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XPI Solutions for Optical/Transmission

Communications Test Equipment

Data Sheet



J2126A/J2127A Transmission Test Sets

A family of field portable transmission test sets for applications to 10Gb/s

SONET: OC-192, OC-48, OC-12, OC-3, OC-1, STS-3, STS-1
SDH: STM-64, STM-16, STM-4, STM-1, STM-0
T-carrier/PDH: DS1, DS3, 2Mb/s, 8Mb/s, 34Mb/s, 140Mb/s
Ethernet: 10BASE-T, 100BASE-TX, 1000BASE-SX, 1000BASE-LX

Agilent Technologies

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Introduction

Agilent Technologies' family of portable transmission test sets provide you with the multi-rate test coverage you'll need to install and maintain today's high-speed, multi-service transmission networks. Compact and rugged, three instrument platforms are available for testing at all standard interface rates from DS1 to 10 Gb/s, including multi-port Ethernet testing

What's more, their all-channel monitoring technology lets you simultaneously monitor all STS/AU channels (up to 192) in a received SONET or SDH line signal, continuously, for fast problem resolution and efficient commissioning of new generation transmission systems. For routine and complex field applications, a broad set of additional measurement tools are available to identify problems associated with errors and alarms, signal quality and network operational performance.

This comprehensive SONET/SDH/DSn/PDH functionality is complimented by best-in-class Ethernet testing for today's multi-service networks. Customer data services at 10, 100 or 1000 Mb/s can now be tested with the same ease as the SONET/SDH services. To further increase your productivity testing can be carried out on ALL of the Ethernet ports at the same time.

A comprehensive on-line help system is accessible at the touch of a button, while context sensitive help is provided automatically as you navigate through the user interface. You can also extend the help available by adding your own documentation.

Specifically designed for use in today's high-speed networks, the testers provide you with the broad range of test capabilities required during installation, acceptance, commissioning and maintenance of SONET, SDH and DWDM multi-service transmission systems.

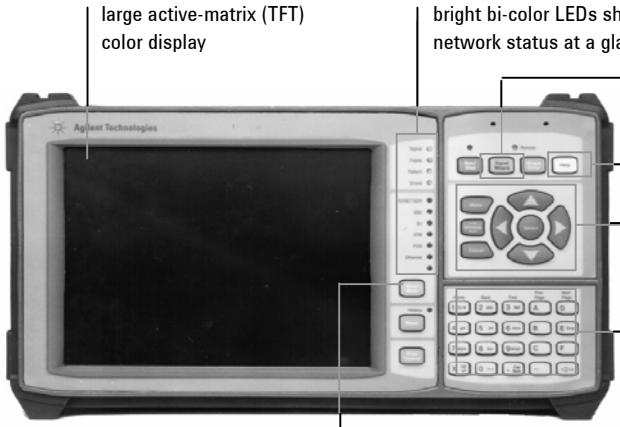
Summary of capability

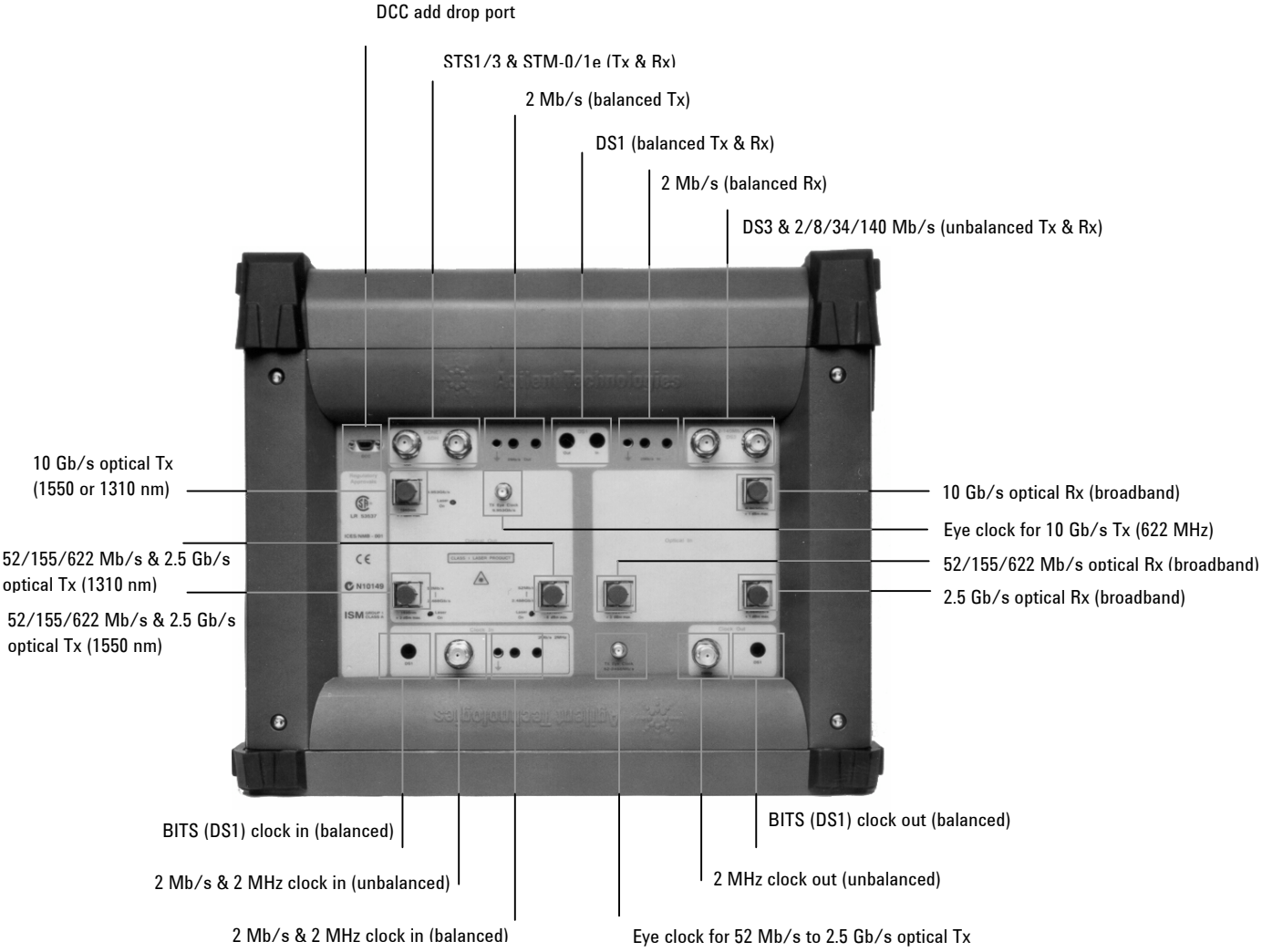
Model	Optical interface rates	Electrical interface rates
J2127A	OC-1 / 3 / 12 / 48 / 192 STM-0 / 1 / 4 / 16 / 64 1000 Mb/s Ethernet	STS-1 / 3, STM-0 / 1, DS1 (1.5 Mb/s), DS3 (45 Mb/s), 2 / 8 / 34 / 140 Mb/s 10/100 Mb/s Ethernet
J2126A	OC-1 / 3 / 12 / 48 STM-0 / 1 / 4 / 16	STS-1/3, STM-0/1, DS1 (1.5 Mb/s), DS3 (45 Mb/s), 2 / 8 / 34 / 140 Mb/s

- Fully integrated all-rate SONET/SDH testing:
  - 52 Mb/s to 10 Gb/s optical
  - 52/155 Mb/s; DS1/3; 2/8/34/140 Mb/s electrical
- Multi-port, Multi-rate Ethernet testing
- Full range of standard and concatenated mappings
- All standard error and alarm measurements, plus:
  - Optical power, electrical level, pulse mask, frequency
  - Service disruption time, pointer movements, delay
- Simultaneous all-channel testing
- Broad range of graphical results tools
- Comprehensive on-line help
- 2 year calibration cycle
- 3 year standard warranty

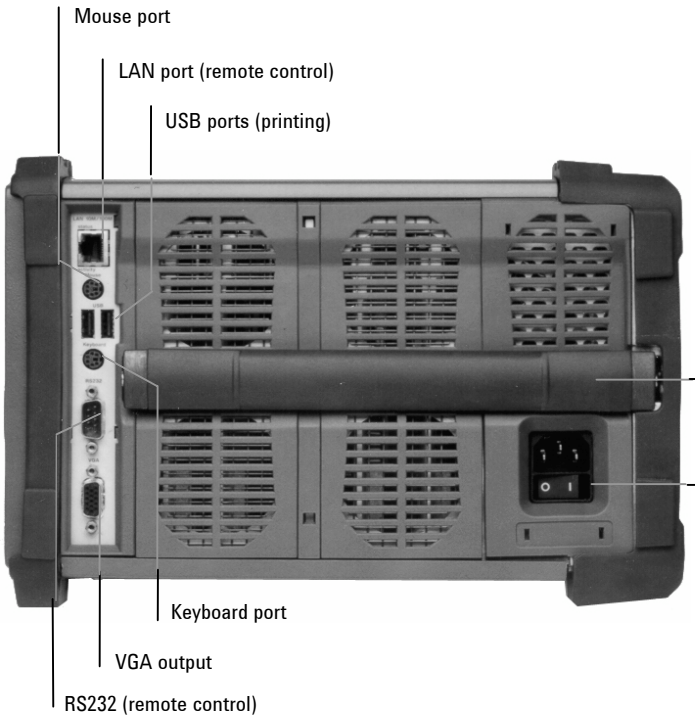


Instrument tour (Non-Ethernet version shown)





