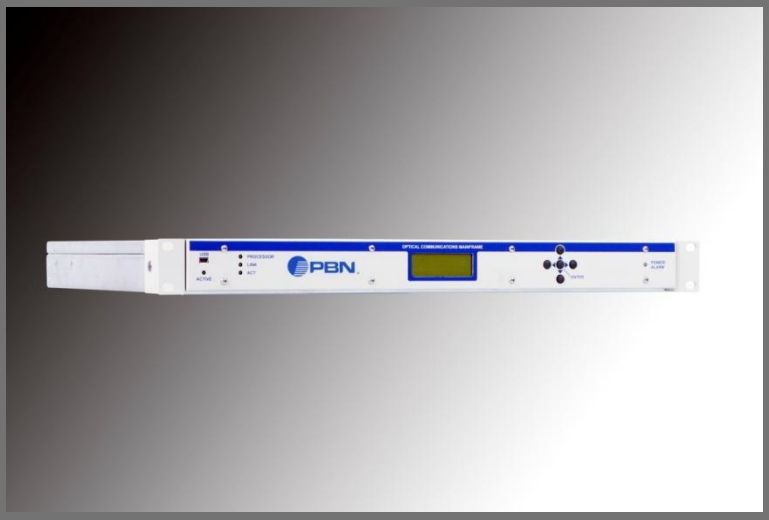
LT1310 / LT1550

Laser Transmitter with Return Path Receivers

Product User Manual



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Last update	19 September 2011
Document version	3a
Document reference	PBN.LT1310-1550 - Manual V3a - Released 19 Sep 11
Document status	Released
Prepared by	Pacific Broadband Networks
Prepared for	Product Users

Contents

1 Precautions

WARNING!

This equipment is intended for indoor applications. To prevent fire or electrical shock, or damage to the equipment, do not expose units to water or moisture.

- Ensure adequate cooling and ventilation as specified.
- The installation and operation manual should be read and understood before units are put into use.
- Always replace protective caps on optical connectors when not in use.
- The typical connectors fitted are SC/APC 8°. Note: 8° angle polished connectors must be used.
- Dangerous voltages are present within the unit at all times. **Mains power kills.**
- Do not operate unit without all covers and panels properly installed. **Mains power kills.**

Cleaning

Use only a damp cloth for cleaning front panel. Use a soft dry cloth to clean top of unit. Do not use spray cleaner of any kind.

Overloading

Overloading wall outlets and extension cords can result in a risk of fire or electric shock. Use approved electrical cords.

Damage requiring service

Unplug unit and refer servicing to Pacific Broadband Networks qualified service personnel only.

Servicing

Do not attempt to service this unit yourself. Refer all servicing to Pacific Broadband Networks qualified service personnel only.

WARNING!

Exposure to class 3R laser radiation is possible. Access should be restricted to trained personnel only. Do not view exposed fibre or connector ends when handling optical equipment.

2 Introduction

2.1 Overview

The LT1310 and LT1550 optical transmitters have been designed to provide optical transmission in the 1310 nm or 1550 nm wavelength range respectively. The transmitters employs high performance, thermally stabilised DFB low-chirp isolated lasers to transmit AM-VSB CATV or DVB QAM signals on a wavelength of 1310 nm or on one ITU frequency grid optical wavelength, within the 1550 nm range.

The LT1310 is designed to transmit optical broadband signals on a wavelength of 1310 nm with optical power output levels from 1 to 31 mW and a bandwidth of 45…1000 MHz.

The LT1550 operates with a bandwidth of 45 to 1000 MHz, with power output levels from 6 to 400 mW. The LT1550 suits single-mode optical fibres with or without dense wavelength division multiplexing (DWDM). The high-power transmitter (optical output power is from 20 mW to 400 mW) already includes erbium doped fibre amplifiers (EDFAM) internally. When combined with the optical splitter (OSP-19), it is suitable in short haul fibre-to-the-home (FTTH) applications with a maximum of up to 10 km of normal fibre or up to 30 km on 1550 nm dispersion-shifted fibres.

The provision of up to four optical return-path receivers permits easy integration with a CMTS, serving an entire small village or suburb with cable television and DOCSIS. There is also a configuration as a repeater by using a forward-path receiver module.

The LT1310 and LT1550 optical transmitters incorporate a comprehensive alarm and status monitoring system of all laser operating parameters such as DC laser bias current, cooler current and optical output power. These parameters are available for either local or remote-site monitoring.

Control features include laser shut down and manual or automatic gain control. This is controlled via the front panel keypad on the unit or managed remotely using PBN's network management system, NMS3.

2.2 Features

- High quality 1310 nm / 1550 nm distributed feedback (DFB) laser with cooler and isolator. Suits NTSC, PAL, DVB-C, DVB-T, and other standards.
- Separate broadcasting and narrowcasting input for easy DOCSIS CMTS integration.
- 45…1000 MHz forward-path RF amplifier with automatic gain control (AGC) for a constant optical modulation index (OMI).
- Self-contained 19” sub-rack 1 RU with integrated universal mains power supply.
- Lateral fan cooling permits the full use of all available rack space.
- Large backlit LCD display with keypad provides status monitoring and control.
- Options for up to 4 return-path receivers with pilot detection and FSK decoder for remote optical node status monitoring. Another option provides for configuration as a complete repeater, employing an FPRM-based forward-path receiver.
- Front-panel mounted USB craft port with optional Ethernet port on the rear panel for SNMP/HTTP network management.

2.3 Models and Options

Model number: LT1310-[W]-[X]-[Y]-[Z]

W Optical output power (mW)

01	1.6 mW (2 dBm)
02	2.5 mW (4 dBm)
04	4 mW (6 dBm)
06	6 mW (8 dBm)
08	8 mW (9 dBm)
10	10 mW (10 dBm)
13	13 mW (11 dBm)
16	16 mW (12 dBm)
20	20 mW (13 dBm)
25	25 mW (14 dBm)
31	31 mW (15 dBm)

X Receiver

0	transmitters only
FPR	with forward-path receiver
R1	with one return-path receiver
R2	with two return-path receivers
R3	with three return-path receivers
R4	with four return-path receivers

Y Optical connectors

SC	SC/APC optical connectors
E	E2000/APC optical connectors

Z NMS3 Network Management

0	with USB port only
SNMP	with USB port and Ethernet port for SNMP/HTTP network monitoring

> **Note:**
>
> Specific customer options may be available upon request.

Examples:

LT1310-08-0-SC-0

Laser transmitter 45~1000 MHz for 1310 nm with 8 mW optical output, with SC/APC optical connector.

LT1310-04-R1-E-0

Laser transmitter 45~1000 MHz for 1310 nm with 4 mW optical output, with one return-path optical receiver 5~200 MHz, with E2000/APC optical connectors.

LT1310-20-FPR-E-0

Laser transmitter 45~1000 MHz for 1310 nm with 20 mW optical output, with integrated forward-path receiver module 45~1000 MHz (configured as an optical line repeater), with E2000/APC optical connectors.

LT1310-16-R4-SC-SNMP

Laser transmitter 45~1000 MHz for 1310 nm with 16 mW optical output, with four return-path optical receivers 5~200 MHz, with SC/APC optical connectors, with SNMP/HTTP network management port and node status monitoring decoder.

Model Number: LT1550-[V-W]-[X]-[Y]-[Z]

V-W Optical output power (mW) and number of optical outputs

006-1	6 mW, one optical output (1 x 8 dBm)
006-2	6 mW, two optical outputs (2 x 4 dBm)
008-1	8 mW, one optical output (1 x 9 dBm)
010-1	10 mW, one optical output (1 x 10 dBm)
020-1	20 mW, one optical output (1 x 13 dBm) *
040-1	40 mW, one optical output (1 x 16 dBm) *
040-2	40 mW, two optical outputs (2 x 13 dBm) *
080-2	80 mW, two optical outputs (2 x 16 dBm) *
100-2	100 mW, two optical outputs (2 x 17 dBm) *
160-4	160 mW, four optical outputs (4 x 16 dBm) *
200-4	200 mW, four optical outputs (4 x 17 dBm) *
200-5	200 mW, five optical outputs (5 x 16 dBm) *
250-6	250 mW, six optical outputs (6 x 16 dBm) *
250-8	250 mW, eight optical outputs (8 x 15 dBm) *
320-8	320 mW, eight optical outputs (8 x 16 dBm) *
400-8	400 mW, eight optical outputs (8 x 17 dBm) *

X ITU grid channel (Optical wavelength) **

21	192.1 THz (1560.61 nm)
23	192.3 THz (1558.98 nm)
25	192.5 THz (1557.36 nm)
27	192.7 THz (1555.75 nm)
29	192.9 THz (1554.13 nm)
31	193.1 THz (1552.52 nm)
33	193.3 THz (1550.92 nm) ***
34	193.4 THz (1550.12 nm)
35	193.5 THz (1549.32 nm)

Y Optical connectors

SC	SC/APC optical connector
E	E2000/APC optical connector
FC	FC/APC optical connector (narrow key)

Z NMS3 Network Management

USB	USB port only ****
SNMP	USB port and Ethernet port for SNMP/HTTP network monitoring

** High power model of the LT1550, includes an EDFAM in bay 2.*

*** Refer to **Section 4.3.9** for ITU frequency plan. Not all wavelengths may be available at time of order. Contact PBN for details if a specific wavelength is required.*

**** Default wavelength if none is specified by customer.*

***** Units without SNMP option only available to special production orders. Minimum order volumes apply.*

3 Installation

3.1 Equipment Inventory

On receiving your new laser transmitter, you should carefully unpack and examine the contents for loss or damage that may have occurred during shipping. Refer to warranty registration if loss or damage has occurred. The LT1310 / LT1550 should consist of the following:

Qty	Description
1	LT1310 or LT1550 module
1	USB Craft utilities software CD
1	USB cable
1	Product user manual (includes individual test sheet)
1	Warranty registration certificate

3.2 Packaging and Transportation

Keep all packing boxes and packaging of the unit for future transport.

Use only the original packaging when transporting. This packaging has been specifically designed to protect the equipment.

3.3 Power and Cooling Requirements

The laser transmitter requires an input of 90 Vac to 264 Vac at 50 Hz to 60 Hz. Depending on model options the unit may consume up to 220 W. The mains input socket on the unit is IEC configuration. Overload and over-voltage protection is included in the unit, which may cause it to shut down in extreme circumstances. If this occurs, remove the fault condition and the system will recover automatically.

The unit should be located in an environment not exceeding a temperature range from 0...45 °C. The internal temperature (parameter P06) should never reach 70 °C.

Should the temperature exceed the above limits, the unit should be relocated in the equipment rack where the ambient temperature will be less than 45 °C.

Horizontal, fan-forced airflow permits the mounting of multiple laser transmitters without the need for a 1 RU rack space clearance between other devices, thus maximising rack space at the headend location. Ensure adequate space behind the unit for ventilation as air flow is through the back of the unit.

3.4 Unit Installation and Adjustment

The laser transmitter can be mounted in a standard 483 mm (19”) wide, 600 mm deep rack (IEC297 compliant). Do not place the transmitter near any strong RF radiation or in-line transients capable of damaging the unit. The unit should be mounted in a rack giving access to the front and rear of the unit.

3.4.1 Laser Transmitter Setup

To ensure long term reliability, clean all optical connectors and record optical output levels for future reference. The performance of the optical transmitter is very dependent on the RF input level to the unit.

Suggested RF input levels to increase CNR for low channel loading (assumes initial factory setting of modulation adjust unchanged).

Channel Loading	RF Input Level / Channel	Test Point RF Level / Channel
8	34 dBmV	Recorded COP level +6 dB
16	31 dBmV	Recorded COP level +3 dB
42	25 dBmV	Recorded COP level
64	22 dBmV	Recorded COP level -3 dB

Connect your RF input signal to the main RF input at the rear of the unit.

Connect your auxiliary RF input to the auxiliary RF port (digital) if applicable; otherwise terminate this port with a 75 Ω terminator.

If the laser is not on, you will have to activate the laser and check that the output power is as specified in the LT1310 / LT1550 Certificate of Performance (COP). To activate the laser, set CONTROL1. See **Section 5.4.1**.

Note:

The transmitter should be energised for approximately 10 minutes in order to reach operating temperature before final system alignment commences.

Set the number of channels used in the system. See **Section 5.4.6**.

Set the transmitter to AGC mode. See **Section 5.4.3**.

Verify that no alarm conditions exist via the user interface.

Note:

For return path operation of DOCSIS upstream transmission or any other “bursty” digital return path signals, the unit should be operated in MGC mode.

3.4.2 Forward Path Receiver Setup

1. Always terminate all unused RF ports with 75 Ω F-type terminators.
2. Ensure that the optical input signal level is within -5…+2 dBm.

> **CAUTION:**
>
> **Never apply optical power greater than this into the Forward Path Receiver. Measure the optical input power before connecting.**

3. Connect the optical input signal to the rear OPTICAL INPUT connector of the receiver. This will cause the optical input indicator LED to change from red to green.
4. The receiver should be energised for approximately 1 minute in order to reach operating temperature before system alignment commences.
5. Under normal operating conditions the factory set adjustments should provide optimum system performance for a 42 channel system with an optical input of 0 dBm and a 4 % optical modulation index (OMI). For a different channel loading of your system you may have to change the number of channels specified at parameter 23.

For the following steps refer to Section 5.5.

6. Set the gain control for MGC or AGC.
7. Set the number of channels in the system.
8. Set the slope control for in-line equalisation of the system.
9. Set the analogue MGC level if operating in MGC mode.

3.4.3 Return Path Receiver Setup

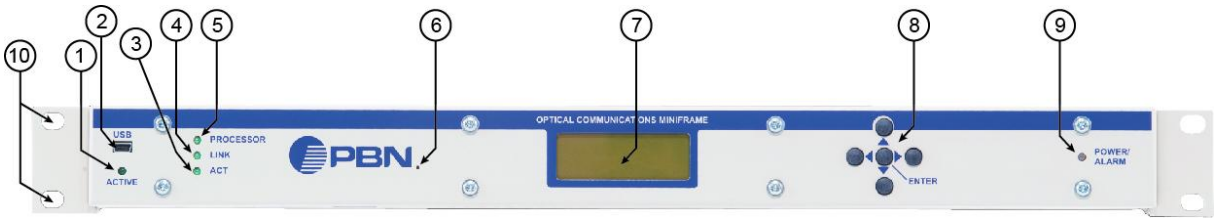
1. Ensure that the optical input power is within -10...+3 dBm.
2. Connect your optical input signal(s) to the optical inputs at the rear of the transmitter unit.
3. Connect your RF output cables to the outputs at the rear of the transmitter unit.
4. Enable the receiver. See **Section 5.6.3**.
5. Enable status monitoring for channels that are to be monitored. See **Section 5.6.4**.
6. Set the appropriate channels to AGC / MGC mode. See **Section 5.6.5**.
7. Set the analogue MGC mode level if operating in MGC mode. See **Section 5.6.6**.
8. Verify that no alarm conditions exist via the user interface.

3.4.4 LT1550 High Power Model Setup

Due to Laser Safety precautions, the Erbium Doped Fibre Amplifier (EDFAM) inside the LT1550 is shipped with the output power switched OFF, (i.e. SHUT DOWN).

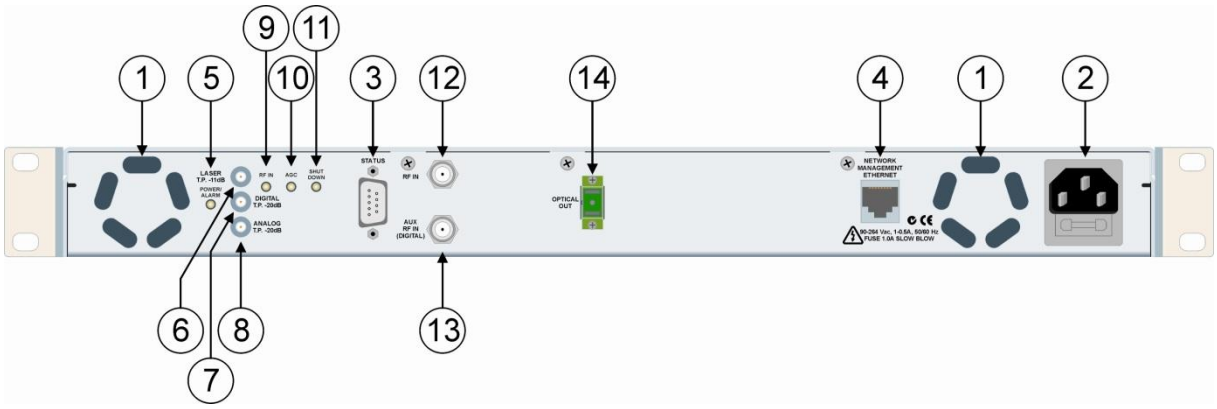
The user will have to activate the EDFAM via CONTROL1; refer to **Section 5.7.1**.

3.5 Front Panel



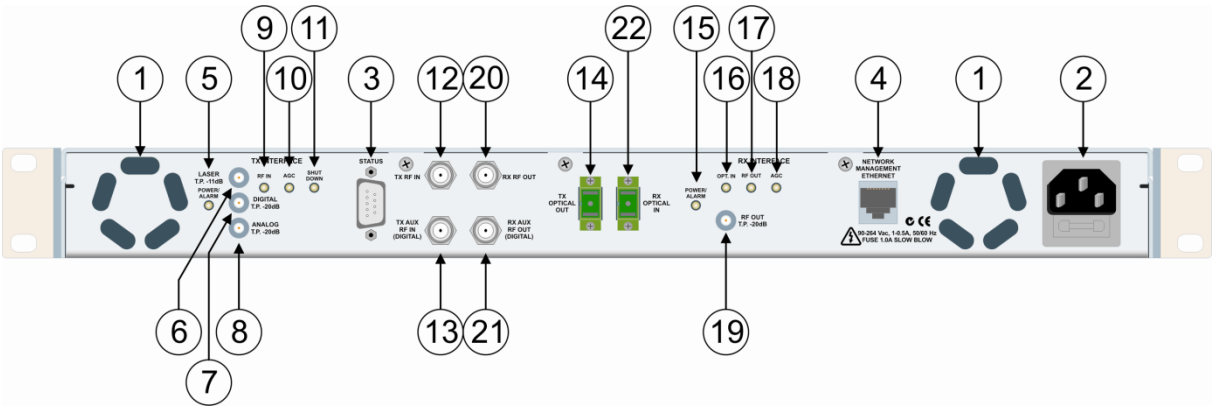
Item	Description	
1	ACTIVE	LED indicator will flash during active data transmission on USB port
2	USB	Serial port for local terminal connection
3	ACT	LED indicator will flash during active data transmission on Ethernet port
4	LINK	LED indicator will remain ON while an Ethernet connection is present
5	PROCESSOR	LED indicator will blink during normal operation, If LED remains ON or does not blink, this indicates a fault with the CPU
6	RESET	Reset button for SNMP agent
7	LCD	LCD to display user interface
8	KEYPAD	Keypad for navigating menus and making selections with the user interface
9	POWER / ALARM	Unit alarm status LED
		GREEN — No alarm detected
		AMBER — Non-urgent alarm detected
		RED — Urgent alarm detected
10	1 RU MOUNTING	Mounting holes for installation in rack

3.6 Rear Panel (no receivers or no EDFA)



Item	Description	
1	FAN	Fan vent
2	IEC SOCKET	Mains input socket
3	STATUS (TX)	DE9 female, refer to **Section 3.10** for details
4	ETHERNET	RJ-45 Ethernet connection for SNMP option
5	POWER/ALARM (TX)	Power / alarm summary indicator for transmitter
6	LASER T.P. -11dB	-11 dB RF test point of RF input to drive the laser
7	DIGITAL T.P. -20dB	-20 dB RF test point of digital channel input
8	ANALOG T.P. -20dB	-20 dB RF test point of analogue channel input
9	RF IN LED	RF input indicator GREEN — RF power is present AMBER — RF power is too low RED — RF power is too high
10	AGC LED	AGC indicator, mode of AGC operation GREEN — AGC locked AMBER — AGC not locked GREEN FLASH — MGC mode
11	SHUTDOWN LED	Laser shutdown status indicator GREEN — Laser is active AMBER — Laser is deactivated
12	TX RF IN	Main RF input port (analogue channel)
13	TX AUX RF IN	Auxiliary RF input port (digital channel)
14	TX OPTICAL OUT	Transmitter optical output port

3.7 Rear Panel (forward path receiver) for LT1310



Item	Description		
1	FAN	Fan vent	
2	IEC SOCKET	Mains input socket	
3	STATUS (TX)	DE9 female, refer to **Section 3.10** for details	
4	ETHERNET	RJ-45 Ethernet connection for SNMP option	
5	POWER/ALARM (TX)	Power / alarm summary indicator for transmitter	
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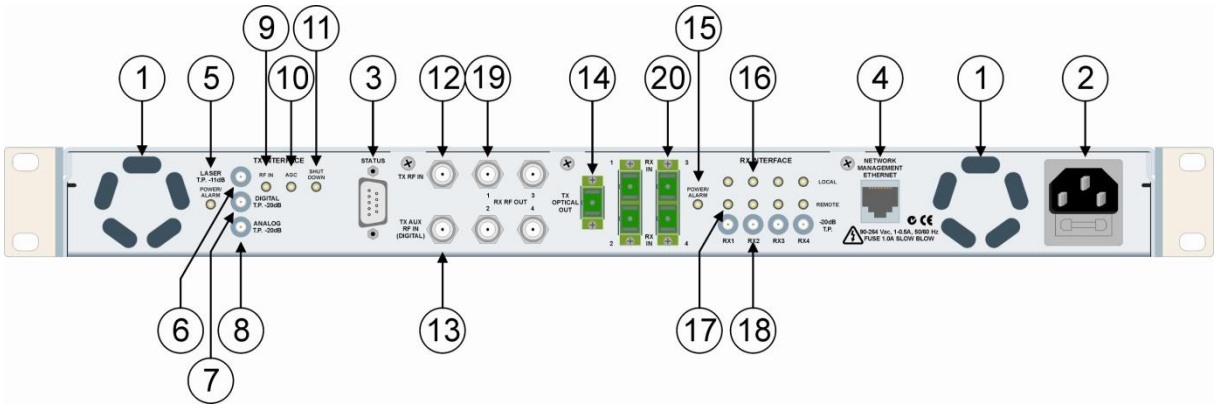
8	ANALOG T.P. -20dB	-20 dB RF test point of analogue channel input	
9	RF IN LED	RF input indicator	
		GREEN	RF power is present
		AMBER	RF power is too low
		RED	RF power is too high
10	AGC LED	AGC indicator, mode of AGC operation	
		GREEN	AGC locked
		AMBER	AGC not locked
		GREEN FLASH	MGC mode
11	SHUT DOWN LED	Laser shutdown status indicator	
		GREEN	Laser is active
		AMBER	Laser is deactivated
12	TX RF IN	Main RF input port (analogue channel)	
13	TX AUX RF IN	Auxiliary RF input port (digital channel)	
14	TX OPTICAL OUT	Transmitter optical output port	

