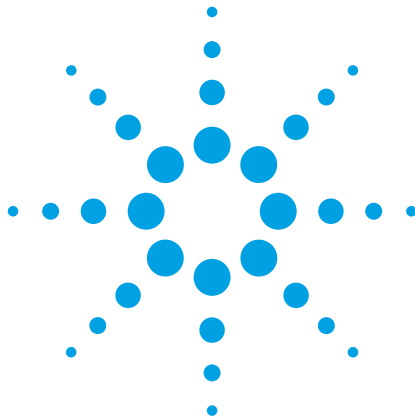


Agilent OmniBER OTN Family

OmniBER OTN
communications
performance analyzer

Verification Manual



Agilent Technologies



Agilent OmniBER Family OmniBER OTN

J7231B

Verification Manual



Agilent Technologies

Notices

© 2003 Agilent Technologies UK Limited

No part of this manual may be reproduced in any form or by any means (including electronic storage and retrieval or translation into a foreign language) without prior agreement and written consent from Agilent Technologies UK Limited as governed by international copyright laws.

Sales and Service Offices

An up-to-date list of Agilent Offices is available through the Agilent Website at URL:

<http://www.agilent.com>

Manual Part Number

J7230-90056

Edition

First edition, August 2003

Printed in UK

Agilent Technologies UK Limited
Data Networks Division
South Queensferry, West Lothian, Scotland
EH30 9TG

Warranty

The material contained in this document is provided "as is," and is subject to being changed without notice in future editions. Further, to the maximum extent permitted by applicable law, Agilent Technologies disclaims all warranties of merchantability and fitness for a particular purpose. Agilent Technologies shall not be liable for errors or for incidental or consequential damages in connection with the furnishing, use, or performance of this document or of any of the products to which it pertains. Should Agilent Technologies have a written contract with the user and should any of the contract terms conflict with these terms the contract terms shall control.

Technology Licenses

The hardware and/or software described in this document are furnished under a license and may be used or copied only in accordance with the terms of such license.

Restricted Rights Legend

If software is for use in the performance of a U.S. Government prime contract or subcontract, Software is delivered and licensed as "Commercial computer software" as defined in DFAR 252.227-7014 (June 1995), or as a "commercial item" as defined in FAR 2.101(a) or as "Restricted computer software" as defined in FAR 52.227-19 (June

1987) or any equivalent agency regulation or contract clause. Use, duplication or disclosure of Software is subject to Agilent Technologies' standard commercial license terms, and non-DOD Departments and Agencies of the U.S. Government will receive no greater than Restricted Rights as defined in FAR 52.227-19(c)(1-2) (June 1987). U.S. Government users will receive no greater than Limited Rights as defined in FAR 52.227-14 (June 1987) or DFAR 252.227-7015 (b)(2) (November 1995), as applicable in any technical data.

Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A **WARNING** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a **WARNING** notice until the indicated conditions are fully understood and met.

In This Manual...

You will find information for verifying the performance of your instrument

1 Performance Tests

This chapter details the procedures to test the performance of the instrument and provides a test record table to record the results of the tests.

2 Self Test Overview

This chapter details all of the Self Test procedures.

Conventions Used in this Manual

The conventions used in this manual to illustrate instrument keys and display information are as follows:

- <Menu>** This is an example of a hardkey. Hardkeys (located to the right of the display) are used to give access to different sets of instrument settings, or select dedicated instrument functions.
- Menu Items** Menu items appear in text in **bold** with the greater than (>) symbol separating each menu level. For example, if you are instructed to choose Errors and Alarms from the Test Functions menu, it appears as **Test Functions > Errors and Alarms**.
- Field Items** Field items you can select will appear in **bold**, for example select **Signal Rate** field.
- Drop Down Lists** The item you must select from a drop down list is also shown in bold. For example, select **Signal Rate** field and choose **STM-1** or **OC-3** from the drop down list.

Contents

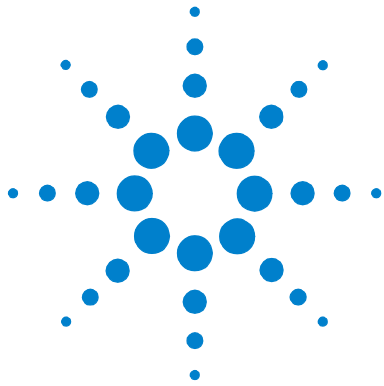
1 Performance Tests

Introduction	8
Recommended Test Equipment	9
Self Test Loopback Cables and Accessories	11
Recall Default Settings	12
Performance Self Test	13
Description of the Performance Self Test	13
Loopback Connections Required for Self Test	14
How to run the self test	16
What to do if the Self Test fails	17
Internal Reference Clock Accuracy	18
Alternative DS1 Clock test (if suitable DS _n Test Set is not available)	23
External Clock Reference Inputs and Clock Reference Output	24
Optical Pulse Mask and Output Characteristics	31
52/155 and 622 Mb/s Optical Output Checks	32
2.5 Gb/s Optical Output Checks	37

9.95 Gb/s and 10.71 Gb/s Optical Output Checks	40
Optical Receiver Sensitivity, Optical Power and Frequency Measurement	45
Electrical Pulse Mask and Output Level Characteristics (Option 012 Only)	63
Optical Transmit/Receive Jitter Amplitude Accuracy	87
Performance Test Record	108

2 Self Test Overview

Description of the Self Test	128
List of Self Tests	129
Loopback Connections Required for Self Test	131
How to Run a Self Test	135
What to Do if the Self Test Fails	143



1 Performance Tests

Introduction	8
Recommended Test Equipment	9
Recall Default Settings	12
Performance Self Test	13
Internal Reference Clock Accuracy	18
External Clock Reference Inputs and Clock Reference Output	24
Optical Pulse Mask and Output Characteristics	31
Optical Receiver Sensitivity, Optical Power and Frequency Measurement	45
Optical Transmit/Receive Jitter Accuracy	
Performance Test Record	108



Introduction

The procedures given in this section test the performance of the Agilent J7231B OmniBER OTN model using the instrument specifications (available on the instrument website) for test accuracy limits. The tests are intended to be performed in the recommended order for a full instrument calibration check. Tests can be run individually, however it will be assumed that any preceding test would meet specifications.

Equipment Required

Equipment required for the performance tests is given in [“Recommended Test Equipment”](#) on page 9. Any equipment which meets or exceeds the critical specification of the equipment listed may be substituted. Recommended models are those typically used in Agilent Service Centers. Where appropriate, alternative models are also listed.

Performance Test Record

The results of the performance tests may be recorded in the [“Performance Test Record”](#) on page 108. The performance test record lists all the tested specifications and the acceptable limits. The results recorded at incoming inspection may be used for comparison during periodic maintenance, troubleshooting or after repair or adjustment.

Calibration Check Cycle

This instrument requires periodic verification of performance. Depending on use and environmental conditions, the instrument should be checked at least once every 2 years, using these performance tests.

Instrument Option Configuration

Please refer to Chapter 1 and the instrument specifications for information on option configuration.

Recommended Test Equipment

Instrument	Critical Specification	Recommended Model
High Speed Optical oscilloscope	oscilloscope Mainframe 3 GHz Opt/Elect Module with STM-1/4 Filter 20 GHz Opt/Elect Module with STM-16/64 Filter.	86100A 86103A option 201 86105A option 202
Frequency Counter	Range 0 to 200 MHz, accuracy <0.1 ppm.	53181A option 001 or 5325A option 010
Optical Power Meter and Sensor Module	Range -8 dBm to -33 dBm, Wavelength 1260 - 1600 nm	8163A and 81633A or 8153A and 81536A
Optical Attenuator	Wavelength 1200 - 1600 nm, Range 0 - 30 dB	8156A option 100 or 8157A
Spectrum Analyzer	Frequency >11 GHz Resolution BW 10 Hz	8562EC
Optical Coupler	1310 and 1550nm compatible, 10 and 90% outputs.	15744C
O/E Converter	Wavelength 1300 to 1560nm, DC to 15 Gb/s. Conversion Gain >300 volts/watt.	11982A
Function Generator	Sine Output 500 kHz 50 ohm	33250B or 33120A
FC/PC Optical Interface Connector	Unique	81000FI (Qty 4)
Optical Cables	Unique	1005-0337 (Qty 2)
PDH/DSn Structured test set	Unique	OmniBER 718, with option 012 or OmniBER 719 with option 013
Oscilloscope with Communications Mask Kit	>400 MHz BW communications mask measurement kit with appropriate connectors/adaptors. Capability DS1 to STS-3/STM-1e	54830B/54845B/54810A with option 100 (option 100 provides E2625A Communications Mask test kit)
Termination Adaptor Probe	Balanced 110/120 ohms to unbalanced 50 ohms	E2621A (part of E2625A)
Adaptor	75/50 ohms unbalanced	E2622A (part of E2625A)
Adapter	Siemens 3-pin to Bantam	E2623A (part of E2625A)
Patch Cable	Bantam 110 ohms	15670A

1 Performance Tests

Instrument	Critical Specification	Recommended Model
Patch Cable	Siemens 3-pin 120 ohms	15512A
75Ω Termination	0 to 200 MHz	15522-80010
T Connector	BNC to Dual BNC	1250-0781
Adaptor	BNC(m) to SMA(f)	E9632A
Cable	SMA to SMA	8120-4948
Balanced/Unbalanced Converter	110Ω balanced: 75Ω Unbalanced (nominal)	15508B

Self Test Loopback Cables and Accessories

- 1005-0337 1m fiber optic patchcord FC/PC connectors.
- 1005-1148 10 dB optical attenuator FC/PC.
- 1005-0433 15 dB optical attenuator FC/PC.
- 15525A 75 ohm BNC cable, 2 off.
- 15512A Siemens 3-pin cable.
- 15670A Bantam 110 ohm cable.
- J2125-65011 DCC Port 9-pin loopback plug.

Recall Default Settings

The performance tests require the OmniBER OTN to be set to a pre-defined (default) state at the beginning of each test.

- 1 Press **<Menu>**, choose **System > Stored Settings** then press **<Select>**.
- 2 Select **Default** then **Recall**.
- 3 Select **OK**, then wait a few seconds for instrument to reconfigure to the default settings. Recall has completed when the dialog box clears.
- 4 Select **Close** on the Tx/Rx - Stored Settings window.

Performance Self Test

Part of the instrument self test is used for the performance tests. This provides a high degree of confidence that the relevant measurement hardware is operating correctly in advance of completing the performance tests.

NOTE

A full overview of the self test is given later in the manual.

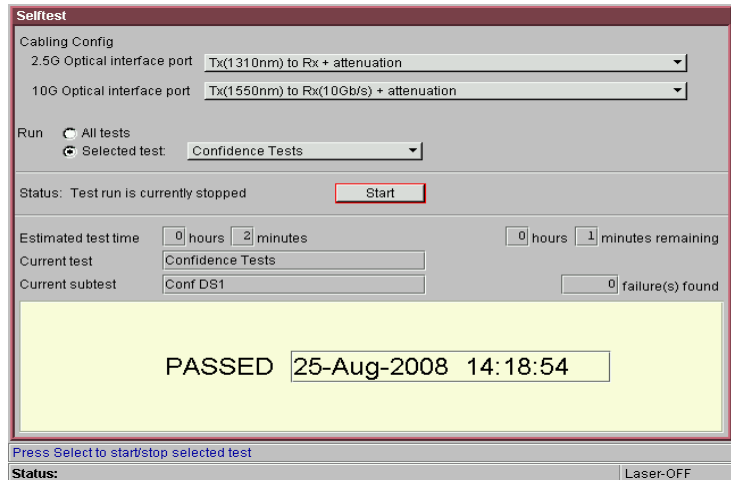
This section gives an description of the self tests that are required to be completed as part of the performance tests and covers the following

- Description of the self tests.
- Loopback connections required for self test
- How to run the self test.
- What to do if the self test fails.

Description of the Performance Self Test

The self test comprises of a selection of tests covering different areas of hardware in the instrument. For the purposes of the Performance self tests, the **Confidence Test** and the **Frequency Measurement Test** should be completed. These are selected from the main self test menu. If a failure occurs during a test then a descriptive text message and Fail Code is returned.

Press <Menu>, choose **System > Self Test** then press <Select>. This opens the self test page. An example is shown below.



Loopback Connections Required for Self Test

The confidence test verifies all the optical and electrical (instruments with Option 012 only) test ports on the unit. Therefore loopback connections are required on the instrument. The following loopback connections are required (see [Figure 1](#) on page 15).

Optical Loopback Connections (Required on all instruments)

Use optical cables P/N 1005-0337 a 10 dB attenuator P/N 1005-1148 and 15 dB attenuator P/N 1005-0433.

- Connect 9.95/10.71 Gb/s Optical Out <> 10 dB Attenuator <> 9.95/10.71 Gb/s Optical In
- Connect 52 Mb/s-2.5 Gb/s Optical Out <> 15 dB Attenuator <> 2.5 Gb/s Optical In

Electrical connections SONET/SDH 52 Mb/s to 155 Mb/s (Instruments with Option 012 only)

Use BNC cable P/N 15525A

- Connect SONET/SDH Out (BNC) <> SONET/SDH In (BNC)

Unbalanced Electrical Connections PDH/DSn 2-140 Mb/s and DS3 (Instruments with Option 012 only)

Use BNC cable P/N 15525A

- Connect 2-140 Mb/s DS3 Out (BNC) <> 2-140 Mb/s DS3 In (BNC)

Balanced Electrical Connections 2M/DS1 (Instruments with Option 500/012 enabled only)

Use Bantam cable P/N 15670A

- Connect 2M/DS1 Out <> 2M/DS1 In

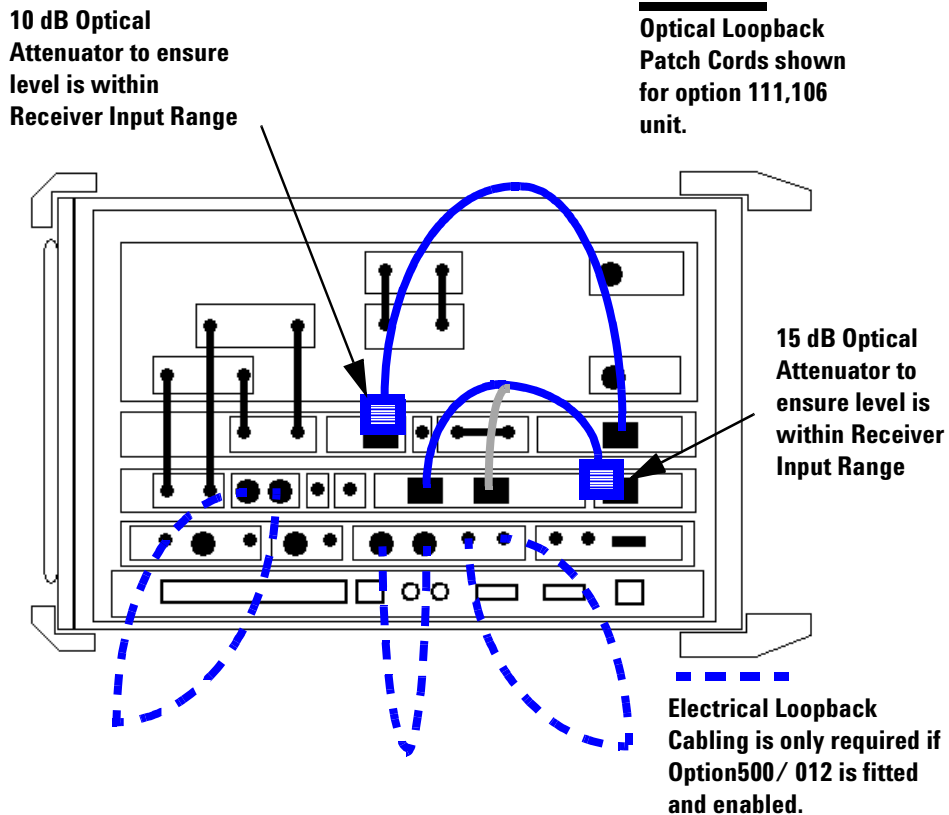


Figure 1 Self Test Loopback Connections

NOTE

Where dual wavelength optical transmitters fitted the self test should be re-cabled and re-run to verify the alternative transmitter's wavelength output. Select the cable configuration from the self test menu as appropriate.

CAUTION

Safety precautions care and connection cleanliness must be observed to ensure that the optical connections are not damaged or degraded. Ensure the recommended optical attenuation is present in all optical loopback connections as failure to do so could cause self test failure or damage to the optical receivers.

How to run the self test

- 1 Press **<Menu>**, choose **System > Self Test** then press **<Select>**.
- 2 Ensure all loopbacks are in place and, from the self test page menu, select the appropriate 1310/1550 nm 2.5 G - 52 M optical loopback Cabling Configuration.
- 3 On the self test page choose **Run Selected Test** and choose **Confidence Test**. Choose **START** to begin the test.
- 4 The self test will now run selecting each sub-test in sequence. The remaining test time to complete the tests is displayed on the right hand side of the self test page.
- 5 If any sub-test fails an error message and error code will be returned. Up to five errors are recorded.
- 6 On the self test page choose **Run Selected Test** and choose **Frequency Measurement**. Choose **START** to begin the test.

Further information on the self test can be obtained in the Self Test Overview section at the rear of this manual.

What to do if the Self Test fails

- 1 Check all connections to make sure that all the correct loopback connections are in place.
- 2 If any of the optical interface tests fail, clean all optical connections with a recognized cleaning kit before retrying the self test.
- 3 If the problem persists then contact your local Agilent Service Office or representative.

Internal Reference Clock Accuracy

Specification

Clock Output	Frequency	Accuracy
2 MHz	2.048 MHz	± 4.5 ppm
DS1 (BITS Clock)	1.544 MHz	± 4.5 ppm

Accuracy of transmitter internal clock:

- Settability ± 0.5 ppm
- Stability ± 3 ppm over temperature range
- Ageing ± 1 ppm/year

NOTE

The 2 MHz output is only available when SDH or En rate is selected on the transmitter. The DS1 output is only available when SONET or T-Carrier rate is selected on the transmitter.

BITS Clock is not a binary format signal. Signal is a Ternary All 1s DS-1 signal with ESF Framing, clocked at 1.544 MHz.

Description

The test uses a frequency counter or DS_n test set connected to the appropriate clock output port. When the transmitter is set to internal clock the reference output is derived from the instrument internal 10 MHz reference which is also used in main signal generation.

An alternative test method using the frequency counter is provided for the DS1 check if a suitable DS_n test set is not available. However, in this case it should be noted that as this signal is a framed all 1s ternary signal the expected result on the frequency counter is offset due to the effect of framing bits in the signal.

Equipment Required

Frequency Counter	Agilent 53181A Option 010,015 (see Note)
DSn Test Set	Agilent 37718C with Option 012
Bantam/Bantam Cable	Agilent 15670A
75/50 ohm Matching Pad	Agilent E2629A
Bal/Unbal Converter	Agilent 15508B

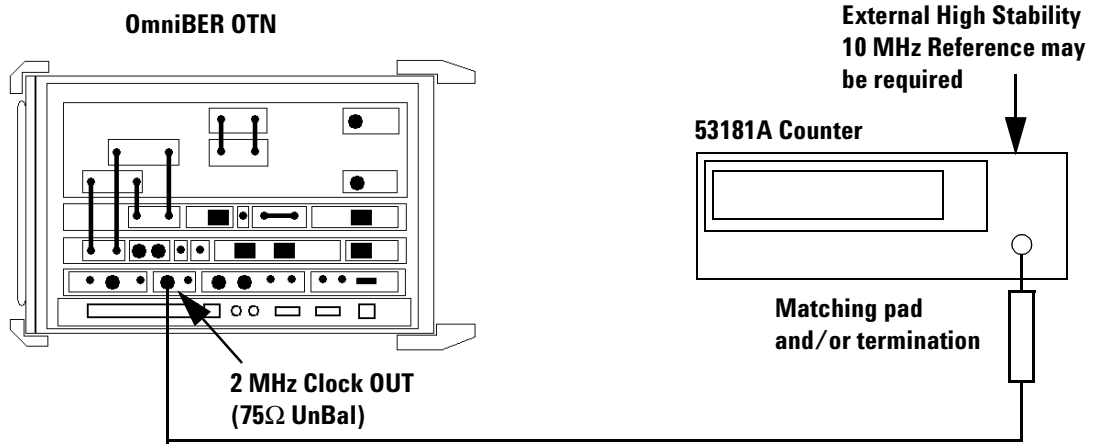
NOTE

For accuracy required the counter **MUST** have high stability Internal Timebase option or be externally referenced to an in-house Standard.

Procedure

- 1 Press **<Menu>**, choose **System > Stored Settings** then press **<Select>**. Select **Default** then **Recall**.
- 2 Press **<Menu>**, choose **Tx/Rx > Transmitter Settings > Physical** then press **<Select>**. Set the **Signal Mode** to **SDH**.
- 3 Connect the OmniBER OTN's 2 MHz Clock Out port to the frequency counter input using a 75/50Ω matching pad, set the input impedance to 50Ω. Alternatively, a 75Ω termination can be used with the input impedance set to 1MΩ.

1 Performance Tests



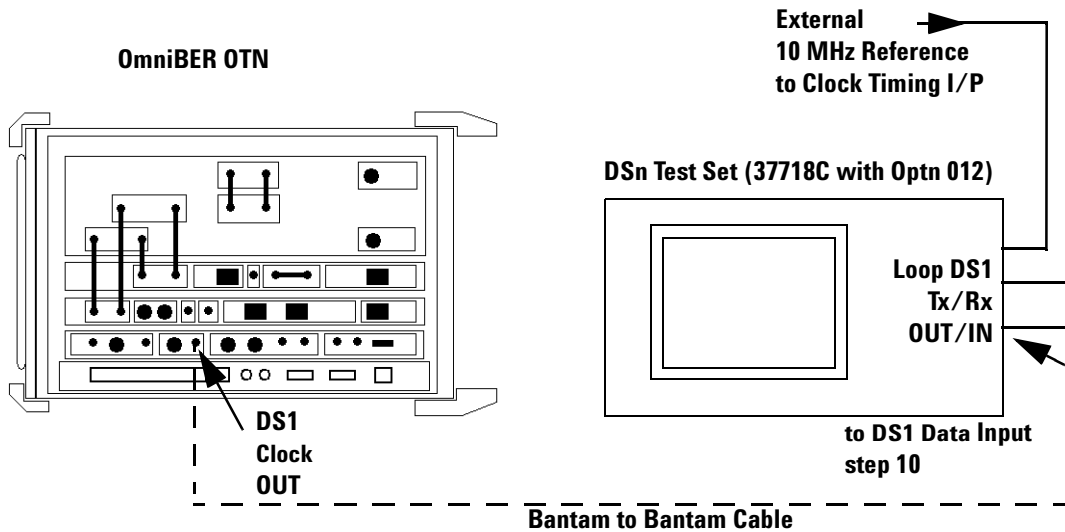
- 4 Adjust the frequency counter trigger level to obtain a stable reading and check that the frequency counter reads between:

2.0479908 MHz and 2.0480092 MHz.

NOTE

The reading should be well within these limits. However, after several years of operation the main reference oscillator may need adjustment optimized to compensate for drift/ageing. If necessary contact your local Agilent Service for advice. Before doing so ensure the counter being used has the appropriate internal/external reference accuracy.

- 5 Press **<Menu>**, choose **Tx/Rx > Transmitter Settings > Physical** then press **<Select>**. Set the **Signal Mode** to **SONET**.
- 6 Connect the DS1 transmit OUT to Receive IN ports of the test set using a Bantam to Bantam cable. Also connect an external 10 MHz Reference signal to the test set 10M CLOCK input port.



7 Setup the test set Settings as follows:

Tx/Rx to COUPLED mode.

SIGNAL to DS1 rate

PAYLOAD TYPE to ESF UNSTRUCTURED

PATTERN to ALL ONES

Set the transmitter CLOCK to EXTERNAL 10 MHz REF

NOTE

This ensures the test set transmitter generates a DS1 signal locked to the external 10 MHz reference signal, e.g. in-house standard. The signal is looped to the test set receiver to take note of the receiver frequency measurement accuracy/error.

8 Check there are no errors or alarms indicated by the test set receiver.

NOTE

If the test set CLOCK LOSS LED is ON check the external reference signal.

- 9** Set the test set to display the frequency measurement and ppm offset results and check these are between:

1543993 and 1544007 Hz.

-4.5 and +4.5 ppm

- 10** Change the test setup as follows. Disconnect the loopback connection between test set tx/rx then connect the OmniBER OTN DS1 clock out port to the test set DS1 receive port using the Bantam to Bantam cable.

- 11** Check there are no errors or alarms indicated by the test set receiver.

- 12** Set the test set to display the frequency offset measurement result and check this is between:

-9 ppm and +9 ppm

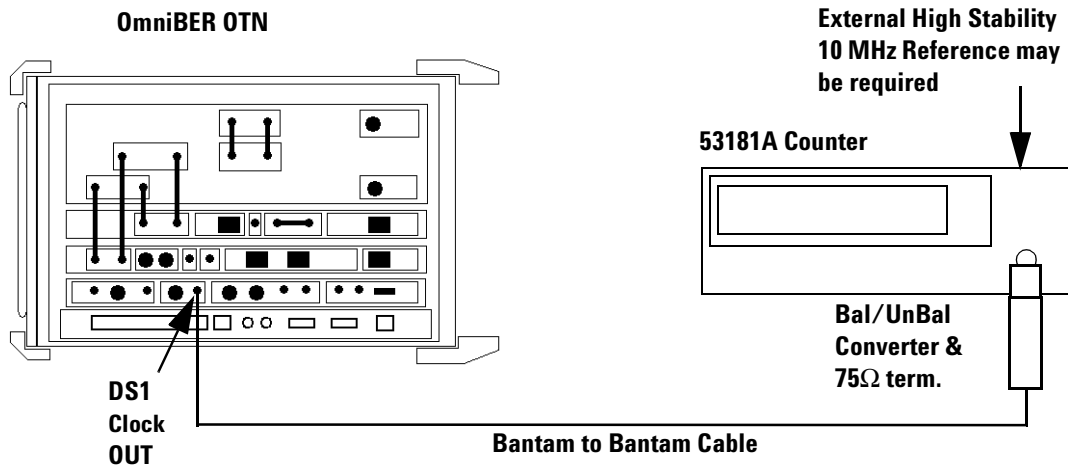
- 13** Subtract the ppm test set error noted in step 9 from the result in step 12 to give the OmniBER OTN transmitter DS1 Bits frequency error in ppm and check this is between:

-4.5 ppm and +4.5 ppm

- 14** Test is now complete.

