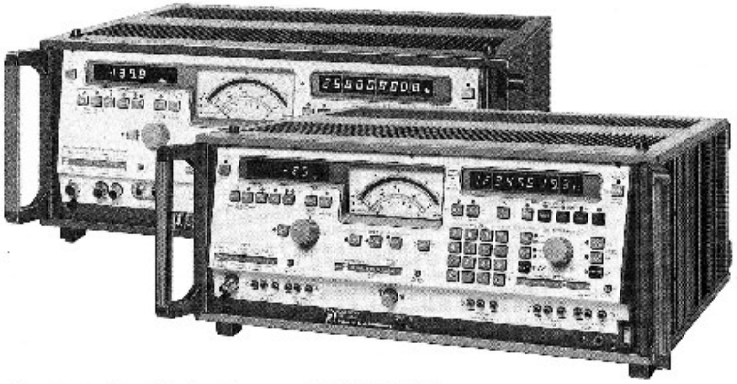
SPM-19
Selective Level Meter

with wideband section, for level measurements in the frequency range 50 Hz to 25 MHz

IEEE 488
IEC 625



- **Crystal controlled frequency setting via keyboard, stepwise or continuous**
- **High frequency accuracy; max. resolution 0.1 Hz**
- **Swept tuning frequency on request**
- **Absolute and relative measurements with high resolution**
- **Voltage measurements in the range 1 µV to 2 V (Version BN 829/03)**
- **Fast search-scan and selective end-to-end measurements**
- **Storage and call-up of any fixed frequency and of complete instrument settings**
- **SSB demodulation and phase jitter measurements**
- **High intrinsic NPR makes noise measurements possible**
- **External tuning of the PS-19 (PS-18) Generator or the PSS-19 Send Section**
- **Point-by-point measurements and sweep measurements with frequency offset (PS-18/SPM-19)**
- **Auto sync. facility for end-to-end measurements on power-line CF systems**

Applications

The SPM-19 Level Meter is used for carrying out the level, noise and phase jitter measurements that occur when balanced and coaxial FDM communication systems with up to 3600 speech channels are developed, manufactured, installed and maintained. The SPM-19 is also suitable for measurements at the lower multiplex level of single sideband radio-link systems, and on single telephone channels. The SPM-19 has facilities for fast search-scans with low signal-to-noise ratio, panorama reception or long-term monitoring. A complete level and sweep measuring setup is obtained if the PSS-19 Send Section or the PS-19 Level Generator are used in conjunction with the SPM-19. The remote control facility enables a wide range of measurements to be made quickly and economically.

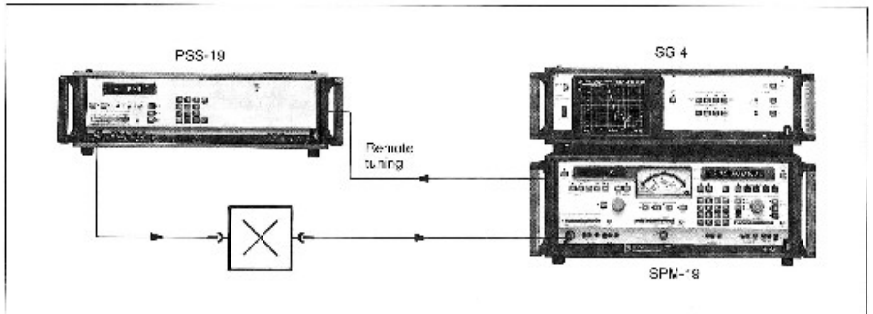
Characteristics

The SPM-19 contains a synthesizer whose spectral features are low spurious modulation and high spectral purity. The SPM-19's frequency can be set via a keypad, tuned continuously, or tuned via step and automatic step facilities. The SPM-19 is ideal for sweep measurements as the frequency can be changed without causing phase discontinuities.
When measuring the total signal level, the microprocessor control ensures that the signal drive range of the level measuring section is optimal. The result of this is high sensitivity, high resolution (0.01 dB) and a large dynamic range for the display (80 dB). Selected frequencies or complete SPM-19 settings can be stored to take the tedium out of repetitive measurements. These parameters are not lost if there is a power failure.

