



## **Optical Receiver/Transmitter**

***sat-nms* LFTRX**

## **User Manual**

Version 2.0.005

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# sat-nms LFTRX User Manual

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## Abstract

This document is the user manual provided with the *sat-nms* LFTRX fibre optical receiver/transmitter module. It contains all necessary information how to install, setup, and operate the unit.

Based on the *sat-nms* LFTX Optical Transmitter and *sat-nms* LFRX Optical Receiver for analog multi-carrier RF transportation on fibre optical media, SatService delivers also a transceiver module. This unit has a very compact mechanical footprint for easy integration into existing or new system solutions. It also allows a communication equipment manufacturer seamless integration of optical interfaces into its RF equipment or sub-system.>

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## 1 Introduction

The *sat-nms* LFTRX fibre optical link is a high performance transmission system which transmits a complete frequency band, with all its separate carriers, over a single mode fibre with length up to 5km. The big advantages of fibre optical links are:

- Lightning protection

- Fully isolated between the two destinations
- No ground loops
- bug proof

The module includes a Tx and a Rx module

- TX --- optical transmitter which converts from IF input spectrum to optical output at 1310nm
- RX --- optical receiver which regenerates the optical signal back to an IF spectrum

SatService offer the LFTRX modules for different frequency bands.

- **sat-nms** LFTRX-B --- 50 to 2150MHz
- **sat-nms** LFTRX-L --- 950 to 2150MHz
- **sat-nms** LFTRX-10 --- 10MHz only
- **Installation** : The installation chapter guides through the installation and setup of the **sat-nms** LFTRX. It describes the mechanical concept of the chassis and the assignment of the connectors.
- **Operation** : Operating the **sat-nms** LFTRX is mostly self-explanatory. Nevertheless, the 'Operation' chapter outlines the **sat-nms** LFTRX user interface and elaborately describes the meaning of each alterable parameter.
- **Remote Control** : The **sat-nms** LFTRX provides a versatile remote control interface. A monitoring & control software may fully operate the **sat-nms** LFTRX through a analog interface. This chapter lists all parameters accessible through the remote interface.
- **Theory of Operation** : This chapter gives a short overview how the optical links work and which features are supported.
- **Specifications** : At the end of the document, the specifications applicable to the **sat-nms** LFTRX are summarized in this chapter.

## Support and Assistance

If you need any assistance regarding our **sat-nms** Optical Links, don't hesitate to contact us. We would be pleased to help you by answering your questions.

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## 1.1 Compliances

### 1.1.1 CE Compliances

#### 1.1.1.1 EMC compliance

This equipment has been tested and meets the specification of following EMC standards:

- EN 55032
- EN 55024
- FCC, part 15B
- ICES003 To meet all EMC requirements it is necessary to keep with the cabling requirements mentioned in the installation chapter.

#### 1.1.1.2 Federal Communications Commission (FCC)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference; in which case, users are required to correct the interference at their own expense.

Note: To ensure compliance, properly shielded cables for data, I/O and RF connections shall be used. Use double shielded twisted pair cables for I/O connections. We recommend to use CAT7 S/FTP cable, e.g. DRAKA UC900 SS27 Cat.7 PUR. These cables have to be shielded from end to end, ensuring a continuous shield.

For RF connections use double shielded coaxial cable like e.g. RG223.

#### 1.1.2 Safety compliance

This equipment has been tested and meets the specification of following safety standards:

- EN 62368 Every single delivered unit is tested according to EN 60950 to ensure best possible user safety.

To meet all safety requirements it is necessary to keep with the cabling requirements mentioned in the installation chapter.

## 2 Installation

This chapter describes how to install the **sat-nms** LFTRX Fibre Optical Link. You find a guide how to connect, configure and mechanically mount the equipment below.

Before you start, please first read the [Safety Instructions](#) chapter below. It contains some important recommendations to prevent damage from the equipment.

### 2.1 Safety Instructions

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Failure to observe all Warnings and Cautions may result in personnel injury and/or equipment damage not covered by the warranty.