Instrument tour (continued)





SmartTest

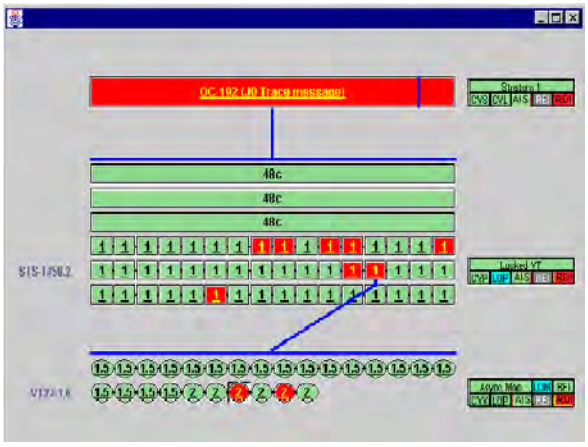
The front panel Smart Test key provides fast access to the test set's extensive measurement capability. With only a few key presses you can quickly access:

- SignalWizard
- Optical power measurement
- Frequency measurement
- Trouble scan
- Pulse Mask
- Service Disruption
- Round Trip Delay

SignalWizard

Signal Wizard is a unique test tool that has been specifically designed to meet the challenges associated with testing the new generation of SONET/SDH transmission systems – systems that combine grooming, switching and multiplexing in a single unit. With two simple key presses, Signal Wizard automatically: -

- Discovers the line rate and STS/AU channel structure of a valid OC-n/STM-n signal, including any 'mix' of standard and concatenated channels.
- Simultaneously monitors the line signal and all STS/AU channels (up to 192) for errors, alarms and pointer activity.
- Discovers and simultaneously monitors all VT/TU channels in a selected STS/AU
- Shows which channels are unequipped and the type of service being carried by equipped channels.
- Provides path trace message listing and search tools (including sub-string searches) to assist in identifying path routing errors within the network.



Error and alarm status clearly presented for each detected STS/AU channel, and for all VT/TU channels in a selected STS/AU.



Channel	Size	Trace Message	Signal Label
1,1	STS-48c	San Francisco - New York #3	ATM
17,1	STS-12c	San Francisco - Washington # 17	HDLC/PPP
21,1	STS-3c	San Francisco - Los Angeles #10	ATM
22,2	STS-1	San Francisco - Phoenix #4	VT
23,1	STS-3c	San Francisco - San Jose #8	ATM
24,1	STS-12c	San Francisco - Chicago #6	HDLC/PPP
28,2	STS-1	San Francisco - Little Rock #1	VT
29,3	STS-1	San Francisco - Minnesota #2	VT
30,1	STS-1	San Francisco - San Jose #2	DS3
32,2	STS-1	San Francisco - Las Vegas #4	VT
34,1	STS-1	San Francisco - Seattle#10	VT
50,3	STS-1	San Francisco - New York #20	VT
55,2	STS-1	San Francisco - Denver #5	DS3
63,1	STS-1	San Francisco - Boston #9	DS3

San Francisco - San Jose #8

Clear tabular display of J1 or J2 path trace messages, or those identified based on a sub-string search.

SONET/SDH testing

The SONET/SDH test capability allows comprehensive testing of synchronous networks with the following interface rates: 10 Gb/s, 2.5 Gb/s, 622 Mb/s, 155 Mb/s and 52 Mb/s. Supported functionality includes:

- SONET/SDH error and alarm generation and detection
- Performance analysis G.826, G.828, G.821, M.2100, M.2101, M.2101.1, M.2110, M.2120
- Setup and monitor for all overhead bytes
- Setup and monitoring for linear and ring APS/MSP messages
- Setup and monitoring for J0, J1 and J2 trace messages
- Tandem connection monitoring testing to the SDH standards (both N1 and N2)
- Burst and periodic sequence pointer adjustment control
- Drop-insert of DCC channels
- External drop-insert of asynchronous mapped payloads
- Intrusive and non-intrusive Through-mode test capability

DSn/PDH testing

The DSn/PDH test capability allows comprehensive testing of DSn/PDH signals and networks with the following interfaces: DS1 (1.5 Mb/s), DS3 (45 Mb/s), 2 Mb/s, 8 Mb/s, 34 Mb/s and 140 Mb/s. Supported functionality includes:

- Unframed, framed, and structured (mux/demux) testing
- Error and alarm generation and detection
- 56 kb/s, n x 56 kb/s, 64 kb/s and n x 64 kb/s testing
- Drop/insert DSn/PDH to/from SONET/SDH
- Drop/insert DS1/2 Mb/s to/from DSn/PDH
- DS1 loop codes and DS3 FEAC messages
- PDH spare-bits control and monitoring

Additional measurements

- Optical power
- Electrical level
- Line frequency
- Pointer measurements
- Service disruption
- Round trip delay
- Pulse mask

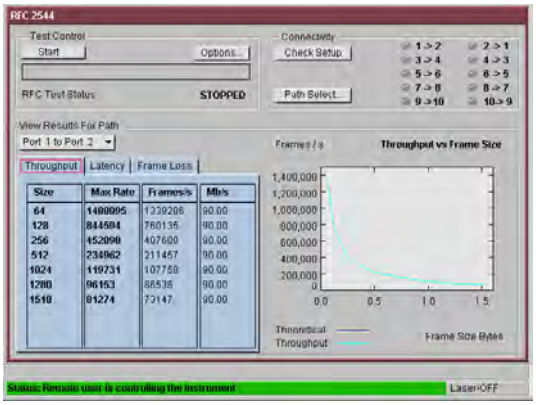
Ethernet Testing (Option #323)

The Ethernet test capability provides multi-port testing of Ethernet transmission systems. The test set has eight 10/100BASE-T test ports and two 1000BASE-X test ports. The 1000BASE-X ports use hot-swappable GBIC modules, giving you flexibility in physical interface choice.

All of these test ports can be run simultaneously, giving up to ten times faster testing and more realistic loading of the network under test. Loading multiple ports in this way ensures the network performs as it would with customer traffic, giving you test results you can rely on. To further reduce your test time Ethernet testing can be carried out at the same time as SONET/SDH or DSn/PDH testing.

Main Ethernet Test Features

- Full-bandwidth testing via all 10 ports
- Automated RFC 2544 benchmark testing
- End-to-End and Loop-back testing
- Unique "Loopthru" mode allows Ethernet to be tested in the same way as SONET/SDH
- Pre-Set mode makes Ethernet testing extremely simple to set-up and operate
- Ethernet auto-negotiation or manual set-up
- Supports VLAN and Priority Tagging
- Frame capture facility for troubleshooting
- Support for undersize (runt) frames and oversize (jumbo) frames



Automated RFC 2544 Testing

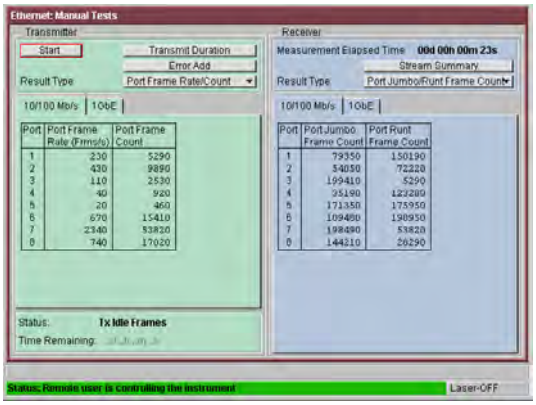
Ethernet Measurements

The Ethernet test capability quickly and easily provides the three most fundamental measures of data-circuit performance:

- Data Throughput
- Frame Loss
- Latency

Other factors which can affect the quality of service you provide to your customers can also be measured, such as:

- Errored frames
- Out-of-sequence frames
- Broadcast and Multicast frames
- Runt frames
- Jumbo Frames



Jumbo and Runt Frame Count

SONET/SDH Technical specifications

The following specification provides details on the J2126A and J2127A transmission test sets, including all standard options.

