

**FACTORY ACCEPTANCE TEST PROCEDURE (FAT)**  
**SDH EQUIPMENT along with Optical Amplifie**

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### **TPS-FOTS-001: Review of Calibration or Manufacturing Certificates**

Equipment Under Test : Test Equipment

Test Parameters : Review of Calibration or Manufacturing Certificates

#### **1.0 TEST DESCRIPTION**

Prior to the commencement of system testing, the calibration certificates of all the test equipment as listed in the TPS for performing the system factory acceptance testing will be reviewed by the inspection team.

#### **2.0 LIST OF TEST EQUIPMENT**

Test Equipment	Make	Model No.	Serial No.	Calibration Valid till Date

#### **3.0 TEST RESULT RECORD**

Copies of the calibration certificates will be attached along with this test sheet.

##### **Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

##### **Remarks**

\_\_\_\_\_  
\_\_\_\_\_

Tested By:

(Manufacturer)

Date:

Witnessed By:

(PrKTCL)

Date:

**TPS-FOTS-002: Inventory Verification**

Equipment Under Test : SDH Equipment

Test Parameters : Inventory Verification

**1.0 TEST DESCRIPTION**

The aim of this test is to verify station-wise inventory of offered equipment.

**2.0 TEST PROCEDURE**

1. Check station wise cards/units along with sub rack.
2. Verify it with the quantity of offered equipment as per approved BOM.

**3.0 TEST RESULT RECORD**

The quantity should be found as per the approved BOM.

**Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

**Remarks**

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Tested By:

(Manufacturer)

Date:

Witnessed By:

(PrKTCL)

Date:

### TPS-FOTS-003: Optical Tx Output Power Measurement

Equipment Under Test : SDH Equipment Optical Units

Test Parameters : Optical Output Power

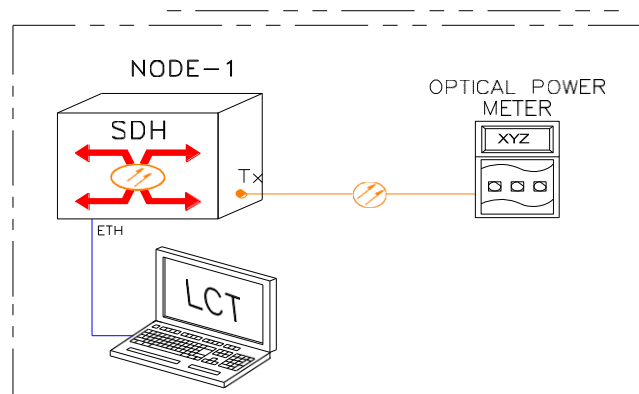
#### 1.0 TEST DESCRIPTION

The purpose of this test is to determine whether the optical interface cards (STM-16 and STM-4) operate at the designed level of optical output power range. This test ensures that the laser providing the optical output has adequate optical output power performance in compliance with ITU-T G.957.

#### 2.0 TEST EQUIPMENT

1. Optical Power Meter
2. Local Craft Terminal (LCT)
3. Low loss optical patch cord

#### 3.0 TEST SETUP



#### 4.0 TEST PROCEDURE

1. Choose SDH equipment and plug optical cards of different application code. Use Low loss optical patch cord to connect the output optical port of the tested SDH node with the input port of Optical Power Meter in turn to test the output power.
2. Connect the optical output port of the SDH to the input port of the optical power meter with low loss optical patch cord to test the output power as shown in above figure.
3. Set the optical power meter to the specified wavelength.
4. Measure the output power level in dBm.
5. Record the result showing on the optical power meter.

**5.0 TEST RESULT RECORD**

\*As per approved DRS

No.	Optical interfaces/ Card tested as per approved BOQ	Min (dBm)*	Max (dBm)*	Actual (dBm)

**6.0 Acceptance Criteria:**

The measured optical output power should be within the limits as per G.957

**Status**

( ) Tested – OK \_\_\_\_\_

( ) Tested – Failed \_\_\_\_\_

**Remarks**

\_\_\_\_\_  
\_\_\_\_\_

Tested By:

(Manufacturer)

Date:

Witnessed By:

(PrKTCL)

Date:

### **TPS-FOTS-004: Receiver Sensitivity Measurement**

Equipment Under Test : SDH Equipment Optical Units

Test Parameters : Receiver Sensitivity Measurement

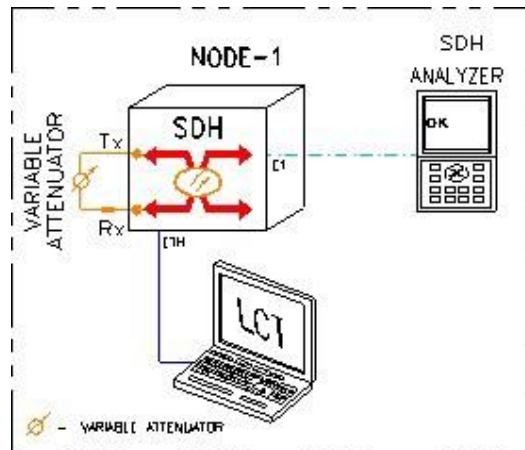
#### **1.0 TEST DESCRIPTION**

This test is performed to test the optical card of the SDH unit to ensure the minimum and maximum optical power level (sensitivity) of optical signal that can be detected and correctly re-constructed in compliance with ITU-T G.957.

#### **2.0 TEST EQUIPMENT**

4. Optical Power Meter
5. Variable Optical Attenuator (VOA)
6. SDH Analyzer
7. Local Craft Terminal (LCT)
8. Low loss optical patch cord

#### **3.0 TEST SETUP**



#### **4.0 TEST PROCEDURE**

##### **Receiver Sensitivity**

1. Choose the SDH equipment with STM-16 and STM-4 optical interface cards. Use optical patch cords to connect the optical ports to SDH Analyzer and VOA as shown in above figure.
2. Setup the SDH Analyzer for BER testing.
3. Increase the attenuation till any error occurs at the tested optical interface card.

4. Decrease the attenuation gradually, so that the error just goes off.
5. The test should continue for a period of 90 seconds.
6. Disconnect the optical patch cord from the tested port (Rx) and connect to the optical power meter.
7. Record the result showing on the optical power meter, is the receive sensitivity.

**5.0 TEST RESULT RECORD**

Sr. No.	Node/ Station	Slot No./ Port No./Sr.No.	Module Type	Receiver Sensitivity as per ITU-T G.957 (dBm)	Actual (dBm)
1					
2					
3					

**Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

**Remarks**

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**Tested By:****(Manufacturer)****Date:****Witnessed By:****(PrKTCL)****Date:**



### TPS-FOTS-005: SDH Optical Units - Laser Safety Check

Equipment Under Test : SDH Optical Units

Test Parameters : Laser Safety Check

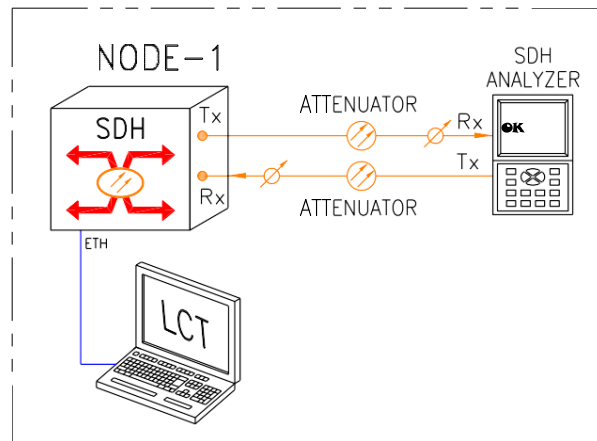
#### 1.0 TEST DESCRIPTION

The aim of this test is to check the Laser safety (ALS: Automatic Laser Shutdown) functionality of the SDH optical interfaces. In this test it is checked if the laser shuts down automatically when the fiber link is broken.

#### 2.0 TEST EQUIPMENT

1. SDH Analyzer
2. Optical Attenuators
3. Local Craft Terminal (LCT)
4. Low loss optical patch cord

#### 3.0 TEST SETUP



#### 4.0 TEST PROCEDURE

1. Set up E1 / Ethernet traffic and loop back the STM-4/16 optical path.
2. Enable ALS in the optical ports (STM-16/STM-4) used.
3. Inject LOS alarm by breaking Rx fiber.
4. Since ALS is enabled, the transmitter will switch OFF after 500 ms or more.
5. Measure the optical power output at Tx of STM-4/16 optical card, no power to be shown.

6. Restore the Rx fiber, the alarm to be cleared and the transmitter should be ON.

7. Record the result.

### 5.0 TEST RESULT RECORD

Sr. No.	Node/ Station	Slot No. / Port No/Sr. no.	Optical Interface	Test Description	Specification	Results (OK/ Not OK)
1				ALS	Optical transmitter should shut off as per G.664 when the optical port receives LOS alarm.	
2				ALS	Optical transmitter should shut off as per G.664 when the optical port receives LOS alarm.	
3				ALS	Optical transmitter should shut off as per G.664 when the optical port receives LOS alarm.	

