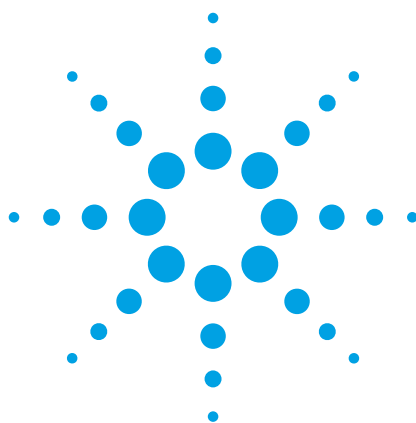


# Agilent OmniBER OTN Family

OmniBER OTN  
communications  
performance analyzer

## Installation & Verification Manual



Agilent Technologies





# **Agilent OmniBER Family OmniBER OTN**

**J7231B & J7232A Models**

## **Installation & Verification Manual**



**Agilent Technologies**

# Notices

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## 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 installing and verifying the performance of your instrument

### **1 Introduction**

This chapter provides a brief description of the product and also all safety requirements the user should be aware of when using the instrument.

### **2 Installation (Getting Started)**

This chapter provides general information on how to install and connect up the instrument.

### **3 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.

### **4 Self Test Overview**

This chapter details all of the Self Test procedures.

### **5 ETSI/ANSI Terminology**

This chapter provides a table explaining the equivalent SDH/SONET terms.

## 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.

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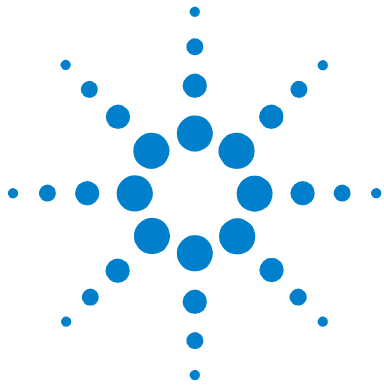
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This chapter provides a brief description of the product and also all safety requirements you should be aware of when using the instrument.



## Product Description

The Agilent OmniBER OTN provides all the test capability you need to test the performance of today's high-capacity transmission systems and networks, in one portable package.

### OmniBER OTN J7231B



- Global test coverage (SONET, SDH) and optical transport network (OTN) G.709 testing at 10.71 Gb/s, including the availability of a range of standard and concatenated mappings
- Jitter testing at all optical rates up to 10.7 Gb/s, including Jitter Tolerance and Jitter Transfer
- Wander testing at all optical rates up to 10 Gb/s, including Wander Tolerance
- All standard error and alarm measurements, plus optical power, frequency, service disruption time, pointer movements and performance analysis
- Simultaneous all-channel testing
- Thru-mode monitoring
- Comprehensive OTN/SONET/SDH overhead testing
- Broad range of graphical results tools
- Comprehensive online help facilities including Online Help, context-sensitive help for each control field and facility for adding your own help documents

See “[Option Guide](#)” on page 12, for more product details.

### **OmniBER OTN J7232A**



- Global test coverage (SONET, SDH), testing up to 2.5 Gb/s, including the availability of a full range of standard and concatenated mappings, GFP/LAPS/Ethernet MAC/VT/TU payload testing and DS1/3 and 2/34/140 Mb/s service mappings
- All standard error and alarm measurements, plus optical power, frequency, service disruption time, pointer movements and performance analysis
- Simultaneous all-channel testing (up to 192 STSs/AUs)
- Thru-mode monitoring
- Comprehensive SONET/SDH overhead testing
- Broad range of graphical results tools
- Comprehensive online help facilities including Online Help, context-sensitive help for each control field and facility for adding your own help documents

See “[Option Guide](#)” on page 12, for more product details.

## Option Guide

This guide explains the features offered with the instrument mainframe and its associated options.

For more information, see:

- [“Mainframe Test Rate Capability”](#) on page 13
- [“Optical Interfaces”](#) on page 13
- [“Optical Transport Network Testing”](#) on page 14
- [“Next Generation SONET/SDH Testing”](#) on page 14
- [“PDH/DSn Testing/Electrical Interfaces”](#) on page 14
- [“Optical Connectors \(Product Options\)”](#) on page 14
- [“Recommended Accessories”](#) on page 15
- [“Accessories”](#) on page 15

## Mainframe Test Rate Capability

Mainframe	Optical Test Interfaces
J7231B BER and Jitter Tester (10 Gb/s)	OC-1, OC-3, OC-12, OC-48, OC-192 STM-0, STM-1, STM-4, STM-16, STM-64
J7232A BER Tester (2.5 Gb/s)	OC-1, OC-3, OC-12, OC-48 STM-0, STM-1, STM-4, STM-16
J7231B-004/J7232A-004	Side mounted connectors
J7231B-005/J7232A-005	Rear mounted connectors

## Optical Interfaces

	Wavelength	Option
Optical Interfaces operating at 2.5 Gb/s. Includes 52 and 155 Mb/s electrical interfaces.	No 52-2488 Mb/s test interfaces required	100*
	1310 nm optical transmitter	104
	1550 nm optical transmitter	105
	1310/1550 nm optical transmitter	106
Optical Interfaces operating at 10 Gb/s and 10.71 Gb/s	1550 nm optical transmitter	108*

\* Not available for J7232A instrument.

### Optical Transport Network Testing

Option for OTN G.709 testing. Not available for J7232A instrument.

	Option
OTU2 testing at 10.71Gb/s	112

### Next Generation SONET/SDH Testing

Not available for J7231B instrument.

	Option
Ethernet-over-SONET/SDH	320

### PDH/DSn Testing/Electrical Interfaces

	Option
DSn/PDH framed/unframed testing plus DSn/PDH electrical interfaces	012

### Optical Connectors (Product Options)

Connector	Option
FC/PC Adapters fitted on all optical interfaces	609
SC Adapters fitted on all optical interfaces	610
ST Adapters fitted on all optical interfaces	611



## Recommended Accessories

**Connectors** Alternative optical connectors are available for your product; order the appropriate J7283A (FC/PC), J7284A (SC) or J7285A (ST) accessory (connector). The number of connectors required for your product is shown below.

	J7283A (FC/PC)	J7284A (SC)	J7285A (ST)
J7231B/J7232A with option 104/105	4	4	4
J7231B/J7232A with option 106	5	5	5
J7231B with option 100	2	2	2

## Warranty and Service Plans

Terms and conditions of the applicable warranty for this product are contained in the sales and related documentation supplied separately.

Please contact your nearest Agilent Technologies Sales Office for further information on warranty and extended warranty options.

For access to Agilent Product information and sales/service contacts, please visit <http://www.agilent.com>.

## Accessories

### Transit Case

**J7266A:** Hard transit case for OmniBER OTN with side mounted connectors (J7230B-004/J7231B-004).

### Additional Documentation

**J7275A-ABA:** Full set of English printed manuals: User Guide, Quick Reference Guide, Remote Control, Verification manual and CD-ROM.

### Optical Adapters and Cables

**J7281A:** DCC port converter cable: 9-pin miniature D-type to 37-pin D-type (RS-449, female)

**J7283A:** FC/PC optical connector (exchangeable)

**J7284A:** SC optical connector (exchangeable)

**J7285A:** ST optical connector (exchangeable)

## General Information

### Responsibilities of the Customer

The customer shall provide:

- 1 Access to the products during the specified periods of coverage to perform maintenance.
- 2 Adequate working space around the products for servicing by Agilent personnel.
- 3 Access to and use of all information and facilities determined necessary by Agilent to service and/or maintain the products. (Insofar as these items may contain proprietary or classified information, the customer shall assume full responsibility for safeguarding and protection from wrongful use.
- 4 Routine operator maintenance and cleaning as specified in the Agilent Operating and Service Manuals.
- 5 Consumables such as paper, disks and cleaning materials.

### Certification

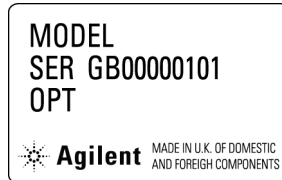
Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent Technologies further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility and to the calibration facilities of other International Standards Organization members.

### Assistance

Product maintenance agreements and other customer assistance agreements are available for Agilent products.

### Instruments Covered By Manual

Attached to the **rear panel** of the instrument is a serial number plate. The serial number plate has a two letter reference denoting country of origin (GB = Great Britain) and an eight digit serial number. The serial number is unique to each instrument and should be quoted in all correspondence with Agilent, especially when ordering replacement parts.



Serial Number Plate

## Storage and Shipment

The instrument may be stored or shipped in environments within the following limits:

### Temperature

-40 to +75 degC

### Altitude

Up to 3,000 meters (9,840 feet)

The instrument should also be protected from temperature extremes which could cause condensation within the instrument.

### Repackaging for Shipment

**Shipping to Service Centers.** You can re-use the packaging, if in its original condition, for onwards transportation and to return the instrument for calibration or servicing. If the instrument is being returned to Agilent for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. In any correspondence, refer to the instrument by model number and full serial number.

### CAUTION

The instrument cover should always be fitted when transporting the instrument.

---

**Packaging.** The following general instructions should be followed when repackaging with commercially available materials:

- Wrap instrument in heavy paper or plastic. If the instrument is being shipped to Agilent, attach a tag indicating the type of service required, return address, model number and full serial number.
- Use a strong shipping container. A double wall carton made of 350 pound test material is adequate.

- Use a layer of shock absorbing material 70 to 100 mm (3 to 4 inch) thick, around all sides of the instrument to provide firm cushioning and prevent movement inside the container. Protect the Front Panel controls and Top Panel connectors with cardboard.
- Seal shipping container securely.
- Mark shipping container FRAGILE to ensure careful handling.
- In any correspondence, refer to instrument by model number and full serial number.

### Weight and Dimensions

---

<b>Weight</b>	J7231B 22.7 kg (50 lb), J7232A 17.2 kg (38 lb)
<b>Dimensions</b>	300 x 365 x 450 mm (11.75 x 14.5 x 17.75 in) (height x width x depth)

---

## Safety Information

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

### **WARNING**

**DO NOT operate damaged equipment. Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to an Agilent Sales and Service Office for service and repair to ensure the safety features are maintained.**

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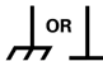
In particular, the operator should note the following safety information:

- ["Safety Symbols"](#) on page 22
- ["Optical Connector Safety Information"](#) on page 24
- ["Laser Warning Symbols"](#) on page 26
- ["Additional Precautions for Service Engineers"](#) on page 27
- ["ESD Precautions"](#) on page 27
- ["Avoiding Problems When Making Measurements"](#) on page 29
- ["Operators Maintenance"](#) on page 30

## Safety Symbols

The following symbols on the instrument and in the user documentation indicate precautions you should take to maintain safe operation of the instrument.

Caution: refer to accompanying instructions in user documentation.



Indicates the field wiring terminal that must be connected to earth ground before operating the equipment - protects against electrical shock in case of fault.

Frame or chassis ground terminal - typically connects to the equipment's metal frame.

Alternating current (AC).

This symbol indicates the position of the operating switch for 'On' mode.

This symbol indicates the position of the operating switch for 'Off' mode.

Indicates hazardous voltages.

This symbol indicates that a device, or part of a device, may be susceptible to electrostatic discharges (ESD) which can result in damage to the product. Observe ESD precautions given on the product, or its user documentation, when handling equipment bearing this mark.

### **WARNING**

**Warning denotes a hazard. It calls attention to a procedure, which if not correctly performed or adhered to could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.**



**CAUTION**

Caution denotes a hazard. It calls attention to a procedure, which if not correctly performed or adhered to could result in damage to or destruction of the instrument. Do not proceed beyond a caution note until the indicated conditions are fully understood and met.

---



Indicates that a laser is fitted. The user must refer to the manual for specific Warning or Caution information to avoid personal injury or damage to the product.

---

## Optical Connector Safety Information

**WARNING**

To prevent personal injury, avoid use that may be hazardous to others, and maintain the instrument in a safe condition. Ensure the information given below is reviewed before operating the instrument.

---

For your protection, review all laser information given in this manual before installing or using the instrument:

- [“Laser Product Classification”](#) on page 25
- [“Connecting or Disconnecting Optical Cables”](#) on page 25
- [“Laser Warning Symbols”](#) on page 26
- [“Avoiding Optical Receiver Overload”](#) on page 26
- [“Additional Precautions for Service Engineers”](#) on page 27
- [“Cleaning Optical Connectors”](#) on page 30

## Laser Product Classification

All optical modules are classified as Class I (non-hazardous) laser product in the USA which complies with the United States Food and Drug Administration (FDA) Standard 21 CFR Ch.1 1040.10, and are classified as Class 1 (non-hazardous) laser products in Europe which complies with EN 60825-1 (1994).

## Connecting or Disconnecting Optical Cables

### CAUTION



When connecting or disconnecting, ensure you are grounded or make contact with the metal surface of the Mainframe with your free hand to bring you, the module, and the mainframe to the same static potential.

Modules may be susceptible to ESD while the module is installed in the mainframe. You should read the additional ESD information provided in this manual before servicing the instrument.

### NOTE

The connectors available depend on the options fitted to your instrument. See the Instrument Tour in the Getting Started section of the Online Help for more information on connectors.

To avoid hazardous exposure to laser radiation, observe the following during system operation:

- ALWAYS DEACTIVATE THE LASER BEFORE CONNECTING OR DISCONNECTING OPTICAL CABLES.
- When connecting or disconnecting optical cables between the test set and device-under-test, observe the connection sequences given below.

**Connecting:** Connect the optical cable to the input of the device-under-test before connecting to any of the instrument's **Optical Out** connectors.

**BEFORE** connecting any signal to the **Optical In** ports ensure sufficient external attenuation is inserted in the signal path so the power level is within the 'Operating Range' for the port. Also

ensure that any signal transient conditions never exceed the maximum stated limit for that port.

Recommended input ‘Operating Power’ levels for each input port are printed on the connector panel adjacent to the port.

**Disconnecting:** Disconnect the optical cable from the **Optical Out** connector before disconnecting from the device-under-test. Always close the fiber optic connector dust caps over the laser aperture.

- NEVER examine or stare into the open end of a broken, severed, or disconnected optical cable when it is connected to one of the Transmission Test Set Optical Out connectors.
- Arrange for service-trained personnel, who are aware of the hazards involved, to repair optical cables.

### Laser Warning Symbols

The instrument’s connector panel is labelled with the following:

CLASS 1 LASER PRODUCT

CLASS 1 LASER PRODUCT translates as follows:

Finnish - LUOKAN 1 LASERLAITE

Finnish/Swedish - KLASS 1 LASER APPARAT

This label indicates that the radiant energy present in this instrument is non-hazardous.

### Avoiding Optical Receiver Overload

Check that you do not overload the receiver when connecting an optical transmitter to an optical receiver. This applies to elements under test and also the receiver input ports. To avoid optical receiver overload, complete the following:

- Check for Status messages on the instrument display warning of overload conditions.
- Check the printed output/input power level information on the connector panel:

- a Tx Optical Out ports:** Maximum available output power.
- b Rx Optical In ports:** Maximum input power (damage level) the receiver input can accept before damage occurs. Recommended input power operating range for signals applied to the receiver. When performing tests, it is recommended that you drive the optical receiver with a signal that has an average power in the middle of the receiver's operating range (mid-way between the upper and lower levels printed next to the Optical In port).

## Additional Precautions for Service Engineers

**DO NOT** substitute parts or modify equipment. Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Agilent Sales and Service Office for service and repair to ensure the safety features are maintained.

**DO NOT** service or adjust the instrument while alone. Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

For more information, see: "[Safety Information](#)" on page 21.

### ESD Precautions

The instrument contains components sensitive to electrostatic discharge (ESD). The smallest static voltage most people can feel is about 3500 volts. It takes less than one tenth of that (about 300 volts) to destroy or severely damage static sensitive circuits. Often, static damage does not immediately cause a malfunction but significantly reduces the component's life.

To prevent component damage, follow the handling precautions below.

- Keep the assembly in its conductive storage box/bag when not installed in the Mainframe. Save the box/bag for future storage of the assembly.

- Before handling the assembly, select a work area where potential static sources are minimized. Avoid working in carpeted areas and non-conductive chairs. Keep body movement to a minimum. It is recommended that you use a controlled static workstation.
- Avoid touching any components or edge connectors. When you install the assembly, keep one hand in contact with the protective bag as you pick up the assembly with your other hand. Before installing the assembly, ensure that you are grounded or make contact with the metal surface of the mainframe with your free hand to bring you, the assembly, and the mainframe to the same static potential. This also applies whenever you connect or disconnect cables on the instrument.

## Avoiding Problems When Making Measurements

Bit errors can occur due to network defects (such as faulty network elements, damaged optical fiber or dust/dirt particles in the fiber connections) or problems with the test environment/setup. Follow the steps below to avoid problems when making measurements.

▶ **To avoid introducing errors when performing tests:**

- 1** Ensure that optical fibers connecting the instrument to the network are not damaged - check that fibers have not been crimped.
- 2** Avoid acute bends in the fiber. Ensure that fibers only have gentle arcs.
- 3** If the instrument is left unattended for a long term test, ensure that the equipment is not in a position where people will disturb the connecting fibers.
- 4** Ensure that all fiber connections are clean and dirt-free. Use a fiberscope to measure the cleanliness of a (unpowered) fiber. A poorly cleaned fiber results in a drop in power. Alternatively, use a power meter (e.g. the instrument's internal power meter) to measure the power at the end of a fiber, the other end of which is connected to the network.
- 5** Before connection is made, always clean the connector ferrule tip with acetone or alcohol using a cotton swab. Dry the connector with compressed air. Failure to maintain cleanliness of connectors is liable to cause excessive insertion loss.
- 6** Ensure that the correct time and date is set on the instrument.

## Operators Maintenance

**WARNING**

**No operator serviceable parts inside. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.**

---

Maintenance appropriate for the operator is:

- Cabinet cleaning - clean the cabinet using a dry cloth only.
- [Cleaning Optical Connectors](#)
- Cleaning SMA Connectors.
- Ensure ventilating fan cover is clean.

### Cleaning Optical Connectors

You should clean the optical connectors at regular intervals using the following materials:

Description	Agilent Part Number
Compressed Air Can or Blow Brush	
Isopropyl Alcohol	8500-5344
Lens Cleaning Paper	9300-0761
Swabs	5080-5400

**CAUTION**

Do not insert any tool or object into the optical IN or OUT ports of the instrument as damage to or contamination of the optical fiber may result.

---



#### To clean the optical connectors

- 1 Disconnect the instrument from the Power Line or switch off the laser transmitter before commencing this cleaning procedure.



- 2 Remove the adapters from the optical IN and OUT ports by flipping back the lever on the optical adapter.
- 3 Using the blow brush with the brush removed blow through the ferrule of the standard flexible connector and the adapter.
- 4 If the optical fiber of the fixed connector requires further cleaning this entails disassembly of the module. This should be carried out only by suitably trained service personnel.
- 5 Apply some isopropyl alcohol to a piece of the cleaning paper and clean the barrel of the adapter. Using a new piece of cleaning paper, clean the face of the adapter. Repeat this operation, using a new piece of cleaning paper each time.
- 6 Use a blow brush or compressed air to remove any particles of cleaning paper which may be present.
- 7 These procedures also apply to any Optical patch cords or attenuators used to avoid subsequent contamination/damage to the Optical ports.

Replace the adapters in the optical connector. Secure in place by clicking the retaining lever back into position.

### Cleaning SMA Connectors

Depending on application and environment it may be appropriate to clean the grounding threads of SMA connectors (and SMA semi-rigid links where fitted) using the following materials: This ensures optimum connection and signal screening.

Description	Agilent Part Number
Compressed Air Can or Blow Brush	
Isopropyl Alcohol	8500-5344
Lens Cleaning Paper	9300-0761
Swabs	5080-5400

**CAUTION**

Do not insert any tool or object into the SMA connector ports to avoid damage.

---

▶ **To clean the SMA connectors**

- 1 Disconnect the instrument from the Power Line before commencing this cleaning procedure.
- 2 Apply some isopropyl alcohol to a piece of the clean lint-free cloth and clean the outer threads of SMA bulkhead connectors taking care not to introduce cleaning fluid into center connection.
- 3 Where a unit has SMA semi-rigid links carefully remove ONE of these using an appropriate spanner, taking note of position and orientation. Clean the bulkhead connectors as in step 2 and clean the inside threads of the SMA link taking care not to bend/damage the center connector pin.
- 4 Carefully refit the link taking care not to mis-thread or overtighten, as damage could result in an expensive repair. Always use a torque spanner to refit and set to 0.9 Nm.
- 5 Repeat for other SMA links and also any SMA cables used in the test configuration to avoid subsequent contamination of instrument connectors.

## Statement of Compliance

This instrument has been designed and tested in accordance with IEC Publication 61010-1 (1990) + A1:1992 + A2(1995) Safety requirements for Electrical Equipment for Measurement, Control and Laboratory Use, and has been supplied in a safe condition. The instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.



The CE mark shows that the product complies with all relevant European legal Directives.

**ISM 1-A**

This is a symbol of an Industrial Scientific and Medical Group 1 Class A product.

**ICES/NMB-001**

This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada.



The CSA mark is a registered trademark of the Canadian Standards Association.



Australian EMC Regulations

The C-Tick mark is a registered trademark of the Australian Communications Authority. This signifies compliance with the Australian EMC Framework Regulations under the terms of the Radiocommunications Act of 1992.

### **Noise Declaration (German)**

LpA<70dB

am Arbeitsplatz (operator position)

normaler Betrieb (normal position)

nach DIN 45635 pt.19 (per ISO 7779)

### **Electromagnetic Compatibility**

This product conforms with the protection requirements of European Council Directive 89/336/EEC for Electromagnetic Compatibility (EMC).

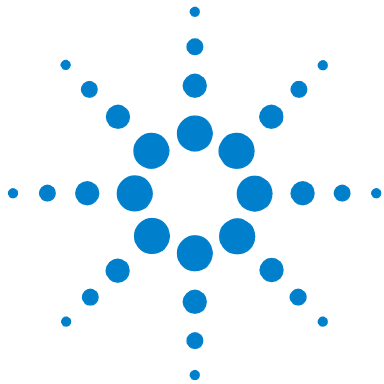
The conformity assessment requirements have been met using the technical Construction file route to compliance, using EMC test specifications EN 55011:1991 (Group 1, Class A) and EN 50082-1:1992.

In order to preserve the EMC performance of the product, any cable which becomes worn or damaged must be replaced with the same type and specification

If this instrument is subjected to ESD discharges whilst performing measurements occasional erroneous jitter hits or bit errors may be recorded.

### **Declaration of Conformity**

A Declaration of Conformity is provided on the CD-ROM shipped with your instrument.



## 2 Installation (Getting Started)

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This chapter provides general information on how to install and connect up the instrument, and how to check that the instrument operates correctly on delivery.



