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सूक्ष्मतरंग प्रयोगशाला

IRISET

MICROWAVE LABORATORY
EXPERIMENT NO.: OFC - 1

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Instructor Initial :

MEASUREMENT OF OPTICAL POWER

INSTRUMENTS REQUIRED:

1. LED light source.
2. Optical power meter.
3. Optical sensor 1310 nm wavelength.
4. FC – PC Patch cord.

The source's Main Frame unit can be used as stabilized light source. This unit can hold two LED source units or one LD (LASER DIODE) source unit. This unit has provided with an inbuilt optical attenuator. This attenuator helps in varying the attenuation of the output level from 0 to 6 dB in 0.1 steps. The internal digital modulation frequency options are provided in this unit. The options are 270 Hz, 1 KHz and 2 KHz. External digital modulation over the frequency range DC to 30 MHz is also provided. The connector used is FC type. The LED light source operates at 1310 nm wavelength and is suitable for existing SMSI fibers. The spectral width is less than 20 nm and typical output level is – 48 dBm for SM fibers. The optical power meter can be used with different types of sensors. It works on inbuilt Ni-Cd battery, which is rechargeable. The sensor covers a wavelength range of 800 to 1700 nm and the power range is – 60 to + 3 dBm (1 nW to 2 mW). The photo detector used is InGaAs PIN Photo diode.

STEPS

OPTICAL POWER MEASUREMENT:

1. Switch on AC power of source by turning the key.
2. Set the Attenuation display to 0 dB by operating the switches.
3. Select CW output by operating the switch MOD/CW on the LED source.
4. Connect the sensor to the optical power meter carefully.

5. Do the Offset adjustment as below:

   a) Select 1310 nm wavelength on the sensor.

   b) Turn ON the power switch of the power meter.

   c) Ensure that the sensor is properly shaded from external light.

   d) Press Offset switch.

When offset adjustment is properly done the LCD will indicate a value about one tenth of the minimum light level or less or zero for the sensor with the Offset INDICATION cleared.

6. Select dBm mode by operating the switch dBm/W on the power meter.
7. Connect a 1m FC-PC patch cord between the optical source LED output and the sensor.
8. Switch on the optical output by operating ' OPT OUT ' switch on the LED source.
9. Measure the optical power output (in both units) in the CW mode and record as below:

Optical Power in CW mode -- dBm.

-- Watts.

10. Select modulated output on the LED source by the switch MOD/CW. Further select ' INT ' modulation and the frequencies alternately as 270 Hz, 1 KHz and 2 KHz and measure the power output.

Modulated power output with 270 Hz --- dBm.

Modulated power output with 1 KHz --- dBm.

Modulated power output with 2 KHz --- dBm.

11. External modulation facility is provided.

Frequency : DC to 30 MHz.
Input Level : +2 V to +5 V.

Impedance : 75 Ohms on BNC connector.

OPTICAL FIBER LOSS MEASUREMENT:

This measurement is made to determine how much attenuation the light emitted from a light source suffers while traveling through the optical fiber.

STEPS

Note the power measured as in the above case say P 1.

Connect the optical fiber under test to the drum by means of a coupler.

Connect the other end of the optic fiber drum to the sensor.

Now make the power measurement say P 2.

Tabulate the readings both in dBm and Watts.

Optical Loss = P 1 – P 2 = ---------------------------- dB

---------------------------- Watts.

Q. 1 Explain the need for Offset adjustment in the optical power meter.

Q. 2 Explain the dB and AVE modes in the optical power meter.

Q. 3 Draw the connecting diagram for the power measurement.

Q. 4 Draw the connecting diagram for loss measurement.

Signature of the Candidate

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IRISET

MICROWAVE LABORATORY

EXPERIMENT NO.: OFC – 2

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STUDY OF OTDR

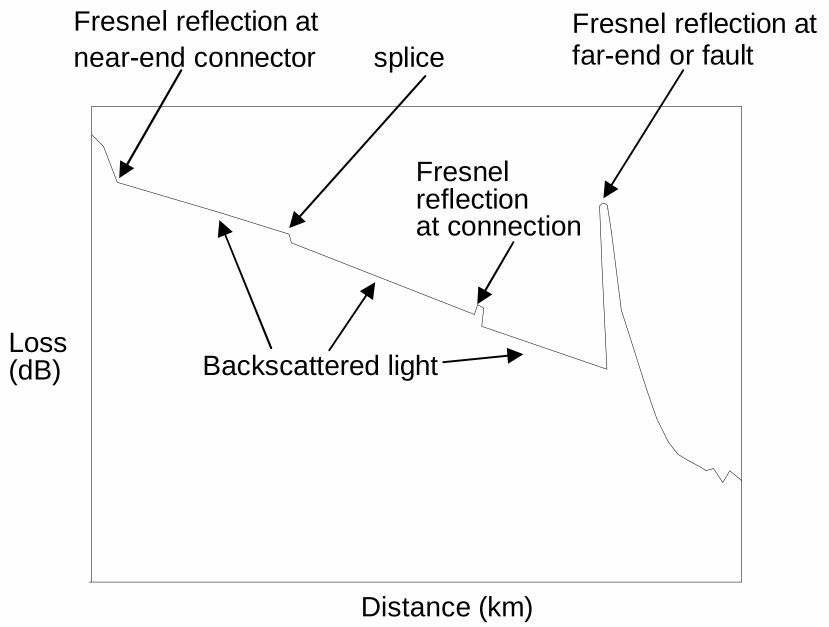
INTRODUCTION:

The OTDR under study is a very accurate instrument for locating faults and measuring the transmission loss, fusion splice losses and connector losses in optical fiber cable. The use of a temperature-controlled laser light source ensures stable optical output and wavelength for very accurate and reproducible measurement. This OTDR measures distances up to 144 Km with a readout resolution of 1m. Los can be read-out at a high resolution of 0.01 dB. Linear approximation using the least squares method enables accurate measurement even under poor S/N ratio conditions. The internal 16-bit microprocessor performs high-speed averaging to improve the S/N ratio. It has a built-in thermal printer for hard-copying measurement conditions and results displayed on the CRT. A laser output safety device is provided so that laser radiation is only emitted when an optical fiber cable is connected to the LASER OUTPUT connector. For easy handling, operation instructions for distance, transmission loss, and splice loss measurements are displayed on the CRT as a menu. So you can easily operate the instrument without the operation manual. A built in LED light source for self-diagnosis is provided to check the functions from the LASER OUTPUT connector to the receiving system.

GENERAL WAVEFORM ANALYSIS:

The figure below shows the CRT waveform display when measuring the splice and transmission losses of a fiber. The horizontal axis is the distance equivalent to the transmission time that actually corresponds to the fiber length. The vertical axis represents reflected light power detected by the OTDR.

The first spike to the extreme left is caused by Fresnel reflection at the near-end connector. The back scattered light indicates the fiber characteristics. For example, if the fiber is low loss and the characteristics are homogeneous along the entire fiber the trace will be a straight line falling along the horizontal axis.



The gradient corresponds to the optical fiber loss. If there is a break or a connection along the fiber, a Fresnel reflection will also appear as shown. When a fiber with a spliced connection is measured, a spike similar to the type caused by a break does not appear, although a step does appear. The step indicates the splice loss.

If the fiber is broken or the end of the fiber cable is detected, a large Fresnel reflection will appear. Ghost spikes, generally known as ghosts, may appear on the CRT. They are caused by large Fresnel reflections or by the relationship between the Fresnel reflection and distance range. When a ghost is suspected of being caused by multiple reflections from a connector, adjust the connection to minimize the Fresnel reflection or apply matching gel to the fiber interface. When a ghost is caused by the relationship between the Fresnel reflection and distance range, select a distance range of more than twice the length of the fiber to be measured.

The optical pulses generated by the laser diode are sent to the fiber to be measured. The Fresnel reflection or backscattered light from a break or splice in the measured fiber is converted to an electric signal by an optical detector (APD) in the plug-in unit. The electrical signal is sent to the mainframe through the plug-in unit connector. To display the measured data, the result data is converted to raster scan display data. Horizontal and vertical synchronized signals and video signals are generated by the display circuit in accordance with access from the CRT controller. These signals are applied to the CRT and the observed waveform is displayed.

EXPLANATION OF CONTROLS:

LASER ON/OFF: Turns the laser radiation ON/OFF. When the LD temperature is constant, the READY LED comes on to indicate that the LD is ready to emit. Laser beam radiation is enabled only when a fiber cable is connected to the LASER OUTPUT connector. When the key is turned OFF, the waveform displayed on the CRT is retained and can be recorded by an external plotter.

