ROHDE&SCHWARZ
Test and Measurement
Division

Manual

Thermal Power Sensor

NRV-Z51 (0 ... 18 GHz)

0857.9004.02/.04

NRV-Z52 (0 ... 26,5 GHz)

0857.9204.02

NRV-Z55 (0 ... 40 GHz)

1081.2005.02

Printed in the Federal
Republic of Germany

Certified Quality System

ISO 9001

DQS REG. NO 1954-04

Qualitätszertifikat

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist nach ISO 9001 zertifiziert.

Certificate of quality

Dear Customer,

You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.

The Rohde & Schwarz quality management system is certified according to ISO 9001.

Certificat de qualité

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Le système de gestion qualité de Rohde & Schwarz a été homologué conformément à la norme ISO 9001.

095.1000.1.0-0796

ROHDE & SCHWARZ

CE

Certificate No.: 9502231

This is to certify that:

Equipment type	Order No.	Designation
NRV-Z1	0828.3018.02/.03	Power Sensor
NRV-Z2	0828.3218.02/.03	"
NRV-Z3	0828.3418.02/.03	"
NRV-Z4	0828.3618.02/.03	"
NRV-Z5	0828.3818.02/.03	"
NRV-Z6	0828.5010.02	"
NRV-Z15	1081.2305.02	"
NRV-Z31	0857.9604.02/.03/.04	Peak Power Sensor
NRV-Z32	1031.6807.04/.05	"
NRV-Z33	1031.6507.03/.04	"
NRV-Z51	0857.9004.02/.04	Thermal Power Sensor
NRV-Z52	0857.9204.02	"
NRV-Z53	0858.0500.02	"
NRV-Z54	0858.0800.02	"
NRV-Z55	1081.2005.02	"

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electromagnetic compatibility
  (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN50081-1 : 1992
EN50082-1 : 1992

Affixing the EC conformity mark as from 1995

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Munich, 1999-10-06

Central Quality Management FS-QZ / Becker

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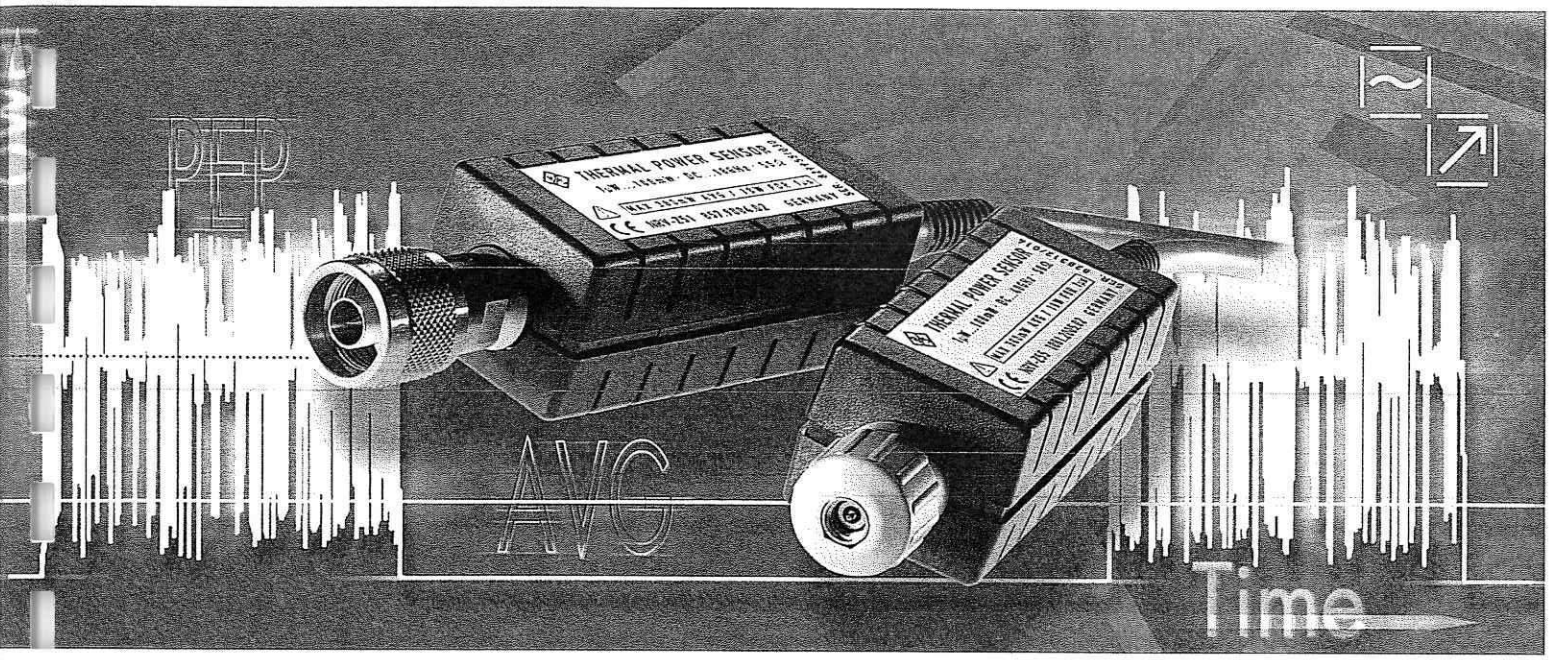


Power Sensors NRV-Z

for RF and microwave power measurements

- Thermal sensors and diode sensors for high-precision power measurements
- Compatible with NRVS, NRVD, URV35 and URV55 basic units
- Frequency range DC to 40 GHz
- Power range 100 pW to 30 W
- Standards: GSM900/1800/1900, DECT, IS-95 CDMA, W-CDMA, NADC, PDC, DAB, DVB etc
- Absolute calibration, simply plug in and measure
- Calibration data memory for sensor-specific parameters
- High long-term stability
- Excellent temperature response

ROHDE&SCHWARZ

With its large variety of power sensors Rohde&Schwarz is able to provide the right tool for power measurements with NRVS, NRVD, URV35 and URV55 basic units.

15 different types of power sensors in all cover the frequency range from DC to 40 GHz and the power range from 100 pW (–70 dBm) to 30 W (+45 dBm). In addition to thermal sensors, which are ideal as a high-precision reference for any waveform, diode sensors with a dynamic range of more than 80 dB are available.

The peak power sensors of the NRV-Z31/-Z32/-Z33 series allow power measurements on TDMA mobile phones to different digital standards as well as measurement of the peak power of pulsed or modulated signals.

Plug in and measure

With the individually calibrated sensors of the NRV-Z series plugged into the basic unit, a fully calibrated power meter is immediately ready for measurements – without need for entering calibration factors and without adjustment to a 50 MHz reference: this means a great benefit in the routine research and development work and an error source less when changing the sensor. These assets are brought about by the calibration data memory first introduced by Rohde&Schwarz which contains all the relevant physical parameters of the sensors, and the excellent long-term stability of the Rohde&Schwarz power sensors. Rohde&Schwarz is worldwide the only manufacturer to provide absolute calibration for its power sensors.

The right sensor for every application

Terminating power sensors are used for power measurements on a large variety of sources. The requirements placed on the sensor regarding frequency and power range, measurement accuracy and speed may therefore differ a great deal.
Four classes of power sensors allow optimum adaptation to the specific measurement task:

- Thermal power sensors NRV-Z51/-Z52/-Z53/-Z54/-Z55
- High-sensitivity diode sensors NRV-Z1/-Z3/-Z4/-Z6/-Z15
- Medium-sensitivity diode sensors NRV-Z2/-Z5
- Peak power sensors NRV-Z31/-Z32/-Z33

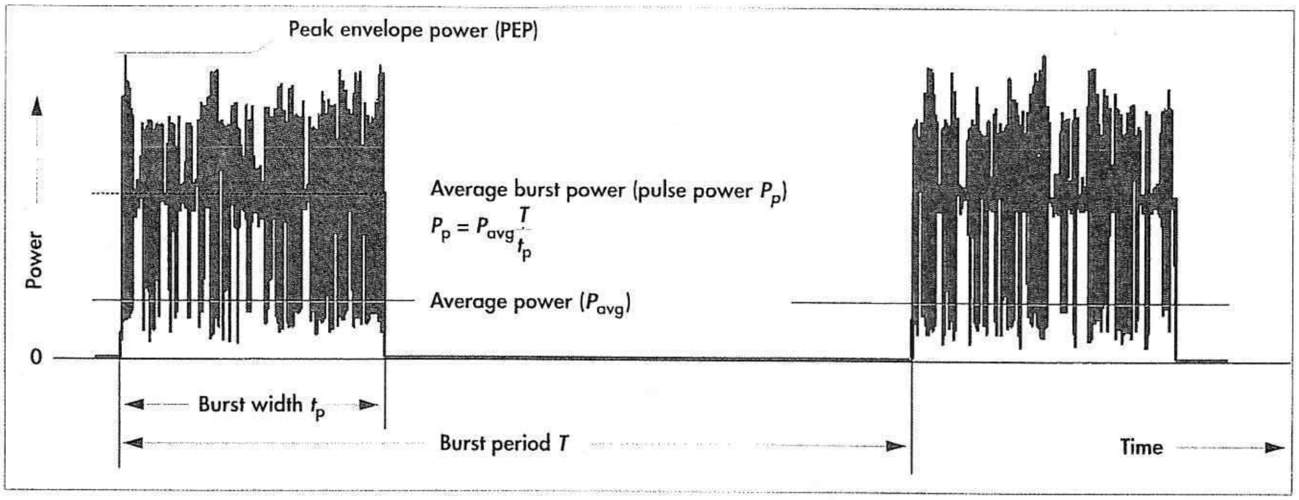
Thermal power sensors

The thermal power sensors of the **NRV-Z51** to **-Z55** series satisfy the most stringent demands placed on measurement accuracy and matching. They cover the power range from 1 μW (–30 dBm) to 30 W (45 dBm) and the frequency range from DC to 40 GHz.

These sensors are capable of measuring – without any degradation of the measurement accuracy – the power of CW signals as well as the average power of modulated or distorted signals by RMS weighting of all spectral components within the specified frequency range. Therefore, thermal sensors are the first choice for power measurements at the output of power amplifiers and on carrier signals with modulated envelope. Needless to say that the linearity of the sensor is independent of frequency, ambient temperature and waveform, and with 0.5% or 0.02 dB its contribution to the measurement uncertainty of sensors NRV-Z51/-Z52/-Z55 is negligible.

High-sensitivity diode sensors

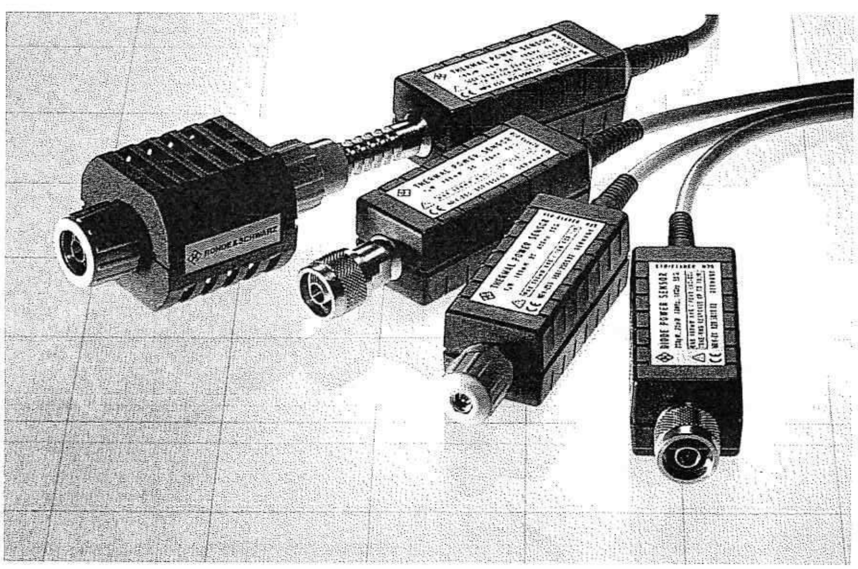
The high-sensitivity power sensors **NRV-Z1/-Z3/-Z4/-Z6/-Z15** based on zero-bias Schottky diodes open up the power range below 1 μW down to the physical limit of 100 pW (–70 dBm). In this range, strictly speaking from –70 dBm to –20 dBm, their behaviour is much the same as that of thermal sensors, ie precise measurement of the average power of modulated signals, RMS weighting of harmonics and lin-



Definition of the main power parameters using the transmitter signal of a NADC mobile station as an example. The average burst power can be displayed on the NRVS, NRVD and URV55 basic units after entering the duty cycle t_p/T. Required is a sensor that is able to precisely measure the average power P_{avg}, ie a thermal sensor or a diode sensor operated in the square-law region

earity independent of temperature and frequency.

All high-sensitivity sensors from Rohde&Schwarz are calibrated to allow precise power measurements also outside the square-law region up to a power of 20 mW (+13 dBm). The high signal-to-noise ratio of the sensor output signal in this region makes for very short measurement times. It should however be noted that the response of high-sensitivity sensors outside the square-law region differs from that of thermal sensors so that only spectrally pure signals with unmodulated envelope (CW, FM, φM, FSK, GMSK) can be measured. Regarding the display linearity, greater measurement uncertainties than with thermal sensors are to be expected in this region due to frequency and temperature effects.



Medium-sensitivity diode sensors

The medium-sensitivity sensors **NRV-Z2** and **NRV-Z5** based on diode sensors with 20 dB attenuator pad close the gap between the thermal and the high-sensitivity sensors in applications where in the power range between –20 dBm and 0 dBm both high measurement speed and the thermal sensor characteristics are required at a time.

Given a continuous load capability of 2 W, this type of sensor is extremely robust.

Peak power sensors

The peak power sensors **NRV-Z31/-Z32/-Z33** take a special place among diode sensors. They enable measurement of the peak envelope power (PEP) of modulated signals during signal peaks of 2 µs to 100 ms duration. They thus open up a large variety of applications, from the measurement of pulsed transmit power of TDMA mobile phones through special measurement tasks in applied physics to the measurement of sync pulse power of terrestrial TV transmitters.

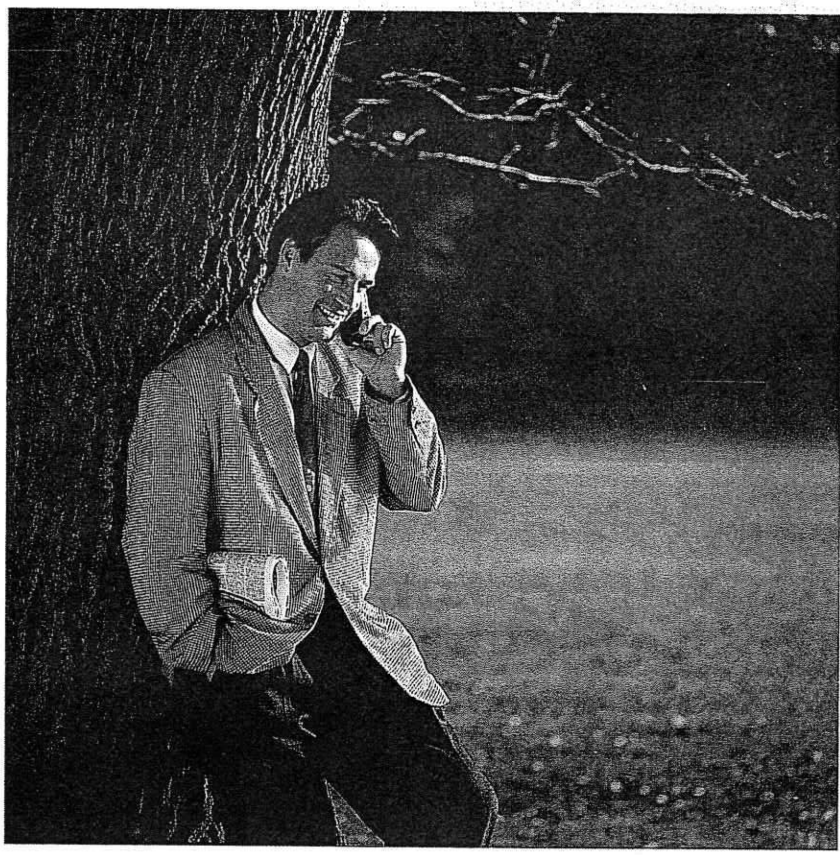
Peak power sensors from Rohde&Schwarz are available for the frequency range 30 MHz to 6 GHz in the power classes 20 mW (NRV-Z31), 2 W (NRV-Z32) and 20 W (NRV-Z33), the latter for direct power measurement at output stages.

DC to 40 GHz / 100 pW to 30 W   GSM900/1800/1900,

Various models within a power class allow the handling of versatile waveforms:

- **Model 02** (of NRV-Z31) and **Model 05** (of NRV-Z32) are designed for general-purpose applications and are suitable for measuring the power of RF bursts from 2 µs width and at repetition rates from
  10/s (NRV-Z31/model 02) and
  25/s (NRV-Z32/model 05).

- **Model 03** (high-speed model of NRV-Z31/-Z33) can be used at repetition rates from 100/s and due to its higher measurement speed it is ideal for system applications and measurement of the sync pulse power of negatively modulated TV signals in line with the relevant standards for terrestrial television (NTSC, CCIR, British and OIRT). The picture content has no effect on the measurement result, while the effect of the sound carrier can be compensated using tabulated correction factors.



- **Models 04** of all peak power sensors are tailored to the requirements of TDMA radio networks and enable measurement of the transmit power of TDMA mobile stations to GSM and DECT standards.

