Agilent RouterTester

P3/2 Test Module

E7905A

Technical Datasheet

- **Enables Internet-scale testing of gigabit and terabit routers — scaling up to 32 modules, providing up to 64 ports at wire-speed!**
- **Dual port OC-3c/STM-1 (155 Mb/s) Packet over SONET/SDH (POS) interfaces**
- **Generates and analyzes IP packets at wire-speed**
- **Measurements between multiple modules are synchronized**
- **Verifies SONET/SDH interfaces**
- **Verifies PPP/HDLC interfaces**

Agilent Technologies

Product Overview

Agilent's RouterTester provides Internet-scale testing by generating many streams of IP traffic from many simulated networks. Quality of Service (QoS) metrics are concurrently measured on multiple streams in real-time to determine the true performance of a gigabit or terabit router.

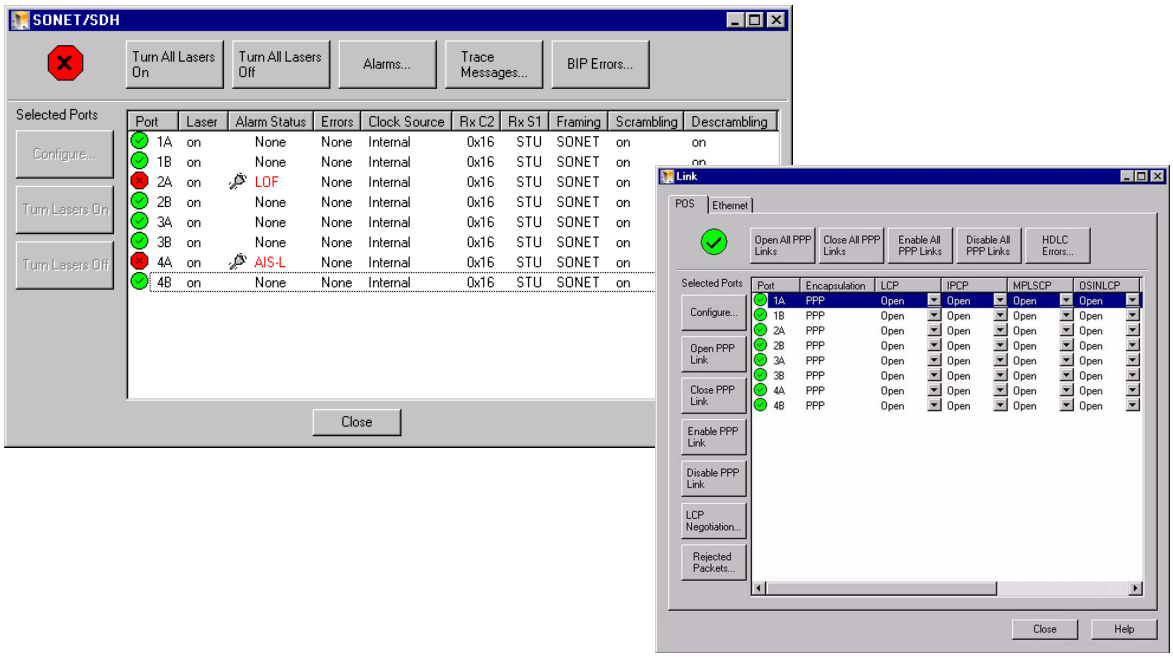
The RouterTester P3/2 Test Module has two OC-3c/STM-1 (155 Mb/s) SONET/SDH interfaces. Each full-duplex port both generates IP packets encapsulated within PPP/HDLC frames at up to wire speed and analyzes every received frame in real-time at wire speed. Up to 32 modules can be utilized in a single system, providing an unparalleled Internet-scale test solution.

In order to verify SONET/SDH, HDLC and PPP layer connectivity, the test module provides alarm and error statistics at the SONET/SDH layer, and transmit, receive and error statistics at the HDLC layer.

The RouterTester's ability to emulate E-BGP, I-BGP, OSPF and IS-IS sessions creates a realistic network cloud around the System under Test (SUT), providing unprecedented realism to router testing.

Any number of routes with a flexible range of attributes can be advertised into the router (or network) under test, building immense and complex forwarding tables within these devices, which will stress the data forwarding abilities of the router under test.

Working in conjunction with the IP performance application, the data can be measured while simultaneously advertising and withdrawing routes. The ability of a router to withstand route flap "storms" as well as the time it takes for a router to converge on new routes can be precisely measured. By benchmarking a network or router with realistic tests, will provide a high degree of confidence that it will perform reliably when deployed in the real world.



