

# HEIDENHAIN

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Kundendienst

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## Service Instructions TNC 151/155 B/Q

### Subject to change (without notice)

DR. JOHANNES HEIDENHAIN GmbH is constantly working on further developments of its TNC Controls. It is therefore possible that details of your Control may differ slightly from those described herein. If that is the case please order a suitably revised issue of the Service Manual.

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### 1. Use of the Service Manual TNC 151/155

In order to determine the fault condition on an NC machine, a fundamental knowledge of the machine and the drives is necessary, as well as a knowledge of their interaction with the Control and measuring system. In addition, improper use of the Control, such as incorrect NC programming or incorrect selection of machine parameters can lead to the occurrence of fault conditions. Further information in this respect can be found in:

- .Operating Manual
- .Mounting Instructions and Interface Circuit Control-Machine
- .PLC-Description

The TNC 151/155 Service Manual is used for the diagnosis, localisation and remedying of faults on TNC controlled machines. In section 2, Fault Diagnosis, a set of flowcharts enables the user to pinpoint the source of a fault from its symptoms.

An integrated supervision system and a Burn-In Test Program specifically developed for testing the Control can aid in the location of faults.

Important guidance for the exchange of entire Controls, individual boards, or software is given in section 3, Exchange Information.

Section 4, Additional Information, contains a block diagram of the Control, a wiring diagram for each version of the Control, and a list of machine parameters with permissible entry values.

## 2. Fault Diagnosis

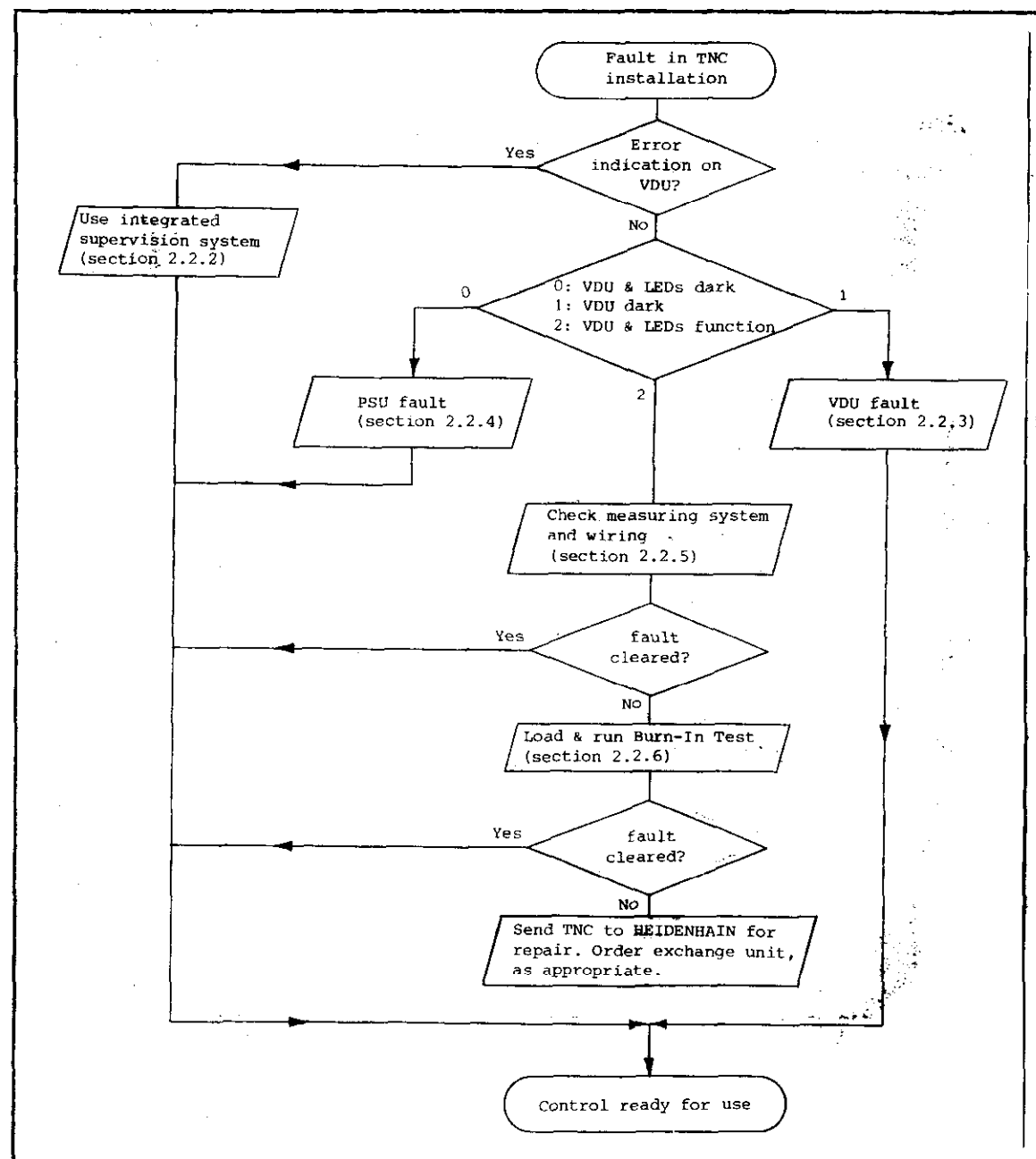
### 2.1 Procedure for fault-finding

To locate and rectify a fault that has arisen in a TNC installation, it is of foremost importance to analyse the behaviour of the system as a whole: that is, the TNC Control, the machine-tool and the measuring system.

2.2.1 shows, in flow diagram form, the procedure for examining the complete installation.

In addition, the HEIDENHAIN TNC 151/155 Contouring Control includes an extensive **integrated supervision system** for the avoidance of entry/operator faults and for the recognition and diagnosis of technical defects in the installation (see section 2.2.2)

The **Burn-In Test Program** can be used as further support in fault localizing and in the dynamic testing of the Control's hardware (see section 2.2.6).

**Kundendienst****2.2 Flow diagrams for fault location****2.2.1 Fault diagnosis for the complete installation  
(Control/Measuring System/Machine-tool)**

### 2.2.2 Use of the integrated supervision system

The TNC 151/155 incorporates an extensive integrated supervision system for the avoidance of operator-errors and the detection and diagnosis of technical faults in the TNC installation (ie the installation comprising the TNC, the machine-tool and the measuring system).

The supervision system is made up of a mixture of hardware and software within the TNC, and operates continuously whilst the TNC is switched on. If a fault is detected, or if an operator-error occurs, a message will be displayed, indicating (in abbreviated form) the nature of the problem.

example of operator-error:

- a) KEY NON-FUNCTIONAL
- b) ENTRY VALUE INCORRECT

example of **fault** with TNC internal electronics:

- a) TNC OPERATING TEMP. EXCEEDED
- b) EXCHANGE BUFFER BATTERY
- c) TNC ELECTRONICS DEFECTIVE 0...3/A...K

example of **fault** with measuring system:

X-MEASURING SYSTEM DEFECTIVE

example of **fault** on machine-tool:

GROSS POSITIONING ERROR A

The system distinguishes between what are considered to be harmless **errors** and serious **faults**, in that **faults** are shown as flashing displays. Examples of **faults** are measuring system faults, drive faults and faults in the TNC's internal electronics. The occurrence of a **fault** leads to the machine being switched off via the emergency-stop contactor. The fault must then be rectified before the TNC is switched on again.

#### Flashing fault messages TNC 151/155

AXIS X/Y/Z/4 MEAS. SYSTEM DEFECTIVE

EMERGENCY STOP DEFECTIVE

WRONG REFERENCE POINT

EMERGENCY STOP PLC

GROSS POSITIONING ERROR A/B/C/D

TNC OPERATING TEMP. EXCEEDED

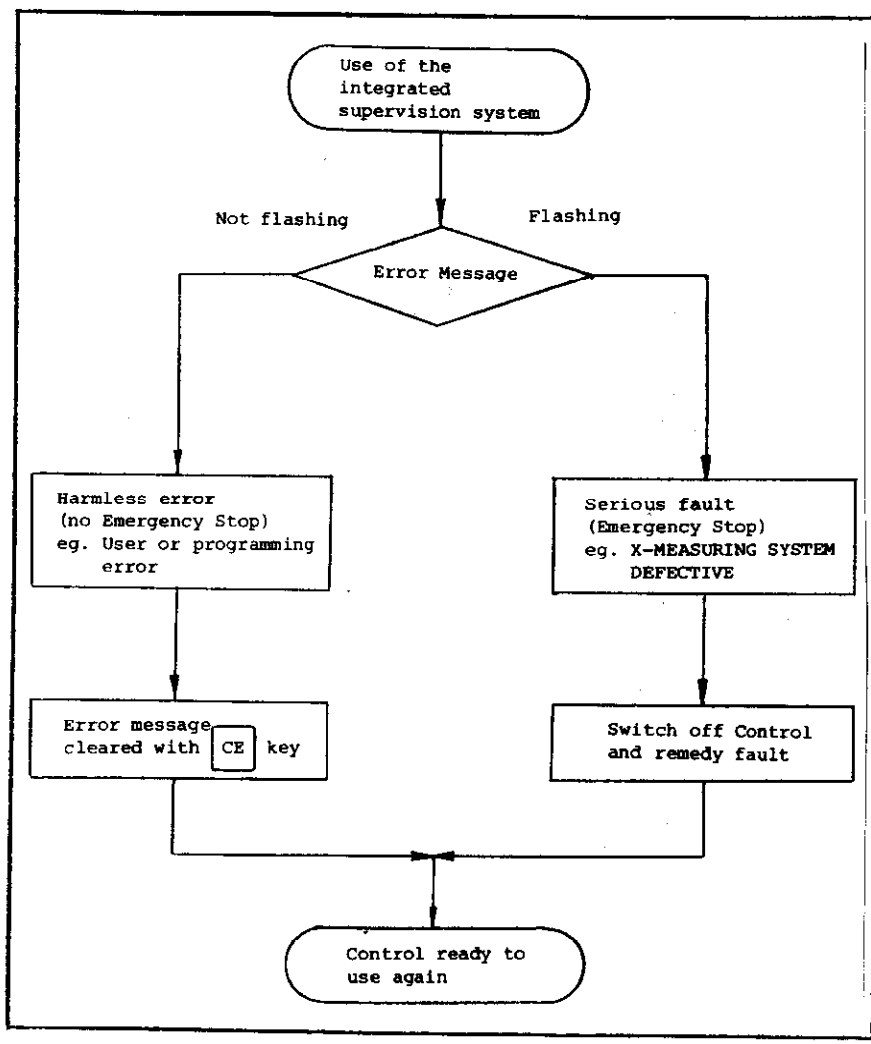
ERROR IN PLC PROGRAM A...Q

TNC ELECTRONICS DEFECTIVE 0...3/A...K

CHECK SUM ERROR XX00...XXFF

The significance of these fault messages is explained on pages 8 to 13.

A (non-flashing) error message can be cleared by pressing the **CE** key on the TNC, after which normal operation may resume. A list of error messages is given on page 7.



### Error message "EXCHANGE BUFFER BATTERY"

Particular mention should also be made about the implications of the instruction to exchange the buffer battery:  
 If the dialog display indicates "EXCHANGE BUFFER BATTERY", new batteries must be inserted within one week.  
 The buffer battery compartment is located behind the screw cover in the lower left-hand corner of the operating panel. When exchanging the batteries, special care should be taken that the polarity is correct (POS-pole of battery outwards). The battery needs to have IEC designation "LR 6" and must be of the leak-proof type. We especially recommend the use of VARTA Alkaline batteries type "4006". With discharged (or missing) buffer batteries, the memory for the machine parameters and for the user-program will be supported only as long as the mains remains switched on. Continued operation is still possible but the memory contents will become erased in the event of a mains failure. Please note that the TNC has to be switched on when exchanging the buffer batteries. If a mains failure occurs during a battery change (or when the battery is discharged or missing), the re-entry of the machine parameters and the user-program will be necessary.

**Kundendienst****Error messages TNC 151/155**

The meanings of many of these error messages are explained in:

- Operating Manual
- Mounting Instructions and Interface Circuit Control-Machine
- PLC-Description

KEY NON-FUNCTIONAL  
PROGRAM MEMORY EXCEEDED  
SEARCH ADDRESS MISSING  
TOOL DEF Ø NOT PERMITTED  
PROGRAM NUMBER ON TAPE ALLOCATED  
JUMP TO LABEL Ø NOT PERMITTED  
ENTRY VALUE INCORRECT  
CC-BLOCK MISSING  
CIRCLE END POS. INCORRECT  
TOOL DEF MISSING  
TOOL CALL MISSING  
LABEL NUMBER NOT ALLOCATED  
EXCESSIVE SUPROGRAMMING  
ANGLE REFERENCE MISSING  
PLANE WRONGLY DEFINED  
TOOL RADIUS TOO LARGE  
ROUNDING RADIUS TOO LARGE  
PATH OFFSET WRONGLY STARTED  
PATH OFFSET WRONGLY ENDED  
ROUNDING-OFF UNDEFINED  
ROUNDING-OFF NOT PERMITTED  
AXIS DOUBLE PROGRAMMED  
WRONG RPM  
NO EDITING OF RUNNING PGM  
RADIUS COMP. UNDEFINED  
LIMIT SWITCH X+  
LIMIT SWITCH X-  
LIMIT SWITCH Y+  
LIMIT SWITCH Y-

LIMIT SWITCH AXIS Z+  
LIMIT SWITCH AXIS Z-  
LIMIT SWITCH AXIS 4+  
LIMIT SWITCH AXIS 4-  
EXCHANGE BUFFER BATTERY  
TRANSFERRED DATA INCORRECT  
ME: CASSETTE MISSING  
ME: CASSETTE LOCKED  
ME: WRONG MODE SELECTED  
ME: WRONG PROGRAM DATA  
ME: CASSETTE EMPTY  
ME: PROGRAM INCOMPLETE  
ME: TAPE END  
WRONG PROGRAM DATA  
MACHINE PARAMETER INCOMPLETE  
EXT. IN-/OUTPUT NOT READY  
MIRROR IMAGE ON TOOL AXIS  
WRONG AXIS PROGRAMMED  
WRONG SIGN PROGRAMMED  
SPINDEL ROTATES MISSING  
SLOT WIDTH TOO LARGE  
CYCLE INCOMPLETE  
SELECTED BLOCK NOT ADDRESSED  
PROGRAM START UNDEFINED  
POSITIONING ERROR  
EMERGENCY STOP  
ARITHMETICAL ERROR  
OPERATION PARAMETERS ERASED  
3D-INTERPOLATION NOT PERMITTED

FURTHER PROGRAM ENTRY IMPOSSIBLE  
PROGRAM NUMBER UNAVAILABLE  
PROGRAM NUMBER ALLOCATED  
LABEL NUMBER ALLOCATED  
TOOL NUMBER ALLOCATED  
RELAY EXT. DC VOLTAGE MISSING  
POWER INTERRUPTED  
PGM XXXXXXXX UNAVAILABLE  
TWO TOOL DEF XXX WITH PGM CALL  
CIRCLE CENTRE UNDEFINED XXXX  
ADDRESS LETTER ALREADY ASSIGNED  
BLOCK TOO LONG  
G-CODE GROUP ALREADY ALLOCATED  
ILLEGAL G-CODE  
BLOCK NUMBER ALREADY ALLOCATED  
BLOCK FORMAT INCORRECT  
N-CODE MISSING  
BLK FORM DEFINITION INCORRECT  
PGM-SECTION CANNOT BE SHOWN  
TOO MANY USER PARAMETERS  
PROTECTED PGM  
ILLEGAL NC-BLOCK  
CHAMFER NOT ALLOWED  
FAULT IN PLC PROGRAM

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Fault descriptions TNC 151/155

| VDU Display (flashing)                                                                                                                                                                               | Fault cause                                                                                                                                                                                                                   | Possible fault location                                                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TRANSDUCER X DEFECT A<br>TRANSDUCER Y DEFECT A<br>TRANSDUCER Z DEFECT A<br>TRANSDUCER S DEFECT A<br>TRANSDUCER X DEFECT B<br>TRANSDUCER Y DEFECT B<br>TRANSDUCER Z DEFECT B<br>TRANSDUCER S DEFECT B | Fault code: A = signal amplitude fault<br>B = signal frequency fault<br>.Measuring system not connected<br>.Cable damaged<br>.Glass scale dirty or damaged<br>.Scanning head damaged<br>.Measuring system supervision damaged | Measuring system<br><br><br><br><br><br><br>Analog Board                                                                                                                                                                      |
| EMERGENCY STOP DEFECTIVE                                                                                                                                                                             | .Fault in the emergency stop<br>circuit of the machine (for checking<br>routine see Mounting Instructions and<br>Interface Circuit Control-Machine<br>manual<br>.Defect in Control's internal Emergency<br>Stop supervision   | Analog Board<br>PLC I/O Board (TNC 151/155 Q)<br>PLC Interface Board (TNC 151/155 Q)<br>SE Board (TNC 151/155 B)<br>Terminal Board (TNC 151/155 B)                                                                            |
| WRONG REFERENCE POINT                                                                                                                                                                                | .Traversed-over reference point lies<br>outside of the reference point end<br>position (also see Mounting Instruc-<br>tions and Interface Circuit Control<br>Machine<br>.Defect in Control/machine interface                  | Machine (cams/switches<br>"reference end-position" or "reference<br>pulse inhibit")<br><br>PLC I/O Board (TNC 151/155 Q)<br>PLC Interface Board (TNC 151/155 Q)<br>SE Board (TNC 151/155 B)<br>Terminal Board (TNC 151/155 B) |

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| VDU Display (flashing)    | Fault cause                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Possible fault location                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMERGENCY-STOP PLC        | With standard PLC program, faulty reply from output A6 ("Lock for spindle on") to input E20 ("reply: Lock for spindle on")<br>Fault message EMERGENCY-STOP PLC appears only when no additional PLC marker is set for the fault message                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Terminal board (TNC 151/155 B)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| GROSS POSITIONING ERROR A | <p>.Trailing error greater than value entered in MP 174.<br/>(see Mounting Instructions and Interface Circuit Control-Machine manual</p> <p>.Deviation from the intended position at standstill greater than the value entered in MP 169<br/>(see Mounting Instructions and Interface Circuit Control-Machine manual</p> <p>.Exceeding the range for the continuous position supervision determined by MP 57.<br/>(see Mounting Instructions and Interface Circuit Control-Machine manual</p> <p>.Relationship between output voltage and traversed distance outside of the defined tolerance.</p> <p>.Defect in the pulse counting section (Control circuitry) after the transducer signal supervision</p> | <p>In the Case of Gross Positioning Errors A/B/C/D the fault could lie with any element in the closed loop servo system. ie Control hardware (CLP Processor/ Graphics Brd.),<br/>Control hardware (Analog Brd.),<br/>servo amplifier (offset voltages),<br/>" " (gain too low),<br/>motor,<br/>tacho,<br/>measuring system,<br/>external forces acting on drives,<br/>inappropriate MP values programmed.</p> <p>Aid:</p> <ol style="list-style-type: none"> <li>1. Program MP 54 (acceleration) as small as possible.</li> <li>2. Adjust rapid traverse (as small a trailing error as possible).</li> <li>3. Gradually increase MP 54.</li> </ol> <p>If this does not help:<br/>fault in the Control hardware (closed loop) or in the machine</p> |

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| VDU Display (flashing)       | Fault cause                                                                                                                                   | Possible fault location                        |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| GROSS POSITIONING ERROR B    | .The analog output voltage calculated by the control (implied by trailing error) is greater than $\pm 10$ V                                   | see above                                      |
| GROSS POSITIONING ERROR C    | .The analog output voltage required to obtain a desired speed deviates more from the calculated voltage than the voltage programmed in MP 234 | see above                                      |
| GROSS POSITIONING ERROR D    | .The actual position at standstill deviates more from the intended position than the distance programmed in MP 169                            | see above                                      |
| GROSS POSITIONING ERROR E    | Automatic offset adjustment (MP 252)<br>Offset voltage is greater than 100mV                                                                  |                                                |
| TNC OPERATING TEMP. EXCEEDED | .Ambient temperature inside the TNC has exceeded +65°C<br>.Fault in the temperature supervision                                               | Ambient temperature of Control<br>Analog Board |

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| VDU Display (flashing)    | Fault cause                                                     | Possible fault location           |
|---------------------------|-----------------------------------------------------------------|-----------------------------------|
| ERROR IN PLC PROGRAM .... | Fault with non-erasable marker<br>(see also PLC-Description)    |                                   |
| " " " " A                 | Start Key<br>or incremental positioning X+                      | PLC Program, Main Processor Board |
| " " " " B                 | Rapid Traverse Key<br>or incremental positioning X-             | " " " " "                         |
| " " " " C                 | Direction Latch Key<br>or incremental positioning Y+            | " " " " "                         |
| " " " " D                 | Feed Release<br>or incremental positioning Y-                   | " " " " "                         |
| " " " " E                 | Start PLC Positioning X-axis<br>or incremental positioning Z+   | " " " " "                         |
| " " " " F                 | Start PLC Positioning Y-axis<br>or incremental positioning Z-   | " " " " "                         |
| " " " " G                 | Start PLC Positioning Z-axis<br>or incremental positioning IV+  | " " " " "                         |
| " " " " H                 | Start PLC Positioning IV-axis<br>or incremental positioning IV- | " " " " "                         |
| " " " " I                 | Directional Key X+                                              | " " " " "                         |
| " " " " J                 | Directional Key X-                                              | " " " " "                         |
| " " " " K                 | Directional Key Y+                                              | " " " " "                         |
| " " " " L                 | Directional Key Y-                                              | " " " " "                         |

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| VDU Display (flashing)   | Fault cause                                                                                     | Possible fault location           |
|--------------------------|-------------------------------------------------------------------------------------------------|-----------------------------------|
| ERROR IN PLC PROGRAM ... | Error with non-erasable marker<br>(see also PLC-Description)                                    |                                   |
| " " " M                  | Directional Key Z+                                                                              | PLC Program, Main Processor Board |
| " " " N                  | Directional Key Z-                                                                              | " " "                             |
| " " " O                  | Directional Key IV+<br>or supplementary axis to be changed to<br>another axis M 2590 and M 2591 | " " "                             |
| " " " P                  | Directional Key IV-<br>or Start PLC Positioning S-axis                                          | " " "                             |
| " " " Q                  | Non-defined macro called up via PLC marker                                                      | " " "                             |

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| VDU Display (flashing)  |   |   |   | Fault cause                                                                                                       | Possible fault location                     |
|-------------------------|---|---|---|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| PROCESSOR CHECK ERROR 0 |   |   |   | Incorrect CRC checksum* of machine-related data excluding machine parameters. (Baud rate, limitation, preset etc) | Main Processor Board                        |
| "                       | " | " | 1 | Incorrect CRC checksum* (machine parameters)                                                                      | Main Processor Board                        |
| "                       | " | " | 2 | Incorrect CRC checksum* (user memory)                                                                             | Main Processor Board                        |
| "                       | " | " | 3 | Integrated Test Program execution incomplete                                                                      | Main Processor Board                        |
| "                       | " | " | A | Software error Main Processor                                                                                     | Main Processor Board                        |
| "                       | " | " | B | Software error CLP Processor                                                                                      | CLP Processor/Graphics Board                |
| "                       | " | " | C | MID interrupt** CLP Processor                                                                                     | Main Processor/CLP Processor/Graphics Board |
| "                       | " | " | D | CLP Processor instruction stack overflow                                                                          | CLP Processor Board                         |
| "                       | " | " | E | False instruction: Main Processor<br>CLP Processor                                                                | Main Processor/CLP Processor/Graphics Board |
| "                       | " | " | F | False instruction (display mode): Main Processor<br>CLP Processor                                                 | Main Processor/CLP Processor/Graphics Board |
| "                       | " | " | G | CLP Processor RAM                                                                                                 | CLP Processor/Graphics Board                |
| "                       | " | " | H | Overflow interrupt                                                                                                | Main Processor Board                        |
| "                       | " | " | I | MID interrupt Main Processor                                                                                      | Main Processor Board                        |
| "                       | " | " | J | Equipped with incorrect language version                                                                          | Main Processor Board                        |
| "                       | " | " | K | RAM E000...FFFF Main Processor                                                                                    | Main Processor Board                        |
| "                       | " | " | L | Enable a function via machine parameters which is not integrated in the software                                  | False machine parameter                     |

\* CRC = Cyclic Redundancy Check  
\*\* MID = Macro Instruction Detection

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| VDU Display (flashing) | Fault cause                                                                                                                  | Possible fault location                    |
|------------------------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| CHECK-SUM ERROR XX00   | CRC CHECK-SUM error with EPROM 3<br>XX = correct CHECK-SUM value<br>00 = code for faulty EPROMs                              | Main Processor Board                       |
| to                     |                                                                                                                              |                                            |
| CHECK-SUM ERROR XX0F   | CRC CHECK-SUM error with EPROM 3                                                                                             | Main Processor Board                       |
| " " XX10               | " " " " with EPROM 4                                                                                                         | Main Processor Board                       |
| to                     |                                                                                                                              |                                            |
| CHECK-SUM ERROR XX1F   | CRC CHECK-SUM error with EPROM 4                                                                                             | Main Processor Board                       |
| " " XX2B               | " " " " with EPROM 5                                                                                                         | Main Processor Board                       |
| to                     |                                                                                                                              |                                            |
| CHECK-SUM ERROR XX2F   | CRC CHECK-SUM error with EPROM 5                                                                                             | Main Processor Board                       |
| " " XX40               | " " " " with EPROM 2                                                                                                         | CLP Processor/Graphics Board               |
| " " XX41               | CRC CHECK-SUM error in RAM area on the<br>CLP Processor/Graphics Board in which a<br>part of the operating program is stored | CLP Processor/Graphics Board               |
| " " XX42               | CRC CHECK-SUM error with EPROM 2                                                                                             | CLP Processor/Graphics Brd. (export vers.) |
| " " XX43               | CRC CHECK-SUM error in the RAM area on the<br>CLP Processor/Graphics Board where part of<br>the operating program is stored  | CLP Processor/Graphics Brd. (export vers.) |
| " " XXFF               | CRC CHECK-SUM error with PLC RAM                                                                                             | Main Processor Board                       |
| " " XX30               | PLC Program from addr. 0-1000H (virtual addr.<br>30000-30FFFF) in PLC-EPROM/PLC-RAM                                          | Main Processor Board                       |
| " " XX31               | PLC Program from addr. 1000-FFFECH (virtual<br>addr. 31000-3FFFECH) in PLC-EPROM/PLC-RAM                                     | Main Processor Board                       |



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### 2.2.3 Testing of the VDU and associated circuitry

The first objective is to determine whether the fault is actually with the Display Unit, in which case it must be returned to DR JOHANNES HEIDENHAIN for repair, or whether it lies elsewhere, with the associated circuitry, in which case repairs may be possible without returning the unit.

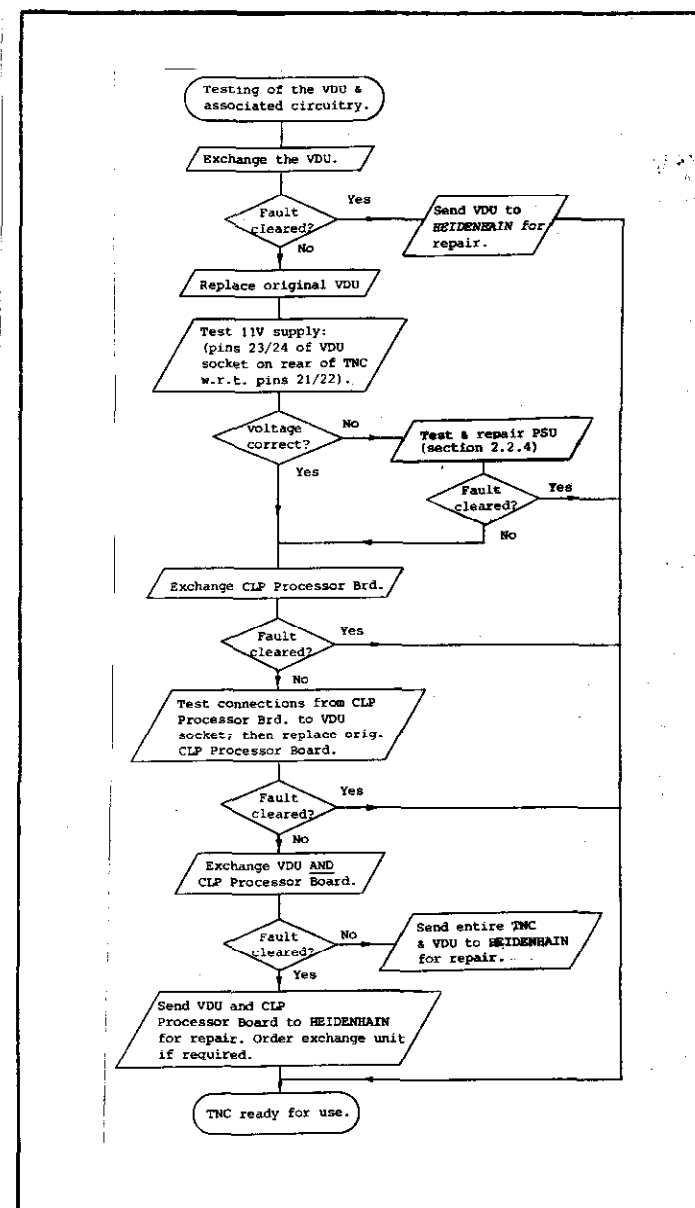
Visual Display Units BE 110 and BE 211 in conjunction with TNC 151

The Display Units BE 111 and BE 211 are supplied by an 11V dc supply from the Power Supply Board. This is a possible source of the fault, in which case the test and repair procedure continues according to section 2.2.4, Testing of the mains supply and the Power Supply Unit.

If the fault is not due to a defective power supply, it is likely to be due to the CLP Processor Board, which contains the control circuitry for the Display Unit. This can be verified by exchanging the board for one is known to function correctly.

If the fault still persists then must be due either to bad connections within the TNC (eg on the Connector Board), or to faults on both the VDU and the CLP Processor Board.

See the diagram opposite for a logical procedure for locating the fault in the system.



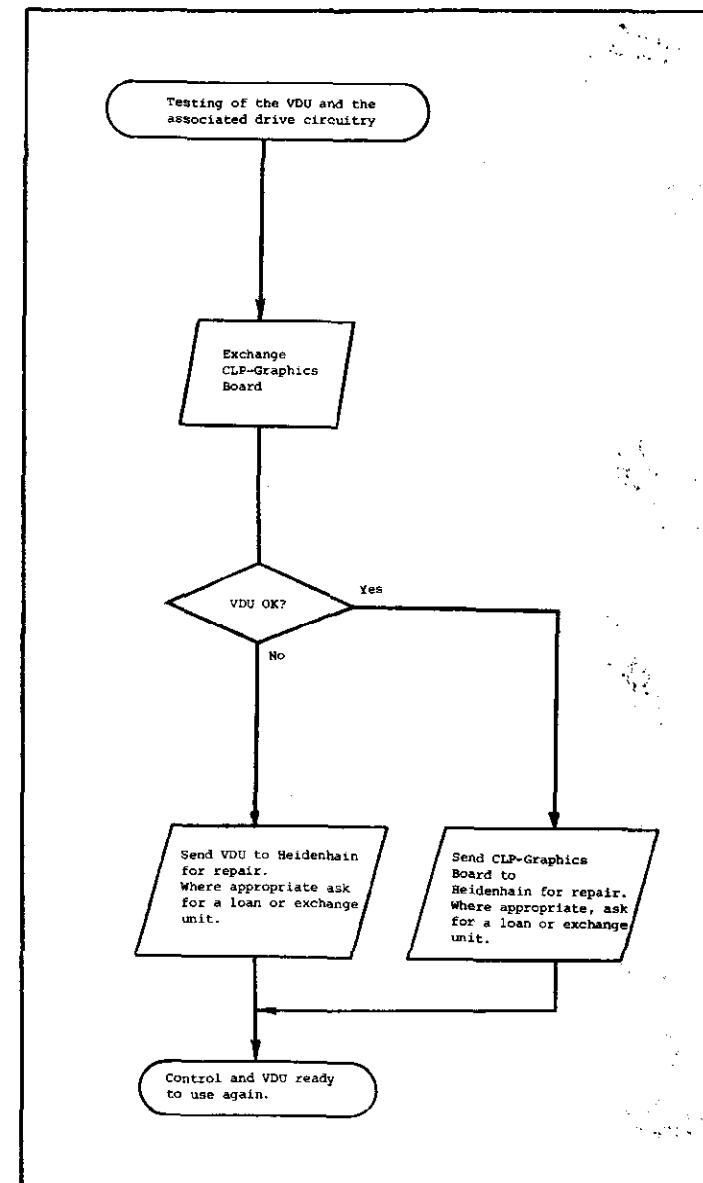
### Visual Display Unit BE 411 in conjunction with TNC 155

The Display Units BE 411 is supplied by 11 Vds from the units own integrated power supply. A defect in this power supply may cause an apparent CRT display fault.

If the fault is not due to the defective power supply, it is likely to be due to the CLP-Graphics Board, which contains the control circuitry for the Display Unit. This can be verified by exchanging the board for one which is known to function correctly.

If the fault still persists then must be due either to bad connections within the TNC (eg on the Connector Board), or to faults on both the VDU and the CLP-Graphics Board.

See the diagram opposite for a logical procedure for locating the fault in the system.



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## 2.2.4 Testing of the Power Supply Unit

The procedure for testing the Power Supply Unit is shown in the flow diagram on page 16. As part of that procedure, it may be necessary to test the voltages at various points on The Power Supply Board under load.

Test Data: Old Power Supply Board (227 601 ..) for TNC 151/155

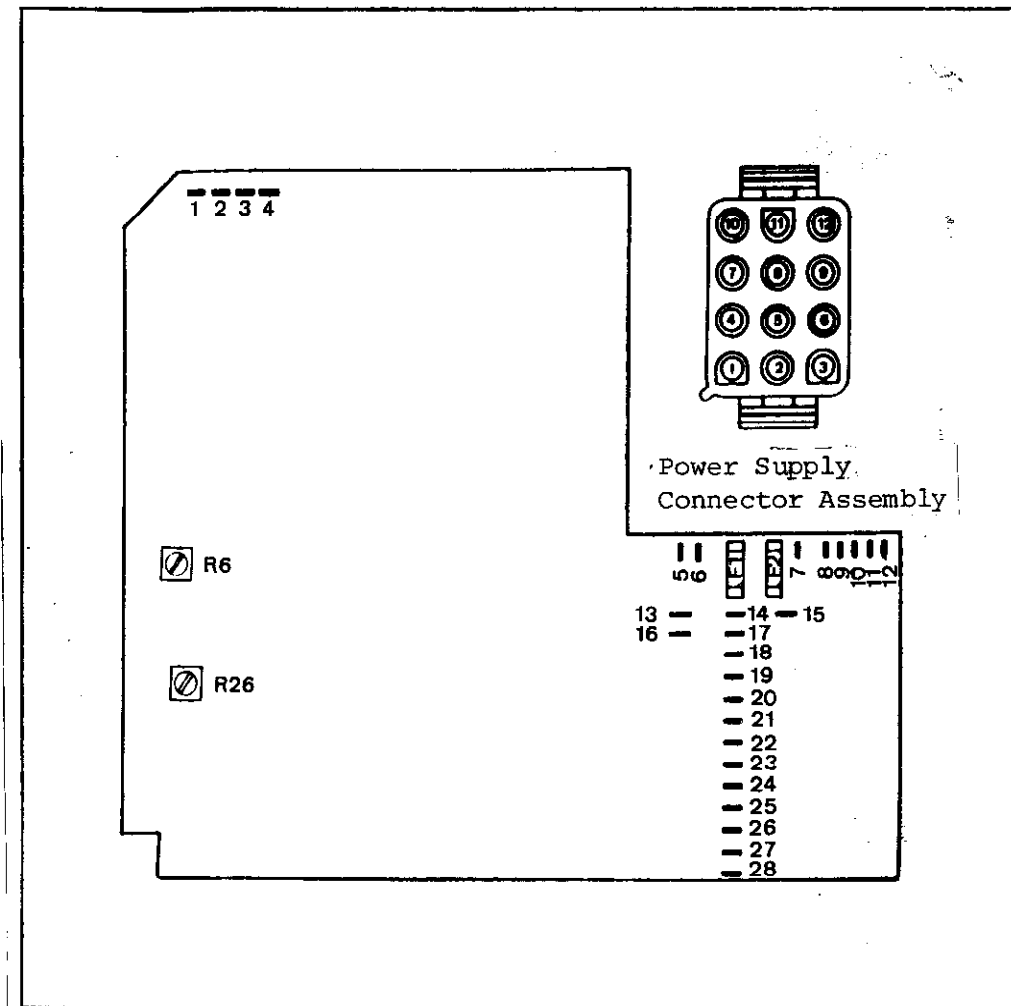
The diagram below and the table opposite show the locations of the test points (solder terminals) on the old Power Supply Board 227 601 .. and the respective "nominal" and "actual" test voltages under load.

