

6 POWER METERS

power meters

NAP

Power Reflection Meter NAP ♦ 25 to 1000 MHz/20 mW to 1100 W



- Continuous frequency range
- Separate power heads for easy measurement at hard-to-get-at points
- Simultaneous display of incident (forward) and reflected functions, digital and analog
- Direct display in W or dBm, VSWR, reflection coefficient, transmission and return loss
- Interchangeable power heads for four power ranges
- Self-test and special service functions
- Basic version: dry-battery operation
- With option NAP-B4: rechargeable-battery and AC-supply operation, IEC-bus connection

IEC625 Bus

Characteristics, uses

The **Power Reflection Meter NAP** is a handy **directional power meter** used to measure power and matching on radio equipment. Its high intelligence permits direct readout of the results of complex functions. Thanks to the ease of operation, its main applications are in servicing and production as well as in development and quality control.

Configuration, measurement ranges The instrument consists of the **NAP display unit** and a **Power Head** NAP-Z3 to NAP-Z6 (depending on power range) connected through a cable and plug. Four power heads are available with the following power ranges:

- NAP-Z3 for 20 mW to 35 W
- NAP-Z4 for 50 mW to 110 W
- NAP-Z5 for 0.2 to 350 W
- NAP-Z6 for 0.5 to 1100 W.

The wide power range and the continuous frequency coverage of all power heads from 25 to 1000 MHz permit measurements to be performed on transceivers, HF transmitters, and ATC systems in the important radio bands.

With its handy shape the NAP is ideal for **mobile use**, e.g. transceiver measurements in motor vehicles. For laboratory measurements, permanent transmitter monitoring or use in **automated measuring systems**, the option NAP-B4 with AC supply connection and IEC bus interface is available.

The insertion unit connected between the signal source and the load – e.g. radio set and antenna – measures the **incident and reflected powers**, and the microprocessor in the display unit computes the values of all the other measurement functions, so no conversion tables, nomograms or 100% calibration are necessary to determine the matching characteristics.

The insertion loss of the power heads is very low, so transmitter systems can be monitored and measurements made under actual operating conditions without affecting the matching between transmitter and load.

The display unit and power heads are RF-pickup-proof, permitting error-free measurement even in the vicinity of antennas.

Measurement functions The following functions can be measured directly using the NAP and an insertion unit, the results being displayed **simultaneously in analog and digital form**:

- incident and reflected power in W or dBm
- VSWR
- reflection coefficient in %
- transmission and return loss in dB
- reflected/incident power ratio in %
- modulation depth in %
- relative measurement (deviation of the incident and reflected powers in % or dB from specified reference values)
- minimum and maximum values of every measurement function observed during a measurement series

Display of measured value Two displays are provided for simultaneous indication of the incident and reflected functions. The functions selected are displayed either with the respective unit (e.g. W) or a brief designation (e.g. SWR). The incident function is always shown on the left and the reflected function on the right display independent of the direction in which the power head is connected between the signal source and the load. Below the **3½-digit display** the measured value is indicated in analog form by means of a bar meter on a calibrated scale of 56 divisions. The **analog display** facilitates adjustment procedures, providing graphical tendency indication.

Measurement rate The measured values are indicated at intervals of 400 ms, yielding 2½ indications per second. The bar meter (analog display) indicates 12½ values/s with AC operation, and with battery operation 2½ or 12½ values/s, as required.

The measured values are output via IEC bus every 400 ms, the transferred values always corresponding to the steady-state condition (triggered measurement value output). In untriggered operation (free-running measurements) values can be output at intervals of 80 ms.

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Simple operation and a clear-cut display make the NAP an easy-to-use measuring instrument. The keys for incident and reflected functions are combined in two groups assigned to the related display. Routine measurement functions can be set by means of a single keystroke: power in W or dBm, VSWR, reflection coefficient, transmission and return loss. There are three possibilities of range selection: a) automatic range selection, b) retaining of selected ranges, c) range preselection.

