# PCM-40 PCM Channel Analyzer
# PCS-40 PCM Channel Selector

**For codec and line card tests on PCM multiplexers and digital exchanges**

### Determining long-term stability (aging)

Communications systems and network elements are subjected to a wide variety of environmental influences which adversely affect component performance to a greater or lesser degree. If the effect of such influences on, say, system gain are to be recorded, the PCM-40 provides support for this application. During system line-up, the results and instrument configuration are stored so that they can easily be recalled. In the subsequent measurement, these results are displayed within the tolerance mask and the new result trace is superimposed. The instrument then determines the difference between the two measurements so that the deviation can be seen directly.

### Status of connected test signal

The PCM-40 continuously monitors the connected test signal during the measurement and displays the result on the front panel and in detail on the screen. This keeps you informed of the status and prevents incorrect interpretation of the measurement results.

### Storage of measurement configurations

The test equipment settings required for routine or specialized manually-performed measurements, along with explanatory comments, can simply be stored by the PCM-40. The number of setups which can be stored is limited only by the system resources of the computer you are using.

ACO

- *Ideal for installation, line-up, commissioning, fault localization and repairs*
- *Handy, modern concept for field applications based on a lightweight analyzer module and IBM-compatible PC or notebook*
- *Menu operation with color (or monochrome) VGA display*
- *Graphical presentation of all results with flexible zooming and scaling*
- *User definable:*
  - *variable test parameters*
  - *automatic test sequences*
  - *graphical tolerance masks*
- *Large memory for instrument settings and test results on PC hard disk*
- *Numerical and graphical result printout on PC printers with selectable conditions*
- *Complete digital and analog tests to ITU-T Recs. G.712 and O.133/O.162*
- *Complex impedances*
- *PCM30 and PCM31 frame structures including CRC error detection code*
- *Comprehensive codec, frame and CAS measurement capabilities incl. G.821 BERT*
- *High accuracy and reproducibility of test results*
- *Selective measurement capability with 30 Hz filter*
- *Monitoring of signalling status for all 30 VF channels (CAS)*
- *Loop, MUX/DEMUX, and Drop & Insert modes for analog and 64 kbit/s interface*
- *Optional 64 kbit/s interface with co- and contradirectional clock to ITU-T Rec. G.703 for D&I and BERT modes*
- *Control of PCS-40 Channel Selector*

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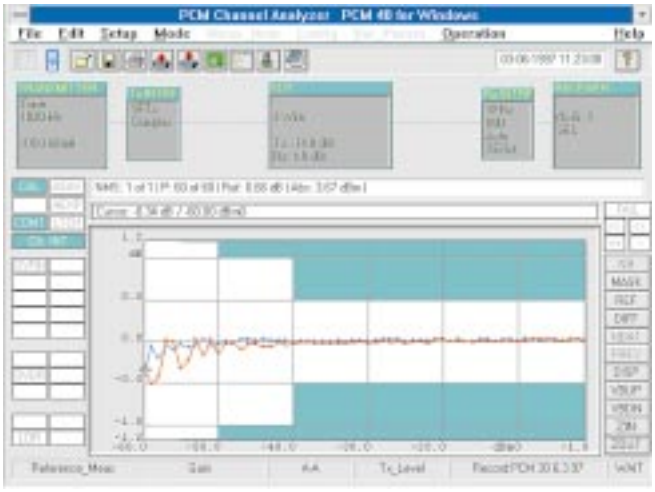
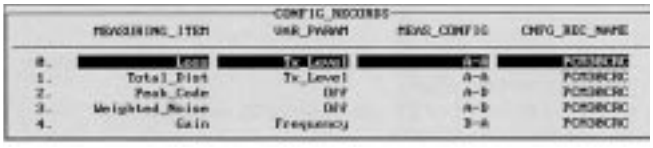


*The fall-off in gain can be clearly seen. The blue trace was recorded on commissioning the system, the red trace at a later date. The "DIFF RESLT" function determines the difference between the two traces. The zoom function and cursors allow every detail to be examined.*



*A test configuration (setup) includes all test and interface parameters required to perform a measurement. The setup name is used to relate the setup to a particular device under test*

### Automatic test sequences

You can produce automatic test sequences by combining several test configurations together from the range of setups which you have stored. All of the measurement functions included in the PCM-40, along with any variations in test variables, parameters and tolerance limits, can be used for this in any order required. The sequence can be programmed to stop if an incorrect result is obtained or before each different measurement task.