Interface specifications

Test interfaces (rates, wavelengths, connectors, line codes)

		J2126A	J2127A
Optical	Line rates	OC-1/3/12/48 STM-0/1/4/16o	OC-1/3/12/48/192 STM-0/1/4/16/64o
	Wavelength (≤ 2.5 Gb/s)		
	Option 100	1310 nm	1310 nm
	Option 101	1550 nm	1550 nm
	Option 102	1310/1550 nm	1310/1550 nm
	Wavelength (10 Gb/s)		
	Option 111	n/a	1550 nm (HS)[1]
	Option 120	n/a	1310 nm (SR)[2]
	Option 121	n/a	1550 nm (SR)[2]
	Connectors		
	Option 190	FC/PC	
	Option 191	SC	
	Option 192	ST	
	Line code	NRZ	
Electrical	Line rates:	STS-1/3 (STM-0/1e); DS1, DS3; 2/8/34/140 Mb/s	
	Connectors		
	STS-1/3 (STM-0/1e)	BNC (75 Ω, unbalanced)	
	DS1	Bantam (100 Ω, balanced)	
	DS3	BNC (75 Ω, unbalanced)	
	2 Mb/s	BNC (75 Ω, unbalanced); 3-pin Siemens (120 Ω, balanced)	
	8/34/140 Mb/s	BNC (75 Ω, unbalanced)	
	Line code		
	STS-3/STM-1e	CMI	
	STS-1/STM-0e	B3ZS	
	DS1	B8ZS, AMI	
	DS3	B3ZS	
	2/8/34 Mb/s	HDB3	
	140 Mb/s	CMI	

Notes:

[1] These optics offer an improved receiver sensitivity specification over the Short Reach 10 Gb/s options.

[2] These optics conform to GR-253 Short Reach (SR) specifications for SONET and the ITU-T G.957 standard for SDH.

Optical transmitters

	J2126A	J2127A
Wavelengths		
1310 nm (≤ 2.5 Gb/s)	1260 to 1360 nm	1260 to 1360 nm
1550 nm (≤ 2.5 Gb/s)	1500 to 1580 nm	1500 to 1580 nm
1310 nm (10Gb/s)	n/a	1290 to 1330 nm
1550 nm (10Gb/s)	n/a	1530 to 1565 nm
Power		
1310 nm (≤ 2.5 Gb/s)	-5 to +0 dBm	-5 to +0 dBm
1550 nm (≤ 2.5 Gb/s)	-2 to +3 dBm	-2 to +3 dBm
1310 nm (10Gb/s)	n/a	-6 to -1 dBm
1550 nm (HS 10 Gb/s)	n/a	-1 to +1 dBm
1550 nm (SR 10 Gb/s)	n/a	-5 to -1 dBm
Spectral width		
1310 nm	< 1.0 nm (-20 dB)	< 1.0 nm (-20 dB)
1550 nm	< 1.0 nm (-20 dB)	< 1.0 nm (-20 dB)
Extinction ratio	> 8.2 dB	> 8.2 dB (option 111 & 121) > 6 dB (option 120)
Pulse mask	Meets ITU-T G.957 (6/1999) and Telcordia GR-253-CORE Issue 3 (9/2000)	
Fibre pigtail	Single mode	
Laser safety	See "Regulatory standards" section for details	

Optical receivers

	J2126A	J2127A
Wavelength	1200 to 1600 nm	1200 to 1600 nm [4] 1280 to 1580 nm (option 120/121)
Min. sensitivity [1]		
52/155 Mb/s	< -33 dBm[2]	< -33 dBm[2]
622 Mb/s	< -28 dBm	< -28 dBm
2.5 Gb/s	< -28 dBm	< -28 dBm
10 Gb/s (option 111)	n/a	< -20 dBm[3]
10 Gb/s (option 120)	n/a	< -11 dBm
10 Gb/s (option 121)	n/a	< -14 dBm
Max. input power [1]:		
52/155 Mb/s	> -10 dBm	> -10 dBm
622 Mb/s	> -8 dBm	> -8 dBm
2.5 Gb/s	> -9 dBm	> -9 dBm
10 Gb/s (option 111)	n/a	> -9 dBm[5]
10 Gb/s (opt. 120/121)	n/a	> -1dBm
Input damage power		
52/155/622 Mb/s	> +3 dBm	> +3 dBm
2.5 Gb/s	> +3 dBm	> +3 dBm
10Gb/s (option 111)	n/a	> +1 dBm
10 Gb/s (opt. 120/121)	n/a	> +3 dBm
Fiber pigtail		
52/155/622 Mb/s	Multi mode	Multi mode
2.5 Gb/s	Single mode	Single mode
10 Gb/s		Single mode

Notes:

1. For BER = 1 x 10^{-10} (input signal extinction ratio = 8.2 dB).
2. Typical: < -34 dBm.
3. Minimum sensitivity for a 1550 nm input signal (as measured at BER = 1 x 10^{-12}; input signal extinction ratio = 8.2 dB). Minimum sensitivity for a 1310 nm input signal is < -19 dBm (under the same measurement conditions).
4. Specifications for the 10 Gb/s optical receiver apply for receive signals with 1310 and 1550 nm (nominal) wavelengths. However, the 10 Gb/s receiver is a broadband device and operates over the 1200 to 1600 nm range of wavelengths.
5. Maximum input power for a 1550 nm input (as measured at BER = 1 x 10^{-12}; input signal extinction ratio = 8.2 dB). Maximum input power for a 1310 nm input is > -10 dBm (under the same measurement conditions).

Electrical interfaces

STS-1/3 and STM-0/1e	Transmitter	Meets Telcordia GR-253-CORE Issue 3 and ITU-T G.703 for level and pulse shape. Level: STS-1: STS-1 (HI), STSX-1 (450 ft), STS-1 (900 ft). STM-0e: as GR-253. STS-3/STM-1e: ± 0.5 Vpk, ± 10%.
	Receiver	Input mode: terminated or monitor. Monitor gain: 20 dB or 26 dB. Equalization: STS-1/STM-0e: Selectable off/on. When enabled, automatic equalization provided for 450 to 900 ft of cable loss. STS-3/STM-1e: Automatic for cable loss to 12 dB at half the bit rate. Jitter tolerance: Meets Telcordia GR-253-CORE Issue 3 and ITU-T G.825.
DS1/3	Transmitter	Meets ANSI T1.102-1993. Level: DS1: DSX-1, DS1-LO. DS3: DS3-HI, DSX-3, DS3-900'.
	Receiver	Meets ANSI T1.102-1993. Input mode: terminated or monitor. Monitor gain: DS1: 20 dB, 26 dB, 30 dB. DS3: 20 dB, 26 dB. Equalization: DS1: Automatically equalizes for DS1-HI, DSX-1, and DS1-LO levels in both terminated and monitor modes. DS3: Selectable off/on. When enabled, automatically equalizes for DS3-HI, DSX-3, and DS3-900' levels in both terminated and monitor modes. Jitter tolerance: Meets Telcordia GR-499 Category II and ITU-T G.824.
2/8/34/140 Mb/s	Transmitter	Meets ITU-T G.703. Level: Meets ITU-T G.703 for all rates.
	Receiver	Meets ITU-T G.703 and G.772. Input mode: terminated or monitor. Monitor gain: 2/8 Mb/s: 20 dB, 26 dB, 30 dB. 34/140 Mb/s: 20 dB, 26 dB. Equalization: Meets ITU-T G.703. Jitter tolerance: Meets ITU-T G.823.

Clock synchronization (inputs, outputs, line frequency offset)

Clock references	Internal: ± 4.5 ppm Includes setting accuracy, stability over temperature and aging. External Clock Inputs: BITS (1.5 Mb/s): Bantam (100 Ω balanced). MTS (2 MHz and 2 Mb/s): BNC (75 Ω unbalanced) and 3-pin Siemens (120 Ω balanced). Loop-timed: Transmitter timed by a clock recovered from the receiver.
Frequency offset	Offsets the transmitted line signal relative to the selected clock reference. ± 100 ppm in 0.1 ppm step.
Clock outputs	Output clocks generated relative to the selected transmit reference clock. BITS (1.5Mb/s): Bantam (100Ω balanced). MTS (2 MHz): BNC (75Ω unbalanced).
Eye clock outputs	Clock outputs that are frequency locked to the transmitted optical line signal. Rate: 52/155/622 Mb/s and 2.5 Gb/s: Output line rate divided by four. 10 Gb/s: Output line rate divided by sixteen (622.08 MHz nominal). Level: Nominal ECL, ac coupled. Impedance: Drives nominal 50 Ω inputs. Connector: SMA.

DCC drop/insert port

Supports the drop and insert of either the section/regenerator section DCC channel (D1-D3) or the line/multiplexer section DCC channel (D4-D12).