### Plug and solder terminal signal designation

| Plug pin | Cable colour | Solder terminal test points | Voltage/Signal (Nominal) | Test values (V) under load |        |          |
|----------|--------------|-----------------------------|--------------------------|----------------------------|--------|----------|
| 1        | black        | 23/24                       | 0V TTL                   | 12,0                       | + 0,5  | at 0,15A |
| 2        | brown        | 17                          | +12 Processor supply     | 5,16                       | + 0,08 | at 3,5A  |
| 3        | red          | 21/22                       | +5V TTL                  | -14,9                      | + 0,6  | at 0,1A  |
| 4        | grey         | 20                          | -15V Switching reg.      | 15,0                       | + 0,6  | at 0,3A  |
| Δ 5      | blue         | 27/28                       | 0V Display Unit          | 45,2                       | + 1,5  | at 0,06A |
| 6        | green        | 16                          | +15V Analogue Board      | 11,2                       | + 0,25 | at 1,4A  |
| 7        | yellow       | 19                          | +45V Switching reg.      | 21,6                       | + 0,8  | at 0,01A |
| Δ 8      | white        | 25/26                       | +11V Display Unit        | 4,2                        | + 0,2  | at 0,17A |
| 9        | green/white  | 13/8                        | Reset                    |                            |        |          |
| * 10     | yellow/white | 18                          | +22V Display             |                            |        |          |
| * 11     | brown/white  | 15                          | 4,2V ~ Heater            |                            |        |          |
| * 12     | brown/white  | 14                          |                          |                            |        |          |
| -        | -            | 1                           | 21V ~ Mains transf.      |                            |        |          |
| -        | -            | 2                           | sec. voltage             |                            |        |          |
| -        | -            | 3                           | 21V ~ Mains transf.      |                            |        |          |
| -        | -            | 4                           | sec. voltage             |                            |        |          |
| * -      | -            | 5                           | 0V                       |                            |        |          |
| * -      | -            | 6                           | 2,1V ~ Mains transf.     |                            |        |          |
| * -      | -            | 7                           | 2,1V ~ sec. voltage      |                            |        |          |
| -        | -            | 9,10,11,12                  | no connection            |                            |        |          |

\* not used with TNC 151/155  
Δ not used with TNC 155

Test points on the Power Supply Board 227 601 ..



Fuses F1 and F2 not used with TNC 151

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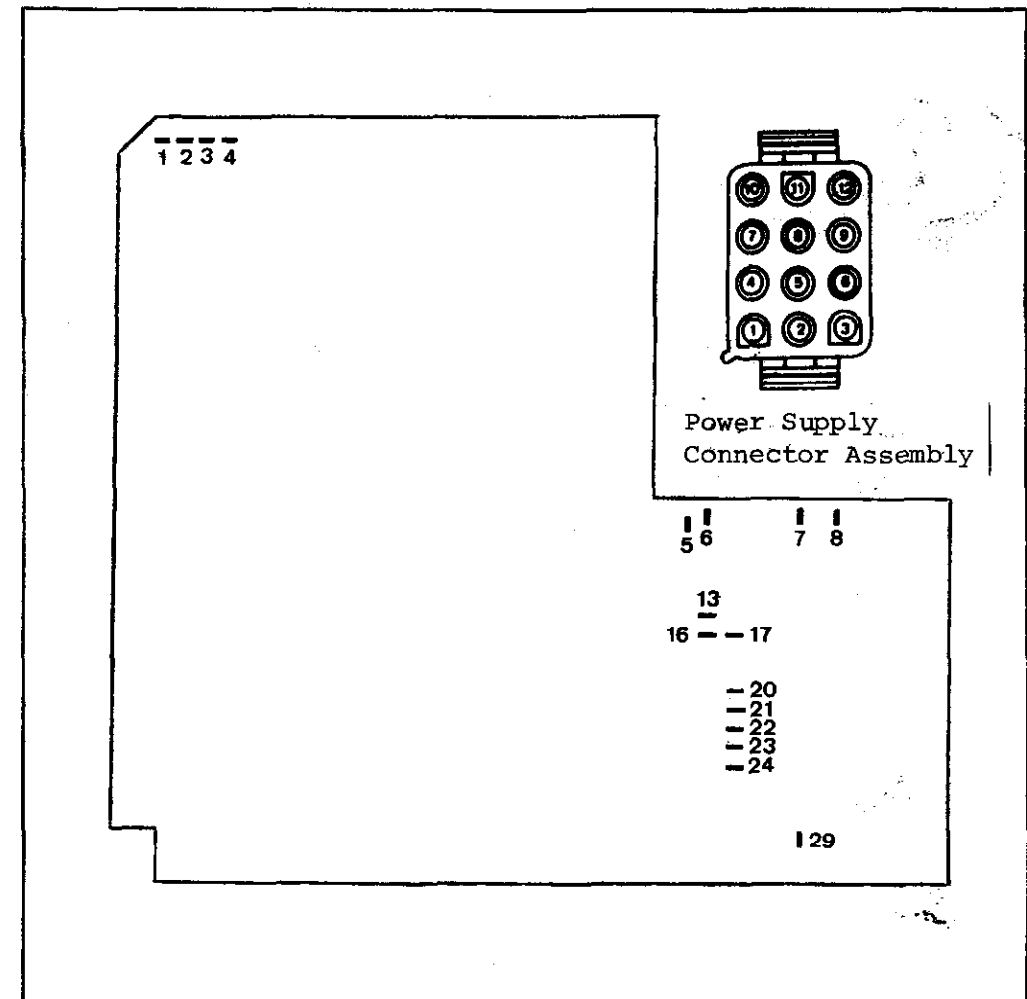
**Test Data: New Power Supply Board (230 802 ...) for TNC 155 only!**

The diagram opposite and the table below show the locations of the test points (solder terminals) on the new Power Supply Board 230 802 ..., and the respective nominal and actual test voltages under load. Previous TNC 155 Controls may be fitted with Power Supply Board 227 601 .. (as used in the TNC 145/150/151). Test points on the Power Supply Board 230 802 ...

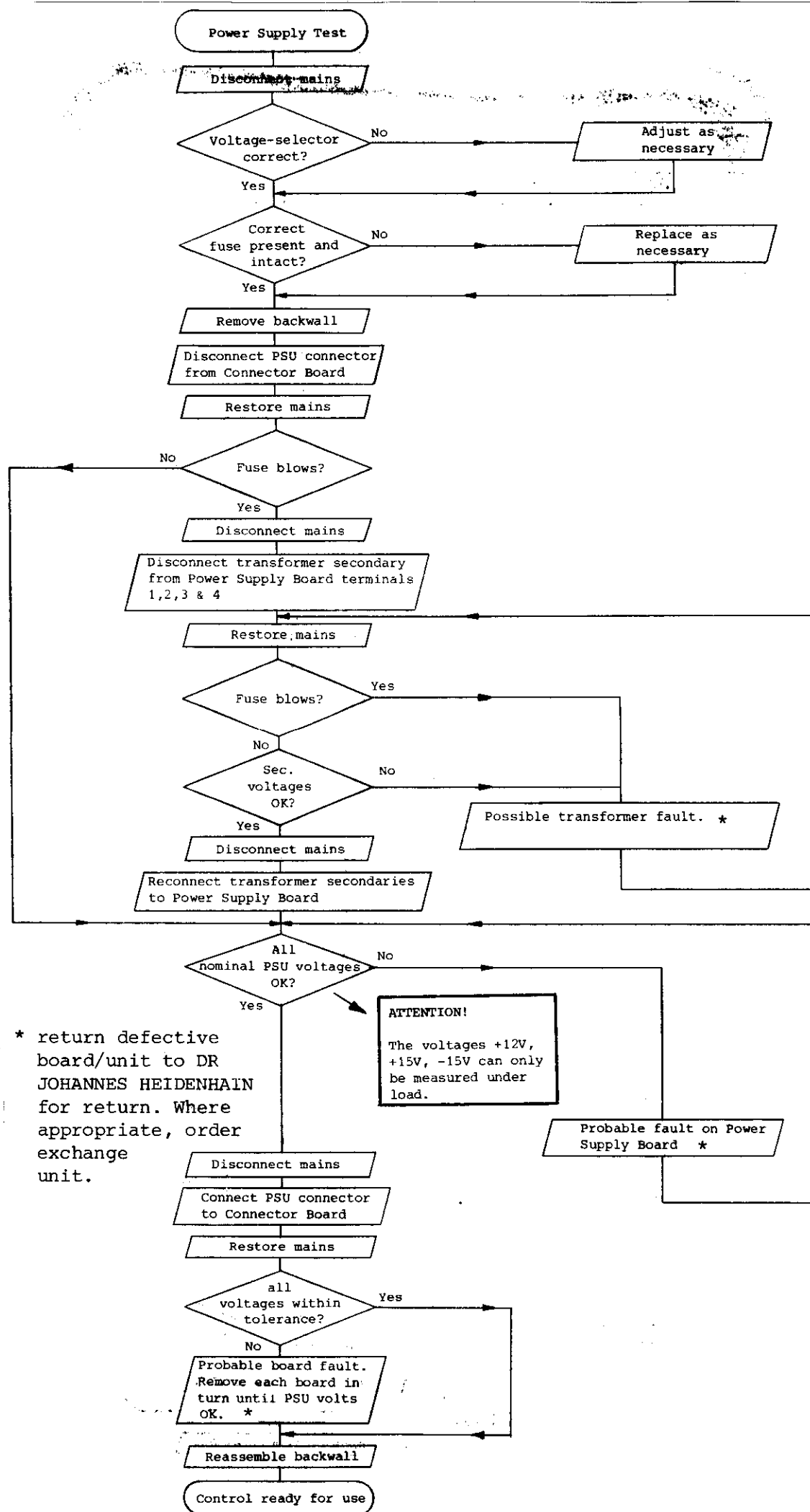
**Plug and solder terminal signal designation**

| Plug pin | Cable colour | Solder terminal test points | Voltage/Signal (Nominal) | Test values (V) under load |       |             |
|----------|--------------|-----------------------------|--------------------------|----------------------------|-------|-------------|
| 1        | black        | 23/24                       | 0V TTL                   |                            |       |             |
| 2        | brown        | 17                          | +12 Processor supply     | 12,0                       | + 0,5 | at 100 ohms |
| 3        | red          | 21/22                       | +5V TTL                  | 5,2                        | + 0,1 | at 1,5 ohms |
| 4        | grey         | 20                          | -15V Switching reg.      | -15,0                      | + 1,5 | at 150 ohms |
| 5        | -            | -                           | n.c.                     |                            |       |             |
| 6        | green        | 16                          | +15V Analogue Board      | 15,5                       | + 0,1 | at 50 ohms  |
| 7        | -            | -                           | n.c.                     |                            |       |             |
| 8        | -            | -                           | n.c.                     |                            |       |             |
| 9        | green/white  | 13/8                        | Reset                    |                            |       |             |
| 10       | -            | -                           | n.c.                     |                            |       |             |
| 11       | -            | -                           | n.c.                     |                            |       |             |
| 12       | -            | -                           | n.c.                     |                            |       |             |
| -        | -            | 1                           | 21V ~ } Mains transf.    |                            |       |             |
| -        | -            | 2                           | sec. voltage             |                            |       |             |
| -        | -            | 3                           | 21V ~ } Mains transf.    |                            |       |             |
| -        | -            | 4                           | sec. voltage             |                            |       |             |
| * -      | -            | 5                           | 0V                       |                            |       |             |
| * -      | -            | 6                           | 2,1V ~ } Mains transf.   |                            |       |             |
| * -      | -            | 7                           | sec. voltage             |                            |       |             |
| -        | -            | 9,10,11,12                  | no connection            |                            |       |             |

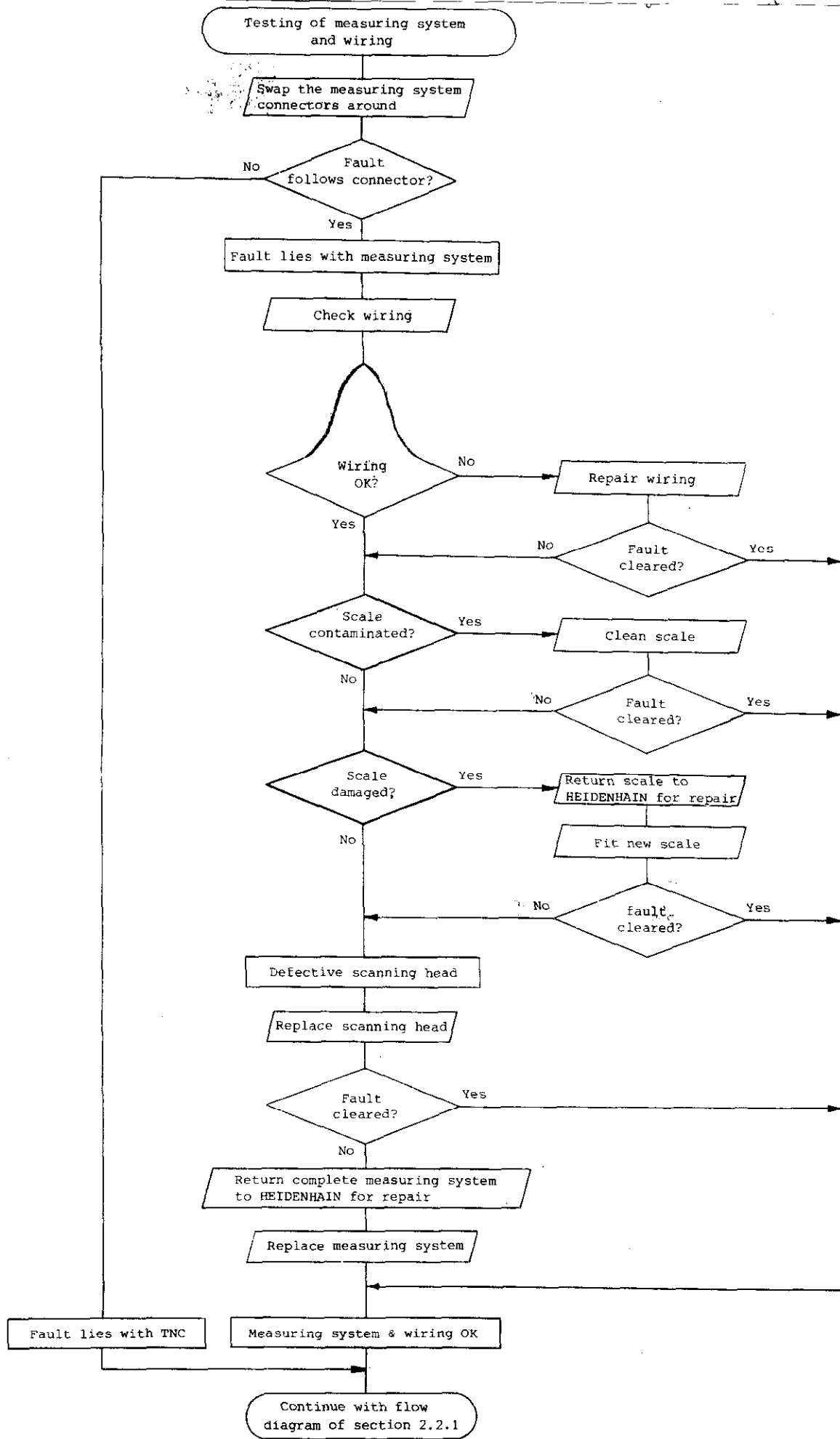
\* not used with TNC 151



## Procedure for testing the Power Supply Unit



## 2.2.5 Testing of the measuring systems and wiring



### 2.2.6 Burn-In Test

In some cases, inspite of there being definite fault conditions on the control, error messages may not be displayed on the VDU. However, the Control's electronics can be tested with the help of the Burn-In test program.

This test program is a means of dynamically testing the Control's hardware and can be used not only for duration testing but also for fault diagnosis.

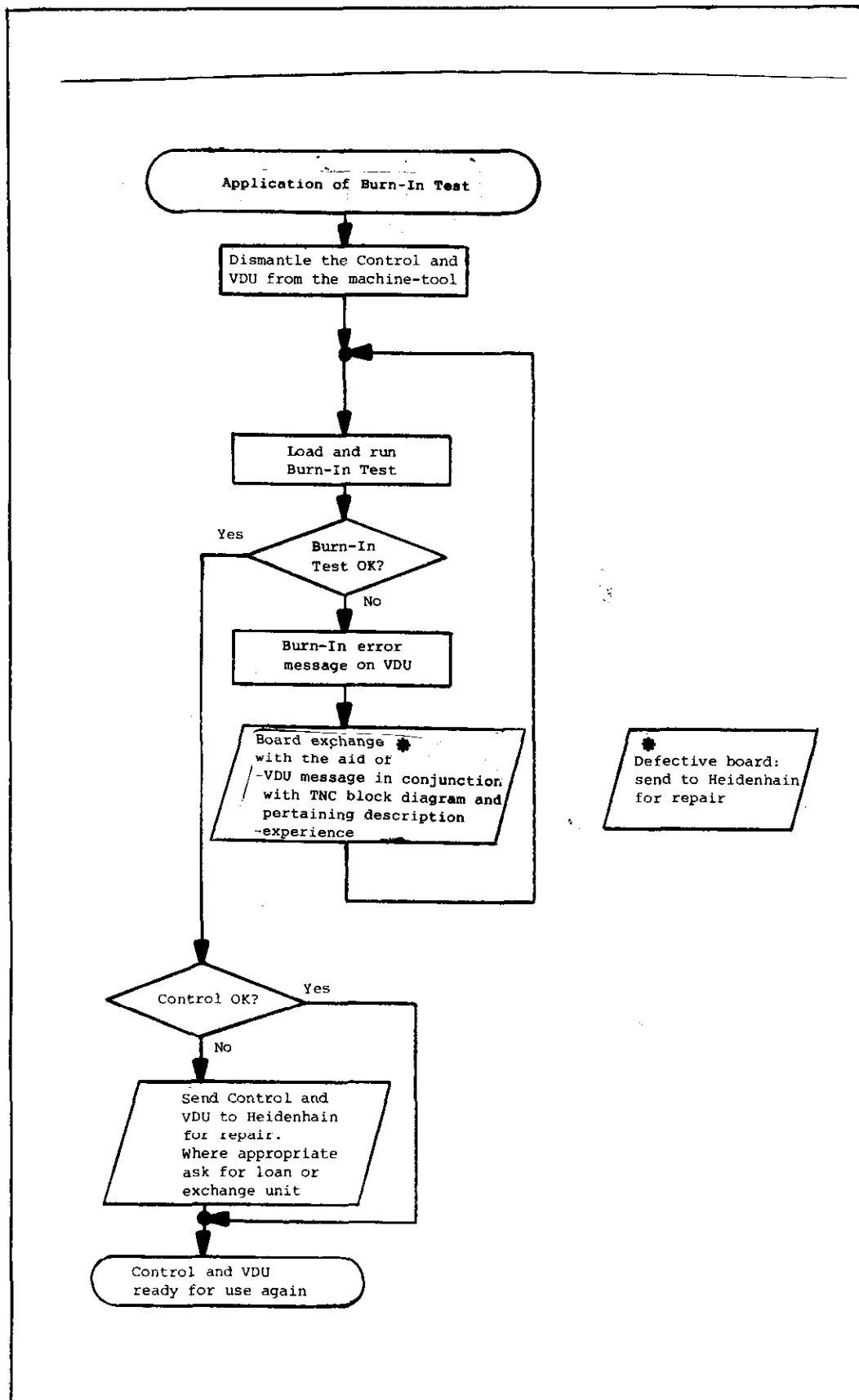
The test program is stored on a digital cassette and can be loaded into the Control via magnetic tape units ME 101 B/102 B or ME 101 C/102 C (Program versions 212 902 05/212 902 09). The test program cannot be loaded into the Control if the flashing error message: "TNC ELECTRONICS DEFECTIVE ." is present on the VDU. In this case, the faulty board must be determined by exchanging each board in turn until the fault is eliminated. However, before exchanging any board, it is advisable to check the output voltage from the Power Supply Unit (see section 2.2.4). To run the Burn-In test program it is necessary to have a set of Burn-In Test Adapters.

Figs. 2 to 4.1 show pictorial and schematic representations of each individual adapter.

Depending on the type of Control, (TNC with either a standard SE interface or with an external PLC I/O Board) the appropriate adapters must be connected as shown in fig. 1.

It is important to have the correct test program for the type of Control and for the Control's current NC Software issue. The test programs are listed on page 20. The type of Control can be determined from the identification number of the unit; the issue of the NC Software can be determined from the NC Software issue number. Both these numbers are found on the type-plate on the rear of the Control.

# Application of the Burn-In Test





**Kundendienst**

Burn-In Test Programs for TNC 151 B/F

on the Philips miniature cassette

| Control Type | Control Id. No. | From NC Software issue | Test dialog | Test Prog. Id. No. |
|--------------|-----------------|------------------------|-------------|--------------------|
| TNC 151 B    | 235 565 99      | ... .. 01              | D           | 230 615 02         |
| TNC 151 F    | 235 565 98      |                        |             |                    |
| TNC 151 B    | 235 565 99      | ... .. 01              | GB          | 230 616 02         |
| TNC 151 F    | 235 565 98      |                        |             |                    |

Burn-In Test Programs for TNC 155 B/F

on the Philips miniature cassette

| Control Type | Control Id. No. | From NC Software issue | Test dialog | Test Prog. Id. No. |
|--------------|-----------------|------------------------|-------------|--------------------|
| TNC 155 B    | 235 567 99      | ... .. 01              | D           | 230 609 02         |
| TNC 155 F    | 235 567 98      |                        |             |                    |
| TNC 155 B    | 235 567 99      | ... .. 01              | GB          | 230 610 02         |
| TNC 155 F    | 235 567 98      |                        |             |                    |

Burn-In Test Programs for TNC 151 Q/W

on the Philips miniature cassette

| Control Type | Control Id. No. | From NC Software issue | Test dialog | Test Prog. Id. No. |
|--------------|-----------------|------------------------|-------------|--------------------|
| TNC 151 Q    | 235 566 99      | ... .. 01              | D           | 230 617 02         |
| TNC 151 W    | 235 566 98      |                        |             |                    |
| TNC 151 Q    | 235 566 99      | ... .. 01              | GB          | 230 618 02         |
| TNC 151 W    | 235 566 98      |                        |             |                    |

Burn-In Test Programs for TNC 155 Q/W

on the Philips miniature cassette

| Control Type | Control Id. No. | From NC Software issue | Test dialog | Test Prog. Id. No. |
|--------------|-----------------|------------------------|-------------|--------------------|
| TNC 155 Q    | 233 568 99      | ... .. 01              | D           | 230 611 02         |
| TNC 155 W    | 233 568 98      |                        |             |                    |
| TNC 155 Q    | 233 568 99      | ... .. 01              | GB          | 230 612 02         |
| TNC 155 W    | 233 568 98      |                        |             |                    |



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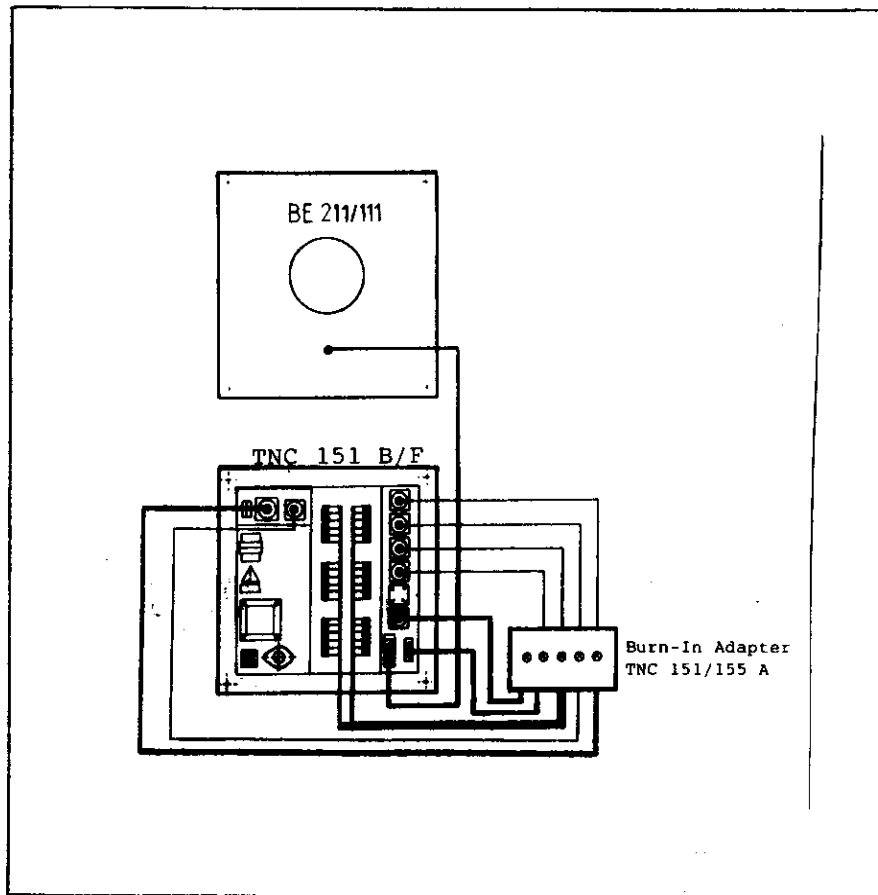
## IMPORTANT!

The following section "BURN-IN TEST", pages 21-35 contains the procedure for testing older TNC 151/155 versions and is therefore to be used as a guide only for the newer TNC 151/155 controls described in this manual.

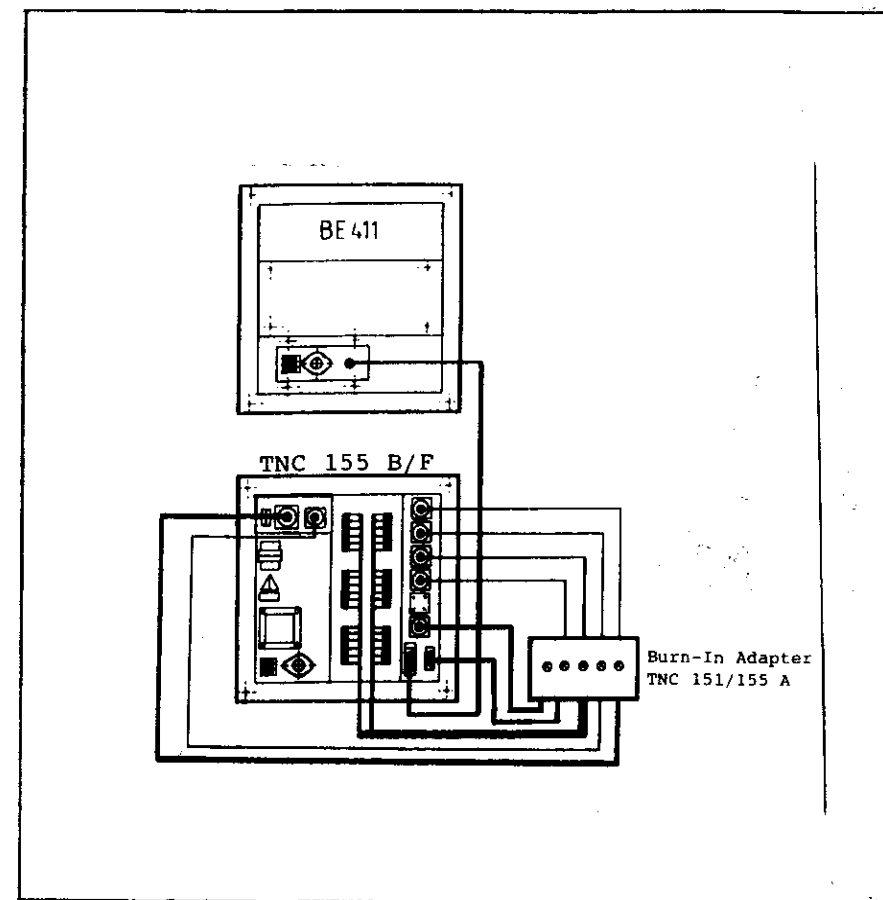
An updated section pertaining to the newer TNC 151/155 is in print. The description contained herein is outdated and should be destroyed upon receiving the updated version.

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Fig. 1 Interconnections of Burn-In Adapters and TNC 151/155 B/F

