Cisco 1.2 GHz GS7000 Node

Installation and Operation Guide

For Your Safety

Explanation of Warning and Caution Icons

Avoid personal injury and product damage! Do not proceed beyond any symbol until you fully understand the indicated conditions.

The following warning and caution icons alert you to important information about the safe operation of this product:

You may find this symbol in the document that accompanies this product. This symbol indicates important operating or maintenance instructions.

You may find this symbol affixed to the product. This symbol indicates a live terminal where a dangerous voltage may be present; the tip of the flash points to the terminal device.

You may find this symbol affixed to the product. This symbol indicates a protective ground terminal.

You may find this symbol affixed to the product. This symbol indicates a chassis terminal (normally used for equipotential bonding).

You may find this symbol affixed to the product. This symbol warns of a potentially hot surface.

You may find this symbol affixed to the product and in this document. This symbol indicates an infrared laser that transmits intensity-modulated light and emits invisible laser radiation or an LED that transmits intensity-modulated light.

Important

Please read this entire guide. If this guide provides installation or operation instructions, give particular attention to all safety statements included in this guide.

Notices

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Contents

Important Safety Instructions

Read and Retain Instructions

Carefully read all safety and operating instructions before operating this equipment, and retain them for future reference.

Follow Instructions and Heed Warnings

Follow all operating and use instructions. Pay attention to all warnings and cautions in the operating instructions, as well as those that are affixed to this equipment.

Terminology

The terms defined below are used in this document. The definitions given are based on those found in safety standards.

Service Personnel - The term *service personnel* applies to trained and qualified individuals who are allowed to install, replace, or service electrical equipment. The service personnel are expected to use their experience and technical skills to avoid possible injury to themselves and others due to hazards that exist in service and restricted access areas.

User and Operator - The terms *user* and *operator* apply to persons other than service personnel.

Ground(ing) and Earth(ing) - The terms *ground(ing)* and *earth(ing)* are synonymous. This document uses ground(ing) for clarity, but it can be interpreted as having the same meaning as earth(ing).

Electric Shock Hazard

This equipment meets applicable safety standards.

WARNING:

To reduce risk of electric shock, perform only the instructions that are included in the operating instructions. Refer all servicing to qualified service personnel only.

Electric shock can cause personal injury or even death. Avoid direct contact with dangerous voltages at all times.

Know the following safety warnings and guidelines:

- Only qualified service personnel are allowed to perform equipment installation or replacement.
- Only qualified service personnel are allowed to remove chassis covers and access any of the components inside the chassis.

Equipment Placement

> **WARNING:**
> **Avoid personal injury and damage to this equipment. An unstable mounting surface may cause this equipment to fall.**

To protect against equipment damage or injury to personnel, comply with the following:

- Install this equipment in a restricted access location (access restricted to service personnel).
- Make sure the mounting surface or rack is stable and can support the size and weight of this equipment.

Strand (Aerial) Installation

> **CAUTION:**
> **Be aware of the size and weight of strand-mounted equipment during the installation operation.**
> **Ensure that the strand can safely support the equipment's weight.**

Pedestal, Service Closet, Equipment Room or Underground Vault Installation

> **WARNING:**
> **Avoid the possibility of personal injury. Ensure proper handling/lifting techniques are employed when working in confined spaces with heavy equipment.**

- Ensure this equipment is securely fastened to the mounting surface or rack where necessary to protect against damage due to any disturbance and subsequent fall.
- Ensure the mounting surface or rack is appropriately anchored according to manufacturer's specifications.
- Ensure the installation site meets the ventilation requirements given in the equipment's data sheet to avoid the possibility of equipment overheating.
- Ensure the installation site and operating environment is compatible with the equipment's International Protection (IP) rating specified in the equipment's data sheet.

Connection to Network Power Sources

Refer to this equipment's specific installation instructions in this manual or in companion manuals in this series for connection to network ferro-resonant AC power sources.

AC Power Shunts

AC power shunts may be provided with this equipment.

Important: The power shunts (where provided) must be removed before installing modules into a powered housing. With the shunts removed, power surge to the components and RF-connectors is reduced.

CAUTION:
RF connectors and housing seizure assemblies can be damaged if shunts are not removed from the equipment before installing or removing modules from the housing.

Equipotential Bonding

If this equipment is equipped with an external chassis terminal marked with the IEC 60417-5020 chassis icon ( ), the installer should refer to CENELEC standard EN 50083-1 or IEC standard IEC 60728-11 for correct equipotential bonding connection instructions.

General Servicing Precautions

WARNING:
Avoid electric shock! Opening or removing this equipment's cover may expose you to dangerous voltages.

CAUTION:
These servicing precautions are for the guidance of qualified service personnel only. To reduce the risk of electric shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

Be aware of the following general precautions and guidelines:

- **Servicing** - Servicing is required when this equipment has been damaged in any way, such as power supply cord or plug is damaged, liquid has been spilled or objects have fallen into this equipment, this equipment has been exposed to rain or moisture, does not operate normally, or has been dropped.
- **Wristwatch and Jewelry** - For personal safety and to avoid damage of this equipment during service and repair, do not wear electrically conducting objects such as a wristwatch or jewelry.
- **Lightning** - Do not work on this equipment, or connect or disconnect cables, during periods of lightning.
- **Labels** - Do not remove any warning labels. Replace damaged or illegible warning labels with new ones.
- **Covers** - Do not open the cover of this equipment and attempt service unless instructed to do so in the instructions. Refer all servicing to qualified service personnel only.

- **Moisture** - Do not allow moisture to enter this equipment.
- **Cleaning** - Use a damp cloth for cleaning.
- **Safety Checks** - After service, assemble this equipment and perform safety checks to ensure it is safe to use before putting it back into operation.

Electrostatic Discharge

Electrostatic discharge (ESD) results from the static electricity buildup on the human body and other objects. This static discharge can degrade components and cause failures.

Take the following precautions against electrostatic discharge:

- Use an anti-static bench mat and a wrist strap or ankle strap designed to safely ground ESD potentials through a resistive element.
- Keep components in their anti-static packaging until installed.
- Avoid touching electronic components when installing a module.

Batteries

This product may contain batteries. Special instructions apply regarding the safe use and disposal of batteries:

Safety

- Insert batteries correctly. There may be a risk of explosion if the batteries are incorrectly inserted.
- Do not attempt to recharge ‘disposable’ or ‘non-reusable’ batteries.
- Please follow instructions provided for charging ‘rechargeable’ batteries.
- Replace batteries with the same or equivalent type recommended by manufacturer.
- Do not expose batteries to temperatures above 100°C (212°F).

Disposal

- The batteries may contain substances that could be harmful to the environment
- Recycle or dispose of batteries in accordance with the battery manufacturer’s instructions and local/national disposal and recycling regulations.

廢電池請回收

- The batteries may contain perchlorate, a known hazardous substance, so special handling and disposal of this product might be necessary. For more information about perchlorate and best management practices for perchlorate-containing substance, see www.dtsc.ca.gov/hazardouswaste/perchlorate.

Modifications

This equipment has been designed and tested to comply with applicable safety, laser safety, and EMC regulations, codes, and standards to ensure safe operation in its intended environment. Refer to this equipment's data sheet for details about regulatory compliance approvals.

Do not make modifications to this equipment. Any changes or modifications could void the user’s authority to operate this equipment.

Modifications have the potential to degrade the level of protection built into this equipment, putting people and property at risk of injury or damage. Those persons making any modifications expose themselves to the penalties arising from proven non-compliance with regulatory requirements and to civil litigation for compensation in respect of consequential damages or injury.

Accessories

Use only attachments or accessories specified by the manufacturer.

Electromagnetic Compatibility Regulatory Requirements

This equipment meets applicable electromagnetic compatibility (EMC) regulatory requirements. Refer to this equipment's data sheet for details about regulatory compliance approvals. EMC performance is dependent upon the use of correctly shielded cables of good quality for all external connections, except the power source, when installing this equipment.

- Ensure compliance with cable/connector specifications and associated installation instructions where given elsewhere in this manual.

EMC Compliance Statements

Where this equipment is subject to USA FCC and/or Industry Canada rules, the following statements apply:

FCC Statement for Class A Equipment

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when this equipment is operated in a commercial environment.

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

Industry Canada - Industrie Canadiene Statement

This apparatus complies with Canadian ICES-003.
Cet appareil est confome à la norme NMB-003 du Canada.

CENELEC/CISPR Statement with Respect to Class A Information Technology Equipment

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

Laser Safety

Introduction

This equipment contains an infrared laser that transmits intensity-modulated light and emits invisible radiation.

Warning: Radiation

WARNING:

- **Avoid personal injury! Use of controls, adjustments, or procedures other than those specified herein may result in hazardous radiation exposure.**
- **Avoid personal injury! The laser light source on this equipment (if a transmitter) or the fiber cables connected to this equipment emit invisible laser radiation. Avoid direct exposure to the laser light source.**
- **Avoid personal injury! Viewing the laser output (if a transmitter) or fiber cable with optical instruments (such as eye loupes, magnifiers, or microscopes) may pose an eye hazard.**

- Do not apply power to this equipment if the fiber is unmated or unterminated.
- Do not stare into an unmated fiber or at any mirror-like surface that could reflect light emitted from an unterminated fiber.
- Do not view an activated fiber with optical instruments (e.g., eye loupes, magnifiers, microscopes).
- Use safety-approved optical fiber cable to maintain compliance with applicable laser safety requirements.

Warning: Fiber Optic Cables

WARNING:

Avoid personal injury! Qualified service personnel may only perform the procedures in this manual. Wear safety glasses and use extreme caution when handling fiber optic cables, particularly during splicing or terminating operations. The thin glass fiber core at the center of the cable is fragile when exposed by the removal of cladding and buffer material. It easily fragments into glass splinters. Using tweezers, place splinters immediately in a sealed waste container and dispose of them safely in accordance with local regulations.

Safe Operation for Software Controlling Optical Transmission Equipment

If this manual discusses software, the software described is used to monitor and/or control ours and other vendors' electrical and optical equipment designed to transmit video, voice, or data signals. Certain safety precautions must be observed when operating equipment of this nature.

For equipment specific safety requirements, refer to the appropriate section of the equipment documentation.

For safe operation of this software, refer to the following warnings.

WARNING:

- **Ensure that all optical connections are complete or terminated before using this equipment to remotely control a laser device. An optical or laser device can pose a hazard to remotely located personnel when operated without their knowledge.**
- **Allow only personnel trained in laser safety to operate this software. Otherwise, injuries to personnel may occur.**
- **Restrict access of this software to authorized personnel only.**
- **Install this software in equipment that is located in a restricted access area.**

Laser Warning Labels

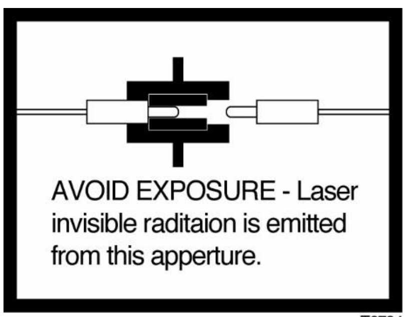
Maximum Laser Power

The maximum laser power that can be expected from the EDFA optical amplifier for various amplifier configurations is defined in the following table.

Output Power	Maximum Output	CDRH Classification	IEC 60825-1 Classification	IEC 60825-2 Hazard Level
17 dBm	17 dBm	1	1M	1M
20 dBm	20 dBm	1	1M	1M
22 dBm	22 dBm	1	1M	3B

Warning Labels

One or more of the labels shown below are located on this product.



T6784

T12630

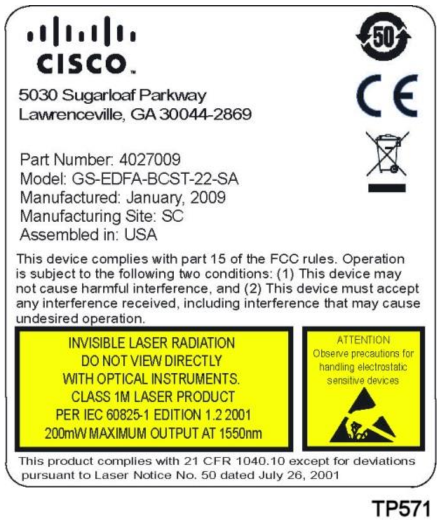
T12629

TP048

TP053

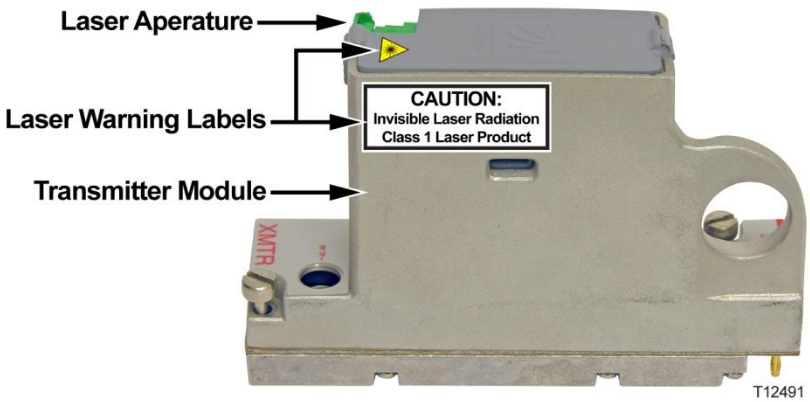
T13485

Laser Warning Labels



Location of Labels on Equipment

The following illustrations display the location of warning labels on this equipment.


Laser Aperature
Laser Warning Labels
CAUTION:
Invisible Laser Radiation
Class 1 Laser Product
Transmitter Module
XMTR
T12491


Laser Warning Label
Product ID/Laser Warning Label
Laser Aperture Warning Label
Laser Classification Label
EDFA Module
1550nm Optical Amplifier
EDFA
T14106

1

General Information

Introduction

This manual describes the installation and operation of the 1.2 GHz GS7000 Node.

In This Chapter

Equipment Description

Overview

This section contains a physical and functional description of the 1.2 GHz GS7000 Node.

Physical Description

The 1.2 GHz GS7000 Node is the latest generation 1.2 GHz optical node platform which uses the housing developed for the GS7000 Node Platform, but it has been painted for improved thermal performance. The housing has a hinged lid to allow access to the internal electrical and optical components. The housing also has provisions for strand, pedestal, or wall mounting.

Note: The 1.2 GHz GS7000 node is painted white, and the pictures in this document which use unpainted housings are used as references.

The base of the housing contains:

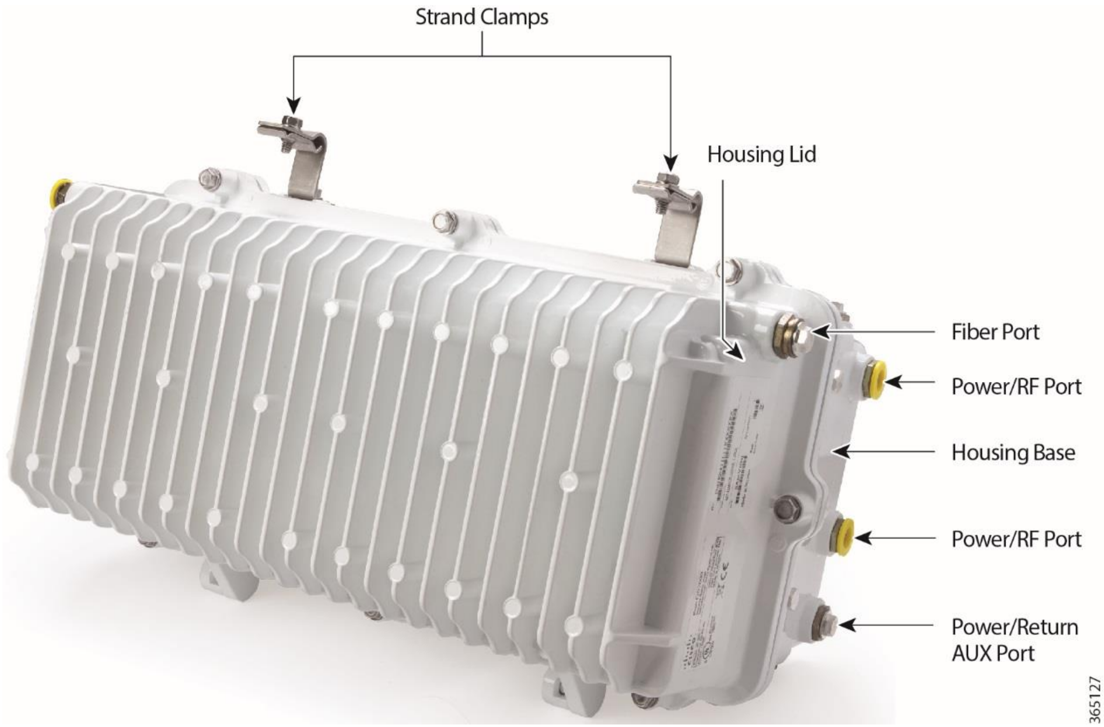
- an RF amplifier module
- AC power routing
- forward and reverse configuration modules (configuration will vary)

The lid of the housing contains:

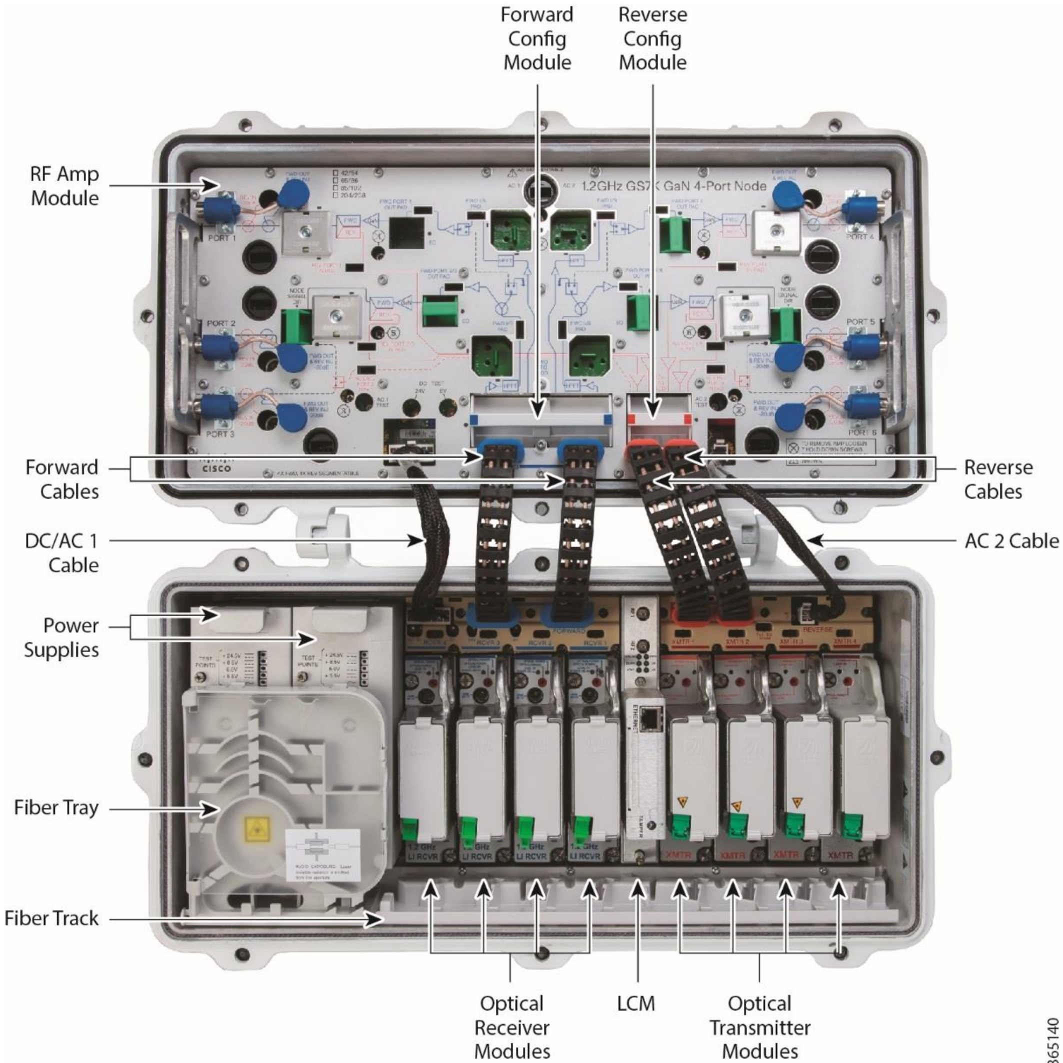
- a fiber management tray and track (included in all nodes)
- optical receiver and transmitter modules (configuration will vary)
- EDFA (erbium-doped fiber amplifier) modules and optical switch modules (for hub node application)
- power supplies (one or two)
- a status monitor/local control module (optional)

Not every 1.2 GHz GS7000 Node contains all of these modules. The 1.2 GHz GS7000 Node is a versatile node that can be configured to meet various network requirements.

The following illustration shows the external housing of the 1.2 GHz GS7000 Node.



The following illustration shows the 1.2 GHz GS7000 Node internal modules and components.



Functional Description

Node

The 1.2 GHz GS7000 Node is used in broadband hybrid fiber/coax (HFC) networks. It is configured with the receivers, transmitters, configuration modules, and other modules to meet your unique network requirements. This platform allows independent segmentation and redundancy for both the forward and reverse paths in a reliable, cost-effective package.

The 1.2 GHz GS7000 Node receives forward optical inputs, converts the input to an electrical radio frequency (RF) signal, and outputs the RF signals at up to six ports. The forward bandwidth is from 54 MHz (or 86, 102, 258 MHz) to 1218 MHz. The lower edge of the passband is primarily determined by the diplex filter and the reverse amplifier assembly. Diplex filter choices are 54 MHz, 86 MHz, 102 MHz, and 258 MHz.

The forward path of the 1.2 GHz GS7000 Node can be deployed with a broadcast 1310/1550 nm optical receiver with common services distributed to either four output ports (all high level) or six output ports (two high level and four lower level). The forward path can also be segmented by using one optical receiver that feeds all output ports, two independent optical receivers that each feed half of the node's output ports (left/right segmentation) or four independent optical receivers that feed four independent forward paths. Forward optical path redundancy is supported via the use of optional local control module. The type of forward segmentation and/or redundancy is determined by the type of RF amplifier assembly and Forward Configuration Module installed in the node.

The 1.2 GHz GS7000 Node's reverse path is equally flexible. Reverse traffic can be segmented or combined and routed to up to four DFB reverse optical transmitters, or up to four Enhanced Digital Return reverse optical transmitters as part of our EDR system. Redundant (back-up) transmitters may be utilized. In addition, an auxiliary input path is provided for reverse signal injection (5 - 210 MHz). Reverse segmentation and/or redundancy are determined by the type of Reverse Configuration Module installed in the node.

The 1.2 GHz GS7000 Node accepts Optical Transmitter Modules based on the existing 694x/GainMaker optical transmitters. Reverse optical transmitters can be installed to transmit data, video, or both. Reverse bandwidth is determined by the diplex filter and the reverse amplifier assembly. Diplex filter choices are 42/54 MHz, 65/86 MHz, 85/102 MHz, and 204/258 MHz.

The 1.2 GHz GS7000 Node utilizes the transmitter and receiver module covers that have been designed to allow fiber pigtails storage within them, providing improved fiber management within the node.

Up to four optical receivers and up to four analog or two digital transmitters can be installed in the 1.2 GHz GS7000 Node.

45 - 90 V AC input power is converted to +24.5, +8.5, -6.0, and +5.5 V DC by an internal power supply to power the 1.2 GHz GS7000 Node.

Hub Node

The GS7000 Hub Node performs the same functions as the GS7000 Node with the added benefit of also providing optical gain and optical switching capability. The hub node allows you to push fiber deeper into your network while taking advantage of the RF plant that is already in place.

The GS7000 Node can be upgraded to a GS7000 Hub Node in the field. This is accomplished by the installation of optical amplification (EDFA) modules, optical switching modules, and the Status Monitor/Local Control Module in the node lid. The GS7000 Hub Node can then serve as a traditional node feeding the local HFC plant and as an optical hub with the optical amplifiers. The node hub with the amplifiers can service up to 32 nodes at a distance of 50 km with only three fibers.

EDFAs are available in 17 dBm, 20 dBm, and 22 dBm for broadcast constant output power. A 17 dBm, 20 dBm and 21 dBm narrowcast constant gain EDFA version is available to fit any architecture for requirements like DWDM narrowcasting.

The optical switch module is used for switching the input of an EDFA module from a primary signal to a backup or secondary signal. The switch is monitored and controlled by the Status Monitor/Local Control Module (SM/LCM) in the node.

A specific model of the SM/LCM is required for use in the hub node. This SM/LCM model monitors and controls several EDFA and optical switch parameters and functions while continuing to monitor the standard node components.

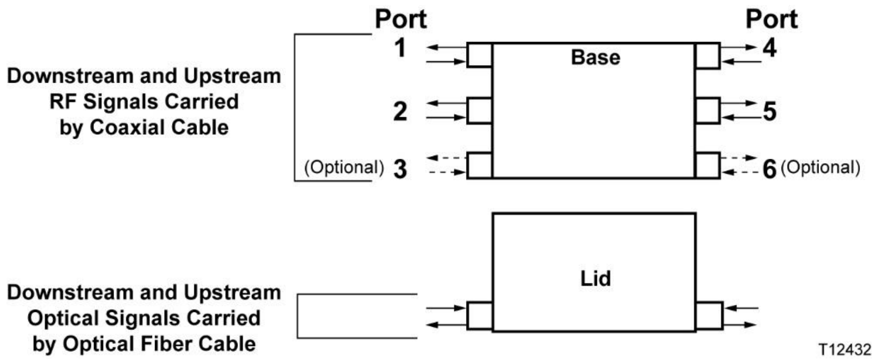
Features

The 1.2 GHz GS7000 Node has the following features:

- Six port 1.2 GHz RF platform
- Uses rugged GaN Technology on the output stage
- Uses standard GainMaker style accessories (i.e., attenuator pads, equalizers, diplexers and crowbar)
- Field accessible plug-in Forward Interstage Linear Equalizers, Forward/Reverse Configuration Modules, and Node Signal Directors
- 3-state reverse switch (on/off/-6 dB) allows each reverse input to be isolated for noise and ingress troubleshooting (status monitor or local control module required)
- Auxiliary reverse injection (5 - 210 MHz) configurable on up to 2 ports (port 3 or port 6)
- Positions for up to 4 optical receivers and 4 optical transmitters in housing lid
- Provides hub node functionality with addition of available optical amplifier and optical switch modules
- Optional low-cost Local Control Module may be installed in conjunction with a Redundant Forward Configuration Module to allow optical forward path redundancy when no status monitor is present
- Fiber entry ports on both ends of housing lid
- Fiber management tray and track provides easy access to fiber connections
- Primary and redundant power supplies with passive load sharing
- Spring loaded seizure assemblies allow coax connectors to be installed or removed without removing amplifier chassis or spring loaded mechanism from the rear of the housing base
- Dual/Split AC powering
- Space provided for mounting WDM modules inside the housing lid.

Node Inputs/Outputs Diagram

The following diagram shows the system-level inputs and outputs of the 1.2 GHz GS7000 Node.



- The AC can be applied to any RF port and routed, if required, to the other ports.
- The DC power supply modules can be fed by any RF port (1 through 6).

Modules Functional Descriptions

This table briefly describes each module. The 1.2 GHz GS7000 Node may not contain all these modules. See ***Theory of Operation*** (on page 15) for detailed descriptions of the modules.

Module	Description
RF Amplifier	The RF Amplifier Module includes: ■ four separate and independent forward amplification paths, each having one or two RF outputs. ■ four independent reverse inputs. ■ forward and reverse bandwidths that are established by diplexer and reverse amplifier assembly selection.

Module	Description
Forward Configuration	There are several types of this module. The 1x4 Forward Configuration Module (FCM) is used when the 1.2 GHz GS7000 Node is configured with a single optical receiver routed to all four outputs of the amplifiers. This module splits the signals equally to the inputs of the RF amplifier module. The 1x4 Forward Configuration Modules with forward RF injection are similar to the 1x4 Forward Configuration Modules, but are used with the Forward Local Injection (FLI) Module. The FLI Module routes an RF signal from an external source to the Forward Configuration Module which is then coupled with other inputs from an optical receiver. The 1x4 Redundant Forward Configuration Module is used when the 1.2 GHz GS7000 Node is configured with two optical receivers routed to all four outputs of the amplifiers in a redundant configuration. Receiver 1 is the primary receiver and Receiver 2 is the backup. The active receiver is selected with a status monitor or local control monitor.

Module	Description
Forward Configuration (cont'd)	The 1x4 Redundant Forward Configuration Modules with forward RF injection are similar to the 1x4 Redundant Forward Configuration Modules, but are used with the Forward Local Injection (FLI) Module. The FLI Module routes an RF signal from an external source to the Forward Configuration Module which is then coupled with other inputs from an optical receiver. The 2x4 Forward Configuration Module is used when the 1.2 GHz GS7000 Node is configured with two optical receivers, each feeding two/three outputs of the amplifier module. In this configuration, the node serving area is divided in half in the forward direction. Receiver 1 is routed to RF amplifier Ports 4 and 5/6, while Receiver 3 is routed to RF amplifier Ports 1 and 2/3. The 2x4 Redundant Forward Configuration Module is used when the GS7000 Node is configured with four optical receivers with each pair feeding two/three RF outputs of the amplifier module in a redundant configuration. In this configuration, the node serving area is divided in half, with redundancy, in the forward direction. Receivers 1 (primary) and 2 (redundant) are routed to RF amplifier Ports 4 and 5/6, while Receivers 3 (primary) and 4 (redundant) are routed to RF amplifier Ports 1 and 2/3. The active receiver is selected with a status monitor or local control monitor. The 3x4 Forward Configuration Module is used when the 1.2 GHz GS7000 Node is configured with three receivers each feeding one/two/three/four outputs of the amplifier module. Two versions of this module are available. In one version Receiver 1 is routed to RF amplifier ports 4/5/6, Receiver 3 is routed to port 1, and Receiver 4 is routed to ports 2/3. In the other version Receiver 1 is routed to RF amplifier ports 5/6, Receiver 2 is routed to port 4, and Receiver 4 is routed to ports 1/2/3. (Note that the 3x4 FCM can only be used with the 4-way RF amplifier module.) The 4x4 Forward Configuration Module is used when the 1.2 GHz GS7000 Node is configured with four optical receivers with each feeding separate RF outputs of the amplifier module. Receiver 1 is routed to RF amplifier Ports 5/6. Receiver 2 is routed to RF amplifier Port 4. Receiver 3 is routed to RF amplifier Port 1. Receiver 4 is routed to RF amplifier Ports 2/3. (Note that the 4x4 FCM can only be used with the 4-way RF amplifier module.)

Module	Description
Reverse Configuration	There are several types of this module. **The 4x1 Reverse Configuration Module (RCM) with auxiliary reverse RF injection** combines all four reverse RF inputs (Ports 1, 2/3, 4, and 5/6) of the node and routes the signal to Transmitter 1. An RF signal from an external source can optionally be injected and coupled with the reverse RF inputs on Ports 3/6 and routed to Transmitter 1. **The 4x1 Redundant Reverse Configuration Module** combines all four reverse RF signals (Ports 1, 2/3, 4 and 5/6) together, splits this RF signal and routes it to Transmitters 1 and 2. **The 4x2 Reverse Configuration Module with auxiliary reverse RF injection** combines reverse inputs from Ports 1 and 2/3 and routes them to Transmitter 1; it also combines reverse inputs from Ports 4 and 5/6 and routes them to Transmitter 3. An RF signal from an external source can optionally be injected and coupled with reverse RF inputs from Ports 3/6 and routed to Transmitter 1. **The 4x2 Redundant Reverse Configuration Module** combines reverse inputs from Ports 1 and 2/3 and routes them to Transmitters 1 and 2; it also combines reverse inputs from Ports 4 and 5/6 and routes them to Transmitters 3 and 4. **The 4x3 Reverse Configuration Module with auxiliary reverse RF injection** is available in two types. The left-combined/right-segmented version combines reverse inputs from Ports 1 and 2/3 and routes them to Transmitter 1; it also routes reverse inputs from Port 4 to Transmitter 3 and from Ports 5/6 to Transmitter 4. An RF signal from an external source can optionally be injected at Ports 3/6 and coupled with the reverse RF input from Port 1 and routed to Transmitter 1. The left-segmented/right-combined version combines reverse inputs from Ports 4 and 5/6 and routes them to Transmitter 4; it also routes reverse inputs from Port 1 to Transmitter 1 and from Ports 2/3 to Transmitter 2. An RF signal from an external source can optionally be injected at Ports 3/6 and coupled with the reverse RF inputs from Ports 2/3 and 1 and routed to Transmitter 1.
Reverse Configuration (cont'd)	**The 4x4 Reverse Configuration Module with auxiliary reverse RF injection** routes reverse inputs from Port 1 to Transmitter 1, from Port 2/3 to Transmitter 2, from Port 4 to Transmitter 3, and from Port 5/6 to Transmitter 4. An RF signal from an external source can optionally be injected and coupled with reverse RF inputs from Ports 3/6 and routed to Transmitter 1. (Note that this module is typically installed when using EDR multiplexing digital reverse modules. Since the digital reverse module occupies the physical space that transmitters 3 and 4 normally occupy in the node base, this reverse configuration module is typically used with a 6-port optical interface board.)
Optical Receiver	This module converts an optical signal from the headend into a forward path RF signal. An SC/APC fiber connector is standard. Optical power, test points, and status LEDs are provided.

Module	Description
Optical Transmitter	This module converts reverse path RF signals from the network into an optical signal. An SC/APC fiber connector is standard. Multiple transmitter options are available such as uncooled DFB, 1550 ITU, and EDR. EDR uses the included LC/APC connector that jumps over to an SC/APC bulkhead. Optical power, test points, and status LEDs are provided.
Optical Amplifier (EDFA)	Erbium-doped fiber amplifier modules are available in two categories: broadcast and narrowcast (gain-flattened). EDFAs are available in 17 dBm, 20 dBm, and 22 dBm for broadcast constant output power. A 17 dBm, 20 dBm and 21 dBm narrowcast constant gain EDFA version is available to fit any architecture for requirements like DWDM narrowcasting. EDFA modules are single-wide, single-output devices. The modules mount in receiver or transmitter slots on the optical interface board in the node lid using a reversible pin adapter. The EDFA is monitored and controlled by the Status Monitor/Local Control Module in the node.
Optical Switch	The optical switch module is used for switching the input of an EDFA module from a primary signal to a backup or secondary signal. The module mounts in receiver or transmitter slots on the optical interface board in the node lid using a reversible pin adapter. The switch is monitored and controlled by the Status Monitor/Local Control Module in the node.
Status Monitor/ Local Control Module (SM/LCM)	The local control module monitors the input optical power of up to four receivers and four transmitters, plus AC power entry and power supply voltage rails. It also provides local reverse path wink and shutdown capabilities through the PC-based GS7000 ViewPort software. It can be upgraded to a status monitor which provides node monitoring and control capability at the cable plant's headend. This module is not required for normal operation of the node. In a hub node application the SM/LCM also monitors and controls the operation of the EDFAs and optical switches.
Power Supply	The 1.2 GHz GS7000 power supply module has multiple output voltages of +24.5, +8.5, -6.0, and +5.5 V DC. A second power supply can be installed in the node for redundancy or load sharing. The 1.2 GHz GS7000 Node can be set up in the following powering configurations: ■ two power supplies powered by different AC sources ■ two power supplies using the same AC source ■ a single supply using a single AC source
Fiber Management Tray and Track	The fiber management system secures and protects the optical fiber inside the node housing.

Module	Description
Optical Interface Board	The Optical Interface Board (OIB) provides all interconnections between the modules in the housing lid of the 1.2 GHz GS7000 Node. Each module in the lid plugs directly into the OIB through a connector header or row of sockets. Input attenuator pads are provided on the OIB for each optical receiver in the housing lid. Output attenuator pads are provided on the OIB for each optical transmitter in the housing lid.

Ordering Information

The 1.2 GHz GS7000 Node is available in a wide variety of configurations. Please refer to the 1.2 GHz GS7000 Node Data Sheet for a full listing of the configured node, components, and accessories that are available.

Note: Please consult with your Account Representative, Customer Service Representative, or System Engineer to determine the best configuration PID for your particular application.

2

Theory of Operation

Introduction

This chapter describes the theory of operation for the 1.2 GHz GS7000 Node, including functional descriptions of each module in the node.

The 1.2 GHz GS7000 Node is comprised of two parts, the lid and the base.

The lid houses an optical interface board (OIB), and some of the following products: one to four optical receivers, one to four optical transmitters, one digital return module with one or two digital transmitters, EDFA (optional), optical switch (optional), a status monitor (optional) or a local control module (optional), one or two power supplies, and a fiber management tray/track.

The base houses the RF amplifier module and the accessories that plug into it. These accessories include a forward configuration module, four forward band linear equalizer modules, multiple attenuator pads, two node signal director jumper or splitter modules, and two auxiliary reverse injection director modules. Also contained within the launch amplifier module are a reverse auxiliary jumper/combiner/amplifier/termination module and a reverse configuration module.

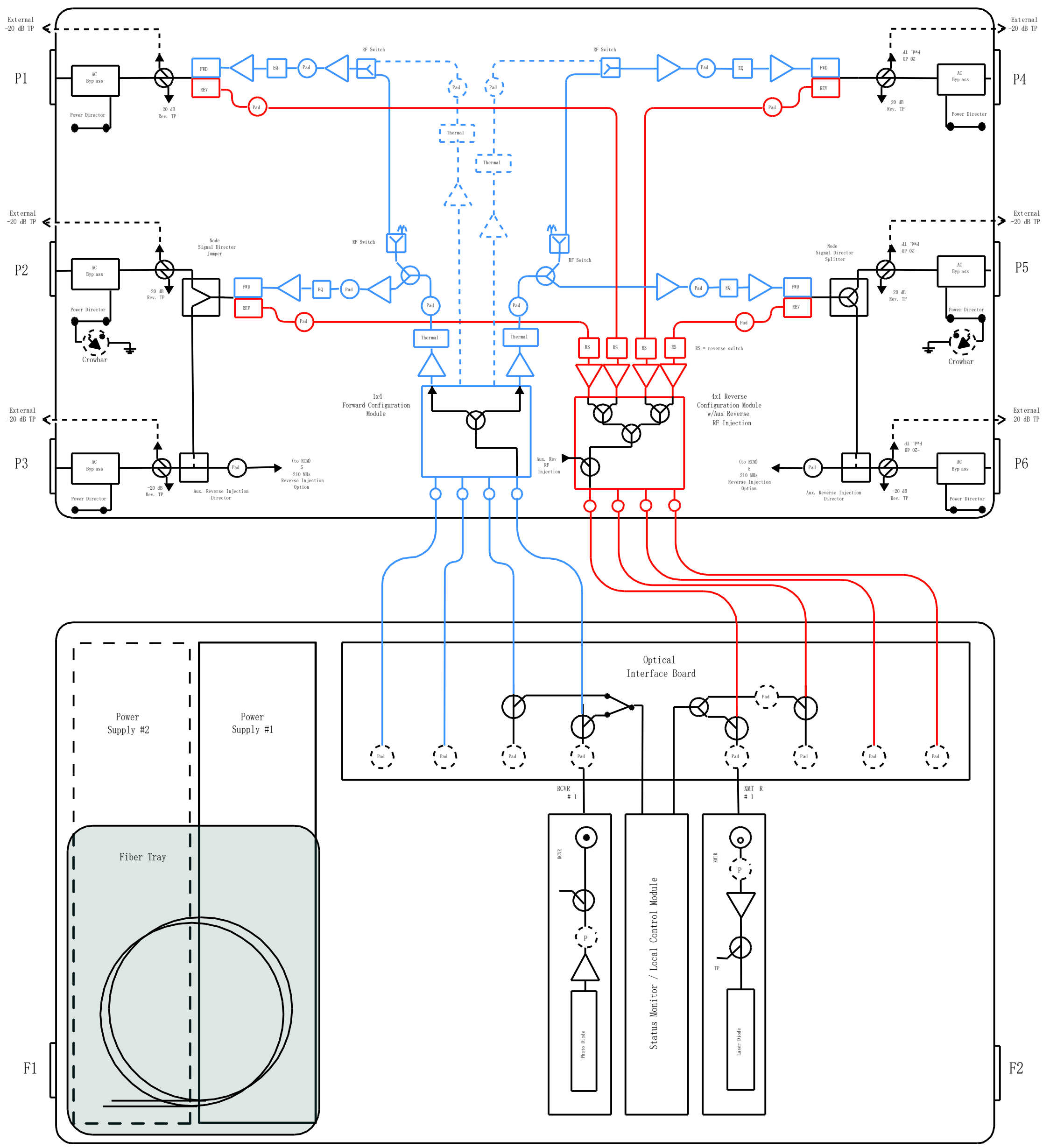
In This Chapter

System Diagrams

Functional Diagrams: 4-Way Forward Segmentable Node

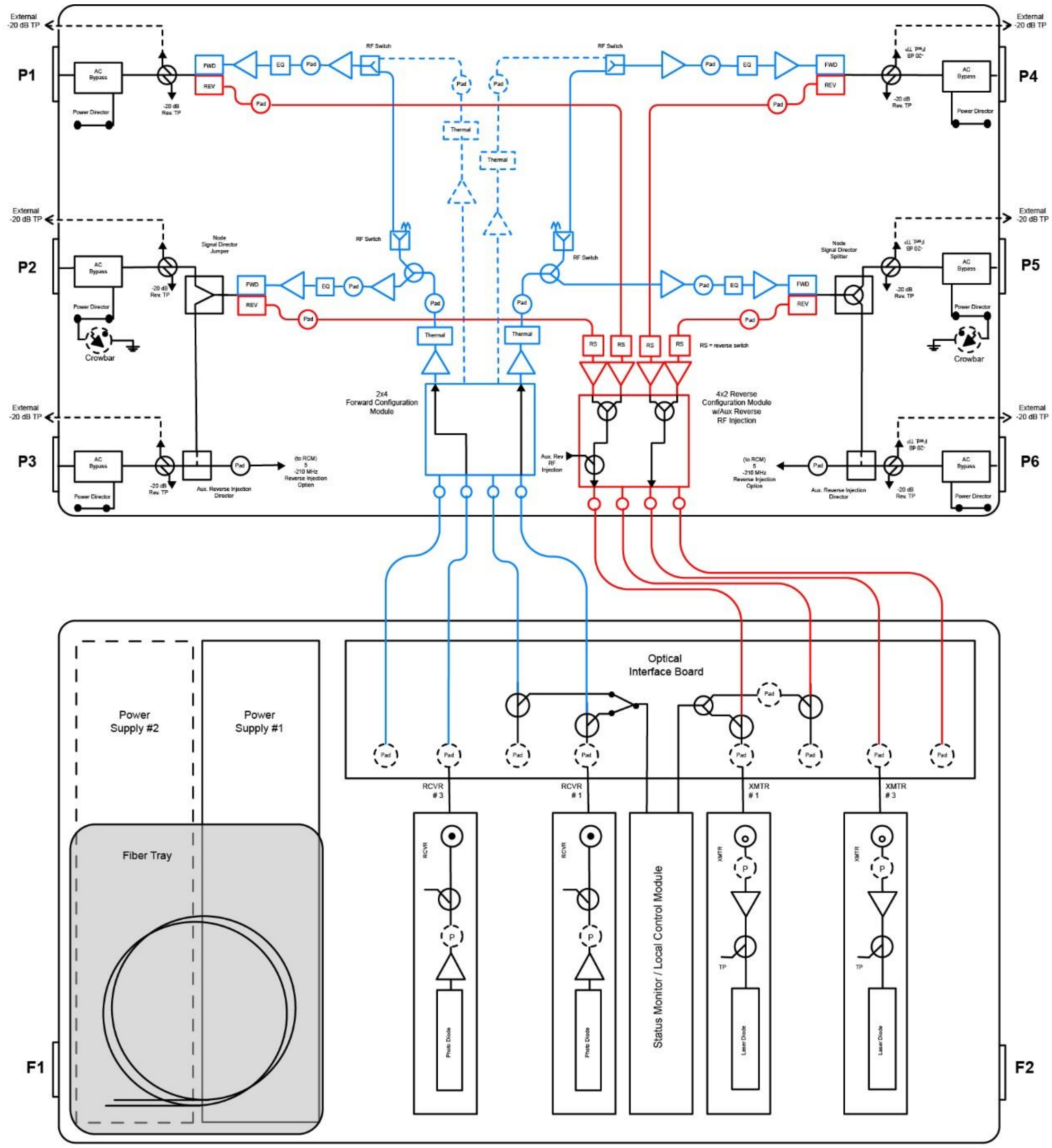
The following diagrams show the signal flow through the 4-way forward segmentable node.

Non-Segmented



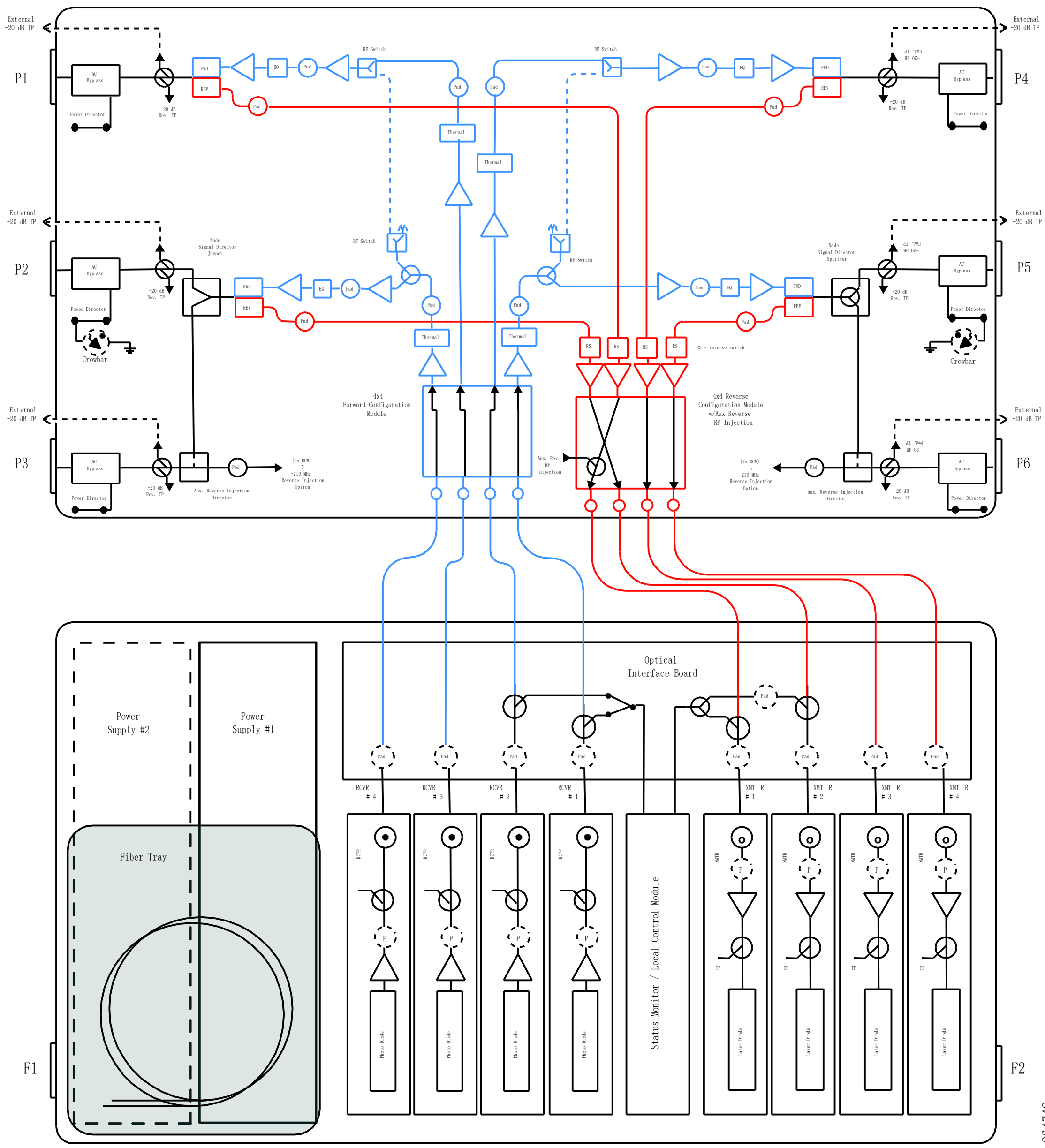
364743

Left-Right Segmented



364744

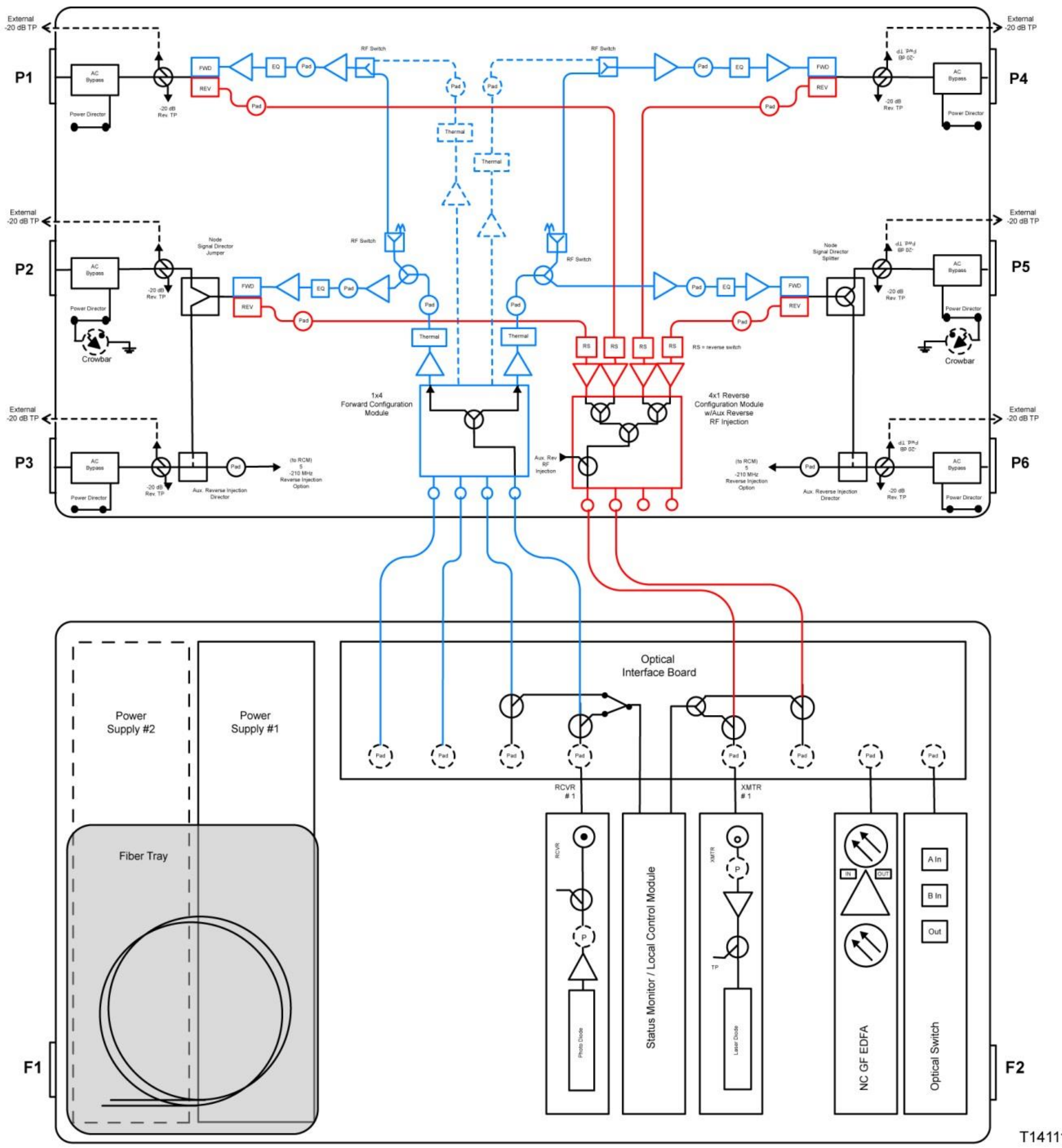
Fully Segmented



364742

Functional Diagram: Hub Node

The following diagram shows the signal flow through a 4-way non-segmented hub node.



Forward Path

Introduction

Forward path refers to signals received by the node from the headend. These signals are amplified in the node and routed to subscribers through the cable distribution network.

4-Way Forward Path Signal Routing

1.2 GHz GS7000 Node 4-way forward path signal routing functions are described below.

Stage	Description
1	1310 nm or 1550 nm optical signals from the headend are applied to receiver module 1 (and/or modules 2, 3, and 4, if used) in the 1.2 GHz GS7000 Node.
2	The receiver module detects the signal on the optical carrier applied to it and outputs an electrical RF signal to the node Optical Interface Board (OIB).
3	The RF signals travel across the OIB and cables to the Forward Configuration Module (FCM). The FCM determines how RF signals from the different receiver modules are routed to the four independent forward amplification paths in the RF amplifier module. The 1X4 FCM splits the RF signals entering it equally between the four forward amplification paths in the RF amplifier module.
4	Each of the forward amplification paths in the RF amplifier module is composed of one input amplification stage and one interstage amplification stages in series followed by a power doubler output amplification stage. This topology provides one driven output port for each of the forward amplification paths in the RF amplifier module, for a total of four driven node output ports.
5	Each of the forward amplification paths in the RF amplifier module also contains padding, trimming, thermal compensation, equalization, and filtering circuitry.
6	Node signal directors are present at two of the nodes forward output ports and allow the signals at those ports to be redirected to the nodes auxiliary output ports or split equally between the primary and auxiliary node output ports. In this way, the node can be configured to have up to six output ports.