# Preparation

## Initial Inspection

### **WARNING**

**To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure.**

---

Inspect the shipping container for damage.

If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked both mechanically and electrically.

For procedures for checking operation on delivery See [“Operation Checks on Delivery”](#) on page 42.

If the contents of the shipment are incomplete, if there is mechanical damage or defect, notify the nearest Agilent Office.

If the instrument does not pass the delivery checks given (See [“Operation Checks on Delivery”](#) on page 42.) notify the nearest Agilent office.

If the shipping container is also damaged, or the cushioning material shows signs of stress, notify the carrier as well as the nearest Agilent office. Keep the shipping materials for the carrier’s inspection. The Agilent office will arrange for repair or replacement without waiting for claim settlement.

## Operating Environment

**DO NOT** operate the product in an explosive atmosphere or in the presence of flammable gasses or fumes.

This instrument may be operated in environments within the following limits:

**Temperature:** 0 to +40 degC (option 004); 0 to +45 degC (option 005).

**Altitude:** Up to 3000 m (9,840 feet).

**Humidity:** Up to 90% relative humidity to 40°C, but it should be protected from temperature extremes which may cause condensation.

To ensure adequate cooling, do not obstruct air vents in the instrument cabinet.

**CAUTION**

This instrument is designed for use in Installation Category II and Pollution Degree 2 per IEC 61010-1 and IEC 60664 respectively.

Ventilation Requirements: When installing the instrument in a cabinet, the convection into and out of the instrument must not be restricted. If the total power dissipated in the cabinet is greater than 800 watts, then forced convection must be used.

---

This product is suitable for indoor use only.

## Preparation for Use

**WARNING**

If this instrument is not used as specified, the protection provided by the equipment could be impaired. This instrument must be used in a normal condition only (in which all means for protection are intact).

---

### Power Requirements

The instrument requires a power source of 100 to 240 V ac at a frequency between 47 and 66 Hz (nominal).

**CAUTION**

Mains supply voltage fluctuations should not exceed +/- 10% of the nominal line voltage.

---

**Power consumption:** 390VA maximum.

There are no customer replaceable fuses in the instrument.

### Connecting to the Power Supply

#### **WARNING**

**This is a Safety Class I instrument (provided with a protective earthing ground, incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the instrument is likely to make the instrument dangerous. Intentional interruption is prohibited.**

**The mains switch fitted to the instrument is a single pole device and must not be used as the disconnect device. An IEC320 coupler is intended as the main disconnect device. The switch is marked I and 0. The I indicates on and the 0 indicates off. Do not position the instrument such that access to the coupler is impaired.**

**Before switching on this instrument, make sure that the line supply voltage is in the specified ranges. Range selection is automatic.**

---

As the IEC320 coupler is the disconnect device, consideration must be given to the following when installing the instrument in a rack:

- An adequately rated switch (250V, 10A) or circuit breaker (250V, 5A) shall be included in the rack.
- It should be in close proximity to the instrument and within easy reach of the operator.
- It shall be marked as a disconnect device.



## Power Cable

### WARNING

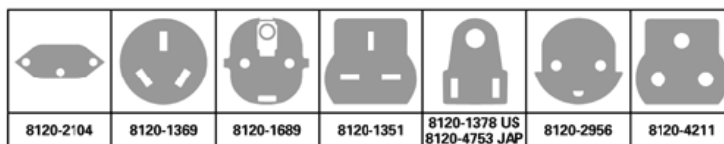
To avoid the possibility of injury or death, the following precautions must be followed before the instrument is switched on:

- (a) While this is a Class I product, provided with a protective earthing conductor in a power cord, an external chassis earthing terminal has also been provided. This terminal is for use where the earthing cannot be assured. At least an 18AWG earthing conductor should be used in such an instance, to ground the instrument to an assured earth terminal. The external chassis earth terminal is on the rear of the instrument.
- (b) If this instrument is to be energized via an auto-transformer to reduce or increase the line voltage, make sure that the common terminal is connected to the neutral pole of the power source.
- (c) The power cable plug shall only be inserted into a socket outlet provided with a protective ground contact. The protective action must not be negated by the use of an extension cord without a protective conductor (grounding).



**Figure 1** Earthing terminal - rear panel

The power cord supplied with each instrument varies with the country of destination. The following figure illustrates the standard power plug and cord configurations that are commonly used. The part number shown beneath each plug is the part number of the appropriate power cord and plug. If the appropriate power cord is not included with the instrument notify the nearest Agilent office and a replacement will be provided.



**Figure 2** Power cable configurations and part numbers

### Removing the Instrument Covers

The instrument covers are a press-fit. To remove them, gently lever them off.

When transporting the instrument, always replace both covers to protect the instrument connectors and display.

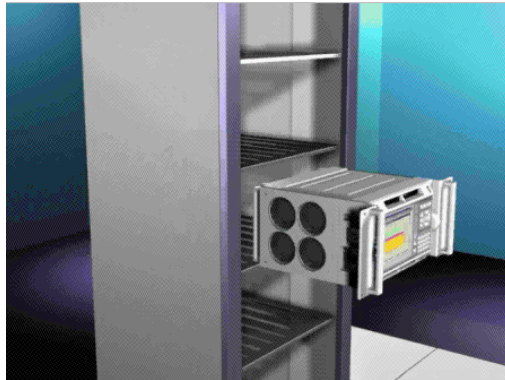
### Useful Information When Requesting Support

When contacting Agilent Technologies for support it is useful to have the following instrument information available:

- Model Number.
- Serial Number. (on instrument base plate in the format GBXXXXXXXXXX)
- Instrument Options. (Press <Menu>, choose **System** > **Options** then press <Select>.)
- Instrument Firmware Revision. (Press <Menu>, choose **System** > **Options** then press <Select>. Select the **Software** tab.)
- Self Test fail codes and messages. (Press <Menu>, choose **System** > **Self Test** then press <Select>.)

## Rack Mounting the Instrument

Option 005 of the instrument is ready to mount directly into a rack. All the hardware required is supplied with this version of the instrument.



Item (all supplied)	Part Number
Shelf	46101-00146
Captive Nuts (8 off) - for mounting shelf and instrument	0590-0804
Screws (4 off) - for mounting shelf	2680-0103
Dressed Screws (4 off) - for mounting instrument	0570-1366

### To Rack Mount the Instrument

- 1 Fit the rack shelf supplied with the instrument to the rack, following the instructions given with the shelf.
- 2 Fit captive nuts (4 off, supplied) to rack uprights.
- 3 Place instrument on shelf.
- 4 Connect power cord and GP-IB cable (if required) *before* sliding the instrument into its final position on the shelf.
- 5 Fit the screws (4 off, supplied) through the flanges into the captive nuts and tighten to a torque setting of 2 Nm.

### Operation Checks on Delivery

The following procedures give a quick Power-up and Back-to-Back functional test of the optical interfaces using the optical accessories provided. These checks should be performed by a user or engineer familiar with making optical interface connections.

#### 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 test failure or damage to the optical receivers.

**NEVER CONNECT THE OPTICAL OUTPUT DIRECTLY TO OPTICAL INPUT WITHOUT ATTENUATION AS THIS WILL EXCESSIVELY OVERLOAD THE RECEIVER AND COULD CAUSE DAMAGE.**

---

#### Power-up Sequence

- 1 For information on how to use the instrument and navigate the graphical user interface, refer to the **Quick Reference Guide** (supplied with the instrument).
- 2 Connect the OmniBER OTN to the AC Power Line using the Power Cord provided and set OmniBER OTN power switch ON (located beside power inlet).
- 3 The fans should start and after a few seconds the display will initialize and indicate the following.

#### Starting Instrument

**Please wait.....**

The Agilent Technologies splash screen will then be displayed while the unit completes initialization.

- 4 On completion (approximately 30 seconds), the display will change to the user windows with instrument settings. The Instrument is now ready for use.

**NOTE**

While running the instrument, a single line of text appears at the bottom of the display. This gives you helpful information relating to the area of the screen that is highlighted. In addition, online help is available on the instrument. If you require assistance at any time press the **<Help>** button on the front panel. This will display the online help.

To return to the normal instrument display press the **<Help>** button again.

---

**Recalling Default Settings**

To ensure instrument is set to a known state:

- 1 Press **<Menu>**, choose **System > Stored Settings** then press **<Select>**.
- 2 Select **Default** then **Recall**.
- 3 Select **OK** then wait for a few seconds for instrument to reconfigure to the default settings. Recall has completed when the dialog box clears.
- 4 Select **Close**.
- 5 Proceed with the Back-to-Back functional checks.

**Back-to-Back Functional Checks**

An Optical Patch Cord and Optical Attenuator(s) are provided to make an optical connection between the Transmit and Receive Ports for these checks.

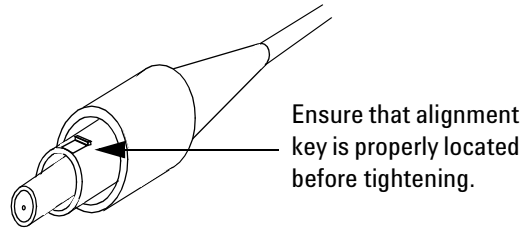
Use the 15 dB Optical Attenuator for up to 2.5 Gb/s Interfaces.

Use the 10 dB Optical Attenuator for the 10/10.7 Gb/s Interface.

Remove any dust protectors from the ends of Patch Cord and Attenuator before fitting and make sure the (white) exposed ends are not touched by fingers or otherwise become contaminated.

When making connections ensure full location in port key/notch then tighten/lock by hand depending on the connector type.

## 2 Installation (Getting Started)

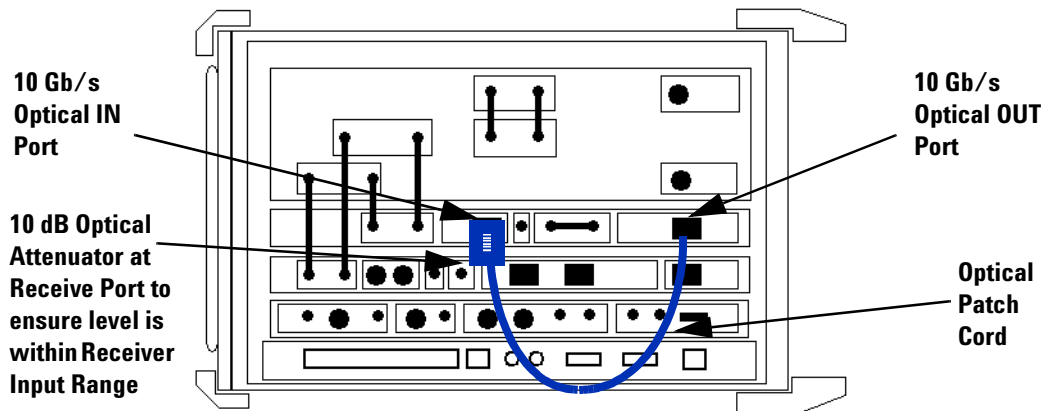


### WARNING

Always ensure Optical Output Laser LEDs beside ports are OFF while making/changing optical connections.

Also refer to "Optical Connector Safety Information" on page 24.

- 1 Connect the J7231B OmniBER OTN as shown in below. For J7232A models (up to 2.5 Gb/s only) refer to [Figure 4](#) for Loopback connection and proceed from [step 12](#), ensuring Tx/Rx Coupling is set to ON as in [step 3](#).



**Figure 3** 9.95 Gb/s (and 10.71 Gb/s) Loopback Connection

- 2 Press <Menu>, choose Tx/Rx > Transmitter Settings > Physical then press <Select>. Set Laser ON. This enables the

10/10.7 Gb/s Output.

The example below shows the Transmitter Settings for an instrument with OTN option. If this is not fitted the default **Signal Mode** will show **SONET** and **Signal Rate OC-192**.

Signal	
Mode	OTN
Rate	OTU2
Line	
Interface	Optical
Wavelength	1550nm
	<input checked="" type="checkbox"/> Laser On
Clock	
Source	Internal
Format	2Mb/s Clock

Check the laser LED is illuminated at the 9.95/10.71 Gb/s Output Port on the OmniBER OTN's connector panel.

- 3 Press **<Menu>**, choose **Tx/Rx > Coupling** then press **<Select>**. Choose **Copy Tx to Rx** to set Coupling On. Select **Close** to close dialog.

Tx / Rx - Coupling

Copy Tx to Rx      Copy Rx to Tx

Coupling On

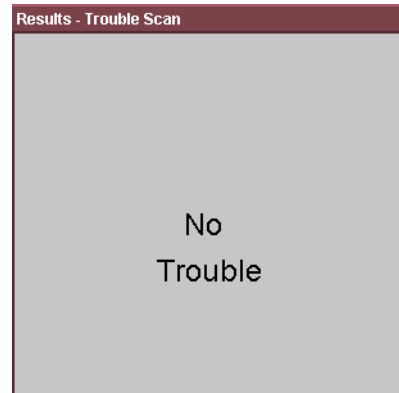
Switch Coupling Off

Close

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

## 2 Installation (Getting Started)

- 5 Check that '**No Trouble**' is displayed in the **Results** window to confirm no errors have been detected. If not then refer to "What to Do if the Test Fails" on page 49.



- 6 Press <**Single Error**> button and check that the Errors Led flashes red and some errors accumulate on the **Results - Trouble Scan** window. Then press the <**Run/Stop**> key to stop gating.
- 7 For units with OTN Option, continue with [step 8](#) otherwise proceed to [step 11](#).
- 8 Change the Transmitter Settings **Signal Mode** to **SONET**, **Signal Rate** to **OC-192**.

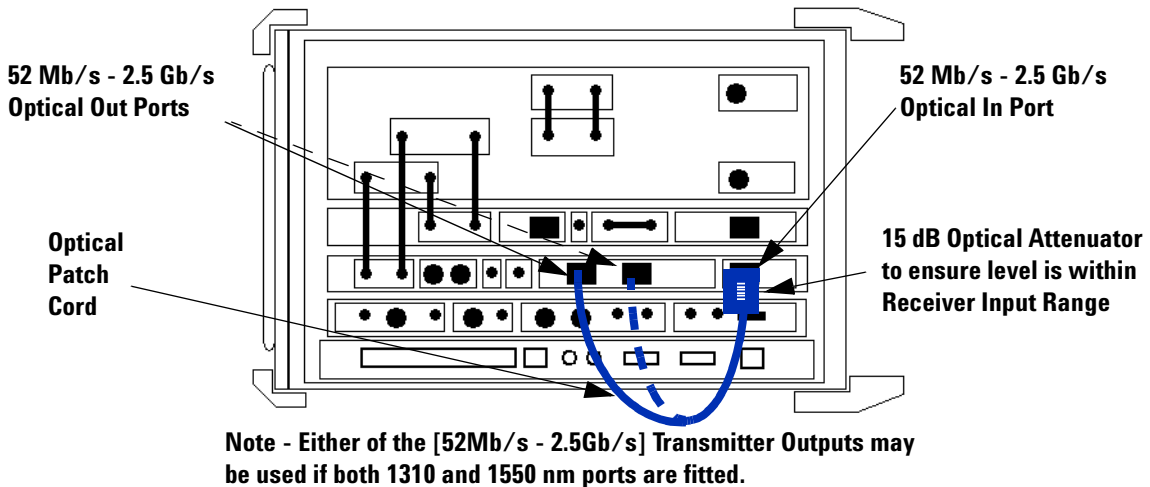
### NOTE

The Receiver will automatically set to the same Signal Rate if the Transmitter as Tx > Rx Coupling is On. The graphical display on lower window indicates the overall set-up of Transmitter & Receiver. Coupling status is shown in left lower corner.

- 9 Check the laser LED is illuminated at the 9.95/10.71 Gb/s Output Port on the OmniBER OTN's connector panel.
- 10 Repeat [step 4](#) to [step 6](#) to confirm correct operation.
- 11 Press <**Window**> key to highlight the **Transmitter Settings** page and set the **Laser** to **OFF**.



**12** Change/Make the following Optical loopback connection to check the 2.5 Gb/s interface as shown in [Figure 4](#).



**Figure 4** 2.5 Gb/s Loopback Connection

- 13** Change/Set the Transmitter Settings **Signal Rate** to **OC-48** and set the **Wavelength** to be the same as the Transmit Port connected in set-up, i.e. **1310nm** or **1550nm**.
- 14** 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.
- 15** Repeat [step 4](#) to [step 6](#) to confirm correct operation.
- 16** Press <Window> key to highlight the **Transmitter Settings** page and set the **Laser** to **OFF**.
- 17** If the instrument has dual **Wavelength** change loopback connection to alternative output port. Otherwise proceed to [step 22](#).
- 18** Change the Transmitter Settings **Wavelength** to be the same as the Transmit Port connected in set-up, i.e. **1310nm** or **1550nm**.

## 2 Installation (Getting Started)

- 19** 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.
- 20** Repeat [step 4](#) to [step 6](#) to confirm correct operation.
- 21** Press <**Window**> key to highlight the **Transmitter Settings** page and set the **Laser** to **OFF**.
- 22** Change the Transmitter Settings **Signal Rate** to **OC-12** and set the Wavelength to the be same as the Transmit Port connected in set-up.
- 23** Set the **Laser** to **ON** and check the laser LED is illuminated at the connected 5 2Mb/s - 2.5 Gb/s Output Port on the OmniBER OTN's connector panel.
- 24** Repeat [step 4](#) to [step 6](#) to confirm correct operation.
- 25** Press <**Window**> key to highlight the **Transmitter Settings** window and set the **Laser** to **OFF**.
- 26** Disconnect all loopback connections.

## What to Do if the Test Fails

**NOTE**

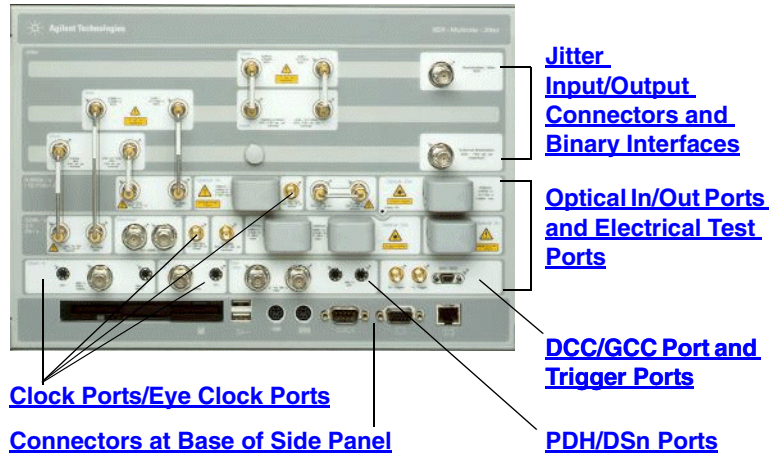
Always ensure Optical Output Laser LEDs beside ports are OFF while making/changing optical connections.

---

- 1 Check all connections and make sure that the correct loopback connection is in place for the interface being checked. Make sure connectors are located in key/notch of the port connectors to ensure full insertion.
- 2 Check Transmitter and Receiver are set to the same Signal Rate and that the correct Laser is On when test is being Run.
- 3 Press <**Smart Test**>, choose **Shortcuts > Optical Power** then press <**Select**>. Check the Received signal level is in the Green BER measurement power range.
- 4 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
- 5 Power down unit and use recognized cleaning kit to clean connectors before retrying the Tests.

If the problem persists then contact your local Agilent Sales/Service representative.

### Side Panel Tour



#### Optical In/Out Ports and Electrical Test Ports

- OTN/SONET/SDH Optical Out Ports
- OTN/SDH/SONET Optical In Ports
- SONET/SDH Electrical Test Ports

#### OTN/SONET/SDH Optical Out Ports

The Optical Out Ports provide OTN signals at 2.5 Gb/s (depending on your instrument model) and 10.71 Gb/s, SONET optical signals OC-1, OC-3, OC-12, OC-48, OC-192, and SDH optical signals STM-0, STM-1, STM-4, STM-16, STM-64 at wavelength 1310 and 1550 nm, depending on instrument model and options.

**52 Mb/s - 2.5 Gb/s 1310 nm** Selectable optical connector (see table below) for a 52 Mb/s to 2.5 Gb/s optical output. Nominal wavelength is 1310 nm. Power output is -1.5 to +3 dBm.

**52 Mb/s - 2.5 Gb/s 1550 nm** Selectable optical connector (see table below) for a 52 Mb/s to 2.5 Gb/s optical output. Nominal wavelength is 1550 nm. Power output is -1.5 to +3 dBm.

**9.95/10.71 Gb/s, 1550 nm** Selectable optical connector (see table below) for a 9.95 Gb/s or a 10.71 Gb/s optical output. Nominal wavelength is 1550 nm. Power output is -1 to +2 dBm.

## OTN/SDH/SONET Optical In Ports

The Optical In ports accept OTN signals at 2.5 Gb/s (depending on your instrument model) and 10.71 Gb/s, SONET OC-1, OC-3, OC-12, OC-48 and OC-192 and SDH STM-0, STM-1, STM-4, STM-16, STM-64 signals, depending on the model and options fitted.

**52 - 2.5/2.5 Gb/s** Selectable optical connector (see table below) for a 52 Mb/s to 2.5/2.5 Gb/s optical input (OC-1, OC-3, OC-12, OC-48, OTU1/STM-0, STM-1, STM-4, STM-16 signals). Wavelength 1550 nm nominal. Input damage power >0 dBm; never exceed maximum input power. The recommended input power operating level for all rates is -32 to -7 dBm.

**9.95/10.71 Gb/s** Selectable optical connector (see table below) for 9.95/10.71 Gb/s (OC-192/STM-64/OTU2) optical input signals. Wavelength 1290 to 1565 nm. Input damage power >+2 dBm; never exceed maximum input power. The recommended input power operating level for OTU2/OC-192/STM-64 signals is -18 to -8 dBm for 9.95 Gb/s and -16 to -8 dBm for 10.71 Gb/s.

<b>Connector</b>	<b>Option</b>
FC/PC Adapters fitted on all optical interfaces	609
SC Adapters fitted on all optical interfaces	610
ST Adapters fitted on all optical interfaces	611

### Clock Ports/Eye Clock Ports

**TX Eye Clock 9.95 Gb/s and 10.71 Gb/s** SMA connector providing a TX Eye Clock signal (at 1/16 of the line rate) which can be used to trigger an oscilloscope when examining data signals.

**DS1 Clock In** Bantam 100 ohm (nominal) connector for a DS1 BITS external reference clock input.

**2 Mb/s, 2 MHz, 10 MHz Clock In** BNC 75 ohm (nominal) unbalanced connector for a 2 Mb/s and 2 MHz MTS external clock source input. You can also use this connector to input a 10 MHz clock reference.