#### Status

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

#### Remarks

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Tested By:

(Manufacturer)

Date:

Witnessed By:

(PrKTCL)

Date:

### TPS-FOTS-006: Electrical Interface Input Jitter Tolerance

Equipment Under Test : E1 (2 Mbit/s) Interface Unit

Test Parameters : Electrical (E1) Interface Input Jitter Tolerance

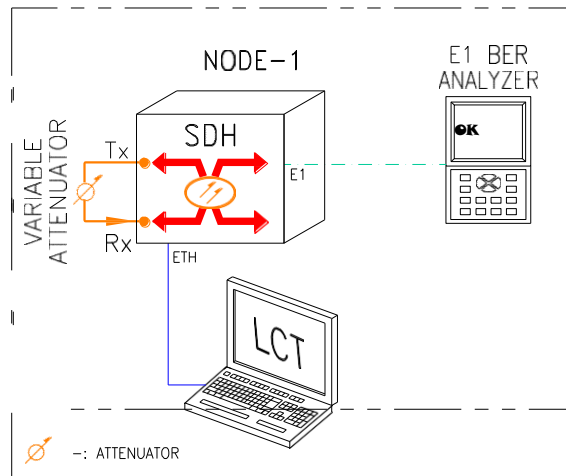
#### 1.0 TEST DESCRIPTION

Measurement of input jitter tolerance of the electrical interface in compliance with ITU-T G.823

#### 2.0 TEST EQUIPMENT

1. E1 Analyzer
2. Local Craft Terminal (LCT)
3. Connecting Cables

#### 3.0 TEST SETUP



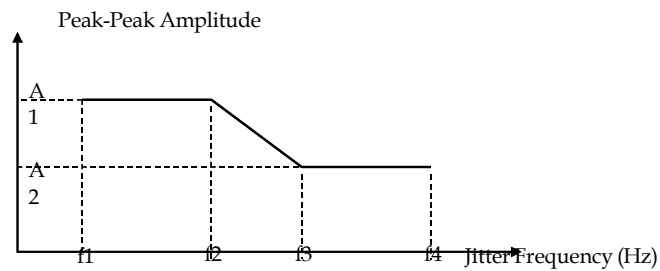
#### 4.0 TEST PROCEDURE

1. Choose one SDH node with E1 interface card (DUT). Use cable to connect the electrical output port of the tested node to the electrical input port of E1 Analyzer and connect the electrical input port of the tested node to the electrical output port of E1 Analyzer.
2. Select relevant rate for E1 Analyzer Rx / Tx port.
3. Set up E1Traffic from E1 Analyzer.
4. Loop back the optical port of the SDH equipment.
5. With the loop-back, there shall be no bit errors reported in the test set.
6. Setup the E1 Analyzer for jitter tolerance measurement. Choose an ITU-T G.823 mask.
7. Now go to Jitter Test Menu and perform Jitter Tolerance test by selecting Auto Tolerance Menu from the options (In Auto Jitter Tolerance test, the E1 Analyzer automatically increases the Jitter until the point of failure and plots the point on the graph and then proceeds to the next Jitter Frequency).

8. Print out the plot of the result.

## 5.0 TEST RESULTS

Input jitter tolerance of E1 electrical interfaces:



Measured value should be as per ITU-T G.823. The test results will be attached with this test record.

### Status

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

### Node

Details \_\_\_\_\_

Station \_\_\_\_\_

Unit Type \_\_\_\_\_

### Remarks

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Tested By:

(Manufacturer)

Witnessed By:

(PrKTCL)

Date:

Date:

### **TPS-FOTS-007: Electrical (2 Mbit/s) Interface Output Jitter Generation**

Equipment Under Test : E1 (2 Mbit/s) Interface Unit

Test Parameters : Electrical (2 Mbit/s) Interface Output Jitter Generation

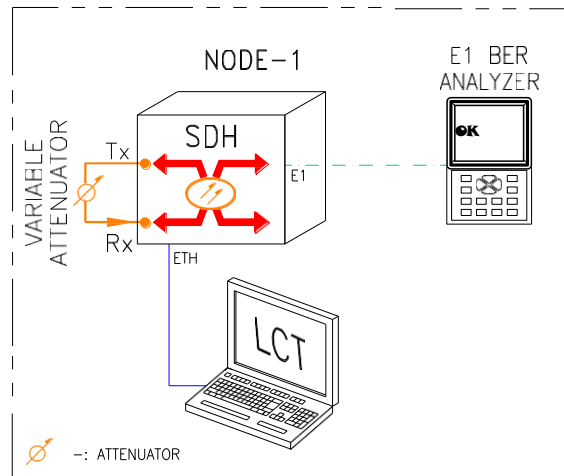
#### **1.0 TEST DESCRIPTION**

The aim of this test is to measure the jitter in 2Mbit/s output signal and check if it is as per ITU-T G.823.

#### **2.0 TEST EQUIPMENT**

1. E1 Analyzer
2. Local Craft Terminal (LCT)
3. Low loss optical patch cord

#### **3.0 TEST SETUP**



#### **4.0 TEST PROCEDURE**

1. Make setup as shown in above figure.
2. Set up E1 Traffic from E1 Analyzer.
3. Loop back the optical port of the SDH equipment.
4. With the loop-back, there shall be no bit errors reported in the test set.
5. Apply E1 Analyzer to send test signals, and configure proper measurement filter at the receiving end.

6. Perform continuous test with duration of 60 seconds.
7. Record the measured maximum peak-to-peak value of jitter.

## 5.0 TEST RESULTS

Interface	Measuring Filter		Peak-peak Jitter
2048 Kbit/s (E1 Interface)	20Hz to 100kHz (LP+HP1)	Standard	1.50 UI
		Measured	
	18kHz to 100kHz (LP+HP2)	Standard	0.2 UI
		Measured	

The measured value should not exceed the limits given in the above table.

### Status

- ( ) Tested - OK \_\_\_\_\_
- ( ) Tested - Failed \_\_\_\_\_

### Node Details

#### Station Unit

Type \_\_\_\_\_

\_\_\_\_\_

### Remarks

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**Tested By:**

(Manufacturer)

**Date:**

**Witnessed By:**

(PrKTCL)

**Date:**

**TPS-FOTS-008: Electrical Interface Line Rate Tolerance**

Equipment Under Test : E1 (2 Mbit/s) Interface Unit

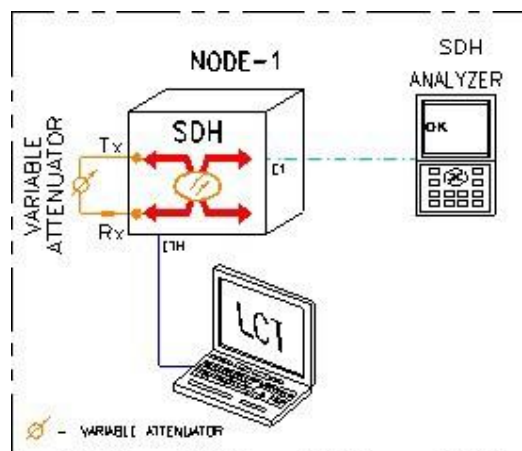
Test Parameters : Electrical (2 Mbit/s) Interface Line Rate Tolerance

**1.0 TEST DESCRIPTION**

Measurement of line rate tolerance of the Electrical interface in compliance with ITU-T G.703

**2.0 TEST EQUIPMENT**

1. SDH Analyzer
2. Local Craft Terminal (LCT)

**3.0 TEST SETUP****4.0 TEST PROCEDURE**

1. Set up E1 traffic from SDH Analyzer and make suitable cross-connection using LCT.
2. Loop back optical port of SDH by means of an attenuator.
3. Setup the SDH Analyzer for BER testing.
4. Vary the offset ppm value up to the tolerable value in both positive and negative sides.
5. Record the result.

**5.0 TEST RESULTS**

Interface	Line Rate Tolerance	Measurement
E1 (2 Mbit/s)	2.048Mbits/s $\pm$ 50 ppm	

There should not be any errors during the test.

**Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

**Node Details**

Station

Unit Type \_\_\_\_\_

\_\_\_\_\_

**Remarks**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Tested By:**

(Manufacturer)

**Date:**

**Witnessed By:**

(PrKTCL)

**Date:**



### **TPS-FOTS-009: Protection Switching of Redundant Cards**

Equipment Under Test : SDH Equipment

Test Parameters : Equipment Protection

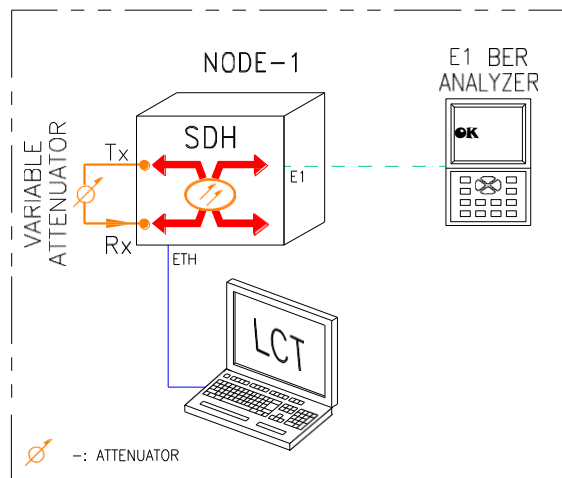
#### **1.0 TEST DESCRIPTION**

To verify that the protection switching mechanisms for the Common Control & Cross-connect card of SDH node is working properly.