OUTPUT: The connector for the fiber cable to be measured is located under the protective cover. A safety device is provided in addition to the protective cover to prevent hazardous laser beam radiation. Laser beam radiation is enabled only when a fiber cable is connected to this connector

DISTANCE: Sets the measurement distance range. The following distances are selected each time the key is pressed and are displayed at the upper-right corner of the CRT. 144 Km → 72 Km → 36 Km → 18 Km.

PULSE: Selects the pulse width of laser beams. The following pulse widths are selected and are displayed at the bottom of CRT each time the key is pressed. For the 144 Km distance range, the following pulse widths are alternately selected. 100 ns → 1 μs → 10 μs. For the 18, 36 and 72 Km distance ranges, the following pulse widths are alternately selected. 100 ns → 1 μs.

SPLICE/LOSS: Selects splice loss or optical fiber transmission loss measurement. The measurement is switched each time the key is pressed and the selected measurement LED comes ON.

LSA/2 POINTS: Selects whether linear approximation is calculate using the Least Squares Approximation (LSA) or the 2-point approximation (2 points) methods. Each method is alternately selected each time the key is pressed. The selected method is displayed on the lower left corner of the CRT and the corresponding LED of the selected method comes on.

AVERAGE ON/OFF: Selects averaging ON or OFF. When ON averaging starts. The S/N ratio of the waveform displayed on the CRT is gradually improved as time elapses after averaging begins to facilitate highly-accurate measurement. When OFF averaging is discontinued and new waveforms are constantly displayed on the CRT.

V-SCALE: Selects the vertical scale. The following scales are selected each time the key is pressed. 4 dB/div → 2.5 dB/div → 1 dB/div → 0.5 dB/div → 0.2 dB/div.

H-ZOOM IN/OUT: Selects the CRT horizontal axis distance scale. The scale from 25 m/div to 8 Km/div can be selected by using the IN and OUT keys. The selected scale is displayed at the upper-right corner of the CRT.

THE ROTARY KNOB: The rotary knob is used with the following items.

* MARKER
* MASK
* SHIFT-V
* SHIFT-H
* ATT. MANUAL (Advanced function)
* AVE. NUMBER (Advanced function)
* IOR (Advanced function)
* M-SAVE (Advanced function)
* M-RECALL (Advanced function)
* TITLE (Advanced function)
* DATE/TIME (Advanced function)
* METER/FEET (Advanced function)
* TRACE (Advanced function)
* HELP

MARKER: Positions the cursor on the marker as follows each time the key is pressed. The marker under the cursor is shifted by using the rotary knob. Splice measurement X1 → X2 → * →X3 → X4. Loss measurement X1 → *.

SHIFT-V: This enables the displayed waveform to be moved up or down the CRT by using the rotary knob. The thick part of the vertical line at the left of the CRT represents the displayed range.

SHIFT-H: Shifts the start position of the waveform displayed on the CRT.

ADVANCED FUNCTION SELECT: Press this key to display the advanced functions on the CRT. The key LED will also come on. In this state, an advanced function can be selected by pressing the (ADVANCED FUNCTION SELECT) key again. The advanced function consists of the following 11 functions.

- Initialize.
- ATT. Manual.
- AVE.Number.(averaging number)
- Mask clear.
- IOR (Index of refraction)
- M-Save. (Memory save)
- M-Recall. (Memory recall)
- Title.
- Date/Time.
- Meter/Feet.
- Trace.

ADVANCED FUNCTION SET: This key sets the advanced functions. If an advanced function mode is left without pressing this key, all the previous setting become void.

DESCRIPTION OF SOME OF THE ADVANCED FUNCTIONS:

ATT.Manual (Attenuator manual): This function enables the attenuator to be manually. Select AUTO or the attenuator value by using the rotary knob. AUTO is used when the attenuator is in auto setting. Selectable values are:

AUTO, 0.0 → 2.5 → 5.0 → 7.5 → 10.0 → 12.5 dB.

AVE.NUMBER (Averaging number): This function enables the number of averaging to be set when the average processing is ON by pressing the AVERAGE key. This number of averaging can be set to unlimited.

IOR (Index of refraction): This function enables the refractive index of the optical fiber to be set. The index range is 1.4000 to 1.5999 in 0.0001 steps. The displayed digit is settable with the rotary knob.

Signature of the Candidate

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MEASUREMENTS WITH OTDR

Optical Time Domain Reflectometer is a very accurate measuring instrument for locating faults on the optic fiber cable. The following measurements can be done with the help of the

OTDR.

- Break fault.
- Transmission loss.
- Fusion splices loss.
- Connector loss.
- Loss between two points.

FEATURES

- This OTDR is suitable for 1300 nm wavelength SM fiber.
- A highly stable temperature controlled Laser light source is used for very accurate and reproducible measurement.
- It has 1-meter readout resolution over long distances.
- Optical masking function facility eliminates detector saturation caused by large Fresnal reflection at the light input coupling to improve measurement linearity.
- Least square method enable accurate measurement even under poor S/N conditions.
- A built in LED light source for self-diagnosis is provided to check the functions from the LASER output connector to the receiving system.
- Laser radiation is only emitted when an optical fiber cable is connected to the LASER output connector for safety.
- It has a built in thermal printer for hard copying measurement conditions and results displayed on the CRT.

INITIAL PREPARATION

- Connect the fiber under test to the LASER OUTPUT connector on the front panel.
- Press the POWER key (The pilot lamp should come on).
- When the power is turned on all keys and LEDs are set to the same setting as when the power was turned off.
- When the LASER READY LED comes on press the output ON/OFF Key. This launches the laser diode output beam into the fiber under test. (The ON/OFF LED should come on)
- Set the refractive index to 1.4690 by selecting IOR from the ADVANCED FUNC SELECT MENU. The required numeric value can be selected using the rotary knob. Press the SET key each time the numeric value is entered.
- Set the attenuation to 2.5 dB by following the procedure as explained above.
- Set the distance to 18 Km by pressing the distance key.
- Set the pulse width to 100 ns by pressing the pulse key.

OVERALL DISTANCE MEASUREMENT TO SPLICE AND BREAKS

STEPS

1. Select the required distance range by pressing the distance key. Four distance ranges 18 Km, 36 Km, 72 Km and 144 Km are available. The distance range so selected is displayed on the upper right of the CRT. You should select a distance range that is twice the length of the fiber you are testing.
2. Set the SPLICE/LOSS Key to LOSS.
3. Move the vertical line cursor to the point at which you wish to measure the distance.
4. The value displayed directly under the vertical line cursor is the distance from the output connector to the point on the fiber you have selected.
5. Press the H-Zoom key and set m/div setting to 25 m/div or 50 m/div. This setting is displayed on the top right portion of the CRT.
6. Adjust the position of the vertical line cursor at the Fresnal reflection or splice by using

   the rotary knob. Now read the resulting distance measurement on the CRT.
7. Set the X and * markers to the two points marking the beginning and end of the fiber segment to be measured.
8. The relative distance between X and * markers is displayed on the second line on the lower middle portion of the CRT.

   Example: $\boxed{\text{LOSS X - *}}$ 3.97 dB

   7.20 Km.

   0.55 dB/Km.
9. Actual distance to break ____________________________________
10. Actual distance to connector ____________________________________

FIBER LOSS MEASUREMENT

TYPICAL LOSS AND dB/KM MEASUREMENTS:

STEPS

- Set the SPLICE/LOSS Key to ‘LOSS’
- Set the ‘X’ and ‘*’ markers similar to the set up described above.
- The loss (dB) between ‘X’ and ‘*’ markers is displayed on the first line at the lower left portion of the CRT. The dB/Km value between the ‘X’ and * marker is also displayed on the third line.
- When the Noise level cannot be sufficiently eliminated using the AVERAGE ON function, set LSA/2 points Key to LSA. LSA/2 POINTS KEY should be set to 2 points when measuring the loss between the arbitrary points with known splices.
- Fiber loss is ___________________________________ dB.

  ___________________________________ dB/Km.

TYPICAL SPLICE LOSS MEASUREMENT

STEPS

- Set the SPLICE/LOSS Key to LOSS.
- Set the vertical line cursor Key on the * marker.
- Set the * marker on the lending edge of the splicing step by moving the vertical line cursor using the rotary Knob.
- Set the SPLICE/LOSS Key to SPLICE.
- When no splice is present between each of the two X markers you can read the measured splice loss at the lower middle left of the CRT.
- Splice/Connector loss is ------------------------------------ dB.

AUTOMATIC SPLICE LOSS MEASUREMENT

- Set the * marker at the lending edge (left edge) of Splice under observation.
- Set the AUTO/MANUAL Key to AUTO.
- Both the * and X markers are set to standard position automatically.
- Read the splice Loss displayed as before on the CRT.

