

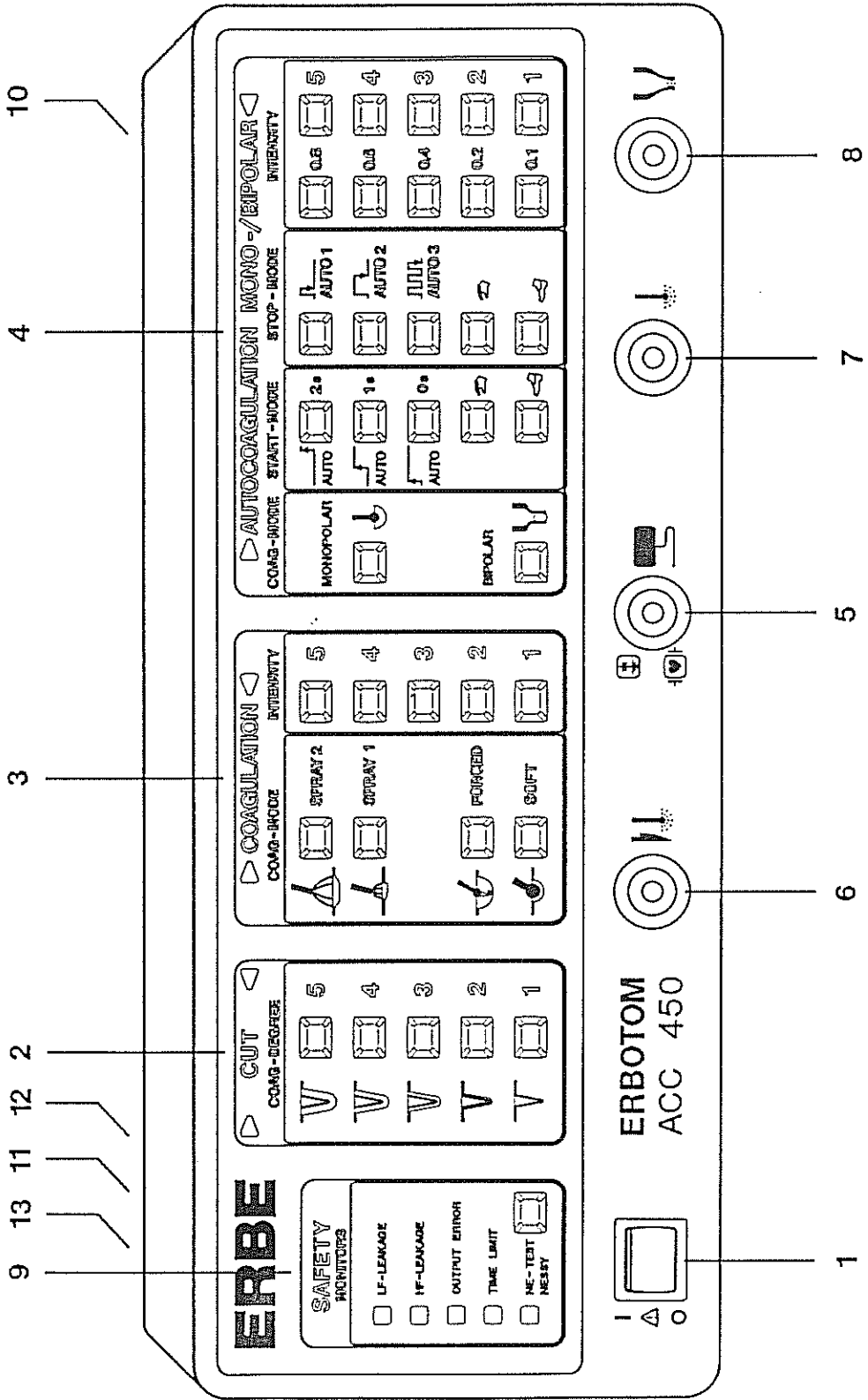
# **ERBE**

## **ERBOTOM ACC**

**Service Documentation**

1990

All rights reserved. No part of this document may be translated, reproduced, stored in information retrieval systems, or transmitted, in any form or by any means — electronic, mechanical, photocopying, recording, or otherwise — without the prior written permission of the publisher.



## DESCRIPTION OF THE CONTROL ELEMENTS

### 1 Power switch

Whenever the equipment is switched on, it automatically performs a number of function tests. If these reveal a fault, this is indicated visually and/or acoustically.

If the equipment was only briefly switched off (for up to approx. 15 seconds), the settings previously selected in the function fields (CUTTING, COAGULATION, MONO/BIPOLAR AUTOAGULATION) will be retained and the equipment is immediately operational, unless other settings are required.

If it was switched off for a longer period of time, the settings previously selected in the function fields are retained (the labels adjacent to the corresponding keys flash to indicate that they have been selected), but these settings must be confirmed by pressing the keys concerned or other keys must be pressed to set new values.

**IMPORTANT:** The function fields (CUTTING, COAGULATION, MONO/BIPOLAR AUTOAGULATION) can only be activated by means of the push-button or foot-operated switch or by Autostart when the power is switched on and the individual function fields have been set completely, i.e. when all the indicators in the function field concerned have stopped flashing. Whenever the power is switched off, all settings are retained until the equipment is switched on again.

### 2-4 Function fields

The function fields CUTTING, COAGULATION, MONO/BIPOLAR AUTOAGULATION can be set and used independently of one another. It is only necessary to set those function fields which are actually required. For instance, if soft coagulation is required alone, it will suffice to press only the buttons SOFT and the required INTENSITY in the function field COAGULATION after

switching on the power . The indications in the other function fields, which are not required, will stop flashing after a short time.

Although the settings in the function fields can be changed as required, this is not possible while the equipment is activated.

## 2 Function field CUTTING

The automatically controlled cut makes HF power adjustment unnecessary in the ERBOTOM ACC ... series (ACC = automatically controlled cut). The only setting that is required is for the degree of coagulation of the cut. Level 1 corresponds to the minimum coagulation degree, level 5 being the maximum degree.

## 3 Function field COAGULATION

The COAGULATION function field encompasses four different coagulation modes, namely SOFT COAG., FORCED COAG., SPRAY COAG. 1 and SPRAY COAG. 2.

When setting this function field, the COAGULATION MODE must always be set first, and then the required INTENSITY.

## 4 Function field MONO/BIPOLAR AUTO COAGULATION

This function field can be used for monopolar or bipolar coagulation totally independently of the COAGULATION field (3). It offers a variety of coagulation techniques. It can be activated conventionally via push-button or foot-operated switches (MANUAL or PEDAL), semi-automatically (AUTOSTART) and fully automatically (AUTOSTART/AUTOSTOP).

When setting this function field, always proceed from left (COAG. MODE) to right (INTENSITY). This also applies when altering the settings.

5 Connecting socket for neutral electrodes

A suitable neutral electrode must be applied to the patient and connected to the equipment for monopolar coagulation techniques.

The ERBOTOM ACC 450 is equipped with an NEUTRAL ELECTRODE monitoring system (refer to the Section entitled "SAFETY FEATURES, NE MONITOR") which monitors the electrical connection between the neutral electrode and the equipment, as well as between the neutral electrode and the patient. However, the latter is only possible if suitable neutral electrodes with two contact surfaces are used.

This socket is used for all function fields (CUTTING, COAGULATION and MONOPOLAR AUTOACOAGULATION).

**IMPORTANT:** The ERBOTOM ACC 450 and ACC 430 are equipped with a low-frequency leakage current monitor which monitors any low-frequency leakage currents flowing into or out of the equipment.

In this way, the equipment fulfils the requirements for type CF, although the neutral electrode is grounded via a capacitor.

6 CUTTING and COAGULATION socket for the CUTTING and COAGULATION function fields.

Electrode handles with or without push-button switches can be operated via this socket. However, it can also be used to connect other instruments, such as rigid or flexible endoscopes.

Push-button or foot-operated switches can be used for activation.

7 Monopolar AUTOACOAGULATION socket for the AUTOACOAGULATION function field

Electrode handles with or without push-button switches can be operated via this socket. However, it can also be used to

connect other instruments, such as special-purpose monopolar coagulation electrodes or monopolar coagulation forceps.

Activation is possible via push-button or foot-operated switches or automatically.

**8 Bipolar AUTOCOAGULATION socket for the AUTOCOAGULATION function field.**

Bipolar coagulation instruments, such as bipolar coagulation forceps, can be connected to this socket.

Activation is possible via foot-operated switch or automatically.

**9 Monitoring panel**

The high-frequency surgical equipment of the ERBOTOM ACC 430 and 450 series includes a variety of safety features designed to protect both the patient and the user against injury due to low-frequency leakage current, HF leakage current, output errors, excessively long unintentional activation of the HF current and burns due to incorrect application of the neutral electrode.

These safety features are described in Cap. 8.

**10 Socket for foot pedal (on the rear panel)**

Both a single or a double pedal can be connected to this socket.

Only the CUTTING field can be activated by means of the yellow pedal on the left.

**NOTE:**

Use of the blue pedal for different coagulation modes:

The blue pedal can be used to activate SOFT, FORCED or SPRAY coagulation, as well as for the AUTOCOAGULATION function field.

If the blue pedal is first used for the AUTOCOAGULATION function field and then for SOFT, FORCED or SPRAY coagulation, a different START MODE, such as MANUAL, must be selected in the AUTO-COAGULATION field so that the blue pedal becomes free for SOFT, FORCED or SPRAY coagulation.

11 Connection for potential equalization (on the rear panel)

12 Volume control for the acoustic signal (on the rear panel)

The volume of the acoustic signal can be adjusted by means of this control during activation of the high-frequency generator.

**IMPORTANT:** One of the main purposes of this acoustic signal is to protect both the patient and the staff against burns due to accidental activation of the high-frequency generator.

13 Power socket (on the rear panel)

**IMPORTANT:** The ERBOTOM ACC 430 and ACC 450 may only be connected to correctly installed earthed sockets using the mains lead supplied by the equipment manufacturer or a lead of the same quality and bearing the national calibration mark. Adapters or extension leads should not be used, for safety reasons. If their use is unavoidable, they must also be fitted with a faultless protective earth conductor.

The mains socket must have a fuse with a rating of at least 10 A.



## TECHNICAL DATA OF THE ERBOTOM ACC 450

### Mains connection

Mains voltage	220 V $\pm$ 20% / 50 Hz $\pm$ 5%, switchable to 110 V $\pm$ 20% / 60 Hz $\pm$ 5%
Protection class to DIN/IEC 601-1	I
Type according to DIN/IEC 601-1	CF
Mains fuses	In both poles of the mains line, fusible inserts to DIN 41 662, 4 A slow-blow (220 V), 8 A slow-blow (110 V), fuse holders in the rear panel
Mains lead	With PE conductor, with earthed mains plug connector to DIN 49 441 and CEE 7, Sheet VII, with earthed jack on the equipment side to DIN 49 457, Sheet 1, plug con- nector and jack vulcanized onto the lead, 3 m long
Potential equalization	Plug connector to DIN
Power consumption	600 W

### Operating modes

#### **Cutting**

Rated output	400 W at 350 ohm
Rated frequency	350 kHz
Output voltage	Sine-wave AC voltage
Power adjustment	Automatic
Voltage regulation during cutting	Automatic
Degree of coagulation of the cut surfaces	Choice of 5 coagulation degrees
Power reduction during a coagulating cutting process	None

### Soft coagulation

Rated output	140 W at 125 ohm
Rated frequency	350 kHz
Output voltage	Without harmonics, sine-wave AC voltage, unmodulated 5 degrees can be set between 50 V <sub>eff</sub> and 134 V <sub>eff</sub>
Power adjustment	Automatic
Max. HF current	1.5 A <sub>rms</sub>

### Forced coagulation

Rated output	150 W at 500 ohm
Rated frequency	350 kHz
Max. output voltage	1000 V <sub>p</sub> Sine-wave AC voltage, pulse-modulated
Power adjustment	Automatic
Depth of coagulation	Choice of 5 different relative depths

### Spray coagulation (fulguration)

Spray 1: Max. rated output	75 W at 500 ohm
Max. output voltage	3000 V <sub>p</sub>
Spray 2: Max. rated output	120 W at 500 ohm
Max. output voltage	4000 V <sub>p</sub>
Intensity of the electric arc	Choice of 5 different intensities

### Auto-coagulation

Rated output: monopolar and bipolar	120 W at 125 ohm
-------------------------------------	------------------

### Activation

Cutting	Push-button or pedal Colour code as per DIN/IEC 601, Part 2-2: yellow
Soft coagulation	Push-button or pedal Colour code as per DIN/IEC 601, Part 2-2: blue
Forced coagulation	Push-button or pedal Colour code as per DIN/IEC 601, Part 2-2: blue
Spray coagulation	Push-button or pedal Colour code as per DIN/IEC 601, Part 2-2: blue
Automatic coagulation	Activated via push-button, pedal or automatically; automatic de-activation

### Labelling

Language	German or English plus pictograms
Colour code	As per DIN/IEC 601-2-2 Cutting channel: yellow, left Coagulation channel: blue, right

### Optical and acoustic signals

see encl. list

External dimensions	W x H x D: 410 x 152 x 368 mm
Weight	12.5 kg



## INSTALLATION

### 1 Spatial requirements

HF surgical equipment may only be operated in rooms used for medical purposes if these rooms satisfy the requirements set out in DIN 57 107 (VDE 0107).

With regard to the electrical installations, these requirements concern, for example, the protective earth system, potential equalization and leakage current protection.

Refer also to the Chapter entitled "Protection against explosion hazards".

### 2 Possibilities for installation in operating rooms

The ERBOTOM ACC units can basically be set up on tables, brackets suspended from the ceiling or wall-mounted brackets, as well as on special-purpose equipment trolleys.

### 3 Line connection

The power outlet must be fitted with a fuse with a minimum rating of 10 A.

#### 4 Potential equalization

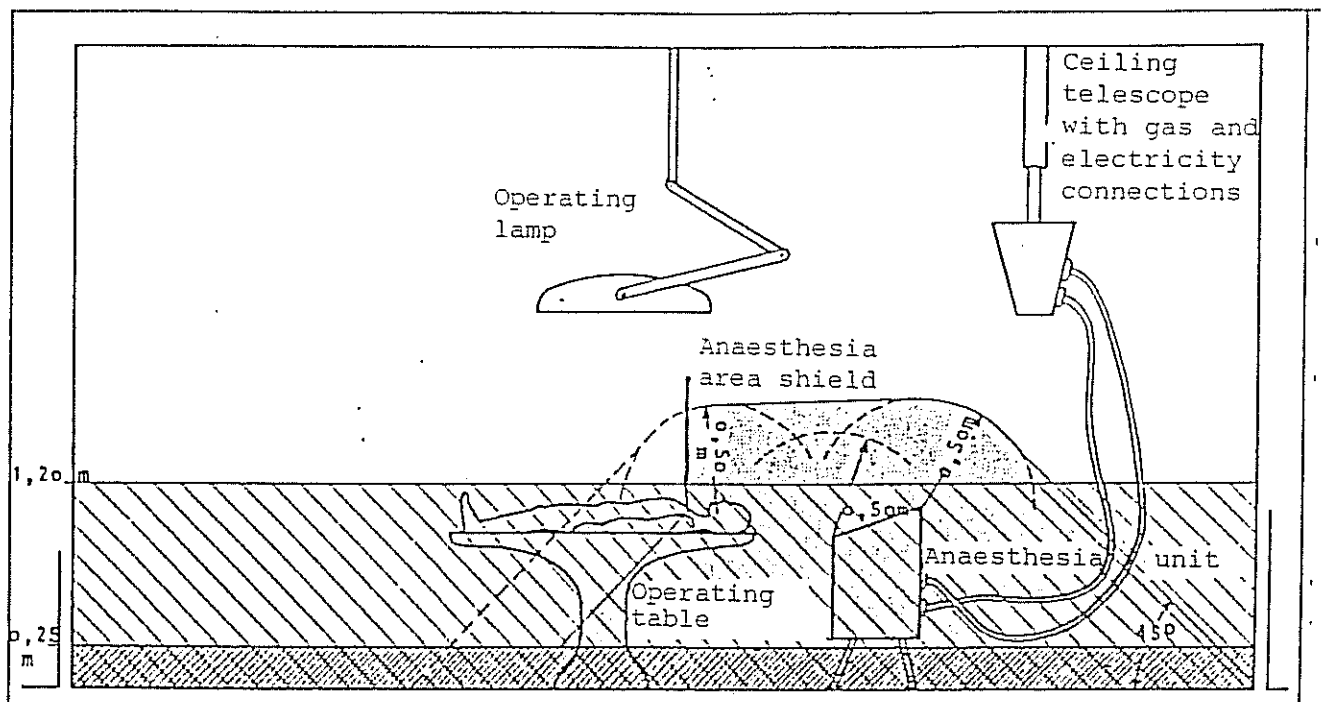
DIN 57 753 Part 2/VDE 0753 Part 2 specifies that all equipment used for intracardiac operations must be connected to the potential equalization of the room. The purpose of this requirement is to prevent any danger to the patient due to low-frequency currents, such as the low-frequency leakage currents in a defective protective earth conductor.

In order to satisfy this requirement, the ERBOTOM ACC units all have a potential equalization connector to DIN 42 801 on their rear panel. The units can be connected to the potential equalization system in the room by means of an equipotential cable plugged into this socket.

#### 5 Protection against explosion hazards

High-frequency surgical equipment naturally produces electric arcs between the active electrode and the tissue. Electric arcs may also be produced inside the equipment. HF surgical equipment must therefore not be used in explosion-hazard areas.

The entire area up to 20 cm above the floor, as well as the area around and below the operating table are potentially explosive areas if flammable or explosive cleansers, disinfectants, anaesthetics, etc. are used. This is illustrated in the following diagram showing the potentially dangerous areas of an operating theatre when using ignitable anaesthesia gas mixtures.






- 
 Must always be considered an explosion-hazard area for stationary and movable electrical wiring and equipment, as well as electromedical equipment.
- 
 Must always be considered an explosion-hazard area for stationary electrical wiring and equipment, as well as stationary electromedical equipment.
- 
 Temporary explosion-hazard area when using ignitable inhalation anaesthetics.

Fig.: Explosion-hazard areas in the operating theatre (source: Guidelines on protection against explosions [Ex-RL] issued by the employers' liability insurance association for the chemical industry).

High-frequency surgical equipment is normally installed outside the area marked as an explosion-hazard zone.

**IMPORTANT:** Pedal switches must, however, always be used in the explosion-hazard area and must be correspondingly explosion-proofed.

## 6 Protection against moisture

The ERBOTOM ACC series of HF surgical units is protected against the ingress of moisture and splash-water as required by DIN/IEC 601 Part 2-2/VDE 0750 Part 202.

Nevertheless, the equipment should not be installed near hoses or vessels containing liquids. Do not place any liquids above or on the equipment itself.

Only use waterproof pedal switches in accordance with DIN/IEC 601 Part 2-2/VDE 0750 Part 202, Section 44.6 aa), draft edition.

Only use waterproof electrode handles with push-button switches in accordance with DIN/IEC 601 Part 2-2/VDE 0750 Part 202, Section 44.6 bb), draft edition. If electrode handles are used which are not waterproof, care must be taken to ensure that no moisture enters the handles during use (refer also to the Chapter entitled "Accidental activation of the equipment").

## 7 Cooling

The ERBOTOM ACC units must be set up in such a way as to ensure an unobstructed flow of air around the housing. They must not be installed in small niches, shelves, etc.!

## 8 HF interference

High-frequency surgical units naturally generate high-frequency voltages and currents. The fact that they may cause interference in other electromedical equipment must be taken into account when they are installed and during operation.

**Note:** Because they are equipped with a harmonics-free HF generator and automatic voltage regulator, the ERBOTOM ACC series of HF surgical units generate considerably less HF interference than conventional units of this type. This is particularly advantageous when they are used in combination with video monitors.



## SAFETY CHECKS FOR THE ERBOTOM ACC 450

- Check the labelling and user manual.
- Inspect the equipment and accessories to ensure they are not damaged.
- Check the electrical safety as required by DIN VDE 0751, Part 1
  - a) Protective earth conductor
  - b) Leakage currentThe leakage currents can alternatively be measured and assessed in accordance with DIN IEC 601/VDE 0750, Part 1.
- Check the correct functioning of all switches and indicators on the equipment.
- Check the safety monitors.
- Check the automatic start mode.
- Check the automatic stop mode.
  - a) AUTO 1
  - b) AUTO 2
  - c) AUTO 3
- Measure the high-frequency voltages for CUTTING mode.
- Measure the high-frequency voltages for SOFT COAGULATION mode.
- Measure the high-frequency voltages for FORCED COAGULATION mode.
- Measure the high-frequency voltages for SPRAY COAGULATION mode.

The results of these checks must be recorded and filed with the equipment log.

**ATTENTION!**

If these safety checks reveal any defects capable of endangering patients, staff or third parties, the equipment must be withdrawn from service until the defects have been eliminated through correct technical servicing.

## FUNCTION CHECKS

The ERBOTOM ACC 450 includes a number of automatic function checks which are run through very quickly whenever the power is switched on.

The functions required for each application should additionally be checked before the equipment and its accessories are used.

### - Automatic function checks

Whenever the power is switched on, the equipment immediately runs through an internal automatic test routine which detects and signals the following faults in the equipment controls and in the accessories connected to the equipment:

1. If one of the keys on the front panel has been shorted due to a fault or if it is pressed when the power is switched on, this fault is indicated acoustically after switching on the power; the digit or word alongside the defective or pressed key flashes to identify the key concerned.
2. If one of the keys on an electrode handle has been shorted due to a fault or has been bridged with low impedance (e.g. due to moisture in the electrode handle) or was pressed when the power is switched on, this fault is indicated acoustically after switching on the power; the triangles in the frame of the corresponding function field flash to identify which key is defective or pressed.
3. If one of the contacts in the foot pedal has been shorted due to a fault, if a pedal has jammed or is pressed when the power is switched on, this fault will be indicated acoustically and the triangles in the frame of the corresponding function field flash to identify which pedal is involved.

- Manual function checks

1. NE test

The neutral electrode test (NE test) is used to

- check the correct functioning of the neutral electrode monitor,
- check that the neutral electrode is correctly connected to the equipment and,  
if neutral electrodes with two contact surfaces are used,
- to check that the neutral electrode has been applied to the patient (refer also to the Section entitled "NE test").

2. Checking the acoustic signal

The relevant acoustic signal must always sound whenever a function field is activated.

3. Checking the HF output voltage

The equipment will generate visual and acoustic alarms if the set HF output voltage differs from that prevailing when a particular operating mode, such as CUTTING or SOFT COAGULATION, is activated (refer to the Section entitled "Output errors").

## TROUBLESHOOTING PROCEDURES

The failure monitoring and reporting systems of ERBOTOM ACC-equipments allow rapid detection and location of faults occurring in the equipments and in their accessory items (finger switches and footswitches) without need for employing test equipment.

The failure reporting systems of ERBOTOM ACC-instruments distinguish:

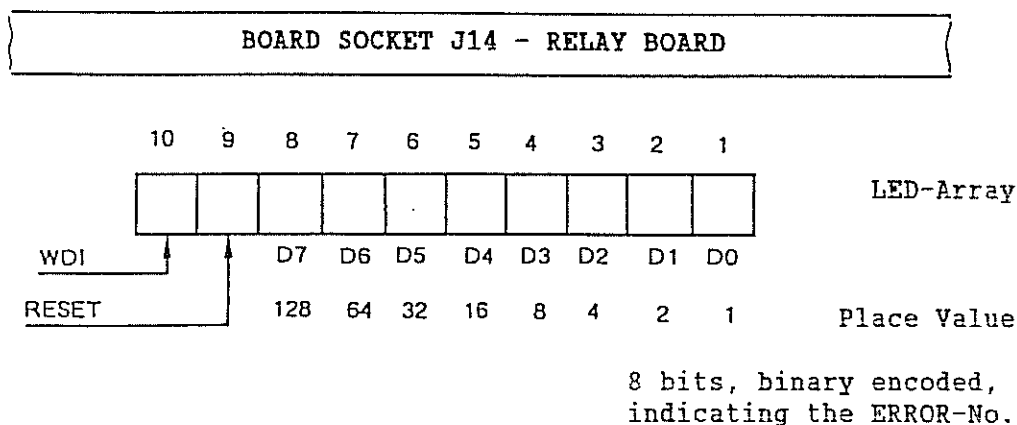
- Failures detected at main power switch-on Type 1
- Failures occurring during the activation phase Type 2
- Failures occurring while the equipment is activated Type 3
- Failures detected on front-panel button depression Type 4

BLE

Failure reporting utilizes:

- Illumination of an LED in the "SAFETY" section of the front panel
- Sounding of an acoustic alarm tone
- Blinking of the LED for the activation channel
- Output of a failure code number

The failure code number (ERROR-No.) is output to a linear LED-array situated on the motherboard. 8 bits, designated D0 through D7, are output in binary encoded form. The last 5 ERROR-Nos. are kept in memory and can be displayed using TEST PROGRAM No. 2.



Display: Illumination of LED's 1, 4, and 5 indicates ERROR-No. 25.

The detailed description of ERROR-No. 25 can be found in the LISTING OF ERROR MESSAGES.

The error message will continue to be displayed as long as the instrument remains activated:

The NE-TEST LED will be lit, the acoustic warning will sound, the LED for the activated channel will be blinking, and the ERROR-No. will then be displayed.

Possible causes of this particular failure:

- existence of an unsymmetric current distribution over the two parts of the split neutral electrode due to improper application of the electrode.
- failure in the symmetry monitoring system.

The operation of LED's Nos. 9 and 10 is described on p. 5, "TROUBLESHOOTING THE MICROPROCESSOR SYSTEM."

## TROUBLESHOOTING AND FAULT ELIMINATION

The best method for locating faults is to proceed as follows:

- determine the type of failure,
- read the linear LED-array to establish the ERROR-No.,
- use the ERROR-No. to arrive at the module that triggered the error message,
- replace the suspected module or functional unit,
- eliminate the cause of failure using the test programs.

To determine the type of failure, the failure conditions which the microprocessor system recognizes during the switch-on phase, and while the equipment is activated, must be known.

**Example:** Channel A is activated by the footswitch. An APM 600 is interconnected, the setting is 500 R, with the intensity set to 4. When the instrument is activated, the instrument displays the following error signals:

- the LED for output error lights (indicating no RF output voltage),
- the acoustic alarm sounds, and
- the activation-indicator LED's for Channel A are blinking.

ERROR-No. 4 will be output to the LED-array upon activation.

Referring to the programming sequence, it can be seen that for output of the message ERROR-No. 4, the RF-generator was activated, and the failure is thus of Type 2.

ERROR-No. 4 indicates: no feedback frequency present

The feedback frequency for Channel A is generated by the RF output voltage.

Potential causes of the failure:

- failure of the RF power supply,
- a failure in the feedback circuitry, or
- failure of the RF-generator.

Localizing the failure:

Remove the 3 circuit boards of the RF-generator and reset the instrument to the FORCED COAGULATION mode. Activate Channel B for the FORCED COAGULATION mode.

- If no error message appears, this means that the power supply is operating properly.

**Replacing the line fuse**

If the line fuse should blow, first check for a short circuit in the power supply (the rectifier circuit on the motherboard) and in the transistorized output stage of the power supply. To performed these checks, proceed as follows:

- Withdraw the upper circuit board. This circuit board transmits the supply voltage to the power supply via 3 lines.
- Check the power supply output-stage transistors for the presence of shorts.
- Remove the fuse for the small transformer.
- Unplug the main power cord from the electrical supply.
- SWITCH-ON the instrument's main power switch.
- Measure the resistance across the two line conductors of the main power cord. If this exceeds 10 kOhms, then the power supply is OK.

**CAUTION:** If new fuses are inserted before eliminating any shorts present, the resistor in the startup delay circuit will burn out.

**CAUTION:** The upper circuit board and the rectifier circuit of the power supply all carry line voltage. Use an isolation transformer when conducting any measurements.

## TROUBLESHOOTING THE MOTHERBOARD

All interconnections from the microprocessor system (board slot J1) found on the motherboard can be checked using TEST PROGRAMS.

In performing servicing, system operations can be tested with the aid of the following TEST PROGRAMS:

TEST PROGRAM 1  
TEST PROGRAM 20  
TEST PROGRAM 21  
TEST PROGRAM 22

TEST PROGRAM 1 checks the signal lines of the external control bus. TEST PROGRAM 1 is the most important of the TEST PROGRAMS.

Call up TEST PROGRAM 1 whenever any servicing is to be performed.

## TROUBLESHOOTING THE FRONT PANEL

The buttons of the front panel are monitored when the main power switch is actuated.

If an error condition is detected, the error message

ERROR 45

will be output. TEST PROGRAM 14 may be used to check the front panel's light-emitting diodes.



## TROUBLESHOOTING THE MICROPROCESSOR SYSTEM

### Board slot J1

The microprocessor system incorporates several hardware and software monitoring subsystems.

A RESET will be triggered if any of the microprocessor system operations should fail.

This RESET will be indicated on LED's 10 and 9 of the linear LED-array.

#### LED No. 10

This LED lights to indicate the presence of the WDI ("watchdog input") trigger signal. The WDI-signal is a monitoring signal that monitors program (software) execution and the microprocessor system by means of a monitoring circuit. The WDI-signal has a frequency of 732 Hz, and is derived from the processor clock frequency.

#### LED No. 9

This LED lights to indicate the presence of the RESET-signal. The RESET-LED will remain off during normal operation.

Either alternate blinking of LED's 10 and 9, or both LED 10 and LED 9 being simultaneously off indicates a failure in the microprocessor system.

Memory (RAM) failure will be indicated by output of ERROR-No. 44.

All interconnections of the microprocessor system to functional units can be checked using the following TEST PROGRAMS :

TEST PROGRAM	1
TEST PROGRAM	15
TEST PROGRAM	20
TEST PROGRAM	21
TEST PROGRAM	22
TEST PROGRAM	14

TROUBLESHOOTING THE LOW-VOLTAGE POWER SUPPLY AND THE ACOUSTIC SIGNAL CIRCUIT

Board slot J2

The low-voltage power supply has outputs of + 5 VDC, + 15 VDC, and - 15 VDC. The presence of these voltages is indicated both by the illumination of LED's on the power supply board and on the motherboard.

Acoustic signal circuit

In performing servicing, testing for correct operation is supported by the following TEST PROGRAMS:

TEST PROGRAM 16  
TEST PROGRAM 17  
TEST PROGRAM 18  
TEST PROGRAM 19

## TROUBLESHOOTING THE POWER SUPPLY AND THE RF-GENERATOR

Board slots J3, J4, J5, J6, J7, and J8

The operation of the power supply and of the RF-generator are continuously monitored while the equipment is in the activated status.

If any operating parameters should depart from their prescribed tolerances, one or more of the following error messages will be output:

ERROR 1  
ERROR 2  
ERROR 3  
ERROR 4

Monitoring of the current actual values of parameters is performed by measuring the RF output voltage at the output of the RF-generator while the instrument is in the CUT, SOFT-COAGULATION, or AUTOCOAGULATION modes.

Monitoring of the current actual values of parameters is performed by measuring the power supply output voltage while the equipment is in the FORCED COAGULATION mode. The RF-generator is not monitored in FORCED COAGULATION mode.

### Troubleshooting:

1. Withdraw all 3 of the RF-generator circuit boards from the instrument.

Board slot J6 - the QK output stage board

Board slot J7 - the RF-generator output filter board

Board slot J8 - the RF-generator control board

2. Activate the FORCED COAGULATION mode.

- If no error message appears, the 400-W power supply is OK, and the cause of failure is in the RF-generator.
- If an error message appears, the power supply is defective. The power supply consists of a total of 3 circuit boards:

Board slot J3 - the power supply control board

Board slot J4 - the QK output stage board

Board slot J5 - the power supply output filter board

The QK output stage boards of the power supply and the of the RF-generator are identical, and can be interchanged without need for recalibration.

**TROUBLESHOOTING THE POWER SUPPLY AND THE RF-GENERATOR (cont'd.)**

The power supply control board and the power supply output filter cannot be replaced singly without readjustment of their phase-regulation and voltage-regulation circuits.

The RF-generator control board and the RF-generator output filter cannot be replaced singly without readjustment of their phase-regulation and voltage-regulation circuits.

If either the RF-generator or the 400-W power supply has been replaced, the output error monitoring system will have to be checked and readjusted, if required, using **TEST PROGRAM 39**.

In performing servicing, testing for correct operation is supported by the following **TEST PROGRAMS**:

- TEST PROGRAM 3
- TEST PROGRAM 4
- TEST PROGRAM 5
- TEST PROGRAM 15
- TEST PROGRAM 39
- TEST PROGRAM 22

## TROUBLESHOOTING THE SPRAY/TUR-GENERATOR

Board slot J9

The operation of the SPRAY/TUR-generator and of the RF-generator are continuously monitored while the instrument is in the activated status. If any operational parameters should depart from their prescribed tolerances, one of the following error messages will be output:

ERROR 47 through ERROR 54

In performing servicing, testing for correct operation is supported by the following TEST PROGRAM:

TEST PROGRAM 11

TROUBLESHOOTING THE CONTACT MONITOR AND THE CURRENT AND SPARKING MONITORS

Board slot J10

The operations of the monitor circuits are continuously monitored while the instrument is in the activated status.

If a failure should be detected, one or more of the following error messages will be output:

ERROR 9

ERROR 12

ERROR 13

ERROR 33

ERROR 38

In performing servicing, testing for correct operation of these circuits is supported by the following TEST PROGRAMS:

TEST PROGRAM 7

TEST PROGRAM 22

TROUBLESHOOTING THE NESSY NE-MONITORING SYSTEM AND THE RF LEAKAGE CURRENT MONITORING SYSTEM

Board slot J11

The operations of the NESSY-system and of the RF leakage current monitoring system are monitored at all times.

If a failure should be detected, one or more of the following error messages will be output:

ERROR 6  
ERROR 7  
ERROR 24  
ERROR 25  
ERROR 26  
ERROR 28

In performing servicing, testing for correct operation is supported by the following TEST PROGRAMS:

TEST PROGRAM 8  
TEST PROGRAM 9  
TEST PROGRAM 20  
TEST PROGRAM 22  
TEST PROGRAM 27  
TEST PROGRAM 28

## TROUBLESHOOTING THE SAFETY LOGIC BOARD

Board Slot J12

The operation of the safety logic circuitry is continuously monitored while the equipment is activated.

If a failure should be detected, one or the other of the following error messages will be output:

ERROR 27

ERROR 43

In performing servicing, testing for correct operation is supported by the following TEST PROGRAMS:

TEST PROGRAM 10

TEST PROGRAM 22



## TROUBLESHOOTING THE FINGER-SWITCH MONITOR

Board slot J13

The operation of the finger-switch monitors are checked at all times.

If a failure should be detected, one or more of the following error messages will be output:

ERROR 17  
ERROR 18  
ERROR 19  
ERROR 29  
ERROR 30  
ERROR 31  
ERROR 32  
ERROR 33  
ERROR 34  
ERROR 35  
ERROR 36  
ERROR 37  
ERROR 38  
ERROR 39

In performing servicing, testing for correct operation is supported by the following TEST PROGRAMS:

TEST PROGRAM 20  
TEST PROGRAM 21

TROUBLESHOOTING THE RELAY BOARD AND THE LF LEAKAGE CURRENT MONITORING SYSTEM

Board slot J14

The LF leakage current monitoring system outputs error message: ERROR 4.

TEST PROGRAM 12  
TEST PROGRAM 34  
TEST PROGRAM 35  
TEST PROGRAM 36  
TEST PROGRAM 37  
TEST PROGRAM 21

ACC FAILURE MONITORING AND REPORTING SYSTEM

---

Monitoring of operations immediately  
after SWITCH-ON

Failure indication/response

---

Check whether a button on the front  
panel has been actuated

LED adjacent to the button will be  
blinking, ALARM sounds

Valid front panel logic mask?

Basic initialization, LED's lit

Shutdown period       $\geq$  15 seconds  
                          $\leq$  15 seconds

LED's will be blinking  
No LED's will be blinking

LF leakage current immediately after  
switch-on

Capacitive grounding of the neutral  
electrode will be interrupted; ALARM  
will sound and activation will be  
locked out.

Check whether the activation signal is  
present (footswitch A and B, finger  
switch A and B, contact monitor)

LED of activated channel will blink;  
ALARM will sound and activation will  
be locked out.  
Basic initialization of Channel C.

ACC FAILURE MONITORING AND REPORTING SYSTEM

---

Continuous check of operations

Failure indication/response

---

Monitoring of timing of program execution ("time out")

RESET

Internal system test (stack, synchronization, WDI)

RESET

External interference (lightning, electrostatic discharges)

RESET

---

STANDBY status

---

Measurement of conductivity of the NE on depression of the

NE-TEST button:  $R_{NE} \geq 130 R$   
 $R_{NE} \leq 100 R$

Red LED<sub>NE</sub> lit & ALARM sounds (error)  
Red LED off (OK)

ACC FAILURE MONITORING AND REPORTING SYSTEM

Activation of CHANNEL A, CUT,  
or CHANNEL B, SOFT COAGULATION

Failure indication/response

Multiple activation,  
e.g., finger switches A & B, etc.

5 seconds wait-period with no response, then channel activation LED will commence to blink, ALARM will sound, and activation will be locked out.

Valid front panel parameter:  
Has a button been depressed;  
is an LED blinking?

Channel activation LED will blink, ALARM will sound, and activation will be locked out.

Analysis of NE conductivity  
measurement:  $R_{NE} \geq 130 R$   
 $R_{NE} \leq 100 R$

Red LED lit, ALARM sounds, activation locked out  
activation enabled

(Hardware) safety system:  
initialization and check  
enabling signal of the  
safety system:

enabled OK  
enablement locked out channel activation LED blinks and ALARM sounds

Output error: RF output voltage  
+ 20 % or - 20 % limit  
+ 40 % limit or short

Red LED lit  
Red LED and activation LED blinking, ALARM sounds, plus SHUTDOWN

RF leakage current:  $\geq 150 \text{ mA}$  (time constant)  
 $\geq 300 \text{ mA}$  (time constant)

Red LED lit  
Red LED lit, 3 ALARM tones sound

Current density: limiting value exceeded

LED blinks, 3 ALARM tones sound

Unsymmetry: Limit 1 exceeded  
Limit 2 exceeded

Red LED blinks, 3 ALARM tones sound  
Red LED blinks, ALARM sounds, activation LED blinks, plus SHUTDOWN

Time limit: 15 seconds  
25 seconds

Red LED lit plus warning tone  
Red LED blinks, ALARM sounds, activation LED blinks, plus SHUTDOWN

ACC FAILURE MONITORING AND REPORTING SYSTEM

Activation of CHANNEL B, FORCED  
COAGULATION and SPRAY COAGULATION

Failure indication/response

Multiple activation,  
e.g., finger switches A & B, etc.

5 seconds wait-period with no response, then Channel B activation LED will commence to blink, ALARM will sound, and activation will be locked out.

Valid front panel parameter:  
Has a button been depressed;  
is an LED blinking?

Channel B activation LED will blink, ALARM will sound, and activation will be locked out.

Analysis of NE conductivity  
measurement:  $R_{NE} \geq 130 R$

Red LED lit, ALARM sounds, activation locked out

$R_{NE} \leq 100 R$

Activation enabled

(Hardware) safety system:  
initialization and check  
enabling signal of the  
safety system:

enabled

OK

enablement, locked out

Channel B activation LED blinks and ALARM sounds

Output error:  
power supply voltage  
+ 10 % or - 10 % limit  
+ 40 % limit or short

Red LED lit

Red LED and activation LED blinking, ALARM sounds, plus SHUTDOWN

RF leakage current:  $\geq 150 \text{ mA}$  (time constant)  
 $\geq 300 \text{ mA}$  (time constant)

Red LED lit

Red LED lit, 3 ALARM tones sound

Current density: limiting value exceeded

LED blinks, 3 ALARM tones sound

Unsymmetry:  
Limit 1 exceeded  
Limit 2 exceeded

Red LED blinks, 3 ALARM tones sound

Red LED blinks, ALARM sounds, activation LED blinks, plus SHUTDOWN

Time limit:  
15 seconds  
25 seconds

Red LED lit plus warning tone

Red LED blinks, ALARM sounds, activation LED blinks, plus SHUTDOWN

ACC FAILURE MONITORING AND REPORTING SYSTEM

Activation of CHANNEL C, AUTOAGGULATION	Failure indication/response
Incorrect activation signal relative to front panel settings	5 seconds wait-period with no response, channel activation LED commences blinking, ALARM sounds, activation locked out.
Valid front panel parameter: Has a button been depressed; is an LED blinking?	Channel activation LED blinks, ALARM sounds, activation locked out.
Analysis of NE conductivity measurement: $R_{NE} \geq 130 R$	Red LED lit, ALARM sounds, activation locked out
$R_{NE} \leq 100 R$	Activation enabled
(Hardware) safety system: initialization and check enabling signal of the safety system: enabled	OK
enablement locked out	Channel B activation LED blinks, ALARM sounds
Shutdown monitors, U/J-monitor	OK
Shutdown signal present before switch-on (monitoring circuit defective)	Activation LED blinking Activation locked out
Output error: RF output voltage	
+ 20 % limit	Red LED lit
+ 40 % limit	Red LED and activation LED blinking, ALARM sounds, plus SHUTDOWN
RF leakage current: $\geq 150 \text{ mA}$ (time constant)	Red LED lit
$\geq 300 \text{ mA}$ (time constant)	Red LED lit, 3 ALARM tones sound
Current density: limiting value exceeded	LED blinks, 3 ALARM tones sound
Unsymmetry: Limit 1 exceeded	Red LED blinks, 3 ALARM tones sound
Limit 2 exceeded	Red LED blinks, ALARM sounds, activation LED blinks, plus SHUTDOWN
Time limit: 15 seconds	Red LED lit plus warning tone
25 seconds	Red LED blinks, ALARM sounds, activation LED blinks, plus SHUTDOWN

ACC FAILURE MONITORING AND REPORTING SYSTEM

---

With CHANNELS A, B, or C activated

Failure indication/response

---

ONLY the activation signal switches OFF.

A further activation signal from CHANNEL A or CHANNEL B is present at the time of the SHUTDOWN

Wait-period of 5 seconds;  
Channel A activation LED will blink,  
ALARM will sound, activation will be locked out

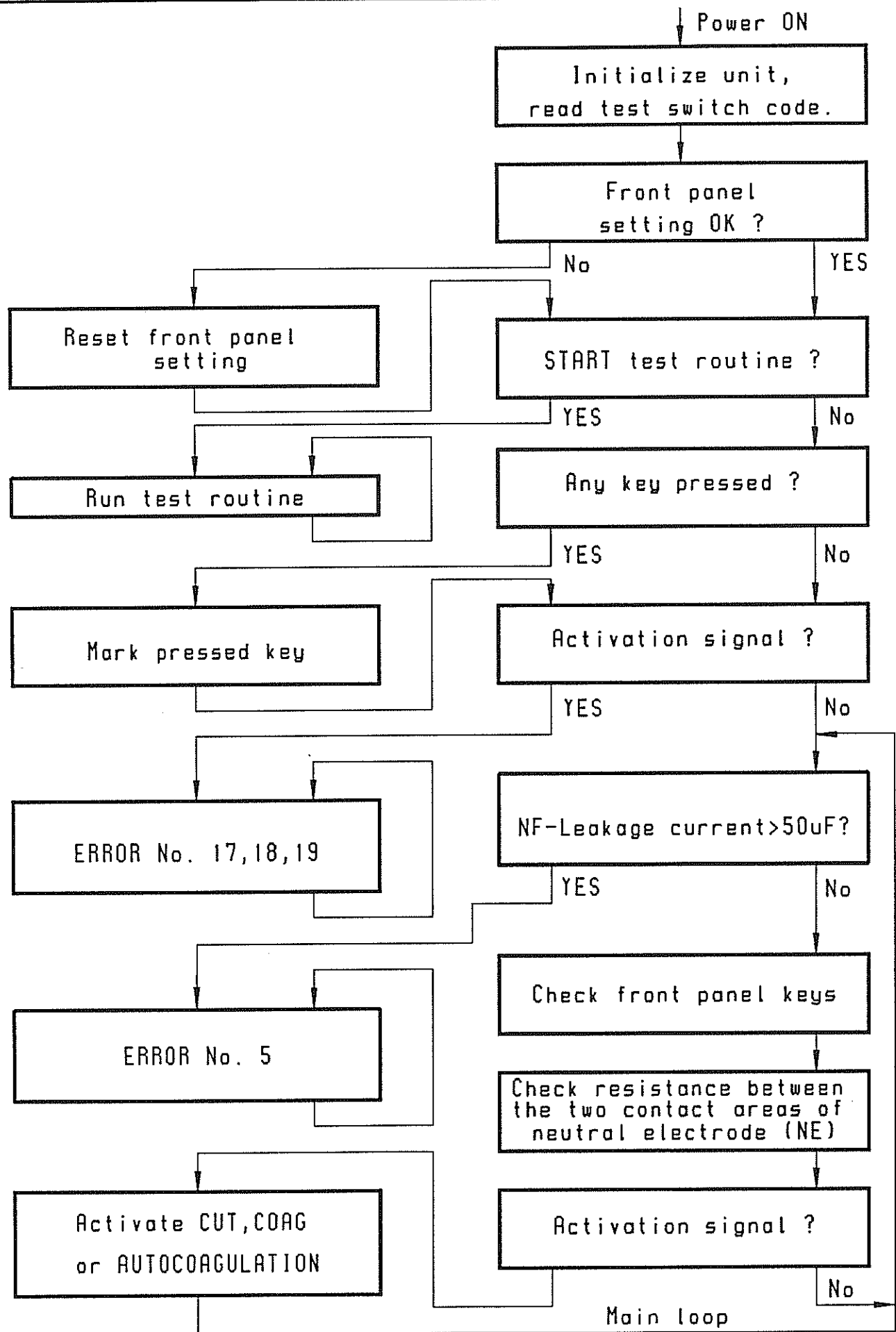
---

With CHANNEL C activated

---

All other activation signals will be taken as plausible





**ERBE**

7400 Tübingen

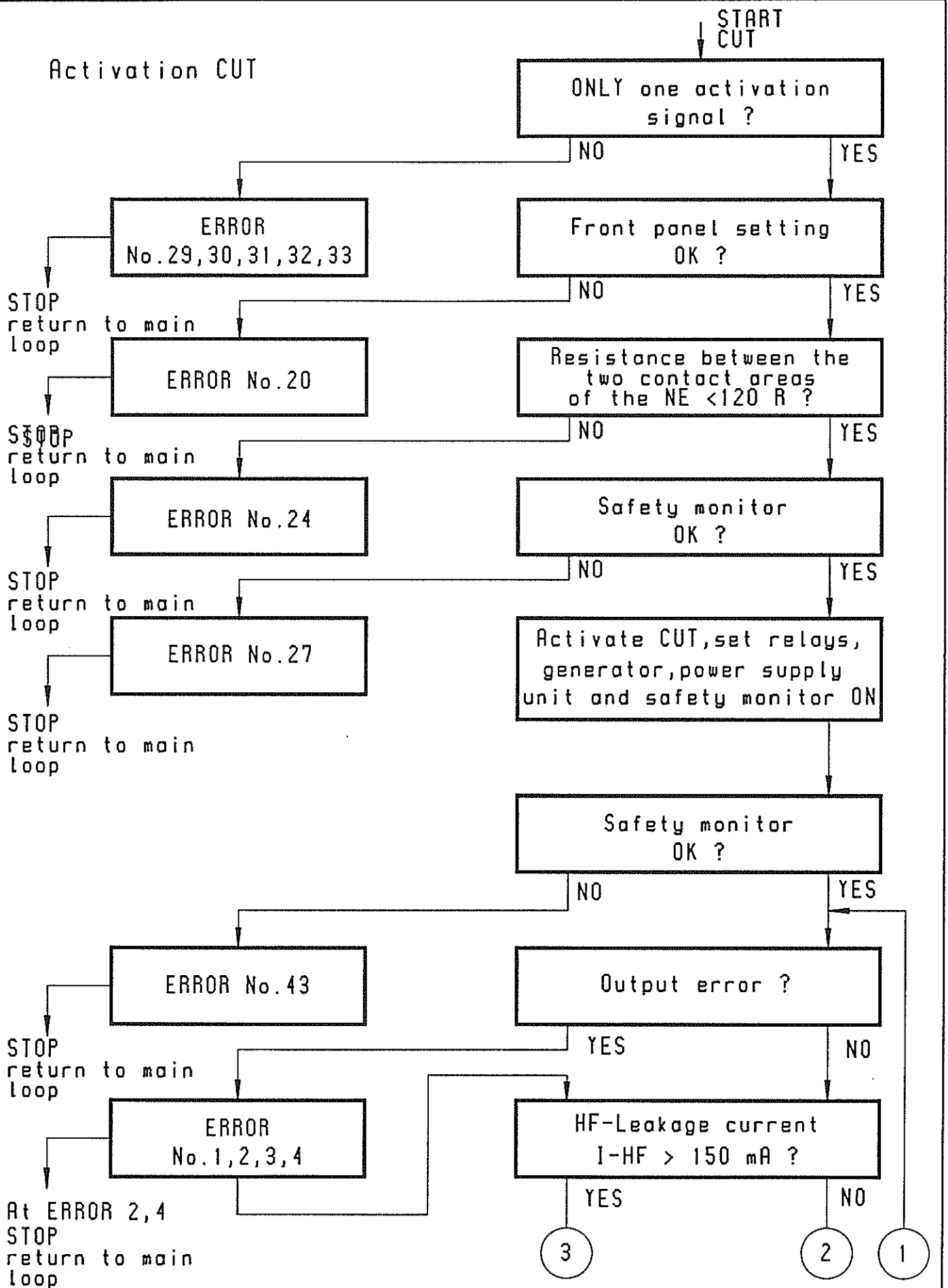
FLOWCHART

Unit: Erbotom ACC450, 430, 410

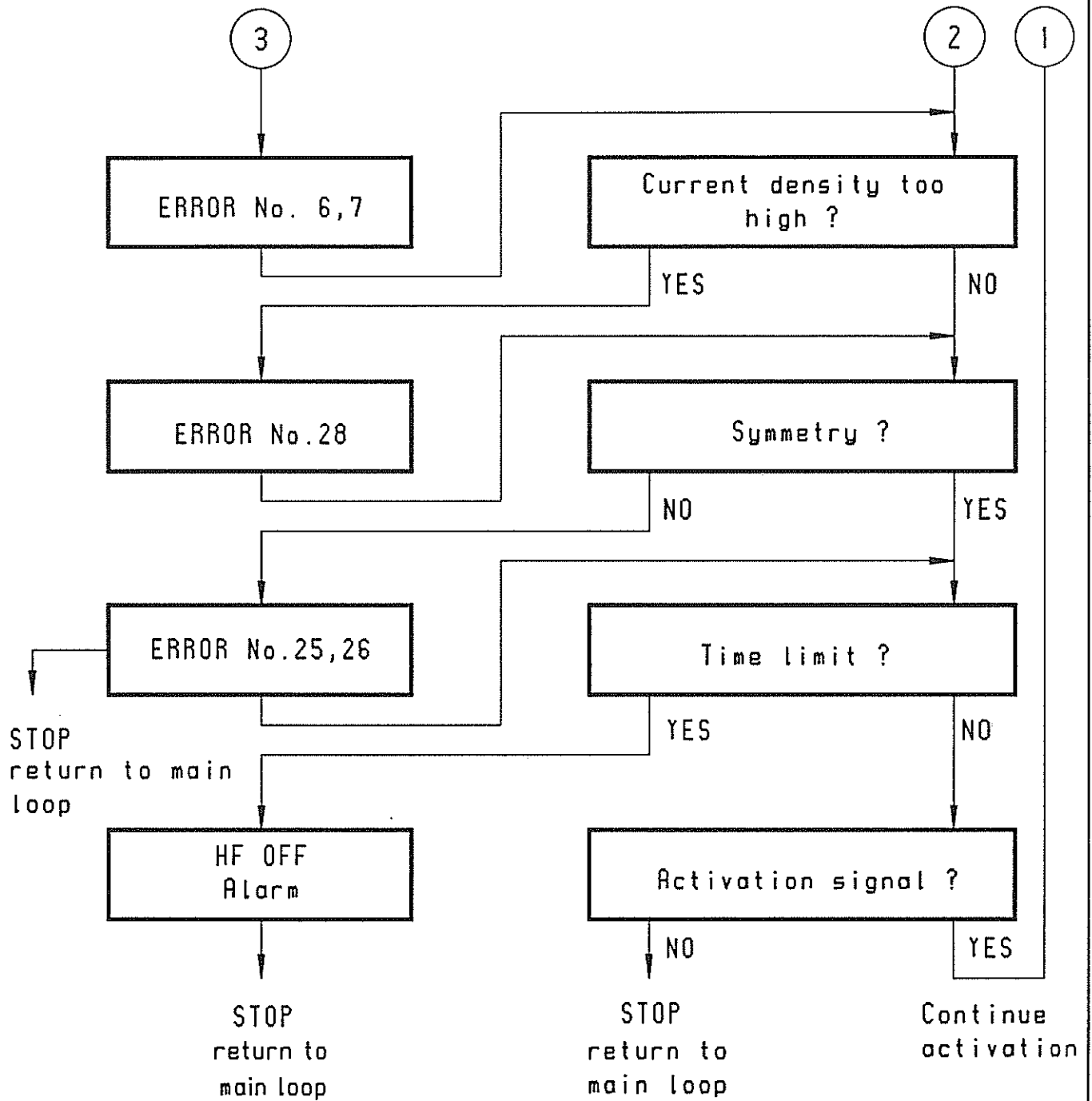
SOFT version V2.0

	Date	Name
Drawn	23.02.90	Hanisch
Insp.		
Plan-No.		
Page-No.	1	

# Activation CUT

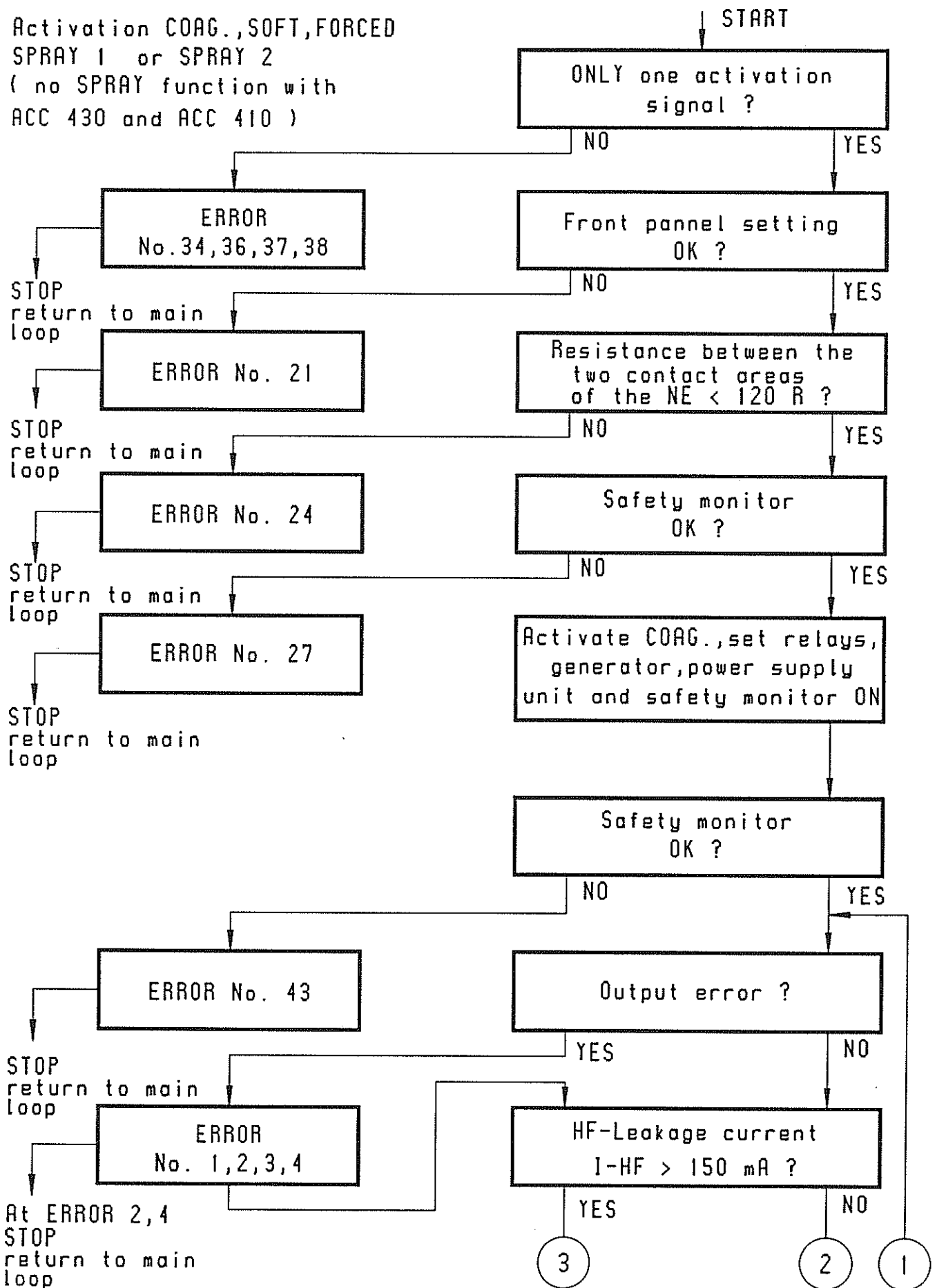


<b>ERBE</b>  7400 Tübingen	FLOWCHART	Date	Name
	Unit: Erbotom ACC 450, 430, 410	Drawn	23.02.90 Hanisch
	SOFT version V 2.0	Insp.	
		Plan-No.	
		Page-No.	2

