Service-Instructions
HEIDENHAIN TNC 145
Contouring Control

DR. JOHANNES HEIDENHAIN
Feinmechanik, Optik und Elektronik · Präzisionsteilungen
Postfach 1260 · D-8225 Traunreut · Telefon (08669) 31-1
Telex 56831 · Telegrammanschrift DIADUR Traunreut

Customer Service

KD·G·007·01/83 · Printed in West Germany

CONTENTS

GENERAL REMARKS (PAGES 1 - 2) 21.10.82

Subject to Change (without notice)

HEIDENHAIN is constantly working on further developments of its TNC-controls. It is therefore possible that details of a certain control may differ slightly to the control version which is being described herein. For this reason it may be necessary to request an updated service manual from us.

Note

The TNC 145 contains sub-assemblies with CMOS elements. Although MOS IC's 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:

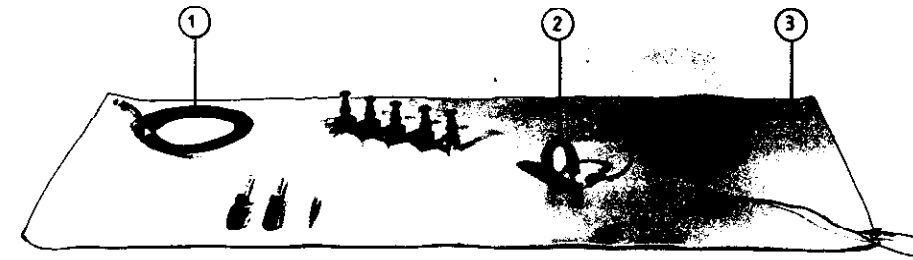
Prior to working with CMOS components or with assemblies packed with CMOS elements, all table coverings, all operated instruments or tools, as well the work personnel, must be properly grounded.

A portable "MOS-HANDLING-SET" for field service is necessary when exchanging the operating software and/or servicing the TNC 145:

1) a cable that equalizes potential differences between conductive work surface and ground

2) a wristband that provides an electrical connection between person and conductive work surface

3) a conductive work surface



TECHNICAL SPECIFICATIONS (PAGES 1 - 4) 21.10.82

Work shop programmable 3-axis continuous path control with 2 1/2 D circular path and straight cut interpolation

KEY BOARD ENTRY

for - numerical values
- operation mode
- continuous path function
- program and edit functions

DISPLAY

- 9 inch VDU with max. 14 x 32 characters for displaying plain language dialogue, error messages and the machine program

- Flourescent-displays for the momentary positioning X, Y and Z
7 1/2 decades with polarity sign character height 12.3 mm

- Fluourescent displays for the input value
7 1/2 decades with polarity symbol character height 6,5 mm

INPUT COMMAND UNIT

- with position values in the Cartesian coordinate system to 0.001 mm (0.0001 in.)

- with input in the polar coordinates:
polar radius to 0.001 mm (0.0001 in.)
polar angle to 0.001°

DISPLAY STEP

- for momentary positioning 0.001 mm (0.0001 in.)
or 0.005 mm (0.0002 in.)

PROGRAM MEMORY

- buffered semiconductor for max. 1000 program statements

PROTECTION SUPERVISION

The control checks the function of its important electronic sub-assemblies as well as the positioning system, the transducer system, the spindel stand still, and the EMERGENCY-OFF circuit. In case of failure a plain language dialogue error message is issued and the machine is electrically disconnected by the EMERGENCY-OFF

REFERENCE MARK EVALUATION

After a mains power interruption, automatic regeneration of datum value by traversing over the transducer system reference marks

TRANSDUCER SYSTEM INPUTS

Connectable measuring systems

- incremental HEIDENHAIN length measure systems with 20 µm grid constants without built-in impulse former stage
(ex LS 703, LS 903)

- incremental HEIDENHAIN rotary encoder with 18000 grid marks
(ex ROD 250, ROD 700)

- electronic handwheel
(ex HR 150, HR 250)

Maximum cable length between measuring system/ electronic handwheel and control: 20 m

CONTROL-INPUTS

Potential free, switched together opto-couplers in one group

operating voltage	max. 30 V (filtered)
opto-coupler switched	_ 15 V
opto-coupler open	_ 8 V

Protection resistor (SKS 2) of 5.1 KOhm in every input line.

CONTROL RELAY OUTPUTS

Potential-free, relay contacts (switched in groupes)

operating voltage	max. 30-V min., 15-V max.
operating current per contact	max. 50 mA
permitted load	- resistive load - inductive load; only with quenching diode parallel to inductivity

To prevent welding of contacts in the event of short circuiting, every contact is provided with a current limiting resistor of 47 Ohms/5 Watt in series

INTENDED VALUE OUTPUTS

X : ± 10 V
Y : ± 10 V
Z : ± 10 V

loading capacity of the voltage source
$R_{min.}$ = 2 KOhm
$C_{max.}$ = 4.7 nF
max. allowed procedural speed: 10 m/min.

EXTERN DATA INPUT/OUTPUT

RS232C compatible data input and output
selectable data transmission speed:
110, 150, 300, 600, 1200, 2400

DIRECT VOLTAGE OUTPUT

+ 15 V
+ 12 V (for extern feed potentiometer)

EXTERN DIRECT VOLTAGE

max. 30 V (filtered)
min. 15 V (filtered)

LINE VOLTAGE

switchable 100/120/140/200/220/240 V
(+ 10 % - 15 %)

LINE FREQUENCY

48 ... 62 Hz

LINE FUSING

with 100/120/140 V : T 1,0 A
with 200/220/240 V : T 0,8 A

POWER CONSUMPTION

max 60 W ± 5 W

BATTERY VOLTAGE

4.6 V ± 0.2 V

BATTERY CURRENT CONSUMPTION

max. 220 µA
typ. 30 µA with the unit in the OFF position

AMBIENT TEMPERATURE

Operating: 0 ... + 45 °C

Storage: - 30 ... + 70 °C

DIMENSIONS

TNC 145	281 mm x 274 mm x 272 mm
VDU	281 mm x 190 mm x 249 mm

WEIGHT

TNC 145	11.2 kg
VDU	6.8 kg

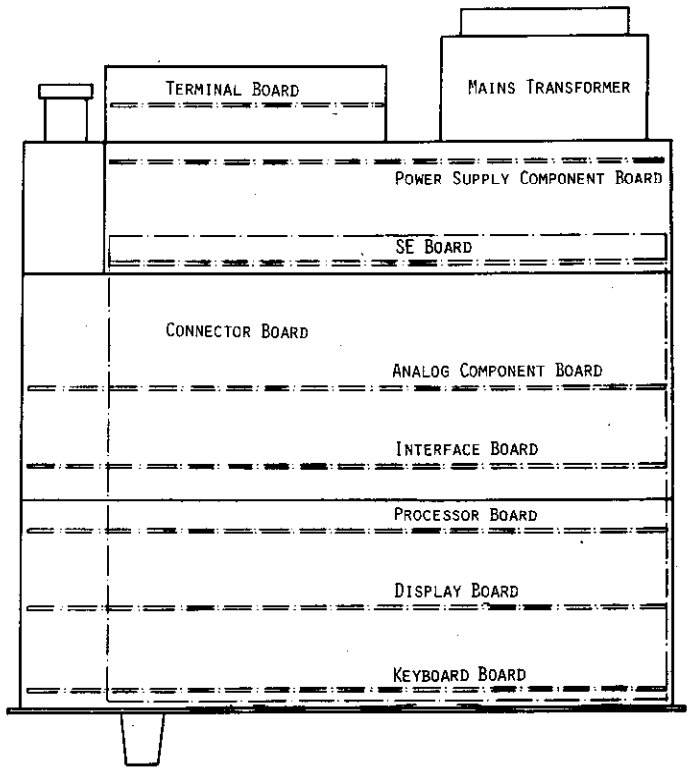
BRIEF DESCRIPTION OF THE TNC 145 (PAGES 1 - 10) 21.10.82

