

PCM-4, PCM-5

PCM Channel Measuring Sets

The PCM-4 and PCM-5 are reference measuring sets which can be used to determine characteristics between the analog and digital levels (“half-channel” measurements) with excellent speed and precision. The instruments include built-in self-tests and calibration routines to handle the demanding requirements placed on test and measurement equipment by the digital systems used in transmission and switching.

- **Chaining of setups to form automatic test sequences**
- **A-A, A-D, D-A, D-D measurements (“half-channel” and “full-channel”)**
- **Digital signal processing for speed and precision**
- **Graphical display of application-specific tolerance masks**
- **Out-of-band measurements up to 128 kHz**

“Half-channel” measurements The PCM-4 and PCM-5 measuring sets can perform a wide variety of measurements between the analog and digital levels of PCM multiplex equipment or digital exchange modules. Transmultiplexers can also be tested since the instruments also perform D-D measurements. For measurements on individual modules such as CODECs, all of the necessary test capabilities are accessible via the 64 kbit/s interfaces.

Simple operation with straightforward analysis of results The instruments are easy to operate, whether they are remotely controlled via the IEC 625/IEEE 488 interface or operated manually. The built-in screen is used to set up measurements via menus and to display results. Results can be displayed as tables, graphs or histograms. Measurement modes and parameters are selected using softkeys. Presettings for common applications help to speed up interaction with the instruments. A maximum of 40 setups can be chained together to form a test sequence. You can build automatic test procedures to meet specific requirements in this way.



PCM-4 as an automatic measuring system

With the PCM-4, you don't need to make routine measurements manually: When the instrument is used as a system controller (SC), it is simple to program the desired measurement sequences.

- User-specific programming of a measurement sequence by simple chaining of up to 40 setups.
- Definable number of channel steps per setup, e.g. frequency response measurement in each channel.
- Fully automatic measurement sequences without an external controller. The PCM-4 controls the MU-30 test point scanner (details on request) and logs the results on a suitable printer.

With the LabWindows® driver, it is easy to integrate the PCM-4/5 and MU-30 into the LabWindows software development platform. LabWindows is ideal for R&D work, production testing and calibration. A simple mouse click is enough to set the PCM-4 with the prepared instrument driver. Once the commands are copied, the measurement sequence is incorporated into the application program.

Ideal solutions for different test scenarios

Different measurement modes are required for different applications. The PCM-4 provides the entire range, while the PCM-5 is a basic version of the instrument with a smaller selection of modes.

