

Figure 13: Password Setting

6.3. Block Description

Main constituents of the system are:

1) Master Optical Unit (MOU)

The MOU is installed at the indoor location close to the BTSs. In the DL path, the received RF signals from the BTSs are fed to the MOU, which converts the RF signals to a stream of optical signals to be applied to the optical fibers for transmission to the DBROUs installed at different locations. The optical signals between MOU & each of the DBROUs are propagated on two single mode fibers.

In the UL path, the optical signals received from each of the DBROUs are converted back to the RF signals in the preset frequency bands for application to the BTSs.

The connectivity between the MOU and the BTS is through low loss RF coaxial cable via directional coupler. The type of directional coupler shall depend on the loss between the BTS & the MOU.

Modules in the MOU

- a) **Duplexer:** It is provided in the RF path interfacing BTSs for providing isolation between the DL & UL frequency bands. One duplexer is equipped for each band.
 - b) **Optical Transmitter Unit (OTX):** It receives RF signals in the preset frequency bands in the DL path & converts the same to the optical signals in 1310 nm wavelength at a level of $-1.5\pm 1\text{dBm}$ for application to the optical fiber. Two OTX units are equipped in MOU for handling signals for 8 DBROUs.
 - c) **Optical Splitter 1:4 Unit:** As indicated earlier, one MOU supports 8 DBROUs at different locations, the optical signals from OTX are split in this unit in to 4 in case of BTS Link-204. Two splitters shall be equipped in case of 8 DBROUs.
 - d) **Optical Receiver Unit (ORX):** Up to 8 ORX units (depending on the number of DBROUs) are equipped in the MOU and each of them receives optical signals in 1550 nm wavelength from the DBROU in the UL path. Out put from ORX units are converted in to RF signals for application to BTS at the desired power.
 - e) **Power Supply Unit (PSU):** The unit gets input of -48 V DC or 100 to 240 V AC (depending on option) for deriving different DC voltages required for other active units in the MOU.
 - f) **Gain Module:** It is available after ORX in the UL path for making RF signals available for application to the BTS.
 - g) **Supervisory & ASK Modem:** Supervisory and ASK modem enable the monitoring the status of MOU & DBROUs at different locations and the information can be extracted through USB interface available in the front panel.
 - h) **VFD & Key Pad:** It is possible to set the required parameters for configuration through the VFD & Key pad in the absence of PC/laptop. USB interface is available for connecting the Laptop/PC for downloading the CMC software and monitoring of the whole link. A wireless modem (optional) is equipped in the system for remote monitoring & configuration through Dial up connection.
- II) Optical Fiber & Patch Cords:** It is very important part of the system, which connects MOU with DBROU through two fibers. Two single mode optical fibers are needed between the MOU and each of the DBROUs. Each pair of fibers for the specific DBROU is terminated at the corresponding ORX/TRX unit(s) in the MOU.

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- III) Dual Band Remote Optical Unit (DBROU):** As indicated earlier, maximum up to 8 DBROUs are located at different sites as per requirement. The DBROU shall be installed at indoor location for providing coverage in the targeted area. It houses the following modules:
- a) Optical Receiver Unit (ORX):** One such unit is provided in the DBROU, which receives the optical signals in the 1310 nm wavelength in the DL path from MOU and converts the same to RF signals in the preset frequency bands.
 - b) Power Amplifier (PA):** The PA unit is responsible for generating the desired RF power of +33dBm for application to the server antennas. For detailed specifications regarding gain, refer to clause 7.1. Two PA units are equipped in each DBROU, one for each band.
 - c) Duplexer:** It is provided to isolate the DL & UL RF signals. It interfaces with the server antenna through Diplexer.
 - d) Low Noise Amplifier (LNA):** It is provided in the UL path after the duplexer to provide the amplification to the RF signals.
 - e) Optical Transmitter Unit (OTX):** It receives RF signals in the preset frequency bands in the UL path & converts the same to the optical signals in 1550 nm wavelength at a level of $+4\pm 1$ dBm for application to the optical fiber. One OTX unit is equipped in SBROU.
 - f) Power Supply Unit (PSU):** One PSU is equipped in the DBROU for deriving DC voltages required for operation of different devices, it gets AC in the range of 100-240 V, 47/63 Hz.
 - g) Supervisory & ASK Modem:** Supervisory and ASK modem enable the monitoring the status of MOU & SBROUs at different locations and the information can be extracted through USB interface.
 - h) Gain Modules:** One is provided between ORX and PA in the DL path for enabling generation of the desired RF band. Another one is provided with the OTX unit.
 - i) Attenuator:** A variable attenuator up to 31 dB in step of 1 dB is provided for adjusting the RF power radiated from the Power Amplifier in the UL path.
 - j) Server Antenna:** It does not form main part of the equipment. The RF signals from SBROU are distributed to the mobile users through a set