### Monitoring digital paths in through mode or via high-impedance taps

For long-term monitoring of 2 Mbit/s paths, the circuit can be looped-through the PCM-40 transparently or tapped via a high impedance monitor point. If the power supply fails during loop-through measurements, the signal path is not interrupted. The
following measurements can be performed:

- Frame monitoring with FAS errors recorded as histograms
- Level, frequency and coder level monitoring including audio monitoring in a selected channel
- Recording of byte changes in the selected frame or data channel
- Signaling status display for individual channels

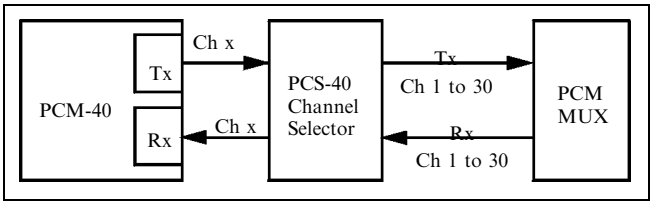
### Quality monitoring in an idle channel

Facilities for monitoring the quality of PCM systems which do not use CRC frames are limited to monitoring the frame alignment signals. The PCM-40 can, however, perform a loop-back or end-to-end measurement to ITU-T G.821 in an idle channel. The instrument transmits a test pattern which it then evaluates. The results can be shown as a table or as an error histogram.

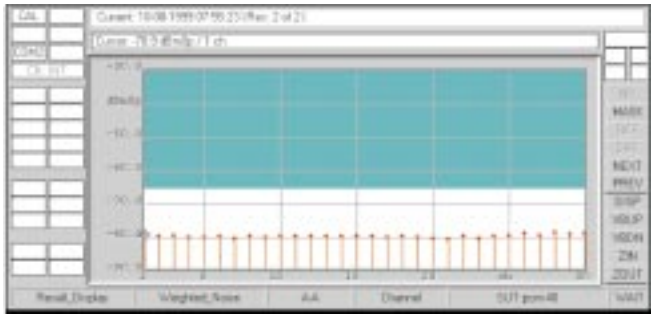
*Errors in the idle channel shown with their times of occurrence. Sporadic faults can thus be easily seen and matched in time to possible sources of interference.*

### PCM-40 as an automated measuring system

When testing PCM multiplexers, the PCS-40 Channel Selector connects up to 30 analog TX and RX channels sequentially to the PCM-40 analog test ports. The PCS-40 Channel Selector allows return loss and longitudinal conversion loss measurements on individual VF channels using the built-in bridges. Also test needing D.C. loop holding circuit or feeding bridge are possible. The result is a flexible and powerful test system well suited to production, installation and maintenance of 2 Mbit/s multiplexers.




*Automatic sequential connection of up to 30 analog Tx and Rx ports of a PCM MUX equipment to the PCM-40 Channel Analyzer*