**2 Mb/s, 2 MHz Clock In** Bantam 100 ohm (nominal) connector for a 2 Mb/s and 2 MHz MTS external clock source input.

**TX Eye Clock 52 - 2.5 Mb/s** SMA connector providing a TX Eye Clock signal (at 1/4 of the line rate) which can be used to trigger an oscilloscope when examining data signals.

**2 MHz Clock Out** BNC 75 ohm (nominal) unbalanced connector for a 2 MHz MTS clock reference output. Generated relative to the selected transmit reference clock.

**DS1 Clock Out** Bantam 100 ohm (nominal) connector for a DS1 BITS clock reference output. Generated relative to the selected transmit reference clock.

### DCC/GCC Port and Trigger Ports

**DCC/GCC Connector** R5449 15-way D-type.

Use this port to drop and insert OTN GCC channels (OTU GCC0, ODU GCC1, ODU GCC2), the D1-D3 DCC channel or the D4-D12 DCC channel.

<u>Pin Number</u>	<u>DCC/GCC</u>
1	Rx Data Output (+)
2	Rx Clock Output (+)
3	Signal ground
4	Tx Clock Output (+)
5	Tx Data Input (+)
6	Rx Data Output (-)
7	Rx Clock Output (-)
8	Tx Clock Output (-)
9	Tx Data Input (+)

**Rate** D1-D3 DCC: 192 kb/s, D4-D12 DCC: 576 kb/s, OTU/ODU GCC0/GCC1/GCC2: 1.3124 Mb/s.

**DCC/GCC Port Input Termination** 100 ohms differential. The first bit of data inserted will be put into the MSB of the DCC channel. The MSB of the dropped data bytes will be output first. The drop and insert capabilities are independent, meaning the transmit and receive clock rates can be set to different rates. Note that the instrument acts as a DCE (Data Communications Equipment), supplying the clock signal for both drop and insert operation.

**Input Sensitivity** 200 mV over a common mode input voltage range from -0.3V to 5.5V.

**Output Level** Logic '1' = 2.3 V typical; Logic '0' = 0.8 V typical

**Trigger Ports** SMA connectors. Use these ports to output transmitter and receiver triggers.

**Output Level** Logic '1' = 4.0 V typical; Logic '0' = 0 V typical

### SONET/SDH Electrical Test Ports

**SONET/SDH Out** BNC 75 ohm unbalanced connector for an STS-1/STM-0 (B3ZS) or STS-3/STM-1 (CMI) electrical output.

**SONET/SDH In** BNC 75 ohm unbalanced connector for an STS-1/STM-0 (B3ZS) or STS-3/STM-1 (CMI) electrical input. Input Mode - Terminate or Monitor. Monitor mode conforms to G.772-1993. Monitor Gain - 20 or 26 dB.

### PDH/DSn Ports

**DS1/2 Mb/s Out** Bantam balanced connector for a DS1/E1 Transmit or DS1/E1 Drop signal output. Port is 100 ohm for DS1, 120 ohm for E1. Either this port or the 2-140 Mb/s, DS3 unbalanced Out port can be active for the E1 Transmit function.

**DS1/2 Mb/s In** Bantam balanced connector for a DS1/E1 Receive or DS1/E1 Insert signal input. Port is 100 ohm for DS1, 120 ohm for E1. Either this port or the 2-140 Mb/s DS3 unbalanced In port can be active for the E1 Receive function.

**2-140 Mb/s DS3 Out** BNC 75 ohm unbalanced connector for E1, E2, E3, E4, DS3 transmit or E1, E3, E4, DS3 Drop signals. Either this port or the 2 Mb/s balanced Out port can be active for the E1 Transmit function.

**2-140 Mb/s DS3 In** BNC 75 ohm unbalanced connector for E1, E2, E3, E4, DS3 receive or E1, E3, E4, DS3 Insert signals. Either this part or the 2 Mb/s balanced In port can be active for E1.

### Jitter Input/Output Connectors and Binary Interfaces

**Demodulated Jitter Output** BNC 50 ohm connector providing demodulated jitter output.



**External Modulation Input** BNC 50 ohm connector for external jitter modulation input. Primarily designed for sinusoidal signals, but can be used with any wave shape. Maximum input level +/- 5V peak AC/DC composite.

**Binary Clock and Data Interfaces** SMA connectors, providing binary clock and data transmitter and receiver interfaces, which can be configured independently.

## Connectors at Base of Side Panel

The following descriptions describe the connectors as they appear from left to right. (Note that on some options the following connectors may be on the rear of the instrument.)

**Floppy Disk Drive** Accepts 1.44 Mb IBM formatted disks.

**USB** Two Universal Serial Bus ports for connecting to a printer. The printer may be attached after power-on.

**Mouse** PS/2 port for connecting a mouse.

**Keyboard** PS/2 port for connecting an external keyboard. Ensure that keyboard port is used - if connected to mouse PS/2 port in error the instrument will require to be restarted.

**RS232** Remote Control port providing following configurations:

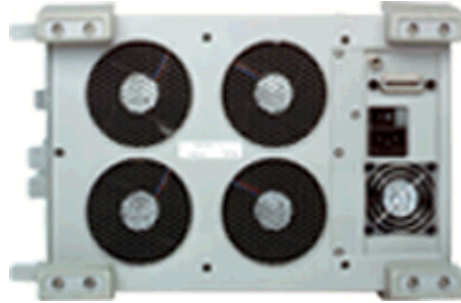
- **Controller Type:** Computer and Terminal.
- **Handshaking Protocol:** None, Xon/Xoff and RTS/CTS.
- **Speed:** 300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400 baud.
- **Parity:** Odd, Even.
- **Stop Bits:** 1, 2
- **Data Length:** 8, 7 bits.

## 2 Installation (Getting Started)

**VGA** Connector for displaying contents of instrument screen on an external display. Ensure that the external display is connected before powering up the instrument.

**LAN 10M/100M** 10/100 Base-T LAN interface port. Supports remote control of instrument and the downloading of firmware upgrades. Note that to ensure compliance with EN 55011 (1991) a category 5, STP patch lead, RJ45 cable should be used to connect to the LAN port.

## Rear Panel Tour



**GPIB** Allows instrument to be remotely controlled via the GPIB control bus.

**External Protective Earth** Connect an external earth connection to the instrument at this point.

**AC Power** Connect the instrument power cord here and set the switch to 1 to turn on and to 0 to turn off.

### Instrument Reboot (Cold Start)

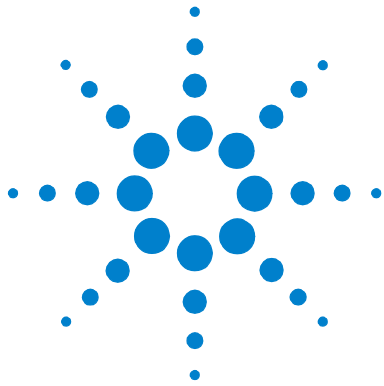
An instrument “cold start” routine is provided to reset the instrument in the event of an unplanned hardware or firmware event. A cold start reboots the instrument and restarts the instrument using a default configuration file. Performing a cold start erases existing configuration information. Current menu settings will be lost and the instrument will power up in its default state.

▶ **To perform a cold start**

- 1 Switch the instrument off and wait a few seconds.
- 2 Switch the instrument on and as the instrument boots up, look carefully at the display.
- 3 Wait for the “Starting instrument” text to be displayed. After a few seconds start to repeatedly press the **<Menu>** key until the Agilent splash screen appears with an options menu in the top left corner of the display.

The following options are available:

- 3 Cold start.
- 5 Normal start.
- 4 Press 3 on the numeric keypad to select cold start. The unit will then continue with the boot up process.
- 5 When the boot-up procedure is complete, the instrument displays a dialog box with the message: “Instrument reset to default settings.”



## 3 Performance Tests

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# Introduction

The procedures given in this Section test the performance of the Agilent J7231B or J7232A OmniBER OTN models using the instrument specifications 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 61. 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 160. 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

### 3 Performance Tests

<b>Instrument</b>	<b>Critical Specification</b>	<b>Recommended Model</b>
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

**NOTE**

\* Equipment is only required for Jitter tests, e.g. J7231B model Only.



### 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.

---

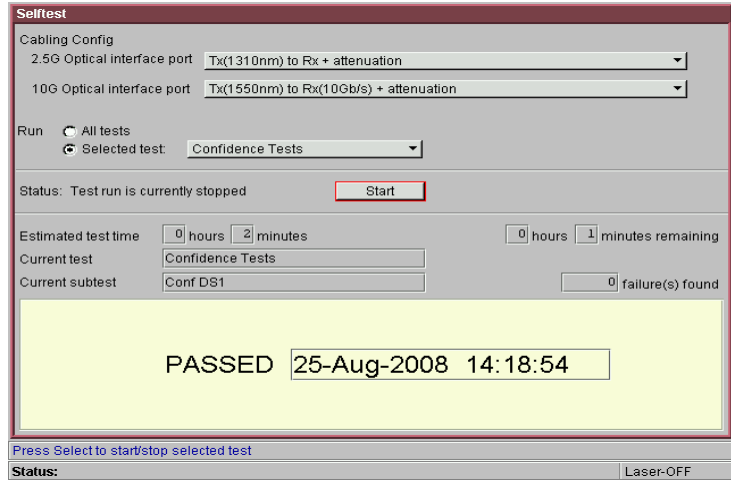
This section gives an description of the Self Tests that are required to be completed as part of the Performance Tests and covers the following

- 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 5](#) on page 67).

### 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)

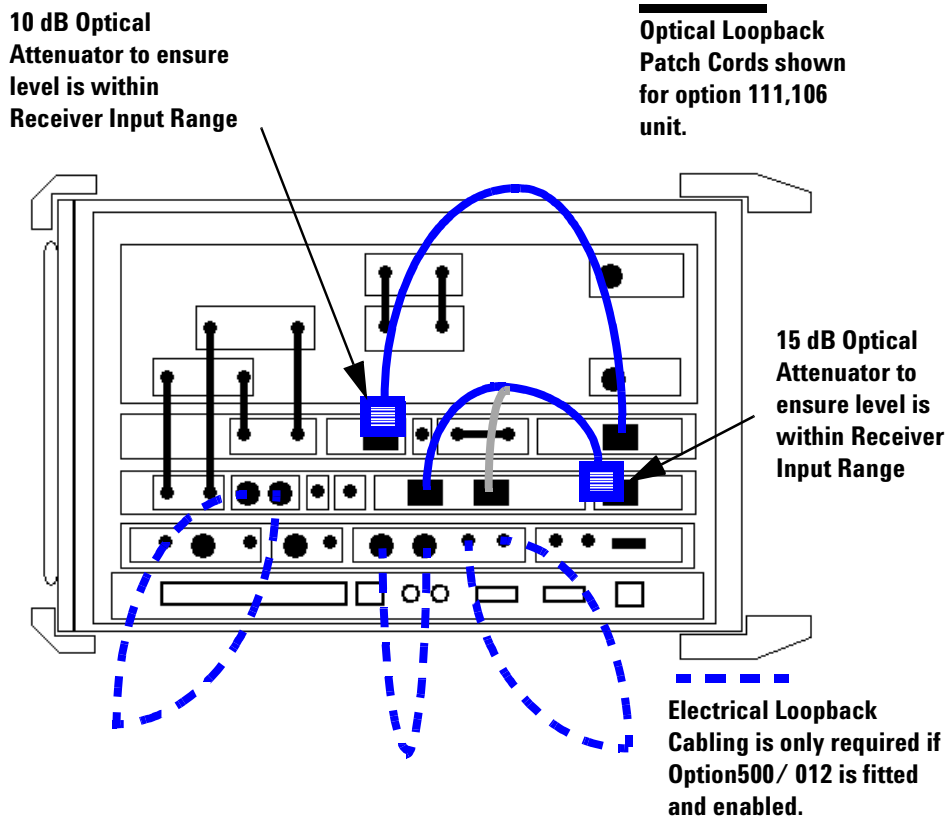
Use BNC cable P/N 15525A

- 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 5** 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 Transmitters 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 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 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<sub>n</sub> 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<sub>n</sub> 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

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

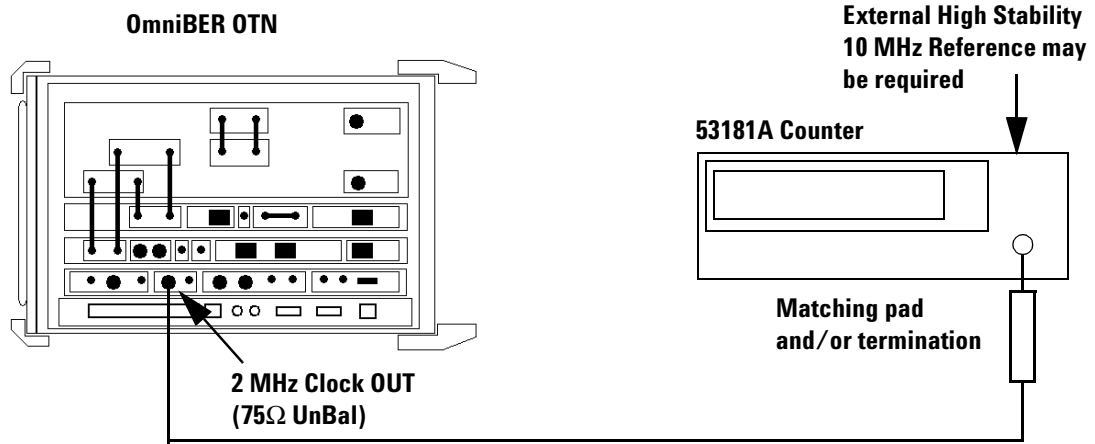
### NOTE

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.

### 3 Performance Tests



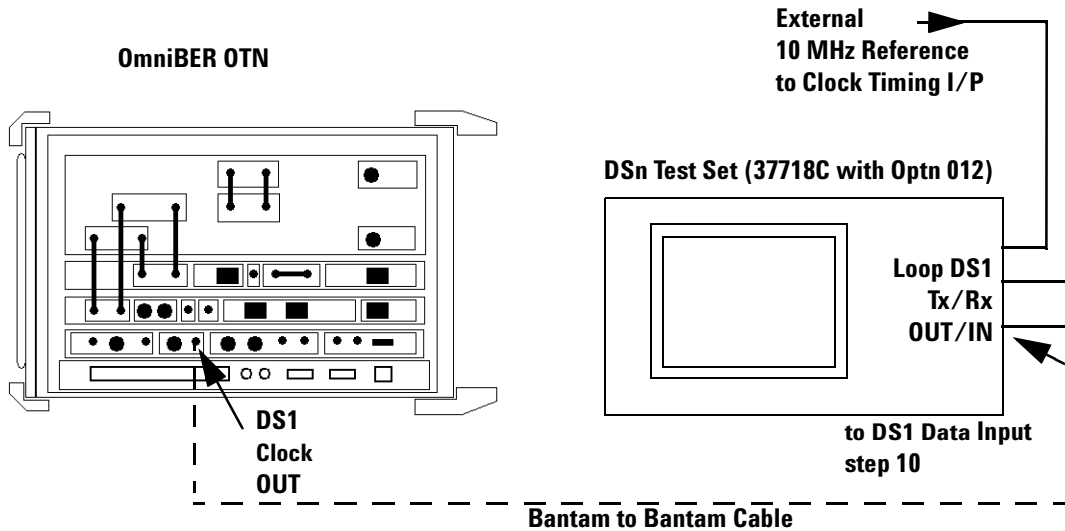
- 4 Adjust the Frequency Counter Trigger Level to obtain a stable reading and check that the Frequency Counter reads between:

**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 Alarms/Errors indicated by the Test Set Receiver.

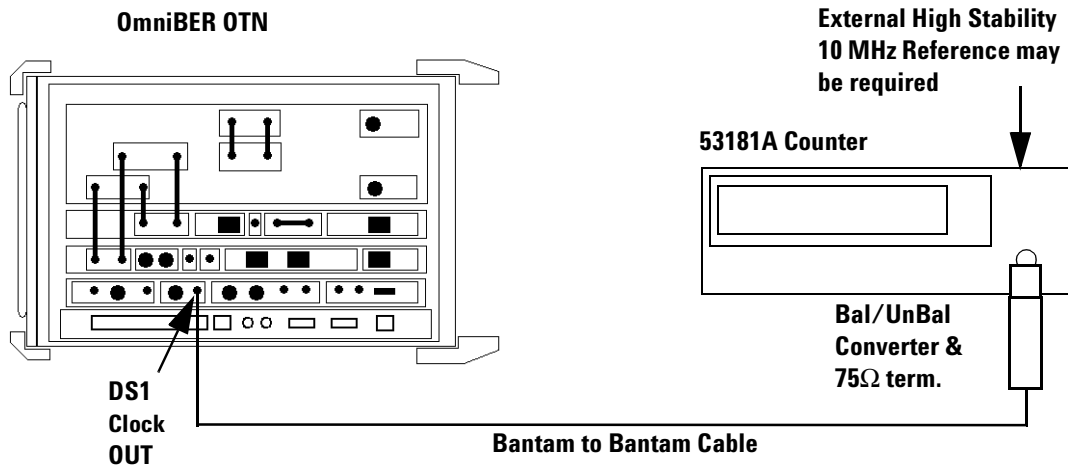
**NOTE**

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 Alarms/Errors 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 Complete.

### Alternative DS1 Clock test (if suitable DS<sub>n</sub> 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 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

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

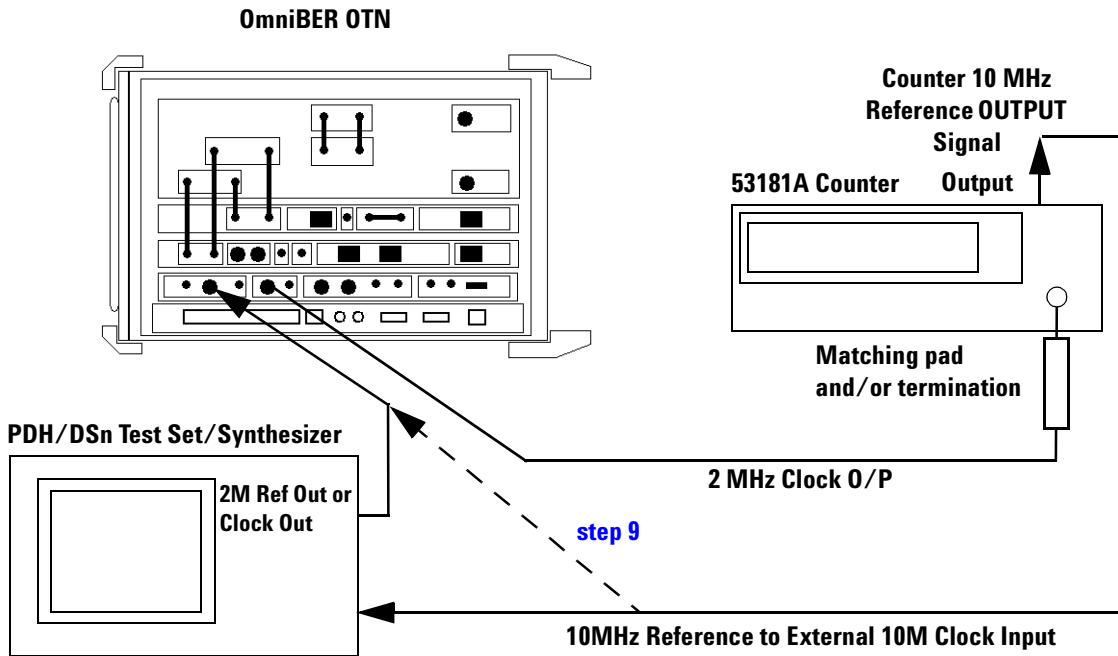


- 3 Connect the OmniBER OTN's 2 MHz Clock Out port to the Frequency Counter Input using a 75/50Ω matching pad, set the input impedance to 50Ω. Alternatively, a 75Ω termination can be used with the input impedance set to 1MΩ.

Connect the Counter rear panel 10 MHz Reference Output to the PDH/DSn Test Set external 10M CLOCK input port.

### 3 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

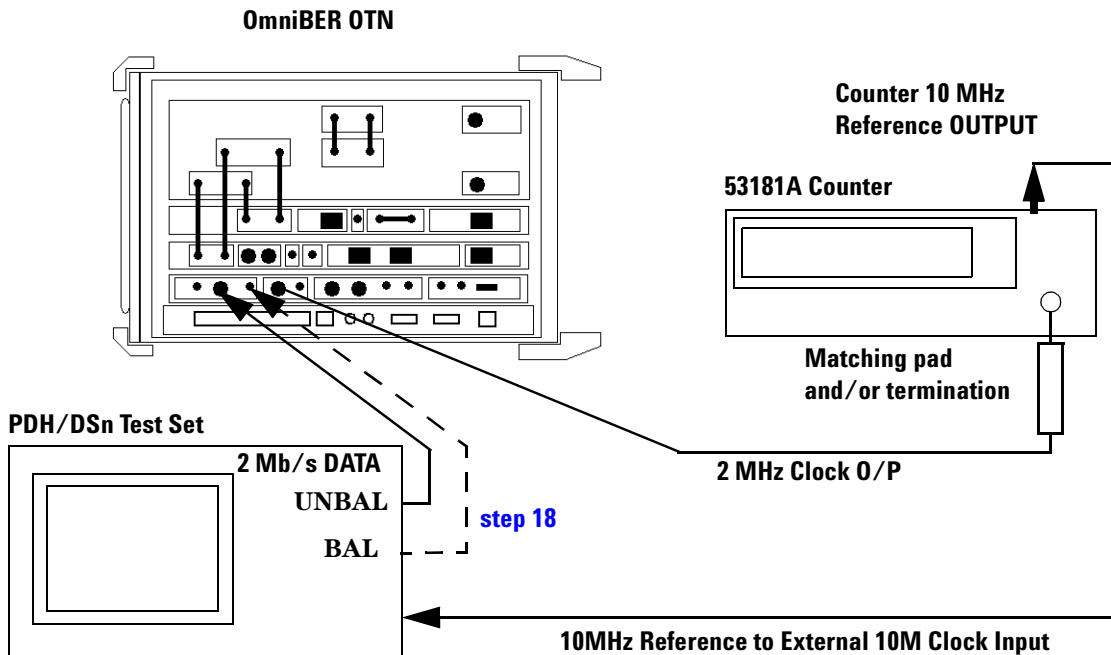
**(External 10M Clock as Reference)**

- 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.

### 3 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 set-up 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.