of server antennas mounted at the appropriate indoor locations. The antennas should be of appropriate gain & required frequency band.

7. BTS LinK-208 Repeater Specifications

7.1. Electrical Specifications-RF & Optical

S.NO.	Parameter	Specifications MOU	Specifications DBROU
1.	Optical Wavelength (TX)	1310 nm	1550 nm
2.	Optical Wavelength (RX)	1550 nm	1310 nm
3.	Frequency Band	Same as indicated in clause 5.1	Same as indicated in clause 5.1
4.	Optical Power TX	-1.5±1dBm	+4±1dBm
5.	RF power in DL path	-	+33dBm
6.	Impedance at RF ports	50 Ohms	50 Ohms
6.	Spurious Emission	< -36dBm @ 9 KHz to 1 GHz, <-30dBm @ 1 GHz to 12.75 GHz	< -36dBm @ 9 KHz to 1 GHz, <-30dBm @ 1 GHz to 12.75 GHz
7.	System Noise figure	-----5dB max. ---	-----
8.	Group delay without fiber	---< 5 microseconds----	-----

7.2. Electrical Specification Power Requirement

S.NO.	Parameter	Specifications MOU	Specifications DBROU
1.	Power Supply	-48 V DC/AC mains	100-240 V AC, 47/63 Hz
2	Power consumption	60 watts (Fully equipped)	150 watts

7.3. External Electrical/Optical Interface

S.NO.	Parameter	Specifications for MOU	Specifications for ROU
1.	RF Port	N-type	N-type
2.	Optical Port	FC-PC	FC-PC

7.4. Mechanical Specification

S.NO.	Parameter	Specifications MOU	Specifications DBROU
1.	Dimensions (w x h x d)	485x400x135 mm (19x16x5 inches)	700x385x210 mm (27x15x8 inches)
2.	Weight	12 Kg. (26 lbs.)	25 Kg. (55 lbs.) +33dBm,
3.	Housing	Metal Housing for Indoor application	Metal Housing for Indoor application

4.	Housing Color	Grey	Grey
5.	Cooling	Convection	Convection

7.5. Environmental Specification

Conditions	Specification
Operating Temperature	-5 ⁰ C to +55 ⁰ C (+23 ⁰ F to +131 ⁰ F)
Storage Temperature	-30 ⁰ C to +75 ⁰ C (-22 ⁰ F to +167 ⁰ F)
Enclosure	In accordance with Indoor application

7.6. Contents of Delivery

ITEMS	QUANTITY
Repeater BTS Link-208 MOU	1
Repeater BTS Link-208 DBROU	As per requirement
PC interface cable for USB port	As per requirement
Power cable 3 pin – 3 meter length	As per requirement
Operation & Installation manual	As per requirement
CD containing the application software	As per requirement
Wireless Modem (Optional)	As per requirement
Mounting Clamps with Nuts-bolts	As per requirement

7.7. Safety Precautions-Handling Optical Equipment

Special care has to be taken while handling the optical equipment to avoid damage not only to the equipment but also to the technicians/Engineers. MOU and DBROUs are equipped with Lasers; direct exposure to the human eyes must be avoided. Though the Lasers used in the equipment are of low power and are classified as class III B (norm EN60825) even then enough care needs to be taken to avoid exposure.