- **The equipment described in this manual is designed to be installed and used by properly trained personnel only!**



- **ATTENTION invisible Optical Radiation!** If connected to a power supply, the unit provides invisible Laser-radiation. The source is class 3R Laser diode as defined in DIN EN 60825-1:2001-11.  $P_0=2\text{mW}$ ,  $\text{Lambda}=1310\text{nm}$ .
- **Never look into fibre-optical components** like connectors or fibres. Use an infrared viewer, optical power meter or fluorescent screen for optical output verification.
- Do not allow any dirt or foreign material to get into the optical connector bulkheads. This may cause damage to the polished optical connector end faces
- Follow standard Electrostatic Discharge (ESD) procedures when handling the chassis and the modules of the LFTRX.
- Select and apply the appropriate 924DC voltage according to the data sheet and documentation **before** connecting power.
- Install suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) or overcurrent can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
- The LFTRX can be damaged if the total RF input power is higher than +10dBm specified maximum value. Do not connect equipment where the total output power is higher than the specified value of the data sheet or indicated on the LFTRX unit.
- In case of a failure do not open the **sat-nms** LFTRX, you will lose warranty, call SatService GmbH for a RMA number.
- Observe normal safety precautions when operating, servicing, and troubleshooting this equipment.
- Take standard safety precautions with hand and/or power tools.
- When connecting the units fault relay circuits, observe the maximum ratings: 24V D/C 50mA.

## 2.2 Handling instructions for optical connectors

- Do not allow any kind of dust or dirt on the fibre.
- Do not touch the fibre! Otherwise you will get optical attenuation and the opposite fibre in the corresponding connector will be contaminated as well.
- When installing or changing optical connections, ensure that the environment of the room where the unit is installed is as dust-free as possible.
- If you install the unit on-site, make sure that the complete work that causes dust (e.g. plastering or concreting) is already finished and the resulted dust is cleaned up properly.
- Remove the fibre protection cap of FC/APC connectors just before you connect the optical connector.
- Store the protection caps in a closable box that is absolutely dirt- and dust-free.
- After disconnecting a fibre, put a dirt- and dust-free protection cap into the connector in order to avoid dust contamination.
- Before connecting, we strongly recommend to clean the fibre. We recommend to use clean compressed air spray like e.g. 'Kontakt 334' or a special cleaning device like e.g. 'CLETOP' or 'one click cleaner'. Do not use compressed air produced by a standard air compressor, this air is not clean enough! If a dirty fibre (e.g. contaminated with dust) is connected to a LFTRX unit, the internal fibre of the LFTRX unit will be contaminated as well and you will get optical attenuation. In the worst case, the fibre-end might be irreparably damaged and has to

be replaced. **You always have to consider: optical attenuation causes a twice RF-signal attenuation!** So e.g. an optical attenuation of 2dB causes 4dB RF signal attenuation.

## 2.3 Mechanical installation

The *sat-nms* LFTRX enclosure provide mounting holes to fix it on an base plate. To ensure sufficient airflow for cooling the unit, we recommend to keep 30mm free space below and above the unit. If you have not enough space for meeting this requirement, call SatService to develop a suitable solution.

When planning the mechanical installation of the chassis, please consider that the connectors are placed at the front and the backside of the enclosure. Depending on the flexibility of the cables you are going to use, you will require about 10 centimetres space for cabling on both sides of the chassis.

## 2.4 Connecting the *sat-nms* LFTRX

The connectors of the enclosure are placed on the front and on the rear side. The rear side contains the fibre optic connectors, the front side contains the the corresponding RF In/Out connectors and also the the DC-power and Data-connector.





When you connect the L-Band Optical Link chassis, please consider the following:

- J1 *DC-Power Interface* is a standard 9-pin SUB-D socket-connector. This connector contains the alarm contacts of the internal failure open collector transistor, the signal monitor and the DC-Power Supply Input. To meet mentioned EMC standards, use double shielded twisted pair CAT7 S/FTP Network cable, e.g. DRAKA UC900 SS27 Cat.7 PUR. Take care, that cable shielding is connected properly.
- RF-In/ Out *RF-Interface* The input and output RF-connectors are all SMA/50Ohm female. Use double shielded coaxial cables, e.g. RG223, only.
- Optic TX/ RX *Optic-Interface* The fibre optic connectors are FC/APC types. It is essentially to use single mode cables with 8° angled polish for proper function.