#### **2.0 TEST EQUIPMENT**

1. E1 Analyzer
2. Local Craft Terminal (LCT)
3. Low loss optical patch cord

#### **3.0 TEST SETUP**



#### **4.0 TEST PROCEDURE**

- a. Connect the electrical (Tx, Rx) of the SDH equipment to the E1 Analyzer.
- b. Loop back the optical port (Tx, Rx) of the SDH equipment.
- c. Create the cross connection between the electrical port and the optical port.
- d. Unplug the active Common Control & Cross-connect card of SDH node from card slot.
- e. The standby Common Control & Cross-connect card should take over, and the traffic should be restored.

#### **5.0 TEST RESULTS**

Traffic is restored even if one of the Common Control & Cross-connect cards failed.

**Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

**Node Details****Station****Unit****Type** \_\_\_\_\_**Remarks**

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**Tested By:****(Manufacturer)****Date:****Witnessed By:****(PrKTCL)****Date:**

### TPS-FOTS-010: Multiplex Section Protection in SDH Network

Equipment Under Test : SDH Transmission System

Test Parameters : Multiplex Section Protection

#### 1.0 TEST DESCRIPTION

The aim of this test to check the multiplex section protection scheme in compliance with the ITU-T G.841.

#### 2.0 TEST EQUIPMENT

1. E1 Analyzer
2. Ethernet Analyzer
3. Cables and accessories

#### 3.0 TEST SETUP

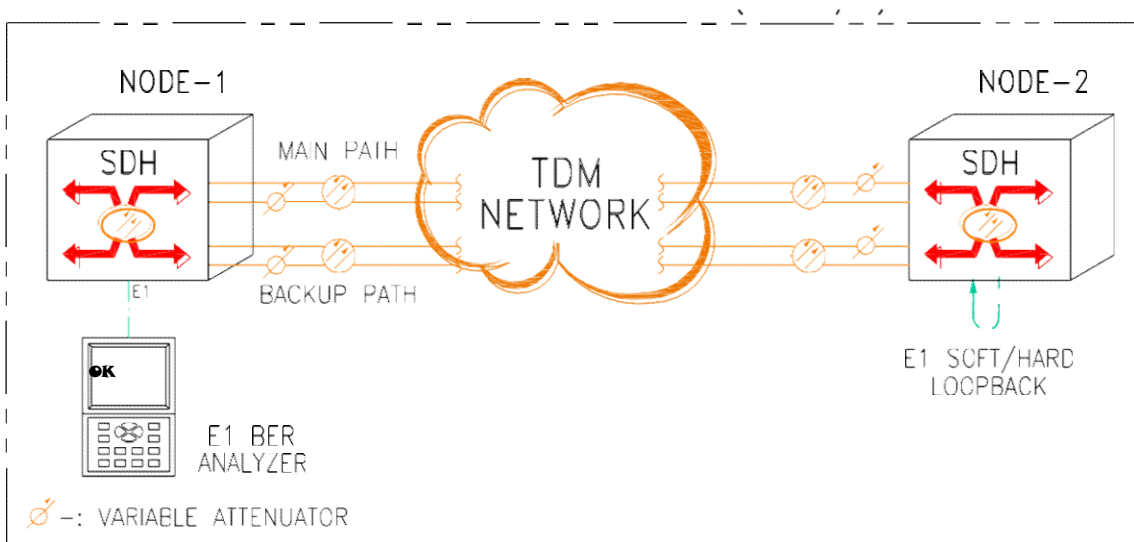


Figure 1: MSP Protection Test E1

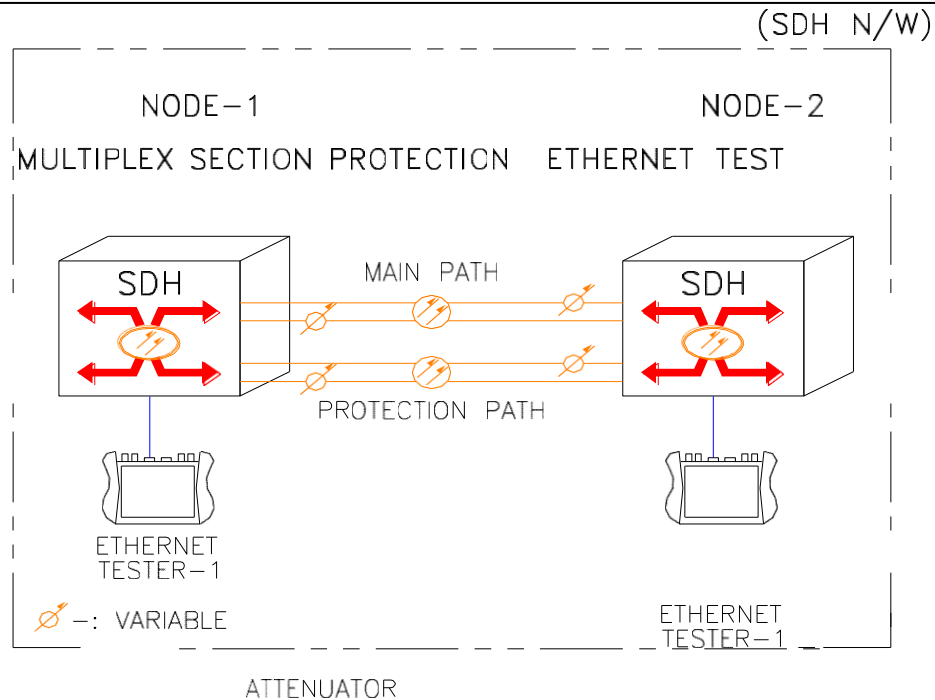


Figure 2: MSP Protection Test Ethernet

#### 4.0 TEST PROCEDURE

##### E1 Protection test

- Make the test setup as shown in Figure 1.
- Create the required cross connections with Switching Protection in the SDH Nodes across the link through which the testing will be done.
- Set up an E1 from the E1 Analyzer and connect it to the local SDH node.
- Provide a soft loop / hard loop on the configured E1 of the remote SDH node.
- The tester will show "OK" with the loop back on the remote node concerning the configured channel.
- With the loop-back, there shall be no bit errors.
- Break main link between the two stations and verify that E1 signal is through over standby link.
- Verify the Cross-connect redundancy, by jacking out one of the redundant modules at a time.
- Tabulate the observation in test result table at Point 1, 2 and 3.

##### Ethernet Protection test

- Make the test setup as shown in Figure 2.
- Create the required cross connections with Switching Protection in the SDH Nodes across the link through which the testing will be done.

- Set up an E1 / Ethernet Traffic from the Ethernet Analyzer and connect it to the local SDH node.
- Provide a soft loop on the configured Ethernet of the remote Ethernet Tester.
- The tester will show “OK” with the loop back on the remote node concerning the configured channel.
- With the loop-back, there shall be errors.
- Break main link between the two stations and verify that Ethernet signal is through over standby link.
- Verify the Cross-connect redundancy, by jacking out one of the redundant modules at a time.
- Tabulate the observation in test result table at Point 4 & 5.

## 5.0 TEST RESULT

Sr. No.	Test Description	Results (OK/Not OK)
1	Switching to standby path is occurred when working path failed for E1 test	
2	Switching can be auto restored after the fail disappeared for E1 test.	
3	Switching time should be less than 50ms (Applicable to APS test)	
4	Switching to standby path is occurred when working path failed for Ethernet test.	
5	Switching can be auto restored after the fail disappeared for Ethernet test.	

### Status

( ) Tested – OK \_\_\_\_\_

( ) Tested – Failed \_\_\_\_\_

### Remarks

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**Tested By:**

**(Manufacturer)**

**Date:**

**Witnessed By:**

**(PrKTCL)**

**Date:**

### TPS-FOTS-011: Sub Network Connection Protection (SNCP) in SDH Network

Equipment Under Test : **Fiber Optic Transmission System**

Test Parameters : **Sub Network Connection Protection (SNCP)**

#### 1.0 TEST DESCRIPTION

The aim of this test to check the sub network connection protection scheme in compliance with the ITU-T G.841.