1. Board arrangement

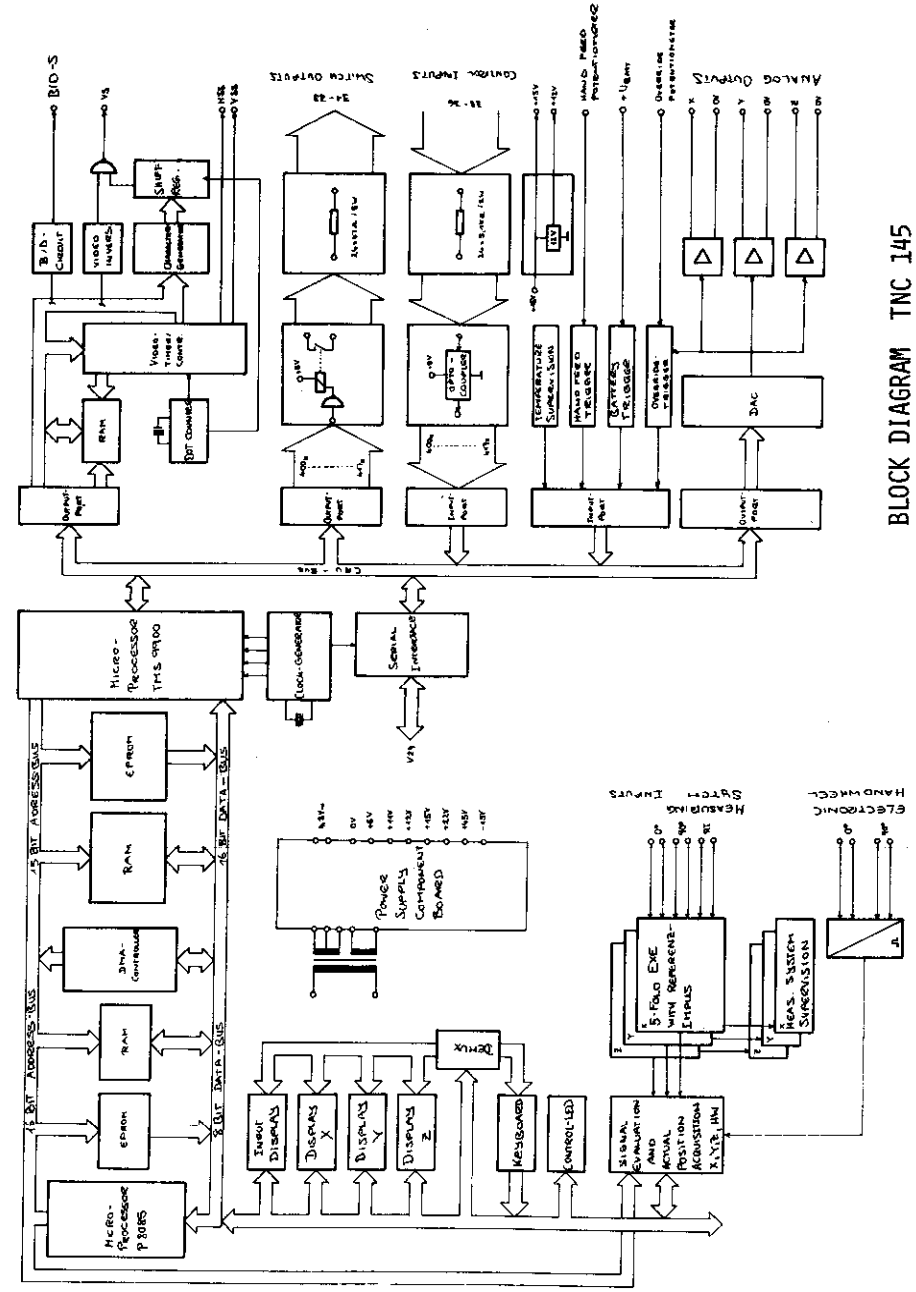
The single function sub-assemblies of the TNC 145 are found on the following 8 boards:

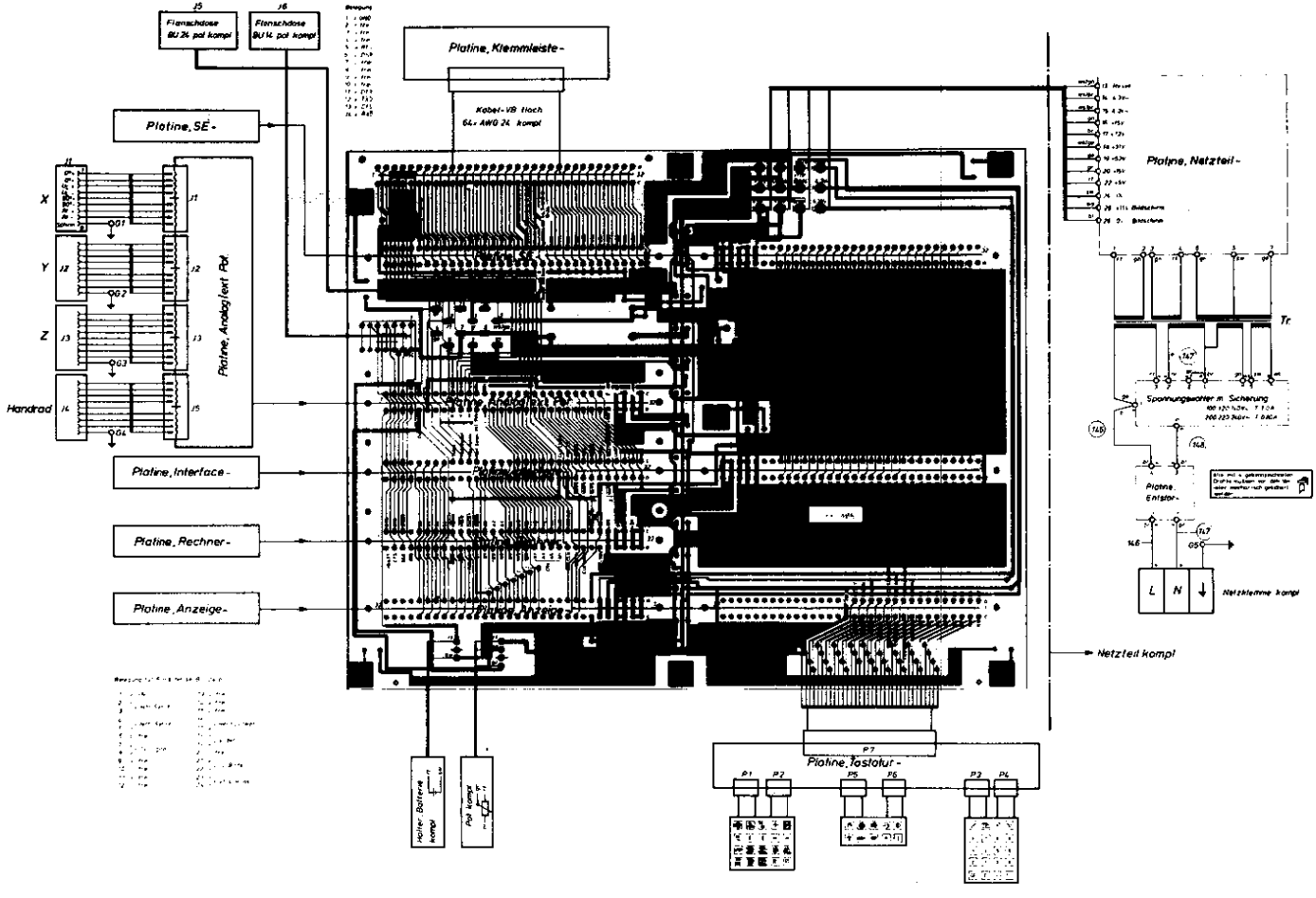
- Power supply component board
- Processor board
- Display board
- Keyboard board
- Analog component board
- Interface board
- SE board
- Terminal board

which are connected together by the Connector board



BLOCK DIAGRAM TNC 145




J5
Flanschdose
BU 24 pol kompl
J6
Flanschdose
BU 14 pol kompl
Platine, Klemmleiste -
Kabel-VB flach
64 x AWG 24 kompl
Platine, SE -
Platine, Analogtest Pot
X
Y
Z
Handrad
Platine, Interface -
Platine, Rechner -
Platine, Anzeige -
Platine, Netzteil -
Tr
Spannungswähler m. Schirmung
Platine Entstör -
L
N
Netzklemme kompl
Netzteil kompl
Platine, Testsatz -
Halter Batterie kompl
Pot kompl

3. Power supply component board

The power supply component board of the TNC 145 consists of

- Line anti-interference board
- Line voltage selector with built-in fusing
- Safety transformer in accordance with VDE 0551
- Power supply board

The output voltages of the power supply are produced by switching and series regulators that are constantly monitored for over and under voltages. These output voltages are protected against overloading.