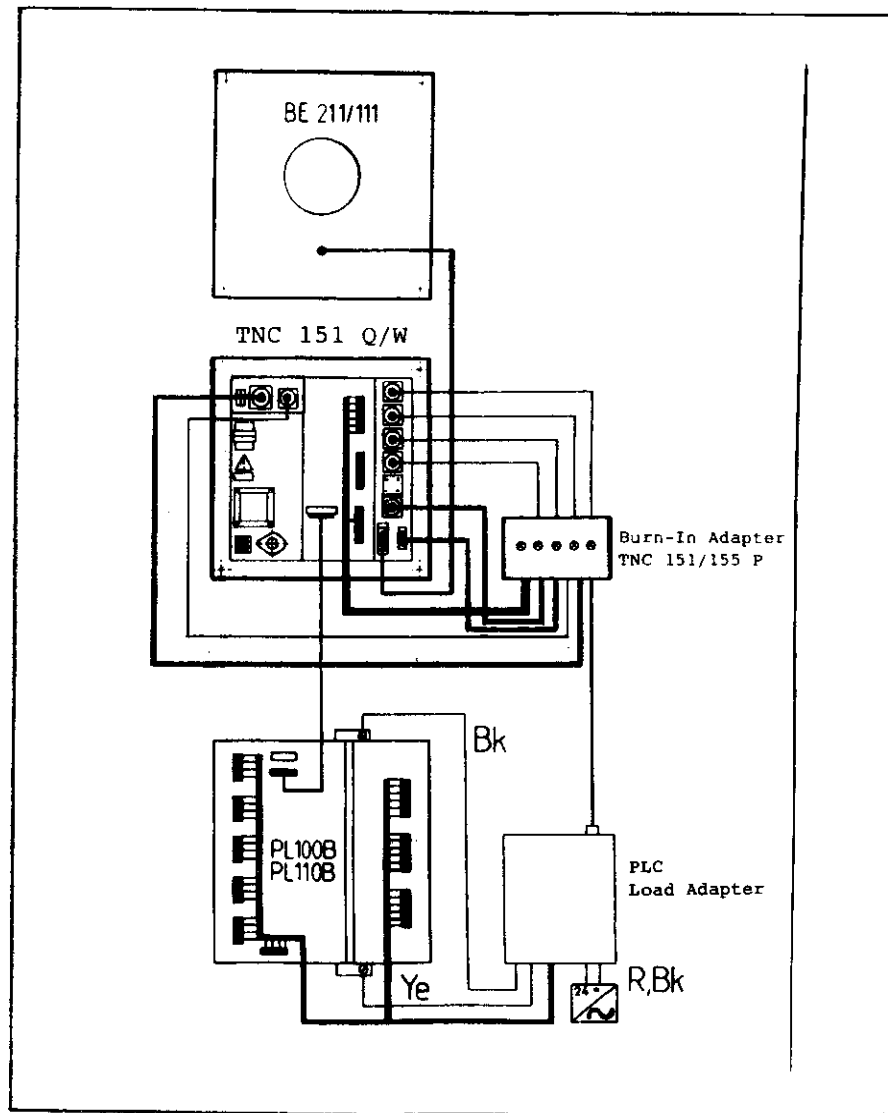


a) TNC 151 B/F

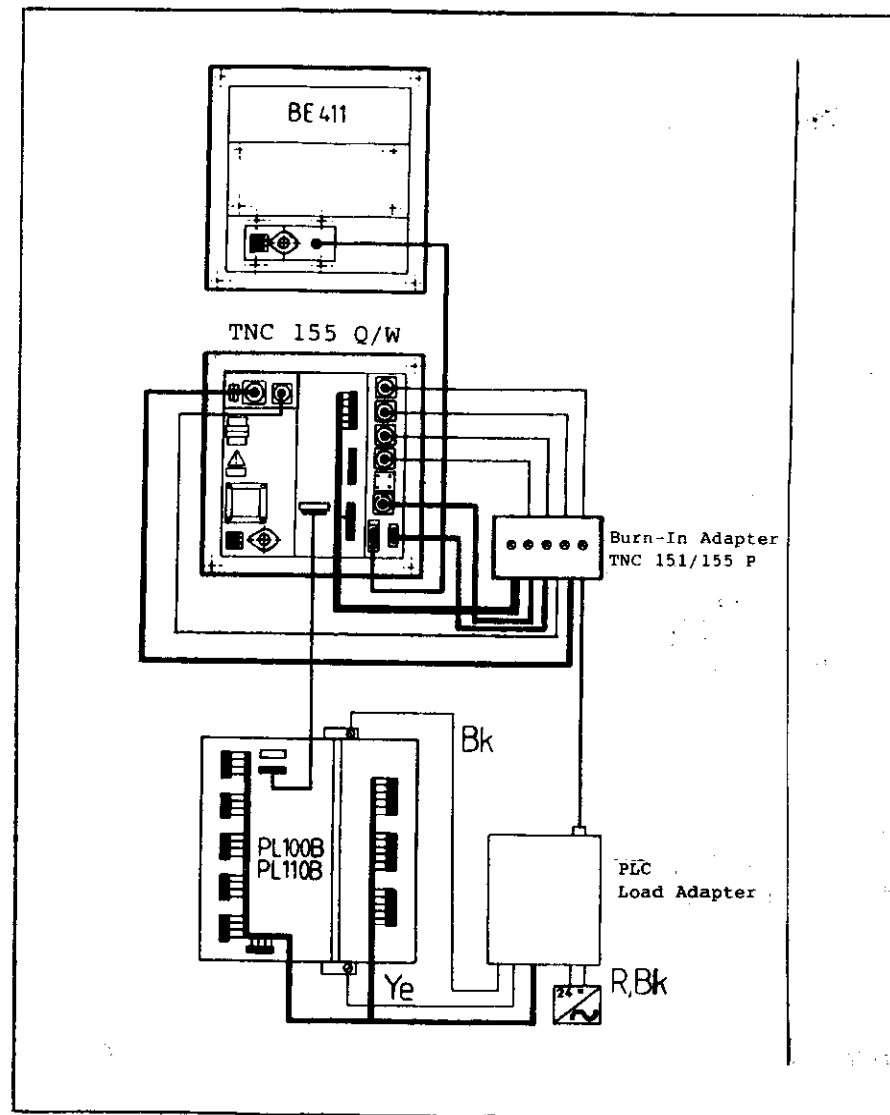


b) TNC 155 B/F

Fig. 1 Interconnections of Burn-In Adapters and TNC 151/155 Q/W



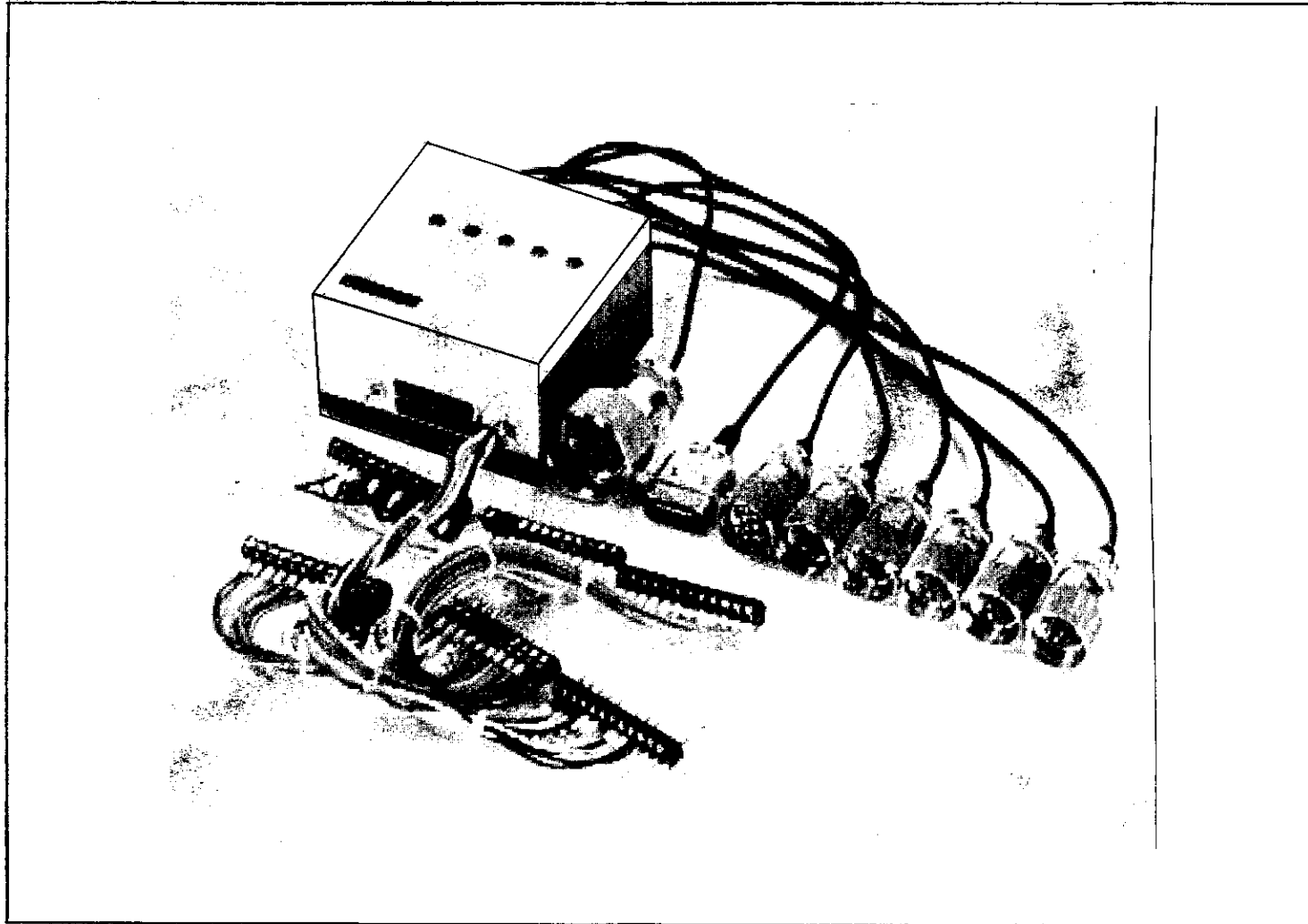
a) TNC 151 Q/W



b) TNC 155 Q/W

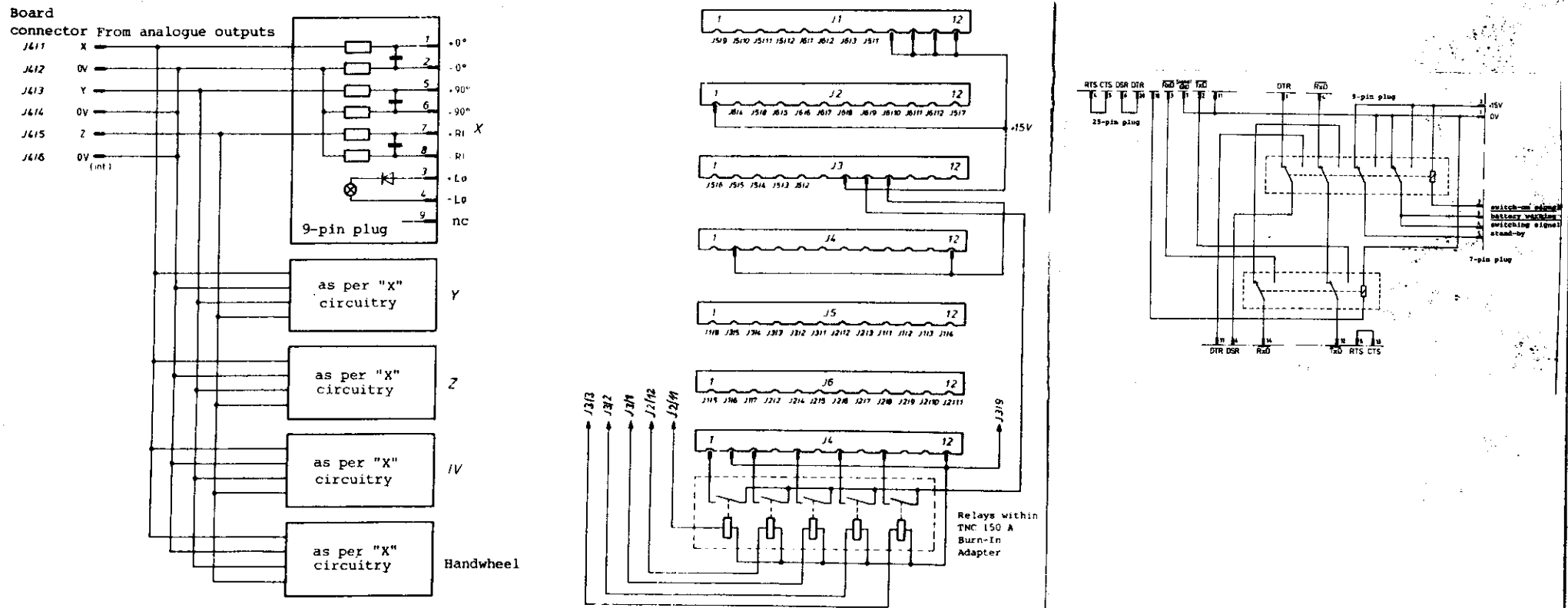
**Kundendienst**

Fig. 2 Burn-In Adapter TNC 151/155 A (n) (Id.No. 233 514 ZY)



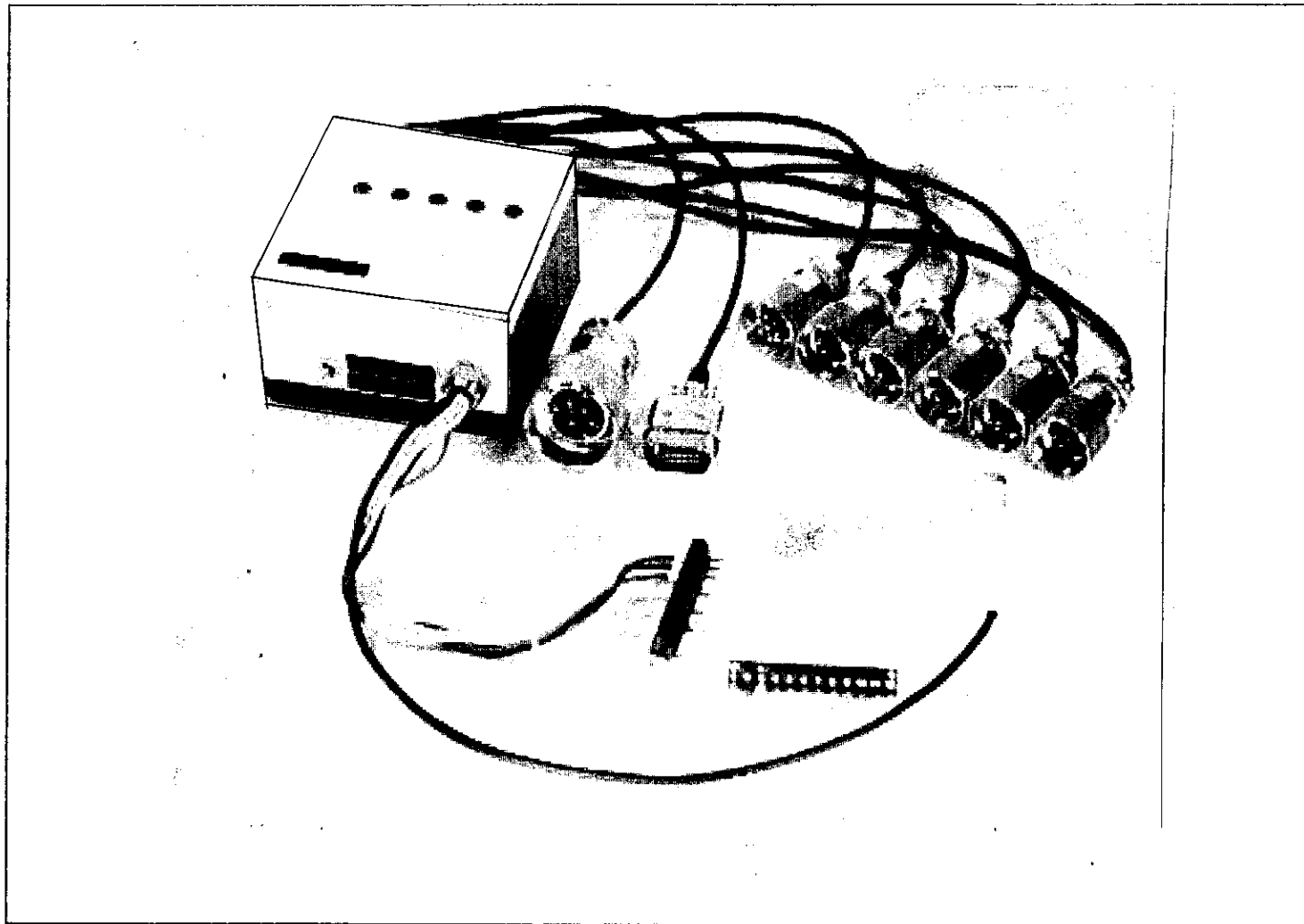
Kundendienst

Fig. 2.1 Burn-In Adapter TNC 151/155 A (n) (Id.No. 233 514 ZY) wiring



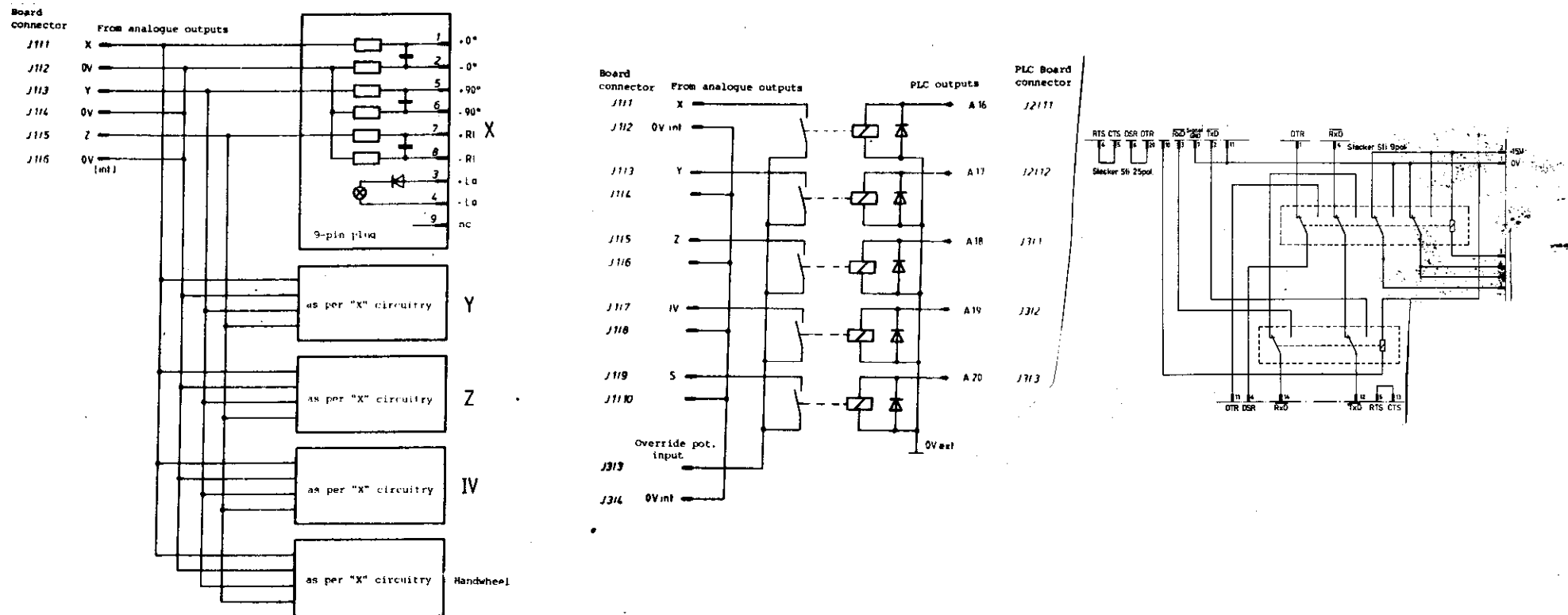
**Kundendienst**

Fig. 3 Burn-In Adapter TNC 151/155 P (n) (Id.No. 233 513 ZY)



**Kundendienst**

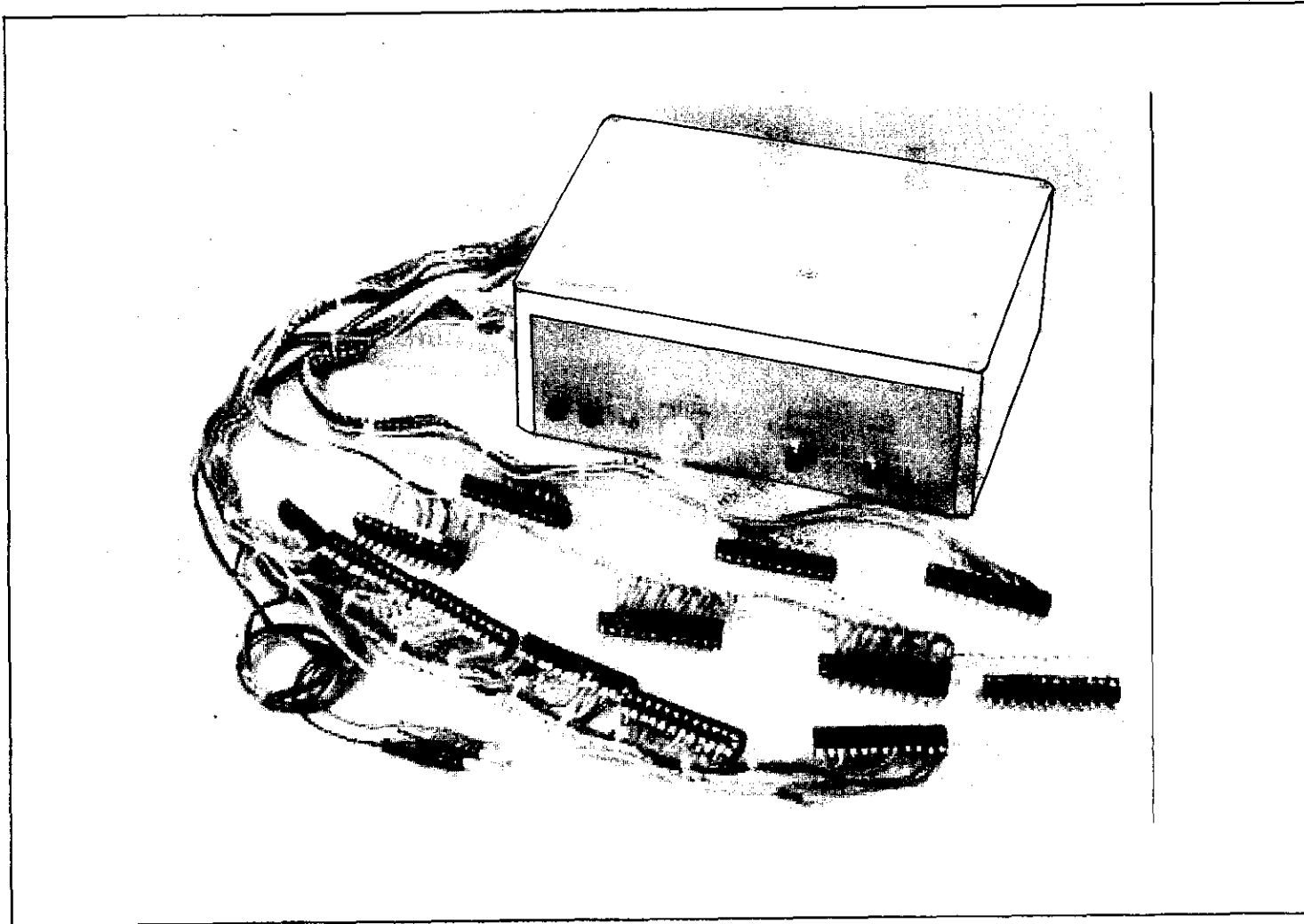
Fig. 3.1 Burn-In Adapter TNC 151/155 P (n) (Id.No. 233 513 ZY) wiring



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Fig. 4 PLC Load Adapter

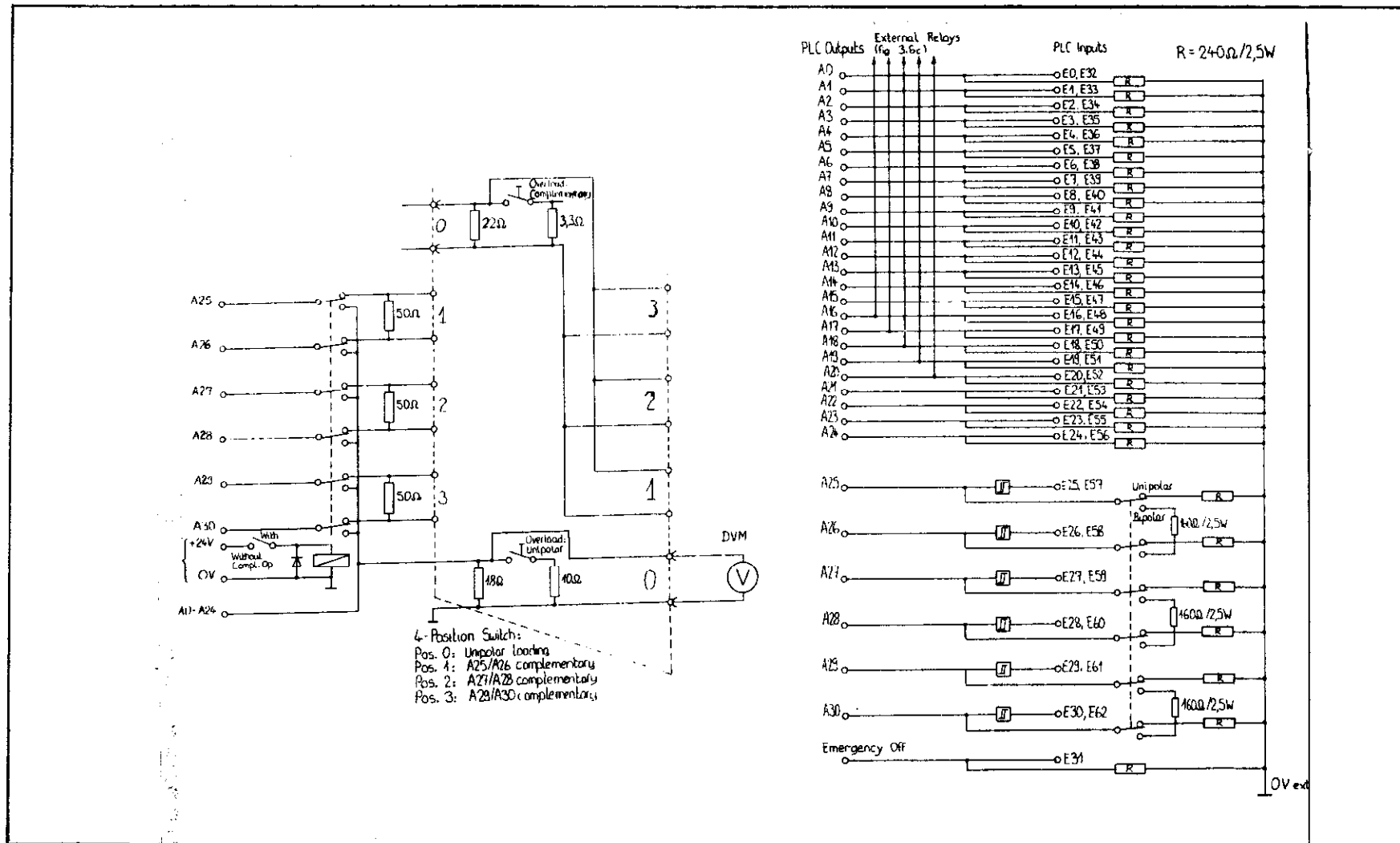
(Id. No. 224 873 ZY)



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Fig. 4.1 PLC Load Adapter

(Id. No. 224 873 ZY) wiring



Additional circuitry for overload facility

Standard circuitry, with unipolar/bipolar switch-over

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Loading the Burn-In test program

(Burn-In test program not already loaded)

1. Connect the Magnetic Tape Cassette Unit (ME 101/102) to the V.24 socket on the rear of the Control.
2. Prepare the ME unit to down-load the test program to the Control by inserting the appropriate program cassette (see list, page 20) and pressing the following buttons:

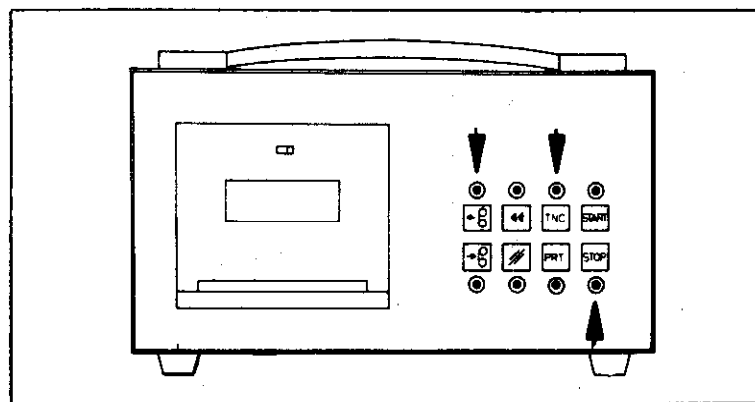


Fig. 6 Initialization of ME unit

3. Control must now be prepared:  
 After applying power to the Control, it automatically carries out a memory test. During this time the dialogue

"MEMORY TEST"

will be displayed on the VDU.

Upon completion of this test, the dialogue will be replaced by

"POWER INTERRUPTED".

The necessary code number for reading in the Burn-In test program is entered by pressing the following keys:

**MOD** - as often as necessary to obtain the display:

"CODE NUMBER =", and then:

**6 2 0 1 5 9**

(Errors in entering these numbers can be corrected by pressing **CE** ).

4. The data transfer is then initiated by pressing:



During the loading of the Burn-In test program from the ME unit, the following dialogue will be displayed:

"POWER INTERRUPTED  
 EXTERNAL DATA INPUT"

If necessary, the ME unit will first rewind the cassette tape before transmitting the data, blockwise, to the Control. Any user-programs already loaded/programmed into the Control will be **unaffected** by loading the Burn-In test program.

5. The Burn-In test program occupies both tracks of the cassette tape. Consequently, when all the data from the first track has been transferred, the following dialogue will be displayed:

"EXCHANGE CASSETTE - ME START  
 EXTERNAL DATA INPUT"

To complete the data transfer, turn over the cassette and press the START button on the ME unit. The VDU will again display the dialogue

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"POWER INTERRUPTED  
 EXTERNAL DATA INPUT"

6. After completion of a successful data transfer, the ME unit will rewind the cassette and the VDU will display the question

"EXTERNAL UNIT CONNECTED ?"

Any other display implies either a transmission error or an incorrect/faulty test program cassette.

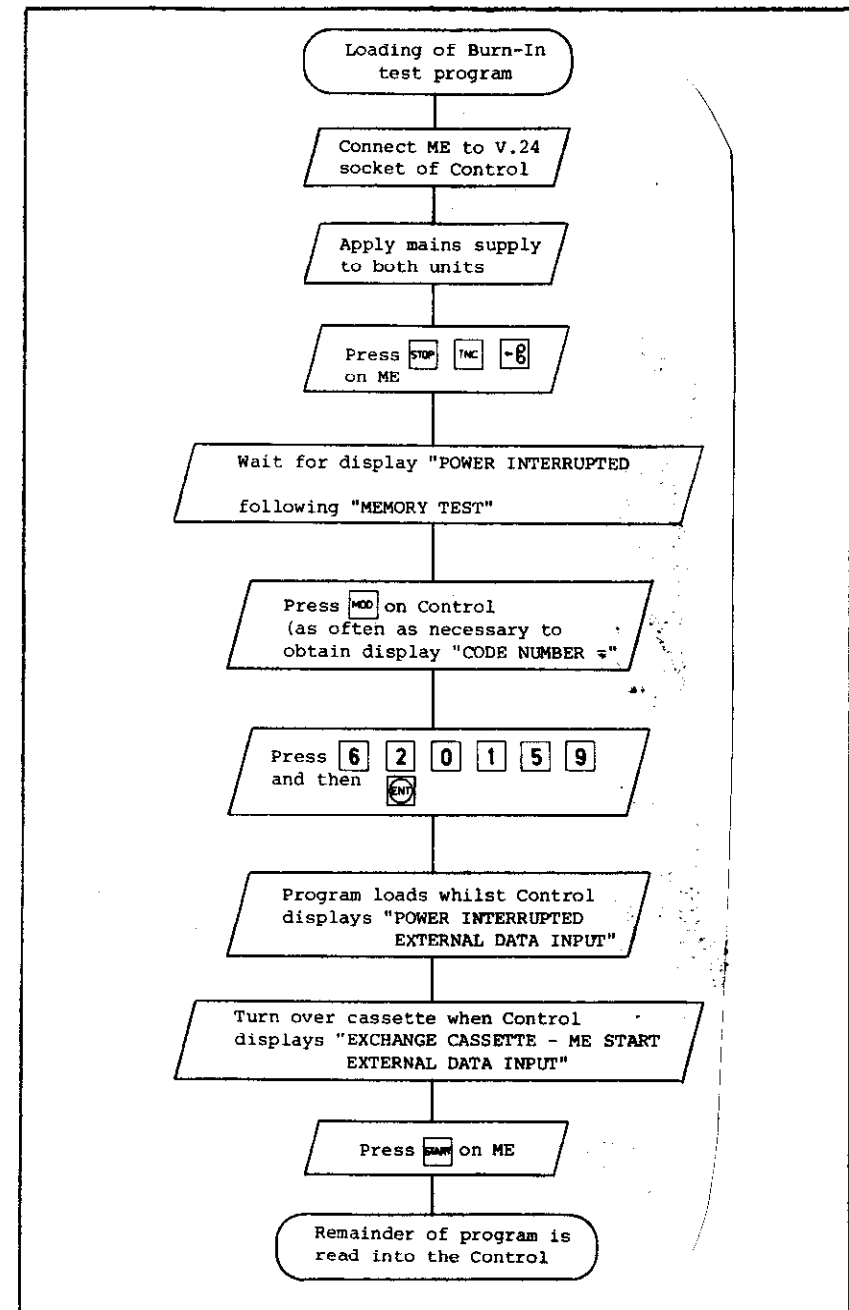


Fig. 7 Loading and Initialization of Burn-In Test Program

### Re-initialization of a previously loaded Burn-In test program

The possibility exists that the Burn-In test program has been loaded and then the power removed. In this situation the buffer batteries will maintain the program in memory until the mains is restored.

It is also possible that the system has been warm-booted, during the execution of the Burn-In test, by pressing



Under both of these circumstances the following procedure is to be followed in order to restart the Burn-In test program:

The Control will automatically carry out a memory check. This test takes approx. 17 sec, during which time the dialogue

"MEMORY TEST"

will be displayed on the VDU.

Upon completion of this test, the dialogue will be replaced by

"PRESS NOENT KEY"

**IMPORTANT:**

Only press the key



if you wish to **erase** the Burn-In test program and return to the normal operating system.

To restart the Burn-In test program press

The following dialogue will then be displayed:

"EXTERNAL UNIT CONNECTED ?"

Any other display implies an error in the stored test program and the program must be reloaded from the cassette.

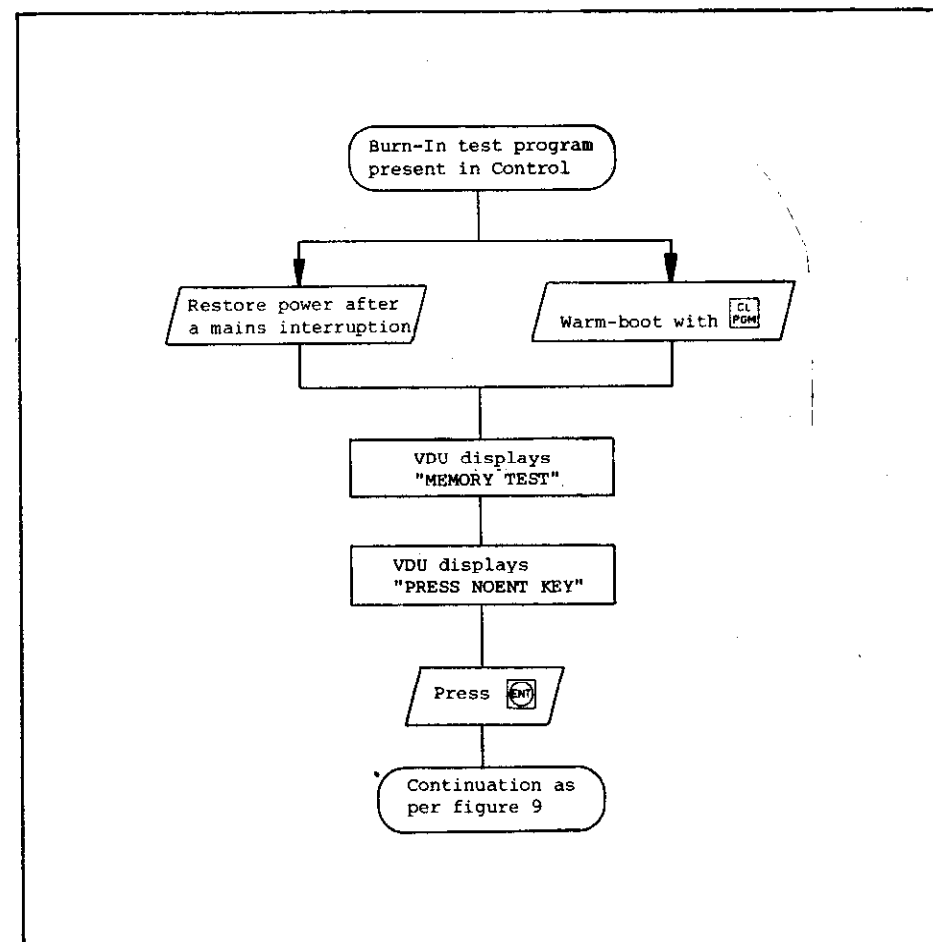


Fig. 8 Re-initialization of a previously loaded Burn-In test program



## Continuation of the Burn-In test initialization

The remainder of the initialization procedure must be described in conjunction with the flow diagram of figure 9, page 29

### 1. Beginning with the display

"EXTERNAL UNIT CONNECTED ?"

which refers to the use of an external test computer, the operator must respond by pressing



### 2. A check is now automatically carried out, to ensure that the test program data has not been corrupted in any way. If an error is detected, the display

"REREAD-IN PROGRAM XXXX  
CHECK SUM ERROR"

will appear on the VDU, and the test program must be reloaded from the ME unit.

### 3. If the keyboard test has not already been carried out (eg. prior to a mains interruption) the option of carrying out this test will now be displayed:

"BI: SOFTWARE NUMBER XXXXXX XX  
JUMP OVER KEYBOARD TEST ?"

The keyboard test can be skipped by pressing the key



Any other key will cause the test to be carried out, in which case the following display will appear on the VDU:

..... E  
..... E  
..... E  
.... E (only with TNC 155!)  
..... E

The lines of dots represent the individual keys in each of the four keying fields. The keys must now be pressed once each, in a defined sequence, in order that the Control can check that each key is making contact and delivering the correct code to the keyboard interface.

The keying sequence is as follows:

- top right set of 20 keys
- top left set of 10 keys
- middle left set of 20 keys
- bottom left set of 4 keys (only with TNC 155!)
- bottom right set of 10 keys

In each case, the sequence is from left to right, beginning with the top row.

For each correct key-push, the respective dot on the VDU will be replaced with a "\*".

If an incorrect code is received, the keyboard test will start again from the beginning.

If the keyboard test has previously been carried out (eg before a power failure), the option of carrying out the test is not displayed. In this case, assuming no error message has been stored from a previous run, the program jumps into the sequential tests (see page 30).

### 4. If the keyboard test has previously been carried out, and an error message has been stored from an earlier run, this error message will be displayed and the program will wait for an interrupt (see point 7).

### 5. In the case of a Control designed for use with an external PLC I/O Board, (TNC 151/155 Q/W) the following text will appear on the VDU, following a successful keyboard test:

"0, 1, OR 2 PC-BOARD ?"

This refers to the number of external PLC I/O Boards connected to the Control during the test, and must be answered with the appropriate numeric key;

0 , 1 2



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6. The final step of the full initialization procedure is the calibration of the two potentiometers on the front panel of the Control. These must be adjusted to give the display:

"OVERRIDE POT ADJUST: 100  
 SP. ROT. SPEED ADJUST: 100"

If necessary, the caps of the knobs must be removed, the securing screws slackened, and the knobs realigned and tightened in the 100% position.

7. At the beginning of the initialization procedure, interruptions of the program are inhibited. After completion of the initialization, interrupts are enabled to permit jumps, at any time, to various points in the test procedure. Once the interrupts have been enabled, the test program can be interrupted by pressing one of a number of keys. The keys:

CL PGM    TOOL CALL    CYCL CALL    LBL CALL    GOTO □

for example, cause restarts at various points during the initialization routine, as shown in figs. 8 and 9.

CL PGM    System re-boot

TOOL CALL    "EXTERNAL UNIT CONNECTED ?"