NOTE: Connector loss can also find out in the same manner described as above.

SIGNATURE OF THE CANDIDATE

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FUSION SPLICING OF OPTICAL FIBER

INSTRUMENTS REQUIRED

- Optical fiber cable slitter.
- Loose tube stripper.
- 0.25 mm Stripper.
- Cleaver.
- Fusion splicing machine.

MATERIAL REQUIRED

- Isopropyl Alcohol.
- Fiber protection heat shrinkable sleeves.
- Tissue paper.
- Cotton buds for cleaning the electrodes and cleaver blade.

SPLICING OPERATION

The splicing operation can be broadly divided into eight steps.

- Removing the Sheath, armor and jacket of the cable.
- Removing the loose tube.
- Removing the primary coating on the optical fiber using the tool stripper.
- Cleaning the fiber using Isopropyl Alcohol.
- Cleaving the fiber ends to 90 degrees using the tool Cleaver.
- Positioning the fibers between the electrodes and aligning the fibers.
- Fusing of the two optical fibers by the application of Electric Arc using the Fusion-splicing Machine.

- Sleeving of the spliced portion and heating for reinforcement.

SPLICING PROCEDURE

- Switch on the power to the splicing machine.
- After a while the screen permanently shows

MANUAL MODE

Both the electrodes can be seen on the screen along with the fibers.

- Press the LINE Switch twice.
  30 times magnified Fiber image and two marker lines are seen.

- By using the forward and backward keys move the fibers to the marker lines.
- Press SPAT key. This burns out on the fiber by a short duration arc (0.1 sec).
- Press F/C key. 100 times magnified image of the fiber and a single marker line are seen.
- By using the forward and backward keys move the fibers to the marker line (fine adjustment).
- Press ARC key. Arc fusion takes place and fibers are fused.
- On the screen the following display appears:

LOSS ESTIMATION

Arc count ----------------------------------- appears in blue colour. Wait till this display disappears.

Select YES by pressing the SELECT key. Loss estimation selected.

- Analyzing please wait is displayed on the screen. It shows the loss.
- Estimated loss = ------------------------------ dB.
  Splice loss maximum = 0.2 dB.

  Ideal loss = 0.02 dB.

- Press any key as shown on the display.
- Switch off the splicing machine and take out the fiber carefully.
- Install the pre-inserted heat shrinkable fiber protection sleeve enclosing the joint.

REINFORCEMENT OPERATION

- Place the fiber along with the sleeve in the heating chamber.
- Clamp the fiber by the fixed clamps.
- Close the cover of the heating chamber.
- Pull the tension lever and hold it for 1 sec and release it. This applies a 50 gm force on the fiber joint.
- Verify the joint visually whether the joint is intact or broken.
- Push the yellow switch after verifying the fiber is not broken. The yellow lamp will light and remain on till heating is completed.
- The Red lamp will turn on when heating is finished.
- Allow the fiber to remain in that position till it is cooled. After completion of cooling process the Red lamp will turn off.
- Remove the fiber from the heating chamber.
- The splicing is finished.

1. Give the purpose of the following.

CLEAVER.

ISOPROPYL ALCOHOL.

STRIPPER

FIBER PROTECTION SLEEVES.

2. Give the function of the following keys on the splicing machine.

SPAT

F/C

LINE

ARC

3. What is the nominal value for:

i) Splice loss. ii) Fiber loss/Km. iii) Connector loss.

4. What is the purpose of mechanical splice?

5. Can you distinguish between CORE and CLADDING on the display of the splicing machine? Say Yes/No.

Signature of the Candidate

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OPTICAL FIBER FUSION SPLICING (MODEL TYPE-36)

Tools Required

1. Jacket Remover (Optical Fiber Jacket Stripper)
2. Precision Fiber Cleaver(Optical Fiber Cutter)
3. Fusion Splicing Machine Type-36

Accessories

1. Isopropyl Alcohol (Cleanser)
2. Tissue Paper (to clean the stripped fiber with alcohol).
3. Fiber Protection Sleeves (to give strength to fiber joint).
4. Cotton Swab (to clean the electrodes and cleaver blade).

Splicing Operation Procedure : The following is the summary of steps required to make Splice with fusion Splicer.

1. Removing the primary coating on the optical fiber using the jacket remover or stripper.

2. Cleaning of the stripped fiber with Isopropyl Alcohol.

3. Cleaving (cutting) of optical fiber end to 90 degree to fiber axis using Precision fiber cleaver. Recommended cleave length is 16-18 mm.

4. Slip the fiber protection sleeve over one of the two fibers to be spliced.

5. Fusing of the two optical fibers by the application of Electric Arc using the Fusion Splicing Machine.

6. Center the fiber protection sleeve over the spliced portion of the fiber and heat up for reinforcement.

Preparation of Bare Fiber:

1. Take the two optical bare fibers to be spliced.

2. Remove the primary coating on the fiber up to a length of 40 mm using the Jacket remover.

3. Clean the stripped portion using a tissue paper moistened with Isopropyl Alcohol And wipe the 1-2 times to remove any coating residues.

4. Cleave (cut) the optical fiber end to 90 degree to fiber axis using Precision fiber cleaver.

5. Prepare the other fiber with also in the same manner.

6. Slip the fiber protection sleeve over one of the two fibers to be spliced.

7. Place the two cleaved fibers in the grooves provided on the Splicing machine.

8. These two fibers should be as close as possible (but should not touch each other) near the tips of the electrodes.

9. Center the fiber protection sleeve over the spliced portion of the fiber.

10. Place the protection sleeve in the heater chamber provided on Splicing Machine and heat up to reinforce the sleeve.

SPLICING PROCEDURE:

1. The Fusion Splicer receives power from AC source or from battery pack BP-01.The Machine has got a Switch position marked AC-OFF-DC. Set the AC-OFF-DC Switch to the AC position when AC power is connected and switch to DC side if connected to DC power. To switch OFF, keep the switch in OFF position(Middle).

2. Fusion Splicer completes initialization after switching on , a tone sounds and the "SPLICE MODE MENU" screen appears. If different screen appears, press RESET before continuing. Please also ensure the Splice is automatic mode and Splice condition is set to SMF standard ,Core alignment and 60mm sleeve length. The splicer is ready for operation.

3. Press SET switch to begin automatic splicing after inserting the fibers as explained in above preparation.

4. In "AUTOMATIC MODE", the LCD will display this series of messages:

   ****** GAP ADJUST- Adjusts the gap between the ends of the fibers.

   ****** FOCUS –adjusts the focus for the 280X magnified image.

   ****** SPATTERING-a brief arc that polishes fiber end faces and sharpens fiber image.

   ****** FIBER END CHECK-checks the fiber cleave angle and cleanliness.

   ****** FIELD CHANGE- changes view between Y and X image.

   ****** CORE or DIAMETER ALIGN-aligns the fiber cores or diameters in the X and Y directions.

   ****** ARC FUSION-heats the ends, and then feeds the fibers together to fuse them.

   ****** INSPECTION (HDCM)-High resolution direct core monitoring is used to inspect the completed splice in the X and Y axis.

   ****** EST.LOSS-displays the estimated loss in dB any observed defects. If the splice is good ,the messages "OPEN HOOD" will appear. Machine shows the ideal Splice loss 0.02 dB.

5. Open the heater clamps on both sides. One heater clamp is attached to heater door and will open with clamp.

6. Open the Splicer hood and the fiber clamp to release the spliced fiber carefully.

7. Center the fiber protection sleeve over the spliced portion of the fiber.

8. Position the fiber and reinforcing sleeve in to the heater chamber. Both doors will close simultaneously.
9. Press HEATER SET on the keypad to apply heat cycle to shrink the reinforcing sleeve. The GREEN led on the HEATER SET key indicates that the heater is active. To cancel the heating ,press the HEATER SET again.

10. When the heater starts, begin preparing next splice.

11. After about 90 seconds, a single long beep indicates the heat cycle is completed.

12. Open both the clamps. Remove the reinforced splice while pulling gently on the fiber to keep it straight. Visually inspect cleave (Sleeve may be hot! Handle with care).

SAFETY PRECAUTIONS:

1. Fusion Splicer is precision instrument .For best results, keep the unit clean and handle it with care.
2. Handle glass fibers with care. They can easily puncture skin and break off.
3. Do not use Alcohol near heat, flames, nor electric arcs, including the arc in fusion splicer.
4. Use a grounded three pin AC power source to electrically ground the main body of the splicer and protect against accidental electrical shocks.
5. Do not lubricate any part of the splicer. Oil based residues on the V groove, electrodes or fiber checks will limit the effectiveness of the equipment .

