	7266.20	-	04			21
	7266.21	-	04			22
Items in the pocket table (TOOL.P file)					0 = not displayed	
T (tool number)	7267.0	◆	◆	◆	1 - 99 = position of the element in the tool table	1
ST (replacement tool)	7267.1	◆	◆	◆		2
F (fixed pocket)	7267.2	◆	◆	◆	smallest value = first position	3
L (locked pocket)	7267.3	◆	◆	◆	highest value = last position	4
PLC (PLC status)	7267.4	◆	◆	◆		5

* accessible via code number 123

Function		MP No.	Bit	A	B	C	Input	AE-6 Entry value
Display of the feed rates in the MANUAL operating modes		7270 *		◆	◆	◆	0 = display of the axis feed rate only when an axis-direction key is pressed (axis-specific feed rate from MP1020.X) 1 = display of the axis feed rate before operating an axis-direction key (smallest value from MP1020.X for all axes)	0
Decimal sign		7280*		◆	◆	◆	0 = decimal comma 1 = decimal point	0
Tool length in nominal / actual value display		7285*		◆	◆	◆	0 = tool length ignored 1 = tool length taken into account	0
Display step	X Y Z IV V	7290.0 * 7290.1 * 7290.2 * 7290.3 * 7290.4 *		◆ ◆ ◆ ◆ ◆	◆ ◆ ◆ ◆ ◆	◆ ◆ ◆ ◆ ◆	0 = 0.1 mm or 0.1° 1 = 0.05 mm or 0.05° 2 = 0.01 mm or 0.01° 3 = 0.005 mm or 0.005° 4 = 0.001 mm or 0.001° 5 = 0.0005 mm or 0.0005° 6 = 0.0001 mm or 0.0001°	6 6 6 6 6
Inhibiting datum setting (axis keys and soft key)	 X Y Z IV V	7295*	 0 1 2 3 4	◆	◆	◆	0 = not disabled + 1 = X axis disabled + 2 = Y axis disabled + 4 = Z axis disabled + 8 = IV axis disabled +16 = V axis disabled	0
Datum setting with axis keys		7296		08	◆	◆	0 = datum can be set with axis keys and soft key 1 = datum can be set with soft key only	0

* accessible via code number 123

Function	MP No.	Bit	A	B	C	Input	AE-6 Entry value
Cancelling	7300		◆	◆	◆	0 to 7	0
- status data (**S**)		0					
- TOOL data (**T**)		1					
- Q-parameters (**Q**)		2				program end | program selection	
with M02, M30, END PGM						0 = S Q T | - - -	
						1 = - - - | - - -	
						2 = S Q T | - Q -	
						3 = - Q - | - Q -	
						4 = S Q T | - - T	
						5 = - - T | - - T	
						6 = S Q T | - Q T	
						7 = - Q T | - Q T	
						- = data are erased	
Graphics display	7310*		◆	◆	◆		
• 3-plane display		0				+ 0 = German standard + 1 = American standard	0
• rotation of the coordinate system in the machining plane		1				+ 0 = no rotation + 2 = coordinate system is rotated by + 90°	
• BLK form after datum shift		2				+ 0 = BLK form will not shift + 4 = BLK form will shift	
• display of cursor position in 3-plane display		3				+ 0 = not shown + 8 = cursor position shown	

* accessible via code number 123

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Graphic simulation of a program **without TOOL CALL** or **without infeed movement** in the tool axis in "Program Run" and "Test Run"						
Tool radius	7315*	◆	◆	◆	0 to 99 999 [mm]	0
Penetration depth (from top surface of the blank)	7316*	◆	◆	◆	0 to 99 999 [mm]	0
M function to start the simulation	7317.0*	◆	◆	◆	0 to 88	0
M function ton interrupt the simulation	7317.1*	◆	◆	◆	0 to 88	0