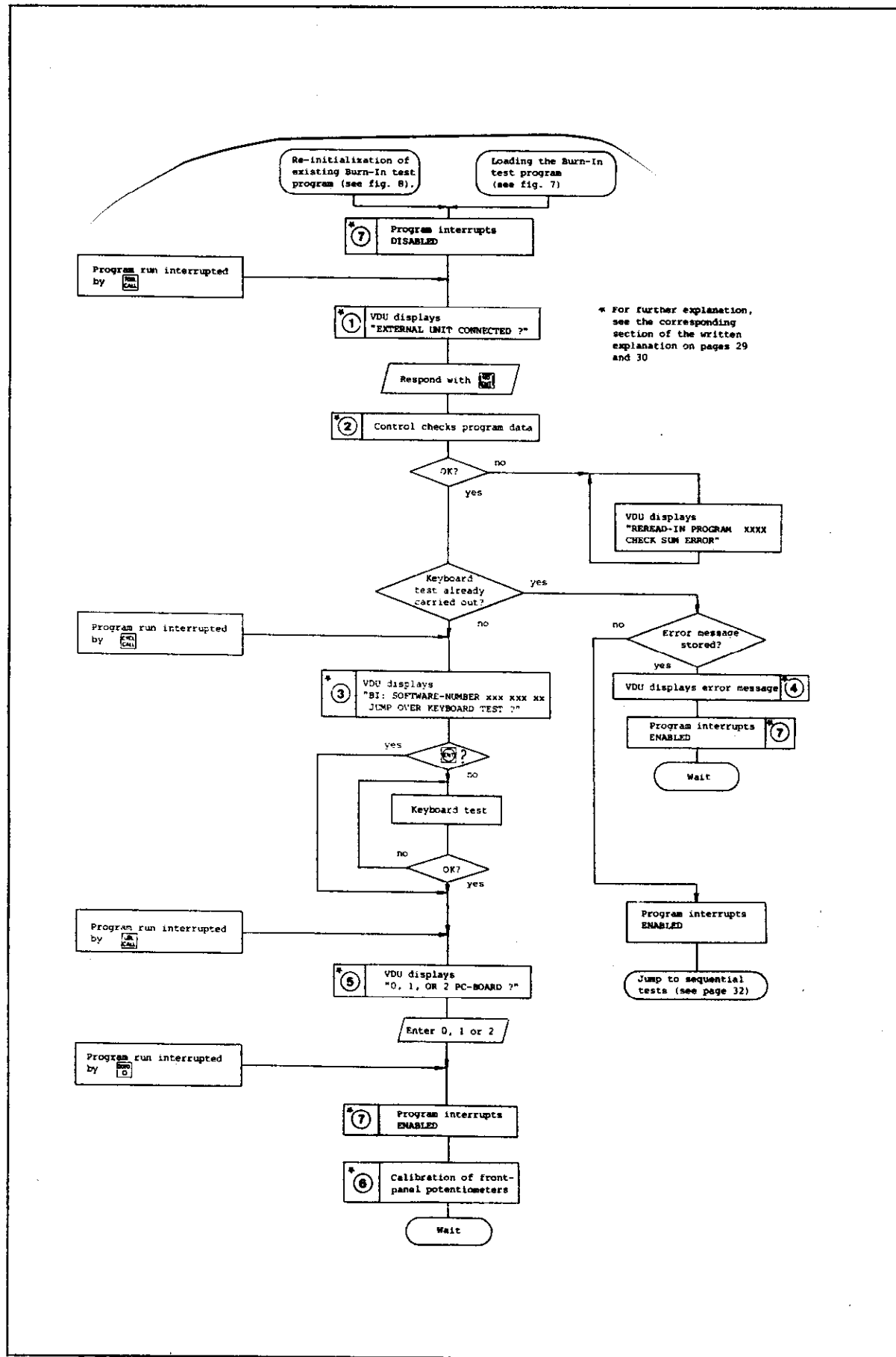
CYCL CALL    "JUMP OVER KEYBOARD TEST ?"

LBL CALL    "0, 1, OR 2 PC-BOARD ?"

GOTO □    "OVERRIDE POT ADJUST: 100  
 SP. ROT. SPEED ADJUST: 100"

Other interrupts are also possible; these are described in the following section.

Fig. 9 Complete initialization of the Burn-In test program



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Sequential (duration) test

Check that all test adapters are correctly connected, including the connection to the V.24 interface socket.

The sequential test for the TNC 151 is comprised of the following individual tests:

- a) Key .  
"TEST INT.POT, BATTERY TRIGGER"  
The internal potentiometers (on the front panel) are in order when set to  $100 \pm 2\%$ .
- b) Key 0  
"EPROM TEST CPU"  
XXXX XXXX  
The contents of the EPROMS addressed by the main processor are tested through their CRC check-sums. The sums of the individual address ranges are displayed in one data word. The MS-byte contains the generated check-sum, the LS-byte contains the expected check-sum. The address range displayed in a fail condition is the first that deviates from the expected check-sum.
- c) Key 1  
"RAM TEST NOT MAPPED"  
Addressed is the range from E000H to FFF9H, which is battery backed-up during power interruption.
- d) Key 2  
"RAM TEST MAPPED"  
Addressed is the range from FFFFFH and upwards depending on RAMS equipped. During this test, no power interruption should occur.
- e) Key 3  
"TEST PC RAM"  
Range: E000H to FFFFH (through CRU addressing)
- f) Key 4  
"TEST STATIC RAM CLP PROCESSOR BOARD"  
Range: D800H to DFFFH

The sequential test for the TNC 155 is comprised of the following individual tests:

- a) Key .  
"TEST INT.POT, BATTERY TRIGGER"  
The internal potentiometers (on the front panel) are in order when set to  $100 \pm 2\%$ .
- b) Key 0  
"EPROM TEST CPU"  
XXXX XXXX  
the contents of the EPROMS addressed by the main processor are tested through their CRC check-sums. The sums of the individual address ranges are displayed in one data word. The MS-byte contains the generated check-sum, the LS-byte contains the expected check-sum. The address range displayed in a fail condition is the first that deviates from the expected check-sum.
- c) Key 1  
"RAM TEST NOT MAPPED"  
Addressed is the range from E000H to FFF9H, which is battery backed-up during power interruption.
- d) Key 2  
"RAM TEST MAPPED"  
Addressed is the range from FFFFFH and upwards depending on RAMS equipped. During this test, no power interruption should occur.
- e) Key 3  
"TEST PC RAM"  
Range: E000H to FFFFH (through CRU addressing)
- f) Key 4  
"TEST STATIC RAM CLP GRAPHICS BOARD"  
Range: A000H to BFFFH  
D800H to DFFFH

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g) Key **5**

"PC INSTRUCT DECODER, ACCU-FF TEST"

The circuitry used for decoding and carrying out the PLC instructions is tested.

h) Key **6**

"INPUT/OUTPUT TEST 1. PC BOARD" (only with Q versions)

The PLC I/O Board outputs are resistively loaded and connected to the inputs by means of the PLC Burn-In Adapter. Each output is connected to 2 inputs. By writing "1"s to the outputs, and checking the corresponding inputs, the Control is able to deduce whether a fault is on an input or an output. If a fault is detected (a "0" on an input) the input conditions are displayed on the VDU:

eg.:

"INPUT/OUTPUT TEST 1. PC BOARD  
 INPUT/OUTPUT FAILURE"

| INPUT | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0     | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 20    | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 40    | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 60    | 1 | 1 | 1 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

AX -- EX, EY

always

Input 31 is used to monitor a 20 ms monostable pulse generated on the Emergency Off output. If the duration of this pulses falls outside its tolerance limits, a fault condition will be displayed:

eg.: "MONOFLOP TIME TOO SHORT 20MS"

This pulse can be generated manually by individual presses of the key **+** or, repetitively, by pressing the key twice in quick succession. This repetitive mode will be indicated by a "1" at input position 31 on the VDU.

To aid in locating an I/O fault, each output can be driven individually. By pressing the key



(after a short delay) the VDU will display the input conditions when only output 0 is being driven high.

g) Key **5**

"TEST DYNAMIC RAM CLP GRAPHICS BOARD"

h) Key **6**

"TEST VIDEO RAM CLP GRAPHICS BOARD"

i) Key **7**

"PC INSTRUCT DECODER, ACCU-FF TEST"

The circuitry used for decoding and carrying out the PLC instructions is tested.

j) Key **8**

"INPUT/OUTPUT TEST 1. PC BOARD" (only with Q versions)

The PLC I/O Board outputs are resistively loaded and connected to the inputs by means of the PLC Burn-In Adapter. Each output is connected to 2 inputs. By writing "1"s to the outputs, and checking the corresponding inputs, the Control is able to deduce whether a fault is on an input or an output. If a fault is detected (a "0" on an input) the input conditions are displayed on the VDU:

eg.:

"INPUT/OUTPUT TEST 1. PC BOARD  
 INPUT/OUTPUT FAILURE"

| INPUT | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0     | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 20    | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 40    | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 60    | 1 | 1 | 1 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

AX -- EX, EY

always 0

Input 31 is used to monitor a 20 ms monostable pulse generated on the Emergency Off output. If the duration of this pulses falls outside its tolerance limits, a fault condition will be displayed:

eg.: "MONOFLOP TIME TOO SHORT 20MS"

This pulse can be generated manually by individual presses of the key **+** or, repetitively, by pressing the key twice in quick succession. This repetitive mode will be indicated by a "1" at input position 31 on the VDU.

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eg.: "INPUT 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9  
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
 20 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0  
 40 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
 60 0 0 0 1 ← (always a)  
 AX -- EX, EY

Subsequent pressing of the key



allows successive outputs (in ascending order) to be driven high, or in descending order with the key



All outputs can be cleared with the key



i) Key **7**

"EXT. POT, ANALOG OUTPUT TEST"

CONNECTION: ANALOG-OVER EXT.

RELAY ON INPUT EXT. POT

Five external relays (within the TNC 151/155 A/P Burn-In Adapter), driven from outputs A16 - A20, are used to connect the analogue outputs X, Y, Z, IV, S, in turn, to the ext. pot. input (see Burn-In Adapters TNC 151/155 A/P). The test is made at three different voltages: 200mV, 5V, 9.5V

j) Key **8**

"TEST V24-INTERFACE"

k) Key **9**

"TEST 3D-SCANNER INTERFACE"

f) Key **X**

"TEST SERIAL HANDWHEEL INPUT"

Checks the interface to the HE 310 Handwheel Unit

To aid in locating an I/O fault, each output can be driven individually. By pressing the key  (after a short delay) the VDU will display the input conditions when only output 0 is being driven high.

eg.: "INPUT 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9  
 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
 20 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0  
 40 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
 60 0 0 0 1 ← (always a)  
 AX -- EX, EY

Subsequent pressing of the key



allows successive outputs (in ascending order) to be driven high, or in descending order with the key



All outputs can be cleared with the key



k) Key **9**

"EXT. POT, ANALOG OUTPUT TEST"

CONNECTION: ANALOG-OVER EXT.

RELAY ON INPUT EXT. POT

Five external relays (within the TNC 151/155 A/P Burn-In Adapter), driven from outputs A16 - A20, are used to connect the analogue outputs X, Y, Z, IV, S, in turn, to the ext. pot. input (see Burn-In Adapters TNC 151/155 A/P). The test is made at three different voltages: 200mV, 5V, 9.5V

l) Key **X**

"TEST V24-INTERFACE"

m) Key **Y**

"TEST 3D-SCANNER INTERFACE"

n) Key **Z**

"TEST SERIAL HANDWHEEL INPUT"

Checks the interface to the HE 310 Handwheel Unit

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- m) Key **Y**  
"Supervision Circuit Test"  
XX XX XX XX  
checks the threshold values of the circuitry which monitors the measuring system inputs.  
The contents of the counter status registers for the X, Y, Z and IV axis are displayed.
- n) Key **Z**  
"TEST REFERENCE IMPULSE INPUT"  
XX XX XX XX  
Checks the effect of a signal applied to the reference-pulse inputs.  
The contents of the counter status registers for the X, Y, Z, IV axis and handwheel are displayed.
- o) Key **IV**  
"TEST TRANSDUCER INPUTS, EXE"  
XXXX XXXX XXXX XXXX XXXX  
Checks the effect of signals applied to the measuring system inputs.  
The contents of the counter status registers for the X, Y, Z, IV axes and handwheel are displayed.

- o) Key **IV**  
"Supervision Circuit Test"  
XX XX XX XX  
checks the threshold values of the circuitry which monitors the measuring system inputs.  
The contents of the counter status registers for the X, Y, Z and IV axis are displayed.
- p) Key **Q**  
"TEST REFERENCE IMPULSE INPUT"  
XX XX XX XX  
Checks the effect of a signal applied to the reference-pulse inputs.  
The contents of the counter status registers for the X, Y, Z and IV axis are displayed.
- q) Key **Q DEF**  
"TEST TRANSDUCER INPUTS, EXE"  
XXXX XXXX XXXX XXXX XXXX  
Checks the effect of signals applied to the measuring system inputs.  
The contents of the counter status registers for the X, Y, Z, IV axes and handwheel are displayed.

Starting the sequential tests

A detected fault will be displayed on the VDU the test cycle is interrupted and the BURN IN TIME is stopped. With an Override Potentiometer fault the LEDs for the following keys:

 ,  ,  ,  ,  will flash.

With a Spindle Override Potentiometer fault the LEDs for the following keys:  ,  , **MOD** , **P** , **I** will flash.

With a Battery Trigger fault both the **R<sub>L</sub>** and **R<sub>R</sub>** LEDs will flash.

In all other cases several LEDs will flash. Through pressing the respective key, each individual test can be restarted.

An error message remains memorized until overwritten by a newly detected fault. An error message can be called up using the **TOOL CALL** and **NO ENT** keys. Pressing the **DEL** key erases the fault message and restarts the sequential tests.

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Individual test runs

Each of the individual, sequential tests can also be made to run cyclically. To do this, the test program must be interrupted with the key



The VDU will then display:

"1 = CYCLIC  
2 = STOP AT FAULT"

Pressing key **1** causes the test (still to be selected) to run cyclically, regardless of whether a fault is detected. Pressing key **2** causes the test to run cyclically until such time as a fault is detected.

When one mode or the other has been selected, the VDU will display:

"SELECT TEST"

The desired test must then be selected with the appropriate key.

Another possible interrupt to the Burn-In test program is by means of the key



With this key the entire set of ASCII characters can be displayed on the VDU.

(With TNC 155 only!)

A graphics display consisting of a square grid with a circle in the centre can be displayed by pressing the key marked



Similarly the NC and PLC software numbers can be displayed by pressing the key



Calibration check of the Analogue Board ("TRIMMING ROUTINES")  
Interrupting the Burn-In test program with the key



gains access to the calibration tests. Exit from these tests is only possible with the key



Within the calibration mode the following tests can be selected:

- Key **1**: Reference amplifier performance \*  
("TRANSMISSION BEHAVIOUR REF. AMP.")
- Key **2**: Analogue output voltage \*\*  
("ANALOG VOLTAGE OUTPUT")
- Key **3**: 32-step monotonic DAC \*  
("MONOTONIC DAC; 32 STEPS")
- Key **4**: DAC performance \*  
("TRANSMISSION BEHAVIOUR DAC")
- Key **5**: + 10V analogue output \*\*  
("DAC + ANALOG OUTPUT + 10V")
- Key **6**: Linearity of analogue output \*  
("DAC + ANALOG OUTPUT LINEARITY")
- Key **7**: Battery voltage check \*\*  
("TEST BATTERY VOLTAGE")
- Key **8**: Transducer pulse count comparison \*  
("PULSE COUNT OUTPUT")

() text in brackets appears on VDU

\* these test are not suitable for customer use.

\*\* see following explanations:

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Key **2**: Analog output voltage

The performance of the analog output circuitry can be checked by connecting a DVM to each of the analog outputs (eg X-axis: J1, pin1, w.s.t. pin 2) and selecting this test. Using the keys

**X** **Y** **Z** **IV**

voltage increments of 2,44mV, 24,4mV, 244mV and 2,44V respectively can be summed at each of the analog outputs (X, Y, Z, IV, S).

eg.: if the **X** key is pushed 5 times, the **Y** key 3 times, and the **IV** key once, the output voltage should read:  
 $(5 \times 2.44\text{mV}) + (3 \times 24.4\text{mV}) + (1 \times 2.44\text{V}) = \underline{2.525\text{V}}$

The polarity of the output can be reversed using the key

**+/-**

The output can be cleared using the key

**0**

The hold time of the sample and hold amplifier can be selected to either 5ms or 500ms using the **.** key.

Key **5**: **±** 10V analog output

The analog outputs should generate their maximum output of **±** 10V. The polarity can be reversed as in test 2.

Key **7**: Battery voltage check

A "1" will be displayed on the VDU if the battery voltage is adequate, otherwise a "0" is displayed.

Key **8**: Transducer pulse count comparison

The counting function of each axis can be checked by connecting a rotary encoder to the respective transducer input.

Key **Q**: Start count after reference mark is detected

Key **Q DEF**: Stop count after reference mark is detected

If no encoder is connected "VVVVVVVVVV" is displayed in the respective axis (excluding handwheel).

eg. testing using - 100 line rotary encoder  
 - 20-fold TNC interpolation

$$\begin{aligned} \text{pulse count} &= \text{no. of lines} \times \text{interpolation} \\ &= 100 \times 20 \\ &= 2000 \end{aligned}$$

From this example the display has to be divisible by 2000.

Display: 32000 : 2000 = 16 in order

Display: 32250 : 2000 = 16,125 defective

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**3. Exchange Information**

**Note:** All inputs/outputs from the TNC 151/155 Control can only be connected to circuits which have voltages conforming to VDE S.73 §8.

Do not disconnect or connect plugs under power!

NC machines also need protection and installation safety as required for manually operated machines (e.g. Emergency Stop). Their function should be checked during commissioning of the machine and of a new Control.

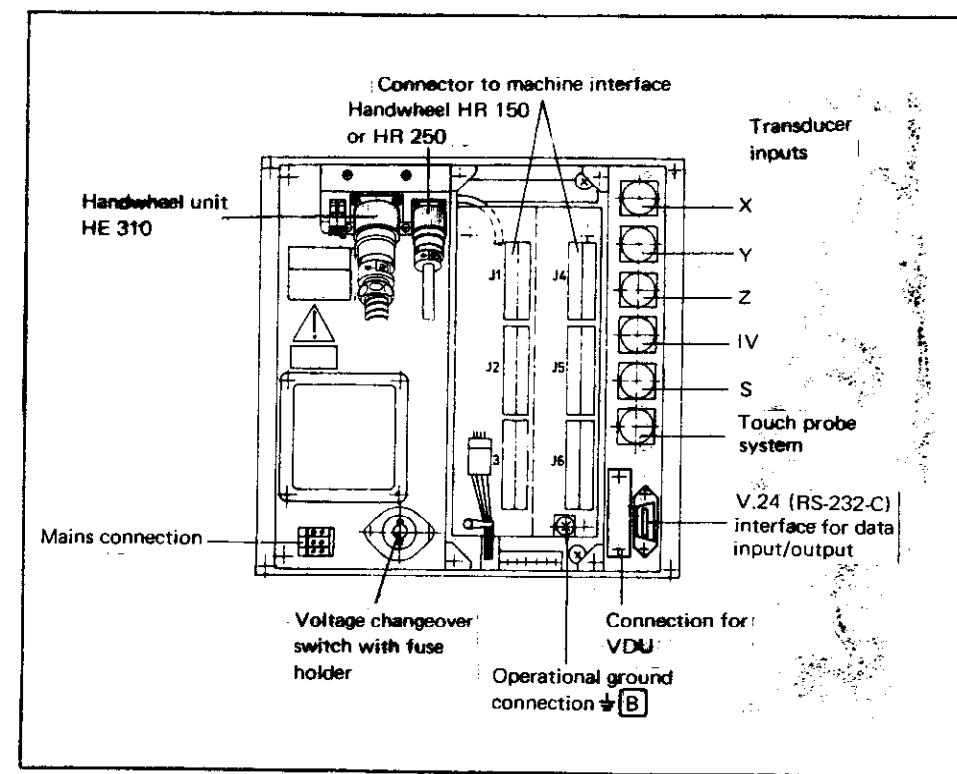
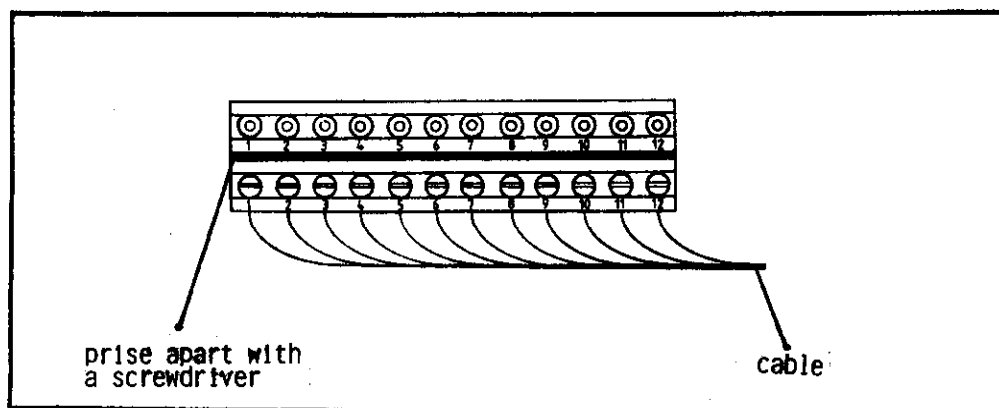
Before exchanging a Control the machine parameters should be noted or stored on magnetic tape!

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**3.1 Exchanging Control Units**

**3.1.1 Procedure for exchanging the TNC 151/155 B/F Control.**

1. Gain access to the rear of the Control.
2. Remove the mains supply.
3. Remove the connector box cover-plate from the rear of the Control.
4. Mark the measuring system plugs (X,Y,Z,4, Axes, S if present, 3D Touch Probe) and remove them.
5. Disconnect the VDU from the Control.
6. Disconnect the Handwheel Unit from the Control (if present).
7. Disconnect any external data devices.
8. Disconnect connector strips J1-J6, using a screwdriver to prise the connectors apart (Do not unscrew individual wires).

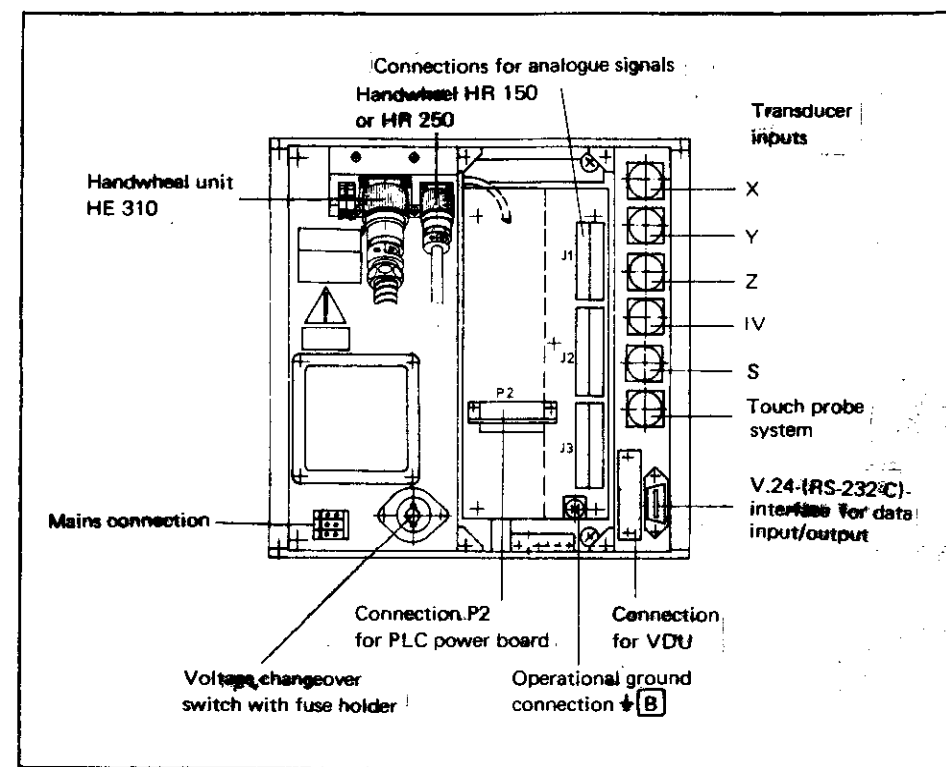
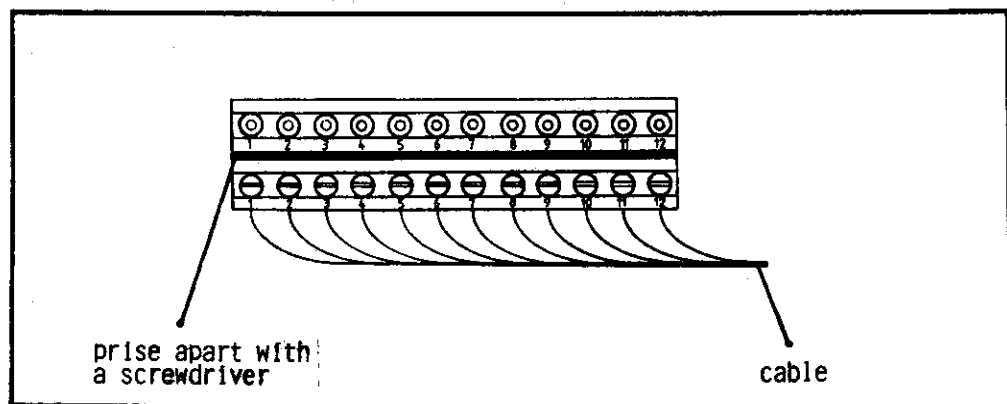


9. Remove the faulty Control, removing the fixing screws if not already removed in 1.
10. Install the new Control - check the voltage selector position.
11. Check the fuse-rating (see type-plate).
12. Reconnect all cables previously removed.
13. Obtain from the type-plate the Control's Id. No., NC and PLC Software Nos., and write them in the machine handbook.
14. Refit the connector box cover-plate.
15. Turn on the mains voltage.
16. Reprogram the machine parameters.
17. TNC is now ready to use.

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**3.1.2 Procedure for exchanging the TNC 151/155 Q/W Control.**

1. Gain access to the rear of the Control.
2. Remove the mains supply.
3. Remove the connector box cover-plate from the rear of the Control.
4. Mark the measuring system plugs (X,Y,Z,4 Axes, S if present, 3D Touch Probe) and remove them.
5. Disconnect the VDU from the Control.
6. Disconnect the Handwheel Unit from the Control (if present).
7. Disconnect any external data devices.
8. Disconnect connector strips J1-J3, using a screwdriver to prise the connectors apart (Do not unscrew individual wires).
9. Remove the connecting cable P2 to the PL 100 B/110 B from the Control.

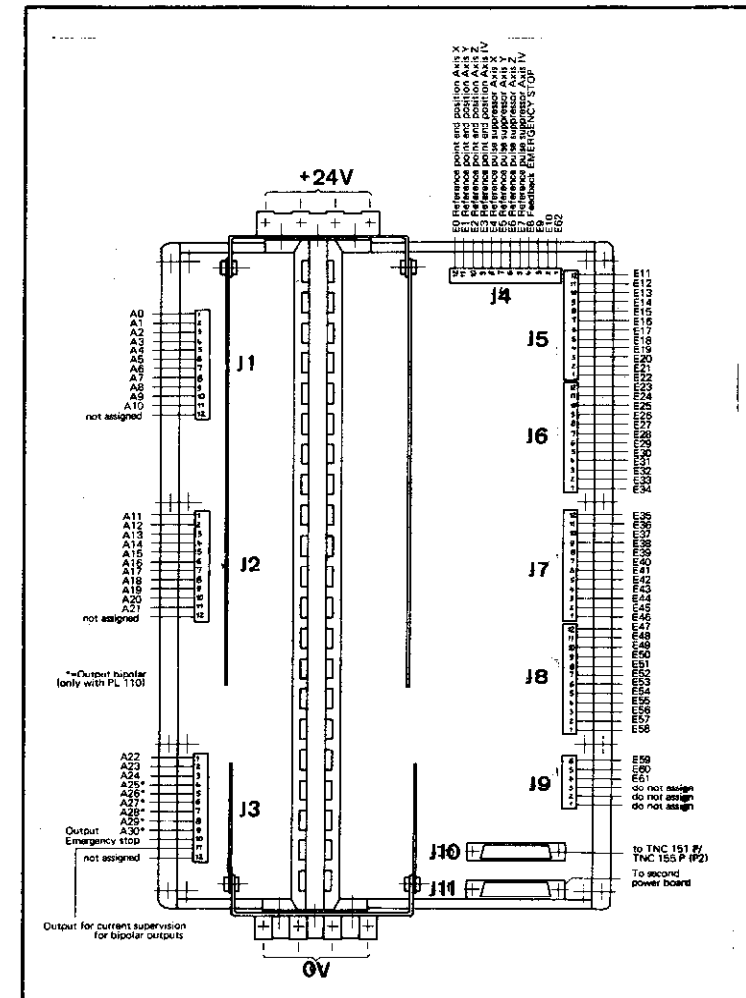


10. Remove the faulty Control, removing the fixing screws if not already removed in 1.
11. Install the new Control - check the voltage-selector position.
12. Check the fuse-rating (see type-plate).
13. Reconnect all cables previously removed.
14. Obtain from the type-plate the Control's Id. No., NC and PLC Software Nos., and write them in the machine handbook.
15. Refit the connector box cover-plate.
16. Turn on the mains voltage.
17. Reprogram the machine parameters.
18. TNC is now ready to use.

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### 3.1.3 Procedure for exchanging the PLC I/O Board of the PL 100 B/110

1. Remove the fixing screws of the heatsink cover-plate.
2. Remove the heatsink cover-plate.
3. Disconnect the TNC 151/155 connecting cable.
4. Disconnect connector strips J1-J9, using a screw driver to prise the connectors apart.  
(Do not unscrew individual wires)
5. Remove the voltage supply (+24V and 0V)
6. Remove the fixing screws of the PL 100 B/110 B unit.
7. Install the new unit following the above procedure in reverse order.



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**3.2 Board Exchange**

**Board Arrangement**

The TNC 151/155 consists of three main sections:

- 1) The frontplate/Keypad Board assembly;
- 2) The housing/Connector Board assembly,  
with five plug-in boards, namely:
  - .Main Processor Board
  - .CLP-Processor/Graphics Board
  - .Analog Board
  - .either SE Board TNC 151/155 B/F
  - or PLC Interface Board TNC 151/155 Q/W
- 3) The backplate, Power Supply Unit and Terminal Board assembly.

Board arrangement TNC 151/155 B/F  
TNC 151/155 Q/W

PLC I/O Board  
TNC 151/155 Q  
(224 389/223 691)

Connector Board  
(233 273)

Terminal Board  
(228 164/228 166)

Power Supply Board  
(230 802)

PLC Interface Board  
TNC 151/155 Q  
(226 761)

SE Board  
TNC 151/155 B  
(227 278)

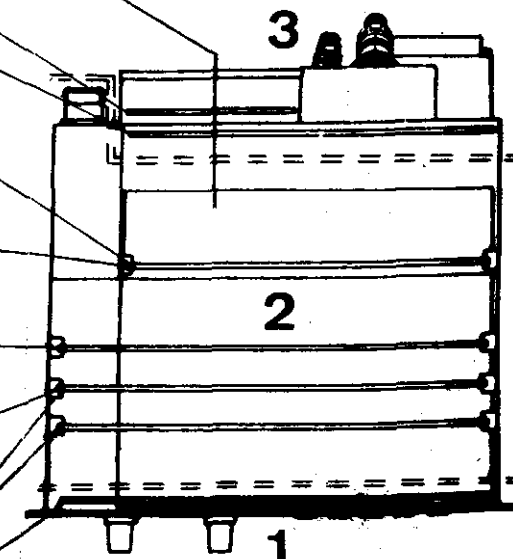
Analog Board  
(232 228/234 509)

CLP Processor Board TNC 151  
(233 556)

CLP-Graphics Board TNC 155  
(233 554)

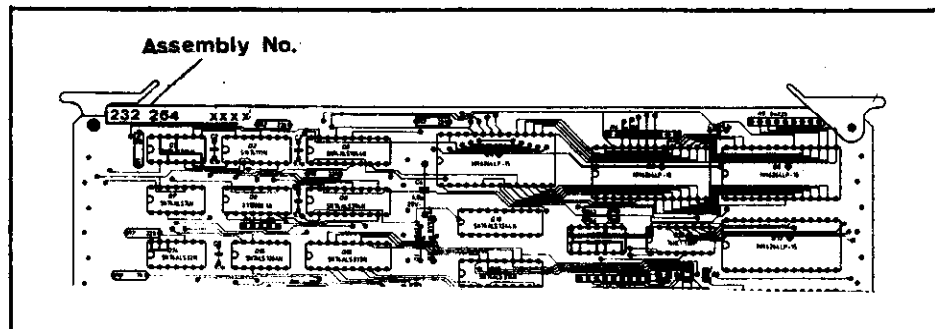
Main Processor Board  
(235 647)

Keypad Board  
(224 825)



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**Caution:** .Please observe MOS protection measures when exchanging boards.  
    .Exchange boards with the same assembly no. only.  
    The assembly no. is impressed on every board, to the left of the serial no.

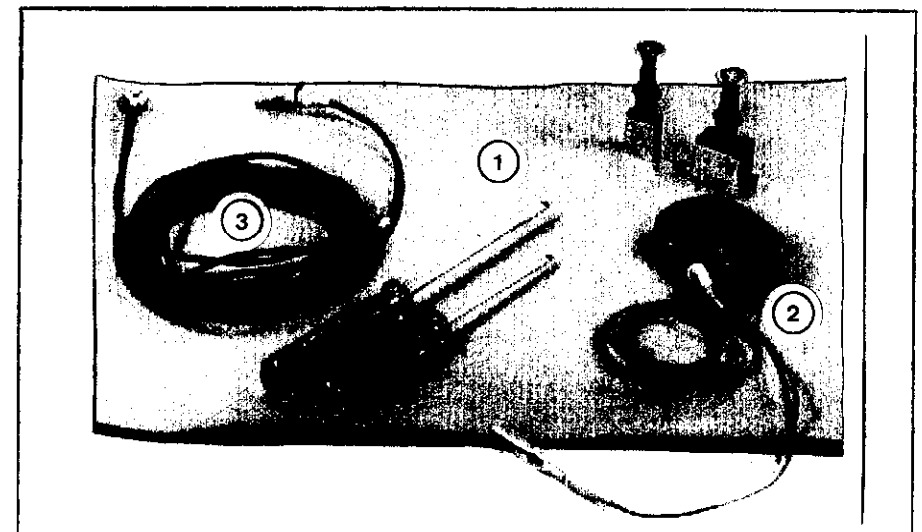


**Work area requirements**

The TNC 151/155 contains sub-assemblies with MOS elements. Although MOS ICs are equipped with an input protection diode network to eliminate the build-up of static charges, care must be taken when handling these elements. The following requirements in the work area must be met: Prior to working with MOS components or with assemblies containing MOS elements, all table coverings, instruments, tools, and work personnel must be properly grounded.

A portable "MOS-HANDLING-SET" for field service is necessary when exchanging the operating software and/or servicing the Control:

- ① a conductive work surface
- ② a wristband that provides an electrical connection between person and conductive work surface
- ③ a cable that equalizes potential differences between conductive work surface and ground



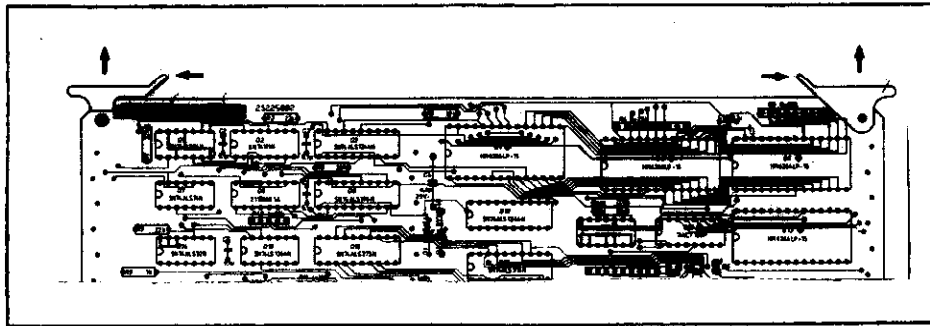
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**Exchanging the pluggable boards**

Unscrew the 5 mounting screws and remove the housing cover.

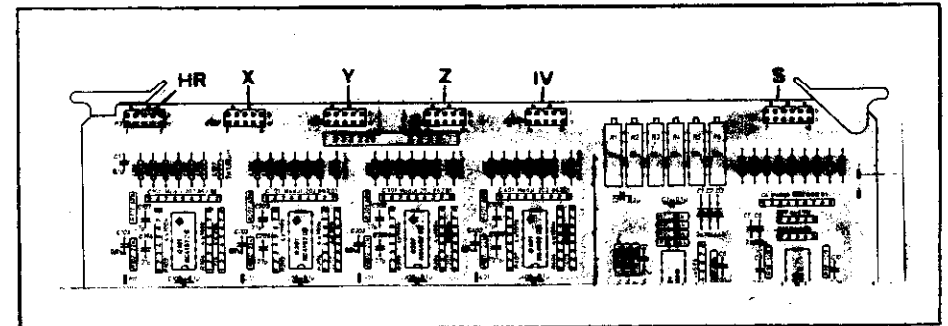
Removing the boards:

Press the board ejector keys outwards and pull out the individual board from the top.



**Analog Board**

Before removing the Analog/Analog TTL Board pull off and mark the connector plugs for the measuring system inputs/ square wave signal inputs and the electronic handwheel input. The connector sockets on the board are coded with coding pins.



