ROHDE&SCHWARZ
Geschäftsbereich
Meßtechnik

Servicehandbuch

POWERMETER
NRVS

1020.1809.02

MILLIVOLTMETER
URV55

1029.1701.02

ENGLISH MANUAL FOLLOWS FIRST COLOURED DIVIDER

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Introduction

This service manual describes calibration and repair of the power meter NRVS and the millivoltmeter URV55. It is included in service kit NRVS-S1 (part no. 1029.2708.02), which contains all instrument-specific accessories.

A list of the other measuring instruments and accessories is to be found in sections 6.2.1 (calibration) and 7.2.1 (troubleshooting).

Components of Service Kit NRVS-S1:

- **Service Manual** (part no. 1020.1973.24) providing calibration instructions, a detailed circuit description and hints for troubleshooting.
- **Cal Adapter** (part no. 0350.7818.02) to calibrate the NRVS/URV55 via the measuring head interface.
- **EPROM 512 kB** (part no. 1029.2766.00) with service firmware.
- **Floppy 5.25"/1.2 MB** and **3.5"/1.44 MB** (part no. 1029.2850) for R&S PAT/PSA and IBM-AT-compatible computers.

  Contents:

INST_S.BAT	installation program
CAL_S.BAS	calibration program (→ 6.2.5.3)
IECERR.BAS	utility program to control the NRVS/URV55 via the IEC/IEEE bus interface and to output errors in an easy-to-understand format (→ 7.2.1.2)
DIAG_S.BAS	control program for service firmware (→ 7.2.3.2)
R&S BASIC	BASIC interpreter including all drivers

The installation for all programs is described in sections 6.2.4 and 6.2.5.2.

6 Repair of Complete Instrument

(see complete circuit diagram 1020.1809.01S, function circuit diagram Fig. 7-15 and block diagram 1029.0605.01S sheet 1)

6.1 Function Description of Complete Instrument

The NRVS/URV55 consists of the basic instrument with the main board, power supply and front panel with LCD and a measuring head. The measurement is made via an integrating A/D converter. Processing and filtering of the measurement results is almost exclusively performed in the microprocessor.

Since neither the main board nor the measuring head contain adjustable components (in order to make the instrument reliable and easy to service), all deviations from nominal are taken into account using special algorithms. The correction values for the main board are stored in a protected area of the battery-backed RAM, which cannot be overwritten in normal operation; the characteristics of the measuring head are stored in a read-only memory integrated into the connector housing of the measuring head.

The function circuit diagram (Fig. 7-15) permits to follow the processing path of a signal:

The **measuring head** provides at its output a DC voltage corresponding to the input RF voltage. Depending on the measuring head used, it may be bipolar or unipolar referred to the circuit ground. Depending on the RF level, the output voltage is either proportional to the input power (square-law range with RMS weighting up to approx. 22 mV_{eff} or 10 µW) or to the input voltage (linear range of the rectifier diode as of approx. 1 V_{eff} or 20 mW). The area in between is the so-called transition area with an exponent between 1 and 2 of the output voltage referred to the input power.

In order to prevent linearity errors in spite of the wide dynamic range of the RF rectifier, the transfer characteristic is stored in a data memory together with other characteristics, which is inseparably connected with the measuring head. By taking into account the diode characteristics with respect to input level (linearity), test frequency (frequency response) and ambient temperature, a correct indication of the input level is always ensured automatically. For temperature compensation, all measuring heads URV5-Z.../NRV-Z... are provided with a temperature sensor installed in the measuring head.

The output DC voltage of the measuring head is amplified in the **AC probe amplifier** (all AC voltage and power sensors) or in the **DC probe amplifier** (only DC probe URV5-Z1) to such an extent that it can be taken via a **multiplexer** to the **A/D converter**.
In the microprocessor, the measurement result is processed, taking all correction data (RF diode and probe amplifier) into consideration, and an appropriate PWM signal for driving the **analog output** is generated.

Via a customer-specific circuit (D600), the processor also causes the **supply voltages of the measuring head** to be switched on and off. If the data memory contents is to be read out, + 5 V are applied to the appropriate terminals. If a passive measuring head has been identified, the supply voltage is switched off again, whereas an active measuring head is supplied with ± 12 V after reading out is terminated.

The IEC/IEEE bus interface permits virtually all functions which can be operated via the keyboard to be performed by a controller via remote control. Likewise, the measured values can be fetched via this interface and taken to the controller for further processing.

Fundamental operation of a measuring head may be checked by means of the optional sensor check source NRVS-B1. It delivers a stable, almost harmonic-free signal with 1 mW of calibrated power at 50 MHz.

6.2 Calibration

Calibration and testing of the basic instruments NRVS and URV55 (with exception of the sensor ceck source, → 6.2.6.7) is performed using a DC voltage calibrator. The measuring head interface is accessible via a calibration adapter.

The complete procedure can only be performed via the IEC/IEEE bus interface of the NRVS/URV55, either by using a program (→ 6.2.5) or manually in single steps (→ 6.2.6). Calibration using the calibration program on the service floppy disk requires an IBM-AT-compatible computer. A printer permits to print out a test/calibration report and an error report (→ Fig. 6-1).

The program supports three of the most often used DC voltage calibrators:

- Analogic (Data Precision) 8200
- Datron 4000
- Fluke 5700.

The use of other calibrators which are not supported by the calibration program is described in section 6.2.3.

Calibration is performed using the firmware contained in the NRVS/URV55. It is not necessary to use the service EPROM.

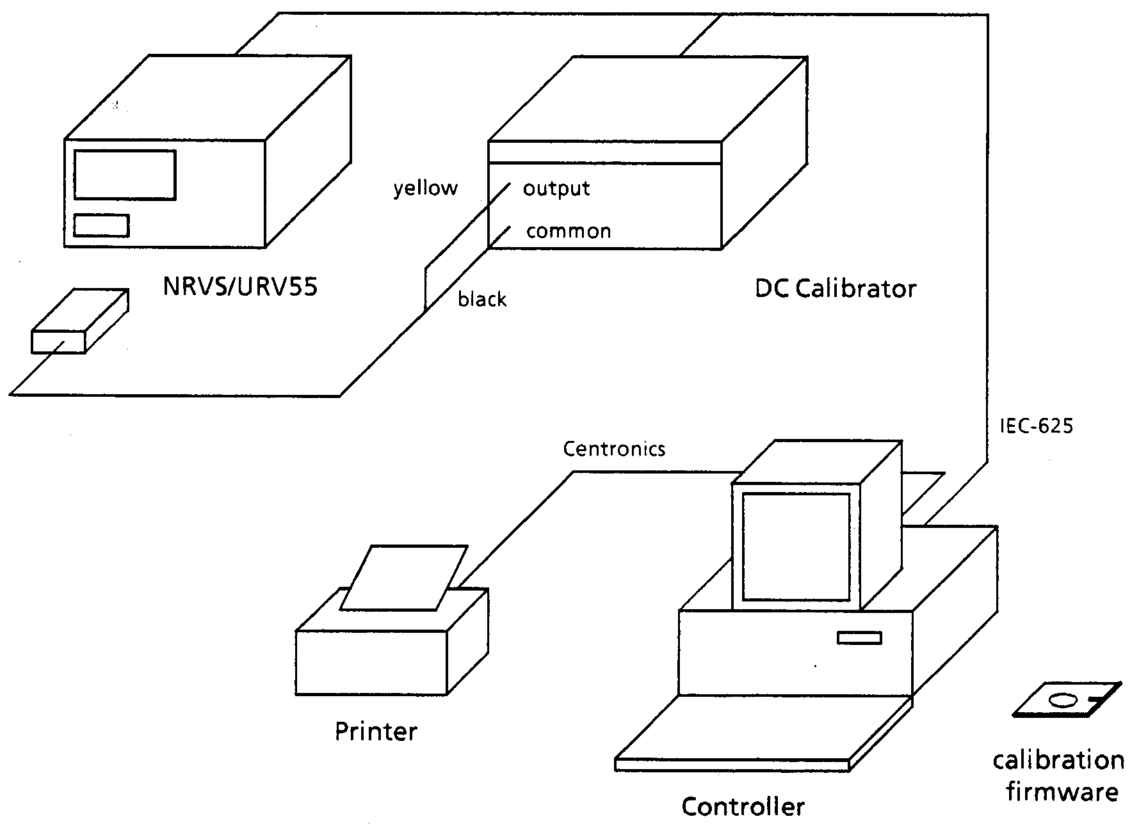


Bild 6-1 Test setup for testing/calibrating the NRVS/URV55

6.2.1 Required Measuring Equipment and Auxiliary Means

Device	Required Specifications	Appropriate instrument	R&S order no.
Cal adapter		in NRVS-S1	350.7818.02
DC calibrator 1)	± 0,01/0,0195/0,05 V ± 0,1/0,195/0,5 V ± 1/1,95/5/10/19,5 V (0,005 %)		
Digital multimeter 2)	1 MΩ ±0,015 % 3)	UDS5	349.1510.02
Controller with IEC-bus interface			
Printer			
BNC cable			
Adapter, female BNC connector on banana plug			
IEC-bus cable		PCK	292.2013
Connection cable for Centronics interface (36-contact)			
Precision Power Meter	Measurement uncertainty less than 0.5 % at 1 mW / 50 MHz. SWR of sensor max. 1.10.		

1) Further characteristics of the calibrator and hints for adapting the supplied software are given in section 6.2.3.

2) The digital multimeter is only required for adjusting the 1-MΩ resistor in the cal adapter. If an UDS5 is not available, the 1-MΩ resistor should be checked manually (→ 6.2.6.1).

3) in the restricted temperature range 23 ± 1 °C

6.2.2 Calibration Concept

This section briefly deals with the method of measurement used for manual verification/calibration in single steps and for the program-controlled procedure.

Since all measuring heads for the NRVS/URV55 provide the basic instrument with DC voltages or DC currents, the measuring head amplifiers are also checked and calibrated with DC voltages or currents. For the AC voltage probes and power sensors, a DC voltage amplifier with 11 measurement ranges and an input for measuring the output voltage of the temperature sensor are available. For the DC Probe URV5-Z1, the basic instrument is equipped with a current/voltage converter with 4 measurement ranges.

Table 6-1 shows the individual function blocks or circuits which are to be calibrated:

Table 6-1 Instrument functions which can be calibrated

To be calibrated:		Command
AC probe amplifier +	(11 ranges)	CA5
AC probe amplifier –	(11 ranges)	CA5
DC probe amplifier	(4 ranges)	CA6
Temperature sensor input	100 µA/-0.3 V	CA1
Temperature sensor input	1 mA/-3 V	CA1
DC-FREQ input		CA7
DC-LEV output		CA8

For calibration of the measuring head interface (functions CA1, CA5, CA6), the voltage provided by the DC voltage calibrator is applied to the various test inputs using the cal adapter. To this end, the cal adapter contains two relays which are set by the basic instrument according to the function (→ 7.1.6). Table 6-2 lists the required voltages for the individual measurement ranges. The voltage/current conversion for the DC probe amplifier is performed by a variable resistor in the cal adapter (→ 6.2.5.4 and 6.2.6.1).

Table 6-2 Calibration voltages

Calibration voltage V	Meas. range	Perm. offset voltage ± V	Perm. meas. range error ± %	CAL function
±0.01	1	0.00005	0.12	AC probe amplifier
±0.0195	2	0.00005	0.12	
±0.05	3	0.00005	0.12	Cal function
±0.10	4	0.00005	0.12	**CA5**
±0.195	5	0.00005	0.12	
±0.50	6	0.0002	0.12	
±1.00	7	0.0002	0.12	
±1.95	8	0.0005	0.12	
±5.00	9	0.001	0.12	
±10.0	10	0.002	0.12	
±19.5	11	0.005	0.12	
+0.10	1	0.0005	0.12	DC probe amplifier
+1.0	2	0.0005	0.12	Cal function
+10.0	3	0.005	0.12	**CA6**
+40.0	4	0.05	0.12	
–0.3	---	0.001	0.15	Input for temp. sensor Cal. function
–3.0	---	0.005	0.10	**CA1**
+10.0	---	0.005	0.12	DC-FREQ Cal-function **CA7**

As illustrated by Table 6-2, a positive and a negative voltage are required for calibration of the AC probe amplifier for each measurement range. This is due to the fact that the probe amplifier is designed as instrument amplifier with two external inputs, and a separate divider is assigned to each input. One input is provided with positive, the other with negative rectified voltages (against ground) by the measuring heads. As a result of component tolerances, the attenuation ratios of the two input dividers slightly differ for voltages of positive and negative polarity and must therefore be tested and calibrated separately. The measuring heads URV5-Z2/-Z4/-Z7 and NRV-Z3/-Z4/-Z5/-Z31/-Z33/-Z31/-Z33 provide a bipolar voltage, whereas all other measuring heads provide a unipolar voltage.

In order to prevent the verifications/calibrations from being affected by offset voltages, the DC voltage calibrator is set to zero prior to each calibration step; if possible, this should be done in the output voltage range in which the calibration voltage is also set. Then the offset specific to this setting of calibrator and basic instrument is determined by the basic instrument and taken into account during calibration and verification.

Calibration lockout

The correction factors determined during calibration are stored in a write-protected area of the battery-backed RAM. The write-protection must be removed before any calibration or test measurement can be performed. A jumper located on the main board is used to switch off the write protction. **Attention! Observe the safety instructions in chapter 7.3 before opening the instrument. The main board is easily accessible after removal of the two rear panel feet and the lower instrument cover.** Then move the jumper across connector X717 to the calibration position, as shown in Fig. 6-2. After successful completion of the calibration or test measurement, return the jumper to its previous position.

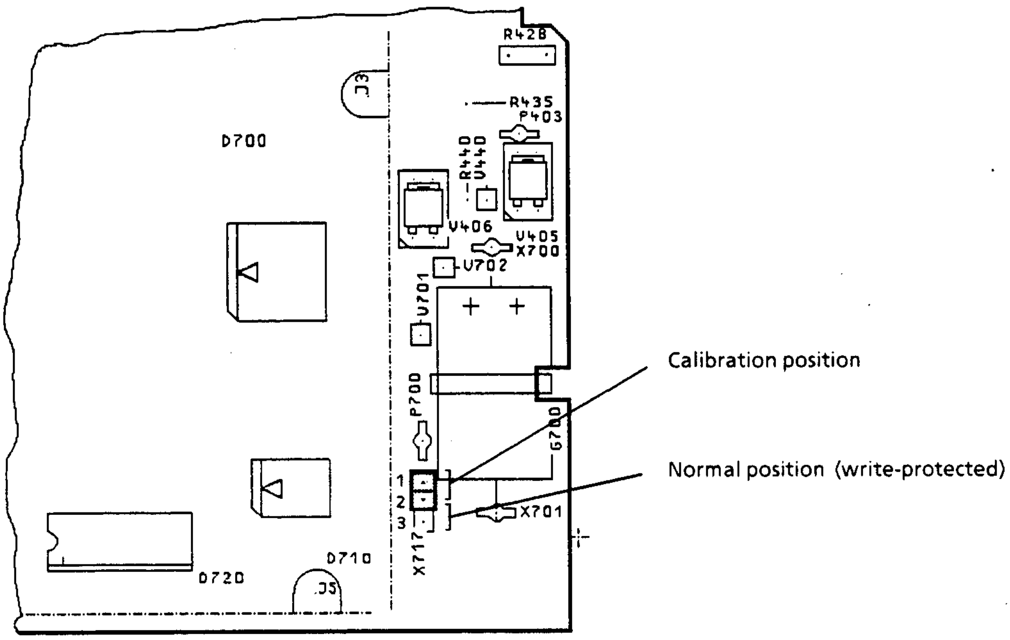


Fig. 6-2 Position of calibration connector X717 (main board)

6.2.3 Requirements Placed on the DC Voltage Calibrator

The verification/calibration program for the NRVS/URV55 has been written for the following DC voltage calibrators:

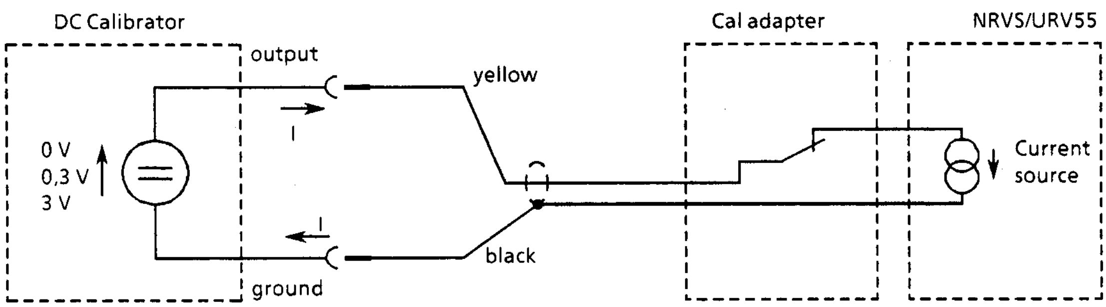
Analogic (Data Precision) 8200
Datron 4000
Fluke 5700

When using other calibrators, check whether the requirements given below are met. In addition, the software has to be adapted.

- It must be possible to set the calibrator to the voltages specified in Table 6-2.
- It must be possible to set the calibrator to zero in the output voltage range relevant to the current calibration voltage (offset measurement, → 6.2.2).
- The calibrator must act as a current sink for the output voltages of -3 V / -0.3 V / 0 V (see below).
- The output terminals must be floating (otherwise, the measurements may be impaired by current loops).
- It must be possible to change the polarity of the output signal without having to reconnect the cal adapter.
- The calibrator must be remote-controllable via the IEC bus.

The calibration voltages up to 0.1 V must be tapped at the rear 100-mV output in the case of model 8200. During the program-controlled verification/calibration run, the user is requested via the screen to reconnect the cal adapter.

With the basic unit connected, the cal adapter generally acts on the DC voltage calibrator as a resistive load of 1 to 10 MΩ. Only when testing or calibrating the temperature sensor input does the basic unit operate as a source, providing a current of max. 2 mA (→ Fig. 6-3). However, the output voltage of the calibrator must not be impaired by this. Check whether the calibrator used still provides the set voltage at its output terminals in this operating mode. In general, this is guaranteed in the case of modern calibrators with a bipolar output stage.



Calibration range	Current
– 0,3 V	100 µA during the calibration phase and during offset measurement
– 3,0 V	1 mA during the calibration phase 2 mA during offset measurement

Fig. 6-3 Current flow during calibration of the temperature sensor input

Software adaptation:

The string constants for the three DC calibrators supported by the program are listed under the markers "Cal_vars_1:", "Cal_vars_2:" and "Cal_vars_3:". In order to use a different calibrator, one of these constant fields is to be rewritten. In addition, enter the name of the calibrator in the lines under the marker "Select_cal:" if required.

An IEC-bus address that has been changed need not be corrected in the program listing. A check is made in the program run to determine whether a remote-controllable device can be addressed under this address.

6.2.4 Requirements Placed Upon the Controller

- IBM-AT-compatible computer.
- Graphic card Hercules/EGA/VGA.
- IEC-bus card and driver PAT-B1, Id.-Nr. 1007.1150.02
  (compatible in terms of function with the PCIIA card from National).
- Parallel interface (LPT1:) for printer connection.
- Available memory: 300 kB hard disk, 250 kB RAM

6.2.5 Program-controlled Calibration/Verification

6.2.5.1 General

The test setup can be seen in Fig. 6-1. The printer can be dispensed with if no documentation of the calibration or verification results is necessary. If a Digital Multimeter UDS5 is not available, the cal adapter is to be adjusted or checked according to section 6.2.6.1.

Make sure that, for calibration, all devices used are allowed to warm up for at least one hour and that the ambient temperature lies within the range of 23 ± 1 °C. The AC supply voltage should not deviate by more than ± 10 % from the nominal value, the relative humidity should be less than 80 %.

6.2.5.2 Installing and Starting the Delivered Programs

Both floppies contain all programs necessary for calibration and troubleshooting in the subdirectory \SER-S. The subdirectory \RS-BASIC contains the BASIC interpreter BASIC.COM, the subdirectory RS-DRIV contains all necessary drivers.

Installation

The program INST_S.BAT in the main directory handles the complete installion to the hard disk. At first, all of the programs for calibration and troubleshooting are copied into the newly created directory C:\SER-S by the installation program.

The BASIC interpreter R&S BASIC must be installed so that the mentioned programs are executable. If the interpreter is not present, it is possible to install it. Here, the directories C:\RS-BASIC and C:\RS-DRIV are created and the approriate files are copied from the floppy. The files CONFIG.SYS and AUTOEXEC.BAT in the directory C:\ are automatically updated. The old versions are saved in the subdirectory C:\SER-DRIV.

Starting the installation program

- Insert floppy into drive A: (B:).
- Enter **A: (B:)** and press the **Enter key**.
- Enter **INST_S** and press the **Enter key**.
- *The installation takes place interactively.*
- Remove the floppy and restart the computer (**Ctrl + Alt + Del** or **Strg + Alt + Entf**) so that the drivers get loaded.

Starting the BASIC programs

- Enter **BASIC** and press the **Enter key**, this loads the interpreter .
- Press the **function key F5** and enter the *program name* or enter
  LOAD:" *program name*, for example

  LOAD:" \SER-S\CAL_S

  to load the calibration program. Then press the Enter key.
- Press the **function key F2** or enter **RUN** and press the Enter key, this will start the loaded program .

Note: ***If BASIC is not started from the subdirectory \SER-S, you must enter the complete path with the program name.***

6.2.5.3 Calibration Program CAL_S.BAS

After the program start, the program heading with the version number (e.g. 1.02) appears for about 1.5 s. Then the following menu can be seen on the screen:

```
            Main Menu

Cal-Adapter Adjustment        <A>
NRVS/URV55 Verification       <V>
NRVS/URV55 Calibration        <C>
Calibration Factors           <F>
Calibration Dates             <D>

End of Program                <E>
```

The order in the menu is not arbitrary but reflects the recommended timing sequence:

- Before calibrating the instrument, make sure that the variable resistor in the cal adapter lies within the permissible limits. Menu item "Cal-Adapter Adjustment <A>" is used for checking this (→ 6.2.5.4).
- To determine the drift since the last calibration it is recommended to perform a verification prior to the calibration. This serves to prevent that a faulty instrument may be "repaired" by the calibration (menu item "NRVS/URV55 Verification <V>", → 6.2.5.5).
- Then perform the instrument calibration proper (menu item "NRVS/URV55 Calibration <C>", → 6.2.5.6).
- The calibration factors determined during the last calibration can be quickly checked using menu item "Calibration Factors <F>". The factors stored in the NRVS/URV55 are read out under program control and output on the screen, to a printer or to a file.
- The menu item "Calibration Dates <D>" permits to read out the dates of calibration of the individual function blocks. It can be called up before or after a calibration. If this item is called up following a complete calibration, the current date is output for all function blocks. In addition, the information whether a complete (C) or only a partial (P) calibration has been performed is also given.

Attention: ***Before starting any of the above-mentioned calibration functions, be sure that the jumper across X717 has been moved to the calibration position (see Fig. 6-2).***

6.2.5.4 Adjustment of Cal Adapter under Program Control

After entry of "A" in the main menu, the test setup required is displayed on the screen (→ Fig. 6-4).

Insert the cal adapter into the measuring head receptacle of the NRVS/URV55 and connect it to the input of the UDS5 (connect yellow banana plug with **INPUT HI**, black one with **INPUT LO**). The NRVS/URV55 then sets the cal adapter such that the 1-MΩ resistance can be measured via the connectors (yellow/black). For this purpose, remove the cal adapter from the NRVS/URV55 when requested to do so. The measured value in kΩ is displayed on the screen:

```
Cal-Adapter Adjustment
------------------------------
999.95 <  1000.02  < 1000.05
Return to Main-Menu with R
```

Adjust the trimming resistor in the cal adapter (→ Fig. 6-4) such that the value lies within the specified interval. Terminate the program item by pressing the "**R**" key (return to main menu).

***Attention:** The accuracy of the UDS5 in the 1-MΩ measurement range considerably affects the adjustment! Check whether the specified calibration interval has been adhered to.*

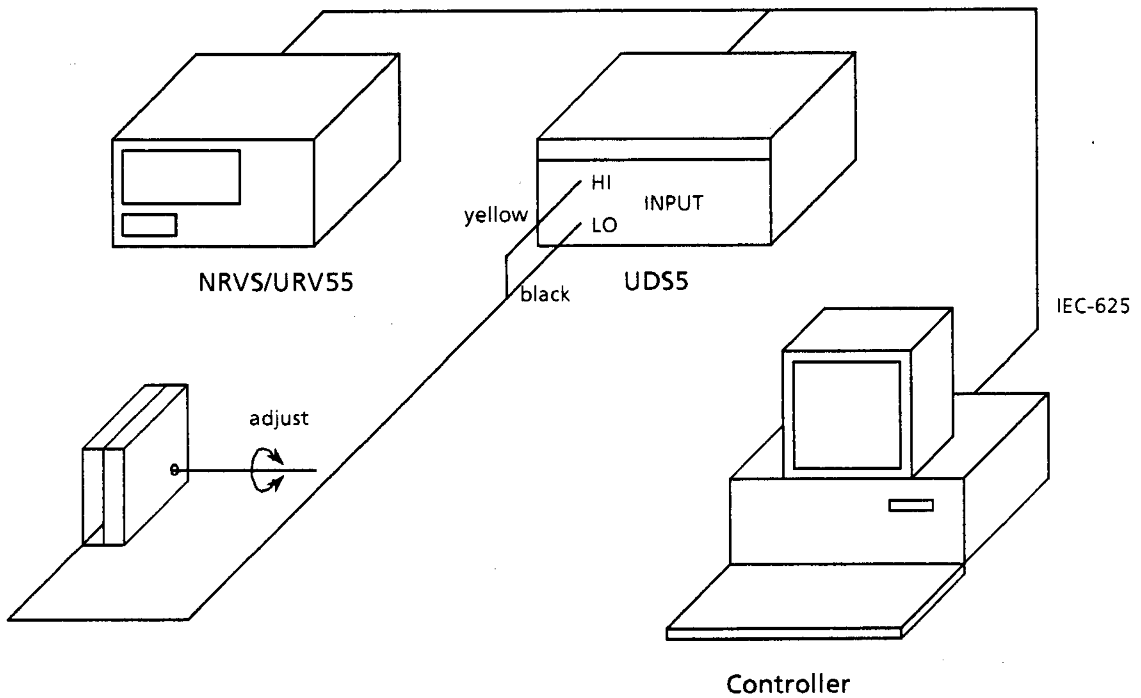


Fig. 6-4 Adjustment of cal adapter

6.2.5.5 Verification

By pressing the "V" key in the main menu, a mere verification run can be started. This test does not change the calibration data in the RAM. However, the jumper X717 has to be configured nevertheless to the calibration position (→ Fig. 6-2). The verification checks all measurement ranges of the measuring head amplifiers and the function of the temperature sensor input, DC-FREQ input and DC-LEV output.

After termination of the verification run, the results can be output either on the screen or on a printer (→ 6.2.5.7). When a limit value is exceeded, the measured value is marked by an asterix both in the measurement run and in the verification report. The measured values found to be faulty can be indicated in the error report. In addition, the message "**NRVS/URV55 out of tolerance**" appears in the verification report below the table with the measured values. If the NRVS/URV55 is within limits, "**NRVS/URV55 is ok**" is displayed.

Before performing a calibration, a verification should be started at any rate in order to record the actual status of the NRVS/URV55. This permits to determine the drift relative to the last calibration, and prevents a faulty instrument from being repaired by calibration.

After entry of "V" in the main menu the following appears on the screen:

```
          NRVS/URV55 Verification
Date (dd.mm.yy)              ?23.02.92
Tested by (Name)             ?
NRVS/URV55 Serial No.        ?
```

The date is taken as a default from the real-time clock of the controller. All entries can be responded to at will or just acknowledged using <RETURN>. Then the setup according to Fig. 6-1 is displayed on the screen. The program requests to acknowledge the error message "ERROR CALIB" and/or "ERROR DATA" via the instrument keyboard if this appears on the NRVS/URV55 display :

```
if >ERROR CALIB< or >ERROR DATA<
    appears on display:
    press →MEAS until
    >READ SENSOR< appears
   press <SPACE> when ready
```

After acknowledgement using the <SPACE> key, the calibration program initializes the IEC/IEEE bus interface, checks the position of the jumper on X717 (write protection) and, if necessary, requests the user to enable the protected RAM area by reconnection.

After testing the connected cal adapter, the program shows the three calibrators supported:

```
        Select Calibrator:
Analogic (Data Precision) 8200  <1>
Datron 4000                     <2>
Fluke 5700                      <3>
```

When the user has selected a calibrator, the program will attempt to talk to it using an address that was entered during a previous program run or by using one of the following default addresses:

- Analogic (Data Precision) 8200 → IEC address 20
- Datron 4000 → IEC address 26
- Fluke 5700 → IEC address 04

If it is not possible to address the calibrator, the program prompts for an entry via keyboard.

After termination of the entries, the calibration menu is displayed on the screen of the controller.

```
        Select Verification
AC Sensor Amplifier             <1>
DC Probe Amplifier              <2>
Temperature Sensor Input        <3>
DC FREQ Input                   <4>
DC Output                       <5>
complete NRVS/URV55             <6>
     Return to Main Menu with R
```

As can be seen from the menu, the program permits to check the listed functions individually (<1> to <5>). By selecting menu item <6>, a complete verification is performed.

After at least one instrument function has been checked (which can be simultaneously observed on the screen), the controller screen displays the different possible reports:

```
Verification Report             <1>
Error Report                    <2>
Calibration Factors             <3>

Return to Verification Menu     <R>
End of Program                  <E>
```

The calibration program thus offers three different reports, which can be output on the screen, to a file or on a printer (→ 6.2.5.7). The respective prompt appears immediately after one of the menu items has been selected.

Note: ***Deviations of ±0.1 % are normal when testing the temperature sensor input in the calibration range of -0.3 V and do not affect the measuring accuracy.***

If the user can do without the output of reports, since other instrument functions have to be tested before, the program permits to return directly to the verification menu. Likewise, the program can be terminated at this point without having to run through the previous menus.

When the calibration program is terminated, the user is requested to restore the write protection for the calibration data by rearranging the jumper on X717. In addition, all entries (name, serial number, model and IEC bus address of the calibrator) are saved in the file CAL_S.CFG. They are then automatically available when the program is invoked again.

6.2.5.6 Calibration

By pressing the "C" key in the main menu, a calibration of the NRVS/URV55 is selected. During the complete calibration run, all analog functions are calibrated and then a new measurement is made with the aid of the new calibration factors. The program requests the user to establish the necessary connections for calibration and remeasurement of the DC-FREQ input and the DC-LEV output. During a complete calibration run, the lower edge of the screen shows a bar which is filled in as the calibration progresses, providing an overview of the current state of calibration.

If a recalibration becomes necessary prior to the next regular calibration, e.g. because of a repair, the program permits to specifically calibrate only the section involved. Thus it may be possible to calibrate the DC voltage output (DC LEV) without the need of a DC calibrator, which is required for the other functions only.

In the case of a partial calibration of the NRVS/URV55, the screen display showing the measured values remains preserved after termination of this step until the <SPACE> key is pressed. This permits to visually check the measured values without the need to hurry. During a complete calibration, no screen stop is provided in view of a fully automatic run.

6.2.5.7 Reports

The program provides the following outputs all of them being available on screen, on a printer or to a file.

- A calibration report (after calibration) or a verification report (after verification)
- An error report
- A list of all calibration factors

For generation of a printed report, the first Centronics interface referred to as "LPT1:" is used. If this interface does not respond, the program prompts for the entry of another interface (LPT1 to LPT4).
The calibration program intentionally does not use any printer-specific control sequences so that every printer equipped with the standard IBM character set can be used.

In addition to the measured data proper, the **calibration report** and the **verification report** also contain the date of calibration and space for the person in charge to sign. Fig. 6-5 shows the calibration report, Fig. 6-6 the verification report:

Calibration Report

NRVS/URV55 1020.1809.02 Serial No.: 864262/020

Function	Range	Nominal/V	Tolerance/%	Measured/V	Deviation/%
AC AMP				Next Calibration:	97
	1	10E-3	0.12	+9.9999E-3	-0.00
	1	-10E-3	0.12	-9.9999E-3	-0.00
	2	19.5E-3	0.12	+1.9500E-2	-0.00
	2	-19.5E-3	0.12	-1.9500E-2	+0.00
	3	50E-3	0.12	+5.0001E-2	+0.00
	3	-50E-3	0.12	-4.9999E-2	-0.00
	4	100E-3	0.12	+1.0000E-1	+0.00
	4	-100E-3	0.12	-1.0000E-1	+0.00
	5	195E-3	0.12	+1.9500E-1	+0.00
	5	-195E-3	0.12	-1.9500E-1	-0.00
	6	500E-3	0.12	+5.0001E-1	+0.00
	6	-500E-3	0.12	-5.0000E-1	-0.00
	7	1E0	0.12	+1.0000E0	+0.00
	7	-1E0	0.12	-9.9998E-1	-0.00
	8	1.95E0	0.12	+1.9500E0	-0.00
	8	-1.95E0	0.12	-1.9500E0	-0.00
	9	5E0	0.12	+4.9999E0	-0.00
	9	-5E0	0.12	-5.0001E0	+0.00
	10	10E0	0.12	+1.0000E1	+0.00
	10	-10E0	0.12	-1.0000E1	-0.00
	11	19.5E0	0.12	+1.9501E1	+0.00
	11	-19.5E0	0.12	-1.9501E1	+0.00
DC AMP				Next Calibration:	97
	1	100E-3	0.12	+9.9993E-2	-0.00
	2	1E0	0.12	+1.0000E0	+0.00
	3	10E0	0.12	+1.0000E1	+0.00
	4	40E0	0.12	+3.9996E1	-0.01
Temperature Sensor Input				Next Calibration:	97
		-300E-3	0.15	-3.0005E-1	+0.02
		-3E0	0.10	-2.9986E0	-0.05
DC FREQ Input				Next Calibration:	97
		10E0	0.12	+1.0000E1	+0.00
DC LEV Output				Next Calibration:	97
		3E0		+2.9994E0	-0.02
Sensor Check Source				Next Calibration:	97
(Option NRVS-B1)		1E0 mW		1.001 mW	+0.1

Result: NRVS/URV55 is ok

Tested by: Mustermann Date: 11.05.95 Signature

Fig. 6-5 Calibration report

Verification Report

NRVS/URV55 | 1020.1809.02 | Serial No.: 864262/020

Function	Range	Nominal/V	Tolerance/%	Measured/V	Deviation/%
AC AMP				Last Calibration:	06.07.92
	1	10E-3	0.12	+1.0003E-2	+0.03
	1	-10E-3	0.12	-1.0003E-2	+0.03
	2	19.5E-3	0.12	+1.9510E-2	+0.05
	2	-19.5E-3	0.12	-1.9510E-2	+0.05
	3	50E-3	0.12	+5.0003E-2	+0.01
	3	-50E-3	0.12	-5.0003E-2	+0.01
	4	100E-3	0.12	+1.0001E-1	+0.01
	4	-100E-3	0.12	-1.0001E-1	+0.01
	5	195E-3	0.12	+1.9500E-1	+0.00
	5	-195E-3	0.12	-1.9500E-1	-0.00
	6	500E-3	0.12	+4.9999E-1	-0.00
	6	-500E-3	0.12	-4.9996E-1	-0.01
	7	1E0	0.12	+1.0002E0	+0.02
	7	-1E0	0.12	-1.0002E0	+0.02
	8	1.95E0	0.12	+1.9496E0	-0.02
	8	-1.95E0	0.12	-1.9495E0	-0.03
	9	5E0	0.12	+4.9990E0	-0.02
	9	-5E0	0.12	-4.9987E0	-0.03
	10	10E0	0.12	+9.9965E0	-0.03
	10	-10E0	0.12	-9.9965E0	-0.03
	11	19.5E0	0.12	+1.9494E1	-0.03
	11	-19.5E0	0.12	-1.9493E1	-0.04
DC AMP				Last Calibration:	06.07.92
	1	100E-3	0.12	+1.0002E-1	+0.02
	2	1E0	0.12	+1.0002E0	+0.02
	3	10E0	0.12	+9.9994E0	-0.01
	4	40E0	0.12	+3.9998E1	-0.01
Temperature Sensor Input				Last Calibration:	06.07.92
		-300E-3	0.15	-3.0000E-1	-0.00
		-3E0	0.10	-2.9999E0	-0.00
DC FREQ Input				Last Calibration:	06.07.92
		10E0	0.12	+1.0001E1	+0.01
DC LEV Output				Last Calibration:	06.07.92
		3E0		+2.9998E0	-0.01
Sensor Check Source . . . . (Option NRVS-B1)				Next Calibration:	97
		1E0 mW		1.004 mW	+0.4

Result: NRVS/URV55 is ok

Tested by: Mustermann | Date: 22.10.92 | Signature

Fig. 6-6a Verification report (NRVS/URV55 is o.k.)

Verification Report

NRVS/URV55 1020.1809.02 Serial No.: 864262/020

Function	Range	Nominal/V	Tolerance/%	Measured/V	Deviation/%
AC AMP				Last Calibration:	11.05.95
	1	10E-3	0.12	+9.9999E-3	- 0.00
	1	-10E-3	0.12	-1.0000E-2	- 0.00
	2	19.5E-3	0.12	+4.1669E-6 *	-99.98
	2	-19.5E-3	0.12	-2.6969E-4 *	-98.62
	3	50.0E-3	0.12	-1.5640E-4 *	-99.99
	3	-50.0E-3	0.12	-4.9999E-2	- 0.00
	4	100.0E-3	0.12	+1.0000E-1	+ 0.00
	4	-100.0E-3	0.12	-1.0000E-1	- 0.00
	5	195.0E-3	0.12	+1.9500E-1	- 0.00
	5	-195.0E-3	0.12	-1.9500E-1	- 0.00
	6	500E-3	0.12	+5.0000E-1	+ 0.00
	6	-500E-3	0.12	-4.9999E-1	- 0.00
	7	1E0	0.12	+1.0000E0	+ 0.00
	7	-1E0	0.12	-9.9999E-1	- 0.00
	8	1.95E0	0.12	+1.9499E0	- 0.01
	8	-1.95E0	0.12	-1.9500E0	+ 0.00
	9	5E0	0.12	+4.9998E0	- 0.00
	9	-5E0	0.12	-5.0000E0	- 0.00
	10	10E0	0.12	+1.0000E1	+ 0.00
	10	-10E0	0.12	-9.9999E0	- 0.00
	11	19.5E0	0.12	+1.9500E1	+ 0.00
	11	-19.5E0	0.12	-1.9500E1	+ 0.00
DC AMP				Last Calibration:	11.05.95
	1	100E-3	0.12	+7.6842E-4 *	-99.99
	2	1E0	0.12	+5.4542E-3 *	-99.45
	3	10E0	0.12	+9.9999E0	- 0.00
	4	40E0	0.12	+3.9996E1	- 0.01
Temperature Sensor Input				Last Calibration:	3
		-300E-3	0.15	-2.9994E-1	- 0.02
		-3E0	0.10	-2.9999E0	- 0.00
DC FREQ Input				Last Calibration:	3
		10E0	0.12	-6.0000E-5 *	-99.99
DC LEV Output				Last Calibration:	3
		3E0		+2.9998E0	-0.01
Sensor Check Source (Option NRVS-B1)				Next Calibration:	97
		1E0 mW		1.004 mW	+0.4

Result: NRVS/URV55 is out of tolerance

Tested by: Mustermann Date: 11.05.95 Signature

Fig. 6-6b Verification report (NRVS/URV55 is out of tolerance)

In the **error report**, a detected error is documented for every range of a function marked by the nominal value of the corresponding calibration voltage. A distinction is made between offset measurement and measurement of the calibration voltage (→ Fig. 6-7). The measured offset voltage is compared with the permissible value and, if it exceeds this value, identified as an error. If an offset measurement is off limits, first check whether the zero voltage of the calibrator used is too high (if applicable, a respective adjustment is required). After measuring the calibration voltage and subtracting the previously determined offset voltage, the calibration factor is calculated. If it is outside the range from 0.95 to 1.05, an error is signalled and entered into the appropriate column in the error report. If there is no error, the message ok appears for the individual device functions (e.g. **AC AMP is ok**).

```
                              Error Report

NRVS/URV55                       1020.1809.02          Serial No.: 864262/020

AC amplifier
Range        Nominal/V     +Offset     +Voltage      -Offset     -Voltage
------------------------------------------------------------------------------
  1            10E-3
  2            19.5E-3                 +4.167E-6    +1.066E-4   -2.697E-4
  3             50E-3     +3.254E-4   -1.564E-4
  4            100E-3
  5            195E-3
  6            500E-3
  7              1E0
  8            1.95E0
  9              5E0
 10             10E0
 11            19.5E0

DC Amplifier
Range        Nominal/V     +Offset     +Voltage
------------------------------------------------------------------------------
  1            100E-3                  -7.684E-4
  2              1E0      -5.245E-3   +5.454E-3
  3             10E0
  4             40E0

Temperatur sensor
             Nominal/V     +Offset     +Voltage
------------------------------------------------------------------------------
                    TSENS is ok

DC FREQ Input
             Nominal/V     +Offset     +Voltage
------------------------------------------------------------------------------
               10.0      +2.580E0    -6.000E-5

DC LEV Output
             Nominal/V     +Offset     +Voltage
------------------------------------------------------------------------------
                   DC LEV is ok

------------------------------------------------------------------------------
Tested by: Mustermann        Date: 31.08.92            Signature
```

Fig. 6-7 Error report

The **calibration factors** are the quotients from actual value and nominal value and are about 1. They are used for internal display correction. They can be polled at any time via the IEC/IEEE bus interface using the command "SI" (or "CASI" if the NRVS/URV55 is in calibration mode) and contain a validity statement ("OK" or "ER" in case the limits have been exceeded). Fig. 6-8 lists the complete calibration factor set by way of example.

```
                              Calibration Factors

NRVS/URV55                      1020.1809.02            Serial No.: 864262/020

AC+ RANGE  1  OK CF=0.996483
AC- RANGE  1  OK CF=0.996482
AC+ RANGE  2  OK CF=1.000392
AC- RANGE  2  OK CF=1.000406
AC+ RANGE  3  OK CF=1.001758
AC- RANGE  3  OK CF=1.001823
AC+ RANGE  4  OK CF=1.001824
AC- RANGE  4  OK CF=1.001844
AC+ RANGE  5  OK CF=1.002000
AC- RANGE  5  OK CF=1.002045
AC+ RANGE  6  OK CF=0.996351
AC- RANGE  6  OK CF=0.997514
AC+ RANGE  7  OK CF=0.999706
AC- RANGE  7  OK CF=0.999864
AC+ RANGE  8  OK CF=0.999834
AC- RANGE  8  OK CF=1.000988
AC+ RANGE  9  OK CF=1.002964
AC- RANGE  9  OK CF=1.004073
AC+ RANGE 10  OK CF=1.002843
AC- RANGE 10  OK CF=1.004398
AC+ RANGE 11  OK CF=1.000888
AC- RANGE 11  OK CF=1.001484

DC  RANGE  1  OK CF=1.007255
DC  RANGE  2  OK CF=1.002945
DC  RANGE  3  OK CF=1.001969
DC  RANGE  4  OK CF=1.002809

TEMP 0.1MA    OK CF=1.004280
TEMP 1  MA    OK CF=1.004207

DC_FREQ←      OK CF=0.996902
DC_LEV→ (G)   OK CF=1.003373
DC_LEV→ (O)   OK CF=1.003110

DEF LIN   0   OK CF=0.999505
DEF LIN  10   OK CF=1.002535
DEF LIN  30   OK CF=0.999196
DEF LIN  50   OK CF=0.998949
DEF LIN  70   OK CF=0.998701
DEF LIN  90   OK CF=0.999011
DEF LIN 100   OK CF=0.999320

DEF ACCEL     OK CF=1.143062
----------------------------------------------------------------------------------
Tested by: Mustermann        Date: 31.08.92            Signature
```

Fig. 6-8 Listing of the calibration factors

6.2.6 Manual Calibration

The complete calibration of the analog section can also be performed, without having to use a program, in single steps(→ table 6-3). This will be explained in greater detail in the following section. If you don't want to update all of the calibration data, it is possible to perform a partial calibration.

