HEWLETT PACKARD

specification

HP | OmniBER 717 | Communications Performance Analyzer

New dual SONET/SDH and DS1/DS3 capability

SONET (STS-1, STS-3, OC-1, OC-3, OC-12)
SDH (STM-0, STM-1, STM-4, STM-4c)
PDH (704 kb/s, 2/8/34/140 Mb/s)
DSn (DS1, DS3)
ATM (1.5/2/34/45/140 Mb/s, STM-1, OC-3)
Jitter (2/8/34/140/155/622 Mb/s)
Binary (700 kb/s to 170 Mb/s)

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About this document

This technical specification provides detailed product specifications and characteristics appropriate to and covering the HP OmniBER 717 and its options.

Options quick reference

Introduction

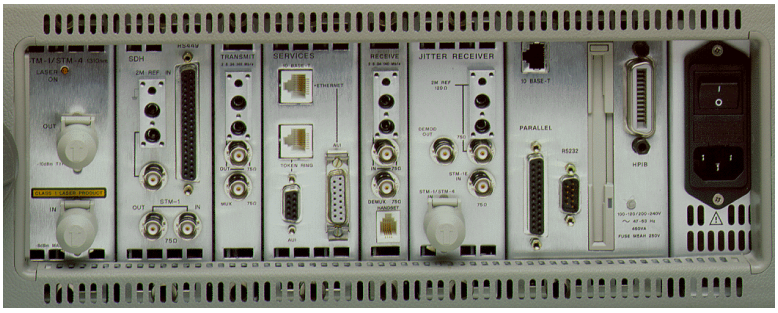
The HP OmniBER 717 is a modular, portable analyzer that supports optical and electrical interfaces for T-Carrier, PDH, SONET, SDH, ATM, jitter and LAN applications from 704 kb/s to 622 Mb/s (OC-12/STM-4).

The HP OmniBER 717 has an easy-to-read color display. It offers an extensive range of T-carrier, PDH, SONET, SDH, ATM, jitter and LAN measurements.

Each analyzer provides dedicated slots for an optical interface and the printer/ remote-control module, plus up to eight slots for other interface and measurement modules. This provides the analyzer with the flexibility to offer dedicated modules for T-Carrier, PDH, SONET/SDH, SDH only, ATM, and jitter which can be combined together in the one mainframe enabling a range of test requirements to be covered.

The test and interface modules offer a range of measurements including detailed overhead, parity and alarm testing as well as frequency offset tolerance tests, frequency measurement and optical power measurement. The analyzers also offer enhanced test features like pointer sequence generation, overhead access and manipulation, overhead sequence generation and capture, service disruption measurement, plus thru mode capability. The structured T-carrier and PDH modules also offer ITU-T M.2100/ M.2101/M.2110/M.2120 testing with comprehensive ITU-T G.821 and G.826 in-service and out-of-service analysis. Dedicated test hardware provides all results and analysis simultaneously, so all relevant measurements are made in one test run saving time and hence money.

For transmit and receive testing of short-, intermediate- and long-reach optical circuits, there is a choice of 1310 and/ or 1550 nm OC-1/STM-0, OC-3/ STM-1 and OC-12/STM-4 optical modules. Electrical interfaces at STS-1/STM-0 and STS-3/STM-1 are also available, as are jitter generation and measurement interfacing options.



Side view of the HP OmniBER 717 communications performance analyzer

HP OmniBER 717 analyzer with color display and optional in-lid graphics printer

Test/interface/periheral modules supported include:

- STS-1, STS-3/STS-3c, OC-1, OC-3/OC-3c, OC-12/OC-12c measurements
- OC-1, OC-3/OC-3c, OC-12/OC-12c optical (1310/1550 nm) and NRZ interfaces
- STM-0, STM-1, STM-4/STM-4c measurements
- STM-0, STM-1, STM-4/STM-4c optical (1310/1550 nm) and NRZ interfaces
- Structured PDH interfaces at 2/8/34/140 Mb/s
- Structured T-carrier/ETSI interfaces at DS1/DS3/E1/E3
- ATM services layer testing with/without native LAN connectivity
- ATM cell layer generation and measurement for ANSI/ETSI standards(DS1/DS3/E1/E3/OC-3c/STM-1)
- External printer/remote-control interfaces
- In-lid 80 column graphics printer (including screen dump facility).

Features

The HP OmniBER 717 offers powerful, dedicated features that simplify the assessment of networks.

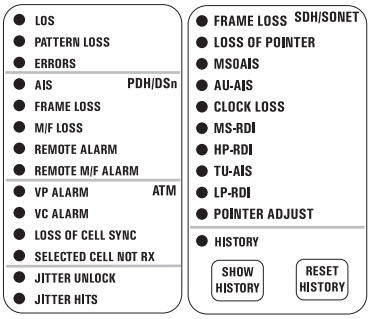
This section covers features as follows:

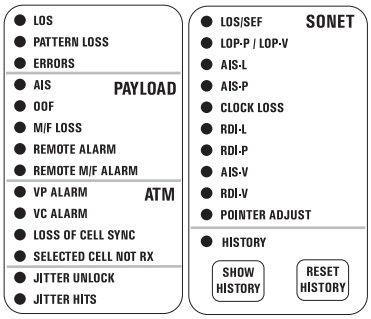
- General
- Optional PDH
- Optional DS1/DS3
- Optional SDH
- Optional SONET
- Optional ATM cell layer
- Optional ATM services
- Optional jitter

General

Status indicators

HP OmniBER 717:

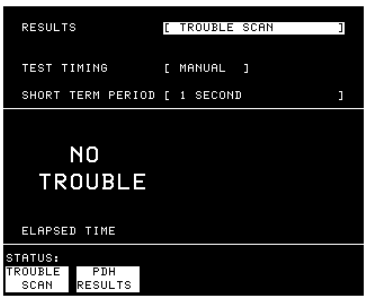




Screen dump

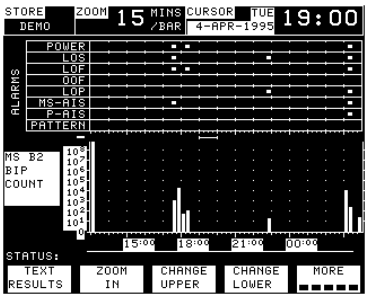
Full-width printing of instrument screen to HP OmniBER 717 analyzer's graphics printer at press of a key.

'Trouble Scan' mode



Use 'Trouble Scan' mode to scan for alarms and to display non-zero error counts in extra large characters.

Stored measurement graphics

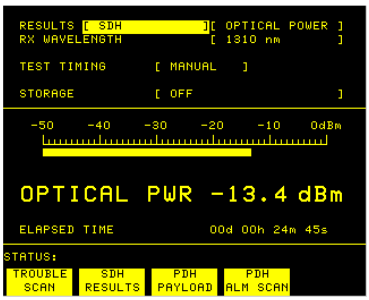


View results graphically. Event-based time and date stamped measurement results are stored by the instrument with a 1 second resolution. A text summary of the results is also available. Graphics displays may be logged to a printer.

Parametric testing

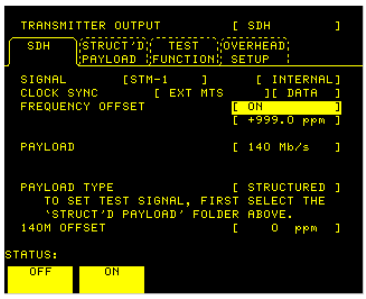
Optical power measurement

(requires optical interface options 130/131 or USN/UKT)



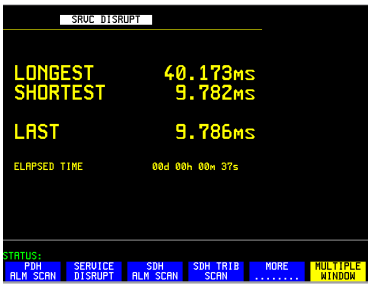
Avoid the need to carry additional optical power meters!

Frequency offset



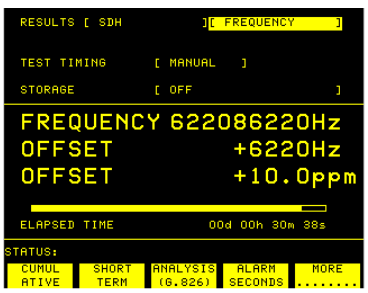
Test the capability of network equipment to reliably recover the clock by varying the clock rate of the generated data and checking for the occurrence of transmission errors.

Protection switch times



Test protection switching mechanisms to ITU-T G.783, G.841 or Bellcore GR-253 limits using the service disruption test.

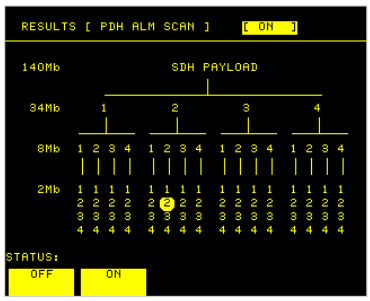
Frequency measurement



Measure the clock frequency and the amount of offset from the Bellcore/ITU-T standard rate. Out-of-service or in-service frequency measurement can be made at all the interface rates.

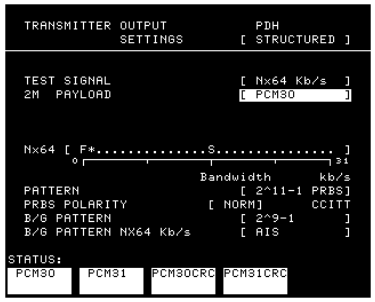
PDH/DSn features

'Alarm Scan' mode



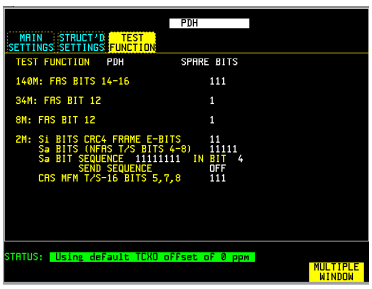
Automatically scan the PDH/DSn network hierarchy carried within an SDH/SONET signal structure for alarms with the press of a key. 'Alarm Scan' mode shows the alarm state of all alarms in a structured signal.

N × 64 kb/s



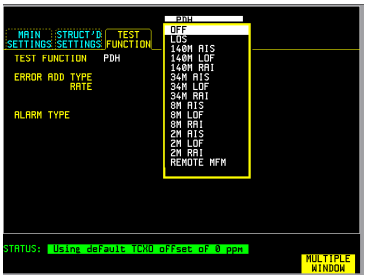
Readily check 64 kb/s or N × 64 kb/s digital paths (to ITU-T G.704: 1 to 31 contiguous and non-contiguous timeslots).

Spare bits access



Modify the spare bits at 2, 8, 34 and 140 Mb/s interface rates. Modify and access the ABCD signaling bits. (CAS multiframe mode).

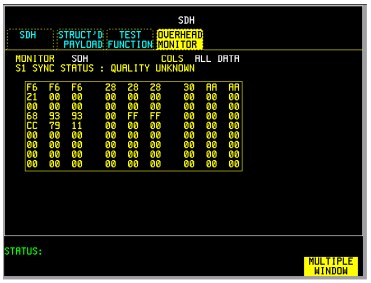
Alarm generation



Check your PDH/DSn network elements and tributary insert ports using the PDH/DSn alarm generation facility.

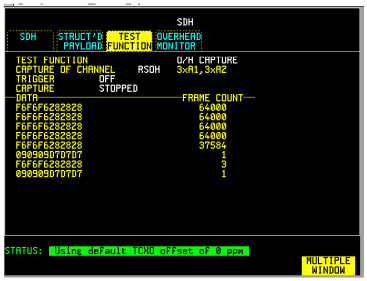
SDH features

Overhead access



View the section and path overhead bytes of a received SDH signal. Bit by bit access of transmitted section and path overhead bytes. Display in hex or binary.

Overhead sequences



Overwrite static values in a single overhead channel with a single or repeated sequence of user-defined values. Detect intermittents by capturing selected section and path overhead channels.

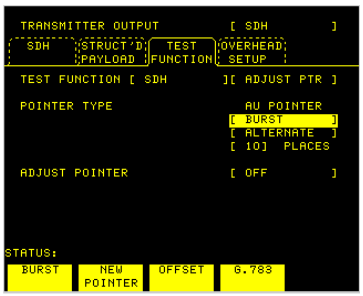
Overhead BER measurement

Perform a BER measurement on a selected section or path channel. Error count, error ratio, error free seconds and % error free seconds are displayed.

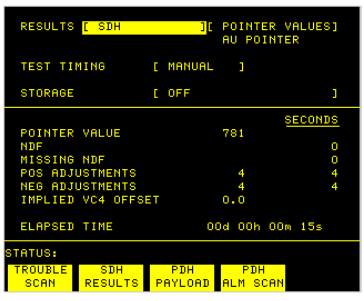
DCC drop and insert

Drop or insert RSOH and MSOH DCC channels via the SDH module's RS-449 connector.

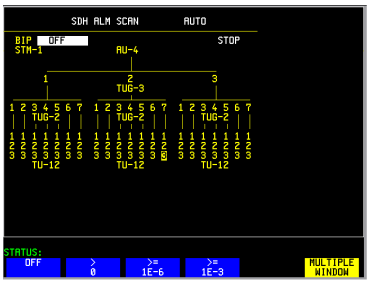
Pointer adjustments and analysis



Make positive and negative adjustments with added and canceled pointers as per ITU-T G.783 plus 87:3 pointer test sequence, then view the AU and TU pointer value and AU and TU positive and negative adjustments.

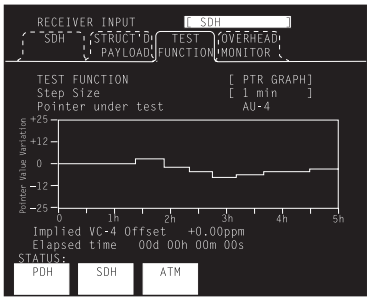


SDH alarm scan



In-service SDH alarm and BIP scan automatically scans all TU-n tributaries within a received STM-n signal allowing fast sectionalization of faults. Auto scan facilities automatically determines the received signal structure.

Pointer location graph



Determine the synchronization status of your network by monitoring the received AU/TU pointer value over time. Check for wander problems or excessive pointer movements.

PDH drop and insert

Drop/insert of 34/140/2 Mb/s to or from an STM-1/STM-4 signal.

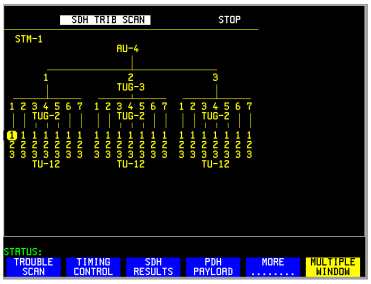
Thru mode

Use the STM-0/STM-1/STM-4 thru mode for in-service monitoring where no protected monitor points are available.

Mixed payloads

Generate mixed TU-3 and TU-12 signal structures in order to test network elements, configured to carry mixed 2 Mb/s and 34 Mb/s traffic.

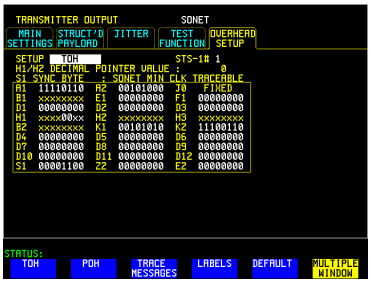
SDH tributary scan



Automatic verification of VC-n paths within an ADM etc, using the out-of-service tributary scan for faster installation testing.

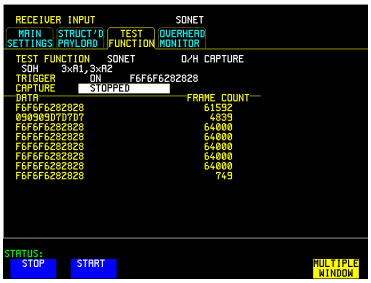
SONET features

Overhead access



View the transport and path overhead bytes of a received SONET signal. Bit by bit access of transmitted section and path overhead bytes. Display in hex or binary.

Overhead sequences



Overwrite static values in a single overhead channel with a single or repeated sequence of user-defined values. Detect intermittents by capturing selected section and path overhead channels.

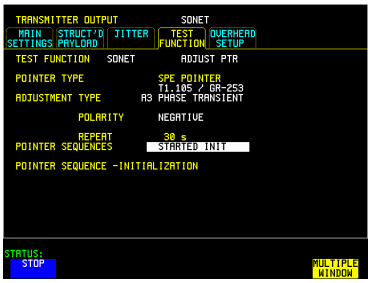
Overhead BER measurement

Perform a BER measurement on a selected section, line or path channel. Error count, error ratio, error free seconds and % error free seconds are displayed.

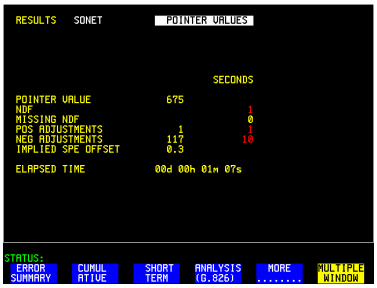
DCC drop and insert

Drop or insert TOH and TOH DCC channels via the SONET/SDH module's RS-449 connector.

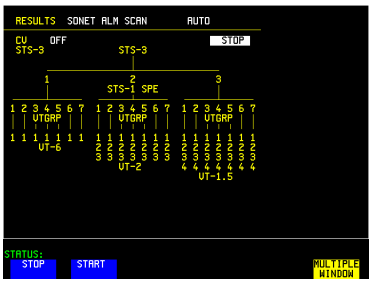
Pointer adjustments and analysis



Make positive and negative adjustments with added and canceled pointers as per ANSI T1.105.03 plus 87:3 pointer test sequence, then view the SPE and VT pointer value and SPE and VT positive and negative adjustments.

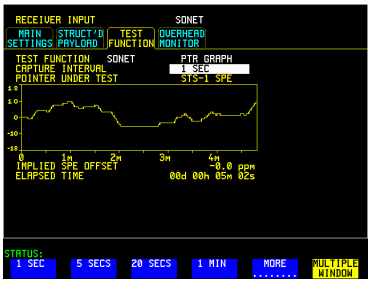


SONET alarm scan



In-service SONET alarm and BIP scan automatically scans all VTn tributaries within a received OC-n/STS-n signal allowing fast sectionalization of faults. Auto scan facilities automatically determines the received signal structure.

Pointer location graph



Determine the synchronization status of your network by monitoring the received SPE/VT pointer value over time. Check for wander problems or excessive pointer movements.

DSn/PDH drop and insert

Drop/insert of DS1/DS3/2M to or from an OC-3/OC-12 signal.

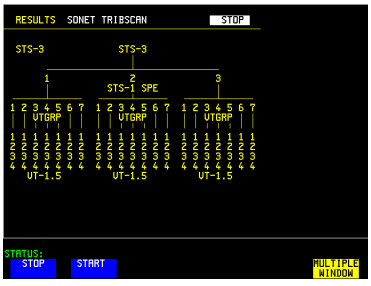
Thru mode

Use the OC-1/OC-3/OC/12 thru mode for in-service monitoring where no protected monitor points are available.

Mixed payloads

Generate mixed STS-1 signal structures within STS-3/OC-3 signal structures in order to test network elements.

SONET tributary scan

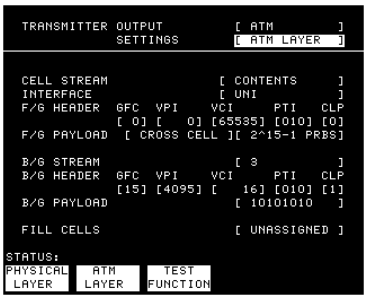


Automatic verification of VTn paths within an ADM etc, using the out-of-service tributary scan for faster installation testing.

ATM features

Change cell stream bandwidth to obtain quickly quality-of-service data for the ATM network.

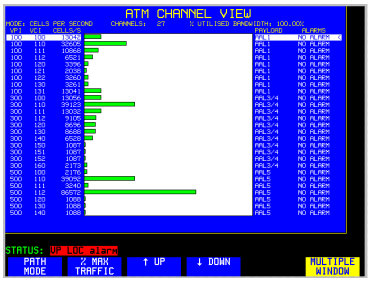
A single ATM virtual channel (VC) is set up as the foreground test signal. The remaining bandwidth is then filled with background VCs and idle or unassigned cells.



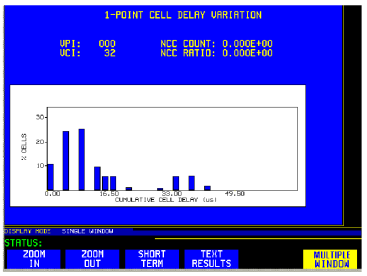
Set cell content to ITU-T O.191 test cells for cell performance measurements (eg, cell loss, delay, misinsertion or errors), PRBS or user defined pattern.

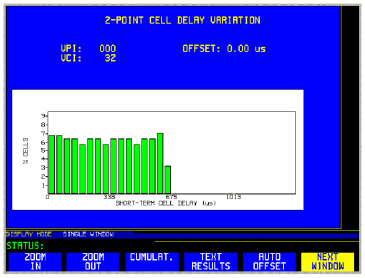
Channel View

Find and identify the VPI/VCI of up to 1023 channels, showing cell rates or percentage for all found VCs; VPI display filter, AAL type and ATM alarms displayed against each VC.



Cell delay

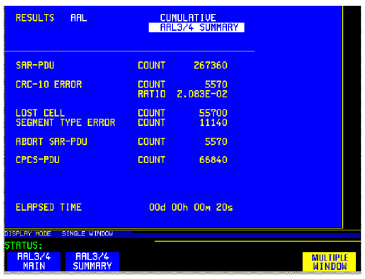




Graphical display for 1-point and 2-point cell delay variation (ITU-T I.356) and non-conforming cell count.

AAL monitoring

(AAL-1, AAL-3/4, AAL-5)

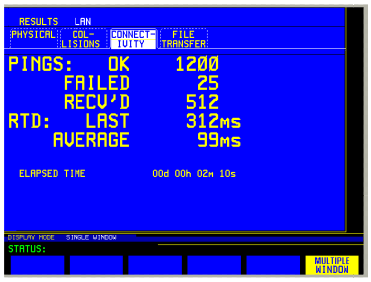


SAR-PDU counts/rate, CRC errors, sequence errors, lost cell count, aborted PDUs and length errors.

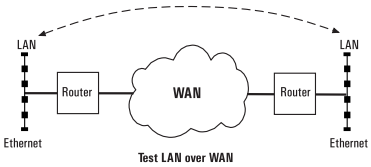
VC rate history

Graphical display of maximum, mean and minimum cell rate on a chosen VC for short or extended periods (up to a month).

Native LAN



Ethernet LAN interfaces; 'ping' tests for lost packet counts; round trip delay under different load conditions. Verification of file transfer and transfer time.

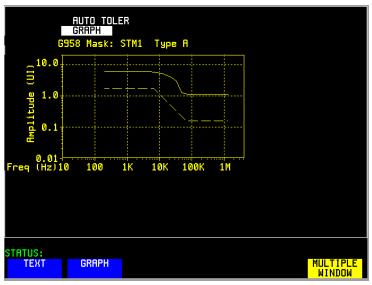


Test LAN over WAN

After installing a native LAN over WAN service and before handing over to the customer, you'll want to be certain that the service performs properly. Using the provided IP protocol, you can readily check latency (delay) and connectivity in such installations.

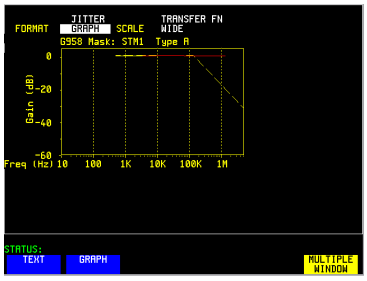
Jitter features

Jitter tolerance



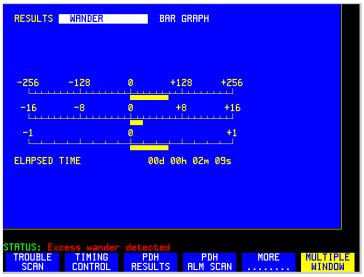
Use the automatic jitter tolerance test to verify network equipment's performance margins relative to ITU-T G.823 (PDH) and G.958 (SDH) jitter masks.

Jitter transfer

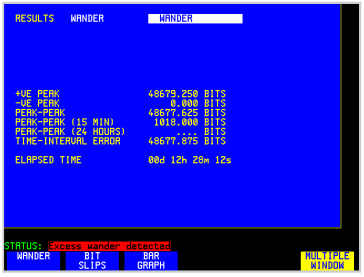


Automatic jitter transfer test (with narrow bandwidth selective filtering) tests jitter accumulation in regenerative repeators etc.

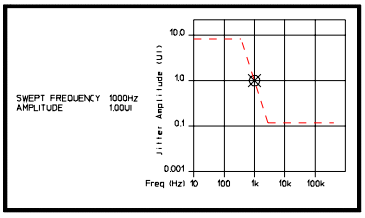
Wander measurement



View current measurements in graphical or text format on the results display. Three +ve and –ve sliding graphs, each showing ± 1 UI, ± 16 UI and ± 256 UI are provided.