The following voltages are produced:

Alternating voltage (AC)	Direct voltage (DC)
4.2 V	+ 5 V + 11 V + 12 V + 15 V - 15 V + 22 V + 45 V

4. Processor board

The processor board contains

a 16-bit CPU consisting of:

- 16-bit microprocessor TMS 9900
- 24K x 16 read-only-memory (12 EPROMs) to store the operating software (for the TMS 9900 microprocessor)
- 6K x 16 read buffered write memory (6 RAMs) to store the user program (max. 1000 statements) and data that is necessary for program execution
- 2K x 16 unbuffered read/write memory (2 RAMs) used as work space for the TMS 9900 microprocessor thereof 64 words (64 bytes) reserved for the data exchange process DMA (Direct Memory Access) between both microcomputer systems

the serial interface for extern data input/output follows RS232C norm

5. Display Board

The display board includes

an 8-bit microcomputer system consisting of:

- 8-bit microprocessor P 8085
- 4K x 8 read only memory (1 EPROM) for storage of the operating system for the 8085 microprocessor
- 1K x 8 read/write memory (2 RAMs) unbuffered used as work space for the P 8085 microprocessor and for data exchanging between the two microcomputer systems using the DMA process
- DMA controller P 8257 for controlling the data exchanging between both microcomputer systems TMS 9900 and P 8085

the control for

- keyboard scanning
- control LED output
- input display
- actual positions of the 3 axis X, Y and Z

the display for

- input values
- actual positions of the 3 axis X, Y and Z

6. Keyboard Board

On the keyboard there are 6 connectors of the 3 keying-fields which are merged onto a 34-pole connector.

Extern keyboard

- 20 keys for input values of the contouring function
- 20 keys for programming and editing functions
- 10 keys for operating modes

Also found on the keyboard board

the control LEDs for the

- axis keys
- operating mode keys
- radius correction keys

7. Analog Component Board

The analog component board includes

the analog-input part consists of

- 5-fold EXE with difference line receivers, with hysteresis and cable termination in accordance with EIA RS422 for the 3 axis X, Y and Z
- a reference impulse decoding for the 3 axis X, Y, Z
- a measuring system supervision for the 3 axis X, Y, Z
- an input for symmetrical analog and for digital signals with invertation for the connection of an electronic handwheel

Comparator stage

- the integrated override potentiometer
- an external hand feed potentiometer

Supervision circuit for the

- battery voltage
- internal temperature of the control

The analog output component consists of

- a 12 bit digital to analog converter DAC with extern voltage reference source and reference voltage amplifier
- a current-to-voltage converter for converting the output current of the DAC to a voltage
- a sample-and-hold amplifier and an output amplifier for the 3 analog outputs X, Y and Z

8. Interface Board

The interface board contains

the count impulse preperation of the 3 axis X, Y, Z and the electronic handwheel by means of a direction discriminator with 4-fold evaluation, with X, Y and Z (2-fold or 1-fold evaluation can be achieved by opening PC board paths and inserting bridges)

the actual position of the axis X, Y and Z and the handwheel through the timer IC

the reference impulse evaluation fo the axis X, Y and Z

the input/output port area with

- 24 input ports for the control input
- 24 output ports for the control switch outputs

the VDU control by means of the

- video timer/controller IC TMS 9927
- 1K x 8 RAM for 448 characters
- character generator (EPROM) for the generation of the required dialogue characters

  Field dimensions: 8 x 16 point matrix
  Character dimensions: 5 x 10 point matrix

9. SE-Board

To be found on the SE board

- the potential free, in one group switched together opto-couplers with protection circuit and driver circuit for the 24 control inputs

- the relays with their in together switched groups potential free contacts and the driver stage for the driving of the relays

10. Terminal Board

The terminal board contains:

the terminal strips and protection resistors (5.1 KOhm, 2 W) for the control inputs

the terminal strips and protection resitors (42 Ohm, 5 W) tor the control switch outputs

the terminal strip for the analog outputs X, Y and Z, the + 15 DC voltage output and for the connection of an extern feed potentiometer

a 12 V voltage regulator for providing the extern feed potentiometer

the filter circuit for the analog outputs X, Y, Z and + 15 V

ERROR LOCALIZING CONTROL/MACHINE (PAGES 1 - 6) 21.10.82

It is of great importance for the error localizing of the control/machine when the failure of the total system is analized. Only then can the failure be efficiently localized.

Supporting the fail diagnostics

- a supervision system contained in the control (see 4.0, 4.1)
- a "BURN-IN-TEST" program (see point 5)
- the following check list for failure localizing control/machine (see 4.1)

1. Check list for failure localizing control/machine

1.1 Checks before machine switch-on

Check setting of the mains power switch and TNC-mains fuses for 100/120/140 V - fuse T 1,0 A for 200/220/240 V - fuse T 0,8 A	○

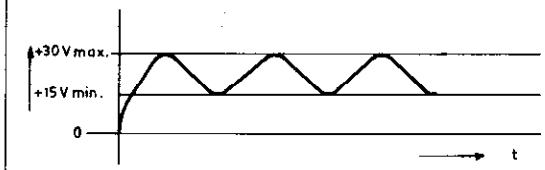
Controls of the measuring system	○
Disconnect the cable on the control The transducer connectors (connector housing) must have a conductive connection to the machine via the outer shielding of the cable and via the scanning heads.	
a) the connection exists with the X-axis	○
b) the connection exists with the Y-axis	○
c) the connection exists with the Z-axis	○
The inner shield (pin 9) of the transducer connector must not have a conductive connection to the connector housing	
a) no connection with the X-axis	○
b) no connection with the Y-axis	○
c) no connection with the Z-axis	○

All remaining transducer connector pins must have no conductive connection with pin 9 or connector housing	
a) no connection with the X-axis	○
b) no connection with the Y-axis	○
c) no connection with the Z-axis	○

Controls of the terminal strip connections	○
a) examine all cables on the connectors J1 and J6 for possible loose connections	○
b) control the wiring according to plan: "Layout of connector" (see 6.2)	○
c) the inputs of the servo-amplifiers must be directly connected to the appropriate analog output of the TNC 145 via shielded cables (intermediate resistors etc. are not permitted)	○

Controls of the OV-line and their respective groundings	○
The OV return line of the external 24 V auxiliary voltage must be grounded to the common earthpoint of the adapter cabinet	○
The OV connections of the servo-inputs must be grounded at the common earthing point of the servo-amplifiers (connections at J4, pins 2 / 4 / 6)	○

1.2 Controls after switching on the adapter cabinet

Measure external DC volatage Does the voltage meet the specified requirements?  	○
Examine the function of EMERGENCY-STOP limit.	○

1.3 Controls before the switching on of the TNC 145

Remove the battery from the TNC and measure its voltage: $U_{BATT} \geq 3.6$ V	○
Measure battery current: I_{BATT} = 30 µA typ (200 µA max.)	○

1.4 Controls after the switching on of the TNC 145

Fault/error indication

The TNC 145 possesses an extensive monitoring system for prevention of entry and operating errors and for diagnosis of technical defects within the control/machine system.

The following is under supervision

Programing and operating failure
e.g. error indication

BUTTON NON-FUNCTIONAL
CIRCLE END POS. INCORRECT
ENTRY VALUE INCORRECT

Internal control electronics
e.g. error indication

TNC-ELECTRONICS DEFECTIVE
TNC-OPERATING TEMPERATUR EXCEEDED
EXCHANGE BUFFER BATTERY

Certain machine funcions
e.g. error indication

GROSS POSITIONING ERROR
X-MEASURING SYSTEM DEFECTIVE
RELAY EXT. DC VOLTAGE MISSING

Cancellation of error messages

The control is locked as long as an error message is displayed and further operations can only then be carried out when the error message is cancelled.

The TNC 145 control distinguishes between 2 groups of error messages:

- Minor faults/errors
  e.g. BUTTON NON-FUNCTIONAL
  Errors such as these are displayed as non-flashing and can be cancelled by pressing the CE key

- Major faults/errors
  such as malfunctioning of measuring systems, drives and failures in control electronics.

  This simultaneously activates an automatic machine switch-off via the EMERGENGY STOP contact of the control.

  These faults/errors are indicated by a flashing signal and can only be cancelled by switching off the mains power and rectify the fault.

Fault indication "EXCHANGE BUFFER BATTERY"

If the dialogue display indicates "EXCHANGE BUFFER BATTERY", new batteries must be inserted (discharged batteries retain the program content for at least 1 week). The buffer battery compartment is located beneath the PG-screw-cap in the lower left-hand corner of the operating panel (see section C). When exchanging the batteries, special care should be taken that the polarity is correct (POS-pole of battery outwards).

The batteries to be used have IEC designation "LR 6" and must be of the leak-proof type. We especially recommend the use of Mallory-Alkali batteries type "MN 1500".