Make sure that, for calibration, all devices used are allowed to warm up for at least one hour and the ambient temperature is in the range of 23 ± 1 °C. The AC supply voltage should not deviate by more than ± 10 % from the nominal value, the relative humidity should be less than 80 %.

Before performing any calibration or test, remove the calibration lockout (→ Fig. 6-2).

For the functions CA1, CA5, CA6 and CA7, the calibration runs according to the following pattern (Fig. 6-1):

User		NRVS/URV55
Call up the desired calibration function	→	Hardware setting
Enter nominal value and polarity of the cal voltage V_C	→	Range setting
Apply 0 V		
Trigger the offset measurement	→	Offset measurement V_0
Apply the calibration voltage		
Trigger the calibration measurement	→	Calibration measurement V_M
	→	Calculation of cal factor K $K = \frac{V_M - V_0}{V_C}$
	→	The following is valid for calibration function CA1 $K = \frac{V_M}{V_C}$ Here the offset voltage V_0 is only checked to make sure that it is between the permissible limits, otherwise it is not taken into account.

The calibration procedure for three measurement ranges of the AC probe amplifier is listed by way of example. The actions are represented in chronological order from the top left to the bottom right in the table.

User actions	Entry on controller	NRVS/URV55 display
	CALIBRATION	Date?
	dd.mm.yy (Calibration date)	CALMODE
		NO SENSOR
Insert cal adapter		READ SENSOR CALMODE
	CA5	ACAMP
Set DC calibrator to 0 V	CARB0.01	OFFSET
	CAL	RUN DC 0.01
Set DC calibrator to 0.01 V	CAL	RUN AC AMP
Set DC calibrator to 0 V	CARB-0.01	OFFSET
	CAL	RUN DC -0.01
Set DC calibrator to -0.01 V	CAL	RUN AC AMP
Set DC calibrator to 0 V	CARB0.0195	OFFSET
	CAL	RUN DC 0.02
Set DC calibrator to 0.0195 V	CAL	RUN AC AMP
⋮	CAE1	CALMODE
⋮	CALEND	CAL SENSOR

Table 6-3 gives an overview of the complete calibration syntax.

After calibration, the instrument should be switched off and on again in order to check the function of the lithium cell which permits the storage of the calibration data in the RAM. If it does not function properly (e.g. too low cell voltage) or if the calibration has been faulty, "ERROR CALIB" is read out on the display.

Table 6-3 Calibration syntax

Command	Function	NRVS/URV55 display
CALIB[RATION]	Turns the calibration mode on and the normal measuring mode off	Date?
dd.mm.yy	Date (day.month.year), immediately following keyword "CALIBRATION"	CALMODE
CA1	Temperature sensor calibration	T SENS
CA5	AC probe amplifier calibration	AC AMP
CA6	DC probe amplifier calibration	DC AMP
CA7	DC-FREQ input calibration	DC FREQ
CA8	DC-LEV output calibration	OFFSET CALMODE 3 V DC 3.0V DC LEV
CAE1	To terminate a calibration function	CALMODE
CARB <x>	To input a calibration voltage	OFFSET
CAL	To trigger a calibration or offset measurement	RUN DC X.XX or function
CAX1	To trigger a control measurement	RUN function
CAZM	To read out a triggered measurement	X.XXX V
CASE<x>	Output of error status register x (0 to 3), corresponds to command SE<x> in measurement mode	
CALEND	Exits the calibration mode and returns to the normal measurement mode	CAL SENSOR

6.2.6.1 Adjustment of Cal Adapter

For calibration and testing of the DC probe amplifier, the cal adapter contains a variable precision resistor which directly influences the calibration or measurement uncertainty. Its value should be checked regularly and readjusted if required (1.0000 MΩ).

The resistance can be measured via the two cal adapter connectors. For this purpose, the two relays in the cal adapter must first be set accordingly (first remove the calibration lockout, → Fig. 6-2):

- Insert cal adapter into the measuring head receptacle of the NRVS/URV55.
- Send "calibration" via the IEC/IEEE bus interface.
- Send the current date "dd.mm.yy" via the IEC/IEEE bus interface.
- Remove the cal adapter from the instrument.
- Measure and, if necessary, adjust the resistor using the UDS5 or an equivalent multimeter (→ Fig. 6-4).

Attention: ***The accuracy of the instrument for the resistance measurement considerably affects the adjustment! Check whether the accuracy conditions according to section 6.2.1 are met.***

6.2.6.2 AC Probe Amplifier

The AC probe amplifier is to be calibrated according to the above pattern with the voltages and polarities given in Table 6-4 (→ Fig. 6-1).

Table 6-4 Calibration of AC probe amplifier

Cal function	Polarity	Calibration voltage V_C/V	Range
CA5	+	0.01*)	1
	and	0.0195*)	2
	–	0.05*)	3
		0.1*)	4
		0.195	5
		0.5	6
		1.0	7
		1.95	8
		5.0	9
		10.0	10
		19.5	11

*) DC calibrator 8200 in the 100-mV range

6.2.6.3 DC Probe Amplifier

The DC probe amplifier is to be calibrated according to the above pattern with the voltages given in Table 6-5.

Table 6-5 Calibration of DC probe amplifier

Cal function	Polarity	Calibration voltage V_C/V	Range
CA6	+	0.1	1
		1.0	2
		10.0	3
		40.0	4

6.2.6.4 Temperature Sensor Input

The temperature sensor input is to be calibrated according to the above pattern with the voltages given in Table 6-6.

Table 6-6 Calibration of temperature sensor input

Cal function	Polarity	Calibration voltage V_C/V	Range
CA1	–	0.30	---
		3.00	---

6.2.6.5 DC-FREQ Input

Connect DC calibrator via BNC cable with the DC-FREQ input.

Using the calibration function "CA7", the DC-FREQ input is calibrated according to the above pattern with the voltage given in Table 6-7.

Table 6-7 Calibration of DC-FREQ input

Cal function	Polarity	Calibration voltage V_C/V	Range
CA7	+	10.0	---

6.2.6.6 DC-LEV Output

Connect DC output via BNC cable with the DC-FREQ input.

After sending the command "CA8", the routine for calibration of the DC voltage output runs automatically. The DC-FREQ input should have been calibrated before, as the calibration of the DC-LEV output depends on it.

6.2.6.7 Adjustment of the Sensor Check Source (Option NRVS-B1)

During normal use, i.e. testing of the fundamental operation of measuring heads, the accuracy of the sensor check source is not critical at all. Therefore the factory setting may be sufficient for the whole lifetime of the instrument.

Nevertheless, if an adjustment of the sensor check source should become necessary, please proceed as follows:

- Be sure that the precision power meter used as reference does not exceed the uncertainty limits, outlined in chapter 6.2.1. Only under this assumption and considering the ambient conditions mentioned below, the sensor check source will meet the data sheet specifications after calibration.
- Remove the rear panel feet and loosen the top cover of the instrument.
- Let the instrument warm up at 23 ± 2°C for at least one hour, the top cover being closed for the whole time.
- Connect the precision power meter to the sensor check source. Don't forget zeroing preparatory to measurement, since the sensor check source cannot be switched off for this purpose.
- Remove the top cover and adjust the sensor check source so that the power meter reads exactly 1.0000 mW (see Fig. 6-5).
- Disconnect the precision power meter and close the top cover. Let the instrument stabilize for some minutes and check for the correctness of adjustment again.

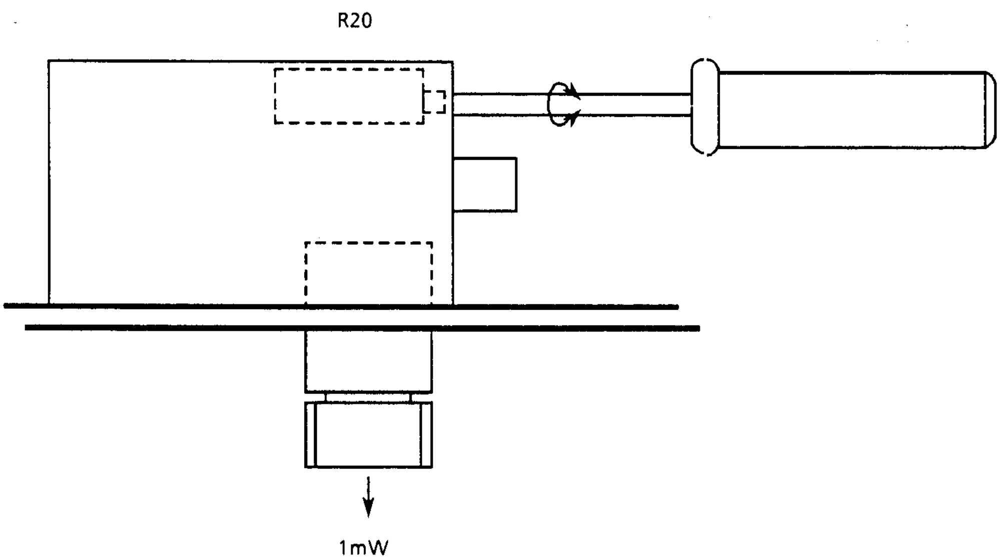


Fig 6-5 Adjustment of the Sensor Check Source

7 Testing and Repair of the Function Blocks

7.1 Function Description

(see also Fig. 7-15 at the end of section 7)

7.1.1 Analog Section

(see circuit diagram 1029.0605.01S, sheet 1)

The analog section mainly consists of amplifiers for the various measuring heads, an A/D converter with pre-connected multiplexer and a circuit for generating the various supply voltages for the measuring heads. Address decoder D716 is used for driving the hardware latches, which cause the setting of the measuring amplifiers and the control of the D/A converters for the automatic offset adjustments in the analog section. The data bus permits access to the various registers included in the customer-specific circuit D600 (L5A8803S), which contain the result of an A/D conversion, the internal setting of D600 or the status of the probe detector. The probe detector consists of an RS flip-flop, which is set on removal of a measuring head from the basic instrument.

An additional multiplexer inside of D600 is used for serial data reception from to the data memory of the measuring head. Fig. 7-1 shows the internal circuitry of D600 in simplified form. It illustrates the individual functions regarding A/D conversion, serial data transmission to the measuring head, measuring head detection, applying of a clock to the measuring head, I/O interface and control of the probe supply voltages.

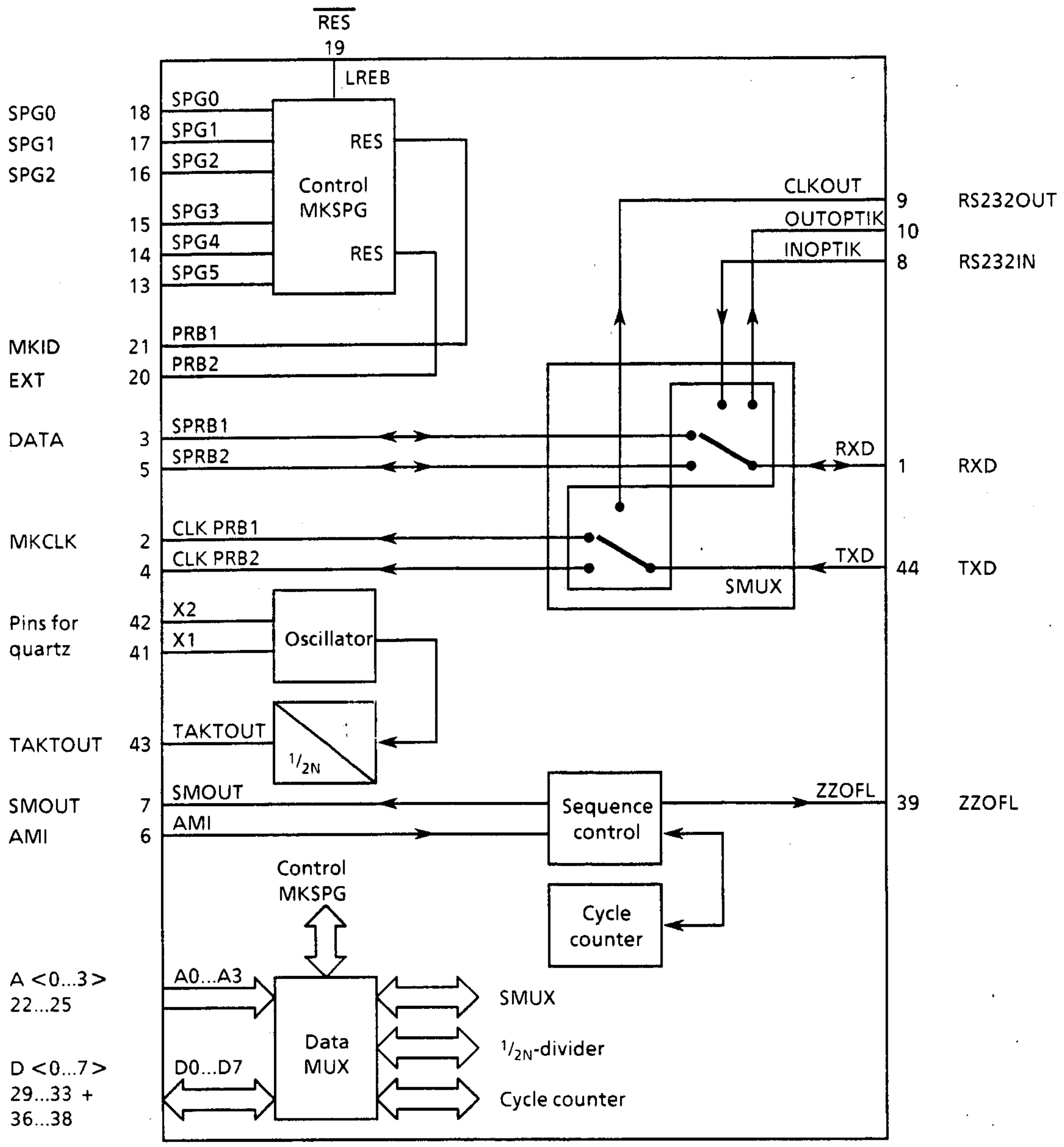


Fig. 7-1 Simplified internal circuitry of D600

7.1.1.1 AC Probe Amplifier

(see circuit diagram 1029.0605.01S, sheet 2)

This module amplifies the output signal of AC voltage probes and power sensors to such an extent that it can be taken to the A/D converter. Depending on the measuring head, the output signal is positive, negative or bipolar referred to circuit ground. Because of the square-law characteristic of the rectifier with low input voltages, the amplifier must cope with a wide dynamic range of the rectified voltage. For input voltages of 200 μV_{rms} to 10 V_{rms} with the URV5-Z2 insertion unit (2 mV_{rms} to 100 V_{rms} with the URV5-Z4 100-V insertion units), the output voltage of the measuring heads is 700 nV to 15 V.

The gain can be switched in 11 steps.

In the five most sensitive ranges, the signal is applied to the instrumentation amplifier without being divided and is further amplified there. In the other measurement ranges, it is first divided by approx. 34 dB. The total gain is composed as follows:

Table 7-1 Amplification ranges of the AC probe amplifier

Measurement range	Total gain	Divider	Amplifier
1	268	× 1	× 268
2	122	× 1	× 122
3	55.9	× 1	× 55.9
4	25.9	× 1	× 25.9
5	12.0	× 1	× 12.0
6	5.79	× 0.0216	× 268
7	2.64	× 0.0216	× 122
8	1.21	× 0.0216	× 55.9
9	0.559	× 0.0216	× 25.9
10	0.259	× 0.0216	× 12.0
11	0.122	× 0.0216	× 5.64

The gain is switched using the analog multiplexers D202/D204 and the FETs V228, V229, V237, V238, V239, V241, V243 and V244. For offset measurement, the two amplifier inputs are cyclically applied to ground via V237/V238 in the six less sensitive measurement ranges. In the other five measurement ranges a bridge chopper is simulated by cyclically reversing the polarity of the input voltage using the FETs V243/V244/V228/V229 and by subtracting subsequent measurement results.

The FETs V240/V242 limit the input signal for the multiplexer to max. ±2 V without loading the rectifier circuit.

Using the FETs V234/V235/V236, the discharge resistance can be reduced from approx. 10 MΩ (R202/R204/R268/R297) to approx. 0.5 MΩ for the sensor diodes. In particular with large input voltages, in which case the diodes exhibit peak hold performance, the measurement speed can thus be considerably increased. The discharge circuit is actuated for a few milliseconds prior to every measurement in the ranges with cut-in divider.

The instrumentation amplifier consists of a low-noise FET input stage (V226) and a highly amplifying operational amplifier (N202). N201-A is used to keep the drain currents of V226 constant. In order to prevent the dynamic range of the amplifier from being restricted by too large offset voltages of V226 in the most sensitive measurement range, the offset voltage can be adjusted via D203 in 128 steps of 400 µV each. The adjustment is performed by successive approximation when the instrument is switched on. Besides, the offset voltage is monitored during the measurement and, if necessary, corrected in steps up or down.

7.1.1.2 DC Probe Amplifier

(see circuit diagram 1029.0605.01S, sheet 3)

Together with the precision resistor of the DC probe (9 MΩ), this module forms an inverting amplifier. The gain can be set in four steps via D323:

Table 7-2 Amplification ranges of the DC probe amplifier

Measurement range	1	2	3	4
Gain	2.028	0.203	0.0203	0.00203

The multiplexers D321 and D322 permit to select the DC input, the frequency correction input (DC-FREQ) or the circuit ground via R308/R309 or R315. The three currently unused inputs are connected to ground via R313/R314/R318 at low impedance. Thus, a high crosstalk attenuation is obtained between the multiplexer positions. R308/R309 permits to record the offset with each measurement. D324 is used to set the input current of the circuit in 128 steps with an accuracy of typ. 10 pA. The adjustment is made by successive approximation when the instrument is switched on. Besides, the input current is monitored during the measurement and, if required, corrected in steps up or down. The input current can be determined by the microprocessor from the difference between the offset voltages with different input connections. In one case, the inverting input of N305 is connected to circuit ground via R308/R309 (9 MΩ), in the other case via R315 (4.75 kΩ).

7.1.1.3 Multiplexer

(See circuit diagram 1029.0605.01S, sheet 4)

Analog switch D400 (HEF4051) permits to apply various voltages to the A/D converter in order to measure the sensor output voltage and investigate the voltage level at specific points of the circuit for servicing purposes.

Apart from applying the output voltages of the AC and DC probe amplifier and the voltage drop of the temperature sensor to the multiplexer, it is also possible to monitor the voltages -12 V, -5 V -6 V and VCC.

The voltage selected by means of the control lines C0 to C2 is applied to the A/D converter via the operational amplifier N400-A, which is connected up as a buffer.

7.1.1.4 A/D Converter

(See circuit diagram 1029.0605.01S, sheet 6)

The circuit consists of the two modules pulse-width modulator (N400, N610, D610) and count or evaluate logic (D600). The A/D conversion is accomplished such that first the input DC voltage (P400) is converted into a pulse-width-modulated squarewave signal (SMOUT), whose pulse width is measured in the counting circuit. The counting clock is 12 MHz. The pulse-width-modulated signal results from a control process during which the duty factor is varied until the sum of the current at the inverting input of N400 disappears. N400 is connected up as integrator, three currents being applied to its inverting input:

1. Input current (R611), linearly depending on the input DC voltage

2. Reference pulse current (R618), proportional to the reference voltage (N611.6) and the duty factor of the pulse-width-modulated squarewave signal.

3. Driver current 6 kHz (C610) for generating a triangular output signal (N400.7).

The voltage curves of the A/D converter are to be seen in Fig. 7-2.

As long as the average value of the sum of the three currents is different from zero, the triangular output signal is shifted in the positive or negative direction, thus varying the time difference between the zero crossings of this signal. Comparator N610, which detects these zero crossings, thus changes the duty factor of its output signal. After synchronization with the counting clock, this output signal is the pulse-width-modulated squarewave signal, which in turn varies the reference pulse current via D610 such that the average input current of the integrator disappears. As soon as a disequilibrium is produced by variation of the input voltage, the duty cycle will change until the reference pulse current compensates for the input current again.

The integration time of the A/D converter can be set in steps of 167 µs and is selected depending on the desired resolution or measurement speed. The entire process is controlled by the microprocessor, which simultaneously reads out the measurement result via the data bus.

The clock of D600 also serves as clock for the microprocessor D700.

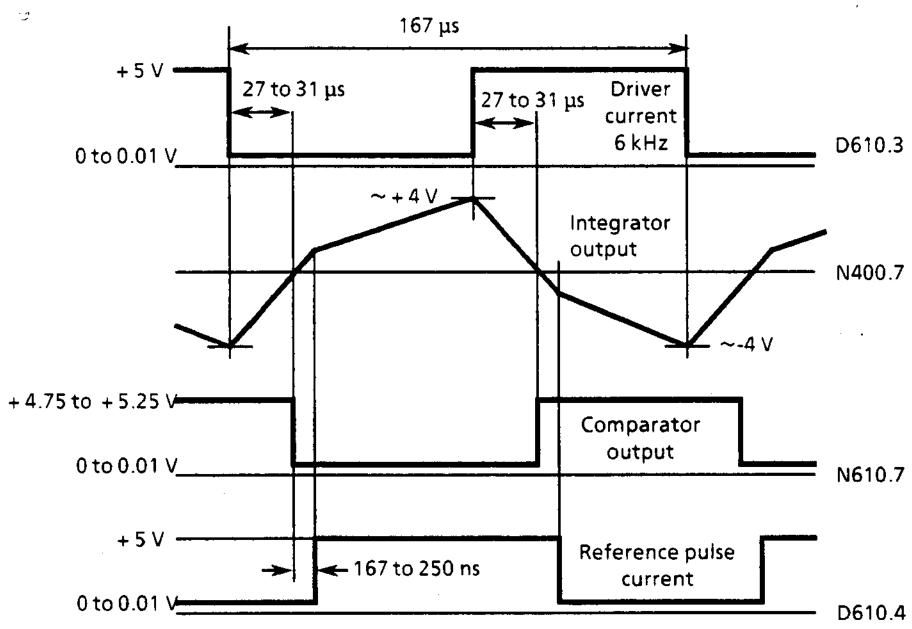


Fig. 7-2 Timing A/D converter

7.1.2 Digital Section

The digital section mainly consists of the processor unit, the IEC/IEEE bus interface, the D/A converter and the processing of the probe supply voltage.

7.1.2.1 Processor Unit

(see circuit diagram 1029.0605.01S, sheet 7)

The core of the processor unit is a CPU of the 80C51 type (D700) with storage devices D710 (EPROM 512 kbits) and D720 (RAM 256 kbits). Bus latch D705 is used for generation of the low-order address byte A0 to A7.

Address line A15 is used for selecting the RAM, gate D715-D implementing a protection against inadvertent writing during the reset phase. Besides, this chip-select line is linked with the $\overline{WR}$ and $\overline{RD}$ signal so that the RAM is only selected when it is to be accessed. This serves to keep the current-carrying period as short as possible.

The write pulse for the RAM must still pass gate D715-C, which, in combination with D717, makes sure that the calibration data (one kilobyte of memory at the upper boundary of the adress range) cannot be overwritten in normal measurement mode. For this purpose, the write pulse is disabled via D715 if an illegal address is applied.

To write to the upper address range for calibration purposes, the jumper across X717 must be moved manually to the according position. If pins X717.1 and X717.2 are connected (i.e. inputs D717.1/D717.2/D717.11 are connected to ground), the disabling function of D715 does not work and the write pulse is passedon to the RAM even with the protected are being addressed.

D716 produces the latch enable signals for the bus latches (D100/D101/D203/D324), which perform the hardware settings. In order to prevent collisions with the available address range, the addresses to be set are additionally linked with the write signal.

The chip-select signals for D600, the IEC/IEEE bus interface chip D730 and the keyboard are generated by means of address lines A10, A11, A14 and A15, D714 being used.

Inverter D615-D inverts the interrupt signal of the keyboard provided in positive logic for the processor. The second interrupt input (INT1) is driven by D600 via the line "ZZOFL", which provides a logic 1-0 transition when the main cycle counter indicates an overflow and thus the end of a measurement.

Using the two terminals "RXD" and "TXD", the processor operates the data memory of the measuring head via D600 as multiplexer.

The remaining outputs of ports 1 and 3 are used as control lines, the individual assignments being indicated in Table 7-3:

Table 7-3 Assignment of ports

Port	Signal	Meaning
1.0	$\overline{\text{CS}}$1	Select LCD driver 1
1.1	IECINT	IEC/IEEE bus interrupt
1.2	$\overline{\text{CS}}$2	Select LCD driver 2
1.3	RESLCD	Reset for LCD driver
1.4	C/$\overline{\text{D}}$	Command/Data line LCD driver
1.5	$\overline{\text{CS}}$3	Select LCD driver 3
1.6	$\overline{\text{CS}}$4	Select LCD driver 4
1.7	P1.7	PWM for the analog output
3.4	$\overline{\text{BUSY}}$	Acknowledge signal of the LCD driver
3.5	LED1	Control for DATA LED

Table 7-4 Address assignment

Address	Signal/Meaning	Access
0000H to FFFFH	EPROM	PSEN
0000H to 7FFFH	RAM	$\overline{\text{RD}}$/$\overline{\text{WR}}$
7C00H to 7FFFH	protected RAM area	accessible via X717
8400H	$\overline{\text{CS KEY}}$	$\overline{\text{RD}}$
8800H	$\overline{\text{CS-IEC}}$	$\overline{\text{RD}}$/$\overline{\text{WR}}$
A000H	$\overline{\text{LE}}_0$	$\overline{\text{WR}}$
A001H	$\overline{\text{LE}}_1$	$\overline{\text{WR}}$
A002H	$\overline{\text{LE}}_2$	$\overline{\text{WR}}$
A003H	$\overline{\text{LE}}_3$	$\overline{\text{WR}}$
C000H to C00CH	$\overline{\text{CEVOLC}}$	$\overline{\text{RD}}$
C000H to C006H	$\overline{\text{CEVOLC}}$	$\overline{\text{WR}}$

For illustration of the sequences in the processor unit, Table 7-5 indicates the interrupt assignment of the NRVS/URV55 and the appropriate priorities.

Table 7-5 Interrupt assignment of NRVS/URV55

Source	activ	Request bit	Priority	Meaning/function
$\overline{\text{INT0}}$	$1 \rightarrow 0$	IE0	0	Keystrokedetecdet
$\overline{\text{INT1}}$	$1 \rightarrow 0$	IE1	0	A/D conversion terminated

The microprocessor derives its clock directly from D600 via the "CLOCK" line.

The two diodes V701 and V702 cause the supply voltage for the RAM to be automatically switched over to the built-in lithium battery when the NRVS/URV55 is switched off in order to save the stored RAM contents. Thus, the calibration data are preserved even with the instrument being switched off.

7.1.2.2 IEC/IEEE Bus Interface

(see circuit diagram 1029.0605.01S, sheet 7)

The NRVS/URV55 contains an IEC/IEEE bus interface, which serves two purposes:
On the one hand, it permits calibration of the basic instrument under processor control, on the other hand it allows the NRVS/URV55 to be used in a system.

Under processor control, the IEC/IEEE bus interface chip D730 handles all control tasks for the remote control interface. The µP delivers the system clock with the ALE output signal. The 8 data lines, 5 control lines and 3 handshake lines of the 24-pin IEC/IEEE bus connector X730 are terminated as called for in the bus standard by the bidirectional driver chips D731 and D732.

7.1.2.3 DC Voltage Output

(see circuit diagram 1029.0605.01S, sheet 4)

To generate a DC voltage analogous to the bargraph display, a pulse-width-modulated signal from the microprocessor is used (port 1.7). This signal controls the analog switch D420, which, depending on the duty cycle, switches between the reference voltage and the -5 V supply. The subsequent lowpass filter with Bessel characteristic extracts the dc component from the bipolar squarewave signal that is proportional to the bargraph display with the following features:

Resolution = 750 µV
Output voltage range = 0 to +3.00 V

7.1.2.4 Measuring Head Control

(see circuit diagram 1029.0605.01S, sheets 1, 4 and 6)

7.1.2.4.1 Voltage Supply

The electronic circuitry within the NRVS/URV55 is capable of producing three different states at the V_{CC} and R_{GND}/V_{EE} terminals:

a) $V_{CC} = 0$ V / $V_{EE} = 0$ V: This corresponds to normal measurement mode with a passive measuring head.

b) $V_{CC} = 5$ V / $V_{EE} = 0$ V: In this state, the calibration data of the measuring head can be read out.

c) $V_{CC} = 12$ V / $V_{EE} = -12$ V: This corresponds to normal measurement mode with an active measuring head.

The individual measuring head supply voltages are controlled via D600, the respective control voltages being only generated when a measuring head is found to be connected. Otherwise, all voltages are set to 0 V.

For switching the measuring head supply voltages, P-channel VMOSFETs are used. In order to obtain a sufficient voltage difference between gate and source of the FETs in case b, V405/V406 are driven with -12 V. The analog switch S100-C is used for this purpose. The combination of the control signals SPG0 and SPG1 by D405-C and R440/V440 prevents V404 and V405/V406 to be simultaneously forward-biased in case of faulty control.

Analog switches S100-A/B/C cause the switchover of the ground reference for the AC probe amplifier and switching on the -12V supply with with active measuring heads.

7.1.2.4.2 Temperature Sensor

The output voltage of all AC probes and power sensors depends on temperature. To obtain a high measuring accuracy, it is necessary to measure the ambient temperature and take it into account in the evaluation of the measurement results. A sensor in the measuring head is used for this purpose. A current is applied to the sensor via the line "MKTEMP" and the voltage drop across the sensor is measured. Depending on the measuring head, currents of 100 µA or 1 mA are fed in with V401 or V402, respectively.

The comparators N401-C/D cause a level conversion of the logic control signal from bus latch D101.

Via pin 5 of multiplexer D400, the voltage drop across the temperature sensor can be measured. It is approx. -0.3 V with a 100-µA sensor or -3 V with a 1-mA sensor.

7.1.2.4.3 Measuring Head Detection

Via terminal "MKID", the chip D600 is informed whether a measuring head is connected or not. If not, all supply voltages to the measuring head connector are switched off via a logic function within D600 (SPG0 to SPG5 to 0 V). If a measuring head is connected, the line "MKID" is set to a low level and the processor causes a supply voltage of V_{CC} = +5 V to be applied to the measuring head and the data memory to be read out bit by bit.

The read clock pulses are applied via line "MKCLK", the data bits are read in via the "DATA" line.

If the processor recognizes a passive measuring head, the supply voltage V_{CC} is switched off after reading out the data memory. In the case of an active measuring head, a symmetrical supply voltage of ± 12 V is applied.

7.1.3 Display/Keyboard

(see circuit diagram 1029.0705.01S)

The display board contains an LCD field, 18 operating keys, an LED and control circuitry for display and keyboard. The LED indicator is switched on whenever data are to be input via keyboard.

7.1.3.1 LCD

The LCD field H1 is a device-specific display that is realized in twisted nematic technology and characterized by high contrast and a large readout angle. Four control chips D1 to D4 control the LCD with 4 × 128 display segments in a 4-fold multiplex operation (MUX 4), for which a voltage supply with 4 different levels is necessary (→ Fig. 7-3).

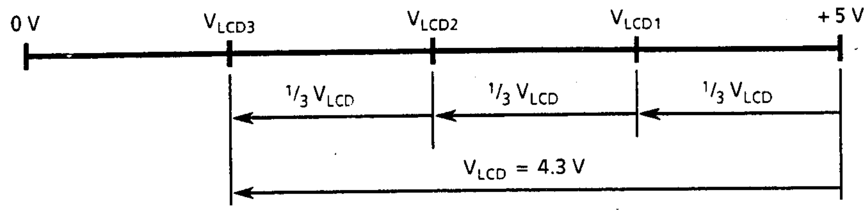


Fig. 7-3 LCD voltage levels for MUX4

The voltage levels necessary for operation are obtained via the divider networks R14/R15/R16 and R17/R18/R19. The voltage VLCD3 can be varied with R24, enabling the contrast to be optimally adjusted. This voltage is fed in via the amplifier N1-A. The characteristic of voltage VLCD temperature ensures for a constant display contrast over the instrument's entire operating temperature range.

The LCD drivers D1 to D4 are synchronously clocked with a 125-kHz clock signal from the keyboard chip D5. The reset signal $\overline{RESLCD}$ is supplied by microprocessor D6 via port 1.3. The timing diagram for the reset control of the LCD drivers is shown in Fig. 7-4.

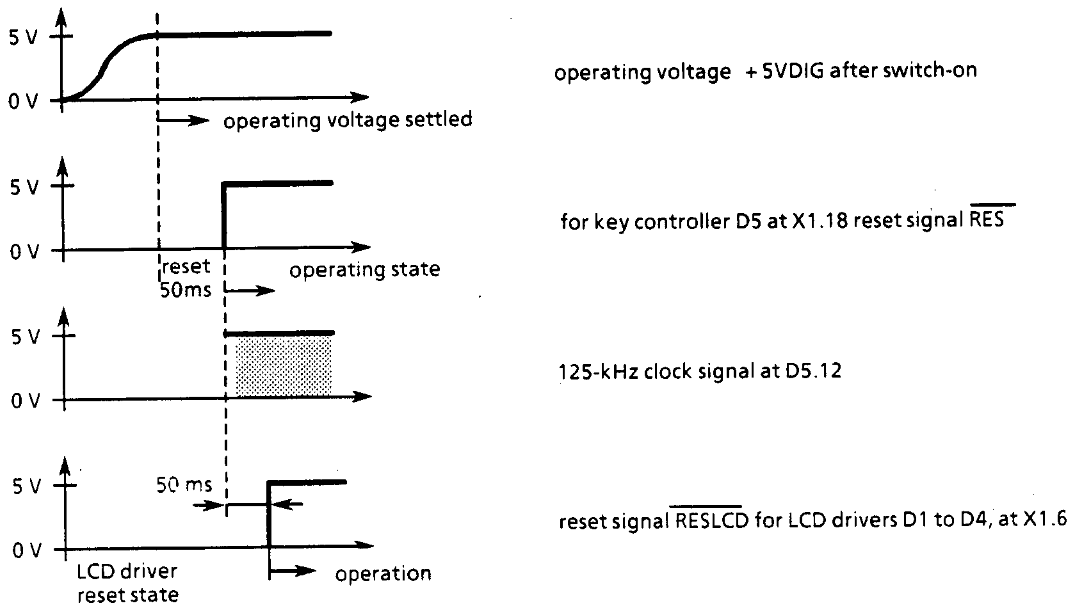


Fig. 7-4 Timing diagram for the reset control of the LCD drivers

The display information is transmitted byte by byte via the serial interface X1.19 (SI = serial input) and X1.20 ($\overline{SCK}$ = serial clock). The control line X1.17 (C/$\overline{D}$ = c[illegible]and data) is used to distinguish between command and data bytes. An LCD driver is selected for [illegible]smission via the chip select lines ($\overline{CS1}$ to $\overline{CS4}$) X1.24/X1.21/X1.26/X1.22. The $\overline{BUSY}$ line (X1.23), wh[illegible] serves as a global acknowledge signal for all drivers, is set to a logical low (0 V) after each transferred byte. The timing diagrams for the input and output signals of the LCD drivers are shown in figures 7-5 and 7-6.