Frequency range, coaxial	50 Hz to 25 MHz
balanced	50 Hz to 14 MHz
Methods of setting frequency	via keypad, quasi-continuously, manual step or auto-step, sweep (as option)
Error limits of tuned frequency	$+3\times10^{-7}$ or $+1\times10^{-7}$
Level range,	
selective	−140 to +22 dB (−130 to +32 dBm)
Error on level display, selective, Z_a = 75 Ω,	
at 0 dB (dBm)	±0.1 dB
Intrinsic NPR,	
noise band 0.3 to 12 MHz	approx. 60 dB
Input impedances	75 or 50, 124, 150 (135), 600 Ω, high impedance
Fixed frequencies (100/200) and complete settings (10/50) can be stored	

Further Characteristics and Applications

- **High frequency accuracy:** The small uncertainty of 3×10^{-7} (1×10^{-7}, if required) means that the tuned frequency can be set accurately – even at high frequencies. Measuring pilot levels is one of many applications where this requirement is essential. The error given is correct over the rated range of use for temperature and includes reference-crystal ageing.
- **Sweep facility** (BN 829/02, /03 and /22): When a sweep is being carried out, the phase of the swept frequency does not vary; this means that accurate measurements on test items with steep frequency responses and high attenuations can be made. Sweep curves may be displayed on the *SG-4 Storage Display Unit*.
- **Fast search scan with automatic printout:** The SPM-19 finds any spurious signals or hot tones that exceed a certain level entered on the SPM-19 and that lie between two selected frequency limits independent of each other. If required their levels and frequencies can be printed out automatically.
- **Selective end-to-end measurements:** In the operating mode *receiver track* the SPM-19 tunes itself automatically to the discrete frequencies sent from the opposite end. No additional synchronisation is required. If the transmission path is very noisy (e.g. power-line carrier systems), the generator and receiver can be switched to the *autostop* operating mode, and a special routine called up which ensures frequency synchronism. The attenuation/frequency response is displayed on the SG-4 oscilloscope.
- **Digital and analog level display:** The maximum resolution of the digital level display is 0.01 dB; an autoranging facility is provided. Ranges of 1 dB, 20 dB or 80 dB can be selected for the analog display (alignment work, sweep measurements). The measurement range can be set manually in steps of 1 dB or 5 dB, or automatically.
- **Voltage display:** Precise voltage measurements in the range 1 µV to 2 V can be performed with version BN 829/03 [1]. An autoranging facility and a digital display (in mV) with a max. resolution of 1 µV are provided.
- **Absolute or relative level measurements:** Absolute or relative level measurements (display dB or dBm) can be made. The level which is to act as the reference level is measured digitally and stored. Deviations from this reference level in subsequent measurements (e.g. frequency response measurements) are shown on a digital or analog display. When making measurements on transmission paths the relative level of one test point (dU) can be stored and subsequent results displayed as a level referred to point of zero relative level (dBm0, dU0).
- **Level difference measurements:** The level difference (N-X or X-N) between two items-under-test can be measured precisely with digital methods using the *RU-3 Relay Changeover Switch*. The RU-3 is controlled by the SPM-19 and can be purchased as a separate item [3]. The resolution is 0.01 dB.
- **Selectable bandwidths:** A narrow 25 Hz filter is used to measure pilots, carrier leaks or frequency spectra. The 400 Hz bandwidth is required for sensitive level measurements.
  A 1.74 kHz filter is used to make weighted noise measurements in single voice-channels at the CF level. A 3.1 kHz filter with a flat response is also available. Noise power in a basic group (48 kHz) can also be measured. If required, the 400 Hz filter can be replaced by a *2.5 kHz Channel Filter* so that the channel power of submarine-cable systems can be measured.
- **Internal demodulator with large dynamic range:** This device demodulates SSB signals in the erect or inverted positions. The demodulated signal can be assessed qualitatively using the built in loudspeaker. Alternatively, the signal can be processed further externally. The large dynamic range is especially useful for making accurate noise or impulsive noise measurements (with extra instrument) on translated voice channels.
- **Phase jitter measuring device:** Phase jitter measurements can be carried out directly in voice channels or at the CF level using a 1 kHz test tone. Jitter measurements on pilot and carrier frequencies can also be carried out during trouble-shooting. These measurements conform with CCITT Recommendation O.91 or IEEE 743. Two weighting filters are available (20 Hz to 300 Hz and 4 Hz to 300 Hz).
- **Measurements with frequency offset:** Using the PS-19/SPM-19 combination, point-by-point and sweep measurements with frequency offset (e.g. on translators) can be performed. Any combination of positive or negative frequency offsets can be chosen for the send and receive frequencies [2].
- **Use as a white noise receiver:** As the SPM-19 has a high immunity to overloading when loaded with white noise, it



PSM-19 Level and Sweep Measuring setup and the SG-4 Storage Display Unit

can be used for intermodulation and thermal noise measurements on FDM cable, radio-links or satellite links. The *white noise measuring program* can be called up to measure noise power (in pW0p), noise level (in dBm0p) or NPR (in dB). The measuring frequencies, as specified by CCITT/CCIR and INTELSAT, are entered via a keypad or can be stored in the working memory (RAM) of the SPM-19.