With discharged (or missing) buffer batteries, the program memory is supplied by the mains power supply. Continuation of operation is still possible, however, the memory content will become erased in the event of a mains power failure.

If a mains power failure occurs during a battery change (discharge on missing batteries) a new entry of the machine parameters is necessary.

Test control functions

Switch on TNC 145 as described in the Operating Instructions Manual	◯
If required, program machine parameters (see Operating Manual)	◯
Traverse reference mark of X-axis	◯
Traverse reference mark of Y-axis	◯
Traverse reference mark of Z-axis	◯
Test keyboards	◯
Do the values entered via the 10 key keyboard correspond with the entry display?	◯
Are the values transferred correctly into the position display of the respective axis by pressing the axis key X, Y or Z and ENT ?	◯

Check the transducer inputs and counting function

Monitoring of measuring systems

If the error indication in the dialog display of the VDU is flashing:

"X-MEASURING SYSTEM DEFECTIVE"

after X-axis is disconnected?

"Y-MEASURING SYSTEM DEFECTIVE"

after Y-axis is disconnected?

"Z-MEASURING SYSTEM DEFECTIVE"

after Z-axis is disconnected?

In case of one axis not counting: Find the source of error on meas.system/control by replacing the connection cables of meas.system and traversing of the respective machine axis by hand.

Test control function

Enter the following test program into the control and run program without workpiece

```
1  X + 100,000  RO F 9999 M
2  X +   0,000  RO F 9999 M
3  X - 100,000  RO F 9999 M
4  Y + 100,000  RO F 9999 M
5  Y +   0,000  RO F 9999 M
6  Y - 100,000  RO F 9999 M
7  Z + 100,000  RO F 9999 M
8  Z +   0,000  RO F 9999 M
9  Z - 100,000  RO F 9999 M
```

BURN-IN-TEST TNC 145 (PAGES 1 - 13) 01.06.83

The BURN-IN-TEST is a program used to dynamically test the hardware of the TNC 145.
Duration testing as well as error diagnostics is also possible.

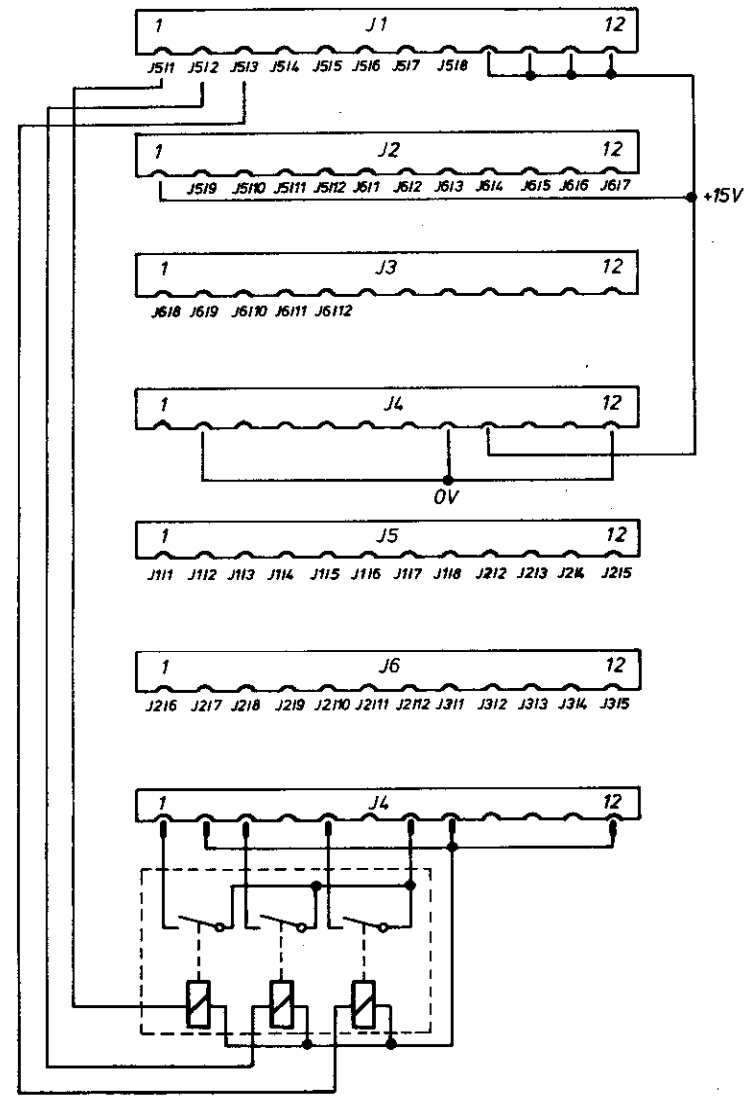
The BURN-IN-TEST program is stored on a cassette and can be read into the control via the magnetic tape unit (ME 101/ME 102).

In order to BURN-IN-TEST a "BURN-IN-TEST set" is required.

The BURN-IN-TEST set for the TNC 145 consists of:

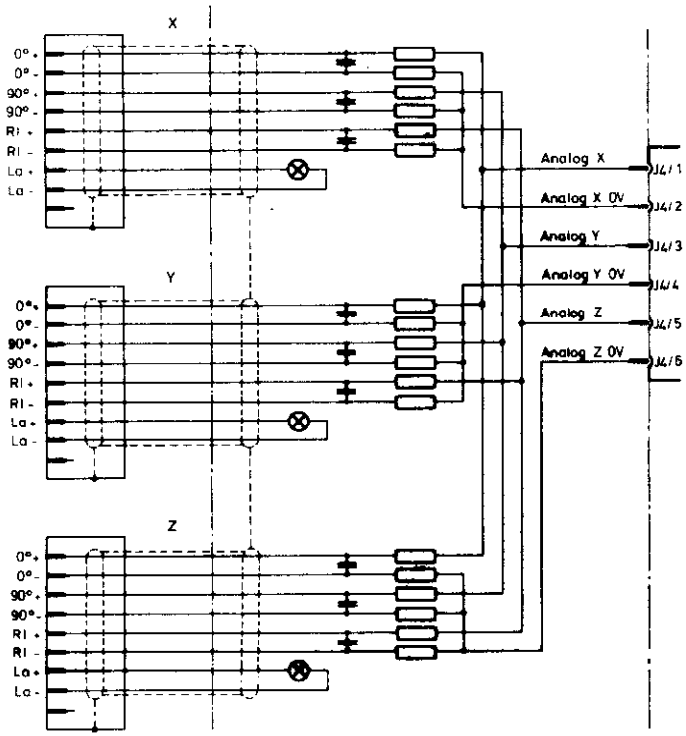
Designation	Ident-Number	Remarks
BURN-IN-Adapter TNC 145	221 006 ZY	see Dia 1a, b
V.24 Test connector	218 954 01	see Dia 2
BURN-IN-Test program	212 946 01	for TNC 145 (217 330 --, 219 064 --) with program variation 06
BURN-IN-Test program	212 944 01	for TNC 145 (219 065 --) with program variation 06
BURN-IN-Test program	212 946 03	for TNC 145 (217 330 --, 219 064 --) from programm variation 07
BURN-IN-Test program	212 944 04	for TNC 145 (219 065 --) from program variation 07
BURN-IN-Test program	212 950 01	for TNC 145 (217 330 --, 219 064 --) from program variation ... ... 07 Test-Dialogue: English
BURN-IN-Test program	212 949 01	for TNC 145 (219 065 --) from program-variation ... ... 07 Test-Dialogue: English
BURN-IN-Test program	212 952 01	for TNC 145 CS (221 201 --) to program-variation ... ... 03 Test-Dialogue: German
BURN-IN-Test program	212 953 01	for TNC 145 CS (221 201 --) to programm-variation ... ... 03 Test-Dialogue: English
BURN-IN-Test program	212 952 02	for TNC 145 CS (221 201 --) from program-variation ... ... 04 Test-Dialogue: German
BURN-IN-Test program	212 953 02	for TNC 145 CS (221 201 --) from program-variation ... ... 04 Test-Dialogue: English

Dia.1a: Test connector for the terminal-board



Dia. 1b: Test connector for transducer inputs

Connector 9-pole Wiring on terminal strip board



Cable LiYCY 2 x 2 x 0,14 Id.-No. 363 NE 200 854 01

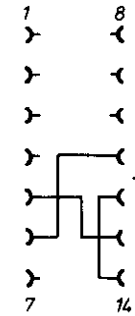
Resistance R = 18 x 130 KOhm Id.-No. 470 NE 200 909 47

Capacitors C = 9 x 1000 pF Id.-No. 471 NE 200 751 35
F21 BA 217 004 --

Dia. 2: Test connector V.24 interface (external data input/output)

SE-outputs (14-pole Amphenol connector)

$\overline{DTR}$	11	- 6	$\overline{DSR}$
$\overline{RTS}$	5	- 13	$\overline{CTS}$
$\overline{TxD}$	12	- 14	RxD



BURN-IN-TEST PROGRAM FOR TESTING THE COMPLETE CONTROL

Note:
When testing with BURN-IN-TEST programs the control must be completely separated from the machine for reasons of safety.
e.g. EMERGENGY-STOP, STOP etc. are inoperative

1. Connections

Connect the VDU with the control and the BURN-IN-TEST adapter (dia. 1a, b) to the terminal strip board and 3 transducer inputs X, Y, Z

2. Reading-in of the program

Test programs can be read into the control memory without having previously stored the machine parameters.