Reverse Path

Introduction

Reverse path refers to signals received by the node from the cable distribution network. These signals are amplified in the node and returned to the headend optically through the fiber portion of the network. The reverse path is not used in all networks.

Reverse Path Signal Routing

1.2 GHz GS7000 Node reverse path signal routing functions are described below.

Stage	Description
1	Reverse path RF signals are applied to node output ports 1, 2, 4, and 5. A fifth reverse path RF signal can be applied to node auxiliary output port 3 or 6 if the node is configured for local reverse path injection.
2	The RF signals from each of the four node output ports are amplified independently in the RF amplifier module and routed to the Reverse Configuration Module (RCM).
3	Each of the reverse amplification paths in the RF amplifier module also contains padding, trimming, filtering, -6 db wink, and RF On/Off switch circuitry.
4	The RCM determines how RF signals from the different node output ports are combined and routed to the four transmitter module paths on the Optical Interface Board (OIB). The 4X1 RCM combines the reverse path signals from the four node output ports together and directs them to the transmitter module 1 path on the OIB. (Note that other RCMs combine and direct signals to OIB transmitter module paths 2, 3, and 4 differently.)
5	The RF signals travel across the OIB to transmitter module 1 (and/or modules 2, 3, and 4, if used and proper RCM is installed.) The transmitter modulates the RF signals entering it onto an optical carrier and routes it through the fiber portion of the network back to the headend.

Note: Node output ports 3 and 6 can be configured as primary reverse ports. See ***Reconfiguring Reverse Signal Routing*** (on page 108) for further details on this configuration.

Power Distribution

Introduction

The 1.2 GHz GS7000 Node is powered by one or two power supplies.

Power Distribution

1.2 GHz GS7000 Node power distribution functions are described below.

Stage	Description
1	45 to 90 V AC is applied to one or two power supply modules in the 1.2 GHz GS7000 Node.
2	The power supply module(s) convert(s) the AC input to +24.5, +8.5, -6.0, and +5.5 V DC.
3	The +24.5, +8.5, -6.0, and +5.5 V DC lines are routed to 1.2 GHz GS7000 Node internal modules.
4	If two power supplies are installed and both are active, the load is shared equally between them.
5	An AC segmentable shunt is available to separate the AC connection to ports 1-3 from that of ports 4-6. This allows the node to be configured where one power supply is powered from ports 1-3 and a second power supply is powered from ports 4-6.

RF Amplifier Module

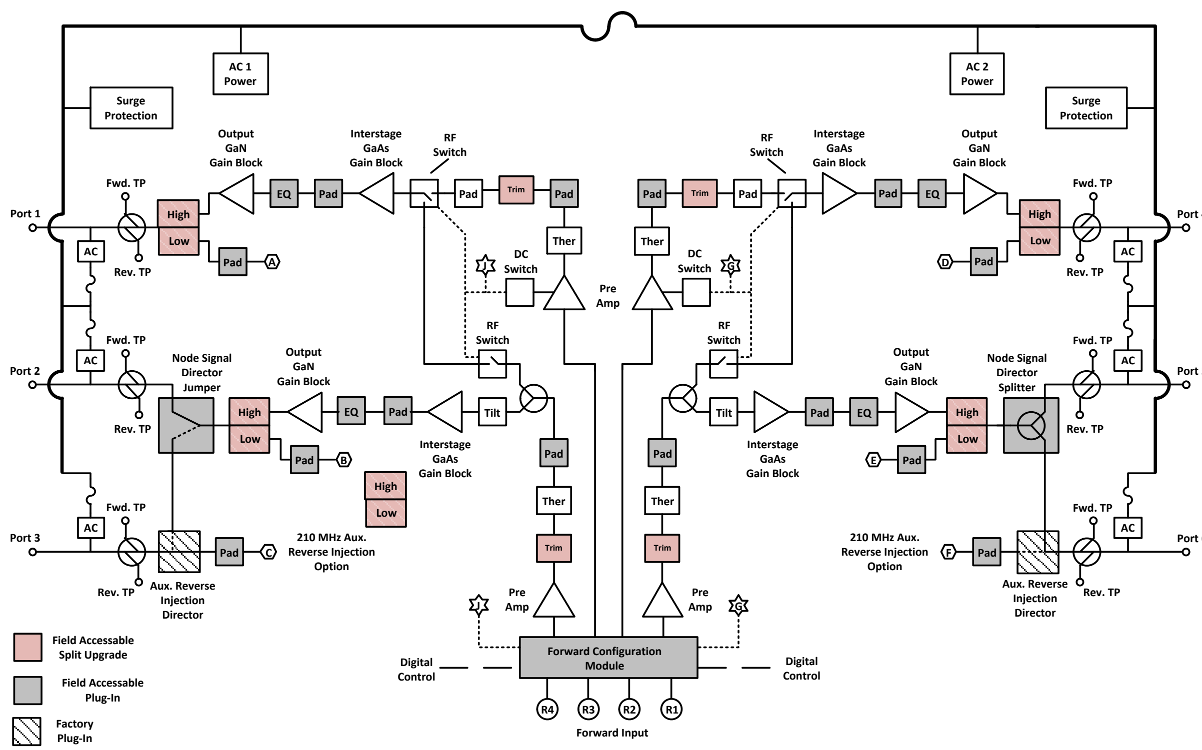
Introduction

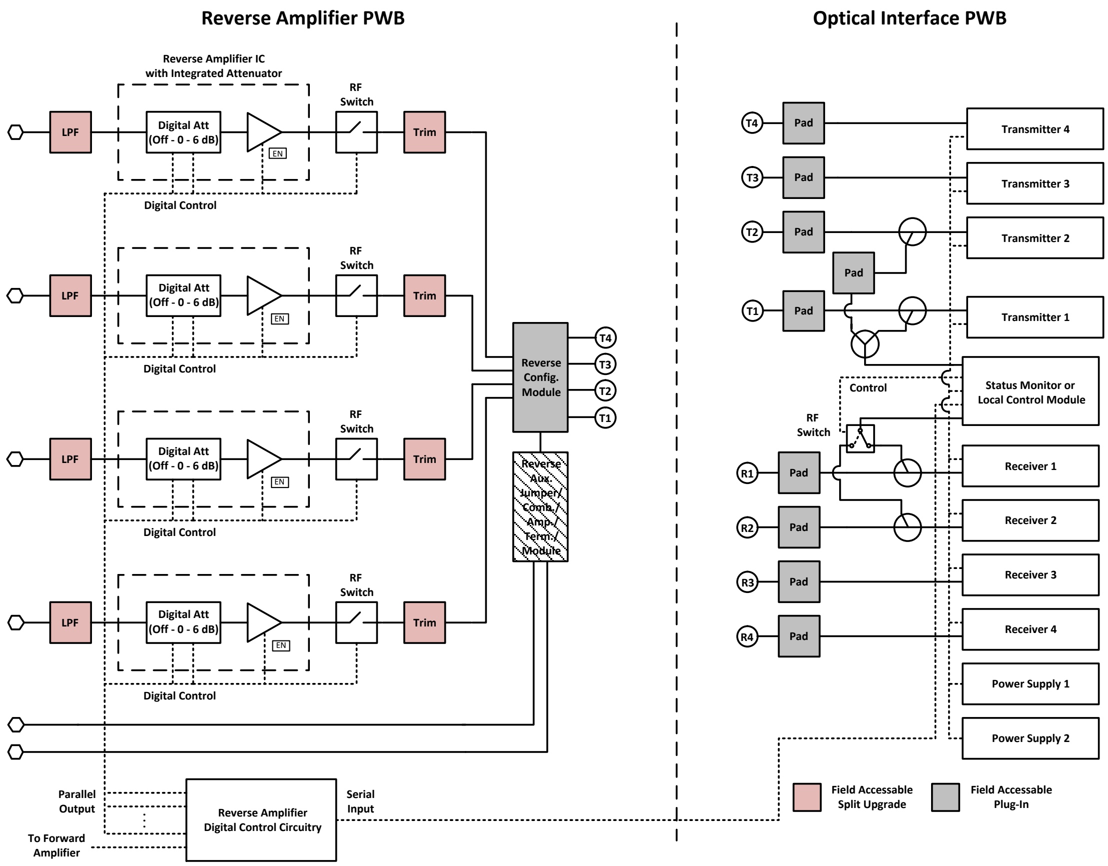
This section describes the RF amplifier module. The RF amplifier module contains the forward band and the reverse band amplifiers.

Functional Diagrams

The following diagrams show how the RF amplifier functions.

1.2GHz GS7000 Node
4 Way Forward Segmentable Launch Amplifier Module





Forward Band Amplification 4-Way Path Description

The RF amplifier module provides all forward signal amplification outside the optical receiver modules in the GS7000 Node.

The 4-way segmentable launch amplifier contains four independent forward amplification paths, each having one input near the center of the amplifier module and one, two or three outputs at one end of the amplifier module. Each of the forward paths is comprised of the forward configuration module, an input gain block, a frequency response trim circuit, a thermal compensation circuit, an inter-stage pad, a 2-way splitter or RF switch circuit, an inter-stage gain block, a plug-in forward band linear equalizer, an output pad, an output gain block, a diplex filter, a bi-directional 20 dB down forward test point, and finally an AC bypass circuit.

The thermal circuit on the RF amplifier module is designed to compensate for the RF forward path thermal movement of the entire node RF station. This includes the forward path amplifier module circuitry, RF cables, and optical interface board circuitry. It does not include the thermal movement of the optical receivers.

Forward Configuration Module

The forward configuration module determines the forward path topology in the RF amplifier module and the 1.2 GHz GS7000 Node. The output signals from one to four optical receivers enter the forward configuration module where they are combined and or directed to the two or four independent forward paths in the RF amplifier module. Forward path segmentation and/or redundancy are set by plugging the appropriate forward configuration module into the RF amplifier module. The forward configuration module is a plug-in, field accessible module. See ***Forward Configuration Module*** (on page 28) for more information.

Forward Band Linear Equalizer Module

The forward band linear equalizer module sets the overall forward path tilt of the RF amplifier module and the 1.2 GHz GS7000 Node. The 1.2GHz GS7000 Node launch amplifier is shipped with four 18.0 dB linear equalizers installed in the RF amplifier module. One equalizer is installed in each of the four amplifier module forward paths. This sets the nodes forward path tilt to 17.5 dB linear. Forward band linear equalizer modules of other values are available. This allows the nodes forward path tilt to be adjusted as needed. The forward band linear equalizer module is a plug-in, field accessible module. See the equalizer charts in ***Appendix A - Technical Information***.

Node Signal Director Jumper/Splitter Module

The node signal director jumper/splitter module is a plug-in, field accessible module. It is present on the center output ports on either end of the RF amplifier module. The orientation of these modules determines where the RF amplifiers center output port signals are directed. The node signal director jumper allows the center output port signals to be routed to either the amplifiers primary center output port or to its auxiliary corner output port. The node signal director splitter module splits the center output port signals equally between the primary and auxiliary output ports.

Auxiliary Reverse Injection Director Module

The auxiliary reverse injection director module is a plug-in module. It is accessible only after the RF amplifier modules cover has been removed. Auxiliary reverse injection director modules are present on the auxiliary corner output ports on either end of the RF amplifier module. The orientation of these modules determine if the nodes auxiliary output ports are configured to be primary or split node output ports, or local reverse injection ports.

Reverse Band Amplification Path Description

The RF amplifier module provides all reverse signal amplification outside the optical transmitter modules in the 1.2 GHz GS7000 Node. It contains four independent reverse paths comprised of an AC bypass circuit, a bi-directional 20 dB down reverse test point, a diplex filter, an input pad, a low pass filter, a 6 dB switched attenuator, a 16 dB gain block, a second low pass filter, an RF on/off switch, a frequency response trim circuit, and a reverse configuration module. The 6 dB switched attenuator and RF on/off switch circuits allow each reverse path to have 6 dB (wink) and on/off capabilities. These circuits are controllable from the headend via the status monitor or locally via the local control module and a hand held controller. A serial communication link is provided between status monitor or local control module and the reverse band launch amplifier. Circuitry on the amplifier converts the serial communications to parallel control signals and routes them as needed.

The RF amplifier module also provides the routing for the auxiliary ports, 5 to 210 MHz reverse band local injection signals. Each of the two auxiliary port reverse band local injection paths is comprised of an AC bypass circuit, a bi-directional 20 dB down reverse test point, an input pad, and a reverse auxiliary jumper/amplifier/termination module. Signals from port 3 or port 6 of the nodes auxiliary path are directed by the reverse auxiliary/jumper/amplifier/termination module to the reverse configuration module.

Reverse Configuration Module

The reverse configuration module determines the reverse path topology in the RF amplifier module and 1.2 GHz GS7000 Node. The input signals from four independent amplifier module output ports and possibly the auxiliary reverse injection amplifier module port enter the reverse configuration module where they are combined and/or directed to one to four optical transmitters. Reverse path segmentation and or redundancy as well the ability to locally inject signals into the reverse path of the amplifier is set by plugging the appropriate reverse configuration module into the RF amplifier module. The reverse configuration module is a plug-in, field accessible module. See ***Reverse Configuration Module*** (on page 33) for more information.

Reverse Auxiliary Jumper/Combiner/Amplifier/Termination Module

The reverse auxiliary jumper/combiner/amplifier/termination module determines how reverse band signals, locally injected into the RF amplifier modules auxiliary ports, are routed within the amplifier module. The reverse auxiliary jumper module directs signals for one of the RF amplifiers auxiliary ports to the reverse configuration module.

The reverse auxiliary amplifier module amplifies signals for one or both of the RF amplifiers auxiliary ports and directs them to the reverse configuration module. The reverse auxiliary termination module terminates both auxiliary port reverse injection signal paths in 75 ohms as well as the path to the reverse configuration module.

Forward Configuration Module

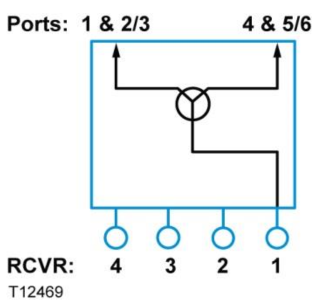
Introduction

The forward configuration module determines the forward path topology in the RF amplifier module and the 1.2 GHz GS7000 Node. The output signals from one to four optical receivers enter the forward configuration module where they are combined or directed to the four independent forward paths in the RF amplifier module. The various types of the forward configuration module are described below.

1x4 Forward Configuration Modules Description

The 1x4 Forward Configuration Module is used when the 1.2 GHz GS7000 Node is configured with a single optical receiver routed to all four outputs of the RF amplifier module. This module splits the signals equally to the inputs of the RF amplifier module.

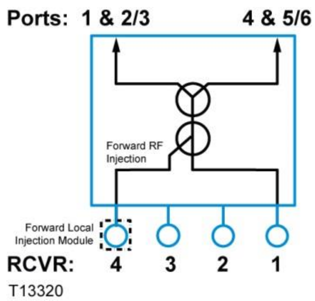
The following diagram shows how this module functions.



1x4 Forward Configuration Modules with Forward RF Injection Description

The 1x4 Forward Configuration Modules with forward RF injection are similar to the 1x4 Forward Configuration Modules, but are used with the Forward Local Injection (FLI) Module. The FLI Module routes an RF signal from an external source to the Forward Configuration Module which is then coupled with other inputs from an optical receiver.

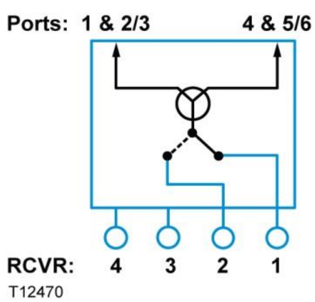
The following diagram shows how this module functions.



1x4 Redundant Forward Configuration Modules Description

The 1x4 Redundant Forward Configuration Module is used when the 1.2 GHz GS7000 Node is configured with two optical receivers routed to all four outputs of the amplifiers in a redundant configuration. Receiver 1 is the primary receiver and Receiver 2 is the backup. The active receiver is selected with a digital signal from the status monitor/local control module.

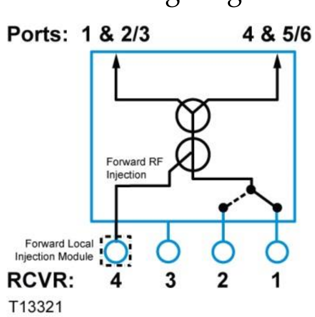
The following diagram shows how this module functions.



1x4 Redundant Forward Configuration Modules with Forward RF Injection Description

The 1x4 Redundant Forward Configuration Modules with forward RF injection are similar to the 1x4 Redundant Forward Configuration Modules, but are used with the Forward Local Injection (FLI) Module. The FLI Module routes an RF signal from an external source to the Forward Configuration Module which is then coupled with other inputs from an optical receiver.

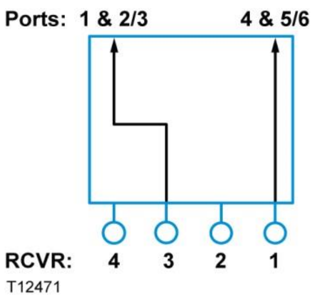
The following diagram shows how this module functions.



2x4 Forward Configuration Modules Description

The 2x4 Forward Configuration Module is used when the 1.2 GHz GS7000 Node is configured with two optical receivers, each feeding two outputs of the amplifier module. In this configuration, the node serving area is divided in half in the forward direction. Receiver 1 is routed to RF amplifier Ports 4 and 5/6, while Receiver 3 is routed to RF amplifier Ports 1 and 2/3.

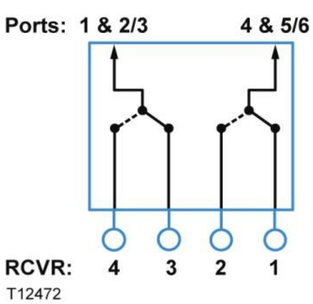
The following diagram shows how this module functions.



2x4 Redundant Forward Configuration Modules Description

The 2x4 Redundant Forward Configuration Module is used when the 1.2 GHz GS7000 Node is configured with four optical receivers with each pair feeding two RF outputs of the amplifier module in a redundant configuration. In this configuration, the node serving area is divided in half for redundancy in the forward direction. Receivers 1 (primary) and 2 (redundant) are routed to RF amplifier Ports 4 and 5/6, while Receivers 3 (primary) and 4 (redundant) are routed to RF amplifier Ports 1 and 2/3. The active receiver is selected with digital signal from the status monitor/local control module.

The following diagram shows how this module functions.

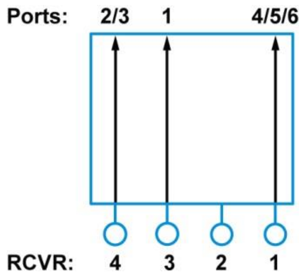


3x4-1, 3, 4 Forward Configuration Module Description

The 3x4-1, 3, 4 Forward Configuration Module is used when the 1.2 GHz GS7000 Node is configured with three receivers each feeding one/two/three/four outputs of the amplifier module. Receiver 1 is routed to RF amplifier ports 4/5/6, Receiver 3 is routed to port 1, and Receiver 4 is routed to ports 2/3.

Note: The 3x4-1, 3, 4 FCM can only be used with the 4-way RF amplifier module.

The following diagram shows how this module functions.



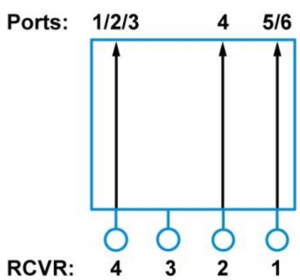
T13871

3x4-1, 2, 4 Forward Configuration Module Description

The 3x4-1, 2, 4 Forward Configuration Module is used when the 1.2 GHz GS7000 Node is configured with three receivers each feeding one/two/three/four outputs of the amplifier module. Receiver 1 is routed to RF amplifier ports 5/6, Receiver 2 is routed to port 4, and Receiver 4 is routed to ports 1/2/3.

Note: The 3x4-1, 2, 4 FCM can only be used with the 4-way RF amplifier module.

The following diagram shows how this module functions.



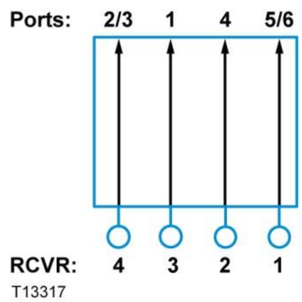
T13872

4x4 Forward Configuration Module Description

The 4x4 Forward Configuration Module is used when the 1.2 GHz GS7000 Node is configured with four optical receivers with each feeding separate RF outputs of the amplifier module. Receiver 1 is routed to RF amplifier Ports 5/6. Receiver 2 is routed to RF amplifier Port 4. Receiver 3 is routed to RF amplifier Port 1. Receiver 4 is routed to RF amplifier Ports 2/3.

Note: The 4x4 FCM can only be used with the 4-way RF amplifier module.

The following diagram shows how this module functions.


Ports:
2/3
1
4
5/6
RCVR:
4
3
2
1
T13317

Reverse Configuration Module

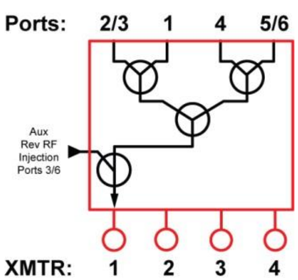
Introduction

The reverse configuration module determines the reverse path topology in the RF amplifier module and 1.2 GHz GS7000 Node. The input signals from four independent amplifier module output ports enter the reverse configuration module where they are combined and/or directed to one to four optical transmitters. The various types of the reverse configuration module are described below.

4x1 Reverse Configuration Module with Auxiliary Reverse RF Injection Description

The 4x1 Reverse Configuration Module with auxiliary reverse RF injection combines all four reverse RF inputs (Ports 1, 2/3, 4, and 5/6) of the node and routes the signal to Transmitter 1. An RF signal from an external source can optionally be injected and coupled with the reverse RF inputs on Ports 3/6 and routed to Transmitter 1.

The following diagram shows how this module functions.

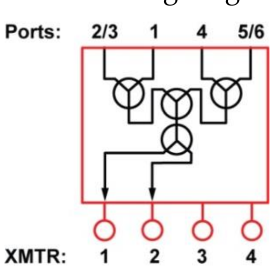


T12473

4x1 Redundant Reverse Configuration Module Description

The 4x1 Redundant Reverse Configuration Module combines all four reverse RF signals (Ports 1, 2/3, 4 and 5/6) together, splits this RF signal and routes it to Transmitters 1 and 2.

The following diagram shows how this module functions.



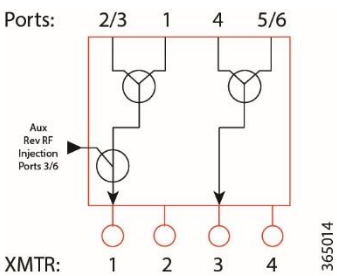
T12474

4x2 Reverse Configuration Module with Auxiliary Reverse RF Injection Description

The 4x2 Reverse Configuration Module with auxiliary reverse RF injection combines reverse inputs from Ports 1 and 2/3 and routes them to Transmitter 1; it also combines reverse inputs from Ports 4 and 5/6 and routes them to Transmitter 3. An RF signal from an external source can optionally be injected and coupled with reverse RF inputs from Ports 3/6 and routed to Transmitter 1.

Note: This module can only be used with an 8-port optical interface board. (There is no transmitter 3 position with a 6-port optical interface board.)

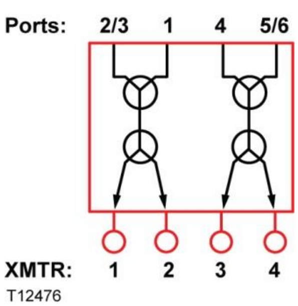
The following diagram shows how this module functions.



4x2 Redundant Reverse Configuration Module Description

The 4x2 Redundant Reverse Configuration Module combines reverse inputs from Ports 1 and 2/3 and routes them to Transmitters 1 and 2; it also combines reverse inputs from Ports 4 and 5/6 and routes them to Transmitters 3 and 4.

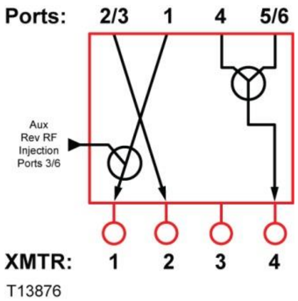
The following diagram shows how this module functions.



4x3-1, 2, 4 Reverse Configuration Module with Auxiliary Reverse RF Injection Description

The 4x3-1,2,4 Reverse Configuration Module with auxiliary reverse RF injection combines reverse inputs from Ports 4 and 5/6 and routes them to Transmitter 4; it also routes reverse inputs from Port 1 to Transmitter 1 and from Ports 2/3 to Transmitter 2. An RF signal from an external source can optionally be injected at Ports 3/6 and coupled with the reverse RF input from Port 1 and routed to Transmitter 1.

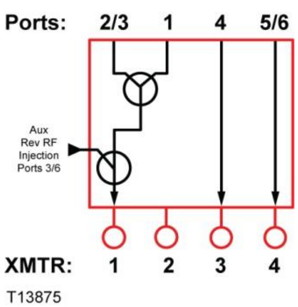
The following diagram shows how this module functions.



4x3-1,3,4 Reverse Configuration Module with Auxiliary Reverse RF Injection Description

The 4x3-1,3,4 Reverse Configuration Module with auxiliary reverse RF injection combines reverse inputs from Ports 1 and 2/3 and routes them to Transmitter 1; it also routes reverse inputs from Port 4 to Transmitter 3 and from Ports 5/6 to Transmitter 4. An RF signal from an external source can optionally be injected at Ports 3/6 and coupled with the reverse RF inputs from Ports 2/3 and 1 and routed to Transmitter 1.

The following diagram shows how this module functions.

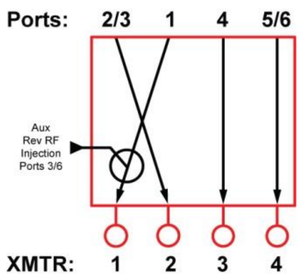


4x4 Reverse Configuration Module with Auxiliary Reverse RF Injection Description

The 4x4 Reverse Configuration Module with auxiliary reverse RF injection routes reverse inputs from Port 1 to Transmitter 1, from Port 2/3 to Transmitter 2, from Port 4 to Transmitter 3, and from Port 5/6 to Transmitter 4. An RF signal from an external source can optionally be injected and coupled with reverse RF inputs from Ports 3/6 and routed to Transmitter 1.

Note: This module is typically installed when using EDR multiplexing digital reverse modules. Since the digital reverse module occupies the physical space that transmitters 3 and 4 normally occupy in the node base, this reverse configuration module is typically used with a 6-port optical interface board.

The following diagram shows how this module functions.



T12477

Optical Interface Board (OIB)

Optical Interface Board Description

The Optical Interface Board (OIB) provides all interconnections between the modules in the housing lid of the 1.2 GHz GS7000 Node. The modules in the housing lid include the optical receiver, optical transmitter, power supply, and status monitoring/local control modules. Each module in the lid plugs directly into the OIB through a connector header or row of sockets. Input attenuator pads are provided on the OIB for each optical receiver in the housing lid. Output attenuator pads are provided on the OIB for each optical transmitter in the housing lid. All RF and power cables running between the housing lid and base also plug into the OIB.

The OIB is field replaceable. All optical modules, power supplies, RF cables, power cables, and OIB mounting screws must be removed in order to remove the OIB from the housing lid.

The upstream status monitoring signal goes through LPF then splits. Splitter output 1 goes through a 17dB coupler into transmitter 1 input. Splitter output 2 goes through a plug-in attenuator pad, a 17dB coupler and into transmitter 2 input.

The purpose of the attenuator (AT9) is to terminate the upstream status monitoring signal going into transmitter 2 when either the node is segmented or EDR transmitter is in use. When the node is configured in either segmented or EDR mode, a 75 dB pad must be placed in the Tx2 SM Term.

This solution resolves the issue of transmitting and receiving duplicate copy of the upstream signal from transponder at the CMTS.

Optical Receiver Module

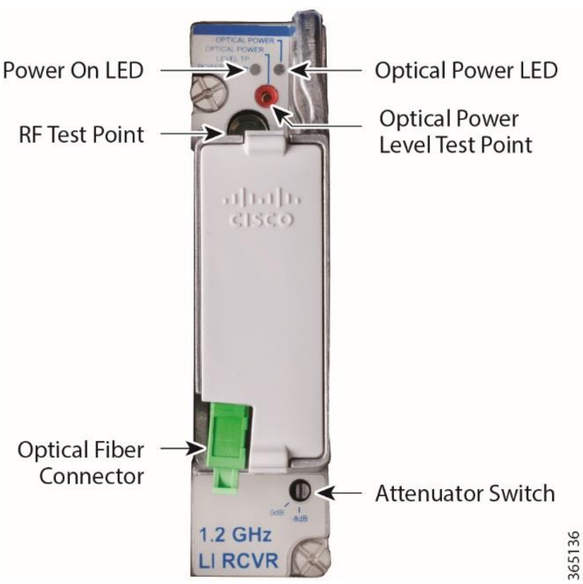
Optical Receiver Module Description

The optical receiver module takes in optical signals and puts out forward band RF signals. The module cover has a sliding tray incorporated into it allowing the receivers fiber pigtail to be spooled up and contained within the receiver module. This greatly improves fiber management within the node.

The optical receiver modules plug directly into the optical interface board via a connector header and are secured in place with two screws. Input attenuator pads are provided on the optical interface board for each receiver mounted in the housing lid.

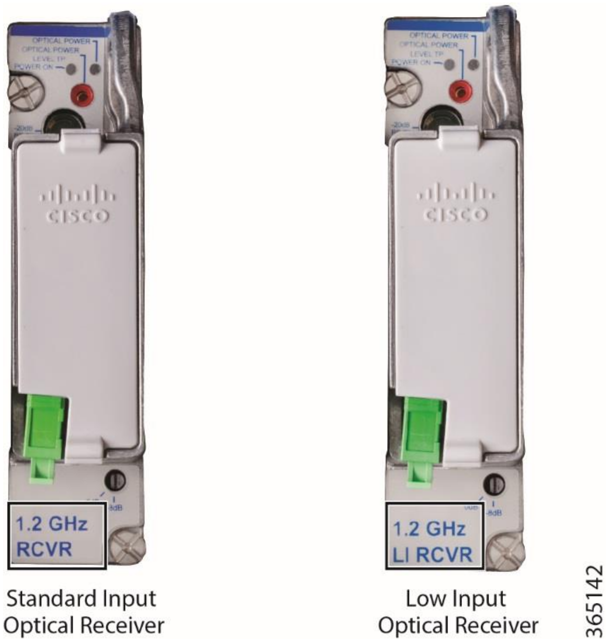
All optical receiver test points are provided and are accessible through holes in the module housing. The optical power test points for the optical receiver module has a scaling ratio of 1 V = 1 mW. A -20 dB RF power test point is accessible through the front panel.

The optical receiver module has an optical power LED to indicate the presence of optical power that is either above or below the specified range. ON indicates optical power is within operating limits and OFF indicates that optical power is below the alarm threshold.



The optical power level into the optical receiver module is monitored by the status monitor or local control module. When the node is setup for redundant optical receiver operation, a digital signal is generated by the status monitor or local control module to switch between the primary and redundant optical receiver module in the forward configuration module.

There are two types of the receiver module: Standard Input Optical Receiver and Low Input Optical Receiver.

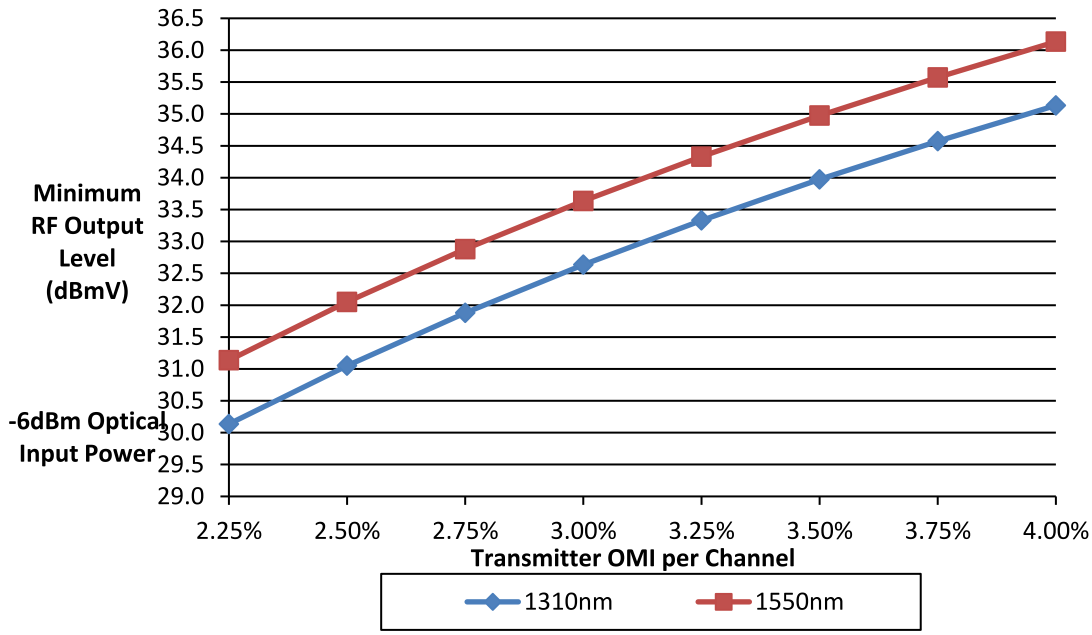


Standard Input Optical Receiver

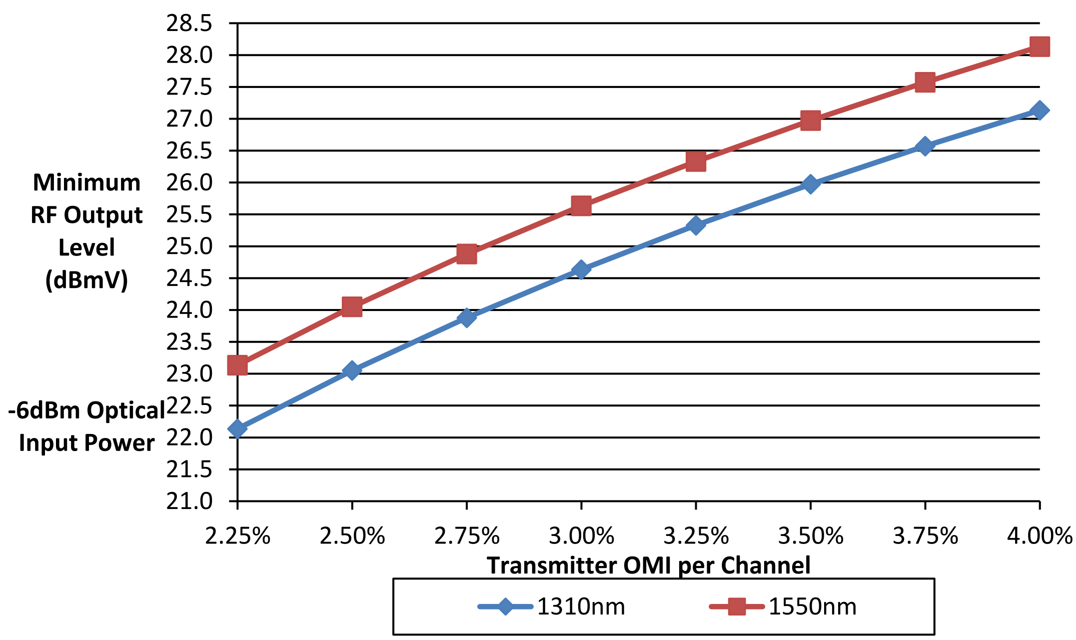
Low Input Optical Receiver

The optical input range for the low input receiver is 0.1 w to 0.63 w (-10 dBm to -2 dBm). Compared to the standard input optical receiver (the optical input range is -6 dBm to +2 dBm (0.25 w to 1.58 w)), the low input optical receiver can work with lower optical input level, in order to support fiber deep applications.

The illustration below is Low Input Receiver RF Output Level and Transmitter OMI: Rx Switch in 0 dB Setting:



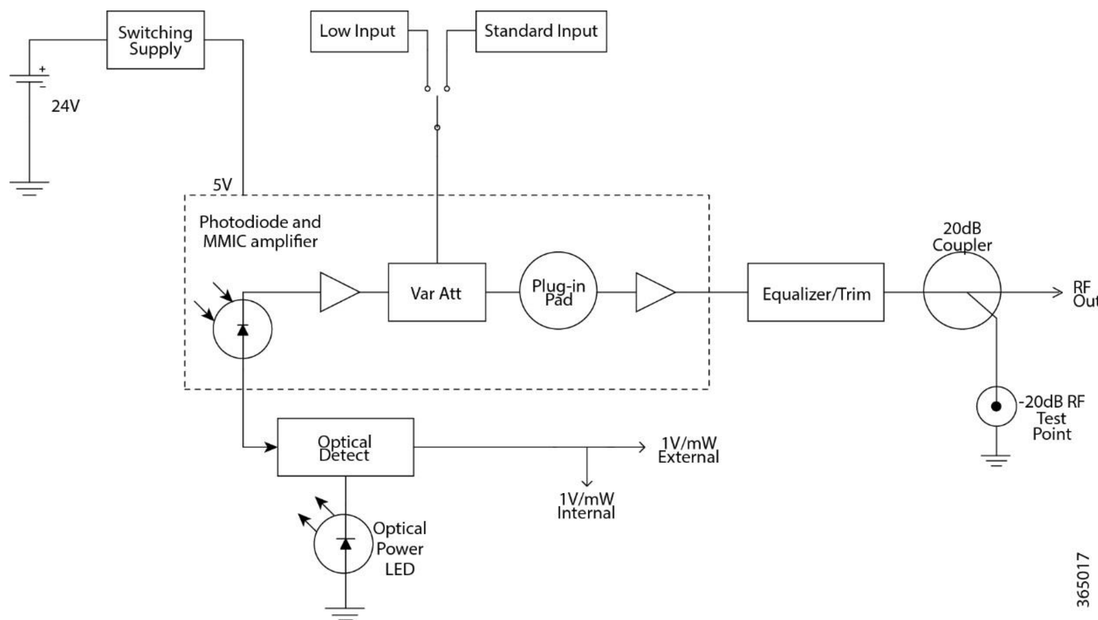
The illustration below is Low Input Receiver RF Output Level and Transmitter OMI: Rx Switch in -8 dB Setting:



For the detailed information about the low input optical receiver, please refer to the latest GS7000 Data Sheet.

Optical Receiver Module Diagram

The following diagram shows how the optical receiver module functions.



Optical Analog Transmitter Modules

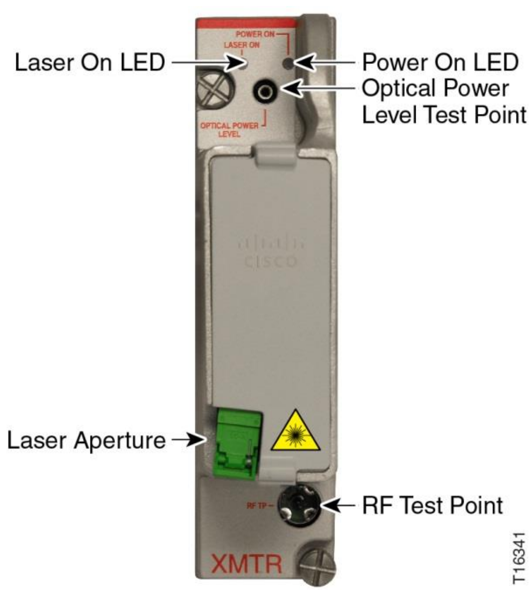
Optical Analog Transmitter Module Descriptions

The optical analog transmitter module takes in reverse band RF signals and puts out optical signals. The 1.2 GHz GS7000 Node is designed to work specifically with the existing mid gain, temperature compensated DFB optical transmitters. Other mid and high gain optical transmitters may be installed in the 1.2 GHz GS7000 Node with varying effects on the overall node specifications. The new module cover fits on all existing optical transmitters. This module cover has a sliding tray incorporated into it allowing the transmitters fiber pigtail to be spooled up and contained within the transmitter module. This greatly improves fiber management within the node.

The optical transmitter modules plug directly into the optical interface board via a connector header and are secured in place with two screws. Output attenuator pads are provided on the optical interface board for each transmitter mounted in the housing lid.

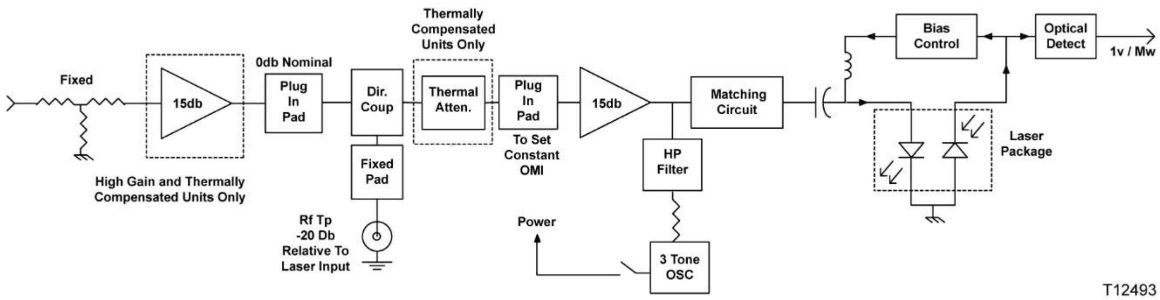
RF test points are accessible through holes in the module housing. The optical power test point for the optical transmitter module has a scaling ratio of 1 V = 1 mW. A -20 dB RF power test point is accessible through the module top cover.

The top cover contains a status monitor LED. Each optical transmitter module laser power indicator turns off when the laser power output falls outside the alarm threshold. It is on (green) when within the alarm threshold.



Optical Analog Transmitter Module Diagram

This illustration shows how the optical analog transmitter module functions.



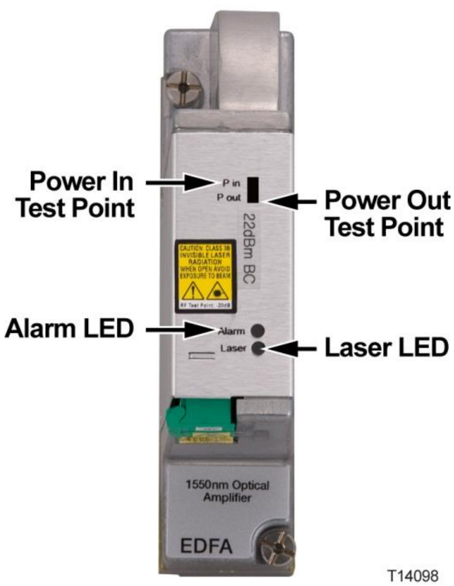
Optical Amplifier (EDFA) Modules

Optical Amplifier Module Descriptions

Erbium-doped fiber amplifier modules are available in two categories: broadcast and narrowcast (gain-flattened). Broadcast EDFAs are used for the amplification of broadcast signals which are carried by a single optical channel anywhere between 1530 nm and 1565 nm. (Gain-flattened) EDFAs are used for the amplification of multiple optical channels. For uniformity of performance, EDFAs need to be gain flattened in the designated operating wavelength range between 1536 nm and 1562 nm.

Broadcast EDFAs are available in 17 dBm, 20 dBm, and 22 dBm versions. Narrowcast (gain-flattened) EDFAs are available in 17 dBm, 20 dBm, and 21 dBm versions to fit any architecture for requirements like DWDM narrowcasting.

Both broadcast and (gain-flattened) EDFAs can be operated in constant power and constant gain modes. The default setting for a broadcast EDFA is constant power mode, while the default setting for a (gain-flattened) EDFA is constant gain mode.



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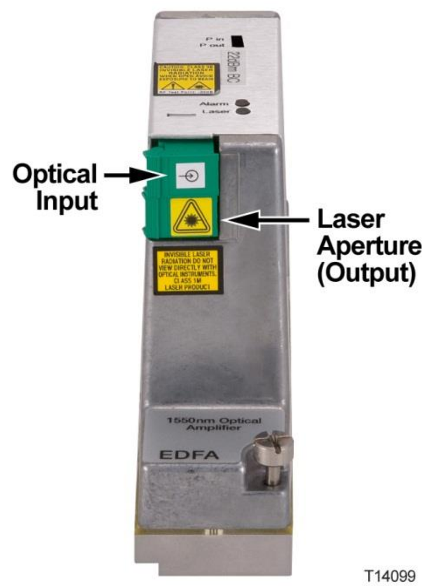

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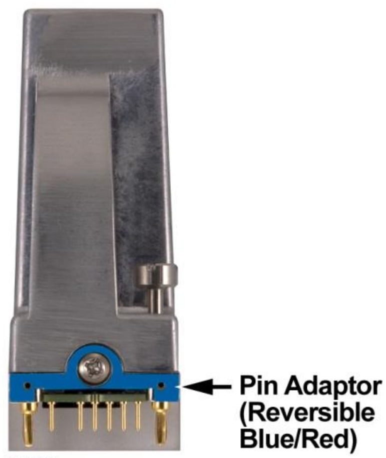
The table below lists the part number and description of the new gain-flattened EDFA:

Part Number	Description
GS7K-GFEDFA-17L=	17 dBm gain flattened low gain EDFA
GS7K-GFEDFA-17H=	17 dBm gain flattened high gain EDFA
GS7K-GFEDFA-21L=	21 dBm gain flattened low gain EDFA
GS7K-GFEDFA-21H=	21 dBm gain flattened high gain EDFA

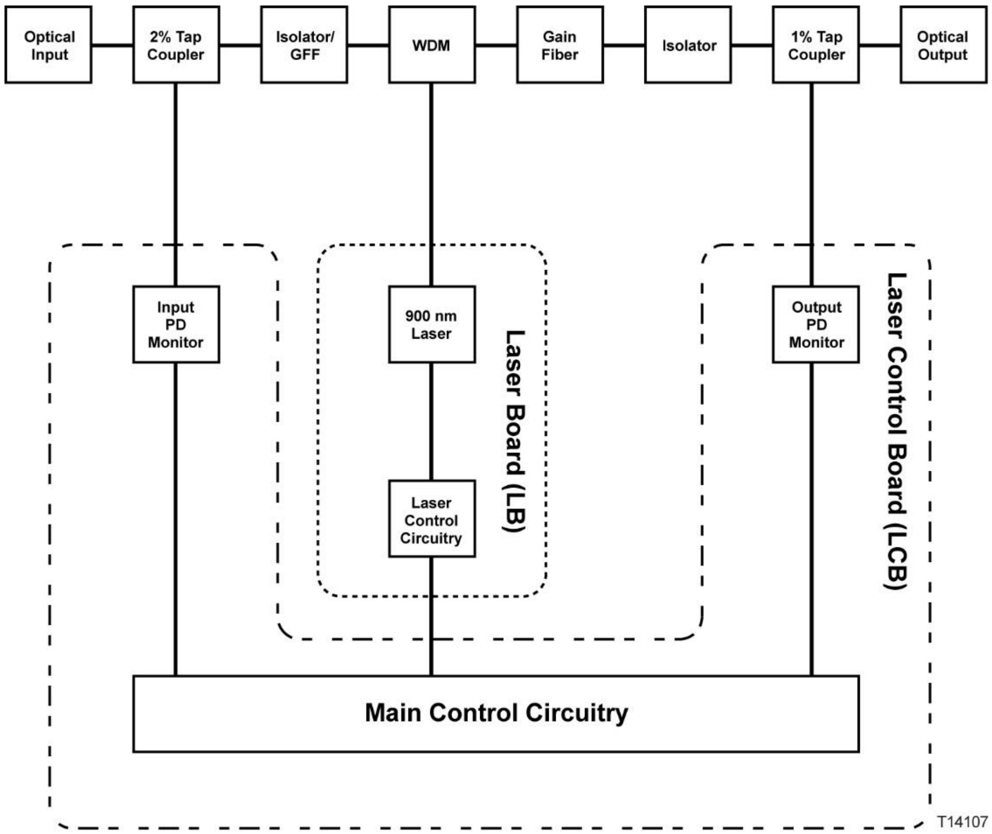
EDFA modules are single-wide, single-output devices. Each module is connected to one input fiber and one output fiber through optical fiber connectors on the side of the module housing. The modules can be mounted in either receiver or transmitter slots on the optical interface board in the node lid using a reversible pin adaptor. The pin adaptor is used to adapt the module to the connector arrangement for a transmitter slot or a receiver slot, which are different. To mount the module in a transmitter slot the red side of the pin adaptor must face out. To mount the module in a receiver slot the blue side of the pin adaptor must face out.

Refer to ***Optical Amplifier and Optical Switch Module Pin Adaptor*** (on page 124) for pin adaptor installation instructions.



Optical Amplifier Module Diagram

The following block diagram shows how the optical amplifier module functions.



Optical Amplifier Operating Parameters

This section is a reference for the operating parameters of the EDFA. The EDFA is configured through the Status Monitor/Local Control Module in the housing lid. Refer to the *GS7000 Hub/Node Status Monitor/Local Control Module Installation and Operation Guide*, part number OL-29937, for complete instructions on configuring the EDFA.

Configurable Parameters

The following table defines the configurable parameters for the EDFA.

Param Name	Products	Function	Default Value	Min	Typical	Max	Step	Unit
Mode	All	Sets operating mode of amplifier	[A]	na	na	na	Constant Gain (0) Constant Power (1)	na
Enable	All	Enables or disables amplifier	Off(0)	na	na	na	Off(0) On(1)	na
Set Power	BCST 17	Sets optical output level [B]	17	14	17	17	0.1	dBm
	BCST 20	Sets optical output level [B]	20	17	20	20	0.1	dBm
	BCST 22	Sets optical output level [B]	22	19	22	22	0.1	dBm
	GF 17	Sets optical output level [B]	17	14	17	17	0.1	dBm
	GF 21	Sets optical output level [B]	21	18	21	21	0.1	dBm
Set Gain	BCST 17	Sets gain level in Constant Gain Mode [A][B]	12	10	12	14	0.1	dB
	BCST 20	Sets gain level in Constant Gain Mode [A][B]	15	13	15	17	0.1	dB
	BCST 22	Sets gain level in Constant Gain Mode [A][B]	17	15	17	19	0.1	dB
	GF 17L	[A]	7	5	7	9	0.1	dB
	GF 17H	[A]	12	10	12	14	0.1	dB
	GF 21L	[A]	11	9	11	13	0.1	dB
	GF 21H	[A]	16	14	16	18	0.1	dB

[A] For the Broadcast amplifier, the default is Constant Power. For the (gain-flattened) amplifier, the default is Constant Gain.

[B] In Constant Power mode only.

Operating Status Parameters

The following table defines the monitored operating parameters for the EDFA.

Parameter Name	Function	Typical Value	Units
Optical Input Power	Optical input power	5.0	dBm

Parameter Name	Function	Typical Value	Units
Output Power	Optical output power	19.5	dBm
Laser Temperature	Laser temperature	25.0	degC
Laser Bias Current Limit	Laser operating current limit	0.825	A
Laser Bias Current	Laser operating current	0.625	A
TEC Current	Thermoelectric cooler current	0.25	A
Module Temperature	Module temperature	26.5	degC
Laser On Time	Time the laser has been on	1.0	Hrs

Alarm Parameters

The following table defines the alarm parameters for the EDFA.

Alarm Name	Major High	Minor High	Minor Low	Major Low	Values	Typical Value	Hysteresis	Units
Laser Bias Current	-0.001	-0.010	na	na	Ok Alarm	0.625	0.001	A
Optical Output Level	1.0	0.7	-0.7	-1.0	Ok Alarm	17 20 21 22	0.1	dBm
Input Power [1]	[5]	[5]	[5]	[5]	Ok Alarm	na	0.1	dBm
Laser Temperature [1][4]	20.0	15.0	-15.0	-20.0	Ok Alarm	25.0	1.0	degC
OIB Voltage Status [1][2]	na	na	na	na	Ok Alarm	Ok	na	na
Internal Power Status [1][3]	na	na	na	na	Ok Alarm	na	na	na
Laser Enabled Status [1]	na	na	na	na	Ok Alarm	na	na	na

[1] This alarm sets the unit to the safe state. In the safe state, the amplifier is turned off causing the optical amplifier output to be disabled.

[2] This alarm tests for presence of +24V, -6V from the OIB.

[3] This alarm indicates the state of the internal voltages (+24V, +5.0V, Vref).

[4] See following for laser nominal set point temperature based on module temperature.

[5] See next table for input power alarm values.

Input Power Alarm Parameters

The following tables define the input power alarm parameters for the EDFA.

(Gain-flattened) EDFA - Constant Gain Mode (Default)

Product Type	Major High	Minor High	Minor Low	Major Low	Values	Typical Value	Hysteresis	Units
17.0 / 20.0 /21.0 dBm Low Gain	45.0	25.0	-8.0	-10.0	Ok Alarm	-7.0	0.1	dBm
17.0 / 20.0 /21.0 dBm High Gain	45.0	25.0	-13.0	-15.0	Ok Alarm	-12.0	0.1	dBm

(Gain-flattened) EDFA - Constant Power Mode

Product Type	Major High	Minor High	Minor Low	Major Low	Values	Typical Value	Hysteresis	Units
17.0 / 20.0 /21.0 dBm Low/High Gain	45.0	25.0	0	-10.0	Ok Alarm	5.0	0.1	dBm

Broadcast EDFA - Constant Power Mode (Default)

Product Type	Major High	Minor High	Minor Low	Major Low	Values	Typical Value	Hysteresis	Units
17.0/20.0/22.0 dBm	45.0	25.0	0	-10.0	Ok Alarm	5.0	0.1	dBm

Broadcast EDFA - Constant Gain Mode

Product Type	Major High	Minor High	Minor Low	Major Low	Values	Typical Value	Hysteresis	Units
17.0/20.0/22.0 dBm	45.0	25.0	-13.0	-15.0	Ok Alarm	-12.0	0.1	dBm

Laser Temperature Set Point Adjustment

In an effort to reduce EDFA power consumption, laser temperature set point is changed based on EDFA module temperature. Typically, the laser temperature set point is set at 25°C. When module temperature is greater than 60°C and less than 10°C, laser temperature set point is adjusted.