Signature of the Candidate

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STUDY OF OFC SYSTEM (PDH – NOKIA)

The OFC system of NOKIA make is working on C.Rly and S.E. Rly is a 2 Mb system. It consists of digital MUX and OLTE. A Block Interface unit is employed in association with this system to implement the Block communication through OFC. The Block Interface unit used is from M/s NKT DENMARK. The Multiplexing equipment used is organized in two configurations. One is the DM-2 configuration and the other is the DB-2 configuration. The DM-2 configuration is used at a terminal station and the DB-2 configuration is used at a drop insert station. The various user interface cards employed in the system are commonly used with both the configurations. The complete system is software controlled through a Service Terminal or through a NMS/TMS. The various cards used in the system are:

OLTE (OPTICAL LINE TERMINATING EQUIPMENT)

DM-2 (TERMINAL MULTIPLEXER CARD)

DB-2 (DROP/INSERT MULTIPLEXER CARD)

VF CARD

DIU 64 Kb CARD (G.703 DATA CARD)

FXO CARD (FOR EXCHANGE INTERFACE)

FXS CARD (FOR SUBSCRIBER INTERFACE)

RG CARD (FOR RING GENERATION)

LB CARD

The VF card is available in two configurations, 8 channels per card or 10 channels per card.

The DIU 64 Kb card is having 10 channels per card.

FXO and FXS cards are available in 6 channels per card.

LB card is available in 8 channels per card.

The OLTE Card is normally available for 2 Mb/s data transmission and can be configured for 8 Mb/s transmission rate through software setting.

The speech circuits can be configured for 2W working or 4W working through software setting.

The equipment works on –48 V DC.

The following settings are possible with the Service Terminal or TMS.

- Time slot selection.
- Branching of channels.
- Input / Output level settings.
- Signalling parameters.
- Impedance settings.
- Data Interface parameters etc.

The following are the CCITT recommendations.

G. 703 Digital interface.

G. 704 Basic frame structure.

G. 711 PCM coding law.

G. 712 4 W interface.

G. 713	Characteristics of a speech channel for 2 W interfaces.
G. 714	Separate characteristics of a 4 W interface of the transmit and receive directions.
G. 732	PCM MUX equipment.
G. 735	PCM MUX equipment with facility for a synchronous data interface.
G. 832	Jitter and Wander.
G. 507	Characteristics of a speech channel in a terminal exchange.

The OLTE employs LASER as the transmitter. In the LASER transmitter there is a PELTIER-DEMENT to keep the temperature of the laser diode below 25 degrees approx. The output power of the LASER into a multimode fiber is approx. 0 dBm (1mW) and into the single mode fiber is –3 dBm. The optical receivers employed are PIN FET (detectors). PIN devices produce less noise compared to Silicon and Germanium. A Trans-impedance amplifier follows the photo detector along with load resistor.

DF-2: this card occupies 2 slots in a catridge. This card can be placed in any sub-rack (to be programmed). This is also called as OLT card.

DM-2: This is a primary MUX and DEMUX card. This occupies one slot. This card is used for terminal station.

Q. What are the functions of DM-2 CARD?

BRANCHING EQUIPMENT:

The branching condition is defined via the service bus common to all of the transmission equipment. This is done by TMS or ST.

DB-2: DB-2 configuration consists of two cards B2 and X2. B2 card works as an interface between two directions and X2 card is for branching of time slots and provides interface for local channels.

Q. Draw the front connections of B2 card and X2 card.

64 Kb data interface unit (DIU): The G. 703 data interface unit has 10 data channels which fulfill CCIT recommendations.

VF/E&M: One card has 8 VF channels. Nominal impedance is 600 Ohms.

Q. What are the functions of this card?

LB card: The LB adaptor is intended to operate together with E&M unit. It adapts the signalling of LB telephone to the E&M signalling. The LB adaptor is provided with 8 channels. For cabling between LB unit and E&M unit interconnecting cable sets are available.

RG card: Generates the ringing voltage used for the telephone set ringing tone. It is a plug-in unit. The green LED glows whenever the unit is in the operation mode.

PS card: The power supply unit operates over input voltage range of 20 ………………72 V DC. The PS unit provides operating voltages for E&M speech channel units (+ 5 and – 5 and – 12 or – 16 V).

Q. Show with a neat diagram how the OLTE is connected to block instrument through the block interface (as existing in the lab).

Q. What are the different block instruments that can be interfaced through OLTE?

Q. How many alarms are provided on the power supply unit? Mention their significance.

Signature of the Candidate

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STUDY OF OMX-8

OMX-8 is manufactured by Punjab Communications Limited, Chandigarh. This is a flexible system, which can be configured as

2/8 Mb OPTI-MUX.

2 Mb OLTE

8 Mb OLTE

2/8 Mb higher order MUX.

Rack arrangement: The OMX-8 consists of

One power supply card.

One order wire card.

One OLTE card and

One 2 Mb card

Or

2 Mb + Supervisory card

or

2/8 Mb + Supervisory card

A standard 21 cm slim rack can take up to three OMX-8 Sub racks. The top portion of the rack has power distribution panel and visual and audio alarm unit. The rack comes wired for these alarms. User should do the optical fiber cabling at the time of installation. The cabling for optical fiber should be done in such a way that the bend radius should not exceed the manufacturer’s specifications for the fiber. All the configurations have the same rack arrangement.

DESCRIPTION

TRANS: The 2/8 MUX unit provides interfaces for 4 numbers of 2 Mb streams. It multiplexes the four 2 Mb streams into one 8 Mb stream. As per G.742 Rec. the multiplexed stream is sent to the optical line terminating unit for conversion to optical format and vice versa. In the OLTU the bit rate of the 8.448 Mb stream received is raised to 8.976 Mb.

8.976 = 8.448 + NMS + O/W

The increased bits are utilized to provide an additional 33 Kbps for digital EOW, 2400 bits for Supervisory channel, for providing framing and parity information for line error rate monitoring and the rest of the bits are reserved for future use. This 8.976 Mb optical signal is HDB-3 coded. The output signal is continuously monitored and if it goes below an acceptable level an ‘OPTICAL OUTPUT DOWN’ alarm is generated. BIAS CURRENT OUT OF LIMIT alarm is generated if the bias current increases beyond a certain threshold value.

RECEIVE: The optical signal received is converted into electrical signal and clock is recovered from it. The incoming optical signal is monitored and if the received level is below threshold ' OPTICAL INPUT DOWN' alarm is generated. This alarm can be used to disable the LASER output of the transmitter to prevent LASER emission in case of cable rupture or if the cable is removed from the system when it is operational. An AGC amplifier amplifies the received optical signal, which is low level signal. The AGC voltage is a measure of the received optical power. The recovered electrical stream is monitored for three consecutive frames and if found correct EOW channel and Supervisory channels are separated. An alarm is generated if frame sync. is lost. Also an alarm is generated when the error rate exceeds 1 x 10 E-6 or 1 x 10 E-3 limit for which the system is designed. The 8 Mb recovered is demultiplexed to give 4 x 2 Mb streams. In case of regenerator it is fed to another OLTU for the other direction. All the alarms generated in the system are collected by the supervisory unit and can be monitored over NMT/PC at local or remote station. Alarms generated in individual units are shown on the units itself using LEDs and are divided as Major and Minor alarms. A red lamp on the top of the rack glows along with a buzzer in case of failure of any of the systems in the rack.

ENGINEERING ORDER WIRE: For the use of maintenance staff the system has an order wire. A handset is connected to the card. Calling is by pressing the switch on the front panel, which extends a buzzer to the remote station. There is provision for adjusting the volume of the received voice signal.

ALARMS:

- PS FAILURE
- CARD REMOVED
- TRIBUTARY LOSS OF SIGNAL
- OPTICAL INPUT DOWN
- OPTICAL OUTPUT DOWN
- BIAS CURRENT OUT OF LIMIT
- FREME SYNC LOSS
- BER > 1 X 10 E – 3
- BER > 1 X 10 E – 6
- AUTO LASER SHUT OFF FUNCTION DISABLED

POWER SUPPLY:

Input Voltage : - 48 V DC (nominal)

Input voltage range : - 40 to –56 V.

The power supply unit generates + 5, - 5, + 12, - 12 V DC required for the operation of the components in different units. 2 A fuse is provided. The card has input reverse polarity protection. It also has protection for output short circuit and over voltage. The card has LEDs for alarm conditions or failures.

MAINTENANCE: The design of OLT is modular. This results in simplified trouble shooting and reduced down time. Adequate alarms and monitoring points have been provided on the system to denote faulty units. Periodic checks are performed on the link. Power supply, Optical power, Receiver sensitivity, Dynamic range etc., are some of the measurements conducted on the equipment periodically. Whenever measurements are carried out ensure that optical patch cables are cleaned with proper cleaning agent. Power supply should be switched off whenever any card is inserted or removed.