Alternative DS1 Clock test (if suitable DS_n Test Set is not available)

- 1 Connect the OmniBER OTN's DS1 Clock Out port to the frequency counter input using a 110/75Ω Bal/Unbal converter and 75Ω termination. Set the frequency counter input impedance set to 1MΩ.



NOTE

As the DS1 clock output is a Framed All '1's signal the average frequency measured by the counter will be less than expected, e.g. 1541000 Hz rather than 1544000 Hz due to the effects of framing bits in the signal. The ternary format of the signal can also mean that depending on input attenuation/trigger setting the counter may trigger on exactly half the signal rate e.g. 770500 Hz.

- 2 Adjust the frequency counter trigger level to obtain a stable reading and it will also be necessary to increase the gating time due to the effects of framing bits. Check that the frequency counter reads between:

1.540993 MHz and 1.541007 MHz

- 3 Alternative test is now complete.

External Clock Reference Inputs and Clock Reference Output

Specifications

Clock Rate	Description
2.048 Mb/s MTS	Accepts timing reference as per ITU-T G.703-1998
2.048 MHz Clock	Accepts timing reference as per ITU-T G.703-1998
1.544 Mb/s BITS	Accepts DS-1 timing reference as per TA-TSY-000378

NOTE

The 2 MHz input is only available when SDH or En rate is selected on the transmitter. The DS1 input is only available when SONET or T-Carrier rate is selected on the transmitter.

BITS Clock is not a binary format signal. Signal is a ternary All 1's DS-1 signal with ESF framing, clocked at 1.544 MHz.

Description

The test uses a PDH/DSn test set and a frequency counter connected to the appropriate external clock input and output ports. When the transmitter is set to external clock the reference clock output port timing and signal rate generation is derived from the external clock source.

Equipment Required

Frequency Counter	Agilent 53181A Option 010,015 (see Note)
DSn Test Set	Agilent 37718C with Option 012
Bantam/Bantam Cables (2)	Agilent 15670A
75/50 ohm Matching Pad	Agilent E2629A
Bal/Unbal Converter	Agilent 15508B

NOTE

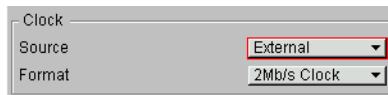
For accuracy required the counter must have high stability internal timebase option or be externally referenced to an in-house standard.

Procedure

(External 2M Clock as Reference)

- 1 Press <Menu>, choose **System > Stored Settings** then press <Select>. Select **Default** the **Recall**.
- 2 Press <Menu>, choose **Tx/Rx > Transmitter Settings > Physical** then press <Select>. Set the **Signal Mode** to **SDH**.

Now set **Clock Source** to **External**, **Format** to **2Mb/s Clock**.

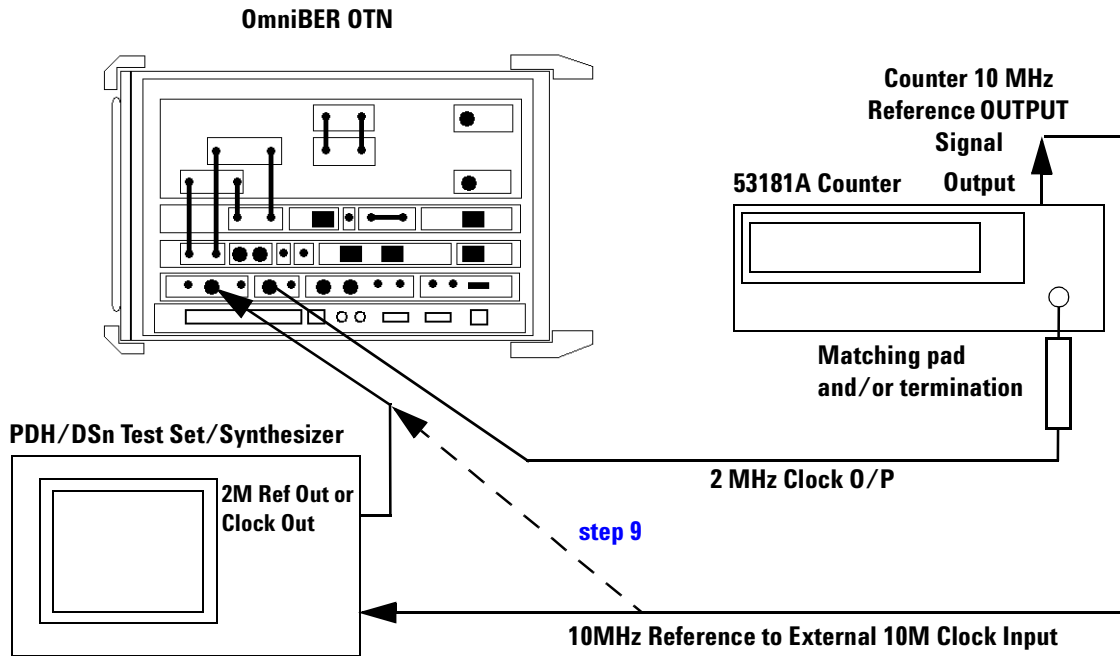


- 3 Connect the OmniBER OTN's 2 MHz clock uut port to the frequency counter input using a 75/50Ω matching pad, set the input impedance to 50Ω. Alternatively, a 75Ω termination can be used with the input impedance set to 1MΩ.

Connect the counter rear panel 10 MHz reference output to the PDH/DSn test set external 10M CLOCK input port.

1 Performance Tests

Connect the PDH/DSn test set CLOCK REF OUT or TRANSMIT CLOCK OUT port to the instrument's CLOCK IN 2MHz BNC port.



- 4 Set the PDH/DSn test set transmitter as follows.
SIGNAL to 2 Mb/s rate
CLOCK to EXTERNAL 10 MHz REF
- 5 Check that the PDH/DSn test set CLOCK LOSS Alarm Led is not lit.
- 6 Adjust the frequency counter trigger level to obtain a stable reading and check that the frequency counter reads between:
2.047999999 MHz and 2.048000001 MHz.

- 7 Confirm that the OmniBER OTN is locked to the external signal by disconnecting/re-connecting the BNC cable at the instrument CLOCK IN port

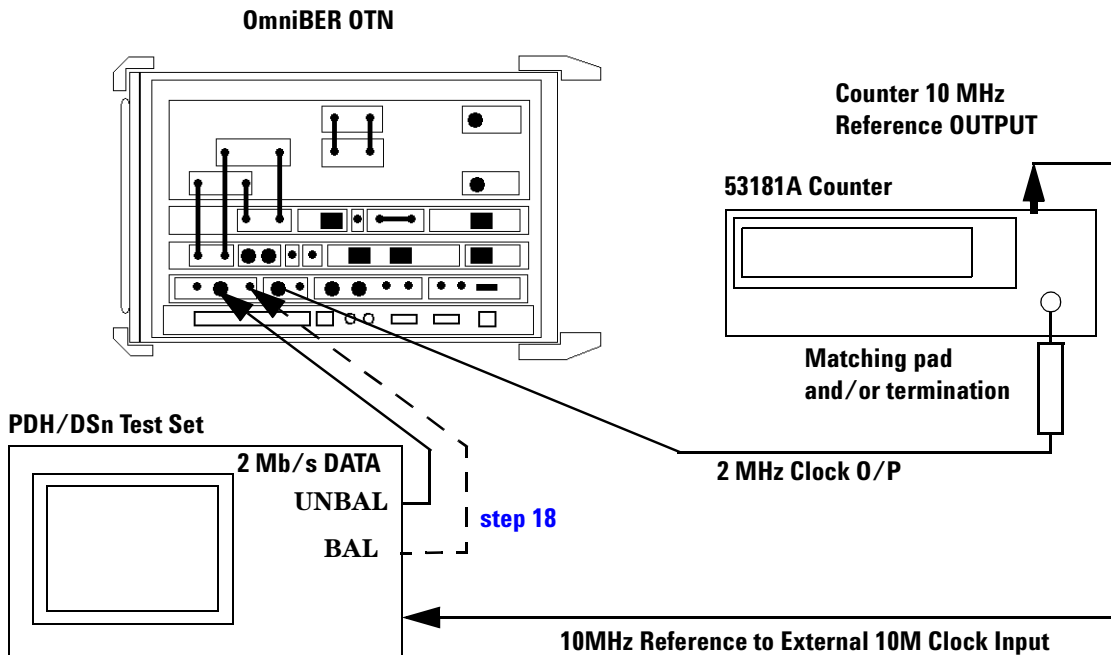
(External 10M Clock as Reference)

- 8 Now set the instrument to **External Clock, 10M Ref.**
- 9 Disconnect the 10M Reference signal from the PDH/DSn test set and connect it directly to the OmniBER OTN as shown in the diagram above.
- 10 Repeat [step 5](#) through [step 7](#)

(External 2M Unbalanced Data as Reference)

- 11 Re-connect as in the diagram below.
- 12 Change the OmniBER OTN **External Clock, Format** setting to **2 Mb/s Data**.
- 13 Change the 2 MHz CLOCK OUT connection at the PDH/DSn test set to connect the transmit 2 Mb/s DATA out BNC to the OmniBER OTN CLOCK IN BNC port.

1 Performance Tests



14 Ensure the PDH/DSn test set transmitter is set as follows.

SIGNAL to 2 Mb/s rate

CLOCK to EXTERNAL 10 MHz REF

TERMINATION to 75 ohm UNBAL

LINE CODE to HDB3

PAYLOAD TYPE to UNFRAMED

PATTERN to 2^{23} PRBS

15 Check that the test set CLOCK LOSS alarm LED is not lit.

16 Adjust the frequency counter trigger level to obtain a stable reading and check that the frequency counter reads between:

2.047999999 MHz and 2.048000001 MHz

- 17** Confirm that the OmniBER OTN is locked to the external signal by disconnecting/re-connecting the BNC cable at the OmniBER OTN CLOCK IN port.

(External 2M Balanced Data as Reference)

- 18** Change the setup as follows. Disconnect and remove the test set to OmniBER OTN (BNC to BNC) signal connection. Connect a Bantam to Bantam balanced cable between the test set data OUT port and OmniBER OTN CLOCK IN port. (A 3-pin Siemens to Bantam adapter/cable may be required depending on the test set's connector option)
- 19** Change the test set transmit TERMINATION to 120 ohm BALANCED.
- 20** Check that the test set CLOCK LOSS Alarm Led is not lit.
- 21** Adjust the frequency counter trigger level to obtain a stable reading and check that the frequency counter reads between.

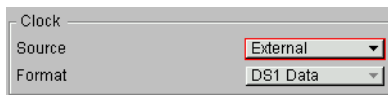
2.047999999 MHz and 2.048000001 MHz

- 22** Confirm that the OmniBER OTN is locked to the external signal by disconnecting/re-connecting the BNC cable at the OmniBER OTN CLOCK IN port.

(External DS1 Balanced Data as Reference)

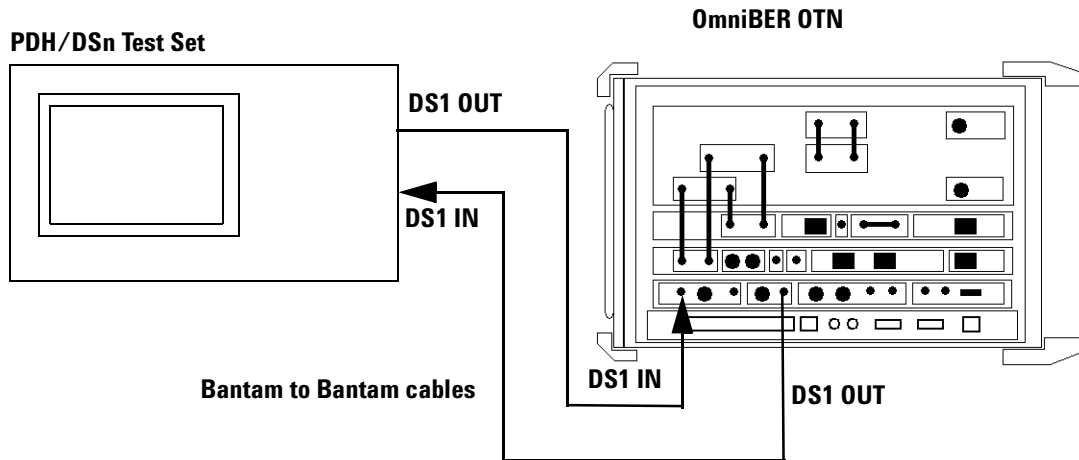
- 23** Press <Menu>, choose **Tx/Rx > Transmitter Settings > Physical** then press <Select>. Set the **Signal Mode** to **SONET**.

Now set **Clock Source** to **External**, **Format** to **DS1 Data**.



- 24** Connect the test set DS1 transmit OUT port to the OmniBER OTN Clock IN DS1 port using a Bantam cable. Connect the OmniBER OTN's DS1 Clock Out port to the test set DS1 Receiver IN using a Bantam cable.

1 Performance Tests



25 Set the PDH/DSn test set as follows:

TRANSMIT/RECEIVE settings to COUPLED

SIGNAL to DS1 rate

CLOCK to INTERNAL

OUTPUT LEVEL to DSX-1

LINE CODE to B8ZS

PAYLOAD TYPE to ESF UNSTRUCTURED

PATTERN to ALL ONES

26 Check there are no errors or alarms detected by the test set receiver

27 Set the test set to Frequency Measurement Results and check that the displayed frequency is between:

1543999 Hz and 1544001Hz

28 Confirm that the OmniBER OTN is locked to the external signal by disconnecting/re-connecting the BNC cable at the OmniBER OTN CLOCK IN port.

29 Test is now complete.

Optical Pulse Mask and Output Characteristics

Specifications

Optical Output Power

1310 nm	
1550 nm (<=2.5 Gb/s)	-2.5 to +4 dBm *
1550 nm (9.95/10.71 Gb/s)	-1 to +2 dBm *

* Typical transmit power level is in the middle of the stated range.

Extinction ratio	>8.2 dB
-------------------------	---------

Pulse mask	Meets ITU-T G-957 (6/1999) and Telcordia GR-253-CORE Issue 3 (9/2000)
-------------------	---

Description

This test ensures the optical transmitter(s) output power level and waveform meet the required eye mask, extinction ratio and average power specifications. The transmitter output is connected to an optical oscilloscope and the eye compared with the predefined masks stored in the oscilloscope memory. The average signal power levels and extinction ratio are also measured using the oscilloscope.

NOTE

These tests are identical for SONET or SDH modes and can be tested in either mode and should not be repeated for both.

Equipment Required

High Speed Optical Oscilloscope	Agilent Infinium 86100A Mainframe Agilent Infinium 86103A option 201, Optical Plug-in Agilent Infinium 86105A option 202, Optical Plug-in
Optical Attenuator	Agilent 8156A
Optical Patch Cord(s)	Agilent PN 1005-0337
BNC(m) to SMA(f) Adapter	Agilent E9632A
SMA(m) to SMA(m) cable	Agilent PN 8120-4948

Procedure

NOTE

This performance test uses the Infinium 86100A Optical Oscilloscope (DCA) with appropriate optical Plug-in modules and built-in filters. If a different oscilloscope is used refer to the oscilloscope information for Optical Eye Mask measurement.

The OTU-2 pulse mask files may not be available on your oscilloscope. If required these can be obtained from the Agilent.com web site at <http://www.agilent.com/cm/rdmfg/omniber/otn/library> under the heading "Software and Drivers"

52/155 and 622 Mb/s Optical Output Checks

OC-1/STM-0 Power Level and Eye Mask Tests

- 1 Press <Menu>, choose **System > Stored Settings** then press <Select>. Select **Default** then **Recall**.
- 2 Press <Menu>, choose **Tx/Rx > Transmitter Settings > Physical** then press <Select>. Set the **Signal Mode** to **SONET**, the **Signal Rate** to **OC1** and the **Wavelength** **1310 nm** (or if this is not fitted, or already tested, select **1550 nm**). Ensure the **Laser** is set to **OFF**.

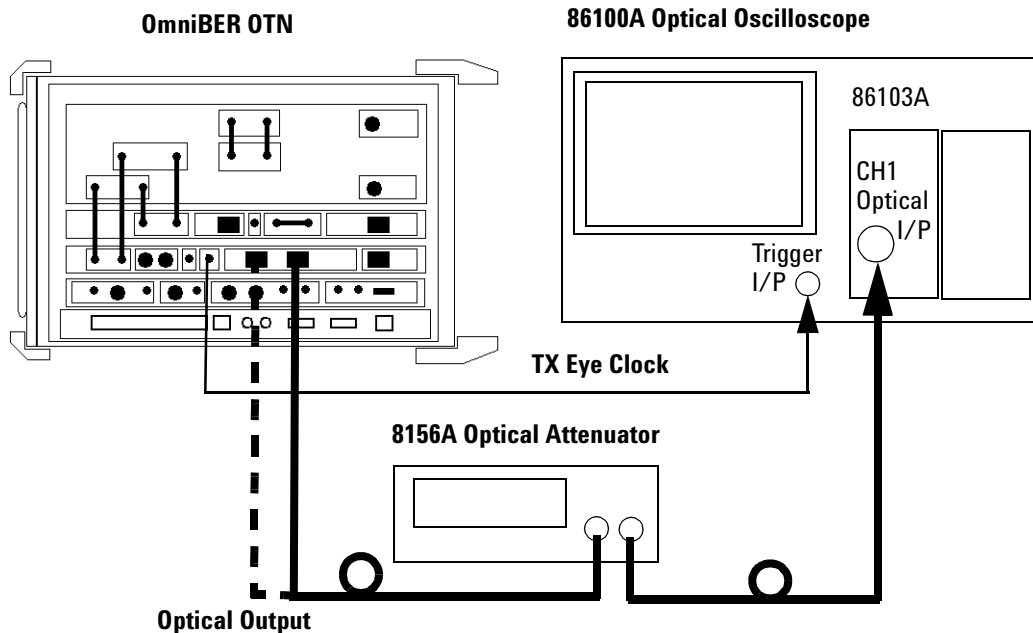
Signal	
Mode	SONET
Rate	OC-1
Line	
Interface	Optical
Wavelength	1310nm
	<input type="checkbox"/> Laser On
Clock	
Source	Internal
Format	DS1 Data

- 3** Connect the **52 Mb/s Optical Out Port** (1310/1550 nm) to the oscilloscope via an optical attenuator. Set the attenuator to provide approximately 6dB attenuation (see Note). Also connect the **TX Eye Clock** (52 Mb/2.5 Gb/s) to the oscilloscope trigger input.

NOTE

Optical signal should be attenuated to ensure specified maximum input for 86103A (-4 dBm) is not exceeded. To ensure this, Set the 8156A to 3 dB, (typical 8156A attenuator insertion loss of approximately 3 dB), giving approximately 6 dB total attenuation.

1 Performance Tests



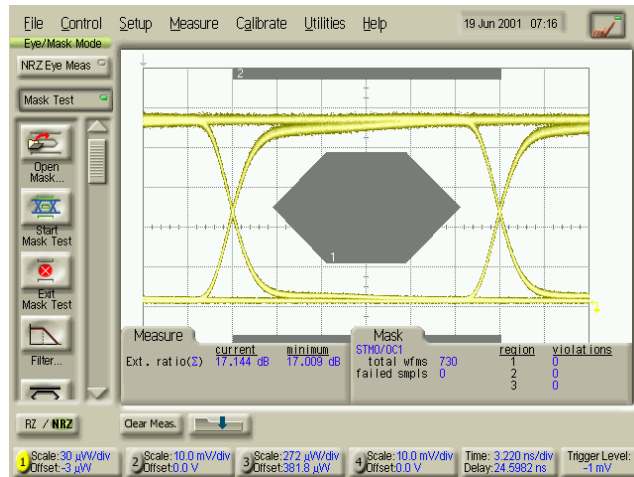
- 4 Set OmniBER OTN **Laser** to **ON** and set optical attenuator to **Enable**.
- 5 On the oscilloscope select **Setup > Channel 1 > Advanced settings**. Switch oscilloscope Channel 1 ON, set it to the correct optical wavelength for the signal being tested and set **Mask Filter** to **OC-3 (156Mb/s)**, **ON**, see Note.

NOTE

Normally an OC-1 filter would be used, however as this may not be available, it is permissible to use the OC-3 Filter for this check. The procedures for higher bit rates using OC-3, OC-12 and OC-48 filters will give confirmation that laser overshoot response is as expected.

- 6 Set all other oscilloscope channels off.
- 7 Select **Eye/Mask Mode**, **Mask Test**. Select **Open Mask** and open the **STM000_OC1.msk**.
- 8 Select oscilloscope **Autoscale** and allow the oscilloscope to find signal and trigger inputs.

- 9 Start **Mask Test** and check that the optical output meets the mask. See example below.



OC-1/STM-0 Eye Mask

- 10 Set the oscilloscope to **Eye Measure** mode and select **Extinction Ratio** measurement.

NOTE

Ensure Vertical Calibration and Extinction Ratio Calibration have been performed for the oscilloscope channel and vertical sensitivity range to ensure measurement accuracy. Refer to oscilloscope information/Help if necessary.

- 11 Check the extinction ratio is greater than **8.2 dB** and record the measured value.

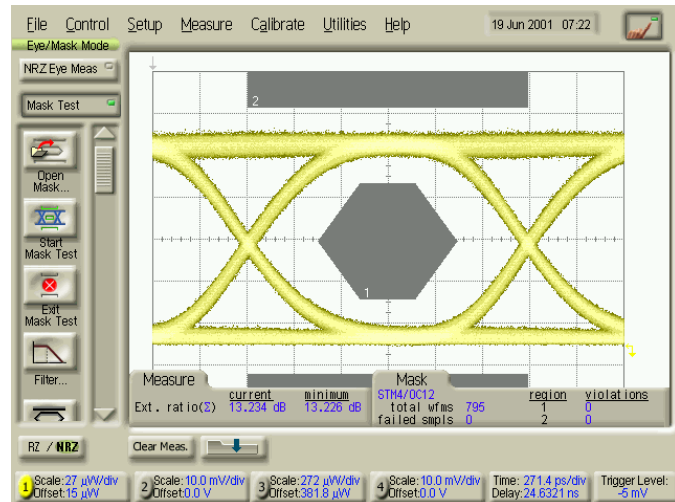
OC-3/STM-1 Power Level and Eye Mask Tests

- 12 Change the OmniBER OTN signal rate. Press **<Menu>**, choose **Tx/Rx > Transmitter Settings > Physical** then press **<Select>**. Set the **Signal Rate** to **OC3**.
- 13 Select **Eye/Mask Mode**, **Mask Test**. Select **Filter** and ensure it is set to **OC-3 (156Mb/s)**, **ON**
- 14 Select **Open Mask** and open the **STM001_OC3.msk**.

- 15 Select oscilloscope **Autoscale** and allow the oscilloscope to find signal and trigger inputs.
- 16 Start **Mask Test** and check the optical output meets the mask. See example on [page 37](#).
- 17 Set the oscilloscope to **Eye Measure** mode and select **Extinction Ratio** measurement.
- 18 Check the extinction ratio is greater than **8.2 dB** and record the measured value.

OC-12/STM-4 Power Level and Eye Mask Tests

- 19 Change the OmniBER OTN signal rate. Press **<Menu>**, choose **Tx/Rx > Transmitter Settings > Physical** then press **<Select>**. Set the **Signal Rate** to **OC12**.
- 20 Select **Eye/Mask Mode, Mask Test**. Select **Filter** and set it to **OC-12 (622Mb/s), ON**
- 21 Select **Open Mask** and open the **STM004_OC12.msk**.
- 22 Select oscilloscope **Autoscale** and allow the oscilloscope to find signal and trigger inputs.
- 23 Start **Mask Test** and check the optical output meets the mask. See example on [page 37](#).
- 24 Set the oscilloscope to **Eye Measure** mode and select **Extinction Ratio** measurement.
- 25 Check the extinction ratio is greater than **8.2 dB** and record the measured value.