The RouterTester dual-port OC-3c POS Test Module provides complete SONET/SDH connectivity verification and rapid PPP/HDLC verification through the user interface.

Product Features

Internet-scale Testing

RouterTester scales up to 64 ports of OC-3c/STM-1 Packet over SONET/SDH interfaces. With the IP Performance Test Software and the BGP-4 Emulation Software, each port can advertise over 200,000 network prefixes, and then can generate streams of realistic traffic from these simulated networks.

Dual Packet Over SONET/SDH Interfaces

Each port supports the Packet over SONET/SDH interface, encapsulating IP packets using PPP in HDLC-like framing (as per RFC 1662). The Link Control Protocol (LCP) and IP Control Protocol (IPCP) are supported for parameter negotiation and IP address discovery.

RouterTester also supports Cisco's HDLC encapsulation of IP packets.

Wire Speed Transmission and Analysis

All frames can be transmitted at up to wire speed, with a minimum of one HDLC flag octet between frames. IP packets can be transmitted at up to 398,297 packets per second, per port(40 Byte IP with 16 bit FCS). On the receive side, every received frame, at up to wire speed with the smallest size frame, is counted and analyzed.

Synchronized Measurements

All transmitted packets can be instrumented with a sequence number and transmit timestamp, allowing accurate packet loss and latency measurements. Multiple modules are synchronized via a clock signal, distributed amongst all modules within the test system.

SONET/SDH Verification

In order to verify the state of the physical layer, the RouterTester P3/2 Test Module reports all SONET/SDH alarms and error conditions. Statistics and errored seconds are counted and reported for alarms and BIP errors. To test the SONET/SDH interface, access is provided to generate alarms, to manipulate the automatic protection switching bytes (K1/K2), path and section trace messages (J0/J1), and synchronization byte (S1).

PPP/HDLC Verification

To measure the performance of IP encapsulation using PPP in HDLC-like framing, a complete set of transmit and receive statistics are accumulated. Frames and octets transmitted and received before and after stuffing/destuffing, indicate the HDLC transmit efficiency. The maximum number of frames both transmitted and received per measurement interval indicate the relative burstiness of traffic. Aborted frames, invalid frames and frames with FCS errors are also counted.

Rapid Configuration of Packet over SONET/SDH interfaces

At a glance, the user interface reveals the status of the SONET/SDH, HDLC and PPP layers, and provides easy access to statistics and to alarm generation.

Online Help

An extensive online help system provides complete descriptions and detailed usage instructions for every component of RouterTester. Dialog-level context-sensitive help provides rapid access to the relevant sections of the online help. A technology reference section provides a complete library of background information pertaining to gigabit and terabit router performance testing.

Technical Specifications

System Specifications

Clock and timestamp system

Resolution	• 10 nanoseconds
Accuracy	• 20 nS +/— 10 PPM
Transmit clock source	• The transmit clock source can be: – internally generated, – recovered from the received SONET/SDH signal, or – based upon an external signal received via the external clock connector
Module synchronization	• All measurements are synchronized across all modules within the test system

External Reference Clock

Connector	• SMB connector
Specification	• 0 dBm (nominal) terminated in 50 ohm to ground input
Signal	• 19.44 MHz (nominal)
Duty cycle	• 50 +/— 5%

Measurement System

Result types	• Cumulative: measurements are reported from the start of the measurement interval • Sampled: measurements are reported from the most recently completed sampling interval
Measurement period	• Range: 1 second to 7 days • Sampling period: the sampling period can range from 1 second to 1 hour

Optical Interface

Connector	• Duplex (transmit and receive) SC female connector
Optical interface	• 1310 nm single-mode PIN based receiver • 1310 nm Class 1 single mode laser compliant with: – Telcordia Technologies GR-253-CORE (Issue 2, Rev. 2, Jan. 99) – ITU-T G.957 (July, 1995) intermediate reach specifications
Input sensitivity	• -28 dBm (min)
Maximum input power	• -8 dBm
Average output power	• -8.0 dBm (max), -15 dBm (min)
Safety	• Complies with the Optical safety standards listed in the Regulatory Compliance section (page 9)

Packet over SONET/SDH Layer Specifications

Physical Interface

Interface	• Packet over SONET/SDH: RFC 1619, PPP over SONET/SDH • Cisco HDLC (Ethertype protocol field)