Review Questions:

Q. 1 Describe the front panel of SUP unit with a neat diagram.

Q. 2 Describe the front panel of OLTE unit with a neat diagram.

Signature of the Candidate

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STUDY OF DIGITAL TRANSMISSION ANALYSER – TREND Make

INTRODUCTION

The observable digital transmission performance impairments of a digital transmission system can be broadly divided into various categories of interruptions.

- BIT ERRORS
- BIT INTEGRITY (slips)
- JITTER
- WANDER

For monitoring the performance of a digital transmission system two methods of measurements are categorized.

i) In-service measurement
ii) Out of service measurement.

Victoria Jitter/Wander is a versatile digital analyzer, which is used to know the quality of performance of digital data generated and transmitted to one network to another network or within a network.

There is a possibility of data loss during the transmission and reception of digital data due to impairments of transmission lines and data communication equipment. This instrument analyzes all the possible errors of the digital data transmitted and received and displays a performance result through which we know the quality of service. Measurements can be carried out on STM-1 in SDH and in PDH up to 140 Mb/s data rates. Using this analyzer the following measurements can be performed.

- BER TEST
- STIMULUS-RESPONSE TEST
- MONITORING TESTS
- ALARM AND ERROR SCAN
- STRESS TESTS
- MUX/DEMUX TESTS
- SYNCHRONISATION TESTS

- ERROR PERFORMANCE TEST
- FREQUENCY MEASUREMENT TEST
- TIME INTERVAL ERROR (TIE) MEASUREMENT TEST
- APS TEST
- MEASUREMENTS IN E1
- JITTER MEASUREMENT TEST
- WANDER MEASUREMENT TEST

PHYSICAL FEATURES

The physical feature of the meter is as follows: -

It is well guarded from shock and vibration and is very compact.

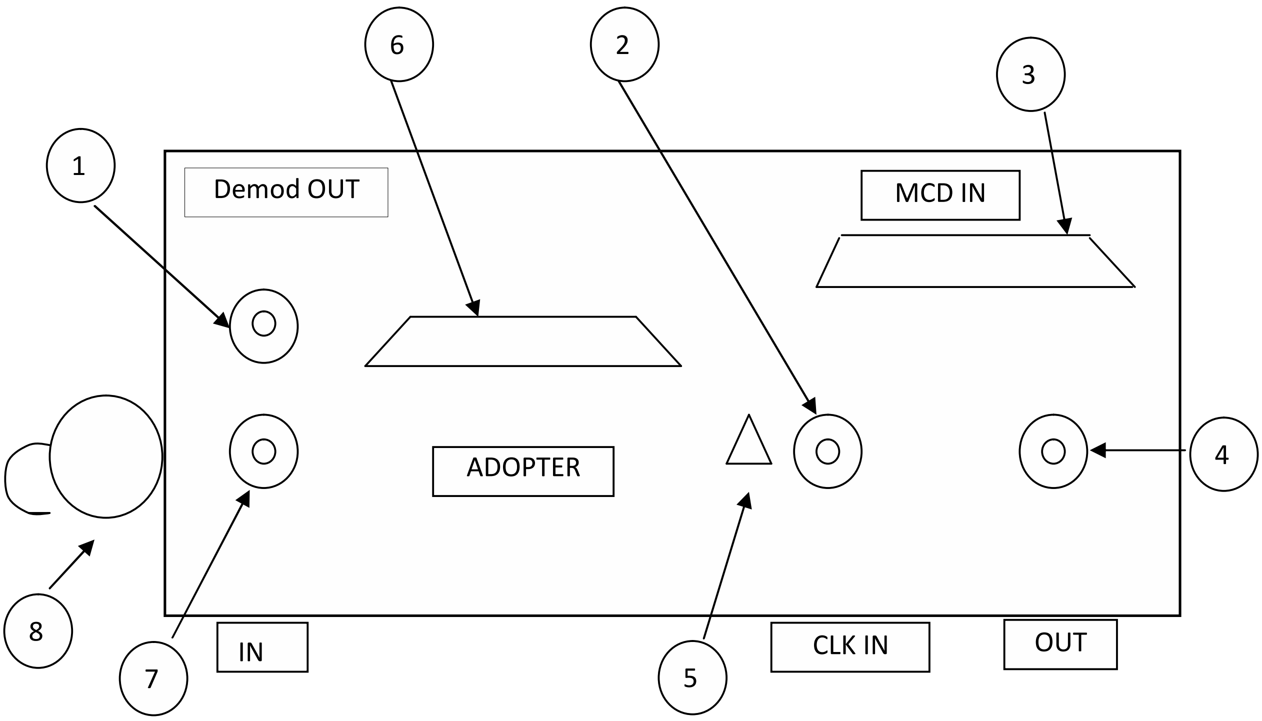
It has three external views: -

1) **Top panel**—Left side viewed from the side-carrying handle.

2) **Bottom panel-**Right side viewed from the side-carrying handle.

3) **Front panel-**Top view.

a) Top panel (Left side)

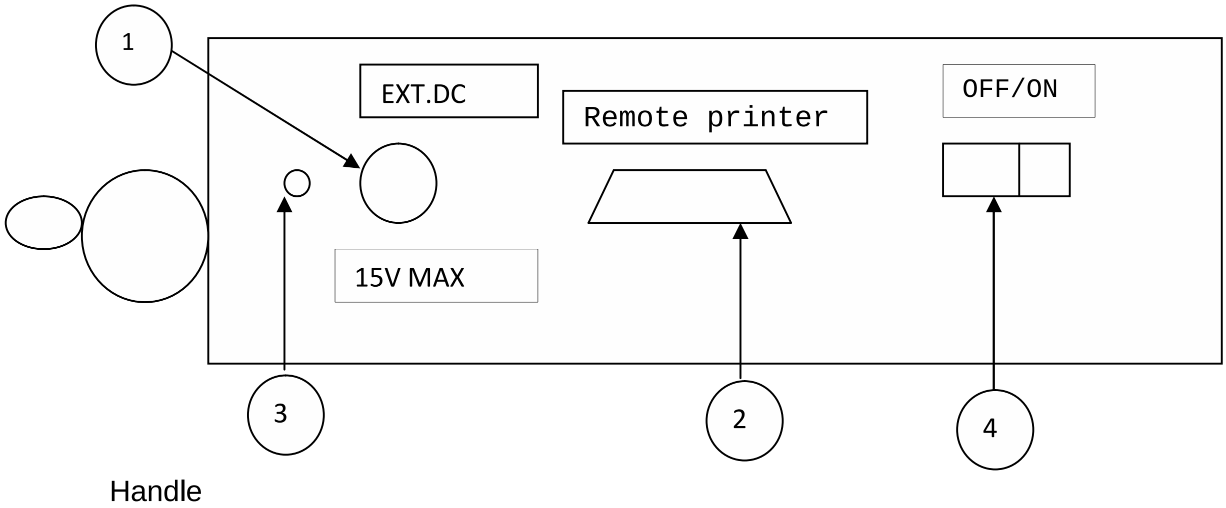


Top panel view (Left side)

1) SMB Connector – The out going signal is the Jitter modulation of the signal analyzed, and always present at this outer interface.
2) BNC connecter – Connector for external clock input.
3) Expansion Connector – For special application.
4) BNC connector – For output interface.

5) Warming label – About the power supply in BNC connector for external reference clock adopter AD340 from the instrument.
6) DB 25 connector – For adopter modes with optical input and output interface.
7) BNC connector – For input interfaces.
8) Side carrying handle – To carry the meter.

b) Bottom panel (Right side)



Bottom panel view (Right side)

1) DIN connecter for AC adaptor / charger.
2) DB9 connector for RS232C inter face.
3) LED showing battery / mains power supply.
4) ON/OFF Switch.

c) Front Panel (Front view)