- Economical design: Only one tuning oscillator is required to set the frequency when measurements are performed at the same send and receive frequencies. This oscillator can be provided by the *PSS-19 Send Section* which is used in conjunction with the SPM-19. The SPM-19 has a *tracking generator output* for simplified measurements of this kind.
- Wide range of accessories:
  - TK-11 or TK-12 Active Test Probes (also balanced) for high impedance, low capacitance measurements.
  - Return loss bridge RFZ-1 and RFZ-12 Return Loss Measuring Attachments (also balanced) for measuring the variation in return loss with frequency.
  - SDZ-12 Signal Balance Ratio Measuring Attachment for measuring the variation in signal balance ratio with frequency.
  - SDG-40 Balanced Attenuator for high impedance measurements on levels up to −50 dBm. Power-line carrier systems, for example, use levels of this magnitude.
  - SNZ-1 Standard Frequency Adaptor Option is used for external synchronisation using frequencies between 0.9 and 9.9 MHz (100 kHz steps). Power supply from separate mains unit (e.g. BN 964/00.0X; 12 V/50 mA).
  - V.24/V.28 Printer Interface for listing results in various formats (printout of generator and receiver data).
  - Interface <IEC 625>/IEEE 488 for controlling the SPM-19 when it is used (instead of the printer interface) in an automatic test system. It must be used when the SG-4 Storage Display Unit and the SPM-19 are operated together.
  - For precision measurements a compensated test cable (BN 862/00.01) with an almost flat frequency response (+0.05 dB) is available.

1) Without dBm0 display and White Noise Measuring Program
2) K 368 control cable is necessary (can be purchased as accessory)

Specifications of the Selective Level Meter — SPM-19

Unless otherwise stated, the specifications are valid for the rated ranges of use of a.c. line voltage, a.c. line frequency and ambient temperature 15 min after the SPM-19 has been switched on. The level and measuring ranges for the dBm calibration are given in brackets.

Inputs

Coaxial input . . . . . Versacon®9 Universal Connector adaptable to all commercially available connector systems
BN 829/21 and /22: fem. connector for a WECO 358 A male connector

Input impedance,
switchable . . . . . 75 Ω *), and high impedance (bridging)
*) 50 Ω on request

Frequency range 1) . . . . . 50 Hz to 25 MHz

Balanced inputs 2) . . . . . 3 pole CF connectors

Input impedance, switchable . . . . . 124 Ω, 150 Ω, and high impedance (bridging)

Frequency range . . . . . 10 kHz to 14 MHz

Signal balance ratio,
60 kHz to 5 MHz . . . . . ≥40 dB
60 kHz to 14 MHz . . . . . ≥30 dB

Input impedance,
switchable . . . . . 150 Ω, 600 Ω, and high impedance

Frequency range 1) . . . . . 50 Hz to 620 kHz

Signal balance ratio . . . . . ≥40 dB

Tolerable input voltage for all inputs,
overload limit when terminated by Z_n . . . . . $V_{rms} \leq 10$ V

Tolerable d.c. input voltage
at high impedance input . . . . . ≤60 V

Frequency

Frequency setting

Digital, entered at keypad, resolution . . . . . 0.1 Hz

Quasi-continuously, manually
over complete range without changeover;
smallest step . . . . . 1 Hz

in steps via increment key, smallest step . . . . . 1 Hz

1) The lower frequency limit is 200 Hz for wideband measurements
2) BN 829/21 and /22: 135 Ω instead of 150 Ω
124 Ω female connector for a WECO 372 A/379 A male connector
135 Ω female connector for a WECO 241 A male connector
600 Ω female connector for a WECO 310 male connector

Automatic frequency-setting modes

Search-scan
One shot over the complete frequency range, stopped by signal detector and automatic fine-tuning.
Periodic between adjustable frequency limits.

