



ROHDE & SCHWARZ

NAP

POWER REFLECTION METER NAP

0.2 to 100 MHz / 1 mW to 1950 W



- Direct display of incident and reflected functions
- PEP measurement
- Battery operation



IEC 625 Bus
IEEE 488

CHARACTERISTICS AND USES

NAP

Power Reflection Meter NAP

◆ 0.2 to 1000 MHz/1 mW to 1950 W

- Separate power heads for easy measurement at hard-to-get-at points
- 7 interchangeable power heads
- PEP measurement in the shortwave range
- Simultaneous display of incident (forward) and reflected functions, digital and analog
- Direct display in W or dBm, VSWR, reflection coefficient, transmission and return loss
- Self-test and special service functions
- Model for dry-battery operation
- Model for rechargeable-battery and AC-supply operation with IEC/IEEE-bus connector



IEC625Bus

Characteristics, uses

The **Power Reflection Meter NAP** is a handy **directional power meter** used to measure power and matching on radio equipment. 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 a display unit and a plug-on power head connected by a cable. The following power heads are available:

| | | |
|--------|-----------------|------------------|
| NAP-Z7 | 0.1 W to 195 W | 0.4 to 80 MHz |
| NAP-Z8 | 1 W to 1950 W | 0.2 to 80 MHz |
| NAP-Z9 | 1 mW to 1.1 W | 100 to 1000 MHz |
| NAP-Z3 | 20 mW to 35 W | } 25 to 1000 MHz |
| NAP-Z4 | 50 mW to 110 W | |
| NAP-Z5 | 0.2 W to 350 W | |
| NAP-Z6 | 0.5 W to 1100 W | |

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**, a model with AC supply connection and IEC/IEEE-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.

Ranges of application are transceivers, HF transmitters, and ATC systems (with NAP-Z3 to -Z8) as well as radiopaging systems, medical engineering and industrial radio telecontrol (with NAP-Z9).

The power heads NAP-Z7 and NAP-Z8 for the shortwave range permit **measurement of the peak envelope power (PEP) and the average power (AVG)** of modulated signals. A calibration report is supplied with each power head. The measurement error can be reduced by taking the calibration factor into account: e.g. from 6% to 4% in the frequency range 1.5 to 30 MHz.

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

Measurement functions

- incident and reflected powers 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
- measurement of peak envelope power (PEP) or average power (AVG)

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.

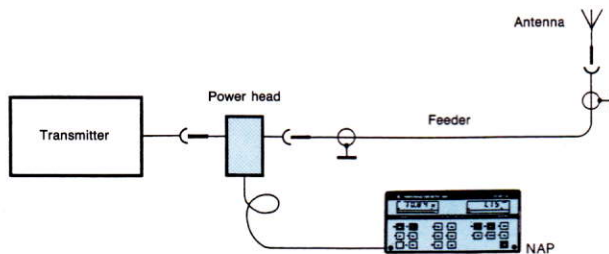
The measurement time for IEC/IEEE-bus operation is 400 ms (NAP-Z3 to -Z6 and -Z9) or 500/1500 ms (NAP-Z7 and -Z8, AVG/PEP).

The transferred values always correspond to the steady-state condition (triggered measurement value output). In untriggered operation (free-running measurements) values can be output at intervals of 80 ms.

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:

- automatic range selection
- retaining of selected ranges
- 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 (in % or dB) or checking of a reference value in a unit other than that used in the first place (W, dBm) 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/IEEE-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.



Power measurement on antenna feeder using the NAP

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 operating conditions.

In contrast to this, the Rohde & Schwarz concept employing a directional coupler offers decisive advantages. Due to their

extremely low insertion loss (0.015 to 0.75 dB depending on power head), 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 digitalized one after the other in successive approximation.

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/IEEE-bus operation
- Battery voltage indication
- Input and output of IEC/IEEE-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.