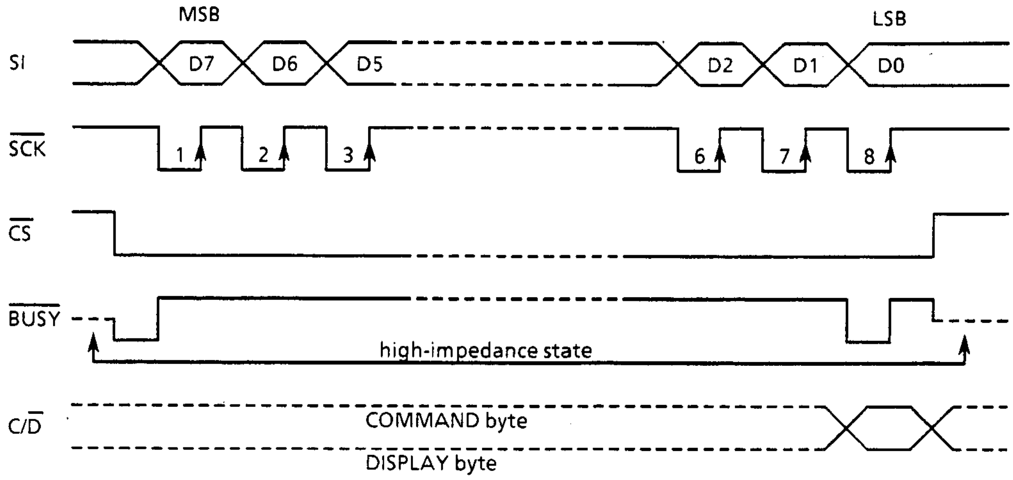


Fig. 7-5 Timing for one data byte

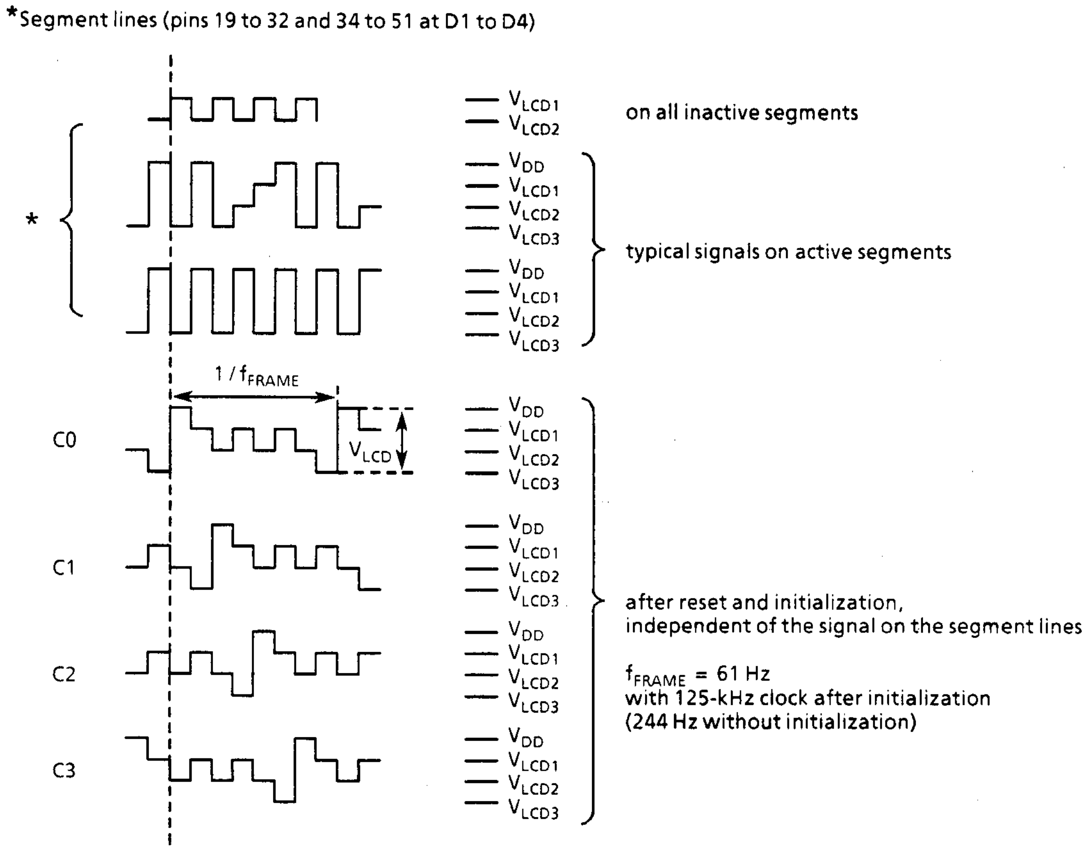
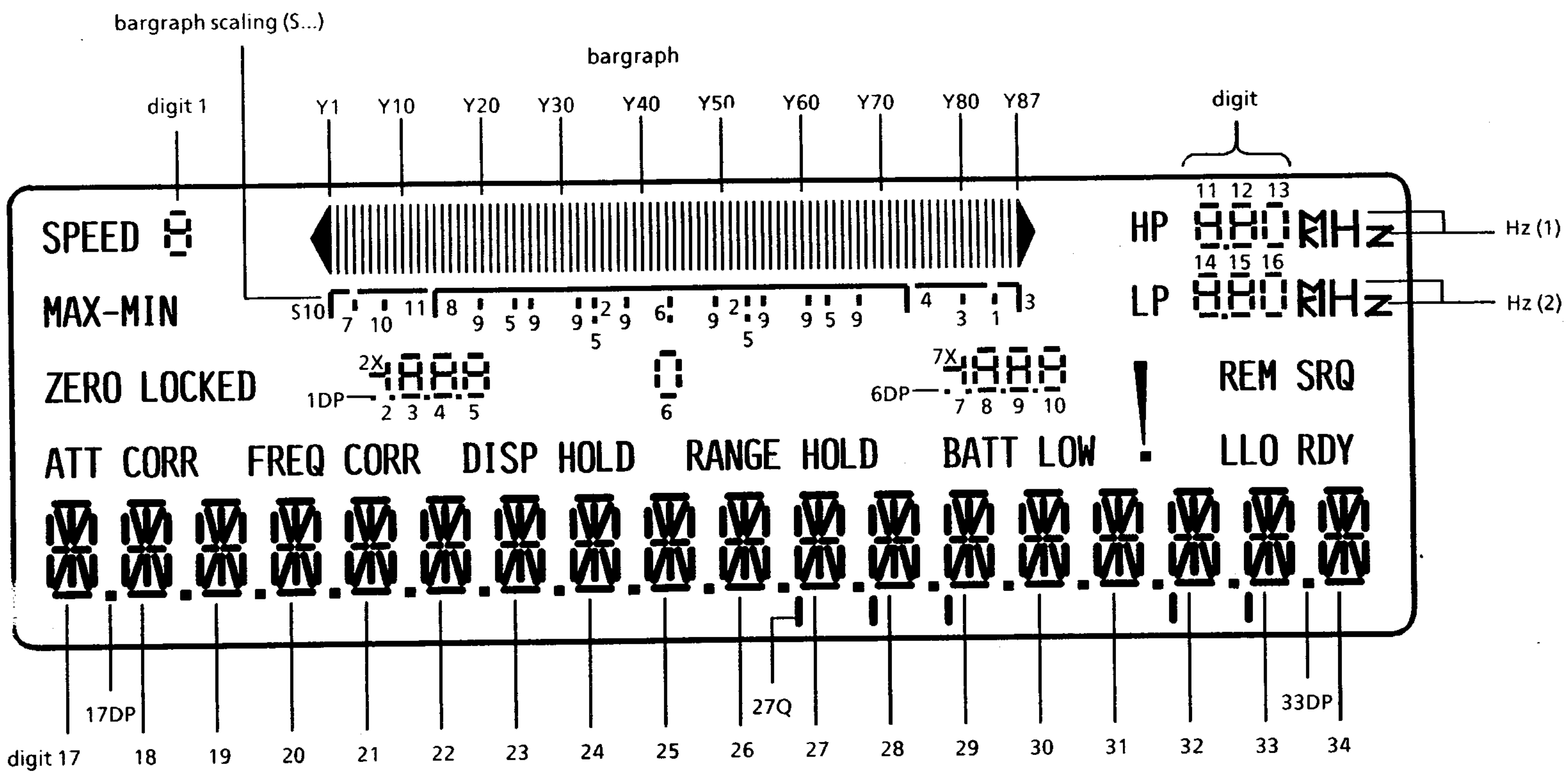


Fig. 7-6 Principle timing of the LCD driver outputs



14-segment digit:

7-segment digit:

unit:

MHz
kHz

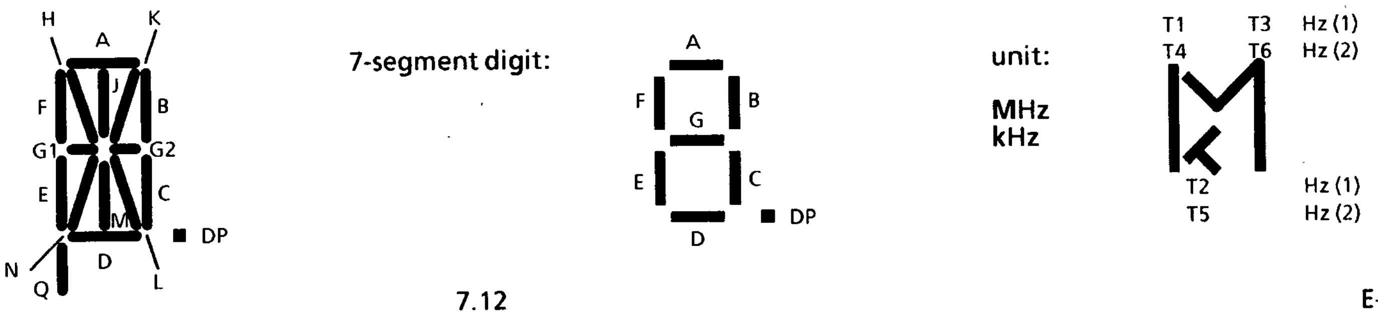


Fig. 7-7 LCD display field

Table 7-6 Pin and segment assignments of the LCD H1 and the LCD driver chips D1 to D4.

Units	7-segment digit no.							Inscriptions		
	11	12	2	3	4	5	1			
Hz (1)	F A	F A	X	F A	F A	F A	F A	-	SPEED	C0
T3	G B	G B	B, C	G B	G B	G B	G B	MIN	MAX	C1
T1	E C	E C	1DP	E C	E C	E C	E C	LOCKED	ZERO	C2
T2	D DP	D 13 A...F	2DP	D DP	D DP	D DISP HOLD	D	FREQ CORR	ATT CORR	C3
H1. 99	103 102	101 100	161	162 163	164 165	166 167	169 168	170	171	
D1. 51	50 49	48 47	46	45 44	43 42	41 40	39 38	37	36	

	14-segment digit no.															
	20				19				18				17				
	B	K	H	A	B	K	H	A	B	K	H	A	B	K	H	A	C0
	G2	J	G1	F	G2	J	G1	F	G2	J	G1	F	G2	J	G1	F	C1
	C	L	N	E	C	L	N	E	C	L	N	E	C	L	N	E	C2
	DP	M	D		DP	M	D		DP	M	D		DP	M	D		C3
H1.	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	
D1.	35	34	32	31	30	29	28	27	26	25	24	23	22	21	20	19	

	14-segment digit no.																
	28				27				26				25				
	B	K	H	A	B	K	H	A	B	K	H	A	B	K	H	A	C0
	G2	J	G1	F	G2	J	G1	F	G2	J	G1	F	G2	J	G1	F	C1
	C	L	N	E	C	L	N	E	C	L	N	E	C	L	N	E	C2
	DP	M	D	Q	DP	M	D	Q	DP	M	D		DP	M	D		C3
H1.	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	
D2.	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	

	14-segment digit no.																
	24				23				22				21				
	B	K	H	A	B	K	H	A	B	K	H	A	B	K	H	A	C0
	G2	J	G1	F	G2	J	G1	F	G2	J	G1	F	G2	J	G1	F	C1
	C	L	N	E	C	L	N	E	C	L	N	E	C	L	N	E	C2
	DP	M	D		DP	M	D		DP	M	D		DP	M	D		C3
H1.	40	39	38	37	32	31	30	29	28	27	26	25	24	23	22	21	
D2.	35	34	32	31	30	29	28	27	26	25	24	23	22	21	20	19	

Table 7-6 (continued)

	7-segment digit no.							Bargraph scale S...			
	7	8		9		10		6			
	X	F	A	F	A	F	A	S1	S7	S10	C 0
	B, C	G	B	G	B	G	B	S2	S5	S9	C 1
	6DP	E	C	E	C	E	C	6 A...F	S6	S11	C 2
	7DP	D	DP	D	DP	D		S3	S4	S8	C 3
H1.	106	107	108	109	110	111	112	113	114	160	
D3.	51	50	49	48	47	46	45	44	43	19	

	Bargraph Y1 to Y87																					
	87	80	79	72	71	64	63	56	55	48	47	40	39	32	31	24	23	16	15	8	7		C 0
	86	81	78	73	70	65	62	57	54	49	46	41	38	33	30	25	22	17	14	9	6	1	C 1
	85	82	77	74	69	66	61	58	53	50	45	42	37	34	29	26	21	18	13	10	5	2	C 2
	84	83	76	75	68	67	60	59	52	51	44	43	36	35	28	27	20	19	12	11	4	3	C 3
H1.	115	116	117	119	120	123	124	128	129	133	134	138	139	143	144	147	148	150	151	152	153	154	
D3.	42	41	40	39	38	37	36	35	34	32	31	30	29	28	27	26	25	24	23	22	21	20	

	Inscription	7-segment digit no.				Units, inscriptions			14-segment digit no.				
		14		15					22				
		F	A	F	A	Hz (2)	LP	HP	B	K	H	A	C 0
		G	B	G	B	T6	!	REM	G2	J	G1	F	C 1
		E	C	E	C	T4	BATT LOW	LLO	C	L	N	E	C 2
	SRQ	D	DP	D	16 A...F	T5	RANGE HOLD	RDY		M	D		C 3
H1.	81	82	83	84	85	94	105	104	80	79	78	77	
D4.	51	50	49	48	47	46	45	44	43	42	41	40	

	14-segment digit no.																				
	33				32				31				30				29				
	B	K	H	A	B	K	H	A	B	K	H		B	K	H	A	B	K	H	A	C 0
	G2	J	G1	F	G2	J	G1	F	G2	J	G		G2	J	G1	F	G2	J	G1	F	C 1
	C	L	N	E	C	L	N	E	C	L	N		C	L	N	E	C	L	N	E	C 2
	DP	M	D	Q	DP	M	D	Q	DP	M	D		DP	M	D		DP	M	D	Q	C 3
H1.	76	75	74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	
D4.	39	38	37	36	35	34	32	31	30	29	28	27	26	25	24	23	22	21	20	19	

7.1.3.2 Keyboard

The operating keys S1 to S18, arranged in an array of 3 rows (R0 to R2) and 6 columns circuits (C0 to C5), are directly connected with the keyboard chip D5. Pressing a key connects a row with a column.

The row R0 to R2 and the column terminals C0 to C5 of chip D5 are equipped with bidirectional drivers, allowing a pressed key to be unambiguously recognized in two steps (by exchanging rows and columns).

In the idle state (no key is pressed), the column drivers are switched active (to 0 V), the row circuits (acting as receivers) are pulled up to 5 V via pull-up resistors. When a key is pressed, the affected row circuit is pulled down to 0 V by the corresponding column driver. After being internally debounced, the row information is placed into the key register by the control circuit.

In the next step, the column drivers are tristated and the row drivers are switched on (+ 5 V). The row circuits now act as transmitters, the column circuits as receivers (reply mode). The active column delivers +5 V, all others 0 V. The column information is thus available and can be placed in the key register. Afterwards, a reset to the idle state takes place. The interrupt line INT0 signals the processor that the key information is ready.

The processor reads out the 8-bit key information via the data bus and resets the interrupt.

The keyboard chip D5 is reset via the reset pin X1.18 after the instrument has been switched on. Only when this has occurred does the clock oscillator, at 250 kHz. This halved clock is available on The output D5.12 and is used to control the LCD drivers D1 to D4 are fed with half the oscillator frequency (125 kHz) via pin D5.12.

Table 7-7 Coding of keys

Key	Meaning	Data word								Hexadecimal code
		D7	D6	D5	D4	D3	D2	D1	D0	
S1	ATTCORR 7	0	0	0	1	0	1	0	1	15
S2	W ↔ dBm 8	0	0	0	0	1	1	0	1	0D
S3	ZERO 9	0	0	0	0	0	1	0	1	05
S4	MODE 4	0	0	0	1	0	1	0	0	14
S5	UNIT 5	0	0	0	0	1	1	0	0	0C
S6	RANGE 6	0	0	0	0	0	1	0	0	04
S7	MEAS → REF 1	0	0	0	1	0	0	1	1	13
S8	REF 2	0	0	0	0	1	0	1	1	0B
S9	DISP 3	0	0	0	0	0	0	1	1	03
S10	FILTER 0	0	0	0	1	0	0	1	0	12
S11	FREQ .	0	0	0	0	1	0	1	0	0A
S12	SPEC ±	0	0	0	0	0	0	1	0	02
S14	MENU1 CLR	0	0	0	1	0	0	0	1	11
S15	MENU2	0	0	0	0	1	0	0	1	09
S16	MENU3	0	0	0	0	0	0	0	1	01
S17	→ MEAS LCL	0	0	0	1	0	0	0	0	10
S18	SETUP EXP	0	0	0	0	1	0	0	0	08

7.1.4 Current Supply and Reset Generation

(see circuit diagram 1029.0605.01S, sheet 5)

In the NRVS/URV55, the following voltages are generated from the secondary voltage of the line transformer:

Table 7-8 Internally generated voltages

Voltage	Test point	Use
+5 V -5 V	X505.6 X505.7	Operating voltage for the digital chips in the analog section
+6 V -6 V	X505.4 X505.5	Operating voltage for MUX and offset correction
+12 V -12 V	X505.2 X505.8	Supply voltage for operational amplifiers
V_{REF} (+5 V)	X505.3	Reference voltage for A/D converter
+5 V_{Dig}	X505.1	Supply voltage for digital section/display

All voltages generated in the instrument are referred to instrument ground.

For generating the + 12 V supply voltage for the amplifiers, the upward switching regulator N501 is used, which receives the input voltage (+5 V_{DIG}) via storage choke L500. Using the combination V505/V506/C512/C510, the -12 V supply voltage is generated from the 50-kHz squarewave voltage which is supplied by N501. Since this voltage is obtained by means of a doubler circuit, it is of relatively high impedance and seems virtually unstabilized.

The reference voltage V_{REF} is generated by the reference voltage source N505 from the + 12 V supply voltage. The dual operational amplifier N506 generates -6 V and -5 V supply voltages by inversion of the reference voltage. The + 6 V supply voltage is also taken from the reference voltage. To this end, operational amplifier N503-B is used, whose output is buffered by transistor V530 for better control of transient current spikes.

Chip N500 is a low-power linear regulator that is used for generating the supply voltages +5 V_{DIG}, + 5 V and UE. The standby voltage UE (+ 5 V) is also available when the instrument is switched off (see below). Whenever the instrument is switched on or if the input voltage to N500 becomes too low, a reset signal, whose length is determined by the time constant R505/C505 and is approx. 60 ms.

7.1.5 Switching the NRVS/URV55 On and Off

(see circuit diagram 1029.0605.01S, sheet 5)

To this end, the D-type flip-flop D500 is used. The clock input of D500-A is controlled by the Q-output of D500-B that is wired as a Schmitt trigger. By pressing the "ON/STBY" key (S19), a positive edge is applied to the input, and the inverting output of D500-A changes to a logical high (+ 5 V). By pressing the "ON/STBY" key again, another pulse is applied to the clock input of D500-A. Since the $\overline{Q}$-potential had been returned to the data input of D500-A, the Q-output changes back to low potential.
The $\overline{Q}$-output of D500 controls the enable input of N500 and thus switches the instrument on and off. D500 is supplied from the standby voltage of N500.

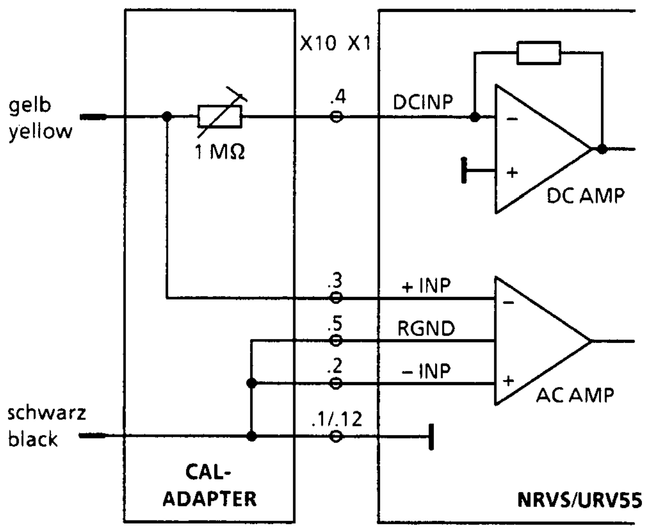
D500-B, which is connected up as a Schmitt trigger, causes debouncing of the ON/STBY key.

7.1.6 Cal Adapter (see circuit diagram 350.7818.01 S and 1029.0805.01 S)

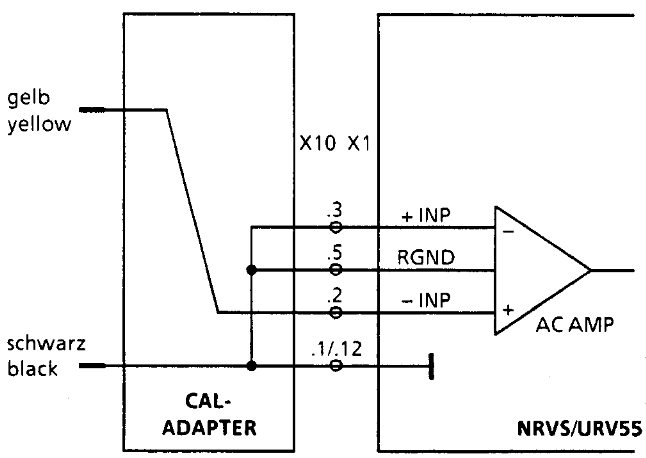
By means of the calibration adapter, the analog measuring head interface is accessible for calibration purposes. The adapter contains 2 bistable relays, with which 4 different settings can be realized (Fig. 7-8).

A clock signal at X10.9 (MKRESET) is used to control the setting of the relays. Each pulse increments the count in the Norton counter D10 by one, thus energizing the corresponding relay winding. The setting can be controlled by pulse width. Relay windings which should not be energized receive current for a very short amount of time (short pulse width). All of the others receive current until the relay responds.

The counter is reset via X10.7 (MKCLOCK). The 5 V supply voltage is switched off immediately after the adapter has been set.

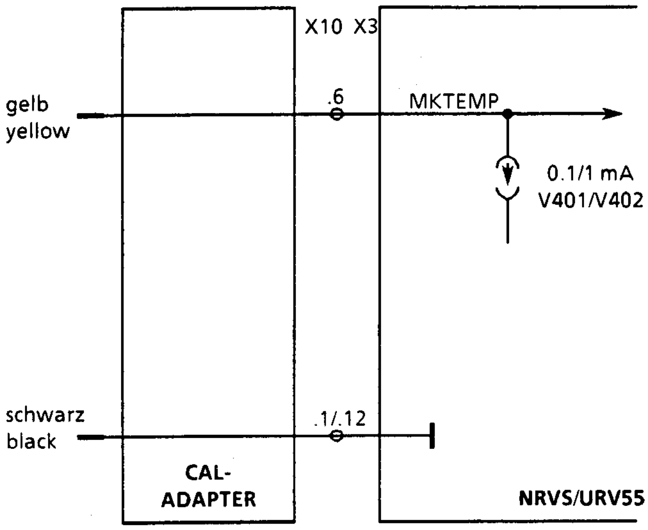


Setting AC + /DC

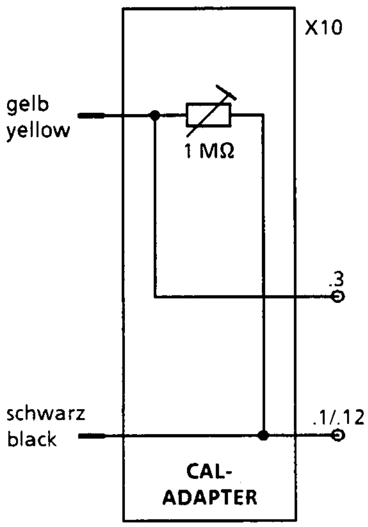


Setting AC –

Fig. 7-8a Cal adapter settings



Setting TEMP



Setting 1MΩ ADJ

Fig. 7-8b Cal adapter settings (continued)

7.1.7 Sensor Check Source (Option NRVS-B1)

(see circuit diagram 1029.2950.01S)

The sensor check source uses a 50 MHz digital crystal oscillator (B1) for signal generation. The output signal is low-pass filtered, fed to a capacitive voltage divider (C7, C8) and output via a 50 Ω source resistance (R2, R3). Stabilization of output power is achieved by comparing the amplitude of the filtered RF signal with a dc reference and by regulating the supply voltage of B1 according to the stated difference (N2, V1, V2).
The reference voltage is derived from reference diode V7 and temperature sensor V6, resulting in an overall temperature characteristic equal to that of the rectified RF signal. R20 allows for adjustment of the output power level, whereas R15 offers a means for setting the operating voltage of B1.

7.2 Troubleshooting

Most functional errors can be recognized because of some visible fault, or they are found by the NRVS/URV55 itself. Self tests are run automatically when the instrument is switched on, when the measuring head is exchanged, and cyclic during normal measurement mode. The messages

- ERROR HARDWARE
- SENSOR ERROR
- ERROR CALIB
- ERROR DATA

in the display indicate that a failure has occurred during one of the self tests.

A smaller number of errors can be recognized due to the fact that specifications are out of tolerance. In this case, run the performance tests (→ Operating Manual) before attempting to repair the instrument.

7.2.1 Measuring Instruments and Auxiliary Means

Table 7-9 Required measuring instruments

Item-No.	Instrument	Specifications	Appropriate R&S device
1	Digital voltmeter	DC, 0 ... 300 V ±0,05 %, 0 ... 2 A	UDS5
2	Oscilloscope	DC ... 100 MHz	
3	Controller with IEC/IEEE bus interface		
4	Frequency counter	10 Hz ... 30 MHz	

7.2.1.1 Evaluating the Error Status Registers

All of the error messages (ERROR HARDWARE, ERROR CALIB etc.) are grouped together in the global error register (table 7-10). One bit is assigned to each type of error. The errors ERROR HARDWARE and ERROR CALIB are broken down in more detail in the corresponding registers (tables 7-11 and 7-12).

All of the error status registers can be read out via the IEC/IEEE bus interface using the commands SE0 (global), SE1 (hardware) and SE2 (calibration data). Four bits are grouped together to form a hexadecimal digit 0 to 9 or A to F and transmitted as an ASCII character. The first character transmitted contains the information for the bits 0 to 3. The evaluation can be made easier by using the utility program IECERR.BAS (→ 7.2.1.2).

Note: *All hardware errors are combined in the global error bit 55.*

Table 7-10 Global error register

Error bits	Meaning
0 (LSB)	Measuring head is not detected or is faulty (SENSOR ERROR).
1	Hardware error (ERROR HARDWARE).
2	Checksum of calibration data memory is faulty (ERROR CALIB).
3	Error in IEC/IEEE bus operation.
4	Error in ZERO measurement (ERROR ZERO).
5	Error in value entry (ERROR LIMIT).
6	Offset calibration out of tolerance
7	Calibration factor out of tolerance.

Table 7-11 Hardware errors (ERROR HARDWARE)

Error bits	Meaning
0	0 V Supply voltage of probe
1	+ 5 V Supply voltage of probe
2	+ 12 V Supply voltage of probe
3,4	Reserved
5 to 10	Offset voltage AC probe amplifier range 6 to 11
11, 12	Reserved
13, 14	Switch-off status of current source for temperature sensor
15	Output voltage of 100 µA-temperature
16	Output voltage of 1 mA-temperature
17 to 20	Offset voltage DC probe amplifier, range 1 to 4
21	Offset current DC probe amplifier
22	Supply voltage -12 V
23	Supply voltage -5 V
24	Supply voltage -6 V
25	Reserved
26	Offset A/D converter
27 to 46	Reserved
47	Timeout A/D converter
48	Offset DAC setting for AC probe amplifier
49	Offset DAC setting for DC probe amplifier
50 to 54	Reserved
55	Global error bit (ORing of bits 0 to 54)

Table 7-12 Calibration data errors (ERROR CALIB)

Error bits	Faulty data set
0	AC probe amplifier
1	DC probe amplifier
2	DC-FREQ input and DC output
3	Temperature sensor
4	Reserved
5	Reserved
6	Reserved
7	Reserved

7.2.1.2 The Utility Program IECERR.BAS

Using this program, commands can be sent to the NRVS/URV55 via the IEC/IEEE bus interface, and the response strings can be output to the monitor. Each error is displayed in plain English after being read out of the error status register. Thus, the program is especially helpful when reading out the hardware error status with its many bit combinations and when testing the IEC/IEEE bus interface.

Operation: The desired command string (without quotes) can be input immediately following program startup. Transfer to the NRVS/URV55 begins once the Enter key has been pressed. A reply is usually displayed, without modification, on the screen. The error status is displayed in plain English together with the reply only when the error status registers are read out by means of the commands SE0 to SE3 (SE3: IEC/IEEE bus operating error).

Before sending additional commands, the Enter key must be pressed. As soon as the string COMMAND appears, a new string can be input. Instruction sequences are allowed (separated with commas).

7.2.2 Determining Which Module is Faulty

The tables 7-13 to 7-15 contain error messages (left column) and their possible causes (right column) which are characteristic of the actions power-up, connection of the measuring head, and measuring.

The causes are listed in descending order of probability. References to sections describing functionality (normal print) and to sections containing detailed troubleshooting instructions (bold print) are also included.

The error message ERROR HARDWARE is further broken down in table 7-16. Bit combinations which are characteristic for the hardware error status are listed in the left column; the probable faulty module is listed in the right column.

Errors in the main functional units, e.g. A/D converter and power supply, can cause errors to appear in other correctly functioning modules. Instead of one error bit being set, many are set. In these cases, start the troubleshooting process with the module which is listed nearest to the top of table 7-13.

Table 7-13 Error in the powerup sequence (without measuring head)

Error		Cause
Instrument can't be switched on, or it switches itself immediately off again.	 MAINBOARD:	The AC voltage selector is set incorrectly (→ Operating Manual). Supply voltage at N500.1 is smaller than 6.5 V. Other operating voltages are faulty (→ 7.1.4, **7.2.6**). Defect in powerup/powerdown circuit (→ 7.1.5).
Error message ERROR DATA and/or ERROR CALIB.	MAINBOARD:	Backup battery for RAM is empty (→ Operating Manual). Backup circuit is defective or other problem in processor unit(→ 7.1.2.1).
Error message ERROR HARDWARE.	MAINBOARD:	Offset error in DC probe amp., faulty supply voltages or defective A/D converter (→ **Table 7-16**).

Table 7-14 Error when connecting the measuring head

Error		Cause
Device does not respond (NO SENSOR)	MAINBOARD:	Measuring head interface (D600) is defective (→ 7.1.2.4.3).
Error message SENSOR ERROR.	MEAS. HEAD: MAINBOARD: FRONT PANEL	Data memory is defective (try another measuring head). Measuring head interface is defective (→ 7.1.2.4.3, **7.2.3.2.6**).
Error message ERROR HARDWARE.	MAINBOARD: MEAS. HEAD:	Offset error in AC probe amp. or faulty temperature measurement (→ **Table 7-16**). Supply voltage V_{CC} for measuring head is not of tolerance (→**Table 7-16**) The temperature sensor is defective (→ **Table 7-16**).

Note: *If the measuring head has been exchanged in order to localize an error, be sure to use the same type of measuring head. Switch the NRVS/URV55 off and on after the new measuring head has been connected.*

Table 7-15 Error in measurement mode

Error	Cause	
Error message ERROR HARDWARE	MAINBOARD:	Offset error in measuring head amps or temperature measurement is faulty (→ **Table 7-16**).
	MEAS. HEAD:	The temperature sensor is defective (→ **Table 7-16**)
Device does not respond to alterations of the input signal to be measured or displays fautly measurement results.	MEAS. HEAD:	RF sensor or temperature sensor is defective.
	MAINBOARD:	A measuring head amp or the evaluation circuit for the temperature sensor is faulty. In order to localize the error further, check the calibration (→ 6.2) of the basic instrument.
	FILTER BOARD:	The analog signal path or the feed of the supply voltage (for active meas. head →7.1.2.4.1) disrupted.
Device displays frequency incorrectly (input DC FREQ).	MAINBOARD:	DC probe amp is defective. In order to localize the error further, check the calibration of the DC FREQ input and of the DC probe amplifier (→ 6.2).
Faulty DC output voltage.	MAINBOARD:	PWM signal of the processor is faulty or processing circuit is defective (→ 7.1.2.3).
LCD failure.	DISPLAY BOARD:	LCD is defective suffers from poor contacts. A driver chip (D1 to D4)has failed or the signal path to the mainboard is disrupted (→7.1.3.1, **7.2.5**).
	MAINBOARD:	Faulty control by the processor (→ 7.1.2.1) If the keyboard fails at the same time, concentrate troubleshooting efforts to the data bus (D0 to D7) and to the voltage supply for the DISPLAY BOARD.
Keyboard failure.	DISPLAY BOARD:	Key controller D5 is defective (→ 7.1.3.2, **7.2.4**). The signal path to the mainboard is disrupted.
	MAINBOARD:	Faulty control by the processor. If the LCD fails at the same time, concentrate troubleshooting efforts to the data bus (D0 to D7) and to the voltage supply for the front panel.
IEC/IEEE bus interface failure.	MAINBOARD:	Interface chip or drivers are defective (→ 7.1.2.2).

Table 7-16 Error message ERROR HARDWARE in detail

Error	Cause
Error bit 26 Offset A/D converter 47 Timeout A/D converter	MAINBOARD: A/D converter or multiplexer is defective (→ 7.1.1.3, 7.1.1.4, **7.2.3**, **7.2.3.2.4**, **7.2.3.2.5**).
Error bit 22 Supply volt. -12 V 23 -5 V 24 -6 V	MAINBOARD: Supply voltages are faulty (→ 7.1.4, **7.2.6**).
Measuring head supply voltage V_{CC} Error bit 0 0 V 1 +5 V 2 +12 V	MAINBOARD: Electronic switchover of supply voltage is defective (→7.1.2.4.1, **7.2.3.2.2**, **7.2.3.2.4**)
AC probe amplifier Error bit 7 Offset voltage, range 8 48 DAC for offset setting	MAINBOARD: Offset adjustment for AC probe amplifier is faulty (→ 7.1.1.1, **7.2.3.2.2**).
AC probe amplifier Error bit 5 Offset voltage, range 6 6 7 8 9 9 10 10 11	MAINBOARD: Functional error in the given measurement ranges (→ 7.1.1.1, **7.2.3**).
Temp. measurement, 100-µA sensor Error bit 13 Voltage shift by switch-off 15 Meas. voltage at 100 µA	MAINBOARD: 100 µA current source or multiplexer is defective (→ 7.1.1.3, 7.1.2.4.2, **7.2.3**, **7.2.3.2.2**). MEAS. HEAD: Temperature sensor is defective (when only bit 15 is set).
Temp. measurement, 1mA sensor Error bit 14 Offset after switch-off 16 Meas. voltage at 1mA	MAINBOARD: 1 mA current source or multiplexer is defective (→ 7.1.1.3, 7.1.2.4.2, **7.2.3**, **7.2.3.2.2**). MEAS. HEAD: Temperature sensor is defective (when only bit 16 is set).
DC probe amplifier Error bit 17 Offset voltage, range 1 18 2 19 3 20 4	MAINBOARD: Functional error in the DC probe amplifier (→ 7.1.1.2, **7.2.3**).
DC probe amplifier Error bit 21 Offset current 49 DAC for offset current	MAINBOARD: Adjustment for offset current is faulty (→ 7.1.1.2, **7.2.3**).

7.2.3 Troubleshooting the Measurement Modules and the Measuring Head Interface

7.2.3.1 Service Firmware for the NRVS/URV55

To make the troubleshooting process in the analog section easier, various help functions have been made available with the service firmware. These help functions can be invoked via the IEC/IEEE bus interface. They allow self tests to be carried out, all hardware switches to be tested, A/D conversions to be triggered, and the measuring head interface to be checked (table 7-17). These functions can be easily invoked using the delivered utility program DIAG_S.BAS (→ 7.2.3.2). The service functions are not as helpful when troubleshooting the digital section, the display and the keyboard.

To install the service firmware, turn off the instrument. Then remove both instrument covers and the screening cover of the main board (→ 7.3.2). The EPROM D710 can now be replaced. If tweezers are used to pry it out of its socket, be careful not to short-circuit the lithium battery G700 which is used to backup the CMOS RAM. If an EPROM is replaced often, it is possible that neighbouring leads come in contact with each other. If the service firmware has been installed correctly, the string Vx.y S will appear in the display during the power-up sequence.

The normal measuring mode is still available when the service firmware is installed, some functions are however deactivted.

Affected in the manual mode of operation are:

- the **MODE** menu
- the **SETUP** menu
- the key **MEAS→REF**
- the special functions **SPEC →SETUP-LOCK** and **SPEC →CHECKS**

The following commands have no effect via IEC/IEEE bus:

ST, S0, S1, SC0...SC3, Fx, Gx, DSLxxx, DSRxxx, ZSL, ZSR, DY, ZY, MS

To use the service functions, you must first send the keyword SERVICE (via IEE/IEEE bus).

Table 7-17 Service functions

Command	Function	Response string to controller
SERVICE	**SERVICE MODE ON.** Turns the service mode on and the normal measuring mode off.	
SERCHK<x>	**INTERNAL CHECK.** Invokes an internal self test (test sequence x, → table 7-18). If out of tolerance, the hardware error bit x is set.	"INTERNAL CHECK <x>"
SERSEV<x>	**CHECK VALUE.** Reads out the test value and tolerance range for test sequence x (table 7-18).	"EB (<x>) <lower limit> <test value> <upper limit>"
SERSET<x>	**HARDWARE SETTING.** Sets various hardware switches, (table 7-19).	"SWITCH <x>"
SERCON<x>	**A/D CONVERSION.** Triggers a voltage measurement at D400.3. The integration time can be controlled with the parameter x: x — integration time/ms 0 — 0.5 1 — 1 2 — 2 3 — 5 4 — 10 5 — $16\,^2/_3$ 6 — 20	"<Voltage value in V>"
SERPID	**PROBE READ.** Performs a cyclical read-out of the first 16 bytes (measuring head identifier) of the measuring head's data memory. Each byte is transfered in the form of two ASCII characters for both of the hex digits (0 to 9, A to F).	"<measurement head identifier>" "<measurement head identifier>" ... ... "<measurement head identifier>"
SERSID	**SWITCH IDENTIFY.** The hardware latches D100, D203, D324 and D101 are cyclically activated. Each output is inverted for 100 µs.	"SWITCH IDENTIFICATION"
SERSE<x>	Output of the error status register x (0 to 3) (corresponds to the command SE<x> in measurement mode).	"<error status>"
SERVEND	**SERVICE MODE OFF.** Switches the service mode off and the normal measuring mode on again.	

7.2.3.2 The Utility Program DIAG_S.BAS

The program makes it easier to use the service functions, as it allows the desired settings to be made using a minimum of keystrokes. It can be found on both floppies which are delivered with the Service Kit NRVS-S1 (installation → 6.2.5.2).

Each of the service functions listed in the menu can be selected immediately after starting the program. For this purpose, only input the letter which appears in parentheses. After calling the functions INTERNAL CHECK, CHECK VALUE and HARDWARE SETTING, the desired test routine is started by inputting in its specific code, called "routine number" later on in the text (three digits are required). One or two-digit numbers must be inputted with leading zeros (e.g. 2 → 002). The selected function is automatically executed after the third digit has been inputted. Illegal entries cause the string "Error" to be displayed.

7.2.3.2.1 SERVICE MODE ON/OFF (O)

The normal measurement run is halted when switching to service mode. The only settings and measurements executed are those which are invoked with a service function.

If a measuring head needs to be used in service mode, connect it and read it in while still in measurement mode. The instrument then knows about the measuring head (it is identified), and all functions which depend on a measuring head being present can be executed. The NRVS/URV55 will not recognize a measuring head that gets connected while the NRVS/URV55 is in service mode.

The first thing that a NRVS/URV55 with an installed measuring head does after exiting service mode is to execute a read operation. Do not interrupt this read operation. The service mode can be invoked again once the read operation has been finished.

7.2.3.2.2 INTERNAL CHECK (I)

Each test sequence which leads to the setting of a hardware error bit can be individually invoked using the function INTERNAL CHECK. After the routine number (that must be indentical to the corresponding error bit) has been put in, the NRVS/URV55 sets up the appropriate hardware configuration and tests a voltage value which is appropriate for the invoked function using the internal A/D converter. If something is out of tolerance, the global error bit (55) and the specific error bit are set. The program DIAG_S.BAS checks the status of this bit and returns the string "ERROR" if a fault has been found. In addition, DIAG_S.BAS, reads out the test value and the tolerance limits and shows all three values on the display .

Using the information provided in table 7-18, it is possible to get an idea of what happens during a test sequence. The table contains the hardware switch codes as found in table 7-19, the wait times preceding an A/D conversion, and the measurement or integration times of the A/D converter. Because the zero error of the converter is relatively large, the difference to a reference voltage and not the absolute value of the measured voltage is generally evaluated. The reference voltage is usually the voltage which is measured when the A/D converter input is short-circuited (v_{26}). Measurement values obtained in this manner are thus offset-corrected.

A test function that is marked in the menu can be repeated once by pressing the "R" key or cycled by pressing the "C" key. For evaluation purposes using an oscilloscope, pin D700.9 of the microprocessor is set to 0 V for the duration of the test run. The global error bit (55) can be set after calling a reserved test function. Bit 55 will be reset by the next error-free test run.

Table 7-18 INTERNAL CHECKS

Routine no. (error bit)	Test function	Hardware setting (Switch code)	Wait time Voltage	Meas. time v_x (ms)	Test value	Tolerance range
0 [1]	V_{CC} 0 V	92, 200 ms, 29	2 ms, v_0	1	v_0-v_{26}	-0.010 to +0.400 V
1 [1]	V_{CC} +5 V	93, 29	2 ms, v_1	1	v_1-v_{26}	+0.445 to +0.530 V
2 [2]	V_{CC} +12 V	95, 200 ms, 29	2 ms, v_2	1	v_2-v_{26}	+1.100 to +1.270 V
3, 4	reserved					
5	Offset range 6	6, 12, 14, 27,	3 ms, v_5	1	v_5-v_{26}	−0.480 to +0.480 V
6	7	7, 12, 14, 27,	3 ms, v_6	1	v_6-v_{26}	−0.230 to +0.230 V
7	AC probe amp. 8	8, 12, 14, 27,	3 ms, v_7	1	v_7-v_{26}	−0.075 to +0.075 V
8	9	9, 12, 14, 27,	3 ms, v_8	1	v_8-v_{26}	−0.064 to +0.064 V
9	10	10, 12, 14, 27,	3 ms, v_9	1	v_9-v_{26}	−0.040 to +0.040 V
10	11	11, 12, 14, 27,	3 ms, v_{10}	1	v_{10}-v_{26}	−0.030 to +0.030 V
11, 12	reserved					
13, 15 [1),3)]	100-µA sensor	17, 32,	6 ms, v_{15}	20	v_{15}-v_{26}	−0.410 to −0.190 V
		16, 32,	6 ms, v_{13}	1	v_{13}-v_{15}	+0.100 to +5.000 V
14, 16 [1),3)]	1-mA sensor	18, 32,	2 ms, v_{16}	20	v_{16}-v_{26}	−3.540 to −2.420 V
		16, 32,	2 ms, v_{14}	1	v_{14}-v_{26}	−0.100 to +0.100 V
17	Offset range 1	19, 25, 31,	3 ms, v_{17}	1	v_{17}-v_{26}	−0.500 to +0.500 V
18	2	20, 25, 31,	5 ms, v_{18}	5	v_{18}-v_{26}	−0.050 to +0.050 V
19	DC probe amp. 3	21, 25, 31,	3 ms, v_{19}	1	[illegible]-v_{26}	−0.010 to +0.010 V
20	4	22, 25, 31,	3 ms, v_{20}	1	[illegible]-v_{26}	−0.010 to +0.010 V
21	Off. current DC × 3 GΩ	20, 26, 31,	3 ms, v_{21}	1	v_{21}-v_{18}	−0.075 to +0.075 V
22	-12 V	34,	2 ms, v_{22}	1	v_{22}-v_{26}	−1.210 to −0.880 V
23	-5 V	30,	2 ms, v_{23}	1	v_{23}-v_{26}	−0.524 to −0.467 V
24	-6 V	33,	2 ms, v_{24}	1	v_{24}-v_{26}	−0.617 to −0.572 V
25	reserved					
26	Offset A/D converter	28,	2 ms, v_{26}	20	v_{26}	−0.250 to +0.250 V
27 to 47	reserved					
48 [1),4)]	Offset adjustment	27,8,12	2 ms, v_{48a}	1	v_{48a}-v_{26} [5]	
		latch 1 (D203)	2 ms, v_{48b}	1	v_{48b}-v_{26} [5]	
	AC probe amplifier	varied,	2 ms, v_{48c}	1	v_{48c}-v_{26} [5]	
		..." ...,	..., ...	...	...	
		..." ...,			latch 1	02 to FCH
		test function 7 ...	... v_7		v_7-v_{26}	-0.075 to +0.075V
49 [4]	Offset adjustment	test function 18...	... v_{18}		v_{18}-v_{26}	-0.050 to + 0.050 V
		20, 26, 31,	2 ms, v_{49a}	1	v_{49a}-v_{18} [5]	
		latch 2 (D324)	2 ms, v_{49b}	1	v_{49b}-v_{18} [5]	
	DC probe amplifier	varied,	2 ms, v_{49c}	1	v_{49c}-v_{18} [5]	
		..." ...,	..., ...	...	...	
		..." ...,			latch 2	02 to FCH
		test function 21	... v_{21}		v_{21}-v_{18}	-0.075 to +0.075V
		...				
50 to 55	reserved					

1) Only with identified measuring head, any type permissable.