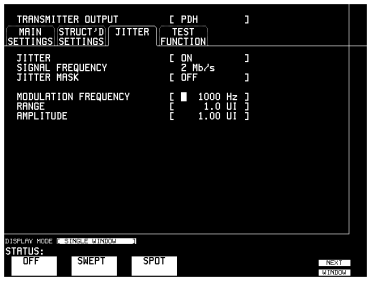


Jitter sweep

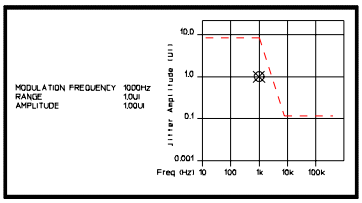


Sweep the ITU-T G.823 (PDH) and G.958 (SDH) jitter masks to quickly check for jitter tolerance problems. View the progress of the jitter sweep on the analyzer's display.

Spot frequency

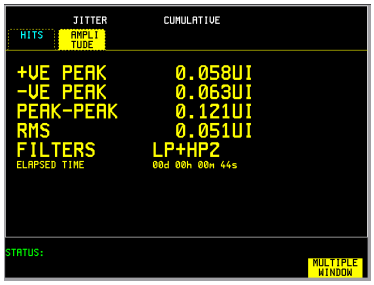


Alternatively, reproduce and further investigate those jitter problems by generating a specified amplitude of jitter at a spot frequency.



The analyzer's display shows the generated value of jitter relative to the ITU.T mask.

Output jitter



Perform PDH and SDH ouput jitter measurements to ITU-T G.783, G.825 with ITU-T O.171 LP, HP1 and HP2 filters. RMS jitter measurements to ITU-T G.958 are also available with additional 12 kHz HP filter.

Capability summary

SDH and DSn/PDH supported configurations

PDH/ATM cell test and PDH interfaces

Option UKK *Page 14*
Unstructured PDH: 0.7, 2, 8, 34 and 140 Mb/s.

Option UKJ *Page 14*
Structured PDH generation and measurement: 2, 8, 34 and 140 Mb/s.

Option UKN *Page 14, 53*
ATM cell generation and analysis: 2, 34 and 140 Mb/s (includes all capability of option UKJ structured PDH).

Option UH3 *Page 73*
Binary (NRZ) clock and data Tx/Rx interfaces plus external clock input. Must also order option UKK, UKJ, UKN or 110.

Option UHC *Page 76*
Three additional 2, 8, 34 and 140 Mb/s outputs. Must also order option UKK, UKJ or UKN.

Option 110 *Page 18*
Structured: DS1, DS3, E1, E3.

STM-0, STM-1e test and interfaces

Option A3R *Page 22*
STM-0e (52 Mb/s) and STM-1e (155 Mb/s) electrical interface: STM-0/STM-1 overhead access, thru mode and pointer sequence generation and full ITU-T G.707 mappings.

STM-1 and STM-4 interfaces

Option UH1 *Page 29, 67*
STM-1 (1310 nm).

Option 130 *Page 30*
Combined STM-0, STM-1 and STM-4 (1310 and 1550 nm), STM-0, STM-1 and STM-4 overhead access, optical power measurement.

Option 131 *Page 30*
Combined STM-0, STM-1 and STM-4 (1310 nm), STM-0, STM-1 and STM-4 overhead access, optical power measurement.

Option 0YH *Page 72*
STM-0, STM-1 and STM-4 NRZ interfaces. Must also order option 130 or 131.

(See Note 1)

Jitter, wander and slips testing

Option A3K *Page 40*
PDH and SDH jitter and wander generation.

Option 140 *Page 40*
PDH and SDH jitter generation.

Option UHN *Page 45*
PDH jitter measurement: 2, 8, 34 and 140 Mb/s.

Option A3L *Page 45*
STM-1e line and PDH jitter measurement: 2, 8, 34, 140 and 155 Mb/s.

Option A3V *Page 45*
STM-1o, STM-1e line and PDH jitter measurement: 2, 8, 34, 140 Mb/s electrical and 155 Mb/s electrical and optical.

Option A3N *Page 45*
STM-4o, STM-1o, STM-1e line and PDH jitter measurement: 2, 8, 34, 140 Mb/s electrical, 155 Mb/s electrical and optical and 622 Mb/s optical.

Note 1: *All optical interface modules require the STM-0e/STM-1e test and interface module (option A3R).*

Dual standard SONET/SDH and DSn/PDH supported configurations

PDH/DSn interfaces

Option 110 *Page 18*
Structured: DS1, DS3, E1, E3.

Option UKK *Page 14*
Unstructured PDH: 0.7, 2, 8, 34 and 140 Mb/s.

Option UKJ *Page 14*
Structured PDH: 2, 8, 34 and 140 Mb/s.

Option UKN *Page 14, 53*
ATM cell: 2, 34 and 140 Mb/s (includes all capability of option UKJ).

Option UH3 *Page 73*
Binary (NRZ) clock and data plus external clock input. Must also order option UKK, UKJ, UKN or 110.

SONET/SDH test and interfaces

Option 120 *Page 34*
STS-1/STM-0e (52 Mb/s) and STS-3/STM-1e (155 Mb/s) electrical interface: Overhead access, thru mode and pointer sequences. Full ITU-T G.707 and Bellcore G-253 mappings.

Optical interfaces

Option UH1 *Page 29, 67*
155 Mb/s (1310 nm).

Option 130 *Page 30*
622/155/52 Mb/s optical interface (1310 and 1550 nm), optical power measurement.

Option 131 *Page 30*
622/155/52 Mb/s optical interface (1310 nm), optical power measurement.

Option 0YH *Page 72*
622/155/52 Mb/s binary (NRZ) interfaces. Must also order option 130 or 131.

(See Note 1)

Jitter, wander and slips testing – generation*

Option A3K *Page 40*
PDH, 155 Mb/s, 622 Mb/s jitter and wander generation.

Option 140 *Page 40*
As option A3K, but without wander generation.

Jitter, wander and slips testing – measurement*

Option UHN *Page 45*
PDH jitter measurement.

Option A3L *Page 45*
155 Mb/s electrical and PDH jitter measurement.

Option A3V *Page 45*
155 Mb/s optical, electrical and PDH jitter measurement.

Option A3N *Page 45*
622 and 155 Mb/s optical, electrical and PDH jitter measurement.

Note 1: *All optical interface modules require the SONET/SDH test and interface module (option 120).*
** Jitter capability does not include DS1/DS3. Synchronous line rate measurements are to ITU-T specifications.*

Broadband test plug-in modules

ATM cell test and PDH interfaces

Option UKN[1] *Page 14, 53*
ATM cell generation and analysis: 2, 34 and 140 Mb/s (includes all capability of option UKJ structured PDH).

Option UKZ[2] *Page 56*
Generation and measurement of ATM payloads: 1.544 (DS1), 44.736 (DS3), 2.048 (E1) and 34.368 (E3) Mb/s.

[1] *ITU-T*
[2] *ANSI/ITU-T*

ATM services layer test

Option 0YK *Page 60*
Adds Channel View, graphical display of CDV, AAL analysis, rate history, benchmark traffic generation. Must also order option UKN or UKZ.

Option USL *Page 60*
Adds Ethernet LAN connectivity testing plus all features of option 0YK. Must also order option UKN or UKZ.

STM-1e test and interfaces

Option A1T *Page 63*
STM-1e (155 Mb/s) electrical interface from ATM testing.

Optical interfaces

Option UH1 *Page 29, 67*
155 Mb/s (1310 nm).

Option USN *Page 68*
Combined STM-1 and STM-4 (1310 and 1550 nm) STM-1 and STM-4 overhead access, optical power measurement.

Option UKT *Page 68*
Combined STM-1 and STM-4 (1310 nm), STM-1 and STM-4 overhead access, optical power measurement.

Option UH3 *Page 73*
Binary (NRZ) clock and data Tx/Rx interfaces plus external clock input. Must also order option UKK, UKJ or UKN.

Jitter, wander and slips testing

Option A3K *Page 40*
PDH and SDH jitter and wander generation.

Option 140 *Page 40*
PDH and SDH jitter generation.

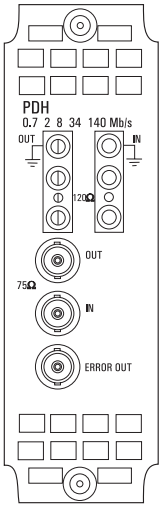
Option UHN *Page 45*
PDH jitter measurement: 2, 8, 34 and 140 Mb/s.

Option A3L *Page 45*
STM-1e line and PDH jitter measurement: 2, 8, 34, 140 and 155 Mb/s.

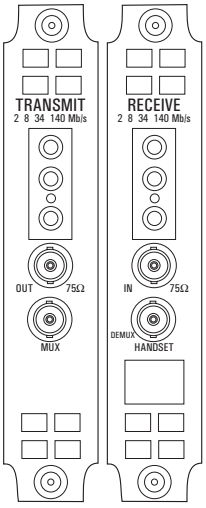
Option A3V *Page 45*
STM-1o, STM-1e line and PDH jitter measurement: 2, 8, 34, 140 Mb/s electrical and 155 Mb/s electrical and optical.

Option A3N *Page 45*
STM-4o, STM-1o, STM-1e line and PDH jitter measurement: 2, 8, 34, 140 Mb/s electrical, 155 Mb/s electrical and optical and 622 Mb/s optical.

PDH



Option UKK



Option UKJ
Option UKN

Option UKK
Unstructured PDH: 0.7, 2, 8, 34 and 140 Mb/s.

Option UKJ*
Pair of modules providing structured PDH generation and measurement: 2, 8, 34 and 140 Mb/s.

Option UKN
Pair of modules providing ATM cell generation and analysis: 2, 34 and 140 Mb/s (includes all capability of option UKJ structured PDH).

Key to all tables
● = compliance
– = non-compliance

PDH test options

		Unstructured PDH	Structured PDH
		UKK	**UKJ* , UKN**
OUT and IN ports (used for transmit and receive)			
Type	Electrical: To ITU-T G.703.	●	●
Connectors	BNC, 75 ohm, unbalanced and Siemens 3-pin, 120 ohm balanced. *(Small Siemens 75 ohm unbalanced option available.)*	●	●
Rate	PDH: 704 kb/s.	●	–
	PDH: 2.048, 8.448, 34.368 and 139.264 Mb/s.	●	●
	ATM: 2.048, 34.368, 139.264 and 155.52 Mb/s‡.	–	●
	‡ *For ATM you require option UKN and for 155.52 Mb/s you also require an STM-1 test option (option A3R or A1T).*		
PDH transmitter			
Clock timing	Internal: All rates.	●	●
	Recovered (loop timed): From 704 kb/s input.	●	–
	Recovered (loop timed): From 2.048 Mb/s input.	●	●
	Recovered (loop timed): From 8.448, 34.368 and 139.264 Mb/s input.	–	●
Frequency offset generation	Up to ± 100 ppm in 1 ppm steps.	●	●
Test pattern	PRBS (to ITU-T O.151): $2^{15}-1$ and $2^{23}-1$.	●	●
	PRBS: $2^{9}-1$, $2^{11}-1$ and $2^{20}-1$.	–	●
	Word: User-defined 16-bit word, all ones, all zeros, 1010, 1000.	●	●
Output	704 kb/s: HDB3 or AMI balanced/unbalanced.	●	–
	2.048 Mb/s: HDB3 or AMI balanced/unbalanced.	●	●
	8.448 Mb/s: HDB3 or AMI unbalanced.	●	●
	34.368 Mb/s: HDB3 unbalanced.	●	●
	139.264 Mb/s: CMI unbalanced.	●	●
Bit error add	1 in 10^{3}.	●	●
	1 in 10^{4}, 1 in 10^{5}, 1 in 10^{6} and 1 in 10^{7}.	–	●
	Single error.	●	●

**Adding ATM (option UKN) capability to structured PDH (option UKJ) can be accomplished via a firmware upgrade.*

PDH test options (continued)

		Unstructured PDH UKK	Structured PDH UKJ, UKN
Frame error add	1 in 10^3, 1 in 10^4, 1 in 10^5, 1 in 10^6, 1 in 10^7 and error one to four consecutive frames.	–	●
Code error add	2.048, 8.448, 34.368 Mb/s: 1 in 10^3, 1 in 10^4, 1 in 10^5, 1 in 10^6, 1 in 10^7 and single error.	–	●
CRC4 error add	1 in 10^3, 1 in 10^4, 1 in 10^5, 1 in 10^6, 1 in 10^7 and single error.	–	●
REBE error add	1 in 10^3, 1 in 10^4, 1 in 10^5, 1 in 10^6, 1 in 10^7 and single error.	–	●
Alarm generation	LOS, AIS, LOF, RAI, RMFAI, CASMFL.	–	●
Spare bits generation	The following spare bits may be modified: 140 Mb/s: FAS bits 14 to 16. 34 Mb/s: FAS bit 12 8 Mb/s: FAS bit 12. 2 Mb/s Si bits (international bits): Timeslot 0 bit 1 in both FAS and NFAS frames. 2 Mb/s E bits: CRC4 frames 13 and 15; timeslot 0 bit 1. 2 Mb/s Sa bit (national bits): NFAS timeslot bits 4 to 8 . 2 Mb/s Sa bit sequences: An 8 bit sequence may be transmitted in any selected NFAS Sa bit when CRC4 framing has been selected. The sequence appears in odd-numbered CRC4 frames, starting at frame 1. 2 Mb/s CAS multiframe: MFAS timeslot bits 5, 7 and 8.	–	●
CAS signaling bits generation	Modify the ABCD signaling bits (timeslot 16 CAS multiframe only).	–	●
Tx frame formats	All rates: Unframed only. All rates: Unframed, framed and structured. 2.048 Mb/s: To ITU-T G.706 and G.732 (No MFM, CAS, CRC4 MFM, CAS + CRC4 MFM). 2.048 Mb/s: N × 64 kb/s to ITU-T G.704. 8.448 Mb/s: To ITU-T G.742. 34.368, 139.264 Mb/s: To ITU-T G.751.	● – – – – –	– ● ● ● ● ●
Test signal at any level within signal structure	N × 64 kb/s, 64 kb/s, 2.048, 8.448, 34.368 and 139.264 Mb/s.	–	●
Test signal at interface rate only	704 kb/s, 2.048, 8.448, 34.368 and 139.264 Mb/s.	●	–
Background patterns	Unframed $2^9 - 1$ PRBS, AIS or same pattern as foreground test signal.	–	●
Ext 2 Mb/s mux input	To ITU-T G.703, unbalanced HDB3 signal.	–	●

PDH receiver

Jitter tolerance	To ITU-T O.171.	●	●
Equalization at f/2	To ITU-T G.703. 704 kb/s. 2.048, 8.448 Mb/s. 34.368, 139.264 Mb/s.	● 6 dB 6 dB 12 dB	● – 6 dB 12 dB
Monitor point compensation	704 kb/s. 2.048, 8.448 Mb/s. 34.368, 139.264 Mb/s.	26 to 30 dB 26 to 30 dB 26 dB	– 20, 26 or 30 dB 20 or 26 dB
Frame formats	All rates: Unframed and framed. All rates: Structured. 2.048 Mb/s: To ITU-T G.706 and G.732 (No MFM, CAS, CRC4 MFM, CAS + CRC4 MFM). 2.048 Mb/s: N × 64 kb/s to ITU-T G.704. 8.448 Mb/s: To ITU-T G.742. 34.368, 139.264 Mb/s: To ITU-T G.751.	● – ● – ● ●	● ● ● ● ● ●

PDH test options (continued)

		Unstructured PDH UKK	Structured PDH UKJ, UKN
Frequency measurement	Frequency displayed in Hz, 1 Hz resolution. Offset displayed in ppm and Hz.	●	●
Ext. 2 Mb/s demux output	Nominally to ITU-T G.703, unbalanced HDB3 signal only.	–	●
Autosetup	Bit rate, code, framing and level of incoming signal. Test pattern for unframed and framed signals.	●	●
Errors (out-of-service)	Error count and ratio: Bit, code.	●	–
Errors (ISM only†)	Error count and ratio: Code, frame.	●	–
Errors	Error count and ratio: Bit, code, frame. CRC4 (2.048 Mb/s only), REBE (2.048 Mb/s only).	–	●
Alarm indication (out-of-service)	AIS, LOS, pattern sync loss, errors present.	●	●
Alarm seconds (out-of-service)	As for alarm indication above, plus power loss.	●	●
Alarm indication (ISM only†)	All rates: AIS, frame loss, LOS, pattern sync loss, remote alarm, errors present; 2 Mb/s: CAS/CRC multiframe loss, remote multiframe alarm.	●	–
Alarm seconds (ISM only†)	As for alarm indication above, plus power loss.	●	–
Alarm indication	All rates: AIS, frame loss, LOS, pattern sync loss, remote alarm, minor alarm, errors present; 2 Mb/s: CAS/CRC multiframe loss, remote multiframe alarm.	–	●
Alarm seconds	As for alarm indication above, plus power loss.	–	●
G.821 analysis (out-of-service)	(Bit): EC, SES, %SES, ES, %ES, EFS, %EFS, unavailability, %unavailability, degraded minutes, %degraded minutes, code error seconds, elapsed time (including Annex D).	●	–
G.821 analysis (ISM only†)	(Frame, CRC, REBE): EC, SES, %SES, ES, %ES, EFS, %EFS, unavailability, %unavailability, degraded minutes, %degraded minutes, code error seconds, elapsed time.	●	–
G.821 analysis	(Bit, frame, CRC, REBE): EC, SES, %SES, ES, %ES, EFS, %EFS, unavailability, %unavailability, degraded minutes, %degraded minutes, code error seconds, elapsed time (including Annex D for bit errors).	–	●
G.826 analysis (CRC, REBE)	Errored blocks (EB), errored seconds (ES), severely errored seconds (SES), unavailable second count (UAS), path unavailable second count (PUAS), background block error count (BBE), errored second ratio (ESR), severely errored second ratio (SESR), background block error ratio (BBER).	–	●
M.2100 error analysis (out-of-service)	Same as G.821 (bit errors only).	●	–
M.2100 error analysis (ISM only†)	(Frame, CRC, REBE): Tx ES, Tx SES, Rx ES, Rx SES, unavailability.	●	–
M.2100 error analysis	(Bit frame, CRC, REBE): Tx ES, Tx SES, Tx UNAV, Rx ES, Rx SES, Rx UNAV.	–	●
M.2110 bringing into service test	2 hour, 24 hour and 7 day PASS/–?–/FAIL indication. Run a 24 hour out-of-service test using a PRBS. After 24 hours the instrument compares ES, SES and UAS results against the S1 and S2 thresholds derived from the path allocation and flags either PASS/–?–/FAIL. The 7 day test is then performed on uncertain paths (–?–) during the 24 hour test, ie, run contiguously for a further 6 days.	–	●

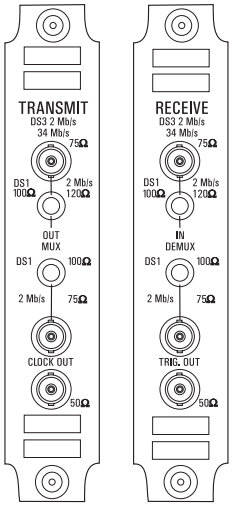
† ISM = In-service measurement mode on framed signals (unstructured PDH option UKK).

PDH test options (continued)

		Unstructured PDH UKK	Structured PDH UKJ, UKN
M.2120 in-service test for maintenance	Contiguous 15 minute (T1) and 24 hour (T2) periods with TR1 and TR2 threshold reports. Based on the user entered path allocation and maintenance factors, the T1-ES, T1-SES, T2-ES and T2-SES thresholds are calculated. A single threshold report (TR1 for 15 minute, TR2 for 24 hour) is generated when any of the relevant thresholds are exceeded within each 15 minute or 24 hour period.	–	●
Spare bit display (ISM only†)	At all rates. NFAS (2 Mb/s), multiframe sync (2.048 Mb/s CAS), FAS (8.448, 34.368 to 139.264 Mb/s).	●	–
Error output	One pulse per bit error or code error. Nominal ECL, 75 ohm –2 V BNC.	●	–
Round trip delay	Up to 2 seconds delay between transmit and receive.	–	●
Alarm scan	Automatically scans the PDH network hierarchy for alarms (frame loss, AIS and remote alarms).	–	●
CAS signaling bit monitor	Displays the ABCD signaling status of all 30 timeslots (timeslot 15 CAS multiframe only).	–	●
N × 64 kb/s	To ITU-T G.704; 1 to 31 contiguous and non-contiguous timeslots.	–	●
Telephone handset connection	Provides full talk/listen capability – RJ11 connector (Telephone handset accessory available – HP 15722A).	–	●

† *ISM = In-service measurement mode on framed signals (unstructured PDH option UKK).*

DS1/DS3/E1/E3 structured test interfacing



Option 110

Option 110
Pair of modules providing structured DSn and PDH generation and measurement at DS1 (1.5 Mb/s), DS3 (45 Mb/s) and E1 (2 Mb/s), E3 (34 Mb/s).

DS1/DS3/E1/E3 structured test interfaces

		Structured DSn/PDH
		110
OUT and IN ports (used for transmit and receive)		
Type	Electrical: To ANSI T1.102-1993; ITU-T O.171, G.703.	●
Connectors	DS1 (1.554 Mb/s): WECO bantam, 100 ohm balanced. DS3 (44.736 Mb/s): BNC, 75 ohm, unbalanced. E1 (2.048 Mb/s): BNC, 75 ohm, unbalanced and WECO bantam, 120 ohm balanced. E3 (34.368 Mb/s): BNC, 75 ohm, unbalanced.	●
Rate	1.544, 2.048, 34.368, 44.736 Mb/s.	●
DSn/PDH transmitter		
Clock timing	Internal: All rates; Recovered by the receiver.	●
Frequency offset generation	Up to ± 100 ppm in 1 ppm steps.	●
Clock output	Selected transmitter clock (internal or looped receiver clock) used to generated DS1/DS3/E1/E3 test output signal. (BNC connector, externally terminated 50 ohm to ground).	●
Line coding	DS1: B8ZS, AMI. DS3: B3ZS. E1: AMI, HDB3. E3: HDB3.	●
Output level	DS1: DSX-1, DS1-LO. DS3: DS3-HI, DSX-3, DS3-900'	●

DS1/DS3/E1/E3 structured test interfaces (continued)

		Structured DSn/PDH
		110
Framing	All rates: Unframed, framed and structured. DS1: SF (D4), SLC-96. DS1: ESF to ANSI T1.403-1989, Bellcore TR-TSY-000499 and ITU-T G.704; the ESF data link (DL) defaults to repetition of idle code (01111110). DS3: M13 to ANSI T1.107-1995. DS3: C-bit parity to ANSI T1.107a-1990. E1: To ITU-T G.706/G.732. E3: To ITU-T G.751. N × 64 kb/s structured to ITU-T G.704 for E1, E3 N × 64 kb/s and N x 56 kb/s structured for DS1 and DS3.	●
Test pattern	PRBS: $2^9 - 1$, $2^{11} - 1$, $2^{15} - 1$, $2^{20} - 1$, $2^{23} - 1$. QRSS (DS1 only). 3-in-24 stress pattern (DS1 only). Word: 1010, 1000, 16 bit user word, all ones, all zeros. The PRBS polarity of patterns is user selectable.	●
Error add	DS1: Bit, FAS (Frame Alignment Signal), BPV/code, CRC-6, EXZ (excess zeros). DS3: Bit, FAS, MFAS (MultiFrame Alignment Signal), BPV/code, parity(P bits), CP (path parity), FEBE, EXZ (excess zeros). E1: Bit, FAS, BPV/code, CRC-4, REBE. E3: Bit, FAS, BPV/code.	●
Error insertion rate	Single. $1.0^E - 3$. $1.1^E - 3$. $1.0^E - 4$ to 9.9E-9. Mantissa step size 0.1, exponent step size 1.	●
Alarm generation	DS1: Loss of signal (LOS); Out of frame (OOF); alarm indication signal (AIS); remote alarm indication (RAI). DS3: LOS; LOF; AIS; RAI; far end alarm and control (FEAC): As per T1.107-1995. E1: LOS, LOF, AIS, RAI. E3: LOS, LOF, AIS, RAI.	●
FEAC code generation	With C-Bit parity framing loopback and alarm/status codes as per ANSI T1.107-1995 can be generated. Loopback codes: A single burst of N loopback codes and M messages where N and M are in the range 1 through 15. Alarm/status codes: Any ANSI T1.107-1995 message or any 0xxxxxx011111111, message where x is selectable, may be transmitted either in a single burst of 1 to 15 times or continuously.	●
Spare bits generation	The following spare bits can be modified; 34 Mb/s: FAS bit 12 2 Mb/s Si bits (international bits): Timeslot 0 bit 1 in both FAS and NFAS frames. 2 Mb/s E bits: CRC4 frames 13 and 15; timeslot 0 bit 1. 2 Mb/s Sa bit (national bits): NFAS timeslot bits 4 to 8 . 2 Mb/s Sa bit sequences: An 8 bit sequence may be transmitted in any selected NFAS Sa bit when CRC4 framing has been selected. The sequence appears in odd-numbered CRC4 frames, starting at frame 1. 2 Mb/s CAS multiframe: MFAS timeslot bits 5, 7 and 8.	●
Signaling bits generation	DS1: User selectable Signaling ON or OFF. When ON user selectable AB bits for SF, ABCD for ESF and AB bits for SLC-96 framing.	●
Background patterns	Unframed $2^9 - 1$ PRBS, AIS or same as test pattern as foreground test signal.	●
Ext DS1 mux input	Weco bantam connector, AMI or B8ZS.	●
Ext 2 Mb/s mux input	BNC to ITU-T G.703, AMI or B8ZS.	●