*30 channel automatic sequential weighted noise measurement*

# Test modes and configurations

| Test modes | Variable parameters | Test configuration | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | A-A | A-D | D-A | D-D | T-D | D-T | T-T |
| **Gain or loss** | Channel | ⊗ | ⊗ | ⊗ | ⊗ | | | |
| | Frequency Tone, MTTS/ Level/Tone, Nopise/Time | ● | ● | ● | ● | | | |
| | Frequency & Channel Level & Channel | ⊗ | ⊗ | ⊗ | ⊗ | | | |
| **Transhybrid loss** | Frequency | | | | ●[1)] | | | |
| **Level** | Channel | ⊗ | ⊗ | ⊗ | ⊗ | | | |
| | Frequency, Time | ● | ● | ● | ● | | | |
| **Received level** | Channel Level | | | ⊗ ● | | | | |
| **Peak code** | Channel Level | | ⊗ ● | | | | | |
| **Coder offset** | Channel Level | | ⊗ ● | | | | | |
| **Total distortion** | Channel Level & Channel | ⊗ | ⊗ | ⊗ | ⊗ | | | |
| | Level/Tone, Noise | ● | ● | ● | ● | | | |
| **Weighted noise** | Channel Time | ⊗ ● | ⊗ ● | ⊗ ● | | | | |
| **Far end crosstalk** | Channel Level | ⊗ ● | ⊗ ● | ⊗ ● | | | | |
| **Near end crosstalk** | Channel Level | ⊗ ● | | | ⊗ ● | | | |
| **Group delay/Distortion** | Frequency/MTTS | ● | ● | ● | ● | | | |
| **Dual tone intermodulation** | Channel Level | ⊗ ● | ⊗ ● | ⊗ ● | ⊗ ● | | | |
| **Return loss** | Channel Frequency Frequency & Channel | ⊗ | | | | | | |
| **Longitudinal balance** | Channel Frequency Frequency & Channel | ⊗ | | | | | | |
| **Frame Monitor/O.162,G.821** | Time (FAS, Channel) | | | | ● | | | |
| **Word test** | Time | | | | ● | ● | ● | ● |
| **Event counter** | Time | | | | ● | ● | ● | ● |
| **BERT/G.821** | Time | | | | ● | ● | ● | ● |
| **Channel associated signaling status** | Time | | | | ● | | | |
| **Signaling distortion** | | | | | ● | | | |
| **Drop & Insert** | | | ● | ● | | ● | ● | |

A = 600, 900 Ω or complex, 4-wire or 2-wire analog interface
D = 2048 kbit/s digital interface to ITU-T Recs. G.703, G.704
T = 64 kbit/s digital interface to ITU-T Rec. G.703 (optional)

● indicates available test configurations
⊗ available only with PCS-40

1) with external 2-wire termination

# Specifications PCM 40 PCM Channel Analyzer

## Analog signal generator

Sinewave signal
- Frequency range ..... 200 to 3600 Hz
- Resolution ..... 4 Hz
- Frequency accuracy ..... $\pm 50 \times 10^{-6}$
- Harmonic distortion ..... > 56 dB at 0 dBm0
- Level range ..... −60 to +5 dBm0
- Level increments ..... 0.1 dB

Dual-tone signal
- Frequency range ..... 200 to 3600 Hz
- Resolution ..... 4 Hz
- Level range ..... −60 to −1 dBm0
- Level ..... same for both spectral lines

Pseudo-random noise signal to ITU-T Rec.O.131
- Sequence repetition rate (period) ..... 256 ms
- Bandwidth ..... 350 to 550 Hz
- Peak factor ..... 10.5 dB
- Level range ..... −60 to 0 dBm0
- Level increments ..... 0.1 dB

MTTS (Multi Tone Test Signal)
- Frequency range ..... 200 to 3860 Hz
- Level range ..... −30 to +0 dBm0
- Levels ..... same for all 37 spectral lines

Output
- Impedance ..... 600 Ω, 900 Ω, and complex [1)]
- Return loss ..... > 36 dB (200 to 4000 Hz)
- Balance ..... > 50 dB (200 to 3600 Hz)
- Relative level/increments ..... −15 to +5 dBr/0.1 dB
- Max. d.c. voltage ..... 60 V (between a/b and ground)
- Connector ..... balanced, 3pole CF

## Auxiliary signal generator

Sinewave signal
- Frequency range ..... 200 to 3600 Hz
- Resolution ..... 4 Hz
- Level range/increments ..... −60 to −30 dBm0/0.1 dB
- Impedance ..... 600 Ω
- Connector ..... balanced, 3pole CF

Output
- Impedance ..... 600 *Ω
- Return loss ..... > 36 dB (300 to 3600 Hz)
- Balance ..... > 46 dB (200 to 3600 Hz)
- Max. d.c. voltage ..... 60 V (between a/b and ground)
- Connector ..... balanced, 3pole CF

## Analog receiver

Filters
- Flat filter ..... 200 to 3600 Hz
- Psophometric filter ..... to ITU-T Rec. O.41
- Selective filter ..... between 200 and 3600 Hz, center frequency settable in 4 Hz increments, bandwidth 30 Hz
- Filter for distortion measurement ..... 850 to 3250 Hz or 1380 to 3240 Hz
- Notch filter ..... at aux. signal frequency, bandwidth 30 Hz