The right sensor for digital modulation

There are two main features of digitally modulated signals that have to be considered in power measurements:

The following table serves as a guide in choosing the suitable sensor for digital modulation:

Modulation	Time structure	Application	Suitable sensor	Measured parameter	Dynamic range
GMSK, GFSK, 4FSK (unmodulated envelope)	continuous	GSM, DECT base stations; same power in all timeslots	all sensors, without any restrictions	P_{avg}	50 to 80 dB
	one timeslot active, frame length <10 ms	GSM, DECT mobile stations	NRV-Z31/-Z32/-Z33 model 04	P_p (PEP) [1]	43 dB
QPSK, OQPSK	continuous	IS-95 CDMA, W-CDMA base stations	NRV-Z51 to -Z55	P_{avg}	50 dB
OFDM	continuous	DVB-T / DAB transmitters	NRV-Z51 to -Z55	P_{avg}	50 dB
π/4DQPSK, 8 PSK, 16QAM, 64QAM symbol rate: any	continuous	NADC, PDC, PHS, TETRA base stations; same power in all timeslots	NRV-Z51 to -Z55	P_{avg}	50 dB
π/4DQPSK, 8 PSK, 16QAM, 64QAM symbol rate <25 kS/s	continuous	NADC, PDC TETRA base stations; same power in all timeslots	NRV-Z31/-Z32/-Z33 model 02/03/05	PEP	43 dB
	one timeslot active, frame length ≤40 ms	NADC, PDC mobile stations	NRV-Z32, model 05	PEP	43 dB
			NRV-Z51	P_p	40 dB

Footnotes see fold-out page

DECT, IS-95, CDMA, W-CDMA, NADC, PDC, DAB, DVB ...

- The pulsed envelope power to CDMA, DAB and DVB standards and all standards prescribing the modulation modes PSK, QAM and π/4DQPSK (eg NADC, PDC, PHS and TFTS) requires a differentiation between average power and peak power.
  All thermal power sensors can be used without any restrictions for average power measurements. Diode sensors may be used provided they are operated inside the square-law region. The peak power sensors of the NRV-Z31/-Z32/-Z33 series (models 02, 03 and 05) are suitable for measuring the peak value at symbol rates of up to 25 kS/s.

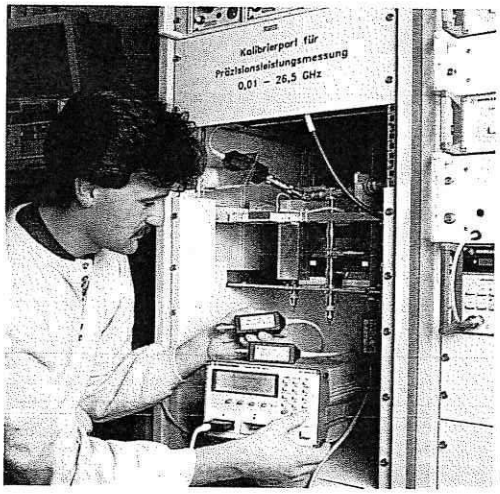
- In the case of transmission standards using TDMA structure, like GSM, DECT, NADC, PDC or PHS, the data stream for a channel is compressed to fit into one of several timeslots, so that the power measurement has to be carried out in a certain time interval. In the case of one active timeslot in the transmit signal (mobile station), the peak power sensors of the NRV-Z31/-Z32/-Z33 series can be used, with models 02, 03 and 05 being suitable for measuring the peak power and model 04 for measuring the average transmit power (GSM and DECT only).

Precision calibration

A power sensor can only be as precise as the measuring instruments used for its calibration. Therefore, the calibration standards used by Rohde&Schwarz are directly traceable to the standards of the German Standards Laboratory.

All data gained in calibration as well as the essential physical characteristics of the sensor, eg temperature effect, are stored in a data memory integrated in the sensor and can be read by the basic unit and considered in the measurements.

Since all Rohde&Schwarz power sensors feature absolute calibration, measurements can be started immediately after plugging the sensor into the basic unit without prior calibration to a 1 mW reference source. To activate the frequency-dependent calibration factors all the user needs to do is to enter the test frequency on the basic unit.

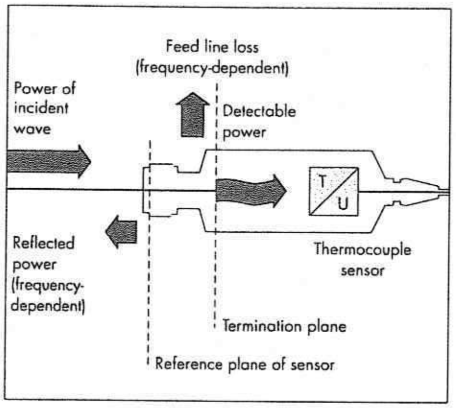


Calibration of the NRV-Z sensors is directly traceable to the standards of the German Standards Laboratory.

Power sensors are calibrated to the power of the incident wave.

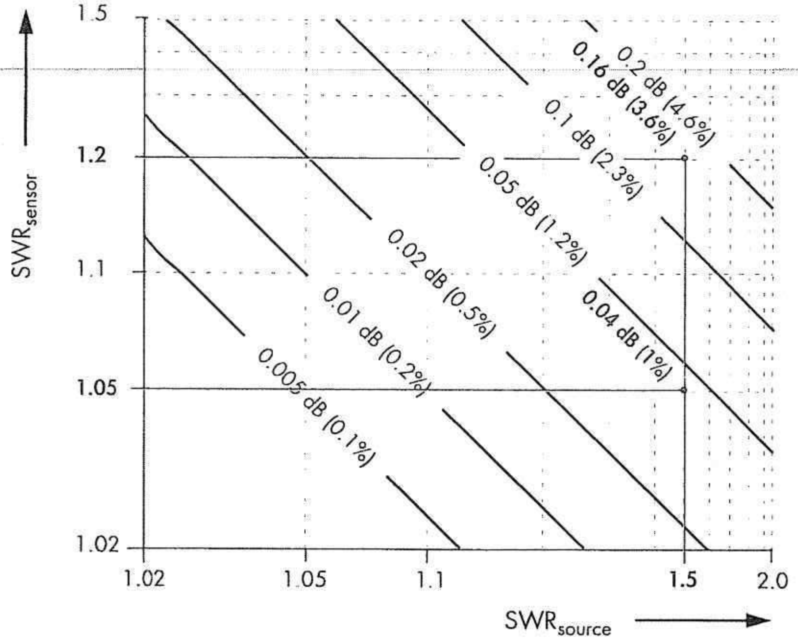
This ensures that with a matched source the available source power into 50 Ω (or 75 Ω) is measured.

With a mismatched source the power of the incident wave will differ from the available power according to the mismatch uncertainty.



Measurement accuracy and matching

The accuracy of power measurements is determined by diverse parameters, such as the measurement uncertainty in calibration, linearity or ambient temperature: parameters whose effect can directly be specified. In contrast, the effect of a mismatched power sensor can only be estimated if the source matching is known. Mismatch of source and sensor causes the device under test – the source – to supply a somewhat higher or lower power than for an exactly matched output. As shown in the graph on the right, the resulting measurement error can be several times greater than the measurement errors caused by all other parameters. Power sensors from Rohde & Schwarz therefore feature excellent matching to ensure optimum measurement accuracy even under conditions of strong reflections.



Maximum measurement error due to mismatch for source power available into 50 Ω (75 Ω). Values stated in dB and in % of power in W.

Example shown:
Power measurement on a source with SWR of 1.5.
A sensor with excellent matching with 1.05 SWR (eg NRV-Z5) generates a measurement error of as little as 0.04 dB (1%), while a SWR of 1.2 would result in a measurement error four times greater.

The basic units

All power sensors can be used with the following basic units from Rohde & Schwarz:

NRVD
- Modern dual-channel power meter
- Menu-guided operation
- IEC/IEEE-bus interface (SCPI)
- Ideal for relative measurements in two test channels (attenuation, reflection)
- Large variety of measurement functions
- Result readout in all standard units
- Many extras like 1 mW test generator, indication of measurement uncertainty etc

NRVS
- Cost-effective, single-channel power meter
- Manual operation like NRVD
- Many measurement functions
- Result readout in all standard units
- Analog output fitted as standard
- IEC/IEEE-bus interface (syntax-compatible with NRV/URV 5)

NRVD

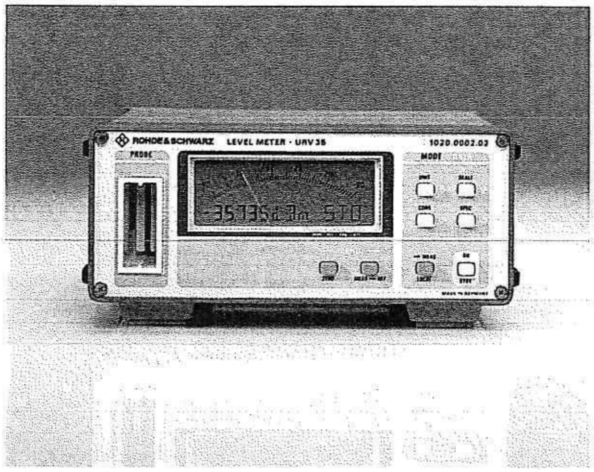
NRVS

URV 35

- Compact voltmeter and power meter for use in service, test shop and lab
- Unique combination of analog and digital display in form of moving-coil meter plus LCD with backlighting
- Many measurement functions
- Result readout in all standard units
- Choice of battery or AC supply operation
- RS-232 interface

URV 55

Cost-effective single-channel voltmeter; similar to NRVS.



URV 35

URV 55

Sensors for voltage and level measurements

Probes and insertion units (data sheet PD 756.9816) open up further applications of the power meters:

RF Probe URV5-Z7

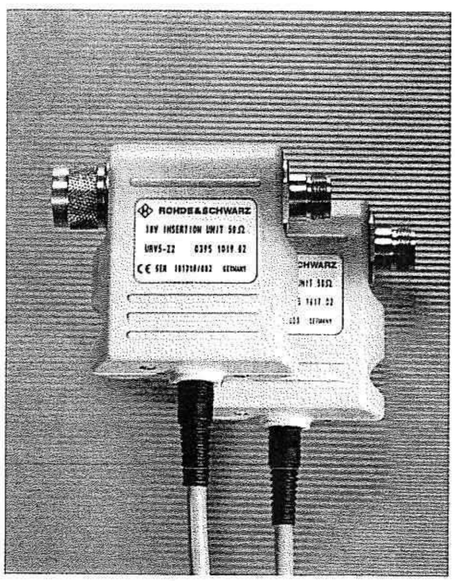
- For practically no-load measurements in non-coaxial RF circuits; frequency range 20 kHz to 1 GHz
- Comprehensive accessories, including adapters for 50 Ω and 75 Ω connectors

Insertion Units URV5-Z2/-Z4

- For level measurement between source and load in coaxial 50 Ω and 75 Ω systems. With an optimally matched load, power measurements from –60 to +53 dBm are possible even without directional coupler
- Frequency range 9 kHz to 3 GHz

DC Probe URV5-Z1

For low-load DC measurements in RF circuits from 1 mV to 400 V.



URV5-Z2/-Z4

Model connector, impedance	Frequency range	Power meas. range, *max. power*	Max. SWR (reflection coefficient)	Zero offset [2]	Display noise [3]	Linearity uncertainty	Power coefficient
High-sensitivity diode sensors (RMS weighting up to 10 µW; NRV-Z3 up to 6 µW)							
NRV-Z4 N connector, 50 Ω	100 kHz to 6 GHz	100 pW to 20 mW *100 mW (AVG)* *100 mW (PK)*	0.1 to 100 MHz 1.05 (0.024) >0.1 to 2 GHz 1.10 (0.048) >2 to 4 GHz 1.20 (0.09) >4 to 6 GHz 1.35 (0.15)	±50 pW	20 pW	0.03 dB (0.7%) [4]	0
NRV-Z1 N connector, 50 Ω	10 MHz to 18 GHz	200 pW to 20 mW *100 mW (AVG)* *100 mW (PK)*	0.01 to 1 GHz 1.06 (0.03) >1 to 2 GHz 1.13 (0.06) >2 to 4 GHz 1.27 (0.12) >4 to 18 GHz 1.41 (0.17)	±100 pW	40 pW	0.03 dB (0.7%) [4]	0
NRV-Z6 PC-3.5 connector, 50 Ω	50 MHz to 26.5 GHz	400 pW to 20 mW *100 mW (AVG)* *100 mW (PK)*	0.05 to 0.1 GHz 1.30 (0.13) >0.1 to 18 GHz 1.20 (0.09) >18 to 26.5 GHz 1.40 (0.165)	±200 pW	80 pW	0.04 dB (1%) [4]	0
NRV-Z15 K connector [5] (2.92 mm), 50 Ω	50 MHz to 40 GHz	400 pW to 20 mW *100 mW (AVG)* *100 mW (PK)*	0.05 to 4 GHz 1.15 (0.070) >4 to 40 GHz 1.37 (0.157)	±200 pW	80 pW	0.04 dB (1%) [4]	0
NRV-Z3 N connector, 75 Ω	1 MHz to 2.5 GHz	100 pW to 13 mW *70 mW (AVG)* *70 mW (PK)*	1 MHz to 1 GHz 1.11 (0.05) >1 to 2.5 GHz 1.20 (0.09)	±40 pW	16 pW	0.03 dB (0.7%) [4]	0
Medium-sensitivity diode sensors (RMS weighting up to 1 mW)							
NRV-Z5 N connector, 50 Ω	100 kHz to 6 GHz	10 nW to 500 mW *2 W (AVG)* *10 W (PK)*	100 kHz to 4 GHz 1.05 (0.024) >4 to 6 GHz 1.10 (0.048)	±5 nW	2 nW	0.03 dB (0.7%) [4]	0
NRV-Z2 N connector, 50 Ω	10 MHz to 18 GHz	20 nW to 500 mW *2 W (AVG)* *10 W (PK)*	0.01 to 4 GHz 1.05 (0.024) >4 to 8 GHz 1.10 (0.048) >8 to 12.4 GHz 1.15 (0.07) >12.4 to 18 GHz 1.20 (0.09)	±10 nW	4 nW	0.03 dB (0.7%) [4]	0
Thermal power sensors (RMS weighting in complete power measurement range)							
NRV-Z51 N connector, 50 Ω	DC to 18 GHz	1 µW to 100 mW *300 mW (AVG)* *10 W (PK, 1 µs)*	DC to 2 GHz 1.10 (0.048) >2 to 12.4 GHz 1.15 (0.07) >12.4 to 18 GHz 1.20 (0.09)	±60 nW	22 nW	0.02 dB (0.5%)	0
NRV-Z52 PC-3.5 connector, 50 Ω	DC to 26.5 GHz	1 µW to 100 mW *300 mW (AVG)* *10 W (PK, 1 µs)*	DC to 2 GHz 1.10 (0.048) >2 to 12.4 GHz 1.15 (0.07) >12.4 to 18 GHz 1.20 (0.09) >18 to 26.5 GHz 1.25 (0.11)	±60 nW	22 nW	0.02 dB (0.5%)	0
NRV-Z55 K connector [5] (2.92 mm), 50 Ω	DC to 40 GHz	1 µW to 100 mW *300 mW (AVG)* *10 W (PK, 1 µs)*	DC to 2 GHz 1.10 (0.048) >2 to 12.4 GHz 1.15 (0.07) >12.4 to 18 GHz 1.20 (0.09) >18 to 26.5 GHz 1.25 (0.11) >26.5 to 40 GHz 1.30 (0.13)	±60 nW	22 nW	0.02 dB (0.5%)	0
NRV-Z53 N connector, 50 Ω	DC to 18 GHz	100 µW to 10 W *18 W (AVG)* *1 kW (PK, 1 µs)* (see diagram page 9)	DC to 2 GHz 1.11 (0.052) >2 to 8 GHz 1.22 (0.099) >8 to 12.4 GHz 1.27 (0.119) >12.4 to 18 GHz 1.37 (0.157)	±6 µW	2.2 µW	0.03 dB (0.7%)	0.011 dB/W (0.25%/W)
NRV-Z54 N connector, 50 Ω	DC to 18 GHz	300 µW to 30 W [6] *36 W (AVG)* *1 kW (PK, 3 µs)* (see diagram page 9)	DC to 2 GHz 1.11 (0.052) >2 to 8 GHz 1.22 (0.099) >8 to 12.4 GHz 1.27 (0.119) >12.4 to 18 GHz 1.37 (0.157)	±20 µW	7 µW	0.03 dB (0.7%)	0.007 dB/W (0.15%/W)
Peak power sensors							
NRV-Z31 N connector, 50 Ω	30 MHz to 6 GHz [7]	1 µW to 20 mW *100 mW (AVG)* *100 mW (PK)*	0.03 to 0.1 GHz 1.05 (0.024) >0.1 to 2 GHz 1.10 (0.048) >2 to 4 GHz 1.20 (0.09) >4 to 6 GHz 1.35 (0.15)	±30 nW	3 nW	included in calibration uncertainty	0
NRV-Z32 N connector, 50 Ω	30 MHz to 6 GHz [7]	100 µW to 2 W **(model 04)**, 100 µW to 4 W [8] **(model 05)**; *1 W (AVG)* *4 W (PK, 10 ms)* *8 W (PK, 1 ms)*	0.03 to 4 GHz 1.11 (0.052) >4 to 6 GHz 1.22 (0.099)	±3 µW **(model 04)** ±4 µW **(model 05)**	0.3 µW **(model 04)** 0.4 µW **(model 05)**	included in calibration uncertainty	0.044 dB/W (1.0%/W)
NRV-Z33 N connector, 50 Ω	30 MHz to 6 GHz [7]	1 mW to 20 W *18 W (AVG)* *80 W (PK)* (see diagram page 9)	0.03 to 2.4 GHz 1.11 (0.052) >2.4 to 6 GHz 1.22 (0.099)	±30 µW	3 µW	included in calibration uncertainty	0.015 dB/W (0.35%/W)