Hot Condition (Module Temperature > 60°C)

For module temperature less than 60.0°C, laser set point temperature is set at 25°C. For every degree of module temperature greater than 60°C, laser set point temperature is also increased by that amount until module temperature reaches 70°C, then laser temperature set point is fixed at 35°C. For example, if module temperature is 64°C, laser set point temperature is 29°C. If module temperature is 85°C, laser set point temperature is 35°C.

Cold Condition (Module Temperature < 10°C)

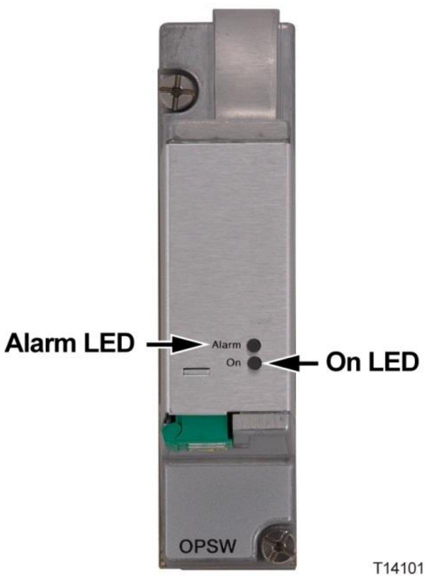
For module temperature greater than 10°C, laser set point temperature is set at 25°C. For every degree of module temperature less than 10°C, laser set point temperature is also decreased by that amount until the module temperature reaches -5°C, then laser temperature set point is fixed at 10°C. For example, if module temperature is -4°C, laser set point temperature is 11°C. If module temperature is -25°C, laser set point temperature is 10°C.

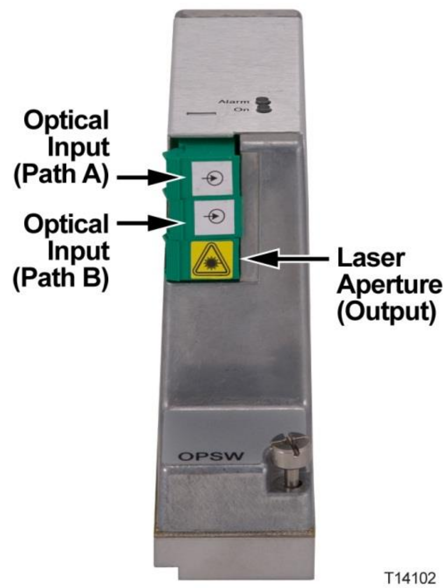
Optical Switch Module

Optical Switch Module Description

The optical switch module is used for switching the input of an EDFA module from a primary signal to a backup or secondary signal. The switch operates in the 1550 nm wavelength range since its application is high power/long haul systems that employ EDFAs.

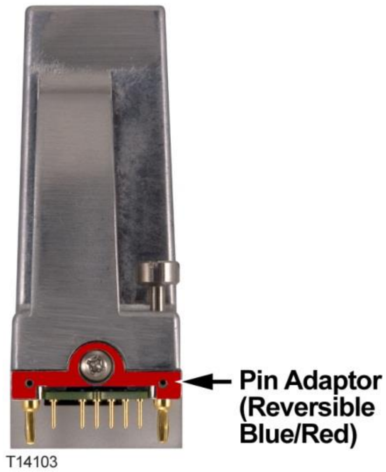
The switch has two operating modes: manual and automatic. In automatic mode, the switch can be triggered by a loss of light. The loss of light activation triggers the switch when the light level drops below the threshold value set by the operator. In manual mode, the switch can be triggered through the Local Control Module (LCM).





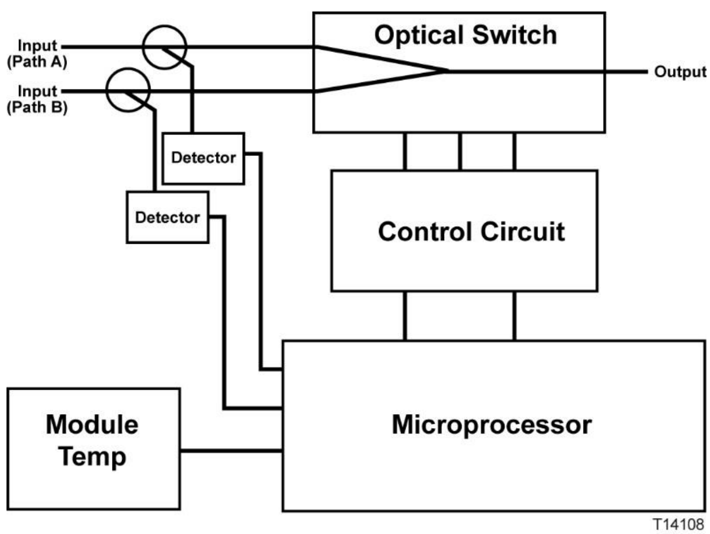
The module mounts in receiver or transmitter slots on the optical interface board in the node lid using a reversible pin adaptor. The pin adaptor is used to adapt the module to the connector arrangement for a transmitter slot or a receiver slot, which are different. To mount the module in a transmitter slot the red side of the pin adaptor must face out. To mount the module in a receiver slot the blue side of the pin adaptor must face out.

Refer to ***Optical Amplifier and Optical Switch Module Pin Adaptor*** (on page 124) for pin adaptor installation instructions.



Optical Switch Module Diagram

The following block diagram shows how the optical switch module functions.



Optical Switch Operating Parameters

This section is a reference for the operating parameters of the optical switch. The optical switch is configured through the Status Monitor/Local Control Module in the node. Refer to the *GS7000 Hub/Node Status Monitor/Local Control Module Installation and Operation Guide*, part number OL-29937, for complete instructions on configuring the optical switch.

Switch Operation

The following table describes the optical switch function.

Primary Input	Secondary Input	Alarms	Optical Switch
Path A Optical Power > ThresholdA (default)	Path B Optical Power > Threshold B [1]	None	Switch to Path A
Path A Optical Power < ThresholdA (default)	Path B Optical Power > Threshold B [1]	Loss of Input Light at Path A	Switch to Path B Optical Power
Path B Optical Power > Threshold B [1]	Path B Optical Power < Threshold B [1]	Loss of Input Light at Path B	Switch to Path A
Path A Optical Power < ThresholdA (default)	Path B Optical Power < Threshold B [1]	Both Dark	Switch to Path A Optical Power
Path B Optical Power > ThresholdB (User Setting)	Path A Optical Power > ThresholdA [1]	None	Switch to Path B
Path B Optical Power < ThresholdB (User Setting)	Path A Optical Power > ThresholdA [1]	Loss of Input Light at Path B	Switch to Path A Optical Power
Path B Optical Power > ThresholdB (User Setting)	Path A Optical Power < ThresholdA [1]	Loss of Input Light at Path A	Switch to Path B
Path B Optical Power < ThresholdB (User Setting)	Path A Optical Power < ThresholdA [1]	Both Dark	Switch to Path B Optical Power

[1] Hysteresis Amplitude (default 1.0 dB) is the value above which the input optical power must rise for the switch to begin sequence to return to the primary switch position. Hysteresis Amplitude is a user configurable parameter.

Configurable Parameters

The following table defines the configurable parameters for the optical switch.

Parameter	Function	Default Value	Values	Min	Max	Step	Unit
Mode	Automatic or manual mode	Auto(0)	Auto(0) Manual(1)				
Threshold B	Switching threshold, input optical power at input B	5.0		-10.0	14.0	0.1	dBm
Threshold A	Switching threshold, input optical power at input A	5.0		-10.0	14.0	0.1	dBm

Parameter	Function	Default Value	Values	Min	Max	Step	Unit
Hysteresis Amplitude	Hysteresis Amplitude: The value (in dB relative to the switching threshold) above which the input optical power must raise for the switch to begin the hysteresis timer before restoring primary switch position. Only applies if Revert is On.	1.0		0.5	9.5	0.1	dB
Hysteresis Time	Hysteresis Time: The length of time, in seconds, that primary optical power must remain above the restore threshold before switch is allowed to revert to primary position. Only applies if Revert is On.	60		0	600	1	sec
Revert	On (1) allows switch to revert to primary position after optical power restored. In Off (0), switch will remain in backup (non-primary) position.	On(1)	Off(0) On(1)	na	na	na	na
Primary Optical Input	Selects the primary optical input	PathA(0)	PathA(0) PathB(1)	na	na	na	na
Switch Position	Selects the Normal switch position	PathA(0)	PathA(0) PathB(1)	na	na	na	na

Operating Status Parameters

The following table defines the monitored operating parameters for the optical switch.

Parameter Name	Function	Typical Operating Range	Units
Switch Position	Read optical switch position (Calibrated at 1550 nm only)	PathA/PathB	state
Path A Optical Power	Input optical power on Path A (Calibrated at 1550 nm only)	-10 to 14	dBm
Path B Optical Power	Input optical power on Path B	-10 to 14	dBm
Module Temp	Module temperature	Ambient temp + 7	degC
Switch Temp	Switch temperature	Ambient temp + 7	degC

Alarm Parameters

The following table defines the alarm parameters for the optical switch.

Alarm Name	Error Condition	Values	Hysteresis
Loss of Input Light at Path A	Optical input at path A is less than the switching threshold at path A	Minor Alarm(0) Ok(1)	[1]
Loss of Input Light at Path B	Optical input at path B is less than the switching threshold at path B	Minor Alarm(0) Ok(1)	[1]
Both Dark	Loss of light at both inputs (Loss of Input Light at Path A and Loss of Input Light at Path B)	Major Alarm(0) [2] Ok(1)	
No Switch	Optical switch failed to change states when commanded	Major Alarm(0) [2] Ok(1)	
Power Supply OK	Failure of external power supply rails	Major Alarm(0) [2] Ok(1)	
Excessive Input Optical Power	Optical input at Path A or optical input at Path B is greater than or equal to 24 dBm	Major Alarm(0) [2] Ok(1)	

[1] Hysteresis Amplitude (default 1.0 dB) is the value above which the input optical power must rise for the switch to begin sequence to return to the primary switch position. Hysteresis Amplitude is a user configurable parameter.

[2] In some cases this may display as Fault (0).

Local Control Module

Overview

A local control module and a status monitor are available for the 1.2 GHz GS7000 Node and Hub Node. A status monitor consists of a local control module with a transponder core module installed in the housing. The same housing is used for both units. The units perform the following function:

- Local Control Module - controls redundancy and forward segmentation, and configures the modules
- Status Monitor - adds status monitoring capability to the local control module
- DOCSIS capability

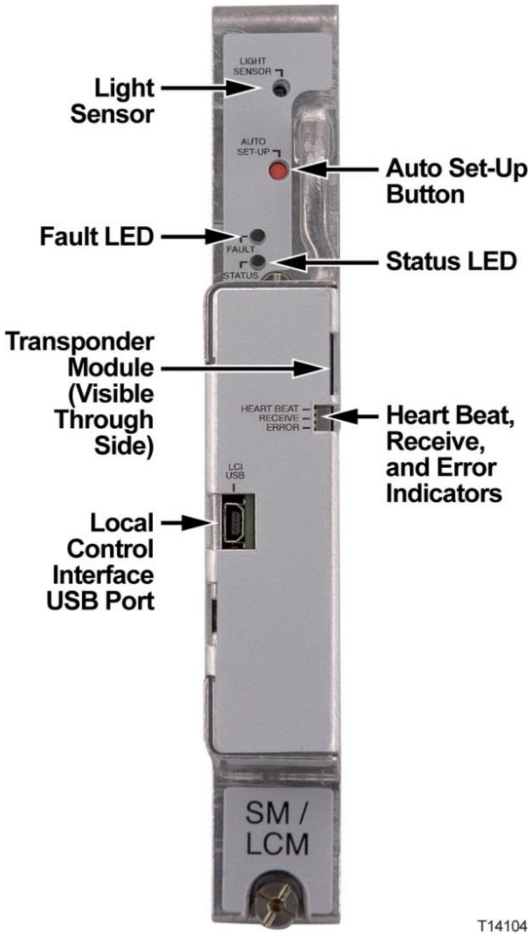
Status Monitor Description

The status monitor is HMS compliant and provides node monitoring and control capability at the cable plant's headend. The following node voltages and signals are monitored and their status reported to the headend by the status monitor.

- Receiver optical input level (all receivers)
- Transmitter optical output level (all transmitters)
- AC power presence and peak voltage (for split AC powering cases, AC power from both sides of node housing is monitored)
- DC voltages from both primary and redundant power supplies
- Optical amplifier operating parameters
- Optical switch operating parameters

Commands are sent from the headend to the status monitor. The status monitor communicates serially with the RF amplifier module to control the optional forward band redundancy switches on the forward configuration module, the reverse band 6 dB (wink) attenuators on the reverse amplifier PWB, and the reverse band on/off switches on the reverse amplifier PWB.

Note: Configuration parameters for the transponder core module, such as IP address, can be changed using the PC-based GS7000 ViewPort software.



Note: The transponder core module can be seen through the Heart Beat/Receive/Error indicator cutout in the cover.

Local Control Module Description

The local control module locally monitors the following node voltages and signals:

- Receiver optical input level (all receivers)
- Transmitter optical output level (all transmitters)
- AC power presence and peak voltage (for split AC powering cases, AC power from both sides of node housing is monitored)
- DC voltages from both primary and redundant power supplies
- Optical amplifier operating parameters
- Optical switch operating parameters

The local control module communicates serially with the RF amplifier module to control the optional forward band redundancy switches on the forward configuration module. It is a low-cost module that plugs into the status monitor connectors on the optical interface board.

The local control module is equipped with a USB port to allow local control of the optional forward band redundancy switches, the reverse band 6 dB (wink) attenuators, the reverse band on/off switches, the optical switch, and optical amplifiers through the PC-based GS7000 ViewPort software. All parameters monitored by the local control module can be displayed and reviewed using ViewPort.

Note: The local control module can be upgraded to a status monitor through the addition of a transponder core module. The transponder core module plugs directly onto the local control module's PWB. The mechanical housing for the status monitor and the local control module are the same. The Heart Beat, Receive, and Error indicator LEDs are only present if the transponder module is installed.

Power Supply Module

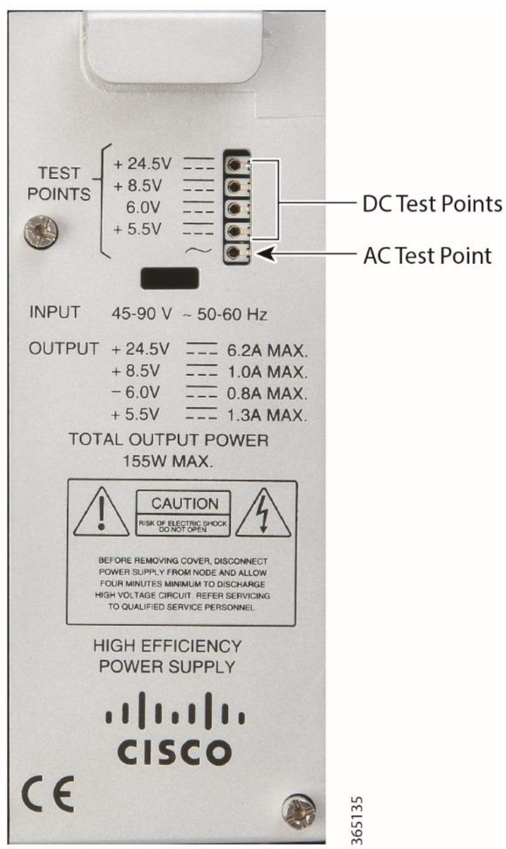
Power Supply Module Description

The power supply module converts a quasi-square wave, 50 – 60 Hz AC input voltage into four well-regulated DC output voltages. The supply is an off-line, switched-mode power supply with a large operative input range. This reduces service outages by converting long duration AC surges into load power. The power supply is a constant power device, meaning that it automatically adjusts its internal operating parameters for the most efficient use of the different levels of input voltage and current it will receive within the cable plant.

The DC output voltages generated by the power supply, at given load currents, are shown below:

+24.5 VDC @ 6.2 Amps
+8.5 VDC @ 1.0 Amps
+5.5 VDC @ 1.3 Amps
-6.0 VDC @ 0.8 Amps

Test points are provided on top of the power supply module for AC input and all output DC voltage rails.



The power supply module plugs directly into the optical interface board, no external cables are required.

A 1.2 GHz GS7000 Node can be configured with one or two power supplies. AC input voltage can be routed to both power supplies commonly from any node output port. In addition, AC input voltages can be routed in a split fashion to the two power supplies. AC input voltages from the left half of the node (output ports 1 – 3) can be routed to power supply 1 independent of AC input voltages from the right half of the node (output ports 4 – 6) being routed to power supply 2. Each of the power supplies output voltage rails is diode OR'd within the supply. This creates common DC powering circuits when multiple supplies are present in the node.

Node Power Limitations

Nodes and hub nodes must be configured in a manner that prevents potential thermal overloads. Heat generated by the node can reduce the life of the equipment.

CAUTION:
The life of the equipment may be reduced if configured to draw more than the recommended level of power from the power supplies.

Two power supplies can provide a maximum power level of 100 watts to the node or hub node. The RF amplifier uses the majority of the available power. Maintain the total power consumption of all modules in the housing within these guidelines to minimize the heat generated. Find the optimal configuration by summing the power consumption of the RF amplifier plus the other individual modules in the housing using the following table.

Important: Do not populate the housing with any combination of modules that would draw more than the available power of 100 watts.

The following table lists the modules and their respective power consumption.

Equipment	Type	Maximum Power Draw (Watts)	Typical Power Draw (Watts)
Transmitter	1310 nm dfb, analog CWDM	4.1	3.4
Transmitter	analog DWDM	5.4	4.8
Standard Input Receiver	operating	4.1	3.9
Standard Input Receiver	standby	0.5	0.4
Low Input Receiver	operating	4.1	3.85
Low Input Receiver	standby	0.5	0.4
EDFA	17 dBm	4.5	4
EDFA	20 dBm	7	5
EDFA	22 dBm	9	7
Optical Switch		2	1.5
Status Monitor/ Local Control Module		2.6	0.9
RF Amplifier	4-way forward segmentable	72.8	72.9
1:1 EDR Transmitter		< 3	
2:1 EDR Transmitter		< 7	

3

Installation

Introduction

This chapter describes the installation of the 1.2GHz GS7000 Node.

In This Chapter

Tools and Test Equipment

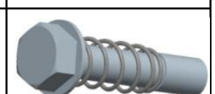
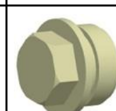
Required Tools and Test Equipment

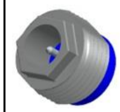
The following tools and equipment are required for installation.

- Torque wrench capable of 5 to 12 ft-lbs (6.8 to 16.3 Nm)
- 4-inch to 6-inch extension for torque wrench
- 1/2-inch socket for strand clamp bolts and cover bolts
- 1/4-inch flat-blade screwdriver
- #2 Phillips-head screwdriver
- Long-nose pliers
- 1/2-inch deep-well socket for seizure connector
- True-rms digital voltmeter (DVM)
- EXFO FOT 22AX optical power meter with adapters
- Optical connector cleaning supplies
- Optical connector microscope with appropriate adapters for your optical connectors

Node Fastener Torque Specifications

Be sure to follow these torque specifications when assembling/mounting the node.

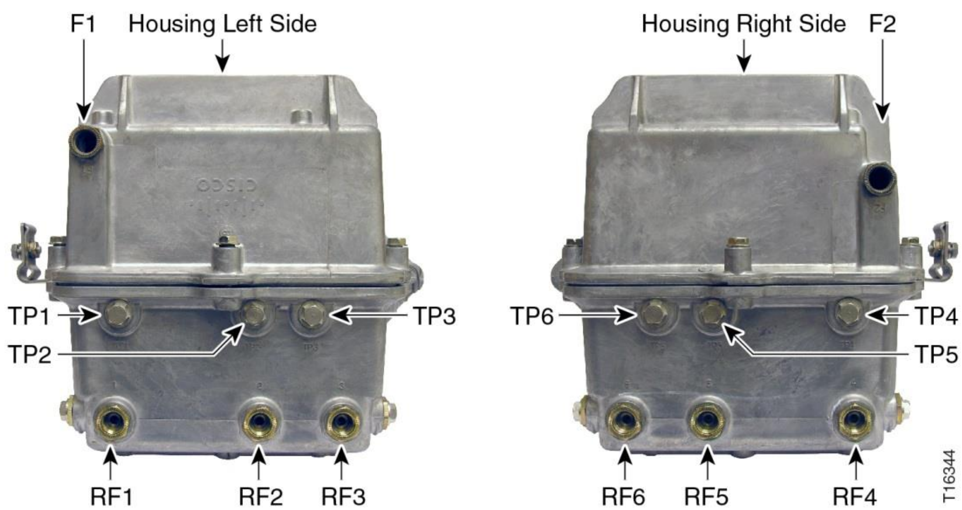
Fastener	Torque Specification	Illustration
Housing closure bolts	5 to 12 ft-lbs (6.8 to 16.3 Nm)	
Test point port plugs Housing plugs	5 to 8 ft-lbs (6.8 to 10.8 Nm)	
Strand clamp mounting bracket bolts	5 to 8 ft-lbs (6.8 to 10.8 Nm)	
Pedestal mounting bolts	8 to 10 ft-lbs (10.8 to 13.6 Nm)	
Module securing screws (Tx, Rx, PS, and SM/LCM modules)	25 to 30 in-lbs (2.8 to 3.4 Nm)	
RF Amplifier assembly shoulder screws (cross head screw)	18 to 20 in-lbs (2.0 to 2.3 Nm)	

Fastener	Torque Specification	Illustration
Seizure nut	2 to 5 ft-lbs (2.7 to 6.8 Nm)	
RF cable connector*	Per manufacturer instructions	
Fiber optic cable connector	20 to 25 ft-lbs (27.1 to 33.9 Nm)	

Note: The typical insertion force required for RF connectors and RF terminators is 20-30 lbsf. However, in some field situations the required insertion force can be higher. RF Connector/Terminators used should be able to withstand at least 80 pounds of insertion force without damage to the center pin.

Node Housing Ports

The following illustration shows the location of available RF ports, fiber ports, and test points on the 1.2 GHz GS7000 Node housing.



Notes:

- External test points are only active on models with the "Amplifier Type 3 - External Test Points Activated" option.
- When replacing test point port plugs, torque from 5 to 8 ft-lbs (6.8 to 10.8 Nm).

Strand Mounting the Node

Description

The following procedure explains how to install the 1.2 GHz GS7000 Node on a strand (aerial installation). Strand mounting allows street-side access to the housing.

Procedure

Follow this procedure to mount the housing to a strand. The housing does not need to be opened for strand installation.

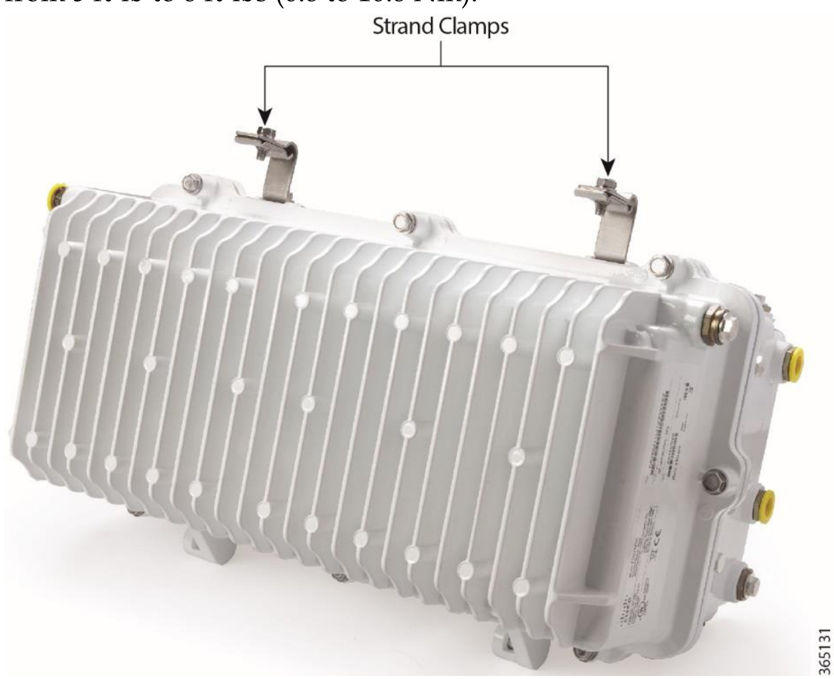
WARNING:

Be aware of the size and weight of the node while strand mounting. Ensure that the strand can safely support the node's maximum weight. A fully loaded 1.2 GHz GS7000 Node weighs over 50 lbs (22.7 kg).

Ensure the ground area below the installation site is clear of personnel before hoisting the node. If possible, block off walkway below the hoisting area to prevent pedestrian traffic during hoisting.

Failure to observe these admonishments can result in serious injury or death.

1. Check the strand size. The minimum strand diameter should be 5/16 inch.
2. Attach the strand clamp brackets to the housing in the position shown in the following illustration. Use a torque wrench tightens the strand clamp bracket bolts from 5 ft-lb to 8 ft-lbs (6.8 to 10.8 Nm).

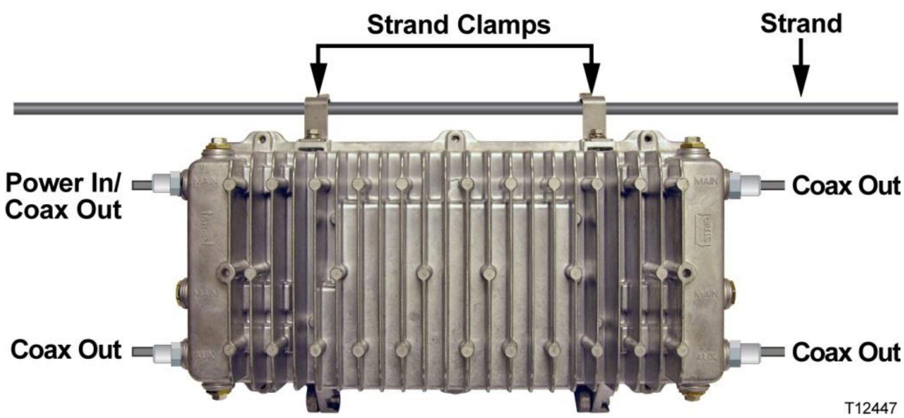


3 Loosen the strand clamp bolts to separate the clamps enough to insert the strand, but do not remove them. Then lift the housing into proper position on the strand.

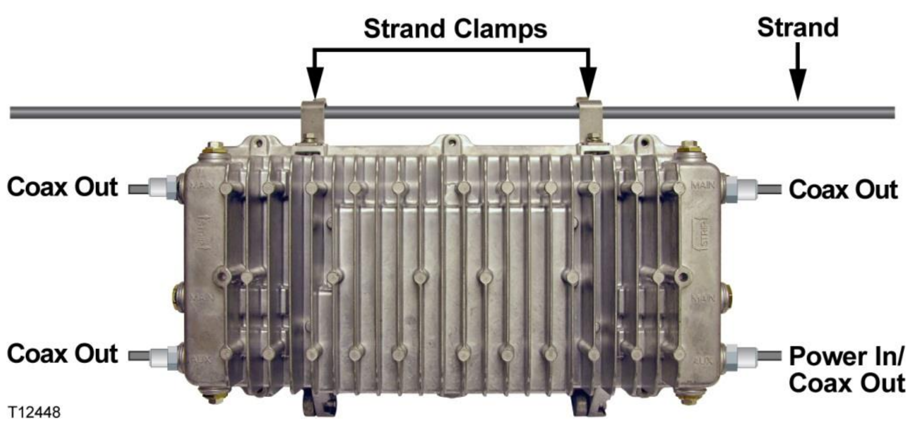
4 Slip the clamps over the strand and finger-tighten the clamp bolts. This allows additional side-to-side movement of the housing as needed.

5 Move the housing as needed to install the coaxial cable and connectors. See the illustrations below for an example

Powered from Left



Powered from Right



Note: If supplying power to the node through a main output port, a power inserter must be installed to inject the AC voltage onto the RF signal.

6 Use a torque wrench and a 1/2-inch socket to tighten the strand clamp bolts from 5 ft-lb to 8 ft-lbs (6.8 to 10.8 Nm).

Note: A slight tilt of the face of the housing is normal. Cable tension will cause the housing to hang more closely to vertical.

7 Connect the coaxial cable to the pin connector according to the pin connector manufacturer's specifications.

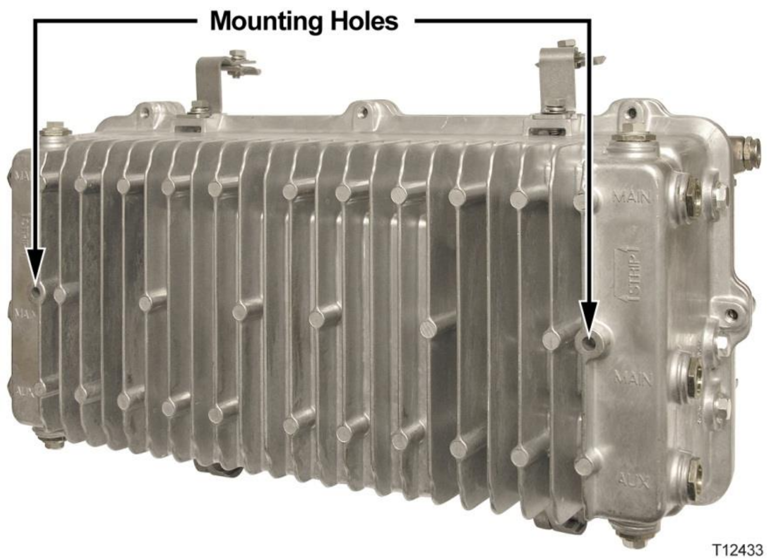
8 Continue to ***Fiber Optic Cable Installation*** (on page 72) and ***RF Cable Installation***

(on page 79).

Pedestal or Wall Mounting the Node

Description

Two mounting holes on the housing allow pedestal or wall mounting.



Procedure

Follow this procedure for pedestal or wall mounting.

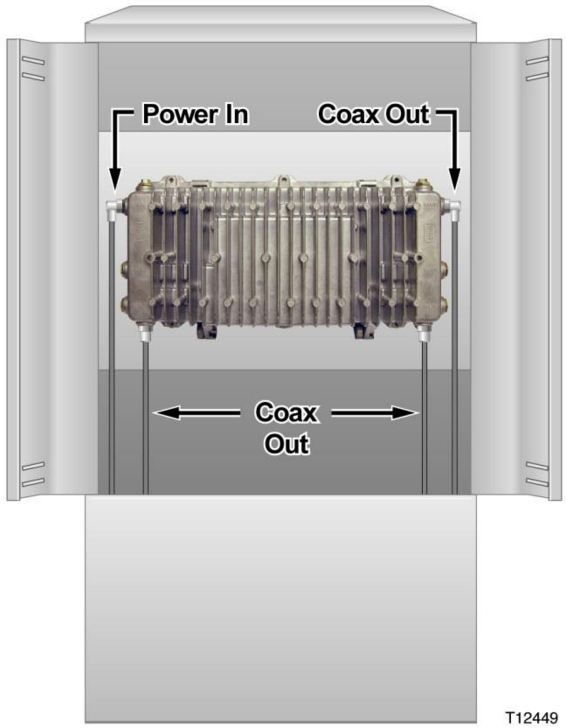
WARNING:

Be aware of the size and weight of the node while mounting. A fully loaded 1.2 GHz GS7000 Node weighs over 50 lbs (22.7 kg).

Ensure that proper handling/lifting techniques are employed when working in confined spaces with heavy equipment.

Failure to observe these admonishments can result in serious injury or death.

1. Remove the cover of the pedestal.
2. Remove the self-tapping bolts from the strand clamps, if previously installed, and set the bolts and strand clamps aside.
3. Position the 1.2 GHz GS7000 Node horizontally in the enclosure and allow for free flow of air around it. Inadequate airflow could cause the node to exceed thermal parameters. Line up the bolt holes on the bottom of the housing with the mounting holes on the pedestal bracket provided by the pedestal manufacturer.



Important: The node housing must be mounted horizontally, as shown, to ensure proper airflow over the housing cooling fins. Do NOT mount the node housing vertically.

4 Secure the node housing to the pedestal bracket using the strand clamp bracket bolts you removed in step 2. Insert the bolts into the mounting holes. Use the strand clamps as spacers if necessary. Torque the bolts from 8 ft-lb to 10 ft-lb (10.8 Nm to 13.6 Nm).

5 Connect the coaxial cable to the pin connector according to connector manufacturer's specifications.

6 Ground the equipment in accordance with local codes and regulations.

7 Continue to ***Fiber Optic Cable Installation*** (on page 72) and ***RF Cable Installation*** (on page 79).

Fiber Optic Cable Installation

Overview

The 1.2 GHz GS7000 Node can accept a fiber optic cable connector from either the right or left side of the housing, or both. The fiber optic cable(s) carries forward and reverse optical signals.

This procedure assumes a specific type of connector as an example. Your connector may be different from the one shown in these illustrations. Be sure to install the connector according to the connector manufacturer's instructions.

Important: Fiber optic cable installation is a critical procedure. Incorrect installation can result in severely degraded 1.2 GHz GS7000 Node performance. Be sure to carefully follow fiber connector manufacturer's instructions. See ***Care and Cleaning of Optical Connectors*** (on page 129).

Color Code

Fiber connectors and adapters are labeled with the following color code.

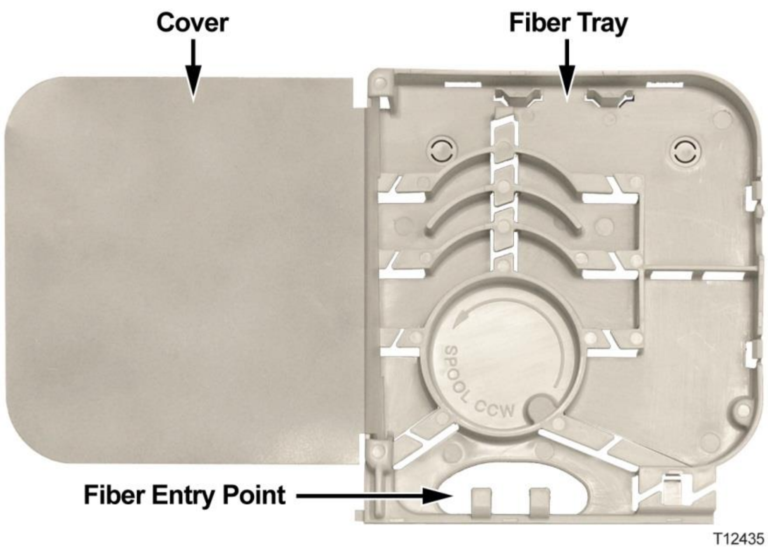
Note: This is only a suggested setup. Your fiber assignment may be different. Refer to your network diagrams to verify your color code.

Connector/Adapter Number	Fiber Color Code	Connects to
1	Blue	forward receiver 1
2	Orange	forward receiver 2
3	Green	reverse transmitter 1
4	Brown	reverse transmitter 2
5	Slate	spare
6	White	spare
7	Red	spare
8	Black	spare

Fiber Management System

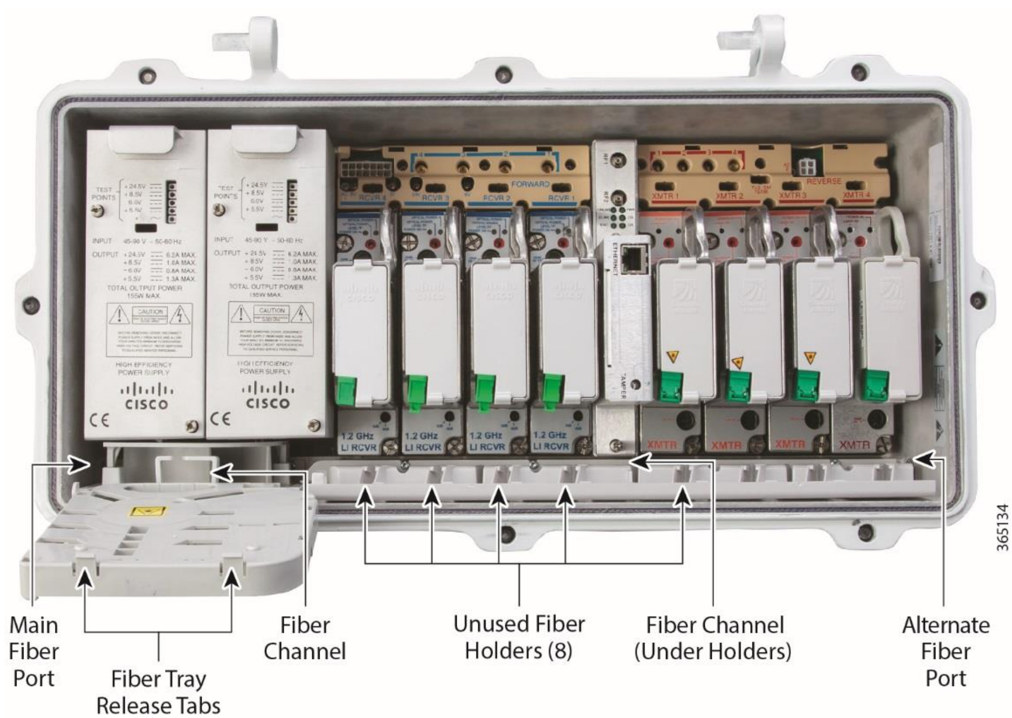
The fiber management system is made up of a fiber tray and a fiber routing track. The fiber tray provides a convenient location to store excess fiber and up to two WDM modules in the node. The tray is hinged to allow it to move out of the way during the insertion of the fibers and for installation or replacement of the node power supplies. The fiber routing track provides a channel for routing fiber pigtails to their appropriate optical modules as well as a location to snap in unused fiber connectors for storage.

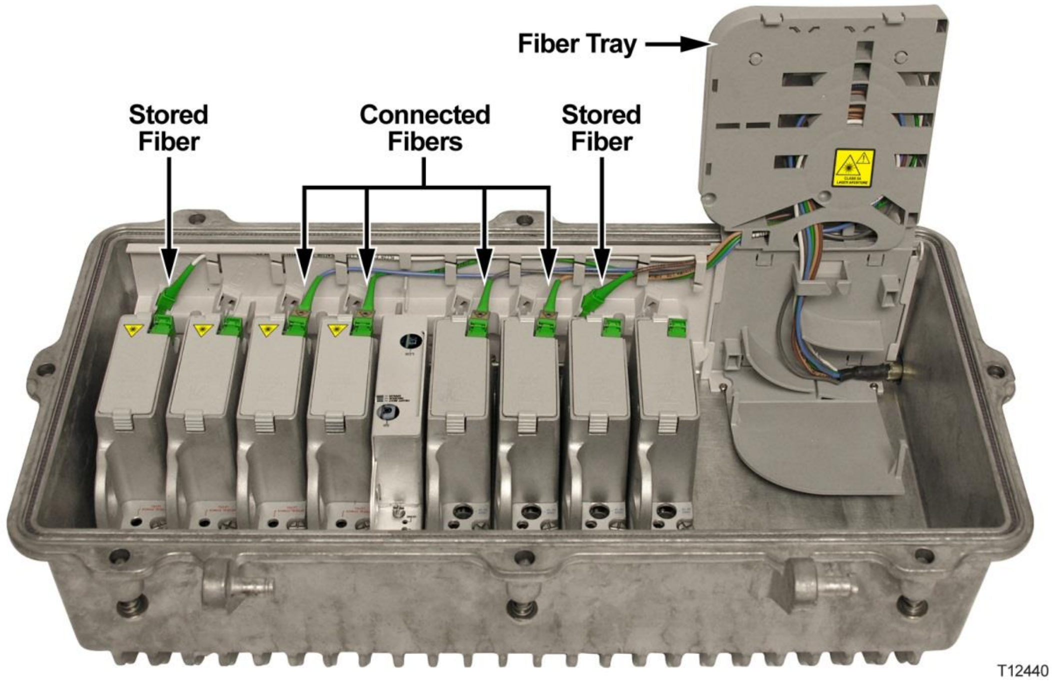
The following illustration shows the design of the fiber tray.



Note: Fibers are spooled in a counterclockwise direction in the tray.

The following illustrations show the location and layout of the fiber tray and track in the housing lid.





Note: Power supplies are removed in the previous illustration for clarity.

Procedure

Install fiber optic cable as described below.

> **WARNING:**
>
> **Laser light hazard. The laser light source on this product emits invisible laser radiation. Avoid direct exposure. Never look into the end of an optical fiber or connector. Failure to observe this warning can result in eye damage or blindness.**

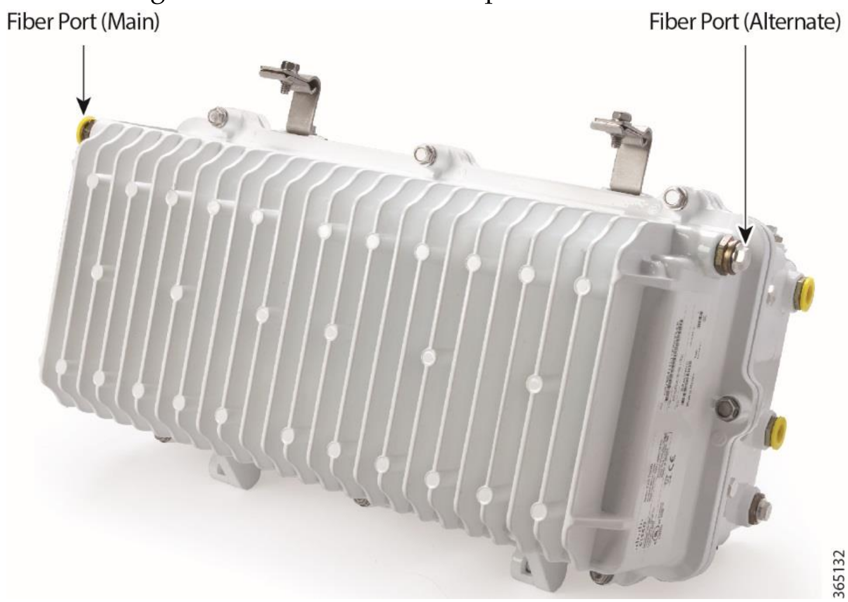
- Do not apply power to this product if the fiber is unmated or unterminated.
- Do not stare into an unmated fiber or at any mirror-like surface that could reflect light that is emitted from an unterminated fiber.
- Do not view an activated fiber with optical instruments.

1 The first step depends on whether the fiber optic cable is factory installed or not.

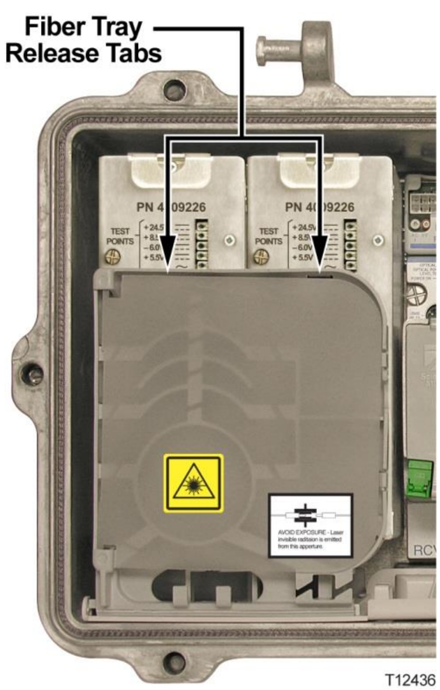
IF...	THEN...
fiber optic cable is factory installed	splice fiber pigtail of optical fiber input cable to your splice enclosure and continue to **RF Cable Installation**.

fiber optic cable is not installed	go to step 2.

2 Select the right or left fiber connection port for use and remove its sealing plug.

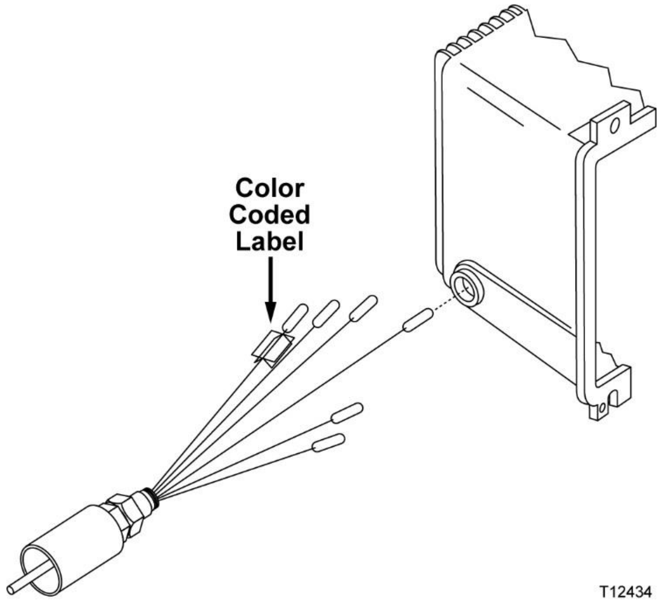


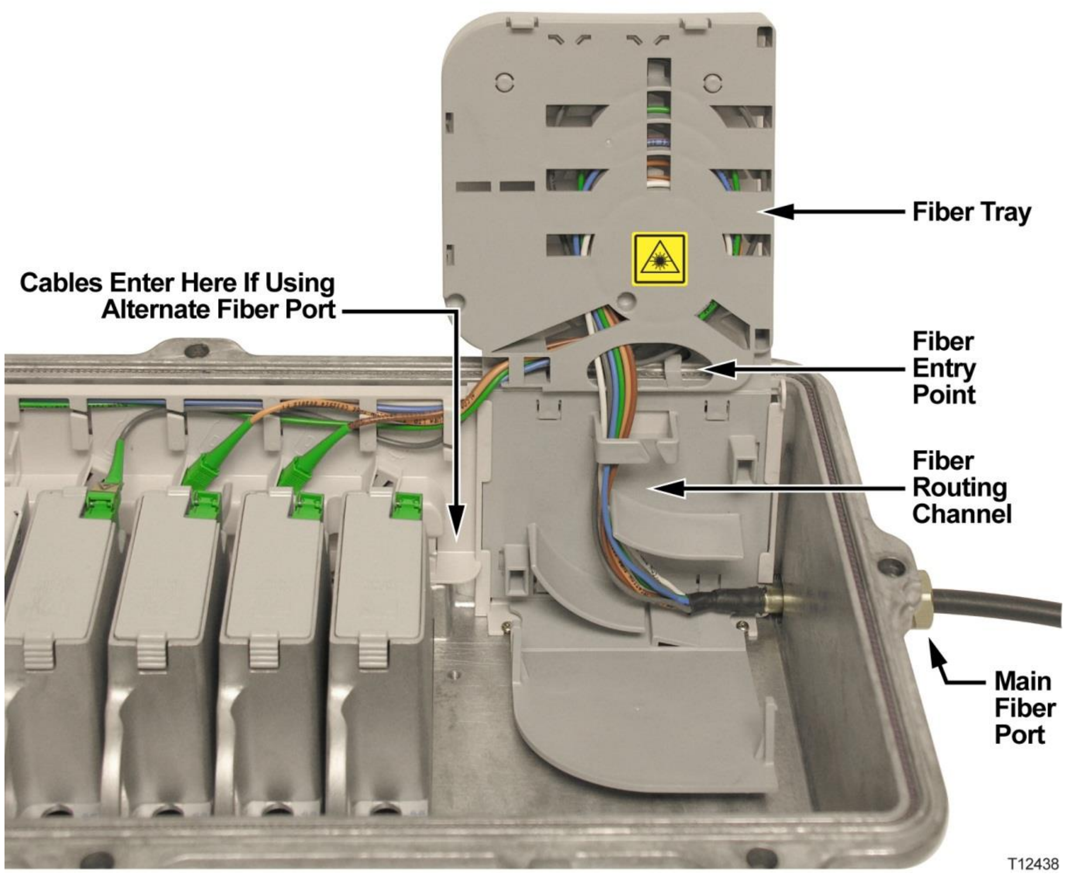
3 Push in the two release tabs at the top of the fiber tray and swivel the top of the fiber tray up and back to allow a clear view of the fiber routing channel below.



4 One at a time, carefully insert fibers with attached connectors through the fiber connection port, the fiber channel, and then up and through the fiber entry point in the bottom of the fiber tray. Do not bend or kink fibers. Though not necessary, you

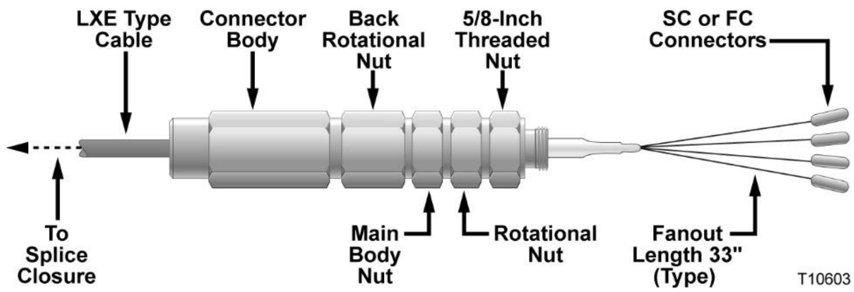
can also remove the power supplies and open the fiber routing channel cover for additional access.





Note: If using the alternate (right-side) fiber connection port, you have to route the fibers through the fiber channel in the fiber track located underneath the unused fiber holders.

5 Hold the connector body to prevent rotation of the connector or fibers.



6 Carefully thread the 5/8-inch threaded nut into the threaded hole of the fiber port. Tighten to 20 to 25 ft-lbs (27.1 to 33.9 Nm).

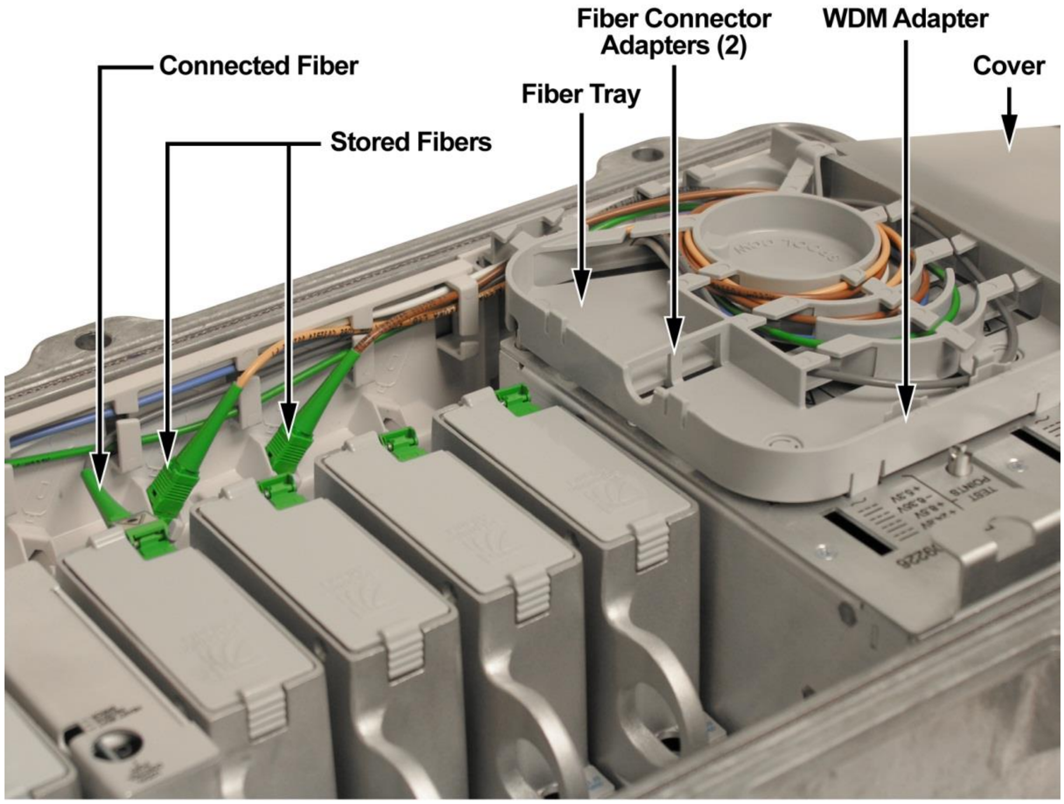
7 Firmly tighten the rotational nut against the 5/8-inch threaded nut.

8 Push heat shrink tubing over the connector and fiber port and shrink in place.

9 Identify individual fibers according to their color code and determine to which receiver or transmitter module each fiber will connect.

10 Pivot the fiber tray back down and snap it into place on top of the power supply with its locking tabs.

11 Open the fiber tray cover and carefully wind the fibers around the spool in a counterclockwise direction. Be sure to leave enough fiber so that each connector can reach its intended module. Note that different diameter spool paths are provided to properly adjust the fiber length.



12 Route each fiber to its intended module through the fiber track as shown.
13 Before connection, carefully clean the optical connectors on both fiber and module according to the procedures in ***Care and Cleaning of Optical Connectors*** (on page 129).
14 Open the receiver or transmitter module fiber connector cover. Carefully slide the fiber connector into the module connector until it clicks.
15 Repeat steps 12 and 13 for each receiver and transmitter module.
16 Splice fiber pigtail of optical fiber input cable to your splice enclosure.
17 Continue to ***RF Cable Installation*** (on page 79).