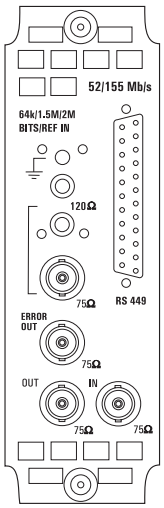
DS1/DS3/E1/E3 structured test interfaces (continued)

		Structured DSn/PDH 110
DSn/PDH receiver		
Type, connectors, rates, line code and framing	As for DSn/PDH transmitter.	●
Jitter tolerance	To Bellcore TR-TSY-000009 (DS1/DS3) and ITU-T O.171.	●
Operating level (terminate)	User selectable as follows: DS1 (balanced): DSX-1 to DS1-LO levels. DS3 (unbalanced): DS3-HI, DSX-3 and DS3-900 levels. E1 (balanced): 3.0 V ± 20% for cable lengths as per ITU-T G.703. E1 (unbalanced): 2.37 V ± 20% for cable lengths as per ITU-T G.703. E3 (unbalanced): 1.0 V ± 20% with automatic equalization for cable lengths as per ITU-T G.703.	●
Monitor point compensation	DS1 (balanced), E1 (balanced and unbalanced): 20, 26 or 30 dB gain relative to terminate mode. E1 (balanced) is restricted to half cable length with respect to ITU-T G.703 for 26 and 30 dB gains. DS3 and E3: 20 or 26 dB gain relative to terminate mode.	●
Framing	All rates: Unframed , framed and structured. DS1: SF (D4), SLC-96. DS1: ESF to ANSI T1.403-1989, Bellcore TR-TSY-000499 and ITU-T G.704. DS3: M13 to ANSI T1.107-1995. DS3: C-bit parity to ANSI T1.107a-1990. E1: To ITU-T G.706/G.732 E3: To ITU-T G.751 N × 64 kb/s structured to ITU-T G.704 for E1, E3 N × 64 kb/s and N x 56 kb/s structured for DS1 and DS3.	●
Frequency measurement	Frequency displayed in Hz, 1 Hz resolution. Offset displayed in ppm and Hz.	●
Error results	DS1 (counts & ratios): Bit, B8ZS/AMI code violations, frame errors, CRC6 errors. DS3 (counts & ratios): Bit, B3ZS code violations, frame errors, P-parity, CP-parity, FEBE. E1 (counts & ratios): Bit, HDB3/AMI code violations, frame errors, CRC4, REBE. E3 (counts & ratios): Bit, HDB3 code violations, frame error.	●
Alarm indication	DS1:LOS, pattern loss, AIS, OOF, Multiframe Loss, RAI, EXZ, Idle DS3:LOS, Pattern loss, AIS, OOF, Multiframe Loss, RAI, EXZ, Idle E1: LOS, Pattern loss, AIS, LOF, RAI, RMFAI, CASMFL E3: LOS, Pattern loss, AIS, LOF, RAI	●
FEAC code indication	With C-Bit parity framing loopback and alarm/status codes are decoded and displayed. Displays shows current and last active FEAC message.	●
G.826 analysis	Errored blocks (EB), errored seconds (ES), severely errored seconds (SES), unavailability seconds (UAS), error second ratio (ESR), severely errored second ratio (SESR), background block error ratio (BBER), path unavailable seconds (PUAS).	●
G.821 analysis	EC, SES, %SES, ES, %ES, EFS, %EFS, unavailability, %unavailability, degraded minutes, (%) degraded minutes, code error seconds, elapsed (including Annex D for bit errors)	●
M.2100 analysis	Tx ES, Tx SES, Rx ES, Rx SES, unavailability	●
M.2110 bringing into service test	2 hour, 24 hour and 7 day PASS/–?–/FAIL indication. Run a 24 hour out-of-service test using a PRBS. After 24 hours the instrument compares ES, SES and UAS results against the S1 and S2 thresholds derived from the path allocation and flags either PASS/–?–/FAIL. The 7 day test is then performed on uncertain paths (–?–) during the 24 hour test, ie, run contiguously for a further 6 days.	●

DS1/DS3/E1/E3 structured test interfaces (continued)

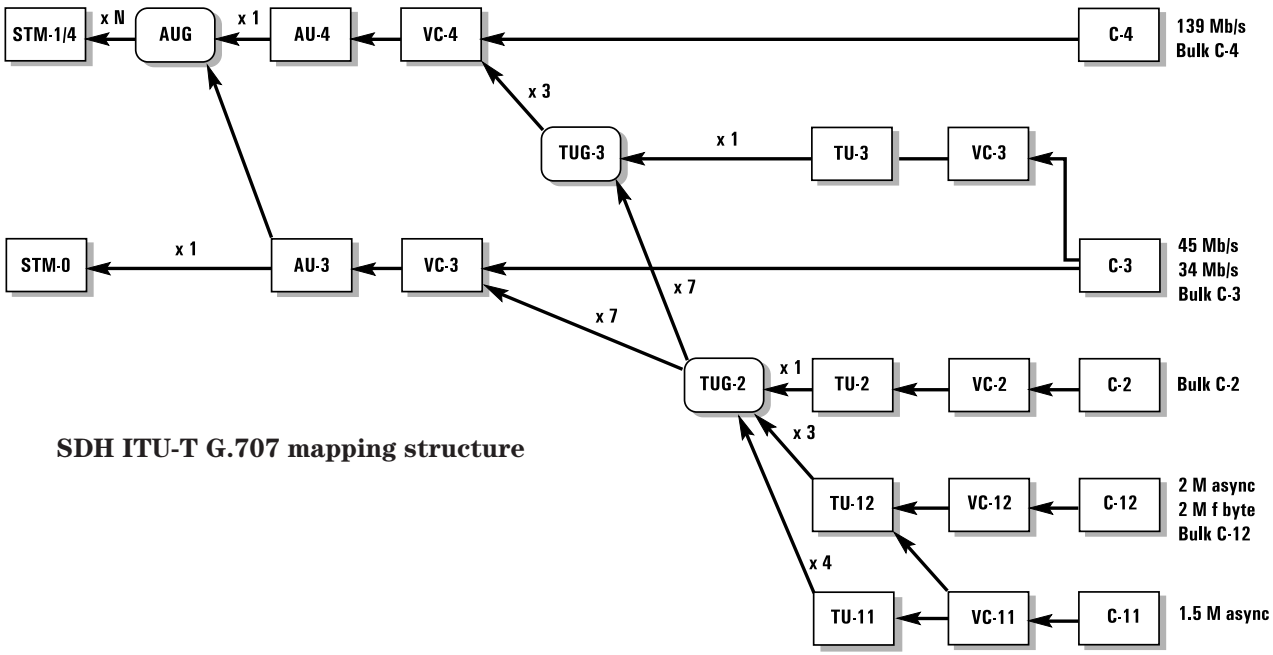
		Structured DSn/PDH
		110
M.2120 in-service test for maintenance	Contiguous 15 minute (T1) and 24 hour (T2) periods with TR1 and TR2 threshold reports. Based on the user entered path allocation and maintenance factors, the T1-ES, T1-SES, T2-ES and T2-SES thresholds are calculated. A single threshold report (TR1 for 15 minute, TR2 for 24 hour) is generated when any of the relevant thresholds are exceeded within each 15 minute or 24 hour period.	●
Signaling monitor	DS1: Signaling bit state is displayed. ABCD format for ESF and AB for SF/SLC-96. SLC-96 can display one of three states; 0,1 or alternating. E1: Graphical display, simultaneously showing the ABCD signalling status of all 30 channels is available.	●
Alarm scan	Alarms at the Interface Rate and at all lower levels in the hierarchy are scanned continuously. A graphical picture of the hierarchy is shown which displays the alarm state for all streams.	●

STM-0/STM-1e test and interfacing



Option A3R

Option A3R
STM-0e (52 Mb/s) and STM-1e (155 Mb/s) electrical interface: STM-0/STM-1 overhead access, thru mode and pointer sequence generation. Full ITU-T G.707 mappings plus frequency offset generation, alarm and error generation/detection plus an error output, SDH alarm and BIP scan, tributary scan and protection switch times.



SDH ITU-T G.707 mapping structure

STM-0/STM-1e test and interfacing options (continued)

		STM-0/STM-1e testing
		A3R
OUT and IN ports (used for transmit)		
Type	Electrical: To ITU-T G.703.	●
Connectors	BNC, 75 ohm, unbalanced. (Small Siemens 75 ohm unbalanced option available.)	●
Rate	155.52 Mb/s. 51.84 Mb/s.	● ●
Line code	155.52 Mb/s: CMI. 51.84 Mb/s: B3ZS.	● ●
Output level	155.52 Mb/s: ± 0.5 V ± 10%. 51.84 Mb/s: Output level is user configurable. STM-0 X CON: 1.1 V peak nominal (0 ft). STM-0 HI: 530 mV peak nominal (450 ft). STM-0 LOW: 350m V peak nominal (900 ft).	● ●
Error output	B3 error output pulse on receipt of STM-0 and STM-1 signals. TTL pulse termination 75 ohm or 10 kohm.	●
Simultaneous STM-1e/ STM-1e and STM-1o	When used in conjunction with the appropriate optical interfaces, transmit STM-1 electrical output signal simultaneously with STM-1 optical output signal.	●
Transmitter		
Clock timing	Internal: All rates. Recovered: From SDH input (CMI or NRZ electrical or optical). Ext MTS: 64 kb/s conforming to ITU-T G.703, 2 Mb/s conforming to ITUT-G.811. BNC, 75 ohm, unbalanced or Siemens (3-pin), 120 ohm, balanced. (Siemens (3-pin) connector is present on option A3R. Option 120 replaces this connector with a Bantam connector).	● ● ● ●
Frequency offset generation	Up to ± 999 ppm in 0.1 ppm steps.	●
Error addition		●

Error type	Single	Rate 10^{-N}	Comments
Frame A1A2	●		N in four frame words
B1	●	4 to 9	
B2†	●	3 to 9	
MS REI	●	3 to 9	
AU-4 path BIP-8 (B3)	●	4 to 9	
AU-4 path REI	●	4 to 9	
AU-4 path IEC	●	4 to 9	
AU-3 path BIP-8 (B3)	●	4 to 9	
AU-3 path REI	●	4 to 9	
AU-3 path IEC	●	4 to 9	
TU-3 path BIP-8 (B3)	●	3 to 9	
TU-3 path REI	●	3 to 9	
TU-2 path BIP (V5)	●	4 to 9	
TU-2 path REI	●	5 to 9	
TU-12 path BIP (V5)	●	3 to 9	
TU-12 path REI	●	4 to 9	
TU-11 path BIP	●	3 to 9	
TU-11 path REI	●	4 to 9	
Bit error*	●	3 to 9	

† MSP threshold N errors in T ms where 0 ≤ N ≤ 1920 (STM-1) and 10 ms ≤ T ≤ 10000 s, in decade steps.
** For SDH stand-alone operation, bulk-filled payloads and DS1, DS3 mapped payloads only. For bit error rates supported with other payloads refer to the PDH test option for details.*

STM-0/STM-1e test and interfacing options (continued)

		STM-0/STM-1e testing
		A3R
Alarm generation	LOS, LOF, OOF, MS AIS, MS RDI, AU-4 path AIS, AU-4 path RDI, AU-4 LOP, AU-4 path unequipped, AU-3 path AIS, AU-3 path RDI, AU-3 LOP, AU-3 path unequipped, TU-3 path AIS, TU-3 path RDI, TU-3 LOP, TU-3 path unequipped, TU-2 path AIS, TU-2 path RDI, TU-2 LOP, TU-2 path unequipped, TU-2 H4 LOM (loss of multiframe), TU-12 path AIS, TU-12 path RDI, TU-12 LOP, TU-12 path unequipped, TU-12 H4 LOM (loss of multiframe), TU-11 path AIS, TU-11 path RDI, TU-11 LOP, TU-11 path unequipped, TU-11 H4 LOM (los of multiframe).	●
Payload capability		
STM-0/STM-1/STM-4 payload mappings (to ITU-T G.707)	139.264 Mb/s into a VC-4 and VC-4 bulk-filled mappings. 34.368 Mb/s into VC-3 and VC-3 bulk-filled mappings. 2.048 Mb/s (async and fl. byte sync) into VC-12 and VC-12 bulk-filled mappings. DS3 (44.736 Mb/s) into VC-3 and VC-3 bulk-filled mappings† DS1 (1.544 Mb/s) async into VC-11†. VC-3 - TU-3 - TUG-3 - VC-4 - AU-4; VC-3 - AU-3.* VC-2 bulk filled mapping and TU-2-Nc (for N = 2 to 6): VC-2 - TU-2 - TUG-2 - TUG-3 - VC-4 - AU-4. VC-2 - TU-2 - TUG-2 - VC-3 - AU-3.* VC-12 - TU-12 - TUG-2 - TUG-3 - VC-4 - AU-4. VC-12 - TU-12 - TUG-2 - TUG-3 - VC-3 - AU-3.* VC-11 - TU-11 - TUG-2 - TUG-3 - VC-4 - AU-4.† VC-11 - TU-11 - TUG-2 - VC-3 - AU-3.*† † *DS1 and DS3 mappings require PDH options UKJ, UKN or 110 to be fitted.* * *AU-3 mappings require HP OmniBER 717 analyzer mainframe.*	●
Payload data	The following unframed patterns can be generated: (Framed and structured signals are available in conjunction with the PDH/DSn option UKJ/UKN/110). PRBS: 2^9-1 (O.150), $2^{11}-1$ (O.152), $2^{15}-1$ (O.151) and $2^{23}-1$ (O.151) QRSS ($2^{20}-1$, 14 zero limited)† Word: User-defined 16-bit word, all ones, all zeros, 1010, 1000. All PRBS patterns can be set to inverted or non-inverted. † *Applicable to DS1 mappings only.*	●
Payload framing	139.264, 34.368 and 2.048 Mb/s: Unframed. *139.264, 34.368 and 2.048 Mb/s: Framed and structured*†. DS3 payloads: Unframed, C-Bit parity (to ANSI T1.107a-1990)† M13 (to ANSI T1.107-1988). TU-2: Unframed. DS1 payloads: Unframed, SF (D4), ESF (to ANSI T1.403-1989, TR-TSY-000499 and ITU-T G.704), SLC-96†. † *Only available in conjunction with the PDH/DSn option UKJ/UKN/110.*	●
Drop/insert	139.264Mb/s: Drop/insert via Tx/Rx on options UKJ/UKN. 44.736 (DS3): Drop/insert via Tx/Rx on option 110. 34.368 Mb/s: Drop/insert via Tx/Rx on options UKJ/UKN/110. 2.048 Mb/s: Drop/insert via drop/insert ports on options UKJ/UKN/110. 1.544 Mb/s: Drop/insert via drop/insert ports on option 110.	●

STM-0/STM-1e test and interfacing options (continued)

		STM-0/STM-1e testing A3R
Pointer adjustment generation		
Increment/decrement/ alternating	Provides a burst, selectable between 1 and 10 pointer adjustments (between 1 and 5 for TU-12 or TU-11 pointer).	●
New pointer value	The AU-4, AU-3, TU-3, TU-2, TU-12 or TU-11 moves to a selectable new location in a single jump, with or without an accompanying new data flag (NDF).	●
Frequency offset (and 87:3)	Pointer sequences are generated by offsetting the frequencies of the AU-4, AU-3 (in these modes the 87:3 sequence is generated to ITU-T G.783) or TU-3, TU-2, TU-12, TU-11 and the line rate relative to each other. Range: ± 100 ppm in 0.1 ppm steps.	●
ITU-T G.783 sequences	Bursts of periodic single adjustments with added or canceled adjustments. Polarity is selectable. Bursts of periodic double adjustments with pairs alternating in polarity. In all cases the interval between adjustments or pairs of adjustments is programmable. On starting to run any of the pointer sequences an initialisation sequence followed by a cool down period may be run prior to the chosen sequence.	●
Transmit overhead		
Overhead	Default selection: Standard overhead values to ITU-T G.707.	●
SOH user-settable bytes	SOH can be set in binary or HEX. RSOH: A1, A2, J0, E1, F1, D1 to D3. J0 path trace: User-defined/predefined 16-byte ITU-T E.164 sequence. MSOH: K1, K2, D4 to D12, S1, M1, Z1†, Z2†, E2 (and access to bytes reserved for national use plus all bytes reserved for future international standardization). VC-4 and VC-3 POH: J1, C2, G1, F2, H4, F3, K3, N1. J1 path trace: User-defined/predefined 16-byte ITU-T E.164 sequence or 64-byte sequence. VC-2, VC-12, VC-11 POH: V5, J2, N2, K4. J2 path trace: User defined/predefined 16-byte ITU-T E.164 sequence. † *Z1 and Z2 are not present in STM-0 mode.*	● ● ●
Overhead sequence generation	A single or multi-byte overhead channel is overwritten with a single or repeated sequence of programmed values. The sequence can contain up to five different values each being transmitted for up to 64,000 frames. RSOH: 6-byte channel A1A2 3-byte channel D1 to D3 Single byte channels: C1, E1, F1. MSOH: 9-byte channel D4 to D12 2-byte channel K1K2. Single byte channels: S1, M1, Z1†, Z2†, E2. † *Z1 and Z2 are not present in STM-0 mode.* High order POH: Single byte channels: J1, C2, G1, F2, H4, F3, K3, N1.	●

STM-0/STM-1e test and interfacing options (continued)

		STM-0/STM-1e testing A3R
Overhead BER test	Any RSOH, MSOH or POH (except A1, A2, H1, H2, Z1, Z2) channel is selected and a BER measurement is performed using a $2^9 - 1$ PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern.	●
MSP message generation	Messages are displayed in text form as per ITU-T G.783 for linear architecture and to ITU-T G.841 for ring architectures (MSP-ring).	●
	User programmed sequences (K1K2).	●
DCC drop/insert	The data supplied to the DCC port can be inserted into either the regenerator section or multiplexer section data communications channel. Similarly, data can be dropped from either channel. The data may be dropped/inserted MSB or LSB first. The data rate for access is: 192 kb/s (RSOH DCC), 576 kb/s (MSOH DCC).	●
Optical interface stress test	2 to 259 bytes of the payload are overwritten with a block of zeros or ones after scrambling. Alternatively the ITU-T G.958 CID (consecutive identical digits) test can be selected.	●
Tributary scan	Automatically test BER on each SDH tributary for error free operation. Rx setup is used to determine tributary structure and test pattern. Alarms: Pattern loss. Test time: Fully user selectable. User selectable bit error threshold: Off, > 0, $\geq 10^{-3}$, $\geq 10^{-6}$.	●
Mixed payloads	Backgrounds can be individually configured to have TU-11, TU-12 or TU-3 independently of foreground testing channel.	●
Keep alive signals	PDH: Transmit last configured SDH signal while transmitting a PDH signal. SDH: With structured PDH options transmit unframed fixed word PDH signal while transmitting an SDH signal. SDH: Using unstructured PDH option transmit last configured PDH signal while transmitting an SDH signal.	●
Thru mode		
Transparent thru mode	The signal is passed through the instrument without being altered for monitoring purposes where no protected monitor point is available.	●
Overhead overwrite thru mode	In addition to the above, the test features associated with the SOH and POH can be enabled to control one single- or multi-byte overhead channel (ie, errors and alarms, optical stress test, overhead sequences, MSP messages, DCC insert, overhead BER. Full Rx functionality also available).	●
AU-4/AU-3 overwrite thru mode	In addition to both of the above, overwrite the complete AU-4/AU3 with the internally generated payload. This enables the SOH to be looped through while a new payload is inserted. All of the test features which affect the VC-4/VC-3 and/or the POH are enabled (ie, errors and alarms, adjust pointer, overhead sequences, MSP messages, overhead BER. Full Rx functionality also available).	●
Tributary overwrite thru mode	When the payload passing through the instrument contains a TU structure, thru mode it will be possible to choose a single TU to be overwritten, as opposed to the complete payload. All of the test features which affect the TU and/or the POH are enabled (ie, errors and alarms, adjust pointer. Full Rx functionality also available).	●

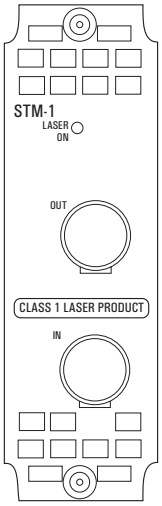
STM-0/STM-1e test and interfacing options (continued)

		STM-0/STM-1e testing
		A3R
STM-1e and STM-0/STM-1e receiver functions		
STM-1 receive input		
Equalization	Automatic for cable loss up to 12 dB at half the bit rate.	●
Monitor point compensation	Monitor mode conforms to ITU-T G.772. Monitor gain.	● 20 to 26 dB
STM-0 receive input		
Operating level	Receiver mode is user selectable. STM-0 HI: 1.1 V peak nominal, equalization up to 450 ft STM-0 LOW: 1.1 V peak nominal, equalization from 450 to 900 ft	●
Monitor point compensation	Monitor mode conforms to ITU-T G.772. Monitor gain.	● 20 to 26 dB
Results		
Error results	Frame (A1A2), B1, B2, MS REI, AU-4 path BIP (B3), AU-4 path REI, AU-4 path IEC, AU-3 path BIP (B3), AU-3 path REI, AU-3 path IEC, TU-3 path BIP (B3), TU-3 path REI, TU-2 path BIP (V5), TU-2 path REI, TU-12 path BIP (V5),TU-12 path REI, TU-11 path BIP (V5), TU-11 path REI, bit errors (bulk filled, PDH payload).	●
	AU-3 path BIP (B3), AU-3 path REI, AU-3 path IEC .	●
DS1/DS3 error results	Frame error, CRC6 error (DS1 ESF), P-bit parity (DS3), C-bit Parity (DS3 CBP framing), REI (DS3 CBP framing). Bit errors (DS1 and DS3).	●
Error analysis	To ITU-T G.826 in-service and out-of-service (G.821 and M.2100/2101/2110/2120 for PDH payload).	●
Alarm indication	LOS, LOF, OOF, MS AIS, MS RDI, K1K2 change AU-3 path AIS, AU-3 path RDI, AU-3 LOP, AU-3 pointer adj AU-4 path AIS, AU-4 path RDI, AU-4 LOP, AU-4 pointer adj TU-3 path AIS, TU-3 path RDI, TU-3 LOP, TU-3 pointer adj TU-2 path AIS, TU-2 path RDI, TU-2 LOP, TU-2 pointer adj TU-12 path AIS, TU-12 path RDI, TU-12 LOP, TU-12 pointer adj TU-11 path AIS, TU-11 path RDI, TU-11 LOP, TU-11 pointer adj H4 multiframe sync loss, pattern sync loss, clock loss, power loss and errors (any type).	●
	DS1/DS3 alarm indication: AIS, frame loss, RDI.	●
Alarm seconds	As for alarm indication, plus NDF, missing NDF and clock loss.	●
AlarmScan plus alarm and BIP scan	Automatically scans the SDH network hierarchy for alarms and BIP errors or alarms only with a graphical display of the network hierarchy's status including the indication of unequipped channels. Alarms: LOP, path AIS, path RDI, H4 LOM†, TU LOP*, TU path AIS*, TU path RDI.* † *For TU-11, TU-12 and TU-2 structures.* * *If applicable.* BIP errors: AU-4 payloads: VC-4 B3. AU-3 payloads: VC-3 B3. TU-3 payloads: VC-4 B3 and VC-3 B3. TU-2/TU-12/TU-11 payloads: VC-4/VC-3 B3 and V5 BIP-2. User selectable BIP error threshold: Off, > 0, $> 10^{-3}$, $> 10^{-6}$.	●

STM-0/STM-1e test and interfacing options (continued)

		STM-0/STM-1e testing A3R
Protection switch times	Service disruption test measures error burst length for measurement of protection switch times†. Accuracy: < 50 µs. Results: Longest burst length, shortest burst length, last burst length. Resolution: 1 µs. † *Service disruption test requires PDH/DSn option UKJ, UKN or 110 to be fitted.*	●
Pointer results	AU pointer value, AU NDF seconds, AU missing NDF seconds, AU +ve adjustment count/seconds, AU –ve adjustment count/seconds, TU pointer value, TU NDF seconds, TU missing NDF seconds, TU +ve adjustment count/seconds, TU –ve adjustment count/seconds, implied VC-4, VC-3, VC-2, VC-12, VC-11 offset.	●
Frequency measurement	Frequency displayed in Hz, 1 Hz resolution. Offset displayed in ppm and Hz.	●
Received overhead snapshot	SOH can be set in binary or HEX. SOH and POH of a received STM-1 signal. SOH and POH of a received STM-0 signal. Text message displayed for signal label (C2 and V5) and sync status (S1) decoded.	● ● ●
Overhead sequence capture	Any one overhead channel is selected. After a manual or programmed trigger, the captured byte values are displayed together with the number of consecutive frames containing the value.	●
Pointer location graph	A graphical display that shows the variation with time of the AU-n and TU-n pointer location. Up to four days of pointer location activity can be monitored. Implied VC offset: The total positive and negative pointer movements since the start of the measurement period are summed and the implied mean VC offset calculated from this total.	●
Overhead BER measurement	Any RSOH, MSOH or POH (except A1, A2, H1, H2, Z1, Z2) channel is selected and a BER measurement is performed using a $2^9 - 1$ PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern. Error count, error ratio, error free seconds, % error free seconds and pattern loss seconds are measured.	●

STM-1 optical interfacing



Option UH1

Option UH1
STM-1 (1310 nm) optical interfacing. Also provides OC-3 optical interfacing when used in conjunction with dual standard SONET/SDH option 120.