Footnotes see fold-out page

Calibration uncertainties in dB (bold type) and in % of power reading

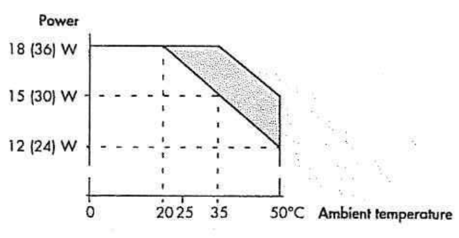
The calibration uncertainties in dB were calculated from the values in percent and rounded to two decimal places so that different values in percent may give one and the same value in dB

Frequency in GHz	up to 0.03	>0.03 to 0.1	>0.1 to 1	>1 to 2	>2 to 4	>4 to 6	>6 to 8	>8 to 10	>10 to 12.4	>12.4 to 15	>15 to 16	>16 to 18	>18 to 20	>20 to 24	>24 to 26.5	>26.5 to 30	>30 to 35	>35 to 40
NRV- Z1	**0.07** 1.5	**0.07** 1.6	**0.07** 1.6	**0.07** 1.6	**0.08** 1.7	**0.08** 1.8	**0.09** 1.9	**0.10** 2.2	**0.10** 2.3	**0.11** 2.5	**0.14** 3.0	**0.15** 3.3						
NRV-Z2	**0.07** 1.4	**0.07** 1.5	**0.07** 1.5	**0.07** 1.5	**0.07** 1.6	**0.07** 1.6	**0.07** 1.6	**0.08** 1.8	**0.08** 1.8	**0.09** 2.1	**0.11** 2.4	**0.13** 2.8						
NRV-Z3	**0.06** 1.4	**0.06** 1.4	**0.07** 1.4	**0.07** 1.5	**0.07** 1.6	calibrated up to 2.5 GHz												
NRV-Z4	**0.05** 1.2	**0.06** 1.3	**0.06** 1.3	**0.06** 1.3	**0.06** 1.4	**0.07** 1.5												
NRV-Z5	**0.05** 1.1	**0.05** 1.2	**0.05** 1.2	**0.05** 1.2	**0.06** 1.3	**0.06** 1.3												
NRV-Z6		**0.06** 1.2	**0.06** 1.2	**0.06** 1.2	**0.06** 1.3	**0.06** 1.4	**0.07** 1.6	**0.08** 1.8	**0.08** 1.9	**0.10** 2.1	**0.11** 2.5	**0.13** 2.9	**0.09** 1.9	**0.09** 2.0	**0.09** 2.0			
NRV-Z15		**0.05** 1.1	**0.05** 1.2	**0.05** 1.2	**0.06** 1.3	**0.07** 1.6	**0.09** 2.0	**0.10** 2.2	**0.10** 2.3	**0.12** 2.7	**0.14** 3.1	**0.15** 3.4	**0.08** 1.8	**0.09** 2.0	**0.09** 2.0	**0.10** 2.2	**0.11** 2.4	**0.10** 2.2
NRV-Z31	**0.05** 1.2	**0.06** 1.2	**0.07** 1.6	**0.07** 1.6	**0.11** 2.4	**0.11** 2.5	0 to 10 mW											
	0.05 1.2	**0.06** 1.2	**0.07** 1.6	**0.07** 1.6	**0.15** 3.4	**0.16** 3.5	>10 mW to 20 mW											
NRV-Z32 (04)	**0.08** 1.7	**0.08** 1.7	**0.09** 2.0	**0.09** 2.0	**0.13** 2.9	**0.17** 3.8	0 to 1 W											
	0.08 1.7	**0.08** 1.7	**0.09** 2.0	**0.09** 2.0	**0.17** 3.7	**0.20** 4.5	>1 W to 2 W											
NRV-Z32 (05)	**0.08** 1.7	**0.08** 1.7	**0.09** 2.0	**0.09** 2.0	**0.13** 2.9	**0.17** 3.8	0 to 1 W											
	0.09 1.9	**0.09** 1.9	**0.10** 2.2	**0.10** 2.2	**0.25** 5.6	**0.28** 6.1	>1 to 4 W											
NRV-Z33	**0.08** 1.7	**0.08** 1.7	**0.09** 2.0	**0.09** 2.0	**0.14** 3.2	**0.17** 3.8	0 to 10 W											
	0.08 1.7	**0.08** 1.7	**0.09** 2.0	**0.09** 2.0	**0.18** 3.9	**0.20** 4.5	>10 W to 20 W											
NRV-Z51	9)	**0.05** 1.0 9)	**0.05** 1.0	**0.05** 1.1	**0.05** 1.2	**0.06** 1.2	**0.06** 1.4	**0.07** 1.6	**0.07** 1.6	**0.09** 1.9	**0.10** 2.3	**0.12** 2.7						
NRV-Z52	9)	**0.05** 1.1 9)	**0.06** 1.2	**0.06** 1.2	**0.06** 1.3	**0.06** 1.4	**0.07** 1.5	**0.08** 1.7	**0.08** 1.8	**0.10** 2.1	**0.11** 2.5	**0.13** 2.9	**0.08** 1.8	**0.09** 1.9	**0.09** 1.9			
NRV-Z53	9)	**0.07** 1.6 9)	**0.07** 1.6	**0.07** 1.6	**0.10** 2.2	**0.10** 2.2	**0.10** 2.3	**0.12** 2.7	**0.13** 2.8	**0.16** 3.6	**0.17** 3.8	**0.18** 4.1						
NRV-Z54	9)	**0.08** 1.7 9)	**0.08** 1.7	**0.08** 1.7	**0.10** 2.2	**0.10** 2.3	**0.11** 2.3	**0.12** 2.8	**0.13** 2.8	**0.16** 3.6	**0.17** 3.8	**0.18** 4.1						
NRV-Z55	9)	**0.05** 1.1 9)	**0.05** 1.2	**0.05** 1.2	**0.06** 1.3	**0.06** 1.4	**0.07** 1.5	**0.08** 1.7	**0.08** 1.8	**0.10** 2.1	**0.11** 2.5	**0.13** 2.9	**0.08** 1.7	**0.09** 1.9	**0.09** 1.9	**0.10** 2.2	**0.11** 2.4	**0.10** 2.1

Temperature effect (relative measurement error in dB (bold type) and in % of power reading)

T_{amb}	22 to 24 °C	18 to 28 °C		10 to 40 °C		0 to 50 °C	
		max.	typ.	max.	typ.	max.	typ.
NRV-Z1 to -Z5, -Z31	included in calibration uncertainty	**0.05** 1.0	**0.015** 0.3	**0.14** 3.0	**0.05** 1.0	**0.32** 7.0	**0.09** 2.0
NRV-Z6/-Z15		**0.03** 0.6	**0.005** 0.1	**0.09** 2.0	**0.02** 0.5	**0.18** 4.0	**0.05** 1.0
NRV-Z32		**0.06** 1.3	**0.02** 0.4	**0.16** 3.6	**0.06** 1.2	**0.37** 8.1	**0.10** 2.3
NRV-Z33		**0.06** 1.4	**0.02** 0.4	**0.19** 4.2	**0.06** 1.3	**0.41** 9.0	**0.11** 2.5
NRV-Z51/-Z52/-Z55		**0.02** 0.4	**0.005** 0.1	**0.06** 1.3	**0.02** 0.4	**0.09** 2.0	**0.02** 0.5
NRV-Z53/-Z54		**0.04** 0.8	**0.01** 0.2	**0.11** 2.5	**0.03** 0.7	**0.18** 4.0	**0.05** 1.0

Max. power as a function of ambient temperature for sensors NRV-Z33, NRV-Z53 and NRV-Z54. Values for NRV-Z54 in ( )



Grey area:
The maximum surface temperatures permitted to IEC 1010-1 are exceeded.
Provide protection against inadvertent contacting or apply only short-term load to sensor.

Supplementary data for Peak Power Sensors NRV-Z31/-Z32/-Z33

Waveform

Model	02	03	04	05
Min. burst width	2 µs	2 µs	200 µs	2 µs
Min. burst repetition rate [10]	10 Hz	100 Hz	100 Hz	25 Hz
Min. duty cycle [11]	5×10^{-4} (2×10^{-3})	10^{-3} (10^{-2})	2×10^{-2} (2×10^{-2})	5×10^{-4} (2×10^{-3})

Peak weighting error

NRV-Z32 (model 05)
Max. peak weighting errors in % of power reading for burst signals of TDMA mobile stations in line with GSM 900/1800/1900, PDC and NADC specifications:

Average burst power	GSM 900/1800/1900	NADC / PDC
10 mW to 2 W	**1.5** [1.5]	**5.5** [5.5]
1 mW to 10 mW	**1.5** [2.0]	**5.5** [6.5]
0.3 mW to 1 mW	**3.5** [4.5]	**6.5** [8]
0.1 mW to 0.3 mW	**8.0** [11]	**15** [20]

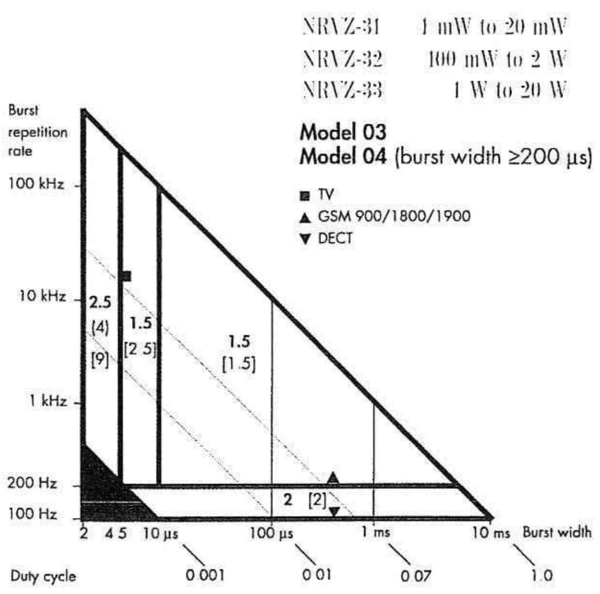
Values without brackets (bold type) T_{amb} = 18°C to 28°C
Values in [ ] 0°C to 50°C
For conversion into dB see table on the right.
For other waveforms the diagrams shown for NRV-Z31 model 02 apply approximately, with burst repetition rates of 10 Hz and 50 Hz corresponding to burst repetition rates of 25 Hz and 125 Hz of NRV-Z32.

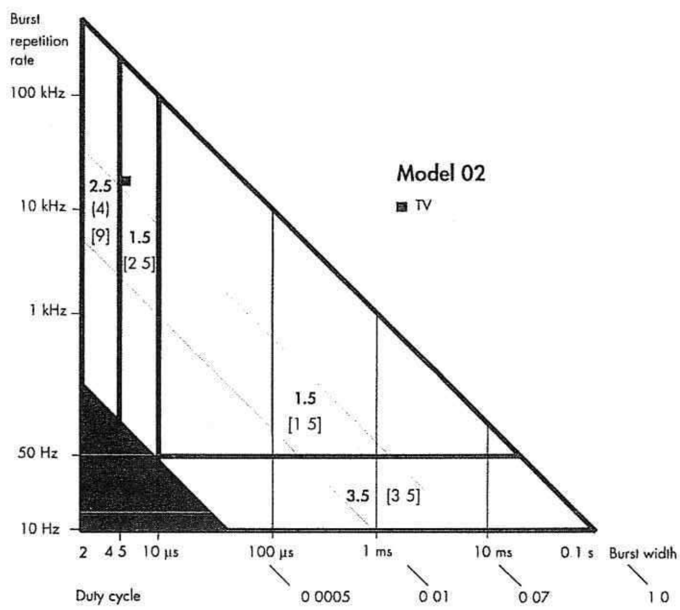
NRV-Z31/-Z32 (model 04)/-Z33
The maximum measurement errors specified in the following diagrams for burst signals with corresponding width and repetition rate compared to a CW signal of same power hold true for all peak power sensors (except NRV-Z32 model 05 – see above)

Numeric values: maximum error in % of power reading.
– without brackets (bold type): T_{amb} = 18°C to 28°C
– in ( ): 10°C to 40°C
– in [ ]: 0°C to 50°C
– black areas: not specified
For conversion into dB see table on the right.
Where no value is specified for the temperature range 10°C to 40°C, the correct value is obtained by forming the average from the values specified for 18°C to 28°C and 0°C to 50°C.

Conversion of measurement error in % of power reading into dB:

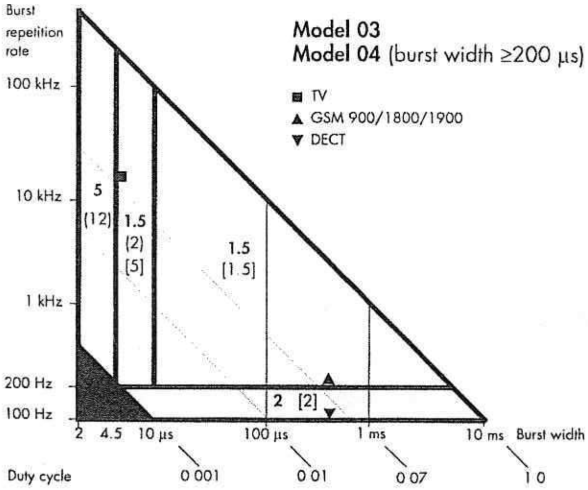
%	dB
±1.5	–0.066/+0.065
±2	–0.088/+0.086
±2.5	–0.110/+0.107
±3	–0.132/+0.128
±3.5	–0.155/+0.149
±4	–0.177/+0.170
±5	–0.223/+0.212
±6	–0.269/+0.253
±7	–0.315/+0.294
±8	–0.362/+0.334
±9	–0.410/+0.374
±10	–0.458/+0.414
±11	–0.506/+0.453
±12	–0.555/+0.492
±13	–0.605/+0.531
±14	–0.655/+0.569
±15	–0.706/+0.607
±16	–0.757/+0.645
±18	–0.862/+0.719
±20	–0.969/+0.792

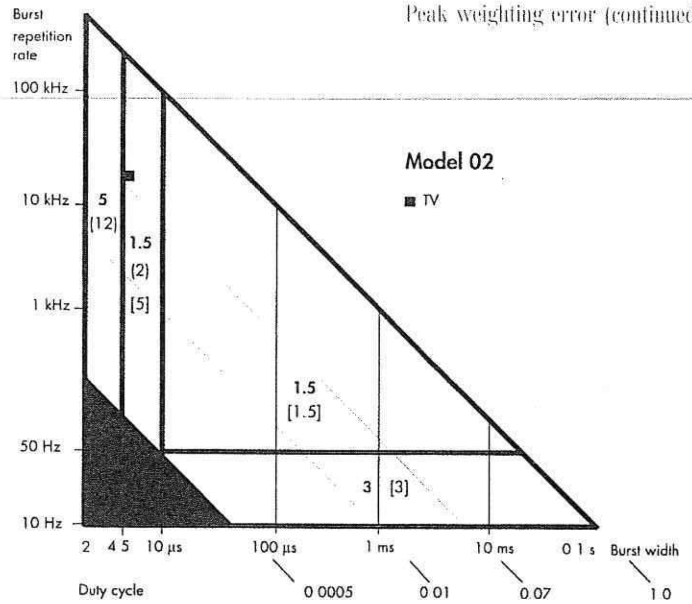




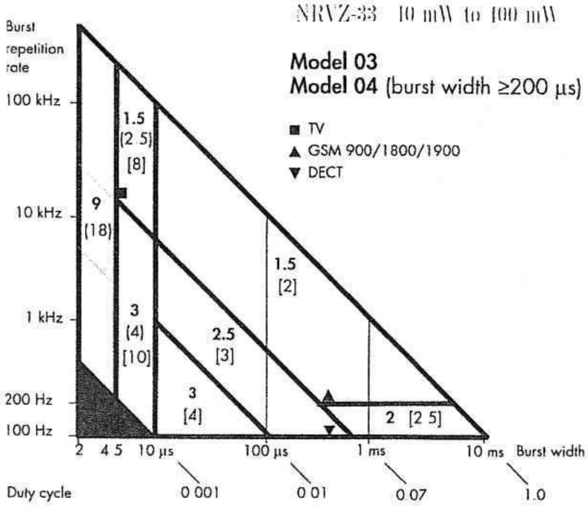
Footnotes see fold-out page

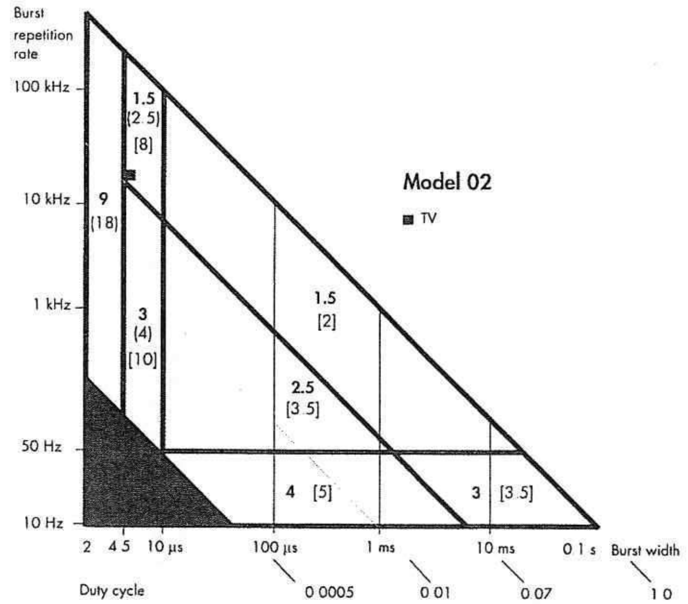
NRVZ-31 100 µW to 1 mW
NRVZ-32 10 mW to 100 mW
NRVZ-33 100 mW to 1 W



