1. How to Use this Service Manual

The service manual TNC 426 CA/PA 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 426 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 is displayed on the screen in plain language.

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

Further error messages are described in the

- **Operating Manual** (HEIDENHAIN)
- **Technical Manual** (HEIDENHAIN)
- **Documentation by the machine tool manufacturer**
- **Operating Instructions FE 401 B**.

Error Message	Section
AXIS DOUBLE PROGRAMMED	15.2
BAUD RATE NOT POSSIBLE	17.3.
CYCLE PARAMETER INCORRECT	15.2
DATA TRANSFER ERRONEOUS X	17.3
EMERGENCY STOP	20.6
ERR: 001	17.3
ERR: 002	17.3
ERR: 003	17.3
ERR: 004	17.3
ERR: 005	17.3
ERR: 006	17.3
ERR: 007	17.3
ERR: 010	17.3
ERR: 011	17.3
ERR: 012	17.3
ERR: 013	17.3
ERR: 014	17.3
ERR: 015	17.3
ERR: 016	17.3
ERR: 017	17.3
ERR: 018	17.3
ERR: 100	17.3
ERR: 101	17.3
ERR: 102	17.3
ERR: 103	17.3
ERR: 104	17.3
ERR: 105	17.3
ERR: 106	17.3
ERR: 107	17.3
ERR: 108	17.3
ERR: 109	17.3
EXCHANGE BUFFER BATTERY	10.5
EXCHANGE TOUCH PROBE BATTERY	15.2
EXT. IN-/OUTPUT NOT READY	17.3

Error Message	Section
FAULTY RANGE DATA	15.2
HANDWHEEL DEFECTIVE	14.4
INPUT ERROR 1	22.2 22.3
INPUT ERROR 5	22.2 22.3
INTERFACE ALREADY ASSIGNED	17.3
LANGUAGE LOAD ERROR XX	2.1 22.2 22.3
LIMIT SWITCH <Axis>	2.1
MIRRORING NOT PERMITTED	15.2
OPERATING PARAMETERS ERASED	2.1
PLANE WRONGLY DEFINED	15.2
PLC PROGRAM NOT TRANSLATED	2.1
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POWER INTERRUPTED	2.1 22.2 22.3
PROBE SYSTEM NOT READY	15.2
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RELAY EXT. DC VOLTAGE MISSING	2.1
ROTATION NOT PERMITTED	15.2
SCALING FACTOR NOT PERMITTED	15.2
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STYLUS ALREADY IN CONTACT	15.2
TIME LIMIT EXCEEDED	15.2
TOUCH POINT INACCESSIBLE	15.2
TRANSFERRED VALUE ERRONEOUS X	17.3
UPDATE THE SYSTEM DATA!	2.1 22.3
WRONG AXIS PROGRAMMED	15.2

2.1 Causes of Minor Error Messages

OPERATING PARAMETERS ERASED

- When the control is booted after power-on for the first time (new and exchange controls); When the control is booted for the first time after a software exchange;
- Defective buffer batteries and (Gold) capacitor;
- RAM error on the processor board;

LIMIT SWITCH <Axis>

- "Manual" operating mode:
  The preset **software limit switch** has been reached when traversing 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 4574 and M 4575

POWER INTERRUPTED

- After a reset signal at the power supply unit (e.g. line voltage drops)
- Important machine parameters have been changed (e.g. MP 110.X, MP 210)
- During each power-on routine (see section 20.5)

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 and readjust, if necessary.)

PLC PROGRAM NOT TRANSLATED

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

RELAY EXT. DC VOLTAGE MISSING

- After the message POWER INTERRUPTED was confirmed by pressing the CE key, the TNC waits during the power-on routine for the 24V control voltage (input "acknowledgement control ready for operation, X42/4); see section 20.5

PLC: ERROR 00	marker	2924	
to	to		— set
PLC: ERROR 99	marker	3023	(only if MP 4020 bit 3 = **1**)

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

UPDATE THE SYSTEM DATA

During the power-on routine the control checks in the file SYS:\HDDVERS.A whether the current data (cycles, output templates, drive data etc.) are stored on harddisk. If this is not the case, the error message is output. To update the data a setup must be executed with the file disk.
(see section: Software Exchange)

LANGUAGE LOAD ERROR XX

The current NC dialogues are not stored on the harddisk. To update the data a setup must be executed with the file disk.
(see section: Software Exchange)

3. Major Error Messages and their Causes

The integral monitoring system distinguishes between minor and gross errors. Gross errors are characterized by a **blinking display** (e.g. malfunctions of the encoders, drives and data processing errors).
If a gross error occurs, the control opens the contact **"Control Read for Operation"**, which 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.

Blinking Display	Error Cause
DSP ERROR XXXX (no axis ID)	XXXX = FF01 Undefined error, no causalitiy FF02 Host command not recognized / invalid FF03 Host / DSP watchdog do not match FF04 Undefined Interrupt FF05 Invalid hardware code FF06 No V_NOML value received from host FF07 AC fail FF08 Emergency stop fail FF09 Stack overflow FF0A Delta signal pulse width modulation FF0B Error on memory request FF0C No speed control interrupt FF0D Error during sum check (code) FF0E Time of speed interrupt exceeded EF01 Invalid oscilloscope parameter requested EF02 Host command not recognized EF03 EMERGENCY STOP active (emerg. stop test) EF04 EMERGENCY STOP inactive (emerg. stop test) EF05 Stack overflow warning EF07 No interrupt from GA EF08 Response to a host command too late (communication monitor) EF09 Spurious interrupt (AC fail, emerg. stop) EF0A Emergency stop fail EFF0 Error during sum check (code) E800 Idle loop of time monitor; the last 2 positions contain time x 3ms E900 Corrected angle deviation when aligning EA00 Time of speed interrupt exceeded; the last 2 positions contain time [ms] (hex!)
DSP ERROR XXXX Y	XXXX = Run time error messages 1000 Y Command time out 1001 Y Incorrect acknowledgement of command 1002 Y Error when starting command execution 1003 Y Error when terminating command execution 1004 Y Wrong status message from DSP Error messages when booting the DSP system 1100 Y Error during check sum formation 1101 Y Time-out during word transfer command 1102 Y Time-out during check sum formation 1103 Y Time-out during GO command Y = 0 = DSP axes 1 = DSP spindle (TNC 430 only)

Blinking Display	**Error Cause**
DSP ERROR XXXX Y (with axis ID)	Y = 0 ≙ X-axis 1 ≙ Y-axis 2 ≙ Z-axis 3 ≙ IV. axis 4 ≙ V. axis 5 ≙ spindle XXXX = F010 Unknown motor type (MP2200) F020 reserved F030 reserved F040 Number of pairs of poles too large (MP2230) F050 ASM: field-defining current (MP 2280> MP 2110/2310) F060 Grating period of speed encoder F070 ASM: time constant of armature (MP2290 =0 or too large) F080 Kink point rpm / noml. rpm (MP2210 = 0 or too large) F090 Unknown drive model (MP2000) F0A0 reserved F0B0 reserved F0C0 reserved F0D0 Voltage of current sensor (MP2130 too large) F0E0 Peak current of power stage (MP2110 too large) F0F0 Proportional factor of current controller (MP2400 too large) F100 Integral factor of current controller (MP2410 too large) F110 Motor temperature (MP2270 > 255) F120 reserved F130 Oscilloscope parameter incorrect (for testing) F140 Nominal current of power stage (MP 2110 > MP2110/MP2310) F150 Nominal current of motor (MP2300 too large or < MP2280) F160 Peak current of motor (MP2310 too large) F180 Wrong angle compensation values with SM (MP2340/MP2350) F170 Max. motor rpm (MP2220 too large) F200 Amplitude of speed encoder (Zn track) too small F210 Amplitude of speed encoder (Z1 track) too small F220 reserved F230 Motor temperature too high F240 Unknown counter IC at speed input F250 reserved F260 reserved F270 Angle deviation too large when aligning, ZN/Z1 tracks do not match; this message may also be generated, if MP2250.X is not correct. F280 Motor cannot be controlled (an incorrect movement of the motor is detected when the max. current is output by the controller) F290 Error 3D-touch probe/evaluation; latch not with L1 input (G19/G26)

ASM : asynchronous motor
SM : synchronous motor

Blinking Display	Error Cause
INCORRECT ENTRY MP 2000.X	The control detected an incorrect entry value (motor type unknown) in this parameter.
INCORRECT ENTRY MP 2120.X	The entry value in MP 2120.X is **larger** than the values in MP 2110.X and MP 2310.X.
INCORRECT ENTRY MP 2280.X	The entry value in MP 2280.X is **larger** than the values in MP 2110.X and MP 2310.X. .X symbolizes the index of the machine parameter: .0 ≙ X-axis .1 ≙ Y-axis .2 ≙ Z-axis .3 ≙ IV. axis .4 ≙ V. axis .5 ≙ spindle

Blinking Display	Error Cause
FILE SYSTEM ERROR X	X = 1 Defective cluster number in routine "get_cluster. 2 Defective cluster number in routine "put_cluster". 3 Defective cluster number in routine "next_cluster" 4 Defective cluster number in routine "update_cluster". 5 Defective cluster number in routine "get_free_cluster". 6 Defective cluster number in routine "get__last_cluster". 7 Defective cluster number in routine "get_cluster_befor". 8 Defective cluster number in routine "read_dos_data". 9 Defective cluster number in routine "write_dos_data". 10 Unidentifiable software error in routine "test_file“. A Semaphore or queue could not be created. B Partition defective or cannot be read. Harddisk or RAM cannot be mounted. C Partitioning of disk faulty. D Faulty sector number in harddisk server task. Wrong sector number or write-protected sector. E Time-out when waiting for the harddisk interrupt. F Harddisk write or read error. The TNC has detected and excluded a defective cluster on the harddisk. G Time-out interrupt line. H Time-out disk not ready. I Disk always busy. J Sector in FAT or root directory defective, disk defective. K Recalibrate error L No data request from harddisk although expected

If the error message **"FILE SYSTEM ERROR X"** (X = code letter) is generated repeatedly, note down the error message **and** the register contents and contact HEIDENHAIN.

Blinking Display	Error Cause
PROCESSOR CHECK ERROR YX	X = 3 Test plane incomplete / will not run 8 CRC sum PLC program OP-code A Software error B Software error M Operating voltage out of tolerance O Export version: axis 4 or 5 paraxial R Attempt to start a PLC positioning (M4120 to M4124), a datum shift (M4132) or to switch the range (M4574 and M4575), although MP7440/bit 2 was set or MP3030 = 1. CPU number 1 = host computer 2 = DSP

If the error message **"PROCESSOR CHECK ERROR XY"** (XY = code letters, see above) is generated repeatedly, please send the **complete LOGIC UNIT** to HEIDENHAIN for repair.
Please indicate **error message, code letters and register contents**.

Blinking Display	Error Cause	Y
ERROR IN PLC PROGRAM X	**X** = 0 Invalid command The line cannot be interpreted as PLC command	ESC
	1 free (earlier versions: operand for jump is not label)	-
	2 Invalid operand type An invalid operand type was indicated. The command cannot be used for this operand type.	ESC
	3 Operand not found An operand type was indicated without value.	ESC
	4 Operand out of permissible range The operand number is out of the value range permissible for this operand.	ESC
	5 No limiter after command Characters have been detected after the PLC command which cannot be interpreted.	ESC
	6 No end of line found The line is longer than 128 characters.	ESC
	7 Label not defined Reference to a label which is not defined elsewhere by LBL, KFIELD or EXTERN.	SC
	8 No end of block found At its end the program file contains commands that are not terminated by an EM or JP instruction. Therefore, an undefined program range may be run.	SC
	9 Program too long (RAM overflow) The total length of the program to be generated exceeds the memory space available in the control.	SC

Error classification (not displayed on the screen)

Y = E: Error recognized during editing; line is not formatted.

S: Error recognized during syntax check in the PLC editor (COMPILE soft key). Under certain circumstances this error is already recognized during the syntax check, otherwise when the compiler is run.

C: Error recognized during compiler run, either when the control is switched on or in the PLC PLC programming mode.

Blinking Display	Error Cause	Y
ERROR IN PLC PROGRAM XX	**XX** =	
	10 Assign in parentheses An attempt to assign the result of a gating to an operand, although arithmetic parentheses are open.	SC
	11 Excessive nesting of parentheses An attempt to nest more than 16 parentheses.	SC
	12 Jump within a gating sequence An unconditional jump has been programmed, although the previous gating sequence was not yet assigned.	SC
	13 "Close Parenthesis" without "Open Parenthesis" A "Close Parenthesis" command was programmed, although no parentheses were open.	SC
	14 Label within parentheses A label has been programmed within parentheses. This is not permissible, since "Close Parenthesis" commands cannot be processed without corresponding "Open Parenthesis"	SC
	15 Label within gating sequence A label has been programmed within a gating sequence. This is not permissible, since (depending on the program) the first command after the label would have to be interpreted as a gating and as a load command.	SC
	16 Jump within parentheses A jump command has been programmed within parentheses. This is not possible, since due to internal implementation open parentheses must be closed, which would not be the case, if a jump command was permitted.	SC
	17 Open parenthesis at end of block An EM instruction has been programmed with open parentheses, although parentheses must always be closed.	SC
	18 Label defined twice The same label name was used twice for an LBL or a KFIELD instruction. A label name imported from another module via EXTERN was used again with an LBL or a KFIELD instruction. A name reserved for internal modules (9000 to 9025) was used with an LBL, KFIELD or EXTERN instruction.	SC
	19 Word assign missing A word gating has been programmed without assigning the result to an operand; a new gating was started instead.	SC

Error classification (not displayed on the screen)

Y = S: Error recognized during syntax check in the PLC editor (COMPILE soft key). Under certain circumstances this error is already recognized during the syntax check, otherwise when the compiler is run.

C: Error recognized during compiler run, either when the control is switched on or in the PLC programming mode.

Blinking Display	Error Cause	Y
ERROR IN PLC PROGRAM XX	**XX** =	
	20 Logic assign missing A logic gating has been programmed without assigning the result to an operand; a new gating was started instead.	SC
	21 Word accumulator not loaded A command has been programmed to gate, assign or manipulated the word accumulator, although it was not loaded.	SC
	22 Logic accumulator not loaded A command has been programmed to gate, assign or manipulated the logic accumulator, although it was not loaded.	SC
	23 Accumulators not loaded on "Open Parentheses" An "Open Parentheses" command has been programmed, although neither a logic nor a word sequence were started.	SC
	24 Incorrect type of parentheses result Depending on the gating programmed before the parentheses and the type of parentheses, the gating sequence in parentheses is expected to provide a result of the same type (word / logic). If the type is not the same, the gating requested in the "Open Parentheses" command is not possible.	SC
	25 Conditional jump with incorrect logic accumulator A conditional jump (CMT/CMF/JPT/JPF/EMT/EMF) has been programmed, although no gating sequence was started before in the logic accumulator.	SC
	26 ENDC/ENDK not within CASE/KFIELD instruction An ENDC command has been programmed without preceding CASE instruction. An ENDK command has been programmed without preceding KFIELD label.	SC
	27 Wrong command within CASE table / KFIELD A command different from CM was programmed after a CASE instruction and before the corresponding ENDC instruction. A command different from K was programmed after a KFIELD label and before the corresponding ENDK label.	SC
	28 Too many entries in CASE table A CASE statement with more than 128 entries has been programmed.	SC

Error classification (not displayed on the screen)

Y = S: Error recognized during syntax check in the PLC editor (COMPILE soft key). Under certain circumstances this error is already recognized during the syntax check, otherwise when the compiler is run.

C: Error recognized during compiler run, either when the control is switched on or in the PLC programming mode.

Blinking Display	Error Cause	Y
ERROR IN PLC PROGRAM XX	**XX** =	
	29 Empty CASE instruction/KFIELD An ENDC instruction has been programmed immediately after a CASE instruction. An ENDK label has been programmed immediately after a KFIELD label.	SC
	30 String accumulator not loaded A command was programmed to gate, assign or manipulate the string accumulator, although it was not loaded.	SC
	31 String instruction in parentheses A string instruction was programmed within parentheses. However, string operations cannot be nested with parentheses.	SC
	32 String assign missing A new gating sequence was started without having assigned the gating previously formed in the string accumulator.	SC
	33 GLOBAL/EXTERN not at beginning of file In the file the commands GLOBAL or EXTERN have been programmed after another program code. Such commands have to be programmed before the program code.	SC
	34 Too many modules An attempt to combine more than 64 files to a program by means of the USES instruction.	(S)C
	35 File not found A file included via USES cannot be found. An attempt to include a .PLC file with MP4010=0 (EPROM).	(S)C
	36 File too long The program code of a single file is larger than 64 kBytes and therefore cannot be compiled. The file must be subdivided into several files and linked with USES.	SC
	37 Too many local labels More than 1000 labels have been allocated in a file. All LBL, KFIELD and EXTERN instructions are counted as well as all (invisible) labels created by structured commands. The file must be subdivided into several files and linked with USES.	SC
	38 Too many global labels More than 1000 labels have been defined by all files involved.	C

Error classification (not displayed on the screen)

Y = S: Error recognized during syntax check in the PLC editor (COMPILE soft key). Under certain circumstances this error is already recognized during the syntax check, otherwise when the compiler is run.

C: Error recognized during compiler run, either when the control is switched on or in the PLC programming mode.

Blinking Display	Error Cause	Y
ERROR IN PLC PROGRAM XX	**XX** =39 External label not defined A label declared EXTERN was not defined GLOBAL in one of the modules involved.	C
	40 External label in CASE instruction A label declared EXTERN was inserted in the CM list of a CASE instruction. A local module must be defined which in the most simple case only calls the global module via CM.	SC
	41 External label in JP instruction An attempt to jump to an EXTERNAL label by means of a JP/JPF/JPT instruction.	SC
	42 Global label defined twice The same label has been defined GLOBAL several times in one or several files.	(S)C
	43 Wrong structured instruction An ELSE/ENDI/ENDW/UNTIL instruction has been programmed without the corresponding IF/ELSE/WHELP/REPEAT instruction. Several structured instructions were interlaced instead of nested. The structures must always be closed in the reverse order that they were opened.	SC
	44 Open structure at end of file A structured instruction was opened and not closed at the end of the file.	SC
	45 GLOBAL instruction in main file A module of the main file was defined GLOBAL. Only modules from files included with USES may be made accessible for other files by means of the GLOBAL instruction.	SC
	46...49 free	R
	50 Excessive nesting An attempt to nest more than 32 module calls. A recursive module call has been programmed that exceeds the nesting depth limit of 32.	
	51 Stack underflow An attempt to retrieve data from the stack which were not stored there.	R
	52 Stack overflow An attempt to load more than 128 data bytes onto the stack. Word operands (B/W/D/K) require 4 bytes, logic operands (M/I/O/T/C) 2 bytes.	R

Error classification (not displayed on the screen)

Y = S: Error recognized during syntax check in the PLC editor (COMPILE soft key). Under certain circumstances this error is already recognized during the syntax check, otherwise when the compiler is run.

C: Error recognized during compiler run, either when the control is switched on or in the PLC PLC programming mode.

R: Error recognized during cycle time of the PLC program.

Blinking Display	Error Cause	Y
ERROR IN PLC PROGRAM XX	**XX** =	
	53 Time out It took more than 10 ms to execute the program part to be run cyclically. The subprogram structure needs to be checked and very time-consuming processes started as SUBMIT jobs. The processing time displayed may be increased by transfers via RS232 and by handwheel operation. If in doubt, select the handwheel mode and start data transfer via RS232 at the same time (if possible 38 400 bauds); then check "PROCESSING TIME MAXIMUM" in PLC programming mode. 100% corresponds to 5 ms; with this degree of utilization the block processing time is still observed, values of more than 150% should not occur (safety margin for unfavourable operating conditions).	R
	54 CASE out of range The operand for the CASE instruction contains a value that cannot be interpreted as offset in the CM table (<0 or > length of table -1).	R
	55 Subprogram not defined Currently this error cannot occur.	R
	56 Indexed access out of range Since the index register has been taken into account, the address for a write access to the data types B/W/D/M/I/O/T/C is located in a range that is not permissible for this type of operand. In the case of an access to a constant field, the index register contains a value that is not permitted for this field (<0 or > field length –1). By considering the index register the address of a string results in a non-permissible value. By considering the index register the number of a dialogue (S#Dn[X]) or an error message (S#En[X]) results in a non-permissible value (<0 or >999). When addressing a string component (Sn^X) the value range for the index register has been exceeded (0 to 127).	R
	57 No PLC error table found A PLC error module 9085/9086 has been called although not error table was compiled or the table does not contain any entries.	R
	58...89 free	

Error classification (not displayed on the screen)

Y = R: Error recognized during cycle time of the PLC program.

Blinking Display	Error Cause	Y
ERROR IN PLC PROGRAM XX	**XX** = 90 PLC error table The error table selected in OEM.SYS is not a .PET file. 91 PLC error table The error table selected in OEM.SYS was not found (wrong file name or path). 92 PLC error table The format of the error table selected in OEM.SYS is not the current binary format (e.g. when a new software was loaded).	 C C C

Error classification (not displayed on the screen)

Y = C: Error recognized during compiler run, either when the control is switched on or in the PLC programming mode.

Error message GROSS POSITIONING ERROR with axes with **analogue** speed controller

Blinking Display	Error Cause
GROSS POSITIONING ERROR <Axis> A	**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> B	**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 velocity feed-forward control)
GROSS POSITIONING ERROR <Axis> C	**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> D	**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> E	**Monitoring of the Offset Voltage** • The offset voltage limit of 100mV has been reached during an automatic offset adjustment with MP1220.

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
- Defective motor, measuring system or cables
- Mechanical error (bearing, spindle, guides)
- Excessive mechanical forces on a drive

Error message GROSS POSITIONING ERROR with axes with **integral** current and speed controller

Blinking Display	Error Cause
GROSS POSITIONING ERROR <Axis> A	**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> B	**Monitoring of the Analogue Voltage Limit** • When operating with servo lag the spindle speed is limited to the value in MP2220.X. With velocity feedforward control this error message is generated as soon as the value of MP2220.X is reached.
GROSS POSITIONING ERROR <Axis> C	**Movement monitoring** • The difference between the counts of the position encoder and of the speed encoder has reached the tolerance programmed in MP2800.X (only effective, if two separate encoders are used for acquisition of nominal position and speed). **or** • The path covered in a certain time is less than 1/4 or more than 4x the nominal value calculated by the control; can be influenced via MP1140.X.
GROSS POSITIONING ERROR <Axis> D	**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> F	**Movement monitoring (with NC software 280 462 and 280 463)** • The difference between the counts of the position encoder and of the speed encoder has reached the tolerance programmed in MP2800.X (only effective, if two separate encoders are used for acquisition of nominal position and speed).

Error Location

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

e.g.
- Error in control
- Monitoring function of servo amplifier has responded (e.g. monitoring of current intensity)
- Electrical defect at the servo amplifier
- Defective motor, position or speed encoder, cables
- Mechanical defect (bearing, spindle, guides)
- Excessive mechanical forces on a drive

Blinking Display	Error Cause
MEASURING SYSTEM <Axis> DEFECTIVE A	Signal amplitude error, position encoder
MEASURING SYSTEM <Axis >` DEFECTIVE A	Signal amplitude error, speed encoder(Zn or Z1 track)
MEASURING SYSTEM <Axis> DEFECTIVE B	Signal frequency error, position encoder
MEASURING SYSTEM <Axis >` DEFECTIVE B	Signal frequency error, speed encoder
MEASURING SYSTEM <Axis> DEFECTIVE C	Error with distance-coded scales (position encoder) **Error Causes:** • measuring system not connected • cable damaged • glass scale contaminated or damaged • scanning head defective • encoder monitoring system defective
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	The temperature inside the logic unit has exceeded + 70°C.
MOTOR TEMPERATURE TOO HIGH <Axis>	The motor temperature has reached the value of MP2270.X. The current motor temperature is transferred to the TNC via the connectors of the speed encoder X15 to X20 as analogue voltage at the pins "temperature +/-.
EMERGENCY STOP DEFECTIVE	Error during the test routine for the output "control is ready" when the control is switched on. (see section 20.5)
EMERGENCY STOP PLC	This error message is generated, if the marker 2815 is set without additional marker (M2924 - M3023). (only if MP4020 bit 3 = **1)**
RELAY EXT. DC VOLTAGE MISSING	No PLC operating voltage at connector X44.

Blinking Display	Error Cause
PLC: Error 00 1) to **PLC: Error 99** 1)	marker 2924 to marker 3023 — **and** marker 2815 set (only if MP 4020 bit 3 = **1**)
CHECK SUM ERROR YX	The TNC has detected a CRC sum error during operation YA CRC sum of main processor EPROM, chips 1/2 YB CRC sum of main processor EPROM, chips 3/4 Y = CPU number 1 = main processor 2 = DSP
CHECK SUM ERROR	The TNC has detected a CRC sum error during the power-on routine.

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)

Please contact HEIDENHAIN, if one of these error messages occurs repeatedly.

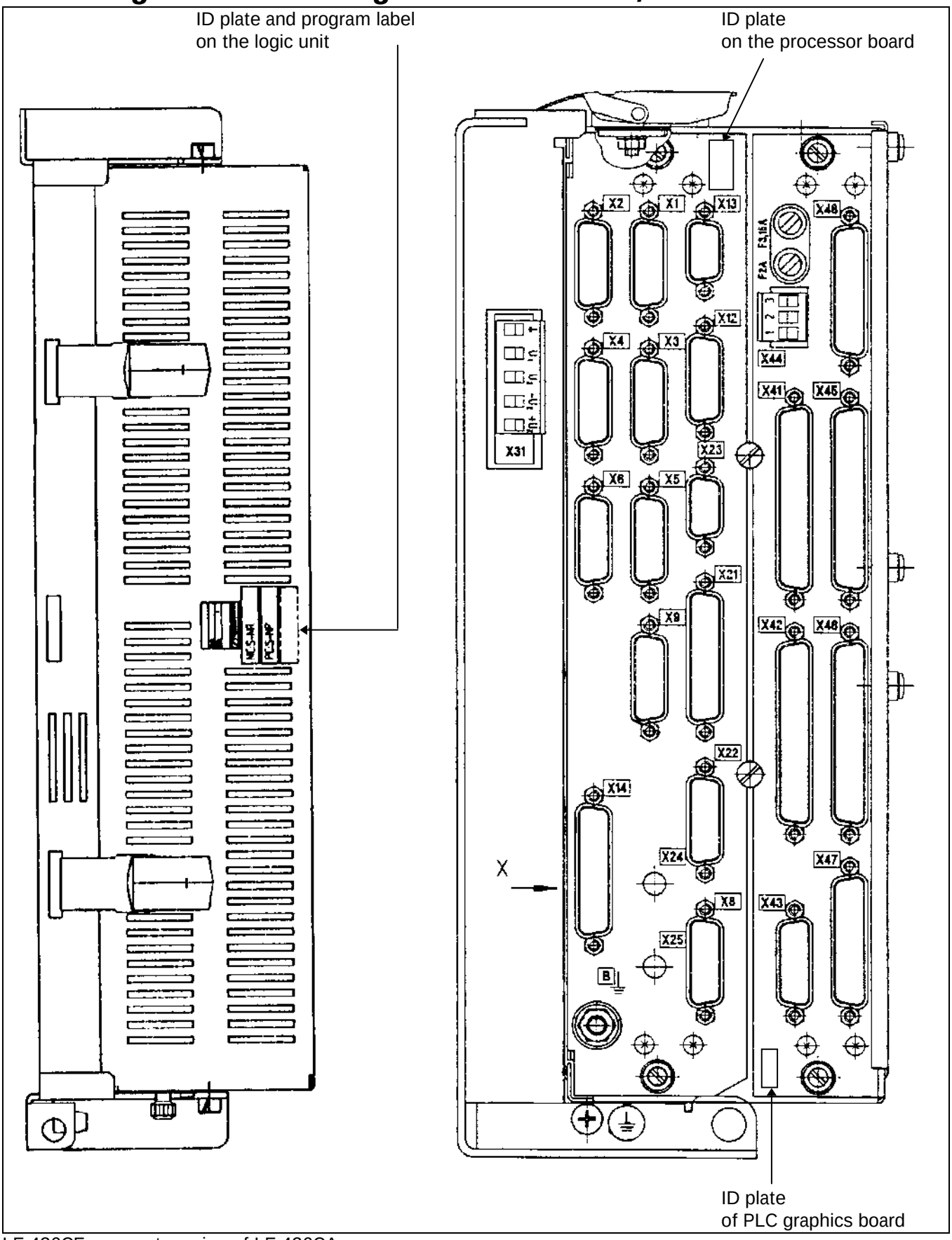
4. Hardware Components TNC 426 CA/PA

TNC Component	TNC 426 CA/CE	TNC 426 PA/PE
LOGIC UNIT LE 426 CA/CE [1]		
Id.No. 293 423 -- [5]	x	
Id.No. 295 199 -- [6]	x	
Id.No. 297 461 -- [7]	x	
LOGIC UNIT LE 426 PA/PE [1]		
Id.No. 286 839 -- [5]		x
Id.No. 295 198 -- [6]		x
Id.No. 297 740 -- [7]		x
VISUAL DISPLAY UNIT BC 110B		
Id.No. 260 520 --	x	x
KEYBOARD UNIT TE 401		
Id.No. 250 517 04	x	x
KEYBOARD UNIT TE 411 (customized version)		
Id.No. 264 105 07/08	x	x
PLC I/O BOARD PL 405B (option) [3]		
Id.No. 263 371 22	x	x
PLC I/O BOARD PL 410B (option) [4]		
Id.No. 263 371 --	x	x

1) CE/PE: export versions of the controls (different software; hardware identical
2) PA/PE: control model with integral current and speed controller
3) digital part only (32 PLC inputs / 16 PLC outputs)
4) version 02: 64 PLC inputs / 32 PLC outputs with analogue part
   version 12: 64 PLC inputs / 32 PLC outputs without analogue part
5) position encoder input of the spindle: 1Vpp, of the axes: 11µA
6) position encoder input of the spindle: TTL, of the axes: 11µA
7) position encoder input of the spindle and the axes: 1Vpp

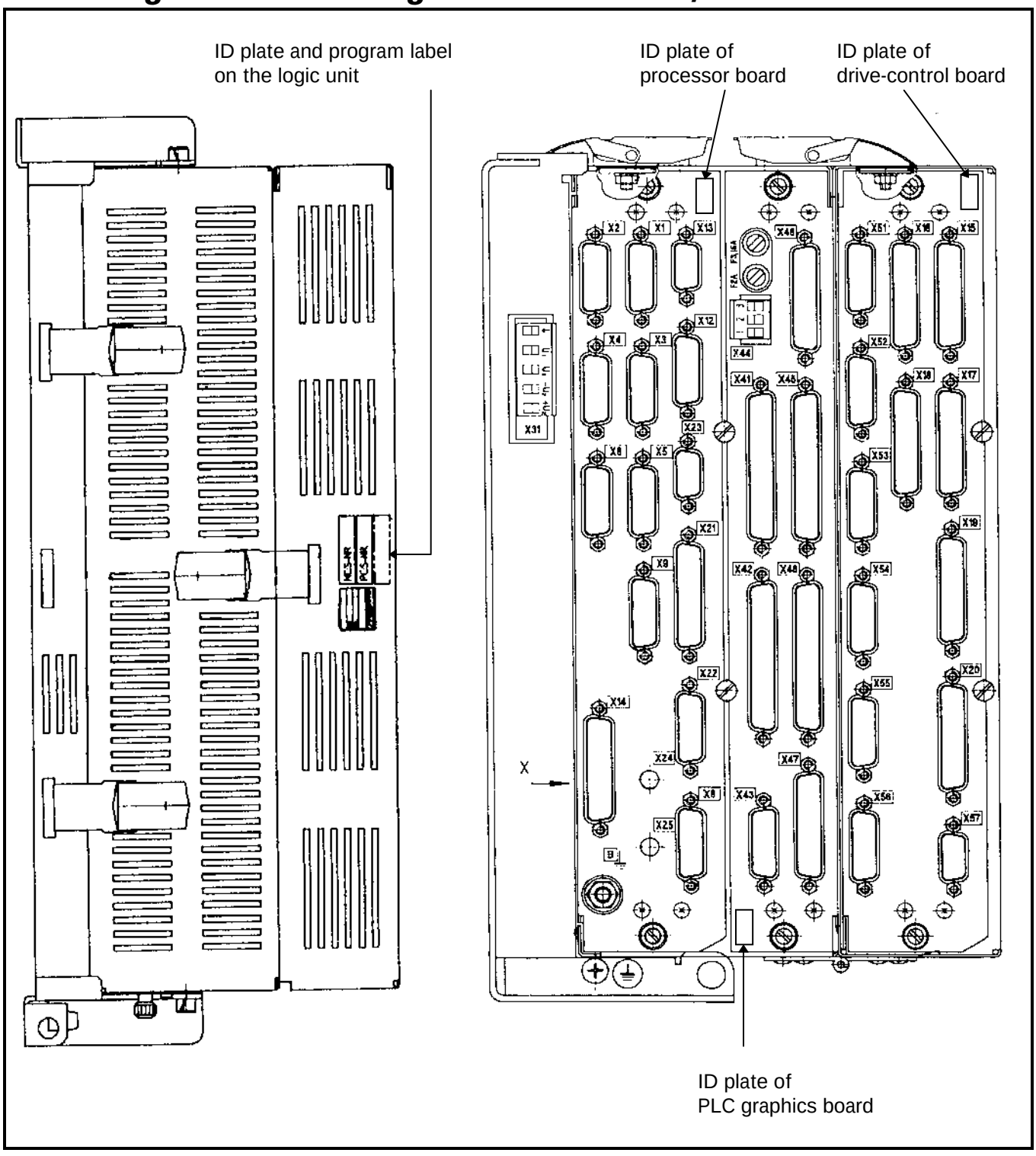
5. LOGIC UNIT LE 426 CA/PA

5.1 Designation of the Logic Unit LE 426 CA/CE



LE 426CE = export version of LE 426CA

5.2 Designation of the Logic Unit LE 426 PA/PE



LE 426PE = export version of LE 426PA

5.3 Hardware Components of the LOGIC UNIT LE 426 CA/PA

Overview of the boards in LE 426 CA/CE

BOARD	TNC 426 CA/CE LE 426 CA/CE 293 423 3-	TNC 426 CA/CE LE 426 CA/CE 295 199 3-	TNC 426 CA/CE LE 426 CA/CE 297 461 3-
PROCESSOR Board			
292 115 01	x		
296 688 01		x	
292 115 02			x
PLC GRAPHICS Board			
291 073 01	x	x	x
TOUCH PROBE Board (option)			
286 955 01	x	x	x
293 163 01	x	x	x
DRIVE (complete)			
289 135 02	x	x	x

Overview of the boards in LE 426PA/PE

BOARD	TNC 426 PA/PE LE 426 286 839 1-	TNC 426 PA/PE LE 426 286 839 2-	TNC 426 PA/PE LE 426 PA/PE 286 839 3-	TNC 426 PA/PE LE 426 PA/PE 295 198 3-	TNC 426 PA/PE LE 426 PA/PE 297 740 3-
PROCESSOR Board					
287 376 01	x				
289 450 01		x			
292 115 01			x		
292 115 02					x
296 688 01				x	
PLC GRAPHICS Board					
289 472 01	x				
291 073 01		x	x	x	x
DRIVE CONTROL Board					
289 469 01	x				
291 061 01		x			
291 064 01			x	x	x
TOUCH PROBE Board (option)					
286 955 01	x	x	x	x	x
293 163 01	x	x	x	x	x
DRIVE (complete)					
289 135 02	x	x			

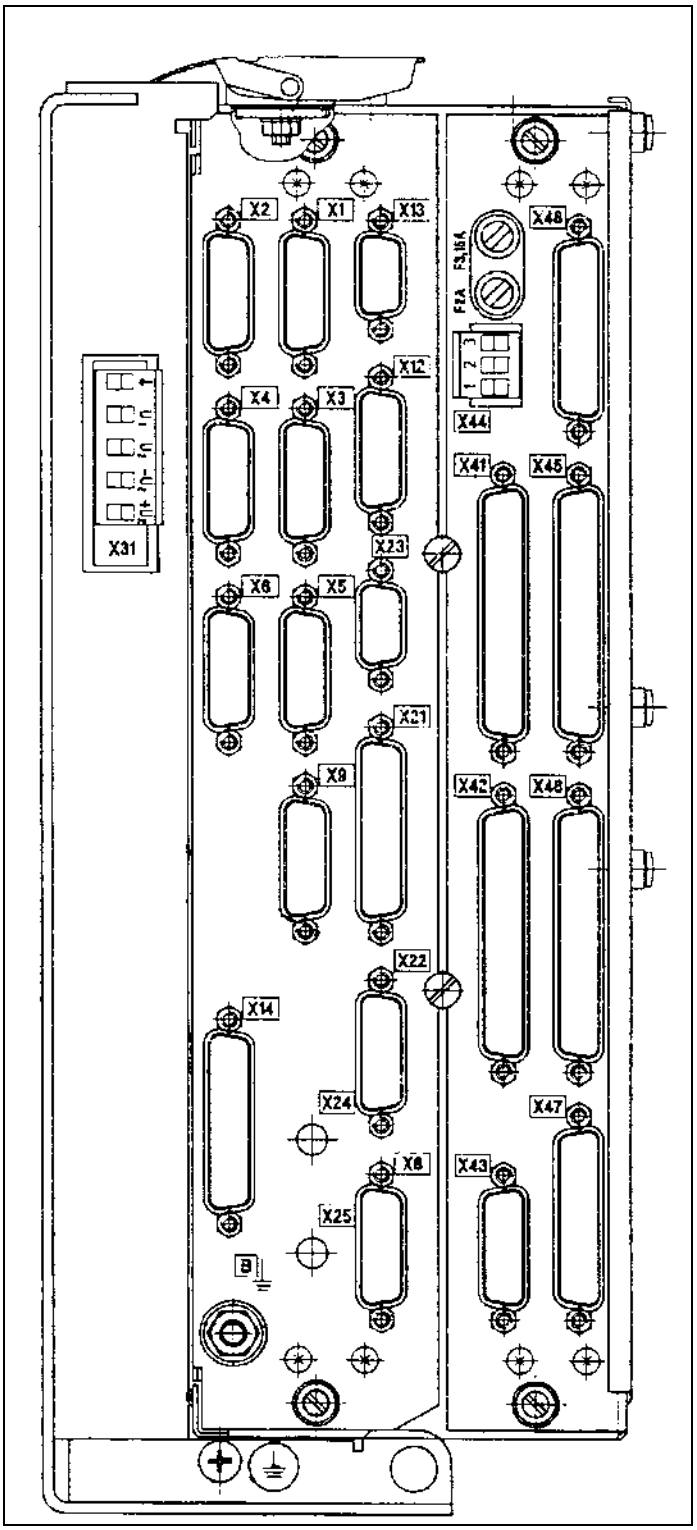
6. Connector Designation and Pin Layout

6.1 Connectors on the logic unit LE 426 CA/PA

6.1.1 Connector designation: logic unit LE 426 CA/PA

LE 426 CA/CE

NC power-supply | processor board | PLC graphics board



Processor board

X1 = encoder 1
X2 = encoder 2
X3 = encoder 3
X4 = encoder 4
X5 = encoder 5
X6 = encoder S
X8 = noml. value output 1, 2, 3, 4, 5, S
X9 = PLC analogue output
X12 = touch trigger probe for workpiece calibration
X13 = touch trigger probe for tool calibration
X14 = measuring touch probe (option)
X21 = data interface V.24/RS-232-C
X22 = data interface V.11/RS-422
X23 = serial handwheel
B = signal ground

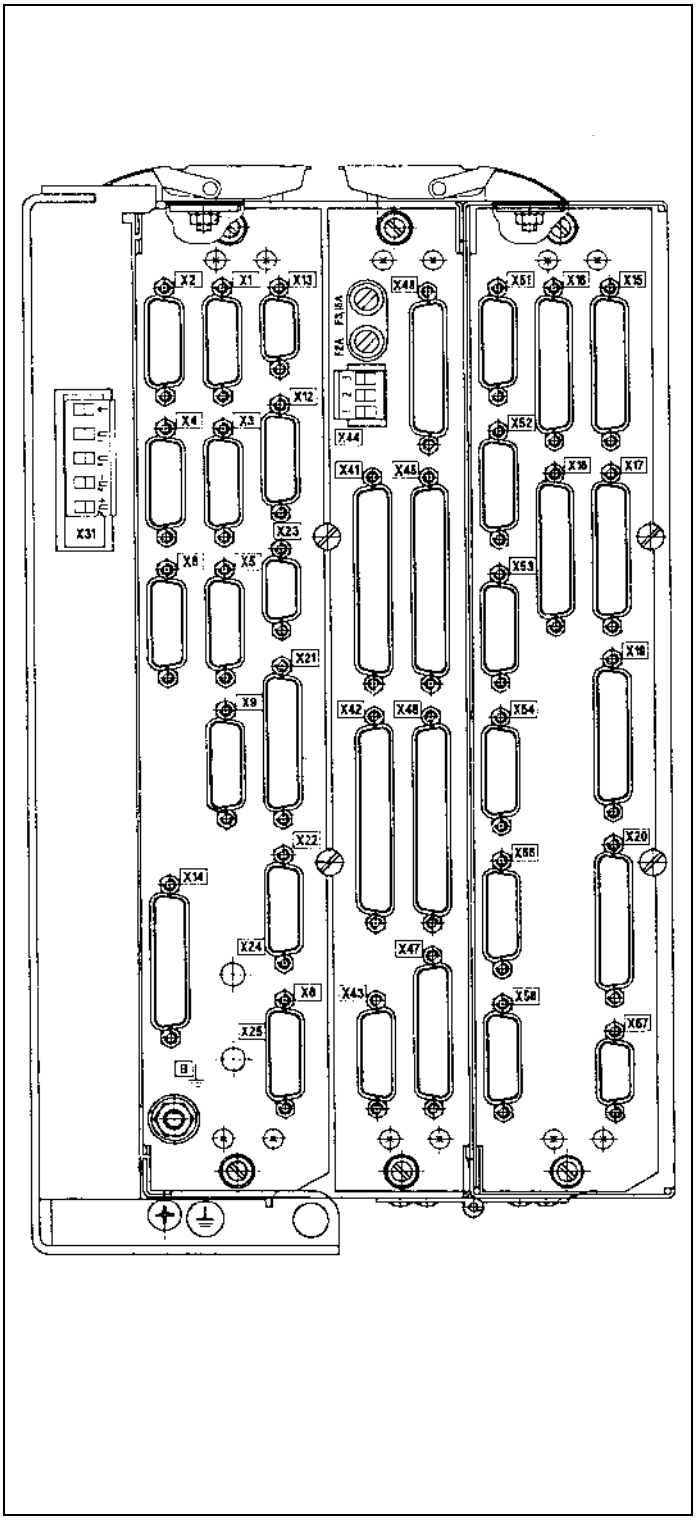
PLC Graphics Board

X41 = PLC output
X42 = PLC input
X43 = visual display unit
X44 = 24 V power supply for PLC
X45 = TNC operating panel
X46 = machine operating panel
X47 = PLC expansion interface
X48 = PLC analogue input

X31 = NC power supply (DC link power supply)

LE 426 PA/PE

NC power supply | processor board | PLC graphics board | drive control board



Processor board

X1 = position encoder 1
X2 = position encoder 2
X3 = position encoder 3
X4 = position encoder 4
X5 = position encoder 5
X6 = position encoder S
X8 = nominal value output 1, 2, 3, 4, 5, S
X9 = PLC analogue output
X12 = touch trigger probe for workpiece calibration
X13 = touch trigger probe for tool calibration
X14 = measuring touch probe (option)
X21 = data interface V.24/RS-232-C
X22 = data interface V.11/RS-422
X23 = serial handwheel
B = signal ground

PLC Graphics Board

X41 = PLC output
X42 = PLC input
X43 = visual display unit
X44 = 24 V power supply for PLC
X45 = TNC operating panel
X46 = machine operating panel
X47 = PLC expansion interface
X48 = PLC analogue input

Drive Control Board

X15 = speed encoder X-axis
X16 = speed encoder Y-axis
X17 = speed encoder Z-axis
X18 = speed encoder IV. axis
X19 = speed encoder V. axis
X20 = speed encoder spindle
X51 = power stage connector X-axis
X52 = power stage connector Y-axis
X53 = power stage connector Z-axis
X54 = power stage connector IV. axis
X55 = power stage connector V. axis
X56 = power stage connector spindle
X57 = reserved

X31 = NC power supply (DC link power supply)

6.1.2 Pin Layout of the NC Power Supply of LE 426 CA/PA

X31 NC power supply
terminal block (pluggable) 5-pin

PIN	Assignment	LE 426PA	LE 426CA
⏚	GND conductor (ye/gr)		
U_1	phase 1	330V~ to 450V~ via isolating transformer 50 to 60Hz	140V~ to 450V~ via isolating transformer 50 o 60Hz
U_2	phase 2		
$-U_Z$	DC-link power –	385V– to 660V–	–
$+U_Z$	DC-link power +		

6.1.3 Pin Layout of the processor board LE 426 CA/PA

X1,X2,X3,X4,X5 position encoders 1,2,3,4,5

Logic unit **LE 426PA Id.No. 286 839 .. and Id.No. 259 198 ..**
LE 426CA Id.No. 293 423 .. and Id.No. 295 199 ..

maximum input frequency: 50kHz
sinusoidal input
current interface: 11µA
subdivision in TNC: 1024-fold
max. current consumption per input: 200 mA
flange socket with male insert (15-pin, D-Sub)

Logic Unit		Encoder Cable	
D-Sub connector (male) 15-pin	Assignment	D-Sub connector (female) 15-pin	
1	+ 5 V	1	brown
2	0 V	2	white
3	I_1+	3	green
4	I_1-	4	yellow
5	0 V	5	white/brown (internal shield)
6	I_2+	6	blue
7	I_2-	7	red
8	0 V	8	
9	+ 5 V	9	
10	I_0+	10	grey
11	0 V	11	
12	I_0-	12	pink
13	0 V	13	
14	not assigned	14	
15	not assigned	15	
chassis	external shield	chassis	external shield

X1,X2,X3,X4,X5 position encoders 1,2,3,4,5

Logic unit **LE 426PA Id.No. 297 461 ..**
LE 426CA Id.No. 297 740 ..

maximum input frequency: 50kHz
sinusoidal input
voltage interface: 1Vpp
subdivision in TNC: 1024-fold
maximum current consumption per input: 200 mA
flange socket with male insert (15-pin, D-Sub)

Logic Unit		**Encoder Cable**	
D-Sub connector (male) 15-pin	**Assignment**	**D-Sub connector (female) 15-pin**	
1	+ 5 V (U_P)	1	brown/green
2	0 V (U_N)	2	white/green
3	A+	3	brown
4	A–	4	green
5	0 V	5	
6	B+	6	grey
7	B–	7	pink
8	0 V	8	
9	+ 5 V	9	blue
10	R+	10	red
11	0 V	11	white
12	R–	12	black
13	0 V	13	
14	not assigned	14	violet
15	not assigned	15	
chassis	external shield	chassis	external shield

X6 Position encoder, spindle

Logic unit LE 426PA Id.No. 286 839 .. and Id.No. 297 740 ..
LE 426CA Id.No. 293 423 .. and Id.No. 297 461 ..

maximum input frequency: 350kHz
sinusoidal input, voltage interface 1Vpp
subdivision in TNC: 1024-fold
maximum current consumption: 200 mA
flange socket with male insert (15-pin, D-Sub)

Logic Unit		Encoder Cable	
D-Sub connector (male) 15-pin	**Assignment**	**D-Sub connector (female) 15-pin**	
1	+ 5 V (U_P)	1	brown/green
2	0 V (U_N)	2	white/green
3	A+	3	brown
4	A–	4	green
5	0 V	5	
6	B+	6	grey
7	B–	7	pink
8	0 V	8	
9	+ 5 V	9	blue
10	R+	10	red
11	0 V	11	white
12	R–	12	black
13	0 V	13	
14	not assigned	14	violet
15	not assigned	15	
chassis	external shield	chassis	external shield

Logic unit LE 426PA Id.No. 295 198 ..
LE 426CA Id.No. 295 199 ..

maximum input frequency: 350kHz
square-wave input (TTL)
subdivision in TNC: 4-fold
maximum current consumption: 200 mA
flange socket with male insert (15-pin, D-Sub)

Logic Unit		Encoder Cable	
D-Sub connector (male) 15-pin	**Assignment**	**D-Sub connector (female) 15-pin**	
1	+ 5 V (U_P)	1	brown/green
2	0 V (U_N)	2	white/green
3	U_{a1}	3	brown
4	U_{a1}	4	green
5	0 V	5	
6	U_{a2}	6	grey
7	U_{a2}	7	pink
8	0 V	8	
9	+ 5 V	9	blue
10	U_{a0}	10	red
11	0 V	11	white
12	U_{a0}	12	black
13	0 V	13	
14	U_{as}	14	violet
15	not assigned	15	
chassis	external shield	chassis	external shield

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

flange socket with female insert (15-pin)

TNC 426 CA/CE output of nominal speed voltage ± 10V

TNC 426 PA/PE output of nominal speed voltage ± 10V , if selected via MP2000.X.

Logic Unit		Connecting Cable	
D-Sub connector (male) 15-pin	**Assignment**	**D-Sub connector (female) 15-pin**	
1	noml. value output 1	1	brown
2	do not assign	2	brown/green
3	noml. value output 2	3	yellow
4	noml. value output 5	4	red/blue
5	noml. value output 3	5	pink
6	0 V noml. value output 5	6	grey/pink
7	noml. value output 4	7	red
8	noml. value output axis S	8	violet
9	0 V noml. value output 1	9	white
10	do not assign	10	white/grey
11	0 V noml. value output 2	11	green
12	do not assign	12	
13	0 V noml. value output 3	13	grey
14	0 V noml. value output 4	14	blue
15	0 V noml. value output axis S	15	black
chassis	external shield	chassis	external shield

X9 PLC analogue outputs ± 10V

flange socket with female insert (15-pin)

Logic Unit		Connecting Cable	
D-Sub connector (male) 15-pin	**Assignment**	**D-Sub connector (female) 15-pin**	
1	analogue output 1 ± 10V	1	brown
2	analogue output 7 ± 10V	2	brown/green
3	analogue output 2 ± 10V	3	yellow
4	analogue output 5 ± 10V	4	red/blue
5	analogue output 3 ± 10V	5	pink
6	analogue output 5 0V	6	grey/pink
7	analogue output 4 ± 10V	7	red
8	analogue output 6 ± 10V	8	violet
9	analogue output 1 0V	9	white
10	analogue output 7 0V	10	white/grey
11	analogue output 2 0V	11	green
12	not assigned	12	
13	analogue output 3 0V	13	grey
14	analogue output 4 0V	14	blue
15	analogue output 6 0V	15	black
chassis	external shield	chassis	external shield

X12 Touch trigger probe for workpiece calibration

flange socket with female insert (15-pin)

PIN No.	Assignment
1	0V
3	standby
4	start
5	+15V ± 10% (U_P)
6	+5V ± 5% (U_P)
7	$\overline{\text{Batteriewarning}}$
8	0V (U_N)
9	trigger signal
10	$\overline{\text{trigger signal}}$ [1]
2, 11 to 15	not assigned
chassis	external shield

[1] stylus at rest = high level

AK Id.No. 274 543			**TS120 Id.No. 265 348 .. TS220 Id.No. 293 488 ..**	
D-Sub connector (male) 15-pin		**Coupling on mounting base, 6-pin**	**Quick disconnect, 6-pin**	
3	pink	4	4	grey
5	grey			
6	brown/green	2	2	brown
7	grey	3	3	grey
8	white/green	1	1	white
9	green	5	5	green
10	yellow	6	6	yellow
chassis	ext. shield	chassis	chassis	external shield

VB Id.No. 310 197 ..			**EA Id.No. 262 904 01**		**TS 630**
D-Sub conn. (male) 15-pin		**Connector (female) 7-pin**	**Coupling on mount. base, 7-pin**		**Id.No. 293 714 ..**
1	white/brown internal shield	7	7	internal shield	
3	grey	5	5	grey	
4	yellow	3	3		
5	brown	2	2	brown	
7	blue	6	6	blue	
8	white	1	1	white	
10	green	4	4	green	
chassis	ext. shield	chassis	chassis	ext. shield	

X13 Touch trigger probe for tool calibration

Flange socket with female insert (9-pin)

Pin No.	Assignment
1	standby
2	0V (U_N)
4	+15V ± 5% (U_P)
7	+5V ± 5% (U_P)
8	trigger signal
9	$\overline{\text{trigger signal}}$ [1]
3, 5, 6	not assigned
chassis	external shield

[1] stylus at rest = high level

AK Id.No. 310 200 ..			TT120 Id.No. 295 743 03	
D-Sub connector (male) 9-pin		**Coupling on mounting base (female), 6-pin**	**Connector (male) 6-pin**	
1	pink	6	6	
2	white/green	1	1	white
4	grey	5	5	
7	brown/green	2	2	brown
8	green	3	3	green
9	yellow	4	4	yellow
chassis	external shield	chassis	chassis	external shield

X21 V.24/RS-232-C Data interface

Flange socket with female insert (25-pin)

Logic Unit		VB Id.No. 239 760 ..			AB Id.No. 239 758 01		VB Id.No. 274 545 01		
D-Sub connector (female) 25-pin-	**Assignment**	**D-Sub connector (male) 25-pin**		**D-Sub connector (female) 25-pin**	**D-Sub connector (male) 25-pin**	**D-Sub connector (female) 25-pin**	**D-Sub connector (male) 25-pin**		**D-Sub connector (female) 25-pin**
1	GND	1	white/brown ext. shield	1	1	1	1	white/brown ext. shield	1
2	RXD	2	green	3	3	3	3	yellow	2
3	TXD	3	yellow	2	2	2	2	green	3
4	CTS	4	grey	5	5	5	5	pink	4
5	RTS	5	pink	4	4	4	4	grey	5
6	DTR	6	blue	20	20	20	20	brown	6
7	signal GND	7	red	7	7	7	7	red	7
20	DSR	20	brown	6	6	6	6	blue	20
8 to 19, 21 to 25	not assigned			8	8	8	8		8
chassis	ext. shield	chassis	ext. shield	chassis	chassis	chassis	chassis	ext. shield	chassis

The interface complies with the recommendations in VDE 0160, 5.88 for separation from line power.

X14 Measuring touch probe (option)

flange socket with female insert (25-pin)

Logic Unit (kit, Id.No. 286 955 51)			AK Id.No. 285 289			VB Id.-No. 284 574			TM 110
D-Sub conn. (female) 25-pin	**Assignment**		**D-Sub conn. (male) 25-pin**		**Coupl. on mount. base (female) 21-pin**	**Connector (male) 21-pin**		**Connector (female) 21-pin**	**Coupl. on mount. base, 21-pin**
1	0 V		1	white	1	1	white	1	1
15	+ 5 V		15	brown	2	2	brown	2	2
4	I_1 –	X axis	4	yellow	5	5	yellow	5	5
17	I_1 +		17	green	4	4	green	4	4
3	I_2 –		3	red	7	7	red	7	7
16	I_2 +		16	blue	6	6	blue	6	6
5	0 V		5	white/black	3	3	white/black	3	3
19	+ 5 V		19	brown/black	17	17	brown/black	17	17
8	I_1 –	Y axis	8	yellow/black	9	9	yellow/black	9	9
21	I_1 +		21	green/black	8	8	green/black	8	8
7	I_2 –		7	red/black	11	11	red/black	11	11
20	I_2 +		20	blue/black	10	10	blue/black	10	10
9	0 V		9	white/violet	15	15	white/violet	15	15
23	+ 5 V		23	brown/violet	16	16	brown/violet	16	16
12	I_1 –	Z axis	12	yellow/violet	13	13	yellow/violet	13	13
25	I_1 +		25	green/violet	12	12	green/violet	12	12
11	I_2 –		11	red/violet	19	19	red/violet	19	19
24	I_2 +		24	blue/violet	18	18	blue/violet	18	18
13	0 V		13	internal shield	21	21	internal shield	21	21
2, 6, 10, 14, 18, 22	not assigned								
chassis	ext. shield		chassis	ext. shield	chassis	chassis	ext. shield	chassis	chassis

Logic Unit (kit, Id.No. 293 163 51)			**AK Id.No. 296 839**			**VB A-1016-6640 RENISHAW**			**RENISHAW SP 2/1**
D-Sub conn. (female) 25-pin	**Assignment**		**D-Sub conn. (male) 25-pin**		**Coupl. on mount. base (female) 21-pin**	**Connector (male) 21-pin**			
3	$\overline{Ua2}$	X axis	3	pink	7				
4	$\overline{Ua1}$		4	yellow	5				
16	Ua2		16	grey	6				
17	Ua1		17	green	4				
7	$\overline{Ua2}$	Y axis	7	brown/blue	11				
8	$\overline{Ua1}$		8	red	9				
20	Ua2		20	white/blue	10				
21	Ua1		21	blue	8				
11	$\overline{Ua2}$	Z axis	11	violet	19				
12	$\overline{Ua1}$		12	red/blue	13				
24	Ua2		24	black	18				
25	Ua1		25	grey/pink	12				
1	0 V		1	white	1				
5	+ 12 V		5	brown	3				
9	overtravel 1		9	white/green	15				
13	0 V		13						
14	overtravel 2		14	brown/green	21				
18	ERROR		18	white/grey	14				
22	$\overline{SWITCH}$		22	grey/brown	20				
2, 6, 10, 15, 19, 23	not assigned								
chassis	ext. shield		chassis	ext. shield	chassis	chassis	ext. shield	chassis	chassis

X22 V.11/RS-422 data interface

flange socket with female insert (15-pin)

Logic Unit		VB Id.No. 289 208 ..			AB Id.No. 249 819 01	
D-Sub connector (female) 15-pin	**Assignment**	**D-Sub connector (male) 15-pin**		**D-Sub connector (female) 15-pin**	**D-Sub connector (male) 15-pin**	**D-Sub connector (female) 15-pin**
1	chassis GND	1	black ext. shield	1	1	1
2	RXD	2	blue	2	2	2
3	CTS	3	grey	3	3	3
4	TXD	4	white	4	4	4
5	RTS	5	green	5	5	5
6	DSR	6	white/green	6	6	6
7	DTR	7	green/pink	7	7	7
8	signal GND	8	black	8	8	8
9	$\overline{\text{RXD}}$	9	red	9	9	9
10	$\overline{\text{CTS}}$	10	pink	10	10	10
11	$\overline{\text{TXD}}$	11	brown	11	11	11
12	$\overline{\text{RTS}}$	12	yellow	12	12	12
13	$\overline{\text{DSR}}$	13	brown/green	13	13	13
14	$\overline{\text{DTR}}$	14	red/blue	14	14	14
15	not assigned	15	violet	15	15	15
chassis	ext. shield	chassis		chassis	chassis	chassis

The interface complies with the recommendations in VDE 0160, 5.88 for separation from line power.