RF Cable Installation

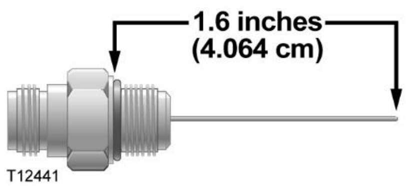
Overview

The 1.2 GHz GS7000 Node can accept up to six RF cables. These cables carry forward path RF signal outputs and reverse path RF signal inputs. The RF cables also supply the 45 to 90 V AC power input.

Trimming the Center Conductor

The 1.2 GHz GS7000 Node requires pin-type connectors for all RF connections.

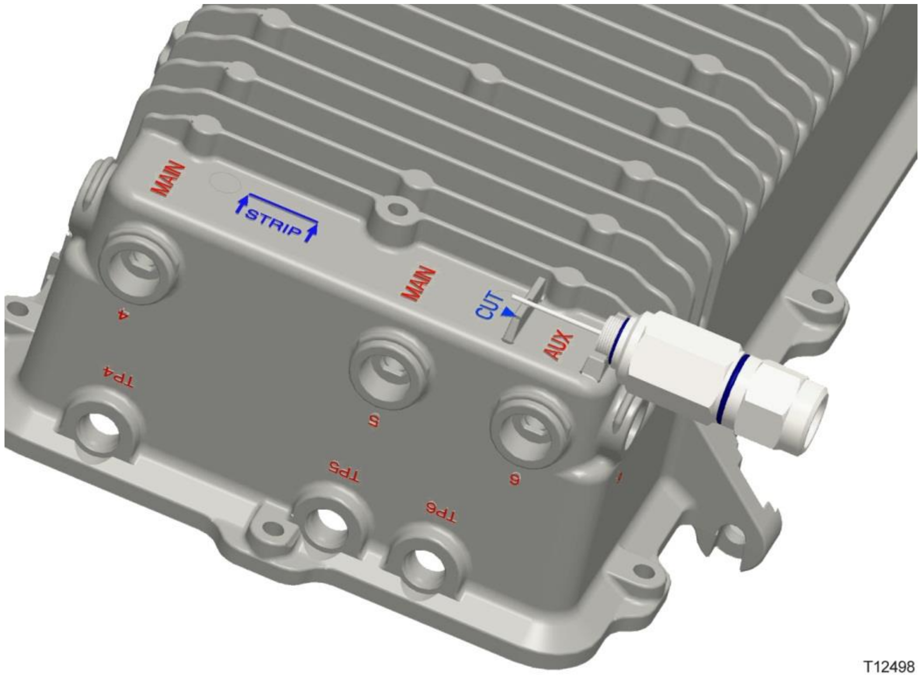
Standard pin connectors, with pins extending 1.5 in. to 1.6 in. (3.8 cm to 4.064 cm) from connector shoulder, require no trimming. You must trim longer pins before inserting them into the housing.



Trimming Using the Integrated Cradle

To trim long pins using the integrated cradle, follow these steps.

1 Place the connector on the cradle as shown in the following illustration.



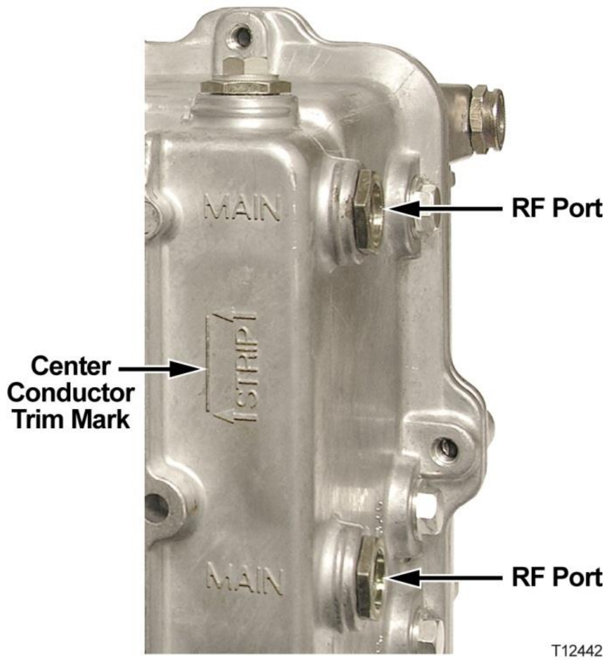
2 If the center conductor extends past the **CUT** stanchion on the housing, trim the pin flush with the end of the **CUT** stanchion.

3 Remove any burrs or sharp edges from the trimmed end of the pin.

Trimming Using the Strip Line Mark

To trim long pins using the strip line mark on the housing, follow these steps.

1 Place the connector above the entry port so that it lines up with its installed position.



2 If the center conductor extends past the **STRIP** line on the housing, trim the pin flush with the **STRIP** line.

3 Remove any burrs or sharp edges from the trimmed end of the pin.

Connecting the RF Cables to the Node Housing

Follow these steps to connect the RF cables.

1 Determine which ports receive an RF cable for your configuration.

2 The length of the RF connector center pin is critical to proper operation. The pin length must be 1.6 inches (4.064 cm). Trim pin if necessary before installation. See ***Trimming the Center Conductor*** (on page 79).

   Note: Assemble each RF connector to its cable according to manufacturer's instructions.

3 Remove the sealing plug of each port to which cables connect. Note that Ports 1, 3, 4, and 6 have the option of a vertical or horizontal connection.

4 Insert the appropriate coaxial connector of each RF cable to the desired housing port and torque to the manufacturer's specification. Do not exceed recommended torque.

5 Repeat steps 2 through 4 for each RF port used.

6 Continue to **Applying Power to the Node**.

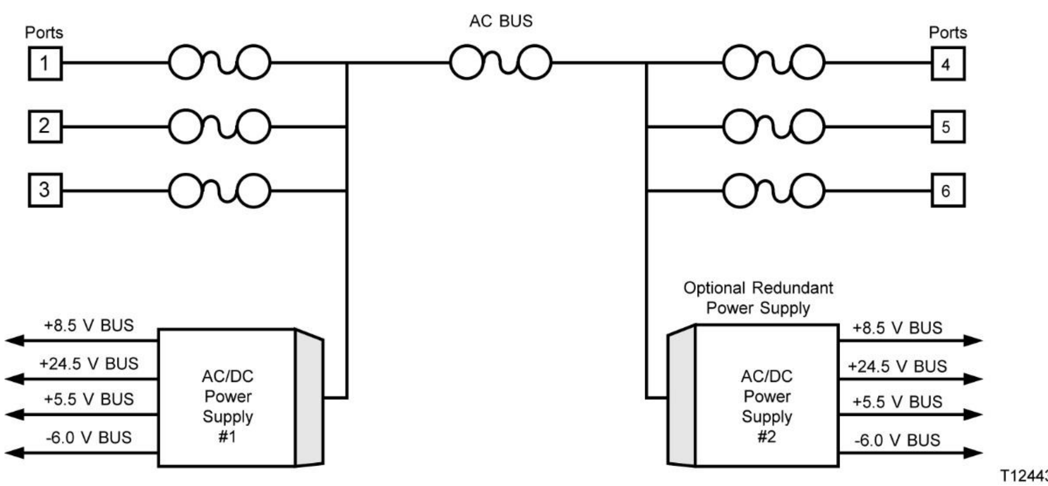
Applying Power to the Node

Overview

The 1.2 GHz GS7000 Node requires input power of 45 to 90 V AC from an external power source. This power is supplied through one or more of the RF cables.

The powering configuration is flexible and can be changed to meet most network requirements. Power direction is configured by installing AC shunts for the ports through which you want to pass AC power. An AC segmentable shunt is provided to configure power direction between the two sides of the node.

The following schematic diagram illustrates 1.2 GHz GS7000 Node powering.



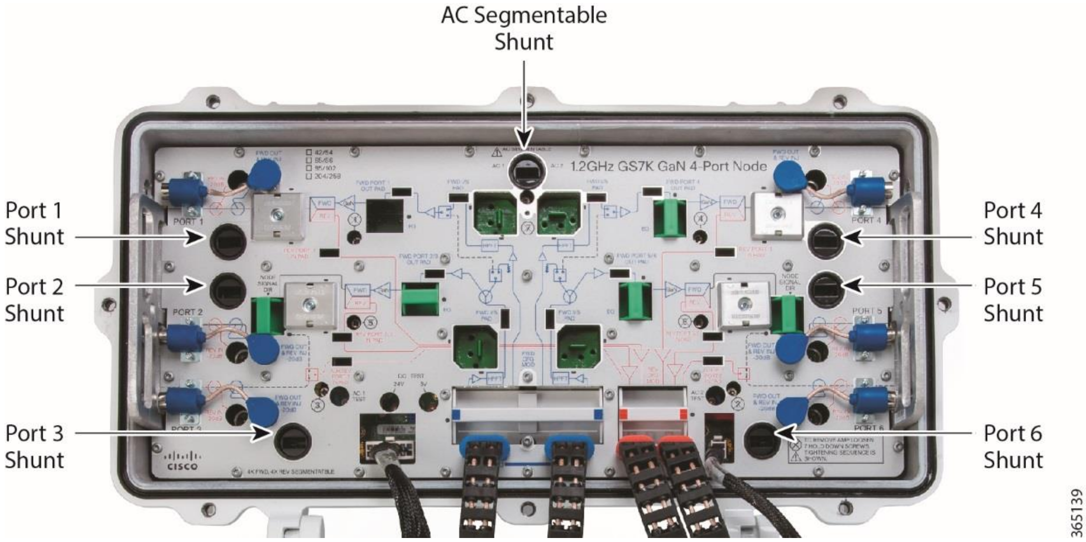
Node Powering Procedure

Follow these steps to apply power.

1 Determine which of the RF cables carry 45 to 90 V AC input power.

2 Install shunts in the locations that correspond to the AC-powered RF ports. Each port's shunt is located on the RF amplifier module near the port as shown in the following illustration.

4-Way RF Amplifier Module



Note: Shunts are available with both red and black tops. Use red to indicate that power is applied to that port. Use black to indicate that input power is not applied.

3 If desired, remove shunts to block AC power at the individual ports.

4 The next step depends on the power path, as follows:

IF...	THEN...
power will pass from left side of housing (Ports 1, 2, and 3) to right side of housing (Ports 4, 5, and 6)	ensure that the AC segmentable shunt is installed.
power is to be blocked between left side of housing (Ports 1, 2, and 3) and right side of housing (Ports 4, 5 and 6)	ensure that the AC segmentable shunt is removed.
Ports 1, 2, and 3 are powered from one source and Ports 4, 5 and 6 are powered from another source	ensure that the AC segmentable shunt is removed.

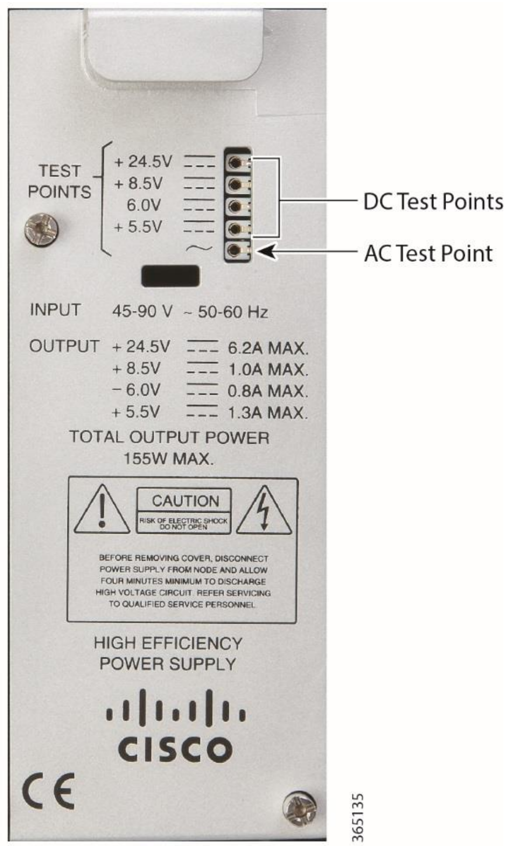
5 Continue to **Voltage Check Procedure**.

Voltage Check Procedure

Always check both AC and DC voltages during initial setup of the 1.2 GHz GS7000 Node.

Follow these steps to check AC and DC voltages.

1 Use a true-rms DVM to check for 45 to 90 V AC input voltage at the AC test point on the power supply module.



2 Check for the various DC output voltages (+24.5, +8.5, -6.0, and +5.5) of the power supply at the DC test points on the power supply module.

3 Verify that the Power ON LED on the receiver module is on.

4 Carefully close the housing lid. See ***Opening and Closing the Housing*** (on page 118).

4

Setup and Operation

Introduction

This chapter describes how to set up and operate the 1.2 GHz GS7000 Node. These procedures assume the 1.2 GHz GS7000 Node is installed according to the procedures in Chapter 3 of this manual.

Network Requirements

Refer to your network design diagrams during setup. The design diagrams should specify the exact input and output signal levels required for your network. The 1.2 GHz GS7000 Node is configured to have a specific amount of gain at 18 dB of linear tilt from 52 MHz to 1218 MHz.

In This Chapter

Tools and Test Equipment

Required Tools and Test Equipment

Tools and test equipment required for setup are listed below. Equivalent items may be substituted. Ensure test equipment is calibrated and in good working order.

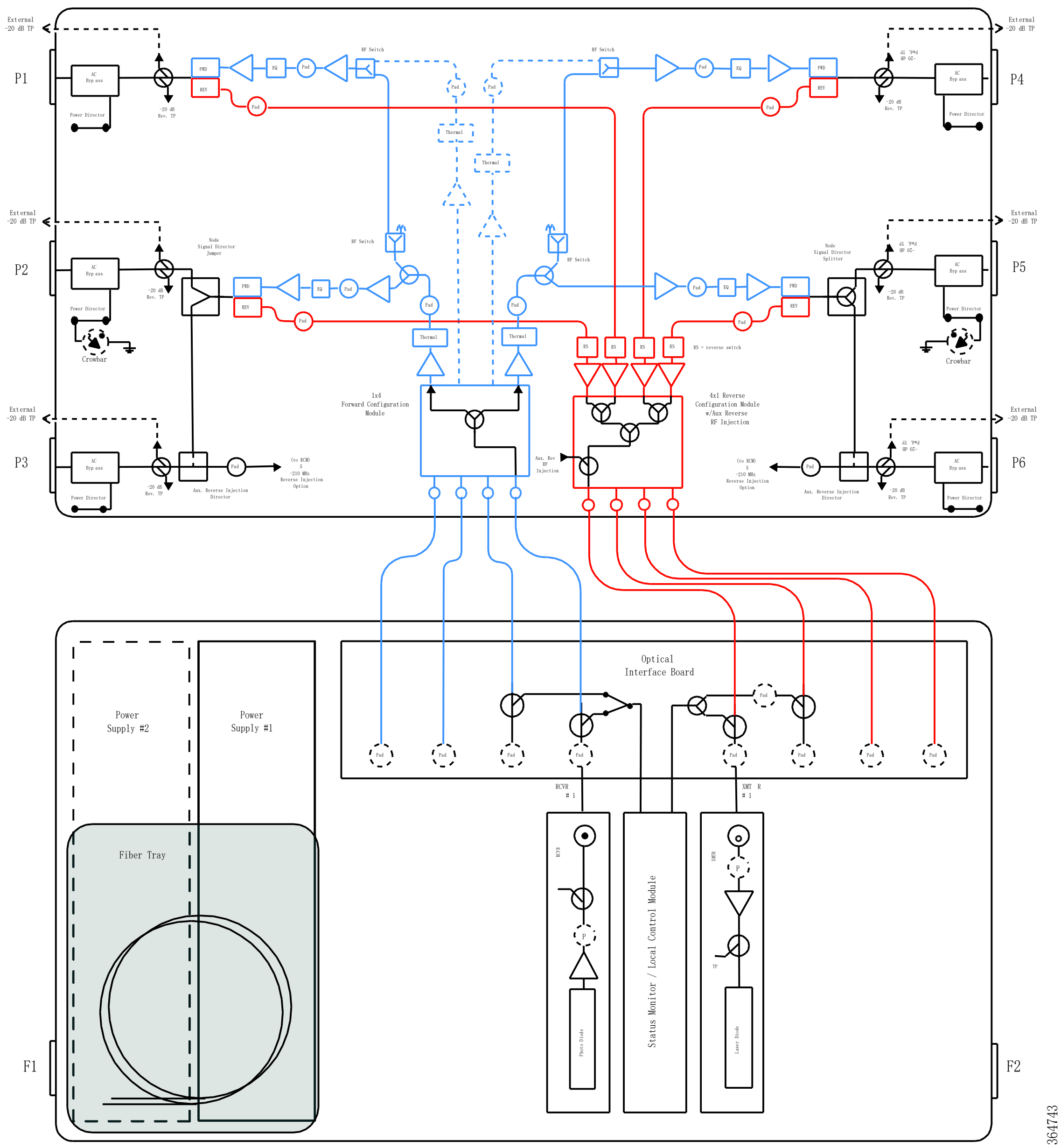
- Fluke Model 77 (or equivalent) true-rms digital voltmeter (DVM) with 0.001 resolution.
- Signal generator capable of generating carriers at 55.25 MHz and 1.2GHz
- "F" barrel adapter – 1.2 GHz
- Field strength meter capable of measuring up to 1.2GHz
- Field sweep receiver/transmitter with a minimum bandwidth of 1.2 GHz
- EXFO FOT 22AX optical power meter with adapters
- Fiber optic jumper to test transmitter optical output power
- Glendale Technologies optical eye protection blocking 900–1600 nm light

System Diagrams

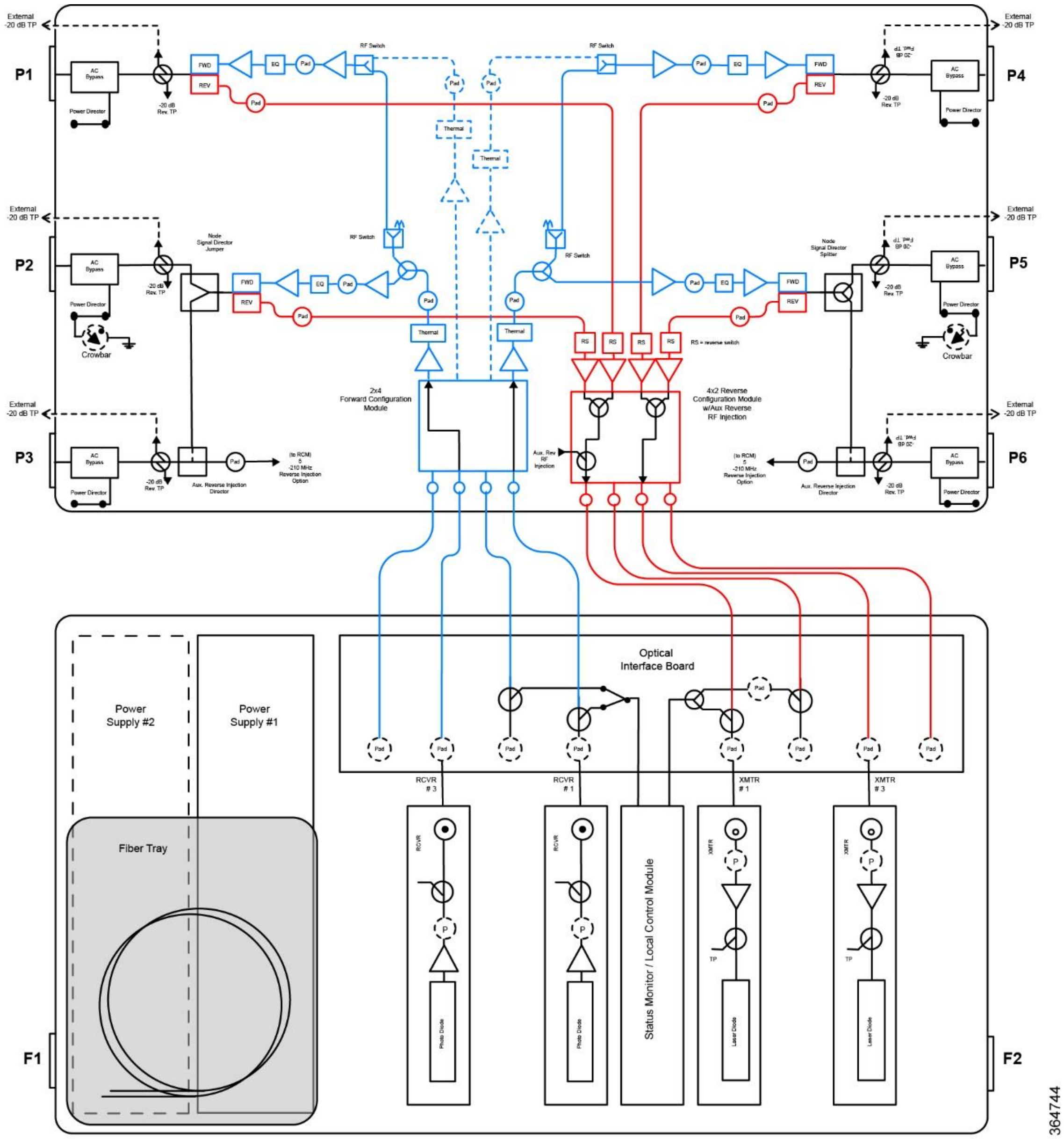
Functional Diagrams: 4-Way Forward Segmentable Node

The following diagrams show the signal flow through the 4-way forward segmentable node.

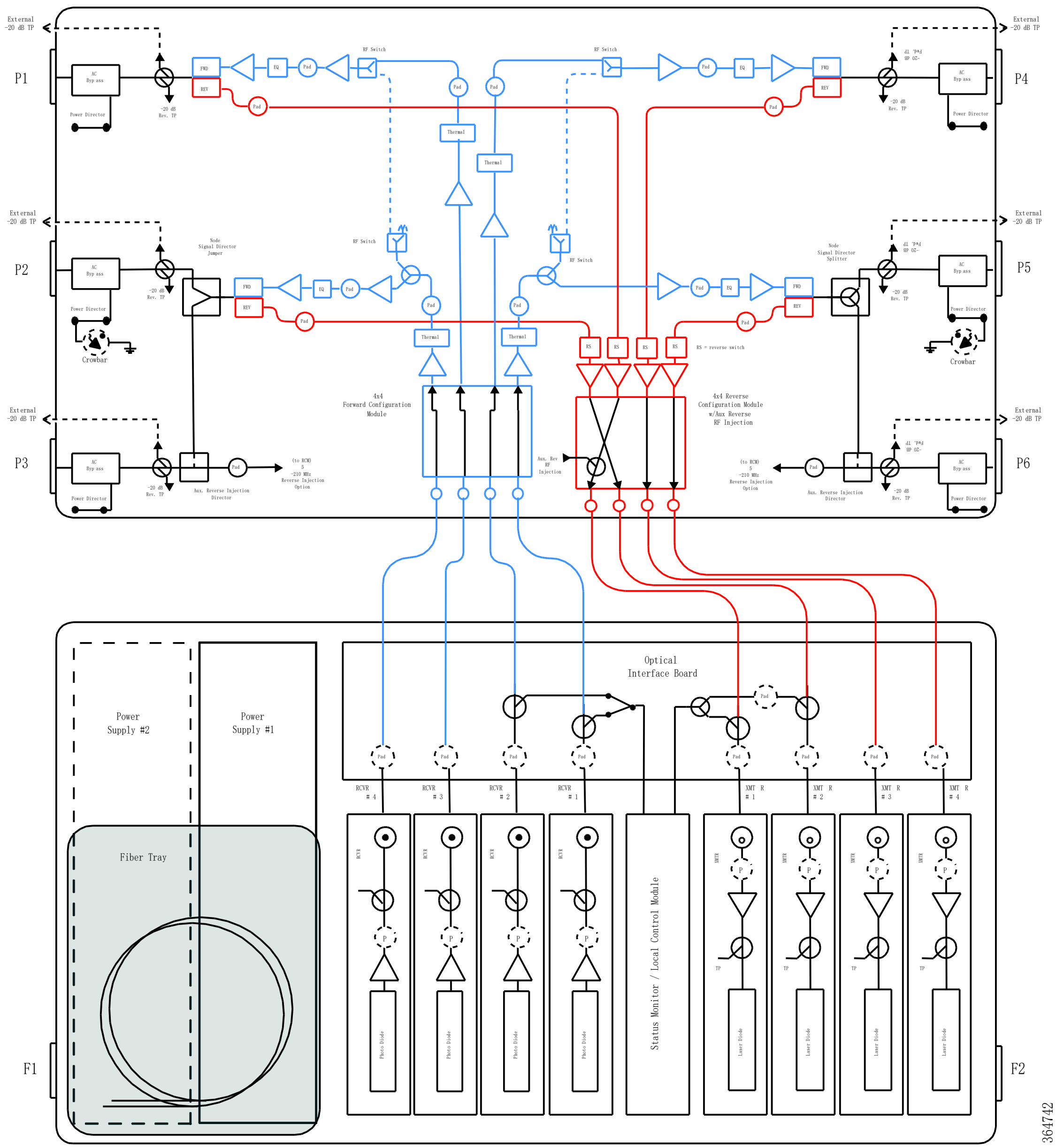
Non-Segmented



Left-Right Segmented

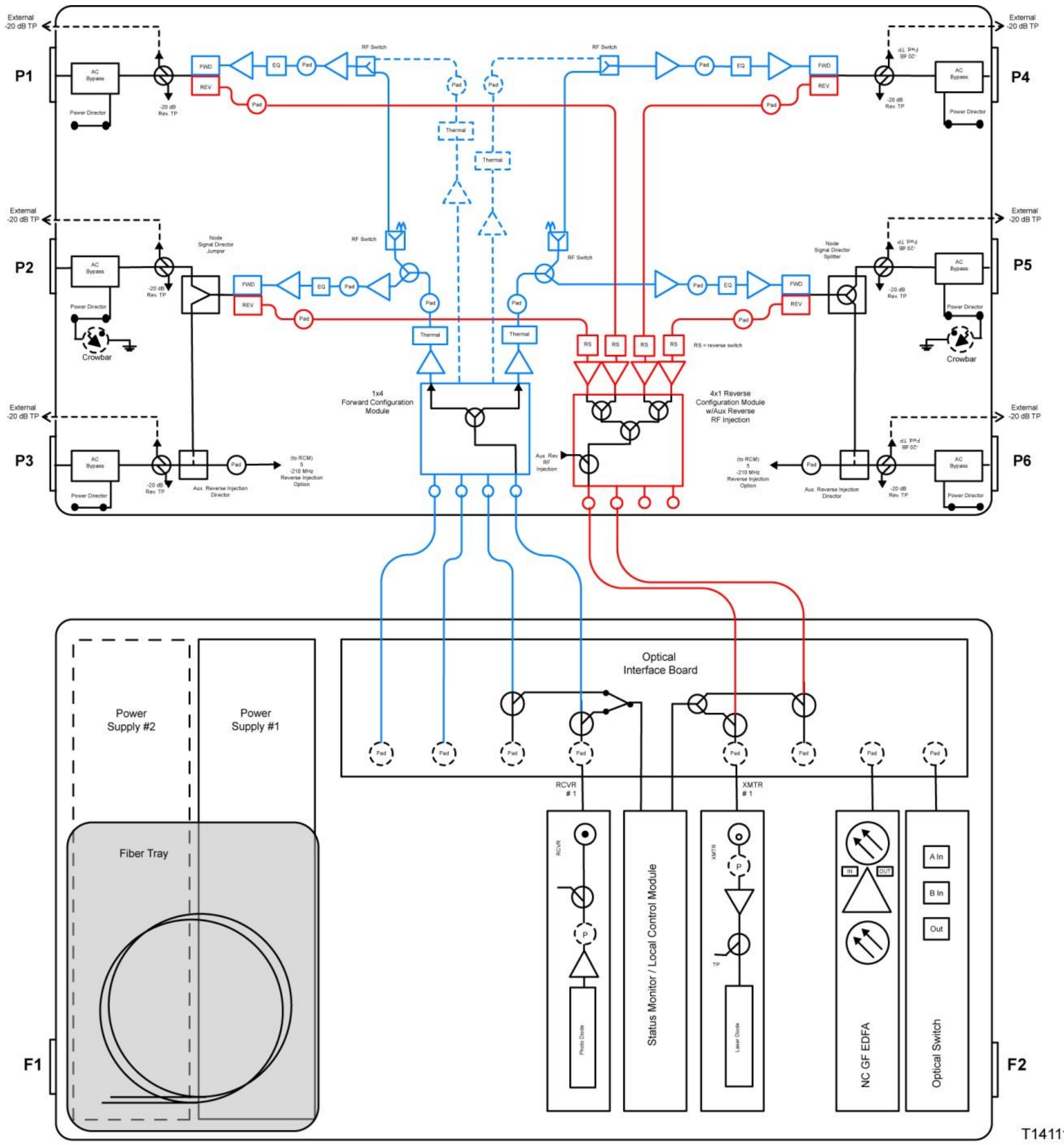


Fully Segmented



Functional Diagram: Hub Node

The following diagram shows the signal flow through a 4-way non-segmented hub node.



RF Assembly

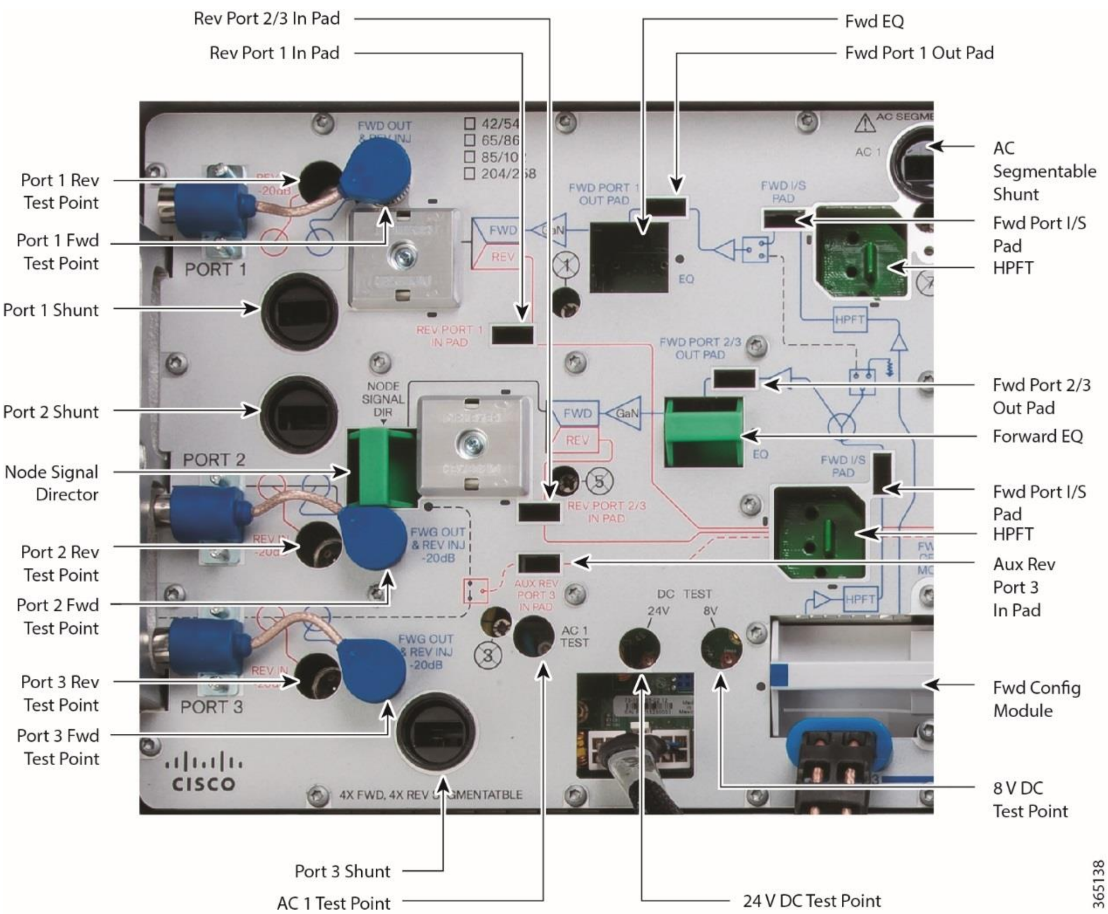
Become familiar with the function and component layout of the RF assembly before aligning the 1.2 GHz GS7000 Node. The cover of the RF assembly is printed with a diagram that shows the functional signal flow and identifies each field-replaceable component.

Some of these components (pads, equalizers, and node signal directors) are removed and replaced with different value components during the setup procedures.

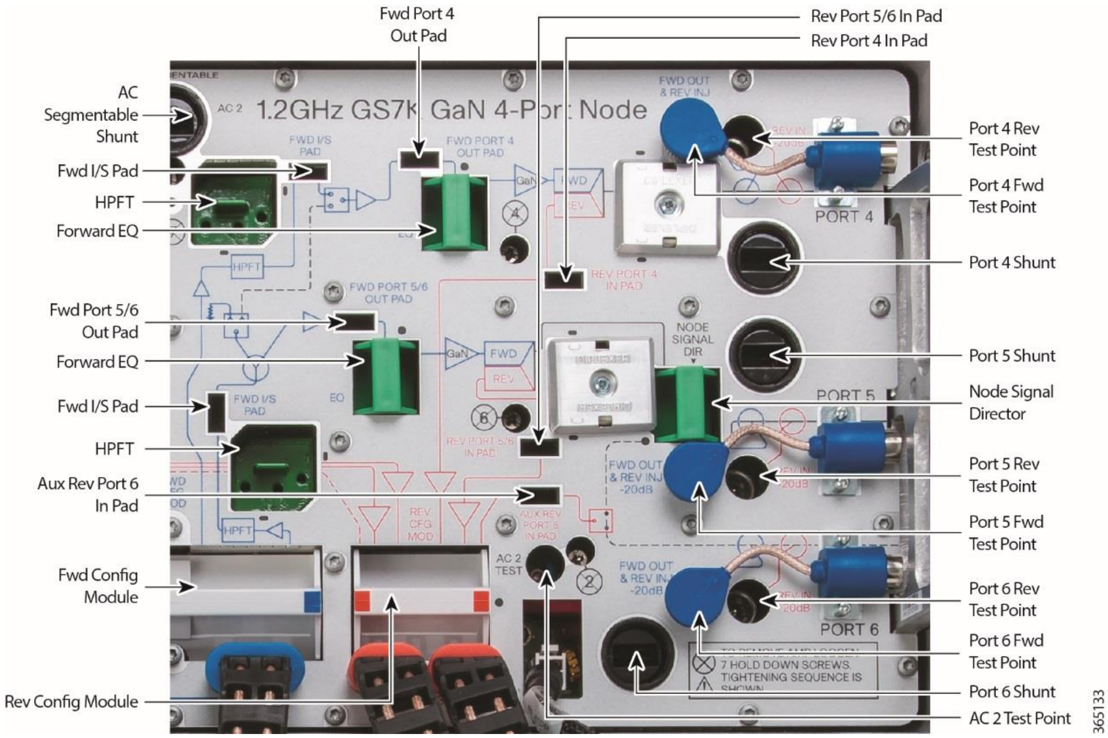
4-Way Forward Segmentable Node RF Assembly

The following illustrations show the 4-way forward segmentable node RF assembly.

Left side Ports 1, 2, and 3 illustration.



Right side Ports 4, 5, and 6 illustration.



Forward Path Setup Procedure

Introduction

This procedure describes how to perform the forward path setup.

Note: The procedure uses an example with a transmitter modulation index of 2.5% per channel and the 1.2GHz node with RF output level of 54 dBmV @ 1218 MHz.

Setup Procedure

Perform the following steps to set up the forward path.

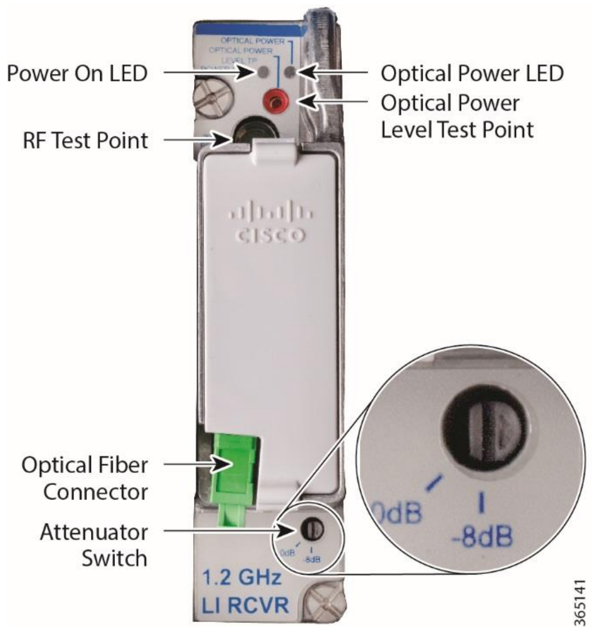
1. Ensure all unused RF ports are terminated with 75 ohms. Use an AC load if AC is routed to the RF port.
2. Open the housing according to ***Opening and Closing the Housing*** (on page 118).
3. Carefully disconnect the forward path optical fiber(s), if connected.

> ⚠ **WARNING:**
> **Laser hazard. This product contains a class 3B laser with no safety interlocks. Under no circumstances should connectors be viewed with equipment enabled. Direct viewing of connectors can cause eye damage. Failure to adhere to this admonishment may result in serious injury to the eye(s) or even blindness.**

> ⚠ **CAUTION:**
> **Disconnecting the optical fibers of a working network element will interrupt customer service.**

Note: Ensure all optical connectors are clean. See ***Care and Cleaning of Optical Connectors*** (on page 129).

4. Use an optical power meter to measure the level of the input light signal from the forward path optical fiber cable(s). Signal should be 0 dBm, 1mW, nominal. For a standard receiver, record the measurement(s).
5. Connect the forward path optical fiber(s) to the receiver. Use a DVM to measure DC voltage at receiver optical power level test point. Scale: 1V DC = 1mW (1310 nm transmitter) and 1.12 V DC = 1mW (1550 nm transmitter).



6 Set the receiver module attenuator switch as follows:

	IF received optical power is...	THEN set the attenuator switch to...
Standard Receiver	−2 to +2 dBm	-8 dB
	-6 to -2 dBm	0 dB
Low Input Receiver	-6 to -2 dBm	-8 dB
	-10 to -6 dBm	0 dB

7 For standard input receiver, check the RF level at the -20 dB RF test point on each forward path receiver. Signal level should be +7 dBmV at the test point with 0 dBm optical input power and 2.5% index modulation of the laser headend transmitter. (With optical receiver attenuator set to the -8 dB switch setting.) This represents an optical receiver output of +27 dBmV. For low input receiver follow the same process to check the RF level and refer the table below.

	For standard receiver	For low input receiver	Att/OMI
Output level	27dBmV	27dBmV	8 dB/2.5%
Input optical power	0dBm	-4dBm	8 dB/2.5%

8 The next step depends on your RF output levels.

IF your RF output ports will...	and you have...	THEN...
all have equal output levels	1X, 2X, or 4X segmentation	Go to step 9.
be driven at different levels	4X segmentation	Go to step 10.

be driven at different levels	1X or 2X segmentation	Go to step 11.

9 If all four of the node's output ports are to have equal output levels, re-balancing of the RF level should not be required for 4-way segmentation.

To achieve an output level of 54 dBmV @1218MHz / 50.7 dBmV @ 1002 MHz

- with 27 dbmV output from the optical receiver, install a 15 dB attenuator pad into the optical interface board just above the receiver module.

Go to step 14.

10 If using 4-way segmentation, all four of the node's output ports can be set to have un-equal output levels. Re-balancing of the RF level should not be required for 4-way segmentation.

11 Example: To achieve an output level of 54 dBmV @1218MHz / 50.7 dBmV @ 1002 MHz at output port 1

- with 27 dBmV output from the optical receiver, install a 15 dB attenuator pad into the optical interface board just above the optical receiver 3 module.

To achieve an output level of 55 dBmV @1218MHz / 51.7 dBmV @ 1002 MHz at output port 2

- with 27 dBmV output from the optical receiver, install a 14dB attenuator pad into the optical interface board just above the optical receiver 4 module.

Repeat this process to obtain the desired output levels for all remaining output ports.

Go to step 14.

12 If the node's output RF ports are to be driven at different levels, and the node is not set up in 4-way forward segmentation, the port with the highest output level should be used to set up the node. Measure signal level at the forward RF test point, on the amplifier module, to identify the port with the highest level output signal. Verify the output power level is correct using the OIB Pad as in Step 9.

Go to step 13.

13 Increase the attenuator pad value at the FWD PORT OUT PAD locations on the RF amplifier module to reduce the output level of the ports which need to be driven at a lower level than the port used to setup the node. See ***Appendix A - Technical Information*** for pad selection charts.

14 The GS7000 Node is set for 18 dB of linear tilt between 54 and 1218 MHz / 14.7 dB between 54 MHz and 1002 MHz.

4-Way Forward Segmentable RF Amplifier Note: Four 18.0 dB linear field replaceable equalizers are installed in the node at the factory, one each on the four independent forward amplification paths. This achieves 18.0 dB of linear tilt between 54 MHz and 1218 MHz (14.7 dB between 54 MHz and 1002 MHz).

If your network requires a different value, remove the field replaceable 18 dB equalizers and replace with equalizers of the appropriate value. See ***Forward Equalizer Chart*** (on page 150).

15 Continue to **Reverse Path Setup Procedure** or close the housing according to ***Opening and Closing the Housing*** (on page 118).

Reverse Path Setup Procedure

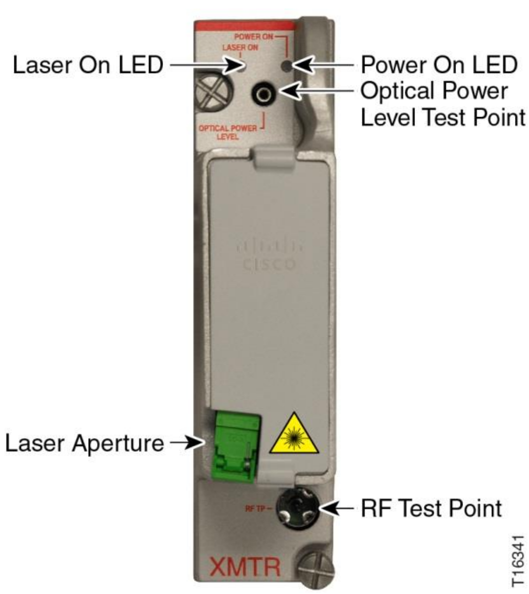
Introduction

This procedure describes how to perform the reverse path setup. Perform this procedure only if your 1.2 GHz GS7000 Node has an active reverse path.

Optical Transmitter Setup Procedure

Perform the following steps to set up the proper level into the reverse path optical transmitters.

1. Open the housing according to ***Opening and Closing the Housing*** (on page 118).
2. Verify the level of the input reverse RF signals at the RF test points located near the main ports of the RF amp module. Nominal level is +17 dBmV per channel. Install the appropriate value input pad at the REV PORT IN PAD location to attenuate the signal to the desired level for the reverse path of the node.
3. With the input to the node port set to 17 dBmV per channel, a 4 dB transmitter input attenuator pad should be installed on the optical interface board (just above the transmitter module) to achieve 13 dBmV level into the optical transmitter (-7 dBmV at the transmitter -20 dB test point). This RF input level into the high gain reverse transmitter will achieve an optical modulation index (OMI) of 10%.
4. Repeat steps 2 and 3 for each RF port carrying a reverse path signal.
5. Use an optical power meter to measure the transmitter optical output power. (1330 nm or 1550 nm)



6 Using a DVM, measure the DC voltage at the optical test point and record the value.

7 Check the connection of the optical connector. Make sure the optical connector is seated and verify that the fiber bend radius is greater than 1 inch.

WARNING:
When handling optical fibers always follow laser safety precautions.

Reconfiguring Forward Signal Routing

Introduction

This section describes how to configure the forward signal routing of the 1.2 GHz GS7000 Node.

Forward Routing Configurations

The receiver modules and the forward configuration module determine the forward signal routing. Each module must be in its proper slot to achieve the different node configurations.

The following table shows the required modules and their slot locations for various node configurations.

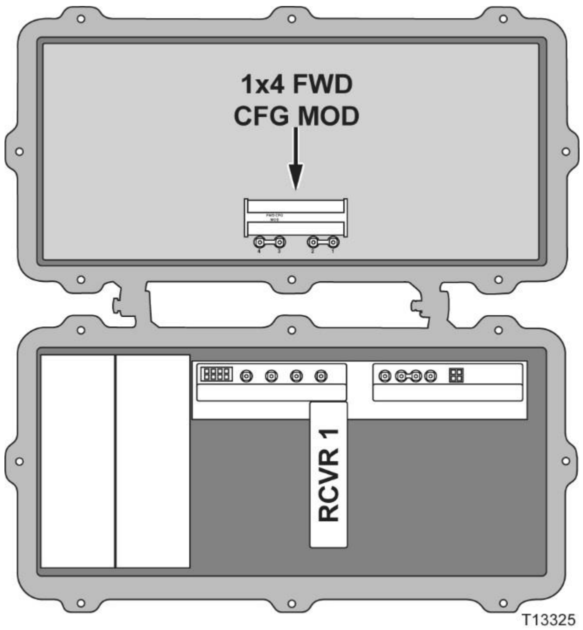
If the configuration is…	Then use configuration module…	Install Receivers in Positions...
one receiver, four outputs	1x4 Forward	1
one receiver, four outputs (with external RF source)	1x4 Forward with Forward RF Injection, plus FLI module	1
two receivers, four outputs, redundant	1x4 Redundant Forward, plus SM/LCM	1, 2
two receivers, four outputs, redundant (with external RF source)	1x4 Redundant Forward with Forward RF Injection, plus SM/LCM and FLI module	1, 2
two receivers, each feeding two outputs, 2-way segmented	2x4 Forward	1, 3
four receivers, each pair feeding two outputs, 2-way segmented, redundant	2x4 Redundant Forward, plus SM/LCM	1, 2, 3, 4
three receivers, four outputs	3x4 Forward (for receivers 1, 3, and 4)	1, 3, 4
three receivers, four outputs	3x4 Forward (for receivers 1, 2, and 4)	1, 2, 4
four receivers, each feeding separate outputs	4x4 Forward	1, 2, 3, 4

1x4 Forward Configuration Modules

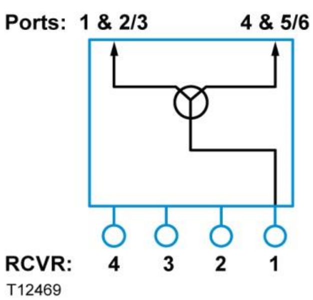
A single forward receiver (RCVR 1) feeds all RF output ports.

Install the receiver in RCVR 1.

4-way forward segmentable node



The following diagram illustrates forward path signal flow in this configuration module.

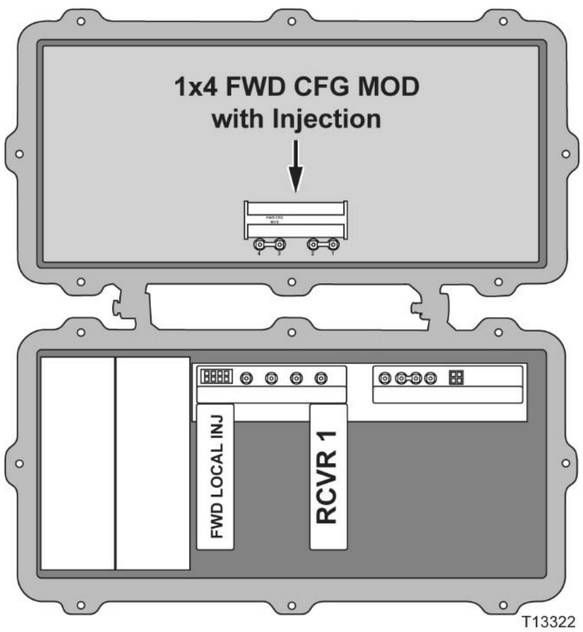


1x4 Forward Configuration Modules with Forward RF Injection

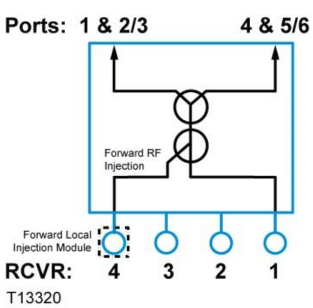
A single forward receiver (RCVR 1) feeds all RF output ports. The Forward Local Injection (FLI) Module routes an RF signal from an external source to the Forward Configuration Module which is then coupled with the input from RCVR 1.

Install the receiver in RCVR 1. Install the FLI Module in the RCVR 4 position.

4-way forward segmentable node



The following diagram illustrates forward path signal flow in this configuration module.



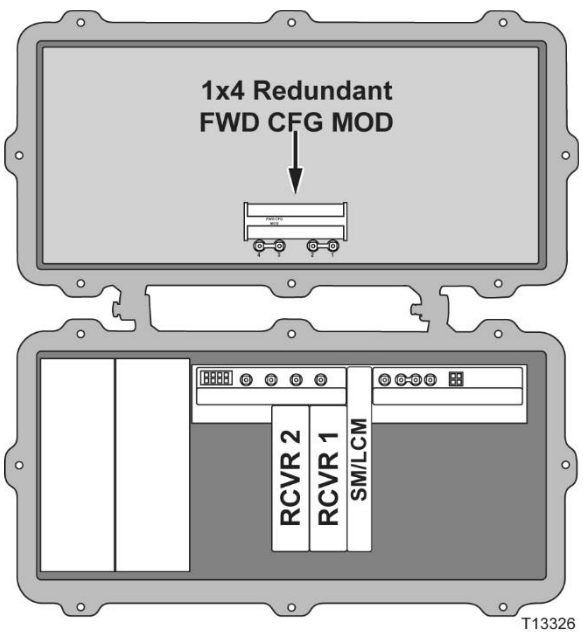
1x4 Redundant Forward Configuration Modules

A primary receiver (RCVR 1) and a redundant receiver (RCVR 2) feed all RF output ports.

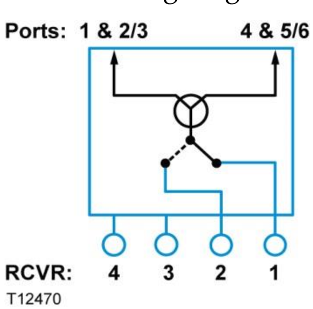
The Status Monitor/Local Control Module automatically switches from primary receiver to redundant receiver when it senses a loss of optical input to the primary receiver. Once optical input is restored, the system automatically switches back to the primary receiver.

Install the primary receiver in RCVR 1 and the redundant receiver in RCVR 2.

4-way forward segmentable node



The following diagram illustrates forward path signal flow in this configuration module.



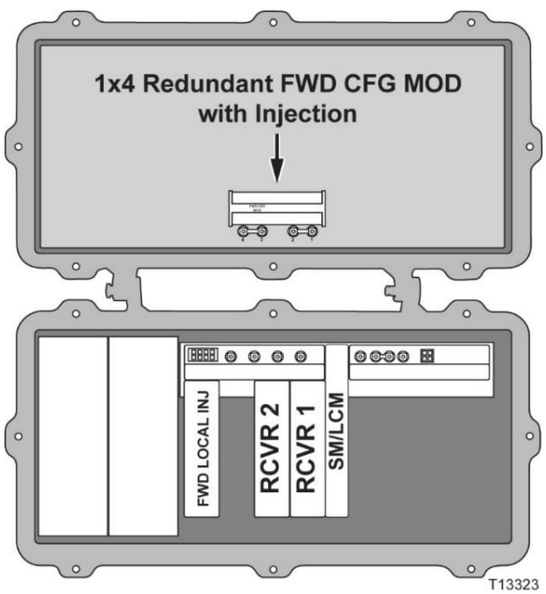
1x4 Redundant Forward Configuration Modules with Forward RF Injection

A primary receiver (RCVR 1) and a redundant receiver (RCVR 2) feed all RF output ports. The FLI Module routes an RF signal from an external source to the Forward Configuration Module which is then coupled with the input from RCVR 1/2.

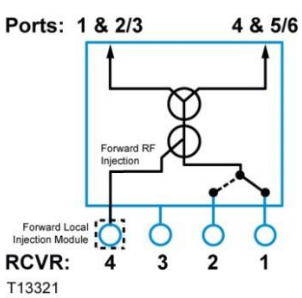
The Status Monitor/Local Control Module automatically switches from primary receiver to redundant receiver when it senses a loss of optical input to the primary receiver. Once optical input is restored, the system automatically switches back to the primary receiver.

Install the primary receiver in RCVR 1 and the redundant receiver in RCVR 2. Install the FLI module in the RCVR 4 position. When using this module remove the 0.5dB forward interstage attenuator pads and replace with 0dB attenuator pads.

4-way forward segmentable node



The following diagram illustrates forward path signal flow in this configuration module.