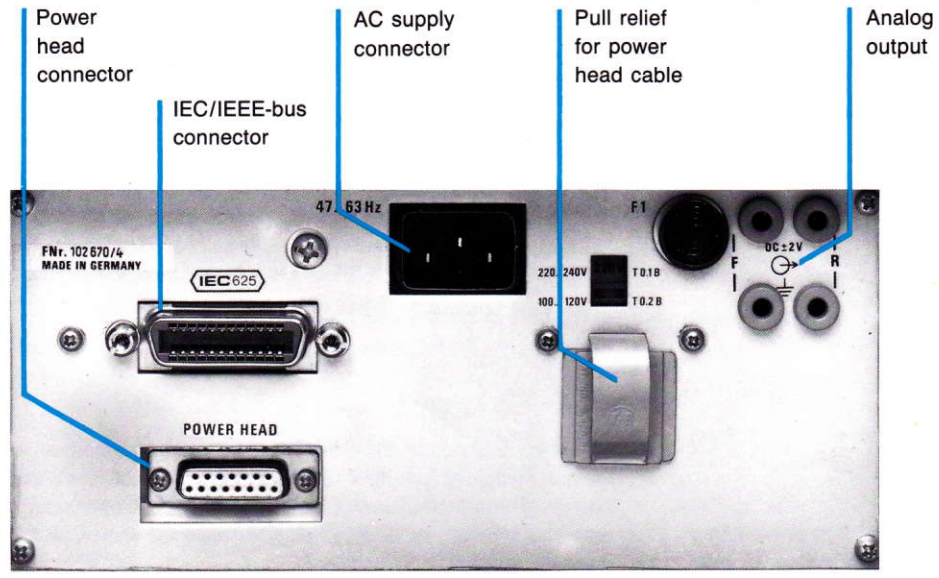
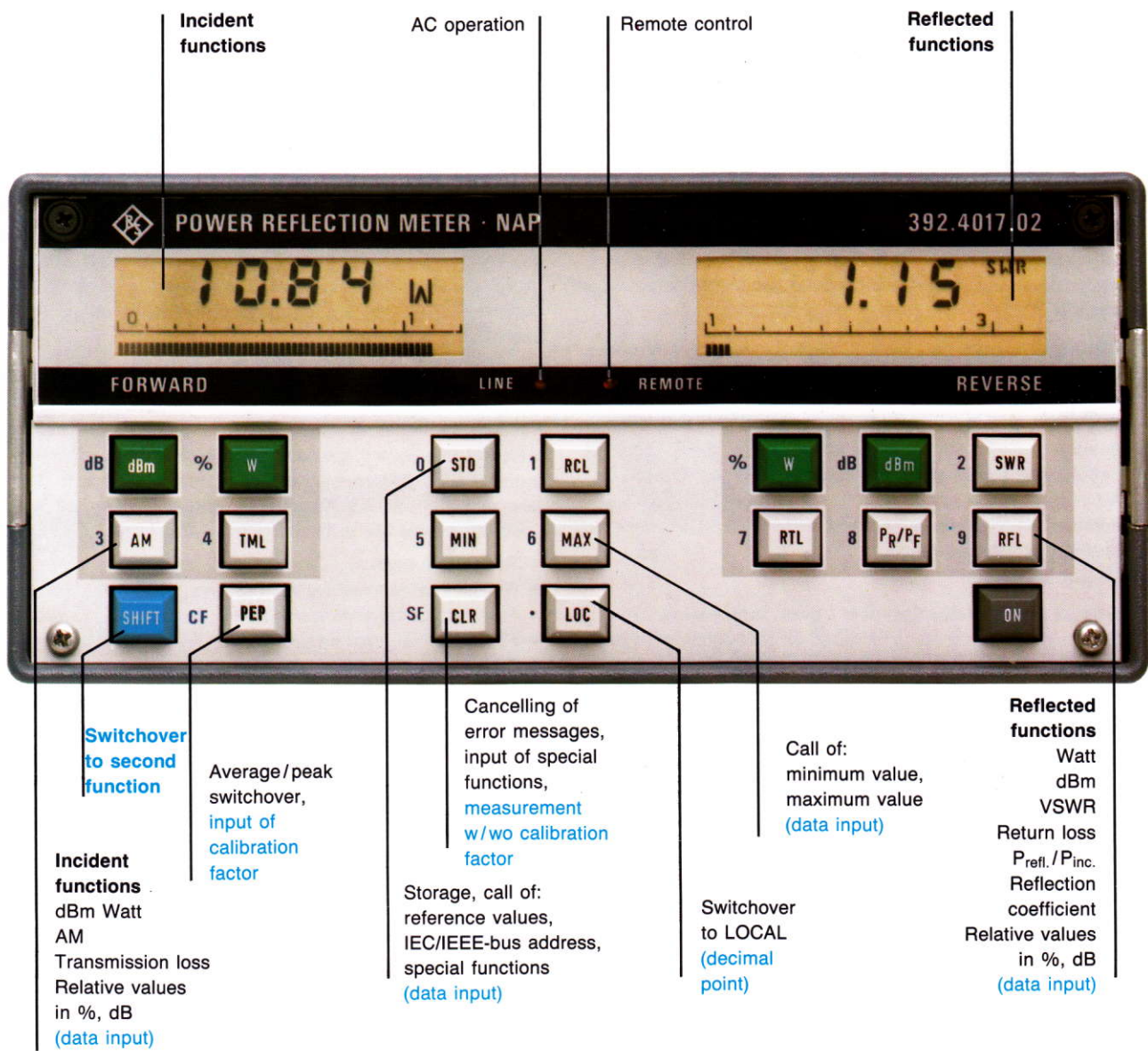
Power supply The NAP is a battery-operated unit designed for mobile use independent of AC supply. The basic model is equipped with six round cells. With eight hours of operation per day the dry alkali-manganese batteries will yield a lifetime of over 400 operating hours.