Item	Description		
15	POWER/ALARM (RX)	Power / alarm summary indicator for receiver	
16	OPT. IN LED	Optical input level indicator	
		GREEN	Optical level is within range
		AMBER	Optical level is too low
		RED	Optical level is too high
17	RF OUT LED	RF modulation indicator	
		GREEN	RF modulation is present
		AMBER	No RF modulation
18	AGC LED	Automatic gain control indicator	
		GREEN	AGC active
		AMBER	MGC active
		FLASH	RF level out of range (AGC mode)
19	RF OUT T.P. -20dB	RF test point for –20 dB from main output	
20	RX RF OUT	Main RF output	
21	RX AUX RF OUT	Auxiliary RF output	
22	OPTICAL IN/OUT	Optical port, SC/APC connector default	

3.8 Rear Panel (4 return path receiver option) for LT1310



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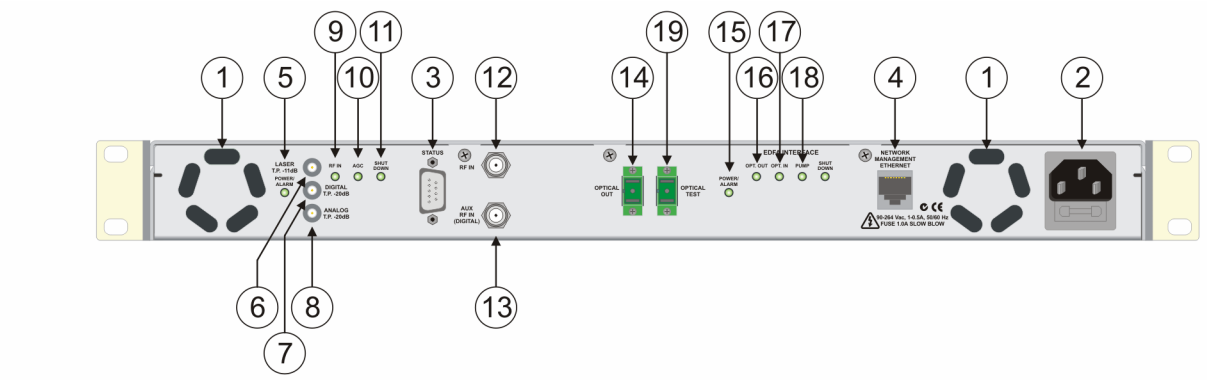
8	ANALOG T.P. -20dB	-20 dB RF test point of analogue channel input	
9	RF IN LED	RF input indicator	
		GREEN	RF power is present
		AMBER	RF power is too low
		RED	RF power is too high
10	AGC LED	AGC indicator – mode of AGC operation	
		GREEN	AGC locked
		AMBER	AGC not locked
		GREEN FLASH	MGC mode
11	SHUT DOWN LED	Laser shutdown status indicator	
		GREEN	Laser is active
		AMBER	Laser is deactivated
12	TX RF IN	Main RF input port (analogue channel)	
13	TX AUX RF IN	Auxiliary RF input port (digital channel)	
14	TX OPTICAL OUT	Transmitter optical output port	
15	POWER/ALARM (RX)	Power / alarm summary indicator for receiver	
16	LOCAL (LEDs) (RX1…RX4)	Local receiver (1…4) status alarm summary indicator	
17	REMOTE (LEDs) (RX1…RX4)	Remote node (1…4) status/alarm summary indicator	
18	-20 dB, T.P. (RX1…RX4)	-20 dB RF test point for receivers (1…4)	
19	RX RF OUT 1…4	RF output, 1 port per receiver stage	
20	RX OPTICAL IN	Optical input connectors, (1…4) receiver inputs	

3.9 Rear panel (with EDFA) for high power LT1550



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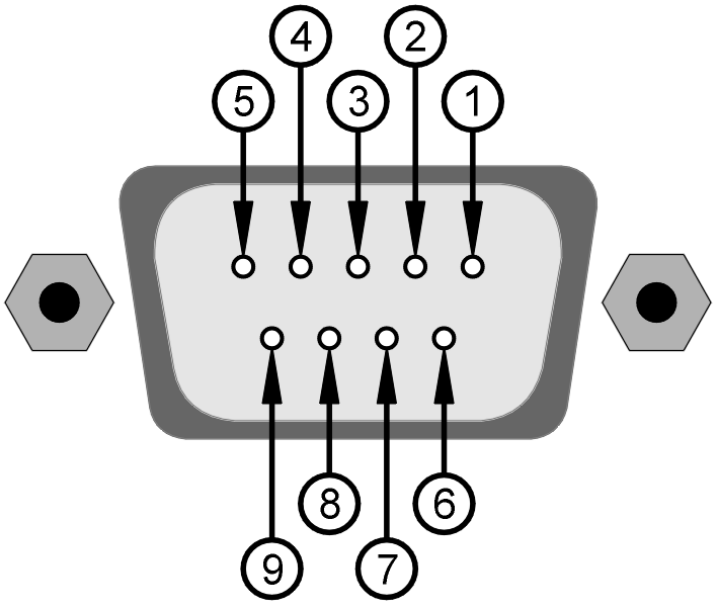
11	SHUTDOWN LED	Laser shutdown status indicator GREEN — Laser is active AMBER — Laser is deactivated
12	TX RF IN	Main RF input port (analogue channel)
13	TX AUX RF IN	Auxiliary RF input port (digital channel)
14	TX OPTICAL OUT	Transmitter optical output port
15	POWER/ALARM (RX)	Power / alarm summary indicator for receiver

Item	Description		
16	OPT.OUT LED	Optical output level indicator	
		GREEN	Optical level is within range
		AMBER	Optical level is too low
		RED	Optical level is too high
17	OPT.IN LED	Optical input level indicator	
		GREEN	Optical level is within range
		AMBER	Optical level is too low
		RED	Optical level is too high
18	PUMP LED	EDFA pump status indicator	
		GREEN	Pump lasers operating OK
		RED	Pump laser alarm
19	OPTICAL TEST	Test point for internal optical laser raw power	

3.10 Status Output



Please note that pins 1, 2, 3 and 6 are un-buffered ports, and are reserved for interface to PBN equipment.

PIN	Description
1	RF modulation power (0…5 Vdc)
2	Laser temperature (0…5 Vdc)
3	Laser power (0…5 Vdc)
4	Not used
5	Signal ground
6	Laser bias current (0…5 Vdc)
7	Not used
8	+TTL input for external laser shut down
9	-TTL input for external laser shut down
SHIELD	Earth

Note:

The status port provides monitoring only of the laser transmitter; it does not provide any information related to the receiver(s).

4 Technical Description

4.1 Overview

The LT1310 / LT1550 essentially packages two separate modules available from PBN with a power supply and control and communication circuitry. The functionality of this unit is comparable to an LTM13 / LTM15 (Laser Transmitter Module) and an FPRM (Forward Path Receiver Module), an RPQRM (Return Path Quad Receiver Module), or an EDFAM (Erbium Doped Fibre Amplifier Module) installed inside an OCMR (Optical Communications Mainframe Chassis).

4.2 Physical Description

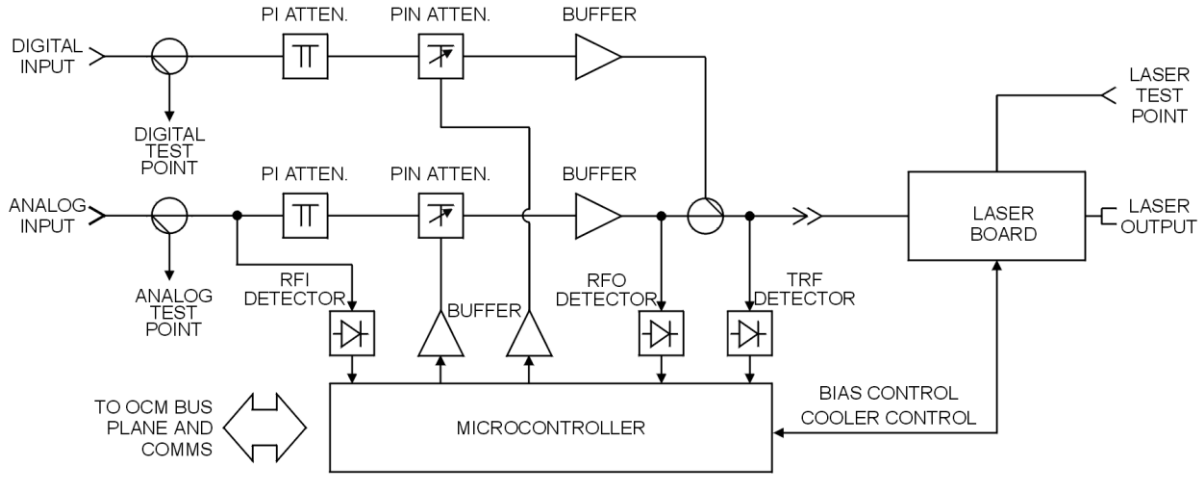
This is a family of products that share a similar physical layout. Each consists of a self-contained 19” sub-rack (1 RU) with integrated universal mains power supply.

The LT1310 / LT1550 are self-contained units. However, for the purpose of user control, each unit is considered in three segments. The control and communications section occupies Bay 0, the laser transmitter Bay 1 and the return path receiver, forward path receiver, or fibre amplifier in Bay 2. For more information on software operations refer to **Section 5**.

4.3 Laser Transmitter

4.3.1 General

The laser transmitter consists of 3 main sections. The first section is the power and data interface. The second is the microcontroller section which monitors and controls the various functions of the transmitter module and integrates this with the user interface. The third is the RF and optical sections which make up the optoelectronics of the module for transmission of broadband signals over fibre optics.



4.3.2 Optical Section

The laser transmitter uses a thermally-stabilised DFB laser to transmit signals over a single-mode optical fibre. The standard forward-path transmitter may have an in-built pre-distortion circuit which allows the transmission of optical broadband signals of up to 110 channels with exceptionally low distortion characteristics. Precision circuitry allows for constant optical output power, controlled laser bias current and thermoelectric cooler current (TEC) for laser temperature control.

The feedback circuits are used by the CPU to give true readings (to within ± 10%) of the optical output power, laser bias current, TEC and laser temperature.

4.3.3 Radio Frequency Section

The transmitter has two RF input ports. The main and auxiliary ports, also termed analogue and digital respectively, accept signal frequencies in the range of 45…1000 MHz, at a nominal input of 25 dBmV per channel. The transmitter can handle an input range of a single channel at 20 dBmV up to 64 channels at 35 dBmV/ch (equivalent level of a single channel at 53 dBmV).

The digital channel provides basic processing allowing the signal to be attenuated under manual control only. This channel is then merged with the analogue channel and the combined signal is fed to the laser board.

The analogue channel provides the same basic processing as the digital channel with the addition of AGC capability, a wider window of operation and the monitoring of RF levels. The monitoring of RF levels is at the input and also at the amplified output, just prior to it being combined with the digital channel.

There are three RF test points at the rear of the module. These are the analogue input at -20 dB, digital input at -20 dB and RF input to laser at -11 dB.

Most levels are monitored by the in-built CPU and displayed in two pages of up to 32 parameters each.

4.3.4 RF Detection and Reading of Parameters P10, P11 and P12

The laser transmitter has three readings of RF levels as displayed at parameters P10, P11 and P12. For details on reviewing these parameters refer to **Section 5**. These levels are:

P10	***ERF***	Total RF power modulating the laser, in dBmV/ch *(Analogue and digital channels combined, correct reading is dependent on P28, number of channels set by user)*
P11	***RFI***	RF input power, analogue channel only, in dBmV *(Channel number is independent. Refer to formula below)*
P12	***RFO***	RF output power of analogue channel prior to combining with digital channel, in dBmV *(Channel number is independent. Refer to formula below)*

Total RF power, ERF is the combined analogue and digital channels which modulate the laser.

The analogue channel portion of the total RF signal is basically the RF output level (RFO) from the gain control stage. It is this detected level, together with the detected RF input level (RFI), which determine the action of the AGC circuits.

Parameters P11 and P12 read the total RF power referenced back to a single channel. To translate these numbers to the real value per channel, use the following:

Real Value (dBmV/ch) = M – 10 x log(N)

where M is the reading at parameters P11 or P12, and N is the number of channels through the analogue channel.

Example:

M for P11 reads 40 dBmV. Number of channels in the system is 42 channels. Hence:

Real Value (dBmV/ch) = **40** - 10 x log (**42**)

= 40 - 16

= **24 dBmV/ch**

> **Note:**
>
> This will be valid only if the number of channels through the analogue channel is greater than 4.

4.3.5 Analogue Channel - MGC / AGC Operation

The main channel (or analogue channel) can operate in MGC mode and AGC mode. The gain on this signal is determined by the analogue MGC setting (ANMGC) as set in parameter P26. Refer to **Section 5.4.4** – Set Analogue MCG Level, for programming.

The table below shows the relationship between the setting at ANMGC, the gain and the available range for AGC action when set.

The AGC operation ensures that the main RF channel provides a constant RF signal to drive the laser. This will in turn result in obtaining the best performance from the optical transmitter module.

On selecting AGC mode of operation, the CPU will store the last detected level at RF Operation. This stored level will serve as the reference to be maintained for AGC action.

For example when in MGC mode with the RF input level set at 25 dBmV/ch at 42 channels, upon activation of AGC, the CPU will maintain this laser drive level constantly - as long as the RF input is within 18…40 dBmV/ch. Outside of this range, the AGC action will not hold.

ANMGC setting	Gain	Input range for AGC
99	+4 dBr	0…+22 dB
40 (factory set)	-4 dBr	-7…+15 dB
01	-19 dBr	-22…0 dB

Note:

Input range is referenced back to the original input level as set when AGC action was selected.

4.3.6 Digital Channel - MGC operation

The auxiliary channel (or digital channel) only operates in MGC mode. The gain on this signal is determined by the digital MGC setting (DGMGC) as set in parameter P27. The factory default setting for DGMGC is 60. Refer to **Section 5.4.5** – Set Digital MGC Level, for programming.

The table below shows the relationship between the setting at DGMGC and the gain available.

DMGC setting	Gain
99	+1.5 dBr
60 (factory set)	-4 dBr
01	-15 dBr

The digital channel is intended for auxiliary input of less than four channels or downstream DOCSIS applications. It is for this reason that the digital path does not have AGC capability.

Input levels for downstream DOCSIS in the range of -10 dBc -6 dBc relative to the level of the analogue carriers are recommended - for example QAM64 at 10 dB from analogue carriers and QAM256 at -6 dB from analogue carriers.

Reference: DOCSIS Radio Frequency Interface Specification, SP-RFIv1.1-106-001215, Section 2.4.

4.3.7 Optical Modulation Index (OMI), Parameter P09

The unit also reads the OMI of the transmitter. This reading is directly related to the laser drive level as ERF (parameter P10) and the number of channels set at P28.

The following table indicates the expected OMI reading for values of ERF.

ERF reading (dBmV)	OMI
18.00	1.8%
19.00	2.0%
20.00	2.2%
21.00	2.5%
22.00	2.8%
23.00	3.2%
24.00	3.5%
25.00	4.0%
26.00	4.5%
27.00	5.0%
28.00	5.6%
29.00	6.3%
29.50	6.7%
30.00	7.1%
31.00	7.9%
32.00	8.9%
33.00	10.0%
34.00	11.2%
35.00	12.6%

Note:

Reading is dependent on the correct setting of the number of channels in your system.

The module has been factory set for optimum performance with an RF input of 25 dBmV/ch. This in turn determines the modulation level that will achieve the best compromise between Carrier to Noise Ratio (CNR) and the distortion levels of Composite Second Order (CSO) and Composite Triple Beat (CTB).

Increasing the RF level into the optical transmitter will yield a better CNR but will result in poorer CSO and CTB distortion.

4.3.8 Microcontroller Section

The transmitter incorporates an internal computer which monitors the module and conveys data to and from the user interface. The data is listed in two pages of up to 32 parameters each. The data includes model, serial numbers, RF levels, laser operating parameters, as well as voltages, currents and other relevant data.

The user interface will automatically display urgent alarm conditions and maintain real-time monitoring of all parameters corresponding to the module.

4.3.9 ITU Frequency Grid - LT1550 Wavelength Options

The following table contains the ITU frequency plan with corresponding wavelengths available to the LT1550. The order code used in our model number must specify the desired channel.

Example: LT1550-[V-W]-33-[Y]-[Z]

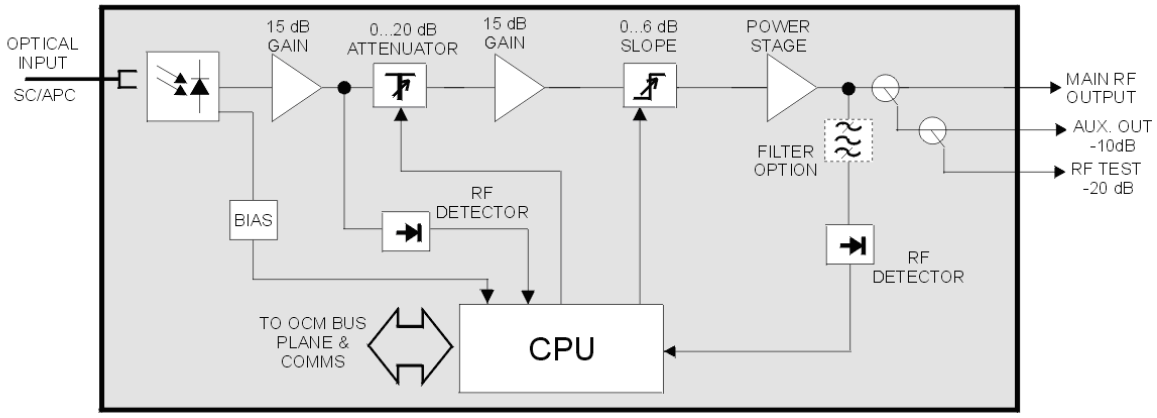
i.e. as shown below, this order code indicates Channel 33, 193.3 THz, 1550.92 nm.

Channel	ITU Freq. (THz)	Avail. ITU W'lengths (nm)	Channel	ITU Freq. (THz)	Avail. ITU W'lengths (nm)
Order Code			*Order Code*		
60	196.0	1529.55	**40**	194.0	1545.32
59	195.9	1530.33	**39**	193.9	1546.12
58	195.8	1531.12	**38**	193.8	1546.92
57	195.7	1531.90	**37**	193.7	1547.72
56	195.6	1532.68	**36**	193.6	1548.51
55	195.5	1533.47	**35**	193.5	1549.32
54	195.4	1534.25	**34**	193.4	1550.12
53	195.3	1535.04	**33**	193.3	1550.92
52	195.2	1535.82	**32**	193.2	1551.72
51	195.1	1536.61	**31**	193.1	1552.52
50	195.0	1537.40	**30**	193.0	1553.33
49	194.9	1538.19	**29**	192.9	1554.13
48	194.8	1538.98	**28**	192.8	1554.94
47	194.7	1539.77	**27**	192.7	1555.75
46	194.6	1540.56	**26**	192.6	1556.55
45	194.5	1541.35	**25**	192.5	1557.36
44	194.4	1542.14	**24**	192.4	1558.17
43	194.3	1542.94	**23**	192.3	1558.98
42	194.2	1543.73	**22**	192.2	1559.79
41	194.1	1544.53	**21**	192.1	1560.61

4.4 Forward Path Receiver

4.4.1 Overview

The forward path receiver consists of 3 basic sections being optic, radio frequency and micro-controller sections as described below. Its user interface is via the control keypad to directly monitor the various parameters as listed in **Section 5**.



Receiver section block diagram

The forward-path receiver incorporates the latest wide-bandwidth photodiode. This photodiode receives the optical signal and provides the equivalent electrical signal to a microprocessor-controlled PIN attenuator. The PIN attenuator has an adjustable range of 0…18 dB and may be user defined for AGC or MGC. The signal then passes through a microprocessor-controlled slope adjustment with a 0…6 dB range for line equalisation.

The linear RF amplifier provides a gain of 12 dB with minimal noise contribution to the power doubling, broadband amplifier. The output of this final gain stage is supplied at the main RF output, F-type female connector on the rear panel. Part of the signal is tapped at -10 dB to provide an auxiliary RF output and another at -20 dB as the RF test point. The main signal is tapped and taken to an RF detector circuit to provide feedback for the gain-control circuit.

4.4.2 Optical Section

The forward-path receiver uses a thermally-stabilised photodiode module with trans-impedance amplifier to generate a wideband, low-noise and low-distortion RF signal. The detector operates from 1300 nm to 1610 nm from a single-mode optical fibre connection. The optical input power range is 5…+2 dBm. Outside of this range the unit will indicate an alarm condition.

4.4.3 Radio Frequency Section

The main radio frequency (RF) path has a bandwidth of 45…1000 MHz. The RF signal is provided at the output of the trans-impedance amplifier stage to the PIN attenuator. A variable attenuation range of 0…18 dB and an in-line slope control of 0…6 dB is user-controllable via the user interface or NMS software.

A highly linear RF pre-amplifier provides a 12 dB gain followed by the low-noise, low-distortion broadband power doubling amplifier. This signal is then available at the main RF output on the rear panel. A 10 dB directional coupler taps off the main RF path to provide the auxiliary output and another at -20 dB for the RF test point.

There is an RF detector circuit which detects the total output RF power. The microprocessor control circuit uses this level to achieve automatic gain control (AGC).