Connect the ME with TNC, insert the "BURN-IN-TEST" program cassette and then switch-on mains power.

Further Instructions	VDU display
press the following keys on the ME	
STOP TNC -/0	POWER INTERRUPTED
press the following keys on the TNC	
4 6 8 0 ENT	POWER INTERRUPTED
	EXTERNAL DATA-INPUT

After reading in the test program into the RAM (approx. 2 min.), the inputted data is examined with a check sum test
If error(s) occur, the dialog will display — REREAD-IN PROGRAM / CHECK-SUM-FAILURE

If the data is read correctly, the axis display will display the number: -8888.8888 and in the input display the number: -88888.888
All LEDs are on
Visual Disply unit displays: — KEYBOARD TEST / ADJUST OVERRIDE-POTI: %

The BURN-IN-TEST adapter is now connected in place of the ME connection on the control.

3. Keyboard Test

3.1 Adjustment of the override-potentiometer
The override-potentiometer is to be adjusted to the value of 100 ± 1%. The LED ⊳ is off when the 100 % value is reached.

3.2 Keyboard

The keyboard is tested by pressing the single keys in the correct sequence.

keyboard 1

first ↗ then ↻ ↺ ↖
first X then 7 8 9
first Y then 4 5 6
first Z then 1 2 3
first CE then 0 . +/-

keyboard 2

first EXT then CL PGM DEL C + ENT
first GO TO then ↑ ↓ ← →
first STOP then EXCL DEF CYCL CALL LBL SET LBL CALL
first INSERT then TOOL DEF TOOL CALL R+ R-

keyboard 3

first ⟲ then ⊞ ⊟ ⊡ ⊠
first ⊛ then MOD REF P I

With each correct pressing of a key a "*" will be displayed on the VDU.
If a failure occurs (e.g. key not functional, incorrect keying sequence) the error indication "KEYBOARD FAILURE" will appear on the VDU and after approx. 1 sec. a jump will be made to the beginning of the tests.

If more than one wrong key is pressed in succession a message "KEYBOARD FAILURE" will be displayed until all false keys have been eliminated.

4. 7-Segment Display Test

After a failure free keyboard test has been completed the test for the LEDs axis and input display is immediately begon.

VDU display: TEST 7-SEGMENT-DISPLAY
BURN IN TIME: XXXX,X STD

The BURN-IN-TEST time is set to 0 and displayed in the VDU (Display step 0.1 hours)

Test run: Axis display (X, Y, Z)	Input display	LED
0.000	00000.000	STiB
11111.111	1.1111111	X
22222.222	22.222222	Y
33333.333	333.33333	Z
44444.444	4444.4444	
55555.555	55555.555	
66666.666	666666.66	
77777.777	7777777.7	
88888.888	888888.88	
99999.999	999999.99	I
12345.678	12345.678	P
-11111.111	-1.1111111	REF
-22222.222	-22.222222	INCH
-33333.333	-333.33333	
-44444.444	-4444.4444	R
-55555.555	-55555.555	R
-66666.666	-666666.66	STiB
-77777.777	-7777777.7	X
-88888.888	-88888.888	Y
-99999.999	-99999.999	Z
-12345.678	-12345.678	all except INCH
-88888.888	-88888.888	all LED's until begin of cyclic tests

This display test is not initiated in further cyclic runs but can be called back at any time using the [60/10] key

5. Cyclic Tests

- EPROM TEST CPU-BOARD
  CHECK-SUM-TEST
  5 address areas

0000H	1FFEH	(Q18 + Q17)
2000H	3FFEH	(Q14 + Q13)
4000H	5FFEH	(Q10 + Q 9)
6000H	7FFEH	(Q 6 + Q 5)
8000H	BFFEG	(Q3 + Q2, Q4 + Q1)

- EPROM TEST DISPLAY BOARD
  CHECK-SUM-TEST

- RAM-TEST CPU-BOARD
  Address range COOOH to FFFEH
  Address failure is displayed on the VDU

- RAM-TEST DISPLAY BOARD
  Address range: 2000H to 23FFH

- EPROM-TEST CPU-BOARD "CS/CR"
  CHECK-SUM-TEST and
  IDENTIFICATION-DIGIT-TEST
  8 address areas

0000H → 1FFFH	Q21		
2000H → 3FFFH	Q33		
4000H → 5FFFH	Q14	Map	Bit 0
6000H → 7FFFH	Q28	Map	Bit 0
8000H → 9FFFH	Q9	Map	Bit 0
4000H → 5FFFH	Q15	Map	Bit 1
6000H → 7FFFH	Q6	Map	Bit 1
8000H → 9FFFH	Q10	Map	Bit 1

- TIMER TEST

- TEST MANUAL-FEED, ANALOG-OUTPUT and output-port X, Y, Z release

  On account of the output ports X, Y, Z release by the output ports X, Y, Z release, whose outputs are each connected with the feed input for testing purposes (dia 1 a)
  3 different test voltages are used: 200 mV, 5 V, 9.5 V

- Test input/output ports, monoflop time
  (connection input/output ports with test connector dia 1a)

- TEST V.24-INTERFACE

- Test battery-trigger and temperature switch
  TEMPERATURE SWITCH ADDRESSED

- ADJUST OVERRIDE POTI: ...%
  Adjustment in order by 100 ± 1 %

- TEST SUPERVISION CIRCUIT

- TEST REFERENCE PULSE INPUT
  START/STOP-FLIPFLOP

- TEST TRANSDUCER INPUTS, EXE
  COUNTING DIRECTION INVERTED

If no error is detected the tests will begin from the start and run until the program is interrupted. A test run is of approx. 2 minutes duration
All LEDs must light during a cyclic test run
(exception RAM and EPROM test see 10.a)

6. Error recognition

If a failure is detected, an appropriate VDU message will be displayed.
The cyclic test run is interrupted and the BURN-IN-TEST time will be stopped.
The axis display and the INCH LED will blink.

The test cycle can be restarted with the pressing of the GO TO key whereby the error message will be memorized.
The error message can be called up and displayed on the VDU by pressing the CL PGM and ENT

The error message can be cancelled and the cyclic tests can be restarted by pressing the DEL key.

7. Stopping the program

The program can be stopped using the CL PGM and the VDU will display

POWER INTERRUPTED
NEW OPERATING MODE?

The display test will start from the beginning if this message is answered with the ENT key

8. Keyboard test restart

The override potentiometer can be correctly adjusted by pressing the CYCL CALL in which case the keyboard test is initiated. This results in the setting back of the BURN-IN-TEST time and concelling the error message.

9. Interrupting the BURN-IN-TESTS

The test can at any time be interrupted by switching-off the mains power.
This, however, does not apply for the processor board RAM tests.
A new test run for the 7-segment display can be initiated by again switching on the mains power and pressing the ENT key

A keyboard test must first of all be absolved if not completed before the mains power was interrupted.

An eventual error message and the BURN-IN-TEST time are not lost through a mains power interruption.

A rereading-in of the test program is required if on the VDU a message appears:

REREAD-IN PROGRAM
CHECK-SUM-FAILURE

A mains power interruption occured in this case during the RAM tests.

10. Operation without VDU

The mains power can be switched-off and the VDU disconnected after the keyboard test has been completed. The rerunning of the tests is described in point 9.

If the 7-segment display test does not begin immediately, an error has been detected or the keyboard test has not been completed.