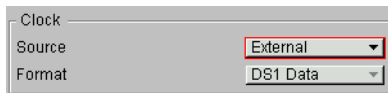
**2.047999999 MHz and 2.048000001 MHz**

- 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)**

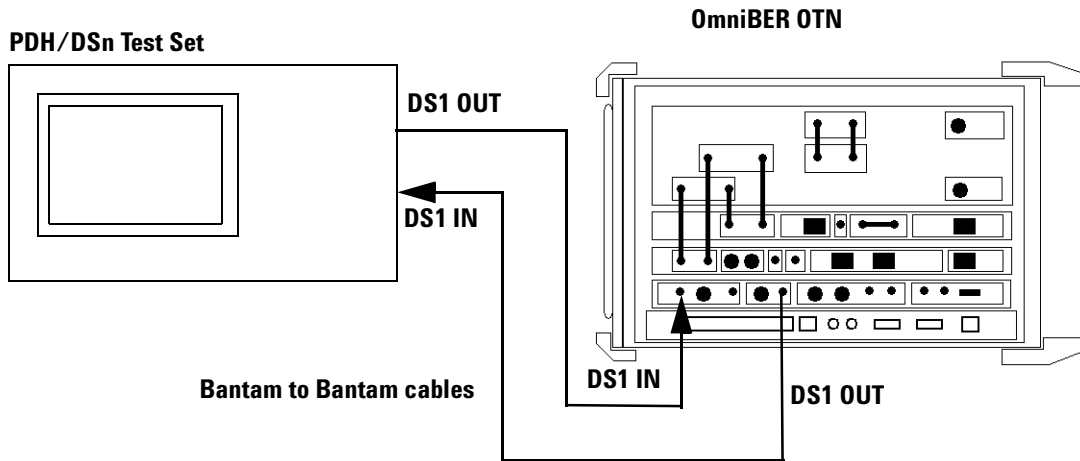
- 23** Press <Menu>, choose Tx/Rx > **Transmitter Settings** > **Physical** then press <Select>. Set the **Signal Mode** to **SONET**.

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.

### 3 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 ALARMS/ERRORS 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 Complete.

## Optical Pulse Mask and Output Characteristics

### Specifications

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#### 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.

<b>Extinction ratio</b>	>8.2 dB
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<b>Pulse mask</b>	Meets ITU-T G-957 (6/1999) and Telcordia GR-253-CORE Issue 3 (9/2000)
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### 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

<b>High Speed Optical Oscilloscope</b>	Agilent Infinium 86100A Mainframe Agilent Infinium 86103A option 201, Optical Plug-in Agilent Infinium 86105A option 202, Optical Plug-in
<b>Optical Attenuator</b>	Agilent 8156A
<b>Optical Patch Cord(s)</b>	Agilent PN 1005-0337
<b>BNC(m) to SMA(f) Adapter</b>	Agilent E9632A
<b>SMA(m) to SMA(m) cable</b>	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-1 and 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**.

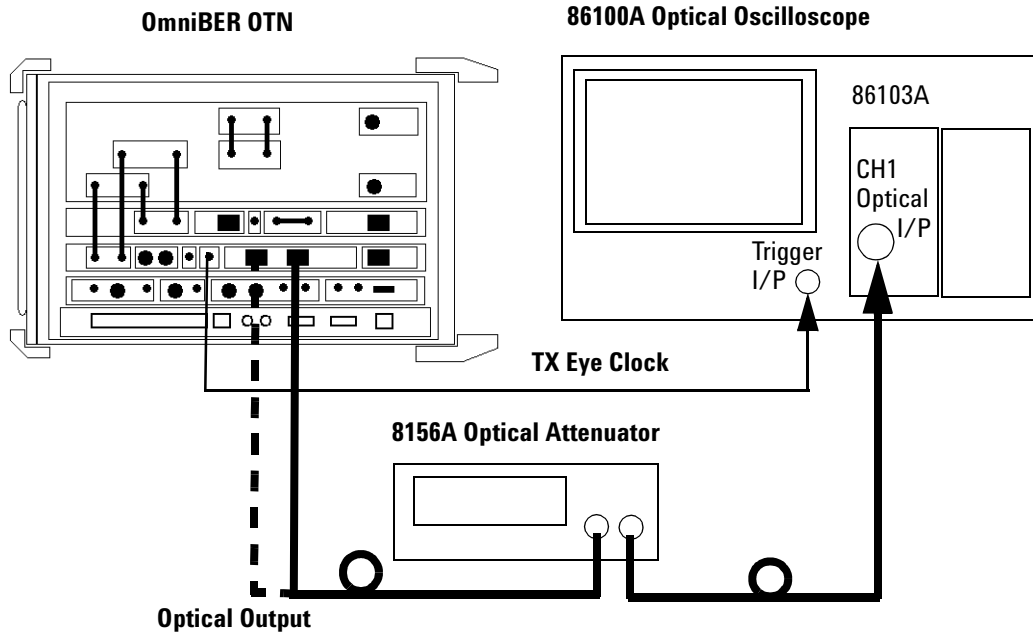
Signal	
Mode	SONET
Rate	OC-1
Line	
Interface	Optical
Wavelength	1310nm
	<input type="checkbox"/> Laser On
Clock	
Source	Internal
Format	DS1 Data

- 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.

### 3 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.

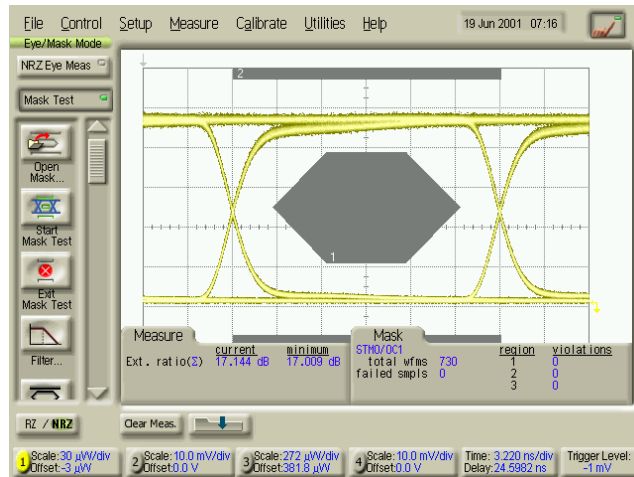
#### NOTE

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 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.

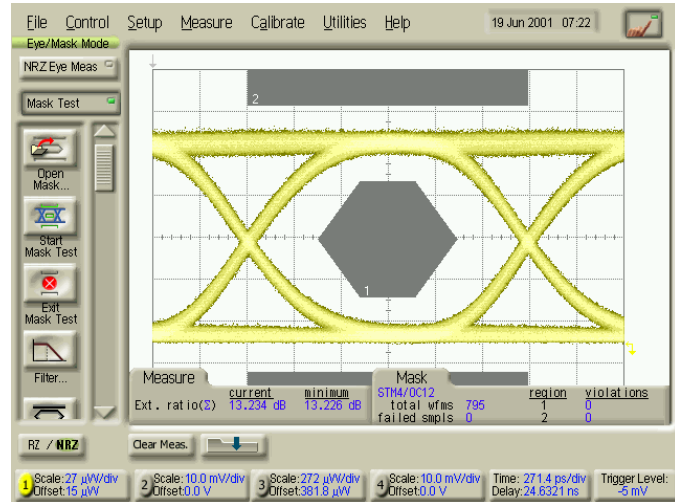
#### OC-3/STM-1 Power Level and Eye Mask Tests

- 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 89](#).
- 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 89](#).
- 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.



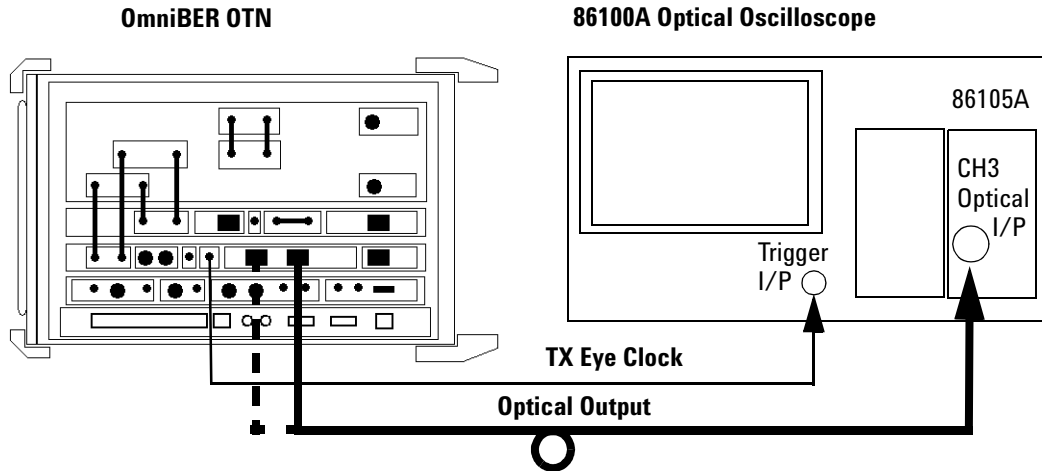
OC-12/STM-4 Eye Mask

## 2.5 Gb/s and 2.66Gb/s Optical Output Checks

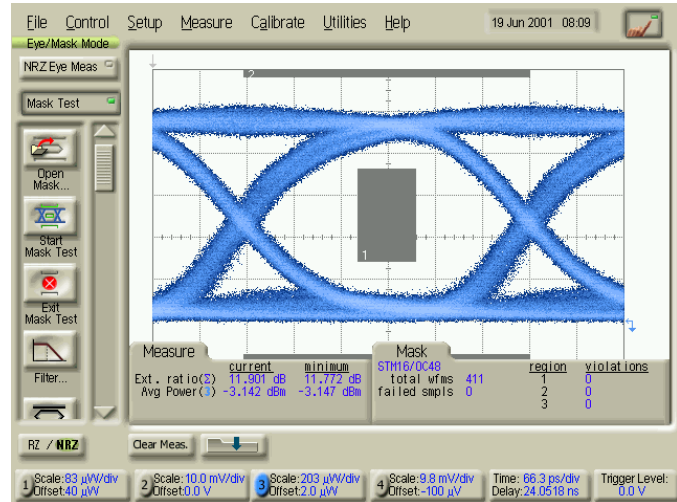
### OC-48/STM-16 Power Level and Eye Mask Tests

- 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.

### 3 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 91](#).



### 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**

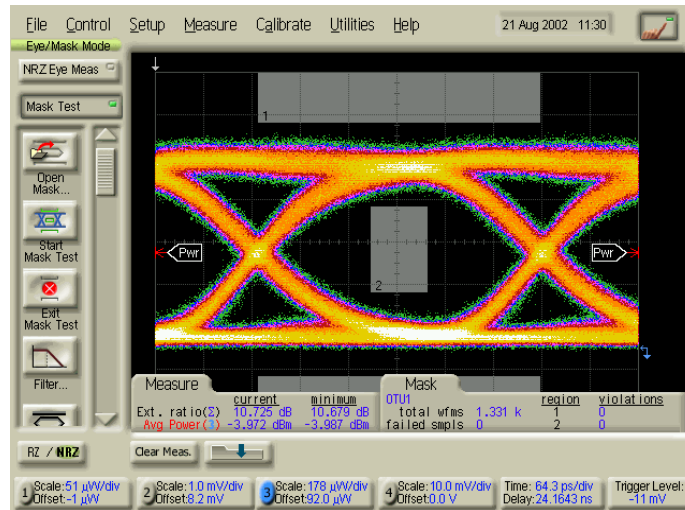
- 36** Check the Extinction Ratio is greater than **8.2 dB** and record the measured value.

### 3 Performance Tests

#### OTU-1 Power Level and Eye Mask Tests (opt 111 only)

37 Set the OmniBER OTN **Signal Mode** to **OTN** and the **Signal Rate** to **OTU-1** and repeat [step 33](#) through [step 36](#) with the OTU-1 mask loaded into the scope.

38 Check that the output meets the mask as shown below



#### OTU-1 Eye Mask

39 If the instrument has Dual Wavelength option (1310 and 1550 nm ports) for 51 - 2.66 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 (J7231B Only)

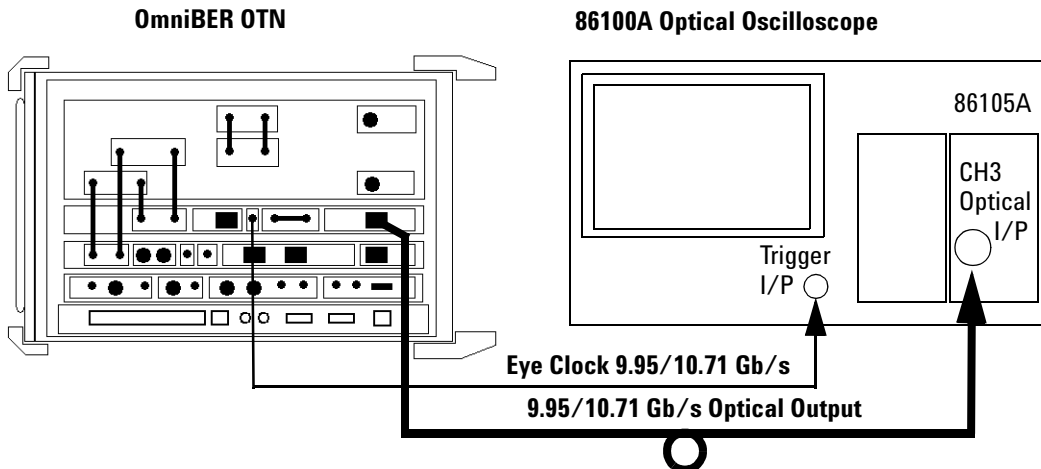
#### OC-192/STM-64 Power Level and Eye Mask Tests

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.



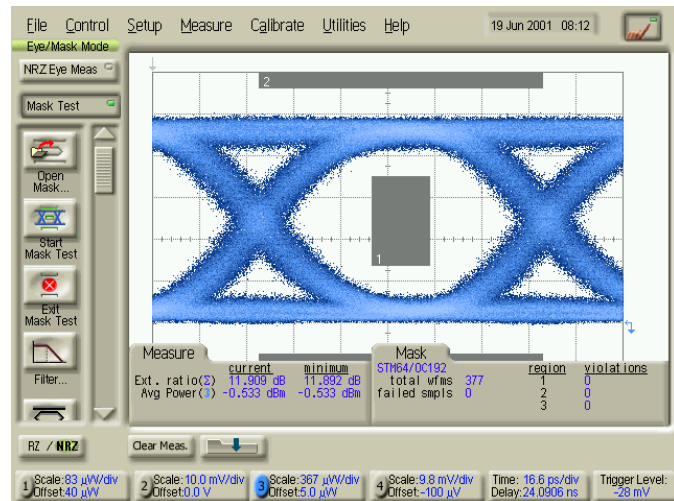
- 4 Set the OmniBER OTN **Laser** to **ON**.

- 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 94
- 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**.
- 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**.

The screenshot shows a configuration menu with the following settings:

- Signal Mode:** OTN (highlighted with a red box)
- Signal Rate:** OTU2
- Line Interface:** Optical
- Wavelength:** 1550nm
- 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 96](#).

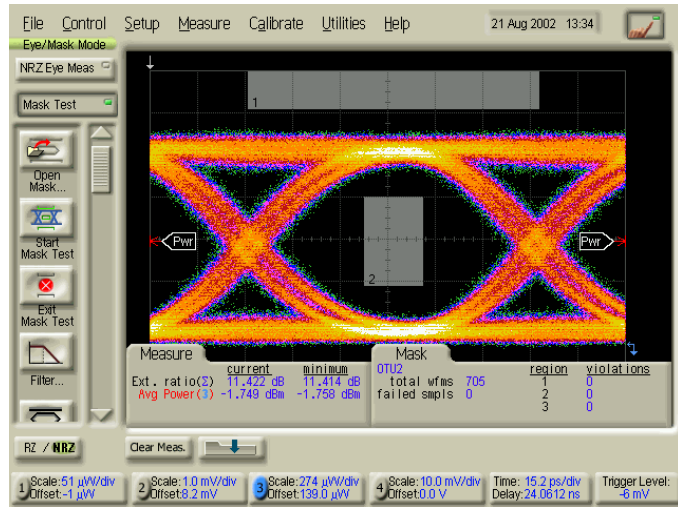
18 Set the oscilloscope to **Eye Measure** mode and setup to measure the **Average Power** (in dBm) and **Extinction Ratio**.

#### 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.

### 3 Performance Tests

- 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 Complete. Set the Laser to OFF before disconnecting setup.



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
2.66 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
2.66 Gb/s	-9 dBm
9.95 Gb/s	-9 dBm
10.71 Gb/s	-9 dBm

---

1. For 52 Mb/s – 2.66 Gb/s the Min. sensitivity quoted is for BER =  $1 \times 10^{-10}$  (input signal extinction ratio = 8.2 dB).  
For 9.95 Gb/s & 10.71 Gb/s the Min. sensitivity quoted is for BER =  $1 \times 10^{-12}$  (input signal extinction ratio = 8.2 dB).

---

<b>Optical power measurement</b>	<p>Supported for all optical receive rates.</p> <p><b>Ranges:</b>            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.</p> <p><b>Accuracy:</b>            10 Gb/s: <math>\pm 1.5</math> dB.            2.5 Gb/s: <math>\pm 2</math> dB.            622 Mb/s and below: <math>\pm 1</math> dB.</p> <p><b>Resolution:</b> 0.1 dB.</p>
<b>Line frequency measurement</b>	<p>Supported for all optical and electrical receive rates.</p> <p><b>Results:</b> Frequency (MHz), Offset (Hz and ppm).</p> <p><b>Accuracy:</b> <math>\pm 4.5</math> ppm.</p> <p><b>Resolution:</b>  <b>Frequency:</b> 0.01 kHz (up to 622 Mb/s),            0.1 kHz.(2.5 Gb/s and 10 Gb/s).  <b>Offset:</b> 0.1 ppm.</p>

**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**

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

**WARNING**

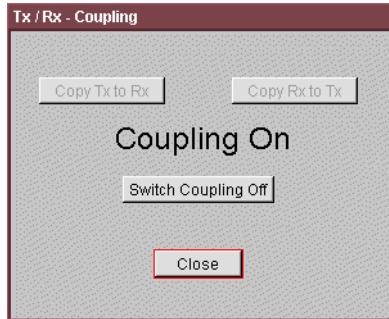
**Safety precautions must be observed when handling the OmniBER OTN's Optical Modules as these generate laser signals which can cause serious injury. The guidelines below must be followed:**

- 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.

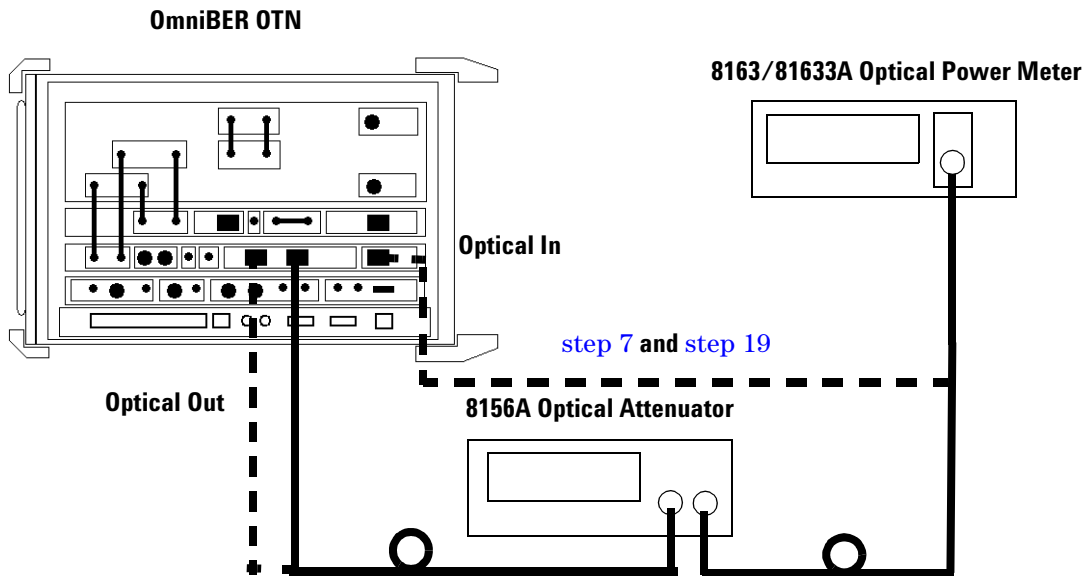
**Procedure****OC-1/STM-0 and OC-3/STM-1 Rates**

- 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 Performance Tests



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



- 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

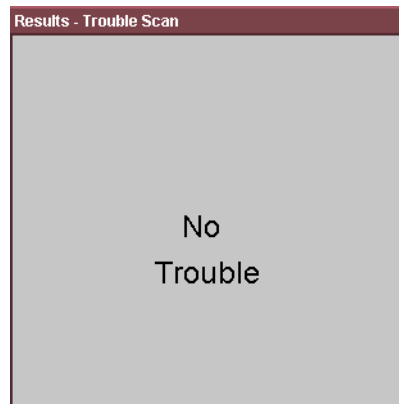
- 6 Adjust the Optical Attenuator to obtain a reading of  $-33$  dBm on the Power Meter (that is, the Receiver minimum sensitivity for 52/155 Mb/s rates). Take note of the Attenuator setting.
- 7 Set the Optical Attenuator to Disable mode.

Note, do not switch OFF the OmniBER OTN laser.

### 3 Performance Tests

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).

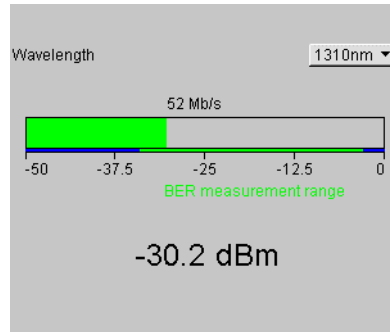
Set the OmniBER OTN's Receiver to display **Optical Power** as follows:

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:

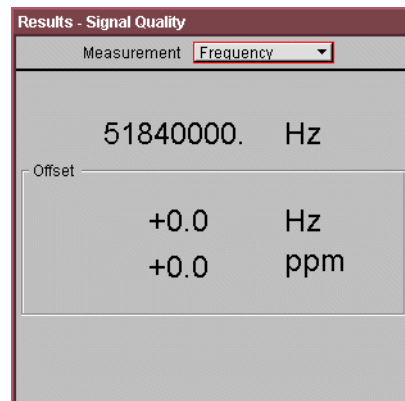
**-31 dBm and -29 dBm**



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.

- 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**

#### **2.66 Gb/s rate (Not available on all options)**

- 14** Set the OmniBER OTN Transmitter to provide an OTU-1 output with PRBS bulk payload as follows:

Press <**Menu**>, choose **Tx/Rx > Transmitter Settings > Physical** then press <**Select**>. Set the **Signal Mode** to **OTN** and **Signal Rate** to **OTU-1**.

- 15** Adjust the Optical Attenuator to obtain a reading of -28 dBm on the Power Meter (that is, the Receiver minimum sensitivity for 2.66 Gb/s rate). Take note of the Attenuator setting.