Optical connectors for single mode fibers are designed for sub micron tolerances. Such a connector has an optical section of only 9-micrometer diameter.

Even a small particle of dust shall cause excessive loss & adversely affect the performance:

For safety reasons & optimum performance, following points need attention:

- The optical connectors should never be left in open condition to avoid entry of dust/moisture etc.
- When working with the optical connectors or the optical fiber, check at each end that both optical transmitters are switched off.
- The connectors should be cleaned regularly with ethyl alcohol and tissue paper; the tip should not be touched with bare hands.

- The connectors are very delicate in nature therefore proper aligning without applying excessive force should carry out removal & insertion.

8. Installation

8.1. Preparation Sheet-Pre Installation

1. General

Application: Indoor

Frequency Bands:

Cellular

Frequency Band DL: 869 MHz to 894 MHz

Frequency Band UL: 824 MHz to 849 MHz

PCS

Frequency Band DL: 1930 MHz to 1990 MHz

Frequency Band UL: 1850 MHz to 1910 MHz

Number of DBROUs installed at different sites:

2. Master Unit

Parameter	Remarks
BTS power	
Estimated Feeder Loss between BTS & Coupler	
Estimated Coupling loss (in coupler)	
Estimated Feeder loss between coupler & Master unit	
Estimated Input RF power in DL to Master unit	
Arrangement for termination of optical fibers	
Optical power in link path (DL)	
Estimated RF power in UL	

3. Optical Path

Parameter	Remarks
Optical Fiber length between MOU-DBROU 1.....8	
Estimated optical loss between MOU-DBROU 1.....8	
Estimated optical signal level at each DBROU input in DL	
Estimated optical signal level at MOU from each of the DBROUs	

4. Remote Unit (s)

Parameter	Remarks
Estimated attenuation in DL	
Estimated attenuation in UL	
Arrangement for termination of optical fibers	
Desired power at server antenna in DL	
Proposed gain setting in DL	

Date:.....

Prepared by.....

Site Address:.....

8.2. MOU Installation

As mentioned earlier in this document, the MOU is placed at indoor location, which is close to the BTS from where the signals are to be fed through directional coupler. Following points need consideration:

- The MOU should be installed at the spot where optical fiber ends are terminated and is a secured place where unauthorized access can be avoided.
- The length of RF coaxial cable route from MOU to the BTS via directional coupler should also not be excessive & sharp bends are to be avoided to minimize losses.
- MOU is operated from –48 V DC or AC mains as the case may be. Suitable supply has to be insured depending on the application.
- The site should be easily accessible for maintenance purposes.
- The environment should be free from excessive moisture, chemical fumes and ultra-violet radiations.
- The environment is not subjected to any Automobile Ignition noise, Generator noise etc.

Installation Tools

- a. Standard wrenches/screwdrivers/cable stripper/cable cutter/pliers set for installing the system and antennas. (Refer to the manufacturer's recommendations for installing the antennas).
- b. RF coaxial cable connection tools for fixing connectors.
- c. Multi-meter.
- d. Optical power meter.

Termination/Connections at MOU: Connections as detailed below need to be carried out:

- Optical fibers for connectivity to DBROUs at different locations are required to be terminated on MOU. Two fibers are needed for each of the DBROUs.
- RF connection for transfer of signals from/to BTS.
- Power connection for extending –48 V DC or AC mains to MOU.

Important:

- Continuity/short circuiting of RF coaxial wherever used should be checked before making connections.
- Continuity of each fiber to the respective ROU should be ensured.
- The system should not be switched ON till the installation is completed and certain settings for the system is made.
- No optical connector should be left open.