The model for AC-supply operation 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/IEEE-bus interface for remote control.

In the case of battery operation, the instrument is switched off automatically if no measurements are taken for about ½ 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.

FRONT PANEL DETAILS, REAR VIEW



REMOTE CONTROL, DISPLAY

For the AC-supply-operated model, measurement and special functions can be set via IEC/IEEE-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.

Measurement functions

- Basic setting
- Power in W or dBm
- Amplitude modulation in %
- Transmission loss in dB
- VSWR
- Return loss in dB
- Reflected/incident power ratio in %
- Reflection coefficient in %
- Peak value measurement
- Average value measurement
- Relative power variation in % or dB

Measurement start

- Start of a single measurement
- Start by data request
- Continuous measurement
- Start with storage of reference values

Data output

- Output for both channels
- Output for one channel
- Output w/wo header

Calibration factors

- Input of calibration factors (separately for incident/reflected functions)

Special functions

- Automatic range selection
- Retain measurement ranges
- Preset measurement ranges
- Fixed point indication
- Zero offset correction
- Test functions

Interface

- Enable/disable service request
- Data output with standard end characters

Service request

- Measurement completed
- Underrange/overrange
- Zero offset correction completed
- Syntax error in programming
- Output in local
- Output without measurement start
- Overflow of readout
- Measured value undefined
- Illegal calibration factor
- Hardware error