- 16** 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 (2.66 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.

- 17** Set the OmniBER OTN to **TX>RX Coupled Mode**.

- 18** 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.

- 19** 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.
- 20** Re-set Optical Attenuator to the setting noted in [step 15](#) (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:

**2666.0570 MHz and 2666.0572 MHz**

- 21** Reduce the Optical Attenuator setting by a further 20 dB and check the Receiver **Optical Power** result is between:

**-10 dBm and -6 dBm**

- 22** 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.

- 23** 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.

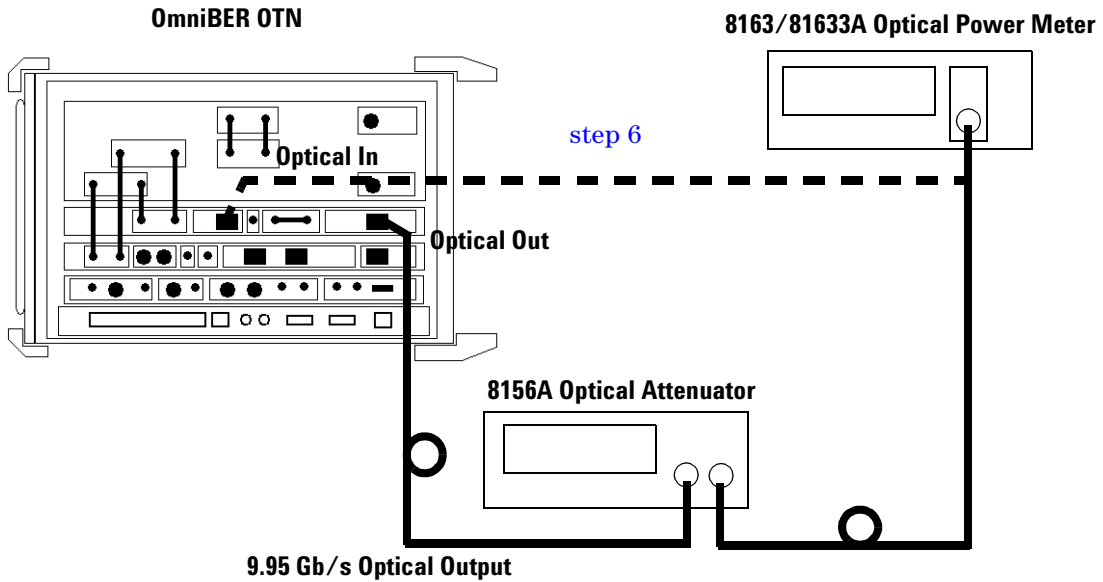
- 24** Check the Power Meter reading is between:

**-8.5 dBm and -7.5 dBm**

### 3 Performance Tests

#### OC-192/STM-64 Rate (J7231B Only)

- 1 Press <Menu>, choose **System > Stored Settings** then press <Select>. Select **Default** then **Recall**.
- 2 Connect the Test Set-up 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.

<b>Extinction Ratio measured in Optical Pulse Mask and Output Characteristics Test</b>	<b>Additional Sensitivity</b>
> 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

## 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
STXS-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

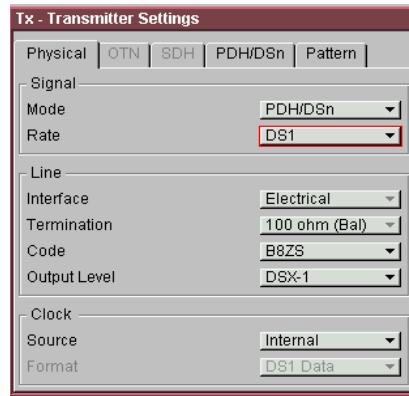
**NOTE**

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.

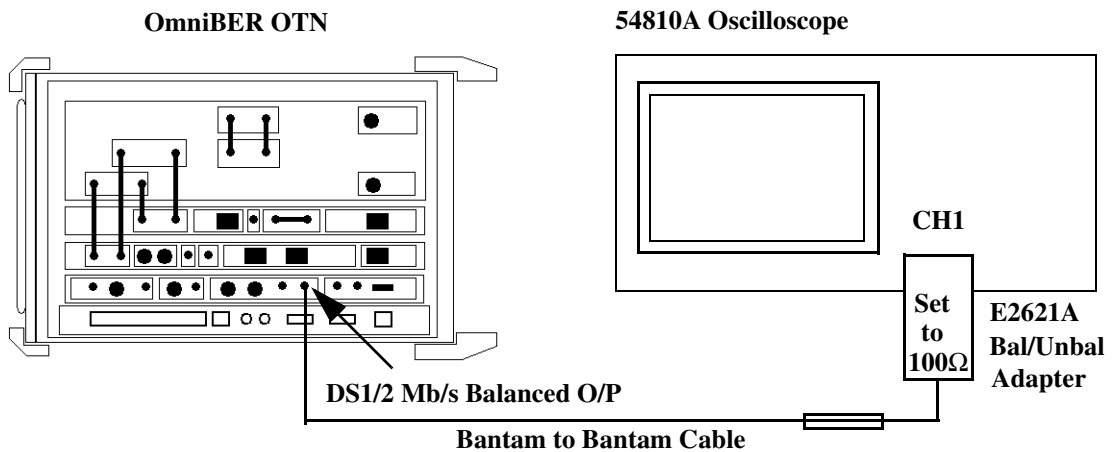
---

### DS1 Output Mask Test

- 1 Recall the OmniBER OTN's default settings as shown on "[Recall Default Settings](#)" on page 64.
- 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**.

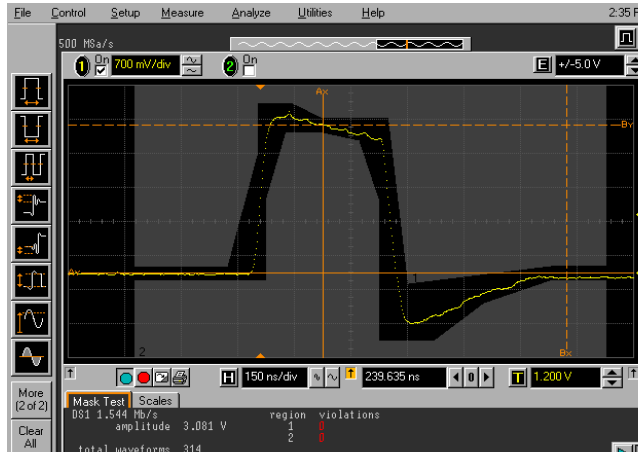


### 3 Performance Tests

- 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 Set-up** 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.

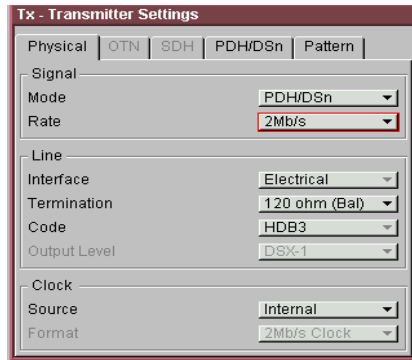
### NOTE

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.

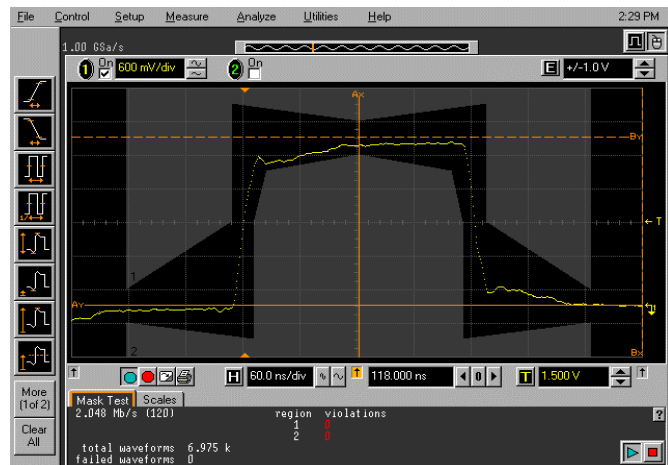
### 3 Performance Tests



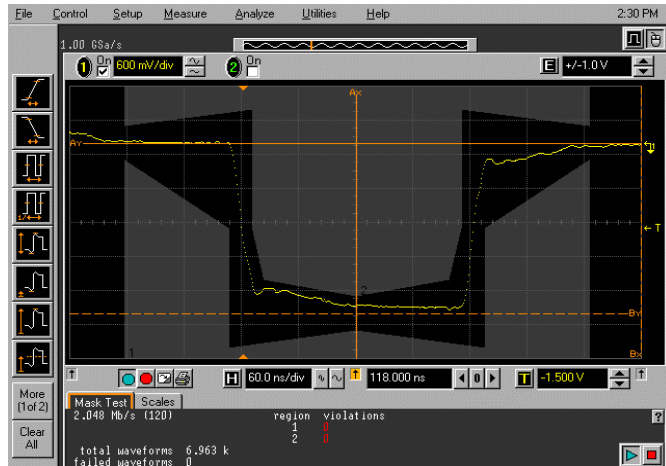
- 2 Load the **2Mb\_ITU\_120.msk** test mask and check the Positive and Negative pulses are within the mask (see examples).

#### NOTE

To test Negative pulse set the Scope **Mask Test Set-up** panel to **Invert Mask**.



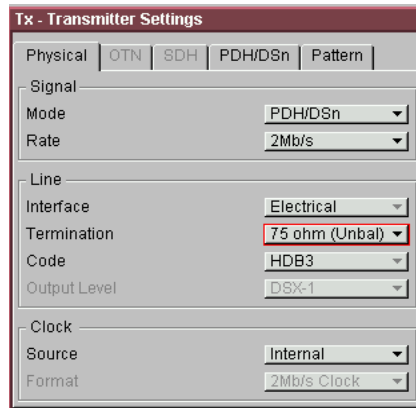
2M Balanced Positive Pulse



2M Balanced Negative Pulse

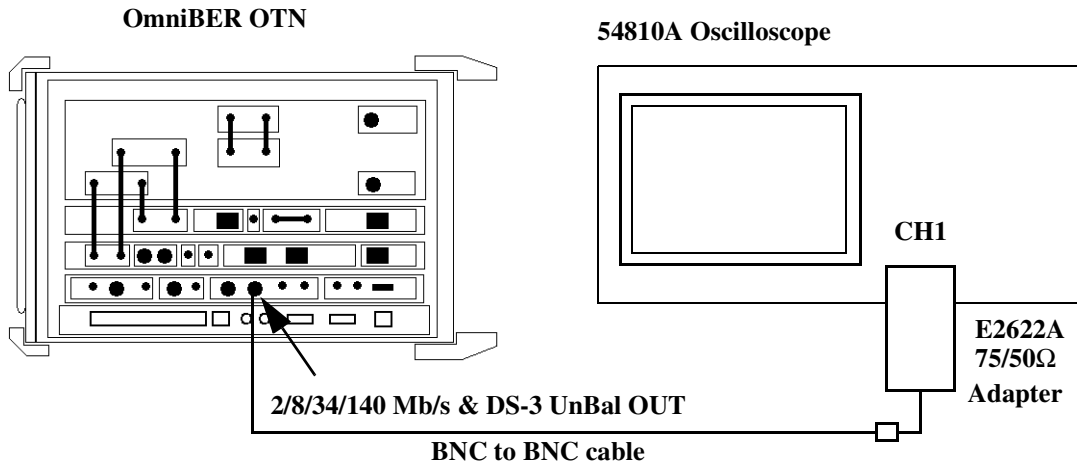
## 2 Mb/s Unbalanced Output Mask Tests

- 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.

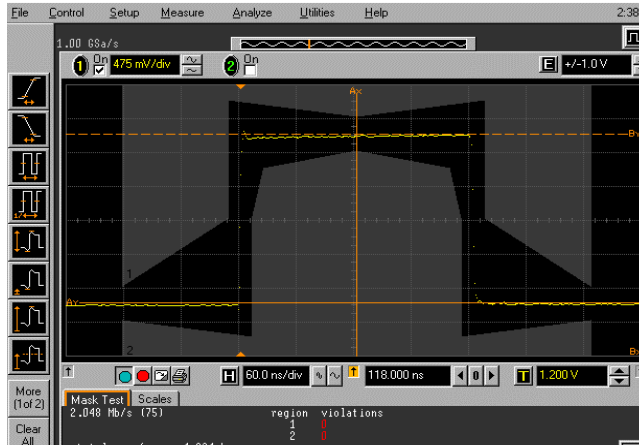
### 3 Performance Tests



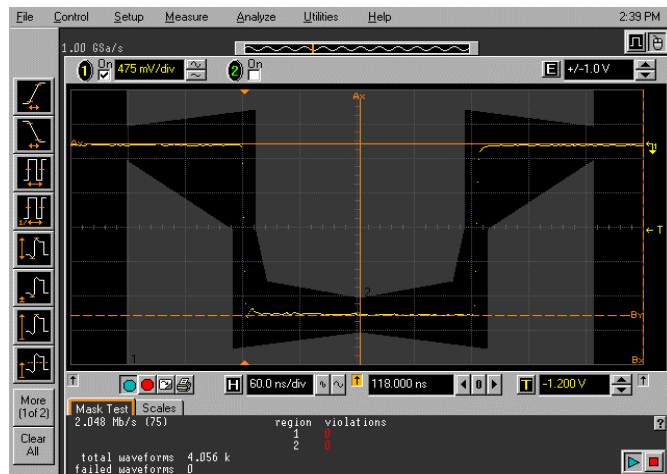
- 3 Load the **2Mb\_ITU\_75.msk** test mask and check the Positive and Negative pulses are within the mask (see examples).

#### NOTE

To test Negative pulse set the Scope **Mask Test Set-up** panel to **Invert Mask**



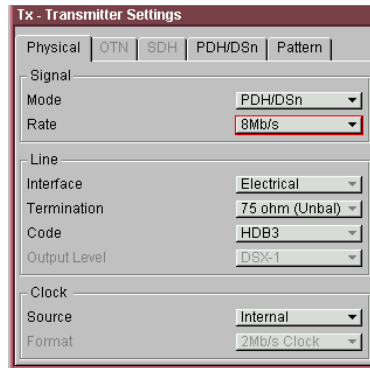
2M Unbalanced Positive Pulse



2M Unbalanced Negative Pulse

#### 8 Mb/s Output Mask Tests

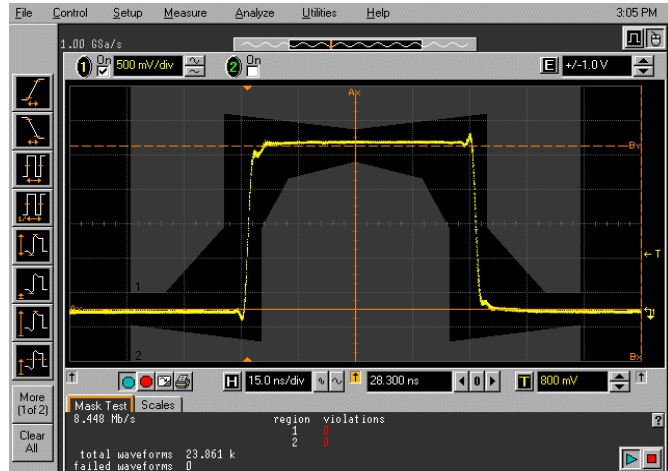
- 1 Press <Menu>, select **Tx/Rx > Transmitter Settings** and set the **Signal Mode** to **PDH/DSn**. Now set the **Signal Rate** to **8 Mb/s**.



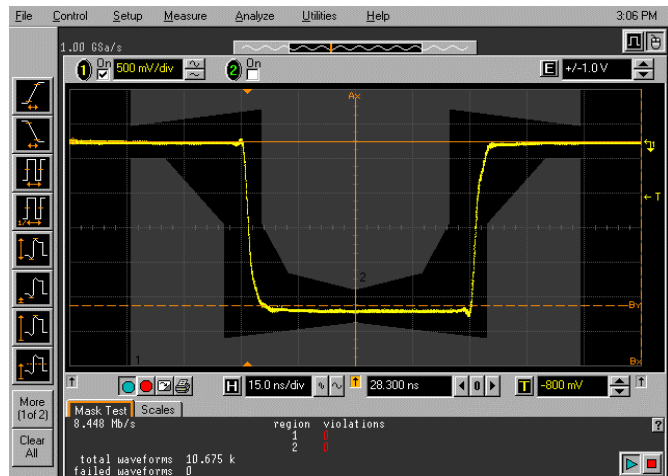
- 2 Load the **8Mb\_ITU.msk** test mask and check the Positive and Negative pulses are within the mask (see examples).

#### NOTE

To test Negative pulse set the Scope **Mask Test Set-up** panel to **Invert Mask**



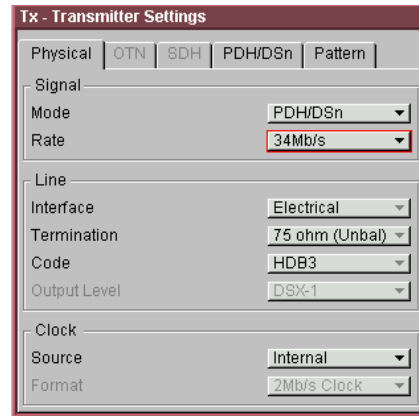
8M Unbalanced Positive Pulse



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**.

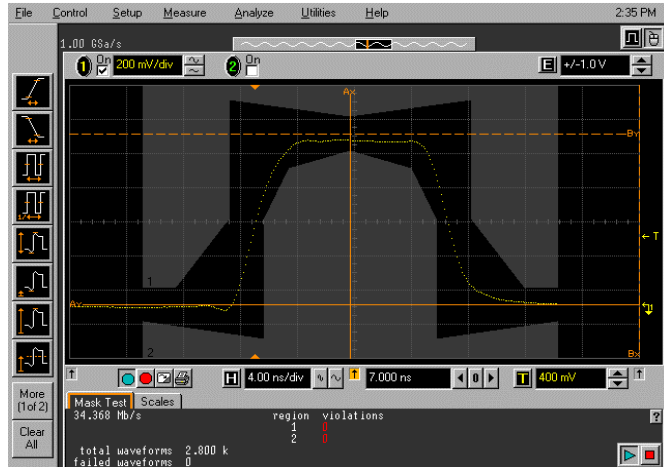


- 2 Load the **34Mb\_ITU.msk** test mask and check the Positive and Negative pulses are within the mask (see examples).

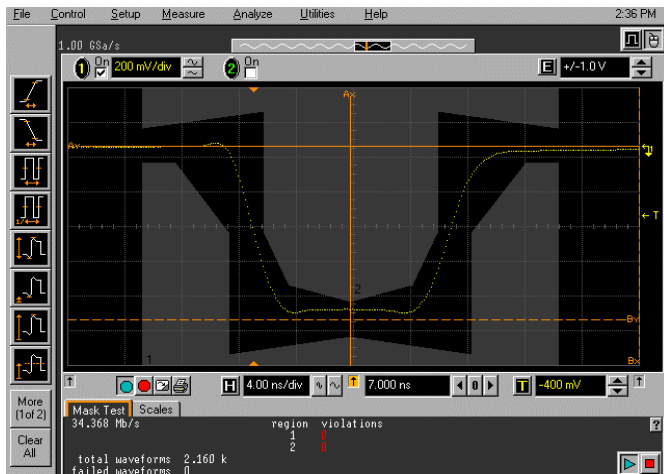
#### NOTE

To test Negative pulse set the Scope **Mask Test Set-up** panel to **Invert Mask**





34M Unbalanced Positive Pulse

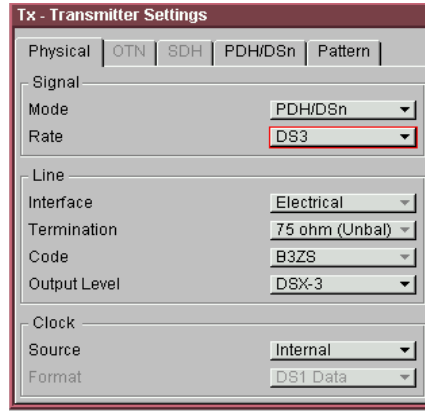


34M Unbalanced Negative Pulse

### 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.

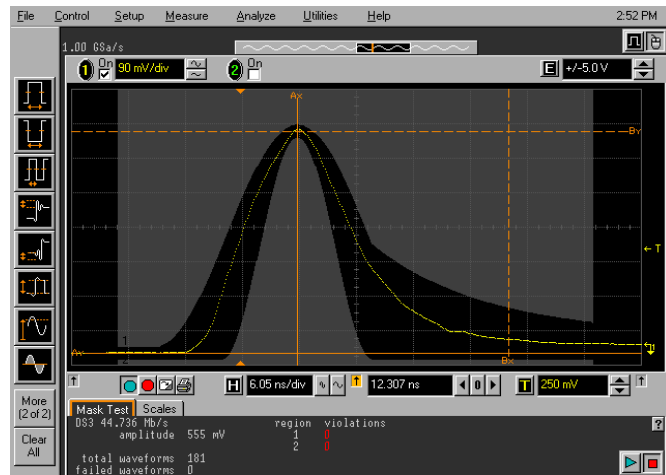
### 3 Performance Tests



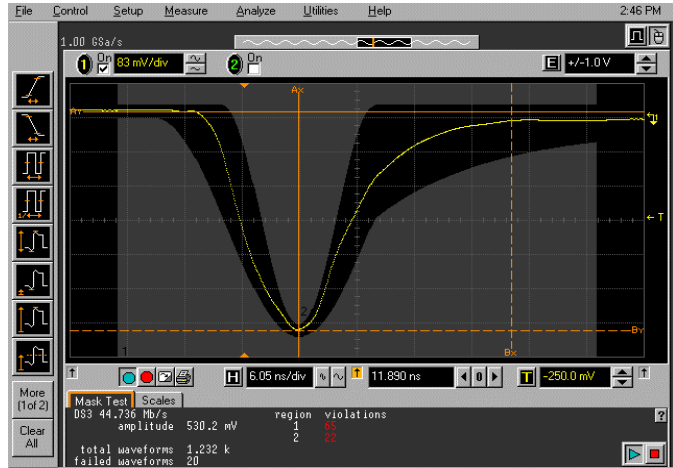
- 2 Load the **DS3\_ANSI.msk** test mask and check the Positive and Negative pulses are within the mask (see examples).