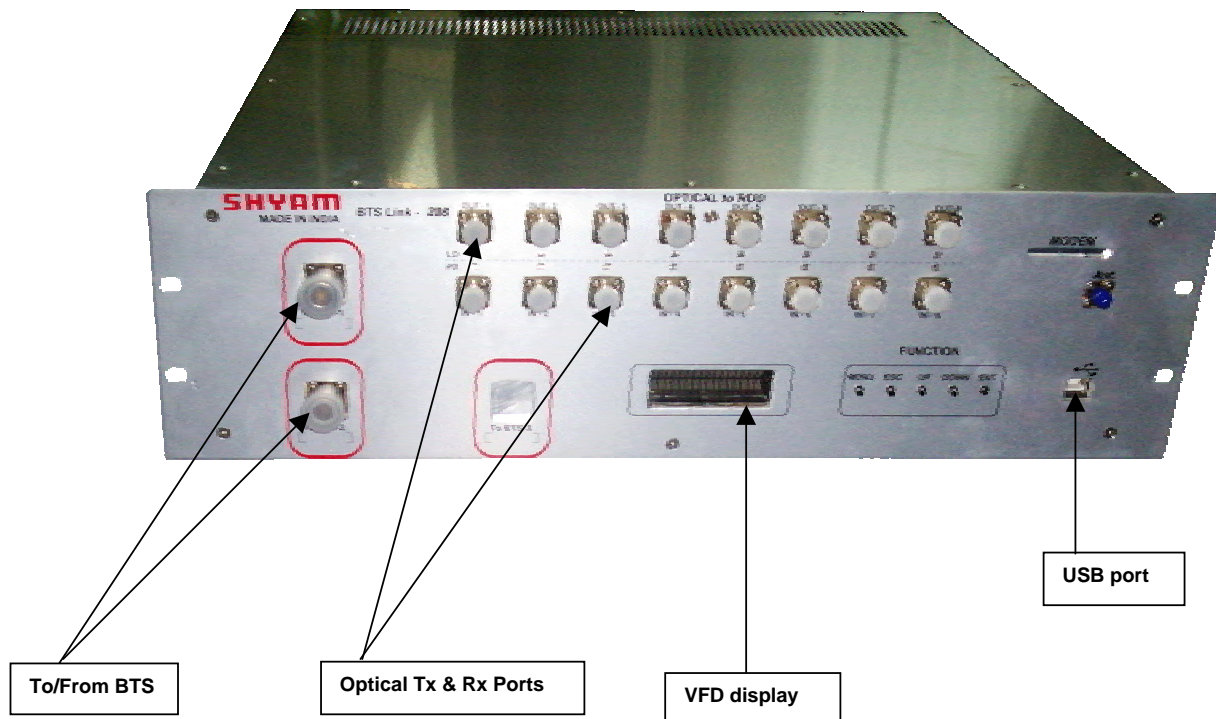


Figure 16: Different Ports on MOU

Commissioning MOU:

Preliminary verify the correct operation of MOU:

- Visual inspection of MOU cards before use, for any mechanical or component damage.
- Insert the cards in the designated slot only.
- Switch-ON the MOU sub rack.
- Measure the optical power.
- Verify the LED status through CMC software.

WARNING:

Do not remove or insert any module into sub rack, without switching off the power supply.

8.3. Optical Fiber Cable Laying

The connectivity between the MOU and the DBROUs at different sites is through optical fibers. In case the fibers are not available, the laying of optical fiber cable has to be under taken. Single mode fibers are in use for which two fibers are required between the MOU and each of the DBROUs.

Depending on the situation, the type of optical fiber cable could be of **aerial** type or of **buried** type. In aerial type, the OFC is firmly fixed/clamped on the poles/pillars in the open atmosphere and such cables are normally armored to provide adequate protection/strength. The advantage of using such cable is that the installation job can be completed in less time. However, the cost of the cable is higher. Whereas the buried type, the OFC is placed in pipes which are laid underground.

A variety of cable designs are available to meet the requirements of different installations. Some of the designs are given below:

- **Loose tube construction:** The fibers lie loosely inside a surrounding plastic tube so that it can adjust itself when the cable is bent; micro bending is almost completely eliminated by this technique. Loose tube cables are preferred for long distance links and for almost all outdoor applications.
- **Tight buffer construction:** The buffered fiber is completely enclosed in a cushioning material (secondary coating up to an external diameter of 900 micro meters) to improve crush resistance and vibration isolation, minimizing micro bending. Tight buffer cables are usually adopted for outdoor applications because they offer small cross-section dimensions and small bending radius.