### 2.4.1 DC and data connector

The Alarm and data connectors of the **sat-nms** LFTRX chassis are located at the front side of the enclosure up right. The figure below illustrates the location of the connectors and the pin out.

To meet mentioned EMC standards, use double shielded twisted pair CAT7 S/FTP Network cable, e.g. DRAKA UC900 SS27 Cat.7 PUR, for connecting network, serial and alarm interfaces. Ensure that the shield is connected properly.

#### DC Power Supply

The unit needs 9..24V DC at the corresponding pins of this interface. The LED *PS* shows the presence of the power supply.

#### Alarm

Open collector contacts represent a fault state of the unit. With solder jumper SJ1 and SJ2 the polarity of the alarm interface can be chosen (NC or NO at Alarm). The LED *LD* shows the status of the Laser Diode Alarm (green light means current is in the current limit range (10 to 45.5mA). The LED *PD* shows the status of the PIN Diode Alarm (green light means the optical level is above 220uW).

#### Monitoring



The laser diode (tx) monitoring point shows the actual laser diode current. 100mV relates to 10mA laser current against GND. The pin diode (rx) monitoring point shows the actual optical receive level. 100mV relates to 100uW optical input power against GND.

#### DC interface pin out

Pin	Alarm contacts (DSUB-9 male)	Description
1	NC	not connected
2	NC	not connected
3	NC	not connected
4	+9..24V / 260mA@12V	Power Supply Input. te .ts 5
7	TXAlarm	Open Collector max. 24VDC/50mA
8	RX Optical Monitor	100uW = 100mV
9	RXAlarm	Open Collector max. 24VDC/50mA

#### 2.4.2 RF connectors

On the front side the in-/ out RF-connectors are placed.

In the standard configuration all RF-connectors are SMA/ 50Ohm female connectors.

#### 2.4.3 Optical connectors

**ATTENTION: Optical Radiation!**



If connected to a power supply, the **sat-nms** LFTRX provides invisible laser radiation. The source is class 3R Laser diode as defined in DIN EN 60825-1:2001-11. P0=2mW, Lambda=1310nm. Never look into fibre-optical components like connectors or fibres. Use an infrared viewer, optical power meter or fluorescent screen for optical output verification.

FC/APC FOL-connectors are used. They are placed on the back side of the enclosure. Pay attention to the type of the connectors, only use single mode APC fibres with 8° angled polish. Otherwise the connectors or the fibres might be damaged.

Do not allow any dirt or foreign material to get into the optical connector bulkheads. This may cause damage to the polished optical connector end faces.

### 2.5 Line-up the Optical Links

Before lining up the optical links, you have to take care that the input signals do not exceed the

maximum levels (see [Specifications](#) on last page of this document)!

In the standard configuration you should have approx. 4dB gain over the whole optical link. Due to variance of laser- and receive-diodes you might have some gain-spreading between different links.

When connecting an occasional use antenna, point your dish to the satellite with the highest total power. This is to ensure not to generate a maximum level fault during normal operation.

## 3 Operation

The *sat-nms* LFTRX Optical Link is designed to be operated as stand-alone unit. The DC-Interface connector allows to read out some basic alarm and analog monitoring voltage. See chapter [DC and data connector](#) for a detailed description of the signals.

## 4 Remote Control

The *sat-nms* LFTRX Optical Link is designed to be operated as stand-alone unit. The DC-Interface connector allows to read out some basic alarm and analog monitoring voltage. See chapter [DC and data connector](#) for a detailed description of the signals.

## 5 Theory of Operation

The *sat-nms* L-Band optical transmitters and receivers were developed to cover all applications in the field of satellite communication, satellite ground stations, VSAT and cable networks.

### 5.1 Frequency bands

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While the fibre optical links were designed by SatService GmbH mainly for the transmission of the satellite L-Band frequency band (950 to 2150MHz) also a broadband version from 50MHz to 2150MHz is available. So this link type can also be used to transmit the traditional 70 or 140MHz IF bands of satellite ground stations and a microwave link. But also other terrestrial applications are feasible like the transmission of GSM signals in the 800 and 1800MHz frequency bands.