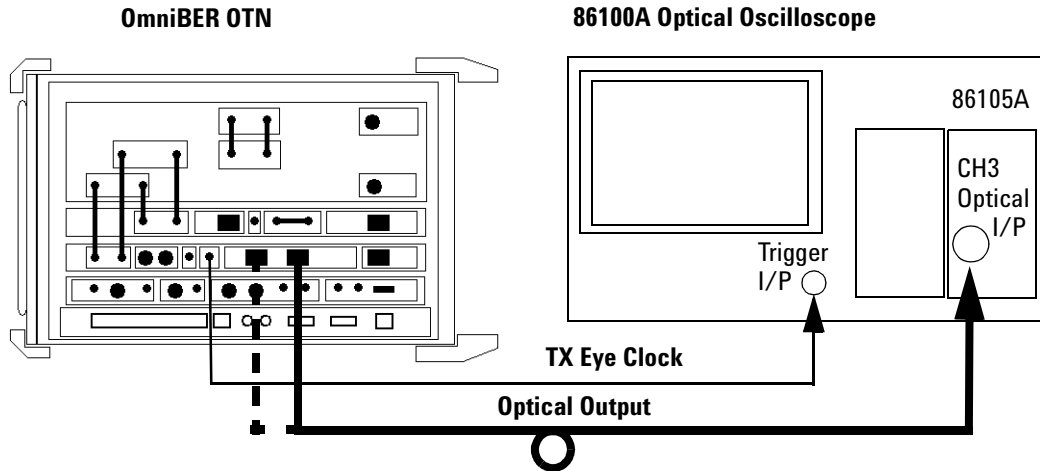
OC-12/STM-4 Eye Mask

2.5 Gb/s Optical Output Checks

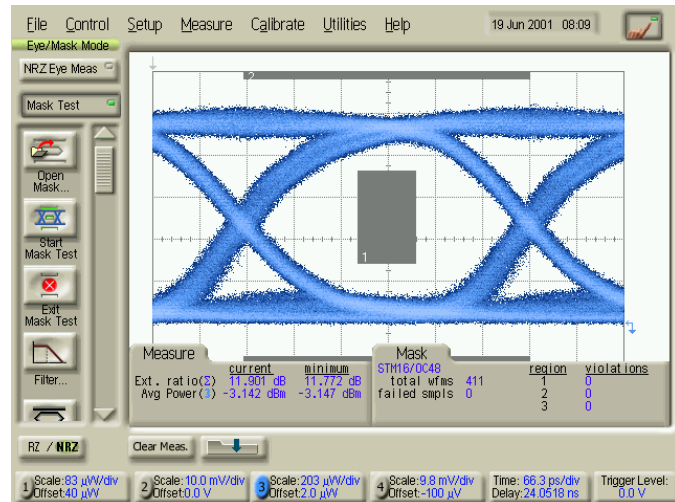
OC-48/STM-16 Power Level and Eye Mask Tests

- 26 Change the OmniBER OTN signal rate. Press **<Menu>**, choose **Tx/Rx > Transmitter Settings > Physical** then press **<Select>**. Set the **Signal Mode** to **SONET** and the **Signal Rate** to **OC48**. Set **Laser** to **OFF**.
- 27 Remove the attenuator from the setup and connect the **2.5 Gb/s Optical Out Port** (1310/1550 nm) directly to the oscilloscope channel 3 input as shown on the next page.

1 Performance Tests



- 28 Set the OmniBER OTN laser to ON.
- 29 On the oscilloscope select **Setup > Channel 3 > Advanced settings**. Switch oscilloscope channel 3 ON, set it to the correct optical wavelength for the signal being tested and set **Mask Filter to OC-48 (2.488Gb/s), ON**,
- 30 Set all other oscilloscope channels off.
- 31 Select **Eye/Mask Mode, Mask Test**. Select **Open Mask** and open the **STM016_OC48.msk**.
- 32 Select oscilloscope **Autoscale** and allow the oscilloscope to find signal and trigger inputs.
- 33 Start **Mask Test** and check the optical output meets the mask. See example on [page 39](#).



OC-48/STM-16 Eye Mask

- 34** Set the oscilloscope to **Eye Measure** mode and setup to measure the **Average Power** (in dBm) and **Extinction Ratio**.

NOTE

Ensure Vertical Calibration and Extinction Ratio Calibration have been performed for the oscilloscope channel and vertical sensitivity range to ensure measurement accuracy. Refer to oscilloscope information/Help if necessary

- 35** Check the average optical power is between:

-2.5 dBm to +4 dBm

- 36** Check the extinction ratio is greater than **8.2 dB** and record the measured value.
- 37** If the instrument has dual wavelength option (1310 and 1550 nm ports) for 51 - 2.5 Gb/s, repeat [step 1](#) through [step 37](#) for the 1550 nm output and use 1550 nm settings as appropriate for oscilloscope channel inputs.

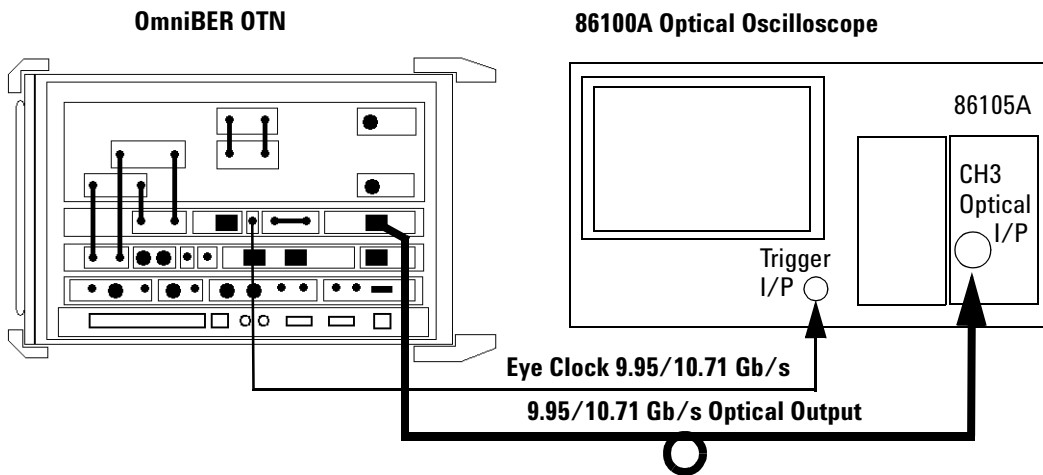
9.95 Gb/s and 10.71 Gb/s Optical Output Checks

OC-192/STM-64 Power Level and Eye Mask Tests

- 1 Press <Menu>, choose **System** > **Stored Settings** then press <Select>. Select **Default** then **Recall**.
- 2 Press <Menu>, choose **Tx/Rx** > **Transmitter Settings** > **Physical** then press <Select>. Set the **Signal Mode** to **SONET** and **Signal Rate** to **OC192**. Ensure the **Laser** is set to **OFF**.

Signal	
Mode	SONET
Rate	OC-192
Line	
Interface	Optical
Wavelength	1550nm
	<input type="checkbox"/> Laser On
Clock	
Source	Internal
Format	DS1 Data

- 3 Connect the **9.95/10.71 Gb/s Optical Out** port to the oscilloscope using an optical patch cord. Also connect the **TX Eye Clock** (9.95/10.71 Gb/s) to the oscilloscope trigger input as shown.



- 4 Set the OmniBER OTN **Laser** to **ON**.
- 5 On the oscilloscope select **Setup > Channel 3 > Advanced settings**. Set it to the correct optical wavelength for the signal being tested and set **Mask Filter** to **OC-192 (9.95Gb/s)**, **ON**,
- 6 Select **Eye/Mask Mode, Mask Test**. Select **Open Mask** and open the **STM064_OC192.msk**.
- 7 Select oscilloscope **Autoscale** and allow the oscilloscope to find signal and trigger inputs.
- 8 Start **Mask Test** and check the optical output meets the "[OC-192/STM-64 Eye Mask](#)" on page 42
- 9 Set the oscilloscope to **Eye Measure** mode and setup to measure the **Average Power** (in dBm) and **Extinction Ratio**.

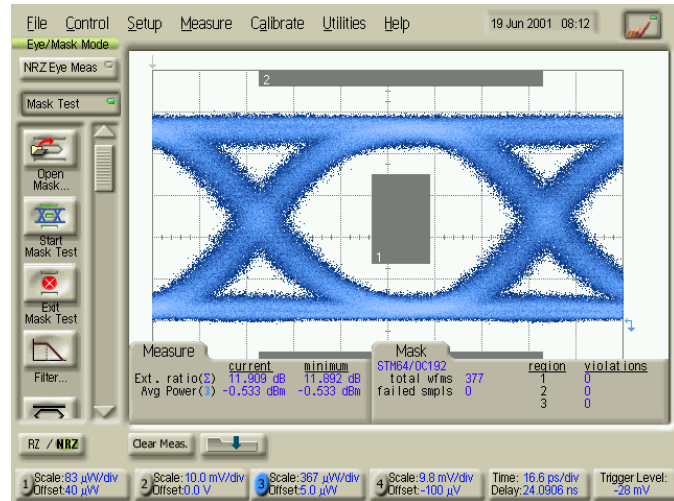
NOTE

Ensure vertical calibration and extinction ratio calibration have been performed for the oscilloscope channel and vertical sensitivity range to ensure measurement accuracy. Refer to oscilloscope information/Help if necessary.

- 10 Check the average optical power is between **-1 to +2 dBm**.

1 Performance Tests

- 11 Check the extinction ratio is greater than **8.2 dB** and record the measured value.



OC-192/STM-64 Eye Mask

10.71 Gb/s (OTU-2) Power Level and Eye Mask Tests (Option 112 only)

- 12 Set the transmitter display as shown below.

Press <Menu>, choose **Tx/Rx > Transmitter Settings > Physical** then press <Select>. Set the **Signal Mode** to **OTN** and the **Signal Rate** to **OTU-2**.

Signal	
Mode	OTN
Rate	OTU2
Line	
Interface	Optical
Wavelength	1550nm
	<input type="checkbox"/> Laser On
Clock	
Source	Internal
Format	DS1 Data

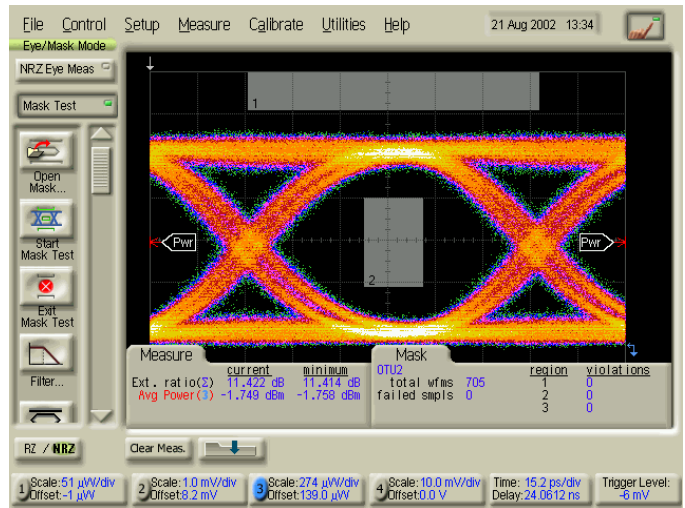
- 13** Ensure the OmniBER OTN **Laser** is **ON**.
- 14** Select **Eye/Mask Mode**, **Mask Test**. Select **Filter** and ensure it is set to **OC-192 (9.95Gb/s)**, **ON**
- 15** Change the mask to OTU-2.
- 16** Select oscilloscope **Autoscale** and allow the oscilloscope to find signal and trigger inputs
- 17** Start **Mask Test** and check the optical output meets the OTU-2 mask on [page 44](#).
- 18** Set the oscilloscope to **Eye Measure** mode and setup to measure the **Average Power** (in dBm) and **Extinction Ratio**.

NOTE

Ensure Vertical Calibration and Extinction Ratio Calibration have been performed for the oscilloscope channel and vertical sensitivity range to ensure measurement accuracy. Refer to oscilloscope information/Help if necessary.

- 19** Check the average optical power is between **-1 to +2 dBm**. Check the extinction ratio is greater than **8.2 dB** and record the measured value.
- 20** Tests are now complete. Set the Laser to OFF before disconnecting setup.

1 Performance Tests



OTU-2 Eye Mask

Optical Receiver Sensitivity, Optical Power and Frequency Measurement

Specifications

Min. sensitivity (1):

52/155 Mb/s	-34 dBm
622 Mb/s	-28 dBm
2.5 Gb/s	-28 dBm
9.95 Gb/s	-18 dBm
10.71 Gb/s	-16 dBm

Max. input power (1):

52/155 Mb/s	-10 dBm
622 Mb/s	-8 dBm
2.5 Gb/s	-9 dBm
9.95 Gb/s	-9 dBm
10.71 Gb/s	-9 dBm

1. For 52 Mb/s – 2.5 Gb/s the Min. sensitivity quoted is for BER = 1×10^{-10} (input signal extinction ratio = 8.2 dB).

For 9.95 Gb/s & 10.71 Gb/s the Min. sensitivity quoted is for BER = 1×10^{-12} (input signal extinction ratio = 8.2 dB).

Optical power measurement

Supported for all optical receive rates.

Ranges:

10 Gb/s: -3dBm to -25 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.

2.5 Gb/s: ± 2 dB.

622 Mb/s and below: ± 1 dB.

Resolution: 0.1 dB.

Line frequency measurement

Supported for all optical and electrical receive rates.

Results: Frequency (MHz), Offset (Hz and ppm).

Accuracy: ± 4.5 ppm.

Resolution:

Frequency: 0.01 kHz (up to 622 Mb/s),

0.1 kHz.(2.5 Gb/s and 10 Gb/s).

Offset: 0.1 ppm.

NOTE

The rates and wavelengths available are dependent on the OmniBER OTN options fitted.

Description

The transmitter output is attenuated and set for appropriate level using an external Power meter. The receiver sensitivity is verified using the attenuated transmitter output and checking for no errors in back-to-back mode. Checks of the receiver operation at Operating Max and Min levels is performed. The receiver optical power and frequency measurements are also checked during these tests.

Sensitivity measurements are affected by the Extinction Ratio of the laser used in the test. Receiver sensitivity specifications are quoted for worst case, that is minimum laser extinction ratio specification. A table is provided at the end of these tests to check the typical additional receiver sensitivity expected against the extinction ratio of the laser used in test.

NOTE

- These tests are identical for SONET or SDH modes and can be tested in either mode and should not be repeated for both.
 - Always set the Laser to OFF before changing optical output port connections.
 - It is most important that advice on optical cleanliness is adhered to ensure accuracy of these tests and to prevent damage to optical interfaces
-

Equipment Required

Power Meter	Agilent 8163A
Power Meter Sensor Module	Agilent 81633A
Optical Attenuator	Agilent 8156A
FC/PC Connector Interface (qty 4)	Agilent 81000FI
Optical Cables (qty 2)	Agilent PN 1005-0337

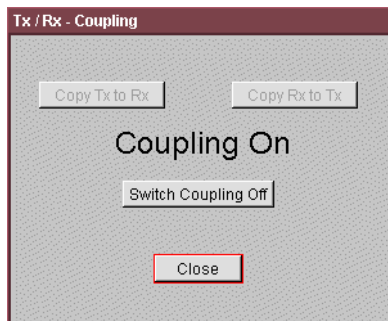
WARNING

Safety precautions must be observed when handling the OmniBER OTN's Optical Modules as these generate laser signals which can cause serious injury. The guidelines below must be followed:

- Check the connector configuration of the Fiber Optic Interfaces. If non FC/PC connectors are fitted then remove them, then fit the FC/PC connector interface.
- Check for any damage to the OmniBER OTN's Fiber Optic Interface spring loaded aperture covers and connectors. Do not power up the instrument if in any doubt about the integrity of these connectors.

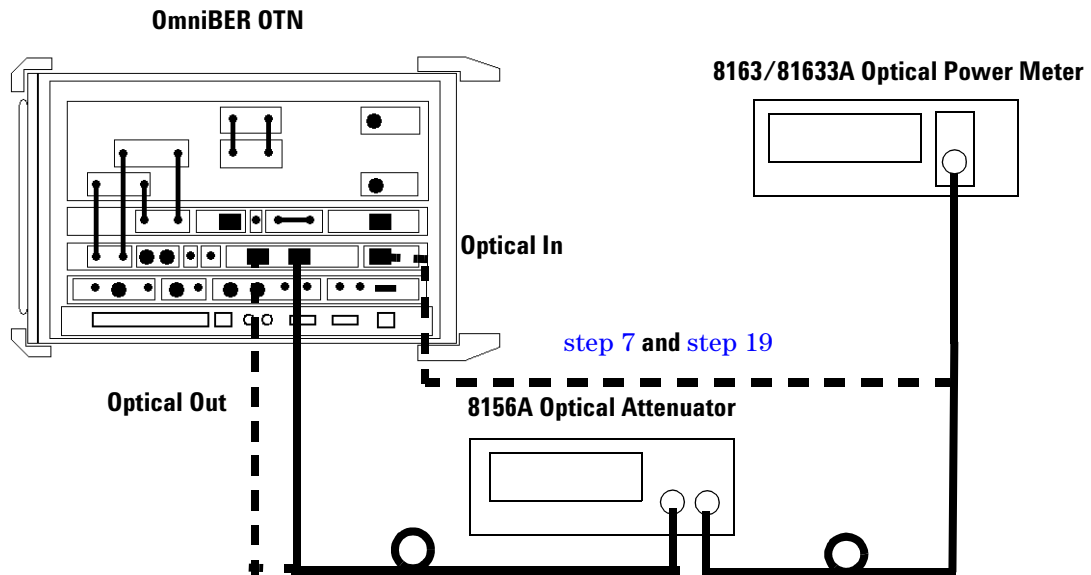
Procedure**OC-1/STM-0 and OC-3/STM-1 Rates**

- 1 Press <Menu>, choose **System > Stored Settings** then press <Select>. Select **Default** then **Recall**.
- 2 Press <Menu>, choose **Tx/Rx > Coupling** then press <Select>. Select **Copy Tx to Rx**.



- 3 Connect the test set-up as shown below depending on the wavelengths installed.

1 Performance Tests



4 Set the optical attenuator to:

ATTEN 15 dB

WAVELENGTH 1310 nm (or 1550 nm depending on wavelength used)

CAL=0

ENB ON

Set the optical power meter to:

WAVELENGTH 1310 nm (or 1550 nm depending on wavelength used)

Connect the optical attenuator between the Power Meter and the OmniBER OTN's **Optical Out** port (ensure that all connections are tight and that the cable has no twists).

- 5 Press <Menu>, choose **Tx/Rx > Transmitter Settings > Physical** then press <Select>. Set the **Signal Mode** to **SONET** and **Signal Rate** to **OC1**, **Wavelength 1310 nm** (or if this is not fitted, select **1550 nm**). Ensure the **Laser** is set to **ON**. Check the laser LED is illuminated at the selected Output Port on the OmniBER OTN's connector panel.

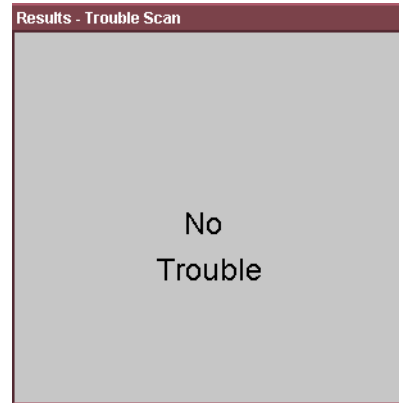
Signal	
Mode	SONET
Rate	OC-1
Line	
Interface	Optical
Wavelength	1310nm
	<input checked="" type="checkbox"/> Laser On
Clock	
Source	Internal
Format	DS1 Data

- 6 Adjust the optical attenuator to obtain a reading of -33 dBm on the power meter (that is, the receiver minimum sensitivity for 52/155 Mb/s rates). Take note of the attenuator setting.
- 7 Set the optical attenuator to Disable mode.

Note, do not switch off the OmniBER OTN laser.

Disconnect the optical attenuator output from the power meter and connect to the OmniBER OTN's **Optical IN** port (52–622 Mb/s). Ensure all optical connectors are clean and all connections are tight with no twists in the optical cable. Set the optical attenuator to enable.

- 8 Press <Smart Test>, choose **Shortcuts > Trouble Scan** then press <Select>. Press <Run/Stop> to begin measurement.
- 9 After 1 minute check that '**No Trouble**' is displayed in the Results window to confirm no errors have been detected.



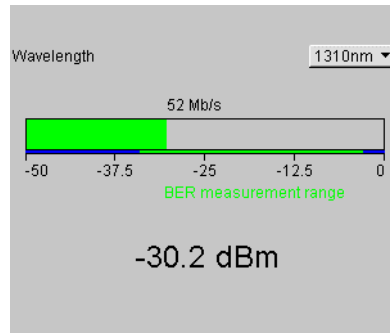
- 10 Add more attenuation by increasing the optical attenuator setting to find the point just before the occurrence of errors. This can be done by observing the Errors LED while adjusting attenuator. Record the additional attenuation setting (typically this will be at least 1 dB). Press **<Run/Stop>** to stop measurement.
- 11 Set the optical attenuator to the setting noted in [step 6](#), then reduce setting by a further 3 dB (that is, providing -30 dBm output).

Set the OmniBER OTN's receiver to display **Optical Power** as follows:

Press **<Smart Test>**, choose **Shortcuts > Optical Power** then press **<Select>**. Set **Wavelength** to 1310/1550 nm as appropriate.

Check that the optical power measurement reads between:

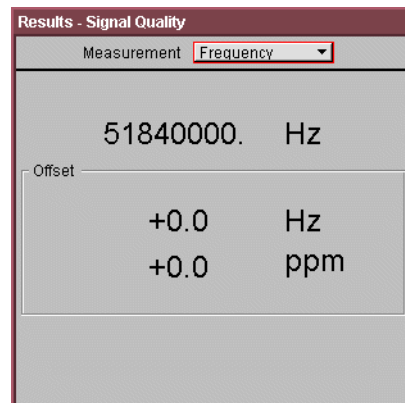
-31 dBm and -29 dBm



Press <Smart Test>, choose **Shortcuts > Frequency Measurement** then press <Select>. The OmniBER OTN now displays the received frequency results.

Check that the frequency measurement reads between:

51.83999 and 51.84001 MHz for [STM-0 OPT] or [OC-1]
(155.51999 and 155.52001 MHz for [STM-1 OPT] or [OC-3])



12 Reduce the optical attenuator setting by a further 20 dB and check the receiver **Optical Power** result is between:

-11 dBm and -9 dBm

- 13** Press <Smart Test>, choose **Shortcuts > Trouble Scan** then press <Select>. Press <Run/Stop> to begin measurement.

After 1 minute check that ‘**No Trouble**’ is displayed in the Results window to confirm no errors have been detected.

Press <Run/Stop> to stop measurement.

- 14** Disable the optical attenuator then disconnect the optical signal from the OmniBER OTN **Optical IN** port and connect to the power meter. Re-enable the optical attenuator.

- 15** Check the power meter reading is between:

-10.5 dBm and -9.5 dBm

- 16** Repeat [step 4](#) through [step 15](#), substituting SIGNAL RATE [OC-3] in [step 5](#).

OC-12/STM-4 Rate

- 17** Set the OmniBER OTN transmitter to provide OC-12 output with PRBS bulk payload as follows:

Press <Menu>, choose **Tx/Rx > Transmitter Settings > Physical** then press <Select>. Set the **Signal Rate** to **OC12, Wavelength 1310 nm** (or if this is not fitted, select **1550 nm**). Ensure the **Laser** is set to **ON**.

Check the laser LED is illuminated at the selected output port.

Ensure the optical attenuator and optical power meter are set for the wavelength being used.

- 18** Adjust the optical attenuator to obtain a reading of -28 dBm on the power meter (that is, the receiver minimum sensitivity for 622 Mb/s rates). Take note of the attenuator setting.

- 19** Set the optical attenuator to Disable mode.

Note: do not switch OFF the OmniBER OTN laser.

Disconnect the optical attenuator Output from the power meter and connect to the OmniBER OTN’s **Optical IN** Port (51–622 Mb/s). Ensure all optical connectors are clean and all connections are tight with no twists in the optical cable. Set the optical attenuator to Enable.

- 20** Ensure the OmniBER OTN is set to **TX>RX Coupled Mode**.
- 21** Press **<Smart Test>**, choose **Shortcuts > Trouble Scan** then press **<Select>**. Press **<Run/Stop>** to begin measurement.
- After 1 minute check that **'No Trouble'** is displayed in the Results window to confirm no errors have been detected.
- 22** Increase the optical attenuator setting to find the point just before the occurrence of errors by observing the Errors LED while adjusting attenuator. Record the additional attenuation setting. (typically, this will be at least 1 dB). Press **<Run/Stop>** to stop measurement.
- 23** Re-set the optical attenuator to the setting noted in [step 18](#). (providing -28 dBm output)

Set the OmniBER OTN's Receiver to display **Optical Power**. Press **<Smart Test>**, choose **Shortcuts > Optical Power** then press **<Select>**. Set **Wavelength** to 1310/1550 nm as appropriate and check that the optical power measurement reads between:

-29 dBm and -27 dBm

Set the OmniBER OTN's receiver to display **Frequency** and check that the frequency measurement reads between:

622.07999 MHz and 622.08001 MHz

- 24** Decrease the optical attenuator setting by a further 20 dB and check the receiver **Optical Power** result is between:
- 9 dBm and -7 dBm**
- 25** Press **<Smart Test>**, choose **Shortcuts > Trouble Scan** then press **<Select>**. Press **<Run/Stop>** to begin measurement.
- After 1 minute check that **'No Trouble'** is displayed in the Results window to confirm no errors have been detected.
- Press **<Run/Stop>** to stop measurement.
- 26** Disable the optical attenuator then disconnect the optical signal from the OmniBER OTN **Optical IN** port and connect to the power meter. Re-enable the optical attenuator.
- 27** Check the power meter reading is between:

-8.5 dBm and -7.5 dBm

OC-48/STM-16 Rates

1 Press <Menu>, choose **System > Stored Settings** then press <Select>. Select **Default** then **Recall**.

2 Set the optical attenuator to:

ATTEN 15 dB

WAVELENGTH 1550 nm (or 1310 nm depending on wavelength used)

CAL=0

ENB ON

Set the optical power meter to

WAVELENGTH 1550 nm (or 1310 nm depending on wavelength used)

Connect the optical attenuator between the power meter and the OmniBER OTN's **Optical Out** port (ensure that all connections are tight and that the cable has no twists).

3 Set the OmniBER OTN transmitter to provide OC-48 output with PRBS bulk payload as follows:

Press <Menu>, choose **Tx/Rx > Transmitter Settings > Physical** then press <Select>. Set the **Signal Mode** to **SONET** and **Signal Rate** to **OC48, Wavelength 1550 nm** (or if this is not fitted, select **1310 nm**). Ensure the **Laser** is set to **ON**.

Check the laser LED is illuminated at the selected output port.

4 Adjust the optical attenuator to obtain a reading of -28 dBm on the power meter (that is, the receiver minimum sensitivity for 2.5 Gb/s rate). Take note of the attenuator setting.

5 Set the optical attenuator to Disable mode.

Note: do not switch off the OmniBER OTN laser.