Measurement modes	Measurement conditions	A-A	A-D	D-A	D-D
Level measurement	With sinusoidal signal 20 Hz to 4 kHz (72 kHz) With noise signal to ITU-T O.131 and North American standards	•	•	•	•
Overall loss	With sinusoidal signal at 813 or 1014 Hz ¹ and a level of -10 or 0 dBm0	•	•	•	•
Echo return loss	With noise signal ERL and a level of ±10 dBm0, to North American standards	•	•	•	•
Signing return loss	With noise signal SRL or SRL HI and a level of -10 dBm0, to North American standards	•	•	•	•
Transhybrid loss	2-wire termination with 910 Ω 39 nF ²	•			•
Variation of gain with frequency	With sinusoidal signal 20 Hz to 4 kHz and a level of -10 or 0 dBm0. Ref. frequency 813 or 1014 Hz ¹ (other reference frequencies available using VAR. MODE)	•	•	•	•
Variation of gain with input level	With sinusoidal signal at 813 or 1014 Hz ¹ . With noise signal to ITU-T O.131 and North American standards.	•	•	•	•
Total distortion	With noise signal at 350...550 Hz or sinusoidal signal at 422 Hz, to ITU-T O.131 and North American standards. With sinusoidal signal at 813 or 1014 Hz ¹ psoph. or C-message weighted to ITU-T O.132 and North American standards. With sinusoidal signal at 300...3350 Hz	•	•	•	•
Idle channel noise	At 300...3350 Hz or weighting with psoph. Or C-message filter. Activating tone at 2 kHz possible.	•	•	•	•
Crosstalk different channel	With sinusoidal signal at 301, 813, 1014 ¹ , or 3343 Hz. With "Conventional Telephone Signal" to ITU-T G.227 and North American standards	•	•	•	•
Crosstalk same channel	With sinusoidal signal at 301, 813, 1014 ¹ , or 3343 Hz.	•			•
Out-of-band measurement	With sinusoidal signal in the range 4.6...72 kHz; receive range 0.2...4 kHz With sinusoidal signal in the range 0.2...4 kHz; receive range 4.6...128 kHz	•	•	•	
Harmonic distortion	2 nd or 3 rd order harmonic ratio with sinusoidal signal at 1014 Hz ¹	•	•	•	•
4-tone intermodulation	2 nd or 3 rd order distortion with four equal-level tones at 857 Hz, 862 Hz, 1373 Hz, and 1388 Hz	•	•	•	•
Return loss (option)*	Using BN 984/00.10 bridge: reference impedances 600 Ω, 900 Ω, CPLX ³ Using BN 984/00.11 bridge: reference impedances 600 Ω, 850 Ω, CPLX ³ BN 984/00.16 bridge impedance addition, upgrades possible, with 4 customer specific CPLX impedances, selectable by IEC-/IEEE bus	Audio frequency ports			
Longitudinal conversions loss* (option)	Measured to ITU-T Rec. O.121 Using BN 984/00.10 bridge: reference impedances 600 Ω, 900 Ω Using BN 984/00.11 bridge: reference impedances 600 Ω, 850 Ω	Audio frequency ports			
Longitudinal conversion* transfer loss (option)	Measured to ITU-T Rec. O.121 Using BN 984/00.10 bridge: reference impedances 600 Ω, 900 Ω Using BN 984/00.11 bridge: reference impedances 600 Ω, 850 Ω	•	•	•	
Overload capacity Peak load Coder offset	With positive or negative peak code, at 813 or 1014 Hz ¹		•		•
Absolute group delay* Group delay distortion	Loop measurements: AM-Signal with 8 fixed measuring frequencies similar to the signal described in ITU-T Rec. O.81 and IEEE Standards	•	•	•	•
Signalling distortion (option)*	Measures the duty cycle deviation of a rectangular signal of 10 or 20 Hz. Duty cycle settable in steps between 10 and 90%	•	•	•	•
Interference from signalling (option)*	Weighted measurement (to ITU-T Rec. O.41 and North American standards) in voice channel. Duty cycle of rectangular signal adjustable.	•	•	•	•
Error measurements	Framing errors (FAS and MFAS), CRC errors. Error ratio, error count and error free seconds with pseudorandom sequences or user programmable 8 bit word in one channel at 64 kbit/s or via 64 kbit/s interface				•
Rx frame evaluation	Evaluation on screen of words and bits		•		•
MUX/DEMUX operation	One channel multiplexer: with 64 kbit/s input (option) only One channel demultiplexer: with 64 kbit/s output (option) only				•

*These modes are not included in the PCM-5 and cannot be retrofitted.

¹ BN 984/02, BN 984/52, BN 984/05 and BN 984/55: 1004 Hz

² 910 Ω || 39 nF can be modified at factory.

³ 220Ω in series with 820 Ω || 115 nF, can be modified at factory.

Note: Measurements on digital transmit (TX) or receive (RX) interfaces can be carried out using the 2048 kbit/s, 1544 kbit/s or 64 kbit/s interface (option).

The following TX/RX combinations are possible: 2 M/2 Mbit/s; 64 k/64 kbit/s; 64 k/2 Mbit/s; 2 M/64 kbit/s; 1.5 M/1.5 Mbit/s; 64 k/1.5 Mbit/s; 1.5 M/64 kbit/s.

If nothing to the contrary is stated, the values given below are valid for all operating conditions and device settings within the rated ranges of use for a.c. line voltage, a.c. line frequency and ambient temperature.