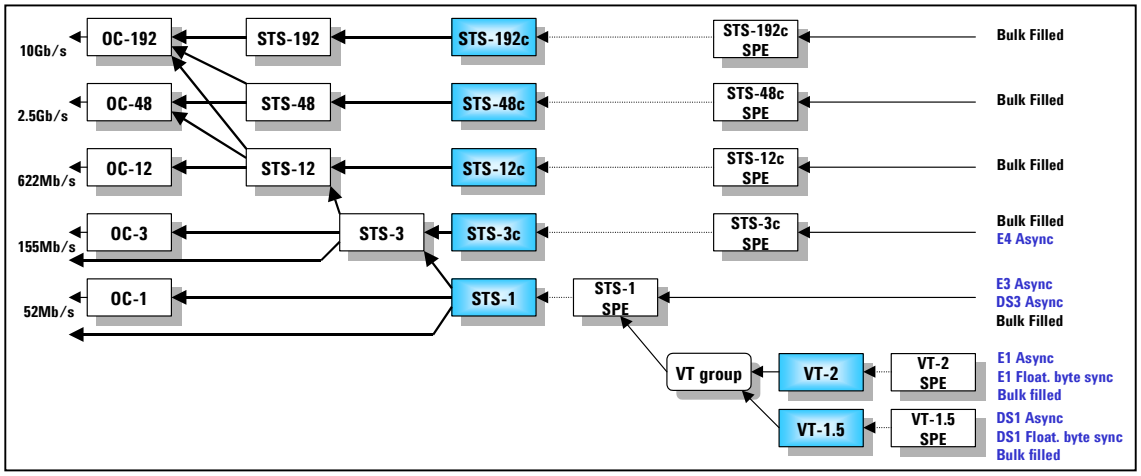
Connector	9-pin miniature D-type.
Rates	D1-D3 DCC channel: 192 kb/s. D4-D12 DCC channel: 576 kb/s.
Signal type	Unipolar differential signal as defined in ANSI EIA-422-B and EIA-423-B.
Input termination	100 Ω differential.
Input sensitivity	500 mV over a ±15 V common-mode range; 200 mV over a ±7 V common-mode range.
Output voltage swing	> 2 V.
Order of transmission	Most significant bit (MSB) transmitted first (for both data input and data output).

DCC drop/insert connector pin-out	
Pin number	**RS-449/422 signal**
1	Rx data output (+)
2	Rx clock output (+)
3	Signal ground
4	Tx clock output (+)
5	Tx data input (+)
6	Rx data output (-)
7	Rx clock output (-)
8	Tx clock output (-)
9	Tx data input (-)

Payload signal structures

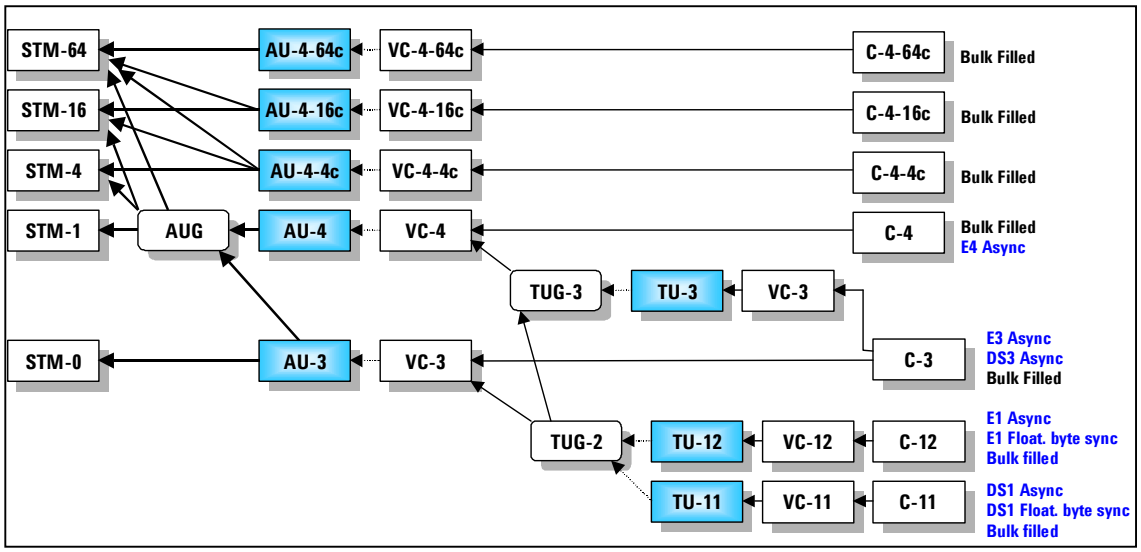
SONET mappings

Bulk STS-1 and STS-Nc, VT mappings and DSn/En service mappings supplied as standard.



SDH mappings

Bulk C-3, C-4 and C-4-Nc, TU mappings and DSn/En service mappings supplied as standard. .



DSn/PDH frame formats and channel structures

Supports generation and analysis of framed, channel structured (mux/demux) and unframed test signals.

Signal	Framing	Channel structures
DS1	SF (D4), ESF, SLC-96, no frame, bit	56 kb/s, 64 kb/s, n x 56 kb/s, n x 64 kb/s
DS3	M13, C-bit	DS1, 2 Mb/s, 56 kb/s, 64 kb/s, n x 56 kb/s, n x 64 kb/s
2 Mb/s	PCM30, PCM30CRC, PCM31, PCM31CRC	64 kb/s, n x 64 kb/s
8 Mb/s	ITU-T G.742	2 Mb/s, 64 kb/s, n x 64 kb/s
34 Mb/s	ITU-T G.751	8 Mb/s, 2 Mb/s, 64 kb/s, n x 64 kb/s
140 Mb/s	ITU-T G.751	34 Mb/s, 8 Mb/s, 2 Mb/s, 64 kb/s, n x 64 kb/s

Test patterns

PRBS	2^9–1, 2^{11}–1(1), 2^{15}–1, 2^{20}–1(1), QRSS (2), 2^{23}–1, 2^{31}–1(3). Polarity control: Inverted, non-inverted.
Word	All 1's, All 0's, 1010, 1000, 16-bit word.
Additional DS1 patterns	3-in-24, 1-in-8, 2-in-8, 55-octet (Daly).

Notes:

1. Not provided for STS-192c/C-4-64c bulk payloads.
2. Non-inverted only. Provided for DSn signals (including 56/64 kb/s channel testing) and VT1.5 bulk payloads by J2129A.
3. Provided for bulk mapped STS-N(c) and C-4-N(c) payloads.

Measurements

Error measurements

Measurement control	Manual, single, timed start.
Basic results	Error count, error ratio. Provided for the total measurement period and the most recent (last) measurement second.
SONET	TOH: Frame (A1,A2), CV-S (B1), CV-L (B2), CV-LFE (REI-L). STS path: CV-P (B3), CV-PFE (REI-P). Bulk payload: Bit. Signal: BPV (STS-1 and STS-3 interfaces). VT: CV-V(V5), CV-VFE(REI-V). DSn/En payload: See DSn and PDH (En) measurements for details.
SDH	SOH: Frame (A1A2), B1, B2, MS-REI. HO-path: B3, HP-REI. Tandem path (VC-3/4 and VC-4-Nc): TC-REI, TC-OEI, TC-IEC. Bulk payload: Bit. Signal: Code (STM-0e and STM-1e interfaces). LO-path: B3 (VC-3), BIP-2; LP-REI Tandem path (VC-11/12): TC-REI, TC-OEI, N2-BIP PDH/DSn payload: See PDH and DSn measurements for details.
DSn	DS1: BPV, frame, CRC6, bit. DS3: BPV, frame, P-bit, CP-bit, FEBE, bit.
PDH (En)	2 Mb/s: Code, frame, CRC4, E-bit, bit. 8Mb/s and 34 Mb/s: Code, frame, bit. 140 Mb/s: Frame, bit.
Performance analysis	G.826, G.828. G.821, M.2100, M.2101, M2101.1, M.2110, M.2120.

Alarm detection and measurement

Results	Alarm seconds. Provided for all supported alarm except power loss and clock loss.
Alarm LEDs	Front panel LEDs: Red/green: Signal, frame (all levels of framing), errors (any error type), pattern. Red: SONET/SDH (any SONET/SDH alarm), DSn (any DSn alarm), PDH (any PDH alarm), history (any alarm earlier in measurement period). Virtual LEDs (accesses via front panel 'Show More' key): Graphical alarm display showing status information (including history) for all supported alarm types.
SONET	Signal: LOS. TOH: LOF, OOF, AIS-L, RDI-L, K1/K2 change. STS path: LOP-P, LOP-C, AIS-P, AIS-C, UNEQ-P, RDI-P, RDI-P-P, RDI-P-S, RDI-P-C, STS pointer adjustment. Payload: Pattern loss. Other: Clock loss, power loss. VT path: H4-LOM, P1P2 Loss, LOP-V, AIS-V, UNEQ-V, RDI-V, RDI-V-P, RDI-V-S, RDI-V-C, RFI-V, VT pointer adjustment. DSn/En payload: See DSn and PDH (En) alarms for details.
SDH	Signal: LOS. SOH: LOF, OOF, MS-AIS, MS-RDI, K1/K2 change. HO-path: AU-LOP, AU-LOP-C, AU-AIS, HP-UNEQ, HP-RDI, VC-AIS, AU pointer adjustment. Payload: Pattern loss Tandem path (VC-3/4 and VC-4-Nc): TC-RDI, TC-ODI, IncAIS, TC-OOM, TC-UNEQ. Other: Clock loss, power loss LO-path: H4-LOM, TU-AIS, TU-LOP, LP-UNEQ, LP-RDI, LP-RFI, TU pointer adjustment. Tandem path (VC-11/12): TC-RDI, TC-ODI, IncAIS, TC-OOM, TC-UNEQ. PDH/DSn payload: See PDH and DSn alarms for details.
DSn	DS1: LOS, OOF, AIS, RAI, excess zeros, pattern loss. DS3: LOS, OOF, LOMF, AIS, RAI, idle, DS3 framing mismatch, DS2 LOF, excess zeros, pattern loss.
PDH (En)	2 Mb/s: LOS, LOF, LOMF, AIS, RDI, RDI (MF), minor alarm, pattern loss. 8 /34/140 Mb/s: LOS, LOF, AIS, RDI, minor alarm, pattern loss.