Framing

Encapsulation	• IP datagrams are encapsulated using: – PPP in HDLC-like framing, as per IETF RFC 1662, or – Cisco HDLC (Ethertype protocol field)
FCS	• 16 or 32 bit FCS length (user selection) • Negotiated between test port and device under test
Frame spacing	• Frames can be transmitted continuously with a minimum one flag octet between frames
PPP	• Supports the Link Control Protocol and the IP Control Protocol • Rejected packets are counted by protocol type • Configurable parameters: – Restart Timer (default 3 seconds) – Max-terminate (default 2) – Max-configure (default 10) – Max-failure (default 5) • Negotiated parameters: – Maximum-Receive-Unit (default 1500) – Magic-Number (default is randomly chosen) – FCS (16 and 32-bit supported only)
Scrambling/descrambling	• 1 + X43, after HDLC framing • Scrambling can be enabled or disabled
Minimum frame size	• 11 octets for HDLC, so as to encapsulate a minimum PPP frame size of 6 octets with FCS-16 • 47 octets for IP, so as to encapsulate a minimum-IP frame size of 40 octets with FCS-16

HDLC Real-Time Transmit Statistics

Frames transmitted	• Count of total frames transmitted
Maximum frames transmitted	• The maximum sample value measured during the current measurement interval
Octets transmitted (before octet stuffing)	• Count of octets transmitted prior to the escape sequence transparency octets being inserted
Octets transmitted (after octet stuffing)	• Count of octets transmitted, including transparency octets

Maximum octets transmitted (after octet stuffing)	• The maximum sample value measured during the current measurement interval
HDLC transparency efficiency (percentage)	• Octets transmitted (before octet stuffing) divided by octets transmitted (after octet stuffing)

HDLC Real-Time Receive Statistics

Frames received	• Count of all HDLC frames received, including FCS errors, aborted frames and invalid frames
Maximum frames received	• The maximum sample value measured during the current measurement interval
Octets received (before destuffing)	• Count of octets received including all octets between flag sequence octets before removal of escape sequence octets
Maximum octets received (before destuffing)	• The maximum sample value measured during the current measurement interval
Octets received (after destuffing)	• Count of octets received after removal of flag and escape sequence octets
Maximum octets received (after destuffing)	• The maximum sample value measured during the current measurement interval
FCS errors	• Count of HDLC frames received with an invalid FCS
Aborted frames	• Count of HDLC frames that end with the frame abort sequence 0x7D 0x7E
Invalid frames	• Count of HDLC frames received with an address field or control field not equal to the preset values, or length too short (eg. less than 8 octets with FCS-32)

Frame Transmitter/Receive

Frame transmit	• Frames can be transmitted at up to wire speed (398,000 packets per second FCS-16), with a minimum of one flag octet between frames and 40 byte IP frame
Frame receive	• Frames can be received an analyzed at wire speed (398, 000 packets per second FCS-16), at full bandwidth with minimum sized (40 octet) IP frames

SONET/SDH Layer Specifications

Framing Formats

SONET	• STS-3c as per ANSI T1.105 and Telcordia Technologies GR-253-CORE (Issue 2, Rev. 2, Jan. 1999)
SDH	• SDH STM-1 as per ITU-T Rec. G.707/G.708/G.709, (03/1996)

Scrambling

SONET	• Frame synchronous scrambler as per ANSI T1.105 and Telcordia Technologies GR-253-CORE (Issue 2, Rev. 2, Jan. 1999) • Scrambling can be enabled or disabled
SDH	• STM-1 as per ITU-T Rec. G.708/G.709, 1993 • Scrambling can be enabled or disabled

Section/Regenerator Section Overhead Octet Generation

A1, A2	• Set to 0xF628 (for all STS-Ns/STM-Ns)
J0/Z0	• In Section Growth mode (Default), J0 = 1 and each Z0 octet set based on position in the STS-N frame (e.g. Z02=2, ... Z03 = 3 for STS-3c) • In Section Trace mode, J0 set to 64 byte message (ASCII string, CRLF terminated), Z0 unused, set to zero
B1	• Automatically calculated
E1, F1, D1...D3	• Unused, set to zero
Undefined octets	• Unused, set to zero

Line/Multiplexer Section Overhead Octet Generation

H1...H3	• Automatically calculated, including concatenation indicators
B2	• Automatically calculated (for all STS-Ns)
K1/K2	• User-definable 16 bit field, default zero
D4...D12	• Unused, set to zero
S1	• Least significant 4 bits can be set to predefined values, default zero.
Z1, Z2	• Unused, set to zero
M1	• Automatically calculated
E2	• Unused, set to zero
All other line overhead octets	• Unused, set to zero

Path Overhead Octet Generation

J1	• Can be set to a 64 byte message (ASCII string, CRLF terminated)
B3	• Automatically calculated
C2	• Automatically calculated as per framing and scrambling format, or user defined
G1	• Path REI bits are automatically calculated (count of errors from B3); path RDI bits are set as per alarm generation

