



1 GHz GainMaker Broadband Amplifier Platform Line Extender Modules and Housings 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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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

Important Safety Instructions

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.

Connecting to Utility AC Power

Important: If this equipment is a Class I equipment, it must be grounded.

- If this equipment plugs into an outlet, the outlet must be near this equipment, and must be easily accessible.
- Connect this equipment only to the power sources that are identified on the equipment-rating label, which is normally located close to the power inlet connector(s).
- This equipment may have two power sources. Be sure to disconnect all power sources before working on this equipment.
- If this equipment **does not** have a main power switch, the power cord connector serves as the disconnect device.
- Always pull on the plug or the connector to disconnect a cable. Never pull on the cable itself.

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.

Grounding (Utility AC Powered Equipment in Pedestals, Service Closets, etc.)

This section provides instructions for verifying that the equipment is properly grounded.

Safety Plugs (USA Only)

This equipment is equipped with either a 3-terminal (grounding-type) safety plug or a 2-terminal (polarized) safety plug. The wide blade or the third terminal is provided for safety. Do not defeat the safety purpose of the grounding-type or polarized safety plug.

To properly ground this equipment, follow these safety guidelines:

- **Grounding-Type Plug** - For a 3-terminal plug (one terminal on this plug is a protective grounding pin), insert the plug into a grounded mains, 3-terminal outlet.

Note: This plug fits only one way. If this plug cannot be fully inserted into the

Important Safety Instructions

outlet, contact an electrician to replace the obsolete 3-terminal outlet.

- **Polarized Plug** - For a 2-terminal plug (a polarized plug with one wide blade and one narrow blade), insert the plug into a polarized mains, 2-terminal outlet in which one socket is wider than the other.

Note: If this plug cannot be fully inserted into the outlet, try reversing the plug. If the plug still fails to fit, contact an electrician to replace the obsolete 2-terminal outlet.

Grounding Terminal

If this equipment is equipped with an external grounding terminal, attach one end of an 18-gauge wire (or larger) to the grounding terminal; then, attach the other end of the wire to a ground, such as a grounded equipment rack.

Safety Plugs (European Union)


- **Class I Mains Powered Equipment** – Provided with a 3-terminal AC inlet and requires connection to a 3-terminal mains supply outlet via a 3-terminal power cord for proper connection to the protective ground.

Note: The equipotential bonding terminal provided on some equipment is not designed to function as a protective ground connection.

- **Class II Mains Powered Equipment** – Provided with a 2-terminal AC inlet that may be connected by a 2-terminal power cord to the mains supply outlet. No connection to the protective ground is required as this class of equipment is provided with double or reinforced and/or supplementary insulation in addition to the basic insulation provided in Class I equipment.

Note: Class II equipment, which is subject to EN 50083-1, is provided with a chassis mounted equipotential bonding terminal. See the section titled **Equipotential Bonding** for connection instructions.

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.

Fuse Replacement

To replace a fuse, comply with the following:

Important Safety Instructions

- Disconnect the power before changing fuses.
- Identify and clear the condition that caused the original fuse failure.
- Always use a fuse of the correct type and rating. The correct type and rating are indicated on this equipment.

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 Canadienne Statement

This apparatus complies with Canadian ICES-003.
Cet appareil est conforme 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.

1

Introduction

Overview

The GainMaker® Broadband Amplifier Platform includes a variety of RF amplifiers that address the divergent needs of today's broadband networks. All GainMaker amplifiers provide superior two-way performance and reliability combined with a user-friendly layout.

This chapter introduces the GainMaker Line Extender and describes its main components, configuration options, and accessories.

Purpose

This guide provides instructions for installing, configuring, setting up, and troubleshooting the GainMaker Line Extender.

Who Should Use This Document

This document is intended for authorized service personnel who have experience working with similar equipment. The service personnel should have appropriate background and knowledge to complete the procedures described in this document.

Qualified Personnel



WARNING:

Allow only qualified and skilled personnel to install, operate, maintain, and service this product. Otherwise, personal injury or equipment damage may occur.

Only appropriately qualified and skilled personnel should attempt to install, operate, maintain, and service this product.

Scope

This guide discusses the following topics.

- Description of the GainMaker Line Extender
- Installing and configuring the amplifier
- Balancing and setup of amplifier forward and reverse signal paths
- Troubleshooting the amplifier
- Customer support information
- Descriptions of configuration options and accessories

Document Version

This is the first release of this guide.

In This Chapter

■ Description	3
■ Accessories.....	6
■ Illustrations.....	8
■ Block Diagrams.....	10

Description

The GainMaker Line Extender is available in the following forward bandwidth.

- 1 GHz

The GainMaker Line Extender is available in the following amplifier types.

- Manual
- Thermal
- Automatic Gain Control (AGC)

The GainMaker Line Extender is available in the following reverse path splits.

- 40/52 MHz
- 42/54 MHz
- 55/70 MHz
- 65/86 MHz
- 85/102 MHz

GainMaker Line Extender Characteristics

GainMaker Line Extender modules have the following characteristics.

- -20 dB test points, located electrically outside of the diplex filter, provide for testing of forward output signals and reverse input signals without disrupting normal operation
- Housing lids offered with or without external test point
- Room for optional status monitoring transponder in housing lid
- Direct module plug-in to the housing provides superior amplifier heat sinking
- Symmetrical housing and modules provide convenient mounting
 - Amplifier housings that can be installed facing either toward or away from the street
- AC circuitry provides 15 A of steady state current capability that is able to withstand 25 A of peak current (for a maximum of 2 hours)
- Surge-resistant circuitry provides improved resistance to high voltage transients
- Chromated housing protects outdoor equipment in coastal areas and other corrosive environments; uncoated housing also available
- Input and output reverse pad locations increase flexibility in reverse path design

and alignment

This line extender can also be set up to operate at 870 MHz by using 870 MHz equalizers. The 870 MHz equalizers are listed together with the 1 GHz equalizers in *Accessories* (on page 6).

Power Supply

The DC power supply has the following features.

- Located in housing lid for ease of maintenance
- AC and DC test points provided on the power supply
- Selectable AC undervoltage lockout feature
 - The 30 volt lockout is for 60 volt systems (factory default)
 - The 40 and 50 volt lockout positions are for 90 volt systems (field configurable by moving a jumper)

Input and Output Ports

The GainMaker Line Extender has one input and one output port.

Configuration

The GainMaker Line Extender is configured with the following.

- Diplex Filters
- Reverse Amplifier
- Forward Interstage Equalizer
- Forward Interstage and Reverse Input Attenuator Pads

Test Points

There are five RF test points on the GainMaker Line Extender module.

There are three voltage test points on the GainMaker Line Extender power supply.

AC Shunt Power Directors

The GainMaker Line Extender has two AC shunt power directors that are used to direct AC current to and from the amplifier input and output ports.