Additional measurements

Optical power	Supported for all optical receive rates. Ranges: 10 Gb/s: -3dBm to –25 dBm. 10 Gb/s (SR): -1 to –14 dBm 2.5 Gb/s: 0 dBm to –28 dBm. 622 Mb/s and below: 0 dBm to –30 dBm. Accuracy: 10 Gb/s: ± 1.5 dB. 10 Gb/s (SR): ± 2dB 2.5 Gb/s: ± 2 dB. 622 Mb/s and below: ± 1 dB. Resolution: 0.1 dB.
Line frequency	Supported for all optical and electrical receive rates. Results: Frequency (Hz), Offset (Hz and ppm). Accuracy: ± 4.5 ppm. Resolution: Frequency: 1 Hz (up to 622 Mb/s), 0.1 kHz (2.5 Gb/s and 10 Gb/s). Offset: 0.1 ppm.
Pointer measurements	Supported for both STS/AU and VT/TU pointers. Results: Pointer value, increment count, decrement count, increment seconds, decrement seconds, NDF seconds, missing NDF seconds, SPE/VC offset (in ppm).
Electrical level	Supported for all electrical receive signals up to 52Mb/s. Results: +Vpk, -Vpk, Vpk-pk; +dBdsx, -dBdsx, dBdsx. Accuracy: ± 5% of nominal or ±10mV up to 120% of nominal, ±10% for levels greater than 120%.
Service disruption	Measures the duration of an error burst detected in the received test pattern (not available for word patterns). Supported for all SONET/SDH mappings and DSn/PDH signals. Results: Longest burst, shortest burst, last burst. Range: 50 μs to 2 s. Accuracy: ± 100 μs plus the sum of the applicable re-framing times. Resolution: 1 μs. Re-framing time (maximum): SONET/SDH: 250 μs; STS/AU Pointer: 500 μs; H4 multiframe (VT/TU): 1000 μs VT/TU Pointer: 2000 μs; PDH framer: 125 μs.
Delay	Round trip delay measurement. Supported for all DSn and PDH signals, both as a line signal and as a mapped payload in SONET/SDH. Range: 0 to 1999.999 ms. Resolution: 1 μs.
Pulse mask	Supported for electrical receive signals up to 52 Mb/s, except 8Mb/s. Rates: DS1/3; 2/34 Mb/s; STS-1/STM-0e. Pulse polarity: Evaluates both positive and negative pulses. Results: Graphical display versus selected mask (with pass/fail result), level (Vpk), level ratio (ratio of positive to negative pulse levels), pulse width (ns), pulse width ratio (ratio of positive to negative pulse widths). Masks: T1.102, T1.404, GR-499, GR-253-CORE, G.703, off.

SignalWizard (all-channel testing)

Line rates	SONET: OC-1/3/12/48/192, STS-1/3. SDH: STM-0/1/4/16/64o, STM-0/1e. DSn: DS3, DS1. PDH: 140Mb/s, 34Mb/s, 8Mb/s, 2Mb/s.
Channel sizes	Supports detection and simultaneous monitoring of any 'mix' of the following channel types: SONET: STS-1, STS-Nc (where N = 3, 12, 48, 192). SDH: AU-3, AU-4, AU-4-Nc (where N = 4, 16, 64). Note: SignalWizard will identify STS/AU channels of any size (for example STS-24c, AU-4-8c). However, error and alarm results will only be provided for the channel types identified above.

Signal discovery and monitoring	▪ Discovers the line rate and STS/AU channel structure of a received signal.
	▪ Monitors the line signal for:
	  ▪ CV-S (B1), CV-L (B2), CV-LFE (MS-REI) errors.
	  ▪ LOS, LOF, OOF, AIS-L (MS-AIS), RDI-L (MS-RDI).
	  ▪ Signal power/level.
	  ▪ Synchronization status (S1) message.
	  ▪ J0 section trace message.
	▪ Simultaneously monitors each STS/AU channel for:
	  ▪ CV-P (B3), CV-PFE (HP-REI) errors.
	  ▪ AIS-P (AU-AIS), LOP-P (AU-LOP), RDI-P (HP-RDI) alarms.
	  ▪ Payload mapping type and VT payload defects (C2 signal label).
	  ▪ Pointer activity.
	  ▪ J1 path trace message.
	▪ Discovers and simultaneously monitors all VT/TU channels in a selected STS/AU for:
	  ▪ CV-V (BIP-2), CV-VFE (LP-REI) errors.
	  ▪ AIS-V (TU-AIS), LOP-V (TU-LOP), RFI-V (LP-RFI), RDI-V (LP-RDI) alarms.
	  ▪ Payload mapping type (V5 signal label).
	  ▪ Pointer activity.
	  ▪ J2 path trace message.
	VT/TU channels in other STS/AU channels are scanned on a sequential basis.

STS/AU channel viewer display	Results are clearly presented on a colour-coded graphical display that shows:
	▪ Line rate and power/level of the received signal.
	▪ Status indicators (including history) for each line/section error and alarm.
	▪ Text decode of synchronization status (S1) and J0 section trace.
	▪ For each STS/AU channels:
	  ▪ Channel size and channel traffic information (equipped/unequipped and channels carrying VT/TU payloads).
	  ▪ Aggregated error/alarm status (including history) and pointer activity.
	▪ For a selected STS/AU channel:
	  ▪ Status indicators (including history) for each channel error/alarm.
	  ▪ Pointer activity.
	  ▪ The payload mapping being carried (C2 signal label decode).
	  ▪ J1 path trace message.
	▪ For each VT/TU channel in a selected STS/AU:
	  ▪ Channel size and channel traffic information (equipped/unequipped).
	  ▪ Aggregated error/alarm status (including history) and pointer activity.

	▪ For a selected VT/TU channel: ▪ Status indicators (including history) for each channel error and alarm. ▪ The payload mapping being carried (V5 signal label decode). ▪ Pointer activity. J2 path trace message.
PDH/DSn Channel Scan	▪ Automatically discover line rate, framing and structure of a received PDH/DSn signal. ▪ Automatically discover framing and structure of PDH/DSn signal contained within a SONET/SDH signal. ▪ Sequentially monitors each channel for: ▪ 140Mb/s, 34Mb/s, 8Mb/s: AIS, LOF, RAI ▪ 2Mb/s: AIS, LOF, RAI, CAS, CRC, RMF ▪ DS3: AIS, OOF, RAI (XBIT), FM, Idle, LOMF ▪ DS2: AIS, OOF, LOMF ▪ DS1: AIS, OOF, RAI (Yellow) ▪ Display channel numbering and status indication (including history) for each PDH/DSn error or alarm.

SignalWizard *(continued)*

Path routing test facilities	Overview of received path trace messages:
	▪ Tabular display showing the J1 path trace message associated with each STS/AU channel in the received line signal.
	▪ Tabular display showing the J2 path trace message associated with each VT/TU channel in a selected STS/AU.
	Search for specified path trace message:
	▪ Identifies channel that is carrying a user-specified path trace message.
	▪ For J1 messages, the search is performed on all STS/AU channels in received signal.
	▪ The J2 message search is performed on:
	  ▪ All VT/TU channels in a selected STS/AU channel.
	  ▪ All VT/TU channels in all STS/AU channels.
	▪ Search can be performed using any sub-string contained in the target path trace message. Search results report up to 25 matches.

Channel traffic overview	Tabular display that lists for each STS/AU channel in the received signal: ▪ Channel number. ▪ Channel size/type. ▪ The payload mapping being carried. ▪ J1 path trace message. Tabular display that lists for each VT/TU channel in a selected STS/AU: ▪ Channel number. ▪ Channel size/type. ▪ The payload mapping being carried. ▪ J2 path trace message.