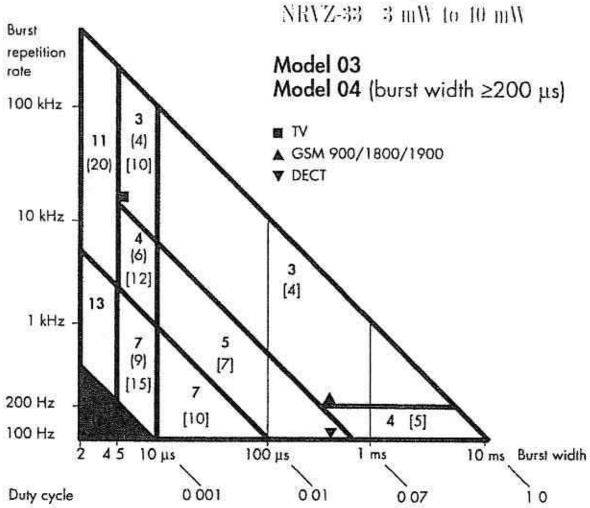


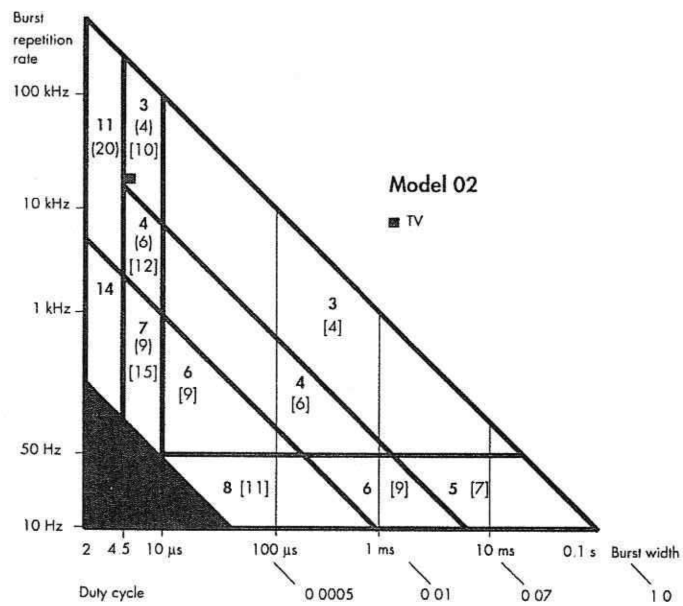
NRVZ-31 10 µW to 100 µW
NRVZ-32 1 mW to 10 mW
NRVZ-33 10 mW to 100 mW



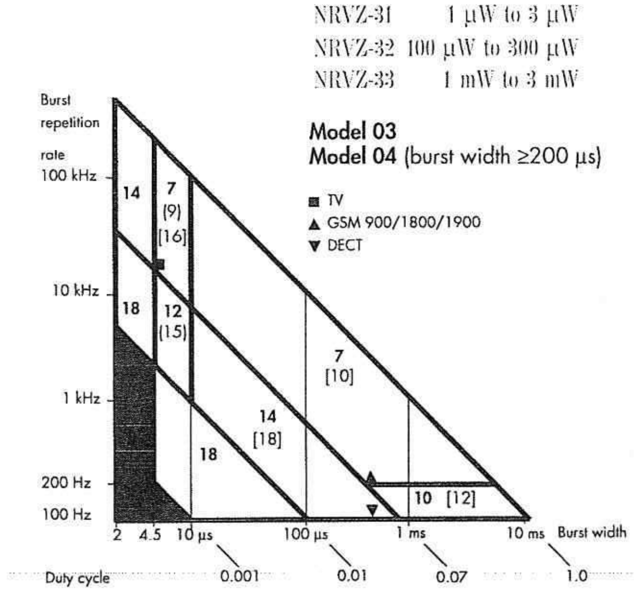


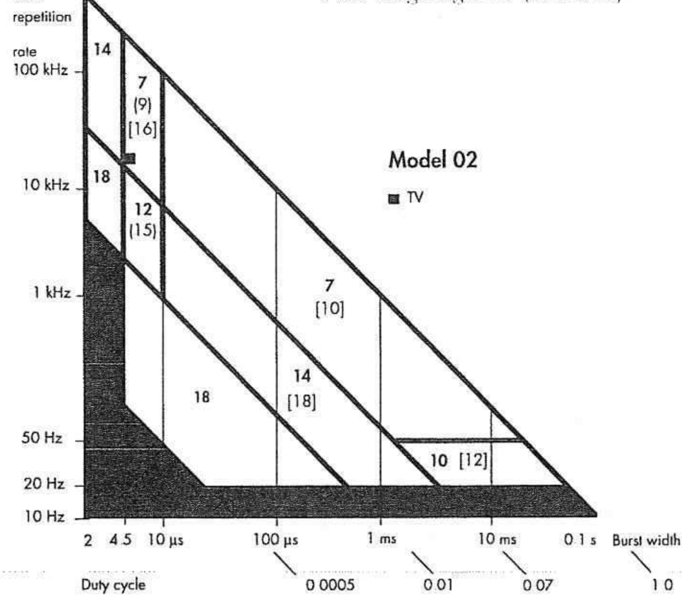
NRVZ-31 3 µW to 10 µW
NRVZ-32 300 µW to 1 mW
NRVZ-33 3 mW to 10 mW





Peak weighting error (continued)





General data

Environmental conditions	
Temperature ranges	meet DIN IEC 68-2-1/68-2-2
Operating	0 °C to +50 °C
Storage	–40 °C to +70 °C
Permissible humidity	max. 80%, without condensation
Vibration, sinusoidal	5 Hz to 55 Hz, max. 2 g; 55 Hz to 150 Hz, 0.5 g cont. (meets DIN IEC 68-2-6, IEC 1010-1 and MIL-T-28800 D class 5)
Vibration, random	10 Hz to 500 Hz, acceleration 1.9 g (rms) (meets DIN IEC 68-2-36)
Shock	40 g shock spectrum (meets MIL-STD-810 D, DIN IEC 68-2-27)
EMC	meets EN 50081-1 and 50082-1, EMC directive of EU (89/336/EEC), EMC law of the Federal Republic of Germany and MIL-STD-461 C (RE 02, CE 03, RS 03, CS 02)
Safety	meets EN 61010-1
Dimensions and weight	
NRV-Z1 to -Z15/-Z31 NRV-Z51/-Z52/-Z55	120 mm × 37 mm × 31 mm; 0.35 kg
NRV-Z51, model 04	156 mm × 37 mm × 31 mm; 0.35 kg
NRV-Z32	190 mm × 37 mm × 31 mm; 0.42 kg
NRV-Z33, NRV-Z53	240 mm × 54 mm × 60 mm; 0.53 kg
NRV-Z54	298 mm × 54 mm × 60 mm; 0.68 kg
Length of connecting cable	1.3 m / 5 m (other lengths on request)

Certified Quality System
ISO 9001
DQS REG. NO 1954-04

Ordering information

High-Sensitivity Diode Sensors		
20 mW, 50 Ω, 18 GHz	NRV-Z1	0828.3018.02
with 5 m cable	NRV-Z1	0828.3018.03
13 mW, 75 Ω, 2.5 GHz	NRV-Z3	0828.3418.02
with 5 m cable	NRV-Z3	0828.3418.03
20 mW, 50 Ω, 6 GHz	NRV-Z4	0828.3618.02
with 5 m cable	NRV-Z4	0828.3618.03
20 mW, 50 Ω, 26.5 GHz	NRV-Z6	0828.5010.02
20 mW, 50 Ω, 40 GHz	NRV-Z15	1081.2305.02
Medium-Sensitivity Diode Sensors		
500 mW, 50 Ω, 18 GHz	NRV-Z2	0828.3218.02
with 5 m cable	NRV-Z2	0828.3218.03
500 mW, 50 Ω, 6 GHz	NRV-Z5	0828.3818.02
with 5 m cable	NRV-Z5	0828.3818.03
Thermal Power Sensors		
100 mW, 50 Ω, 18 GHz	NRV-Z51	0857.9004.02
with 5 m cable, thermally insulated*)	NRV-Z51	0857.9004.04
100 mW, 50 Ω, 26.5 GHz	NRV-Z52	0857.9204.02
10 W, 50 Ω, 18 GHz	NRV-Z53	0858.0500.02
30 W, 50 Ω, 18 GHz	NRV-Z54	0858.0800.02
100 mW, 50 Ω, 40 GHz	NRV-Z55	1081.2005.02
Peak Power Sensors		
20 mW, 50 Ω, 6 GHz	NRV-Z31	
– Standard model	– Model 02	0857.9604.02
– High-speed model	– Model 03	0857.9604.03
– TDMA model	– Model 04	0857.9604.04
2 W, 50 Ω, 6 GHz	NRV-Z32	
– TDMA model	– Model 04	1031.6807.04
– Universal model	– Model 05	1031.6807.05
20 W, 50 Ω, 6 GHz	NRV-Z33	
– High-speed model	– Model 03	1031.6507.03
– TDMA model	– Model 04	1031.6507.04
Calibration Kit		
Calibration Kit for Power Sensors 1 µW to 100 mW; DC to 18 GHz	NRVC	1109.0500.02
Verification Set for NRVC	NRVC-B1	1109.1007.02
Accessory Set for Linearity Measurements	NRVC-B2	1109.1207.02

*) For use at RF connectors with high temperature difference to the environment of the power sensor, eg at the output of power attenuators.

Definitions

Measurement uncertainty
Parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand. Regarding calibrations and data sheet specifications Rohde & Schwarz conforms to the relevant international guidelines[15] recommending the specification of an expanded uncertainty with a coverage factor k=2. With normally distributed measurement errors it can be assumed that the limits thus defined will be adhered to in 95% of all cases.

Calibration uncertainty
Expanded (k=2) uncertainty attributed to the calibration factors in the data memory of a sensor and hence smallest measurement uncertainty that can be attained for absolute power measurements under reference conditions[16]. The data sheet specifications for NRV sensors are based on the measurement uncertainty in calibration[17] plus an additional uncertainty for aging and wear and tear.

Mismatch uncertainty
Measurement uncertainty contribution that has additionally to be taken into account with a mismatched source, if the value measured by the power meter is to be used to determine the source power available with a matched load.

Linearity
Measure of a power meter's capability to express an increase/reduction of the measured power in a corresponding change of the reading. Linearity is affected by negative influences in the calibration of the sensor (linearity uncertainty), zero offset, display noise and influence of the basic unit (upon change of the measurement range). With diode sensors operated outside the square-law region the following parameters may additionally influence the linearity: frequency-dependent linearity errors, temperature effect, harmonics.

Linearity uncertainty
Smallest expanded (k=2) uncertainty that can be attained for relative power measurements under reference conditions[18] relative to the sensor-specific reference power. The magnitude of the linearity uncertainty is mainly determined by the calibration method.

Frequency-dependent linearity error
Linearity errors outside the square-law region caused by the voltage-dependent junction capacitance of a diode detector and noticeable from about ¼ of the upper frequency limit. Rohde & Schwarz specifies the error relative to the sensor-specific reference power.

Power coefficient
Measure of the sensitivity of a high-power sensor to the self-heating of the attenuator pad at the input. Multiplication by the average power of the test signal yields the maximum variation of the attenuation value that causes a variation of the reading by the same amount. As a function of the variation speed of the measured quantity, this behaviour may cause linearity errors. The thermal time constants of the attenuator pads used lie in the range of seconds.

Zero offset
Error in the measurement result caused by the power meter in the form of a systematic, absolute measurement error independent of the magnitude of the measured power. Zero offsets can very easily be recognized if the reading is other than zero with no power applied. The relative measurement uncertainty caused by zero offsets is inversely proportional to the measured power.

Footnotes see fold-out page

Definitions (continued)

Display noise
Statistical component superimposed on the reading whose absolute magnitude is independent of the measured power. Therefore the relative measurement uncertainty caused by display noise is inversely proportional to the measured power.

Peak weighting error
Measurement error of a peak power sensor in case of a pulsed but otherwise unmodulated RF signal with squarewave envelope (burst) compared to a CW signal of same power.

Harmonics effect
Harmonics may adversely affect the measurement accuracy of diode sensors, and compared to a thermal sensor the reading is increased or decreased depending on the phase position relative to the fundamental. Thermal sensors always measure the power of the total signal and therefore exclusively provide RMS weighting of the harmonics – provided these are within the specified frequency range.

For details on the behaviour of diode sensors please refer to the Rohde&Schwarz brochure on Voltage and Power Measurements (PD0757.0835). As a rule of thumb it can be assumed that the harmonics effect for power ratings below 1 µW (–30 dBm) with high-sensitivity sensors and 100 µW (–10 dBm) with medium-sensitivity sensors is negligible. Harmonics below –60 dBc can be considered to be noncritical irrespective of the power measured.

Temperature effect
Effect of the ambient temperature on the accuracy of the sensor. Rohde&Schwarz specifies the residual relative measurement error after internal correction of the temperature response of the sensor, ie the maximum value and a typical value corresponding approximately to one standard deviation.
The specifications apply without any restrictions to thermal sensors and to diode sensors operated inside the square-law region, whereas for diode sensors outside the square-law region they refer exclusively to CW signals.

Influence of basic unit
Rohde&Schwarz specifies the maximum measurement error caused by the basic unit in absolute power measurements at different ambient temperatures.

Calibration Kit NRVC

Footnotes

5) K connector is a trademark of Anritsu Corp

6) In the temperature range 35°C to 50°C only short-term or reduced load (see diagram) permitted if there is no protection against inadvertent contacting.

7) The lower frequency limit is 10 MHz for ambient temperatures up to 28°C.

8) 4 W peak power corresponds to an average power of approx. 2.1 W of a mobile to NADC or PDC standard.

9) For frequencies below 50 MHz, no calibration factors are stored in the EPROM of the sensor.
Therefore, frequency-response correction should not be used in this range and a calibration uncertainty of 2% be assumed.

10) The burst repetition rate is the reciprocal value of the burst period T

11) The values in parentheses should not be exceeded in remote-controlled operation. Otherwise it is not ensured that the first value measured after triggering is a settled reading. Repeat triggering until steady results are output or provide for an appropriate delay before triggering after power to be measured has been applied.

12) Sensors with attenuator pad only

13) At upper limit of square-law region

14) To be considered when measuring in different ranges

15) ISO Guide to the Expression of Uncertainty in Measurement. International Organization for Standardization, Geneva, Switzerland, ISBN: 92-67-10188-9, 1995.
Radio Equipment and Systems (RES); Uncertainties in the measurement of mobile radio equipment characteristics. ETSI Technical Report ETR028, June 1997, 3rd Edition, European Telecommunications Standards Institute. Valbonne, France.

16) Sensor temperature 22°C to 24°C, matched source, CW signal with sensor-specific reference power, >50 dB harmonic suppression for diode sensors
Influence of basic unit neglected (eg after calibration)
The sensor-specific reference power is
1 µW to 10 µW for high-sensitivity diode sensors,
0.1 mW to 1 mW for medium-sensitivity diode sensors,
1 mW for NRV-Z51/-Z52/-Z55,
10 mW to 100 mW for NRV-Z53 and
10 mW to 300 mW for NRV-Z54.
For the peak power sensors NRV-Z31/-Z32/-Z33 the specified calibration uncertainties are valid in the total power range, however with a harmonic suppression of 60 dB or more.

17) Calculated for an average sensor of the relevant type. The uncertainties stated in the calibration report may slightly differ since they are determined taking into account the individual characteristics of the sensor and of the calibration system used. Usually the values are better than the data sheet specs; they may occasionally be somewhat poorer at specific frequency values.

18) Thermal sensors and diode sensors operated inside the square-law region:
No restrictions on part of the sensor, only the influence of the basic unit and zero offset should be negligible (sufficient measurement power, basic unit calibrated, ambient temperature 15 °C to 35 °C).
Diode sensors operated outside the square-law region:
Sensor temperature 22 °C to 24 °C, CW signal with harmonics suppression >60 dB, frequency within the range without frequency-dependent linearity uncertainties, influence of basic unit and zero offset negligible (sufficient measurement power, basic unit calibrated).

Fax Reply (Power Sensors NRV-Z)

- ❑ **Please send me an offer**
- ❑ **I would like a demo**
- ❑ **Please call me**
- ❑ **I would like to receive your free-of-charge CD-ROM catalogs**

Others: ____

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1 Characteristics

1.1 Application

Power sensors NRV-Z51, NRV-Z52 and NRV-Z55 are thermal power sensors for basic instruments NRVS, NRVD, URV35 and URV55. They permit power measurement from 1 µW to 100 mW within the frequency ranges DC ... 18 GHz (NRV-Z51), DC ... 26.5 GHz (NRV-Z52) or DC ... 40 GHz (NRV-Z55) in systems having a characteristic impedance of 50 Ω.

The thermal conversion principle always permits measurements of the RMS value independently of the waveform and modulation of the test signal. Depending on whether the measured value is output as a power and/or a power level or as a voltage, the average power (and/or the equivalent power level) or the RMS value of the voltage is displayed.

All measuring heads are d.c. coupled so that even power in the audio-frequency range can be measured.

1.2 Design and Functioning

The power sensor contains a thermo-electric transducer made of silicon by means of semiconductor technology. Due to the power supplied, the 50-Ω termination situated on it heats up. Immediately next to this resistor there is a thermoelement generating a direct voltage proportional to the heating. As termination and thermoelement are dc-decoupled, the power sensors do not contain coupling capacitors. This means that even d.c. powers can be measured, and there is no lower cut-off frequency below which matching and frequency response deteriorate again.