X23 Serial handwheel

flange socket with female insert (9-pin)

Pin No.	Assignment (TNC)
2	0V
4	+12V ± 0.6V (UV)
6	DTR
7	TXD
8	RXD
9	DSR
1, 3, 5	not assigned
chassis	external shield

The interface complies with the recommendations in VDE 0160, 5.88 for separation from line power.

6.1.4 Pin layout at the PLC graphics board LE 426 CA/PA

X44 PLC power supply

terminal strip (pluggable) 3-pin

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

X41 PLC output

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

Logic Unit		VB Id.No. 244 005 .. / Id.No. 263 954 ..	
D-Sub connector (female) 37-pin	**Assignment**	**D-Sub connector (male) 37-pin**	
1	O0	1	grey/red
2	O1	2	brown/black
3	O2	3	white/black
4	O3	4	green/black
5	O4	5	brown/red
6	O5	6	white/red
7	O6	7	white/green
8	O7	8	red/blue
9	O8	9	yellow/red
10	O9	10	grey/pink
11	O10	11	black
12	O11	12	pink/brown
13	O12	13	yellow/blue
14	O13	14	green/blue
15	O14	15	yellow
16	O15	16	red
17	O16	17	grey
18	O17	18	blue
19	O18	19	pink
20	O19	20	white/grey
21	O20	21	yellow/grey
22	O21	22	green/red
23	O22	23	white/pink
24	O23	24	grey/green
25	O24	25	yellow/brown
26	O25	26	grey/brown
27	O26	27	yellow/black
28	O27	28	white/yellow
29	O28	29	grey/blue
30	O29	30	pink/blue
31	O30	31	pink/red
32	do not assign	32	brown/blue
33	do not assign	33	pink/green
34	„control is ready“	34	brown
35	24 V (PLC) test output; do not assign	35	yellow/pink
36	24 V (PLC) test output; do not assign	36	violet
37	24 V (PLC) test output; do not assign	37	white
chassis	external shield	chassis	external shield

X42 PLC input

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

Logic Unit		**VB Id.No. 244 005 .. / Id.No. 263 954 ..**	
D-Sub connector (female) 37-pin	**Assignment**	**D-Sub connector (male) 37-pin**	
1	I0	1	grey/red
2	I1	2	brown/black
3	I2	3	white/black
4	I3 acknowledgement ”control is ready”	4	green/black
5	I4	5	brown/red
6	I5	6	white/red
7	I6	7	white/green
8	I7	8	red/blue
9	I8	9	yellow/red
10	I9	10	grey/pink
11	I10	11	black
12	I11	12	pink/brown
13	I12	13	yellow/blue
14	I13	14	green/blue
15	I14	15	yellow
16	I15	16	red
17	I16	17	grey
18	I17	18	blue
19	I18	19	pink
20	I19	20	white/grey
21	I20	21	yellow/grey
22	I21	22	green/red
23	I22	23	white/pink
24	I23	24	grey/green
25	I24	25	yellow/brown
26	I25	26	grey/brown
27	I26	27	yellow/black
28	I27	28	white/yellow
29	I28	29	grey/blue
30	I29	30	pink/blue
31	I30	31	pink/red
32	I31	32	brown/blue
33	do not assign	33	pink/green
34	do not assign	34	brown
35	0 V (PLC) test output; do not assign	35	yellow/pink
36	0 V (PLC) test output; do not assign	36	violet
37	0 V (PLC) test output; do not assign	37	white
chassis	external shield	chassis	external shield

X45 TNC operating panel (TE)

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

Logic Unit		VB Id.No. 263 954 ..			TE 401
D-Sub connector (female) 37-pin	**Assignment**	**D-Sub connector (male) 37-pin**		**D-Sub connector (female) 37-pin**	**X2 D-Sub connector (male) 37-pin**
1	RL0	1	grey/red	1	1
2	RL1	2	brown/black	2	2
3	RL2	3	white/black	3	3
4	RL3	4	green/black	4	4
5	RL4	5	brown/red	5	5
6	RL5	6	white/red	6	6
7	RL6	7	white/green	7	7
8	RL7	8	red/blue	8	8
9	RL8	9	yellow/red	9	9
10	RL9	10	grey/pink	10	10
11	RL10	11	black	11	11
12	RL11	12	pink/brown	12	12
13	RL12	13	yellow/blue	13	13
14	RL13	14	green/blue	14	14
15	RL14	15	yellow	15	15
16	RL15	16	red	16	16
17	RL16	17	grey	17	17
18	RL17	18	blue	18	18
19	RL18	19	pink	19	19
20	SL0	20	white/grey	20	20
21	SL1	21	yellow/grey	21	21
22	SL2	22	green/red	22	22
23	SL3	23	white/pink	23	23
24	SL4	24	grey/green	24	24
25	SL5	25	yellow/brown	25	25
26	SL6	26	grey/brown	26	26
27	SL7	27	yellow/black	27	27
28	RL19	28	white/yellow	28	28
29	RL20	29	grey/blue	29	29
30	not assigned	30	pink/blue	30	30
31	RL21	31	pink/red	31	31
32	RL22	32	brown/blue	32	32
33	RL23	33	pink/green	33	33
34	spindle override (wiper)	34	brown	34	34
35	feed rate override (wiper)	35	yellow/pink	35	35
36	+5 V override potentiometer	36	violet	36	36
37	0 V override potentiometer	37	white	37	37
chassis	external shield	chassis	external shield	chassis	chassis

X43 Visual display unit (BC 110B)

flange socket with female insert (15-pin, D-SUB)

Logic Unit		VB Id.No. 250 477 ..			BC 110 B
D-Sub connector (female) 15-pin	**Assignment**	**D-Sub connector (male) 15-pin**		**D-Sub connector (female) 15-pin**	**X2 D-Sub connector (male) 15-pin**
1	GND	1		1	1
2	not assigned	2		2	2
3	not assigned	3		3	3
4	not assigned	4		4	4
5	not assigned	5		5	5
6	not assigned	6		6	6
7	R	7	coaxial, red	7	7
8	GND	8		8	8
9	VSYNC	9	yellow	9	9
10	HSYNC	10	pink	10	10
11	GND	11	black	11	11
12	not assigned	12		12	12
13	not assigned	13		13	13
14	G	14	coaxial, green	14	14
15	B	15	coaxial, blue	15	15
chassis	external shield	chassis	external shield	chassis	chassis

X46 Machine operating panel

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

Logic Unit		VB Id.No. 263 954 ..		
D-Sub connector (female) 37-pin	**Assignment**	**D-Sub connector (male) 37-pin**		**D-Sub connector (female) 37-pin**
1	I128	1	grey/red	1
2	I129	2	brown/black	2
3	I130	3	white/black	3
4	I131	4	green/black	4
5	I132	5	brown/red	5
6	I133	6	white/red	6
7	I134	7	white/green	7
8	I135	8	red/blue	8
9	I136	9	yellow/red	9
10	I137	10	grey/pink	10
11	I138	11	black	11
12	I139	12	pink/brown	12
13	I140	13	yellow/blue	13
14	I141	14	green/blue	14
15	I142	15	yellow	15
16	I143	16	red	16
17	I144	17	grey	17
18	I145	18	blue	18
19	I146	19	pink	19
20	I147	20	white/grey	20
21	I148	21	yellow/grey	21
22	I149	22	green/red	22
23	I150	23	white/pink	23
24	I151	24	grey/green	24
25	I152	25	yellow/brown	25
26	O0	26	grey/brown	26
27	O1	27	yellow/black	27
28	O2	28	white/yellow	28
29	O3	29	grey/blue	29
30	O4	30	pink/blue	30
31	O5	31	pink/red	31
32	O6	32	brown/blue	32
33	O7	33	pink/green	33
34	0 V (PLC)	34	brown	34
35	0 V (PLC)	35	yellow/pink	35
36	+ 24 V (PLC)	36	violet	36
37	+ 24 V (PLC)	37	white	37
chassis	ext. shield	chassis	ext. shield	chassis

X47 PLC expansion interface

12 V interface
flange socket with male insert (25-pin D-SUB)

Logic Unit		VB Id.No. 289 111 ..		
D-Sub connector (male) 25-pin	**Assignment**	**D-Sub connector (female) 25-pin**		**D-Sub connector (male) 25-pin**
1	0 V	1	brown, yellow, pink, red, violet	1
2	0 V	2	red/blue, brown/green, yellow/brown, grey/brown, pink/brown	2
3	0 V	3	brown/blue, brown/red, brown /black, yellow/grey, yellow/pink	3
4	serial IN 2	4	grey/green	4
5	do not assign	5	white/green	5
6	do not assign	6	pink/green	6
7	$\overline{\text{RESET}}$	7	green/blue	7
8	$\overline{\text{WRITE EXTERN}}$	8	white/blue	8
9	WRITE EXTERN	9	white/red	9
10	$\overline{\text{address 5}}$	10	grey/pink	10
11	$\overline{\text{address 3}}$	11	blue	11
12	$\overline{\text{address 1}}$	12	green	12
13	do not assign	13		13
14	+ 12 V (from PL)	14	yellow/blue, pink/blue, yellow/black	14
15	+ 12 V (from PL)	15	yellow/red, grey/red, pink/red	15
16	board ID	16	grey/blue	16
17	do not assign	17	green/black	17
18	do not assign	18	white/yellow	18
19	serial IN 1	19	white/black	19
20	EMERG. STOP	20	green/red	20
21	$\overline{\text{serial OUT}}$	21	white/grey	21
22	serial OUT	22	white/pink	22
23	$\overline{\text{address 4}}$	23	black	23
24	$\overline{\text{address 2}}$	24	grey	24
25	$\overline{\text{address 0}}$	25	white	25
chassis	external shield	chassis	external shield	chassis

X48 PLC analogue input

flange socket with female insert (25-pin)

Pin No.	Assignment
1	I_1+ constant current for Pt 100
2	I_{1-} constant current for Pt 100
3	U_1+ measuring input for Pt 100
4	U_{1-} measuring input for Pt 100
5	I_2+ constant current for Pt 100
6	I_{2-} constant current for Pt 100
7	U_2+ measuring input for Pt 100
8	U_{2-} measuring input for Pt 100
9	I_3+ constant current for Pt 100
10	I_{3-} constant current for Pt 100
11	U_3+ measuring input for Pt 100
12	U_{3-} measuring input for Pt 100
13	not assigned
14	analogue input 1 –10V to +10V
15	analogue input 1 0V (reference potential)
16	analogue input 2 –10V to +10V
17	analogue input 2 0V (reference potential)
18	analogue input 3 –10V to +10V
19	analogue input 3 0V (reference potential)
20 to 25	not assigned
chassis	external shield

6.1.5 Pin layout of the drive control board LE 426PA

X15 speed encoder of X-axis
X16 speed encoder of Y-axis
X17 speed encoder of Z-axis
X18 speed encoder of IV. axis
X19 speed encoder of V. axis
X20 speed encoder of spindle

maximum input frequency: 350kHz
voltage interface 1Vpp
flange socket with male insert (25-pin)

Logic Unit		AK Id.No. 289 440 ..		
D-Sub connector (male) 25-pin	**Assignment**	**D-Sub connector (female) 25-pin**		**D-Sub connector (female 17-pin**
1	(U_P) + 5 V or + 6.4V[1)]	1	brown/green	10
2	0 V (U_N)	2	white/green	7
3	A+	3	green/black	1
4	A–	4	red/black	2
5	0 V	5		
6	B+	6	blue/black	11
7	B–	7	yellow/black	12
8	0 V	8	internal shield	17
9	not assigned	9		
10	0 V	10		
11	not assigned	11		
12	not assigned	12		
13	temperature +	13	yellow	8
14	+ 5 V or not assigned [1)]	14	blue	16
15	analogue output (test)	15		
16	0 V	16	white	15
17	R+	17	red	3
18	R–	18	black	13
19	C+	19	green	5
20	C–	20	brown	6
21	D+	21	grey	14
22	D–	22	pink	4
23	+ 5 V (test)	23		
24	0 V	24		
25	temperature –	25	violet	9
chassis	external shield	chassis	external shield	chassis

X51 Output to power stage X-axis
X52 Output to power stage Y-axis
X53 Output to power stage Z-axis
X54 Output to power stage IV. axis
X55 Output to power stage V. axis
X56 Output to power stage spindle

flange socket with female insert (15-pin)

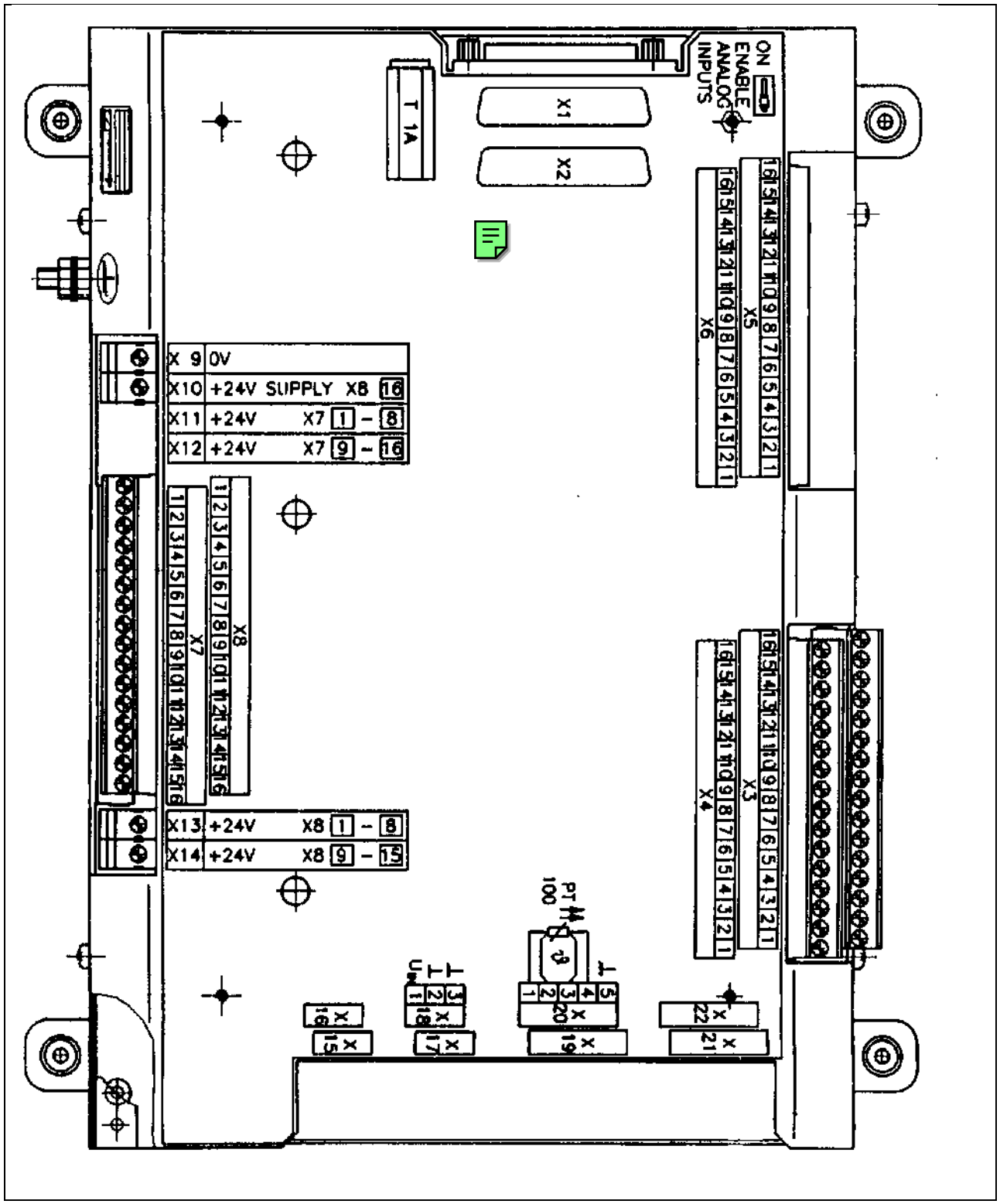
Logic Unit		VB Id.No. 289 208 ..			Expansion Card Id.No. 291 070 01	
D-Sub connector (female) 15-pin	**Assignment**	**D-Sub connector (male) 15-pin**		**D-Sub connector (female) 15-pin**	**X1, X2 D-Sub connector (female) 15-pin**	
1	not assigned	1	black	1	1	
2	PWM U_1	2	blue	2	2	
3	PWM U_2	3	grey	3	3	
4	PWM U_3	4	white	4	4	
5	$\overline{\text{reset}}$	5	green	5	5	
6	standby	6	white/green	6	6	
7	$I_{actl\ 2}-$	7	grey/pink	7	7	
8	$I_{actl\ 1}-$	8	black	8	8	
9	0V U_1	9	red	9	9	
10	0V U_2	10	pink	10	10	
11	0V U_3	11	brown	11	11	
12	0V (analogue)	12	yellow	12	12	
13	$\overline{\text{temperature warn.}}$	13	brown/green	13	13	
14	$I_{actl\ 2}+$	14	red/blue	14	14	
15	$I_{ist1}+$	15	violet	15	15	
chassis	external shield	chassis	ext. shield	chassis	chassis	

logic level: 5V
analogue signals I_{actl}: ± 7.5V
maximum PWM frequency: 5 kHz

X57 reserved

6.2 Connectors on the PLC Expansion Boards

6.2.1 Connectors on PL 405B



6.2.2 Pin layout of PL 405B

X1 Connection to LE or to 1. PL

Logic Unit		VB Id.No. 289 111 ..			1. PL 410 B	
D-Sub connector (male) 25-pin	**Assignment**	**D-Sub connector (female) 25-pin**		**D-Sub connector (male) 25-pin**	**X1 D-Sub connector (female) 25-pin**	**Assignment**
1	0 V	1	brown, yellow, pink, red, violet	1	1	0 V
2	0 V	2	red/blue, brown/green, yellow/brown, grey/brown, pink/brown	2	2	0 V
3	0 V	3	brown/blue, brown/red, brown /black, yellow/grey, yellow/pink	3	3	0 V
4	serial IN 2	4	grey/green	4	4	serial IN 2
5	do not assign	5	white/green	5	5	address 6
6	do not assign	6	pink/green	6	6	INTERRUPT
7	RESET	7	green/blue	7	7	RESET
8	WRITE EXTERN	8	white/blue	8	8	WRITE EXTERN
9	WRITE EXTERN	9	white/red	9	9	WRITE EXTERN
10	address 5	10	grey/pink	10	10	address 5
11	address 3	11	blue	11	11	address 3
12	address 1	12	green	12	12	address 1
13	do not assign	13		13	13	do not assign
14	+ 12 V (from PL)	14	yellow/blue, pink/blue, yellow/black	14	14	+ 12 V
15	+ 12 V (from PL)	15	yellow/red, grey/red, pink/red	15	15	+ 12 V
16	board ID	16	grey/blue	16	16	board ID 2
17	do not assign	17	green/black	17	17	board ID 1
18	do not assign	18	white/yellow	18	18	address 7
19	serial IN 1	19	white/black	19	19	serial IN 1
20	EMERG. STOP	20	green/red	20	20	EMERG. STOP
21	serial OUT	21	white/grey	21	21	serial OUT
22	serial OUT	22	white/pink	22	22	serial OUT
23	address 4	23	black	23	23	address 4
24	address 2	24	grey	24	24	address 2
25	address 0	25	white	25	25	address 0
chassis	external shield	chassis	external shield	chassis	chassis	external shield

X2 Connection to 2. PL

1. PL 410 B		VB Id.No. 289 111 ..			2. PL 410 B	
X2 D-Sub connector (male) 25-pin	**Assignment**	**D-Sub connector (female) 25-pin**		**D-Sub connector (male) 25-pin**	**X1 D-Sub connector (female) 25-pin**	**Assignment**
1	0 V	1	brown, yellow, pink, red, violet	1	1	0 V
2	0 V	2	red/blue, brown/green, yellow/brown, grey/brown, pink/brown	2	2	0 V
3	0 V	3	brown/blue, brown/red, brown /black, yellow/grey, yellow/pink	3	3	0 V
4	do not assign	4	grey/green	4	4	serial IN 2
5	address 6	5	white/green	5	5	address 6
6	INTERRUPT	6	pink/green	6	6	INTERRUPT
7	RESET	7	green/blue	7	7	RESET
8	WRITE EXTERN	8	white/blue	8	8	WRITE EXTERN
9	WRITE EXTERN	9	white/red	9	9	WRITE EXTERN
10	address 5	10	grey/pink	10	10	address 5
11	address 3	11	blue	11	11	address 3
12	address 1	12	green	12	12	address 1
13	do not assign	13		13	13	do not assign
14	board ID 4	14	yellow/blue, pink/blue, yellow/black	14	14	+ 12 V
15	board ID 3	15	yellow/red, grey/red, pink/red	15	15	+ 12 V
16	board ID 2	16	grey/blue	16	16	board ID 2
17	board ID 1	17	green/black	17	17	board ID 1
18	address 7	18	white/yellow	18	18	address 7
19	serial IN 1	19	white/black	19	19	serial IN 1
20	EMERG. STOP	20	green/red	20	20	EMERG. STOP
21	serial OUT	21	white/grey	21	21	serial OUT
22	serial OUT	22	white/pink	22	22	serial OUT
23	address 4	23	black	23	23	address 4
24	address 2	24	grey	24	24	address 2
25	address 0	25	white	25	25	address 0
chassis	external shield	chassis	external shield	chassis	chassis	external shield

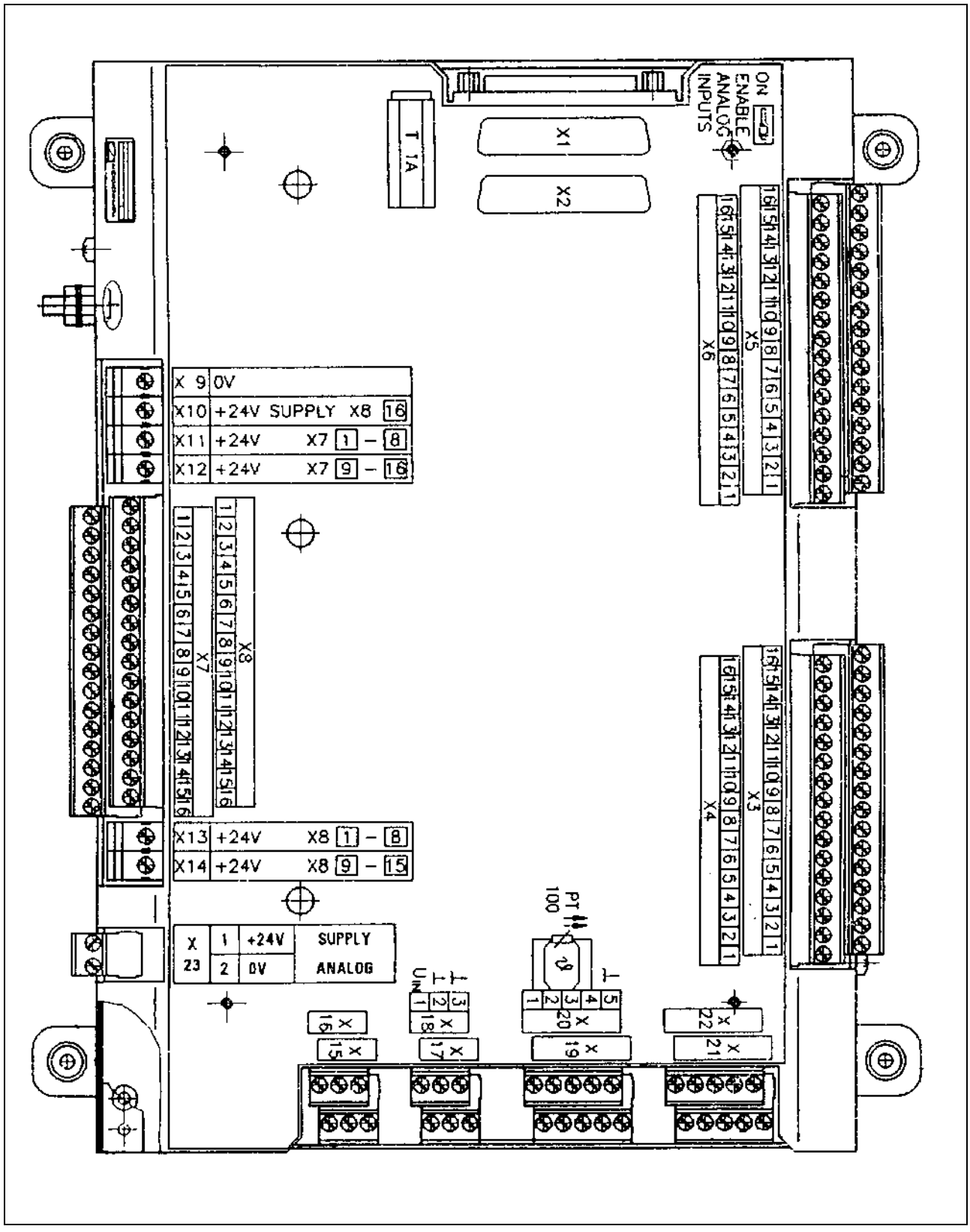
X3 PLC inputs	
Pin No.	**Assignment**
1	I64
2	I65
3	I66
4	I67
5	I68
6	I69
7	I70
8	I71
9	I72
10	I73
11	I74
12	I75
13	I76
14	I77
15	I78
16	I79

X4 PLC inputs	
Pin No.	**Assignment**
1	I80
2	I81
3	I82
4	I83
5	I84
6	I85
7	I86
8	I87
9	I88
10	I89
11	I90
12	I91
13	I92
14	I93
15	I94
16	I95

X8 PLC outputs and "control is ready"	
Pin No.	**Assignment**
1	O48
2	O49
3	O50
4	O51
5	O52
6	O53
7	O54
8	O55
9	O56
10	O57
11	O58
12	O59
13	O60
14	O61
15	O62
16	Control is ready

X9, X10, X13, X14 Power supply of PL 405B	
Terminal	*Assignment*
X9	0V
X10	+24 V- supply of logic unit and "control is ready"
X13	+24 V- supply of outputs O48 - O55
X14	+24 V- supply of outputs O56 - O62

6.2.3 Connectors on PL 410B



6.2.4 Pin layout of PL 410B

X1 Connection to LE or to 1. PL

Logic Unit		VB Id.No. 289 111 ..			1. PL 410 B	
D-Sub connector (male) 25-pin	**Assignment**	**D-Sub connector (female) 25-pin**		**D-Sub connector (male) 25-pin**	**X1 D-Sub connector (female) 25-pin**	**Assignment**
1	0 V	1	brown, yellow, pink, red, violet	1	1	0 V
2	0 V	2	red/blue, brown/green, yellow/brown, grey/brown, pink/brown	2	2	0 V
3	0 V	3	brown/blue, brown/red, brown /black, yellow/grey, yellow/pink	3	3	0 V
4	serial IN 2	4	grey/green	4	4	serial IN 2
5	do not assign	5	white/green	5	5	address 6
6	do not assign	6	pink/green	6	6	INTERRUPT
7	RESET	7	green/blue	7	7	RESET
8	WRITE EXTERN	8	white/blue	8	8	WRITE EXTERN
9	WRITE EXTERN	9	white/red	9	9	WRITE EXTERN
10	address 5	10	grey/pink	10	10	address 5
11	address 3	11	blue	11	11	address 3
12	address 1	12	green	12	12	address 1
13	do not assign	13		13	13	do not assign
14	+ 12 V (from PL)	14	yellow/blue, pink/blue, yellow/black	14	14	+ 12 V
15	+ 12 V (from PL)	15	yellow/red, grey/red, pink/red	15	15	+ 12 V
16	board ID	16	grey/blue	16	16	board ID 2
17	do not assign	17	green/black	17	17	board ID 1
18	do not assign	18	white/yellow	18	18	address 7
19	serial IN 1	19	white/black	19	19	serial IN 1
20	EMERG. STOP	20	green/red	20	20	EMERG. STOP
21	serial OUT	21	white/grey	21	21	serial OUT
22	serial OUT	22	white/pink	22	22	serial OUT
23	address 4	23	black	23	23	address 4
24	address 2	24	grey	24	24	address 2
25	address 0	25	white	25	25	address 0
chassis	ext. shield	chassis	ext. shield	chassis	chassis	ext. shield

X2 Connection to 2. PL

1. PL 410 B		VB Id.No. 289 111 ..			2. PL 410 B	
D-Sub connector (male) 25-pin	**Assignment**	**D-Sub connector (female) 25-pin**		**D-Sub connector (male) 25-pin**	**X1 D-Sub connector (female) 25-pin**	**Assignment**
1	0 V	1	brown, yellow, pink, red, violet	1	1	0 V
2	0 V	2	red/blue, brown/green, yellow/brown, grey/brown, pink/brown	2	2	0 V
3	0 V	3	brown/blue, brown/red, brown /black, yellow/grey, yellow/pink	3	3	0 V
4	do not assign	4	grey/green	4	4	serial IN 2
5	address 6	5	white/green	5	5	address 6
6	INTERRUPT	6	pink/green	6	6	INTERRUPT
7	RESET	7	green/blue	7	7	RESET
8	WRITE EXTERN	8	white/blue	8	8	WRITE EXTERN
9	WRITE EXTERN	9	white/red	9	9	WRITE EXTERN
10	address 5	10	grey/pink	10	10	address 5
11	address 3	11	blue	11	11	address 3
12	address 1	12	green	12	12	address 1
13	do not assign	13		13	13	do not assign
14	board ID 4	14	yellow/blue, pink/blue, yellow/black	14	14	+ 12 V
15	board ID 3	15	yellow/red, grey/red, pink/red	15	15	+ 12 V
16	board ID 2	16	grey/blue	16	16	board ID 2
17	board ID 1	17	green/black	17	17	board ID 1
18	address 7	18	white/yellow	18	18	address 7
19	serial IN 1	19	white/black	19	19	serial IN 1
20	EMERG. STOP	20	green/red	20	20	EMERG. STOP
21	serial OUT	21	white/grey	21	21	serial OUT
22	serial OUT	22	white/pink	22	22	serial OUT
23	address 4	23	black	23	23	address 4
24	address 2	24	grey	24	24	address 2
25	address 0	25	white	25	25	address 0
chassis	ext. shield	chassis	ext. shield	chassis	chassis	ext. shield

X3 PLC inputs	
Pin No.	**Assignment**
1	I64
2	I65
3	I66
4	I67
5	I68
6	I69
7	I70
8	I71
9	I72
10	I73
11	I74
12	I75
13	I76
14	I77
15	I78
16	I79

X4 PLC inputs	
Pin No.	**Assignment**
1	I80
2	I81
3	I82
4	I83
5	I84
6	I85
7	I86
8	I87
9	I88
10	I89
11	I90
12	I91
13	I92
14	I93
15	I94
16	I95

X5 PLC inputs	
Pin No.	**Assignment**
1	I96
2	I97
3	I98
4	I99
5	I100
6	I101
7	I102
8	I103
9	I104
10	I105
11	I106
12	I107
13	I108
14	I109
15	I110
16	I111

X6 PLC inputs	
Pin No.	**Assignment**
1	I112
2	I113
3	I114
4	I115
5	I116
6	I117
7	I118
8	I119
9	I120 [1)]
10	I121 [1)]
11	I122 [1)]
12	I123 [1)]
13	I124 [1)]
14	I125 [1)]
15	I126 [1)]
16	I127 [1)]

[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.

X7 PLC outputs	
Pin No.	**Assignment**
1	O32
2	O33
3	O34
4	O35
5	O36
6	O37
7	O38
8	O39
9	O40
10	O41
11	O42
12	O43
13	O44
14	O45
15	O46
16	O47

X8 PLC outputs and "control is ready"	
Pin No.	**Assignment**
1	O48
2	O49
3	O50
4	O51
5	O52
6	O53
7	O54
8	O55
9	O56
10	O57
11	O58
12	O59
13	O60
14	O61 1)
15	O62 1)
16	control is ready

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.

X9, X10, X11, X12, X13, X14 Power supply of the PL	
Terminal	**Assignment**
X9	0 V
X10	+24 V- supply of logic and "control is ready"
X11	+24 V- supply of outputs O32 - O39
X12	+24 V- supply of outputs O40 - O47
X13	+24 V- supply of outputs O48 - O55
X14	+24 V- supply of outputs O56 - O62
X23 1) PIN 1	+24 V- supply of analogue part
X23 1) PIN 2	0 V for analogue part

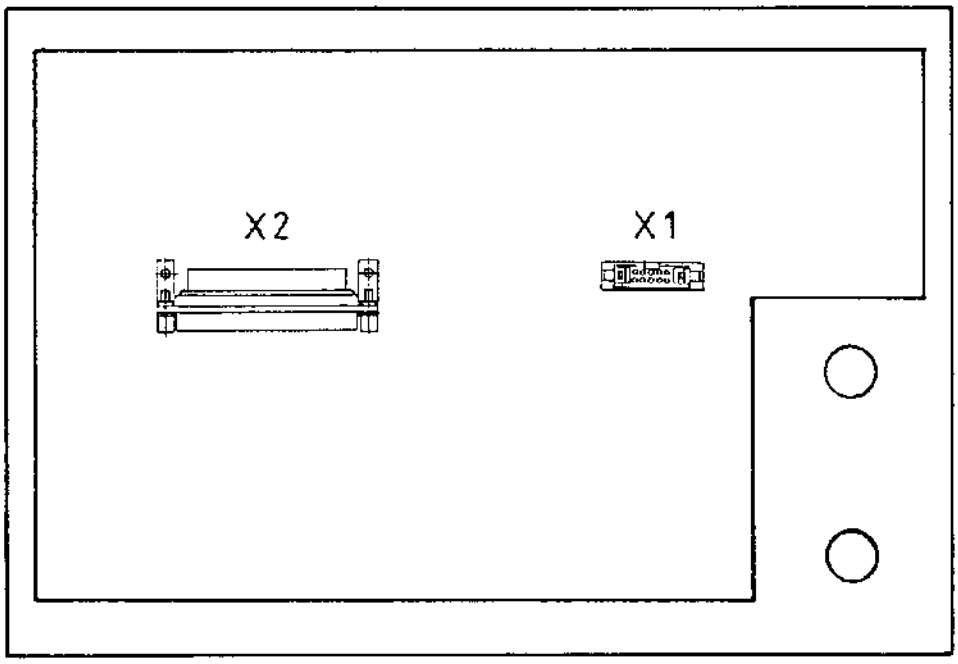
X15 2), X16 2), X17 2), X18 2) Analogue inputs ± 10V	
Pin No.	**Assignment**
1	voltage input (± 10V)
2	0V
3	shield

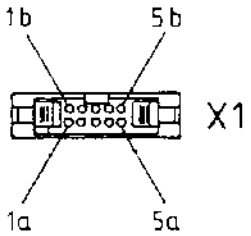
X19 2), X20 2), X21 2), X22 2) Inputs for PT 100 Thermistors Four-wire Connector with constant current source	
Pin No.	**Assignment**
1	I+ constant current for PT 100
2	U+ measuring input
3	U- measuring input
4	I- constant current for PT 100
5	shield

2) not inserted on PL 410B, version 12

6.3 Connectors on the Keyboard Units

6.3.1 Connectors on TE 401





4820 E KD 6084

6.3.2 Pin layout of TE 401

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

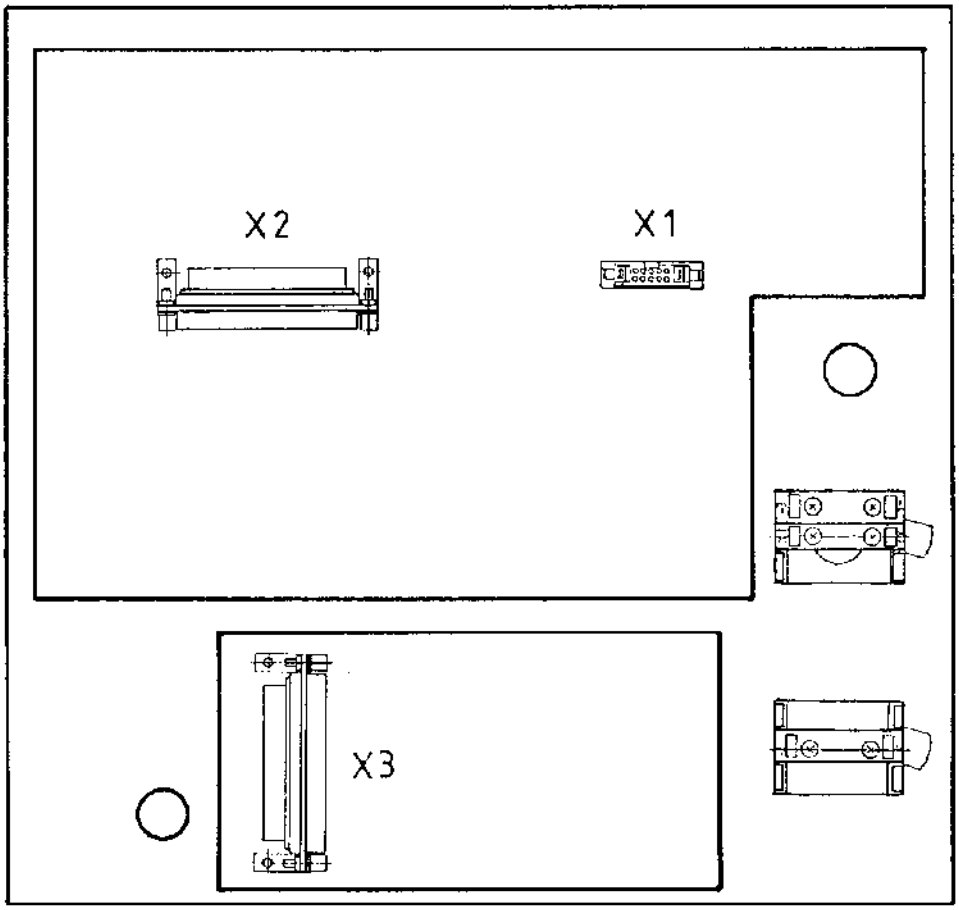
= key matrix

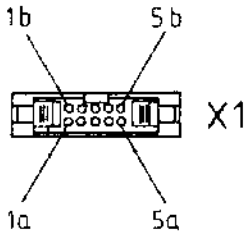
X2 Connection of the logic unit (LE)

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 rate override (wiper)
36	+ 5V
37	0V

6.3.3 Connectors on TE 411





4820 E KD 6084

6.3.4 Connectors on TE 411

X1 Connection of the soft key of the VDU 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 rate override (wiper)
36	+ 5V
37	0V

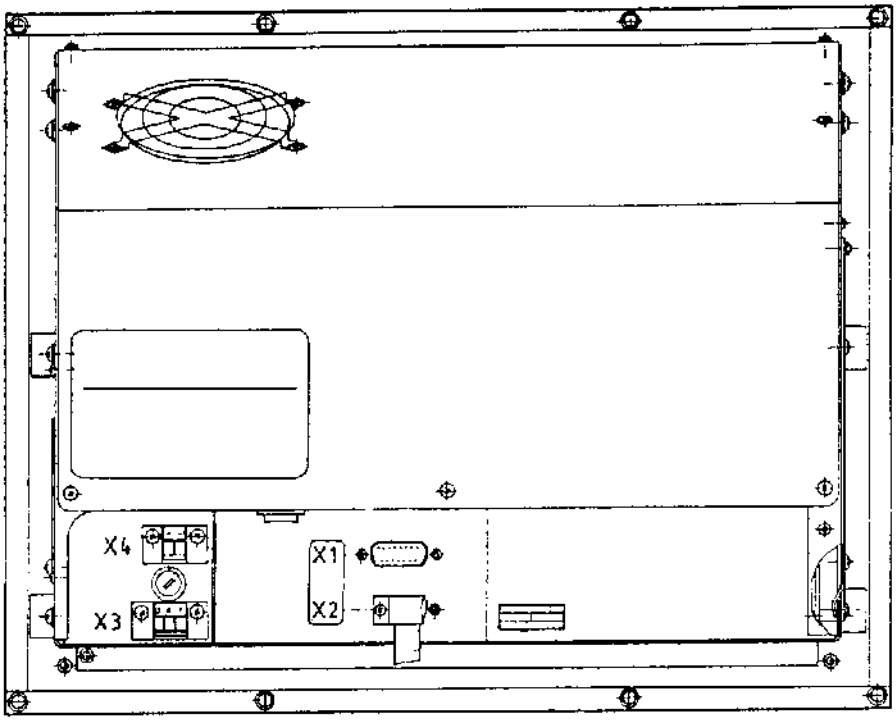
X3 Connection to the logic unit flange socket with male insert(37-pin)	
Pin No.	**Assignment**
1	I 128 unlock shelter door 3)
2	I 129 coolant ON/OFF
3	I 130 spindle OFF
4	I 131 NC OFF
5	I 132 NC ON
6	I 133 axis dir. button X- 1) X+ 2)
7	I 134 axis dir. button Y- 1) Z- 2)
8	I 135 axis dir. button Z- 1) Y- 2)
9	I 136 axis dir. button Z+ 1) Y+ 2)
10	I 137 axis dir. button Y+ 1) Z+ 2)
11	I 138 axis dir. button X+ 1) X- 2)
12	I 139 axis dir. button IV+
13	I 140 axis dir. button 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 dir. button V+
20	I 147 axis dir. button V-
21	I 148 spindle incremental jog
22 - 35	do not assign
36, 37	+ 24V - PLC

= key matrix

1) = TE version 01/03
2) = TE version 02/04
3) = TE Id.No. 264 105 05/06

6.4 Connectors on the Visual Display Unit

6.4.1. Connectors on the VDU BC 110 B



X1 Connection of logic unit flange socket with male insert (15-pin)	
Pin No.	**Assignment**
7	R-analog
9	V-sync
10	H-sync
11	0V
14	Y-analog
15	B-analog

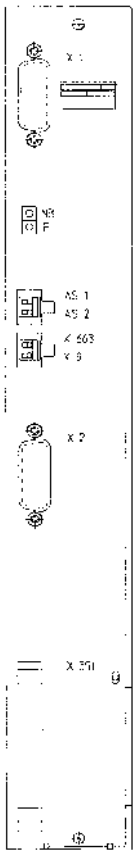
X2 Connection of the soft keys to the keyboard unit flange socket with male insert (9-pin)	
Pin No.	**Assignment**
1	SL0
2	SL1
3	SL2
4	SL3
6	RL15
7	RL14
8	RL13
9	RL12

X3 Power connector Terminal strip (3-pin)
Assignment as labelled

X4 Test output Terminal strip (2-pin)	
Pin No.	**Assignment**
+	6V
-	0V

= key matrix

6.5 Connectors on the Interface Board



X1 and X2 Connection of power stage (X51 to X56) of LE 426PA
X351 SIMODRIVE device bus
NB = not ready
monitoring of Uz, temperature (power stage), power supply and pulse enable
IF = pulse enable
AS1 contact 1 of normally closed contact
AS2 contact 2 of normally closed contact
K663 safety relay for pulse enable
K9 supply voltage from SIMODRIVE device bus

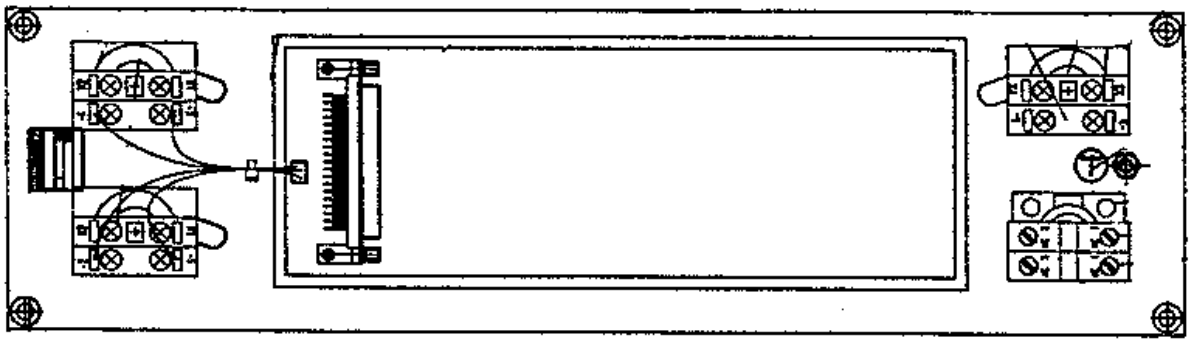
X1, X2 Connection of LE 426PA

D-Sub connector (male) 15-pin

Pin No.	Assignment
1	not assigned
2	PWM U_1
3	PWM U_2
4	PWM U_3
5	$\overline{\text{RESET}}$
6	standby
7	$I_{actl\ 2-}$
8	$I_{actl\ 1-}$
9	0V U_1
10	0V U_2
11	0V U_3
12	0V (analog)
13	$\overline{\text{temperature warning}}$
14	$I_{actl\ 2+}$
15	$I_{actl\ 1+}$
chassis	external shield

The interface complies with the recommendations in VDE 0160, 5.88 for separation from line power.

6.6 Connectors on the Machine Operating Panel MB 410

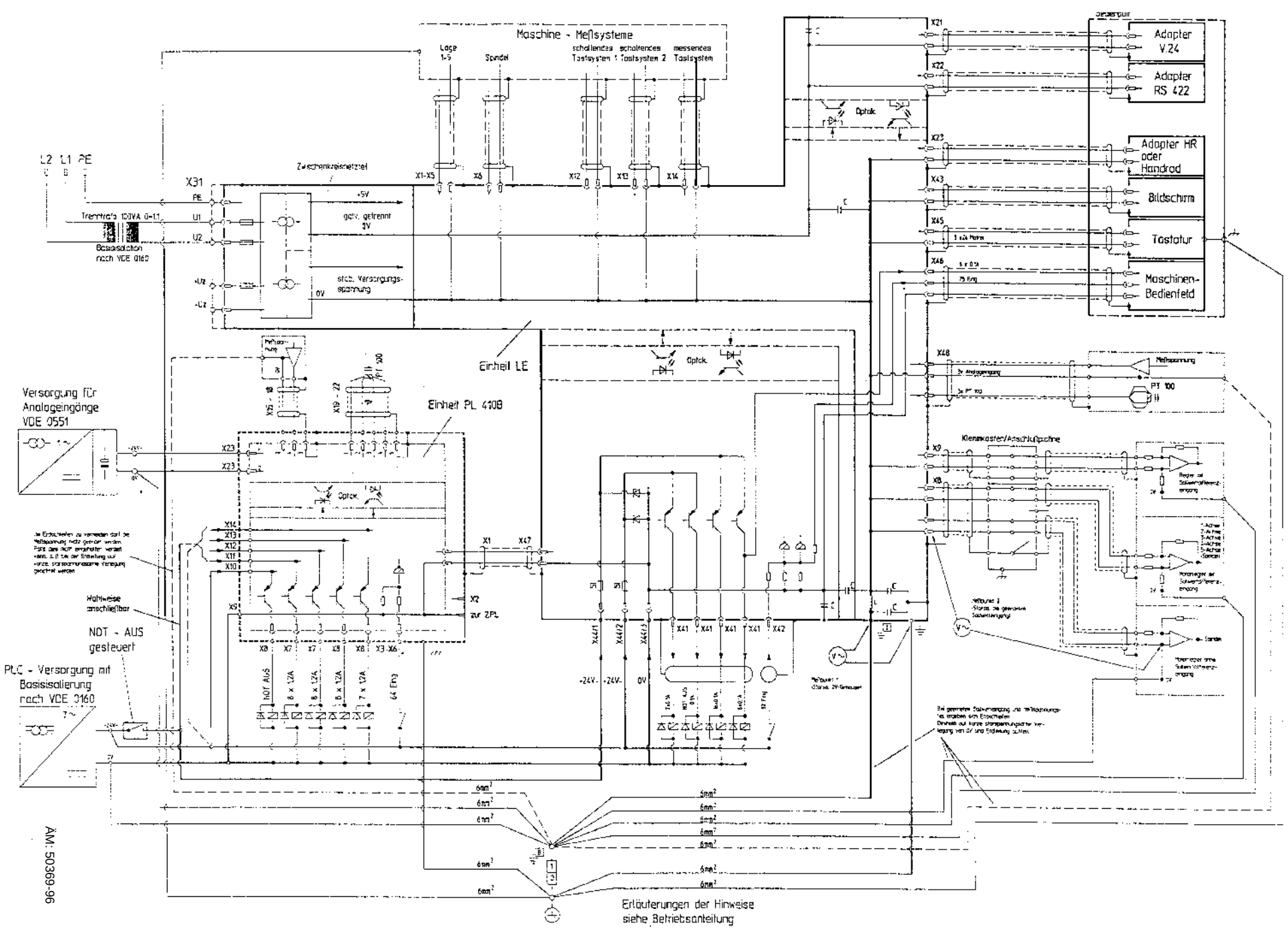


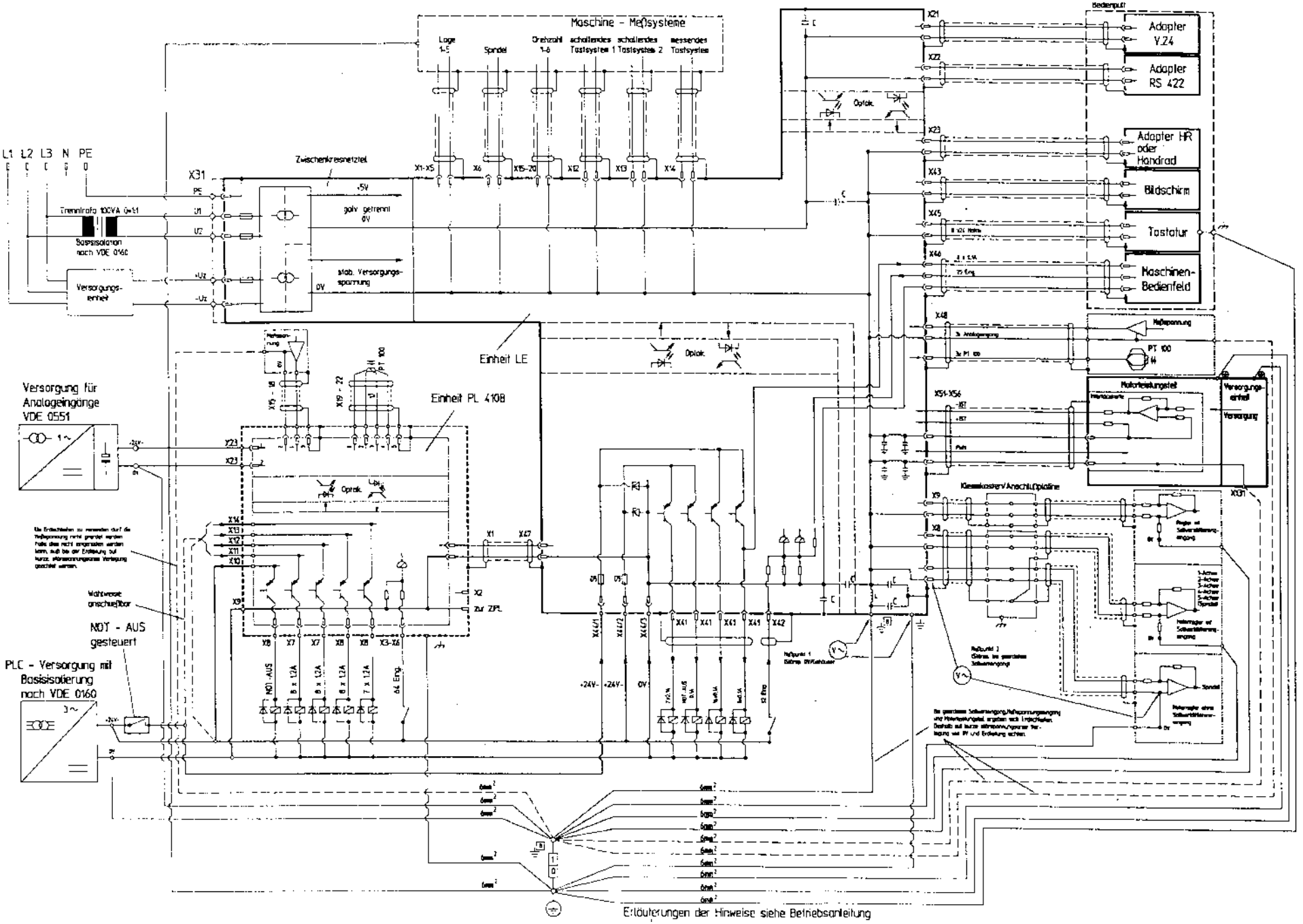
Connection to TNC

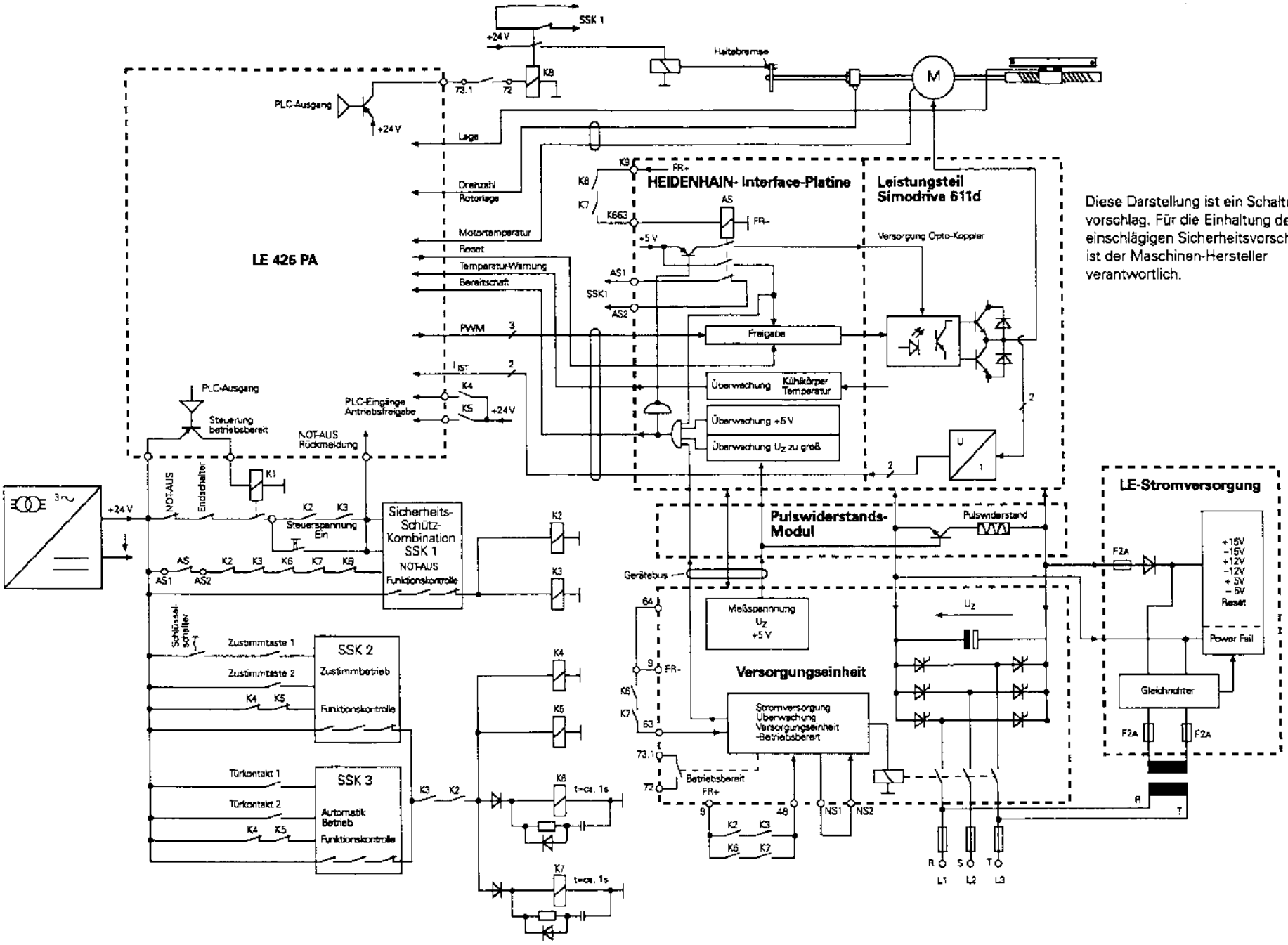
Flange socket with male insert (37-pin)

	MB 410
PIN	**Key**
1	X–
2	Y–
3	Z–
4	IV–
5	V–
6	X+
7	Y+
8	Z+
9	IV+
10	V+
11	FN1
12	FN2
13	FN3
14	FN4
15	FN5
16	spindle on
17	spindle off
18	coolant on/off
19	NC start
20	NC stop
21	rapid traverse
22	black
23	black
24 - 37	not assigned
chassis	

The keys for "Control voltage on", "NC stop" and "NC start" are equipped with lamps which are powered externally with +24V at X2 + ⇨ +24V DC and X1 – ⇨0V.