#### 2.0 TEST EQUIPMENT

1. E1 Analyzer
2. Cables and accessories

#### 3.0 TEST SETUP

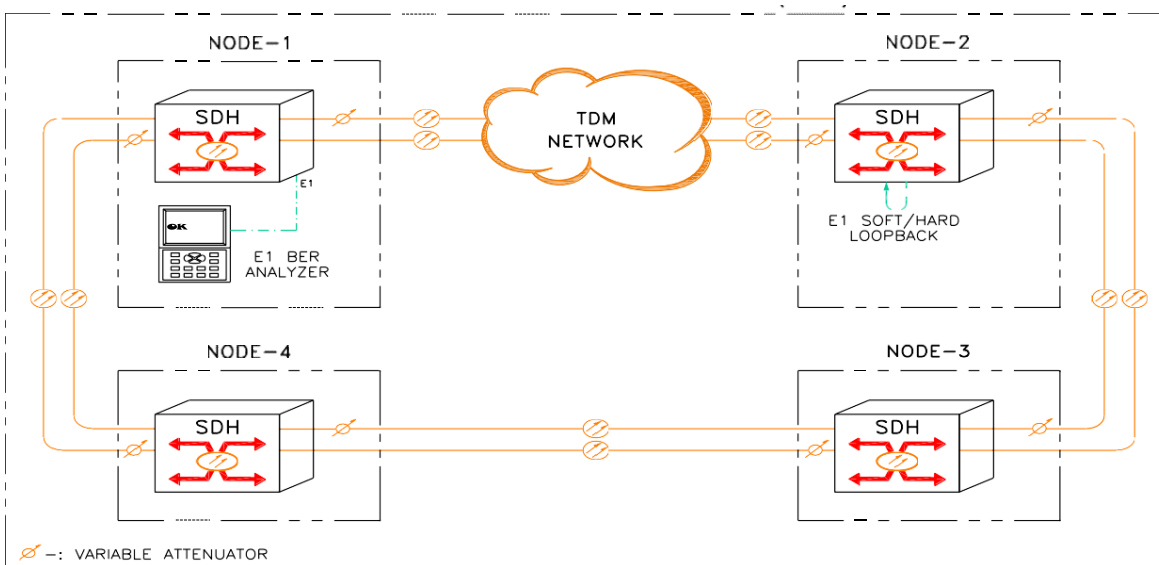


Figure 1: SNCP Protection Test

#### 4.0 TEST PROCEDURE

- Make the test setup as shown in Figure 1.
- Create the E1 channel from STM node-1 to STM Node-2 via STM optical path.
- Configure the protection path for the E1 channel between Node-1 to Node-2 using sub-network connection protection in that particular ring via Node-4 to Node-3 STM path as shown in above figure.
- Connect the tested port (E1) at Node-1 to the E1 Analyzer and loop back the corresponding tributary at Node-2.

- Setup the BER Tester for BER testing. While the BER test is in progress, now break the working fiber link (STM path) between Node-1 & Node-2, verify whether the protection to alternate path (Node-3 and Node-4 i.e., optical path in ring) occurred correctly.
- Restore the working fiber links; verify whether the switch can be auto restored after the failure disappeared.
- Tabulate the results as under Section 5.0.

**5.0 TEST RESULT**

Sr. No.	Test Description	Results (OK/Not OK)
1	Switching to alternate path occurs when working path failed.	
2	Switching can be auto restored after the fail disappeared.	
3	Switching time should be less than 50ms.	

**Status**

( ) Tested – OK \_\_\_\_\_

( ) Tested – Failed \_\_\_\_\_

**Remarks**

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**Tested By:****(Manufacturer)****Date:****Witnessed By:****(PrKTCL)****Date:**

### TPS-FOTS-012: Measurement of Order Wire channel

Equipment Under Test : SDH Optical Units  
 Test Parameters : EOW Station to Station Dial Testing

#### 1.0 TEST DESCRIPTION

The purpose of this test will be an operational test to be performed for checking the satisfactory EOW operation.

#### 2.0 TEST EQUIPMENT

1. EOW Phone.
2. LAN Cable

#### 3.0 TEST SETUP

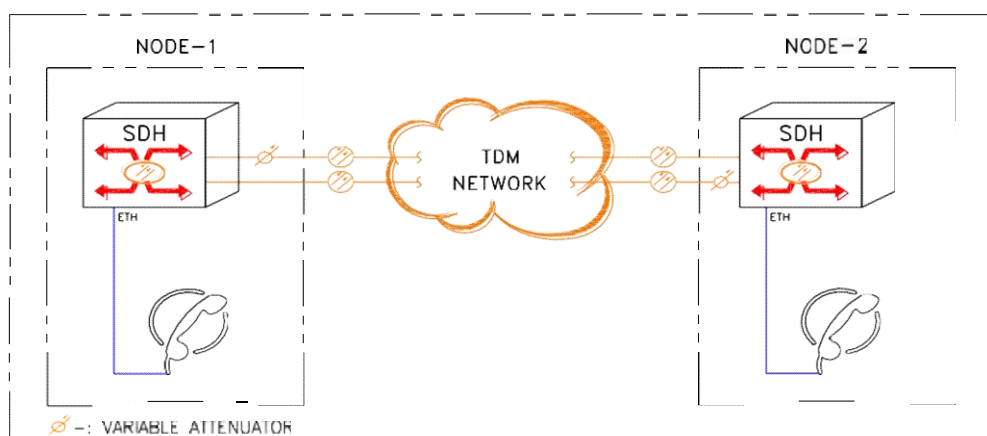


Figure 1: EOW Functionality

#### 4.0 TEST PROCEDURE

- By using the EOW telephone connected on SDH system, dial the telephone number of any other SDH station and check the EOW operation. Repeat the test for other stations.
- Check the operation of EOW as specified above and tabulate the results as under section 5

#### 5.0 TEST RESULT RECORD

Sr.No.	Station	EOW Number	Station	EOW Number	Results (OK/NOT OK)
1					
2					



**Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

**Remarks**

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**Tested By:**

**(Manufacturer)**

**Date:**

**Witnessed By:**

**(PrKTCL)**

**Date:**

### **TPS-FOTS-013: SDH Equipment (STM 16 & STM 4) - Power Supply Test**

Equipment Under Test : SDH Equipment (STM 16 & STM 4)

Test Parameters : Power Supply Test

#### **1.0 TEST DESCRIPTION**

The purpose of this test is to check the operation of SDH equipment in power supply conditions as listed below of a fully equipped equipment rack.

1. Test of equipment against input power variation from -40 to -60V DC.
2. Automatic recovery of the equipment when the power supply is restored to normal.
3. Reverse power protection test (polarity reversal) and automatic recovery.
4. Short circuit protection
5. Power supply protection test

#### **2.0 TEST EQUIPMENT**

1. Variable DC power supply
2. SDH Analyzer
3. Local Craft Terminal (LCT)
4. Cables and accessories

#### **3.0 TEST SETUP**

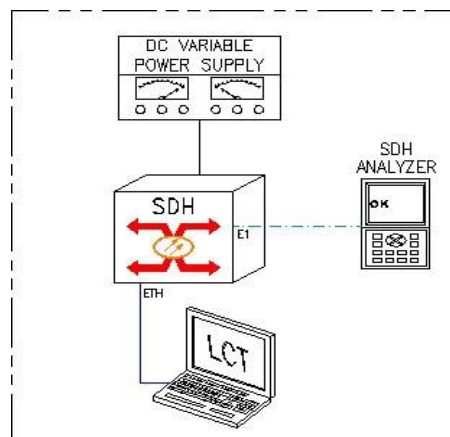


Figure 2: Test set up for Variable Power supply Measurement test.

#### 4.0 TEST PROCEDURE

##### 1. Maximum Voltage, Minimum Voltage Test

- Connect the input supply cables from variable power supply unit and the SDH Analyzer to the equipment sub-rack as shown in above figure.
- Adjust the output voltage of the variable power supply unit to -48 VDC and switch ON the SDH equipment.
- Vary the input power supply from -48 Volts to -60 Volts (in steps) at this point check the operation of SDH equipment with the help of SDH Analyzer and it should operate as in normal condition.
- Restore the power supply to normal i.e. -48 Volts and check the operation of SDH equipment. It should operate as in normal condition.
- Vary the input power supply from -48 Volts to -40 Volts (in steps) at this point check the operation of SDH equipment with the help of SDH Analyzer and it should operate as in normal condition.
- Restore the power supply to normal again i.e., -48 Volts and check the operation of SDH equipment. It should operate as in normal condition.
- Switch off the power supply and the switch on the power supply and check the operation of SDH equipment. It should operate as in normal condition.

##### 2. Power Supply Protection Test

- Connect both the input power supply cables to the power inputs of the SDH equipment.
- Switch ON the equipment power supply.
- Disconnect one of the power supply input from the power interface panel, the equipment should operate in normal condition.

##### 3. Reverse Power Supply Protection Test

- Apply power with reverse polarity at the input, check if the system is protected against reverse polarity connection of the input supply. Restore the normal power supply connection and check if the system gets powered ON and working.

##### 4. Short Circuit Protection

Verify whether the power supply card shuts off on short circuit.

#### 5.0 TEST RESULT RECORD

Sr. No.	Test Description	Specification	Results (OK/NOT OK)
1	Operation of SDH equipment at -48-volt DC input supply	No bit errors	

2	Operation of SDH equipment at -60-volt DC input supply	No bit errors	
3	Operation of SDH equipment at -40 Volt DC input supply	No bit errors	
4	Power supply protection	Should be protected.	
5	Reverse polarity connection	Should be protected.	
6	Short Circuit test	Should be protected.	

### Status

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

### Node

Details \_\_\_\_\_

Station \_\_\_\_\_

Unit Type \_\_\_\_\_

### Remarks

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**Tested By:**

(Manufacturer)

**Witnessed By:**

(PrKTCL)

**Date:**

**Date:**

### **TPS-FOTS-014: Ethernet Parameters Measurements**

Equipment Under Test : SDH Equipment along with Ethernet Interface Unit

Test Parameters : Throughput, Latency and Frame Loss Test

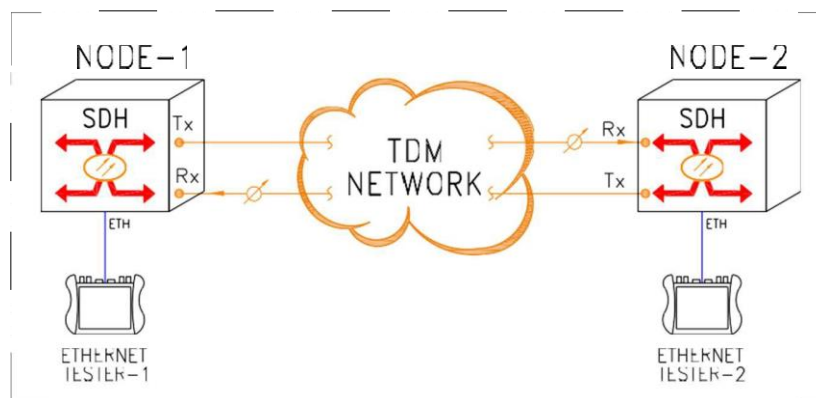
#### **1.0 TEST DESCRIPTION**

To verify that the Ethernet card is in compliance with the specifications of IEEE 802.3. The ethernet link shall be tested for Throughput, Latency and Frame loss as per RFC2544.