Auto-step
Automatic stepping of frequency between adjustable frequency limits.
Entry of step values, frequency limits, and stepping rate via keypad.

Receiver tracking
Automatic advancing of the tuning frequency between adjustable frequency limits by a set frequency step when the level display disappears.

Sweep mode (Versions BN 829/02 /03 and /22)
Setting of upper and lower sweep limit or setting of centre frequency and sweep width
Sweep . . . . . periodic (triangular), single shot and manual
Sweep duration for one half period . . . . 0.1, 0.3, 1, ..., 300 s

Error limits of frequency:
including ageing over 1 year . . . . . $\pm 5 \times 10^{-7}$
or with Option BN 865/00.03 . . . . . $\pm 1 \times 10^{-7}$

Level and voltage display

Display of:
power level (dBm) referred to . . . . . 1 mW
voltage level (dB) referred to . . . . . 0.775 V
level difference . . . . . dB
absolute level in decibels referred to a point of
zero relative level dBm0, dB0
relative level . . . . . dBr
voltage shown by Version BN 829/03 in . . . . . mV
or else of noise power by "white noise program"
with Versions BN 829/01, /02, /21 and /22 in . dBm0p, pW0p

Display, switchable . . . . . digital/analog
Digital display, max. resolution . . . . . 0.01 dB
Analogmeter, switchable scale ranges . . 1 dB, 20 dB, 80 dB

Level range

Input 1)	Selective	Wideband
$Z_n = 75\ \Omega$	−140 to +22 dB −130 to +32 dBm	−60 to +22 dB −50 to +32 dBm
$Z_n = 124/150\ \Omega$	−130 to +22 dB −120 to +22 dBm	−50 to +22 dB −40 to +22 dBm
$Z_n = 150/600\ \Omega$	−130 to +22 dB (dBm)	−50 to +22 dB (dBm)

1) BN 829/21 and 22: Z_n = 135 Ω instead of 150 Ω. All level values given also apply to 50 Ω impedance

Error limits of level display

Operating mode selective, bandwidths 25 Hz to 3.1 kHz
Error limits at input level 0 dB (0 dBm), display digital or analog (1 dB scale), with reading averaged, $Z_{in} = Z_{out} = Z_0$ and at (23 ± 3) °C (Table values in dB), also valid for version fitted with 50 Ω instead of 75 Ω impedance.

$Z_0 = 75\ \Omega$	±0.50	±0.12	±0.10								
Z_0 = 124/150 Ω	—			−0.8	±0.20					—	
Z_0 = 150/600 Ω	±0.50	±0.20	±0.15				+0.23				
	50 Hz	200 Hz	2 kHz	6 kHz	60 kHz	100 kHz	320 kHz	1.4 MHz	2.5 MHz		

Additional error for any input level ≥25 dB above the intrinsic noise level, after calibration
Z_0 = 75 Ω, f = 200 Hz to 25 MHz

−22	0 dBm	70	−90	−100	
	±0.08 dB	±0.15 dB	±0.3 dB		
22	0 dB	−80	100	−110	

Z_0 = 124/150/600 Ω, f = 200 Hz to 620 kHz

−22	0 dBm	−45	−85	−95	
	±0.06 dB	−0.15 dB	−0.3 dB		
−22	0 dB	−70	−90	−100	

Variations in level reading with frequency, automatic calibration on, $Z_{in} = Z_{out} = Z_0$ at (23 ± 3) °C
Digital display with noise averaging, or analog display, bandwidth 25 Hz to 3.1 kHz, referred to 10 kHz (coaxial) or 100 kHz (Z_0 = 124/150 Ω), in the ranges
at Z_0 = 75 Ω . . . . . −80 to −22 dB (−70 to +32 dBm)
at Z_0 = 124/150/600 Ω . . . . . −70 to +22 dB (−65 to −22 dBm)
(Tabulated values in dB)

$Z_0 = 75\ \Omega$	±0.03	±0.08									
Z_0 = 124/150 Ω	—			±0.15		±0.20	—				
Z_0 = 150/600 Ω		±0.15			±0.20		—				
	200 Hz	2 kHz	60 kHz	100 kHz	620 kHz	1 MHz	5 MHz	14 MHz	25 MHz		

Error limits of the voltage display (BN 829/03)
Operating mode selective, f ≥ 200 Hz
Coaxial input . . . . . ±3% of reading ± 1 µV

Total error, operating mode wideband
with digital reading, and $Z_{in} = Z_{out} = Z_0$ (tabulated values in dB)