Analog generator

Generator output

BN 984/01; 984/51 . . . balanced, floating, 3-pin CF connector

BN 984/02; 984/52. balanced,

fem. connector compatible with WECO

310

BN 984/05; 984/55. balanced,

fem. connector compatible with I 214 APS

Output impedance, switch-selectable 600, 850, 900 Ω and complex¹

Permissible d.c. voltage to earth ≤60 V

Send signals

Sinusoidal signals

Frequency range 20Hz to 72kHz

Pseudorandom noise signals

Noise band	ITU-T Recommendation	Spectraline spacing	Peak factor 20log Vp/Vr.m.s.
350 to 550 Hz	O.131	3.906 Hz	10.5 +0.5 dB
350 to 550 Hz	O.131	7.813 Hz	10.5 +0.5 dB
Conventional telephone signal	G.227	7.813 Hz	10.5 +0.5 dB
560 to 1965 Hz (Echo Return Loss)	North	7.813 Hz	10.5 +0.5 dB
260 to 500 Hz (Singing Return Loss)		7.813 Hz	10.5 +0.5 dB
2200 to 3400 Hz (Singing Return Loss High)		7.813 Hz	10.5 +0.5 dB
	American standards		

Group-delay measuring signal (PCM-4 only)

Similar to the measuring signal described in ITU-T Rec. O.81 and IEEE Standards.

Measuring frequencies 292, 500, 604, 1000,

1792, 2604, 2792 and 3396

Hz

Modulation frequency selectable 41.66 or 83.33 Hz

4-tone signal

Four equal level tones at 857, 862, 1373 and 1388 Hz

Send levels

Display of power levels (dBm0), can be switched over to voltage levels (dB0).

Relative level

Level entry in steps of 0.01 dB from -19.9 to +9.9 dB

Displayed on screen in steps of 0.1 dB.

Levels relative to 1 mW at a point of 0 rel. level

Level entry in steps of 0.01 dB.

Level range in the preferred range for relative level

-17 to +3 dB, at 600 Ω

for noise (350 to 550 Hz), at least -60.0 to +2.0 dBm0

for sine signals (f - 4200 Hz), at least -60.0 to +10.0 dBm0

for all other signals, at least -30.0 to +2.0 dBm0

1) Complex impedance: 220 Ω in series with 820 Ω || 115 nF (modifiable ex-works)

2) Complex impedance: 910 Ω || 39 nF (modifiable ex-works)

3) BN 984/02, BN 984/52, BN 984/05 and BN 984/55: 1004 Hz

Analog receiver

Receiver input. see "analog generator output"

Additional input impedance. ≥30 kΩ

Two-wire input and output

The two-wire connector can be terminated with a complex impedance ² for transhybrid loss measurements.

Receive levels

Calibration, see "analog generator"

Relative levels, see "analog generator"

Levels relative to 1mW at a point of 0 rel. level

Level range in the preferred range of the relative level

-9.9 to +9.9 dB and at 600 Ω,

signal level measurements, at least -60.0 to +10.0 dBm0

noise and crosstalk measurements,

at least -80.0 to 0 dBm0

Receive filters

Wideband filters passband range:	Narrow-band filters passband at:
200 Hz to 4 kHz	301 Hz
20 Hz to 4 kHz	813 Hz
330 Hz to 3100 Hz	1014 Hz ¹
20 Hz to 72 kHz	3343 Hz
4.6 kHz to 128 kHz (PCM-4 only)	350 bis 550 Hz

Filters for weighted noise measurements

Psophometer filter (ITU-T Rec. P.53/O.41)

C-message weighting filter to North American standards

3 kHz flat filter to North American standards

Psophometer filter with 2 kHz notch-filter

C-message weighting filter with 2 kHz notch-filter

Bandpass 300 to 3350 Hz, with 2 kHz notch-filter

Filter for S/N measurements

Signal filter	Noise filter	Rec.