F2 H4 Z3 (SONET) / F3 (SDH) Z4 (SONET) / K3 (SDH) Z5 (SONET) / N1 (SDH)	• Unused, set to zero

SONET/SDH Alarm Generation

LOS LOP AIS-L (SONET) MS-AIS (SHD) RDI-L (SONET) MS-RDI (SDH) AIS-P (SONET) AU-AIS (SDH) RDI-P (SONET) Path-RDI (SDH)	• Can be set to on or off

SONET/SDH Real-Time Measurement

SONET/SDH alarms are reported to the user. An Errored Seconds statistic counts the number of one second intervals in which the condition was reported at least once.

Automatic Protection Switching (APS) octets (K1/K2) Synchronization status (S1) value Section trace (J0) message Path trace (J1) message Path signal level value (C2)	• Values are decoded and displayed
Section BIP-8 (B1) errors Line BIP-8 (B2) errors Path BIP-8 (B3) errors	• Number of occurrences reported • Number of errored seconds reported
LOS LOF LOP AIS-L/MS-AIS RDO-L/MS-RDI) AIS-P/AU-AIS RDI-P/Path RDI	• Alarm is detected and indicated • Number of errored seconds

Mechanical Specifications

Module Details

Size	• 441 mm (width) x 390 mm (depth) x 44 mm (height)
Weight	• 4.8 kg
Supply voltage	• 100 to 240 Volts AC only
Supply frequency	• 50 to 60 Hz
Power consumption	• 120 watts maximum
Input current	• Less than 3.0 amps RMS, measured at 85 VAC
Input protection	• Non-user serviceable, internally located 5 amp, anti-surge AC input line fuse
Inrush current	• 35 amps peak (Vin = 230 VAC, one cycle, 25°C.) • Current internally limited by thermistor
Power factor	• 0.95 W/VA (Per EN61000-3-2)
Rear connectors	• Ethernet: – RJ-45 • Clock line connectors (input/output): – SMA • Event lines (input/output): – Twin BNC • External trigger input / external trigger output: – BNC

Front Panel LED Indicators

Power	• Green when module has power
Status	• Yellow to indicate module start-up, green to indicate that a test application is running, red to indicate a module error
Module	• Numerical module identifier
Laser	• Red when output laser is on
Signal	• Green when a valid optical receive signal is detected (opposite of LOS condition)
LOF/LOP	• Yellow when a Loss of Frame or Loss of Pointer condition exists at the receiver
AIS/RDI	• Yellow when a Line/MS AIS, Line/MS RDI, Path AIS or Path RDI condition exists at the receiver
TX	• Green when a HDLC frame is transmitted. Does not indicate integrity of the transmitted SONET SPE
RX	• Green when a HDLC frame is received. Indicates integrity of the SONET SPE and HDLC framing

Environmental Operating Conditions

Operating temperature	– 0° C to 55° C
Storage temperature	– -40° C to 70° C
Humidity	– 50% to 95% relative humidity from 25° C to 40° C

Regulatory Compliance

Electrical (Electromagnetic Compliance EMC)

- As per EN 61326-1:1997: Electrical equipment for measurement, control and laboratory use

Emission standards

- CISPR 11:1992 + A2: 1996 (electrical disturbance): Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical radio frequency equipment. This equipment meets Group 1, Class A limits
- EN 61000-3-2:1995 / IEC 1000-3-2:1995, Section 2: Limits for harmonic current emissions
- EN 61000-3-3:1994 / IEC 1000-3-3:1994, Section 3: Limitation of voltage fluctuations and flicker

Immunity standards

- EN 61000-4-2:1997 / IEC 1000-4-2:1995, Section 2: Electrostatic discharge test
- EN 61000-4-3:1995 / IEC 1000-4-3:1995, Section 3: Radiated electromagnetic field test
- EN 61000-4-4:1995 / IEC 1000-4-4:1995, Section 4: Electrical fast transient/burst test
- EN 61000-4-5:1995 / IEC 1000-4-5:1995, Section 5: Surge immunity test
- EN 61000-4-6:1996 / IEC 1000-4-6:1996, Section 6: Radiated electromagnetic field test
- EN 61000-4-8:1993 / IEC 1000-4-8:1993, Section 8: Power frequency magnetic field immunity test
- EN 61000-4-11:1994 / IEC 1000-4-11:1994, Section 11: Voltage dips, short interruptions, voltage variations immunity test

Electrical (safety)

- CSA22.2 No. 1010.1, NRTL/C, EN 61010-1:1993 + A2: 1995/IEC 1010-1:1990 + A1: 1992 + A2: 1995 Safety requirements for electrical equipment for measurement, control, and laboratory use

Optical (safety)

- EN 60825-1:1994 + A1:1997, Part 1: Equipment Classification, Requirements and User's Guide
- FDA Standard 21 CFR Ch1, 1040.10 & 1040.11 (laser safety)

Environmental

- ETM757, Temperature Tests.
- ETM758, Humidity Tests.
- ETM754, Thermal Profile Mapping.