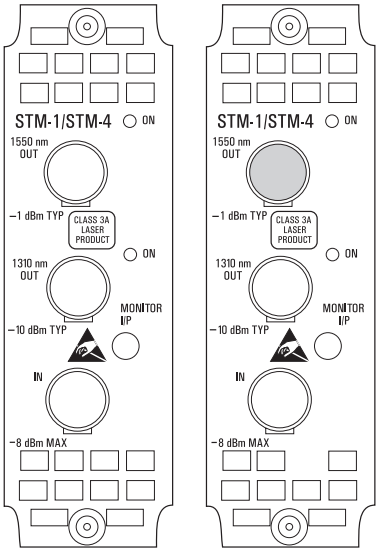
STM-1 optical interfacing options

Requires option A1T, A3R or 120 to be fitted.

		STM-1 (1310 nm) **UH1**
OUT and IN ports (used for transmit and receive)		
Type	Optical.	●
Connectors	Customer exchangeable optical adaptors allow a range of interfaces to be attached.	
Rate	STM-1 (155.52 Mb/s).	●
Line code	NRZ.	●
Transmitter		
Wavelength	1280 to 1330 nm.	●
Spectral width (3 dB)	2.5 nm rms.	●
Optical power output	Nominal.	–9 dBm
Source type	SLM (single mode).	●
Tx classification to ITU-T G.957	STM-1 (parameters Table 2 G.957): S-1.1 (1310 nm).	 ●
Safety classification	Class 1 (EN 60825-1): 1994. Class I (21 CFR CH1 1040.10 (1996).	● ●
Receiver		
Wavelength	1270 to 1600 nm.	●
Minimum sensitivity	Using 1300 nm wavelength, 100% modulation depth and BER of 10^{-10} and PRBS of $2^{23} - 1$.	–28 dBm
Maximum input power	For BER of 10^{-10}.	–8 dBm
Detector type	MLM (multi mode).*	●
Rx classification to ITU-T G.957	STM-1 (parameters Table 2 G.957): S-1.1 (1310 nm); S-1.2 (1550 nm).	 ● ●
Alarms detected	Loss of optical signal.	●

** MLM receivers work with both MLM (multi mode) and SLM (single mode) transmitters.*

STM-4c, STM-4, STM-1 and STM-0 test and optical interfacing



Option 130 **Option 131**

Option 130
STM-4c/STM-4/STM-1 and STM-0 overhead access, thru mode. Dual 1310 and 1550 nm optical interfaces and optical power measurement.

Option 131
STM-4c/STM-4/STM-1 and STM-0 overhead access, thru mode. 1310 nm optical interfaces and optical power measurement.

Both modules also provide OC-12c/OC-12/OC-3c/OC-3 and OC-1 overhead access and thru mode when used in conjunction with option 120.

STM-4c, STM-4, STM-1 and STM-0 test and interfacing options

Requires option A3R or 120 to be fitted.

		130 (1310 and 1550 nm)	**131** (1310 nm)
OUT and IN ports (used for transmit and receive)			
Type	Optical.	●	●
	Electrical monitor point.	●	●
Connectors	Customer exchangeable optical adaptors allow a range of interfaces to be attached.	●	●
	Electrical monitor port: SMA (50 ohm ECL).	●	●
Rate	STM-0 (51.84 Mb/s).	●	●
	STM-1 (155.52 Mb/s).	●	●
	STM-4 (622.08 Mb/s).	●	●
Line code	NRZ.	●	●
Transmitter			
Wavelength	1280 to 1330 nm at STM-0, STM-1, STM-4.	●	●
	1520 to 1565 nm at STM-1, STM-4.	●	-
Spectral width (3dB)	2.5 nm rms.	●	●
Extinction ratio	> 8.2 dB nominal 1310 nm.	●	●
	> 10 dB nominal 1550 nm.	●	-
Optical power output	1310 nm nominal.	–10 dBm	–10 dBm
	1550 nm nominal.	–1 dBm	-
Source type	SLM (single mode).	●	●
Tx classification to ITU-T G.957	STM-1 (parameters Table 2 G.957):		
	S-1.1 (1310 nm);	●	●
	L-1.2 (1550 nm).	●	-
	STM-4 (parameters Table 3 G.957):		
	S-4.1 (1310 nm);	●	●
	L-4.2 (1550 nm).	●	-
Safety classification	Class I (FCC 21 CFR CH.1 1040.10 (1994)).	●	●
	Class 3A (EN 60825-1:1994).	●	●

STM-4c, STM-4, STM-1 and STM-0 test and interfacing options (continued)

		130 (1310 and 1550 nm)	131 (1310 nm)
Receiver			
Wavelength	1200 to 1600 nm.	●	●
Minimum sensitivity	Using 1300 nm wavelength, 100% modulation depth and BER of 10^{-10} and PRBS of $2^{23}-1$. To ITU-T G.957.		
	52 , 155 Mb/s.	–34 dBm	–34 dBm
	622 Mb/s.	–28 dBm	–28 dBm
Maximum input power	For BER of 10^{-10}.	–8 dBm	–8 dBm
Detector type	MLM (multi mode)*.	●	●
Rx classification to ITU-T G.957	STM-1 (parameters Table 2 G.957):		
	S-1.1, L-1.1 (1310 nm);	●	●
	S-1.2, L-1.2 (1550 nm).	●	●
	STM-4 (parameters Table 3 G.957):		
	S-4.1, L-4.1 (1310 nm);	●	●
	S-4.2, L-4.2 (1550 nm).	●	●
Protected monitor point input level	150 mV to 1000 mVp-p (nominal): ac coupled, nominal 50 ohm.	●	●
Optical power measurement	Accuracy: ± 1 dB . Range: –8 to –30 dBm.	●	●
Transmitter functions			
Clock timing	Internal.	●	●
	Recovered:		
	From received STM-0, STM-1 or STM-4 optical signal.	●	●
	From received STM-0, STM-1 electrical signal.	●	●
	Ext. MTS: Data or clock format (as ITU-T G.811).	●	●
Frequency offset generation	Up to ± 999 ppm in 0.1 ppm steps.	●	●
STM-4 error addition		●	●

Error type	Single	Rate 10^{-N}	Comments
Frame A1A2	●		N in four frame words
B1	●	N = 4 to 9	
B2 %	●	N = 3 to 9	
MS REI	●	N = 3 to 9	

% MSP threshold, N in T where $0 \le N \le 1920$ and 10 ms ≤ T ≤ 10000 s, in decade steps.

STM-1 error addition	One STM-1 is selected for test. STM-1 error add capability is provided for the STM-1 under test. Refer to STM-0/STM-1 test option A3R for details.	●	●
STM-4 alarm generation	LOS, LOF, OOF, MS AIS, MS RDI.	●	●
STM-1 alarm generation	One STM-1 is selected for test. For STM-1 alarm generation capability of the STM-1 under test, refer to STM-0/STM-1 test option A3R for details.	●	●
Payload capability	One STM-1 is selected for test. The payload data capability of the STM-1 under test is defined by the STM-0/STM-1 test option. Refer to STM-0/STM-1 test option A3R for details.	●	●
Background payload	Background STM-1 contains 00000000 in all bytes or VC-4 payload data is loaded into all four VC-4s of the STM-4.		
VC-4-4c error add		●	●

Error type	Single	Rate 10^{-N}
B3	●	N = 4 to 9
HP REI	●	N = 4 to 9
HP IEC	●	N = 4 to 9
Bit	●	N = 3 to 7

** MLM receivers work with both MLM (multi mode) and SLM (single mode) transmitters.*

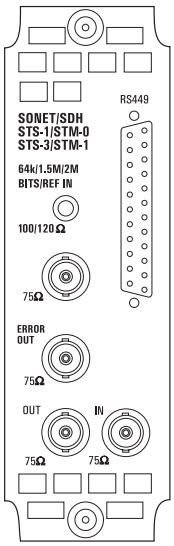
STM-4c, STM-4, STM-1 and STM-0 test and interfacing options (continued)

		130 (1310 and 1550 nm)	131 (1310 nm)
VC-4-4c alarm generation	AU-AIS, HP-RDI, AU-LOP, path unequipped.	●	●
Pointer adjustment generation	One STM-1 is selected for test. The pointer adjustment generation capability of the STM-1 under test is defined by the STM-0/STM-1 test option. Refer to STM-0/STM-1 test option A3R for details.	●	●
Transmit overhead			
Overhead	Standard overhead values to ITU-T G.707.	●	●
STM-4 user-programmable bytes	RSOH:.A1, A2, J0, Z0, E1, F1, D1 to D3. MSOH: SS bits, K1, K2, D4 to D12, S1, Z1, Z2, M1. J0 path trace: user-defined/predefined 16-byte ITU-T E.164 sequence.	●	●
STM-0/STM-1 user-programmable bytes	The user-programmable STM-0/STM-1 overhead capability is defined by the STM-0/STM-1 test option. Refer to STM-0/STM-1 test option A3R for details.	●	●
Path overhead user-programmable bytes	The user-programmable path overhead capability is defined by the STM-0/STM-1 test option. Refer to STM-0/STM-1 test option A3R for details.	●	●
Overhead sequence generation	A single- or multi-byte overhead channel is over-written with a single or repeated sequence of programmed values. The sequence can contain up to five different values each being transmitted for up to 64,000 frames. RSOH: D1 to D3 (3-byte channel); J0, E1, F1; Z0 for STM-1 under test. MSOH: D4 to D12 (9-byte channel); K1 to K2 (2-byte channel); S1, E2; Z1, Z2; M1. High order POH: J1, C2, G1, F2, H4, F3, K3, N1.	●	●
Overhead BER test	Any overhead channel detailed above, for overhead sequences (except Z1 and Z2) can have a $2^9 - 1$ PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern and a BER measurement performed.	●	●
MSP message generation	Messages are displayed in text form as per ITU-T G.783 for linear architecture and to ITU-T G.841 for ring architectures (MSP-ring). User programmed sequences (K1K2).	● ●	● ●
DCC drop/insert	The DCC drop/insert capability is defined by the STM-0/STM-1 test option. Refer to STM-0/STM-1 test option A3R for details.	●	●
STM-4 thru mode	The signal is passed through the instrument without being altered for monitoring purposes where no protected monitor point is available.	●	●
Overhead overwrite STM-4 mode	The test features assocuated with the section overhead can be enabled in order to control one single- or multi-byte overhead channel. The B1 and B2 bytes are recalculated.	●	●
Overhead overwrite STM-4-4c mode	The test features assocuated with the section overhead and path overhead can be enabled in order to control one single- or multi-byte overhead channel. The B1, B2 and B3 bytes are recalculated.	●	●
AU-4 overwrite mode	Overwrite the complete AU-4 with the internally generated payload. This enables the SOH and the three background AU-4s to be looped through while a new payload is inserted into the STM-1 under test. All of the test features which affect the VC-4 and/or the POH are enabled. The B1, B2 and B3 bytes are recalculated. The AU-4 under test is delayed by a greater amount than the three background AU-4s.	●	●
Tributary overwrite	If the payload contains a TU structure a single TU can be overwritten. All of the test features which affect the tributary and/or the POH are enabled. The B1, B2, B3 and TU BIP bytes are recalculated.	●	●

STM-4c, STM-4, STM-1 and STM-0 test and interfacing options (continued)

		130 (1310 and 1550 nm)	131 (1310 nm)
Receiver functions			
STM-4 error results	Frame A1A2, B1, B2, MS REI.	●	●
STM-0/STM-1 error results	One STM-1 is selected for test. The errors detected in the payload of the STM-1 under test are defined by the STM-0/STM-1 test option. Refer to STM-0/STM-1 test options A3R for details.	●	●
VC-4-4c error results	B3, HP REI, HP IEC, bit.	●	●
Error analysis	Refer to STM-0/STM-1 test options A3R for details.	●	●
Pointer results	Refer to STM-0/STM-1 test options A3R for details.	●	●
Alarm indication	LOS, LOF, OOF, LOP (refer to STM-1 test option A1T or A3R for details), MS AIS, MS FERF, K1/K2 change, clock loss.	●	●
	One STM-1 is selected for test. The alarm detection capability in the payload of the STM-1 under test are defined by the STM-1 test option. Refer to STM-1 test options A1T or A3R for details.	●	●
VC-4-4c alarms detected	As above plus LOP, path AIS, AU AIS, HP RDI, pattern sync loss.	●	●
Alarm seconds	As for alarm indication, plus power loss, NDF and missing NDF, and except clock loss.	●	●
Received overhead snapshot	SOH and POH from STM-1 number 1, or from STM-1 under test can be displayed. Refer to STM-1 test options A1T or A3R for details.	●	●
Overhead sequence capture	A single- or multi-byte overhead channel can be selected to be monitored. After a manual or programmed trigger, the captured byte values are displayed together with the number of consecutive frames containing the value. RSOH: D1 to D3 (3-byte channel); J0, E1, F1; Z0 for STM-1 under test. MSOH: D4 to D12 (9-byte channel); K1 to K2 (2-byte channel); S1, E2; Z1, Z2; M1.	●	●
	High order POH: J1, C2, G1, F2, H4, F3, K3, N1.		
Pointer location graph	A graphical display that shows the variation with time of the AU-n and TU-n pointer location. Refer to STM-0/STM-1 test option A3R for details.	●	●
Overhead BER measurement	Any RSOH, MSOH or POH channel detailed above (for overhead sequences capture) can be selected and a BER measurement performed using a $2^9 - 1$ PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern. Error count, error ratio, error free seconds and % error free seconds, pattern loss seconds are measured.	●	●

Dual standard SONET/SDH test and interfacing



Option 120

Option 120
Dual standard SONET/SDH module.
Provides electrical outputs at STS-3/STS-1 and STM-1/STM-0. SONET/SDH optical interfaces provided when used in conjunction with option UH1 (page 29) and options 130/131 (page 30).

SONET specifications detailed below. Please see option A3R for SDH specification (page 22).

STS-3/STS-1 and STM-1e/STM-0e test and interfacing

(for SDH specifications see option A3R)

		Dual standard SONET/SDH testing
		120
OUT and IN ports (used for transmit)		
Type	Electrical: To ITU-T G.703.	●
Connectors	BNC, 75 ohm, unbalanced.	●
Rate	155.52 Mb/s. 51.84 Mb/s.	● ●
Line code	155.52 Mb/s: CMI. 51.84 Mb/s: B3ZS.	● ●
Output level	155.52 Mb/s: ± 0.5 V ± 10%. 51.84 Mb/s: Output level is user configurable. STS-1 X CON: 1.1 V peak nominal (0 ft). STS-1 HI: 530 mV peak nominal (450 ft). STS-1 LOW: 350m V peak nominal (900 ft).	● ●
Error output	B3 error output pulse on receipt of STS-1 and STS-3 signals. TTL pulse termination 75 ohm or 10 k ohm.	●
Simultaneous STS-1 and OC-1	When used in conjunction with the appropriate optical interfaces, transmit STS-1 electrical output signal simultaneously with OC-1 optical output signal.	●
Transmitter		
Clock timing	Internal: All rates. Recovered: From SONET input (CMI or NRZ electrical or optical) Bits: 1.544Mb/s DS1 timing reference as per TA-TSY-000378 Bantam, 100 ohm nominal, unbalanced Ext MTS: 64kb/s conforming to ITU-T G.703 , Bantam, 120 ohm, balanced 2 Mb/s conforming to ITU-T G.811, BNC 75 ohm unbalanced, Bantam 120 ohm balanced.	●

STS-3/STS-1 and STM-1e/STM-0e test and interfacing (continued)

(for SDH specifications see option A3R)

Dual standard SONET/SDH testing

120

Frequency offset generation

Up to ± 999 ppm in 0.1 ppm steps. ●

Error addition ●

Error type	Single	Rate 10^{-N}	Comments
Frame A1A2	●		N in four frame words
CV-S (B1)	●	4 to 9	
CV-L (B2)†	●	3 to 9	
REI-L	●	3 to 9	
STS SPE CV-P (B3)	●	4 to 9	
STS SPE REI-P	●	4 to 9	
STSc SPE IEC-P	●	4 to 9	
VT6 CV-V (V5)	●	4 to 9	
VT6 REI-V	●	5 to 9	
VT2 CV-V (V5)	●	3 to 9	
VT2 REI-V	●	4 to 9	
VT1.5 CV-V	●	3 to 9	
VT1.5 REI-V	●	4 to 9	
Bit error*	●	3 to 9	

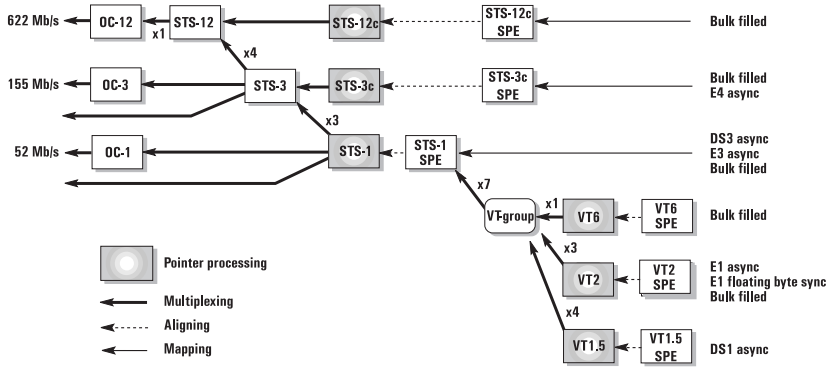
† APS threshold N errors in T ms where 0 ≤ N ≤ 1920 (STM-3) and 10 ms ≤ T ≤ 10000 s, in decade steps.
**For SONET stand-alone operation, bulk-filled payloads and DS1, DS3 mapped payloads only. For bit error rates supported with other payloads refer to the DSn/PDH test option for details.*

Alarm generation ●

LOS, LOF, SEF, AIS-L, RDI-L.
STS SPE AIS-P, STS SPE RDI-P, STS SPE LOP, STS SPE path unequipped.
VT6 path AIS, VT6 RDI-V, VT6 LOP, VT6 path unequipped, VT6 H4 LOM (loss of multiframe).
VT2 path AIS, VT2 RDI-V, VT2 LOP, VT2 path unequipped, VT2 H4 LOM (loss of multiframe).
VT1.5 path AIS, VT1.5 RDI-V, VT1.5 LOP, VT1.5 path unequipped, VT1.5 H4 LOM (loss of multiframe).

Payload capability

Payload mappings (to Bellcore GR-253-CORE)



OC-12/OC-12c/OC-3/OC-3c/OC-1 capability when optical module fitted.
DS3(44.736 Mb/s) into STS-1 SPE† and STS-1 SPE bulk filled mappings: ●
DS1(1.544Mb/s) async into VT1.5†.
139.264 Mb/s into a STS-3c SPE and STS-3c SPE bulk-filled mappings.
2.048 Mb/s (async and fl. byte sync) into VT2 SPE and VT2 SPE bulk filled mappings:
34.368 Mb/s, into STS-1 SPE and STS-1 SPE bulk filled mappings:
VT6 SPE bulk filled mapping and VT6 -Nc (for N = 2 to 6):

† DS1, DS3 mappings require DSn/PDH option UKJ, UKN or 110 to be fitted.

STS-3/STS-1 and STM-1e/STM-0e test and interfacing (continued)

(for SDH specifications see option A3R)

		Dual standard SONET/SDH testing 120
Payload data	The following unframed patterns can be generated: (Framed and structured signals are available in conjunction with the PDH/DSn options UKJ/UKN/110).	
	PRBS: 2^9-1 (O.150), $2^{11}-1$ (O.152), $2^{15}-1$ (O.151) and $2^{23}-1$ (O.151) QRSS ($2^{20}-1$, 14 zero limited)† Word: User-defined 16-bit word, all ones, all zeros, 1010, 1000. All PRBS patterns can be set to be inverted or non-inverted.	●
	† Applicable to DS1 mappings only.	
Payload framing	139.264, 34.368 and 2.048 Mb/s: Unframed. 139.264, 34.368 and 2.048 Mb/s: Framed and structured signals† DS3 payloads: Unframed, C-Bit parity (to ANSI T1.107a-1990) M13 (to ANSI T1.107-1988)†. VT6 : Unframed. DS1 payloads: Unframed, SF (D4), ESF (to ANSI T1.403-1989, TR-TSY-000499 and ITU-T G.704), SLC-96†.	●
	† Only available in conjunction with the PDH/DSn option UKJ/UKN/110.	
Drop/insert	139.264Mb/s: Drop/insert via Tx/Rx on options UKJ/UKN. 44.736 (DS3): Drop/insert via Tx/Rx on option 110. 34.368 Mb/s: Drop/insert via Tx/Rx on options UKJ/UKN/110. 2.048 Mb/s: Drop/insert via drop/insert ports on options UKJ/UKN/110. 1.544 Mb/s (DS1): Drop/insert via drop/insert ports on option 110.	●

Pointer adjustment generation

Increment/decrement/ alternating	Provides a burst, selectable between 1 and 10 pointer adjustments (between 1 and 5 for VT6, VT2 and VT1.5 pointer).	●
New pointer value	The STS SPE, VT6, VT2 or VT1.5 moves to a selectable new location in a single jump, with or without an accompanying new data flag (NDF).	●
Frequency offset (and 87:3)	Pointer sequences are generated by offsetting the frequencies of the SPE, (in this mode the 87:3 sequence is generated to Bellcore GR-253-CORE/ANSI T1.105.03) or VT6, VT2, VT1.5 and the line rate relative to each other. Range: ± 100 ppm in 0.1 ppm steps.	●
Bellcore GR-253-CORE and ANSI T1.105.03	Bursts of periodic single adjustments with added or canceled adjustments. Polarity is selectable. Bursts of periodic double adjustments with pairs alternating in polarity. In all cases the interval between adjustments or pairs of adjustments is programmable. On starting to run any of the pointer sequences an initialisation sequenced followed by a cool down period may be run prior to running the chosen sequence.	●

Transmit overhead

Overhead	Default selection: Standard overhead values to Bellcore GR-253-CORE . and ANSI T1.05	●
STS-3/STS-1 user-settable bytes	TOH can be set in binary or HEX. SOH: A1, A2, J0, E1, F1, D1 to D3. J0 path trace: User-defined/predefined 16-byte ITU-T E.164 sequence. LOH: K1, K2, D4 to D12, S1, M1, E2 (and access to bytes reserved for national use plus all unmarked bytes reserved for future international standardization).	●
	STS SPE POH: J1, C2, G1, F2, H4, Z3, Z4 ,N1. J1 path trace: User-defined/predefined 16-byte ITU-T E.164 sequence or 64-byte sequence.	●
	VT6 SPE , VT2 SPE, VT1.5 SPE POH: V5, J2, Z6, Z7. J2 path trace: User defined/predefined 16-byte ITU-T E.164 sequence.	●

STS-3/STS-1 and STM-1e/STM-0e test and interfacing (continued)

(for SDH specifications see option A3R)

		Dual standard SONET/SDH testing 120
Overhead sequence generation	A single or multi-byte overhead channel is overwritten with a single or repeated sequence of programmed values. The sequence can contain up to five different values each being transmitted for up to 64,000 frames. SOH: 6-byte channel A1A2 3-byte channel D1 to D3 Single byte channels: C1, E1, F1. LOH: 9-byte channel D4 to D12 2-byte channel K1K2 Single byte channels: S1, M1, Z1†, Z2†, E2. *† Z1 and Z2 are not present in STS-1 mode.* High order POH: Single byte channels: J1, C2, G1, F2, H4, Z3, Z4, N1.	●
Overhead BER test	Any SOH, LOH or POH (except A1, A2, H1, H2, Z1, Z2) channel is selected and a BER measurement is performed using a $2^9 - 1$ PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern.	●
APS message generation	Messages are displayed in text form as per Bellcore GR-253-CORE for linear architecture and to Bellcore GR-1230-CORE for ring architectures (BLSR). User programmed sequences (K1/K2).	●
DCC drop/insert	The data supplied to the DCC port can be inserted into either the regenerator section or multiplexer section data communications channel. Similarly, data can be dropped from either channel. The data may be dropped/inserted MSB or LSB first. The data rate for access is: 192 kb/s (SOH DCC), 576 kb/s (LOH DCC).	●
Optical interface stress test	2 to 259 bytes of the payload are overwritten with a block of zeros or ones after scrambling. Alternatively the ITU-T G.958 CID (consecutive identical digits) test can be selected.	●
Tributary scan	Automatically test BER on each SONET tributary for error free operation. Rx setup is used to determine tributary structure and test pattern. Alarms: Pattern loss. Test time: Fully user selectable. User selectable bit error threshold: Off, > 0, $\geq 10^{-3}$, $\geq 10^{-6}$.	●
Mixed payloads	Mixed payloads: Each STS-1 SPE within an STS-3 can be independently configured to contain a STS-1 SPE user word, VT2 or VT1.5 structure.	●
Keep alive signals	DSn/PDH:Transmit last configured SONET signal while transmitting a DSn/PDH signal.	●

