Contents

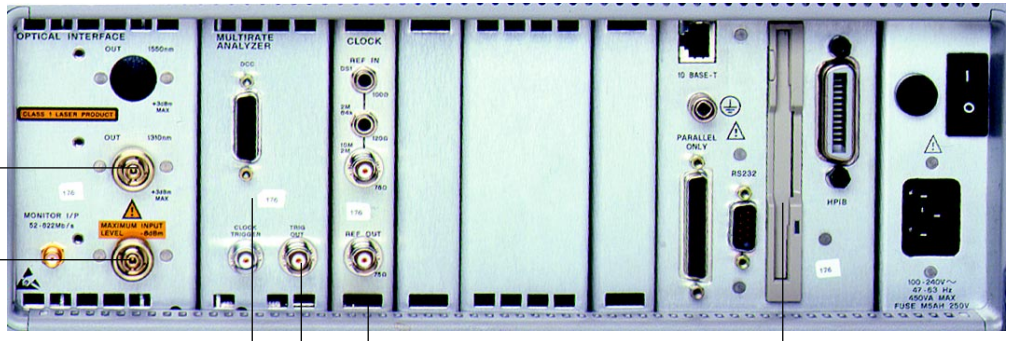
OmniBER 720

communications performance analyzer

The Agilent Technologies OmniBER 720 communications performance analyzer offers a single-box field-portable multi-rate SONET/SDH tester up to 2.5 Gb/s (OC-48/STM-16). The analyzer is ideally suited to installation, maintenance, commissioning and system verification of SONET/SDH and DWDM transmission systems.

This new low-cost member of the OmniBER family includes a choice of instrument variants for multi-rate testing. This choice allows you to buy the SONET-only, SDH-only or SONET/SDH test configuration. The OmniBER 720 is optimized for BER testing of optical tributaries up to OC-48/STM-16. Testing is supported by a comprehensive set of features and the same user interface that's common to all OmniBER analyzers for fast, intuitive operation.

Side view



Summary of capability

J1407A	OmniBER 720 communications performance analyzer mainframe
Option 104	OC-48/12/3/1 testing (1310 nm) and/or STM - 16o /4o /1o /0o testing (1310 nm)
Option 001	SDH configuration
Option 002	Dual SONET/SDH configuration
Option 003	SONET configuration
Option 601	LAN/RS-232/GPIB remote control
Option 602	Graphical printer
Option 610	Replace FC/PC with SC connectors
Option 611	Replace FC/PC with ST connectors

OmniBER 720 include:

- OC-48/12/3/1 rates and/or STM - 16o /4o /1o /0o rates.
- Bulk payloads from STS-48c/STM-16c and VT 1.5/TU-11.
- Auto-discovery of all received payload channels.
- SONET/SDH error and alarm generation/measurement.
- SONET/SDH alarm scan.
- Full SONET/SDH overhead setup and monitoring, including text decode of:
  - Sync status (S1)
  - APS messages (K1K2)
  - Signal labels (C2 and V5).
- J0 section trace for DWDM test.
- J1 and J2 path trace for network path testing.
- Optical power and line frequency measurements.
- Line frequency offset.
- SONET/SDH pointer adjustments to GR-253/ITU-T G.783.
- Powerful thru-mode testing for SONET/SDH ring turn-up.
- Optional integrated graphical printer.
- Dual standard configuration (SONET and SDH).

Smartsetup

Not only is the OmniBER 720 analyzer rugged and portable, its easy-to-use **Smartsetup** and **Smart Tests** simplify and speed up the installation and maintenance of SONET networks.

The OmniBER 720 analyzer lets you start testing with just ***two key presses!*** With the analyzer connected to any signal, simply press the **Smart Test** key on the front panel, select **Smartsetup** and the instrument's autodiscover wizard automatically identifies the line rate and payload structure of the unknown input signal. The analyzer also automatically displays all of the J1 trace identifiers, that is 48/16 J1 identifiers in an OC-48/ STM-16 signal. With the signal structure now identified it's a simple process, using the cursor control keys, to select a channel of interest and to explore right down into the payload.

Smart Tests

The front panel Smart Test key offers a simple shortcut to the extensive capabilities of the OmniBER 720 analyzer. The Smart Tests are grouped together in functional blocks so you don't need to be an instrument 'expert' to get tests up and running quickly. Test capability that is accessed with only a couple of key presses include:

- Optical power measurement
- Line frequency measurement
- Error and alarm summary results.

Large color display

The color VGA display on the OmniBER 720 analyzer operates in single- or multi-window mode. In multi-window mode, four windows are diplayed allowing simultaneous viewing of transmitter settings, receiver settings, graphical results and text results.

A VGA output is provided on the analyzer's front panel for connection to VGA projector for training purposes.

SONET/SDH ring testing

Configuring SONET/SDH rings and verifying their functionality is a complex and time-consuming process. Using the comprehensive thru mode capability of the OmniBER 720 analyzer can help to speed up the task and ensure that the advantages of the SONET/SDH ring configuration will be delivered when problems arise on the live network.

The three different thru modes of operation available are:

- **Transparent:** The SONET/SDH signal is monitored and normal measurements made. The line signal is passed through unaltered without recalculation of BIPs.
- **STS/AU-n Payload overwrite:** Select an STS/AU-n SPE channel and overwrite with an internally generated payload. BIPs are recalculated and all other SPEs are retransmitted unaltered. Standard transmit test functions are enabled so that it is possible to add errors, alarms, pointer adjustments etc.
- **VT/TU-n payload overwrite:** Select a VT/TU-n channel and overwrite with an internally generated payload. All other VTs are retransmitted unaltered. Standard transmit test functions are enabled so that it is possible to add errors, alarms and pointer adjustments.