**Inserting the boards:**

The connectors of the boards are coded: incorrect insertion is therefore avoided. Press the board firmly into the Connector Board using the ejector keys tilted inwards.

**Main Processor and CLP Processor/Graphics Board:**

When exchanging these boards insert program EPROM's IC-P1 and IC-P2 on the CLP Processor/Graphics Board and IC-P3 to IC-P6 on the Main Processor Board.

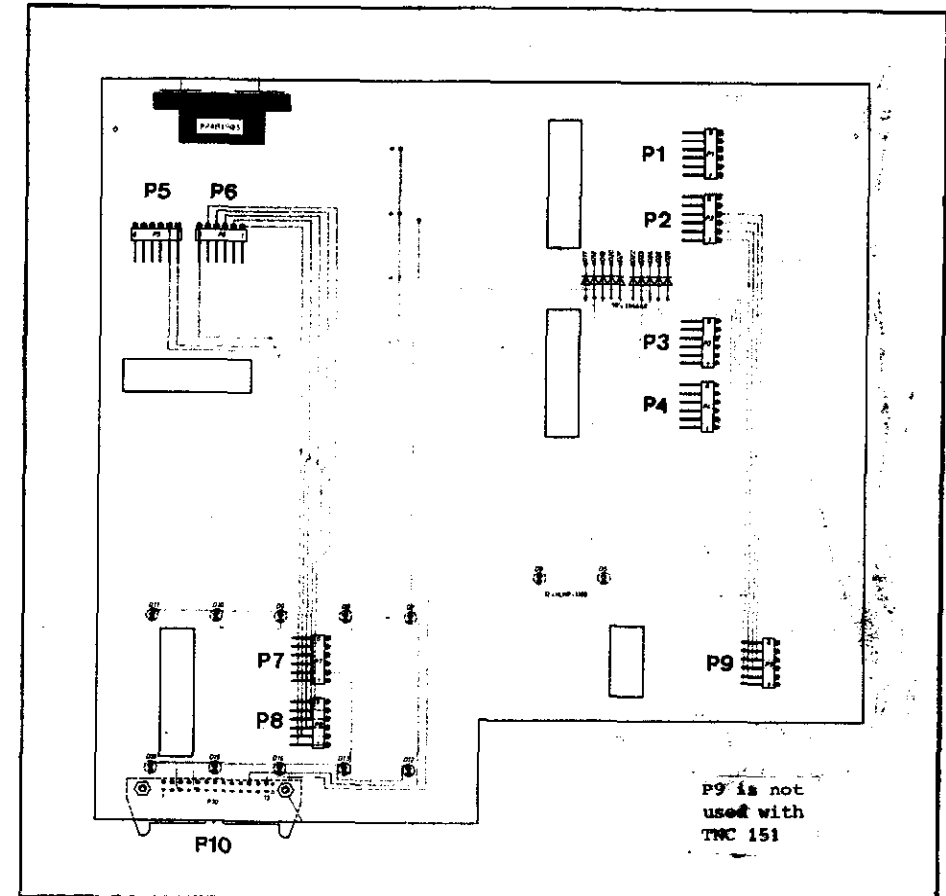
**Main Processor Board:**

During the exchange or removal of the Main Processor Board the buffered RAM will no longer be supplied with voltage, which means that the machine parameters and any user-programs will be lost!

Before inserting the new Board plug in the relevant EPROMs (EPROM IC-P3 to IC-P6), paying particular attention to their correct location and orientation.

Exchanging the Keypad Board:

- .Remove the 6 cross-head fixing screws from the frontplate.
- .Tilt the frontplate outwards.
- .Remove connectors J13 (feedrate-override potentiometer) and J14 (spindle-override potentiometer) from the Connector Board.
- .Remove the ribbon cable connector P10 from the Keypad Board.
- .Remove the 7 cross-head fixing screws which secure the Keypad Board to the frontplate.
- .Pull off the Keypad connectors, P1 to P8 respectively P9 for the TNC 155 from the Keypad Board.
- .Remove the Keypad Board.

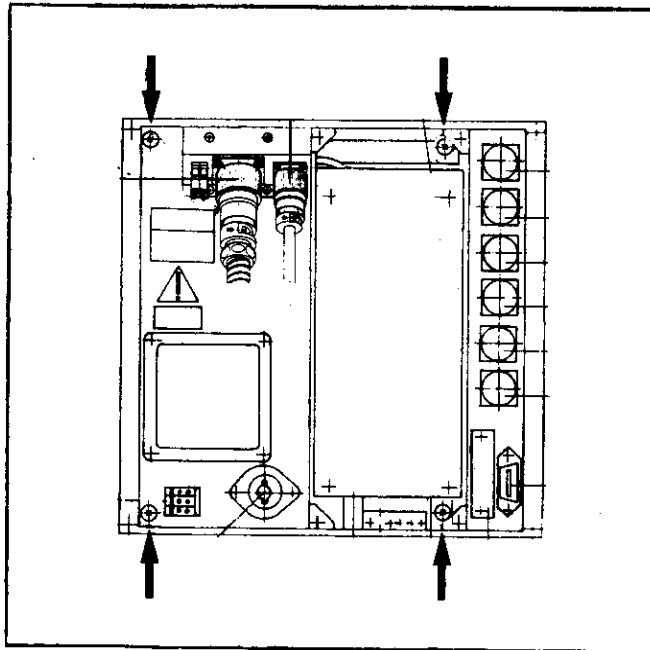


When rebuilding the assembly, ensure that the keypad connectors are firmly engaged in their respective sockets, and that the LEDs project through the corresponding bored holes in the keypad housing.

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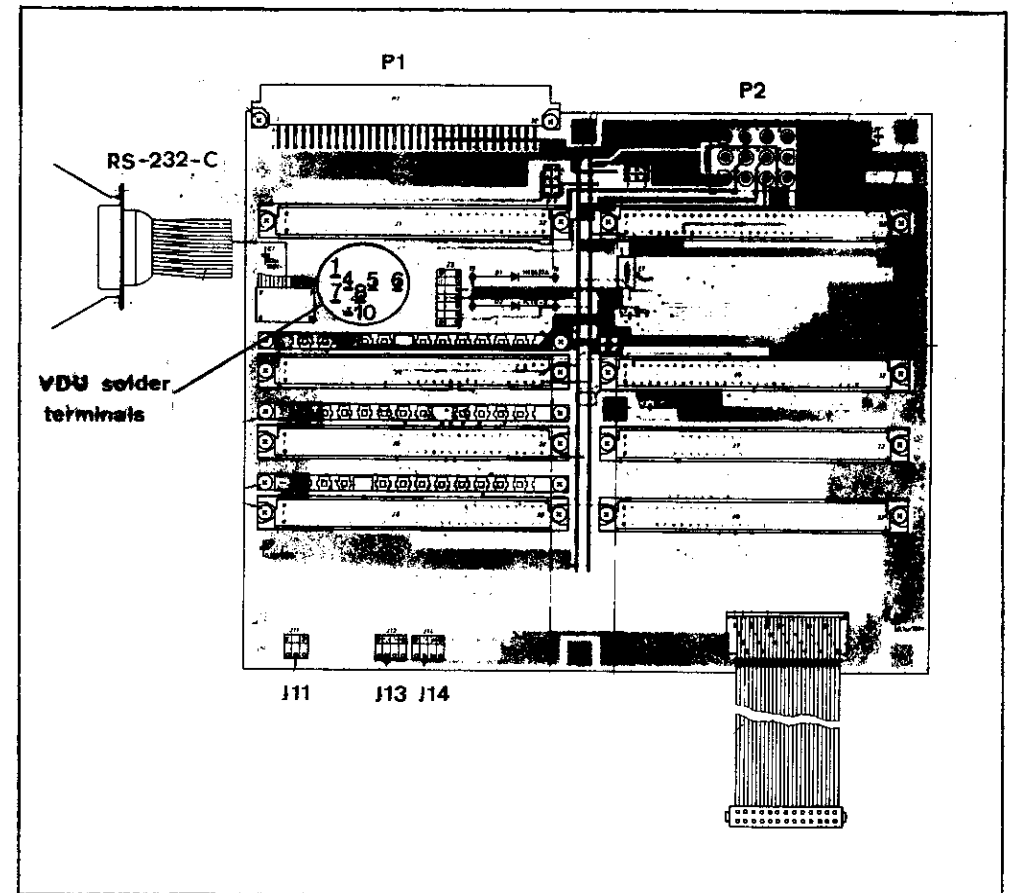
**Exchanging the Power Supply Unit:**

- .Remove the 4 cross-head mounting screws from the rear of the Control (2 screws are found in the connector box).
- .Remove the back wall with the Power Supply Unit and Terminal Board.
- .Disconnect the ribbon cable connector, P1, from the Connector Board (see diagram).
- .Remove the voltage supply plug, P2, from the Connector Board (see diagram).



**Exchanging the Connector Board:**

- .Remove the 2 cross-head fixing screws of the V.24 connector on the rear of the Control.
- .Push the V.24 socket through its recess in the Control housing.
- .Unsolder the connectors to the VDU socket from the Connector Board (solder terminals 1,4,5,6,7,8,10). Note the colour of the wire connected to each terminal.
- .Pull the Connector Board from the front of the Control housing.



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### 3.3 Software Exchange

#### General

The TNC 151/155 operating software is stored in 6 EPROMs consisting of:

- IC-P1, IC-P2 (CLP Processor/Graphic Board)
- IC-P3...IC-P6 (Main Processor Board)

Every operating software is specified with an 8 digit Software No.:

#### example:

| TNC 151    |                           |  | TNC 155    |
|------------|---------------------------|--|------------|
| 234 000 01 | complete software Id. No. |  | 234 020 01 |
| 234 000    | primary software Id. No.  |  | 234 020    |
| 01         | update software index     |  | 01         |

Each of the 6 programmed EPROMs (IC-P1...IC-P6) is specified with an 8 digit Id. No.:

#### example:

| TNC 151    |                                     |  | TNC 155    |
|------------|-------------------------------------|--|------------|
| 234 000 4A | complete Id. No. of the Prog. EPROM |  | 234 020 4A |
| 234 000    | primary Id. No. of the Prog. EPROM  |  | 234 020    |
| 4          | position on the board               |  | 4          |
| A          | update index                        |  | A          |

The operating software includes:

- o NC software (IC-P2...IC-P5)
- o PLC software (IC-P6)

TNC 151/155 B: Control with o NC software and  
 o PLC standard software

TNC 151/155 Q: Control with o NC software and  
 o PLC standard software, or  
 PLC custom software

The dialog language of the TNC 151/155 is determined by IC-P3 (located on Main Processor Board) and is discernible from the different Id. Nos. of the programmed EPROMs.

Following dialog languages are available at this time

|         |      |
|---------|------|
| German  | (D)  |
| English | (GB) |
| French  | (F)  |
| Italian | (I)  |
| Spanish | (E)  |
| Swedish | (S)  |
| Finnish | (SF) |
| Dutch   | (NL) |

The Id. No. of the other programmed EPROMs are the same (for a given IC position) in all languages.  
 (prerequisite: same software issue!)

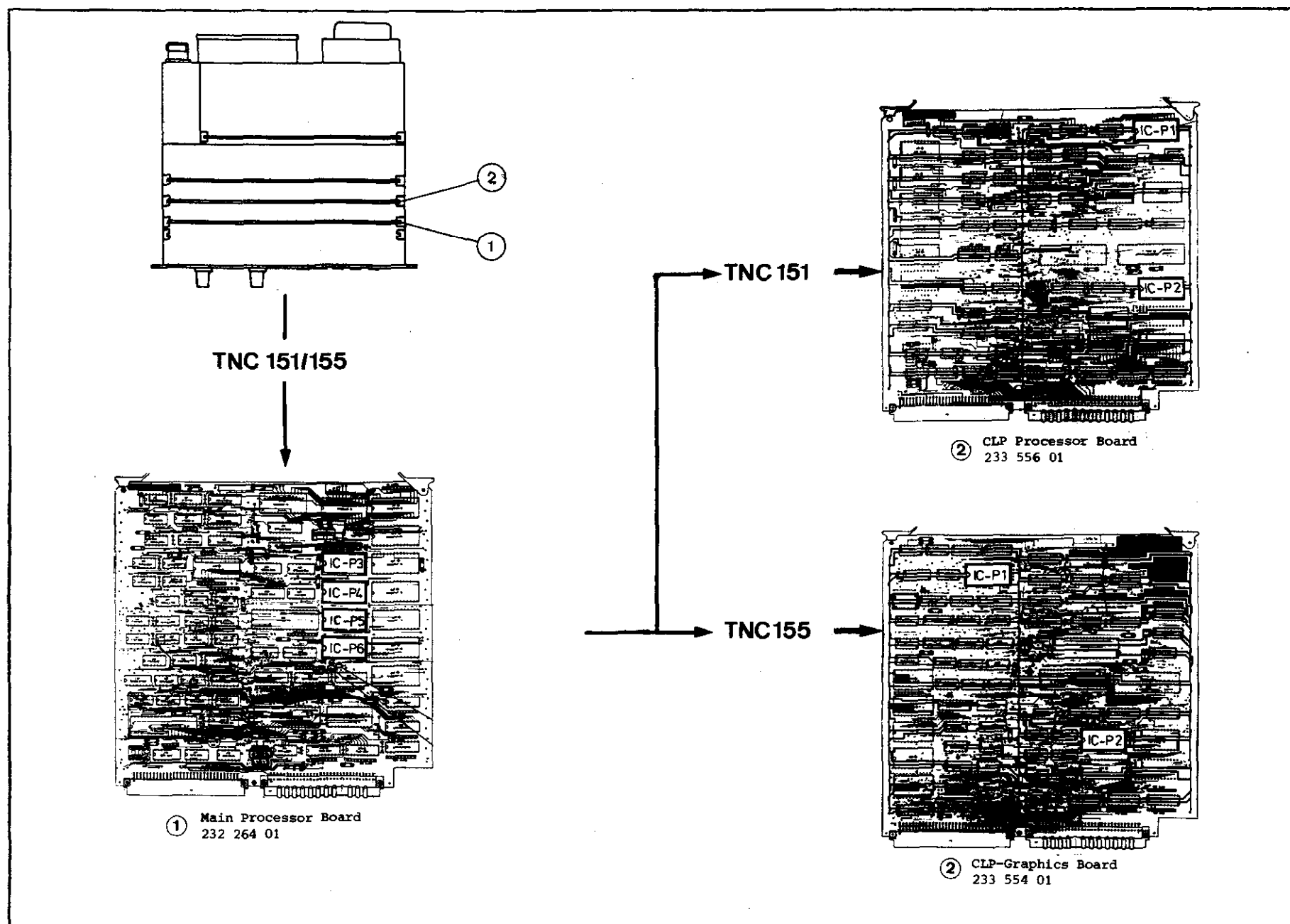
#### Exception: IC-P6 (PLC software)

The standard PLC program (EPROM position IC-P6) can be replaced with a custom PLC program for the TNC 151/155 Q.

#### IC-P2

The export NC Software differs from the standard NC Software in EPROM position IC-P2.

The dot matrix for all VDU displayed characters is contained in IC-P1 (character generator).



## Software Exchange

**Caution:** When exchanging the software observe the MOS protection procedures!

- o The cover of the Control can be removed after unscrewing the 5 cross-head mounting screws (top side).
- o To exchange the program, the following boards
  - Main Processor Board
  - CLP Processor/Graphics Boardhave to be removed from the assembled Control.

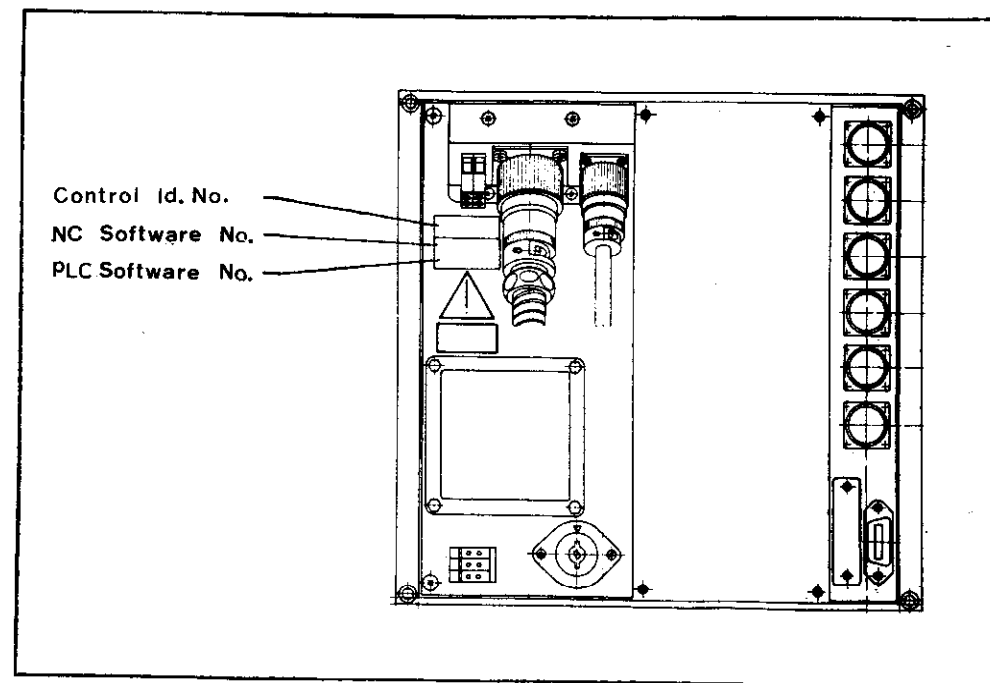
Thereto, lift the board ejector keys and press outwards, pull out board from above and lay onto MOS protection mat.

- o Push screwdriver blade carefully between EPROM and socket, remove EPROM with extraction tool and place onto MOS protection mat.
- o Insert EPROM into appropriate socket using insertion tool.

**Important:** - When exchanging EPROMs, observe the position number (second to last digit of the programmed EPROM Id. No.

- The EPROM package index must point in the same direction as the ICs on the board.
- Visually check if the EPROMs are contacting their respective sockets after an exchange.

- After the software exchange has been concluded, the Id.-Nos. of the NC and PLC software have to be changed. The description plate for the software numbers is found on the rear of the control under the type-plate.



**The RAM memory of the Memory Board is unbuffered during the EPROM (software) exchange. The machine parameters and any stored user-program are therefore erased!**

For continued operation, the machine parameters have to be re-entered into memory.

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**3.4 Replacement Parts, Loan/Exchange/Service Units**

**Replacement Parts TNC 151/155**

In general, replacement parts are available for all sub-assemblies discernible from the wiring diagrams (see section 4.2). However, it is strongly recommended that all repairs and maintenance work are entrusted to an official HEIDENHAIN agency. No responsibility can be accepted by DR. JOHANNES HEIDENHAIN GmbH for repairs undertaken by anyone else.

The list on page 49 shows the Id. Nos. and names of all parts available for the TNC 151/155. These parts can be ordered from the department **Kundendienst** (Customer Service) at HEIDENHAIN Traunreut. It is of utmost importance, when ordering, to give (i) the Id. No., (ii) the name, in German, and (iii) the quantity of each part required. Telexed order should be sent to the Kundendienst Telex: 17 866 982.

**Loan, Exchange, Service Units**

In order to keep machine down-time as short as possible, HEIDENHAIN offers a loan and exchange service.

**Loan units**

Loan units are available, free of charge, for the duration of a repair carried out at HEIDENHAIN Traunreut or by an official HEIDENHAIN agent. The only charges to the customer are the shipping charges.

**Exchange units**

An exchange unit can be requested for a unit that is returned for repair. This exchange unit is equipped with the latest hardware and software issue and is externally in excellent condition. The only charges to the customer in this case are for the repair of his own unit.

**Transaction**

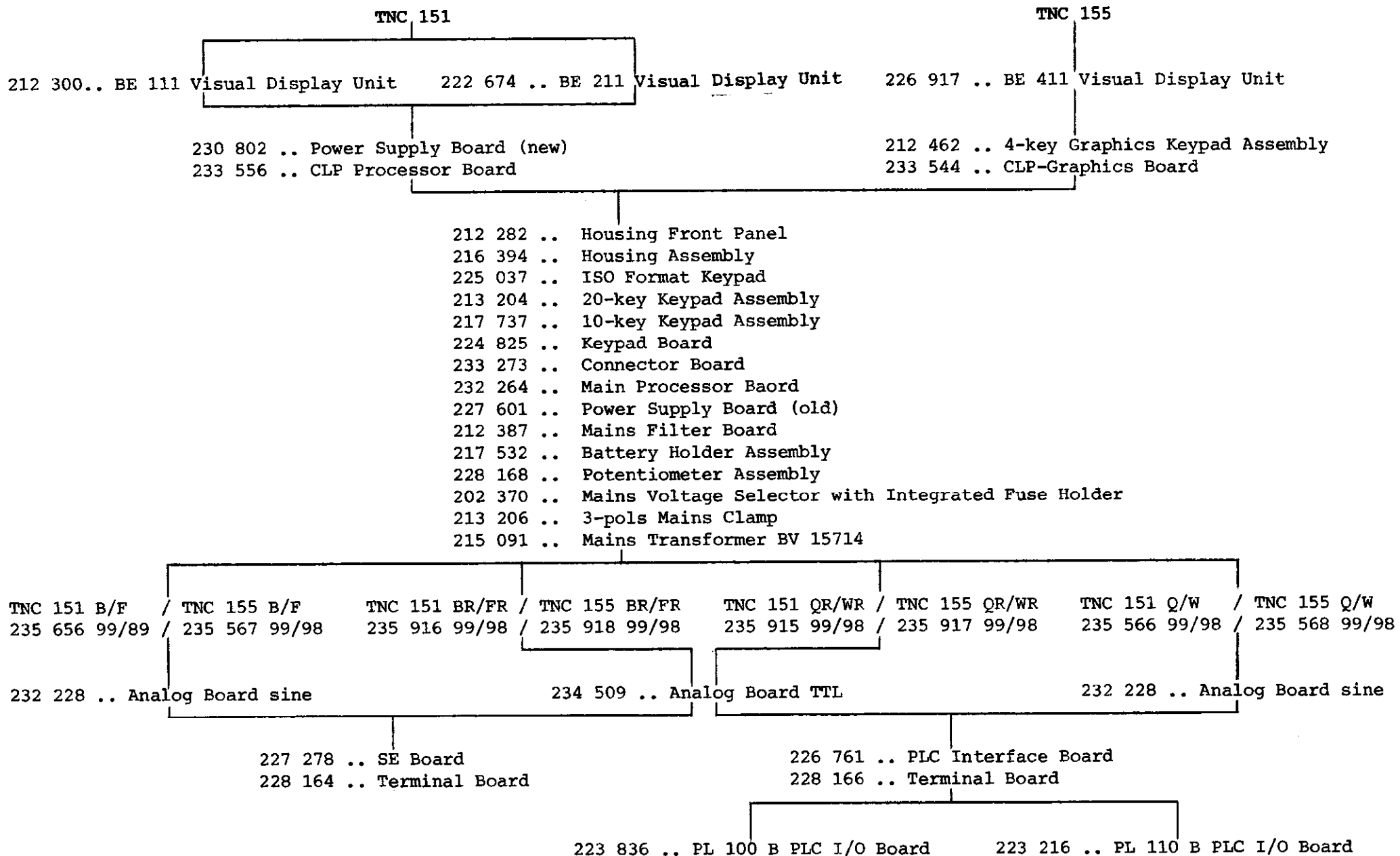
Requested loan or exchange units are shipped on the date of request, or the following day, provided that the unit is available from our stock.

A customer's faulty unit should be returned to DR. JOHANNES HEIDENHAIN within 14 days of receiving the exchange unit.

**Service units**

Service units are new units which are used for service purposes and can be obtained from DR. JOHANNES HEIDENHAIN at non-repeatable discount prices.

### 3.5 Configuration List



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**4. Additional Information**

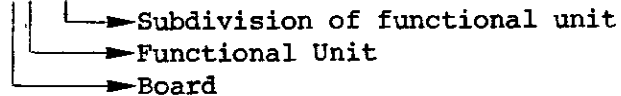
**4.1 Block Diagram Description**

The TNC 151/155 block diagram shows, in simplified form, the internal functional units of the control, their relationship to the various boards, and their interconnections. The graphic layout of the diagrams and the way it is folded permit:

- the representation of any of the TNC 151/155 (B/BR/Q/QR) models
- simplified representation of functional processes

Numbers enclosed between dashes inform about the board and its functional unit.

e.g.: -50.1-



**Simplified Description of the TNC 151/155 (Block Diagram)**

- Keypad Board (1)
- Main Processor Board (2)
- CLP Processor/Graphics Board (3)
- Analogue Board/Analogue Board TTL (4)
- with SE Board (5) it corresponds to a B(F)-Type;
- without SE Board, with PLC Interface (5), however
- with PLC I/O-Board(s), it corresponds to a Q(W)-Type or, respectively, QR(WR)-Type
- Power Supply Board (6)
- Terminal Board (7)

The functional processes of the control are divided between two microprocessor systems, each comprising:

- Microprocessor (TMS 9995)
- Program Memory (EPROMs)
- Write-Read Memory (RAMs)

- Input/Output facilities (e.g. keypad, screen, measuring system inputs, analog outputs, LEDs, V.24 interfaces etc.)

The functions of the control are divided between the two microprocessor systems as follows:

**1. "Main Processor System"**

- Keypad, LEDs
- User Program Interpreter
- Provision of programming "environment"
- Generation of PLC program addresses
- \* - Transfer of input and output states via the SE-board or PLC interface and PLC I/O-board
- \* - Control of the V.24 interface

**2. "CLP/Graphics System"**

- Ascertainment of instantaneous positions
- Interpolation Calculations
- VDU Control
- \* - Demand Speed Values to DAC
- \* - Interface with handwheel unit

- \* Serial data transfer via CRU bus.

**Main Processor Unit**

- Primarily on the main processor board (which is common to TNC 151 and TNC 155).
- The operating system (NC software) is contained in EPROMs:

- 20.1- IC-P3 (Dialog Language)
- 20.3- IC-P4, IC-P5
- 23.1- IC-P6 (PLC-Software)

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- The RAMs -20.2- on the main processor board can be accessed either by the main processor -20- or by the CLP processor. The intended coordinates, programmed feed, display texts etc. can therefore be transferred. These RAMs also serve as register file memory for the main processor -20-. User programs, machine parameters, and (under certain circumstances) the PLC program are programmed in RAMs -20.4-.
- The 16-bit address bus is extended to 20-bit by a memory mapper 1.
- The keyboard controller -22- has the task of driving the LEDs and scanning the keypads -22.1- on the front plate.
- The main processor is connected with V.24 interface via a (serial) CRU-bus. This interface is used to exchange data by means of a magnetic tape unit (ME) or, respectively, an external processor.
- The PLC program contained in IC-P9 -23.1- is processed by the "1-bit-PLC-processor" -23- mounted discretely on the main processor board. The input and output states are stored in a 8k x 8 PLC-RAM -23.2-.
- I/O-Functions:
  - a) TNC 151/155 B-Versions:  
24 galvanically separated inputs (E0 to E23) -50- and 24 floating relay contact outputs (A0 to A22 + emergency stop) -51- on the SE Board. The inputs and outputs are protected on the terminal board (B/F version) by special protective resistances 5.1k $\Omega$ -70- and 47 $\Omega$ -70.1-.  
**Protective resistances should never be replaced with normal resistances!**  
They are led via LC-filter -71- as protection against the oscillation of analog outputs.

b) TNC 151/155 Q-Versions:

The inputs and outputs are loaded on an external PLC I/O-boards (e.g. PL 100B or, respectively, PL 110B) which is driven by the main processor -20- via the PLC interface board. The data is serially transferred via the CRU-bus. All lines of this bus as well as the required addresses are galvanically separated by the optocoupler -50- and are converted from the TTL level (5V) to the MOS level (12V) by means of a level converter -51-. Thus a higher noise immunity is obtained.

Under the control of CRU addresses 63 programmable inputs (E0 to E62) -E2- located on the PLC I/O board are multiplexed on CRUIN 1 line. If 2 PLC I/O boards are connected the inputs from the 2nd board are multiplexed on CRUIN 2. On the PLC interface board either CRUIN 1 or CRUIN 2 are selected -54- and are led to the main processor via CRUIN.

The serial CRUOUT signal is converted in 31 outputs via a serial-parallel-converter -E1.1-. The outputs (each having its own current supervision -E1-) are transferred via line drivers to the machine interface.

- An overloaded output only switches off during the period of the overload.

- If the current supervision detects overcurrent no emergency-stop results in the standard PLC program.

The input E63 is used to indicate an overloaded output to the main processor -20-.

PL 100B: 31 unipolar, programmable outputs + emergency-stops protected against overload.

PL 110B: 26 unipolar, programmable outputs + 5 bipolar outputs protected against overload.

On the PLC I/O board a 12V voltage is generated by an external 24V supply PLC I/O board. On the PLC interface board this 12V voltage is transformed in a 5V voltage for its TTL modules.

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**CLP Processor System:**

- Primarily on the CLP processor board which is common to the TNC 155 CLP/Graphics board.
- Operating system is contained in EPROM IC-P2 -30.1-.
- The main task is the calculation of the instantaneously intended values of the analog output voltages dependent on:
  - .the instantaneous actual positions
  - .the programmed intended position
  - .the distance of the intended position (influence on deceleration ramp)
  - .the programmed feed rate
  - .the fast traverse rates determined per machine parameter
  - .the settings of the override and feed potentiometerThe calculating speed requires a wait-free RAM -30.2--
- The measuring system signals are processed on the analog board. These signals are amplified at first -40.1- and then subdivided -40- by delaying (phase shifted) and combining them differently. The subdivided 0 degree, 90 degrees and RI signals are then led to the gate arrays -32- of the CLP processor board. The gate arrays are especially developed LSI circuits consisting of different gates and counters in which the direction of the movement and the number of pulses are calculated. This information can then be scanned by CLP processor -30- to ascertain the actual values of the axes.
- The symmetry, the on-to-off ratio and the amplitude of the system signals are constantly controlled by a supervision circuit -40-.
- The signals from the handwheel (if present) are shaped via the functional block -43- and are also processed by the CLP processor.
- If the distance between the control and measuring system is more than 20m, an EXE has to be interposed. The measuring signals are thus already amplified, subdivided, evaluated, supervised and converted in TTL signals. An "R" version of the control is used accordingly (e.g. TNC 151 BR) equipped with a combined EXE connection for X-, Y-, and Z-axis and an analog board TTL. The input amplifiers and the wiring for the signal subdivision are replaced with line receivers -40- on this analog board whose outputs are directly connected to the gate arrays -32- on the CLP processor board. The supervision signal of the EXE is also buffered -40- and transferred to the CLP processor board. The signals of the handwheel are likewise processed -43- as on the "normal" (sine) analog board.

If instead of linear position transducers incremental encoders are used to ascertain actual values a reference pulse appears once per revolution. Since only one reference pulse is to be evaluated all other reference pulses of the axes X, Y, Z, IV are inhibited on the analog board -40-. The signal lines are connected with the analog board via the PLC I/O board and the PLC interface board. The level conversion MOS/TTL as well as the galvanic decoupling is carried out on the PLC interface boards via -51- and -50-.

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- The data of the CLP processor is transferred to the analog outputs via the serial CRU bus. The digital output values calculated for all axes are multiplexed on the CRU OUT line and are converted in a 12 bit parallel format on the analog board. These successive digital values are then converted in analog values (voltages) by means of a DAW -42.1- (digital-analog-converter). These voltages are compared with the adjusted values of the override and feed potentiometers -42- and the results are transmitted to the CLP processor via CRUIN. The output voltages can thus be adapted to the values adjusted by the override or, respectively, the feed potentiometer. The X-, Y-, Z-, IV- and S-analog values generated shortly one after the other at the output of the DAW are allocated to the single axes by means of five samples and hold circuits -42.2-. The five individual analog voltages are amplified and buffered subsequently -42.3- and are led to the terminal board.  
On the analog board the buffer battery (3,46V) and the internal temperature (65°) of the control are also supervised -41-. The supervision signals are led to the CLP processor via the CRUIN line.
- Two "watch dog" monoflops -41.1- are on the analog board. These must be triggered separately once every 5ms by the CLP processor -20- and once every 20ms by the main processor -30-. If the monoflops are not driven within 5ms or 20ms (error state), an emergency-stop signal is triggered.
- The drive of the screen is another important task of the TNC 151 CLP processor. It only has to write the texts to be displayed into the CRT RAM -31.1-. A special CRT controller TMS 9937 -31- generates the necessary addresses for the CRT RAM and the character generator IC-P1 -31.2- so that the data are transferred to the shift register -31.3- in the right sequence. Thus signal can be inverted by means of an exclusive-or-gate -31.4- to generate an inverse video display. The video signal, the bright/dark signal, the horizontal/vertical sync. signals and an 11V supply are used to operate the screen.
- The function of the TNC 155 CLP graphic processor is similar. The screen can either be operated in the text or in the graphic mode. The control of the routine processes required for the test and the graphic representation are taken over by the graphic controller  $\mu$ PD 7220 -31-. This controller has to receive the corresponding commands and pertaining parameters of the CLP processor via the data bus. To permit a fast generation of a given representation all necessary commands and parameters are calculated in advance and are stored in the 64K x 8 dynamic graphic memory. Priority decisions between reading or, respectively, writing and refreshing of the memory are carried out by the DRAM controller -31.5- The graphic controller, which is dependent on the commands received by the CLP processor, sets up the required bit pattern in the 32k x 16 video memory. The constant issue of these data and the synchronisation signal to the screen is also controlled by the graphic controller. In the graphic mode the 16-bit-pixel-words are read out by the CLP processor and are converted in a serial format by means of a graphic shift register -31.7-. The signal can be inverted by means of an exclusive-or-gate -31.4- to generate, under certain circumstances, an inverse video display.  
In the text mode the video memory contains the 6-bit-ASCII-values and the pertaining mode data. The ASCII values and some of the mode bytes form the addresses for the character generator IC-P1 -31.2-. The bit pattern for the momentarily addressed sequence of the intended sign is converted in a serial format by means of a video shift register -31.3-.

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Under certain circumstances, an inverse video display can again be generated by means of the exclusive-or-gate-wiring -31.4-. A discretely mounted timer circuit synchronizes the procedures of the entire CLP/Graphics board.

- On the SE-board (or the PLC interface board) the V.24 signals of the handwheel unit are connected to the line drivers or, respectively, to the line receivers. A serial interface module on the CLP/Graphics board stands between line receivers/drivers and the CLP processor to transfer data with the handwheel unit and to format data. (start/stop pulse e.g.)
- The signals of the 3D-probe are buffered via the 3D-probe-interface on the SE board (or PLC interface board) -53- and is evaluated via the counter module -32- on the CLP processor/graphics board.

**Power Supply Unit**

- +5V are generated for the TTL modules via the flow converter -70-. The flyback regulator -70.1- inductively coupled with the flow converter generates +/-15V for the operation amplifier.
- The +12V supply voltage for the V.24 interface is generated with the help of the +15V by means of a linear regulator -70.2-.
- +11V are generated via the flow converter -70.3- for the TNC 151 (BE 111, BE 211) screen which in contrast to the TNC 155 (BE 411) screen does not have an own power supply unit. The switch regulator -70.01- and -70.31- readjust the output voltage load controlled.
- The soft start -71- limits the relatively high switch-on current.