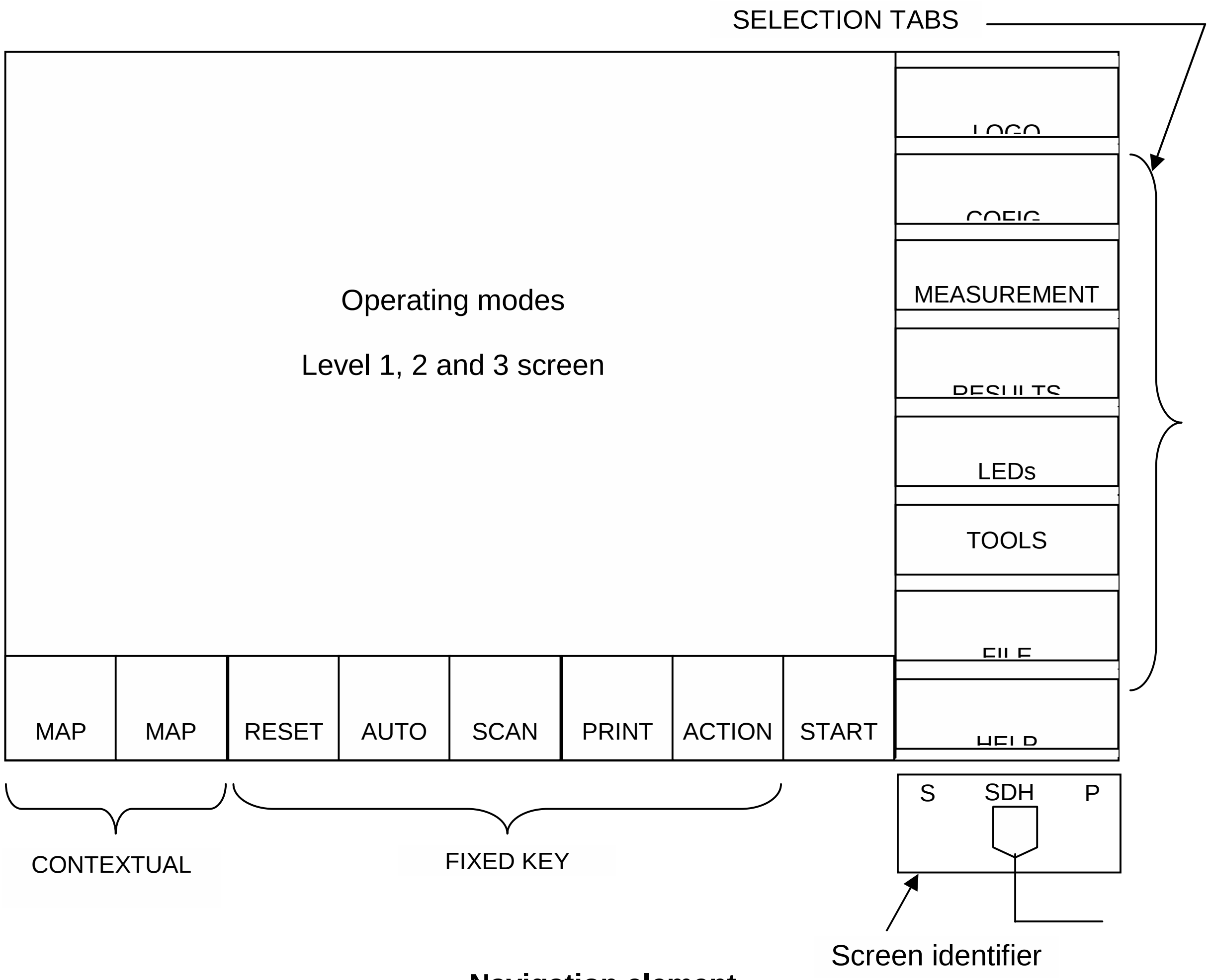
1) Rechargeable battery holder.
2) Color liquid crystal display.
3) Tricolor soft LEDs.
4) Side carrying handle.

Graphic user interface (GUI)

Navigation elements

1) **Cursor** – Appears a cross when any point on the display is pressed.

2) **Selection tabs** – There are seven tabs associated to each navigation path.



Navigation element

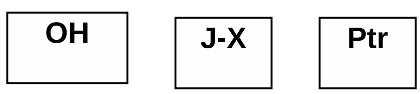
3) **Fixed keys** – Six tabs work for insertion of events, printing, starting the measurement, resetting the LEDs or auto configuration. They are always on screen except when a contextual keyboard is displayed. Fixed keys are depressed when pushed and return to their initial position when the action finishes.

4) **Contextual keyboard** – A set of keys that appear at the bottom of the screen and shift the fixed keys left to right sequentially. Once contextual key has been selected, its content appears in the associated contextual button.

1	2	3	4	5	6	7	---	--
8	9	A	B	C	D	E	----	--

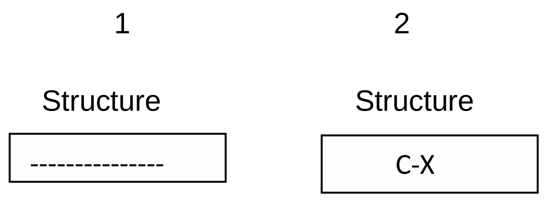
Contextual keyboard

5) **Contextual fixed keys –** A special case of field keys, since they appear depending on the screen or measurement to perform. They are neither fixed keys nor contextual keys. ***Map Rx*** and ***Map Tx*** are two examples of this case, as they appear only when the test set performs SDH/SONET measurements.
6) **Navigation buttons –** To go to another screen. They are not depressed when pushed.



Exp. of a particular operating mode-Navigation buttons

7) **Contextual button** – When this type of button is pushed, a contextual keyboard is deployed at the bottom of the screen. Once a key has been selected. The keyboard disappears and the selected value appears inside the button.



Contextual button

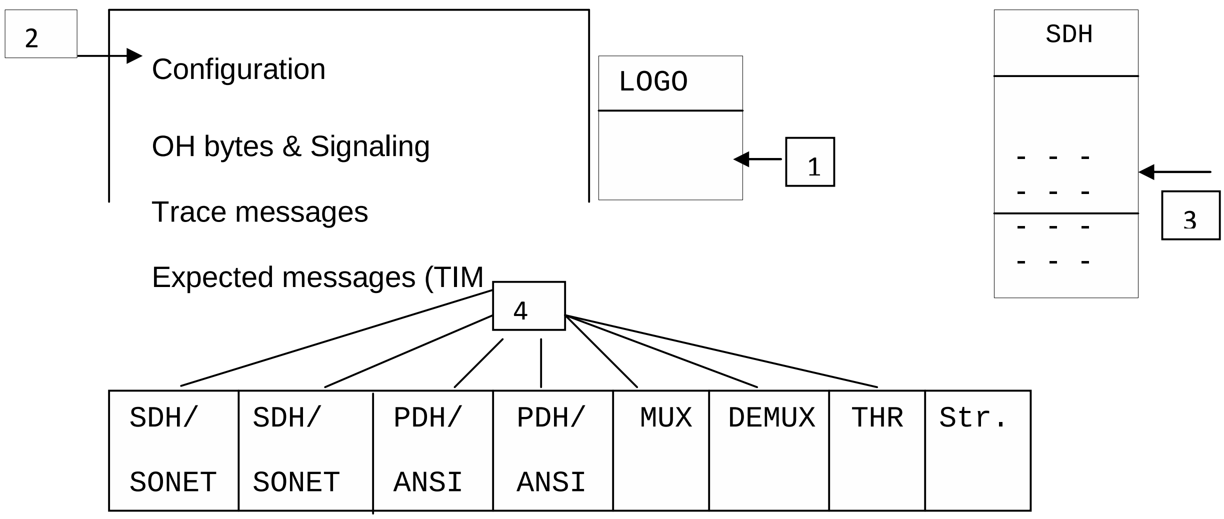
8) **Checkbox button** – To enable a previously programmed value push the checkbox button. The symbol ✓ will appear on the button. Push again to disable the selection (the symbol will disappear).

Checkbox button

Programming an operation mode For any mode the configuration screen displays a block diagram that shows the parameters to be programmed for either the transmission section or the receiving section, except in GUI ISM modes (analyzer only- means Rx).

These parameters appear as contextual buttons (Pressing a contextual button, a set of buttons appear in place of fixed buttons and any one of these keys is selected to select value), navigation buttons or auto list buttons.

The analyzing and generating sections of the instrument can be coupled, i.e. the programming of one section can automatically be copied to the other section and vice-versa. They can also be uncoupled. On the other hand, there are parameters for generation only (Tx clock) or for analysis only (Gain).



Selecting a mode (Operating mode)

INSERVICE MEASUREMENTS (ISM)

In service measurements that do not interrupt communication on the network, must be employed. ISM is based on the checking of error in fixed bit or allowed patterns during the flow of data from the user (real traffic), as well as in the calculation of parity (checksum) in predefined data blocks, parity bit or line code violations, FAS or CRC errors/ Some of these measurements apply only to lines, since the parameters are not reset for an intermediary network interface. Others are only useful at the level of a line or a section. These measurements allow us to monitor the long term behavior of the network and carryout preventive maintenance without interrupting the use.