4.4.4 Micro-controller Section

The receiver incorporates an internal processor that monitors the receiver and conveys data for user control. The keypad control and LCD allow the user to select and display information such as model, serial numbers, voltages, currents and other relevant data.

The processor has predetermined limits for certain parameters and will automatically register an urgent or non-urgent alarm for that parameter if the monitored value exceeds these limits.

4.4.5 Automatic Gain Control (AGC) and Manual Gain Control (MGC)

The factory settings for the forward-path receiver are to provide an RF output of 44 dBmV per channel, in a 42 channel system when applying 0 dBm of optical signal with 4 % OMI.

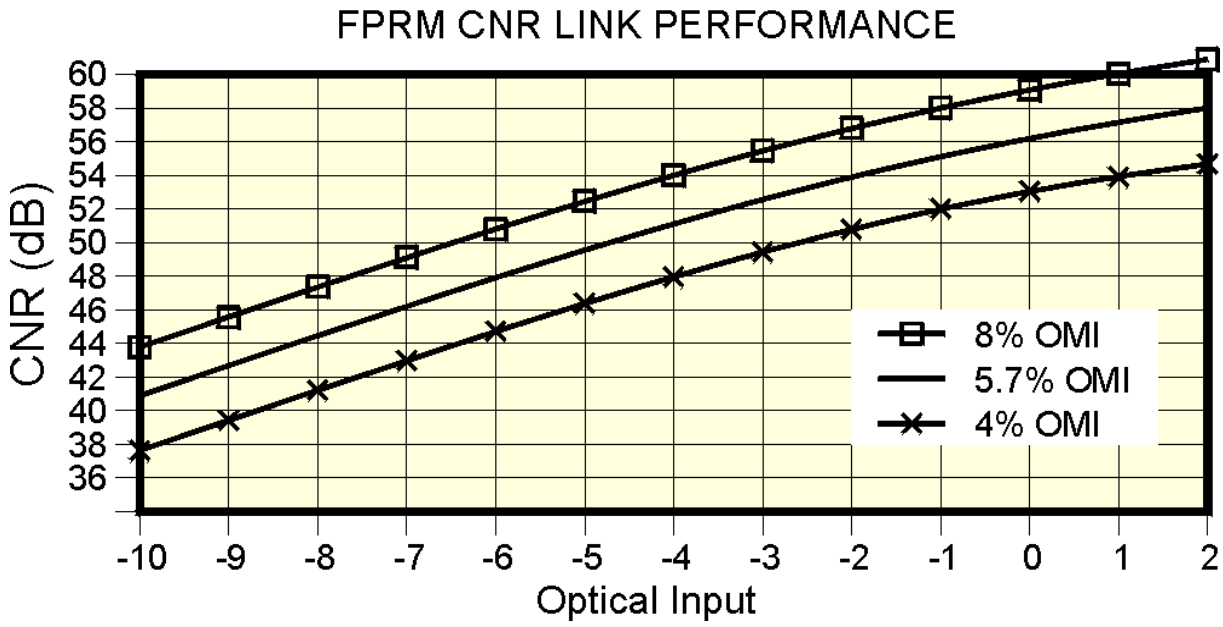
The optical receiver will maintain its AGC level for up to a ± 3 dB of optical variance or ± 6 dB of RF variance. This also takes into account the variance in channels within the system (up to 110 channels).

The receiver may be switched to manual gain control mode as described in **Section 5.5.1**.

> **Note:**
>
> When the receiver is switched on, it will check the optical signal at the input. If there is no signal (e.g. fibre is disconnected or laser transmitter is switched off) the unit will switch to MGC mode and continue to check the optical input until it is reconnected. The unit will then resume its state of operation before it was switched off.

4.4.6 CNR vs. Optical Power

CNR is dependent on the modulation index per channel, with 4% being standard. For a typical system where less than the maximum number of channels is being transmitted, a higher modulation index may be used to obtain maximum CNR as shown; however maximum output must be reduced accordingly.



Note:

Based on PBN LTM13 series optical transmitter, 10km single mode fibre, 0dBm receiver input at 1310 nm with 4% OMI. For 1550 nm performance, add 1 dB to CNR.

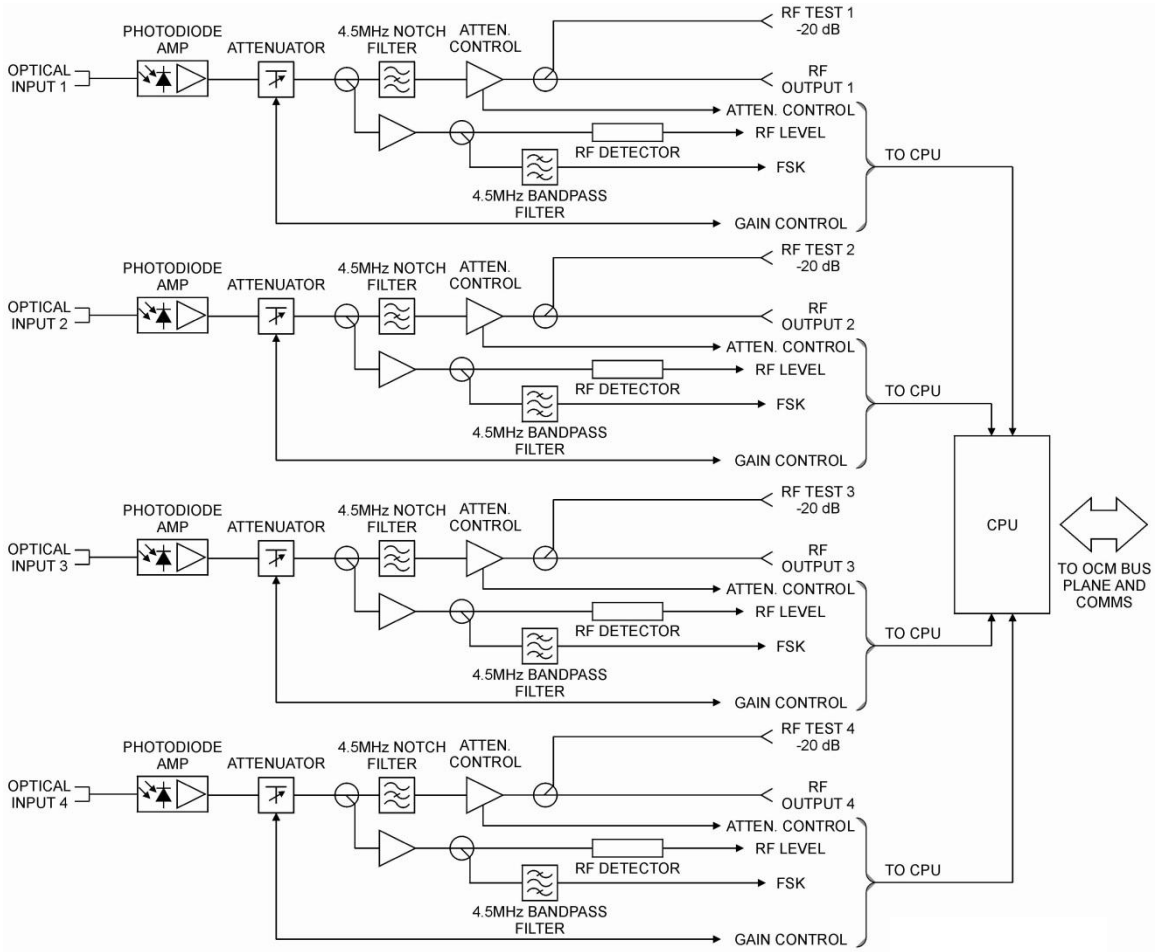
4.5 Return Path Receiver

4.5.1 Overview

The return-path receiver has been primarily designed to maximise receiver density within a compact system. The powerful functionality of the LT1310 / LT1550 gives the user full network management capability, hence not only managing the forward transmission network, but also the return-path network. Up to four independent optical receiver stages are supported, each being converted into an electrical signal and processed individually.

4.5.2 Optical RF Converter Module (ORFCM)

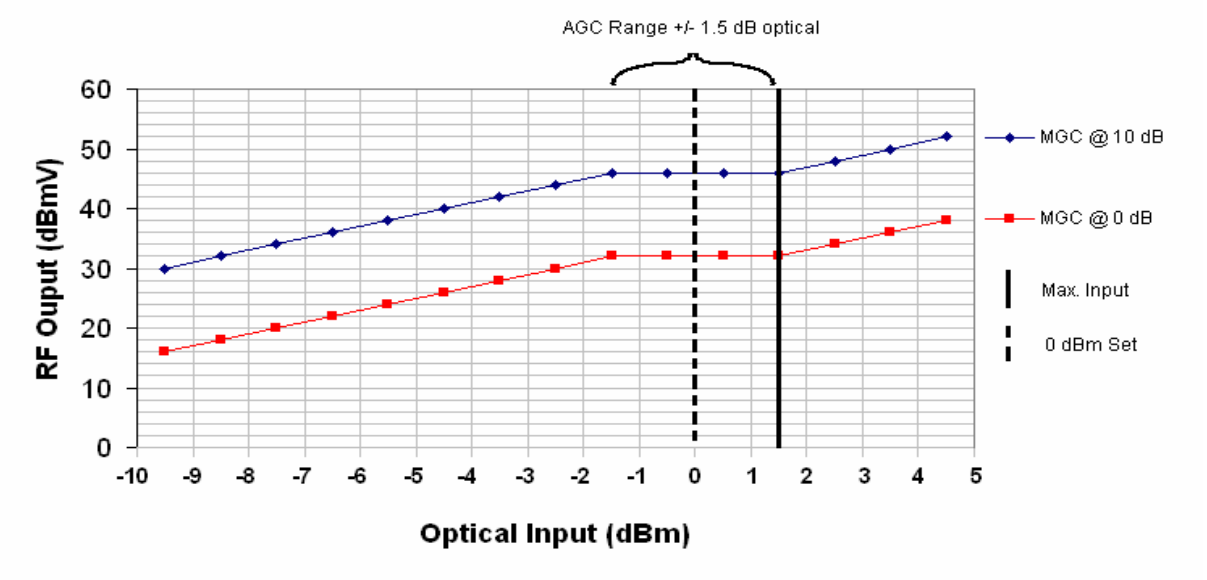
The unit consists of an independent optical-electrical converter for each receiver installed; these are controlled and monitored by a microcontroller. The Optical RF Converter Module, ORFCM, has been designed as a plug-in module for ease of manufacture and service. Power is supplied by the main board as is the RF gain control voltage and various other signals for monitoring and control.



4.5.3 Gain Control and Optical Signal Level Monitoring

The microprocessor monitors the optical input power and controls the gain. Alarms are activated if the levels are outside the normal working range.

When in AGC mode the gain adjustment is limited to ± 3 dB. This is to prevent very high or very low gains due to erratic change in pilot tone level, e.g. a cut fibre.



4.5.4 Output Control and Ingress Control

The output stage functions as a power gain stage and as a means to implement ingress control and redundancy. The output can be adjusted in 6 dB steps, from +6 dB to -42 dB, using the ATTEN control. Output control is further enhanced with the ability to turn the channel off completely, thus providing in excess of 60 dB isolation. These controls can be used to diagnose which system channel is the source of extraneous noise. They can also be used, in conjunction with the other control lines, to switch channels where redundancy is required. Normally ATTEN will be set to 0 dB.

RF level detection is provided for monitoring ingress. The detection point is before the output stage to facilitate diagnosis of an ingress problem. The back-panel test point signal is also taken from the output stage.

4.5.5 Pilot Carrier

In a normal system implementation, a pilot carrier is provided as a reference RF level. This pilot carrier is used to implement the AGC function and is normally set 13 dB below the RF carriers in the channel. The carrier level is monitored and limit tested, however it should be noted that the level recorded assumes the output is ON and set for 0 dB attenuation.

An enhanced function of the pilot carrier is to carry information from the optical transmitter in order to achieve status monitoring of remote nodes (SMS). Data is transmitted by modulating the carrier using FSK. The ORFCM filters the RF channel for the pilot tone then supplies the signal for further processing and decoding to the main board.

4.5.6 FSK Decoding

The main board FSK decoding circuitry samples each channel, in turn, in an attempt to lock on to the pilot carrier frequency. The demodulator circuit then feeds the data stream to the controller to validate the packet, extract the data and prepare it for display. Each of the four channels is treated independently and can have SMS enabled or disabled as required.

4.5.7 Control and Monitoring System

The heart of the control and monitoring system is the microcontroller on the main board. It is responsible for the timely acquisition of the data from the various sources, checking data integrity and limits, controlling various operating parameters and formatting the data when requested by the user interface.

Aside from the monitored signals mentioned above, the controller monitors the power supplies, temperature and communications bus. The controller is also responsible for displaying the status of the RPQRM using the LEDs on the back panel.

Each channel has 2 LEDs associated with it. The first indicates the reported status directly related to the remote transmitter - FSK packet content. The second indicates the status of the channel from the local perspective – optical level, ingress, FSK packet reception, power-supplies etc.

An on board EEPROM stores the operating parameters; both internal parameter blocks and those set by the operator. Gain and attenuation levels, AGC/MGC mode/level and SMS enable/disable states are stored whenever they are changed. This enables the unit to power-up to its previous state.

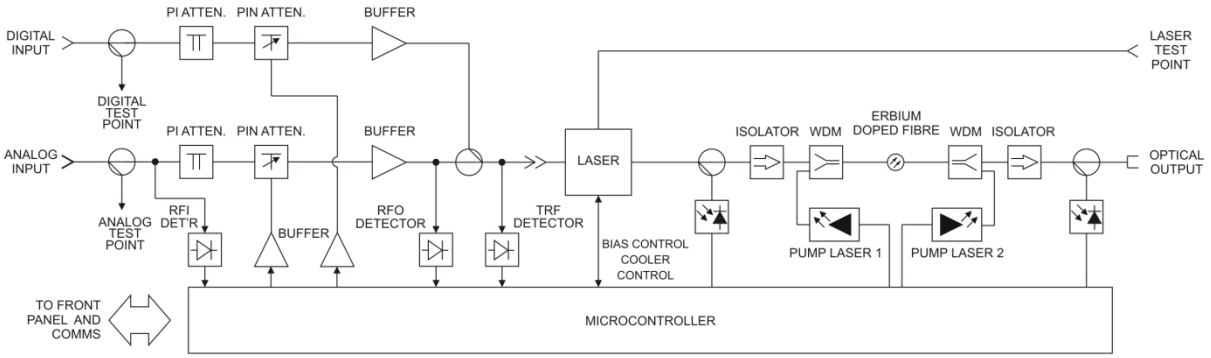
4.5.8 Alarm System and LED Indicators

Remote LED	Local LED	Status
Flashing Quickly (Green)		SMS is active and the FSK data stream from the remote node is being scanned.
	Flashing Slowly (Green)	AGC mode is active. (Regardless of SMS)
Flashing Slowly (Green)	On (Green)	Channel is OFF.
On (Green)	On (Green)	SMS is disabled and the channel is in MGC mode.
On (Red)	On (Red)	An urgent alarm exists on this channel. (Either LED is red)
On (Amber)	On (Amber)	A non-urgent alarm exists on this channel. (Either LED is amber)

4.6 LT1550 High Power Model Option

4.6.1 Overview

The high power LT1550 (20 mW to 400 mW options) includes an erbium doped fibre amplifier module (EDFAM) in bay 2. The output from the 1550 nm laser transmitter is fed into an optical circulator then to the connector on the back panel (OPTICAL TEST) and to the EDFAM. The optical signal is amplified by the EDFAM, then is fed to the connector on the back panel (OPTICAL OUTPUT).



LT1550 (High Power)

The EDFAM comprises an optical gain block, control board and an internal communications interface block.

The optical gain block consists of an erbium doped fibre in conjunction with single or dual 980 nm pump lasers for high optical power efficiency.

The control board monitors and controls the optical gain block and feeds the rear panel LED indicators as described in **Section 3.9**.

The internal communications interface block performs module identification and system integration for front interface control and NMS3 (network management).

4.6.2 Optical Gain Block

The output of the 1550 nm laser transmitter is fed into the optical gain block of the EDFAM.

The optical gain is determined by the required optical output power minus the optical input power. The higher the gain, the higher the noise figure (typically greater than 5.5 dB).

The optical gain block is driven by the control board which also performs the shutdown function of the EDFAM lasers.

4.6.3 Control Board and Internal Communications Interface

The control board is designed to drive, monitor and control the optical gain block. This also controls the LED indicators located on the back panel of the unit.

The control board in conjunction with the internal communications interface block gives the user full monitoring and control capabilities via the front panel or remotely using NMS3 (network management). It also allows the user to control the shutdown feature of the EDFAM via these two interfaces.

4.6.4 Alarm System

The EDFAM alarm system is designed to generate only urgent alarms. This is due to the importance of the EDFAM, as this module will usually drive a large portion of the optical distribution network. The urgent alarm is triggered as follows.

Urgent Alarm:

OPT. OUT LED RED: Optical output is too low, i.e. 3 dB less than rated output power.

This urgent alarm is communicated to the front panel and makes the LCD flash when displaying PBN STATUS.

5 Software Description - Operation

5.1 LT1310 / LT1550 Program Structure

The basic program structure is similar to that of all OCM plug-in modules.

The laser transmitter's software is fully automatic and constantly monitors parameters as outlined in **Section 5.9**. These parameters are stored in the unit's EEPROM and/or microcontroller. Some may be changed via external communications.

The unit is designed for local and remote monitoring and control, with PBN's NMS3 software packages.

5.1.1 Factory Defaults / EEPROM Settings

The software uses EEPROM for memory back up of the lower and upper alarm limits for analogue parameters and for control variables as set by the user.

These settings will be saved into EEPROM so that the user will not need to reset these in case of a power failure.

The factory default setting of the unit is to have an IP address of **192.168.25.168**.

The laser transmitter module is factory-set to have the laser switched on, MGC mode selected and set for 42 channels.

The factory default settings for the receiver have the monitoring of the remote nodes RN1, RN2, RN3 and RN4 disabled and SMS switched off.

5.2 LT1310 / LT1550 User Interface Lock for Control Variable Access

LT1310 / LT1550 software has a keypad lock and unlock feature for accessing the control variables. This is so that only the trained technician has the ability to change any of the CONTROL variables, restricts an unauthorised person from modifying the control variables, and prevents tampering.

The OCM user interface will require the keypad unlock sequence to be input by the user if they intend to access any of the CONTROL variables for any given module. This includes the LCD's CONTRAST level. With the keypad locked, the user has access to the following menu items only: PBN STATUS, ALARMS and MODULES. When the keypad is unlocked, access to CONTROL1, CONTROL2 and CONTROL3 becomes available.

5.2.1 Unlock access to CONTROL variables

1. Ensure that the display is at the home screen with PBN STATUS displayed. If you are not sure of your location in the menu, press **ENTER** twice to go to the home screen.
2. Press the **right** arrow key four times.
3. Press **ENTER** once.

You now have full access to the CONTROL menu items.

The interface is in its unlocked condition. The user has access to six menu items. They are: PBN STATUS, ALARMS, MODULES, CONTROL1, CONTROL2 and CONTROL3.

5.2.2 Lock access to CONTROL variables

There are three ways to lock access to CONTROL variables:

- Resetting the power
- Automatic time-out
- Manual operation

By resetting the power, the interface will start up in the locked condition by default.

Automatic time-out happens when there has been no activity (key pressing) for 15 minutes. This will also bring the display back to the PBN STATUS menu.

Manual Operation

4. Ensure that the display is at the home screen with PBN STATUS displayed. If you are not sure of your location in the menu, press **ENTER** twice to go to the home screen.

Press the **left** arrow key once.

Press **ENTER** once.

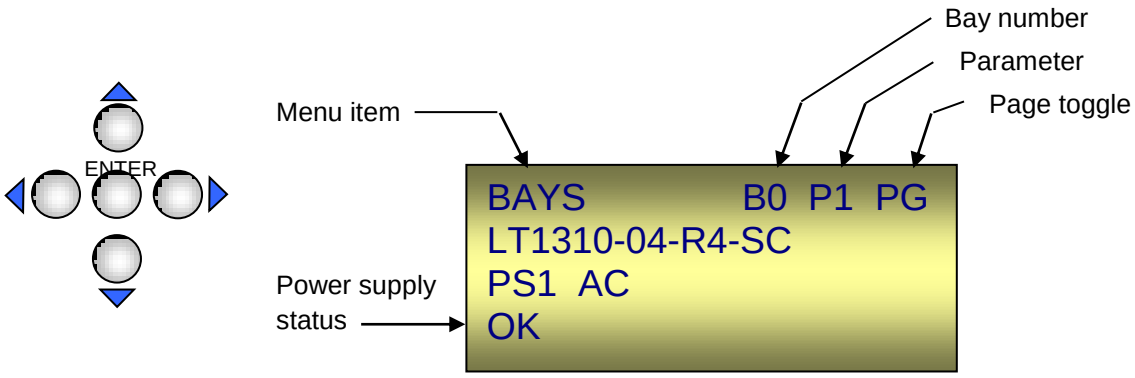
You have now locked access to the CONTROL menu items.

5.3 Programming Sequence for LT1310 / LT1550

The user has the ability to perform the following functions on the LT1310 / LT1550 via the user interface.

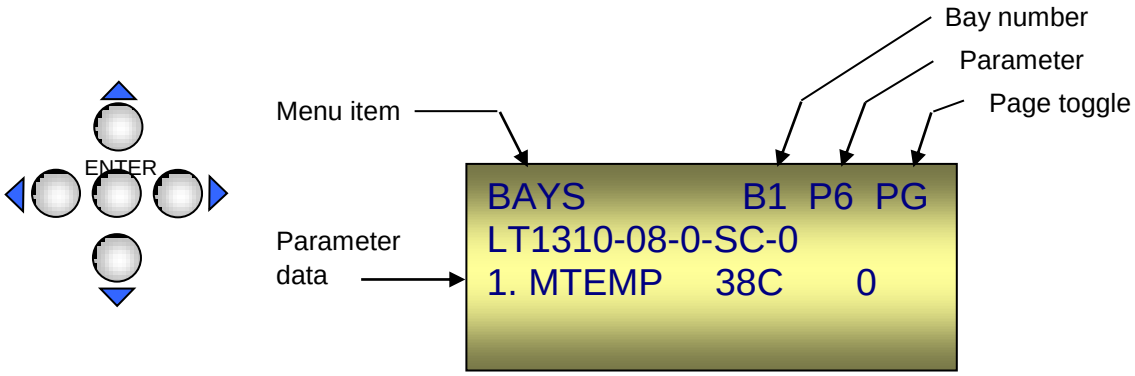
- Select the transmitter or receiver for monitoring and controlling
- Check all 32 parameters for the transmitter or receiver
- Set the contrast level
- Set the IP address, subnet mask or gateway
- Set IP_Commit

5.3.1 Selecting the Transmitter or Receiver for Monitoring and Controlling



- Scroll down to menu item **BAYS** using the ▼ key.
- Place the cursor at **BX** using the ▶ key, where **X** represents the bay number of the device.
- Select the bay number using the ▼ or ▲ keys.
- You have now selected the device within the unit to monitor and control.