2) Only with identified active measuring head. During the test phase, the positive supply voltage V_{CC} as well as the negative supply voltage V_{EE} = -12 V are set.

3) These test functions can be invoked using one of the two given numbers, the test run in both cases is the same. The NRVS/URV55 does not test whether the chosen sensor type matches the measuring head. If the selected type doesn't match, an error is generally set, even when the sensor and the current source are o.k. To reset, you must power cycle the NRVS/URV55. The thermal measuring heads contain 100-µA sensors, all others contain 1-mA temperature sensors.

Dynamic function test of the current source for temperature measurement using the cal adapter:

- Set the cal adapter to TEMP (HARDWARE SETTING no. 100)
- Connect the black and yellow connectors together via a 3-kΩ resistor.
- Invoke the test functions 13 (15) and 14 (16), and measure the voltage drop at the resistor with an oscilloscope. Normally, a rectangular pulse with an amplitude of -0.3 or -3 V and a duration of approx. 20 ms must appear.

4) The number of adjustment steps depends on the actual voltage difference v_{xa}-v_y. Up to ±14mV: latch setting is not changed; up to ±60 mV: the latch setting is changed by ±1 digit. With larger deviations, a new adjustment is performed using the method of successive approximation. After the adjustment has been completed the remaining offset is measured once more and evaluated (test function xyz is called).

In order that the offset adjustment be performed without error, two conditions must be true: the remaining offset must fall within the specified limits of the test function xyz, and the latch must not be set to 00H or 0FEH.

5) Evaluation only for the purpose of calculating the appropriate latch setting.

7.2.3.2.3 CHECK VALUE (V)

Using this function, it is possible to display the tolerance range and the last test value for the selected test sequence of the corresponding error bit. In contrast to INTERNAL CHECK, a test is not performed.

7.2.3.2.4 HARDWARE SETTING (H)

The NRVS/URV55 sets up the hardware configurations listed in table 7-19 but doesn't perform any tests whatsoever. The global hardware error bit (55) is never set, irregardless of the state of the bits 0 to 54. Pin D700.9 of the microprocessor is set to 0V for the duration of the setting operation.

The hardware configuration is not affected by the triggering of an A/D conversion or by the function SWITCH IDENTIFY. Calling the function PROBE READ or an internal test sequence (INTERNAL CHECK) will generally cause the hardware configuration to be changed.

The function HARDWARE SETTING, when coupled with the calibration adapter, is especially suited for controlling the measuring head amplifiers (→ 7.1.6, Fig. 7-8)

Table 7-19 HARDWARE SETTINGS

Routine no.	Setting	Module	Latch state D 76543210	Latch no. Symbol Address	Remarks
0	reserved				
1	x268 (1)	AC probe amplifier	XXXX0001	Latch 0 D100 A000	Amplification factor: total amplification from the measuring head interface +INP/-INP to the output INP1.
2	x122 (2)		XXXX0010		
3	x55.9 (3)		XXXX0011		
4	x25.9 (4)		XXXX0100		
5	x12.0 (5) amplification		XXXX0101		
6	x5.79 (6) factor		XXXX1001		
7	x2.64 (7) (range)		XXXX1010		
8	x1.21 (8)		XXXX1011		GND/INV: reference setting: reversed polarity of the meas. voltage in the ranges 1 to 5, otherwise connection from X211.1/2 with RGND.
9	x0.559 (9)		XXXX1100		
10	x0.259 (10)		XXXX1101		
11	x0.122 (11)		XXXX1110		
12	GND/INV meas. mode		XXX0XXXX		
13	NORMAL		XXX1XXXX		
14	OFF discharge		XX0XXXXX		
15	ON circuit		XX1XXXXX		
16	OFF meas. current	Temperature measurement meas. head	XX00XXXX	Latch 3 D101 A003	
17	0.1 mA		XX10XXXX		
18	1.0 mA		XX01XXXX		
19	x2.0 (1) amplification	DC probe amplifier	00XXXXXX		Amplification factor: with source imp. 9 MΩ (DC FREQ or DC probe). With calibration adapter (1 MΩ) 9 times larger values.
20	x0.20 (2) factor		01XXXXXX		
21	x0.020 (3) (range)		10XXXXXX		
22	x0.002 (4)		11XXXXXX		
23	DC meas. mode		00XXXXXX	Latch 0 D100 A000	GND, OFFS ADJ: The input is grounded via 9 MΩ (GND) or 4.75 kΩ (OFFS ADJ).
24	DC FREQ		01XXXXXX		
25	GND		10XXXXXX		
26	OFFS ADJ		11XXXXXX		
27	INP1 (AC)	Multiplexer D400	XXXX000X	Latch 3 D101 A003	
28	GND		XXXX001X		
29	V_{CC}		XXXX010X		
30	-5 V		XXXX011X		
31	INP2 (DC)		XXXX100X		
32	MKTEMP		XXXX101X		
33	-6 V		XXXX110X		
34	-12 V		XXXX111X		
35	0 V read	Control of Data memory	XXXXXXX0		
36	5 V reset		XXXXXXX1		
37 to 79	reserved				
80	00H Offset DAC	AC probe amplifier	00000000	Latch 1 D203 A001	
81	80H		10000000		
82	FEH		11111110		
83	00H Offset DAC	DC probe amplifier	00000000	Latch 2 D324 A002	
84	80H		10000000		
85	FEH		11111110		
86 to 91	reserved				

continued of table 7-19

Routine no.	Setting	Module	Setting SPG 210	Latch no. Symbol Address	Remarks
92 93 94 95	0 V/0 V V_{CC}/V_{EE} + 5 V/0 V reserved + 12 V/-12 V	Measuring head supply	000 010 101	D600 C001	Settings only possible with identified measuring head. + 12 V/-12 V only with active measuring head
96 to 99	reserved				
100 101 102 103	TEMP AC- 1 MΩ ADJ AC + /DC	Cal adapter		D2	Settings only possible with identified cal adapter.
104 to 255	reserved				

7.2.3.2.5 A/D CONVERSION (X)

Using this function, the input voltage of the A/D converter at D400.3 can be measured. The integration time is always 20 ms. Thus, when also taking into consideration the function HARDWARE SETTING, it is possible to understand all of the documented test sequences. Pin D700.9 of the microprocessor is set to 0V for the duration of the A/D conversion.

The measured voltages are referred to circuit ground and completely corrected. The last reference measurement obtained when the input was short-circuited (v_{26}) is used to compensate for the converter's offset. The sensitivity of the A/D converter is corrected using the calibration factor of the temperature sensor input (100 µA). Remaining measurement error ± (0.1 % + 200 µV).

7.2.3.2.6 PROBE READ (P)

Using this function, it is possible to test the digital interface to the data memory of the measuring head. The following sequence is cyclically executed until another service function is called:

- The + 5 V supply voltage for the data memory is switched on .
- The address counter in the data memory is reset, then the first 16 bytes are read out.
- The supply voltage is switched off .

For control purposes, the bytes which have been read out are shown on the screen. The ASCII equivalents are shown in the uppermost line, both of the next two lines present the data in an ASCII-hex format (two ASCII characters 0 to 9, A to F per byte). Because all measuring heads contain pure ASCII data at addresses 0 to 15, a text which makes sense must appear in the ASCII line, e.g. URV5-Z2 / 501025.

If an error occurs, compare the voltage waveforms at the most important circuit points with fig. 7 to 9.

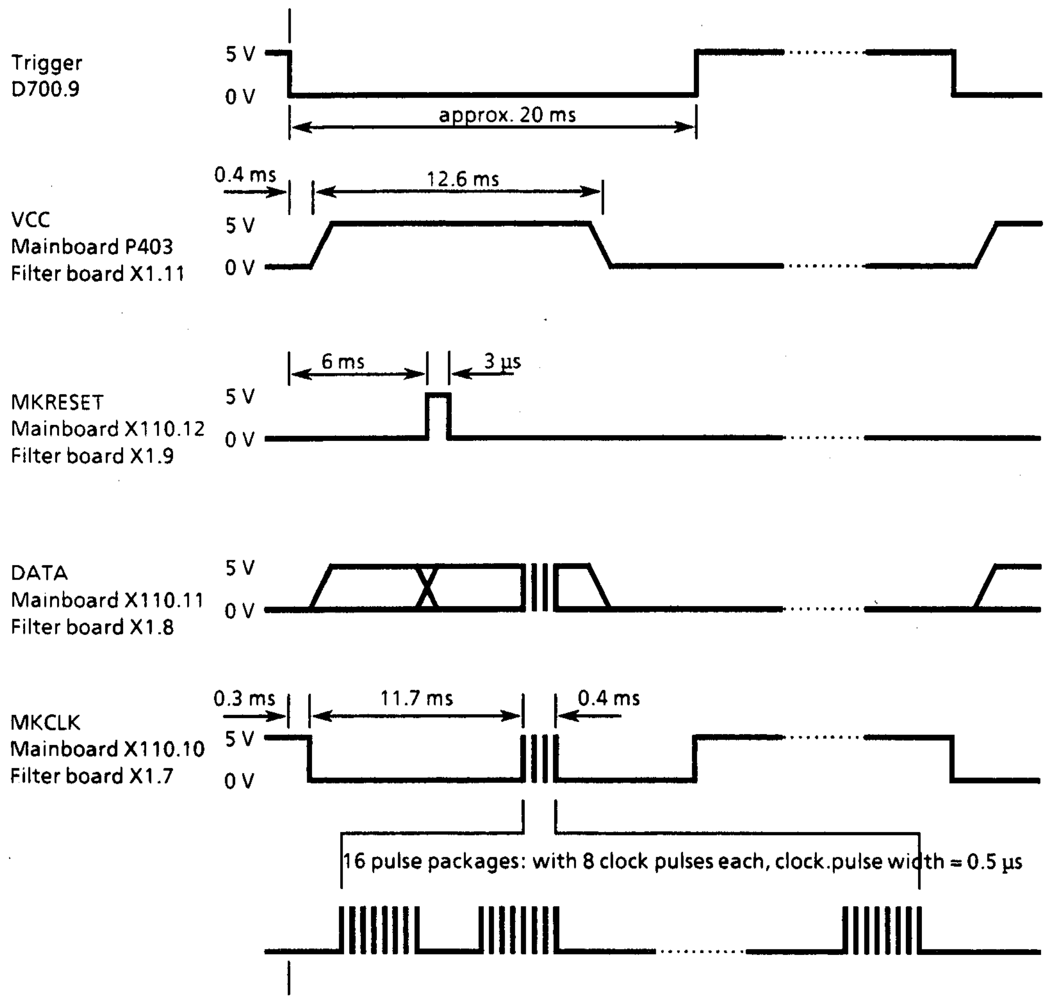


Fig. 7-9 Voltage waveforms of a data memory read operation (function PROBE READ)

7.2.3.2.7 SWITCH IDENTIFY (S)

This function makes it easy to check the logical control of most of the analog switches. Using the current hardware settings as the initial state, each output of the latches 0 to 3 is cyclically inverted for 100 µs. If the output voltage is displayed on an oscilloscope, a periodical sequence of square pulses, lasting 100 µs each, should be visible.The outputs are activated in the order: bit 0 → 1 → 2 →...→ 7 , the latches are addressed according to their index:

latch 0 → 1 → 2 → 3 → 0 → ...

When SWITCH IDENTIFY is finished, the latches assume their initial state again.

When using an oscilloscope triggered tby he negative edge of the signal at D700.9, the horizontal position of the 100-µs pulses shows, to control whether the desired output has been really activated (see the waveform for D101.15 as an example).

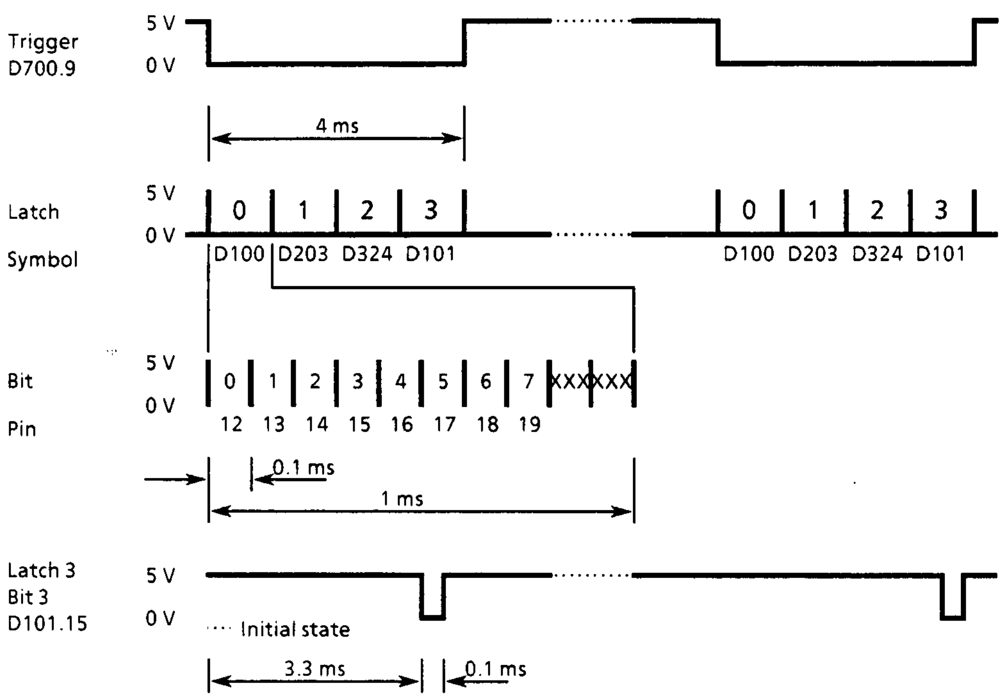


Fig. 7-10 Latch control by means of the service function SWITCH IDENTIFY

7.2.3.2.8 ERROR REPORT (E)

This function reads out the hardware error bits of the NRVS/URV55. The meaning of the bits and their position in the bit string can be taken from table 7-11.

7.2.4 Troubleshooting the Keyboard

Invoke the key test routine (SPEC → CHECKS → KEY): press the keys one after the other; with each key you should see a display which corresponds to the pressed key's inscription. To exit the test routine, press the same key twice. If an error occurs, begin troubleshooting with the DISPLAY BOARD. If a complete failure of the keys occurs, also check the functional block "processor unit".

Partial failure:

- Keyboard chip D5
- Row and column circuits
- Rubber keyboard mat (is contact made?)

Complete failure:

- Keyboard chip D5
- Reset
- Clock
- Data interface

7.2.5 Troubleshooting the LCD

Invoke the LCD test routine (SPEC → CHECKS → LCD/LED). All LCD segments should be displayed simultaneously, the DATA LED should also be lit. If an error occurs, begin by checking plug X100 on the main board. Otherwise proceed as follows:

Partial failure:

- LCD mounting (contacts)
- Affected LCD driver according to table 7-6

Complete failure:

- Reset
- Clock
- Input/output signal
- Functionality of driver chips D1 to D4
- LCD voltage supply

Contrast:

- Setting range (→7.2.5.1)
- LCD voltage supply
- Circuit surrounding R24 and N1-A

7.2.5.1 Setting the LCD Contrast

The contrast of the LCD can be adjusted with R24 (→ Fig. 7-11). To begin, remove the covering plate of the front module. R24 can be reached through a hole in the mounting plate; using a screwdriver, adjust it as follows:

- Stand the NRVS/URV55 up, so that you are looking down at the LCD.
- Enter the key sequence REF → LEV.
- Enter the reference value 1.234.
- Adjust for optimum contrast by rotating R24.

If the contrast is adjusted correctly, only those segments which are activated should be visible. All others should remain invisible. To check the setting, it helps to vary the angle at which you view the display.

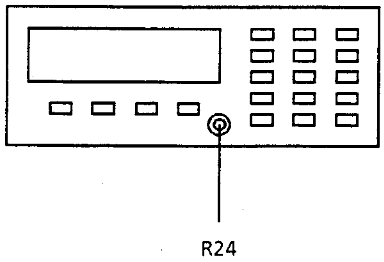


Fig. 7-11 Setting the LCD contrast

7.2.6 Testing the Operating Voltages

(see circuit diagram 1029.0605.01S, sheets 5 and 7)

The following table shows the voltages generated on the main board and their acceptable range:

Table 7-20 Supply voltages

Pin	Voltage	Acceptable range	Supplied ICs
X505.1	+ 5 V_{DIG}	4.8 to 5.2 V	D405, D600, D615, D705, D710, D714, D716, D717, N610, S100
X505.2	+ 12 V	11.4 to 12.6 V	N201, N202, N305, N400, N401, N425, N426, N503, N505, N506, S100
X505.3	V_{REF}	4.95 to 5.05 V	D610
X505.4	+ 6 V	5.88 to 6.12 V	D203, D324, D400
X505.5	− 6 V	− 5.93 to − 6.07 V	D400
X505.6	+ 5 V	4.8 to 5.2 V	D100, D101, D201, D202, D204, D321, D322, D323, D420
X505.7	− 5 V	− 4.85 to − 5.15 V	D202, D204, D321, D322, D323, D420
X505.8	− 12 V	− 10 to − 12.1 V	N201, N305, N400, N401, N425, N426, N503, N506, S100
P700	V_{RAM}	3.2 to 3.7 V	D715, D720
N500.1	rectifed transformer output voltage	6.5 to 14 V	N500

7.2.7 Testing the Clock Frequency for the Microprocessor

First connect a frequency counter to D600.42 via a 10:1 probe.
Then measure the clock frequency: 11.988 to 12.012 MHz.

7.2.8 Testing the Clock Frequency for the Keyboard Chip and the LCD Driver

Using a 10:1 probe and either a frequency counter or an oscilloscope, measure the clock frequency at D5.12:

124.375 to 125.625 kHz

7.2.9 Troubleshooting the Sensor Check Source (Option NRVS-B1)

(see circuit diagram 1029.2950.01S)

First check the supply voltage of +5 V at the X1 connector. Then proceed according to the type of error noticed at the output of the sensor check source (all voltages with respect to ground):

Improper Power Level

Check dc reference voltage and rectified signal voltage at N2.2 and N2.3. Both must be approximately +1.2 V. With improper reference voltage scan V7 (+1.2 V) and V6 (+3.0 V). Otherwise examine operation of diode V3 and check the operating voltage at P1 (more than 1.5 V, see below). The RF signal amplitude at the cathode of V3 should be approximately 1.4 V.

Excessive AM

Check the supply voltage at X1.1. Superimposed hum and noise should be well below 10 mV.

Instability

Examine the RF connector and then proceed according to "Improper Power Level".

7.2.9.1 Setting the operating point of the crystal oscillator

By means of R15 the operating voltage of B1 can be adjusted (necessary only after replacement of B1). For this purpose the sensor check source must be removed from the instrument and terminated with 50 Ω, e.g. with a power sensor. After warm-up adjust the operating voltage at P1 to the maximum possible value - at least 1.5 V but no more than 4.0 V.

For adjustment of the output power level see chapter 6.2.6.7.

7.3 Disassembly and Assembly

Attention! Disconnect the power plug before opening the instrument!

If an opened instrument needs to be connected to the AC mains for troubleshooting purposes, keep in mind that a shock hazard exists on the main board! Make sure that the plastic cover is properly seated over the connection pins of the voltage selector!

Be careful when handling a removed main board! Before connecting it to the AC mains, also make sure that the plastic cover near the power transformer on the solder side is properly seated!

7.3.1 Terminology Used

Mainboard	A1	Main printed circuit board of the NRVS/URV55 containing the current supply, the analog unit, the digital unit and all rear connectors.
Screening cover		Sheet metal covering the two chambers on the main board.
Cover plate		Paint-coated sheet metal on the front, which contains the name of the instrument, the company logo, the key inscription etc.
Front module		Mounting unit, consisting of the mounting plate, the display board with LCD and keyboard, and the filter board with receptacle.
Mounting plate		2-mm thick sheet metal with openings for the LCD and keys. It is used to support the display board and the screening receptacle of the filter board.
Display board	A2	Printed circuit with LCD, keyboard, driver chips and a ribbon cable (W1) which connects to the main board.
Contact pad		Piece of molded rubber which, together with a contact field on the display board, forms the keyboard.
Filter board	A3	Connector unit for the measuring head with connector strip, EMI suppression parts and cable (W3) which connects to the main board.

7.3.2 Removal and Replacement of the Main Board

- Remove the two rear-panel feet and both covers.
- Loosen the 6 Phillips screws and then remove the screening cover.
- Disconnect 34-way ribbon cable to the display board.
- Disconnect 16-way ribbon cable to the filter board.
- Remove the protective ground connection of the line filter from the rear-panel.
- Remove the 7 Phillips screws (2 of them are on the rear panel) (→ Fig. 7-12).
- Slightly lift the main board at the front, push towards the front of the instrument and remove.

Be careful when handling the main board!

Even after removal of the main board, various circuits are still supplied with voltage from the lithium backup battery.

To replace the main board, carefully proceed in the reverse order. Don't forget the protective ground connection of the line filter! When fastening the rear panel feet with screws, firmly press the two instrument panels together.

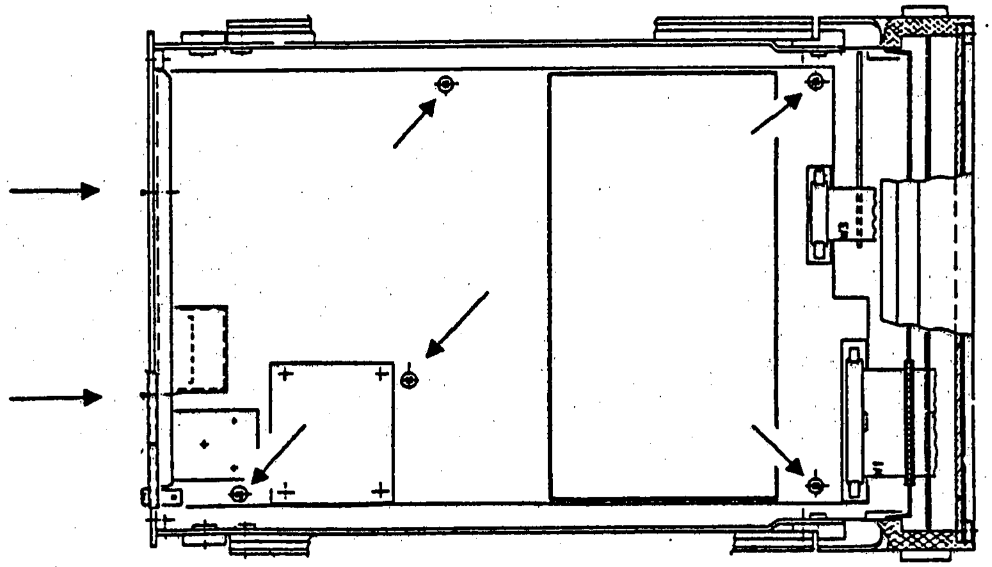


Fig. 7-12 Fastening points of the main board

7.3.3 Operating the Instrument With the Main Board Removed

The main board is fully functional only when connected together with the display board and the filter board.

There are two ways to connect these two printed circuit boards with the removed main board:
a) The front module is also removed (→7.3.4) and connected to the main board via the two ribbon cables.
b) The instrument is placed on its side and the main board is placed at 90 ° (also on its side) to the instrument. Once both ribbon cables have been connected, there is usually enough support to hold the main board in place.

***Attention!** Read the safety instructions in section 7.3 before connecting to the AC mains!*

7.3.4 Removal and Replacement of the Front Module

- Remove the 2 rear panel feet and the lower cover.
- Disconnect the 34-way connection from the display board to the main board.
- Disconnect the 16-way connection from the filter board to the main board.
- Remove the 4 Phillips screws on the front of the instrument.
- Remove the cover plate; then remove the front module from the frame, bringing it out towards the front.

To replace the module, proceed in the reverse order. When fastening the rear panel feet with screws, firmly press the two instrument panels together.

7.3.5 Removal and Replacement of the Filter Board

After removing the front module:

- Remove the 2 countersunk Phillips screws, located on both sides of the measuring head receptacle, from the mounting plate.
- Slide the measuring head receptacle to the bottom edge of the mounting plate.
- Pull the filter board with the measuring head receptacle out towards the rear.

To remove the measuring head receptacle:

- Press apart the 2 retaining clips in the filter board.
- At the same time, press the 2 retaining clips on the metal cover of the measuring head receptacle together.
- Remove the measuring head receptacle from the filter board by pushing it out towards the front.

7.3.6 Removal and Replacement of the Display Board

In order to troubleshoot the component side, or to remove the LCD or the contact pad, it is necessary to remove the display board.

After having removed the filter board, remove the 4 Phillips screws on the solder side of the display board (→ Fig. 7-13).

When fastening the display board back in place, make sure that all keys are centered as best as possible in the openings of the mounting plate.

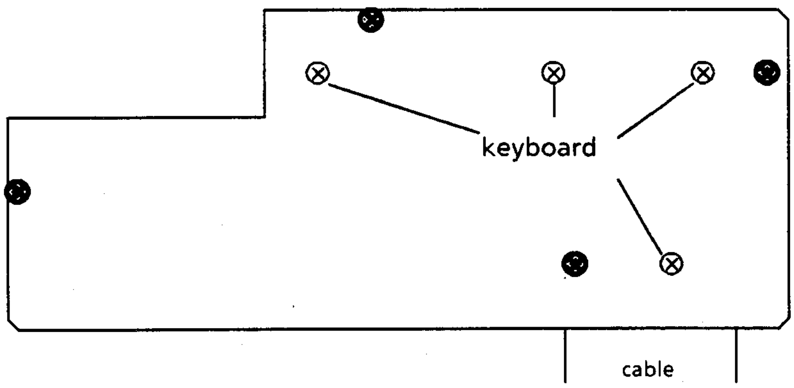


Fig. 7-13 Fastening points of the display board

7.3.6.1 Replacing the LCD

After having removed the display board, remove the LCD as follows:

- Using a flat-nose pliers, straighten out the fastening flaps of the mounting frame. They are located on the solder side of the display board (→ Fig. 7-14 below).
- Lay the display board with the solder side up onto a flat pad and push the fastening flaps of the mounting frame out of the display board.
- After removing the plastic plate (which acts as a spacer) and both contact strips, remove the LCD from the sheet metal frame. When doing this, make sure that the spring-like safety flap doesn't damage the glass protrusion (which resulted from sealing the glass).

To replace the LCD, proceed in the reverse order. To ensure that good contact is made where needed, remove all dust and lint particles from the contact areas of the LCD and both contact strips before beginning.

When assembling the unit, make sure that the LCD is properly seated in the sheet metal frame. Before you twist the fastening flaps, firmly press the display board and mounting frame together, in order to avoid damaging the display board.

After the instrument has been reassembled, check the LCD with the special function SPEC→CHECKS→LCD/LED.

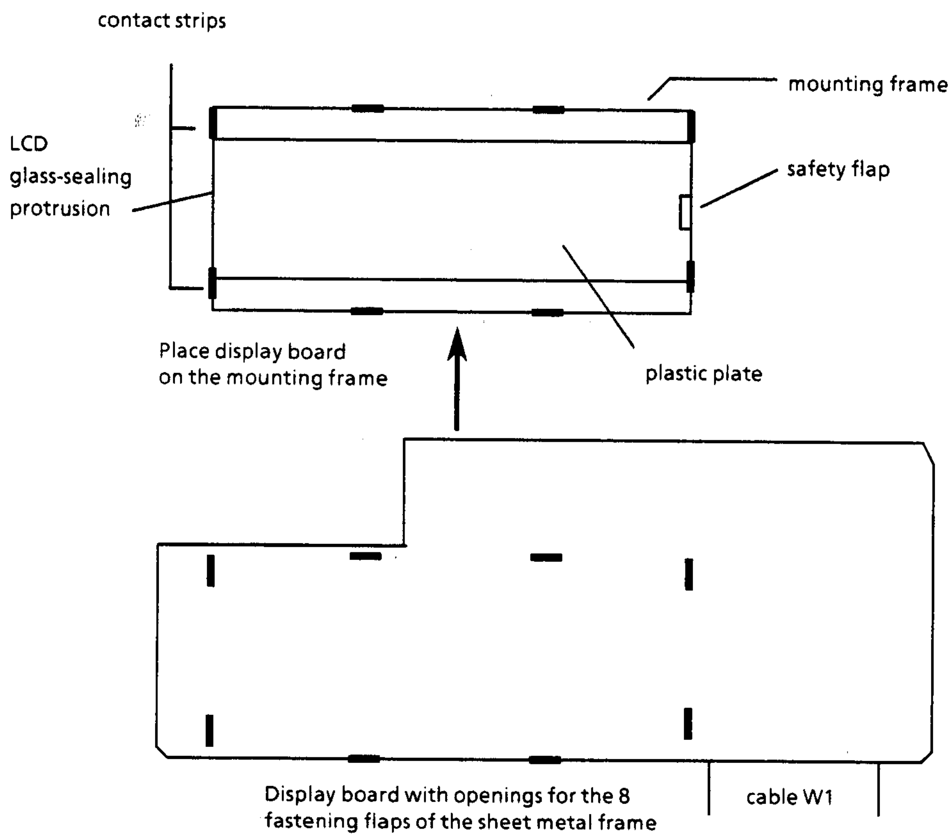


Fig. 7-14 Mounting the LCD

7.3.6.2 Removal and Replacement of the Keyboard

Replacing key buttons:

After the cover plate has been removed, a button can be replaced by simply taking it off and putting it back on.

Replacing the contact pad:

- Remove the display board.
- Remove the fastening screws of the retaining plate according to Fig. 7-13.
- Remove the contact pad and the retaining plate.

When reassembling the parts, keep them as free of dust as possible. Tighten the 4 fastening screws, applying a torque of 0.1 to 0.2 Nm, and secure them with glyptal WV 0082.5818.

7.4 Interfaces

Main board

Pin	Name	Input/output	Origin/ destination	Value range	Signal description
X100.1	RD	output	D700.19	CMOS	read signal
X100.2	WR	output	D700.18	CMOS	write signal
X100.3	A0	output	D705.2	CMOS	address 0
X100.4	A1	output	D705.5	CMOS	address 1
X100.5	UE	output	N500.9	4.75-5.52 V	supply voltage for switch-on circuitry
X100.6	RESLCD	output	D700.5	CMOS	reset for LCD driver
X100.7	D7	input/output	D700.36	CMOS	data bus
X100.8	TASTINT	input	D615.9	TTL	key interrupt
X100.9	D5	input/output	D700.38	CMOS	data bus
X100.10	D6	input/output	D700.37	CMOS	data bus
X100.11	D3	input/output	D700.40	CMOS	data bus
X100.12	D4	input/output	D700.39	CMOS	data bus
X100.13	D1	input/output	D700.42	CMOS	data bus
X100.14	D2	input/output	D700.41	CMOS	data bus
X100.15	CS KEY	output	D714.11	CMOS	chip select for KEYINT
X100.16	D0	input/output	D700.43	CMOS	data bus
X100.17	C/D	output	D700.6	CMOS	control line for LCD driver
X100.18	RES	output	N500.7	0 / + 5.25 V	reset signal for keyboard chip
X100.19	SI	output	D600.5	CMOS	serial input
X100.20	SCK	output	D600.4	CMOS	serial clock
X100.21	CS2	output	D700.4	CMOS	chip select for LCD driver 2
X100.22	CS4	output	D700.8	CMOS	chip select for LCD driver 4
X100.23	BUSY	input	D700.16	CMOS	acknowledge of LCD driver
X100.24	CS1	output	D700.2	CMOS	chip select for LCD driver 1
X100.25	EIN	input	S19	0 / + 5.25 V	on/off signal
X100.26	CS3	output	D700.7	CMOS	chip select for LCD driver 3
X100.27	N.C.				no connection
X100.28	LED1	output	D700.17	CMOS	DATA LED
X100.29	GND			0 V	ground
X100.30	N.C.				no connection
X100.31	+ 5 VDIG	output	D321/322	4.75-5.25 V	voltage supply
X100.32	+ 5 VDIG	output	D321/322	4.75-5.25 V	voltage supply
X100.33	GND			0 V	ground
X100.34	GND			0 V	ground
X110.1	GND			0 V	ground
X110.2	GND			0 V	ground
X110.3	RGND/VEE	input/output	S100	0/-12 V	voltage supply for measuring head
X110.4	+ INP	input	R252	0 to + 15 V	measuring input AC probe amplifier
X110.5	- INP	input	R252	0 to -15 V	measuring input AC probe amplifier
X110.6	GND			0 V	ground
X110.7	DCINP	input	D321/322	0 to 45 µA	measuring input DC probe amplifier
X110.8	GND			0 V	ground
X110.9	MKTEMP	input/output	D400.5	0 /-0.3 /-3 V	temperature sensor
X110.10	MKCLK	output	R626	CMOS	read clock for data memory
X110.11	DATA	input/output	R625	CMOS	serial data from data memory
X110.12	MKRESET	output	D101.12	CMOS	reset for data memory
X110.13	MKID	input	D600.21	TTL	measuring head identification
X110.14	VCC	output	V404/406	0 / + 5 / + 12 V	voltage supply for measuring head
X110.15	GND			0 V	ground
X110.16	GND			0 V	ground
X320.1	DCFREQ	input	R131	0 to + 12 V	frequency correction input
X320.2		input		0 V	ground
X420.1	DCOUT	output	R424	0 to + 3 V	DC voltage output
X420.2		output		0 V	ground
X500.1		input	T500.1	115/230V 47 to 400 Hz	phase/neutral line (mains connection)
X500.2		input	T500.4		phase/neutral line
X500.3		input		0 V	protective ground
X730	<IEC 625>				IEC/IEEE bus interface, pin assignments in accordance with standard

Filter board

Pin	Name	Input/output	Origin/ destination	Value range	Signal description
X1.1				0 V	ground
X1.2	-INP	input	W3.5	0 to -15 V	measuring input AC probe amplifier
X1.3	+ INP	input	W3.4	0 to + 15 V	measuring input AC probe amplifier
X1.4	DCINP	input	W3.7	0 to 45 µA	measuring input DC probe amplifier
X1.5	RGND/VEE	input/output	W3.3	0/-12 V	voltage supply for measuring head
X1.6	MKTEMP	input/output	W3.9	0/-0.3/-3 V	temperature sensor
X1.7	MKCLK	output	W3.10	CMOS	read clock for data memory
X1.8	DATA	input/output	W3.11	CMOS	serial data from data memory
X1.9	MKRESET	output	W3.12	CMOS	reset for data memory
X1.10	MKID	input	W3.13	TTL	measuring head identification
X1.11	VCC	output	W3.14	0/ + 5/ + 12 V	voltage supply for measuring head
X1.12				0 V	ground
	w/o ref.	input/output	X1.5	0 V	ground
	SCHIRM	input/output		0 V	ground
W3.1	RGND	input/output	X1.3	0 V/-12 V	voltage supply for measuring head
W3.2			X1.2		
W3.3	+ INP	output		0 to 14 V	measuring input AC probe amplifier
	-INP	output	X1.4	0 to 14 V	measuring input AC probe amplifier
W3.4	w/o ref.	input/output		0 V	ground
W3.5	DC INP	output	X1.6	0 to 400 V	measuring input DC probe amplifier
W3.6	w/o ref.	input/output	X1.7	0 V	ground
W3.7	MKTEMP	output	X1.8	0 to -3 V	temperature sensor
W3.8	MKCLK	input	X1.9	TTL	read clock for data memory
W3.9	DATA	input/output	X1.10	TTL	serial data from data memory
W3.10	MKRESET	input	X1.11	CMOS	reset for data memory
W3.11	MKID	output		TTL	measuring head identification
W3.12	V_{CC}	input		0/ + 5 V/ + 12 V	voltage supply for measuring head
W3.13					
W3.14	w/o ref.	input/output		0 V	ground
	DGND	input/output		0 V	ground
W3.15					
W3.16					

Display board

Pin	Name	Input/output	Origin/ destination	Value range	Signal description
X1.1	RD	input	D5.5	CMOS	read signal
X1.2	WR	input	D5.6	CMOS	write signal
X1.3	A0	input	D5.4	CMOS	address 0
X1.4	A1	input	D5.3	CMOS	address 1
X1.5	UE	input	S19	5.6 to 8.5 V	voltage for input signal
X1.6	RESLCD	input	D1 to 4.13	CMOS	reset for LCD driver
X1.7	D7	input/output	D5.44	CMOS	data bus
X1.8	TASTINT	output	D5.11	TTL	key interrupt
X1.9	D5	input/output	D5.46	CMOS	data bus
X1.10	D6	input/output	D5.45	CMOS	data bus
X1.11	D3	input/output	D5.48	CMOS	data bus
X1.12	D4	input/output	D5.47	CMOS	data bus
X1.13	D1	input/output	D5.50	CMOS	data bus
X1.14	D2	input/output	D5.49	CMOS	data bus
X1.15	CS KEY	input	D5.9	CMOS	chip select for KEYINT
X1.16	D0	input/output	D5.51	CMOS	data bus
X1.17	C/D	input	D1 to 4.12	CMOS	control line for LCD driver
X1.18	RES	input	D5.52	CMOS	reset signal for keyboard chip
X1.19	SI	input	D1 to 4.9	TTL	serial input
X1.20	SCK	input	D1 to 4.8	TTL	serial clock
X1.21	CS2	input	D2.10	CMOS	chip select for LCD driver 2
X1.22	CS4	input	D4.10	CMOS	chip select for LCD driver 4
X1.23	BUSY	output	D1 to 4.11	CMOS	acknowledge of LCD driver
X1.24	CS1	input	D1.10	CMOS	chip select for LCD driver 1
X1.25	EIN	output	S19	5.0 to 8 V	on/off signal
X1.26	CS3	input	D3.10	CMOS	chip select for LCD driver 3
X1.28	LED1	input	V1.2	CMOS	DATA LED
X1.29	DGND	input/output		0 V	ground
X1.31	+5 VDIG	input	V1.1	4.75 to 5.25 V	voltage supply
X1.32	+5 VDIG	input	V1.1	4.75 to 5.25 V	voltage supply
X1.33	DGND	input/output		0 V	ground
X1.34	DGND	input/output		0 V	ground

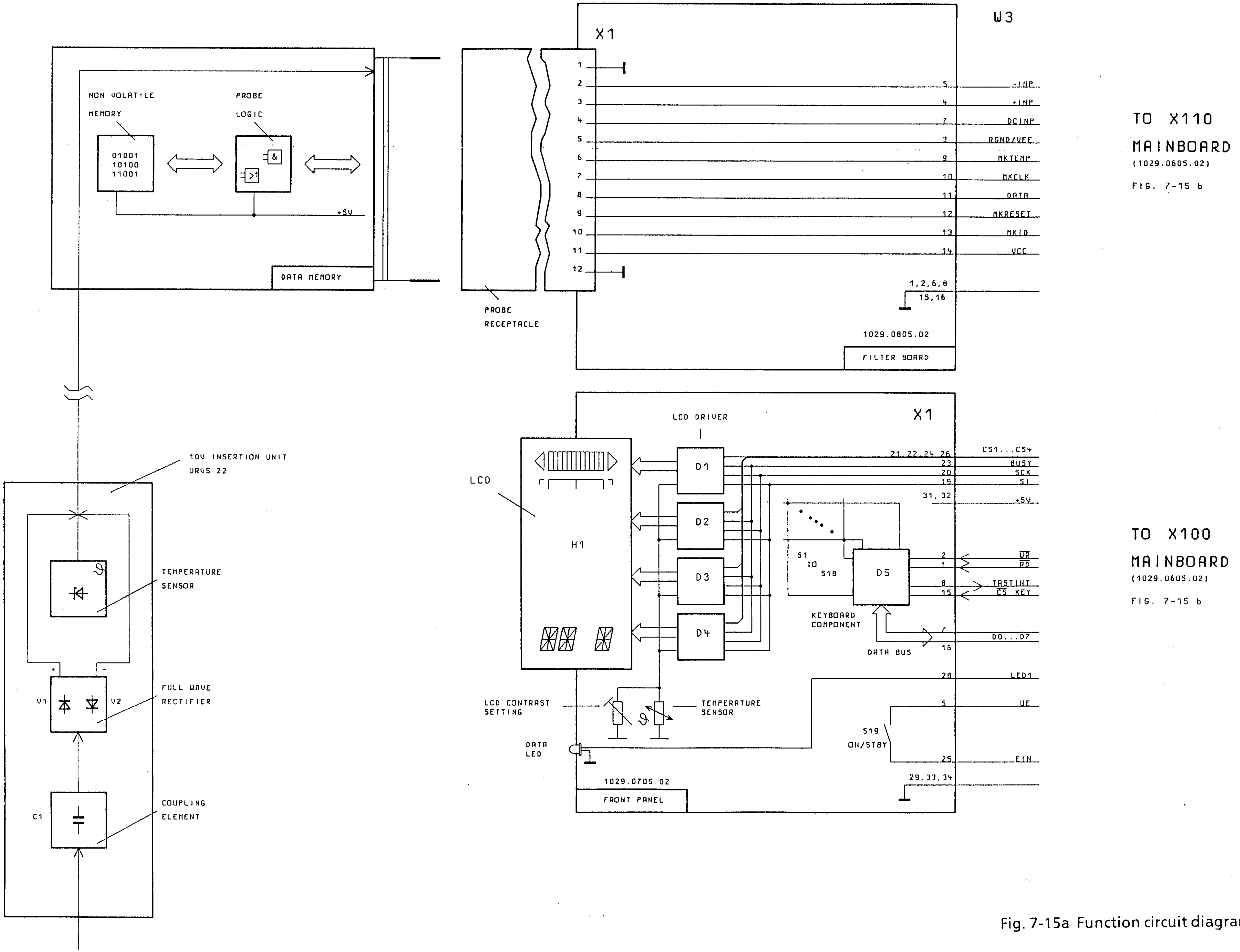
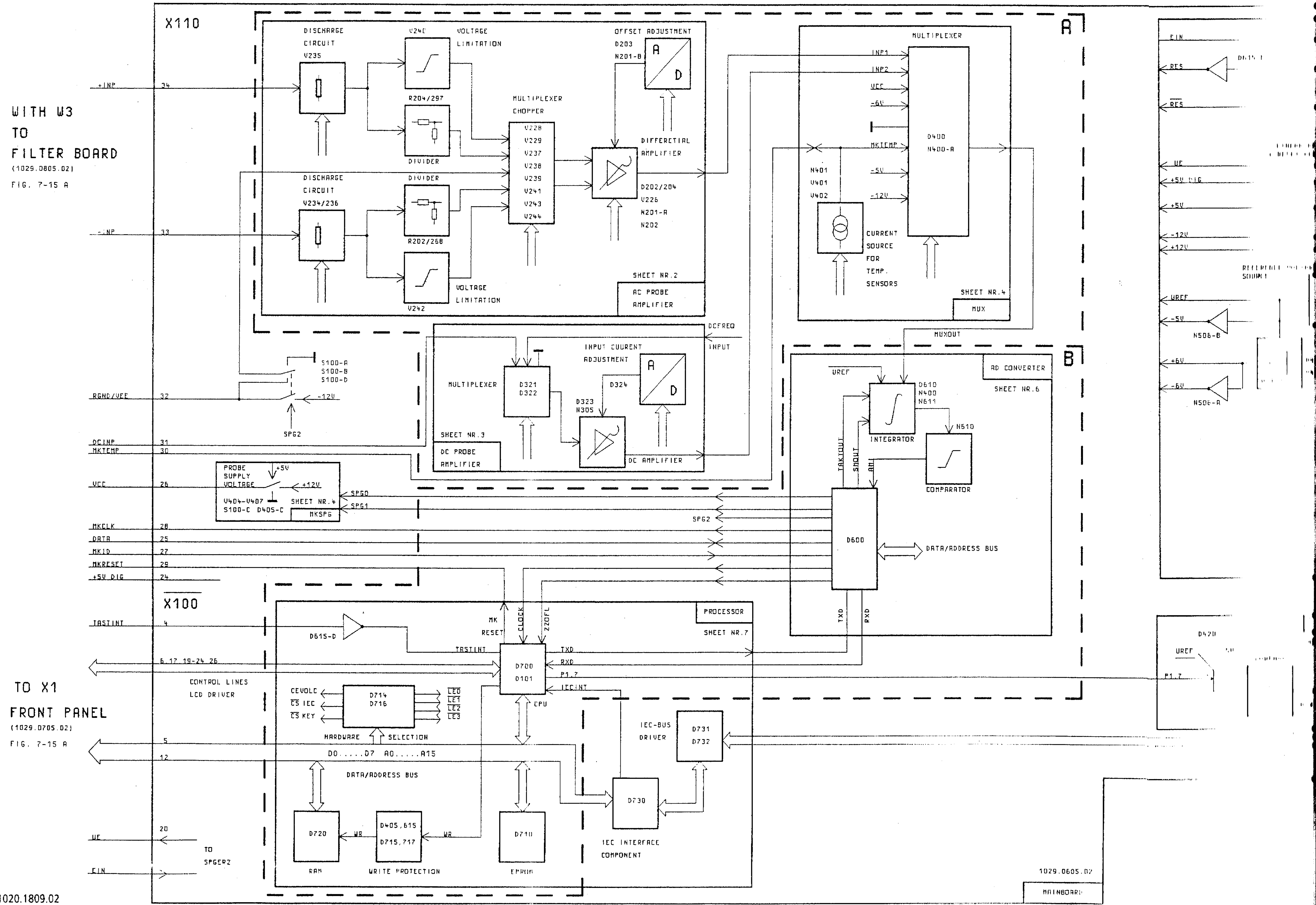