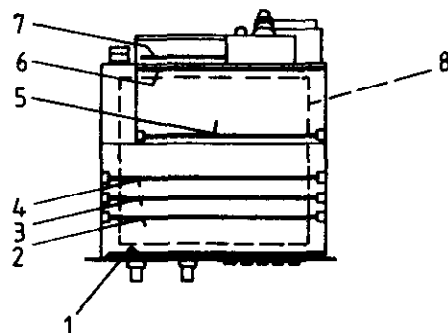
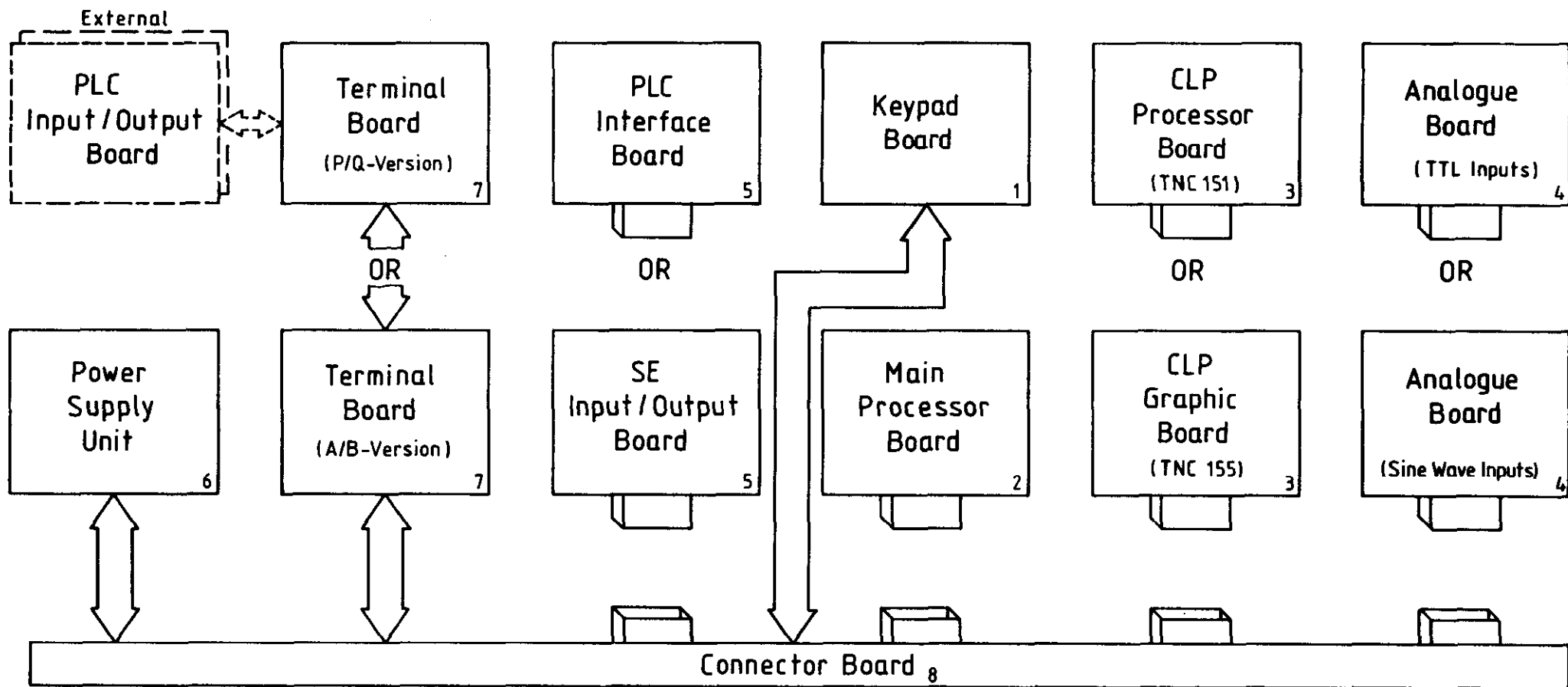
- On the power supply board there is, moreover, a voltage supervision -62- triggering a reset signal if the power supply is interrupted or if the supply voltage drops below a predetermined minimum level (187V if set for 220V operation) for a short time.

If U2 (+5V) exceeds if there is a failure the overvoltage recognition -63- is immediately effective and causes the overvoltage protection (thyristor) -63.1- to connect through. Thus U1 is short-circuited coming directly from the power supply transformer -64- via the rectifier -65-. A greater damage at the subsequent electronics is thus inhibited by means of this protective measure.

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4.2 Block Diagrams TNC 151/155

| Block Diagram                | Drawing Number   | Page |
|------------------------------|------------------|------|
| Arrangement                  | 4820 EKD 1600900 | 56   |
| PLC-I/O-Board                | 4820 EKD 1601700 | 57   |
| Power Supply                 | 4820 EKD 1602000 | 58   |
| Terminal Board (P/Q-Version) | 4820 EKD 1601900 | 59   |
| Terminal Board (A/B-Version) | 4820 EKD 1601800 | 60   |
| PLC Interface Board          | 4820 EKD 1601600 | 61   |
| SE-I/O-Board                 | 4820 EKD 1601500 | 62   |
| Main Processor Board         | 4820 EKD 1601000 | 63   |
| CLP Processor Board          | 4820 EKD 1601100 | 64   |
| CLP Graphic Board            | 4820 EKD 1601200 | 65   |
| Analog Board (TTL-Input)     | 4820 EKD 1601400 | 66   |
| Analog Board                 | 4820 EKD 1601300 | 67   |

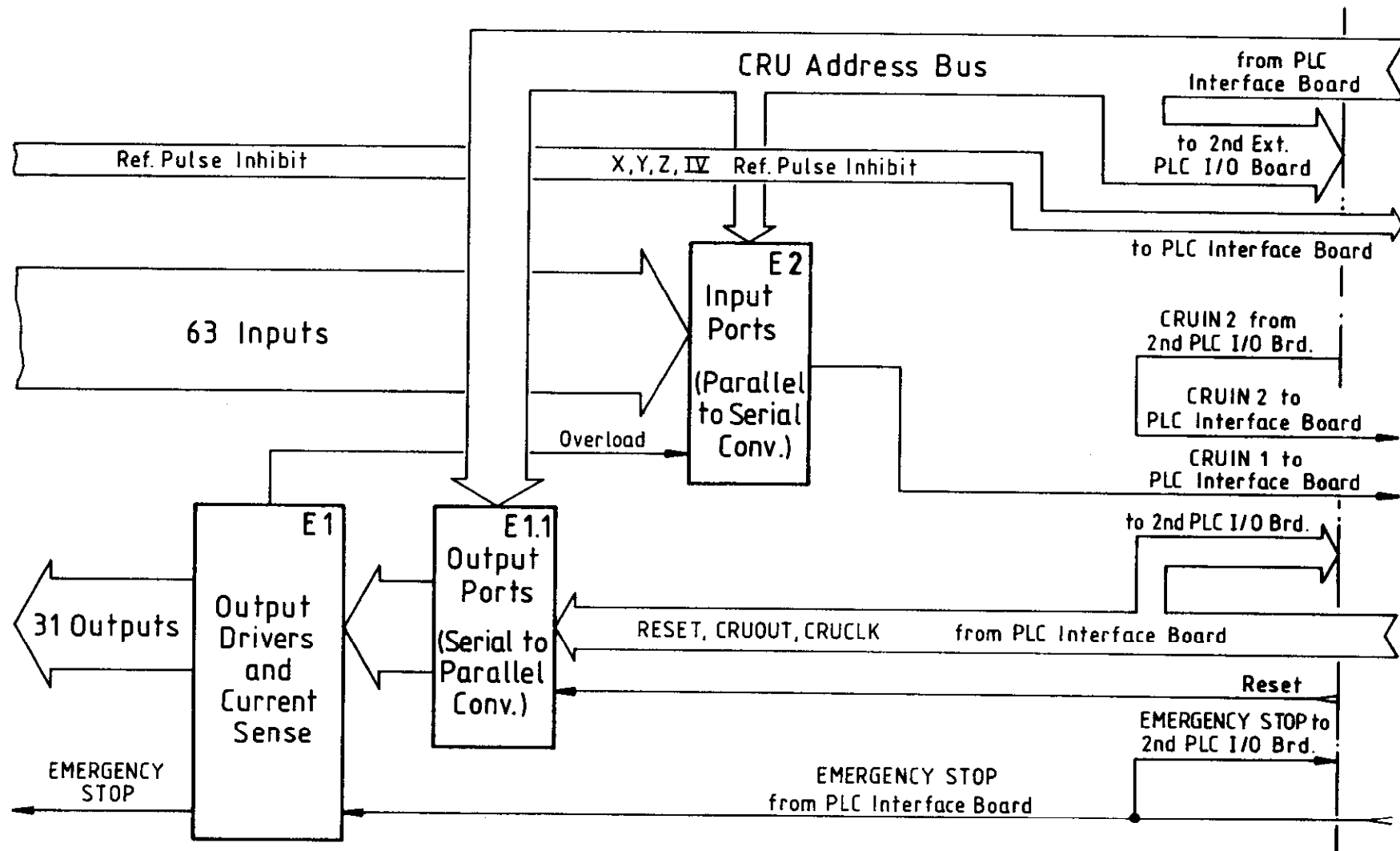


Drawing No.:  
4820 E KD 16009 00

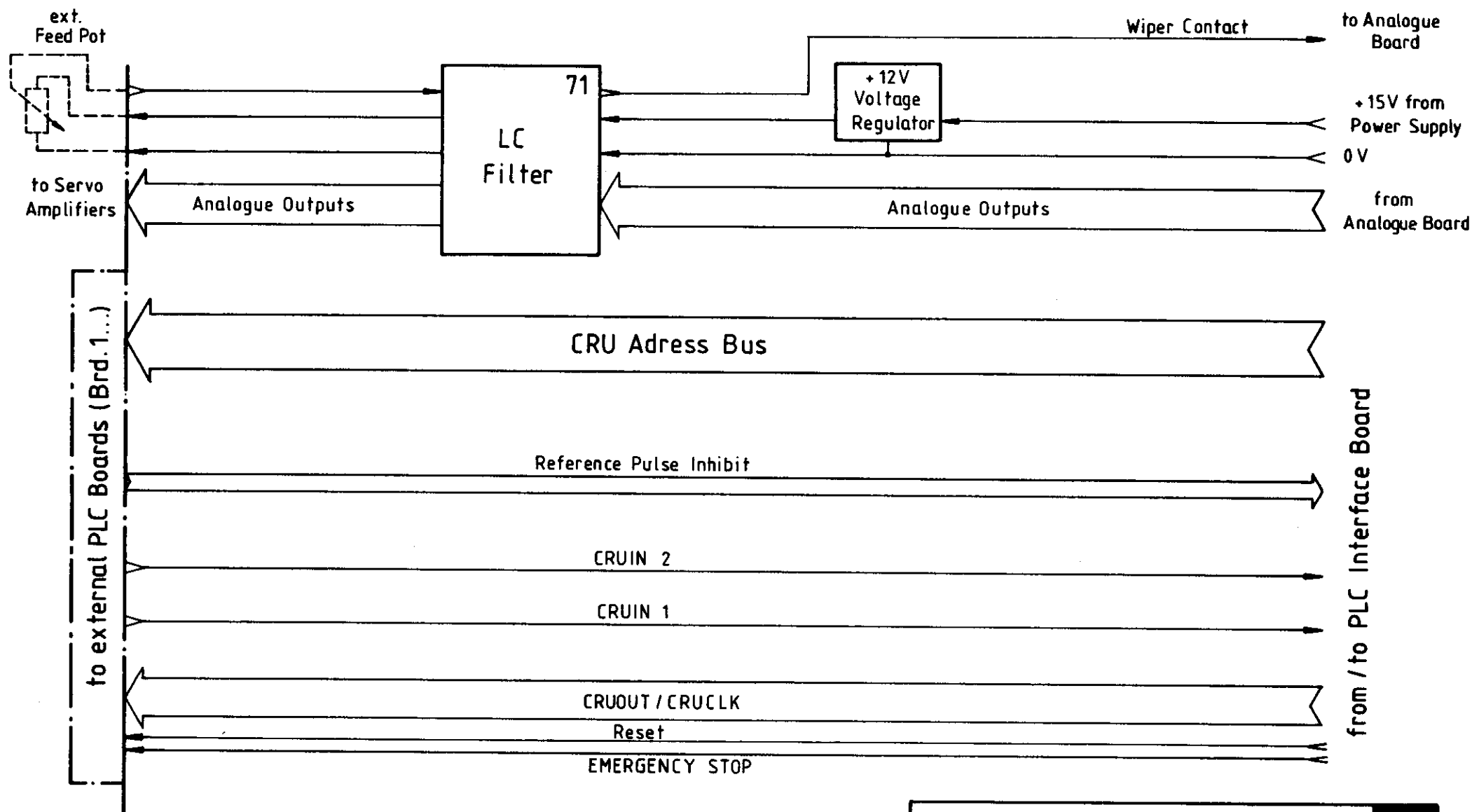


Layout of the Block Diagrams  
and Boards in the TNC 151/155

Machine Interface



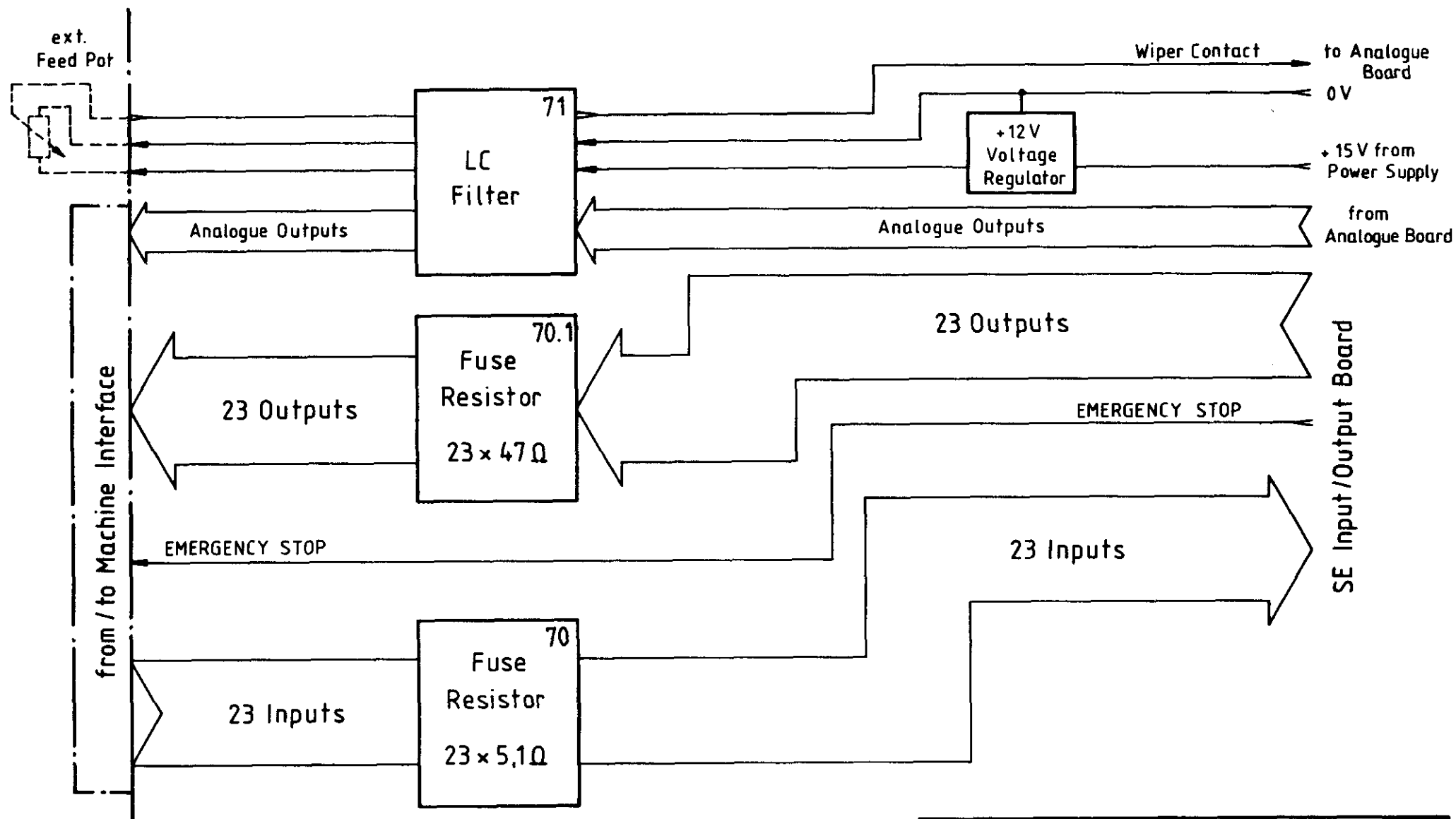




Drawing No.:  
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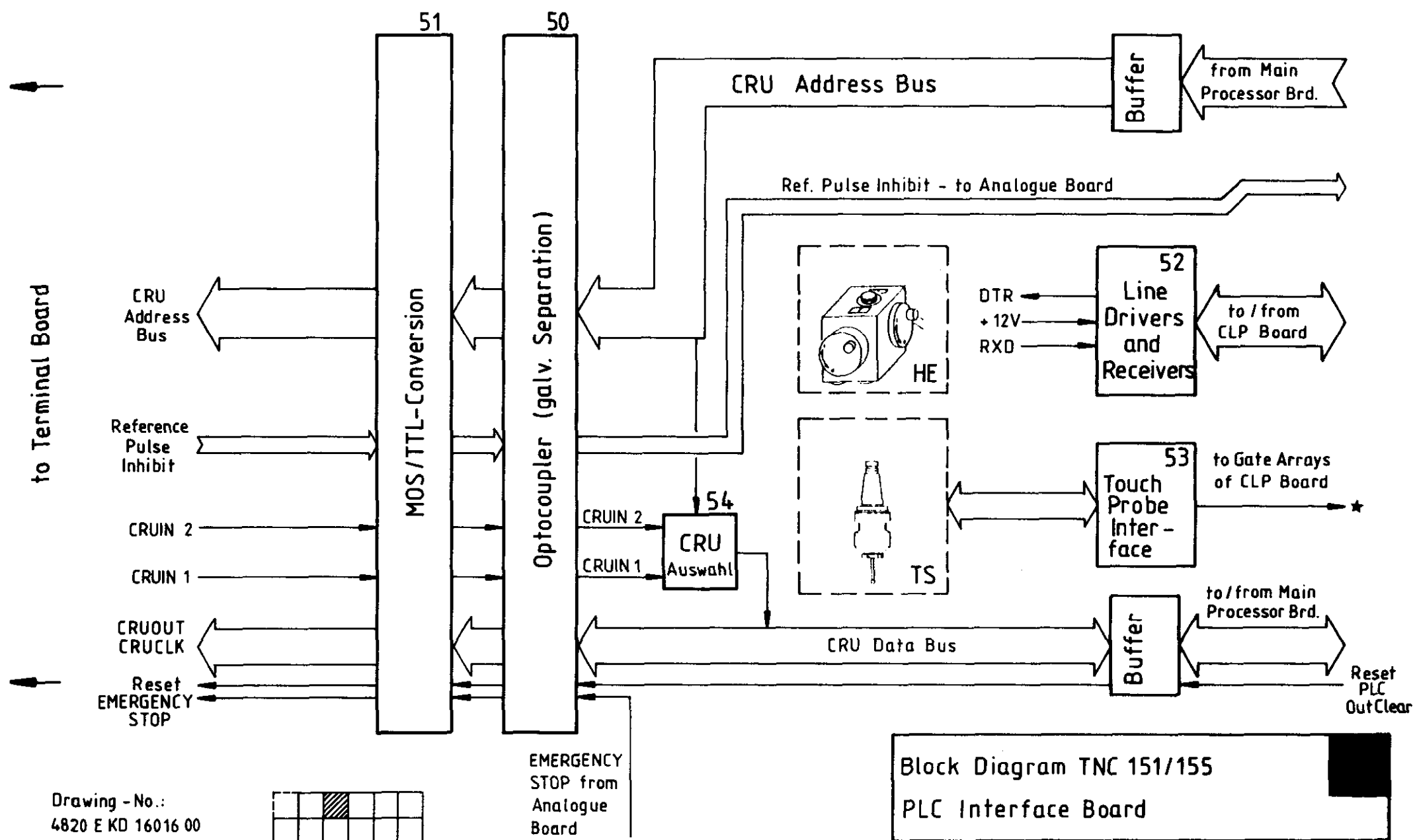
Block Diagram TNC 151/155  
Terminal Board (P/Q-Version)



Drawing No:  
4820 EKD 16018 00



Block Diagram TNC 151/155  
Terminal Board (A/B Version)

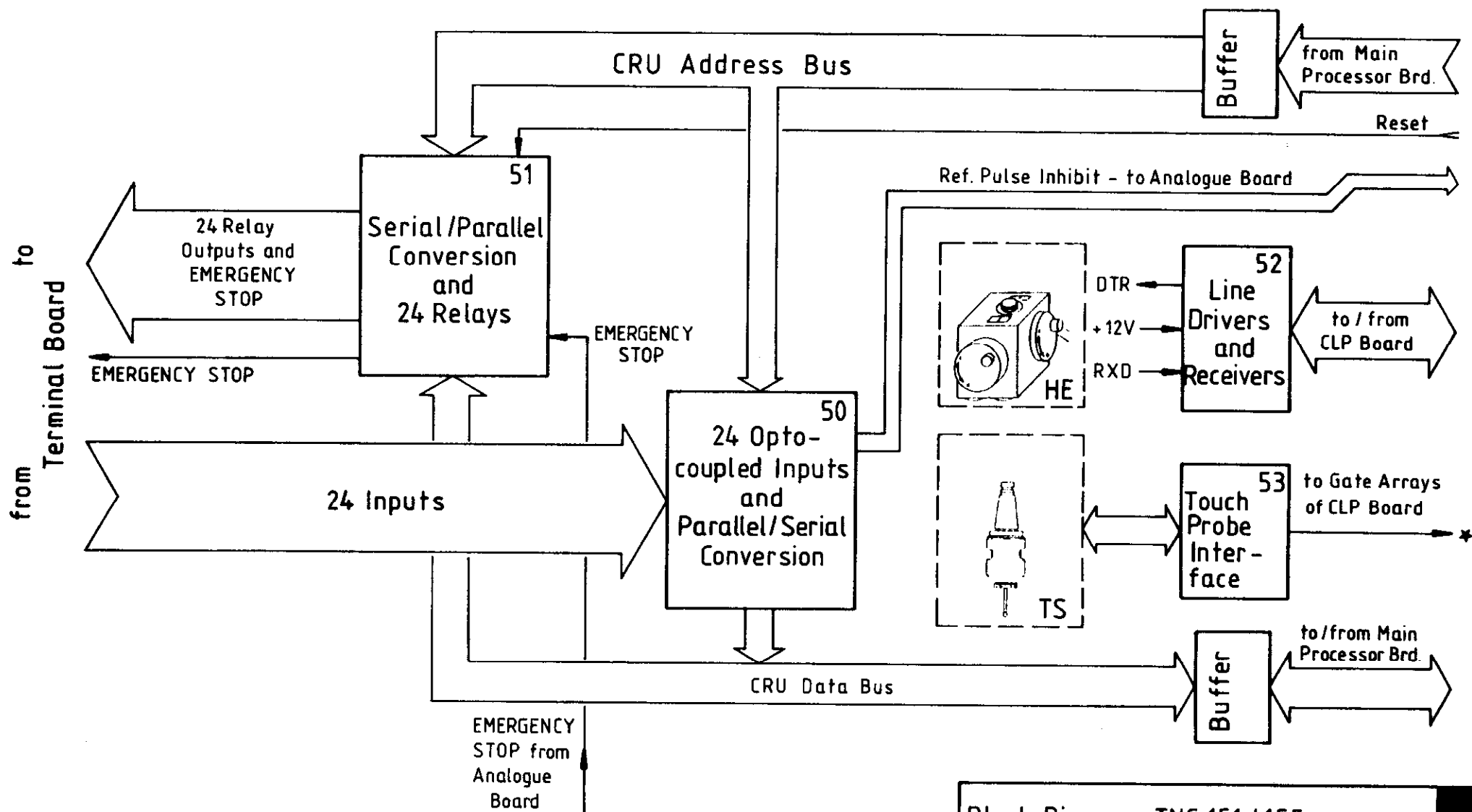


Drawing - No.:  
4820 E KD 16016 00



EMERGENCY  
STOP from  
Analogue  
Board

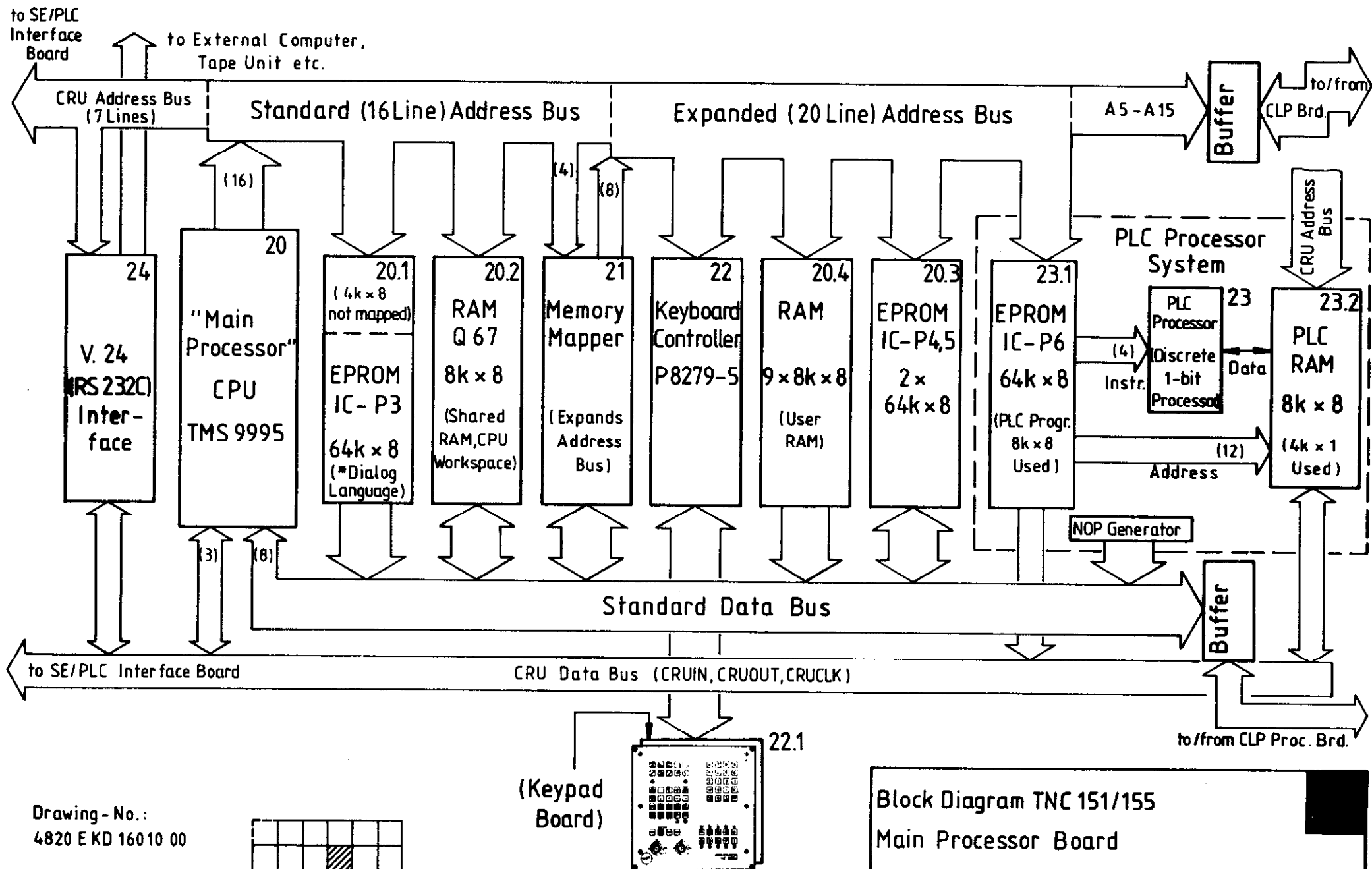
Block Diagram TNC 151/155  
PLC Interface Board