Connecting MOU and ROU with optical cables

Under the normal circumstances, two fibers are utilized for connecting MOU to a particular DBROU, one for the UL & other for the DL path.

Every fiber must be labeled in order to indicate the connection particulars & route.

Sharp bends on the pigtailed are to be avoided while making connections. The optical connectors must be cleaned thoroughly to avoid entry of dust and obstructions to the optical signals.

Guidelines for OFC laying are:

- The exact route may be decided before starting the laying work.
- Extra length of OFC may be kept for future use at each end.
- The OFC should be free from all optical connectors and should be sealed at both the ends at the time of laying.
- Sharp bends, extra pressure, and pull should be avoided during laying to avoid damage to the fibers.
- Proper splicing should be carried out for minimum splice losses.

- All technical specifications from the OFC supplier should be followed.
- The termination of OFC at each end should be done at FDFs, which should be located close to the equipment.
- Connection between the OFC (terminated at FDF) and the equipment should be carried out through optical jumpers with FC-PC connectors.

8.4. Installation-DBROU

Following points need to be considered

- Availability of AC in the range 100-240 V 47/63 Hz for energizing the DBROU.
- All other points as indicated in 8.2 above.
- A set of server antennas of omni/directional type for providing coverage in different areas of the building is to be installed. Site plan is prepared in advance where coverage is required to be provided.
- The antennas should be of proper gain and frequency band.

Termination/Connections at ROU: Connections as detailed below need to be carried out:

- Optical fibers for connectivity to MOU. Two fibers are needed for each of the DBROUs.
- RF connection for transfer of signals from/to antennas.
- Connection to the AC mains.