$Z_0 = 75\ \Omega$	±0.6				
Z_0 = 124/150 Ω	—	±0.6		±0.7	
Z_0 = 150/600 Ω	±0.5			—	
	200 Hz	60 kHz	620 kHz	5 MHz	14 MHz	25 MHz

Additional analog display errors
20 dB scale, in range −5 to +2 dB . . . . . ±0.2 dB
80 dB scale . . . . . ±2 dB

Phase jitter measurement complies with CCITT Rec. O.91 or IEEE 743.
Measurement of peak-to-peak jitter
Display digital or analog . . . . . 0.3 to 30°
Maximum resolution . . . . . 0.1°
Measurement bandwidths,
switchable, STD . . . . . 20 Hz to 300 Hz
I.F.–STD . . . . . 4 Hz to 300 Hz
Error limits of reading at a jitter frequency of 150 Hz, input level ≥ −60 dB (−50 dBm) . . . + 10 % of reading ± 0.3° (for I.F.–STD: ± 0.7°)

Selectivity, bandwidth switchable between

Bandwidth	Effective noise bandwidth	Separation, Δf, from the centre of filters for attenuation ≥50 dB	≥60 dB
25 Hz	—	±80 Hz	±250 Hz
400 Hz 1)	400 Hz	—	±2 kHz
1.74 kHz	1.74 kHz	—	±3 kHz
3.1 kHz	3.1 kHz	—	±3 kHz
48 kHz	48 kHz	±35 kHz	—

1) The 400 Hz filter and the 2.5 kHz Channel Filter cannot both be fitted

Harmonic ratio, k_2 and k_3, when level of fundamental ≥0 dB (+10 dBm), with autoranging or with manual range selection and sensitivity raised
by 50 dB over fundamental, f ≥ 3 kHz . . . . . ≥60 dB

Image frequency and IF rejection . . . . . ≥70 dB

Noise-power-ratio (NPR)
with white noise loading in a frequency band 300 kHz to 12 MHz, measured in any band-stopped slot in a band with B_{nf} ≥ 20 kHz, bandwidth 1.74 kHz and wideband level −25 dBm to −10 dBm . . . . . approx. 60 dB

Intrinsic noise
selective, 25 Hz bandwidth, input terminated with Z_0 and summer level ≤ −60 dB (−50 dBm), f ≥ 10 kHz
Input 75 Ω or 50 Ω . . . . . ≤ −140 dB (−130 dBm)
Input 124 Ω, 150 Ω . . . . . ≤ −130 dB (−125 dBm)
Input 150 Ω, 600 Ω . . . . . ≤ −125 dB (−120 dBm)
The level values increase by +6 dB for the 400 Hz bandwidth, by −12 dB for the 1.74 kHz bandwidth, by −15 dB for the 3.1 kHz bandwidth, by +27 dB for the 48 kHz bandwidth (f ≥ 60 kHz).

Outputs and Inputs

IF output * . . . . . 10 kHz

Y-d.c. voltage output . . . . . Z_{out} = 5 kΩ, 0 to −5 V

X-d.c. voltage output . . . . . Z_{out} = 5 kΩ, −2.5 V

Demodulator output . . . . . 3 pole CF connector
BN 829/21 and 22: female connector for WECO 310 male connector

Single sideband demodulation . . . . . upright/inverted
Frequency position of translated channel when SPM-19 is tuned to the channel centre . . . . . 0 to 4 kHz

Tracking generator output * . . . . . 200 Hz to 25 MHz/ −10 dBm

Output * for internal standard frequency . . . . . 10 MHz

Input * for external standard frequency . . . . 1, 2.5, 10 MHz

Control outputs for slave tuning
the Level Generators PS-18, PS-19 or PSS-19

Penlift function for activating an X-Y recorder

Type of test probe
that can be connected TK-11

AFC
can be switched off, functional with all receive filter bandwidths to 3.1 kHz.
Automatic Frequency Control of the tuning frequency to track with the receive frequency in operating mode search-scan in conjunction with the fast signal detector.
Frequency holding range . . . . . whole frequency range

Memory
100 fixed frequencies and 11 complete instrument settings (RAM area) can be user programmed.
Entry and call-up via keyboard.
Memory contents are erased by writing over them.
Retention of the data entered in the store, if the a.c. power is interrupted.