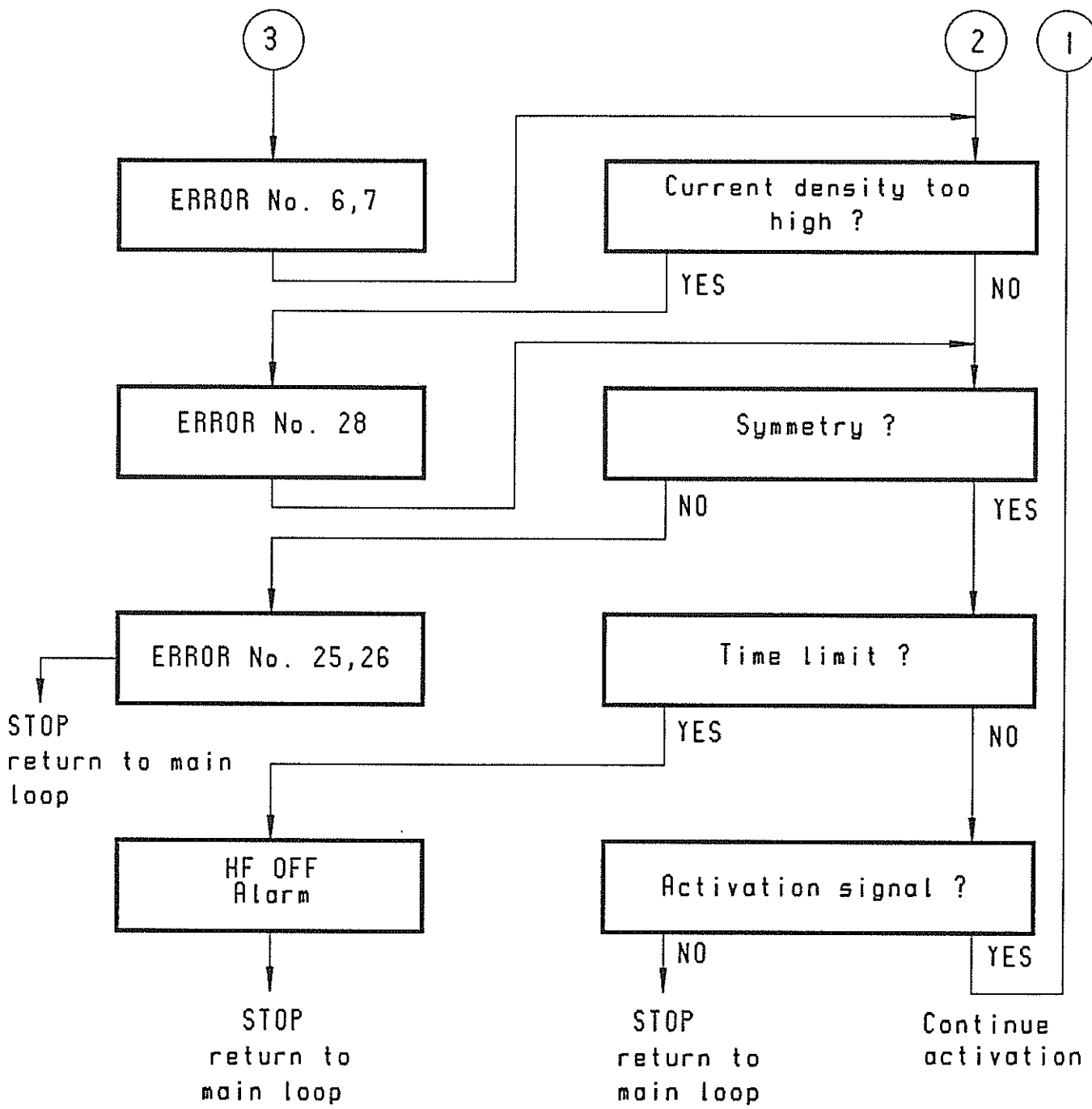


<b>ERBE</b> 7400 Tübingen	FLOWCHART		Date	None
	Unit: Erbotom ACC450, 430, 410		Drawn	23.02.90
			Insp.	
	SOFT Version V2.0		Plan-No.	
Page-No.			3	

Activation COAG., SOFT, FORCED  
 SPRAY 1 or SPRAY 2  
 ( no SPRAY function with  
 ACC 430 and ACC 410 )

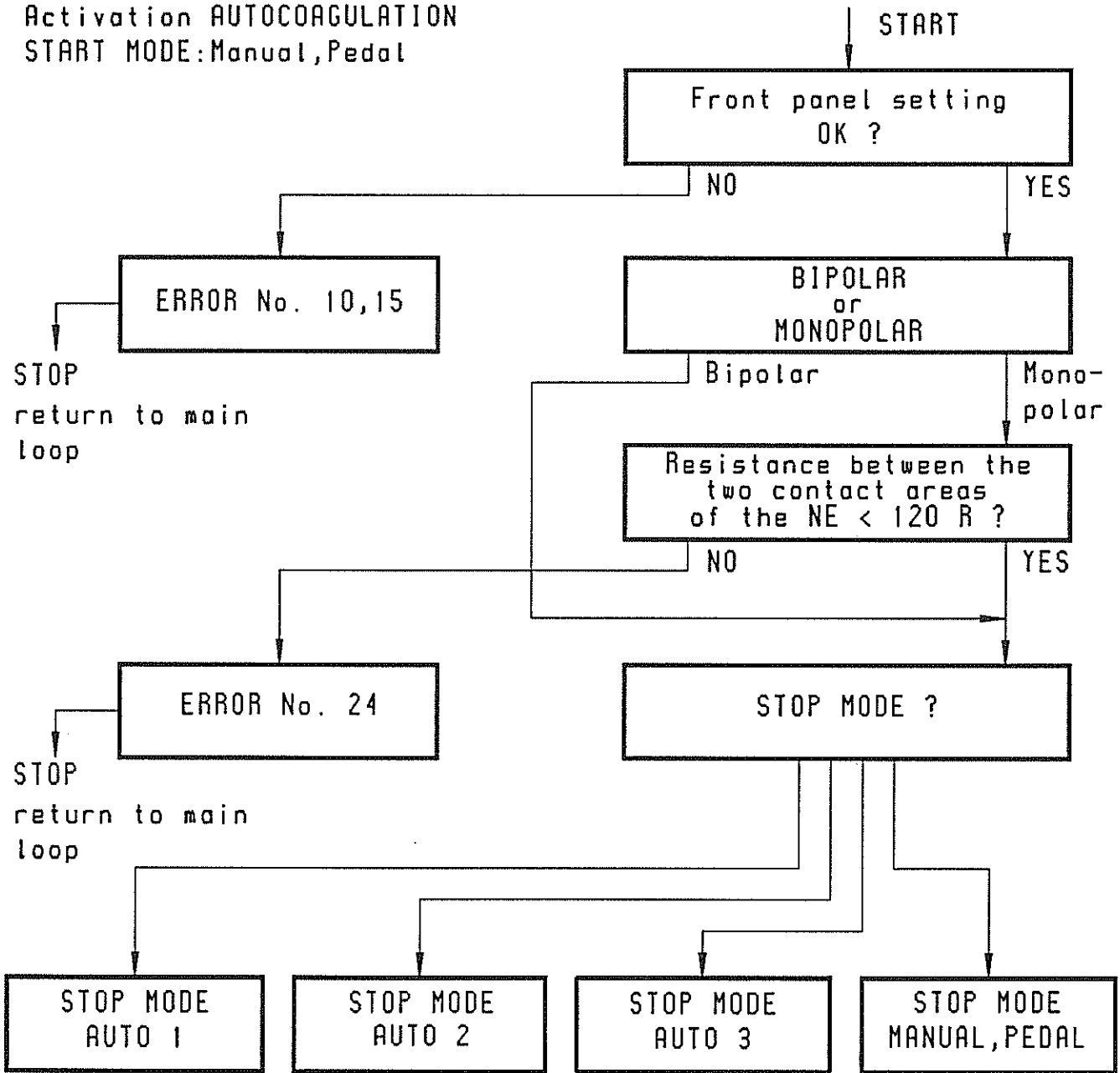


<b>ERBE</b> 7400 Tübingen	FLOWCHART		Date	Name
	Unit: Erbotom ACC450, 430, 410		Drawn	23.02.90 Hanisch
			Insp.	
	SOFT Version V2.0		Plan-No.	
			Page-No.	4



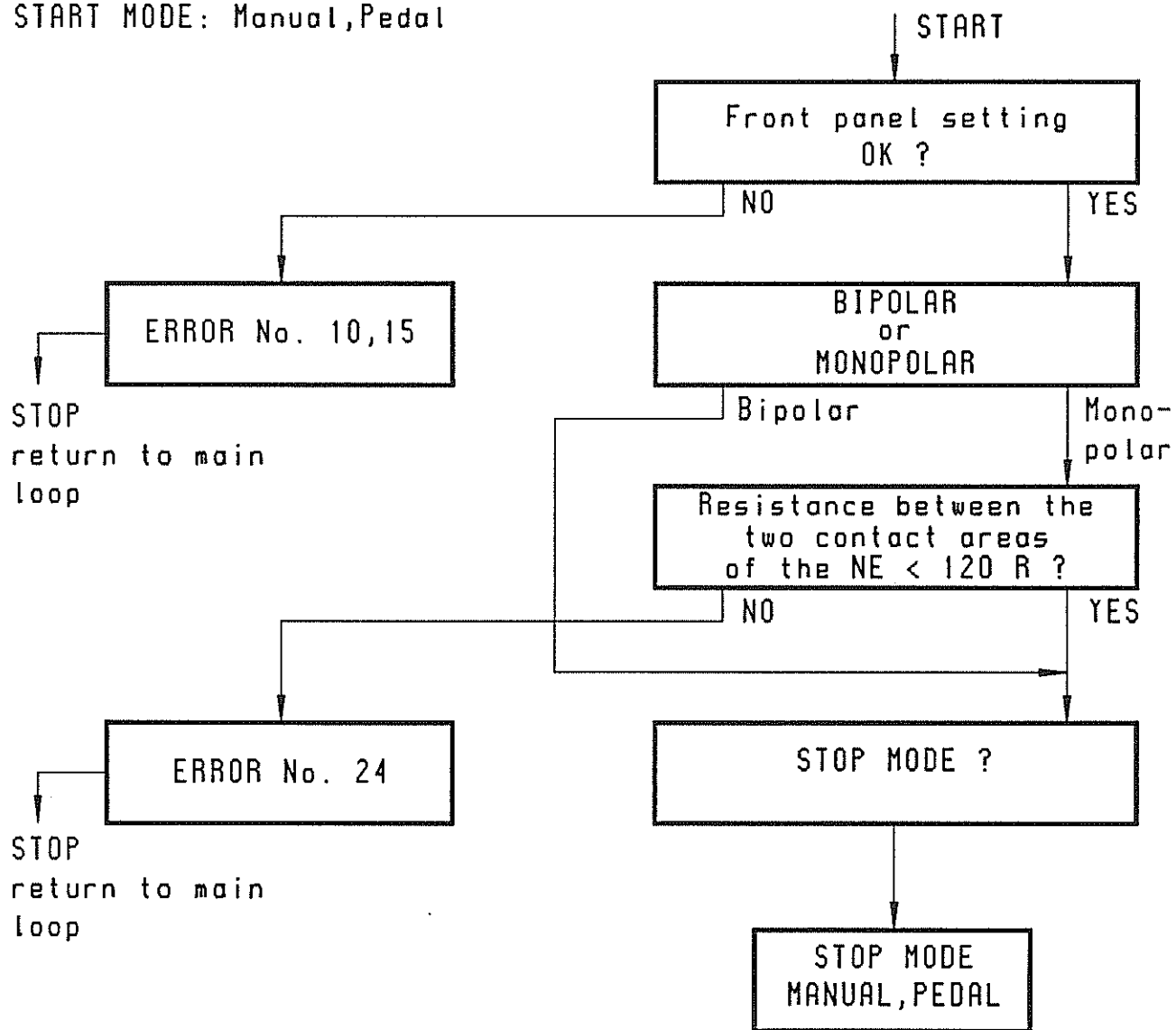
<b>ERBE</b>	FLOWCHART		Datum	Name
	Unit: Erbotom ACC450, 430, 410		Drawn	23.02.90 Hanisch
			Insp.	
	SOFT Version V2.0		Plan-No.	
			Page-Nr.	5

Activation AUTO COAGULATION  
 START MODE: Manual, Pedal



<b>ERBE</b>	FLOWCHART		Date	Name
	Unit: Erbotom ACC 450		Drawn	23.02.90 Hanisch
			Insp.	
	SOFT Version V2.0		Plan-No.	
			Page-No.	6

START MODE: Manual, Pedal



**ERBE**

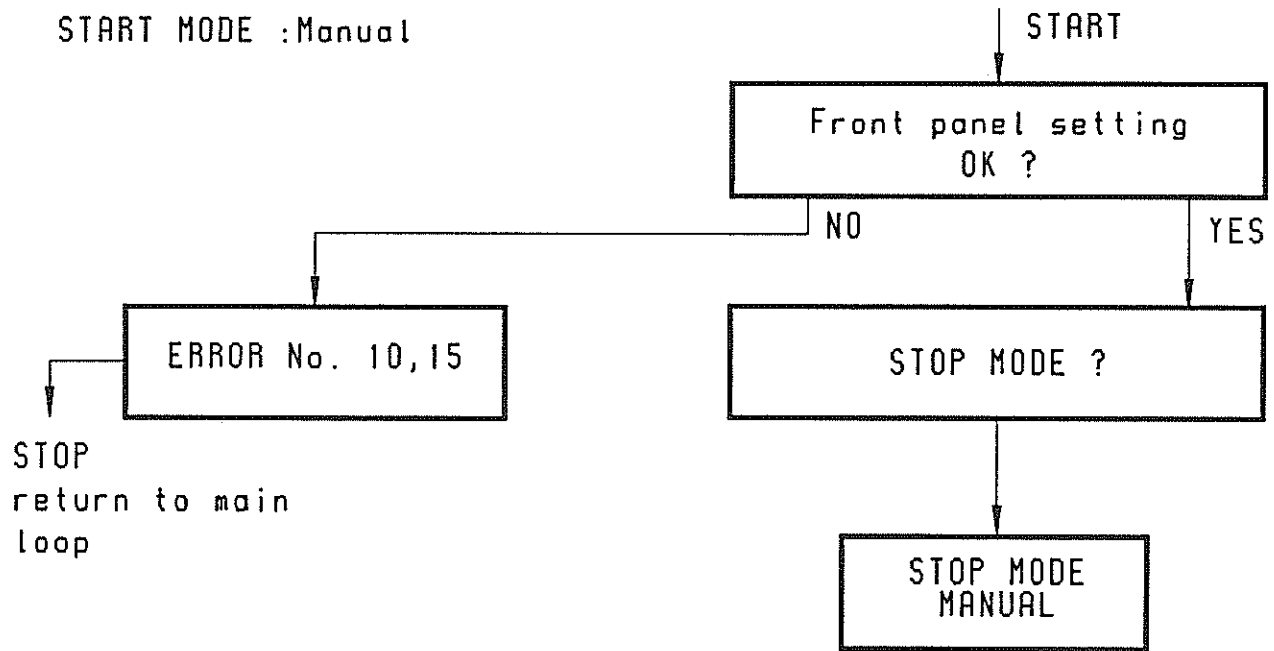
FLOWCHART

Unit: Erbotom ACC 430

SOFT Version V2.0

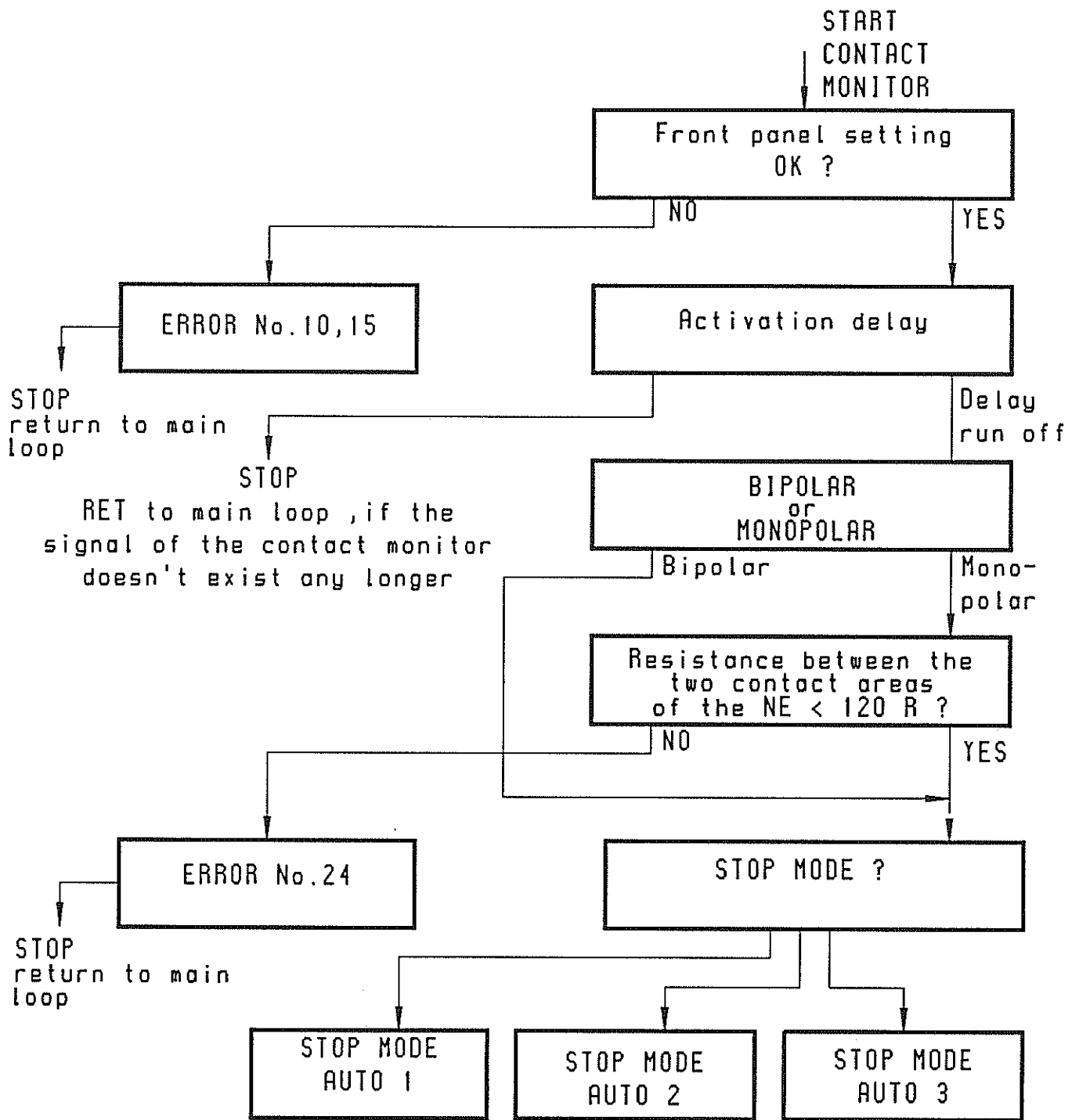
	Date	Name
Drawn	23.02.90	Hanisch
Insp.		
Plan-No.		
Page-No.	7 v.	

START MODE :Manual



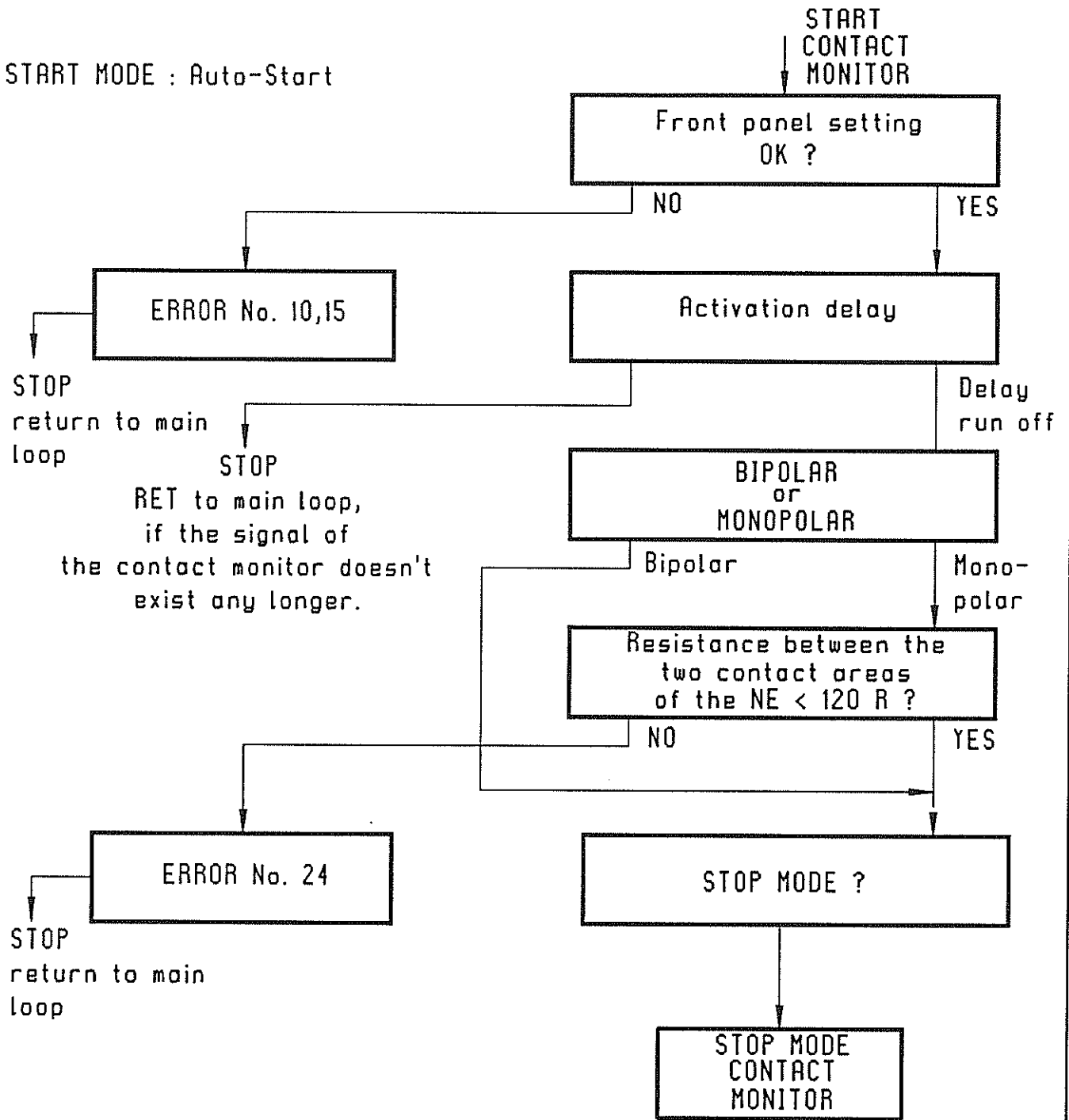
<b>ERBE</b> 7400 Tübingen	FLOWCHART	Date	Name
	Unit:Ebotom ACC410	Drawn 23.02.90	Hanisch
	SOFT Version V2.0	Insp.	
		Plan-No.	
		Page-No.	8





<b>ERBE</b> 7400 Tübingen	FLOWCHART		Date	Name
	Unit: Erbotom ACC 450		Drawn	23.02.90 Hanisch
	SOFT Version V2.0		Insp.	
			Plan-No.	
		Page-No.	9	

START MODE : Auto-Start



**ERBE**

7400 Tubingen

FLOWCHART

Unit:Erbotom ACC430

SOFT Version V2.0

Date

23.02.90

Name

Honisch

Drawn

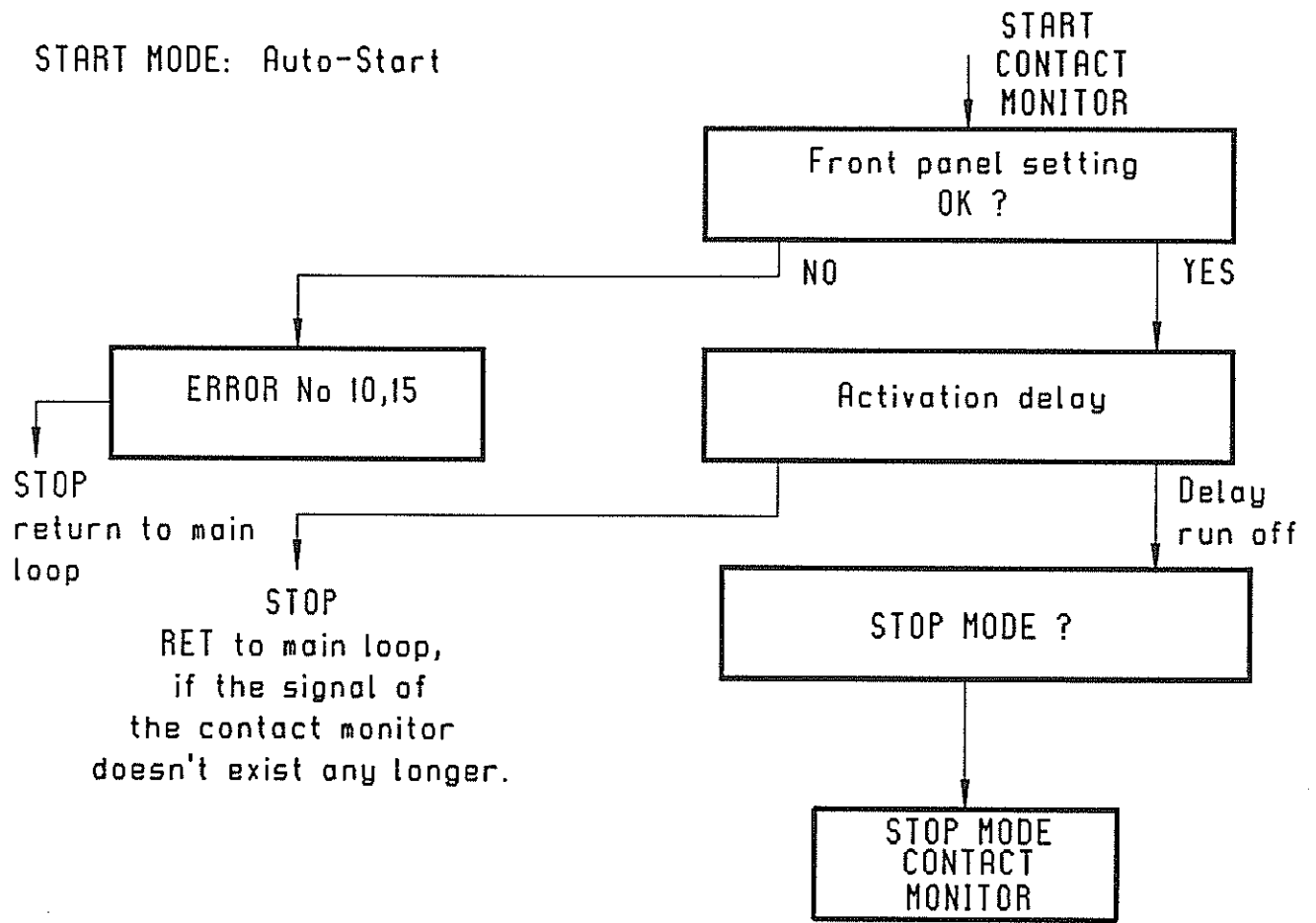
Insp.

Plan-No.

Page-No.

10

START MODE: Auto-Start



**ERBE**

7400 Tübingen

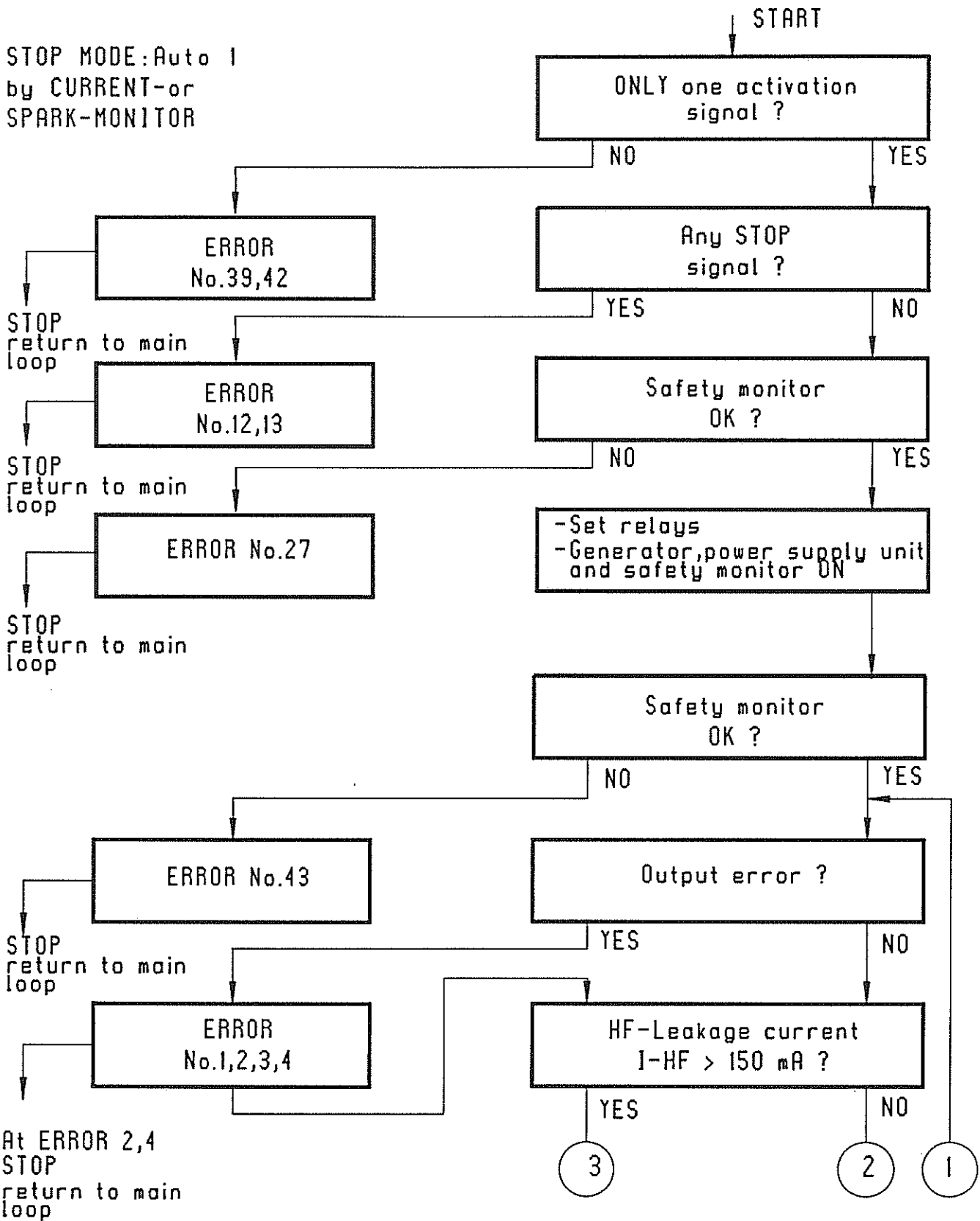
FLOWCHART

Unit: Erbotom ACC410

SOFT Version V2.0

	Date	Name
Drawn	23.02.90	Honisch
Insp.		
Plan-No.		
Page-No.	11	

STOP MODE: Auto 1  
by CURRENT-or  
SPARK-MONITOR



**ERBE**

7400 Tübingen

FLOWCHART

Unit: Erbotom ACC450

SOFT Version V2.0

Date

23.02.90

Name

Hanisch

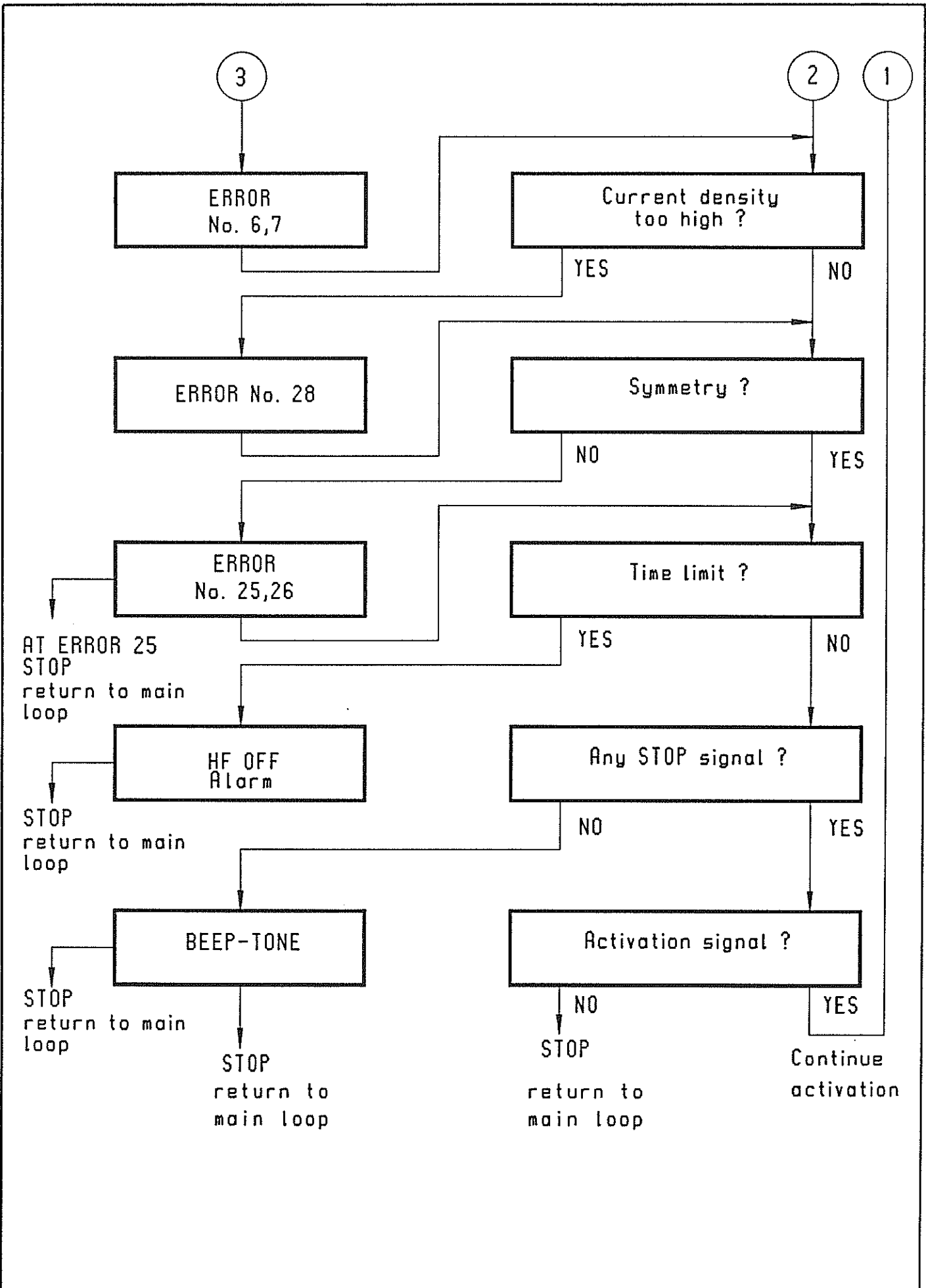
Drawn

Insp.

Plan-No.

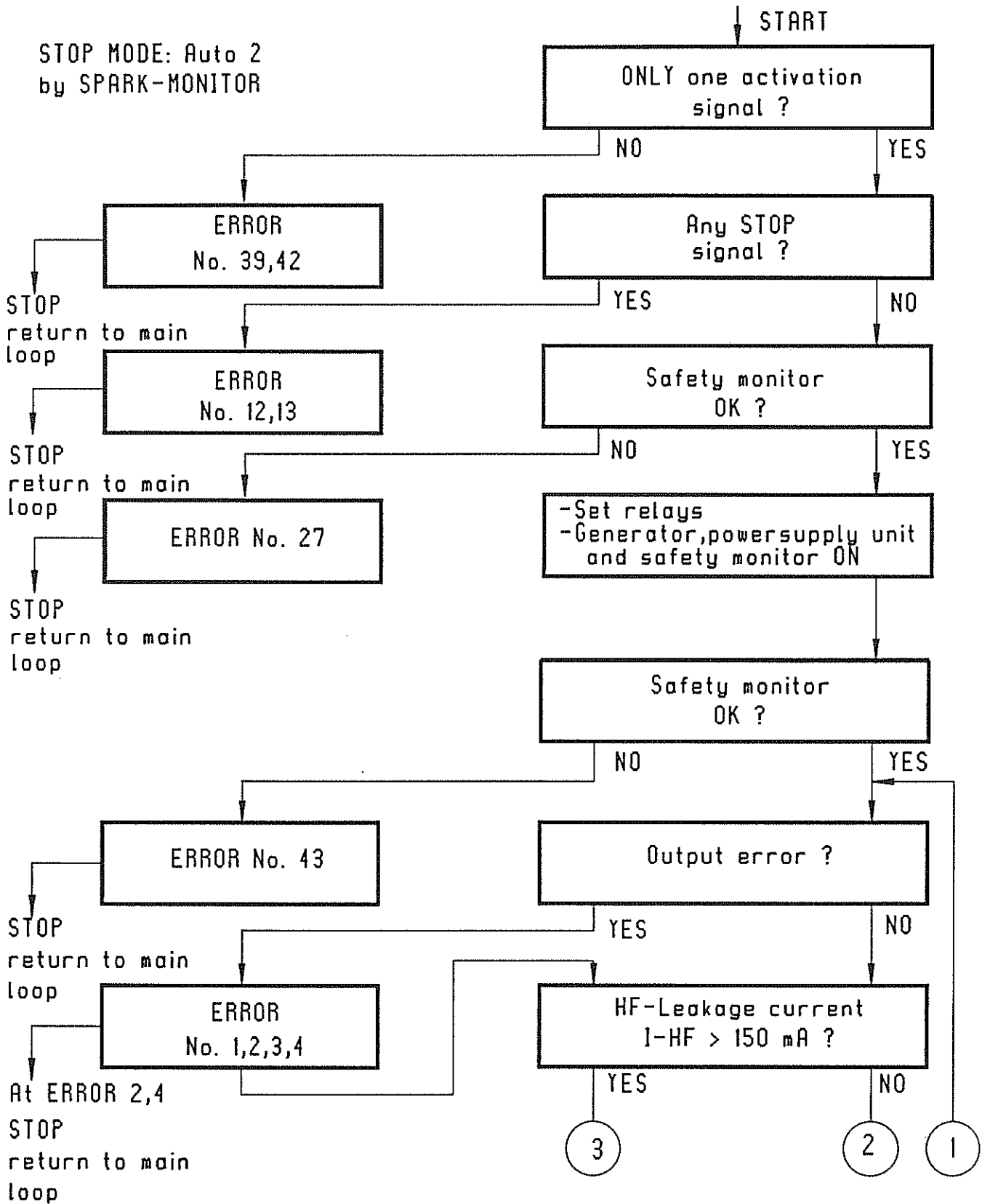
Page-No.

12



<b>ERBE</b> 7400 Tübingen	FLOWCHART		Date	Name
	Unit: Erbotom ACC450,430,410		Drawn	23.02.90 Hanisch
	SOFT Version V2.0		Insp.	
			Plan-No.	
		Page-No.	13	

STOP MODE: Auto 2  
by SPARK-MONITOR



**ERBE**

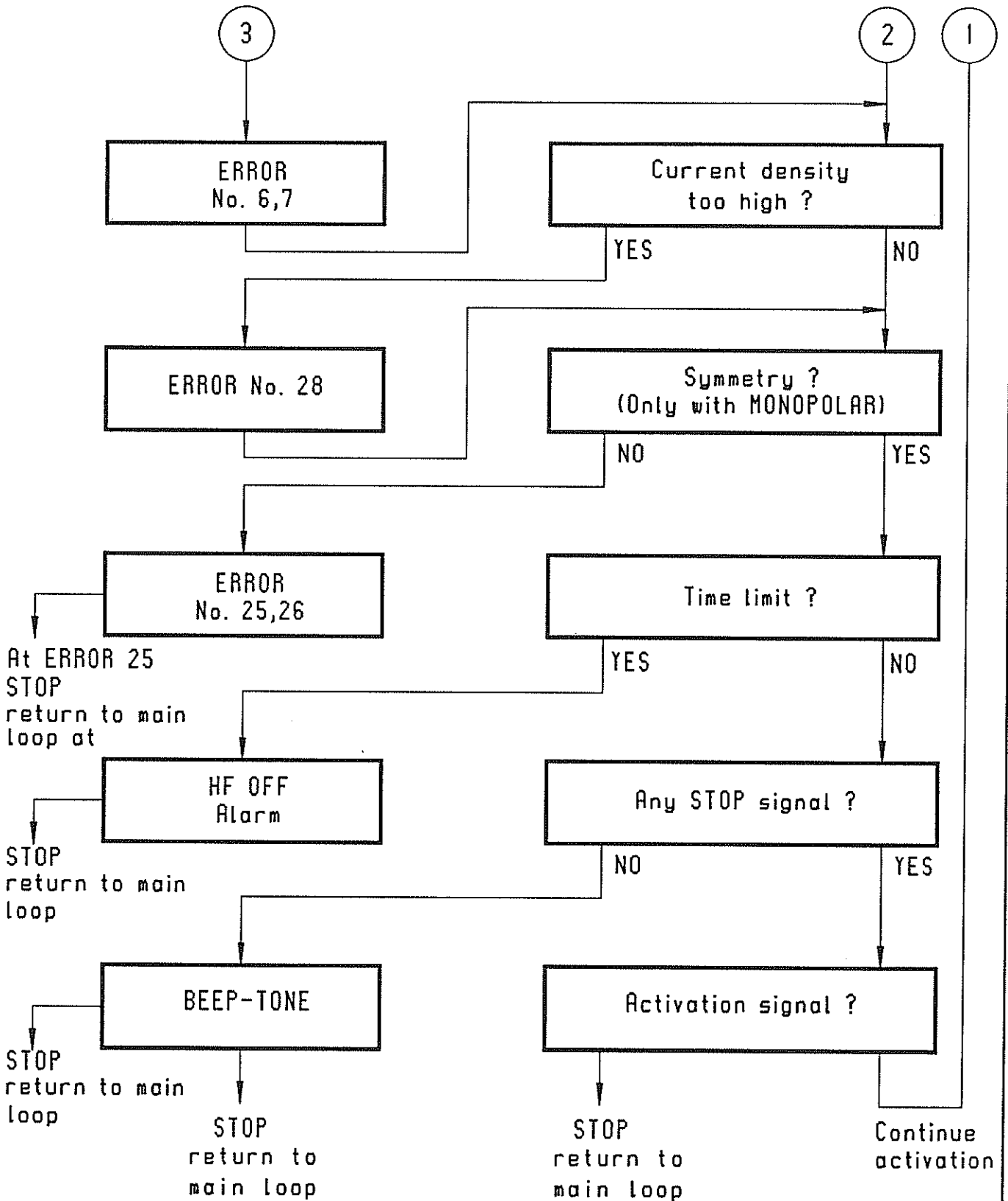
7400 Tübingen

FLOWCHART

Unit: Erbotom ACC450

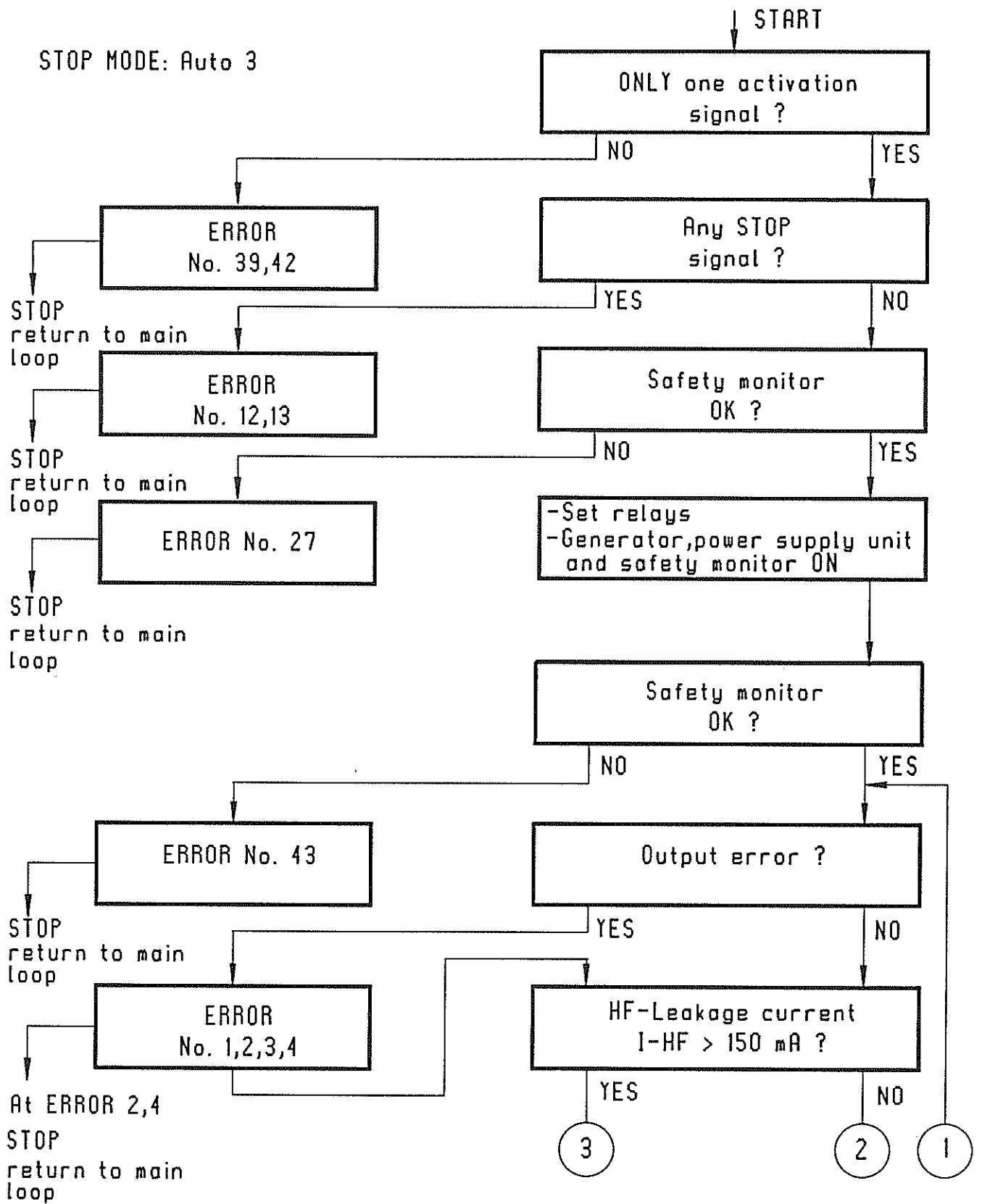
SOFT Version V2.0

	Date	Name
Drawn	23.02.90	Hanisch
Insp.		
Plan-No.		
Page-No.	14	



<b>ERBE</b> 7400 TUBINGEN	FLOWCHART		Date	Name	
	Unit :Erbotom ACC450,430,410		Drawn	23.02.90	Hanisch
			Insp.		
	SOFT Version V2.0		Plan-No.		
			Page-No.	15	

STOP MODE: Auto 3



**ERBE**

7400 Tübingen

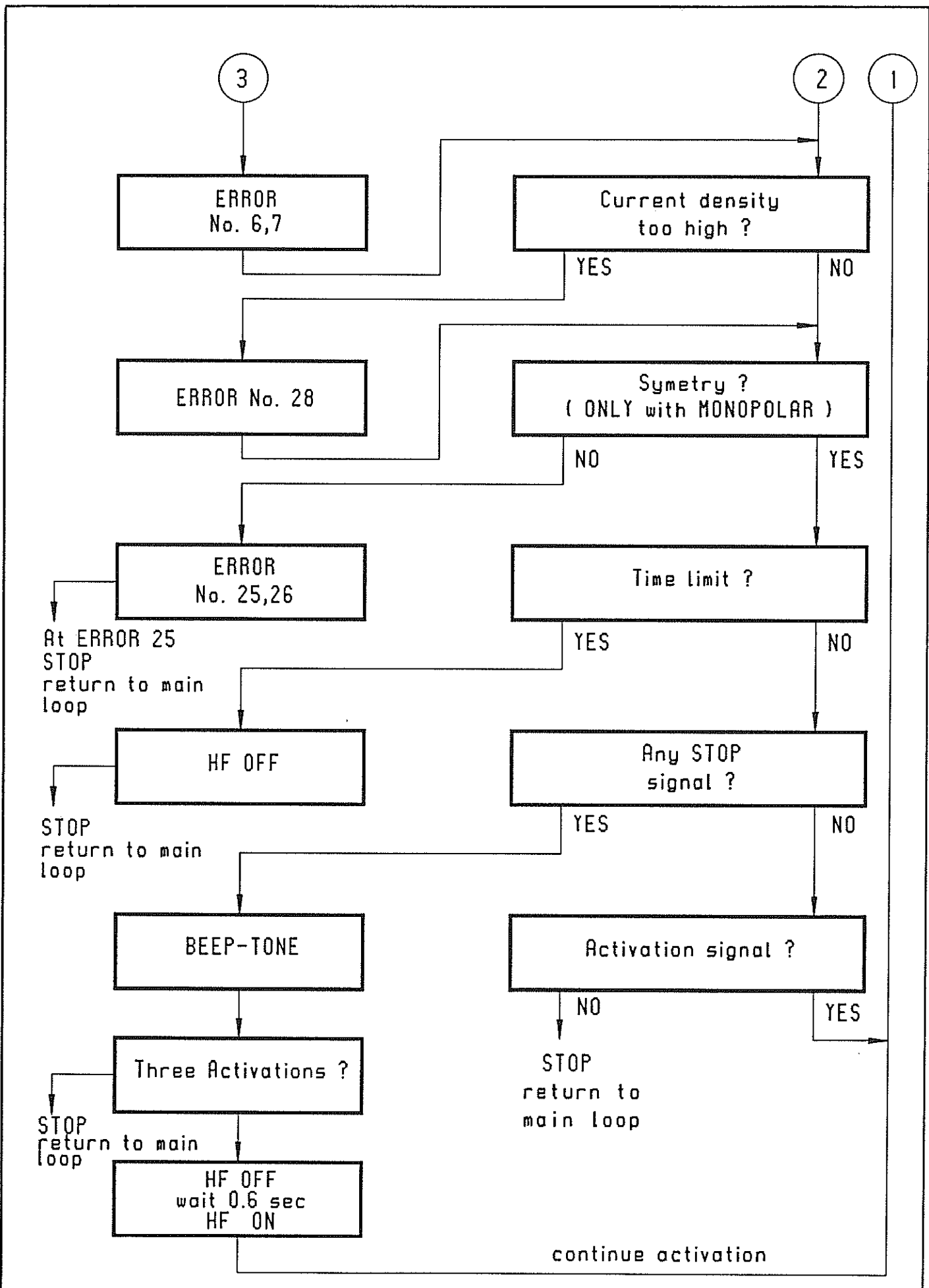
FLOWCHART

Unit: Erbotom ACC450

Soft Version V2.0

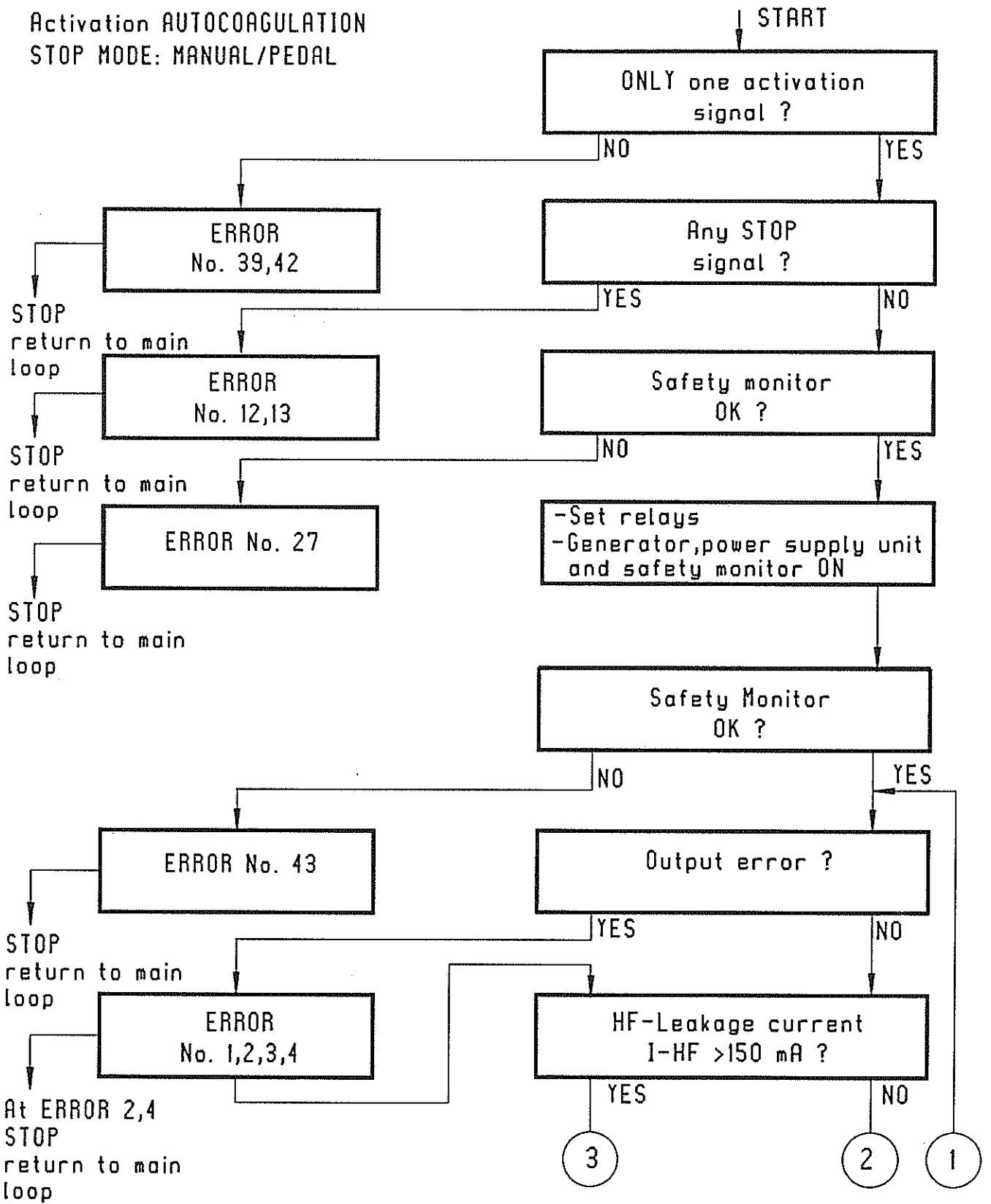
	Date	Name
Drawn	23.02.90	Hanisch
Insp.		
Plan-No.		
Page-No.	16	





<b>ERBE</b> 7400 Tübingen	FLOWCHART		Date	Name	
	Unit: Erbotom ACC450,430,410		Drawn	23.02.90	Hanisch
	SOFT Version V2.0		Insp.		
			Plan-No.		
		Page-No.	17		

Activation AUTOAGGULATION  
STOP MODE: MANUAL/PEDAL



**ERBE**

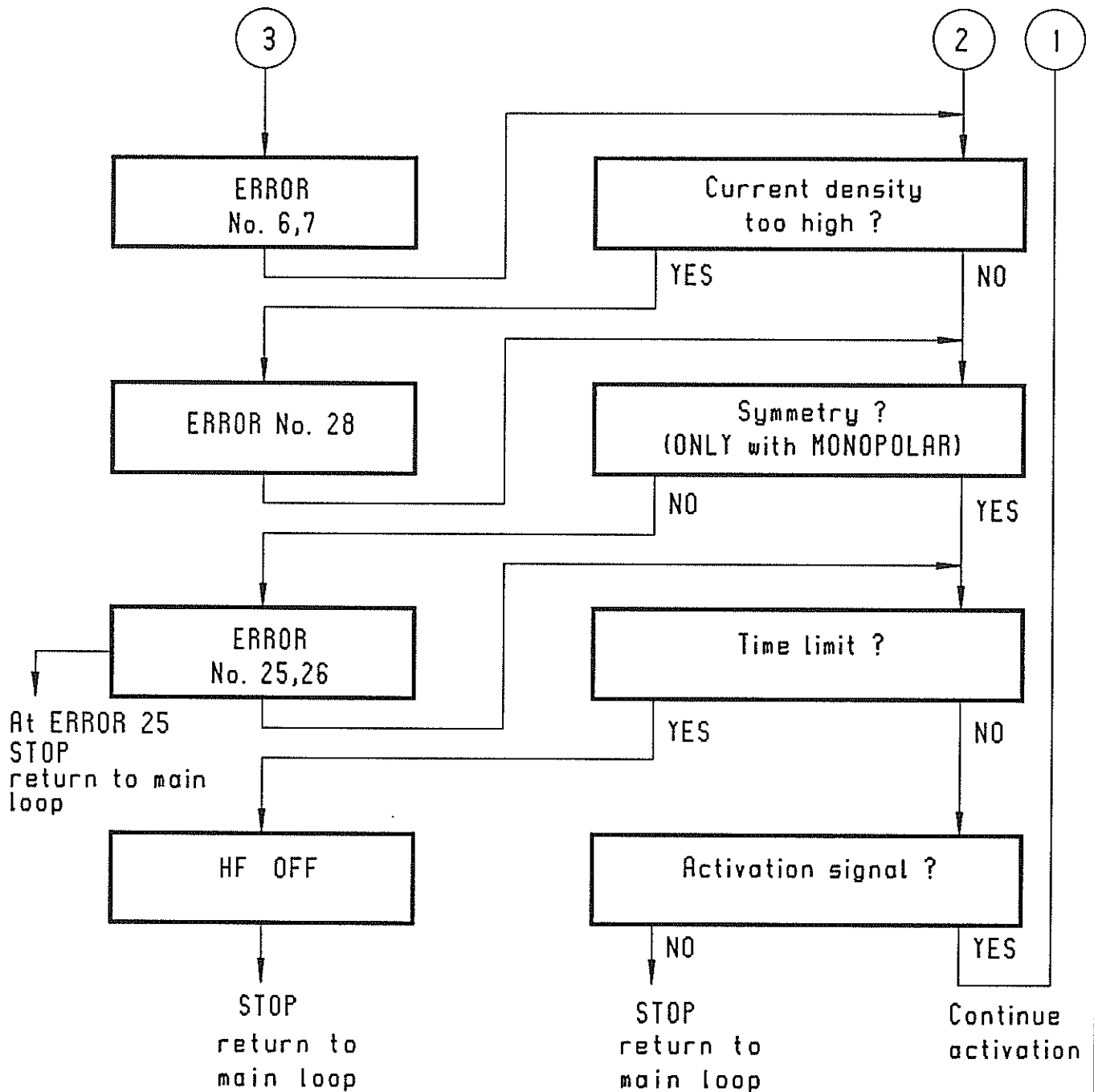
7400 Tubingen

FLOWCHART

Unit: Erbotom ACC450

SOFT Version V2.0

	Date	Name
Drawn.	23.02.90	Hanisch
Insp.		
Plan-No.		
Page-No.	18	



**ERBE**

7400 Tübingen

FLOWCHART

Unit: Erbotom ACC450,430,410

SOFT Version V2.0

Date

23.02.90

Name

Hanisch

Drawn

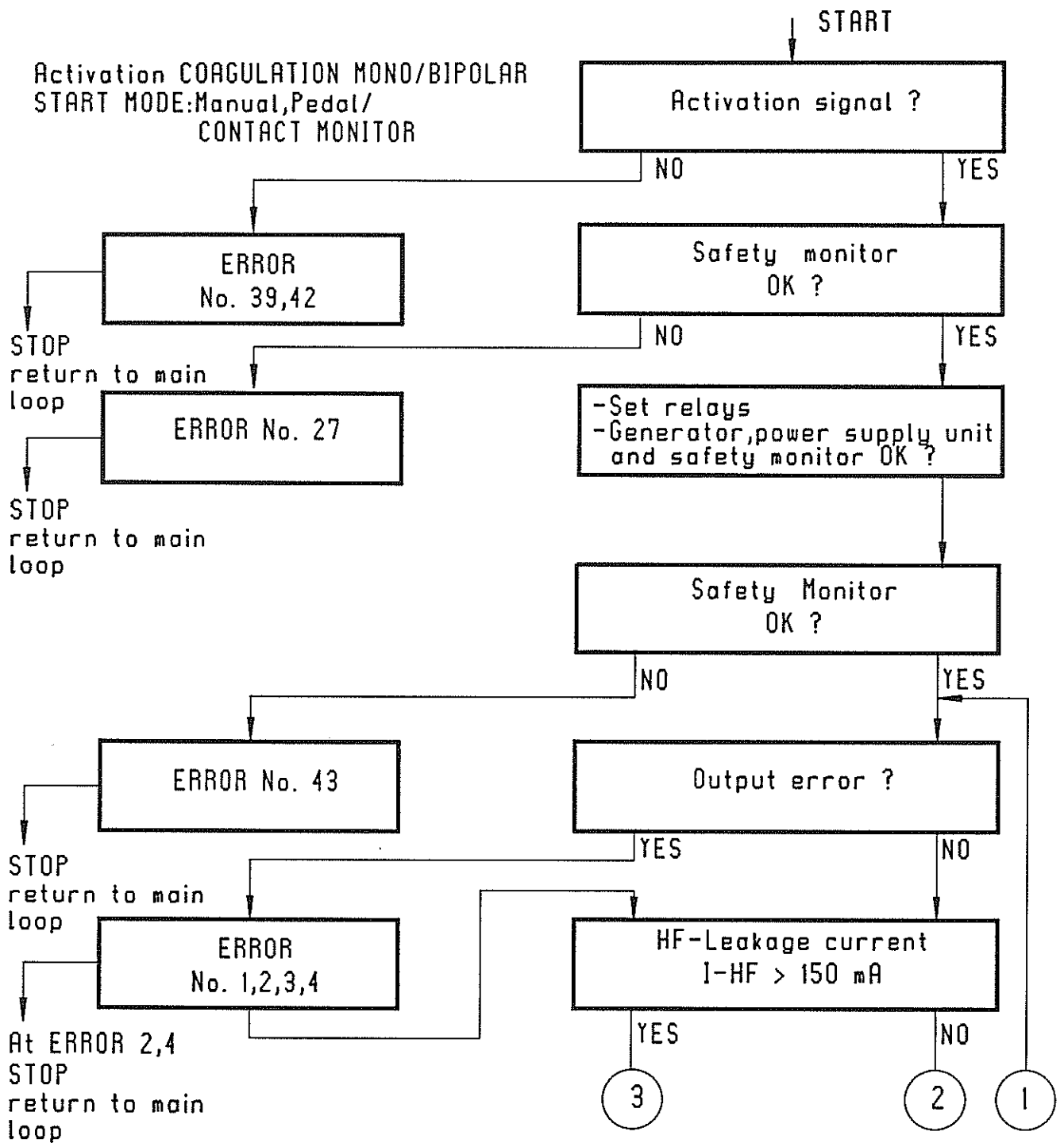
Insp.