Thru mode

Transparent thru mode	The signal is passed through the instrument without being altered for monitoring purposes where no protected monitor point is available.	●
Overhead overwrite thru mode	In addition to the above, the test features associated with the TOH and POH can be enabled to control one single- or multi-byte overhead channel (ie, errors and alarms, optical stress test, overhead sequences, APS messages, DCC insert, overhead BER. Full Rx functionality also available).	●

STS-3/STS-1 and STM-1e/STM-0e test and interfacing (continued)

(for SDH specifications see option A3R)

		Dual standard SONET/SDH testing 120
STS-3c/STS-1 SPE overwrite thru mode	In addition to both of the above, overwrite the complete SPE with the internally generated payload. This enables the TOH to be looped through while a new payload is inserted. All of the test features which affect the SPE and/or the POH are enabled (ie, errors and alarms, adjust pointer, overhead sequences, APS messages, overhead BER. Full Rx functionality also available).	●
Tributary overwrite thru mode	When the payload passing through the instrument contains a VT structure, thru mode it will be possible to choose a single VT to be overwritten, as opposed to the complete payload. All of the test features which affect the VT and/or the POH are enabled (ie, errors and alarms, adjust pointer. Full Rx functionality also available).	●

STS-3 and STS-1 receiver functions

STS-3 receive input

Equalization	Automatic for cable loss up to 12 dB at half the bit rate.	●
Monitor point compensation	Monitor mode conforms to ITU-T G.772. Monitor gain.	● 20 to 26 dB

STS-1 receive input

Operating level	Receiver mode is user selectable. STS-1 HI: 1.1 V peak nominal, equalization up to 450 ft STS-1 LOW: 1.1 V peak nominal, equalization from 450 to 900 ft	●
Monitor point compensation	Monitor mode conforms to ITU-T G.772. Monitor gain.	● 20 to 26 dB

Results

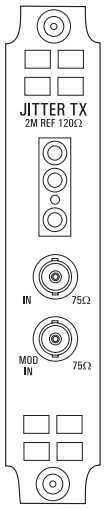
Error results	Frame (A1A2), B1, B2, REI-L, STS-3c SPE CV-P (B3), STS SPE REI-L, STS SPE IEC-P. VT6 CV-V (V5), VT6 REI-V, VT2 CV-V (V5),VT2 REI-V, VT1.5 CV-V (V5),VT1.5 REI-V, bit errors (bulk filled, DSn/PDH payload).	●
DS1/DS3 error results	Frame error, CRC6 error (DS1 ESF), P-bit parity (DS3), C-bit parity (DS3 CBP framing), FEBE (DS3 CBP framing). Bit errors (DS1 and DS3).	●
Error analysis	To ITU-T G.826 (G.821 and M.2100/2110/2120 for PDH payload).	●
Alarm indication	LOS, LOF, SEF, AIS-L, RDI-L, K1/K2 change STS-1 SPE path AIS, STS-1 SPE RDI-P, STS-1 SPE LOP, STS-1 SPE pointer adj VT6 path AIS, VT6 RDI-V, VT6 LOP, VT6 pointer adj VT2 path AIS, VT2 RDI-V, VT2 LOP, VT2 pointer adj VT1.5 path AIS, VT1.5 RDI-V, VT1.5 LOP, VT1.5 pointer adj H4 multiframe sync loss, pattern sync loss, clock loss, power loss and errors (any type).	●
	DS1/DS3 alarm indication: AIS, frame loss, RDI.	●
Alarm seconds	As for alarm indication, plus NDF, missing NDF and except clock loss.	●

STS-3/STS-1 and STM-1e/STM-0e test and interfacing (continued)

(for SDH specifications see option A3R)

		Dual standard SONET/SDH testing 120
AlarmScan plus alarm and BIP scan	Automatically scans the SONET network hierarchy for alarms and BIP errors or alarms only with a graphical display of the network hierarchy's status including the indication of unequipped channels. Alarms: LOP, path AIS, RDI-P, H4 LOM†, VT LOP*, AIS-V*, RDI-V.* *† For VT6 , VT2 AND VT1.5 structures.* ** If applicable.* BIP errors: STS SPE payloads: STS SPE CV-P (B3). VT6 /VT2 /VT1.5 payloads: STS-3c SPE/STS-1 SPE B3 and CV-V (V5). User selectable BIP error threshold: Off, > 0, $> 10^{-3}$, $> 10^{-6}$.	●
Protection switch times	Service disruption test measures error burst length for measurement of protection switch times†. Accuracy: < 50 µs. Results: Longest burst length, shortest burst length, last burst length. Resolution: 1 µs. *† Service disruption test requires PDH/DSn option UKJ, UKN or 110 to be fitted.*	●
Pointer results	STS Path pointer value, NDF-P seconds, STS Path missing pointer, NDF seconds, STS Path +ve adjustment count/seconds, STS Path –ve adjustment count/seconds, VT pointer value, NDF-V seconds, VT pointer missing NDF -V seconds, VT+ve adjustment count/seconds, VT–ve adjustment count/seconds, implied STS-3c SPE, STS-1 SPE, VT6 SPE , VT2 SPE offset.	●
Frequency measurement	Frequency displayed in Hz, 1 Hz resolution. Offset displayed in ppm and Hz.	●
Received overhead snapshot	TOH can be set in binary or HEX. TOH and POH of a received STS-3 signal. TOH and POH of a received STS-1 signal. Text message displayed for signal label (C2 and V5) and sync status (S1) decoded.	●
Overhead sequence capture	Any one overhead channel is selected. After a manual or programmed trigger, the captured byte values are displayed together with the number of consecutive frames containing the value.	●
Pointer location graph	A graphical display that shows the variation with time of the STS Path and VT pointer location. Up to four days of pointer location activity can be monitored. Implied SPE offset: The total positive and negative pointer movements since the start of the measurement period are summed and the implied mean SPE offset calculated from this total.	●
Overhead BER measurement	Any SOH, LOH or POH (except A1, A2, H1, H2, Z1, Z2) channel is selected and a BER measurement is performed using a $2^9 - 1$ PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern. Error count, error ratio, error free seconds, % error free seconds and pattern loss seconds are measured.	●

Jitter generation



Option A3K
Option 140

Option 140
PDH jitter generation: 2, 8, 34 and 140 Mb/s up to 80 UI (2 Mb/s).
SDH jitter generation: STM-1 (155 Mb/s) and STM-4 (622 Mb/s) up to 200 UI (STM-4).

Option A3K
All the capability of option 140 plus wander generation: 2 Mb/s, STM-1 (155 Mb/s) and STM-4 (622 Mb/s) up to 14400 UI (STM-4).

Jitter generation option†

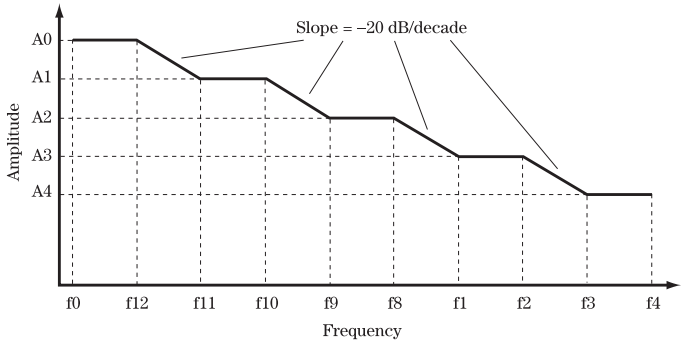
PDH jitter generation requires a PDH test option (UKK, UKJ or UKN) to be fitted.
SDH jitter generation requires an STM-1 test option (A3R, 120 or A1T) to be fitted.

		SDH and PDH jitter generation	
		A3K	**140**
OUT and IN ports (used for transmit and receive)			
Connectors	PDH jitter generation uses the Tx ports on the PDH option (UKK, UKJ, UKN or UH3). SDH jitter generation uses the electrical Tx ports on the STM-1 test option (A1T, 120 or A3R) or the Tx ports on the optical interfacing STM-1/STM-4 (UH1, USN, UKT, 130, 131 or 0YH).	●	●
Rate	2.048, 8.448, 34.368 and 139.264 Mb/s if appropriate PDH option fitted. 155.52 Mb/s (STM-1) and 622.08 Mb/s (STM-4) if appropriate SDH and optical interface options fitted.	●	●
Other ports	External jitter modulation input (75 ohm, unbalanced).	●	●
	Ext MTS: Data or clock format (as ITU-T G.811).	●	●
Jitter modulation			
Frequency	0.1 Hz to 5 MHz.	●	●
Frequency accuracy	± 1% above 3 Hz, ± 3% below 3 Hz.	●	●
Frequency resolution	1 Hz for 1 and 10 UI ranges steps. 0.1 Hz for 50, 80 and 200 UI ranges.	●	●

† NB: Jitter generation can be used simultaneously with frequency offset.

Jitter generation option (continued)

		SDH and PDH jitter generation	
		A3K	140
ITU-T 0.171 specification	Meets and exceeds the requirements of ITU-T G.825, G.958 and G.823.	●	●

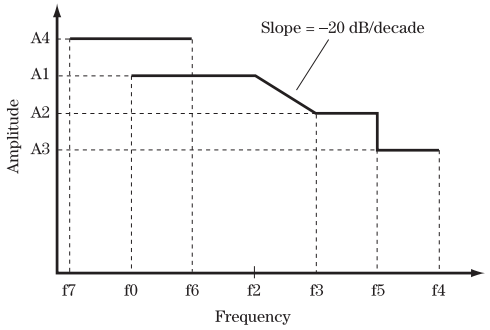


Meets the following ITU-T O.171 jitter amplitude versus modulation frequency specification.

Bit rate (kb/s)	A0 (UI)	A1 (UI)	A2 (UI)	A3 (UI)	A4 (UI)	F0 (µHz)	F12 (µHz)	F11 (mHz)	F10 (mHz)	F9 (Hz)	F8 (Hz)	F1 (Hz)	F2 (Hz)	F3 (Hz)	F4 (Hz)
2,048	40	-	20	10	0.5	12	-	-	-	-	5	10	900	18k	100k
8,448	-	-	-	10	0.5	-	-	-	-	-	10	20	400	8.5k	400k
34,368	-	-	-	10	0.5	-	-	-	-	-	50	100	1.0k	20k	800k
139,264	-	-	-	10	0.5	-	-	-	-	-	50	100	500	10k	3.5M
155,520	3,600	400	50	2	0.2	12	178	1.6	15.6	0.125	100	500	6.5k	65k	1.3M
622,080	14,400	1,600	200	2	0.2	12	178	1.6	15.6	0.125	9.65	1k	25k	250k	5.0M

The actual corner frequencies of the jitter generator will be beyond those in the ITU-T mask.

Jitter amplitude versus modulation		●	●



Bit rate (kb/s)	A4 (UI)	A1 (UI)	A2 (UI)	A3 (UI)	F7 (Hz)	F0 (Hz)	F6 (Hz)	F2 (kHz)	F3 (kHz)	F5 (kHz)	F4 (kHz)
2,048	80	10	1	0.6	0.1	2	100	13	25	50	102
8,448		10	1	0.6	-	2	-	50	100	200	430
34,368		10	1	0.6	-	2	-	100	200	400	840
139,264		10	1	0.6	-	2	-	5	10	2,000	4,000
155,520	50	5	1	0.6	0.1	2	500	5	50	1,000	4,000
622,080	200	5	2	1.2	0.1	2	500	5	50	1,000	5,000

Jitter generation option (continued)

		SDH and PDH jitter generation A3K	140
Amplitude	To ITU-T O.171.	●	●
Jitter amplitude range		●	●

Range	Min. UI	Max. UI	Step size (UI)
1	0. 01	1. 00	0.01
10	0.1	10. 0	0.1
80	0.5	80. 0	0.5
50	0.5	50. 0	0.5
200	0.5	200. 0	0. 5

Jitter amplitude accuracy

± 5% ± X ± Y (± Z at STM-1e only), ● ●
where X is the amplitude accuracy given in the table below:

Amplitude accuracy

Range	X (UI)
1	0.01
10	0.1
80	1
50	0.5
200	2

where Y is the Generator intrinsic jitter given in the table below:

Generator intrinsic jitter

Bit rate (kb/s)		Y (UI)
2,048		0.02
8,448		0.02
34,368		0.03
139,264	<10 kHz	0.04
	>10 kHz	0.02
155,520	<10 kHz	0.04
	>10 kHz	0.03
622,280		0. 10

where Z is the additional STM-1e high frequency accuracy[1] shown in the table below:

Interface	Selected jitter frequency and amplitude	Z (UI) nominal
STM-1e	> 1.3 MHz **and** < 0.2 UI	10%
STM-1e	> 1.3 MHz **and** > 0.2 UI	20%
All other rates and interfaces	All	0

[1] The high frequency accuracy factor only applies outwith the ITU-T O.171 specified modulation frequency range.

Values are peak-to-peak jitter in UI measured with HP1 filter present

Jitter generation option (continued)

		SDH and PDH jitter generation	
		A3K	140
Tolerance masks	Four fixed jitter tolerance masks with peak-to-peak jitter amplitudes and modulating frequencies to ITU-T G.823 Table 2 covering low and high Q systems. The masks can be used to measure tolerance to jitter amplitude at spot jitter frequencies or can be swept in 20% frequency increments. When generating an SDH signal, the masks available are those specified in ITU-T G.958. A choice of type A or B masks is available at STM-1 and STM-4.	●	●
Automatic jitter tolerance	The mask is swept in frequency increments and at each frequency the jitter amplitude is increased until errors (of any type) are detected.	●	●
Number of frequency points	3 to 55 in steps of 1. Step sizes calculated as follows $\log (m) = \frac{\log (f_{max}) - \log (f_{min})}{(n - 1)}$ n = Number of frequency steps m = Multiplier applied to the frequency to determine the next frequency value. For 55 steps, the multiplier is +20%. For 10 steps, the multiplier is +200%.	●	●
Dwell time	0.1 to 99.9 seconds in 0.1 second steps. Time spent at each amplitude point/frequency point waiting for error events.	●	●
Delay time	0.1 to 99.9 seconds in 0.1 second steps. Time spent at each amplitude/frequency point waiting for the system under test to settle before performing the measurement.	●	●
Bit error threshold	Any error or 1 to 10^6 bit errors in steps of 1. Any error allows jitter tolerance testing using the "Onset of Errors Technique" The bit error threshold allows the instrument to record a pass at a particular point when the bit error count is non-zero and allows the instrument to make measurements using the "1 dB Power Penalty Technique"	●	●
Jitter tolerance results masks		●	●

Rate	Pass masks	Type
2 Mb/s	ITU-T G.823	Low Q and high Q
8 Mb/s	ITU-T G.823	Low Q and high Q
34 Mb/s	ITU-T G.823	
140 Mb/s	ITU-T G.823	
STM-1	ITU-T G.958	Type A and type B
STM-4	ITU-T G.958	Type A and type B

Jitter generation option (continued)

		SDH and PDH jitter generation A3K	140

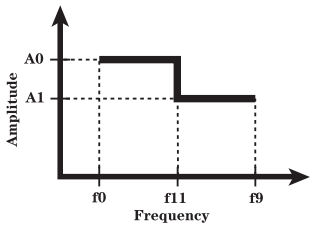
Wander modulation

External MTS clock input
Data or clock format (as ITU-T G.811).
BNC, 75 ohm, unbalanced or Siemens (3-pin) 120 ohm balanced.
● –

Frequency
10 µHz to 0.125 Hz.
● –

Frequency accuracy
± 1%.
● –

Frequency resolution
1 µHz.
● –



Wander amplitude versus modulation frequency'
Generated wander amplitude versus modulation frequency
● –

Bit rate (kb/s)	A0 (UI)	A1 (UI)	F0 (µHz)	F11 (mHz)	F9 (Hz)
2,048	80	80	10	-	0.125
155,520	3,600	400	10	1.6	0.125
622,080	14,400	1,600	10	1.6	0.125

Meets or exceeds the ITU-T O.171 specification.

Wander amplitude range
● –

Bit rate (kb/s)	Minimum (UI)	Maximum (UI)	Step size (UI)
2,048	0.5	80	0.5
155,520	0.5	3,600	0.5
622,080	0.5	14,400	0.5

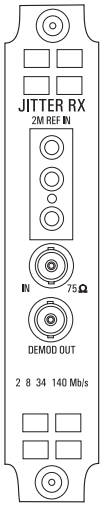
Wander amplitude accuracy
± 5% ± X ± Y.
● –

Bit rate (kb/s)	X (UI)	Y (UI)
2,048	1	0.1
155,520	0.5	0.1
622,080	0.5	0.1

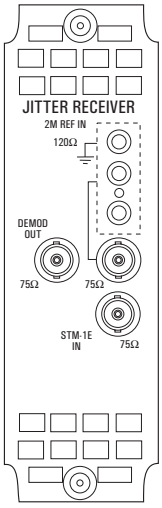
Fixed wander tolerance mask
A pre-programmed wander tolerance mask to ITU-T G.823 Table 2 and ITU-T G.958 can be selected to automatically control the wander amplitude. The analyzer will automatically select the appropriate amplitude for the selected frequency.
● –

Bit rate (kb/s)	A0 (UI)	A1 (UI)	A2 (UI)	F0 (µHz)	F12 (mHz)	F11 (mHz)	F10 (Hz)	F9 (Hz)
2,048	36.9	18	1.5	12	4.88 m	10 m	0.125	-
155,520	2,800	311	39	12	178 µ	1.6 m	15.6 m	0.125
622,080	11,200	1,244	156	12	178 µ	1.6 m	15.6 m	0.125

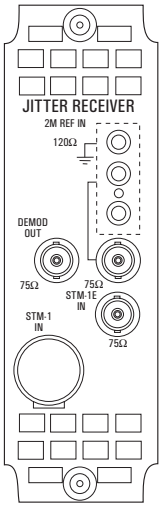
Jitter measurement



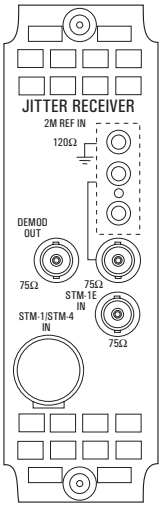
Option UHN



Option A3L



Option A3V



Option A3N

Option UHN
PDH jitter measurement: 2, 8, 34 and 140 Mb/s electrical interface.

Option A3L
STM-1e line and PDH jitter measurement: 2, 8, 34, 140 and 155 Mb/s.

Option A3V
STM-1o, STM-1e line and PDH jitter measurement: 2, 8, 34, 140 Mb/s electrical and 155 Mb/s electrical and optical.

Option A3N
STM-4o, STM-1o, STM-1e line and PDH jitter measurement: 2, 8, 34, 140 Mb/s electrical, 155 Mb/s electrical and optical and 622 Mb/s optical.

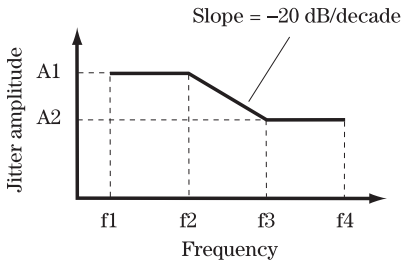
Jitter measurement test options

Requires a PDH test option (UKK, UKJ or UKN) for PDH jitter measurement.		PDH jitter UHN	STM-1e and PDH jitter A3L	STM-1o, STM-1e and PDH jitter A3V	STM-4o, STM-1o, STM-1e and PDH jitter A3N
OUT and IN ports (used for transmit and receive)					
Type	Electrical SDH: To ITU-T G.703.	–	●	●	●
	Optical.	–	–	●	●
Connectors	Uses the Rx ports on the PDH option (UKK, UKJ or UKN) or the Rx clock port on the PDH binary option UH3 for PDH jitter measurement.	●	●	●	●
	STM-1e jitter measurement uses BNC, 75 ohm, unbalanced. *(Small Siemens 75 ohm unbalanced option available.)*	–	●	●	●
	STM-1o, STM-4o customer exchangeable optical adaptors allow a range of interfaces to be attached.	–	–	●	●
Other ports	External MTS clock input (75 ohm unbalanced, 120 ohm balanced).	●	●	●	●
	Demodulated jitter output (75 ohm, unbalanced).	●	●	●	●
Receiver					
Rate	2.048, 8.448, 34.368 and 139.264 Mb/s.	●‡	● ‡	● ‡	● ‡
	STM-1e (155 Mb/s electrical).	–	●	●	●
	STM-1o (155 Mb/s optical).	–	–	●	●
	STM-4o (622 Mb/s optical).	–	–	–	●
	‡ *PDH jitter measurement uses Rx ports on PDH module.*				
PDH input	Refer to PDH test option UKK, UKJ, UKN or UKZ.	●	●	●	●
Detector type	MLM (multi mode).*	–	●	●	●
STM-1e input	Line code: CMI. Impedance: 75 ohm. Equalization: Automatic for cable loss up to 12 dB at half the bit rate. Monitor: 20 to 26 dB of flat gain.	–	●	●	●

** MLM receivers work with both MLM (multi mode) and SLM (single mode) transmitters.*

Jitter measurement test options (continued)

		PDH jitter	STM-1e and PDH jitter	STM-1o, STM-1e and PDH jitter	STM-4o, STM-1o, STM-1e and PDH jitter
		UHN	A3L	A3V	A3N
STM-1o input	Line code: NRZ. Wavelength: 1200 to 1600 nm. Sensitivity: –28 dBm minimum. Using 1300 nm wavelength, 100% modulation depth and BER of 10^{-10} and PRBS of $2^{23} - 1$. Dynamic range: 20 dB minimum. Maximum input power: –8 dBm.	–	–	●	●
STM-4o input	Line code: NRZ. Wavelength: 1200 to 1600 nm. Sensitivity: –26 dBm minimum. Using 1300 nm wavelength, 100% modulation depth and BER of 10^{-10} and PRBS of $2^{23} - 1$. Dynamic range: 18 dB minimum. Maximum input power: –8 dBm.	–	–	–	●
SDH-PDH jitter transfer					
Automatic jitter transfer	Automatic jitter transfer test at 2, 8, 34, 139 Mb/s, STM-1e, STM-1o– or STM-4o. Narrow band selective filtering is performed in the receiver. Jitter transfer results are plotted graphically alongside the relevant ITU-T mask.		●	●	●
Number of frequency points	1 to 55 in steps of 1. **NB** *When a single point is selected, no graph is available. Only text results will be displayed.* Step sizes calculated as follows $\log(m) = \frac{\log(f_{max}) - \log(f_{min})}{(n-1)}$ n = Number of frequency steps m = Multiplier applied to the frequency to determine the next frequency value. For 55 steps, the multiplier is +20%. For 10 steps, the multiplier is +200%.	–	●	●	●
Delay time	5 to 30 seconds in 1 second steps. Time spent at each amplitude point/frequency point waiting for the system under test to settle before performing the measurement. During calibration, the delay time used is fixed at 5 sec.	–	●	●	●
Dwell time	5 to 30 seconds in 1 second steps. Test period time spent at each amplitude/frequency point. The result recorded is the maximum peak-to-peak jitter amplitude detected during the dwell time test period.	–	●	●	●
Jitter transfer input mask	Select between ITU-T defined fixed mask or user selectable input mask.	–	●	●	●



Jitter measurement test options (continued)

		PDH jitter	STM-1e and PDH jitter	STM-1o, STM-1e and PDH jitter	STM-4o, STM-1o, STM-1e and PDH jitter
		UHN	A3L	A3V	A3N
Fixed jitter transfer input masks	See table below	–	●	●	●
User selectable jitter transfer input mask	F1 < F2 < F3 < F4 $F1_{min}$ = 15 Hz, $F4_{max}$ = F4 in ITU-T O.171 Table 3. $A1_{max}$ = max value that can be generated at F2. $A2_{max}$ = max value that can be generated at F4. Note: The maximum value that can be generated is as defined by ITU-T O.171 Table 3 (shown in jitter and wander generation section except for 8 Mb/s where $F2_{max}$ = 10.7 kHz. When user selectable is enabled, the ITU-T pass mask can also be displayed along with the results.	–	●	●	●
Jitter transfer measurement bandwidth	10 Hz.	–	●	●	●
Jitter transfer dynamic range	+5 dB to –40 dB.	–	●	●	●
Jitter transfer stability	0.02 dB. Measurements must be completed within 10 mins of the completion of the calibration cycle.	–	●	●	●
Jitter transfer calibration	0.01 dB.	–	●	●	●
Jitter transfer accuracy	Figures quoted below include stability and calibration factors.	–	●	●	●

Bit rate (Mb/s)	**Mask**	**F1** (Hz)	**F2** (Hz)	**F3** (Hz)	**F4** (Hz)	**A1** (UI)	**A2** (UI)
2 Mb/s	G.823, High Q G.823, Low Q	20 20	2.4 k 93	18 k 700	100 k 100 k	1.5 1.5	0.2 0.2
8 Mb/s	G.823, High Q G.823, Low Q	20 20	400 10.7 k	3 k 80 k	400 k 400 k	1.5 1.5	0.2 0.2
34 Mb/s	G.823	100	1 k	10 k	800 k	1.5	0.15
140 Mb/s	G.823	200	500	10 k	3500 k	1.5	0.08
STM-1	G.958, Type A G.958, Type B	500 [1]	6 .5 k	65 k	1300 k [2]	1.5	0.15
STM-4	G.958, Type A G.958, Type B	1 k [1]	25 k	250 k	5000 k [2,3]	1.5	0.15

Rx jitter amplitude (UI)	**Accuracy** (dB)
3 to 0.3	0.04
0.3 to 0.03	0.25
0.03 to 0.01	0.5
0.01 to 0.003	1
0.003 to 0.001	3

The accuracy figures were verified using the following patterns,
PDH: Unframed 1000, unframed default PRBS (refer to UKJ specification).
STM-1, STM-4: VC-4 containing unframed 140 Mb/s at $2^{23} - 1$.