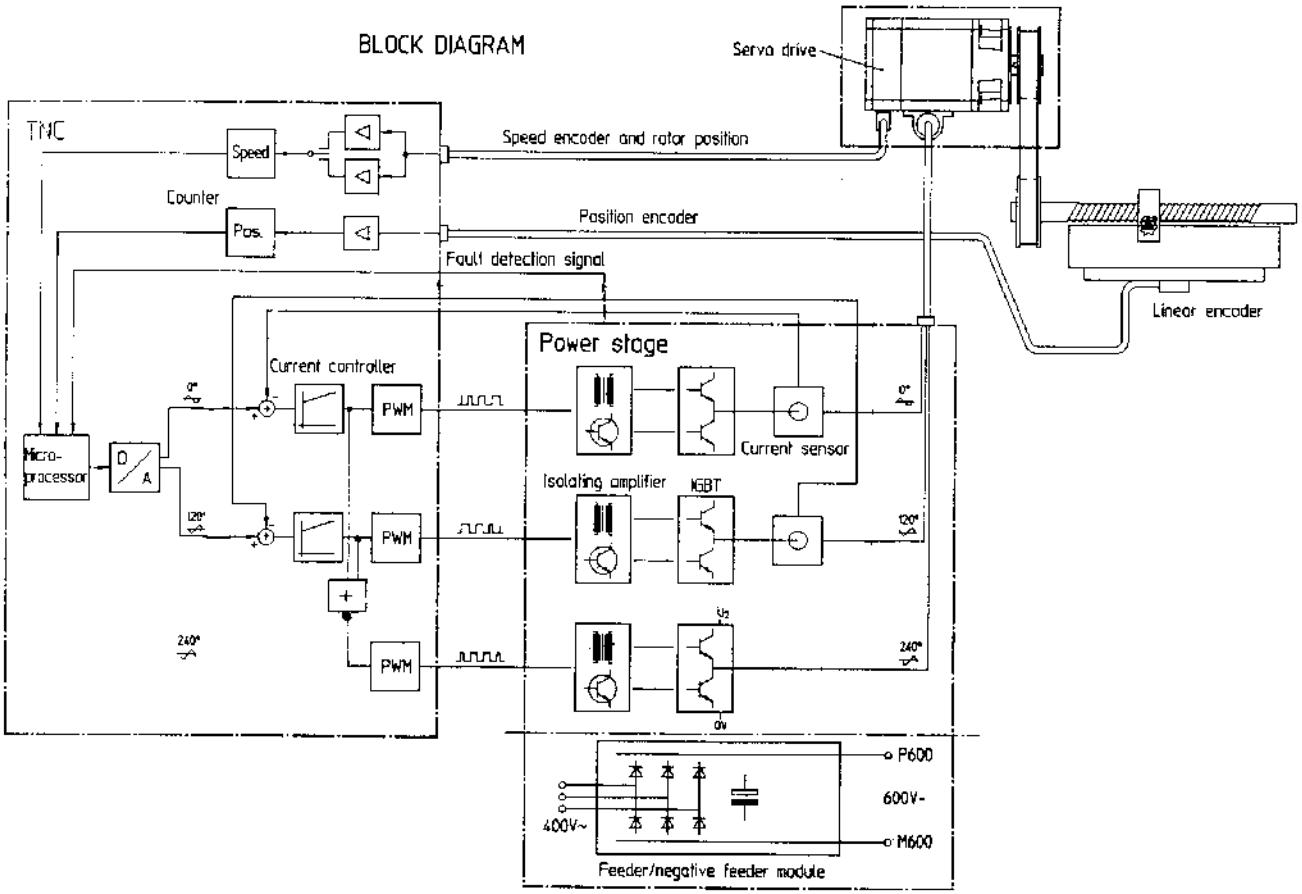

Maschine - Meßsysteme
Lage 1-5
Spindel
schaltendes Tastsystem 1
schaltendes Tastsystem 2
messendes Tastsystem
L2 L1 PE
X31
PE
U1
U2
Trenntrafo 120VA 0-11
Basisisolation nach VDE 0160
Zwischenkreisnetzteil
+5V
galv. getrennt 0V
stab. Versorgungsspannung
0V
+Uz
-Uz
X1-X5
X6
X12
X13
X14
X21
X22
X23
X43
X45
X46
Optok.
Adapter V.24
Adapter RS 422
Adapter HR oder Handrad
Bildschirm
Tastatur
Maschinen-Bedienfeld
Einheit LE
Einheit PL 410B
Versorgung für Analogeingänge VDE 0551
X48
Meßspannung
PT 100
Klemmkasten/Anschlußpfoine
X9
X8
X1
X47
X2
zur ZPL
X41
X42
-24V
0V
Wahlweise anschließbar
NOT - AUS gesteuert
PLC - Versorgung mit Basisisolierung nach VDE 0160
hOF AUS
8 x 12A
7 x 12A
64 Eing
6mm²
5mm²
Erläuterungen der Hinweise siehe Betriebsanleitung
ÄM: 50369-96


Maschine - Meßsysteme
Lage 1-5
Spindel
Drehzahl 1-6
schallendes Tastsystem 1
schallendes Tastsystem 2
messendes Tastsystem
L1 L2 L3 N PE
X31
Zwischenkreisnetzteil
Trennstufe 100VA 0+51
Basisisolation nach VDE 0160
Versorgungseinheit
+5V
galv. getrennt 0V
stab. Versorgungsspannung
Einheit LE
Einheit PL 410B
Versorgung für Analogeingänge VDE 0551
Optok.
Bedienpult
Adapter V.24
Adapter RS 422
Adapter HR oder Handrad
Bildschirm
Tastatur
Maschinen-Bedienfeld
PT 100
Motorleistungsteil
Klemmkasten/Anschlußplatine
Wahlweise anschließbar
NOT - AUS gesteuert
PLC - Versorgung mit Basisisolierung nach VDE 0160
zur ZPL
Erläuterungen der Hinweise siehe Betriebsanleitung



Diese Darstellung ist ein Schaltungsvorschlag. Für die Einhaltung der einschlägigen Sicherheitsvorschriften ist der Maschinen-Hersteller verantwortlich.

Block Diagram: TNC 426 PA / Drive



NOTES

9. Board Descriptions

LE 426 CA/CE

Processor board

- **Interface**
  Data interface V.24/RS-232-C
  Data interface V.11/RS-422
  Serial handwheel
  Position encoder inputs
  3-D touch probes

- **Monitoring**
  Position encoder inputs
  Axis positions
  Program memory
  Data processing
  EMERGENCY STOP

- **Storage**
  Operating program (NC software)

PLC Graphics Board

- **Interface**
  57 PLC inputs
  31 PLC outputs
  Visual display unit
  Keyboard unit
  Machine operating panel
  PLC expansion boards

- **Monitoring**
  Temperature
  Voltages
  Buffer battery

LE 426 PA/PE

Processor board

- **Interface**
  Data interface V.24/RS-232-C
  Data interface V.11/RS-422
  Serial handwheel
  Position encoder inputs
  3-D touch probes

- **Monitoring**
  Position encoder inputs
  Axis positions
  Program memory
  Data processing
  EMERGENCY STOP

- **Storage**
  Operating program (NC software)

PLC Graphics Board

- **Interface**
  57 PLC inputs
  31 PLC outputs
  Visual display unit
  Keyboard unit
  Machine operating panel
  PLC expansion boards

- **Monitoring**
  Temperature
  Voltages
  Buffer battery

Drive Control Board

- **Interface**
  Speed encoder inputs
  Connection of power stage

- **Monitoring**
  Temperature of the motor
  Temperature of the servo amplifier (see PLC module 9160)
  Speed encoder inputs

10. Power Supply

10.1 External Power Supply Requirements

10.1.1 NC Power Supply (dc-link power supply)

LE 426CA:

For LE 426CA an NC power supply of 140 V~ to 450 V~ at the terminals U1 and U2 is required. The monitor of the supply voltage can be switched off via module 9167.
To observe the European standards for electromagnetic compatibility (EN 55022), LE 426 may only be connected to the public AC line via an isolating transformer or in connection with a line filter. Among other things these standards have to be observed to attach the CE label.
If a line filter has already been installed for the supply voltage of the inverter, this voltage may also be used for LE 426CA.

LE 426PA:

For LE 426PA an NC power supply of 330 V~ to 450 V~ at the terminals U1 and U2 has to be applied. This voltage must be applied via an isolating transformer (100 VA) with basic insulation according to VDE 1060.
To ensure the power supply of the drive control in the case of power failure, the LE 426PA must be powered with the dc-link power of the servo amplifier (385 V– to 660 V–) at the terminals +Uz and –Uz.
If the dc-link power is available immediately after power-on, the supply voltage at the terminals U_1 and U_2 is not required. In this case a bridge must be inserted between +Uz and U_1. A short-time overvoltage (approx. 5 seconds) up to 720 V– is permissible. If the voltage exceeds 720 V–, the NC switches off the pulse enable ($\overline{\text{Reset}}$) for the IGBT of the power stage. The motors run out non-controlled and no power can be fed into the dc link.
If the voltage is lower than 385 V– (power fail) the halting procedure for all drives is controlled. The monitor of the supply voltage can be switched on and off via the module 9167. If the voltage falls below 155 V–, the control is reset; the dc-link power supply switches off at 135 V–.

Voltages

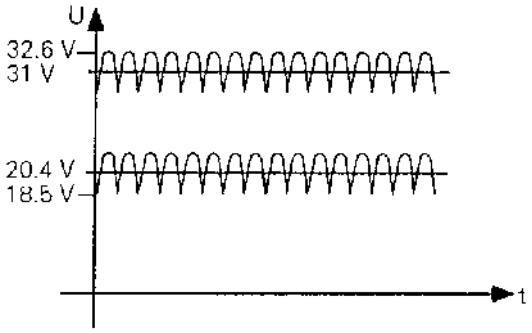
	DC Voltage +UZ/–UZ	AC Voltage U1/U2
Line voltage range I	540 V/600 V	400 V
range II	300 V	220 V
Maximum input voltage		
ranges I and II	660 V	450 V
short-time	720 V	
Threshold for power-fail signal (≙ minimum input voltage)		
range I	385 V	330 V
range II	210 V	185 V
Threshold for reset signal		
ranges I and II	155 V	140 V
Cutoff of power supply unit	135 V	125 V

Range I: power fail monitor active (via module 9167)
Range II: power fail monitor inactive (via module 9167)

10.1.2 PLC Power Supply

The PLC of the LE and the PL are operated with a control voltage of 24V- of the machine tool, generated according to IEC 742 EN 50 178 (basic insulation).

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

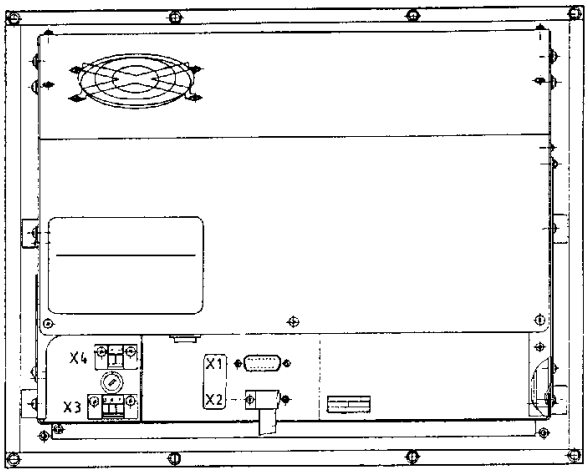


The 0V line of the PLC supply voltage must be connected to the signal ground of the machine via a ground connection ($\varnothing \geq 6mm^2$).
(see grounding diagram)

Supply voltage	**Voltage range** **Mean value of dc voltage**	**Maximum current consumption** (if half of the outputs are active simultaneously)	**Power consumption** (if half of the outputs are active simultaneously)
24V– IEC 742 EN 50 178 basic insulation	lower limit 20.4V upper limit ⎓ 31V voltages up to 36V are permissible with t < 100ms	**LE 426:** 2A **PL 410B:** 20A	**LE 426:** 48W **PL 410B:** 480W

10.1.3 Power Supply of the Visual Display Unit

BC 110B



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

X3 = Power 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 range	49 ... 61 Hz	
Power consumption	60 W	

X4 = Voltage output [1)]	
Connection	Assignment
+	6 V
-	0 V

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

[1)] do not assign

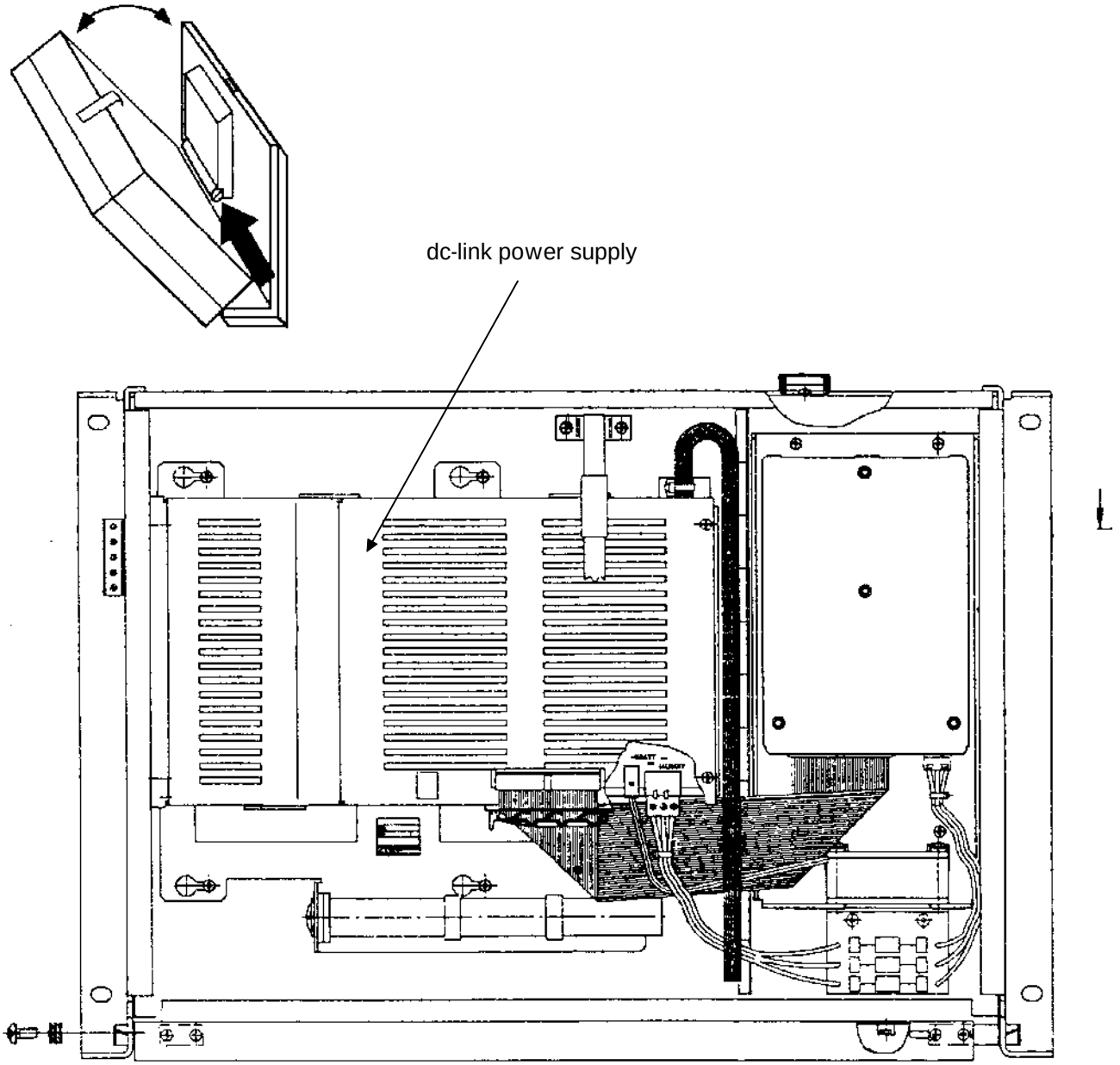
10.2 Power Supply of the NC (dc-link power supply)

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

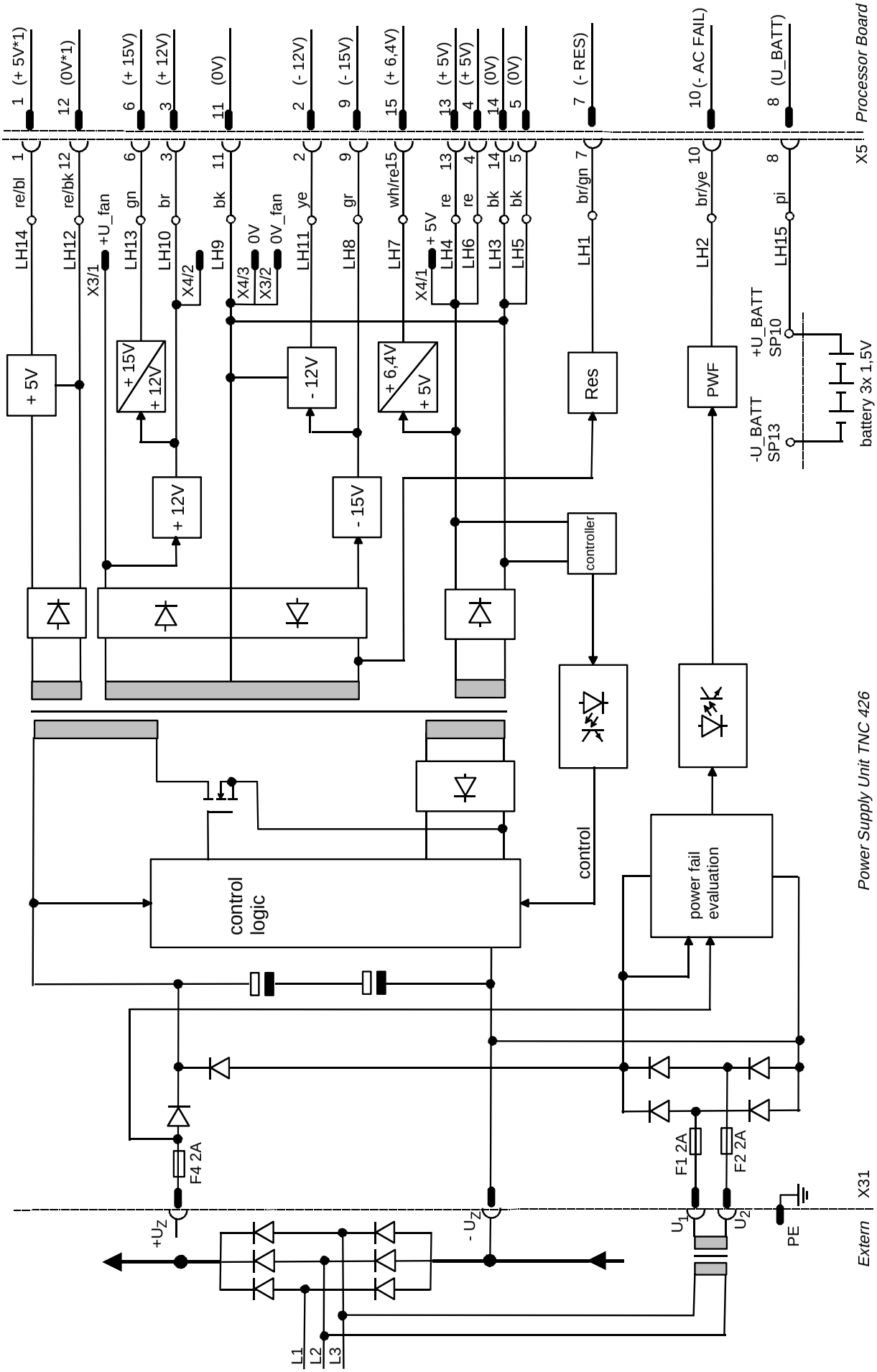
X31 NC supply voltage

Terminals	Assignment	LE 426PA	LE 426CA
⏚	grounding conductor (yellow/grey)		
U_1	phase 1	330V~ to 450V~ via isolating transformer 50 to 60Hz	140V~ to 450V~ via isolating transformer 50 to 60Hz
U_2	phase 2		
$-U_Z$	dc-link power –	385V– to 660V–	–
$+U_Z$	dc-link power +		

Danger of electrical shock!
The dc-link power supply may only be opened by the HEIDENHAIN service staff.



10.2.1 Block Diagram of the NC Power Supply

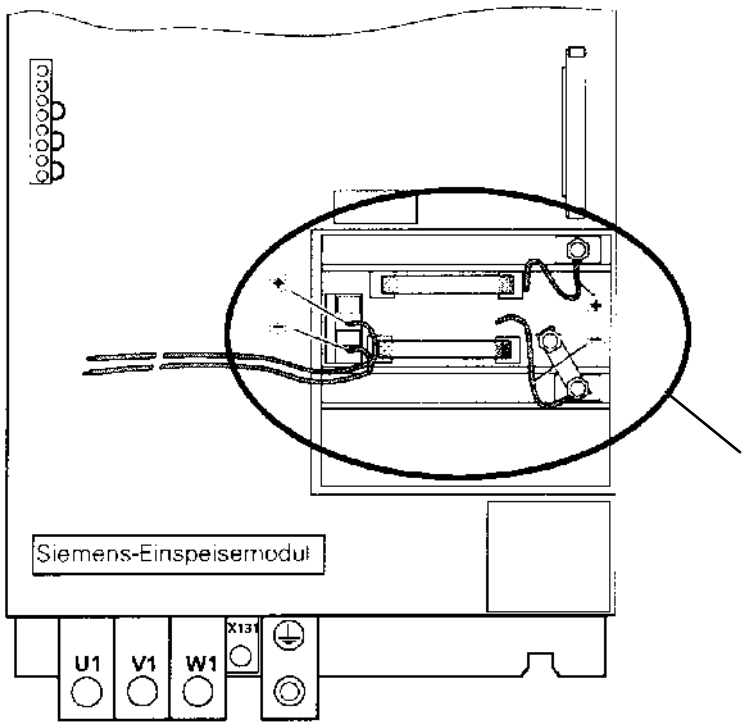


10.3 Checking the NC Power Supply (dc-link power supply)

Three low-voltage fuses are located on the POWER SUPPLY assembly which are **not** accessible from outside (see block diagram). If an error occurs in the dc-link power supply (all voltages missing), first check the power supply line (5-pin terminal strip X31). Moreover, the supply line of the dc-link power supply (of TNC 426PA only) may be protected by HEIDENHAIN by means of a protective PCB (see fig. 1)
The voltages may only be measured on the processor board and on the drive-control board (sections 10.3.1 and 10.3.2).
The measured values and their tolerances can be seen from the table below.
If the measured values deviate **distinctly** from the values in the table, the power supply assembly is defective.

Danger of electrical shock!
The dc-link power supply may only be opened by the HEIDENHAIN service staff.

Fig. 1:



The protective PCB is equipped with 4A/500V fuses

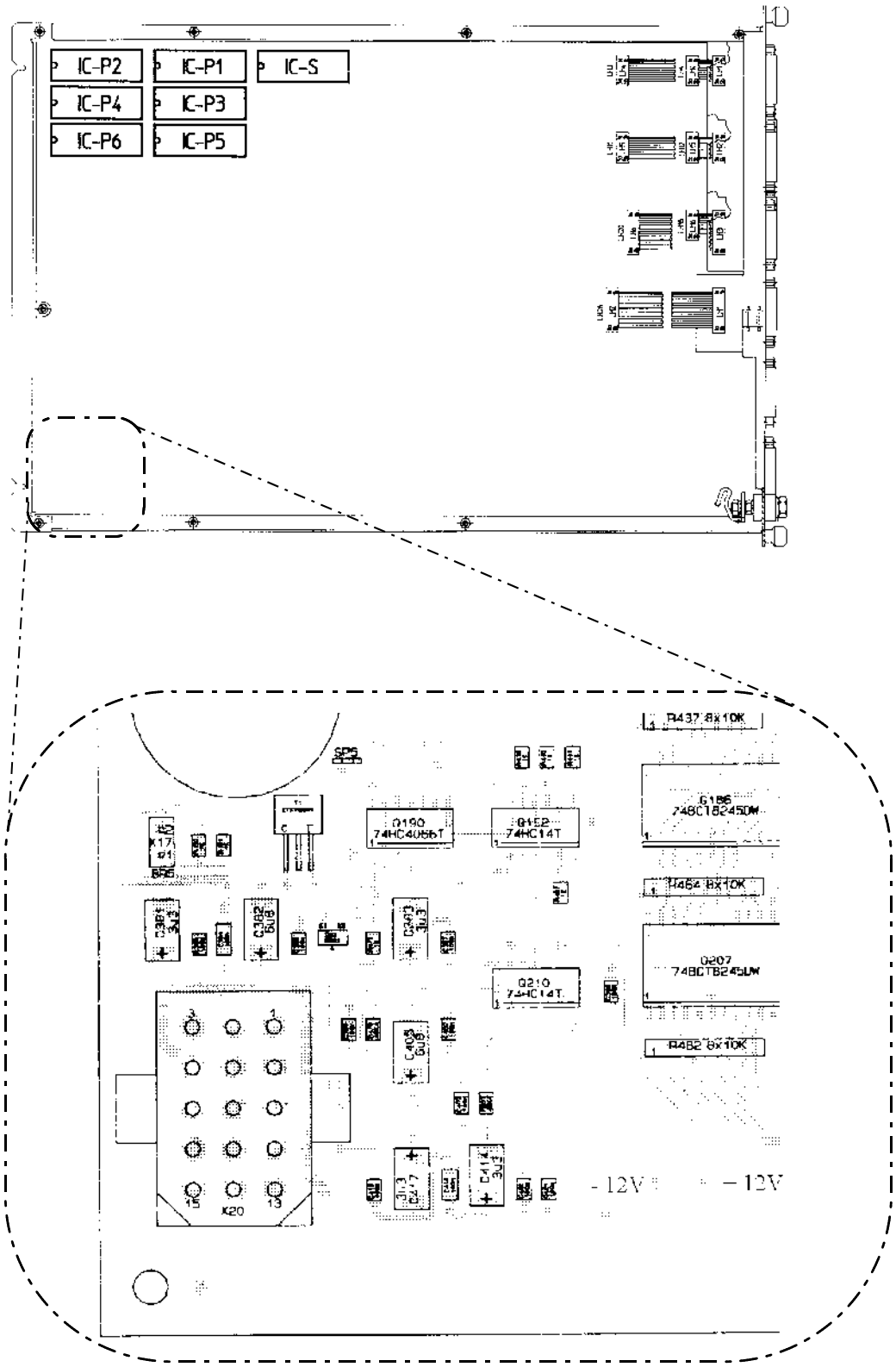
10.3.1 Voltage Table

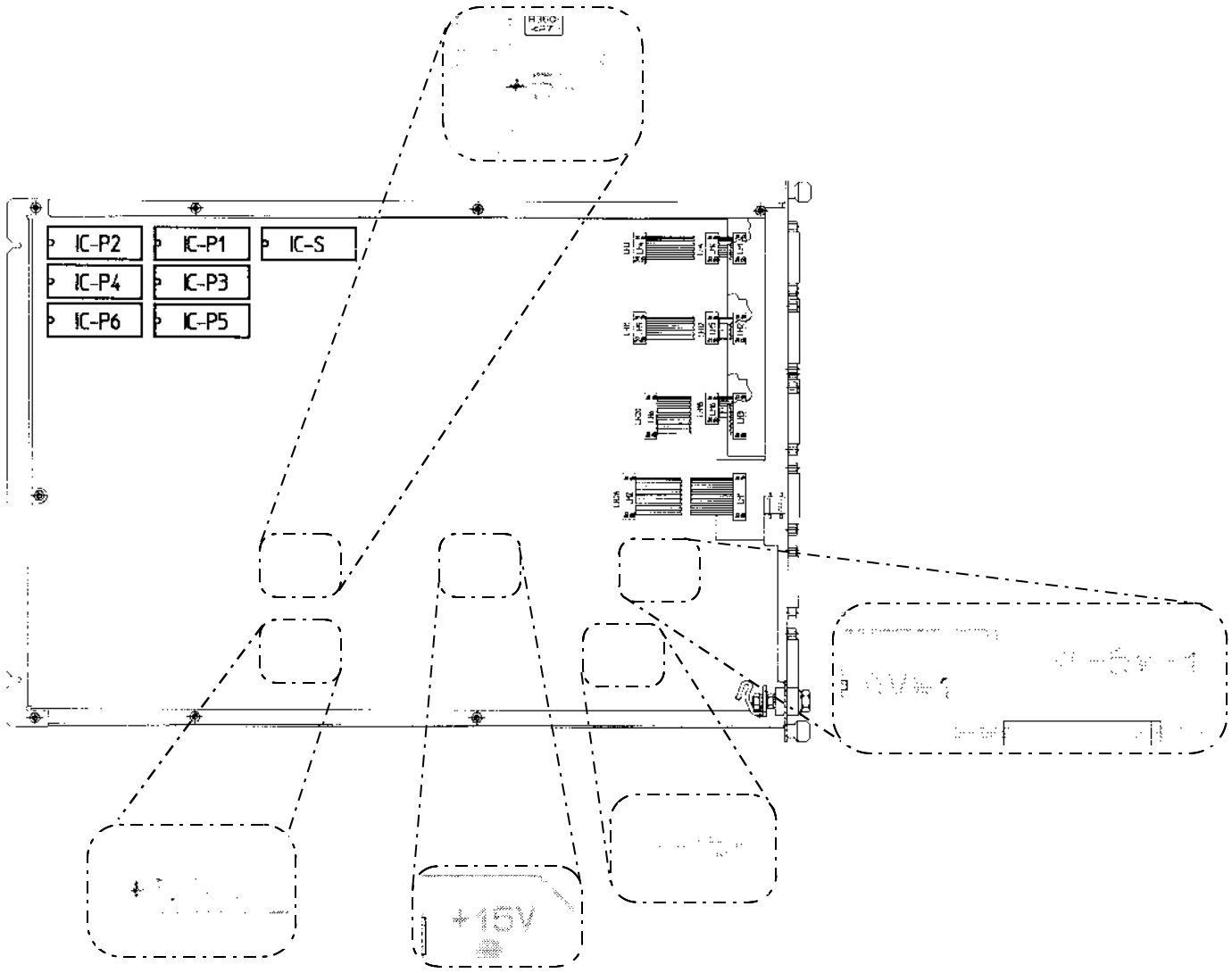
Test point on the board	Reference point on the board	Output	UNOML	Tolerance
+ 5V	0V	+ 5V	+ 5V	+/- 0.2V
+ 6.4V	0V	+ 6.4V	+ 6.4V	+/- 0.25V
+ 15V	0V	+ 15V	+ 15V	+/- 0.6V
+ 12V	0V	+ 12V	+ 12V	+/- 0.5V
- 12V	0V	- 12V	- 12V	+/- 0.5V
- 15V	0V	- 15V	- 15V	+/- 0.6V
+ 5V * 1	0V * 1	+ 5V * 1 [1)]	+ 5V-	+/- 0.2V

1) potential-free supply voltage for the data interfaces

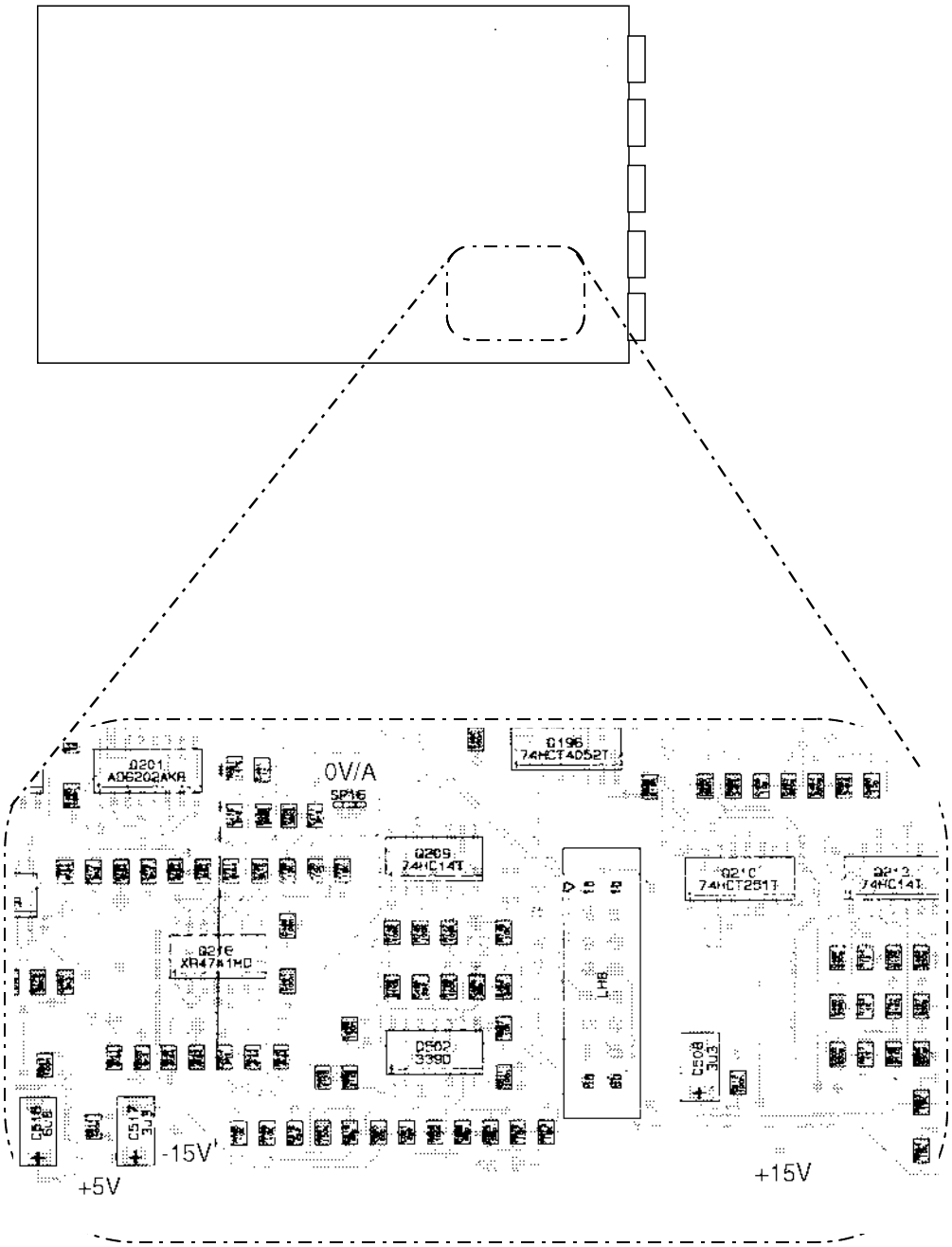
Observe the safety instructions!

10.3.2 Voltage Test Points on the Processor Board




IC-P2
IC-P1
IC-S
IC-P4
IC-P3
IC-P6
IC-P5
+15V

Voltage Test Points on the Drive-Control Board



10.4 Power Supply of the PLC

The power supply line for the internal PLC of LE 426 is connected to the terminal strip X44.

X44 PLC power supply of LE 426

terminal strip (pluggable) 3-pin

Pin No.	Assignment	Fuse
1	+ 24 V_A, can be switched off with EMERGENCY STOP	F 3.15A
2	+ 24 V, cannot be switched off with EMERGENCY STOP	F 2A
3	0V	

The PLC power supply of PL 405B, PL 410B is connected to the following terminals:

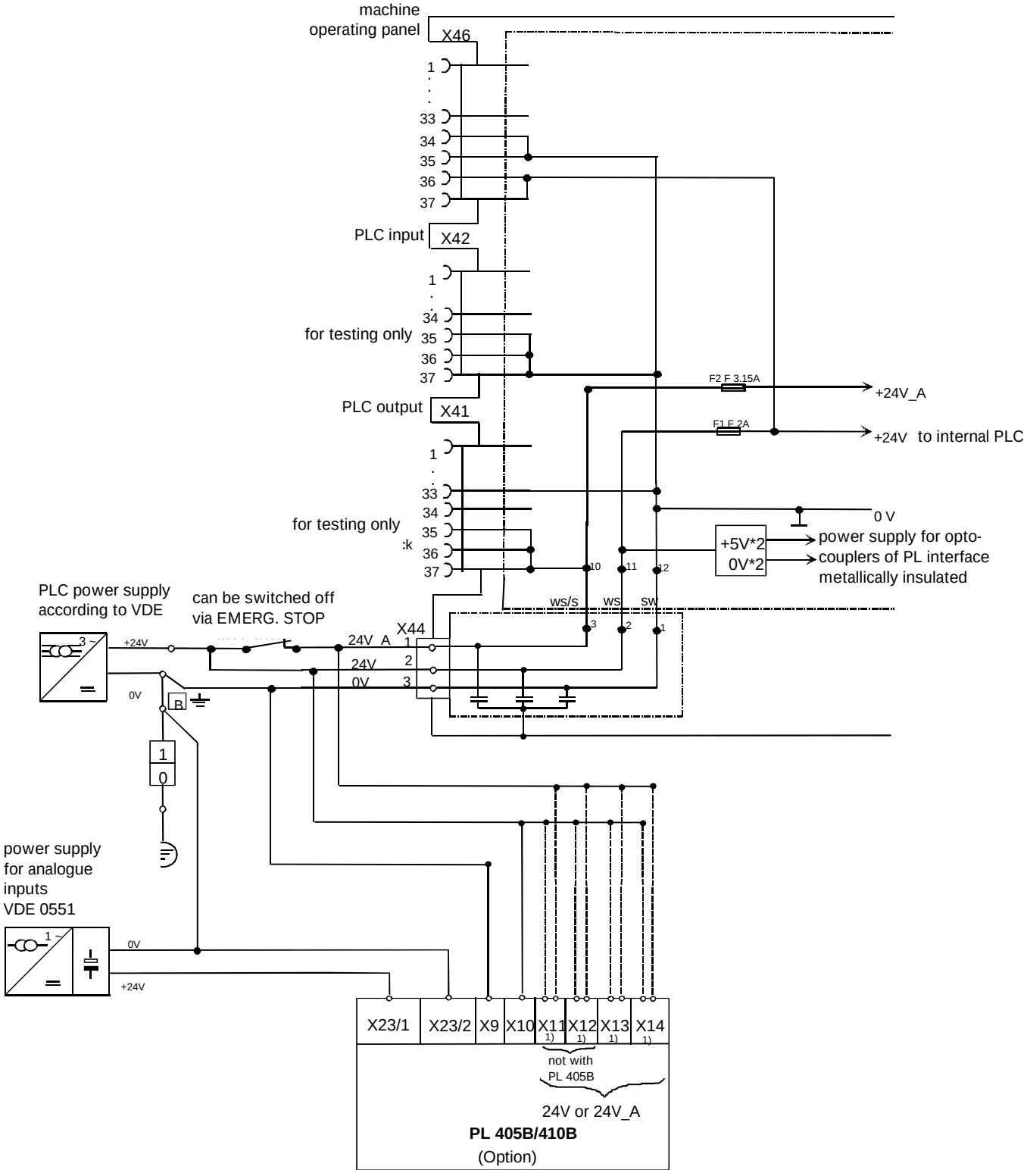
Power supply PL 405B / 410B

X9, X10, X11, X12, X13, X14, X23 Power supply of PL			
Terminal	Assignment	1.PL	2.PL
X9	0V		
X10	+ 24V- logic supply and "control is ready "		
X11 [1)]	+ 24V- logic supply for outputs	O32 - O39	O64 - O71
X12 [1)]	+ 24V- logic supply for outputs	O40 - O47	O72 - O79
X13	+ 24V- logic supply for outputs	O48 - O55	O80 - O87
X14	+ 24V- logic supply for outputs	O56 - O62	O88 - O94
X23 [1)] pin 1 pin 2	+ 24V- supply of analogue part 0V		

Fuse: F1: F1A (+ 24V- logic supply)

[1)] not for PL 405B

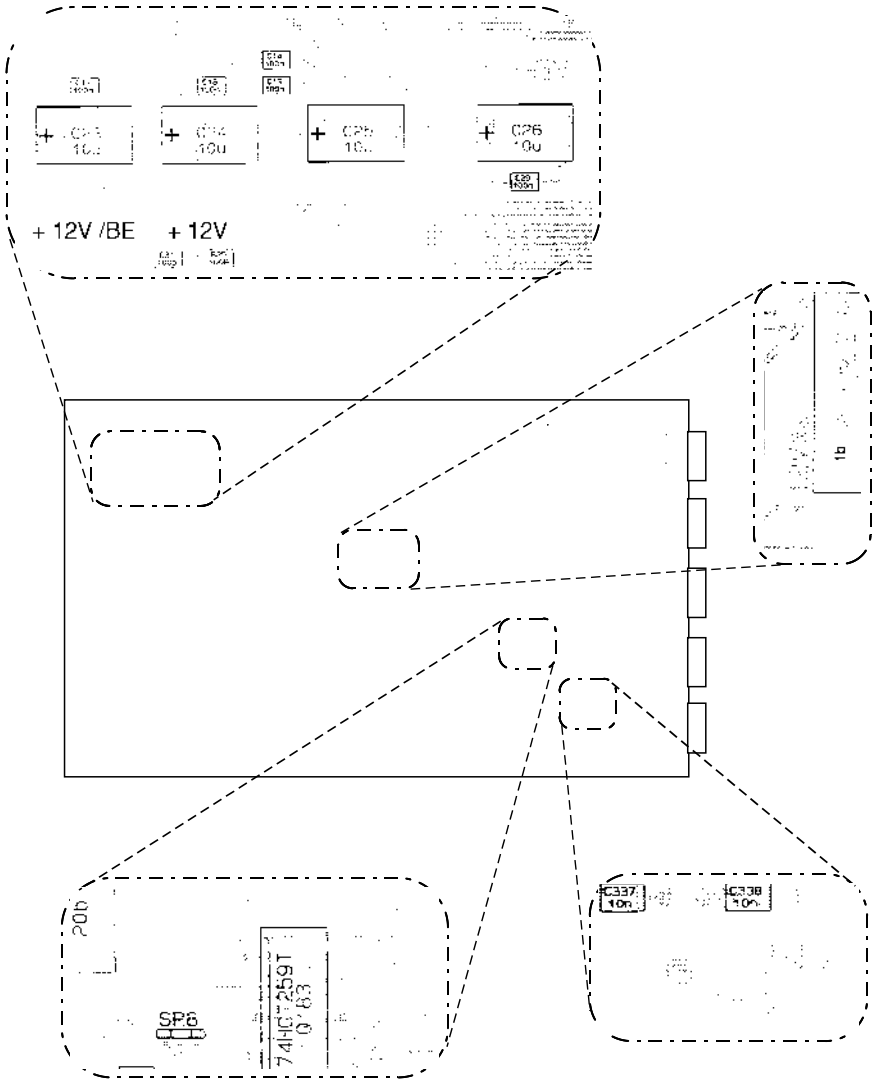
10.4.1 PLC Power Supply: Block Diagram



1) can be powered with 24V or 24V_A

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

10.4.2 Voltage Test Points on the PLC Graphics Board



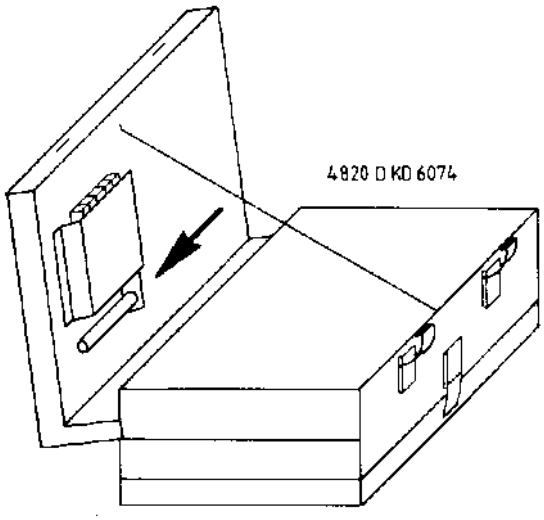
This voltage is not available on the PLC graphics board, but fed from the external PL board.

10.5 Buffer Battery

The buffer battery is the voltage source for the RAM when the machine is switched off.
If the error message

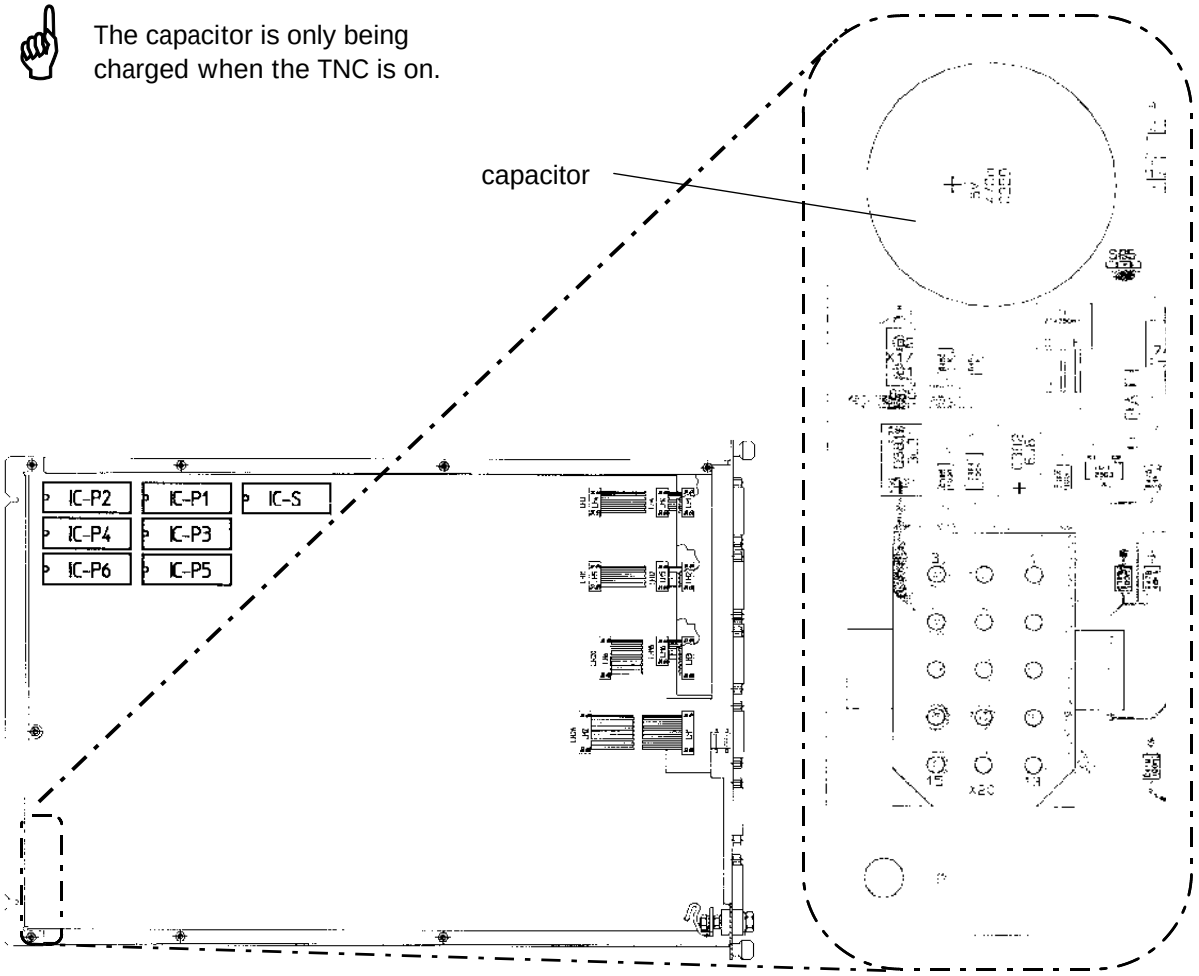
EXCHANGE BUFFER BATTERY

is displayed, 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, open the LE by undoing both snaps.
In addition to the batteries, TNC 426 features a capacitor to ensure the power supply of the RAM.
This capacitor is located on the processor board.
Therefore, the line voltage may be switched off when the batteries are to be exchanged.
Without the batteries the capacitor is capable of maintaining the memory contents for about one day.
The charge of the capacitor and the current voltage of the buffer battery can be displayed in the "Info" menu (see section 10.6).



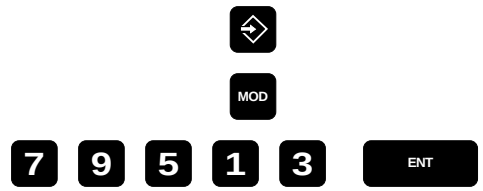
Battery model:
3 AA-size batteries, leak-proof
IEC designation "LR6"

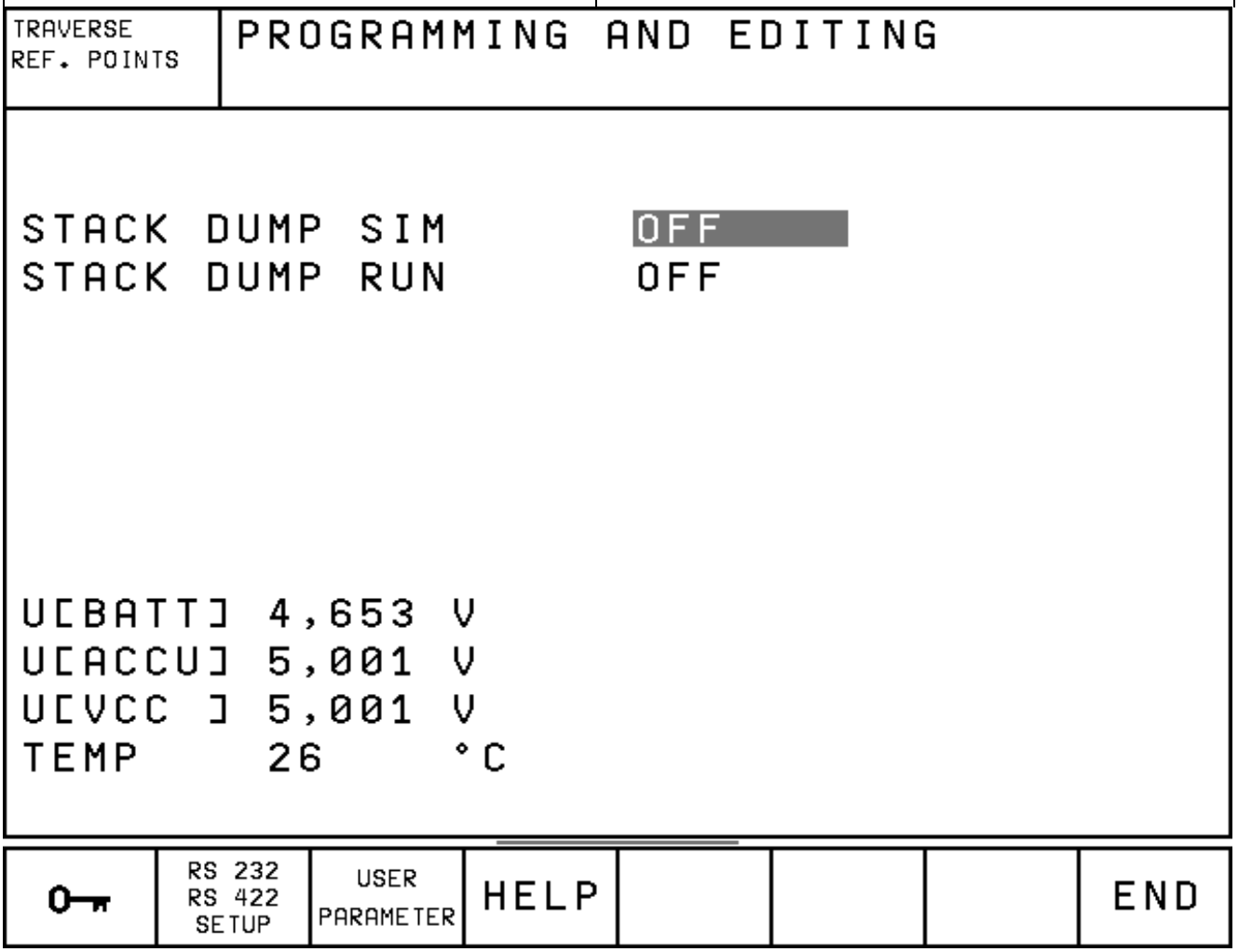
The capacitor is only being charged when the TNC is on.



Processor board

10.6 Info Menu

Press key	Function
	TNC in operating mode PROGRAMMING/EDITING Prepare TNC for input of code number Enter code number, confirm with ENT



The screen now contains the following information:

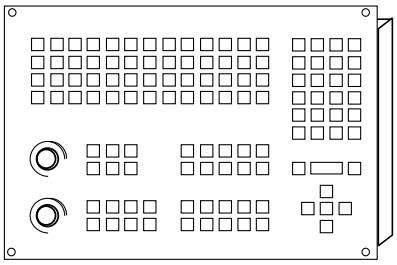
U[BATT] 4,651 V
U[ACCU] 5,001 V ⇨ voltage of the buffer battery
U[VCC] 5,001 V ⇨ charge of the capacitor
TEMP 25 °C ⇨ 5V supply voltage
⇨ temperature inside the logic unit

Note: These values are internally updated every minute. The display however, is only updated when the Info menu is called up.

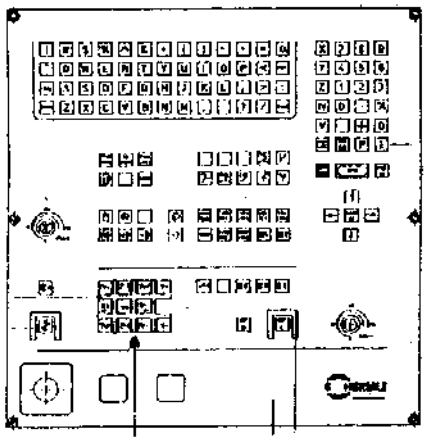
11. Keyboard Units TE 401/411

11.1 Overview

TE 401 Id.No. 250 517 04



TE 411 Id.No. 264 105 07/08



11.2 Checking the Keyboard Unit

The keyboard unit can be checked fast and reliably by means of the measuring adapter.

11.2.1 Checking the Key Functions

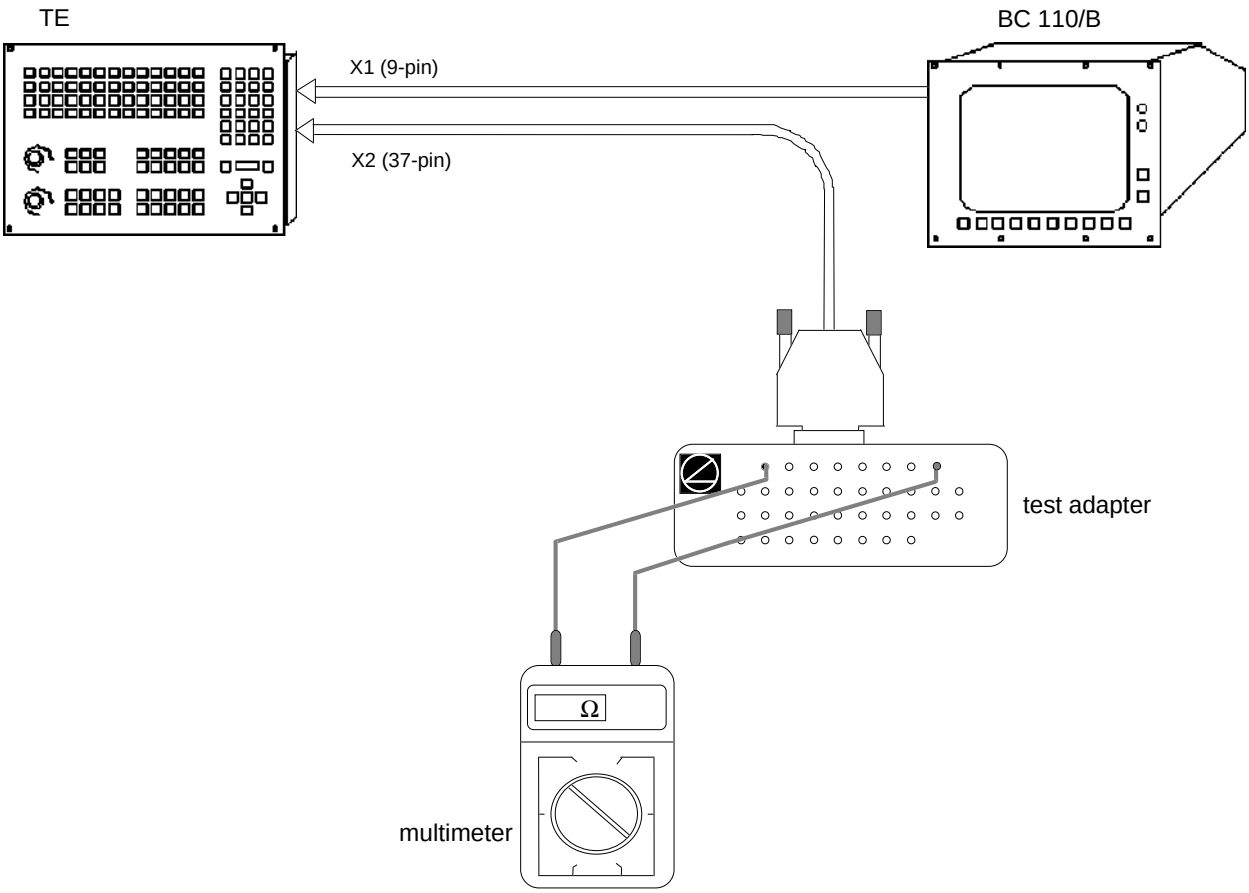
Proceeding:

Observe the safety instructions!

- Switch off the main switch.
- Disconnect the keyboard unit from the LE and connect the measuring adapter (see section 21) to the keyboard unit.
  Now the contacts of the keys can be measured at the measuring adapter with an Ohmmeter.

