

System Description and Configuration for *sat-nms* LFTX / LFRX

The *sat-nms* L-Band Optical Transmitters and Receivers were developed to cover all applications of our customers in the field of satellite communication, satellite ground stations, VSAT and cable networks.

Two types of optical converters are available:

<i>sat-nms</i> LFTX	Optical Transmitter converting from IF input spectrum to optical output at 1310nm
<i>sat-nms</i> LFRX	Optical Receiver regenerating the optical signal back to an IF spectrum

SatService offers the LFTX/RX modules for different frequency bands:

<i>sat-nms</i> LFTXL and LFRXL	950 to 2150MHz
<i>sat-nms</i> LFTXB and LFRXB	50 to 2150MHz
<i>sat-nms</i> LFTX10 and LFRX10	950 to 2150MHz and 10MHz reference frequency for BUC on same fiber

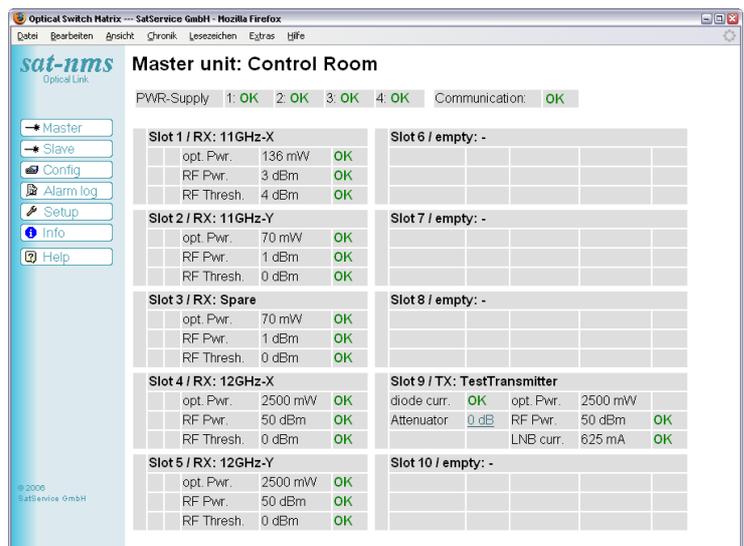
The advanced solution offered by SatService is equipped with multiple remote MNC-Interfaces: web-browser interface for the user, a local operator interface via LCD, keypad and SNMP. Already the baseline configuration includes redundant power supplies. So you do not have to add a second power supply as in competing products. Optional feature is the hot-swap capability, given in any case for the optical transmitter and receiver. Furthermore, PC boards can be extended to the power supplies.



With the SatService solution you will get full local and remote monitoring & control capability of all your optical links. The 19" unit provides an LCD Display and a keyboard allowing the service personal to monitor & control the optical links from the front panel in an easy way. An alarm log shows the last 20 alarm messages. Parallel to the local front panel control, the M&C module includes an integrated web server with an Ethernet interface so that the operator can also monitor and control the optical links via its web-browser - both locally or remote whenever it is connected to the same LAN. The M&C module provides the following interfaces for monitoring & control via external equipment:

- Serial remote control protocol via RS232
- TCP/IP via the 100-Base-T Ethernet interface
- SNMP (Simple Network Management Protocol)
- Remote Control Protocol over HTTP get request

The mechanical configuration of the *sat-nms* LFTX/RX Family is based on a 19" 2 height units (HU) rack-mount chassis providing in its newest version space for 10 modules which can be a mix of optical receivers and optical transmitters. A widespread application is that the first chassis on one side of the link contains all optical transmitters and the second chassis on the other side of the link, where the L-Band signal destination is, contains all the optical receivers. This is the most common uni-directional configuration.



But the **sat-nms** LFTX/RX equipment can also be used in bidirectional configurations. As you can see in the setup screen of the web-browser interface each slot can be configured to be a TX or RX card. An example of a bidirectional application is the usage for transmit and receive earth stations or VSAT applications.

Connectors

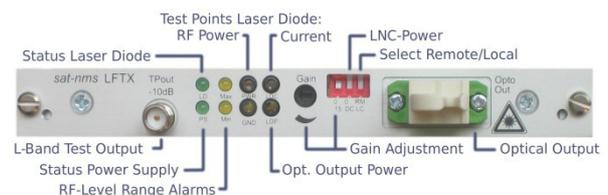
For the optical interface, SatService provides E2000 connectors from Diamond or Huber & Suhner by default. But we are also in a position to deliver on request FC/APC or other single mode connectors. The optical interface is located at the front panel of the 19" chassis because the optical patch panels are most likely also at the front of a 19" rack. The connectors are slightly shifted backwards from the normal front plane of the 19" rack-mount chassis, so that they don't interfere at the front of the rack nor can they become destroyed or snapped off. The RF-input and -output connectors are in the standard configuration SMA 50Ohm. If you need 75Ohm input or output connectors then we can integrate into the 19" chassis a 50 to 75Ohm impedance converter providing a good return loss flat frequency response. The 75Ohm connector type, which we recommend, is F-female. In principle, we can also deliver BNC 75Ohm female connectors, but the measurement results show at 2GHz much better return loss performance with F than with BNC connectors. Therefore we cannot recommend using BNC connectors. The impedance converter will introduce an additional attenuation of 7dB at the input or output port, see our explanation in chapter "Gain Calculation and Adjustment".