Plan-No.

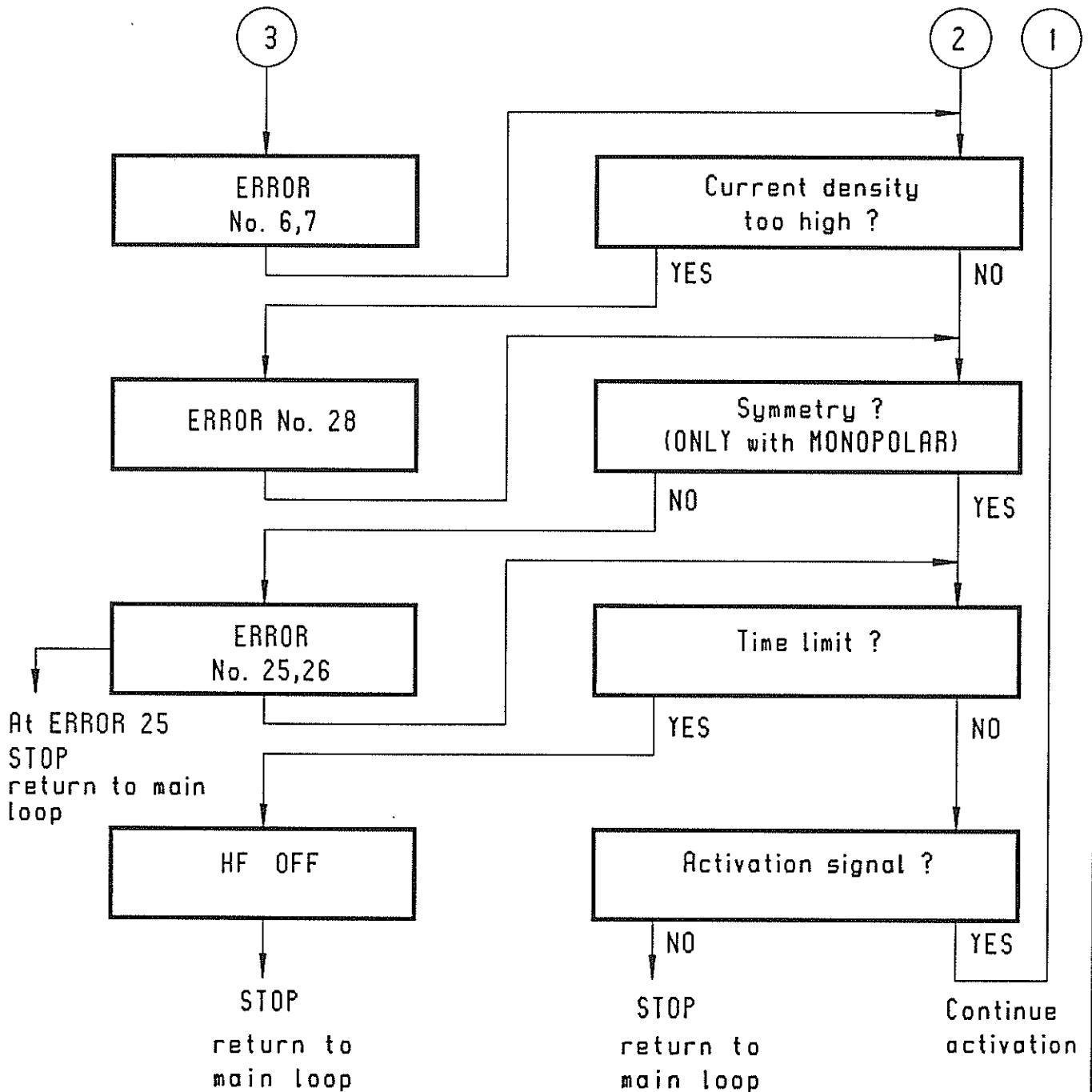
Page-No.

19

Activation COAGULATION MONO/BIPOLAR  
 START MODE: Manual, Pedal/  
 CONTACT MONITOR

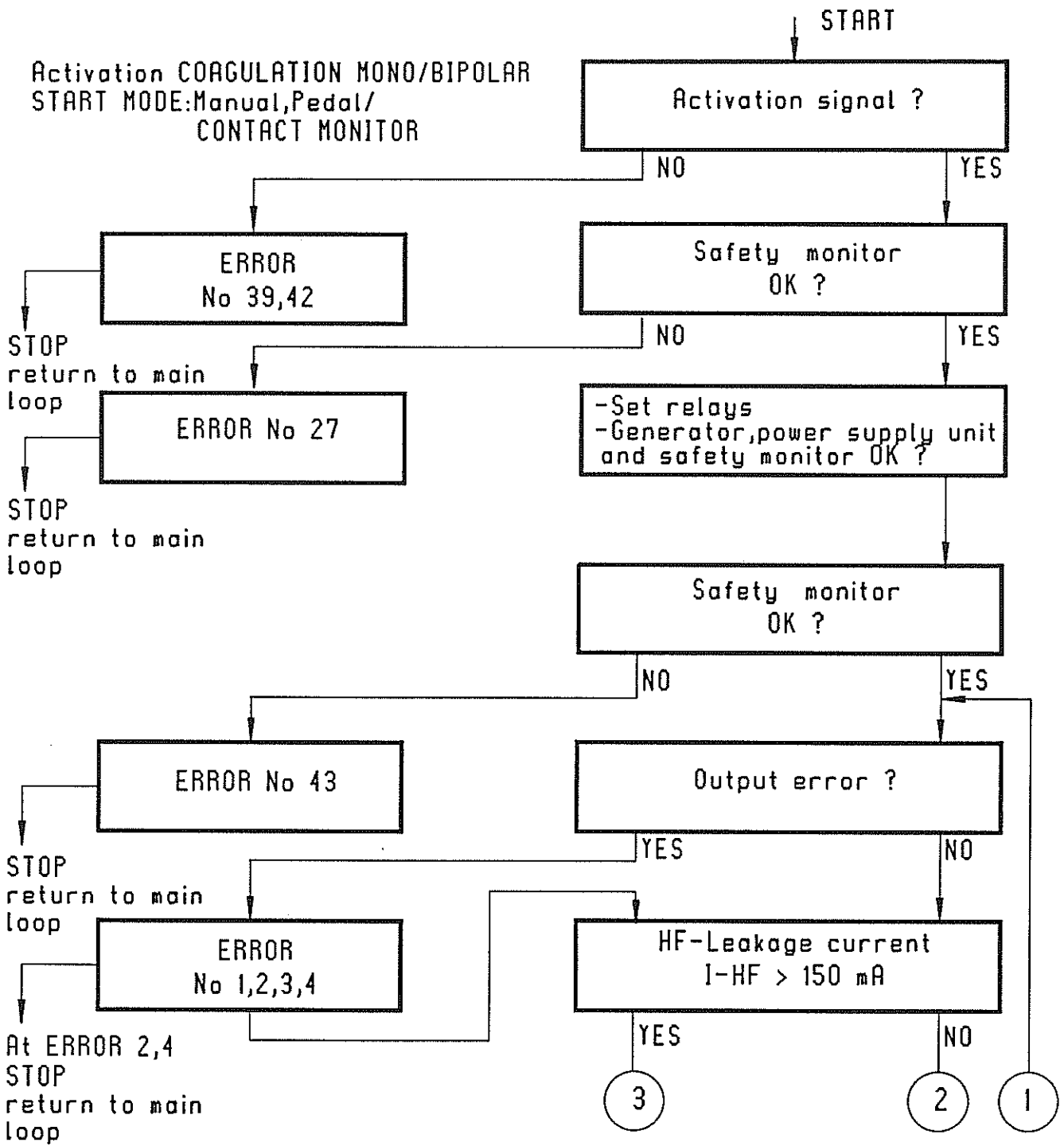


<b>ERBE</b> 7400 Tübingen	FLOWCHART		Date	Name
	Unit: Erbotom ACC430		Drawn	23.02.90 Hanisch
	SOFT Version V2.0		Insp.	
			Plan-No.	
		Page-No.	20	

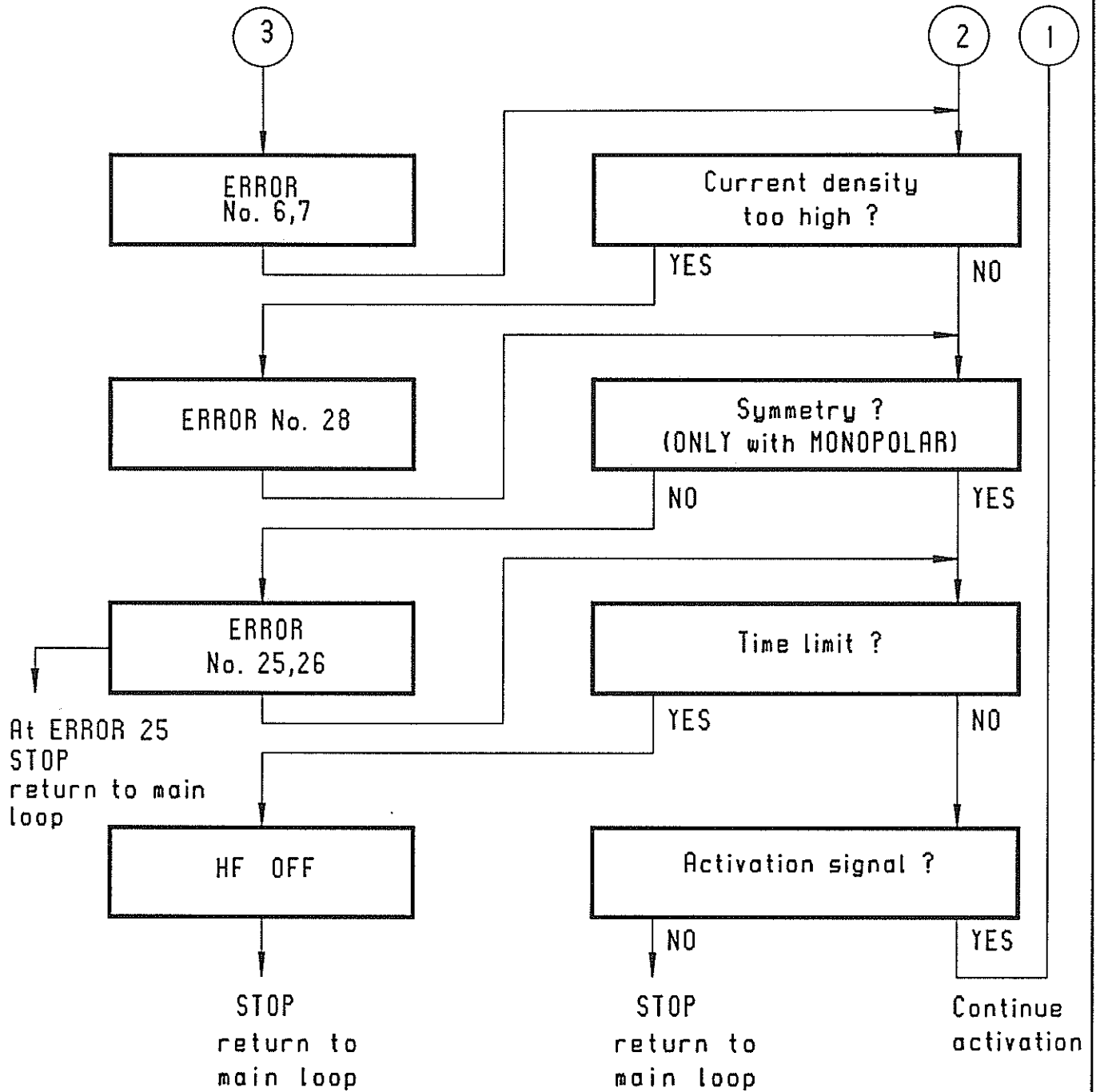


<b>ERBE</b> 7400 Tübingen	FLOWCHART		Date	Name
	Unit: Erbotom ACC450,430,410		Drawn	23.02.90 Hanisch
	SOFT Version V2.0		Insp.	
			Plan-No.	
			Page-No.	21

Activation COAGULATION MONO/BIPOLAR  
 START MODE: Manual, Pedal/  
 CONTACT MONITOR



<b>ERBE</b> 7400 Tübingen	FLOWCHART		Date	Name
	Unit: Erbotom ACC410		Drawn	23.02.90 Hanisch
	SOFT Version V2.0		Insp.	
			Plan-No.	
			Page-No.	22



**ERBE**

7400 Tübingen

FLOWCHART

Unit: Erbotom ACC450,430,410

SOFT Version V2.0

Date

23.02.90

Name

Hanisch

Drawn

Insp.

Plan-No.

Page-No.

23

ext. CONTROL BUS ERROR  
 No. Error Description

---

- 1 Output error - upper limit exceeded by more than 20 %
- 2 Output error - upper limit exceeded by more than 40 %
- 3 Output error - dosage more than 20 % below lower limit
- 4 Output error - no RF-power
- 5 LF leakage current exceeds 50  $\mu$ A
- 6 LF leakage current exceeds 300 mA
- 7 LF leakage current exceeds 150 mA
- 8 CHANNEL C front panel setting incorrect
- 9 CHANNEL C front panel setting incorrect
- 10 CHANNEL C front panel setting incorrect
- 11 not used
- 12 CHANNEL C activation error > current signal present, but no RF-power
- 13 CHANNEL C activation error > spark signal present, but no RF-power
- 14 not used
- 15 CHANNEL C manual activation > wrong START MODE
- 16 not used
- 17 CHANNEL A activation signal present at switch-on
- 18 CHANNEL B activation signal present at switch-on
- 19 CHANNEL C activation signal present at switch-on
- 20 CHANNEL A front panel setting incorrect
- 21 CHANNEL B front panel setting incorrect
- 22 not used
- 23 not used
- 24 NE measurement R > 120 R on activation, (NESSY)
- 25 Unsymmetry shutdown, (NESSY)
- 26 Unsymmetry LED + ALARM, (NESSY)
- 27 Signal from safety circuit ON prior to activation
- 28 Current density signal, (NESSY)
- 29 CHANNEL A activation error, several activation signals
- 30 CHANNEL A activation error, several activation signals
- 31 CHANNEL A activation error, several activation signals
- 32 CHANNEL A activation error, several activation signals
- 33 CHANNEL A activation error, several activation signals
- 34 CHANNEL B activation error, several activation signals
- 35 CHANNEL B activation error, several activation signals
- 36 CHANNEL B activation error, several activation signals
- 37 CHANNEL B activation error, several activation signals
- 38 CHANNEL B activation error, several activation signals
- 39 CHANNEL C activation error, several activation signals
- 40 not used
- 41 not used
- 42 CHANNEL C activation error, several activation signals
- 43 Signal from safety circuit absent on activation
- 44 Basic initialization error
- 45 Front panel pushbutton operation error

**ERBE**  
 D-7400 Tübingen

Instr.: Erbotom ACC450, 430, 410  
 LISTING OF ERROR MESSAGES V2.0

	Date	Name
Drawn	22.01.90	S. Klein
Checked		
Drwg. No.		
Sheet No.	1 of 2	



ext. CONTROL BUS ERROR  
No. Error Description

---

- 46 CHANNEL C front panel setting incorrect
- 47 CHANNEL B SPRAY timer discrepancy exceeding + 20 %
- 48 CHANNEL B SPRAY timer discrepancy exceeding + 40 %
- 49 CHANNEL B SPRAY timer discrepancy exceeding - 20 %
- 50 CHANNEL B SPRAY timer error, no response
- 51 CHANNEL B SPRAY RF-voltage error, incorrect dosage, upper dosage limit exceeded by more than 20 %
- 52 CHANNEL B SPRAY RF-voltage error, incorrect dosage, upper dosage limit exceeded by more than 40 %
- 53 CHANNEL B SPRAY RF-voltage error, incorrect dosage, dosage more than 20 % below lower limit
- 54 CHANNEL B SPRAY RF-voltage error, no RF-voltage

---

ERBE  
D-7400 Tübingen

Instr.: Erbotom ACC450, 430, 410  
LISTING OF ERROR MESSAGES V2.0

	Date	Name
Drawn	22.01.90	S. Klein
Checked		
Drwg. No.		
Sheet No.	2 of 2	

Display on LED-Array

ERROR No. : 1

Failure Mode: 3

### Failure Description

Failure detected during activation of an operating mode.

- Output error RF output voltage exceeds 20 % overrange limit at activation of CUT, SOFT-COAGULATION, or AUTOCOAGULATION.

or:

- Output error, RF output voltage exceeds 20 % overrange limit at activation of FORCED COAGULATION.

### Failure Indication

- Output error indication in SAFETY section of operator panel.

### Potential Causes

- Failure in RF-voltage regulation or in feedback system
- Failure in power supply, RF-generator, or activation line operating units, or of feedback line on the motherboard or on the CPU-board.

### Suggested Remedies

- Replace 400-W power supply unit.  
If problem persists, then:
  - Replace RF-generator unit.  
If problem persists, then:
    - check external control bus using TEST No. 1
    - check feedback line using TEST No. 22
    - check activation lines using TEST No. 5
- If failures are detected in TEST Nos. 1, 22, or 15:
- Replace CPU-board.  
If problem persists, then:
  - Replace motherboard.

Calibration Procedure: Refer to the calibration manual.

ERROR No. : 2

Failure Mode: 3

Failure Description

Failure detected during activation of an operating mode.

- Output error, RF output voltage exceeds 40 % overrange limit at activation of CUT, SOFT-COAGULATION, or AUTOCOAGULATION.

or:

- Output error, RF output voltage exceeds 40 % overrange limit at activation of FORCED COAGULATION.

Failure Indications

- Activation indicator for activated mode will be blinking. Power supply and RF-generator will be shut down.
- Alarm sounds.
- Output error indication in SAFETY section of operator panel.

Failure indications will persist as long as operating mode is activated.

Potential Causes

- Failure in RF-voltage regulation or in feedback system
- Failure in power supply, RF-generator, or activation line operating units, or of feedback line on the motherboard or on the CPU-board.

Suggested Remedies

- Replace 400-W power supply unit.  
If problem persists, then:
- Replace RF-generator unit.  
If problem persists, then:
  - check external control bus using TEST No. 1
  - check feedback line using TEST No. 22
  - check activation lines using TEST No. 5

If failures are detected in TEST Nos. 1, 22, or 15:

- Replace CPU-board.  
If problem persists, then:
- Replace motherboard.

Calibration Procedure: Refer to the calibration manual.

Display on LED-Array

ERROR No. : 3

Failure Mode: 3

### Failure Description

Failure detected during activation of an operating mode.

- Output error, RF output voltage below 20 % underrange limit at activation of CUT, SOFT-COAGULATION, or AUTO-COAGULATION.

or:

- Output error, power supply output voltage belows 20 % underrange limit at activation of FORCED COAGULATION.

### Failure Indication

- Output error indication in SAFETY section of operator panel.

### Potential Causes

- Failure in RF-voltage regulation or in feedback system
- Output-current limiter actuating too early.
- Failure in power supply, RF-generator, or activation line operating units, or of feedback line on the motherboard or on the CPU-board.

### Suggested Remedies

- Replace 400-W power supply unit.  
If problem persists, then:
  - Replace RF-generator unit.  
If problem persists, then:
    - check external control bus using TEST No. 1
    - check feedback line using TEST No. 22
    - check activation lines using TEST No. 5
- If failures are detected in TEST Nos. 1, 22, or 15:
- Replace CPU-board.  
If problem persists, then:
  - Replace motherboard.

Calibration Procedure: Refer to the calibration manual.

ERROR No. : 4

Failure Mode: 3

Failure Description

Failure detected during activation of an operating mode.

- Output error, RF output voltage absent at activation of CUT, SOFT-COAGULATION, or AUTOAGULATION.

or:

- Output error, power supply output voltage absent at activation of FORCED COAGULATION.

Failure Indications

- Activation indicator for activated mode will be blinking. Power supply and RF-generator will be shut down.
- Alarm sounds.
- Output error indication in SAFETY section of operator panel.

Failure indications will persist as long as operating mode is activated.

Potential Causes

- Short in RF output circuit.
- Failure in RF-voltage regulation or in feedback system
- Failure in power supply, RF-generator, or activation line operating units, or of feedback line on the motherboard or on the CPU-board.

Suggested Remedies

- Replace 400-W power supply unit.  
If problem persists, then:
- Replace RF-generator unit.  
If problem persists, then:
  - check external control bus using TEST No. 1
  - check feedback line using TEST No. 22
  - check activation lines using TEST No. 5If failures are detected in TEST Nos. 1, 22, or 15:
- Replace CPU-board.  
If problem persists, then:
- Replace motherboard.

Calibration Procedure: Refer to the calibration manual.

Display on LED-Array

ERROR No. : 5

Failure Mode: 2

### Failure Description

The neutral electrode is capacitively grounded in STANDBY-mode. The low-frequency leakage current measurement system is active.

If leakage current exceeds 50  $\mu$ A, capacitive grounding of the neutral electrode will be interrupted and all outputs will be disconnected. The LF leakage current indicator will be actuated. The instrument cannot be activated. Reset by switching off the line voltage.

### Failure Indications

- Alarm sounds.
- LF leakage current indicator in SAFETY section of operator panel actuates.

Failure indications will be present at all times.

### Potential Causes

- LF leakage current actually present.
- Failure on relay board with its LF leakage current measurement circuit, board slot J14, or of feedback line on the motherboard or on the CPU-board.
- LF leakage current signal triggered by failure of - 15 VDC supply.

### Suggested Remedies

- Replace relay board, LF leakage current measurement circuit, connector J14.

If problem persists, then:

- check feedback line using TEST No. 21
- check - 15 VDC supply voltage, test point J2.

If a failure is detected in TEST No. 21:

- Replace CPU-board.  
If problem persists, then:
- Replace motherboard.

### Calibration Procedure:

None required. The "LF leakage current and relay" board is factory calibrated.

**ERBE**  
D-7400 Tübingen

LISTING OF ERROR MESSAGES  
Instr.: Erbotom ACC450, 430  
SOFT Version V2.0

	Date	Name
Drawn	22.01.90	
Checked		
Drwg. No.		
Sheet No.		

Display on LED-Array

ERROR No. : 6

Failure Mode: 3

Failure Description

Failure detected during activation of an operating mode.

- RF leakage current exceeds 150 mA

Failure Indication

- RF leakage current indicator in SAFETY section of operator panel actuates.

Potential Causes

- RF leakage current actually present.
- Failure of RF leakage current measurement unit, or of feedback line on motherboard or CPU-board.

Suggested Remedies

- Replace RF leakage current measurement unit.  
If problem persists, then:
  - check external control bus using TEST No. 1
  - check feedback line using TEST No. 20

If a failure is detected in TEST Nos. 1 or 20:

- Replace CPU-board.  
If problem persists, then:
- Replace motherboard.

Calibration Procedure:

None required. The "RF leakage current" board is factory calibrated.

Display on LED-Array

ERROR No. : 7

Failure Mode: 3

Failure Description

Failure detected during activation of an operating mode.

- RF leakage current exceeds 300 mA

Failure Indications

- RF leakage current indicator in SAFETY section of operator panel actuates.
- Alarm sounds.

Potential Causes

- RF leakage current actually present.
- Failure of RF leakage current measurement unit, or of feedback line on motherboard or CPU-board.

Suggested Remedies

- Replace RF leakage current measurement unit.  
If problem persists, then:
  - check external control bus using TEST No. 1
  - check feedback line using TEST No. 20

If a failure is detected in TEST Nos. 1 or 20:

- Replace CPU-board.  
If problem persists, then:
- Replace motherboard.

Calibration Procedure:

None required. The "RF leakage current" board is factory calibrated.



Display on LED-Array

ERROR No. : 8

Failure Mode:

Not used.

Display on LED-Array

ERROR No. : 9

Failure Mode: 2

Failure Description

Failure detected on depression of AUTO option for START-MODE of AUTOCOAGULATION section of operating panel.

Failure Indications

- Activation indicator in AUTOCOAGULATION section of operator panel blinking.
- Alarm sounds.

Failure indications will persist as long as the button is held depressed. START MODE will proceed when the button is released.

Potential Causes

- Contact signal present at button depression.
- External contact present.
- Failure in contact-monitor unit, or of feedback line on motherboard or CPU-board.

Suggested Remedies

- Check for presence of external contact.
- Replace contact-monitor unit, board slot J10.  
If problem persists, then:
  - check external control bus using TEST No. 1
  - check feedback line using TEST No. 22

If a failure is detected in TEST Nos. 1 or 22:

- Replace CPU-board.  
If problem persists, then:
- Replace motherboard.

Calibration Procedure:

None required. The "contact-monitor" board is factory calibrated.

Display on LED-Array

ERROR No. : 10

Failure Mode: 2

### Failure Description

Failure detected on activation of AUTOACOAGULATION mode.

- Invalid front-panel settings;  
AUTOACOAGULATION mode selection incompletely confirmed.

### Failure Indications

- Activation indicator in AUTOACOAGULATION section of operator panel blinking.
- Alarm sounds.

Failure indications will persist as long as operating mode is activated.

### Potential Causes

- AUTOACOAGULATION mode front-panel settings incomplete.
- Failure on the CPU-board or in RAM.

### Suggested Remedies

- Perform all settings needed for AUTOACOAGULATION mode.  
If problem persists, then:
- Replace CPU-board.

### Calibration Procedure:

No calibration required.

Display on LED-Array

ERROR No. : 1 1

Failure Mode:

Not used.

Display on LED-Array

ERROR No. : 12

Failure Mode: 2

### Failure Description

Failure detected on activation of AUTOAGULATION mode.

- Monitoring signal to shutdown system while CURRENT active is present, even though the operating mode is not yet activated.

### Failure Indications

- Activation indicator in AUTOAGULATION section of operator panel blinking.
- Alarm sounds.

Failure indications will persist as long as operating mode is activated.

### Potential Causes

- Failure in contact-monitor unit or spark-current monitor, or of feedback line on motherboard or CPU-board.

### Suggested Remedies

- Replace contact-monitor unit and spark-current monitor.  
If problem persists, then:
  - check external control bus using TEST No. 1
  - check feedback line using TEST No. 22If a failure is detected in TEST Nos. 1 or 22:
- Replace CPU-board.  
If problem persists, then:
- Replace motherboard.

### Calibration Procedure:

None required. The monitor board is factory calibrated.

Display on LED-Array

ERROR No. : 13

Failure Mode: 2

### Failure Description

Failure detected on activation of AUTOACOAGULATION mode.

- Monitoring signal to shutdown system while SPARK active is present, even though the operating mode is not yet activated.

### Failure Indications

- Activation indicator in AUTOACOAGULATION section of operator panel blinking.
- Alarm sounds.

Failure indications will persist as long as operating mode is activated.

### Potential Causes

- Failure of contact monitor, spark current monitor, or of feedback line on motherboard or CPU-board.

### Suggested Remedies

- Replace contact monitor unit and spark current monitor.  
If problem persists, then:

- check external control bus using TEST No. 1
- check feedback line using TEST No. 22

If a failure is detected in TEST Nos. 1 or 22:

- Replace CPU-board.  
If problem persists, then:
- Replace motherboard.

### Calibration Procedure:

None required. The "contact-monitor" board is factory calibrated.

Display on LED-Array

ERROR No. : 14

Failure Mode:

Not used.

Display on LED-Array

ERROR No. : 15

Failure Mode: 2

### Failure Description

Failure detected on activation of AUTOCOAGULATION mode.

- Activation was attempted using finger-switch.  
START MODE is set to AUTO or PEDAL, or no START MODE setting has been selected.

### Failure Indications

- Activation indicator in AUTOCOAGULATION section of operator panel blinking.
- Alarm sounds.

Failure indications will persist as long as operating mode is activated.

### Potential Causes

- AUTOCOAGULATION mode front-panel settings incorrect.

### Suggested Remedies

- Correct all AUTOCOAGULATION mode front-panel settings.

### Calibration Procedure:

No calibration required.



Display on LED-Array

ERROR No. : 16

Failure Mode:

Not used.

Display on LED-Array

ERROR No. : 17

Failure Mode: 1

### Failure Description

Failure detected on switching on the instrument.

- Activation signal from finger-switch or foot-switch for the CUT operating mode present when the instrument is switched on.

### Failure Indications

- Activation indicator in CUT section of operator panel blinking.

- Alarm sounds.

Failure indications will persist while operating mode is activated.

### Potential Causes

- External activation due to defective foot-switch, defective finger-switch, or defective cabling.

- Internal activation due to defective foot-switch, defective finger-switch, or defective cabling.

### Suggested Remedies

- Disconnect foot-switch and finger-switch from instrument, and replace if indicated. If the problem persists, then the instrument itself is at fault.

- If the LED on the finger-switch monitor board for CHANNEL A is lit, replace the finger-switch monitor board. If the problem persists, then:

- check external control bus using TEST No. 1
- check finger-switch signal line for CHANNEL B using TEST No. 20
- check foot-switch signal line for CHANNEL A using TEST No. 21

If a failure is detected in TEST Nos. 1, 20, or 21:

- Check foot-switch connector jack; replace CPU-board. If problem persists, then:

- Replace motherboard.

### Calibration Procedure:

The finger-switch monitor board requires no calibration.

Display on LED-Array

ERROR No. : 18

Failure Mode: 1

### Failure Description

Failure detected on switching on the instrument.

- Activation signal from finger-switch or foot-switch for the COAGULATION operating mode present when the instrument is switched on.

### Failure Indications

- Activation indicator in COAGULATION section of operator panel blinking.
- Alarm sounds.

Failure indications will persist while operating mode is activated.

### Potential Causes

- External activation due to defective foot-switch, defective finger-switch, or defective cabling.
- Internal activation due to defective foot-switch, defective finger-switch, or defective cabling.

### Suggested Remedies

- Disconnect foot-switch and finger-switch from instrument, and replace if indicated. If the problem persists, then the instrument itself is at fault.
- If the LED on the finger-switch monitor board for CHANNEL B is lit, replace the finger-switch monitor board. If the problem persists, then:
  - check external control bus using TEST No. 1
  - check finger-switch signal line for CHANNEL B using TEST No. 20
  - check foot-switch signal line for CHANNEL B using TEST No. 21If a failure is detected in TEST Nos. 1, 20, or 21:
  - Check foot-switch connector jack; replace CPU-board. If problem persists, then:
  - Replace motherboard.

### Calibration Procedure:

The finger-switch monitor board requires no calibration.

Display on LED-Array

ERROR No. : 19

Failure Mode: 1

### Failure Description

Failure detected on switching on the instrument.

- Activation signal from finger-switch or foot-switch for the AUTOCOAGULATION operating mode present when the instrument is switched on.

### Failure Indications

- Activation indicator in AUTOCOAGULATION section blinking.
- Alarm sounds.

Failure indications will persist while operating mode is activated.

### Potential Causes

- External activation due to defective foot-switch, defective finger-switch, defective cabling, or to bipolar or monopolar contact.
- Internal activation due to a defective foot-switch signal line, or a defective finger-switch monitor or contact-monitor.

### Suggested Remedies

- Disconnect foot-switch and finger-switch from instrument, and replace if indicated. If the problem persists, then the instrument itself is at fault.
- Is the LED on the finger-switch monitor board for CHANNEL C lit?  
If so: Replace the finger-switch monitor board.  
If not: Is the LED for "contact" on the contact-monitor board lit?  
Is so: Replace the contact-monitor board.  
If the problem persists, then:
  - check external control bus using TEST No. 1
  - check finger-switch signal line for CHANNEL C using TEST No. 21
  - check foot-switch signal line for CHANNEL C using TEST No. 21
  - check contact-monitor signal line using TEST No. 22If a failure is detected in TEST Nos. 1, 21, or 22:
  - Check foot-switch connector jack; replace CPU-board.  
If problem persists, then:
  - Replace the motherboard.

### Calibration Procedure:

The finger-switch monitor board requires no calibration. The contact-monitor board is factory calibrated.

Display on LED-Array

ERROR No. : 20

Failure Mode: 2

Failure Description

Failure detected on activation of CUT mode.

- CUT-mode front-panel settings invalid.

Failure Indications

- Activation indicator in CUT section of operator panel blinking.
- Alarm sounds.

Failure indications will persist as long as operating mode is activated.

Potential Causes

- CUT-mode front-panel settings incomplete.
- Failure on CPU-board or in RAM.

Suggested Remedies

- Perform all settings needed for CUT mode.  
If problem persists, then:
- Replace CPU-board.

Calibration Procedure:

No calibration required.

Display on LED-Array

ERROR No. : 21

Failure Mode: 2

Failure Description

Failure detected on activation of COAGULATION mode.

- COAGULATION-mode front-panel settings invalid.

Failure Indications

- Activation indicator in COAGULATION section of operator panel blinking.
- Alarm sounds.

Failure indications will persist as long as operating mode is activated.

Potential Causes

- COAGULATION-mode front-panel settings incomplete.
- Failure on CPU-board or in RAM.

Suggested Remedies

- Perform all settings needed for COAGULATION MODE.  
If problem persists, then:
- Replace CPU-board.

Calibration Procedure:

No calibration required.

Display on LED-Array

ERROR No. : 22

Failure Mode:

Not used.

Display on LED-Array

ERROR No. : 23

Failure Mode:

Not used.



Failure Description

Failure detected on activation of an operating mode.

- Measured impedance of neutral electrode greater than 120 Ohms.

Failure Indications

- Operator-panel activation indicator for activated operating mode blinking.
- Alarm sounds.
- NE-TEST indicator in SAFETY section of operator panel blinking.

Failure indications will persist as long as an operating mode is activated.

Potential Causes

- Neutral electrode not applied, or incorrectly applied.
- Problem with neutral electrode cable.
- Failure of NESSY NE-measurement unit or of feedback line on motherboard or CPU-board.

Suggested Remedies

- Check neutral electrode and its cable.  
If problem still exists, then:
  - Replace NESSY NE-measurement unit.  
If problem persists, then:
    - check external control bus using TEST No. 1
    - check NE feedback-frequency line using TEST No. 22
- If a failure is detected in TEST Nos. 1 or 22:
- Replace CPU-board.  
If problem persists, then:
  - Replace motherboard.

Calibration Procedure:

The "NESSY" NE-measurement board is factory calibrated.

Display on LED-Array

ERROR No. : 25

Failure Mode: 3

### Failure Description

Failure detected on activation of an operating mode.

- Unsymmetry of the neutral electrode surface.  
Limiting value reached: the RF-generator and power supply are shut-off.

### Failure Indications

- Operator-panel activation indicator for activated operating mode blinking.
- Alarm sounds.
- NE-TEST indicator in SAFETY section of operator panel blinking.

Failure indications will persist as long as an operating mode is activated.

### Potential Causes

- Unsymmetry exists because neutral electrode is incorrectly applied.
- Failure of NESSY NE-measurement unit or of feedback line on mother-board or CPU-board.

### Suggested Remedies

- Check if neutral electrode is correctly applied.  
If problem still exists, then:
  - Replace NESSY NE-measurement unit.  
If problem persists, then:
    - check external control bus using TEST No. 1
    - check symmetry feedback line using TEST No. 20
- If a failure is detected in TEST Nos. 1 or 20:
- Replace CPU-board.  
If problem persists, then:
  - Replace motherboard.

### Calibration Procedure:

The "NESSY" NE-measurement board is factory calibrated.

Failure Description

Failure detected on activation of an operating mode.

- Unsymmetry of the neutral electrode surface.  
Limiting value for triggering ALARM.

Failure Indications

- Alarm sounds.
- NE-TEST indicator in SAFETY section of operator panel blinking.

Failure indications will persist as long as the limiting value is exceeded.

Potential Causes

- Unsymmetry exists because neutral electrode is incorrectly applied.
- Failure of NESSY NE-measurement unit or of feedback line on mother-board or CPU-board.

Suggested Remedies

- check if neutral electrode is correctly applied.  
If problem still exists, then:
- Replace NESSY NE-measurement unit.  
If problem persists, then:
  - check external control bus using TEST No. 1
  - check symmetry feedback line using TEST No. 20

If a failure is detected in TEST Nos. 1 or 20:

- Replace CPU-board.  
If problem persists, then:
- Replace motherboard.

Calibration Procedure:

The "NESSY" NE-measurement board is factory calibrated.

Display on LED-Array

ERROR No. : 27

Failure Mode: 2

### Failure Description

Failure detected on activation of an operating mode.

- Feedback line of the safety circuitry reports activation enabled, but activation is locked out at this point.

### Failure Indications

- Operator-panel activation indicator for activated operating mode blinking.
- Alarm sounds.

Failure indications will persist as long as an operating mode is activated.

### Potential Causes

- Failure of safety circuitry unit or of feedback line on motherboard or CPU-board.

### Suggested Remedies

- Replace safety circuitry unit.  
If problem persists, then:
  - check external control bus using TEST No. 1
  - check feedback line using TEST No. 22

If a failure is detected in TEST Nos. 1 or 22:

- Replace CPU-board.  
If problem persists, then:
- Replace motherboard.

### Calibration Procedure:

No calibration required.

Failure Description

Failure detected on activation of an operating mode.

- Current density too high. The surface area of the neutral electrode is too small for the current supplied by the instrument.

Failure Indication

- NE-TEST indicator in SAFETY section of operator panel blinking.

The failure indication will persist as long as the current density remains too high.

Potential Causes

- Surface area of neutral electrode too small.
- Failure of NESSY NE-measurement unit or of feedback line on motherboard or CPU-board.

Suggested Remedies

- Increase surface areas of neutral electrode.  
If problem still exists, then:
  - Replace NESSY NE-measurement unit.  
If problem persists, then:
    - check external control bus using TEST No. 1
    - check current-density feedback line using TEST No. 20
- If a failure is detected in TEST Nos. 1 or 20:
- Replace CPU-board.  
If problem persists, then:
  - Replace motherboard.

Calibration Procedure:

The "NESSY" NE-measurement board is factory calibrated.

Failure Description

Failure detected on activation of the CUT mode of operation.

- Signals from foot-switch and finger-switch to CUT operating mode simultaneously present.

Failure Indications

- Activation indicator of operator panel section for the activated operation mode blinking.
- Alarm sounds.

Failure indications will persist while operating mode is activated.

Potential Causes

- External failure of foot-switch, finger-switch, or cabling.
- Internal failure due to defective finger-switch monitor, or due to defective foot-switch or finger-switch feedback line.

Suggested Remedies

- Disconnect foot-switch and finger-switch from instrument, or replace these items if indicated. If the problem persists, then the instrument itself is at fault.
- If the LED on the finger-switch monitor board for CHANNEL A is lit, replace the finger-switch monitor board. If the problem persists, then:
  - check external control bus using TEST No. 1
  - check finger-switch signal line for CHANNEL A using TEST No. 20
  - check finger-switch signal line for CHANNEL A using TEST No. 21If a failure is detected in TEST Nos. 1, 20, or 21:
- Check foot-switch connector jack; replace CPU-board. If problem persists, then:
- Replace motherboard.

Calibration Procedure:

The finger-switch monitor board requires no calibration.

Display on LED-Array

ERROR No. : 30

Failure Mode: 2

### Failure Description

Failure detected on activation of the CUT mode of operation.

- The finger-switch signal to the CUT operating mode and the finger-switch signal to the COAGULATION operating mode simultaneously present.

### Failure Indications

- Activation indicator of operator panel section for the activated operation mode blinking.
- Alarm sounds.

Failure indications will persist as long as the activation error exists.

### Potential Causes

- External failure of finger-switch or its cabling.
- Internal failure due to defective finger-switch monitor or defective finger-switch feedback line.

### Suggested Remedies

- Disconnect finger-switch from instrument, or replace if indicated. If the problem persists, then the instrument itself is at fault.
- If either of the LED's on the finger-switch monitor board for CHANNELS A and B is lit, replace the finger-switch monitor board. If the problem persists, then:
  - check external control bus using TEST No. 1
  - check finger-switch signal line for CHANNEL A using TEST No. 20
  - check finger-switch signal line for CHANNEL B using TEST No. 20If a failure is detected in TEST Nos. 1 or 20:
  - Replace CPU-board.  
If problem persists, then:
  - Replace motherboard.

### Calibration Procedure:

The finger-switch monitor board requires no calibration.

ERBE  
D-7400 Tübingen

LISTING OF ERROR MESSAGES  
Instr.: Erbotom ACC450, 430, 410  
SOFT Version V2.0

	Date	Name
Drawn	22.01.90	
Checked		
Drwg. No.		
Sheet No.		

Display on LED-Array

ERROR No. : 31

Failure Mode: 2

### Failure Description

Failure detected on activation of the CUT mode of operation.

- The foot-switch signal to the CUT operating mode and the finger-switch signal to the COAGULATION operating mode simultaneously present.

### Failure Indications

- Activation indicator of operator panel section for the activated operation mode blinking.
- Alarm sounds.

Failure indications will persist as long as the activation error exists.

### Potential Causes

- External failure of foot-switch, finger-switch, or their cabling.
- Internal failure due to defective finger-switch monitor, or due to defective foot-switch or finger-switch feedback line.

### Suggested Remedies

- Disconnect foot-switch and finger-switch from instrument, or replace if indicated. If the problem persists, then the instrument itself is at fault.
- If the LED on the finger-switch monitor board for CHANNEL A is lit, replace the finger-switch monitor board. If the problem persists, then:
  - check external control bus using TEST No. 1
  - check finger-switch signal line for CHANNEL B using TEST No. 20
  - check foot-switch signal line for CHANNEL A using TEST No. 21If a failure is detected in TEST Nos. 1, 20, or 21:
  - Check foot-switch connector jack; replace CPU-board. If problem persists, then:
  - Replace motherboard.

### Calibration Procedure:

The finger-switch monitor board requires no calibration.



Display on LED-Array

ERROR No. : 32

Failure Mode: 2

### Failure Description

Failure detected on activation of the CUT mode of operation.

- The foot-switch signal to the CUT operating mode and the finger-switch signal to the AUTO COAGULATION operating mode simultaneously present.

### Failure Indications

- Activation indicator of operator panel section for the activated operation mode blinking.
- Alarm sounds.

Failure indications will persist as long as the activation error exists.

### Potential Causes

- External failure of foot-switch, finger-switch, or their cabling.
- Internal failure due to defective finger-switch monitor, or due to defective foot-switch or finger-switch feedback line.

### Suggested Remedies

- Disconnect foot-switch and finger-switch from instrument, or replace if indicated. If the problem persists, then the instrument itself is at fault.
  - If the LED on the finger-switch monitor board for CHANNEL C is lit, replace the finger-switch monitor board. If the problem persists, then:
    - check external control bus using TEST No. 1
    - check finger-switch signal line for CHANNEL C using TEST No. 21
    - check foot-switch signal line for CHANNEL A using TEST No. 21
- If a failure is detected in TEST Nos. 1 or 21:
- Check foot-switch connector jack; replace CPU-board. If problem persists, then:
  - Replace motherboard.

### Calibration Procedure:

The finger-switch monitor board requires no calibration.

Display on LED-Array

ERROR No. : 33

Failure Mode: 2

### Failure Description

Failure detected on activation of the CUT mode of operation.

- Finger-switch signal to the CUT operating mode and contact signal to the AUTOCOAGULATION operating mode simultaneously present.

### Failure Indications

- Activation indicator of operator panel section for the activated operation mode blinking.
- Alarm sounds.

Failure indications will persist as long as the activation error exists.

### Potential Causes

- External failure of finger-switch or its cabling.
- Internal failure due to a defective finger-switch monitor, a defective finger-switch feedback line, or a defective contact monitor.

### Suggested Remedies

- Disconnect the finger-switch from the instrument, or replace the switch if indicated. If the problem persists, then the instrument itself is at fault.
  - Is the LED on the finger-switch monitor board for CHANNEL C lit?  
If so: Replace the finger-switch monitor board.  
If not: Is the LED for "contact" on the contact-monitor board lit?  
If so: Replace the contact-monitor board.  
If the problem persists, then:
    - check external control bus using TEST No. 1
    - check finger-switch signal line for CHANNEL A using TEST No. 20
    - check the contact-monitor signal line using TEST No. 22
- If a failure is detected in TEST Nos. 1, 20, or 22:
- Replace the CPU-board.  
If the problem persists, then:
  - Replace the motherboard.

### Calibration Procedure:

The finger-switch monitor board requires no calibration.  
The contact-monitor board is factory calibrated.

Display on LED-Array

ERROR No. : 34

Failure Mode: 2

### Failure Description

Failure detected on activation of the COAGULATION mode of operation.

- The foot-switch and finger-switch signals to the COAGULATION operating mode are simultaneously present.

### Failure Indications

- Activation indicator of operator panel section for the activated operation mode blinking.
- Alarm sounds.

Failure indications will persist as long as the activation error exists.

### Potential Causes

- External failure of foot-switch, finger-switch, or their cabling.
- Internal failure due to defective finger-switch monitor, or due to defective foot-switch or finger-switch feedback line.

### Suggested Remedies

- Disconnect foot-switch and finger-switch from instrument, or replace if indicated. If the problem persists, then the instrument itself is at fault.
  - If the LED on the finger-switch monitor board for CHANNEL B is lit, replace the finger-switch monitor board. If the problem persists, then:
    - check external control bus using TEST No. 1
    - check finger-switch signal line for CHANNEL B using TEST No. 20
    - check foot-switch signal line for CHANNEL B using TEST No. 21
- If a failure is detected in TEST Nos. 1, 20, or 21:
- Check foot-switch connector jack; replace CPU-board. If problem persists, then:
  - Replace motherboard.

### Calibration Procedure:

The finger-switch monitor board requires no calibration.

Failure Description

Failure detected on activation of the COAGULATION mode of operation.

- The finger-switch signals to the CUT and COAGULATION operating modes are simultaneously present.

Failure Indications

- Activation indicator of operator panel section for the activated operation mode blinking.
- Alarm sounds.

Failure indications will persist as long as the activation error exists.

Potential Causes

- External failure of finger-switch or its cabling.
- Internal failure due to defective finger-switch monitor or defective finger-switch feedback line.

Suggested Remedies

- Disconnect finger-switch from instrument, or replace if indicated. If the problem persists, then the instrument itself is at fault.
- If either of the LED's on the finger-switch monitor board for CHANNELS A and B is lit, replace the finger-switch monitor board. If the problem persists, then:
  - check external control bus using TEST No. 1
  - check finger-switch signal line for CHANNEL A using TEST No. 20
  - check finger-switch signal line for CHANNEL B using TEST No. 20If a failure is detected in TEST Nos. 1 or 20:
  - Replace CPU-board.  
If problem persists, then:
  - Replace motherboard.

Calibration Procedure:

The finger-switch monitor board requires no calibration.

Failure Description

Failure detected on activation of the COAGULATION mode of operation.

- The foot-switch signal to the CUT operating mode and the finger-switch signal to the COAGULATION operating mode are simultaneously present.

Failure Indications

- Activation indicator of operator panel section for the activated operation mode blinking.
- Alarm sounds.

Failure indications will persist as long as the activation error exists.

Potential Causes

- External failure of foot-switch, finger-switch, or their cabling.
- Internal failure due to defective finger-switch monitor, or due to defective foot-switch or finger-switch feedback line.

Suggested Remedies

- Disconnect foot-switch and finger-switch from instrument, or replace if indicated. If the problem persists, then the instrument itself is at fault.
- If the LED on the finger-switch monitor board for CHANNEL B is lit, replace the finger-switch monitor board. If the problem persists, then:
  - check external control bus using TEST No. 1
  - check finger-switch signal line for CHANNEL B using TEST No. 20
  - check foot-switch signal line for CHANNEL A using TEST No. 21If a failure is detected in TEST Nos. 1, 20, or 21:
  - Check foot-switch connector jack; replace CPU-board. If problem persists, then:
  - Replace motherboard.

Calibration Procedure:

The finger-switch monitor board requires no calibration.

Failure Description

Failure detected on activation of the COAGULATION mode of operation.

- The finger-switch signals to the AUTOCOAGULATION and COAGULATION operating modes are simultaneously present.

Failure Indications

- Activation indicator of operator panel section for the activated operation mode blinking.
- Alarm sounds.

Failure indications will persist as long as the activation error exists.

Potential Causes

- External failure of finger-switch or its cabling.
- Internal failure due to defective finger-switch monitor or defective finger-switch feedback line.

Suggested Remedies

- Disconnect finger-switch from instrument, or replace if indicated. If the problem persists, then the instrument itself is at fault.
- If either of the LED's on the finger-switch monitor board for CHANNELS B and C is lit, replace the finger-switch monitor board. If the problem persists, then:
  - check external control bus using TEST No. 1
  - check finger-switch signal line for CHANNEL C using TEST No. 21
  - check finger-switch signal line for CHANNEL B using TEST No. 20If a failure is detected in TEST Nos. 1, 20, or 21:
  - Replace CPU-board.  
If problem persists, then:
  - Replace motherboard.

Calibration Procedure:

The finger-switch monitor board requires no calibration.

Failure Description

Failure detected on activation of the COAGULATION mode of operation.