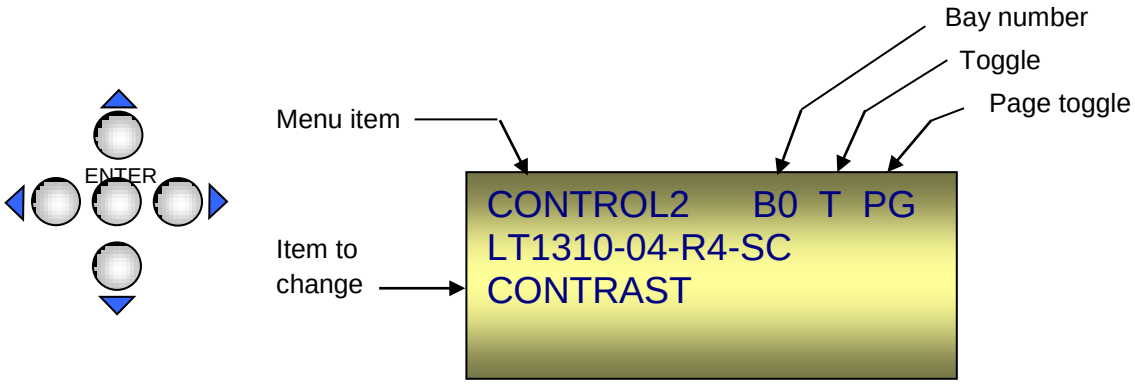
5.3.2 Checking all 32 Parameters in the LT1310 / LT1550



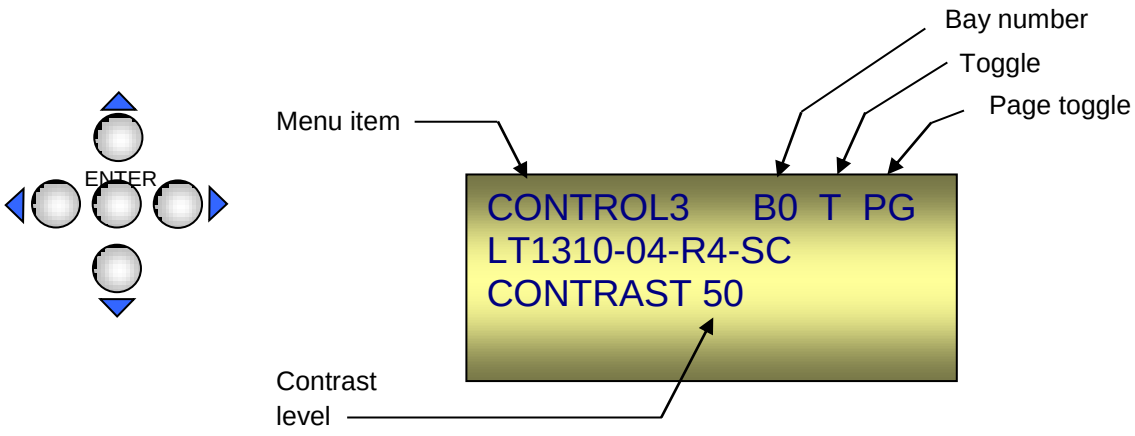
- Scroll down to menu item **BAYS** using the ▼ key.
- Place cursor at **BX** using the ▶ key, where **X** represents a bay number (0 – 2) of the unit in which a device is installed.
- Select bay number with ▼ or ▲ keys, e.g. to select the transmitter, select **B1**.
- Move cursor to **PXX** using the ▶ key, where **XX** is a parameter from 01 to 32.
- Press ▼ or ▲ keys to scroll through the parameter list and values.

5.3.3 Setting the Contrast Level

The LT1310 / LT1550 LCD contrast level can be set for optimum viewing.



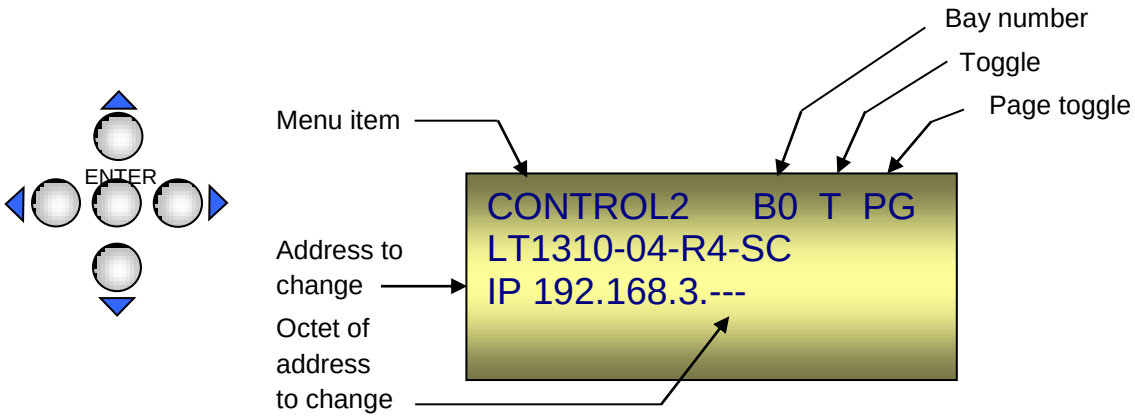
- Use the ▼ or ▲ keys to scroll to **CONTROL2**.
- Use the ◀ or ▶ keys to position the cursor at **T**.
- Use the ▼ or ▲ keys to scroll to **CONTRAST**.



- Press the **ENTER** key once and then use the ▼ or ▲ keys to scroll to **CONTROL3**.
- User the ◀ or ▶ keys to position the cursor at T.
- Use the ▼ or ▲ keys to select the desired value for the contrast level.
- The example above shows 50.

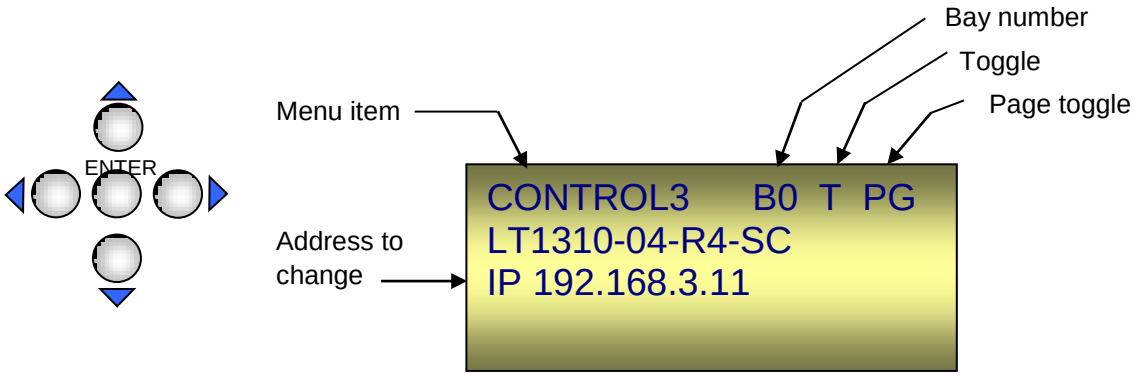
5.3.4 Setting the IP Address, Subnet Mask or Gateway

The unit can communicate over an Ethernet link using TCP/IP (SNMP option); the following section details how to enter the addresses required.



- Use the ▼ or ▲ keys to scroll to **CONTROL2**.
- Use the ◀ or ▶ keys to position the cursor at **T**.
- To set the IP address, use the ▼ or ▲ keys to scroll to **IP #.#.#.- - -.**
- Similarly scroll to **MASK #.#.#.- - -** or **GWY #.#.#.- - -** to set the subnet mask or gateway.

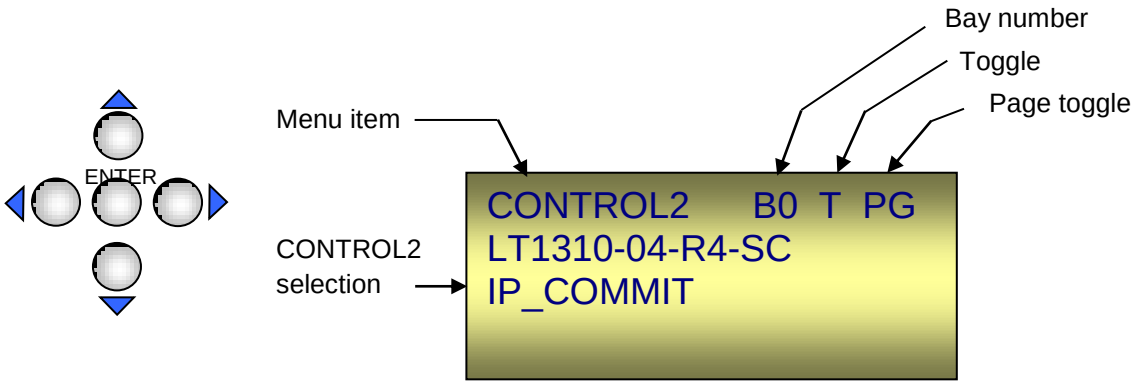
> **Note:**
>
> The **- - -** in the address indicates the octet that will be set.
>
> # denotes the IP address that has already been set.



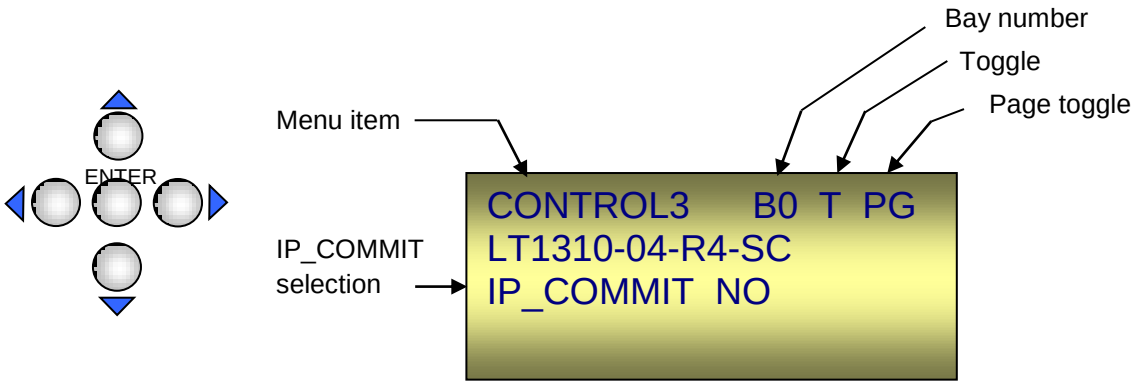
- Press the **ENTER** key once and then use the ▼ or ▲ keys to scroll to **CONTROL3**.
- User the ◀ or ▶ keys to position the cursor at **T**.
- Use the ▼ or ▲ keys to select the desired value for the selected IP octet.
  The example above shows 11.
- Repeat these steps to set the entire address.
- Set the **IP_Commit** option to **YES** (see next page).

5.3.5 Setting IP_Commit

After the IP address, subnet mask and gateway have been entered, it is necessary for the user to set the **IP_Commit** option. This will instruct the unit to change its IP address to the one entered. This must be done for the changes to take effect.



- Use the ▼ or ▲ keys to scroll to **CONTROL2**.
- Use the ◀ or ▶ keys to position the cursor at **T**.
- Use the ▼ or ▲ keys to scroll to **IP_COMMIT**.



- Press the **ENTER** key once and then use the ▼ or ▲ keys to scroll to **CONTROL3**.
- Use the ◀ or ▶ keys to position the cursor at **T**.
- Use the ▼ or ▲ keys to select **YES**.
- Wait until the display changes back to **NO** to indicate that the change has been processed.

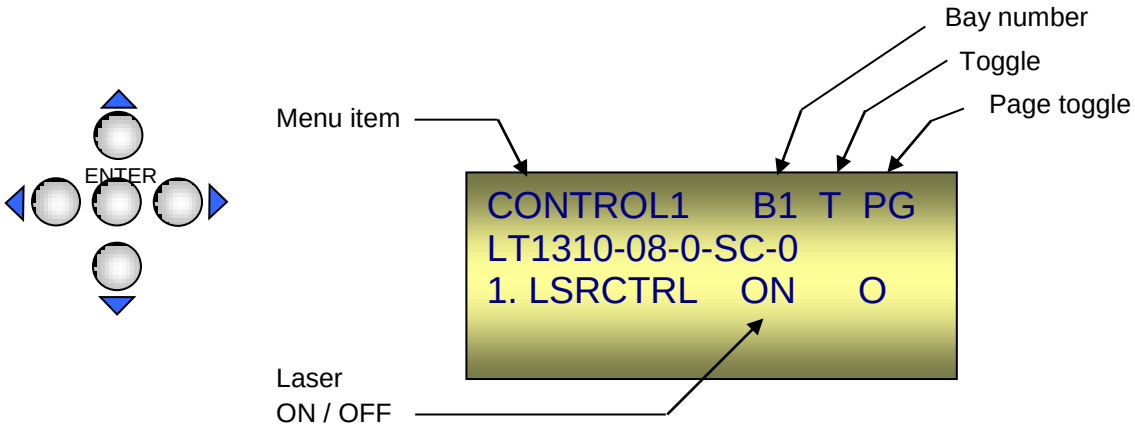
5.4 Programming Sequence for Laser Transmitter

The user has the ability to perform the following functions on the laser transmitter module via the LT1310 user interface.

- Activate the laser
- Select Parameter List PAGE 1 or PAGE 2
- Set the gain control for AGC or MGC
- Set the analogue MGC level
- Set the digital MGC level
- Set the number of channels in your system

5.4.1 Activating the Laser

The transmitter will be in its factory-set mode of laser **ON** when first powered up. To switch the laser **ON** or **OFF** follow the next steps:

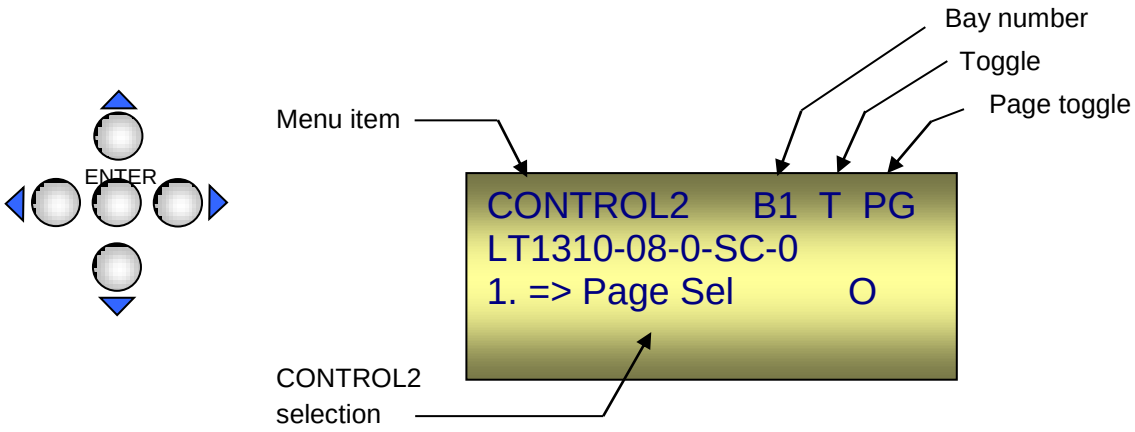


- Perform the steps in **Section 5.3.1** to select the transmitter.
- Scroll down to menu item **CONTROL1**.
- Use the ▶ key to position the cursor at **T**.
- Use the ▼ or ▲ keys to toggle between **ON** and **OFF**.
- **LSRCTRL**…will change accordingly.
- Switch to **ON** for LASER ON.
- Switch to **OFF** for LASER OFF.

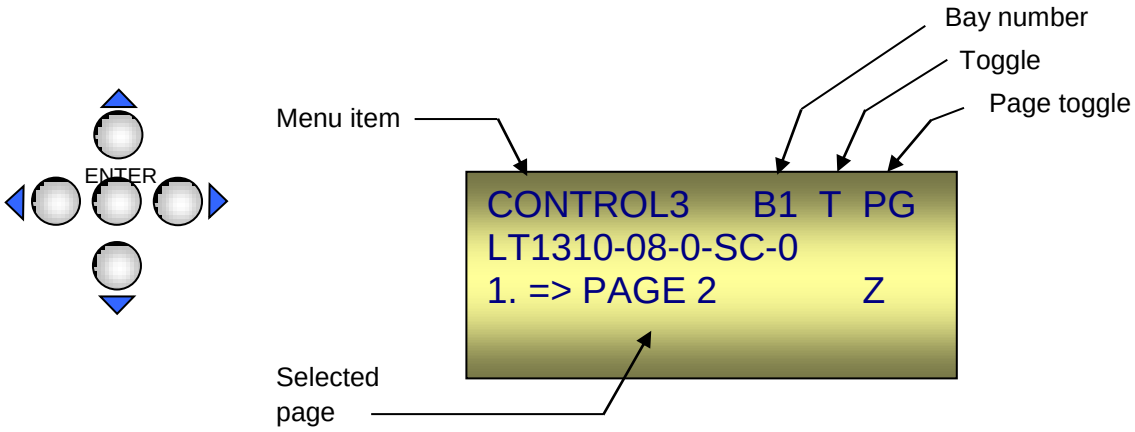
5.4.2 Selecting Parameter List PAGE 1 or PAGE 2

For a full list and explanation of the parameters used for the transmitter refer to **Section 5.8**.

- Perform the steps in **Section 5.3.1** to select the transmitter.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **Page Sel**, **AGC/MGC**, **Ana MGC**, **Dig MGC**, **Channels**.
- Select **Page Sel**.



- Press the ▼ key to get to **CONTROL3**. Selected **PAGE #.**
- Place the cursor at **T** using the ▶ key.
- Press ▼ or ▲ to select **PAGE 1** or **PAGE 2**.
- To view the parameter list on the respective page, refer to **Section 5.3.2**.

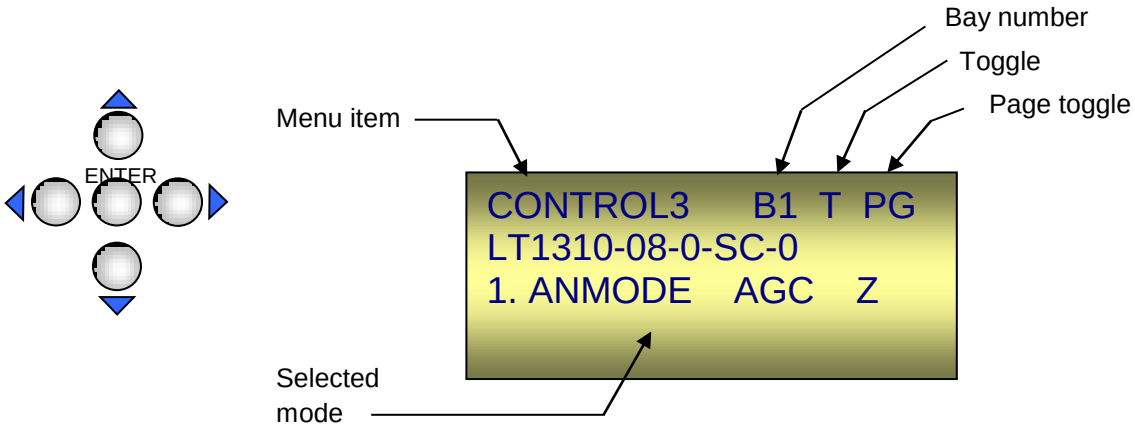


Note:

Alternatively, place the cursor at **PG** with the ▶ key and then press ▼ or ▲ to select **PAGE 1** or **PAGE 2**.

5.4.3 Setting the Gain Control for AGC or MGC

The transmitter's analogue channel can be set for AGC or MGC as follows:



- Perform the steps in **Section 5.3.1** to select the transmitter.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **Page Sel**, **AGC/MGC**, **Ana MGC**, **Dig MGC**, **Channels**.
- Select **AGC/MGC**.
- Place the cursor back at **CONTROL2** with the **ENTER** key.
- Press the ▼ key to get to **CONTROL3**. Selected **ANMODE**.
- Place the cursor at **T** using the ▶ key.
- Press ▼ or ▲ to select **ANMODE AGC** or **MGC** as desired.

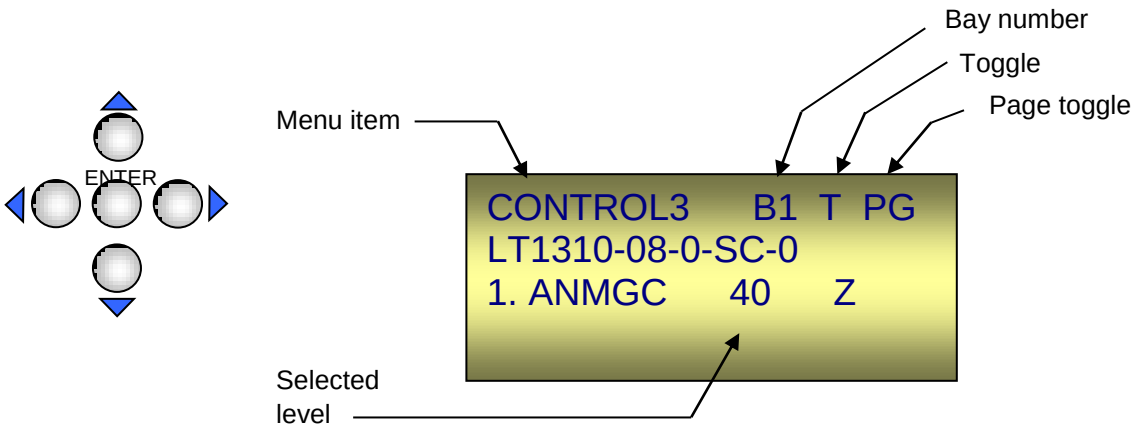
This mode will also switch from **AGC** to **MGC** automatically when the user adjusts the analogue MGC level, **ANMGC (P26)**. In this case the user will then have to reset this back to **AGC**, using the above steps, if AGC mode of operation is desired.