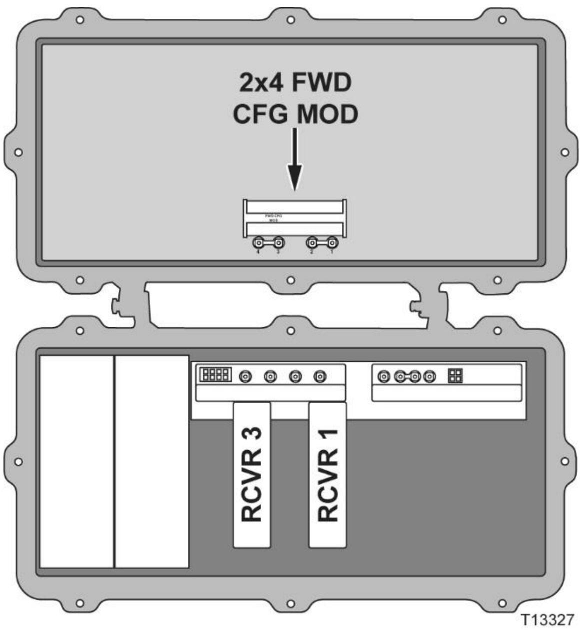
2x4 Forward Configuration Modules

Two receivers (RCVR 1 and RCVR 3) each feed 2/3 output ports.

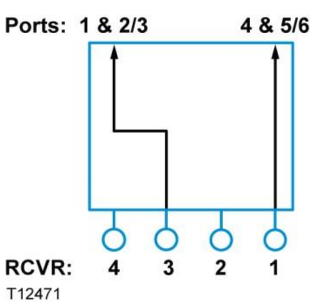
The first receiver (RCVR 1) feeds the right side of the amplifier (Ports 4 and 5/6). The second receiver (RCVR 3) feeds the left side of the amplifier (Ports 1 and 2/3).

Install the first primary receiver in RCVR 1. Install the second primary receiver in RCVR 3.

4-way forward segmentable node



The following diagram illustrates forward path signal flow in this configuration module.



2x4 Redundant Forward Configuration Modules

Two primary receivers (RCVR 1 and RCVR 3) and two redundant receivers (RCVR 2 and RCVR 4) each pair feed 2/3 output ports.

The first pair of primary (RCVR 1) and redundant (RCVR 2) receivers feeds the right side of the amplifier (Ports 4 and 5/6). The second pair of primary (RCVR 3) and redundant (RCVR 4) receivers feeds the left side of the amplifier (Ports 1 and 2/3).

The Status Monitor/Local Control Module switches between primary and redundant receivers upon loss of optical input to a primary receiver, and switches back to the paired primary when optical input is restored.

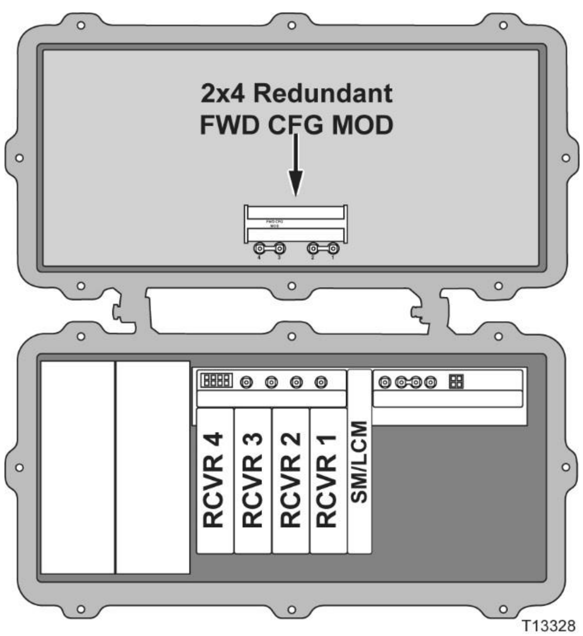
Install the first set of receivers as follows:

- first primary receiver RCVR 1
- first redundant receiver RCVR 2

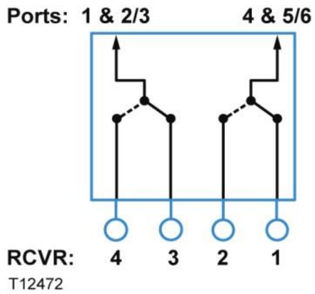
Install the second set of receivers as follows:

- second primary receiver RCVR 3
- second redundant receiver RCVR 4

4-way forward segmentable node



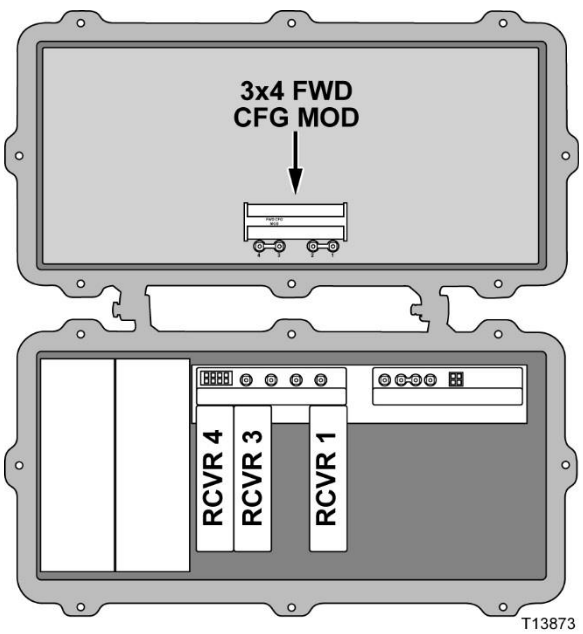
The following diagram illustrates forward path signal flow in this module.



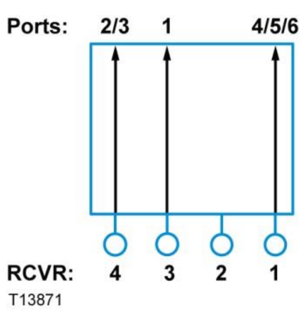
3x4-1, 3, 4 Forward Configuration Module

Three receivers each feeding one/two/three/four RF output ports. RCVR 1 feeds Ports 4/5/6. RCVR 3 feeds Port 1. RCVR 4 feeds Ports 2/3.

Note: The 3x4-1, 3, 4 FCM can only be used with the 4-way RF amplifier module.



The following diagram illustrates forward path signal flow in this module.

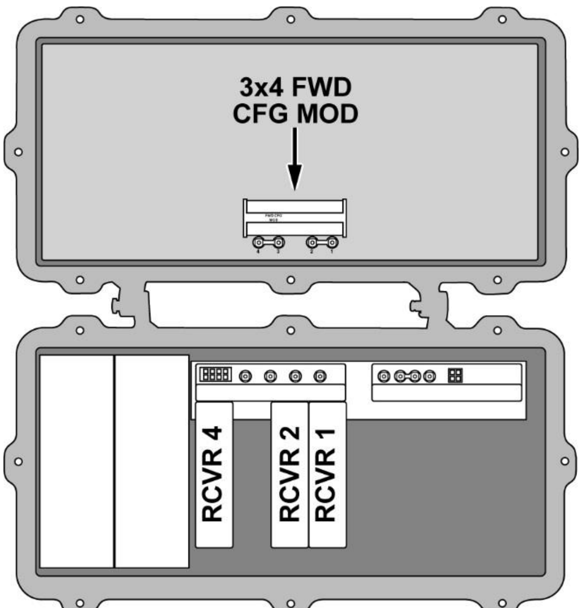


3x4-1, 2, 4 Forward Configuration Module

Three receivers each feeding one/two/three/four RF output ports. RCVR 1 feeds Ports

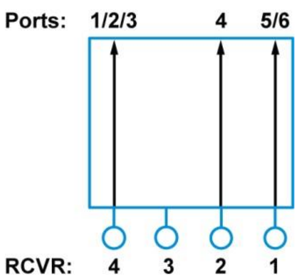
5/6. RCVR 2 feeds Port 4. RCVR 4 feeds Ports 1/2/3.

Note: The 3x4-1, 2, 4 FCM can only be used with the 4-way RF amplifier module.



T13874

The following diagram illustrates forward path signal flow in this module.

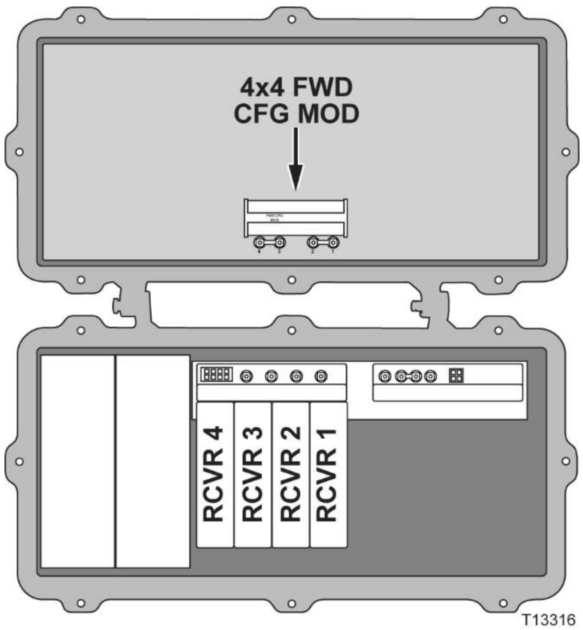


T13872

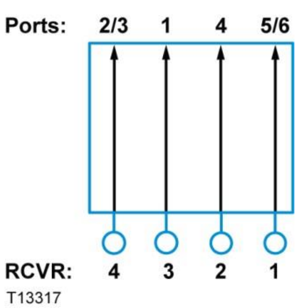
4x4 Forward Configuration Module

Four receivers each feed separate RF outputs. RCVR 1 feeds Ports 5/6. RCVR 2 feeds Port 4. RCVR 3 feeds Port 1. RCVR 4 feeds Ports 2/3.

Note: The 4x4 FCM can only be used with the 4-way RF amplifier module.



The following diagram illustrates forward path signal flow in this module.



Reconfiguring Reverse Signal Routing

Introduction

This section describes how to configure the reverse signal routing of the 1.2 GHz GS7000 Node.

Reverse Routing Configurations

The transmitter modules and the reverse configuration module determine the reverse signal routing. Each module must be in its proper slot to achieve the different node configurations.

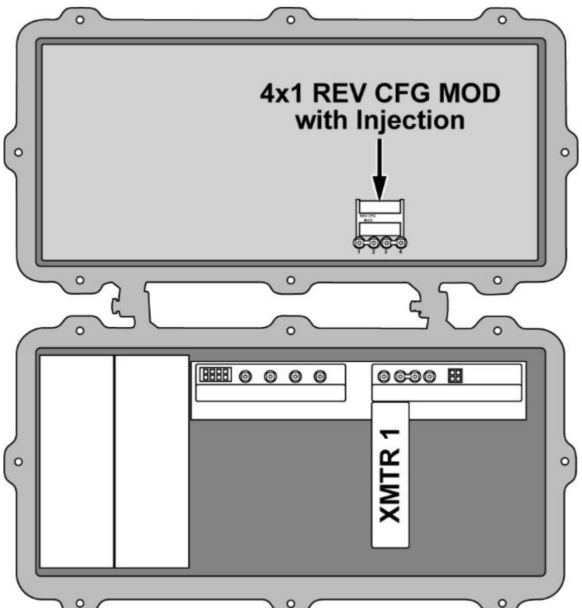
The following table shows the required modules and their slot locations for various node configurations.

If the configuration is...	Then use configuration module...	Install Transmitters in Positions...
four inputs, one transmitter (optional external RF source)	4x1 Reverse with Auxiliary Reverse Injection	1
four inputs, all feeding two transmitters, redundant	4x1 Redundant Reverse	1, 2
four inputs, each pair of inputs feeding a transmitter, 2-way segmented (optional external RF source)	4x2 Reverse with Auxiliary Reverse Injection	1, 3
four inputs, two feeding separate transmitters, two feeding a single transmitter (optional external RF source)	4x3 Reverse with Auxiliary Reverse Injection (left combined, right segmented)	1, 3, 4
four inputs, two feeding separate transmitters, two feeding a single transmitter (optional external RF source)	4x3 Reverse with Auxiliary Reverse Injection (left segmented, right combined)	1, 2, 4
four inputs, each pair of inputs feeding two transmitters, 2-way segmented, redundant	4x2 Redundant Reverse	1, 2, 3, 4
four inputs, each feeding a separate transmitter, 4-way segmented (optional external RF source)	4x4 Reverse with Auxiliary Reverse Injection	1, 2, 3, 4

4x1 Reverse Configuration Module with Auxiliary Reverse RF Injection

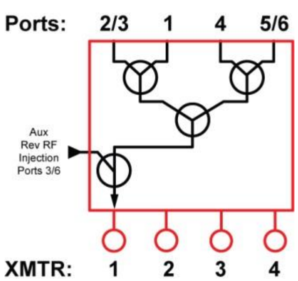
All four ports are combined to a single reverse transmitter. An RF signal from an external source can optionally be injected and coupled with the reverse RF inputs on Ports 3/6 and routed to Transmitter 1.

Install the transmitter module in XMTR 1.



T12461

The following diagram illustrates reverse path signal flow in this configuration module.

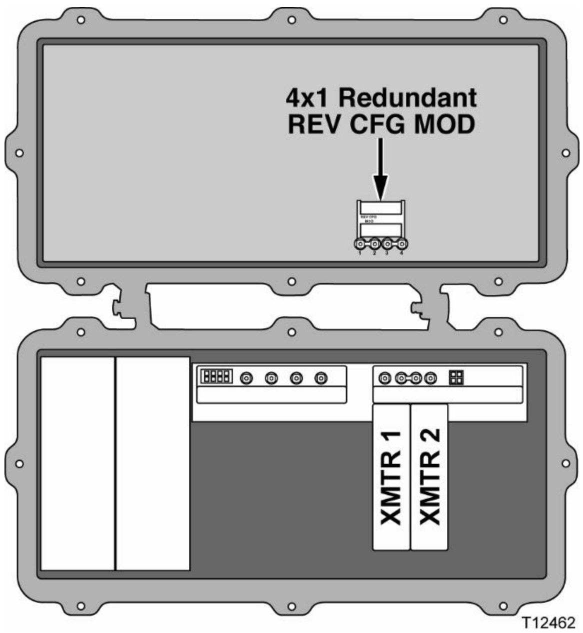


T12473

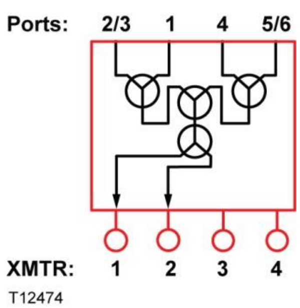
4x1 Redundant Reverse Configuration Module

All four ports are combined and the signal is split to two reverse transmitters. This allows you to have redundant transmitters.

Install the transmitters in XMTR 1 and XMTR 2.



The following diagram illustrates reverse path signal flow in this configuration module.

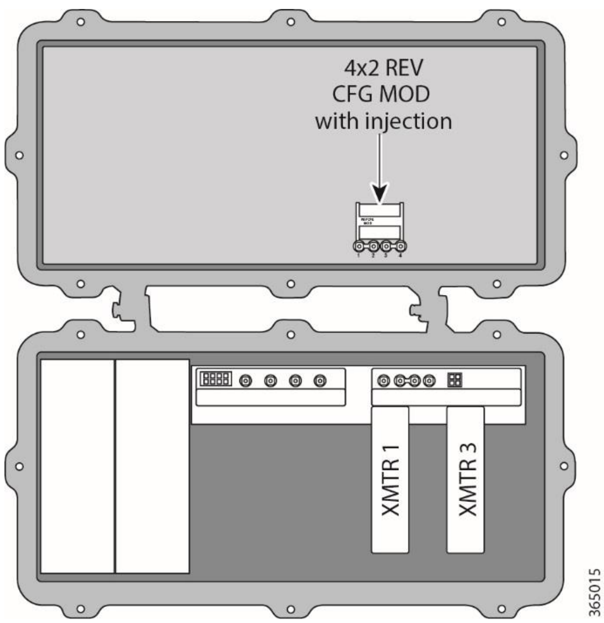


4x2 Reverse Configuration Module with Auxiliary Reverse RF Injection

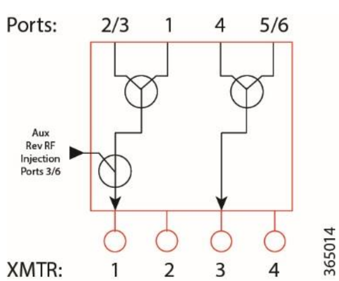
Signals from the left side of the amplifier (Ports 1 and 2/3) are combined and routed to a transmitter (XMTR 1). Signals from the right side of the amplifier (Ports 4 and 5/6) are combined and routed to a different reverse transmitter (XMTR 3). An RF signal from an external source can optionally be injected and coupled with the reverse RF inputs from Ports 3/6 and routed to Transmitter 1.

Install the transmitter that is dedicated to Ports 1 and 2/3 in XMTR 1.

Install the transmitter that is dedicated to Ports 4 and 5/6 in XMTR 3.



The following diagram illustrates reverse path signal flow in this configuration module.

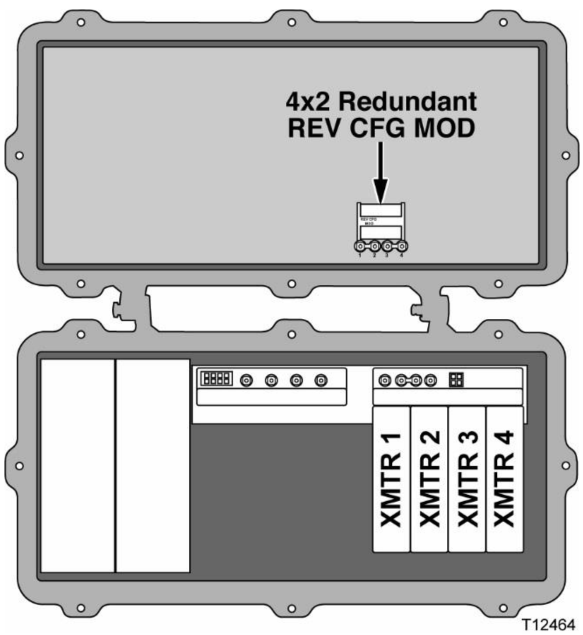


4x2 Redundant Reverse Configuration Module

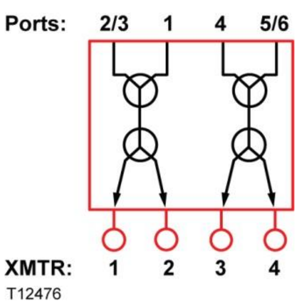
Signals from the left side of the amplifier (Ports 1 and 2/3) are combined and then split evenly to feed two reverse transmitters (XMTR 1 and XMTR 2). Signals from the right side of the amplifier (Ports 4 and 5/6) are combined and then split evenly to feed two reverse transmitters (XMTR 3 and XMTR 4).

Install the transmitters that are dedicated to Ports 1 and 2/3 in XMTR 1 and XMTR 2.

Install the transmitters that are dedicated to Ports 4 and 5/6 in XMTR 3 and XMTR 4.



The following diagram illustrates reverse path signal flow in this configuration module.

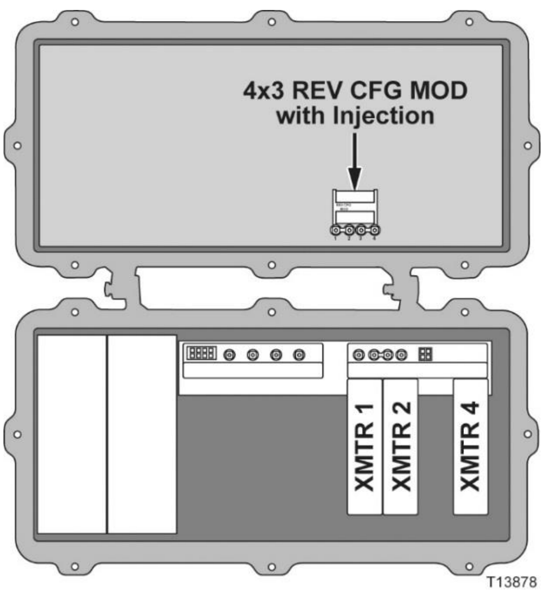


4x3-1, 2, 4 Reverse Configuration Module with Auxiliary Reverse RF Injection

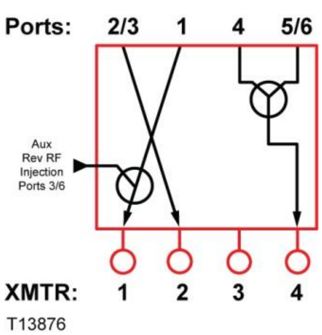
Signals from the right side of the amplifier (Ports 4 and 5/6) are combined and routed to a reverse transmitter (XMTR 4). Signals from Port 1 are routed to XMTR 1. Signals from Ports 2/3 are routed to XMTR 2. An RF signal from an external source can optionally be injected at Ports 3/6 and coupled with the reverse RF input from Port 1 and routed to XMTR 1.

Install modules as follows:

- Transmitter dedicated to Port 1 in XMTR 1
- Transmitter dedicated to Port 2/3 in XMTR 2
- Transmitter dedicated to Port 4/5/6 in XMTR 4



The following diagram illustrates reverse path signal flow in this module.

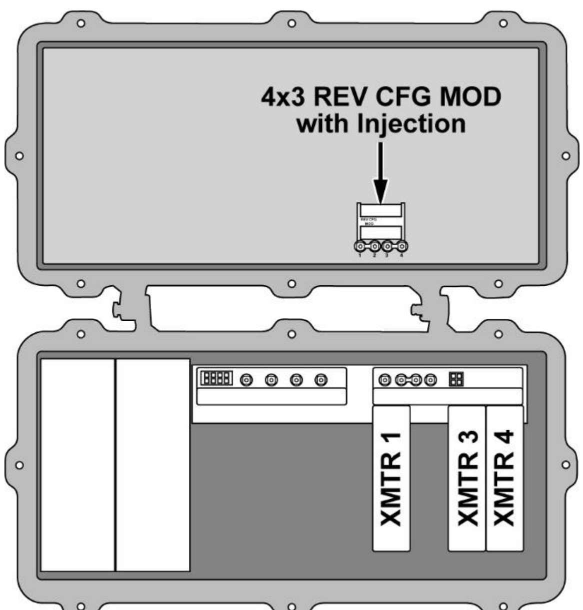


4x3-1, 3, 4 Reverse Configuration Module with Auxiliary Reverse RF Injection

Signals from the left side of the amplifier (Ports 1 and 2/3) are combined and routed to a reverse transmitter (XMTR 1). Signals from Port 4 are routed to XMTR 3. Signals from Ports 5/6 are routed to XMTR 4. An RF signal from an external source can optionally be injected at Ports 3/6 and coupled with the reverse RF inputs from Ports 2/3 and 1 and routed to XMTR 1.

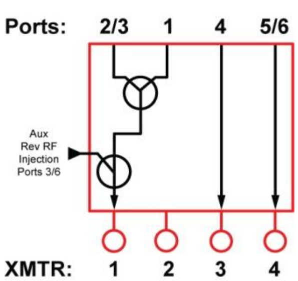
Install modules as follows:

- Transmitter dedicated to Ports 1/2/3 in XMTR 1
- Transmitter dedicated to Port 4 in XMTR 3
- Transmitter dedicated to Port 5/6 in XMTR 4



T13877

The following diagram illustrates reverse path signal flow in this module.



T13875

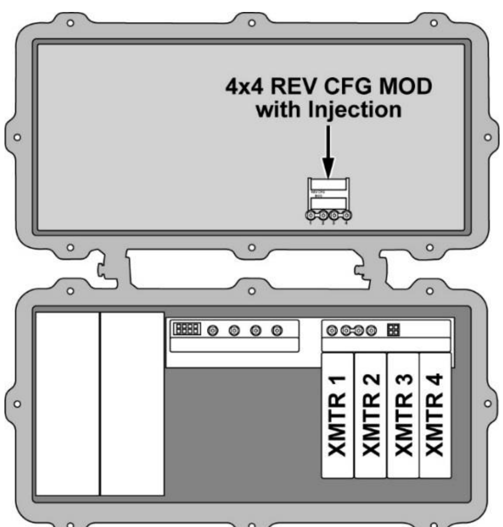
4x4 Reverse Configuration Module with Auxiliary Reverse RF Injection

A signal from each port is assigned to a dedicated reverse transmitter. An RF signal from an external source can optionally be injected and coupled with the reverse RF inputs from Ports 3/6 and routed to Transmitter 1.

Note: This module is typically used when using multiplexing digital reverse modules, such as our EDR Digital Reverse Modules. Since the digital reverse module occupies the physical space that transmitters 3 and 4 used to occupy in the node lid, only a 6-port optical interface board can be used.

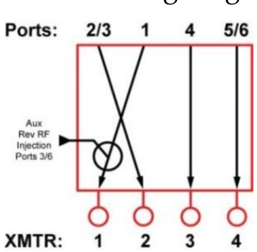
Install modules as follows:

- Transmitter dedicated to Port 1 in XMTR 1
- Transmitter dedicated to Port 2/3 in XMTR 2
- Transmitter dedicated to Port 4 in XMTR 3
- Transmitter dedicated to Port 5/6 in XMTR 4



T12465

The following diagram illustrates reverse path signal flow in this module.



T12477

5

Maintenance

Introduction

This section describes maintenance procedures for the 1.2 GHz GS7000 Node.

In This Chapter

Opening and Closing the Housing

Overview

Installation or maintenance of the 1.2 GHz GS7000 Node requires opening the housing to access the internal modules.

Proper housing closure is important to maintaining the node in good working condition. Proper closure ensures a good seal against the environment, protecting the internal modules.

Opening the Housing

Open the housing as follows.

1. Remove the bolts securing the lid to the base.
2. Carefully open the lid to allow access to the inside of the housing.
3. Inspect gaskets on the cover flange and on the test port plugs.
4. Replace any gaskets showing signs of wear (cracked, twisted, pinched, or dry) with new, silicon-lubricated gaskets.

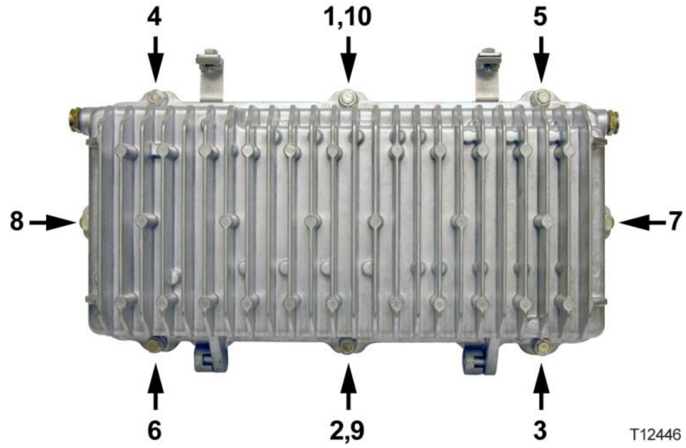
Closing the Housing

Close the housing as follows.

1. Ensure any worn gaskets are replaced, and the gaskets are clean and in the correct position.
2. Carefully close the lid.

> **CAUTION:**
> **Use caution when closing housing. Improper closing may result in the unit not being sealed from the environment.**

3. For strand-mounted housings, pull the lid away from the base and remove the slack from the hinge before rotating the lid up toward the base.
4. Ensure no cables are pinched between lid and base.
5. Secure lid to base with bolts. Tighten from 5 to 12 ft-lbs (6.8 to 16.3 Nm) in the sequence shown in the following illustration. Repeat the sequence twice, ending with the final torque specification.


4
1,10
5
8
7
6
2,9
3
T12446

Preventative Maintenance

Overview

Preventive maintenance procedures are regularly scheduled actions that help prevent failures and maintain the appearance of the equipment.

Schedule

Perform the preventive maintenance procedures at these intervals.

Procedure	Interval
Visual Inspection:	
External Surfaces	Semiannually
Connectors	Semiannually
Indicators	Semiannually
Wiring/Cable Assemblies	Annually
Cleaning:	
External Surfaces	Annually
External Controls/Connectors	Annually
Internal Connectors/Circuit Cards	Annually

Visual Inspection

Visually inspect the following items.

What to Inspect	How to Inspect
Exterior surfaces	Inspect for: ■ dust, dirt, lubricants, or other foreign matter worn spots or deep scratches on surfaces ■ corrosion ■ marred protective finish exposing bare metal ■ missing, incorrect or obliterated marking, decals, or reference designators
Connectors	Inspect for: ■ broken, loose, bent, corroded, or missing pins ■ cracked insulator inserts
	■

What to Inspect	How to Inspect
Wiring and cables	Inspect for: ■ cuts, nicks, burns, or abrasions ■ exposed bare conductors ■ sharp bends ■ pinched or damaged wires ■ broken or loose lacing or clamps

Cleaning

Clean exterior surfaces of the equipment at least annually.

Consumable Materials

Use the materials listed below (or equivalent) when cleaning the equipment.

Item	Specification
Isopropyl alcohol	TT-I-735
Cheesecloth	CC-C-440
Spray-type contact cleaner	(none)

Procedure

Clean the equipment as described below.

1. Use a small paintbrush to brush dust from connectors.
2. Wipe surfaces dry with clean, dry cheesecloth.
3. Clean exterior surfaces with clean cheesecloth moistened with isopropyl alcohol or general-purpose detergent. Do not let alcohol or detergent get inside equipment or connectors.

WARNING:
Isopropyl alcohol is flammable. Use isopropyl alcohol only in well-ventilated areas away from energized electrical circuits and heated objects such as soldering irons or open flames. Avoid excessive inhalation of vapors or prolonged or repeated contact with skin. Wear industrial rubber gloves and industrial safety goggles to avoid contact with skin. Do not take internally. Failure to comply with this admonishment can cause injury, physical disorder, or death.

CAUTION:
Do not use cleaning fluids containing trichloroethylene, trichloroethane, acetone or petroleum-based cleaners on equipment. Failure to comply with this caution could harm equipment surfaces.

4. Clean electrical contacts with spray-type contact cleaner.
5. Clean internal connectors and circuit boards with hand-controlled, dry-air jet. Do not use pressure exceeding 15 lb/in2 (1.05 kg/cm2, or 103.43 kPa).
6. Clean interior surfaces with clean cheesecloth moistened with isopropyl alcohol or general-purpose detergent.
7. Clean internal electrical contacts with clean cheesecloth moistened with spray-type contact cleaner.
8. Dry interior with clean, dry cheesecloth.

Removing and Replacing Modules

Overview

This procedure describes how to remove and replace the internal modules of the 1.2 GHz GS7000 Node. All field-replaceable modules can be removed and replaced without removing power from the 1.2 GHz GS7000 Node.

Field-replaceable modules include:

- Forward optical receiver modules
- Reverse optical transmitter modules
- Optical amplifier modules
- Optical switch modules
- Status monitor/local control module
- Forward configuration module
- Reverse configuration module
- Equalizers
- Node signal directors
- Power supply modules
- RF amplifier assembly

> ⚠ **CAUTION:**
> **Removing power from the 1.2 GHz GS7000 Node will interrupt customer service. Removing any module, except for the status monitor/local control module, will interrupt customer service unless that module has a redundant backup.**

Module Replacement Procedure

Follow this procedure to remove and replace an optical receiver, optical transmitter, optical amplifier, optical switch, status monitor/local control module, or power supply module.

1 Open the housing. See ***Opening and Closing the Housing*** (on page 118).

2 Carefully tag and remove any optical fibers from a receiver or transmitter module.

> ⚠ **WARNING:**
> **Laser light hazard. Never look into the end of an optical fiber or connector. Failure to observe this warning can result in eye damage or blindness.**

3 Loosen the screws securing the module.

4 Lift the module straight up out of the housing to unplug it.

Note: Pull up on the built-in handle on a receiver module, transmitter module, status monitor/local control module, or power supply module.

5 Position the new module in the same location and carefully slide the module into its slot until connected to the optical interface board.

6 Tighten the screws securing the module. Torque screws to 25 to 30 in-lbs (2.8 to 3.4 Nm).

7 Carefully reconnect any optical fibers that were removed from the original module. Clean optical connectors before reconnecting. See ***Care and Cleaning of Optical Connectors*** (on page 129) for cleaning procedure.

> **WARNING:**
> **Laser light hazard. Never look into the end of an optical fiber or connector. Failure to observe this warning can result in eye damage or blindness.**

8 Close the housing. See ***Opening and Closing the Housing*** (on page 118).

Important: If you are using a Local Control Module in the node be sure to press the Auto Set-Up button on the cover of the LCM before you close the node housing. This allows the LCM to check for, and detect, installed modules. If the modules are not detected during this discovery process, they cannot be monitored and controlled by the LCM. The node must be powered and the modules operating properly in order to be detected.

9 Perform the setup procedure in Chapter 4 to verify node performance.

Optical Amplifier and Optical Switch Module Pin Adaptor

Both the EDFA optical amplifier modules and the optical switch module require the use of a pin adaptor to be mounted in the node lid and connected to the optical interface board.

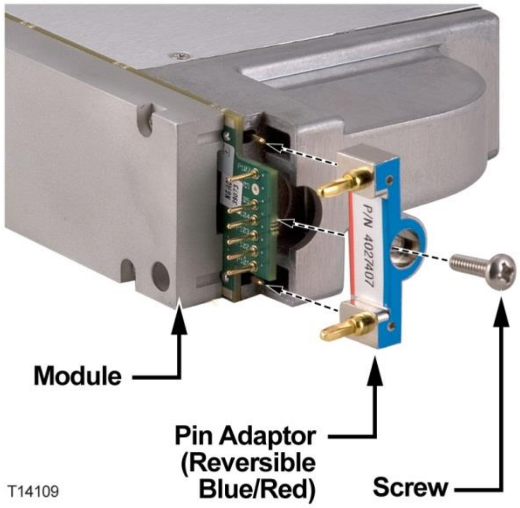
Optical transmitters and optical receivers can only be mounted on their respective sides in the node lid, transmitters on the right and receivers on the left. The pin alignment on these modules is slightly different to prevent accidentally installing a receiver in a transmitter slot or a transmitter in a receiver slot.

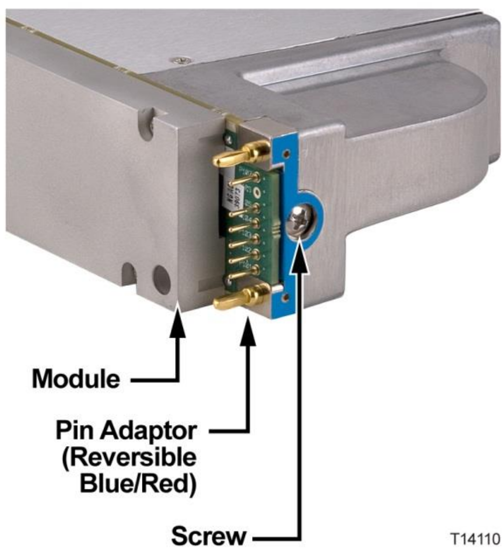
Since the optical amplifier and optical switch modules can be mounted on either the left-hand or right-hand side, they require a reversible pin adaptor that can match the pin alignment for either a transmitter or a receiver slot.

The reversible pin adaptor is color coded. One side is blue and the other side is red. To install the module in a transmitter slot, assemble the pin adaptor on the module with the red side facing outward. To install the module in a receiver slot, assemble the pin adaptor on the module with the blue side facing outward.

The following illustrations show how to assemble the pin adaptor to the module.

> **CAUTION:**
> **To prevent electrostatic damage to electronic equipment, take ESD precautions, including the use of an ESD wrist strap.**





Accessing the Receiver/Transmitter Module Fiber Spool and Connector

Optical receivers and transmitter modules have an integrated fiber spool inside the module housing. This allows the fiber pigtail to be spooled up and contained within the module housing.

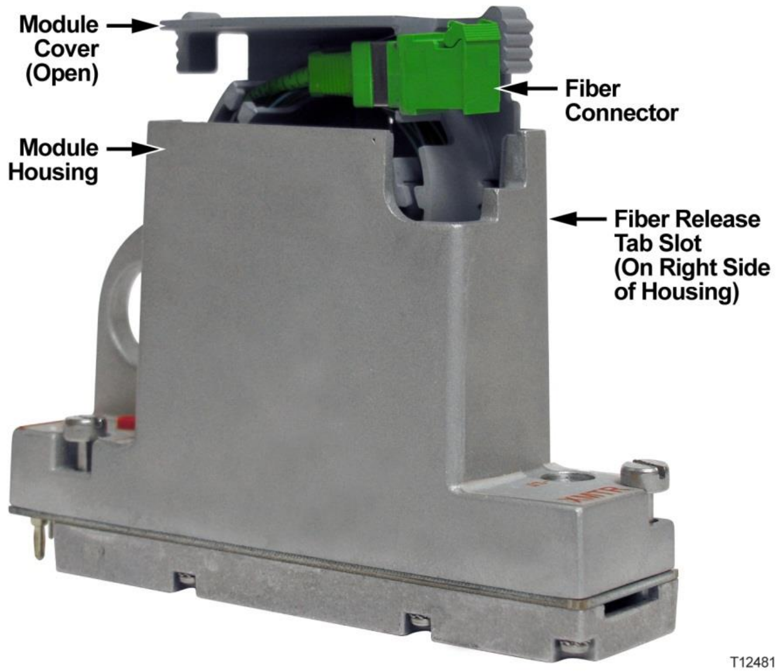
You may need to access this spool to clean or replace a fiber pigtail or connector.

Follow this procedure to access the module fiber spool and connector.

1 Pull up on the two module cover knurled tabs. Use a slight rocking motion.

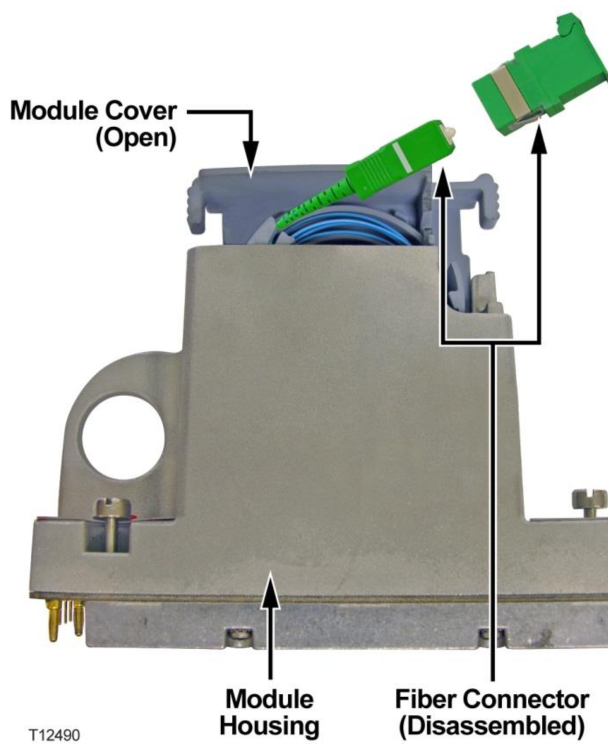
   Note: If the module is out of the housing, it is easier to hold the module in both hands and push up on the two module cover knurled tabs with your thumbs. You can also insert a flat blade screwdriver into the cover release tab slot on the right side of the module housing to assist with opening the cover.

   The module cover opens as shown.



2 Pull the fiber connector straight out from the side of the module cover to remove it.

3 Disassemble the fiber connector and pigtail for cleaning if necessary.



4 Reattach the fiber connector to the module cover and close the cover.

Forward/Reverse Configuration Module, Equalizer, and Node Signal Director Replacement Procedure

The forward and reverse configuration modules, equalizers, and node signal directors plug into the RF amplifier assembly through cut-outs in its cover.

To remove these modules, pull up carefully on their integrated handles until they separate from the RF amplifier assembly.

RF Amplifier Assembly Replacement Procedure

Follow this procedure to remove and replace the RF amplifier assembly.

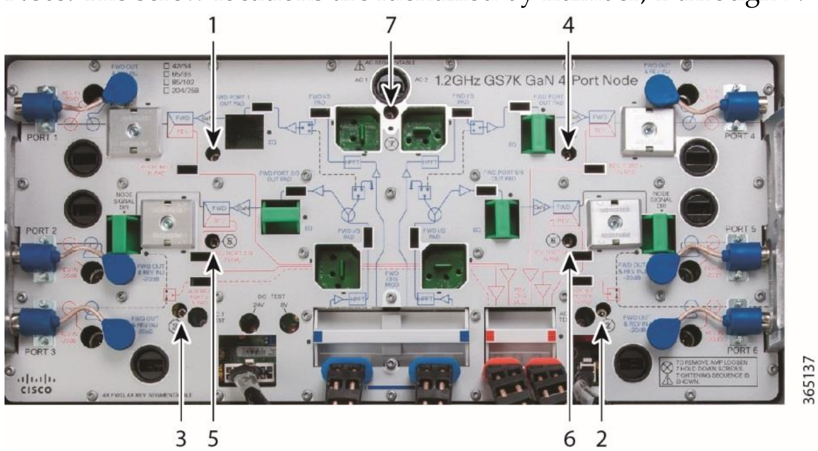
1 Open the housing. See ***Opening and Closing the Housing*** (on page 118).

2 Remove the AC power shunts and make a note of their location for reinstallation in the replacement RF amplifier assembly.

> **CAUTION:**
> **Damage to the node may result if AC power shunts are not removed before replacing the RF amplifier assembly.**

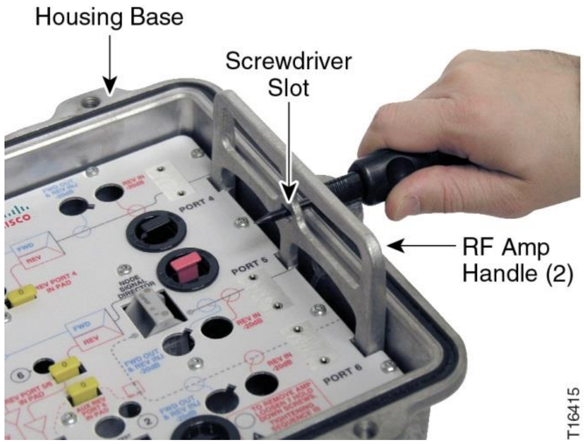
3 Loosen the seven shoulder screws securing the RF amplifier assembly to the housing.

Note: The screw locations are identified by number, 1 through 7.

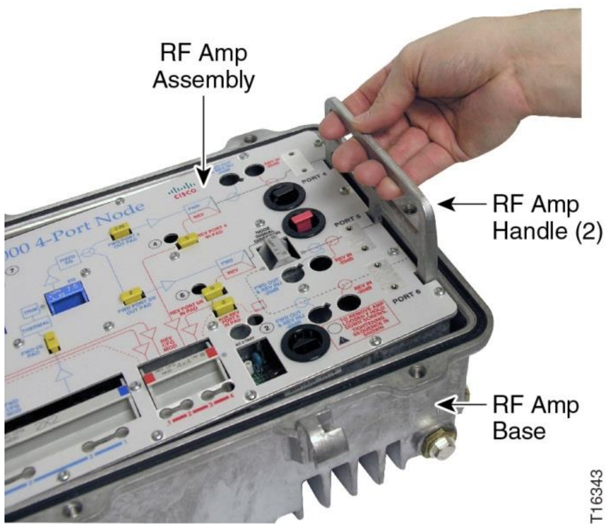


4 Insert a flat-blade screwdriver into the small holes in the metal handles on each side of the RF amplifier assembly and pry up carefully to disconnect the RF amplifier assembly's rear panel connectors.

Important: Be careful not to damage the housing with the screwdriver.



5 Grasp the two metal handles on the RF amplifier assembly and carefully lift the RF assembly out of the housing.



6 To replace the RF amplifier assembly in the housing, carefully align the assembly in the housing, lower it into place and push down to reconnect the rear panel connectors.

7 Secure the RF amplifier assembly to the housing with the seven cross-head shoulder screws.

   Important: Tighten the screws in order by number, 1 through 7. Repeat the sequence twice, ending with a torque of 18 to 20 in-lbs (2.0 to 2.25 Nm).

8 Reinstall the AC power shunts in their proper locations on the RF amp assembly.

9 Close the housing. See ***Opening and Closing the Housing*** (on page 118).

10 Perform the setup procedure in Chapter 4 to verify node performance.

Care and Cleaning of Optical Connectors

CAUTION:
Proper operation of this equipment requires clean optical fibers. Dirty fibers will adversely affect performance. Proper cleaning is imperative.

The proper procedure for cleaning optical connectors depends on the connector type. The following describes general instructions for fiber-optic cleaning. Use your company's established procedures, if any, but also consider the following.

Cleaning fiber-optic connectors can help prevent interconnect problems and aid system performance. When optical connectors are disconnected or reconnected, the fiber surface can become dirty or scratched, reducing system performance.

Inspect connectors prior to mating, clean as needed, and then remove all residues. Inspect connectors after cleaning to confirm that they are clean and undamaged.

Recommended Equipment

- CLETOP or OPTIPOP ferrule cleaner (CLETOP Type A for SC, Type B for LC)
- Compressed air (also called “canned air”)
- Lint-free wipes moistened with optical-grade (99%) isopropyl alcohol
- Bulkhead swabs for LC or SC type connectors (choose appropriate type)
- Optical connector scope

Tips for Optimal Fiber-Optic Connector Performance

- Do not connect or disconnect optical connectors with optical power present.
- Always use compressed air before cleaning the fiber-optic connectors and when cleaning connector end caps.
- Always install or leave end caps on connectors when they are not in use.
- If you have any degraded signal problems, clean the fiber-optic connector.
- Advance a clean portion of the ferrule cleaner reel for each cleaning.
- Turn off optical power before making or breaking optical connections to avoid microscopic damage to fiber mating surfaces.

To Clean Optical Connectors

WARNING:

- **Avoid personal injury! Use of controls, adjustments, or performance of procedures other than those specified herein may result in hazardous radiation exposure.**
- **Avoid personal injury! The laser light source on this equipment emits invisible laser radiation. Avoid direct exposure to the laser light source.**
- **Avoid personal injury! Viewing the laser output with optical instruments (such as eye loupes, magnifiers, or microscopes) may pose an eye hazard.**

- Connect or disconnect fiber *only* when equipment is OFF or in Service mode.
- Do not apply power to this equipment if the fiber is unmated or unterminated.
- Do not look into an unmated fiber or at any mirror-like surface that could reflect light that is emitted from an unterminated fiber.
- Do not view an activated fiber with optical instruments such as eye loupes, magnifiers, or microscopes.
- Use safety-approved optical fiber cable to maintain compliance with applicable laser safety requirements.

Connector cleanliness is crucially important for optimum results in fiber optic communications links. Even the smallest amount of foreign material can make it impossible to obtain the expected insertion and return losses. This can reduce the range of the equipment, shorten its expected service life, and possibly prevent the link from initializing at all.

New equipment is supplied with clean optical connectors and bulkheads. Clean these connectors and bulkheads in the field *only* if you observe and can verify an optical output problem.

Connectors and Bulkheads

Most fiber optic connectors are of the physical contact (PC) type. PC type connectors are designed to touch their mating connector to prevent air gaps, which cause reflections. For optimum performance, *all* dirt must be removed.

Bulkheads can also become dirty enough to affect performance, either from airborne dust or from contamination introduced by connectors.

WARNING:

Avoid damage to your eyes! Do not look into any optical connector while the system is active. Even if the unit is off, there may still be hazardous optical levels present.

Note: Read the above warning before performing cleaning procedures.

Cleaning Connectors

It is important that all external jumper connectors be cleaned before inserting them into the optical module. Follow these steps to clean fiber optic connectors that will be connected to the optical module:

Important: Before you begin, remove optical power from the module or ensure that optical power has been removed.

1 Inspect the connector through an optical connector scope. If the connector is damaged, e.g., scratched, burned, etc., replace the jumper.

2 If the connector is dirty but otherwise undamaged, clean the connector as follows:

- **a** Make several swipes across the face of the connector with the appropriate ferrule cleaner. This will remove dust and some films.
- **b** Listen for a slight "squeak" typically generated during this process, indicating a clean connector.
- **c** Inspect the connector again through the scope to confirm that it is clean.

3 If a second inspection indicates that further cleaning is needed:

- **a** Use 99% isopropyl alcohol and a lint-free wipe to clean the connector.
- **b** Use the appropriate ferrule cleaner again to remove any film left over from the alcohol.
- **c** Inspect the connector again through the scope and confirm that it is clean.

4 If necessary, repeat steps 3a-3c until the connector is clean.

Cleaning Bulkheads

Note: It is generally more difficult to clean bulkhead connectors and verify their condition due to limited accessibility of the fiber end face. For this reason, even on products with accessible bulkhead connectors, you should *only* attempt to clean a bulkhead connector when a dirty connector is indicated.

Follow these steps to clean the bulkhead:

WARNING:

- **Avoid personal injury! Use of controls, adjustments, or performance of procedures other than those specified herein may result in hazardous radiation exposure.**
- **Avoid personal injury! The laser light source on this equipment emits invisible laser radiation. Avoid direct exposure to the laser light source.**
- **Avoid personal injury! Viewing the laser output with optical instruments (such as eye loupes, magnifiers, or microscopes) may pose an eye hazard.**

1 Insert a dry bulkhead swab into the bulkhead and rotate the swab several times.

2 Remove the swab and discard. Swabs may be used only once.

3 Check the bulkhead optical surface with a fiber connector scope to confirm that it is clean. If further cleaning is needed:

- **a** Moisten a new bulkhead swab using a lint-free wipe moistened with optical-grade (99%) isopropyl alcohol.
- **b** With the connector removed, fully insert the bulkhead swab into the bulkhead and rotate the swab several times.
- **c** Remove the swab and discard. Swabs may be used only once.

   d Check with a fiber connector scope again to confirm that there is no dirt or alcohol residue on the optical surface.
   e If any alcohol residue remains, clean it off with a new dry bulkhead swab.

4 Mate all connectors to bulkheads and proceed to **Verifying Equipment Operation** below.

5 It is also recommended that all connectors be visually inspected after cleaning to verify the connector is clean and undamaged.

Verifying Equipment Operation

Perform circuit turn-up. If the equipment does not come up, i.e., fails verification or indicates a reflection problem, clean the connectors and bulkheads again.

For Further Assistance

If you have any questions or concerns about cleaning fiber optic connectors, contact Customer Service using the contact information provided in the **Customer Support Information** chapter.

6

Troubleshooting

Introduction

This troubleshooting section lists common problems and their solutions.

Replacing Modules

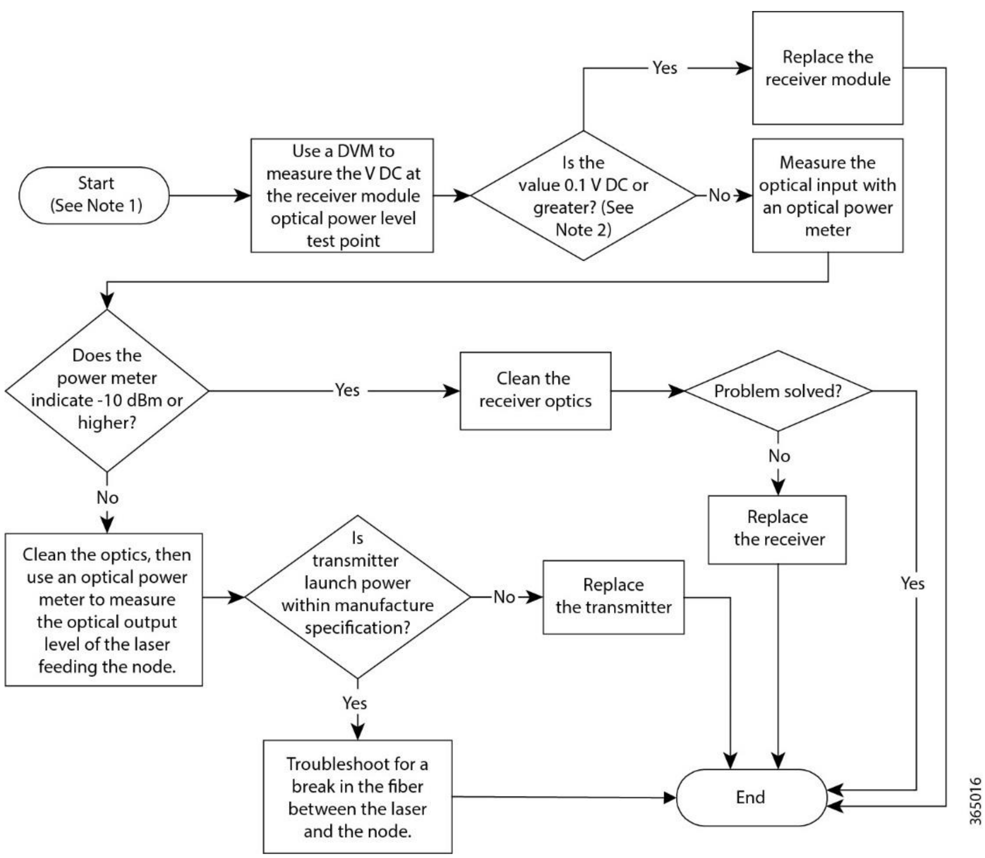
If a troubleshooting procedure directs you to replace a module of the 1.2 GHz GS7000 Node, see ***Removing and Replacing Modules*** (on page 123).

In This Chapter

No RF Output at Receiver RF Test Point: Optical Power LED on Receiver Module is off

Troubleshooting Flowchart

Follow this troubleshooting flowchart. Also see the notes following the chart.