Fig. 7-15a Function circuit diagram


X110
WITH W3
TO
FILTER BOARD
(1029.0805.02)
FIG. 7-15 A
+INP 34
-INP 33
RGND/VEE 32
DCINP 31
MKTEMP 30
VCC 26
MKCLK 28
DATA 25
MKID 27
MKRESET 29
+5V DIG 24
DISCHARGE CIRCUIT V235
DISCHARGE CIRCUIT V234/236
V240
VOLTAGE LIMITATION
R204/297
DIVIDER
R202/268
V242
MULTIPLEXER CHOPPER
V228 V229 V237 V238 V239 V241 V243 V244
OFFSET ADJUSTMENT
D203
N201-B
A
D
DIFFERENTIAL AMPLIFIER
D202/204
V226
N201-A
N202
SHEET NR.2
AC PROBE AMPLIFIER
MULTIPLEXER
INP1
INP2
VCC
-6V
MKTEMP
-5V
-12V
D400
N400-A
N401
V401
V402
CURRENT SOURCE FOR TEMP. SENSORS
SHEET NR.4
MUX
A
B
S100-A
S100-B
S100-D
-12V
SPG2
DCFREQ
INPUT
INPUT CURRENT ADJUSTMENT
MULTIPLEXER
D321
D322
D324
D323
N305
SHEET NR.3
DC PROBE AMPLIFIER
DC AMPLIFIER
MUXOUT
AD CONVERTER
SHEET NR.6
UREF
D610
N400
N611
INTEGRATOR
N610
COMPARATOR
TAKTOUT
SMOUT
AH
D600
DATA/ADDRESS BUS
TXD
RXD
PROBE SUPPLY VOLTAGE
+5V
+12V
V404-V407
S100-C D405-C
SHEET NR.4
MKSPG
SPG0
SPG1
SPG2
X100
TASTINT 4
D615-D
MK RESET
CLOCK
220FL
PROCESSOR
SHEET NR.7
TASTINT
D700
D101
TXD
RXD
P1.7
IECINT
CPU
6,17,19-24,26
CONTROL LINES
LCD DRIVER
TO X1
FRONT PANEL
(1029.0705.02)
FIG. 7-15 A
CEVOLC
CS IEC
CS KEY
D714
D716
LE0
LE1
LE2
LE3
HARDWARE SELECTION
5
12
D0.....D7 A0.....A15
DATA/ADDRESS BUS
IEC-BUS DRIVER
D731
D732
D730
IEC INTERFACE COMPONENT
UE 20
EIN
TO SPGEPZ
D720
RAM
WR
D405,615
D715,717
WRITE PROTECTION
D710
EPROM
EIN
RES
RES
UE
+5V DIG
+5V
-12V
+12V
UREF
-5V
N506-B
+6V
-6V
N506-A
D420
UREF
P1.7
1029.0605.02
MAINBOARD

1020.1809.02

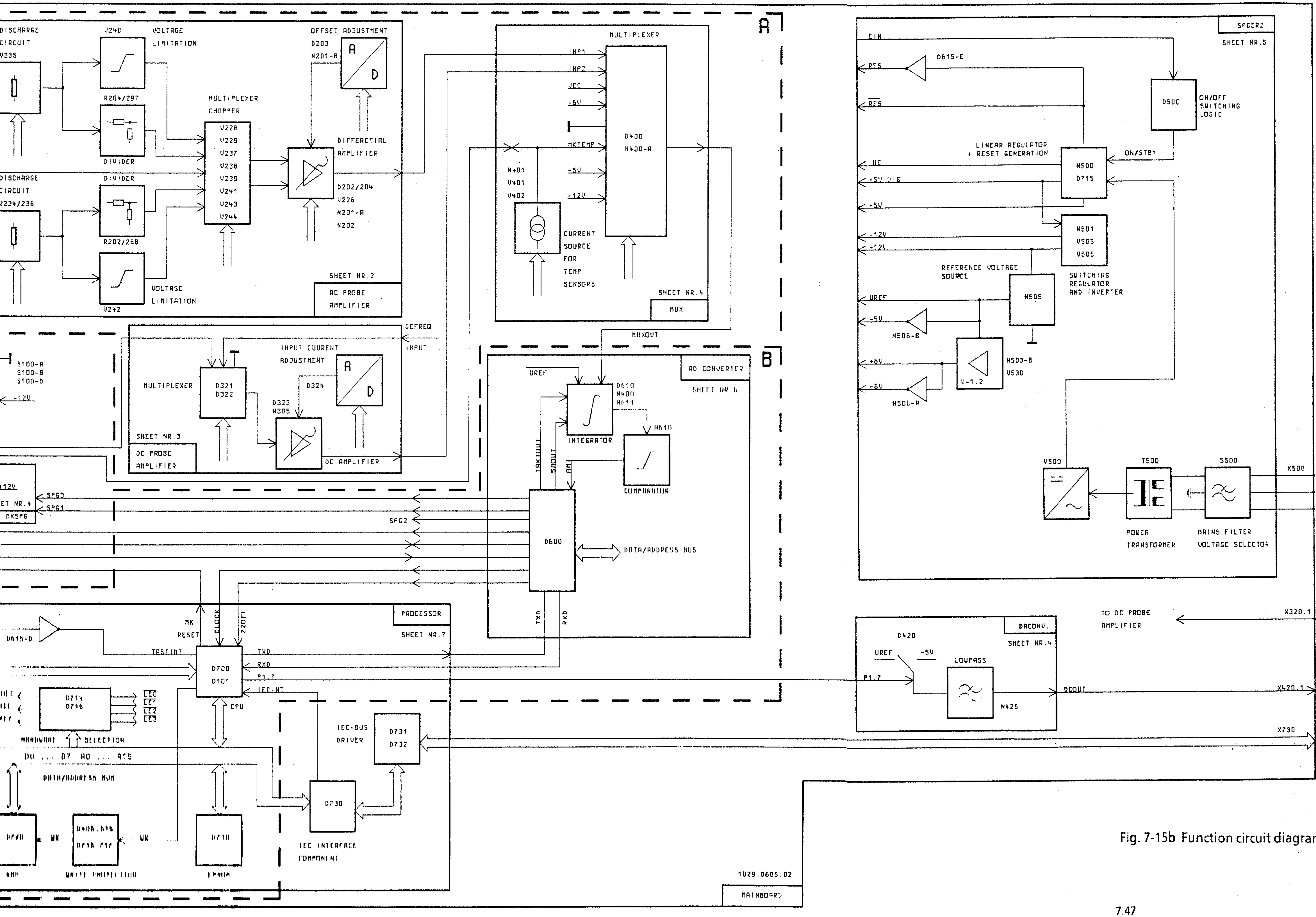


Fig. 7-15b Function circuit diagram

ROHDE&SCHWARZ

Liste mechanischer Teile

Bilder und Erklärung zur Liste mechanischer Teile

List of mechanical parts

Figures and explanation pertaining to list of mechanical parts

Liste des pièces mécaniques

Figures et définitions pour liste des pièces mécaniques

(R 48 010 - 1)
095.1000 Bl. 13

Liste mechanischer Teile

Der NRVS/URV55 ist in ***R&S-Kompaktbauweise 90*** aufgebaut.

Gehäusegröße:
2E, 1 /2, T350

Maße über alles:
220 × 103 × 355 (B × H × T)

Ergänzungen:
19"-Adapter ZZA-92
KS 396.4886.00

List of mechanical parts

The NRVS/URV55 is designed in accordance with the ***R&S design 90***.

Cabinet size:
2E, 1 /2, T350

Overall dimensions:
220 × 103 × 355 (width × height × depth)

Accessories:
19"-Adapter ZZA-92
KS 396.4886.00

Lfd. Nr.	Kenn-zeichen	Menge	Benennung/Beschreibung	Sachnummer
No	Unit/ Comp.No	Qty	Designation	Stock No.
1		1	Haube, oben 2E, 1 /2, T350 Cover, top	350.6128
2		1	Haube, unten 2E, 1 /2, T350 Cover, bottom	350.6157
8		2	Gerätefuß, vorne Instrument foot, front	396.4534
9		2	Aufstellfuß, unten Foot, bottom	396.4540
11		2	Gerätefuß, hinten Instrument foot, rear	396.4586
12		8	Zapfen Pin	396.4634
15		2	Seitenleiste T350 Side strip	396.3073
16		4	M3 x 6 DIN965 A4	081.9378
17		1	Rückwandfuß, links 2E Rear-panel foot, left	396.4305
18		1	Rückwandfuß, rechts 2E Rear-panel foot, right	396.4092
21		1	Tragegriff T350 Carrying handle	396.3215
22		2	Griffbuchse DRM24 Washer	396.3367
23		2	M4 x 10 DIN965 A4	081.9478

Lfd. Nr.	Kenn-zeichen	Menge	Benennung/Beschreibung	Sachnummer
No	Unit/ Comp.No	Qty	Designation	Stock No.
24		2	Abdeckung, Griffseite Cover, handle side	396.3350
25		2	Abdeckung, Leerseite Cover, blank side	396.3344
30		1	Frontrahmen 2E 1/2 Front frame	827.2382
31		4	Seitenfuß Side foot	396.4692
32		2	Stapelnutabdeckung 1/2 Cover for groove	827.5369
40		1,0 M	HF-Dichtschnur O-Prof. 2,0 SI RF seal	396.1035

Gehäuse

Casing

Aufbau

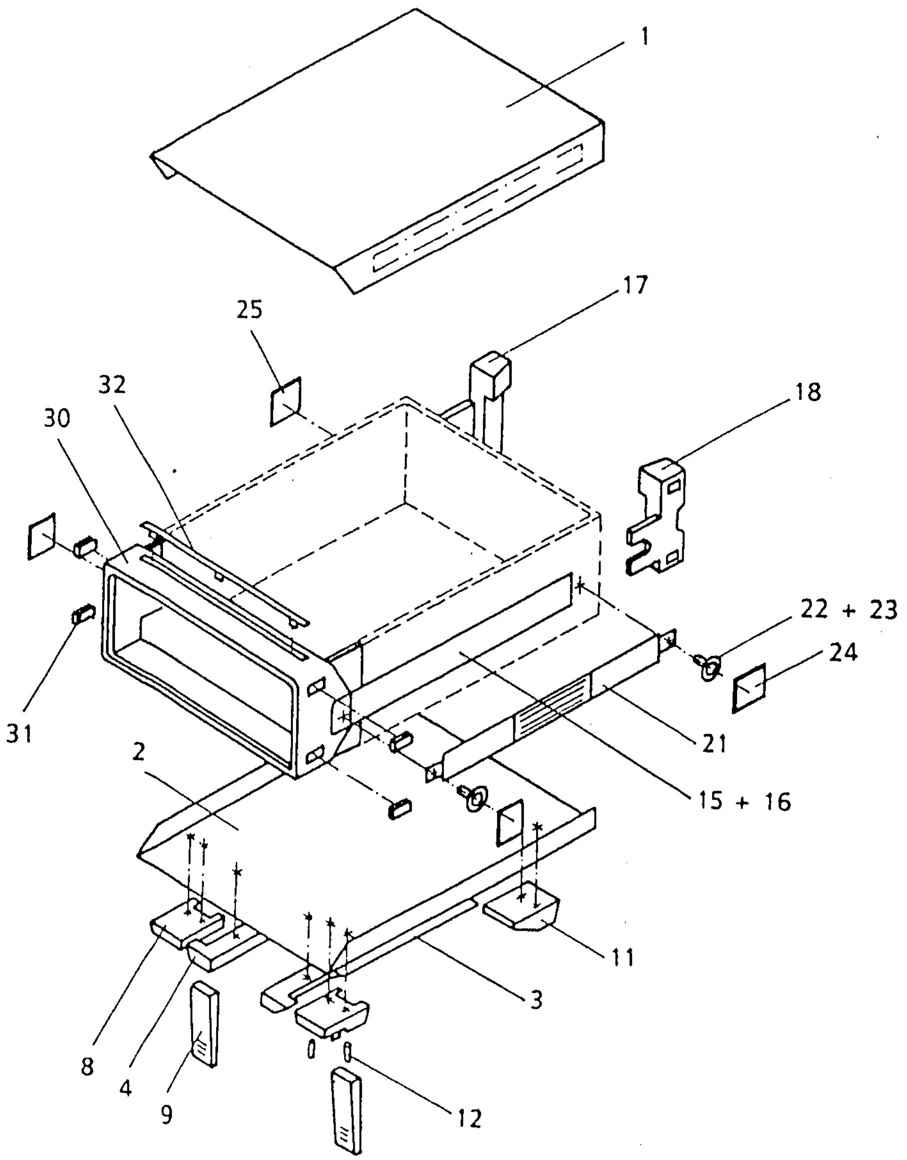
Construction

Der Aufbau besteht aus einer tragenden Aluminium-Druckguß-Rahmenkonstruktion mit gerätespezifischer Front-, Montage- und Rückplatte, die mit einer Ober- und Unterhaube (= Beplankung) ummantelt ist.

The construction consists of a self-supporting aluminium-cast frame with front, mounting and rear panel, top and bottom covers (= panelling).

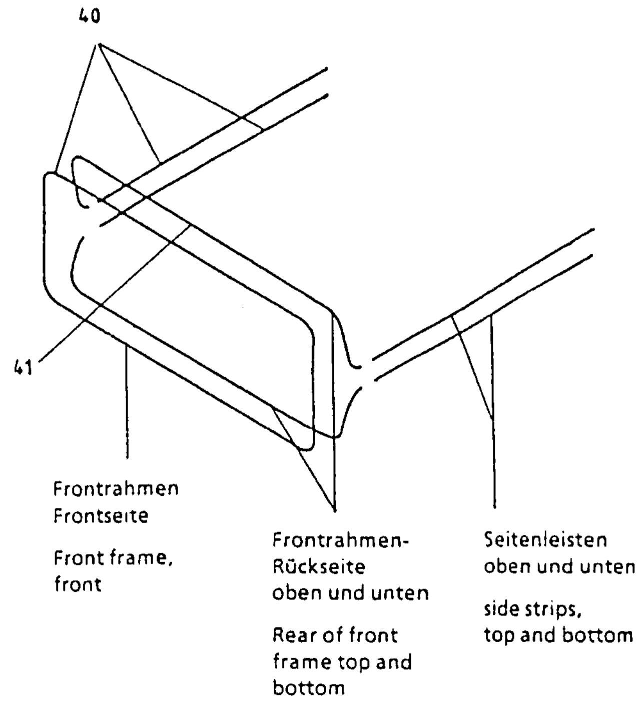
Rahmen und Beplankung:

Frame and panelling:



Dichtschnur (nur bei Geräten mit erhöhtem Schirmdämpfungsbedarf vorhanden) jeweils in die umlaufende Nut einlegen.

Insert the braided cord (provided only for instruments requiring a high degree of shielding) into the respective groove.



Die Dichtschnur in der Frontrahmen-Frontseite muß durch Klebepunkte in Abständen von ca. 80 mm fixiert werden. Dazu Klebepunkte mit ca. ø2 mm im Nutgrund anbringen und Dichtschnur aufdrücken.
Dauerhaft elastischen Kleber wie z.B. Si-Kautschuk 3145 RTV (R&S-Sachnr. WV 088.3152) verwenden.

The braided cord in the front of front frame must be fixed by glued joints approx. every 80 mm. Make joints (ø approx. 2 mm) on the bottom of the groove and press braided cord firmly on it.

Use a permanently elastic adhesive, such as Si-rubber 3145 RTV (R&S Part No. WV 088.3152).

Öffnen und Schließen des Gehäuses

Opening and closing the cabinet

Die gute Schirmdämpfung der Kompaktbauweise 90 erfordert häufige Kontaktstellen und hohe Paßgenauigkeit. In Verbindung mit einem leichten Anlagedruck, der mit dem Festziehen der Rückwandfußschrauben erreicht wird, erhält man einen straffen Sitz der Ober- und Unterhaube auf dem Rahmen.

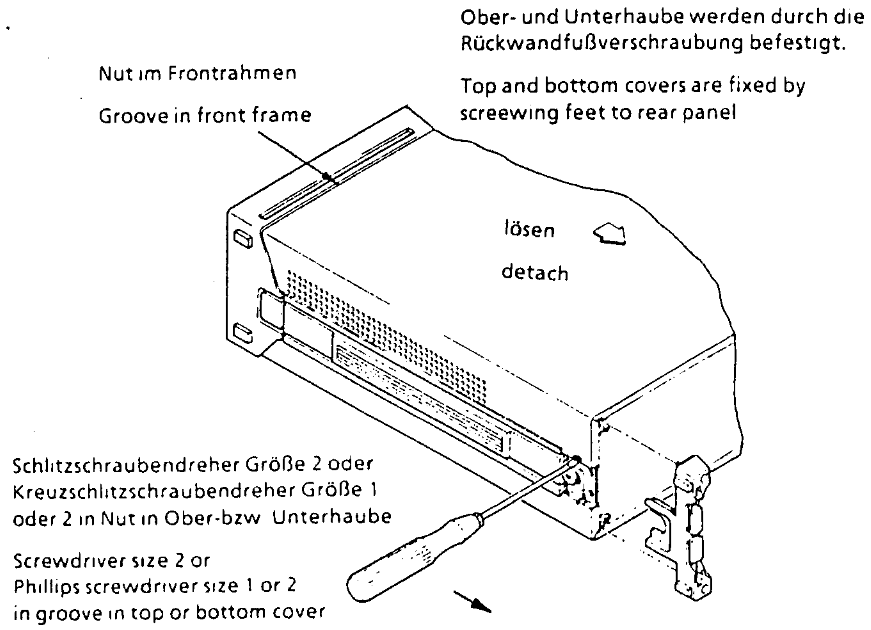
To obtain the high degree of shielding of design 90, many points of contact and accurate fitting are employed. When exerting a slight pressure by tightening the rear-panel feet, tight fitting of the top and bottom covers is ensured.

Zum *Öffnen* muß man die Rückwandfußverschraubung lösen und die Füße nach rückwärts abziehen (Schrauben bleiben im Fuß haften). Je nach Bedarf läßt sich nun Ober- bzw. Unterhaube ebenfalls nach rückwärts abnehmen. Sitzen die Hauben sehr fest, erleichtert man das Abziehen durch abwechselndes Hebeln in Pfeilrichtung mit einem Schraubenzieher an beiden Geräteseiten (siehe Bild).

To *open* the cabinet, first undo the rear panel feet screws and withdraw the feet (captive screws). It is now possible to detach top and bottom cover if required. If the fitting of these cover plates is very tight, removal can be facilitated by alternately levering on both sides of the instrument using a screwdriver (see illustration).

Zum *Schließen* des Gehäuses werden erst die Frontkanten der Hauben in die umlaufende Nut des Frontrahmens und der Seitenleisten eingeführt und dann in die Erhöhungen am Rückrahmen bis Anschlag eingerastet. Das Gerät ist wieder geschlossen, wenn die Rückwandfüße eingeschoben und die Schrauben festgezogen sind.

To *close* the cabinet, insert the front edges of the covers into the groove of the front frame and the side strips and lock them into the catches on the rear frame into detent position. The cabinet is closed when the rear-panel feet are inserted and the screws tightened.



ROHDE&SCHWARZ

Schlüsselliste für Bauteile-Sachnummern

Code list for component stock Nos.

Liste des références des composants

(R 29500 Bl. 5)
095.1000 Bl. 5

ROHDE&SCHWARZ

R&S-Schlüsselliste
R&S key list
Liste des symboles de référence R&S

Die R&S-Schaltteillisten nennen in der Spalte "Benennung/Beschreibung" die technischen Daten der Bauelemente in Kurzform. Die Art des Bauelements (z.B. Schicht-, Draht-Widerstand usw.) beschreiben die 2 Kennbuchstaben vor der "Benennung" (evtl. auch vor der "Sachnummer"), die nachfolgend erklärt werden. In Ersatzteil-Bestellungen an R&S ist stets die Angabe der vollständigen Sachnummer erforderlich.

The R&S Parts Lists give the technical data of the components in short form in the column "Benennung/Beschreibung" (designation). The type of component (e.g. depos.-carbon resistor, wire-wound resistor etc.) is indicated by 2 identification letters before the designation, possibly also before the "Sachnummer" (order number), which are explained below. When ordering spare parts from R&S, the complete order number must always be specified.

La colonne «Désignation/description» des listes de pièces de R&S indique les caractéristiques des éléments sous forme abrégée. Le type d'élément (p. ex. résistance à couche, résistance bobinée etc....) est décrit par les deux lettres précédant la désignation (et éventuellement le numéro de référence), dont voici l'explication. Prière d'indiquer le numéro de référence («Sachnummer») complet dans toute commande de pièces de rechange.

Teilefamilie	Art des Bauelementes	Parts family	Type of component	Famille	Type d'élément
A	**Aktive Bauelemente, Halbleiter**	**A**	**Active components, semiconductors**	**A**	**Composants actifs, semiconducteurs**
AD	Universaldiode, z.B. Gleichrichter, Sperrdiode	AD	General-purpose diode, e.g. rectifier, high-resistance diode	AD	Diode d'usage général, p.ex. redresseur, diode à haute résistance
AE	Spezialdiode, z.B. Tunnel-, Kapazitäts-, Zener-Diode	AE	Diode (special), e.g. tunnel diode, varactor, Zener diode	AE	Diode spéciale, p.ex. diode tunnel, varactor, diode Zener
AF	Fotohalbleiter, z.B. Foto-Diode, -Transistor, -Widerstand, Leuchtdiode	AF	Photo-semiconductor, e.g. resistor, diode, transistor; LED	AF	Semiconducteur photoélectrique, p.ex. diode, transistor, résistance photoél., DEL
AG	Leistungs-Gleichrichter, z.B. Thyristor, Triac, Selengleichrichter	AG	Power rectifier, e.g. thyristor, triac, selenium rectifier	AG	Redresseur de puissance, p.ex. thyristor, triac, redresseur, au sélénium
AK	Kleinsignal-Transistor	AK	Small-signal transistor	AK	Transistor faible puissance
AL	Leistungs-Transistor	AL	High-power transistor	AL	Transistor grande puissance
AM	Spezial-Transistor, z.B. FET, MOSFET	AM	Transistor (special), e.g. FET, MOS-FET	AM	Transistor spécial, p.ex. TEC, MOSTEC
AP	Peltier-, Hall-Element	AP	Peltier element, Hall element	AP	Element Peltier, élement Hall
AR	Röhre für Empfänger, Verstärker, Gleichrichter	AR	Valve for receiver, amplifier, rectifier	AR	Tube pour récepteur, amplificateur, redresseur
AS	Spezialröhre, z.B. Senderöhre, EW-Widerstand, Stabilisator	AS	Valve (special), e.g. for transmitter, baretter, ballast valve	AS	Tube (spécial), p.ex. pour émetteur, résistance fer-hydrogène, ballast
AT	Katodenstrahlröhre, z.B. Bildröhre, Ziffern-Anzeigeröhre	AT	Cathode ray tube, e.g. picture tube, digital indicator tube	AT	Tube à rayon cathodique, p.ex. tube à image, tube à affichage numérique
AZ	Zubehör für Halbleiter u. Röhren	AZ	Accessories for semiconductors and valves	AZ	Accessoires pour semiconducteurs et tubes
B	**Bausteine**	**B**	**PC boards, chips**	**B**	**Cartes imprimées, puces**
BC	Integr. Schaltkreis (Microcomp.)	BC	Integrated circuit (interface, A/D)	BC	Circuit intégré (microprocesseur)
BD	R&S-Dünnschicht- und Dickschichtschaltung	BD	R&S thinfilm or thickfilm circuit	BD	Circuit R&S à couche mince ou épaisse
BG	R&S-spezifische Gate-Arrays	BG	R&S gate arrays	BG	Circuits intégrés prédiffusés R&S
BJ	Integrierter Schaltkreis (Interface, A/D-Wandler)	BJ	Integrated circuit (interface, A/D converter)	BJ	Circuit intégré (interface, convertisseur A/N)
BL	Log. Schaltkreis z.B. DTL, TTL, HTL, ECL, C-MOS	BL	Logic circuit, e.g. DTL, TTL, HTL, ECL, C-MOS	BL	Circuit logique, p.ex. DTL, TTL, HTL, ECL, C-MOS
BM	Hybridbaustein, z.B. Mischer, Tuner, Modulator	BM	Hybrid chip, e.g. mixer, tuner, modulator	BM	Puce hybride, p.ex. mélangeur, tuner, modulateur
BO	Analogschaltkreis, z.B. Operationsverstärker	BO	Analog circuit, e.g. operational amplifier	BO	Circuit analogique. p.ex. amplificateur opérationnel
BP	Optoelektronischer Baustein, z.B. Anzeigeeinheit, Koppler	BP	Optoelectronic component, e.g. display, coupler	BP	Composant optoélectronique, p.ex. afficheur, coupleur
BS	Schalt- und Steuerbaustein, elektronischer Sensor	BS	Switching and control modul, electronic sensor	BS	Modul de commutation et de commande, sonde électronique
BV	Stromversorgung, Übersp.-Schutz	BV	Power pack, protective circuit	BV	Alimentation, protection surcharge
BZ	Zubehör	BZ	Accessories	BZ	Accessoires

Teile-familie	Art des Bauelementes	Parts family	Type of component	Famil-le	Type d'élément
C	**Kondensatoren**	**C**	**Capacitors**	**C**	**Condensateurs**
CB	Bypass-, Durchf.-Kondensator	CB	Bypass capacitor, feed-through capacitor	CB	Condensateur bypass, condensateur de traversée
CC	Keramischer Kondensator	CC	Ceramic capacitor	CC	Condensateur céramique
CD	Drehkondensator	CD	Variable capacitor	CD	Condensateur variable
CE	Elektrolytkondensator	CE	Electrolytic capacitor	CE	Condensateur électrolytique
CG	Glimmerkondensator	CG	Mica capacitor	CG	Condensateur au mica
CH	Sperrschichtkondensator	CH	Semiconductor capacitor	CH	Condensateur semiconducteur
CK	Kunstfolienkondensator	CK	Synthetic-foil capacitor	CK	Condensateur à feuille synthétique
CL	Ker. Hochsp.-Kondensator	CL	HV capacitor (ceramic)	CL	Condensateur HT céramique,
CM	Metallpapier-Kondensator	CM	MP capacitor	CM	Condensateur à papier métallisé
CN	Kondensatornetzwerk	CN	Capacitor network	CN	Réseau capacitif
CP	Papierkondensator	CP	Paper capacitor	CP	Condensateur au papier
CS	Störschutzkondensator	CS	Interference-suppression capacitor	CS	Condensateur anti-parasite
CT	Trimmkondensator	CT	Trimmer capacitor	CT	Condensateur ajustable
CV	Vakuum-Kondensator	CV	Vacuum capacitor	CV	Condensateur à vide
D	**Drähte, Leitungen**	**D**	**Wires, lines**	**D**	**Fils, lignes**
DD	Schalt- und Wickeldraht	DD	Hook-up or winding wire	DD	Fil de câblage, fil de bobinage
DF	Flachleitung, Litze	DF	Flat multiple line, stranded wire	DF	Ligne plate, ligne torsadée
DG	Abgeschirmte Leitung	DG	Shielded line	DG	Ligne blindé
DH	Koaxialkabel	DH	Coaxial line	DH	Ligne coaxiale
DJ	Isolierschläuche, Schrumpfschläuche, Wellrohre, Schutzschläuche	DJ	Insulating sheaths, shrink-on sleeves, corrugated tubes, protective tubes	DJ	Gaines isolantes, gaines thermorétractables tubes ondulés, gaines protectrices
DL	HF-Litzen	DL	RF stranded wires	DL	Lignes torsadées RF
DM	Schaltlitzen (mehrdrähtige Leiter)	DM	Multi-conductor wires	DM	Lignes torsadées (multiconducteurs)
DN	Antenne	DN	Antenna	DN	Antenne
DO	Lichtleiter (optisch)	DO	Optical waveguides	DO	Guides d'onde optiques
DP	Leiterplatten (unbestückt)	DP	Printed circuit boards (bare)	DP	Cartes imprimées (non équipées)
DQ	Multilayer (unbestückt)	DQ	Multilayer boards (bare)	DQ	Cartes multicouche (non équipées)
DS	Anschlußkabel (mehradrig)	DS	Connecting cable, multicore	DS	Câble de connexion (multiconducteur)
DU	Substratplatten für Dickschichtschaltungen	DU	Substrate boards for thickfilm circuits	DU	Cartes à substrat pour circuits à couche épaisse
DW	Festmantelkabel	DW	Rigid cables	DW	Câbles rigides
E	**Elektrische Teile**	**E**	**Electric parts**	**E**	**Organes électriques**
EB	Blei-, NC-Akku, Batterie	EB	Lead or alkaline accumulator, battery	EB	Accumulateur Pb/NC, batterie
ED	Gedruckte Schaltung (bestückte Leiterplatte), nicht steckbar	ED	Printed circuits (assembled), non-pluggable	ED	Circuits imprimés (équipés) non enfichables
EE	Gedruckte Schaltung (bestückte Leiterplatte), steckbar	EE	Printed circuits (assembled), pluggable	EE	Circuits imprimés (équipés) enfichables
EF	Glühlampe, Leuchte	EF	Incandescent lamp, pilot lamp	EF	Lampe à incandescence, voyant
EG	Glimmlampe, Entladungslampe	EG	Glow lamp, discharge lamp	EG	Lampe à luminescence lampe à décharge
EK	Kontakt-Streifen, -Feder	EK	Contact clip, contact spring	EK	Lampe de contact, ressort de contact
EL	Lautsprecher, Kopfhörer, Mikrofon	EL	Loudspeaker, headphones, microphone	EL	Haut-parleur, casque, microphone
EM	Motor, Hubmagnet, Drehfeldsystem	EM	Motor, lifting magnet, synchro system	EM	Moteur, électro-aimant de levage, système synchro
EO	Oszillator, z.B. Quarzoszillator	EO	Oscillator, e.g. crystal oscillator	EO	Oscillateur p.ex. oscillateur à quartz
EP	Tief-, Band-, Hochpaß, Bandsperre, Diskriminator	EP	Lowpass, bandpass, highpass filter, band-stop filter, discriminator	EP	Filtre passe-bas, passe-bande, passe-haut, suppression de bande, discriminateur
EQ	Schwing-, Filter-Quarz	EQ	Oscillator or filter crystal	EQ	Quartz oscillateur, quartz de filtre
ER	Resonator, piezoelektr./magnetostriktiv	ER	Resonator, piezoelectric/ magnetostrictive	ER	Résonateur piézo-électrique/ magneto-strictif
ES	Passive SHF-Bauteile	ES	Passive SHF-components	ES	Composant SHF passif
ET	Thermostat	ET	Thermostat	ET	Thermostat
EV	Lüfter, Gebläse	EV	Ventilator, blower	EV	Ventilateur, soufflerie

ROHDE & SCHWARZ

Teile-familie	Art des Bauelementes	Parts family	Type of component	Famil-le	Type d'élément
F	**Fassungen, Steckverbindungen**	**F**	**Sockets, connectors**	**F**	**Douilles, connecteurs**
FG	Koax-Umrüstsatz	FG	Coaxial screw-in assembly	FG	Ensemble vissable coaxial
FH	Koax-Übergang auf Fremdsystem	FH	Coaxial adapter	FH	Adaptateur coaxial
FJ	BNC-Systemteil	FJ	BNC screw-in assembly	FJ	Ensemble vissable BNC
FK	Koaxial-UHF-Systemteil	FK	Coaxial UHF screw-in assembly	FK	Ensemble vissable coaxial UHF
FM	Mehrfachstecker, Buchsenleiste	FM	Multipoint connector	FM	Connecteur multiple
FN	Netz-Steckverbindung	FN	AC-supply connector	FN	Connecteur secteur
FO	Runde Mehrfach-Steckverbindung	FO	Round multipoint connector	FO	Connecteur multipoles rond
FP	Druckschalt-Steckverbindung	FP	Multipoint connector for PC boards	FP	Connecteur multipoles pour cartes imprimées
FR	Fassung für Lampe, Sicherung, usw.	FR	Socket for lamp, fuse, etc.	FR	Douille pour lampe, fusible etc. . . .
FT	Schwachstrom-Steckverbindung	FT	LV plug and socket	FT	Connecteur pour faible courant
FU	Hochspannungs-Steckverbindung	FU	HV plug and socket	FU	Connecteur pour haute tension
FV	Verbinder (z.B. AMP)	FV	Push-on connector	FV	Connecteur à enfichage
FZ	Zubehör für koax. Bauelemente	FZ	Accessories for coax. components	FZ	Accessoires pour composants coax.
H	**Software**	**H**	**Software**	**H**	**Logiciel**
HP	Software-Komponenten und Software-Module	HP	Rights to software components and software modules	HP	Droits d'utilisation de composants et modules logiciel
HS	Auf Informationsträger geladene Software	HS	Software data media	HS	Logiciel sur support d'information
J	**Meßinstrumente**	**J**	**Indicators**	**J**	**Indicateurs**
JD	Drehspul-Anzeigeinstrument	JD	Moving-coil meter	JD	Galvanomètre à cadre mobile
JE	Dreheisen-Anzeigeinstrument	JE	Moving-iron meter	JE	Galvanomètre à fer mobile
JF	Frequenzmesser	JF	Frequency meter	JF	Fréquencemètre
JG	Drehspulinstrument mit Gleichrichter	JG	Moving-coil meter with rectifier	JG	Galvanomètre à cadre mobile avec redresseur
JH	Betriebsstundenzähler	JH	Operating-hours counter	JH	Compteur d'heures de fonctionnement
JJ	Impulszähler	JJ	Pulse counter	JJ	Compteur d'impulsions
JK	Kleinst-Instrument, z.B. Abstimmanzeiger	JK	Mini-instrument, e.g. tuning indicator	JK	Petit indicateur, p.ex. indicateur d'accord
JM	Mechanisches Zählwerk	JM	Mechanical counter	JM	Compteur mécanique
JP	Projektions-Instrument (Leuchtziffer)	JP	Digital display	JP	Afficheur numérique
JQ	Quotientenmesser (Kreuzspulinstrum.)	JQ	Ratiometer (cross coul)	JQ	Quotientmètre (à cadres croisés)
JU	Uhrwerk	JU	Clockwork	JU	Mouvement d'horlogerie
JW	Elektrodyn. Anzeigeinstrument	JW	Electrodynamic meter	JW	Instrument électrodynamique
L	**Induktivitäten, Magnetik**	**L**	**Inductors, magnetic components**	**L**	**Composants inductifs et magnétiques**
LB	Blech- und Schnittbandkern mit Zubehör	LB	Laminated and C-cores with accessories	LB	Noyaux feuilletés et noyaux de type C, avec accessoires
LC	Keramische Spule	LC	Ceramic coil	LC	Bobine céramique
LD	Netz-, HF-Drossel, Df-Filter	LD	Choke, lead-through filter	LD	Self de choc, filtre de traversée
LE	Einzelkreis, Bandfilter	LE	Single tuned circuit, bandpass filter	LE	Circuit accordé, filtre passe-bande
LF	Ferritkern mit Zubehör	LF	Ferrite cores with accessories	LF	Noyaux en ferrite avec accessoires
LK	Karbonyleisenkern und elektrischer Kupferkern mit Zubehör	LK	Iron carbonyl slugs and copper slugs with accessories	LK	Noyaux en fer carbonyle et en cuivre, avec accessoires
LL	Luftspule	LL	Air-core coils	LL	Bobines à air
LM	Magnetband und -platte	LM	Magnetic tapes and disks	LM	Bandes et disques magnétiques
LS	Schirmbecher	LS	Screening cans	LS	Boîtiers de blindage
LT	Netztransformator	LT	Power transformer	LT	Transformateur secteur
LU	NF-Übertrager	LU	AF transformer	LU	Transformateur BF
LV	Variometer	LV	Variometer	LV	Variomètre
LW	Wickelkörper, allgemein	LW	Coil formers, general	LW	Carcasses de bobine, en général

Teile-familie	Art des Bauelementes	Parts family	Type of component	Famil-le	Type d'élément
R	**Widerstände**	**R**	**Resistors**	**R**	**Résistances**
RD	Drahtwiderstand	RD	Wire-wound resistor	RD	Résistance bobinée
RF	Kohleschicht-Widerstand	RF	Carbon-film resistor	RF	Résistance à couche de carbone
RG	Metallglasur-Widerstand	RG	Metal-coated resistor	RG	Résistance à couche métallique
RJ	Metalloxyd-Widerstand	RJ	Metal-oxide resistor	RJ	Résistance à oxyde métallique
RK	Kaltleiter, Heißleiter, Varistor	RK	PTC, NTC resistors, varistors	RK	Résistances CPT, CNT, varistors
RL	Metallfilm-Widerstand	RL	Metal-film resistor	RL	Résistance à film métallique
RN	Widerstandsnetzwerk	RN	Resistor network	RN	Réseau de résistance
RR	Draht-Potentiometer	RR	Wire-wound potentiometer	RR	Potentiomètre bobiné
RS	Schicht-Potentiometer	RS	Carbon-film potentiometer	RS	Potentiomètre à couche
RT	Dämpfungsglied, Abschlußwiderstand	RT	Attenuator, termination	RT	Atténuateur, charge
RV	Drahtwiderstand mit Abgriff	RV	Wire-wound resistor, tapped	RV	Résistance bobinée à prise
RW	Wendelpotentiometer	RW	Helical potentiometer	RW	Potentiomètre hélicoidal
S	**Schalter, Relais, Sicherungen**	**S**	**Switches, relays, fuses**	**S**	**Commutateurs, relais, fusibles**
SB	Drucktastenschalter	SB	Pushbutton switch	SB	Commutateur à touche
SD	Drehschalter	SD	Rotary switch	SD	Commutateur rotatif
SF	Kontaktfedersatz	SF	Spring contact assembly	SF	Jeu de ressorts de contact
SH	HF-Koaxialschalter, -Relais, -Teiler	SH	Coaxial RF switch, RF relay, RF attenuator	SH	Commutateur RF coaxial, relais RF, atténuateur RF
SK	Kipp-, Wipp- und Schiebeschalter	SK	Toggle switch, slide switch	SK	Commutateur à bascule, à glissière
SL	Leistungsschalter Netz/HF	SL	AC supply switch, high-power RF switch	SL	Commutateur secteur, de puissance RF
SM	Mikroschalter	SM	Microswitch	SM	Microrupteur
SN	Elektromagnet, Relais	SN	Electromagnetic relay	SN	Relais électromagnétique
SP	Leistungsrelais, Luftschütz	SP	Power relay, air-type contactor	SP	Relais de puissance, contacteur à air
SR	Reedrelais	SR	Reed relay	SR	Relais reed
SS	Sicherung, Schutzschalter	SS	Fuse, automatic cut-out	SS	Fusible, coupe-circuit automatique
ST	Thermoschalter	ST	Thermal circuit breaker	ST	Disjoncteur thermique
SU	Überspannungs-Ableiter	SU	Arrester	SU	Eclateur
SW	Wechselrichter, Näherungsschalter	SW	Inverter (DC-AC), proximity switch	SW	Inverseur (DC-AC), commutateur de proximité
SZ	Zeitschalter	SZ	Time switch	SZ	Interrupteur horaire
V	**Verbindungselemente**	**V**	**Connecting elements**	**V**	**Eléments de raccordement**
VK	Klemme, Klemmleiste	VK	Clamp, terminal strip	VK	Pince, réglette à bornes
VL	Lötöse, Stützpunkt	VL	Soldering lug	VL	Cosse à souder
VS	Schraube, Mutter, Scheibe	VS	Screw, nut, washer	VS	Vis, écrou, disque

Farbcode für Widerstände und Kondensatoren

Anmerkung:
Die Wertangabe der weitgehend miniaturisierten Bauelemente erfolgt überwiegend durch Farbkennzeichnungen, deren Bedeutung der nachfolgenden Tabelle entnommen werden kann.