5.4.4 Setting the Analogue MGC Level

The user can vary the analogue MGC level via the following sequence.

The range for this setting is 0, 40 or 99, which adjusts the analogue portion of the modulating signal into the laser.

> **Note:**
>
> If the module has been set for AGC mode, the following sequence will automatically switch it to MGC mode.



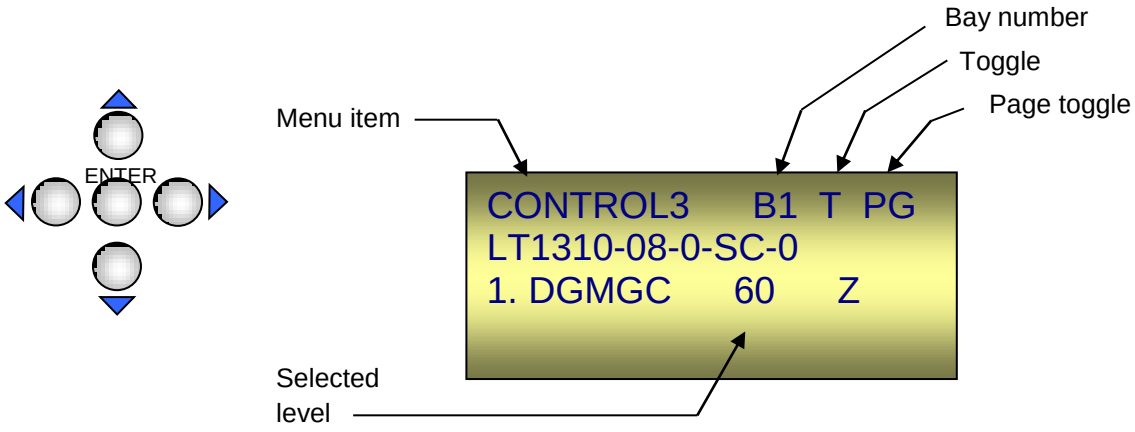
- Perform the steps in **Section 5.3.1** to select the transmitter.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **Page Sel**, **AGC/MGC**, **Ana MGC**, **Dig MGC**, **Channels**.
- Select **Ana MGC**.
- Place the cursor back at **CONTROL2** with the **ENTER** key.
- Press the ▼ key to get to **CONTROL3**. Selected **ANMGC**.
- Place the cursor at **T** using the ▶ key.
- Press ▼ or ▲ to scroll through **0**, **40** and **99**.
- Set the desired level.

> **Note:**
>
> The factory setting is 40, for 25 dBmV RF input to give 4% OMI, 42 channel system.

5.4.5 Setting the Digital MGC Level

The user can vary the digital MGC level via the following sequence.

The range for this setting is **01**, **60** or **99**.



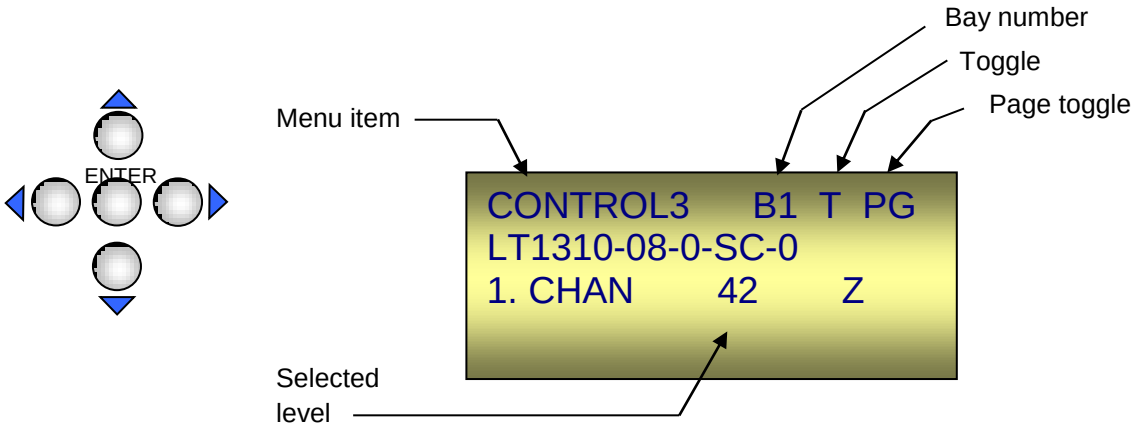
- Perform the steps in **Section 5.3.1** to select the transmitter.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **Page Sel**, **AGC/MGC**, **Ana MGC**, **Dig MGC**, **Channels**.
- Select **Dig MGC**.
- Place the cursor back at **CONTROL2** with the **ENTER** key.
- Press the ▼ key to get to **CONTROL3**. Selected **DGMGC**.
- Place the cursor at **T** using the ▶ key.
- Press ▼ or ▲ to scroll through **0**, **60** and **99**.
- Set the desired level.

Note:

The factory setting is 60, for 25 dBmV RF input to give 4% OMI, 42 channel system.

5.4.6 Setting the Number of Channels

The user can vary the set number of channels in the system as follows:



- Perform the steps in **Section 5.3.1** to select the transmitter.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **Page Sel**, **AGC/MGC**, **Ana MGC**, **Dig MGC**, **Channels**.
- Select **Channels**.
- Place the cursor back at **CONTROL2** with the **ENTER** key.
- Press the ▼ key to get to **CONTROL3**. Selected **CHAN #**.
- Place the cursor at **T** using the ▶ key.
- Press ▼ or ▲ to scroll through **1**…**99**.

Note:

The factory setting is 42 channels. User to change as appropriate.

5.5 Programming Sequence for Forward Path Receiver

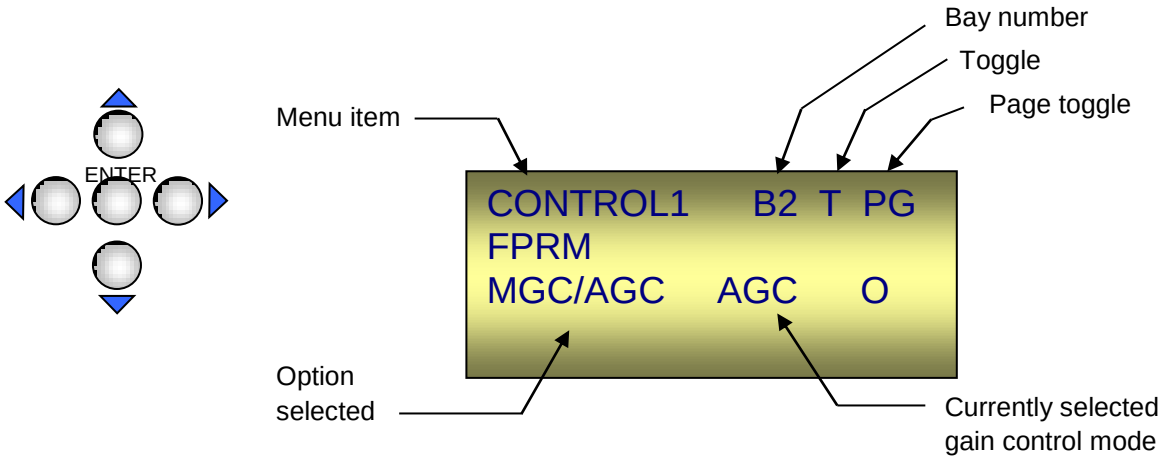
The user has the ability to perform the following functions on the forward path receiver via the user interface.

- Set the gain control for AGC or MGC
- Set the number of channels in the system
- Set the analogue MGC level
- Set the slope control

5.5.1 Setting the Gain Control for MGC or AGC

The receiver will be in its default mode of **AGC** when first powered up.

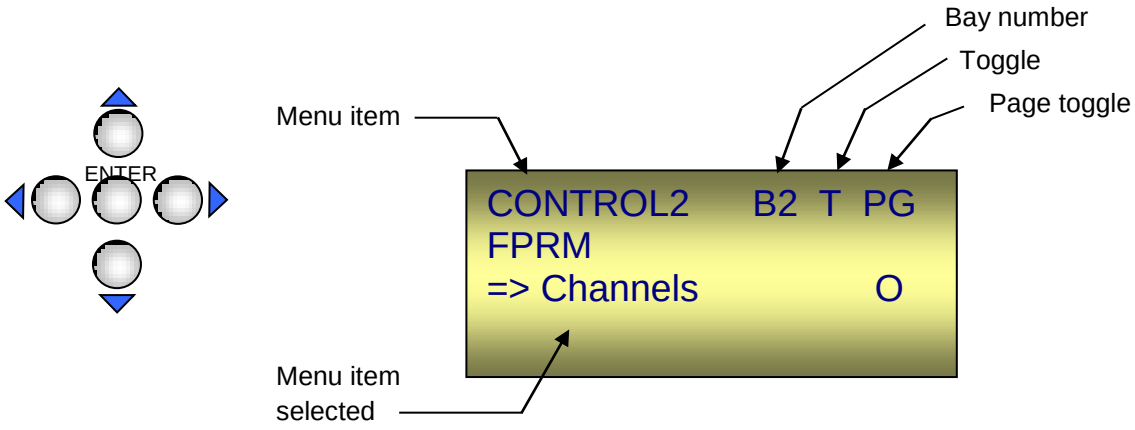
To change the gain type setting:



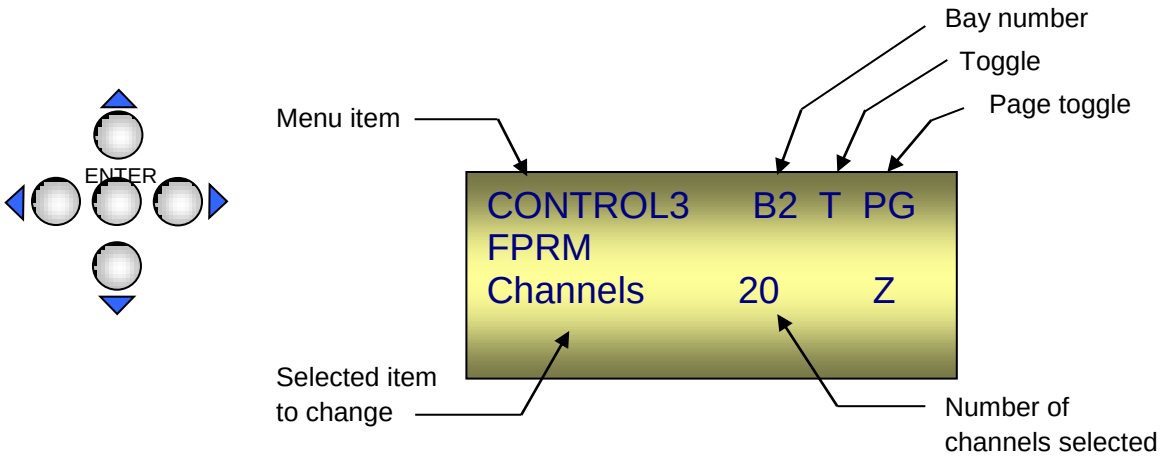
- Perform the steps in **Section 5.3.1** to select the receiver.
- Scroll down to menu item **CONTROL1**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to toggle the gain control mode between **AGC** and **MGC**.

5.5.2 Setting the Number of Channels in the System

The user can vary the set number of channels in the system as follows:



- Perform the steps in **Section 5.3.1** to select the receiver.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **MGC Ctrl**, **SLOPE Ctrl** and **Channels**.
- Select **Channels**.
- Place the cursor back at **CONTROL2** with the ◀ key.
- Press the ▼ key to get to **CONTROL3**.
- Place the cursor at **T** with the ▶ key, press ▼ or ▲ to scroll through **1…99**.



Note:

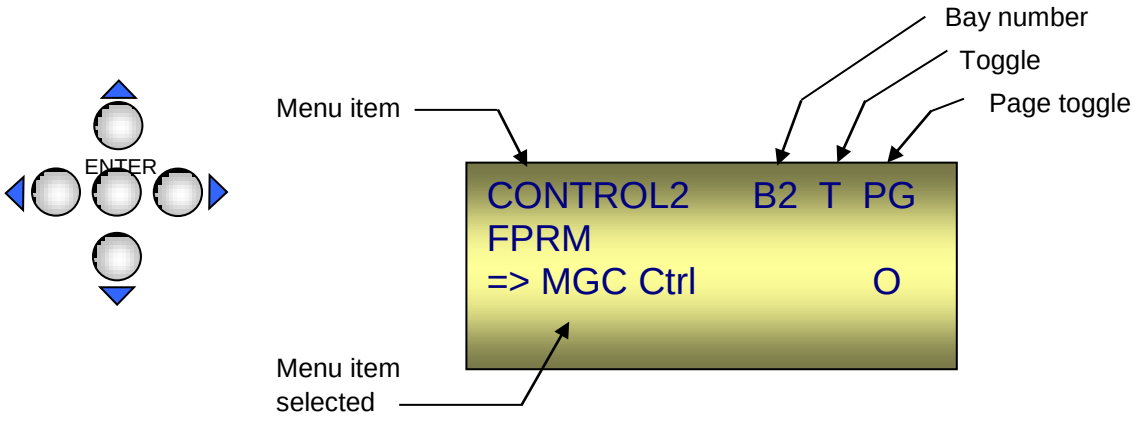
The factory setting is 42 channels. You can change this as appropriate.

5.5.3 Setting the Analogue MGC Level

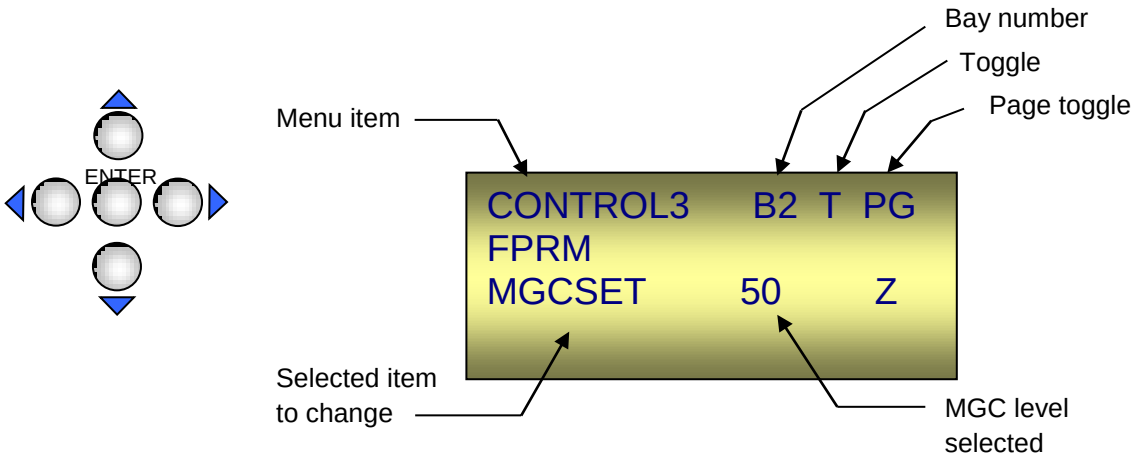
The user can vary the analogue MGC level via the following sequence.

The range for this setting is **1…99**, which adjusts the RF level out of the receiver.

> **Note:**
>
> If the module has been set for AGC mode (as in **Section 5.4.1**), the following sequence will automatically switch it to MGC mode.



- Perform the steps in **Section 5.3.1** to select the receiver.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **MGC Ctrl**, **SLOPE Ctrl** and **Channels**.
- Select **MGC Ctrl**.
- Place the cursor back at **CONTROL2** with the ◀ key.
- Press the ▼ key to get to **CONTROL3**.
- Place the cursor at **T** with the ▶ key, press ▼ or ▲ to scroll through **1…99**.

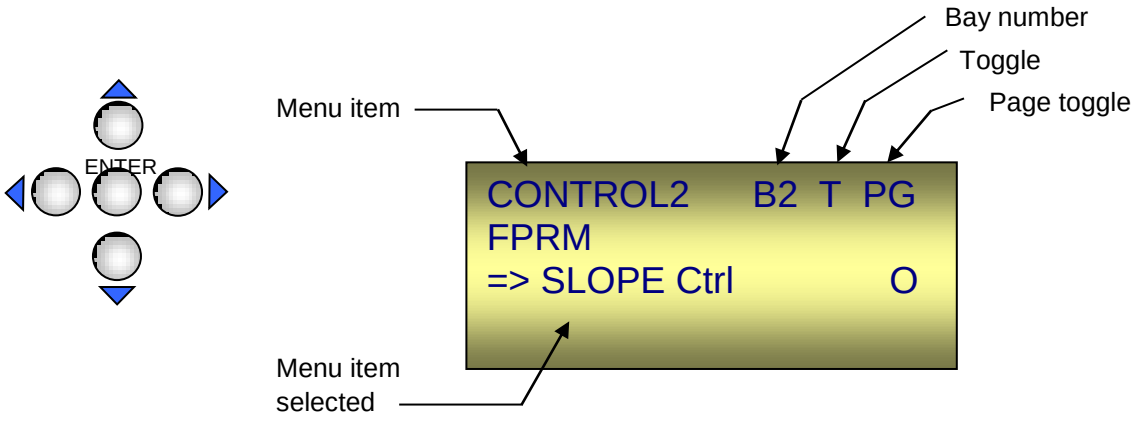


> **Note:**
>
> The factory setting is 40, for 25 dBmV RF input to give 4% OMI, 42 channel system.

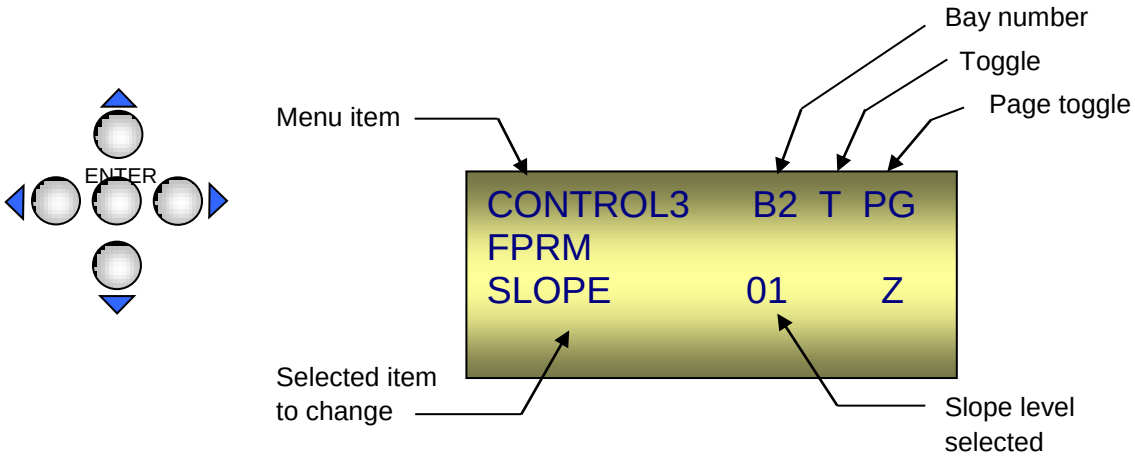
5.5.4 Setting the Slope Control

The user can vary the slope via the following sequence. The range for this setting is **0…25**.

> **Note:**
>
> If the module has been set for AGC mode (as in **Section 5.4.1**), the following sequence will automatically switch it to MGC mode.



- Perform the steps in **Section 5.3.1** to select the receiver.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **MGC Ctrl**, **SLOPE Ctrl** and **Channels**.
- Select **SLOPE Ctrl**.
- Place the cursor back at **CONTROL2** with the ◀ key.
- Press the ▼ key to get to **CONTROL3**.
- Place the cursor at **T** with the ▶ key, press ▼ or ▲ to scroll through **0…25**.
- Set the desired level.



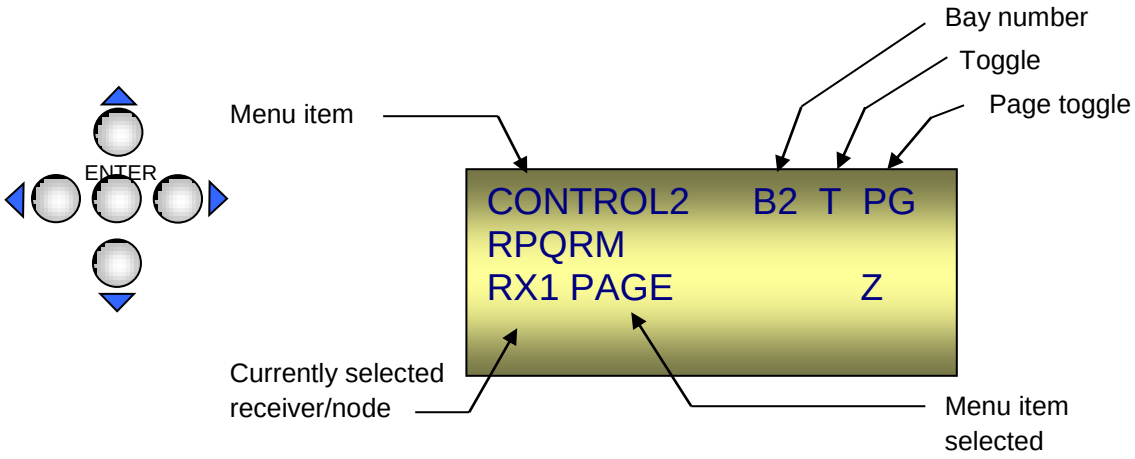
> **Note:**
>
> The factory setting is given on your test sheet.