350 to 550 Hz	800 to 3350 Hz	ITU-T O.131
800 to 855 Hz	Channel filter with notch at 813 Hz	—
	Psophometer filter with notch at 813 Hz	ITU-T O.132
1000 to 1025 Hz	Channel filter with notch at 1014 Hz ³	—
	Psophometer filter with notch at 1014 Hz ³	—
	C-message weighting filter with notch at 1014 Hz ³	ITU-T O.132

		Passband range:
2nd order harmonic distortion		2000 to 2028 Hz
3rd order harmonic distortion		3000 to 3042 Hz
2nd order intermodulation product	B-A	480 to 560 Hz
	B+A	2229 to 2251 Hz
3rd order intermodulation product	2B-A	1885 to 1920 Hz
A = 857 Hz + 862 Hz 1388 Hz		B = 1373 Hz + 1388 Hz
2		2

Filters for harm./interm. distortion measurements

**PCM frame structure
BN 984/01 and BN 984/51**

32 channel PCM frames containing:
30 telephone channels to ITU-T Rec. G.704 Para. 3.3
or 31 telephone channels time slots 1 to 31
or 32 telephone channels all time slots

BN 984/02, BN 984/52, BN 984/05 and BN 984/55
Selectable between T1
"norm."

12 FRM/MFRM to ITU-T G.704 Para. 3.1
and T1 "extd."
24 FRM/MFRM to ITU-T G.704 Para. 3.1

Telephone channels per frame
.24
Channel sequences D3/D4, D2 or D1D
Signalling
µ-law CCIS or CAS (7/5/6)
A-law
CCIS

**Generator outputs
BN 984/01 and BN 984/51**

Interface characteristics comply with ITU-T Rec. G.703
Line codes NRZ, AMI and HDB3
Coaxial output * Versacon 9 Universal Connector
System, adaptable to all common connectors
Output impedance 75Ω
Balanced output 3pole, CF connector
Output impedance 120Ω

BN 984/02, BN 984/52, BN 984/05 and BN 984/55
Interface characteristics comply with ITU-T Rec. G.703 and North American standards.

Line codes AMI and B8ZS
Output pulse characteristic to AT&T
Technical Advisory No. 34
W-bit insertion ON or OFF
Balanced output fem. connector compatible with WECO 310 (BN 984/02 and 984/52); I 214 APS (BN 984/05 and 984/55)
Output impedance 100 Ω

Operation and clock supply

Loop-through operation
A test pattern is injected into one time slot of a PCM frame which has been looped through the PCM-4.

BN 984/01 and BN 984/51

Generator operation
from internal clock 2048 kHz ±25 x 10⁻⁶
or external clock 2048 kHz ±100 x 10⁻⁶
or external 8 kHz sync.-signal 8kHz±100 x 10⁻⁶
or clock derived from receiver signal

Digital loops
2 Mbit/s loop: all time slots are switched through.
2 Mbit/s loop: selected time slots can be switched through (independent selection of the receive and send channel is possible)
64 kbit/s loop: at relevant interfaces (Option).

BN 984/02, BN 984/52, BN 984/05 and BN 984/55

Generator operation
from internal clock 1544 kHz ±25 x 10⁻⁶
or external clock 1544 kHz ±100 x 10⁻⁶
or external 8 kHz sync. signal 8kHz±100 x 10⁻⁶
or clock derived from receiver signal

Digital loops
1.5 Mbit/s loop: all time slots are switched through.
1.5 Mbit/s loop: selected time slots can be switched through (independent selection of the receive and send channel is possible).
64 kbit/s loop: at relevant interfaces (Option).

Digital words for telephone channels

BN 984/01 and BN 984/51
Injection of a digital signal in one of the telephone channels 1 to 30 (or 31, 32) or in all telephone channels, or in all telephone channels except the selected channel.
Encoding law, selectable A-law or µ-law

BN 984/02, BN 984/52, BN 984/05 and BN 984/55
Injection of a digital signal in one of the telephone channels 1 to 24, or in all telephone channels, or in all telephone channels except the selected channel.
Encoding law, selectable A-law or µ-law

Send signals

Sine signals
Frequency range 20Hz to 3.99 kHz
Send level range (in steps of 0.1 dB) -60.0 to +7.5 dBm0
Noise signals
Pseudorandom noise signal
350 Hz to 550 Hz complies with ITU-T Rec. O.131
Send level range (0.1 dB steps) -65.0 to +7.5 dBm0
Wideband noise signal for telephone channels