Incident power



Reflected power



SPECIFICATIONS

| NAP with power head | NAP-Z7 | NAP-Z8 | NAP-Z9 | NAP-Z3 | NAP-Z4 | NAP-Z5 | NAP-Z6 |
|--|---|--------------------------------|--|---|--|---|---|
| Measurement range (AVG) (PEP) | 0.1 to 195 W 0.5 to 195 W | 1 to 1950 W 5 to 1950 W | 1 mW to 1.1 W — | 20 mW to 35 W — | 50 mW to 110 W — | 0.2 to 350 W — | 0.5 to 1100 W — |
| Frequency range (AVG) (PEP) | 0.4 to 80 MHz 0.4 to 80 MHz | 0.2 to 80 MHz 0.4 to 80 MHz | 100 to 1000 MHz — | — | 25 to 1000 MHz — | | — |
| Error of power measurement ¹⁾ plus 1 digit + 0.01 % of max. power of head | (in the frequency range 1.5 to 30 MHz) $\leq 6\%$, $\leq 4\%$ taking into account the calibration factors of test report | | $\leq 6\%$ | | | | |
| Effect of temperature | $\leq 0.25\% / ^\circ\text{C}$ | | | | | | |
| VSWR error (typ.) VSWR ≤ 1.25 VSWR ≤ 2 | 4 % 5 % (in the frequency range 1.5 to 30 MHz) | | 5 % 8 % | | | | |
| PEP error ¹⁾ plus 0.04 % of max. power of head (of sinewave modulation of envelope power) | 2 % (> 0.3 to 3 kHz) 7 % (30 to 300 Hz, > 3 to 10 kHz) | | — | | | | |
| Effect of temperature on PEP error | $\leq 0.003\%$ of max. power of head / $^\circ\text{C}$ | | — | | | | |
| Directivity | ≥ 35 dB (1.5 to 30 MHz) | | ≥ 30 dB (170 to 1000 MHz), ≥ 26 dB (100 to 170 MHz) | | ≥ 30 dB (30 to 1000 MHz) ≥ 26 dB (25 to 30 MHz) | | |
| Characteristic impedance | 50 Ω | | | | | | |
| VSWR | ≤ 1.02 (≤ 30 MHz) ≤ 1.03 (30 to 80 MHz) | | ≤ 1.03 | | | | |
| Insertion loss up to 80 MHz up to 300 MHz up to 500 MHz up to 1000 MHz | ≤ 0.015 dB — — — | | ≤ 0.1 dB ≤ 0.25 dB ≤ 0.75 dB | ≤ 0.1 dB ≤ 0.25 dB ≤ 0.75 dB | ≤ 0.08 dB ≤ 0.15 dB ≤ 0.35 dB | ≤ 0.08 dB ≤ 0.15 dB ≤ 0.2 dB | ≤ 0.05 dB ≤ 0.1 dB ≤ 0.15 dB |
| RF connectors | N type | | | | | | Dezifix B |
| Electrical length | 180 mm | | 140 mm | 140 mm | 135 mm | 133 mm | 132 mm |
| Measurement time (without range switchover) Digital value (manual) (via IEC/IEEE-bus) | 400 ms 500 ms (AVG), 1500 ms (PEP) | | 400 ms 400 ms | | | | |
| Analog value (AC supply operation) (battery operation) | 80 ms 400 ms / 80 ms (switch-selected) | | | | | | |
| Dimensions (mm) Weight (kg) | 118 x 118 x 45 0.7 | | 118 x 105 x 45 0.6 | | | | 125 x 105 x 45 0.6 |

Characteristics of power heads NAP-Z7 and NAP-Z8 in the frequency range 0.2 to 80 MHz:

Error of power measurement¹⁾
(values in parentheses: calibration factors of test report taken into account)

Directivity

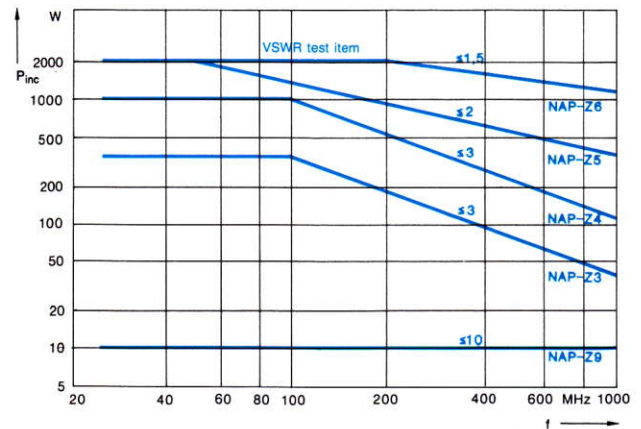
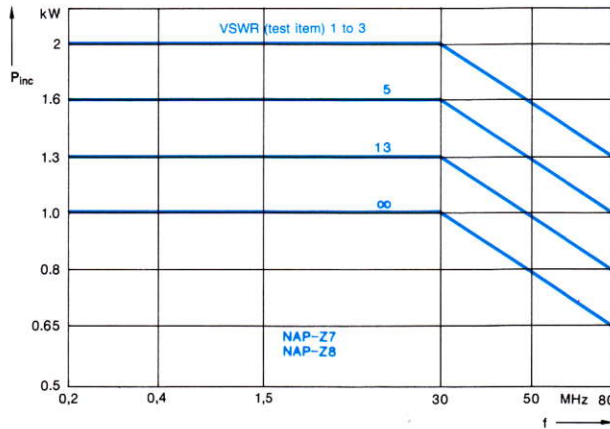
| | 0.2 | 0.4 | 1.5 | 30 | 50 | 80 MHz |
|--------|---------|---------|-------|--------|--------|--------|
| NAP-Z7 | — | 35 (12) | 6 (4) | 11 (4) | 25 (5) | |
| NAP-Z8 | 32 (15) | 13 (6) | 6 (4) | 11 (4) | 25 (5) | |