#### NOTE

To test Negative pulse set the Scope **Mask Test Set-up** panel to **Invert Mask**



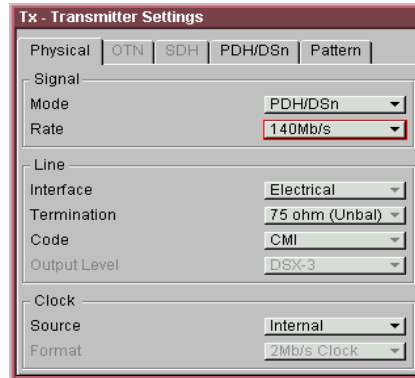
DSX-3 Positive Pulse



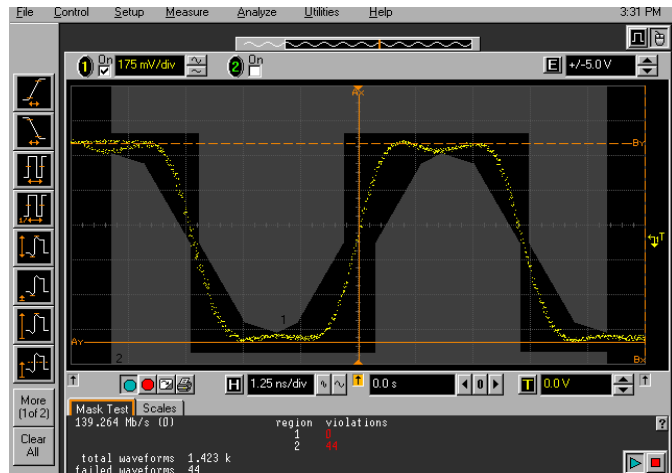
DSX-3 Negative Pulse

#### 140 Mb/s Output Mask Tests

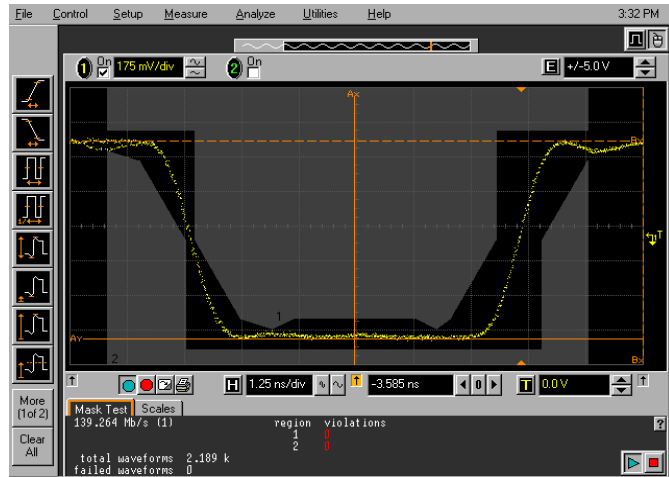
- 1 Press <Menu>, select **Tx/Rx > Transmitter Settings** and set the **Signal Mode** to **PDH/DSn**. Now set the **Signal Rate** to **140 Mb/s**..



- 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



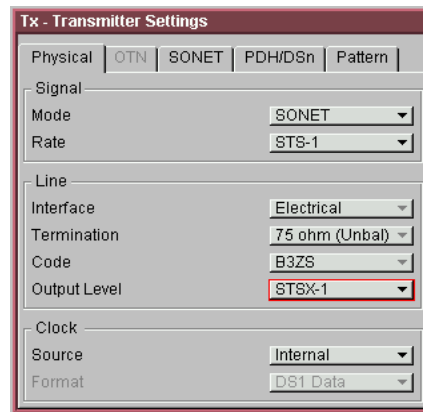
140Mb/s All Ones Mask Test



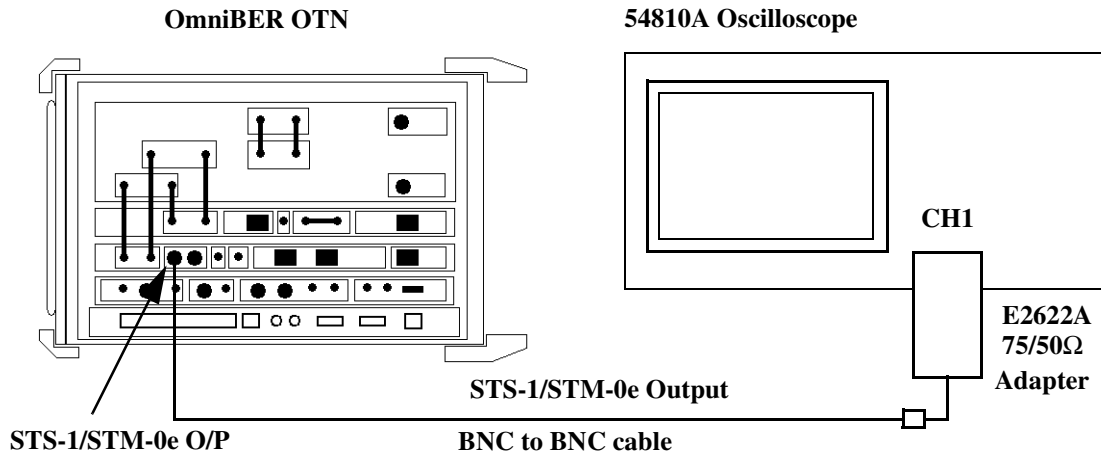
140Mb/s All Ones (inverted) Mask Test

#### 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 64.
- 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.

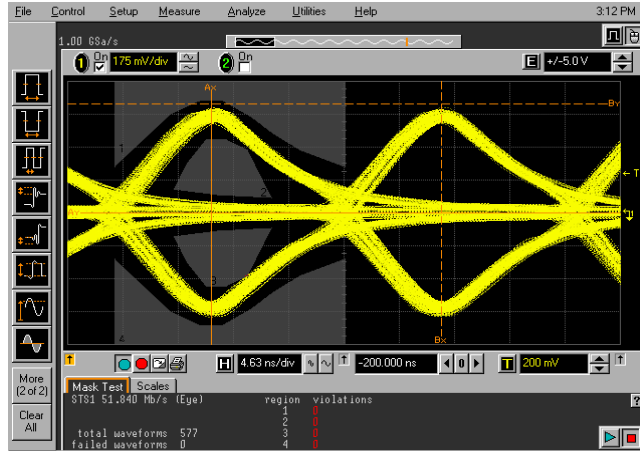


- 4 Load the `STS1_ANSI_EYE.msk` test mask and check the eye meets the mask. See examples

#### NOTE

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

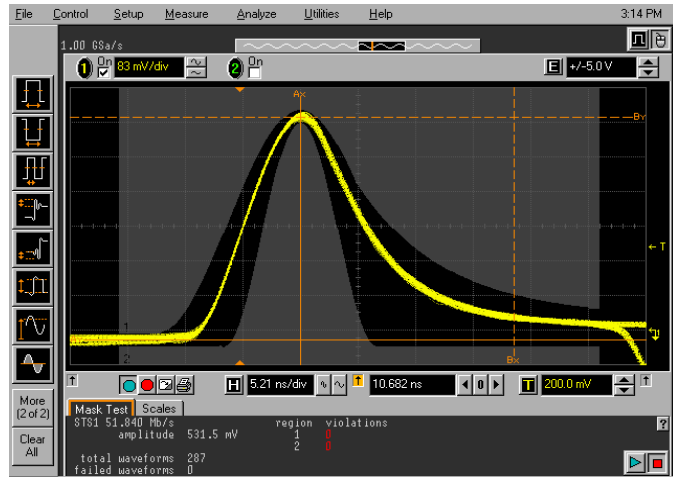
### 3 Performance Tests



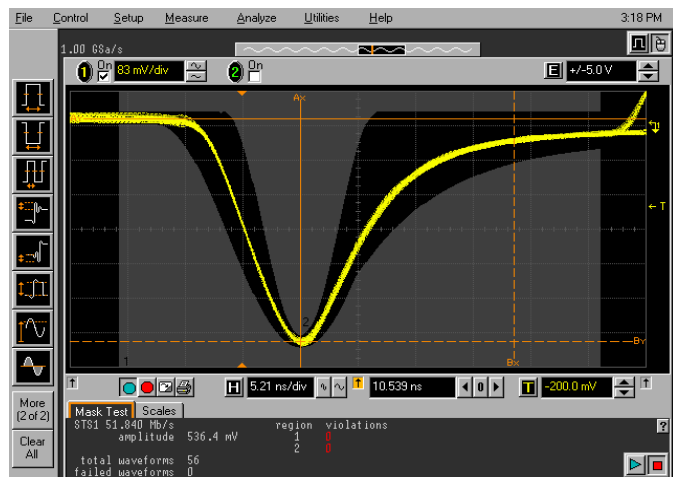
STSX-1 Mask Test



- 5 Load the **STS1\_ANSI\_PULSE.msk** test mask and check the positive and negative pulses meet the mask (see examples).



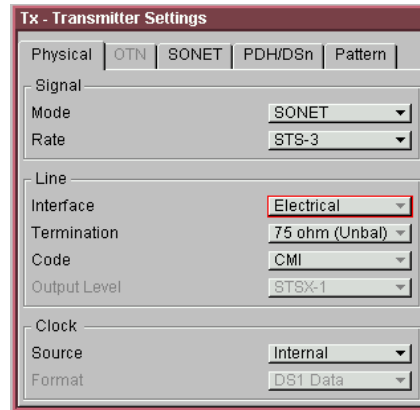
STX-1 Positive Pulse Mask Test



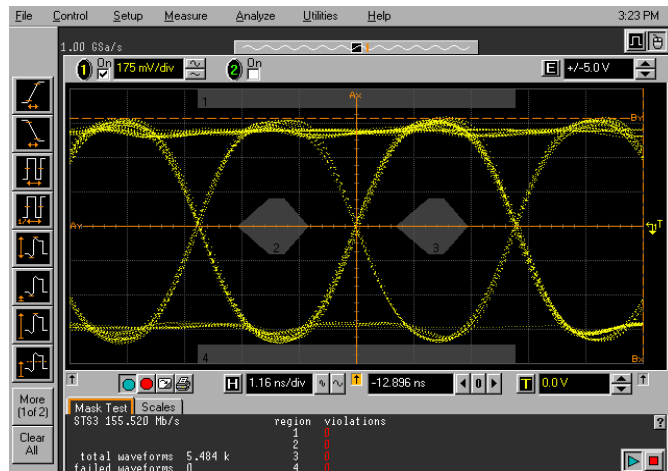
STX-1 Negative Pulse Mask Test

#### 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**.

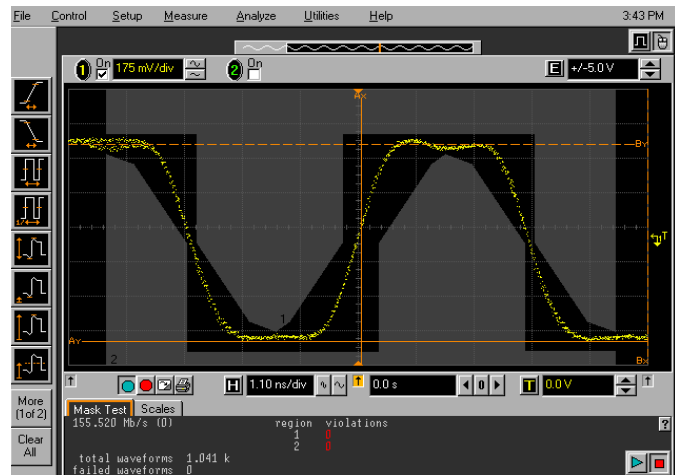


- 2 Load the **STS3\_ANSI.msk** test mask and check the eye meets the mask (see example).



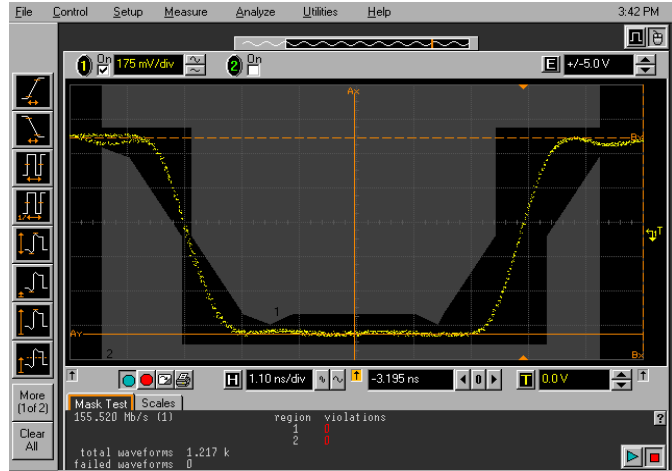
STS-3 Eye Mask Test

- 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).

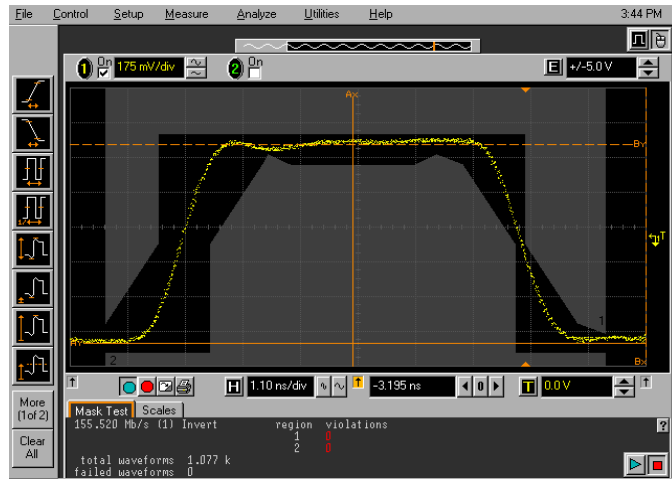


STM-1 All Zeros Mask Test

### 3 Performance Tests



STM-1 All Ones Mask Test



STM-1 All Ones (inverted) Mask Test

## Optical Transmit/Receive Jitter Amplitude Accuracy (J7231B Only)

### Specification

Please refer to the Optical Tx/Rx Jitter Specifications given in the Specifications document provided. 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.

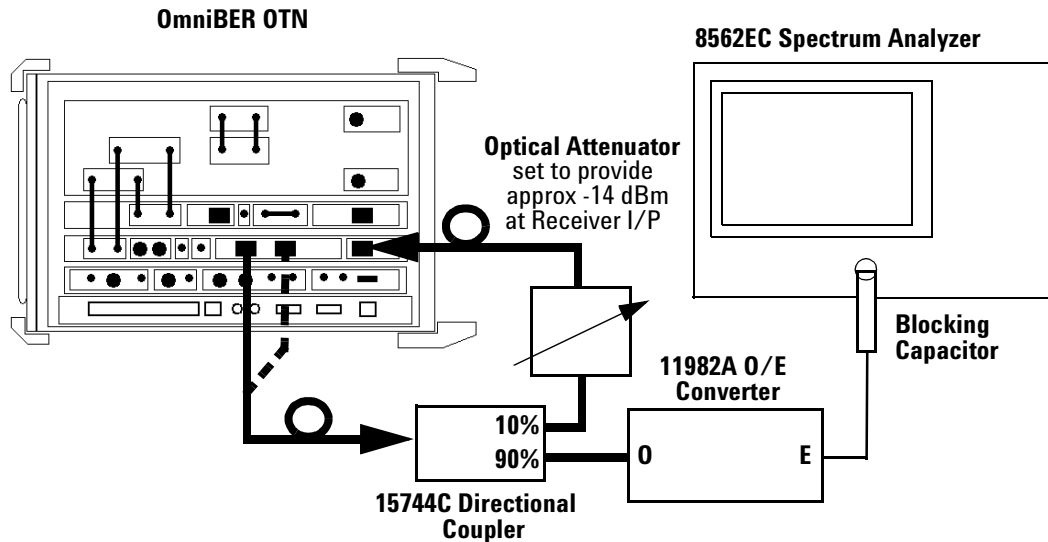
Tests are identical for SDH/Sonet and should only be performed in either SDH or Sonet and not repeated for both.

#### Equipment Required

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

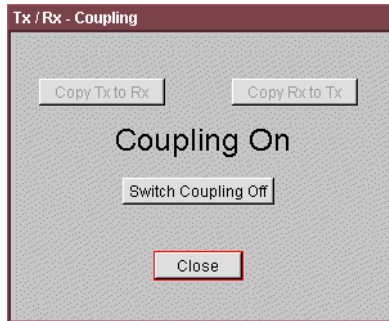
#### Procedure

- 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**.



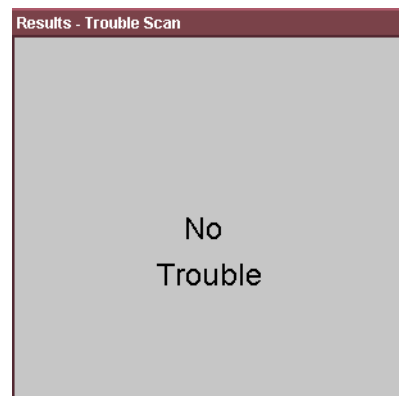
**NOTE**

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.**

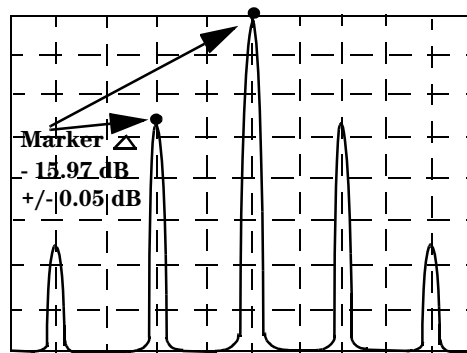
**Frequency Span - 100 kHz** (set to approx 5 times the Jitter frequency in [step 19](#)).

**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.**

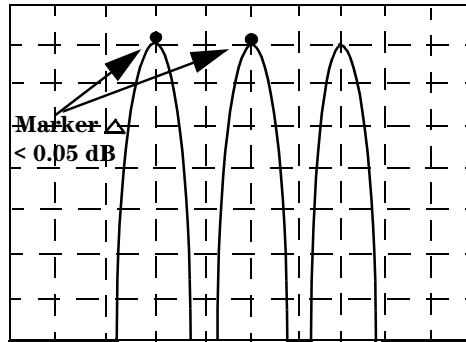
**28** Set the **Test Functions - Jitter/Wander > Transmit Mode > 1010 Unframed** signal **ON**.

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

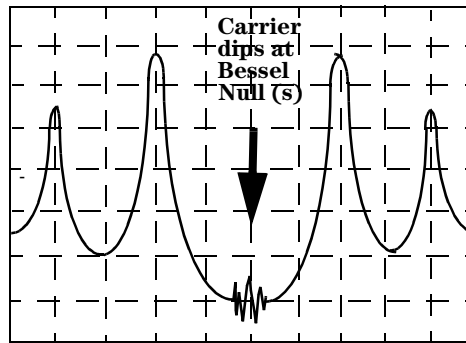
**0.772 and 1.048 UI p-p**  
**0.296 and 0.347 UI RMS.**

**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.**

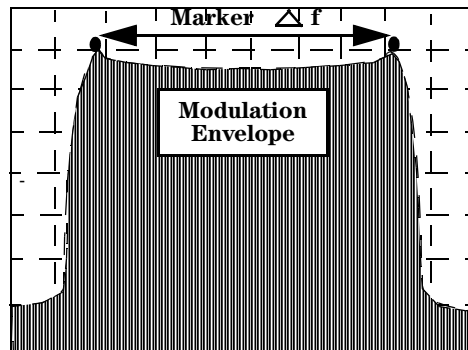
- 47** Press **<Run/Stop>** to halt measurement.

- 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  **$2.90 \pm 0.05$  kHz**.





### Peak Deviation Example

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

**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**.

### 3 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
<a href="#">16</a>	0.8UI	LP+HP2	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0045
<a href="#">16</a>	0.8UI	LP+HP1	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0055
<a href="#">19-22</a>	0.8UI	LP+HP1	0.2	65 kHz	0.164	0.236	0.115	0.285	0.0651	0.0763
<a href="#">25-27</a>	0.8UI	LP+HP2	0.2	650kHz	0.156	0.244	0.113	0.287	0.0650	0.0764
<a href="#">28-31</a>	3.0UI	LP+HP1	0.91	6.5K	0.817	1.003	0.772	1.048	0.296	0.347
<a href="#">33-35</a>	3.0UI	LP+HP1	1.52	5.0K	1.378	1.662	1.3940	1.700	0.497	0.577
<a href="#">38-41</a>	30UI	LP+HP1	3.52	4K	3.218	3.822	3.164	3.876	1.137	1.352
<a href="#">44-46</a>	30UI	LP+HP1	7.52	2.5 kHz	6.898	8.142	6.884	8.156	2.453	2.865
<a href="#">49-523</a>	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
<a href="#">16</a>	0.8UI	LP+HP2	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0045
<a href="#">16</a>	0.8UI	LP+HP1	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0055
<a href="#">19-22</a>	0.8UI	LP+HP1	0.2	250K	0.164	0.236	0.115	0.285	0.0651	0.0763
<a href="#">25-27</a>	0.8UI	LP+HP2	0.2	2.5M	0.146	0.254	0.111	0.289	0.0650	0.0764
<a href="#">28-31</a>	3.0UI	LP+HP1	0.91	25K	0.817	1.003	0.772	1.048	0.296	0.347
<a href="#">33-35</a>	3.0UI	LP+HP1	1.52	15K	1.378	1.662	1.394	1.700	0.497	0.577
<a href="#">38-41</a>	30UI	LP+HP1	3.52	10K	3.218	3.822	3.164	3.876	1.137	1.352
<a href="#">44-46</a>	30UI	LP+HP1	11.52	5K	10.578	12.462	10.603	12.437	3.768	4.378
<a href="#">49-523</a>	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.