The direct voltage generated by the thermoelement is amplified by a low-noise amplifier of high sensitivity within the sensor and supplied to the basic unit for further processing.

All power sensors contain a data storage in which the parameters obtained during calibration in production are stored in a non-volatile memory. The basic instrument reads out these data and takes account of them when indicating the power measured.

Linearity correction of the measured values is effected automatically with the aid of the correction coefficients stored. For temperature correction, the temperature of the measuring head is evaluated additionally via a temperature sensor. For measurements with frequency response correction, the measuring frequency must be entered via keyboard, remote control interface or an analog control input.

2 Preparation for Use

The measuring head is connected to the basic unit by inserting the plug-in adapter into the opening of the basic unit and locking it into position. This can be done with the unit being switched off or on. Each turn on of the basic unit with the measuring head connected or connecting the measuring head to the basic unit when it is switched on results in the calibration data being read out from the data memory of the measuring head.

Notes for Operation:

- Maximum input power 100 mW
- Ambient temperature 0 ... 50 °C
- Connect RF connection to the signal source only by hand and without fitting it askew
- Avoid condensation. Should condensation occur nevertheless, the power sensor is to be dried before switching on the unit.
- Overloading up to 300 mW is permissible, however, the power is not indicated any more.
- When measuring power below 300 µW, let sensor warm up (approx. 10 min), avoid heating up of the measuring head due to heated RF connections of the signal source.
- Calibration applies to power at the RF connector of the power sensor. Adapters situated between sensor and signal source result in additional attenuation and measuring errors due to worse matching with higher frequencies.

3 Operation

3.1 Measuring by means of Power Sensors NRV-Z51, NRV-Z52 and NRV-Z55

3.1.1 Power and Voltage Measurement

Thermal power meters measure the arithmetic mean value of the product of the instantaneous values of voltage and current. This exactly corresponds to the definition of electric true power.

$$P = \frac{1}{T} \int_0^T u \cdot i \cdot dt$$

This means that in the entire control range always the actual true power is measured independently of the waveform of the signal.

If a voltage display is selected at the basic unit, the voltage is calculated from the power measured:

$$U = \sqrt{P \cdot Z_0} \qquad (Z_0 = 50\ \Omega \text{ for NRV-Z51/-Z52/-Z55})$$

V is calculated as the RMS value of a sinusoidal voltage generating the power P at the effective resistance Z_0.

3.1.2 Power Measuring Ranges

The entire measuring range is divided up into five subranges with power sensors NRV-Z51/-Z52/-Z55:

0 ... 10 µW

10 ... 100 µW

0,1 ... 1 mW

1 ... 10 mW

10 ... 100 mW

Basic instruments NRVD and NRVS allow measurement using automatic or manual range selection.

Using automatic range selection (AUTO RANGE) the unit itself sets the suitable measuring range depending on the test level. In the case of manual range selection (FIX RANGE) the user can set a fixed measuring range. Thus the automatic resetting of the most sensitive measuring range with each temporary taking away the measured power can be prevented.

The smaller the test signal, the greater the effect of noise inevitably occurring in electronic circuits. It results in fluctuations of the indicated value. In order to achieve a high measuring accuracy, a filtering of the test signal is necessary. However, the more effective this filtering has to be, the more the measuring rate decreases.

Basic units NRVD and NRVS offer the possibility of measuring by means of automatic or manual filter setting.

With automatic filter setting it is guaranteed that the optimal filter is set depending on the measuring range and the display resolution the user has selected. The measuring rate results from filter setting. Very small test signals (that is to say, a low measuring range) and a high display resolution require the most effective filtering and thus result in the smallest measuring rate.

If automatic filter selection does not seem to be optimally adapted to a specific measurement, that is to say, e.g., a higher measurement rate (deteriorating display noise) is demanded, another filter can be set manually.

The connection between filter number, measuring period and noise can be taken from the Specifications.

3.1.4 Zeroing

When measuring low power, an additive offset - of positive or negative polarity -, as it results, e.g., due to thermo-electromotive force at the measuring head, can invalidate the measurement result. In zeroing the offset is measured, stored and subtracted from the following measured values.

Notes for Zeroing

- No power to be measured must be applied to the measuring head.
- After measuring large powers, wait until the indicated value has become stable before starting zeroing.
- Do not move the sensor cable to a large extent during zeroing.
- In the case of changing ambient temperatures or when the instrument has not yet warmed up completely, check zeroing without a power to be measured applied from time to time and repeat if necessary.
- Ground loops can result in external offsets. If these cannot be completely eliminated by means of correct grounding, the sensor remains connected to the signal generator (with the power to be measured switched off) also during zeroing. In doing so, the external offset is recorded as well and considered in calculating the indicated value.
- The zero offset is not stored after switching off the instrument. Thus it should be carried out after each switching on.

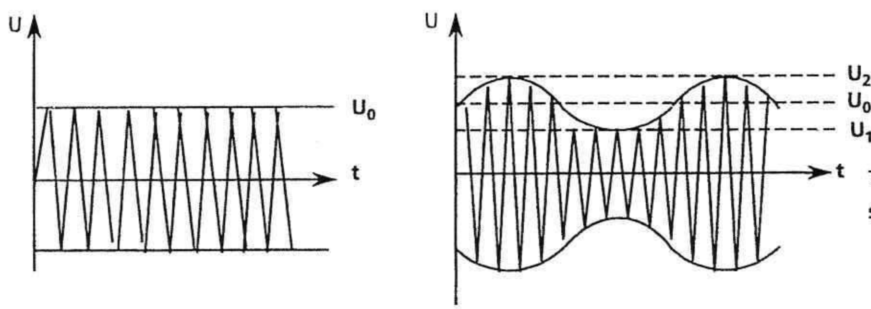
3.1.5 Frequency Response Correction

The frequency response of every power sensor is individually measured in calibrating and stored as a calibration factor (ratio of indicated power to power supplied) in the data memory of the sensor for a plurality of frequencies. Frequency response correction is considered by entering the test frequency into the basic unit. If the frequency entered is between two calibration frequencies, the respective calibration factor is calculated by means of linear interpolation. For power sensors NRV-Z51/-Z52/-Z55 the calibration factors refer to the sensor sensitivity at 50 MHz. If measurement is carried out without frequency response correction, the measured value is indicated as if measurement was carried out at 50 MHz.

3.1.6 Measurement of Modulated Signals

The capability of thermal measuring heads of measuring the average power also in the case of arbitrarily modulated signals allows, together with the basic unit NRVD, to determine the modulation depth in the case of amplitude-modulated carriers (only NRVD) and the pulse power with pulse-modulated RF (NRVD, NRVS, URV55).

Determination of Modulation Depth:



Time characteristic of signal voltage

unmodulated   modulated

Modulation depth is calculated from:

$$m = \frac{(U_2 - U_1)/2}{U_0}$$

In the case of amplitude modulation, two sideband frequencies having the amplitude

$$U = \frac{m}{2} \cdot U_0$$

are formed above and below the carrier frequency, which corresponds to an increase in power.

Unmodulated Power:

$$P_{unmod} = \frac{U_0^2}{Z_0}$$

Modulated Power:

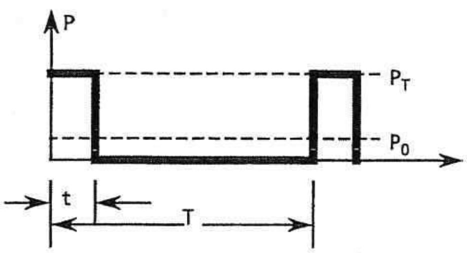
$$P_{mod} = \frac{U_0^2}{Z_0} + 2 \cdot \frac{(U_0 \cdot m/2)^2}{Z_0} = P_{unmod} \cdot \left(1 + \frac{m^2}{2}\right)$$

$$m = \sqrt{2 \cdot (P_{mod}/P_{unmod} - 1)}$$

In order to measure the modulation depth exactly it is necessary for the carrier mean value V_0 to remain constant in modulation and for the modulation to be exactly sinusoidal.

Measurement of pulse-modulated power:

The carrier power can be calculated from the pulse duty factor (Duty Cycle) with pulse-modulated signals. To distinguish it from the maximum envelope power to be measured physically (PEP) this value is designated as pulse power.



P_T = Carrier power

P_0 = Power measured

For calculating the carrier power it is taken for granted that the energy of the average power P_0 measured during the time T is as large as the energy of carrier power P_T during the time t:

$$P_0 \cdot T = P_T \cdot t$$

$$P_T = \frac{T}{t} \cdot P_0$$

When measuring modulated signals, it has to be noted that the thermal power sensors contain a chopper amplifier whose chopping frequency is approx. 575 Hz. Modulation using this frequency, half, two or three times the value, can result in periodic display variations. In this case the modulation frequency should be slightly varied.

3.2 Measuring Accuracy

Every measurement will inevitably have measuring errors of various causes. The error value actually resulting in any measurement is almost never known. It is only possible to indicate the possible maximal values of the individual errors and calculate limits from these between which the total error can be.

3.2.1 Mismatch

Thermal sensors NRV-Z51/-Z52/-Z55 serve to measure the power a source can supply to a load having the ohmic resistance Z_0. In general, however, the impedance of the source as well as the impedance of the power sensor acting as a load are different from the value Z_0. The error in the power measured resulting from this mutual mismatch is calculated from:

$$E_p = \frac{1 - |\Gamma_l|^2}{|1 - \Gamma_g \cdot \Gamma_l|^2} - 1$$

Γ_g: complex reflection coefficient of the source
Γ_l: complex reflection coefficient of the load

The numerator $1 - |\Gamma_l|^2$ in the above equation results in a fraction defective which is only caused by the load. It is determined by measurement during calibration with the power sensors and is included in the calibration factor (see Section 3.2.2).

A second fraction defective is caused by the denominator $|1 - \Gamma_g \cdot \Gamma_l|^2$. As Γ_l and Γ_g are complex a.c. parameters, the error can become positive or negative depending on their phasing. In general, the amount and phase of reflection coefficient Γ_g of the source are not known, thus the size of this error cannot be indicated in the data sheet and not be calculated in practice either.

However, the error limits can be determined from the maximal values of the amounts of the reflection coefficients. The mismatch uncertainty M_u resulting from mismatch between source and load is calculated in percent of the power:

$$M_u\,[\%] = 100 \cdot [(1 \pm r_g \cdot r_l)^2 - 1]$$

By approximation, the following is true:

$$M_u\,[\%] \approx \pm\, 200 \cdot r_g \cdot r_l$$

r_g: Amount of reflection coefficient of the source
r_l: Amount of reflection coefficient of the load

3.2.2 Calibration Uncertainty

Due to the fact that the reflection coefficient of a power sensor is inevitably larger than zero (and its SWR > 1), part of the power offered to the sensor is reflected. Hence all power sensors are individually measured at a plurality of calibration frequencies during production. The power measured is compared with the one supplied by the calibration system and the relation of both values is stored as calibration factor. When frequency response correction is switched on, the measurement result is set off against the calibration factor belonging to the measuring frequency entered.

primary standards by the Physikalisch-Technische Bundesanstalt PTB (Federal Office for Weights and Measures).

In spite of this, even the determination of the calibration factor includes mismatch uncertainties resulting from mismatch, errors in transmitting power and the mismatch uncertainty of PTB primary standards. The error limits of the calibration factor are - depending on the frequency and the respective sensor - indicated as RSS error in the data sheet (see Section 3.2.7).

3.2.3 Linearity Error

An ideal power meter is expected to show a strictly proportional connection between the measured power applied and the measured power indicated over the entire measuring range. The behaviour of real power meters is more or less different from this ideal behaviour, the result is a linearity error which depends on the control.

In the case of the thermal power sensors, the linearity error is very small, because the control characteristic of each sensor is individually measured in production and stored in the non-volatile data memory of the sensor. On the basis of these data, the power indicated by the basic unit is mathematically corrected to result in an almost perfect linearization. The remaining residual error is specified in the Specifications of the power sensors.

3.2.4 Display Noise

The noise superimposed on the output signal generated by the power sensor causes slight variations of the indicated value which result in a measuring error. As the build-up of noise is a statistic process, it is useful to describe the amount of noise using the methods of probability calculus.

R&S states twice the value of the standard deviation for noise power. This means that this value of the noise power is not exceeded in 95% of a statistically sufficiently large number of measurements.

Display noise is an additive value, i.e. the error caused by noise becomes the smaller, the larger the power measured is.

The value of display noise can be influenced by the filter setting (see Section 3.1.3): Each additional doubling in averaging reduces the display noise power by approx. 30%.

3.2.5 Zero Error

A zero error is induced when a power different from zero is displayed without a power measured. Most of the time variations in temperature the measuring head is subjected to are the cause of this offset. In zeroing (see Section 3.1.4) the offset is measured and subtracted from the measured value in the successive measurement.

Zero error as well is an additive value whose error effect becomes the smaller, the larger the power measured is. When measuring small power, it is thus recommended to keep variations in temperature, as they can be induced by the warmth of the hand imparted to the measuring head or heated RF connections of signal generators, small and to repeat zero adjustment from time to time.

3.2.6 Temperature Effect

The temperature effect is an additional error resulting at a temperature which is constant but other than 23 °C.

By means of cyclic temperature measurement, the influence of changing ambient temperatures can be mathematically corrected up to a very small residual error with the aid of the thermal characteristic stored. It is approx. 0.1 %/grd, with respect to a calibration temperature of 23 °C.

3.2.7 Errors of the Basic Unit

The analog unit of the basic instruments basically consists of a precise DC amplifier and a high-resolution A/D converter. The error indicated is only caused by the drift of gain factors (time, temperature) and, like all other errors, refers to the measured value. As the typical error is still substantially smaller in general, the error of the basic instrument can be neglected compared to the other mismatch uncertainties.

3.2.8 Maximum and RSS Error

A correct error indication must contain two pieces of information:

- How large are the error limits and
- how large is the confidence level, i.e. how many measuring results out of a large number of measurements do not exceed the error limits.

In the case of the maximum error the confidence level is 100 %: The error limits are exceeded in no measurement. The maximum error E_{max} is the sum of all individual maximum errors $(E_{max})_i$:

$$E_{max} = \sum_{i=1}^{N} (E_{max})_i$$

In practice, one sees that the maximum error is only rarely achieved. If the total error is composed of many individual errors which have causes independent of each other (and this is the case with the individual errors described up to now), it is, statistically, a very rare event that all individual errors occur with their maximal value and same sign at the same time in a measurement.

In power measurement it has thus become customary to state the RSS error (RSS: Root Sum of the Squares), which is closer to practice.

It is the square root of the sum of the squares of the individual RSS errors $(E_{RSS})_i$:

$$E_{RSS} = \sqrt{\sum_{i=1}^{N} (E_{RSS})_i^{\,2}}$$

The RSS error of a sum of individual errors is the error which is generally not exceeded in 95 % of all measurement results.

The total mismatch uncertainty is calculated (as an RSS value) by an example under the following measurement conditions:

- Power sensor NRV-Z51
- Power measured 5 mW
- Frequency 6.5 GHz
- Ambient temperature 24 °C
- SWR of source 1.35 (r=0.15)
- NRVD filter 4

The following example shows that the greatest individual error is caused due to mismatch between source and measuring head. The measuring accuracy can thus be increased most lastingly by means of better SWR values of the source.

Cause of Error	Description in Section	Indiv. Error (RSS) in %
Matching $r_g = 0.15$ $r_l = 0.07$	3.2.1	2.1
Cal. uncertainty	3.2.2	1.3
Linearity	3.2.3	0.3
Zero ±60 nW	3.2.5	≈ 0
Noise ±240 nW	3.2.4	≈ 0
Basic instrument NRVD	3.2.7	0.3
Temperature	3.2.6	0.1
RSS total mismatch uncertainty		**±2.51%**

4 Maintenance and Troubleshooting

4.1 Maintenance

Power sensors NRV-Z51/-Z52/-Z55 are maintenance-free. The RF plug should be cleaned from time to time. Sticking dirt can be removed by means of a pencil and alcohol.

4.2 Troubleshooting

Troubleshooting can only be limited to the clarification of whether a power sensor is defective. Repair requires a new calibration in almost all cases, which must be carried out by the manufacturer.

If the rated values of the following tests are not observed, the measuring head is defective and should be had repaired.

4.2.1 Testing Sensor Sensitivity

Test Setup:

- Directly connect power sensor (without RF cable) to the testing generator of the NRVD. Enter 50 MHz correction frequency at the NRVD, carry out zero adjustment, switch on testing generator.

Rated Value of Power Readout:

- 0.98 ... 1.02 mW (18 ... 23 °C)

4.2.2 Testing SWR

Test Setup:

- Directly connect power sensor (without RF cable) to an SWR network analyzer.
  The measurement inaccuracy of the network analyzer has to be taken into account for the measured SWR value.

Rated Values SWR:

Frequency	Maximum SWR (r)
DC...2 GHz 2...12.4 GHz 12.4...18 GHz	1.1 (0.048) 1.15 (0.07) 1.2 (0.09)
18...26.5 GHz (NRV-Z52, NRV-Z55)	1.25 (0.11)
26.5...40 GHz (only NRV-Z55)	1.30 (0.13)

Checking Rated Specifications

Due to the multifarious sources of error, power and reflection measurements in the frequency range of up to 40 GHz require a large amount of apparatus, experience and special care.

A remeasurement of the characteristics guaranteed in the Specifications should thus only be carried out with appropriate calibrating facilities or in the service shops of R&S.

For the power sensors NRV-Z51, NRV-Z52 and NRV-Z55 an annual check, if necessary including calibration, with the manufacturer is recommended.