- Finger-switch signal to COAGULATION operating mode and contact signal to AUTOCOAGULATION operating mode simultaneously present.

Failure Indications

- Activation indicator of operator panel section for the activated operation mode blinking.
- Alarm sounds.

Failure indications will persist as long as the activation error exists.

Potential Causes

- External failure of finger-switch or its cabling.
- Internal failure due to a defective finger-switch monitor, a defective finger-switch feedback line, or a defective contact monitor.

Suggested Remedies

- Disconnect the finger-switch from the instrument, or replace the switch if indicated. If the problem persists, then the instrument itself is at fault.
- Is the LED on the finger-switch monitor board for CHANNEL B lit?  
If so: Replace the finger-switch monitor board.  
If not: Is the LED for "contact" on the contact-monitor board lit?  
If so: Replace the contact-monitor board.  
If the problem persists, then:
  - check external control bus using TEST No. 1
  - check finger-switch signal line for CHANNEL B using TEST No. 20
  - check the contact-monitor signal line using TEST No. 22If a failure is detected in TEST Nos. 1, 20, or 22:
- Replace the CPU-board.  
If the problem persists, then:
- Replace the motherboard.

Calibration Procedure:

The finger-switch monitor board requires no calibration.  
The contact-monitor board is factory calibrated.

Failure Description

Failure detected on activation of the AUTOCOAGULATION mode of operation.

- The foot-switch and finger-switch signals to the AUTOCOAGULATION operating mode are simultaneously present.

Failure Indications

- Activation indicator of operator panel section for the activated operating mode blinking.
- Alarm sounds.

Failure indications will persist as long as the activation error exists.

Potential Causes

- External failure of finger-switch or its cabling.
- Internal failure due to defective finger-switch monitor, or due to defective foot-switch or finger-switch feedback line.

Suggested Remedies

- Disconnect foot-switch and finger-switch from instrument, or replace if indicated. If the problem persists, then the instrument itself is at fault.
- If the LED on the finger-switch monitor board for CHANNEL C is lit, replace the finger-switch monitor board. If the problem persists, then:
  - check external control bus using TEST No. 1
  - check finger-switch signal line for CHANNEL C using TEST No. 21
  - check foot-switch signal line for CHANNEL C using TEST No. 21If a failure is detected in TEST Nos. 1 or 21:
  - Check foot-switch connector jack; replace CPU-board. If problem persists, then:
  - Replace motherboard.

Calibration Procedure:

The finger-switch monitor board requires no calibration.



Display on LED-Array

ERROR No. : 40

Failure Mode:

Not used.

---

<b>ERBE</b> D-7400 Tübingen	LISTING OF ERROR MESSAGES Instr.: Erbotom ACC450, 430, 410  SOFT Version V2.0	Drawn 22.01.90 Checked Drwg. No. Sheet No.	Date Name
--------------------------------	--	---	--------------

Display on LED-Array

ERROR No. : 41

Failure Mode:

Not used.

---

<b>ERBE</b> D-7400 Tübingen	LISTING OF ERROR MESSAGES	Date	Name
	Instr.: Erbotom ACC450, 430, 410	Drawn 22.01.90	
		Checked	
	SOFT Version V2.0	Drwg. No.	
		Sheet No.	

Failure Description

Failure detected on activation of the AUTOCOAGULATION mode of operation.

- Foot-switch signal to CUT operating mode and contact signal to AUTOCOAGULATION operating mode simultaneously present.

Failure Indications

- Activation indicator of operator panel section for the activated operation mode blinking.
- Alarm sounds.

Failure indications will persist as long as the activation error exists.

Potential Causes

- External failure of finger-switch or its cabling.
- Internal failure due to a defective finger-switch monitor, a defective foot-switch feedback line, or a defective contact monitor.

Suggested Remedies

- Disconnect the foot-switch from the instrument, or replace if indicated. If the problem persists, then the instrument itself is at fault.

If not: Is the LED for "contact" on the contact-monitor board lit?  
If so: Replace the contact-monitor board.

If the problem persists, then:

- check external control bus using TEST No. 1
- check finger-switch signal line for CHANNEL A using TEST No. 21
- check the contact-monitor signal line using TEST No. 22

If a failure is detected in TEST Nos. 1, 21, or 22:

- Replace the CPU-board.  
If the problem persists, then:
- Replace the motherboard.

Calibration Procedure:

The contact-monitor board is factory calibrated.

Display on LED-Array

ERROR No. : 43

Failure Mode: 2

Failure Description

Failure detected on activation of an operating mode.

- The feedback line of the safety circuitry reports that activation is locked out, but activation should be enabled at this point.

Failure Indications

- Activation indicator of the activated operating mode blinking.
- Alarm sounds.

Failure indications will persist as long as operating mode is activated.

Potential Causes

- Failure of safety circuitry, or of feedback lines on motherboard or CPU-board.

Suggested Remedies

- Replace safety circuitry unit.  
If problem persists, then:
  - check external control bus using TEST No. 1
  - check feedback line using TEST No. 22If a failure is detected in TEST Nos. 1 or 22:
- Replace CPU-board.  
If problem persists, then:
- Replace motherboard.

Calibration Procedure:

No calibration required.

Display on LED-Array

ERROR No. : 44

Failure Mode: 2

Failure Description

The indicators of the CUT, COAGULATION, and AUTO COAGULATION flash sequentially when the instrument is switched on.

Failure Indication

- Sequential flashing of operator panel indicators.

Potential Causes

- Instrument was switched off while front-panel settings were incomplete.
- Memory failure (RAM) on CPU-board, J1.
- Battery or memory circuit on CPU-board failed.

Suggested Remedies

- Complete front-panel settings, shut off line voltage, turn on line voltage again.
- Check battery on CPU-board.
- Replace CPU-board.

Calibration Procedure:

No calibration required.

Display on LED-Array

ERROR No. : 45

Failure Mode: 1

### Failure Description

An indicator lamp on the instrument's front panel blinks when the instrument is switched on.

### Failure Indication

- Indicator lamp blinking.
- Alarm sounds.

### Potential Causes

- A button was held depressed while the instrument was switched on. The button depressed will be identified by the illumination of its associated indicator lamp.
- Failure on an interconnecting line.
- Failure on CPU-board, J1.

### Suggested Remedies

- Check the buttons on the front panel; replace the entire front panel if indicated.  
If the problem persists, then:
- Check the interconnecting cabling; replace if indicated.  
If the problem persists, then:
- Replace the CPU-board.

### Calibration Procedure:

No calibration required.

Display on LED-Array

ERROR No. : 46

Failure Mode: 2

Failure Description

Error detected on activation of the AUTOCOAGULATION operating mode.

Failure Indication

- Activation indicator of AUTOCOAGULATION operating mode blinking.
- Alarm sounds.

Failure indications will remain active during activation.

Potential Causes

- Finger-switch activation is enabled only for COAGULATION MODE setting "MONOPOLAR."

Suggested Remedies

- Rectify front panel setting.

Calibration Procedure:

No calibration required.

Display on LED-Array

ERROR No. : 47

Failure Mode: 3

Failure Description

Failure detected during activation of COAGULATION SPRAY 1 or SPRAY 2 operating modes.

- Output error: The duration of the SPRAY timer cycle is more than 20 % shorter than that preset.

Failure Indication

- Output error indication in SAFETY section of operator panel.

Potential Causes

- Failure of the timer or of the feedback system on the SPRAY/TUR-generator board, board slot J9.
- Failure of activation lines or of the feedback lines on the motherboard or on the CPU-board.

Suggested Remedies

- Replace SPRAY/TUR-generator board, board slot J9.  
If problem persists, then:
  - check external control bus using TEST No. 1
  - check feedback line using TEST No. 22
  - check activation line using TEST No. 15If failures are detected in TEST Nos. 1, 22, or 15:
- Replace the CPU-board.  
If problem persists, then:
- Replace the motherboard.

Calibration Procedure:

None required. The SPRAY/TUR-generator is factory calibrated.



Display on LED-Array

ERROR No. : 48

Failure Mode: 3

### Failure Description

Failure detected during activation of COAGULATION SPRAY 1 or SPRAY 2 operating modes.

- Output error: The duration of the SPRAY timer cycle is more than 40 % shorter than that preset.

### Failure Indication

- Activation indicator of the activated COAGULATION mode panel section blinking. Power supply, RF-generator, and SPRAY/TUR-generator have all been shut off.
- Alarm sounds.
- Output error indication in SAFETY section of operator panel.

Failure indications will persist as long as the operating mode is activated.

### Potential Causes

- Failure of the timer or of the feedback system on the SPRAY/TUR generator board, board slot J9.
- Failure of activation lines or of the feedback lines on the motherboard or on the CPU-board.

### Suggested Remedies

- Replace SPRAY/TUR-generator board, board slot J9.  
If problem persists, then:

- check external control bus using TEST No. 1
- check feedback line using TEST No. 22
- check activation line using TEST No. 15

If failures are detected in TEST Nos. 1, 22, or 15:

- Replace the CPU-board.  
If problem persists, then:
- Replace the motherboard.

### Calibration Procedure:

None required. The SPRAY/TUR-generator is factory calibrated.

---

ERBE D-7400 Tübingen	LISTING OF ERROR MESSAGES	Date	Name
	Instr.: Erbotom ACC450	Drawn 22.01.90	
		Checked	
	SOFT Version V2.0	Drwg. No.	
		Sheet No.	

Failure Description

Failure detected during activation of COAGULATION SPRAY 1 or SPRAY 2 operating modes.

- Output error: The duration of the SPRAY timer cycle is more than 20 % longer than that preset.

Failure Indication

- Output error indication in SAFETY section of operator panel.

Potential Causes

- Failure of the timer or of the feedback system on the SPRAY/TUR-generator board, board slot J9.
- Failure of activation lines or of the feedback lines on the motherboard or on the CPU-board.

Suggested Remedies

- Replace SPRAY/TUR-generator board, board slot J9.  
If problem persists, then:
  - check external control bus using TEST No. 1
  - check feedback line using TEST No. 22
  - check activation line using TEST No. 15If failures are detected in TEST Nos. 1, 22, or 15:
- Replace the CPU-board.  
If problem persists, then:
- Replace the motherboard.

Calibration Procedure:

None required. The SPRAY/TUR-generator is factory calibrated.

Failure Description

Failure detected during activation of COAGULATION SPRAY 1 or SPRAY 2 operating modes.

- Output error: No feedback frequency from the SPRAY/TUR timer.

Failure Indication

- Activation indicator of the activated COAGULATION mode panel section blinking. Power supply, RF-generator, and SPRAY/TUR-generator have all been shut off.
- Alarm sounds.
- Output error indication in SAFETY section of operator panel.

Failure indications will persist as long as the operating mode is activated.

Potential Causes

- Failure of the timer or of the feedback system on the SPRAY/TUR-generator board, board slot J9.
- Failure of activation lines or of the feedback lines on the motherboard or on the CPU-board.

Suggested Remedies

- Replace SPRAY/TUR-generator board, board slot J9.  
If problem persists, then:
  - check external control bus using TEST No. 1
  - check feedback line using TEST No. 22
  - check activation line using TEST No. 15

If failures are detected in TEST Nos. 1, 22, or 15:

- Replace the CPU-board.  
If problem persists, then:
- Replace the motherboard.

Calibration Procedure:

None required. The SPRAY/TUR-generator is factory calibrated.

Failure Description

Failure detected during activation of COAGULATION SPRAY 1 or SPRAY 2 operating modes.

- Output error: The RF output voltage of the supply for the SPRAY/TUR-generator is more than 20 % higher than that preset.

Failure Indication

- Output error indication in SAFETY section of operator panel.

Potential Causes

- Failure of the RF-voltage regulation or the feedback system.
- Failure of the power supply or RF-generator unit, or of the activation line, or of the feedback lines on the motherboard or on the CPU-board.

Suggested Remedies

- Replace the 400-W power supply unit.  
If the problem persists, then:
  - Replace the RF-generator unit.  
If the problem persists, then:
    - check the external control bus using TEST No. 1
    - check the feedback line using TEST No. 22
    - check the activation line using TEST No. 15
- If failures are detected in TEST Nos. 1, 22, or 15:
- Replace the CPU-board.  
If problem persists, then:
  - Replace the motherboard.

Calibration Procedure: Refer to the calibration manual.

ERROR No. : 52

Failure Mode: 3

Failure Description

Failure detected during activation of COAGULATION SPRAY 1 or SPRAY 2 operating modes.

- Output error: The RF output voltage of the supply for the SPRAY/TUR-generator is more than 40 % higher than that preset.

Failure Indication

- Activation indicator of the activated COAGULATION mode panel section blinking. Power supply, RF-generator, and SPRAY/TUR-generator have all been shut off.
- Alarm sounds.
- Output error indication in SAFETY section of operator panel.

Failure indications will persist as long as the operating mode is activated.

Potential Causes

- Failure of the RF-voltage regulation or the feedback system.
- Failure of the power supply or RF-generator unit, or of the activation line, or of the feedback lines on the motherboard or on the CPU-board.

Suggested Remedies

- Replace the 400-W power supply unit.  
If the problem persists, then:
  - Replace the RF-generator unit.  
If the problem persists, then:
    - check external control bus using TEST No. 1
    - check feedback line using TEST No. 22
    - check activation line using TEST No. 15
- If failures are detected in TEST Nos. 1, 22, or 15:
- Replace the CPU-board.  
If problem persists, then:
  - Replace the motherboard.

Calibration Procedure: Refer to the calibration manual.

Display on LED-Array

ERROR No. : 53

Failure Mode: 3

Failure Description

Failure detected during activation of COAGULATION SPRAY 1 or SPRAY 2 operating modes.

- Output error: The RF output voltage of the supply for the SPRAY/TUR-generator is more than 20 % below than that preset.

Failure Indication

- Output error indication in SAFETY section of operator panel.

Potential Causes

1. Activate CUT mode. If Error Message No. 3 appears, refer to the documentation on this error message.
2. Failure of the rectifier circuit or output stage on the SPRAY/TUR-generator board, board slot J9.

Suggested Remedies

- Replace the SPRAY/TUR-generator board, board slot J9.

Calibration Procedure:

None required. The SPRAY/TUR-generator is factory calibrated.

Display on LED-Array

ERROR No. : 54

Failure Mode: 3

Failure Description

Failure detected during activation of COAGULATION SPRAY 1 or SPRAY 2 operating modes.

- Output error: The RF output voltage of the supply for the SPRAY/TUR-generator is less than 20 V.

Failure Indication

- Activation indicator of the activated COAGULATION mode panel section blinking. Power supply and RF-generator have both been shut off.
- Alarm sounds.
- Output error indication in SAFETY section of operator panel.

Failure indications will persist as long as the operating mode is activated.

Potential Causes

1. Activate CUT mode. If Error Message No. 4 appears, refer to the documentation on this error message.
2. Failure of the rectifier circuit or output stage on the SPRAY/TUR-generator board, board slot J9.

Suggested Remedies

- Replace SPRAY/TUR-generator board, board slot J9.

Calibration Procedure:

None required. The SPRAY/TUR-generator is factory calibrated.

---

1	CONTROL BUS, all LED's ON/OFF in sequence
2	Display last 5 errors (ERROR No.).
3	DAC, power supply voltage setting, J3
4	DAC, RF-generator current limit, J8
5	DAC, RF-generator modulation, J8
6	DAC, SPRAY/TUR-generator, J9
7	D-FF, ACC50-monitor, J10
8	D-FF, NE-monitor, J11
9	DAC, RF current density, J11
10	D-FF, safety control, J12
11	SPRAY/TUR-generator timer, J9
12	D-FF, BF/CF-switchover, J14
13	Disable WDI-TEST interrupt. Not for service use.
14	Front panel LED-TEST
15	TEST ACTIVATION; trigger all single-bit activating signals In sequence.
16	TONE 1
17	TONE 2
18	TONE 3
19	TONES 1 - 7, plus ALARM TONES 1 - 7
20	READ INPUT IC6 PORT A and display PORT.
21	READ INPUT IC6 PORT B and display PORT.
22	READ INPUT IC7 PORT B and display PORT.
23	not used
24	not used
25	not used
26	not used
27	NE-frequency adjustment; short-circuit frequency = 200 Hz
28	NE-frequency adjustment; open-circuit frequency = < 12 Hz
29	not used
30	not used
31	not used
32	not used
33	not used
34	Set output relay to SPRAY-status. LF leakage-current monitoring disabled.
35	Set output relays of monopolar channels A and B. LF leakage-current monitoring disabled.
36	Activate spray and generator outputs; no capacitive ground. Measure DC resistance.
37	Activate all relays; capacitive ground. Measure patient leakage currents.
38	not used
39	Set frequency; message: CUT Stage1 176V f=88 Hz.
40	Incorrect dose test; output value: CUT1=176V; pushbutton controls: CUT2 = increase voltage/CUT1 = decrease voltage.



SW1

TEST  
NO.

Test Routine Title

---

- 41 Reset CUT-voltage, no monitoring for incorrect dose;  
pushbutton controls: CUT2 = Increase voltage/CUT1 = decrease  
voltage.
- 42 not used
- 43 not used
- 44 not used
- 45 not used

---

**ERBE**  
D-7400 Tübingen

Schedule of Test Routines  
Instr.: Erbotom ACC450, 430, 410

SW1 V2.0 Test Switch

	Date	Name
Drawn	08.03.90	S. Klein
Checked		
Drwg. No.		
Sheet No.	2 of 2	

## TEST ROUTINE CALLUP

Effective with Version V 1.20, all test routines can be called up using either the instrument's internal test switch or using the buttons on its front panel.

Procedure for Calling Up Test Routines Using the Test Switch:

1. Set the number of the test routine desired on the test switch with the instrument switched off.
2. Switch on the main power switch. The test routine selected will be called up.
3. Test routines can be interrupted at any time by turning off the main power switch.
4. For normal instrument operation, all test-routine selection switches must be set to their "OFF"-positions.

Procedure for Calling Up Test Routines Using the Front-Panel Buttons:

1. Hold both of the buttons "CUT 1" and "CUT 2" down and switch on the instrument's main power switch. An audible alarm signal will sound while the buttons are held depressed.
2. Release both buttons; LED's 1, 2, and 5 located in the "CUT" section of the operating panel will light.
3. The number of the test routine currently selected will appear displayed in the "INTENSITY"-column of the "AUTOCOAG." section of the operating panel.

The multipliers to be applied to the individual elements of the binary-encoded LED array in order to obtain the number of the test routine selected are:

LED 0.1	Multiplier:	1
LED 0.2	Multiplier:	2
LED 0.4	Multiplier:	4
LED 0.6	Multiplier:	8
LED 0.8	Multiplier:	16
LED 1	Multiplier:	32
LED 2	Multiplier:	64
LED 3	Multiplier:	128

4. Each brief depression of the "CUT 1"-button will reduce the number of the selected test routine by one.
5. Each brief depression of the "CUT 2"-button will increase the number of the selected test routine by one.
6. Depressing the "CUT 5"-button will activate the test routine whose number is currently indicated on the LED-array of the "AUTOCOAG." section of the operating panel.
7. Test routines can be interrupted at any time by turning off the main power switch.

**NOTE: Calling up a test routine alters the existing front panel settings!**

		TEST PROCEDURES	Date	Name
ERBE D-7400 Tübingen	Instr.:	Erbotom ACC450, 430, 410	Drawn 22.01.90	
			Checked	
			Drwg. No.	
		SOFT Version V2.0 Test Switch	Sheet No.	

# TEST No. : 1

Test Switch Setting

Motherboard Control Bus

## Test Routine Description:

This is a check of external control bus signal lines D0 through D7. The signal lines will be activated and deactivated in sequence. Switching status is indicated on the LED-array located on the motherboard. Refer to Sheet 1 of the "Motherboard" circuit diagram.

LED D10 will be lit at all times.

## A fault exists if:

- more than one LED illuminates, or if
- the associated LED's fail to illuminate.

## Troubleshooting Procedure:

- Remove the circuit boards from board sockets J3 through J14.  
Is the fault still present? If so, then:
- Replace the CPU board.  
Is the fault still present? If so, then:
- Replace the power supply and the low-voltage supply board.  
Is the fault still present? If so, then:
- The problem is on the motherboard.

# TEST No. : 2

## Test Switch Setting

### Test Routine Description:

The last five "ERROR-Nos." are held in memory, and can be displayed using Test Routine No. 2.

The keys of the "CUT"-section are used to call up the display of the five "ERROR-Nos.," as follows:

Depression of "CUT" Button No.	Will display:
5	The "ERROR-No." stored in stack position 5
4	The "ERROR-No." stored in stack position 4
3	The "ERROR-No." stored in stack position 3
2	The "ERROR-No." stored in stack position 2
1	The "ERROR-No." stored in stack position 1

The "ERROR-Nos." are kept stored in a memory stack.

Depressing the "CUT 1" button calls up the number of the last error detected, depressing the "CUT 2" button calls up the second-last error detected, and so on.

Depressing the "CUT 1" and "CUT 2" buttons simultaneously clears the memory stack.

The "ERROR-Nos." appear displayed in the "INTENSITY"-column of the "AUTOCOAGULATION" field of the operating panel.

INTENSITY	Multiplier
5	-
4	-
3	128
2	64
1	32
0.8	16
0.6	8
0.4	4
0.2	2
0.1	1

$$\text{ERROR-No.} = \sum \text{Indicated multipliers}$$

---

ERBE D-7400 Tübingen	TEST PROCEDURES	Date	Name
	Instr.: Erbotom ACC450, 430, 410	Drawn 22.01.90	
	SOFT Version V2.0 Test Switch	Checked	
		Drwg. No.	
		Sheet No.	

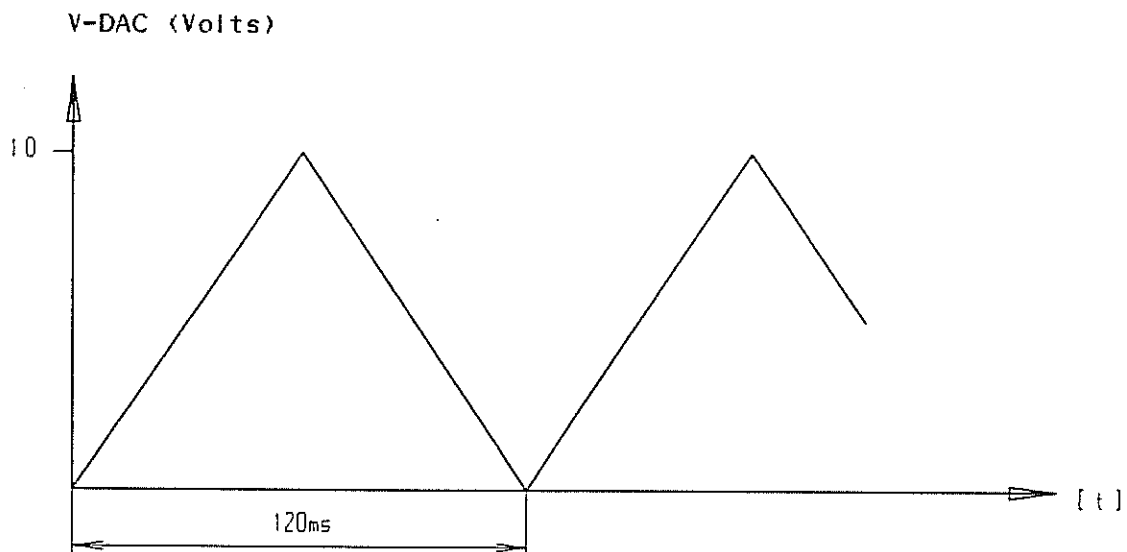
Test Switch Setting

Board Socket J3

Test Routine Description:

This test routine is used for checking the digital/analog converter (DAC) on the power supply control board. This DAC is used to set the nominal power supply output voltage and the RF output voltage (V-setpoint).

The measurement can be performed by connecting an oscilloscope to PIN 2 of IC1 (the DAC).

DAC Output Voltage

If the DAC output voltage waveform is incorrect, check the signal on the "chip-select" line (PIN 15 of the DAC).

Troubleshooting Procedure:

- replace the DFF;
- check connections D0 through D7 of the control bus;
- check the "chip-select" line.

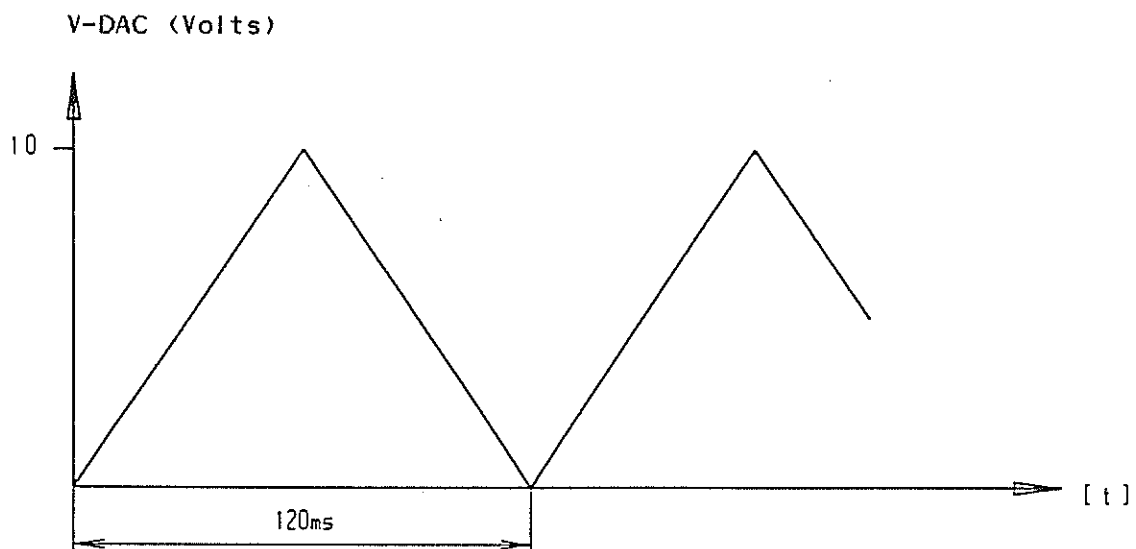
Test Switch Setting

Board Socket J8

Test Routine Description:

This test routine is used for checking the digital/analog converter (DAC) on the RF-generator control board. This DAC is used to set the current limit for the "patient" current circuit (V-setpoint, PAT current limit).

The measurement can be performed by connecting an oscilloscope to PIN 2 of IC2 (the DAC).

DAC Output Voltage

If the DAC output voltage waveform is incorrect, check the signal on the "chip-select" line (PIN 15 of the DAC).

Troubleshooting Procedure:

- replace the DFF;
- check connections D0 through D7 of the control bus;
- check the "chip-select" line.

# TEST No. : 5

Test Switch Setting

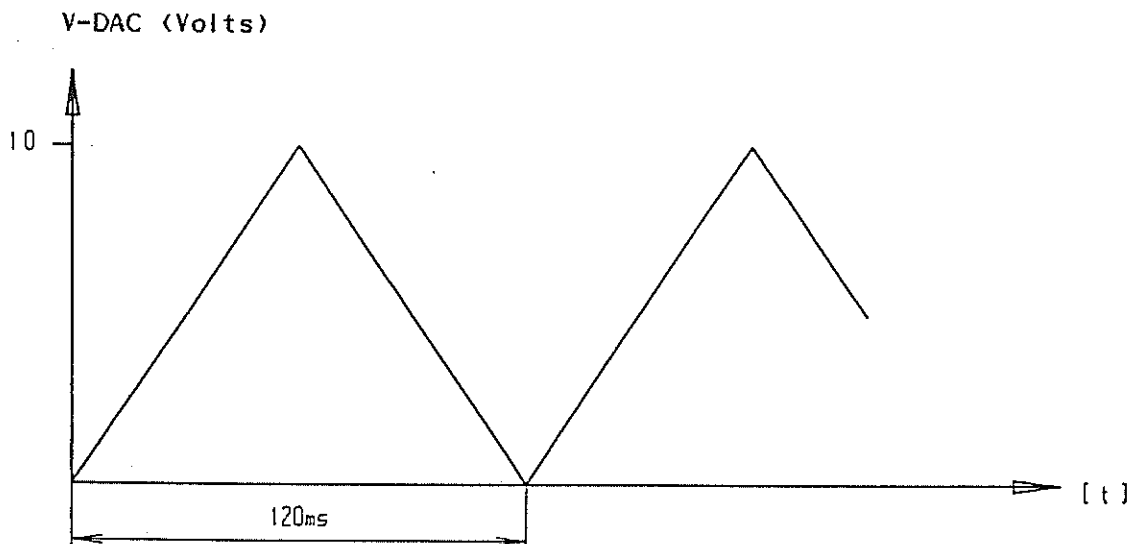
Board Socket J8

## Test Routine Description:

This test routine is used for checking the digital/analog converter (DAC) on the RF-generator control board. This DAC is used to set the length of the modulation period (the MODULATION SETTING) used in "FORC."- mode coagulations.

The measurement can be performed by connecting an oscilloscope to PIN 2 of IC3 (the DAC).

## DAC Output Voltage



If the DAC output voltage waveform is incorrect, check the signal on the "chip-select" line (PIN 15 of the DAC).

## Troubleshooting Procedure:

- replace the DFF;
- check connections D0 through D7 of the control bus;
- check the "chip-select" line.

# TEST No. : 6

Test Switch Setting

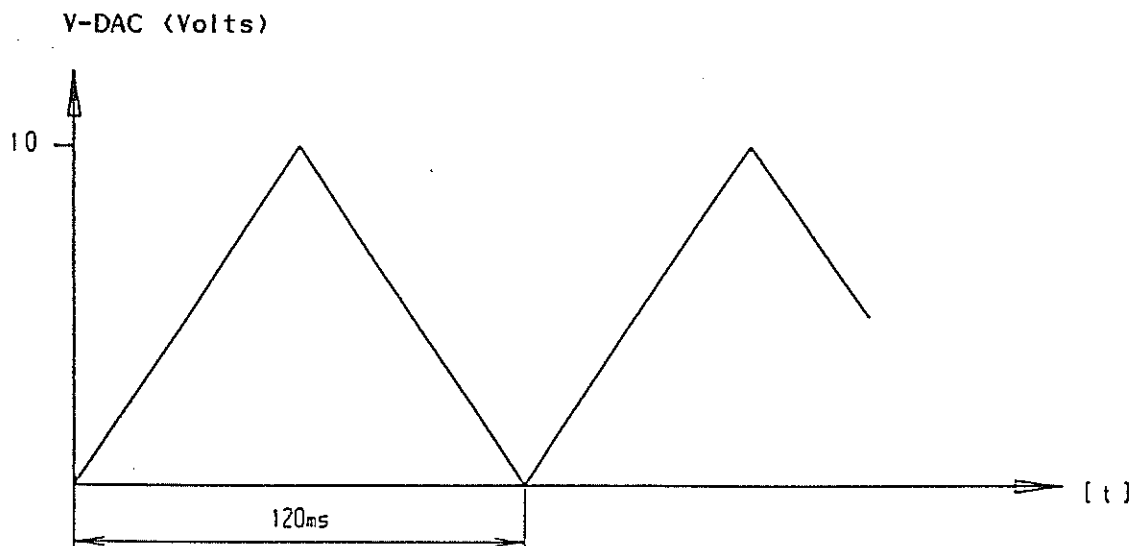
Board Socket J9

## Test Routine Description:

This test routine is used for checking the digital/analog converter (DAC) on the SPRAY / TUR control board. This DAC is used to set the length of the modulation period (the MODULATION SETTING) used in "SPRAY"- mode coagulations.

The measurement can be performed by connecting an oscilloscope to PIN 2 of IC1 (the DAC).

## DAC Output Voltage



If the DAC output voltage waveform is incorrect, check the signal on the "chip-select" line (PIN 15 of the DAC).

## Troubleshooting Procedure:

- replace the DFF;
- check connections D0 through D5 of the control bus;
- check the "chip-select" line.

ERBE  
D-7400 Tübingen

TEST PROCEDURES  
Instr.: Erbotom ACC450, 430, 410  
SOFT Version V2.0 Test Switch

Date 22.01.90  
Name  
Drawn  
Checked  
Drwg. No.  
Sheet No.



Test Switch Setting

Board Socket J10

Test Routine Description:

This test routine is used for checking the D-flip/flop (DFF) memory unit on the contact-monitor/spark-current monitor board.

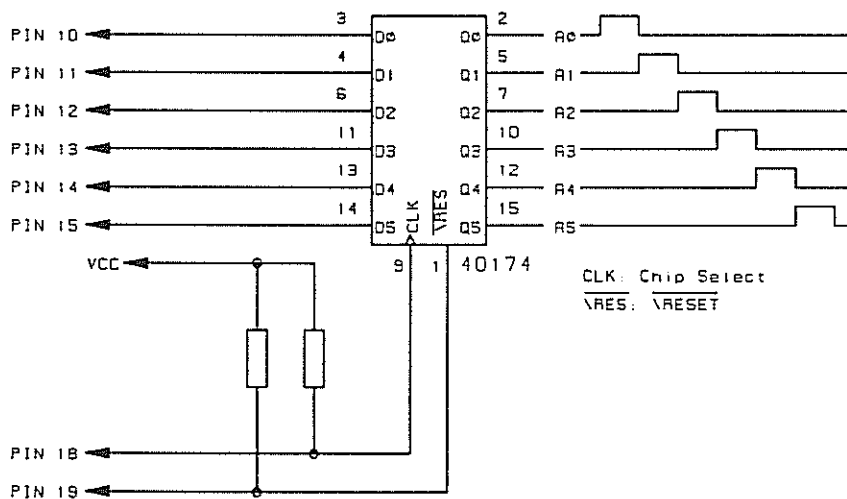
Signal lines D0 through D5 will be activated in sequence. Measurements are performed using an oscilloscope connected to the outputs (PINS 2, 5, 7, 10, 12, and 15).

A failure is indicated by:

- more than one output being under voltage simultaneously, or by
- the absence of voltage at an output.

Board Socket

Output



Troubleshooting Procedure:

- replace the DFF;
- check connections D0 through D5 of the control bus;
- check the "chip-select" line.

Test Routine Description:

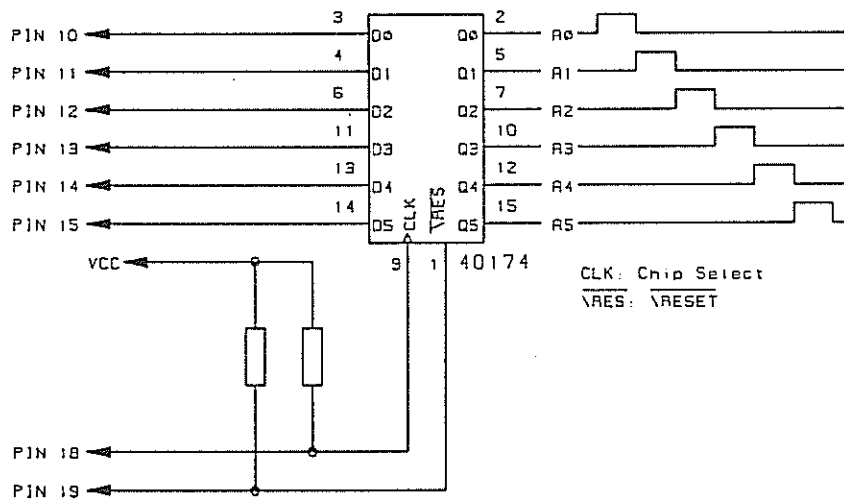
This test routine is used for checking the D-flip/flop (DFF) memory unit on the NE (NESSY) / RF-leakage current monitor board.

Signal lines D0 through D5 will be activated in sequence. Measurements are performed using an oscilloscope connected to the outputs (PINS 2, 5, 7, 10, 12, and 15).

A failure is indicated by: - more than one output being under voltage simultaneously, or by  
- the absence of voltage at an output.

Board Socket

Output



Troubleshooting Procedure:

- replace the DFF;
- check connections D0 through D5 of the control bus;
- check the "chip-select" line.

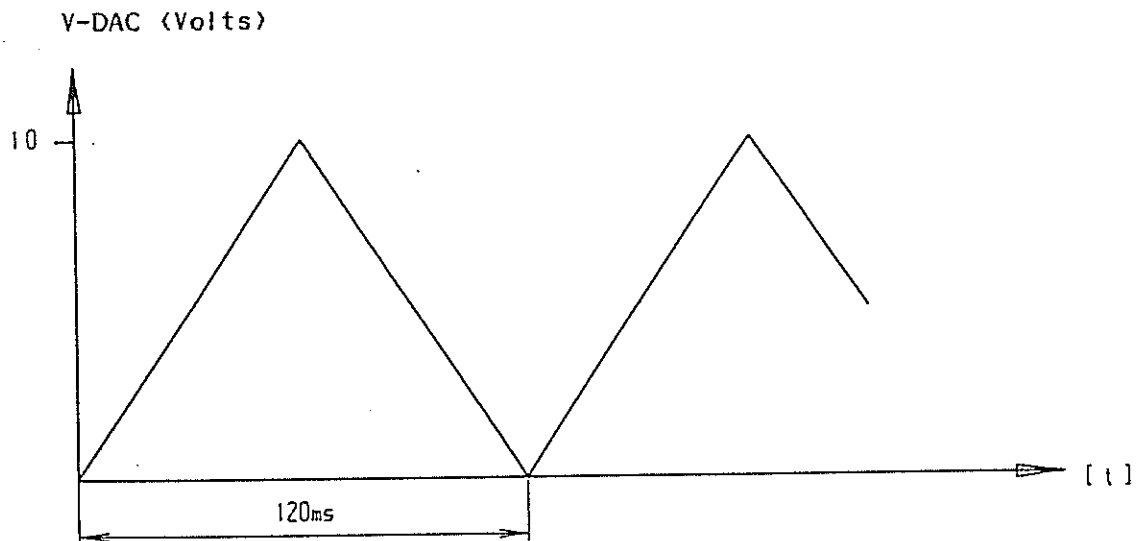
Test Switch Setting

Board Socket J11

Test Routine Description:

This test routine is used for checking the digital/analog converter (DAC) on the NE (NESSY) control board. This DAC is used to set the limit of current density for the neutral electrode (NE).

The measurement can be performed by connecting an oscilloscope to PIN 2 of IC 4 (the DAC).

DAC Output Voltage

If the DAC output voltage waveform is incorrect, check the signal on the "chip-select" line (PIN 15 of the DAC).

Troubleshooting Procedure:

- replace the DFF;
- check connections D0 through D7 of the control bus;
- check the "chip-select" line.

		Date	Name
ERBE D-7400 Tübingen	TEST PROCEDURES	Drawn 22.01.90	
	Instr.: Erbotom ACC450, 430, 410	Checked	
	SOFT Version V2.0 Test Switch	Drwg. No.	
		Sheet No.	

# TEST No. : 10

Test Switch Setting

Board Socket J12

## Test Routine Description:

This test routine is used for checking the D-flip/flop (DFF) memory unit on the safety circuit board.

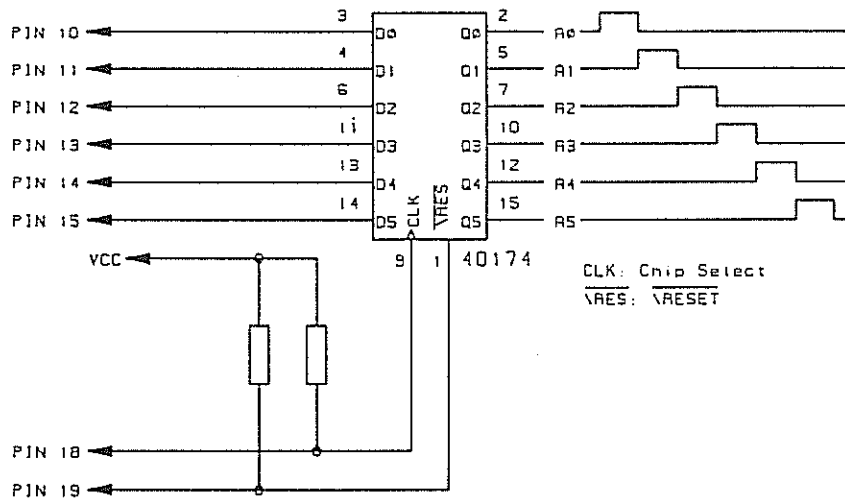
Signal lines D0 through D5 will be activated in sequence. Measurements are performed using an oscilloscope connected to the outputs (PINS 2, 5, 7, 10, 12, and 15).

A failure is indicated by:

- more than one output being under voltage simultaneously, or by
- the absence of voltage at an output.

Board  
Socket

Output



## Troubleshooting Procedure:

- replace the DFF;
- check connections D0 through D5 of the control bus;
- check the "chip-select" line.

# TEST No. : 11

Test Switch Setting

Board Socket J9

## Test Routine Description:

This test routine is used to check and reset the modulation period for pulsed operation set on the SPRAY/TUR-generator board. In pulsed operation, the modulation period is constantly monitored, and any departures from the accepted tolerances will be signaled by the LED-indicator for "INCORRECT DOSE" illuminating and by the appearance of error messages (ERROR-Nos. 47, 48, 49, and 50).

A voltage of VDAC = 5.0 VDC, corresponding to the setting SPRAY 2, INTENSITY 5, is applied to PIN 2 of IC2 (the DAC).

Modulation period, measured at test point MP1: 20  $\mu$ s

Returned frequency, measured at test point MP1: 97.6 Hz

Control voltage, PIN 2 of IC2: VDAC = 5.0 VDC

TEST ROUTINE 11 constantly monitors the modulation period, and the LED-indicator for "INCORRECT DOSE" will illuminate if the modulation period should drift outside the prescribed tolerance limits.

Monitored Limits: upper limit = 98.5 Hz

lower limit = 96.5 Hz

The LED for "INCORRECT DOSE" will be off whenever the modulation frequency lies within this range.

The modulation period may be adjusted by carefully resetting trim potentiometer TP1.

The switching pulse can be set to a pulse width of 150 ns using trim potentiometer TP2.

TEST ROUTINE 11 switches off the RF-generator and the power supply and closes Relays 1 and 2.

---

	TEST PROCEDURES	Date	Name
ERBE D-7400 Tübingen	Instr.: Erbotom ACC450, 430, 410	Drawn 22.01.90	
		Checked	
	SOFT Version V2.0 Test Switch	Drwg. No.	
		Sheet No.	

Test Switch Setting

Board Socket J14

Test Routine Description:

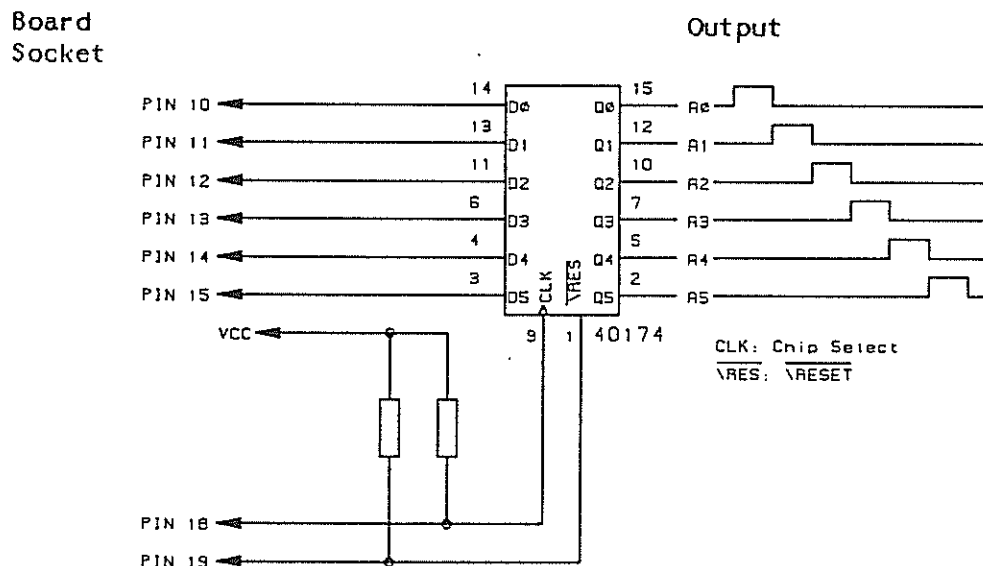
This test routine is used for checking the D-flip/flop (DFF) on the relay board/LF leakage current board.

The switching status of the relay contacts is indicated on the LED-array located on the relay board.

Signal lines D0 through D5 will be activated in sequence. Measurements are performed using an oscilloscope connected to the outputs (PINS 2, 5, 7, 10, 12, and 15).

A failure is indicated by:

- more than one output being under voltage simultaneously, or by
- the absence of voltage at an output.



Troubleshooting Procedure:

- replace the DFF;
- check connections D0 through D5 of the control bus;
- check the "chip-select" line.

# TEST No. : 13

## Test Switch Setting

Output of the "watchdog" trigger signal is disabled under TEST ROUTINE 13.

A RESET occurs after 100 ms.

The RESET will be indicated by LED 9 and LED 10 of the LED-array.

### LED 10

This LED indicates the presence of the WDI ("watchdog" input) trigger signal. The WDI-signal is a monitoring signal that monitors program (software) execution and the microprocessor (hardware) system, assisted by a monitoring circuit. The WDI-signal has a frequency of 732 Hz, and is derived from the processor clock frequency.

LED 10 will be lit at all times under normal system operation. A RESET will be triggered after 100 ms if the WDI-signal should drop out.

### LED 9

This LED indicates that a RESET has taken place. This LED should not illuminate at any time during normal system operation.

If LED 10 and LED 9 are alternately blinking, or if both LED 10 and LED 9 are extinguished, then a failure has occurred in the microprocessor system.

Test Switch Setting

Front-Panel LED-TEST

Test Routine Description:

This routine tests all front-panel LED's by switching them all on simultaneously.

The LED's in the "SAFETY"-section of the operating panel and the LED's for the activation display are somewhat brighter than the others.

Troubleshooting Procedure:

- replace the connecting cables;
- replace the line for the 5-VDC supply voltage;
- replace the CPU-board;
- replace the front panel (circuit board).



# TEST No. : 15

Test Switch Setting                      Board Socket J3

Board Socket J8

Board Socket J9

## Test Routine Description:

This is a test of the single-bit (microprocessor output) control lines.  
Remove the circuit boards from board sockets J3, J8, and J9.

This routine activates and deactivates the output control lines in sequence. The switching status of the control lines is indicated on the LED-array. Refer to the circuit diagram appearing on Sheet 1 of the "Motherboard" drawings.

<u>Designation</u>		<u>Signal Line To</u>
UG1/HF	Switchover DC-voltage/RF-regulation	J3, PIN 28
EIN 2	ON/OFF	J8, PIN 19
Reserve	not used	
MOD	FORC. MODULATION	J8, PIN 22
SPRAY EIN	SPRAY ON/OFF	J9, PIN 23
EIN 1	Power supply ON/OFF	J3, PIN 19

Measure the signal lines using an oscilloscope connected at the socket of the extender board; cf. the column headed "Signal Line To" in the table above.

## Troubleshooting Procedure:

- replace the CPU board;
- replace the driver IC6 and DFF IC7;
- replace the motherboard.

Test Switch Setting

Board Socket J2

Test Routine Description:

This checks the control circuitry for the fundamental tone of audible signal 1. Control is exercised by the D-flip/flop (DFF) on the low-voltage/"TONE" board.

The level of the audible signal can be adjusted using the potentiometer on the rear panel of the instrument.

The frequency of the audible signal is 493 Hz, and can be measured by connecting a suitable frequency counter at test point MP1. The frequency can be adjusted using trim potentiometer TP1.

Troubleshooting Procedure:

- replace the "TONE"-control board;
- check the level-control potentiometer;
- check the "chip-select" line;
- replace the CPU-board;
- replace the motherboard.

Test Switch Setting

Board Socket J2

Test Routine Description:

This checks the control circuitry for the fundamental tone of audible signal 2. Control is exercised by the D-flip/flop (DFF) on the low-voltage/"TONE" board.

The level of the audible signal can be adjusted using the potentiometer on the rear panel of the instrument.

The frequency of the audible signal is 414Hz, and can be measured by connecting a suitable frequency counter at test point MP2. The frequency can be adjusted using trim potentiometer TP2.

Troubleshooting Procedure:

- replace the "TONE"-control board;
- check the level-control potentiometer;
- check the "chip-select" line;
- replace the CPU-board;
- replace the motherboard.

Test Switch Setting

Board Socket J2

Test Routine Description:

This checks the control circuitry for the fundamental tone of audible signal 3. Control is exercised by the D-flip/flop (DFF) on the low-voltage/"TONE" board.

The level of the audible signal can be adjusted using the potentiometer on the rear panel of the instrument.

The frequency of the audible signal is 329 Hz, and can be measured by connecting a suitable frequency counter at test point MP3. The frequency can be adjusted using trim potentiometer TP3.

Troubleshooting Procedure:

- replace the "TONE"-control board;
- check the level-control potentiometer;
- check the "chip-select" line;
- replace the CPU-board;
- replace the motherboard.

Test Switch Setting

Board Socket J2

Test Routine Description:

This checks fundamental tones 1, 2, and 3, the mixtures of the fundamental tones (1 + 2), (1 + 3), (2 + 3), and then the fundamental tones 1, 2, and 3 again, in this sequence. The loudnesses of these tones can be adjusted using the potentiometer on the rear panel of the instrument.

Refer to TEST ROUTINES 16, 17, and 18 regarding checking the fundamental tones.

The alarm tones will be output once all of the variable-loudness tones have been output.

Alarm tones are the fundamental tones and mixed fundamental tones listed above, but output at full loudness level, regardless of the setting of the sound-level potentiometer.

Troubleshooting Procedure:

- replace the "TONE"-control board;
- check the level-control potentiometer;
- check the "chip-select" line;
- replace the CPU-board;
- replace the motherboard.

TEST No. : 20

Test Switch Setting

Board Socket J11

Board Socket J13

Test Routine Description:

This is a test of the 8 (microprocessor input) signal lines.

Remove the circuit boards from board sockets J11, J12, and J13.

Indication of the LED-array on the motherboard:

"1" = LED illuminated

Before the TEST:

"0" = LED extinguished

Signal Line Source	Designation	Indication during TEST	TEST Conn.	Indication after TEST
J11, PIN 22	current density	D0 = "1"	1	D0 = "0"
J11, PIN 24	asymmetry 1	D1 = "1"	1	D1 = "0"
J11, PIN 23	asymmetry 2	D2 = "1"	1	D2 = "0"
J11, PIN 25	RF leakage current 2	D3 = "1"	1	D3 = "0"
J11, PIN 26	RF leakage current 1	D4 = "1"	1	D4 = "0"
J13, PIN 25	finger-control A	D5 = "1"	1	D5 = "0"
J13, PIN 26	finger-control B	D6 = "1"	1	D6 = "0"
J13, PIN 22	reserve (not used)	D7 = "1"	1	D7 = "0"

TEST connections: Connect the signal line source to:

- 1: signal ground (extender board, PINS 1, 2, and 3)
- VCC: + 15 VDC (extender board, PINS 6 and 7)

Troubleshooting Procedure:

- replace the CPU board;
- replace the driver IC6 and DFF IC7;
- replace the motherboard.

Test-Switch Setting

Board Socket J13

Board Socket J14

Test Routine Description:

This is a test of the 8 (microprocessor input) signal lines.

Remove the circuit boards from board sockets J12 and J13 before proceeding.

Indication of the LED-array on the motherboard:

"1" = LED illuminated

Before the TEST:

"0" = LED extinguished

Signal Line Source	Designation	Indication before TEST	TEST Conn.	Indication during TEST
CPU, cap. C13	15-s monitor	D0 = "1"	⊥	D0 = "0"
Footswitch A	footswitch A, J17	D1 = "0"	Footsw. "ON"	D1 = "1"
Footswitch B	footswitch B, J17	D2 = "0"	Footsw. "ON"	D2 = "1"
Switch J18	microswitch	D3 = "0"	Switch "ON"	D3 = "1"
Switch J19	microswitch	D4 = "0"	Switch "ON"	D4 = "1"
J14, PIN 20	LF leakage current	D5 = "1"	⊥	D5 = "0"
J13, PIN 21	reserve (not used)	D6 = "1"	⊥	D6 = "0"
J13, PIN 24	finger-control C	D7 = "1"	⊥	D7 = "0"

TEST connections: Connect the signal line source to:

- 1: signal ground (extender board, PINS 1, 2, and 3)
- VCC: + 15 VDC (extender board, PINS 6 and 7); or:
- Footsw. "ON": Actuate footswitch

Troubleshooting Procedure:

- check the device drivers on the motherboard;
- replace the CPU board;
- replace the motherboard.

Test-Switch Setting      Board Socket J8  
 Board Socket J9  
 Board Socket J10  
 Board Socket J11  
 Board Socket J12

Test Routine Description:

This is a test of the B (microprocessor input) signal lines.  
Remove the circuit boards from board sockets J8, J9, J10, J11, and J12 before proceeding.

Indication of the LED-array on the motherboard:

"1" = LED illuminated

Before the TEST:

"0" = LED extinguished

Signal Line Source	Designation	Indication before TEST	TEST Conn.	Indication during TEST
J11, PIN 21	NE returned freq. ("NESSY")	D0 = "1"	1	D0 = "0"
J10, PIN 22	spark-off signal	D1 = "1"	1	D1 = "0"
J10, PIN 23	current-off signal	D2 = "1"	1	D2 = "0"
J9, PIN 22	"SPRAY" status	D3 = "1"	1	D3 = "0"
J10, PIN 24	skin-contact monitor	D4 = "1"	1	D4 = "0"
J3, PIN 18	returned freq.	D5 = "1"	1	D5 = "0"
		D6 = "0"		D6 = "0"
J12, PIN 32	safety interrupt	D7 = "1"	1	D7 = "0"

TEST connections: Connect the signal line source to:  
 1: signal ground (extender board, PINS 1, 2, and 3)  
 VCC: + 15 VDC (extender board, PINS 6 and 7)

Troubleshooting Procedure:

- check the device drivers on the motherboard;
- replace the CPU board;
- replace the motherboard.



TEST No. : 23-26

Test Switch Settings not used

---

<b>ERBE</b> D-7400 Tübingen	TEST PROCEDURES		Date	Name
	Instr.:	Erbotom ACC450, 430, 410	Drawn 22.01.90	
		SOFT Version V2.0 Test Switch	Checked	
			Drwg. No.	
		Sheet No.		

Test Switch Setting

Board Socket J11

Test Routine Description:

This routine is for testing and adjusting the "NESSY" (neutral electrode) monitor. The procedure to be used is as follows:

1. Insert a 3-m length of shorted electrode cable (for the neutral electrode) into the NE-Jack.
2. TEST ROUTINE 27 is used to check the returned frequency. For a shorted NE-cable, this frequency should be 200 Hz  $\pm$  5 Hz. The returned frequency can be measured at test point MP3.
3. The "NE-TEST" Indicator will illuminated continuously if this frequency is 200 Hz. This Indicator will be blinking if this frequency differs from 200 Hz.
4. Use trim potentiometer TP2 to reset the returned frequency to 200 Hz. Adjust TP2 until the "NE-TEST" Indicator illuminates continuously.
5. TEST ROUTINE 28 will have to be performed if TP2 has been reset.

Test-Switch Setting

Board Socket J1

Test Routine Description:

This routine is for testing and adjusting the "NESSY" (neutral electrode) monitor feature. The procedure to be used is as follows:

1. Connect a 3-m length of unterminated electrode cable (the type used for the neutral electrode) at the NE-jack.
2. TEST ROUTINE 28 is used to check the returned frequency. For an unterminated NE-cable, this frequency should be  $12 \text{ Hz} \pm 1 \text{ Hz}$ . The returned frequency can be measured at test point MP3.
3. The "NE-TEST" indicator will be lit continuously if this frequency is equal to 12 Hz, and will be blinking if this frequency differs from 12 Hz.
4. Use trim potentiometer TP3 to reset the returned frequency to 12 Hz. Adjust TP3 until the "NE-TEST" indicator LED remains continuously lit.
5. TEST ROUTINE 27 will have to be performed if TP3 has been reset.

TEST No. : 29-33

Test Switch Settings      not used

---

<b>ERBE</b> D-7400 Tübingen	TEST PROCEDURES		Date	Name
	Instr.:	Erbotom ACC450, 430, 410	Drawn 22.01.90	
			Checked	
	SOFT Version	V2.0 Test Switch	Drwg. No.	
		Sheet No.		