Notes

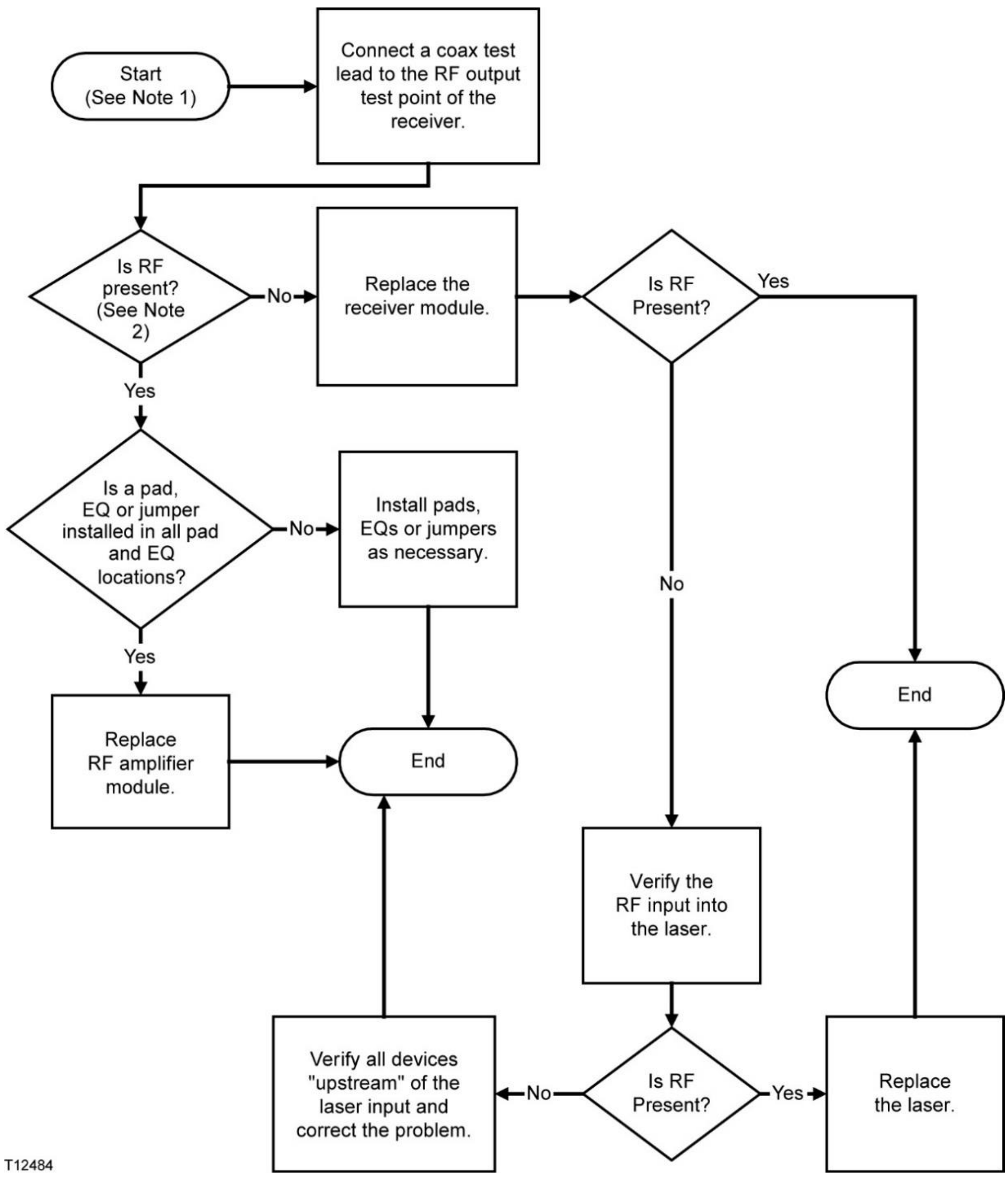
These notes apply to the previous troubleshooting flowchart.

Note	Description	
	For standard receiver	**For low input receiver**
1	This unit will have no RF output.	This unit will have no RF output.
2	The receiver will not function below this DC level which is equal to –10 dBm. ■ The optimum light level input is -6 to 2 dBm. ■ For every 1 dBm change in optical input power, the RF output will change by 2 dB. ■ Excessively high light input levels (> +2 dBm) will cause distortions and/or damage the photo diode.	The receiver will not function below this DC level which is equal to –10 dBm. ■ The optimum light level input is -10 to -2 dBm. ■ For every 1 dBm change in optical input power, the RF output will change by 2 dB. ■ Excessively high light input levels (> -2 dBm) will cause distortions and/or damage the photo diode.

No RF Output: Fiber Optic Light Level is Good, Receiver Optical Power LED is on

Troubleshooting Flowchart

Follow this troubleshooting flowchart. Also see the notes following the chart.



Notes

These notes apply to the previous troubleshooting flowchart.

Note	Description	
	For standard receiver	**For low input receiver**
1	If the green LED is Off, it is outside optical input range. Green (On) indicates that light is present and the optical input value is higher than -10 dBm.	If the green LED is Off, it is outside optical input range. Green (On) indicates that light is present and the optical input value is higher than -14 dBm.
2	The recommended RF output level at the output of the receiver module is 27 dBmV (+7.0 dBmV as measured at the -20 dB RF test point). This setup is recommended to achieve the best possible performance.	The recommended RF output level at the output of the receiver module is 27 dBmV (+7.0 dBmV as measured at the -20 dB RF test point). This setup is recommended to achieve the best possible performance with 8 dB setting.

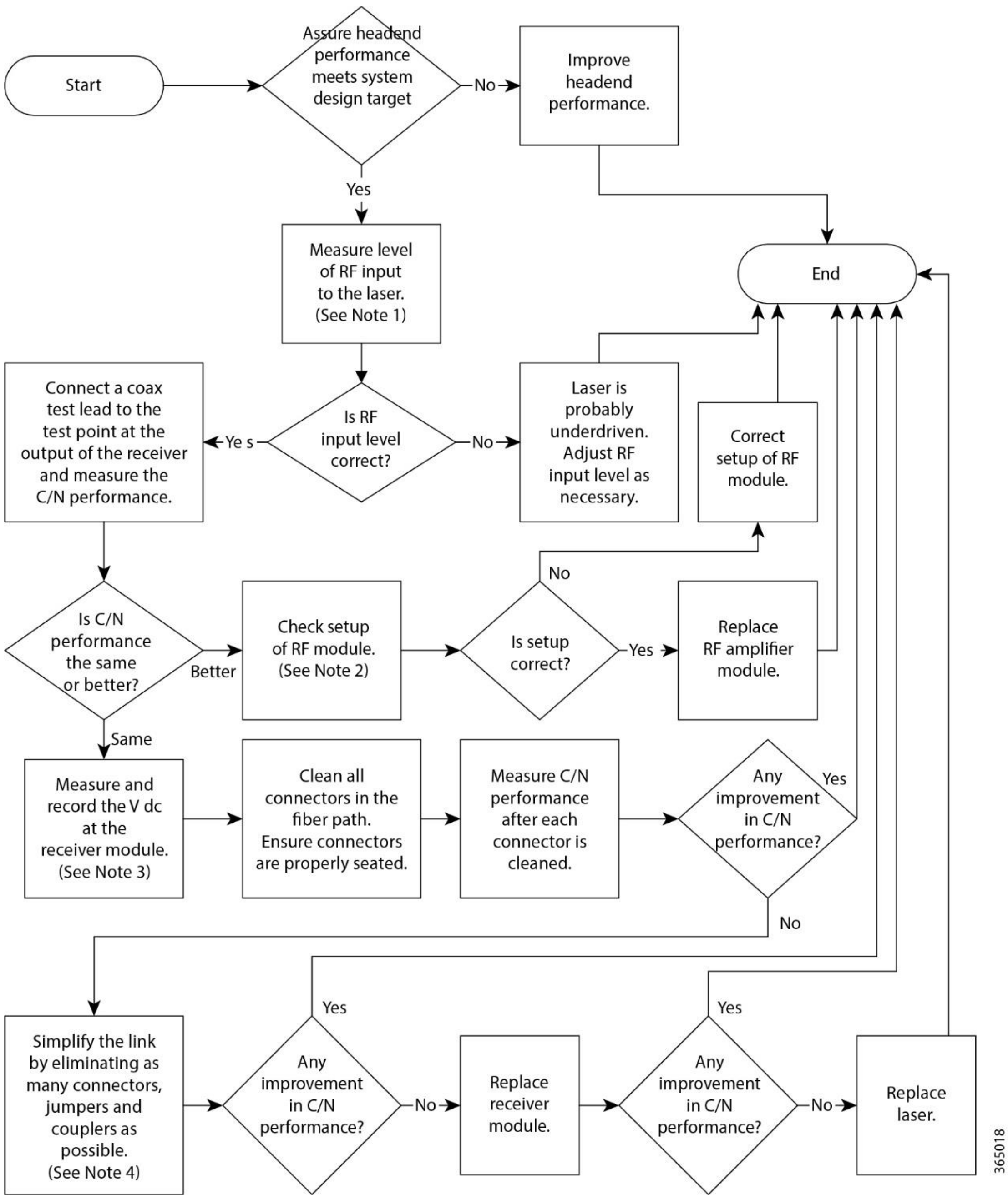
Note:

- Assumes 2.5% OMI/CH or 20% composite.
- Assumes 1310 nm wavelength / Add one dB for 1550
- Assumes 0dB attenuator switch setting unless noted, if otherwise subtract attenuator value from reading
- Assumes -4dB optical input, if otherwise add or subtract 2dB RF for each 1dB optical input

Poor C/N Performance

Troubleshooting Flowchart

Follow this troubleshooting flowchart. Also see the notes following the chart.



Notes

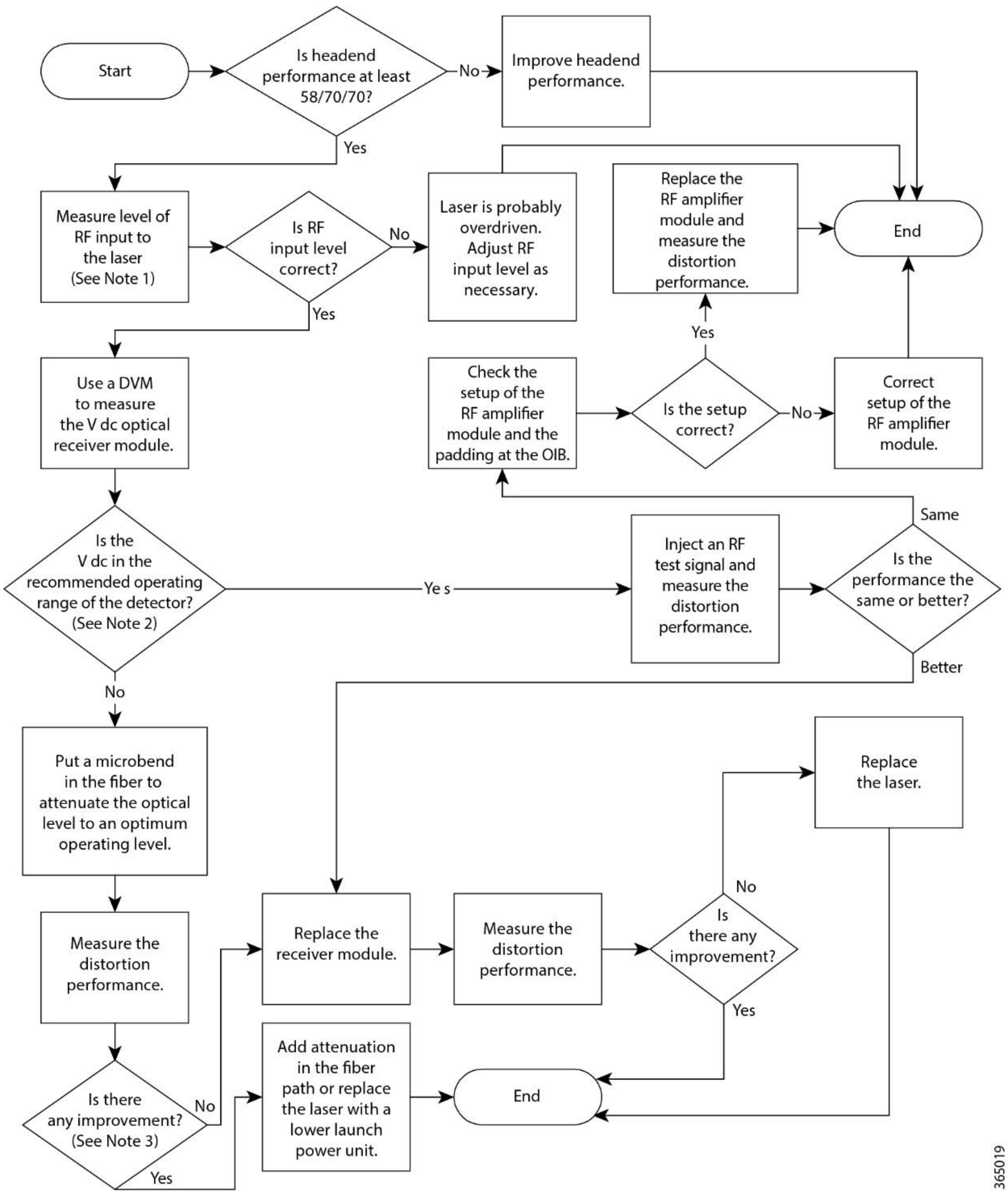
These notes apply to the previous troubleshooting flowchart.

<table>
<tr><th>Note</th><th colspan="2">Description</th></tr>
<tr><td>1</td><td colspan="2">RF drive level to the laser must be set to the laser manufacturer's specification.</td></tr>
<tr><td>2</td><td colspan="2">It is possible that the distribution module is set up incorrectly. See the pad and equalizer selection charts in Appendix A for correct pad and equalization. The C/N performance will suffer if the RF levels are too low into the first gain stage or the interstage.</td></tr>
<tr><td>3</td><td colspan="2">It is important to monitor the DC level at the receiver module because in the process of cleaning the connectors, the transfer of light through each connector may improve or degrade. The DC reading should degrade if there is a reflection in the path depending on the severity of the core mismatch. Scratches on the surface of the fiber of the connector can cause reflections. Scratched connectors must be replaced.</td></tr>
<tr><td rowspan="2">4</td><td>For standard receiver</td><td>For low input receiver</td></tr>
<tr><td>Attenuate the light to simulate the amount of light that should be at the 1.2 GHz GS7000 Node and rerun the C/N performance. Add components into the path one at a time until the problem is found. Change jumpers, couplers, fibers and connectors one at a time, taking C/N measurements after each change.
A phenomenon called "shot noise" will occur if the light level is too high into the receiver. This is noise generated by the photo diode when the light is converted back to RF. An optical input level exceeding +2 dBm at the detector will also generate distortions.</td><td>Attenuate the light to simulate the amount of light that should be at the 1.2 GHz GS7000 Node and rerun the C/N performance. Add components into the path one at a time until the problem is found. Change jumpers, couplers, fibers and connectors one at a time, taking C/N measurements after each change.
A phenomenon called "shot noise" will occur if the light level is too high into the receiver. This is noise generated by the photo diode when the light is converted back to RF. An optical input level exceeding -2 dBm at the detector will also generate distortions.</td></tr>
</table>

Poor Distortion Performance

Troubleshooting Flowchart

Follow this troubleshooting flowchart. Also see the notes following the chart.



Notes

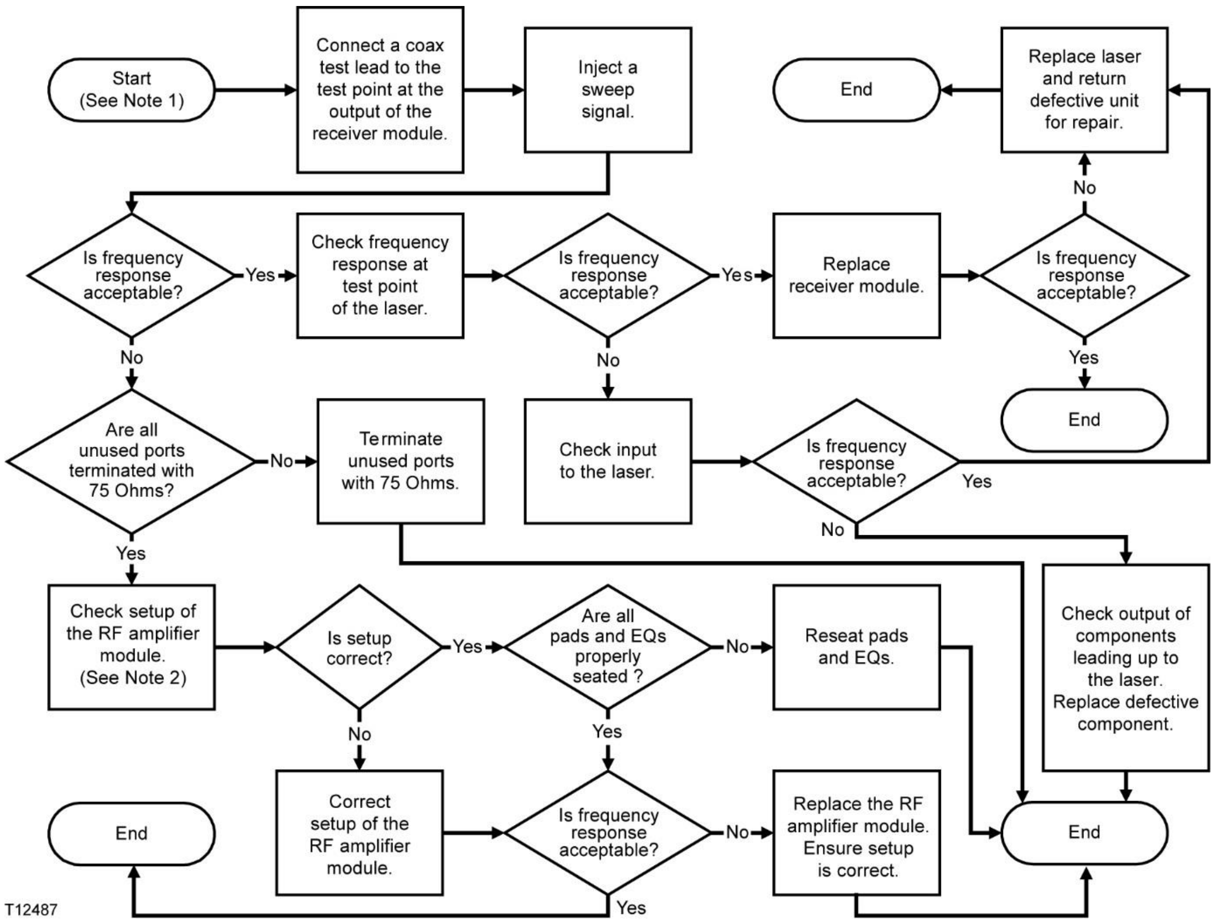
These notes apply to the previous troubleshooting flowchart.

<table>
<tr><th>Note</th><th colspan="2">Description</th></tr>
<tr><td>1</td><td colspan="2">Recommended RF input levels are:
■ Headend transmitter module: 14 dBmV
Note: Based on 79-channel loading. The input will increase as the channel loading decreases.</td></tr>
<tr><td rowspan="2">2</td><td>For standard receiver</td><td>For low input receiver</td></tr>
<tr><td>The range for optical light input level is -6 to +2 dBm which converts to 0.25 to 1.6 V DC. The optimum operating range is -3 dBm to +2 dBm which converts to 0.5 to 1.6 V DC. Levels higher than +2 dBm can cause the photo diode to generate distortions, which add to the distortion performance of the link, effectively degrading the distortion performance.</td><td>The range for optical light input level is -10 to -2 dBm which converts to 0.1 to 0.6 V DC. The optimum operating range is -6 dBm to -2 dBm which converts to 0.25 to 0.6 V DC. Levels higher than -2 dBm can cause the photo diode to generate distortions, which add to the distortion performance of the link, effectively degrading the distortion performance.</td></tr>
<tr><td>3</td><td colspan="2">Attenuate the light to simulate the amount of light that should be at the 1.2 GHz GS7000 Node and rerun the distortion performance. If the distortion performance improves, there is too much light. An inline optical attenuator or a coupler with a higher loss can reduce the light, or the laser may have to be replaced with a lower launch power.</td></tr>
<tr><td>4</td><td colspan="2">Attenuate the RF input level into the amplifier by increasing the pad value at the OIB. If the distortion perform improves, there is too much RF.</td></tr>
</table>

Poor Frequency Response

Troubleshooting Flowchart

Follow this troubleshooting flowchart. Also see the notes following the chart.



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Notes

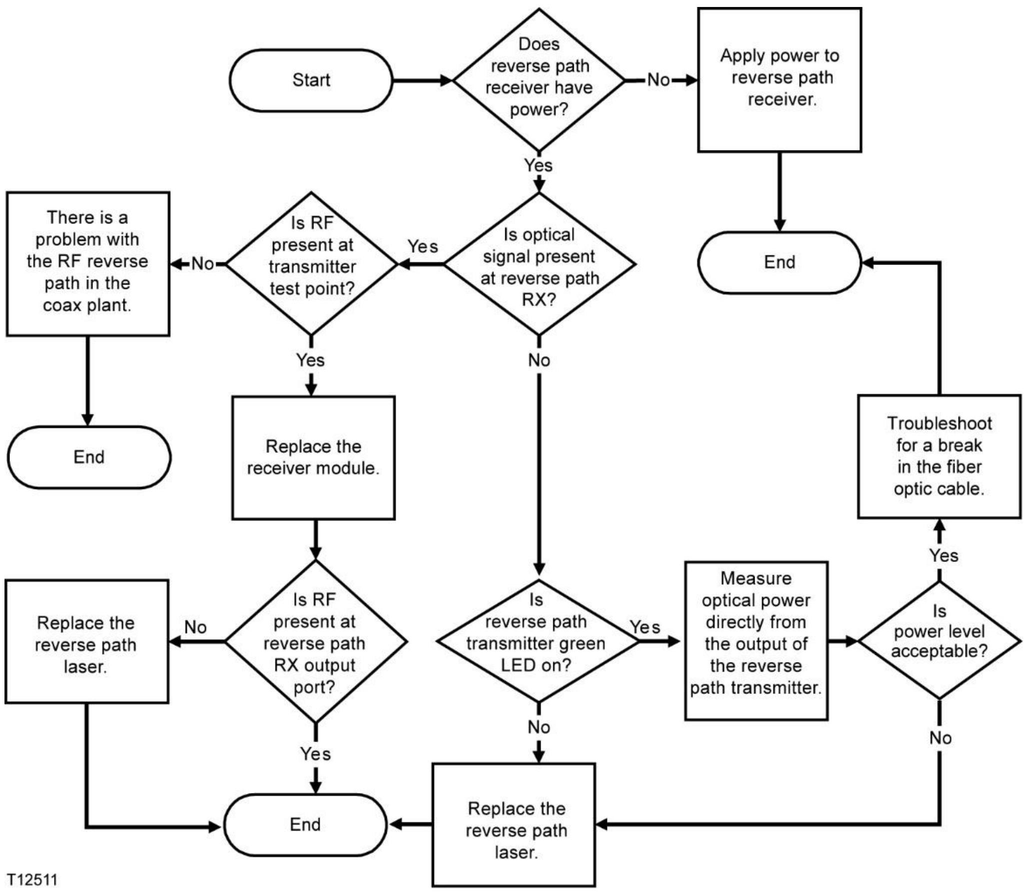
These notes apply to the previous troubleshooting flowchart.

Note	Description
1	Be sure all unused ports are properly terminated into 75 ohms to prevent mismatches. The frequency response is cumulative and reflects the response of each active device in the link: ■ The frequency response for the transmitter is dependent on the transmitter manufacturer's specification. ■ The frequency response of the 1.2 GHz GS7000 Node is ±1.0 dB from 52 MHz to 1218 MHz (for optical receiver and amplifier combined).
2	It is possible that the RF amplifier is set up incorrectly. Always check to see that padding and equalization is correct to ensure proper levels at the inputs to each gain stage. See the pad and equalizer selection charts in Appendix A for correct pad and equalization.

No RF Output from Reverse Receiver

Troubleshooting Flowchart

Follow this troubleshooting flowchart.



7

Customer Support Information

If You Have Questions

If you have technical questions, call Cisco Services for assistance. Follow the menu options to speak with a service engineer.

Access your company's extranet site to view or order additional technical publications. For accessing instructions, contact the representative who handles your account. Check your extranet site often as the information is updated frequently.

A

Technical Information

Introduction

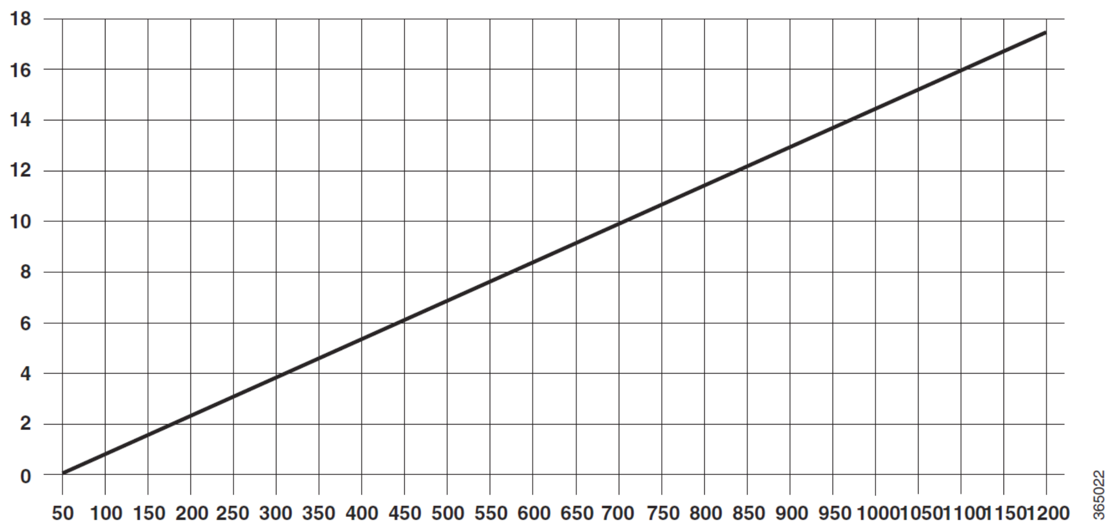
This appendix contains tilt, forward and reverse equalizer charts and pad values and part numbers.

In This Appendix

Linear Tilt Chart

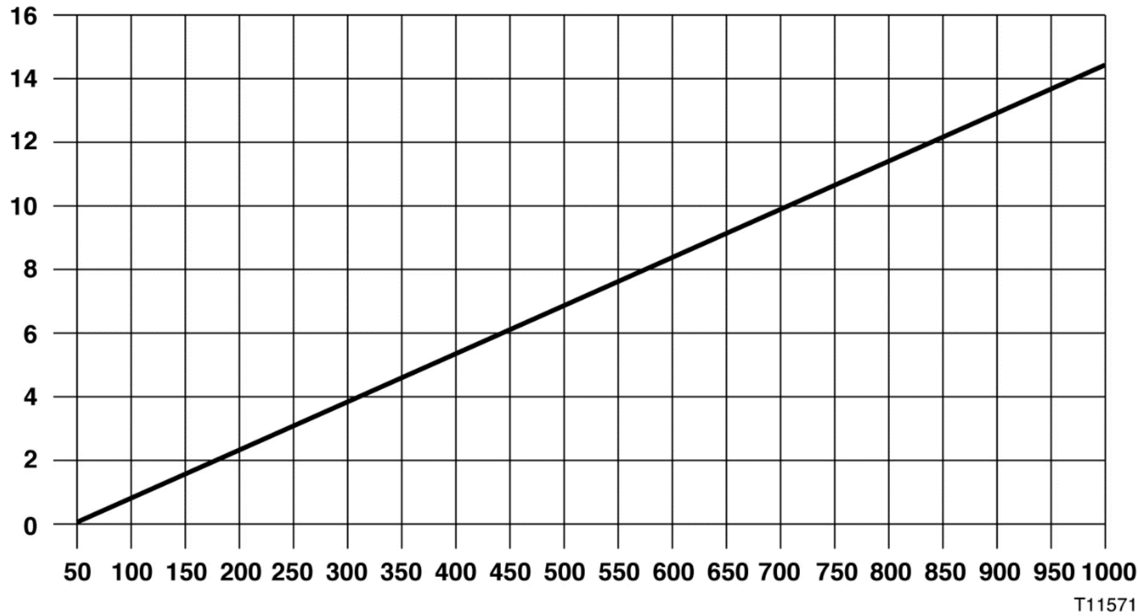
Amplifier Output Linear Tilt Chart for 1.2 GHz

The following chart can be used to determine the operating level at a particular frequency considering the operating linear tilt.



Amplifier Output Linear Tilt Chart for 1 GHz

The following chart can be used to determine the operating level at a particular frequency considering the operating linear tilt.



Example: If the amplifier's 1 GHz output level is 49.0 dBmV with a linear operating tilt of 14.5 dB (from 50 to 1 GHz), the corresponding output level at 750 MHz would be 45.1 dBmV. This was found by taking the difference in tilt between 1 GHz and 750 MHz (14.5 – 10.6 = 3.9 dB). Then subtract the difference in tilt from the operating level (49.0 - 3.9 = 45.1 dBmV).

Forward Equalizer Chart

1.2 GHz Forward Linear Equalizers

The following table shows the 1.2 GHz forward linear equalizer loss.

EQ Value	Insertion Loss at (MHz)		Total Tilt
(dB)	1218	1000	(52-1218 MHz)
1.5	1.0	1.3	**1.5**
3.0	1.0	1.6	**3.0**
4.5	1.0	1.8	**4.5**
6.0	1.0	2.1	**6.0**
7.5	1.0	2.4	**7.5**
9.0	1.0	2.6	**9.0**
10.5	1.0	2.9	**10.5**
12.0	1.0	3.2	**12.0**
13.5	1.0	3.5	**13.5**
15.0	1.0	3.7	**15.0**
16.5	1.0	4.0	**16.5**
18.0	1.0	4.3	**18.0**
19.5	1.2	4.8	**19.5**
21.0	1.2	5.0	**21.0**
22.5	1.2	5.3	**22.5**
24.0	1.2	5.6	**24.0**

1 GHz Forward Linear Equalizers

The following table shows the 1 GHz forward linear equalizer loss.

EQ Value	Insertion Loss at (MHz)									Total Tilt
(dB)	1000	870	750	650	600	550	86	70	52	(52-1000 MHz)
1.5	1.0	1.2	1.4	1.6	1.6	1.7	2.4	2.5	2.5	**1.5**
3.0	1.0	1.4	1.8	2.1	2.3	2.4	3.9	3.9	4.0	**3.0**
4.5	1.0	1.6	2.2	2.7	2.9	3.1	5.3	5.4	5.5	**4.5**
6.0	1.0	1.8	2.6	3.2	3.5	3.8	6.8	6.9	7.0	**6.0**
7.5	1.0	2.0	3.0	3.8	4.2	4.6	8.2	8.4	8.5	**7.5**
9.0	1.0	2.2	3.4	4.3	4.8	5.3	9.7	9.8	10.0	**9.0**
10.5	1.0	2.4	3.8	4.9	5.4	6.0	11.1	11.3	11.5	**10.5**
12.0	1.0	2.6	4.2	5.4	6.1	6.7	12.6	12.8	13.0	**12.0**
13.5	1.0	2.9	4.6	6.0	6.7	7.4	14.0	14.2	14.5	**13.5**
15.0	1.0	3.1	5.0	6.5	7.3	8.1	15.5	15.7	16.0	**15.0**
16.5	1.0	3.3	5.4	7.1	8.0	8.9	16.9	17.2	17.5	**16.5**
18.0	1.5	4.0	6.3	8.2	9.1	10.1	18.9	19.2	19.5	**18.0**
19.5	1.5	4.2	6.7	8.7	9.7	10.8	20.3	20.6	21.0	**19.5**
21.0	1.5	4.4	7.1	9.2	10.2	11.5	21.8	22.1	22.5	**21.0**

B

Enhanced Digital Return Multiplexing Applications

This appendix explains the installation and application of the Cisco Enhanced Digital Return (EDR) 85 Multiplexing System in the GS7000 Node.

The products are intended for digital transmission of reverse path signals over a fiber optic link from the node to the headend.

The Cisco Enhanced Digital Return (EDR) 85 System expands the functionality of GS7000 and GainMaker 4-Port and Reverse Segmentable Nodes by increasing the performance, reach, and efficiency of the reverse path transmissions.

The Cisco EDR 85 System includes EDR Transmitter modules that install in GainMaker and GS7000 Nodes, and companion Cisco Prisma® high-density (HD) EDR PRX85 Receiver modules that install in a Prisma II or Prisma II XD chassis at the headend or hub. The transmitter and receiver use Small Form Factor Pluggable (SFP) optical pluggable modules (OPMs) for enhanced flexibility. The Cisco EDR 85 System operates over the 5-85 MHz range and supports all standard reverse frequency bandwidths at 40, 42, 55, 65, and 85 MHz.

The Cisco Enhanced Digital Return (EDR) 85 Systems includes the EDR 1:1 multiplexing system and the 2:1 multiplexing system.

In This Appendix

Enhanced Digital Return System Overview

Features

The EDR Enhanced Digital Return 1:1 and 2:1 Multiplexing Systems have the following features.

- High-performance Digital Return technology
  - 12 bit encoding enables transmission of analog video in the reverse band
  - High-order digital modulation signals (e.g.,16 QAM, 64 QAM, and 256 QAM)
- Multiple operating modes in the EDR receiver support EDR transmitter
- Optical Pluggable Modules (OPM) enable flexible inventory management
- Long reach transmission capabilities eliminate the need for optical amplifiers, reducing cost and space requirements
- Capable of sending 80 individual 5 – 85 MHz reverse signals over a single fiber
  - Compatible with Cisco's 40 wavelength DWDM system
- Enables independent balancing of reverse traffic at EDR receiver RF ports
- Simplified setup reduces installation time and expertise requirements
- Distance- and temperature-independent link performance simplifies engineering and maintenance requirements
- Space-saving, high-density deployment in Prisma II or Prisma II XD chassis increases deployment cost-efficiency
- Optional monitoring of node (GS7000) and Tx (GS7000 and GainMaker) parameters available at the receiver

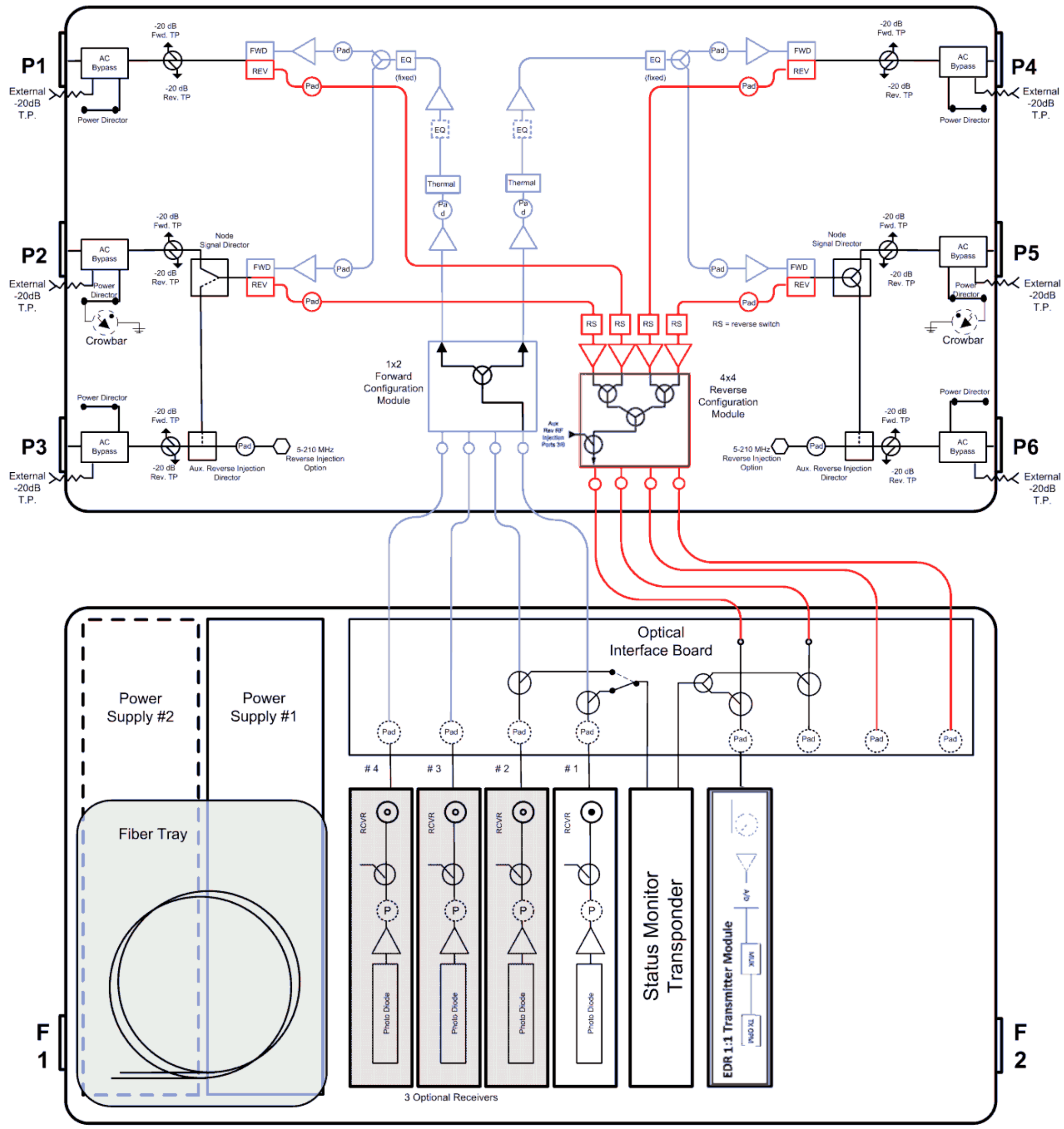
The EDR 2:1 Enhanced Digital Return Multiplexing System leverages 2:1 multiplexing to reduce fiber usage.

System Functional Diagrams

Single Transmitter Configuration

Single Transmitter Configuration for EDR 1:1 Transmitter Module

The following illustration shows how the GS7000 Node functions in Enhanced Digital Return configuration with one 1:1 EDR transmitter module installed as the single transmitter.

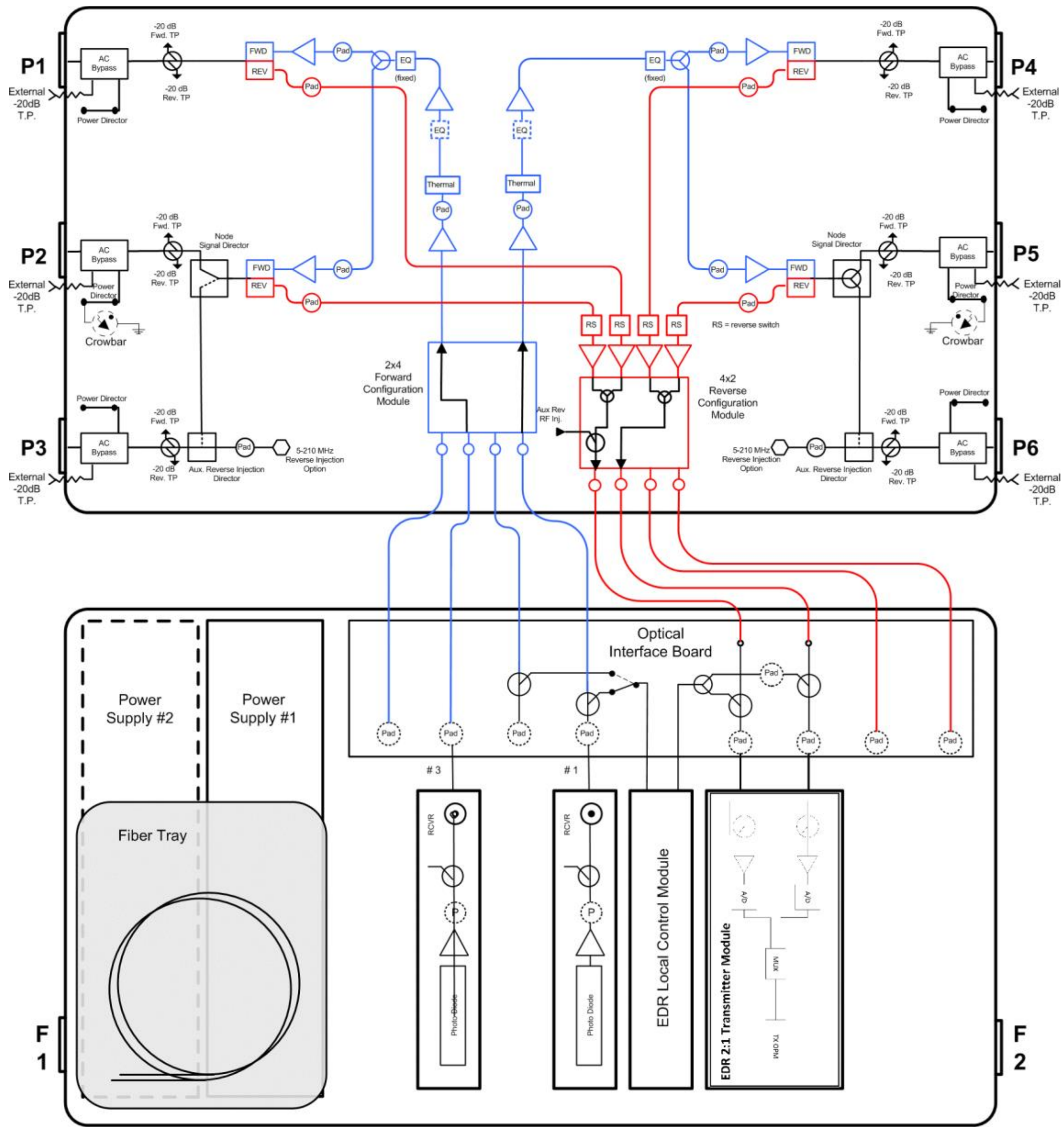


Important: This configuration requires a 4x1 Reverse Configuration Module (for 6-port OIB), as shown.

Single Transmitter Configuration for EDR 2:1 Transmitter Module

The following illustration shows how the GS7000 Node functions in Enhanced Digital Return configuration with one 2:1 EDR transmitter module installed as the single transmitter.

Note: When the node is configured in either segmented or EDR mode, a 75 dB pad must be placed in the Tx2 SM Term.



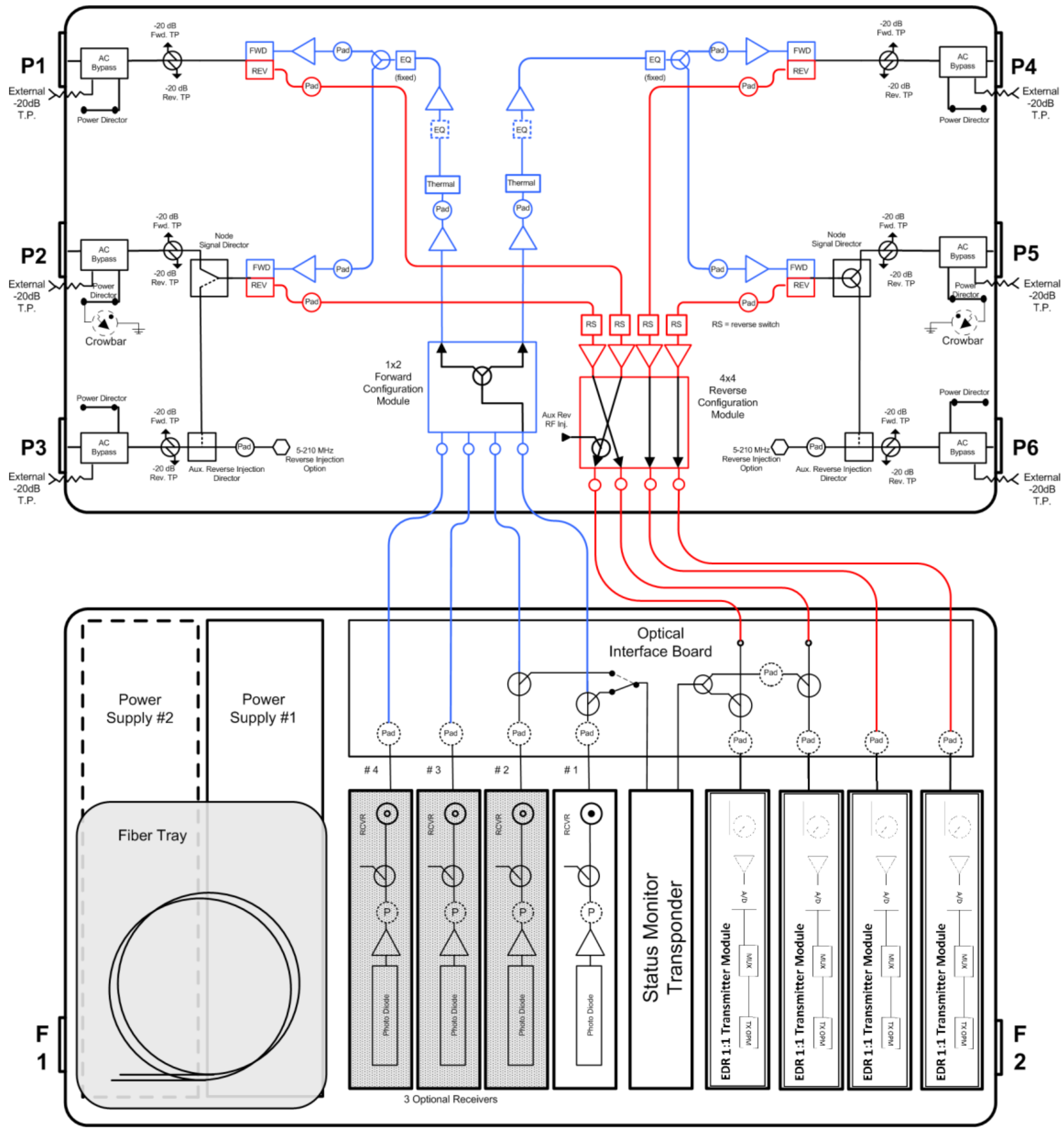
Important: This configuration requires a 4x2 Reverse Configuration Module (for 6-port OIB), as shown.

Full Configuration

Full Configuration for EDR 1:1 Transmitter Module

The following illustration shows how the GS7000 Node functions in Enhanced Digital Return configuration with four 1:1 EDR transmitter modules installed as the maximum configuration.

Note: When the node is configured in either segmented or EDR mode, a 75 dB pad must be placed in the Tx2 SM Term.

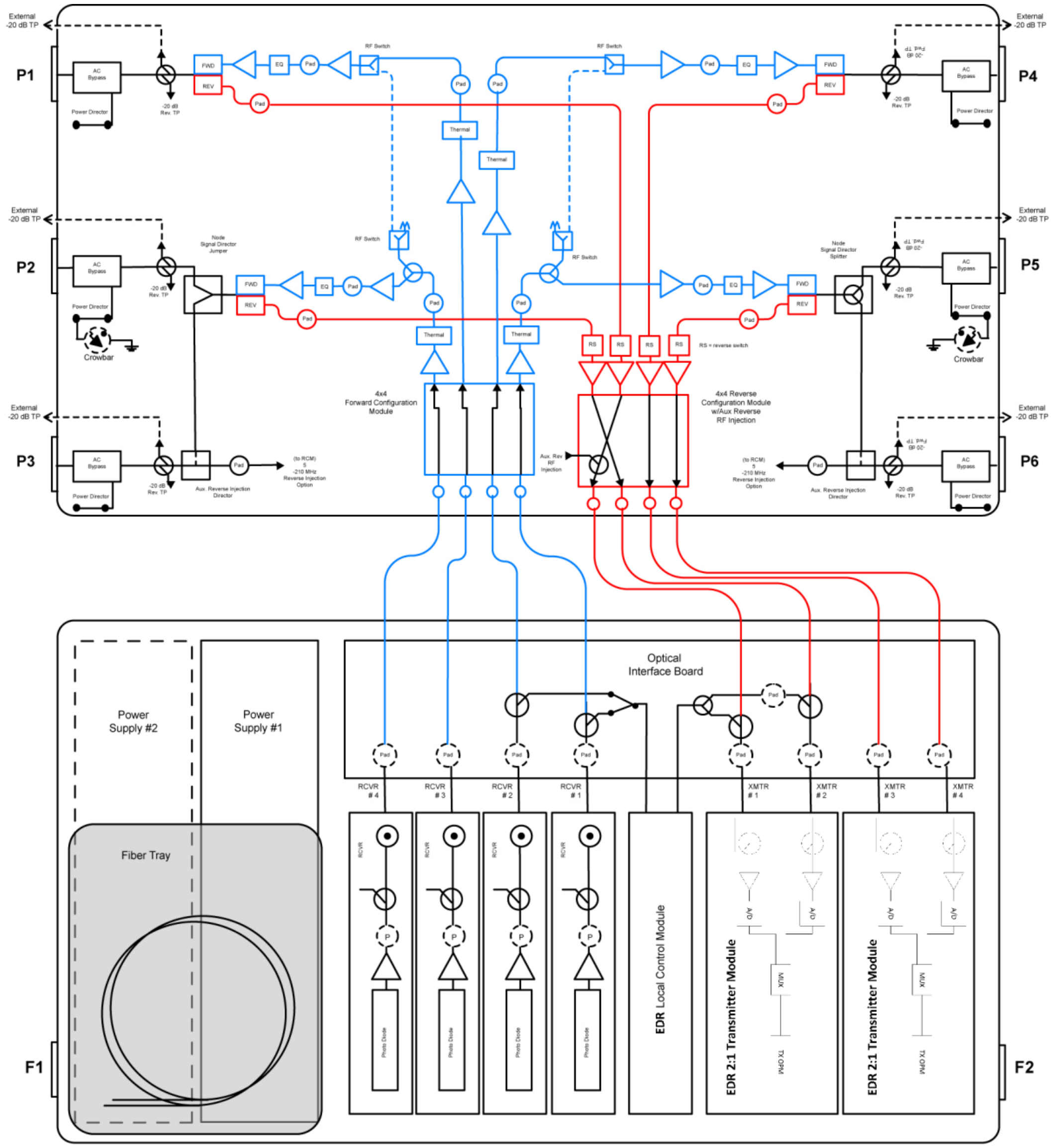


Important: This configuration requires a 4x4 Reverse Configuration Module as shown.

Full Configuration for EDR 2:1 Transmitter Module

The following illustration shows how the GS7000 Node functions in Enhanced Digital Return configuration with two 2:1 EDR transmitter modules installed as the maximum configuration.

Note: When the node is configured in either segmented or EDR mode, a 75 dB pad must be placed in the Tx2 SM Term.

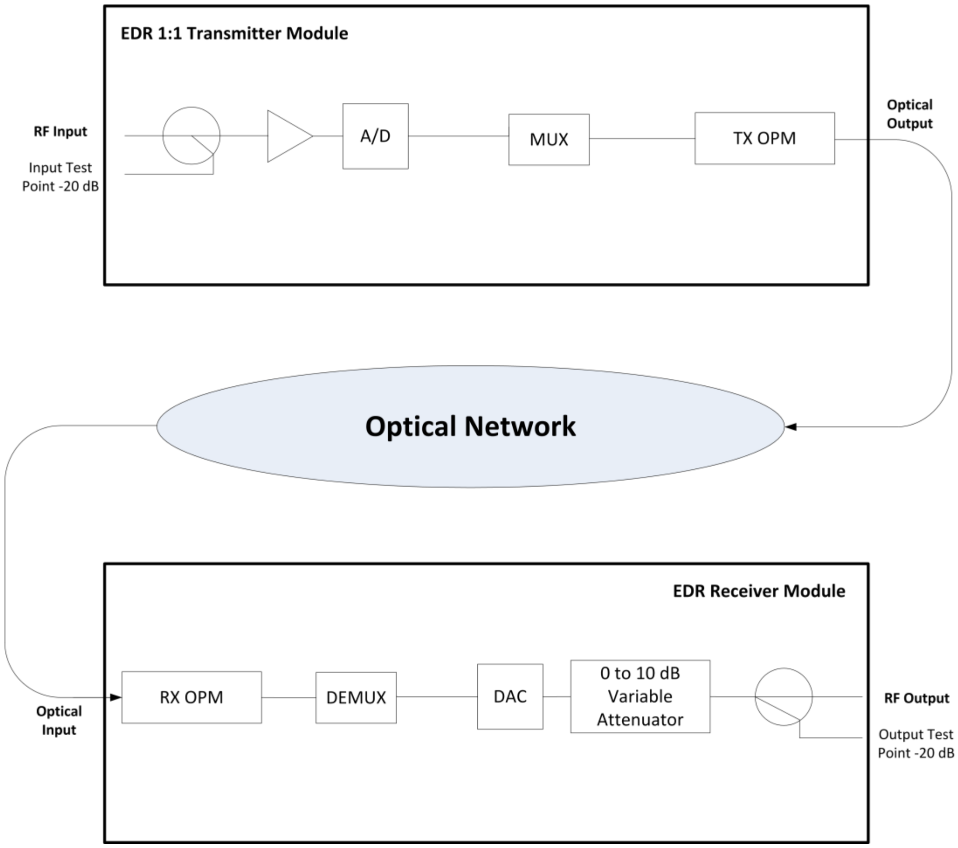


Important: This configuration requires a 4x4 Reverse Configuration Module as shown.