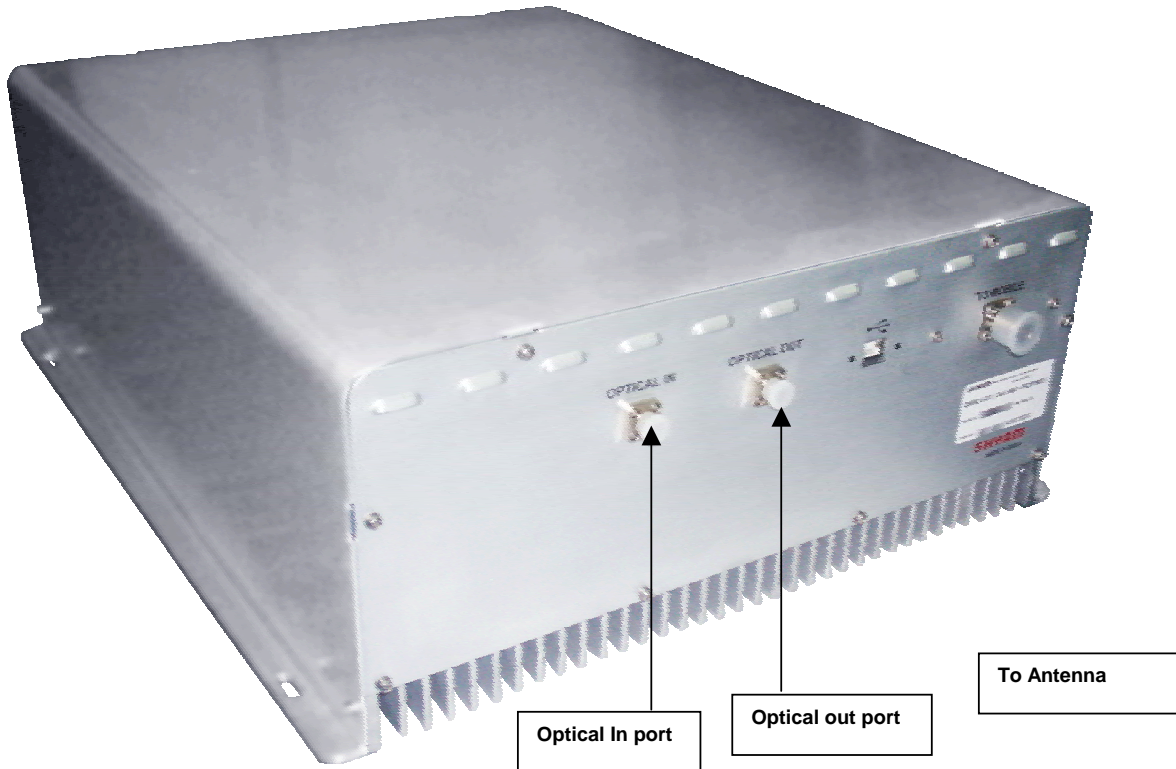


Figure 17: Terminations at Different ports in DBROU

Commissioning DBROU:

- After making the desired connections, Switch “ON” The power supply.
- Check the LED status at DBROU.
- Measure the Optical Output Power. It should be $+4\pm 1\text{dBm}$.
- If any Parameter is not within the specified limits, check the connections and observe alarms.

8.5. Dos & Don't Dos

1. The BTS-208 system is comprised of independent unit's viz. Master Optical unit & Dual Band Remote Optical Unit(s); the site selection should be made with great care for maximum efficiency.
2. The site(s) should be accessible for maintenance purposes.
3. Arrangement is to be made to avoid unauthorized access to the system.
4. Stable power supply for units should be ensured.
5. The route of Cables to/from antennas should be short to limit the cable losses and should be free from sharp bends & kinks.
6. Local standard of cabling should be followed.
7. Route of cable from antenna to the system should be secured to avoid damage and connections have to be made water tight to prevent the entry

- of water in the equipment.
8. There should be adequate separation between the antenna system and power lines.
 9. The Master unit draws RF input from BTS; its level should not be excessively high for satisfactory performance.
 10. The optical fiber termination should be carried out with care and no optical port should be left open when the system is ON.
 11. Bending of optical fiber cable at acute angles must be avoided
 12. The estimation of coverage area should be confirmed.
 13. The system should be configured for normal traffic after actual measurement of:
 - a) RF power in the DL
 - b) RF power in the UL
 14. Feedback regarding performance of the system must be obtained from the user.

8.6. Checklist-Post Installation

Service Band:

Cellular

Frequency Band DL: 869 MHz to 894 MHz

Frequency Band UL: 824 MHz to 849 MHz

PCS

Frequency Band DL: 1930 MHz to 1990 MHz

Frequency Band UL: 1850 MHz to 1910 MHz

A. Coupler Installation

S.NO.	Point(s) To Be Verified	Remarks
1.	30 dB coupler installed on BTS main antenna feeder	
2.	Type N connector closer to antenna terminated with 50 Ohms	
3.	Type N connector closer to BTS connected to donor cable	
4.	BTS operating normally with coupler installed	
5.	Coupler weatherproof	

B. Master Unit Installation

S.NO.	Point(s) To Be Verified	Remarks
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1.	Grounding of the unit	
2.	Cable from coupler terminated at donor (BTS) port	
3.	Termination of optical fibers for different ROUs & no optical fiber port is left open. Two fibers are provided for each ROU.	
4.	-48 V DC cable connected to the Master unit	
5.	RF Cable protection ensured and outdoor connections are waterproof	
6.	Precautions against excessive bending of optical cable.	
7.	Labels showing cautions displayed	

C. Master Unit Setup

S.NO.	Point(s) To Be Verified	Remarks
1.	Master unit switched ON	
2.	Any error/alarm observed	
3.	RF signal strength in DL	
4.	Transmitting optical signal strength at relevant optical port for each ROU	
5.	Received optical signal strength at relevant optical port from each ROU	
6.	Loss for optical signals between MOU and each of the ROUs is within limits.	
7.	RF power set in UL.	
8.	Attenuation inserted in UL.	