5.6 Programming Sequence for Return Path Receivers

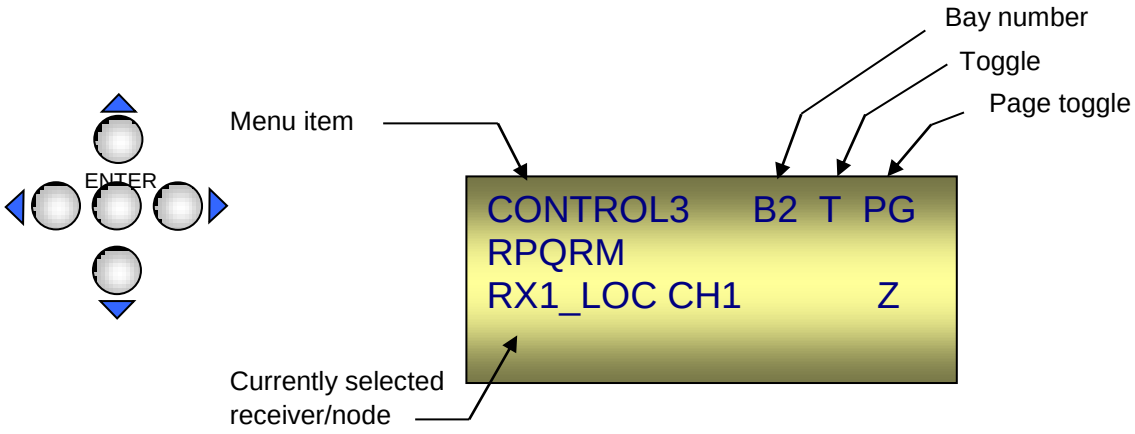
The user has the ability to perform the following functions on the RPQRM switching module via the user interface.

- Select a local receiver (RX1, RX2, RX3 or RX4), or a remote node (RN1, RN2, RN3 or RN4) for monitoring and controlling
- Monitor the 32 parameters for each local receiver or remote node
- Enable or disable each receiver
- Enable or disable the status monitoring system (SMS) of each receiver
- Enable or disable AGC (Automatic Gain Control) of each receiver
- Adjust the gain level of each receiver
- Adjust the output attenuation of each receiver

5.6.1 Selecting a Local Receiver or Remote Node for Monitoring and Controlling



- Perform the steps in **Section 5.3.1** to select the receiver.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **PAGE**, **GAIN**, **ATT**, **MGC/AGC** and **SMS**.
- Select **PAGE**.
- Press the **ENTER** key once and then scroll down to **CONTROL3** using the ▼ key.
- Use the ▶ key to position the cursor at **T**.



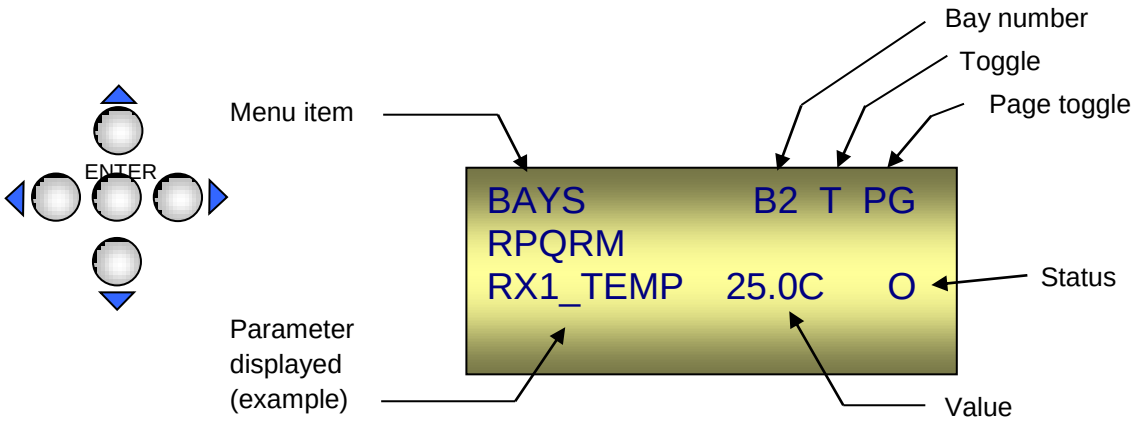
- Pressing ▼ or ▲ will scroll through menu items: **RX1**, **RN1**, **RX2**, **RN2**, **RX3**, **RN3**, **RX4** and **RN4** (see note below).
- Select the desired local receiver, **RX1**, **RX2**, **RX3** or **RX4** or the desired remote node **RN1**, **RN2**, **RN3** or **RN4**.

Note:

If **RN#** is **OFF**, the scroll menu will skip that particular RN#.

5.6.2 Monitoring the 32 Parameters for Each Local Receiver or Remote Node

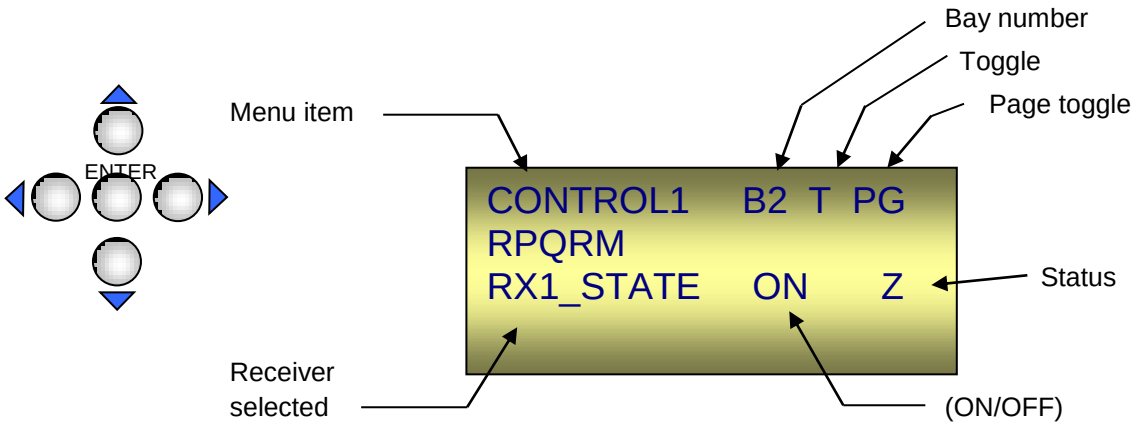
For a full list and explanation of the parameters used in the receiver refer to **Section 5.8** of this manual.



- Perform the steps in **Section 5.6.1** to select the receiver.
- Scroll down to menu item **BAYS**.
- Place the cursor at **PXX** using the ▶ key. **XX** is the parameter number from 01 to 32.
- Press ▼ or ▲ to scroll through the parameter list and to view the parameter values.

5.6.3 Enabling or Disabling Each Receiver

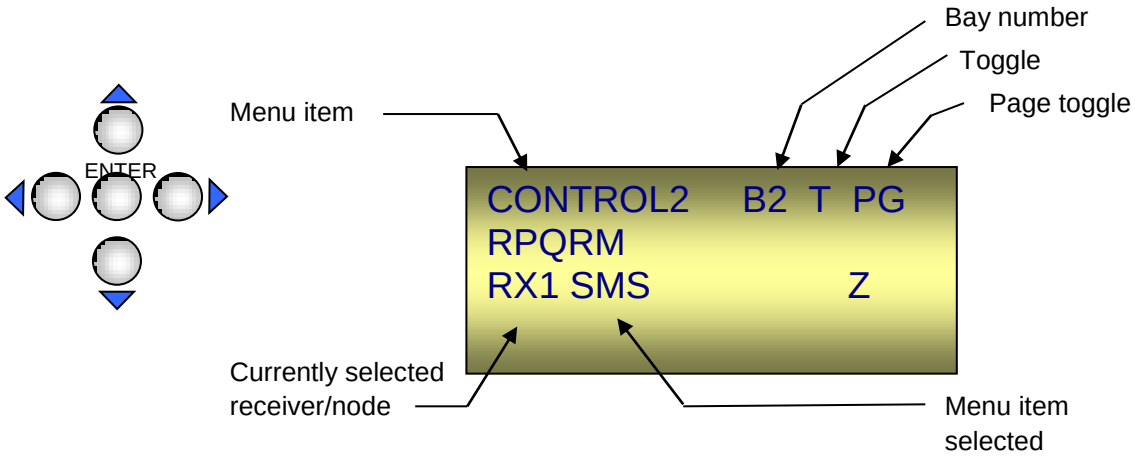
The user may enable or disable the operation of each receiver. When a receiver is disabled there will be no RF output on the disabled channel.



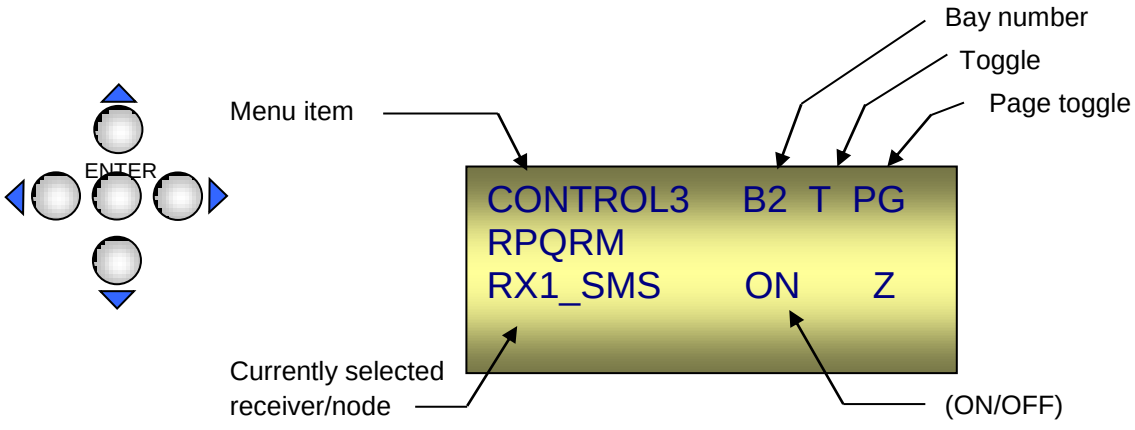
- Perform the steps in **Section 5.6.1** to select the desired receiver **RX1**, **RX2**, **RX3** or **RX4**.
- Scroll down to menu item **CONTROL1**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to toggle the selected receiver state to **ON** or **OFF**.

5.6.4 Enabling or Disabling the Status Monitoring System (SMS) of Each Receiver

The user may enable or disable the monitoring function of the remote nodes. The monitoring of the remote nodes should only be enabled when the return-path link is activated.



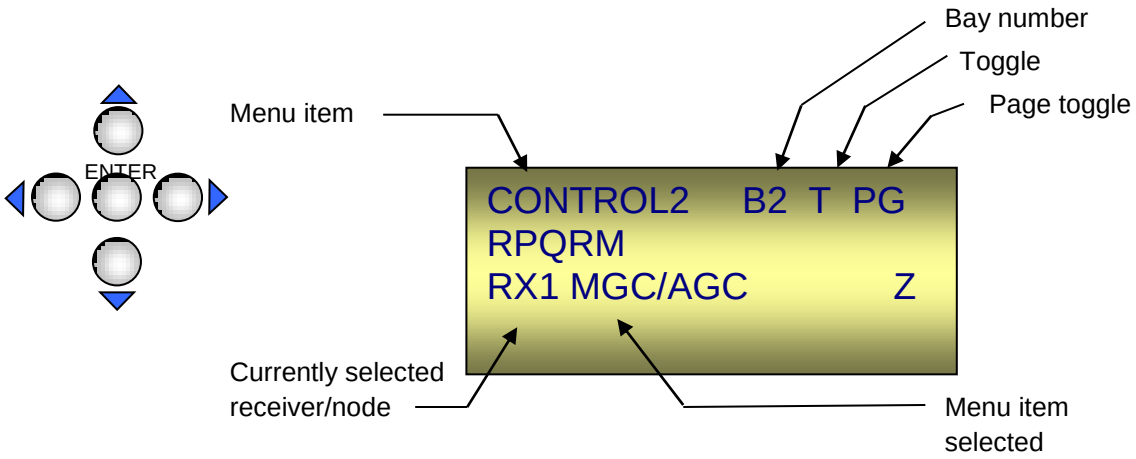
- Perform the steps in **Section 5.6.1** to select the desired receiver **RX1**, **RX2**, **RX3** or **RX4**.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **PAGE**, **GAIN**, **ATT**, **MGC/AGC** and **SMS**.
- Select **SMS**.
- Press the **ENTER** key once and then scroll down to **CONTROL3** using the ▼ key.
- Use the ▶ key to position the cursor at **T**.



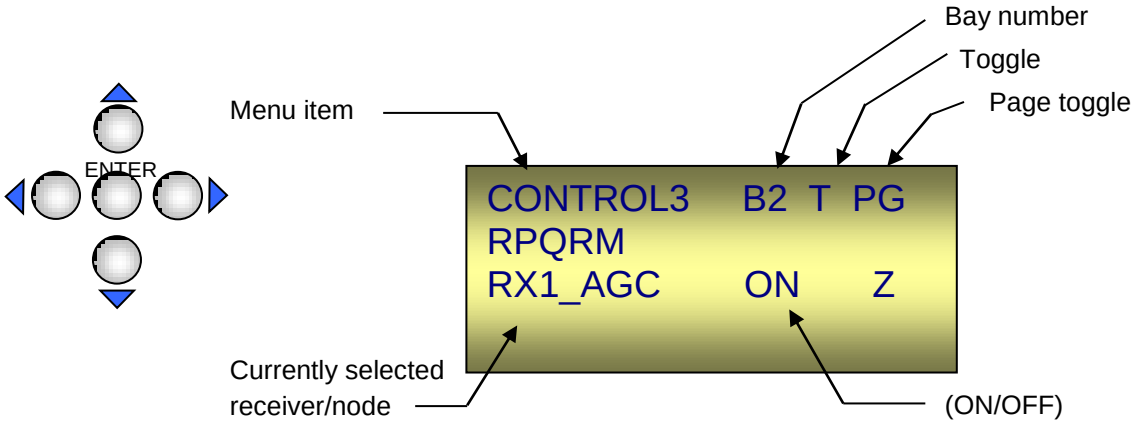
- Press ▼ or ▲ to toggle the selected receiver's SMS to **ON** or **OFF**.

5.6.5 Enabling or Disabling AGC (Automatic Gain Control) of Each Receiver

The user may choose between AGC (Automatic Gain Control) or MGC (Manual Gain Control) for each remote node.



- Perform the steps in **Section 5.6.1** to select the desired receiver **RX1**, **RX2**, **RX3** or **RX4**.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **PAGE**, **GAIN**, **ATT**, **MGC/AGC** and **SMS**.
- Select **MGC/AGC**.
- Press the **ENTER** key once and then scroll down to **CONTROL3** using the ▼ key.
- Use the ▶ key to position the cursor at **T**.



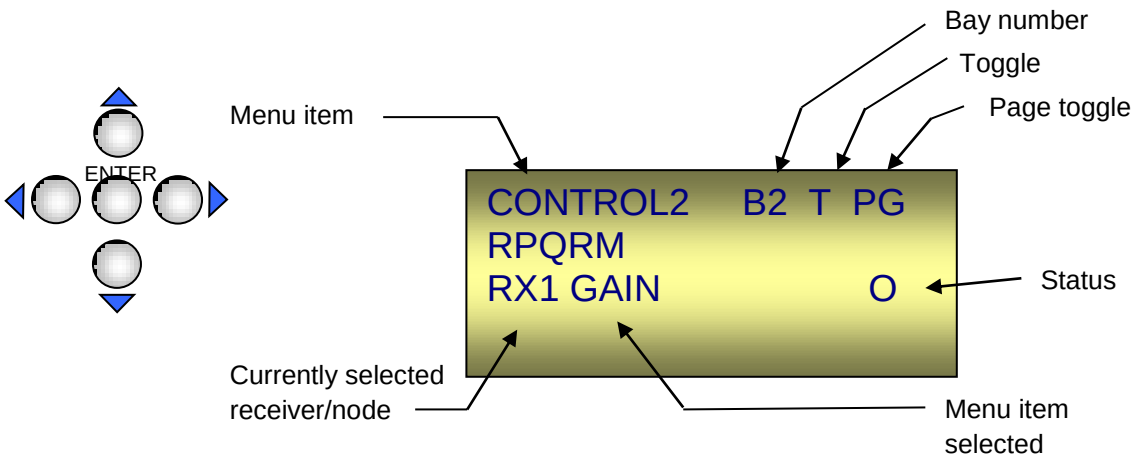
- Press ▼ or ▲ to toggle the selected receiver's AGC status to **ON** or **OFF**. Select **ON** to enable AGC or select **OFF** to disable AGC (thus enabling MGC).

Note:

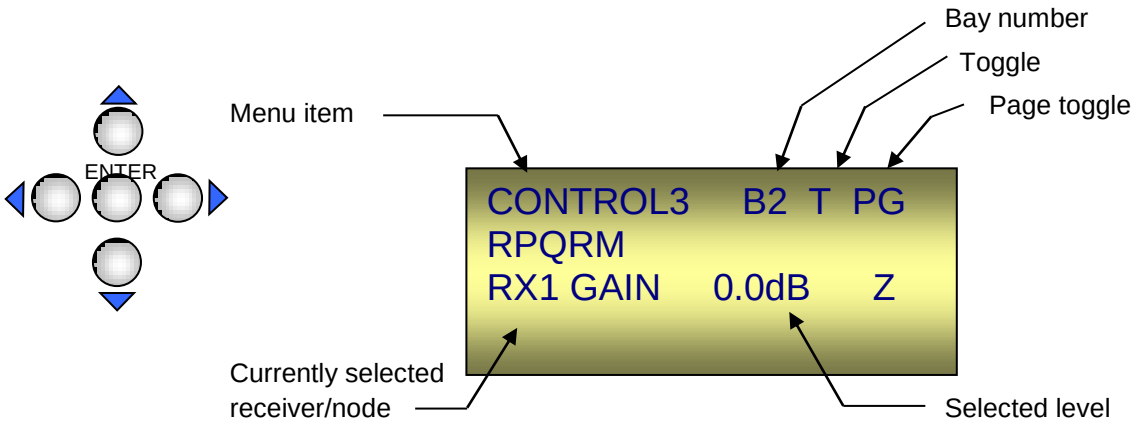
After a gain change or optical level change, wait until the optical level is stable before switching to AGC mode. AGC mode will be maintained with variance in the optical level of up to ± 1.5 dB.

5.6.6 Adjusting the Gain Level for Local Receivers

The user has the ability to vary the gain control level (in MGC mode) with a gain window of 0…20 dB.



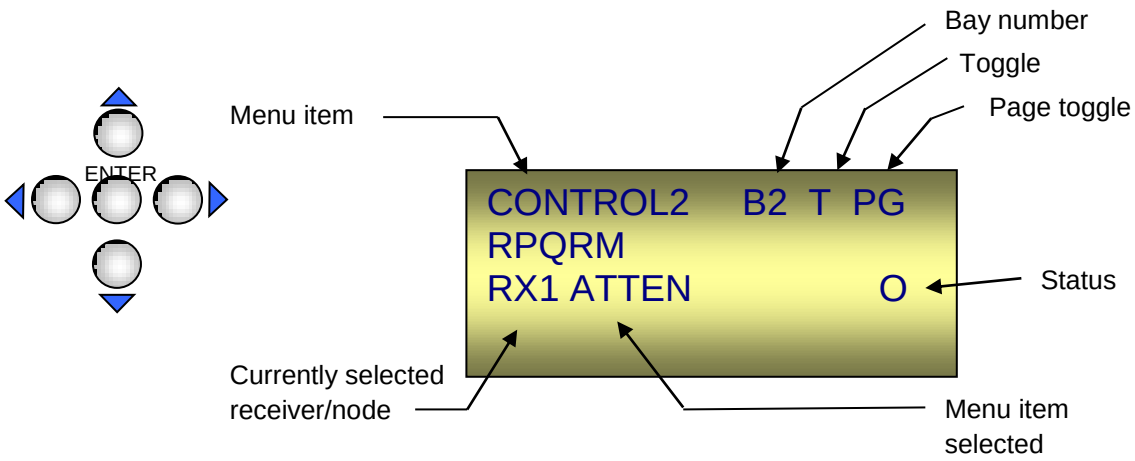
- Perform the steps in **Section 5.6.1** to select the desired receiver **RX1**, **RX2**, **RX3** or **RX4**.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **PAGE**, **GAIN**, **ATT**, **MGC/AGC** and **SMS**.
- Select **GAIN**.
- Press the **ENTER** key once and then scroll down to **CONTROL3** using the ▼ key.
- Use the ▶ key to position the cursor at **T**.



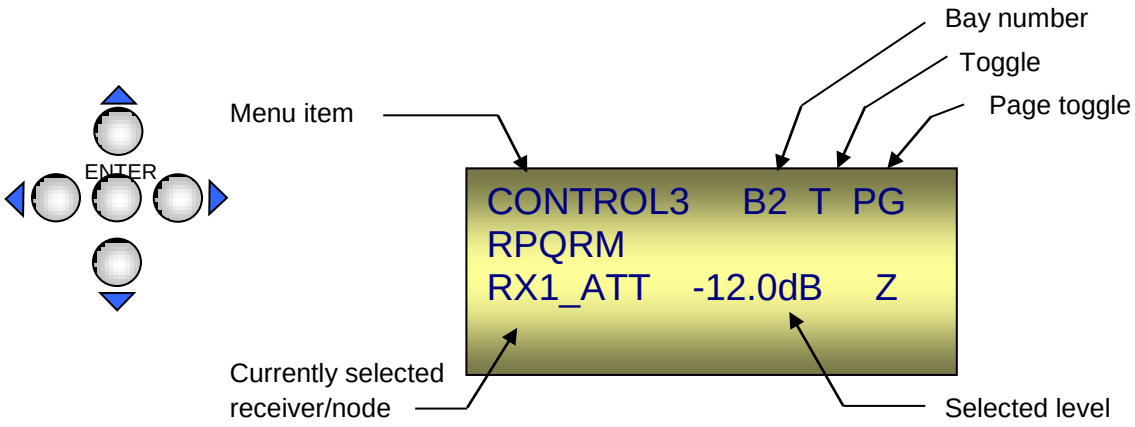
- Press ▼ or ▲ to scroll through the available range of values.
- Select the desired level for the link.

5.6.7 Adjusting the Output Attenuation of Each Receiver

The user has the ability to vary attenuation within a range of 42…6 dB.