If e.g. PGM MGT is pressed at the TNC operating panel, approx. 1 Ω must 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					
SHIFT										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 MGT								X													X			
■							X														X			
■						X															X			
CALC					X																X			
MOD						X													X					
HELP		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							
■						X											X							
PGM CALL					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 the keyboard unit
2) key on VDU

X1: connection of flat cable *VDU ⇨ keyboard unit* (plug-type connector)
X2: connection of 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

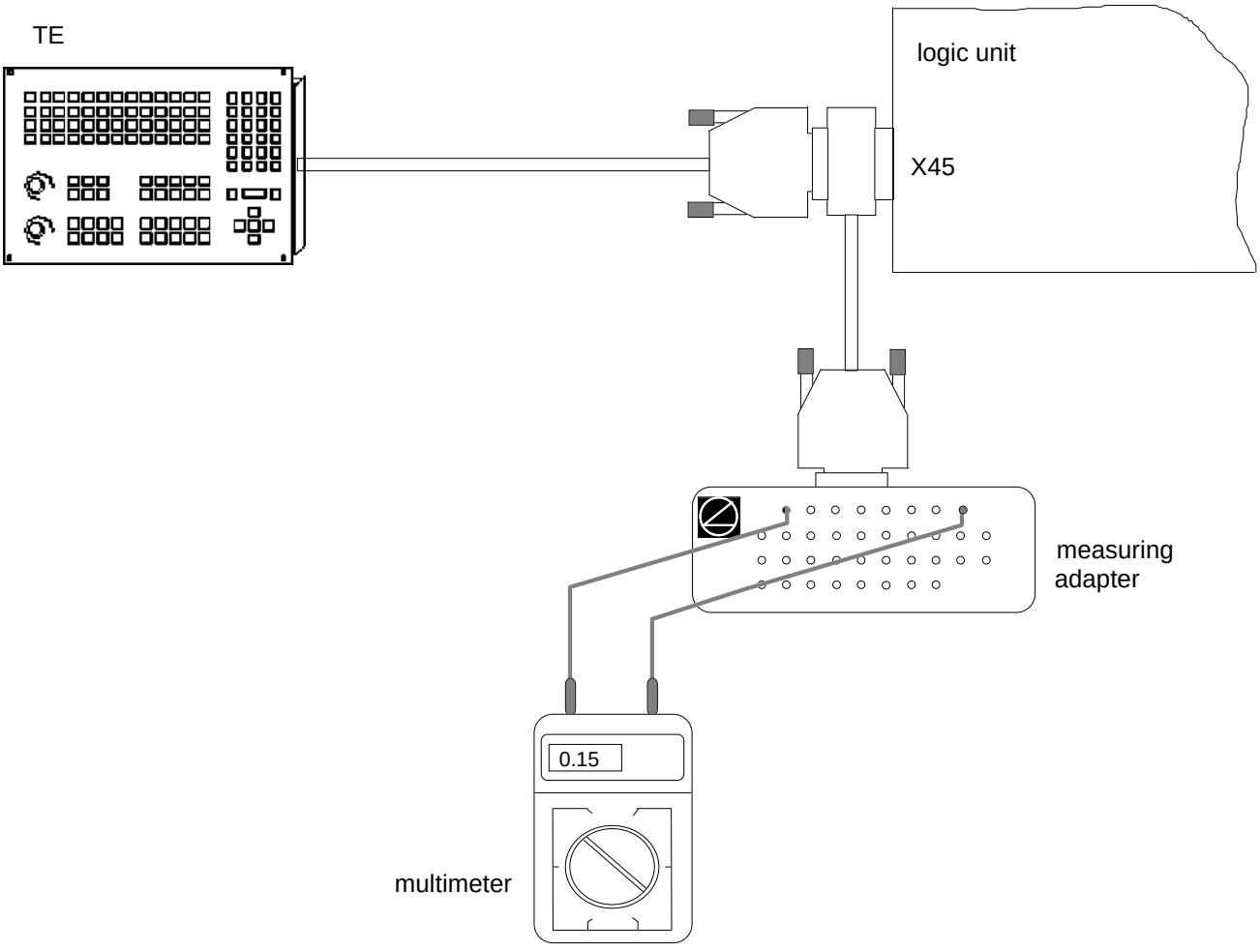
Proceeding:

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 range**
Override F%	37 = 0V / 35 = + pot	(0 ... ca. 4.95)V
Spindle S%	37 = 0V / 34 = + pot	(0 ... ca. 4.95)V

11.2.6 Measuring Setup for Checking the Potentiometers



11.2.7 Machine Operating Panel of TE 411

The PLC inputs of the machine operating panel of TE 411 (I128 to I148) can be checked at the flange socket X3 (37-pin) of the keyboard unit or at the flange socket X46 (connection of machine operating panel) of TNC 426.

For this purpose the TABLE function (see section 20.4) in the PLC mode is helpful as well.

KEY of version 07	KEY of version 08	Flange socket X3 on KEYBOARD UNIT PIN	PIN	PLC 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	Flange socket X3 on KEYBOARD UNIT PIN	PIN	PLC Input
O	3	36,37	I130
I	15	36,37	I142
T	21	36,37	I148
	1	36,37	I128
	2	36,37	I129
NC 0	4	36,37	I131
NC I	5	36,37	I132

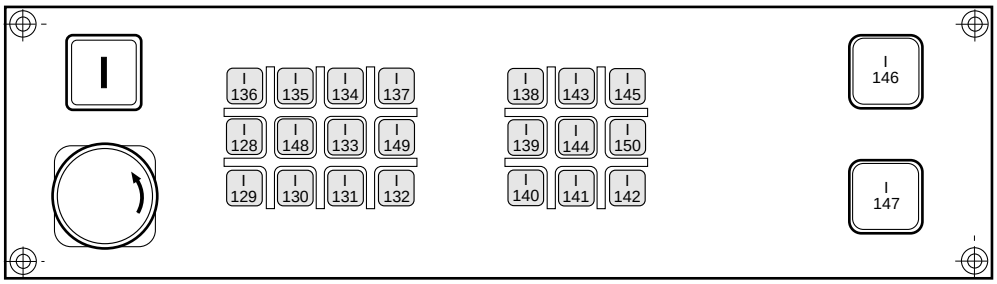
Pin 36/37 = + 24V_PLC

11.2.8 Machine Operating Panel MB 410

The PLC inputs of the machine operating panel MB 410 (I128 - I150) can be checked at the 37-pin flange socket of MB 410 or at the flange socket X46 (connection of machine operating panel) of TNC 426.

The TABLE function in the PLC mode is also useful for this purpose (see section 20.4).

Allocation of the PLC inputs to the keys of MB 410:

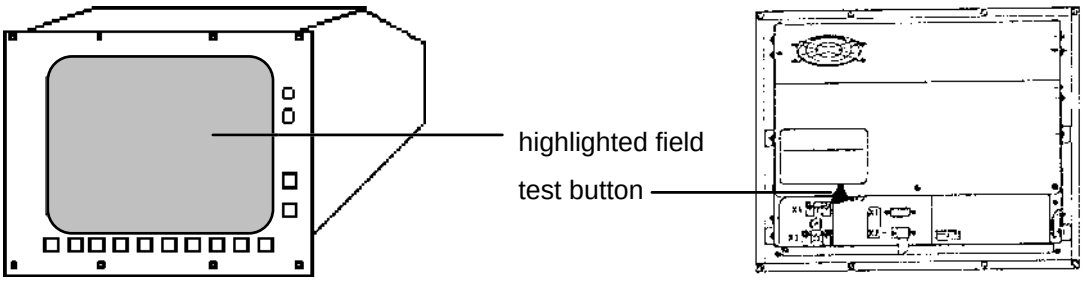


12. Visual Display Unit BC 110B

12.1 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 has been pressed, the VDU is defective and must be exchanged.

The control signals for the VDU can only be checked by means of an oscilloscope.
The diagrams on the following page have been recorded with the VDU connected. The color signals R-analog, Y-analog and B-analog may differ from these diagrams (depending on the machine parameters and on the image depicted).

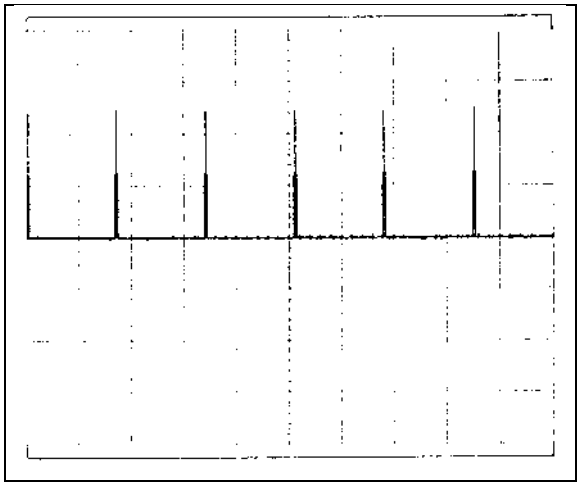
X43 Visual display unit
flange socket with female insert (15-pin)

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

Diagrams

V-SYNC PIN 9

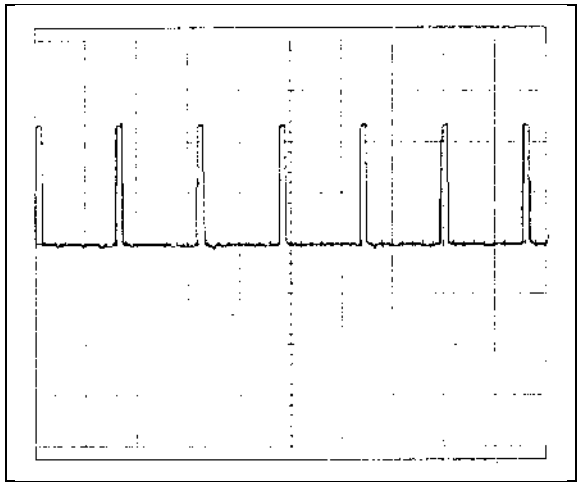
2V/DIV



10 ms/DIV

H-SYNC PIN 10

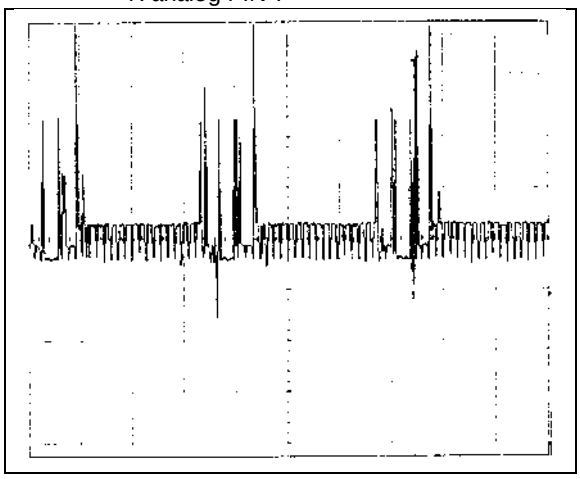
2V/DIV



20 µs/DIV

R-analog PIN 7 [1)]

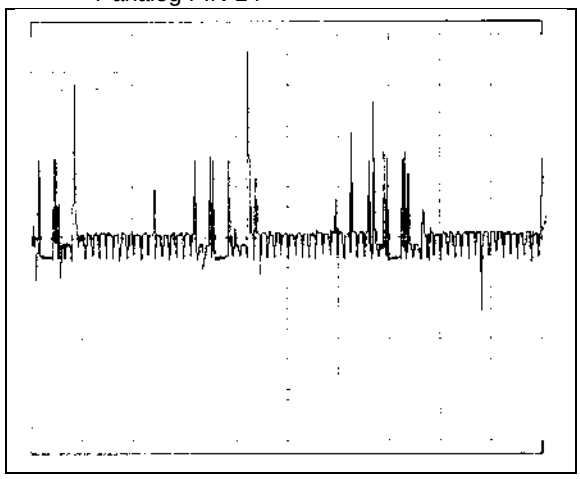
0.2V/DIV



5 ms/DIV

Y-analog PIN 14 [1)]

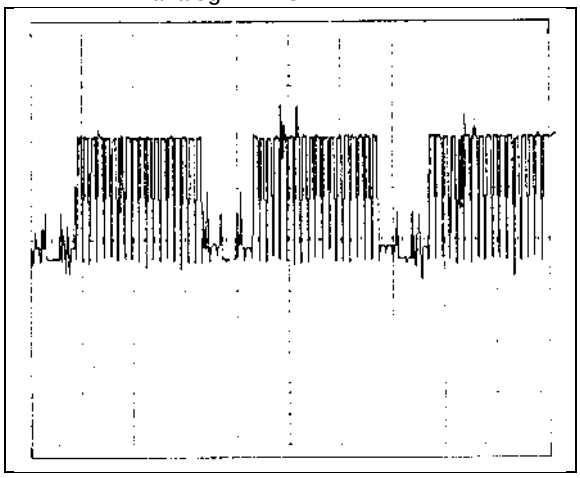
0.2V/DIV



5 ms/DIV

B-analog PIN 15 [1)]

0.2V/DIV



5 ms/DIV

[1)] When measuring the color 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

MEASURING SYSTEM <Axis> DEFECTIVE A

A = signal amplitude error

MEASURING SYSTEM <Axis> DEFECTIVE B

B = signal frequency error

MEASURING SYSTEM <Axis> DEFECTIVE C

C = error with distance-coded scales

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:

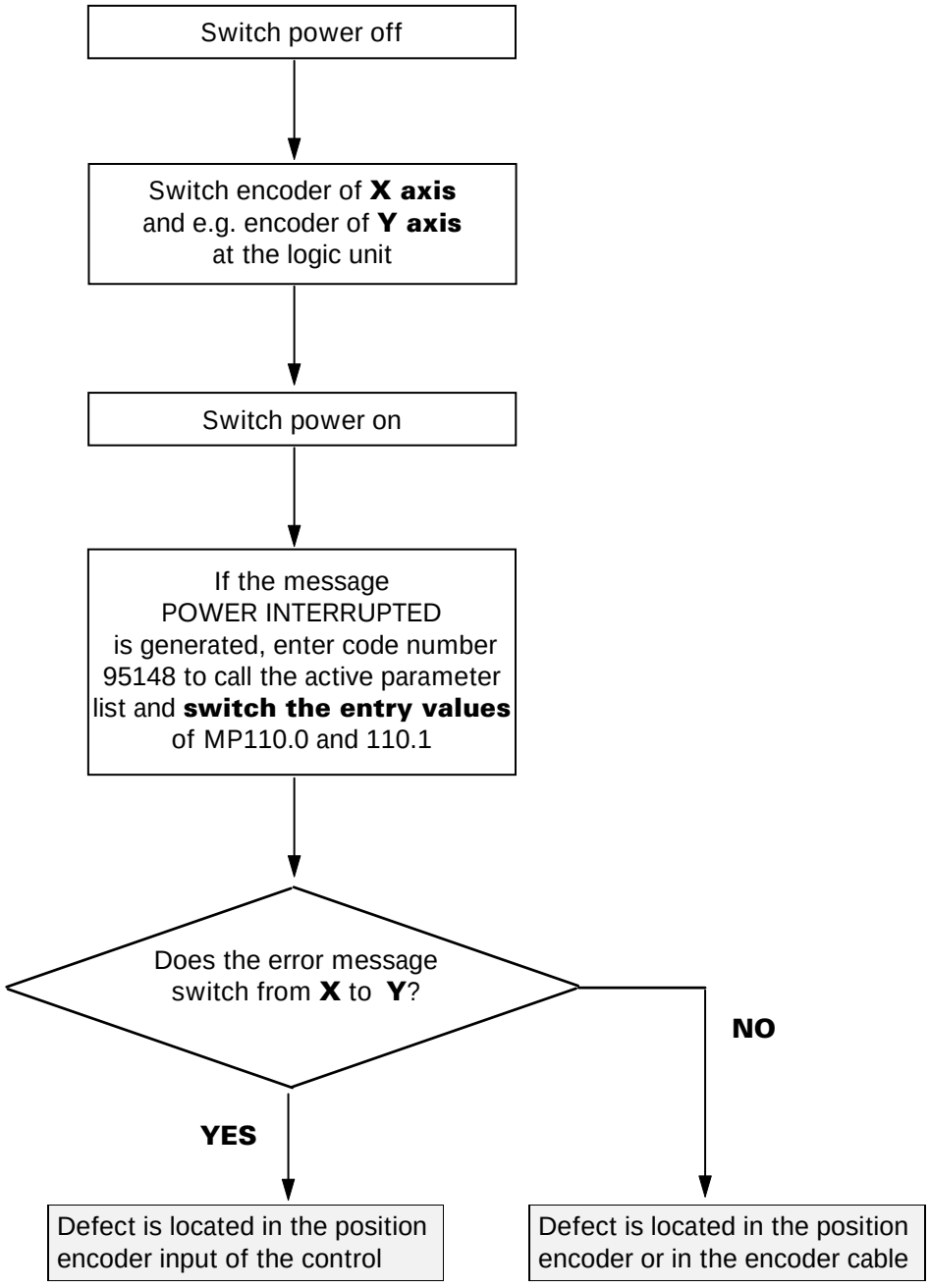
Function		MP	Entry Values
Allocation of the axes	X	110.0	0 = encoder input X1
to the encoder inputs	Y	110.1	1 = encoder input X2
	Z	110.2	2 = encoder input X3
	IV	110.3	3 = encoder input X4
	V	110.4	4 = encoder input X5
			5 = encoder input X6[1)]

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

Flow-Chart for Error Location

MEASURING SYSTEM X DEFECTIVE A

(Example)



Caution: Only switch encoders that provide the same signals!

Observe the safety instructions!

13.2 Error Messages for Axes with Integral Current and Speed Controller

When operating with axes with integral digital speed controller, two encoder inputs are available for each axis:

Encoder input 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 X-axis:	input X15
encoder Y-axis:	input X16
encoder Z-axis:	input X17
encoder IV. axis:	input X18
encoder V. axis:	input X19
encoder spindle:	input X20

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

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

MEASURING SYSTEM <Axis> DEFECTIVE A

A = signal amplitude error, position encoder

MEASURING SYSTEM <Axis> DEFECTIVE B

B = signal frequency error, position encoder

MEASURING SYSTEM <Axis> DEFECTIVE C

C = error with distance-coded scales, position encoder

Monitoring of the actual speed capture(X15, X16, X17, X18, X19, X20)

MEASURING SYSTEM <Axis>` DEFECTIVE A

A = signal amplitude error, speed encoder

MEASURING SYSTEM <Axis>` DEFECTIVE B

B = signal frequency error, speed encoder

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 Location of the error in the position encoder loop (X1 ... X6)

In order to determine whether the position encoder of the axis concerned or the encoder input of the logic unit is defective, the encoders can be switched at the logic unit.

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

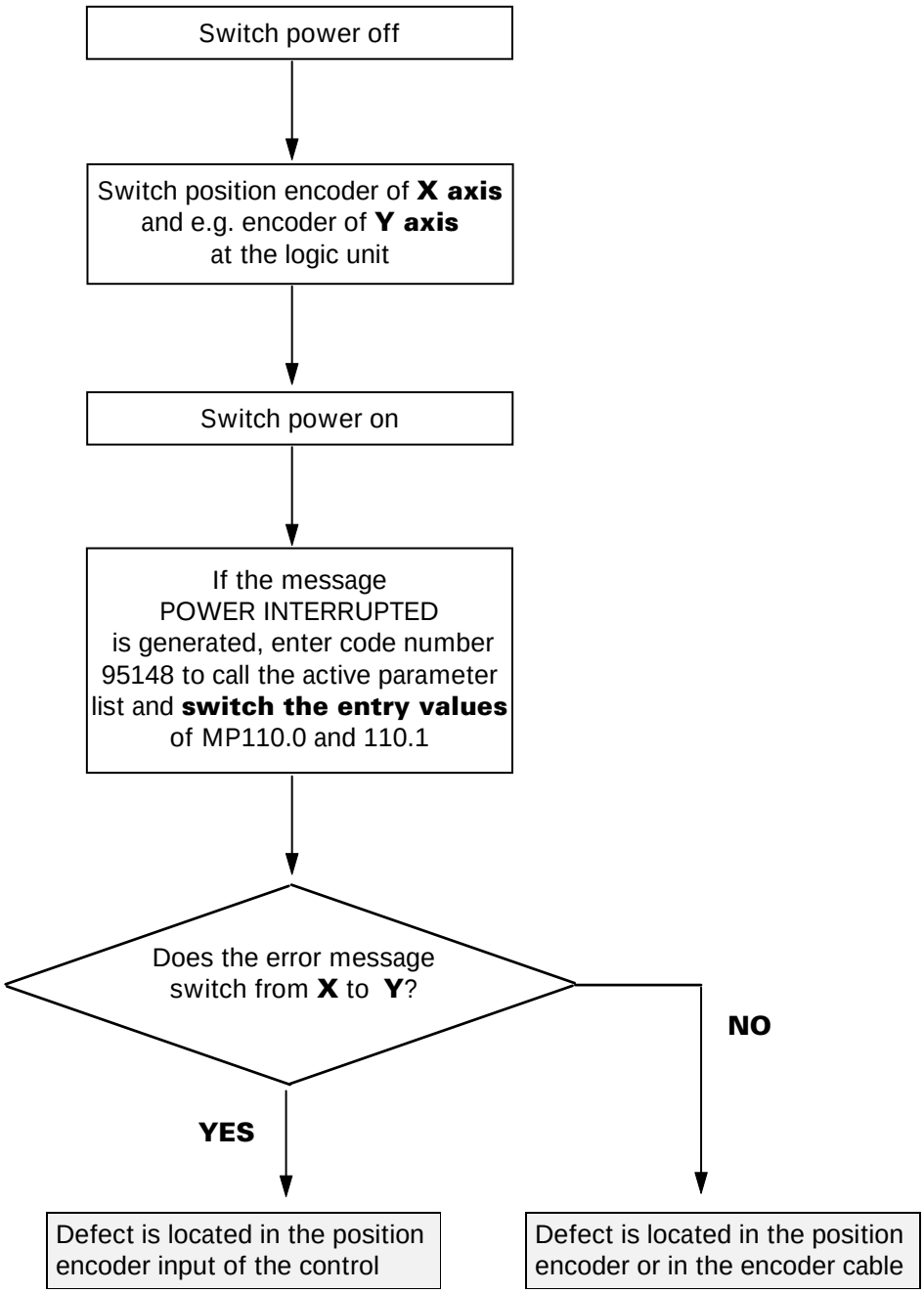
1) X6 may be used for a machine axis, if no oriented spindle stop is required.

The allocation of the **speed encoders** is **fixed**; see above!

Flow chart to locate an error in the position encoder loop (X1 ... X6)

MEASURING SYSTEM X DEFECTIVE A

(Example)



Caution: Only switch encoders that provide the same signals!

Observe the safety instructions!

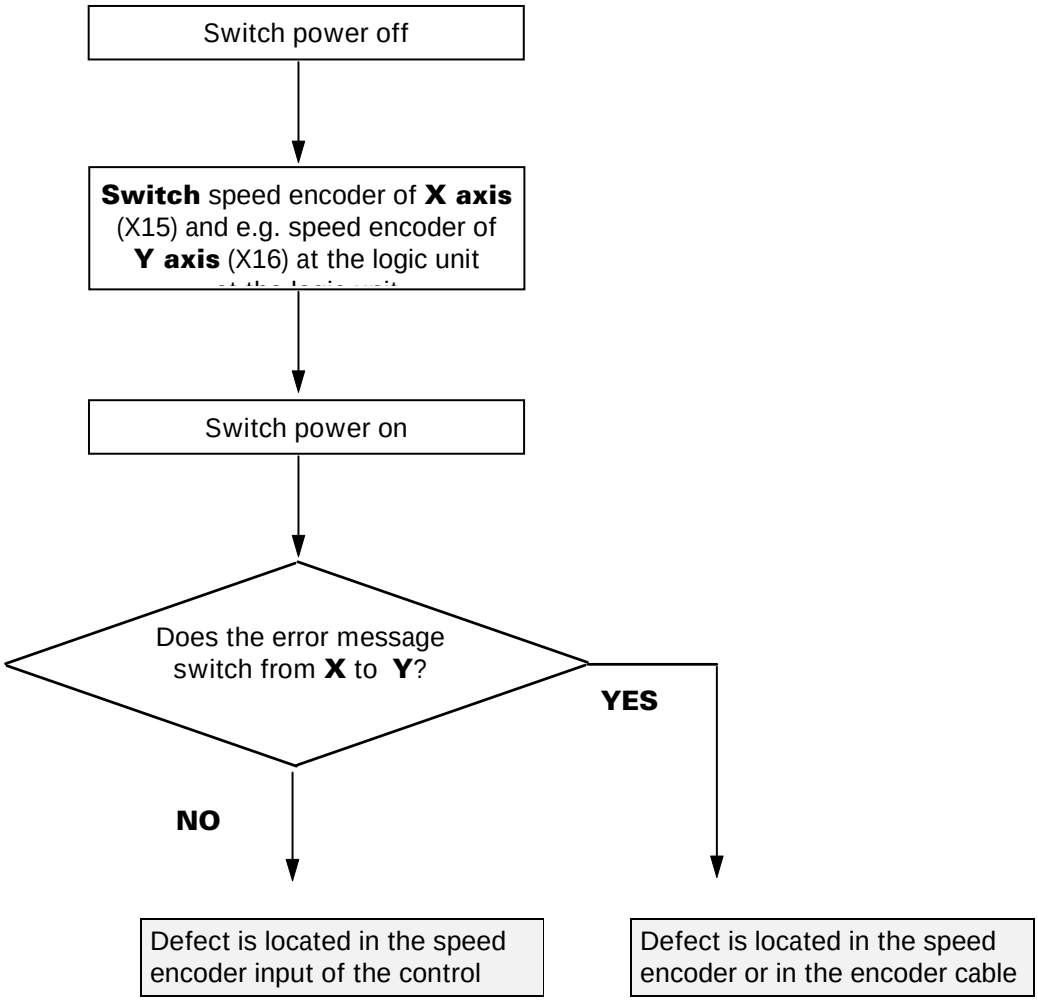
Flow chart to locate an error in the speed encoder loop (X15 ... X20)

MEASURING SYSTEM X` DEFECTIVE A

(Example)

The allocation of the speed encoder inputs of TNC 426 is **fixed**:

Speed encoder **X**-axis: input **X15**
Speed encoder **Y**-axis: input **X16**
Speed encoder **Z**-axis: input **X17**
Speed encoder **IV**. axis: input **X18**
Speed encoder **V**. axis: input **X19**
Speed encoder **spindle**: input **X20**



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)

Several adapters have been created to measure the different types of encoder signals (11µA, 1Vpp, TTL) at TNC426 with the PWM7.
You can find a connection diagram with the adapters (plus Id.No.) in section 21.2.

NOTES

14. Serial Handwheels

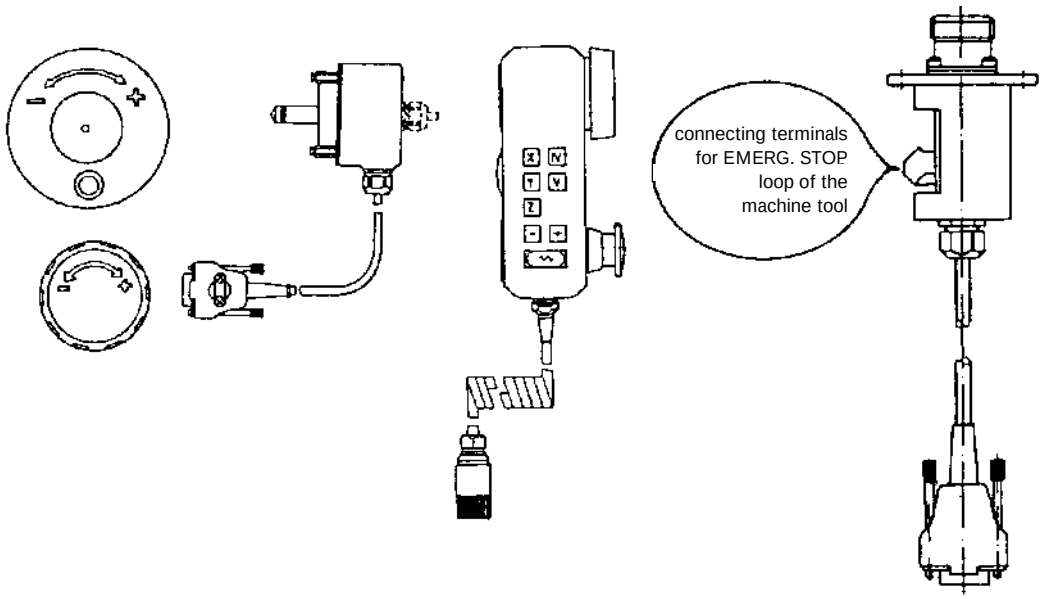
Several serial handwheels can be operated as options with TNC 426. These handwheels are adapted via the machine parameters MP7640 to MP7671.X.

14.1 Handwheel HR 130/330

HR 130 Id.No. 254 040 --
HR 130.001 Id.No. 249 371 --

HR 330 Id.No. 251 534 --

Adapter connector for HR 330 Id.No. 249 889 --

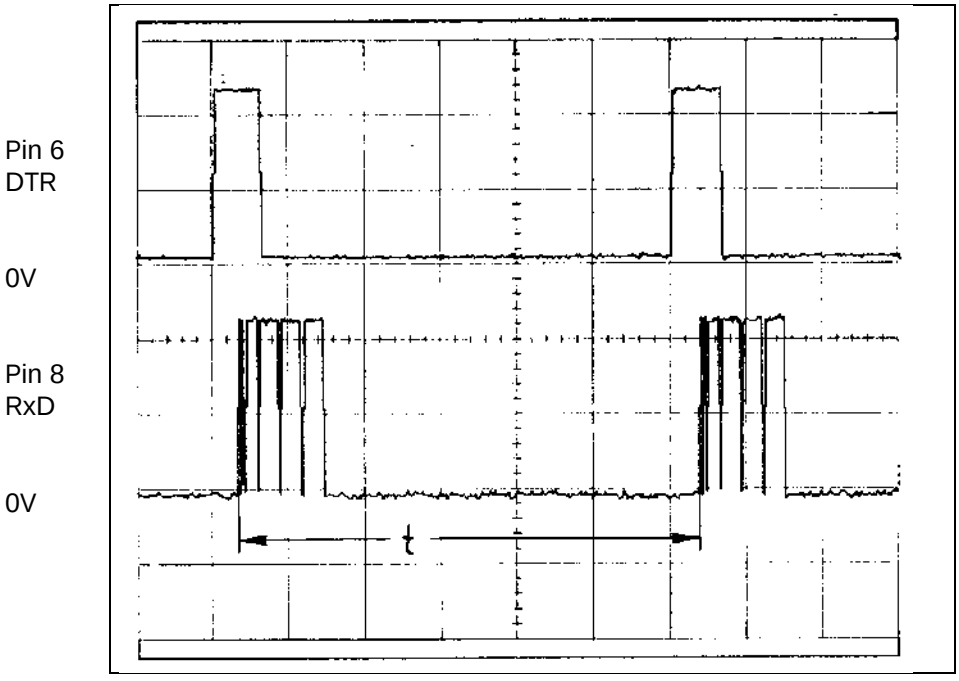


Pin	Color	Sig.
2	wh	0V
4	bn	+12V
6	ye	DTR
8	gn	RxD

Pin	Color	Sig.
1	bl	EMG.
2	bl	STOP
3	gn	RxD
4	ye	DTR
5	bn	+12V
6	wh	0V

14.1.1 Checking the handwheel HR 130/330

The serial handwheel HR 130 (panel-mounted handwheel without auxiliary keys) and HR 330 (portable with auxiliary keys) can be checked with an oscilloscope. The following signals can be measured at the handwheel input X23 of LE 426. The signals have to correspond to the diagram below.



t = 6ms

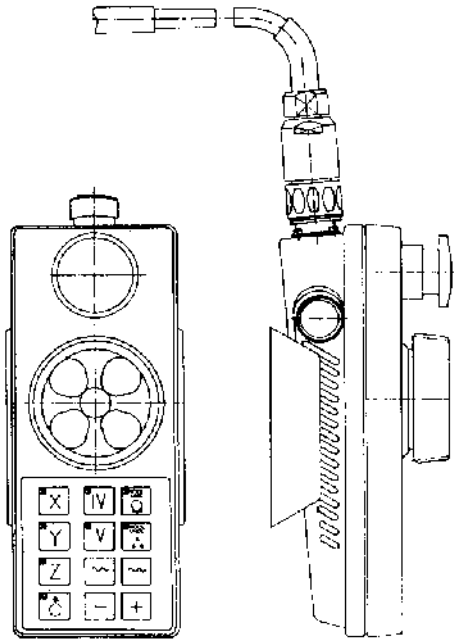
The supply voltage for the handwheel is fed via the logic unit (X23 pin 2 = 0V, pin 4 = + 12V).

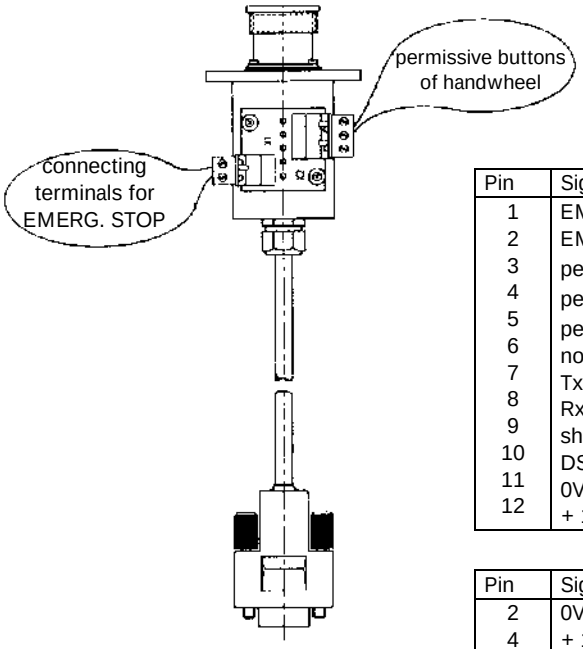
14.2 Handwheel HR 332

HR 332 Id.No. 266 064 --

Connecting cable
Id.No. 272 292 --

Adapter connector
Id.No. 274 556 01, (12-pin / 9-pin)





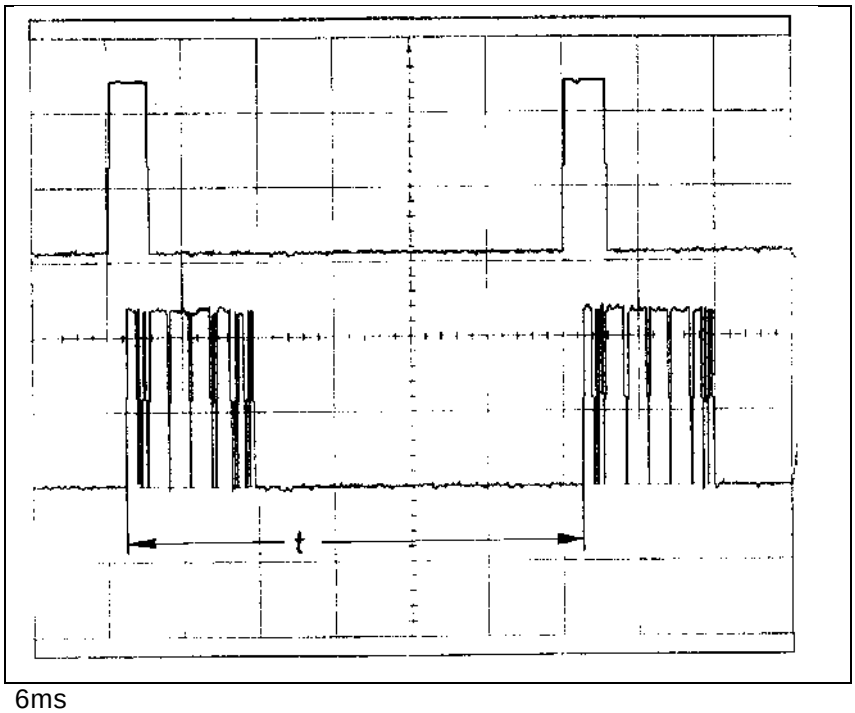
Pin	Signal designation
1	EMERG. STOP
2	EMERG. STOP
3	permissive button[1)]
4	permissive button[1)]
5	permissive button[1)]
6	not assigned
7	TxD
8	RxD
9	shield
10	DSR
11	0V
12	+ 12V

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

The assignment of the handwheel keys depends on the version.
[1)] The number of the permissive buttons and the internal wiring depend 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 426. The signals have to correspond to the diagram below.



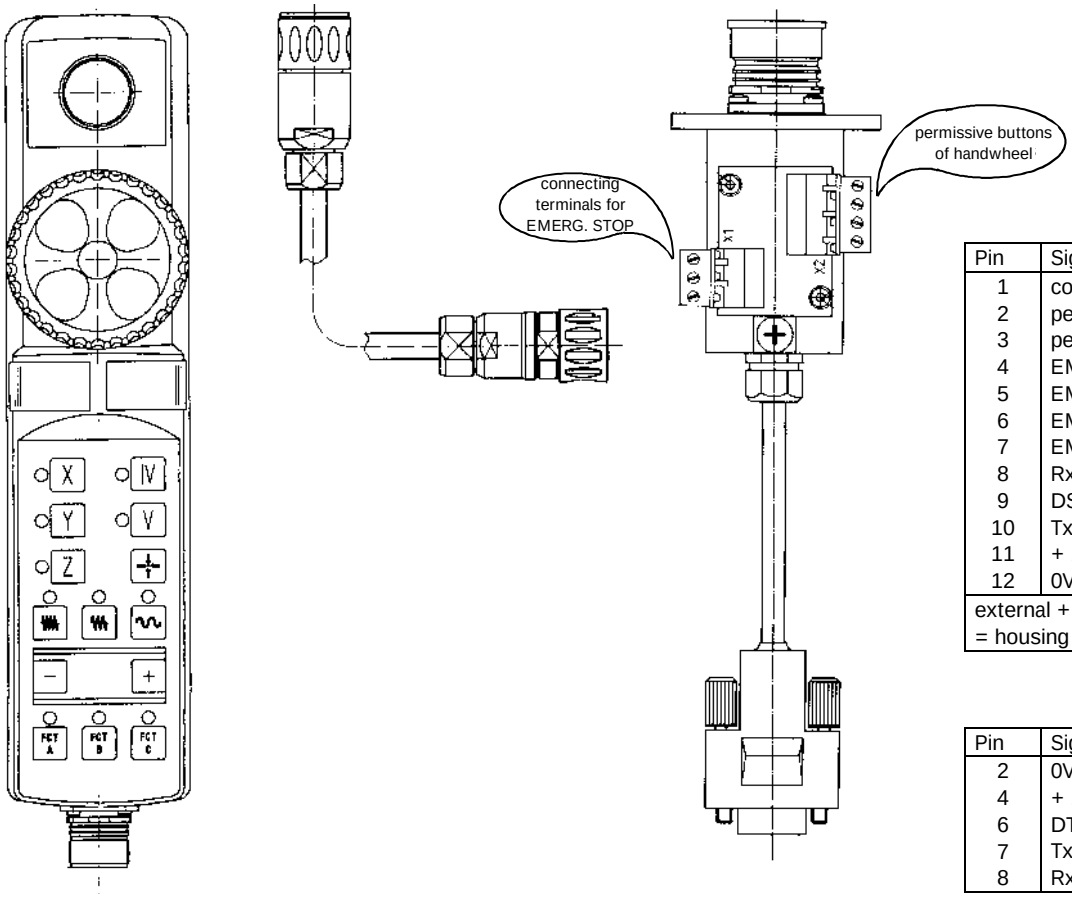
t = 6ms

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

14.3 Handwheel HR 410

HR 410
Id.No. 296 469 --

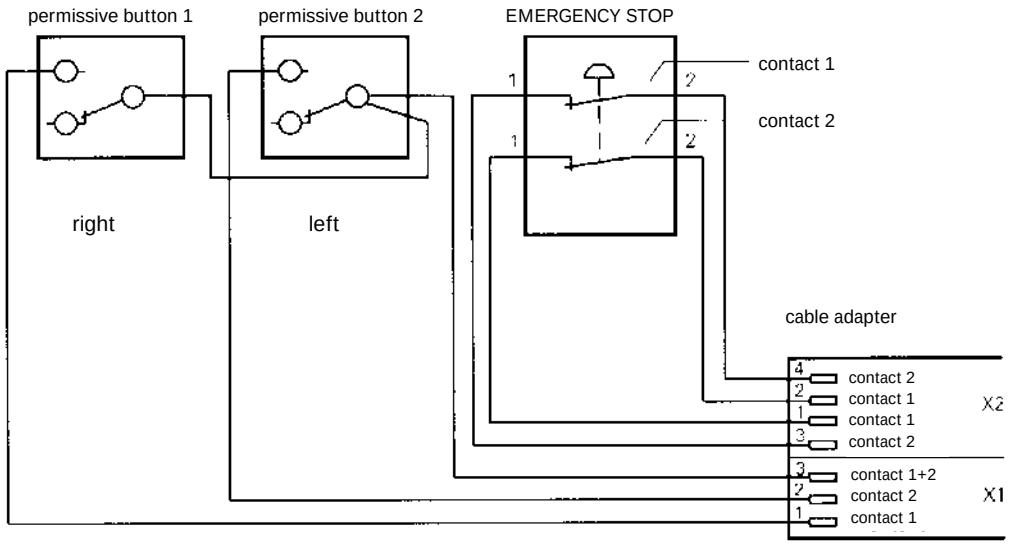
connecting cable
Id.No. 296 467 --, 296 687 --



Pin	Signal designation
1	common permissive button
2	permissive button 2
3	permissive button 1
4	EMERGENCY STOP 1
5	EMERGENCY STOP 1
6	EMERGENCY STOP 2
7	EMERGENCY STOP 2
8	RxD
9	DSR
10	TxD
11	+ 12V
12	0V
external + internal shield = housing	

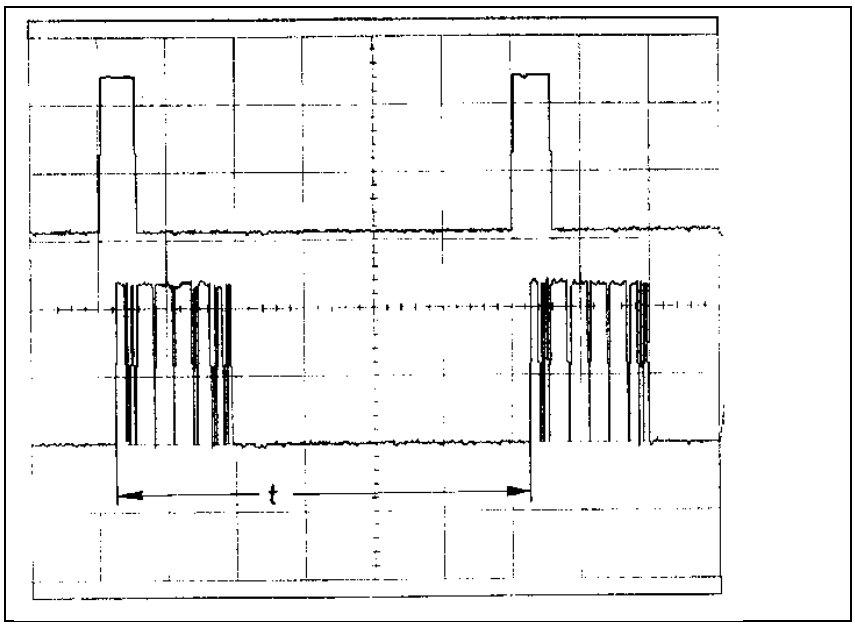
Pin	Signal designation
2	0V
4	+ 12V
6	DTR
7	TxD
8	RxD

Internal wiring of the contacts of the permissive buttons and the EMERGENCY STOP button of HR 410:



14.3.1 Checking the handwheel HR 410

The serial handwheel HR 410 can be checked with an oscilloscope. The following signals can be measured at the handwheel input X23 of LE 426. The signals have to correspond to the diagram below.



t = 6ms

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

14.4 Error Messages

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 transmitted over the serial interface of the handwheel.

HANDWHEEL ? X

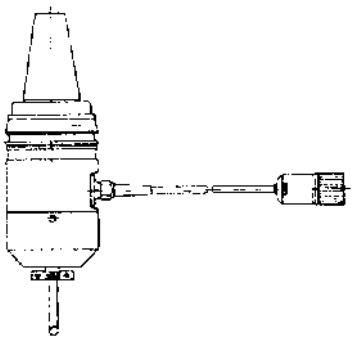
X = A : no peripheral unit connected
B : code of peripheral unit does not match MP7640
C Y : contamination (Y = axis)
D : transmission error during receipt
E : received BCC check sum incorrect
F : peripheral unit has recognized wrong code
G : peripheral unit has recognized wrong BCC check sum
H : peripheral unit shows transfer error
I : peripheral unit shows incorrect number of initializing parameter
J : peripheral unit shows incorrect value of initializing parameter

15. 3-D Touch Probes

15.1 Overview

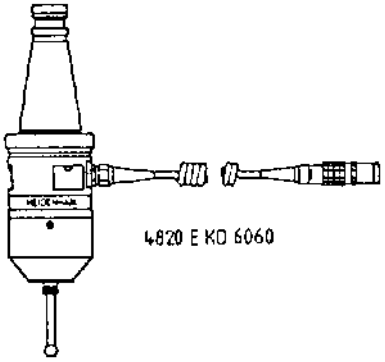
15.1.1 Touch probes to calibrate and setup workpieces

TS 220 Id.No. 293 488 --
with connecting cable

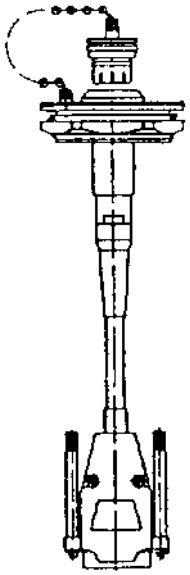


15.1.2 Touch probes for digitizing workpieces

TS 120 Id.No. 265 348 --



Adapter connector for TS 120 Id.No. 274 543 --



NOTES

15.2 Error Messages

15.2.1 Error messages in the probing mode

TOUCH POINT INACCESSIBLE

- After the start of a probing function, the touch 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 when digitizing 3-D 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 3-D 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. File Management of TNC 426 CA/PA

16.1 Structure of the Harddisk

All part programs, tool tables, machine parameters, PLC programs, compensation value tables, NC dialogues in all languages etc. are stored on harddisk.

The TNC harddisk consists of **three** partitions:

TNC: approx. 170 Mbytes for customized data
- NC programs
- tool tables
- datum tables
- pallet tables

PLC: approx. 20 Mbytes for manufacturer´s data
- system files
- PLC program
- machine parameters
- help files
- PLC dialogues by the machine tool builder
- PLC error tables
- compensation value tables
- OEM cycles etc.

The PLC partition can be made visible by entering the code number 807667.

SYS: approx. 20 Mbytes for system data
- NC dialogues in all languages
- HEIDENHAIN cycles etc.

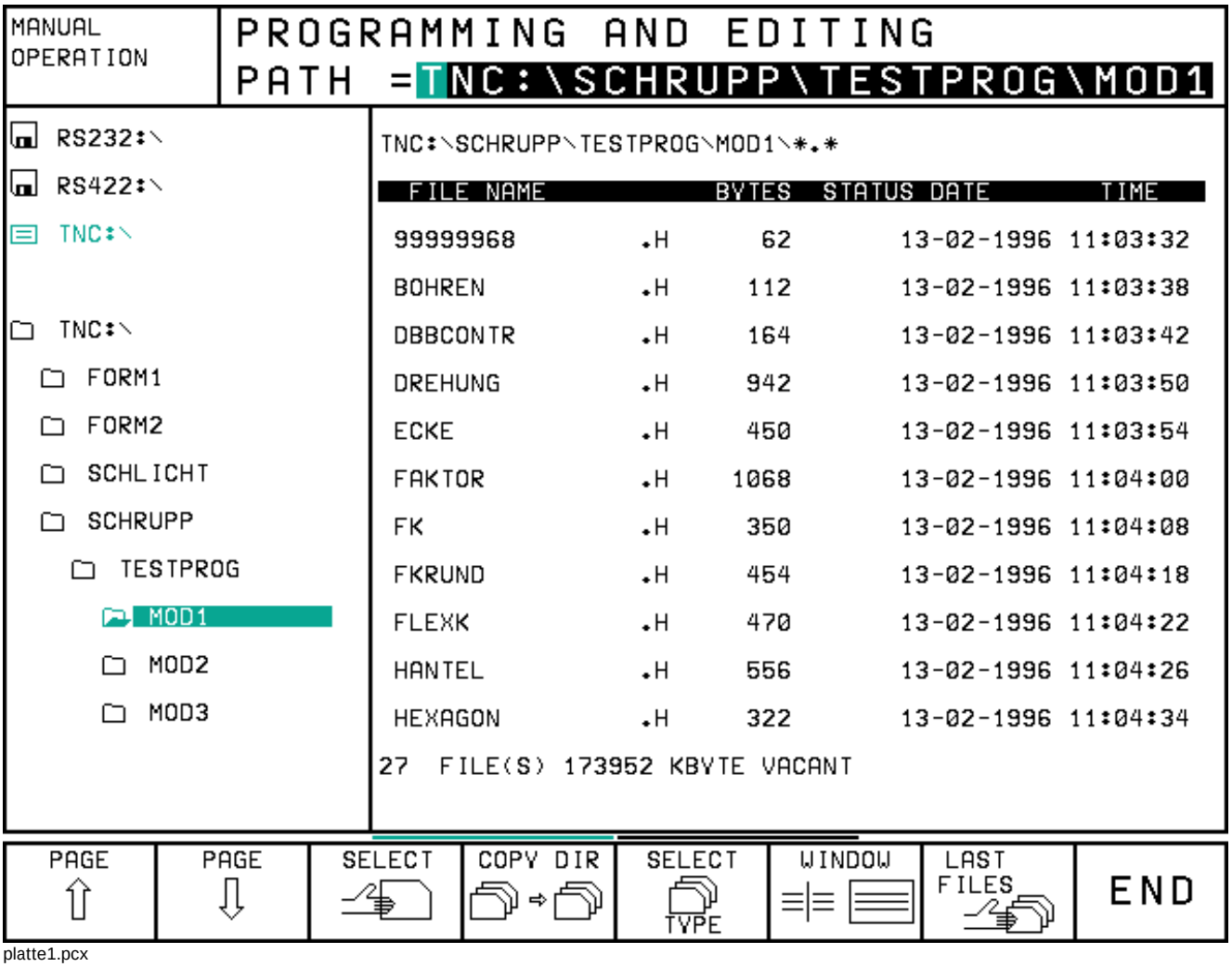
The SYS partition is not visible.

In order to receive an overview over the stored files the user or the machine tool builder can structure the partition. For this purpose directories have to be created. This structure varies with every machine tool.

16.2 TNC Partition (TNC:\)

16.2.1 Calling the TNC partition

Press key	Function
	TNC in operating mode PROGRAMMING/EDITING
	Call program manager



platte1.pcx

The structure of the directory is displayed on the left half of the screen. Press  or  to jump to the subdirectories. In the first line the directory currently selected is displayed. The right half of the screen contains a list of the files in the directory selected.

Press  or  to switch between directory side and file side.

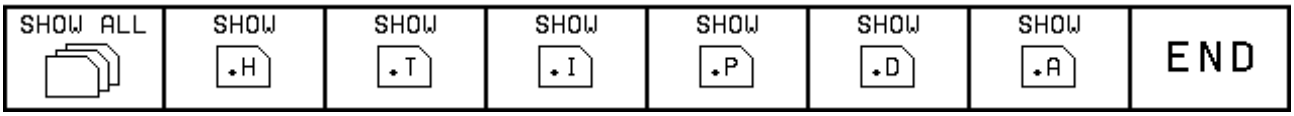
16.2.2 Overview of the files in the TNC partition

The following files are stored in the TNC partition:

File type	Extension in TNC
NC program, HEIDENHAIN dialogue	.H
active tool table	TOOL.T [1]
NC program, DIN/ISO	.I
pallet table	.P
datum table	.D
text file (ASCII)	.A
pocket table	TOOL_P.TCH [1]

[1] always filed in the root directory TNC:\

By pressing the soft key SELECT TYPE the file type to be displayed can be specified.



type.pcx

File Information:

- **FILE NAME:** Files stored in the active directory
- **BYTE:** File size in bytes
- **STATUS:** The STATUS column may contain the following letters:
  - **E:** File selected in PROGRAMMING/EDITING mode
  - **S:** File selected in the TEST mode
  - **M:** File selected in a program run mode
  - **P:** File protected against erasing and editing
  - **IN:** File dimensioned in inches
  - **W:** File incompletely transferred to an external medium; cannot be run
- **DATE:** Date at which the file was edited last
- **TIME:** Time at which the file was edited last

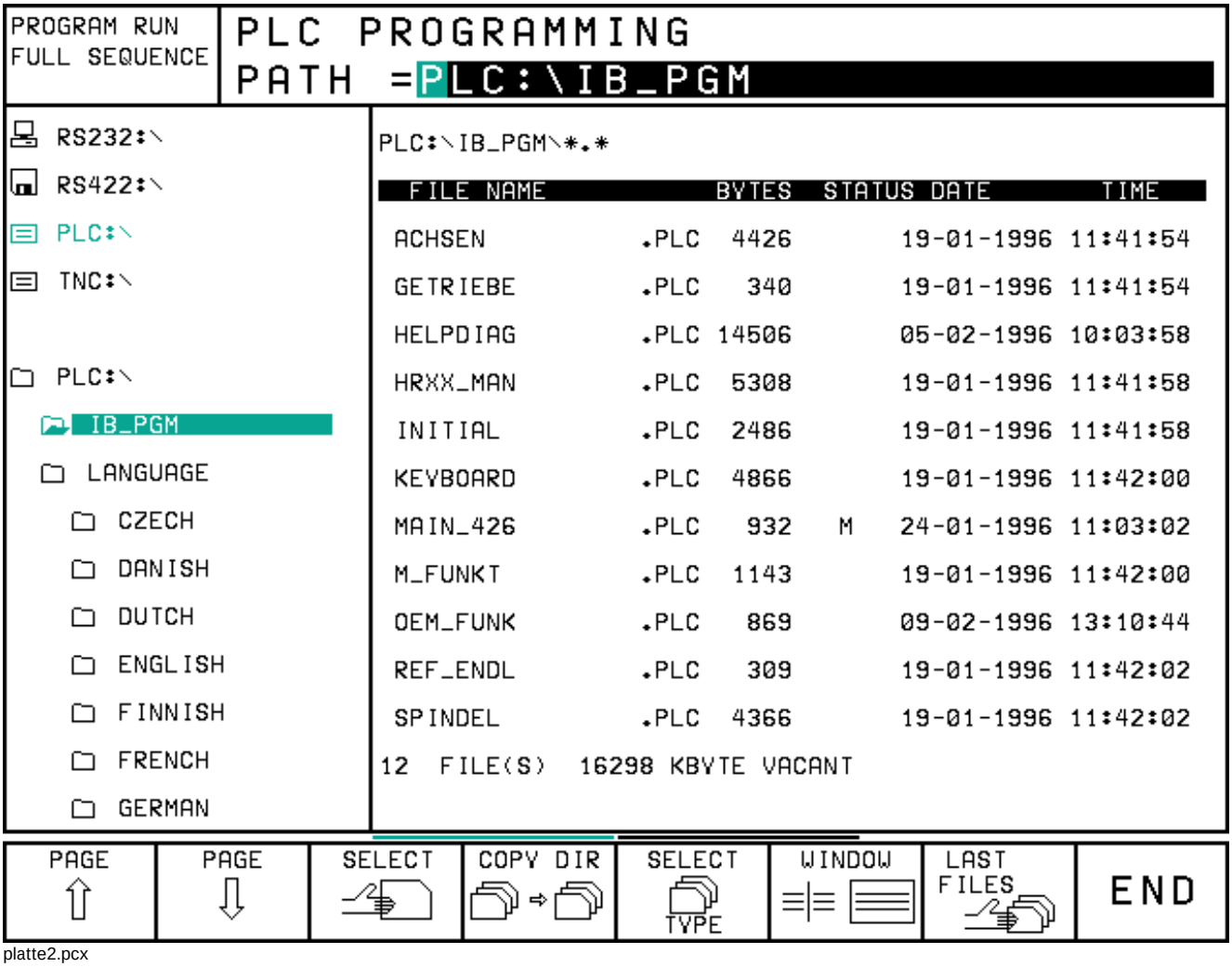
16.3 PLC Partition (PLC:\)

16.3.1 Calling the PLC partition

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

After entering the code number, the PLC menu is displayed. If the dialogue READ ONLY appears at the lower left of the screen, the machine tool builder has protected the PLC partition by a code number.

PGM MGT	Call program manager



platte2.pcx

The structure of the directory is displayed on the left half of the screen. Press ↑ or ↓ to jump to the subdirectories. In the first line the directory currently selected is displayed. The right half of the screen contains a list of the files in the directory selected.

Press ← or → to switch between directory side and file side.

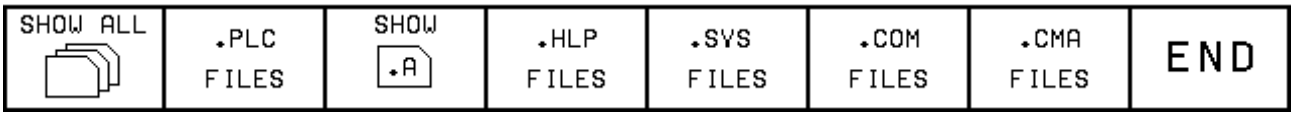
16.3.2 Overview of the files in the PLC partition

The following files are stored in the PLC partition:

File type	Extension in TNC
PLC programs	.PLC
text files (ASCII)	.A
texts for help files	.HLP
important system files	OEM.SYS [1]
other system files	.SYS
data for axis error compensation	.COM
data for axis error compensation	.CMA
PLC error tables	.PET
machine parameter lists	.MP

[1] always filed in the root directory PLC:\

By pressing the soft key SELECT TYPE the file type to be displayed can be specified.



type1.pcx

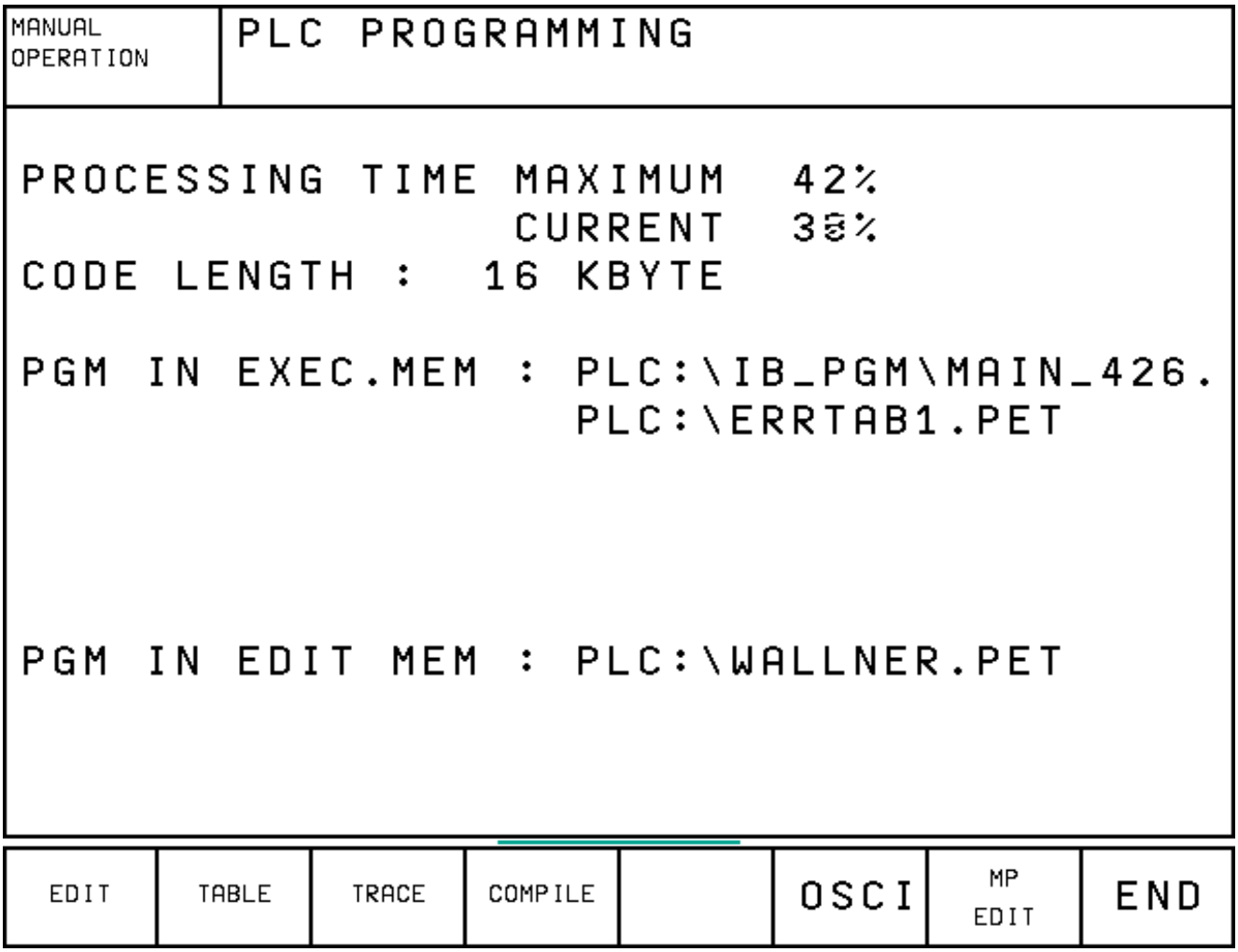
▷ switch the soft-key level

type2.pcx

File Information:

- **FILE NAME:** Files stored in the active directory
- **BYTE:** File size in bytes
- **STATUS:** The STATUS column may contain the following letters:
  - **E:** File selected in PROGRAMMING/EDITING mode
  - **S:** File selected in the TEST mode
  - **M:** File selected in a program run mode
  - **P:** File protected against erasing and editing
  - **IN:** File dimensioned in inches
  - **W:** File incompletely transferred to an external medium; cannot be run
- **DATE:** Date at which the file was edited last
- **TIME:** Time at which the file was edited last

16.4 Compiling the PLC Program



plc1.pcx

Selecting a file as EDITOR PGM:

Press key	Function
PGM MGT ↓ or ↑ SELECT	Call program manager Select and call desired program

The file is now in the **PLC editor** and can be called any time by pressing the soft key EDIT.