Concatenated payloads

Concatenated payloads are vital for the rapid and accurate testing of high bandwidth paths before they are brought into service. The OmniBER 720 analyzer provides concatenated payload testing at all levels of a SONET/SDH signal. As well as providing concatenated payloads at the line rate e.g. OC-48c/STM-16c, the analyzer lets you test SONET/SDH structures containing concatenated payloads from lower levels of the SONET/SDH hierarchy e.g. STS-12c/STM-4c carried in OC-48/STM-16. See Figure 1 (SONET) or Figure 2 (SDH) for the full range of possibilities.

Remote control for remote in-service monitoring

The Distributed Network Analyzer (DNA) software (E4540A) allows control of an OmniBER 720 analyzer from a remote PC via modem or LAN. Changes made on the virtual front panel on the PC are seen in real time at the remote site. Key presses made on the instrument at the remote site are seen in real time on the PC – ideal for remote troubleshooting by a centralized expert!

For long-term monitoring applications it is also possible to dial in to a remote OmniBER 720 analyzer, download results and then disconnect. Re-connect at any time without interrupting test progress.

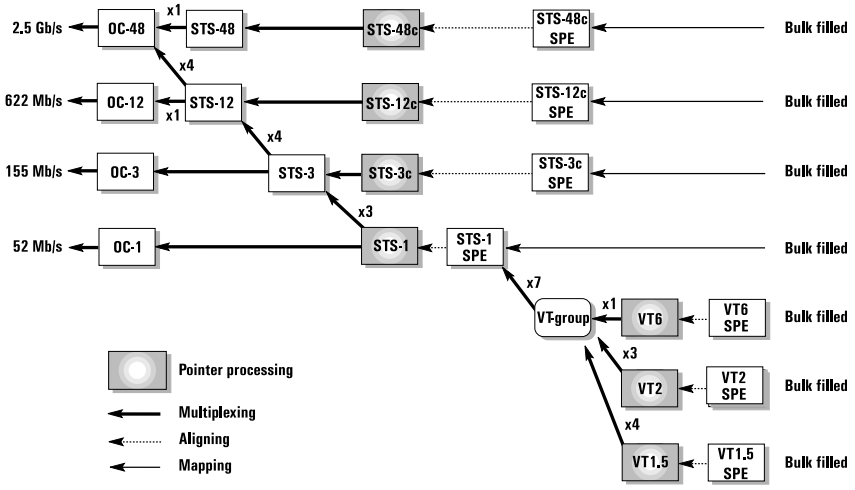


Figure 1: Supported payload mappings

Optical interfaces

Wavelength: 1310 nm (option 104).
Rates: OC-48/12/3/1
Connectors: Customer-exchangeable optical connector system. Select the type of optical connector as follows:
FC/PC (standard)
SC (option 610)
ST (option 611)

Optical transmitters

Line code: NRZ.
Wavelength: 1310 nm: 1290 to 1330 nm.
Power: –1 to +2.5 dBm, typical: +1 dBm.
Spectral width: 3.0 nm RMS (max).
Extinction ratio: > 8.2 dB.
Pulse mask: Meets Bellcore GR-253-CORE and ITU-T G.957.
Fiber pigtail: Single mode.
Laser safety: Class 1 as defined by IEC825-1 and FDA 21 CFR, chapter 1, subchapter J.

Optical receiver

Line code: NRZ.
Wavelength: 1280 to 1335 nm and 1500 to 1580 nm.
Sensitivity:
OC-48: –28 dBm.
OC-12/3: –33dBm.
OC-1: –34dBm.
Max input power: –8 dBm.
Fiber pigtail: Multi-mode.

Notes:

1. *Sensitivity and maximum input power specifications are valid in the 0 to +40 °C temperature range.*
2. *Sensitivity and maximum input power specifications are measured at 10^{-10} error rate using a $2^{23} - 1$ test pattern.*
3. *The optical receiver operates over the range 1200 to 1600 nm. Sensitivity and maximum input power specifications are valid in defined wavelength ranges.*

Protected monitor point input

52 Mb/s, 155 Mb/s and 622 Mb/s.
Line code: NRZ.
Level: Nominal 1 V peak-to-peak into 50 ohms.
Connector: SMA female.

Clock reference

Internal: ± 0.5 ppm; stability: ± 3 ppm; Ageing: ± 1 ppm.
Loop-timed: Clock recovered from receiver's SONET input.
External reference: BITS (1.5 Mb/s), 64 kb/s, 10 MHz.
Connector: Bantam, 100 ohm balanced (BITS, 64 kb/s);
BNC, 75 ohm unbalanced (10 MHz).

Clock trigger

51.840 MHz divided clock output.
Connector: BNC, ECL to –2 V, ac coupled, 50 ohm.

Trigger/error output

60 µsec (nominal) pulse on B1, B2, B3 error, Tx/Rx frame
(TTL level, termination can be 75 ohm or 10 kohm).
Connector: BNC, 75 ohm unbalanced.

Clock offset

± 999 ppm in 0.1 ppm steps; offset accuracy ± 0.02 ppm
Offsets the transmitted OC-n line frequency relative to the selected clock reference.