Level measuring range (minimum)
- Signal level ..... −60 to +8 dBm0
- Resolution ..... 0.01 dB

Noise, crosstalk ..... −80 to 0 dBm0
- Resolution ..... 0.01 dB
- Relative level range/increments ..... −15 to +5 dBr/0.1 dB

Group delay distortion ..... 0 to 10 ms
- Resolution ..... 0.1 ms

Input
- Impedance ..... 600 Ω, 900 Ω, > 30 kΩ and complex [1)]
- Return loss ..... > 36 dB (200 to 4000 Hz)
- Balance ..... > 50 dB (200 to 4000 Hz)
- Max. d.c. voltage ..... 60 V (between a/b and ground)
- Connector ..... balanced, 3pole CF

## Digital signal generator

PCM frame structure ..... to ITU-T Rec. G.704

32 channel PCM frame containing
- 30 telephone channels, or
- 31 telephone channels ..... time slots 1 to 31

Encoding law ..... ITU-T Rec. G.711, A or μ law

Sinewave signal
- Frequency range ..... 200 to 3600 Hz
- Resolution ..... 4 Hz
- Frequency accuracy ..... $\pm 50 \times 10^{-6}$
- Harmonic distortion ..... as per A or μ law
- Level range/increments ..... −60 to +3.1 dBm0/0.1dB

Dual-tone signal
- Frequency range ..... 200 to 3600 Hz
- Resolution ..... 4 Hz
- Level range ..... −60 to −5 dBm0

Pseudo-random noise signal to ITU-T Rec. O.131
- Sequence repetition rate (period) ..... 256 ms
- Bandwidth ..... 350 to 550 Hz
- Peak factor ..... 10.5 dB
- Level range ..... −60 to 0 dBm0/0.1 dB

MTTS (Multi-Tone Test Signal)
- Frequency range ..... 200 to 3860 Hz
- Levels ..... same for all 37 spectral lines
- Level range/increments ..... −30 to 0 dBm0/0.1 dB

Group delay measuring signal ..... MTTS

Test patterns ..... PRBS6, PRBS9, PRBS11, PRBS15
- Insertion in ..... voice channels 1 to 30

Freely selectable n × 8 bit word sequence ..... n = 1 to 60
- Insertion in ..... FAS, FAW, MFW, channel, signalling channel

Repetitions ..... 1 to 9999 or continuous

Freely selectable FAS sequence ..... n × 7 bits, n = 1 to 60

Freely selectable MFAS sequence ..... n × 4 bits, n = 1 to 60

Error insertion ..... FAS, MFAS, MFW, channel, signalling channel
- Error ratio ..... $5 \times 10^{-3}$ to 5 × 10-7

Digital milliwatt signal ..... to ITU-T rec. G.711

Output
- Bit rate ..... 2048 kbit/s
- Interface parameters ..... to ITU-T rec. G.703
- Line code ..... HDB3 or AMI
- Unbalanced impedance ..... 75 Ω
  - Connector ..... coaxial, BNC
- Balanced impedance ..... 120 Ω
  - Connector ..... balanced, 3pole CF

Operating mode
- Loop-through (2 Mbit/s)
- Test pattern insertion into one time slot
- Analysis of one time slot

Generator operation
- from internal clock ..... 2048 kHz $\pm 50 \times 10^{-6}$
- or external clock ..... 2048 kHz $\pm 100 \times 10^{-6}$
- or clock derived from received signal

Digital loops
- 2 Mbit/s loop ..... all time slots switched through
- 2 Mbit/s loop ..... one selected time slot generated internally, remainder switched through
- 2 Mbit/s loop ..... all time slots switched through but channels shifted by 15

1) Complex impedance: 220 Ω in series with 820 Ω in parallel with 115 nF; other values on request