In order for the reason to be found the mains power has to be interrupted and the VDU has to be reconnected

4 different conditions can be recognized without a VDU

a) The LEDs for the X, Y and Z axis are off during the RAM and EPROM tests. During this time the mains power should not be interrupted

b) If a CHECK-SUM-TEST failure occurs (e.g. mains power interruption during the RAM test) several LEDs and the X, Y, Z axis display will blink. The test program has to be reread into the memory in this case.

c) With an override potentiometer error the LED row MANUAL, MANUAL POSITIONING, SINGLE BLOCK, AUTOMATIC PROGRAM ENTER will blink in addition to the INCH LED.

Through adjustment of the override potentiometer and cancelling of the error message a new test run can be initiated.

Note: It is of prime importance to cancel an error message after a failure has been remedied or else a further error is not memorized should a mains power interruption occur.

d) With a battery trigger failure the LED's R1 and R2 will blink in addition to the INCH LED.

11. Jumping back to the control main program (Operating program)

Note: The BURN-IN-TEST program after completion for reasons of safety has to be erased from the control memory before connection is made to the machine.

A BURN-IN-TEST program that is in the control memory is recognized by the following dialogue on the VDU when switching the mains power off and on.

POWER INTERRUPTED
NEW OPERATING MODE?

Jumping back into the main program is accomplished by pressing the RESET key.

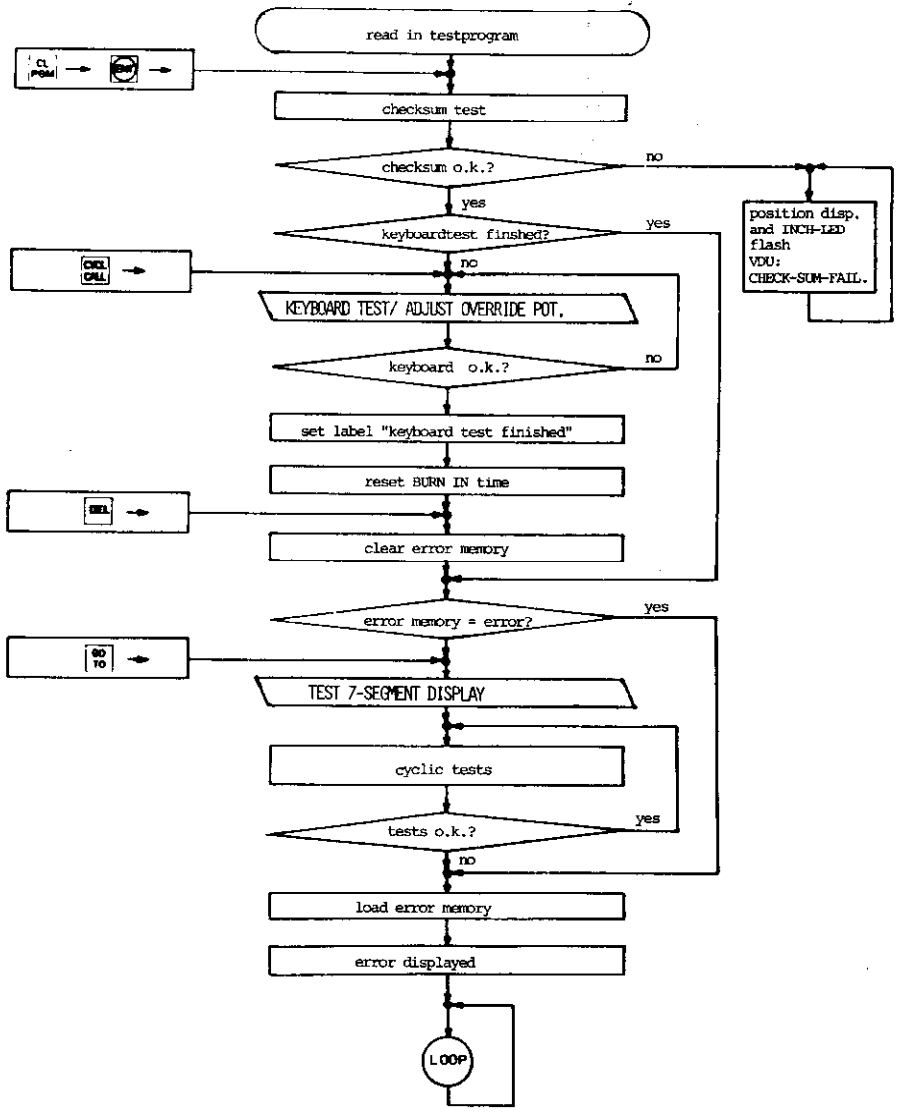
The test program is thereby erased and control is given back to the main program. The following dialog will appear on the VDU.

POWER INTERRUPTED

Jumping back into the control main program during a current test run can be accomplished by pressing the CL PGM and RESET in which case further dialogue appears.

press CL PGM key	VDU display	POWER INTERRUPTED NEW OPERATING MODE?
press RESET key	VDU display	POWER INTERRUPTED

12. Flow-chart BURN-IN PROGRAM



EXCHANGING THE CONTROL (PAGES 1 - 4) 01.02.83

1. General remarks

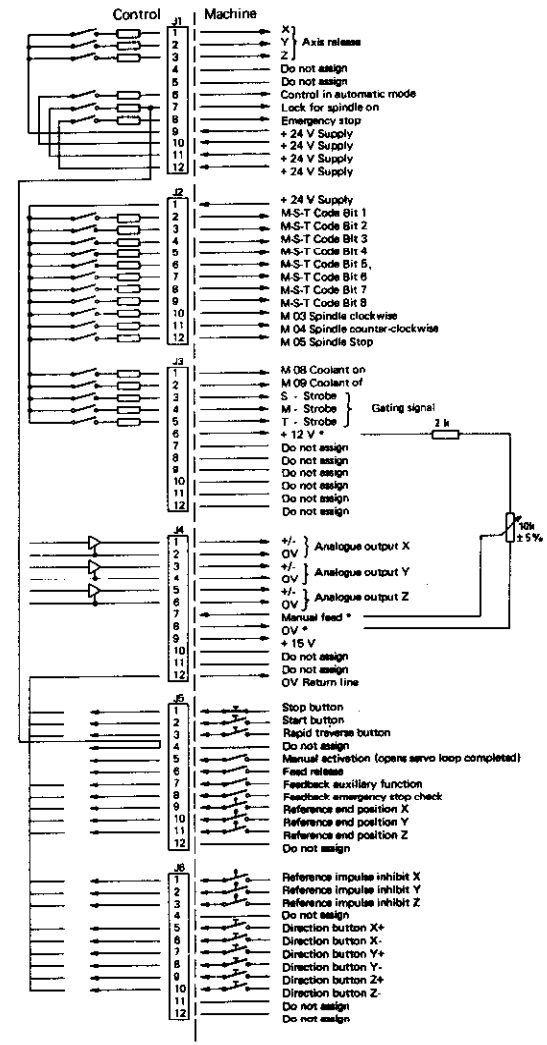
Note: Several inputs/outputs from the control TNC 145 can only be connected to circuits which have voltages produced according to VDE 5.73 § 8.

- Do not disconnect or connect plugs under power

- NC machines also need protection and safety installations as required for manually operated machines (e.g. EMERGENCY OFF)

  The function is to be checked upon commencement of operation

2. Layout of multipoint terminals



*The assignment of these terminals is not permitted with TNC 145-Control Ident.No. 217 330 ..

3. Checklist for exchanging the TNC 145 control

Note: Before exchanging the control note the machine parameters

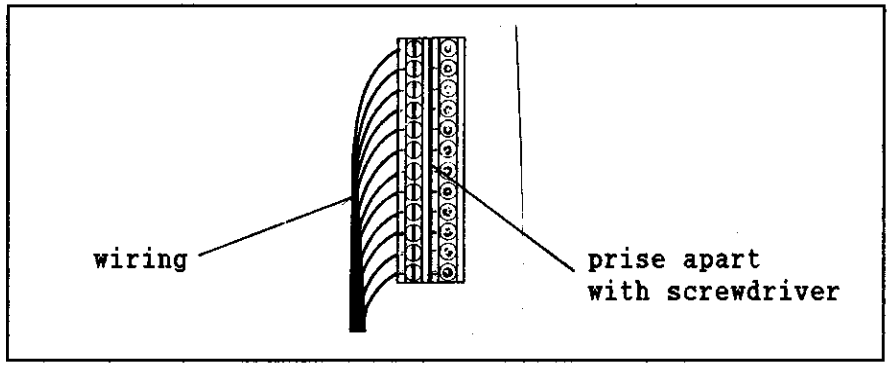
1. Switch-off mains power
2. Remove clamping bolt of the control
3. Demount TNC carefully from the machine console
4. Disconnect mains power to the TNC
5. Disconnect the transducers. Label the X, Y, Z axis
6. If an electronic handwheel is present disconnect it
7. Remove the cover of the connecting cabinet
8. Pull off connectors J1 to J6 to the left of the connector terminal
9. Disconnect VDU
10. If ME is present disconnect it
11. Mains power selector switch in the correct position
    Check line voltage
12. Check mains power fusing 100 ... 140 V: 1,0 A
    200 ... 240 V: 0,8 A
13. Check program number
14. If necessary remove the cooling slot cover
    splashwater-proof in accordance with IP 54.
15. Connect connectors J1 to J6
16. Secure the cover of the connecting cabinet
17. Connect the VDU
18. Secure the axis transducers connector,
    note X, Y, Z
19. If the eletronic handwheel is present connect it
20. If required connect the ME
21. Connect mains power, observe grounding conductor
22. Carefully mount and secure the TNC, observe the cables
23. Reprogram the machine parameters
24. Supervise the TNC with the machine