Selecting <NAME.PLC> as EXECUTABLE PGM:

COMPILE	Press soft key
↓ or ↑ SELECT	Select and call desired program

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

17. Data Interfaces

17.1 Operating Modes of the Data Interfaces

For data transfer the TNC 426 can be switched to the following 5 interface modes:

FE 1: For connection of the HEIDENHAIN floppy disk unit FE 401 B (or 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 - 115 200 bauds
Interface parameters:	fixed
Transfer stop:	software handshake with DC3

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 - 115 200 bauds
Interface parameters:	fixed
Transfer stop:	software handshake with DC3

EXT 1: For adaptation of data transfer in standard format
EXT 2: as well as for blockwise transfer to peripheral units.

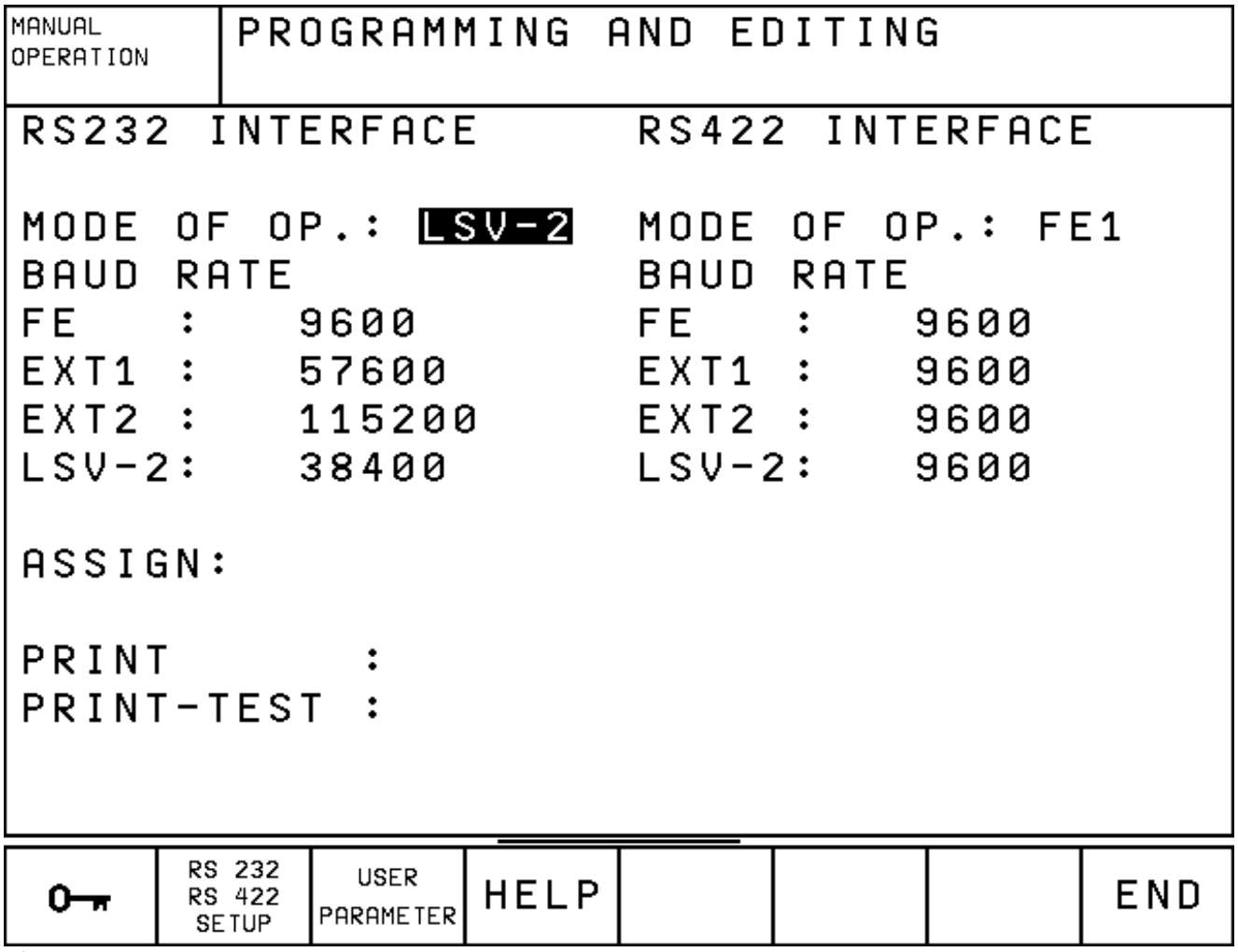
Protocol:	standard or blockwise transfer adaptation via machine parameters (from MP 5000)
Data format:	adaptation via machine parameters (from MP 5000)
Baud rate:	110 - 115 200 bauds
Interface parameters:	adaptation via machine parameters (from MP 5000)
Transfer stop:	software handshake with DC3 or hardware handshake with RTS, selectable via machine parameters (from MP 5000)

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).

Protocol:	bi-directional transfer according to DIN 66019
Data format:	8 data bits, 1 stop bit, no parity
Baud rate:	110 - 115 200 bauds
Interface parameters:	fixed
Transfer stop:	software handshake with protocol

17.1.1 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.



V-24_1.pcx

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.

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

By pressing the arrow keys  the desired settings

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

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

17.2 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).

17.3 Error Messages

17.3.1 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 may be displayed:

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 reformatting the disk.

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

3) Hardware defect

17.3.2 Error messages during data transfer

TRANSFERRED VALUE INCORRECT 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)

DATA TRANSFER ERRONEOUS 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 active 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

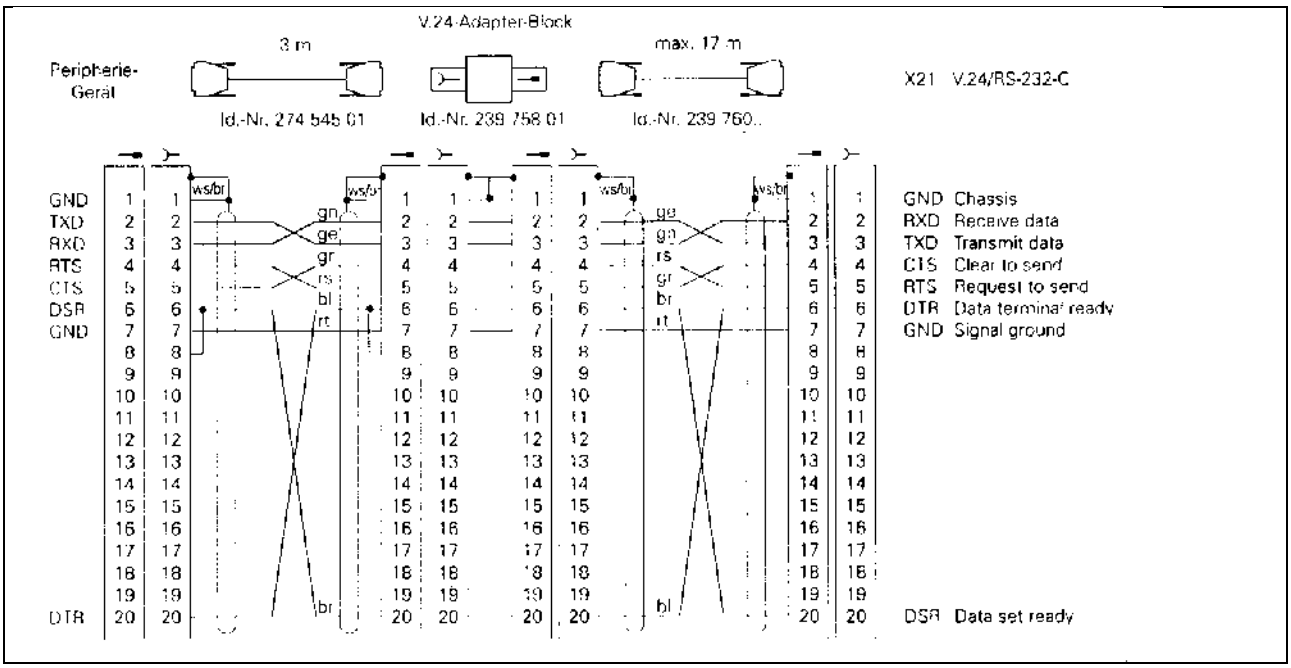
- DSR signal missing at the TNC
- Defective or wrong transfer cable
- Wrong interface assignment

PROGRAM INCOMPLETE

Data transfer was interrupted before the program was completely loaded.

17.4 Wiring Diagrams of the Data Interfaces

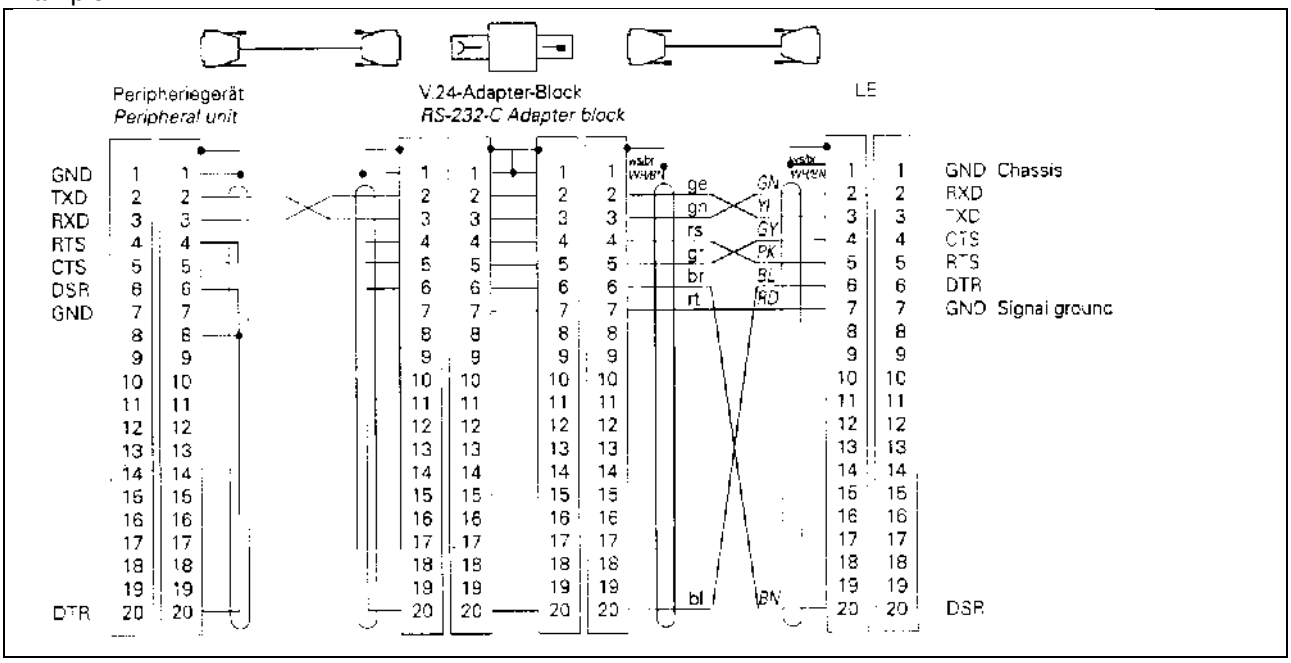
17.4.1 V.24/RS-232-C data interface with RS-232-C adapter block (full wiring)



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

17.4.2 V.24/RS-232-C data interface with RS-232-C adapter block (simplified wiring)

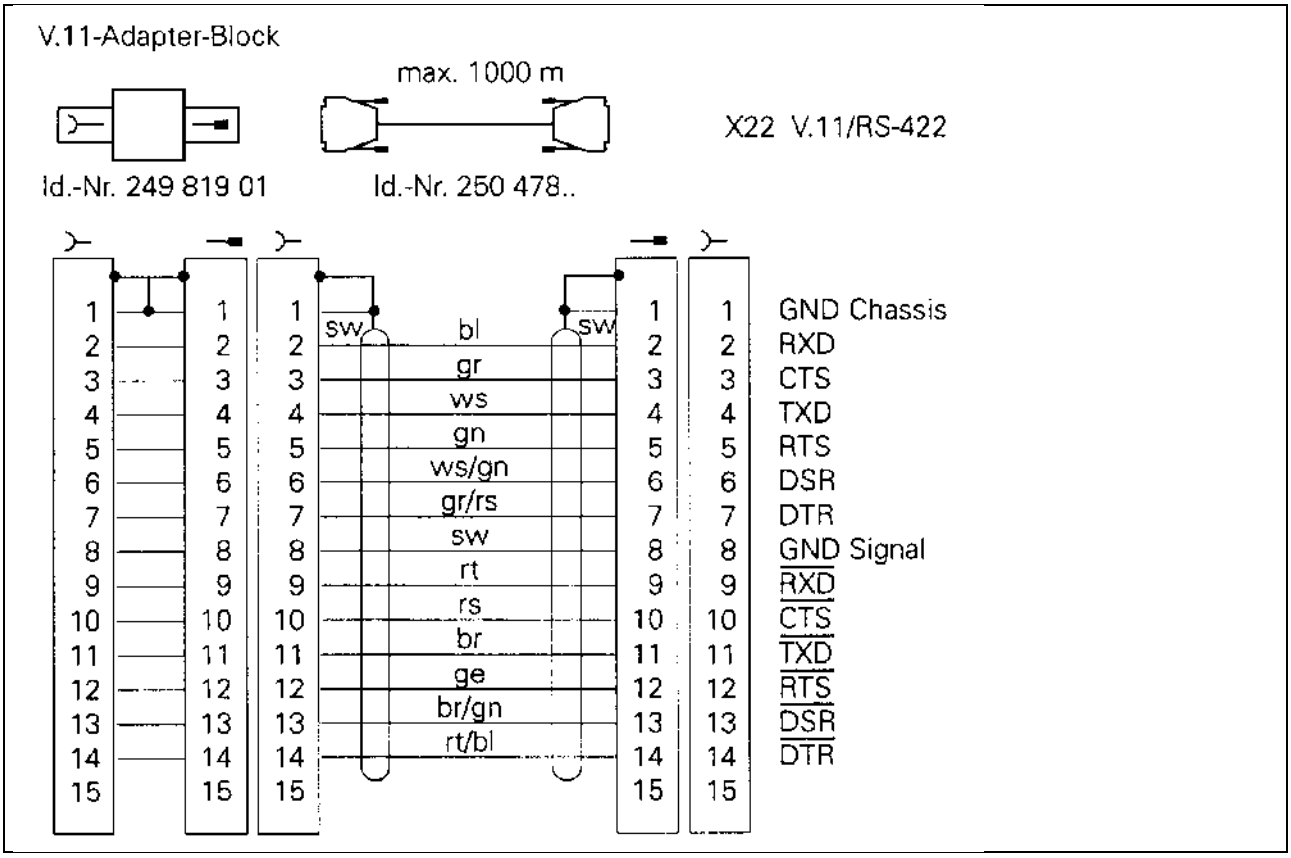
Example:



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.

17.4.3 V.11/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.

18. Data Input and Output

18.1 Data Transfer Menu

The functions described in this section are valid for the interface mode FE1. If you want to use these functions in connection with a personal computer, you require the HEIDENHAIN data transfer software TNC.EXE.

After having called the program manager in the operating mode PROGRAMMING/EDITING the drives are displayed:
RS 232:\ ⇨ V.24 data interface (X21)
RS 422:\ ⇨ V.11 data interface (X22)
TNC:\ ⇨ TNC partition (USER)
PLC:\ ⇨ PLC partition (only with code number)
Depending on the operating a symbol is displayed next to the external drive.

Peripheral unit	**Operating mode**	**Drive symbol in PGM MGT**
HEIDENHAIN floppy disk units • FE 401 B • FE 401 from Prog. No. 230 626 03	 FE1 FE1	
HEIDENHAIN floppy disk unit FE 401 until Prog. No. 230 626 02	FE2	
PC with HEIDENHAIN data transfer software TNC.EXE, version 06	FE2	
Other peripheral units, such as printers, readers, punchers, PC without TNC.EXE	EXT1, EXT2	
PC with HEIDENHAIN software TNC REMOTE for remote control of TNC	LSV2	

Press the arrow keys  and  to switch between the drives or partitions.

18.2 Overview of Files for TNC 426

Depending on the partition (TNC:\, PLC:\) in which the transfer menu is activated, only certain file types are offered to be downloaded or output.

The harddisk may contain the following data:

File type	Extension in TNC	Extension on peripheral unit[1)]
Partition TNC:		
NC program HEIDENHAIN dialogue	.H	.HNC
active tool table	TOOL.T [2)]	TOOL.TNC
NC program DIN/ISO	.I	.DNC
pallet table	.P	.LNC
datum table	.D	.NNC
text file (ASCII)	.A	.ANC
pocket table	TOOL_P.TCH [2)]	TOOL_P.RNC
Partition PLC:		
PLC program	.PLC	.PNC
text file (ASCII)	.A	.ANC
texts for help files	.HLP	.JNC
important system data	OEM.SYS	.OEM.ONC
other system data	.SYS	.ONC
data for axis error compensation	.COM	.VNC
data for axis error compensation	.CMA	.SNC
PLC error table	.PET	.FNC
machine parameter list	.MP	.MNC

[1)] if the file was transferred with the data transfer software TNC.EXE

File Information:

- **FILE NAME:** Files stored in the active directory
- **BYTE:** File size in bytes
- **STATUS:** The STATUS column may contain the following letters:
  - **E:** File selected in PROGRAMMING/EDITING mode
  - **S:** File selected in the TEST mode
  - **M:** File selected in a program run mode
  - **P:** File protected against erasing and editing
  - **IN:** File dimensioned in inches
  - **W:** File incompletely transferred to an external medium; cannot be run
- **DATE:** Date at which the file was edited last
- **TIME:** Time at which the file was edited last

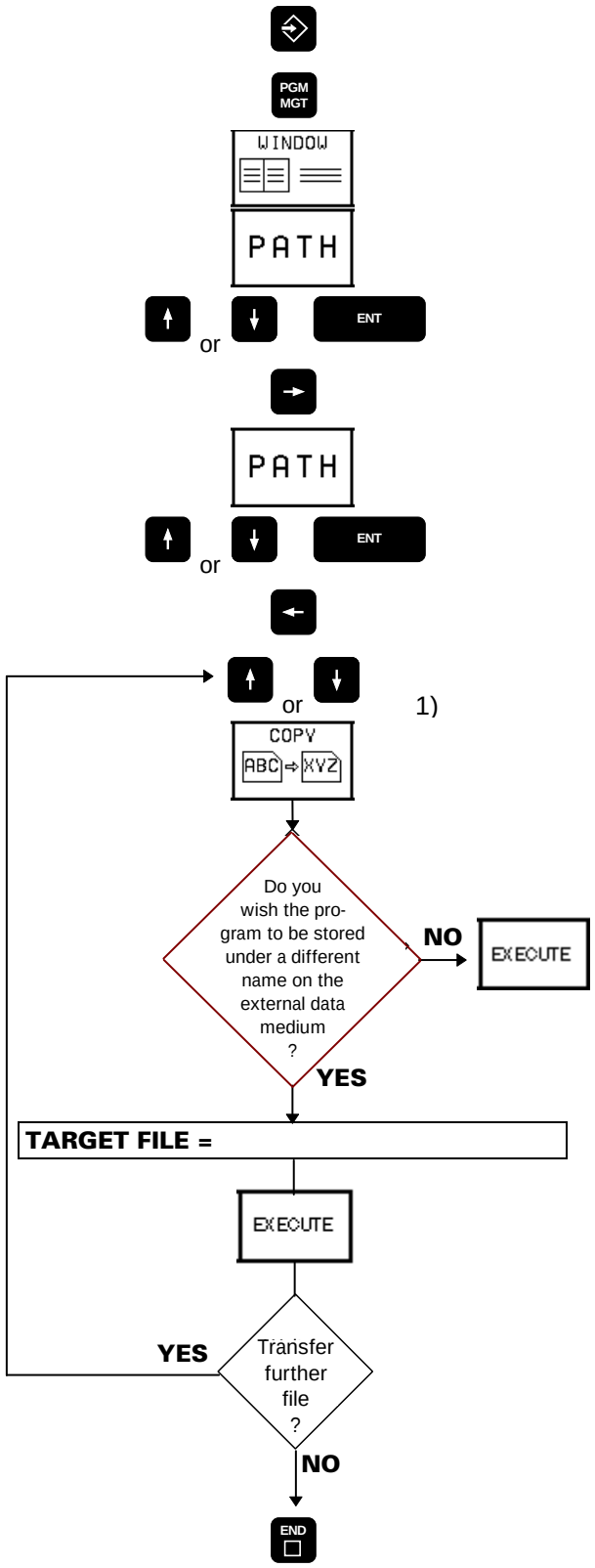
18.3 Data Output

Preparations:

- Connect the external data medium (FE or auxiliary unit) to the TNC.
- Prepare the external data medium for data transfer:

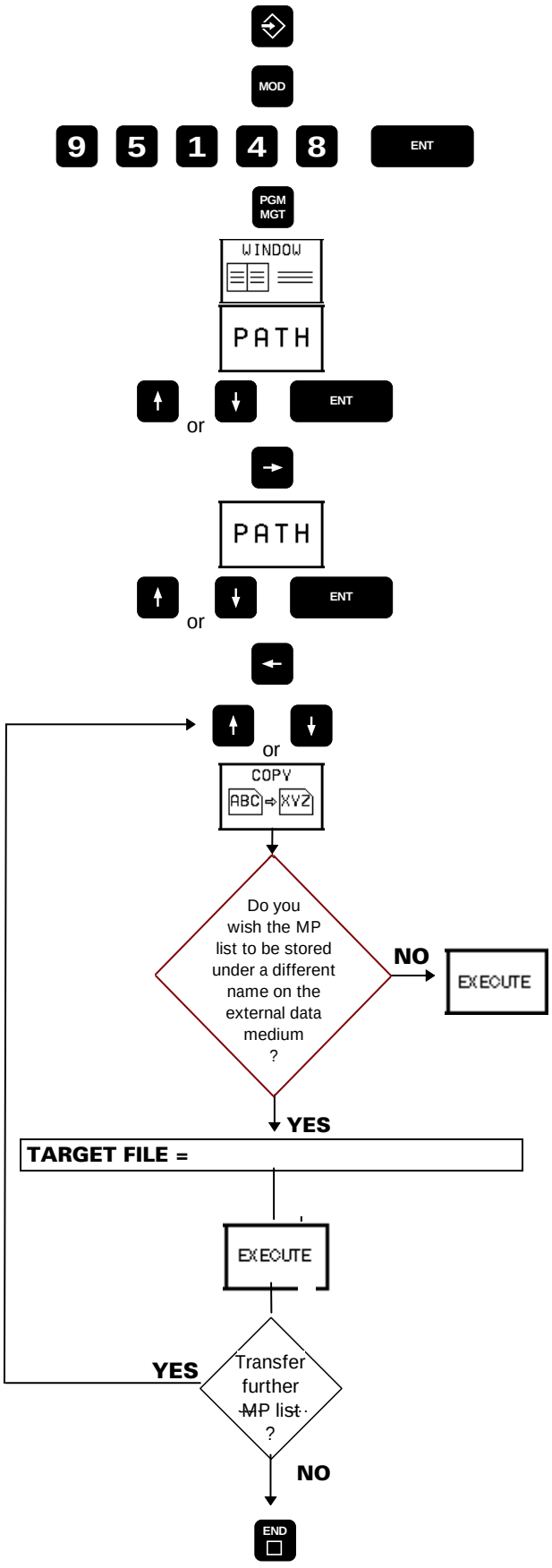
  when operating with an FE unit press STOP.
- Set the operating mode, the baud rate and the interface assignment (see 17.1) at the TNC.

18.3.1 Output of files with the extension .H, TOOL.T, .I, .P, .D, .A, TOOL_P.TCH

Press key	Function
	Operating mode PROGRAMMING/EDITING Call program manager Select the screen structure such that the TNC is displays file names on the left and on the right side. On the left half of the screen select the directory from which you want to copy files to the external data medium. Switch to the right half of the screen. Select the directory (of the external drive) to which you want to copy the files. Switch to the left half of the screen (TNC). Select the file to be transferred. The file is stored with the **same** name on the external data medium. Here, the name must be entered under which the program is to be stored on the external data medium. The file is stored with a **new** name on the external data medium. Terminate the data transfer menu.

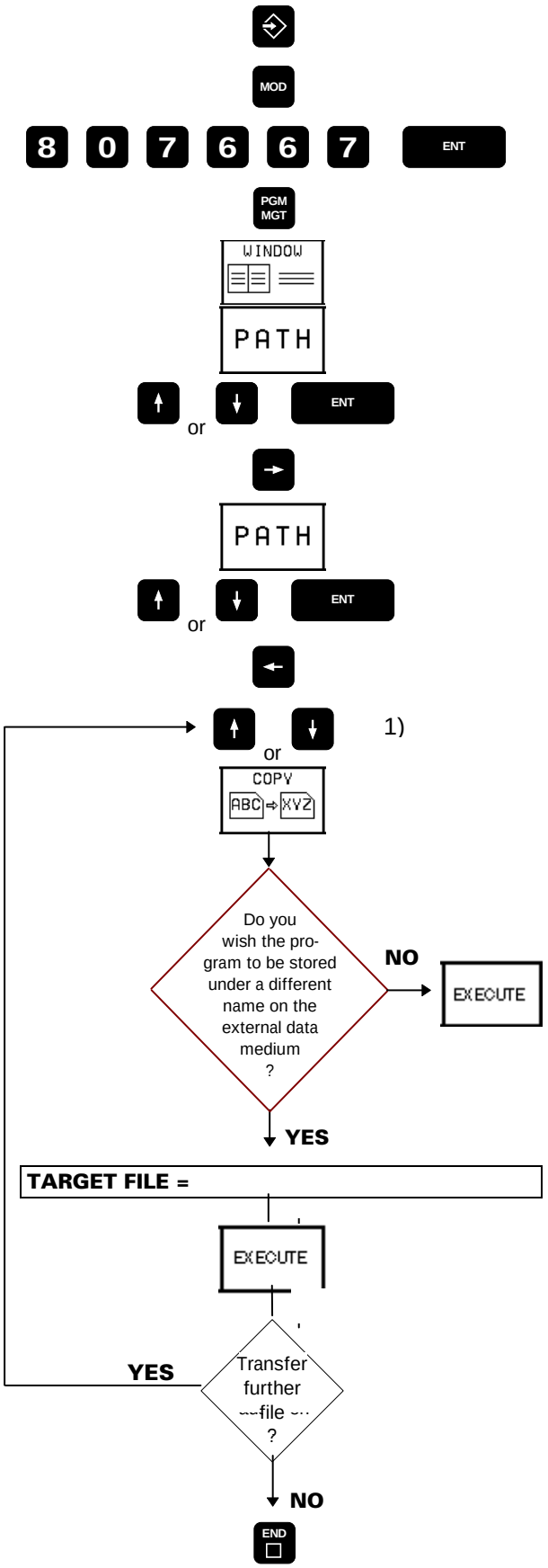
[1] By means of the functions TAG and COPY TAG several files can be transferred automatically.

18.3.2 Output of the machine parameter list <NAME>.MP

Press key	Function
	TNC in operating mode PROGRAMMING/EDITING Prepare TNC for input of code number Enter code number, confirm with ENT Call program manager Select the screen structure such that the TNC is displays file names on the left and on the right side. On the left half of the screen select the directory from which you want to copy files to the external data medium. Switch to the right half of the screen. Select the directory (of the external drive) to which you want to copy the MP list. Switch to the left half of the screen (TNC). Select the MP list to be transferred. The MP list is stored with the **same** name on the external data medium. Here, the name must be entered under which the MP list is to be stored on the external data medium. The MP list is stored with a **new** name on the external data medium. Terminate the 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**.

18.3.3 Output of files with the extension .PLC, .A, .HLP, .SYS, .COM, .CMA, .PET

Press key	Function
	Operating mode PROGRAMMING/EDITING Prepare TNC for input of code number. Enter code number, confirm with ENT. Call program manager. Select the screen structure such that the TNC is displays file names on the left and on the right side. On the left half of the screen select the directory from which you want to copy files to the external data medium. Switch to the right half of the screen. Select the directory (if available) to which you want to copy the files. Switch to the left half of the screen. Select the file to be transferred. The file is stored with the **same** name on the external data medium. Here, the name must be entered under which the program is to be stored on the external data medium. The file is stored with a **new** name on the external data medium. Terminate the data transfer menu.

[1] By means of the functions TAG and COPY TAG several files can be transferred automatically.

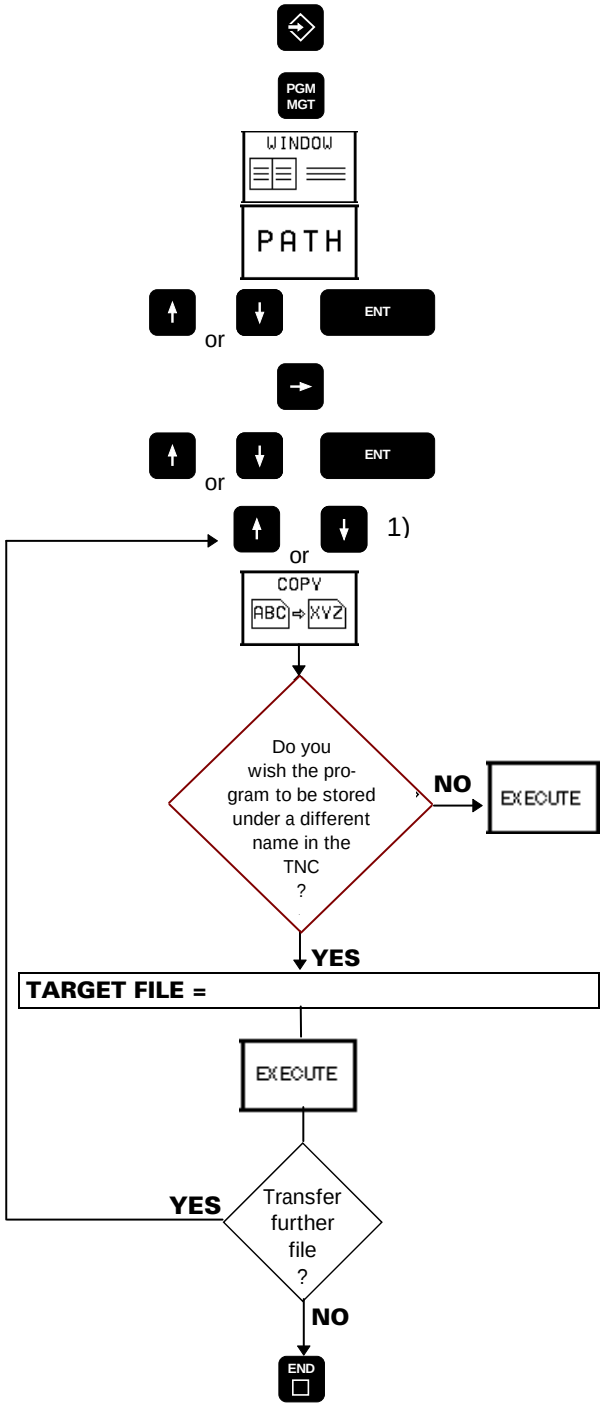
18.4 Data Input

Preparations:

- Connect the external data medium (FE or auxiliary unit) to the TNC.
- Prepare the external data medium for data transfer:

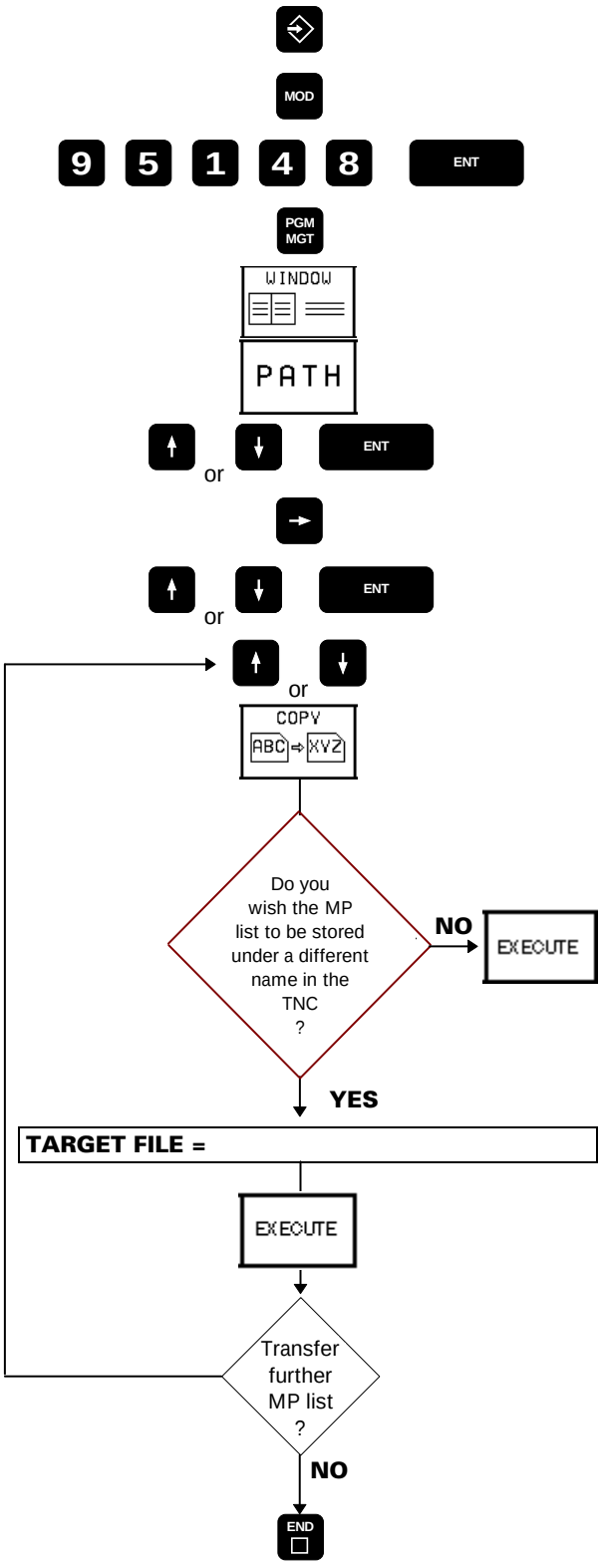
  when operating with an FE unit press STOP.
- Set the operating mode, the baud rate and the interface assignment (see 17.1) at the TNC.

18.4.1 Downloading files with the extension H, TOOL.T, .I, .P, .D, .A, TOOL_P.TCH

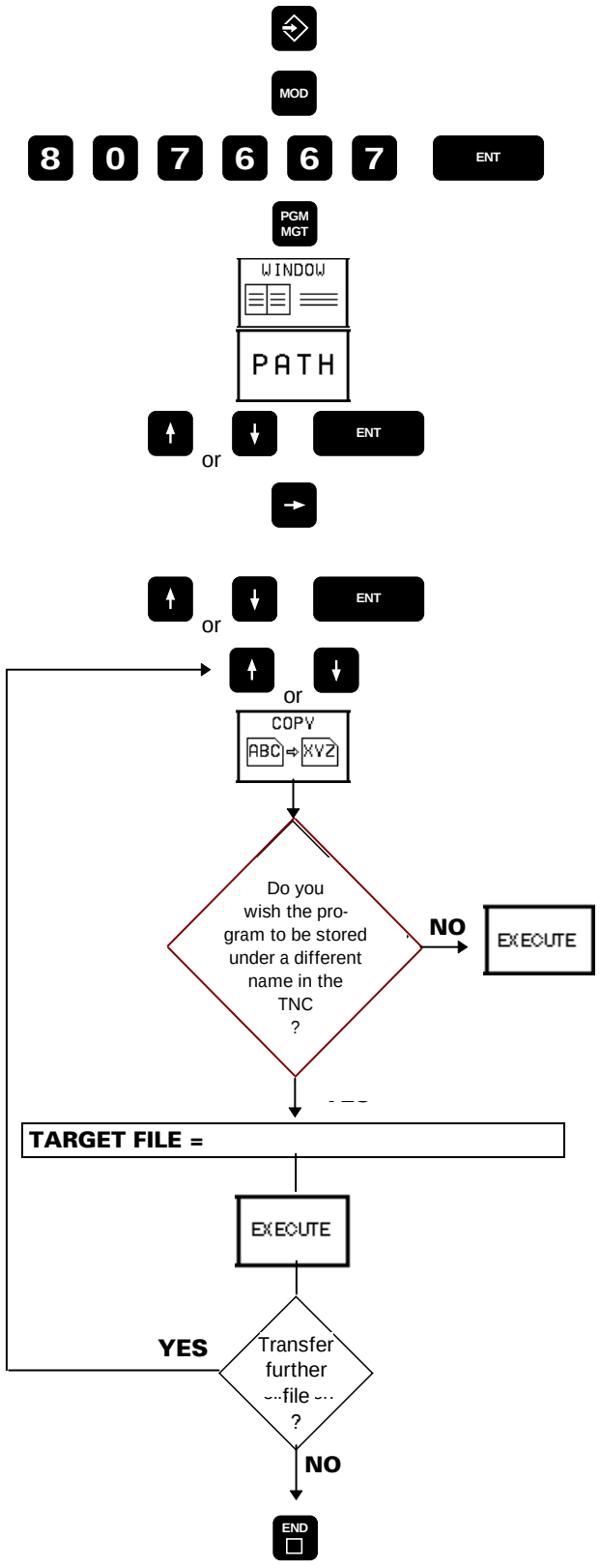
Press key	Function
	TNC in operating mode PROGRAMMING/EDITING Call program manager Select the screen structure such that the TNC is displays file names on the left and on the right side. On the left half of the screen select the directory to which you want to copy files from the external data medium. Switch to the right half of the screen. Select the directory (if available) to which you want to copy the files. Select the file to be transferred. Note: In the operating modes EXT1, EXT2 and FE2 the file name must be entered by hand. The file is stored with the **same** name in the TNC. Here, the name must be entered under which the program is to be stored in the TNC. Terminate the data transfer menu.

[1] By means of the functions TAG and COPY TAG several files can be transferred automatically.

18.4.2 Downloading the machine parameter list <NAME>.MP

Press key	Function
	TNC in operating mode PROGRAMMING/EDITING Prepare TNC for input of code number. Enter code number, confirm with ENT. Call program manager. Select the screen structure such that the TNC is displays file names on the left and on the right side. On the left half of the screen select the directory to which you want to copy the MP list from the external data medium. Switch to the right half of the screen. Select the directory (if available) to which you want to copy the MP list. Select the MP list to be transferred. Note: In the operating modes EXT1, EXT2 and FE2 the name of the MP list must be entered by hand. The MP list is stored with the **same** name in the TNC. Here, the name must be entered under which the MP list is to be stored in the TNC. Terminate the data transfer menu.

18.4.3 Downloading files with the extension .PLC, .A, .HLP, .SYS, .COM, .CMA, .PET

Press key	Function
	TNC in operating mode PROGRAMMING/EDITING Prepare TNC for input of code number. Enter code number, confirm with ENT. Call program manager. Select the screen structure such that the TNC is displays file names on the left and on the right side. On the left half of the screen select the directory to which you want to copy files from the external data medium. Switch to the right half of the screen. Select the directory (if available) to which you want to copy the files. Select the file to be transferred. Note: In the operating modes EXT1, EXT2 and FE2 the file name must be entered by hand. The file is stored with the **same** name in the TNC. Here, the name must be entered under which the program is to be stored in the TNC. Terminate the data transfer menu.

19. Interface to the Servo Amplifier

19.1 Analogue Nominal Speed Interface at Connector X8

TNC 426CA/CE: With TNC 426 CA/CE the nominal speed for the servo amplifier is output as nominal value voltage ± 10V at the connector X8.

TNC 426PA/PE: Depending on the machine parameter MP2000.X the controlled axes of TNC 426PA/PE are individually defined as **analogue** (= TNC 426CA/CE) or as **digital** axes.

MP 2000.X = **0** ⇨ **analogue** axis, output of nominal speed ± 10V to X8
MP 2000.X = **2** ⇨ **digital** axis with integral current and speed controller (see sec. 19.2)

19.1.1 Specifications

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

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

Short-circuit stability: the outputs are permanently short-circuit

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

Machine parameters for the analogue outputs

Analogue output	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	$\frac{10\ V}{65\ 536} = 0.153\ mV$

Pin No.	**Assignment**
1	nominal value output 1
2	not assigned
3	nominal value output 2
4	nominal value output 5
5	nominal value output 3
6	0V nominal value output 5
7	nominal value output 4
8	nominal value output axis S
9	0V nominal value output 1
10	not assigned
11	0V nominal value output 2
12	not assigned
13	0V nominal value output 3
14	0V nominal value output 4
15	0V nominal value output axis S
chassis	external shield

19.1.2 Checking the analogue nominal speed interface

Proportionally to the traverse speed the control outputs an analogue voltage between 0V and ±10V [1]. The easiest way to determine this voltage is to measure with the TEST ADAPTER directly at the LOGIC UNIT or with a multimeter at the connecting terminals of the servo amplifier.

If however, an axis does not move due to a defect, and you want to check whether the defect is inside or outside the control, we recommend to proceed as follows:

- Switch off the power 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 sockets of the defective axis. If you do not have a test adapter, connect the multimeter to the nominal value input of the servo amplifier.
- Switch on power and control voltage.
- Set the position display to LAG (servo lag) (see section 19.3).
- Check and adjust the following machine parameters:
  (If you alter a machine parameter, note down the original value and re-enter it after finishing the inspection.)

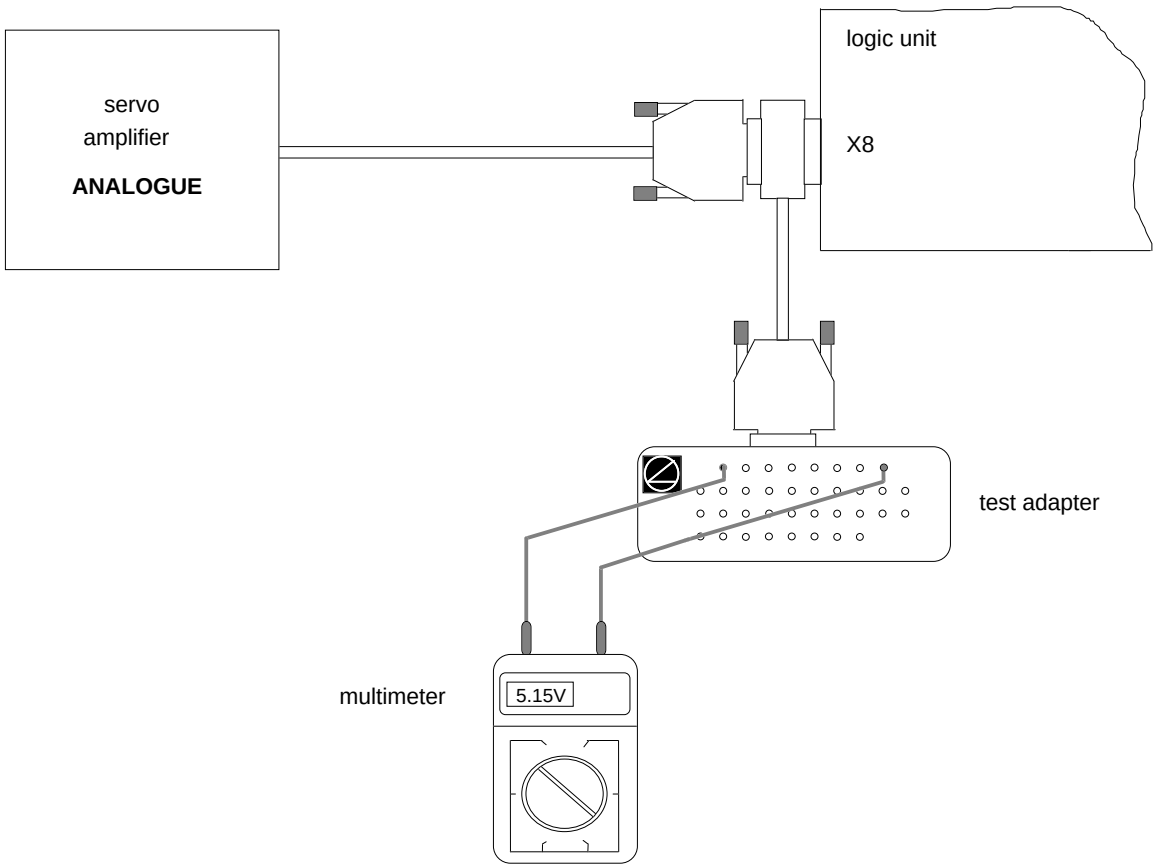
MP	Entry value	Function	Original entry value
1410.X	30 [mm]	servo lag monitoring (cancellable), feed-forward control	
1420.X	30 [mm]	servo lag monitoring (EMERG. STOP), feed-forward control	
1140.X	9.99 [V]	movement monitoring	
1710.X	300 [mm]	servo lag monitoring (cancellable), trailing mode	
1720.X	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 +100,2769) must 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 power 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 power 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.

[1] see machine parameter MP1050.X (analogue voltage for rapid traverse)

Measuring Setup to Check the Analogue Nominal Speed Interface



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

flange socket with female insert (15-pin)

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 S axis
9	0V analogue output 1

Pin No.	Signal Designation
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
chassis	external shield = chassis
2, 10, 12 do not assign	

Observe the safety instructions!

19.2 Digital Interface to Servo Amplifier at Connector X51 - X56

Depending on the machine parameter MP2000.X of TNC 426PA/PE the controlled axes are individually defined as **analogue** (= TNC 426CA/CE) or **digital** (PWM) controlled axes.

MP 2000.X = **0** ⇨ **analogue** axis, output of nominal speed ± 10V at X8 (see sec.19.1)
MP 2000.X = **2** ⇨ **digital** axis, nominal value output (PWM signals) at X51 - X56, see block diagram of servo drive control

19.2.1 Checking the digital nominal speed interface

A **digital** servo amplifier can only be checked with the DCG (**d**rive **c**ontrol **g**enerator).
(see section "Test Units).

Proceeding to check a PWM axis (TNC 426PA):

Preparations at the machine tool:

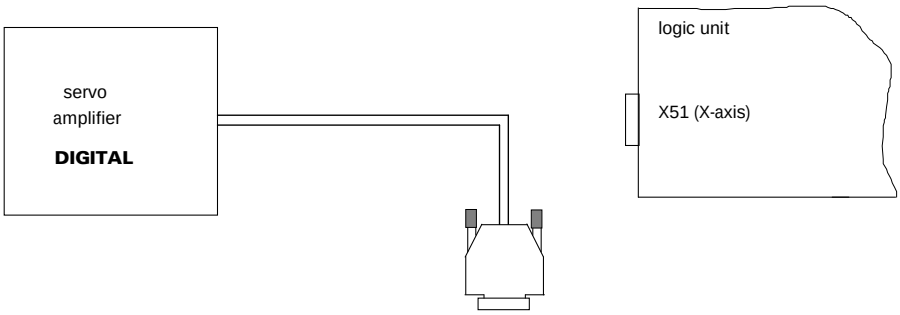
- Switch off the power supply of the machine tool.
- **Disengage** the connector for the power stage of the axis to be checked **from the TNC**.
- Connect the DCG to the servo drive according to the connection diagram.
- Switch on the power supply of the machine tool.
- Define the axis to be checked as counting axis in MP50.
- Check the drive enable at the servo amplifier (see basic circuit diagram of drive control).

Settings at the DCG

- Set toggle switches *Err.1* and *Err.2* to *UP* (active) position.
- Turn the potentiometers *Drehmoment* (torque) and *Drehzahl* (speed) to their left stops.
- Switch on the DCG supply voltage (Netz-Ein).
- Set the toggle switch *Regler Ein* (controller on) to *UP* (on) position.

Now, the DCG is ready for operation. Turn the potentiometers *Drehmoment* (torque) and *Drehzahl* (speed) to the right and back left until the axis moves smoothly.

Measuring setup to check the servo amplifier of the X-axis



DCG

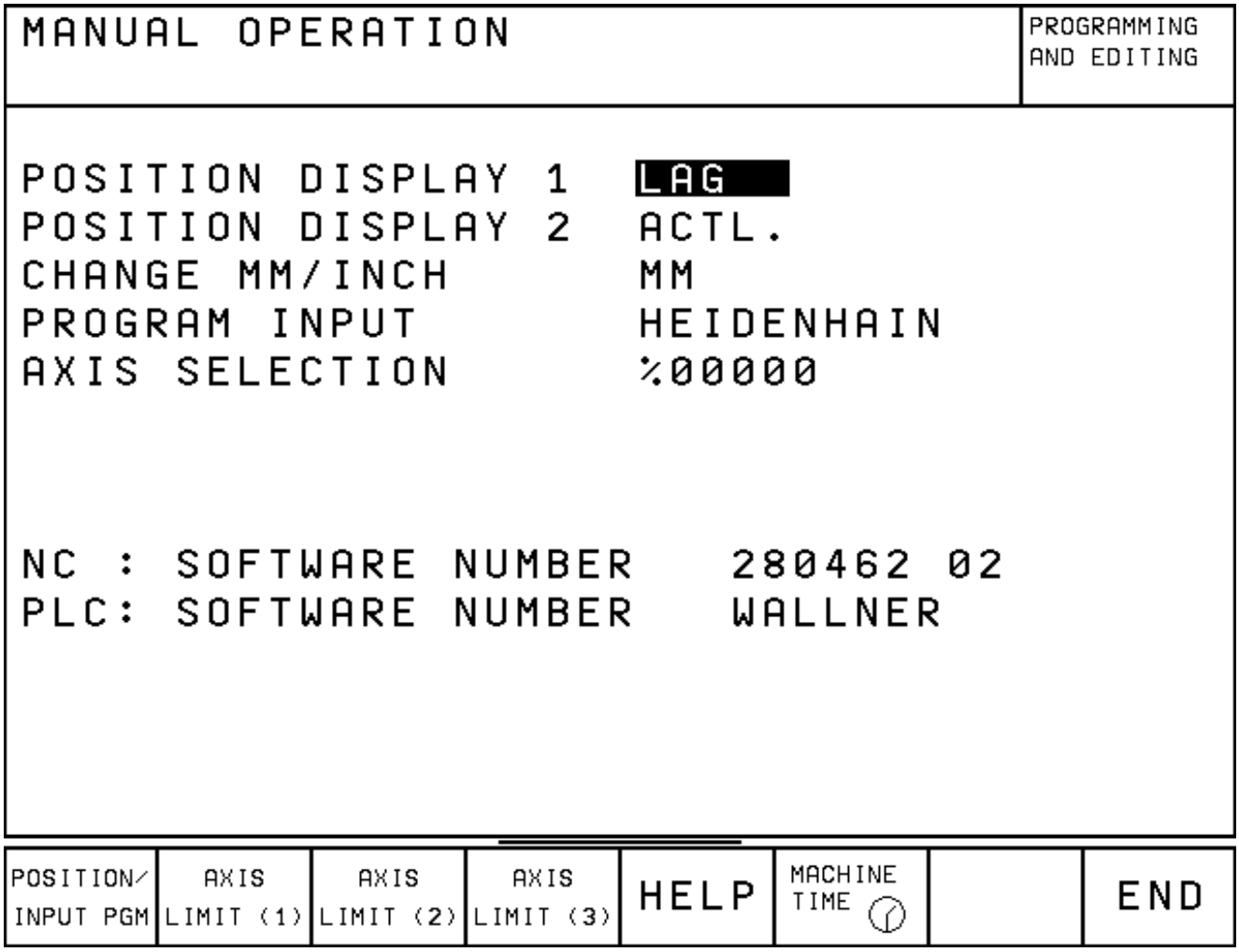
Observe the safety instructions !

NOTES

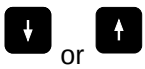
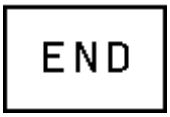
NOTES

19.3 Switching Over the Position Display

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



pos.pcx

 or 	If required, select dialogue POSITION DISPLAY Switch to the desired position display: NOML: nominal position DIST: distance to go ACTL: actual position REF: distance to reference mark (machine datum), with distance-coded measuring system scale reference point LAG: current servo lag
	Exit the subordinate mode

19.4 Adjustment of the Feed Rate

19.4.1 Axes with analogue speed controller

Check and adjust the machine parameters.
(If you alter a machine parameter, note down the original value and re-enter it after finishing the inspection.)

MP	Entry value	Function	Original entry value
1390	0	velocity feedforward control [1)] in automatic operating modes ON	
7290.X	6	display step = 0.1 µm	

- Switch the position display to LAG (display of servo lag).