ROHDE & SCHWARZ

Schaltteillisten numerisch geordnet

Part lists in numerical order

Listes des pièces détachées par numéros de référence

095.1000 Bl. 3

Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer / Bezeichnung Designation	enthalten in contained in
.	XX VARIANTENERKLAERUNG IDENTIFICATION OF MODELS VAR 02 = GRUNDAUSFUEHRUNG MOD 02 = BASIC MODEL VAR 04 = THERM.ISOLIERT UND MIT 3M ANSCHLUSSKABEL MOD 04 = THERM.ISOLATET AND WITH 3M CONNECTING CABLE			
..	XX ZUGEH.STROML. CIRC.DIAGR. 857.9004 S			
A1	ED DATENSPEICHER II MEMORY II NUR VAR/ONLY MOD: 02 HIERZU STROML.395.3040S SEE CIRC.DIAGR.395.3040S	0395.3040.02		0828.4537.01
A1	ED DATENSPEICHER III MEMORY III NUR VAR/ONLY MOD: 03 04 13 HIERZU STROML. 395.3063 S SEE CIRC.DIAGR. 395.3063 S	0395.3063.02		0828.4537.01
A1	ED DATENSPEICHER II MEMORY II NUR VAR/ONLY MOD: 42	0395.3040.42		0828.4537.01
A2	ED MESSKOPFVERSTAERKER PROBE AMPLIFIER NUR VAR/ONLY MOD: 02 03 04 HIERZU STROML.828.4750S SEE CIRC.DIAGR.828.4750S	0828.4750.02		0828.4537.01
A2	ED ANSCHLUSSPLATTE NUR VAR/ONLY MOD: 13 HIERZU STROML. 1028.2486 S SEE CIRC.DIAGR.1028.2886 S	1081.2486.02		0828.4537.01
A2	ED MESSKOPFVERSTAERKER PROBE AMPLIFIER NUR VAR/ONLY MOD: 42 HIERZU STROML. 828.4750 S SEE CIRC.DIAGR. 828.4750 S	0828.4750.42		0828.4537.01
A3	ZE DETECTOR(NRV-Z51) 18 GHZ DETECTOR NUR VAR/ONLY MOD: 02	0857.9040.00		
A3	ZE DETEKTOR(NRV-Z53/Z54) 18GHZ DETECTOR NUR VAR/ONLY MOD: 04	0858.0617.02		
W1	DX KABEL CABLE NUR VAR/ONLY MOD: 02	0852.7032.02		0828.4537.01
W1	DX KABEL CABLE NUR VAR/ONLY MOD: 03 13	0395.1090.02		0828.4537.01
W1	DX KABEL CABLE NUR VAR/ONLY MOD: 42	0852.7032.42		0828.4537.01
W1	DX KABEL NUR VAR/ONLY MOD: 04	0395.1090.03		0828.4537.01
X1	FJ STECKERKOPF N PRAEZ. CONNECTOR	0857.9091.00	ROSENBERGE 05S-121-000-S2 (S3)	0857.9040.00 F
X1	FJ STECKERKOPF N-PRAEZ. CONNECTOR	0858.0630.00	ROSENBERGE 05S122-000S2 (S3)	0858.0617.01

Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
.	XX VARIANTENERKLAERUNG IDENTIFICATION OF MODELS VAR 02 = GRUNDAUSFUEHRUNG MOD 02 = BASIC MODEL				
..	XX ZUGEH.STROML. CIRC.DIAGR. 857.9204 S				
A1	ED DATENSPEICHER II MEMORY II NUR VAR/ONLY MOD: 02 HIERZU STROML.395.3040S SEE CIRC.DIAGR.395.3040S	0395.3040.02			0828.4537.01
A1	ED DATENSPEICHER III MEMORY III NUR VAR/ONLY MOD: 03 04 13 HIERZU STROML. 395.3063 S SEE CIRC.DIAGR. 395.3063 S	0395.3063.02			0828.4537.01
A1	ED DATENSPEICHER II MEMORY II NUR VAR/ONLY MOD: 42	0395.3040.42			0828.4537.01
A2	ED MESSKOPFVERSTAERKER PROBE AMPLIFIER NUR VAR/ONLY MOD: 02 03 04 HIERZU STROML.828.4750S SEE CIRC.DIAGR.828.4750S	0828.4750.02			0828.4537.01
A2	ED ANSCHLUSSPLATTE NUR VAR/ONLY MOD: 13 HIERZU STROML. 1028.2486 S SEE CIRC.DIAGR. 1028.2886 S	1081.2486.02			0828.4537.01
A2	ED MESSKOPFVERSTAERKER PROBE AMPLIFIER NUR VAR/ONLY MOD: 42 HIERZU STROML. 828.4750 S SEE CIRC.DIAGR. 828.4750 S	0828.4750.42			0828.4537.01
A3	ZE DETECTOR(26,5 GHZ) 26,5 GHZ DETECTOR	0857.9240.00			
W1	DX KABEL CABLE NUR VAR/ONLY MOD: 02	0852.7032.02			0828.4537.01
W1	DX KABEL CABLE NUR VAR/ONLY MOD: 03 13	0395.1090.02			0828.4537.01
W1	DX KABEL CABLE NUR VAR/ONLY MOD: 42	0852.7032.42			0828.4537.01
W1	DX KABEL NUR VAR/ONLY MOD: 04	0395.1090.03			0828.4537.01
X1	FJ STECKERKOPF SYST.PC3,5 CONNECTOR	0857.9291.00	AMPHENOL	131-7001	0857.9240.00

1GPK 887 3PLU	Äl	Datum Date	Schaltteilliste für Parts list for	Sachnummer Stock No.	Blatt-Nr. Page
ROHDE&SCHWARZ	09	07.10.99	GG NRV-Z52 MESSKOPF	0857.9204.01 SA	1-

095.0026-0693

Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
A1	ED DATENSPEICHER II MEMORY II NUR VAR/ONLY MOD: 02 HIERZU STROML.395.3040S SEE CIRC.DIAGR.395.3040S	0395.3040.02			0828.4537.01
A1	ED DATENSPEICHER III MEMORY III NUR VAR/ONLY MOD: 03 04 13 HIERZU STROML. 395.3063 S SEE CIRC.DIAGR. 395.3063 S	0395.3063.02			0828.4537.01
A1	ED DATENSPEICHER II MEMORY II NUR VAR/ONLY MOD: 42	0395.3040.42			0828.4537.01
A2	ED MESSKOPFVERSTAERKER PROBE AMPLIFIER NUR VAR/ONLY MOD: 02 03 04 HIERZU STROML.828.4750S SEE CIRC.DIAGR.828.4750S	0828.4750.02			0828.4537.01
A2	ED ANSCHLUSSPLATTE NUR VAR/ONLY MOD: 13 HIERZU STROML. 1028.2486 S SEE CIRC.DIAGR.1028.2886 S	1081.2486.02			0828.4537.01
A2	ED MESSKOPFVERSTAERKER PROBE AMPLIFIER NUR VAR/ONLY MOD: 42 HIERZU STROML. 828.4750 S SEE CIRC.DIAGR. 828.4750 S	0828.4750.42			0828.4537.01
A3	ZE DETEKTORGRUPPE DETECTOR UNIT	1081.2070.02			
W1	DX KABEL CABLE NUR VAR/ONLY MOD: 02	0852.7032.02			0828.4537.01
W1	DX KABEL CABLE NUR VAR/ONLY MOD: 03 13	0395.1090.02			0828.4537.01
W1	DX KABEL CABLE NUR VAR/ONLY MOD: 42	0852.7032.42			0828.4537.01
W1	DX KABEL NUR VAR/ONLY MOD: 04	0395.1090.03			0828.4537.01

Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
.	XX VARIANTENERKLAERUNG IDENTIFICATION OF MODELS VAR02=GRUNDAUSFUEHRUNG MOD02=BASIC_MODEL				
C1 ..3	CC 470NF+-10%50V X7R 1812 CERAMIC CHIP CAPACITOR	CC 0007.7498.00	AVX	1812 5C 474KA TOOF	
C4 ..6	CC 33NF+-10% 25V HDK 0603 SMD CERAMIC CAPACITOR	CC 1051.4697.00	AVX	CM105X7R333K25VAT	
C7	CC 47PF+-1% 50VNPO 0603 SMD-CERAMIC-CAPACITOR	CC 0009.4644.00	MURATA	GRM39C0G***F50ZPT	
C8	CC 47PF+-1% 50VNPO 0603 SMD-CERAMIC-CAPACITOR	CC 0009.4644.00	MURATA	GRM39C0G***F50ZPT	
C9	CC 1,0NF+-10%50V HDK 0603 SMD-CERAMIC-CAPACITOR	CC 0009.4938.00	MURATA	GRM39X7R***K5C500PT*	
D1	BC N28F010 128KX8FL.EPROM FLASH-EPROM	BC 0007.9861.00	AMD	AM28F010-150JC	
D2	BG TH3063.1I MEKOLO ASIC IC GATEARRAY	BG 0857.8350.00	THESYS	TH3063.1I	
N1	BO LP2951CMLOWDROP +VREGL IC VOLTAGE REGULATOR	1020.0890.00	NSC	LP2951CM	
P1	VL EINPRESSSTIFT 5,6 PIN NICHT BESTUECKT NOT FITTED	VL 0010.7250.00	AMP	1-928776-5	
P2	VL EINPRESSSTIFT 5,6 PIN NICHT BESTUECKT NOT FITTED	VL 0010.7250.00	AMP	1-928776-5	
R1	RG 10K +-1% TK100 0603 SMD RESISTOR EIA0603	RG 0009.5357.00	PHILIPS_CO	RC 22 H	
R2 ..5	RG 825R +-1% TK100 0603 SMD RESISTOR EIA0603	0010.8391.00	PHILIPS_CO	RC 22 H	
R6	RG 1K0 +-1% TK100 0603 SMD RESISTOR EIA0603	RG 0009.5340.00	PHILIPS_CO	RC 22 H	
R7 ..13	RG 100K +-1% TK100 0603 SMD RESISTOR EIA0603	RG 0009.5363.00	DRALORIC	CR 0603	
R14	RG 2K2 +-1% TK100 0603 SMD RESISTOR EIA0603	0009.7008.00	PHILIPS_CO	RC 22 H	
S1	SK CODIERSCH..2P.2XEIN DIP-SWITCH	1081.0190.00	C&K	DMR-02-T(R)	
S2	SK CODIERSCH..2P.2XEIN DIP-SWITCH	1081.0190.00	C&K	DMR-02-T(R)	
V1	AE BZV55/C15 0,5W ZDI ZENER DIODE	AE 0006.9900.00	PHILIPS_SE	BZV55B15	
V2	AK BC860B P 45V 200MA TRANSISTOR	AK 0007.7975.00	MOTOROLA	BC860B	
V3	AM SI9948DY P-E DUAL MOSF DUAL P-CH E-MODE MOSFET	0395.1525.00	TEMIC	SI9948AEY	
V4	AK BC860B P 45V 200MA TRANSISTOR	AK 0007.7975.00	MOTOROLA	BC860B	
V7	AE BZV55/C6V2 0,5W ZDI ZENER DIODE	AE 0006.9851.00	PHILIPS	BZV55B6V2	
V8	AE BZV55/C7V5 0,5W ZDI ZENER DIODE	AE 0007.3428.00	PHILIPS_SE	BZV55B7V5	
X1	FP STIFTLEISTE 8POL.WINK. CONNECTOR	1081.1750.00	SUYIN	20010A-08 G5	
X10	FP IND.STECKERLEISTE 12P. CONNECTOR	0516.0200.00	BINDER	10-9839-00-12	

1GPK 887 3PLU	Äi	Datum Date	Schaltteilliste für Parts list for	Sachnummer Stock No.	Blatt-Nr. Page
ROHDE&SCHWARZ	02	07.10.99	ED DATENSPEICHER III	0395.3063.01 SA	1-

Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
C1	CK 2,2UF+-10%50V L7B5H10 FILM CAPACITOR	0828.4789.00	WESTERMANN	MKS 22	
C2	CE 47UF+-20%10V6RD6,3X5 ELECTROLYTIC CAPACITOR	0377.0308.00	NAT_PANASO	ECEA1AKS470	
C3	CC 220NF+-10%50V X7R 1210 CERAMIC CAPACITOR CHIP	CC 0520.6850.00	AVX	1210 5C 224KA 11A	
C4	CE 22UF+-20%16V5RDX5RAD.A ALU ELECTROLYT. CAPACITOR	0358.6062.00	NAT_PANASO	ECE A 1C KS 220 B	
C5	CC 1,8NF+-1% 50V NPO 1206 CERAMIC CHIP CAPACITOR	CC 0007.7423.00	AVX	1206 5A 182 F 3	
C6	CC 100NF+-10%50V X7R 1206 CERAMIC CHIP CAPACITOR	CC 0007.5237.00	PHILIPS_CO	2238 581 55649	
C7	CC 100NF+-10%50V X7R 1206 CERAMIC CHIP CAPACITOR	CC 0007.5237.00	PHILIPS_CO	2238 581 55649	
C8	CK 470NF+-5%63V RD5H10MKT POLYESTER CAPACITOR	CK 0099.2975.00	SIEMENS	B 32 529-A474-J	
C9	CE 10UF +-10% 25V 7343 TANTALUM SMD-CAPACITOR	CE 0007.7246.00	SPRAGUE	293D 106 X9 025 D2W	
C10	CE 10UF +-10% 25V 7343 TANTALUM SMD-CAPACITOR	CE 0007.7246.00	SPRAGUE	293D 106 X9 025 D2W	
C11	CE 1UF +-10% 10V 1206 TANTALUM CHIP CAPACITOR NICHT BESTUECKT/NOT FITTED	CE 0007.7252.00	SPRAGUE	293D 105 X9 010 D2T	
C12	CC 100NF+-10%50V X7R 1206 CERAMIC CHIP CAPACITOR	CC 0007.5237.00	PHILIPS_CO	2238 581 55649	
C13	CK 2,2UF+-10%50V L7B5H10 FILM CAPACITOR	0828.4789.00	WESTERMANN	MKS 22	
D1	BL HEF4047BT MONO/AST MV MULTIFIBRATOR	BL 0350.4102.00	PHILIPS_SE	HEF4047BT	
L1 ..6	LD T-FILTER 3,3NF SMD SMD-FILTER	1039.1362.00	MURATA	NFM61R20T332T1	
N1	BO LT1078S8 2X OPAMP IC DUAL OPAMP	0828.4795.00	LINEAR_TEC	LT1078S8	
N2	BO LT1077S8 LP OPAMP OPAMP	0828.4714.00	LINEAR_TEC	LT1077(S8)	
P1	VL EINPRESSSTIFT 5,6 PIN	VL 0010.7250.00	AMP	1-928776-5	
R1	RG 475 OHM+-1%TK100 1206 RESISTOR CHIP	RG 0007.5695.00	ROEDERSTEI	D25	
R2	RG 22,1KOHM+-1%TK100 1206 RESISTOR CHIP	RG 0007.5872.00	PHILIPS_CO	RC02	
R3	RG 47,5KOHM+-1%TK100 1206 RESISTOR CHIP	RG 0007.5950.00	ROEDERSTEI	D25	
R4	RG 47,5 OHM+-1%TK100 1206 RESISTOR CHIP	RG 0007.5566.00	ROEDERSTEI	D25	
R5	RG 56,2KOHM+-1%TK100 1206 CHIP RESISTOR	RG 0007.1883.00	DRALORIC	CR 1206	
R6	RG 56,2KOHM+-1%TK100 1206 CHIP RESISTOR	RG 0007.1883.00	DRALORIC	CR 1206	
R7	RG 100,0KOH+-1%TK100 1206 CHIP RESISTOR	RG 0007.1948.00	ROEDERSTEI	D25	
R8	RG 100,0KOH+-1%TK100 1206 CHIP RESISTOR	RG 0007.1948.00	ROEDERSTEI	D25	
R9	RG 10,0KOHM+-1%TK100 1206 RG CHIP RESISTOR	RG 0007.0793.00	ROEDERSTEI	D25	
R10	RG 100,0KOH+-1%TK100 1206 CHIP RESISTOR	RG 0007.1948.00	ROEDERSTEI	D25	
R11	RG 24,3KOHM+-1%TK100 1206 RESISTOR CHIP	RG 0007.5889.00	DRALORIC	CR 1206	
R12	RG 15,0KOHM+-1%TK100 1206 RESISTOR CHIP	RG 0007.5843.00	PHILIPS_CO	RC02	
R13 ..15	RG 182 OHM+-1%TK100 1206 RESISTOR CHIP	RG 0007.5595.00	PHILIPS_CO	RC02	
R16	RG 200 KOHM+-1%TK100 1206 RESISTOR CHIP	RG 0007.5995.00	ROEDERSTEI	D25	
R17	RS 0,25W100KOHM+-20% SMD POTENTIOMETER	RS 0007.9678.00	BI_TECHNOL	23 B R... TR	
R18	RG 22K +-1% TK100 0603 SMD RESISTOR EIA0603	0009.7050.00	DRALORIC	CR 0603	
R19	RG 33K +-1% TK100 0603 SMD RESISTOR EIA0603	0009.7066.00	PHILIPS_CO	RC 22 H	
R20	RG 10,0KOHM+-1%TK100 1206 RG CHIP RESISTOR	RG 0007.0793.00	ROEDERSTEI	D25	

1GPK 887 3PLU	Äl	Datum Date	Schaltteilliste für Parts list for	Sachnummer Stock No.	Blatt-Nr. Page
ROHDE&SCHWARZ	04	07.10.99	ED MESSKOPFVERSTAERKER PROBE AMPLIFIER	0828.4750.01 SA	1+

095.0026-0693

Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
R21	RG 4K75 +-1% TK100 1206 RESISTOR CHIP	RG 0007.5820.00	PHILIPS_CO	RC02	
R22	RG 47,5 OHM+-1%TK100 1206 RESISTOR CHIP	RG 0007.5566.00	ROEDERSTEI	D25	
V1	AK MMBT4403 P 40V 600MA PNP SWITCHING TRANSISTOR	0828.4720.00	MOTOROLA	MMBT4403	
V2	AM SST441 DUAL JFET DUAL MONOLITHIC JFET	0828.4743.00	SILICONIX	SST441	
V3	AM SST4393 N 40V JFET N-CHANNEL JFET	AM 0828.4737.00	SILICONIX	SST4393	
X1	FP STIFTLEISTE 7P. R=2MM CONNECTOR	FP 0852.7155.00	SUYIN	20010S-07G2T	
X2	XX ENTHALTEN IN INCLUDED IN LAYOUT				

ROHDE&SCHWARZ

XY-Liste

XY List

Erklärung der Spaltenbezeichnungen:

Part: Bauelement-Kennzeichen.