User Parameters

Function		MP No.	A	B	C	Input	AE-6 Entry value
USER Parameters	Bit						
Determination of the USER parameters	0	7330.0	◆	◆	◆	0 to 9999.99	0
	1	7330.1	◆	◆	◆	number of desired machine parameter	0
	2	7330.2	◆	◆	◆	*NOTE:* the index must have 2 decimal places,	0
	3	7330.3	◆	◆	◆	i.e. 110.10 instead of 110.1	0
	4	7330.4	◆	◆	◆		0
	5	7330.5	◆	◆	◆		0
	6	7330.6	◆	◆	◆		0
	7	7330.7	◆	◆	◆		0
	8	7330.8	◆	◆	◆		0
	9	7330.9	◆	◆	◆		0
	10	7330.10	◆	◆	◆		0
	11	7330.11	◆	◆	◆		0
	12	7330.12	◆	◆	◆		0
	13	7330.13	◆	◆	◆		0
	14	7330.14	◆	◆	◆		0
	15	7330.15	◆	◆	◆		0
Allocation of the dialogs to the defined USER parameters	0	7340.0	◆	◆	◆	0 to 4095	0
	1	7340.1	◆	◆	◆	0 = first line of the corresponding file	0
	2	7340.2	◆	◆	◆		0
	3	7340.3	◆	◆	◆		0
	4	7340.4	◆	◆	◆		0
	5	7340.5	◆	◆	◆		0
	6	7340.6	◆	◆	◆		0
	7	7340.7	◆	◆	◆		0
	8	7340.8	◆	◆	◆		0
	9	7340.9	◆	◆	◆		0

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
10	7340.10	◆	◆	◆		0
11	7340.11	◆	◆	◆		0
12	7340.12	◆	◆	◆		0
13	7340.13	◆	◆	◆		0
14	7340.14	◆	◆	◆		0
15	7340.15	◆	◆	◆		0

Colours, General Display and FK Graphics

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Window frame	7350	◆	◆	◆	$000 000 to $3F3F3F	$030200C
Error messages	7351	◆	◆	◆		$03F3F0F
Operating mode display "Machine"						
Background	7352.0	◆	◆	◆		$0000000
Text for operating mode	7352.1	◆	◆	◆		$0342008
Dialogue	7352.2	◆	◆	◆		$03F3828
Operating mode display						
"Programming"	7353.0	◆	◆	◆		$0000000
Background	7353.1	◆	◆	◆		$0342008
Text for operating mode	7353.2	◆	◆	◆		$03F3828
Dialogue						

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Program text display "Machine"					$000000 to $3F3F3F	
Background	7354.0	◆	◆			$0080400
General program text	7354.1	◆	◆			$038240C
Current block	7354.2	◆	◆			$038341C
Background of active window	7354.3	◆	◆			$00C0800
Background of inactive window	7354.3	-	04			$0040800
Program text display "Programming"					$000000 to $3F3F3F	
Background	7355.0	◆	◆			$0080400
General program text	7355.1	◆	◆			$038240C
Current block	7355.2	◆	◆			$038341C
Background of active window	7355.3	◆	◆			$00C0800
Status-and PLC window					$000000 to $3F3F3F	
Background	7356.0	◆	◆			$00C0800
Axis pos. in the status display	7356.1	◆	◆			$03F2C18
Status display, except axis positions	7356.2	◆	◆			$03F280C
Soft key display "Machine"					$000000 to $3F3F3F	
Background	7357.0	◆	◆			$0000000
Symbols	7357.1	◆	◆			$03F3828
Soft key display "Programming"					$000000 to $3F3F3F	
Background	7358.0	◆	◆			$0000000
Symbols	7358.1	◆	◆			$03F3828
Graphics: 3D-view					$000000 to $3F3F3F	
Background	7360.0	◆	◆			$0000000
Surface	7360.1	◆	◆			$0203038
Front face	7360.2	◆	◆			$00C1820
Text display in graphics window	7360.3	◆	◆			$03F3F3F
Side face	7360.4	◆	◆			$0102028

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Graphics: View in 3 planes (and oscilloscope)					$000000 to $3F3F3F	
Background	7361.0	◆	◆	◆		$0000000
Plan (grating)	7361.1	◆	◆	◆		$0203038
Front and side view (not selected channel)	7361.2	◆	◆	◆		$0203038
Axis cross and text in graphics display (cursor, data, screen window)	7361.3	◆	◆	◆		$03F3F3F
Cursor (selected channel)	7361.4	◆	◆	◆		$03F0000
Additional status display in graphics window					$000000 to $3F3F3F	
Background graphics window	7362.0	◆	◆	◆		$0080400
Background status display	7362.1	◆	◆	◆		$00C0800
Status symbols	7362.2	◆	◆	◆		$038240C
Status values	7362.3	◆	◆	◆		$03F2C18
FK graphics					$000000 to $3F3F3F	
Background	7363.0	◆	◆	◆		$0000000
Resolved contour	7363.1	◆	◆	◆		$03F3F3F
Subprograms and frame for zoom	7363.2	◆	◆	◆		$0003F00
Alternative solutions	7363.3	◆	◆	◆		$0003F00
Non-resolved contour	7363.4	◆	◆	◆		$03F0000