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

```
0  BEGIN PGM  X  MM
1  LBL 1
2  X + 0  F  MAX
3  X + 100  F  MAX      (enter 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) such that the display of the servo lag is approximately zero during positionings 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 "velocity feedforward control" must be optimized!

19.4.2 Axes with integral current and speed controller

Depending on the machine parameters MP2000.0 - MP2000.5 of TNC 426PA/PE the driving axes are individually defined as **analogue** (= TNC 426CA/CE) or as **digital** controlled axes.

For axes with **integral current and speed controller** (corresponding parameter = 2), the feed rate adjustment at the servo amplifier as described in section 19.4.1 is not required.

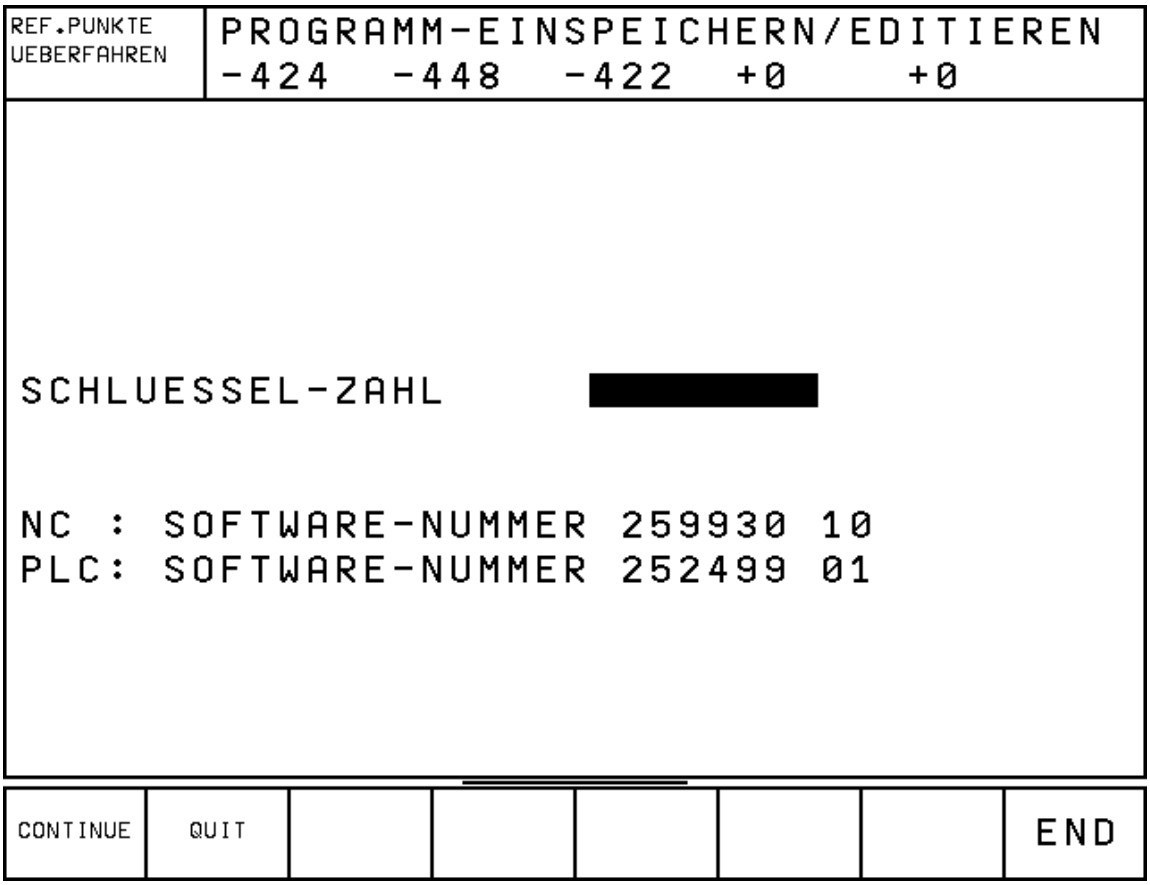
19.5 Offset Adjustment

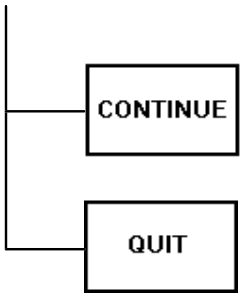
19.5.1 Axes with analogue speed controller

a) Offset adjustment with code number

Press key	Function
	TNC in operating mode PROGRAMMING/EDITING
	Prepare TNC for input of code number
	Enter code number of offset adjustment, confirm with ENT

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



	Offset compensation is performed Offset compensation is not performed or 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 [1s] is defined 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.

Caution!

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 a parameter.)

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	velocity feedforward control ON	
1510.0 1510.1 1510.2 1510.3 1510.4	≥ 1 ≥ 1 ≥ 1 ≥ 1 ≥ 1	KV factor for velocity feedforward control	
7290.X	6	display step = 0.1 µm	

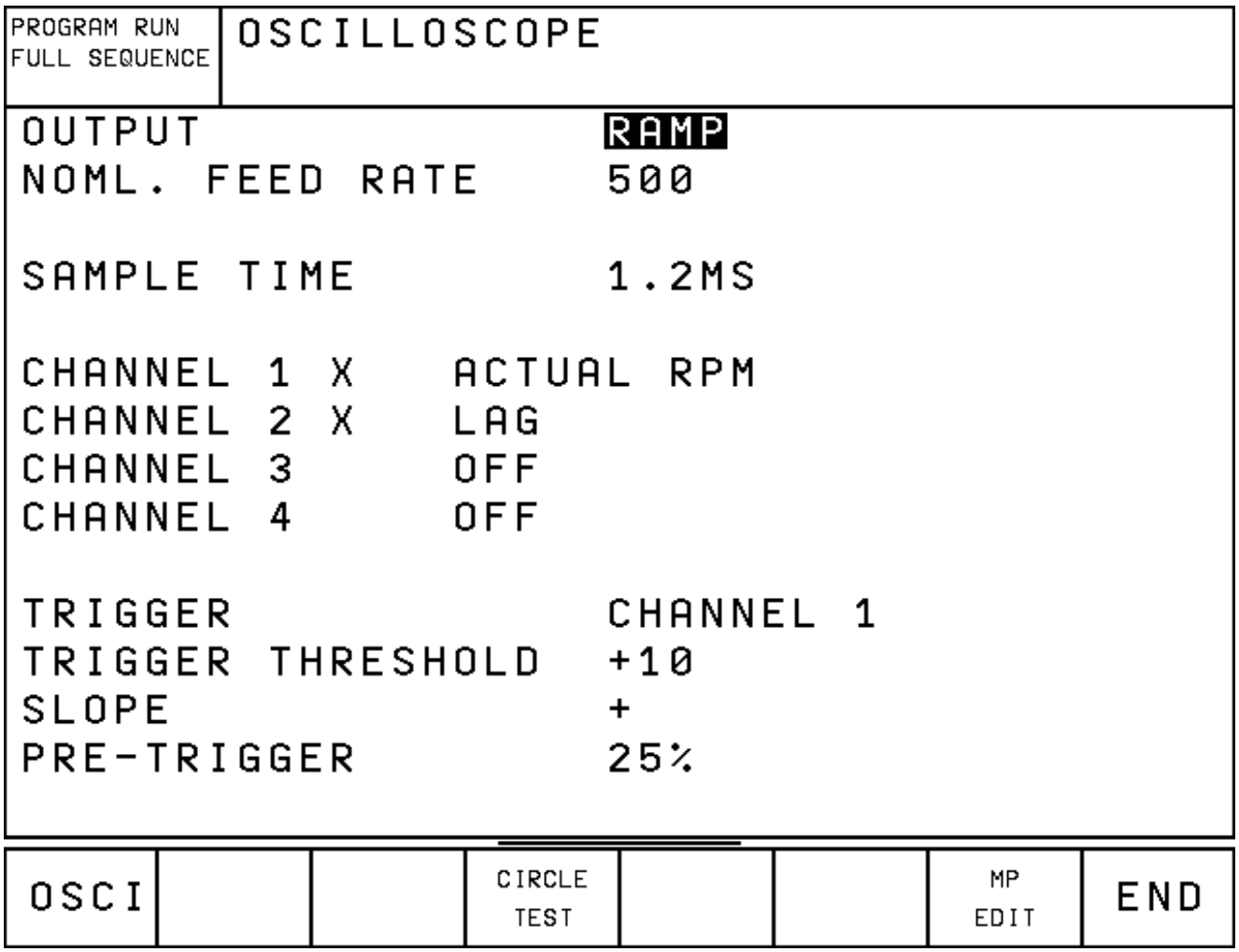
- Switch position display to LAG (display of servo lag); see section 19.3.
- Cancel the offset compensation with code number (see item a)
- Adjust the offset at the servo amplifier until the values of the individual axes are zero or oscillate symmetrically about zero.
- Reset the machine parameter values and the position display to their original values.

19.5.2 Axes with Integral Digital Speed Controller

For axes with **integral digital speed controller** (TNC 425, corresponding bit of MP1900 = 1) the offset adjustment as described in section 19.5.1 is not required.

19.6 Integral Oscilloscope

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



oszi_1.pcx

With this oscilloscope you can trace and store the characteristic curves of the axes in up to 4 channels:

V ACTL		Actual feed rate of the axis [mm/min]; calculated by means of the position encoder
V NOML		Nominal feed rate of the axis [mm/min]; feed rate resulting from the difference of the nominal position values; the servo lag is not considered.
FEED		Machining feed rate [mm/min]
S ACTL		Actual position [mm]
S NOML		Nominal position [mm]
S DIFF		Servo lag of position controller [µm]
ENCODER: I1		Encoder signal 1 of the position encoder
ENCODER: I2		Encoder signal 2 of the position encoder
SAVED		The signal traced last is saved.
Analogue axes:	U ANALOG	Analogue voltage = nominal speed [mV]
Digital axes:	V (N ACTL)	Actual rpm [mm/min]; calculated by means of the speed encoder and adapted via MP2020.
	V (N NOML)	Nominal speed [mm/min]; output value of position controller.
	I (N INT)	Integral-action component of the nominal current [A]
	I NOML	Nominal current decisive for the torque [A]
	PLC	Any PLC signal

The traced data are stored until you start a new tracing operation or activate another graphic function.
The colors for the oscilloscope can be defined in MP7356.X (NC software 280 462 - 463 only). Select the desired position by pressing the cursor keys and then set the parameters.

OUTPUT

You may choose whether the nominal speed is to be output as jump or as ramp. If a ramp is output, the programmed feed rate is effective as well as the kv factors and accelerations set in the machine parameters.
If you have chosen the nominal speed to be output as jump, a jump is output as nominal speed value when the axis direction keys are pressed in the operating mode MANUAL. During the output the position loop is open. The height of the jump can be defined in the entry field for the feed rate.

FEED RATE

Enter the jump height for the nominal speed (in mm/min). With "ramp" output, this entry value is of no importance.

SAMPLE TIME

The time resolution for tracing the signals can be set between 0.6 and 6 ms. 4096 grid points are stored, i.e. the time in which the signals are stored may vary from 2.4576 to 24.576 seconds.

CHANNEL 1 TO CHANNEL 4

Here the type of signal to be traced for an axis is selected for the four channels. Input values: see above.

TRIGGER

Here you set the type of tracing. Possible settings are:

- FREE RUN Tracing is started and terminated via soft keys.
- SINGLE SHOT As soon as the trigger condition has occurred, one full memory contents (4096 grid points) is traced.
- CHANNEL 1 to 4 Tracing is started as soon as the trigger threshold of the channel set here is exceeded.

TRIGGER THRESHOLD

Enter the trigger threshold dimensioned as follows:

- Feed rate (mm/min)
- Position (mm)
- Shaft speed (mm/min)
- Servo lag (µm)
- Analogue voltage (mV)
- Current (A)

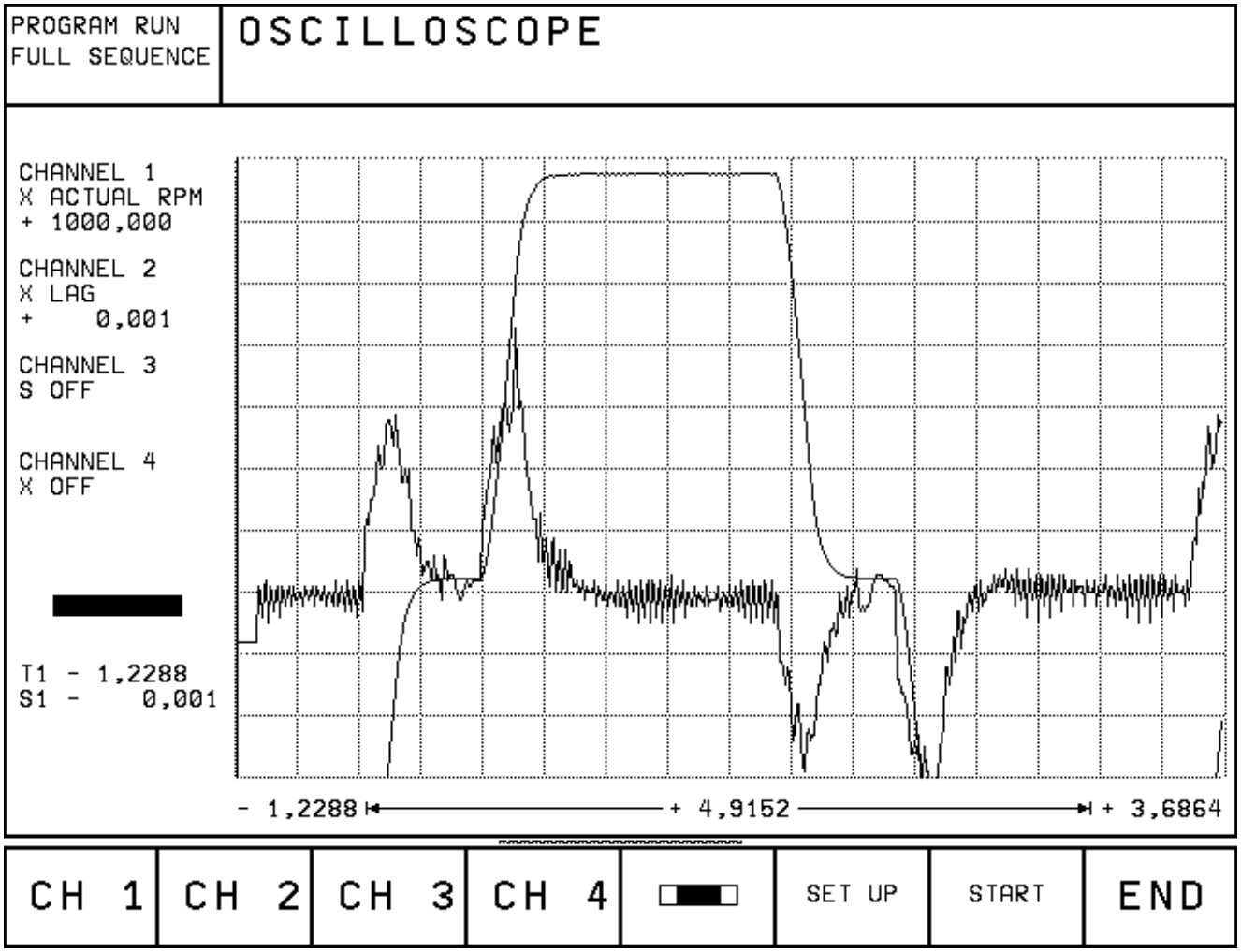
SLOPE

Select, whether the rising (positive) or the falling (negative) edge is to be triggered.

PRE-TRIGGER

The stored tracing is started by the value set here before the trigger event.

Press the soft key OSCI to switch the **Oscilloscope display**:

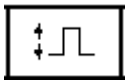
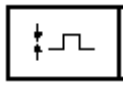
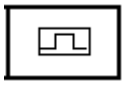
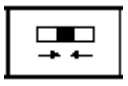


oszi_2.pcx

When tracing, the trains of selected signals are constantly depicted. After terminating the tracing, the memory contents is displayed. In addition, the signal type and the resolution are displayed for each channel. The length of the traced range referenced to the entire memory contents is displayed as a bar in the status field.

The cursor can be moved by pressing the arrow keys. The status field contains the amplitude of the selected channel and the time (referenced to the beginning of the tracing operation). A second cursor can be activated by pressing the soft key CURSOR 1/2. For this cursor the current amplitude and the time are displayed as well. The time of the second cursor is referenced to the position of the first cursor. By means of this function you can e.g. measure the acceleration time of an axis.

Explanation of the soft keys:

CH 1	Select one of the four channels to display a soft-key row consisting of the following soft keys:
INVERT	The signal is inverted.
Arrows	Shift the signal upwards or .
	Increase vertical resolution.
	Decrease vertical resolution.
	Optimum vertical resolution. The signal is centered in the middle of the screen. Press NO ENT to return to the resolution originally selected.
CURSOR 1/2	Switch to second cursor.
END	Return to Oscilloscope display.
	Select the memory range to be displayed. A soft-key row is displayed containing the following soft keys:
Arrows	Shift the signals left or right.
	Decrease horizontal resolution.
	Increase horizontal resolution.
END	Return to Oscilloscope display.
SET UP	Return to Setup menu.
START	Start tracing. Tracing is finished either with a trigger condition or by pressing the soft key STOP.
END	Terminate the Oscilloscope function.

20. PLC Interface

20.1 PLC Inputs

20.1.1 PLC Inputs on LE

Connector X42: I0 to I31 and acknowledgement "Control is ready"
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

20.1.2 PLC Inputs on PL 405B/410B

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

20.2 PLC Outputs

20.2.1 PLC Outputs on LE

Connector X41: O0 to O30 and output "Control is ready"
Connector X46: O0 to O7 [1)]

[1)] available either at X46 or X41

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

Load capacity: resistance load; inductive load with quenching diode in parallel to inductance.
It is not permitted to simultaneously short-circuit more than one output on the logic unit. If **one** output is short-circuited the maximum load is not exceeded.
Only half the PLC outputs may be connected at a time (simultaneity factor 0.5).

20.2.2 PLC Outputs on PL 405B/410B

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

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

Pin layout: see section 6

Load capacity: resistance load; inductive load with quenching diode in parallel to inductance.
It is not permitted to simultaneously short-circuit more than one output on the logic unit. If **one** output is short-circuited the maximum load is not exceeded.
Only half the PLC outputs may be connected at a time (simultaneity factor 0.5).

20.3 Checking the PLC Inputs and Outputs

The test unit (see section 21) 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.

20.3.1 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**
	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 the table of the inputs
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 20.1). 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.	
END	Exit the TABLE function
END	TNC in operating mode PROGRAMMING/EDITING

Observe the safety instructions!

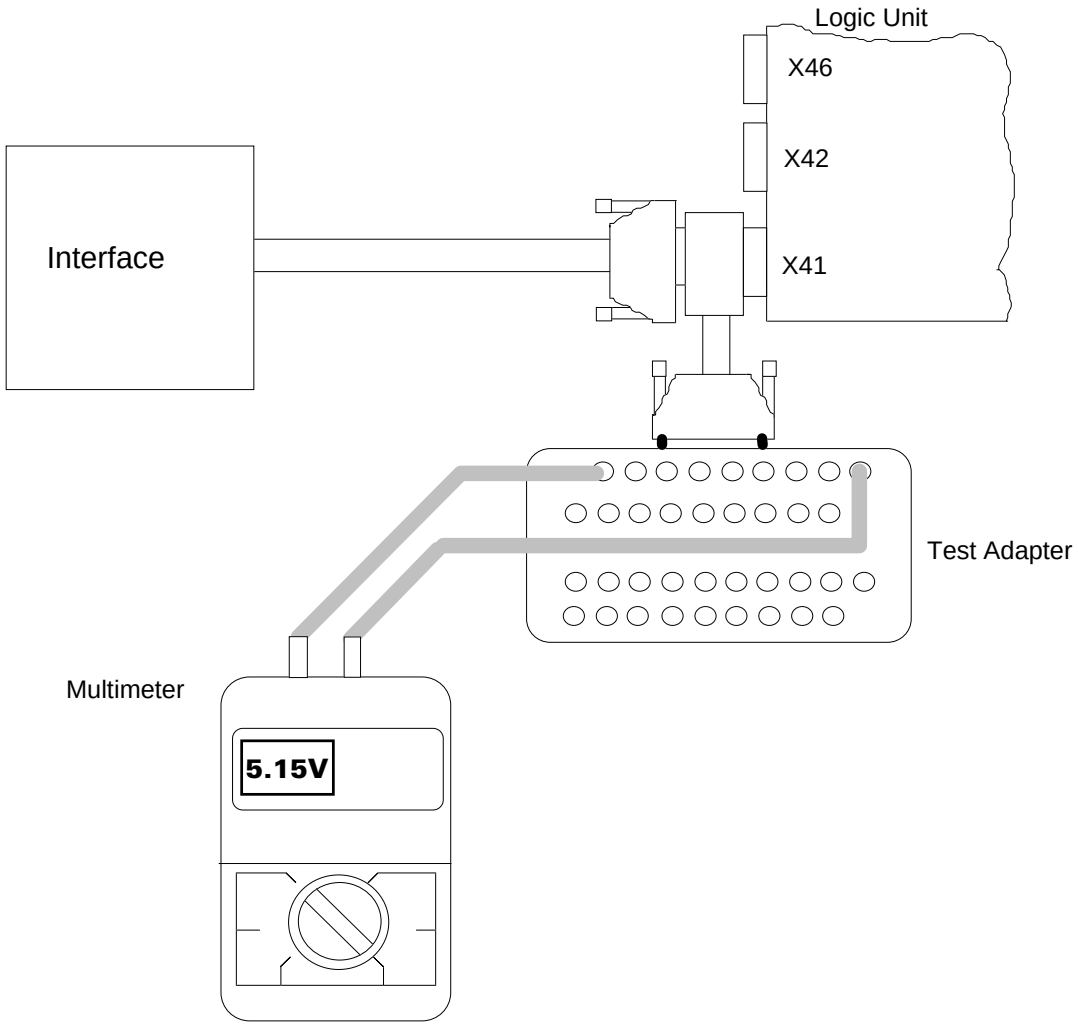
20.3.2 PLC Outputs

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 the TABLE function
OUTPUT	Display the table for the outputs
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.	
END	Exit the TABLE function
END	TNC in operating mode PROGRAMMING/EDITING

 **Observe the safety instructions!**

20.3.3 Measurement Setup for PLC Inputs and Outputs on the LE



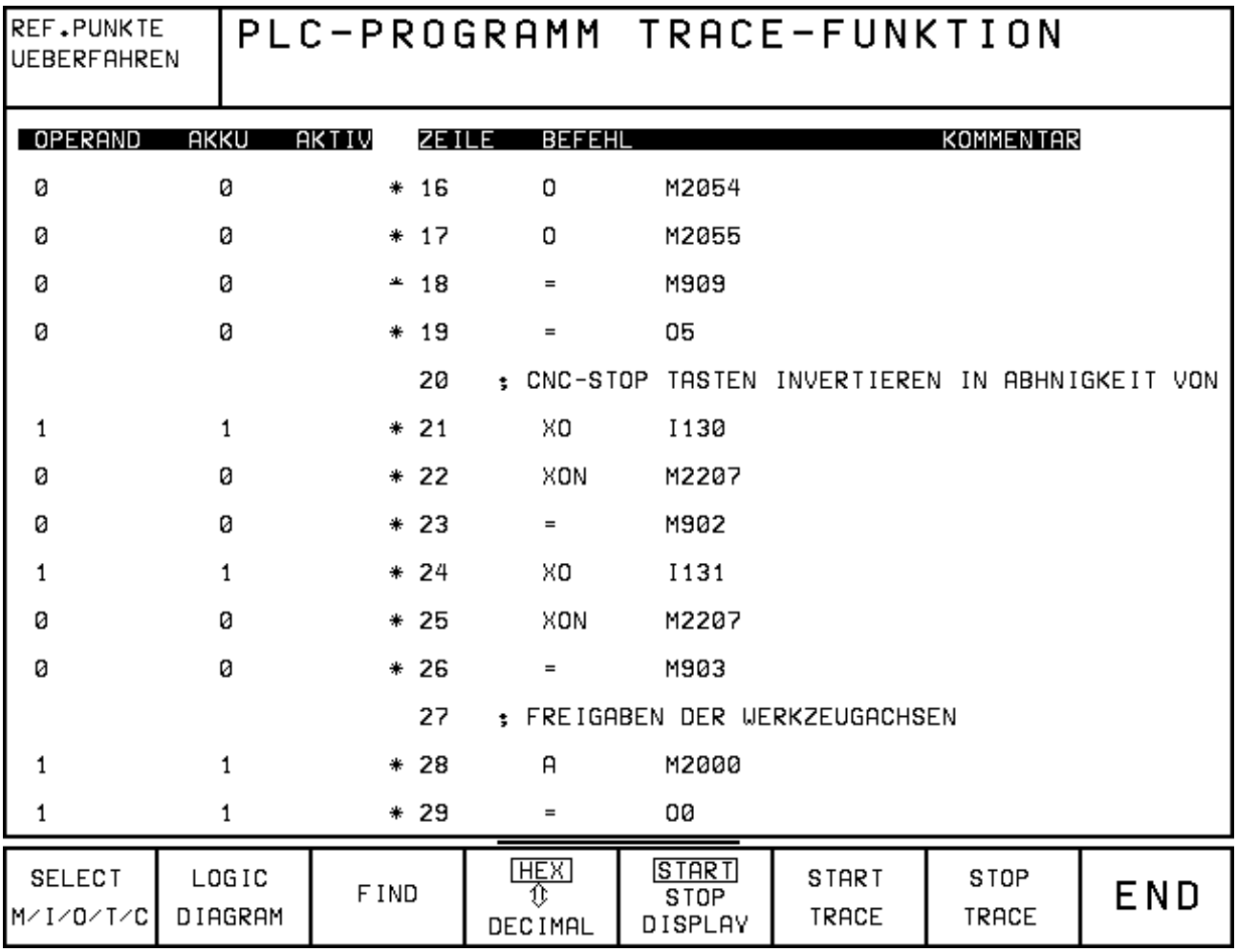
X41 : PLC output
X42 : PLC input
X46 : machine operating panel

Observe the safety instructions!

20.4 Diagnosis Possibilities in the PLC Mode

20.4.1 TRACE Function

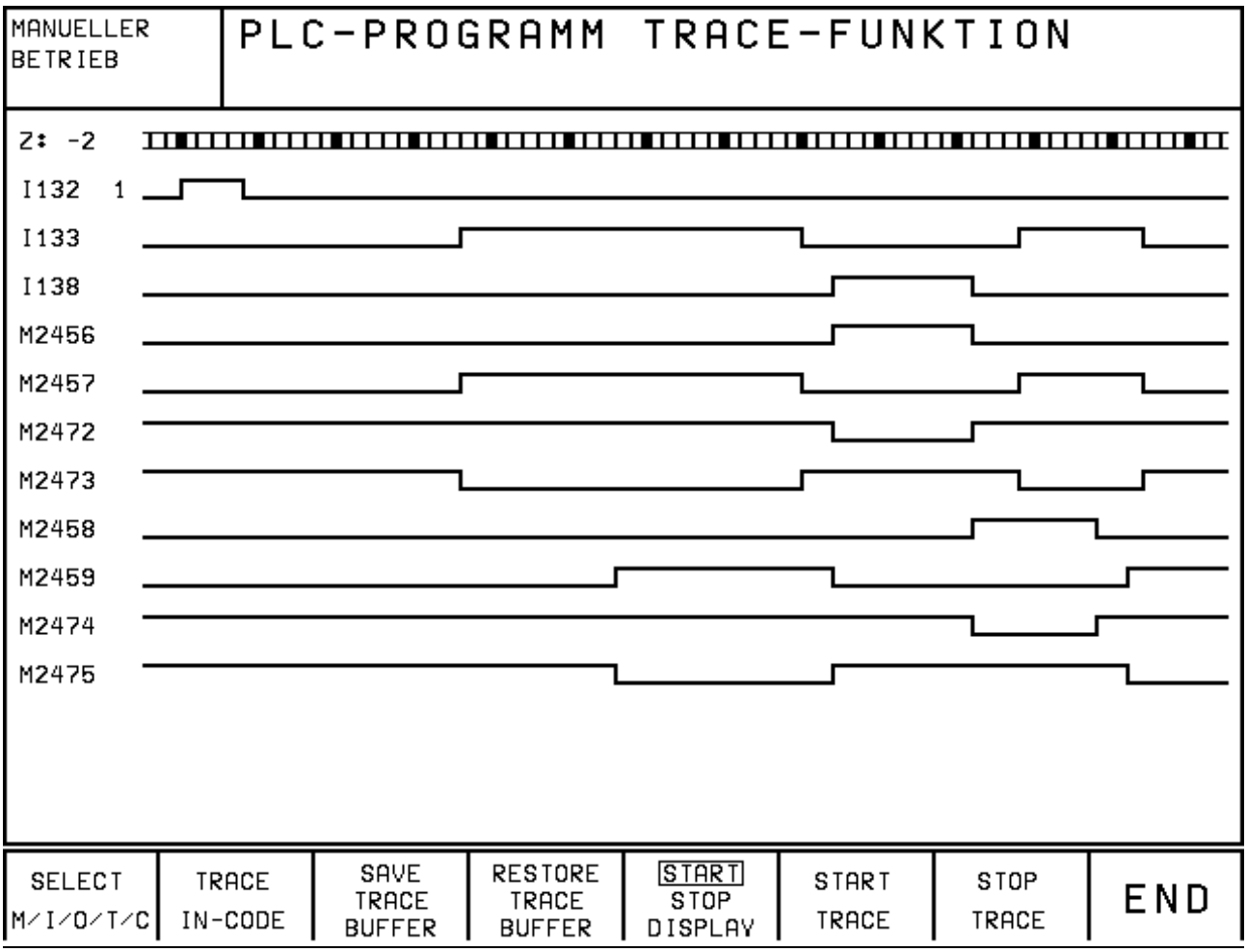
Activation via soft key [TRACE].



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 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.

20.4.2 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

START TRACE	Start the 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

	Switch to the TRACE mode
LOGIC DIAGRAM	Call the logic diagram

20.4.3 TABLE Function

Press key	Function
TABLE	Call the TABLE function

SET	RESET	MARKER	INPUT	OUTPUT	COUNTER	TIMER	END

▷	Key on VDU

BYTE	WORD	DOUBLE	HEX ⇕ DECIMAL		SAVE M/B/W/D	RESTORE M/B/W/D	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.

20.5 Output "Control is ready" and Acknowledgement for Test " Control is ready "

Important functions are monitored by the TNC 426 by way of a self-diagnosis system (electronic assemblies such as micro-processor, EPROM, RAM, positioning systems, encoders etc.).

For the emergency- stop routine a PLC input (X42/4) and a PLC output designated „Control is ready“ are available at the control.

The output " Control is ready " is available via:

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

If the control detects a malfunction, it switches off the output "Control is ready"; a blinking error message is displayed and the PLC program stopped. This error message cannot be cleared by pressing CE. The error must be eliminated and then the power-on routine repeated.

If the input "Control is ready" is switched off by a procedure outside the control, the error message EMERGENCY STOP is generated, and the NC sets the markers M4177 and M4178. Moreover, zero is output as nominal speed and the drives are switched off. This error message can be cleared by pressing CE after having switched off and on the control voltage.

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 is ready" each time the control is switched on.

TNC 426 features two monitoring systems (main processor, DSP) which are also tested when the machine tool is switched on.

If the +24V at the input "Acknowledgement control is ready" 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.

If the control detects an error during the power-on test routine, a bridge can be inserted between the output "Control is ready" and the input "Acknowledgement control is ready" (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.

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

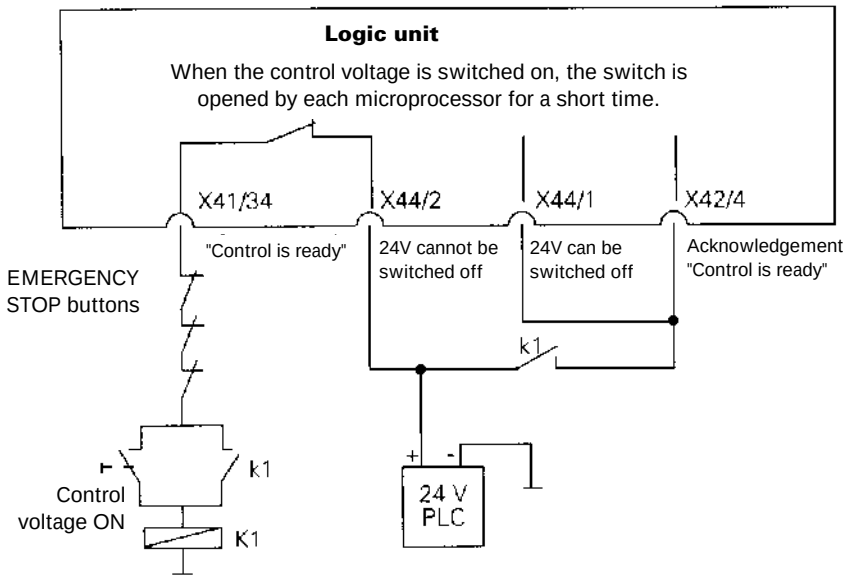
Observe the safety instructions!

20.6.1 Wiring of the EMERGENCY STOP Interface (simplified)

Connection

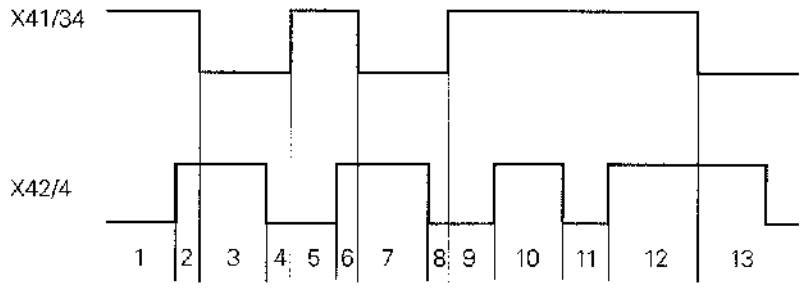
If an error occurs, the output "Control is ready" must generate an EMERGENCY STOP. Since this function is of great importance, the control checks this output each time when the power is switched on.

HEIDENHAIN recommends the following wiring:



Flow chart

The external electronics has to match the preset conditions.
Above all ensure that "Control is ready" is acknowledged within 380 ms.



		Screen display
1	Waiting for control voltage	RELAY EXT. DC VOLTAGE MISSING
2	Recognition of control voltage at X42/2 and switching off the signal "Control is ready" at X41/34 by main processor (t < 66 ms)	
3	Maximum time in which the acknowledgement "Control is ready" at X42/4 must be set to zero (t < 380 ms)	EMERGENCY STOP DEFECTIVE
4	Recognition of acknowledgement and setting of X41/34 (t < 20 ms)	
5	Waiting for control voltage	RELAY EXT. DC VOLTAGE MISSING
6	Recognition of control voltage at X42/4 and switching off the signal "Control is ready" at X41/34 by DSP (t < 120 ms)	
7	Maximum time in which the acknowledgement "Control is ready" at X42/4 must be set to zero (t < 380 ms)	EMERGENCY STOP DEFECTIVE
8	Recognition of acknowledgement and setting of X41/34 (t < 120 ms)	
9	Waiting for control voltage	RELAY EXT. DC VOLTAGE MISSING
10	Normal operation of control; output and acknowledgement "Control is ready" are high	
11	Control voltage is switched off from outside	EMERGENCY STOP
12	Error message can be cleared when the control is switched on again; then again normal operation of control	
13	When an error is detected, the control switches off the output "Control is ready" (X41/34)	Blinking error message

20.6 Non-volatile PLC markers and words

Note: The function described in section 20.6 can only be run on TNC 426 with NC software 280 462 and 280 463. With the NC software versions 280 460 and 480 461 this function is not available. In this case the states of the PLC markers and words must be noted down, if required.

20.6.1 Backing up on harddisk

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
	Switch soft-key row
SAVE M/B/W/D	
RANGE =	Enter the range of PLC markers or words to be backed up. Default setting automatically entered by the TNC: **maximum** range of the **non-volatile** PLC markers and words (e.g. M0 ... M999, W0 ... W126).
ENT	Confirm setting
File: PLC\PLCMEM.A	Enter target path and file name under which the data are backed up on harddisk. Default setting automatically entered by the TNC is PLC\PLCMEM.A. If required, several files can be backed up on the harddisk.
ENT	The states and contents of the PLC markers/words are stored on harddisk in the file specified above.
END END	Exit the PLC mode.

20.6.2 Playing back data into RAM

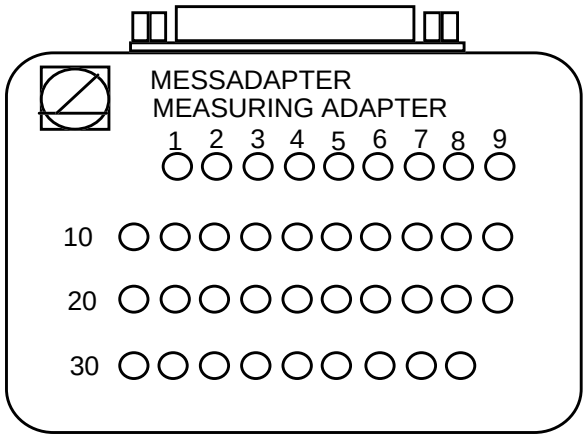
Press key	Function
	TNC in operating mode PROGRAMMING/EDITING
MOD	Prepare TNC for input of code number
8 0 7 6 6 7 ENT	Enter code number; confirm with ENT
TABLE	Call TABLE function
	Switch soft-key row
RESTORE M/B/W/D	
File: PLC\PLCMEM.A	Enter target path and file name under which the states of the PLC markers and words are backed up on harddisk. Default setting automatically entered by the TNC is PLC\PLCMEM.A.
ENT	The backed up states of the PLC markers and words are played back into RAM.
END END	Exit PLC mode

21. Test Units

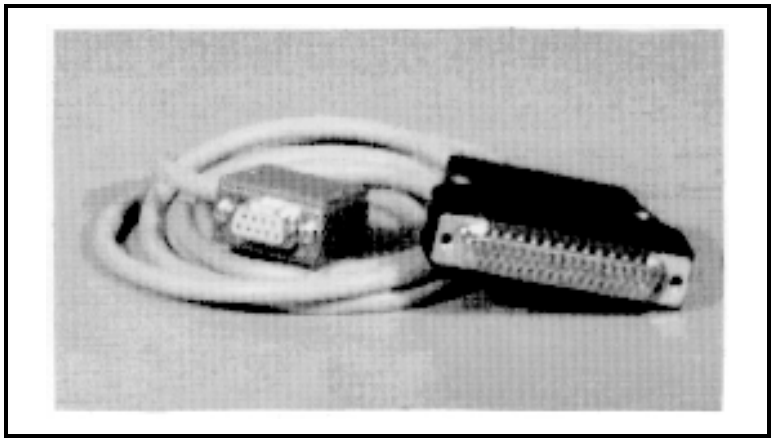
21.1 Universal Measuring Adapter

Used:

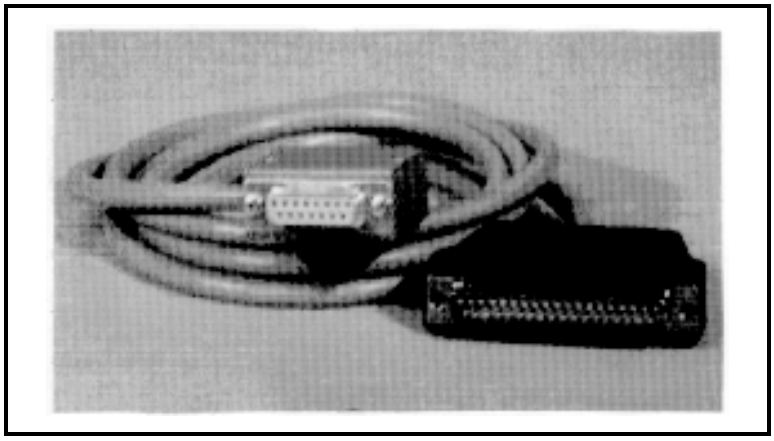
- Universal test unit for D-Sub connectors, 9-pin to 37-pin (Id.No. 255 480 01)



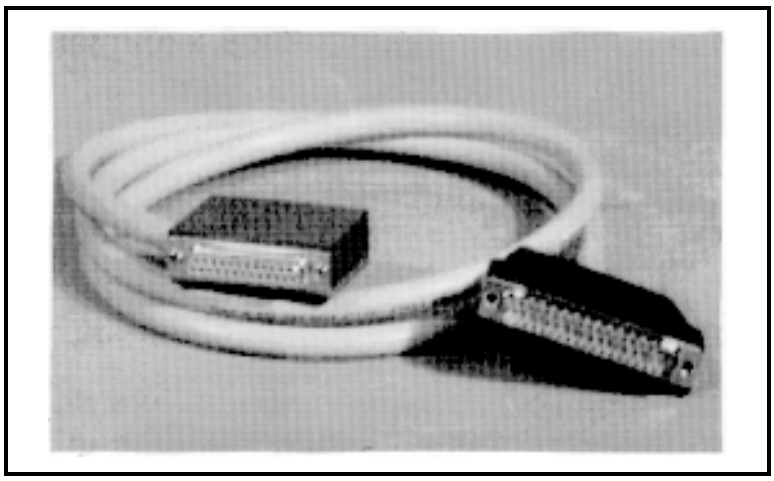
The measuring adapter can be used to test the inputs and outputs of D-Sub connectors (9-pin to 37-pin).
On the following page the adapter cables are shown that are required for the different connectors.



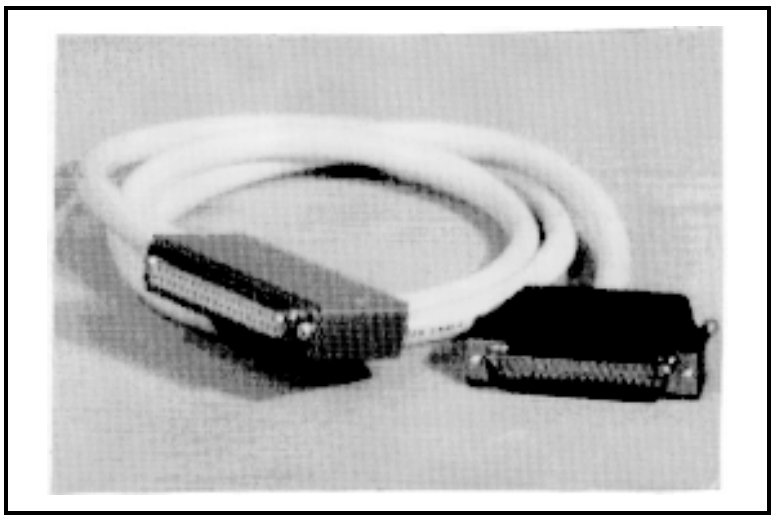
Adapter cable, 9-pin
Id.No. 255 481 01



Adapter cable, 15-pin
Id.No. 255 482 01



Adapter cable, 25-pin
Id.No. 255 483 01

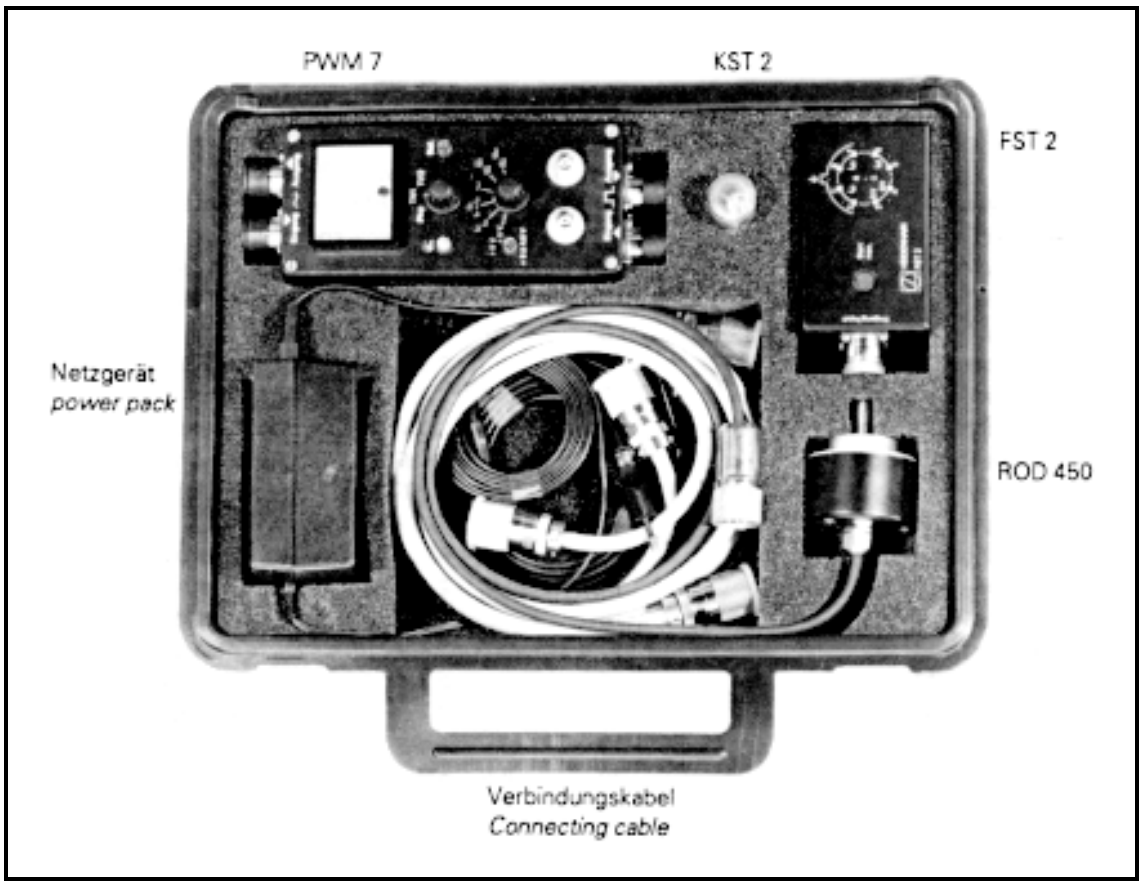


Adapter cable, 37-pin
Id.No. 255 484 01

21.2 Encoder Diagnostic Set

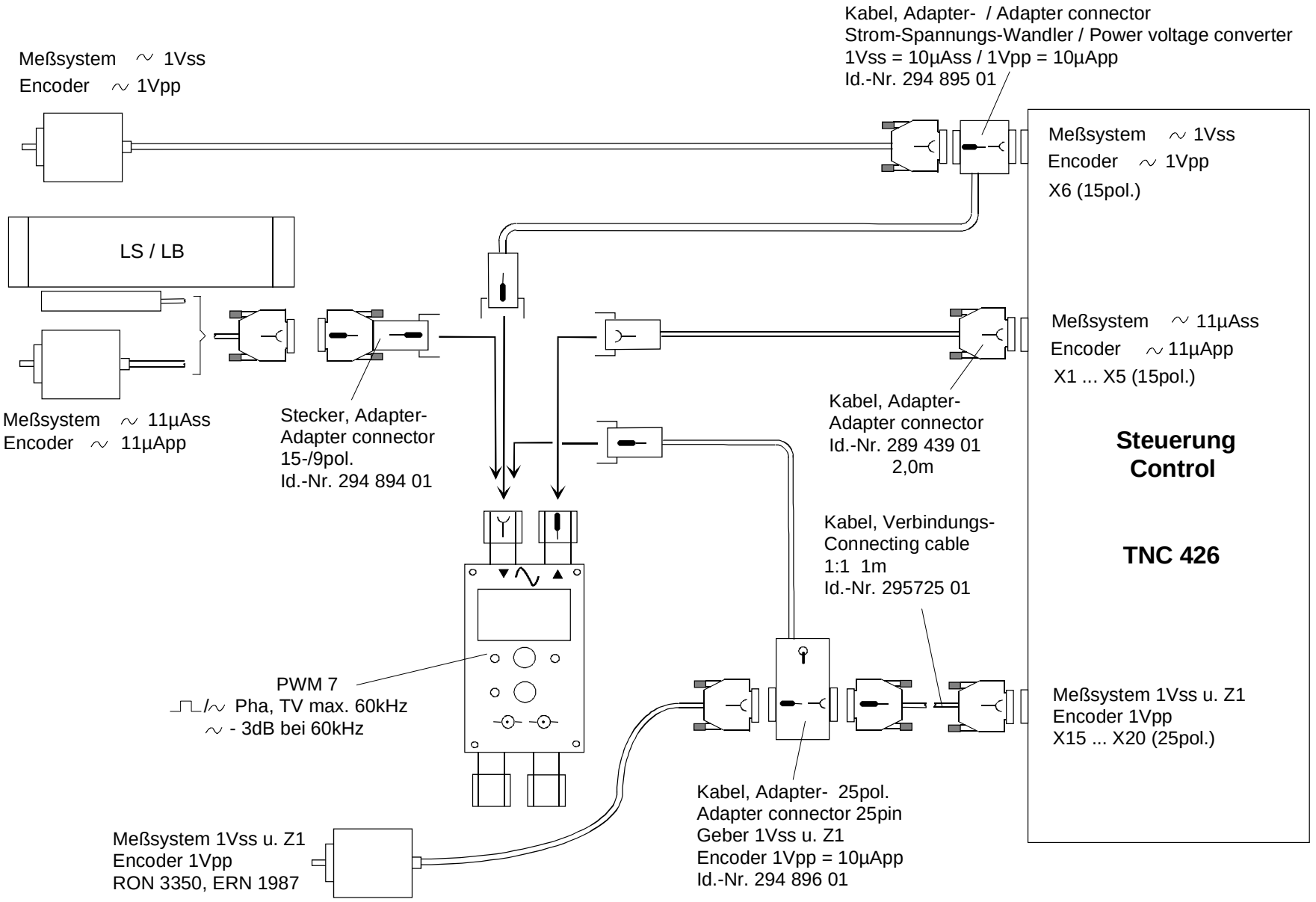
Used:

- to test the electrical functions of an encoder (Id.-No. 254 599 01)
  (Further information please see from the operating instructions of the Diagnostic Set.)
- Adapter block TNC 426 - PWM7, see page 150



Adapter Block TNC 426 - PWM 7

Several adapters have been developed to measure
the encoder signals (~ Vpp, ~ 11µA, TTL) with the PWM7.



21.3 Drive-Control-Generator (DCG)

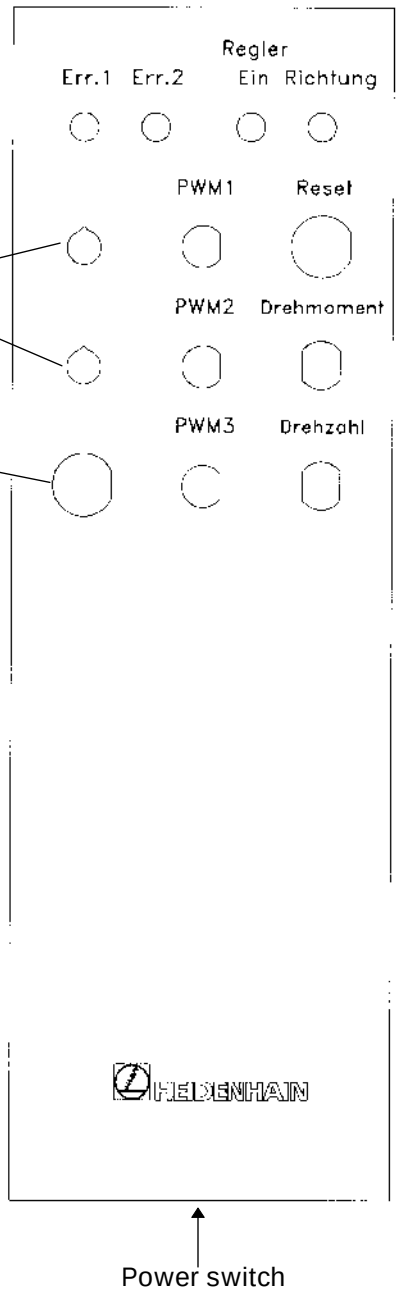
Used:

- to drive inverters with PWM signals (Id.No. 296 737 01)

Specifications:

- Supply voltage 230 V
- Power consumption 4 W
- Rotational speed and torque can be set individually
- Direction can be switched

Control and displays:



Pole terminals

key button
(make contact)
to connect
the pole terminals

Power switch

Err.1	toggle switch (STANDBY)
Err.2	toggle switch
	TEMPERATURE WARNiNG
Regler Ein	toggle switch (controller on)
Richtung	toggle switch (direction)
PWM1	BNC socket
PWM2	BNC socket
PWM3	BNC socket
Reset	key button
Drehmoment	potentiometer (torque)
Drehzahl	potentiometer (speed)

Description of the controls and displays:

Err.1 If the drive does not send a STANDBY signal when the switch is in UP position (active), the DCG is not switched on and the axis cannot be moved.
By setting the toggle switch to DOWN position (off), the STANDBY signal is not evaluated and the axis can be moved.

Err.2 If the switch is set to UP position (active) when the signal $\overline{\text{TEMPERATURE WARNING}}$ is transmitted, the DCG is not switched on and the axis cannot be moved.
By setting the toggle switch to DOWN position (off), this signal is not evaluated and the axis can be moved.

Caution:
An error has occurred, if the drive does not output the STANDBY signal or the $\overline{\text{TEMPERATURE WARNING}}$ signal. If the drive is selected still, the servo amplifier may be **destroyed**.

Regler Ein (controller on) switch position *UP* (ON): controller of DCG switched on, DCG is ready for operation.
switch position *DOWN* (OFF): controller of DCG switched off, DCG is not ready for operation.

Richtung (direction) When shifting the toggle switch the direction is inverted. The direction can **only** be changed, if the speed is zero.

PWM1 BNC socket for connection of an oscilloscope for PWM signal, phase 1.
PWM2 BNC socket for connection of an oscilloscope for PWM signal, phase 2.
PWM3 BNC socket for connection of an oscilloscope for PWM signal, phase 3.

Reset The drive is reset, when this key button is pressed (axis stops).

Drehmoment (torque) Potentiometer to set the torque; left stop = off.

Drehzahl (speed) Potentiometer to set the speed; left stop = off.

Key button When this button is pressed, the two pole terminals are connected. By means of this function e.g. an external decelerating contactor or a clamping fixture can be selected.

Vertical axes:
After having changed the direction of a vertical axis, the axis may drop (speed and torque = 0).
If required, select decelerating contactor or clamping fixture by means of the key button and pole terminals at the DCG.

Basic proceeding to check a PWM axis (TNC 426PA):

Preparations on the machine:

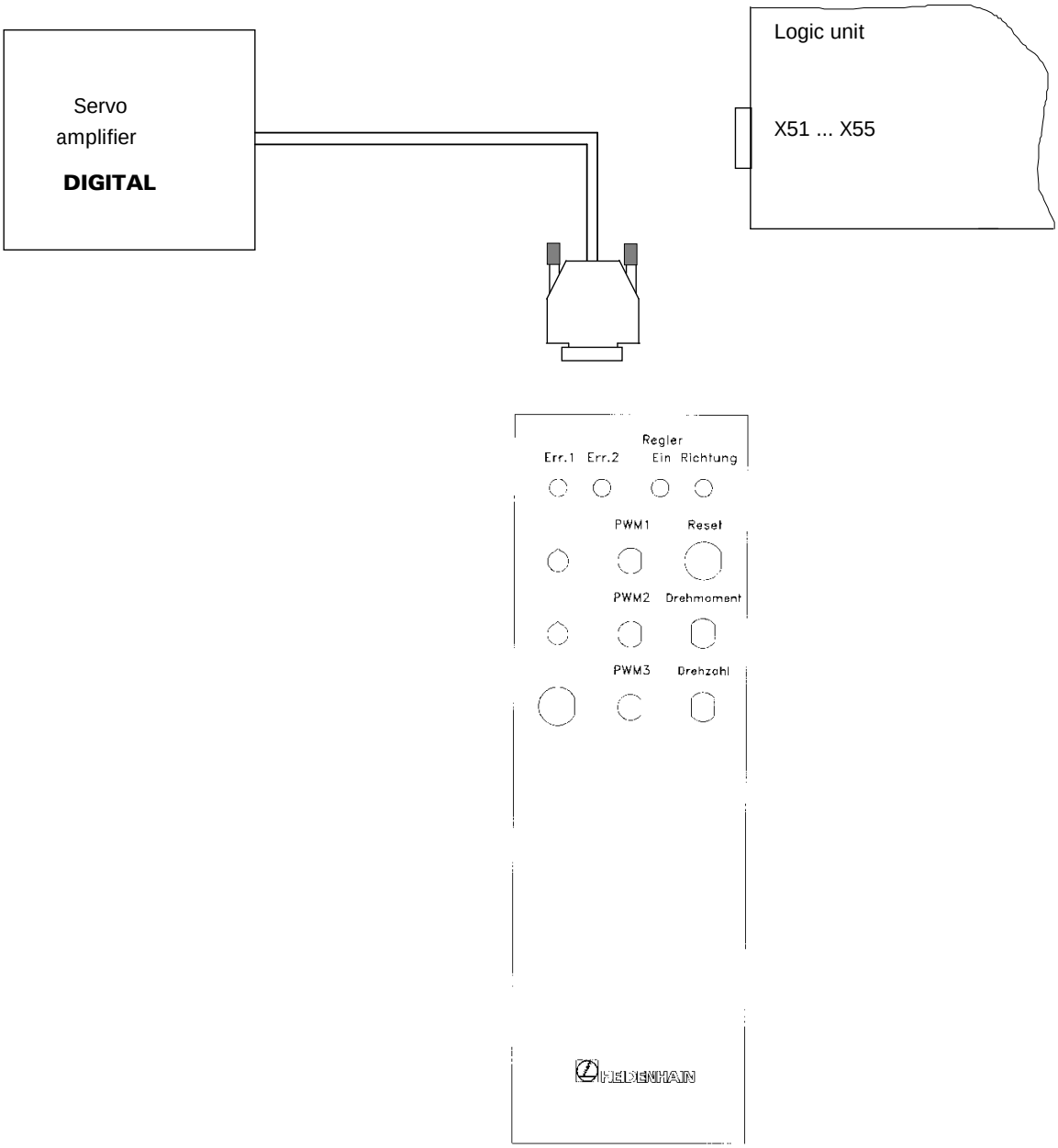
- Switch off the power switch of the machine tool.
- Disengage the connector of the power stage of the axis to be checked from the **TNC**.
- Connect the DCG to the servo amplifier as per the connection diagram.
- Switch off the power switch of the machine tool.
- Define the axis to be checked as counting axis in MP50.
- Check the drive enable at the servo amplifier (see Basic Circuit Diagram of Drive Control, page 56).

Settings at the DCG

- Set toggle switches *Err.1* and *Err.2* to *UP* position (active).
- Turn the potentiometers *Drehmoment* (torque) and *Drehzahl* (speed) to their left stops.
- Switch on the power supply of the DCG (Netz-Ein).
- Set the toggle switch *Regler Ein* to *UP* position (ON).

Now, the DCG is ready for operation. Turn the potentiometers *Drehmoment* and *Drehzahl* right and back left again, until the axis moves smoothly.

Measuring setup to check the servo amplifier



Observe the safety instructions!

In order to correctly judge the behaviour of a machine tool controlled by TNC, fundamental knowledge of the machine tool and the drives as well as their interaction with the measuring systems are required.

Considerable damage and personal injury may result from improper use.

HEIDENHAIN is not liable for any damage or personal injury caused directly or indirectly or by improper use or incorrect operation.

22 Exchange Instructions

22.1 Important Information

Observe the safety instructions!

22.1.1 Required equipment

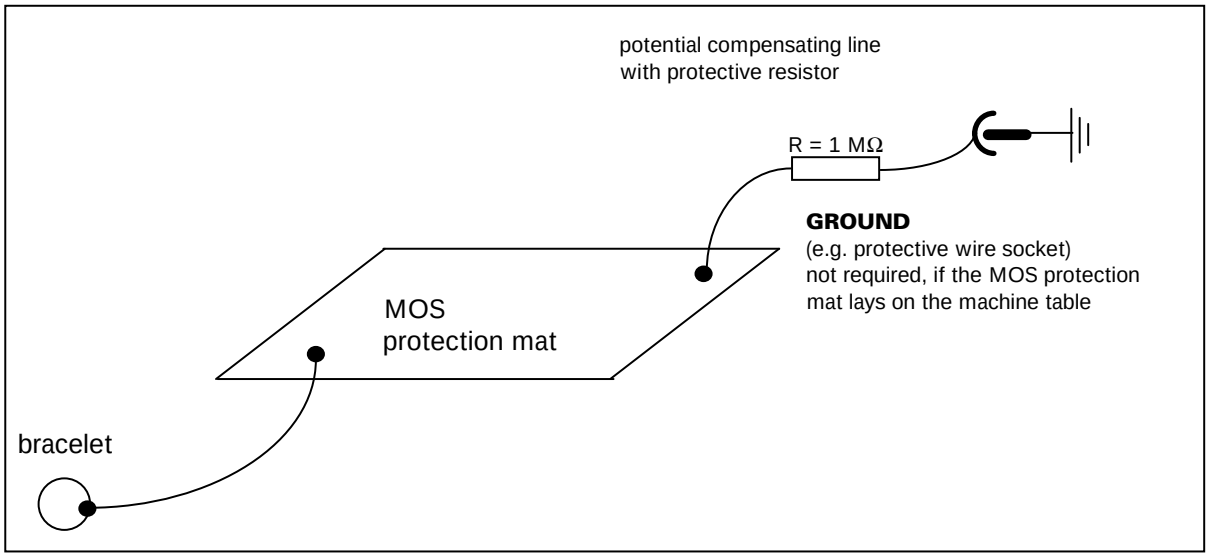
PC with HEIDENHAIN data transfer software TNCBACK.EXE
1 IC-extraction and insertion tool (for exchanging NC software and boards)
1 MOS protection device (only required for exchanging boards or EPROMs)

22.1.2 MOS protection

If the EPROMs are to be exchanged, a MOS protection is definitely required, since otherwise EPROMs may be destroyed.

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

MOS Protection



22.1.3 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!)

22.2 Exchanging the NC Software PGM No. 280 460 - 461 --

With TNC 426 PA/CA (PE/CE) the NC software should be exchanged in the order described below. These instructions **only** apply for the software types **280 460 - 461 --**! Depending on the version of the NC software, the machine tool model and features, some items may by skipped.

Basically all files stored on the harddisk should be backed up on an external data medium. For this purpose HEIDENHAIN offers the data transfer software TNCBACK.EXE free of charge (see section 22.4).

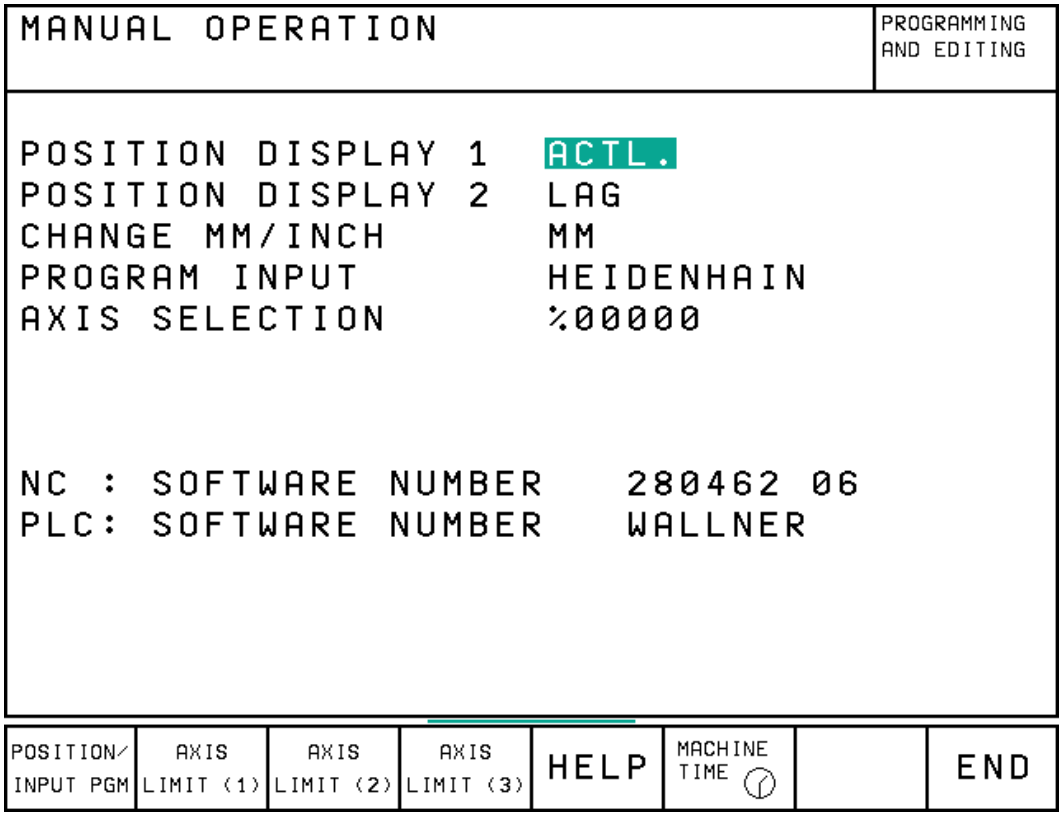
22.2.1 Backing up RAM data

Before exchanging the NC software, important information stored in RAM must be backed up, i.e. noted down:

MODE settings (position display etc.)
AXIS-LIMIT (limitations of the traverse range, datums)
RS 232/422 SETUP (assignment, baud rate etc.)

MODE Settings

Press key	Function
	TNC in operating mode MANUAL
	Call subordinate mode

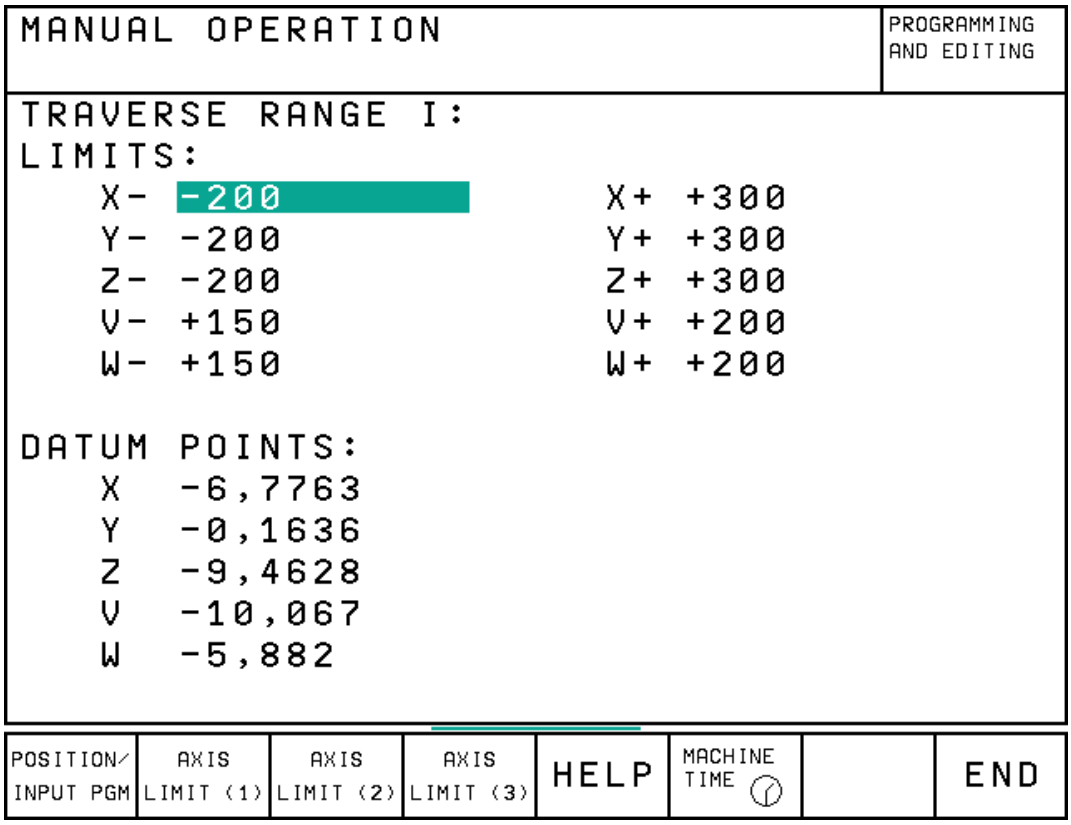


The displayed settings must be **noted down** and re-entered after the software exchange.

NOTES

AXIS-LIMIT and DATUMS

Press key	Function
AXIS LIMIT (1)	Call the settings for the (1.) traverse range



NOTE: Three ranges (LIMIT (1) to (3)) may be activated via machine parameters.
The settings can be displayed by pressing the corresponding soft keys.

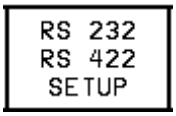
The displayed settings must be **noted down** and re-entered after the software exchange.

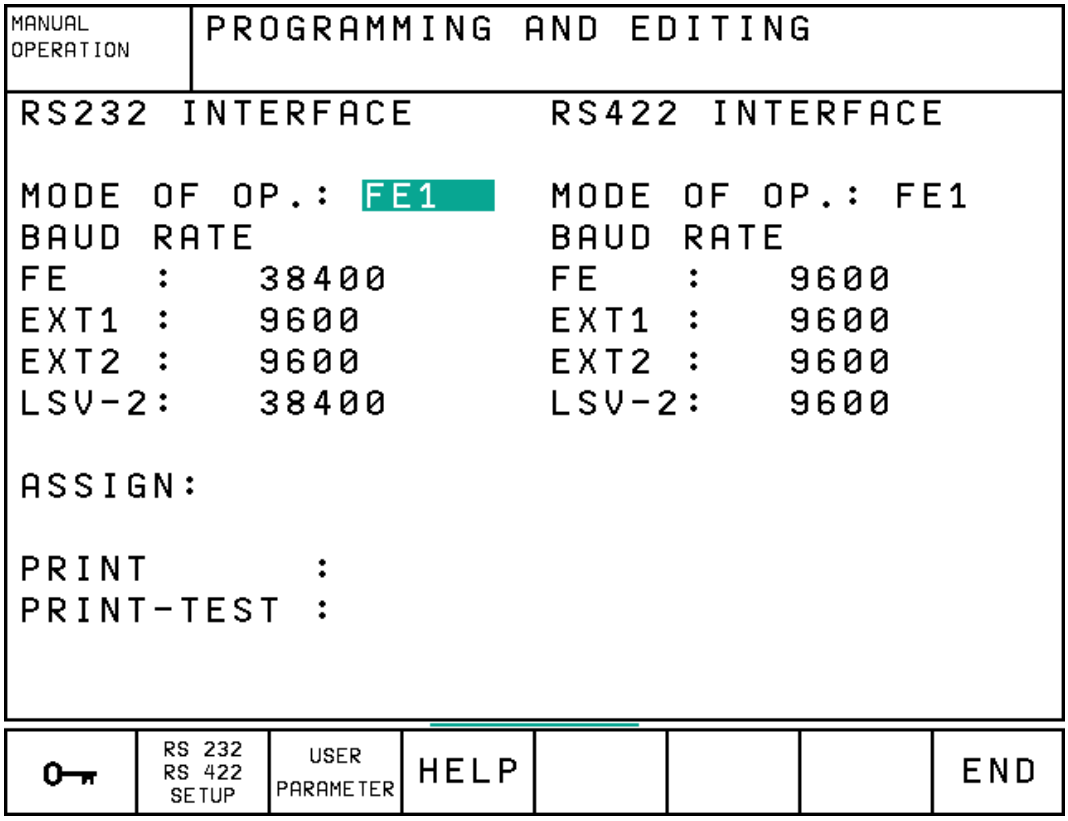
The values of the datum shift must be re-entered as datums after the software exchange **before** the ref. mark traverse.

Starting with NC software 280 460 - 461 **06** AXIS-LIMIT and DATUMS are **automatically** backed up on the harddisk and re-set after the software exchange!

NOTES

RS 232/422 SETUP

Press key	Function
	TNC in operating mode PROGRAMMING/EDITING
	Call subordinate mode
	Call interface menu



The displayed settings must be **noted down** and re-entered after the software exchange.

Starting with NC software 280 460 - 461 **06** the interface settings are **automatically** backed up on the harddisk and re-set after the software exchange!

NOTES

22.2.2 Putting the machine (axes) in a defined status

Machines with swivel head:

- Bring the swivel head into a defined position (normal position).
  Information can be obtained from the machine tool builder!

Machines with tool changer:

- Bring the tool changer into a defined position.
  Information can be obtained from the machine tool builder!

Machine axes in general:

- Move the axes to the middle of the traverse range
  (away from the hardware limit switches)

Non-volatile PLC memory (markers and words)

The non-volatile PLC memory of TNC 426 B0 - B127
M0 - M999 if MP 4020 bit 4 = 0
M1000 - M1999 if MP 4020 bit 4 = 1
is **always reset** during an NC software exchange.

On machines with e.g. an automatic tool changer important information on e.g. initializing the tool changer after the NC software exchange may be lost this way.
Information can be obtained from the machine tool builder!

22.2.3 Converting data on the harddisk from binary format to ASCII format

Before the EPROMs on the processor board of TNC426 can be exchanged, the data on the harddisk must be converted from **binary** into **ASCII** format. A minimum free memory of 1.5 times the largest file on the harddisk is required. If this is not the case, this file must be transferred via the data interface.

To keep the time for data conversion as short as possible (1 Mbytes approx. 1 minute) we recommend to delete all programs no longer required.

Binary files and the corresponding ASCII files are related as follows:

.H	⇔	.H%	.I	⇔	.I%	.T	⇔	.T%
.TCH	⇔	.TC%	.D	⇔	.D%	.P	⇔	.P%
.PNT	⇔	.PN%	.COM	⇔	.CO%	.CMA	⇔	.CM%

Press key	Function
	TNC in operating mode PROGRAMMING/EDITING
MOD	Prepare TNC for input of code number
9 5 1 4 8 ENT	Enter code number; confirm with ENT
MOD	Call interface setup
UPDATE DATA / CONVERT BIN=>ASC	The files on the harddisk are converted into ASCII format one after the other.

The files to be converted must not be selected in PROGRAMMING/SINGLE BLOCK or FULL SEQUENCE!
The file **TNC:\CVREPORT.A** contains a list of the files that were converted!

22.2.4 Exchanging EPROMs

- Switch off the machine and exchange the EPROMs using the IC-extraction tool.

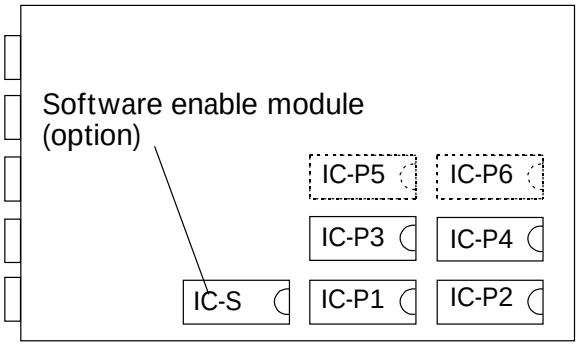
When exchanging the EPROMs, a MOS protection is definitely required, since otherwise MOS components on the board or the EPROMs may be destroyed.

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

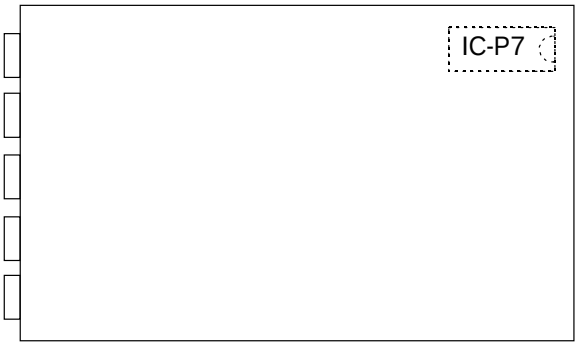
EPROM location diagram TNC 426/PA/PE/CA/CE

PGM No. 280 460 --, standard version
PGM No. 280 461 --, export version

Processor board Id.No. 287 376 01
Processor board Id.No. 289 450 01
Processor board Id.No. 292 115 01/02
Processor board Id.No. 296 688 01



Drive control board Id.No. 289 489 01
Drive control board Id.No. 291 061 01
Drive control board Id.No. 291 064 01



⇒ EPROM currently mounted

⇒ EPROM currently not mounted

22.2.5 Putting the control into service

- Switch power on.
- Confirm error messages with CE.

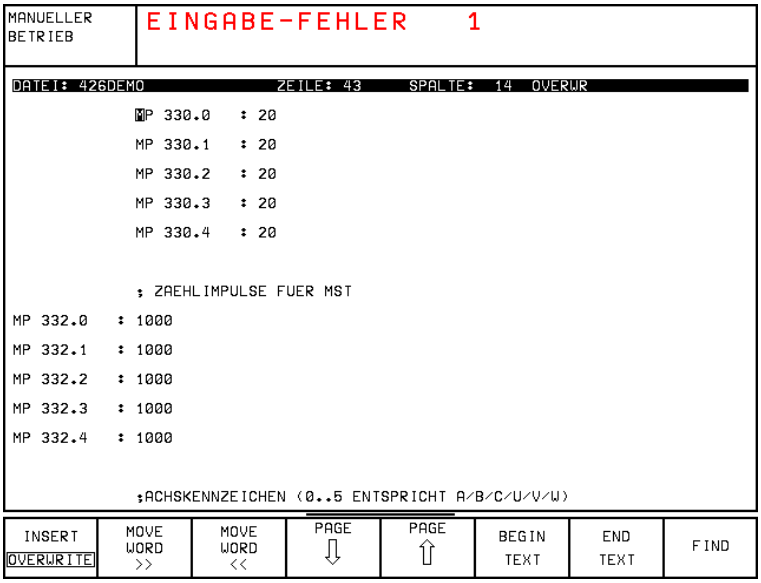
  Message | LANGUAGE LOAD ERROR XX | ⇒ see sec. 22.2.7

  Message | POWER INTERRUPTED | ⇒ see sec. 2

- Activate the machine parameters:
  The file **OEM.SYS** contains the machine parameter file used last by the TNC (status **M** in the file manager). This file is automatically **reactivated** after a software exchange.
  If machine parameters are introduced or eliminated with a software exchange, the control enters the MP editor of the active MP list after power-on.

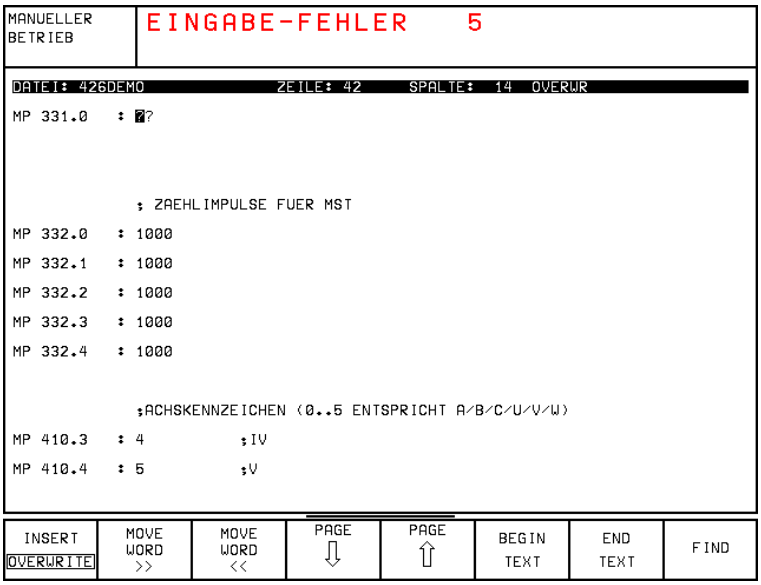
  Pressing END activates the MP file loaded in the editor. Depending on the software version machine parameters must be removed or entered (see file MPDOC.A on the language disk).
  The following dialogues may be displayed:

INPUT ERROR 1 → Parameter **eliminated**, clear by pressing DEL.



[4265d.PCX]

INPUT ERROR 5 → Parameter **introduced**, enter a value [1)]



[4266d.PCX]

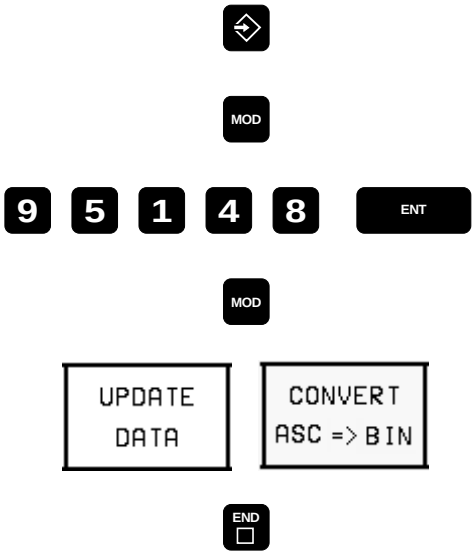
[1)] **Information can be obtained from the machine tool builder!**

22.2.6 Converting the files on the harddisk from ASCII format to binary format

After activating the machine parameters the **ASCII** files have to be reconverted into **binary** format.

Binary files and the corresponding ASCII files are related as follows:

.H	⇔	.H%	.I	⇔	.I%	.T	⇔	.T%
.TCH	⇔	.TC%	.D	⇔	.D%	.P	⇔	.P%
.PNT	⇔	.PN%	.COM	⇔	.CO%	.CMA	⇔	.CM%

Press key	**Function**
	TNC in operating mode PROGRAMMING/EDITING Prepare TNC for input of code number Enter code number; confirm with ENT Call interface setup The files on the harddisk are converted into binary format one after the other. Exit the subordinate mode

The file **TNC:\CVREPORT.A** contains a list of the files that were converted!

22.2.7 Installing the current dialogues on harddisk

If after the power-on routine of the control the message LANGUAGE LOAD ERROR XX is generated, the current dialogues are not stored on harddisk

After clearing the error message by pressing CE the English dialogue stored in the EPROM is automatically loaded.
The other dialogues are provided by HEIDENHAIN on a floppy disk (in DOS format) together with a transfer program. They have to be installed on the harddisk of TNC426.

Contents of the language disk Id.No. 280 465 --:

CZECH.BNC	Binary files of the dialogues (will be superseded by the file SETUP.BCK)
DANISH.BNC	
DUTCH.BNC	
FINNISH.BNC	
FRENCH.BNC	
GERMAN.BNC	
ITALIAN.BNC	
SPANISH.BNC	
SWEDISH.BNC	
PORTUGUE.BNC	
TNCBACK.EXE	Data transfer program (can also be used for data backup)
SETUP.BAT	Setup file of the data transfer software
SETUP.BCK	Backup file containing all dialogues
SETUP.LST	List file
README.TXT	Description of the data transfer program, English
LIESMICH.TXT	Description of the data transfer program, German
MPDOC.A	Description of the machine parameters, German

Installing the dialogues on harddisk:

1. TNC settings
- Select a baud rate of 9600 or higher in the operating mode LSV2.

2. Starting data transfer
- Insert the disk containing the language files and the data transfer software in the drive (e.g. a:\).
- Type a: to change to drive a.
- Enter the following line: **A:\> SETUP <CR>**

Note: If no command line parameters are entered when calling the SETUP, the data are transferred via the serial interface **COM1**. If you wish to activate another interface, a command line must be entered.

e.g. **A:\>SETUP (SP) 2 <CR>** for interface COM 2 (SP = space)

3. Activating the dialogues
After having transferred the dialogues (approx. 4 minutes) the control must be **switched off and on** to activate the new dialogues.

22.2.8 Re-establishing the original state of the machine

- Re-enter the **settings** noted down in section 22.2.1.
- Load the preset values (datum) acquired before the software exchange as ACTL values (DATUM SET) before traversing the ref. mark.
- Enter the code number 75368 to perform **offset adjustment** (TNC 426CA/CE only).
- If a **touch probe** is used, it must be **re-calibrated** after the software exchange.
- Machines with **swivel head**:
  Re-initialize the swivel head.
  Information can be obtained from the machine tool builder
- Machines with **tool changer**:
  Re-initialize the tool changer
  Information can be obtained from the machine tool builder
- **Non-volatile PLC memory** (see section 22.2.2)
  The non-volatile PLC memory of TNC 426 is **always reset** during an NC software exchange.
  If not covered by the PLC program, settings (e.g. initialization of an automatic tool changer) must be entered by hand.
  Information can be obtained from the machine tool builder

22.3 Exchanging the NC Software PGM No. 280 462 - 463 --

With TNC 426 PA/CA (PE/CE) the NC software should be exchanged in the order described below. These instructions **only** apply for the software types **280 462 - 463 --**! Depending on the version of the NC software, the machine tool model and features, some items may by skipped.

Basically all files stored on the harddisk should be backed up on an external data medium. For this purpose HEIDENHAIN offers the data transfer software TNCBACK.EXE free of charge (see section 22.4).

22.3.1 Backing up RAM data

When TNC426 is prepared for an exchange of the NC software, all important information in RAM are **automatically backed up** on the harddisk.

MODE settings (position display etc.)
AXIS-LIMIT (limitations of the traverse range, datums)
RS 232/422 SETUP (assignment, baud rate etc.)
Touch probe calibration data
Non-volatile PLC memory (markers and words from a certain group)

After the NC software exchange these data are **automatically** restored.

22.3.2 Putting the machine (axes) in a defined status

Machines with swivel head:

- Bring the swivel head into a defined position (normal position).
  Information can be obtained from the machine tool builder!

Machines with tool changer:

- Bring the tool changer into a defined position.
  Information can be obtained from the machine tool builder!

Machine axes in general:

- Move the axes to the middle of the traverse range
  (away from the hardware limit switches)

NOTES

22.3.3 Converting data on the harddisk from binary format to ASCII format

Before the EPROMs on the processor board of TNC426 can be exchanged, the data on the harddisk must be converted from **binary** into **ASCII** format. A minimum free memory of 1.5 times the largest file on the harddisk is required. If this is not the case, this file must be transferred via the data interface.

To keep the time for data conversion as short as possible (1 Mbytes approx. 1 minute) we recommend to delete all programs no longer required.

Binary files and the corresponding ASCII files are related as follows:

.H	⇔	.H%	.I	⇔	.I%	.T	⇔	.T%
.TCH	⇔	.TC%	.D	⇔	.D%	.P	⇔	.P%
.PNT	⇔	.PN%	.COM	⇔	.CO%	.CMA	⇔	.CM%

Press key	Function
	TNC in operating mode PROGRAMMING/EDITING
MOD	Prepare TNC for input of code number
9 5 1 4 8 ENT	Enter code number; confirm with ENT
MOD	Call interface setup
UPDATE DATA / CONVERT BIN=>ASC	The files on the harddisk are converted into ASCII format one after the other.

The files to be converted must not be selected in PROGRAMMING/SINGLE BLOCK or FULL SEQUENCE!
The file **TNC:\CVREPORT.A** contains a list of the files that were converted!

22.3.4 Exchanging EPROMs

- Switch off the machine and exchange the EPROMs using the IC-extraction tool.

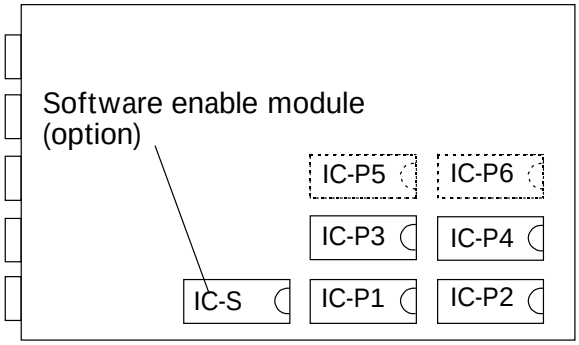
When exchanging the EPROMs, a MOS protection is definitely required, since otherwise MOS components on the board or the EPROMs may be destroyed.

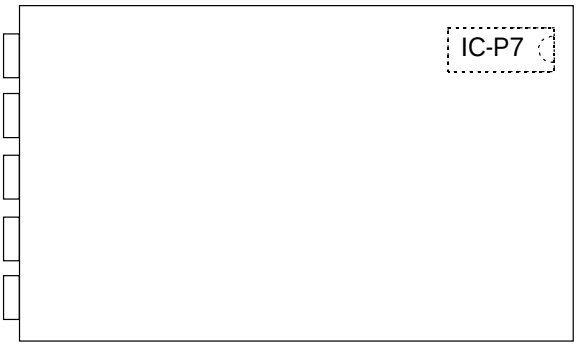
Caution!
Avoid any unprotected handling or contact of the boards or EPROMs with statically charged objects (packaging material, storage etc.).

EPROM location diagram TNC 426/PA/PE/CA/CE
PGM No. 280 462 --, standard version
PGM No. 280 463 --, export version

Processor board Id.No. 287 376 01
Processor board Id.No. 289 450 01
Processor board Id.No. 292 115 01/02
Processor board Id.No. 296 688 01

Drive control board Id.No. 289 489 01
Drive control board Id.No. 291 061 01
Drive control board Id.No. 291 064 01





⇒ EPROM currently mounted

⇒ EPROM currently not mounted

22.3.5 Putting the control into service

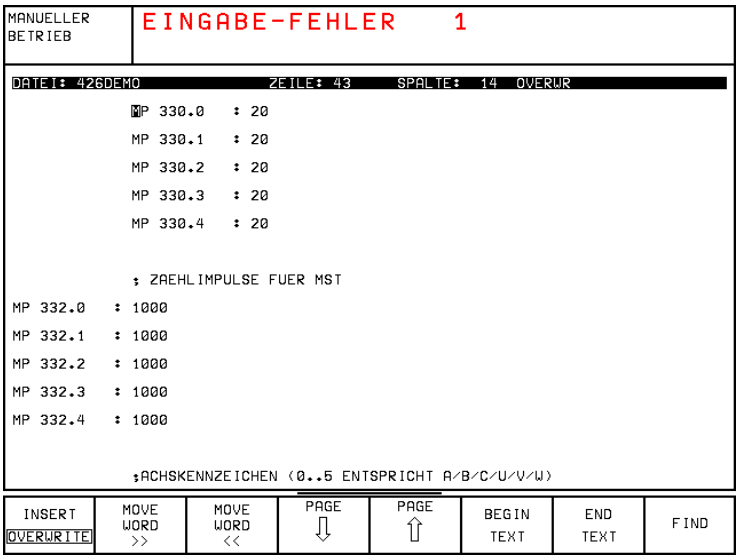
- Switch power on
- Confirm error messages with CE.

Message	LANGUAGE LOAD ERROR XX	⇒ see sec. 22.3.7
Message	UPDATE THE SYSTEM DATA!	⇒ see sec. 22.3.7
Message	POWER INTERRUPTED	⇒ see sec. 2

- Activate the machine parameters:
  The file **OEM.SYS** contains the machine parameter file used last by the TNC (status **M** in the file manager). This file is automatically **reactivated** after a software exchange.
  If machine parameters are introduced or eliminated with a software exchange, the control enters the MP editor of the active MP list after power-on.

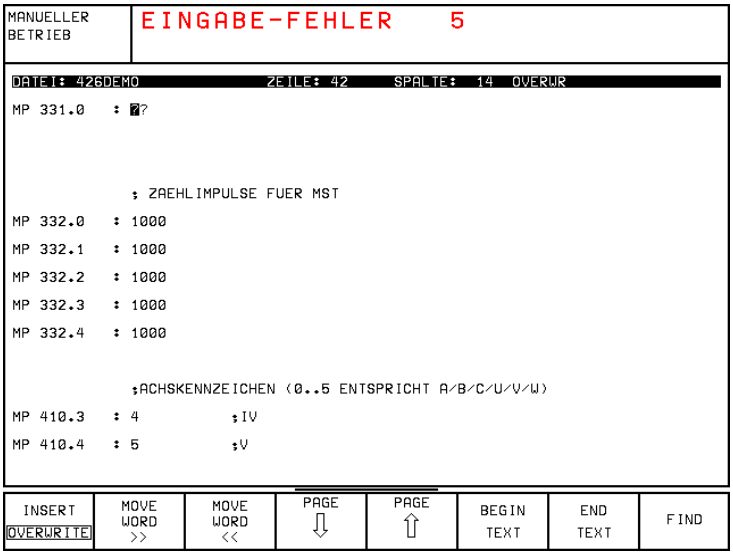
  Pressing END activates the MP file loaded in the editor. Depending on the software version machine parameters must be removed or entered (see file READ_MP.A on the file disk).
  The following dialogues may be displayed:

INPUT ERROR 1 → Parameter **eliminated**, clear by pressing DEL



[4265d.PCX]

INPUT ERROR 5 → Parameter **introduced**, enter a value[1)]



[4266d.PCX]

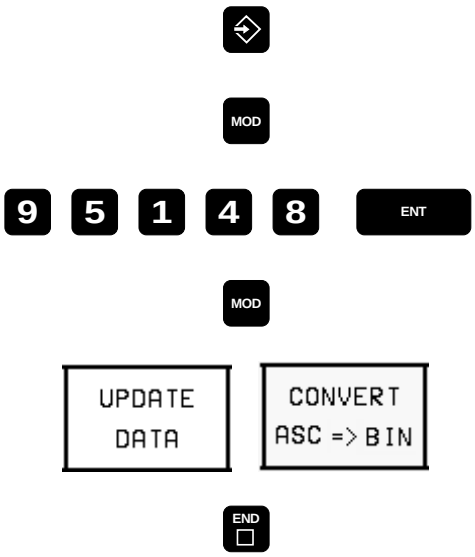