Test Switch Setting

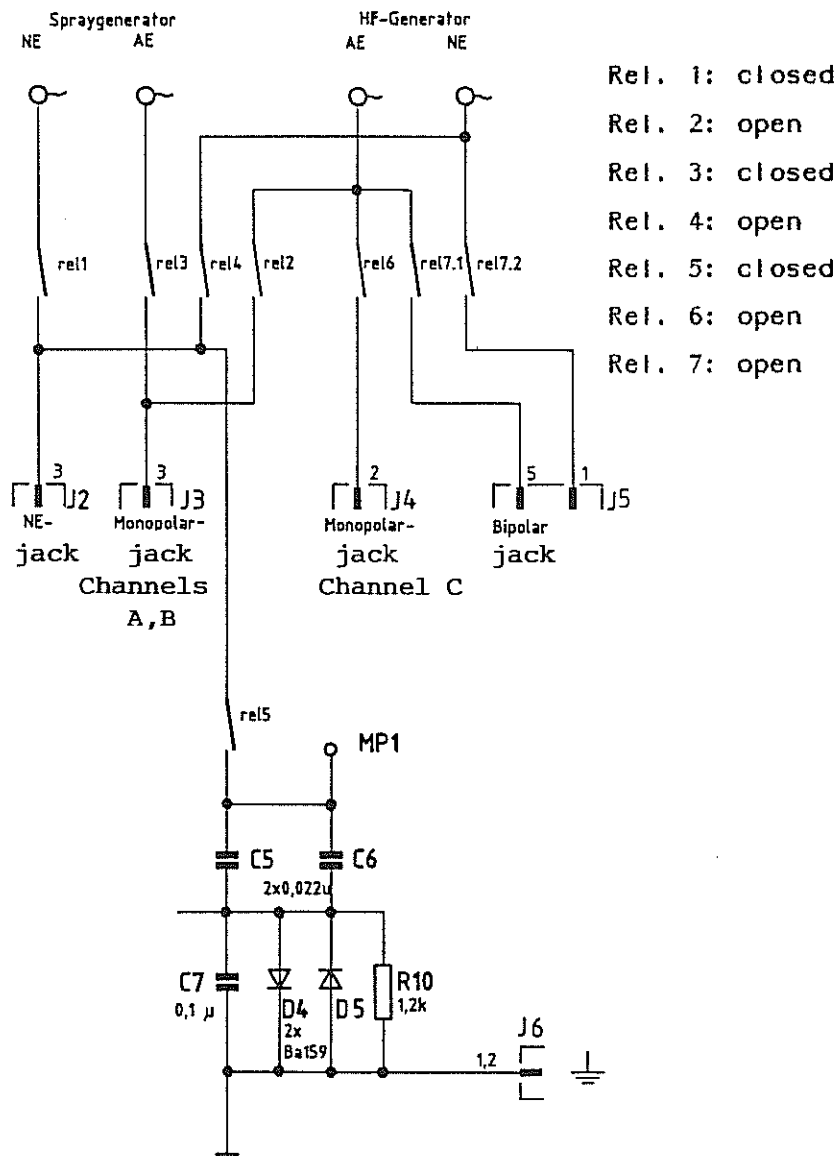
Board Socket J14

Test Routine Description:

This routine is used for adjusting the output relays, e.g., for testing the finger switch function. This adjustment is performed with the RF-generator out of operation.

Relay Contact Status:

SPRAY COAGULATION



- Rel. 1: closed
- Rel. 2: open
- Rel. 3: closed
- Rel. 4: open
- Rel. 5: closed
- Rel. 6: open
- Rel. 7: open

Test Switch Setting

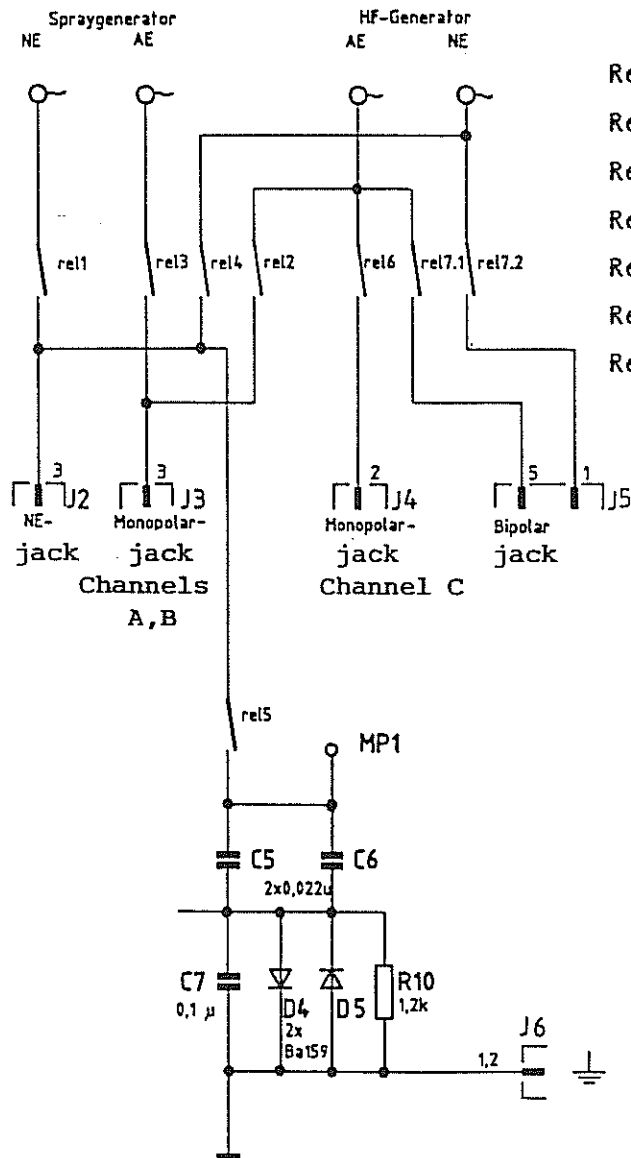
Board Socket J14

Test Routine Description:

This routine is used for adjusting the output relays, e.g., for testing the finger switch function. This adjustment is performed with the RF-generator out of operation.

Relay Contact Status:

SOFT COAGULATION, CUT



- Rel. 1: open
- Rel. 2: closed
- Rel. 3: open
- Rel. 4: closed
- Rel. 5: closed
- Rel. 6: open
- Rel. 7: open

Test Switch Setting

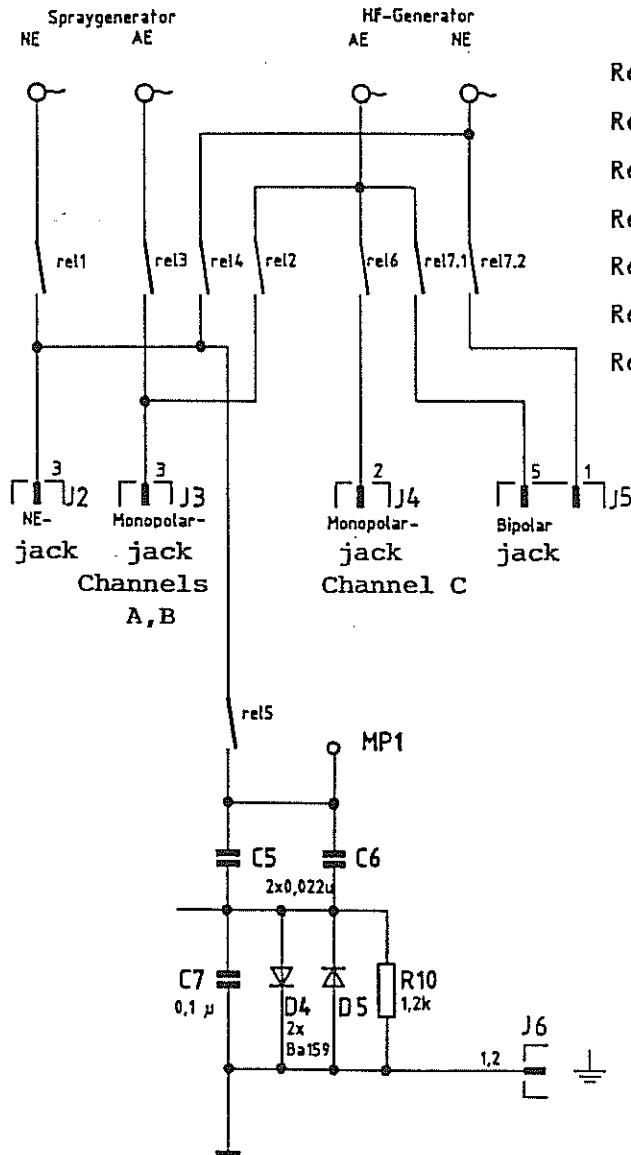
Board Socket J14

Test Routine Description:

This routine is used for adjusting the output relays, e.g., for testing the patient leakage currents. This adjustment is performed with the RF-generator out of operation.

Relay Contact Status:

Relays for CUT and  
SPRAY COAGULATION closed



- Rel. 1: closed
- Rel. 2: closed
- Rel. 3: closed
- Rel. 4: closed
- Rel. 5: closed
- Rel. 6: open
- Rel. 7: open

Test Switch Setting

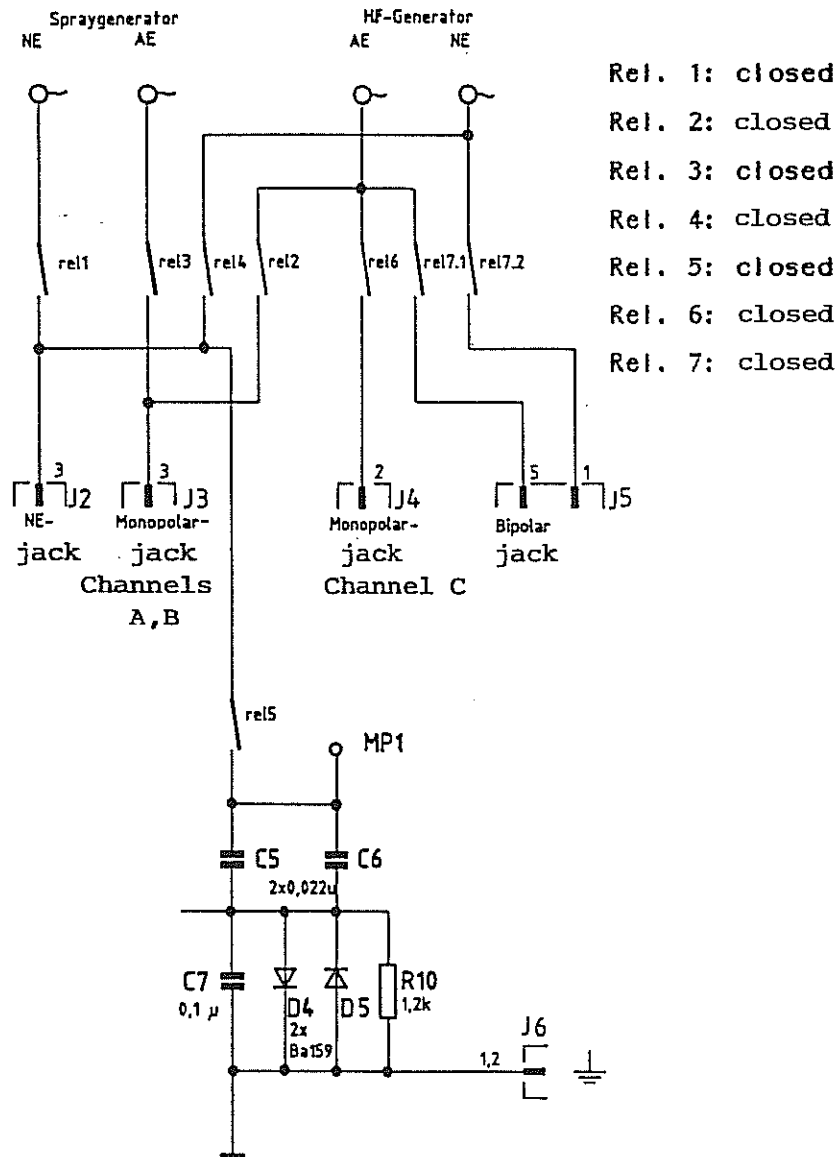
Board Socket J14

Test Routine Description:

This routine is used for adjusting the output relays, e.g., for testing the patient leakage currents. This adjustment is performed with the RF-generator out of operation.

Relay Contact Status:

Relays closed



- Rel. 1: closed
- Rel. 2: closed
- Rel. 3: closed
- Rel. 4: closed
- Rel. 5: closed
- Rel. 6: closed
- Rel. 7: closed



TEST No. : 38

Test Switch Setting      not used

---

**ERBE**  
D-7400 Tübingen

TEST PROCEDURES  
Instr.: Erbotom ACC450, 430, 410  
SOFT Version V2.0 Test Switch

	Date	Name
Drawn	22.01.90	
Checked		
Drwg. No.		
Sheet No.		

Test Switch Setting

Board Socket J3

Test Routine Description:

This routine is for adjusting the returned frequency for the "INCORRECT DOSE" measurement. If either the RF-generator or the 400-W power supply, or both, have been replaced, the "INCORRECT DOSE" measurement system will have to be checked, and may require readjustment.

Test Setup:

Connect an APM 600 RF power meter to the "CUT" and "NEUTRAL ELECTRODE" output jacks. Use a load resistor  $R_L = 500 \text{ Ohms}$ . Disconnect the APM test instrument's guard contact.

Use the yellow pedal of the foot switch to activate the "CUT" and "SET INTENSITY 1" modes of operation.

The rms output voltages of the "CUT" and "SET INTENSITY 1" modes should both be  $V_{rms} = 176 \text{ V}$ . This yields a power output of  $62 \text{ W} \pm 2 \text{ W}$ . If the measured power should depart significantly from this range, the RF output voltage should be checked.

Setting the Reporting Frequency:

- Activate the "CUT" mode using the foot switch.  
 If the adjustment is correct, the "INCORRECT DOSE" LED will be continuously lit;  
 If the adjustment is incorrect, the "INCORRECT DOSE" LED will be blinking and an audible alarm tone will sound.
  
- Readjust trim potentiometer TP3 on the power supply control board (inserted into board socket J3) until the "INCORRECT DOSE" LED remains continuously lit.

Test Routine Description:

TEST ROUTINE 40 can be used to continuously adjust the RF output voltage over the range 0 V to 320 V (rms), as well as to continuously adjust the current limit over the range 0 A to 2 A. The output voltage and current limit settings will be displayed. The default settings effective at the start of this test routine are 176 V (rms) and 1.5 A. These correspond to the settings for the "CUT 1" mode of operation.

The RF output voltage and the current limit can be readjusted whenever the "CUT" section of the operating panel has been activated using the yellow foot pedal.

The "INCORRECT DOSE" measurement mode is active during TEST ROUTINE 40. The trigger-points for the "incorrect dose" monitoring feature are established relative to the 176 V (rms) default setting of the "CUT1" mode of operation:

- an "incorrect dose" message will be triggered if the rms RF output voltage differs from 176 V by more than  $\pm 20\%$ ;
- both an "incorrect dose" message and an alarm will be triggered, and the RF output voltage will be interrupted, if the rms RF output voltage exceeds 176 V by more than 40 % (about 50 V).

The default settings of 176 V (rms) and 1.5 A will be set when this test routine is activated.

## Test Switch Setting

40-2

Test Routine Description:Adjustment of the RF output voltage and current limit

The adjustment is performed using the pushbuttons of the "CUT" section of the operating panel.

CUT Pushbutton No.	Action
5	Increase current limit
4	decrease current limit
2	increase RF output voltage
1	decrease RF output voltage

The effective RF output voltage will be displayed in the "INTENSITY"-column of the "COAGULATION" section of the operating panel.

INTENSITY	Multiplier
5	128
4	64
3	32
2	16
1	8

$$\text{RF output voltage} = \sum [\text{multipliers} * (V_{\text{max}}/255) * V_{\text{rms}}],$$

with  $V_{\text{max}}$  the maximum output voltage used for cutting; cf. the technical data.

Test Routine Description:

The current limit setting will be displayed in the "INTENSITY"-column of the "AUTOCOAGULATION" section of the operating panel, indicated by a set of multiplier-factors, as follows:

INTENSITY	Multiplier
5	N/A
4	N/A
3	128
2	64
1	32
0.8	16
0.6	8
0.4	4
0.2	2
0.1	1

The current limit setting (expressed in mA) can be computed from the relation:

$$I \text{ (mA)} = 7.85 * \sum \text{multipliers}$$

# TEST No. : 41

## Test Switch Setting

### Test Routine Description:

TEST ROUTINE 41 can be used to continuously adjust the RF output voltage over the range 0 V to 320 V (rms), as well as to continuously adjust the current limit over the range 0 A to 2 A. The output voltage and current limit settings will be displayed. The default settings at the start of the test routine are 176 V (rms) and 1.5 A. These correspond to the settings used for the "CUT 1" mode of operation.

The RF output voltage and the current limit can be readjusted whenever the "CUT" section of the operating panel has been activated using the yellow foot pedal.

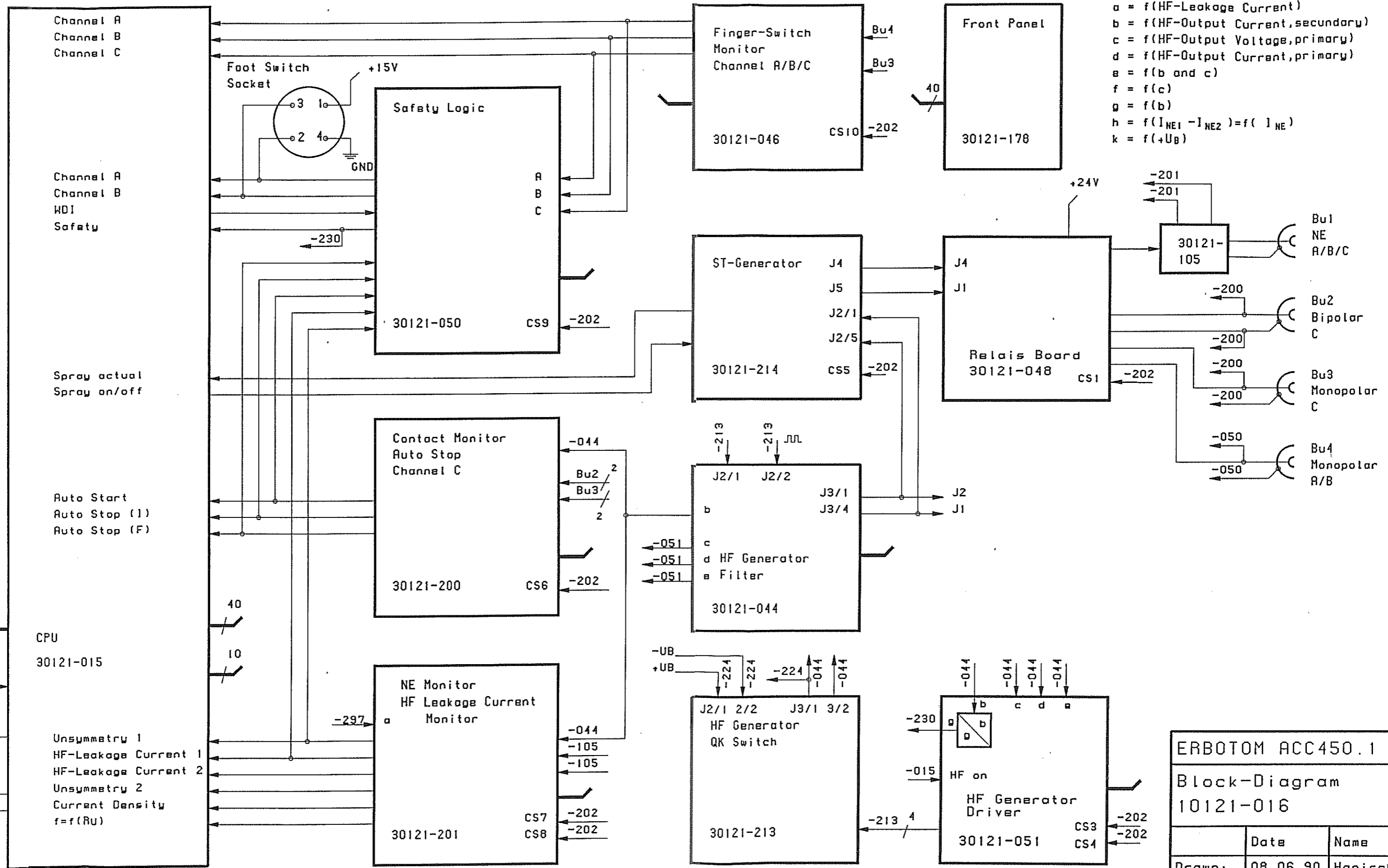
The measurement of "INCORRECT DOSE" is disabled when TEST ROUTINE 41 is active.

When TEST ROUTINE 41 is activated, the current actual settings of RF output voltage and current limit will be stored in memory.

Adjustment and display of the RF output voltage and current limit are as described in TEST ROUTINE 40.

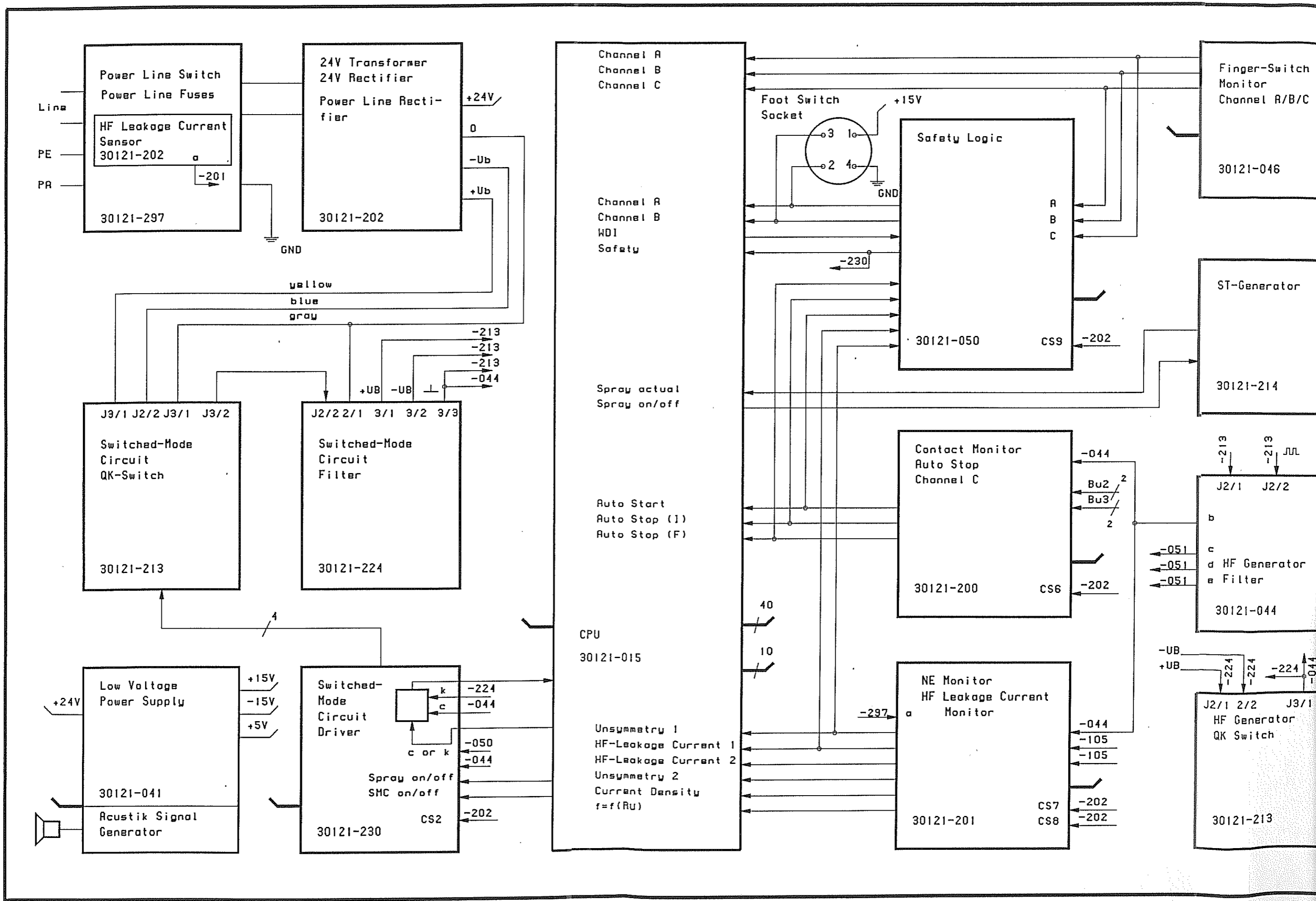
---

	TEST PROCEDURES	Date	Name
ERBE D-7400 Tübingen	Instr.: Erbotom ACC450, 430, 410	Drawn 22.01.90	
		Checked	
	SOFT Version V2.0 Test Switch	Drwg. No.	
		Sheet No.	



$a = f(\text{HF-Leakage Current})$   
 $b = f(\text{HF-Output Current, secondary})$   
 $c = f(\text{HF-Output Voltage, primary})$   
 $d = f(\text{HF-Output Current, primary})$   
 $e = f(b \text{ and } c)$   
 $f = f(c)$   
 $g = f(b)$   
 $h = f(I_{NE1} - I_{NE2}) = f(I_{NE})$   
 $k = f(+U_B)$

ERBOTOM ACC450.1		
Block-Diagram		
10121-016		
	Date	Name
Drawn:	08.06.90	Hanisch
Checked:		



Power Line Switch  
Power Line Fuses  
HF Leakage Current Sensor  
30121-202 a  
-201  
30121-297

24V Transformer  
24V Rectifier  
Power Line Rectifier  
+24V  
0  
-Ub  
+Ub  
30121-202

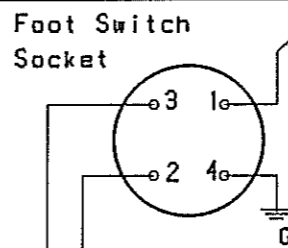
J3/1 J2/2 J3/1 J3/2  
Switched-Mode Circuit  
QK-Switch  
30121-213

J2/2 2/1 3/1 3/2 3/3  
Switched-Mode Circuit  
Filter  
+UB -UB  
-213  
-213  
-213  
-044  
30121-224

Low Voltage Power Supply  
+24V +15V -15V +5V  
30121-041  
Acustik Signal Generator

Switched-Mode Circuit Driver  
k c  
c or k  
-224 -044  
-050 -044  
Spray on/off SMC on/off  
-202  
30121-230 CS2

Channel A  
Channel B  
Channel C  
Channel A  
Channel B  
WD1  
Safety  
Spray actual  
Spray on/off  
Auto Start  
Auto Stop (I)  
Auto Stop (F)  
CPU  
30121-015  
Unsymmetry 1  
HF-Leakage Current 1  
HF-Leakage Current 2  
Unsymmetry 2  
Current Density  
 $f=f(Ru)$



Safety Logic  
A B C  
30121-050 CS9  
-230  
-202

Finger-Switch Monitor  
Channel R/B/C  
30121-046

ST-Generator  
30121-214

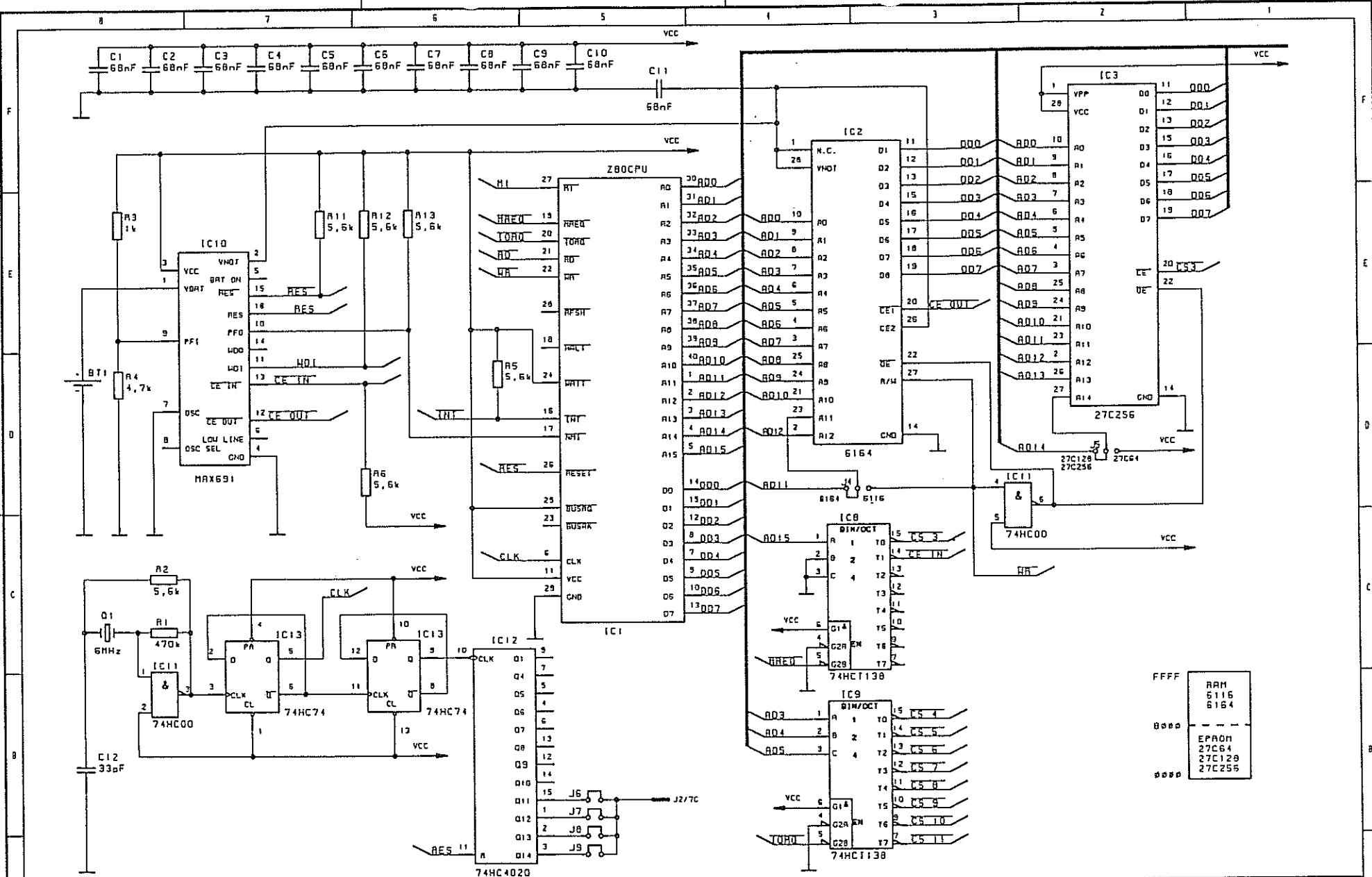
Contact Monitor  
Auto Stop  
Channel C  
-044 Bu2 2 Bu3 2  
30121-200 CS6  
-202

J2/1 J2/2  
b  
c  
d HF Generator  
a Filter  
-051 -051 -051  
30121-044

NE Monitor  
HF Leakage Current Monitor  
-297 a  
-044 -105 -105  
30121-201 CS7 CS8  
-202 -202

J2/1 2/2 J3/1  
HF Generator  
QK Switch  
-UB +UB -224 -224 -224  
30121-213



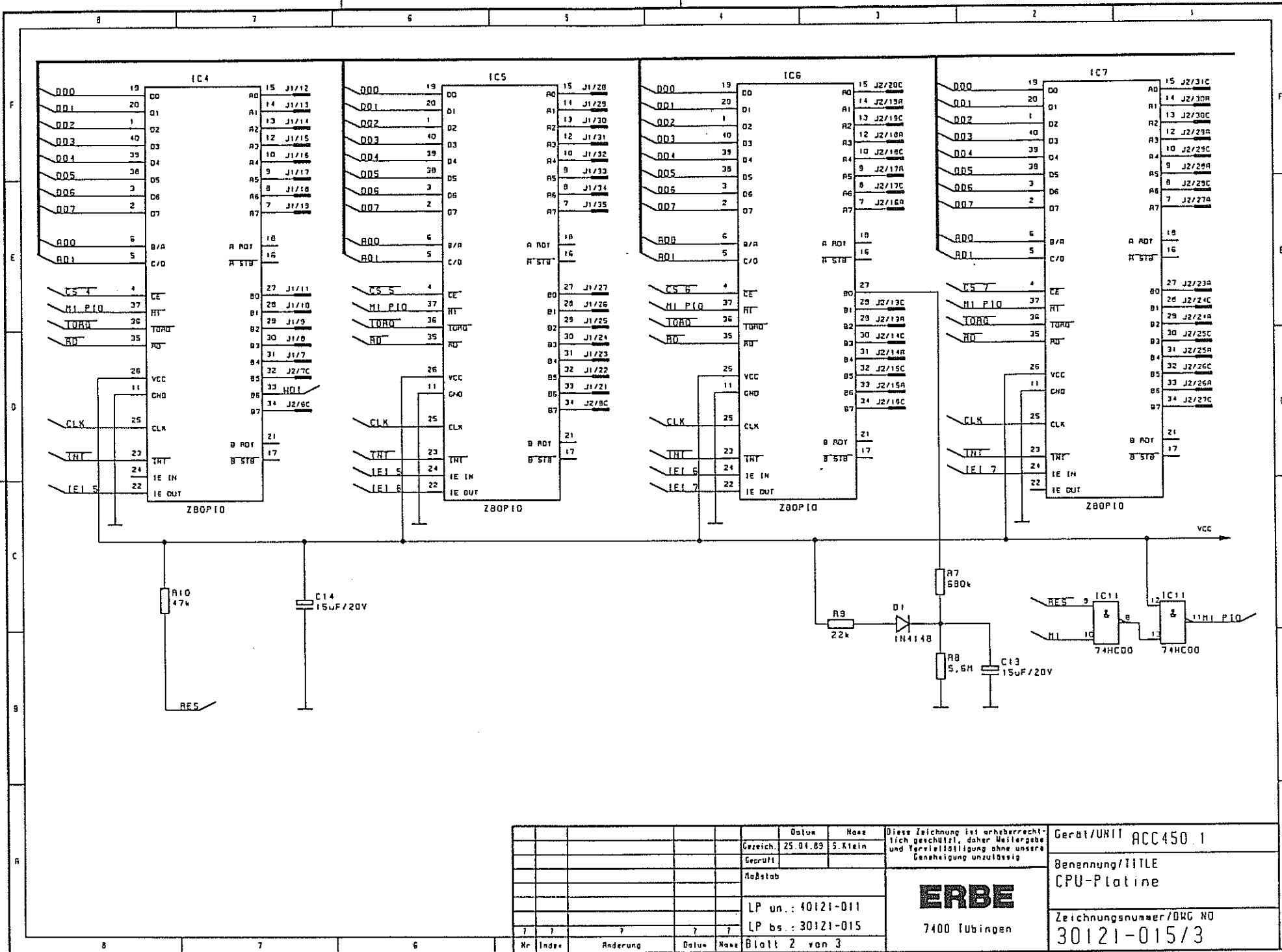


FFFF	RAM
6116	6164
0000	-----
	EPRAM
	27C64
	27C128
	27C256

		Datum		Name		Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig		Gerät/UNIT ACC450.1	
		Gezeichnet		25.01.89		S. Klein		Benennung/TITLE	
		Geprüft						CPU-Platine	
		Abgest.:						Zeichnungsnummer/DWG. NO.	
		LP un.:		40121-011				30121-015/3	
		LP bs.:		30121-015					
		Nr. Index		Änderung		Datum		Blatt 1 von 3	



7400 Tübingen

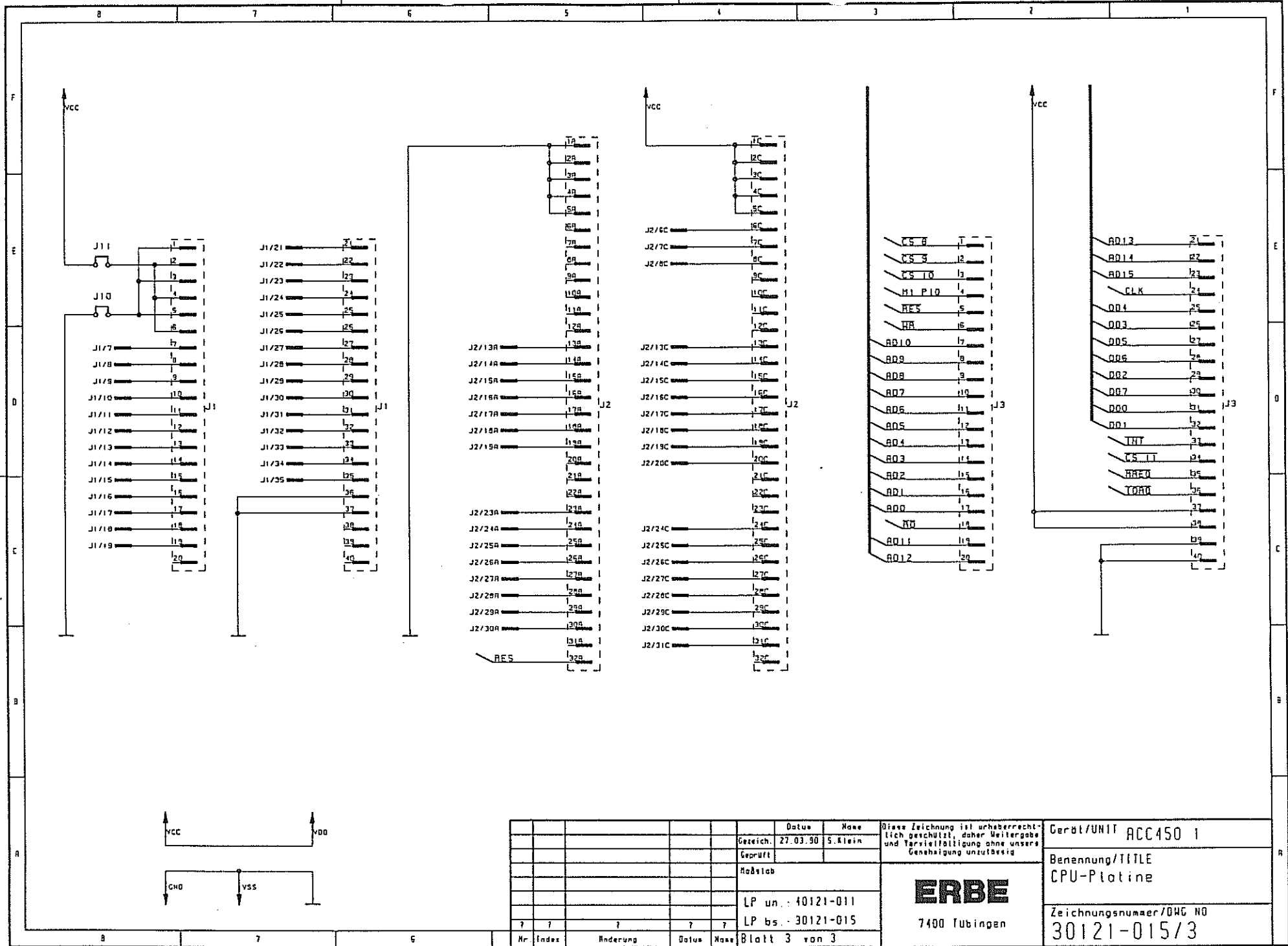



		Datum		Name	
		Gezeichnet	25.04.89	S.Klein	
		Geprüft			
		Maßstab			
		LP un.:	40121-011		
		LP bs.:	30121-015		
7	7	?	?	?	?
Nr	Index	Anderung	Datum	Name	Blatt 2 von 3

Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig.

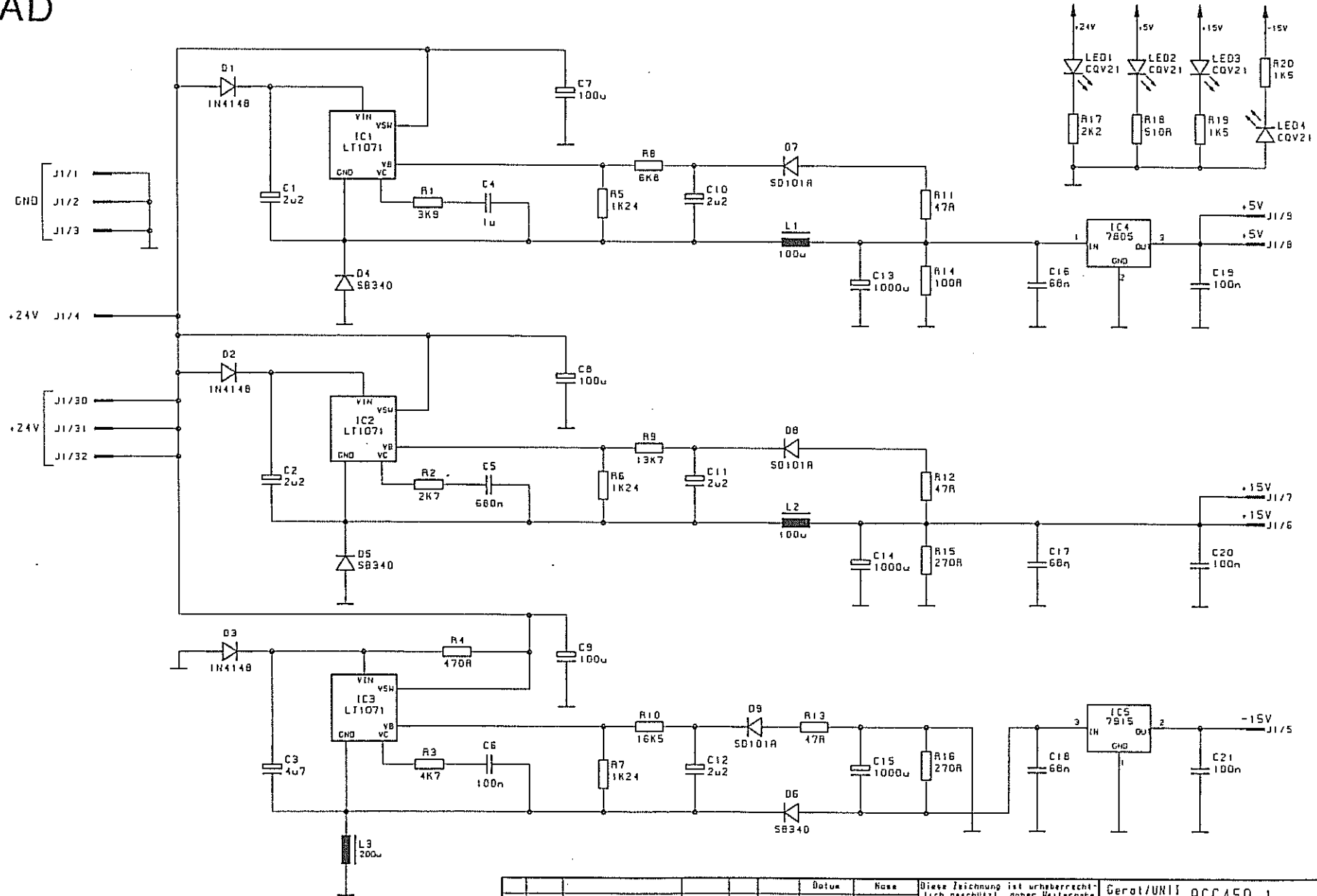
**ERBE**  
7400 Tübingen

Gerät/UNIT ACC450.1  
Benennung/TITLE CPU-Platine  
Zeichnungsnummer/DWG NO 30121-015/3



		Datum		Name		Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT ACC450 1
		Gezeichnet 27.03.90		S. Klein			Benennung/TITLE CPU-Platine
		Geprüft		Radstlab		 7400 Tübingen	Zeichnungsnummer/DWG NO 30121-015/3
		LP un. : 40121-011		LP bs. : 30121-015			
?	?	?	?	?	?		Blatt 3 von 3
Hr.	Index	Änderung	Datum	Name			

# CAD



					Datum	Name
					Gezeichnet	27.03.90 Hiesl
					Geprüft	
					Maßstab	
					LP un.:	10121-019
					LP bs.:	30121-041
?	?	?	?	?	?	?
Mr	Index	Änderung	Datum	Name	Blatt 1 von 2	

Diese Zeichnung ist urheberrechtlich geschützt, daher Vervielfältigung und Vervielfältigung ohne unsere Genehmigung unzulässig.

**ERBE**  
7400 Tübingen

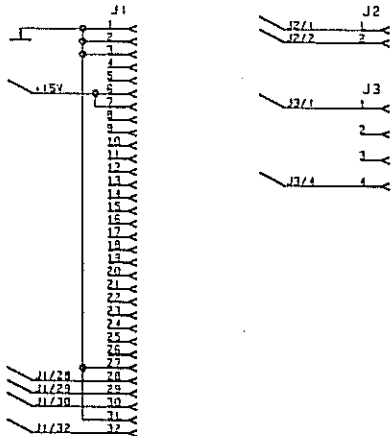
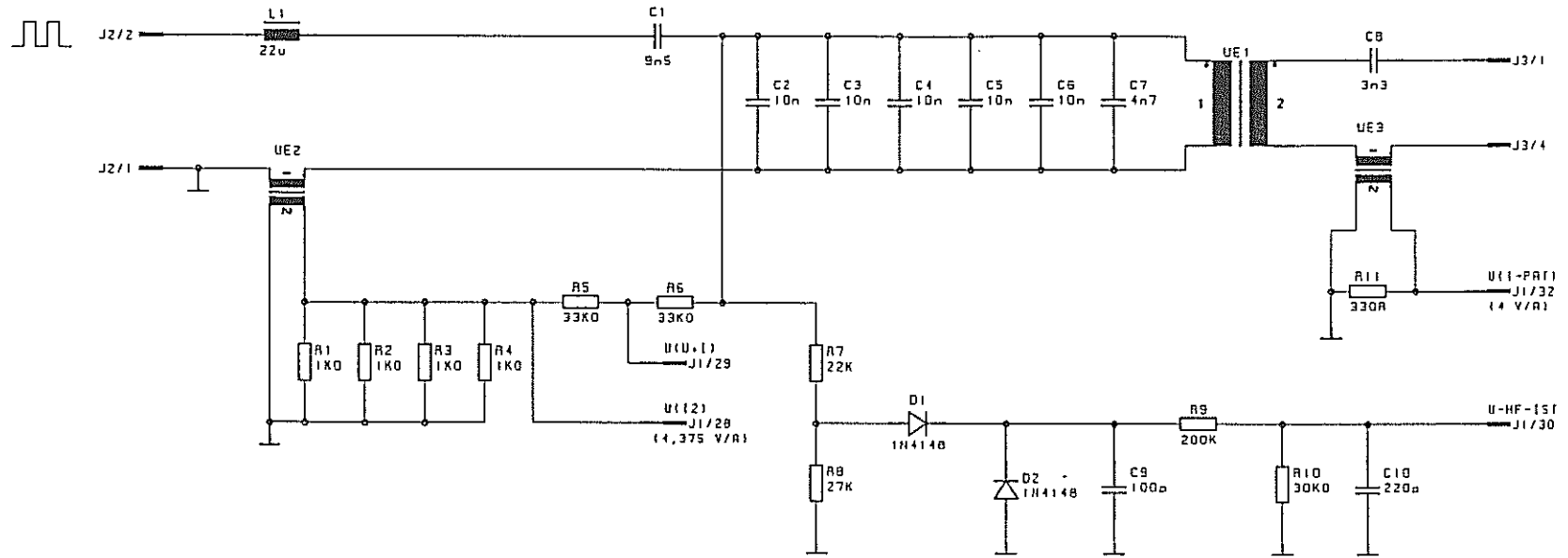
Gerät/UNIT ACC450 1

Benennung/TITLE  
Kleinspannung u Ton

Zeichnungsnummer/DWG NO  
30121-041/3



# CAD



Nr.	Index	Änderung	Datum	Name
?	?	?	?	?
?	?	?	?	?

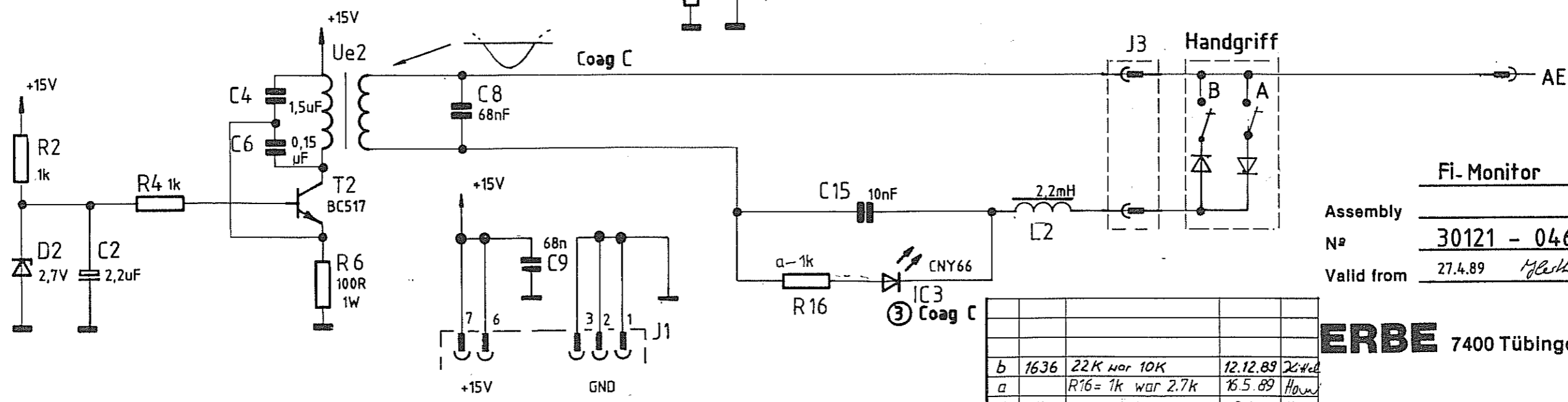
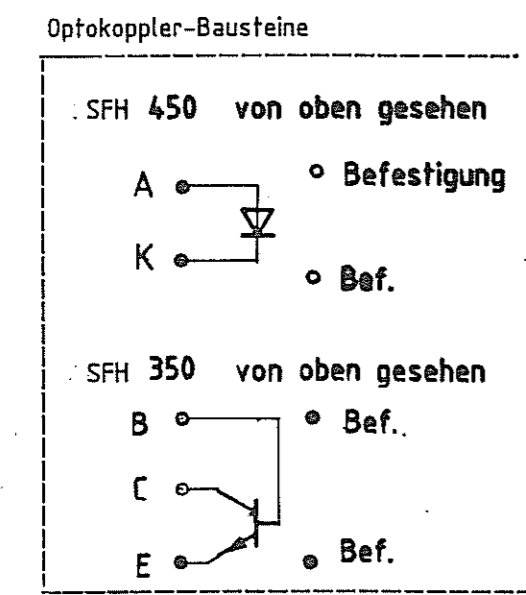
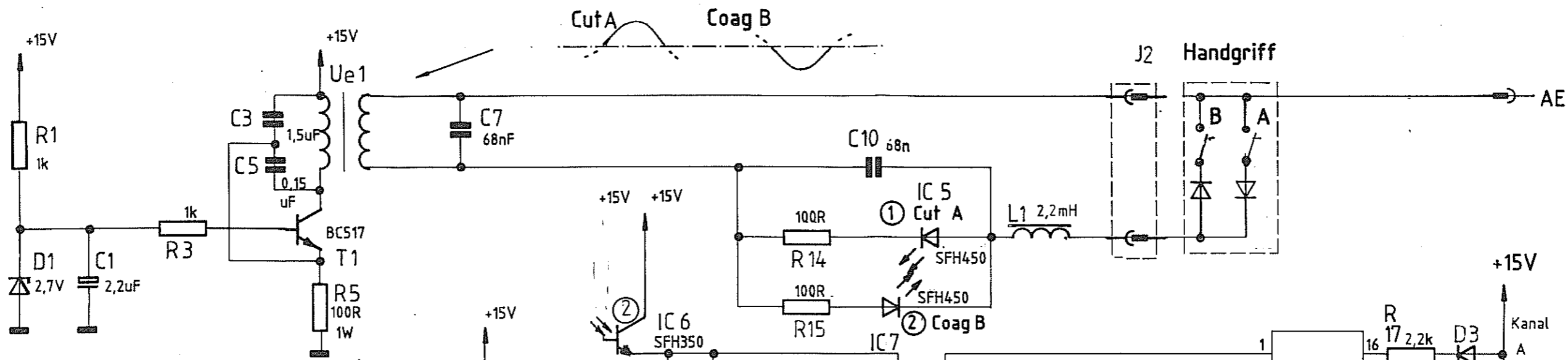
Datum	Name
21.03.90	Hiest
Geprüft	
Hörslab	
LP un.: 40121-022.	
LP bs.: 30121-044	

**ERBE**

7400 Tübingen

Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig

Gerät/UNIT ACC450 1
Benennung/TITLE A.-Filter HF-Generator
Zeichnungsnummer/DWG NO 30121-044/3



Fi-Monitor ACC450

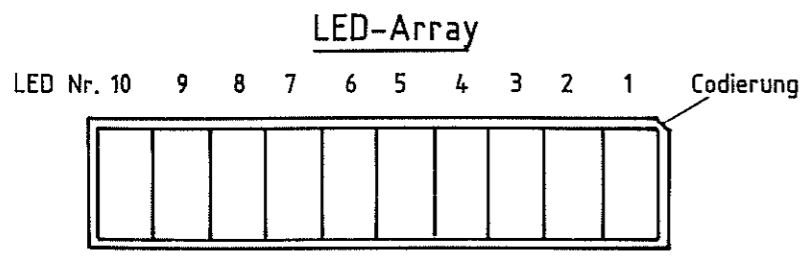
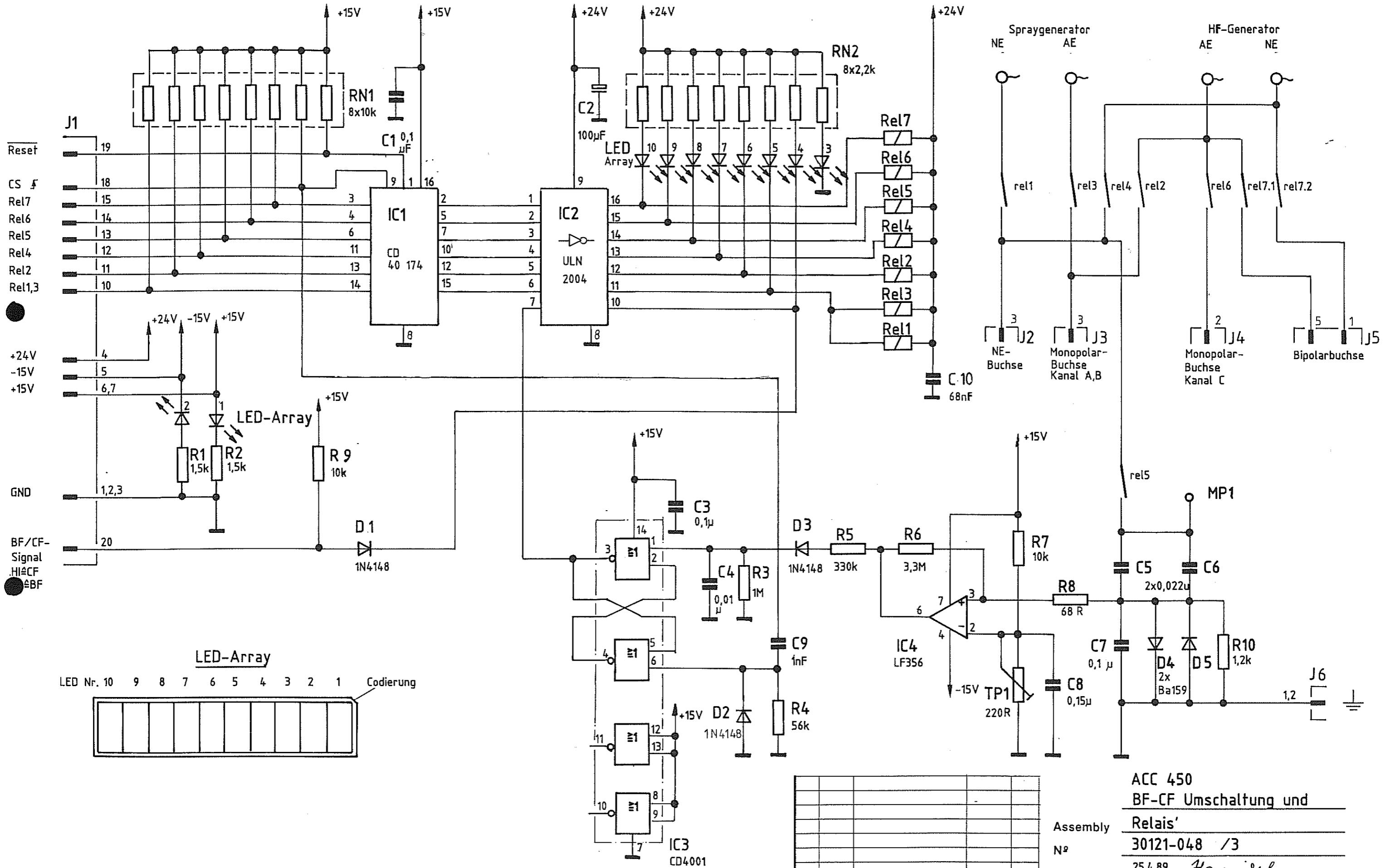
Assembly № 30121 - 046

Valid from 27.4.89 *H. K. H. H. H.*

ERBE 7400 Tübingen W.-Germany

Index	Nr.	Änderung	Datum	Name
b	1636	22K war 10K	12.12.89	Z. H. H.
a		R16 = 1k war 2.7k	16.5.89	H. H. H.