Disconnect the optical attenuator Output from the Power Meter and connect to the OmniBER OTN's **Optical IN** Port (2.5 Gb/s). Ensure all optical connectors are clean and all connections are tight with no twists in the optical cable. Set the optical attenuator to Enable.

- 6 Set the OmniBER OTN to **TX>RX Coupled Mode**.
- 7 Press **<Smart Test>**, choose **Shortcuts > Trouble Scan** then press **<Select>**. Press **<Run/Stop>** to begin measurement.

After 1 minute check that **'No Trouble'** is displayed in the Results window to confirm no errors have been detected.

- 8 Increase the optical attenuator setting to find the point just before the occurrence of errors by observing the Errors LED while adjusting attenuator. Record the additional attenuation setting. (typically, this will be at least 1 dB). Press **<Run/Stop>** to stop measurement.
- 9 Re-set optical attenuator to the setting noted in [step 4](#) (providing -28 dBm output)

Set the OmniBER OTN's Receiver to display **Optical Power**. Press **<Smart Test>**, choose **Shortcuts > Optical Power** then press **<Select>**. Set **Wavelength** to 1310/1550 nm as appropriate, and check that the optical power measurement reads between:

-30 dBm and -26 dBm

Set the OmniBER OTN's Receiver to display **Frequency** and check that the frequency measurement reads between:

2488.3199 MHz and 2488.3201 MHz

- 10 Reduce the optical attenuator setting by a further 20 dB and check the Receiver **Optical Power** result is between:

-10 dBm and -6 dBm

- 11 Press **<Smart Test>**, choose **Shortcuts > Trouble Scan** then press **<Select>**. Press **<Run/Stop>** to begin measurement.

After 1 minute check that **'No Trouble'** is displayed in the Results window to confirm no errors have been detected.

Press **<Run/Stop>** to stop measurement.

1 Performance Tests

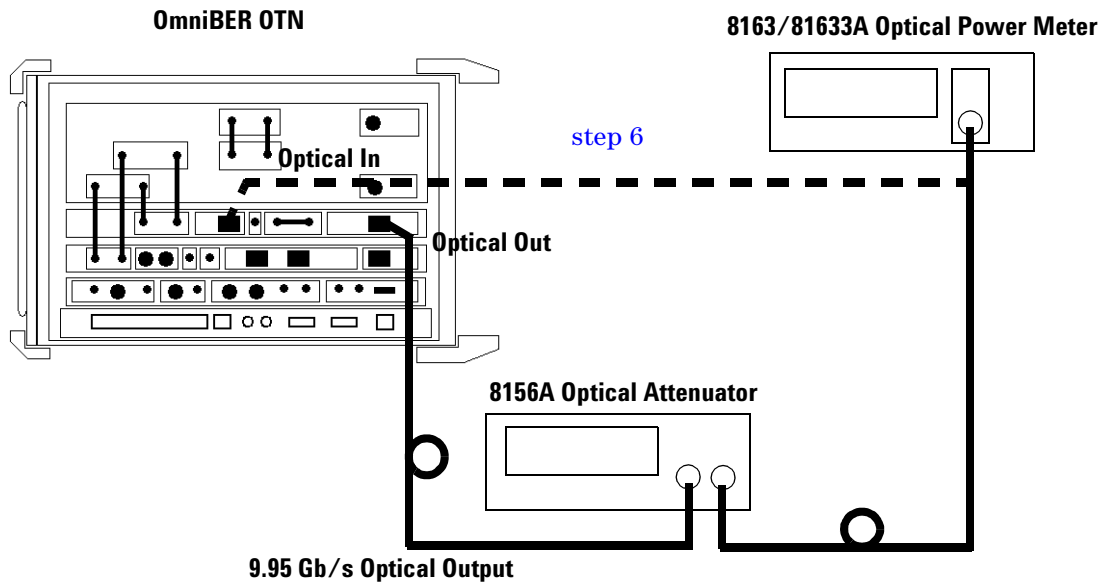
12 Disable the optical attenuator then disconnect the optical signal from the OmniBER OTN **Optical IN** port and connect to the Power Meter. Re-enable the optical attenuator.

13 Check the Power Meter reading is between:

-8.5 dBm and -7.5 dBm

OC-192/STM-64 Rate

- 1 Press <Menu>, choose **System > Stored Settings** then press <Select>. Select **Default** then **Recall**.
- 2 Connect the test setup as shown below.



- 3 Set the optical attenuator to:

ATTEN 15 dB

WAVELENGTH 1550 nm

CAL=0

ENB ON

Set the optical power meter to

WAVELENGTH 1550 nm

Connect the optical attenuator between the Power Meter and the OmniBER OTN's **Optical Out** port (ensure that all connections are tight and that the cable has no twists).

- 4 Set the OmniBER OTN transmitter to provide OC-192 output with PRBS bulk payload as follows:

Press **<Menu>**, choose **Tx/Rx > Transmitter Settings > Physical** then press **<Select>**. Set the **Signal Mode** to **SONET** and the **Signal Rate** to **OC192**. Ensure the **Laser** is set to **ON**.

Check the laser LED is illuminated at the 9.95/10.71 Gb/s optical Out Port.

- 5 Adjust the optical attenuator to obtain a reading of -18 dBm on the Power Meter (that is, the Receiver minimum sensitivity for 9.95 Gb/s rate). Take note of the Attenuator setting.
- 6 Set the optical attenuator to Disable mode.

Note: do not switch OFF the OmniBER OTN laser.

Disconnect the optical attenuator Output from the Power Meter and connect to the OmniBER OTN's **Optical IN** Port (9.95/10.71 Gb/s). Ensure all optical connectors are clean and all connections are tight with no twists in the optical cable. Set the optical attenuator to Enable.

- 7 Set the OmniBER OTN to **TX>RX Coupled Mode**.
- 8 Press **<Smart Test>**, choose **Shortcuts > Trouble Scan** then press **<Select>**. Press **<Run/Stop>** to begin measurement.

After 1 minute check that **'No Trouble'** is displayed in the Results window to confirm no errors have been detected.

- 9 Increase the optical attenuator setting to find the point just before the occurrence of errors by observing the Errors LED while adjusting attenuator. Record the additional attenuation setting. (typically, this will be at least 1 dB).

Press **<Run/Stop>** to stop measurement.

- 10 Re-set optical attenuator to the setting noted in [step 5](#) (providing -18 dBm output).

Set the OmniBER OTN's Receiver to display **Optical Power** and check that the optical power measurement reads between:

-19.5 dBm and -16.5 dBm

Set the OmniBER OTN's Receiver to display **Frequency** and check that the frequency measurement reads between:

9953.2799 MHz and 9953.2801 MHz

- 11** Reduce the optical attenuator setting by 11 dB and check the Receiver **Optical Power** result is between:

-8.5 dBm and -5.5 dBm

- 12** Press <**Smart Test**>, choose **Shortcuts > Trouble Scan** then press <**Select**>. Press <**Run/Stop**> to begin measurement.

After 1 minute check that '**No Trouble**' is displayed in the Results window to confirm no errors have been detected. Press <**Run/Stop**> to stop measurement.

- 13** Disable the optical attenuator then disconnect the optical signal from the OmniBER OTN **Optical IN** port and connect to the Power Meter. Re-enable the optical attenuator.

- 14** Check the Power Meter reading is between:

-8.5 dBm and -5.5 dBm

10.71 Gb/s Rate (Option 112 Only)

- 15** Set the OmniBER OTN transmitter to provide an OTN output with PRBS bulk payload as follows:

Press <**Menu**>, choose **Tx/Rx > Transmitter Settings > Physical** then press <**Select**>. Set the **Signal Mode** to **OTN**. Ensure the **Laser** is set to **ON**.

Check the laser LED is illuminated at the 9.95/10.71 Gb/s optical out port.

- 16** Adjust the optical attenuator to obtain a reading of -18 dBm on the Power Meter (that is, the Receiver minimum sensitivity for the 10.71 Gb/s rate). Take note of the Attenuator setting.

- 17** Set the optical attenuator to Disable mode.

Note, do not switch OFF the OmniBER OTN laser.

Disconnect the optical attenuator Output from the Power Meter and connect to the OmniBER OTN's **Optical IN** Port (9.95/10.71 Gb/s). Ensure all optical connectors are clean and all connections are tight with no twists in the optical cable. Set the optical attenuator to Enable.

18 Ensure the OmniBER OTN to **TX>RX Coupled Mode**.

19 Press **<Smart Test>**, choose **Shortcuts > Trouble Scan** then press **<Select>**. Press **<Run/Stop>** to begin measurement.

After 1 minute check that **'No Trouble'** is displayed in the Results window to confirm no errors have been detected.

20 Increase the optical attenuator setting to find the point just before the occurrence of errors by observing the Errors LED while adjusting attenuator. Record the additional attenuation setting. (typically, this will be at least 1 dB).

Press **<Run/Stop>** to stop measurement.

21 Re-set optical attenuator to the setting noted in [step 16](#) (providing -16dBm).

Set the OmniBER OTN's Receiver to display **Optical Power** and check that the optical power measurement reads between:

-17.5 dBm and -14.5 dBm

Set the OmniBER OTN's Receiver to display **Frequency** and check that the frequency measurement reads between:

1070.9224 MHz and 1070.9226 MHz

22 Reduce the optical attenuator setting by 9 dB and check the Receiver **Optical Power** result is between:

-8.5 dBm and -5.5 dBm

23 Press **<Smart Test>**, choose **Shortcuts > Trouble Scan** then press **<Select>**. Press **<Run/Stop>** to begin measurement.

After 1 minute check that **'No Trouble'** is displayed in the Results window to confirm no errors have been detected. Press **<Run/Stop>** to stop measurement.

24 Disable the optical attenuator then disconnect the optical signal from the OmniBER OTN **Optical IN** port and connect to the Power Meter. Re-enable the optical attenuator.

25 Check the Power Meter reading is between:

-8.5 dBm and -5.5 dBm

26 Test Complete. Set Laser to OFF before disconnecting Set-up.

Checking the Receiver Minimum Sensitivity Margin Against Laser Transmitter Extinction Ratio (ER).

The transmitter lasers used in the tests have extinction ratio significantly better than the minimum (ER) specification. The table below gives correction factors for a range (ER) values to check the additional receiver sensitivity measured in tests.

Using the extinction ratio results from the **Optical Pulse Mask and Output Characteristics** tests for the laser used confirm the typical 'additional' margin measured in sensitivity tests exceed values in table.

Extinction Ratio measured in Optical Pulse Mask and Output Characteristics Test	Additional Sensitivity
> 8.2 dB to 9 dB	>0.4 dB
> 9 dB to 10 dB	>0.6 dB
> 10 dB to 12 dB	>0.93 dB
> 12 dB to 15 dB	>1.05 dB
> 15 dB to 20 dB	>1.2 dB

1 Performance Tests

Electrical Pulse Mask and Output Level Characteristics (Option 012 Only)

Specifications

Rate	Level	Waveshape
DSX-1	2.4V - 3.6V	Fits Mask T1.102-1993
DS1-LO	As DSX-1 with 655 ft ABAM cable	
DS3-HI	0.9 V pk (nominal)	
DSX-3	560 mV pk (nominal)	Fits Mask T1.102-1993
DS3-900	330mV pl (nominal)	
2 Mb/s Balanced	3.00 V pk (nominal)	As per ITU rec G.703
2 Mb/s Unbalanced	2.37 V pk (nominal)	As per ITU rec G.703
8 Mb/s Unbalanced	2.37 V pk (nominal)	As per ITU rec G.703
34 Mb/s Unbalanced	1.0 V pk (nominal)	As per ITU rec G.703
140 Mb/s Unbalanced	1.0 V \pm 0.1 V pk to pk	As per ITU rec G.703
STSX-1 (450 ft)	530 mV pk (nominal)	Compliant with GR-253 Issue 3& ITU-R F.750 Appendix 1
STS-1- HI	1 V pk (nominal)	
STS-1-LO (900 ft)	300 mV pk (nominal)	
STM-0e	1.1 V \pm 0.1 V pk	
STS-3/STM-1e	0.5 V \pm 0.05 pk	As per ITU rec G.703

Description

This test ensures the electrical transmitter output level and pulse shape meet the required specifications. The transmitter output is connected to an oscilloscope and the waveshape compared with the predefined masks stored in the oscilloscope memory. The signal levels are also measured using the oscilloscope.

Equipment Required

Oscilloscope	54810A with Option 100 Communication Mask Kit (E2625A)
Patch Cable	15512A Siemens 3 pin
Patch Cable	15670A Bantam 110 ohm
Adapter	E2621A Termination Adapter Probe

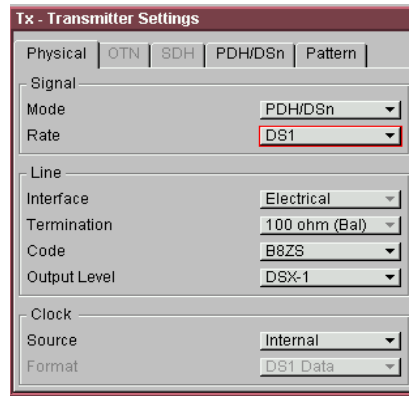
Procedure

NOTE

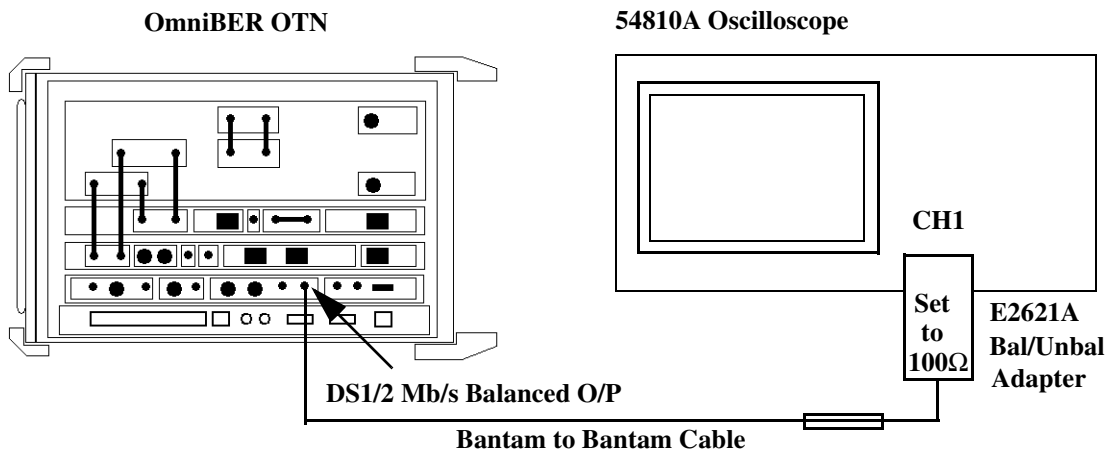
This performance test uses the Infinium 54810A Oscilloscope with Option 100 (E2625A) Telecom Masks Template Kit. If any other Oscilloscope is used refer to the scope information for Mask measurement. It is assumed the appropriate Masks are installed in the Infinium.

DS1 Output Mask Test

- 1 Recall the OmniBER OTN's default settings as shown on "[Recall Default Settings](#)" on page 12.
- 2 Press <Menu>, select Tx/Rx > **Transmitter Settings** and set the **Signal Mode** to **PDH/DSn**. Now set the **Signal Rate** to **DS1** as shown in the example below.



- 3 Connect the OmniBER OTN's **DS1/2 Mb/s OUT** port to the Oscilloscope using the E2621A Termination Adapter Probe, set probe switch to **100Ω**.



1 Performance Tests

- 4 Load the **DS1_ANSI.msk** test mask and run the mask test. Check the Positive and Negative pulses are within the mask (see examples).

NOTE

To test Negative pulse set the Scope **Mask Test Setup** panel to **Invert Mask**.



DSX-1 Positive Pulse



DSX-1 Negative Pulse

- 5 Check the DSX-1 pulse amplitudes are between 2.4-3.6V pk.
- 6 Set the instrument Output Level to DS-1-LO and check that the Pulse Output Amplitude decreases by approximately 20% and pulse shape has slower rise/fall edges.

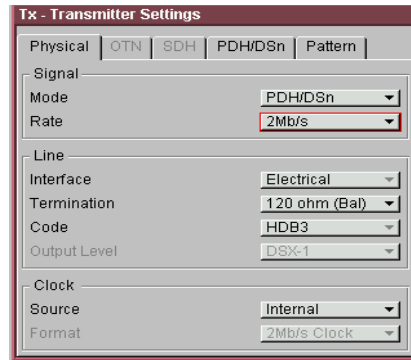
NOTE

The DS1-LO Pulse mask test is not applicable to step 6 and the check is included to provide a functional confirmation of the LO selection.

2 Mb/s Balanced Output Mask Tests

- 1 Press <Menu>, select **Tx/Rx** > **Transmitter** and set the **Signal Mode** to **PDH/DSn**. Now set the **Signal Rate** to **2Mb/s**, and **Termination** to **120 ohm (Bal)** and also set E2621A Termination Adapter Probe to 120 ohn.

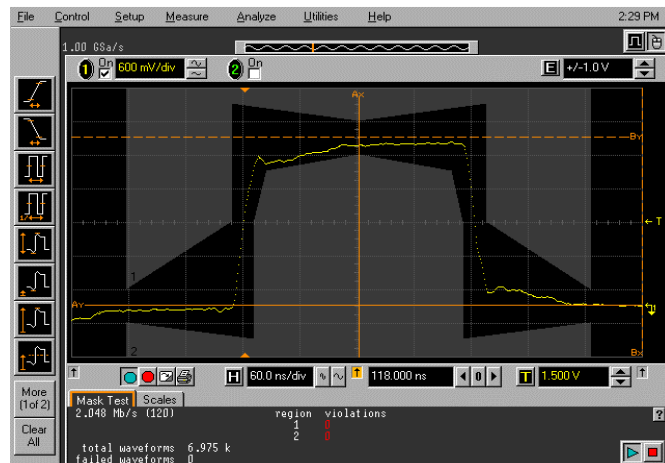
1 Performance Tests



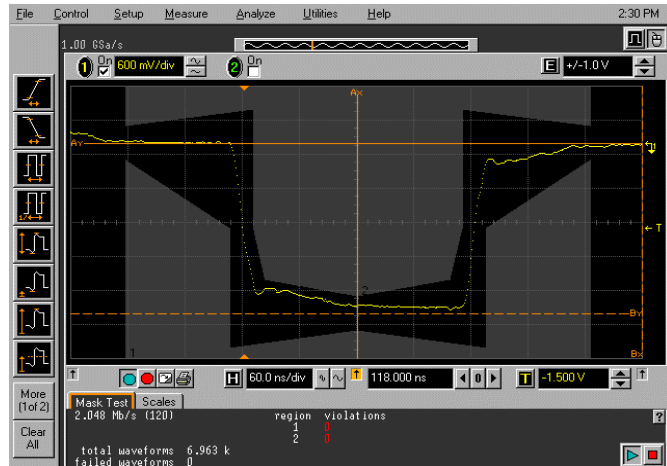
- 2 Load the **2Mb_ITU_120.msk** test mask and check the Positive and Negative pulses are within the mask (see examples).

NOTE

To test Negative pulse set the Scope **Mask Test Setup** panel to **Invert Mask**.



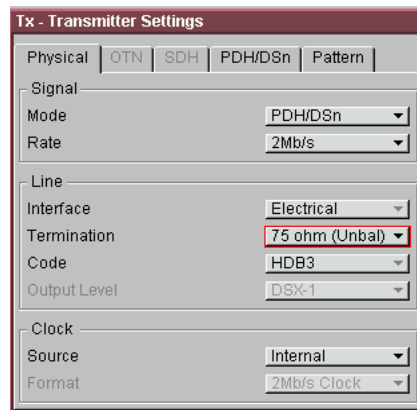
2M Balanced Positive Pulse



2M Balanced Negative Pulse

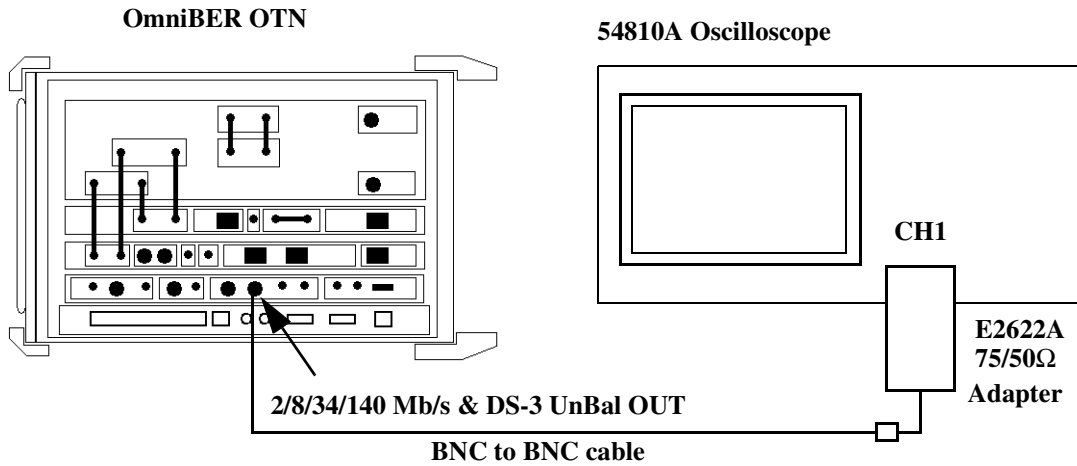
2 Mb/s Unbalanced Output Mask Tests

- 1 Press <Menu>, select Tx/Rx > **Transmitter** and set the **Signal Mode** to PDH/DSn. Now set the **Signal Rate** to 2Mb/s, **Termination 75 ohms (Unbal)**..



- 2 Connect the **2 Mb/s BAL OUT** port to the Oscilloscope CHAN 1, using the E2622A Termination Adapter Probe.

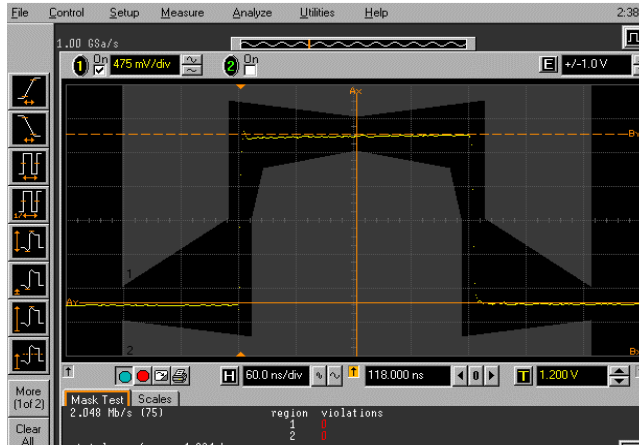
1 Performance Tests



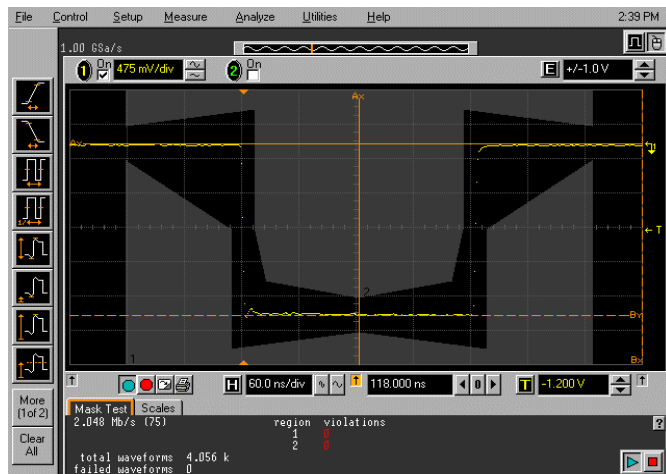
- 3 Load the **2Mb_ITU_75.msk** test mask and check the Positive and Negative pulses are within the mask (see examples).

NOTE

To test Negative pulse set the Scope **Mask Test Setup** panel to **Invert Mask**



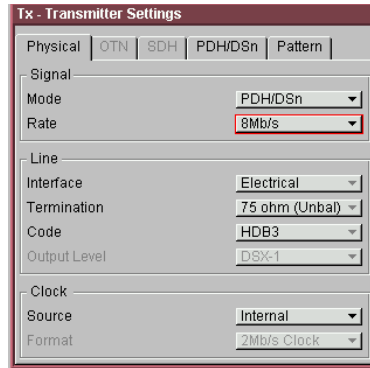
2M Unbalanced Positive Pulse



2M Unbalanced Negative Pulse

8 Mb/s Output Mask Tests

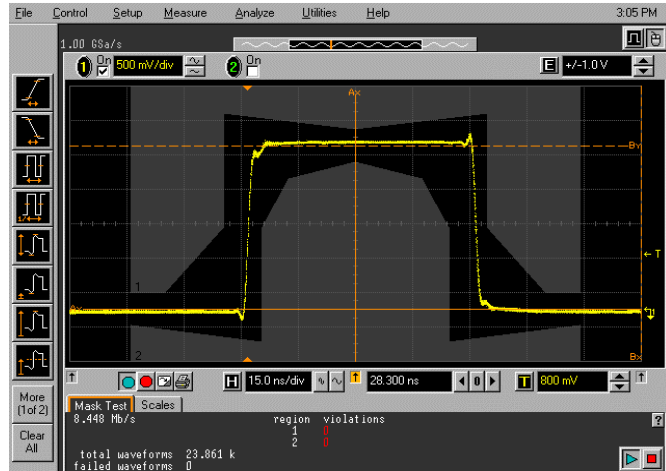
- 1 Press <Menu>, select **Tx/Rx > Transmitter Settings** and set the **Signal Mode** to **PDH/DSn**. Now set the **Signal Rate** to **8 Mb/s**.