[1)] **Information can be obtained from the machine tool builder!**

22.3.6 Converting the files on the harddisk from ASCII format to binary format

After activating the machine parameters, the **ASCII** files have to be reconverted into **binary** format.

Binary files and the corresponding ASCII files are related as follows:

.H	⇔	.H%	.I	⇔	.I%	.T	⇔	.T%
.TCH	⇔	.TC%	.D	⇔	.D%	.P	⇔	.P%
.PNT	⇔	.PN%	.COM	⇔	.CO%	.CMA	⇔	.CM%

Press key	**Function**
	TNC in operating mode PROGRAMMING/EDITING Prepare TNC for input of code number Enter code number, confirm with ENT Call interface setup The files on the harddisk are converted into binary format one after the other. Exit the subordinate mode

The file **TNC:\CVREPORT.A** contains a list of the files converted!

22.3.7 Installing the current system files on harddisk

If after the power-on routine of the control the message LANGUAGE LOAD ERROR XX or UPDATE THE SYSTEM DATA! is generated, the current files (cycles, NC dialogues etc.) are not stored on harddisk.

After clearing the error messages by pressing CE the English dialogue stored in the EPROM is automatically loaded.
The other files are provided by HEIDENHAIN on a floppy disk (in DOS format) together with a transfer program. They have to be installed on the harddisk of TNC426.

Contents of the disk Id.No. 280 467 --:

TNCBACK.EXE	Data transfer program (can also be used for data backup)
SETUP.BAT	Setup file of the data transfer software
SETUP.BCK	Backup file containing all dialogues
SETUP.LST	List file
README.TXT	Description of the data transfer program, English
LIESMICH.TXT	Description of the data transfer program, German
LIES_MP.A	Description of the machine parameters, German
READ_MP.A	Description of the machine parameters, English

Installing the system files on harddisk:

1. TNC settings
- Select a baud rate of 9600 or higher in the operating mode LSV2.

2. Starting data transfer
- Insert the disk containing the language files and the data transfer software in the drive (e.g. a:\).
- Type a: to change to drive a.
- Enter the following line: **A:\> SETUP <CR>**

Note: If no command line parameters are entered when calling the SETUP, the data are transferred via the serial interface **COM1**. If you wish to activate another interface, a command line must be entered.

e.g. **A:\>SETUP (SP) 2 <CR>** for interface COM 2 (SP = space)

3. Activating the system files

After having transferred the system files (approx. 4 minutes) the control must be **switched off and on** to activate the new system files.

22.3.8 Re-establishing the original state of the machine

- Enter the code number 75368 to perform **offset adjustment** (TNC 426CA/CE only).

- If a **touch probe** is used, it must be **re-calibrated** after the software exchange.

- Machines with **swivel head**:
  Re-initialize the swivel head.
  Information can be obtained from the machine tool builder

- Machines with **tool changer**:
  Re-initialize the tool changer
  Information can be obtained from the machine tool builder

NOTES

22.4 Backing-up Harddisk Data

For a software exchange, the harddisk data do not have to be backed up.

The harddisk data should be backed up regularly on an external data medium (PC).

For this purpose **HEIDENHAIN** offers the data transfer software **TNCBACK.EXE** which is supplied with every service manual (disk in envelope). This program can also be ordered separately (Id.No. 280 534 03). With this program the entire contents of the harddisk or of individual partitions (including the subdirectories) can be read out easily in LSV2 protocol. The data can also be restored on harddisk.
Please contact HEIDENHAIN, if you require this software.

1. TNC settings

- Select a baud rate of 9600 or higher in the operating mode LSV2.

2. Backing-up TNC harddisk data on an external data medium

- Install the data transfer software on e.g. drive C (harddisk of personal computer).
- Call TNCBACK.EXE by entering the following command line:

C:\>TNCBACK (SP) <target file> (SP) <partition> (SP) <interface> (SP = space)

- **<interface>**: no entry: COM1; otherwise e.g. PCOM2 for COM2
- **<partition>**: Partition to be backed up
  e.g. TNC: for entire TNC partition
  e.g. TNC:\FORM1 for a subdirectory
  e.g. parameter F for entire harddisk
- **<target file>**: Name of the backup file (without extension!)

Note: Enter **C:\>TNCBACK (SP) ?** to display a help text.

After finishing data transfer, two files are created on the external data medium:
<NAME>.**BCK** → backup file containing the data
<NAME>.**LST** → list file to restore the backup file on the harddisk of TNC 426.

3. Restoring backed-up data on the TNC harddisk

- Call TNCBACK.EXE by entering the following command line:

C:\>TNCBACK (SP) <source file> (SP) R (SP) <interface>

- **<interface>**: no entry: COM1; otherwise e.g. PCOM2 for COM2
- **<source file>**: backup file on external data medium (without extension!)

NOTE:
The data transfer program **TNCBACK.EXE** is supplied with the text file **README.TXT** containing a description of the functions of the data transfer software.

22.5 Exchanging the LOGIC UNIT

22.5.1 Preparations at the machine tool

- Back-up of the data in RAM (see sec. 22.2.1)
- Bring machine or axes in defined state (see sec. 22.2.2)
- Back-up of non-volatile PLC markers and words on harddisk (see sec. 20.6)

22.5.2 Important harddisk information

All part programs, tool tables, machine parameters, PLC programs, compensation value tables, NC dialogues in all languages etc. are stored on the harddisk.
When the logic unit is to be exchanged, the contents of the harddisk of the defective logic unit can be prepared for the exchange logic unit in two different ways.

1. Way: Back-up of the harddisk data by means of data transfer program TNCBACK.EXE

- Back-up the harddisk data of the **defective** logic unit (see section 22.4)
- Dismount the defective logic unit (see section 22.5.3)
- Mount the exchange logic unit (see section 22.5.4)
- Restore the backed-up harddisk data of the defective logic unit on the harddisk of the exchange logic unit (see section 22.4)
- Load the backed-up states of the non-volatile PLC markers and words back into RAM before ref. mark traverse (see sec. 20.6)
- Re-establish the original state of the machine tool (see section 22.2.8)

2. Way: Exchanging the harddisk

Proceeding:

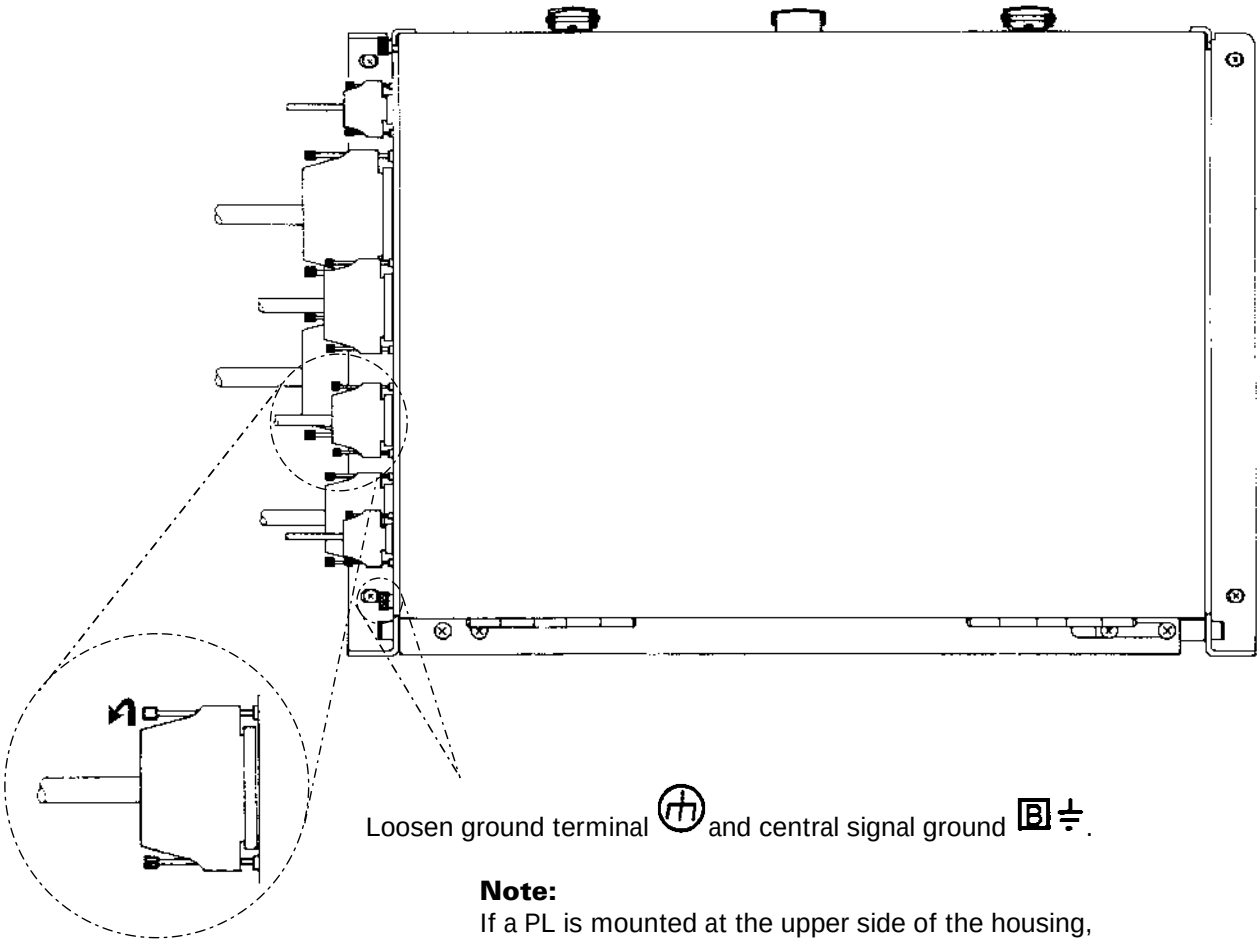
- Convert the harddisk data of the **defective** logic unit from binary to ASCII format (see section 22.2.3)
  Note:
  This step is only required, if the NC software version of the two logic units is not the same.
- Dismount the defective logic unit (see section 22.5.3)
- Dismount the harddisk of the defective logic unit (see section 22.6)
- Dismount the harddisk of the exchange logic unit (see section 22.6)
- Mount the harddisk from the defective logic unit in the exchange logic unit and vice versa (see section 22.6)
- Mount the exchange logic unit (see section 22.5.4)
- In the exchange logic unit convert the harddisk data from ASCII to binary format (see section 22.2.6)
  Note:
  This step is only required, if the NC software version of the two logic units is not the same.
- Load the backed-up states of the non-volatile PLC markers and words back into RAM before ref. mark traverse (see sec. 20.6)
- Re-establish the original state of the machine tool (see section 22.2.8)

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.

Observe the safety instructions!

22.5.3 Dismounting the logic unit

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

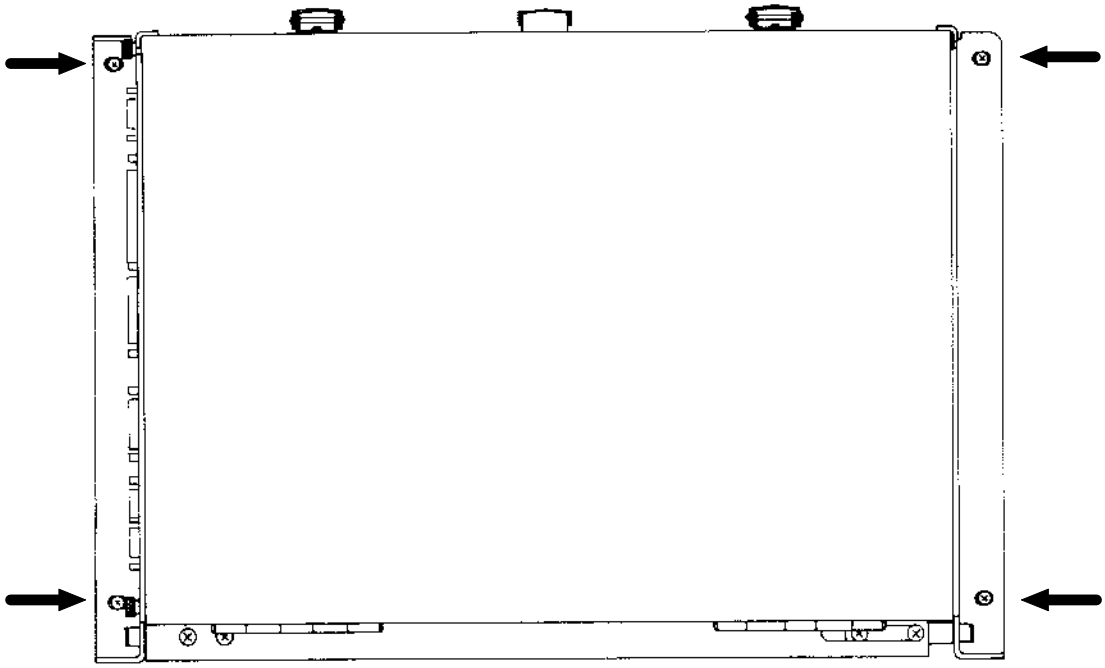


D-Sub connector
Loosen knurled screw

Loosen ground terminal ⏚ and central signal ground ⏚.

Note:
If a PL is mounted at 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.

22.5.4 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.

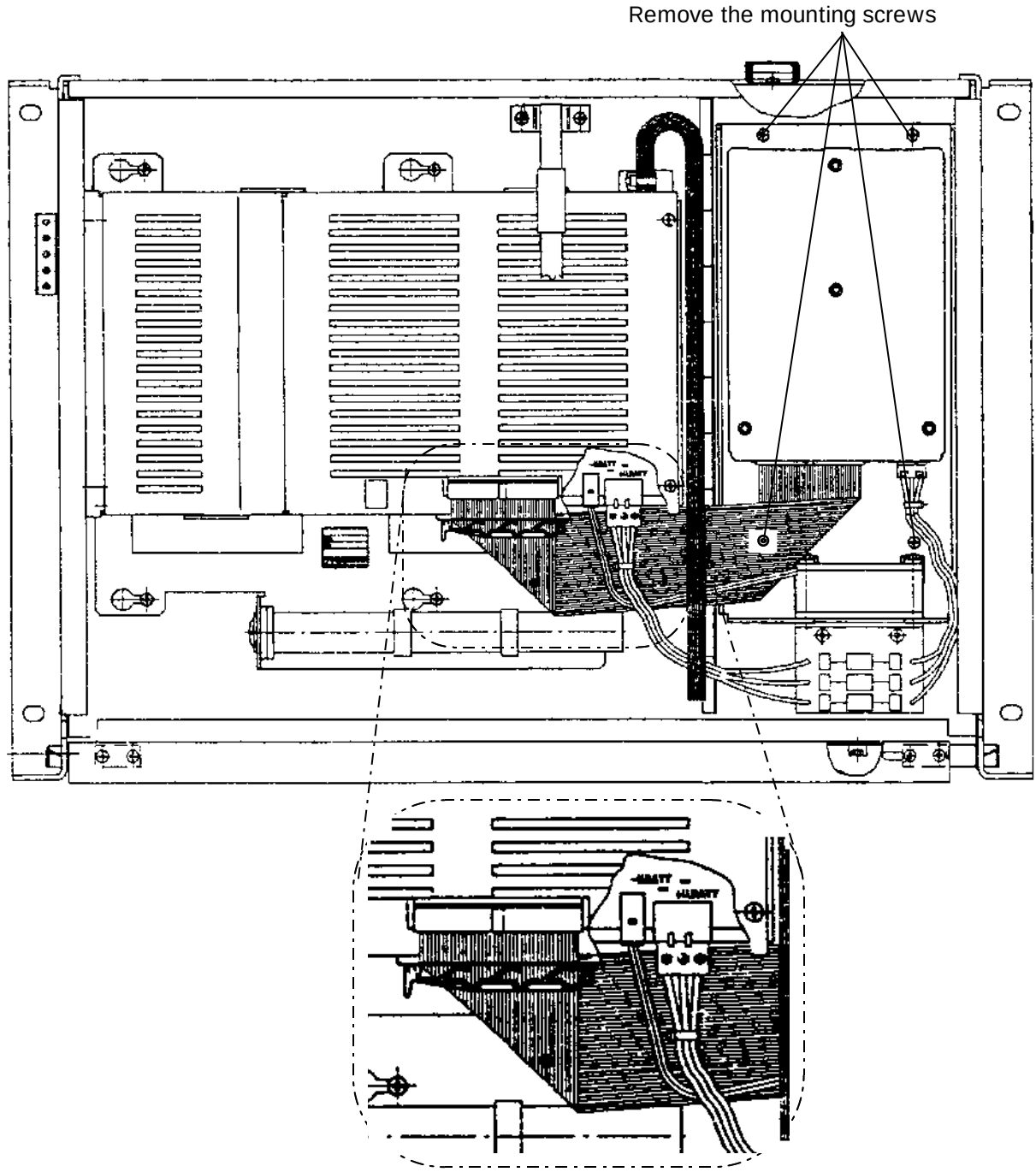
Observe that no connectors are switched!

c) Switch on power.
d) Re-establish the original state of the machine (see sec. 22.2.8).

22.6 Exchanging the Harddisk

Proceeding:

- Back-up the harddisk data (see sec. 22.4).
- Switch power off.
- Open the logic unit.
- Disengage the plug connections ☆ and loosen the mounting screws of the harddisk.



Disconnect ☆ 2-pin connecting element (power supply of fan) at the power supply unit.
Disconnect ☆ 3-pin connecting element (power supply of HDD) at the power supply unit.
Open ☆ holder of flat cable and disconnect the cable from the processor board.

- Remove the old harddisk and insert the new one. The harddisk is mounted in the reverse order that it was dismounted.
- Load the backed-up data on the exchange harddisk.

23. Machine Parameter List

MACHINE PARAMETER LIST
(excerpt from R.H. 1.0 TNC 426, folder 5)

Code Numbers

123	MACHINE PARAMETER EDITING FOR END USERS (marked by *)
75368	OFFSET ADJUSTMENT (TNC 426 CA only)
79513	VOLTAGE AND TEMPERATURE DISPLAY
86357	REMOVE EDIT/ERASE PROTECTION
95148	MP MODE
531210	RESET M0 TO M999 AND BYTES 0 - 127
807667	PLC MODE
688379	INTERNAL OSCILLOSCOPE

Machine Parameters

The following list contains the machine parameters for all software versions.
Since however, certain machine parameters are only valid for a certain software or have been introduced with a certain software version, there are columns with symbols for differentiation after the parameter number.

Explanation of the Symbols:

◆ = The machine parameter of this control applies for all software versions.
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 on this control.

Explanation of the Columns:

A = TNC 426PA/CA with NC software 280 460 -- or 280 461 --
B = TNC 426PA/CA with NC software 280 462 -- or 280 463 --
C = reserved
D = reserved
AE6 = Entry value for HEIDENHAIN test unit

Function		MP No.	Bit	A	B	C	D	Input		AE-6 Entry value
Axes with encoder		10		◆	◆			0 =	without encoder	
(active axes)	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	
Monitoring of position encoder Input of position encoder at X1 to X6		30		◆	◆			0 =	no axis monitored	
Absolute position with 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	D	Input	AE-6 Entry values
Screen 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	◆	◆			+32 = position of the controlled spindle (not with M03/M04)	
Controlled axes	50		◆	◆			0 = no axis controlled (counting axis only)	
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 ⇒ NC 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...5 TNC 426CA/CE: / TNC 426PA/PE:[2] 0 = input X1 / 0 = input X1 1 = input X2 / 1 = input X2 2 = input X3 / 2 = input X3 3 = input X4 / 3 = input X4 4 = input X5 / 4 = input X5 5 = input X6[1] / 5 = input X6[1]	
X	110.0		◆	◆				0
Y	110.1		◆	◆				1
Z	110.2		◆	◆				2
IV	110.3		◆	◆				3
V	110.4		◆	◆				4

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

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Assignment of the nominal value outputs to the machine axes (no function with PWM axes)	X	120.0		◆	◆			0 ... 5 0 = output 1 1 = output 2 2 = output 3 3 = output 4 4 = output 5 5 = output S [1]	 0 1 2 3 4
	Y	120.1		◆	◆				
	Z	120.2		◆	◆				
	IV	120.3		◆	◆				
	V	120.4		◆	◆				
Counting direction of the encoder signals for the position encoder		210		◆	◆			0 = positive	
	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 (Displacement per grating period. Consider the screw pitch when using a rotary encoder.) With square-wave input signals the displacement per square-wave period must be indicated. (Consider the external interpolation.)	X	330.0		I02	-			0.1...1000 [µm]	20
	Y	330.1		I02	-				20
	Z	330.2		I02	-				20
	IV	330.3		I02	-				20
	V	330.4		I02	-				20
Calculation of the signal period Path for counting pulses from MP 332.X	X	331.0		02	◆			0 ... 99 999.9999 [mm]	0.02
	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 MP 331.X	X	332.0		02	◆			1 ... 16 177 215 [counting pulses] The TNC automatically calculates the signal period. signal period [mm] = $\frac{\text{MP 331}}{\text{MP 332}}$	1
	Y	332.1		02	◆				1
	Z	332.2		02	◆				1
	IV	332.3		02	◆				1
	V	332.4		02	◆				1

[1] S-Analog 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	D	Input	AE-6 Entry values
Axis designation									
	IV	410.3		◆	◆			0 = A (angular axis to X)	4
	V	410.4		◆	◆			1 = B (angular axis to Y) 2 = C (angular axis to Z) 3 = U (parallel axis to X) 4 = V (parallel axis to Y) 5 = W (parallel axis to Z)	5
Hirth coupling									
Activation	IV	420.3		◆	◆			0 = inactive	0
	V	420.4		◆	◆			1 = active	0
Prescribed step	IV	430.3		◆	◆			0 ... 30.0000 [°]	1
	V	430.4		◆	◆				1

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Backlash compensation									
	X	710.0		◆	◆			-1.0000 ... +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		◆	◆			-1.0000 ... +1.0000 [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 ... 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 **M105**)	X	715.0		◆	◆			-1.0000 ... +1.0000 [mm]	0
	Y	715.1		◆	◆				0
	Z	715.2		◆	◆				0
	IV	715.3		◆	◆				0
	V	715.4		◆	◆				0
• feed rate to compensate the reversal spike (only effective with **M105**)	X	716.0		◆	◆			0 ... 1 [mm per CLP cycle time]	0
	Y	716.1		◆	◆				0
	Z	716.2		◆	◆				0
	IV	716.3		◆	◆				0
	V	716.4		◆	◆				0

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Factor for linear axis error compensation	X	720.0		◆	◆			-1.0000 ... +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 ... ± 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 and AXIS LIMIT **active**	0
	Z	810.2		◆	◆			≠ 0 ⇒ modulo value for display	0
	IV	810.3		◆	◆			software limit switch and AXIS LIMIT **inactive**	0
	V	810.4		◆	◆				0

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

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
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 ... +99 999.9999 [mm]	"
	Z+	910.2		◆	◆				"
Activation via PLC:	IV+	910.3		◆	◆			rotary axis:	"
M2817 = 0. M2816 = 0	V+	910.4		◆	◆			-99 999.9999 ... +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 via 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 via 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	D	Input	AE-6 Entry values
Datum for positioning blocks with M92 (referenced to machine datum)	X	950.0		◆	◆			linear axis:	0
	Y	950.1		◆	◆			-99 999.9999 ... +99 999.9999 [mm]	0
	Z	950.2		◆	◆				0
	IV	950.3		◆	◆			rotary axis:	0
	V	950.4		◆	◆			-99 999.9999 ... +99 999.9999 [°]	0
Target position for simulated tool change for TOOL CALL with block scan	X	951.0		◆	◆			linear axis:	0
	Y	951.1		◆	◆			-99 999.9999 ... +99 999.9999 [mm]	0
	Z	951.2		◆	◆				0
	IV	951.3		◆	◆			rotary axis:	0
	V	951.4		◆	◆			-99 999.9999 ... +99 999.9999 [°]	0
Shifting the machine datum (referenced to the reference mark of the measuring system)	X	960.0		◆	◆			linear axis:	0
	Y	960.1		◆	◆			-99 999.9999 ... +99 999.9999 [mm]	0
	Z	960.2		◆	◆				0
	IV	960.3		◆	◆			rotary axis:	0
	V	960.4		◆	◆			-99 999.9999 ... +99 999.9999 [°]	0

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Rapid traverse	X	1010.0		◆	◆			linear axis:	10000
	Y	1010.1		◆	◆			10 ... 300 000 [mm/min]	"
	Z	1010.2		◆	◆			rotary axis:	"
	IV	1010.3		◆	◆			10 ... 300 000 [°/min]	"
	V	1010.4		◆	◆				"
Manual feed	X	1020.0		◆	◆			linear axis:	10000
	Y	1020.1		◆	◆			10 ... 300 000 [mm/min]	"
	Z	1020.2		◆	◆			rotary axis:	"
	IV	1020.3		◆	◆			10 ... 300 000 [°/min]	"
	V	1020.4		◆	◆				"
Positioning window	X	1030.0		◆	◆			linear axis:	0.05
	Y	1030.1		◆	◆			0.0001 ... 2.0000 [mm]	"
	Z	1030.2		◆	◆			rotary axis	"
	IV	1030.3		◆	◆			0.0001 ... 2.0000 [°]	"
	V	1030.4		◆	◆				"
Polarity		1040		◆	◆			0 = positive	
of the nominal value voltage	X		0					+1 = X axis negative	% 00000
(**analogue** axes)	Y		1					+2 = Y axis negative	
or the nominal shaft speed (**PWM** axes)	Z		2					+4 = Z axis negative	
with positive traverse direction	IV		3					+8 = IV. axis negative	
	V		4					+16 = V. axis negative	
Analogue voltage for rapid traverse	X	1050.0		◆	◆			4.5 ... 9 [V]	9
(for analogue axes)	Y	1050.1		◆	◆				9
	Z	1050.2		◆	◆			no function with **PWM** axes	9
	IV	1050.3		◆	◆			⇒ entry value = **1**	9
	V	1050.4		◆	◆				9

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Acceleration	X	1060.0		◆	◆			0.001 ... 5.0 [m/s²]	1
	Y	1060.1		◆	◆				1
	Z	1060.2		◆	◆				1
	IV	1060.3		◆	◆				1
	V	1060.4		◆	◆				1
Radial acceleration		1070		◆	◆			0.001 ... 5.0 [m/s²]	0.5
Integral factor	X	1080.0		◆	◆			0 ... 65 535	0
	Y	1080.1		◆	◆			no function with PWM axes	0
	Z	1080.2		◆	◆			⇒ entry value = **0**	0
	IV	1080.3		◆	◆				0
	V	1080.4		◆	◆				0
Standstill monitoring	X	1110.0		◆	◆			0.0001 ... 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 ... 10 [V] with **analogue** axes	1
	Y	1140.1		◆	◆			0.03 ... 10 [1000/min] with **PWM** axes	1
	Z	1140.2		◆	◆				1
	IV	1140.3		◆	◆			**Warning:** entry value 10 ⇨ monitoring **inactive**	1
	V	1140.4		◆	◆				1
Time out to switch off the residual nominal value voltage on error message "POSITIONING ERROR"		1150		◆	◆			0 ... 65 535 [s]	0
Automatic cyclic offset adjustment for analogue axes		1220		◆	◆			1 ... 65 535 [s] 0 = no automatic adjustment no function with PWM axes ⇒ entry value = 0	1

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Reference mark evaluation		1320		◆	◆			0 = positive	
Direction for traversing the reference	X		0					+1 = X axis negative	% 00000
marks	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	X	1330.0		◆	◆			linear axis:	10 000
marks	Y	1330.1		◆	◆			10 ... 300 000 [mm/min]	"
	Z	1330.2		◆	◆				"
	IV	1330.3		◆	◆			rotary axis:	"
	V	1330.4		◆	◆			10 ... 300 000 [°/min]	"
Feed rate for leaving the reference end	X	1331.0		◆	◆			linear axis:	200
position	Y	1331.1		◆	◆			10 ... 300 000 [mm/min]	"
(only if MP1350 = 2)	Z	1331.2		◆	◆				"
	IV	1331.3		◆	◆			rotary axis:	"
	V	1331.4		◆	◆			10 ... 300 000 [°/min]	"
								0 = no ref. mark traverse	
Axis sequence for 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 ref. marks	1
	Y	1350.1		◆	◆			(1. mode)	1
	Z	1350.2		◆	◆			1 = position encoder without distance-coded	1
	IV	1350.3		◆	◆			ref. marks	1
	V	1350.4		◆	◆			2 = special operation (linear measurement with	1
								rotary encoder)	
								3 = position encoder with distance-coded ref. marks	
								(2. mode)	

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	D	Input	AE-6 Entry values
Feed forward control or trailing mode in the operating modes "Positioning with Manual Data Input" "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	◆			bit = 0: control in the operating modes "Positioning with MDI", "Program Run, Single Block" and "Program Run, Full Sequence" according to MP 1390 bit = 1: feed forward control in all operating modes	% 00000

Operation with Feed Forward Control

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

Function		MP No. Bit	A	B	C	D	Input	AE-6 Entry values
1. block of KV factors	X	1510.0	◆	◆			0.1 ... 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 ... 16 777 215	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 ... 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 ... 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 ... 20	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 ... 10 [m/min]	1
Feed rate below which the							0.1 ... 10.000 [mm/min]	
positioning window is monitored	X	1525.0	◆	◆				0
	Y	1525.1	◆	◆			recommended value: 0.5 m/min	0
	Z	1525.2	◆	◆				0
	IV	1525.3	◆	◆				0
	V	1525.4	◆	◆				0

Operation with Servo Lag

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Position monitoring for operation with servo lag								0 ... 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 ... 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 operation with servo lag	X	1810.0		◆	◆			0.1 ... 20	1
	Y	1810.1		◆	◆				1
	Z	1810.2		◆	◆				1
	IV	1810.3		◆	◆				1
	V	1810.4		◆	◆				1
2. block of KV factors for operation with servo lag M105: enable M106: inhibit	X	1815.0		◆	◆			0.1 ... 20	1
	Y	1815.1		◆	◆				1
	Z	1815.2		◆	◆				1
	IV	1815.3		◆	◆				1
	V	1815.4		◆	◆				1

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Multiplication factor for KV	X	1820.0		◆	◆			0.001 ... 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 ... 100.000 [%]	
	Y	1830.1		◆	◆				100
	Z	1830.2		◆	◆				100
	IV	1830.3		◆	◆				100
	V	1830.4		◆	◆				100
									100

Integral Speed and Current Controller (TNC 426 PA/PE)

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Drive mode	X	2000.0		◆	◆			0 = output of nominal speed to X8 ⇒TNC 426 **CA/CE**	0
	Y	2000.1		◆	◆			1 = reserved	0
	Z	2000.2		◆	◆			2 = PWM structure ⇒ TNC 426 **PA/PE**	0
	IV	2000.3		◆	◆				0
	V	2000.4		◆	◆				0
	S	2000.5		◆	◆				0
Measuring system for position control		2010		◆	◆			bit = 0: 2 encoders are used per axis: - linear encoder for position (X1 to X6) - rotary encoder for speed (X15 to X20) bit = 1: 1 encoder (X15 to X20) (rotary encoder on motor) is used for actual position and actual speed	%00000
	X		0						
	Y		1						
	Z		2						
	IV		3						
	V		4						
Displacement with one revolution of the drive Displacement of the feed axis with one revolution of the servo drive	X	2020.0		◆	◆			1 ... 100[mm]	1
	Y	2020.1		◆	◆				1
	Z	2020.2		◆	◆				1
	IV	2020.3		◆	◆				1
	V	2020.4		◆	◆				1
	S	2020.5		◆	I02				1
Power stage model	X	2100.0		◆	-			with SIEMENS power stage: 0	0
	Y	2100.1		◆	-				0
	Z	2100.2		◆	-				0
	IV	2100.3		◆	-				0
	V	2100.4		◆	-				0
	S	2100.5		◆	-				0

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Maximum current [1]	X	2110.0		◆	◆			0 ... 999.999[As]	0
of the power stage	Y	2110.1		◆	◆			e.g. with SIEMENS power stage 6SN1123-1AA00-0BA0:	0
	Z	2110.2		◆	◆			18 A · $\sqrt{2}$ = 25.45 As	0
	IV	2110.3		◆	◆				0
	V	2110.4		◆	◆			The speed controller limits the maximum current to the	0
	S	2110.5		◆	◆			minimum value in MP2110.X and MP2310.X	0
Nominal current of the power stage[1]	X	2120.0		◆	◆			0 ... 999.999[As]	0
(reference value for I^2t monitoring)	Y	2120.1		◆	◆			e.g. with SIEMENS power stage 6SN1123-1AA00-0BA0:	0
see MP2302.X	Z	2120.2		◆	◆			9 A · $\sqrt{2}$ = 12,72 As	0
	IV	2120.3		◆	◆				0
	V	2120.4		◆	◆				0
	S	2120.5		◆	◆				0
Voltage of the current sensor	X	2130.0		◆	◆			0 ... 99.999 [V]	0
at the current intensity defined in	Y	2130.1		◆	◆				0
MP2110.X [1]	Z	2130.2		◆	◆				0
	IV	2130.3		◆	◆				0
	V	2130.4		◆	◆				0
	S	2130.5		◆	◆				0
Motor type [2]	X	2200.0		◆	◆			0 ... 5	0
	Y	2200.1		◆	◆			0 = synchronous motor	0
	Z	2200.2		◆	◆			1 = asynchronous motor	0
	IV	2200.3		◆	◆			2 ... 5 = reserved	0
	V	2200.4		◆	◆				0
	S	2200.5		◆	◆				0

[1] entry values depending on the power stage: see item 1 on page 20
[2] entry values depending on the motor: see item 2 on page 20

1. Entry values depending on the power stage

The entry values of the machine parameters MP 2110. MP 2120 and MP 2130 depend on the power stage model used. These values are calculated by HEIDENHAIN and listed in a table. When using the NC software 280 462 -- this table is filed on the harddisk under SYS:\MP\AMPLIFY.A. The correct power stage can be selected directly via a menu in the machine parameter list of the TNC. The machine parameters are then automatically programmed with the correct data. When using the NC software 280 460 -- the values have to be entered by hand.

2. Entry values depending on the drive

The entry values of the machine parameters MP 2200 to MP 2350 depend on the motor used. These values are calculated by HEIDENHAIN and listed in a table. When using the NC software 280 462 -- this table is filed on the harddisk under SYS:\MP\MOTOR.A. The correct motor can be selected directly via a menu in the machine parameter list of the TNC. The machine parameters are then automatically programmed with the correct data. When using the NC software 280 460 -- the values have to be entered by hand.

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Nominal rpm (synchronous motor) [1]	X	2210.0		◆	◆			0 ... 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 ... 99 999 [rpm] [2]	0
	Y	2220.1		◆	◆				0
	Z	2220.2		◆	◆			When operating with servo lag the speed is limited	0
	IV	2220.3		◆	◆			to the value of MP2220.X. With feed forward control,	0
	V	2220.4		◆	◆			the error message	0
	S	2220.5		◆	◆			**GROSS POSITIONING ERROR <Axis> B**	0
								is generated when the value of MP2220 is reached.	
Number of pairs of poles [1]	X	2230.0		◆	◆			1 ... 4	1
	Y	2230.1		◆	◆				1
	Z	2230.2		◆	◆			**Number of pairs of poles** = $\frac{\text{number of poles}}{2}$	1
	IV	2230.3		◆	◆				1
	V	2230.4		◆	◆				1
	S	2230.5		◆	◆				1
Line count of rotary encoder	X	2240.0		◆	◆			0 ... 10 000 [lines/revolution]	0
(speed encoder)	Y	2240.1		◆	◆				0
	Z	2240.2		◆	◆				0
	IV	2240.3		◆	◆				0
	V	2240.4		◆	◆				0
	S	2240.5		◆	◆				0

[1] Drive-dependent entry values: see page 20

[2] Due to the different behaviour of the HEIDENHAIN and the SIEMENS current controllers, the maximum shaft speed of TNC 426 is **15 % below** the values of the SIEMENS data specifications. If the motor is selected via menu, the reduced value is automatically entered.

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Counting direction of the signals of the rotary encoder (speed encoder)	X	2250.0		◆	◆			0 = not inverted 1 = inverted	0
	Y	2250.1		◆	◆				0
	Z	2250.2		◆	◆				0
	IV	2250.3		◆	◆				0
	V	2250.4		◆	◆				0
	S	2250.5		◆	◆				0
reserved	X	2260.0		◆	◆			entry value = 0	0
	Y	2260.1		◆	◆				0
	Z	2260.2		◆	◆				0
	IV	2260.3		◆	◆				0
	V	2260.4		◆	◆				0
	S	2260.5		◆	◆				0
Maximum motor temperature [1]	X	2270.0		◆	◆			0 ... 255 [°C] 255 = no monitoring or no temperature sensor available!	0
	Y	2270.1		◆	◆				0
	Z	2270.2		◆	◆				0
	IV	2270.3		◆	◆				0
	V	2270.4		◆	◆				0
	S	2270.5		◆	◆				0
Magnetising current for asynchronous motors [1] (in free run)	X	2280.0		◆	◆			0 ... 999.999 [As]	0
	Y	2280.1		◆	◆				0
	Z	2280.2		◆	◆				0
	IV	2280.3		◆	◆				0
	V	2280.4		◆	◆				0
	S	2280.5		◆	◆				0

[1] Drive-dependent entry values: see page 20

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Time constant of armature of asynchronous motor [1]	X	2290.0		◆	◆			0 ... 10 000 [ms] with NC software 280 460 ..	0
	Y	2290.1		◆	◆			0 ... 3.0000 [s] with NC software 280 462 ..	0
	Z	2290.2		◆	◆				0
	IV	2290.3		◆	◆			**Example:** Calculation of the rotor time constant from the drive parameters of the SIEMENS spindle drive 1PH6107-4NG4	0
	V	2290.4		◆	◆				0
	S	2290.5		◆	◆				0
								SIEMENS drive parameters: P164 = nominal frequency = 68.9 Hz P168 = resistance of armature (cold) = 157 mΩ P170 = leakage reactance of armat. = 785 mΩ 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 drive current [1]	X	2300.0		◆	◆			0 ... 1000.000 [A]	0
	Y	2300.1		◆	◆			NC software 280 460 ..	0
	Z	2300.2		◆	◆			MP2300.X is used for calculation of I^2t-monitoring and	0
	IV	2300.3		◆	◆			utilization display (modules 9160 and 9166)	0
	V	2300.4		◆	◆				0
	S	2300.5		◆	◆			NC software 280 462 ..	0
								If MP 2302.X = 0. MP 2300.X is used for calculation of I^2t-monitoring (module 9160).	
Reference value for I^2t-monitoring	X	2302.0		-	02			0 ... 1000.000 [A]	0
	Y	2302.1		-	02			0 ⇒ MP 2300.X is reference value for I^2t-monitoring	0
	Z	2302.2		-	02			≠ 0 ⇒ MP 2302.X is reference value for I^2t-monitoring	0
	IV	2302.3		-	02			The smaller value from MP 2302.X and MP 2120.X is used	0
	V	2302.4		-	02			for I^2t-monitoring (see module 9160).	0
	S	2302.5		-	02				0
Maximum current [1]	X	2310.0		◆	◆			0 ... 1000.000 [As]	0
of the drive	Y	2310.1		◆	◆				0
	Z	2310.2		◆	◆			The speed controller limits the maximum current to the	0
	IV	2310.3		◆	◆			minimum value from MP2110.X and MP2310.X	0
	V	2310.4		◆	◆				0
	S	2310.5							0

[1] Drive-dependent entry values: see item 2 on page 20

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Reference value for utilization display	X	2312.0		-	02			0 ... 1000.000 [A]	
								0 ⇒ MP 2300.X is ref. value for utilization display	0
	Y	2312.1		-	02			≠ 0 ⇒ MP 2312.X is ref. value for utilization display	0
	Z	2312.2		-	02				0
	IV	2312.3		-	02				0
	V	2312.4		-	02				0
	S	2312.5		-	02				0
Temperature coefficient								0 to 1 [1/k]	
of the armature conductor of an	X	2320.0		08	◆			0 = no compensation or no temperature sensor available	0
asynchronous drive	Y	2320.1		08	◆			0.0040 = temperature coefficient of aluminium	0
	Z	2320.2		08	◆			0.0039 = temperature coefficient of copper	0
	IV	2320.3		08	◆				0
	V	2320.4		08	◆			The calculation of the time constant of the armature depends on	0
	S	2320.5		08				the temperature (determined via temperature sensor)	0
reserved		2330.X		◆	◆			Entry value: 0	0

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Displacement of the field angle when operating with a synchronous drive [1]									
Speed, from which the field angle	X	2340.0		08	◆			0 ... 30 000 [rpm]	0
is shifted	Y	2340.1		08	◆			0 = no displacement of the field angle	0
	Z	2340.2		08	◆				0
	IV	2340.3		08	◆				0
	V	2340.4		08	◆				0
	S	2340.5		08	◆				0
Field angle (angle of compensation)								0 ... 60 [°]	
for displacement;	X	2350.0		08	◆			0 = no displacement of the field angle	0
If the speed exceeds 1.2 x MP2340.X the	Y	2350.1		08	◆				0
field angle is no longer shifted. From this	Z	2350.2		08	◆				0
speed on the compensation angle of	IV	2350.3		08	◆				0
MP2350.X is added.	V	2350.4		08	◆				0
	S	2350.5		08	◆				0

[1] In normal operation, the maximum shaft speed is 15% less than the SIEMENS specifications. By entering a displacement of the field angle, the maximum shaft speed as indicated in the SIEMENS data sheet can be obtained.
Entry values: MP 2220 = maximum shaft speed from **SIEMENS data sheet**
MP 2340 = nominal shaft speed (from MP 2210.X) / 1.2
MP 2350 = 30°

Note:
"Displacement of the field angle" should only be activated, if the maximum speed (as per SIEMENS specifications) is required.
Reason: The larger the compensation angle, the smaller is the torque and the higher the current intensity.

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Amplification of current controller	X	2400.0		◆	◆			0 ... 30 000 [1/V]	0
	Y	2400.1		◆	◆			0 = current controller inactive	0
	Z	2400.2		◆	◆			values >1.7 are reduced to 1.7!	0
	IV	2400.3		◆	◆				0
	V	2400.4		◆	◆				0
	S	2400.5		◆	◆				0
reserved		2410.X						entry value = 0	0
Proportional factor of speed controller	X	2500.0		◆	◆			0 ... 1000 [As]	0
	Y	2500.1		◆	◆				0
	Z	2500.2		◆	◆				0
	IV	2500.3		◆	◆				0
	V	2500.4		◆	◆				0
	S	2500.5		◆	◆				0
Integral factor of speed controller	X	2510.0		◆	◆			0 ... 100 000 [A]	0
	Y	2510.1		◆	◆				0
	Z	2510.2		◆	◆				0
	IV	2510.3		◆	◆				0
	V	2510.4		◆	◆				0
	S	2510.5		◆	◆				0
Limitation of integral factor of speed controller (PT1 element)	X	2512.0		-	05			0 to 30.000 [s]	0
	Y	2512.1		-	05			0 = inactive (normal case)	0
	Z	2512.2		-	05			standard value: 0.1 to 2 [s]	0
	IV	2512.3		-	05			entry value 2 → normal effect	0
	V	2512.4		-	05			entry value 0.1 → **very strong** effect	0
	S	2512.5		-	05			This function should only be used, if the drive jogs during standstill owing to stiction. The larger the input value, the more the behavior resembles that of a PI controller.	0
Differential factor of speed controller	X	2520.0		08	◆			0 ... 1 [As^2]	0
	Y	2520.1		08	◆				0
	Z	2520.2		08	◆			In normal operation **no** differential factor is required for	0
	IV	2520.3		08	◆			the speed controller → entry value **0**	0
	V	2520.4		08	◆				0
	S	2520.5		08	◆				0

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
T2 element of the speed controller	X	2530.0		08	◆			0 to 1 [s]	0
(2nd order delay)	Y	2530.1		08	◆			0 = no delay active (standard)	0
	Z	2530.2		08	◆			In normal operation **no** T2 element is required for the	0
	IV	2530.3		08	◆			speed controller → entry value **0**	0
	V	2530.4		08	◆				0
	S	2530.5		08	◆				0
Acceleration forward control	X	2600.0		08	◆			0 ... 1000 [A / (rev/s^2)]	0
	Y	2600.1		08	◆				0
	Z	2600.2		08	◆			Warning:	0
	IV	2600.3		08	◆			New internal evaluation from NC software 280 462 02.	0
	V	2600.4		08	◆			0.0000 ... 3.0000 [A / (rev/s^2)]	0
	S	2600.5		08	◆			New entry value = old entry value • 0.0006	0
Friction compensation									
with **low** speed	X	2610.0		08	◆			0 ... 30 [A]	0
	Y	2610.1		08	◆			0 = no friction compensation	0
	Z	2610.2		08	◆				0
	IV	2610.3		08	◆			This MP contains the current intensity required	0
	V	2610.4		08	◆			by the drive at a speed of 10 rpm.	0
	S	2610.5		08	◆				0
delay time	X	2612.0		-	02			0 ... 1.0000 [s]	0
	Y	2612.1		-	02			This MP contains a delay time required to counteract	0
	Z	2612.2		-	02			overcompensation when changing the direction at	0
	IV	2612.3		-	02			high feed rates.	0
	V	2612.4		-	02			standard value = 0.0155	0
	S	2612.5		-	02				0
with **nominal** speed	X	2620.0		08	◆			0 ... 30 [A]	0
	Y	2620.1		08	◆			0 = no friction compensation	0
	Z	2620.2		08	◆				0
	IV	2620.3		08	◆			This MP contains the current intensity required	0
	V	2620.4		08	◆			by the drive at nominal speed.	0
	S	2620.5		08	◆				0

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Holding current for height axes	X	2630.0		06	◆			0 ... ± 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 ... 99 999.999 [mm]	0
position and speed	Y	2800.1		02	◆				0
	Z	2800.2		02	◆			0 = no monitoring	0
	IV	2800.3		02	◆			The position is calculated from the pulses of the	0
	V	2800.4		02	◆			position encoder and from the pulses of the speed encoder. If the difference of the results is larger than the value of MP2800.X, the error message **GROSS POSITIONING ERROR <Axis> C** is output.	0

Spindle

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
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	
Regulated 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 spindle analogue output (only if MP3010 < 3)	3011		◆ ◆ ◆ ◆	◆ ◆ ◆ ◆			0: no function 1: voltage 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 10 V (only if MP3011 = 1)	3012		◆	◆			0 ... 300 000 [mm/min]	0

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
LASER function with M202							10 ... 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 • Voltage	3014.0		◆	◆			0 ... 9.999 [V]	0
	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		◆	◆			0 ... 99 999 00991 = no limitation	00991

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Axis halt on TOOL CALL with only a spindle speed output	3030		◆	◆			0 = axis standstill 1 = no axis standstill	0
Programming the speed S = 0	3120		◆	◆			0 ⇒ S = 0 permitted 1 ⇒ S = 0 not permitted	0
Polarity of the S-analogue voltage (analogue spindle) or the nominal S-speed value (digital spindle)	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 position encoder for the spindle	3140		◆	◆			0 = positive 1 = negative	0
Line count of the position encoder for the spindle	3142		◆	◆			NC software 280 460 .. 0 = 1024 [lines/rev] 1 = 2048 [lines/rev] NC software 280 462 .. 100 ... 9999 [lines/rev]	0
Mounting mode of the position encoder of the spindle	3143		-	◆			0 = position encoder directly at spindle 1 = position encoder via gear (transmission in MP 3450.X and MP 3451.X). PLC input from MP 4130.1 = ref. pulse 2 = position encoder via gear (transmission in MP 3450.X and MP 3451.X). PLC input from MP 4130.1 = enable ref. pulse of spindle encoder	

Function			MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
S-analogue voltage with nominal speed		1	3210.0		◆	◆			0 ... 9.999 [V]	9
(analogue spindle)	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
	gear range									
Drive rpms with nominal speed										
(digital spindle)									0 ... 9.999 [1000/min]	
	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	D	Input	AE-6 Entry values
Controlled range for output of nominal spindle speed								
(analogue spindle)	3240.1		◆	◆			0 ... 9.999 [V]	0
Min. drive speed that can be output	3240.2		◆	◆			0 ... 9.999 [V]	0.1
Jog voltage for gear switching (markers for direction of rotation 2490 and 2491)								
Controller range for output of S-speed								
(digital spindle)	3240.1		◆	◆			0 ... 9.999 [1000/min]	0
Min. drive speed that can be output	3240.2		◆	◆			0 ... 9.999 [1000/min]	0.1
Drive speed for gear switching								
Limitation of S-override upper limit	3310.0		◆	◆			0 ... 150 [%]	150
lower limit	3310.1		◆	◆				0
Ramp gradient of the spindle:							0 ... 1.999 [V/ms]	
(analogue spindle)								
- spindle ON/OFF, M03, M04, M05;	3410.0		◆	◆				0.1
- oriented spindle stop	3410.1		◆	◆				0.1
- TAPPING cycle	3410.2		◆	◆				0.1
- RIGID TAPPING cycle	3410.3		◆	◆				0.1