KANAL C  
KANAL A  
KANAL B

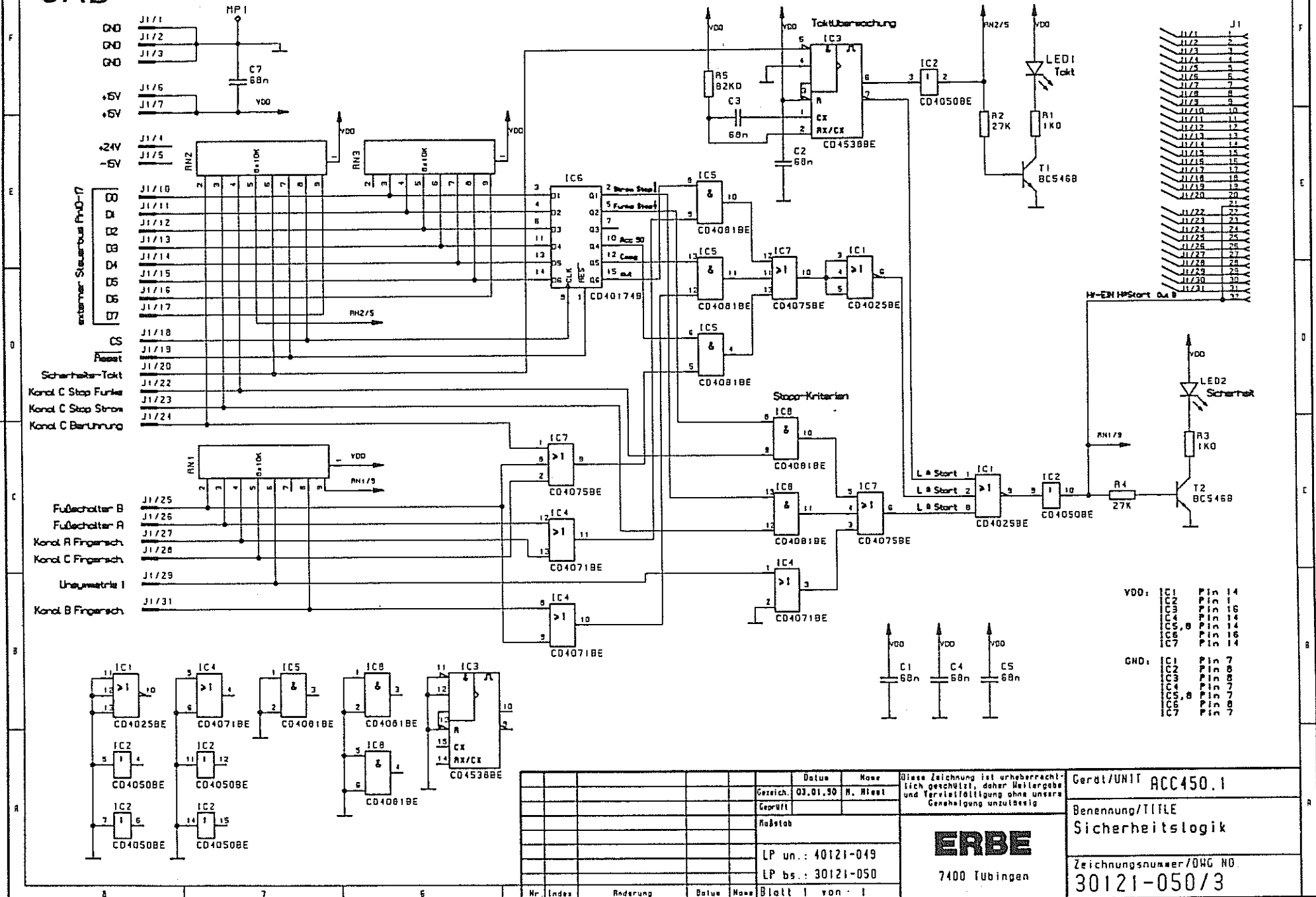


Index	Nr.	Aenderung	Datum	Name
1538	C7 = 0,1 uF		13.9.89	Haw

ACC 450  
 BF-CF Umschaltung und  
 Relais'  
 Assembly  
 N° 30121-048 /3  
 Valid from 25.4.89 *Hawisch*



# CAD



J1	Pin
11/1	1
11/2	2
11/3	3
11/4	4
11/5	5
11/6	6
11/7	7
11/8	8
11/9	9
11/10	10
11/11	11
11/12	12
11/13	13
11/14	14
11/15	15
11/16	16
11/17	17
11/18	18
11/19	19
11/20	20
11/21	21
11/22	22
11/23	23
11/24	24
11/25	25
11/26	26
11/27	27
11/28	28
11/29	29
11/30	30
11/31	31

Y00:	IC	Pin
	IC1	Pin 14
	IC2	Pin 1
	IC3	Pin 16
	IC4	Pin 14
	IC5	Pin 14
	IC6	Pin 16
	IC7	Pin 14

GND:	IC	Pin
	IC1	Pin 7
	IC2	Pin 8
	IC3	Pin 8
	IC4	Pin 7
	IC5	Pin 7
	IC6	Pin 8
	IC7	Pin 7

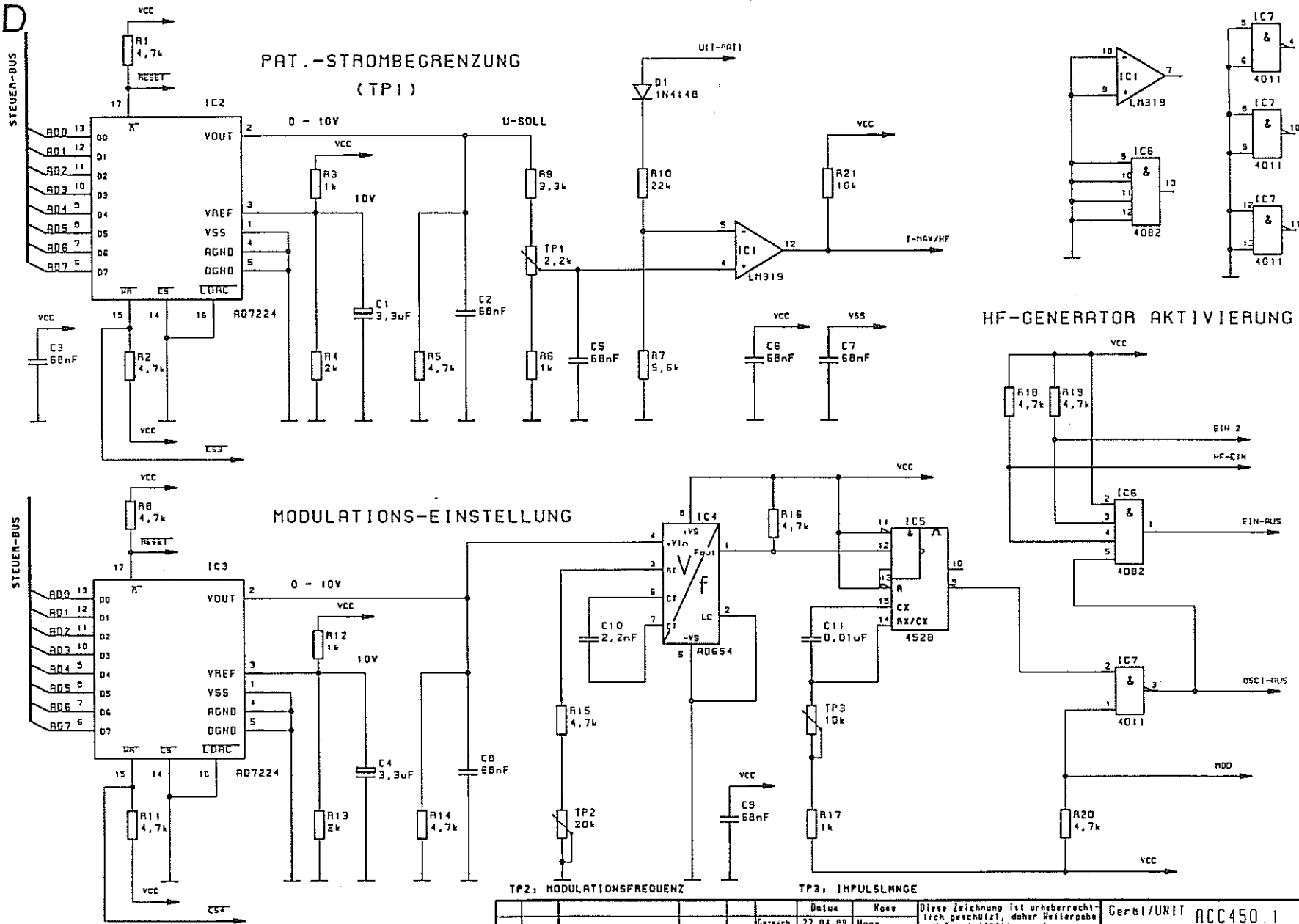
Nr.	Index	Änderung	Datum	Name	Blatt
					1 von 1

Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig.

**ERBE**  
 7400 Tübingen


Gerät/UNIT	ACC450.1
Benennung/TITLE	Sicherheitslogik
Zeichnungsnummer/DWG NO.	30121-050/3

CAD

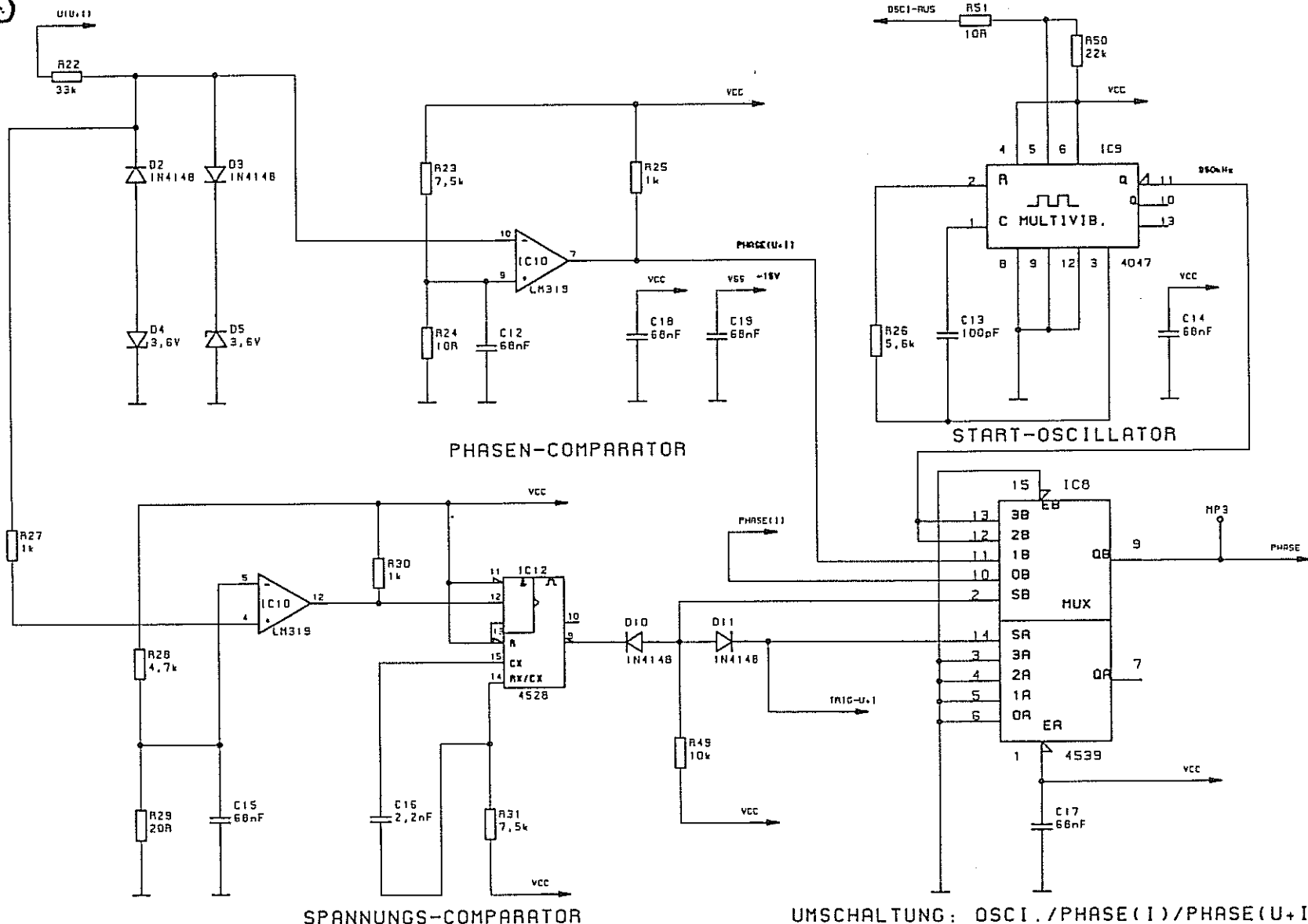


TP2: MODULATIONSFREQUENZ

TP3: IMPULSLÄNGE

		Datum		Name		Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT ACC450.1
		Gezeichnet	27.04.89	Haupt			Benennung/TITLE Steuerung HF-Generator
		Geprüft		Maßstab		 7400 Tübingen	Zeichnungsnummer/DWG NO 30121-051/3
		LP un. : 40121-023		LP bs. : 30121-051			
		Blatt 1 von 4					

CAD



PHASEN-COMPARATOR

START-OSCILLATOR

SPANNUNGS-COMPARATOR

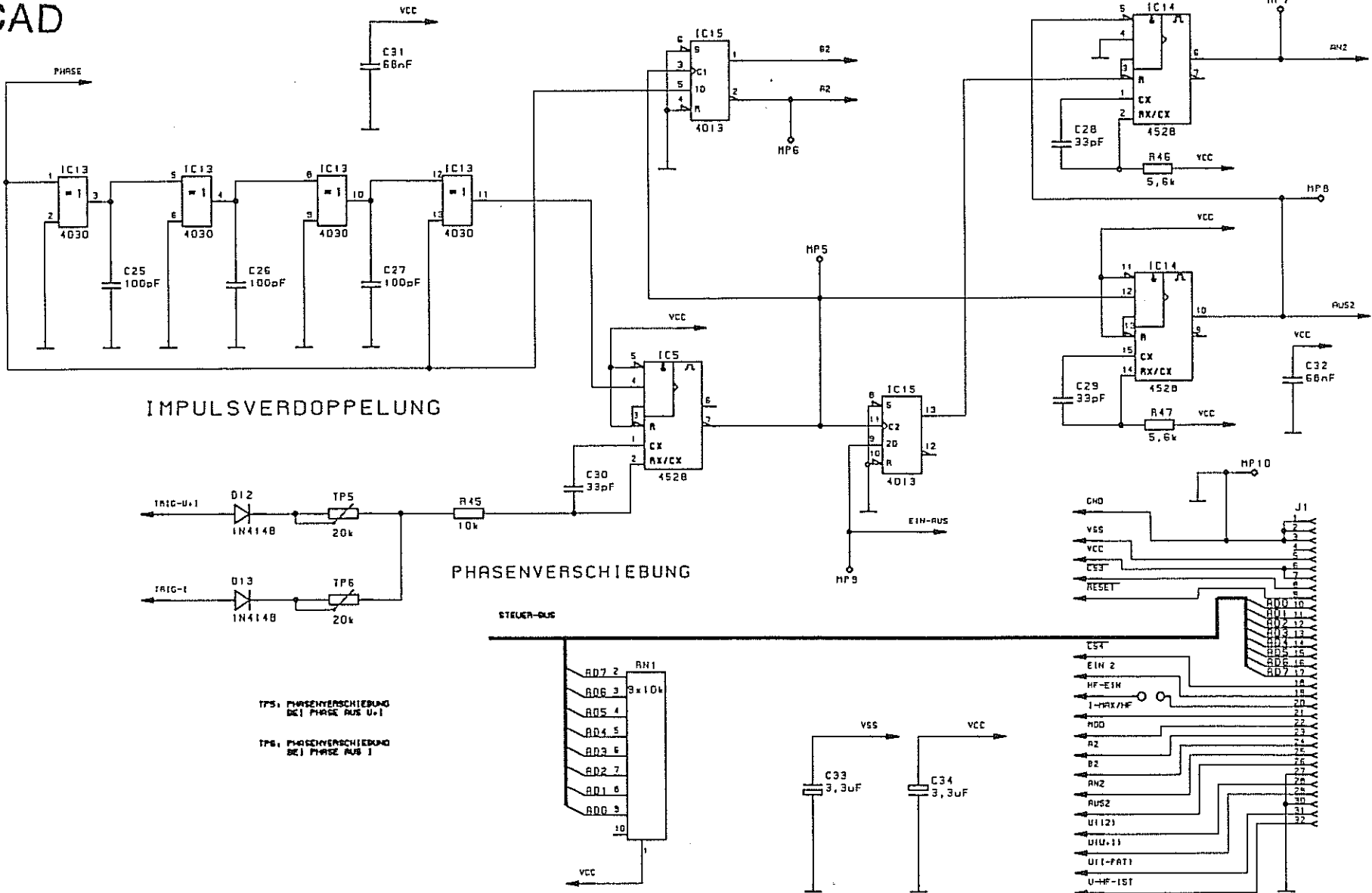
UMSCHALTUNG: OSCI./PHASE(I)/PHASE(U+I)

Datum		Name		Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT	ACC450.1
Gezeichnet	27.04.85	Maßstab			Benennung/TITEL	Steuerung HF-Generator
Geprüft		LP un.:	40121-023		Zeichnungsnummer/DWG NO	30121-051/3
		LP bs.:	30121-051			
Hr	Index	Änderung	Datum	Name	Blatt 2 von 4	





CAD



TP5: PHASENVERSCHIEBUNG  
BEI PHASE AUS U-1

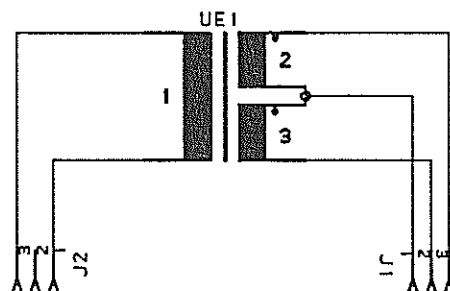
TP6: PHASENVERSCHIEBUNG  
BEI PHASE AUS I

				Datum	Mass	Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig
			Gezeichnet	27.04.89	Hopp	
			Geprüft			
			Maßstab			
						LP un.: 40121-023
						LP bs.: 30121-051
Nr	Index	Änderung	Datum	Mass	Blatt 4 von 4	

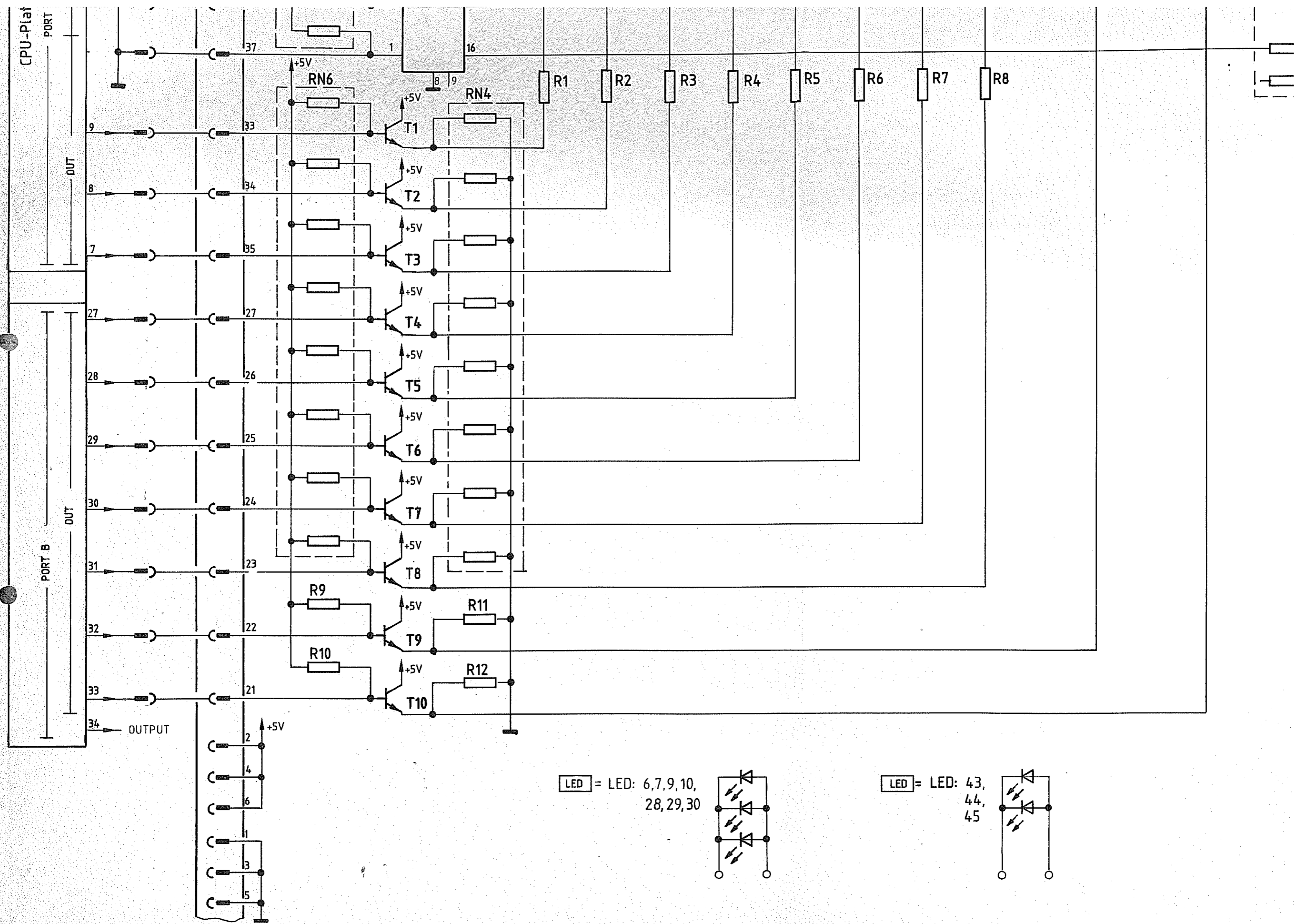
**ERBE**  
7400 Tübingen

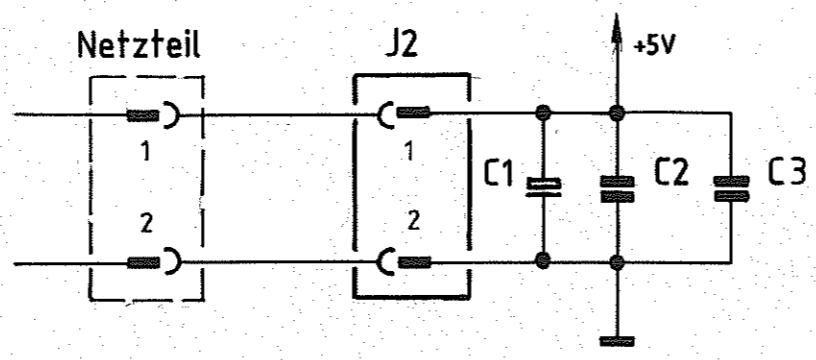
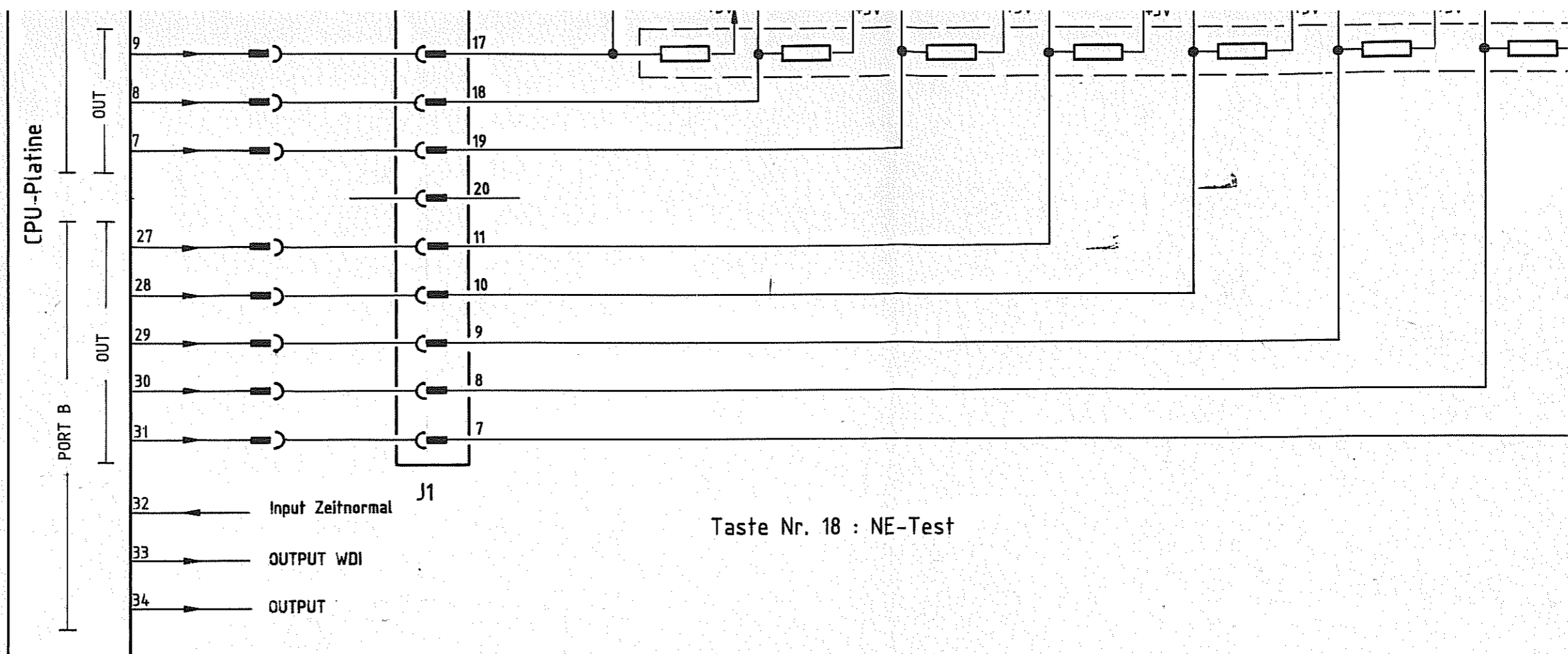
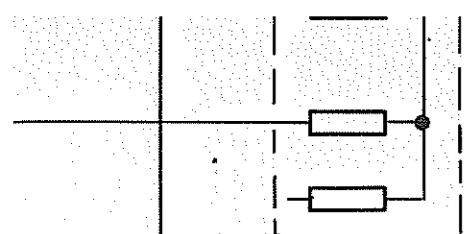
Gerät/UNIT ACC450.1  
Benennung/TITLE  
Steuerung HF-Generator  
Zeichnungsnummer/DWG. NO  
30121-051/3

CAD



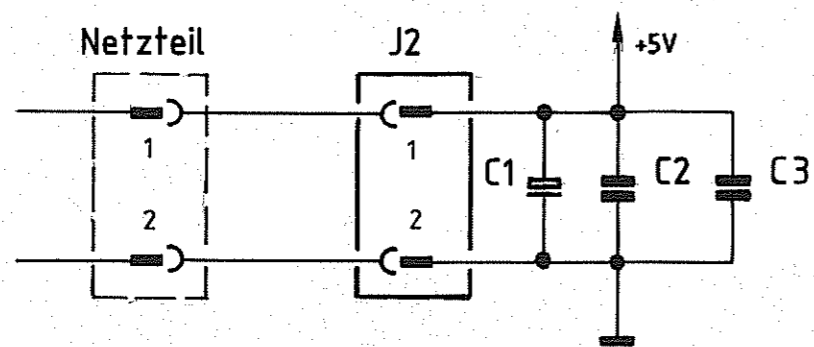
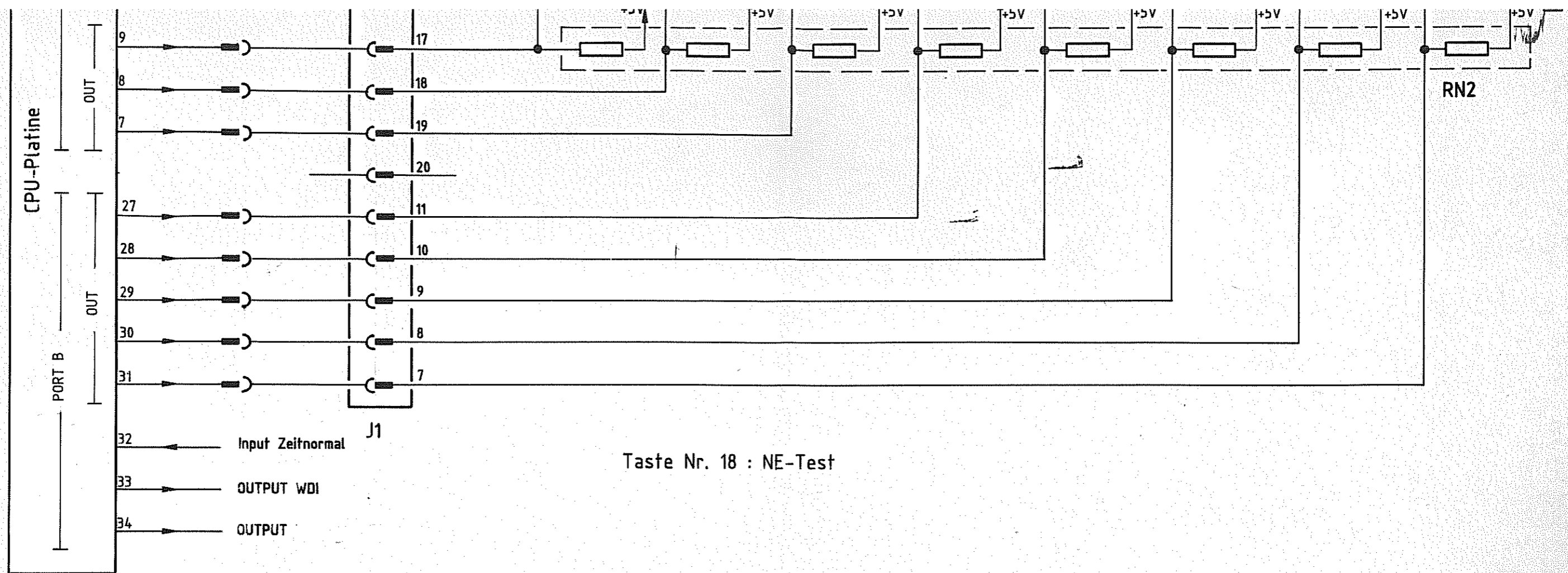
					Datum	Name	Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT ACC450.1
					Gezeichnet	15.02.89 S.Klein		Benennung/TITLE NE-Anschlussplatine
					Geprüft		<b>ERBE</b> 7400 Tübingen	Zeichnungsnummer/DWG.NO. 30121-105/4
					Maßstab			
					LP un.: 40121-036 LP bs.: 30121-105			
Nr.	Index	Änderung		Datum	Name		Blatt 1 von 1	





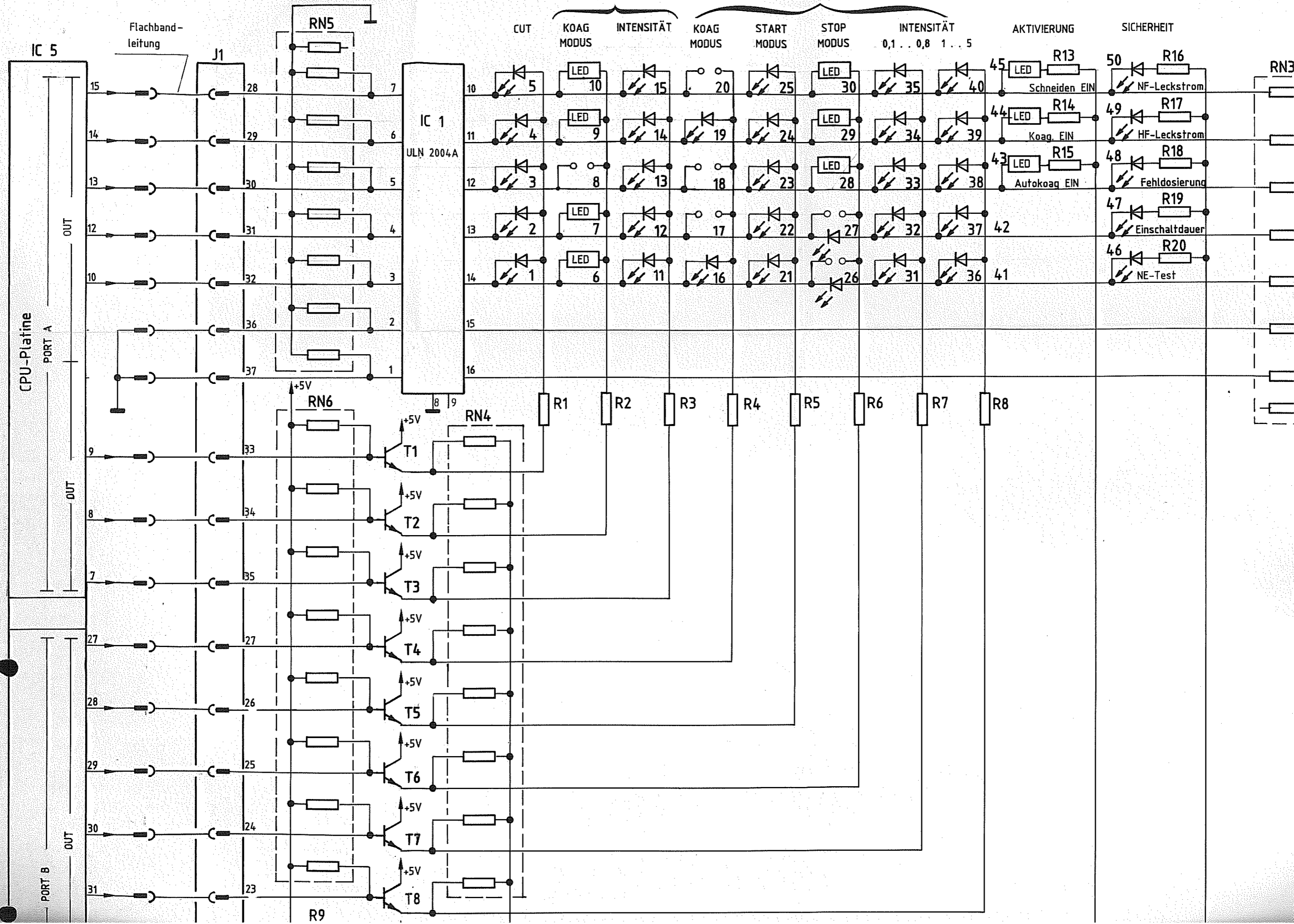
ACC 1  
 Assembly Anzeig  
 № 30121  
 Valid from 12.89





ACC 450.1  
 Assembly Anzeige u. Tastaturplatine  
 N<sup>o</sup> 30121-178/11  
 Valid from 12.89 *Hanisch*

**ERBE** 7400 Tübingen W.-Germany



Flachband-leitung

IC 5

J1

RN5

IC 1  
ULN 2004A

CUT

KOAG  
MODUS

INTENSITÄT

KOAG  
MODUS

START  
MODUS

STOP  
MODUS

INTENSITÄT  
0,1 .. 0,8 1 .. 5

AKTIVIERUNG

SICHERHEIT

RN3

R13

R16

Schneiden EIN

NF-Leckstrom

R14

R17

Koag. EIN

HF-Leckstrom

R15

R18

Autokoag EIN

Fehldosierung

R19

R19

Einschaltdauer

Einschaltdauer

R20

R20

NE-Test

NE-Test

RN6

RN4

R1

R2

R3

R4

R5

R6

R7

R8

T1

T2

T3

T4

T5

T6

T7

T8

R9

CPU-Platine

PORT A

OUT

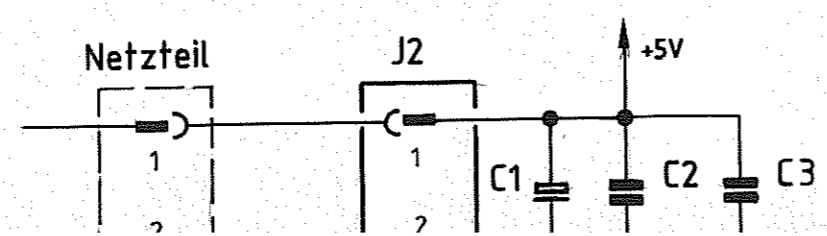
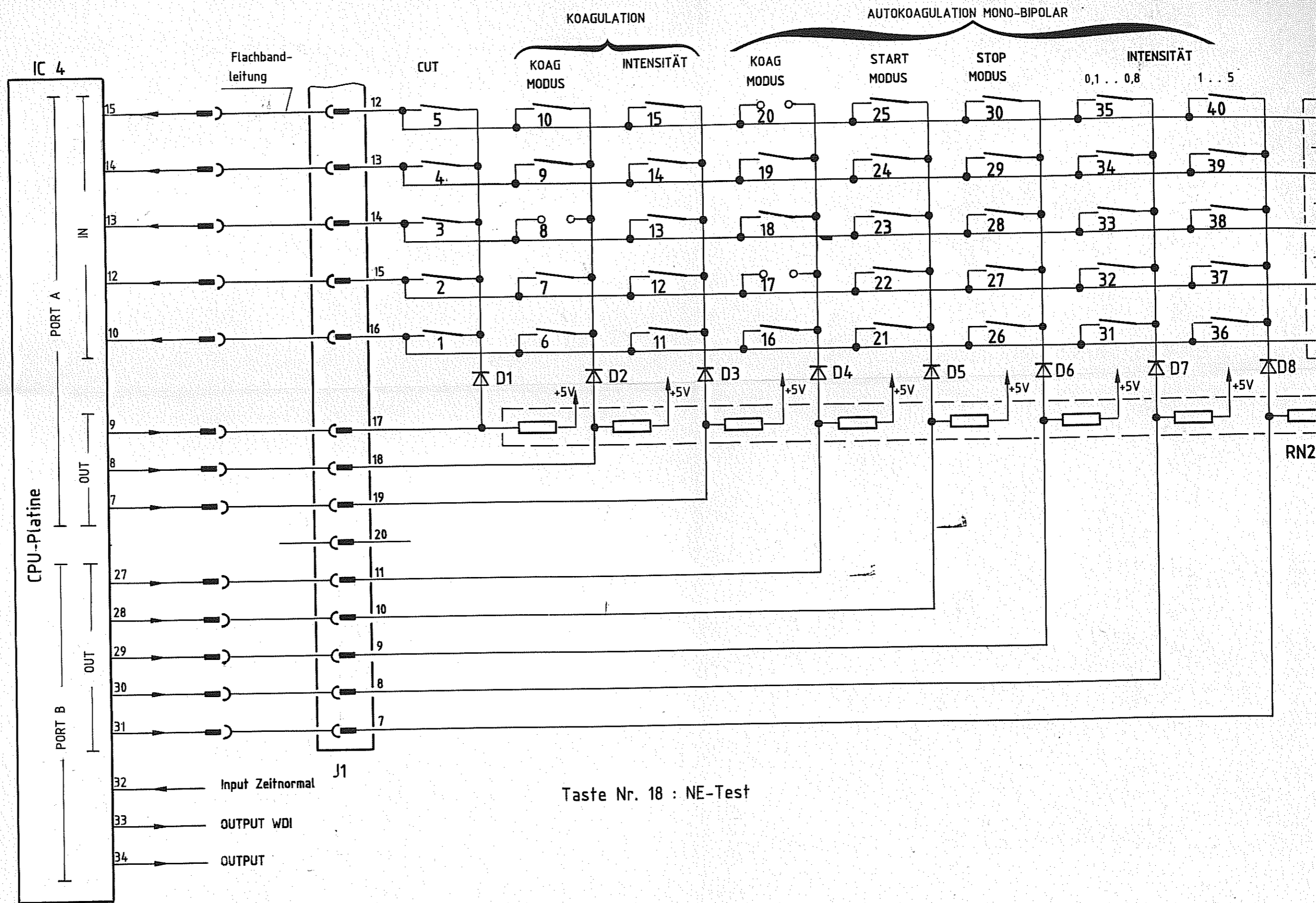
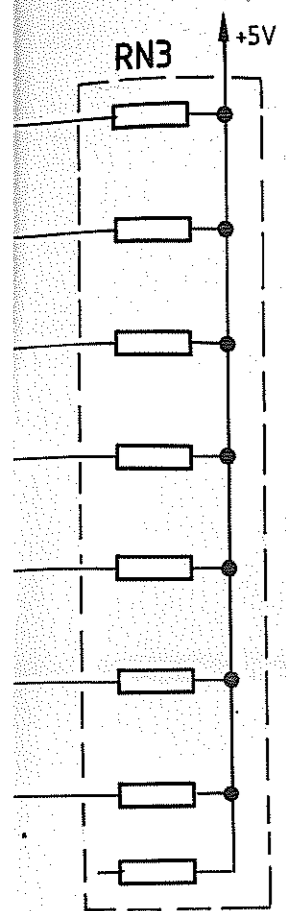
OUT

OUT

OUT

OUT

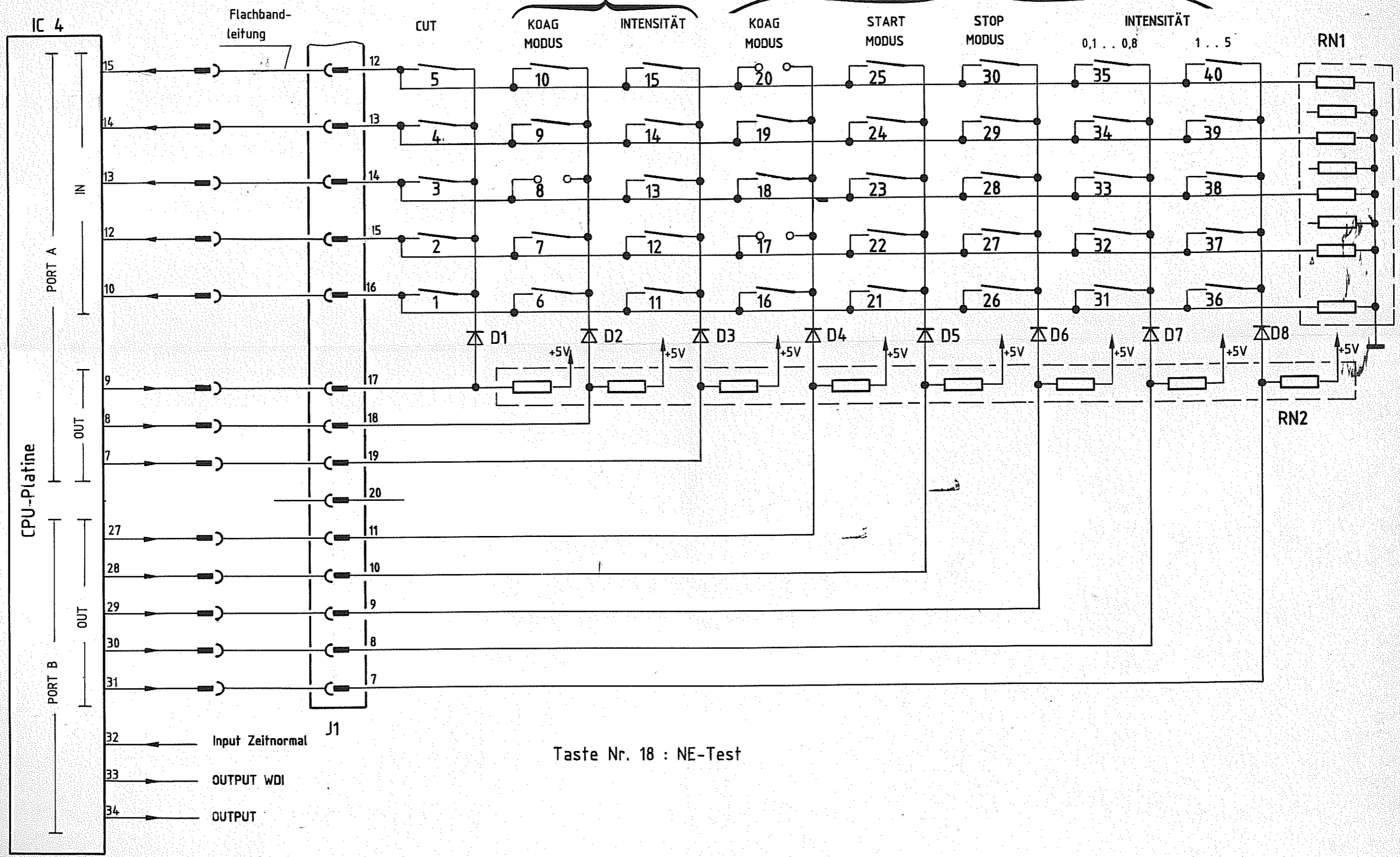
PORT B



+5V

KOAGULATION

AUTOKOAGULATION MONO-BIPOLAR



CPU-Platine

PORT A

PORT B

IN

OUT

OUT

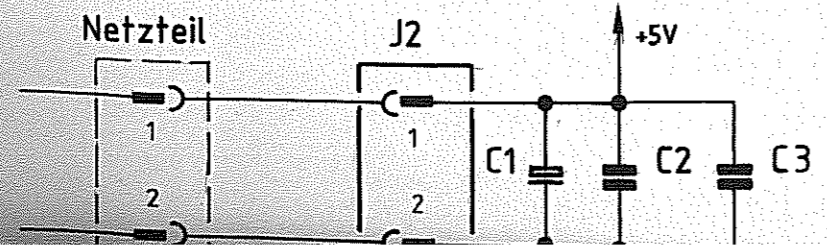
OUT

Input Zeitnormal

OUTPUT WDI

OUTPUT

Taste Nr. 18 : NE-Test

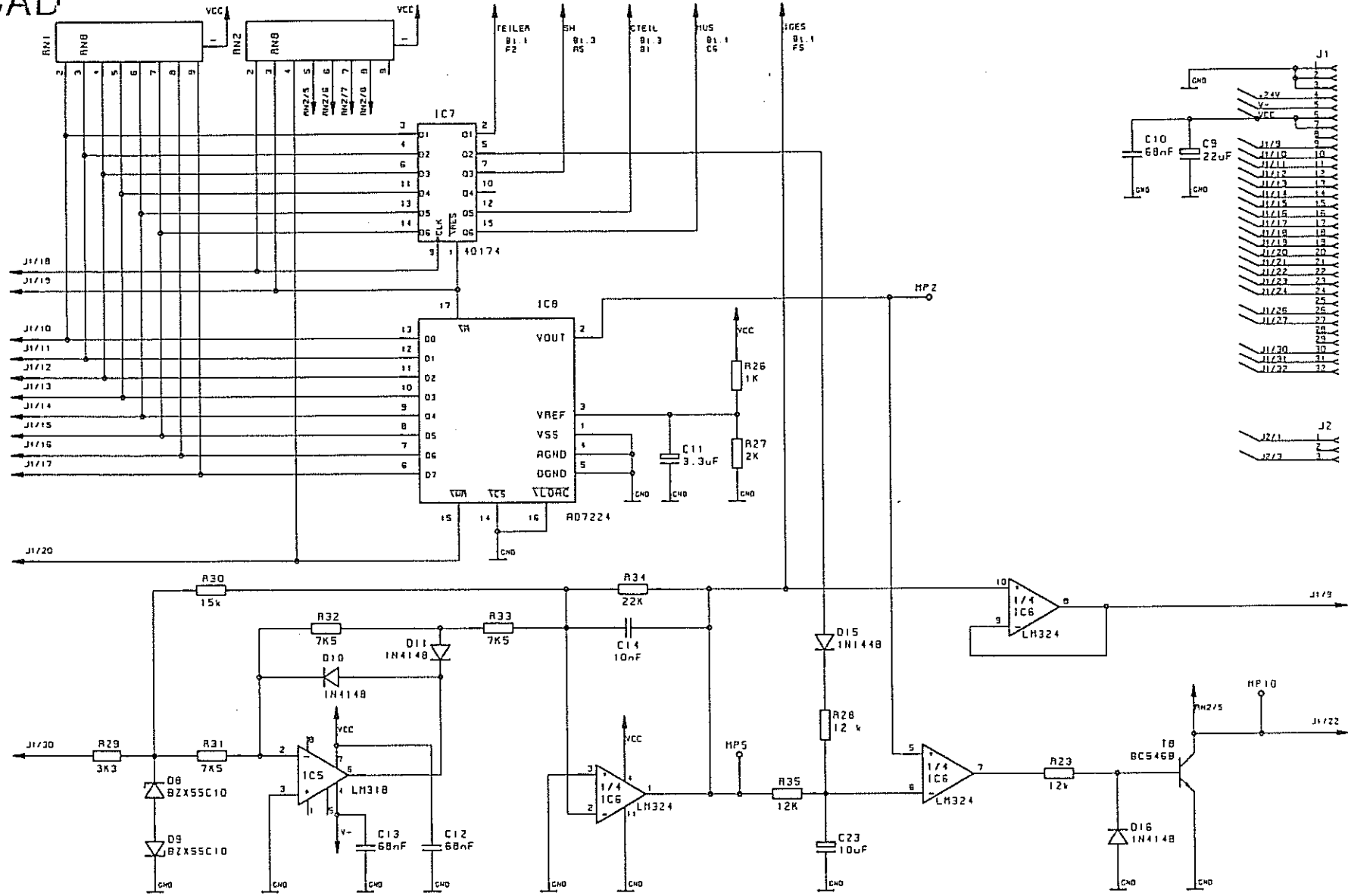








# CAD



Datum		Name	
Gesicht	4.12.89	S.Klein	
Geprüft			
Maßstab			
	LP un. 40121-044		
	LP bs. 30121-201		
Nr. Index	Anderung	Datum	Name
			Blatt 2 von 3

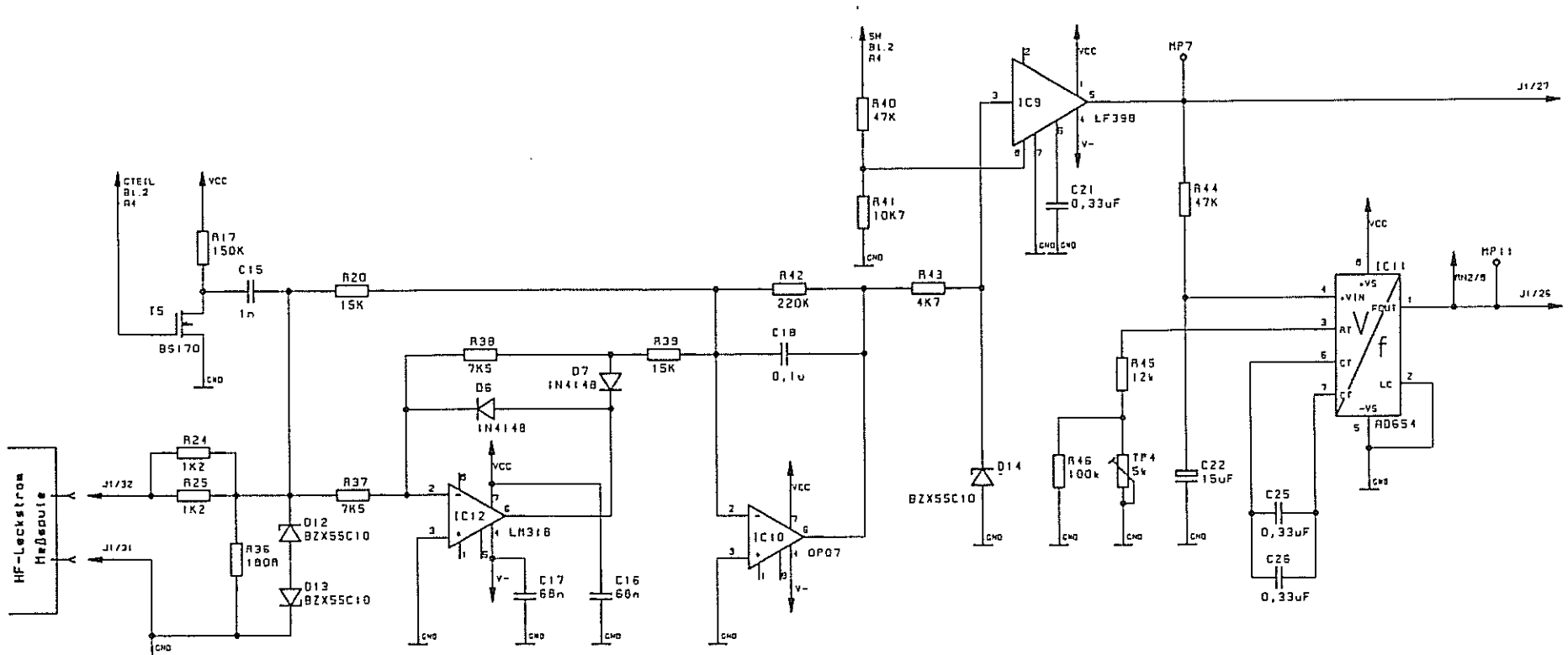
Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig.