Test and Control Functions

During the development of the two modules, we emphasized to incorporate as much test- and control functionality as possible. This differentiates the **sat-nms** LFTX/RX modules from its competitors. We have implemented all functionality, which we missed during system integration of other vendor equipment over the last years to set-up and optimize an optical link efficiently.

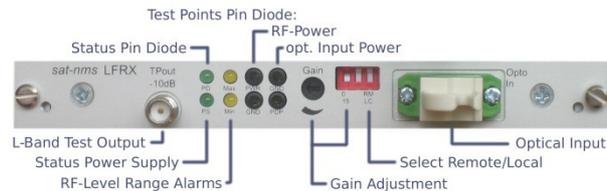
sat-nms LFTX Optical Transmitter

- Supply voltage for LNC to be connected to its L-Band input
 - Including current monitoring and alarm
- Local monitoring and control via the front panel
 - L-Band gain adjustment of +/-15dB in 1dB steps
 - L-Band SMA test output to measure L-band signals or connect a beacon receiver
 - Monitoring of alarms and input level range via LEDs
 - Measurement points at the front panel to measure:
 - L-Band input power
 - Laser diode optical output power
 - Laser diode current
- Monitoring & control via Web Browser interface, SNMP, TCP/IP and RS232
 - L-Band gain adjustment +/-15dB in 1dB steps
 - L-Band input power
 - Monitoring of alarms and input level range



sat-nms LFRX Optical Receiver

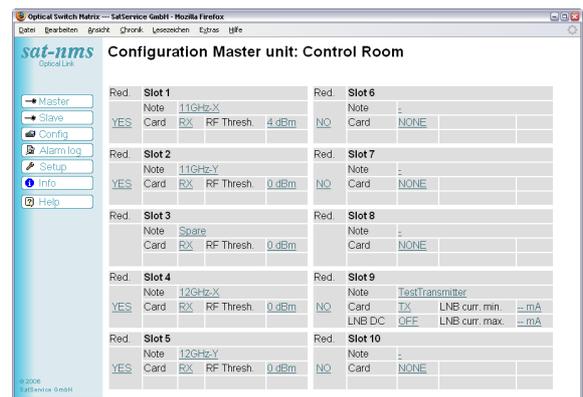
- Local monitoring and control via the front panel
 - Gain adjustment of 30dB in 1dB steps
 - L-Band SMA test output to measure L-Band signals
 - Monitoring of alarms and output level range via LEDs
 - Measurement points at the front panel to measure:
 - L-Band output power
 - Optical input power
- Monitoring & Control via Web Browser interface, SNMP, TCP/IP and RS232
 - L-Band output power
 - Monitoring of alarms and output level range



Redundancy Switching of Complete Optical Links

A novel and additional feature of the **sat-nms** LFTX/RX-System is the capability to switch complete optical links and restore operation within a second if one of the optical links becomes defective. This can effectively increase the availability of optical transmission systems. In order to provide this feature the **sat-nms** LF-CH2MNC chassis can be equipped with a different internal back-plane including the necessary L-Band switches and the software with redundancy switching capability.

A common application example is the connection of a Ku-Band Antenna, normally providing 4 L-Band outputs from 4 LNCs (11/12GHz and Horizontal/Vertical) to a central building or a teleport. In this case, a 5th module will be integrated in both the optical transmitter and the optical receiver chassis on both sides of the link. All 5 links will be monitored and controlled via the MNC module in the **sat-nms** LF-CH2MNC chassis. The two MNC modules talk to each other via TCP/IP and one is the master module initiating the redundancy switching. The master module also provides the M&C information for the slave module so that the operator does have all information available from both if it is in front of the units or if it operates the unit via the web browser interface. If one optical link becomes defective - for whatever reason, e.g. a faulty module or the optical fiber cable is cut - the redundancy switching will be initiated in both chassis from the master M&C module.

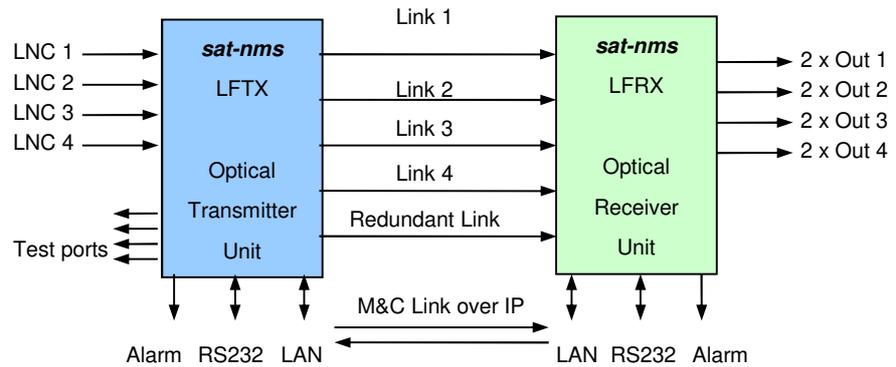


The redundancy switching capability is defined by the back plane in the **sat-nms** LF-CH2MNC chassis and how the switches are routed internally in the backplane. The main principle is that the two columns are two separate redundancy combinations interconnected internally by L-Band switches. So each column itself will provide redundancy, where in slot 3 and 8 the redundant modules will be plugged.