Machining and Program Run

Function	MP No.	Bit	A	B	C	Input	AE-6 Entry value
"Scaling factor" cycle in two or three axes	7410*		◆	◆	◆	0 = 3 axes 1 = only in the machining plane	0
Tool data in TOUCH PROBE cycle	7411*		◆	◆	◆	0 = the current tool data are overwritten with the calibrated data of the touch probe 1 = the calibrated tool data are retained	0
Cycles for milling pockets with free-programmed contour	7420*					0 to 31	%00000
• Slot milling direction		0	◆	◆		0 = anti-clockwise slot milling of the pocket contours, clockwise for islands 1 = clockwise slot milling of the pocket contours, anti-clockwise for islands	
• Sequence for clearing out and slot milling		1	◆	◆		0 = first slot milling, then clear out pocket 2 = first clear out pocket, then slot milling	
• Merge programmed contours		2	◆	◆		0 = contours merged only if the tool center paths intersect 4 = contours merged if the programmed contours overlap	
• Clear out and slot milling to pocket depth for each peck		3	◆	◆		0 = clearing out and slot milling performed in one operation for all pecks 8 = for each peck, first perform slot milling and then feed clearing out (depending on bit 1) before next peck	
• Position after finishing a contour pocket (cycles 6, 15, 16, 21, 22, 23, 24)		4	-	05		0 = the control moves to the position at which it was before the cycle call 16 = only the tool axis is lifted to clearance height after the cycle	

* accessible via code number 123

Function	MP No.	Bit	A	B	C	Input	AE-6 Entry value
Overlap-factor for pocket milling	7430*		◆	◆	◆	0.1 to 1414	1
Arc-end point tolerance Linear contour	7431*		◆	◆	◆	0.0001 to 0.016 [mm]	0,01
Output of M functions	7440*		◆	◆	◆		
Programmed halt on M06		0				+ 0 = programmed halt on M06 + 1 = no programmed halt on M06	%00010
Output of M89, modal cycle call		1				+ 0 = no cycle call, normal code transfer of M89 at beginning of block + 2 = modal cycle call at end of block	
Axis standstill when an M function is output Exceptions: axis standstill always occurs after M functions that result in a programmed halt (such as M00, M02 ...) or in case of STOP or CYCL-CALL block		2				+ 0 = program halt until acknowledgement of M function + 4 = no program halt; TNC does not wait for acknowledgement	
Select Kv factors (M105/106)		3				+ 0 = function not active + 8 = function active	
Reduced feed rate in the tool axis with M103		4				+ 0 = function not active + 16 = function active	
Calculate tool change position from MP951.X in block scan	7450		08	◆	◆	0 = do not calculate	%00000
X		0				+1 = X axis	
Y		1				+2 = Y axis	
Z		2				+4 = Z axis	
IV		3				+8 = IV. axis	
V		4				+16 = V. axis	
Feed rate for reapproaching the contour after a program interruption						10 to 300 000 [mm/min]	
X	7451.0		-	-	06		0
Y	7451.1		-	-	06		0
Z	7451.2		-	-	06		0
IV	7451.3		-	-	06		0
V	7451.4		-	-	06		0

* accessible via code number 123

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Constant feed rate in corners	74 60 *	◆	◆	◆	0 to 179.9999 [°]	10
Display mode and software limit switches for rotary axis	74 70 *	I08	-	-	0 = 0 to ± 359.999° (software limit switches are not monitored) 1 = 0 to ± 99 999.9999 [°]	0
Datum in datum table	7475	◆	◆	◆	0 = datum point is workpiece datum 1 = datum point is machine datum	0
Output of tool number or pocket number with TOOL CALL block	7480.0	◆	◆	◆	0 to 6 0 = no output 1 = output of tool number only when tool number changes (W262) 2 = output of tool number with every TOOL CALL (W262) 3 = output of pocket number (W262) and tool number (W264) only when tool number changes 4 = output of pocket number (W262) and tool number (W264) with every TOOL CALL 5 = output of pocket number (W262) and tool number (W264) only when tool number changes; pocket table does not change. 6 = output of pocket number (W264) with every TOOL CALL; pocket table does not change.	2