Error generation

SONET	**Signal**: Data.[1] **TOH**: Frame (A1A2), CV-S (B1), CV-L (B2), REI-L. (CV-LFE) [2] **STS path**: CV-P (B3), CV-PFE (REI-P), CV-IEC (STS path IEC). ***Bulk payload**: Bit.* **Signal**: BPV (STS-1). **VT path**: CV-V (V5), REI-V (CV-VFE). **DSn/En payload**: See DSn and PDH (En) error add for details. **Error Control**: Single, error all[3], M.P x 10^{-n} (where M.P = 0.1 to 9.9 in 0.1 steps; n = 3 to 9)[4], N-in-4[5], N-in-T[6].
SDH	**Signal**: Data.[1] **SOH**: Frame (A1A2), B1, B2, MS-REI.[2] **HO-path**: B3, HP-REI, HP-IEC. **Tandem path** (VC-3/4 and VC-4-Nc): TC-REI, TC-OEI. **Bulk payload**: Bit. **Signal**: Code (STM-0e). **LO-path**: B3 (VC-3), BIP-2 (VC-1/2); LP-REI. **Tandem path** (VC-11/12): TC-REI, TC-OEI, N2-BIP. **PDH/DSn payload**: See PDH and DSn error add for details. **Error Control**: Single, Error All [3], M.P x 10^{-n} (where M.P = 0.1 to 9.9 in 0.1 steps; n = 3 to 9) [4], N-in-4 [5], N-in-T [7]
DSn	**DS1**: BPV[8], excess zeros[9], frame, CRC6, bit. **DS3**: BPV [8], excess zeros[9], frame, MFAS, P-bit, CP-bit, FEBE, bit. **Error control**: Single, M.P x 10^{-n} (where M.P = 0.1 to 9.9 in 0.1 steps, and n = 3 to 9)[4], N-in-4[10] , N-in-6[11]
PDH (En)	**2 Mb/s**: Code[8], frame, CRC4, E-bit, bit. **8 Mb/s and 34 Mb/s**: Code[8], frame, bit. **140 Mb/s**: frame, bit. **Error control**: Single, M.P x 10^{-n} (where M.P = 0.1 to 9.9 in 0.1 steps, and n = 3 to 9)[4], N-in-4[10].

Notes:

1. Errors transmitted pseudo-randomly in the signal frame.
2. For OC-192/STM-64, supports both the 'M1 only' and 'M0+M1' options of the standards.
3. Not supported for data, frame, BPV/code or bit.
4. The maximum error rate for any error type is 1 x 10^{-3} or the maximum error rate supported by the error type (its saturation value), whichever is the lower.
5. Supported for frame (A1A2) errors. N = 1 to 4.
6. B2 errors only. N errors transmitted during time T (T = 10 ms to 1000 s in decade steps; N = 0 to 640 x n errors, where n is the hierarchical level of the STS-n signal).
7. B2 errors only. N errors transmitted during time T (T = 10 ms to 1000 s in decade steps;
   N = 0 to 640 errors for STM-0, and 0 to 1920 x n errors for all other line rates, where n is the hierarchical level of the STM-n signal).
8. Not available when signal is a mapped payload in SONET/SDH or a channel within a higher rate DSn/PDH signal.
9. Single burst of 3 to 16 zeros (user selectable) transmitted without line coding.
10. Supported for DS3 frame, DS3 MFAS and PDH frame errors. N = 1 to 4.
11. Supported for DS1 frame errors. N = 1 to 6.

Alarm generation

Alarm control	On/off.
SONET	Signal: LOS. TOH: LOF, OOF, AIS-L, RDI-L. STS path: AIS-P, LOP-P, RDI-P, RDI-P-P, RDI-P-S, RDI-P-C, UNEQ-P. VT path: H4-LOM, AIS-V, LOP-V, RDI-V, RDI-V-P, RDI-V-S, RDI-V-C, RFI-V, UNEQ-V.
SDH	Signal: LOS. SOH: LOF, OOF, MS-AIS, MS-RDI. HO-path: AU-AIS, AU-LOP, HP-RDI, HP-UNEQ. Tandem path (VC-3/4 and VC-4-Nc): TC-RDI, TC-ODI, VC-AIS, TC-UNEQ. LO-path: H4-LOM, TU-AIS, TU-LOP, LP-RDI, LP-RFI, LP-UNEQ. Tandem path (VC-11/12): TC-RDI, TC-ODI, VC-AIS, TC-UNEQ.
DSn	DS1: LOS, OOF, AIS, RAI. DS3: LOS, OOF, AIS, RAI, idle.
PDH (En)	2 Mb/s: LOS, LOF, LOMF, AIS, RDI, RDI (MF), minor alarm. 8 /34/140 Mb/s: LOS, LOF, AIS, RDI, minor alarm.

SONET/SDH overhead testing

Overhead setup	All TOH/SOH, STS-path/HO-path, and VT-path/LO-path overhead bytes user programmable in hexadecimal. Restrictions: B1, B2, B3, H1 (SS-bits programmable), H2, H3, V1 to V4, V5 (bits 5-7 programmable).
Overhead monitor	Displays all TOH/SOH overhead bytes in a selected STS-3/STM-1group, plus all STS-path/HO-path and VT path/LO-path overhead bytes. Received byte values are presented in hexadecimal.
APS/MSP messages (K1K2)	Text-based setup and monitoring of APS/MSP messages. Linear: Messages comply with Telcordia GR-253-CORE Issue 3 and ITU-T G.783. Ring: Messages comply with Telcordia GR-1230 and ITU-T G.841.
Trace messages (J0, J1, J2, TC-APId)	Text-based setup and monitoring of all trace messages (J0, J1, J2, TC-APId (VC-3/4, VC-4-Nc), TC-APId (VC-11/12). Message formats: J0/J1/J2: Selectable as 16-byte or 64-byte format. TC-APId (SDH only): 16-byte format.
Synchronization status message (S1)	Text-based setup and monitoring of Synchronization Status messages. Messages comply with Telcordia GR-253-CORE Issue 3 and ITU-T G.707 (04/00 draft).
Signal labels (C2, V5)	Text-based setup and monitoring of payload signal labels (both STS path/HO-path and VT path/LO-path). Signal labels comply with Telcordia GR-253-CORE Issue 3 and ITU-T G.707 (04/00 draft).

SONET/SDH pointer adjustment control

The following pointer adjustment controls are provided as standard for STS-Nc/AU-4-Nc, STS/AU payload pointers and VT/TU pointers.

New pointer	Transmits a new pointer address with or without a new delta flag (NDF). Supports setting of any valid pointer value.
Burst	Single burst of adjustments transmitted in a selected pointer. Adjustment polarity: Incrementing, decrementing, alternating. Burst size: STS/AU and STS-Nc/AU-4-Nc: 1 to 10. VT/TU: 1 to 5. Separation of adjustments in burst: STS/AU and STS-Nc/AU-4-Nc: 4 frames (500μs). VT/TU: 4 multiframes (2 ms).
Periodic sequence	Periodic sequence of pointer adjustments created by generating a frequency offset between the line and SPE/VC clocks. Clock control: User selectable as either: 1. SPE/VC clock offset, line clock locked to reference. 2. Line clock offset, SPE/VC clock locked to reference. Offset: User selectable in the range ± 100 ppm. Setting resolution: 0.1 ppm. Accuracy: 0.02 ppm.

Drop/insert capabilities

DCC channels	Supports the drop-insert of a selected DCC channel in SONET/SDH via a serial datacom interface. DCC channel: D1-D3 (192 kb/s) or D4-D12 (576 kb/s). Connector: 9-pin miniature (see DCC connector for details). Interface type: DCE (drop and insert clocks supplied by test set).
DSn/PDH to/from SONET	Supports the external drop/insert of asynchronous mapped DSn/PDH payloads. Drop/insert is performed via the instrument's DSn/PDH electrical test ports. Supported rates: DS1, E1 (2Mb/s), DS3.
DSn/PDH to/from SDH	Supports the external drop/insert of asynchronous mapped DSn/PDH payloads. Drop/insert performed via the instrument's DSn/PDH electrical test ports. Supported rates: DS1, 2 Mb/s, 34 Mb/s, DS3, 140 Mb/s.
DSn/PDH to/from DSn/PDH	Supports the external drop/insert of a DS1 or 2 Mb/s channel to/from a higher-rate DSn/PDH signal. Drop-insert performed via the instrument's DSn/PDH electrical test ports. Supported rates: DS1 to/from DS3; 2 Mb/s(1) to/from 8/34/140 Mb/s or DS3.
Voice drop	Allows the traffic in a selected 56 kb/s or 64 kb/s timeslot carried within a DS1 or 2 Mb/s signal to be dropped to an internal speaker. The DS1 or 2 Mb/s signal can be at the primary signal rate or carried within a higher-rate line signal (SONET/SDH or DS3/PDH). Coding: A-law (2 Mb/s), μ-law (DS1).
Note: 2 Mb/s drop/insert to/from an 8/34/140 Mb/s signal is performed via the 120 Ω balanced test ports (3-pin Siemens connectors)	

Thru-mode testing

SONET/SDH	Non-intrusive (Transparent) Receive signal passes unaltered through test set. All receiver test facilities are available. Rates: SONET: OC-1, OC-12, OC-48, OC-192, *STS-1, STS-3.* SDH: STM-0o, STM-1o, STM-4o, STM-16o, STM-64o, *STM-0e, STM-1e.* Intrusive (Overhead Overwrite) Allows user selected error, alarm and overhead-byte test conditions to be injected in to a received SONET/SDH signal before it is re-transmitted. All receiver test functions are available. B1, B2 and B3 (for selected STS/AU test channel) parity bytes are recalculated before re-transmission. Rates: Same as non-intrusive thru-mode Error generation: As specified in 'Error generation' section for Signal, TOH/SOH, STS-path/HO-path and Tandem path (VC-3/4 and VC-4-Nc) error types. Alarm generation: As specified in 'Alarm generation' section for Signal, TOH/SOH, STS-path/HO-path and Tandem path (VC-3/4 and VC-4-Nc) alarm types. Overhead setup: Trace Messages (J0, J1), APS (K1K2), Sync. Status Message (S1), Signal Label (C2)
DSn/PDH	Receive signal passes unaltered through test set. All receiver test facilities are available. Rates: DS1, DS3, 2Mb/s, 8Mb/s, 34Mb/s, 140Mb/s.