Side: Leiterplatten-Seite, auf der sich das Bauelement befindet.

X/Y: Koordinaten (Millimeter) des Bauelementes auf der Leiterplatte bezogen auf den Nullpunkt.

SQR, PG: Planquadrat und Seite des Schaltbildes für das jeweilige Bauelement.

Explanation of column designations:

Part: Identification of instrument part.

Side: Side of the PC board on which instrument part is positioned.

X/Y: Coordinates (millimeter) of the component on the PC board in reference to zero point.

SQR, PG: Square and page of the diagram for the respective instrument part.

Nicht-Service-Relevante Bauteile / Non-Service-Relevant Components

Part	Side	X	Y	Sqr	Pg	Part	Side	X	Y	Sqr	Pg	Part	Side	X	Y	Sqr	Pg
C1	B	23	3	5B	1	P2	B	41	24	5D	1	S1	B	54	20	3D	1
C2	B	12	3	4A	1	R1	B	35	25	5D	1	S1	B	54	20	3D	1
C3	B	7	15	3F	1	R2	B	37	27	2C	1	S2	B	54	27	3C	1
C4	B	10	9	8E	1	R3	B	37	30	2C	1	S2	B	54	27	3D	1
C5	B	10	11	8E	1	R4	B	37	23	2D	1	V1	B	34	8	3B	1
C6	B	10	13	8E	1	R5	B	37	29	2D	1	V2	B	25	8	3A	1
C7	B	1	19	6C	1	R6	B	36	32	5D	1	V3	B	20	9	4B	1
C8	B	1	34	6C	1	R7	B	10	7	8E	1	V3	B	20	9	6A	1
C9	B	37	34	5D	1	R8	B	30	6	3A	1	V4	B	27	11	5B	1
D1	B	8	19	3F	1	R9	B	31	8	3A	1	V7	B	34	12	6B	1
D1	B	8	19	6D	1	R10	B	22	13	5A	1	V8	B	10	16	5C	1
D2	B	25	17	2F	1	R11	B	30	13	6B	1	X1	B	55	15	3E	1
D2	B	25	17	5C	1	R12	B	31	11	6B	1	X10	B	58	4	2E	1
N1	B	20	2	4A	1	R13	B	22	10	3B	1						
P1	B	41	27	5D	1	R14	B	6	10	2E	1						

Nicht-Service-Relevante Bauteile / Non-Service-Relevant Components

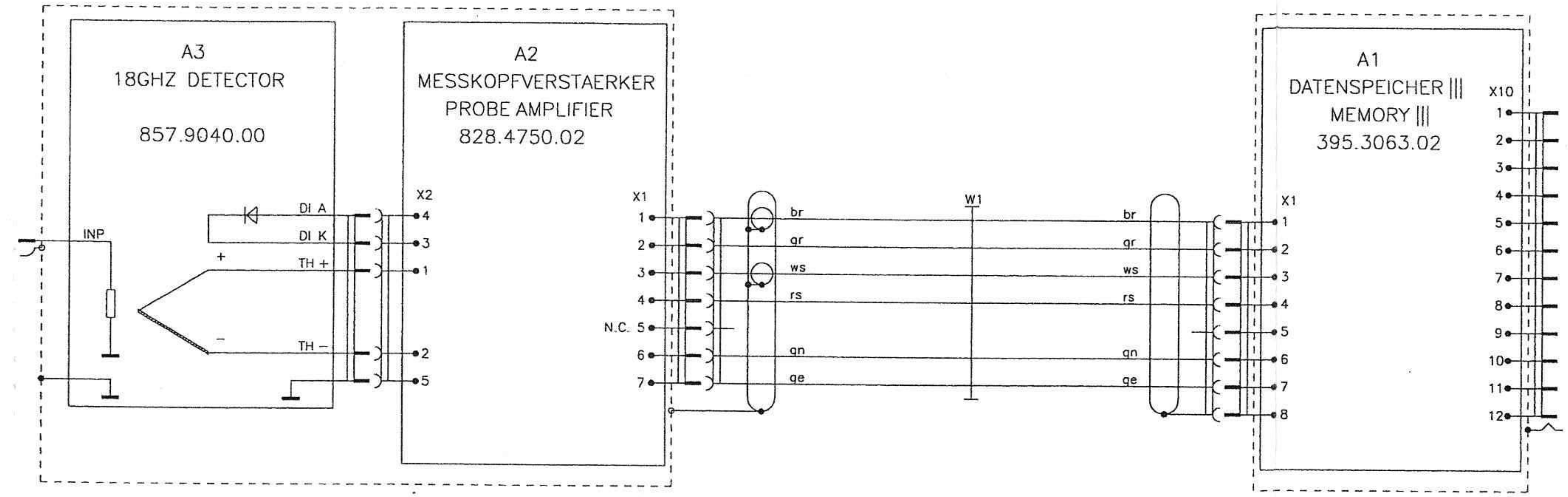
Part	Side	X	Y	Sqr	Pg	Part	Side	X	Y	Sqr	Pg	Part	Side	X	Y	Sqr	Pg
C1	B	10	23	2C	1	L5	B	34	7	7D	1	R11	A	26	8	6B	1
C2	B	20	20	4B	1	L6	B	40	22	7E	1	R12	A	34	10	7B	1
C3	A	8	4	3B	1	N1-A	B	25	14	5B	1	R13	B	45	14	8B	1
C4	B	31	6	4C	1	N1-B				6B	1	R14	B	45	6	8D	1
C5	B	16	1	4D	1	N1-C				4E	1	R15	B	47	19	8E	1
C6	A	26	17	5B	1	N2-A	B	22	10	4C	1	R16	B	18	2	4D	1
C7	A	27	4	6B	1	N2-B				4E	1	R17	B	26	1	4D	1
C8	B	28	17	7B	1	P1	B	29	2	3D	1	R18	B	32	14	4D	1
C9	A	24	3	7D	1	R1	A	8	17	2B	1	R19	B	32	11	4D	1
C10	A	40	3	7E	1	R2	A	14	5	3B	1	R20	A	10	8	5C	1
C11	A	3	15	2C	1	R3	A	27	10	4B	1	R21	A	32	14	4D	1
C12	B	9	12	4E	1	R4	A	19	10	4B	1	R22	A	8	7	2D	1
C13	B	15	23	2C	1	R5	A	24	14	4B	1	V1	A	17	8	4B	1
D1	B	13	2	4D	1	R6	A	22	10	4C	1	V2-A	A	17	14	3C	1
L1	B	34	15	7A	1	R7	A	31	17	5B	1	V2-B				3B	1
L2	B	34	17	7A	1	R8	A	23	23	5B	1	V3	B	21	6	5C	1
L3	B	34	12	7B	1	R9	A	23	17	5B	1	X1	B	43	7	8A	1
L4	B	34	10	7C	1	R10	A	29	14	5B	1	X2	B	3	15	1C	1

ROHDE & SCHWARZ

Stromläufe
Bestückungspläne

Circuit diagrams
Component plans

Schémas de circuit
Plans des composants



PROBE	A1	MEMORY |||		
	S1a	S1b	S2a	S2b
NRV–Z51	off	off	off	on

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

VARIANTENERKLAERUNG/VERSIONS
VAR02 = GRUNDAUSFUEHRUNG
MOD02 = BASIC MODEL

ROHDE&SCHWARZ	04	1GPK	Datum	Name
		Bearb.	24.01.97	SR
		Gepr.		SR
	Aend. Zust. / Aenderunsmitteilung / Datum / Name	Norm		

Benennung: NRV–Z51 MESSKOPF 18GHZ
SENSOR 18GHZ

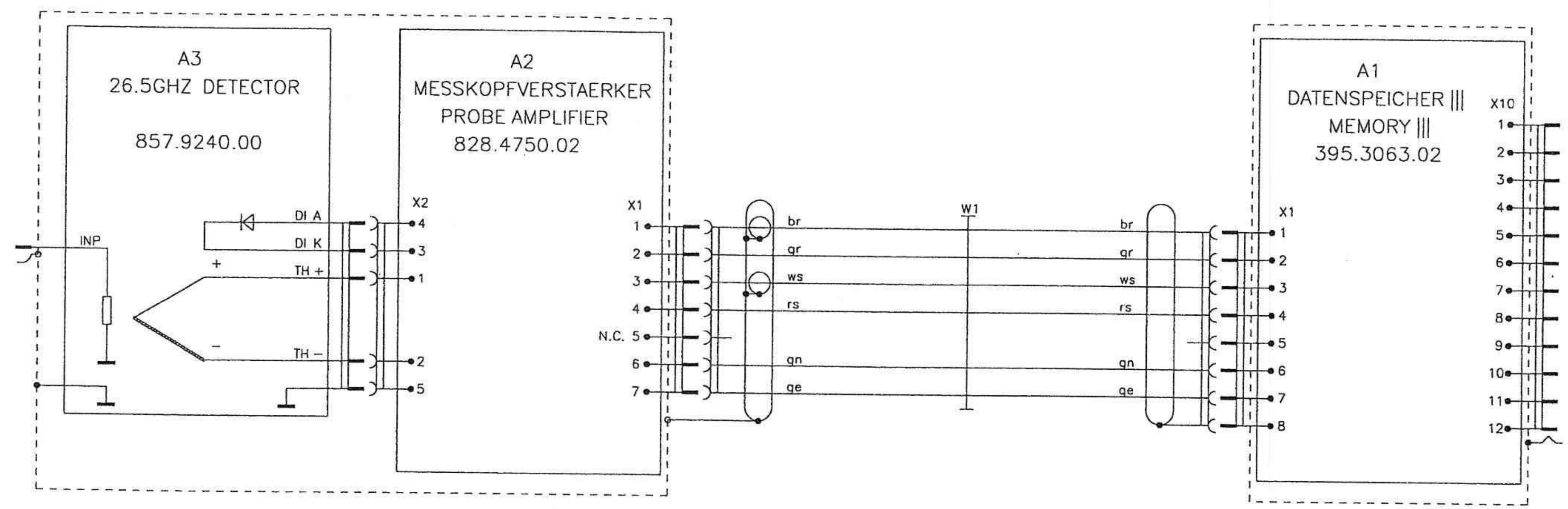
ZU GERAET: NRV–Z51

Zeichn.-Nr.: 857.9004.01 S

BLATT-NR.: 1 –

REG. 1 V.: 857.9004 V

ERSTE Z: 857.9004.01



PROBE	A1 MEMORY |||			
	S1a	S1b	S2a	S2b
NRV−Z52	off	off	off	on

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

VARIANTENERKLAERUNG/VERSIONS
VAR02 = GRUNDAUSFUEHRUNG
MOD02 = BASIC MODEL

ROHDE&SCHWARZ

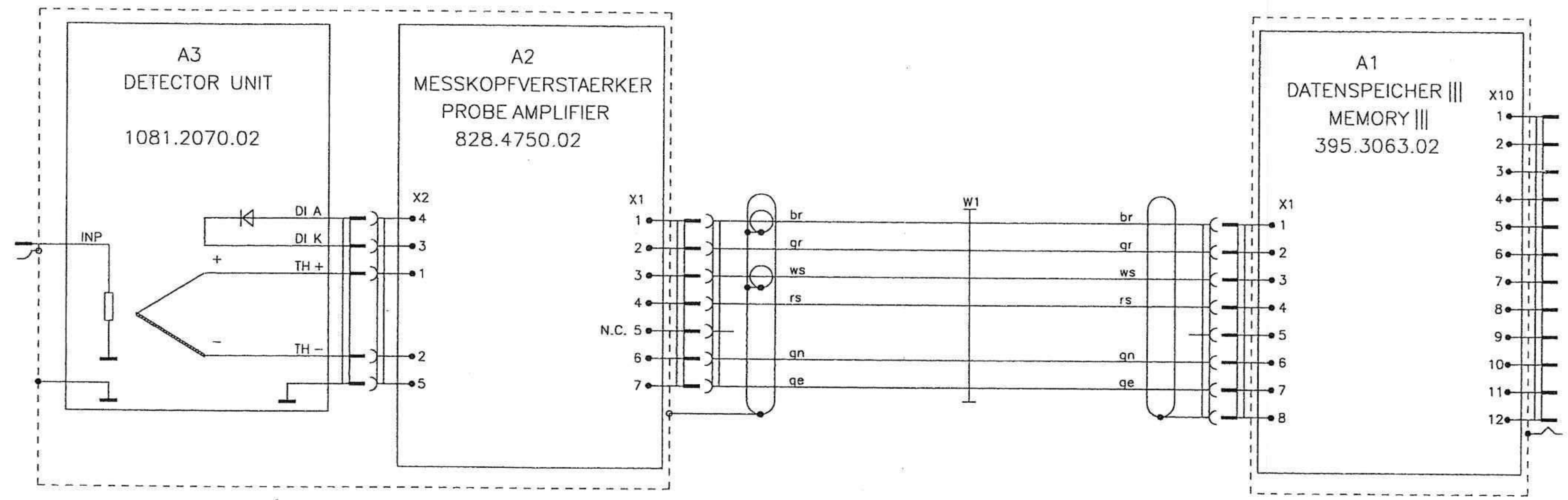
04	1GPK	
Datum	Name	
Bearb.	24.01.97	SR
Gepr.		SR
Norm		

Aend. Zust. | Aenderunsmitteilung | Datum | Name | Aend. Zust. | Aenderunsmitteilung | Datum | Name

Benennung: NRV−Z52 MESSKOPF 26.5GHZ
SENSOR 26.5GHZ
ZU GERAET NRV−Z52

Zeichn.-Nr: 857.9204.01 S
BLATT-NR. 1
REG. I. V. 857.9204 V
ERSTE Z. 857.9204.01

2

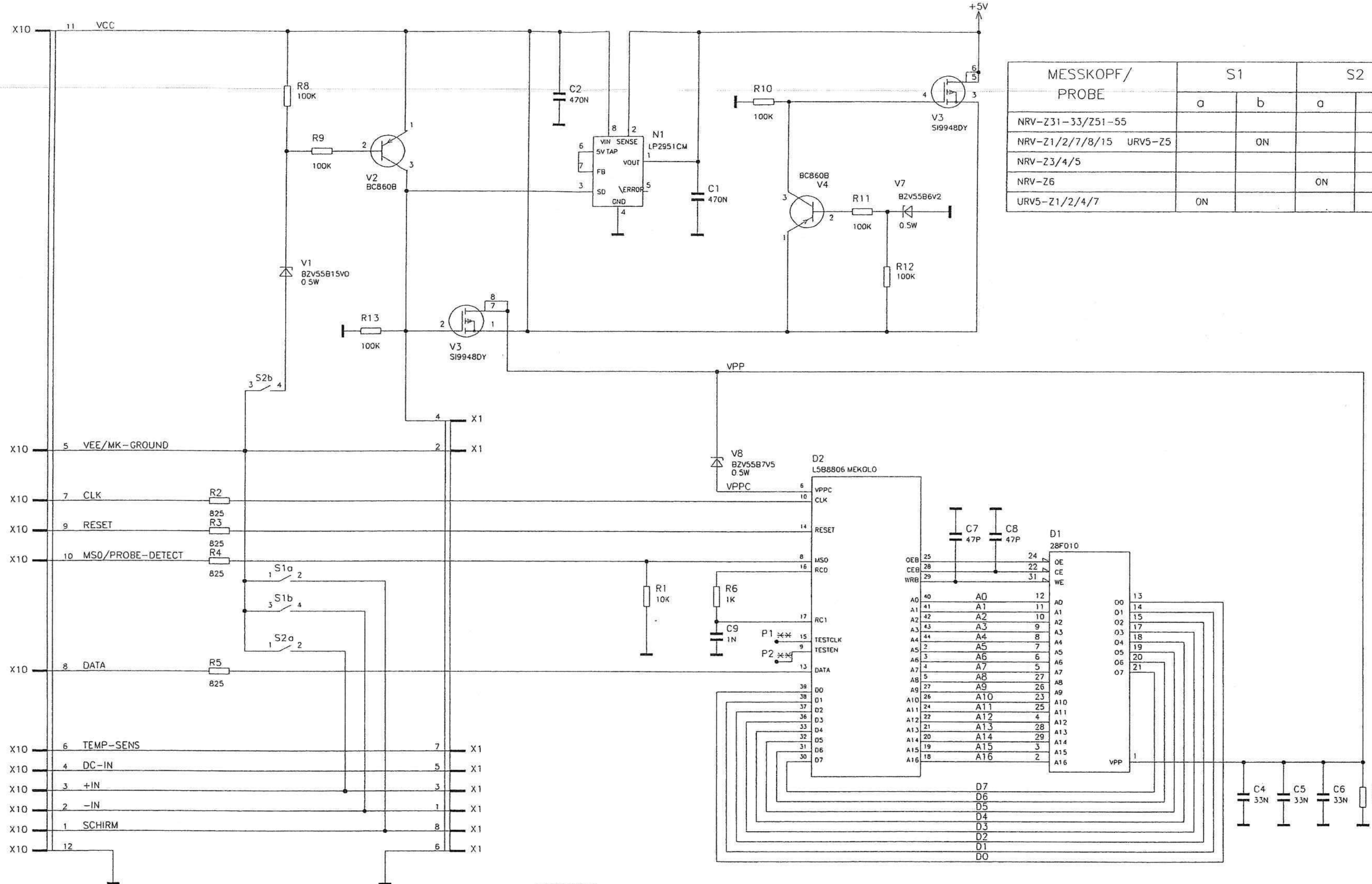


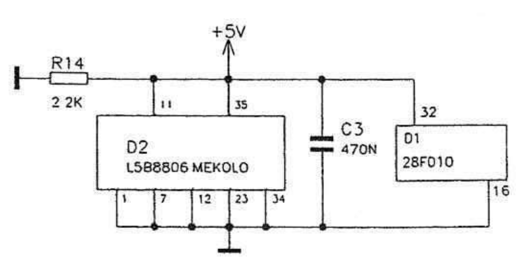
PROBE	A1 MEMORY |||			
	S1a	S1b	S2a	S2b
NRV-Z55	off	off	off	on