#### **2.0 TEST EQUIPMENT**

1. Ethernet Analyzer
2. Local Craft Terminal (LCT)
3. Low loss optical patch cord & CAT cable

#### **3.0 TEST SETUP**



#### **4.0 TEST PROCEDURE**

##### **1. Data Channel (Throughput) Test**

- a. Connect the two (2) SDH nodes (Node-1 & 2) with optical patch cords as shown in above figure.
- b. Connect one of the Ethernet Analyzer to LAN port-1 of Node-1 & another Ethernet Analyzer to LAN port-1 of Node-2 with CAT cable.
- c. Set the LAN ports of both the nodes on "100M full duplex" mode.
- d. Set the test duration to 10 seconds and the length of test frame to 1518 bytes. Measure the throughput.
- e. Observe and record the test results.

##### **2. Latency Measurement**

- a. Connect the two (2) SDH nodes (Node-1 & 2) with optical patch cords as shown in above figure.

- b. Connect one of the Ethernet Analyzer to LAN port-1 of Node-1 & another Ethernet Analyzer to LAN port-1 of Node-2 with CAT cable.
- c. Set the LAN ports of both the nodes on "100M full duplex" mode.
- d. Set the test duration to 10 seconds and the length of test frame to 1518 bytes respectively. Test the latency.
- e. Observe and record the test results.

### 3. **Frame Loss**

- a. Connect the two (2) SDH nodes (Node-1 & 2) with optical patch cords as shown in above figure.
- b. Connect one of the Ethernet Analyzer to LAN port-1 of Node-1 & another Ethernet Analyzer to LAN port-1 of Node-2 with CAT cable.
- c. Set the LAN ports of both the nodes on "100M full duplex" mode.
- d. Set the test duration to 10 seconds and the length of test frame to 1518 bytes respectively. Test the Frame Loss.
- e. There should be no frame loss, record the test results.

## 5.0 TEST RESULTS

### **Throughput**

The throughput of the Ethernet card should not be less than the bandwidth configured.

Sr. No.	Bandwidth (Mbit/s)	Measured Throughput	Data Channel Results (OK / Not OK)
1	2		
2	4		
3	10		
4	100		

### **Latency**

Sr. No.	Bandwidth (Mbit/s)	Measured Latency	Results (OK / Not OK)
1	2		
2	4		
3	10		
4	100		

### Frame Loss

Sr. No.	Bandwidth (Mbit/s)	Throughput Rate%	Frame Loss	Results (OK/Not OK)
1	2			
2	4			
3	10			
4	100			

### Status

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

### Node - 1 Details

Station \_\_\_\_\_

Unit Type \_\_\_\_\_

### Node - 2 Details

Station \_\_\_\_\_

Unit Type \_\_\_\_\_

### Remarks

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Tested By:

(Manufacturer)

Date:

Witnessed By:

(PrKTCL)

Date:

### TPS-FOTS-015: Ethernet Provisioning and VLAN Separation Test

Equipment Under Test : SDH Transmission System

Test Parameters : Ethernet Provisioning and VLAN Separation

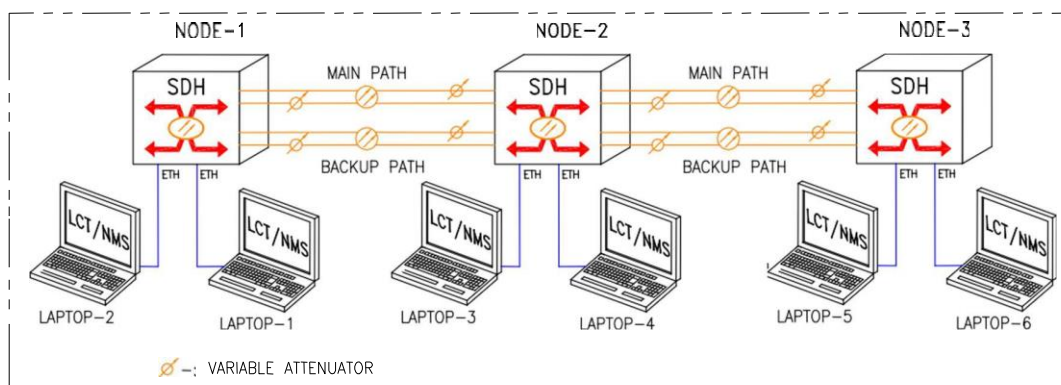
#### 1.0 TEST DESCRIPTION

The purpose of this test is to check the provisioning of Ethernet channels and configuration of VLAN per application. Enable traffic separation at layer 2 thus segregating Broadcast domains based VLAN membership.

#### 2.0 TEST EQUIPMENT

1. Ethernet Analyzer
2. Cables and accessories

#### 3.0 TEST SETUP



#### 4.0 TEST PROCEDURE

- Make the test setup as per Figure 1.
- Create the required cross connections to provision an Ethernet link and assignment of VLAN in the SDH Nodes across the link through which the testing will be done.
- A Ping response should be present between the two laptops.
- Tabulate the results as under Section 5
- Verify that laptops connected on the same VLAN can communicate and laptops on separate VLAN's cannot communicate with each other.
- Repeat the procedure on other Ethernet Channels (if required).

#### 5.0 TEST RESULT

The tested ports can receive continuous packets from each other, and WAN bandwidth capacity should be as per Ethernet channel plan.



Sr. No	Local Station	Remote Station	Slot No. / Port No.		VLAN Configuration (OK / Not OK)
			Local	Remote	
1			SL___/P___	SL___/P___	
2			SL___/P___	SL___/P___	
3			SL___/P___	SL___/P___	
4			SL___/P___	SL___/P___	

### Status

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

### Remarks

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**Tested By:**

(Manufacturer)

**Date:**

**Witnessed By:**

(PrKTCL)

**Date:**

### **TPS-FOTS-016: E1 (2 Mbit/s) Interface Unit - Bit Error Rate**

Equipment Under Test : **E1 (2 Mbit/s) Interface Unit**

Test Parameters : **Bit Error Rate**

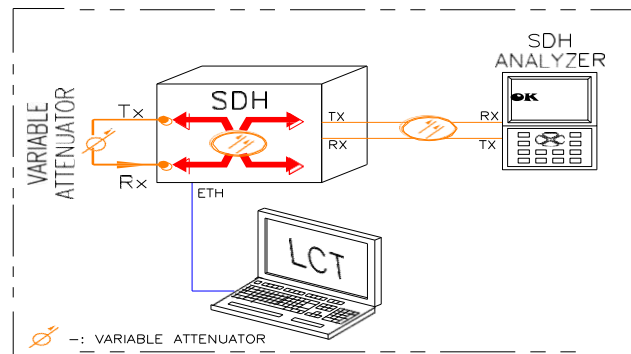
#### **1.0 TEST DESCRIPTION**

The purpose of this test is to check Bit Error Rate (BER) in E1 (2 Mbit/s) interface unit of SDH node in compliance with ITU-T G.821.

#### **2.0 TEST EQUIPMENT**

1. SDH Analyzer
2. Local Craft Terminal (LCT)
3. Low loss optical patch cord

#### **3.0 TEST SETUP**



#### **4.0 TEST PROCEDURE**

1. The test set-up will be as indicated in the above figure.
2. Connect the SDH Analyzer to the configured E1 of the 2M tributary card of STM-4/16 node.
3. Create a cross connection to terminate E1 from one of the optical ports. Apply soft or hard loop back on the optical port using fixed attenuator.
4. Set-up SDH Analyzer to perform 2 Mbit/s BER testing.
5. Commence the BER testing and run the BER test for 10 Minutes duration.
6. Record the result. The test results recorded will be as per ITU-T recommendation G.821.