Hinweis:
Im Zuge des technischen Fortschrittes setzt R&S zunehmend Metallschichtwiderstände mit 1% Toleranz anstelle von Kohleschichtwiderständen mit 5% Toleranz ein. Metallschichtwiderstände können sich dabei an Stellen befinden, an denen gemäß Schaltteilliste Kohleschichtwiderstände vorgesehen sind. Etwaige geringfügige Differenzen der Nennwerte zwischen Stromlaufplan, Schaltteilliste und Gerät liegen im zulässigen Toleranzbereich.

Colour code for resistors and capacitors

Note:
The electrical values of the largely miniaturized components are mainly identified by a colour code, the meaning of which can be taken from the table below.

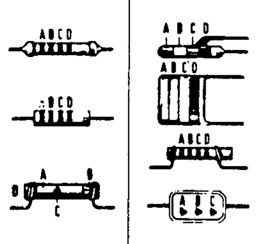
N. B.:
Following the state of the art R&S makes increasing use of metal-film resistors (1% tolerance) instead of carbon-film resistors (5% tolerance). Metal-film resistors may have been employed where carbon-film resistors are specified in the parts list. Any slight differences of nominal values between circuit diagram, parts list and equipment are within tolerance.

Code couleur pour résistances et condensateurs

Remarque:
Les valeurs électriques des composants fort miniaturisés sont indiquées dans la plupart des cas par un code couleur dont voici l'explication.

N. B.:
Suivant le progres technique R&S utilise de plus en plus des résistances à film métallique (tolérance 1%) au lieu des résistances à couche de carbone (tolérance 5%). Des résistances à film metallique peuvent se trouver en des points où des types à couche de carbone figurent dans la liste des composants. Les différences minimes des valeurs nominales existant eventuellement entre le schéma de circuit, la liste des composants et l'appareil sont dans la marge de tolérance.

Farbe/Colour/Couleur	A	B	C	D	Anordnungsbeispiele für Examples for / Exemple pour	
Schwarz/Black/Noir	—	0			Widerstände (R)	Kondensat. (C)
Braun/Brown/Marron	1	1	0	± 1%	Resistors (R)	Capacitors (C)
Rot/Red/Rouge	2	2	00	± 2%	Résistance (R)	Condensateur (C)
Orange/Orangé	3	3	000			
Gelb/Yellow/Jaune	4	4	0000			
Grün/Green/Vert	5	5	00000	± 0,5%		
Blau/Blue/Bleu	6	6	000000			
Violett/Violet	7	7	—	± 0,1%		
Grau/Gray/Gris	8	8	—			
Weiß/White/Blanc	9	9	—			
Gold/Doré	—	—	—	± 5%		
Silber/Silver/Argenté	—	—	—	± 10%		
Ohne Farbe/No colour/ Pas de couleur	—	—	—	± 20%		



1) Toleranzring, hier nicht spezifiziert.
1) Tolerance ring, here not specified.
1) Anneau de tolérance, ne pas spécifié ici.

Definition* / Définition *

Kennzeichen A (Bauteilfarbe/1. Farbring) = 1. Zahl
Kennzeichen B (Bauteilende/2. Farbring) = 2. Zahl
Kennzeichen C (Punkt/3. Farbring) - 3. Zahl = Zahl der Nullen
Kennzeichen D (Punkt/4. Farbring) = Toleranz des Nennwerts in % (Fehlendes Kennzeichen für D bedeutet ±20%)
Das Fehlen eines Kennzeichens bedeutet, daß die Farbe des Bauteilkörpers die Wertangabe darstellt.

Marking A (body colour or first coloured ring) = 1st digit
Marking B (body end or second coloured ring) = 2nd digit
Marking C (dot or third coloured ring) = number of zeroes
Marking D (dot or fourth coloured ring) = tolerance on nominal value in % (with no D marking tolerance ± 20%)
The absence of a marking signifies that the body colour gives the corresponding information.

Repérage A (couleur du corps ou 1er anneau) = 1er chiffre
Repérage B (bout du corps ou 2e anneau) = 2e chiffre
Repérage C (point ou 3e anneau) = nombre de zéros.
Repérage D (point ou 4e anneau) = tolérance en % de la valeur nominale (L'absence du repérage D signifie ± 20%)
L'absence de tout repérage signifie que la couleur du corps du composant représente la valeur correspondante.

* Siehe auch DIN 41 429 und DIN 40 825
* see also IEC publication 62-1952 and 62-1968
* Voir aussi DIN 41 429 et DIN 40 825

ROHDE&SCHWARZ

Zusammenstellung der lieferbaren Netzkabel
List of power cables available
Liste des câbles d'alimentation disponibles

Sach-Nr. Stock No. Référence	Schutzkontaktstecker nach: Earthed-contact connector: Fiche à contact de protection:	Vorzugsweise verwendet in: Preferably used in: Utilisé de préférence en:
DS 006.7013	BS 1363: 1967' 13A entspr. IEC 83: 1975 Standard B2 BS 1363: 1967' 13A complying with IEC 83: 1975 Standard B2 BS 1363: 1967' 13A suivant CEI 83: 1975 norme B2	Großbritanien Great Britain Grande-Bretagne
DS 006.7020	Typ 12 nach SEV-Vorschrift 1011.1059, Normblatt S 24 507 Type 12 complying with SEV regulation 1011.1059, standard sheet S 24 507 Type 12 suivant la norme SEV 1011.1059, feuille S 24 507	Schweiz Switzerland Suisse
DS 006.7036	Typ 498/13 nach USA-Vorschrift UL 498, bzw. IEC 83 Type 498/13 complying with US regulation UL 498 or with IEC 83 Type 498/13 suivant la norme E.U.A. UL 498 ou la norme CEI 83	USA / Kanada USA / Canada E.U.A. / Canada
DS 006.7107	Typ SAA3 10 A, 250 V, nach AS C112-1964 Ap. Type SAA3 10 A, 250 V, complying with AS C112-1964 Ap. Type SAA3 10 A, 250 V, suivant AS C112-1964 Ap.	Australien Australia Australie
DS 025.2365	DIN 49 441, 10 A, 250 V	Europa (ohne Schweiz) Europe (Switzerland not included) Europe (Suisse non comprise)

Cross-Reference List of Class Designation Letters

IEC Publication 113-2 (1971) Item Designations, Letter Codes
ANSI Y32.2-1975 (IEEE Std 315-1975), Section 22, Class Designation Letters

***Note:** The designation letters used in the R&S Manuals correspond to the letter codes of the IEC Standard identified in the first column!*

IEC Publication 113-2 Terminology	Letter Code IEC	Letter Code Y32.2
Acoustical indicator	H	LS
Adjustable resistor	R	R
Aerial	W	E
Amplifier	A	AR
Amplifier (with tubes)	A	AR
Arrester	F	E
Assemblies	A	A,U
Auxiliary switch	S	S
Battery	G	BT
Bistable element	D	U,A
Brake	Y	MP
Busbar	W	W
Cable	W	W
Cable balancing network	Z	Z
Capacitor	C	C
Changer	U	A,B,G,MT
Circuit breaker	Q	CB
Clutch	Y	MP
Coder	U	U,A
Compander	Z	A
Connecting stage	S	S
Contactors	K	K
Control switch	S	S
Converter	U	A,U,MG
Core, storage	D	E
Crystal filter	Z	FL
Crystal transducer	B	Y
Current transformer	T	T
Delay device	D	DL
Delay line	D	DL
Demodulator	U	A
Dial contact	S	S
Diode	V	D
Dipole	W	E
Disconnecting plug	X	P
Disconnecting socket	X	X
Discriminator	U	A
Disk recorder	D	A
Dynamotor	B	MG
Electrically operated mechanical device	Y	MT
Electronic tube	V	V
Equalizer	Z	EQ
Filter	Z	FL
Frequency changer	U	A,B,G
Fuse	F	F
Gas discharge tube	V	V
Generator	G	G
Heating device	E	HR
Hybrid	Z	Z
Indicating device	P	DS
Induction coil	L	L
Inductors	L	L
Integrating measuring device	P	M,MT,Z
Inverter	U	A,U,PS,MG
Isolator	Q	AT
Jumper wire	W	W
Laser	A	MT,A
Lighting device	E	DS
Limit switch	S	S
Limiter	Z	MT,RE
Line trap	L	FL,MP,V
Loudspeaker	B	LS
Magnetic amplifier	A	AR

IEC Publication 113-2 Terminology	Letter Code IEC	Letter Code Y32.2
Magnetic tape recorder	D	A
Maser	A	A
Measuring equipment	P	M
Microphone	B	MK
Miscellaneous	E	E
Modulator	U	A
Monostable element	D	A,U
Motor	M	B
Optical indicator	H	DS
Oscillator	G	Y,G
Overvoltage discharge device	F	F,E
Parabolic aerial	W	E
Photoelectric cell	B	V
Pickup	B	PU
Plug	X	P
Pneumatic valve	Y	MP
Potentiometer	R	R
Power switchgear	Q	CB,S
Protective device	F	F
Pushbutton	S	S
Quartz-oscillator	G	Y
Recording device	P	A,M
Register	D	A,U,M
Relay	K	K
Resistor	R	R
Resolver	B	B
Rheostat	R	R
Rotating frequency generator	G	G,MG
Rotating generator	G	G
Selector	S	S
Selector switch	S	S
Semiconductor	V	D,CR,Q
Shunt (resistor)	R	R
Signal generator	P	A
Signaling device	H	DS
Socket	X	X
Soldering terminal strip	X	E,TB
Static frequency changer	U	A
Storage device	D	A,U
Subassembly	A	A
Supply	G	A,PS
Supply device	G	A,PS
Synchro	B	B
Telegraph translator	U	A
Terminal	X	E
Terminal board	X	TB
Termination	Z	AT
Test jack	X	E,J
Testing equipment	P	A
Thermistor	R	RT
Thermo cell	B	A,TC
Thermoelectric sensor	B	A
Thyristor	V	Q
Transducer (nonelectrical quantity to electrical quantity)	B	A,BT
Transformer	T	T
Transmission path	W	W
Transistor	V	Q
Tube (electron)	V	V
Voltage transformer (potential)	T	T
Waveguide	W	W
Waveguide directional coupler	W	DC

ROHDE&SCHWARZ

Schaltteillisten
Stromläufe
Bestückungspläne

Part lists
Circuit diagrams
Components plans

Listes des pièces détachées
Schémas de Circuit
Plans des composants

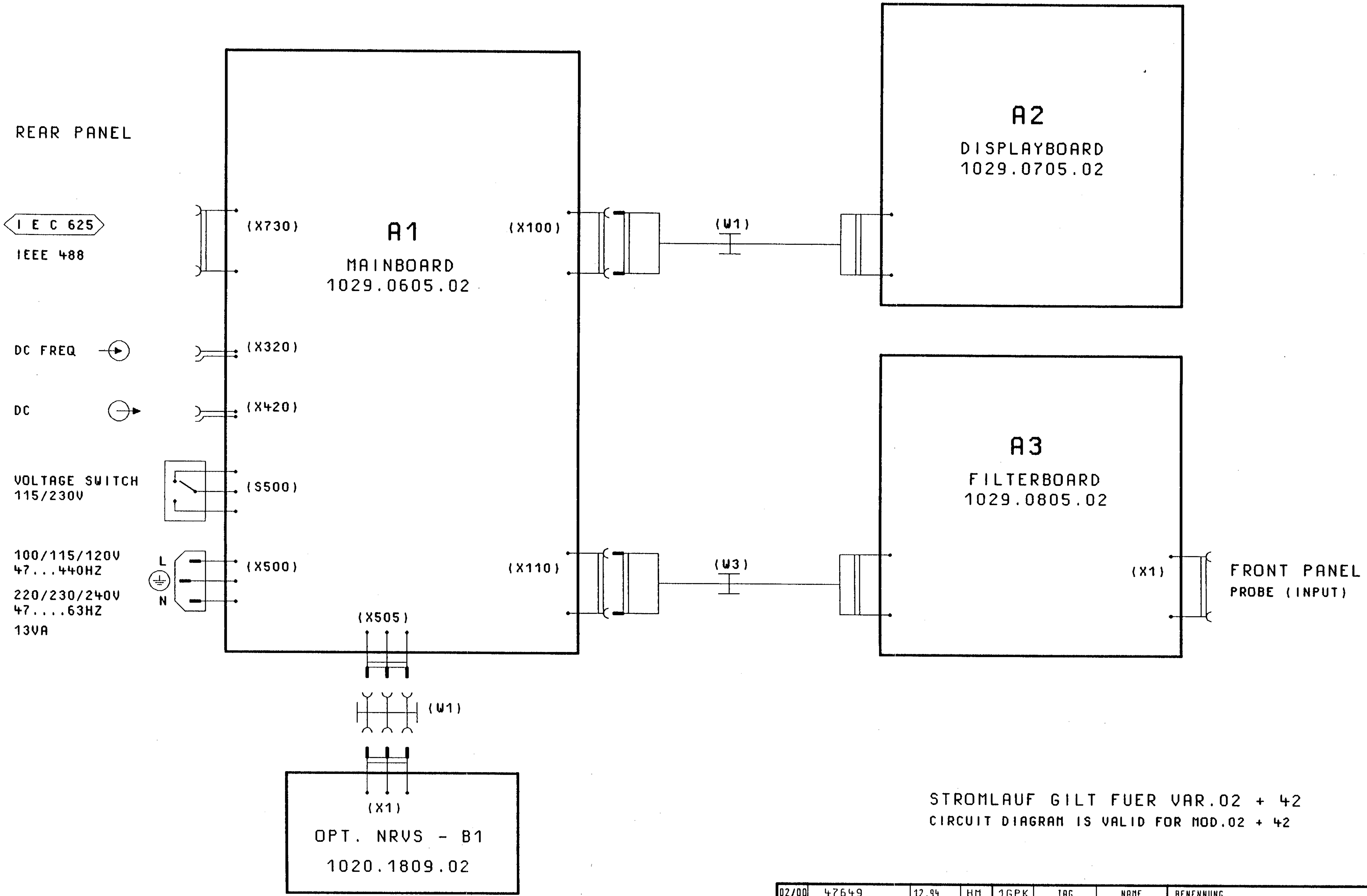
(R 29500 Bl. 2)
095.1000 Bl. 2

Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
.	XX VARIANTENERKLAERUNG VERSIONS VAR 02 = GRUNDAUSFUEHRUNG MOD 02 = BASIC MODEL VAR 42 = MIT LACK.LEITERPL MOD 42 = WITH COATED PCBOARDS				
..	ZUGEH.STROML./CIRC.DIAGR. CIRCUIT DIAGRAM 1020.1809 S				
A1	ED MAINBOARD MAINBOARD NUR VAR/ONLY MOD: 02 92 HIERZ.STROML.1029.0605 S SEE CIRC.DIA.1029.0605 S	1029.0605.02			
A1	ED MAINBOARD NUR VAR/ONLY MOD: 42 SEE CIRC.DIAGR. 1029.0605 S	1029.0605.42			
A2	ED ANZEIGEPLATTE INDICATION BOARD HIERZ.STROML.1029.0705 S SEE CIRC.DIA.1029.0705 S	1029.0705.02			
A3	ED FILTERPLATTE FILTERBOARD NUR VAR/ONLY MOD: 02 92 HIERZU STROML.1029.0805 S SEE CIRC.DIAG.1029.0805 S	1029.0805.02			
A3	ED FILTERPLATTE FILTERBOARD NUR VAR/ONLY MOD: 42 SEE CIRC.DIAGR. 1029.0805 S	1029.0805.42			
D710	HS 27C512 PROG.D710 27C512 PROG.D710 BESTUECKEN IN 1029.0605 ED MAINBOARD" FIT IN 1029.0605 ED MAINBOARD"	1029.0692.00			

MDNP1 938 MDNP	Äi	Datum Date	Schaltteilliste für Parts list for	Sachnummer Stock No.	Blatt-Nr. Page
ROHDE&SCHWARZ	06	10.08.95	GG NRVS EINKANAL-LEIST.M. SINGLE CHANNEL POWERMETER	1020.1809.01 SA	1-

095.0026-0693

Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
.	XX VARIANTENERKLAERUNG VERSIONS VAR 02 = GRUNDAUSFUEHRUNG MOD 02 = BASIC MODEL				
..	ZUGEH.STROML./CIRC.DIAGR. CIRCUIT DIAGRAM 1029.1701S				
A1	ED MAINBOARD MAINBOARD HIERZU STROML.1029.0605S SEE CIRC.DIA. 1029.0605S	1029.0605.02			
A2	ED ANZEIGEPLATTE INDICATION BOARD HIERZU STROML.1029.0705S SEE CIRC.DIA. 1029.0705S	1029.0705.02			
A3	ED FILTERPLATTE FILTERBOARD HIERZU STROML.1029.0805S SEE CIRC.DIAG.1029.0805S	1029.0805.02			
D710	HS 27C512 PROG.D710 BESTUECKEN IN 1029.0605 ED MAINBOARD" FIT IN 1029.0605 ED MAINBOARD"	1029.1830.00			



STROMLAUF GILT FUER VAR.02 + 42
CIRCUIT DIAGRAM IS VALID FOR MOD.02 + 42

ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.
ATTENTION ESD!
ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING

02/00	47649	12.94	HM	1GPK	TAG	NAME
				BEARB.		FW
				GEPR.		FW
				NORM		
				PLOTT	19.12.94	
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ROHDE&SCHWARZ		
				ZU GERAET	NRVS	

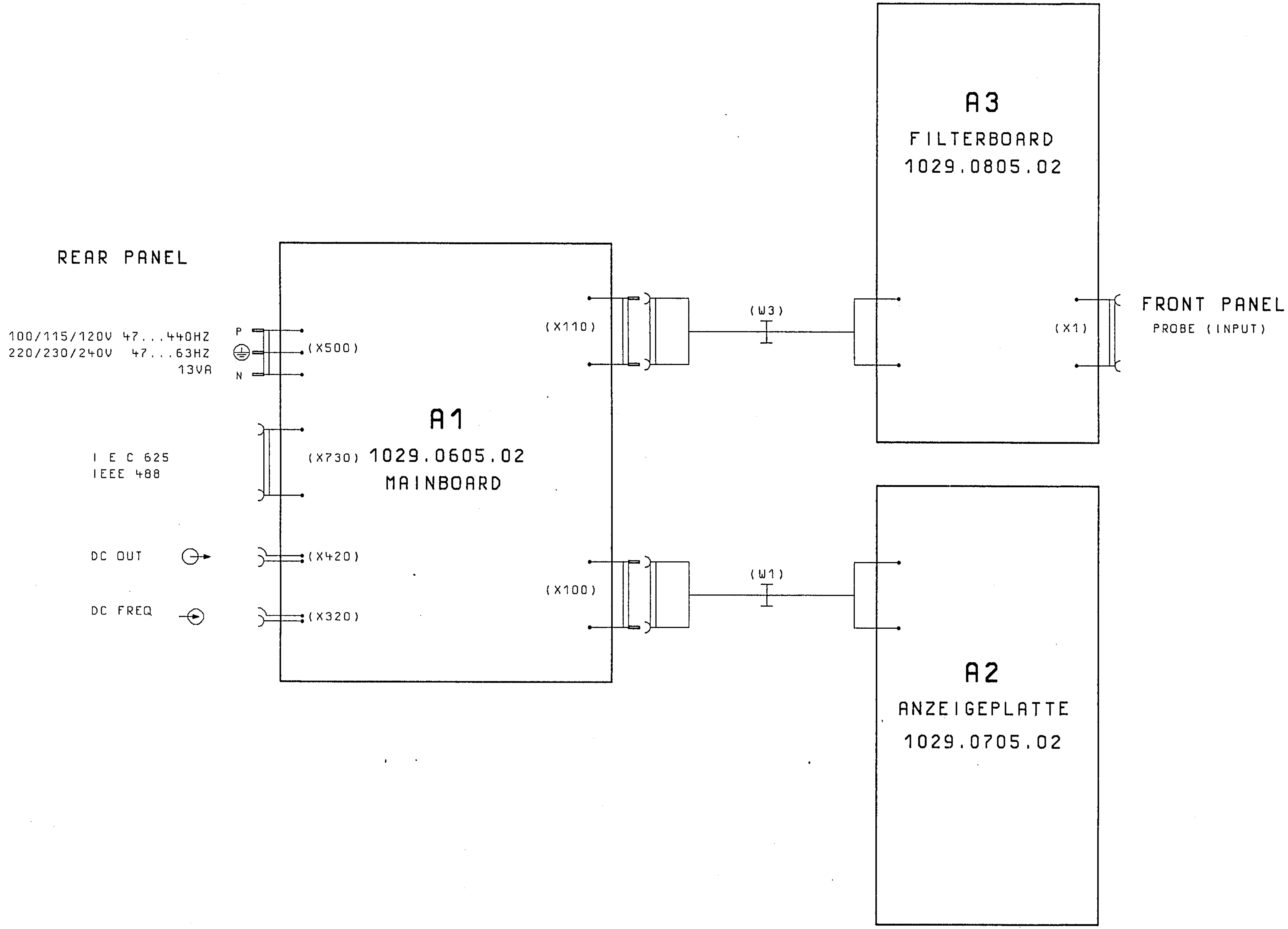
BENENNUNG: NRVS POWER METER

ZEICHN.-NR.: 1020.1809.01S

BLATT-NR. 1 v. 1 BL.

REG.I.V. 1020.1809 ERSTE Z. 000.0000

ZEICHN.-NP



STROMLAUF GILT FUER VAR.02
CIRCUIT DIAGRAM IS VALID FOR MOD.02

ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.
ATTENTION ESD!
ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING

/01				1KGU	TAG	NAME
				BEARB.		SR
				GEPR.		SR
				NORM		
				PLOTT	23.08.91	
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ROHDE&SCHWARZ		
				ZU GERAET	URV55	

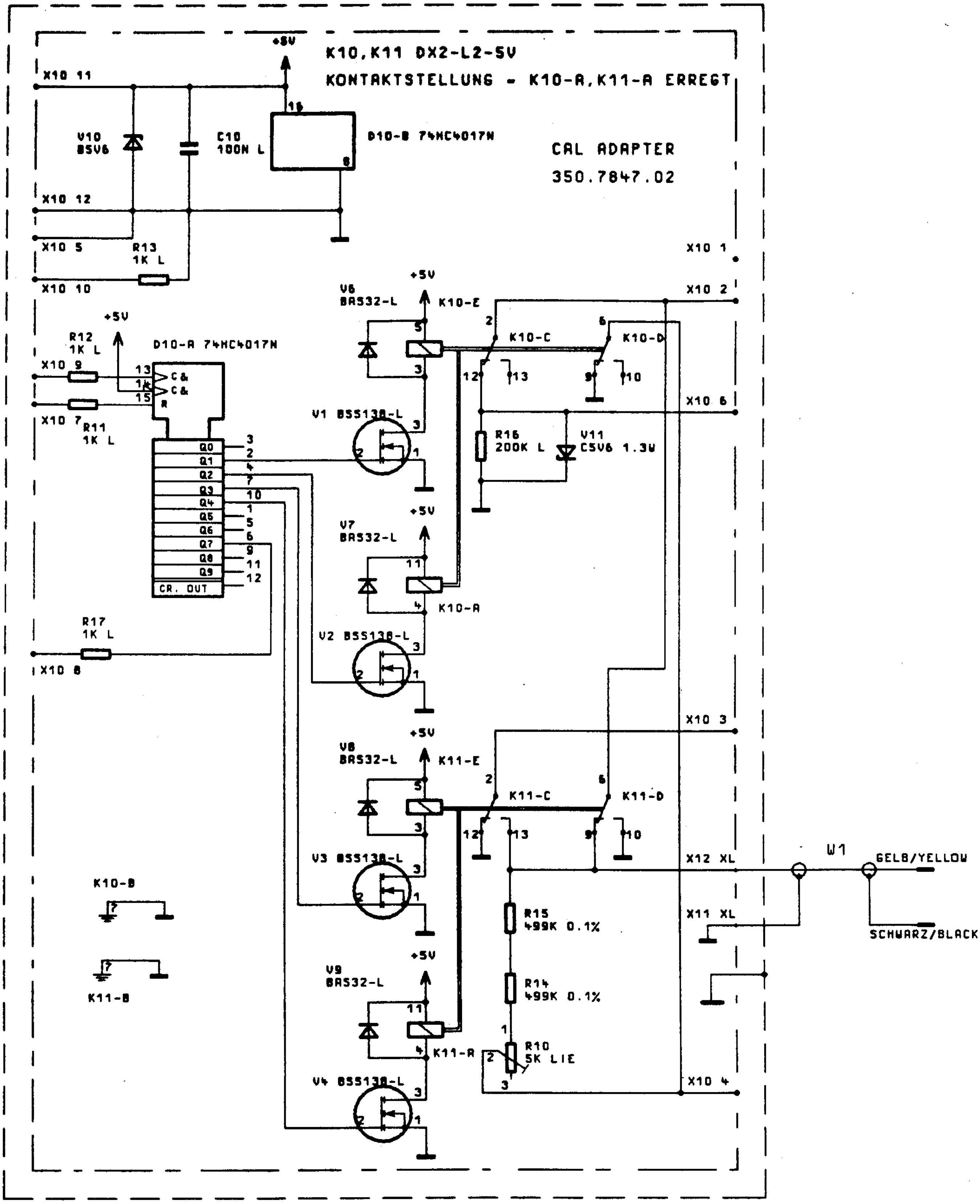
BENENNUNG
URV55 MILLIVOLTMETER
RF-DC-MILLIVOLTMETER

ZEICHN.-NR. 1029.1701.01S

BLATT-NR. 1 v. 1 BL.

REG.I.V. 1029.1701 ERSTE Z. 1029.1701

ZEICHN.-NR.



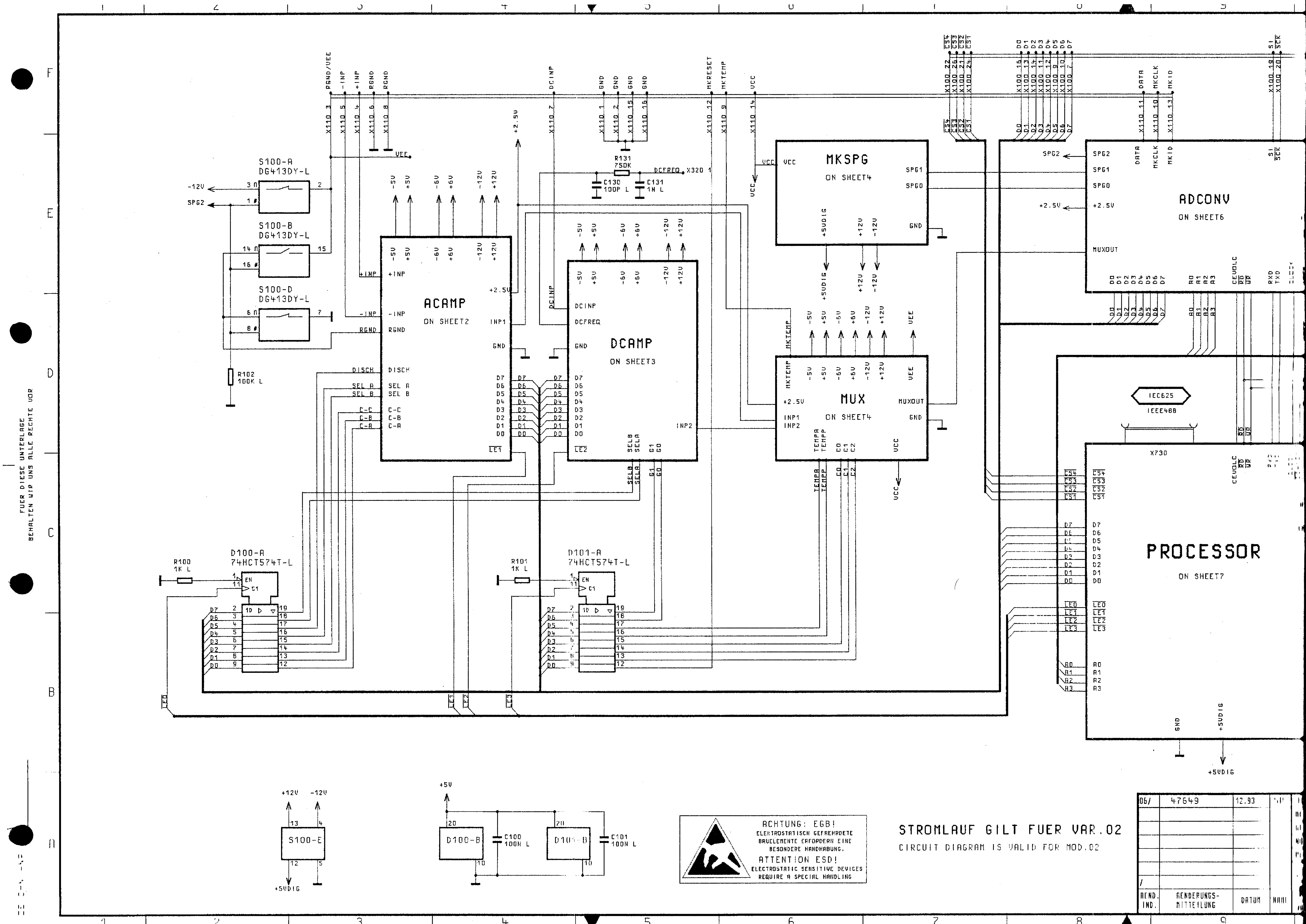
ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.

ATTENTION ESD!
ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING

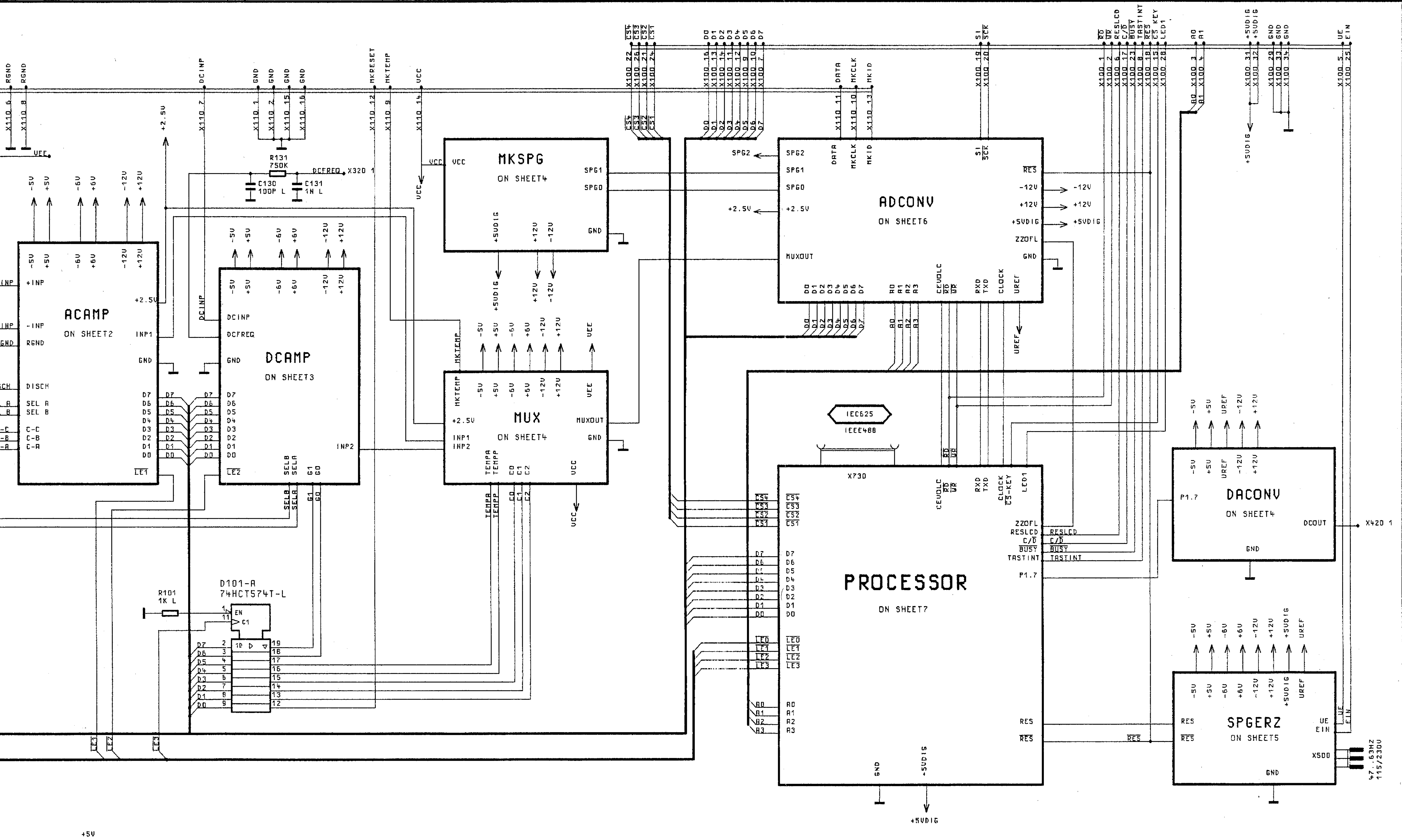
STROMLAUF GILT FUER VAR.02

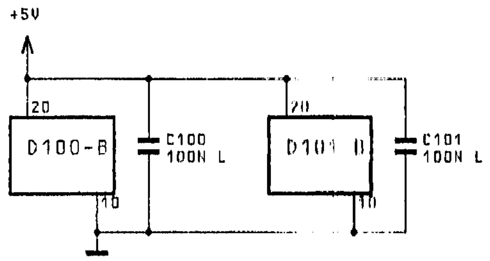
CIRCUIT DIAGRAM IS VALID FOR MOD.02

01				1KGS	TAG	NAME	BENENNUNG
				BEARB.		SE	CALIBRATION ADAPTER
				GEPR.		REI	
				NORM			
				PLOTT	11.09.91		
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ROHDE&SCHWARZ			ZEICHN.-NR. 350.7818.01S — BLATT-NR. 1 — V. 1 BL.
				ZU GERAET	NRVD-S1		REG.I.V. 1029,2808 V — ERSTE Z.



ACAMP
ON SHEET2
DCAMP
ON SHEET3
MKSPG
ON SHEET4
MUX
ON SHEET4
ADCONV
ON SHEET6
PROCESSOR
ON SHEET7
S100-A
DG413DY-L
S100-B
DG413DY-L
S100-D
DG413DY-L
S100-E
D100-A
74HCT574T-L
D101-A
74HCT574T-L
D100-B
D101-B
R100
1K L
R101
1K L
R102
100K L
R131
750K
C130
100P L
C131
1N L
C100
100N L
C101
100N L
X730
IEC625
IEEE488
ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE
BAUELEMENTE ERFORDERN EINE
BESONDERE HANDHABUNG.
ATTENTION ESD!
ELECTROSTATIC SENSITIVE DEVICES
REQUIRE A SPECIAL HANDLING
STROMLAUF GILT FUER VAR.02
CIRCUIT DIAGRAM IS VALID FOR MOD.02
06/
47649
12.93
AEND.
IND.
AENDERUNGS-
MITTEILUNG
DATUM
FUER DIESE UNTERLAGE
BEHALTEN WIR UNS ALLE RECHTE VOR



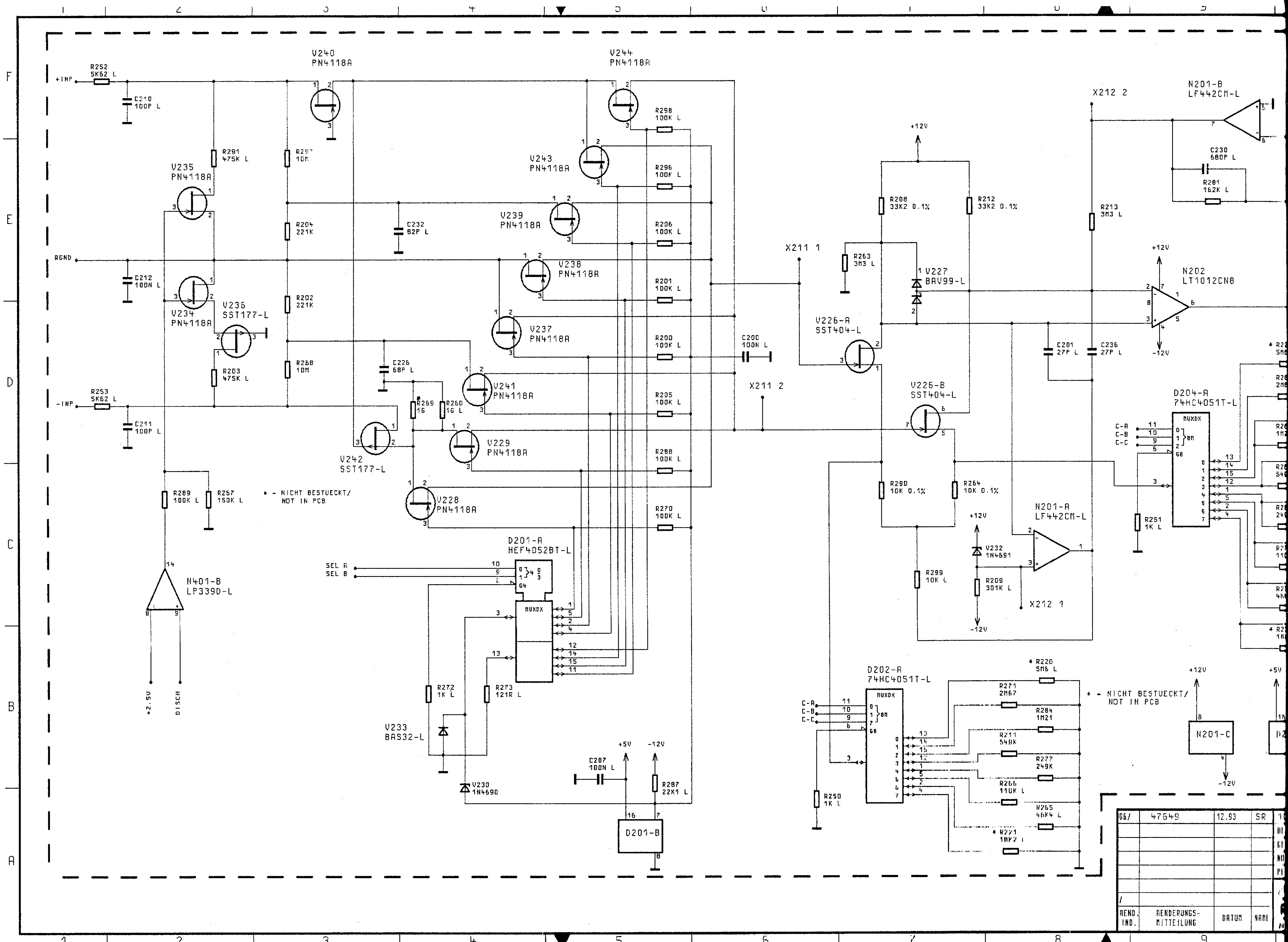


ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.
ATTENTION ESD!
ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING

STROMLAUF GILT FUER VAR.02

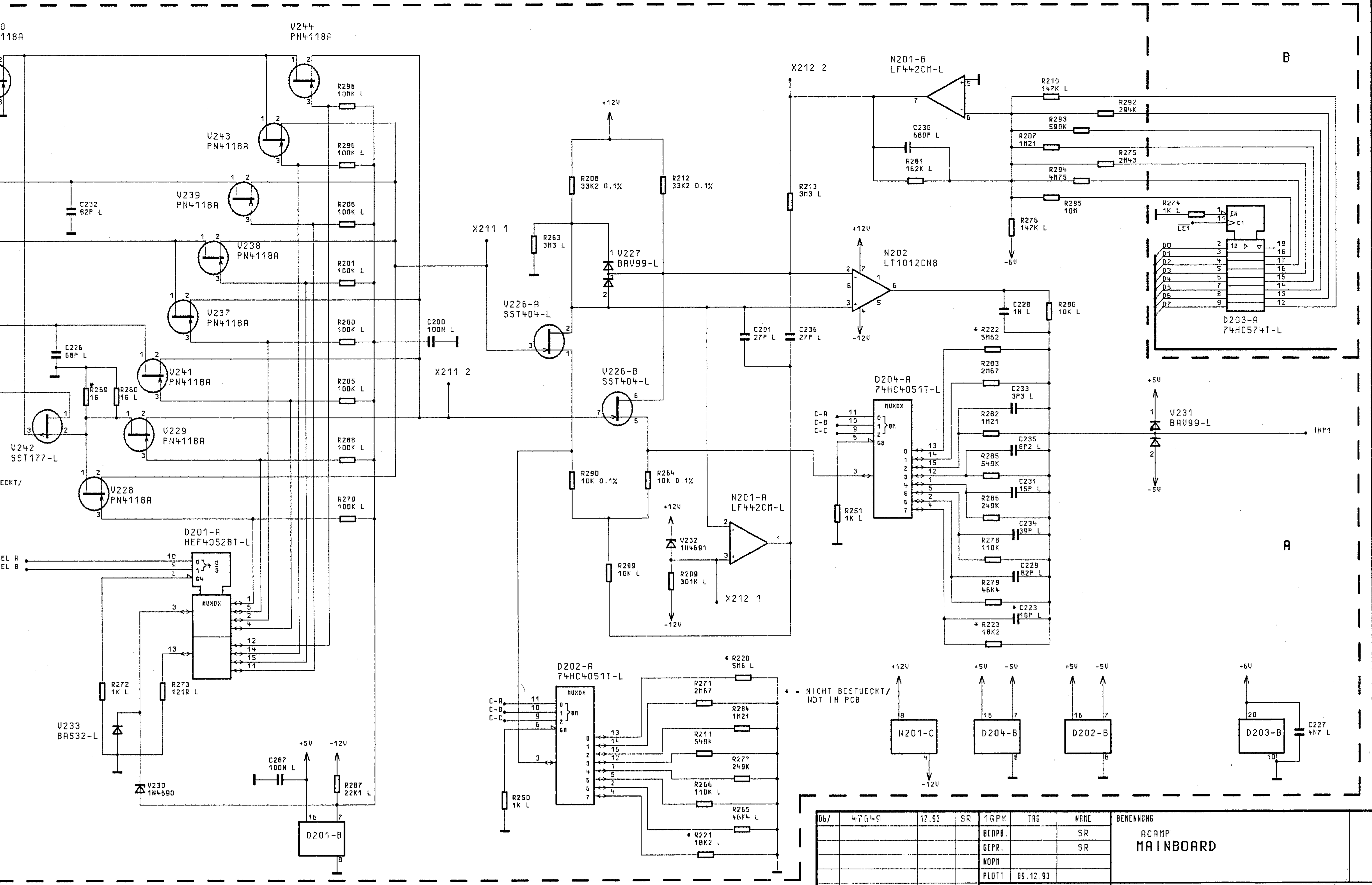
CIRCUIT DIAGRAM IS VALID FOR MOD.02

06/	47649	12.93	SR	1GPK	TAG	NAME	BENENNUNG
				BEARB.		SR	MAINBOARD
				GEPR.		SR	
				NORM			
				PLOTT	09.12.93		
/				ROHDE&SCHWARZ			ZEICHN.-NR. 1029.0605.01S
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ZU GERAET	NRVS		BLATT-NR. 1+
							REG.I.V. 1020.1809 / ERSTE Z. 1020.1809

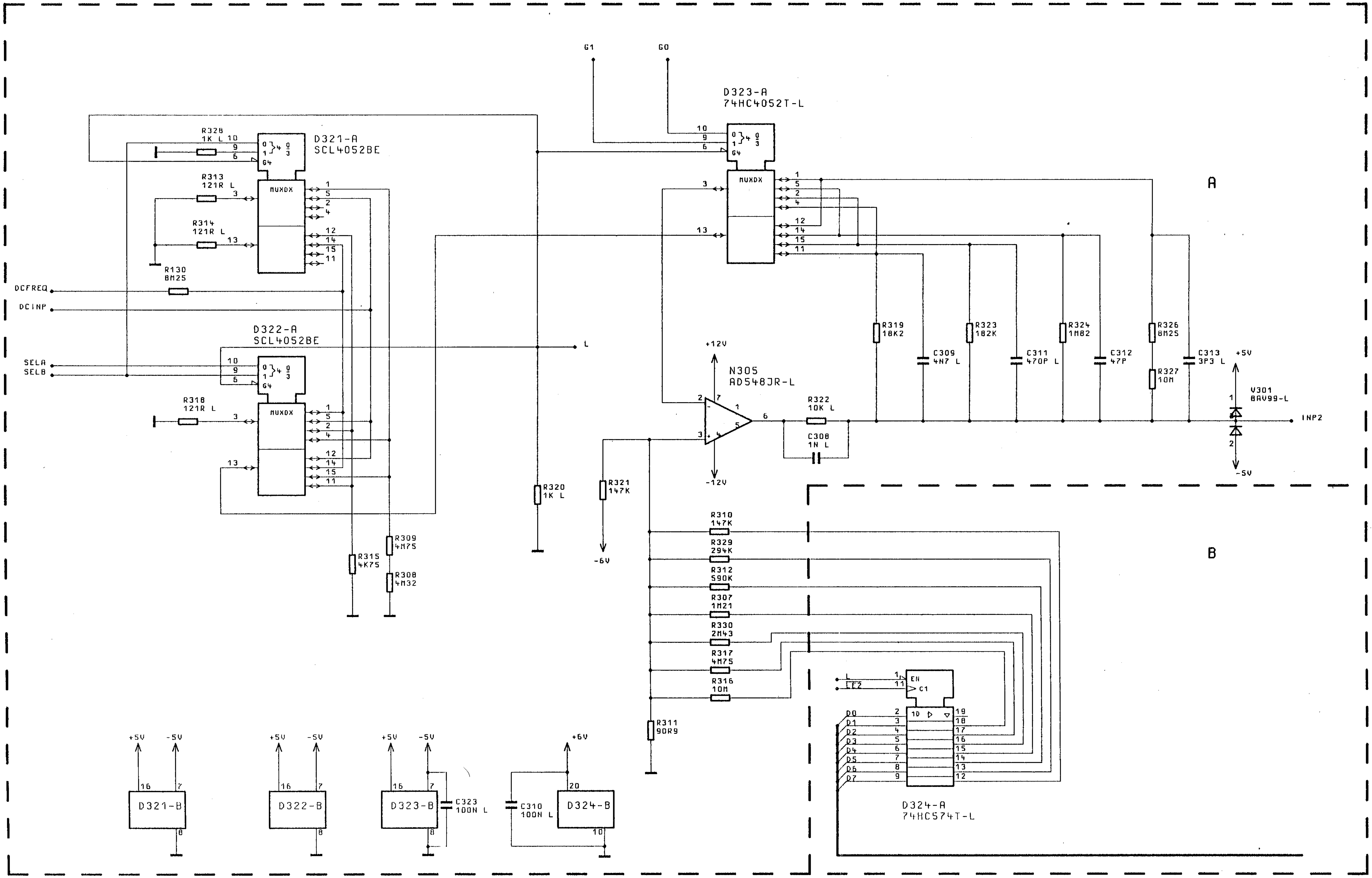


FUER DIESE UNTERLAGE BEHALTEN WIR UNS ALLE RECHTE VOR

ZEICHN.-NR.



06/	47649	12.93	SR	1GPK	TAG	NAME	BENENNUNG
				BEARB.		SR	ACAMP
				GEPR.		SR	MAINBOARD
				NORM			
				PLOTT	09.12.93		
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ROHDE&SCHWARZ			ZEICHN.-NR. 1029.0605.01S — BLATT-NR. 2+
				ZU GERAET	NRVS		REG.I.V. 1020.1809 — ERSTE Z. 1020.1809



AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME
06/	47649	12.93	SR
/			

TGPK	TAG	NAME
BEARB.		SR
GEPR.		SR
NORM		
PLOTT	09.12.93	

BENENNUNG

DCAMP
MAINBOARD

ROHDE&SCHWARZ

ZEICHN.-NR. 1029.0605.01S

BLATT-NR. 3+

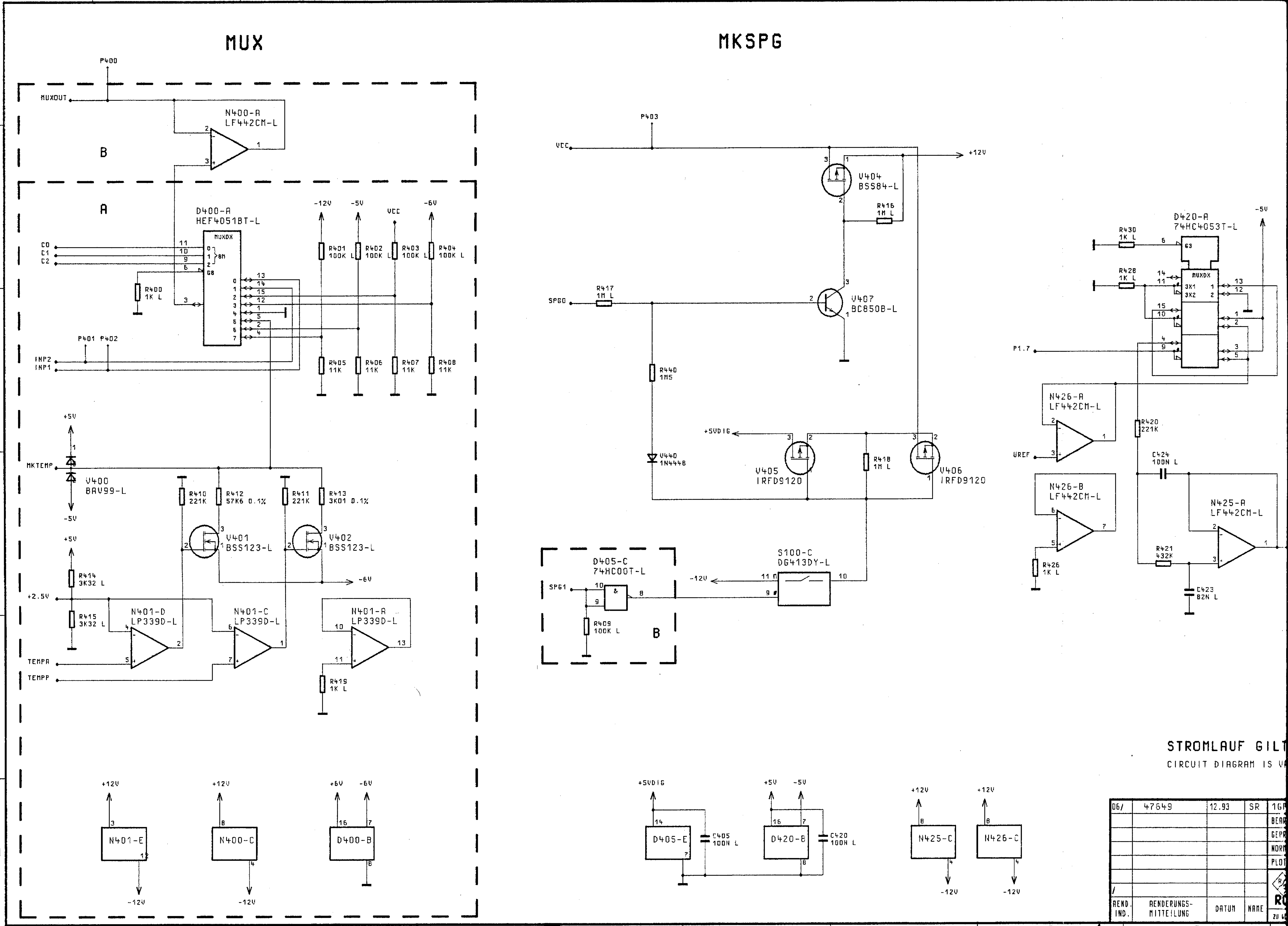
V. BL.

ZU GERAET NRVS

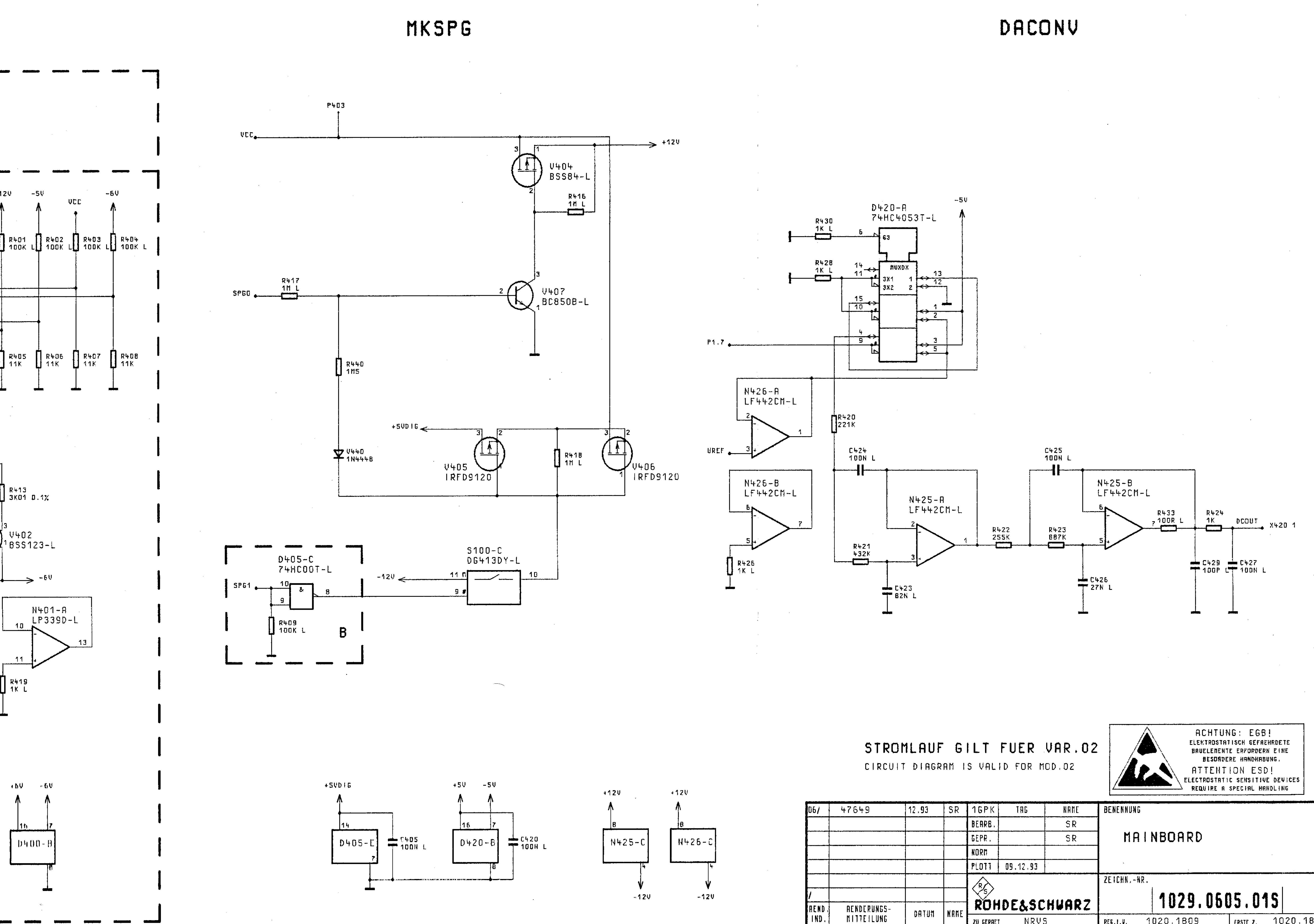
REG.I.V. 1020.1809

ERSTE Z. 1020.1809

ZEICHN.-NR.


MUX
MKSPG
P400
MUXOUT
N400-A
LF442CM-L
B
A
D400-A
HEF4051BT-L
MUXDX
C0
C1
C2
R400
1K L
-12V
-5V
VCC
-6V
R401
100K L
R402
100K L
R403
100K L
R404
100K L
P401
P402
INP2
INP1
R405
11K
R406
11K
R407
11K
R408
11K
+5V
MKTEMP
V400
BAV99-L
-5V
R410
221K
R412
57K6 0.1%
R411
221K
R413
3K01 0.1%
V401
BSS123-L
V402
BSS123-L
-6V
R414
3K32 L
+2.5V
R415
3K32 L
N401-D
LP339D-L
N401-C
LP339D-L
N401-A
LP339D-L
TEMPA
TEMPP
R419
1K L
+12V
N401-E
N400-C
+6V
D400-B
-12V
P403
VCC
+12V
V404
BSS84-L
R416
1M L
SPGO
R417
1M L
V407
BC850B-L
R440
1M5
+5VDIG
V440
1N4448
V405
IRFD9120
R418
1M L
V406
IRFD9120
D405-C
74HC00T-L
SPG1
R409
100K L
S100-C
DG413DY-L
-12V
D405-E
C405
100N L
D420-B
C420
100N L
N425-C
N426-C
D420-A
74HC4053T-L
R430
1K L
R428
1K L
-5V
P1.7
N426-A
LF442CM-L
UREF
R420
221K
C424
100N L
N426-B
LF442CM-L
N425-A
LF442CM-L
R421
432K
R426
1K L
C423
82N L
STROMLAUF GILT
CIRCUIT DIAGRAM IS V
06/
47649
12.93
SR
BEAR
GEPR
NORM
PLOT
AEND. IND.
AENDERUNGS-MITTEILUNG
DATUM
NAME

ZEICHN.-NR.



STROMLAUF GILT FUER VAR.02

CIRCUIT DIAGRAM IS VALID FOR MOD.02

ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.
ATTENTION ESD!
ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING

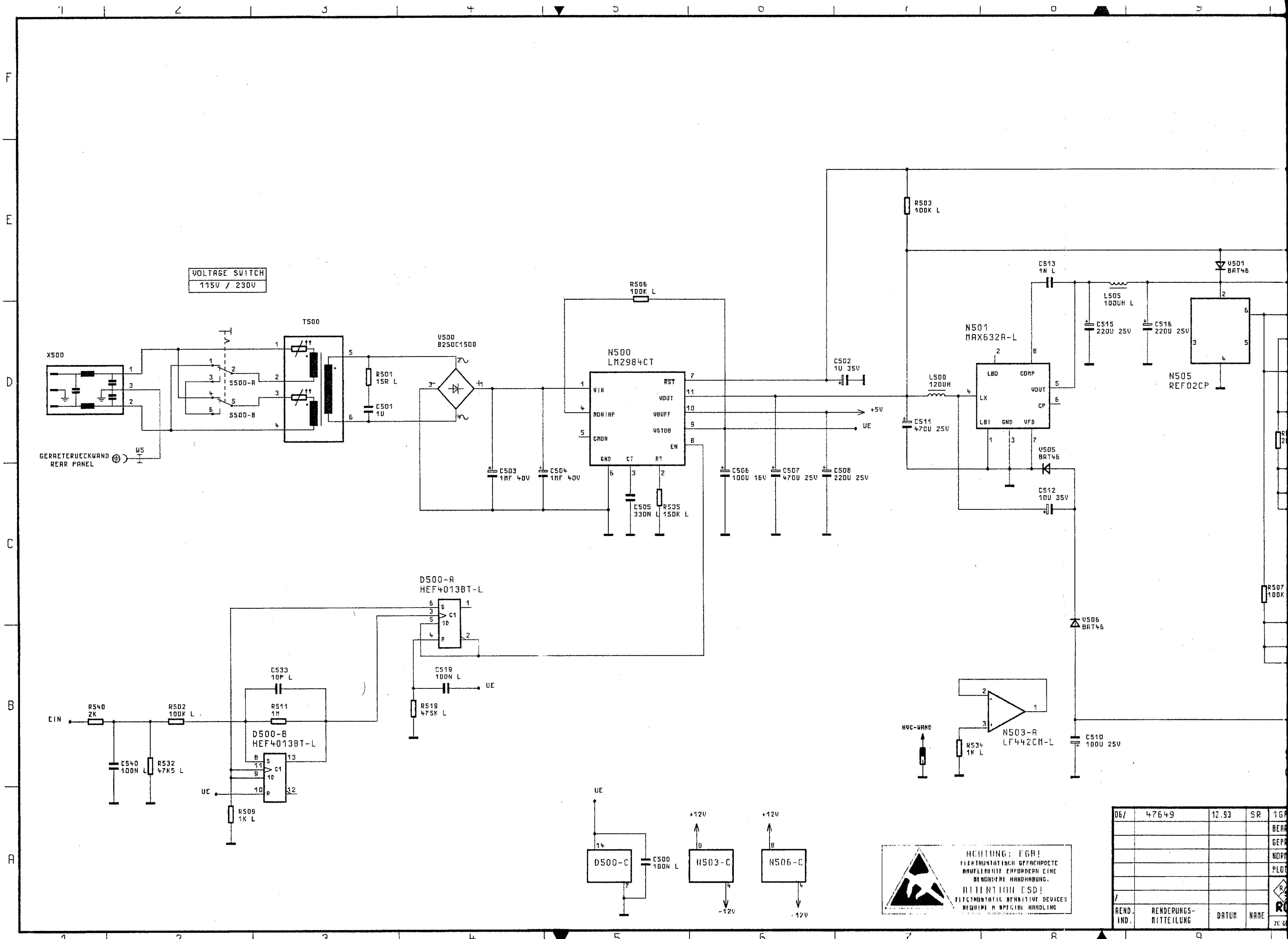
06/	47649	12.93	SR	1GPK	TAG	NAME
				BEARB.		SR
				GEPR.		SR
				NORM		
				PLOTT	09.12.93	
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ROHDE&SCHWARZ		
				ZU GERAET	NRVS	

BENENNUNG: MAINBOARD

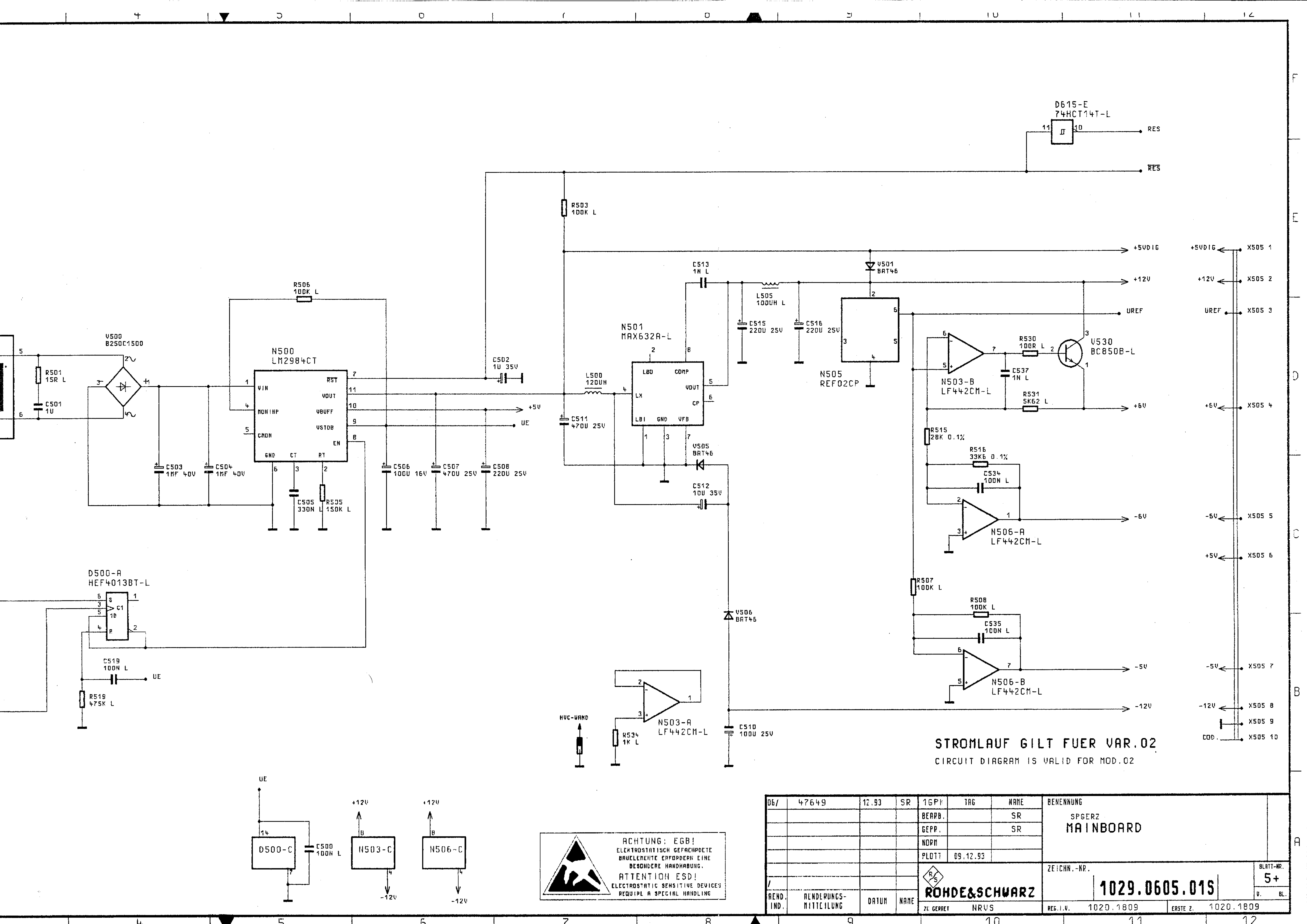
ZEICHN.-NR. 1029.0605.01S

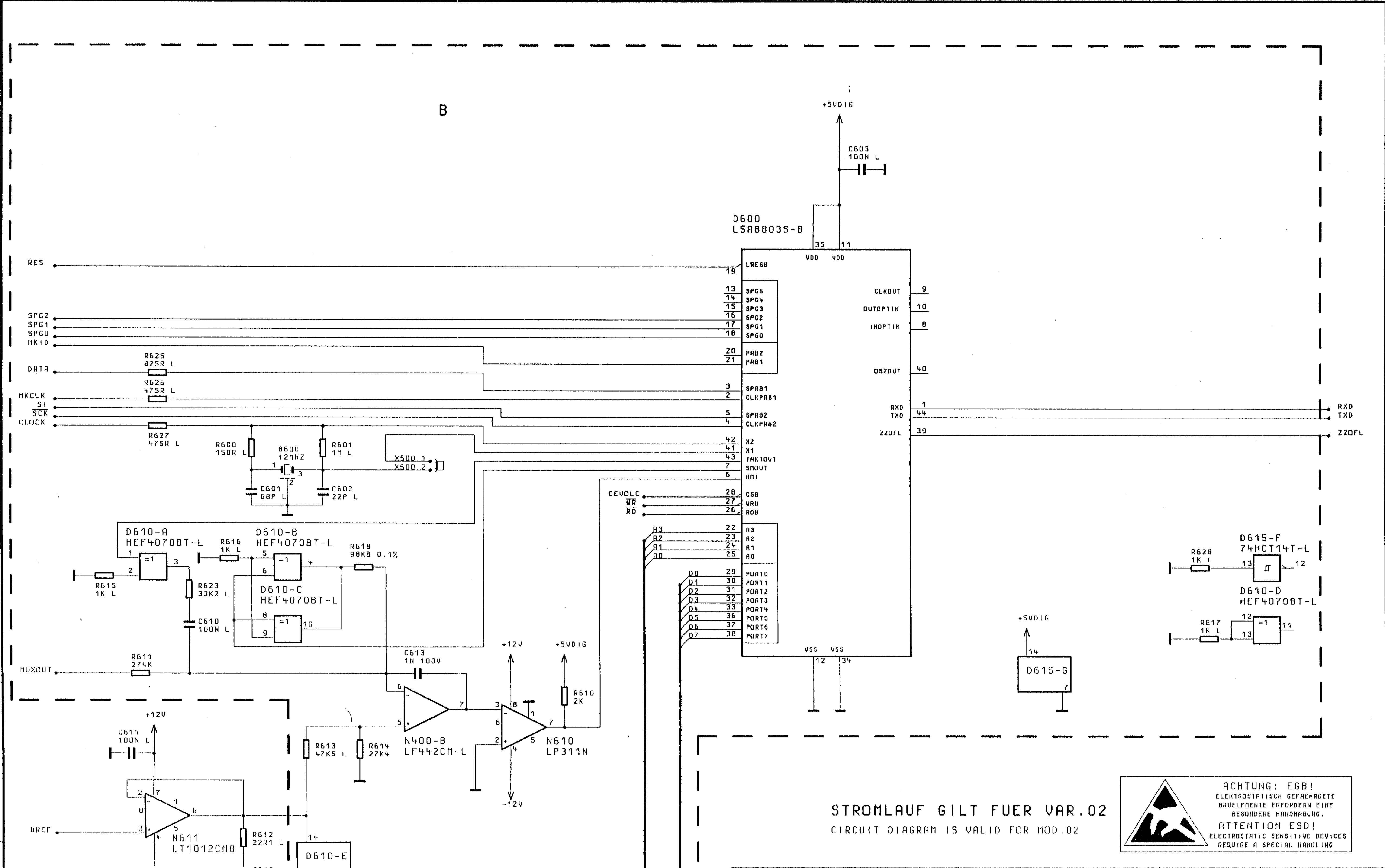
BLATT-NR. 4+

REG.I.V. 1020.1809 ERSTE Z. 1020.1809


VOLTAGE SWITCH
115V / 230V
X500
T500
S500-A
S500-B
GERAETERUECKWAND
REAR PANEL
W5
V500
B250C1500
R501
15R L
C501
1U
R506
100K L
N500
LM2984CT
VIN
MONINP
CMON
GND
CT
RT
RST
VOUT
VBUFF
VSTOB
EN
C503
1MF 40V
C504
1MF 40V
C505
330N L
R505
150K L
C506
100U 16V
C507
470U 25V
C508
220U 25V
C502
1U 35V
+5V
UE
R503
100K L
L500
120UH
C511
470U 25V
N501
MAX632A-L
LBO
COMP
LX
VOUT
CP
LBI
GND
VFB
C513
1N L
L505
100UH L
C515
220U 25V
C516
220U 25V
V501
BAT46
N505
REF02CP
V505
BAT46
C512
10U 35V
V506
BAT46
R507
100K
C510
100U 25V
D500-A
HEF4013BT-L
D500-B
HEF4013BT-L
C533
10P L
R511
1M
C519
100N L
R519
475K L
EIN
R540
2K
R502
100K L
C540
100N L
R532
47K5 L
R509
1K L
HVC-WAND
R534
1K L
N503-A
LF442CM-L
D500-C
C500
100N L
N503-C
N506-C
+12V
-12V
ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.
ATTENTION ESD!
ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING
06/
47649
12.93
SR
AEND. IND.
AENDERUNGS-MITTEILUNG
DATUM
NAME

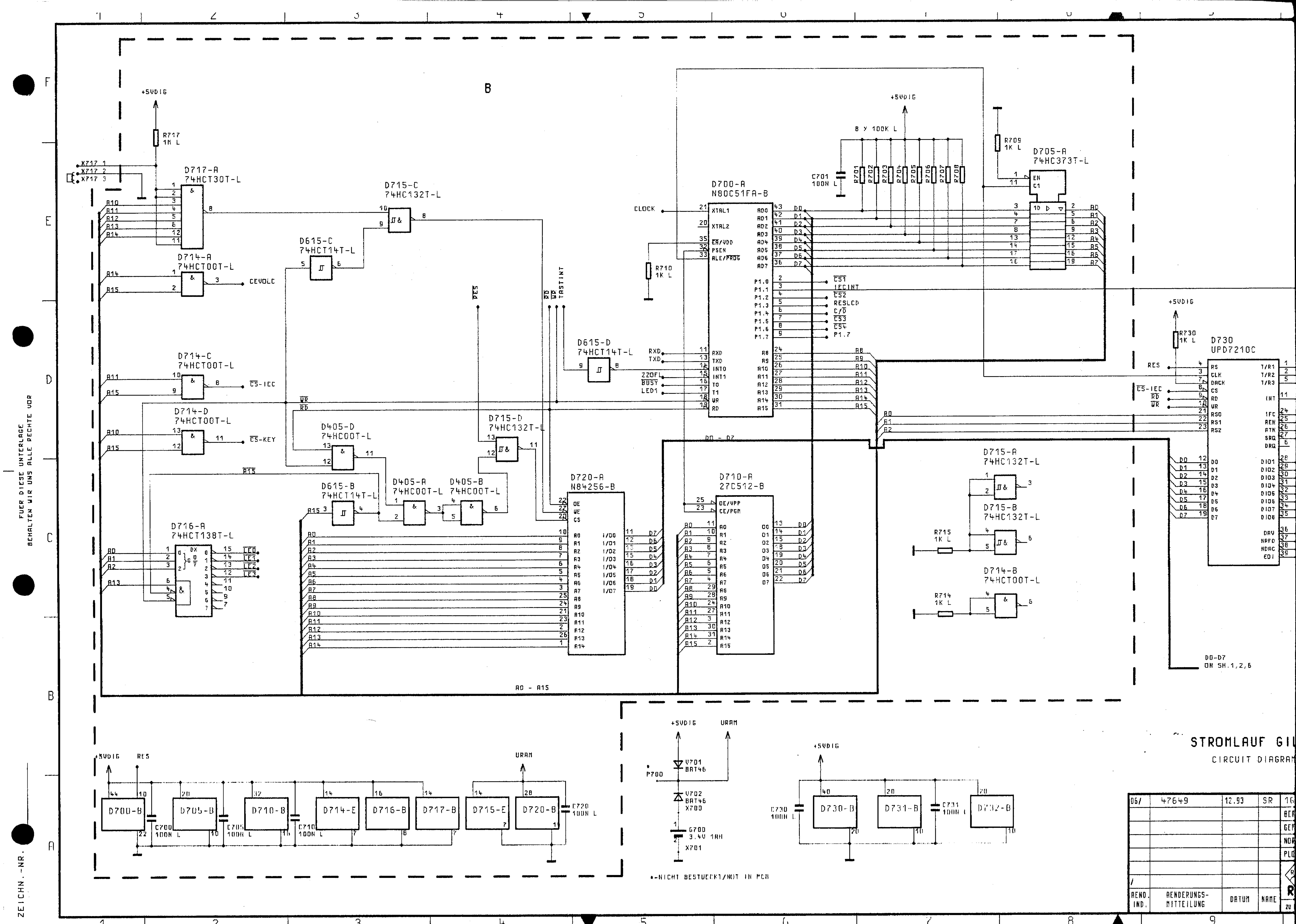
ZEICHN.-NR.


D615-E
74HCT14T-L
RES
RES
R503
100K L
+5VDIG
C513
1N L
V501
BAT46
+12V
L505
100UH L
UREF
R506
100K L
N501
MAX632A-L
C515
220U 25V
C516
220U 25V
N505
REF02CP
R530
100R L
V530
BC850B-L
N503-B
LF442CM-L
C537
1N L
R531
5K62 L
+6V
V500
B250C1500
N500
LM2984CT
C502
1U 35V
L500
120UH
R501
15R L
C501
1U
VIN
MONINP
CRON
GND
CT
RT
RST
VOUT
VBUFF
VSTDB
EN
+5V
UE
LBO
COMP
LX
VOUT
CP
LBI
GND
VFB
C511
470U 25V
V505
BAT46
R515
28K 0.1%
R516
33K6 0.1%
C534
100N L
C503
1MF 40V
C504
1MF 40V
C505
330N L
R505
150K L
C506
100U 16V
C507
470U 25V
C508
220U 25V
C512
10U 35V
N506-A
LF442CM-L
-6V
D500-A
HEF4013BT-L
R507
100K L
R508
100K L
C535
100N L
V506
BAT46
N506-B
LF442CM-L
-5V
C519
100N L
UE
R519
475K L
N503-A
LF442CM-L
HVC-WAND
R534
1K L
C510
100U 25V
-12V
+5VDIG
+12V
UREF
+6V
-6V
+5V
-5V
-12V
COD.
X505 1
X505 2
X505 3
X505 4
X505 5
X505 6
X505 7
X505 8
X505 9
X505 10
STROMLAUF GILT FUER VAR.02
CIRCUIT DIAGRAM IS VALID FOR MOD.02
UE
D500-C
C500
100N L
+12V
N503-C
-12V
+12V
N506-C
-12V
ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.
ATTENTION ESD!
ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING
06/ 47649 12.93 SR
1GPR TAG NAME
BEARB. SR
GEPR. SR
NORM
PLOTT 09.12.93
AEND. IND.
AENDERUNGS-MITTEILUNG
DATUM
NAME
ROHDE&SCHWARZ
ZU GERAET NRVS
BENENNUNG
SPGERZ
MAINBOARD
ZEICHN.-NR.
1029.0605.01S
BLATT-NR.
5+
V. BL.
REG.I.V. 1020.1809
ERSTE Z. 1020.1809

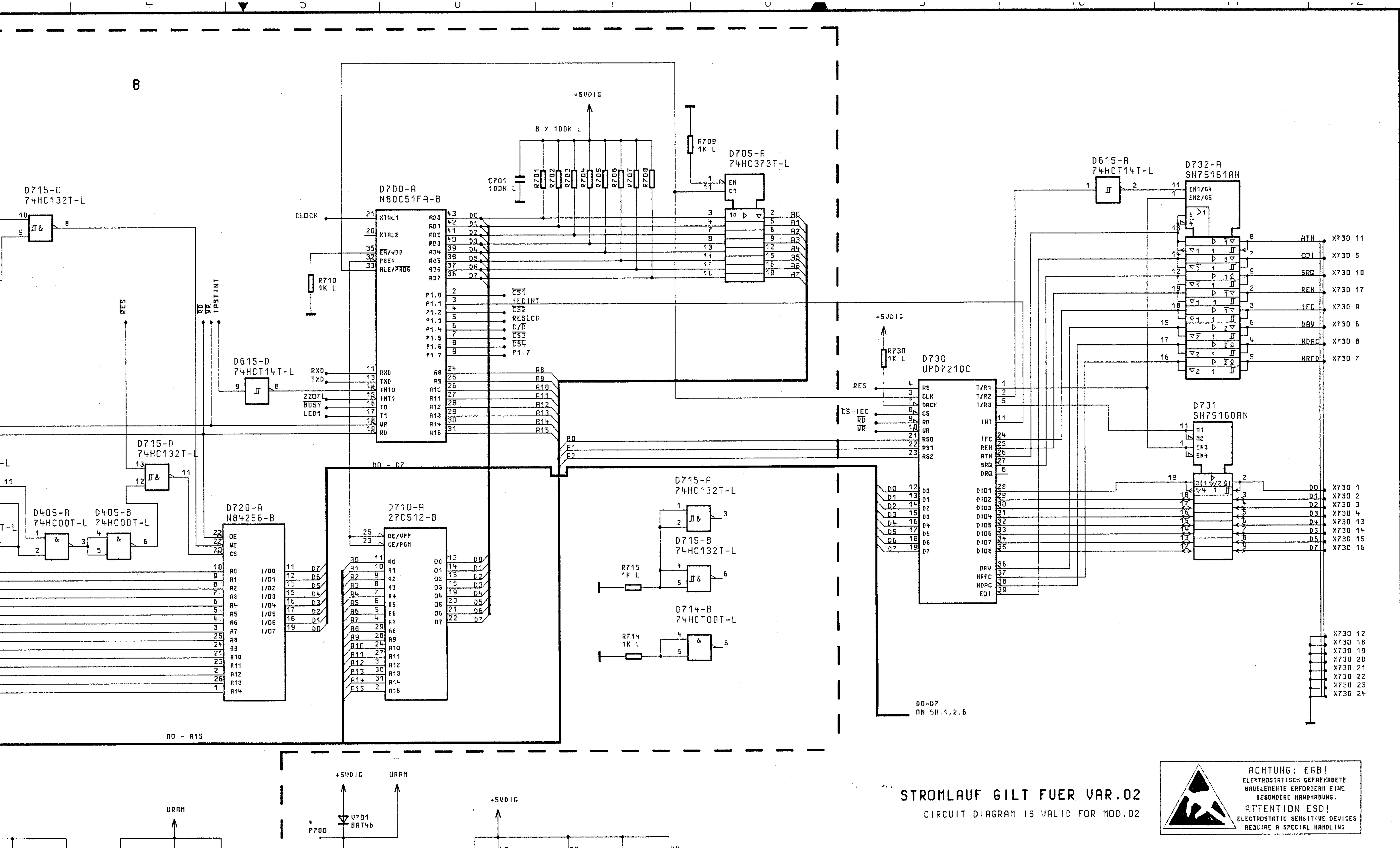


06/	47649	12.93	SR	16PK	TAG	NAME	BENENNUNG: ADCONV / RS232 MAINBOARD
				BEARB.		SR	
				GEPR.		SR	
				NORM			
				PLOTT	09.12.93		
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ROHDE&SCHWARZ			ZEICHN.-NR. 1029.0605.01S
				ZU GERAET	NRVS		REG.I.V. 1020.1809 — ERSTE Z. 1020.1809