Jitter measurement test options (continued)

		PDH jitter	STM-1e and PDH jitter	STM-1o, STM-1e and PDH jitter	STM-4o, STM-1o, STM-1e and PDH jitter
		UHN	A3L	A3V	A3N
Jitter transfer	Tabular or graphical form **results**	–	●	●	●
Jitter transfer pass mask	Results will be compared to ITU-T pass mask specified in the appropriate standard.	–	●	●	●

Bit rate (Mb/s)	Mask	F1 (Hz)	F2 (Hz)	F3 (Hz)	F4 (Hz)	A1 (UI)	A2 (UI)
2 Mb/s	G.823[1] High Q	20	40	400	100 k	0.5	–19.5
	G.823[1] Low Q	20	70	700	100 k	0.5	–19.5
8 Mb/s	G.823[2] High Q	20	100	1 k	400 k	0.5	–19.5
	G.823[2] Low Q	20	8 k	80 k	400 k	0.5	–19.5
34 Mb/s	G.823[2]	100	300	3 k	800 k	0.5	–19.5
STM-1	G.958, Type A		130 k	Note b	–	0.1	–
	G.958, Type B	500	30 k		–	0.1	–
STM-4	G.958, Type A	1 k	500 k	Note b	–	0.1	–
	G.958, Type B	1 k	30 k		–	0.1	–

[1] *Actual values from ITU-T G.742.*
[2] *Actual values from ITU-T G.751.*

Note
(a) No mask is defined in the ITU-T standards for 139 Mb/s.
In this case, the display will show the result without the pass threshold being indicated.
(b) The mask shows threshold falling off by 20 dB per decade after F2.

Jitter transfer graphical results	The result is plotted alongside the pass mask on a graph of gain versus frequency. The y-axis range is selectable as +5 dB to –60 dB or +3 dB to –3 dB.	–	●	●	●
Jitter transfer tabular results	The result will be displayed in a table, with the following information displayed for each result: Point number, frequency, mask value, result, pass fail indication.	–	●	●	●

Peak-peak jitter measurement

Jitter measurement ranges	These ranges cope with the measurements required in ITU-T O.171 Table 3.	●	●	●	●

Range	Receiver range	
	Lower UI	Upper UI
1.6	0	1.6
16	0	16

Peak-to-peak jitter measurement bandwidth	To ITU-T O.171 Table 4.	●	●	●	●

Bit rate (kb/s)	Receiver bandwidth		
	Min	Max	
		Range 1.6 UI	Range 16 UI
2,048	2 Hz	100 kHz	50 kHz
8,448	2 Hz	400 kHz	100 kHz
34,368	2 Hz	800 kHz	400 kHz
139,264	2 Hz	3.5 MHz	800 kHz
155,520	2 Hz	1.3 MHz	800 kHz
622,080	2 Hz	5.0 MHz	800 kHz

Jitter measurement test options (continued)

	PDH jitter	STM-1e and PDH jitter	STM-1o, STM-1e and PDH jitter	STM-4o, STM-1o, STM-1e and PDH jitter
	UHN	A3L	A3V	A3N
Peak measurement accuracy	●	●	●	●
Receiver intrinsic jitter (all rates)	●	●	●	●

To ITU-T O.171

Range (UI)	Accuracy (peak)	Accuracy (peak-to-peak)
1.6	±5% ±X ±Y	±5% ±2X ±Y
16	±5% ±X ±Y	±5% ±2X ±Y

Where X is 0.01 UI for 1.6 UI range, 0.03 UI for 16 UI range,
Y is receiver intrinsic jitter detailed below.

Bit rate (kb/s)	1.6 UI range Intrinsic jitter	16 UI range Intrinsic jitter (UI)	
		Clock (all ones)	PRBS
	Y	Y	Y
2,048	0.02	0.07	0.1 [1]
8,448	0.02	0.07	0.1 [1]
34,368	0.02	0.07	0.1 [1]
139,264	0.02	0.07	0.1 [1]
155,520 (electrical)	0.02	n/a	0.1
155,520 (optical)	0.03	n/a	0.1
622,080 (optical)	0.04	n/a	0.2

[1] *Typically 0.05 UI after calibration*

The following additional intrinsics may apply:
0.01 UI (typical) when using monitor gain.
0.01 UI (typical) when using equalization.
0.01 UI (typical) at STM-1 optical with light levels < –22 dBm.
0.01 UI (typical) at STM-4 with light levels < –16 dBm.
0.02 UI (typical) at STM-4 with light levels < –22 dBm.
0.01 UI (typical) at temperatures outwith ambient.

Values are peak-to-peak jitter in UI measured with HP1 and LP filter present.

Jitter measurement test options (continued)

		PDH jitter	STM-1e and PDH jitter	STM-1o, STM-1e and PDH jitter	STM-4o, STM-1o, STM-1e and PDH jitter
		UHN	A3L	A3V	A3N
Jitter peak results resolution	1.6 UI range: 0.001 UI; 16 UI range: 0.01 UI.	●	●	●	●
Jitter hit threshold resolution	Steps of 0.01 UI (range 1.6); steps of 0.10 UI (range 16).	●	●	●	●
Internal filters	To ITU-T O.171.	●	●	●	●

Internal filters: Nominal 3 dB corner frequencies.

Filter (kb/s)	HP1 (high pass) (Hz)	HP2 (high pass) (kHz)	LP (low pass) (kHz)
2,048	20	18	100
8,448	20	80	400
34,368	100	10	800
139,264	200	10	3,500
155,520	500	65	1,300
622,080	1,000	250	5,000

HP filters: Slope below 3 dB point is 20 dB per decade;
LP filters: Slope above 3 dB point is 60 dB per decade.
Combinations of filters available: Off (no filters), LP only,
HP1 only, HP2 only, LP and HP1, LP and HP2,
12 kHz HP (can be enabled in addition to all of the above or by itself).

Demodulated jitter output	1.0 V per UI (range 1.6); 0.1 V per UI (range 16).	●	●	●	●

RMS jitter measurement

RMS jitter measurement ranges	The RMS ranges are linked to the selection for peak. No separate selection will exist.	–	●	●	●

Receiver range	
Peak range (UI)	**rms range (UI)**
1.6	0.5
16	5.0

RMS measurement accuracy		–	●	●	●

Range (UI)	Accuracy 20 Hz to 3 MHz	Additional factor > 3 MHz
0.5	± 5% ± V ± W ± Z	± 5%
5	± 5% ± V ± W ± Z[1]	± 5%

1.0n 5 UI range: Z (high frequency accuracy) is only applicable at 2 Mb/s rate.

Where V is display resolution: 0.002 UI for 0.5 UI Range, 0.02 UI for 5 UI range.
W is rms receiver intrinsic jitter detailed below.
Z is rms high frequency accuracy detailed below.

Jitter measurement test options (continued)

	PDH jitter	STM-1e and PDH jitter	STM-1o, STM-1e and PDH jitter	STM-4o, STM-1o, STM-1e and PDH jitter
	UHN	A3L	A3V	A3N
RMS receiver intrinsic jitter (all rates)	–	●	●	●
RMS high frequency accuracy	–	●	●	●
RMS results resolution	–	●	●	●

RMS receiver intrinsic jitter (all rates)

Bit rate (kb/s)	0.5 UI range	5 UI range	
		Intrinsic jitter (UI)	
	Intrinsic jitter (UI)	Clock (all ones)	PRBS
	W	W	W
2,048	0.004	0.03	0.04
8,448	0.003	0.03	0.04
34,368	0.02	0.04	0.05
139,264	0.01	0.03	0.04
155520 (electrical)	0.006	n/a	0.04
155520 (optical)	0.015	n/a	0.04
622,080	0.02	n/a	0.08

RMS high frequency accuracy

Bit rate (kb/s)	Selected frequency	Z (UI)
SDH rates	all	0
2,048	> 30 kHz	(f–30)/70 × 6%[1]
8,448	> 150 kHz	(f–150)/250 × 6%[1]
34368 139264	all	0

[1] Where f is the modulation frequency in kHz.

The following additional intrinsics may apply:
0.004 UI_{rms} (typical) when using monitor gain.
0.004 UI_{rms} (typical) when using equalization.
0.004 UI_{rms} (typical) at STM-1o with light levels < –22 dBm.
0.004 UI_{rms} (typical) at STM-4o with light levels < –16 dBm.
0.008 UI_{rms} (typical) at STM-4o with light levels < –22 dBm.
0.005 UI_{rms} (typical) at temperatures outwith ambient.
Values are rms jitter in UI_{rms} measured with 12 kHz HP filter present.

RMS results resolution

0.5 UI range: 0.001 UI rms.
5 UI range: 0.01 UI rms.

Jitter measurement test options (continued)

		PDH jitter	STM-1e and PDH jitter	STM-1o, STM-1e and PDH jitter	STM-4o, STM-1o, STM-1e and PDH jitter
		UHN	A3L	A3V	A3N
Jitter results					
Results	Hits: Jitter hit count, jitter hit seconds, jitter hit-free seconds, Amplitude: +ve peak amplitude, -ve peak amplitude, peak-to-peak amplitude.	●	●	●	●
	Amplitude: rms amplitude.	–	●	●	●
Jitter transfer	Display results from last auto-jitter transfer measurement.	–	●	●	●
Alarms	Loss of signal, jitter unlock and jitter out of range.	●	●	●	●
Graphical results	Jitter hit count result plus jitter unlock, jitter out-of-range and loss of signal alarms are stored/displayed in SMG (stored measurement graphics).	●	●	●	●
Wander measurement					
Timing reference input	Ext. MTS: Data or clock format (as ITU-T G.811). BNC, 75 ohm, unbalanced or Siemens (3-pin), 120 ohm, balanced.	●	●	●	●
Wander results	+ve peak amplitude, -ve peak amplitude, peak-to-peak amplitude, peak-to-peak amplitude (15 minutes) peak-to-peak amplitude (24 hours), time interval error, implied frequency offset, estimated frame slips, estimated bit slips.	●	●	●	●
	All results can be displayed in bits (0..99 999 999.999 bits) or µs (0..99 999 999.999 µs) except: Estimated frame slips: 0..9 999 999 frames, Estimated bit slips: 0..9 999 999 bits, Implied frequency offset: 0..999.99 ppm.				
Wander alarms	No reference and excess wander. If wander > 5 UI in any 15 minute period or > 28 UI in any 24 hour period then the status message "excess wander" is displayed.	●	●	●	●
Bandwidth	Low pass response –3 dB at 10 Hz (nominal).	●	●	●	●
Resolution	0.125 UI.	●	●	●	●
Range	± 99999 UI.	●	●	●	●
Accuracy	± 0.125 UI ± 0.5% of reading (up to 1 Hz wander frequency).	●	●	●	●
Estimate frame slips	0 to 9 999 999 frames.	●	●	●	●
Estimate bit slips	0 to 9 999 999 bits.	●	●	●	●
Implied frequency offset	TIE expressed as a ppm offset to nominal (0 .. 999.99 ppm).	●	●	●	●
Graphical wander	Wander measurement presented in graphical form. Three positive and negative sliding bar graphs each of ± 1 UI, ± 16 UI, ± 256 UI are provided. Bit slips and estimated frame slip results plus wander reference unlock and excessive wander alarms are stored/displayed in SMG (stored measurement graphics).				

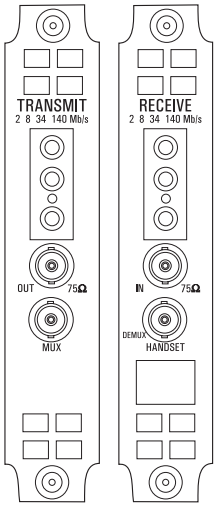
Definitions

Time interval error: *Current offset with respect to the position at start of gating displayed with a resolution of 0.125 UI.*

Estimated frame slips: *Each time a complete UI of wander (+ or –) is accumulated the bit slips count is incremented..*

Estimated bit slips: *Each time the accumulated movement equals +/– 256 UI (ie, the 2 Mb frame size), the frame slips count is incremented.*

ATM cell test options



Option UKN

Option UKN (ETSI only)
Pair of modules providing ATM cell layer generation and measurement: 2, 34 and 140 Mb/s (includes structured PDH generation and measurement: 2, 8, 34 and 140 Mb/s – refer to page 12 and 13).

ATM cell test options – ETSI only

		ATM cell generation and analysis UKN
ATM transmitter		
Physical layer		
Type	Electrical: To ITU-T G.703.	●
Connectors	BNC, 75 ohm, unbalanced and Siemens 3-pin, 120 ohm balanced. *(Small Siemens 75 ohm unbalanced option available.)*	●
Rates	2.048, 34.368, 139.264 and 155.52 Mb/s‡.	●
Frequency offset generation‡	2.048, 34.368 and 139.264 Mb/s: Up to ± 100 ppm in 1 ppm steps.	●
Clock timing‡	Internal: All rates.	●
Framing	2.048 Mb/s (E1): As per ITU-T G.804/G.704; 34.368 Mb/s (E3) and 139.264 Mb/s: As per ITU-T G.832; Error monitoring (EM) contains correct BIP-8; Trail trace (TR) is user-definable (ITU-T E.164 format); Maintenance adaptation (MA) is set to 011 (hexadecimal); Network operator (NR) and general communications (GC) are set to all zeros; 155.520 Mb/s: As per ITU-T G.707‡.	●
Transmission convergence	2.048 Mb/s: To ITU-T G.804/G.704 (CRC4 on/off); 34.368 Mb/s and 139.264 Mb/s: To ITU-T G.804/G.832; 155.52 Mb/s: To ITU-T G.707‡.	●
Error add	Single HEC or double HEC; 1 in 10^3 or single error; HEC error sequences.	●

‡ *For 155.52 Mb/s you also require an STM-1 test option (option A1T or A3R).*

ATM cell test options – ETSI only (continued)

		ATM cell generation and analysis UKN
ATM layer		
ATM layer interfaces	UNI, NNI.	●
Number of foreground virtual channels (VCs)	1.	●
Foreground VC bandwidth	2.048 Mb/s: 100 to 4,528 cells per second in steps of 1 cell/s; 34.368 Mb/s: 100 to 80,000 cells per second in steps of 1 cell/s; 139.264 Mb/s: 100 to 326,037 cells per second in steps of 1 cell/s; 155.52 Mb/s:‡ 100 to 353,207 cells per second in steps of 1 cell/s‡.	●
Foreground VC distribution	Constant: Single cell is transmitted at regular intervals determined by the cell rate (cells/s = 100 to max). Also allows a single burst of consecutive cells from 1 to 2048 in steps of 1 cell. Burst: User-specified burst of up to 2047 consecutive cells added.	●
Foreground VC payload	Cross cell PRBS ($2^{15} - 1$, $2^{23} - 1$ to ITU-T O.151); Single cell PRBS ($2^{9} - 1$); User-defined byte repeated to fill cell payload (48 bytes); Test cell (to draft ITU-T O.191).	●
Error add (foreground VC)	Payload bit errors; 1 in 10^3 or single error.	●
Number of background VCs	Up to 3.	●
Background VC density	Individually set from 0 to maximum in 1% steps after foreground allocation.	●
Background VC distribution	Constant (for constant bit rate service).	●
Background VC payload	User-defined byte repeated to fill cell payload (individually set per background VC).	●
VC priority	Foreground VC has top priortity; background VCs have approximately equal priority.	●
Fill cells	Idle or unassigned. All bytes of the payload are set to 6AH.	●
OAM F4 and F5 flows		
Fault management	Alarm generation: VP-FERF/VP-RDI, VP-AIS, VC-FERF/VC-RDI, VC-AIS. Continuity check: VP-CC, VC-CC.	●

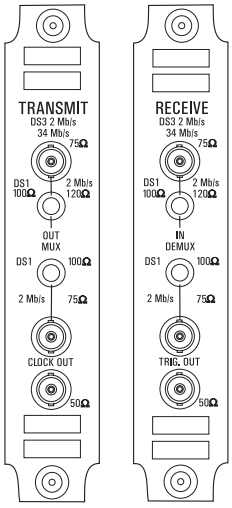
ATM receiver

Physical layer			
Type, connectors, rates	As for ATM transmitter.	●	
Jitter tolerance‡	To ITU-T O.171.	●	
Equalization at f/2‡	To ITU-T G.703; 2.048 Mb/s: 6 dB; 34.368, 139.264 Mb/s: 12 dB.	●	
Monitor point compensation‡	2.048 Mb/s: 20, 26 or 30 dB. 34.368, 139.264 Mb/s: 20 or 26 dB.	●	
Framing, convergence	As for transmitter.	●	
PDH physical layer results	EM BIP-8, FEBE (ITU-T G.832), trail trace: (34 or 140 Mb/s only); CRC4, REBE: 2 Mb/s only, CRC on only.	●	
SDH physical layer results	See STM-1 test options for details (option A3R or A1T).	●	
G.826 analysis	Errored blocks (EB), errored seconds (ES), severely errored seconds (SES), unavailability seconds (UAS), error second ratio (ESR), severely errored second ratio (SESR), background block error ratio (BBE) for EM BIP-8 and FEBE (PDH)‡.		●
PDH physical layer alarm indication‡	LOS, LOF, FERF/RDI, remote alarm, AIS, multiframe loss, remote multiframe alarm.	●	
PDH physical layer alarm seconds‡	As for PDH physical alarm indication above, plus power loss.	●	

‡ For 155.52 Mb/s you require an STM-1 test option (option A1T or A3R).

ATM cell test options – ETSI only (continued)

		ATM cell generation and analysis UKN	
ATM layer			
ATM layer interfaces	UNI, NNI.	●	
Cell stream selected for test (cell filter)	All user cells, by VP, by VC, idle, unassigned, expert mode (all bits selectable).	●	
Measurement modes	In-service and out-of-service.	●	
Payload	Cross cell PRBS, single cell PRBS, user byte, test cell (to draft ITU-T O.191).		●
Test cell synchronization	Synchronization loss when seven consecutive errored cells are received; Synchronization gain when six consecutive error-free cells are received.	●	
ATM layer results	Received cells, corrected HEC, non-corrected HEC, cell loss, cell misinsertion, cell errors, bit errors, gated mean cell transfer delay, min cell transfer delay, peak-to-peak 2-point CDV, max 1-point CDV (to ITU-T I.356). Non-conforming cell count.	●	
ATM layer alarms	Loss of cell sync, selected cell not received, congestion experienced, test cell loss, payload pattern loss; see below for OAM alarms.	●	
OAM F4 and F5 flows			
Performance management	Analysis of PM-OAM cells for end-to-end and segment flows; results for cell loss, cell misinsertion and BEDC BIP-16 errors.	●	
Fault management	Alarm indication: VP-AIS, VP-FERF/VP-RDI, VP-LOC, VC-AIS, VC-FERF/VC-RDI, VC-LOC (all to ITU-T I.610), PM-OAM loss.	●	
	Alarm seconds: As for alarm indication above.	●	
Thru mode			
	Thru mode is provided to allow ATM measurements of live traffic when no protected monitor point is available. This mode is available at all rates.	●	



Option UKZ

HP OmniBER 717 analyzer only

Option UKZ (ITU-T/ANSI)
Pair of modules providing ATM cell generation and analysis at interface rates of 1.544 (DS1), 44.736 (DS3), 2.048 (E1) and 34.368 (E3) Mb/s.

ATM cell test options – ITU-T/ANSI

		ATM cell generation and analysis
		UKZ
ATM transmitter		
Physical layer		
Type	Electrical: To ANSI T1.102-1993; ITU-T O.171, G.703.	●
Connectors	DS1 (1.554 Mb/s): WECO bantam, 100 ohm balanced. DS3 (44.736 Mb/s): BNC, 75 ohm, unbalanced. E1 (2.048 Mb/s): BNC, 75 ohm, unbalanced and WECO bantam, 120 ohm balanced. E3 (34.368 Mb/s): BNC, 75 ohm, unbalanced.	●
Rate	1.544, 2.048, 34.368, 44.736 and 155.52 Mb/s‡.	●
Frequency offset generation‡	1.544, 2.048, 34.368 and 44.736 Mb/s: up to ± 100 ppm in 1 ppm steps.	●
Clock timing‡	Internal: All rates; recovered by the receiver.	●
Clock output	Selected transmitter clock (internal or looped receiver clock) *(BNC connector, externally terminated to 50 ohm to ground).*	●
Line coding	DS1: B8ZS. DS3: B3ZS. E1: AMI, HDB3. E3: HDB3.	●
Output level	DS1: DSX-1, DS1-LO. DS3: DS3-HI, DSX-3.	●
Framing	DS1: ESF to ANSI T1.403-1989, Bellcore TR-TSY-000499 and ITU-T G.704; the ESF data link (DL) defaults to repetition of idle code (01111110); DS3: C-bit parity to ANSI T1.107a-1990. E1: To ITU-T G.804/G.704. E3: To ITU-T G.832; error monitoring (EM) contains correct BIP-8; trail trace (TR) is user-definable (ITU-T E.164 format); maintenance adaptation (MA) is set to 011 (hexadecimal); network operator (NR) and general communications (GC) are set to all zeros. OC-3c to ANSI T1.105-1991 and TR-TSY-000253‡. STM-1 to ITU-T G.707‡.	●

‡ *For 155.52 Mb/s you require test option A1T.*

ATM cell test options – ITU-T/ANSI (continued)

		ATM cell generation and analysis UKZ
Transmission convergence	DS1: To ANSI T1E1.2/95-003 and ITU-T G.804; cell scrambling selectable. DS3 (direct): To ANSI T1E1.2/95-003 and ITU-T G.804; cell scrambling selectable. DS3 (PLCP): To ANSI T1E1.2/95-003 (Annex A) and ITU-T G.804; cell scrambling is selectable; growth bytes Z1 to Z6 default to 0 but are user alterable; link signal status (LSS) defaults to '000' but is alterable; F1, M1 and M2 are set to '11111111'; cycle/stuff counter (C1) can be set to three fixed patterns: 13 14 13 13 14 13 (minimum rate adaption); 13 14 13 13 14 14 (nominal rate adaption); 13 14 14 13 14 14 (maximum rate adaption); E1: To ITU-T G.804/G.704 (CRC4 on/off); cell scrambling is selectable. E3: To ITU-T G.804/G.832; cell scrambling is selectable. STS-3c‡: To Bellcore TR-TSY-000253 and ITU-T G.708/709; cell scrambling is selectable. STM-1‡: To ITU-T G.708/709; cell scrambling is selectable.	●
Error add	DS1: FAS, BPV/code (rates: single or 10^3 to 10^7); CRC-6 (rates: single or 10^4 to 10^7); also, single burst of 1 to 6 consecutive FAS errors; EXZ (excess zeros): single burst of 3 to 16 uncoded zeros sent. DS3: BPV/code, FAS, MFAS, (rates: single or 10^3 to 10^7); parity (P bits), CP (path parity), FEBE (rates: single or 10^4 to 10^7); also, single burst of 1 to 4 consecutive FAS or MFAS errors; EXZ (excess zeros): single burst of 3 to 16 uncoded zeros sent. DS3 PLCP: B1 (error mask; rates: single or 10^3 to 10^7), FEBE (values: 1 to 15 sent in first 4 bits of G1 byte; rates: single or 10^3 to 10^7), C1 (error mask and frame phase selection, single error); frame (1 to 6 pairs of A1A2 bytes can be errored with 16-bit mask). E1: FAS, BPV/code (rates: single or 10^3 through 10^7); CRC-4, REBE (rates: single or 10^4 through 10^7); single burst of 1 to 4 FAS errors. E3: BPV/code (rates: single or 10^3 to 10^7); BIP (rates: single or 10^4 to 10^7); OC-3c and STM-1: As per test option A1T‡. Single HEC or double HEC; 1 in 10^3 or single error; HEC error sequences.	●
Alarm generation	DS1: Loss of signal (LOS); loss of frame (LOF); alarm indication signal (AIS); remote alarm indication (RAI). DS3: LOS; LOF; AIS; RAI; far end alarm and control (FEAC): As per T1.107-1995. DS3 PLCP: RAI. E1: LOF, AIS, RAI. E3: LOF, AIS, far end receive failure (FERF). OC-3c/STM-1: As per test option A1T‡.	●

ATM layer

ATM layer interfaces	UNI, NNI.	●
Number of foreground virtual channels (VCs)	1.	●
Foreground VC bandwidth	DS1: 100 to 3623 cells/s in steps of 1 cell/s. DS3 (direct): 100 to 104,268 cells/s in steps of 1 cell/s. DS3 (PLCP): 100 to 96,000 cells/s in steps of 1 cell/s. E1: 100 to 4,528 cells/s in steps of 1 cell/s. E3: 100 to 80,000 cells/s in steps of 1 cell/s. OC-3c/STM-1: 100 to 353,207 cells/s in steps of 1 cell/s‡.	●
Foreground VC distribution	Constant: Single cell is transmitted at regular intervals determined by the cell rate (cells/s = 100 to max). Also allows a single burst of consecutive cells from 1 to 2047 in steps of 1 cell. Burst: User-specified burst of up to 2047 consecutive cells added.	●
Foreground VC payload	Cross cell PRBS ($2^{15} - 1$, $2^{23} - 1$ to ITU-T O.151); Single cell PRBS ($2^9 - 1$); User-defined byte repeated to fill cell payload (48 bytes); Test cell (to draft ITU-T O.191).	●