**5.0 TEST RESULTS**

Test Description	Results (OK/NOT OK)
BER measurement on 2 Mbit/s (E1) port	BER result should be better than $10^{-10}$

**Status**

( ) Tested – OK \_\_\_\_\_

( ) Tested – Failed \_\_\_\_\_

**Node Details****Station****Unit****Type**

\_\_\_\_\_  
\_\_\_\_\_

**Remarks**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Tested By:****(Manufacturer)****Date:****Witnessed By:****(PrKTCL)****Date:**

### **TPS-FOTS-017: SDH Network - NMS & LCT Functionality Test**

Equipment Under Test : SDH Network Management System & LCT

Test Parameters : NMS & LCT Functionality Test

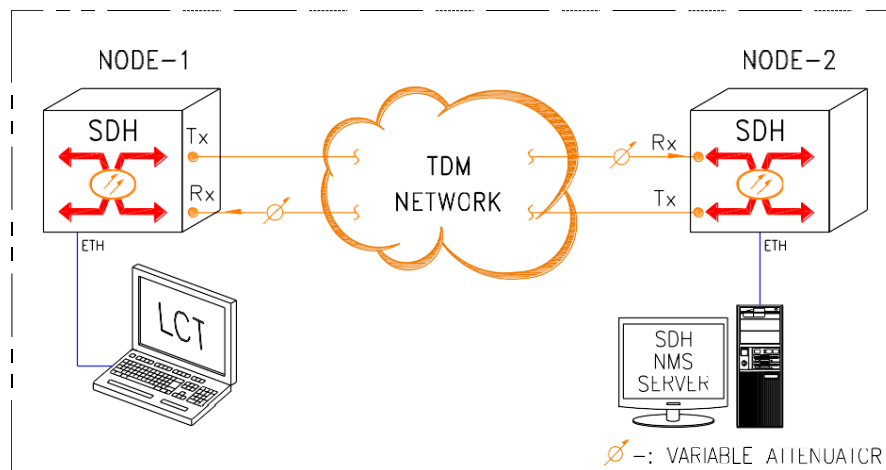
#### **1.0 TEST DESCRIPTION**

The purpose of this test is to confirm proper operation of network management system (TNMS) and Local Craft Terminal (LCT) for SDH system for this project as indicated below.

#### **2.0 TEST EQUIPMENT**

- SDH Network Management System (TNMS)
- Local Craft terminal (LCT)
- SDH Analyzer
- Cables and accessories

#### **3.0 TEST SETUP**



**Figure 1: Remote Node Management**

#### **4.0 TEST PROCEDURE** **CONFIGURATION MANAGEMENT**

- Connect the TNMS system with the management interface of SDH equipment by using Ethernet cable.
- Ensure the SDH equipment is working.
- Login NMS as user of advanced level.
- Check the NMS to see whether it can establish and maintain the network topology.

- Check the NMS whether it provides the tools for planning, establishing, and changing the static equipment configuration, this item can be conducted by changing some parameters & cross connection of the SDH equipment.
- Check the NMS whether it provides verification testing to support new equipment installation, this can be tested by adding a new NE.
- For creating the cross connection, establish the cross connection between any of the two ports in the same or different card.

#### **FAULT MANAGEMENT**

- Connect the TNMS system with the management interface of SDH equipment by using Ethernet cable.
- Ensure the SDH equipment is working.
- Login NMS as user of advanced level.
- Generate the various alarms; check the NMS for relevant alarm status.
- For example, pull out one card from SDH sub-rack; check the NMS for alarm of that fault.
- Insert the card, and then the alarm disappears.
- Check the alarm history, which includes all alarm events.
- Check the capability of alarm retrieval filter. Change the setting and retrieve.
- Check the colors for different level alarm events.
- Print alarm report.

#### **SECURITY MANAGEMENT**

- Connect the TNMS system with the management interface of SDH equipment by using Ethernet cable.
- Ensure the SDH equipment is working.
- Login as Administrator
- Add a user and define the user profile.
- Login as user and verify that user is able to perform various tasks as per profile.

#### **LCT FUNCTIONALITY TEST**

- Connect the LCT to the SDH equipment through LCT interface.
- Ensure the SDH equipment is working.
- Login the LCT.
- Change some configurations of the equipment.
- Get the fault information from the SDH equipment.

**5.0 TEST RESULT**

<b>Sr. No.</b>	<b>Test Description</b>	<b>Results (OK/Not OK)</b>
<b>1.0</b>	<b>CONFIGURATION MANAGEMENT</b>	
1.1	Capability to establish and maintain the backbone topology.	
1.2	Capability to provide graphical maps depicting the sub-rack configurations.	
1.3	Capability to plan, establish and change the static equipment configuration.	
1.4	Verification testing to support new equipment installation.	
1.5	Cross-connect capability between any of the two ports in same or different card.	
<b>2.0</b>	<b>FAULT MANAGEMENT</b>	
2.1	After generating an alarm, it is automatically displayed.	
2.2	Alarm has been shown automatically when there is card failure.	
2.3	NMS can maintain an alarm summary of unacknowledged current alarm.	
2.4	NMS can maintain an alarm history.	
2.5	Operator can acknowledge and clear alarms.	
2.6	Alarm retrieval filter is available.	
2.7	Alarms can be classified and configured as critical alarms, major alarms and minor alarms, in different colors.	
2.8	Alarm reports can be extracted.	
<b>3.0</b>	<b>SECURITY MANAGEMENT</b>	
3.1	Security Management functionality allows user addition and user profile definition.	
<b>4.0</b>	<b>LCT Functionality Test</b>	
4.1	LCT can get fault information from the connected SDH node.	
4.2	LCT is able to change the configuration of the connected SDH node.	
4.3	LCT is able to check for remote loopback & local loopback	
4.4	LCT can get fault/alarm information from the unconnected NE.	
4.5	LCT can get performance data from the unconnected NE.	

**Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

**Remarks**

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**Tested By:**

**(Manufacturer)**

**Date:**

**Witnessed By:**

**(PrKTCL)**

**Date:**

### TPS-FOTS-018: 150, 175, 200, 225, 250 Km Link Optical Amplifier Test

Equipment Under Test : Optical Amplifiers

Test Parameters : Output Power level of optical amplifier

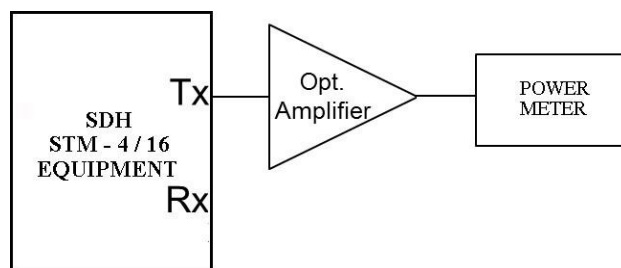
#### 1.0 TEST DESCRIPTION

This test is performed to ensure the proper functionality of the Amplifier used for 150 km, 175 km, 200km, 225 km and 250 km link length and to measure of output power of amplifier.

#### 2.0 TEST EQUIPMENT

- Optical Power Meter
- Low loss Optical Patch chord

#### 3.0 TEST SETUP



#### 4.0 TEST PROCEDURE:

The test procedures are as follows:

- Make the test setup as shown in above figure.
- Connect the output port of amplifier to the optical power meter and switch on the equipment.
- Record the result showing on the optical power meter.

#### 5.0 TEST RESULT

Sl.No.	Amplifiers as per approved BOQ	Result*
1	The optical output power	

\*As per approved DRS.



**Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

**Remarks**

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**Tested By:**

**(Manufacturer)**

**Date:**

**Witnessed By:**

**(PrKTCL)**

**Date:**

### TPS-FOTS-019: Pre-Amplifier Receiver Sensitivity Measurement

Equipment Under Test : Optical Pre-Amplifiers

Test Parameters : Receiver sensitivity level in dBm of Pre-Amplifier

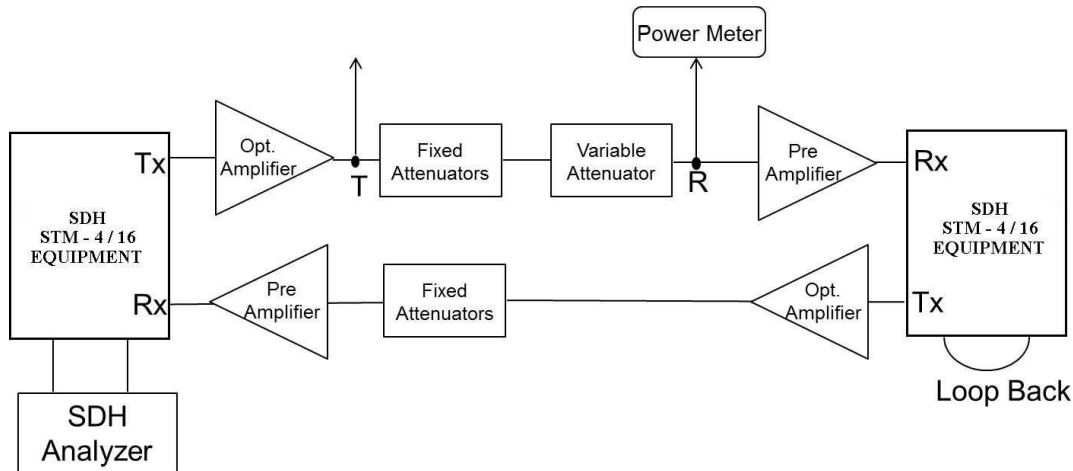
#### 1.0 TEST DESCRIPTION

This test is performed to ensure the proper functionality of the Pre-Amplifier and to measure the receiver sensitivity of Pre-Amplifier.

#### 2.0 TEST EQUIPMENT

- SDH Analyzer
- Optical Power Meter
- Variable Optical Attenuator
- Fixed Optical Attenuators
- Low loss optical patch cords

#### 3.0 TEST SETUP



#### 4.0 TEST PROCEDURE:

The test procedures are as follows:

- Make the test setup as shown in above figure.
- Set the SDH analyzer for BER testing at STM-4/16 level.
- Increase the attenuation by the variable attenuator till any error occurs at the tested optical interface card.
- Decrease the attenuation gradually, so that the error just goes off.