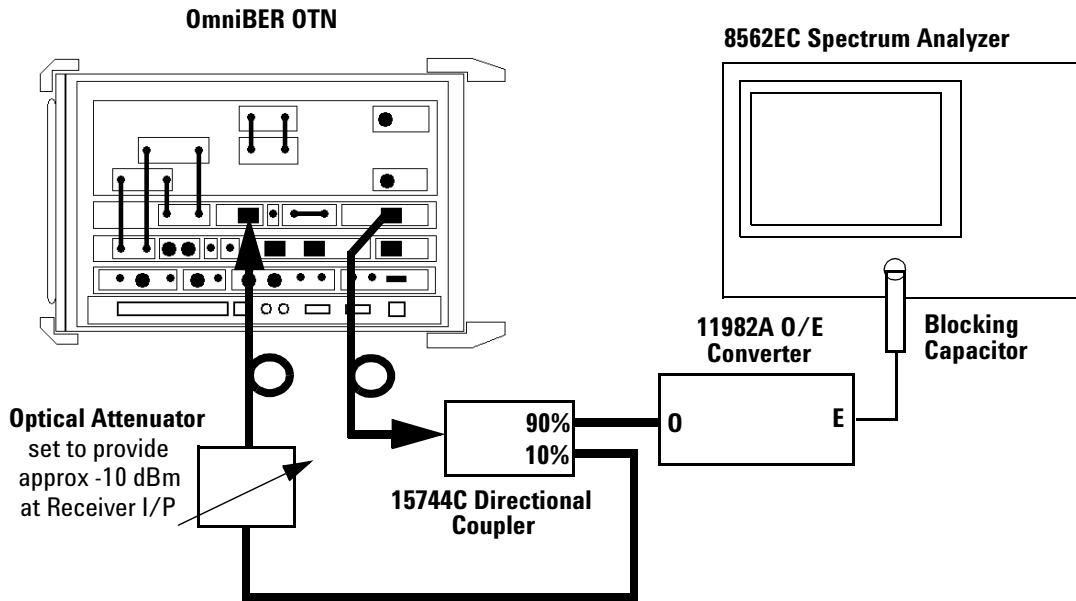
STEP	RX Range	RX Filter	Tx UI p-p	Tx Freq	TX Result MIN p-p	TX Result MAX p-p	RX Result MIN p-p	RX Result MAX p-p	RX Result MIN RMS	RX Result MAX RMS
<a href="#">16</a>	0.8UI	LP+HP2	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0045
<a href="#">16</a>	0.8UI	LP+HP1	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0055
<a href="#">19-22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

### 3 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.

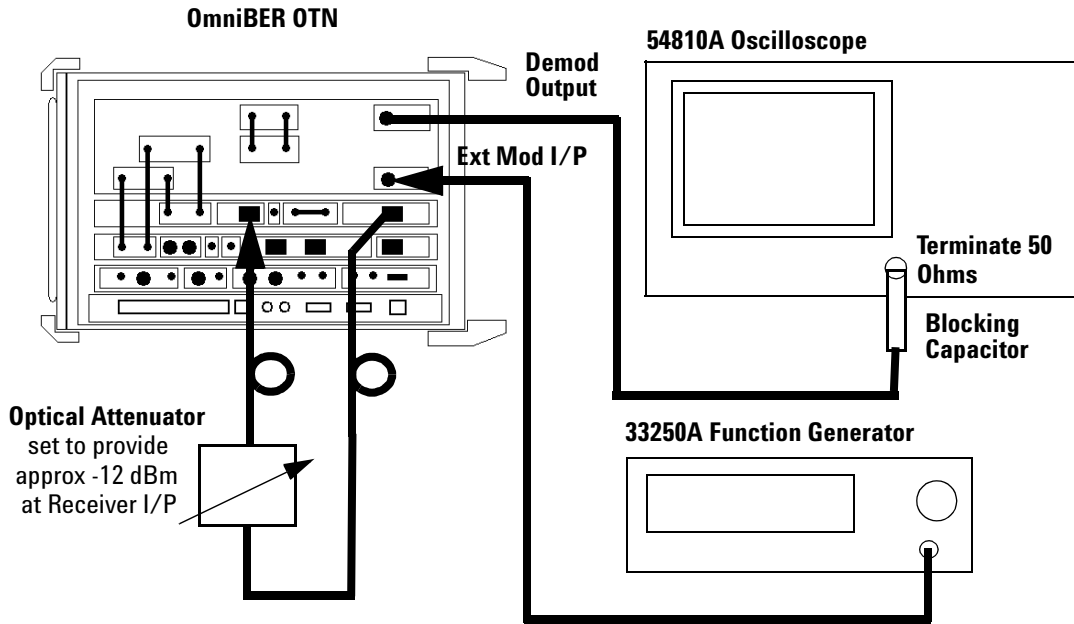
STEP	RX Range	RX Filter	Tx UI p-p	Tx Freq	TX Result MIN p-p	TX Result MAX p-p	RX Result MIN p-p	RX Result MAX p-p	RX Result MIN RMS	RX Result MAX RMS
16	0.8UI	LP+HP2	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0045
16	0.8UI	LP+HP1	OFF	OFF	OFF	OFF	N/A	0.071	N/A	0.0055
19-22	0.8UI	LP+HP1	0.2	4M	0.150	0.250	0.114	0.286	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.

### 3 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

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

**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
<b>Performance Self Test</b>				
68	step 5	Confidence Test	Pass/Fail	
68	step 6	Frequency Measurement	Pass/Fail	
<b>Internal Reference Clock Accuracy</b>				
72	step 4	2 MHz Clock OUT	2.0479908 MHz	2.0480092 MHz
74	step 13	DS1 Clock OUT	-4.5 ppm	+4.5 ppm
75	step 2	Alternative DS1 Test (Counter indication for framed signal)	1.540993 MHz	1.541007 MHz
<b>External Clock Reference Inputs and Clock Reference Output</b>				
78	step 6	2 MHz Clock Ext	2.047999999 MHz	2.048000001 MHz
79	step 7	Signal Locked	Pass/Fail	
79	step 10/step 6	10 MHz Clock Ext	2.047999999 MHz	2.048000001 MHz

Page No.	Test Description	Min	Result Actual	Max
79	<a href="#">step 10/step 7</a> Signal Locked		Pass/Fail	
80	<a href="#">step 16</a> 2 Mb/s Data Ext Unbal	2.047999999 MHz		2.048000001 MHz
81	<a href="#">step 17</a> Signal Locked		Pass/Fail	
81	<a href="#">step 21</a> 2 Mb/s Data Ext Bal	2.047999999 MHz		2.048000001 MHz
81	<a href="#">step 22</a> Signal Locked		Pass/Fail	
82	<a href="#">step 26</a> No Alarm/Errors		Pass/Fail	
82	<a href="#">step 27</a> DS1 Ext	1543999 Hz		1544001 Hz
82	<a href="#">step 28</a> Signal Locked		Pass/Fail	
<b>Optical Pulse Mask and Output Characteristics</b>				
<b>Option 104/106</b>	<b>1310nm Optical Port (52 Mb/s - 2.5 Gb/s)</b>			
87	<a href="#">step 9</a> OC-1/STM-0 Mask		Pass/Fail	
87	<a href="#">step 11</a> OC-1/STM-0 (ER)	>8.2 dB		N/A
88	<a href="#">step 16</a> OC-3/STM-1 Mask		Pass/Fail	
88	<a href="#">step 18</a> OC-3/STM-1 (ER)	>8.2 dB		N/A
88	<a href="#">step 23</a> OC-12/STM-4 Mask		Pass/Fail	
88	<a href="#">step 25</a> OC-12/STM-4 (ER)	>8.2 dB		N/A
90	<a href="#">step 33</a> OC-48/STM-16 Mask		Pass/Fail	
91	<a href="#">step 35</a> OC-48/STM-16 (PWR)	-2.5 dBm		+4 dBm
91	<a href="#">step 36</a> OC-48/STM-16 (ER)	>8.2 dB	Pass/Fail	N/A
<b>Option 111</b>	<b>2.66 Gb/s</b>			
87	<a href="#">step 37/step 33</a> OTU-1 Mask		Pass/Fail	
87	<a href="#">step 37/step 35</a> OTU-1(PWR)	-2.5 dBm		+4 dBm

### 3 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
87	<a href="#">step 37/</a> <a href="#">step 36</a> OTU-1 (ER)	>8.2 dB	Pass/Fail	N/A
<b>Option 105/106</b>	<b>1550nm Optical Port (52 Mb/s - 2.5 Gb/s)</b>			
87	<a href="#">step 9</a> OC-1/STM-0 Mask		Pass/Fail	
87	<a href="#">step 11</a> OC-1/STM-0 (ER)	>8.2 dB		N/A
88	<a href="#">step 16</a> OC-3/STM-1 Mask		Pass/Fail	
88	<a href="#">step 18</a> OC-3/STM-1 (ER)	>8.2 dB		N/A
88	<a href="#">step 23</a> OC-12/STM-4 Mask		Pass/Fail	
88	<a href="#">step 25</a> OC-12/STM-4 (ER)	>8.2 dB		N/A
90	<a href="#">step 33</a> OC-48/STM-16 Mask		Pass/Fail	
91	<a href="#">step 35</a> OC-48/STM-16 (PWR)	-2.5 dBm		+4 dBm
91	<a href="#">step 36</a> OC-48/STM-16 (ER)	>8.2 dB	Pass/Fail	N/A
<b>Option 111</b>	<b>2.66Gb/s</b>			
87	<a href="#">step 37/</a> <a href="#">step 33</a> OTU-1 Mask		Pass/Fail	
87	<a href="#">step 37/</a> <a href="#">step 35</a> OTU-1(PWR)	-2.5 dBm		+4 dBm
87	<a href="#">step 37/</a> <a href="#">step 36</a> OTU-1 (ER)	>8.2 dB	Pass/Fail	N/A
	<b>1550nm Optical Port (9.95 Gb/s and 10.7 Gb/s)</b>			
<b>All options</b>				
94	<a href="#">step 8</a> OC-192/STM-64 Mask		Pass/Fail	
94	<a href="#">step 10</a> OC-192/STM-64 (PWR)	-1 dBm		+2 dBm
94	<a href="#">step 11</a> OC-192/STM-64 (ER)	>8.2 dB	Pass/Fail	
<b>Option 112</b>				

Page No.	Test Description	Min	Result Actual	Max
95	<a href="#">step 17</a>	OTU-2 Output Mask	Pass/Fail	
96	<a href="#">step 19</a>	OTU-2 Output (PWR)	-1 dBm	+2 dBm
96	<a href="#">step 19</a>	OTU-2 Output (ER)	>8.2 dB	Pass/Fail
<b>Optical Receiver Sensitivity, Optical Power and Frequency Measurement</b>				
<b>Optical Receive Port (52 &amp; 155 Mb/s)</b>				
<b>All options</b>				
101	<a href="#">step 5</a>	Laser LED ON	Pass/Fail	
101	<a href="#">step 6</a>	Note Attenuator Setting	N/A	N/A
102	<a href="#">step 9</a>	'No Trouble' Min Sens	Pass/Fail	
102	<a href="#">step 10</a>	Additional Attenuation	Typ > 1 dB	N/A
102	<a href="#">step 11</a>	-30 dBm PWR meas	-31 dBm	-29 dBm
102	<a href="#">step 11</a>	OC-1/STM-0 Frequency	51.83999 MHz	51.84001 MHz
104	<a href="#">step 12</a>	-10 dBm PWR meas	-11 dBm	-9 dBm
104	<a href="#">step 13</a>	'No Trouble' Max Sens	Pass/Fail	
104	<a href="#">step 15</a>	Power Meter check	-10.5	-9.5
101	<a href="#">step 5</a>	Laser LED ON	Pass/Fail	
101	<a href="#">step 6</a>	Note Attenuator Setting	N/A	N/A
102	<a href="#">step 9</a>	'No Trouble' Min Sens	Pass/Fail	
102	<a href="#">step 10</a>	Additional Attenuation	Typ > 1 dB	N/A
102	<a href="#">step 11</a>	-30 dBm PWR meas	-31 dBm	-29 dBm
102	<a href="#">step 11</a>	OC-3 /STM-1 Frequency	155.51999 MHz	155.52001 MHz
104	<a href="#">step 12</a>	-10 dBm PWR meas	-11 dBm	-9 dBm
104	<a href="#">step 13</a>	'No Trouble' Max Sens	Pass/Fail	

### 3 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
104	<a href="#">step 15</a> Power Meter check	-10.5		-9.5
<b>Optical Receive Port (622 Mb/s)</b>				
104	<a href="#">step 17</a> Laser LED ON		Pass/Fail	
104	<a href="#">step 18</a> Note Attenuator Setting	N/A		N/A
105	<a href="#">step 21</a> 'No Trouble' Min Sens		Pass/Fail	
105	<a href="#">step 22</a> Additional Attenuation	Typ > 1 dB		N/A
105	<a href="#">step 23</a> -28 dBm PWR meas	-29 dBm		-27 dBm
105	<a href="#">step 23</a> OC-12/STM-4 Frequency	622.07999 MHz		622.08001 MHz
105	<a href="#">step 24</a> -8 dBm PWR meas	-9 dBm		-7 dBm
105	<a href="#">step 25</a> 'No Trouble' Max Sens		Pass/Fail	
106	<a href="#">step 27</a> Power Meter check	-8.5		-7.5
<b>Optical Receive Port (2.5 Gb/s)</b>				
106	<a href="#">step 3</a> Laser LED ON		Pass/Fail	
106	<a href="#">step 4</a> Note Attenuator Setting	N/A		N/A
107	<a href="#">step 7</a> 'No Trouble' Min Sens		Pass/Fail	
107	<a href="#">step 8</a> Additional Attenuation	Typ > 1 dB		N/A
107	<a href="#">step 9</a> -28 dBm PWR meas	-30 dBm		-26 dBm
107	<a href="#">step 9</a> OC-48/STM-16 Frequency	2488.3199 MHz		2488.3201 MHz
107	<a href="#">step 10</a> -8 dBm PWR meas	-10 dBm		-6 dBm
108	<a href="#">step 11</a> 'No Trouble' Max Sens		Pass/Fail	
108	<a href="#">step 14</a> Power Meter check	-8.5		-7.5
<b>Opt 111</b>	<b>Optical Receive Port (2.66 Gb/s)</b>			

Page No.	Test Description	Min	Result Actual	Max
108	step 15 Note Attenuator Setting	N/A		N/A
108	step 18 'No Trouble' Min Sens		Pass/Fail	
109	step 19 Additional Attenuation	Typ > 1 dB		N/A
109	step 20 -28 dBm PWR meas	-30 dBm		-26 dBm
109	step 20 OTN - OTU-1 Frequency	2666.0570 MHz		2666.0572 MHz
109	step 21 -8 dBm PWR meas	-10 dBm		-6 dBm
109	step 22 'No Trouble' Max Sens		Pass/Fail	
109	step 25 Power Meter check	-8.5		-7.5
<b>Optical Receive Port (9.95 and 10.7 Gb/s)</b>				
111	step 4 Laser LED ON		Pass/Fail	
111	step 5 Note Attenuator Setting	N/A		N/A
111	step 8 'No Trouble' Min Sens		Pass/Fail	
111	step 9 Additional Attenuation	Typ > 1 dB		N/A
111	step 10 -18dBm PWR meas	-19.5 dBm		-16.5 dBm
111	step 10 OC-192/STM-64 Frequency	9953.2799 MHz		9953.2801 MHz
112	step 11 -7 dBm PWR meas	-8.5 dBm		-5.5 dBm
112	step 12 'No Trouble' Max Sens		Pass/Fail	
112	step 14 Power Meter check	-8.5 dBm		-5.5 dBm
<b>Option 112</b>				
112	step 15 Laser LED ON		Pass/Fail	
112	step 16 Note Attenuator Setting	N/A		N/A
113	step 19 'No Trouble' Min Sens		Pass/Fail	

### 3 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
113	<a href="#">step 20</a> Additional Attenuation	Typ > 1 dB		N/A
113	<a href="#">step 21</a> -16dBm PWR meas	-17.5 dBm		-14.5 dBm
113	<a href="#">step 21</a> OTN Output Frequency	1070.9224 MHz		1070.9226 MHz
113	<a href="#">step 22</a> -7 dBm PWR meas	-8.5 dBm		-5.5 dBm
113	<a href="#">step 23</a> 'No Trouble' Max Sens		Pass/Fail	
114	<a href="#">step 25</a> Power Meter check	-8.5 dBm		-5.5 dBm
<b>All options</b>				
114	<b>Check Receiver Sensitivity margin v.s. Transmitter Extinction Ratio</b>		Pass/Fail	
<b>Electrical Pulse Mask and Output Characteristics (opt 012 Only)</b>				
<b>DS1 Output Mask Tests</b>				
118	<a href="#">step 4</a> DS1 ANSI Mask		Pass/Fail	
119	<a href="#">step 5</a> DSX-1 Pulse Amplitudes		Pass/Fail	
119	<a href="#">step 6</a> DSX1-LO Output Level		Pass/Fail	
<b>2 Mb/s Balanced Output Mask Tests</b>				
120	<a href="#">step 2</a> 2 Mb/s ITU 120 Mask		Pass/Fail	
122	<a href="#">step 3</a> 2 Mb/s ITU 75 Mask		Pass/Fail	
<b>8 Mb/s Output Mask Tests</b>				
124	<a href="#">step</a> 8 Mb/s ITU Mask		Pass/Fail	
<b>34 Mb/s Output Mask Tests</b>				
126	<a href="#">step 2</a> 34 Mb/s ITU Mask		Pass/Fail	
<b>DS3 Output Mask Tests</b>				
128	<a href="#">step 2</a> DS3 ANSI Mask		Pass/Fail	
<b>140 Mb/s Output Mask Tests</b>				
130	<a href="#">step 2</a> 140 Mb/s ITU Masks		Pass/Fail	



Page No.	Test Description	Min	Result Actual	Max
<b>STS-1 (51 Mb/s) Output Mask Tests</b>				
133	step 4	STS-1 Eye Mask	Pass/Fail	
135	step 5	STS-1 ANSI Mask	Pass/Fail	
<b>STS-3 Output Mask Tests</b>				
136	step 2	STS-3 ANSI Mask	Pass/Fail	
137	step 4	155 Mb/s ITU_0 Mask	Pass/Fail	
137	step 5	155 Mb/s ITU_1s Mask	Pass/Fail	
<b>J7231B ONLY - Optical Transmit/Receive Jitter Amplitude Accuracy</b>				
<b>STM-0/STS-3 Rate</b>				
143	step 11	Optical Power	-16.0 dBm	-12.0 dBm
143	step 12	No Trouble	Pass/Fail	
143	step 16	RX p-p LP+HP1	N/A	0.071 UI p-p
143	step 16	RX RMS LP+HP1	N/A	0.0055 UI RMS
143	step 16	RX p-p LP+HP2	N/A	0.071 UI p-p
143	step 16	RX RMS LP+HP2	N/A	0.0045 UI RMS
145	step 21	No Trouble	Pass/Fail	
145	step 22	TX p-p result	0.164 UI p-p	0.236 UI p-p
145	step 22	RX p-p LP+HP1	0.115 UI p-p	0.285 UI p-p
145	step 22	RX RMS LP+HP1	0.0651 UI RMS	0.0763 UI RMS
146	step 26	No Trouble	Pass/Fail	
146	step 27	TX p-p result	0.164 UI p-p	0.236 UI p-p
146	step 27	RX p-p LP+HP2	0.113 UI p-p	0.287 UI p-p
146	step 27	RX RMS LP+HP2	0.0650 UI RMS	0.0764 UI RMS
147	step 30	No Trouble	Pass/Fail	
147	step 31	TX p-p result	0.817 UI p-p	1.003 UI p-p

### 3 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
147	step 31 RX p-p LP+HP1	0.772 UI p-p		1.048 UI p-p
147	step 31 RX RMS LP+HP1	0.296 UI RMS		0.347 UI RMS
148	step 34 No Trouble		Pass/Fail	
148	step 35 TX p-p result	1.378 UI p-p		1.662 UI p-p
148	step 35 RX p-p LP+HP1	1.340 UI p-p		1.700 UI p-p
148	step 35 RX RMS LP+HP1	0.497 UI RMS		0.577 UI RMS
149	step 40 No Trouble		Pass/Fail	
149	step 41 TX p-p result	3.218 UI p-p		3.822 UI p-p
149	step 41 RX p-p LP+HP1	3.164 UI p-p		3.876 UI p-p
149	step 41 RX RMS LP+HP1	1.137 UI RMS		1,352 UI RMS
149	step 45 No Trouble		Pass/Fail	
150	step 46 TX p-p result	6.898 UI p-p		8.142 UI p-p
150	step 46 RX p-p LP+HP1	6.884 UI p-p		8.156 UI p-p
150	step 46 RX RMS LP+HP1	2.453 UI RMS		2.865 UI RMS
151	step 51 No Trouble		Pass/Fail	
151	step 52 TX p-p result	18.580 UI p-p		21.420 UI p-p
151	step 52 RX p-p result	15.600 UI p-p		24.400 UI p-p
151	step 52 RX RMS result	5.943 UI RMS		8.199 UI RMS
<b>STM-1/OC-3 Rate</b>				
143	step 11 Optical Power	-16.0 dBm		-12.0 dBm
143	step 12 No Trouble		Pass/Fail	
143	step 16 RX p-p LP+HP1	N/A		0.071 UI p-p
143	step 16 RX RMS LP+HP1	N/A		0.0055 UI RMS
143	step 16 RX p-p LP+HP2	N/A		0.071 UI p-p

Page No.	Test Description	Min	Result Actual	Max
143	step 16	RX RMS LP+HP2	N/A	0.0045 UI RMS
145	step 21	No Trouble	Pass/Fail	
145	step 22	TX p-p result	0.164 UI p-p	0.236 UI p-p
145	step 22	RX p-p LP+HP1	0.116 UI p-p	0.284 UI p-p
145	step 22	RX RMS LP+HP1	0.0608 UI RMS	0.0807 UI RMS
146	step 26	No Trouble	Pass/Fail	
146	step 27	TX p-p result	0.164 UI p-p	0.236 UI p-p
146	step 27	RX p-p LP+HP2	0.115 UI p-p	0.285 UI p-p
146	step 27	RX RMS LP+HP2	0.0651 UI RMS	0.0763 UI RMS
147	step 30	No Trouble	Pass/Fail	
147	step 31	TX p-p result	0.817 UI p-p	1.003 UI p-p
147	step 31	RX p-p LP+HP1	0.772 UI p-p	1.048 UI p-p
147	step 31	RX RMS LP+HP1	0.296 UI RMS	0.347 UI RMS
148	step 34	No Trouble	Pass/Fail	
148	step 35	TX p-p result	1.378 UI p-p	1.662 UI p-p
148	step 35	RX p-p LP+HP1	1.394 UI p-p	1.700 UI p-p
148	step 35	RX RMS LP+HP1	0.497 UI RMS	0.577 UI RMS
149	step 40	No Trouble	Pass/Fail	
149	step 41	TX p-p result	3.218 UI p-p	3.822 UI p-p
149	step 41	RX p-p LP+HP1	3.164 UI p-p	3.876 UI p-p
149	step 41	RX RMS LP+HP1	1.137 UI RMS	1.352 UI RMS
149	step 45	No Trouble	Pass/Fail	
150	step 46	TX p-p result	6.898 UI p-p	8.142 UI p-p
150	step 46	RX p-p LP+HP1	6.884 UI p-p	8.156 UI p-p
150	step 46	RX RMS LP+HP1	2.453 UI RMS	2.865 UI RMS