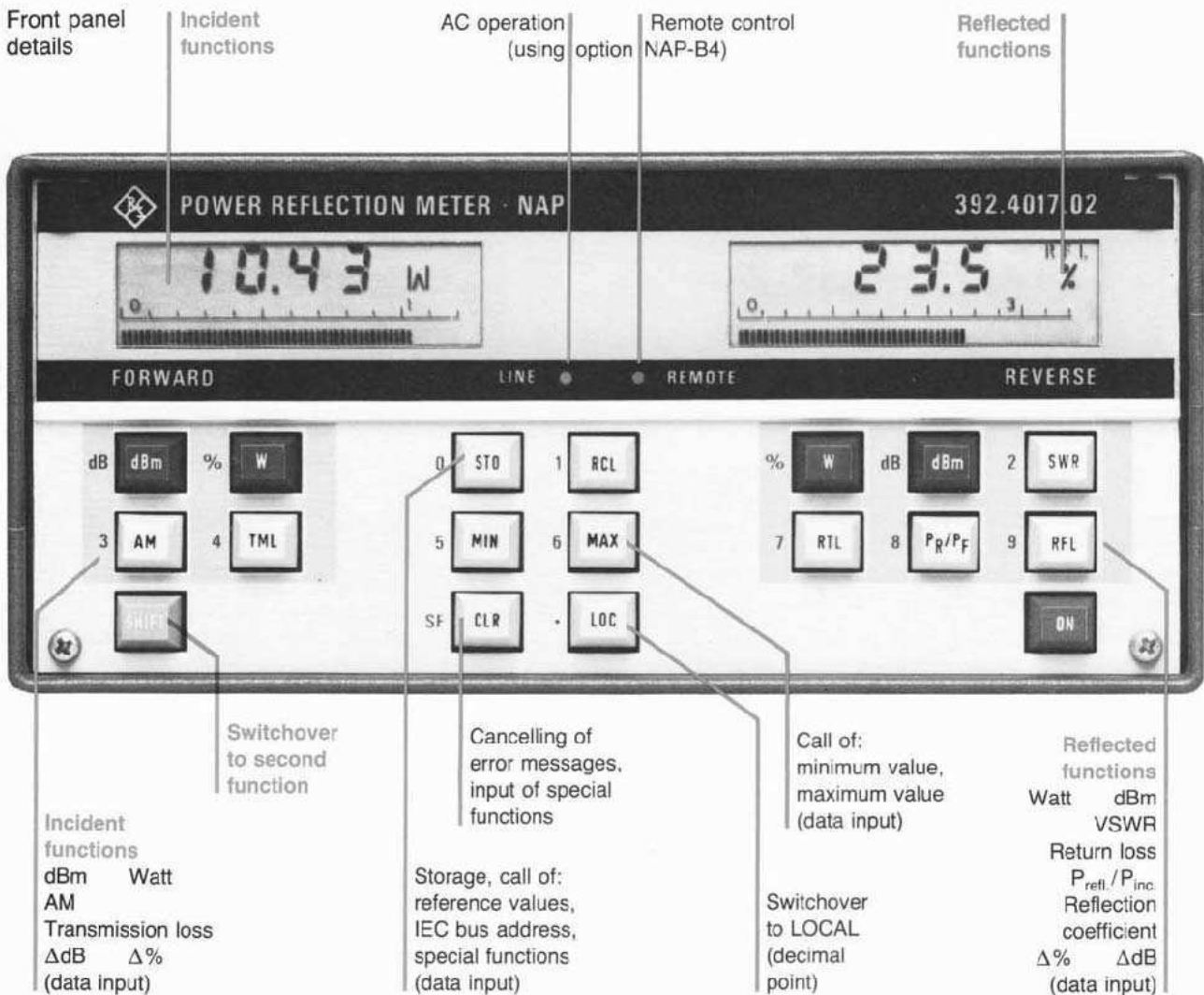
Reference values/measurement data processing The measured power can also be indicated as a deviation in % or dB from a reference value. Reference values are obtained by selecting a measured value or keying in a numerical value. Measurement of relative power variation or checking of a reference value in a unit other than that used in the first place (W, dBm or %, dB) may be effected at any time because the NAP automatically converts the value expressed by one unit into the corresponding value of another unit. Various reference values may be stored for the incident and reflected functions, the reference values as well as the IEC bus address remaining stored upon switching off the unit. With the aid of the minimum and maximum keys provided on the front panel, the minimum and maximum values measured by the NAP as from the measuring function last set can be indicated.

Description

The VSWR bridges used in many instruments absorb the major part of the power, acting like an attenuator between the transmitter and the antenna. Since this configuration provides only limited power-handling capacity, measurement of higher powers is not possible, and in the case of mismatch between the signal source and the load the insertion loss thus produced causes a considerable change in the matching conditions.

In contrast to this, the Rohde & Schwarz concept employing a directional coupler offers decisive advantages. Due to their extremely low insertion loss (<0.75 dB), the NAP power heads can be connected between the signal source and the load without causing any changes in the transfer of power or in the VSWR value. Measurement takes place under actual operating conditions, and transmitter monitoring is possible during operation.

Two rms rectifiers connected to the directional coupler supply DC voltages proportional to the incident and reflected powers. Two low-drift chopper amplifiers in the NAP analog section amplify the DC voltages generated by the power head. The voltages are taken via a multiplexer to a comparator and a D/A converter where they are digitized one after the other in successive approximation.