- Disconnect the optical patch cord from the R port and connect to the optical power meter, record the result showing on the optical power meter.

**5.0 TEST RESULT**

Sr.No.	Test Description	Actual Value (dBm)*
1	The receiver sensitivity of Pre-Amplifier.	The measured receiver sensitivity should be as per approved DRS

**Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

**Remarks**

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**Tested By:****(Manufacturer)****Date:****Witnessed By:****(PrKTCL)****Date:**

### TPS-FOTS-020: Power Supply Range Measurement of Optical Amplifiers

Equipment Under Test : Optical Amplifiers & Pre-Amplifiers

Test Parameters : Power supply range of Optical Amplifier & Pre-Amplifier.

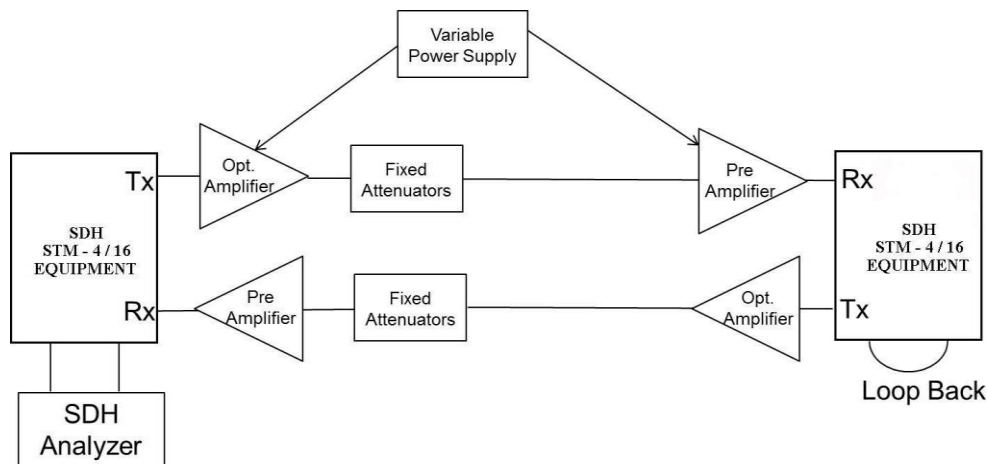
#### 1.0 TEST DESCRIPTION

This test is performed to ensure the proper functionality of the optical amplifier & Pre-Amplifier for power supply voltage range of -40 to -60 VDC.

#### 2.0 TEST EQUIPMENT

- SDH Analyzer
- Optical Power Meter
- Variable Optical Attenuator
- Fixed Optical Attenuators
- Low loss optical patch cords
- Variable Power Supply

#### 3.0 TEST SETUP



#### 4.0 TEST PROCEDURE:

The test procedures are as follows:

- Set the SDH analyzer for BER testing at STM-4/16 level.

- Connect the variable power supply to the optical amplifier and set the output voltage of variable power supply to -40 VDC and run the BER test for 90 min.
- Vary the power supply voltage of optical amplifier from -40 VDC to -60 VDC using variable power supply and run the BER test for 90 min.
- Repeat the above steps with pre-amplifier also. The system should guarantee the performance at BER 10E-10

## 5.0 TEST RESULT

Sr.No.	Test Description	Result
1	Optical Amplifier Voltage @ -40 VDC	
2	Optical Amplifier Voltage @ -60 VDC	
3	Pre-Amplifier Voltage @ -40 VDC	
4	Pre-Amplifier Voltage @ -60 VDC	

### Status

( ) Tested – OK \_\_\_\_\_

( ) Tested – Failed \_\_\_\_\_

### Remarks

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**Tested By:**

**(Manufacturer)**

**Date:**

**Witnessed By:**

**(PrKTCL)**

**Date:**

### **TPS-FOTS-021: Electrical Interface Test**

Equipment Under Test : SDH Equipment

Test Parameters : Pulse Mask Test and Cable Compensation Test.

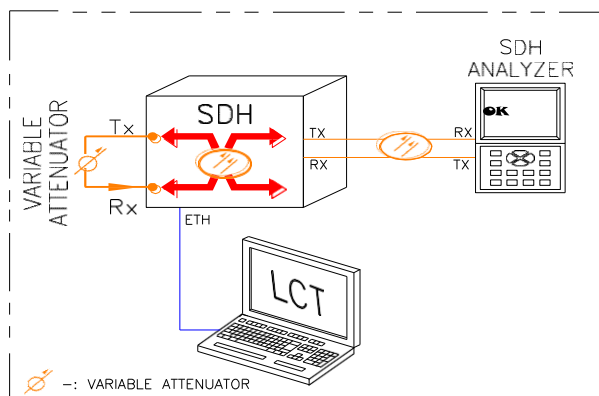
#### **1.0 TEST DESCRIPTION**

- The aim of this test is to check if the shape of 2Mbit/s pulse (of E1 signal) is as per the specifications and performance of 2Mbps tributary by introducing desired attenuation. In this test the shape of an E1 pulse is compared with a standard a G.703 pulse mask using SDH Analyzer.

#### **2.0 TEST EQUIPMENT**

- SDH Analyzer
- Fixed Optical Attenuators
- Low loss optical patch cords
- Local Craft Terminal

#### **3.0 TEST SETUP**



#### **4.0 TEST PROCEDURE:**

The test procedures are as follows:

##### **Pulse Mask Test**

- Make the test set up as shown in the diagram.
- Enable (Admin Up) on E1 tributary for which pulse shape is to be measured, using NMS.
- Set the SDH Analyzer in E1 Pulse Shape mode.
- Observe the pulse shape, record the results, and verify if the results are within the

- specification limits.
- Repeat the test for other tributaries.

#### **Cable Compensation Test**

- Make the test set up as shown in the diagram.
- Set the SDH Analyzer Tester in BER Test mode.
- Use 600 meters of RG59 coaxial cable to extend the Tx interface of the E1 to the SDH Analyzer.
- Introduce a Loop back on the optical interface using a fixed attenuator.
- The tester shall display an OK sign, observe that the test runs error free for 120sec.
- Repeat the test for other tributaries.

### **5.0 TEST RESULT**

Trib · No.	Module	Slot No/ Port No.	TEST DESCRIPTION	SPECIFICATION	RESULTS
1			Pulse Mask/shape	As per G.703 spec	
2			Pulse Mask/shape	As per G.703 spec	
3			Cable Compensation	As per G.703 spec	
4			Cable Compensation	As per G.703 spec	

#### **Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

#### **Remarks**

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**Tested By:**

(Manufacturer)

**Date:**

**Witnessed By:**

(PrKTCL)

**Date:**

### TPS-FOTS-022: Generation of Bit Error Curve

Equipment Under Test : SDH Equipment

Test Parameters : Bit Error Curve

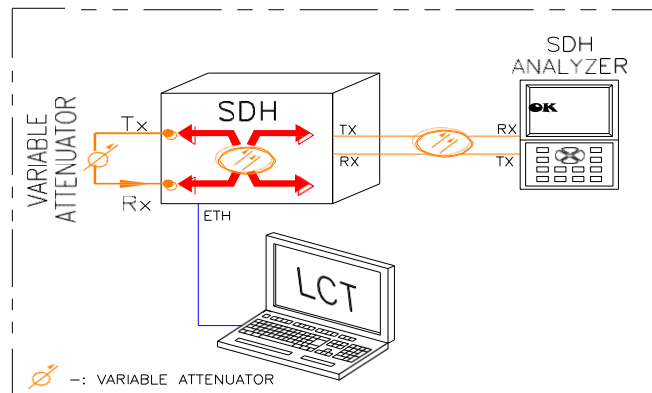
#### 1.0 TEST DESCRIPTION

To plot a BER curve of optical interface by varying the input optical power levels and noting signal degradation values.

#### 2.0 TEST EQUIPMENT

- SDH Analyzer
- Fixed Optical Attenuators
- Optical Variable Attenuator
- Low loss optical patch cords
- Local Craft Terminal

#### 3.0 TEST SETUP



#### 4.0 TEST PROCEDURE:

The test procedures are as follows:

- The test set-up will be as indicated in the above figure.
- Create a cross connection to terminating E1 from one of the optical ports.
- Apply loop on the optical port using fixed attenuator.
- Connect the SDH Analyzer to the configured E1 of the 2M tributary card.



- Measure BER by gradually increasing the attenuation value and check the optical power at different BER values between  $10E^{-10}$  and  $10E^{-6}$
- Record the results and repeat the test for different optical ports.

## 5.0 TEST RESULT

Trib · No.	Module	Slot No/ Port No./Sr no	Optical Input Power (dBm) at BER				RESULTS
			$10E^{-9}$	$10E^{-8}$	$10E^{-7}$	$10E^{-6}$	
1							
2							
3							
4							

### Status

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

### Remarks

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**Tested By:**

(Manufacturer)

**Date:**

**Witnessed By:**

(PrKTCL)

**Date:**

### **TPS-FOTS-023: Test for Spare Cards and Spare Slots**

Equipment Under Test : SDH Equipment

Test Parameters : Test for Spare Cards and Spare Slots

#### **1.0 TEST DESCRIPTION**

This test is performed to ensure the proper functionality of the blank slots in the SDH node and functionality of the spare cards supplied.