This configuration will be defined in the setup page of the MNC software via the web browser interface. Therefore, you can realize two independent redundancy configurations per 19" chassis with its maximum of 10 modules.

Another version is the **sat-nms** LF-RED2LNC providing the additional redundancy switching capability for external LNC. Based on the **sat-nms** LF-RED2 this unit contains also the necessary IO driver hardware card driving a combination of 2/4 waveguide or coaxial switches for redundancy switching of the corresponding LNCs. The switchover criterion is LNC current window. This unit provides a 2:1 protection.

column 1	column 2
1:1	1:1
1:2	1:2
1:3	1:3
1:4	1:4
up to 10 non redundant optical links	



Gain Calculation and Adjustment

The capabilities for gain adjustment of the **sat-nms** LFTX and **sat-nms** LFRX cards are very wide so that the customer can adapt each configuration to his specific requirements. This allows also the compensation of additional attenuation, which is introduced by optional extensions within the chassis. The impact on the overall gain is explained in the following chapter.

The nominal gain of an optical link consisting of a **sat-nms** LFTX and **sat-nms** LFRX card connected together via one optical patch cable is 0dB with an attenuator setting of 13dB. This gain value has a relative wide tolerance of +/-3dB due to tolerances in the laser and pin diodes, which can easily be compensated by the attenuators (0 to 31dB) in the optical link cards. Both **sat-nms** LFTX and **sat-nms** LFRX cards have a 0 to 31dB (one 1dB step size) attenuator integrated. But please keep in mind that satellite communication spectrum in L-Band and also CATV-Band is a multi-carrier environment and therefore the attenuator setting in the **sat-nms** LFTX is primarily used to adjust the total input power level at the laser diode. After adjusting the laser diode RF input level, the remaining gain adjustment is performed via the **sat-nms** LFRX attenuator. This is one of the key-features compared to other vendors' products, which don't have a gain adjustment device in front of the laser diode. In this case you need fixed attenuators in front of the L-Band input if you want to optimize your optical link RF performance!

We recommend an input level at the laser diode of -5 to -3dBm if you want to have the best compromise between intermodulation and noise figure. This power level is measured directly on the printed circuit board and presented to the operator via the web-browser GUI. But this does not mean that it is not possible to have a good operational condition of the optical link if you give to the laser diode only a total input power level of -10 or even -13dBm. The input and output power range is very wide and, as explained, can always be adapted with the help of the two attenuators. Please bear in mind that the absolute total input and output power levels at the output and input ports should be always not higher than -5dBm for a chassis with "normal" 50Ohm input or output ports. This is a power level matching perfectly to the system design of the satellite ground stations even for big antennas with a high receive gain and a 50dB LNC pointing to a DBS satellite. With the flexibility of the gain setting attenuators you can easily adapt to your receive or transmit requirements.

This was the behavior for a "normal" chassis with 50Ohm input and output ports. If we add special features to the **sat-nms** LF-CH2MNC chassis, this can introduce additional attenuation. For example, we implement a real 50 to 75Ohm impedance converter with good performance and also the 1:4 L-Band divider includes decoupling attenuators to improve the isolation and output return loss.



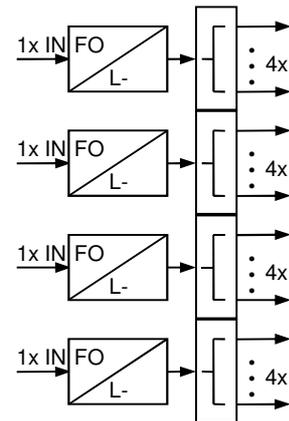
- Impedance converter for 75Ohm input or output ports instead of 50Ohm insertion loss 7dB

- Redundancy switching causes 6dB additional attenuation for the complete link
- 1:4 L-Band distributor gives -12dB additional attenuation

So these values have to be taken into account when you perform your level calculation. But again, don't worry: you can compensate everything with the attenuator integrated in the modules.

Special Configurations

SatService GmbH can also provide a special combination of fiber optical link combined with L-Band distributors. **sat-nms** LFRXv4 is an L-Band distributor that can be integrated in the fiber optical chassis. 4 or 8 fiber optical receivers in combination with the 1:4 L-Band distributor can be used in one 2HU 19" chassis. These are the high quality splitters also used in our **sat-nms** LRXD L-Band Distributor. The overall unit is therefore a combination of an optical receiver and L-Band isolated splitter and provides 4 independent isolated L-Band outputs per optical Link in only 2 height units. This is especially helpful for customers needing a certain L-Band IF distribution as well.



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