- Perform the steps in **Section 5.6.1** to select the desired receiver **RX1**, **RX2**, **RX3** or **RX4**.
- Scroll down to menu item **CONTROL2**.
- Use the ▶ key to position the cursor at **T**.
- Press ▼ or ▲ to scroll and select through the items **PAGE**, **GAIN**, **ATT**, **MGC/AGC** and **SMS**.
- Select **ATT**.
- Press the **ENTER** key once and then scroll down to **CONTROL3** using the ▼ key.
- Use the ▶ key to position the cursor at **T**.



- Press ▼ or ▲ to scroll through the available range of values.
- Select the desired level for the link.

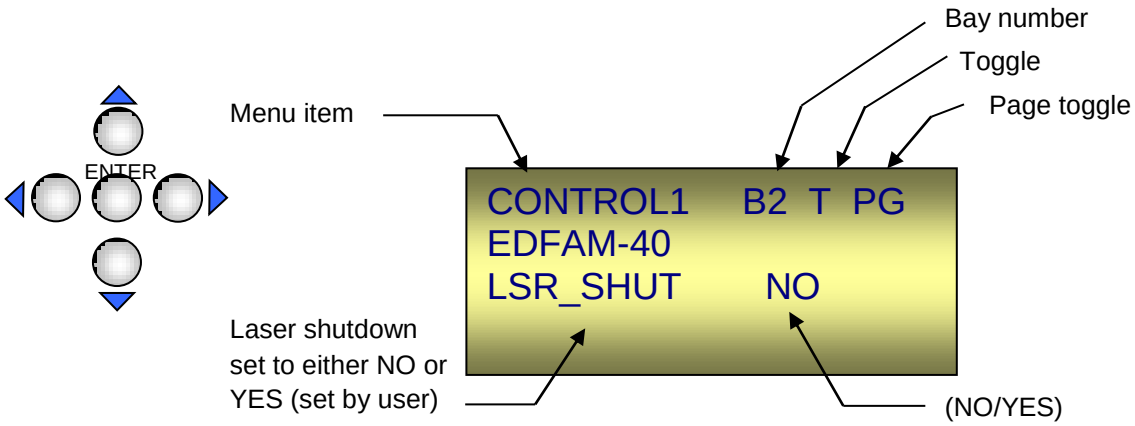
5.7 Programming Sequence for Erbium Doped Fibre Amplifier

The user has the ability to perform the following function on the EDFAM via the user interface.

- Pump laser shut down

5.7.1 Pump laser shut down

The EDFAM will be in its default mode of **LSR_SHUT YES** when first powered up. This means that the EDFAM is non-operational. To activate the pump laser, hence switching on the output of the EDFAM, follow the steps below:



- Scroll down to menu item **CONTROL1**.
- Place cursor at **T** using the ▶ key.
- Press ▼ or ▲ to toggle between **NO** and **YES**.
- **LSR_SHUT** will change accordingly.

Note:

An urgent alarm will be transmitted through the system when **LSR_SHUT** has been activated. This is to inform the operator that there has been a major part of the network left without optical power.

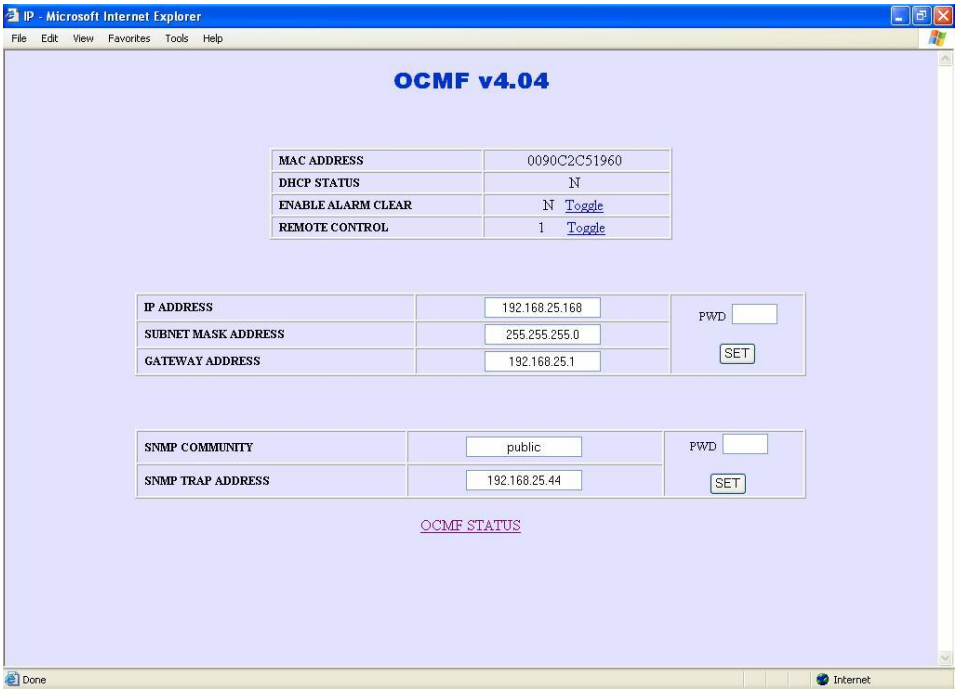
5.8 HTTP Interface for SNMP Option

5.8.1 Connecting to the LT1310 / LT1550

To access the HTTP interface of the LT1310 / LT1550, a web browser such as Internet Explorer is required. The PC must be configured to appear on the same subnet as the transmitter.

Open the network settings dialog of the PC. Ensure the PC is configured to the same subnet as the transmitter. For example, the default IP address of the LT1310 / LT1550 is 192.168.25.168 with a subnet of 255.255.255.0. If the PC terminal is allocated the address 192.168.25.5 (and the same subnet mask), they should appear on the same network segment.

To connect to the transmitter, type its IP address in the 'Address' field of the browser. The following screen should appear.



Note:

If the displayed IP address is 0.0.0.0, please wait approximately 30...60 seconds for it to update.

5.8.2 Changing the IP settings

Using the HTTP interface, the IP settings of the LT1310 / LT1550 can be reconfigured.

MAC ADDRESS	48-bit physical address (non-configurable).
DHCP CONTROL	Yes (Y) when the unit is powered-up. If a DHCP server is not present on the network, the transmitter uses its static IP and DHCP STATUS is set to no (N).
REMOTE CONTROL	Set to 1 when polling is enabled, 0 when the transmitter is not polled. This value can be toggled by clicking 'Toggle'. **CAUTION:** By setting this value to 0, status messages about the LT1310 / LT1550 and its condition will not be generated.
IP, SUBNET AND GATEWAY ADDRESS	IP settings of the transmitter. To change these settings, type the new value in the field provided and click 'SET' (the default password (PWD) is 'PBN').
SNMP COMMUNITY TRAP ADDRESS	SNMP settings of the transmitter. To change these settings, type the new value in the field provided and click 'SET' (the default password (PWD) is 'PBN').

5.8.3 Factory default settings

The LT1310 / LT1550 is programmed with the following factory default settings before shipping.

Section	Parameter	Default Value
DHCP Status	DHCP	Y (Yes)
IP Configuration	IP Address	192.168.25.168
	Subnet Mask Address	255.255.255.0
	Gateway Address	192.168.25.1
	SNMP Trap Address	192.168.25.44
Authentication	IP Settings (PWD)	PBN
	SNMP Settings (PWD)	PBN

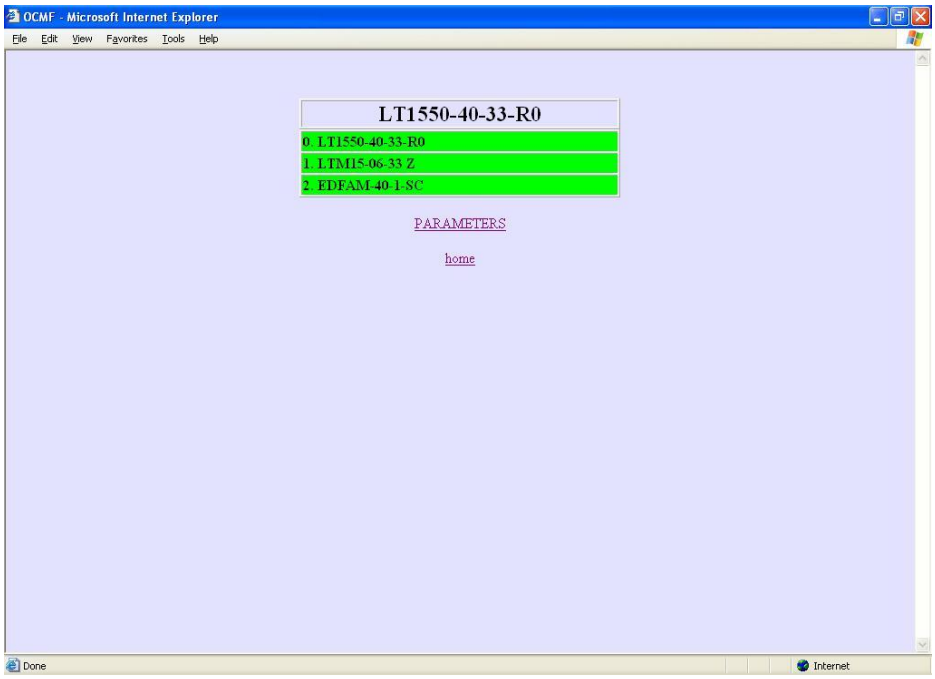
5.8.4 DHCP configuration

The LT1310 / LT1550, by default, is factory set to enable a DHCP server to allocate IP settings to the unit. If a DHCP server does not respond within approximately 30 seconds of the unit being switched on, then the static IP address stored in the SNMP module's flash memory is allocated to the unit and DHCP is disabled.

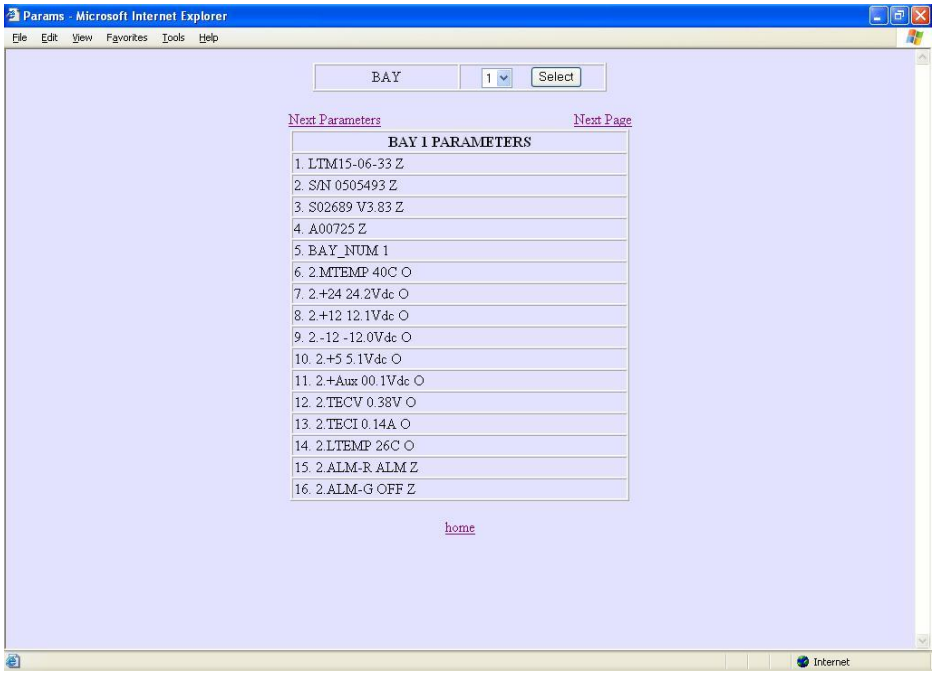
To find the IP address of the unit once it has been assigned by the DHCP server, the MAC address of the unit is required. This is located on the rear panel of the SNMP module and on the 'Certificate of Performance' that accompanies this manual. The DHCP server provides a list of all networked devices and their MAC address / IP address mapping.

5.8.5 LT1310 / LT1550 monitoring

Click on **OCMF STATUS** to open the following window.



Rows 1 and 2 represent the bays of the LT1310 / LT1550. To view the parameters of each bay, click on **PARAMETERS**, then choose a bay number from the drop-down list and click **Select**.



5.9 Control and Communication Parameter List and Alarm Limits

Parameter	Display (examples only)			Description
01	LT1310-10-R4-SC PS1 AC OK			Unit Name
02	S/N 0000001			Serial number of unit
03	S03973	V4.01		Firmware I.D.
04	A01511			Hardware I.D.
05	IP MASK:	192.168.25.13 255.255.255.0		IP address and subnet mask of transmitter. **Note:** This value may take approximately 1-2 minutes to update after a change.
06	MOD_TEMP RANGE	25.0C 0…70C	O	Temperature inside unit O = OK ⇒ < 70°C U = Urgent alarm ⇒ ≥ 70°C
07	RAIL_1 RANGE	26.5Vdc 26…35Vdc	O	+26.5Vdc Voltage rail O = OK ⇒ 26.0…35.0Vdc N = Non-urgent alarm ⇒ > 35.0V U = Urgent alarm ⇒ < 26.0Vdc
08	RAIL_2 RANGE	14.5Vdc 14…23Vdc	O	+14.5Vdc Voltage rail O = OK ⇒ 14.0…23.0Vdc N = Non-urgent alarm ⇒ >23.0Vdc U = Urgent alarm ⇒ <14.0Vdc
09	RAIL_3 RANGE	-14.5Vdc -14…-23Vdc	O	-14.5Vdc Voltage rail O = OK ⇒ -14.0…-23.0Vdc N = Non-urgent alarm ⇒ < -23.0Vdc U = Urgent alarm ⇒ > -14.0Vdc
10	RAIL_4 RANGE	7.5Vdc 7…15Vdc	O	+7.5Vdc Voltage rail O = OK ⇒ 7…15Vdc N = Non-urgent alarm ⇒ > 15Vdc U = Urgent alarm ⇒ < 7.0Vdc
Parameters 11…14 are not used				
15	ALM_R	ON	Z	Power supply alarm RED LED OFF = There is no urgent alarm, ON = There is an alarm, ⇒ urgent or non-urgent depending on parameter 16
16	ALM_G	OFF	Z	Power supply alarm GREEN LED OFF= There is an urgent alarm ON = No urgent alarm,⇒ non-urgent alarm if parameter 15 indicates YES

Parameter	Display (examples only)			Description
17	COM_ALM	OK	Z	This indicates the urgent alarm status from the unit OK = No alarm ALM = Urgent alarm
18	NOT_USED		A	This parameter is not used
19	NOT_USED		A	This parameter is not used
20	CONTRAST			Current **CONTROL2** Selection
21	NOT_USED		A	
22	BAY_ALM	OK	Z	Indicates urgent alarm status from units in the chassis within slots 1 to 10 OK = No alarm ALM = An alarm is present
23	CONTRAST	50		Displays contrast setting as set in **CONTROL3** menu item
Parameters 24…32 are not used				

Note:

The above values displayed are for monitoring purposes only and may vary in accuracy up to 10%

Status character definitions

O indicates Normal

N indicates Non-Urgent Alarm

U indicates Urgent Alarm

Z indicates No Alarm State

5.10 LT1310 / LT1550 - Parameter List and Alarm Limits for Transmitter

Parameter List - Page 1

Parameter	Display (examples only)			Parameter function
P01	LT1310-08-0-SC-0		Z	Model Number of unit
P02	S/N 0000001		Z	Serial Number of unit
P03	C00302	V3.85	Z	Firmware version installed in unit
P04	A00725		Z	Module PCB load
P05	BAY_NUM	1		Bay number transmitter is installed in
P06	1.MTEMP	34C	O	Temperature inside module O = OK 0…69 °C U = Urgent alarm ≥ 70 °C
P07	1.LCUR	70 mA	O	Laser bias current in mA O = OK 30…100 mA N = Non-urgent < 30 mA U = Urgent > 100 mA
P08	1.LPWR	16 mW	O	Laser optical power in mW
P09	1.OMI	4.0%	O	Optical modulation index *Correct reading dependent on P10 and P28*.
P10	1.ERF	25.00 dBmV	O	Total RF power / ch modulating the laser analogue & digital channels combined *Correct reading is dependent on P28* O = OK 20…35 dBmV N = Non-urgent < 20 dBmV U = Urgent > 35 dBmV
P11	1.RFI	40.00 dBmV	O	RF input power total, analogue channel *Independent of channel number* O = OK 20…55 dBmV U = Urgent < 20 dBmV U = Urgent > 55 dBV
P12	1.RFO	40.00 dBmV	O	RF output power of analogue channel prior to combining with digital channel *Independent of channel number*
P13	1.TECI	0.25 A	O	Thermo-electric current O = OK 0…1 A N = Non-urgent > 1 A

Parameter List - Page 1 (continued)

Parameter	Display (examples only)			Parameter function
P14	1.LTEMP	25C	O	Laser temperature O = OK 20…40 °C N = Non-urgent < 20 ° U = Urgent > 40 °C
P15	1.ALM-R	OFF	Z	Summary alarm LED, red indicator OFF No alarm ALM Urgent if P16 is OFF ALM Non-urgent if P16 is ON
P16	1.ALM-G	ON	Z	Summary alarm LED, green indicator ON No alarm if P15 is OFF ON Non-urgent if P15 is ON OFF Urgent alarm
P17	1.COMALM	OK	Z	Common alarm line, flags user interface if urgent OK No urgent alarm ALM Urgent alarm
P18	1.LSRBIAS	ON	O	Laser status ON Laser is on OFF Laser is off
P19	1.LSRCTRL	ON	O	Laser control ON Laser control is active, laser is on OFF Laser control not active, laser is off
P20	1.=>Page	1	O	Selected index parameter in **CONTROL2**
P21	1.TECOP	COOL	O	TEC operation COOL Cooling mode of operation HEAT Heating mode of operation
P22	1.ARFL	OK	O	State of analogue RF level OK RF level is OK LOW RF level is low, < 20 dBmV
P23	1.PAGE	1	Z	As defined by parameter P20
P24	1.PAGE	1	Z	Page number of parameter list, 1 or 2
P25	1.ANMODE	AGC	Z	Gain control mode for analogue channel AGC Automatic gain control mode MGC Manual gain control mode
P26	1.ANMGC	40	Z	MGC setting for analogue channel Range 1…99

Parameter List - Page 1 (continued)

Parameter	Display (examples only)			Parameter function
P27	1.DGMGC	60	Z	MGC setting for digital channel Range 1…99
P28	1.CHAN	42	Z	Number of channels in the system
P29	1.AGC	25.00 dBmV	Z	AGC setting of analogue channel
P30	1.AGC	LOCK	Z	State of AGC mode LOCK AGC is locked and operating NO AGC is not locked NO MGC mode selected
P31	1.SHUTDOWN	NO	Z	External shutdown status NO External shutdown not active YES External shutdown is active
P32	1.	NOT USED	Z	This parameter is not used

Note:

The above values displayed are for monitoring purposes only and may vary in accuracy up to 10%

Status character definitions

O indicates Normal

N indicates Non-Urgent Alarm

U indicates Urgent Alarm

Z indicates No Alarm State

Parameter List - Page 2

Parameter	Display (examples only)			Parameter function
P01	LT1310-08-0-SC-0		Z	Model Number of unit
P02	S/N 0109001		Z	Serial Number of unit
P03	C00302	V3.85	Z	Firmware version installed in unit
P04	A00725		Z	Module PCB load
P05	BAY_NUM	1		Bay number transmitter is installed in
P06	2.MTEMP	34C	O	Temperature inside module O = OK 0…69 °C U = Urgent alarm ≥70 °C
P07	2.+24	24.0Vdc	O	+24 Vdc power rail O = OK 22…26 Vdc U = Urgent < 22 Vdc U = Urgent > 26 Vdc
P08	2.+12	12.0Vdc	O	+12 Vdc power rail O = OK 11…13 Vdc U = Urgent < 11 Vdc U = Urgent > 13 Vdc
P09	2.-12	-12.0Vdc	O	-12 Vdc power rail O = OK -11…-13 Vdc U = Urgent > -11 Vdc U = Urgent < -13 Vdc
P10	2.+5	5.0Vdc	O	+5 Vdc power rail O = OK 4.5…5.5 Vdc U = Urgent < 4.5 Vdc U = Urgent > 5.5 Vdc
P11	2.+AUX	00.0Vdc	O	Auxiliary voltage rail *Not implemented in this model*
P12	2.TECV	0.60Vdc	O	Thermo-electric cooler voltage O = OK 0…1.9 Vdc U = Urgent > 1.9 Vdc
P13	2.TECI	0.25 A	O	Thermo-electric cooler current O = OK 0…1 A N = Non-urgent > 1 A

Parameter List - Page 2 (continued)

Parameter	Display (examples only)			Parameter function
P14	2.LTEMP	25C	O	Laser temperature O = OK 20…40 °C N = Non-urgent < 20 ° U = Urgent > 40 °C
P15	2.ALM-R	OFF	Z	Summary alarm LED, red indicator OFF No alarm ALM Urgent if P16 is OFF ALM Non-urgent if P16 is ON
P16	2.ALM-G	ON	Z	Summary alarm LED, green indicator ON No alarm if P15 is OFF ON Non-urgent if P15 is ON OFF Urgent alarm
P17	2.COMALM	OK	Z	Common alarm line, flags user interface if urgent OK No urgent alarm ALM Urgent alarm
P18	2.LSRBIAS	ON	O	Laser status ON Laser is on OFF Laser is off
P19	2.LSRCTRL	OFF	O	Laser control ON Laser control is active, laser is on OFF Laser control not active, laser is off
P20	1.Page	1	O	Selected index parameter in **CONTROL2**
P21	2.TECOP	COOL	O	TEC operation COOL Cooling mode of operation HEAT Heating mode of operation
P22	2.ARFL	OK	O	State of analogue RF level OK RF level is OK LOW RF level is low, < 20 dBmV
P23	2.PAGE	2	Z	As defined by parameter P20
P24	2.PAGE	2	Z	Page number of parameter list, 1 or 2
P25	2.ANMODE	AGC	Z	Gain control mode for analogue channel AGC Automatic gain control mode MGC Manual gain control mode
P26	2.ANMGC	40	Z	MGC setting for analogue channel Range 1…99

Parameter List - Page 2 (continued)