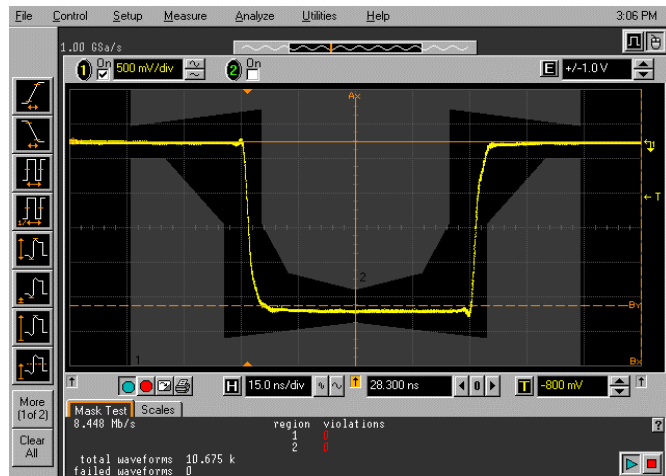
- 2 Load the **8Mb_ITU.msk** test mask and check the Positive and Negative pulses are within the mask (see examples).

NOTE

To test Negative pulse set the Scope **Mask Test Setup** panel to **Invert Mask**



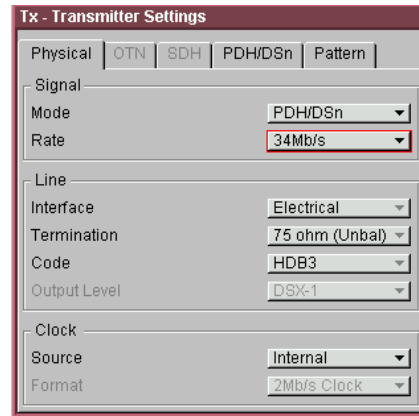
8M Unbalanced Positive Pulse



8M Unbalanced Negative Pulse

34 Mb/s Output Mask Tests

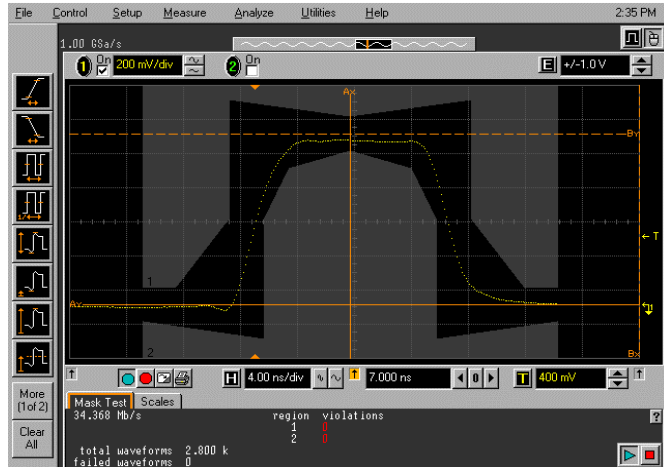
- 1 Press <Menu>, select **Tx/Rx > Transmitter Settings** and set the **Signal Mode** to **PDH/DSn**. Now set the **Signal Rate** to **34 Mb/s**.



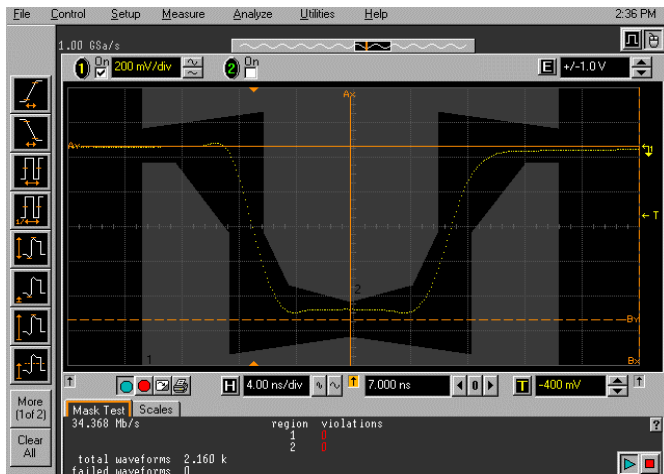
- 2 Load the **34Mb_ITU.msk** test mask and check the Positive and Negative pulses are within the mask (see examples).

NOTE

To test Negative pulse set the Scope **Mask Test Setup** panel to **Invert Mask**



34M Unbalanced Positive Pulse

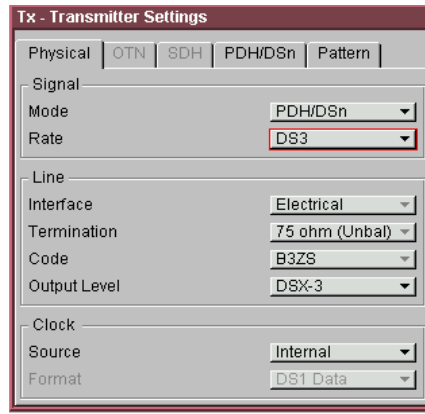


34M Unbalanced Negative Pulse

DSX-3 Output Mask Tests

- 1 Press <Menu>, select Tx/Rx > **Transmitter Settings** and set the **Signal Mode** to PDH/DSn. Now set the **Signal Rate** to DS3.

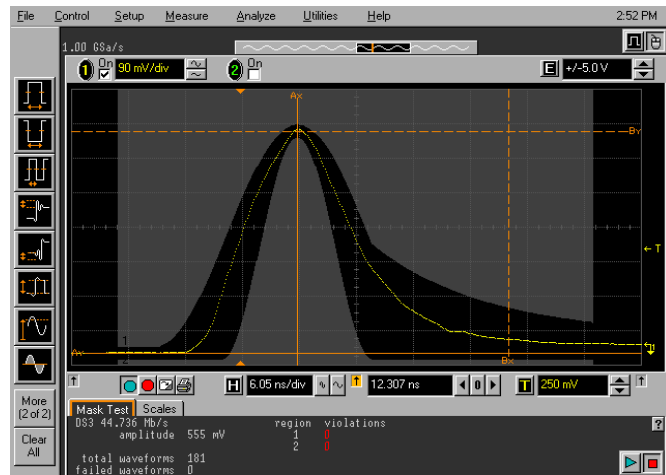
1 Performance Tests



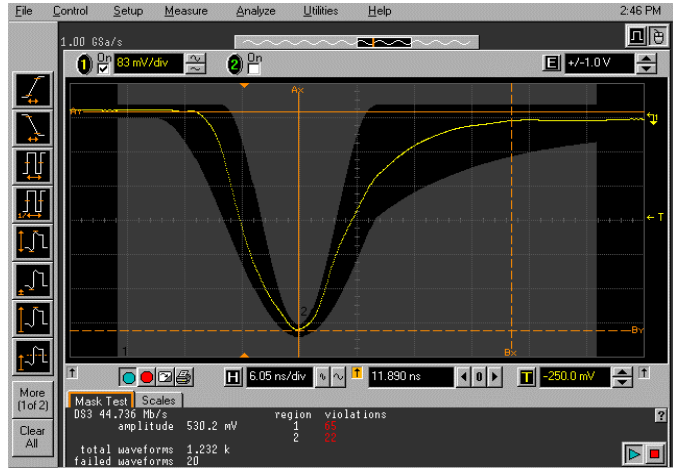
- 2 Load the **DS3_ANSI.msk** test mask and check the Positive and Negative pulses are within the mask (see examples).

NOTE

To test Negative pulse set the Scope **Mask Test Setup** panel to **Invert Mask**



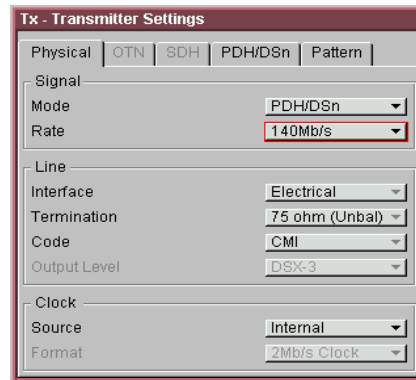
DSX-3 Positive Pulse



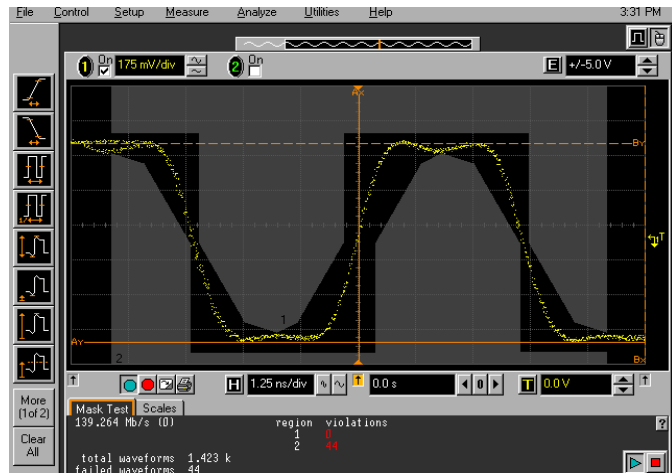
DSX-3 Negative Pulse

140 Mb/s Output Mask Tests

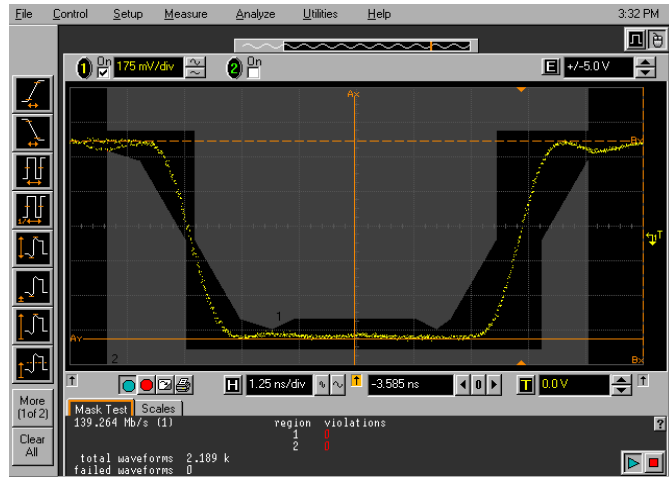
- 1 Press <Menu>, select **Tx/Rx > Transmitter Settings** and set the **Signal Mode** to **PDH/DSn**. Now set the **Signal Rate** to **140 Mb/s**..



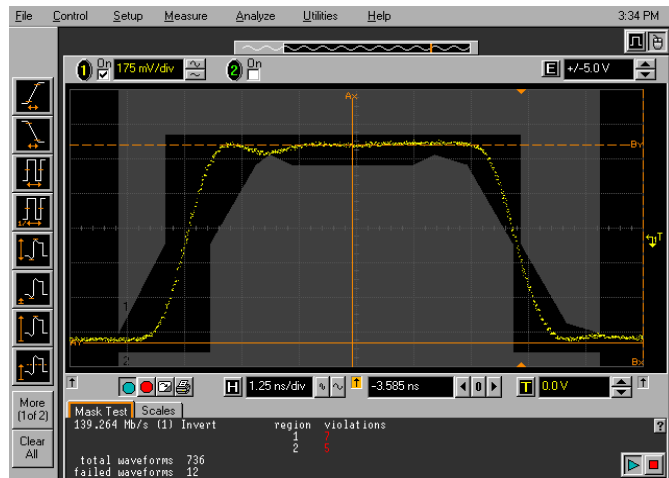
- 2 Load the **140Mb_ITU_0.msk**, **140Mb_ITU_1.msk** and **140Mb_ITU_1_INV.msk** test masks and check each of the pulses are within the mask (see examples).



140Mb/s All Zeros Mask Test



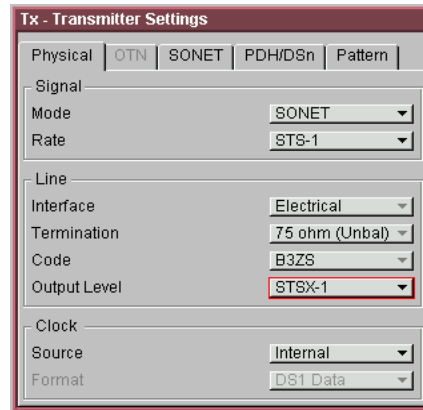
140Mb/s All Ones Mask Test



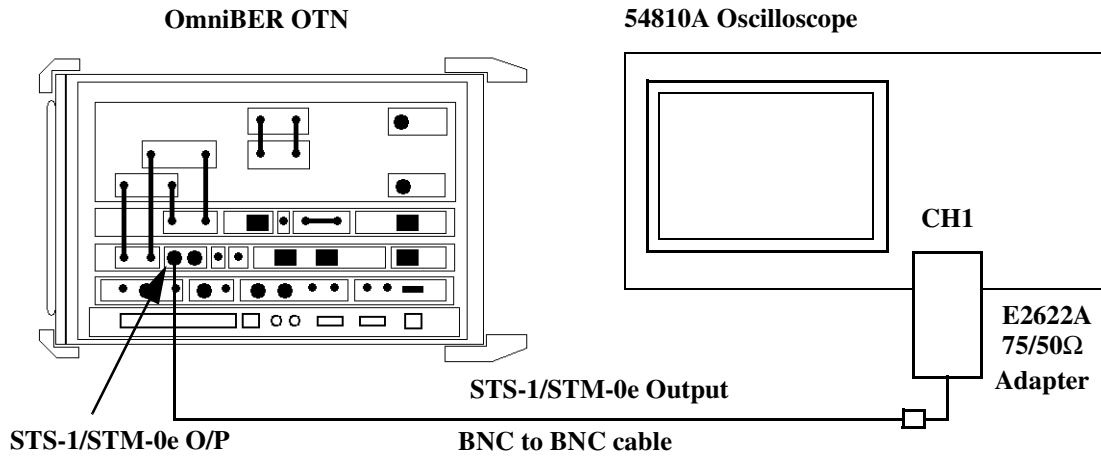
140Mb/s All Ones (inverted) Mask Test

51.84 Mb/s (STS-1) Output Mask Tests

- 1 Recall the OmniBER OTN's default setting as shown on "Recall Default Settings" on page 12.
- 2 Press <Menu>, select Tx/Rx > **Transmitter Settings** and set the **Signal Mode** to **SONET**. Now set the **Signal Rate** to **STS-1** and set the **Output Level** to **STSX-1**.



- 3 Connect the **52 Mb/s OUT** port to the Oscilloscope CHAN 1, using the E2622A Termination Adapter Probe.

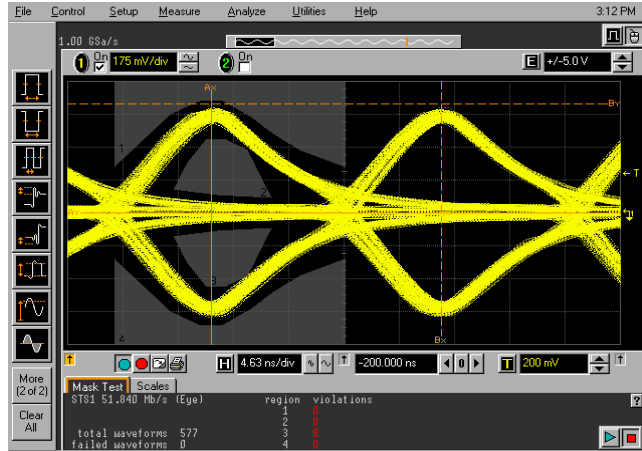


- 4 Load the `STS1_ANSI_EYE.msk` test mask and check the eye meets the mask. See examples

NOTE

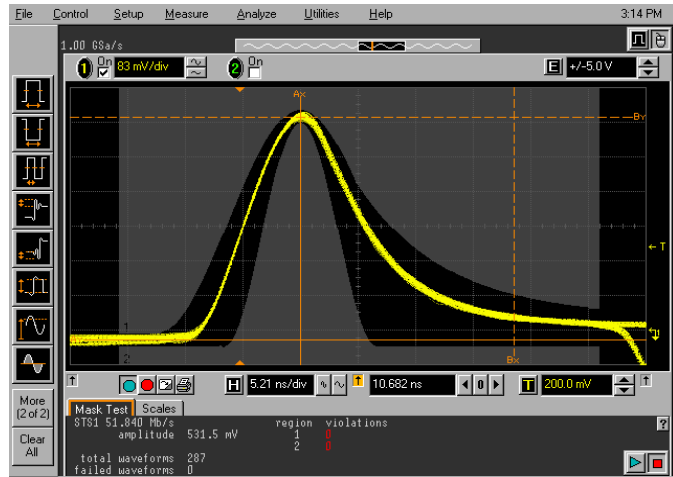
It may be necessary to use Manual settings to Align this mask. If necessary change the selection in the scope Mask Test Setup to allow manual settings rather than File Set-up for Alignment.

1 Performance Tests

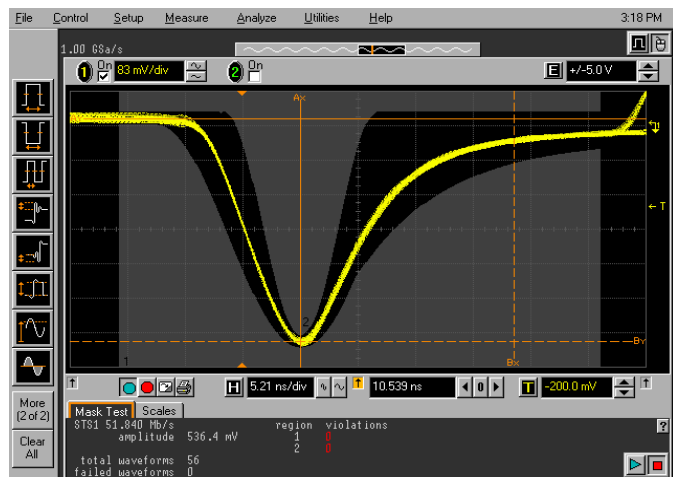


STSX-1 Mask Test

- 5 Load the **STS1_ANSI_PULSE.msk** test mask and check the positive and negative pulses meet the mask (see examples).



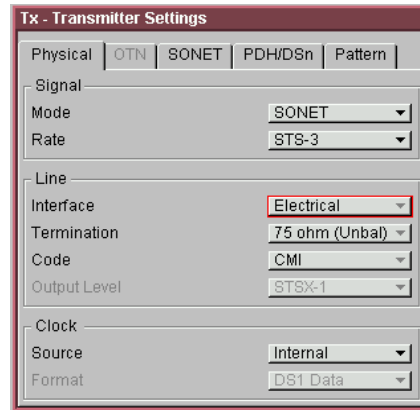
STX-1 Positive Pulse Mask Test



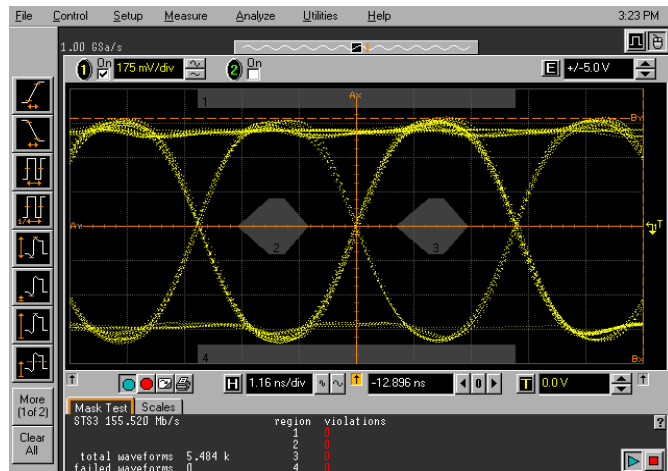
STX-1 Negative Pulse Mask Test

155Mb/s Output Mask Tests

- 1 Press <Menu>, select **Tx/Rx > Transmitter Settings** and set the **Signal Mode** to **SONET**. Now set the **Signal Rate** to **STS-3**.

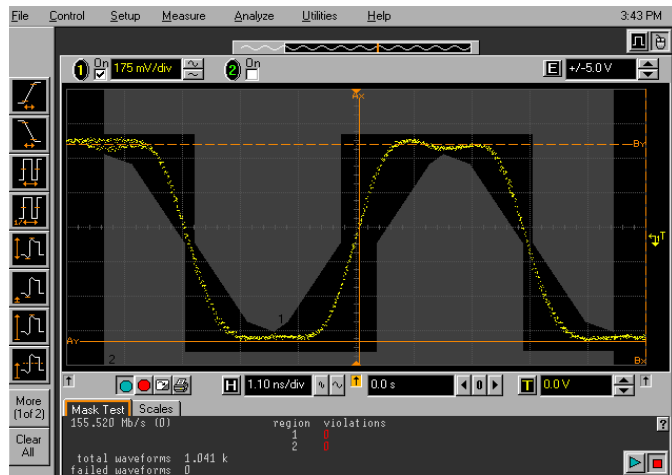


- 2 Load the **STS3_ANSI.msk** test mask and check the eye meets the mask (see example).



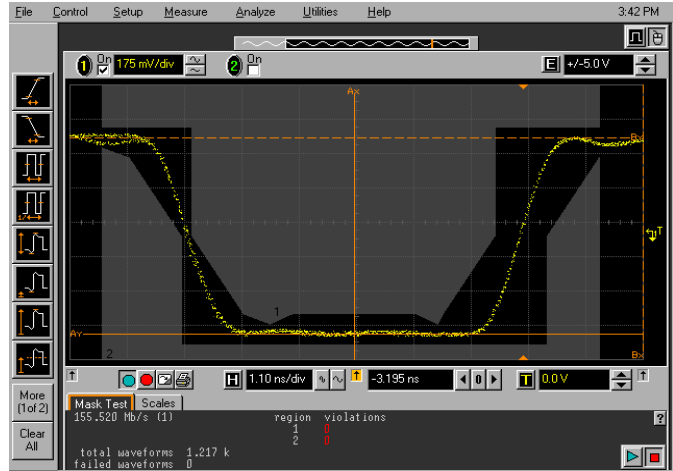
STS-3 Eye Mask Test

- 3 Press <Menu>, select **Tx/Rx > Transmitter settings** and set the **Signal Mode** to **SDH**. Now set the **Signal Rate** to **STM-1**, and **Interface** to **Electrical**.
- 4 Load the **155Mb_ITU_0.msk** test mask and check the 'zero' pulses are within the mask. See examples.
- 5 Also check the 'ones' pulses (normal & inverted) by loading and checking against the **155Mb_ITU_1.msk** and **155_ITU_1_INV.msk** test masks (see examples).

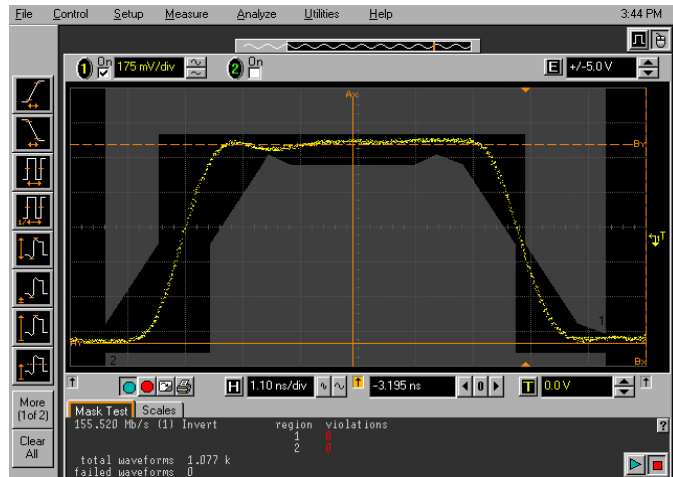


STM-1 All Zeros Mask Test

1 Performance Tests



STM-1 All Ones Mask Test



STM-1 All Ones (inverted) Mask Test

Optical Transmit/Receive Jitter Amplitude Accuracy

Specification

Please refer to the optical Tx/Rx jitter specifications given in the specifications document provided on the web. The rates applicable are dependent on the instrument option.

Description

The J7231B optical transmitter output is connected via an optical splitter and O/E converter to a spectrum analyzer to allow monitor of the signal. Optical signal is also looped back to the J7231B receiver via an optical attenuator for jitter measurement. The J7231B jitter modulation frequency is set to Jitter Amplitude/Frequency check points for the selected SDH Rate and the spectrum analyzer set to observe the displayed spectrum centered at half this bit rate.

The optical data signal is scrambled therefore a special calibration test mode is accessed to set the scrambling off and pattern to alternating 1/0. This allows observation of the the modulation components to determine the the jitter amplitude.

The J7231B jitter modulation amplitude is adjusted to known modulation levels using **Carrier to Sideband Ratio**, **Bessel Null** and **Peak Deviation** methods for reference. Jitter Amplitude (UI pk-pk) displayed on the J7231B transmitter and receiver are checked to ensure within specified limits when the signal in Normal mode, i.e. calibration test signal off. The test is repeated for various jitter amplitude/frequency points to check the TX and RX ranges.

NOTE

Tests should be performed in a normal ambient temperature environment and instruments should be powered up least 0.5 HR before test.

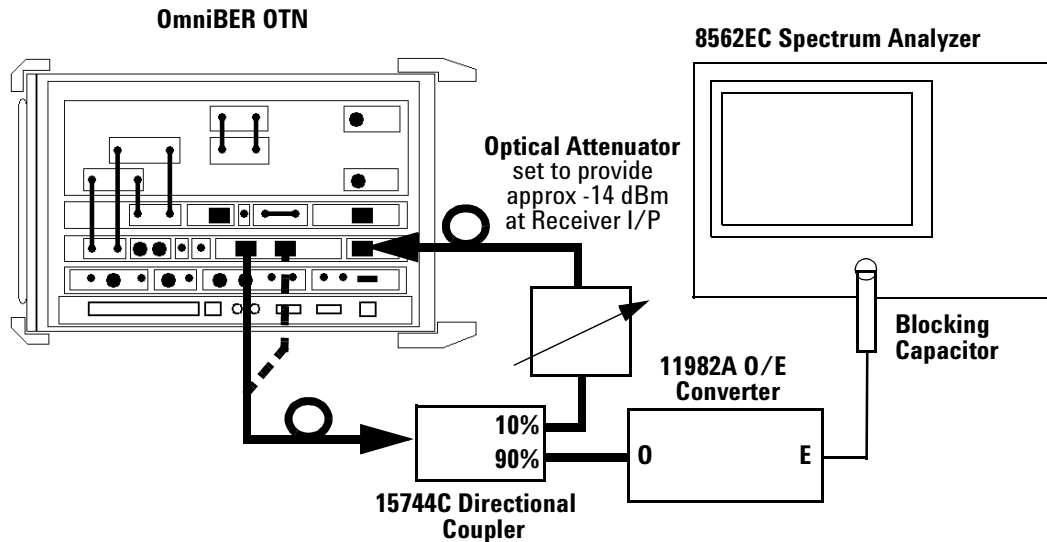
Tests are identical for SDH/Sonet and should only be performed in either SDH or Sonet and not repeated for both.