Noise band300 to 3400 Hz
 Send level range.-65.0 to 0.0 dBm0
 Conventional telephone signal complies with
 ITU-T Rec. G.227
 Send level range.-30.0 to 0.0 dBm0
 Echo return loss and singing return loss signals to North American standards
 Noise band of ERL-signal560 to 1965 Hz
 Noise band of SRL-signal 260 to 500Hz
 Noise band of SRLH-signal2200 to 3400 Hz
 Send level range-30.0 to 0.0 dBm0

Group delay measuring signal
 See: "Analog generator signals"
 Send level range.-30.0 to 0.0 dBm0

4-tone signal
 See: "Analog generator signals"
 Send level range-30.0 to 0.0 dBm0

Idle channel signals
 Any fixed word can be selected. It is also possible to select words which vary randomly or periodically between two neighbouring values.

Bit patterns
 The following are available for bit error measurements:
 Pseudorandom sequence complying with ITU-T Rec. V.52. 2^{9-1} bits long
 Pseudorandom sequence complying with ITU-T Rec. O.152 2^{11-1} bits long
 User-programmable 8 bit word

External analog signal (via VAR. MODE)
 An external analog signal can be input via an internal PCM coder and injected in one telephone channel or output via 64 kbit/s interface.

Test facilities and error insertion

BN 984/01 and BN 984/51

AIS transmission (continuous sequence of "1" s)
 Frame alignment bit error ratio 10^{-3} or 10^{-4}
 Frame alignment word errors 2 or 3 in 4
 Multiframe alignment errors.1 or 2 in 2
 CRC-4 error rate settable in steps of0.1%
 in the range.0.1 to 99.9 %
 based on 1 s (1000 CRC-4 words)

BN 984/02, BN 984/52, BN 984/05 and BN 984/55

ALL ONES transmission
 Bit 2 alarm transmission
 Bit 2 is set to "0" in each channel
 S bit alarm (T1 "norm") transmission
 S-bit in frame 12 is set to "1"
 m bit alarm (T1 "extd") transmission
 Eight "0"-bits alternating with eight "1"-bits
 FAS errors.1 in 6 bits or 2 in 4 bits
 S-bit/MFAS errors1 or 2 in 6 bits
 CRC-6 error rate settable in steps of0.3%
 in the range.0.3 to 99.7 %
 based on 999 ms (333 multiframe)

Signalling facilities

BN 984/01 and BN 984/51

Static signalling bits
 Transmission of signalling bits a b c d in time slot 16 for selected and unoccupied telephone channels
 Signalling bit value settable via menu
 Dynamic signalling bits
 Signalling bit value for selected telephone channel set externally via aux. parallel input

BN 984/02, BN 984/52, BN 984/05 and BN 984/55

Static signalling bits
 Transmission of signalling bits A, B/A, B, C, D for selected and unoccupied telephone channels
 Signalling bit value settable via menu
 Dynamic signalling bits
 Signalling bit value for selected telephone channel set externally via aux. parallel input for CAS (7 5/6) only, or S/m bit
 value set externally via contradirectional 4 kbit/s input.

Digital signal receiver

PCM frame structure

see "digital signal generator"

Receiver inputs

BN 984/01 and BN 984/51

Interface characteristics comply with ITU-T Rec. G.703.
 Line codes NRZ, AMI and HDB3
 Coaxial input * 75 Ω or >3 k Ω
 Balanced input 120 Ω or >3 k Ω
 Input signal monitoring via LEDs:
 NO SIGNAL, AIS, NO FRAME, NO MULTIFRAME.

BN 984/02, BN 984/52, BN 984/05 and BN 984/55

Interface characteristics comply with ITU-T Rec. G.703 and North American standards.
 Line codes AMI and B8ZS
 Balanced input . . fem. connector compatible with WECO 310
 (BN 984/02, 984/52); I 214 APS (BN 984/05, 984/55)
 Input impedance 100 Ω or >3 k Ω
 Input signal monitoring via LEDs:
 NO SIGNAL, ALL ONES, NO SYNC, REMOTE ALARM.