HEIDENHAIN
DR. JOHANNES HEIDENHAIN GmbH
D-8225 Traunreut · Tel. (08669) 31-0

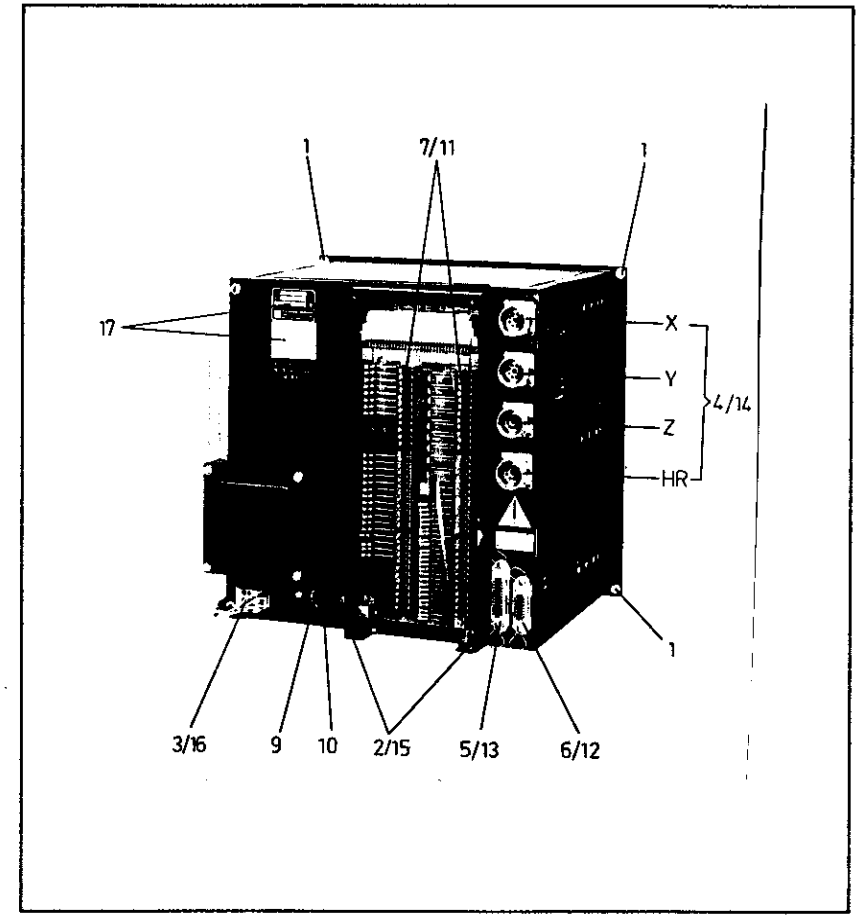
Kundendienst

Checklist for exchanging the control

1. Unscrew the 4 mounting screws from the front plate and remove TNC from machine.
2. Disconnect mains supply.
3. Unscrew the 4 cover plate screws at the rear of the control and remove cover.
4. Mark the transducer plugs (X,Y,Z) electronic handwheel and disconnect.
5. Disconnect the VDU (Visual Display Unit).
6. Disconnect peripheral units (if present).
7. Disconnect connecter strips J1-J6 using a screwdriver to prise apart (Do not unscrew and remove the individual wires).



8. Exchange the control.
9. Install new control ensuring the mains voltage selector switch is in the correct position.
10. Ensure that the correct fuse is inserted.
11. Reconnect connector strips J1-J6.
12. Reconnect peripheral unit (if present).
13. Reconnect VDU.
14. Reconnect transducer plugs (oberving the markings)
15. Mount and secure the rear cover.
16. Reconnect mains supply.
17. Note data on type plate and enter in machine manual.
18. Before switching on control remove batteries for approx. 1 min.
19. Re-insert batteries and switch on mains.
20. Re-enter the machine parameters.
21. TNC is now ready for operation.

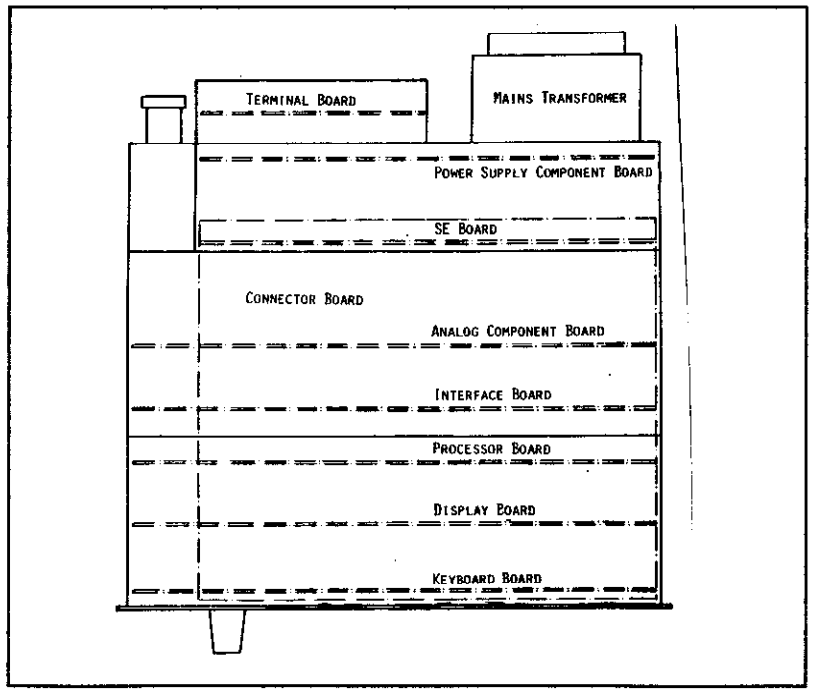


Exchanging Boards

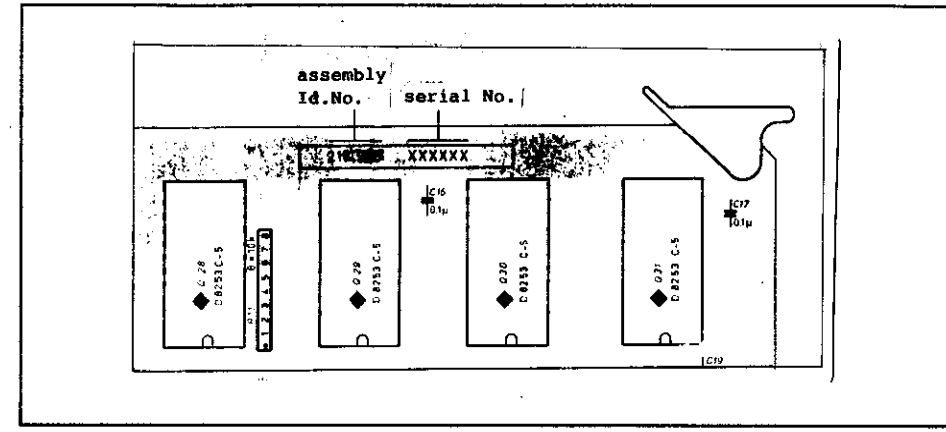
Board arrangement

Mechanically the TNC 145/145 C
consists of 3 sections:

1. Control front plate with fixed mounted Keyboard.
2. Control housing with fixed Connector Board and 5 plugable board assemblies:
   - .Display Board
   - .Processor Board
   - .Interface Board
   - .Analog Board
   - .SE Board
3. Control backplate with fixed mounted Power Supply Unit.



Caution:
- Please observe MOS protection measures when exchanging boards!
- Only exchange boards with the same ident numbers (id.no.)
- The id.no. is stamped on every board to the left of the serial no.