FUER DIE UNTERLAGE BEHALTEN WIR UNS ALLE RECHTE VOR

ROHDE&SCHWARZ	01	1GPK	Datum	Name	Benennung	Zeichn.-Nr.		BLATT-NR.
		Bearb.	26.11.96	SR	NRV-Z55 40GHz THERM.MK	1081.2005.01 S		1
		Gepr.		SR				
	Aend. Zust. / Aenderunsmitteilung / Datum / Name / Aend. Zust. / Aenderunsmitteilung / Datum / Name	Norm			ZU GERAET NRV-Z55	REG. I.V. 1081.2005 V	ERSTE Z. 1081.2005.01	

3





MESSKOPF/ PROBE	S1 a	S1 b	S2 a	S2 b
NRV-Z31-33/Z51-55				ON
NRV-Z1/2/7/8/15 URV5-Z5		ON		
NRV-Z3/4/5				
NRV-Z6			ON	
URV5-Z1/2/4/7	ON			

** = NOT FITTED

Bindende Angaben ueber Varianten, Trimmwerte, Bauteile und nicht bestueckte Bauteile siehe SA

FOR BINDING INFORMATION ON MODELS, TRIMMING AND COMPONENTS VALUES AND NONFITTED COMPONENTS SEE PARTS LIST

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

ATTENTION ESD !
ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING

03		BU	1GPK	DATUM	NAME
			BEARB		SR
			GEPR		
			NORM		
			PLOTT	14 11 96	SR
02					
AEND IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME		

ROHDE&SCHWARZ

ZU GERAET URV5-Z7

BENENNUNG

DATENSPEICHER_III

MEMORY_III

TOP/TOP 1

4

ZEICHN.-NR. 395.3063.01 S

BLATT-NR 1 -

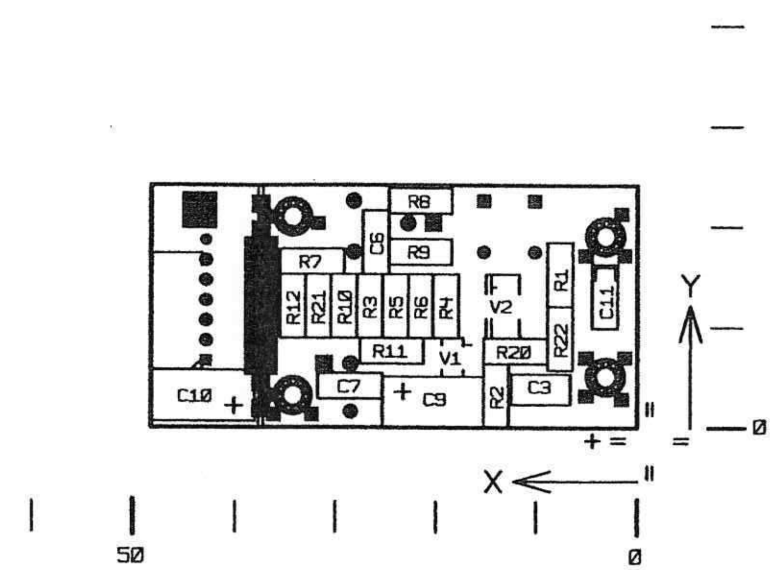
V BL.

REG I V 395 2615

ERSTE Z 000 0000

1 2 3 4 5 6 7 8

FUER D[illegible] UNTERLAGE
BEHALTEN WIR UNS ALLE RECHTE VOR



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

BINDENDE ANGABEN UEBER VARIANTEN, TRIMMWERTE, BAUTEILWERTE UND NICHT BESTUECKTE BAUTEILE SIEHE SA.

FOR BINDING INFORMATION ON MODELS, TRIMMING AND COMPONENTS VALUES AND NONFITTED COMPONENTS SEE PARTS LIST.

AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	1GPK	TAG	NAME
				BEARB.		BU
				GEPR.		BU
				NORM		
				PLOTT	09.02.94	

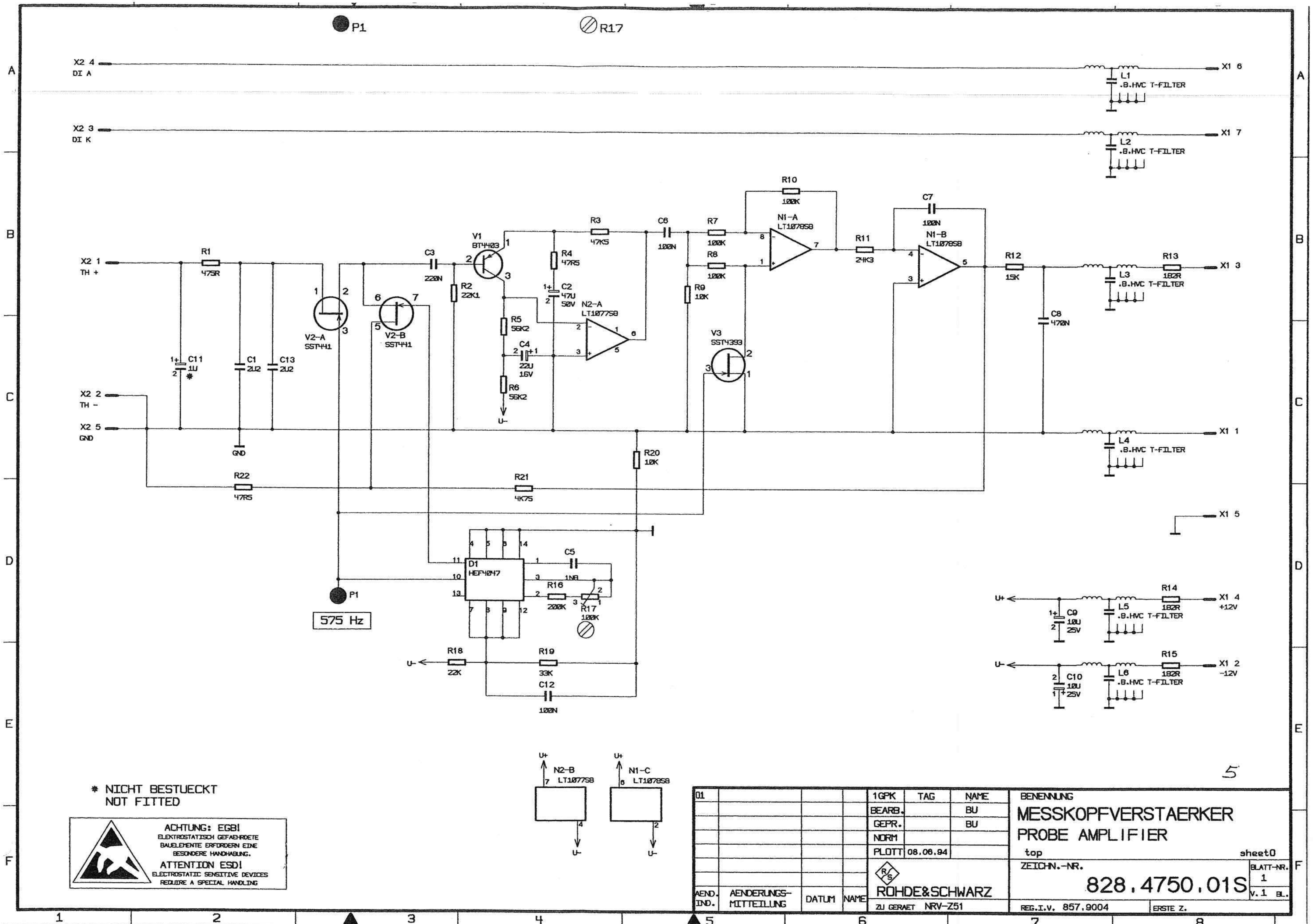
ROHDE&SCHWARZ
ZU GERAET NRV-Z51

BENENNUNG
MESSKOPFVERSTAERKER
PROBE AMPLIFIER

ZEICHN.-NR. 828.4750.01 ED
BLATT-NR. 2-
V. BL.
REG.I.V. 857.9004
ERSTE Z.

8

R&S Visu!



P1
R17
X2 4
DI A
X2 3
DI K
X2 1
TH +
X2 2
TH -
X2 5
GND
X1 6
X1 7
X1 3
X1 1
X1 5
X1 4
+12V
X1 2
-12V
L1 .B.HVC T-FILTER
L2 .B.HVC T-FILTER
L3 .B.HVC T-FILTER
L4 .B.HVC T-FILTER
L5 .B.HVC T-FILTER
L6 .B.HVC T-FILTER
R1 475R
C11 1U
C1 2U2
C13 2U2
V2-A SST441
V2-B SST441
C3 220N
V1 BT4403
R2 22K1
R3 47K5
R4 47R5
C2 47U 50V
R5 56K2
C4 22U 16V
R6 56K2
N2-A LT1077S8
C6 100N
R7 100K
R8 100K
R9 10K
R10 100K
N1-A LT1078S8
V3 SST4393
R11 24K3
C7 100N
N1-B LT1078S8
R12 15K
C8 470N
R13 182R
R20 10K
R21 4K75
R22 47K5
GND
U-
D1 HEF4047
C5 1N8
R16 200K
R17 100K
575 Hz
R18 22K
R19 33K
C12 100N
U+
U-
R14 182R
C9 10U 25V
R15 182R
C10 10U 25V
N2-B LT1077S8
N1-C LT1078S8
5
* NICHT BESTUECKT
NOT FITTED
ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.
ATTENTION ESD!
ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING
01
AEND. IND.
AENDERUNGS-MITTEILUNG
DATUM
NAME
1GPK
TAG
NAME
BEARB. BU
GEPR. BU
NORM
PLOTT 08.06.94
ROHDE&SCHWARZ
ZU GERAET NRV-Z51
BENENNUNG
MESSKOPFVERSTAERKER
PROBE AMPLIFIER
top
sheet0
ZEICHN.-NR.
828.4750.01S
BLATT-NR. 1
V.1 BL.
REG.I.V. 857.9004
ERSTE Z.
A
B
C
D
E
F
1
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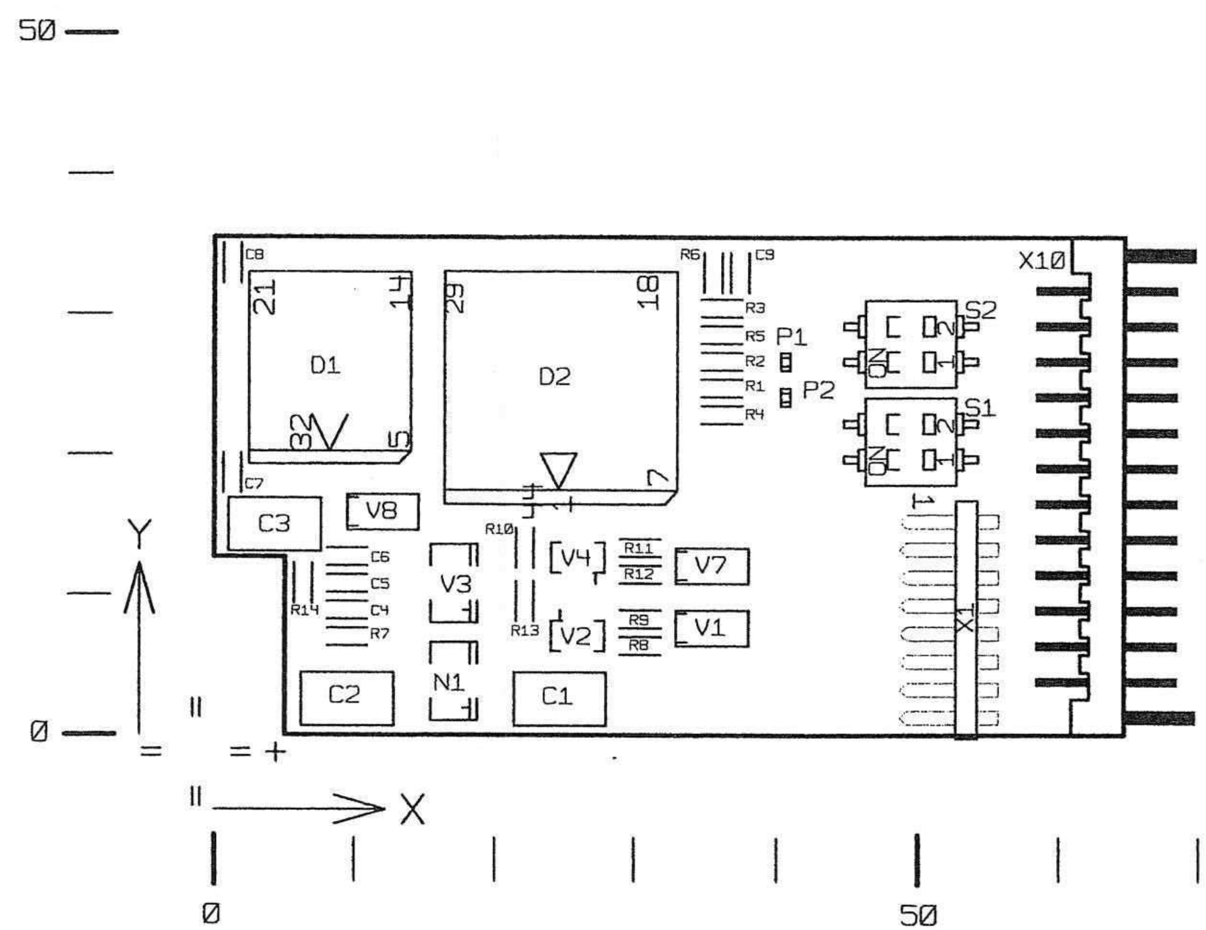
7
8



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

BINDENDE ANGABEN UEBER VARIANTEN, TRIMMWERTE, BAUTEILWERTE UND NICHT BESTUECKTE BAUTEILE SIEHE SA.

FOR BINDING INFORMATION ON MODELS, TRIMMING AND COMPONENTS VALUES AND NONFITTED COMPONENTS SEE PARTS LIST.

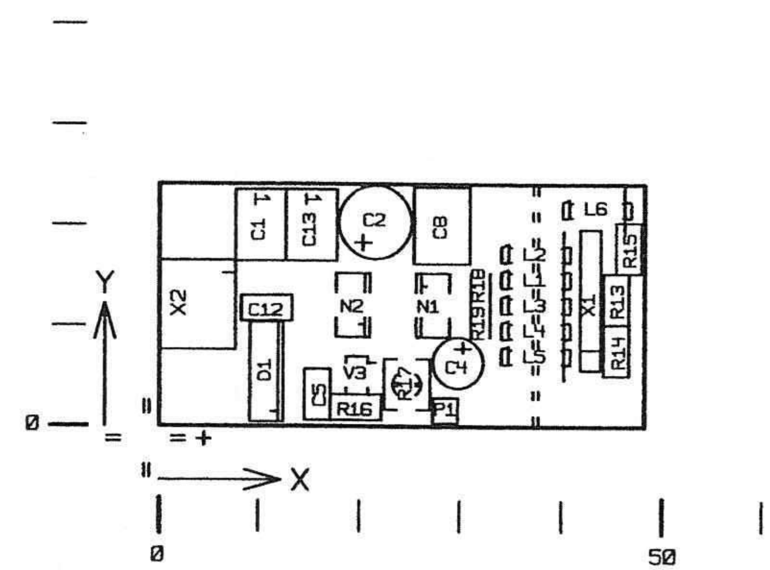
03				1GPK	DATUM	NAME
				BEARB.		SR
				GEPR.		SR
				NORM		
				PLOTT	14.11.96	BAUR_A
02						
AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME	ROHDE&SCHWARZ		
				ZU GERAET URV5-Z7		

BENENNUNG
DATENSPEICHER_III
MEMORY_III

ZEICHN.-NR.
395.3063.01 D

BLATT-NR. 1+
V. BL.

REG.I.V. 395.2615
ERSTE Z. 000.0000



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

BINDENDE ANGABEN UEBER VARIANTEN, TRIMMWERTE, BAUTEILWERTE UND NICHT BESTUECKTE BAUTEILE SIEHE SA.

FOR BINDING INFORMATION ON MODELS, TRIMMING AND COMPONENTS VALUES AND NONFITTED COMPONENTS SEE PARTS LIST.

AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME

1GPK	TAG	NAME
BEARB.		BU
GEPR.		BU
NORM		
PLOTT	09.02.94	

ROHDE&SCHWARZ
ZU GERAET NRV-Z51

BENENNUNG
MESSKOPFVERSTAERKER
PROBE AMPLIFIER

ZEICHN.-NR. 828.4750.01 ED
BLATT-NR. 1+
V. BL.
REG.I.V. 857.9004
ERSTE Z.

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