Ordering Information

The GainMaker System Amplifier is available in a wide variety of configurations. The desired configuration is “built” by accessing the Cisco Commerce Workspace tool at <https://cisco-apps.cisco.com/cisco/psn/commerce>. The user specifies the new Assemble To Order (ATO) Product ID for the GainMaker System Line Extender, “GM LE” and the tool steps through the available options, from which to choose. Services may also be selected during this process. Once all the desired options are selected, the configuration and price are displayed. When the “Done” radio button is clicked, the configuration can be exported and saved for future use or immediate ordering.

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

Accessories

The GainMaker Line Extender is equipped to work with the following customer-installable and miscellaneous accessories.

Customer Installable Accessories for All Amplifiers

The following table lists the customer installable accessories and their part numbers.

Note: All GainMaker Line Extender accessories are unique to the GainMaker Broadband Amplifier Platform product line.

Accessory	Part Number	Legacy Part Number (Reference Only)
Attenuator pads (0 dB through 20.5 dB in 0.5 dB increments)	GM-PAD-1G-00= through GM-PAD-1G-20.5=	589693 through 589734
75 ohm terminating pad (In Attenuator Pad Package) Note: Not for terminating unused amplifier output ports in the field. Instead, use an external screw-on type 75 ohm cable terminator.	GM-PAD-1G-75=	589735
Forward Equalizer Jumper 1 GHz	GM-EQFL-0-1G=	4007228
Forward Cable Equalizer 1 GHz (1.5 dB through 30 dB in 1.5 dB increments)	GM-EQCBL-1.5-1G= through GM-EQCBL-30-1G=	4007229 through 4007248
Forward Equalizer Jumper 870 MHz	589260	-
Forward Cable Equalizer 870 MHz (1.5 dB through 27 dB in 1.5 dB increments)	589261 through 589278	-
Reverse Equalizer Jumper	589627	-
Reverse Cable Equalizer 40 MHz/42 MHz (1 dB through 12 dB in 1 dB increments)	GM-EQREV-1-40M= through GM-EQREV-12-40M=	589628 through 589639
Reverse Cable Equalizer 55 MHz (1 dB through 12 dB in 1 dB increments)	GM-EQREV-1-55M= through GM-EQREV-12-55M=	712679 through 712690
Reverse Cable Equalizer 65 MHz (1 dB through 12 dB in 1 dB increments)	GM-EQREV-1-65M= through GM-EQREV-12-65M=	589736 through 589747
Reverse Cable Equalizer 85 MHz (1 dB through 12 dB in 1 dB increments)	GM-EQREV-1-85M= through GM-EQREV-12-85M=	4036769 through 4036780

Accessory	Part Number	Legacy Part Number (Reference Only)
Forward Inverse Equalizer 1 GHz (1.6 dB through 16.2 dB in 1.5 dB increments)	GM-EQINV-1.6-1G= through GM-EQINV-16.2-1G=	4007486 through 4007495
Forward Inverse Equalizer 870 MHz (1.5 dB through 15 dB in 1.5 dB increments)	589325 through 589334	-
3-State Reverse Switch	568542	-
Power Supply	593020	-
Trim Network 1 GHz	4022212 4021964	-
Trim Network 870 MHz	714446	-
System Trim Jumper	589285	-
Thermal Bode	4007479	-

Miscellaneous Accessories

The following table lists the miscellaneous accessories used with all GainMaker Line Extenders along with their part numbers.

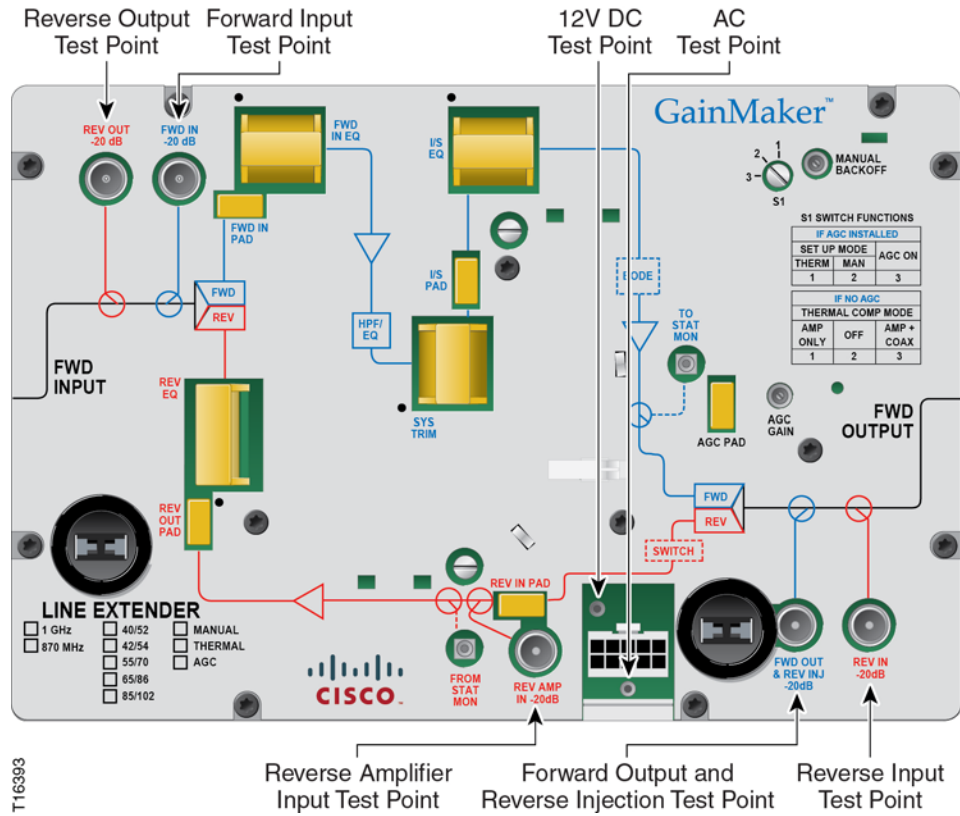
Accessory	Part Number
Surge protector	467351
Status monitoring transponder	715980
GainMaker Line Extender upgrade kit	4042376

Illustrations

Line Extender Test Points

The following diagram shows the test points of the GainMaker Line Extender.