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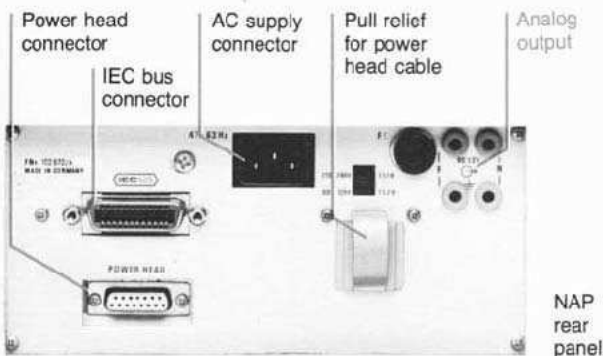
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Special functions A variety of special functions can be entered via the keyboard, providing for adaptation to special measurement tasks and permitting specific device settings to facilitate servicing and adjustment procedures. – The following special functions are available:

- Range preselection
- Retaining of automatically set ranges
- Retaining of set analog scales
- Fixed decimal point display
- Fast analog display in battery operation
- Inhibition of automatic instrument switchoff in battery operation
- Zero offset measurement
- Premature zero measurement in IEC bus operation
- Battery voltage indication
- Input and output of IEC bus address
- Service functions for various device settings

Analog output An analog output for each the incident and the reflected power is provided on the rear panel. The DC voltages available at the outputs are proportional to the values displayed, permitting graphical representation of these values on a recorder for each of the functions. The output voltage is 1 mV/digit (without taking the decimal point into account); this yields a total range of ± 1.999 V with smallest increments of 1 mV.



Power supply The NAP is a battery-operated unit designed for mobile use independent of AC supply. The basic model is equipped with six round cells. With eight hours of operation per day, these alkali-manganese batteries will yield a lifetime of over 500 hours of operation.

Instead of the round cells, option NAP-B4 can be fitted. It comprises an AC supply section and rechargeable nickel-cadmium batteries permitting AC supply or battery operation, as required. In addition, the option includes an IEC bus interface for remote control.

In the case of battery operation, the instrument is switched off automatically if no measurements are taken for about 1/2 hour.

Self-test During the self-test performed upon switching-on of the unit, essential functions of the display unit are checked and operating errors detected (e.g. power head not connected). Errors, if any, can be determined from the code shown on the display.

Remote control

With option NAP-B4 fitted, measurement and special functions can be set via IEC bus and the measured values be transferred, affording the NAP **full system compatibility**.

Simple setting commands facilitate program preparation, permitting the selection of various formats for data output, precise definition of measurement start conditions as well as service request with comprehensive status information.

Setting commands

Measurement functions

Command	Function	
C1	Basic setting	
LWF	Power in W	Incident function
LMF	Power in dBm	
MAM	Amplitude modulation in %	
TML	Transmission loss in dB	
LWR	Power in W	Reflected function
LMR	Power in dBm	
SWR	VSWR	
RTL	Return loss in dB	
ALR	Reflected/incident power ratio in %	
RFL	Reflection coefficient in %	

Data output

Command	Function
DF	Data output incident power channel
DR	Data output reflected power channel
DT	Data output for both channels
N0	Data output with header
N1	Data output without header

Measurement start

Command	Function
X1	Start of a single measurement
X2	Start of a measurement by data request
X3	Continuous measurement
X0	Reset command for X2/X3

Special functions

Command	Function			
S0	Clear all special functions			
S01	Automatic range selection			
S10	1	0	Incident power range	Reflected power range
S11	1	1		
S20	2	0	Incident power range	Reflected power range
S21	2	1		
S22	2	2	Incident power range	Reflected power range
S30	Retain measurement ranges			
S32	Set fixed decimal point indication			
S41	Premature zero measurement			
S43	Zero offset correction			
S70	LCD test			
S80	} D/A converter test			
S81				
S90				
S91	} Analog output test			
S92				

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Interface commands

Command	Function
W0	End character NL (ASCII 10)
W1	CR (ASCII 13)
W2	ETX (ASCII 3)
W3	CR + NL
W4	EOI (end or identify)
W5	NL + EOI
W6	CR + EOI
W7	ETX + EOI
W8	CR + NL + EOI
Q0	Service request disabled
Q1	Service request enabled

Service request

Device status	Status byte	Decimal value
Measurement completed	0101 0000	80
Underrange	0101 0001	81
Overrange	0110 0000	96
Syntax error	0110 0001	97
Output in local	0110 0010	98
Output without measurement start	0110 0011	99
Overflow of readout	0110 0100	100
Measured value undefined	0110 0101	101
Hardware error	1110 0000	224