## Digital receiver

PCM frame structure . . . . . to ITU-T Rec. G.704 (see digital signal generator)
Encoding law . . . . . to ITU-T Rec. G.711, A or μ law
Filters
- Flat filter . . . . . 200 to 3600 Hz
- Psophometric filter . . . . . to ITU-T Rec. O.41 up to 3960 Hz
- Selective filter . . . . . between 200 and 3600 Hz, center frequency can be set with 4 Hz increments, bandwidth 30 Hz
- Filter for distortion measurement . . . . . 850 to 3250 Hz or 1380 to 3240 Hz
- Notch filter . . . . . at aux. signal frequency, bandwidth 30 Hz

Alarm detection . . . . . no signal, frame loss, multiframe loss, AIS, multiframe AIS, remote alarm, remote multiframe alarm
Evaluation
- Bit error count, event count, recording of transients in digital words . . . . . FAS, FAW, MFW, signalling channel, telephone channel
- Telephone channel r.m.s value measurement . . . . . −80 to +6 dBm0
- ITU-T G.821 evaluation. . . . . bit errors, FAS errors
- Error results displayed as histograms

Input
- Bit rate . . . . . 2048 kbit/s
- Interface parameters . . . . . to ITU-T Rec. G.703
- Line code . . . . . HDB3 or AMI
- Unbalanced input impedance . . . . . 75 Ω or > 2 kΩ
  - Connector . . . . . coaxial, BNC
- Balanced input impedance . . . . . 120 Ω or > 2 kΩ
  - Connector . . . . . balanced, 3pole CF
- Clock. . . . . from received signal
  - Pulling range . . . . . $\pm 100 \times 10^{-6}$

**Measurement interval** . . . . . 60 s to 72 h

**Instrument set-up memory** . . . . . depends on PC resources available

## Automatic measurement sequences

Individual measurements linked to a sequence . . . . . max. number depends on PC resources available

## Result documentation

Result output to external printer
- Output in table or graph formats

Result output as ASCII file to disk
- Result in table format can be saved to disk with printout using DOS “PRINT” command.

Result storage and test configuration storage
Depends on PC resources available

## Self-test and level calibration

Triggered automatically by opening the measurement menu

## Codec interface/Handset interface

Input/output impedance . . . . . 600 Ω
- Connector . . . . . RJ11

## 64 kbit/s interface (optional)

Output/input . . . . . to ITU-T Rec. G.703
- Modes . . . . . codirectional, contradirectional

Balanced output . . . . . 120 Ω
- Connector. . . . . balanced, 3pole CF

Clock output. . . . . 120 Ω
- Connector. . . . . balanced, 3pole CF

## General specifications

**Control computer for PCM-40**
- PC AT 486
- WIN 3.1, WIN 95, 98, NT
- min. 600 kB free conventional memory
- min. 256 kB free EMS memory
- min. 40 MB free HD space
- VGA monitor (color or monochrome)
- serial or GPIB (National Instr.) interface

**Communication interfaces for PCM-40**
- Serial I (for computer control) . . . . . RS232C/V.24
- Serial II (for modem connection) . . . . . RS232C/V.24
- GPIB/ <IEC 625> 8.5 /IEEE-488.1-1978 (for computer control)

**Power supply**
- External adapter with a.c. line cord
- AC supply. . . . . 100 to 240 V, 50 to 60 Hz
- Power consumption . . . . . 25 VA

**Ambient temperature**
- Nominal range of use. . . . . +5 to +45 °C
- Limits range of use (for 2 hours) . . . . . 0 to +55 °C
- Storage and transport range . . . . . −40 to +70 °C

**Air humidity**
- Nominal range of use . . . . . 20 to 80% r.h. (< 20 g/m$^3$ absolute)

**Dimensions** (l × w × h) . . . . . 290 × 230 × 70 mm

**Weight** . . . . . approx. 3.5 kg

# Specifications PCS 40 PCM Channel Selector

### Test ports (Ch x)

Maximum level . . . . . +20 dBm
Max. d.c. voltage 60 V (between a/b and ground)
Max d.c. current . . . . . 100 mA
Impedance . . . . . 600 Ω
Insertion loss between test port and selected Tx/Rx port (200 Hz to 4 kHz) . . . . . < 0.02 dB
Connector . . . . . balanced, 3-pole CF