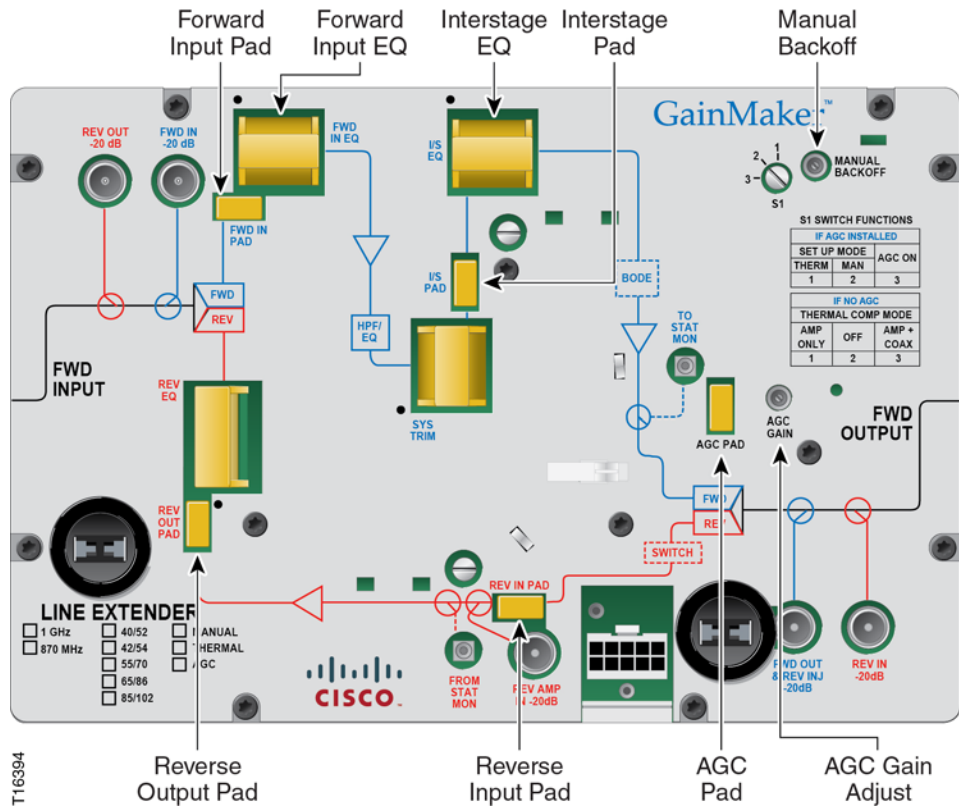
Note: The test point locations are the same for all GainMaker Line Extender models.



Line Extender Accessories

The following diagram shows the accessory locations for the GainMaker Line Extender.

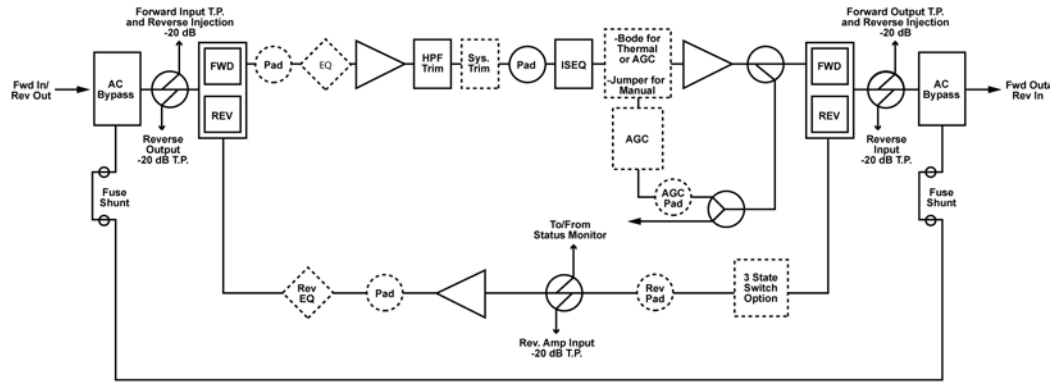
Note: The accessory locations are the same for all GainMaker Line Extender models.



Block Diagrams

GainMaker Line Extender Block Diagram

The following illustration is a block diagram of the GainMaker Line Extender module.



**GainMaker™
Line Extender**

T7307

2

Installation and Configuration

Introduction

This chapter provides instructions for installing and configuring the GainMaker Line Extender in your cable system.

In This Chapter

■ Before You Begin	12
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■ Removing the Amplifier Module from the Housing.....	35
■ Removing and Installing AC Shunt Power Directors.....	37
■ Closing the Node Housing.....	39

Before You Begin

The procedures in this chapter assume that you have completed the following:

- Prepared the installation site
- Located the coaxial cable, with or without the pin-type coaxial connectors mounted on the cable

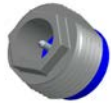






Required Tools


Before you start, make sure that you have the following tools:

- 1/2-inch wrench or nut driver
- Phillips-head or T-15 Torx-bit screwdriver
- Heavy-duty wire cutters or snips

Torque Specifications

The following table gives the torque specifications for the module.

Fastener	Torque Specification	Illustration
Seizure nut	2 ft-lb to 5 ft-lb (2.7 Nm to 6.8 Nm)	
Housing hinge screw	5 in-lb to 8 in-lb (0.56 Nm to 0.90 Nm)	
Power supply module securing screws	18 in-lb to 20 in-lb (2 Nm to 2.3 Nm)	
Strand clamp mounting bracket bolts	5 ft-lb to 8 ft-lb (6.8 Nm to 10.8 Nm)	
75 ohm terminator	2 ft-lb to 4 ft-lb (2.7 Nm to 5.4 Nm)	(Appearance varies by manufacturer)
Line extender module shoulder screws (slotted head)	6 in-lb to 9 in-lb (0.7 Nm to 1.0 Nm)	
Line extender module shoulder screws (cross head)	18 in-lb to 20 in-lb (2.0 Nm to 2.25 Nm)	
Housing closure bolts	5 ft-lb to 12 ft-lb (6.8 Nm to 16.3 Nm)	

Fastener	Torque Specification	Illustration
Test point port plugs	5 ft-lb to 8 ft-lb (6.8 Nm to 10.8 Nm)	

Amplifier Module Cover

GainMaker Line Extender modules have an aluminum cover attached to the chassis with self-tapping screws. Normal field maintenance will not require the removal of this cover.

Module and Housing Compatibility

Housing Lid

The GainMaker Line Extender module is compatible with the GainMaker Line Extender housing lid only. The amplifier will not work with Line Extender II or III housing lids.