D. Remote Unit Installation

S.NO.	Point(s) to be verified	Remarks
1.	Ensure termination of optical fibers at optical Tx & RX ports.	
2.	Grounding of the unit	
3.	RF cable connected between RF port and server antenna.	
4.	Cable to server antenna connected to server antenna port	
5.	Mains cable connected to the Remote unit	
6.	RF Cable protection ensured and outdoor connections are waterproof	

E. Remote Unit Setup

S.NO.	Point(s) To Be Verified	Remarks
1.	Remote unit switched ON	
2.	Any error/alarm observed	
3.	Received optical signals at RX port	
4.	Attenuator inserted for desired RF power	
5.	RF power set	
6.	Optical signal strength at TX port	
7.	Remote unit secured.	

Any Other Remark/Comment:

Date Of Installation:----- Repeater ID:-----

Site Address:-----

Name of the Installer:-----

9. System Maintenance

9.1. General

The system normally operates without any operator intervention or maintenance. If, in the unlikely event of a unit failure, the field replaceable units (antenna unit, cables) should be checked for faults and the system restored. A faulty unit can be removed and replaced with a spare while the rest of the system (other repeaters) is still operating. Soldering or local repair of the modules should be avoided from better maintenance point of view. Faulty module/unit should be replaced with genuine spares from Shyam Telecom Limited only.

The power supply of the faulty unit should be isolated from AC mains and DC power before any module is replaced. In the event of a system malfunction, the status of the antenna systems should be checked as well as the continuity of the cabling before replacing any modules within the unit.

9.2. Preventative Maintenance

The **BTS Link-208** repeater does not require any preventative maintenance. However, some of the common observations are possible; some of them are tabulated below with remedial action suggested:

Observation	Remark
No RF power is available in any of the DBROUs connected to the MOU.	<p>Check if the MOU is ON. If it is not ON, please check the availability of –48 V DC for MOU. Make sure that –48 V is available.</p> <p>Check the alarms, if Laser diode/photo diode failure is indicated. Verify functioning of OTX unit by replacing with working/good unit. Also clean the optical connectors wherever provided.</p> <p>Check the optical power at each port connected to the DBROUs. If it is available at each of the ports, check the optical connectivity between MOU and DBROUs.</p>
RF power high in DL at DBROU	Check for the indication for alarm and insert an additional attenuator to reduce the RF power.
RF power low in DL at DBROU	Check for the indication for alarm and adjust the attenuator to enhance the RF power.
VSWR alarm at ROU	Check the connections at RF ports at antenna and in the system.
LNA failure indication at ROU	Failure of communication between the ROU and the MOU shall be observed, replacing the LNA unit at ROU shall restore the communication.
Power high UL at MOU	Reduce the level by inserting additional attenuator.
RSSI LOW/HIGH DL at MOU	Adjust the attenuator in order to get rid off the alarm. Also check the RF cable between the antenna and the MOU.
Photo-diode 1/2/3/4....8 failure at MOU	It indicates the problem in the ORX unit. Check & verify the ORX unit, if required replace it with the good unit.

In case of malfunctioning, it is suggested that the confirmation should be made if the fault lies in optical path or RF path by observing alarms before initiating any action.

FCC & IC Statements:

FCC ID:S3CBTSLINK208

This device complies with Part 2, 15, 22, 24 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

IC Information:

Trade Name: SHYAM BTS Link-208 Repeater

Model No.: 208

IC: 5751A-BTSLINK208

This device complies with RSS-131, RSS-102 of the IC Rules.

Warning

Changes of modifications not expressly approved by the manufacturer could void the user's authority to operate the equipments.

For Technical Support, please contact at any of the following addresses:

For Americas

Shyam Telecom Inc.

6, KILMER ROAD, SUIT D,
EDISON, New Jersey-08817 (USA)
Email: info@shyamtelecom.com

For Europe

Shyam Telecom GmbH.

Frohsinnstrasse 16, 63739 Aschaffenburg, Germany
Tel: + 49-6021-45901-0 Fax: + 49-6021-45901-29
Email: service@shyamtelecom.com

For ASEAN & Others

Shyam Telecom Ltd.

246, Phase IV, UDYOG VIHAR,
GURGAON – 122015 (INDIA)
Tel: +91-124-4311600 FAX: +91-124-4018117
Email: repeater@shyamtelecom.com

Email: contact@shyamtelecom.com