Replacement Assemblies TNC 145/TNC 145 C

Unit	Id.No.
TNC 145 ST	219 065 ..
TNC 145 RT	219 546 ..
TNC 145 CS/GS	221 201 ..
TNC 145 CR/GR	221 683 ..
Visual Display Unit (VDU) BE 111	212 300 03

Assembly	Id.No.
Connector Brd.	217 912 01
Keyboard Brd.	217 913 01
Display Brd.	217 902 01
Processor Brd.	217 916 01
Processor Brd. "C"-version	220 928 01
Interface Brd.	221 624 01
Analog Brd.	221 622 01
Square-Wave Input Brd.	221 635 01
SE Brd.	217 909 01
Power Supply Unit (housing back plate with Power Supply Unit and Terminal Brd.)	219 873 01

Work area requirements

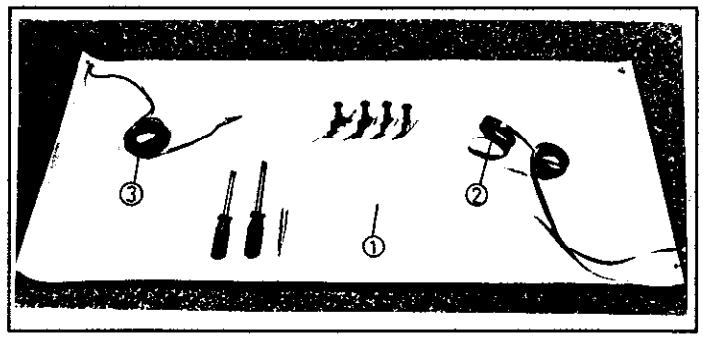
The TNC 145 contains sub-assemblies with MOS elements. Although MOS ICs are equipped with an input protection diode network to eliminate the build-up of static charges, care must be taken when handling these elements.
The following reqiurements in the work area must be met: Prior to working with MOS 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 TNC 145:

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



EXCHANGING THE OPERATING PROGRAM (Pages 1 - 5) 21.10.82

1. General

The operating system software is stored in 13 EPROMS consisting of:

- 12 EPROMS on the processor board (IC-P1...IC-PC):
  for the TMS 9900 microprocessor operating software

- 1 EPROM on the display board (IC-PD):
  for the P8085 microprocessor operating software

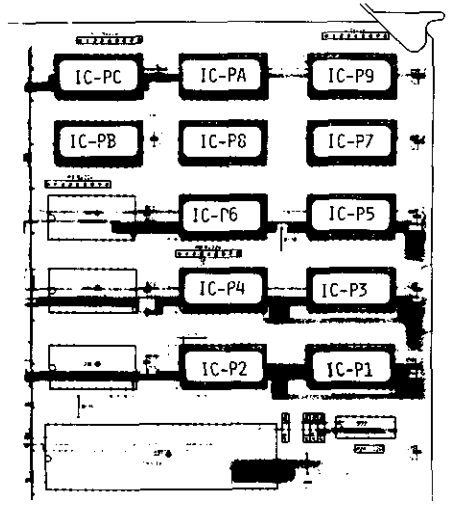
Every program has an 8-digit program indentification number and consists of 13 EPROMS with every chip having an 8 digit program indentification number.

The second to last digit position of the 8 digit IC program indentification number gives the location of the IC to be found on both the processor board and the display board:

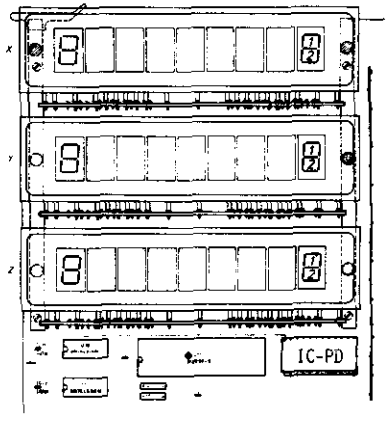
xxx xxx 1x	IC-P1	Processor board
xxx xxx 2x	IC-P2	
xxx xxx 3x	IC-P3	
xxx xxx 4x	IC-P4	
xxx xxx 5x	IC-P5	
xxx xxx 6x	IC-P6	
xxx xxx 7x	IC-P7	
xxx xxx 8x	IC-P8	
xxx xxx 9x	IC-P9	
xxx xxx Ax	IC-PA	
xxx xxx Bx	IC-PB	
xxx xxx Cx	IC-PC	
xxx xxx Dx	IC-PD	Display board

(refer dia. 7.2 arrangement of EPROMS on boards)

2. Arrangement of EPROMS on the boards



Processor board



Display board

EXCHANGING THE OPERATING PROGRAM

1.1 General

The operating system software is stored in 9 EPROMS consisting of:

- 8 EPROMS (IC-P1...IC-P8) on the processor board 220 928 --:
  for the TMS 9995 microprocessor operating software

- 1 EPROM (IC-PD) on the display board 217 902 --:
  for the P8085 microprocessor operating software

Every program has an 8-digit program indentification number and consists of 9 EPROMS with every chip having an 8 digit program indentification number.

The second to last digit position of the 8 digit IC program indentification number gives the location of the IC to be found on both the processor board and the display board:

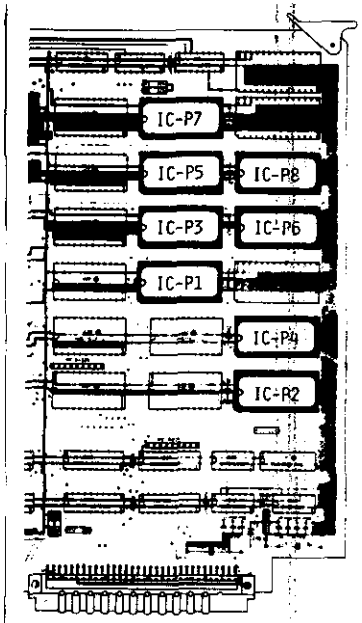
xxx xxx 1x	IC-P1	Processor board (220 928 --)
xxx xxx 2x	IC-P2	
xxx xxx 3x	IC-P3	
xxx xxx 4x	IC-P4	
xxx xxx 5x	IC-P5	
xxx xxx 6x	IC-P6	
xxx xxx 7x	IC-P7	
xxx xxx 8x	IC-P8	
xxx xxx Dx	IC-PD	Display board (217 902 --)

(refer dia. 2.1 arrangement of EPROMS on boards)

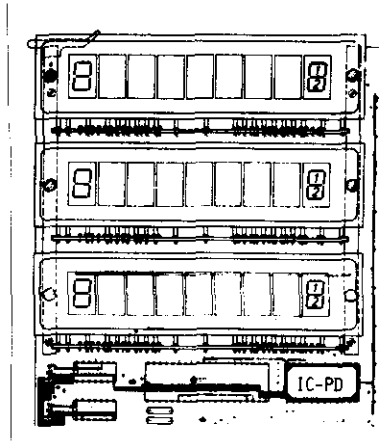
2.1 Arrangement of EPROMS on the boards

Program for "C"-Version

Attention: Arrangement and number of the EPROMs on the processor boards 217 916 -- (TNC 145 S/R) and 220 928 -- (TNC 145 CS/CR) are different!



Processor board
(220 928 --)



Display board
(217 902 --)

3. Exchanging the program IC's

3.1 Opening the TNC 145

After the necessary CMOS protection measures have been met can both of the fastening screws of the control plate be removed.

3.2 Removing the display and processor board

The processor and display boards are to removed when exchanging the operating system. Thereto press both board locking clamps of the respective board outwards, and pull the board from the top.

Exchanging of the program can begin after the board has been placed on the MOS protection mat.

3.3 Exchange

Required tools: IC removal/insertion tool small screwdriver
- Position IC removal tool over EPROM and tighten
- Push the blade of the screw driver between the EPROM and socket, lift EPROM
- Place EPROM on the MOS protection mat
- Insert new EPROM on the board in the required position with the insertion tool

Important:
- It is important to note the position of the IC's when exchanging them
- The program IC's have to be in the same direction as the remaining IC's on the board
- Before installing the boards visually check if the program IC's leads are contacting

4. Commencement of operation

The RAM memory on the processor board is no longer buffered because of the expansion. The machine parameters and stored user program are therefore erased.

With a commencement of operation it is necessary to reenter the machine parameters.

5. Changing the program number and the identification number of the control

After a successful completion of a program exchange, the program number(s) and the identification number of the control must be changed.

The description plate 2 for the identification number of the control and the program number are located on the control back side under the type label 1