- *sat-nms* LFTRX-L --- 950 to 2150MHz
- *sat-nms* LFTRX-B --- 50 to 2150MHz
- *sat-nms* LFTRX-10 --- 10MHz only

The *sat-nms* LFTRX optical link is a broadband device and transmits transparently the complete RF spectrum from one site to the other. All modulation formats, whether they are analog or digital, can be transmitted transparently. The RF signal is directly modulated on to a high performance laser diode and adds no phase noise or frequency instability to the original signal. The result is a very good signal quality.

Due to the very stable design of the optical transmitter and receiver electronics there is no need for an Automatic Gain Control (AGC) within the circuits. So the link is compared to other vendor's solution really transparent.

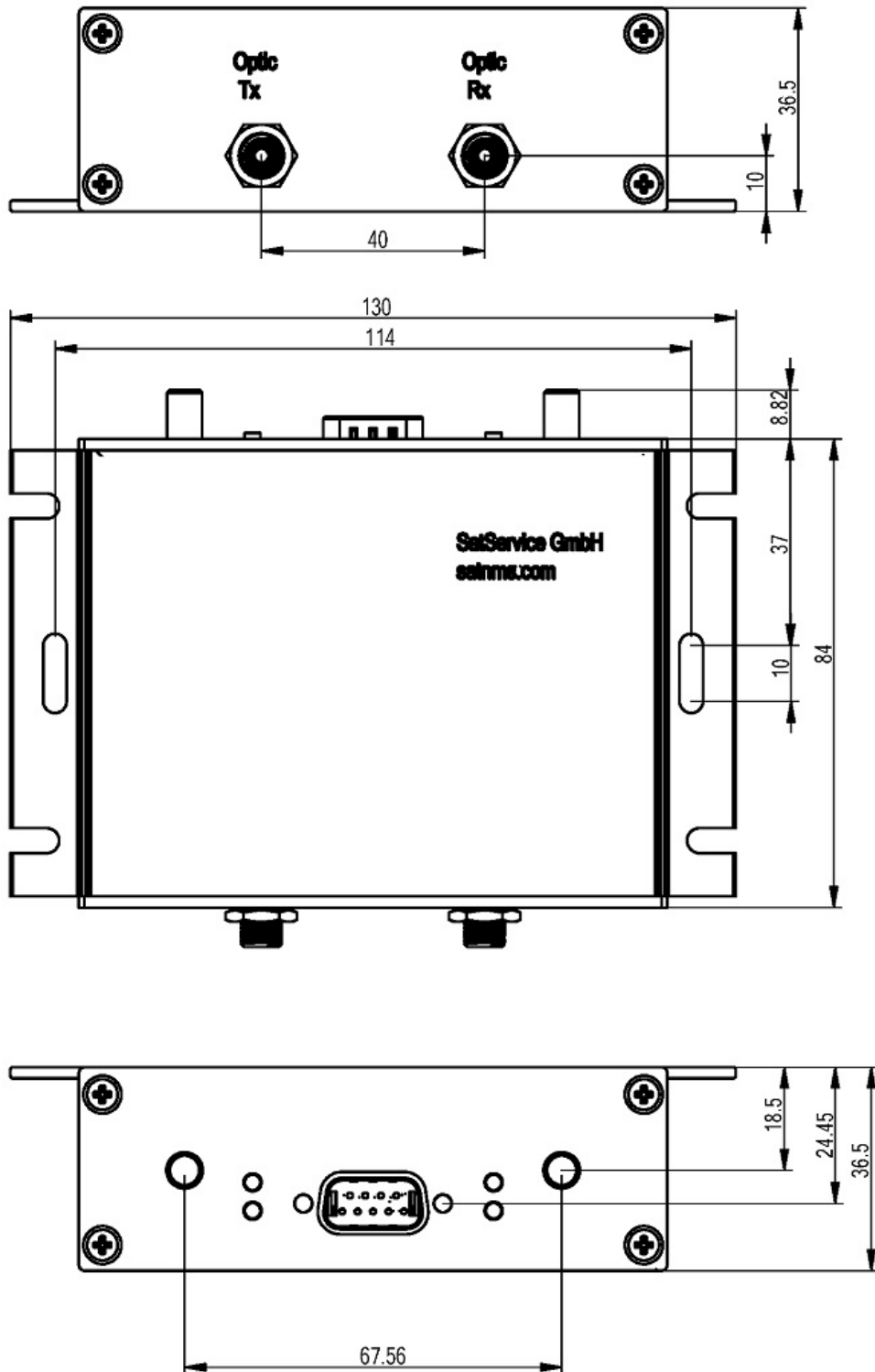
### 5.2 Connectors

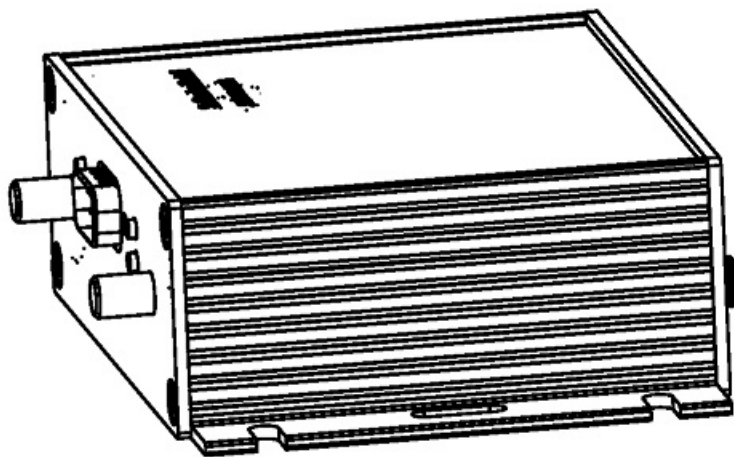
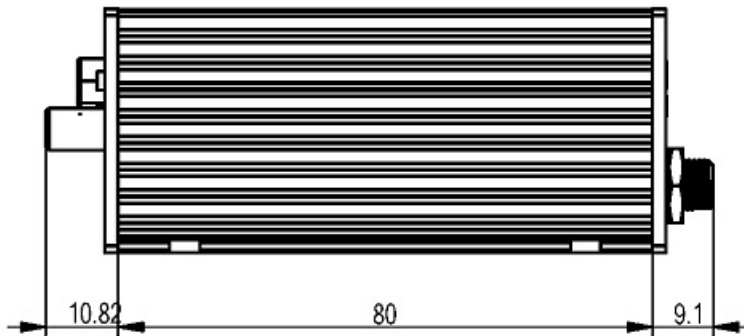
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For the optical interface SatService provides FC/APC connectors from Diamond or Huber &

Suhner by default.