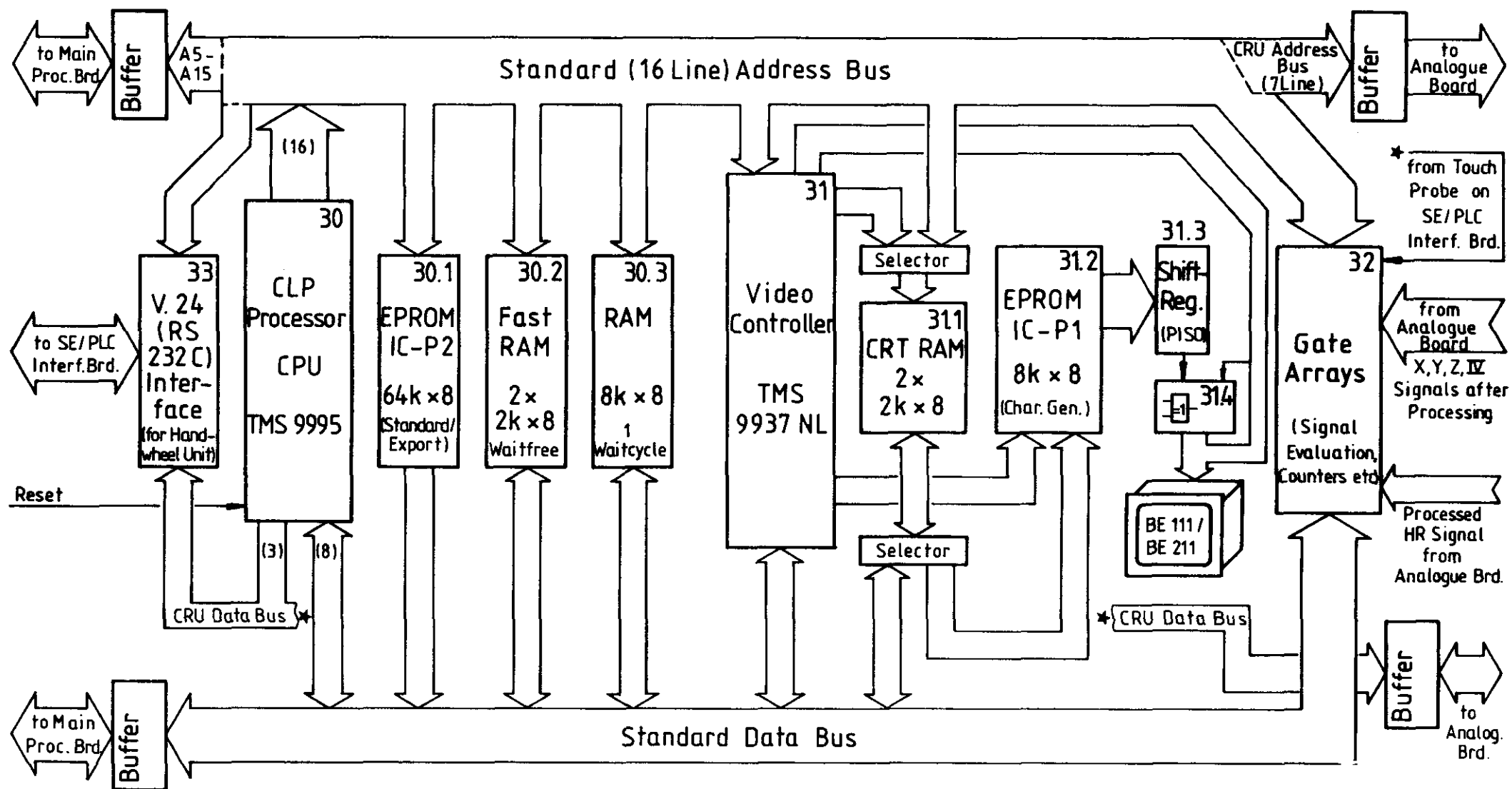


Drawing - No.:  
4820 E KD 16015 00



Block Diagram TNC 151/155  
SE Input/Output Board

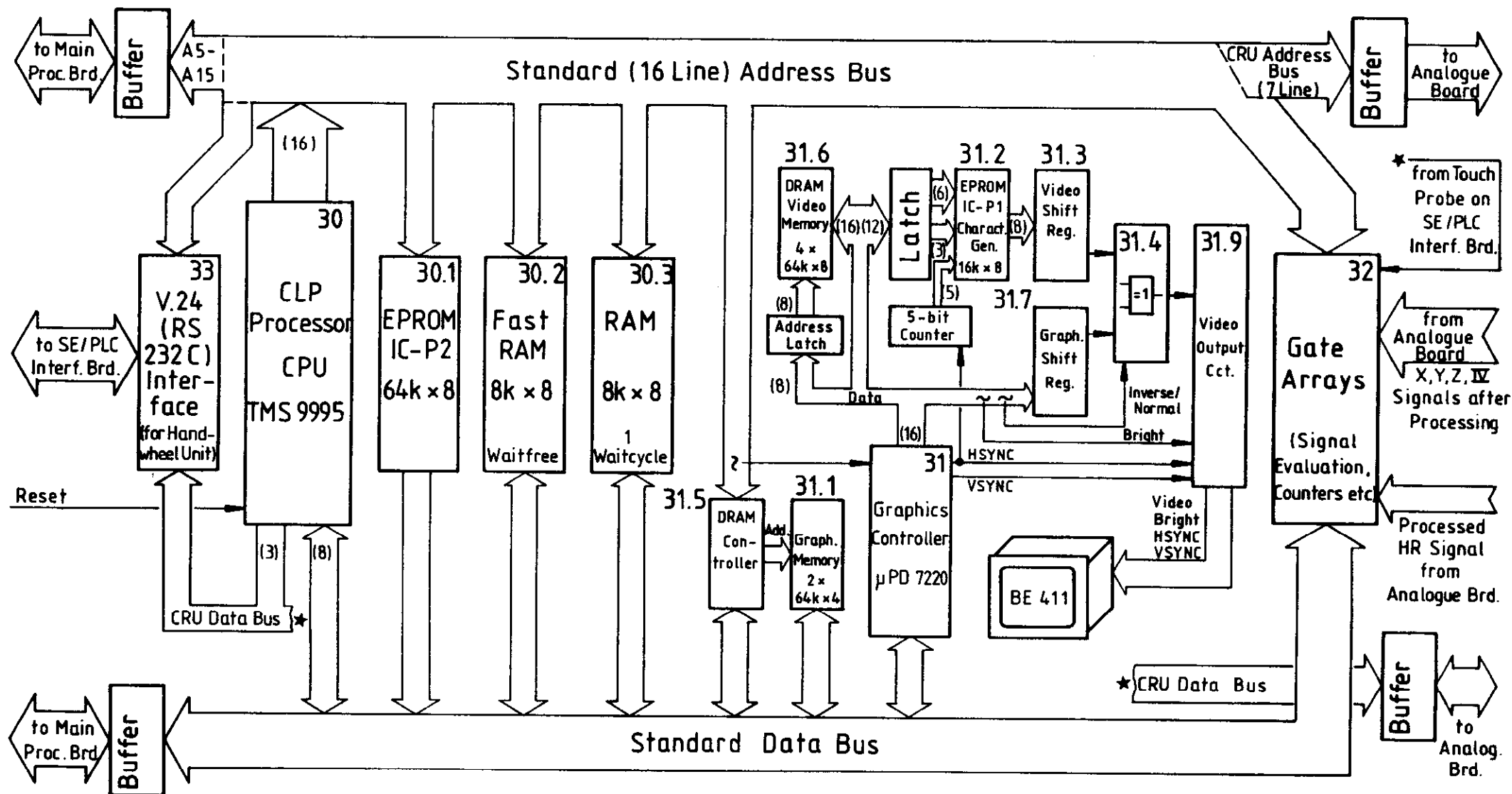


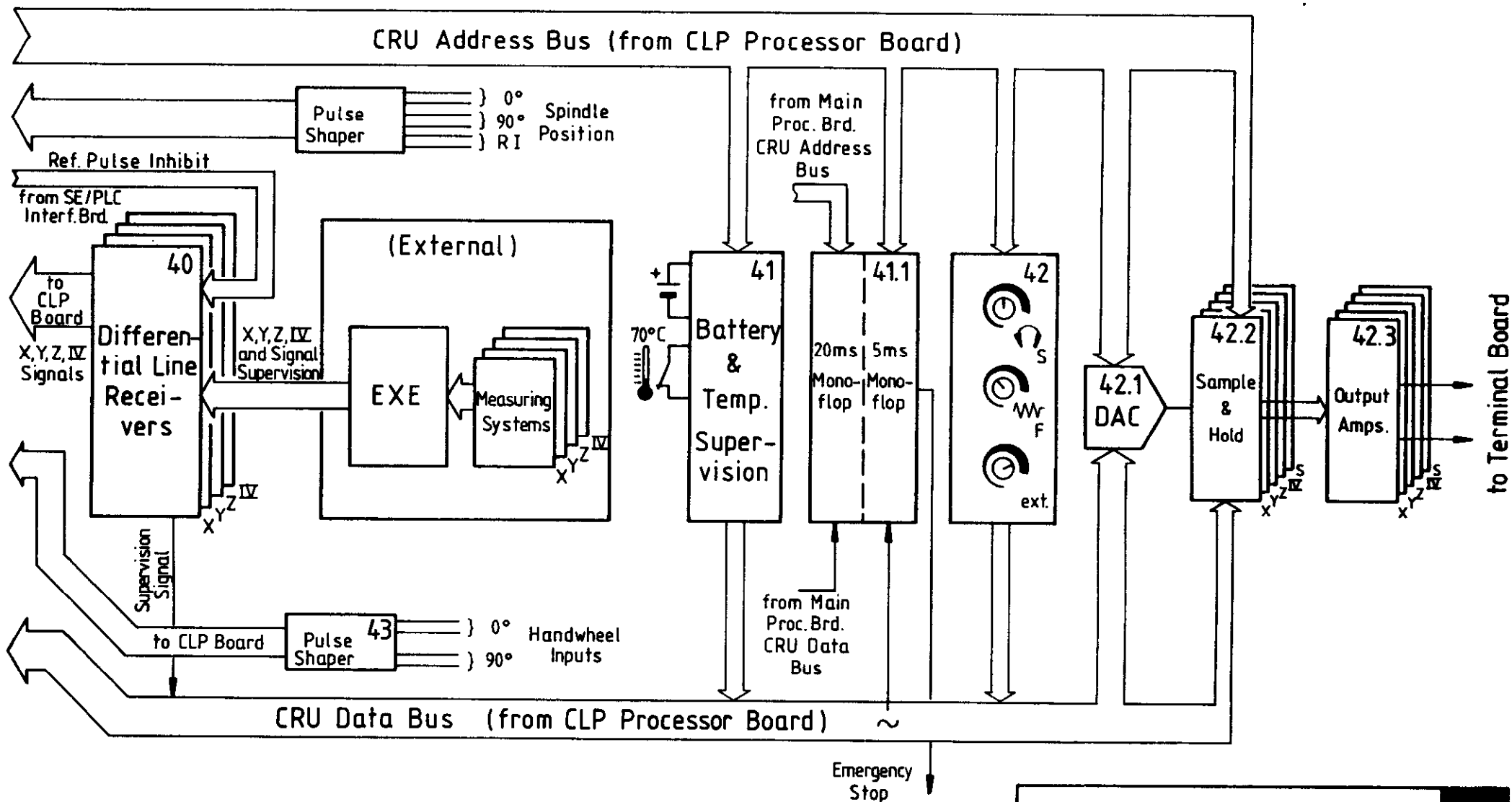


Drawing - No.:  
4820 E KD 16011 00



Block Diagram TNC 151  
CLP Processor Board

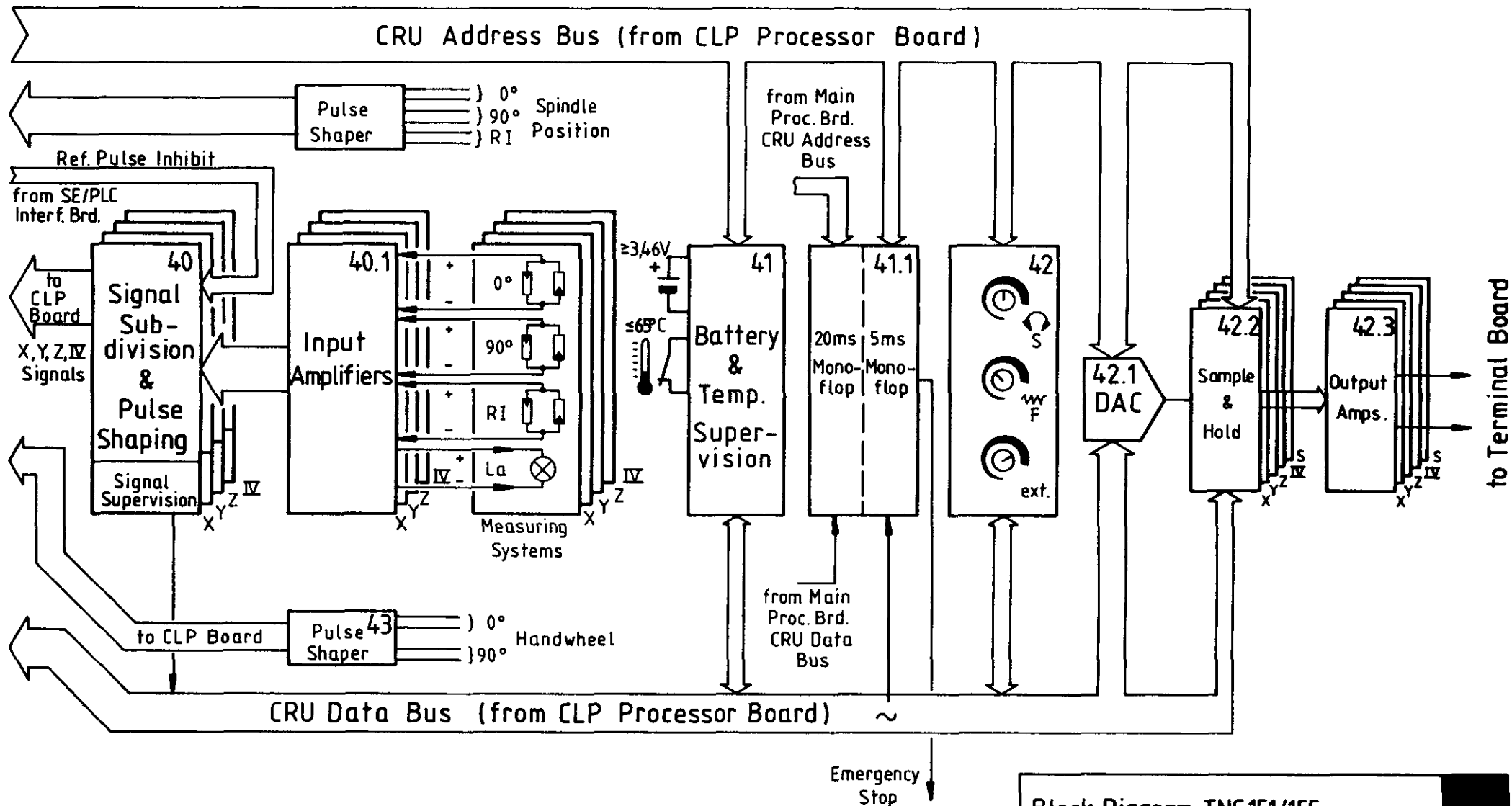




Drawing - No.:  
4820 E KD 16014 00



Block Diagram TNC 151/155  
Analogue Board (TTL Inputs)



Drawing - No.:  
4820 E KD 16013 00



Block Diagram TNC 151/155  
Analogue Board

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**4.3 Wiring diagrams**

Wiring diagram    TNC 151 B    Drawing No. 232 239 00    P.69

Wiring diagram    TNC 151 Q    Drawing No. 232 240 00    P.70

Wiring diagram    TNC 155 B    Drawing No. 239 292 00    P.71

Wiring diagram    TNC 155 Q    Drawing No. 232 293 00    P.72

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**4.4 Machine parameters**

| Function                                                  |    | Parameter | Input values                                                 |
|-----------------------------------------------------------|----|-----------|--------------------------------------------------------------|
| Rapid traverse                                            | X  | 0         | 80 ... 15 999 [mm/min]                                       |
|                                                           | Y  | 1         |                                                              |
|                                                           | Z  | 2         |                                                              |
|                                                           | IV | 3         |                                                              |
| Manual feed                                               | X  | 4         |                                                              |
|                                                           | Y  | 5         |                                                              |
|                                                           | Z  | 6         |                                                              |
|                                                           | IV | 7         |                                                              |
| Speed when approaching the reference marks                | X  | 8         | (Axis IV: degrees/min. with axis designation A or B or C)    |
|                                                           | Y  | 9         |                                                              |
|                                                           | Z  | 10        |                                                              |
|                                                           | IV | 11        |                                                              |
| Signal evaluation                                         | X  | 12        | 1 $\hat{=}$ 20-fold                                          |
|                                                           | Y  | 13        | (max. traversing speed                                       |
|                                                           | Z  | 14        | 16 [m/min])                                                  |
|                                                           | IV | 15        | 2 $\hat{=}$ 10-fold<br>(max. traversing speed<br>12 [m/min]) |
| Traversing direction when approaching the reference marks | X  | 16        | 0 $\hat{=}$ Plus direction                                   |
|                                                           | Y  | 17        | 1 $\hat{=}$ Minus direction                                  |
|                                                           | Z  | 18        | (with correct programming of parameter nos. 20 to 27)        |
|                                                           | IV | 19        |                                                              |
| Counting direction                                        | X  | 20        | 0 or 1                                                       |
|                                                           | Y  | 21        |                                                              |
|                                                           | Z  | 22        |                                                              |
|                                                           | IV | 23        |                                                              |
| Polarity of nominal value voltage                         | X  | 24        | 0 $\hat{=}$ positive with positive traversing direction      |
|                                                           | Y  | 25        | 1 $\hat{=}$ negative with positive traversing direction      |
|                                                           | Z  | 26        |                                                              |
|                                                           | IV | 27        |                                                              |
| Integral factor                                           | X  | 28        | 0 ... 65 535                                                 |
|                                                           | Y  | 29        |                                                              |
|                                                           | Z  | 30        |                                                              |
|                                                           | IV | 31        |                                                              |
| Differential factor                                       | X  | 32        | 0 ... 65.535                                                 |
|                                                           | Y  | 33        |                                                              |
|                                                           | Z  | 34        |                                                              |
|                                                           | IV | 35        |                                                              |

**Kundendienst**

| Function                                    | Parameter | Input values                      |
|---------------------------------------------|-----------|-----------------------------------|
| Backlash compensation                       | X         | 36                                |
|                                             | Y         | 37                                |
|                                             | Z         | 38                                |
|                                             | IV        | 39                                |
| Correction factor for linear correction     | X         | 40                                |
|                                             | Y         | 41                                |
|                                             | Z         | 42                                |
|                                             | IV        | 43                                |
| Software limit switch ranges                | X+        | 44                                |
|                                             | X-        | 45                                |
|                                             | Y+        | 46                                |
|                                             | Y-        | 47                                |
|                                             | Z+        | 48                                |
|                                             | Z-        | 49                                |
|                                             | IV+       | 50                                |
|                                             | IV-       | 51                                |
| Analog voltage with rapid traverse          | 52        | +4.5 ... +9 [V]                   |
| Approach speed                              | 53        | 0.1 ... 10 [m/min]                |
| Acceleration                                | 54        | 0.001 ... 3.0 [m/s <sup>2</sup> ] |
| Circular acceleration                       | 55        | 0.001 ... 3.0 [m/s <sup>2</sup> ] |
| Position supervision (erasable)             | 56        | 0.001 ... 30.000 [mm]             |
| (in precontrolled mode) (emergency stop)    | 57        |                                   |
| Position window X, Y, Z                     | 58        | 0.001 ... 0.5 [mm]                |
| Axis sequence for reference points approach | 59        | 0 ≙ X Y Z IV 12 ≙ Z X Y IV        |
|                                             |           | 1 ≙ X Y IV Z 13 ≙ Z X IV Y        |
|                                             |           | 2 ≙ X Z Y IV 14 ≙ Z Y X IV        |
|                                             |           | 3 ≙ X Z IV Y 15 ≙ Z Y IV X        |
|                                             |           | 4 ≙ X IV Y Z 16 ≙ Z IV X Y        |
|                                             |           | 5 ≙ X IV Z Y 17 ≙ Z IV Y X        |
|                                             |           | 6 ≙ Y X Z IV 18 ≙ IV X Y Z        |
|                                             |           | 7 ≙ Y X IV Z 19 ≙ IV X Z Y        |
|                                             |           | 8 ≙ Y Z X IV 20 ≙ IV Y X Z        |
|                                             |           | 9 ≙ Y Z IV X 21 ≙ IV Y Z X        |
|                                             |           | 10 ≙ Y IV X Z 22 ≙ IV Z X Y       |
|                                             |           | 11 ≙ Y IV Z X 23 ≙ IV Z Y Z       |
| Speed pre-control                           | 60        | 0 ≙ on 1 ≙ off                    |

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| Function                                                                       | Parameter | Input values                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Output of tool numbers or tool store numbers                                   | 61        | <p>0 ≙ No output</p> <p>1 ≙ Output only when tool number changes</p> <p>2 ≙ Output of every tool number with every tool call</p> <p>3 ≙ Output of tool magazine number (if MP 225 &gt; 1)</p>                                                                                                                                                                               |
| Output of spindle speed codes or as S-analog voltage                           | 62        | <p>0 ≙ No output of spindle rpm</p> <p>1 ≙ Coded output only when rpm changes</p> <p>2 ≙ Coded output of all rpms</p> <p>3 ≙ S-Analog voltage output, gear switching signal only when gear ratio changes</p> <p>4 ≙ S-Analog voltage output, output of all gear switching signals with every tool call</p> <p>5 ≙ S-Analog voltage output without gear switching signal</p> |
| rpm code limit                                                                 | 63        | 00001 ... 00991                                                                                                                                                                                                                                                                                                                                                             |
| Oscillation behaviour when accelerating                                        | 64        | 0.01 - 0.999                                                                                                                                                                                                                                                                                                                                                                |
| Display step                                                                   | 65        | 0 ≙ 1 µm                      1 ≙ 5 µm                                                                                                                                                                                                                                                                                                                                      |
| External feed rate potentiometer                                               | 66        | <p>0 ≙ internal potentiometer for override and manual feed</p> <p>1 ≙ external potentiometer for override and manual feed</p> <p>2 ≙ internal potentiometer for override external potentiometer for manual feed</p>                                                                                                                                                         |
| Dwell time, rotation change of spindle in tapping cycle                        | 67        | 0 ... 65.535 [s]                                                                                                                                                                                                                                                                                                                                                            |
| Memory function for directional keys                                           | 68        | 0 ≙ off    1 ≙ on                                                                                                                                                                                                                                                                                                                                                           |
| Special procedure for reference mark approach                                  | 69        | 0 ≙ off    1 ≙ on                                                                                                                                                                                                                                                                                                                                                           |
| Nominal value voltage for spindle drive when changing gear                     | 70        | 0 ... 9.999 [V]                                                                                                                                                                                                                                                                                                                                                             |
| Program end character                                                          | 71        | 0 ... 65 535                                                                                                                                                                                                                                                                                                                                                                |
| Selection for control of inhibited axes                                        | 72        | <p>0 ≙ no axis inhibited</p> <p>1 ≙ X-        "        "</p> <p>2 ≙ Y-        "        "</p> <p>4 ≙ Z-        "        "</p> <p>8 ≙ IV-       "        "</p> <p>Add input values when inhibiting several axes</p>                                                                                                                                                           |
| Pre-cutout time for tapping cycle (only active with BCD-output of spindle rpm) | 73        | 0 ... 65.535 [s]                                                                                                                                                                                                                                                                                                                                                            |

Kundendienst

| Function                                                                                                                                                                                                                                                                                                                        | Parameter | Input values                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Feed rate override and spindle</p> <p>Feed rate override, if rapid traverse key is pressed in operating mode "Program Run"</p> <p>Feed rate override in 2% stages or variable</p> <p>Feed rate override if Rapid Traverse Key and external directional keys are pressed</p> <p>Spindle override in 2% stages or variable</p> | 74        | <p>0 ≙</p> <p>inactive 1 ≙ active</p> <p>2% stages 2 ≙ variable</p> <p>inactive 4 ≙ active</p> <p>2% stages 8 ≙ variable</p> <p>Add input values for functions requested</p>                                                                           |
| Reference signal evaluation for inhibited axes                                                                                                                                                                                                                                                                                  | 75        | 0 ≙ inactive 1 ≙ active                                                                                                                                                                                                                                |
| <p>Display and transducer supervision</p> <p>Display and transducer supervision for inhibited axes</p> <p>Transducer supervision Input X1</p> <p>X2</p> <p>X3</p> <p>X4</p> <p>X5</p> <p>The switching-off of the transducer supervision is valid for <b>inhibited</b> and for <b>released axes</b></p>                         | 76        | <p>0 ≙</p> <p>switched-off 1 ≙ active</p> <p>active 2 ≙ switched-off</p> <p>active 4 ≙ switched-off</p> <p>active 8 ≙ switched-off</p> <p>active 16 ≙ switched-off</p> <p>active 32 ≙ switched-off</p> <p>Add input values for functions requested</p> |
| PLC program from RAM or from EPROM                                                                                                                                                                                                                                                                                              | 77        | 0 ≙ RAM 1 ≙ EPROM                                                                                                                                                                                                                                      |

**Kundendienst**

| Function                                                                                                                                                                                           | Parameter | Input values                                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|----------------------------------------------------------------------------------------------------------|
| RPM-range gear ratios                                                                                                                                                                              | 0         | 0 ... 99 999.999 [RPM]                                                                                   |
| S-Analog output                                                                                                                                                                                    | 1         |                                                                                                          |
|                                                                                                                                                                                                    | 2         |                                                                                                          |
|                                                                                                                                                                                                    | 3         |                                                                                                          |
|                                                                                                                                                                                                    | 4         |                                                                                                          |
|                                                                                                                                                                                                    | 5         |                                                                                                          |
|                                                                                                                                                                                                    | 6         |                                                                                                          |
|                                                                                                                                                                                                    | 7         |                                                                                                          |
| S-Analog voltage with S-Override at 100 %                                                                                                                                                          | 86        | 0 ... 9.999 [V]                                                                                          |
| S-Analog voltage with S-Override at max. output voltage                                                                                                                                            | 87        |                                                                                                          |
| Limitation of S-Override                                                                                                                                                                           |           | 0 ... 150 [%]                                                                                            |
| Maximum                                                                                                                                                                                            | 88        |                                                                                                          |
| Minimum                                                                                                                                                                                            | 89        |                                                                                                          |
| Axis designation for axis IV                                                                                                                                                                       | 90        | 0 ≐ A, 1 ≐ B, 2 ≐ C angular axis<br>3 ≐ U, 4 ≐ V, 5 ≐ W linear axis                                      |
| Constant contouring speed on external corners                                                                                                                                                      | 91        | 0 ... 179.999 angles in degrees                                                                          |
| Multiple function parameter                                                                                                                                                                        | 92        | 0 ≐                                                                                                      |
| Decimal character                                                                                                                                                                                  |           | — decimal comma 1 ≐ decimal point                                                                        |
| Dialog                                                                                                                                                                                             |           | — first 2 ≐ English                                                                                      |
| Memory test when switching on                                                                                                                                                                      |           | — active 4 ≐ switched-off                                                                                |
| Checksum test when switching on                                                                                                                                                                    |           | — active 8 ≐ switched-off                                                                                |
| Change from program run block sequence to program run single block when processing continuous contours according to counting mode for angular axes (IV and V if they function as position displays |           | — precalculated contour (up to 14 blocks) 16 ≐ current block<br>— ± 29 999.999 [°] 32 ≐ 0 ... 359.999[°] |
|                                                                                                                                                                                                    |           | Add input values for functions requested                                                                 |
| Overlapping with pocket milling                                                                                                                                                                    | 93        | 0.100 ... 1.414                                                                                          |
| PLC: Counter preset value for counters 0 - 15                                                                                                                                                      | 94 to 109 | 0 ... 65 535                                                                                             |

**Kundendienst**

| Function                                                                                                                                     | Parameter        | Input values                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PLC: Timer duration<br>for timer 0 - 15                                                                                                      | 110<br>to<br>125 | 0 ... 65 535<br>(in units of 20 ms)                                                                                                                                                                                                                            |
| PLC: 30 position values for<br>PLC-positioning                                                                                               | 126<br>to<br>156 | -30 000.000 ... +30 000.000 [mm]                                                                                                                                                                                                                               |
| Activation of next tool number or of the<br>following tool magazine number                                                                   | 157              | 0 ≙ No output of next tool number<br>1 ≙ Output only with change of tool number<br>2 ≙ Output of next tool number with every tool call<br>3 ≙ Output of next tool number, programmable with<br>TOOL DEF (if MP 225 > 1)<br>0 ... 65 535 (Marker 2192 ... 2207) |
| Setting of 16 markers to binary number                                                                                                       | 158              | 0 ... 65 535 (in 65 535 µm units)                                                                                                                                                                                                                              |
| Automatic lubrication to programmed X                                                                                                        | 159              |                                                                                                                                                                                                                                                                |
| traversing distance in Y                                                                                                                     | 160              |                                                                                                                                                                                                                                                                |
| Z                                                                                                                                            | 161              |                                                                                                                                                                                                                                                                |
| IV                                                                                                                                           | 162              | 80 ... 15 999 [mm/min.]                                                                                                                                                                                                                                        |
| Feed rate for parameters X                                                                                                                   | 163              |                                                                                                                                                                                                                                                                |
| nos. 126 to 156 Y                                                                                                                            | 164              |                                                                                                                                                                                                                                                                |
| Z                                                                                                                                            | 165              |                                                                                                                                                                                                                                                                |
| IV                                                                                                                                           | 166              |                                                                                                                                                                                                                                                                |
| Display of current feed rate before start in<br>MANUAL (in all axes same feed rate, that means<br>smallest feed rate from parameters 4 to 7) | 167              | 0 ≙ off                      1 ≙ on                                                                                                                                                                                                                            |
| Ramp gradient for S-Analog                                                                                                                   | 168              | 0 ... 1.999 [V/ms]                                                                                                                                                                                                                                             |
| Standstill supervision                                                                                                                       | 169              | 0.001 ... 30 [mm]                                                                                                                                                                                                                                              |
| Programming station                                                                                                                          | 170              | 0 ≙ Control<br>1 ≙ Programming station: PLC active<br>2 ≙ Programming station: PLC inactive                                                                                                                                                                    |
| Handwheel and measuring probe                                                                                                                | 171              | 0 ≙ HR 150/250 TS 511<br>1 ≙ HE 310 TS 511<br>2 ≙ HR 150/250 TS 111<br>3 ≙ HE 310 TS 111                                                                                                                                                                       |

Kundendienst

| Function                                                                                           | Parameter        | Input values                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Polarity of S-Analog voltage                                                                       | 172              | $0 \hat{=}$ M03: positive voltage      M04: negative voltage<br>$1 \hat{=}$ M03: negative voltage      M04: positive voltage<br>$2 \hat{=}$ M03 and M04: positive voltage<br>$3 \hat{=}$ M03 and M04: negative voltage |
| Cancellation of status display with M02; M30 and program end                                       | 173              | $0 \hat{=}$ Status display is not erased<br>$1 \hat{=}$ Status display is erased                                                                                                                                       |
| Trailing error supervision in trailing operation<br>emergency-stop<br>erasable                     | 174<br>175       | $0 \dots 100$ [mm]                                                                                                                                                                                                     |
| Multiplication factor for Kv-factor                                                                | 176              | $0.001 \dots 1.000$                                                                                                                                                                                                    |
| Kv-factor for X                                                                                    | 177              | $0.100 \dots 10.000$                                                                                                                                                                                                   |
| Y                                                                                                  | 178              |                                                                                                                                                                                                                        |
| Z                                                                                                  | 179              |                                                                                                                                                                                                                        |
| IV                                                                                                 | 180              |                                                                                                                                                                                                                        |
| Characteristic kink                                                                                | 181              | $0 \dots 100.000$ [%]                                                                                                                                                                                                  |
| Minimum for feed rate override with tapping                                                        | 182              | $0 \dots 150$ [%]                                                                                                                                                                                                      |
| Maximum for feed rate override with tapping                                                        | 183              | $0 \dots 150$ [%]                                                                                                                                                                                                      |
| Minimum voltage for S-Analog output                                                                | 184              | $0 \dots 9.999$ [V]                                                                                                                                                                                                    |
| Waiting time for cutout of remaining nominal value voltage with error display "Positioning error". | 185              | $0 \dots 65.535$ [s]                                                                                                                                                                                                   |
| Tool change position M 92:                                                                         |                  |                                                                                                                                                                                                                        |
| X-Axis                                                                                             | 186              | $-30\ 000.000 \dots +30\ 000.000$ [mm]                                                                                                                                                                                 |
| Y-Axis                                                                                             | 187              |                                                                                                                                                                                                                        |
| Z-Axis                                                                                             | 188              |                                                                                                                                                                                                                        |
| IV.-Axis                                                                                           | 189              |                                                                                                                                                                                                                        |
| Programming of rpm S = 0 permitted<br>(voltage value of MP 184 may be less)                        | 190              | $0 \hat{=}$ S0 = permitted<br>$1 \hat{=}$ S0 = not permitted                                                                                                                                                           |
| Display of current spindle rpm before spindle start in "Manual mode"                               | 191              | $0 \hat{=}$ off $1 \hat{=}$ on                                                                                                                                                                                         |
| Position window for axis IV                                                                        | 192              | $0.001 \dots 0.5$ [mm or °]                                                                                                                                                                                            |
| PLC: Timer duration for timer 16-31                                                                | 193<br>to<br>208 | $0 \dots 65\ 535$<br>[in units of 20ms]                                                                                                                                                                                |
| Support of PLC-macro commands                                                                      | 209<br>to<br>212 | $0 \dots 65\ 535$                                                                                                                                                                                                      |

Kundendienst

| Function                                                                                                                                             | Parameter | Input values                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------------------------------------------------------------------------------------------------------|
| "Scaling" cycle effective for<br>2 or 3 axes                                                                                                         | 213       | 0 $\hat{=}$ 3 axes (spacial)<br>1 $\hat{=}$ 2 axes (machining plane)                                  |
| Output of M- and T-functions                                                                                                                         | 214       | 0 $\hat{=}$                                                                                           |
| Programmed stop with M06                                                                                                                             |           | — programmed stop<br>1 $\hat{=}$ no programmed stop                                                   |
| Output of M89                                                                                                                                        |           | — normal output at the beginning of the block<br>2 $\hat{=}$ modal cycle call at the end of the block |
| Axis standstill if only one spindle rpm is output<br>with a TOOL CALL                                                                                |           | — Axis standstill<br>4 $\hat{=}$ no axis standstill                                                   |
| Axis standstill with output of an M-function                                                                                                         |           | — Axis standstill<br>8 $\hat{=}$ no axis standstill                                                   |
| <b>Exceptions:</b> The axis stands still with M-functions<br>resulting in a programmed stop (as M00, M02 ...) or<br>with a STOP or a CYCL-CALL block |           | Add input values for functions requested                                                              |
| Touch probe system probing speed                                                                                                                     | 215       | 80 ... 3000 [mm/min]                                                                                  |
| Touch probe system measuring distance                                                                                                                | 216       | 0 ... 19999.999 [mm]                                                                                  |
| Switch-over from HEIDENHAIN-Dialog-Programming<br>to DIN/ISO-Programming                                                                             | 217       | 0 $\hat{=}$ HEIDENHAIN-Dialog<br>1 $\hat{=}$ DIN - ISO                                                |
| "Blockwise Transfer"<br>ASCII-code for data input                                                                                                    | 218       | 0 ... 65 535                                                                                          |
| "Blockwise Transfer"<br>ASCII-code for data output                                                                                                   | 219       | 0 ... 65 535                                                                                          |
| "Blockwise Transfer" ASCII-code<br>for the beginning and the end of the command block                                                                | 220       | 0 ... 12 079                                                                                          |
| "Blockwise Transfer" ASCII-code<br>to repeat transfer correction or block                                                                            | 221       | 0 ... 12 079                                                                                          |
| Data format and transfer stop for data inter-<br>face V.24                                                                                           | 222       | 0 ... 255                                                                                             |
| Operating mode data interface V.24                                                                                                                   | 223       | 0 $\hat{=}$ "Standard data interface"<br>1 $\hat{=}$ "Blockwise Transfer"                             |

Kundendienst

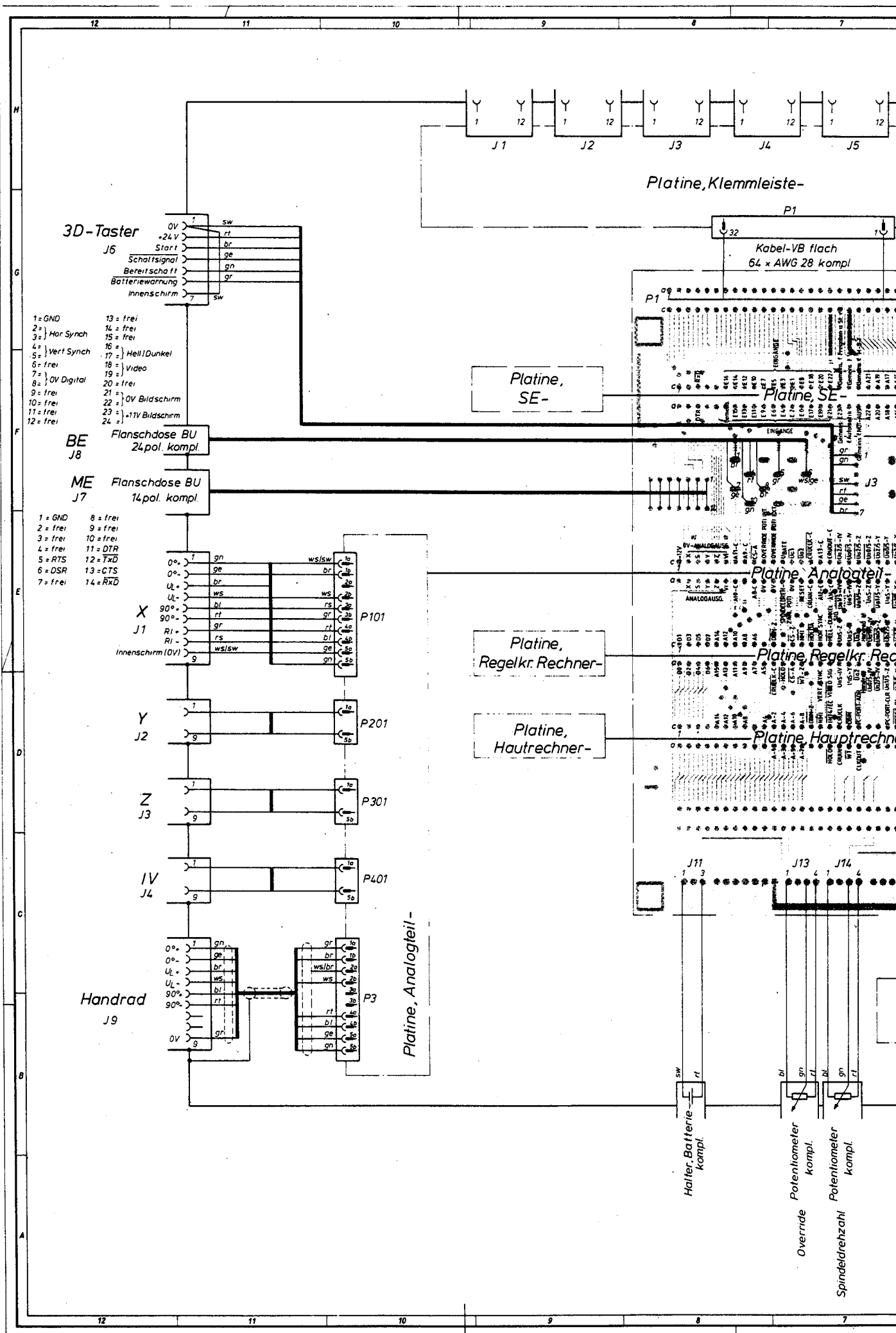
| Function                                                                                                          | Parameter         | Input values                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "Blockwise Transfer"<br>ASCII-code data transfer finished                                                         | 224               | 0 ... 12 079                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Central tool memory                                                                                               | 225               | 0 ^ = no central tool memory<br>1 ... 99 ≐ central tool memory with number of tool stores                                                                                                                                                                                                                                                                                                                                                                             |
| Graphic printout<br>Number of control signs to set the printer inter-<br>face + 1 control sign                    | 226               | 0 ... 65 535                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Graphic printout<br>2 control signs to set the printer interface                                                  | 227<br>228<br>229 | 0 ... 65 535                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Graphic printout number of control signs in front<br>of every printer line + 1 control sign                       | 230               | 0 ... 65 535                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Graphic printout<br>2 control signs in front of every printer line                                                | 231<br>232<br>233 | 0 ... 65 535                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Movement supervision                                                                                              | 234               | 0.03 ... 10 [V]                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Touch probe: Safety clearance over measuring<br>point for automatic measuring                                     | 235               | 0 ... 19 999.999 [mm]                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Graphic<br><br>Representation of graphic in three planes<br><br>Rotating the coordinate system of machining plane | 236               | 0 ≐<br>├ German standard                      1 ≐ American standard<br>└ no rotation                              2 ≐ rotation by 90°<br><br>Add input values for function requested                                                                                                                                                                                                                                                                                  |
| Activation and function of spindle axis                                                                           | 237               | 0 ≐ Spindle axis not active<br>1 ≐ Spindle axis serves to orientate the main spindle<br>without position display<br>2 ≐ as input value 1, with position display, however<br>(is displayed instead of axis IV)<br>3 ≐ Spindle axis is not controlled; the position display,<br>however, is active, axis designation A (is displayed<br>instead of axis IV)<br>4 ≐ as input value 3, axis designation B, however)<br>5 ≐ as input value 3, axis designation C, however) |
| Kv-factor for spindle axis                                                                                        | 238               | 0.100 ... 10.000                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