General Specifications

Power supply
Rated ranges of use for a.c. line voltage, selectable . . . . . 96 to 140 V/193 to 261 V
Rated range for a.c. line frequency . . . . . 47.5 to 63 Hz
Power consumption . . . . . approx. 50 W
Safety class according to IEC 348 and VDE 0411 . . . . Class I

Tolerable ambient temperature
Rated range of use . . . . . +5 to +40 °C
Limits range for storage and transport . . . . . −40 to +70 °C

Dimensions in mm

Bench model		19" Rack mounting (DIN 41 494)	
Width with handles	477	Width	443
Height overall	199	Height (4 units)	175
Depth with handles	432	Depth	377

Weight . . . . . approx. 21 kg
German Post Office Certificate of Approval No.
for the SPM-19, BN 829/01 . . . . . 272 181 823
BN 829/02 . . . . . 272 181 824

Options

Higher Frequency Accuracy, BN 865/00.03
Error limits of frequency . . . . . $\pm 1 \times 10^{-7}$

User-specific Memory, BN 829/00.03
stores 100 fixed frequencies (e.g. measurement frequencies for the white noise program) and 40 setups as specified by the customer.

Interface <IEC 625> Board, BN 853/02
for control by external computer

Printer Interface, BN 905/01
instead of Interface <IEC 625> board BN 853/02 in SPM-19.
For connecting printers with V.24/V.28 interfaces.
Printout of mode, measuring run information, measuring parameters, address and measured result.

2.5 kHz Channel Filter, BN 829/00.06
replaces the 400 Hz filter
Effective noise bandwidth . . . . . 2.5 kHz ±10 %
Attenuation at centre freq. ±1.5 kHz . . . . . ≧60 dB

Ordering Information

Selective Level Meter SPM-19 * **BN 829/..**
The following versions are available

Level display			WN-*) program	Sweep facility	WECO-**) connectors	Order No.
dB dBm	dBm0	V				
■	■		■			BN 829/01
■	■		■	■		BN 829/02
■		■		■		BN 829/03
■	■		■		■	BN 829/21
■	■		■	■	■	BN 829/22

*) White noise program
**) Impedances 75, 124, 135, 600 Ω

Option (no extra charge)
Receiver input 50 Ω (instead of 75 Ω) [1] BN 829/00.15

Options (charged extra)
Higher Frequency Accuracy [1] BN 865/00.03
User-specific Memory [2] BN 829/00.03

Interface <IEC-625> Board [3] BN 853/02
with IEC 625/IEEE 488 (S 834) adaptor and connecting cable for IEEE 488 (K 420)
or
V.24/V.28 Printer Interface BN 905/01

2.5 kHz Channel Filter [1] BN 829/00.06
(instead of 400 Hz bandwidth)

Accessories (charged extra) [4]
Test Probe TK-11,
Z = 75 Ω BN 573/00
Z = 50 Ω BN 573/02
Test Probe TK-12, coaxial and balanced BN 574/00
Power Supply TKN-12, for TK-12 BN 623/00

Balanced Attenuator SDG-40 BN 608/00.01
Relay Changeover Switch RU-3 (75 Ω) BN 323/02
(order cable K 366 as well)

Return loss bridge
RFZ-1, 50 Ω: 50 kHz to 190 MHz BN 2045/..
75 Ω: 75 kHz to 190 MHz BN 2045/..
RFZ-12, 200 Hz to 4.5 MHz BN 810/01

Signal Balance Ratio Measuring Attachment SDZ-12, 200 Hz to 4.5 MHz BN 811/01

Impedance Measuring Attachment SFZ-1, 300 Hz to 612 kHz BN 385/04

Standard Frequency Adaptor SNZ-1 BN 956/00.07

Compensated Test Cable, Z = 75 Ω BN 862/00.01
dc to 100 MHz

Control cable for RU-3
and/or frequency offset measurements K 366
Front and Back Panel Covers SD-4 (1 set) BN 700/00.24
19" conversion kit BN 700/00.04

1) Factory fitted only. Please order with instrument.
2) State chosen fixed frequencies and instrument settings when order is placed (ask for order form 5/784 a, b).
3) Essential for operation with the SG-4 Storage Display Unit, and for computer operation.
4) See Measuring Accessory Specification Sheet for more data and Ordering Information.
* Equipped with the 75 Ω basic connector Versacon® 9 and BNC adapter. For other adapter types, see "Specification Sheet Versacon® 9" and order chosen type when ordering instrument.