SONET payload structure

See Figure 1 for details of supported SONET payload mappings.

The foreground STS-n test signal can be mapped into any select channel in the SONET line signal. Background channels can be set to the same as to the foreground or filled with an unequipped signal structure.

Payload test pattern

2^9–1, 2^{11}–1, 2^{15}–1, 2^{23}–1 (inverted or non-inverted), all ones, all zeros, 1010, 1000, 16 bit user word.

SONET tributary scan

Automatically test BER on each SONET tributary for error free operation. Rx setup is used to determine tributary structure and test pattern. (At OC-48/OC-12 the foreground STS-3 will be scanned).
Alarms: Pattern loss.
User selectable BER threshold: Off, >0, $\geq 10^{-3}$,$\geq 10^{-6}$.

SONET error add

Data (whole frame)[1], frame (A1,A2)[1], CV-S (B1), CV-L (B2), REI-L (M0), REI-L (M1), CV-P (B3), REI-P (G1), STS IEC, CV-V (V5), REI-V (V5), bit[1].

Control: Single, error all, M.P x 10^{-n} (where M.P = 0.1 to 9.9 in 0.1 steps and n = 3 to 9)[2].
N-in-T[3], where N is the number of errors transmitted in time T,
T = 10 ms to 10000s in decade steps.
N = 0 to 640 (STS-1), 1920 (STS-3), 7680 (STS-12), 30720 (STS-48).

1. *No "error all" selection available.*
2. *Max error rate depends on the error type.*
3. *CV-L (B2) errors only.*

SONET alarm generation

LOS, LOF, OOF, AIS-L, RDI-L, AIS-P, RDI-P, LOP-P, UNEQ-P, AIS-V, LOP-V, RDI-V, UNEQ-V, H4 LOM.
Control: On/off.

SONET pointer adjustments

Frequency offset: Offset the SPE/VT relative to the line rate. In the SPE/VT pointer mode the 87:3 sequence is generated. Frequency offset control (±100 ppm in 0.1 ppm steps).
Bellcore GR-253,ANSI T1.105.03 sequences: Initialisation sequence and cool down period

1. Periodic single,
2. Periodic burst,
3. Periodic phase transient burst,
4. Alternating single,
5. Alternating double,
6. Periodic with added,
7. Periodic with cancelled.

Programmable interval between regular adjustments.
Regular: Interval between regular adjustments can be programmed as follows:
10 ms $<$ T $<$ 100 ms in 10 ms steps
100 ms $<$ T $<$ 1 s in 100 ms steps
1 s, 2 s, 5 s or 10 s
Single burst: Incrementing burst, decrementing burst, alternating.
Burst size: 1 to 10 adjustments (SPE). 1 to 5 adjustments (VT).
Adjustments within the burst are separated by the minimum legal limit (4 frames/multiframes).
New pointer: New pointer address transmitted with or without a NDF. SPE/VT payload moves to the user programmed address immediately.

SONET overhead setup	**TOH:** All bytes user settable except B1 B2, H1, H2 and H3. The size bits in H1 are settable. J0: User byte; 16 byte section trace message. S1: Clear text setup of synchronization status message. **STS POH:** All bytes user settable except B3. J1: 64 or 16 byte path trace message. C2: Clear text setup of signal label. **VT POH:** V5, J2, Z6, Z7 user settable. J2: User byte; 16 byte VT path trace message.. V5 (VT signal label): Clear text setup of VT path signal label.
SONET overhead monitor	**SOH, LOH, STS POH, VT POH all bytes** (hex/binary) Text decodes provided for section trace (J0), synchronization status (S1), ASP/MSP messages (K1K2), STS and VT path trace messages (J1, J2), STS and VT signal labels (C2, V5).
APS messages	Clear text setup and decode of protection switching messages. Supports both linear (Bellcore GR-253) and ring (Bellcore GR-1230) messages.
SONET overhead sequence generation	Sequence of up to 5 values transmitted in a selected overhead channel. The transmit duration for each value is user programmable in range 0 to 64000 frames. **Overhead channel:** **SOH:** A1-A2 (6 bytes), D1-D3 (3 bytes), J0, Z0 ,E1, F1, media dependent bytes (row 2 col 2; row 2, col 3; row 3 col 2; row 3, col 3). **LOH:** D4-D12 (9 bytes), K1K2 (2 bytes), S1, M0, M1, Z1, Z2, E2. **POH:** J1, C2, G1, F2, H4, Z3, Z4, N1.
SONET overhead sequence capture	A selected overhead channel can be selected for capture. The capture can be triggered manually or on a user-defined receive value. The first 16 different receive values including the trigger are displayed along with the number of frames for which the value has persisted. **Overhead channel:** **SOH:** A1-A2 (6 bytes), D1-D3 (3 bytes), J0, Z0 , E1, F1, media dependent bytes (row 2 col 2; row 2, col 3; row 3 col 2; row 3, col 3). **LOH:** H1H2 (2bytes), D4-D12 (9 bytes), K1K2 (2 bytes), S1, M0, M1, Z1, Z2 E2 **POH:** J1, C2, G1, F2, H4, Z3, Z4, N1.