Specifications

NAP with power head	NAP-Z3	NAP-Z4	NAP-Z5	NAP-Z6
Measurement range	20 mW to 35 W	50 mW to 110 W	0.2 to 350 W	0.5 to 1100 W
Frequency range	25 to 1000 MHz			
Error of power measurement ¹⁾ at 20 to 25 °C, automatic range selection	≤(6% + 1 digit + 0.01% of max. permissible input power)			
VSWR error	typ. 5%			
VSWR ≤ 1.25	typ. 5%			
VSWR > 1.25 to 2	typ. 8%			
Directivity ¹⁾	≥30 dB			
f ≥ 30 MHz	≥30 dB			
f < 30 MHz	≥26 dB			
Effect of temperature ¹⁾	≤0.25%/°C			
Characteristic impedance	50 Ω			
VSWR	≤1.03			
Insertion loss (dB)	≤0.15			
up to 300 MHz	≤0.1	≤0.08	≤0.08	≤0.05
up to 500 MHz	≤0.25	≤0.15	≤0.15	≤0.1
up to 1000 MHz	≤0.75	≤0.35	≤0.2	≤0.15
RF connectors	N connector/socket			Dezifix B
Electrical length of transmission line	140 mm			

¹⁾ Error applicable for power measurements in W. All other values indicated are determined by way of conversion.

NAP Display unit	Power ranges	1/10/100% of max. permissible input power, automatic or manual selection
Power head connector	Functions displayed	15-contact, to DIN 41652 incident/reflected power in W or dBm, VSWR, reflection coefficient in %, transmission and return loss in dB, reflected/incident power ratio in %, modulation depth in % (30 Hz to 20 kHz), relative measurement in % or dB, minimum/maximum values
Indication of measured values	Measurement rate	digital display: 3½ digits analog display: bar with 56 scale divisions digital display: 2.5 measurements/s analog display: battery operation: 2.5/12.5 measurements/s (selected via special function) AC supply operation: 12.5 measurements/s
Analog outputs	Remote control	for incident and reflected channels two 4-mm sockets each, 1 digit of display corresponding to 1 mV; source impedance: 2.2 kΩ, error: ±20 mV, referred to displayed value with option NAP-B4 and AC supply operation
Interface	Interface functions	to IEC 625-1, 24-contact Amphenol connector SH1, AH1, T6, L4, SR1, RL1, DC1, DT1

General data	Rated temperature range	-10 to +55 °C
Storage temperature range		-40 to +70 °C
Ambient conditions		rated range of use I to IEC 359 (with extended rated temperature range)
RF leakage		the requirements to VDE 0871 and MIL STD 461 A, methods CE 03 and RE 02, regarding radiated and conducted interference as well as the limit values of radio interference grade K to VDE 0875 are complied with
Electromagnetic compatibility		min. 20 V/m
Power supply		basic version: dry batteries, with option NAP-B4: rechargeable batteries or AC supply
Dry batteries		6 round cells, 1.5 V (LR 20), lifetime >500 h (using alkali-manganese batteries 8 h/day)
Rechargeable batteries		5 NiCd button cells 1.2 V (GSZ 1.8 DIN 40766) approx. 100 h between charges
AC supply		100 to 120/220 to 240 V ±10%, 47 to 63 Hz (14 VA)
Dimensions, display unit		241 mm × 110 mm × 219 mm
power head		125 mm × 105 mm × 45 mm
Weight, display unit/power head		3.5 kg/0.6 kg

Ordering information

Order designation	► Power Reflection Meter NAP
NAP basic unit (display unit)	392.4017.02
Power head	
35 W NAP-Z3	392.6610.55
110 W NAP-Z4	392.6910.55
350 W NAP-Z5	392.7116.55
1100 W NAP-Z6	392.7316.54
Option NAP-B4, AC supply/IEC bus	392.5913.02
Accessories supplied	power cable for option NAP-B4
Recommended extras	
Extension cable (25 m) NAP-Z2	392.5813.02

The user can easily adapt these connectors to other systems with the aid of screw-in assemblies; see data sheet 902 100.

Suitable screw-in assemblies (to be ordered separately):	Adaptation to	Male	Female	Max. power at 1000 MHz*)
UHF (small single contact)		017.7384.00	017.5217.00	0.15 kW
BNC		017.7832.00	017.5730.00	0.3 kW
N		017.7532.00	017.5398.00	0.79 kW
4.1/9.5		017.9106.00	017.8516.00	0.75 kW
Dezifix B			018.2486.00	1.3 kW

*) The maximum power at other frequencies is calculated:

$$P_{max} = P_{(1\text{ GHz})} / \sqrt{f(\text{GHz})}$$