Equipment Required

Spectrum Analyzer	: Agilent 8562EC
Optical Coupler	: Agilent 15744C
O/E Converter	: Agilent 11982A
Optical Attenuator	: Agilent 8156A
Function Generator	: Agilent 33250A
Oscilloscope	: Agilent 54810A
Blocking Capacitor	: Agilent 10240B

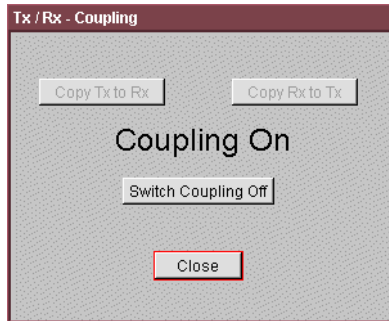
Procedure

- 1 Press **<Menu>**, choose **System > Stored Settings** then press **<Select>**. Select **Default** then **Recall**. Wait for settings to be recalled then **Close, Stored Settings**.
- 2 Press **<Menu>**, choose **System > Preferences > Access Control**. Enter **Item >- perf** and **Code > 1010** to enable to calibration check signal mode. Successful entry is indicated by **PASSED** in the **Code** field. Choose **Enable Item** then **Close** the **Access Control** window.
- 3 Press **<Menu>**, choose **System > Jitter Performance Test**. Check the box to enable.
- 4 Press **<Menu>**, choose **Tx/Rx > Transmitter Settings > Physical** then press **<Select>**. Set the **Signal Mode** to **SDH/SONET**.
- 5 Connect the Test Equipment and OmniBER OTN as shown below.



Set-up for 51 Mb/s - 2.5 Gb/s Rates

- 6 Set the Transmitter Settings **Signal Rate** to **STM-0/OC-1** and set the **Wavelength** to be the same as the transmit Port connected in set-up, i.e. **1310nm** or **1550nm**.
- 7 Set the **Laser** to **ON** and check the laser LED is illuminated at the connected 52Mb/s-2.5Gb/s Output Port on the OmniBER OTN's connector panel.
- 8 Press **<Menu>**, choose **Tx/Rx > Coupling** then press **<Select>**. Choose **Copy Tx to Rx** to set Coupling On. Select **Close** to close dialog.



- 9 Press <Menu>, choose **Tx/Rx > Transmitter Settings > SDH/SONET**. Set the **Mapping** to provide a fully **Bulk Filled** payload as follows depending on the rate being tested.

Rate	Payload Mapping	Pattern
STM-0/OC-1	VC-3/STS-1	PRBS 23
STM-1/OC-3	VC-4/STS-3c	PRBS 23
STM-4/OC-12	VC4-4c/STS-12	PRBS 23
STM-16/OC-48	VC4-16c/STS-48c	PRBS 23
STM-64/OC192	VC4-64c/STS-192c	PRBS 31
OTN - OTU2	VC4-64c/STS-192c	PRBS 31

Check lower display diagram shows TX and RX sections are correctly set.

- 10 Press <Menu>, choose **Test Functions > Jitter/Wander** then press <Select>. Ensure **Transmit Mode** is set to **OFF**. Also ensure **Transmit Mode > 1010** test signal is set to **OFF**.

Set **Receive Mode > Jitter** (takes a few seconds to enable), then set **Range > 0.8 UI** and set **HP and LP Filters ON**.

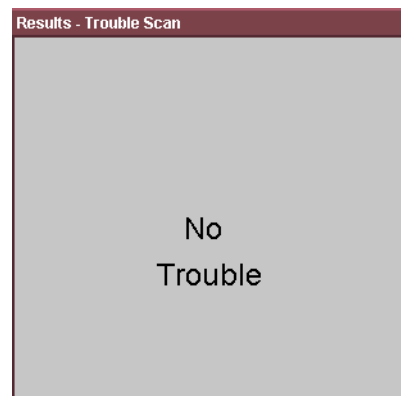
NOTE

If the Transmit Mode 1010 Unframed signal selection field is not displayed check the access to this test mode was correctly enabled in steps 2 & 3. This special performance test mode is automatically disabled whenever the instrument is power-cycled to ensure return to normal operation.

- 11** Press <Smart Test>, choose **Shortcuts > Optical Power** and check displayed Level is between **-16 and -12 dBm**, ensure appropriate power measurement wavelength is selected. (for **10 Gb/s** and **10.7 Gb/s** rates use **-12 and -8 dBm**)

If necessary, adjust set-up Optical Attenuation. Note the actual displayed power level.

- 12** Press <Smart Test>, choose **Shortcuts > Trouble Scan** then press <Select>. Press <Run/Stop> to begin a measurement.
- 13** Check that **'No Trouble'** is displayed in the **Results** window to confirm no errors have been detected.



- 14** Press <Run/Stop> to stop measurement.
- 15** Press <Menu>, choose, **Results > Jitter/Wander** then <Select>. Set to **Amplitude > Filter Summary > Total**.
- 16** Press <Run/Stop> to begin measurement. Check that there are no SDH/SONET result errors and that

the Received Jitter results for the **LP+HP1** and **LP+HP2 Filter** are.

< 0.071 UI p-p and **< 0.0055 UI RMS for LP+HP1**
< 0.071 UI p-p and **< 0.0045 UI RMS for LP+HP2**

NOTE

LP+HP1 filter = f1 - f4 band and **LP+HP2 = f3 - f4 band** in ITU-T standards.

17 Press **<Run/Stop>** to halt measurement.

18 Select **Test Function** window (using **<Window button>**). Set the **Transmit Mode** to **Jitter**. Also in **Transmit Mode** set **1010 Unframed** signal **ON**.

NOTE

The receiver will show SDH/SONET errors, (Frame/Pattern/Errors when set to 1010 Unframed as there is no Framing etc. This performance test signal allows spectral monitoring of the jittered signal

19 Set for **Jitter Frequency - 20kHz** and **Level** to **minimum**, i.e. **0.001UIp-p**

20 Set the Spectrum Analyzer as follows:

Centre Frequency - 25.92 MHz (half of bit rate being tested)

77.76 MHz for STM-1/OC-3

311.04 MHz for STM-4/OC-12

1.24416 GHz for STM-16/OC-48

4.977664 GHz for STM-64/OC192

5.354613 GHz for OTU-2.

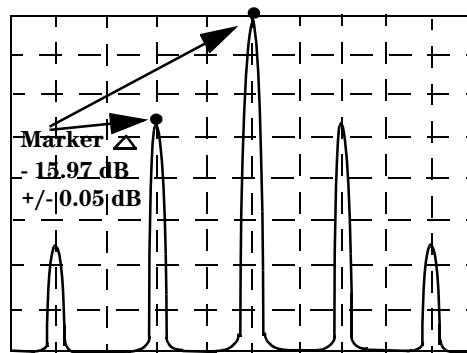
Frequency Span - 100 kHz (set to approx 5 times the Jitter frequency in [step 19](#)).

Reference Level - approx -15dBm depends splitter/optical coupler & O/E converter used.

Sweep Time - Auto.

Video Bandwidth - Auto.
Resolution Bandwidth - Auto.

Increase the **Jitter Amplitude** from minimum until the **Carrier to Sideband Ratio** is nearest to - 15.97dB. This should be at approx 0.2 UI p-p. Use the Spectrum Analyzer dB/Div and delta marker mode to aid measurement.



Carrier to Sideband Ratio Example

NOTE

Compensate the measurement if necessary to balance any difference between the upper and lower sideband amplitudes.

- 21 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **OFF**. Check that there are no SDH/SONET errors shown on instrument Front Panel LEDs..
- 22 Press **<Run/Stop>** to start measurement.
Check the TX Jitter UI p-p setting is between
0.164 and 0.236 UI p-p

Check the **RX Jitter** results for **LP+HP1 Filter** are between

0.115 and 0.285 UI p-p
0.0651 and 0.0763 UI RMS.

23 Press <Run/Stop> to halt measurement.

24 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **ON**.

25 Change the **Jitter Frequency** to **200 kHz** and adjust the Spectrum Analyzer span to approx 5 times the Jitter frequency. Adjust the **Transmit Jitter** amplitude if necessary for a **Carrier to Sideband Ratio** of -15.97 dB = 0.2 UI p-p.

26 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **OFF**. Check that there are no SDH/SONET errors shown on instrument Front Panel LEDs.

27 Press <Run/Stop> to start measurement.
Check the TX Jitter UI p-p setting is between

0.164 and 0.236 UI p-p

Check the **RX Jitter** results for **LP+HP2 Filter** are between

0.113 and 0.287 UI p-p
0.0650 and 0.0764 UI RMS.

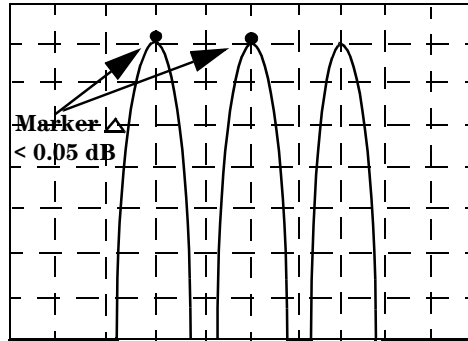
28 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **ON**.

Change **RX Jitter Receiver Range** to **3 UI p-p**.

Change the **TX Jitter Frequency** to **2.0 kHz** and adjust the Spectrum Analyzer span to approx 3 times the Jitter frequency.

29 Adjust the **J7231B jitter amplitude** (approximately **0.91 UI**) and adjust until the Carrier and first sidebands observed on

the Spectrum Analyzer are same amplitude within 0.05 dB.



Carrier/Sideband Equal Example

NOTE

Use Spectrum Analyzer dB/Div to improve Marker Resolution as necessary.

30 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **OFF**. Check that there are no SDH/SONET errors shown on instrument Front Panel LEDs.

31 Press **<Run/Stop>** to start measurement.
Check the TX Jitter UI p-p setting is between

0.817 and 1.003 UI p-p

Check the **RX Jitter** results for **LP+HP1 Filter** are between

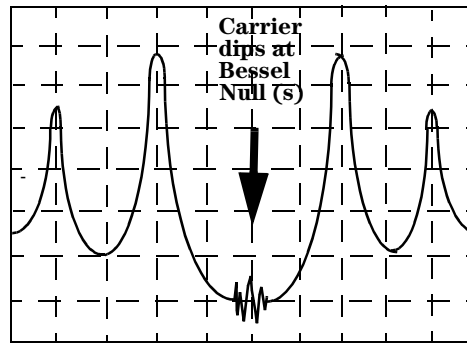
0.772 and 1.048 UI p-p
0.296 and 0.347 UI RMS.

32 Press **<Run/Stop>** to halt measurement.

33 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **ON**.

Change the **Jitter Frequency** to **1.5 kHz** and adjust the Spectrum Analyzer span to approx 5 times the Jitter frequency.

Adjust the J7231B jitter amplitude (approximately 1.52 UI) until the 1st **Bessel Null** is observed on the Spectrum Analyzer i.e, 1st dip of the carrier level as Jitter is increased from minimum.



Bessel Null Example

34 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **OFF**. Check that there are no SDH/SONET errors shown on instrument Front Panel LEDs.

35 Press **<Run/Stop>** to start measurement.
Check the TX Jitter UI p-p setting is between

1.378 and 1.662 UI p-p

Check the **RX Jitter** results for **LP+HP1 Filter** are between

1.340 and 1.700 UI p-p
0.497 and 0.577 UI RMS.

36 Press **<Run/Stop>** to halt measurement.

37 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **ON**.

38 Change the **Receiver Range** to **30UI**.

Change the **Jitter Frequency** to **1 kHz** and adjust the Spectrum Analyzer span to approx 5 times the Jitter frequency.

39 Adjust the J7231B jitter amplitude (approximately 3.52 UI) until the 2nd **Bessel Null** is observed on the Spectrum Analyzer i.e, 2nd dip of the carrier level as Jitter is increased from minimum.

40 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **OFF**. Check that there are no SDH/SONET errors shown on instrument Front Panel LEDs.

41 Press **<Run/Stop>** to start measurement.
Check the TX Jitter UI p-p setting is between

3.218 and 3.822 UI p-p

Check the **RX Jitter** results for **LP+HP1 Filter** are between

3.164 and 3.876 UI p-p
1.137 and 1.352 UI RMS.

42 Press **<Run/Stop>** to halt measurement.

43 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **ON**.

44 Change the **Jitter Frequency** to **800 Hz** and adjust the Spectrum Analyzer span to approx 5 times the Jitter frequency.

Adjust the J7231B jitter amplitude (approximately 7.52 UI) until the 4th **Bessel Null** is observed on the Spectrum Analyzer i.e 4th dip in the carrier level.

For STM-4/OC-12 use 11.52 UI, 6th null.

For STM-16/OC-48 use 9.52 UI, 5th null.

For STM-64/OC192 use 9.52 UI, 5th null.

For OTN - OTU-2 use use 9.52 UI, 5th null.

45 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **OFF**. Check that there are no SDH/SONET errors shown on instrument Front Panel LEDs.

46 Press <Run/Stop> to start measurement.
Check the TX Jitter UI p-p setting is between

6.898 and 8.142 UI p-p

Check the **RX Jitter** results for **LP+HP1 Filter** are between

6.884 and 8.156 UI p-p
2.453 and 2.865 UI RMS.

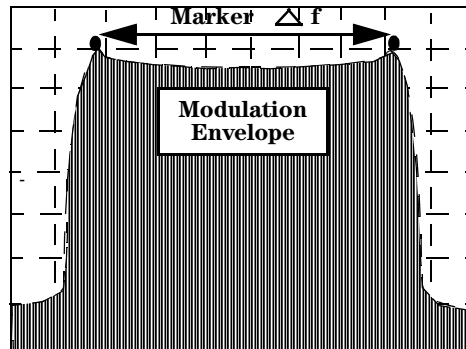
47 Press <Run/Stop> to halt measurement.

48 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal ON.

49 Change the **Receiver Measurement Type** to **EXTENDED**.

Change the **Jitter Frequency** to **50Hz** and **Jitter Amplitude** to **20 UI p-p**.

50 Set the Spectrum Analyzer Center Frequency to half the Bit Rate being tested (i.e. 25,92 MHz for STM-0/OC-1). Set the Span to approx 3.5 kHz and set BW to 10 Hz, Sweep Time to approx. 5 Secs.. Measure the peak to peak deviation of the carrier using marker delta mode. Adjust the Jitter Amplitude until the deviation at the amplitude peaks is **2.90 ± 0.05 kHz**.



Peak Deviation Example

Rate	Centre Freq	Span	Sweep Time	Δ Freq kHz
STM-1/OC-3	77.76 MHz	7 KHz	8 Secs	4.95 ± 0.25
STM-4/OC-12	311.04 MHz	24 kHz	12 Secs	20.3 ± 0.25
STM-16/OC-48	1.24416 GHz	90 kHz	33 Secs	82.3 ± 0.5
STM-64/OC-192	4.97664 GHz	350 kHz	120 Secs	331.5 ± 1.5
OTN - OTU-2	5.35461 GHz	350 kHz	120 Secs	331.5 ± 1.5

51 Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **OFF**. Check that there are no SDH/SONET errors shown on instrument Front Panel LEDs.

52 Press **<Run/Stop>** to start measurement.
Check the TX Jitter UI p-p setting is between

18.580 and 21.420 UI p-p

Check the **RX Jitter** results is between

15.600 and 24.400 UI p-p

5.943 and 8.199 UI RMS.

53 Press **<Run/Stop>** to halt measurement.

54 Set **TX Jitter** to **OFF**.

1 Performance Tests

STM-1/OC-3 Optical

55 Repeat [step 6](#) to [step 54](#) using the information below.

STEP	RX Range	RX Filter	Tx UI p-p	Tx Freq	TX Result MIN p-p	TX Result MAX p-p	RX Result MIN p-p	RX Result MAX p-p	RX Result MIN RMS	RX Result MAX RMS
16	0.8UI	LP+HP2	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0045
16	0.8UI	LP+HP1	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0055
19-22	0.8UI	LP+HP1	0.2	65 kHz	0.164	0.236	0.115	0.285	0.0651	0.0763
25-27	0.8UI	LP+HP2	0.2	650kHz	0.156	0.244	0.113	0.287	0.0650	0.0764
28-31	3.0UI	LP+HP1	0.91	6.5K	0.817	1.003	0.772	1.048	0.296	0.347
33-35	3.0UI	LP+HP1	1.52	5.0K	1.378	1.662	1.3940	1.700	0.497	0.577
38-41	30UI	LP+HP1	3.52	4K	3.218	3.822	3.164	3.876	1.137	1.352
44-46	30UI	LP+HP1	7.52	2.5 kHz	6.898	8.142	6.884	8.156	2.453	2.865
49-523	64	FIXED	33	50Hz	29.670	35.330	27.690	38.310	10.339	12.995

STM-4/OC-12 Optical

56 Repeat [step 6](#) to [step 54](#) using the information below.

STEP	RX Range	RX Filter	Tx UI p-p	Tx Freq	TX Result MIN p-p	TX Result MAX p-p	RX Result MIN p-p	RX Result MAX p-p	RX Result MIN RMS	RX Result MAX RMS
16	0.8UI	LP+HP2	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0045
16	0.8UI	LP+HP1	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0055
19-22	0.8UI	LP+HP1	0.2	250K	0.164	0.236	0.115	0.285	0.0651	0.0763
25-27	0.8UI	LP+HP2	0.2	2.5M	0.146	0.254	0.111	0.289	0.0650	0.0764
28-31	3.0UI	LP+HP1	0.91	25K	0.817	1.003	0.772	1.048	0.296	0.347
33-35	3.0UI	LP+HP1	1.52	15K	1.378	1.662	1.394	1.700	0.497	0.577
38-41	30UI	LP+HP1	3.52	10K	3.218	3.822	3.164	3.876	1.137	1.352
44-46	30UI	LP+HP1	11.52	5K	10.578	12.462	10.603	12.437	3.768	4.378
49-523	256	FIXED	132	50Hz	122.740	142.260	110.760	153.240	41.355	51.984

STM-16/OC-48 Optical

57 Repeat step 6 to step 54 using the information in the Table below for STM-16/OC-48 Optical Rate.

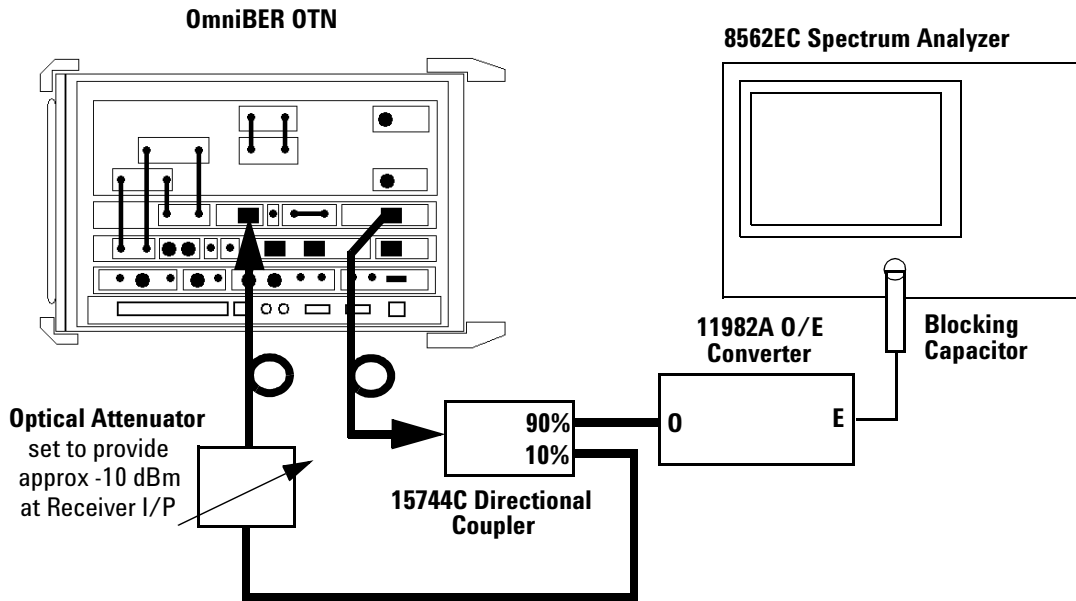
STEP	RX Range	RX Filter	Tx UI p-p	Tx Freq	TX Result MIN p-p	TX Result MAX p-p	RX Result MIN p-p	RX Result MAX p-p	RX Result MIN RMS	RX Result MAX RMS
16	0.8UI	LP+HP2	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0045
16	0.8UI	LP+HP1	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0055
19-22	0.8UI	LP+HP1	0.2	1M	0.156	0.244	0.113	0.287	0.0651	0.0763
25-27	0.8UI	LP+HP2	0.2	10 M	0.146	0.254	0.099	0.301	0.0650	0.0764
28-31	3.0UI	LP+HP1	0.91	100K	0.817	1.003	0.772	1.048	0.296	0.347
33-35	3.0UI	LP+HP1	1.52	75K	1.378	1.662	1.394	1.700	0.497	0.577
38-41	30UI	LP+HP1	3.52	50K	3.218	3.822	3.164	3.876	1.137	1.352
44-46	30UI	LP+HP1	9.52	25K	8.738	10.302	8.743	10.297	3.110	3.622
49-523	2500	FIXED	528	50Hz	491.02	564.98	479.040	576.960	166.183	207.170

58 In the case of units with dual wavelength option (106) for rates up to 2.5 Gb/s. Sets TX selection to the alternative wavelength and change the set-up TX Output connection accordingly then repeat steps 4 to 17 ONLY, for STM-0/OC-1 to STM-16/OC-48 rates at alternative wavelength.

59 Set TX Laser to OFF.

Rates 10G and 10.7G

60 Change the Set-up as shown below for 10G and 10.7G



Set-up for 10 Gb/s & 10.7 Gb/s Rates

61 Repeat steps [step 6](#) to [step 54](#) using the information in the Table below for STM-64/OC-192 Optical Rate.

1 Performance Tests

STEP	RX Range	RX Filter	Tx UI p-p	Tx Freq	TX Result MIN p-p	TX Result MAX p-p	RX Result MIN p-p	RX Result MAX p-p	RX Result MIN RMS	RX Result MAX RMS
16	0.8UI	LP+HP2	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0045
16	0.8UI	LP+HP1	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0055
19-22	0.8UI	LP+HP1	0.2	4M	0.150	0.250	0.114	0.286	0.0651	0.0763
25-27	0.8UI	LP+HP2	0.2	40M	0.150	0.250	0.100	0.300	0.0650	0.0764
28-31	3.0UI	LP+HP1	0.91	400K	0.817	1.003	0.795	1.026	0.296	0.347
33-35	3.0UI	LP+HP1	1.52	300K	1.378	1.662	1.396	1.724	0.497	0.577
38-41	30UI	LP+HP1	3.52	200K	3.218	3.822	3.124	3.916	1.137	1.352
44-46	30UI	LP+HP1	9.52	100K	8.738	10.302	8.733	10.307	3.110	3.622
49-523	10000	FIXED	2112	50Hz	1964.14	2259.86	1764.16	2459.84	667.13	826.279

62 Press <Menu>, choose **Tx/Rx > Transmitter Settings > Physical** then press <Select>. Set the **Signal Mode > OTN Rate > OTU2**.

Repeat steps [step 6](#) to [step 54](#) using the information in the Table below for OTN, OTU2 Optical Rate.

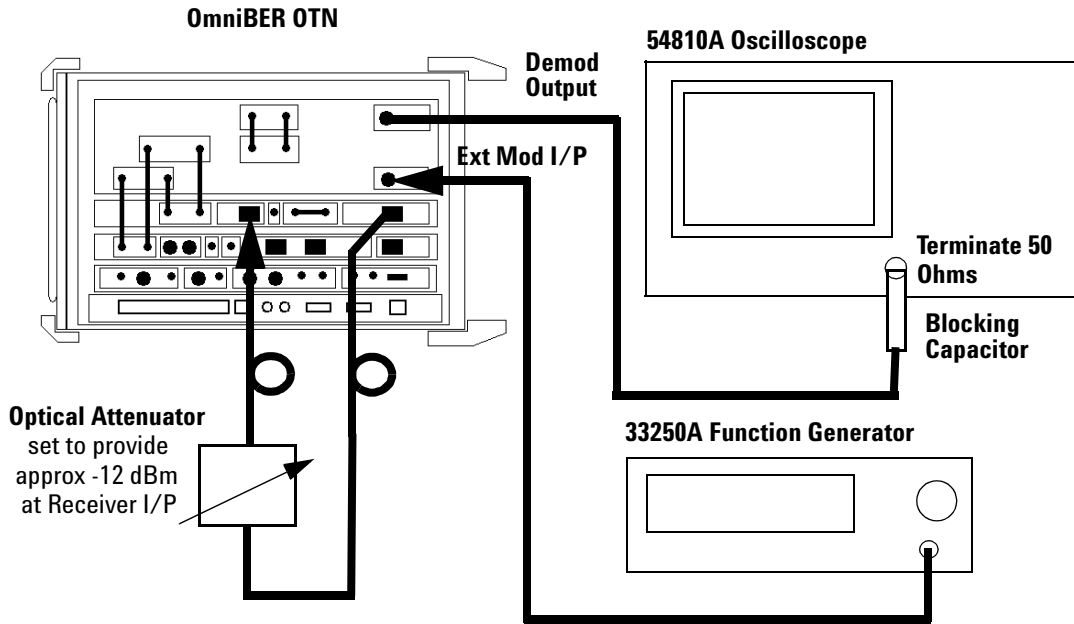
STEP	RX Range	RX Filter	Tx UI p-p	Tx Freq	TX Result MIN p-p	TX Result MAX p-p	RX Result MIN p-p	RX Result MAX p-p	RX Result MIN RMS	RX Result MAX RMS
16	0.8UI	LP+HP2	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0045
16	0.8UI	LP+HP1	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0055
19-22	0.8UI	LP+HP1	0.2	4M	0.150	0.250	0.114	0.286	0.0651	0.0763
25-27	0.8UI	LP+HP2	0.2	40M	0.150	0.250	0.100	0.300	0.0650	0.0764
28-31	3.0UI	LP+HP1	0.91	400K	0.817	1.003	0.795	1.026	0.296	0.347
33-35	3.0UI	LP+HP1	1.52	300K	1.378	1.662	1.396	1.724	0.497	0.577
38-41	30UI	LP+HP1	3.52	200K	3.218	3.822	3.124	3.916	1.137	1.352
44-46	30UI	LP+HP1	9.52	100K	8.738	10.302	8.733	10.307	3.110	3.622
49-523	10000	FIXED	2112	50Hz	1964.14	2259.86	1764.16	2459.84	667.13	826.279

63 Set TX Laser to OFF

External Modulation Input/ Demod Output Function Check.