**ERBE**  
7400 Tübingen

Gerät/UNIT ACC450.1  
Benennung/TITLE HF-Leckstrom und NE-Monitor  
Zeichnungsnummer/DWG NO 30121-201/3



CAD

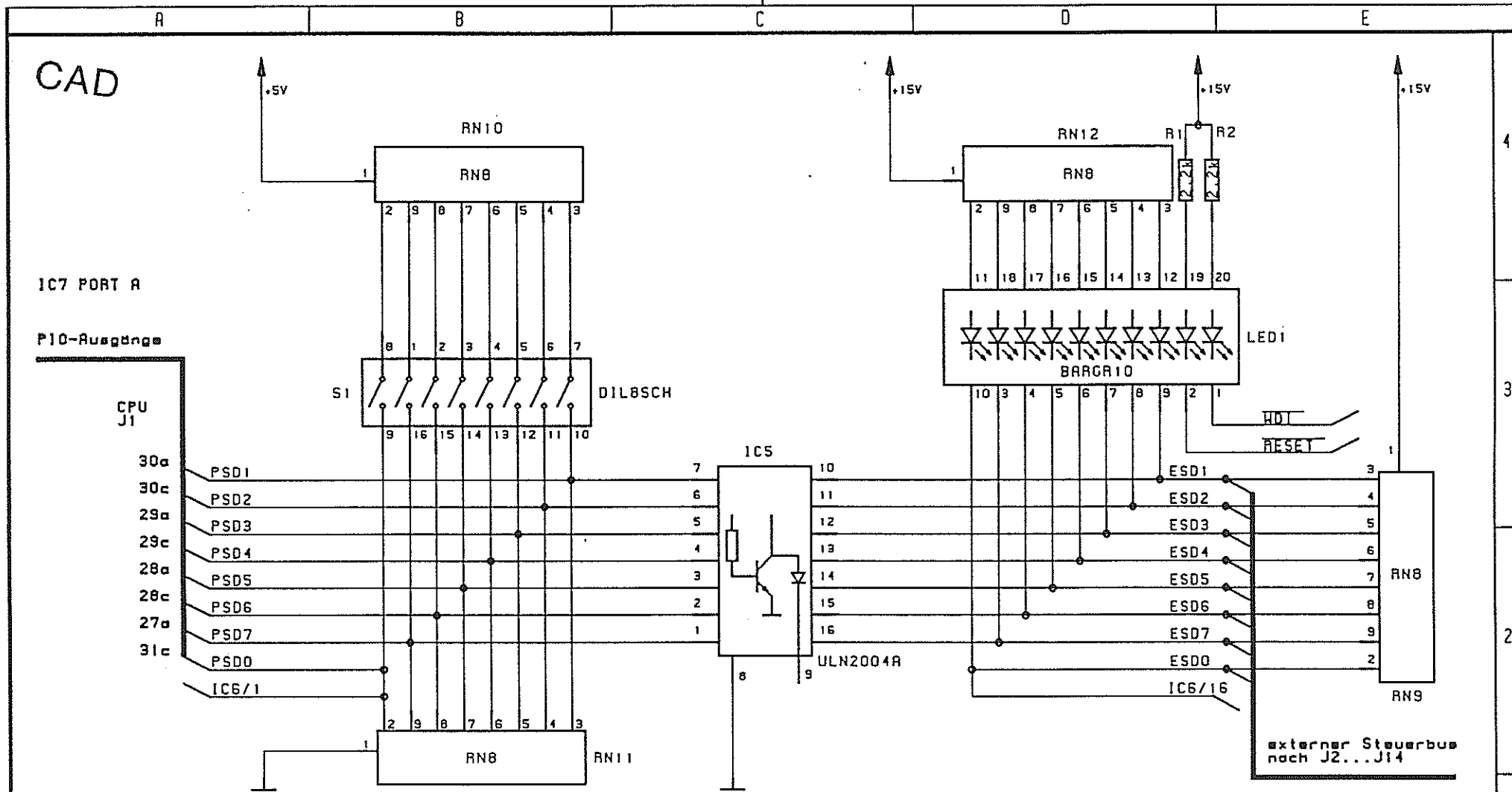


Nr	Index	Änderung	Datum	Name

Datum: 4.12.88  
 Name: S.Klein  
 Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig.  
 Maßstab:  
 LP un.: 40121-044  
 LP bs.: 30121-201  
 Blatt 3 von 3

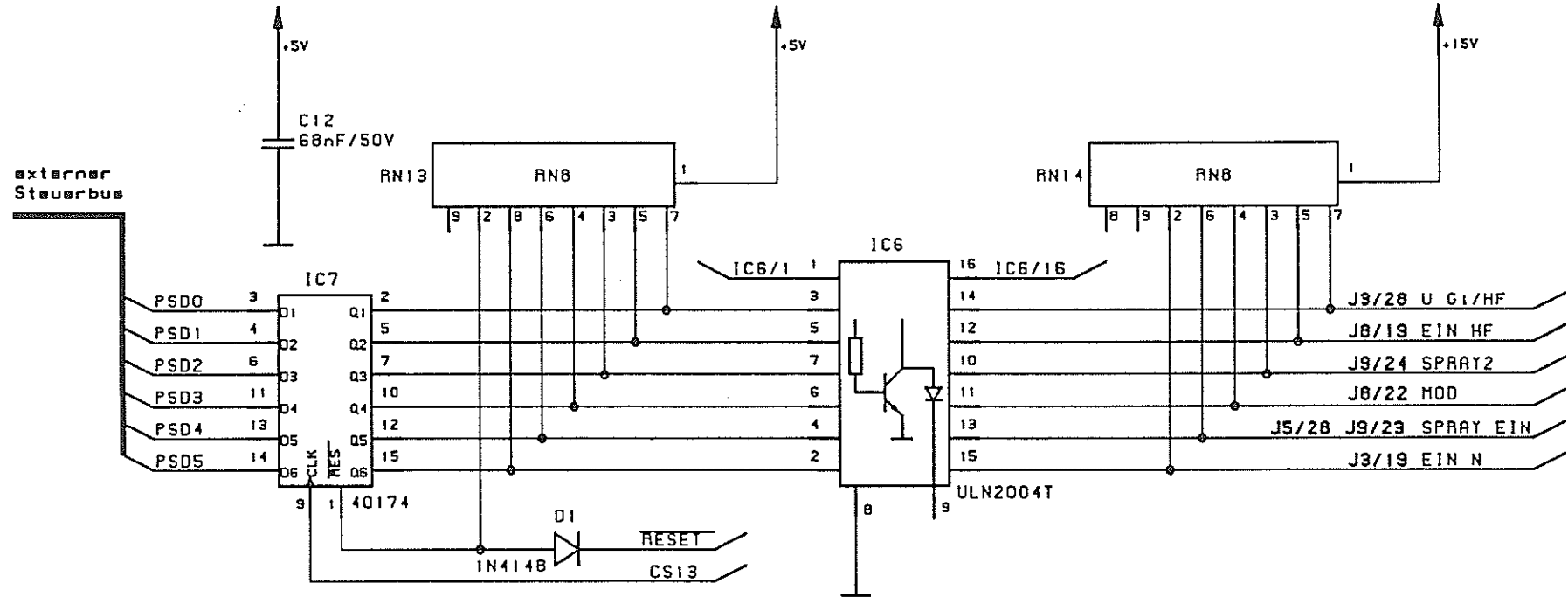


Gerät/UNIT ACC450.1  
 Benennung/TITLE HF-Leckstrom und NE-Monitor  
 Zeichnungsnummer/DWG NO. 30121-201/3



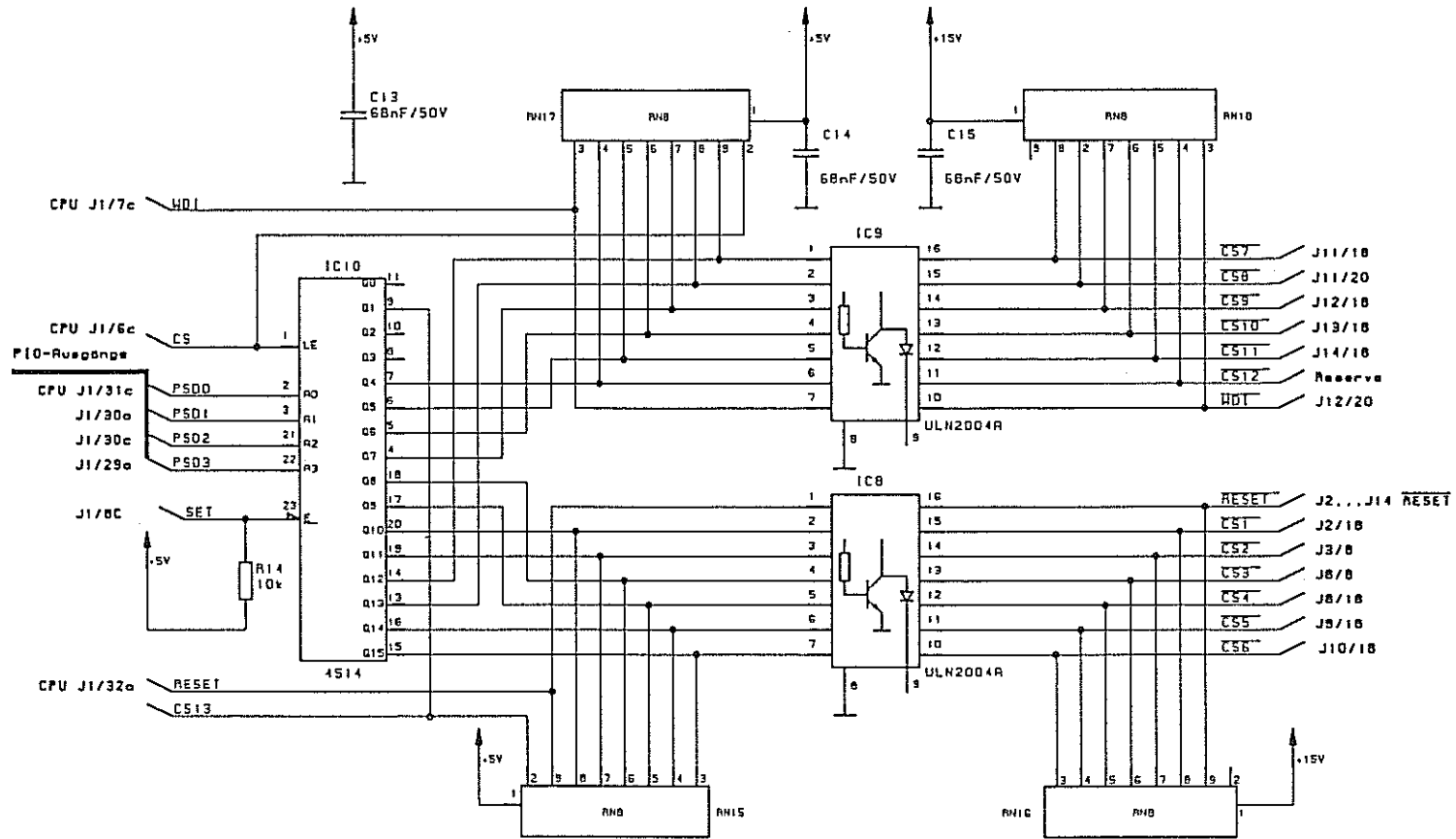
				Datum		Name		Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT ACC450.1	
				Gezeich. 30.10.89		S.Klein			Benennung/TITLE	
				Geprüft					Mutterplatine- Ausgänge	
				Maßstab				<b>ERBE</b> 7400 Tübingen	Zeichnungsnummer/DWG.NO.	
				LP un.: 40121-045					30121-202/4	
				LP bs.: 3012-202						
Nr.	Index	Änderung		Datum	Name		Blatt 1 von 12			

CAD



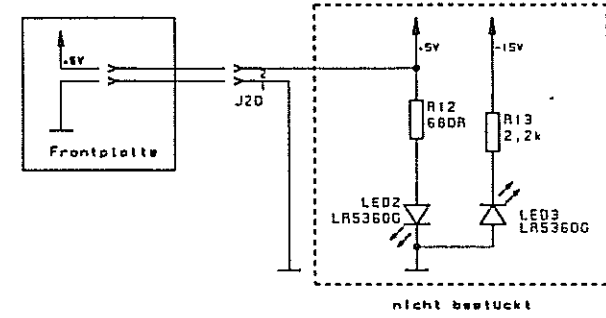
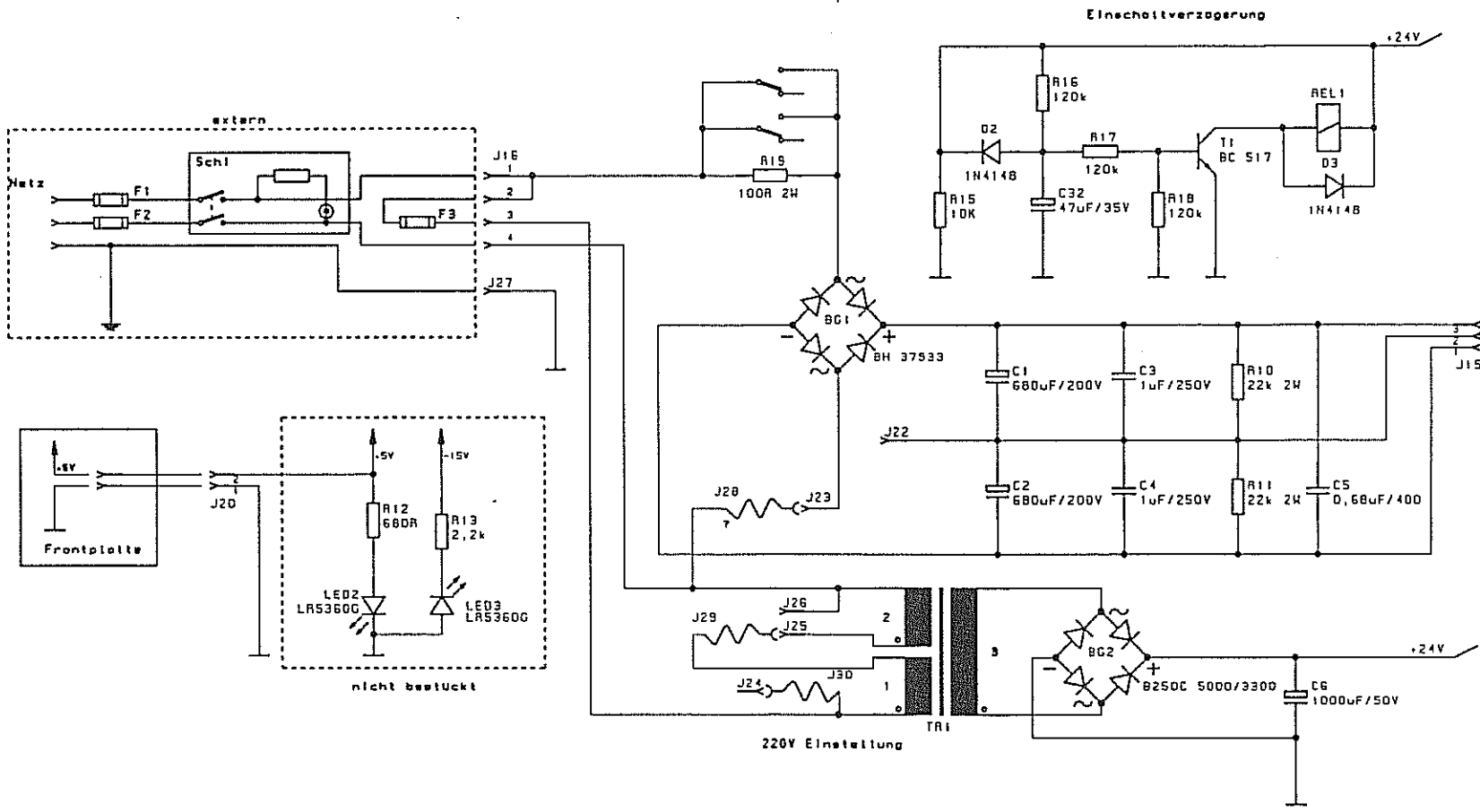
						Datum	Name	Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT ACC450.1
					Gezeich.	30.10.89	S.Klein		Benennung/TITLE Mutterplatine- Ausgänge
					Geprüft				Zeichnungsnummer/DWG.NO. 30121-202
					Maßstab			 7400 Tübingen	
					LP un.: 40121-045 LP bs.: 30121-202				
Nr.	Index	Anderung	Datum	Name	Blatt 2 von 12				

# CAD



		Datum		Name		Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT
		30.10.89		S.Klein			ACC450.1
		Gezeichnet		Geprüft			Benennung/TITLE
				Maßstab			Mutterplotine- Ausgänge
				LP un.: 40121-045		ERBE 7400 Tübingen	Zeichnungsnummer/DWG NO
				LP bs.: 30121-202			30121-202/3
Nr	Index	Änderung		Datum	Name		
					Blatt 3 von 12		

# CAD

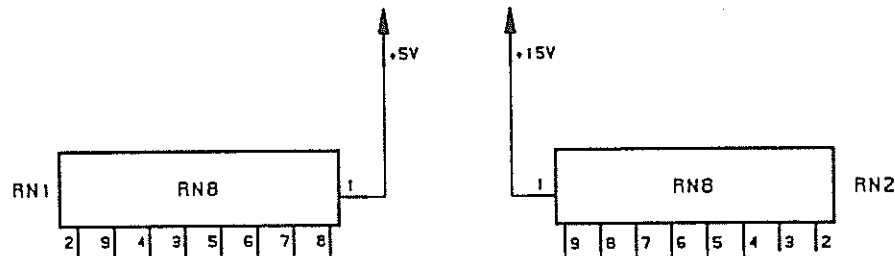


Einstellung 220V/50Hz    Einstellung 120V/60Hz



Nr		Index	Änderung	Datum	Name	Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig.	Gerät/UNIT ACC450.1
							Benennung/TITLE Mutterplatine Gleichrichterschaltung
						 7400 Tübingen	Zeichnungsnummer/DWG NO 30121-202/3
					Blatt 4 von 12		

CAD



	P10	CPU-J1	IC1	von	von	Funktion
EIN1	IC6/PB2	13R	10   1   9 4050	IC11/10		FUSS A1 — Fußschalter A1
EIN12	IC6/PB1	13C	6   1   7 4050	IC11/6		FUSS B1 — Fußschalter B1
EIN2	IC6/PB4	14R	12   1   11 4050	IC11/12	J19/1	SCH1 — Schalter 1
EIN13	IC6/PB3	14C	4   1   5 4050	IC11/4	J18/1	SCH2 — Schalter 2
EIN14	IC6/PB5	15c	15   1   14 4050		J14/20	BF/CF — BF/CF Signal
EIN3	IC6/PB6	15R	2   1   3 4050		J19/21	KANAL A2 — KANAL A2 Fingerschalter

Nr.	Index	Änderung	Datum	Name

Datum	Name
Gezeich. 30.10.89	S.Klein
Geprüft	
Maßstab	
LP un.: 40121-045	
LP bs.: 30121-202	
Blatt 5 von 12	

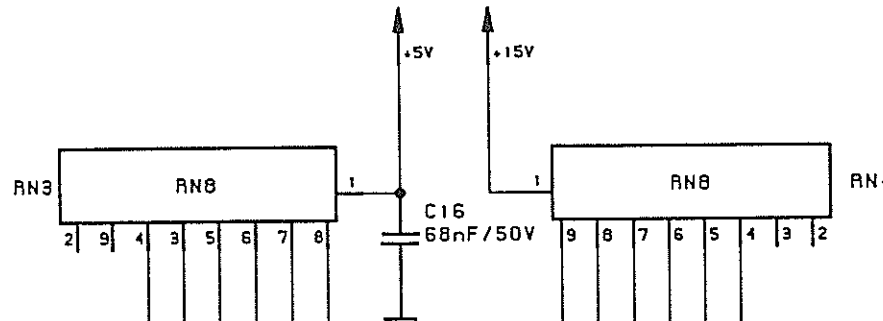
Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig

**ERBE**

7400 Tübingen

Gerät/UNIT ACC450.1
Benennung/TITLE Mutterplatine- Eingänge
Zeichnungsnummer/DWG.NO. 30121-202/4

CAD



	P10	CPU-J1		IC2	von	von	Funktion
EIN4	IC6/PA7	16A		10   1   9		J13/22	KANAL B2 Fingerschalter
EIN15	IC6/PB7	16C		6   1   7	J13/24	J12/28	Kanal CA Fingerschalter
EIN5	IC6/PA5	17A		12   1   11		J13/25	Kanal A1 Fingerschalter
EIN16	IC6/PA6	17C		4   1   5		J13/26	Kanal B1 Fingerschalter
EIN17	IC6/PA4	18C		15   1   14		J11/26	HF-LECK1 HF-Leckstrom 1
EIN6	IC6/PA3	18A		2   1   3		J11/25	HF-LECK2 HF-Leckstrom 2

					Datum	Name
					30.10.89	S.Klein
					Geprüft	
					Maßstab	
					LP un.: 40121-045	
					LP bs.: 30121-202	
					Blatt 6 von 12	
Nr.	Index	Änderung	Datum	Name		

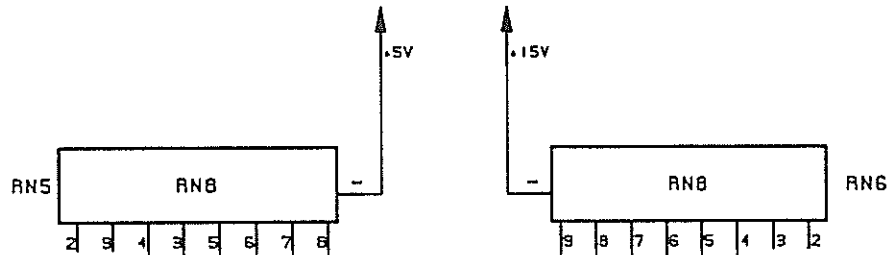
Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig

**ERBE**

7400 Tübingen

Gerät/UNIT	ACC450.1
Benennung/TITLE	Mutterplatine- Eingänge
Zeichnungsnummer/DWG.NO.	30121-202/4

# CAD

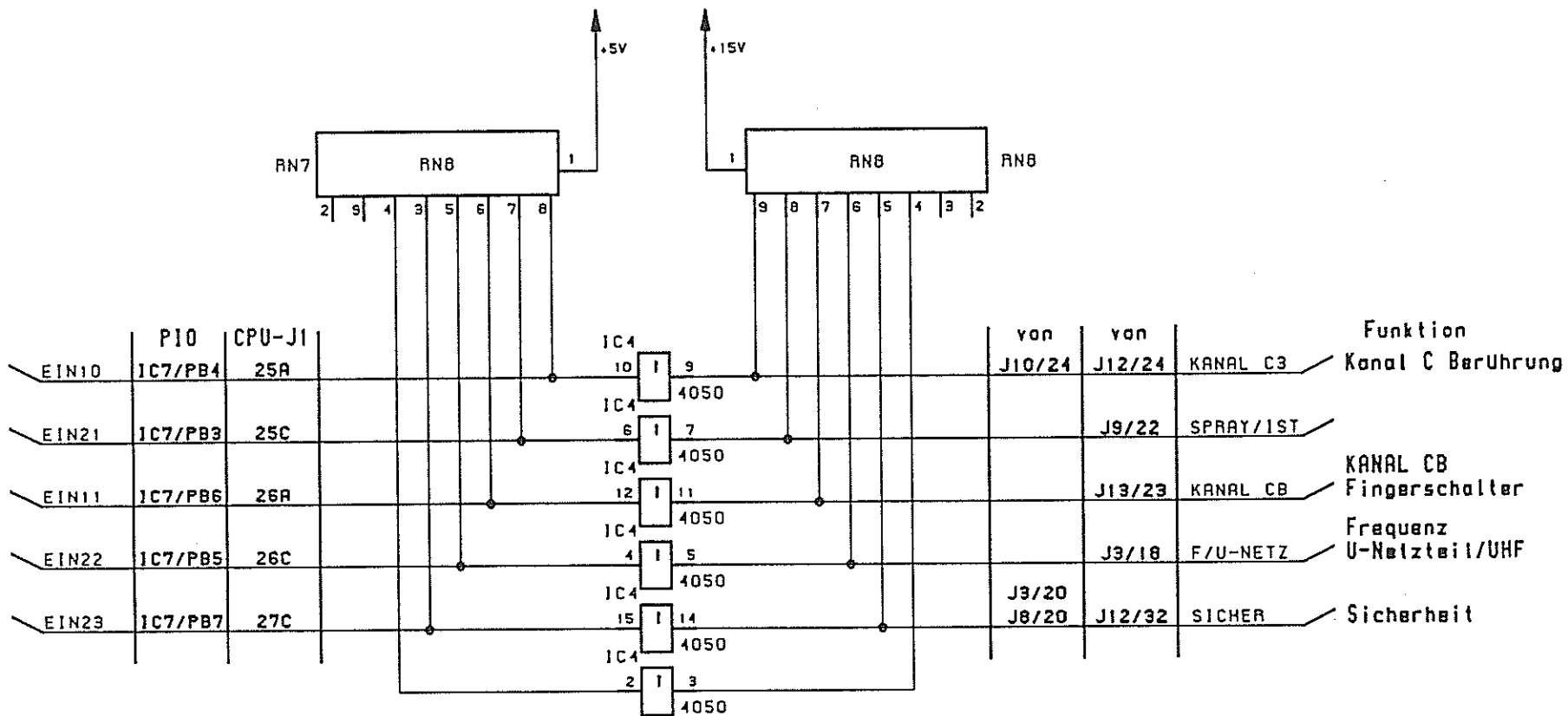



	PIO	CPU-J1		IC3		von	von	Funktion
EIN7	IC6/PA1	19A		10	9	J12/29	J11/24	UNSYH1 / Unsymmetrie 1
EIN18	IC6/PA2	19C		6	7		J11/23	UNSYH2 / Unsymmetrie 2
EIN19	IC6/PA0	20C		12	11		J11/22	STROM-DI / Stromdichte
EIN8	IC7/PB0	23A		4	5		J11/21	NE / NE-RÜCK Rückmeldfrequenz
EIN20	IC/PB1	24C		15	14	J10/22	J12/22	KANAL C1 / Kanal C Stop Funke
EIN9	IC7/PB2	24A		2	3	J10/23	J12/23	KANAL C2 / Kanal C Stop Strom

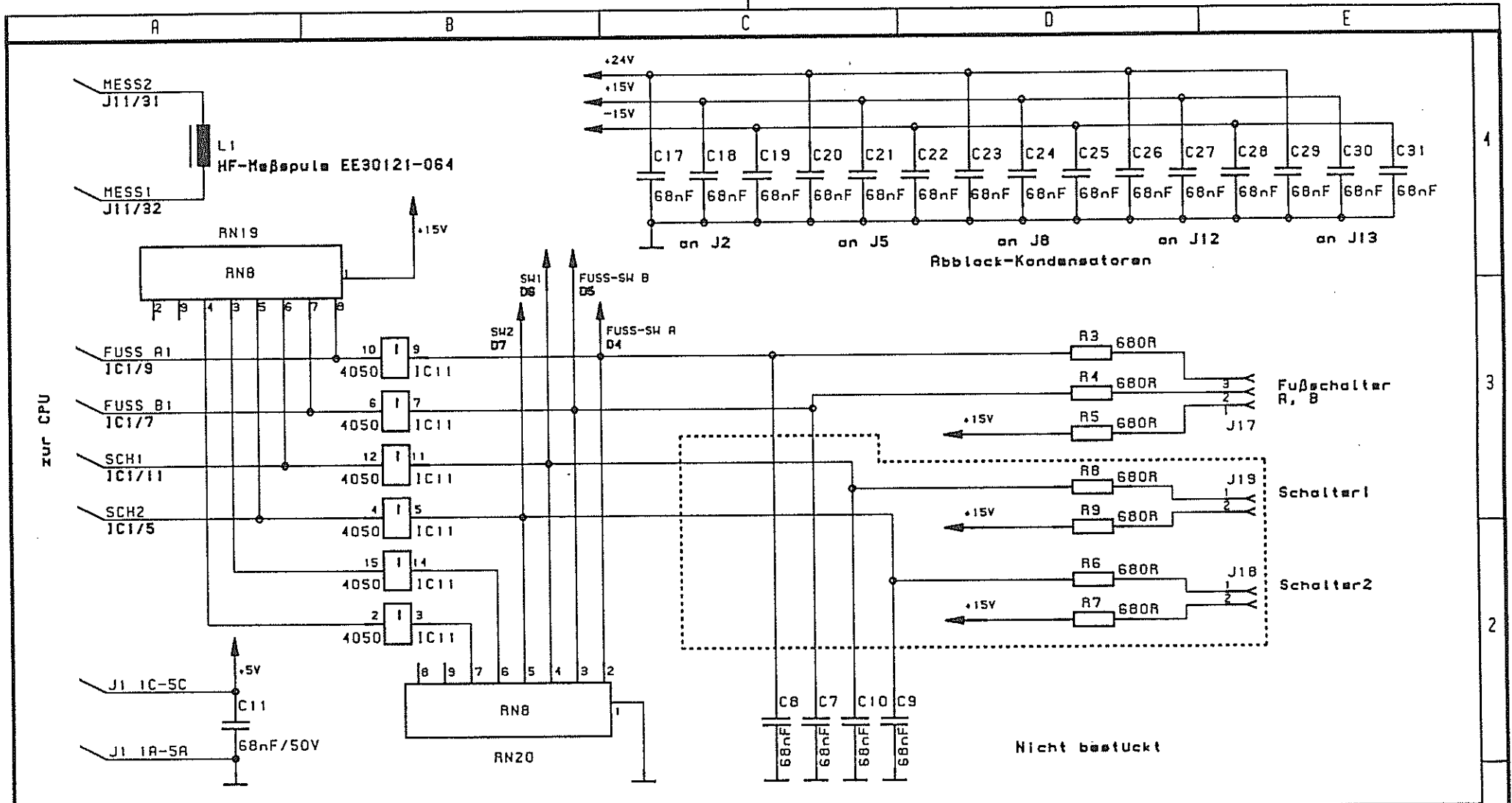
					Datum	Maße	Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT ACC450.1
				Gezeichnet	30.10.89	S.Klein		Benennung/TITLE Mutterplatine- Eingänge
				Geprüft				Zeichnungsnummer/DWG.NO. 30121-202/4
				Maßstab				
							<b>ERBE</b> 7400 Tübingen	
Nr.	Index	Änderung	Datum	Maße	LP un.: 40121-045 LP bs.: 30121-202 Blatt 7 von 12			




# CAD

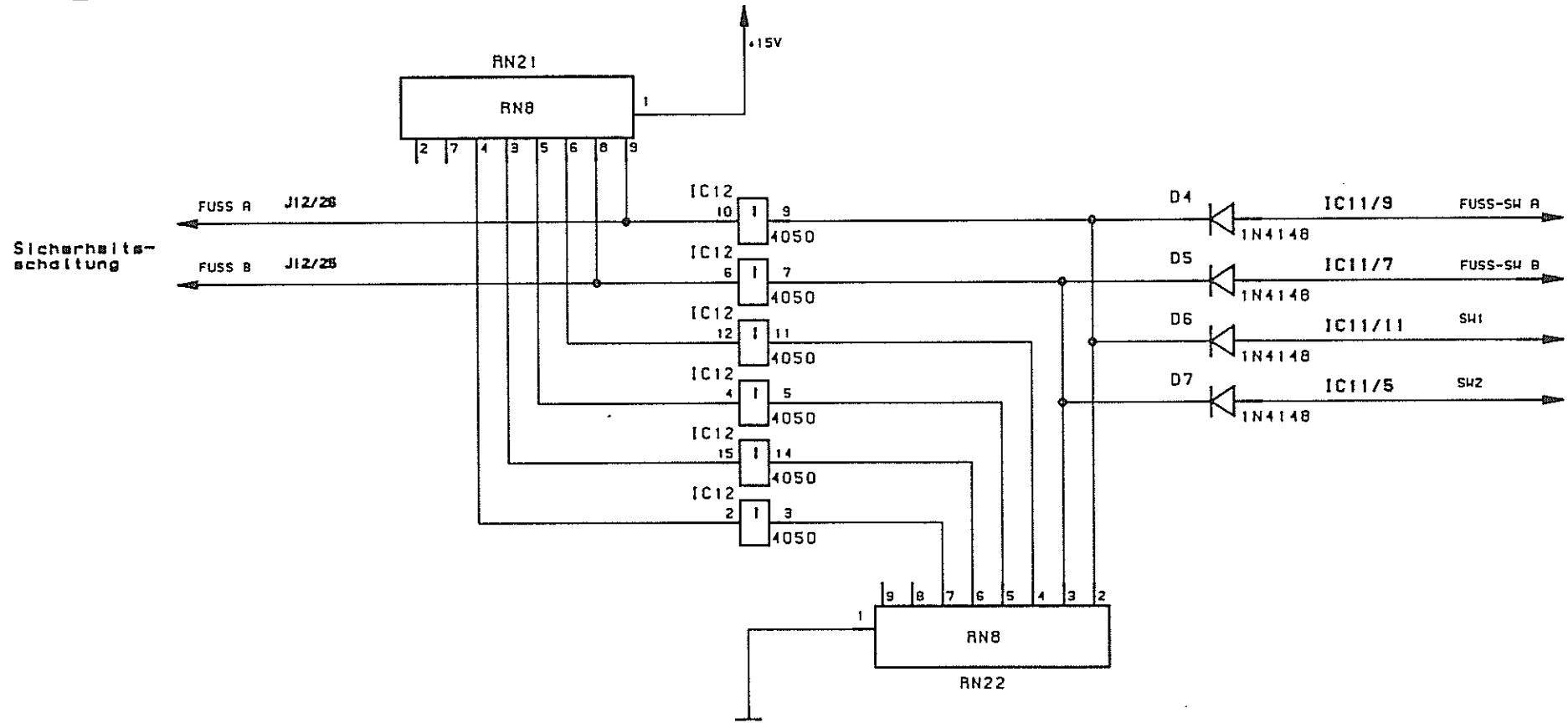


				Datum		Name		Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT ACC450.1		
				Gezeich. 30.10.89		S.Klein			Benennung/TITLE		
				Geprüft					Mutterplatine- Eingänge		
				Maßstab					Zeichnungsnummer/DWG.NO.		
				LP un.: 40121-045		LP bs.: 30121-202		 7400 Tübingen		30121-202/4	
				Blatt 8 von 12							
Nr.	Index	Änderung		Datum	Name						



				Datum	Name	Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT
				Gezeichnet	30.10.89		S. Klein
				Geprüft			Benennung/TITLE
				Maßstab			Mutterplatine- Eingänge
				LP un.: 40121-045		 7400 Tübingen	Zeichnungsnummer/DWG. NO.
				LP bs.: 30121-202			30121-202/4
				Blatt 9 von 12			
Nr.	Index	Änderung	Datum	Name			

CAD



					Datum	Name
				Gezeichnet	30.10.89	S.Klein
				Geprüft		
				Maßstab		
				LP un.: 40121-045		
				LP bs.: 30121-202		
				Blatt 10 von 12		
Nr.	Index	Aenderung	Datum	Name		

Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig

**ERBE**

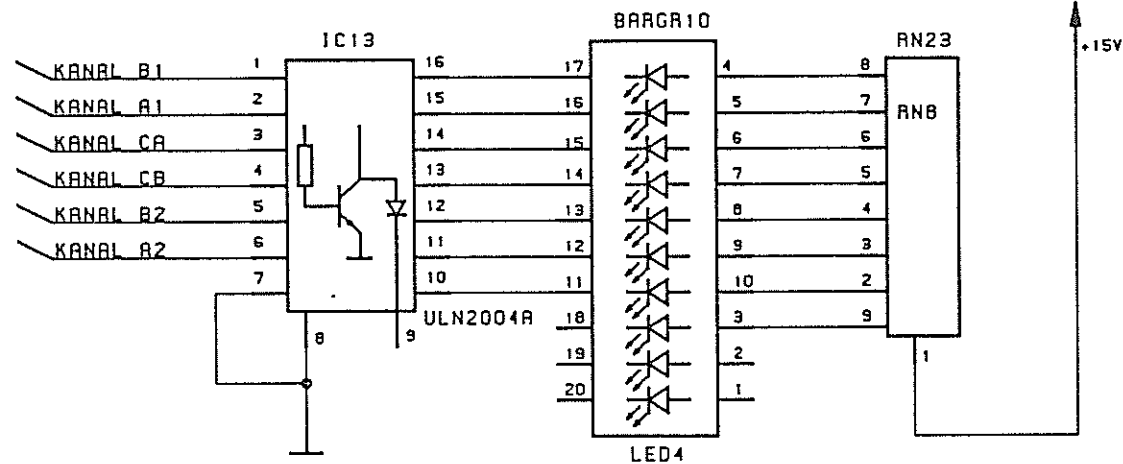
7400 Tübingen


Gerät/UNIT ACC450.1

Benennung/TITLE  
Mutterplatine- Eingänge

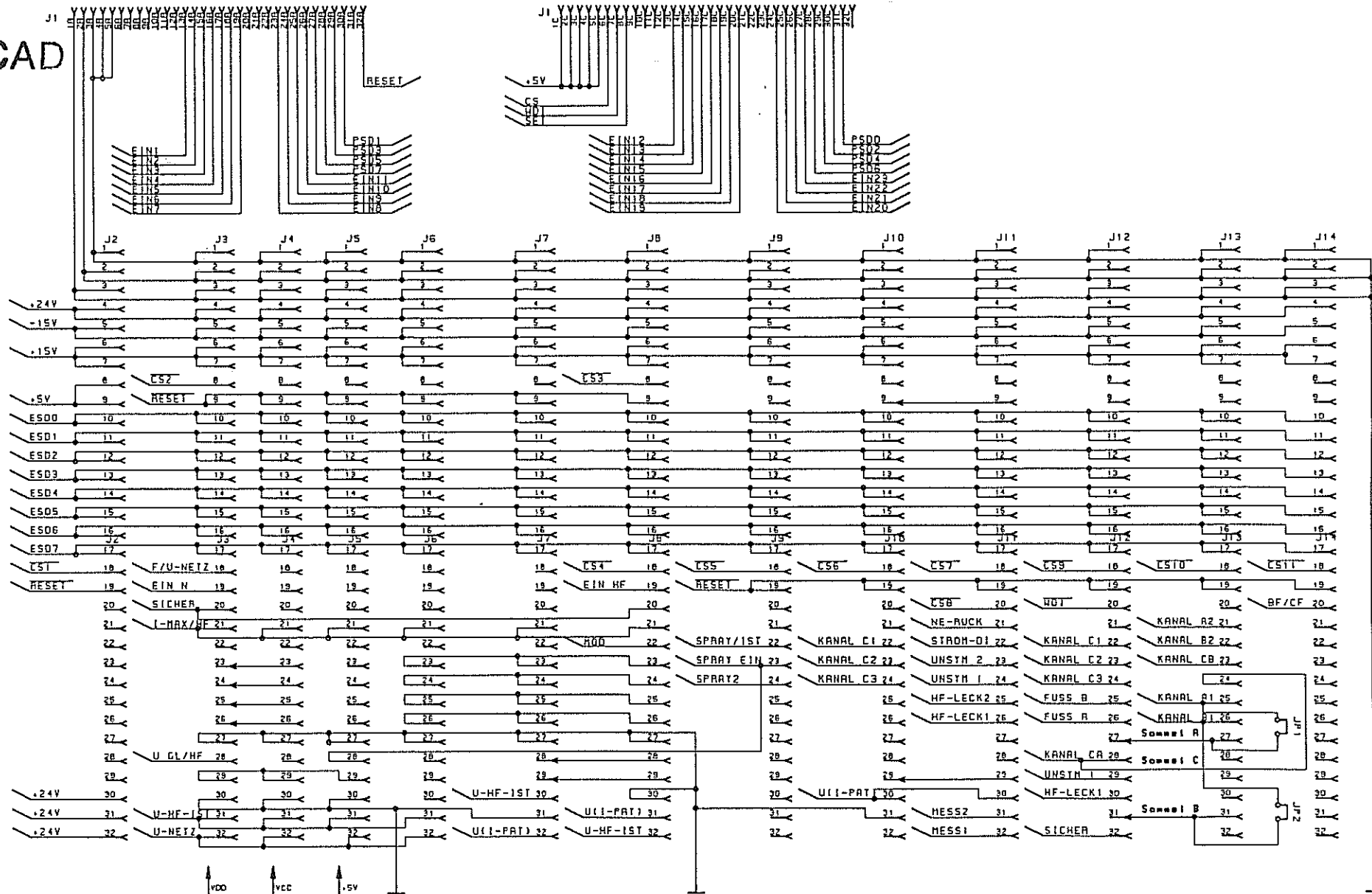
Zeichnungsnummer/DWG.NO.  
30121-202/4


CAD



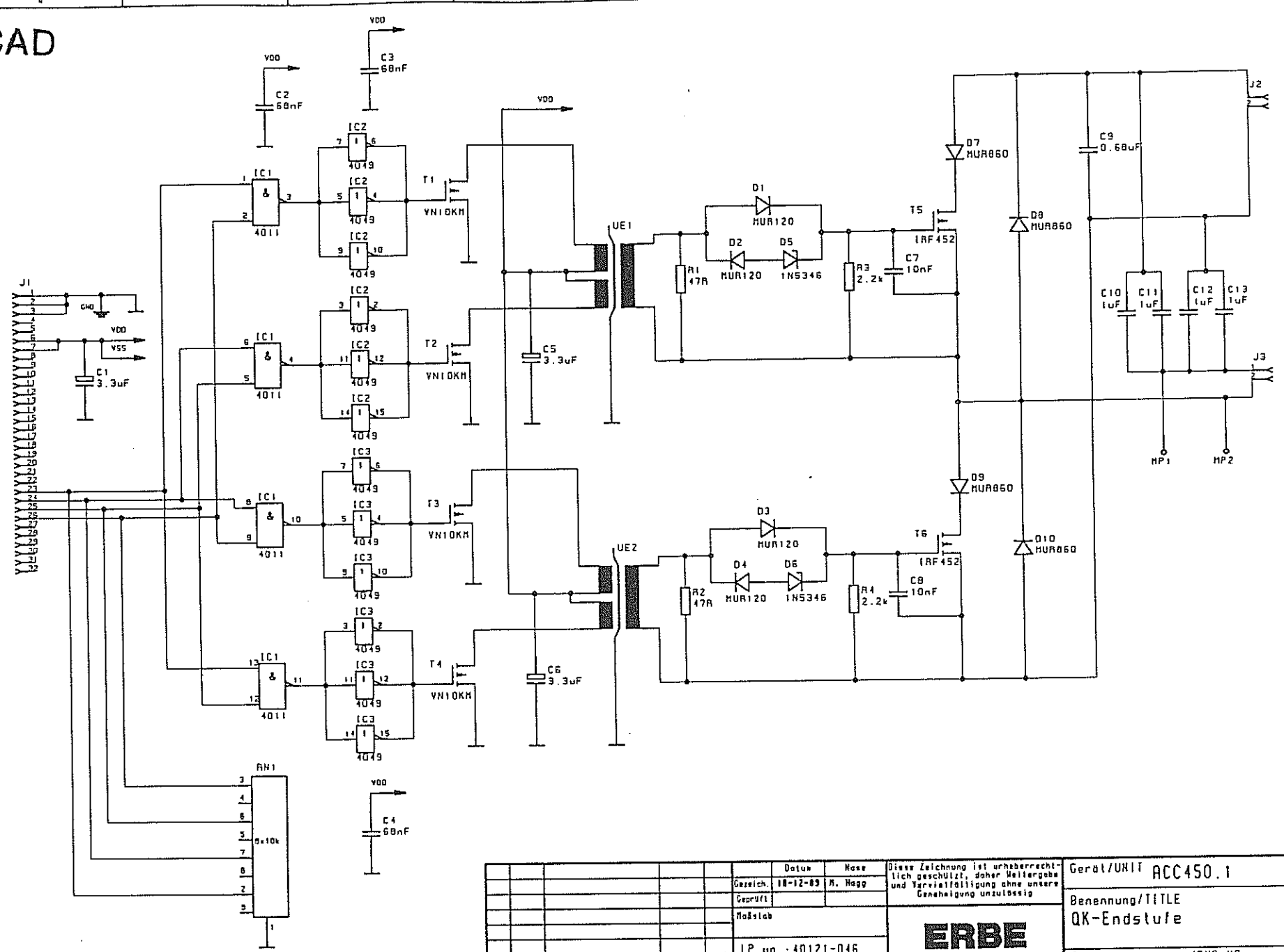
					Datum	Nome	Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT ACC450.1
					Gezeich.	30.10.89		S.Klein
					Geprüft			Mutterplatine
					Maßstab			Anzeige-Fingerschalter
							 7400 Tübingen	Zeichnungsnummer/DWG.NO.
								30121-202/4
Nr.	Index	Aenderung	Datum	Nome	LP un.: 40121-045 LP bs.: 30121-202 Blatt 11 von 12			


# CAD



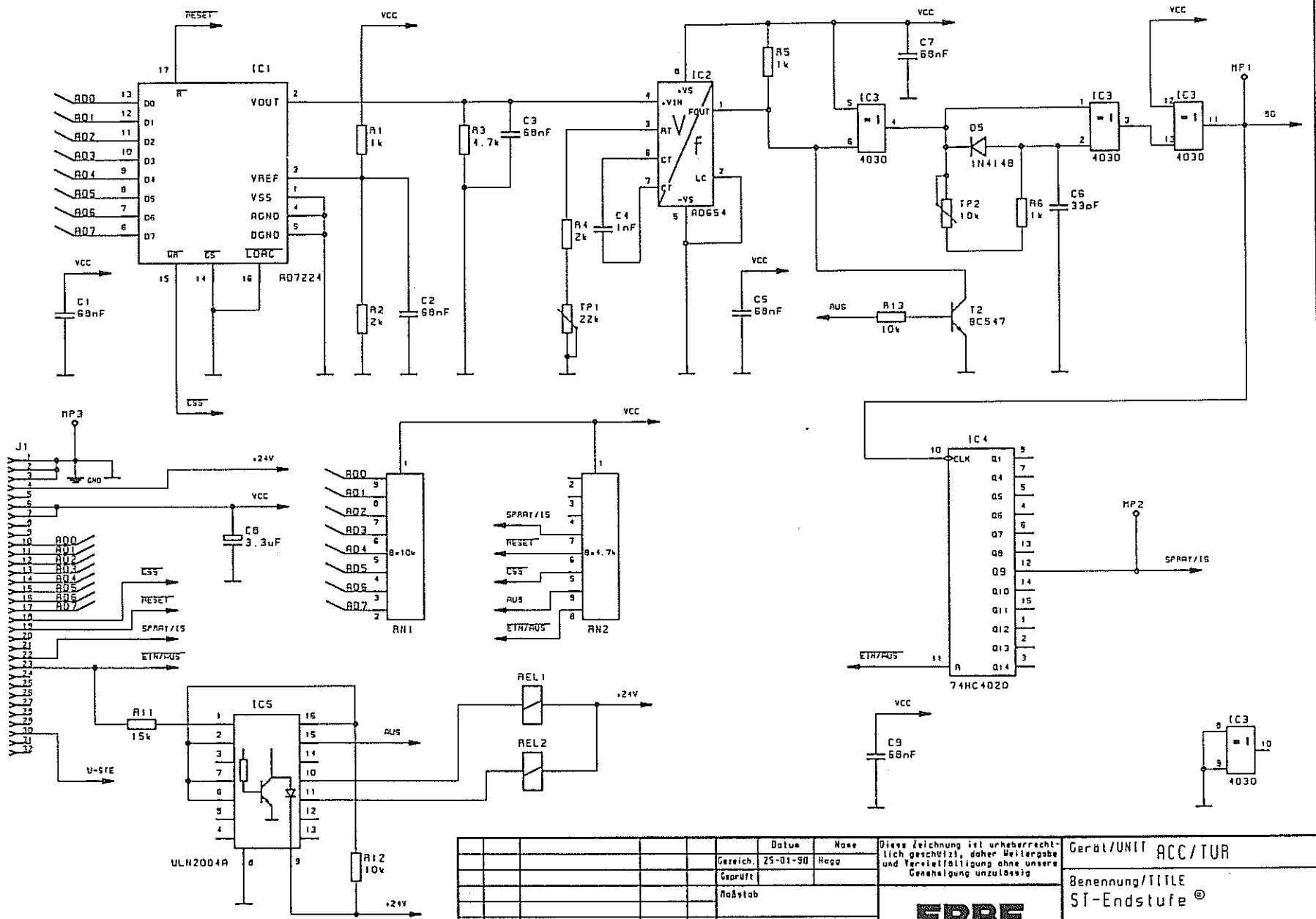
		Datum	30.10.89	Rev	5, Klein	Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT	ACC450.1
		Gezeichnet		Geprüft			Benennung/TITLE	Mutterplatine- Stecker
		Maßstab		LP un.: 40121-045 LP bs.: 30121-202		 7400 Tübingen	Zeichnungsnummer/DWG NO	
				Blatt 12 von 12			30121-202/3	

# CAD



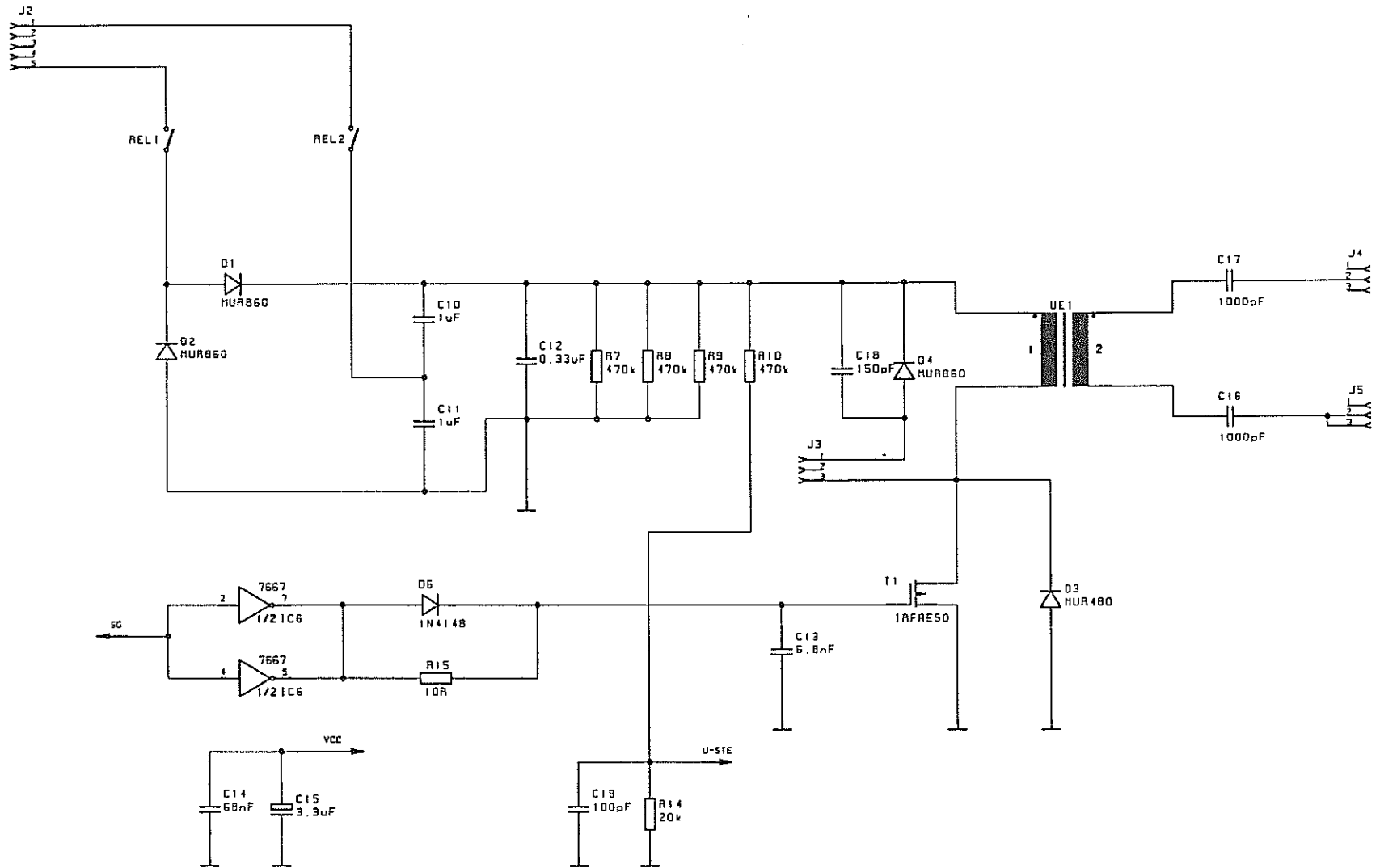
Gezeichnet		Datum		Name		Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT ACC450.1
Geprüft		18-12-83		H. Hagg			Benennung/TITLE
Maßstab							QK-Endstufe
		LP un.: 40121-046					Zeichnungsnummer/DWG NO.
		LP bs.: 30121-213					
Nr. Index		Änderung		Datum		Name	
						Blatt 1 von 1	
						30121-213/3	

# CAD



		Datum		Name		Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT	ACC/TUR	
		Gezeichnet		25-01-90			Haga		
		Geprüft						Benennung/TITLE	
		Nachstap						ST-Endstufe®	
2		U-SIE-Rückmeldung		12-02-90		HC		Zeichnungsnummer/DWG NO	
1		Bezeichnung		13.02.90		SK			
Nr.		Index		Änderung		Datum		Name	
								LP un.: 40121-047	
								LP bs.: 30121-214	
								Blatt 1 von 2	
								 7400 Tübingen	
								30121-214	

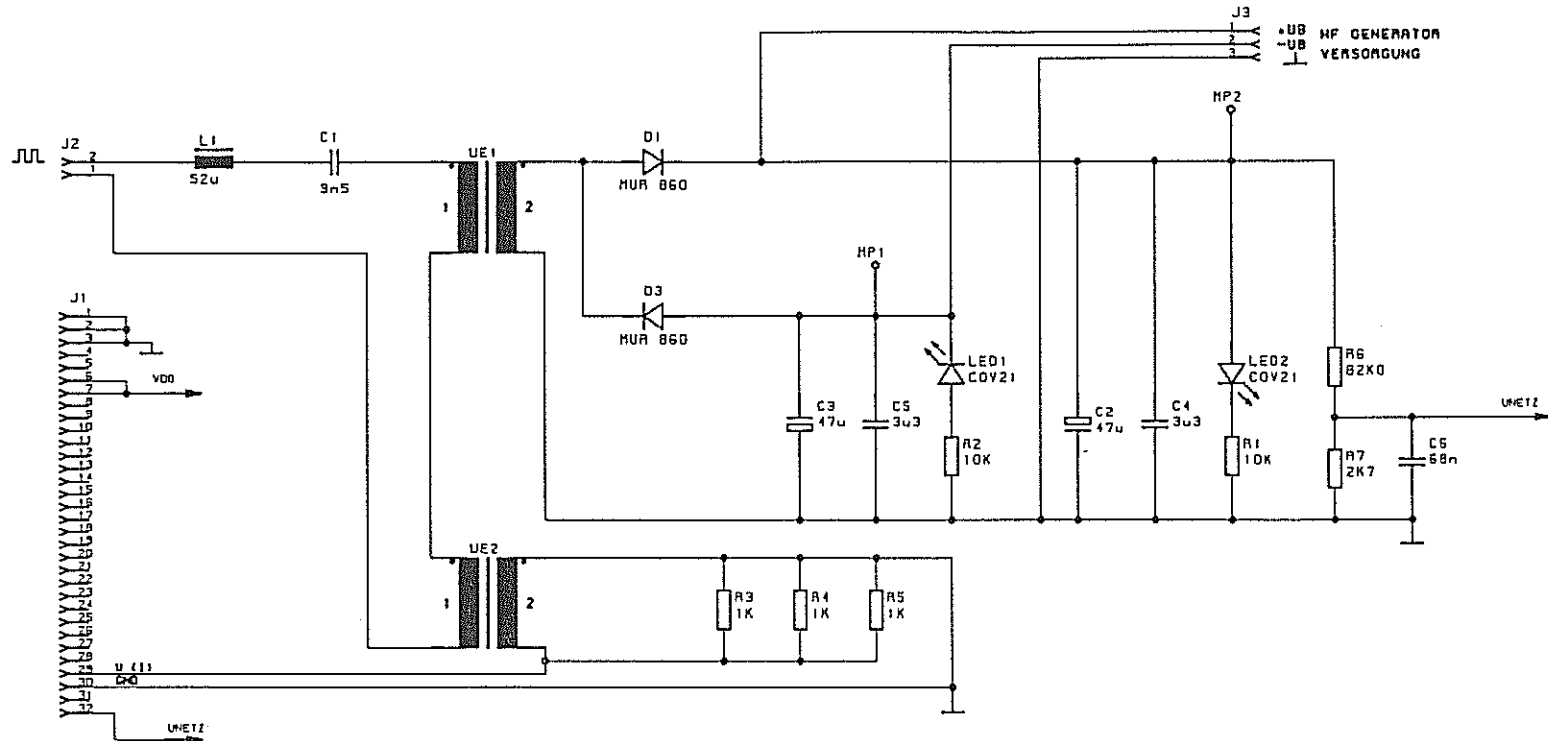
CAD




		Datum	Name	Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT
		Gezeichnet	25-01-90 Hagg		
		Geprüft			Benennung/TITLE
		Maßstab			ST-Endstufe®
					Zeichnungsnummer/DWG. NO.
					30121-214
2	U-STE Rückmeldung	12-03-90	HG	LP un.: 40121-047	<div style="text-align: center;"> <b>ERBE</b>            7400 Tübingen         </div>
1	Bezeichnung	13.02.90	SK	LP bs.: 30121-214	
Nr	Index	Änderung	Datum	Name	

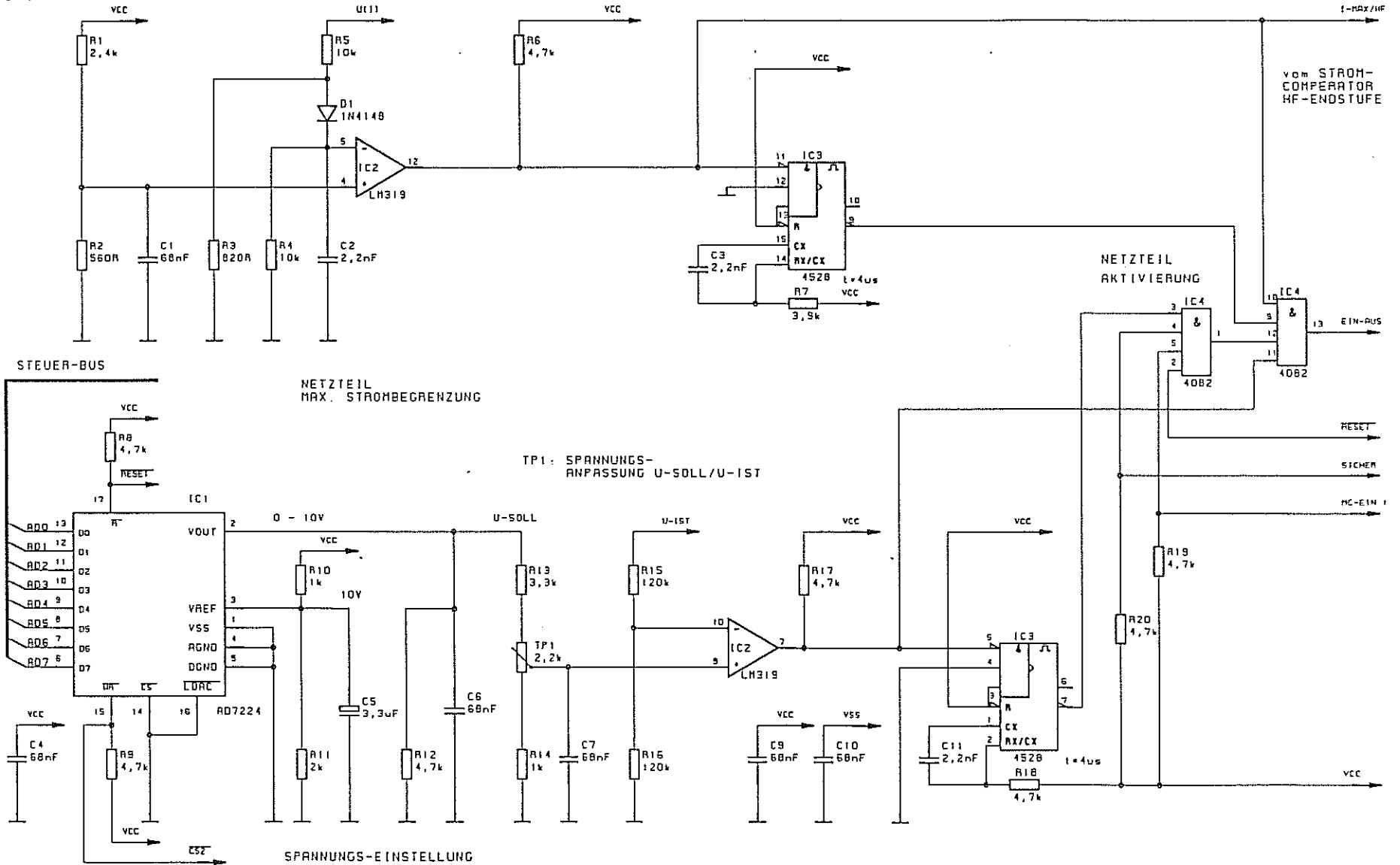


CAD



		Datum		Name		Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig	Gerät/UNIT	ACC450.1
		25-01-90		S.Klein			Benennung/TITLE	Netzteil-Ausgangsfiler
		Gezeichnet				 7400 Tübingen	Zeichnungsnummer/DWG NO	30121-224/3
		Geprüft						
		Maßstab						
		LP un.: 40121-020						
		LP bs.: 30121-224						
		Blatt 1 von 1						
Nr	Index	Änderung	Datum	Name				

# CAD



Nr	Index	Änderung	Datum	Name

Datum	15.02.90
Name	S.Klein
Gezeichnet	
Geprüft	
Noßstab	
LP un.:	40121-015
LP bs.:	30121-230
<b>ERBE</b>	
7400 Tübingen	

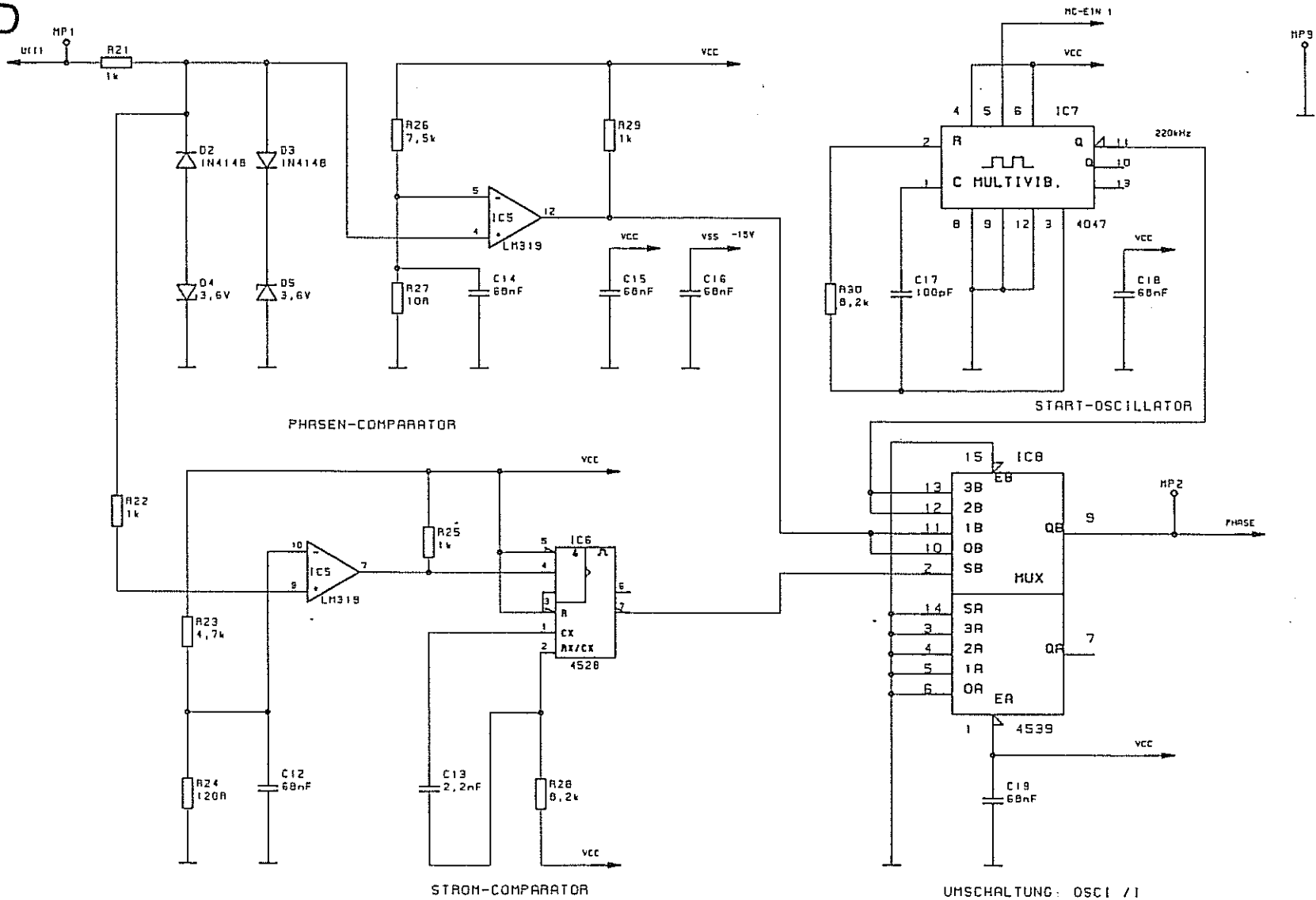
Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig.