BLATT-NR. 6+

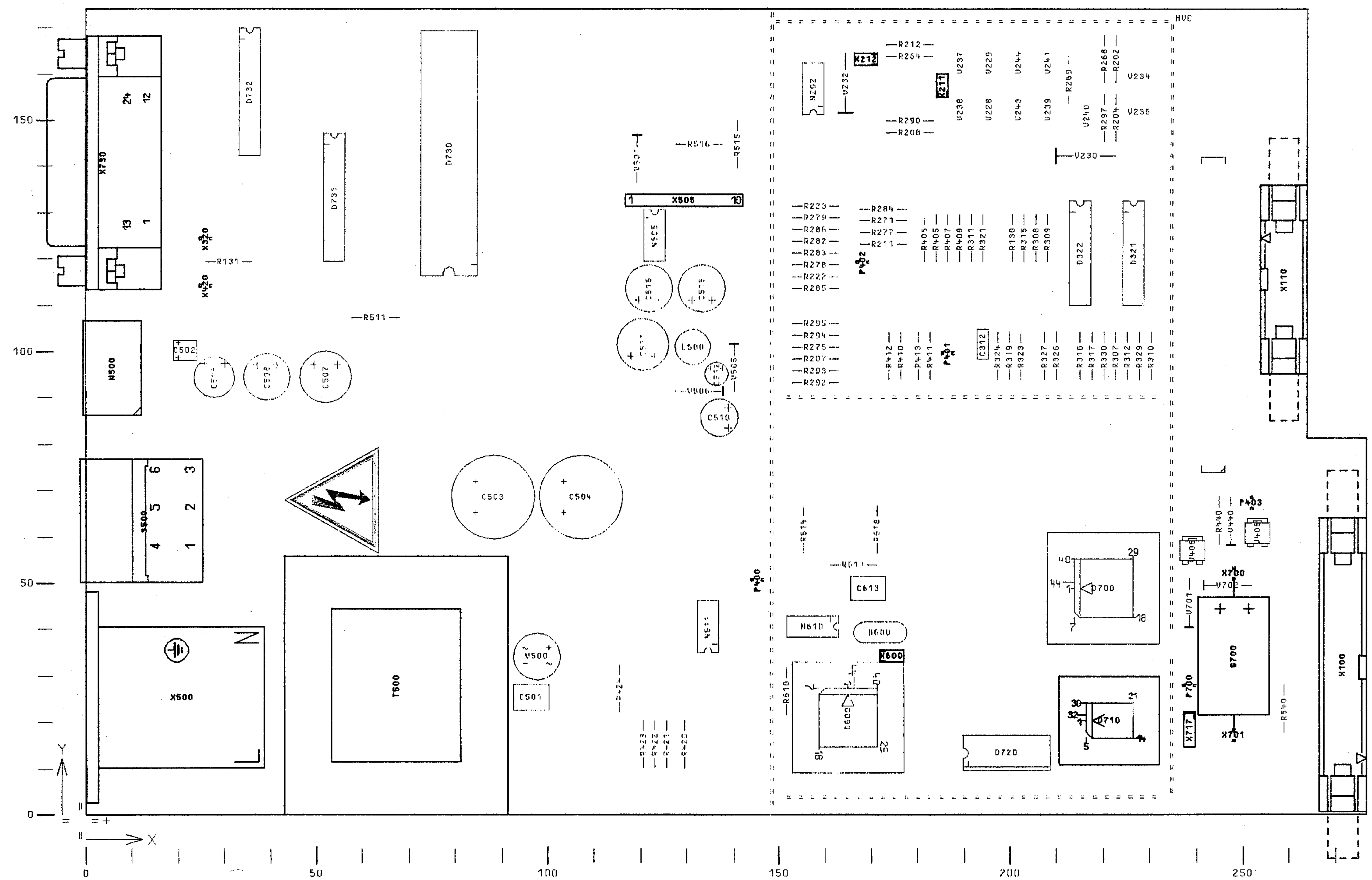


STROMLAUF GI
CIRCUIT DIAGRA
FUER DIESE UNTERLAGE BEHALTEN WIR UNS ALLE RECHTE VOR
ZEICHN.-NR.
B
+5VDIG
R717 1K L
X717
D717-A 74HCT30T-L
D714-A 74HCT00T-L
CEVOLC
D714-C 74HCT00T-L
CS-IEC
D714-D 74HCT00T-L
CS-KEY
D716-A 74HCT138T-L
D715-C 74HC132T-L
D615-C 74HCT14T-L
D615-D 74HCT14T-L
D405-D 74HC00T-L
D405-A 74HC00T-L
D405-B 74HC00T-L
D615-B 74HCT14T-L
D715-D 74HC132T-L
D720-A N84256-B
D710-A 27C512-B
D700-A N80C51FA-B
CLOCK
XTAL1
XTAL2
EA/VDD
PSEN
ALE/PROG
RXD
TXD
INT0
INT1
T0
T1
WR
RD
ZZOFL
BUSY
LED1
R710 1K L
8 X 100K L
C701 100N L
R701 R702 R703 R704 R705 R706 R707 R708
R709 1K L
D705-A 74HC373T-L
CS1
IECINT
CS2
RESLCD
C/D
CS3
CS4
P1.7
D730 UPD7210C
R730 1K L
RES
D715-A 74HC132T-L
D715-B 74HC132T-L
D714-B 74HCT00T-L
R715 1K L
R714 1K L
D0 - D7
D0-D7 ON SH.1,2,6
A0 - A15
URAM
V701 BAT46
V702 BAT46
X700
P700
G700 3.6V 1AH
X701
C730 100N L
D730-B
D731-B
C731 100N L
D732-B
D700-B
C700 100N L
D705-B
C705 100N L
D710-B
C710 100N L
D714-E
D716-B
D717-B
D715-E
D720-B
C720 100N L
*-NICHT BESTUECKT/NOT IN PCB
06/ 47649 12.93 SR
AEND. IND.
AENDERUNGS-MITTEILUNG
DATUM
NAME



06/	47649	12.93	SR	1GPK	TAG	NAME	BENENNUNG
				BEARB.		SR	PROCESSOR MAINBOARD
				GEPR.		SR	
				NORM			
				PLOTT	09.12.93		
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ROHDE&SCHWARZ			ZEICHN.-NR. 1029.0605.01S
				ZU GERAET	NRVS		REG.I.V. 1020.1809 / ERSTE Z. 1020.1809

BLATT-NR. 7-



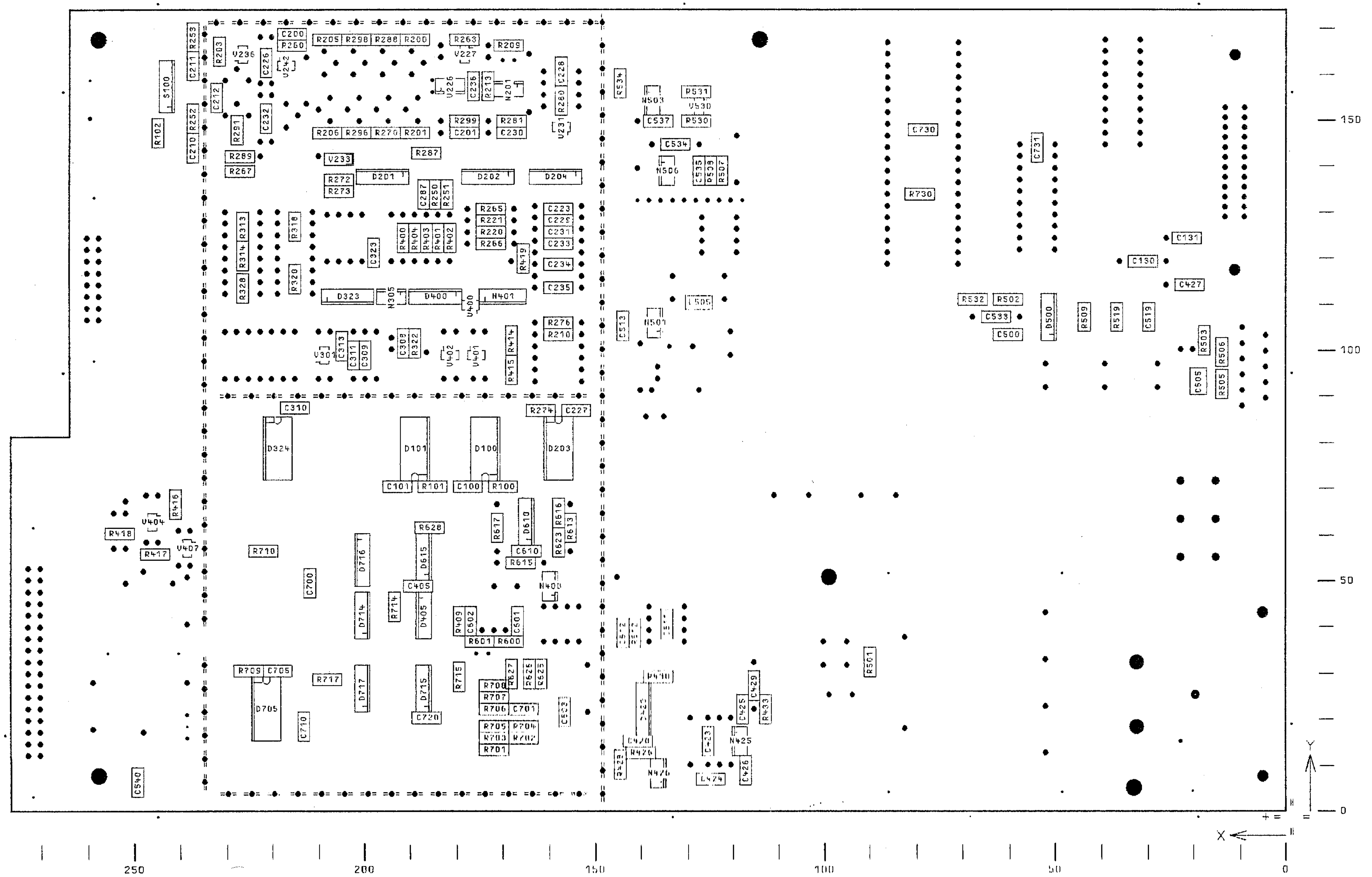
DARSTELLUNG SEITE B
VIEW ON SIDE B

ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.
ATTENTION ESD!
ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING

HINWEISE: ANGABEN UEBER VARIANTEN, BAUTEILWERTE UND NICHT BESTUECKTE BAUTEILE SIEHE SL.

FOR ORDERING INFORMATION ON MODELS, VARIANTS AND COMPONENTS VALUES AND NOT FITTED COMPONENTS SEE PARTS LIST.

05/	47649	12.93	SR	1GPK	TAG	NAME	BENENNUNG: MAINBOARD
				BEARB.		SR	
				GEPR.		SR	Z
				NORM			
				PLOTT	09.12.93		
/				ROHDE&SCHWARZ			ZEICHN.-NR. 1029.0605.01 ED
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ZU GERAET NRVS			BLATT-NR 1+ V. BL.
							REG.I.V. 1020.1809 ERSTE Z. 1020.1809



DARSTELLUNG SEITE A
VIEW ON SIDE A

ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.
ATTENTION ESD!
ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING

[illegible] VARIANTEN, [illegible] BAUTEILWERTE UND [illegible] SIEHE SL

FOR BINDING INFORMATION ON MODELS [illegible] AND COMPONENTS VALUES AND [illegible] COMPONENTS SEE PARTS LIST.

06/	47049	12.93	SR	1GPK	TAG	NAME
				BEARB.		SR
				GEPR.		SR
				NORM		
				PLOTT	09.12.93	
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ROHDE&SCHWARZ	ZU GERAET	NRVS

BENENNUNG: MAINBOARD — Z

ZEICHN.-NR.: 1029.0605.01 ED — BLATT-NR 2+

REG.I.V. 1020.1809 — ERSTE Z. 1020.1809

BEISPIEL:
EXAMPLE:

D2 → 31 (29)

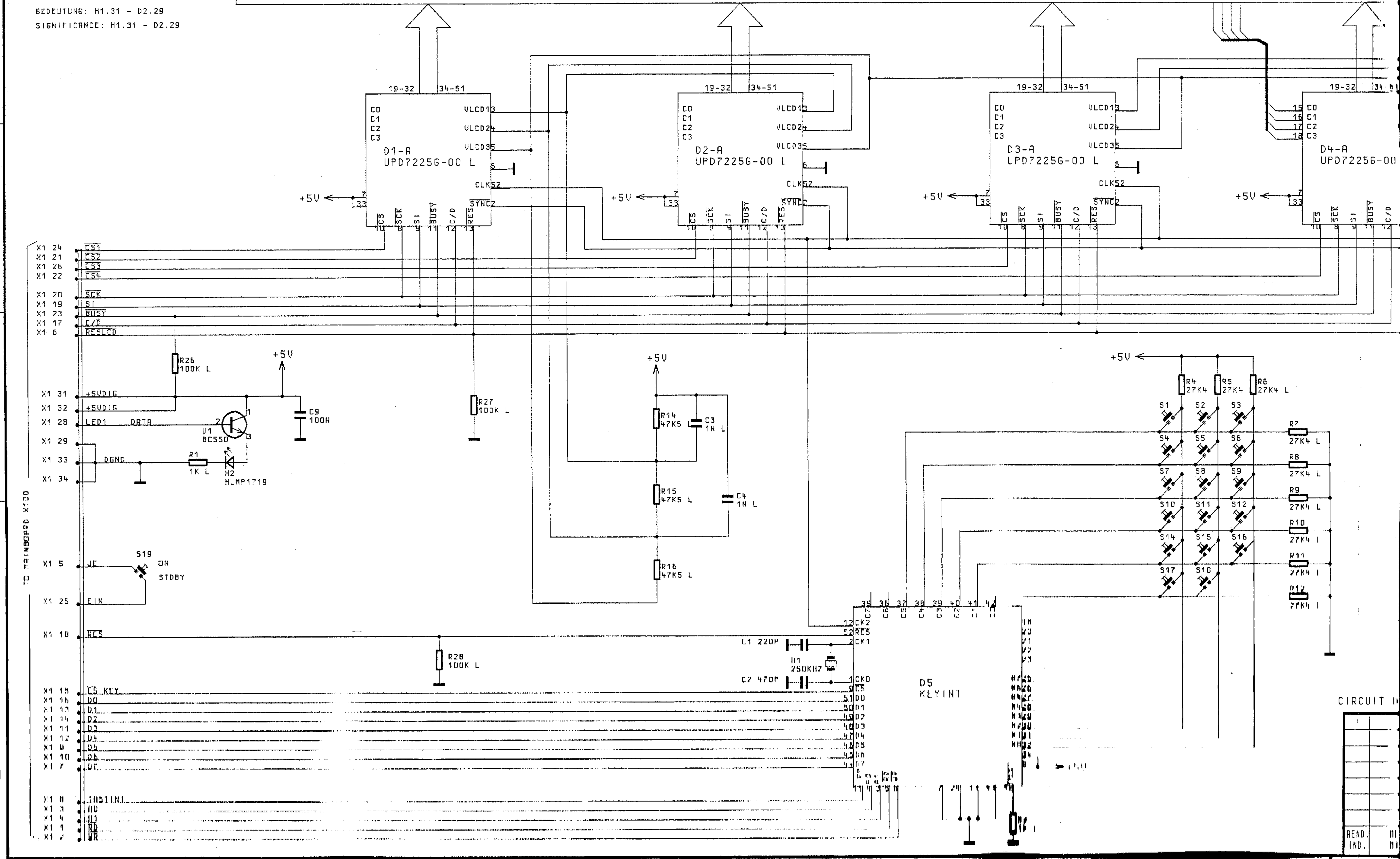
BEDEUTUNG: H1.31 - D2.29
SIGNIFICANCE: H1.31 - D2.29

VERBINDUNGSLISTE LCD H1 - TREIBER D1...D4   LIST OF CONNECTIONS LCD H1 - DRIVERS D1...D4

H1-PINS / PINS D1...D4	19	20	21	22	23	24	25	26	27	28	29	30	31	32	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
ZU D1	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	171	170	168	169	167	166	165	164	163	162	161	100	101	102	103	99
ZU D2	21	22	23	24	25	26	27	28	29	30	31	32	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
ZU D3	160	154	153	152	151	150	148	147	144	143	139	138	134	133	129	128	124	123	120	119	117	116	115	114	113	112	111	110	109	108	107	106
ZU D4	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	104	105	94	85	84	83	82	81

SIEHE ANSCHLUSSLISTE COMMONLEITUNGEN

SEE LIST OF CONNECTIONS FOR COMMON LINES



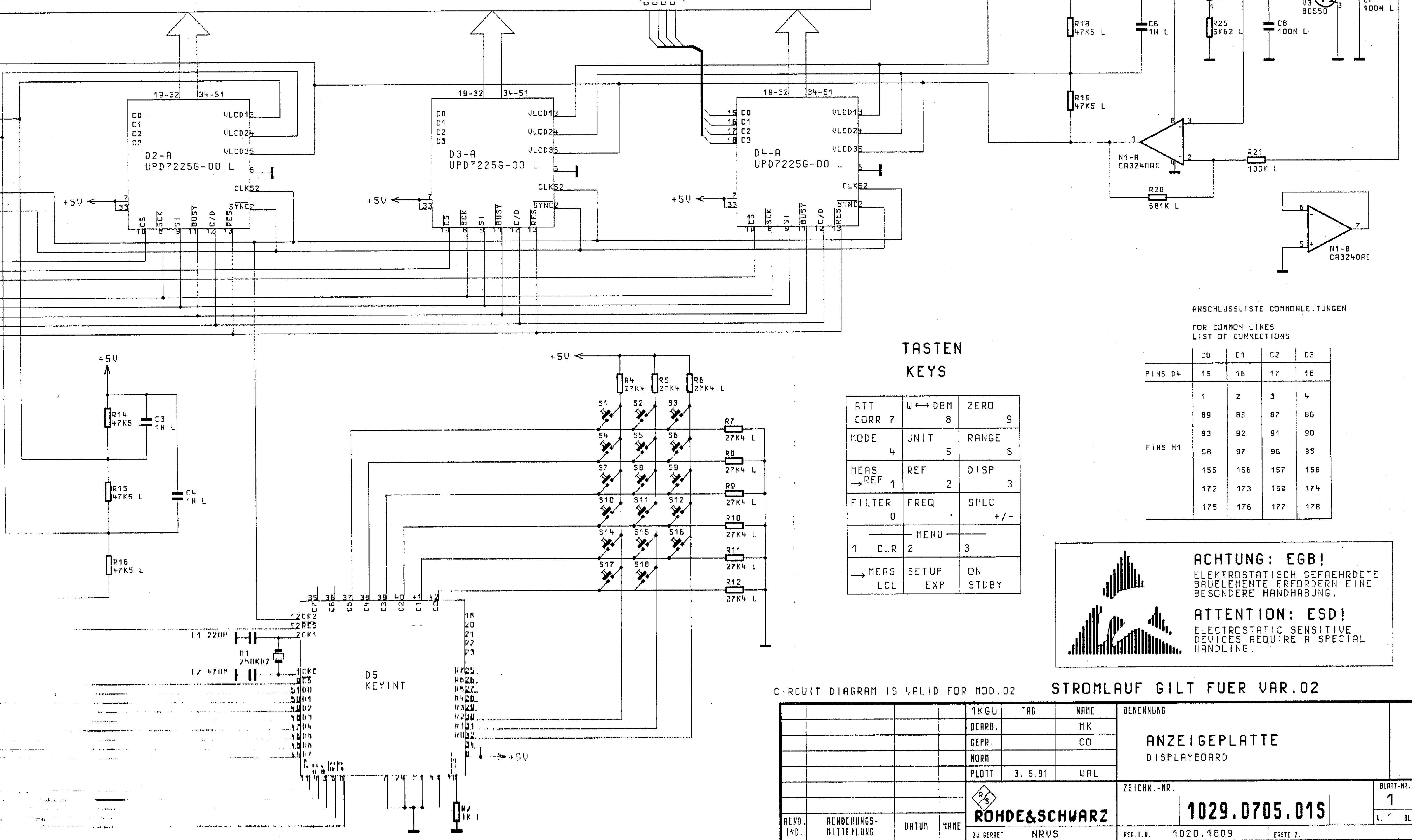
ZEICHN.-NR

BINDUNGSLISTE LCD H1 - TREIBER D1...D4 LIST OF CONNECTIONS LCD H1 - DRIVERS D1...D4

27	28	29	30	31	32	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
3	14	15	16	17	18	19	20	171	170	168	169	167	166	165	164	163	162	161	100	101	102	103	99
9	30	31	32	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
4	143	139	138	134	133	129	128	124	123	120	119	117	116	115	114	113	112	111	110	109	108	107	106
5	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	104	105	94	85	84	83	82	81

SIEHE ANSCHLUSSLISTE COMMONLEITUNGEN

SEE LIST OF CONNECTIONS FOR COMMON LINES



TASTEN

KEYS

ATT CORR 7	W ⟷ DBM 8	ZERO 9
MODE 4	UNIT 5	RANGE 6
MEAS → REF 1	REF 2	DISP 3
FILTER 0	FREQ .	SPEC +/-
MENU		
1 CLR	2	3
→ MEAS LCL	SETUP EXP	ON STDBY

ANSCHLUSSLISTE COMMONLEITUNGEN

FOR COMMON LINES LIST OF CONNECTIONS

	C0	C1	C2	C3
PINS D4	15	16	17	18
PINS H1	1	2	3	4
	89	88	87	86
	93	92	91	90
	98	97	96	95
	155	156	157	158
	172	173	159	174
	175	176	177	178

ACHTUNG: EGB!

ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.

ATTENTION: ESD!

ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING.

CIRCUIT DIAGRAM IS VALID FOR MOD.02

STROMLAUF GILT FUER VAR.02

	TAG	NAME
1KGU		
BEARB.		MK
GEPR.		CO
NORM		
PLOTT	3. 5.91	WAL

BENENNUNG: ANZEIGEPLATTE DISPLAYBOARD

ROHDE&SCHWARZ

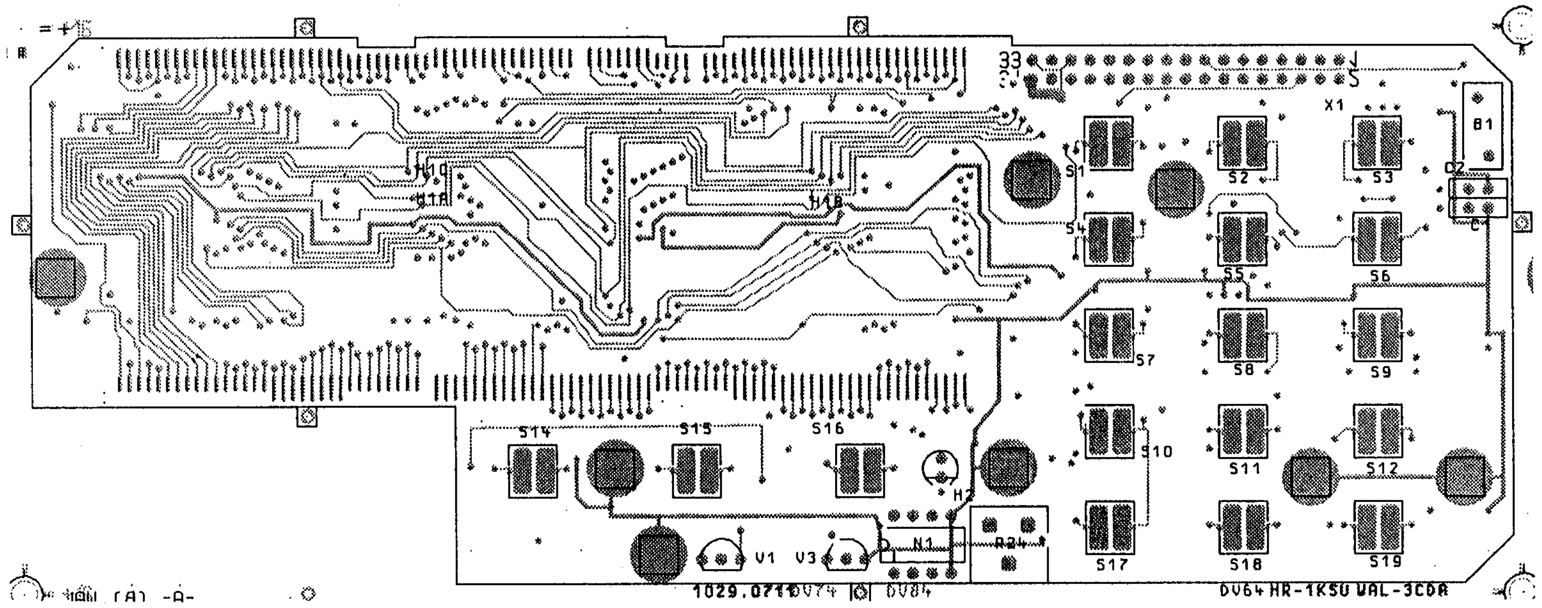
ZEICHN.-NR. 1029.0705.01S

BLATT-NR. 1 — V. 1 BL.

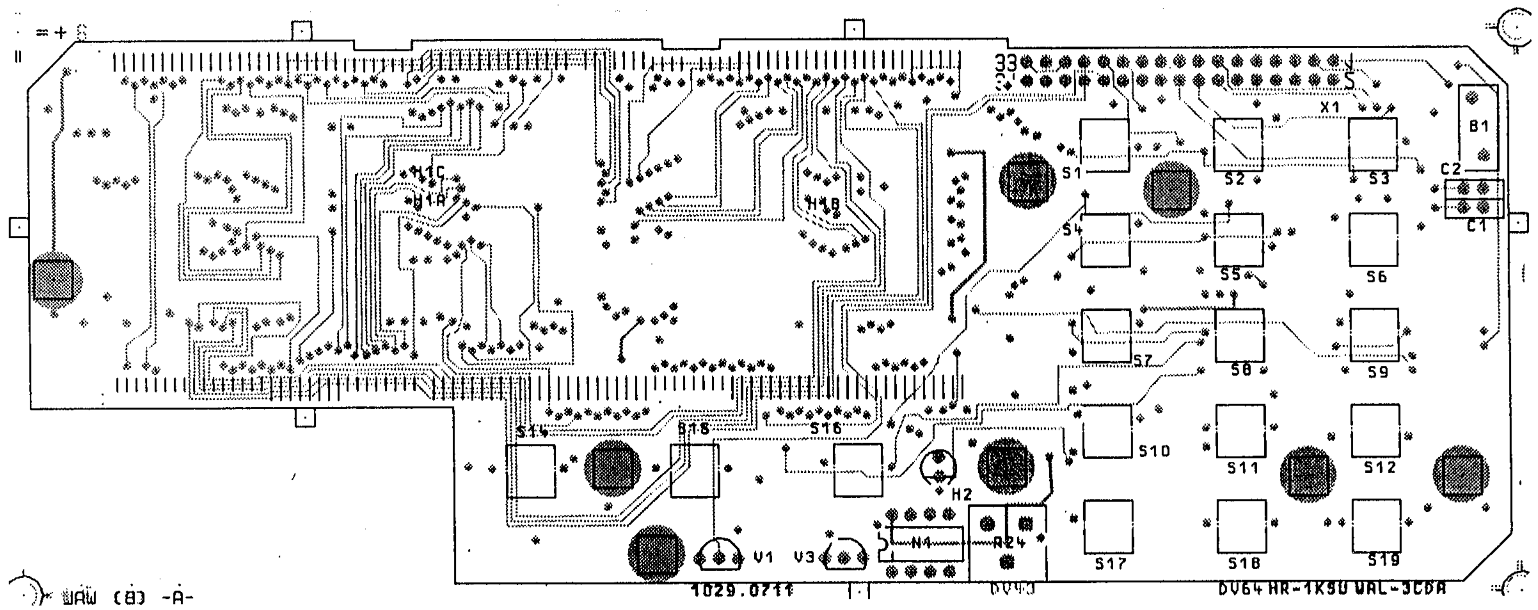
AEND. IND. | AENDERUNGS-MITTEILUNG | DATUM | NAME

ZU GERAET NRVS — REG.I.V. 1020.1809 — ERSTE Z.

Ansicht und Leitungsfuehrung Bauteilseite
View of tracks on component side



DV41



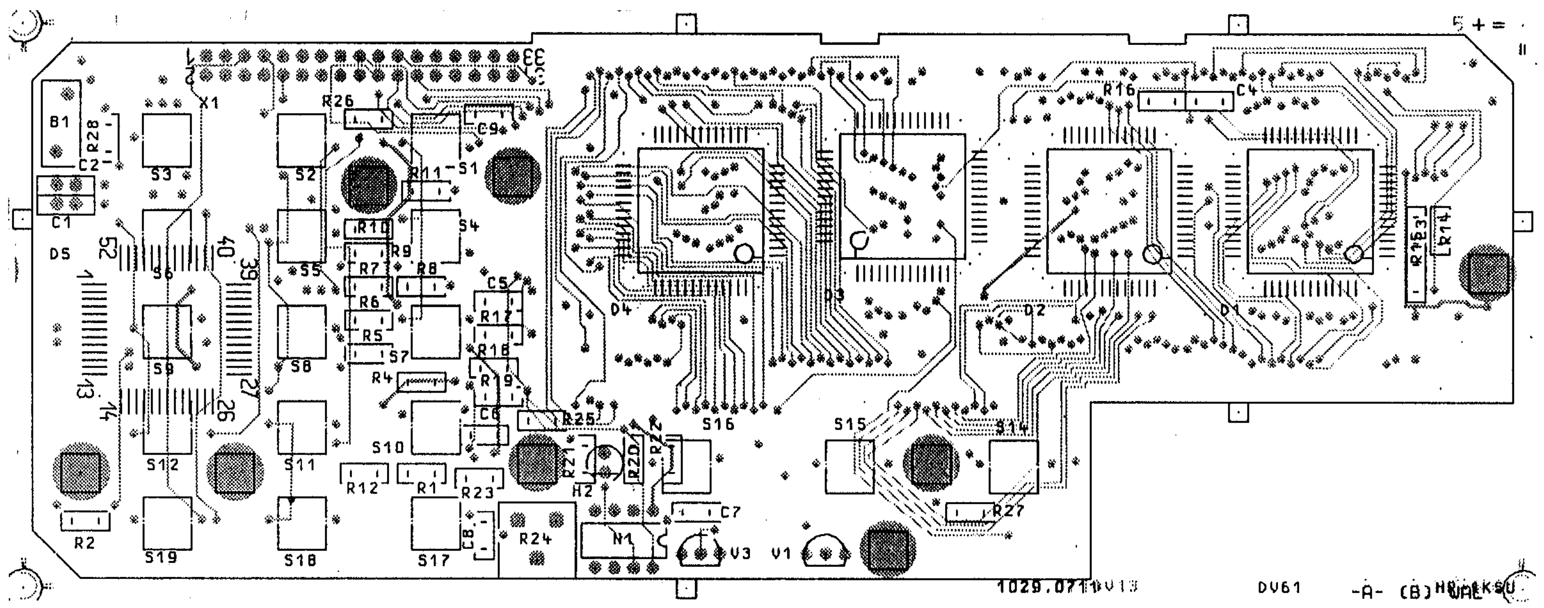
DV43

02		05.91	MK	Maße ohne Toleranzangabe	Maßstab 1 : 1	
					Halbzeug, Werkstoff	
				1KGU / Tag / Name	Benennung	
				Bearb 05.91 MK	ANZEIGEPLATTE	Z
				Gepr.		
				Norm		
				ROHDE & SCHWARZ	Zeichn.-Nr. 1029.0705	Blatt-Nr. 4 v. 5 Bl.
Änd. Zust.	Änderungs-Mitteilung	Tag	Name	zu Gerät NRVS	reg. i. V 1020.1809 V	erste Z.

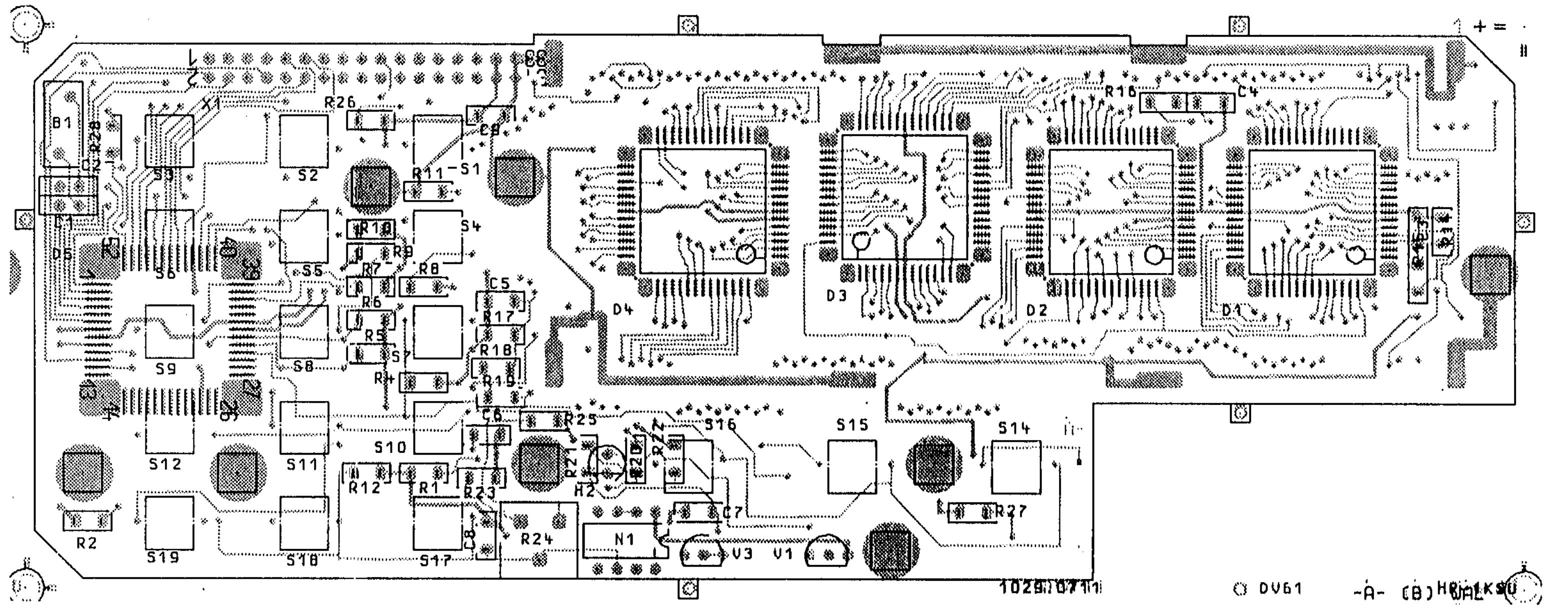
ISO-Projektion Methode E

11 6107 87

Ansicht und Leitungsfuehrung Loetseite
View of tracks on solder side



DV13

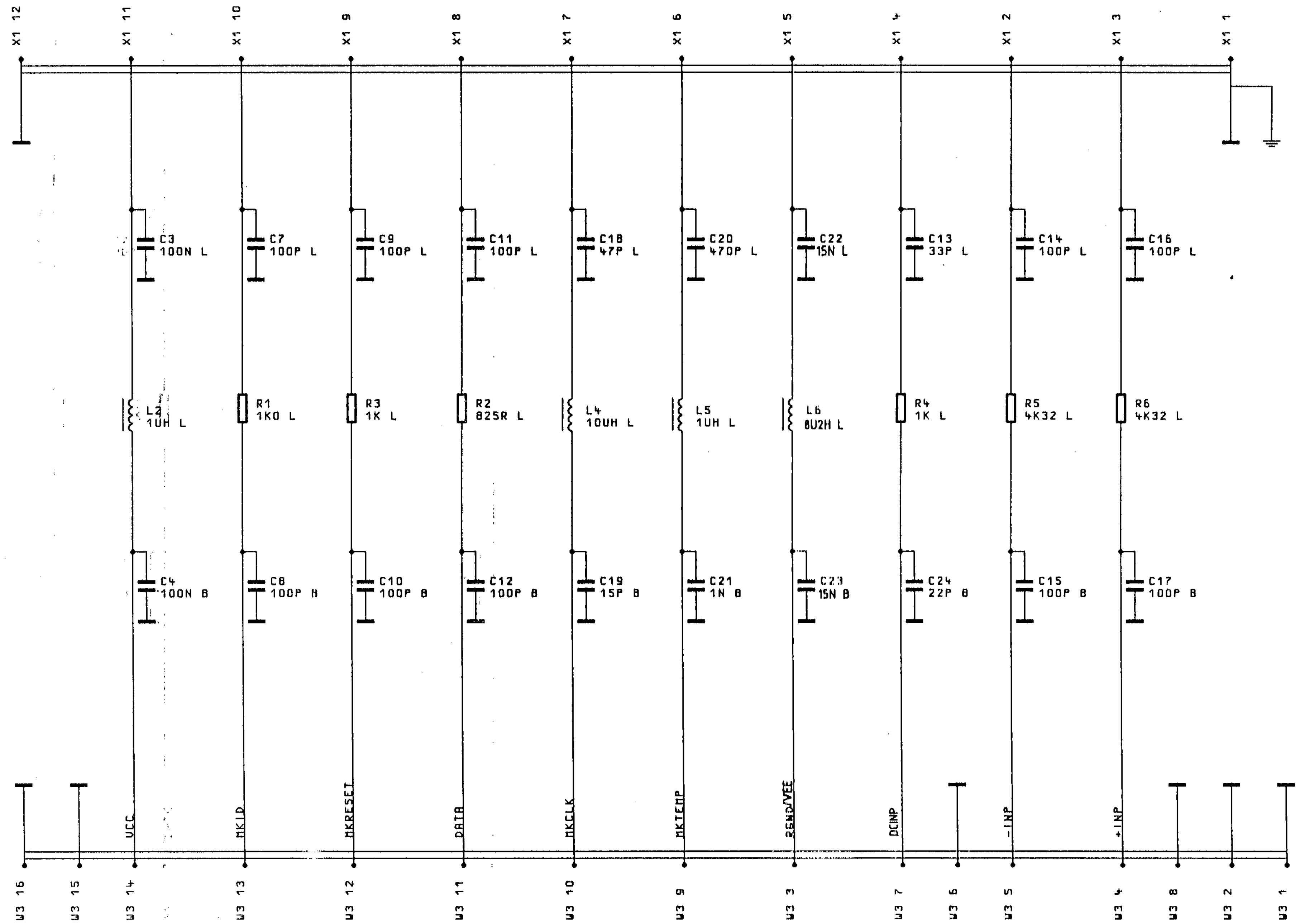


DV11

02		05.91	MK	Maße ohne Toleranzangabe	Maßstab 1 : 1	
					Halbzeug, Werkstoff	
				1KGU / Tag / Name	Benennung	
				Bearb. / 05.91 / MK	ANZEIGEPLATTE	Z
				Gepr.		
				Norm		
				ROHDE&SCHWARZ	Zeichn.-Nr. 1029.0705	Blatt-Nr. 5 v. 5 Bl.
Änd. Zust.	Änderungs-Mitteilung	Tag	Name	zu Gerät NRVS	reg. i. V. 1020.1809 V	erste Z.

11 6107 87

PROBE



STROMLAUF GILT FUER VAR.02

CIRCUIT DIAGRAM IS VALID FOR MOD.02

AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME
02			
03	45810	02.92	SR

	TAG	NAME
BEARB.		SR
GEPR.		MK
NORM		
PLOTT	16. 5.91	MK

BENENNUNG: FILTERPLATTE
FILTERBOARD

ROHDE&SCHWARZ

ZU GERAET: NRVS

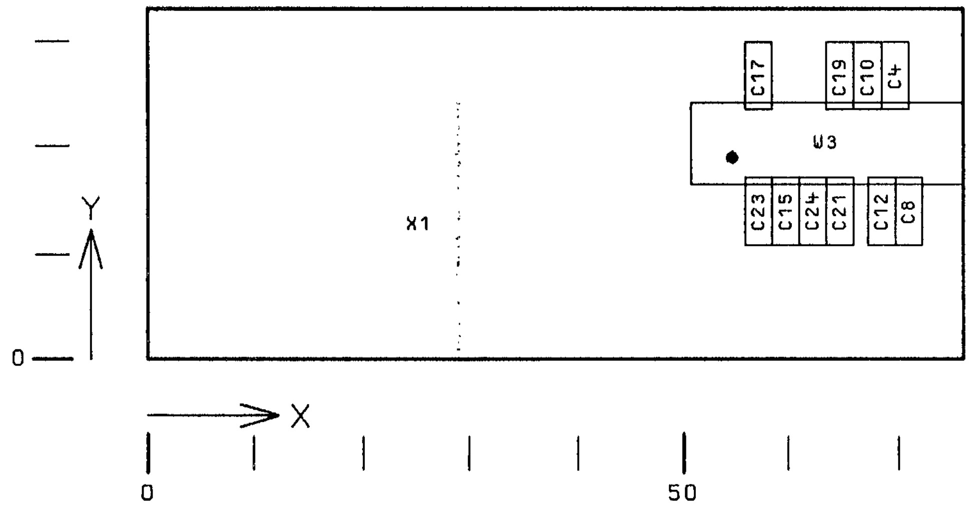
ZEICHN.-NR.: 1029.0805.01S

BLATT-NR. 1, V. 1 BL.

REG.I.V. 1020.1809

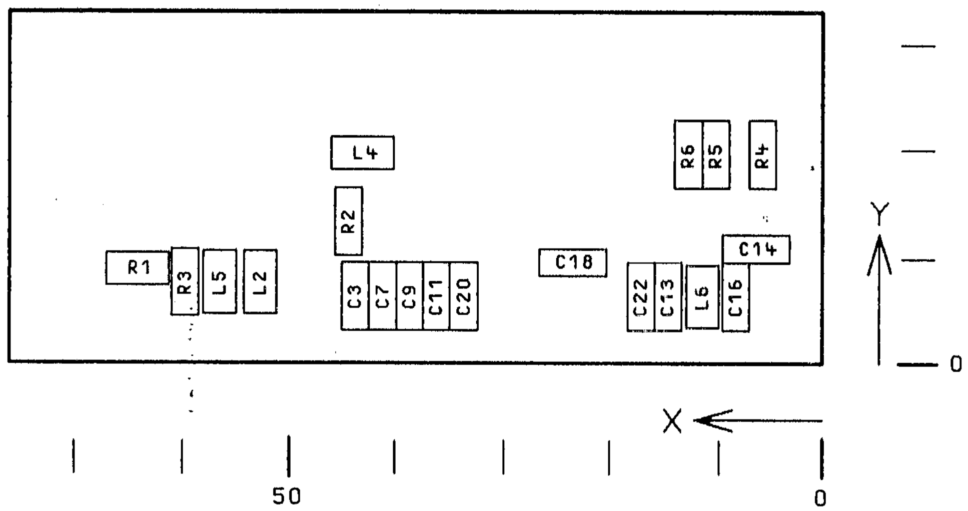
ERSTE Z.

ZEICHN.-NR.



DARSTELLUNG SEITE B
VIEW ON SIDE B

02/00		07.91	MK	1KGU	TAG	NAME	BENENNUNG: FILTERPLATTE / FILTERBOARD — Z
				BEARB.		MK	
				GEPR.		MK	
				NORM			
				PLOTT	20.07.91		
				ROHDE&SCHWARZ			ZEICHN.-NR. 1029.0805.01 — BLATT-NR. 1+
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ZU GERAET	NRVS		REG.I.V. 1020.1809 — ERSTE Z.



DARSTELLUNG SEITE A
VIEW ON SIDE A

02/00		07.91	MK	1KGU	TAG	NAME	BENENNUNG
				BEARB.		MK	FILTERPLATTE
				GEPR.		MK	FILTERBOARD
				NORM			
				PLOTT	20.07.91		
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ROHDE&SCHWARZ			ZEICHN.-NR. 1029.0805.01
				ZU GERAET	NRVS		REG.I.V. 1020.1809 / ERSTE Z.

Z

BLATT-NR. 2-
V. BL.