Housing Base

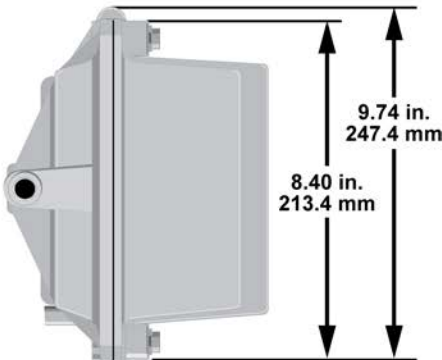
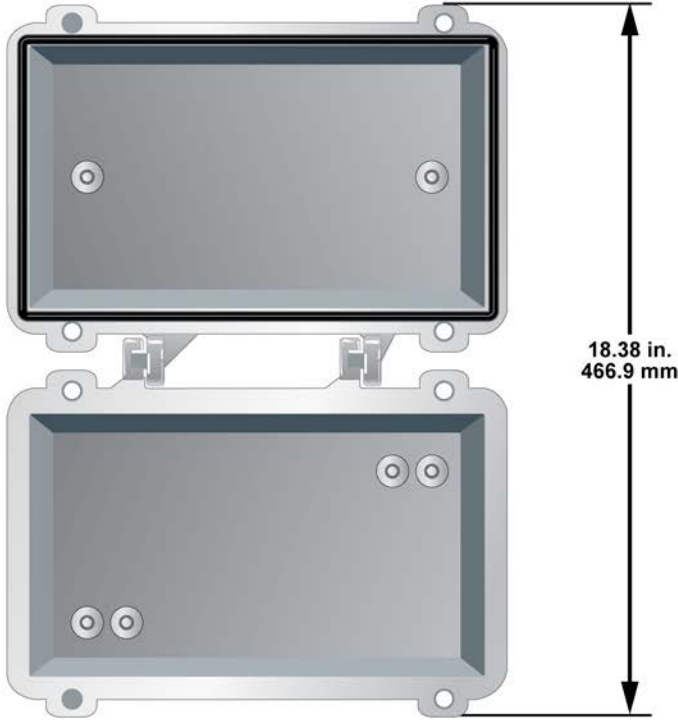
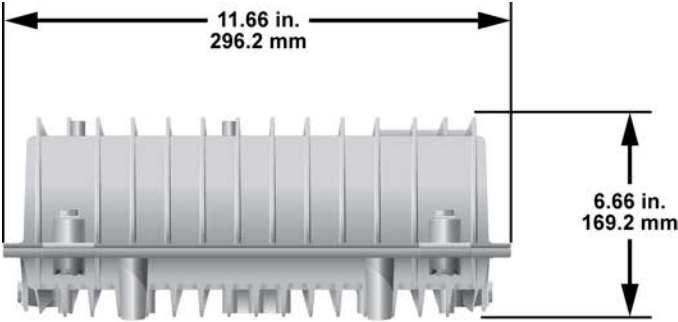
The GainMaker Line Extender module is compatible with the GainMaker Line Extender housing base. The amplifier will also work with Line Extender II or III housing bases.

Important! GainMaker Line Extender modules are marked with a blue label to indicate 15-ampere capability. The RF connectors in these modules are also marked with blue. These amplifier modules must be used in conjunction with the proper GainMaker amplifier housings, which are also marked with a blue label.

Note: 15-ampere capable Line Extender III housings with the blue label and Line Extender II housings that have been upgraded to 15-ampere capability with an available seizure upgrade kit are compatible with GainMaker Line Extender modules.

Housing Dimensions

The diagram below shows the dimensions, in inches and millimeters, of the GainMaker Line Extender housing. Use these measurements to calculate clearance requirements for your installation.



T7308

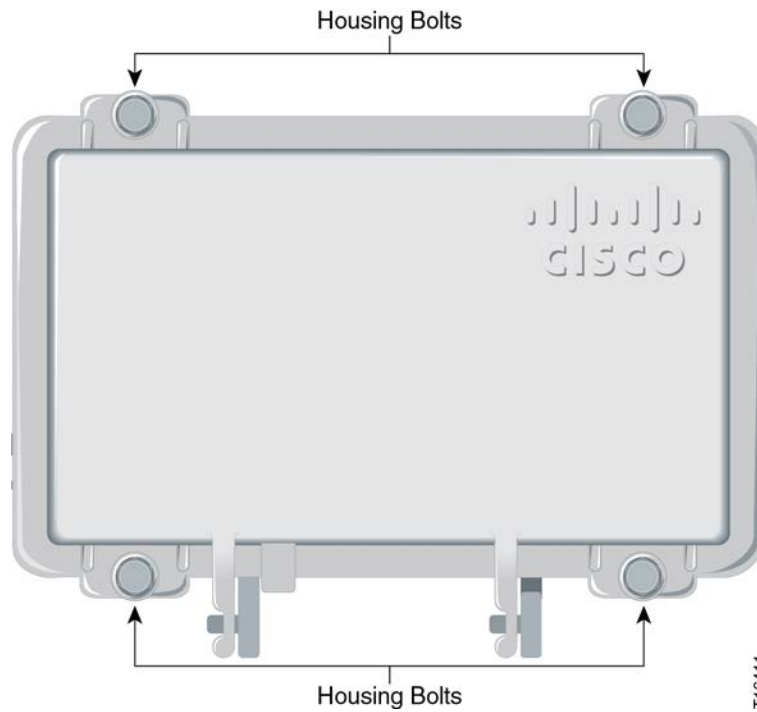
Opening the Node Housing

To Open the Node Housing

Complete the following steps to open the node housing.

Important: Before unscrewing the housing bolts, make sure the removable locking screw in the hinge is in place and secure. The locking screw prevents separation of the lid from the base.

- 1 Unscrew the ½-inch housing closure bolts on the housing lid until they are loose.



- 2 Open the housing.

Note: The closure bolts will remain attached to the housing.

Upgrading Existing Housing Seizures

The GainMaker Line Extender modules have a higher current-carrying capacity than some earlier line extender products. If you are replacing an earlier line extender with a GainMaker Line Extender, you must upgrade the housing to handle the higher current demands.

The 15 A housings have silver-plated 0.063 in. diameter pins in the seizures. The plastic material in the seizures and anvils are glass-filled in order to handle the higher AC currents, as well as higher temperatures.

The 15 A amplifier modules have a newly designed RF connector that accepts 0.063 in. diameter pins rated for higher-current applications.

Note: The RF connectors, seizures, and anvils are coded blue for ease of identification.

To Install the New Housing Seizures

Complete the following steps to upgrade an amplifier housing to 15 A current capacity.