SONET overhead BER

2^9–1 PRBS transmitted and analyzed in a single 64 kb/s overhead channel. Single bit errors can be inserted in the transmitted test pattern.
Overhead channel:
SOH: D1-D3 (single byte), J0, Z0, E1, F1,
media dependent bytes (row 2 col 2; row 2, col 3; row 3 col 2; row 3, col 3).
LOH: D4-D12 (single byte), K1, K2, S1, M1, M0, E2.
POH: J1, C2, G1, F2, H4, Z3, Z4, N1.
Results: Error count, error ratio, error free seconds, % error free seconds, pattern loss seconds.

Optical stress test

Payload is overwritten with a block of zeros or ones after scrambling to stress timing recovery circuits.
Range:
2 to 85 bytes – OC-1.
2 to 259 bytes – OC-3.
2 to 1042 bytes – OC-12.
2 to 4174 bytes – OC-48.

DCC add-drop

D1-D3 (192 kb/s), D4-D12 (576 kb/s)
Serial add-drop of DCC channels via RS-449 (15-pin D-type connector).

SONET thru mode

OC-48, OC-12, OC-3, OC-1 through mode:
Transparent mode: Signal passes through unaltered. BIPs are not recalculated.

Overhead overwrite: The test features associated with the TOH/POH can be enabled to alter one single or multi-byte overhead channel (ie, errors and alarms, overhead sequences, stress test, APS/MSP messages, DCC insert, overhead BER) In this mode the parity bytes are recalculated.

STS payload overwrite: Overwrite a selected STS SPE channel with an internally generated payload. All other SPEs are retransmitted unaltered. All standard transmit test functions are enabled (errors and alarms, pointer adjustments, overhead sequences, stress test, overhead BER).

VT payload overwrite: Overwrite a selected VT with an internally generated payload. All other VTs and SPEs are retransmitted unaltered. All standard transmit test functions are enabled (errors and alarms; pointer adjustments).

SONET alarm detection

LOS, OOF, LOF, AIS-L, RDI-L, LOP-P, AIS-P, RDI-P, H4-LOM, LOP-V, AIS-V, RDI-V, pattern loss, clock loss, K1/K2 change, power loss, pointer adjust.

SONET error measurements

Measurement control: Manual, single, timed start.
Error: Frame (A1,A2), CV-S(B1), CV-L(B2), CV-LFE(REI-L), CV-P(B3), CV-PFE(REI-P), CV IEC (STS path IEC), CV-V(V5), CV-VFE(REI-V), bit.
Basic results: Error count, error ratio, alarm seconds.
Performance analysis: G.826, G.821, M.2100. M2101, M.2110, M.2120.

AlarmScan	Automatically identifies the payload structure then scans each STS/VT channel for alarms and BIP errors. Graphically displays the status of each STS/VT channel. **Alarms:** **STS-SPE:** LOP-P, AIS-P, RDI-P. **VT :** AIS-P, RDI-P, H4 LOM, LOP-V, AIS-V, RDI-V. **BIP errors:** B3 or V5 BIP-2 associated with each STS/VT channel.
TroubleScan	Scans all possible error and alarm sources simultaneously. Non-zero error counts are displayed in large characters, up to a maximum of four different error counts.
Pointer location graph	**Graphical display:** Shows the variation with time of the STS SPE and VT pointer location. Up to four days of pointer location activity can be monitored. **Implied SPE/VT offset:** Calculated from the total +ve and –ve pointer movements since start of the measurement period.
Pointer results	SPE and VT Justifications (pointer value, positive count, positive seconds, negative count, negative seconds, NDF seconds, missing NDF seconds, implied SPE/VT offset).
Optical power measurement	**Accuracy:** $\pm$ 2 dB; Range: –10 dBm to –30 dBm. **Wavelength:** 1310 nm or 1550 nm. **Resolution:** 0.1 dBm.
Frequency measurement	**OC-48:** Frequency displayed in kHz with a 0.1 kHz resolution. Offset in ppm/kHz $\leq$ **OC-12:** Frequency displayed in Hz with a 1 Hz resolution. Offset in ppm/Hz. **Accuracy:** $\pm$ 1 Hz $\pm$ (internal clock error[1]) $\times$ frequency. [1] *See 'clock reference' for details on internal clock error.*
Stored measurement graphics	10 internal SMG stores (increases with floppy disc drive - number of stores limited only by free disc space). **Bar chart:** Results versus time periods with up to 1 second resolution. **Alarm chart:** Alarms versus time periods with up to 1 second resolution. **Resolution:** 1sec, 1min, 15min, 60min **SONET bar graphs:** Frame (A1A2), CV-S (B1), CV-L (B2), CV-LFE (REI-L), CV-P (B3), CV-LFE (REI-P), CV-IEC (STS path IEC), CV-V (V5), CV-VFE (REI-V), bit. **SONET alarms:** LOS, LOF, OOF, LOP-P, NDF, missing NDF, AIS-L, RDI-L, K1K2 change, AIS-P, RDI-P, H4 LOM, LOP-V, VT NDF, VT missing NDF,AIS-V, RDI-V, pattern sync loss, power loss.