%

| | 0.2 | 0.4 | 1.5 | 30 | 50 | 80 MHz |
|--------|-----------|-----------|-----------|-----------|-----------|--------|
| NAP-Z7 | — | ≥ 23 | ≥ 35 | ≥ 30 | ≥ 20 | |
| NAP-Z8 | ≥ 25 | ≥ 30 | ≥ 35 | ≥ 30 | ≥ 20 | |

dB

¹⁾ Error limits applicable for power measurements in W directly at power head at 20 to 25 $^\circ\text{C}$ and with autoranging. All other values indicated are determined by way of conversion.



Max. continuous power rating of power heads

NAP display unit

| | |
|-------------------------------------|---|
| Power ranges | 1/10/100 % of max. power of head, automatic or manual selection |
| Power head connector | 15-way, to DIN 41652 |
| Functions displayed | 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 | digital display: 3½ digits analog display: bar with 56 scale divisions |
| Analog outputs | for incident and reflected channels two 4-mm sockets each, 1 digit of display corresponding to 1 mV EMF; source impedance: 2.2 kΩ error: ± 20 mV, referred to displayed value |
| Remote control | model for AC supply operation |
| Interface | to IEC 625-1/IEEE, 24-way Amphenol connector |
| Interface functions | SH1, AH1, T6, L4, SR1, RL1, DC1, DT1 |

General data

| | |
|-------------------------------------|---|
| Nominal temperature range | -10 to +55 °C |
| Storage temperature range | -40 to +70 °C |
| Ambient conditions | rated range of use 1 to IEC 359 (with extended nominal temperature range) |
| RF leakage | the requirements to VDE 0871 and MIL-STD 461 A, methods CE 03 and RE 02, regarding spurious radiation and interference on connecting cables 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 | depending on model: dry batteries, rechargeable batteries or AC supply |
| Dry batteries | 6 round cells, 1.5 V (LR 20), lifetime > 400 h (using alkaline-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 $\pm 10\%$, 47 to 63 Hz (14 VA) |
| Dimensions | 241 mm x 110 mm x 219 mm |
| Weight | 3.6 kg |

Ordering information

| | | |
|---|------------------------------|---------------------------|
| Order designation | ► Power Reflection Meter NAP | |
| NAP display unit, battery operated | 392.4017.02 | |
| NAP display-unit, AC supply/IEC bus | 392.4017.04 | |
| Power head | | |
| 0.4 to 80 MHz, 195 W | NAP-Z7 | 350.8214.02 ¹⁾ |
| 0.2 to 80 MHz, 1950 W | NAP-Z8 | 350.4619.02 ¹⁾ |
| 100 to 1000 MHz, 1.1 W | NAP-Z9 | 392.5513.55 ¹⁾ |
| 25 to 1000 MHz, 35 W | NAP-Z3 | 392.6610.55 |
| 25 to 1000 MHz, 110 W | NAP-Z4 | 392.6910.55 |
| 25 to 1000 MHz, 350 W | NAP-Z5 | 392.7116.55 |
| 25 to 1000 MHz, 1100 W | NAP-Z6 | 392.7316.54 |

Recommended extras

| | | |
|------------------------------|--------------|-------------|
| Extension cable (25 m) | NAP-Z2 | 392.5813.02 |
| Adapter | NAP-U1 | 350.8914.00 |

The user can easily adapt these connectors to other systems with the aid of screw-in assemblies; see data sheet 902100. Suitable screw-in assemblies (to be ordered separately):

| Adaptation to | Male | Female | Max. power at 1000 MHz |
|---------------|-------------|-------------|------------------------|
| N | 017.7532.00 | 017.5398.00 | 0.6 kW |
| BNC | 017.7832.00 | 017.5730.00 | 0.4 kW |
| 4.1/9.5 | 017.9106.00 | 017.8516.00 | 0.8 kW |
| Dezifix B | | 018.2486.00 | 1.3 kW |

The maximum power at other frequencies is calculated:

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

¹⁾ Software version 3.1 or higher required for operation of power head. Older units (up to Serial No. 880751...) can be retrofitted with NAP-U1.



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