Measurement procedure (ISM)

- Select the tab ***setup*** (pressed).
- Select the option ***configuration***.
- Select the GUI mode ***SDH/SONET ISM or PDH /ANSI ISM***, depending on the signal to be measured. The screen displays the analyzing section only.
- For PDH/ANSI signals, program the expected rate and line code, the gain to compensate the attenuation, if necessary, and indicate framed or not through the corresponding blocks.
- For SDH / SONET signals, program the above-mentioned parameters and also the scrambling of the signal, the structure (C-X, PDH map) and the particular mapping. Alternatively, you can select the path by using the ITU map on the screen associated to the key ***Map Rx.***
- The SDH/SONET ISM mode includes navigation buttons to display the values of OH bytes. Trail trace bytes (J-X) and pointer bytes.
- Connect the instrument properly to the measurement point and view the results through LEDs, results or trace screens.

Out-of-service Measurements (OOS)

The-out-of service measurements (OOS) are made by substituting real traffic in network for a known test pattern, usually a PRBS (PRBS 11, PRBS15, PRBS 20, PRBS 23 patterns with normal or inverted logic) as well as all ones, all zeroes, 1010, 1100, 1000 and 16-bit programmable words, the correct reception of which is checked in the distant end of the communication. These tests disrupt the normal operation (to carry real traffic), but in turn they provide exact quality measurements, since the received signal is verified bit by bit against the transmitted test pattern. The BER (Bit Error Rate) is the fundamental parameter in out of service measurement. End to end tests are also possible, due to the independent operation of each section.

Measurement procedure

To generate the patterns follow the steps explained in the continuing.

- Select the tab ***Setup***
- Select ***configuration***.
- Select the appropriate operating mode according to the measurement to be performed (any of those defined, except for the modes PDH/ANSI ISM & SDH/SONET ISM).
- On the diagram displayed, push the button ***Test*** in the generating section, and select the pattern corresponds to a PRBS, select ITU definition ***PRBS ITU*** or inverted logic

PRBS non ITU (changing the zeroes by ones and vice versa in ITU defined PRBS pattern). You can also program 4 bit words (Fixed) or 16 bit words (User).

- All the previously mentioned operations can be performed either in the analyzing or generating sections in end-to-end measurements. In a loop back measurement, both sections can be coupled, ***Tx to Rx or Rx to Tx.***

When programming background test signals with mappings like for example C12 via AU4, use the ***Background button*** If the background pattern desired is the same as in the tributary under test, go to ***Setup- Summary and program – Main*** on the ***Background*** fields at the bottom of the screen.

Soft LEDs

Instrument includes 10 tricolor soft LEDs

- Green: No anomaly or defect
- Red: Defect (alarm)
- Yellow: Anomaly (error)
- Off: LED disabled

To open the LED screen, select the tab ***LEDs*** and the menu option shown. There is two events register modes for the soft LEDs: ***Current and History***.

In the History mode the detected event color remains in the LED after its cause has disappeared. However, in the ***Current*** mode the color will change (from yellow to green or from red to green). It is possible to reset the display of the history mode by pressing the button Reset at the bottom of the screen.

In a soft LED screen, an empty white box indicates is the position of an event not corresponding to the present to the present configuration.

A libeled white box indicates hierarchical inhibition. Tandem connection Monitoring (TCM) navigation button leads to the screen corresponding to soft LEDs of the TCM events To come back to the first screen, push the navigation button at the bottom right corner.

1. **Line**: LOS (loss of signal), AIS (alarm indication signal), ECOD (error in line cods)
2. **Rs (Regeneration section)**: LOF (loss of frame), TIM (Trace identifier mismatch), OOF (out of frame), B1 (B1 error).
3. **MS (multiplex section):** AIS, RDI (remote defect indication), SD (signal degrade), B2, REI (remote error indication).
4. **AU (administrative unit):** AIS, LOP (loss of pointer), +PJE (pointer justification events-increment), -PJE, NDF (new data flag), INV (pointer inversion).
5. **HP (higher order path):** UNEQ (unequipped), RDI (remote defect indication), TIM (trace identifier mismatch), SLM (signal label mismatch), B3, REI.
6. **TU (tributary unit):** AIS, LOP, LOM (loss of multi-frame), RFI (remote failure indication),+ PJE, -PJE, NDF,INV
7. **LP (lower order path):** UNEQ, RDI, TIM, SLM, REI, B3, BIP-2.
8. **FRAME:** LOF (loss of frame), RAI (remote alarm indication), CRCL EFAS (error in frame alignment signal), ECRC (error in cyclic redundancy checksum), REBE (remote end block error).
9. **Pat:** (LSS, AIS, EBIT, SLIP)
10. System: BAT (battery).

Signature of the Candidate

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BIT ERROR RATE TEST

The Bit Error Rate test consists of determining the ratio between the errored bits and the total received bits. A BER meter is required to perform this test. The instrument generates a test signal by means of its generation section. This test signal is, usually, a pseudorandom binary sequence (PRBS) according to the binary rate of the interface under test. This sequence is sent through the device or the system under test (DUT). At the receiving end, a BER meter receives the transmitted signal and extracts its associated clock to locally generate the expected PRBS. Both sequences, the one received and the one generated locally, are compared bit by bit, in order to determine the total number of received erroneous bits. Once the exact longitude of the PRBS sequence is known, the Bit Error Rate is precisely established.

Victoria Jitter/Wander Analyzer can generate diverse test patterns for the realization of BER test. Among these test patterns are the PRBS 15 appropriate for 2, 8 Mbps and the PRBS 23 appropriate for 34 and 140 Mbps. The instrument can also detect bit errors, among many other events. Besides, bit errors can also be generated in the generation section, to check the response of the network under test.

The aim of this test is to check that there are no bit errors in the payload of the system. Errors are a major source of degradation in that they affect voice services in terms of distortion of voice and data type services in terms of lost or inaccurate information.

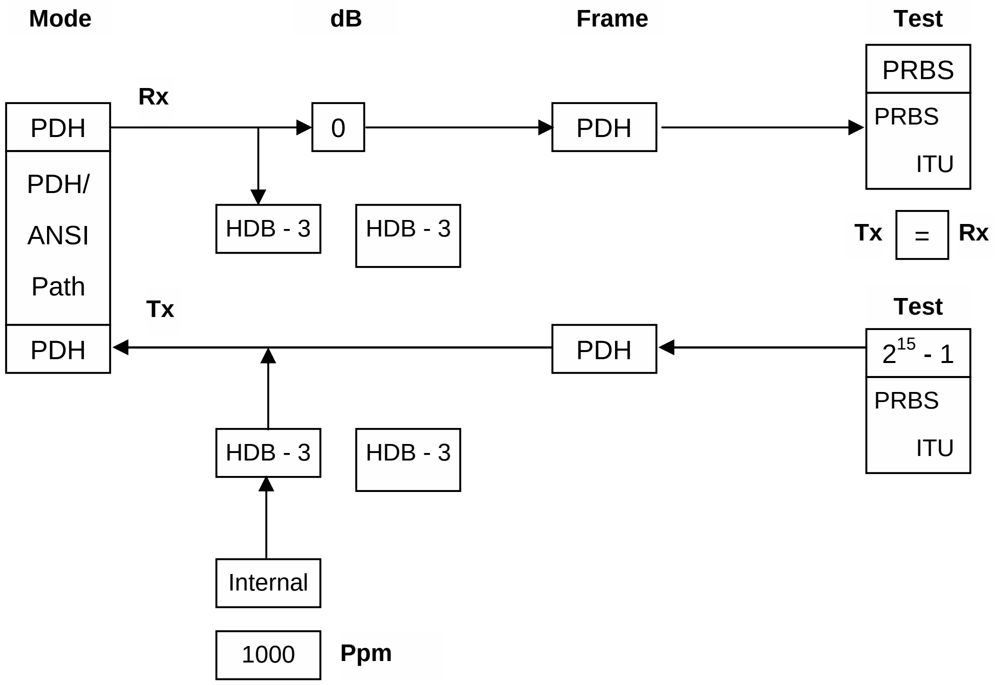
The steps of the procedure to be followed in performing the BER Test are described below.

1) Switch on the Analyzer. After switching on, the analyzer will perform self-test and display the menu pertaining to Setup as follows:

- Configuration
- OH bytes and signaling
- Trace messages
- Expected messages
- Pointer values
- Summary
- Map Rx
- Map Tx

2) Select Configuration by using the pointer.**Don't use fingers to operate the touch screen**. A pointer is provided with the instrument to operate the various tabs. A menu will be displayed.

3) Select the PDH/ANSI Path on the block Mode.



Program the parameters as shown in the diagram with the help of soft keys. Connect the Analyzer to the equipment under test.

3) Select the results tab.

4) Select the option Errors. Results table will be displayed.

5) Press the Start button. Now measurement starts and the results will be displayed in a table after the selected time is completed. (The start button will change to stop mode and will remain in this position till the testing duration is over and again will change to start mode.)