System Block Diagram

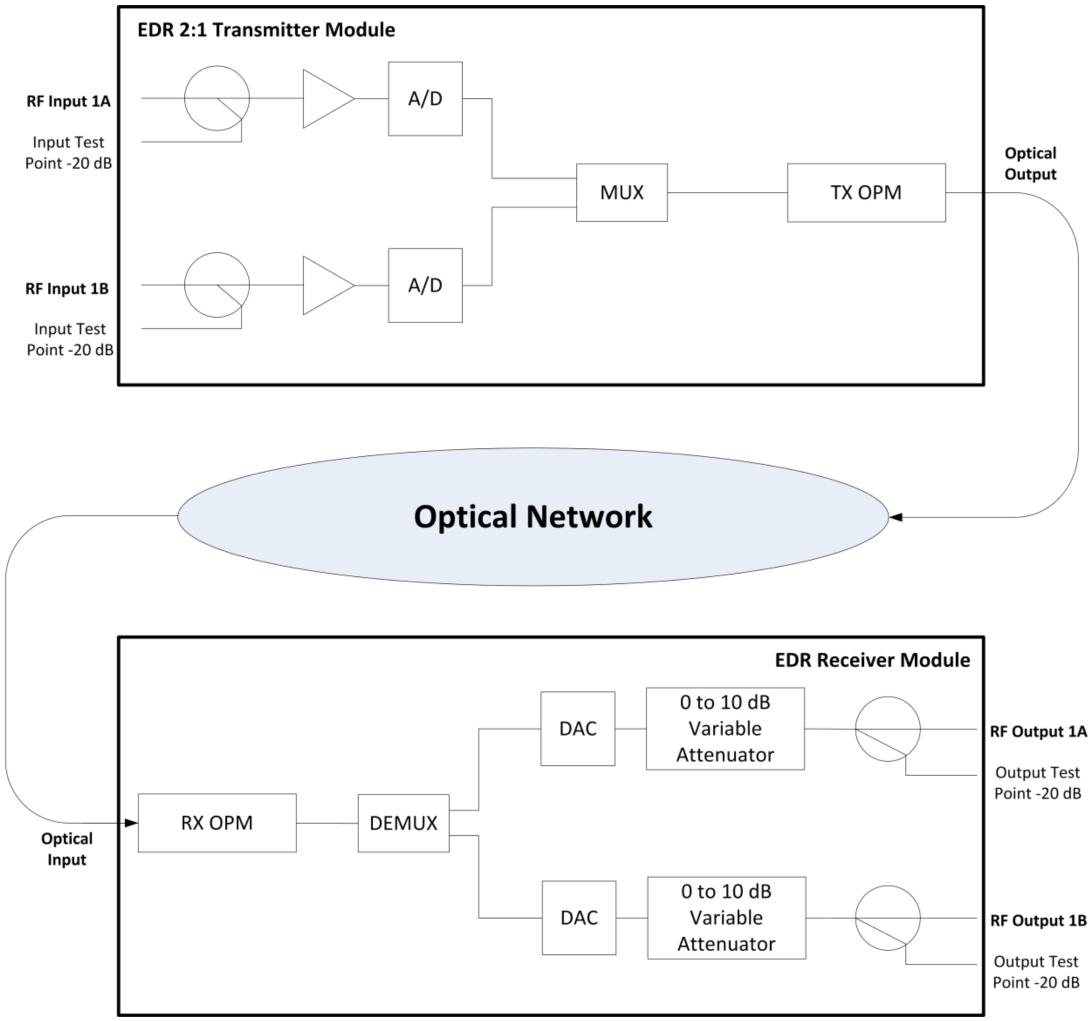
System Block Diagram for EDR 1:1 Transmitter Module

The following is a block diagram of the EDR Enhanced Digital Return 1:1 Multiplexing System.



System Block Diagram for EDR 2:1 Transmitter Module

The following is a block diagram of the EDR Enhanced Digital Return 2:1 Multiplexing System.


EDR 2:1 Transmitter Module
RF Input 1A
Input Test Point -20 dB
A/D
MUX
TX OPM
Optical Output
RF Input 1B
Input Test Point -20 dB
A/D
Optical Network
EDR Receiver Module
DAC
0 to 10 dB Variable Attenuator
RF Output 1A
Output Test Point -20 dB
RX OPM
DEMUX
Optical Input
DAC
0 to 10 dB Variable Attenuator
RF Output 1B
Output Test Point -20 dB

EDR Transmitter Module

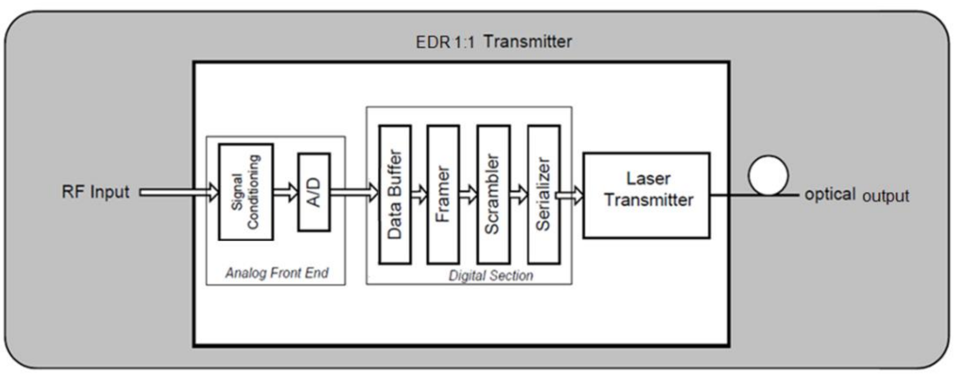
At the transmit (node) end of the system, reverse-path RF input signals from each node port are routed to an EDR 2:1 or EDR 1:1 Transmitter module in the housing lid. The transmitter module converts each signal to a baseband digital data stream and combines the signals into a serial data stream using time-division multiplexing (TDM). The baseband data stream is then converted to an optical signal for transmission to the headend or hub. The double-wide (2:1) transmitter modules occupy two transmitter slots and the 1:1 modules occupy one slot.

The EDR 1:1 transmitter introduces one single RF inputs to produce the discrete 5 to 85 MHz RF signal, while the EDR 2:1 transmitter introduces two RF inputs to produce two discrete 5 to 85 MHz RF signals. The transmitter module also converts each signal to a baseband digital data stream and time division multiplexes the two streams into a single data stream.

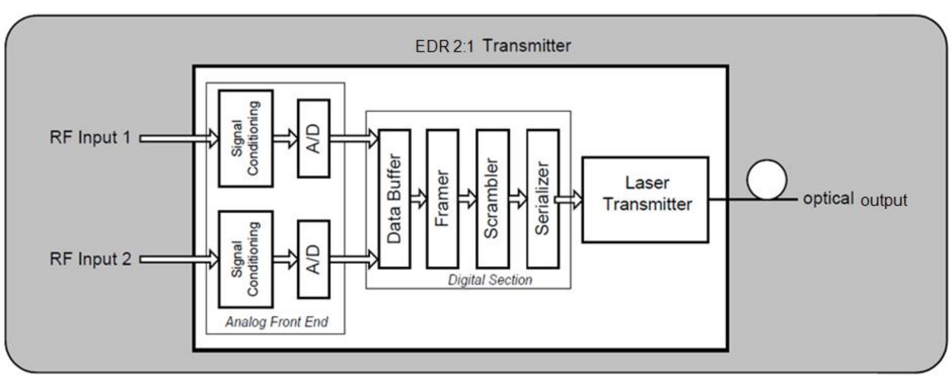
The data stream is carried optically over fiber, via an SFP type OPM module, to a remote hub or headend location where the optical signal is detected and converted back to a serial electrical signal. The data is then de-scrambled and de-framed and switched to a Digital-to-Analog Converter (DAC), where the analog spectrum that was sampled at the transmit side is reconstructed. The baseband data stream is converted to an optical signal for transmission back to the headend or hub.

The following block diagrams show the transmitter module's internal components.

For EDR 1:1 Transmitter Module

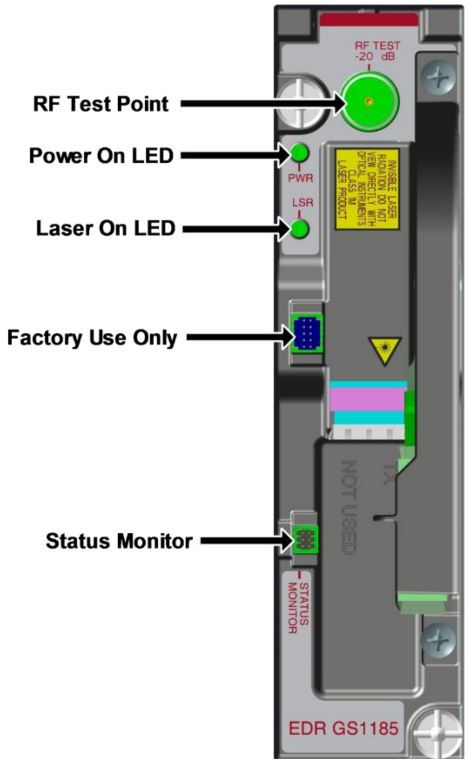


For EDR 2:1 Transmitter Module



The following illustrations show the transmitter module components.

For EDR 1:1 Transmitter Module

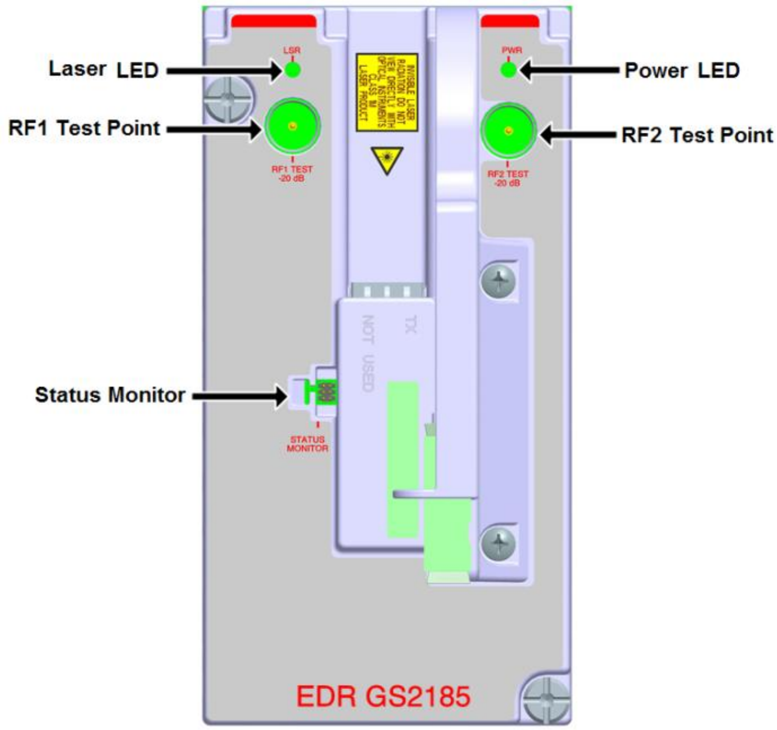


Note:

1. The EDR transmitter cannot monitor the GainMaker Node parameters.
2. The EDR LCM module needs to be installed for EDR transmitter status monitoring.
3. The status monitor interface is not used for data transmission. The Cisco DOCSIS transponder is needed when data transmission is required.

The transmitter module uses the same style housing as the optical receivers and transmitters, and it uses the single-wide module housing. As such, it occupies one standard transmitter positions in the node lid.

For EDR 2:1 Transmitter Module



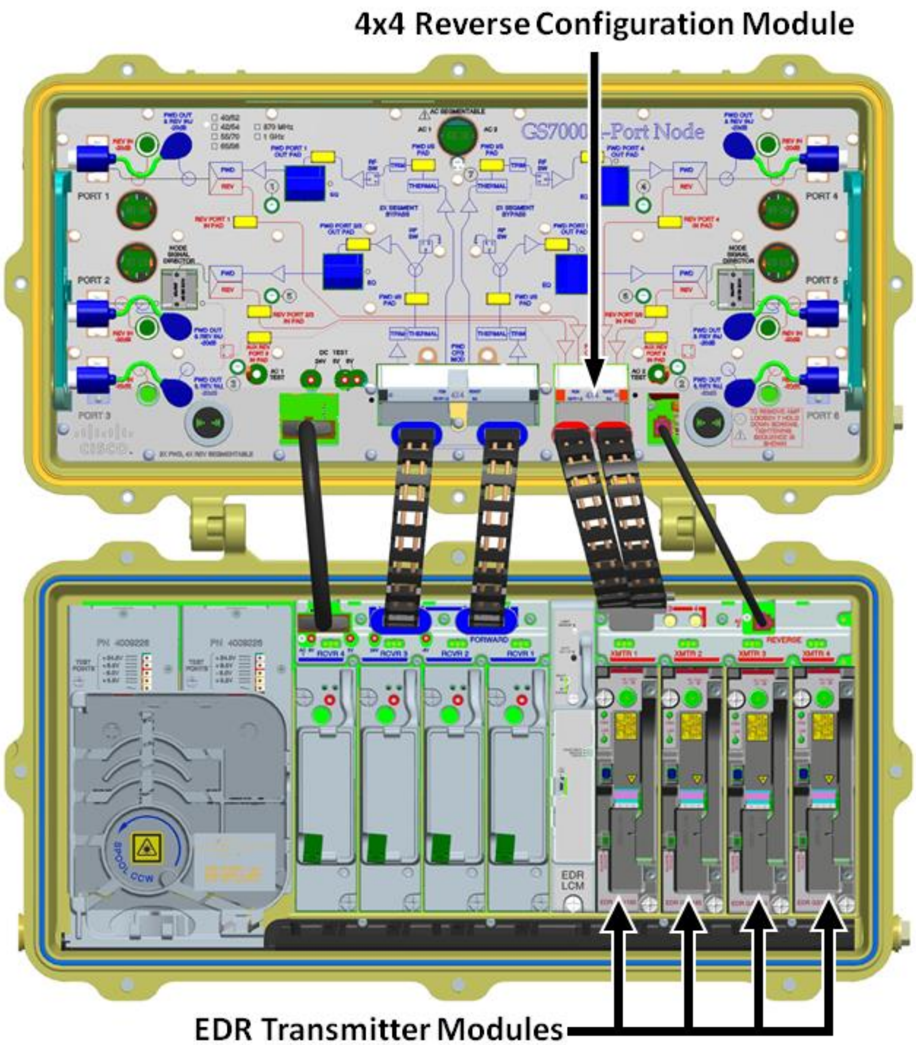
Note:

1. The EDR transmitter cannot monitor the node parameters.
2. The EDR LCM module needs to be installed for EDR transmitter status monitoring.
3. The status monitor interface is not used for data transmission. The Cisco DOCSIS transponder is needed when data transmission is required.

The transmitter module uses the same style housing as the optical receivers and transmitters, except that it uses double-wide module housing. As such, it occupies two standard transmitter positions in the node lid.

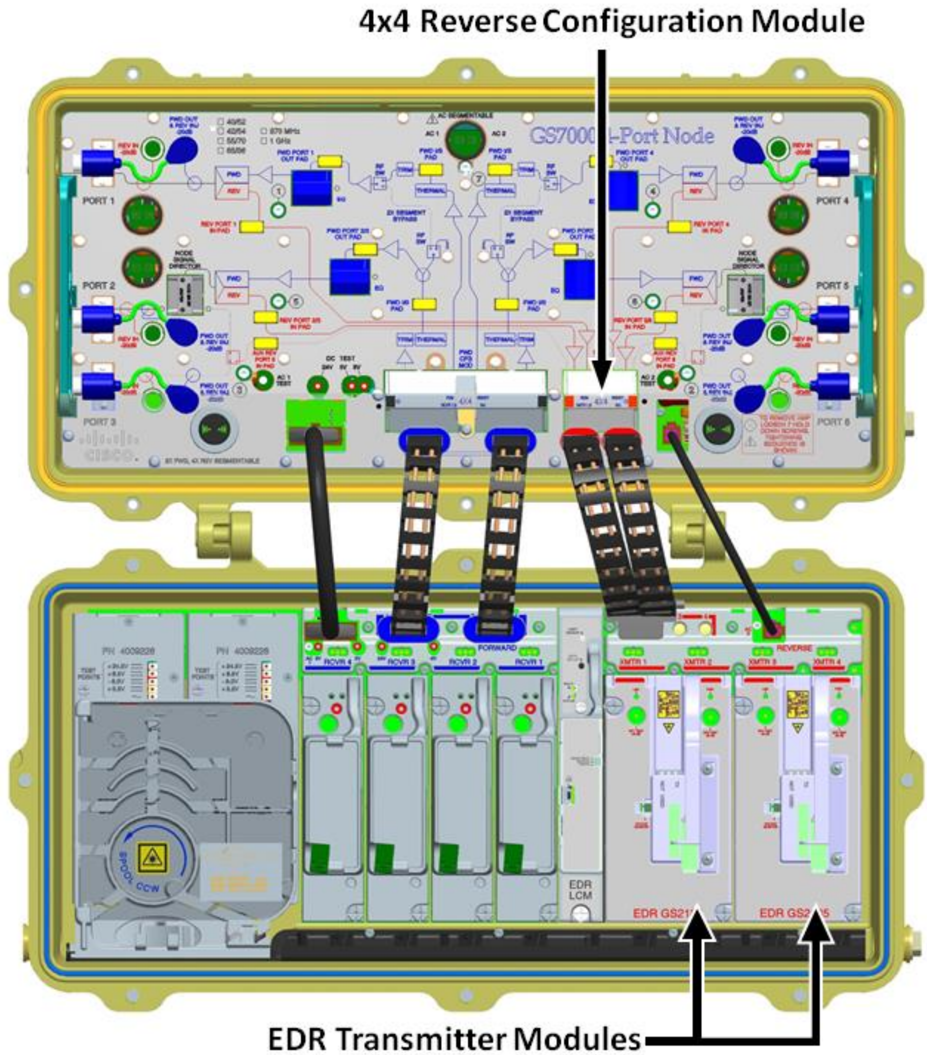
The following illustrations show the location of the modules in the node.

For EDR 1:1 Transmitter Module



Note: This example shows four transmitter modules installed in the node, which requires a 4x4 Reverse Configuration Module.

For EDR 2:1 Transmitter Module



Note: This example shows two transmitter modules installed in the node, which requires a 4x4 Reverse Configuration Module.

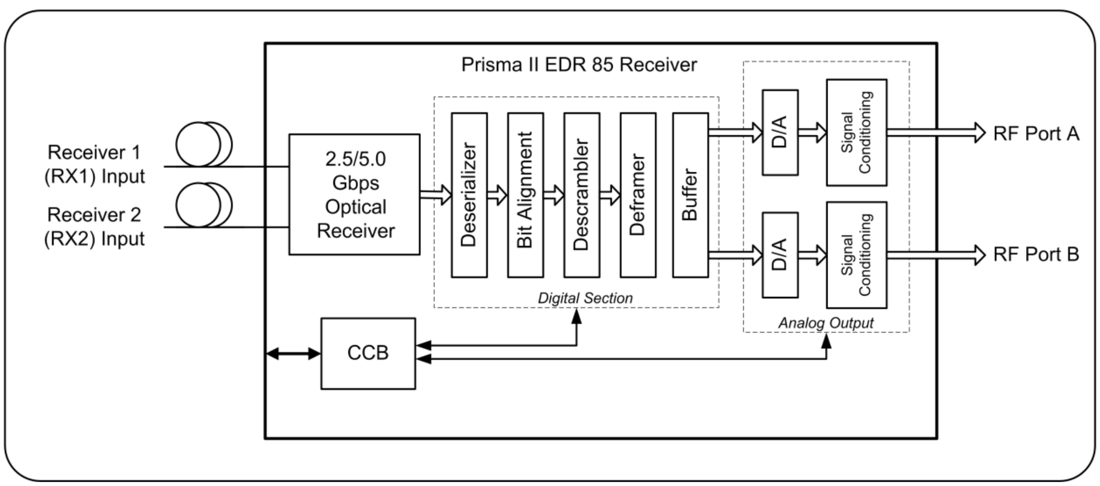
EDR Receiver Module

At the receive end, typically in a large hub or headend, the EDR Receiver module receives the optical signal and performs the conversion back to the baseband data stream. The resulting data streams are converted back to analog reverse path signals for routing to termination equipment. The EDR Receiver module is available in the High Density form factor. The receiver OPMs are available in Standard Range (SR) and Extended Range (XR) configurations. Both configurations feature a dual LC/PC optical input connector that feeds two independent reverse optical receivers, each with its own RF output port.

A single EDR Receiver module occupies one slot in a Cisco Prisma II XD chassis. Two EDR HD receiver modules can be vertically stacked in an associated Prisma II Host Module that occupies a single-wide slot in the Prisma II standard chassis. Up to 26 HD modules can operate in a standard 6 rack unit (6RU) chassis (the 56-connector version of the chassis is required to make use of both receivers in one chassis slot). Up to 16 HD modules can operate in the Prisma II XD chassis. The ability to mix EDR Receiver modules with other Prisma II HD modules in the same chassis greatly enhances the flexibility of the platform.

For instructions on installing the receiver refer to the ***Prisma II Chassis Installation and Operation Guide***, part number 713375.

The following block diagram shows the receiver module's internal components.

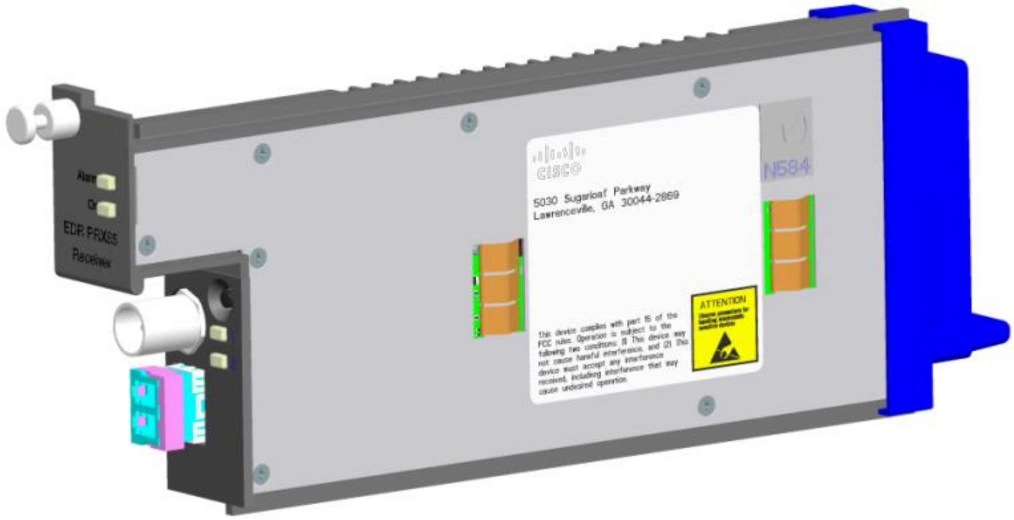


At the headend, the reverse optical receiver converts the optical signal back to an RF signal that is then routed out through the receiver's RF output.

Refer to the ***Cisco Prisma II EDR Receiver Installation Guide***, part number OL-29646, for detailed information on the EDR receiver module.

Receiver Module Diagram

The following illustration shows the receiver module.



Receiver Operating Modes

The receiver module supports receiver mode configuration performed by setting the proper mode ID numbers in the Prisma II Web UI system.

The following diagrams provide a basic walk-through of all the supported modes for the EDR receiver module.

The receiver can be configured for any of the following modes of operation:

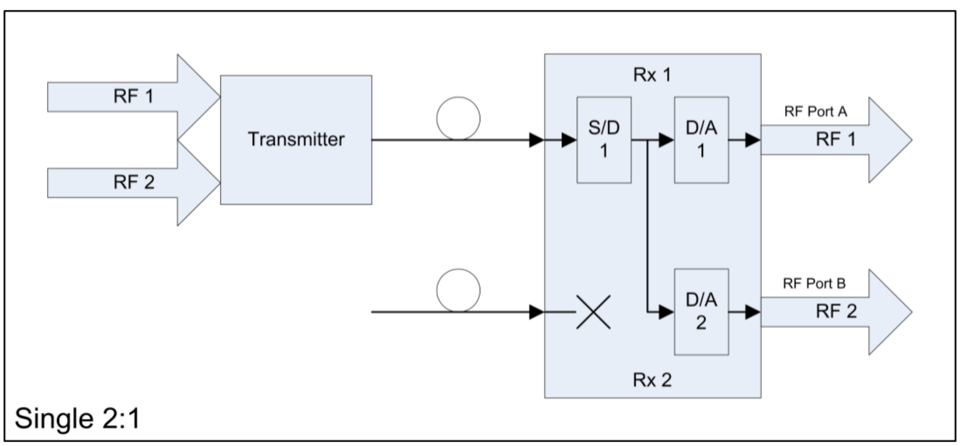
- Single 2:1
- Dual 1:1
- Dual 2:1
- Single 2:1 on Primary + Single 1:1 on Secondary
- Single 1:1 on Primary + Single 2:1 on Secondary
- Legacy Single 2:1
- Legacy Dual 2:1

Each of these operating modes is described below.

Single 2:1 Mode

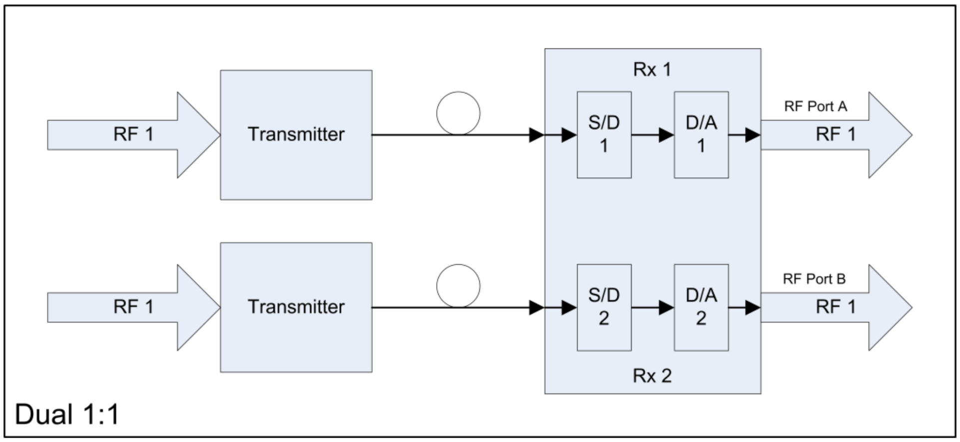
Referring to the diagram below, the EDR transmitter digitizes and combines two RF signals (RF 1 + RF 2) into one serial stream and transmits is over optical fiber to the receiver. At the receiver, the serial stream is de-serialized, converted back to its two analog RF components, and then sent to the two RF connectors on the back of the module. RF 1 appears on RF port A, and RF 2 appears on RF port B.

Note: The optical fiber must be plugged into the top receiver on the OPM.



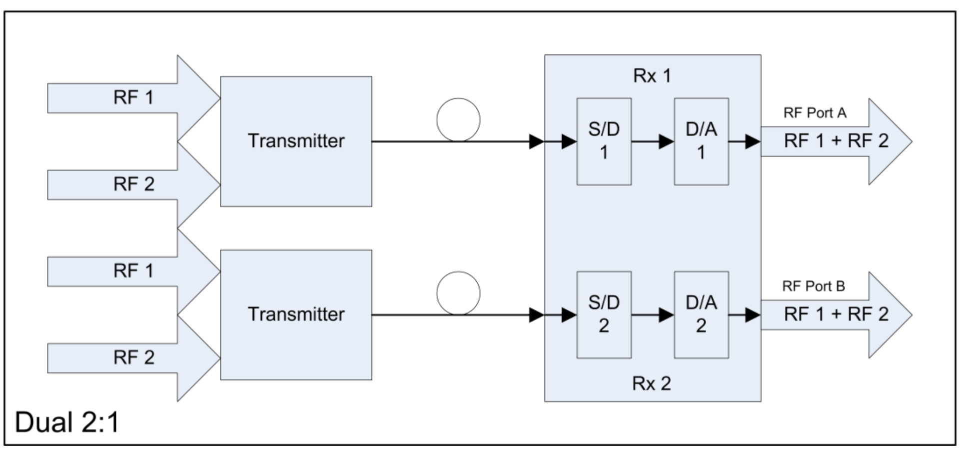
Dual 1:1 Mode

Referring to the diagram below, the EDR transmitter digitizes a single RF signal (RF 1) into a serial stream and transmits it over optical fiber to the receiver. At the receiver, the serial streams from two separate transmitters are deserialized and converted back to an analog RF signal. The RF signal (RF 1) for each transmitter is sent separately to the two RF connectors on the back of the module.



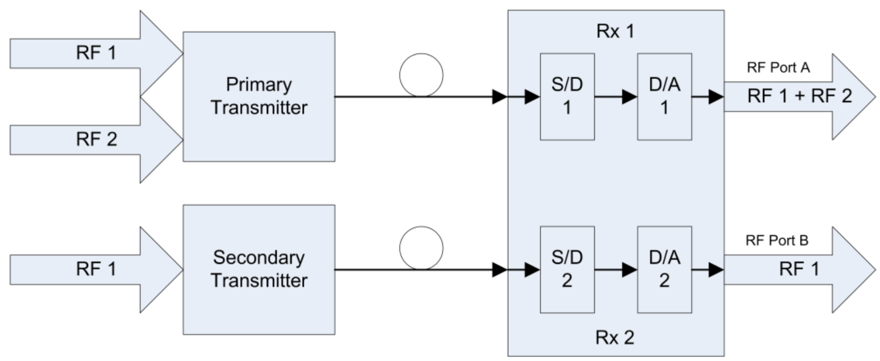
Dual 2:1 Mode

Referring to the diagram below, two EDR transmitters are connected to one receiver. Each EDR transmitter digitizes and combines two RF signals (RF 1 + RF 2) into one serial stream and transmits it over optical fiber to the receiver. At the receiver, the serial streams from the two separate transmitters are deserialized and converted back to their two analog RF components. Since the receiver only has two RF ports, the combined signals (RF 1 + RF 2) for each transmitter are sent to the two RF connectors on the back of the module.



Single 2:1 on Primary + Single 1:1 on Secondary

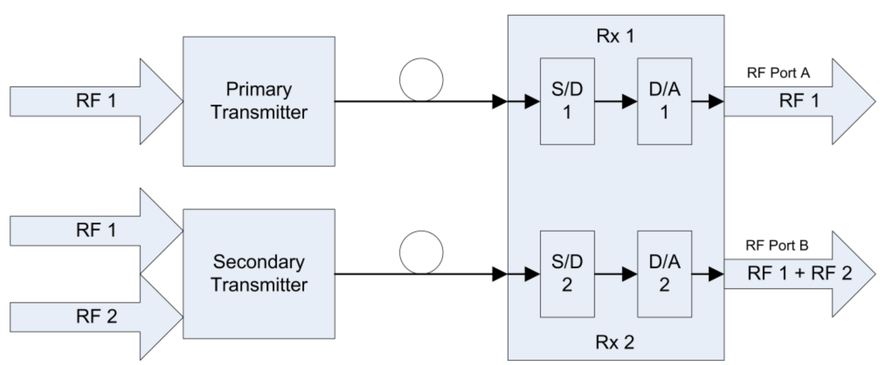
This mode is a combination of the 2:1 and 1:1 modes described above. Referring to the diagram below, one EDR transmitter digitizes and combines two RF signals (RF 1 + RF 2) into one serial stream and transmits it over optical fiber to the receiver. The other EDR transmitter digitizes a single RF signal (RF 1). At the receiver, the serial streams from two separate transmitters are deserialized and converted back to their two analog RF components. The combined Transmitter 1 signal (RF 1 + RF 2) is sent to RF port A, and the Transmitter 2 signal (RF 1) is sent to RF port B on the back of the module.



Single 2:1 Primary + Single 1:1 Secondary

Single 1:1 on Primary + Single 2:1 on Secondary

This mode is identical to the mode just described, except that the 2:1 transmitter is connected to the second receiver and the 1:1 transmitter is connected to the primary receiver.



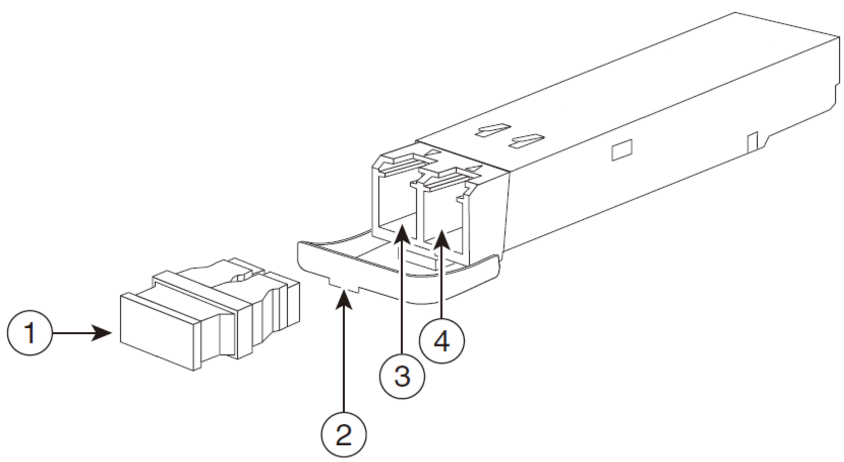
Single 1:1 Primary + Single 2:1 Secondary

EDR OPM and LCM

About the OPM Module

The reverse transmitter converts the RF test signal(s) to an optical signal using the installed Optical Module (OPM) and transmits it to the headend (or hub site) via fiber optic cable. At the headend, the reverse optical receiver also converts the optical signal back to an RF signal that is then routed out through the receiver's RF output using its installed OPM module.

Item	Description
1	Dust Plug
2	Bale Clasp (Open, Push upward to close)
3	Transmit Bore (Not In Use for the Receiver)
4	Receive Bore (Not In Use for the Transmitter)



About the EDR LCM

The EDR Local Control Module is required for in-band status monitoring the node signaling and data transmission.

The packet cable is delivered with the EDR LCM module. Refer to the installation section in the following content for instructions on local status monitoring connection.

Refer to the following sections for EDR OPM and LCM installation.

Enhanced Digital Return (EDR) System Installation

Before You Begin

Overview

Perform these installation instructions only if you are upgrading the GS7000 Node with the EDR. If your node came with the EDR installed, go to ***Reverse Balancing the Node with Digital Return Modules*** (on page 234).

Required Tools

The following tools and equipment are needed to configure and install the EDR.

- ½-inch hex driver or ratchet
- Two adjustable wrenches for coaxial connectors
- Standard flat-head or phillips-head screwdriver
- Torque wrench, capable of settings up to 100 in-lb (11.3 Nm)

Operating Environment

Before operating the node with the EDR installed, ensure that the operating environment meets the following standards.

- Ambient temperature range outside the node must be maintained between -40°C and +60°C (-40°F to 140°F).
- Storage temperature range of the EDR must be maintained between -40°C to +85°C (-40°F to 185°F).
- Humidity range must be maintained between 5% to 95% non-condensing before installation of the EDR Digital Return module(s).

Installing the EDR Transmitter

The transmitter module uses the same style housing as the optical receivers and transmitters, except that it uses double-wide module housing. As such, it occupies two standard transmitter positions in the node lid.

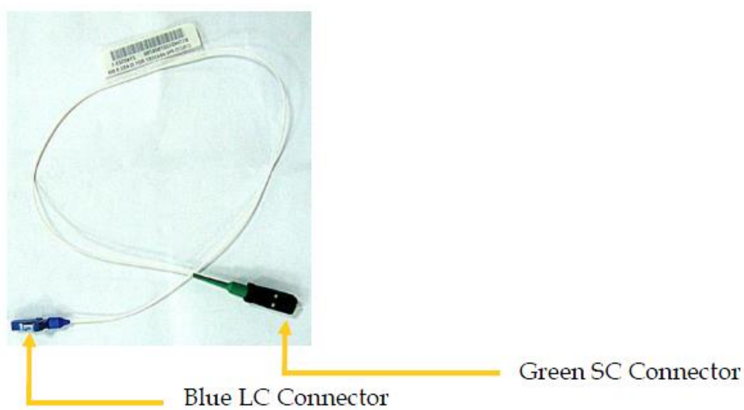
If your EDR transmitter comes without OPM module installed, you need to order the fiber jumper and the OPM module from our sales representatives, and perform the following steps to install the OPM module and connect the fiber jumper to the installed OPM module before installing the EDR transmitter.

To Install the OPM Module in the EDR Transmitter

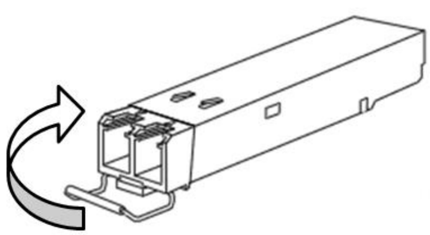
CAUTION:

The OPM modules are electro-static sensitive devices. Always use an ESD wrist strap or similar individual grounding device when handling OPM modules or coming in contact with modules.

1. Connect the blue LC connector to the transmit bore of the OPM module before installing the module. Refer to the **EDR OPM and LCM** section on page 238 for details for the OPM module.



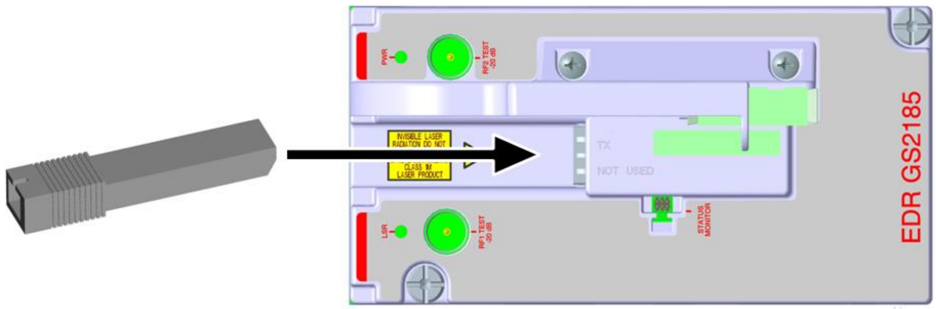
2. Close the bale-clasp before inserting the OPM module.



3. Connect the blue LC connector to the transmit bore of the OPM module.
4. Line up the OPM module with the port, and slide it into the port.
5. Proceed to next section for installation.

The following diagram shows the OPM module installed on the 1:1 transmitter module.

The following diagram shows the OPM module installed on the 2:1 transmitter module.



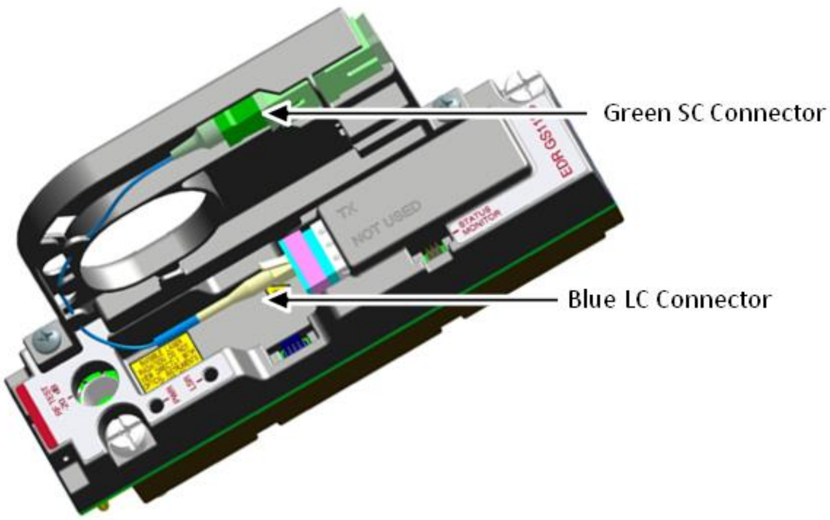
CAUTION:

Removing and installing an OPM module can shorten its useful life. Do not remove and insert OPM modules more often than is absolutely necessary.

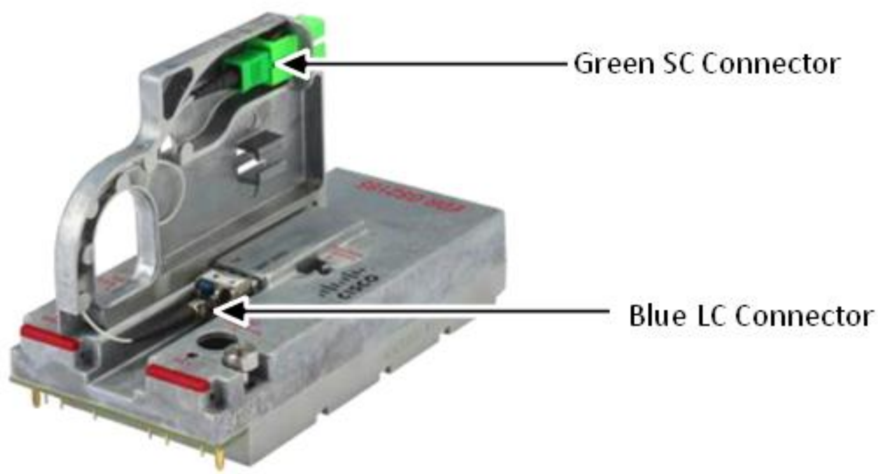
To Route the Fiber Jumper

Make sure the transmitter module is installed with the OPM module before routing the fiber jumper. The fiber jumper must be routed carefully in the fiber tray and aligned under the fiber jumper clip one by one.

The following diagram shows the fiber jumper connection for 1:1 transmitter.



The following diagram shows the fiber jumper connection for 2:1 transmitter.



Note:

1. When removing faulty OPM module, press and remove the blue LC connecter before you can open the bale clasp.
2. OPM modules should be installed before installing the fiber jumper.

To Install the EDR Transmitter

Follow these steps to install the transmitter module(s).

1 See ***Module Replacement Procedure*** (on page 123) for instructions on installing these modules in the housing.

2 Remove any existing transmitter modules from the positions in which you want to install the EDR transmitter module(s).

3 Install one to four 1:1 transmitter modules in the housing lid as required for your application.

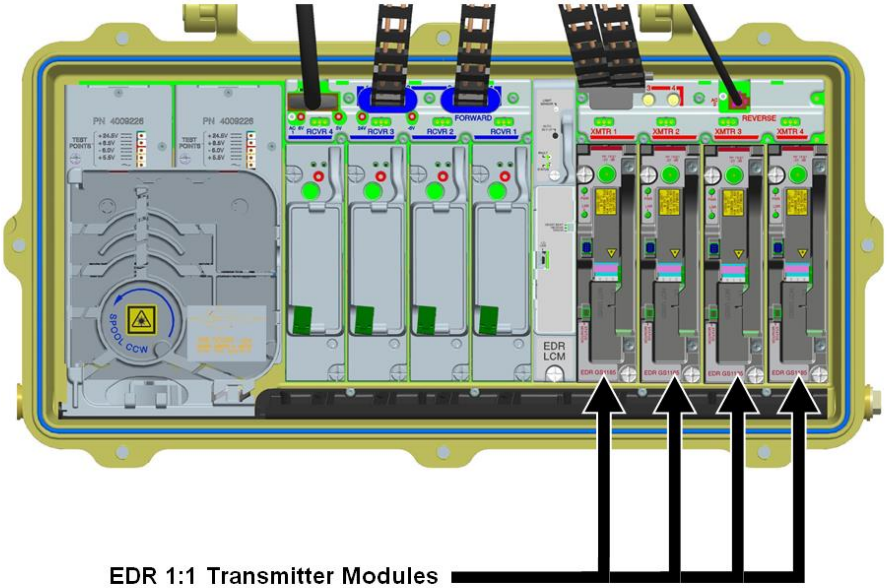
IF you are installing...	THEN...
only one transmitter module	install the module in transmitter positions XMTR 1 AND install an appropriate Reverse Configuration Module in the RF amplifier assembly. Refer to the RCM Section on page 40 for details.
Two or three transmitter modules	install the modules in transmitter positions XMTR 1/XMTR 2, or XMTR 1/XMTR 2/XMTR 3 AND install an appropriate Reverse Configuration Module in the RF amplifier assembly. Refer to the RCM Section on page 40 for details.
four transmitter modules	install the modules in transmitter positions XMTR 1/XMTR 2/ XMTR 3/XMTR 4 AND install an appropriate Reverse Configuration Module in the RF amplifier assembly. Refer to the RCM Section on page 40 for details.

4 Install one or two 2:1 transmitter modules in the housing lid as required for your application.

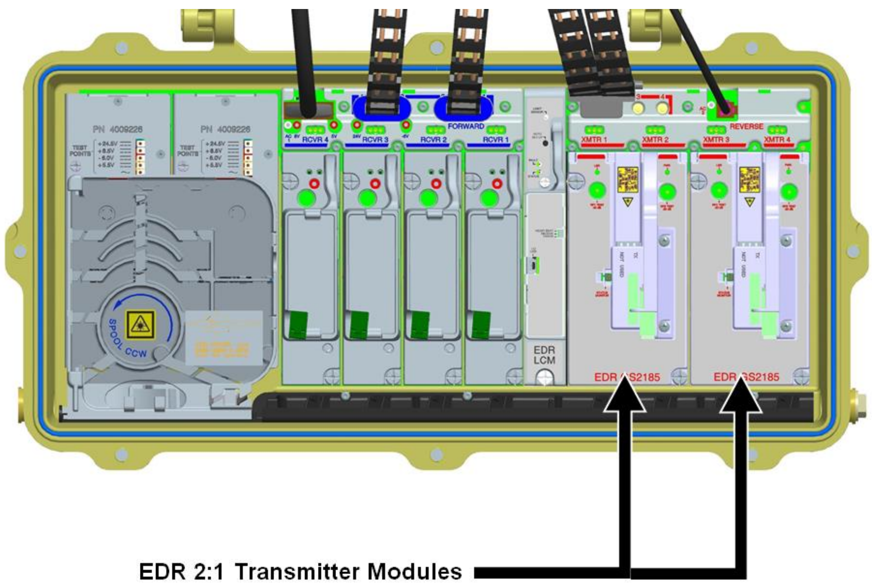
IF you are installing...	THEN...
only one transmitter module	install the module in transmitter positions XMTR 1/XMTR 2 AND install an appropriate Reverse Configuration Module in the RF amplifier assembly. Refer to the RCM Section on page 40 for details.
two transmitter modules	install the modules in transmitter positions XMTR 1/XMTR 2 and XMTR 3/XMTR 4 AND install an appropriate Reverse Configuration Module in the RF amplifier assembly. Refer to the RCM Section on page 40 for details.

The following illustrations show the location of the installed modules in the node.

For EDR 1:1 Transmitter Module:



For EDR 2:1 Transmitter Module:



WARNING:

Laser transmitters when disconnected from their optical fiber path emit invisible laser radiation, which is harmful to the human eye. If viewed at close range, the radiation may be of sufficient power to cause instantaneous damage to the retina of the eye. Only trained service personnel using proper safety precautions and equipment such as protective eyewear should disconnect and service the laser transmitter equipment.

To Connect the Long-haul Fiber

1. Insert the fiber-optic start-head to the optical adapter.
2. Route fiber on the fiber tray of GS7000 GainMaker Node.
3. Connect the fiber-optic end-head to the receive bore of the OPM module installed on the Receiver of the Prisma II platform.
4. The receiver OPM module requires LC connector, conversion maybe needed.
5. Clean the LC connector's fiber-optic end-faces.

See the following Tip for a pointer to a fiber-optic inspection and cleaning white paper.

http://www.cisco.com/en/US/tech/tk482/tk876/technologies_white_paper09186a0080254eba.shtml

To Connect the EDR LCM for Status Monitoring

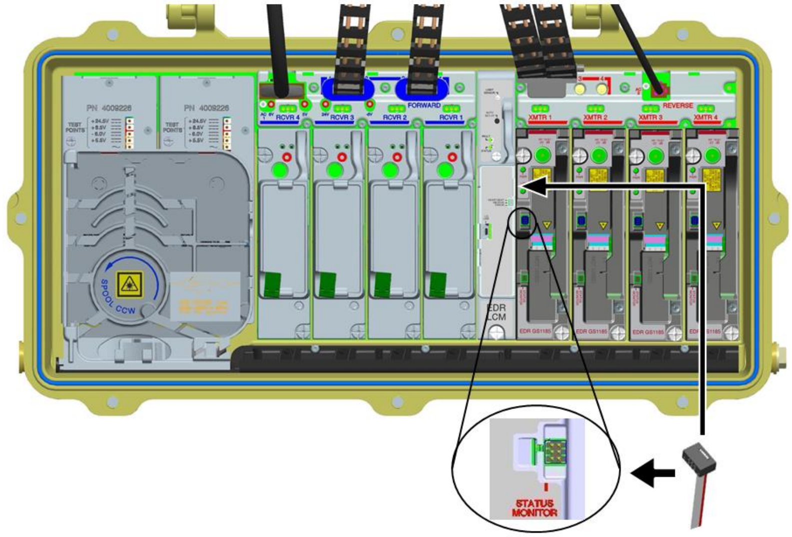
The LCM module is equipped with the interface ribbon cable. The cable can be used to connect the LCM module and the Status Monitor point of the desired EDR transmitter module for local status monitoring.

Note: Local Status monitoring supports one EDR transmitter module at a time.

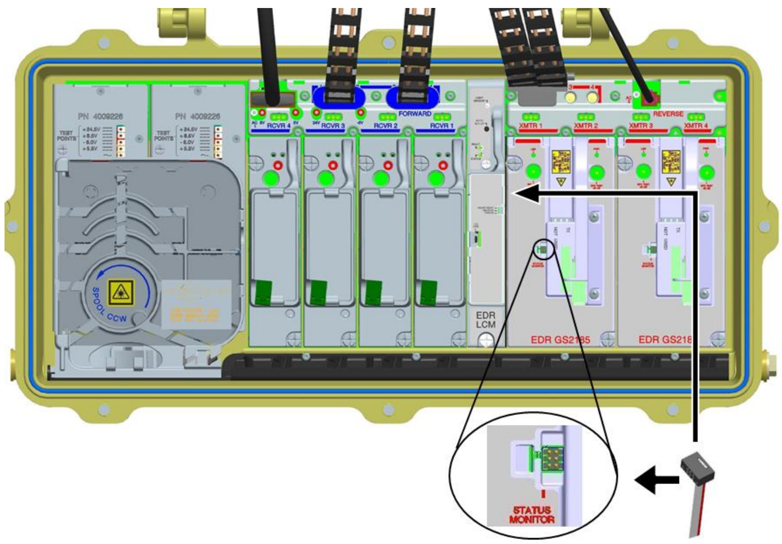
The following diagrams show how to connect the interface ribbon cable.

Note: Insert the cable head-end with the red marker on back.

When EDR 1:1 transmitter module is installed:



When EDR 2:1 transmitter module is installed:



Press the Auto Set-Up button on the LCM to initiate module discovery.

The Auto-Setup process typically takes up to 30 seconds.

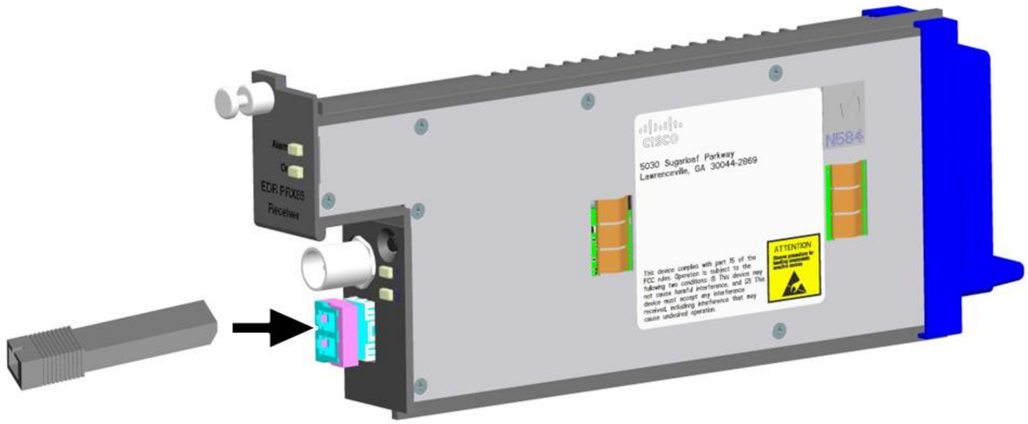
Note: Node data monitoring is only available for GS7000 Nodes with a transponder-less EDR LCM installed. The PC-based GS7000 ViewPort software is not available for GS7000 Node.

Installing the EDR Receiver

Refer to the ***Cisco Prisma II EDR Receiver Installation Guide***, part number 4044294, for detailed information on installing the EDR receiver module on the Prisma II.

To Install the OPM Module on the Receiver Module

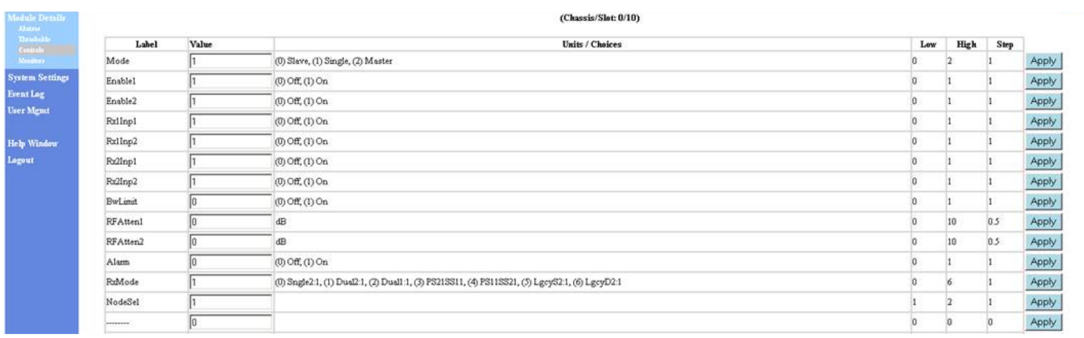
The following diagram shows the OPM module installed on the receiver module of the Prisma II.



To Configure the Receiver Mode

The receiver mode can be configured in the Web UI interface though connection with the Prisma II platform.

For complete configuration steps and setup precautions, refer to the **Cisco** ***Prisma II EDR Receiver Installation Guide***, part number OL-29646, and the ***Cisco Prisma II Platform Configuration Guide***, after system release 2.05.30, part number OL-27998.