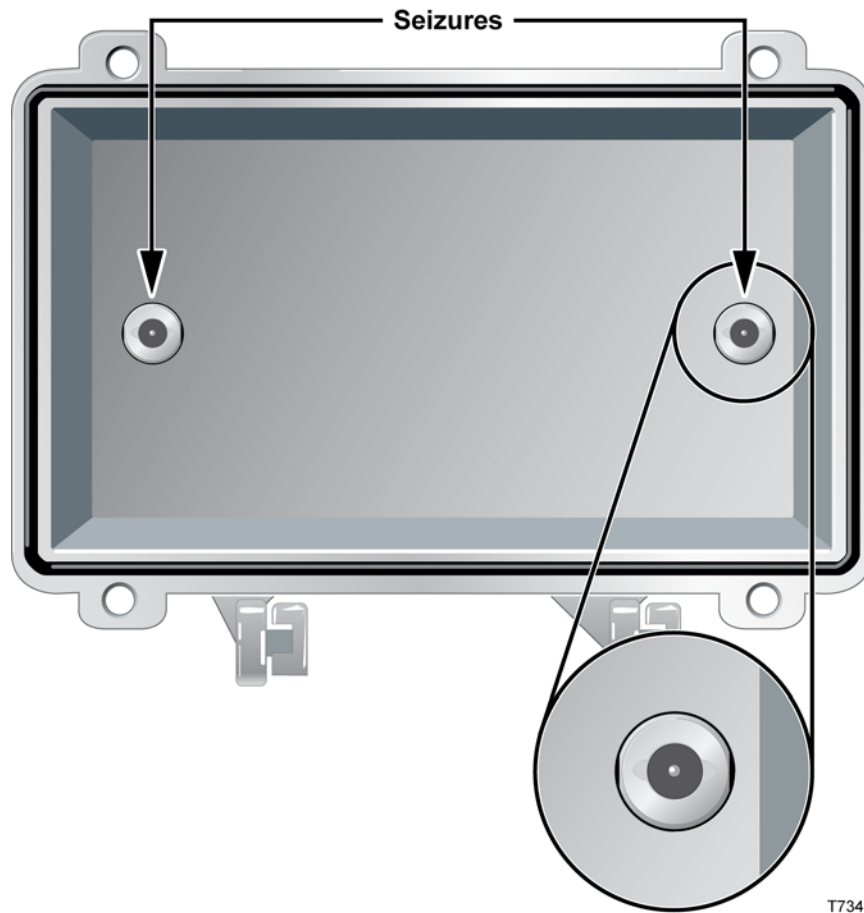
Important: The power shunts must be removed before installing the unit into a powered housing. With shunts removed, it reduces the power surge to the components and F-connectors.



CAUTION:

RF connectors and housing seizure assemblies can be damaged if AC shunt power directors are not removed from the amplifier before installing or removing the amplifier module from the housing.

- 1 If an amplifier module is installed in the housing, you must remove it before continuing. Refer to *Removing the Amplifier Module from the Housing* (on page 35).
- 2 Using a seizure wrench, part number 143190, remove the seizures from the housing. See the diagram below.



- 3 Using a ½ in. nut driver, install the new seizure screws from the upgrade kit (part number 548775) in the housing.
- 4 Do one of the following as appropriate:
 - If the coaxial cable is connected to the housing, tighten each seizure screw from 2 ft-lb to 5 ft-lb (2.7 Nm to 6.8 Nm).
 - If the coaxial cable is not connected to the housing, proceed to *To Connect the Coaxial Cable Pin Connector to the Node Housing* (on page 24).
- 5 Place the blue stickers on the outside of the housing between the ports to indicate that the upgrade has been completed.

Upgrading an Existing Housing Lid

The GainMaker Line Extender has a new style housing lid that allows easier access to the amplifier power supply. If you are replacing an earlier amplifier with a GainMaker amplifier, you will have to replace the existing housing lid with a newer housing lid to accommodate the power supply for the amplifier module.

To Install the New Housing Lid

Complete the following steps to upgrade an amplifier housing with the newest housing lid.



CAUTION:

RF connectors and housing seizure assemblies can be damaged if AC shunt power directors are not removed from the amplifier before installing or removing the amplifier module from the housing.



WARNING:

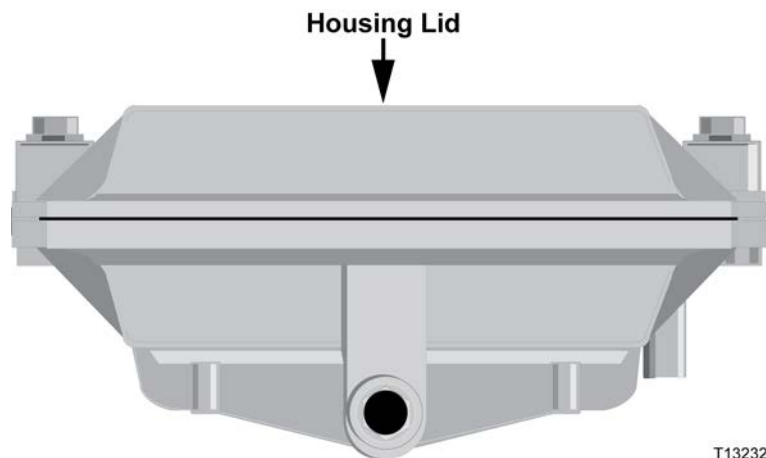
Before starting this procedure in an aerial or strand mounted application, be sure to clear the area below the housing of all people, and if possible, property.



CAUTION:

In an aerial or strand mounted application, you will need to take steps to ensure that the housing lid does not fall to the ground. See the following recommended procedure.

- 1 Use a torque wrench to loosen the housing closure bolts on the housing lid.



- 2 Firmly grasp the housing lid and open it carefully.
- 3 Using a screwdriver, remove the hinge screw from the housing hinge. The housing lid will now swivel completely open, allowing it to be removed from the housing base.

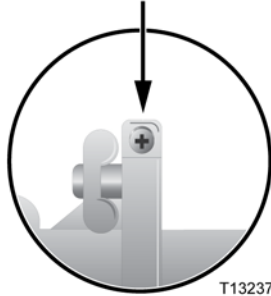
Important: Place the old housing lid in a safe place until it can be disposed of properly.



WARNING:

It is possible for the housing lid to separate from the housing base and fall, possibly causing injury or damage to persons or property below.

Hinge Screw



T13237

- 4 Firmly grasp the new GainMaker housing lid and place it onto the housing bottom, swiveling it into place on the housing hinge.



WARNING:

It is possible for the housing lid to separate from the housing base and fall, possibly causing injury or damage to persons or property below.

- 5 Using a screwdriver, replace the hinge screw in the housing hinge. Tighten the hinge screw from 5 in-lb to 8 in-lb (0.56 Nm to 0.90 Nm).

Installing the Power Supply

Important: The AC shunt power directors must be removed before installing the unit. Removal of the AC shunt power directors reduces the power surge to the components and F-connectors.