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
with TOOL-DEF blocks (only if MP7260 > 0)	7480.1	◆	◆	◆	0 = no output 1 = output of tool number only when tool number changes (W262) 2 = output of tool number with every TOOL DEF (W262) 3 = output of pocket number (W262) and tool number (W264) only when tool number changes 4 = output of pocket number (W262) and tool number (W264) with every TOOL DEF	2
Number of traverse ranges	7490	◆	◆	◆	0 = 1 range, 3 datums 1 = 3 ranges, 3 datums 2 = 1 range, 1 datum 3 = 3 ranges, 1 datum	0

* accessible via code number 123

Tilting the Working Plane

Function	MP No.	Bit	A	B	C	Input	AE-6 Entry value
Tilting the working plane	7500		08	◆		0 = function inactive 1 = function active	0
Swivel head geometry **1. Parameter block** selecting the transformed axis	7510		08	◆		0 to 63	0
		0				+1 = X axis	
		1				+2 = Y axis	
		2				+4 = Z axis	
		3				+8 = A axis	
		4				+16 = B axis	
		5				+32 = C axis	
supplementary identifier for transformation	7511		08	◆			
		0				+0 = tilting head +1 = tilting table	
		1				+0 = incremental dimensions (for tilting head) +2 = absolute values referenced to the machine datum (for tilting table)	
dimensions for transformation	7512		08	◆		-99 999.9999 to +99 999.9999 0 = free tilting axis	
2. Parameter block	7520		08	◆		0 to 63	0
	7521		08	◆		0 to 3	0
	7522		08	◆		-99 999.9999 to +99 999.9999	0

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
3. Parameter block	7530	08	◆		0 to 63	0
	7531	08	◆		0 to 3	0
	7532	08	◆		-99 999.9999 to +99 999.9999	0
4. Parameter block	7540	08	◆		0 to 63	0
	7541	08	◆		0 to 3	0
	7542	08	◆		-99 999.9999 to +99 999.9999	0
5. Parameter block	7550	08	◆		0 to 63	0
	7551	08	◆		0 to 3	0
	7552	08	◆		-99 999.9999 to +99 999.9999	0
6. Parameter block	7560	08	◆		0 to 63	0
	7561	08	◆		0 to 3	0
	7562	08	◆		-99 999.9999 to +99 999.9999	0
7. Parameter block	7570	08	◆		0 to 63	0
	7571	08	◆		0 to 3	0
	7572	08	◆		-99 999.9999 to +99 999.9999	0
8. Parameter block	7580	08	◆		0 to 63	0
	7581	08	◆		0 to 3	0
	7582	08	◆		-99 999.9999 to +99 999.9999	0
9. Parameter block	7590	08	◆		0 to 63	0
	7591	08	◆		0 to 3	0
	7592	08	◆		-99 999.9999 to +99 999.9999	0

Function	MP No.	Bit	A	B	C	Input	AE-6 Entry value
Feed rate and spindle override	7620		◆	◆			% 1101
Feed rate override, if rapid traverse button pressed in "program run"		0				+ 0 = feed rate override inactive + 1 = feed rate override active	
reserved		1					
Feed rate override, if • rapid traverse button pressed in "manual" or • rapid traverse button and handwheel direction key pressed in "handwheel"		2				+ 0 = feed rate override inactive + 4 = feed rate override active	
Override characteristic curve		3				+ 0 = feed rate and spindle override in 1% increm. + 8 = feed rate and spindle override in 0.01% increm., and non-linear characteristic curve	

Hardware

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Handwheel configuration	7640*	◆	◆	◆	0 = no handwheel connected 1 = HR 330 (all keys evaluated by NC) 1) 2 = HR 130, HR 330 (all keys evaluated by NC) 2) 3 = HR 330 "RAPID" key by PLC I 162 "PLUS" key by PLC I 160 "MINUS" key by PLC I 161 4 = HR 332, evaluation of keys and LEDs depends on MP 7645.0 5 = HRA 110, multi-axis handwheel (3 x HR 150) 6 = HR 410, evaluation of keys and LEDs depends on MP 7645.0 3)	0
Entry of interpolation factor	7641	◆	◆	◆	0 = entry via keyboard 1 = entry via PLC module 9036	0

* accessible via code number 123

1) axis can only be switched by handwheel
2) axis can be switched by handwheel and keyboard
3) If the handwheel HR 410 does not receive any initializing parameters (MP 7645.X), it automatically switches to HR 332 mode (MP 7640 = 4).