64 Connect the Test Equipment and OmniBER OTN as shown below.

1 Performance Tests



Set-up for Ext Mod/Demod Out Check

65 With instrument set-up as follows.

TX/RX > STM-64/OC-192 rate
Jitter Transmit Mode > Source - Jitter > External
Jitter Receive Mode > Range - Jitter > 0.8UI
Filters HP and LP - ON
Demod Output Filter - LP+HP1

66 Set **TX Laser** to **ON**

67 Set Function Generator for 500 kHz Sine Output. Level to minimum.

68 Press **<Run/Stop>** and Monitor the Receiver Jitter Amplitude results for **LP+HP (20 kHz) Filter**.

69 Increase the Function Generator Output until the p-p Jitter result is approx. 0.5 UI p-p.

70 Check the Scope Display p-p waveform shows a Sinusoidal signal of between 400 mV p-p and. 600 mV p-p. Note scope termination should be set for 50 ohms.

71 Set **Laser** to **OFF**.

Performance Test Record

Model: Agilent J7231B/J7232A OmniBER OTN	
Location:	Serial No.:
Tested by:	Options:
Temperature:	Certified by:
Humidity:	Date:

NOTE

The test steps applicable are dependent on the instrument options installed. Enter N/A if a test section does not apply for your instrument.

Page No.	Test Description	Min	Result Actual	Max
Performance Self Test				
16	step 5	Confidence Test	Pass/Fail	
16	step 6	Frequency Measurement	Pass/Fail	
Internal Reference Clock Accuracy				
20	step 4	2 MHz Clock OUT	2.0479908 MHz	2.0480092 MHz
22	step 13	DS1 Clock OUT	-4.5 ppm	+4.5 ppm
23	step 2	Alternative DS1 Test (Counter indication for framed signal)	1.540993 MHz	1.541007 MHz
External Clock Reference Inputs and Clock Reference Output				
26	step 6	2 MHz Clock Ext	2.047999999 MHz	2.048000001 MHz
27	step 7	Signal Locked	Pass/Fail	
27	step 10/step 6	10 MHz Clock Ext	2.047999999 MHz	2.048000001 MHz

Page No.	Test Description	Min	Result Actual	Max
27	step 10/step 7 Signal Locked		Pass/Fail	
28	step 16 2 Mb/s Data Ext Unbal	2.047999999 MHz		2.048000001 MHz
29	step 17 Signal Locked		Pass/Fail	
29	step 21 2 Mb/s Data Ext Bal	2.047999999 MHz		2.048000001 MHz
29	step 22 Signal Locked		Pass/Fail	
30	step 26 No Alarm/Errors		Pass/Fail	
30	step 27 DS1 Ext	1543999 Hz		1544001 Hz
30	step 28 Signal Locked		Pass/Fail	
Optical Pulse Mask and Output Characteristics				
Option 104/106	1310nm Optical Port (52 Mb/s - 2.5 Gb/s)			
35	step 9 OC-1/STM-0 Mask		Pass/Fail	
35	step 11 OC-1/STM-0 (ER)	>8.2 dB		N/A
36	step 16 OC-3/STM-1 Mask		Pass/Fail	
36	step 18 OC-3/STM-1 (ER)	>8.2 dB		N/A
36	step 23 OC-12/STM-4 Mask		Pass/Fail	
36	step 25 OC-12/STM-4 (ER)	>8.2 dB		N/A
38	step 33 OC-48/STM-16 Mask		Pass/Fail	
39	step 35 OC-48/STM-16 (PWR)	-2.5 dBm		+4 dBm
39	step 36 OC-48/STM-16 (ER)	>8.2 dB	Pass/Fail	N/A
Option 105/106	1550nm Optical Port (52 Mb/s - 2.5 Gb/s)			
35	step 9 OC-1/STM-0 Mask		Pass/Fail	
35	step 11 OC-1/STM-0 (ER)	>8.2 dB		N/A
36	step 16 OC-3/STM-1 Mask		Pass/Fail	
36	step 18 OC-3/STM-1 (ER)	>8.2 dB		N/A

1 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
36	step 23	OC-12/STM-4 Mask	Pass/Fail	
36	step 25	OC-12/STM-4 (ER)	>8.2 dB	N/A
38	step 33	OC-48/STM-16 Mask	Pass/Fail	
39	step 35	OC-48/STM-16 (PWR)	-2.5 dBm	+4 dBm
39	step 36	OC-48/STM-16 (ER)	>8.2 dB	N/A
1550nm Optical Port (9.95 Gb/s and 10.7 Gb/s)				
All options				
41	step 8	OC-192/STM-64 Mask	Pass/Fail	
41	step 10	OC-192/STM-64 (PWR)	-1 dBm	+2 dBm
42	step 11	OC-192/STM-64 (ER)	>8.2 dB	Pass/Fail
Option 112				
43	step 17	OTU-2 Output Mask	Pass/Fail	
43	step 19	OTU-2 Output (PWR)	-1 dBm	+2 dBm
43	step 19	OTU-2 Output (ER)	>8.2 dB	Pass/Fail
Optical Receiver Sensitivity, Optical Power and Frequency Measurement				
Optical Receive Port (52 & 155 Mb/s)				
All options				
49	step 5	Laser LED ON	Pass/Fail	
49	step 6	Note Attenuator Setting	N/A	N/A
49	step 9	'No Trouble' Min Sens	Pass/Fail	
50	step 10	Additional Attenuation	Typ > 1 dB	N/A
50	step 11	-30 dBm PWR meas	-31 dBm	-29 dBm
50	step 11	OC-1/STM-0 Frequency	51.83999 MHz	51.84001 MHz

Page No.	Test Description	Min	Result Actual	Max
51	step 12	-10 dBm PWR meas	-11 dBm	-9 dBm
52	step 13	'No Trouble' Max Sens	Pass/Fail	
52	step 15	Power Meter check	-10.5	-9.5
49	step 5	Laser LED ON	Pass/Fail	
49	step 6	Note Attenuator Setting	N/A	N/A
49	step 9	'No Trouble' Min Sens	Pass/Fail	
50	step 10	Additional Attenuation	Typ > 1 dB	N/A
50	step 11	-30 dBm PWR meas	-31 dBm	-29 dBm
50	step 11	OC-3 /STM-1 Frequency	155.51999 MHz	155.52001 MHz
51	step 12	-10 dBm PWR meas	-11 dBm	-9 dBm
52	step 13	'No Trouble' Max Sens	Pass/Fail	
52	step 15	Power Meter check	-10.5	-9.5
Optical Receive Port (622 Mb/s)				
52	step 17	Laser LED ON	Pass/Fail	
52	step 18	Note Attenuator Setting	N/A	N/A
53	step 21	'No Trouble' Min Sens	Pass/Fail	
53	step 22	Additional Attenuation	Typ > 1 dB	N/A
53	step 23	-28 dBm PWR meas	-29 dBm	-27 dBm
53	step 23	OC-12/STM-4 Frequency	622.07999 MHz	622.08001 MHz
53	step 24	-8 dBm PWR meas	-9 dBm	-7 dBm
53	step 25	'No Trouble' Max Sens	Pass/Fail	
53	step 27	Power Meter check	-8.5	-7.5
Optical Receive Port (2.5 Gb/s)				

1 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
54	step 3	Laser LED ON	Pass/Fail	
54	step 4	Note Attenuator Setting	N/A	N/A
55	step 7	'No Trouble' Min Sens	Pass/Fail	
55	step 8	Additional Attenuation	Typ > 1 dB	N/A
55	step 9	-28 dBm PWR meas	-30 dBm	-26 dBm
55	step 9	OC-48/STM-16 Frequency	2488.3199 MHz	2488.3201 MHz
55	step 10	-8 dBm PWR meas	-10 dBm	-6 dBm
55	step 11	'No Trouble' Max Sens	Pass/Fail	
56	step 14	Power Meter check	-8.5	-7.5
Optical Receive Port (9.95 and 10.7 Gb/s)				
58	step 4	Laser LED ON	Pass/Fail	
58	step 5	Note Attenuator Setting	N/A	N/A
58	step 8	'No Trouble' Min Sens	Pass/Fail	
58	step 9	Additional Attenuation	Typ > 1 dB	N/A
58	step 10	-18dBm PWR meas	-19.5 dBm	-16.5 dBm
58	step 10	OC-192/STM-64 Frequency	9953.2799 MHz	9953.2801 MHz
59	step 11	-7 dBm PWR meas	-8.5 dBm	-5.5 dBm
59	step 12	'No Trouble' Max Sens	Pass/Fail	
59	step 14	Power Meter check	-8.5 dBm	-5.5 dBm
Option 112				
59	step 15	Laser LED ON	Pass/Fail	
59	step 16	Note Attenuator Setting	N/A	N/A

Page No.	Test Description	Min	Result Actual	Max
60	step 19	'No Trouble' Min Sens	Pass/Fail	
60	step 20	Additional Attenuation	Typ > 1 dB	N/A
60	step 21	-16dBm PWR meas	-17.5 dBm	-14.5 dBm
60	step 21	OTN Output Frequency	1070.9224 MHz	1070.9226 MHz
60	step 22	-7 dBm PWR meas	-8.5 dBm	-5.5 dBm
60	step 23	'No Trouble' Max Sens	Pass/Fail	
61	step 25	Power Meter check	-8.5 dBm	-5.5 dBm
All options				
61	Check Receiver Sensitivity margin v.s. Transmitter Extinction Ratio		Pass/Fail	
Electrical Pulse Mask and Output Characteristics (opt 012 Only)				
DS1 Output Mask Tests				
66	step 4	DS1 ANSI Mask	Pass/Fail	
67	step 5	DSX-1 Pulse Amplitudes	Pass/Fail	
67	step 6	DSX1-LO Output Level	Pass/Fail	
2 Mb/s Balanced Output Mask Tests				
68	step 2	2 Mb/s ITU 120 Mask	Pass/Fail	
70	step 3	2 Mb/s ITU 75 Mask	Pass/Fail	
8 Mb/s Output Mask Tests				
72	step	8 Mb/s ITU Mask	Pass/Fail	
34 Mb/s Output Mask Tests				
74	step 2	34 Mb/s ITU Mask	Pass/Fail	
DS3 Output Mask Tests				
76	step 2	DS3 ANSI Mask	Pass/Fail	
140 Mb/s Output Mask Tests				

1 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
78	step 2 140 Mb/s ITU Masks		Pass/Fail	
STS-1 (51 Mb/s) Output Mask Tests				
81	step 4 STS-1 Eye Mask		Pass/Fail	
83	step 5 STS-1 ANSI Mask		Pass/Fail	
STS-3 Output Mask Tests				
84	step 2 STS-3 ANSI Mask		Pass/Fail	
85	step 4 155 Mb/s ITU_0 Mask		Pass/Fail	
85	step 5 155 Mb/s ITU_1s Mask		Pass/Fail	
Optical Transmit/Receive Jitter Amplitude Accuracy				
STM-0/STS-3 Rate				
91	step 11 Optical Power	-16.0 dBm		-12.0 dBm
91	step 12 No Trouble		Pass/Fail	
91	step 16 RX p-p LP+HP1	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP1	N/A		0.0055 UI RMS
91	step 16 RX p-p LP+HP2	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP2	N/A		0.0045 UI RMS
93	step 21 No Trouble		Pass/Fail	
93	step 22 TX p-p result	0.164 UI p-p		0.236 UI p-p
93	step 22 RX p-p LP+HP1	0.115 UI p-p		0.285 UI p-p
93	step 22 RX RMS LP+HP1	0.0651 UI RMS		0.0763 UI RMS
94	step 26 No Trouble		Pass/Fail	
94	step 27 TX p-p result	0.164 UI p-p		0.236 UI p-p
94	step 27 RX p-p LP+HP2	0.113 UI p-p		0.287 UI p-p
94	step 27 RX RMS LP+HP2	0.0650 UI RMS		0.0764 UI RMS
95	step 30 No Trouble		Pass/Fail	

Page No.	Test Description	Min	Result Actual	Max
95	step 31 TX p-p result	0.817 UI p-p		1.003 UI p-p
95	step 31 RX p-p LP+HP1	0.772 UI p-p		1.048 UI p-p
95	step 31 RX RMS LP+HP1	0.296 UI RMS		0.347 UI RMS
96	step 34 No Trouble		Pass/Fail	
96	step 35 TX p-p result	1.378 UI p-p		1.662 UI p-p
96	step 35 RX p-p LP+HP1	1.340 UI p-p		1.700 UI p-p
96	step 35 RX RMS LP+HP1	0.497 UI RMS		0.577 UI RMS
97	step 40 No Trouble		Pass/Fail	
97	step 41 TX p-p result	3.218 UI p-p		3.822 UI p-p
97	step 41 RX p-p LP+HP1	3.164 UI p-p		3.876 UI p-p
97	step 41 RX RMS LP+HP1	1.137 UI RMS		1,352 UI RMS
97	step 45 No Trouble		Pass/Fail	
98	step 46 TX p-p result	6.898 UI p-p		8.142 UI p-p
98	step 46 RX p-p LP+HP1	6.884 UI p-p		8.156 UI p-p
98	step 46 RX RMS LP+HP1	2.453 UI RMS		2.865 UI RMS
99	step 51 No Trouble		Pass/Fail	
99	step 52 TX p-p result	18.580 UI p-p		21.420 UI p-p
99	step 52 RX p-p result	15.600 UI p-p		24.400 UI p-p
99	step 52 RX RMS result	5.943 UI RMS		8.199 UI RMS
STM-1/OC-3 Rate				
91	step 11 Optical Power	-16.0 dBm		-12.0 dBm
91	step 12 No Trouble		Pass/Fail	
91	step 16 RX p-p LP+HP1	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP1	N/A		0.0055 UI RMS

1 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
91	step 16 RX p-p LP+HP2	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP2	N/A		0.0045 UI RMS
93	step 21 No Trouble		Pass/Fail	
93	step 22 TX p-p result	0.164 UI p-p		0.236 UI p-p
93	step 22 RX p-p LP+HP1	0.116 UI p-p		0.284 UI p-p
93	step 22 RX RMS LP+HP1	0.0608 UI RMS		0.0807 UI RMS
94	step 26 No Trouble		Pass/Fail	
94	step 27 TX p-p result	0.164 UI p-p		0.236 UI p-p
94	step 27 RX p-p LP+HP2	0.115 UI p-p		0.285 UI p-p
94	step 27 RX RMS LP+HP2	0.0651 UI RMS		0.0763 UI RMS
95	step 30 No Trouble		Pass/Fail	
95	step 31 TX p-p result	0.817 UI p-p		1.003 UI p-p
95	step 31 RX p-p LP+HP1	0.772 UI p-p		1.048 UI p-p
95	step 31 RX RMS LP+HP1	0.296 UI RMS		0.347 UI RMS
96	step 34 No Trouble		Pass/Fail	
96	step 35 TX p-p result	1.378 UI p-p		1.662 UI p-p
96	step 35 RX p-p LP+HP1	1.394 UI p-p		1.700 UI p-p
96	step 35 RX RMS LP+HP1	0.497 UI RMS		0.577 UI RMS
97	step 40 No Trouble		Pass/Fail	
97	step 41 TX p-p result	3.218 UI p-p		3.822 UI p-p
97	step 41 RX p-p LP+HP1	3.164 UI p-p		3.876 UI p-p
97	step 41 RX RMS LP+HP1	1.137 UI RMS		1.352 UI RMS
97	step 45 No Trouble		Pass/Fail	
98	step 46 TX p-p result	6.898 UI p-p		8.142 UI p-p
98	step 46 RX p-p LP+HP1	6.884 UI p-p		8.156 UI p-p

Page No.	Test Description	Min	Result Actual	Max
98	step 46 RX RMS LP+HP1	2.453 UI RMS		2.865 UI RMS
99	step 51 No Trouble		Pass/Fail	
99	step 52 TX p-p result	29.670 UI p-p		35.330 UI p-p
99	step 52 RX p-p result	27.690 UI p-p		38.310 UI p-p
99	step 52 RX RMS result	10.339 UI RMS		12.995 UI RMS
STM-4/OC-12 Rate				
91	step 11 Optical Power	-16.0 dBm		-12.0 dBm
91	step 12 No Trouble		Pass/Fail	
91	step 16 RX p-p LP+HP1	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP1	N/A		0.0055 UI RMS
91	step 16 RX p-p LP+HP2	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP2	N/A		0.0045 UI RMS
93	step 21 No Trouble		Pass/Fail	
93	step 22 TX p-p result	0.164 UI p-p		0.236 UI p-p
93	step 22 RX p-p LP+HP1	0.115 UI p-p		0.285 UI p-p
93	step 22 RX RMS LP+HP1	0.0651 UI RMS		0.0763 UI RMS
94	step 26 No Trouble		Pass/Fail	
94	step 27 TX p-p result	0.146 UI p-p		0.254 UI p-p
94	step 27 RX p-p LP+HP2	0.111 UI p-p		0.289 UI p-p
94	step 27 RX RMS LP+HP2	0.0650 UI RMS		0.0764 UI RMS
95	step 30 No Trouble		Pass/Fail	
95	step 31 TX p-p result	0.817 UI p-p		1.003 UI p-p
95	step 31 RX p-p LP+HP1	0.772 UI p-p		1.048 UI p-p
95	step 31 RX RMS LP+HP1	0.296 UI RMS		0.347 UI RMS

1 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
96	step 34	No Trouble	Pass/Fail	
96	step 35	TX p-p result	1.378 UI p-p	1.662 UI p-p
96	step 35	RX p-p LP+HP1	1.394 UI p-p	1.700 UI p-p
96	step 35	RX RMS LP+HP1	0.497 UI RMS	0.577 UI RMS
97	step 40	No Trouble	Pass/Fail	
97	step 41	TX p-p result	3.218 UI p-p	3.822 UI p-p
97	step 41	RX p-p LP+HP1	3.164 UI p-p	3.876 UI p-p
97	step 41	RX RMS LP+HP1	1.137 UI RMS	1.352 UI RMS
97	step 45	No Trouble	Pass/Fail	
98	step 46	TX p-p result	10.578 UI p-p	12.462 UI p-p
98	step 46	RX p-p LP+HP1	10.603 UI p-p	12.437 UI p-p
98	step 46	RX RMS LP+HP1	3.768 UI RMS	4.378 UI RMS
99	step 51	No Trouble	Pass/Fail	
99	step 52	TX p-p result	122.740 UI p-p	142.260 UI p-p
99	step 52	RX p-p result	110.760 UI p-p	153.240 UI p-p
99	step 52	RX RMS result	41.355 UI RMS	51.984 UI RMS
STM-16/OC-48 Rates				
91	step 11	Optical Power	-16.0 dBm	-12.0 dBm
91	step 12	No Trouble	Pass/Fail	
91	step 16	RX p-p LP+HP1	N/A	0.071 UI p-p
91	step 16	RX RMS LP+HP1	N/A	0.0055 UI RMS
91	step 16	RX p-p LP+HP2	N/A	0.071 UI p-p
91	step 16	RX RMS LP+HP2	N/A	0.0045 UI RMS
93	step 21	No Trouble	Pass/Fail	

Page No.	Test Description	Min	Result Actual	Max
93	step 22 TX p-p result	0.156 UI p-p		0.244 UI p-p
93	step 22 RX p-p LP+HP1	0.113 UI p-p		0.287 UI p-p
93	step 22 RX RMS LP+HP1	0.0651 UI RMS		0.0763 UI RMS
94	step 26 No Trouble		Pass/Fail	
94	step 27 TX p-p result	0.146 UI p-p		0.254 UI p-p
94	step 27 RX p-p LP+HP2	0.099 UI p-p		0.301 UI p-p
94	step 27 RX RMS LP+HP2	0.0650 UI RMS		0.0764 UI RMS
95	step 30 No Trouble		Pass/Fail	
95	step 31 TX p-p result	0.817 UI p-p		1.003 UI p-p
95	step 31 RX p-p LP+HP1	0.772 UI p-p		1.048 UI p-p
95	step 31 RX RMS LP+HP1	0.296 UI RMS		0.347 UI RMS
96	step 34 No Trouble		Pass/Fail	
96	step 35 TX p-p result	1.378 UI p-p		1.662 UI p-p
96	step 35 RX p-p LP+HP1	1.394 UI p-p		1.700 UI p-p
96	step 35 RX RMS LP+HP1	0.497 UI RMS		0.577 UI RMS
97	step 40 No Trouble		Pass/Fail	
97	step 41 TX p-p result	3.218 UI p-p		3.822 UI p-p
97	step 41 RX p-p LP+HP1	3.164 UI p-p		3.876 UI p-p
97	step 41 RX RMS LP+HP1	1.137 UI RMS		1.352 UI RMS
97	step 45 No Trouble		Pass/Fail	
98	step 46 TX p-p result	8.738 UI p-p		10.302 UI p-p
98	step 46 RX p-p LP+HP1	8.743 UI p-p		10.297 UI p-p
98	step 46 RX RMS LP+HP1	3.110 UI RMS		3.622 UI RMS
99	step 51 No Trouble		Pass/Fail	
99	step 52 TX p-p result	491.02 UI p-p		564.98 UI p-p

1 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
99	step 52 RX p-p result	479.040 UI p-p		576.960 UI p-p
99	step 52 RX RMS result	166.183 UI RMS		207.170 UI RMS
STM-0/STS-3 Rate (Option 106 Only)				
91	step 11 Optical Power	-16.0 dBm		-12.0 dBm
91	step 12 No Trouble		Pass/Fail	
91	step 16 RX p-p LP+HP1	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP1	N/A		0.0055 UI RMS
91	step 16 RX p-p LP+HP2	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP2	N/A		0.0045 UI RMS
STM-1/OC-3 Rate (Option 106 Only)				
91	step 11 Optical Power	-16.0 dBm		-12.0 dBm
91	step 12 No Trouble		Pass/Fail	
91	step 16 RX p-p LP+HP1	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP1	N/A		0.0055 UI RMS
91	step 16 RX p-p LP+HP2	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP2	N/A		0.0045 UI RMS
STM-4/OC-12 Rate (Option 106 Only)				
91	step 11 Optical Power	-16.0 dBm		-12.0 dBm
91	step 12 No Trouble		Pass/Fail	
91	step 16 RX p-p LP+HP1	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP1	N/A		0.0055 UI RMS
91	step 16 RX p-p LP+HP2	N/A		0.071 UI p-p

Page No.	Test Description	Min	Result Actual	Max
91	step 16 RX RMS LP+HP2	N/A		0.0045 UI RMS
STM-16/OC-48 Rates (Option 106 Only)				
91	step 11 Optical Power	-16.0 dBm		-12.0 dBm
91	step 12 No Trouble		Pass/Fail	
91	step 16 RX p-p LP+HP1	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP1	N/A		0.0055 UI RMS
91	step 16 RX p-p LP+HP2	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP2	N/A		0.0045 UI RMS
STM-64/OC-192 Rate				
91	step 11 Optical Power	-12.0 dBm		-8.0 dBm
91	step 12 No Trouble		Pass/Fail	
91	step 16 RX p-p LP+HP1	N/A		0.081 UI p-p
91	step 16 RX RMS LP+HP1	N/A		0.0055 UI RMS
91	step 16 RX p-p LP+HP2	N/A		0.071 UI p-p
91	step 16 RX RMS LP+HP2	N/A		0.0045 UI RMS
93	step 21 No Trouble		Pass/Fail	
93	step 22 TX p-p result	0.150 UI p-p		0.250 UI p-p
93	step 22 RX p-p LP+HP1	0.114 UI p-p		0.286 UI p-p
93	step 22 RX RMS LP+HP1	0.0651 UI RMS		0.0763 UI RMS
94	step 26 No Trouble		Pass/Fail	
94	step 27 TX p-p result	0.150 UI p-p		0.250 UI p-p
94	step 27 RX p-p LP+HP2	0.100 UI p-p		0.300 UI p-p
94	step 27 RX RMS LP+HP2	0.0650 UI RMS		0.0764 UI RMS
95	step 30 No Trouble		Pass/Fail	