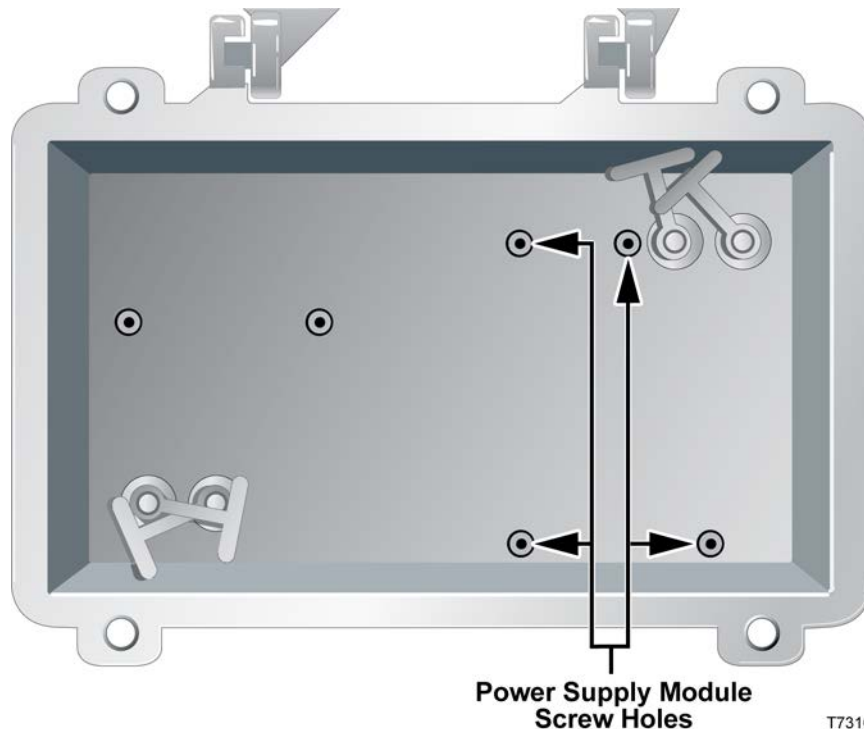
CAUTION:

RF connectors and housing seizure assemblies can be damaged if AC shunt power directors are not removed from the amplifier before installing or removing the amplifier module from the housing.

To Install the Power Supply Module

Complete the following steps to install the power supply module.

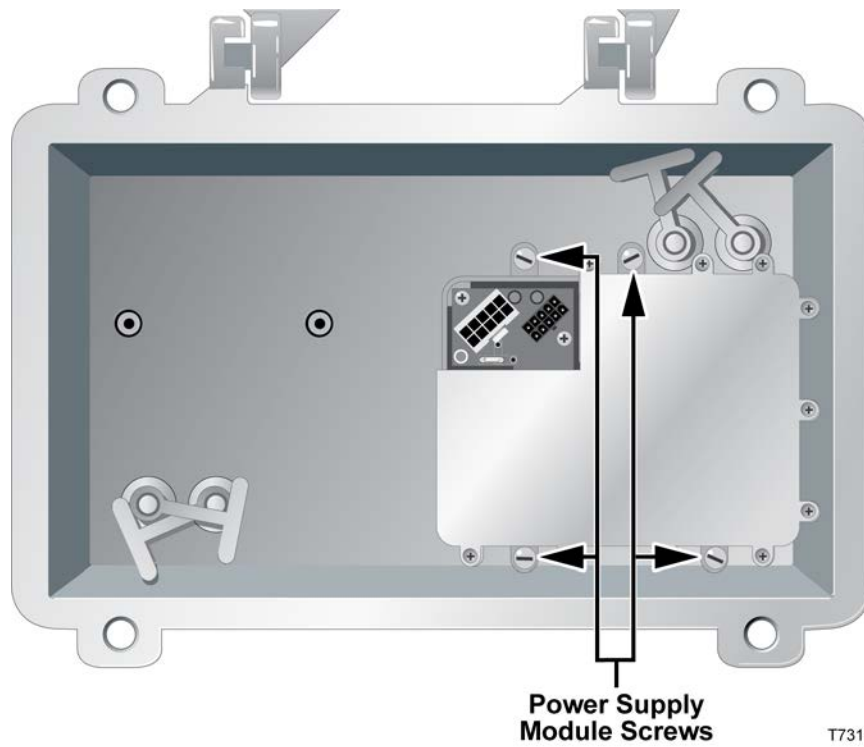
- 1 Start with the housing lid open. The power supply is installed in the housing lid.
- 2 Install the power supply module in the power supply cavity.



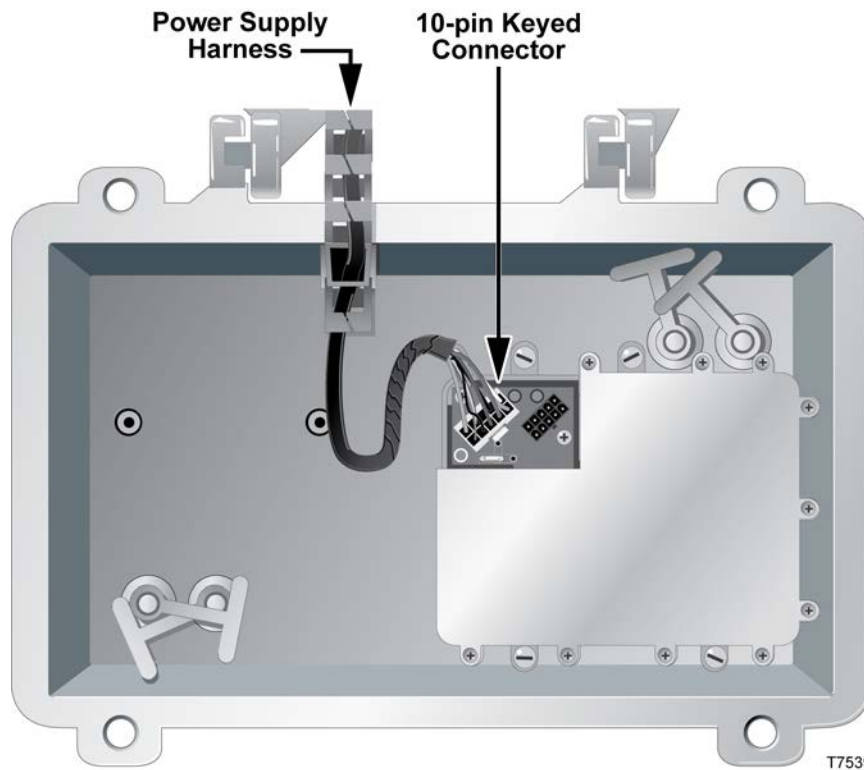
Note:

- There is only one correct way to install the power supply module. Use the metal tabs as a guide to position the power supply module correctly inside the power supply cavity.
 - Be sure that the plastic retaining tabs that secure the test point plugs to the housing lid are not pinched between the power supply and the interior of the housing lid. This will make it difficult to open the test point plug.
- 3 Tighten the four module screws on the power supply module to 18 in-lb to 20 in-lb

(2.0 Nm to 2.3 Nm).



- 4 Attach the 10-pin keyed connector of the power cable and harness to the power supply module.



Note: The 10-pin keyed connector can be connected one way only. Be sure that the connector is installed securely to the power supply board.

- 5 Proceed to *To Set the AC Undervoltage Lockout Selector* (on page 22).