Evaluation of digital words in telephone channels

BN 984/01 and BN 984/51

Selecting a telephone channel
A code word from one telephone channel 1 to 30 (or 31, 32) can be evaluated.
Code word measurements
Encoding law, selectable A-law or μ -law
Receive level range, at least -80 to +6 dBm0

BN 984/02, BN 984/52, BN 984/05 and BN 984/55

Selecting a telephone channel
A code word from one telephone channel 1 to 24 can be evaluated.
Code word measurements
Encoding law, selectable A-law or μ -law
Receive level range, at least -80 to +6 dBm0

Receive filters

see "Analog receiver"

Bit error measurements

on telephone channels (64 kbit/s). Shown as a histogram with the X axis representing measuring periods or channels. Bit patterns: see "digital signal generator send signals" Error counts on FAS/MFAS and CRC-signals.

Signalling distortion measurements (option; PCM-4 only)

Method:
Measure the duty cycle deviation of a rectangular signal.
Generator
Frequency setting. 10Hz or 20Hz
Duty cycle settable in steps
Analog output (back panel)
Output impedance, mark. < 30 Ω
space >20 k Ω
Max. d.c. loading 200 mA
Max. switching voltage 70V
Signalling receiver
Measuring range ± 10 ms
Resolution. 0.1ms

General Specifications

Power supply
Rated ranges of use for a.c. line voltage, -12 % to +10 %, switch-selectable 110/117/127/220/227/237 V
BN 984/05 and BN 984/55 . only
100/110/117/200/210/217 V
Rated range of use of a.c. line frequency 47.5 to 63Hz
Power consumption. approx. 150 VA
Safety class to IEC 348 and VDE 0411 Class I

Ordering information

PCM Channel Measuring Set PCM-4

2048 kbit/s version, menu in English **BN 984/01**
1544 kbit/s version, menu in English, WECO connectors **BN 984/02**
2048 kbit/s version, menu in German **BN 984/03**
1544 kbit/s version, menu in English, I 214 APS connectors **BN 984/05**
2048 kbit/s version, menu in Spanish **BN 984/06**

Analog input (back panel)

Input impedance (connected internally to -15 V) . . . 750 Ω
Short-circuit current 20 mA

Evaluation and monitoring of words and bits

BN 984/01 and BN 984/51

Monitoring via 8 LEDs (bits 1 to 8)
Codewords of selected channel, FAS, NOT FAS, MFAS, NOT MFAS, Signalling bits a b c d (TX and RX)

Evaluation on screen (MODE B 91)
Codewords of selected channel, FAS, NOT FAS, MFAS, NOT MFAS, Signalling bits a b c d (RX)

BN 984/02, BN 984/52, BN 984/05 and BN 984/55

Monitoring via 8 LEDs (bits 1 to 8)
Codewords of selected channel, FAS or MFAS, S bits, Signalling bits A, B/A, B, C, D (TX and RX), m bits (1 ... 6 and 7 ... 12)
Evaluation on screen (MODE B 91)
Codewords of selected channel, FAS or MFAS, S bits or m bits, Signalling bits A, B/A, B, C, D

Auxiliary outputs (back panel)

Activation signal for crosstalk measurements
Analog decoder output for decoded signal of selected telephone channel
Signalling output
Error and alarm outputs
Video signal output

Ambient temperature

Rated range of use. +5 to +40°C

Storage and transportation -40 to +70°C

Dimensions

Bench-top instrument (w x h x d in mm)....477 x 244 x 425

Weight approx. 25 kg

PCM Channel Measuring Set PCM-5

2048 kbit/s version, menu in English **BN 984/51**
1544 kbit/s version, menu in English, WECO connectors **BN 984/52**
2048 kbit/s version, menu in German **BN 984/53**
1544 kbit/s version, menu in English, I 214 APS connectors **BN 984/55**

Options

Interfaces:

Codirectional 64 kbit/s input	BN 984/00.01
Codirectional 64 kbit/s output	BN 984/00.02
Electrical characteristics to ITU-T G.703	
Contradirectional 64 kbit/s input	BN 984/00.03
Contradirektionaler 64 kbit/s output	BN 984/00.04
Electrical characteristics to ITU-T G.703	
Serial 64 kbit/s TTL input	BN 984.00.05
Serial 64 kbit/s TTL output	BN 984.00.06
Co- or contradirectional, depending on mode	
Parallel 64 kbit/s TTL input	BN 984.00.07
Parallel 64 kbit/s TTL output	BN 984.00.08
Parallel 8 bit input/output with 8 kHz clock signal	
64 kbit/s V.11 interface	BN 984/00.09
input/output via 15 way plug to ITU-T X.24	
Analog signalling interface	BN 984/00.19
for measurement of signalling distortion and interference from signalling	
IEEE 488/IEC 625 Interface	BN 958/24
with IEEE 488 connector and K 420 connecting cable	

Bridges:

Return Loss and Longitudinal Conversion	
Transfer Loss Bridge ¹	
600 Ω/900 Ω/CPLX ² (PCM-4 only)	BN 984/00.10
600 Ω/850 Ω/CPLX ² (PCM-4 only)	BN 984/00.11
Impedance modification	
(replaces 850 Ω or 900 Ω and CPLX ²)	BN 984/00.32
Bridge impedance addition	BN 984/00.16
Up to 4 additional customer specific CPLX impedances can be added to the bridge; selection only via IEC/IEEE interface	
120 kHz low pass filter	BN 984/00.14

Software retrofitted to the latest status for PCM-4 BN 984/01	BN 984/00.41
PCM-4 BN 984/02 and BN 984/05	BN 984/00.42
PCM-4 BN 984/03	BN 984/00.43
Specify actual software version and serial no. when ordering.	

User specified modifications
Four out-of-band noise suppression

A detailed specification sheet is available for entering the values required.

Analog generator/receiver impedance	BN 984/00.31
Modifications	
(replaces 850 Ω/900 Ω and CPLX ²)	
Analog generator output impedance modified	BN 984/00.34
to $Z_{out} \approx 0 \Omega$ in place of complex impedance	
Impedance modification	
(replaces 850 Ω or 900 Ω and CPLX ²)	BN 984/00.32
2 wire termination modification	BN 984/00.33
(replaces 910 Ω 39 nF)	
(selected with PARAM 914, D-D mode)	
Tolerance masks programmed	BN 984/00.35
to user specifications	
Instruments are equipped with ITU-T tolerance masks as standard.	
Forms for entering tolerance mask changes are included in Appendix D of the operating manual.	

Accessories

LabWindow® Driver (for PCM-4/-5 and MU-30)	BN 984/95.99
for integration in automatic test systems for development, production and service/calibration	
Test Point Scanner MU-30	BN 823/11
with <IEC 625>Interface Card	
Balanced through-switching of 10, 24 or 30 VF channels in TX and RX directions	
WG PenBERT mini PCM monitor (E1)	BN 4555/11
(see WG PenBERT data sheet for details)	
D.C. Loop Holding Circuit GH-1	BN 984/00.12
with capacitor-coupled output	
1.5 m connecting cable	K 348
CF (male) to WECO 310 (ADC jack)	
1.0 m connecting cable	K 438
CF (male) to I 214 APS (male)	
D.C. Decoupling for analog inputs and outputs, PCMZ-4	BN 984/00.13
for use with BN 984/01, BN 984/51, BN 984/03 and BN 984/53 only. (Not required if GH-1 is used).	
IEEE 488/<IEC625> Adapter (m-m)	S 832
for <IEC 625> Interface card	
Front and Back Panel Covers SD-5 (1 set)	BN 700/00.25
19" conversion kit	BN 700/00.05
* Equipped with the Versacon 9 75 Ω basic connector and BNC adaptor.	
For other adaptor types, see "Specification Sheet Versacon 9", and order chosen type when ordering instrument.	

1) Only one bridge can be fitted at any one time.

2) CPLX is fitted as standard: CPLX = 220 Ω in series with 820 Ω || 115 nF