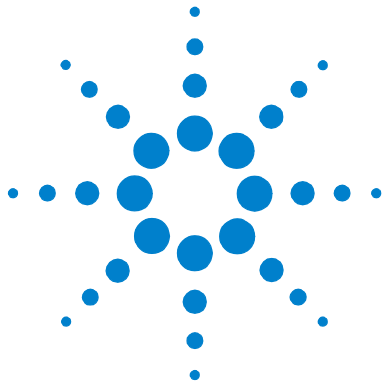
1 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
95	step 31 TX p-p result	0.817 UI p-p		1.003 UI p-p
95	step 31 RX p-p LP+HP1	0.795 UI p-p		1.026 UI p-p
95	step 31 RX RMS LP+HP1	0.296 UI RMS		0.347 UI RMS
96	step 34 No Trouble		Pass/Fail	
96	step 35 TX p-p result	1.378 UI p-p		1.662 UI p-p
96	step 35 RX p-p LP+HP1	1.396 UI p-p		1.724 UI p-p
96	step 35 RX RMS LP+HP1	0.497 UI RMS		0.577 UI RMS
97	step 40 No Trouble		Pass/Fail	
97	step 41 TX p-p result	3.218 UI p-p		3.822 UI p-p
97	step 41 RX p-p LP+HP1	3.124 UI p-p		3.916 UI p-p
97	step 41 RX RMS LP+HP1	1.137 UI RMS		1.352 UI RMS
97	step 45 No Trouble		Pass/Fail	
98	step 46 TX p-p result	8.738 UI p-p		10.302 UI p-p
98	step 46 RX p-p LP+HP1	8.733 UI p-p		10.307 UI p-p
98	step 46 RX RMS LP+HP1	3.110 UI RMS		3.622 UI RMS
99	step 51 No Trouble		Pass/Fail	
99	step 52 TX p-p result	1964.14 UI p-p		2259.86 UI p-p
99	step 52 RX p-p result	1764.16 UI p-p		2459.84 UI p-p
99	step 52 RX RMS result	667.13 UI RMS		826.279 UI RMS
OTN - OTU2 Rate				
91	step 11 Optical Power	-12.0 dBm		-8.0 dBm
91	step 12 No Trouble		Pass/Fail	
91	step 16 RX p-p LP+HP1	N/A		0.081 UI p-p
91	step 16 RX RMS LP+HP1	N/A		0.0055 UI RMS

Page No.	Test Description	Min	Result Actual	Max
91	step 16	RX p-p LP+HP2	N/A	0.071 UI p-p
91	step 16	RX RMS LP+HP2	N/A	0.0045 UI RMS
93	step 21	No Trouble	Pass/Fail	
93	step 22	TX p-p result	0.150 UI p-p	0.250 UI p-p
93	step 22	RX p-p LP+HP1	0.114 UI p-p	0.286 UI p-p
93	step 22	RX RMS LP+HP1	0.0651 UI RMS	0.0763 UI RMS
94	step 26	No Trouble	Pass/Fail	
94	step 27	TX p-p result	0.150 UI p-p	0.250 UI p-p
94	step 27	RX p-p LP+HP2	0.100 UI p-p	0.300 UI p-p
94	step 27	RX RMS LP+HP2	0.0650 UI RMS	0.0764 UI RMS
95	step 30	No Trouble	Pass/Fail	
95	step 31	TX p-p result	0.817 UI p-p	1.003 UI p-p
95	step 31	RX p-p LP+HP1	0.795 UI p-p	1.026 UI p-p
95	step 31	RX RMS LP+HP1	0.296 UI RMS	0.347 UI RMS
96	step 34	No Trouble	Pass/Fail	
96	step 35	TX p-p result	1.378 UI p-p	1.662 UI p-p
96	step 35	RX p-p LP+HP1	1.396 UI p-p	1.724 UI p-p
96	step 35	RX RMS LP+HP1	0.497 UI RMS	0.577 UI RMS
97	step 40	No Trouble	Pass/Fail	
97	step 41	TX p-p result	3.218 UI p-p	3.822 UI p-p
97	step 41	RX p-p LP+HP1	3.124 UI p-p	3.916 UI p-p
97	step 41	RX RMS LP+HP1	1.137 UI RMS	1.352 UI RMS
97	step 45	No Trouble	Pass/Fail	
98	step 46	TX p-p result	8.738 UI p-p	10.302 UI p-p
98	step 46	RX p-p LP+HP1	8.733 UI p-p	10.307 UI p-p

Page No.	Test Description	Min	Result Actual	Max

1 Performance Tests



2 Self Test Overview

Description of the Self Test	128
List of Self Tests	129
Loopback Connections Required for Self Test	131
How to Run a Self Test	135
What to Do if the Self Test Fails	143

The instrument Self Test consists of a number of tests and sub-tests designed to verify the functionality of the instrument measurement and utility ports as well verify the major hardware paths within the instrument.

This section gives an overview of the instrument Self Tests available on the instrument.



Description of the Self Test

The Self Test comprises several tests each consisting of a number of sub tests (the tests available and number of sub tests within each test is option dependent). Self Test can be run as one complete sequence or an individual test may be run. If a failure occurs, then a descriptive text message and Fail Code is returned. An Error example is provided at the end of this section.

The Self Test is selected by pressing the <Menu> key then selecting **System** > **Self Test**. An example of the Self Test page in Selected Test mode is shown below.

The screenshot shows the 'Selftest' interface with the following details:

- Cabling Config:**
 - 2.5G Optical interface port: Tx(1310nm) to Rx + attenuation
 - 10G Optical interface port: Tx(1550nm) to Rx(10Gbs) + attenuation
- Run:**
 - Radio buttons for 'All tests' and 'Selected test'.
 - 'Selected test' dropdown menu is set to 'Confidence Tests'.
- Status:** Test run is currently stopped. A red 'Start' button is visible.
- Estimated test time:** 0 hours 2 minutes remaining.
- Current test:** Confidence Tests
- Current subtest:** Conf DS1
- Failure count:** 0 failure(s) found
- Result:** A large yellow box displays 'PASSED' followed by a timestamp '25-Aug-2008 14:18:54'.
- Footer:** 'Press Select to start/stop selected test' and 'Status: Laser-OFF'.

List of Self Tests

The Self Test comprises of several tests. Each test consists of a number of sub tests. A brief description of each test is given below. The Tests available are dependent on the Model and Option of the instrument.

The Self Test can be run in one of two modes **Run > All Tests** or **Run > Selected Test**.

Title	Description
Confidence Test	This test checks the optical and the electrical paths. A basic signal continuity check is performed. This involves verifying the signal configuration by injecting/detecting a single error. Also includes a subset of the Jitter Accuracy tests if J7231B model.
Optical Power Test	This test checks both the data paths and the optical power measurement circuitry.
DCC Add/Drop Test	The test checks the data paths associated with the DCC add/drop hardware. The DCC loopback should be fitted for this test.
Frequency Test	This test checks the data path through the clock offset and frequency measurement hardware. The test checks the absolute clock offset frequency result.
Jitter Amplitude	Performs checks at all Optical Loopback rates with applied Jitter and uses all Jitter ranges
Jitter Intrinsic	Checks Back to Back intrinsic jitter on all Optical Rates.
Jitter Hit Count	Checks Jitter Hit count on 9.6 Gb/s rate using a 4 MHz Jitter signal.
Jitter Filter	Tests the High Pass Jitter Measurement Filters by applying appropriate Jitter frequency to check filter cut-off point. Repeated for all Optical Rates.

2 Self Test Overview

Title	Description
Jitter Transfer	Runs a single point Jitter Transfer function measurement using 155 Mb/s rate.
Wander Tx/Rx	Applies Wander at known amplitude to test the measurement function. Repeated for all Optical rates.

Loopback Connections Required for Self Test

The Self Test loopbacks required for each test are listed below. Those required are dependent on the Model, Options fitted and Test selected. See diagram on [page 132](#) indicating loopback connections for a J7231B with option 106. The table indicates the minimum test loopback requirements.

Optical Loopback Connections (Dependent on instrument Wavelength options fitted)

Use optical cables P/N 1005-0337 and 15 dB attenuator P/N 1005-0433. Units with 9.95/10.71 Gb/s option also use 10 dB attenuator P/N 1005-1148.

- Connect 9.95/10.71 Gb/s Optical Out <> 10 dB Attenuator <> 9.95/10.71 Gb/s Optical In
- Connect 52 Mb/s-2.5 Gb/s Optical Out <> 15 dB Attenuator <> 52 Mb/s-2.5 Gb/s Optical In

Electrical Connections SONET/SDH 52 Mb/s to 155 Mb/s

(Instruments with Option 012 only)

Use BNC cable P/N 15525A

- Connect SONET/SDH Out (BNC) <> SONET/SDH In (BNC)

Unbalanced Electrical Connections PDH/DSn 2-140 Mb/s and DS3

(Instruments with Option 012 only)

Use BNC cable P/N 15525A

- Connect 2-140 Mb/s DS3 Out (BNC) <> 2-140 Mb/s DS3 In (BNC)

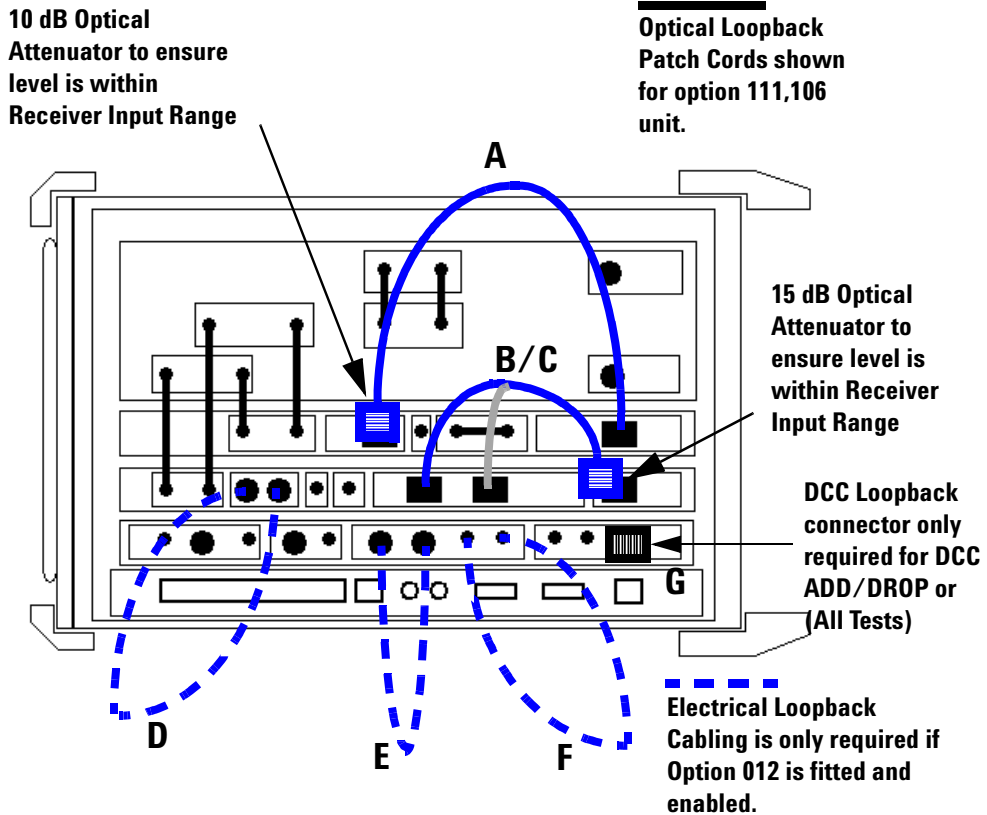
Balanced Electrical Connections 2M/DS1 (Instruments with Option 012 only)

Use 3-pin Siemens cable P/N 15512A and Bantam cable P/N 15670A

- Connect 2M Out (3-pin Siemens) <> 2M In
- Connect DS1 Out <> DS1 In

DCC Loopback Connector (Only required if DCC ADD/DROP TEST or All tests are selected)

- Connect DCC loopback plug to 9-pin DCC port P/N J2125-65011



Loopback connections for option J7231B with 111/106

CAUTION

Safety precautions care and connection cleanliness must be observed to ensure that the optical connections are not damaged or degraded. Ensure the recommended optical attenuation is present in all optical loopback connections as failure to do so could cause self test failure or damage to the optical receivers.

Minimum test loopback requirements

Self Test	Optical Loopback (15 dB attenuation must be used)	Electrical Loopback	DCC Loopback plug
	Loopbacks used are dependent on Options fitted	Only required if Option 012 is installed.	
• All tests	A, B/C	D,E,F	G
• Confidence Test	A, B/C	D,E,F	not required
Confidence Tests (10Gb/s Optics)	A		
Confidence Tests (2.5Gb/s - 52 Mb/s Optics)	B/C		
Confidence Tests Unbalanced SDH/SONET Electrical Ports (155 &- 52 Mb/s)		D	
Confidence Tests(E1, E2, E3, E4 & DS-3 Umbalanced Ports)		E	
Confidence Tests (DS1/ E1 Balanced Ports)		F	
• Optical Power Test	A, B/C	not required	not required
• DCC Add/Drop Test	A	not required	G
• Frequency Test	A, B/C	D,E,F	not required
• Jitter Amplitude	A, B/C		
• Jitter Intrinsic	A, B/C		
• Jitter Hit Count	A, B/C		
• Jitter Filters	A, B/C		

Minimum test loopback requirements

Self Test	Optical Loopback (15 dB attenuation must be used)	Electrical Loopback	DCC Loopback plug
	Loopbacks used are dependent on Options fitted	Only required if Option 012 is installed.	
• Jitter Transfer	A, B/C		
• Wander Tx/Rx	A, B/C		

NOTE

For units with dual wavelength, 1310 & 1550 ports at 52 Mb/s - 2.5 Gb/s. The Self Test should be repeated with the optional optical loopback B/C connection (including attenuator) made to alternative wavelength port. Self Test Port selection should match the wavelength being tested.

How to Run a Self Test

- 1 Press <Menu>, choose **System > Self Test** then press <Select>.
- 2 Ensure all loopbacks are in place and from the Self Test page menu select the appropriate 1310/1550 nm 2.5 G - 52 M optical loopback Cabling Configuration. Loopback accordingly, taking care to ensure attenuation is provided in the Optical loopback paths.
- 3 On the Self Test page choose **Run Selected Test** and choose the selected test. Choose **START** to begin the test.
- 4 The Self Test will now run, selecting each sub test in sequence. The remaining test time to complete the tests is displayed on the right hand side of the Self Test page.
- 5 If any sub test fails an error message and error code will be returned. Up to five sub test errors can be logged before the test ends/aborts.
- 6 End of procedure.

Error messages and codes

The approximate test time for selected test is shown on the Self Test display. Most tests only take 1-2 minutes to complete. If no errors are recorded then all sub tests have passed, indicated by 'PASSED' - time in the lower display. If any sub test fails, an error message is returned along with an error code which returns Test Number, Sub Test Number. An example of a test failure is shown in the following figure.

If a test fails check all the appropriate loopback required for the test/tests selected are in place. Repeat test and refer to "What to do if Self Test fails if necessary.

2 Self Test Overview

Selftest
Cabling Config
2.5G Optical interface port Tx(1310nm) to Rx + attenuation
10G Optical interface port Tx(1550nm) to Rx(10Gb/s) + attenuation
Run All tests Selected test: Confidence Tests
Status: Test run is currently stopped
Estimated test time 0 hours 2 minutes 0 hours 1 minutes remaining
Current test Confidence Tests
Current subtest Conf DS1 4 failure(s) found

Date	Time	Test	Subtest	Failure
25-Aug-2008	14:28:45	Confidence Tests	Conf2.5Gb/s 1310nm	LOS Alarm Detected
25-Aug-2008	14:29:06	Confidence Tests	Conf622Mb/s 1310nm	LOS Alarm Detected
25-Aug-2008	14:29:26	Confidence Tests	Conf155Mb/s 1310nm	LOS Alarm Detected
25-Aug-2008	14:29:47	Confidence Tests	Conf52Mb/s 1310nm	LOS Alarm Detected

[Press Select to start/stop selected test](#)
Status: Laser-OFF

List of Self Test Sub Tests

A list of all the possible sub tests in any given Test is shown below. Each interface is tested in sequence starting with the highest rate interface down to the lowest rate interface. The actual number of sub tests run is dependent on the instrument options fitted, for example single or dual wavelength.

- Confidence Test

Sub Test Number	Sub Test Description
1	Conf 10 Gb/s 1550 nm - Opt Power
2	Conf 10 Gb/s 1550 nm - AU-4-64c
3	Conf 10 Gb/s 1550 nm - AU-4-16c
4	Conf 2.5 Gb/s 1310 nm - Opt Power
5	Conf 2.5 Gb/s 1310 nm
6	Conf 2.5 Gb/s 1550 nm
7	Conf 622 Mb/s 1310 nm
8	Conf 622 Mb/s 1550 nm
9	Conf 155 Mb/s 1310 nm
10	Conf 155 Mb/s 1550 nm
11	Conf 52 Mb/s 1310 nm
12	Conf 52 Mb/s 1550 nm
13 (opt 012 only)	Conf 155 Mb/s
14 (opt 012 only)	Conf 52 Mb/s
15 (opt 012 only)	Conf E4 Unbal
16 (opt 012 only)	Conf E3 Unbal
17 (opt 012 only)	Conf E2 Unbal
18 (opt 012 only)	Conf E1 Unbal
19 (opt 012 only)	Conf E1 Bal
20 (opt 012 only)	Conf DS3 Unbal
21 (opt 012 only)	Conf DS1Bal
22 (opt 112 only)	10.7 Gb/s - Opt Power
23 (opt 112 only)	10.7 Gb/s Test Signal

2 Self Test Overview

24 (opt 112 only)	10.7 Gb/s SDH Payload
25 (opt 112 only)	10.7 Gb/s range 0.8 UI Intrinsic
27 (opt 112 only)	10.7 Gb/s range 30 UI Intrinsic
28	10 Gb/s range 0.8 UI Intrinsic
30	10 Gb/s range 30 UI Intrinsic
31	2.5 Gb/s range 0.8 UI Intrinsic
33	2.5 Gb/s range 30 UI Intrinsic
34 (opt 112 only)	10.7 Gb/s range 0.8 UI Intrinsic
37 (opt 112 only)	10.7 Gb/s range 30 UI Intrinsic
38	10 Gb/s range 0.8 UI Amplitude
41	10 Gb/s range 30 UI Amplitude
42	2.5 Gb/s range 0.8 UI Amplitude
45	2.5 Gb/s range 30 UI Amplitude

- Optical Power Test

Sub Test Number	Sub Test Description
1	10 Gb/s 1550nm
2	2.5 Gb/s 1310/1550nm
3	622 Mb/s 1310/1550nm

- DCC Add/Drop Test

Sub Test Number	Sub Test Description
1	Performed at the maximum available DCC/GCC channel rate

- Frequency Measurement

Sub Test Number	Sub Test Description
1	Performed at the maximum available Optical line rate
2	E4 Unbal
3	E1 Bal

- Jitter Amplitude

Sub Test Number	Sub Test Description
1	52 Mb/s - 200 kHz @ 0.25 UI, 0.8 UI Range
2	52 Mb/s - 200 kHz @ 0.25 UI, 3 UI Range
3	52 Mb/s - 2 kHz @ 4 UI, 30 UI Range
4	52 Mb/s - 20 Hz @ 50 UI, 64 UI Range
5	155 Mb/s - 650 kHz @ 0.25 UI, 0.8 UI Range
6	155 Mb/s - 650 kHz @ 0.25 UI, 3 UI Range
7	155 Mb/s - 6.5 kHz @ 4 UI, 30 UI Range
8	155 Mb/s - 20 Hz @ 50 UI, 64 UI Range
9	622 Mb/s - 2500 kHz @ 0.25 UI, 0.8 UI Range
10	622 Mb/s - 2500 kHz @ 0.25 UI, 3 UI Range
11	622 Mb/s - 25 kHz @ 4 UI, 30 UI Range
12	622 Mb/s - 20 Hz @ 200 UI, 256 UI Range
13	2.5 Gb/s - 10 MHz @ 0.25 UI, 0.8 UI Range
14	2.5 Gb/s - 10 MHz @ 0.25 UI, 3 UI Range
15	2.5 Gb/s - 100kHz @ 4 UI, 30 UI Range
16	2.5 Gb/s - 20 Hz @ 2000 UI, 2500 UI Range
17	10 Gb/s - 40 MHz @ 0.25 UI, 0.8 UI Range
18	10 Gb/s - 40 MHz @ 0.25 UI, 3 UI Range
19	10 Gb/s - 4 MHz @ 4 UI, 30 UI Range
20	10 Gb/s - 20 Hz @ 8000 UI, 10000 UI Range
21	10.7 Gb/s - 40 MHz @ 0.25 UI, 0.8 UI Range
22	10.7 Gb/s - 40 MHz @ 0.25 UI, 3 UI Range

23	10.7 Gb/s - 4 MHz @ 4 UI, 30 UI Range
24	10.7 Gb/s - 20 Hz @ 8000 UI, 10000 UI Range

- Jitter Intrinsic

Sub Test Number	Sub Test Description
1-4	52 Mb/s, all RX ranges
5-8	155 Mb/s all RX ranges
9-12	622 Mb/s RX ranges
13-16	2.5 Gb/s all RX ranges
17-20	10 Gb/s all RX ranges
21-24	10.7 Gb/s all RX ranges

- Jitter Transfer Function

Sub Test Number	Sub Test Description
1	155 Mb/s, 100 kHz @ 0.15 UI

- Jitter Hit Count

Sub Test Number	Sub Test Description
1	10 Gb/s, 4 MHz @ 0.4 UI - Threshold 0.24 UI
2	10 Gb/s, 4 MHz @ 0.4 UI - Threshold 0.16 UI

- Filter Tests

Sub Test Number	Sub Test Description
1	52 Mb/s check all HP filter cut-off

2 Self Test Overview

2	155 Mb/s check all HP filter cut-off
3	622 Mb/s check all HP filter cut-off
4	2.5 Gb/s check all HP filter cut-off
5	10/10.7 Gb/s check all HP filter cut-off

- Wander Tests

Sub Test Number	Sub Test Description
1	52 Mb/s, 100,000 uHz @ 100 UI
2	155 Mb/s, 100,000 uHz @ 250 UI
3	622 Mb/s, 100,000 uHz @ 1250 UI
4	2.5 Gb/s, 100,000 uHz @ 5000 UI
5	10 Gb/s, 100,000 uHz @ 5000 UI

What to Do if the Self Test Fails

- 1 Check all connections to make sure that all the correct loopback connections are in place and Optical Attenuators are fitted as required.
- 2 Be suspicious of any optical interface failures and if necessary clean all optical connections with a recognized cleaning kit before retrying the Self Test.
- 3 Carefully check the Error Code/Messages, in particular ensure all of the required loopback connections are made.
- 4 If the problem persists then contact your local Agilent Service Office or representative.

Tips and Checks to Confirm Correct Optical Loopback

- Make sure connectors are located in key/notch of the port connectors to ensure full insertion.
- Check transmitter and receiver are set to the same signal rate and that the correct laser is on when test is being run.
- Press <Smart Test>, choose **Shortcuts > Optical Power** then press <Select>. Check the Received signal level is in the Green BER measurement power range.
- Ensure all optical connections are clean and fully connected with no sharp bends or twists in the optical patch cord. Check the optical cord and attenuator are not damaged and/or substitute with equivalent.
- If problem relates to a particular operation rate, mode or function perform a manual back to back operation check to confirm signal path.

2 Self Test Overview

Index

Numerics

- 10.71 Gb/s (OTN) Power Level and Eye Mask Tests, 42
- 52/155 and 622 Mb/s Optical Output Checks, 32
- 9.95 and 10.71 Gb/s Optical Output Checks, 40

C

- Calibration Cycle, 8
- Clock Offset/Frequency Measurement Sub Test, 139, 140, 141, 142
- Confidence Sub Test, 137
- Confidence Test, 13, 129

D

- DCC Add/Drop Sub Test, 139
- DCC Add/Drop Test, 129
- Default Settings, Recall of, 12
- DS1 Clock test
 - Alternative, 23

E

- External Clock Reference Inputs and Clock Reference Output, 24

F

- Frequency Measurement Self Test, 129
- Frequency Measurement Test, 13

H

- How to
 - run the Self Test, 135

I

- Internal Reference Clock Accuracy, 18, 87
 - Equipment Required, 19, 88
 - Procedure, 19

L

- Line frequency measurement, 45
- Loopback connections required for Self Test, 14, 131

O

- OC-1/STM-0 Power Level and Eye Mask Tests., 32, 65
- OC-12/STM-4 Power Level and Eye Mask Tests, 36
- OC-192/STM-64 Power Level and Eye Mask Tests, 40
- OC-3/STM-1 Power Level and Eye Mask Tests, 35, 72
- OC-48/STM-16 Power Level and Eye Mask Tests, 37, 39
- Optical Loopback-Tips and Checks, 143
- Optical power measurement, 45
- Optical Power Measurement Sub Test, 139
- Optical Power Test, 129
- Optical Pulse Mask and Output
 - Characteristics, 31, 63
- Optical Receiver Sensitivity, Optical Power and Frequency Measurement, 45
 - OC-1/STM-0 and OC-3/STM-1 Rates, 47
 - OC-12/STM-4 Rate, 52
 - OC-192/STM-64 Rate, 59
 - OC-48/STM-16 Rates, 54

P

- Performance Self Test
 - What to do if it fails, 17
- Performance Test Record, 108
- Performance Tests - Recommended Test Equipment, 9

R

- Recall Default Settings, 12
- Recommended Test Equipment, Performance Tests, 9

S

- Self Test, 13
 - Confidence Test, 129
 - DCC Add/Drop Test, 129
 - Frequency Measurement, 129
 - How to run, 16, 135
 - Loopback Connections, 131
 - Optical Power Test, 129
 - sub tests, 136
 - What to do if it fails, 143
 - Self Test Loopback Cables and Accessories, 11
 - Self Test, Description of, 128
 - Specifications, 45
 - Sub Test
 - Clock Offset/Frequency Measurement, 139, 140, 141, 142
 - DCC Add/Drop Test, 139
 - Optical Power Measurement, 139
 - Sub Tests
 - Confidence Test, 137

T

- Tips and Checks to Confirm Correct Optical Loopback, 143

W

- What to do if the Self Test fails, 143

In This Book

This book contains verification information for the OmniBER OTN instrument.

Printed in U.K. 08/03
J7230-90056



Agilent Technologies