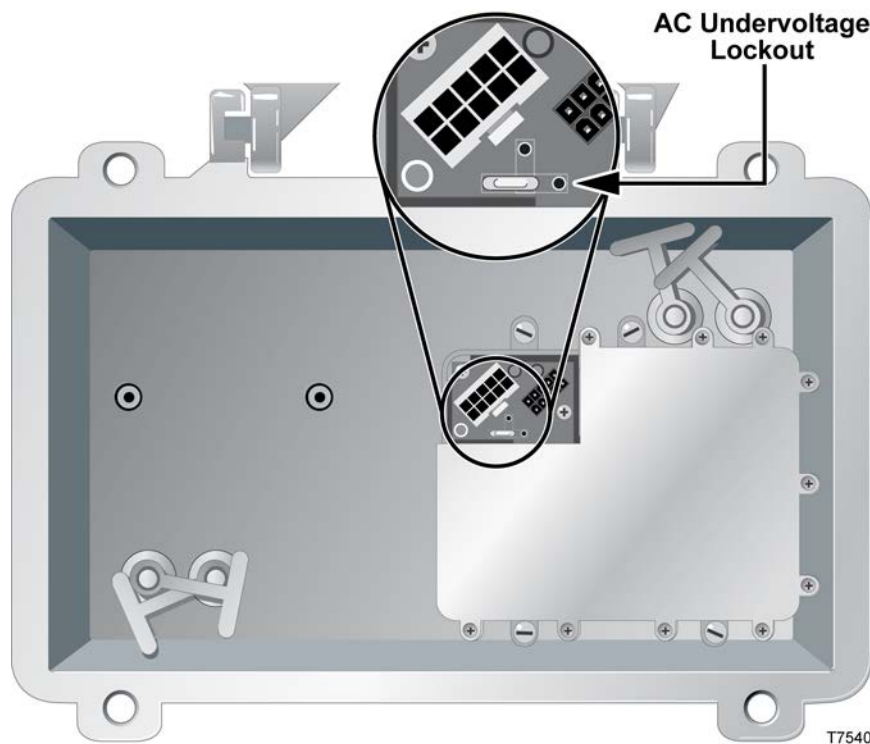
To Set the AC Undervoltage Lockout Selector

Set the AC undervoltage lockout selector for your powering application as specified by your system engineering guidelines.

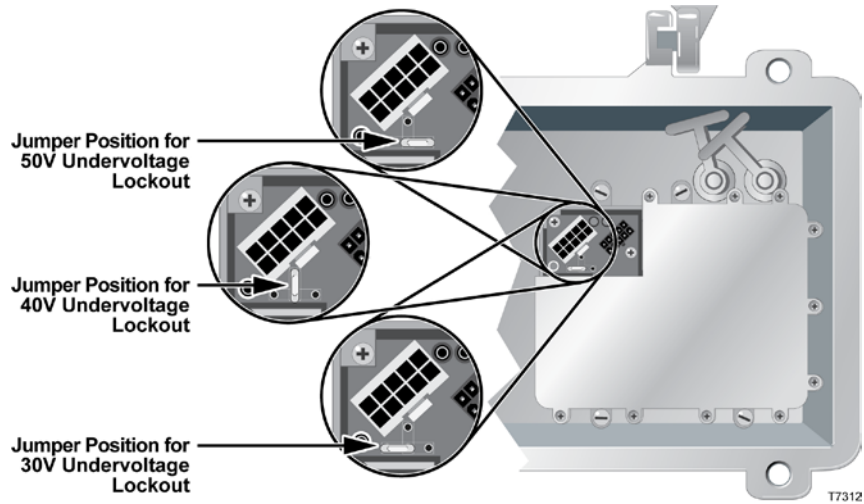
Undervoltage Lockout Setting	Application
30 V Lockout	60 VAC System
40 V Lockout	90 VAC System
50 V Lockout	90 VAC System

Complete the following steps to set the AC undervoltage lockout selector:

- 1 Locate the AC undervoltage lockout selector on the power supply in the housing lid.



- 2 Set the AC undervoltage lockout selector for your powering application as illustrated in the following diagram.



Note: The AC undervoltage lockout selector positions are also noted on the power supply.

- 3 Proceed to *Attaching the Coaxial Connectors* (on page 24).

Attaching the Coaxial Connectors

To Trim the Center Conductor

The GainMaker Line Extender requires pin-type connectors for all RF connections.

Before you begin, confirm the following:

- The coaxial cables are cut to the proper length and core-stripped to connector manufacturer specifications.
- The coaxial cable connector center pins are trimmed to 1.25 inches (31.75 mm) from the shoulder of the connector.

To Connect the Coaxial Cable Pin Connector to the Node Housing

Complete the following steps to connect the coaxial cable pin connector to the GainMaker Line Extender housing:

- 1 Begin this procedure with the node housing open. Refer to *To Open the Node Housing* (on page 15).
- 2 If the coaxial cable connector center pin extends more than the length specified in *To Trim the Center Conductor* (on page 24), trim the pin with heavy-duty wire cutters.
- 3 Insert the appropriate coaxial connector into the housing at the desired housing port. Tighten the connector nut according to manufacturer specifications.
- 4 Tighten the seizure screw from 2 ft-lb to 5 ft-lb (2.7 Nm to 6.8 Nm).
- 5 Repeat steps 2 through 4 for the other RF port.
- 6 Proceed to *Installing the Housing* (on page 25).

Installing the Housing

The following procedures detail how to install the GainMaker Line Extender housing on a strand (aerial) or in a pedestal.

To Install the Housing on a Strand (Aerial)

Complete the following steps to install the housing on a strand (aerial). The housing does not need to be opened for strand installation.

Important: The minimum strand diameter should be 5/16 inch.

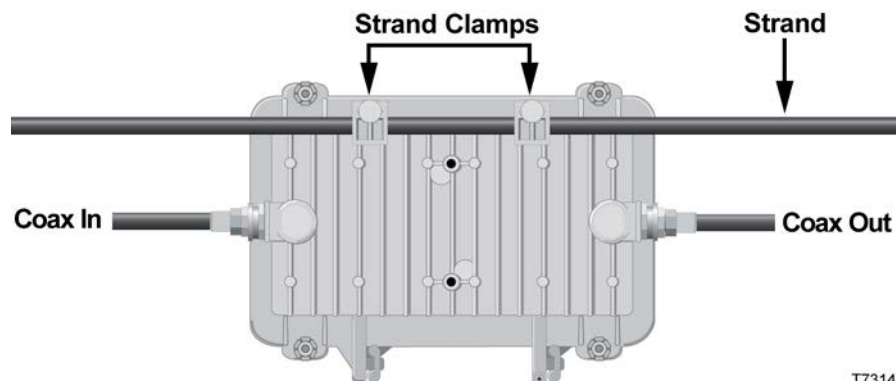


CAUTION:

Be aware of the size and weight of the housing while strand mounting. Ensure that the strand can safely support the weight of the housing.