6) Note down the results.

	Count	Errored seconds	Rate
ECOD			
EFAS			
ECRC	------------	------------	------------
REBE	------------	------------	------------
EBIT			
SLIP			

ECOD	ERROR IN LINE CODE
EFAS	ERROR IN FRAME ALIGNMENT SIGNAL
ECRC	ERROR IN CYCLIC REDUNDANCY CHECKSUM
REBE	REMOTE END BLOCK ERROR
EBIT	ERRORED BIT
SLIP	PATTERN BITS ARE LOST OR REPEATED

Signature of the Candidate

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ERROR PERFORMANCE TEST

Errors are a major source of degradation in that they affect voice services in terms of distortion of voice and data type services in terms of lost or inaccurate information. The performance objective is stated in CCITT recommendations G.821 in terms of error performance parameters. It should be noted that total time is split into two parts, namely, time available and that time when it is unavailable. The following BER and intervals are used in the statement of objectives.

a) A BER of less than 1×10^{-6} for one min.
b) A BER of less than 1×10^{-3} for one second.
c) Zero errors for one second (Equivalent to the concept of error free seconds).

In assessing these objectives, periods of unavailability are excluded.

The performance objectives aim to serve two main functions.

a) To give the user of future national and international digital networks an indication as to the expected error performance under real operating conditions, thus facilitating service planning and terminal equipment design.
b) To form the basis upon which performance standards are derived for transmission equipment and systems.
Since the objectives relate to an overall connection it is necessary to sub-divide this to constituent parts.

- One applicable to the degraded minutes requirement and the errored seconds requirements.
- The other applicable to the severely errored seconds requirement.

Degraded minutes

Fewer than 10% of one-minute intervals to have a bit error ratio worse than 1×10^{-6} .

Error seconds

Fewer than 8% of one-second intervals to have any errors equivalent to 92% error free seconds.

Severely errored seconds

Fewer than 0.2% of one-second intervals to have a bit error ratio worse than 1×10^{-3}.

A period of unavailable time begins when the bit error ratio in each second is worse than 1×10^{-3} for a period of ten consecutive seconds. These ten seconds are considered to be unavailable time. A new period of available time begins with a first second of a period of ten consecutive seconds each of which has a BER better than 1×10^{-3} .

Acceptable quality

Error rate less than 1×10^{-6} in one minute.

Degraded quality

Error rate between 1×10^{-6} and 1×10^{-3} in one minute.

Unacceptable quality

Error rate exceeding 1 x 10-3 in a scan period of one second.

The steps of the procedure to be followed in performing the Error performance Test are described below.

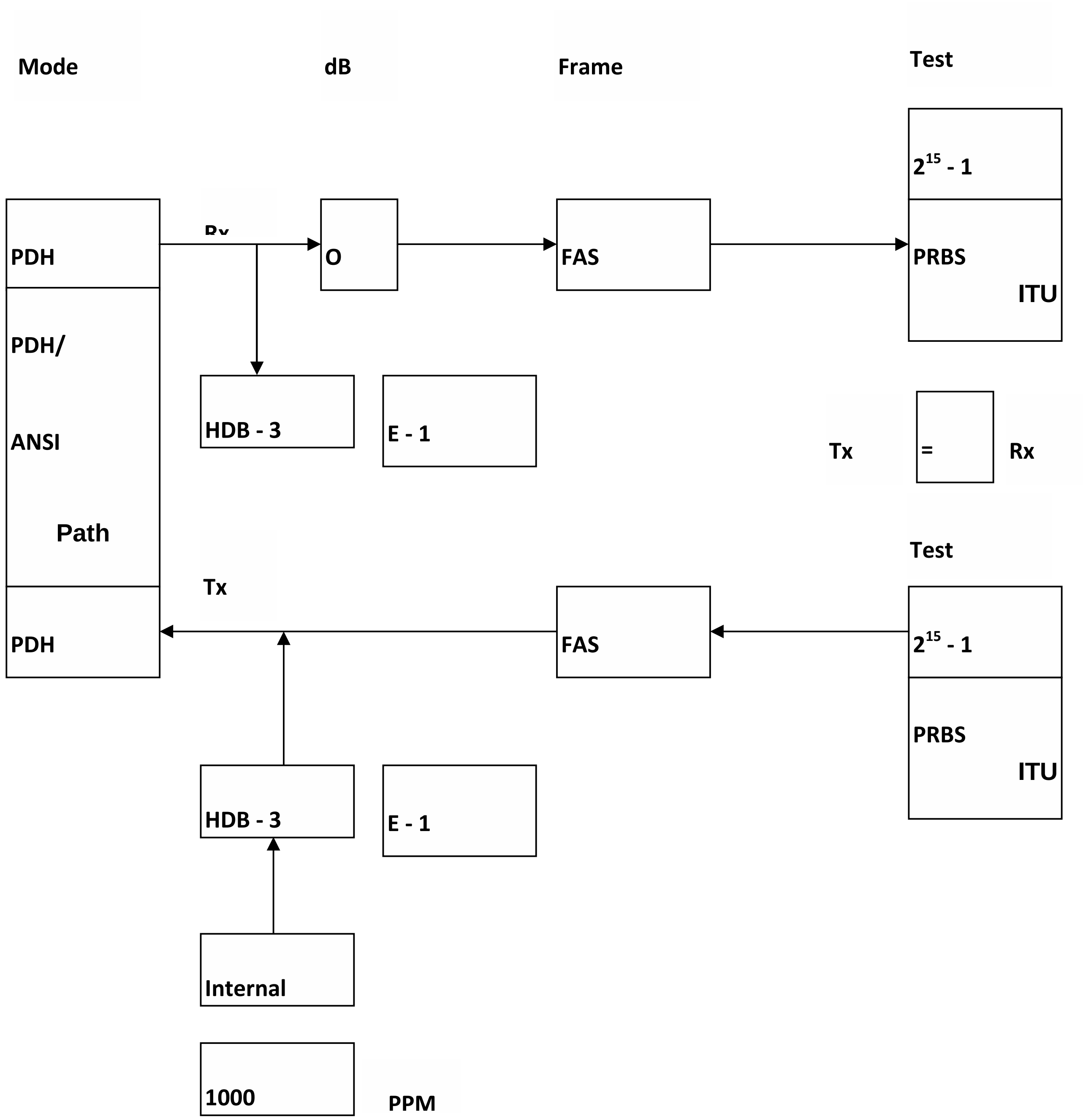
1) Switch on the Analyzer. After switching on, the analyzer will perform self-test and display the menu pertaining to Setup as follows:

- Configuration
- OH bytes and signaling
- Trace messages
- Expected messages
- Pointer values
- Summary
- Map Rx
- Map Tx

2) Select Configuration by using the pointer. **Don't use fingers to operate the touch screen.** A pointer is provided with the instrument to operate the various tabs. A menu will be displayed.

3) Select the PDH/ANSI Path on the block Mode and program the parameters according to the path under test.

4) Set a loop at the far end of the path or alternatively the measurement can be carried out with two instruments in the end-to-end configuration.



5) Select the type of error performance measurement G.821 with the option General setting, the tab Measure and Action.

After selecting Measure and action a menu will be displayed.

- General setting
- Objectives
- Error and Ptr insert
- Alarm insert
- Auto configuration
- Scan
- Print
- Ptr sequences
- Tandem connection M
- Jitter/Wander Tolerance
- Jitter/Wander transfer
- Wander MTIE/TDEV

6) Select objectives. A table is displayed. Program G.821 Objectives.

	HRX %	Threshold
Allocate	60	1

	Objectives (%)	Threshold	
ES	10	4	Secs
	0.1	0	
SES	0.005	0	Secs
US	5	0	Secs
	0.01	6.912E+05	
DM	0.005	3.456E+05	Min.
AE			
BE			

Introduce the allocation HRX % and the overall objectives for each performance event (ES, SES, DM etc) in the column objectives %. The threshold button at the top right corner is programmable value. Normally it is programmed to ‘1’.

7) Connect the Victoria Jitter/Wander to the path under test.

8) Select the tab Results. A menu will be displayed.

- OH bytes and signaling
- Trace messages
- Pointer values
- Synchro
- Errors
- Pointer events
- Alarms
- Performance
- Round trip delay
- Trace
- Transperancy Test
- APS and Optical Power
- SOH POH
- Tandem connection M
- Jitter 0.172
- Wander 0.172

9) Select the option performance. The results table will be displayed.

Started on | | at | |

Elapsed time | | % | |

ES

SES

US

DM

EFS

Count Ratio Objectives

			BE
			AE

10) Push the start Key. Note down the results.

BE – Back ground errors
AE – Error bits in available time

Signature of the Candidate