Function	MP No.	Bit	A	B	C	Input	AE-6 Entry value
Initializing parameters for handwheel Assignment of 3. handwheel via axis selector switch **(MP 7640 = 5)**	7645.0	0 1 2-7	◆	◆		+ 0 = position 1 (left stop) → Z axis position 2 → IV. axis position 3 → V. axis + 1 = position 1 → X axis position 2 → Y axis position 3 → V. axis position 4 → IV. axis position 5 → V. axis + 2 = position 3 → Z axis position 4 → IV. axis position 5 → V. axis reserved	0
Evaluation of the keys and LEDs on HR 332 **(MP 7640 = 4)** HR 410 in HR 332 mode **(MP 7640 = 4)**	7645.0		◆	◆		**HR 332** 0 = keys X, Y, Z, IV and their LEDs evaluated by NC remaining keys: PLC I 164 to 170 remaining LEDs: PLC O 100 to O 106 1 = keys: PLC I 160 to I 171 LEDs: PLC O 96 to O 107 **HR 410** 0 = keys X, Y, Z, IV and their LEDs evaluated by NC remaining keys: PLC I 164 to 171 remaining LEDs: PLC O 100 to O 107 1 = keys: PLC I 160 to I 171 LEDs: PLC O 96 to O 107	0
HR 410 inn HR 410 mode **(MP 7640 = 6)**			-	◆		0 = keys X, Y, Z, IV, actl. value transfer and their LEDs evaluated by NC remaining keys: PLC I 168 to 175 remaining LEDs: PLC O 100 to O 111 1 = keys: PLC I 160 to I 175 LEDs: PLC O 96 to O 111	0

Function	MP No. Bit	A	B	C	Input	AE-6 Entry value
Assignment of 3. handwheel via machine parameter **(MP 7640 = 5)**	7645.1	◆	◆		0 = simulation of 1. position of axis selector switch MP 7645.0 = 0 → Z axis MP 7645.0 = 1 → X axis + 1 = X axis + 2 = Y axis + 4 = Z axis + 8 = IV. axis + 16 = V. axis	0
Axis selection procedure **(MP 7640 = 5)**	7645.2	◆	◆		0 = selection via axis selector switch according to MP 7645.0 1 = axis selection according to MP 7645.1	
reserved	7645.3 to 7645.7	◆	◆		no function	0
Count direction for handwheel	7650	◆	◆		0 = positive count direction 1 = negative count direction	0
Hysteresis for electronic handwheel	7660	◆	◆		0 to 65 535 [increments]	10
Minimum interpolation factor for handwheel	7670	◆	I04		0 to 10	0
Handwheel interpolation factor slow (HR 130/3xx/410) medium (HR 410) fast (HR 410)	 7670.0 7670.1 7670.2	 - - -	 04 04 04		 0 to 10	 0 0 0
HR 410: handwheel % factor slow (HR 410) medium (HR 410) fast (HR 410)	 7671.0 7671.1 7671.2	 - - -	 04 04 04		 0 to 100 [%]	 50 75 100

Function	MP No.	Bit	A	B	C	Input	AE-6 Entry value
Parameter with multiple function	7680						%00011111
• Memory function for axis direction keys		0	◆	◆		0 = not stored +1 = stored	
• Re-approaching the contour		1	◆	◆		0 = inactive +2 = active	
• Block scan		2	◆	◆		0 = inactive +4 = active	
• Interruption of block scan by "STOP" or by M06		3	◆	◆		0 = interruption +8 = no interruption	
• Include dwell time during block scan to change the direction of rotation in a "tapping" cycle		4	◆	◆		0 = dwell time is waited to end +16 = dwell time is not waited to end	
• Start calculation with block scan		5	◆	◆		0 = start from cursor position +32 = start from beginning of program	
• Tool length for blocks with surface normal vector		6	-	◆		0 = without DR2 from the tool table +64 = with DR2 from the tool table	
• Bit reserved		7	-	-			

Function	**MP No.**	**Bit**	**A**	**B**	**C**	**Input**	**AE-6 Entry value**
Incremental positioning after TOOL CALL	7682		-	-	06	0 = tool length difference taken into account 1 = tool length difference ignored	0
Memory test at power-on	7690					0 to 7	%111
RAM		0	◆	◆	◆	+0 = test +1 = no test	
EPROM		1	◆	◆	◆	+0 = test +2 = no test	
Harddisk		2	-	-	◆	+0 = test +4 = no test	