### 3 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
151	<a href="#">step 51</a>	No Trouble	Pass/Fail	
151	<a href="#">step 52</a>	TX p-p result	29.670 UI p-p	35.330 UI p-p
151	<a href="#">step 52</a>	RX p-p result	27.690 UI p-p	38.310 UI p-p
151	<a href="#">step 52</a>	RX RMS result	10.339 UI RMS	12.995 UI RMS
<b>STM-4/OC-12 Rate</b>				
143	<a href="#">step 11</a>	Optical Power	-16.0 dBm	-12.0 dBm
143	<a href="#">step 12</a>	No Trouble	Pass/Fail	
143	<a href="#">step 16</a>	RX p-p LP+HP1	N/A	0.071 UI p-p
143	<a href="#">step 16</a>	RX RMS LP+HP1	N/A	0.0055 UI RMS
143	<a href="#">step 16</a>	RX p-p LP+HP2	N/A	0.071 UI p-p
143	<a href="#">step 16</a>	RX RMS LP+HP2	N/A	0.0045 UI RMS
145	<a href="#">step 21</a>	No Trouble	Pass/Fail	
145	<a href="#">step 22</a>	TX p-p result	0.164 UI p-p	0.236 UI p-p
145	<a href="#">step 22</a>	RX p-p LP+HP1	0.115 UI p-p	0.285 UI p-p
145	<a href="#">step 22</a>	RX RMS LP+HP1	0.0651 UI RMS	0.0763 UI RMS
146	<a href="#">step 26</a>	No Trouble	Pass/Fail	
146	<a href="#">step 27</a>	TX p-p result	0.146 UI p-p	0.254 UI p-p
146	<a href="#">step 27</a>	RX p-p LP+HP2	0.111 UI p-p	0.289 UI p-p
146	<a href="#">step 27</a>	RX RMS LP+HP2	0.0650 UI RMS	0.0764 UI RMS
147	<a href="#">step 30</a>	No Trouble	Pass/Fail	
147	<a href="#">step 31</a>	TX p-p result	0.817 UI p-p	1.003 UI p-p
147	<a href="#">step 31</a>	RX p-p LP+HP1	0.772 UI p-p	1.048 UI p-p
147	<a href="#">step 31</a>	RX RMS LP+HP1	0.296 UI RMS	0.347 UI RMS
148	<a href="#">step 34</a>	No Trouble	Pass/Fail	

Page No.	Test Description	Min	Result Actual	Max
148	step 35	TX p-p result	1.378 UI p-p	1.662 UI p-p
148	step 35	RX p-p LP+HP1	1.394 UI p-p	1.700 UI p-p
148	step 35	RX RMS LP+HP1	0.497 UI RMS	0.577 UI RMS
149	step 40	No Trouble		Pass/Fail
149	step 41	TX p-p result	3.218 UI p-p	3.822 UI p-p
149	step 41	RX p-p LP+HP1	3.164 UI p-p	3.876 UI p-p
149	step 41	RX RMS LP+HP1	1.137 UI RMS	1.352 UI RMS
149	step 45	No Trouble		Pass/Fail
150	step 46	TX p-p result	10.578 UI p-p	12.462 UI p-p
150	step 46	RX p-p LP+HP1	10.603 UI p-p	12.437 UI p-p
150	step 46	RX RMS LP+HP1	3.768 UI RMS	4.378 UI RMS
151	step 51	No Trouble		Pass/Fail
151	step 52	TX p-p result	122.740 UI p-p	142.260 UI p-p
151	step 52	RX p-p result	110.760 UI p-p	153.240 UI p-p
151	step 52	RX RMS result	41.355 UI RMS	51.984 UI RMS
<b>STM-16/OC-48 Rates</b>				
143	step 11	Optical Power	-16.0 dBm	-12.0 dBm
143	step 12	No Trouble		Pass/Fail
143	step 16	RX p-p LP+HP1	N/A	0.071 UI p-p
143	step 16	RX RMS LP+HP1	N/A	0.0055 UI RMS
143	step 16	RX p-p LP+HP2	N/A	0.071 UI p-p
143	step 16	RX RMS LP+HP2	N/A	0.0045 UI RMS
145	step 21	No Trouble		Pass/Fail
145	step 22	TX p-p result	0.156 UI p-p	0.244 UI p-p

### 3 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
145	step 22 RX p-p LP+HP1	0.113 UI p-p		0.287 UI p-p
145	step 22 RX RMS LP+HP1	0.0651 UI RMS		0.0763 UI RMS
146	step 26 No Trouble		Pass/Fail	
146	step 27 TX p-p result	0.146 UI p-p		0.254 UI p-p
146	step 27 RX p-p LP+HP2	0.099 UI p-p		0.301 UI p-p
146	step 27 RX RMS LP+HP2	0.0650 UI RMS		0.0764 UI RMS
147	step 30 No Trouble		Pass/Fail	
147	step 31 TX p-p result	0.817 UI p-p		1.003 UI p-p
147	step 31 RX p-p LP+HP1	0.772 UI p-p		1.048 UI p-p
147	step 31 RX RMS LP+HP1	0.296 UI RMS		0.347 UI RMS
148	step 34 No Trouble		Pass/Fail	
148	step 35 TX p-p result	1.378 UI p-p		1.662 UI p-p
148	step 35 RX p-p LP+HP1	1.394 UI p-p		1.700 UI p-p
148	step 35 RX RMS LP+HP1	0.497 UI RMS		0.577 UI RMS
149	step 40 No Trouble		Pass/Fail	
149	step 41 TX p-p result	3.218 UI p-p		3.822 UI p-p
149	step 41 RX p-p LP+HP1	3.164 UI p-p		3.876 UI p-p
149	step 41 RX RMS LP+HP1	1.137 UI RMS		1.352 UI RMS
149	step 45 No Trouble		Pass/Fail	
150	step 46 TX p-p result	8.738 UI p-p		10.302 UI p-p
150	step 46 RX p-p LP+HP1	8.743 UI p-p		10.297 UI p-p
150	step 46 RX RMS LP+HP1	3.110 UI RMS		3.622 UI RMS
151	step 51 No Trouble		Pass/Fail	
151	step 52 TX p-p result	491.02 UI p-p		564.98 UI p-p
151	step 52 RX p-p result	479.040 UI p-p		576.960 UI p-p

Page No.	Test Description	Min	Result Actual	Max
151	<a href="#">step 52</a> RX RMS result	166.183 UI RMS		207.170 UI RMS
<b>STM-0/STS-3 Rate (Option 106 Only)</b>				
143	<a href="#">step 11</a> Optical Power	-16.0 dBm		-12.0 dBm
143	<a href="#">step 12</a> No Trouble		Pass/Fail	
143	<a href="#">step 16</a> RX p-p LP+HP1	N/A		0.071 UI p-p
143	<a href="#">step 16</a> RX RMS LP+HP1	N/A		0.0055 UI RMS
143	<a href="#">step 16</a> RX p-p LP+HP2	N/A		0.071 UI p-p
143	<a href="#">step 16</a> RX RMS LP+HP2	N/A		0.0045 UI RMS
<b>STM-1/OC-3 Rate (Option 106 Only)</b>				
143	<a href="#">step 11</a> Optical Power	-16.0 dBm		-12.0 dBm
143	<a href="#">step 12</a> No Trouble		Pass/Fail	
143	<a href="#">step 16</a> RX p-p LP+HP1	N/A		0.071 UI p-p
143	<a href="#">step 16</a> RX RMS LP+HP1	N/A		0.0055 UI RMS
143	<a href="#">step 16</a> RX p-p LP+HP2	N/A		0.071 UI p-p
143	<a href="#">step 16</a> RX RMS LP+HP2	N/A		0.0045 UI RMS
<b>STM-4/OC-12 Rate (Option 106 Only)</b>				
143	<a href="#">step 11</a> Optical Power	-16.0 dBm		-12.0 dBm
143	<a href="#">step 12</a> No Trouble		Pass/Fail	
143	<a href="#">step 16</a> RX p-p LP+HP1	N/A		0.071 UI p-p
143	<a href="#">step 16</a> RX RMS LP+HP1	N/A		0.0055 UI RMS
143	<a href="#">step 16</a> RX p-p LP+HP2	N/A		0.071 UI p-p
143	<a href="#">step 16</a> RX RMS LP+HP2	N/A		0.0045 UI RMS

### 3 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
<b>STM-16/OC-48 Rates (Option 106 Only)</b>				
143	step 11	Optical Power	-16.0 dBm	-12.0 dBm
143	step 12	No Trouble	Pass/Fail	
143	step 16	RX p-p LP+HP1	N/A	0.071 UI p-p
143	step 16	RX RMS LP+HP1	N/A	0.0055 UI RMS
143	step 16	RX p-p LP+HP2	N/A	0.071 UI p-p
143	step 16	RX RMS LP+HP2	N/A	0.0045 UI RMS
<b>STM-64/OC-192 Rate</b>				
143	step 11	Optical Power	-12.0 dBm	-8.0 dBm
143	step 12	No Trouble	Pass/Fail	
143	step 16	RX p-p LP+HP1	N/A	0.081 UI p-p
143	step 16	RX RMS LP+HP1	N/A	0.0055 UI RMS
143	step 16	RX p-p LP+HP2	N/A	0.071 UI p-p
143	step 16	RX RMS LP+HP2	N/A	0.0045 UI RMS
145	step 21	No Trouble	Pass/Fail	
145	step 22	TX p-p result	0.150 UI p-p	0.250 UI p-p
145	step 22	RX p-p LP+HP1	0.114 UI p-p	0.286 UI p-p
145	step 22	RX RMS LP+HP1	0.0651 UI RMS	0.0763 UI RMS
146	step 26	No Trouble	Pass/Fail	
146	step 27	TX p-p result	0.150 UI p-p	0.250 UI p-p
146	step 27	RX p-p LP+HP2	0.100 UI p-p	0.300 UI p-p
146	step 27	RX RMS LP+HP2	0.0650 UI RMS	0.0764 UI RMS
147	step 30	No Trouble	Pass/Fail	
147	step 31	TX p-p result	0.817 UI p-p	1.003 UI p-p



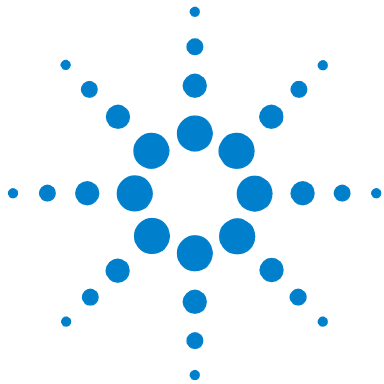
Page No.	Test Description	Min	Result Actual	Max
147	step 31	RX p-p LP+HP1	0.795 UI p-p	1.026 UI p-p
147	step 31	RX RMS LP+HP1	0.296 UI RMS	0.347 UI RMS
148	step 34	No Trouble	Pass/Fail	
148	step 35	TX p-p result	1.378 UI p-p	1.662 UI p-p
148	step 35	RX p-p LP+HP1	1.396 UI p-p	1.724 UI p-p
148	step 35	RX RMS LP+HP1	0.497 UI RMS	0.577 UI RMS
149	step 40	No Trouble	Pass/Fail	
149	step 41	TX p-p result	3.218 UI p-p	3.822 UI p-p
149	step 41	RX p-p LP+HP1	3.124 UI p-p	3.916 UI p-p
149	step 41	RX RMS LP+HP1	1.137 UI RMS	1.352 UI RMS
149	step 45	No Trouble	Pass/Fail	
150	step 46	TX p-p result	8.738 UI p-p	10.302 UI p-p
150	step 46	RX p-p LP+HP1	8.733 UI p-p	10.307 UI p-p
150	step 46	RX RMS LP+HP1	3.110 UI RMS	3.622 UI RMS
151	step 51	No Trouble	Pass/Fail	
151	step 52	TX p-p result	1964.14 UI p-p	2259.86 UI p-p
151	step 52	RX p-p result	1764.16 UI p-p	2459.84 UI p-p
151	step 52	RX RMS result	667.13 UI RMS	826.279 UI RMS
<b>OTN - OTU2 Rate</b>				
143	step 11	Optical Power	-12.0 dBm	-8.0 dBm
143	step 12	No Trouble	Pass/Fail	
143	step 16	RX p-p LP+HP1	N/A	0.081 UI p-p
143	step 16	RX RMS LP+HP1	N/A	0.0055 UI RMS
143	step 16	RX p-p LP+HP2	N/A	0.071 UI p-p

### 3 Performance Tests

Page No.	Test Description	Min	Result Actual	Max
143	step 16 RX RMS LP+HP2	N/A		0.0045 UI RMS
145	step 21 No Trouble		Pass/Fail	
145	step 22 TX p-p result	0.150 UI p-p		0.250 UI p-p
145	step 22 RX p-p LP+HP1	0.114 UI p-p		0.286 UI p-p
145	step 22 RX RMS LP+HP1	0.0651 UI RMS		0.0763 UI RMS
146	step 26 No Trouble		Pass/Fail	
146	step 27 TX p-p result	0.150 UI p-p		0.250 UI p-p
146	step 27 RX p-p LP+HP2	0.100 UI p-p		0.300 UI p-p
146	step 27 RX RMS LP+HP2	0.0650 UI RMS		0.0764 UI RMS
147	step 30 No Trouble		Pass/Fail	
147	step 31 TX p-p result	0.817 UI p-p		1.003 UI p-p
147	step 31 RX p-p LP+HP1	0.795 UI p-p		1.026 UI p-p
147	step 31 RX RMS LP+HP1	0.296 UI RMS		0.347 UI RMS
148	step 34 No Trouble		Pass/Fail	
148	step 35 TX p-p result	1.378 UI p-p		1.662 UI p-p
148	step 35 RX p-p LP+HP1	1.396 UI p-p		1.724 UI p-p
148	step 35 RX RMS LP+HP1	0.497 UI RMS		0.577 UI RMS
149	step 40 No Trouble		Pass/Fail	
149	step 41 TX p-p result	3.218 UI p-p		3.822 UI p-p
149	step 41 RX p-p LP+HP1	3.124 UI p-p		3.916 UI p-p
149	step 41 RX RMS LP+HP1	1.137 UI RMS		1.352 UI RMS
149	step 45 No Trouble		Pass/Fail	
150	step 46 TX p-p result	8.738 UI p-p		10.302 UI p-p
150	step 46 RX p-p LP+HP1	8.733 UI p-p		10.307 UI p-p
150	step 46 RX RMS LP+HP1	3.110 UI RMS		3.622 UI RMS



### **3 Performance Tests**



## 4 Self Test Overview

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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 displays the 'Selftest' interface with the following elements:

- Cabling Config:** Two dropdown menus for '2.5G Optical interface port' (Tx(1310nm) to Rx + attenuation) and '10G Optical interface port' (Tx(1550nm) to Rx(10Gb/s) + attenuation).
- Run:** Radio buttons for 'All tests' and 'Selected test: Confidence Tests'.
- Status:** 'Test run is currently stopped' with a 'Start' button.
- Estimated test time:** 0 hours 2 minutes and 0 hours 1 minutes remaining.
- Current test:** Confidence Tests
- Current subtest:** Conf DS1
- Failure count:** 0 failure(s) found
- Result:** A large yellow box containing 'PASSED' and 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**.

<b>Title</b>	<b>Description</b>
<b>Confidence Test</b>	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.
<b>Optical Power Test</b>	This test checks both the data paths and the optical power measurement circuitry.
<b>DCC Add/Drop Test</b>	The test checks the data paths associated with the DCC add/drop hardware. The DCC loopback should be fitted for this test.
<b>Frequency Test</b>	This test checks the data path through the clock offset and frequency measurement hardware. The test checks the absolute clock offset frequency result.
<b>Jitter Amplitude</b>	Performs checks at all Optical Loopback rates with applied Jitter and uses all Jitter ranges
<b>Jitter Intrinsic</b>	Checks Back to Back intrinsic jitter on all Optical Rates.
<b>Jitter Hit Count</b>	Checks Jitter Hit count on 9.6 Gb/s rate using a 4 MHz Jitter signal.
<b>Jitter Filter</b>	Tests the High Pass Jitter Measurement Filters by applying appropriate Jitter frequency to check filter cut-off point. Repeated for all Optical Rates.

## 4 Self Test Overview

Title	Description
<b>Jitter Transfer</b>	Runs a single point Jitter Transfer function measurement using 155 Mb/s rate.
<b>Wander Tx/Rx</b>	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 184](#) 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)

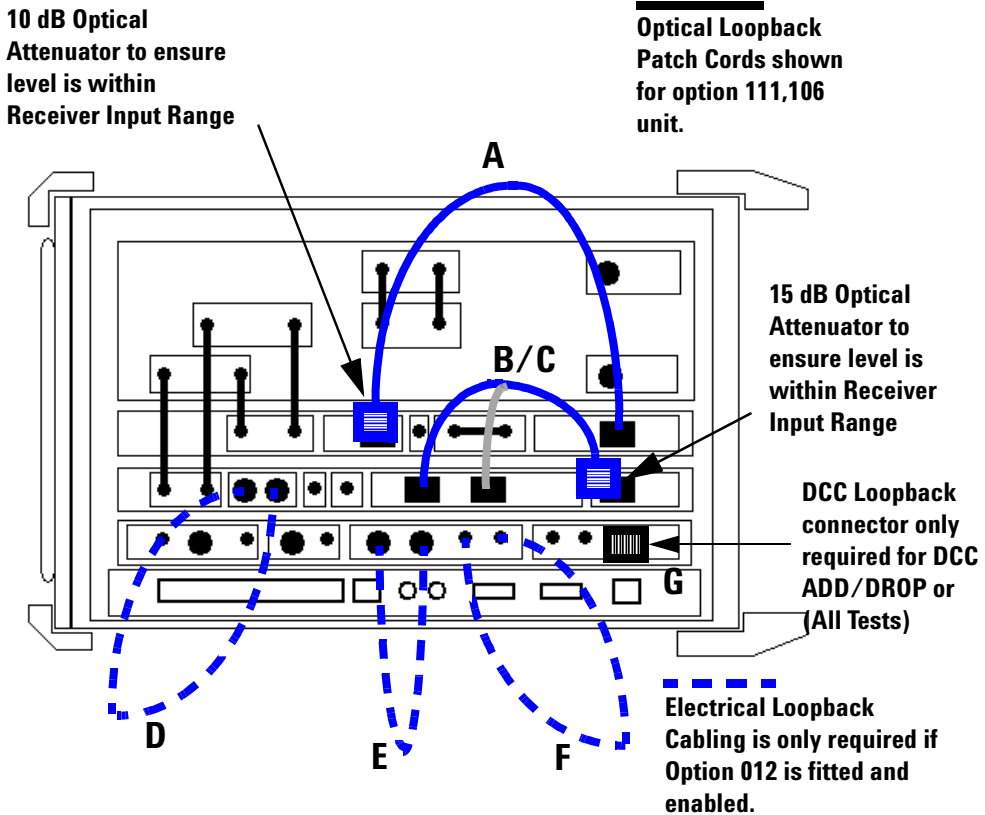
### **Balanced Electrical Connections 2M/DS1** (Instruments with Option 012 only)

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	<b>A, B/C</b>	<b>D,E,F</b>	<b>G</b>
• 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.

## 4 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**

<b>Sub Test Number</b>	<b>Sub Test Description</b>
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

## 4 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**

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

**- DCC Add/Drop Test**

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

**- Frequency Measurement**

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

### - Jitter Amplitude

<b>Sub Test Number</b>	<b>Sub Test Description</b>
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

## 4 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

<b>Sub Test Number</b>	<b>Sub Test Description</b>
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

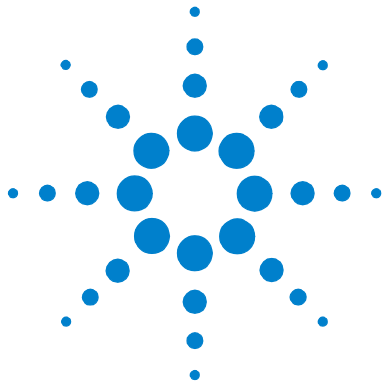
## What to Do if the Self Test Fails

- 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.

## **4 Self Test Overview**



## 5 ETSI/ANSI Terminology

The terminology used on the instrument display can be ETSI (SDH) or ANSI (SONET). Refer to the table given in this section for an explanation of equivalent SDH/SONET terms.



## ETSI/ANSI Conversion and Equivalent Terms

ETSI: European Telecommunications Standards Institute.

ANSI: American National Standards Institute.

<b>ETSI (SDH) Term</b>	<b>ANSI (SONET) Term</b>
AU-3	STS-1 SPE + H1, H2, H3
AU-4	STS-3c SPE + H1, H2, H3
BIP (Bit Interleaved parity)	CV (Code Violation)
High Order Path (HP / HO)	STS Path
I-n Intra Office, (n=STM-n level)	Intermediate Reach (IR)
L-n.1 or L-n.2 long haul	LR long reach
Low Order Path (LP / LO)	VT Path
LP-REI	REI-V
M.S.P	A.P.S
Multiplexer Section (MS)	Line
Multiplexer Section Protection	Automatic Protection Switching
MS-AIS	Line AIS / AIS-L
MS-BIP	Line CV / CV-L
MS-DCC	Line DCC / DCC-L
MS-REI	Line FEBE / REI-L
MS-RDI	Line FERF / RDI-L
Multiplexer Section Overhead	Line Overhead
Network Node Interface	Line Interface
OOF	SEF (severely errored frame defect)
Path AIS / AU-AIS	AIS-P
Path REI / HP REI	REI-P
Path FERF / HP RDI	RDI-P



<b>ETSI (SDH) Term</b>	<b>ANSI (SONET) Term</b>
Path IEC / AU-IEC	IEC-P
Path Overhead	Path Overhead
Regenerator	Repeater
Regenerator Section (RS)	Section
Regenerator Section Overhead	Section Overhead
Remote Alarm Indicator	RAI
RS-DCC	Section DCC (DCC-S)
Section Overhead (SOH)	Transport Overhead (TOH)
S-n.1 or S-n.2 short haul	Short Reach (SR)
SOH	TOH
STM-m	OC-n / STS-n (where $m = n \div 3$ for $m \geq 1$ )
STM-0	STS-1
STM-1	OC3c / STS-3c
STM-4	OC-12 / STS-12
STM-16	OC-48 / STS-48
STM-64	OC-192
Tributary Unit (TU)	Virtual Tributary (VT)
TU	VT
TU-11	VT 1.5
TU-12	VT 2
TU-2	VT 6
TU-3	NONE
TU BIP	VT BIP (CV-V)
TU RDI / LP-RDI	RDI-V
TUG	VT Group
TUG2	VT Group (12 columns)

## 5 ETSI/ANSI Conversion and Equivalent Terms

<b>ETSI (SDH) Term</b>	<b>ANSI (SONET) Term</b>
TUG3	VT Group (86 columns)
TU multiframe	VT superframe
TU PATH AIS	VT AIS (AIS-V)
VC	SPE
VC4	STS3C SPE
Virtual Container (VC)	Synchronous Payload Envelope (SPE)

NOTE: VC is an ETSI abbreviation for Virtual Container and an ETSI / ANSI abbreviation for (ATM) Virtual Channel. The context of VC must therefore be taken into account when converting between standards.

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## **In This Book**

This book contains installation information and methods for checking instrument specifications. Verification of the OmniBER OTN.

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