### 5.3 Outline Drawing





## 6 Specifications

### RF Specification

Frequency range	50 to 2150MHz or 950 to 2150MHz or 10MHz only
L-Band Input Connectors (Transmitter)	SMA female 50Ohm
Input Return Loss	> 18dB
L-Band Output Connector (Receiver)	SMA female 50Ohm
Output Return Loss	> 18dB
Optical connectors	FC/APC 8°

Operating Wavelength	1310nm
Optical Output Power	2.2mW
Input Noise Figure	< 30dB@1500MHz
Gain	4dB +/-2dB@1500MHz
Flatness	+/-1.5dB@ 950-2150MHz +/-0.5dB@ 50-200MHz +/-0.25dB@ any 40MHz
Gain Stability	+/-0.25dB/ 24h
Input signal max	+10 dBm
Intermodulation at -5dBm Input Level per Carrier	<-45dBc@1500MHz

#### M&C Interface Specification

Summary Fault and Monitoring Interface	D-SUB 9 pin Connector
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#### Electrical and Mechanical Specification, Environmental Conditions

Temperature range storage	-40 to + 75°C
Supply voltage	9 to 24V, 260mA@12V
Temperature range operational	-25 to + 55°C
Humidity	up to 90% non condensing
Mechanical size of mainframe	130 x 36.5 x 100 mm (WxHxD)