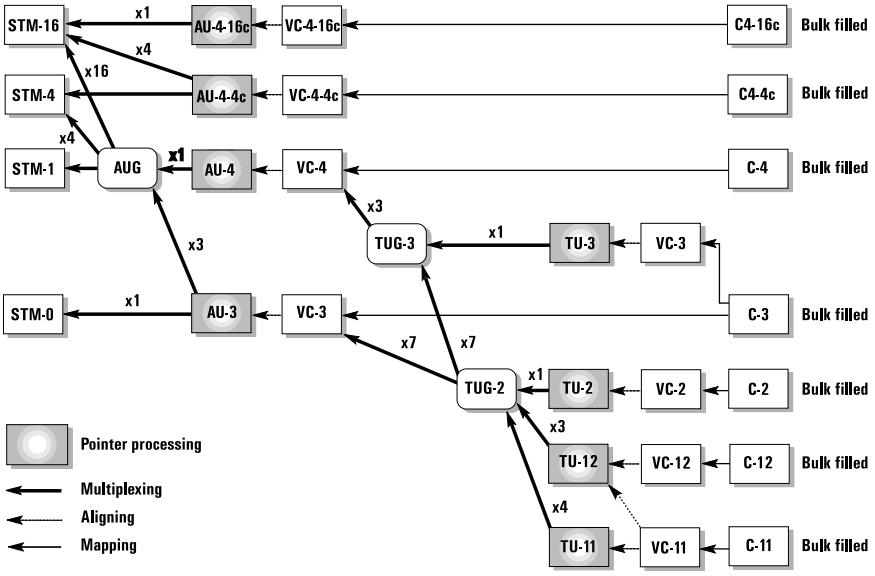


Figure 2: Supported SDH payload mappings

Optical interfaces

Wavelength: 1310 nm (option 104).
Rates: STM-16o /4o /1o /0o
Connectors: Customer-exchangeable optical connector system. Select the type of optical connector as follows:
FC/PC (standard)
SC (option 610)
ST (option 611)

Optical transmitters

Line code: NRZ.
Wavelength: 1310 nm: 1290 to 1330 nm.
Power: –1 to +2.5 dBm, typical: +1 dBm.
Spectral width: 3.0 nm RMS (max).
Extinction ratio: > 8.2 dB.
Pulse mask: Meets ITU-T G.957and Bellcore GR-253-CORE.
Fiber pigtail: Single mode.
Laser safety: Class 1 as defined by IEC825-1 and FDA 21 CFR, chapter 1, subchapter J.

Optical receiver

Line code: NRZ.
Wavelength: 1280 to 1335 nm and 1500 to 1580 nm.
Sensitivity:
STM-16: –28 dBm.
STM-4/1/0: –33 dBm.
STM-0: –34 dBm.
Max input power: –8 dBm.
Fiber pigtail: Multi-mode.

Notes:

1. *Sensitivity and maximum input power specifications are valid in the 0 to +40 °C temperature range.*
2. *Sensitivity and maximum input power specifications are measured at 10^{-10} error rate using a $2^{23} - 1$ test pattern.*
3. *The optical receiver operates over the range 1200 to 1600 nm. Sensitivity and maximum input power specifications are valid in defined wavelength ranges.*

Protected monitor point input

52 Mb/s, 155 Mb/s and 622 Mb/s.
Line code: NRZ.
Level: Nominal 1 V peak-to-peak into 50 ohms.
Connector: SMA female.

Clock reference

Internal: ± 0.5 ppm; stability: ± 3 ppm; Ageing: ± 1 ppm.
Loop-timed: Clock recovered from receiver's SDH input.
External reference: 2 MHz, 2 Mb/s, BITS (1.5 Mb/s), 64 kb/s, 10 MHz.
Connector: 3-Pin Siemens, 120/100 ohm balanced (2M, BITS, 64 kb/s);
BNC, 75 ohm unbalanced (2M, 10 MHz).
Note:
On dual standard configuration (Option 002) the 3-pin Siemens connector is replaced by a Bantam.

Clock trigger

51.840 MHz divided clock output.
Connector: BNC, ECL to –2 V, ac coupled, 50 ohm.

Trigger/error output

60 μsec (nominal) pulse on B1, B2, B3 error, Tx/Rx frame
(TTL level, termination can be 75 ohm or 10 kohm).
Connector: BNC, 75 ohm unbalanced.

Clock offset

± 999 ppm in 0.1 ppm steps; offset accuracy ± 0.02 ppm
Offsets the transmitted STM-n line frequency relative to the selected clock reference.

SDH payload structure

See Figure 2 for details of supported SDH payload mappings.

The foreground STM-n test signal can be mapped into any select channel in the SDH line signal. Background channels can be set to the same as to the foreground or filled with an unequipped signal structure.

Payload test pattern

2^9-1, $2^{11}-1$, $2^{15}-1$, $2^{23}-1$ (inverted or non-inverted), all ones, all zeros, 1010, 1000, 16 bit user word.

SDH tributary scan

Automatically test BER on each SDH tributary for error free operation. Rx setup is used to determine tributary structure and test pattern. (At STM-16/STM-4 the foreground STM-1 will be scanned).
Alarms: Pattern loss.
User selectable BER threshold: Off, >0, $\geq 10^{-3}$,$\geq 10^{-6}$.,

SDH error add

Data (whole frame)[1], frame (A1,A2)[1], B1, B2, MS-REI, HP B3, HP-REI, AU4-IEC, LP BIP-2,
LP-REI, bit[1].
Control: Single, error all, M.P x 10^{-n} (where M.P = 0.1 to 9.9 in 0.1 steps and n = 3 to 9)[2].
N-in-T[3], where N is the number of errors transmitted in time T,
T = 10 ms to 10000s in decade steps.
N = 0 to 640 (STM-0), 1920 (STM-1), 7680 (STM-4), 30720 (STM-16).