‡ *For 155.52 Mb/s you require test option A1T.*

ATM cell test options – ITU-T/ANSI (continued)

		ATM cell generation and analysis UKZ
Number of background VCs	Up to 3 (see option 0YK).	●
Background VC density	Individually set from 0 to maximum in 1% steps after foreground allocation.	●
Background VC distribution	Constant (for constant bit rate service).	●
Background VC payload	User-defined byte repeated to fill cell payload (individually set per background VC).	●
Error add	Payload bit errors; 1 in 10^3 or single error.	●
VC priority	Foreground VC has top priortity; background VCs have approximately equal priority.	●
Fill cells	Idle or unassigned. All bytes of the payload are set to 6AH.	●
ATM alarm generation	VP-FERF/VP-RDI, VP-AIS, VC-FERF/VC-RDI, VC-AIS (all end-to-end).	●
Continuity check	VP-CC, VC-CC.	●

ATM receiver

Physical layer

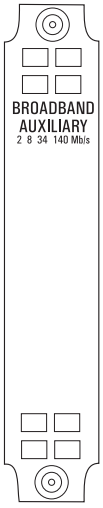
Type, connectors, rates, line code and framing	As for ATM transmitter.	●
Jitter tolerance	To Bellcore TR-TSY-000009 (DS1/DS3) and ITU-T O.171.	●
Operating level (terminate)	User selectable as follows: DS1 (balanced): DSX-1 to DS1-LO levels. DS3 (unbalanced): Automatic equalization for 0 to 900 ft encompassing DS3-HI, DSX-3 and DS3-900 levels. E1 (balanced): 3.0 V ± 20% for cable lengths as per ITU-T G.703. E1 (unbalanced): 2.37 V ± 20% for cable lengths as per ITU-T G.703. E3 (unbalanced): 1.0 V ± 20% with automatic equalization for cable lengths as per ITU-T G.703. OC-3c/STM-1: As per test option A1T‡.	●
Monitor point compensation	DS1 (balanced), E1 (balanced and unbalanced): 20, 26 or 30 dB gain relative to terminate mode. E1 (balanced) is restricted to half cable length with respect to ITU-T G.703 for 26 and 30 dB gains. DS3 and E3: 20 or 26 dB gain relative to terminate mode. OC-3c/STS-3c/STM-1: As per test option A1T‡.	●
Transmission convergence	As for transmitter.	●
PDH physical layer results	DS1 (counts & ratios): B8ZS code violations, frame errors (FAS), CRC6 errors. DS3 (counts & ratios): B3ZS code violations, frame errors, P-parity, CP-parity, FEBE. DS3 PLCP (counts & ratios): BIP-8 (B1), FEBE (G1); (count): trailer mismatches (C1). E1 (counts & ratios): CRC4 (when enabled), REBE (when enabled). E3 (counts & ratios): EM BIP-8, FEBE (ITU-T G.832), trail trace. OC-3c/STM-1: As per test option A1T‡.	●
G.826 analysis	Errored blocks (EB), errored seconds (ES), severely errored seconds (SES), unavailability seconds (UAS), error second ratio (ESR), severely errored second ratio (SESR), background block error ratio (BBER), path unavailable seconds (PUAS). DS1: CRC6. DS3: C-bit and FEBE. E1: CRC4 and REBE. E3: EM BIP-8 and FEBE. OC-3c/STM-1: As per test option A1T‡.	●
PDH physical layer alarm indication	DS1: LOS, LOF, AIS, FERF/RDI, excess zeros. DS3: LOS, LOF, AIS, FERF/RDI, loss of multiframe. DS3 PLCP: Loss of PLCP frame, RAI (yellow). E1: LOS, LOF, AIS, FERF/RDI, loss of CRC multiframe. E3: LOS, LOF, AIS, FERF/RDI. OC-3c/STM-1: As per test option A1T‡.	●
PDH physical layer alarm seconds‡	As for PDH physical alarm indication above, plus power loss, except for FEAC and link signal status (LSS), which are treated as messages, as is trail trace for E3.	●

‡ *For 155.52 Mb/s you require test option A1T.*

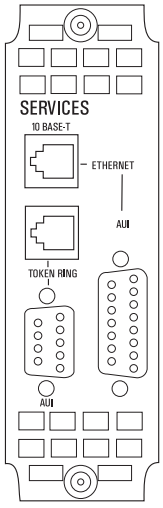
ATM cell test options – ITU-T/ANSI (continued)

		ATM cell generation and analysis
		UKZ
ATM layer		
ATM layer interfaces	UNI, NNI.	●
Cell stream selected for test (cell filter)	All user cells, by VP, by VC, idle, unassigned, expert mode (all bits selectable).	●
Measurement modes	In-service and out-of-service.	●
Payload	Cross cell PRBS, single cell PRBS, user byte, test cell (to draft ITU-T O.191).	●
Test cell synchronization	Synchronization loss when seven consecutive errored cells are received; Synchronization gain when six consecutive error-free cells are received.	●
ATM layer results	Received cells, corrected HEC, non-corrected HEC, cell loss, cell misinsertion, cell errors, bit errors, gated mean cell transfer delay, min cell transfer delay, peak-to-peak 2-point CDV, max 1-point CDV (to ITU-T I.356), non-conforming cell count.	●
ATM layer alarms	Loss of cell sync, selected cell not received, congestion experienced, test cell loss, payload pattern loss; see below for OAM alarms.	●
OAM F4 and F5 flows		
Performance management	Analysis of PM-OAM cells for end-to-end and segment flows. Results for cell loss, cell misinsertion and BEDC BIP-16 errors.	●
Fault management	Alarm indication: VP-AIS, VP-FERF/VP-RDI, VP-LOC , VC-AIS, VC-FERF/VC-RDI, VC-LOC (all to ITU-T I.610), PM-OAM loss. Alarm seconds: As for alarm indication above.	●
Thru mode	This mode is provided to facilitate testing where protected monitoring points are not available. A DS1, DS3, E1 or E3 signal received in the companion receiver module can be retransmitted unchanged from the transmitter module. The digital content of the signal at all levels is maintained. There is a fixed delay from receiver input to transmitter output.	●

ATM services test options



Option 0YK



Option USL

Option 0YK
Adds Channel View, graphical display of CDV, AAL analysis, rate history, benchmark traffic generation.

Option USL
Adds Ethernet LAN connectivity testing plus all features of option 0YK.

ATM services test options

Requires an ATM cell layer option (UKN or UKZ) to be fitted.

		0YK	USL
Transmitter	*Note: When this option is fitted, the foreground and background traffic generation capability of the ATM cell layer modules (options UKN or UKZ) is replaced by that described here. Other features of the ATM cell layer modules apply except where otherwise stated.*		
Physical layer	Refer to ATM cell layer option for details.	●	●
Benchmark traffic	Sets 1 foreground and up to 9 background virtual channels independently.	●	●
Number of foreground virtual channels (VCs)	1.	●	●
Bandwidth	As for ATM cell layer option.	●	●
Foreground VC distribution	Constant: Cells are transmitted at regular intervals determined by the cell rate (cells/s = 1 to max). Burst: User-specified burst of cells, from 1 to 4096 in steps of 1 cell; cell rate during burst can be varied (cells/s = 1 to max). Burst intervals are determined by the cell rate. Random: Poisson distribution of cells (mean cell rate: cells/s = 1 to max).	●	●
Foreground VC payload	Cross cell PRBS ($2^{15} - 1$, $2^{23} - 1$ to ITU-T O.151); Single cell PRBS ($2^{9} - 1$); User-defined byte repeated to fill cell payload (48 bytes); Test cell (to draft ITU-T O.191); Stored cell streams: One of five pre-defined cell streams, provided for training purposes.	●	●
Number of background VCs	Up to 9.	●	●
Background VC density	Individually set from 0 to maximum in 1 cell/s steps after foreground allocation.	●	●
Background VC distribution	Constant, burst, random, as for the foreground channel. Cell contention buffering: Up to 2048 background cells awaiting a cell slot.	●	●
Backgound VC payload	User-defined byte repeated to fill cell payloads (individually set per background).	●	●
VC priority	Foreground VC has top priortity; background VCs have approximately equal priority.	●	●

ATM services test options (continued)

		0YK	USL
Receiver			
Physical layer	Refer to ATM cell layer option (UKN or UKZ) for details.	●	●
Channel View	Finds and displays up to 1023 VCs on a link; specialized hardware is used to detect even single cell events. Calculates and graphically displays mean cell traffic load of each VPI or VPI/VCI. User-defined VPI mask. Easy user selection from link activity graph of the path/channel for detailed analysis. Found channels are scanned sequentially to identify the payload and ATM alarm condition (if any).	●	●
Cell stream identification	Cell stream types: All VPs, all VCs. VCs identifiable: 1023 maximum. Capture range: Entire VPI/VCI range, include user-specified VP_{min} to VP_{max}, exclude user-specified VP_{min} to VP_{max}, include single user- specified VP, exclude single user-specified VP.	●	●
Display	Display modes: Cell count, cells/sec, % of possible max traffic. Display type: Histogram showing traffic level. Maximum number of VP/VCs displayed: 27 simultaneously (page up/down for others). Display sorting: Hierarchically by VPI/VCI or by order of occurence. Resolution of cell rate: 1 cell/s. Resolution of cell count: Displayed as 8 digit integer then x.xx E+xx. Resolution of % possible max traffic: xxx.xx%.	●	●
ATM payloads identified	AAL-1, AAL-3/4, AAL-5, test cell, unknown, VP-CC, VC-CC, no cells; where cells are found in VCI < 32, the payload is described by the expected content, as specified in ITU-T I.610.	●	●
ATM alarms identified	VC-AIS, VC-FERF/VC-RDI, VC-LOC, VP-AIS, VP-FERF/VP-RDI, VP-LOC, congestion experienced.	●	●
VP/VC rate history	Displays the variation of maximum, mean and minimum cell rates of the cell stream selected for test. Results are displayed graphically against real time.	●	●
Measurement period	1 second to 1 hour (represented by one histogram bin).	●	●
Number of periods	1000 maximum.	●	●
Cell delay variation	Graphical display of the 1-point CDV and 2-point CDV measurements described in the ATM cell layer specification. Refer to ATM cell layer option. Provides a multi-point bar graph of the delay distribution. Numerical values of CDV are also available (see ATM cell layer option specification).	●	●
Measurement details	Refer to ATM cell layer option.	●	●
Cell time-deviation units	Microseconds.	●	●
Delay display range	Autoranged, linear.	●	●
No of distribution points displayed	32 maximum.	●	●
Permanently displayed numerically	NCC (non-conforming cell) count/ratio.	●	●

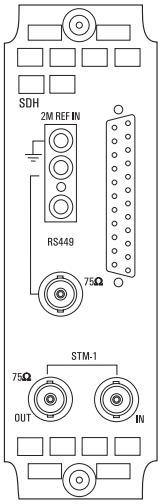
ATM services test options (continued)

		0YK	USL
In-service AAL monitoring	For services using standard AALs, error analysis of AAL structures is provided.	●	●
AAL types selectable	AAL-1, AAL-3/4, AAL-5, auto search for type.	●	●
AAL-1 SAR sublayer error monitoring	Non-corrected sequence number errors: Count and ratio. Corrected sequence number protection errors: Count and ratio. Lost cells (based on sequence number): Count. SAR-PDU: Count.	●	●
AAL-3/4 SAR sublayer error monitoring	Maximum number of simultaneous MIDs: 1024. SAR-PDU CRC-10 errors: Count and ratio. Lost cells (based on sequence number): Count. Segment type errors: Count. SAR-PDUs received: Count. CPCS-PDUs received: Count. Aborted SAR-PDUs received: Count.	●	●
AAL-5 CPCS sublayer error monitoring	CPCS-PDU CRC-32 errors: Count/ratio. CPCS-PDU length errors: Count. CPCS-PDUs received: Count. CPCS-PDU length over-run: Count. Aborted CPCS-PDUs: Count.	●	●
AAL loss alarm	AAL loss criterion: 7 consecutive PDUs. AAL regain criterion: Receipt of the first PDU without error.	●	●
Auto search for AAL	User initiated automatic search for AAL type.	●	●

LAN over WAN

Ethernet	Ethernet MAC standard: IEEE Std 802.3; Ethernet "DIX" standard. Physical network address: 48 bit address. Physical connectors: Standard Ethernet AUI (15-pin D-submin) for attachment of multistation access unit (MAU) (not supplied) allowing access to 10Base-5 (ThickLAN), 10Base-2 (ThinLAN) etc. RJ-45 for direct connection of Ethernet 10Base-T unshielded twisted pair (EtherTwist).	-	●
Networking protocols	IP.	-	●
LAN measurement and generation	Ping origination: Single ping packet manually initiated. Continuous ping rate: Off, 1 to 10 per second. End-to-end packet load: Packet load length mix: All packets min length; all packets max length; 20% min/80% max length packets; 80% min/20% max length packets. Packet load level: Rate variable from 1 to 5000 (where appropriate) packets/sec. File transfer simulation (bulk transfer): Approx length 1 Mbyte.	-	●
LAN measurement analysis	Verification of ping received: Response time for ping, ping packet return count, ping packet loss count. Verification of file transfer.	-	●
Ping history	Displays the variation of maximum, mean and minimum ping response delays over extended time. Results are displayed graphically against real time. Measurement period: 1 second to 1 hour (represented by one histogram bin). Number of measurement periods: 1000 maximum.	-	●

STM-1e ATM test and interfacing



Option A1T

Option A1T – HP OmniBER 717 only
STM-1e (155 Mb/s) electrical interface:
STM-1 overhead access, thru mode and pointer sequence generation, TU-12, TU-2 and VC-4 mappings plus frequency offset generation, alarm and error generation/detection. Only for use with options 0YK/USL/UKZ

STM-1e ATM test and interfacing options

This module can work alone. Also work with STM-1 optical module (option UH1) and STM-1 and STM-4 optical modules (eg, options UH2, URU, USN, UKT).

		STM-1 overhead and stress testing A1T
OUT and IN ports (used for transmit and receive)		
Type	Electrical: To ITU-T G.703.	●
Connectors	BNC, 75 ohm, unbalanced. *(Small Siemens 75 ohm unbalanced option available.)*	●
Rate	155.52 Mb/s.	●
Line code	CMI.	●
Transmitter		
Clock timing	Internal: All rates. Recovered: From SDH input. Ext MTS: Data or clock format (as ITU-T G.811).	● ● ●
Frequency offset generation	Up to ± 999 ppm in 0.1 ppm steps.	●
Error addition		●

Error type	Single	Rate 10^{-N}	Comments
Frame A1A2	●		N in four frame words
B1	●	4 to 9	
B2†	●	3 to 9	
AU-4 path BIP-8 (B3)	●	4 to 9	
AU-4 path FEBE	●	4 to 9	
TU-3 path BIP-8 (B3)	●	3 to 9	
TU-3 path FEBE	●	3 to 9	
TU-12 path BIP (V5)	●	3 to 9	
TU-12 path FEBE	●	4 to 9	
Bit error	●	3 to 9	

† *MSP threshold N in T where 0 ≤ N ≤ 1920 (STM-1) and 10 ms ≤ T ≤ 10000 s, in decade steps.*

Error type	Single	Rate 10^{-N}	Comments	
MS FEBE	●	3 to 9		
AU-4 path IEC	●	4 to 9		
TU-2 path BIP (V5)	●	4 to 9		
TU-2 path FEBE	●	5 to 9		

STM-1e ATM test and interfacing options (continued)

		STM-1 overhead and stress testing
		A1T
Payload capability		
Payload mappings	139.264 Mb/s: Mapped into VC-4 to ITU-T G.707.	●
	34.368 Mb/s: Mapped into VC-3 to ITU-T G.707.	●
	2.048 Mb/s (asynchronous): Mapped into VC-12 to ITU-T G.707.	●
	2.048 Mb/s (floating byte synchronous): Mapped into VC-12 to ITU-T G.707.	●
	VC-2: Bulk loaded and mapped into TU-2 and TU-2-Nc (for N = 2 to 6) to ITU-T G.707.	●
Payload data	The following unframed patterns can be generated: (Framed and structured signals are available in conjunction with the PDH option UKJ/UKN).	
	PRBS (to ITU-T O.151): $2^{15} - 1$ and $2^{23} - 1$.	●
	Word: User-defined 16-bit word, all ones, all zeros, 1010, 1000.	●
	PRBS (to ITU-T O.151): $2^{9} - 1$ and $2^{11} - 1$.	●
Payload framing	139.264, 34.368 and 2.048 Mb/s: Unframed.	●
	139.264, 34.368 and 2.048 Mb/s: Framed and structured signals are available in conjunction with the PDH option UKJ/UKN.	●
	TU-2: Unframed.	●
Drop/insert	139.264 and 34.368 Mb/s: Data may be inserted and dropped via the Tx/Rx ports on the structured PDH option UKJ/UKN.	●
	2.048 Mb/s: Data may be inserted and dropped via the 2 Mb/s drop/insert ports on the structured PDH option UKJ/UKN.	●
Pointer adjustment generation		
Increment/decrement/ alternating	Provides a burst, selectable between 1 and 10 pointer adjustments (between 1 and 5 for TU-12 and TU-2 pointer).	●
New pointer value	The AU-4, TU-3, TU-12 or TU-2 moves to a selectable new location in a single jump, with or without an accompanying new data flag (NDF).	●
Frequency offset	Pointer sequences are generated by offsetting the frequencies of the AU-4 (in this mode the 87:3 sequence is generated to ITU-T G.783) or TU-3, TU-12, TU-2 and the line rate relative to each other. Range: ± 100 ppm in 0.1 ppm steps.	●
ITU-T G.783 sequences	Bursts of periodic single adjustments with added or canceled adjustments. Polarity is selectable. Bursts of periodic double adjustments with pairs alternating in polarity. In all cases the interval between adjustments or pairs of adjustments is programmable.	●
Transmit overhead		
Overhead	Standard overhead values to ITU-T G.707.	●
User-programmable bytes	RSOH: A1, A2, C1, E1, F1, D1 to D3.	●
	MSOH: K1, K2, D4 to D12, S1, M1, Z1, Z2, E2 (and access to bytes reserved for national use plus all unmarked bytes reserved for future international standardization).	●
	VC-4 and VC-3 POH: J1, C2, G1, F2, H4, Z3 to Z5.	●
	J1 path trace: User-defined/preprogrammed 64 byte.	●
	J1 path trace: 16 byte ITU-T E.164 sequence.	●
	VC-2, VC-12 POH: J2, V5 signal label.	●
	J2 path trace: 16 byte ITU-T E.164 sequence user defined/ preprogrammed.	●

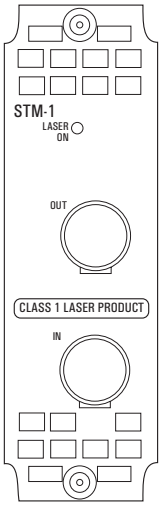
STM-1e ATM test and interfacing options (continued)

		STM-1 overhead and stress testing
		A1T
Alarm generation	LOF, MS AIS, MS FERF, AU-4 LOP, AU-4 path AIS, AU-4 path FERF, TU-3 LOP, TU-3 path AIS, TU-3 path FERF, TU-12 LOP, TU-12 path AIS, TU-12 path FERF.	●
	LOS, OOF, AU-4 path unequipped, TU-3 path unequipped, TU-2 path AIS, TU-2 path FERF, TU-2 LOP, TU-2 path unequipped, TU-12 path unequipped.	●
Overhead sequence generation	A single or multi-byte overhead channel is overwritten with a single or repeated sequence of programmed values. The sequence can contain up to five different values each being transmitted for up to 64,000 frames.	●
Overhead BER test	Any RSOH, MSOH or POH (except A1, A2, H1, H2, Z1, Z2) channel is selected and a BER measurement is performed using a $2^9 - 1$ PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern.	●
MSP message generation	Messages are displayed in text form as per ITU-T G.783.	●
	User programmed sequences (K1K2).	●
DCC drop/insert	The data supplied to the DCC port can be inserted into either the regenerator section or multiplexer section data communications channel. Similarly, data can be dropped from either channel. The data may be dropped/inserted MSB or LSB first. The data rate for access is: 192 kb/s (RSOH DCC), 156 kb/s (MSOH DCC).	●
Optical interface stress test	2 to 259 bytes of the payload are overwritten with a block of zeros or ones after scrambling. Alternatively the ITU-T G.958 CID (consecutive identical digits) test can be selected.	●
STM-1 thru mode		
Transparent thru mode	The signal is passed through the instrument without being altered for monitoring purposes where no protected monitor point is available.	●
Overhead overwrite thru mode	In addition to the above, the test features associated with the SOH and POH can be enabled to control one single- or multi-byte overhead channel (ie, errors and alarms, optical stress test, overhead sequences, MSP messages, DCC insert, overhead BER. Full Rx functionality also available).	●
AU-4 overwrite thru mode	In addition to both of the above, overwrite the complete AU-4 with the internally generated payload. This enables the SOH to be looped through while a new payload is inserted. All of the test features which affect the VC-4 and/or the POH are enabled (ie, errors and alarms, adjust pointer, overhead sequences, MSP messages, overhead BER. Full Rx functionality also available).	●
STM-1 receiver functions		
Equalization	Automatic for cable loss up to 12 dB at half the bit rate.	●
Monitor point compensation	Monitor mode conforms to ITU-T G.772.	●
	Monitor gain.	20 or 26 dB
Error results	B1, B2, AU-4 path BIP-8 (B3), AU-4 path FEBE, TU-3 path BIP-8 (B3), TU-3 path FEBE, TU-12 path FEBE, TU-12 path BIP (V5), bit errors (PDH payload).	●
	Frame (A1A2), MS FEBE, AU-4 path IEC, TU-2 path FEBE, TU-2 path BIP (V5).	●
Error analysis	To ITU-T G.826 (G.821 and M.2100/2110/2120 for PDH payload).	●

STM-1e ATM test and interfacing options (continued)

		STM-1 overhead and stress testing A1T
Pointer results	AU pointer value, AU NDF seconds, AU missing NDF seconds, AU +ve adjustment count seconds, AU –ve adjustment count/seconds, implied VC-4 offset, TU pointer value, TU NDF seconds, TU missing NDF seconds, TU +ve adjustment count/seconds, TU –ve adjustment count/seconds.	●
Alarm indication	LOS, LOF, OOF, LOP (AU-4, TU-3, TU-12), MS AIS, MS FERF, path AIS (AU-4), path FERF (AU-4), TU path AIS (TU-3, TU-12), TU path FERF (TU-3, TU-12), pattern sync loss, clock loss and errors (any type).	●
	LOP (TU-2), K1/K2 change, H4 multiframe sync, TU path AIS (TU-2), TU path FERF (TU-2).	●
Alarm seconds	As for alarm indication, plus power loss, NDF and missing NDF, and except clock loss.	●
Frequency measurement	Frequency displayed in Hz, 1 Hz resolution. Offset displayed in ppm and Hz.	●
Received overhead snapshot	SOH and POH of a received STM-1 signal. Text message displayed for signal label (C2 and V5) and sync status (S1) decoded.	●
Overhead sequence capture	Any one overhead channel is selected. After a manual or programmed trigger, the captured byte values are displayed together with the number of consecutive frames containing the value.	●
AU-4 pointer location graph	A graphical display that shows the variation with time of the pointer location. Up to four days of pointer location activity can be monitored. Implied VC offset: The total positive and negative pointer movements since the start of the measurement period are summed and the implied mean VC offset calculated from this total.	●
Overhead BER measurement	Any RSOH, MSOH or POH (except A1, A2, H1, H2, Z1, Z2) channel is selected and a BER measurement is performed using a $2^9 - 1$ PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern. Error count, error ratio, error free seconds, % error free seconds and pattern loss seconds are measured.	●

STM-1 optical interfacing



Option UH1

Option UH1
STM-1 (1310 nm) optical interfacing. Also provides OC-3 optical interfacing when used in conjunction with dual standard SONET/SDH option 120.

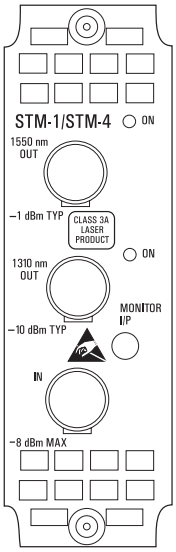
STM-1 optical interfacing options

Requires option A1T, A3R or 120 to be fitted.