DS1 loopcodes and DS3 FEAC messages

DS1 loopcodes	Transmits and monitors both in-band and out-of-band DS1 loopcodes. In-band: Line, payload, network, user (selectable in range 3 to 8 bits). Transmit: Selected code transmitted for 8 seconds (nominal). Monitor: Indicates the detection of a selected loop-up and loop-down code. Displays the last valid loopcode received. Out-of-band: Line, payload, network, universal, user (11111111 0xxxxxx0). Transmit: Selected code transmitted either continuously or in a burst of n-messages (where n is selectable in the range 1 to 15). Monitor: Displays in decode form the two most recently received loopcodes (current and previous).
DS3 FEAC messages	Applies to DS3 C-bit framed signals. Transmits and monitors loopback and alarm/status codes as per ANSI T1.107-1995. Loopback code transmit: Transmits any user selected loopback code as a single burst of 'N loopback codes' and 'M messages' (where N and M are selectable in the range 1 to 15). Alarm/status code transmit: Transmits any ANSI T1.107-1995 message or any user specified code (0xxxxxx0 11111111), either continuously or in a single burst (selectable in the range 1 to 15). Monitor: Displays in decoded form the two most recently received FEAC messages (current and previous).

PDH spare-bits testing

Supports user-programming and monitoring of PDH frame spare-bits.

2 Mb/s (non-CRC framing)	Si-bit (timeslot 0, bit 1); Sa4 to Sa8 (NFAS timeslot); timeslot 16 (MFAS) bits 5, 7 and 8 (PCM30 framing).
2 Mb/s (CRC framing)	E-bits (Si-bit in frames 13 and 15); 8-bit pattern in each NFAS Sa-bit (Sa4 to Sa8); timeslot 16 (MFAS) bits 5, 7 and 8 (PCM30CRC framing).
8/34/140 Mb/s	8 Mb/s and 34 Mb/s: FAS bit 12. 140 Mb/s: FAS bits 14 to 16.

Signaling-bits testing

2 Mb/s	Framing formats: PCM30, PCM30CRC (CAS). Transmit: User-programmed value transmitted in ABCD signaling-bits associated with all 30-channels. Monitor: Displays ABCD signaling-bits associated with all 30-channels.
DS1	Frame formats: SF (D4), ESF, SLC-96 Channel type: 56 kb/s structured timeslots. Transmit: User-programmed value transmitted in AB or ABCD signaling-bits associated with all 24-channels. Monitor: Displays AB or ABCD signaling-bits associated with all 24-channels.

Ethernet Testing

Physical Specifications

Physical Interfaces – 10/100Mb/s Ports

All parametric specifications are typical

Connector Type	Eight RJ45 Connectors	
Port Settings (With Auto Negotiate ON)	Data Rate	10Mb/100Mb (Restricted Negotiation) /Auto Negotiate
	Duplex Mode	Full/Half (Restricted Negotiation) /Auto Negotiate
	Flow Control	On/Off/(Restricted Negotiation) / Auto Negotiate
Port Settings (With Auto negotiate OFF)	Data Rate	10Mb or 100Mb, Fixed Setting
	Duplex Mode	Full or Half, Fixed Setting
	Flow Control	On/Off
10Mb/s Operation	Complies with IEEE802.3 (2000) 10BASE-T for operation over two pairs of CAT5 UTP cabling. Note: To guarantee RFI performance shielded twisted pair must be used	
	Maximum Cable Length	100 Metres
	Modes of operation	Full Duplex, Half Duplex
	Data Rate	10Mb/s ± 0.01%, Manchester encoded to give a binary signal at 10Mbaud/s in accordance with IEEE802.3 (2000)
100Mb/s Operation	Complies with ANSI X3.1995 (TP-PMD) referenced in IEEE802.3 (2000) 100BASE-TX for operation over two pairs of CAT5 UTP cabling. Note: To guarantee RFI performance shielded twisted pair must be used	
	Maximum Cable Length	100 Metres
	Modes of operation	Full Duplex, Half Duplex
	Data Rate	100Mb/s ± 0.01%, 4B/5B encoded to give a tertiary signal at a symbol rate of 125Mbaud/s in accordance with IEEE802.3 (2000)

Physical Interfaces – 1000Mb/s Ports

All parametric specifications are typical

Connector Type	Two slots for GBIC Modules (see Note)
Data Rate	1000Mb/s This is 8B/10B encoded as per ANSI X3.230-1994 (FC-PH), clause 11 (referenced in IEEE802.3 (2000) 36.2.4) to give a Line Transmission rate of 1250Mb/s
Port Settings (With Auto Negotiate ON)	Full duplex
	Flow Control ON, Flow Control OFF or Auto Negotiate Flow control
Port Settings (With Auto Negotiate OFF)	Full duplex
	On/Off
Tx Power	GBIC dependent (see Note)
Rx Sensitivity	GBIC dependent (see Note)

Note

The gigabit interfaces use GBIC (GigaBit Interface Converter) plug-in modules and parameters such as connector type or optical signal specifications are therefore dependent on the GBIC that is fitted. "Standard" GBICs are 1000BASE-SX (850nm, multi mode) and 1000BASE-LX (1300nm multi mode or single mode). Agilent recommend the following GBICs

Interface Type	Agilent Part No.	Order Details
1000BASE-SX	J5491A (1 Pair)	Option #325
1000BASE-LX	J5492A (1 Pair)	Option #326

There are many other GBICs available, including "non-standard" formats such as 1000BASE-ZX (1550nm single mode) or GBICs with non-standard connector types. The GBIC sockets will supply up to 4W, allowing any of these GBICs can be used provided they operate at the 1.25Gb/s line rate and meet the GBIC specification. (SFF Standard, Document Number SFF-8053 Rev 5.5)

The Ethernet module GBIC interfaces comply with the GBIC standard and full details of the electrical connections can be found in that standard.

Physical Interfaces – Port Status

The instrument will display the following status information for the test ports

All Ports	Auto Negotiation Status	This will display the outcome of the auto-negotiation process
	Paused	Displayed if Flow control is enabled and PAUSE frames are being received
10/100Mb Ports	No Signal	This is defined a loss of fast link pulse
Gigabit Ethernet Ports	No Signal	This is defined as a Loss of Signal indication from the GBIC Module
	Tx Fault	Displayed if the GBIC module detects a fault
	GBIC information	Displays the type of GBIC installed. For example 1000BASE-SX
	Data Invalid	Displayed if coding violations are detected e.g. Signal voltage exceeds 200mVpp or K28.5 pattern is not detected within 64K+24 symbols

Physical Interfaces – Tx Eye Clock

The transmit eye clock is only operational for 100Mb/s and 1000Mb/s

Connector Type	SMA
Frequency	100Mb/s - 25MHz
	1000Mb/s – 1.25MHz
Impedance	Drives 50Ω Inputs
Signal Level	Nominal ECL level, AC coupled

Traffic Generation

Port Settings

The following parameters can be set individually for all of the test ports.

Data Throughput	Programmable	From 0.1Mb/s to 10, 100 or 1000Mb/s in 0.1Mb/s steps
Transmission modes	Programmable Burst – Time	From 1 second to 99 Days in 1 second steps
	Programmable Burst – Number of Frames	From 1 to $1x10^9$ frames
	Continuous Transmission	
Programmable fields	MAC address	Any valid address can be set. A warning will be displayed to the user for broadcast, multicast and MAC control addresses.
	Frame Length	Any length can be set from 58 bytes to 16384 bytes (10/100Mb/s ports) or 64K bytes (1000Mb/s ports) in 1 byte increments
	VLAN Tag OFF/ON	When ON, any valid VLAN value can be set
	Priority Tag (Requires VLAN to be ON)	Any valid value can be set

Transmit Counts

The instrument provides counts of transmitted data as follows:

Port Frame Count	The total number of frames transmitted from a port. Includes learning frames and "faulty" frames but not PAUSE control frames
Port Frame Rate	Port frame count on a per second basis
Stream Frame Count	The total number of frames transmitted in a single data stream on a given port. I.e. All frames with the same source/destination MAC address and test cell number. Does not include learning frames

Test Function Frames

The tester can generate the following "faulty" frames for verifying the behaviour of the device under test.