1. *No "error all" selection available.*
2. *Max error rate depends on the error type.*
3. *B2 errors only.*

SDH alarm generation

LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-unequipped, TU-AIS, LP-RDI,
TU-LOP, LP-unequipped, H4 LOM.
Control: On/off.

SDH pointer adjustments

Frequency offset: Offset the VC/TU relative to the line rate. In the AU pointer mode the 87:3 sequence is generated. Frequency offset control (±100 ppm in 0.1 ppm steps).
ITU-T G.783 sequences: Initialisation sequence and cool down period
1. Periodic Single,
2. Periodic Burst,
3. Periodic Phase Transient Burst,
4. Alternating Single,
5. Alternating Double,
6. Regular with Added,
7. Regular with Missing.

Programmable interval between regular adjustments.
Regular: Interval between regular adjustments can be programmed as follows:
10 ms $<$ T $<$ 100 ms in 10 ms steps.
100 ms $<$ T $<$ 1 s in 100 ms steps.
1 s, 2 s, 5 s or 10 s.
Single burst: Incrementing burst, decrementing burst, alternating.
Burst size: 1 to 10 adjustments (AU and TU-3),1 to 5 adjustments (TU-2 and TU-12).
Adjustments within the burst are separated by the minimum legal limit (4 frames/ multiframes).
New pointer: New pointer address transmitted with or without a NDF. VC-n payload moves to the user programmed address immediately.

SDH overhead setup	**RSOH:** All bytes (hex/binary) user settable except B1. J0: User byte; 16 byte section trace message. **MSOH:** All bytes (hex/binary) user settable except B2, H1, H2 and H3. (The size bits in H1 col1 are settable). K1K2: See APS messages. S1: Clear test setup of synchronization status message. **VC-4/VC-3 POH:** All bytes (hex/binary) user settable except B3. J1: 64 or 16 byte path trace message. C2: Clear text setup of signal label. **TU-2/TU-12/TU-11 POH:** V5, J2, N2, K4 (hex/binary) user settable. J2: User byte; 16-byte path trace message. V5 (LP signal label): Clear text setup of LP signal label.
SDH overhead monitor	**RSOH, MSOH, VC-4/VC-3 POH, TU-2/TU-12/TU-11 LPOH all bytes** (hex/binary). Text decodes provided for regenerator section trace (J0), synchronization status (S1), HP and LP Signal Labels (C2,V5) ASP/MSP messages (K1K2), HP and LP path trace messages (J1,J2).
APS messages	Clear text setup and decode of protection switching messages. Supports both linear (ITU-T G.783) and ring (ITU-T G.841) messages.
SDH overhead sequence generation	Sequence of up to 5 values transmitted in a selected overhead channel. The transmit duration for each value is user programmable in range 0 to 64000 frames. **Overhead channel:** **RSOH:** A1-A2 (6 bytes), D1-D3 (3 bytes), J0, Z0 , E1, F1. **Media dependent bytes:** Row 2, col. 2; row 2, col. 3; row 3, col. 2; row 3, col. 3. **MSOH:** H1H2 (2bytes), D4-D12 (9 bytes), K1K2 (2 bytes), S1, M0, M1, Z1, Z2, E2. **HPOH:** J1, C2, G1, F2, H4, F3, K3, N1.
SDH overhead sequence capture	A selected overhead channel can be selected for capture. The capture can be triggered manually or on a user-defined receive value. The first 16 different receive values including the trigger are displayed along with the number of frames for which the value has persisted. **Overhead channel:** **RSOH:** A1-A2 (6 bytes), D1-D3 (3 bytes), J0, Z0 , E1, F1. **Media dependent bytes:** Row 2, col. 2; row 2, col. 3; row 3, col. 2; row 3, col. 3. **MSOH:** H1H2 (2bytes), D4-D12 (9 bytes), K1K2 (2 bytes), S1, M0, M1, Z1, Z2, E2. **HPOH:** J1, C2, G1, F2, H4, F3, K3, N1.

SDH overhead BER

2^9–1 PRBS transmitted and analyzed in a single 64 kb/s overhead channel. Single bit errors can be inserted in the transmitted test pattern.
Overhead channel:
RSOH: D1 to D3 (single byte), J0, E1, F1.
MSOH: D4 to D12 (single byte), K1, K2, S1, M1, M0, E2.
HPOH: J1, C2, G1, F2, H4, F3, K3, N1.
Results: Error count, error ratio, error free seconds, % error free seconds, pattern loss seconds

Optical stress test

Payload is overwritten with a block of zeros or ones after scrambling to stress timing recovery circuits.
Range:
2 to 85 bytes – STM-0.
2 to 259 bytes – STM-1.
2 to 1042 bytes – STM-4.
2 to 4174 bytes – STM-16.
CID test: Consecutive 1s digital test to ITU-T G,958 Appendix 1.

DCC add-drop

D1-D3 (192 kb/s), D4-D12 (576 kb/s)
Serial add-drop of DCC channels via RS-449 (15-pin D-type connector).

SDH thru mode

STM-16, STM-4, STM-1, STM-0 through mode
Transparent mode: Signal passes through unaltered. BIPs are not recalculated.

Overhead overwrite: The test features associated with the SOH/POH can be enabled to alter one single or multi-byte overhead channel (ie, errors and alarms, overhead sequences, stress test, APS/MSP messages, DCC insert, overhead BER). In this mode the B1,B2 BIPs are recalculated.