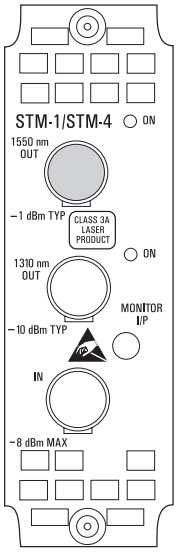
		STM-1 (1310 nm) **UH1**
OUT and IN ports (used for transmit and receive)		
Type	Optical.	●
Connectors	Customer exchangeable optical adaptors allow a range of interfaces to be attached.	
Rate	STM-1 (155.52 Mb/s).	●
Line code	NRZ.	●
Transmitter		
Wavelength	1280 to 1330 nm.	●
Spectral width (3 dB)	2.5 nm rms.	●
Optical power output	Nominal.	–9 dBm
Source type	SLM (single mode).	●
Tx classification to ITU-T G.957	STM-1 (parameters Table 2 G.957): S-1.1 (1310 nm).	 ●
Safety classification	Class 1 (EN 60825-1): 1994. Class I (21 CFR CH1 1040.10 (1996).	● ●
Receiver		
Wavelength	1270 to 1600 nm.	●
Minimum sensitivity	Using 1300 nm wavelength, 100% modulation depth and BER of 10^{-10} and PRBS of $2^{23} - 1$.	–28 dBm
Maximum input power	For BER of 10^{-10}.	–8 dBm
Detector type	MLM (multi mode).*	●
Rx classification to ITU-T G.957	STM-1 (parameters Table 2 G.957): S-1.1 (1310 nm); S-1.2 (1550 nm).	 ● ●
Alarms detected	Loss of optical signal.	●

** MLM receivers work with both MLM (multi mode) and SLM (single mode) transmitters.*

STM-4 and STM-1 test and optical interfacing



Option USN



Option UKT

Option USN
STM-4 and STM-1 overhead access, thru mode. Dual 1310 and 1550 nm optical interfaces and optical power measurement.

Option UKT
STM-4 and STM-1 overhead access, thru mode. 1310 nm optical interfaces and optical power measurement.

STM-4 and STM-1 test and interfacing options

Requires an STM-1 test option (A1T) to be fitted.

		USN (1310 and 1550 nm)	UKT (1310 nm)
OUT and IN ports (used for transmit and receive)			
Type	Optical.	●	●
	Electrical monitor point.	●	●
Connectors	Customer exchangeable optical adaptors allow a range of interfaces to be attached.	●	●
	Electrical monitor port: SMA (50 ohm ECL).	●	●
Rate	STM-1 (155.52 Mb/s).	●	●
	STM-4 (622.08 Mb/s).	●	●
Line code	NRZ.	●	●
Transmitter			
Wavelength	1280 to 1330 nm.	●	●
	1520 to 1565 nm.	●	-
Spectral width (3dB)	2.5 nm rms.	●	●
Extinction ratio	> 8.2 dB nominal 1310 nm.	●	●
	> 10 dB nominal 1550 nm.	●	-
Optical power output	1310 nm nominal.	–10 dBm	–10 dBm
	1550 nm nominal.	–1 dBm	-
Source type	SLM (single mode).	●	●
Tx classification to ITU-T G.957	STM-1 (parameters Table 2 G.957):		
	S-1.1 (1310 nm);	●	●
	L-1.2 (1550 nm).	●	-
	STM-4 (parameters Table 3 G.957):		
	S-4.1 (1310 nm);	●	●
	L-4.2 (1550 nm).	●	-
Safety classification	Class I (FCC 21 CFR CH.1 1040.10 (1994)).	●	●
	Class 3A (EN 60825-1:1994).	●	●

STM-4 and STM-1 test and interfacing options (continued)

		USN (1310 and 1550 nm)	UKT (1310 nm)
Receiver			
Wavelength	1200 to 1600 nm.	●	●
Minimum sensitivity	Using 1300 nm wavelength, 100% modulation depth and BER of 10^{-10}. and PRBS of $2^{23} - 1$. To ITU-T G.957.		
	155 Mb/s .	–34 dBm	–34 dBm
	622 Mb/s .	–28 dBm	–28 dBm
Maximum input power	For BER of 10^{-10}.	–8 dBm	–8 dBm
Detector type	MLM (multi mode)*.	●	●
Rx classification to ITU-T G.957	STM-1 (parameters Table 2 G.957):		
	S-1.1, L-1.1 (1310 nm);	●	●
	S-1.2, L-1.2 (1550 nm).	●	●
	STM-4 (parameters Table 3 G.957):		
	S-4.1, L-4.1 (1310 nm);	●	●
	S-4.2, L-4.2 (1550 nm).	●	●
Protected monitor point input level	150 mV to 1000 mVp-p (nominal): ac coupled, nominal 50 ohm.	●	●
Optical power measurement	Accuracy: ± 1 dB . Range: –8 to –30 dBm.	●	●
Transmitter functions			
Clock timing	Internal.	●	●
	Recovered:		
	From received STM-1 or STM-4 optical signal.	●	●
	From received STM-1 electrical signal.	●	●
	Ext MTS: Data or clock format (as ITU-T G.811).	●	●
Frequency offset generation	Up to ± 999 ppm in 0.1 ppm steps.	●	●
STM-4 error addition		●	●

Error type	Single	Rate 10^{-N}	Comments
Frame A1A2	●		N in four frame words
B2 %	●	N = 4 to 9	

% MSP threshold, N in T where $0 \le N \le 1920$ and 10 ms ≤ T ≤ 10000 s, in decade steps.

Note: STM-4 error addition capability is only available with STM-1 test options A1T or A3R.

STM-1 error addition	One STM-1 is selected for test. STM-1 error add capability is provided for the STM-1 under test. Refer to STM-1 test options A1T or A3R for details.	●	●
STM-4 alarm generation	LOS, LOF, MS AIS, MS FERF.	●	●
STM-1 alarm generation	One STM-1 is selected for test. For STM-1 alarm generation capability of the STM-1 under test, refer to STM-1 test options A1T or A3R for details.	●	●
Payload capability	One STM-1 is selected for test. The payload data capability of the STM-1 under test is defined by the STM-1 test option. Refer to STM-1 test options A1T or A3R for details. Background STM-1 contains 00010001 in all payload bytes.	●	●
Pointer adjustment generation	One STM-1 is selected for test. The pointer adjustment generation capability of the STM-1 under test is defined by the STM-1 test option. Refer to STM-1 test options A1T or A3R for details.	●	●

** MLM receivers work with both MLM (multi mode) and SLM (single mode) transmitters.*

STM-4 and STM-1 test and interfacing options (continued)

		USN (1310 and 1550 nm)	UKT (1310 nm)
Transmit overhead			
Overhead	Standard overhead values to ITU-T G.707.	●	●
STM-4 user-programmable bytes	RSOH: A1, A2, C1, E1, F1, D1 to D3. MSOH: SS bits, K1, K2, D4 to D12, S1, Z2 (column 4); Z1, Z2 for STM-1 under test; M1 when STM-1 number 3 selected for test. STM-4 user-programmable bytes are only available with STM-1 test options A1T or A3R.	●	●
STM-1 user-programmable bytes	The user-programmable STM-1 overhead capability is defined by the STM-1 test option. Refer to STM-1 test options A1T or A3R for details.	●	●
Path overhead user-programmable bytes	The user-programmable path overhead capability is defined by the STM-1 test option. Refer to STM-1 test options A1T or A3R for details.	●	●
Overhead sequence generation	A single- or multi-byte overhead channel is over-written with a single or repeated sequence of programmed values. The sequence can contain up to five different values each being transmitted for up to 64,000 frames. RSOH: D1 to D3 (3-byte channel); E1, F1; C1 for STM-1 under test. MSOH: D4 to D12 (9-byte channel); K1 to K2 (2-byte channel); S1, E2; Z1, Z2 for STM-1 under test; M1 for STM-1 number 3 under test. High order POH: J1, C2, G1, F2, H4, Z3, Z4, Z5.	●	●
Overhead BER test	Any overhead channel detailed above, for overhead sequences (except Z1 and Z2) can have a $2^9 - 1$ PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern and a BER measurement performed.	●	●
MSP message generation	Messages are displayed in text form as per ITU-T G.783 for linear architecture and to ITU-T G.841 for ring architectures (MSP-ring). User programmed sequences (K1K2).	● ●	● ●
DCC drop/insert	The DCC drop/insert capability is defined by the STM-1 test option. Refer to STM-1 test options A1T or A3R for details.	●	●
STM-4 thru mode	The signal is passed through the instrument without being altered for monitoring purposes where no protected monitor point is available.	●	●
Receiver functions			
STM-4 error results	B1, B2.	●	●
STM-1 error results	One STM-1 is selected for test. The errors detected in the payload of the STM-1 under test are defined by the STM-1 test option. Refer to STM-1 test options A1T or A3R for details.	●	●
Error analysis	Refer to STM-1 test options A1T or A3R for details.	●	●
Pointer results	Refer to STM-1 test options A1T or A3R for details.	●	●
Alarm indication	LOS, LOF, OOF, LOP (refer to STM-1 test option A1T or A3R for details), MS AIS, MS FERF, K1/K2 change, clock loss.	●	●
	One STM-1 is selected for test. The alarm detection capability in the payload of the STM-1 under test are defined by the STM-1 test option. Refer to STM-1 test options A1T or A3R for details.	●	●
Alarm seconds	As for alarm indication, plus power loss, NDF and missing NDF, and except clock loss.	●	●

STM-4 and STM-1 test and interfacing options (continued)

		USN (1310 and 1550 nm)	UKT (1310 nm)
Received overhead snapshot	SOH and POH from STM-1 number 1, or from STM-1 under test can be displayed. Refer to STM-1 test options A1T or A3R for details.	●	●
Overhead sequence capture	A single- or multi-byte overhead channel can be selected to be monitored. After a manual or programmed trigger, the captured byte values are displayed together with the number of consecutive frames containing the value. RSOH: A1, A2 (6-byte channel) for STM-1 under test; E1, F1; C1 for STM-1 under test; D1 to D3 (3-byte channel); MSOH: H1 to H2 (2-byte channel) for STM-1 under test; K1 to K2 (2-byte channel); D4 to D12 (9-byte channel); S1, E2, Z1, Z2 for STM-1 under test; M1 for STM-1 number 3 under test; High order POH: J1, C2, G1, F2, H4, Z3, Z4, Z5.	●	●
Pointer location graph	A graphical display that shows the variation with time of the AU-n and TU-n pointer location. Refer to STM-1 test options A1T or A3R for details.	●	●
Overhead BER measurement	Any RSOH, MSOH or POH channel detailed above (for overhead sequences capture) can be selected and a BER measurement performed using a $2^9 - 1$ PRBS inserted into a 64 kb/s channel. Single errors can be added to the test pattern. Error count, error ratio, error free seconds and % error free seconds, pattern loss seconds are measured.	●	●

STM-4, STM-1 and STM-0 binary interfaces

Option 0YH

Option 0YH
STM-4, STM-1 and STM-0 binary interfaces provide all capability of options 130/131.
NB: Must be ordered with option 130/131.

STM-4, STM-1 and STM-4 binary interfaces		**SDH binary**
Requires an STM-4, STM-1 and STM-0 test and interfacing option (130 or 131) to be fitted.		**0YH**
Out and in ports (used for transmit and receive)#		
Type	Electrical.	●
Connectors	SMA, Tx clock and data, Rx clock and data.	●
Level	ECL: 50 ohm to –2 V.	●
Rates	STM-0, STM-1, STM-4.	●
Binary transmitter		
Clock rate	51.84, 155.52, 622.08 MHz.	●
Clock polarity	Positive or inverted.	●
Clock waveform	Nominal squarewave.	●
Clock duty cycle	50% nominal.	●
Data rate	51.84, 155.52, 622.08 Mb/s.	●
Data polarity	Positive or inverted.	●
Clock to data timing	STM-0, STM-1 clock edge nominally 800 ps prior to center of data output. STM-4 clock edge nominally centered on data output.	● ●
Binary receiver		
Clock rate	51.84, 155.52, 622.08 MHz.	●
Clock polarity	Positive or inverted.	●
Clock waveform	Nominal squarewave.	●
Clock duty cycle	50% ± 10% nominal.	●
Data rate	51.84 Mb/s nominal, 155.52 Mb/s nominal, 622.08 Mb/s nominal.	●
Data polarity	Positive or inverted.	●
Date setup and hold time	600 ps min.	●

* *STM-0, STM-1 and STM-4 thru mode is not available when using the binary interfaces to transmit or receive an STM-0, STM-1 or STM-4 binary signal.*

\# *Jitter generation is available on SDH NRZ interfaces when used in conjunction with jitter generation modules A3K/140. Jitter measurement is not available on SDH NRZ interfaces.*

PDH binary interfaces

Option UH3

Option UH3
Single module providing binary interfaces and external clock input for the PDH test options UKK, UKJ, UKN and 110.

PDH binary interfaces

Requires a PDH test option UKK, UKJ, UKN or 110 to be fitted.		PDH binary interfaces UH3
Transmitter		
Binary data output		
Data rates	700 kb/s to 50 Mb/s (TTL); 700 kb/s to 170 Mb/s (ECL). *PDH test option dependent. See "Related information" on page 75.*	●
Format	NRZ.	●
Connector	BNC.	●
Source impedance	Selectable, nominal TTL into 75 ohm to ground, or nominal ECL into 75 ohm to –2 V.	●
Polarity	Selectable, normal or inverted.	●
Return loss	> 15 dB, 500 kHz to 100 MHz (TTL), typical.	●
Protection	± 5 V maximum input voltage.	●
Binary clock output		
Clock rates	700 kb/s to 50 Mb/s (TTL); 700 kb/s to 170 Mb/s (ECL). *PDH test option dependent. See "Related information" on page 75.*	●
Format	Nominal squarewave, 60/40 to 40/60 duty cycle.	●
Connector	BNC.	●
Source impedance	Selectable, nominal TTL into 75 ohm to ground or nominal ECL into 75 ohms to –2 V.	●
Polarity	Selectable, normal or inverted.	●
Return loss	> 10 dB, 500 kHz to 100 MHz (TTL), typical.	●
Protection	± 5 V maximum input voltage.	●

PDH binary interfaces

		PDH binary interfaces UH3
External binary clock input		
Clock rates	700 kb/s to 50 Mb/s (TTL); 700 kb/s to 170 Mb/s (ECL). Clocks the transmitter instead of internal clock source. Coded interfaces can be clocked at the fixed telecom rates. *See "related information" on page 75.*	●
Logic threshold	1.5 V (TTL), –1.3 V (ECL), ground (0 V), signal mean level.	●
Termination	Selectable, nominal TTL into 75 ohm to ground, or nominal ECL into 75 ohm to –2 V.	●
Format	Nominal squarewave, 60/40 to 40/60 duty cycle.	●
Connector	BNC.	●
Polarity	Selectable, normal or inverted.	●
Return loss	> 15 dB, 500 kHz to 200 MHz (TTL), typical.	●
Protection	± 5 V maximum input voltage.	●
Receiver		
Binary data input		
Data rates	700 kb/s to 50 Mb/s (TTL); 700 kb/s to 170 Mb/s (ECL). *PDH test option dependent. See "Related information" on page 75.*	●
Logic threshold	1.5 V (TTL), –1.3 V (ECL), ground (0 V).	●
Termination	Selectable, nominal TTL into 75 ohm to ground, or nominal ECL into 75 ohm to –2 V.	●
Format	NRZ.	●
Connector	BNC.	●
Polarity	Selectable, normal or inverted.	●
Return loss	> 15 dB, 500 kHz to 200 MHz (TTL), typical.	●
Protection	± 5 V maximum input voltage.	●
Binary clock input		
Clock rates	700 kb/s to 50 Mb/s (TTL); 700 kb/s to 170 Mb/s (ECL). *PDH test option dependent. See "Related information" on page 75.*	●
Logic threshold	1.5 V (TTL), –1.3 V (ECL), ground (0 V), signal mean level.	●
Termination	Selectable, nominal TTL into 75 ohm to ground, or nominal ECL into 75 ohm to –2 V.	●
Format	Nominal squarewave, 60/40 to 40/60 duty cycle.	●
Connector	BNC.	●
Polarity	Selectable, normal or inverted.	●
Return loss	> 15 dB, 500 kHz to 200 MHz (TTL), typical.	●
Protection	± 5 V maximum input voltage.	●

PDH binary interfaces

PDH binary interface

UH3

Related information

Interworking between option UH3 and the PDH test options

Binary outputs	**Internal clock***	**External clock†**
Module combination:		
UKK + UH3	704 kb/s, 2, 8, 34, 140 Mb/s	0.7 to 170 Mb/s
UKJ/UKN + UH3	2, 8, 34, 140 Mb/s	2, 8, 34, 140 Mb/s with ability to vary rate ± 10%
110 + UH3	2, 34 Mb/s, DS1, DS3	2, 34 Mb/s DS1, DS3 with ability to vary rate ± 10%
Coded outputs	**Internal clock***	**External clock†**
Module combination:		
UKK + UH3	704 kb/s, 2, 8, 34, 140 Mb/s	0.7 to 50 Mb/s
UKJ/UKN + UH3	2, 8, 34, 140 Mb/s	2, 8, 34, 140 Mb/s with ability to vary rate ± 10%
110 + UH3	2, 34 Mb/s, DS1, DS3	2, 34 Mb/s DS1, DS3 with ability to vary rate ± 10%

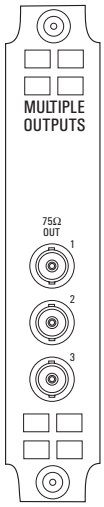
** Uses instruments own internal clock*
† Uses external clock supplied to instruments clock input port

Output amplitudes consistent with ITU-T G.703.
Selected bit rate determines coding scheme.

Additional measurement capability

- Frequency measurement on external clock and receive clock input. ●
- Jitter generation simultaneously of the binary clock and data outputs (needs jitter generation option A3K/140: 2.048, 8.448, 34.368, 139.264 Mb/s).
- Jitter measurement on the binary receive clock input (needs jitter measurement option UHN/A3L/A3V/A3N: 2.048, 8.448, 34.368, 139.264 Mb/s ± 100 ppm). ●

Multiple PDH outputs



Option UHC

Option UHC
Three additional 2, 8, 34 and 140 Mb/s outputs.
Must be ordered with a PDH test option (UKK, UKJ or UKN).

Multiple PDH outputs option		**Multiple PDH outputs**
Requires a PDH test option (UKK, UKJ or UKN) to be fitted.		**UHC**
OUT ports (used for transmit)		
Type	Electrical: To ITU-T G.703.	●
Connectors	Provides three additional output signals: BNC, 75 ohm, unbalanced. *(Small Siemens 75 ohm unbalanced option available).*	●
Rate	704 kb/s (requires option UKK).	●
	2.048, 8.448, 34.368 and 139.264 Mb/s.	●
Bit delay (relative to main output)	Output 2, 4 bits; output 3, 8 bits; output 4, 12 bits; 139.264 Mb/s: No bit delay.	●

General specifications

Disk drive

		Standard
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 to/from floppy disk drive. Extends internal event based storage from 10,000 events to 310,000 events.	●
Logging	Direction of logging output to floppy disk drive.	●
PC results format	Save SMG stored results in a CSV (comma separated variable) PC compatible format for importing to PC spreadsheets etc.	●
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

		Standard
Max test result stores	5 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.	●
Unstructured PDH bar graphs (option UKK)	Bit error count, code error count, frame error count, CRC error count, REBE error count and PDH alarms.	●
Structured PDH bar graphs (option UKJ)	Bit error count, code error count, frame error count, CRC error count, REBE error count and PDH alarms.	●
ATM bar graphs (option UKN)	Received cells, corrected HEC, non-corrected HEC, cell loss, errored cells, misinserted cells, BEDC BIP-16, bit errors, mean cell transfer delay, min cell transfer delay, peak-to-peak 2-point CDV, max 1-point CDV (to ITU-T I.356). Non-conforming cell count and PDH physical layer alarms and ATM cell layer alarms.	●
SDH bar graphs (options A1T/A3R)	Frame errors (A1A2), B1, B2, MS FEBE, B3, HP FEBE, HP IEC, LP BIP, LP FEBE bit errors. DS1/DS3: CRC6, P.bit parity, C-bit parity, DSn frame, FEBE.	●
Jitter bar graphs (options UHN/A3L/ A3V/A3N)	Jitter hit count, plus jitter loss and jitter out-of-range alarms.	●
Wander bar graphs (options UHN/A3L/ A3V/A3N)	Frame slip count and bit slip count, plus no reference and excess wander 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

		HP OmniBER 717 Option UKX	External Printer
Internal	24-column thermal 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	–
	Printer storage temperature.	–15 to +50°C	–

Remote control/printer interface options

		A3B	A3D
Capability	RS-232-C printer/remote-control interface.	●	●
	HP-IB printer/remote-control interface.	●	●
	Parallel printer interface.	●	●
	LAN remote control interface.	●	–

Distributed/remote testing

HP E4540A distributed network analyzer (DNA) software

PC/laptop/MS Windows® software (Windows 3.1, Windows NT or Windows 95) which allows control of HP 377xx PDH/SDH/ATM 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 HP OMNIBER 717 analyzer and other telecom testers from HP, please ask your local HP representative for brochure 5964-2240E (distributed network analyzer software).

At remote site		HP OMNIBER 717 Option USS
Instrument firmware	Allows instrument to be controlled by HP E4540A distributed network analyzer software. Also order an RS-232-C interface.	●

General

		Standard
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	180 to 264, and 90 to 132 Vac; 47 to 63 Hz, 450 VA nominal.	●
Dimensions (mm)	190 (H) × 340 (W) × 470 (D) (× 510 (D) with lid fitted).	●
Weight	8 kg (unladen); 10 kg (typical).	●
Internal clock	Accuracy: ± 0.5 ppm. Stability: ± 3 ppm. Ageing: ± 1 ppm.	●
Environmental	Operating temperature. Storage temperature.	0 to +45 °C –20 to +70 °C
CE mark	ESD/Electrical fast transients/radiated susceptibility: Meets EN50082-1 (1992). Radiation emissions/conducted emissions: Meets EN55011 (1991).	●
Product safety	EN 61010-1 (1993); IEC 1010-1 (1990) +A1 (1992); CSA C-22.2 No 1010.1-92.	●
EMC compatibility	Immunity: EN 50082-1 (1992); Emmissions: EN 55011 (1991).	●
Regulatory standards	21 CFR CH.1 1040; EN 60825-1 (1994); Group 1, Class A; EN 55011 (1991); EN 50082-1 (1992).	●

Accessories

Optical connector-pair adaptor and optical coupler	If you order an SDH optical interface module or SDH optical jitter measurement module, specify the connector adaptor(s) to suit your particular equipment. Option UH4: FC/PC. Option UH5: DIN47526. Option UH6: ST. Option UH7: Biconic. Option UH8: NEC D4. Option UKP: SC. Option UKQ: HMS-10/HP. HP15744A: Optical coupler.* **Order the appropriate option. For full details of the HP 15744A optical coupler, please ask your local HP representative for publication 5963-7498E.* HP 15722A: Telephone handset for options UKJ or UKN.
Carrying cases	HP 15910B: Soft, vinyl carrying case. HP 15772B: Hard, robust transit case.
Rack mount kit	HP 15770A: Rack mount kit.
Warranty	3-year warranty as standard.
Manuals	Option AVA: Calibration manual Option OB3: Service manual. Option OB2: One additional operating manual. Option OBF: One additional manual for remote operation.
Calibration certificate	Option UK6: Commercial calibration certificate with test data.

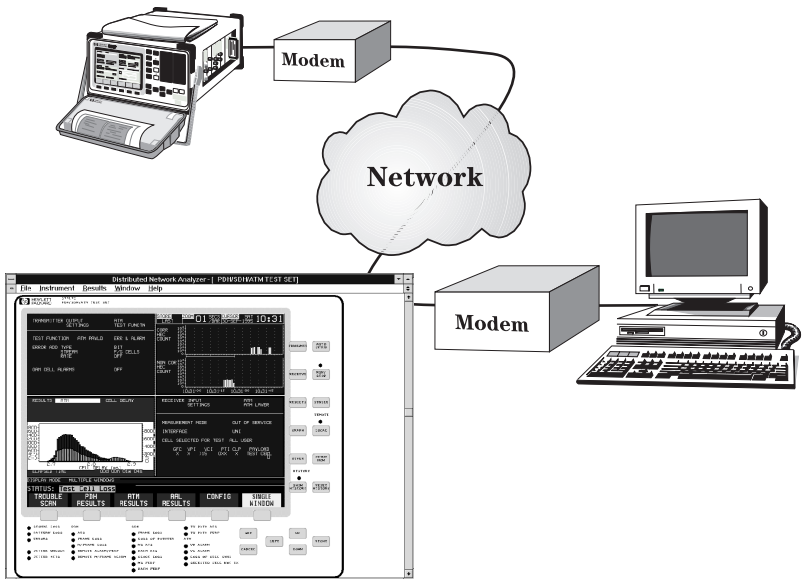
Distributed network analyzer (DNA) features

Use HP E4540A DNA software to pin-point elusive network faults and identify links with low performance. The DNA software's long-term testing and automatic results logging capability let you easily monitor the PDH, SDH and ATM 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.



MS Windows and Windows are US trademarks of Microsoft Corporation.

HP manufactures the HP OmniBER 717 analyzer under a quality system approved to the international standard ISO 9001 plus TickIT (BSI Registration Certificate No FM 10987).

Class 3a laser product
EN60825-1: 1994

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

UNIVERSAL INSTRUMENT DRIVERS

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European Marketing Centre
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Tel: (31 20) 547 9999

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