Gerät/UNIT ACC450 1

Benennung/TITLE  
Netzteil-Steuerung

Zeichnungsnummer/DWG NO  
30121-230/3

# CAD



Nr	Index	Änderung	Datum	Name
1808	7	Oszil-Abschaltung	21-05-90	SK

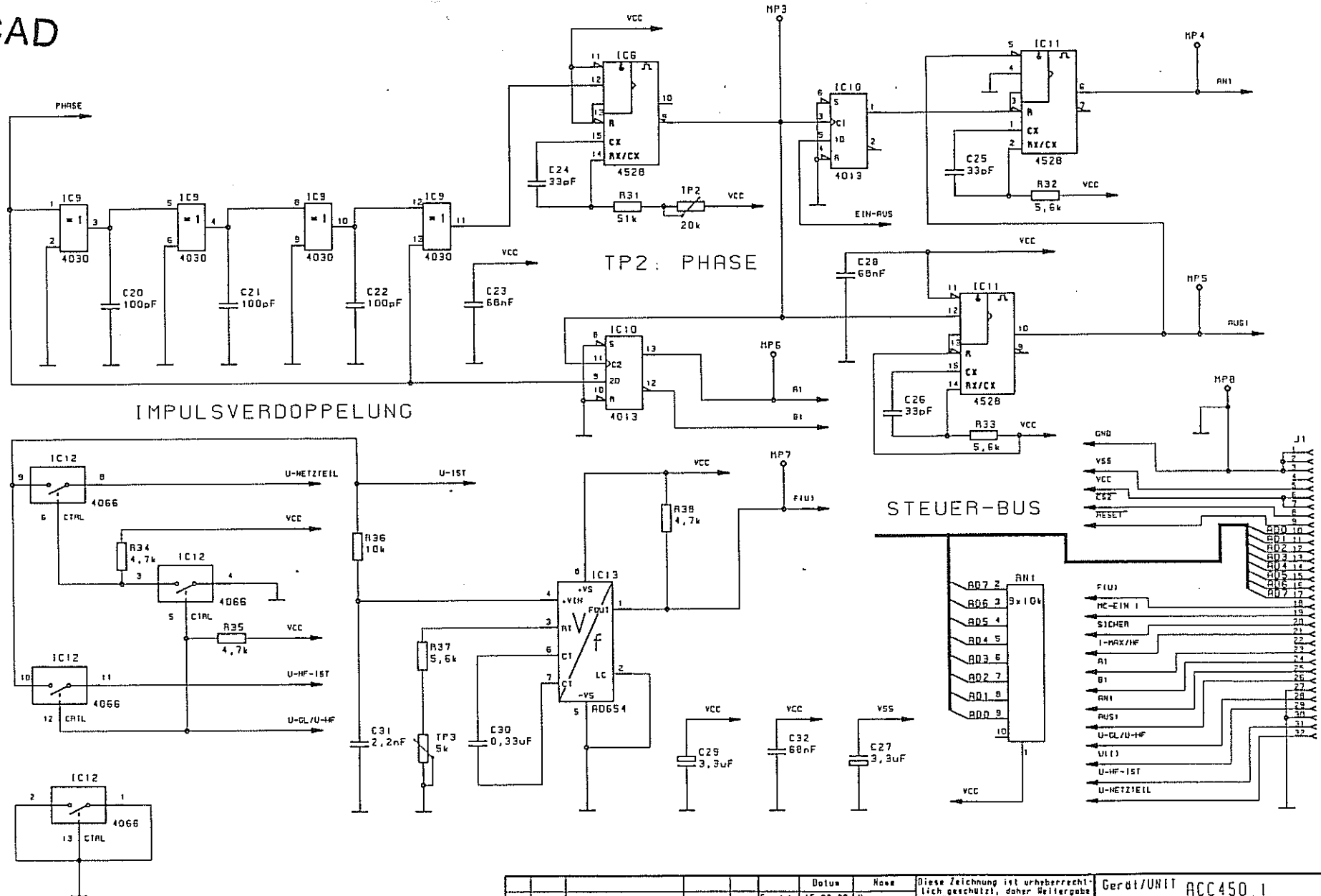
Datum	Name
15.02.90	S. Klein
Gezeichnet	
Geprüft	
Abgestimmt	
LP un.: 40121-015	
LP bs.: 30121-230	
Blatt 2 von 3	

Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig.

**ERBE**  
7400 Tübingen

Gerät/UNIT	ACC450 1
Benennung/TITEL	Netzteil-Steuerung
Zeichnungsnummer/DWG NO	30121-230/3

# CAD



## UMSCHALTUNG SPANNUNGSREGELUNG

Nr.	Index	Änderung	Datum	Notiz

Datum: 15.02.90  
 Name: Hopp  
 Diese Zeichnung ist urheberrechtlich geschützt, daher Weitergabe und Vervielfältigung ohne unsere Genehmigung unzulässig.  
**ERBE**  
 7400 Tübingen

Gerät/UNIT	ACC450.1
Benennung/TITEL	Netzteil-Steuerung
Zeichnungsnummer/DWG NO	30121-230/3

## Replaceable Parts

Reference Designation Code	Description	Index
<b>Front panel</b>		
	Membrankappe / membrane element	
	Führungsteil / guide lever	
	Abstandsrolle / distance tube	
<b>Mainboard</b>		
L	HF-Leckstrom-Meßspule / HF leakage current transformer	
IC	Darlington-Treiber / Darlington driver	
IC	Dekoder / decoder	
T	Transistor / transistor	
D	Schaltdiode / diode	
Led	Leuchtdiode / LED	
Rel	Relais / relay	
BR	Brückengleichrichter / bridge rectifier	
Sw	Dual-In-Line Schalter / Dual-In-Line switch	
R	Metallschichtwiderstand / resistor	
R	Kohleschichtwiderstand / resistor	
RN	Widerstandsnetzwerk / resistor array	
C	Alu.-Elko / capacitor	
C	Kondensator / capacitor	
C	Alu-Elektrolytkondensator / capacitor	
C	Keramikkondensator / capacitor	
C	Tantal E.Kondensator / capacitor	
Tr	Transformator / transformer	
	Gerätesteckdose / utensil socket	
	Sicherung / fuse	
	Sicherungshalter / fuse holder	
<b>CPU board</b>		
IC	Überwachungsschaltkreis / Microprocessor control circuit	
IC	Binaer-Zaehler / binary counter	
Q	Schwing-Quarz / crystal	
BT	Lithium-Batterie / battery	

## Replaceable Parts

Reference Designation Code	Description	Index
	<b>Low voltage &amp; sound generator</b>	
L	Speicherdrossel / inductivity	
IC	Schaltregler / switching regulator	
IC	Spannungsregler / voltage regulator	
IC	Analog-Schalter / Analog switch	
IC	NF-Verstärker / NF amplifier	
	<b>Schaltnetzteil / Switching power supply</b>	
	Steuerung-Netzteil / logic for power supply	
IC	Digital-Analog Wandler / Digital-Analog converter	
IC	Spannungs-Frequenzwandler / voltage-frequency converter	
D	Zenerdiode / diode	
Tp	Trimmwiderstand / trimming resistor	
	QK-Endstufe / QC power stage	
Ue	Ansteueruebertrager / driving transformer	
	Ausgangsfiler / output filter	
L	Serienkreisspule / inductivity	
	<b>HF-Generator/Filter</b>	
Ue	HF-Endstufenuebertrager / transformer	
Ue	Strom-Monitor / transformer	
	<b>HF-Generator/Logic</b>	
J1	Stiftleiste / pin header	
	Kodierstift / keying plug	
	IC-Stecksocket / Multiple connector	

## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
	Frontplatte komplett ACC 450.1 bestückt u. geprüft Front Panel complete assembled and checked	30121-211
	Membrankappe RAL7035	40121-000
	Membrankappe RAL7001 (n. Zeichg. 40121-000/3)	40121-018
	FUEHRUNGSTEIL	40121-001
	Abstandsrolle d6xd3,4x8,2 Polyamid schwarz	30121-030
	Mutterplatine LP bestückt und geprüft Mainboard assembled and checked	30121-202
L1	HF-Leckstrom-Messspule gewickelt u. geprueft	30121-064
Ic1, Ic2, Ic3, Ic4, Ic11, Ic12 Ic5, Ic6, Ic8, Ic9, Ic13 Ic7 Ic10	Hex Buffer/Converter CD 4050 BE	50007-036
T1	Darlington-Treiber (npn) ULN 2004 A	50000-010
	Hex D Flip-Flop CD 40174 BE	50007-031
	1 of 16 Dekoder CD 4514 BE	50007-037
	TRANSISTOR NPN BC 517	50200-003
D1, D2, D3, D4, D5, D6, D7 Led1, Led4 Led2, Led3	SCHALTDIODE 1 N 4148	50220-000
	Led-Bargraph Display rot MV 57164 G	50602-023
	Leuchtdiode rot 5mm LR 5360 G	50602-003
Rel1	Relais AZ 732-560-2 250V 6A 24V 2 Wechsler	50400-015
BR1	Brueckengleichrichter BH 37933 (25A 800V)	50224-016
BR2	Brueckengleichrichter B 250 C 5000/3300	50224-015
Sw1	Dual-In-Line Schalter CDD L8 (8 Schaltm./Hebel)	50507-000
R1, R2, R13	Metallschichtwiderstand 2,2k 0,4W 1% TK50	51014-131
R3, R4, R5, R6, R7, R8, R9, R12 R10, R11	METALLSCHICHTWIDERSTAND 680R 0,4W 1% TK50	51014-050
R14, R15	KOHLESCHICHTWIDERSTAND 22K 2W 5%	51006-018
R16, R17, R18	Metallschichtwiderstand 10k 0,4W 1% TK50	51014-010
R19	Metallschichtwiderstand 120k 0,4W 1% TK50	51014-125
RN1-RN9, RN13-RN19, RN21RN22 RN10, RN20	KOHLESCHICHTWIDERSTAND 100R 2W 5%	51006-008
RN11	Widerstandsnetzwerk 8x10k (9 Pin) 4609X-101	51015-006
RN12, RN23	Widerstandsnetzwerk 8x4,7k Single in Line	51015-003
C1, C2	WIDERSTANDSNETZWERK 47K L 09-1	51015-001
C3, C4	Widerstandsnetzwerk 8x2,2k (9 Pin) 4609X-101	51015-007
C5	Alu.-Elko. 680uF/200V Phil. Typ 2222/057/42681	51100-044
C6	Kondensator MKP 1uF 250V 5% RM22,5	51103-030
	Polypr.-Kondensator MKP 0,68uF 400V- 10% RM22,5	51103-037
	ALU-ELEKTROLYTKONDENSATOR 1000UF 50V EKM05 STEHEND	51100-039

## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
C7-C31	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
C32	TANTAL E.KONDENSATOR 47uF 35V	51101-003
Tr1	Transformator 2x110V 1x18V 30VA 50/60Hz UL-gel	51300-008
	GERAETESTECKDOSE 8843-2 SP.FL 4/3.60-SCHW.	51603-000
	SICHERUNG T4A/250V 5X20MM	51611-051
	SICHERUNGSHALTER UH 031 5010	51610-009
	CPU-Platine LP bestückt u. geprüft CPU Board assembled and checked	30121-015
	CPU-Platine LP unbestueckt	40121-011
Ic1	CPU Z 80 A CPU C-Mos	50001-000
Ic2	RAM CDM 6116 AE 3	50001-008
Ic4,Ic5,Ic6,Ic7	Parallel-Port Z 80 A PIO C-Mos	50001-001
Ic8,Ic9	3-8 Decoder CD 74 HCT 138 E	50003-005
Ic10	Ueberwachungsschaltkreis MAX 691 CPE	50001-009
Ic11	4 fach NAND-Gatter CD 74 HC 00 E	50003-001
Ic12	14 stuf. Binser-Zaehler CD 74 HCT 4020 E	50003-004
Ic13	2 fach D Flip-Flop CD 74 HC 74 E	50003-000
Q1	Schwing-Quarz 6000kHz HC-18/U	50302-000
D1	SCHALTDIODE 1 N 4148	50220-000
C1-C10,C11	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
C12	Keramikkondensator 33pF 200V 10% (CK 05 Bx)	51104-041
C13,C14	TANTAL ELEKTROLYT KONDEN- SATOR 15 uF / 20 V	51101-000
R1	Metallschichtwiderstand 470k 0,4W 1% TK50	51014-102
R2,R5,R6,R11, R12,R13	Metallschichtwiderstand 5,6k 0,4W 1% TK50	51014-101
R3	Metallschichtwiderstand 1,0k 0,4W 1% TK50	51014-001
R4	Metallschichtwiderstand 4,7k 0,4W 1% TK50	51014-100
R7	Metallschichtwiderstand 680k 0,4W 1% TK50	51014-103
R8	Metallschichtwiderstand 5,6M 0,4W 1% TK50	51014-104
R9	Metallschichtwiderstand 22k 0,4W 1% TK50	51014-135
R10	METALLSCHICHTWIDERSTAND 47 K 0.4 W 1% TK 50	51014-023
BT1	Lithium-Batterie 3V ER 2/3 AA SLF	51800-010
	E-Prom 450.1 V 2.1 (CF)	30121-253



## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
	Kleinspannung u. Ton LP bestückt u. geprüft Low Voltage assembled and checked	30121-041
	Kleinspannung u. Ton LP unbestueckt	40121-019
L1,L2	Speicherdrössel 100uH gewickelt u. gepreuft	30121-060
L3	Speicherdrössel 200uH gewickelt u. gepreuft	30121-061
Ic1,Ic2,Ic3	Schaltregler LT 1071 CKV	50002-019
Ic4	SPANNUNGSREGLER MC 7915 CT	50002-003
Ic5	Positiv-Spannungsregler MC 7805 CT	50002-011
Ic6,Ic7,Ic8	Timer ICM 7555 C	50000-012
Ic9	ANALOG-SCHALTER CD 4016 BE	50007-008
Ic10	Hex D Flip-Flop CD 40174 BE	50007-031
Ic11	NF-Verstaerker TDA 7052	50000-013
D1,D2,D3	SCHALTDIODE 1 N 4148	50220-000
D4,D5,D6	Schottky-Diode SB 340	50220-018
D7,D8,D9	SCHOTTKY-DIODE SD 101 A	50220-013
D10,D11,D12,D13	Leuchtdiode rot 5mm LR 5360 G	50602-003
C1,C2,C10, C11,C12	ALU-ELEKTR.KONDENSATOR EK 2,2UF 50V	51100-038
C3	ALU ELEKTROLYT KONDENS.EK 4.7 MF/63V	51100-001
C4	METALL.POLY.KOND. MKT1822 -510/01 1.00MF100/63V 20%	51102-015
C5	METAL.POLY.KOND. MKT1822 -468/014-2 0.68MF/100/63V	51102-005
C6,C19,C20,C21,	METAL.POLY.KOND. MKT 1822 -410/01 0.10MF100/63V 20%	51102-016
C30		
C7,C8,C9	ALU ELEKTROLYT KONDENS.EK 100 MF/40V	51100-003
C13,C14,C15	ALU ELEKTROLYT KONDENS.EG 1000 MF/40V	51100-005
C16-C18,C28, C29,C32,C33	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
C22,C23,C24, C25,C26,C27	KERAMIKKONDENSATOR 10 NF 100 V 10%	51104-022
C31	KERAMIKKONDENSATOR 2.2 NF 100 V 10%	51104-021
C34	TANTAL E. KONDENSATOR 1UF 35V	51101-004
R1	METALLSCHICHTWIDERSTAND 3,9K 0,4W 1% TK50	51014-036
R2	Metallschichtwiderstand 2,7k 0,4W 1% TK50	51014-126
R3	Metallschichtwiderstand 4,7k 0,4W 1% TK50	51014-100
R4	Metallschichtwiderstand 470R 1W 1% TK50	51005-005
R5,R6,R7	Metallschichtwiderstand 1,24k 0,4W 1% TK50	51014-003
R8	Metallschichtwiderstand 6,8k 0,4W 1% TK50	51014-143
R9	METALLSCHICHTWIDERSTAND 13,7K 0,4W 1% TK 50	51014-029
R10	Metallschichtwiderstand 16,5k 0,4W 1% TK50	51014-073
R11,R12,R13	Metallschichtwiderstand 47R 0,4W 1% TK50	51014-113
R14	METALLSCHICHTWIDERSTAND 100R 0,4W 1% TK50	51014-049

## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
R15,R16	Metallschichtwiderstand 270R 1W 1% TK50	51005-006
R17,R33	Metallschichtwiderstand 2,2k 0,4W 1% TK50	51014-131
R18	Metallschichtwiderstand 510R 0,4W 1% TK50	51014-141
R19,R20	Metallschichtwiderstand 1,5k 0,4W 1% TK50	51014-108
R21,R22,R23, R27,R28,R29	Metallschichtwiderstand 10k 0,4W 1% TK50	51014-010
R24,R25,R26,R31	METALLSCHICHTWIDERSTAND 100,0 K 0,4W 1% TK 50	51014-017
R30,R34	METALLSCHICHTWIDERSTAND 5,1K 0,4W 1% TK50	51014-040
R32	Metallschichtwiderstand 51k 0,4W 1% TK50	51014-116
RM1	Widerstandsnetzwerk 8x10k (9 Pin) 4409X-101	51015-006
Tp1,Tp2,Tp3	Trimmwiderstand T7X 220 / 200 KOHM	51030-007
	Schaltnetzteil QK-Stufe bestückt u. geprüft Switched Mode Circuit / QK Switch assembled and checked	30121-213
	Schaltnetzteil / Filter bestückt u. geprüft Switched Mode Circuit / Filter assembled and checked	30121-224
	Schaltnetzteil / Steuerung bestückt u. geprüft Switched Mode Circuit / logic assembled and checked	30121-230
	Steuerung-Netzteil LP unbestueckt	40121-015
Ic1	Digital-Analog Wandler AD 7224	50000-014
Ic2,Ic5	KOMPARATOR LM 319 N	50002-010
Ic3,Ic6,Ic11	MONO-FLOP HF 4528 BP	50007-007
Ic4	Dual 4-Input And-Gate CD 4082 BE	50007-033
Ic7	Multivibrator CD 4047 BE	50007-034
Ic8	Dual 4 Cha. Multiplexer HEF 4539 BP	50007-035
Ic9	EXOR - GATTER CD 4030 BE	50007-009
Ic10	D - FLIP - FLOP CD 4013 BE	50007-012
Ic12	Analog-Schalter CD 4066 BE	50007-028
Ic13	Spannungs-Frequenzwandler AD 654 JN	50000-011
D1,D2,D3	SCHALTDIODE 1 N 4148	50220-000
D4,D5	Zenerdiode BZX 55 C 3V6	50222-014
C1,C4,C6,C7, C9,C10,C12,C14 C15-16,C18-19, C23,C28,C32	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
C2,C3,C11,C13,C31	KERAMIKKONDENSATOR 2,2 NF 100 V 10%	51104-021
C5,C27,C29	TANTAL E.KONDENSATOR 3,3uF 35V	51101-002
C17,C20,C21,C22	Keramikkondensator 100pF 200V 10% (CK 05 BX)	51104-044
C24,C25,C26	Keramikkondensator 33pF 200V 10% (CK 05 Bx)	51104-041
C30	METAL.POLY.KOND. MKT 1822 0,33MF 63V 20% RM10	51102-000

## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
R1	METALLSCHICHTWIDERSTAND 2,4K 0,4W 1% TK50	51014-033
R2	Metallschichtwiderstand 560R 0,4W 1% TK50	51014-115
R3	Metallschichtwiderstand 820R 0,4W 1% TK50	51014-000
R4,R5,R34	Metallschichtwiderstand 10k 0,4W 1% TK50	51014-010
R6,R8,R9,R12, R17,R18,R19 R20,R23,R34, R35,R38 R7	Metallschichtwiderstand 4,7k 0,4W 1% TK50 Nachtrag zur obigen Referenznummer	51014-100 50000-999
R10,R14,R21, R22,R25,R29, R11	METALLSCHICHTWIDERSTAND 3,9K 0,4W 1% TK50 Metallschichtwiderstand 1,0k 0,4W 1% TK50	51014-036 51014-001
R13	METALLSCHICHTWIDERSTAND 2k 0,4W 1% TK50	51014-051
R15,R16	Metallschichtwiderstand 3,3k 0,4W 1% TK50	51014-122
R24	Metallschichtwiderstand 120k 0,4W 1% TK50	51014-125
R24	Metallschichtwiderstand 120R 0,4W 1% TK50	51014-118
R26	Metallschichtwiderstand 7,5k 0,4W 1% TK50	51014-119
R27	Metallschichtwiderstand 10R 0,4W 1% TK50	51014-114
R28,R30	Metallschichtwiderstand 8,2k 0,4W 1% TK50	51014-070
R31	Metallschichtwiderstand 51k 0,4W 1% TK50	51014-116
R32,R33,R37	Metallschichtwiderstand 5,6k 0,4W 1% TK50	51014-101
RH1	Widerstandsnetzwerk 8x10k (9 Pin) 4609X-101	51015-006
Tr1	Trimmwiderstand (Wendel) 2,2k 10% T18T	51030-055
Tr2	TRIMMWIDERSTAND (WENDEL) 20 K 10% T18 T	51030-032
Tr3	Trimmwiderstand (Wendel) 5k 10% T18T ; OK-Endstufe LP bestueckt und geprueft OK-Endstufe LP unbestueckt	51030-054 30121-213 40121-046
Ue1,Ue2	Ansteueruebertrager gewickelt u. geprueft	30121-057
Ic1	C-MOS ZAEHLER IC 4011 NAND	50007-003
Ic2,Ic3	C-MOS INVERTER CD 4049 BE	50007-017
T1,T2,T3,T4	V-mos Transistor VN 10 KM	50203-001
T5,T6	Power-Mosfet IRF 452	50203-003
D1,D2,D3,D4	Diode MUR 120 (DO 41)	50220-022
D5,D6	Zenerdiode 1N5346B (9,1V 150mA 5W)	50221-006
D7,D8,D9,D10	Diode MUR 860 (TO-220 AC)	50220-023
C1,C5,C6	TANTAL E.KONDENSATOR 3,3uF 35V	51101-002
C2,C3,C4	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
C7,C8	KERAMIKKONDENSATOR 10 NF 100 V 10%	51104-022
C9	Polypr.-Kondensator MKP 0,68uF 400V- 10% RM22,5	51103-037
C10,C11,C12,C13	Kondensator MKP 1uF 250V 5% RM22,5	51103-030
R1,R2	Metallschichtwiderstand 47R 0,4W 1% TK50	51014-113
R3,R4	Metallschichtwiderstand 2,2k 0,4W 1% TK50	51014-131
RH1	Widerstandsnetzwerk 8x10k (9 Pin) 4609X-101	51015-006

## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
	Ausgangsfilter/Netzteil LP bestueckt und geprueft	30121-224
	Ausgangsfilter/Netzteil LP unbestueckt	40121-020
Ue1	Netzteil-Uebertraeger gewickelt u. geprueft	30121-052
Ue2	Strom-Monitor gewickelt u. geprueft	30121-073
L1	Serienkreisspule 52 uH gewickelt u. geprueft	30121-132
D1,D3	Diode MUR 860 (TD-220 AC)	50220-023
D5,D6	Leuchtdiode rot 5mm LR 5360 G	50602-003
R1,R2	Metalloxydschichtwiderst. 10K 4W 5% WK8	51008-010
R3,R4,R5	Metallschichtwiderstand 1k 1W 1% TK50	51005-003
R6	Metallschichtwiderstand 82,0k 0,4W 1% TK50	51014-112
R7	Metallschichtwiderstand 2,7k 0,4W 1% TK50	51014-126
C1	Glimmerkondensator 9,5nF RM40	51109-003
C2,C3	Alu-Elektrolytkondensator 47uF 250V RM33	51100-042
C4,C5	Kondensator MKP 3,3uF 250V 5% RM27,5	51103-029
C6	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
	HF-Generator LP-Satz eingestellt u. geprueft	30121-213, ... -044, ... -051
	HF-Generator assembly	
	HF-Generator/QK-Stufe bestueckt u. geprueft	30121-213
	HF-Generator/QK-Switch assembled and checked	
Ue1,Ue2	Ansteueruebertraeger gewickelt u. geprueft	30121-057
Ic1	C-MOS ZAEHLER IC 4011 NAND	50007-003
Ic2,Ic3	C-MOS INVERTER CD 4049 BE	50007-017
T1,T2,T3,T4	V-mos Transistor VN 10 KM	50203-001
T5,T6	Power-Mosfet IRF 452	50203-003
D1,D2,D3,D4	Diode MUR 120 (DD 41)	50220-022
D5,D6	Zenerdiode 1N5346B (9,1V 150mA 5W)	50221-006
D7,D8,D9,D10	Diode MUR 860 (TD-220 AC)	50220-023
C1,C5,C6	TANTAL E.KONDENSATOR 3,3uF 35V	51101-002
C2,C3,C4	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
C7,C8	KERAMIKKONDENSATOR 10 NF 100 V 10%	51104-022
C9	Polypr.-Kondensator MKP 0,68uF 400V- 10% RM22,5	51103-037
C10,C11,C12,C13	Kondensator MKP 1uF 250V 5% RM22,5	51103-030
R1,R2	Metallschichtwiderstand 47R 0,4W 1% TK50	51014-113
R3,R4	Metallschichtwiderstand 2,2k 0,4W 1% TK50	51014-131
RH1	Widerstandsnetzwerk 8x10k (9 Pin) 4609X-101	51015-006

## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
	HF_Generator/Ausgangs-Filter bestückt u. geprüft HF-Generator/Filter assembled and checked	30121-044
Ue1	HF-Endstufeneübertrager gewickelt u. geprüeft	30121-020
Ue2,Ue3	Strom-Monitor gewickelt u. geprüeft	30121-073
L1	Serienkreisspule 22uH gewickelt u. geprüeft	30121-054
D1,D2	SCHALTDIODE 1 N 4148	50220-000
C1	Glimmerkondensator 9,5nF RM40	51109-003
C2,C3,C4,C5,C6	Kondensator FKP1 0,01uF 5% 1600V RM22,5	51103-032
C7	Kondensator FKP1 4700pF 5% 1600V RM22,5	51103-033
C8	KONDENSATOR 3300 PF 1500 V 5%	51103-020
C9	Keramikkondensator 100pF 200V 10% (CK 05 BX)	51104-044
C10	KERAMIKKONDENSATOR 220 PF 200V 10% (CK05BX)	51104-027
R1,R2,R3,R4	Metallschichtwiderstand 1k 1W 1% TK50	51005-003
R5,R6	Metallschichtwiderstand 33,0k 0,4W 1% TK50	51014-111
R7	Metallschichtwiderstand 22k 0,4W 1% TK50	51014-135
R8	METALLSCHICHTWIDERSTAND 27K 0.4W 1% TK50	51014-032
R9	Metallschichtwiderstand 200k 0,4W 1% TK50	51014-098
R10	Metallschichtwiderstand 30,0k 0,4W 1% TK50	51014-110
R11	Metallschichtwiderstand 330R 1W 1% TK50	51005-008
	HF-Generator/Steuerung bestückt u. geprüft HF-Generator/logic assembled and checked	30121-051
Ic1,Ic10,Ic11	KOMPARATOR LM 319 N	50002-010
Ic2,Ic3	Digital-Analog Wandler AD 7224	50000-014
Ic4	Spannungs-Frequenzwandler AD 654 JN	50000-011
Ic5,Ic12,Ic14	MONO-FLOP HF 4528 BP	50007-007
Ic6	Dual 4-Input And-Gate CD 4082 BE	50007-033
Ic7	C-MOS ZAEHLER IC 4011 NAND	50007-003
Ic8	Dual 4 Cha. Multiplexer HEF 4539 BP	50007-035
Ic9	Multivibrator CD 4047 BE	50007-034
Ic13	EXOR - GATTER CD 4030 BE	50007-009
Ic15	D - FLIP - FLOP CD 4013 BE	50007-012
T1	V-mos Transistor VN 10 KM	50203-001
D1-D3,D6,D7, D10-D13	SCHALTDIODE 1 N 4148	50220-000
D4,D5,D8,D9	Zenerdiode BZX 55 C 3V6	50222-014
C1,C4,C33,C34	TANTAL E.KONDENSATOR 3,3uF 35V	51101-002
C2,C3,C5-C9, C12,C14,C15, C17-C20,C22, C23,C31,C32	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
	Nachtrag zur obigen Referenznummer	50000-999

## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
C10, C16	KERAMIKKONDENSATOR 2.2 NF 100 V 10%	51104-021
C11, C24	KERAMIKKONDENSATOR 10 NF 100 V 10%	51104-022
C13, C25, C26, C27, C35	Keramikkondensator 100pF 200V 10% (CK 05 BX)	51104-044
C21	Keramikkondensator 1000pF 200V 10% (CK05BX)	51104-043
C28, C29, C30	Keramikkondensator 33pF 200V 10% (CK 05 Bx)	51104-041
C33	KERAMIKKONDENSATOR 220 PF 200V 10% (CK05Bx)	51104-027
R1, R2, R5, R8, R11, R14, R15, R16, R18, R19, R20, R23	Metallschichtwiderstand 4,7k 0,4W 1% TK50 Nachtrag zur obigen Referenznummer	51014-100 50000-999
R3, R6, R12, R17, R25, R27	Metallschichtwiderstand 1,0k 0,4W 1% TK50 Nachtrag zur obigen Referenznummer	51014-001 50000-999
R30, R33, R41		
R4, R13	METALLSCHICHTWIDERSTAND 2k 0,4W 1% TK50	51014-051
R7, R26, R46, R47	Metallschichtwiderstand 5,6k 0,4W 1% TK50	51014-101
R9	Metallschichtwiderstand 3,3k 0,4W 1% TK50	51014-122
R10, R50	Metallschichtwiderstand 22k 0,4W 1% TK50	51014-135
R21, R32, R36, R45	Metallschichtwiderstand 10k 0,4W 1% TK50	51014-010
R22	Metallschichtwiderstand 33,0k 0,4W 1% TK50	51014-111
R23, R31, R35, R38, R49	Metallschichtwiderstand 7,5k 0,4W 1% TK50	51014-119
R24, R34, R51	Metallschichtwiderstand 10R 0,4W 1% TK50	51014-114
R29	Metallschichtwiderstand 20R 0,4W 1% TK50	51014-142
R44	Metallschichtwiderstand 2,2k 0,4W 1% TK50	51014-131
R37, R39	METALLSCHICHTWIDERSTAND 100.0 K 0,4W 1% TK 50	51014-017
R40	Metallschichtwiderstand 150R 0,4W 1% TK50	51014-097
R42	Metallschichtwiderstand 120k 0,4W 1% TK50	51014-125
R43	METALLSCHICHTWIDERSTAND 5,1K 0,4W 1% TK50	51014-040
R48	METALLSCHICHTWIDERSTAND 150 K 0,4 W 1% TK 50	51014-018
RN1	Widerstandsnetzwerk 8x10k (9 Pin) 4609X-101	51015-006
Tr1	Trimmwiderstand (WENDEL) 2,2k 10% T18T	51030-055
Tr2, Tr5, Tr6	TRIMMWIDERSTAND (WENDEL) 20 K 10% T18 T	51030-032
Tr3, Tr4	TRIMMWIDERSTAND (WENDEL) 10 K 10%	51030-037
J1	Stiftleiste 32 pol. G 04 D 64 P8 BEBL-005-702	51602-113
	Kodierstift 201 285 24-003	51602-111
	IC-Stecksocket 8 polig	51610-044
	IC-STECKSOCKEL 14-POL.	51610-025
	IC-SFECKSOCKEL 16-POL.	51610-015
	IC-Stecksocket 18 polig 0,3"	51610-050
	LOETSTIFT 324	51607-000

## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
	ST-Generator bestückt u. geprüft ST-Generator assembled and checked	30121-214
Ue1	S-T-Uebertrager gewickelt und geprüeft	30121-216
Ic1	Digital-Analog Wandler AD 7224	50000-014
Ic2	Spannungs-Frequenzwandler AD 654 JN	50000-011
Ic3	EXOR - GATTER CD 4030 BE	50007-009
Ic4	Zaehler (14 Stage) CD 4020 BE	50007-039
Ic5	Darlington-Treiber (npn) ULN 2004 A	50000-010
Ic6	MOSFET-Treiber ICL 7667 CPA	50000-009
T1	N-Channel-Mosfet IRFAE50	50203-012
T2	TRANSISTOR NPN BC 547 B	50200-002
D1, D2, D4	Diode MUR 860 (TD-220 AC)	50220-023
D3	Diode MUR 480	50220-024
D5, D6	SCHALTDIODE 1 N 4148	50220-000
Re1, Re2	Reedrelais (1 Schliesser) Typ 305-1W24-24V	50400-038
R1, R5, R6	Metallschichtwiderstand 1,0k 0,4W 1% TK50	51014-001
R2, R4	METALLSCHICHTWIDERSTAND 2k 0,4W 1% TK50	51014-051
R3	Metallschichtwiderstand 4,7k 0,4W 1% TK50	51014-100
R7, R8, R9, R10	Metallschichtwiderstand 470k 0,4W 1% TK50	51014-102
R11	METALLSCHICHTWIDERSTAND 15K 0,4W 1% TK50	51014-030
R12, R13	Metallschichtwiderstand 10k 0,4W 1% TK50	51014-010
R15	Metallschichtwiderstand 10R 0,4W 1% TK50	51014-114
RR1	Widerstandsnetzwerk 8x10k (9 Pin) 4609X-101	51015-006
RR2	Widerstandsnetzwerk 8x4,7k Single in Line	51015-003
Tr1	TRIMMWIDERSTAND (WENDEL) 20 K 10% T18 T	51030-032
Tr2	TRIMMWIDERSTAND (WENDEL) 10 K 10%	51030-037
C1, C2, C3, C5, C7, C9, C14	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
C4	Keramikkondensator 1000pF 200V 10% (CK05BX)	51104-043
C6	Keramikkondensator 33pF 200V 10% (CK 05 D::)	51104-041
C8, C15	TANTAL E.KONDENSATOR 3,3uF 35V	51101-002
C10, C11	Kondensator MKP 1uF 250V 5% RM22,5	51103-030
C12	Kondensator MKP 0,33uF 400V 5% RM27,5	51103-038
C13	Keramikkondensator 6,8nF 10% 50V RM5	51104-040
C16, C17	KONDENSATOR KP1836 1000PF 2000 V, 10 %, RM 22,5	51103-026
C18	KERAMIKKONDENSATOR 150 PF 3 KV 10%	51104-031

## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
	Berührungsmonitor bestückt u. geprüft Contact Monitor assembled and checked	30121-200
Ue1	Ringkernuebertrager	30121-114
Fm1	Selektiver Uebertrager	30121-059
Ic1	DUAL OP - VERSTAERKER TL 082 C	50004-009
Ic2, Ic3	KOMPARATOR LM 311	50004-018
Ic4	D - FLIP - FLOP CD 4013 BE	50007-012
Ic5	Hex Buffer/Converter CD 4050 BE	50007-036
Ic6, Ic10	Hex D Flip-Flop CD 40174 BE	50007-031
Ic7	NF-Verstaerker TDA 7052	50000-013
Ic8	NOR-GATTER MC 14001 BCP	50007-004
Ic9	OP. - VERSTAERKER LF 356	50004-012
T1, T2, T3, T4, T5	TRANSISTOR NPN BC 546 B	50200-001
D1, D11, D12	Zenerdiode BZX 55 C 13	50222-015
D2	Diode (hochsperrend) BAS 45	50220-015
D3-D10, D14, D17	SCHALTDIODE 1 N 4148	50220-000
Led13-Led15	Leuchtdiode rot 5mm LR 5360 G	50402-003
Rel1, Rel2	Relais AZ 8-1C-24D (Zettler)	50400-043
C1, C4, C10, C15-C17, C20-C25	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
C2	Keramikkondensator 180nF 50V 10% (CK05BX)	51104-045
C3	TANTAL E. KONDENSATOR 1UF 35V	51101-004
C5, C18, C19	KERAMIKKONDENSATOR 560 PF 200 V 10%	51104-029
C6	Styroflex-Kondensator KS 2200pF 160V 2%	51103-034
C8, C26	TANTAL E.KONDENSATOR 3,3uF 35V	51101-002
C11	KERAMIKKONDENSATOR 47 NF 50 V 10%	51104-024
C12	KERAMIKKONDENSATOR 10 NF 100 V 10%	51104-022
C13	KERAMIKKONDENSATOR 22 NF 50 V 10%	51104-023
C14	METAL.POLY.KOND. MKT 1822 -515/06 1.50MF63/40V 20%	51102-002
R1, R19, R24, R30, R31, R32	Metallschichtwiderstand 1,0k 0,4W 1% TK50	51014-001
R2, R4, R14, R27, R28	Metallschichtwiderstand 1M 0,4W 1% TK50	51014-124
R3, R11, R25	METALLSCHICHTWIDERSTAND 27K 0,4W 1% TK50	51014-032
R5, R13	Metallschichtwiderstand 22k 0,4W 1% TK50	51014-135
R6, R12	Metallschichtwiderstand 56,0k 0,4W 1% TK50	51014-081
R7	Metallschichtwiderstand 3,3M 0,4W 1% TK50	51014-128
R8, R16	METALLSCHICHTWIDERSTAND 15K 0,4W 1% TK50	51014-030
R9, R26	Metallschichtwiderstand 10M 0,4W 1% TK50	51014-129
R10	Metallschichtwiderstand 33,0k 0,4W 1% TK50	51014-111
R15, R20-21, R23, R29, R40-43	Metallschichtwiderstand 10k 0,4W 1% TK50	51014-010



## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
R17	METALLSCHICHTWIDERSTAND 100R 0,4W 1% TK50	51014-049
R18	Metallschichtwiderstand 2,2k 0,4W 1% TK50	51014-131
R22	Metallschichtwiderstand 180R 0,4W 1% TK50	51014-058
R33	METALLSCHICHTWIDERSTAND 47 K 0.4 W 1% TK 50	51014-023
RM1, RM2	Widerstandsnetzwerk 8x10k (9 Pin) 4609X-101	51015-004
Tr1	TRIMMWIDERSTAND (WENDEL) 200 K 10%	51030-038
Tr2, Tr4	TRIMMWIDERSTAND (WENDEL) 20 K 10% T18 T	51030-032
Tr3, Tr5	TRIMMWIDERSTAND (WENDEL) 1 K 10 % T 18 T	51030-031
L1, L2, L3, L4	Festinduktivitaet 3,3 mH +-5%	51302-004
L3	FESTINDUKTIVITAET 680 uH F 2500-20	51302-000
	HF-Leckstrom u. NE-Monitor bestückt u. geprüft HF-Leakage Current and NE Monitor assembled and checked	30121-201
Ic1, Ic2	C-MOS PLL CD 4046 BE	50007-018
Ic3	KOMPARATOR 4-FACH LM 339 DP	50004-017
Ic4, Ic5, Ic12	Operationsverstaerker LM 318 N (schnell)	50004-021
Ic6	OP - VERSTAERKER LM 324 N	50004-008
Ic7	Hex D Flip-Flop CD 40174 DE	50007-031
Ic8	Digital-Analog Wandler AD 7224	50000-014
Ic9	S+H Verstaerker LF 398 N	50004-020
Ic10	Operationsverstaerker OP 07 CN (praezise)	50004-022
Ic11	Spannungs-Frequenzwandler AD 654 JN	50000-011
T1, T4, T8	TRANSISTOR NPN BC 546 B	50200-001
T2	TRANSISTOR PNP BC 557 B	50201-000
T3, T5	TRANSISTOR V-MOS BS 170	50203-002
D1, D2, D5-D7, D10, D11, D15-16	SCHALTDIODE 1 N 4148	50220-000
D3, D4, D8, D9, D12, D13, D14	ZENERDIODE BZX 55 C 10	50222-010
L1	Drossel 100 uH +-5%	51302-005
Rel1	Flachformrelais AZ 7-2C-24D	50400-035
C1, C6, C7, C10, C12-13, C16-17	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
C2, C8	KERAMIKKONDENSATOR 2.2 NF 100 V 10%	51104-021
C3	KERAMIKKONDENSATOR 220 PF 200V 10% (CK05BX)	51104-027
C4	METAL.POLY.KOND. MKT 1822 0.47uF 63/40V 5% RM10	51102-024
C5, C14	KERAMIKKONDENSATOR 10 NF 100 V 10%	51104-022
C9	ALU ELEKTROLYT KONDENS.EK 22 MF/40V	51100-007
C11	TANTAL E.KONDENSATOR 3,3uF 35V	51101-002
C15	Keramikkondensator 1000pF 200V 10% (CK05BX)	51104-043
C18	METAL.POLY.KOND. MKT 1822 -410/01 0.10MF100/63V 20%	51102-014
C21, C25, C26	METAL.POLY.KOND. MKT 1822 0.33MF 63V 20% RM10	51102-000

## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
C22	TANTAL ELEKTROLYT KONDEN- SATOR 15 UF / 20 V	51101-000
C23	TANTAL E. KONDENSATOR ETP 3 G 10UF/35V	51101-001
R1,R16,R19	Metallschichtwiderstand 20k 0,4W 1% TK50	51014-012
R2	METALLSCHICHTWIDERSTAND 39 K 0.4W 1% TK 50	51014-015
R3,R5,R21-R23, R28,R35,R45	Metallschichtwiderstand 12k 0,4W 1% TK50	51014-134
R4	Metallschichtwiderstand 470k 0,4W 1% TK50	51014-102
R6	METALLSCHICHTWIDERSTAND 36K 0,4W 1% TK50	51014-035
R7,R20,R30,R39	METALLSCHICHTWIDERSTAND 15K 0,4W 1% TK50	51014-030
R8,R31,R32,R33, R37,R38	Metallschichtwiderstand 7,5k 0,4W 1% TK50	51014-119
R9,R10	Metallschichtwiderstand 10k 0,4W 1% TK50	51014-010
R11,R26	Metallschichtwiderstand 1,0k 0,4W 1% TK50	51014-001
R12,R17,R18	METALLSCHICHTWIDERSTAND 150 K 0.4 W 1% TK 50	51014-018
R13	METALLSCHICHTWIDERSTAND 100R 0,4W 1% TK50	51014-049
R14,R47	Drahtwiderstand 68R 7W 5%	51008-009
R15	METALLSCHICHTWIDERSTAND 300 K 0.4 W 1% TK 50	51014-025
R24,R25	Metallschichtwiderstand 1,2k 0,4W 1% TK50	51014-120
R27	METALLSCHICHTWIDERSTAND 2k 0,4W 1% TK50	51014-051
R29	Metallschichtwiderstand 3,3k 0,4W 1% TK50	51014-122
R34	Metallschichtwiderstand 22k 0,4W 1% TK50	51014-135
R36	Metallschichtwiderstand 180R 0,4W 1% TK50	51014-058
R40,R44	METALLSCHICHTWIDERSTAND 47 K 0.4 W 1% TK 50	51014-023
R41	METALLSCHICHTWIDERSTAND 10,7K 0,4W 1% TK 50	51014-028
R42	METALLSCHICHTWIDERSTAND 220 K 0.4W 1% TK 50	51014-019
R43	Metallschichtwiderstand 4,7k 0,4W 1% TK50	51014-100
R46	METALLSCHICHTWIDERSTAND 100.0 K 0.4W 1% TK 50	51014-017
R48	Metallschichtwiderstand 51k 0,4W 1% TK50	51014-116
R49	Metallschichtwiderstand 33,0k 0,4W 1% TK50	51014-111
RN1,RN2	Widerstandsnetzwerk 8x10k (9 Pin) 4409X-101	51015-006
TP1	TRIMMWIDERSTAND (WENDEL) 20 K 10% T18 T	51030-032
TP2	TRIMMWIDERSTAND (WENDEL) 10 K 10%	51030-037
TP3	Trimmwiderstand (Wendel) 500k 10% T18T	51030-053
TP4	Trimmwiderstand (Wendel) 5k 10% T18T	51030-054

## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
	Sicherheitslogik bestückt u. geprüft Safety Logic assembled and checked	30121-050
Ic 1	3-FACH NOR-GATTER CD 4025 BE	50007-021
Ic 2	Hex Buffer/Converter CD 4050 BE	50007-036
Ic 3	DUAL-MONO-FLOP C-MOS CD 4538 BE	50007-020
Ic 4	OR-GATTER CD 4071 B	50007-036
IC 5, Ic 8	AND-GATTER CD 4081 B	50007-025
Ic 6	Hex D Flip-Flop CD 40174 BE	50007-031
Ic 7	3 Fach-OR CD 4075 BE	50007-038
T 1, T 2	TRANSISTOR NPN BC 546 B	50200-001
D 1, D 2	Leuchtdiode rot 5mm LR 5360 G	50602-003
C1, C2, C3, C4, C5, C7	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
R 1, R 3	METALLSCHICHTWIDERSTAND 1K 0,33W 1% TK 50	51001-004
R 2, R 4	METALLSCHICHTWIDERSTAND 27K 0,4W 1% TK50	51014-032
R 5	Metallschichtwiderstand 82,0k 0,4W 1% TK50	51014-112
RN 1, RN 2, RN 3	Widerstandsnetzwerk 8x10k (9 Pin) 4609X-101	51015-006
	Fingerschalter-Monitor bestückt u. geprüft Finger-Switch-Monitor assembled and checked	30121-046
Ue1, Ue2	Uebertrager EF 32	30121-084
L1, L2	Drossel	30121-090
Ic1	Darlington-Treiber (npn) ULN 2004 A	50000-010
Ic2	Hex Buffer/Converter CD 4050 BE	50007-036
Ic3	Optokoppler CNY 46	50600-007
Ic4, Ic6	Fototransistor SFH 350 V	50600-008
Ic5, Ic7	Sendediode SFH 450 V	50600-009
	Kunststofflichtleitkabel 39,5mm (50600-010)	30121-276
	Kunststofflichtleitkabel	50600-010
T1, T2	TRANSISTOR NPN BC 517	50200-003
D1, D2	ZENERDIODE BZX 55 C 2V7	50222-000
D3, D4, D5	Leuchtdiode rot 5mm LR 5360 G	50602-003
C1, C2	ALU-ELEKTR.KONDENSATOR EK 2,2UF 50V	51100-038
C3, C4	METAL.POLY.KOND. MKT 1822 -515/06 1.50MF63/40V 20%	51102-002
C5, C6	METAL.POLY.KOND. MKT 1822 -415/0 0.15MF100/63V 5%	51102-027
C7, C8, C9, C10, C11	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
C12, C13, C14	METAL.POLY.KOND. MKT 1822 0.47UF 63/40V 20% RN10	51102-001
C15	KERAMIKKONDENSATOR 10 NF 100 V 10%	51104-022

## Replaceable Parts

Reference Designation Code N°	Description Specification	ERBE Part N°
R1,R2,R3,R4,R16	Metallschichtwiderstand 1,0k 0,4W 1% TK50	51014-001
R5,R6	Metallschichtwiderstand 100R 1,0W 1% TK50	51005-007
R9,R12	Metallschichtwiderstand 22k 0,4W 1% TK50	51014-135
R13	Metallschichtwiderstand 10k 0,4W 1% TK50	51014-010
R14,R15	METALLSCHICHTWIDERSTAND 100R 0,4W 1% TK50	51014-049
R17,R18,R19	Metallschichtwiderstand 2,2k 0,4W 1% TK50	51014-131
RN1	Widerstandsnetzwerk 8x10k (9 Pin) 4609X-101	51015-006
	Relais-Platte bestückt u. geprüft Relay Board assembled and checked	30121-048
Ic1	Hex D Flip-Flop CD 40174 BE	50007-031
Ic2	Darlington-Treiber.(nnp) ULN 2004 A	50000-010
Ic3	NOR-GATTER MC 14001 BCP	50007-004
Ic4	OP. - VERSTAERKER LF 356	50004-012
D1,D2,D3	SCHALTDIODE 1 N 4148	50220-000
D4,D5	DIODE BA 159	50220-002
Led	Led-Bargraph Display rot MV 57164 G	50602-023
Rel1,Rel2,Rel3,	Reedrelais (1 Schliesser) Typ 805-1R27-24V BV1026	50400-036
Rel4,Rel5		
Rel6	Reedrelais (1 Schliesser) Typ 805-1R27-24V	50400-039
Rel7	Reedrelais (2 Schliesser) Typ 805-2W24-24V	50400-037
C1,C3,C7	METAL.POLY.KOND. MKT 1822 -410/01 0.10MF100/63V 20%	51102-016
C2	ALU ELEKTROLYT KONDENS.EK 100 MF/40V	51100-003
C4	METAL.POLY.KOND. MKT 1822 -310/63 0.01MF/630/220V20	51102-013
C5,C6	MP-KONDENSATOR 0,022 UF PME 271-Y 522	51106-010
C8	METAL.POLY.KOND. MKT 1822 -415/0 0.15MF100/63V 5%	51102-027
C9	Keramikkondensator 1000pF 200V 10% (CK05BX)	51104-043
C10	KERAMIKKONDENSATOR 68 NF 50 V 10%	51104-025
R1,R2	Metallschichtwiderstand 1,5k 0,4W 1% TK50	51014-108
R3	Metallschichtwiderstand 1M 0,4W 1% TK50	51014-124
R4	Metallschichtwiderstand 56,0k 0,4W 1% TK50	51014-081
R5	Metallschichtwiderstand 330k 0,4W 1% TK50	51014-123
R6	Metallschichtwiderstand 3,3M 0,4W 1% TK50	51014-128
R7,R9	Metallschichtwiderstand 10k 0,4W 1% TK50	51014-010
R8	Metallschichtwiderstand 68R 0,4W 1% TK50	51014-121
R10	Metallschichtwiderstand 1,2k 0,4W 1% TK50	51014-120
RN1	Widerstandsnetzwerk 8x10k (9 Pin) 4609X-101	51015-006
RN2	Widerstandsnetzwerk 8x2,2k (9 Pin) 4609X-101	51015-007
TP1	Trimmwiderstand T7X 220 / 200 OHM	51030-011
	SICHERUNG T0,2A/250V 5X20MM	51611-055