Parameter	Display (examples only)			Parameter function
P27	2.DGMGC	60	Z	MGC setting for digital channel Range 1…99
P28	2.CHAN	42	Z	Number of channels in the system
P29	2.AGC	25.00 dBmV	Z	AGC level of analogue channel
P30	2.AGC	LOCK	Z	State of AGC mode LOCK AGC is locked and operating NO AGC is not locked
P31	2.SHUTDOWN	NO	Z	External shutdown status NO External shutdown not active YES External shutdown is active
P32	2.	NOT USED	Z	This parameter is not used

Note:

The above values displayed are for monitoring purposes only and may vary in accuracy up to 10%

Status character definitions

O indicates Normal

N indicates Non-Urgent Alarm

U indicates Urgent Alarm

Z indicates No Alarm State

5.11 LT1310 / LT1550 - Parameter List and Alarm Limits for Forward Path Receiver

Parameter	Display (examples only)			Parameter function
P01	FPRM-100W-SC			Model Number of unit
P02	S/N 0200101			Serial Number of unit
P03	C00349	V3.82		Firmware version installed in unit
P04	A00934			PBN's part number of Module
P05	BAY_NUM	1		Bay number receiver is installed in
P06	MODTEMP	34C	O	Temperature inside module O = OK 0…69 °C U = urgent alarm ≥ 70 °C
P07	+24V	24.0Vdc	O	+24 Vdc power rail O = OK 22…26 Vdc U = Urgent < 22 Vdc U = Urgent > 26 Vdc
P08	+12V	12.0Vdc	O	+12 Vdc power rail O = OK 11…13 Vdc U = Urgent < 11 Vdc U = Urgent > 13 Vdc
P09	-12V	-12.0Vdc	O	-12 Vdc power rail O = OK -11…-13 Vdc U = Urgent > -11 Vdc U = Urgent < -13 Vdc
P10	+5V	5.0Vdc	O	+5 Vdc power rail O = OK 4.5…5.5 Vdc U = Urgent < 4.5 Vdc U = Urgent > 5.5 Vdc
P11	OPT.IN	0.0 dBm	O	Optical input level,
P12	RXOMI	4.0%	O	OMI reading
P13	RFOCH	44dBmV	O	RF output level per channel O = OK 32…52 dBmV N = Non-urgent < 32 dBmV U = Urgent > 52 dBmV
P14	NOT USED		A	Parameter is not used
P15	ALM-R	OFF	O	Summary alarm LED, red indicator OFF No alarm ON Urgent if P16 is OFF ON Non-urgent if P16 is ON

Parameter	Display (examples only)			Parameter function
P16	ALM-G	ON	O	Summary alarm LED, green indicator ON No alarm if P15 is OFF ON Non-urgent if P15 is ON OFF Urgent alarm
P17	COMALM	OK	O	Common alarm line OK No urgent alarm ALM Urgent alarm
P18	MODE	AGC	O	Indicates current gain control setting, MGC or AGC
P19	MGC/AGC	AGC	O	Indicates current gain control setting, MGC or AGC
P20	=> Channels		O	Selected index parameter in **CONTROL2**
P21	NOT USED		Z	This parameter is not used
P22	AGC	LOCK	Z	AGC lock status LOCK AGC is locked NO AGC is not locked
P23	CHANNELS	32	O	As defined by parameter P20
P24	MGCSET	30	Z	MGC setting Range 1…99, factory setting printed on test sheet
P25	SLOPE	01	Z	Slope for RF path Range 0…25 dB, factory setting printed on test sheet
P26	CHANNELS	42	Z	Number of channels in the system Range 1…99, factory setting printed on test sheet
P27	AGC	42.0dBmV	Z	AGC level of analogue channel
Parameters 28 to 32 are not used				

Note:

The above values displayed are for monitoring purposes only and may vary in accuracy up to 10%

Status character definitions

O indicates Normal

N indicates Non-Urgent Alarm

U indicates Urgent Alarm

Z indicates No Alarm State

5.12 LT1310 / LT1550 - Parameter List and Alarm Limits for Return Path Receivers

The following example descriptions correspond to local receiver 1 (RX1)

Parameter	Display (examples only)			Description
01	[RX1] RPQRM			Model number of unit
02	S/N 0000001			Serial number of unit
03	S03848	V4.02		Firmware number and version installed in unit
04	A01362			PBN's part number of module
05	BAY_NUM	2		Bay number receiver is installed in
06	RX1_TEMP	25.0C	O	Temperature inside module O = Ok (≤ 69 °C) U = Urgent alarm (≥ 70 °C)
07	RX1_VR1	32.0V	O	Raw DC voltage from power supply O = Ok status 22…38 Vdc N = Non-urgent < 22 Vdc U = Urgent alarm > 38 Vdc
08	RX1_V12	12.0 V	O	+12 Vdc rail monitored, analogue reading O = Ok status 11…13 Vdc N = Non-urgent < 11 Vdc U = Urgent alarm > 13 Vdc
09	RX1_V5	5.0 V	O	+5 Vdc (logic) rail monitored, analogue reading O = Ok status 4.5…5.5 Vdc N = Non-urgent < 4.5 Vdc U = Urgent alarm > 5.5 Vdc
10	RX1_V5R	5.0 V	O	+5 Vdc (RF) rail monitored, analogue reading O = Ok status 4.5…5.5 Vdc N = Non-urgent > 4.5 Vdc U = Urgent alarm < 5.5 Vdc
11	RX1_RF	45dBmV	Z	Broadband RF level
12	RX1OP	0.50dBm	O	Received optical level O = Ok status -10…+3 dBm N = Non-urgent < -10 dBm U = Urgent alarm > +3 dBm
13	RX1_PLT	32dBmV	O	Pilot tone RSSI O = Ok status 10…42 dBmV N = Non-urgent < 10 dBmV N = Non-urgent > +42 dBmV
14	RX1_Not Used		A	Parameter is not used

Parameter list for local receiver (continued)

Parameter	Display (examples only)			Description
15	RX1_ALM_R	OFF	Z	Urgent alarm status OFF No alarm ON There is an alarm (urgent or non-urgent) depending on state of parameter 16 alarm
16	RX1_ALM_G	ON	Z	Non-urgent alarm status OFF There is an urgent alarm ON No urgent alarm, but there may be a non-urgent alarm if parameter 15 indicates ON also
17	RX1_ALM	OK	Z	Common alarm status OK No urgent alarms ALM Urgent alarm
18	RX1_MODE	ON	O	Mirror of Control 1
19	RX1_STATE	ON	O	Control 1
20	RX1 [INDEX]	OK	O	Control 2
21	RX1 NOT_USED		A	Parameter is not used
22	RX1_AGCLK	OK	Z	AGC status OK AGC is ON and locked NO AGC is not ON
23	RX1GAIN	20.0dB	Z	Control 3
24	RX1_LOC			Page status
25	RX1GAIN	20.0dB	Z	Gain level
26	RX1_ATT	0dB	Z	O/p attenuator level
27	RX1_AGC	OFF	Z	Gain control status
28	RX1_SMS	OFF	Z	SMS ON/OFF
29	RX1_RG	20.0dB	Z	AGC reference gain level
30	RX1_APL	32dBmV	Z	AGC pilot set
31	RX1 NOT_USED		A	Parameter is not used
32	STATUS	FFFF0000Z		Combined alarm status

Note:

The displayed parameters and limits are dependent on the return transmitter used at the remote node. The following example corresponds to the ODNRT-A. For other nodes, refer to the operation manual provided with the node for a complete list of parameters.

The following example descriptions correspond to remote node (RN1)

Parameter	Display (examples only)			Description
01	[RN1] ODNRT-A			Model number of transmitter unit inside the remote node (vi)
02	S/N 0000001			Serial number of the transmitter unit
03	NOT_USED		A	This parameter is not used
04	NOT_USED		A	This parameter is not used
05	REM_ADR	0.001	Z	Unique address of transmitter
06	RN1_TEMP	25.0C	O	Temperature inside the remote node
07	RN1RO	0.0 dBm	O	Received optical power at remote node (from forward receiver)
08	RN_TO	3.0 dBm	O	Transmit optical power from remote node (from return transmitter)
09	RN1GR	-1.0 dBm	O	Secondary received optical power at remote node (secondary forward path receiver)
10	RN1_LB	45.0 mA	Z	Laser bias current of remote node transmitter
11	RN1AC	62.3 Vac	O	AC voltage input to remote node
12	RN1_DC	13.5 Vdc	O	DC voltage at remote node
13	RN1RR	5.0 dBm	Z	Forward path total RF power output at remote node (v)
14	RN1TR	LOW	Z	Return path RF level, input to transmitter Used in certain models only
15	RN1_UALM	OK	O	Remote Node (RN), urgent alarm flag OK RN is operating within limits ALM RN has an urgent alarm
16	RN1_NALM	OK	O	Remote Node (RN), non-urgent alarm OK RN is operating within limits ALM RN has a non-urgent alarm
17	RN1_FLG1	ON	O	Indicates whether the optical node is being tampered with (ii) ON Tamper activated OFF Normal condition
18	RN1_MODE	ON	O	Remote node monitoring (RNM) ON RNM is enabled OFF RNM is disabled (iii)

Parameter list for remote node (continued)

Parameter	Display (Examples)			Description
19	RN1_STATE	OFF	O	Remote node transmitter monitoring state ON RNM is enabled OFF RNM is disabled (iii)
20	RN1 [SELECT]		O	Remote node # number selected
21	RN1_FLG2	ON	O	Optical switch alarm state (iv) ON Alarm OFF OK
22	RN1_FLG4	ON	O	Optical receiver switch status ON Secondary receiver OFF Primary receiver
23	RN1_REM	CH1	Z	Control 3
24	RN1_REM	CH1	Z	Remote channel select
25	RN1_CTL1	6dB	Z	Remote Control 1
26	RN1_CTL2	0dB	Z	Remote Control 2
27	RN1_CTL3	48dB	Z	Remote Control 3
28	RN1_CTL4	12dB	Z	Remote Control 4
29	RN1 NOT_USED		A	This parameter is not used
30	RN1 NOT_USED		A	This parameter is not used
31	RN1 NOT_USED		A	This parameter is not used
32	STATUS	FFFF0000Z		Combined alarm status

Notes:

(i) The values displayed are for monitoring purpose and may vary in accuracy by up to 10%.

(ii) The ODN1315 may be fitted with a tamper switch kit. If fitted, this will display “ON” when the lid of the optical node is open and cause an urgent alarm condition.

(iii) When these parameters are OFF, the user will not be able to view the above parameter list as the monitoring of the remote node will be disabled.

(iv) The optical switch alarm and optical receiver switch status are parameters relating to the forward path optical receiver/s in the ODN1315.

Notes continued:

(v) Parameter 13, RN#RR. The total RF power reading does not directly relate to the number of channels used in the system. To determine the level per channel, use the following:

(dBm reading) - (dBch factor) = dBm per channel

To convert dBm to dBmV, add 48.75 dB to dBm per channel

where dBch factor is the dB factor corresponding to the number of channels in the system. Refer to the table below.

(vi) Parameter 1 indicates the model of the return transmitter connecting to the RPQRM (these models must be ordered with the SMS option).

Number of Channels	dBch factor
1	0
2	3
4	6
8	9
16	12
32	15
64	18
128	21

5.13 LT1310 / LT1550 - Parameter List and Alarm Limits for Erbium Doped Fibre Amplifier

Parameter	Display (examples only)			Description
01	EDFAM-40-1-SC			Model Number of unit
02	S/N 0003001			Serial Number of unit
03	C00175	V4.00		Firmware version installed in unit
04	A00485			PBN's part number of Module
05	SLOT_NUM	9		Slot number of unit inside chassis. Set by internal bus plane of OCMC
06	MOD_TEMP	25C	O	Temperature inside module O= ok ⇒ (0°C – 69°C) or U = urgent alarm ⇒ (≥69°C)
07	OPT_IN	0dBm	O	Optical input power in dBm O = level is OK, (≥ -5 dBm) U = urgent alarm = LOW = < -5 dBm
08	OPT_OUT	16dBm	O	Optical output power in dBm O = level is OK, (as rated) LOW = level is low, (< 3 dB from rated power)
09	PUMP1	248mA	O	Pump 1 laser current in mA
10	PUMP2	136mA	O	Pump 2 laser current in mA
11	COOLER1	340mA	O	Cooler current 1 in mA
12	COOLER2	300mA	O	Cooler current 2 in mA
13	LASER1	120mW	O	Pump laser power 1
14	LASER2	74mW	O	Pump laser power 2
15	ALM_LED_R	OFF		Summary Alarm RED LED OFF= there is no urgent alarm ON= there is an urgent alarm
16	ALM_LED_G	ON		Summary Alarm GREEN LED OFF= there is an urgent alarm ON = no urgent alarm
17	EDFA_ALM	OK		This indicates the alarm status from the EDFAM unit OK = no alarm ALM= alarm
18	LSR_SHUT	NO	Z	Laser shut down state NO = shut down not activated YES = shut down activated

Parameter	Display (examples only)			Description
19	LSR_SHUT	NO	Z	Laser shut down state NO = shut down not activated YES = shut down activated
20	INP_LOW	NO	Z	Input power low indicator NO = input power is OK, ≥ -5 dBm YES = input power is too low, < -5 dBm
21	OUT_LOW	NO	Z	Output power low indicator NO = output power is OK YES = output power is too low, < 3 dB from rated power
22	PUMP_ALM	NO	Z	Pump laser alarm NO = pump lasers are OK YES = pump lasers have failed
23	NOT USED		Z	This parameter is not used
Parameters 23…32 are not used.				
32	NOT USED		Z	This parameter is not used

Note:

The above values displayed are for monitoring purposes only and may vary in accuracy up to 10%

Status character definitions

O indicates Normal

N indicates Non-Urgent Alarm

U indicates Urgent Alarm

Z indicates No Alarm State

6 Specifications

6.1 LT1310 Specifications

Optical Forward Path Transmitter

Wavelength	1310 nm
Output power	1~31 mW
Laser RIN ***(relative intensity noise)***	-156 dBHz to -160 dBHz
Connector	SC/APC, E2000/APC
Return loss	> 60 dB

RF Forward Path Transmitter

Bandwidth	45~1000 MHz
Flatness	± 0.75 dB
Input level	25 dBmV *(for 4% OMI, factory set)*
AGC range	-15 dB to +7 dB
Input connectors	SCTE - F
Input impedance	75 Ω
Test points	-20 dB Mini-SMB 75 Ω

Forward Path Link Performance

64 PAL B/G,D channels

CNR	> 53 dB
CSO	> 64 dBc
CTB	> 70 dBc

42 CENELEC carriers (as per EN50083-3)

CNR	> 53 dB
CSO	> 63 dBc
CTB	> 67 dBc

79 NTSC CW channels + Digital

CNR	> 54 dB
CSO	> 64 dBc
CTB	> 65 dBc

Measured in a typical system with 4% OMI over 10 km single mode optical fibre with 0 dBm optical input on a FPRM optical receiver.

Optical Return Path Receivers

Wavelength	1300 nm to 1610 nm
Input power	-10 dBm to +3 dBm
Connectors	SC/APC, E2000/APC
Return loss	> 50 dB

RF Return Path Receiver

Bandwidth	5~200 MHz
Flatness	± 0.75 dB
Output level	40 dBmV *(@ -3dBm, 6% OMI)*
Gain control range	0 dB to 20 dB
Pilot AGC detection	4.5 MHz @ -13 dB
FSK demodulator ***(For detection of remote node SMS data)***	Fitted with SNMP option only
Ingress mute steps	+6 dB to -42 dB *(in 6 dB steps)*
Output connectors	SCTE - F
Output impedance	75 Ω
Output return loss	> 14 dB
Test points	-20 dB Mini-SMB 75 Ω

Return Path Link Performance

Measured in a typical system with ODNRT-A, 10 km single mode optical fibre, -2 dBm optical input.

CNR (5 MHz NBW)	> 48 dB (6% OMI)
IMD2	> 52 dB (4 tones at 6% OMI)
NPR	> 40 dB over dynamic range of 15 dB using 35 MHz noise loading

General

Mains power	90~264 Vac 50/60 Hz
Operating temperature	0 °C to 45 °C
Dimensions ***(H x W x D)***	44 x 483 x 360 mm
Weight	4.5 kg
Ship size ***(H x W x D)***	120 x 510 x 490 mm
Ship weight	6.7 kg
Craft port	USB on front panel
Network port ***(optional)***	10BaseT *(SNMP/HTTP)*

6.2 LT1550 Specifications

Optical and RF

Optical wavelength	One ITU grid channel in the 1550 nm range
Optical output power options	6, 8, 10, 20, 40, 80, 100, 120, 160, 200, 250, 320, 400 mW
Optical return loss	> 60 dB
Optical connectors	SC/APC, E2000/APC, FC/APC
Laser RIN	< -155 dB/Hz
RF bandwidth	45 MHz to 1000 MHz
RF input level	25 dBmV for 4% OMI
RF flatness	± 0.75 dB
RF gain control	-15 dB to +5 dB
RF input	75 Ω, SCTE F-type
RF test point	-20 dB±1dB, 75 Ω Mini-SMB

General

Power	90 Vac to 264 Vac, 50 Hz to 60 Hz
Operating temperature	0 °C to 45 °C
Dimensions (H x W x D)	44 x 483 x 360 mm
Ship size (H x W x D)	120 x 510 x 490 mm
Weight	5 kg
Ship weight	5.5 kg
RF connectors	SCTE F-type
Craft port	USB on front panel
Network port *(option SNMPI)*	10BaseT with HTTP and SNMP
Local system management	via front panel display and keyboard
Remote management *(option SNMP)*	via integrated web server (HTTP) via NMS3-NetCraft field tool (SNMP) *(free inclusion with SNMP option)* via NMS3-Enterprise-II network operating software (SNMP)

Link Performance for 6, 8 or 10 mW

64 PAL B/G, D channels

CNR:	> 53 dB
CSO:	> 56 dBc
CTB:	> 62 dBc

42 CENELEC channels (as per EN50083-3)

CNR:	> 53 dB
CSO:	> 55 dBc
CTB:	> 61 dBc

79 NTSC CW channels + digital

CNR:	> 54 dB
CSO:	> 56 dBc
CTB:	> 61 dBc

This link performance is measured at 0 dBm optical input, 1550nm 10 km SMF and 4% OMI for 45~870 MHz.

Link Performance for 20, 40, 80, 100, 120, 160, 200, 250, 320, 400 mW

64 PAL B/G, D channels

CNR:	> 52 dB
CSO:	> 56 dBc
CTB:	> 62 dBc

42 CENELEC channels (as per EN50083-3)

CNR:	> 52 dB
CSO:	> 55 dBc
CTB:	> 61 dBc

79 NTSC CW channels + digital

CNR:	> 53 dB
CSO:	> 56 dBc
CTB:	> 61 dBc

This link performance is measured at 0 dBm optical input, 1550nm 10 km SMF and 4% OMI for 45~870 MHz.

7 Product Warranty

Pacific Broadband Networks warrants its equipment to be free of manufacturing defects in material and workmanship for a period of one year from date of shipment, provided it is installed and operated in accordance with factory recommendations.

The liability of Pacific Broadband Networks under this warranty is solely limited to repairing; replacing or issuing credit provided that:

1. The warranty registration has been completed and received by Pacific Broadband Networks.
2. Pacific Broadband Networks' helpdesk is promptly notified in writing or by telephone that a failure or defect has occurred.
3. A return authorisation number is obtained from Pacific Broadband Networks' helpdesk and clearly marked on the outside of the shipping container and all documents.
4. Customer is responsible for all shipping and handling charges. C.O.D. and freight collect will not be accepted without prior approval from Pacific Broadband Networks' helpdesk.
5. The equipment (in PBN's sole discretion) has not been abused, misused or operated under conditions outside manufacturer's specifications.

The warranty does not cover the following:

1. Products purchased from someone other than an authorised Pacific Broadband Networks dealer.
2. Damage caused by accident, negligence, misuse, abuse, improper operation or failure to operate the equipment within the manufacturer's specifications.
3. Damage caused by fluctuation in electrical current, lightning, power surges, etc.
4. Damage resulting from overhaul, repair or attempt to repair caused by someone other than Pacific Broadband Networks' qualified service personnel.
5. Any product, in which the serial number has been defaced, modified or removed.
6. Any product that has been opened or modified without prior written permission from PBN.
7. Replacement of parts necessitated by normal wear and tear.
8. Any consequential or implied damages.
9. Pacific Broadband Networks will not be liable for DFB Laser failure after 90 days from receipt of item. Any claim for DFB Lasers will be presented to the laser vendor for replacement. Pacific Broadband Networks will make every effort to replace faulty lasers although ultimate judgement is at the laser vendor's discretion. Pacific Broadband Networks will provide all labour costs associated with the replacement of the laser within the one-year warranty period.

8 Declaration of Conformity

According to ISO/IEC Guide 22 and EN45014

Manufacturer's Name:	Pacific Broadband Networks
Manufacturer's Address:	8-10 Keith Campbell Court, Scoresby, Victoria 3179, Australia
Declares, that the product Product Name:	LT1310 – Laser Transmitter with Forward or Return Receivers LT1550 – Laser Transmitter with Erbium Doped Fibre Amplifier

Conforms to the following standards:

Safety:	EN 80083-1, EN 60950, IEC 950, AS/NZS 3260:1993, EN-60825-1, IEC 825-1, AS/NZS 2211.1 Laser Safety
EMC:	EN 50083-2, EN-55022:1994, IEC/CISPR 22:1993, AS/NZS CISPR 22:2006
CATV/HFC:	EN-50083

Supplementary Information:

CE

This is a class A product. In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate measures.

The product herewith complies with the requirements of the following directives and carries the CE-marking accordingly:

- The EMC Directive 89/336/EEC
- The Low Voltage Directive 73/23/EEC

The product was tested in a typical configuration with Pacific Broadband Networks.

FCC WARNING

This equipment has been tested and found to comply with the limits for class A device, pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against harmful interference in a commercial installation. This equipment generates, uses and can radiate radio frequency and, if not installed in and used in accordance with the instructions, may cause harmful interference to radio communication. Operation of this equipment in a residential area is likely to cause harmful interference, in which case, the user will be required to correct the interference at the user's own expense.

For Compliance Information ONLY, contact:

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9 Notes

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