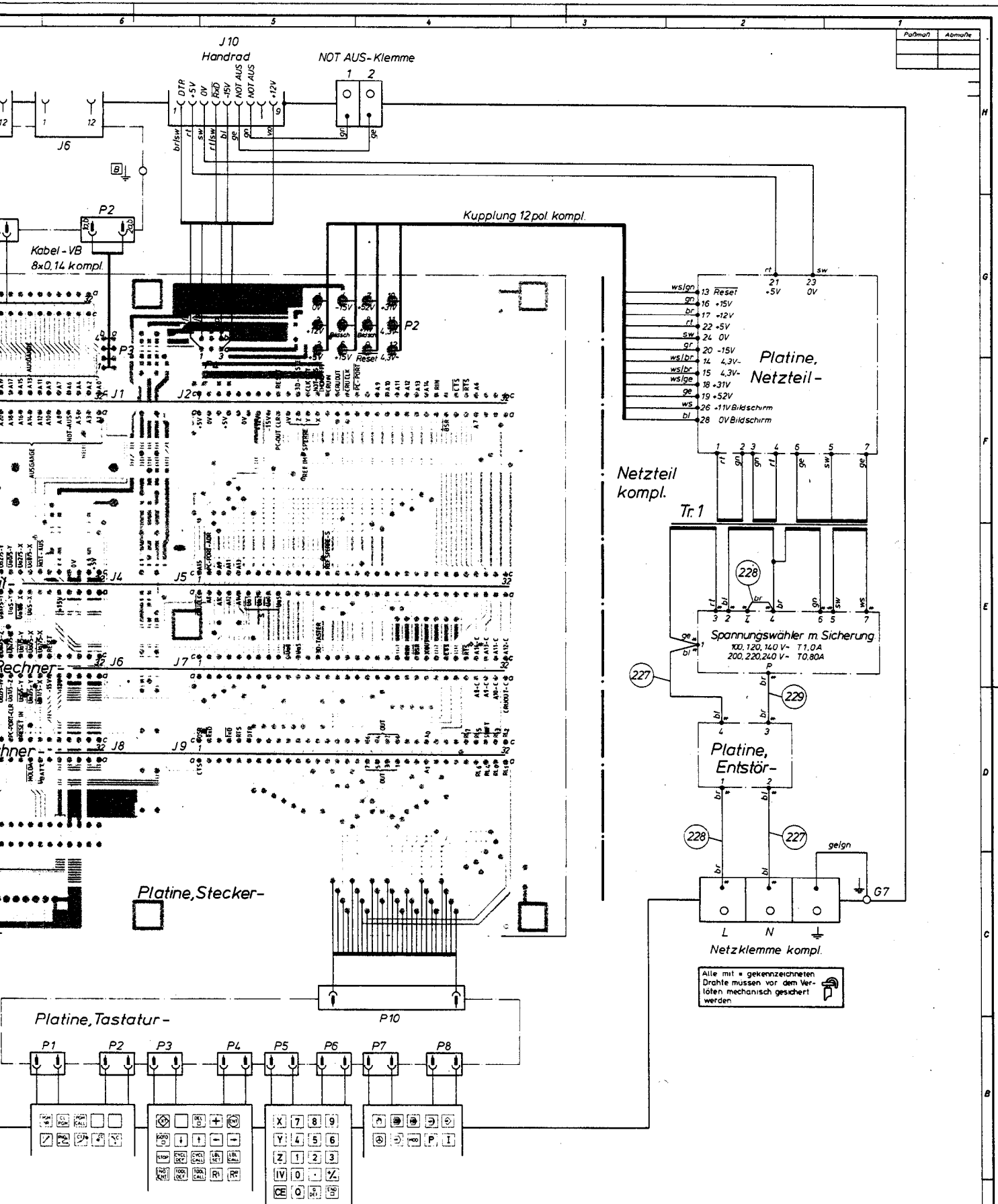
Kundendienst

| Function                                                      | Parameter | Input values                                                                                                                                                            |
|---------------------------------------------------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Counting direction of spindle axis                            | 239       | 0 ≙ positive traversing direction<br>1 ≙ negative traversing direction                                                                                                  |
| Position value of reference mark for spindle axis             | 240       | 0 ... 360 [°]                                                                                                                                                           |
| Cycle to mill pockets with any contour                        | 241       | 0 ≙                                                                                                                                                                     |
| Cycle "Reaming" milling direction to rough out contour        |           | — Roughing out contour pockets counterclockwise;<br>with islands clockwise<br><br>1 ≙ Roughing out the contour with pockets clockwise;<br>with islands counterclockwise |
| Cycle "Reaming" sequence for reaming and roughing out         |           | — Mill channel round the island, then ream the pocket<br><br>2 ≙ Ream pocket first, then mill channel around the contour                                                |
| Combining corrected or uncorrected contours                   |           | — Combining corrected contours<br><br>4 ≙ Combining uncorrected contours                                                                                                |
|                                                               |           | Add input values for functions requested                                                                                                                                |
| Reference mark distance for distance-coded linear transducers |           | 0 ... 65 535                                                                                                                                                            |
| X                                                             | 242       | 0 ≙ no distance-coded reference mark                                                                                                                                    |
| Y                                                             | 243       | Input value for distance-coded reference marks =                                                                                                                        |
| Z                                                             | 244       |                                                                                                                                                                         |
| IV                                                            | 245       | Ref. distance e.g. 20 mm = 1 000<br>grating pitch 20 µm                                                                                                                 |
| Position window for spindle axis                              | 246       | 0 ... 65 535 [Incrementals]                                                                                                                                             |
| Hysteresis for electronic handwheel                           | 247       | 0 ... 65 535 [Incrementals]                                                                                                                                             |
| Spindle rpm for spindle orientation                           | 248       | 0 ... 99 999.999 [U/min]                                                                                                                                                |
| Setting of 16 markers to binary number                        | 249       | 0 ... 65 535 (Marker 2208 to 2223)                                                                                                                                      |
| Setting of 16 markers to binary number                        | 250       | 0 ... 65 535 (Marker 2224 to 2239)                                                                                                                                      |
| Touch probe: rapid traverse to scan                           | 251       | 80 ... 15 999 [mm/min]                                                                                                                                                  |
| Cycle time for automatic offset adjustment                    | 252       | 1 ... 65 535 [in units of 20 ms]<br>0 ≙ no automatic adjustment                                                                                                         |

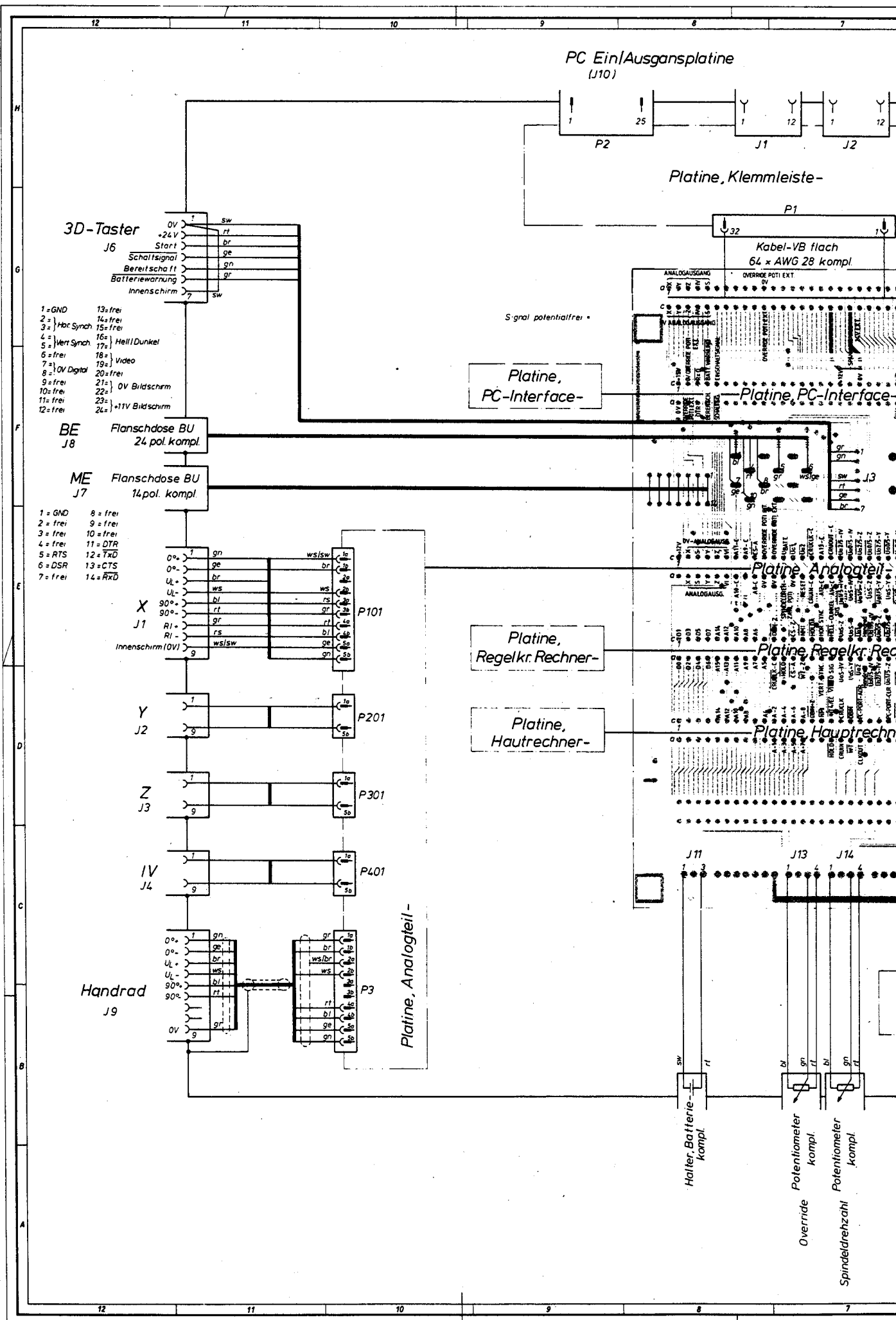
**Kundendienst**

| Function                                                                                                                | Parameter | Input values                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Allocation of the axes to the measuring system inputs:                                                                  | X         | 253                                                                                                                                                                                                                                                                 |
|                                                                                                                         | Y         | 254                                                                                                                                                                                                                                                                 |
|                                                                                                                         | Z         | 255                                                                                                                                                                                                                                                                 |
|                                                                                                                         | IV        | 256                                                                                                                                                                                                                                                                 |
|                                                                                                                         | V         | 257                                                                                                                                                                                                                                                                 |
|                                                                                                                         |           | 0 ≙ X1      1 ≙ Measuring system input: X1<br>0 ≙ X2      2 ≙ Measuring system input: X2<br>0 ≙ X3      3 ≙ Measuring system input: X3<br>0 ≙ X4      4 ≙ Measuring system input: X4<br>0 ≙ X5      5 ≙ Measuring system input: X5<br>Input 0 ≙ Standard allocation |
| Spindle rpm if marker 2501 is set                                                                                       | 258       | 0 ... 99 999.999 [U/min] Direction of rotation always positive                                                                                                                                                                                                      |
| Language conversion for user cycles:<br>Difference between dialog numbers of the second (English) and the first dialog. | 259       | 0 ... 50                                                                                                                                                                                                                                                            |
| without function                                                                                                        | 260       | 0                                                                                                                                                                                                                                                                   |
|                                                                                                                         | 261       | 0                                                                                                                                                                                                                                                                   |
|                                                                                                                         | 262       | 0                                                                                                                                                                                                                                                                   |
| Difference between Q-parameter numbers for "DLG-DEF"-block and "DLG-CALL"-block                                         | 263       | 0 ... 50<br>0 if only "DLG-CALL"-blocks                                                                                                                                                                                                                             |





|                                                      |                 |                                               |                         |
|------------------------------------------------------|-----------------|-----------------------------------------------|-------------------------|
| F21 BA 233 550 --                                    |                 | Code Ch.F. Ident.-Nummer                      |                         |
| Für diese Zeichnung behalten wir uns alle Rechte vor |                 | Tele.-Nummer                                  |                         |
| Maßstab                                              | 1:1             | DR. JOHANNES HEIDENHAIN                       | Ang.-Mittg. Datum Index |
| Gezeichnet                                           | Schell, 16.4.86 | Platz 1, 1986, 15 8076 Technische Zeichnungen | Entwurf                 |
| Geprüft                                              | 16.4.86         | 15 8076 15 8076 15 8076 15 8076               | Einbau                  |
| Gezeichnet                                           | 16.4.86         | 15 8076 15 8076 15 8076 15 8076               | Einbau                  |
| Vedrahtungsplan                                      |                 | 013 AB 232 239 00                             |                         |
|                                                      |                 | Code Ch.F. Ident.-Nummer                      |                         |
|                                                      |                 | Zeichnungs-Nummer                             |                         |



PC Ein/Ausgangsplatine  
(J10)

Platine, Klemmleiste-

P1  
Kabel-VB flach  
64 x AWG 28 kompl.

Platine,  
PC-Interface-

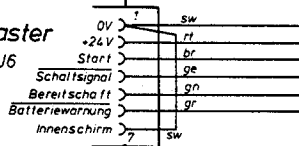
Platine, PC-Interface-

Platine,  
Regelkr. Rechner-

Platine,  
Hauptrechner-

Platine, Analogteil-

3D-Taster  
J6



- 1 = GND
- 2 = Hor. Synch
- 3 = Vert. Synch
- 4 = Vert. Synch
- 5 = frei
- 6 = frei
- 7 = 0V Digital
- 8 = frei
- 9 = frei
- 10 = frei
- 11 = frei
- 12 = frei
- 13 = frei
- 14 = frei
- 15 = frei
- 16 = Hell/Dunkel
- 17 = Video
- 18 = 0V Bildschirm
- 19 = 0V Bildschirm
- 20 = frei
- 21 = 0V Bildschirm
- 22 = 0V Bildschirm
- 23 = 0V Bildschirm
- 24 = 0V Bildschirm

BE J8 Flanschdose BU 24 pol. kompl.

ME J7 Flanschdose BU 14 pol. kompl.

- 1 = GND
- 2 = frei
- 3 = frei
- 4 = frei
- 5 = RTS
- 6 = DSR
- 7 = frei
- 8 = frei
- 9 = frei
- 10 = frei
- 11 = DTR
- 12 = Tx/D
- 13 = CTS
- 14 = Rx/D

X J1

Y J2

Z J3

IV J4

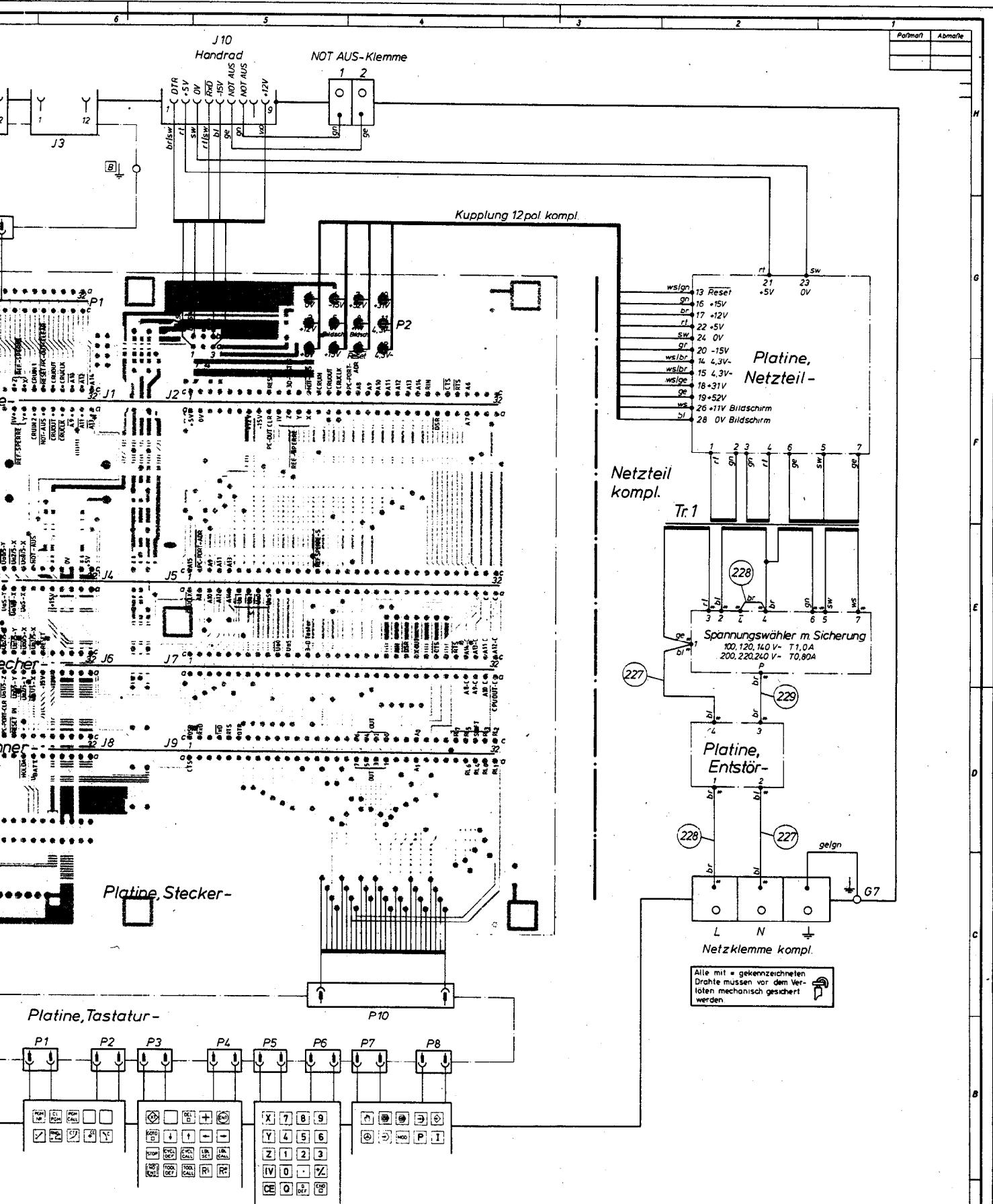
Handrad  
J9

Halter Batterie kompl.

Potentiometer kompl.

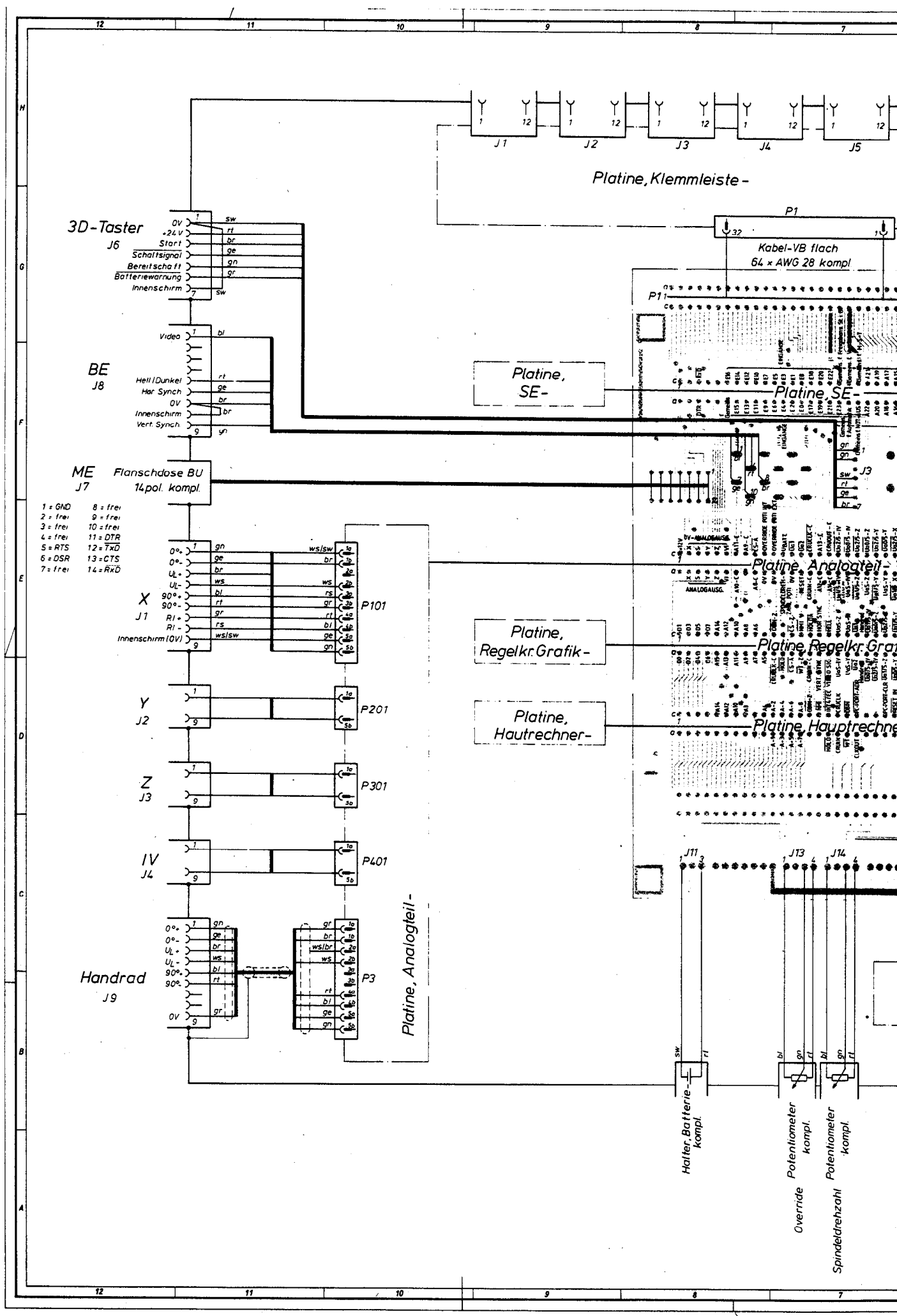
Potentiometer kompl.

Spindeldrehzahl



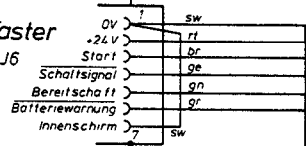
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|-----------------------------------------------------|--|----------------------|--|---------------|--|
| F21 BA 233 551                                      |  | Code Ch.F.           |  | Ident.-Nummer |  |
| Für diese Zeichnung behalten wir uns die Rechte vor |  |                      |  |               |  |
| Hofstabs                                            |  | Name                 |  | Datum         |  |
| DR. JOHANNES HEIDENHAIN                             |  | Technische Zeichnung |  | 16.4.88       |  |
| And. -Menge                                         |  | Datum                |  | Index         |  |
| 013 AB 232 240 00                                   |  | Code Ch.F.           |  | Ident.-Nummer |  |
| Zeichnungs-Nummer                                   |  | 170 AD 206 148 01    |  |               |  |

Vedrahtungsplan



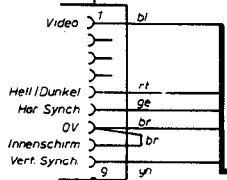
3D-Taster

J6



BE

J8



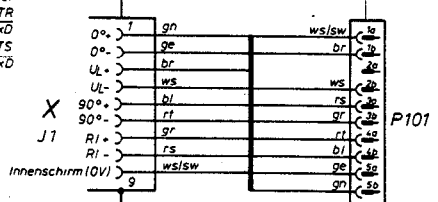
ME

Flanschdose BU  
J7  
14 pol. kompl.

- 1 = GND
- 2 = frei
- 3 = frei
- 4 = frei
- 5 = RTS
- 6 = DSR
- 7 = frei
- 8 = frei
- 9 = frei
- 10 = frei
- 11 = DTR
- 12 = TxD
- 13 = CTS
- 14 = RxD

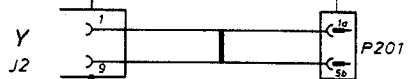
X

J1



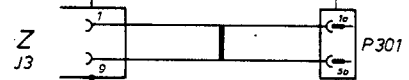
Y

J2



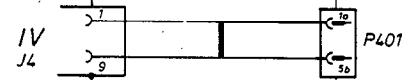
Z

J3



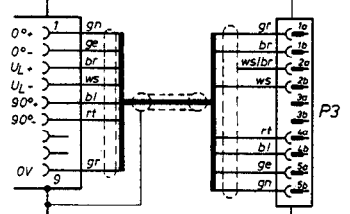
IV

J4



Handrad

J9



Platine, Analogteil -

Platine,  
Regelkr. Grafik -

Platine,  
Hautrechner -

Platine, Klemmleiste -

Platine,  
SE -

Platine, Analogteil

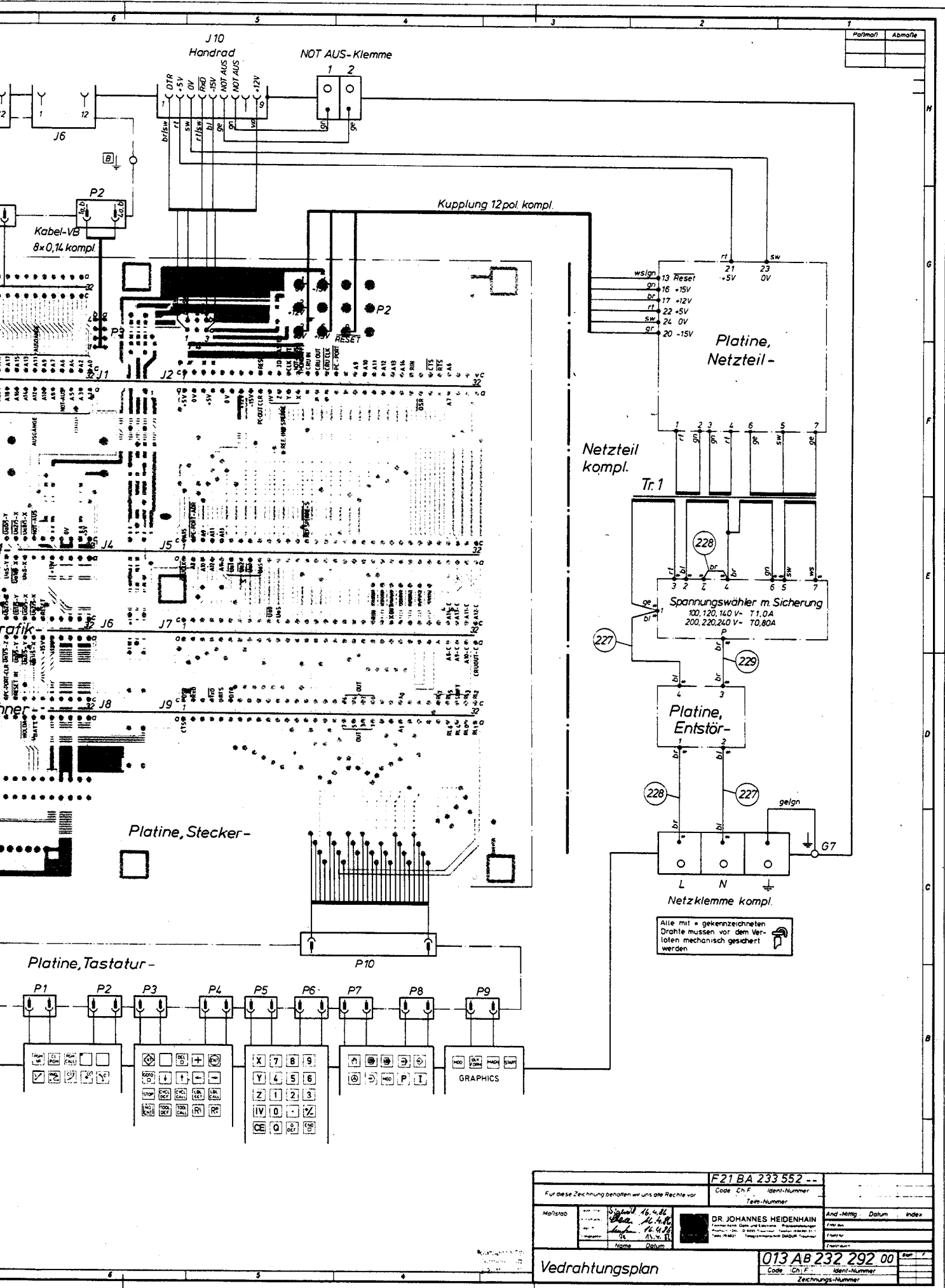
Platine, Regelkr. Grafik

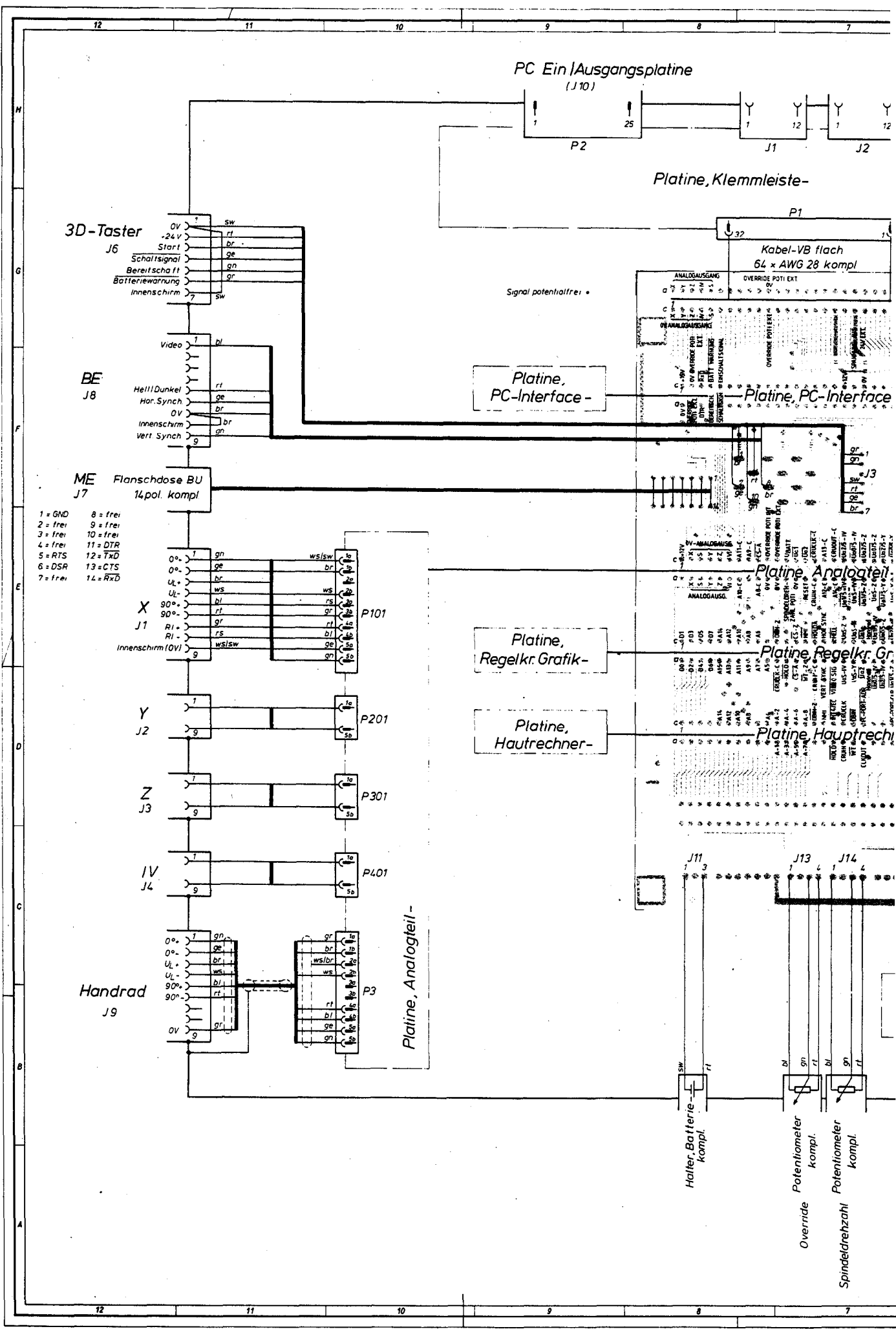
Platine, Hautrechner

Halter, Batterie  
kompl.

Potentiometer  
kompl.  
Override

Potentiometer  
kompl.  
Spindel-drehzahl





PC Ein/Ausgangsplatine  
(J10)

Platine, Klemmleiste-

3D-Taster  
J6

BE  
J8

ME Flanschdose BU  
J7  
14 pol. kompl.

- 1 = GND
- 2 = frei
- 3 = frei
- 4 = frei
- 5 = RTS
- 6 = DSR
- 7 = frei
- 8 = frei
- 9 = frei
- 10 = frei
- 11 = DTR
- 12 = TxD
- 13 = CTS
- 14 = RxD

X  
J1

Y  
J2

Z  
J3

IV  
J4

Handrad  
J9

Platine,  
PC-Interface -

Platine,  
Regelkr. Grafik -

Platine,  
Hautrechner -

Platine, Analogteil -

Platine, Regelkr. Gr

Platine, Hauptrechner

Platine, Analogteil -

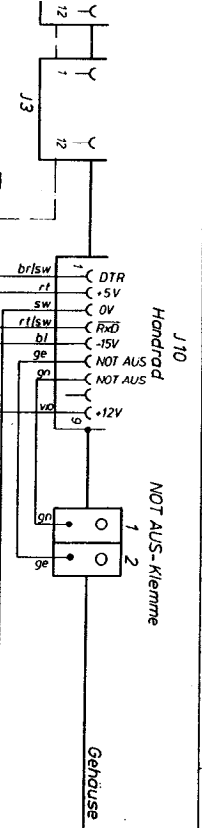
Halter, Batterie  
kompl.

Potentiometer  
kompl.

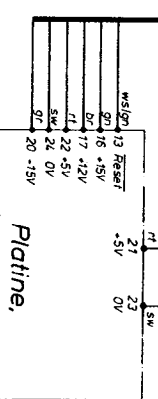
Override

Potentiometer  
kompl.

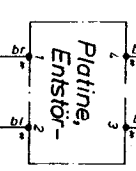
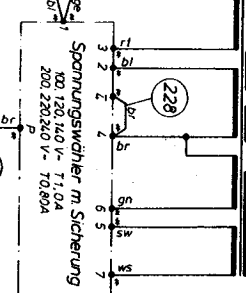
Spindel drehzahl



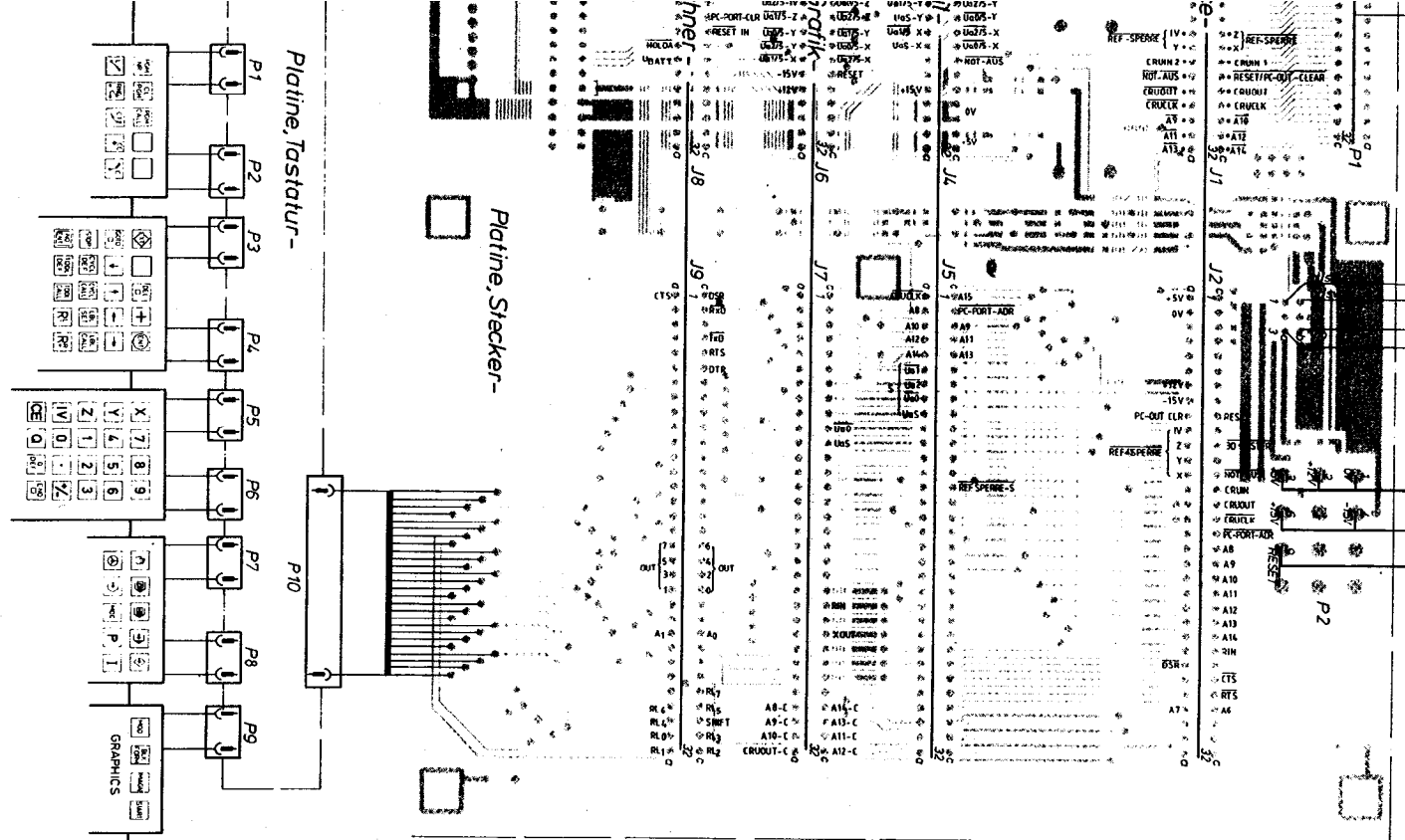
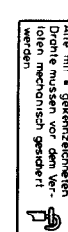
Kupplung 12pol kompl



Netzteil kompl. T1



Netzklammer kompl.



|                   |              |
|-------------------|--------------|
| F21 BA 233 553    |              |
| Code C11          | Ident-Nummer |
| F21 BA 233 293 00 |              |
| Code C11          | Ident-Nummer |