AU-4/AU-3 payload overwrite: Overwrite a selected AU-n channel with the internally generated payload. All other AU-n channels are retransmitted unaltered. All standard transmit test functions are enabled (ie, errors and alarms, adjust pointer, overhead sequences, stress test, overhead BER).

TU-3/TU-12 payload overwrite: Overwrite a selected TU with the internally generated payload. All the other TUs and AUs are retransmitted unaltered. All standard transmit test functions are enabled. (ie, errors and alarms, adjust pointer).

SDH alarm detection

LOS, OOF, LOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, H4-LOM, TU-AIS, TU-LOP, TU-RDI, pattern loss, clock loss, K1/K2 change, power loss, pointer adjust.

SDH error measurements

Measurement control: Manual, single, timed start, power loss.
Error: Frame (A1A2), B1, B2, MS-REI, B3, HP-REI, HP-IEC, LP-REI, LP-BIP-2, bit.
Basic results: Error count, error ratio, alarm seconds.
Performance analysis: ITU-T G.826, G.821, M.2101, M.2110, M.2120.

AlarmScan	Automatically identifies the payload structure then scans each STM/TU channel for alarms and BIP errors. Graphically displays the status of each STM/TU channel. **VC-n:** AU-LOP, AU-AIS, HP-RDI **TU:** AU-AIS, HP-RDI, H4 TU-LOM, TU-LOP, TU-AIS, LP-RDI. **BIP Errors:** B3 or VSBIP-2 associated with each VC-n/TU.
TroubleScan	Scans all possible error and alarm sources simultaneously. Non-zero error counts are displayed in large characters, up to a maximum of four different error counts.
Pointer location graph	**Graphical display:** Shows the variation with time of the AU and TU pointer location. Up to four days of pointer location activity can be monitored. **Implied VC offset:** Calculated from the total +ve and –ve pointer movements since start of the measurement period.
Pointer results	AU and TU Justifications (pointer value, positive count, positive seconds, negative count, negative seconds, NDF seconds, missing NDF seconds, implied AU/TU offset).
Optical power measurement	**Accuracy:** $\pm$ 2 dB; Range: –10 dBm to –30 dBm. **Wavelength:** 1310 nm or 1550 nm. **Resolution:** 0.1 dBm.
Frequency measurement	**STM-16:** Frequency displayed in kHz with a 0.1 kHz resolution. Offset in ppm/kHz $\leq$ **STM-4:** Frequency displayed in Hz with a 1 Hz resolution. Offset in ppm/Hz. **Accuracy:** $\pm$ 1 Hz $\pm$ (internal clock error[1]) $\times$ frequency. [1] *See 'clock reference' for details on internal clock error.*
Stored measurement graphics	10 internal SMG stores (increases with floppy disc drive - number of stores limited only by free disc space). **Bar chart:** Results versus time periods with up to 1 second resolution. **Alarm chart:** Alarms versus time periods with up to 1 second resolution. **Resolution:** 1sec, 1min, 15min, 60min **SDH bar graphs:** Frame (A1A2), B1, B2, MS REI, B3, HP REI, HP IEC, LP REI, LP BIP, bit. **SDH alarms:** LOS, LOF, OOF, AU LOP, AU NDF, AU missing NDF, MS AIS, MS RDI, K1K2 change, HP AIS, HP RDI, H4 LOM, TU LOP, TU NDF, TU missing NDF, LP AIS, LP RDI, pattern sync loss, power loss.

Disk drive

Configurations	Save/recall of instrument configurations to/from floppy disk drive (in addition to the 5 internal stored settings).
Graphics	Save/recall of stored measurements graphics (SMG) to/from floppy disk drive. Extends internal event based storage from 10,000 events to 310,000 events.
Logging	Save measurement results to floppy disk.
PC results format	Save SMG (stored measurement graphics) results in a CSV (comma separated variable) PC compatible format for importing to PC spreadsheets etc.
Screen dumps	Save screen dumps to disk in Windows-compatible .BMP format.
Disk management	Instrument provides the following disk drive features: Copying of instrument measurement graphics files to/from internal instrument storage to/from floppy disk drive. Copying of stored measurement graphics files from internal instrument storage to floppy disk drive. Deleting files or directories from floppy disk drive. Renaming of files. Labeling of floppy disks. Formatting of floppy disks.
Firmware upgrades	Allows the upgrading of instrument firmware from the floppy disk drive.

Graphics/logging

Max test result stores	10 internal SMG stores (stored graphics and data) (increases with floppy disk drive – number of stores limited only by free disk space).
Graphic display or printout	Bar chart (results versus time periods with up to 1 second resolution) for current or stored measurement period.
Storage capacity	10,000 events (increases to 310,000 events with floppy disk drive).
Bar resolution	1 second or 1, 15, 60 minutes.
SONET bar graphs	Frame errors (A1A2), CV-S (B1), CV-L (B2), CV-LFE (REI-L), CV-P (B3), CV-PFE (REI-P), CV-IEC (STS path IEC), CV-V (V5), CV-VFE (REI-V), bit plus all SONET alarms.
Printing/logging	Results, time, date and instrument control settings to internal/external printer or floppy disk drive. **Print/logging period:** 10 minutes, 1 hour, 24 hours, user-defined (10 to 99 minutes, or 1 to 99 hours).