Ramp gradient of the spindle:							0 ... 1.999 [$\frac{1000 / \text{min}}{\text{ms}}$]	
(digital spindle)								
- spindle ON/OFF, M03, M04, M05;	3410.0		◆	◆				0.1
- oriented spindle stop	3410.1		◆	◆				0.1
- TAPPING cycle	3410.2		◆	◆				0.1
- RIGID TAPPING cycle	3410.3		◆	◆				0.1

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Transient behaviour of the spindle:							0 ... 1000 [ms]	
- spindle ON/OFF, M03, M04, M05;	3415.0		◆	◆				1
- oriented spindle stop	3415.1		◆	◆			This parameter block corresponds to MP 1520.	1
- TAPPING cycle	3415.2		◆	◆				1
- RIGID TAPPING cycle	3415.3		◆	◆				1
Positioning window for the spindle	3420		◆	◆			NC software 280 460 .. 0 ... 65 535 [increments] 1 increment = $\frac{360°}{(\text{pulses/rev.}) \bullet 4}$ NC software 280 462 .. 0 ... 360 [°]	10
Spindle pre-set	3430		◆	◆			0 ... 360 [°]	0
KV factor for the spindle per gear range gear range 1	3440.0		◆	◆			0.1 ... 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
Number of revolutions of the spindle drive (only if MP 3143 = 1 or 2)							0 ... 65 535 [rpm]	
gear range 1	3450.0		-	◆				0
gear range 2	3450.1		-	◆				0
gear range 3	3450.2		-	◆				0
gear range 4	3450.3		-	◆				0
gear range 5	3450.4		-	◆				0
gear range 6	3450.5		-	◆				0
gear range 7	3450.6		-	◆				0
gear range 8	3450.7		-	◆				0

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Number of revolutions of the spindle (only if MP 3143 = 1 or 2)							0 ... 65 535 [rpm]	
gear range 1	3451.0		-	◆				1
gear range 2	3451.1		-	◆				1
gear range 3	3451.2		-	◆				1
gear range 4	3451.3		-	◆				1
gear range 5	3451.4		-	◆				1
gear range 6	3451.5		-	◆				1
gear range 7	3451.6		-	◆				1
gear range 8	3451.7		-	◆				1
Nominal speed								
gear range 1	3510.0		◆	◆			0 ... 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 ... 99 999.999 [rpm]	
gear range 1	3515.0		◆	◆				1200
gear range 2	3515.1		◆	◆				2400
gear range 3	3515.2		◆	◆				3600
gear range 4	3515.3		◆	◆				4800
gear range 5	3515.4		◆	◆				6000
gear range 6	3515.5		◆	◆				7200
gear range 7	3515.6		◆	◆				8400
gear range 8	3515.7		◆	◆				9600
Spindle speed activated by marker M4011	3520.0		◆	◆			0 ... 99 999.999 [rpm]	200
Spindle speed for oriented spindle stop	3520.1		◆	◆			0 ... 99 999.999 [rpm]	100

Integral PLC

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
PLC compatibility to TNC 415/425	4020		◆	◆			0 ... 31	%00000
transform axis words W1024ff into markers		0					corresponding bit = 0 ⇒ function inactive corresponding bit = 1 ⇒ function active	
transform new markers into old markers		1						
transform configuration bits from MP 4210 into markers		2						
error markers are available (M2815 to M3023)		3						
remanent markers in the range M1000 to M1999		4						
Automatic lubrication X	4060.0		◆	◆			0 ... 99 999.999 [mm]	100
Y	4060.1		◆	◆				200
Z	4060.2		◆	◆				300
IV	4060.3		◆	◆				400
V	4060.4		◆	◆				0
Maximum change of the temperature compensation per scan in the PLC words W576 - W584	4070		◆	◆			0.0001 ... 0.005 [mm/PLC cycle]	0.0001

Function	MP No. Bit	A	B	C	D	Input	AE-6 Entry values
PLC: time for timers 0 - 29	4110.0	◆	◆			0 ... 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	D	Input	AE-6 Entry values
PLC: time for timers 30 - 47						0 ... 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
PLC: pre-set values for the counters 0 - 10						0 ... 65 535 [PLC cycles]	
	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	D	Input	AE-6 Entry values
PLC: pre-set values for the 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
	4120.30	◆	◆				30
	4120.31	◆	◆				31

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Fast PLC input to suppress the monitoring functions								
number of input	4130		◆	-			0 ... 255 [number]	0
condition for activation	4131		◆	-			0 = activation with LOW level 1 = activation with HIGH level	0
Number of the fast input to:								
• suppress the monitoring functions	4130.0		-	◆			0 ... 255 [number] Description of the function of MP 4130.0:	0
• evaluate the ref. signal of the spindle								
• set M 4590 (signal duration > 4ms)	4130.1		-	◆			As soon as the input is set, the monitoring functions are switched off. Moreover, the axes are automatically	0
	4130.2		-	◆			brought to standstill, the drives switched off and an noml./actl. value transfer is performed. The monitoring functions are reactivated when the fast PLC input is reset or the function disabled via W522.	0
Activating conditions for fast input from:							0 = activation with LOW level 1 = activation with HIGH level	
MP 4130.0	4131.0		-	◆				0
MP 4130.1	4131.1		-	◆				0
MP 4130.2	4131.2		-	◆				0

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Setting a number	D768	4210.0		◆	◆			-99 999.9999 ... +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	D	Input	AE-6 Entry values
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 ... 30 000	1800
multiple function	W962	Y	4220.1		◆	◆			- setting a number in the PLC	1800
	W964	Z	4220.2		◆	◆			or	1800
	W966	IV	4220.3		◆	◆			- feed rate to reapproch the contour	1800
	W968	V	4220.4		◆	◆			[mm/min] or [°/min]	1800
Setting a number			4230.0		◆	◆			-99 999.9999 ... +99 999.9999 [mm]	0
(readable with module 9032)			.		.	.				-
			.		.	.				-
			.		.	.				-
			4230.31		◆	◆				0

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Setting a number (readable with module 9032)	4231.0 . . . 4231.31		◆ . . . ◆	◆ . . . ◆			-99 999.9999 ... +99 999.9999	0 - - - 0
PLC: setting a number							-99 999.9999 ... +99 999.9999	
W976 (M2192 ... 2207)	4310.0		◆	◆				20480
W978 (M2208 ... 2223)	4310.1		◆	◆				0
W980 (M2224 ... 2239)	4310.2		◆	◆				0
W982 (M3200 ... 3215)	4310.3		◆	◆				0
W984 (M3216 ... 3231)	4310.4		◆	◆				0
W986 (M3232 ... 3247)	4310.5		◆	◆				0
W988 (M3248 ... 3263)	4310.6		◆	◆				0
Reserved for special function via PLC expansion interface (X47)	4410[1)]		◆	◆			for operation **without** special function: entry value = **0**	%0000
no function		0					-	
no function		1					-	
special function		2					bit set -> special function 1 active	
special function		3					bit set -> special function 2 active	

1) The machine parameter **MP4410** does no longer have any influence on the adaptation of the analogue inputs on the PL board. With TNC 426 the analogue inputs as well as the PLC inputs and outputs of the PL board must be read and written via **PLC modules**.

Adaptation of the Data Interface

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Inhibiting a data interface	5000		◆	◆			0 = no interface inhibited 1 = RS-232 inhibited 2 = RS-422 inhibited	0
Data format and transfer stop for operating mode **EXT1** for operating mode **EXT2** for operating mode **EXT3** (PLC)	5020.0* 5020.1* 5020.2*		◆ ◆ ◆	◆ ◆ ◆			0 ... 255	168 168 168
7 or 8 data bits		0					**+ 0** = 7 data bits, bit 8 = parity + 1 = 8 data bits, bit 8 = 0 and bit 9 = parity	
Block check character		1					**+ 0** = all characters can be BCC + 2 = BCC not control character	
Transmission stop by RTS		2					**+ 0** = inactive + 4 = active	
Transmission stop by 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	D	Input	AE-6 Entry values
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 ... 9 0 = 110 bd 5 = 2400 bd 10 = 57600 bd 1 = 150 bd 6 = 4800 bd 11 = 115200 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 program start							0 ... 127	
EXT 1 (STX)	5200.0*		I02	-				0
EXT 2	5200.1*		I02	-				0
EXT3 (PLC)	5200.2*		I02	-				0
ASCII character for end of program							0 ... 127	
for EXT1 (ETX)	5201.0*		I02	-				0
for EXT2	5201.1*		I02	-				0
for PLC	5201.2*		I02	-				0
ASCII character for file type (for data input)							0 ... 127	
for EXT1	5202.0*		I02	-				0
for EXT2	5202.1*		I02	-				0
for PLC	5202.2*		I02	-				0

* accessible via code number 123

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

* accessible via code number 123

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
ASCII character for positive acknowledgement							0 ... 127	
for EXT1 (ACK)	5208.0*		I02	-				0
for EXT2	5208.1*		I02	-				0
for EXT3 (PLC)	5208.2*		I02	-				0
ASCII character for negative acknowledgement							0 ... 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 ... 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	D	Input	AE-6 Entry values
Selection of touch trigger probe	6010*		◆	◆			0 = transmission via cable (TS 120) 1 = infra-red transmission (TS 510)	0
Probing feed rate	6120*		◆	◆			10 ... 3 000 [mm/min]	80
Maximum measuring range	6130*		◆	◆			0.001 ... 99 999.9999 [mm]	1
Safety clearance over measurement point for automatic measurement	6140*		◆	◆			0.001 ... 99 999.9999 [mm]	1
Rapid traverse for probe cycle	6150*		◆	◆			10 ... 10 000 [mm/min]	2000
M function for 180° spindle rotation to compensate stylus mismatch when probing is started	6160*		I06	I06			0 = function inactive 1 ... 88 = number of the M function for probing	0
			08	◆			-1 = oriented spindle stop by NC 0 = function inactive +1 ... 88 = number of the M function for oriented spindle stop by PLC	0

Triggering or Measuring 3D-Touch Probe

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

* Accessible via code number 123

Digitizing with 3D-Touch Probe

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Number of oscillations in normal direction	6210		◆	◆			0 ... 65.535 [1/sec]	0
Lubrication of probing axis Displacement for lubrication at the end of a line	6220		◆	◆			0.000 ... 999.999 [mm]	0
Time intervals for lubrication	6221		◆	◆			0 ... 65 535 [min]	0
Feed rate in normal direction	6230		◆	◆			0 ... 1 000 [mm/min]	0
Maximum deflection of the stylus	6240		◆	◆			0 ... 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	D	Input	AE-6 Entry values
Deflection depth of the stylus	6310		◆	◆			0.1 ... 2.000 [mm]	1
Counting direction of the encoders in the touch probe X Y Z	6320	0 1 2	◆	◆			0 = positive +1 = X axis negative +2 = Y axis negative +4 = Z axis negative	0
Calculating the center offset when calibrating the TM110	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	6322.0		◆	◆			0 = X-axis is probe axis	0
machine axis Y	6322.1		◆	◆			1 = Y-axis is probe axis	1
machine axis Z	6322.2		◆	◆			2 = Z-axis is probe axis	2
Maximum deflection of the stylus	6330		◆	◆			0.1...4 [mm]	3
Feed rate for plunging and traversing to Z-Min	6350		◆	◆			10...3 000 [mm/min]	300
Feed rate for probing in measuring cycles	6360		◆	◆			10...3 000 [mm/min]	1000
Rapid traverse for probing	6361		◆	◆			10...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
Radial acceleration for digitizing with measuring touch probe	6370		-	◆			0.001...3.000 [m/s^2] recommended entry value: 0.1	0.1
Target window for contour lines	6390		◆	◆			0.1...4.0	1

Tool Calibration with TT 120

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Tool calibration with TT 120	6500		◆	I02			0 = cycles disabled 1 = cycles enabled	0
Tool calibration with TT 120	6500		-	02			Bits 0 to 8 (see page 51.1)	% 000000000
		0					0 = tool calibration cycles disabled; 1 = tool calibration cycles not disabled;	
		1		02			0 = calibration of tool radius permitted; calibration of tool length with rotating spindle; 1 = calibration of tool radius and teeth disabled;	
		2		02			0 = calibration of tool length with non-rotating spindle (bit 1 = 1); 1 = calibration of tool length with rotating spindle; tool length calibration only with rotating spindle, if the tool table contains a tool radius offset (TT:R-OFFS);	
		3		02			0 = tool calibration with oriented spindle stop; 1 = tool calibration without oriented spindle stop; calibration of teeth not possible; tool radius calibration may be faulty;	
		4		05			0 = the maximum shaft speed for calibration is **always** limited to 1000 rpm; i.e. the minimum speed must be lower than 1000 rpm; 1 = the maximum shaft speed for calibration is **not** limited to 1000 rpm; the minimum speed is always output; i.e. the minimum spindle speed may be higher than 1000 rpm;	
		5		I08			0 = the NC program is not stopped when the breakage tolerance is exceeded 1 = when the tolerance is exceeded, the NC program is stopped and the message TOOL BREKAGE generated	

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Tool calibration with TT 120 (continued)	6500	5	-	08			Bits 0 to 6 **Bit 5**: **CHECK TOOL** 0 = the NC program is not stopped when the breakage tolerance is exceeded 1 = when the tolerance is exceeded, the NC program is stopped and the message TOOL BREKAGE generated	% 000000000
		6	-	08			**Bit 6: MEASURE TOOL** 0 = the NC program is not stopped when the breakage tolerance is exceeded 1 = when the tolerance is exceeded, the NC program is stopped and the message TOOL BREKAGE generated **Bit 7:** reserved, entry value 0 **Bit 8:** Tool calibration cycle 30.0 0 = The stylus is contacted from all sides (standard case). 1 = The stylus is only contacted from one side. E.g. if the TT is mounted at the end of the working range or when operating with a square stylus.	
Probing direction for tool calibration	6505		◆	◆			0 = positive probing direction in the angle reference axis (0° axis) 1 = positive probing direction in the + 90° axis 2 = negative probing direction in the angle reference axis (0° axis) 3 = negative probing direction in the + 90° axis	0
Calculation of the probing feed	6507		◆	◆			0 = calculation of the probing feed with constant tolerance 1 = calculation of the probing feed with variable tolerance 2 = constant probing feed	0

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Maximum permissible measuring error for measurement with a rotating tool	6510		◆	◆			0.002 ... 0.999 [mm]	0.005
Probing feed rate for measurement with a non-rotating tool	6520		◆	◆			10 ... 3 000 [mm/min]	10
Distance between lower edge of tool and upper edge of stylus for tool radius measurement	6530		◆	◆			0.001 ... 99.9999 [mm]	10
Diameter or edge length of the TT 120 stylus	6531		◆	◆			0.001 ... 99 999.9999 [mm]	10
Safety zone around the stylus of TT 120 for pre-positioning	6540		◆	◆			0.001 ... 99 999.9999 [mm]	10
Rapid traverse in the probing cycle	6550		◆	◆			10 ... 10 000 [m/min]	10
M function for oriented spindle stop for calibration of teeth	6560		I06	I06			0 = without function 1 ... 88 = number of M function	0
			08	08			-1 = oriented spindle stop by NC 0 = function inactive +1 ... 88 = number of the M function for oriented spindle stop by PLC	0
Maximum permissible rotational speed at the cutting edge of the tool	6570		◆	◆			1.0000 ... 120.0000 [m/min]	100
Center coordinates of the TT 120 stylus							- 99 999.9999 ... + 99 999.9999 [mm]	
referenced to the machine datum X	6580.0		◆	◆				0
Y	6580.1		◆	◆				0
Z	6580.2		◆	◆				0

Tapping

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

Display and Programming

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
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 in confirmed automatically	1
Block-number increment size (for ISO programming)	7220*		◆	◆			0 ... 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, in the table of contents and for external 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	◆	◆			+64 = disabled	
reserved		7	◆	◆			-	

* Accessible via code number 123

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
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	◆	◆			+64 = protected	
reserved		7	◆	◆			-	
Pre-set size								
Pallet table (**.P**)	7226.0*		◆	◆			0 ... 255 = number of reserved entries	10
Datum table (**.D**)	7226.1*		◆	◆			(can be expanded with soft key)	10
Size of NC memory for DNC mode								
minimum	7228.0		◆	-			1...1024 [kBytes]	1
maximum	7228.1		◆	-			1...1024 [kBytes]	100
Length of program								
to check the program	7229.0		◆	◆			100 ... 9999	100
up to which FK blocks are permitted	7229.1		◆	◆				
Changing the dialogue language							0 = English 6 = Portuguese	
NC dialogues	7230.0		◆	◆			1 = German 7 = Swedish	1
PLC dialogues (OEM cycles, USER parameters)	7330.1		◆	◆			2 = Czech 8 = Danish 3 = French 9 = Finnish	1
PLC error messages	7230.2		◆	◆			4 = Italian 10 = Dutch	1
HELP files	7230.3		-	◆			5 = Spanish	1
Deviation from Greenwich time	7235		◆	◆			– 23 to + 23 [hours] 0 = Greenwich time 1 = CET 2 = Central European summer time The factory default setting of the control is Greenwich time. To adapt the time of the program manager to your local time, the difference between local time and Greenwich time must be entered in MP7235.	

* Accessible via code number 123

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
PLC counters								% 00000000
Display counters	7237.0						0 = no counter is displayed	
counter 1		0	-	◆			+ 1 = counter 1 displayed	
counter 2		1	-	◆			+ 2 = counter 2 displayed	
counter 3		2	-	◆			+ 4 = counter 3 displayed	
counter 4		3	-	◆			+ 8 = counter 4 displayed	
counter 5		4	-	◆			+ 16 = counter 5 displayed	
counter 6		5	-	◆			+ 32 = counter 6 displayed	
counter 7		6	-	◆			+ 64 = counter 7 displayed	
counter 8		7	-	◆			+ 128 = counter 8 displayed	
Reset counters with code no. 857 282	7237.1						0 = no counter is reset	% 00000000
counter 1		0	-	◆			+ 1 = counter 1 reset	
counter 2		1	-	◆			+ 2 = counter 2 reset	
counter 3		2	-	◆			+ 4 = counter 3 reset	
counter 4		3	-	◆			+ 8 = counter 4 reset	
counter 5		4	-	◆			+ 16 = counter 5 reset	
counter 6		5	-	◆			+ 32 = counter 6 reset	
counter 7		6	-	◆			+ 64 = counter 7 reset	
counter 8		7	-	◆			+ 128 = counter 8 reset	
Reset NC counters	7237.2		-				0 = counter is not reset	% 00000000
with code number 857 282		0		-			reserved	
		1		◆			+ 2 = "Machine ON" counter is reset	
		2		◆			+ 4 = "Program Run" counter is reset	
		3-7		-			reserved	

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Dialogues for PLC counters							0 ... 4095	
counter 1	7238.0		-	◆			1 = 1. line of the file	0
counter 2	7238.1		-	◆			2 = 2. line of the file	0
counter 3	7238.2		-	◆			etc.	0
counter 4	7238.3		-	◆				0
counter 5	7238.4		-	◆				0
counter 6	7238.5		-	◆				0
counter 7	7238.6		-	◆				0
counter 8	7238.7		-	◆				0
from the file programmed in the line **PLCDIALOG =** in OEM.SYS.								

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Inhibit PGM entry if PGM No. = No. of OEM cycle	7240*		◆	-			0 = inhibited 1 = not inhibited	1
Inhibiting HEIDENHAIN cycles	7245.0		◆	I07			0 ... 65 535 Bit = 0 ⇒ cycle not inhibited Bit = 1 ⇒ cycle inhibited Note: With the NC software 280 462 .. JH cycles can be disabled in Cycle Design. ISO cycles currently cannot be disabled.	$ 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		◆	I07			0 ... 65 535 Bit = 0 ⇒ cycle not inhibited Bit = 1 ⇒ cycle inhibited Note: With the NC software 280 462 .. JH cycles can be disabled in Cycle Design. ISO cycles currently cannot be disabled.	$ 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	D	Input	AE-6 Entry values
Disable paraxial positioning blocks with R+/R- compensation	7246	◆	◆			0 = not disabled 1 = disabled	0
Difference between Q parameter numbers for "DLG-DEF" and "DLG-CALL" blocks in OEM cycle	7250	◆	◆			0 ... 50 0. if only "DLG-CALL" blocks Note: With the NC software 280 462 .. this machine parameter is only effective for ISO cycles.	0
Number of global Q parameters transferred from OEM cycle to calling program	7251	◆	◆			0 ... 100 40 = the Q parameters Q60 to Q90 are global	0
Number of tools in the tool table	7260*	◆	◆			0 ... 254 0 = no central tool file	254
Number of tools with pocket number	7261*	◆	◆			0 ... 254	254

* Accessible via code number 123

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Items in the tool table (.T file) that can be displayed and output via interface								0 = no display 1 - 99 = position of the respective element in the tool table	
NAME	(tool name)	7266.0		◆	◆				1
L	(tool length)	7266.1		◆	◆			smallest value = first position	2
R	(tool radius 1)	7266.2		◆	◆			highest value = last position	3
R2	(tool radius 2)	7266.3		◆	◆				4
DL	(oversize tool length)	7266.4		◆	◆				5
DR	(oversize tool radius 1)	7266.5		◆	◆				6
DR2	(oversize tool radius 2)	7266.6		◆	◆				7
TL	(tool locked)	7266.7		◆	◆				8
RT	(replacement tool)	7266.8		◆	◆				9
TIME1	(max. tool life)	7266.9		◆	◆				10
TIME2	(max. tool life with TOOL CALL)	7266.10		◆	◆				11
CUR.TIME	(current tool life)	7266.11		◆	◆				12
DOC	(tool comment)	7266.12		◆	◆				13
CUT	(number of cutting edges)	7266.13		◆	◆				14
LTOL	(tolerance for tool length)	7266.14		◆	◆				15
RTOL	(tolerance for tool radius)	7266.15		◆	◆				16
DIRECT	(cutting direction of the tool)	7266.16		◆	◆				17
PLC	(PLC status)	7266.17		◆	◆				18
TT: L-OFFS	(tool offset, length)	7266.18		06	◆				19
TT: R-OFFS	(tool offset, radius)	7266.19		06	◆				20
LBREAK	(breakage tolerance, tool length)	7266.20		06	◆				21
RBREAK	(breakage tolerance, tool radius)	7266.21		06	◆				22
LCUT	(length of cutting edge)	7266.22		-	◆				23
ANGLE	(plunge angle)	7266.23		-	◆				24
Items in the TOOL.P file (pocket table)								0 = no display 1 - 99 = position of the respective element in the tool table	
T	(tool number)	7267.0		◆	◆				1
ST	(special 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	D	Input	AE-6 Entry values
Display of current feed rate before start in the manual operating modes	7270*		◆	◆			0 = display of feed rate only when an axis key is pressed (axis-specific feed rate from MP1020.X) 1 = display of the feed rate before an axis key is pressed (smallest value from MP1020.X for all axes)	0
Decimal sign	7280*		◆	◆			0 = decimal comma 1 = decimal point	0
Tool length in noml./actl. value display	7285*		◆	◆			0 = tool length ignored 1 = tool length not ignored	0
Display step X	7290.0*		◆	◆			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
Y	7290.1*		◆	◆				6
Z	7290.2*		◆	◆				6
IV	7290.3*		◆	◆				6
V	7290.4*		◆	◆				6
Inhibit datum setting	7295*		◆	◆			0 = input not inhibited	0
(axis keys and soft key) X		0					+ 1 = X axis inhibited	
Y		1					+ 2 = Y axis inhibited	
Z		2					+ 4 = Z axis inhibited	
IV		3					+ 8 = IV. axis inhibited	
V		4					+16 = V. axis inhibited	
Datum setting with axis keys	7296		◆	◆			0 = datum setting with axis keys and soft key 1 = datum setting with soft key only	0

* Accessible via code number 123

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Cancelling • Status data (**S**) • TOOL data (**T**) • Q parameters (**Q**) with M02, M30. END PGM	7300	0 1 2	◆	◆			0 ... 7 Program End / Program Selection 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 **-** = files are erased	0
Graphics display • 3-plane view	7310*	0	◆	◆			+ 0 = German standard + 1 = US standard	0
• rotation of the coordinate system in the machining plane		1					+ 0 = no rotation + 2 = coordinate system 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 view		3					+ 0 = not shown + 8 = shown	

* Accessible via code number 123

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
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 ... 99 999 [mm]	0
Penetration depth (from top surface of the blank)	7316*		◆	◆			0 ... 99 999 [mm]	0
M function to start the simulation	7317.0*		◆	◆			0 ... 88	0
M function to interrupt the simulation	7317.1*		◆	◆			0 ... 88	0

USER Parameters

Function		MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
USER parameters									
Defining the USER parameters	0	7330.0		◆	◆			0 ... 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. enter 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 dialogues	0	7340.0		◆	◆			0 ... 4095	0
to the defined USER parameters from	1	7340.1		◆	◆			0 = first line of the respective file	0
the file programmed in the line	2	7340.2		◆	◆				0
PLCDIALOG = in OEM.SYS.	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	D	Input	AE-6 Entry values
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	D	Input	AE-6 Entry values
Window frame	7350		◆	◆			$000 000 ... $3F3F3F	$030200C
Error messages	7351		◆	◆				$03F3F0F
Operating mode display "Machine"								
Background	7352	0	◆	◆				$0000000
Text for operating mode	7352	1	◆	◆				$0342008
Dialogues	7352	2	◆	◆				$03F3828
Operating mode display "Programming"	7353	0	◆	◆				$0000000
Background	7353	1	◆	◆				$0342008
Text for operating mode	7353	2	◆	◆				$03F3828
Dialogues								

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Program text display "Machine"							$000000 ... $3F3F3F	
Background	7354.0		◆	◆				$0080400
General program text	7354.1		◆	◆				$038240C
Current block	7354.2		◆	◆				$038341C
Background of active window	7354.3		I06	-				$00C0800
Background of **inactive** window	7354.3		08	◆				$0040800
Program text display "Programming"							$000000 ... $3F3F3F	
Background	7355.0		◆	◆				$0080400
General program text	7355.1		◆	◆				$038240C
Current block	7355.2		◆	◆				$038341C
Background of active window	7355.3		I06	-				$00C0800
Background of **inactive** window	7355.3		08	◆				$0040800
Status and PLC window							$000000 ... $3F3F3F	
Background	7356.0		◆	◆				$00C0800
Axis positions in status display	7356.1		◆	◆				$03F2C18
Status display except axis positions	7356.2		◆	◆				$03F280C
Soft key display "Machine"							$000000 ... $3F3F3F	
Background	7357.0		◆	◆				$0000000
Symbols	7357.1		◆	◆				$03F3828
Soft key display "Programming"							$000000 ... $3F3F3F	
Background	7358.0		◆	◆				$0000000
Symbols	7358.1		◆	◆				$03F3828
Graphics: 3D view							$000000 ... $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	D	Input	AE-6 Entry values
Graphics: View in 3 planes (and Oscilloscope)						$000000 ... $3F3F3F	
Background	7361.0	◆	◆				$0000000
Plan (grating)	7361.1	◆	◆				$0203038
Front and side view (non-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 ... $3F3F3F	
Additional status display in graphics window and pocket calculator	7362.0	◆	◆				$0080400
Background of graphics window and pocket calculator	7362.1	◆	◆				$00C0800
Background of status display and keys of pocket calculator	7362.2	◆	◆				$038240C
Status symbols and symbols of pocket calculator (c with cos) Status values and texts of pocket calculator (os with cos)	7362.3	◆	◆				$03F2C18
FK Graphics						$000000 ... $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

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Auxiliary images for cycles							$000 000 ... $3F3F3F	
Color 1 of the graphics program used	7364.0		-	◆				$0000000
Color 2 of the graphics program used	7364.1		-	◆				$0000000
Color 3 of the graphics program used	7364.2		-	◆				$0000000
Color 4 of the graphics program used	7364.3		-	◆				$0000000
Color 5 of the graphics program used	7364.4		-	◆				$0000000
Color 6 of the graphics program used	7364.5		-	◆				$0000000
Color 7 of the graphics program used	7364.6		-	◆				$0000000
Line color	7364.7		-	◆				$038240C
Cursor	7364.8		-	◆				$038241C
Background	7364.9		-	◆				$0000000
Colors of internal oscilloscope							$000 000 ... $3F3F3F	
Background	7365.0		-	02				$0000000
Channel 1	7365.1		-	02				$0203038
Channel 2	7365.2		-	02				$0003F00
Channel 3	7365.3		-	02				$03F3F00
Channel 4	7365.4		-	02				$03F003F
Selected channel	7365.5		-	02				$03F0000
Grating	7365.6		-	02				$030200C
Cursor and text	7365.7		-	02				$03F3F3F
Screen saver	7392		-	◆			0 ... 99 [min] 0 ⇨ no screen saver ≠ 0 ⇨ time after which the screen saver is activated	1

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
"Scaling Factor" cycle in two or three axes	7410*		◆	◆			0 = 3 axes 1 = in the machining plane only	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 current tool data are retained	0
Cycles for milling pockets with free-programmed contour	7420*		◆	◆			0 ... 15	%0000
• 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 or 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	
• Contour pocket cycle		4	10	02			+ 0 = After finishing the contour pocket, the TNC moves to the position at which it was before the cycle call. +16 = After finishing the contour pocket, the TNC moves the tool axis to clearance height.	

* Accessible via code number 123

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Overlap factor for pocket milling	7430*		◆	◆			0.1 ... 1.414	1
Arc-end point tolerance Linear contour	7431*		◆	◆			0.0001 ... 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 a 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		◆	◆			0 = no calculation	
X		0					+1 = consider position of X-axis	%00000
Y		1					+2 = consider position of Y-axis	
Z		2					+4 = consider position of Z-axis	
IV		3					+8 = consider position of IV. axis	
V		4					+16 = consider position of V. axis	
Feed rate for reapproaching							10 ... 300 000 [mm/min]	
the contour after a program- X	7451.0		06	◆				0
interruption Y	7451.1		06	◆				0
Z	7451.2		06	◆				0
IV	7451.3		06	◆				0
V	7451.4		06	◆				0

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Function	MP No. Bit	A	B	C	D	Input	AE-6 Entry values
Constant contour speed in corners	7460*	◆	◆			0 ... 179.9999 [°]	10
Maximum feed rate with 100% override	7470	-	◆			0 ... 300 000 [mm/min] 0 = no limitation	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...6 0 = no output 1 = output of tool number only when tool number changes (W264) 2 = output of tool number with every TOOL CALL (W264) 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 if 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	D	Input	AE-6 Entry values
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	D	Input	AE-6 Entry values
Tilting the Working Plane	7500							0
Function "Tilt Working Plane"		0	◆	◆			+ 0 = OFF + 1 = ON	
Angle		1	-	◆			+ 0 = angles correspond to the position of the swivel axis of the head / table + 2 = angles correspond to the solid angles (the TNC computes the position of the swivel axes of the head / table.)	
Positioning with cycle 19		2	-	◆			+ 0 = the swivel axes are not positioned with cycle 19 + 4 = the swivel axes are positioned with cycle 19	
Selecting the transformed axis								% 000 000
Parameter block 1	7510.0		◆	◆			0 ... 63 0 = end of transformation chain	
		0					+1 = X axis	
		1					+2 = Y axis	
		2					+4 = Z axis	
		3					+8 = A axis	
		4					+16 = B axis	
		5					+32 = C axis	
Parameter block 2	7510.1		◆	◆				% 000 000
Parameter block 3	7510.2		◆	◆				% 000 000
Parameter block 4	7510.3		◆	◆				% 000 000
Parameter block 5	7510.4		◆	◆				% 000 000
Parameter block 6	7510.5		◆	◆				% 000 000
Parameter block 7	7510.6		◆	◆				% 000 000
Parameter block 8	7510.7		◆	◆				% 000 000
Parameter block 9	7510.8		◆	◆				% 000 000
Parameter block 10	7510.9		◆	◆				% 000 000
Parameter block 11	7510.10		◆	◆				% 000 000
Parameter block 12	7510.11		◆	◆				% 000 000
Parameter block 13	7510.12		◆	◆				% 000 000
Parameter block 14	7510.13		◆	◆				% 000 000
Parameter block 15	7510.14		◆	◆				% 000 000

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Supplementary identifier for transformation parameter block 1	7520.0		◆	◆			0 ... 3	% 000 000
Swivel axis		0					+0 = swivel head +1 = tilting table	
Dimension in MP 7530.X		1					+0 = incremental dimensions (for swivel head) +2 = absolute related to machine datum (for tilting table))	
parameter block 2	7520.1		◆	◆				0
parameter block 3	7520.2		◆	◆				0
parameter block 4	7520.3		◆	◆				0
parameter block 5	7520.4		◆	◆				0
parameter block 6	7520.5		◆	◆				0
parameter block 7	7520.6		◆	◆				0
parameter block 8	7520.7		◆	◆				0
parameter block 9	7520.8		◆	◆				0
parameter block 10	7520.9		◆	◆				0
parameter block 11	7520.10		◆	◆				0
parameter block 12	7520.11		◆	◆				0
parameter block 13	7520.12		◆	◆				0
parameter block 14	7520.13		◆	◆				0
parameter block 15	7520.14		◆	◆				0

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Dimensions for transformation								
parameter block 1	7530.0		◆	◆			0 = swivel axis	0
parameter block 2	7530.1		◆	◆			-99 999.9999 ... +99 999.9999	0
parameter block 3	7530.2		◆	◆				0
parameter block 4	7530.3		◆	◆				0
parameter block 5	7530.4		◆	◆				0
parameter block 6	7530.5		◆	◆				0
parameter block 7	7530.6		◆	◆				0
parameter block 8	7530.7		◆	◆				0
parameter block 9	7530.8		◆	◆				0
parameter block 10	7530.9		◆	◆				0
parameter block 11	7530.10		◆	◆				0
parameter block 12	7530.11		◆	◆				0
parameter block 13	7530.12		◆	◆				0
parameter block 14	7530.13		◆	◆				0
parameter block 15	7530.14		◆	◆				0

Hardware

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
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 and ext. direction keys pressed in "manual" or • rapid traverse button and handwheel direction key pressing 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% increments + 8 = feed rate and spindle override in 0.01% increm. and non-linear characteristic curve	
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
Input 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 via handwheel

[2] axis can be switched via handwheel and keyboard

[3] If the 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 values
Initializing parameters for the handwheel Assignment of 3. handwheel via axis selector switch **(MP 7640 = 5)**	7645.0	0	◆	◆		+ 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	0
		1				+ 2 = position 3 → Z-axis position 4 → IV. axis position 5 → V. axis	
		2-7				reserved	
Evaluation of the keys and LEDs of 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 are directly evaluated by NC remaining keys: PLC I 164 to I 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 are directly evaluated by NC remaining keys: PLC I 164 to I 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 in HR 410 mode **(MP 7640 = 6)**	7645.0		-	◆		0 = keys X, Y, Z, IV, V, actual value transfer and their LEDs are directly evaluated by NC remaining keys: PLC I 168 to I 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 values
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	0
reserved	7645.3 ... 7645.7	◆	◆		no function	0
Counting direction for handwheel	7650	◆	◆		0 = positive counting direction 1 = negative counting direction	0
Hysteresis for electronic handwheel	7660	◆	◆		0 ... 65 535 [increments]	10
Minimum interpolation factor for handwheel	7670	◆	-		0 ... 10	0
Handwheel interpolation factor					0 ... 10	
slow (HR130/3xx/410)	7670.0	-	◆			0
medium (HR 410 only)	7670.1	-	◆			0
fast (HR 410 only)	7670.2	-	◆			0
%-factor of HR 410 handwheel feed rate					0 ... 100 [%]	
slow (HR 410 only)	7671.0	-	◆			50
medium (HR 410 only)	7671.1	-	◆			75
fast (HR 410 only)	7671.2	-	◆			100

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Parameter with multiple function **Memory function** for direction keys	7680	0	◆	◆			0 = not stored +1 = stored	%000011111
Reapproaching the contour		1	◆	◆			0 = inactive +2 = active	
Block scan		2	◆	◆			0 = inactive +4 = active	
Block scan interrupted 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 tool table +64 = with DR2 from tool table	
Positioning directon for rotary axes with modulo display		7	I06	-			0 = positioning along the number scale +128 = positioning follows the shortest path	
Inserting roundings defined with M112		7	-	◆			0 = roundings are always inserted + 256 = roundings are only inserted, if the acceleration of MP 1060.x or MP 1070.x would be exceeded.	
Acceleration rate-of-change reduction with M112		8	-	◆			0 = no reduction + 512 = acceleration rate-of-change reduction during M112. This may cause slight contouring deviations.	

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
M/S/T/Q transfer to PLC during block scan	7681		-	◆			0 ... 15	%0000
		0					+ 0 = output M-functions to PLC during block scan. + 1 = collect M-functions and output the functions to PLC after block scan.	
		1					+ 0 = output T-code to PLC during block scan. + 2 = output last T-code to PLC after block scan. + 0 = output S-code or G-code to PLC during block scan. + 4 = output last S-code or G-code to PLC after block scan.	
		2					+ 0 = transfer FN19 outputs to PLC during block scan. + 8 = transfer last FN19 outputs to PLC after block scan.	
		3						

Function	MP No.	Bit	A	B	C	D	Input	AE-6 Entry values
Incremental positioning after TOOL-CALL	7682	0	06	◆			0 = tool length considered in an l-block following a TOOL CALL 1 = tool length **not** considered in an l-block following a TOOL CALL	%00
		1		07			0 = **actual** value is datum for calculation of the preset for datum setting 1 = **nominal** value is datum for calculation of the preset for datum setting	
Memory test at power on	7690						0 ... 7	%111
RAM		0	◆	◆			+0 = test +1 = no test	
EPROM		1	◆	◆			+0 = test +2 = no test	
Harddisk		2	◆	◆			+0 = test +4 = no test	