Shock and Vibration

ETM759 Vibration	• Operational Functional: Class B2 Random Vibration • Survival, Swept Sine: Class B2 Swept Sine • Survival, Random Vibration: Class B2
ETM760 Shock	• End Use Handling: Class B2 • Transportation Environment: Type 1
ETM package Performance	• Vibration: Swept Sine Type 1 • Random Vibration • Impact: Type 1

Applicable Standards

Optical transmitter and receiver	• Telcordia Technologies GR-253-CORE (Issue 2, Rev. 2, Jan. 99) • ITU-T G.957 (07/95) intermediate reach specifications
SONET/SDH	• SONET STS-3c as per ANSI T1.105 and Telcordia Technologies GR-253-CORE (Issue 2, Rev. 2, Jan. 1999) • SDH STM-1 as per ITU-T Rec. G.707/G.708/G.709, (03/1996)
IP over Packet Over SONET/SDH	• Packet over SONET/SDH according to IETF RFC 1619, PPP over SONET/SDH
PPP/HDLC	• IETF RFC 1662, PPP in HDLC-like Framing
Link Control Protocol	• IETF RFC 1661, The Point-to-Point Protocol (PPP)
IP Control Protocol	• IETF RFC 1332, The PPP Internet Protocol Control Protocol (IPCP)

Agilent's RouterTester system

Agilent's RouterTester system offers a powerful and versatile test platform to address the evolving test needs of metro/edge platforms, core routers and optical switches. RouterTester provides Network Equipment Manufacturers and Service Providers with the industry's leading tools for wire speed, multiport traffic generation and performance analysis of today's networking devices.

Warranty and Support

Hardware Warranty

All RouterTester and QA Robot hardware is warranted against defects in materials and workmanship for a period of 3 years from the date of shipment.

Software Warranty

All RouterTester and QA Robot software is warranted for a period of 90 days. The applications are warranted to execute and install properly from the media provided. This warranty only covers physical defects in the media, whereby the media is replaced at no charge during the warranty period.

Software Updates

With the purchase of any new system controller Agilent will provide 1 year of complimentary software updates. At the end of the first year you can enroll into the Software Enhancement Service (SES) for continuing software product enhancements.

Support

Technical support is available throughout the support life of the product. Support is available to verify that the equipment works properly, to help with product operation, and to provide basic measurement assistance for the use of the specified capabilities, at no extra cost, upon request.

Ordering Information

To order and configure the test system consult your local Agilent field engineer.

United States:

Agilent Technologies
Test and Measurement Call Center
P.O. Box 4026
Englewood, CO 80155-4026
1-800-452-4844

Canada:

Agilent Technologies Canada Inc.
5150 Spectrum Way
Mississauga, Ontario
L4W 5G1
1-877-894-4414

Europe:

Agilent Technologies
European Marketing Organisation
P.O. Box 999
1180 AZ Amstelveen
The Netherlands
(31 20) 547-2323

United Kingdom
07004 666666

Japan:

Agilent Technologies Japan Ltd.
Measurement Assistance Center
9-1, Takakura-Cho, Hachioji-Shi,
Tokyo 192-8510, Japan
Tel: (81) 426-56-7832
Fax: (81) 426-56-7840

Latin America:

Agilent Technologies
Latin American Region Headquarters
5200 Blue Lagoon Drive, Suite #950
Miami, Florida 33126
U.S.A.
Tel: (305) 269-7500
Fax: (305) 267-4286

Asia Pacific:

Agilent Technologies
19/F, Cityplaza One, 1111 King's Road,
Taikoo Shing, Hong Kong, SAR
Tel: (852) 3197-7777
Fax: (852) 2506-9233

Australia/New Zealand:

Agilent Technologies Australia Pty Ltd
347 Burwood Highway
Forest Hill, Victoria 3131
Tel: 1-800-629-485 (Australia)
Fax: (61-3) 9272-0749
Tel: 0-800-738-378 (New Zealand)
Fax: (64-4) 802-6881

www.agilent.com/comms/RouterTester

Specifications subject to change
December 1, 2001.
5980-1972E, Rev C

Agilent Technologies