#### **2.0 TEST EQUIPMENT**

- E1 Datacom Tester
- Optical Power Meter
- SDH Analyzer
- Ethernet Tester
- Local Craft Terminal

#### **3.0 TEST PROCEDURE:**

The test procedures are as follows:

- In order to test the spare slot in the SDH node, eject the working card from the configured slot and insert it in one of the blank slots.
- Re-configure the newly inserted cards as per the initial configuration and test the functionality.
- Refer Test Procedures for receiver Sensitivity, Optical Output power, E1 BER TEST & Ethernet parameter test and check the functionality.
- In order to test the spare supplied, replace the working card with the spare card and test the functionality.
- Tabulate the results.

#### **4.0 TEST RESULT**

Sr No.	Station Name	Blank Slot	Card Type	Configuration Status (OK/ NOT OK)
4.1		Slot____		
4.2		Slot____		
4.3		Slot____		
4.4		Slot____		

Sr No.	Station Name	Spare Card model	Test Slot	Functionality Status (OK/ NOT OK)
4.5			Slot__	
4.6			Slot__	
4.7			Slot__	
4.8			Slot__	

**Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

**Remarks**

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Tested By:

(Manufacturer)

Date:

Witnessed By:

(PrKTCL)

Date:

**TPS-FOTS-024: Random Inspection to verify the Accuracy of Documents**

Equipment Under Test : SDH Equipment

Test Parameters : Verify the Documents and Drawings.

**1.0 TEST DESCRIPTION**

To conduct additional tests to verify the accuracy of the product documentation i.e., Brochures, DRS. One or two parameters shall be chosen from the list of Parameters in Data sheet and tests shall be conducted to verify the same.

**2.0 TEST EQUIPMENT**

- As required by the Test Procedure.

**3.0 TEST PROCEDURE:**

The procedures followed to test the parameters / functionality shall be enclosed with the FAT report.

**4.0 TEST RESULT**

The test results shall be confirmed with the data sheet.

**Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

**Remarks**

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**Tested By:**

**(Manufacturer)**

**Date:**

**Witnessed By:**

**(PrKTCL)**

**Date:**

### TPS-FOTS-025: Cable Compensation on Ethernet Interface

Equipment Under Test : Ethernet Card of SDH Equipment

Test Parameters : Cable Compensation (Attenuation) Test.

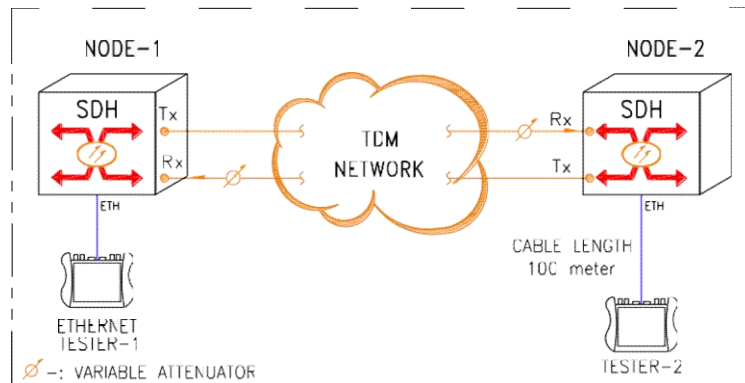
#### 1.0 TEST DESCRIPTION

The aim of this test is to verify that the Ethernet interface functions are error free until the maximum allowable cable length.

#### 2.0 TEST EQUIPMENT

- Ethernet Tester
- Local Craft Terminal

#### 3.0 TEST SETUP



#### 4.0 TEST PROCEDURE:

The test procedures are as follows:

- Connect the two (2) SDH nodes (Node-1 & 2) with optical patch cords as shown in above figure.
- Connect one Ethernet Analyzer to the configured LAN port of Node-1 in loopback mode.
- Connect another Ethernet Analyzer in terminal mode to the configured LAN port of Node-2 using 100 meters of LAN cable.
- Set the LAN ports of both the nodes on "100M full duplex" mode.
- Verify that the Ethernet link test runs without any error and record the test results.

**5.0 TEST RESULT**

Sr No.	Station Name	Slot \ Port No.\Sr. No.	Ethernet link functionality @ 100 meter.	Remarks
4.1				
4.2				
4.3				
4.4				

**Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

**Remarks**

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**Tested By:**

(Manufacturer)

**Date:****Witnessed By:**

(PrKTCL)

**Date:**

### **TPS-FOTS-026: Spectral Characteristics & Central Wavelength (Optical Interface)**

Equipment Under Test : SDH Equipment

Test Parameters : Optical Spectrum and Center Wavelength

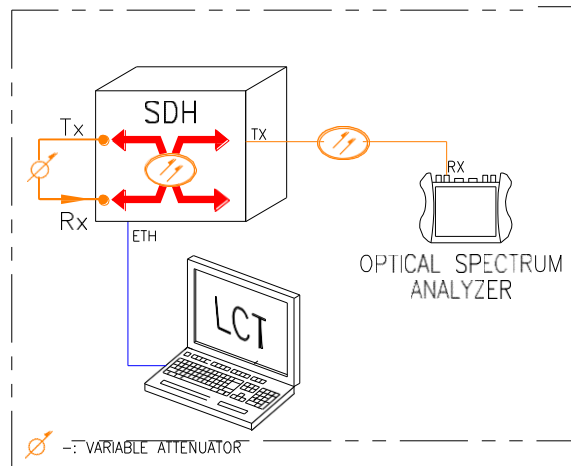
#### **1.0 TEST DESCRIPTION**

This purpose of this test is to measure the Spectral line width (-20 dB / RMS level) & Output Central Wavelength of the Optical Interfaces is as per specification.

#### **2.0 TEST EQUIPMENT**

- Optical spectrum analyzer
- Optical power meter
- Optical Patch Chords
- LCT/NMS

#### **3.0 TEST SETUP**



#### **4.0 TEST PROCEDURE:**

The test procedure is as follows:

- Make the test setup as shown in above figure.
- Connect the Tx port of the Optical Interface to be tested to the Optical Spectrum Analyzer.
- Enable the admin status of the (STM-16/4) optical port to be tested by using LCT/NMS.
- Measure the optical spectrum of the (STM-16/4) optical transmitters using optical spectrum analyzer.
- Tabulate the results.

- Measure the Centre Wavelength of the (STM-16/4) optical transmitters using optical spectrum analyzer.
- Tabulate the results.

## 5.0 TEST RESULT

### Optical Spectrum

Sr. No.	Module	Slot / Port	Specification		Result in dBm
			-20 db	RMS	

\*Optical spectrum measurements shall be as per G.957 Standard

### Output Centre Wavelength

Sr. No.	Module	Slot / Port	Central Wavelength (In dBm) ( OK / NOT OK )

\*Optical spectrum measurements shall be as per G.957 Standard

### Status

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

### Remarks

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**Tested By:**

(Manufacturer)

**Date:**

**Witnessed By:**

(PrKTCL)

**Date:**



### TPS-FOTS-027: Data Channel Testing

Equipment Under Test : SDH Equipment

Test Parameters : Testing of Data Channel

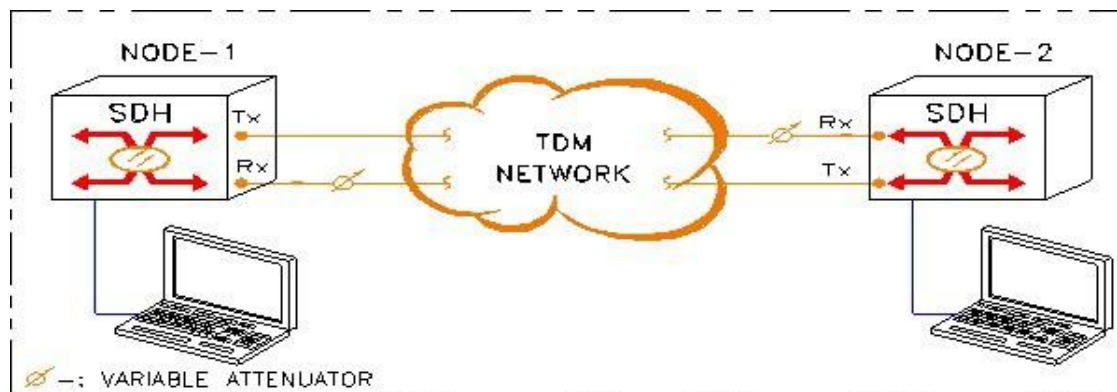
#### 1.0 TEST DESCRIPTION

This purpose of this test is to verify user data channel available on SDH Equipment

#### 2.0 TEST EQUIPMENT

- Laptop
- Optical Patch Chords

#### 3.0 TEST SETUP



#### 4.0 TEST PROCEDURE:

The test procedure is as follows:

- Make the test setup as shown in above figure.
- Connect the laptop to data channels at both the nodes.
- Run the ping test to check the data channel.

#### 5.0 TEST RESULT

Both laptops ping each other through data channel.

**Status**

( ) Tested - OK \_\_\_\_\_

( ) Tested - Failed \_\_\_\_\_

**Remarks**

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**Tested By:**

**(Manufacturer)**

**Date:**

**Witnessed By:**

**(PrKTCL)**

**Date:**