Label	Value	Units / Choices	Low	High	Step	
Mode	1	(0) Slave, (1) Single, (2) Master	0	2	1	Apply
Enable1	1	(0) Off, (1) On	0	1	1	Apply
Enable2	1	(0) Off, (1) On	0	1	1	Apply
Rx1Inp1	1	(0) Off, (1) On	0	1	1	Apply
Rx1Inp2	1	(0) Off, (1) On	0	1	1	Apply
Rx2Inp1	1	(0) Off, (1) On	0	1	1	Apply
Rx2Inp2	1	(0) Off, (1) On	0	1	1	Apply
BwLimit	0	(0) Off, (1) On	0	1	1	Apply
RFAtten1	0	dB	0	10	0.5	Apply
RFAtten2	0	dB	0	10	0.5	Apply
Alarm	0	(0) Off, (1) On	0	1	1	Apply
RxMode	1	(0) Sngle2:1, (1) Dual2:1, (2) Dual1:1, (3) PS21SS11, (4) PS11SS21, (5) LgcyS2:1, (6) LgcyD2:1	0	6	1	Apply
NodeSel	1		1	2	1	Apply
--------	0		0	0	0	Apply

Transmitter Module Setup Procedure

Perform the following steps to set up the reverse transmitter module(s).

1. Open the housing according to ***Opening and Closing the Housing*** (on page 118).
2. In the base of the housing verify that the Reverse Configuration Module installed in the RF amplifier is correct for your application.

IF you have installed...	THEN the installed Reverse Configuration Module must be...
The minimum configuration of one 1:1 transmitter module in transmitter positions XMTR 1	an appropriate Reverse Configuration Module Refer to the RCM Section on page 40 for details.
The minimum configuration of one 2:1 transmitter module in transmitter positions XMTR 1/XMTR 2	an appropriate Reverse Configuration Module Refer to the RCM Section on page 40 for details.
The maximum configuration of two 2:1 transmitter modules in transmitter positions XMTR 1/XMTR 2 and XMTR 3/XMTR 4	an appropriate Reverse Configuration Module Refer to the RCM Section on page 40 for details.
The maximum configuration of four 1:1 transmitter modules in transmitter positions XMTR 1/XMTR 2 and XMTR 3/XMTR 4	an appropriate Reverse Configuration Module Refer to the RCM Section on page 40 for details.

3. Verify the level of the reverse path RF signal at the RF test points on the RF module. Nominal level is +15 dBmV per channel. Install the appropriate value input pad at the REV PORT IN PAD location to give the desired signal level into the node.
4. Repeat step 3 for each RF cable carrying a reverse path signal.
5. Measure the transmitter module(s) optical output power.
6. Check the connection of the optical connector. Make sure the optical connector is seated and verify fiber bend radius is greater than 1 inch.

WARNING:
When handling optical fibers always follow laser safety precautions.

EDR Transmitter Status Indicators

The transmitter module has two status indicator LEDs.

The following section describes the LED status and the correspondent indications. The input level overdrive indicates the input signal level exceeds the limit of 35 dBmV.

For EDR 1:1 transmitter module

The following table lists the LED status and the indicated OPM, and the overdrive status of the RF port.

LED		Indication	
Power (PWR)	Laser (LSR)	OPM Module	Port Input Overdrive
OFF	OFF	-	-
Green	Green	Cisco Standard OPM Module	No
Green	Orange (Solid)	Non-Cisco Standard OPM Module	No
Green	Orange (Blink)	Cisco Standard OPM Module/ Non-Cisco Standard OPM Module	Yes

For EDR 2:1 transmitter module

The following table lists the LED status and the indicated OPM, and the overdrive status of both RF port 1 and RF port 2.

LED		Indication		
Power (PWR)	Laser (LSR)	OPM Module	Port 1 Input Overdrive	Port 2 Input Overdrive
OFF	OFF	-	-	-
Green	Green	Cisco Standard OPM Module	No	No
Green	Orange (Solid)	Non-Cisco Standard OPM Module	No	No
Green	Orange (Blink)	Cisco Standard OPM Module	No	Yes
Orange (Blink)	Green	Cisco Standard OPM Module	Yes	No
Orange (Blink)	Orange (Solid)	Non-Cisco Standard OPM Module	Yes	No
Orange (Blink)	Orange (Blink)	Cisco Standard OPM Module	Yes	Yes

Reverse Balancing the Node with EDR

Introduction

This section explains the reverse balancing procedures for the GS7000 Node using EDR.

When balancing the reverse path, reference your system design print for the required reverse signal level. Use appropriate padding and equalization to provide proper signal level to the reverse transmitter.

CAUTION:
Never attempt to reconfigure the unit beyond its normal setup. Changes to the node's configuration may cause degradations that affect its performance. Do not use digital carrier measurement to set up the forward or reverse paths. Familiarize yourself with your cable system's specifications before performing the setup.

There are a variety of test equipment combinations that enable proper balancing of the reverse path. Regardless of the type of equipment used, the balancing process is fundamentally the same. A reverse RF test signal (or signals) of known amplitude is injected into the RF path at the RF input of the node. The reverse transmitter converts the RF test signal(s) to an optical signal and transmits it to the headend (or hub site) via fiber optic cable. At the headend, the reverse optical receiver converts the optical signal back to an RF signal that is then routed out through the receiver's RF output. The amplitude of the injected test signal must be monitored at the receiver's output, and compared to the expected (design value) amplitude.

Method of Generating and Monitoring Test Signals

The reverse RF test signals that are injected into the reverse path of the RF launch amplifier being balanced may be generated by the following method.

- Multiple CW signal (tone) generator
- Reverse sweep transmitter

The amplitude of the received test signals at the output of the reverse optical receiver in the headend or hub may be measured and monitored using the following:

- Spectrum analyzer (when using a CW generator for test signals)
- Signal level meter (when using a CW generator for test signals)
- Reverse sweep receiver (when using a reverse sweep transmitter for test signal)

The variance in relative amplitude of the received signal from desired (reference) may be relayed to the field technician via the following:

- Radio (by a second technician in the headend/hub who is monitoring a spectrum analyzer or signal level meter)
- A dedicated forward TV channel, whose associated modulator has its video input being generated by a video camera focused on the spectrum analyzer display
- An associated forward data carrier (if using a particular type of reverse sweep system)

If a portable reverse sweep generator with built-in forward data receiver is used to generate the reverse test signals, only one technician is required to perform the balancing. This type of system is becoming increasingly popular due to its ease of use.

In this case, the sweep system includes a combination reverse sweep receiver and forward data transmitter, which is located in the headend/hub. The frequency response characteristics of the received sweep signal (including relative amplitude and tilt) are converted by the headend sweep receiver to a data format, and transmitted in the forward RF path as a data carrier (by combining it into the forward headend combiner). The portable sweep generator/data receiver that is injecting the test signal into the RF launch amplifier's reverse path in the field is simultaneously receiving the incoming data carrier via the forward RF path. The incoming data is converted back to a sweep display that represents what is being received by the headend unit.

Reverse Balancing and Alignment Procedure

Overview

Digital Return technology is designed to have a constant link gain, regardless of the length of fiber or amount of passive optical loss in the link. That is, if the RF signal amplitude of all ports in all nodes is set to a constant value, the signal level at the output of the receiver will be balanced automatically to a constant power level. Minor differences in levels can be trimmed out at the receiver with no penalty to link performance.

Balancing and Alignment

Follow these steps to reverse balance and align the node with EDR.

1 Refer to the reverse system design print on the RF amplifier assembly cover and inject the proper level into the forward output test point of a port of the RF launch amplifier with a reverse sweep transmitter or a CW signal generator. The insertion

loss of all forward output test points is 20 dB (relative to corresponding port).

Note: For the location of the forward output test point of each port, see ***RF Assembly*** (on page 90).

Important: To calculate the correct signal level to inject, add the reverse input level (from the design print) to the insertion loss of the forward output test point.

Formula:

Reverse input + Insertion loss = Signal generator setting

Example:

Reverse input = 15 dBmV

Insertion loss = 20 dB

Result: Signal generator setting=15 dBmV + 20 dB = 35 dBmV

Note: The ADC full-scale (100%) level for a single CW carrier is +33 dBmV. This is the level at which the ADC begins clipping.

Note: The reverse attenuator (pad) and reverse equalizer in the GS7000 Node is selected during the reverse system design, and it is based on the drive level into the digital module which is determined by system performance requirements, type and quantity of return carriers, etc. Consult data sheet to determine proper operational level.

2. Verify the level of the reverse output test point. This output level leaves the RF launch amplifier via the coaxial cable to the multiplexing digital module input. (Use an SMB connector to F-connector test cable.)
3. Have the person in the headend refer to the headend system design and set the output of the receiver to the specified output level. See the instruction guide that was shipped with receiver for setup procedures.

Troubleshooting

Equipment

The following equipment may be necessary to perform some troubleshooting procedures.

- Cisco fiber optic ferrule cleaner, part number 468517, to clean fiber optic connectors
- Cisco 99% alcohol and lint free wipes to clean fiber connectors
- Optical power meter to measure light levels
- Proper fiber connector for optical power meter to make optical connections
- Digital voltmeter to measure voltages
- Spectrum analyzer or a field strength meter to measure RF levels
- Cisco test probe, part number 501111, to access test points
- Cisco external test probe, part number 562580, to access external test points

Transmitter Module Troubleshooting Chart

Follow the steps in the table below to troubleshoot the transmitter module on LED signaling. The following steps indications and solutions apply to both EDR 1:1 and 2:1 transmitter modules.

Follow the steps in the table below to troubleshoot the transmitter module on LED signaling.

For EDR 1:1 Transmitter Module

LED Warning		**Indication**	**Possible Solutions**
PWR	**LSR**		
OFF	OFF	No power supply.	Verify the power supply of the node with the transmitter installed. Verify that connectors of the transmitter are clicked into the interface connectors in the transponder slot. If still no power supply, contact the Cisco Technical Service Center for assistance.
Green	Orange (Solid)	Non-Cisco Standard OPM Module is installed.	No need for troubleshooting. Cisco Standard OPM Module is highly recommended for better system performance and stability. See the data sheet of the node for ordering information.
Green	Orange (Blink)	Input Level Overdrive.	Verify the input level of RF port. The output level overdrive indicates the output signal level exceeds the limit of 35 dBmV.

For EDR 2:1 Transmitter Module

LED Warning		Indication	Possible Solutions
PWR	**LSR**		**PWR**
OFF	OFF	No power supply.	Verify the power supply of the node with the transmitter installed. Verify that connectors of the transmitter are clicked into the interface connectors in the transponder slot. If still no power supply, contact the Cisco Technical Service Center for assistance.
Green	Orange (Solid)	Non-Cisco Standard OPM Module is installed.	No need for troubleshooting. Cisco Standard OPM Module is highly recommended for better system performance and stability. See the data sheet of the node for ordering information.
Green	Orange (Blink)	Input Level Overdrive.	Verify the input level of RF port 2. The output level overdrive indicates the output signal level exceeds the limit of 35 dBmV.
Orange (Blink)	Green	Non-Cisco Standard OPM Module is in use.	Verify the input level of RF port 1. The output level overdrive indicates the output signal level exceeds the limit of 35 dBmV.
Orange (Blink)	Orange (Solid)	Non-Cisco Standard OPM Module is in use. Output Level Overdrive.	Verify the input level of RF port 1. The output level overdrive indicates the output signal level exceeds the limit of 35 dBmV. Cisco Standard OPM Module is highly recommended for better system performance and stability. See the data sheet of the node for ordering information.

Orange (Blink)	Orange (Blink)	Non-Cisco Standard OPM Module is in use. Input Level Overdrive.	Verify the input level of RF port 1. The output level overdrive indicates the output signal level exceeds the limit of 35 dBmV. Verify the input level of RF port 1. The output level overdrive indicates the output signal level exceeds the limit of 35 dBmV. Cisco Standard OPM Module is highly recommended for better system performance and stability. See the data sheet of the node for ordering information.

Follow the steps in the table below to troubleshoot the transmitter module.

Symptom	Possible Cause	Possible Solutions
No optical signal output	Laser temperature could be too high or low.	Allow up to one minute after power is ON for the temperature to stabilize. If still no output, contact the Cisco Technical Service Center for assistance.
	Laser could be faulty.	Contact the Cisco Technical Service Center for assistance.
	Automatic power control circuit failure.	Contact the Cisco Technical Service Center for assistance.
	Damaged fiber.	Contact the Cisco Technical Service Center for assistance.

Symptom	Possible Cause	Possible Solutions
No optical signal output (cont'd)	One or more power supply voltages are out of specification.	Check the power supply for proper operation.
	No AC at receptacle.	Check the receptacle for AC power.
	Blown fuse on the power supply.	Check the power supply fuse and replace as necessary.
	Faulty module.	Contact the Cisco Technical Service Center for assistance.

C

Expanded Fiber Tray

Introduction

This appendix explains the installation and configuration of the GS7000 Node expanded fiber tray.

In This Appendix

Expanded Fiber Tray Overview

Introduction

The expanded fiber tray is an optional replacement for the standard fiber tray in the GS7000 Node. The expanded fiber tray provides additional space for fiber management/storage and the installation of additional bulkhead adaptors. The expanded fiber tray also provides the space for the installation of various passive devices such as CWDM and OADM cassettes and raw WDM cartridges.

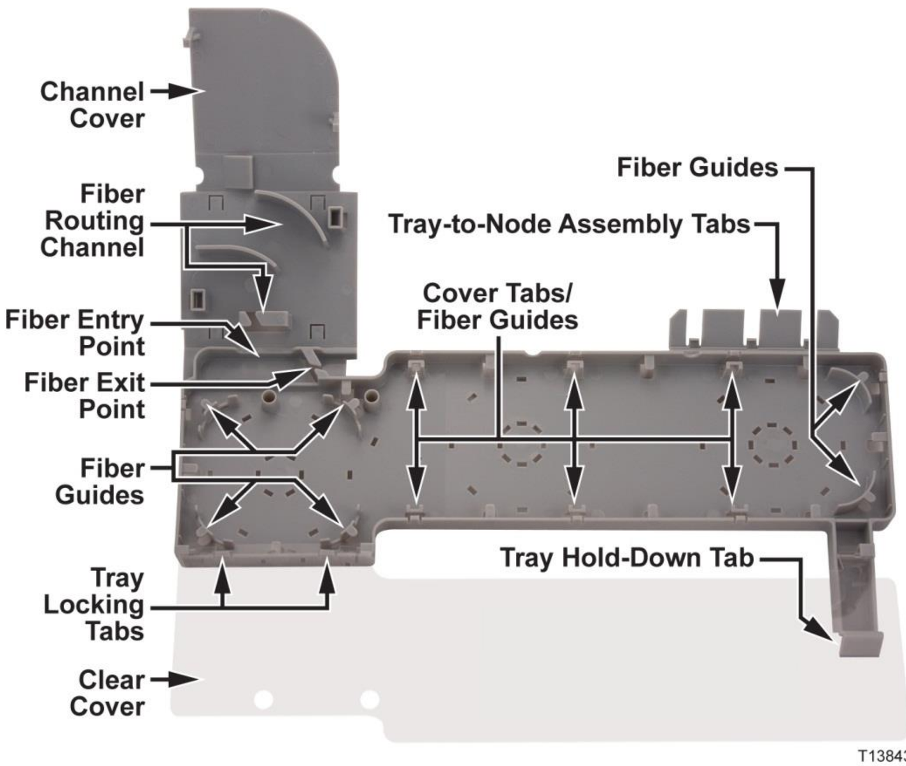
Features

The expanded fiber tray provides the following features:

- Design allows for configuration flexibility.
- Built-in fiber guides and tabs aid management of slack fiber and maintenance of minimum bend radiuses.
- Accommodates most commercially available optical passive devices.
- Circular indexed slot pattern in tray base allows flexibility in mounting components.
- Custom mounting clips provided to secure various components in tray.
- Tray design facilitates additional securing of fibers and components with Velcro straps.

Tray Components

The following illustration shows the unassembled expanded fiber tray components.



Expanded Fiber Tray Installation

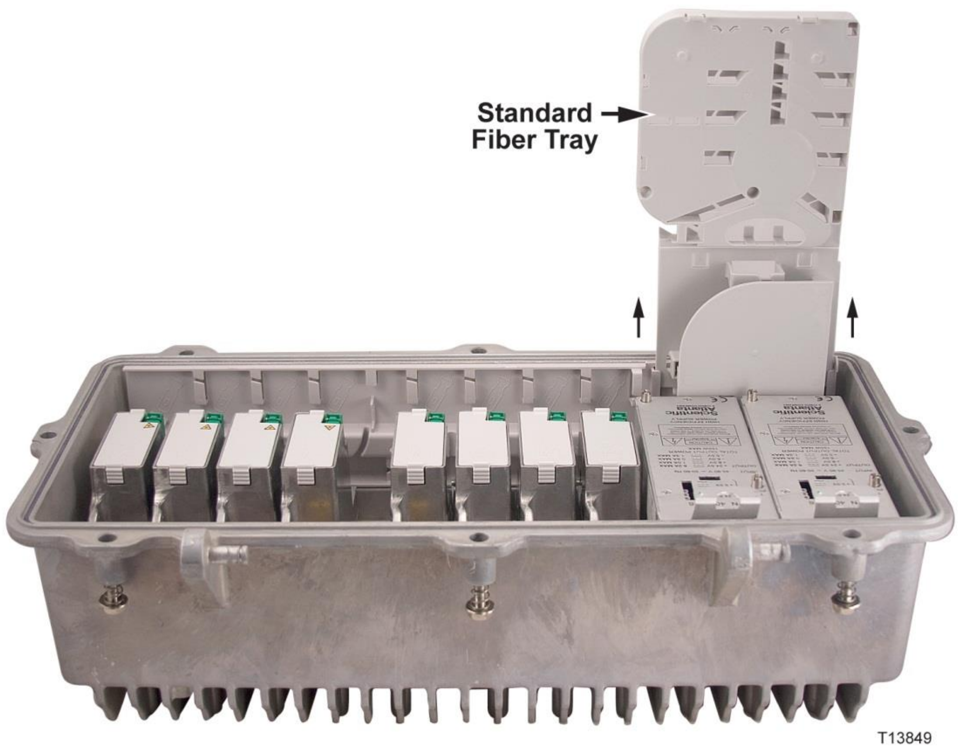
Installation Procedure

Perform the following steps to install the expanded fiber tray in the node.

1 If you are replacing a standard fiber tray in an existing node, go to step 2.

If you are not replacing a standard fiber tray, go to step 3.

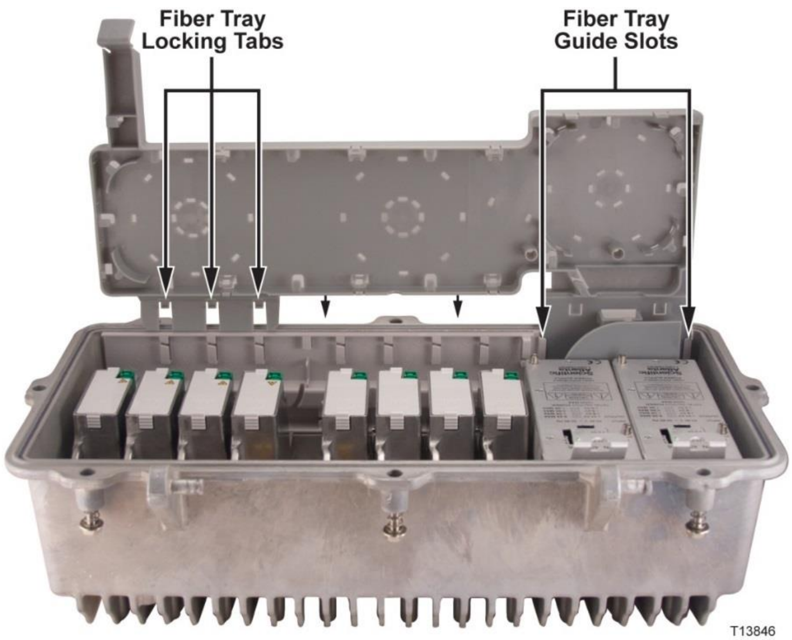
2 Remove any installed fibers from the existing standard fiber tray and then remove the fiber tray from the node by pulling up on the fiber tray assembly as shown in the following illustration.



3 Make sure that the expanded fiber tray clear cover is secured in place on the fiber tray.

Note: Push down on the cover at the cover locking tabs around the periphery of the fiber tray to secure the cover.

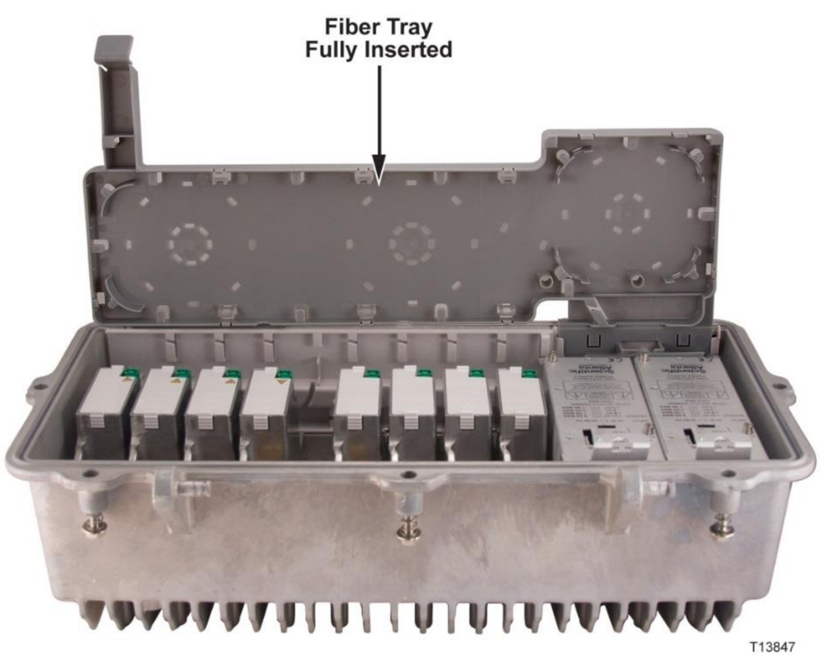
4 Insert the expanded fiber tray part way into the node lid as shown in the following illustration.



Important:

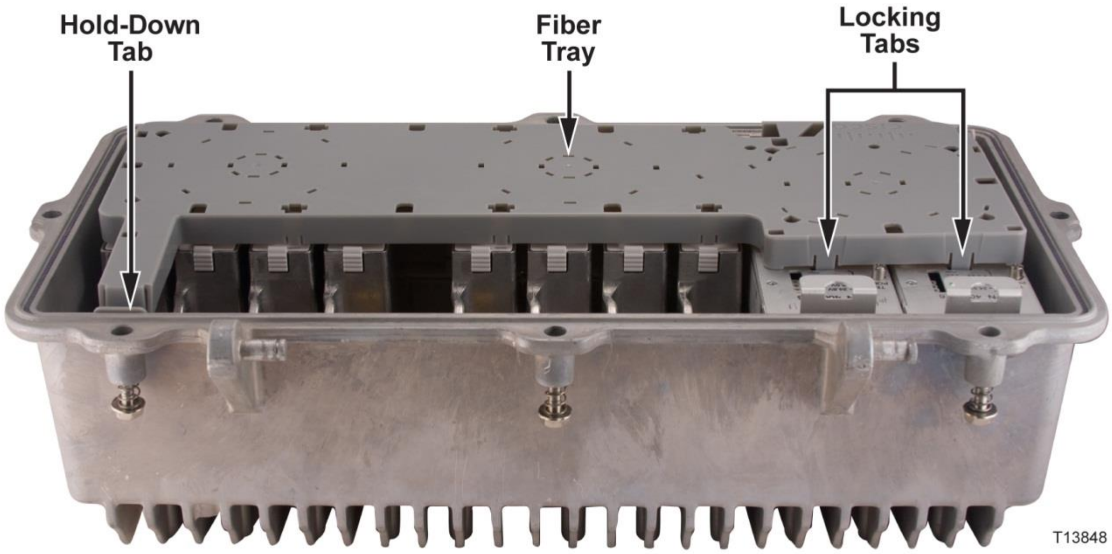
- Make sure that the fiber tray fits into the two guide slots in the fiber track near the power supplies.
- Make sure that the fingers and locking tabs on the other end of the fiber tray are inserted between the fiber track and the aluminum node housing.

5 Push down on the fiber tray housing until the fiber tray snaps into place and is fully inserted into the node as shown in the following illustration.



6 Pivot the fiber tray down and snap it into place on top of the power supplies with its

locking tabs and in the node lid with its hold-down tab as shown in the following illustration.



Fiber Management System

Overview

The fiber management system is made up of a fiber tray and a fiber routing track. The fiber tray provides a convenient location to mount passive devices and store excess fiber. The tray is hinged to allow it to move out of the way during the insertion of the fibers and for installation or replacement of the various node modules. The fiber routing track provides a channel for routing fiber pigtails to their appropriate optical modules as well as a location to snap in unused fiber connectors for storage.

The expanded fiber tray provides various clips to hold passive devices and bulkhead adaptors neatly in the tray while providing easy access. An indexed pattern of mounting slots in the tray allows you to install a variety of components in the tray in various configurations. Several features are incorporated into the tray to provide fiber protection and aid in maintaining the proper bend radius of the fiber. A sheet of blank, stick-on, labels is also included for use in identifying the installed components and configuration.

Quality fiber management focuses on four key areas, as follows:

- Maintaining fiber bend radius
- Proper fiber routing
- Connectors and bulkhead access
- Fiber protection

These topics are discussed in detail in the next sections.

Maintaining Fiber Bend Radius

Observe the following considerations regarding fiber bend radius:

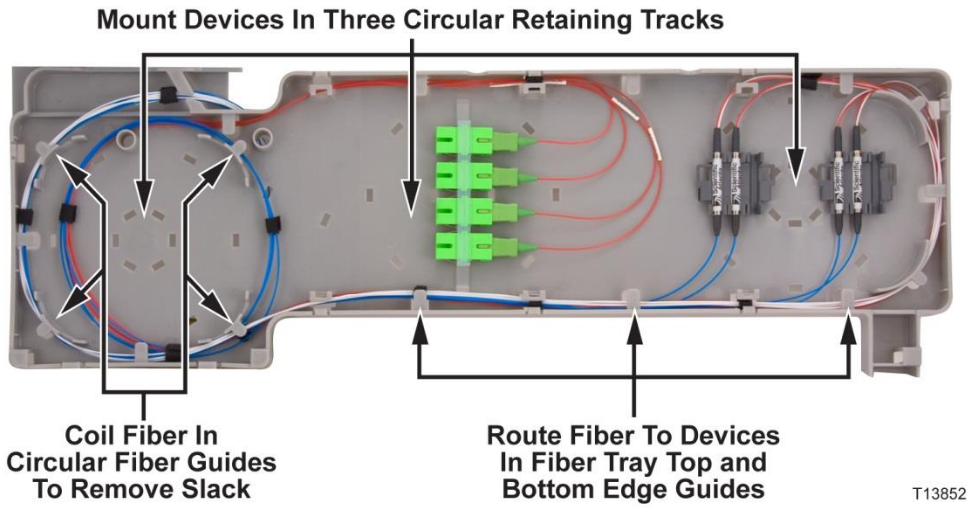
- Bent fibers can induce higher losses that can lead to signal degradation and service disruption.
- Current industry standards call for a minimum bend radius of 1.5 inches (38 mm).
- Using bend insensitive fiber, as defined in ITU-T G.657.A, can allow for a smaller bend radius. However, this does not diminish the need to control fiber bends.
- The expanded fiber tray provides several guide walls for spooling and routing fiber. Use these guides to maintain the bend radius of the fiber.

Proper Fiber Routing

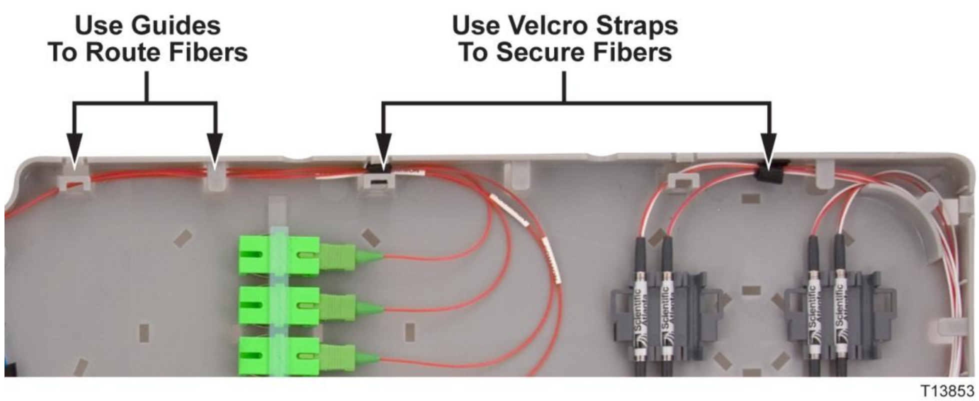
Observe the following considerations regarding fiber routing:

- Poor fiber routing is a major cause of bend radius violations.

- Proper fiber routing provides well-defined paths, making it easier to access individual fibers.
- Easy to follow paths aid technicians in performing fiber tracing, testing, and reconfiguration.
- When fiber is not managed, slack fiber tends to become entangled, making tracing and rearrangement difficult.
- The expanded fiber tray provides fiber guides to contain slack fiber. Slack fiber can be coiled in a circular fashion using the guides on the left side of the tray, or by routing through the guides on the outer edge of the tray.



- The FIBER guides are designed to allow Velcro tie-down straps to be looped through the posts to further maintain neat fiber placement.



Connector and Bulkhead Access

Observe the following considerations regarding connector and bulkhead access:

- Connector access is critical for reconfiguration, testing, maintenance, and troubleshooting.
- The expanded fiber tray provides a clip which can accommodate up to four SC-type bulkhead adapters, and a smaller clip which can hold up to two SC-type bulkhead adapters.
- The clips can be placed in any one of the three circular retaining tracks in various orientations.

Fiber Protection

Observe the following considerations regarding fiber protection:

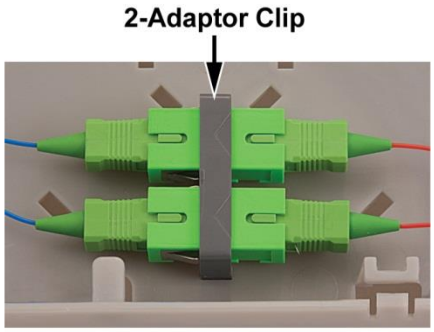
- Fibers are subject to serious damage from mishandling that can cause pinching and bending of the fiber beyond its capabilities.
- The expanded fiber tray comes with a clear protective cover. After fibers have been properly routed in the tray, the cover should be closed and locked in position with the locking tabs before stowing the tray in the node.
- Always route fibers in the tray using the fiber guides located about the tray periphery. This will retain the fiber within the tray and prevent inadvertent displacement or pinching of the cable when opening or closing the node.
- The mounting surface of the tray faces downward in the stowed position and upwards when the tray is in the access position, thereby discouraging inadvertent contact with the fibers and passive devices.

Passive Device and Bulkhead Mounting

Mounting clips are provided for installing available passive devices and bulkhead adaptors. These clips can be used to mount devices in various orientations in any of the three circular retaining tracks in the expanded fiber tray. The following illustrations show the available mounting clips.

2-Adaptor Clip

The following illustration shows a 2-adaptor clip for bulkhead adaptors.



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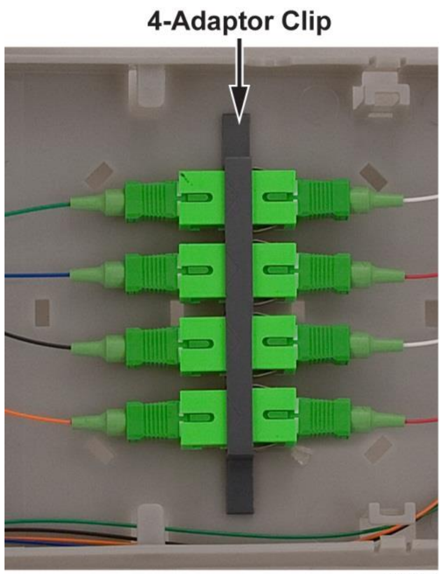
4-Adaptor Clip

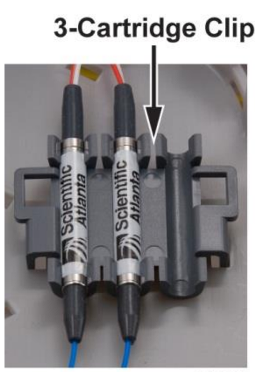
The following illustration shows a 4-adaptor clip for bulkhead adaptors.



T13839

3-Cartridge Clip

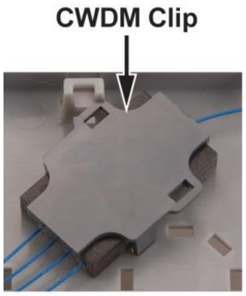
The following illustration shows a 3-cartridge clip holding raw WDM cartridges.



T13840

CWDM Clip

The following illustration shows a CWDM clip.



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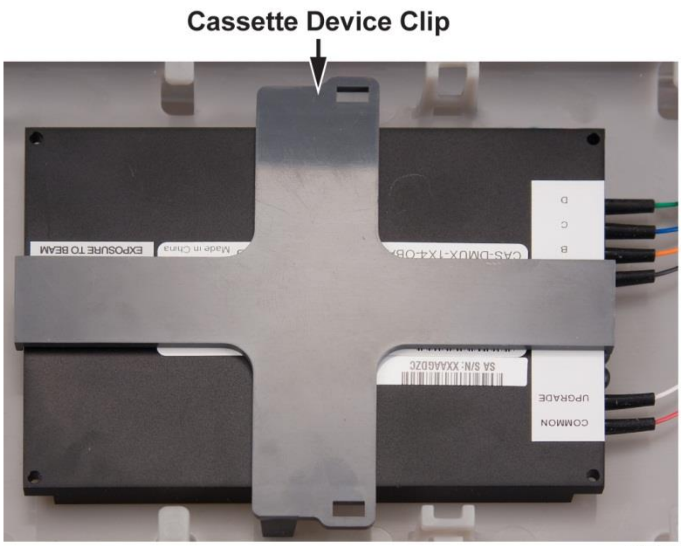
Cassette Device Clip

The following illustration shows a cassette device clip holding a demultiplexer.



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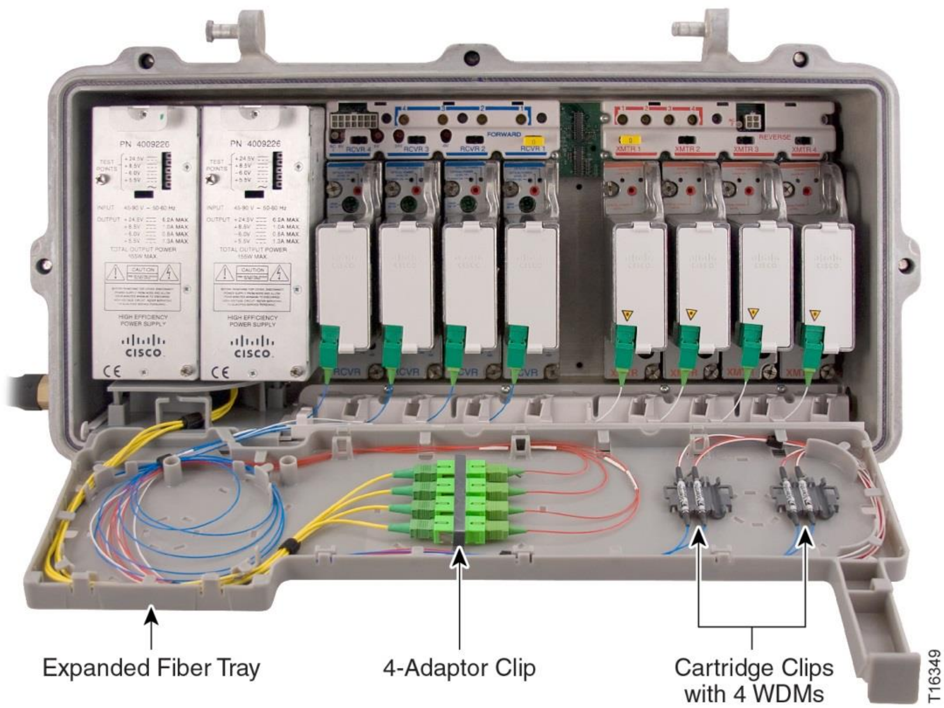
Fiber Installation

For general instructions on installing and routing the fiber optic cables in the node, refer to the ***Fiber Optic Cable Installation*** (on page 72).

Configuration Examples

WDM Configuration Example

The following illustration shows a cartridge style WDM configuration of the expanded fiber tray.

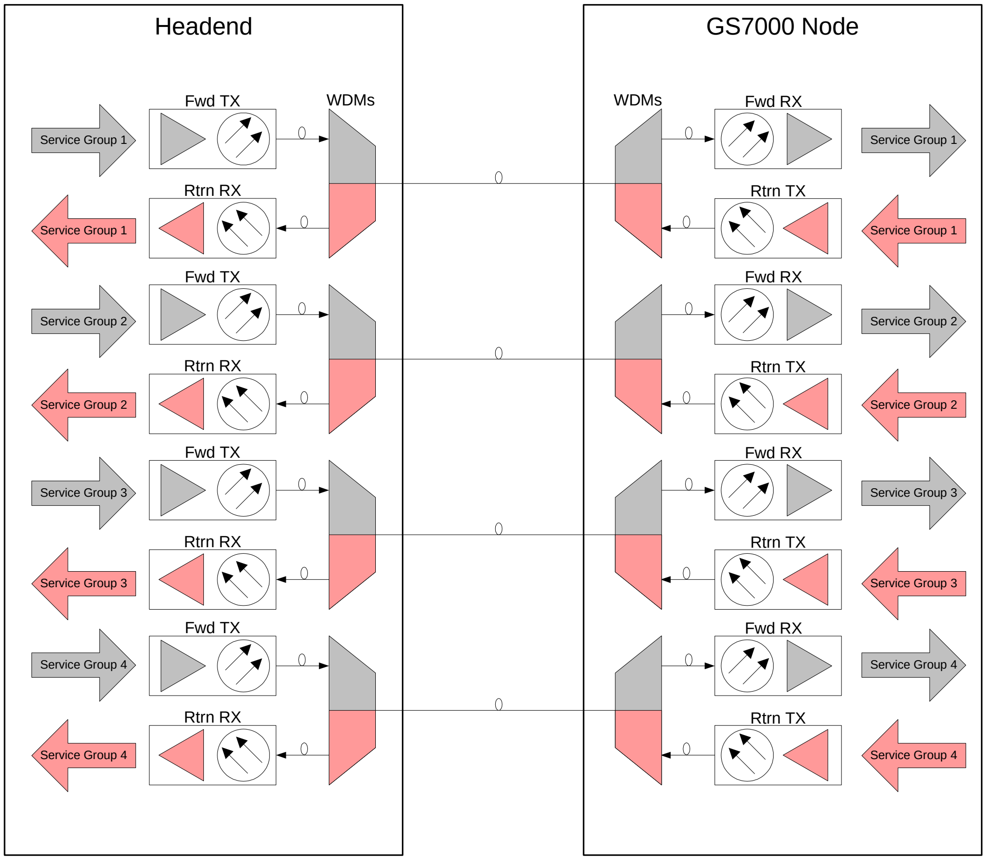


This application is used to fully segment the GS7000 4-Port Node when limited fiber counts are available, or as means to conserve fibers for future use.

The GS7000 Node comes with several optical module options to help you combine 3x3, and 4x4 forward and return segments utilizing coarse wave division multiplexing (CWDM), dense wave division multiplexing (DWDM), and available analog or digital laser options.

With the use of four 1310 nm/1550 nm WDMs or four 1310 nm CWDMs installed in the node's expanded fiber tray, the 1310 nm forward path signals can be combined with the DWDM or CWDM return signals to achieve full 4x4 segmentation with half the quantity of fibers.

Note: This solution requires WDM modules at headend as shown in the following illustration.



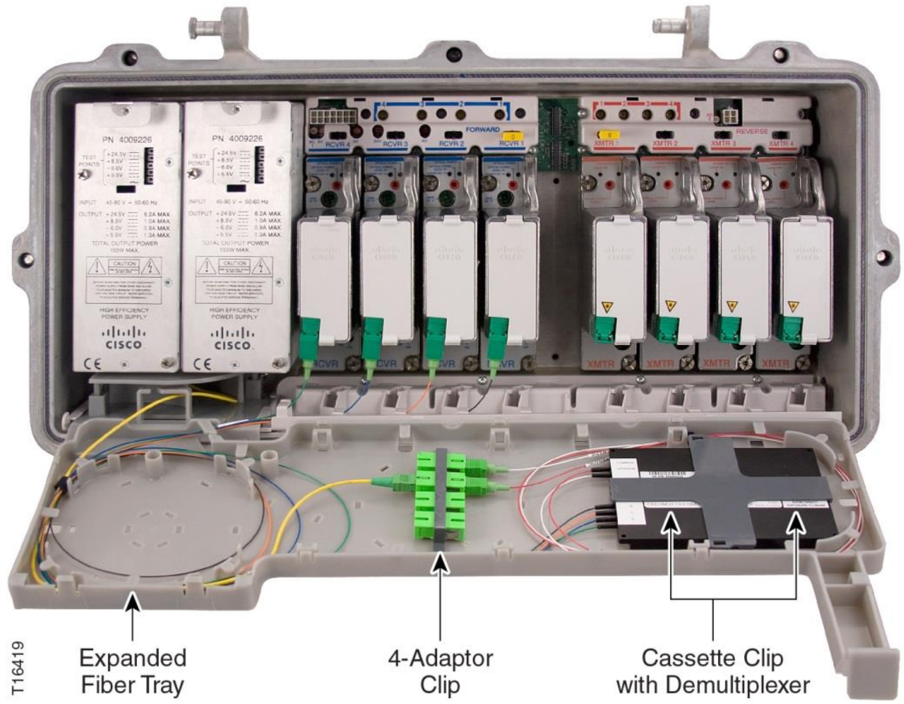
Multi-Wave O-Band Demultiplexer Configuration Example

As the demand for bandwidth continues to grow and clusters of homes decrease into smaller serving areas, networks can become capacity constrained or "fiber starved." A cost-effective approach to solving this problem uses multiple wavelengths on a single fiber.

The Prisma II™ Multi-Wavelength (O-Band) system solution enables dramatic bandwidth increase over a single optical fiber. This system uses forward transmitters capable of co-propagating multiple wavelengths in the 1320 nm to 1335 nm window down a single fiber using wavelength division multiplexing (WDM), with each transmitter carrying a full RF load.

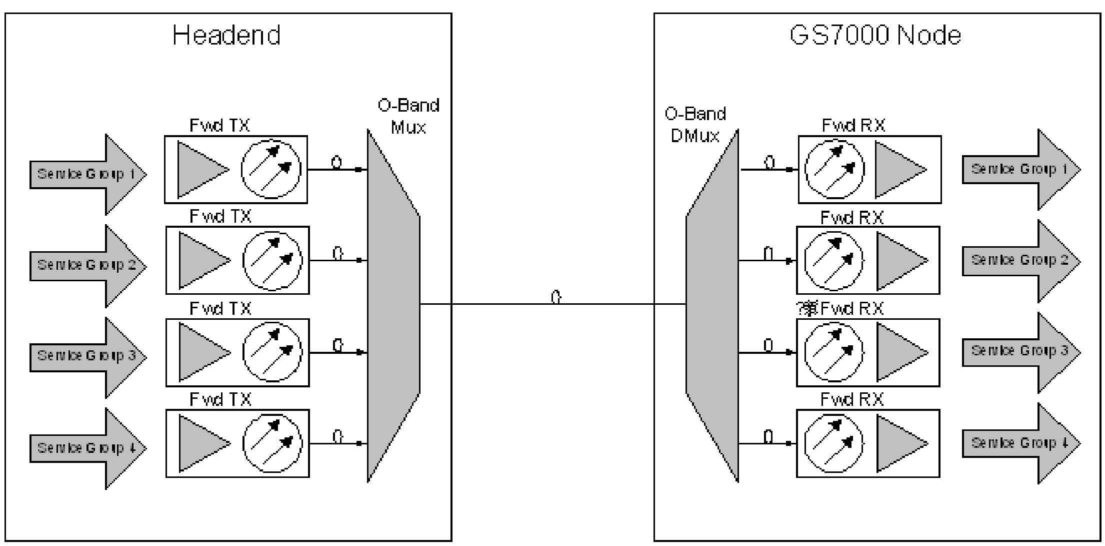
The multi-wavelength solution is ideal for segmentation of node service areas because they enable the reuse of existing fiber up to six times, over distances of up to 30 kilometers.

The following illustration shows a cassette style O-Band demultiplexer configuration of the expanded fiber tray.



Using the O-Band demultiplexer in the expanded fiber tray, the four multiplexed 13xx multi-wave forward path signals are demultiplexed and feed into the four individual receiver modules to achieve 4x forward segmentation with a single fiber.

Note: This solution requires an O-Band multiplexer at the headend as shown in the following illustration.



Glossary

A

ampere. A unit of measure for electrical current.

ac, AC

alternating current. An electric current that reverses its direction at regularly recurring intervals.

AC/RF

alternating current radio frequency.

AFC

automatic frequency control. An arrangement whereby the tuning of a circuit is automatically maintained within specified limits with respect to a reference frequency.

AGC

automatic gain control. A process or means by which gain is automatically adjusted in a specified manner as a function of input level or other specified parameters.

AMPL

amplitude.

amplifier cascade

two or more amplifiers in a series, the output of one feeding the input of another.

attenuation

The difference between transmitted and received signal strength due to loss through equipment, lines, or other transmission medium. Usually expressed in decibels.

attenuator

A passive device designed to reduce signal strength without distorting the waveform. Usually specified in dB.

AUX

auxiliary.

baseband

The original band of frequencies occupied by the signal before it modulates the carrier frequency to form the transmitted signal. Characteristic of any network technology that uses a single carrier frequency and requires all stations attached to the network to participate in every transmission.

baud (Bd)

A measure of signaling rate based on the number of signaling events per unit of time.

beamwidth

The included angle between two rays (usually the half-power points) on the radiation pattern, which includes the maximum lobe, of an antenna.

BIOS

basic input/output system.

blanking level

The amplitude of the front and back porches of the composite video signal. The blanking level separates the range containing picture information from the range containing synchronization information.

BNC

A coaxial connector that uses two bayonet lugs on the side of the female connector. BNC stands for Bayonet Neill Concelman and is named after Amphenol engineer Carl Concelman.

BPF

bandpass filter.

BW

bandwidth. A measure of the information-carrying capacity of a communications channel, for example the range of usable frequencies that can be carried by a CATV system. The bandwidth corresponds to the difference between the lowest and highest frequency that can be carried by the channel.

C/N or CNR

carrier-to-noise ratio. The ratio, in decibels, of the carrier to that of the noise in a receiver's IF bandwidth after specified band limiting and before any nonlinear process such as amplitude limiting and detection takes place.

C/T

carrier-to-noise temperature ratio.

CISC

Complex Instruction Set Computer. A computer that uses many different types of instructions to conduct its operations, i.e., IBM PCs, Apple Macintosh's, IBM 370 mainframes.

compression

The non-linear change of gain at one level of a signal with respect to the change of gain at another level for the same signal. Also, the elimination of redundant information from an audio, data, or video signal to reduce transmission requirements.

CW

continuous wave.

CWDM

coarse wave-division multiplexing. CWDM allows a modest number of channels, typically eight or less, to be stacked in the 1550 nm region of the fiber called the C-Band. This capacity is greater than WDM (wave-division multiplexing) and lesser than DWDM (dense wave-division multiplexing).

dB

decibel. One tenth of a bel, the number of decibels denoting the ratio of two amounts of power being ten times the common logarithm of this ratio.

dBc

decibels relative to a reference carrier.

dBi

decibels of gain relative to an isotropic radiator.

dBm

decibels relative to 1 milliwatt.

dBmV

decibels relative to 1 millivolt.

dBuV

decibels relative to 1 microvolt.

dBW

decibels relative to 1 watt.

DC

directional coupler.

dc, DC

direct current. An electric current flowing in one direction only and substantially constant in value.

deviation

The peak difference between the instantaneous frequency of the modulated wave and the carrier frequency, in an FM system.

differential gain

The difference in amplification of a signal (superimposed on a carrier) between two different levels of carrier.

diplex filter

A filter which divides the frequency spectrum into a high frequency segment and a low frequency segment so that two different signals can be sent down the same transmission path.

distribution

The activities associated with the movement of material, usually finished products or service parts, from the manufacturer to the customer.

distribution system

The part of a CATV system consisting of the transmission medium (coaxial cables, fiber optic cables, etc.) used to carry signals from the headend system to subscriber terminals.

DSP

digital signal processor.

duplexer

A device which permits the connection of both a receiver and a transmitter to a common antenna.

DVM

digital voltmeter.

DWDM

dense wave-division multiplexing. A method of placing multiple wavelengths of light into a single fiber that yields higher bandwidth capacity. Dense WDM indicates close spacing and more than 4 to 8 wavelengths.

EC

European Community.

EEPROM

electrically erasable programmable read-only memory.

EMC

electromagnetic compatibility. A measure of equipment tolerance to external electromagnetic fields.

emission designer

An FCC or CCIR code that defines the format of radiation from a transmitter.

EPROM

erasable programmable read-only memory.

EQ

equalizer.

equalization

The process of compensating for an undesired result. For example, equalizing tilt in a distribution system.

ERP

effective radiated power.

ESD

electrostatic discharge. Discharge of stored static electricity that can damage electronic equipment and impair electrical circuitry, resulting in complete or intermittent failures.

FCM

forward configuration module.

FET

field-effect transistor. A transistor in which the conduction is due entirely to the flow of majority carriers through a conduction channel controlled by an electric field arising from a voltage applied between the gate and source electrodes.

FM

frequency modulation. A transmission technique in which the frequency of the carrier varies in accordance with the modulating signal.

frequency

The number of similar shapes in a communications or electrical path in a unit of time. For example, the number of sine waves moving past a fixed point in a second.

frequency agile

The ability to change from one frequency to another without changing components.

frequency response

The effect that changing the frequency has on the magnitude of a signal.

ft-lb

foot-pound. A measure of torque defined by the application of one pound of force on a lever at a point on the lever that is one foot from the pivot point.

gain

A measure of the increase in signal level, relative to a reference, in an amplifier. Usually expressed in decibels.

Hertz

A unit of frequency equal to one cycle per second.

HFC

hybrid fiber/coaxial. A network that uses a combination of fiber optics and coaxial cable to transport signals from one place to another. A broadband network using standard cable television transmission components, such as optical transmitters and receivers, coaxial cable, amplifiers, and power supplies. The broadband output stream is transmitted as an optical signal, over the high-speed, fiber optic transmission lines to local service areas where it is split, converted to electrical RF signals, and distributed to set-tops over coaxial cable.

I/O

input/output.

IC

integrated circuit.

IEC

International Electro-technical Commission.

IF

intermediate frequency. The common frequency which is mixed with the frequency of a local oscillator to produce the outgoing radio frequency (RF) signal.

in-lb

inch-pound. A measure of torque defined by the application of one pound of force on a lever at a point on the lever that is one inch from the pivot point.

ITU

International Telecommunications Union.

LE

line extender.

LED

light-emitting diode. An electronic device that lights up when electricity passes through it.

LNC

low-noise converter.

Mbps

megabits per second. A unit of measure representing a rate of one million bits (megabits) per second.

multipath, multipath transmission

The phenomenon which results from a signal traveling from point to point by more than one path so that several copies of the signal arrive at the destination at different times or at different angles.

Nm

Newton meter. A measure of torque defined by the application of one Newton of force on a lever at a point on the lever that is one meter from the pivot point. (1 Nm = 0.737561 ft-lb)

OIB

optical interface board.

PCB

printed circuit board.

PROM

programmable read-only memory. A memory chip on which data can be written only once. Once data has been written onto a PROM, it cannot be written to again.

PWB

printed wiring board.

QAM

quadrature amplitude modulation. An amplitude and phase modulation technique for representing digital information and transmitting that data with minimal bandwidth. Both phase and amplitude of carrier waves are altered to represent the binary code. By manipulating two factors, more discrete digital states are possible and therefore larger binary schemes can be represented.

QPSK

quadrature phase-shift keying. A phase modulation technique for representing digital information. QPSK produces four discrete states, each state representing two bits of information.

RCM

reverse configuration module.

RCVR

receiver.

reverse path

Signal flow direction toward the headend.

RF

radio frequency. The frequency in the portion of the electromagnetic spectrum that is above the audio frequencies and below the infrared frequencies, used in radio transmission systems.

RFI

radio frequency interference.

RMA

return material authorization. A form used to return products.

RX

receive or receiver.

S/N or SNR

signal-to-noise ratio. The ratio, in decibels, of the maximum peak-to-peak voltage of the video signal, including synchronizing pulse, to the root-mean-square voltage of the noise. Provides a measure and indication of signal quality.

SA

system amplifier.

SM

status monitor.

SMC

status monitoring and control. The process by which the operation, configuration, and performance of individual elements in a network or system are monitored and controlled from a central location.

SMIU

status monitor interface unit.

SNMP

simple network management protocol. A protocol that governs network management and the monitoring of network devices and their functions.

synchronous transmission

A transmission mode in which the sending and receiving terminal equipment are operating continuously at the same rate and are maintained in a desired phase relationship.

torque

A force that produces rotation or torsion. Usually expressed in lb-ft (pound-feet) or N-m (Newton-meters). The application of one pound of force on a lever at a point on the lever that is one foot from the pivot point would produce 1 lb-ft of torque.

TX

transmit or transmitter.

UPS

un-interruptible power supply.

uV

microvolt. One millionth of a volt.

V

volt.

W

watt. A measure of electrical power required to do work at the rate of one joule per second. In a purely resistive load, 1 Watt = 1 Volt x 1 Amp.

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