### Access ports (Ch 1 to Ch 30)

Balanced through-switching of up to 30 VF channels in Tx and Rx directions
Connector DIN 41612 type socket, 64 way, female
Switching time . . . . . < 10 ms

### Return loss measurement

Built-in bridge for return loss measurements on a selectable VF channel
Measurement range . . . . . 0 to 45 dB
Frequency range . . . . . 200 Hz to 4 kHz
Accuracy
0 to 30 dB . . . . . 1 dB
30 to 45 dB . . . . . 2 dB
Reference impedance
internal . . . . . 600 Ω
external (connected to auxiliary input) . . . . . 600 to 900 Ω
Max. input level
200 Hz to 300 Hz . . . . . −6 dBm
300 Hz to 4 kHz . . . . . 0 dBm

### Longitudinal conversion loss (LCL) measurement

Built-in bridge for LCL measurements according to ITU-T Rec. O.9 on a selectable VF channel
Measurement range . . . . . 5 to 56 dB
Frequency range . . . . . 200 Hz to 4 kHz
Accuracy
5 to 46 dB . . . . . 1 dB
46 to 56 dB . . . . . 2 dB
Terminating impedance . . . . . 600 Ω
Max. input level . . . . . −6 dBm

### DC current loop

Two built-in current loops connected to each test port
DC current . . . . . < 150 mA
Voltage drop at 20 mA (100 mA) . . . . . < 5.5 V ( < 12 V)
Output impedance (200 Hz to 4 kHz) . . . . . approx. 30 kΩ

### DC feeding bridge

Two built-in current loops connected to each test port
Supply voltage (It = 0) . . . . . approx. 30 V
Supply current (Rt = 400 Ω) . . . . . > 20 mA
Supply current (Rt = 0 Ω) . . . . . approx. 38 mA
Output impedance (200 Hz to 4 kHz) . . . . . approx. 50 kΩ
LCL (200 Hz to 4 kHz) . . . . . > 45 dB

### Line status indication (TX and RX)

Line feeding voltage on
Line looped

### Remote control

Control of all functions from PCM-40 Channel Analyzer or personal computer via GPIB/IEC625/IEEE488 interface
Interface . . . . . IEEE 488 connector

### General specifications

**Power supply**
External adapter with a.c. line cord
AC supply . . . . . 100 to 240 V, 50 to 60 Hz
Power consumption . . . . . 10 VA
(One adapter can supply both the PCM-40 and PCS-40)

**Ambient temperature**
Nominal range of use . . . . . +5 to +45 °C
Limits range of use (for 2 hours) . . . 0 to +55 °C
Storage and transport range . . . . . −40 to +70 °C

**Air humidity**
Nominal range of use . . . . . 20 to 80 % r.h. ( < 20 g/m³ absolute)

**Dimensions** (l × w × h) . . . . . 290 × 230 × 70 mm

**Weight** . . . . . approx. 2 kg

# Ordering information

**PCM-40 Channel Analyzer** EL 3039/01
Including AC adapter, RS232C/V.24 cable and operation manual (in English)
A separate PC is required for operation
Calibration report for PCM-40 EL 3039/60

**PCS-40 Channel Selector** EL 3039/20
Including return loss and longitudinal conversion loss (LCL) measuring bridge, DC current loop and DC feeding bridge, cables for interconnection of PCM-40 and PCS-40, 64 way female connector set for accessing PCM MUX and operation manual (in English)

**Options**
64 kbit/s Interface EL 3039/01
(for codirectional/contradirectional clock) for BERT and D&I
Impedance modification EL 3039/02
(replaces complex impedance)

**Accessories**
GH-1 DC Loop Holding/Line Feeding BN 0984/00.12
Nylon Carrying Case EL 2237/01
(for PCM-40, Notebook PC and accessories)
TPK-960/33 Transport Container BN 960/00.09
(for PCM-40, PCS-40, Notebook PC and accessories)
64-way female connector set for PCS-40 EL 3039/203
IEEE Interface cable for PCS-40 EL 3039/201
AC Adapter for PCS-40 EL 3039/202

**Documentation**
Service manual for PCM/PCS-40 (in English) EL 3039/83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