Printers

		OmniBER 720 Option 602	**External Printer**
In-lid	80-column full-width graphics printer.	●	-
Results logging	Logging of instrument results to printer.	●	●
Graphics logging	Logging of instrument graphics results to printer.	●	●
Screen dump	Full-width printing of instrument screen to printer at press of a key.	●	-
Environmental	Printer operating temperature:	5 to 35°C	n/a
	Printer storage temperature:	–15 to +50°C	n/a
	Printer humidity range:	30% to 85% RH	n/a

Remote control/printer interface options

		601
Capability	RS-232-C printer/remote-control interface.	●
	HP-IB printer/remote-control interface.	●
	Parallel printer interface.	●
	LAN remote control interface.	●

General

Preset facility
Complete instrument configurations can be saved in non-volatile memory. Four independent configurations plus one factory default can be saved. Each store has a user-programmable name (disk drive increases storage – number of stores only limited by free disk space).

Supply
90 to 260 Vac nominal;
47 to 63 Hz, 450 VA nominal.

Dimensions
7.5 (H) × 13.40 (W) × 18.5 in (D) (× 20.10 in (D) with lid fitted).
190 (H) × 340 (W) × 470 mm (D) (× 510 mm (D) with lid fitted)

Weight
12 kg (typical); 26 lb.

Internal clock error
Basic accuracy: < 0.5 ppm at 77 °F (25 °C).
Temperature stability: < 3 ppm over operating temperature range.
Ageing rate: < 1 ppm per year.

Environmental
Operating temperature: 32 to 113°F (0 to 45 °C).
Storage temperature: 68 to 168 °F (–20 to + 70 °C).
Humidity range: 15% to 95% RH.

CE mark
ESD/Electrical fast transients/radiated susceptibility: Meets EN50082-1 (1992).
Radiation emissions/conducted emissions: Meets EN55011 (1991).

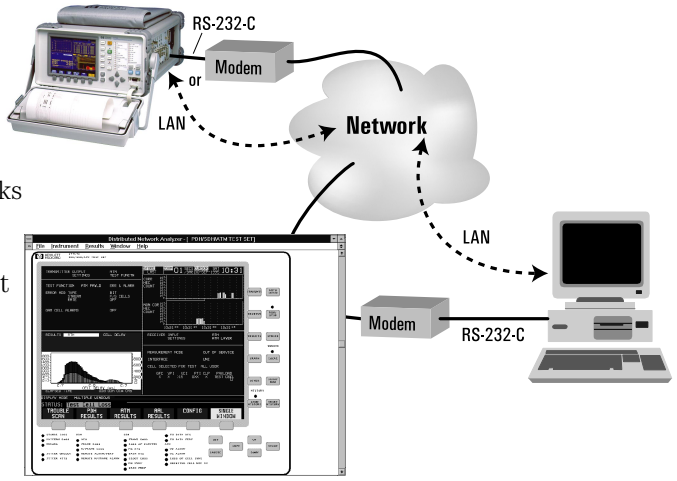
Regulatory standards

Product safety	EN 61010-1 (1993); IEC 1010-1 (1990) + A1 (1992) + A2 (1995); CSA C-22.2 No 1010.1-92.
EMC compatibility	**Immunity:** EN 50082-1 (1992); **Emmissions:** EN 55011 (1991), Group 1 Class A.
Laser safety standards	21 CFR CH.1 1040; EN 60825-1 (1994).

Accessories

Optical accessories	**E4545A:** 3 m fiber optic cable (FC/PC connectors) **E4546A:** FC/PC 15 dB attenuator.
Optical coupler	**15744B:** In-lid optical coupler. **15744C:** In-pouch optical coupler.
Carrying cases	**15910B:** Soft, vinyl carrying case. **15772C:** Hard, robust transit case.
Rack mount kit	**15989A:** Rack mount kit. **15990A:** Connector access panel (see publication number 5968-2793E).
Warranty	3-year warranty as standard.
Calibration certificate	**Option UK6:** Commercial calibration certificate with test data.
Graphics printer paper	**9270-1360:** Printer paper.

Distributed network analyzer (DNA) features



Use E4540A (Version A.03.20 or later) DNA software to pin-point elusive network faults and identify links with poor performance. The DNA software's long-term testing and automatic results logging capability let you easily monitor the quality of service you provide to key customers.

Monitor the network to identify performance and signal degradation. Interactively control analyzers for faster problem resolution.

Create and run your own customized test sequences effectively.

Transfer results to other Windows®-based applications and provide detailed quality-of-service
information for managers and customers.

Distributed/remote testing

E4540A
distributed network

PC/laptop/MS Windows® software (Windows NT or Windows 95) that allows control of the OmniBER family of analyzers via a virtual instrument display. Allows remote user to store and recall instrument configurations, create and run test sequences, transfer test results to other Windows-based applications and provide quality-of-service information for managers and customers.

Option 0A9: License to use up to 10 copies.
Option UAT: License to use unlimited copies.

For full details of centralized testing using the OmniBER 720 analyzer and other telecom testers from Agilent Technologies, please ask your local Agilent representative for further information.

Also order an RS-232-C or LAN remote control interface (option 601).

Notes

OmniBER 720 is a
Class 1 laser product
EN60825-1: 1994

Class I laser product
FDA 23 CER CH.1 1040.10 (1994)

MS Windows and Windows are US trademarks of Microsoft Corporation.

Agilent Technologies manufactures the OmniBER 720 analyzer under a quality system approved to the international standard ISO 9001 plus TickIT (BSI Registration Certificate No FM 10987).

Notes