Dropped Frame	The tester will generate a test frame but not actually send it to the device under test, causing a gap in the sequence
Errored Frame	Transmits a frame with an incorrect check sequence (FCS)
Out of Sequence Frame	Transmits a frame in the "wrong" order
Non-test frame	Transmits a frame that contains no test data and will therefore not be recognised by the test set receiver

Learning Frames

The instrument will send learning frames to the device under test when required. Learning frames are similar in format to "normal" test frames but will not be counted as test frames when calculating stream results.

Traffic Reception

Port Results

The Ethernet module continually monitors the receivers in the test ports and displays the following information for all of the test ports.

Data Throughput	The actual achieved data throughput. Resolution: 0.1Mb/s
Frame Count	The number of frames received on a port. This will include errored frames and learning frames but not PAUSE or MAC control frames
Frame Rate	Frame count per second
Errored Frames	The number of received frames for which the checksum is incorrect
Non-Test Frames	The number of frames received which did not originate from the local tester when operated in loopback mode or the far-end tester in end-to-end mode.
Jumbo Frames	The number of received frames that exceed either: 1518 Bytes with VLAN disabled Or 1522 Bytes with VLAN enabled
Runt Frames	The number of received frames that are below the minimum 64 Byte size.
Broadcast Frames	The number of received broadcast frames. (Destination MAC address set to all ones)
Multicast Frames	The number of received frames with the multicast bit set in the destination MAC Address

Stream Results

The test instrument provides the following summary data for each of the identifiable data streams received within each of the test ports

Source Address	MAC address in hexadecimal
Destination Address	MAC address in hexadecimal
Frame Size	The frame size in Bytes
Source and Destination Port	The tester will interpret the unique data stream number and provide the source and destination ports. This alleviates the need for the user to interpret the MAC addresses.
VLAN ID	VLAN ID tag in decimal (if any)
Priority Tag	The Priority tag as a number in the range 0 to 7 (if present)
Stream Status	"Active", "Quiet" "Active" indicates frames have been received for this stream in the last ten seconds "Quiet" indicates that no frames have been received for this stream in the last ten seconds

The instrument will display the following information about each of the identified data streams.

Stream Data Rate	Displayed as Minimum/Maximum/Average over the last second	Display resolution: 0.1Mb/s
Latency	The time taken from a frame being transmitted to being received. Displayed as Minimum/Maximum/Average over the last second	Measurement Range: 0.01 ms to 1999.99 ms Accuracy: ±1μs
Stream Frame Count	The total number of frames received for the stream	
Stream Frame Rate	Frame count on a per second basis	
Dropped Frame Count	The number of frames that were transmitted but never received (This count is only available once transmission has stopped.)	
Errored frame count	The number of received frames in this data stream that were errored	
Out of sequence Count	The number of frames which were received in a different order to that in which they were transmitted	
Frames in Transit Count	The number of frames that have been transmitted but not yet received	

Frame Capture

The instrument provides a frame capture facility as an aid to troubleshooting network problems. The instrument will capture a number of frames (up to eight per port) that meet defined trigger conditions. The capture depth has been designed to support the identification of faulty devices or incorrect service provisioning. The specifications are:

Trigger Types	Input Fields	Values
Trigger if <field> is equal to <value>	Source Address	User select, any address
	Destination Address	User select, any address
	Length/Type	User select, any value
	VLAN frame	User select, off or on
	VID	User select, any VLAN tag
	Priority	User select, any priority tag
Trigger if <field> is in error	Frame check sequence	N/A
Trigger if frame is a non-test frame	N/A	Captures all frames that did not originate from a test set
Trigger Now	N/A	Captures the next eight frames

The trigger conditions can be applied to any number of the test ports. The following data is captured by the test set when triggered:

- Source Address
- Destination Address
- Length/Type field
- VLAN frame indicator
- VLAN ID
- Priority Tag
- A Minimum of 20 Bytes of Payload Data, including the IP Address (if any) and header information

General features

Help facilities	On-line user documentation: Accessed via front panel key. Context-sensitive help: Provided for each control-field on a dedicated line of the instrument's display. The displayed help information automatically tracks the cursor. User-help documentation: Supports the installation (from floppy disk) of up to 1.44 Mbytes of user-authored help files in the instrument's non-volatile memory. This help information is available in addition to that provided as standard.
Stored configurations	Provides storage for ten instrument configurations (one factory-default configuration plus nine user configurations) in non-volatile memory. Additional instrument configurations can be saved to and recalled from the floppy disk.
Graphical results	The following graphical results are available for display during a measurement: STS/AU pointer: Line graph of STS/AU pointer address versus time. Additional graphical result capability provided by J2129A: Errors: Bar graph for each supported error types versus time. Alarms: Line graph for each supported alarm type versus time. VT/TU pointer: Line graph of VT/TU pointer address versus time. Time resolution: 1-second, 1 min, 1 hr, 12hr, 1 day, 2-7 days. Storage: Up to 10 sets (or 10 Mbytes in total) of graphical results can be saved in the instrument's non-volatile memory.
Result logging	Supports logging of results during a measurement to a printer or to a file in the instrument's non-volatile memory. Logged information: Instrument settings, time and date, period-results, end-of-measurement results (the results logged are user selectable). Logging period: 10-minutes, 1-hour, 24-hours, user-defined (in ranges 10 to 99-minutes; 1 to 99-hours).
Printing	Supports printing of logged results and screen dumps via USB port.
Beep-on-error	Audible beep emitted on detection of any valid error-type. Control: Off/on (with user controlled volume).

General specifications

Display	8.4" VGA display (TFT active matrix).
Floppy disk	1.44 Mb IBM-compatible. Supported facilities include: Stored configurations: Save and recall of instrument configurations. Logged results: Saving the results generated during measurement logging. Results saved in Windows®-compatible 'plain text' format. Screen dumps: Saving the current instrument display in Windows-compatible .BMP format. User-help files: Downloading user-help files to the instrument.
Remote control interfaces	LAN (10/100BaseT), RS-232, GP-IB.
Peripheral interfaces	PS/2 keyboard; PS/2 mouse 2 x USB (for printer).
Remote graphical user interface	A Java™ application connected remotely via LAN or modem. Compatible with PC-based Windows® operating systems.
Firmware upgrades	Downloaded to the test set from a PC via LAN or RS-232 interface.
AC power	Voltage range: 90 to 260 Vac nominal (auto-ranging). Frequency range: 47 to 63 Hz. Power: 150 VA (J2126A); 250 VA (J2127A).
Environmental	Operating temperature: 0 to 45 °C (32 to 113 °F). Storage temperature: -20 to 70 °C (-4 to 158 °F). Humidity: 15% to 90% relative humidity at 40 °C (104 °F).
Dimensions (approximate) **(height x width x depth)**	J2126A: 180 mm x 331 mm x 224 mm (7.1" x 13" x 8.8"). J2127A: 180 mm x 331 mm x 288 mm (7.1" x 13" x 11.3"). J2127A (extended chassis): 180 mm x 331 mm x 402 mm (7.1" x 13" x 15.8")
Weight (approximate)	J2126A: 8.7 kg (19 lbs) (covers all rates to 2.5 Gb/s). J2127A: 11.2 kg (25 lbs) (covers all rates to 10 Gb/s). J2127A (extended chassis): 13.5 kg (30 lbs) (covers all rates to 10Gb/s & Ethernet).
Warranty	3-year as standard. Option W50: Extends warranty period to 5-years.
Calibration cycle	2-years.

Regulatory standards

EMC	Complies with: ▪ EMC Directive 89/336/EEC. ▪ Australian EMC Framework Act 1992. ▪ ICES/NMB-001. Meets: ▪ EN 55011:1991 Group 1, Class A. ▪ EN 50082-1:1992.
Electrical safety	Complies with: ▪ Low Voltage Directive 73/23/EEC. Meets: ▪ EN 61010-1:1993. ▪ IEC 61010-1 (1990) +A1(1992) +A2(1992) ▪ CSA C22.2 No. 1010.1-93.
Laser safety	Meets: ▪ EN 60825-1:1994 +A2: 2001 Class 1. ▪ IEC 60825-1 (1993) +A2 (2001) Class 1. ▪ 21 CFR Chapter 1 1040.10 Class I.

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Notes

Notes

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Canada-English	877 894 4414
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Japan	0120 421 345
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Malaysia	1800 888 848
Mexico	+52 01800 506 4800
Netherlands	+31 (0) 20 5472111
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Switzerland-French	+33 (0) 825 010 700
Taiwan	0800 047 866
Thailand	1800 226 008
United Kingdom	+44 (0) 7004 666666
USA	800 452 4844

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