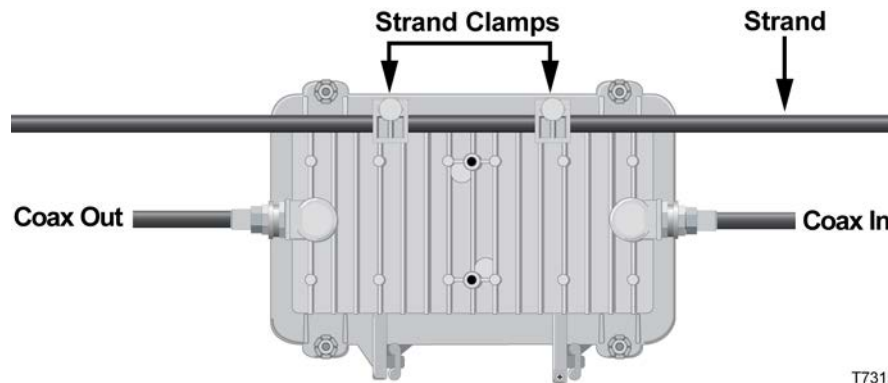
- 1 Loosen the strand clamp bolts.
- 2 Lift the housing into proper position on the strand.
- 3 Slip the strand clamps over the strand and finger-tighten the clamp bolts. This allows additional movement of the housing as needed.
- 4 Move the housing as needed to install the coaxial cable and connectors. See the diagrams below for examples.

Signal Flow from Left to Right



T7314

Signal Flow from Right to Left



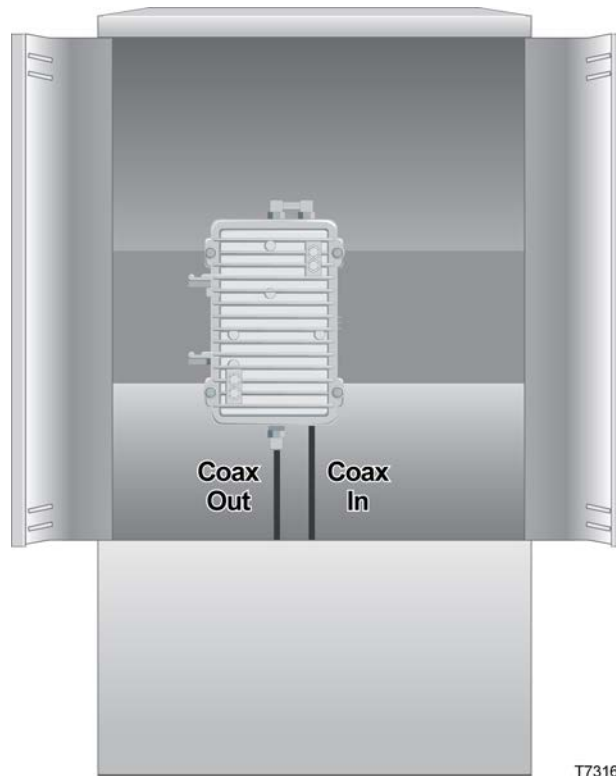
Note: **Coax In** may be switched with the **Coax Out** if you reverse the amplifier module and feed the signal from right to left.

- 5 Using a ½-inch torque wrench, tighten the strand clamp bolts from 5 ft-lb to 8 ft-lb (6.8 Nm to 10.8 Nm). Make sure there is good mechanical contact between the strand and the housing.
Note: A slight tilt of the face of the housing is normal. Cable tension will cause the housing to hang more closely to vertical.
- 6 Connect the coaxial cable to the pin connector according to connector manufacturer specifications.
- 7 Proceed to *Installing Accessories* (on page 28).

To Install the Housing in a Pedestal

Complete the following steps to install the node in a pedestal.

- 1 Remove the cover of the pedestal.
- 2 Remove the self-tapping bolts from the strand clamps and set the bolts and strand clamps aside.
- 3 Position the housing in the pedestal frame as shown in the following illustration. Line up the self-tapping bolt holes on the bottom of the housing with the mounting holes on the bracket.



Note: The housing mounts to the bracket provided by the pedestal manufacturer.

- 4 Secure the housing to the bracket by using the bolts that you removed in step 2. 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 specifications.
- 6 Proceed to *Installing Accessories* (on page 28).

Installing Accessories

The following section provides instructions for installing accessories into the GainMaker Line Extender.

To Install Attenuator Pads

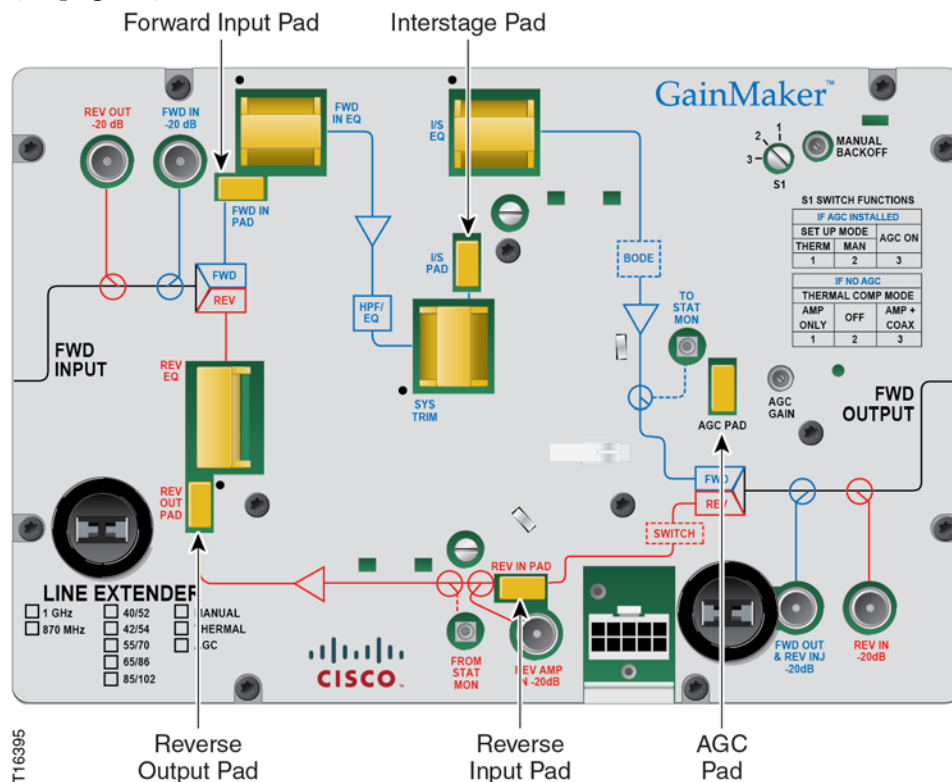
Complete the following steps to install the attenuator pads in the amplifier.

Note: For best results, follow this installation procedure exactly.

- 1 Begin this procedure with the housing open. Refer to *To Open the Node Housing* (on page 15).

Note: These accessories can be installed without removing the cover.

- 2 Install the pad(s) specified by the design print in the appropriate pad slot(s). For a list of available accessory pad values and part numbers, see *Technical Information* (on page 95).



Notes:

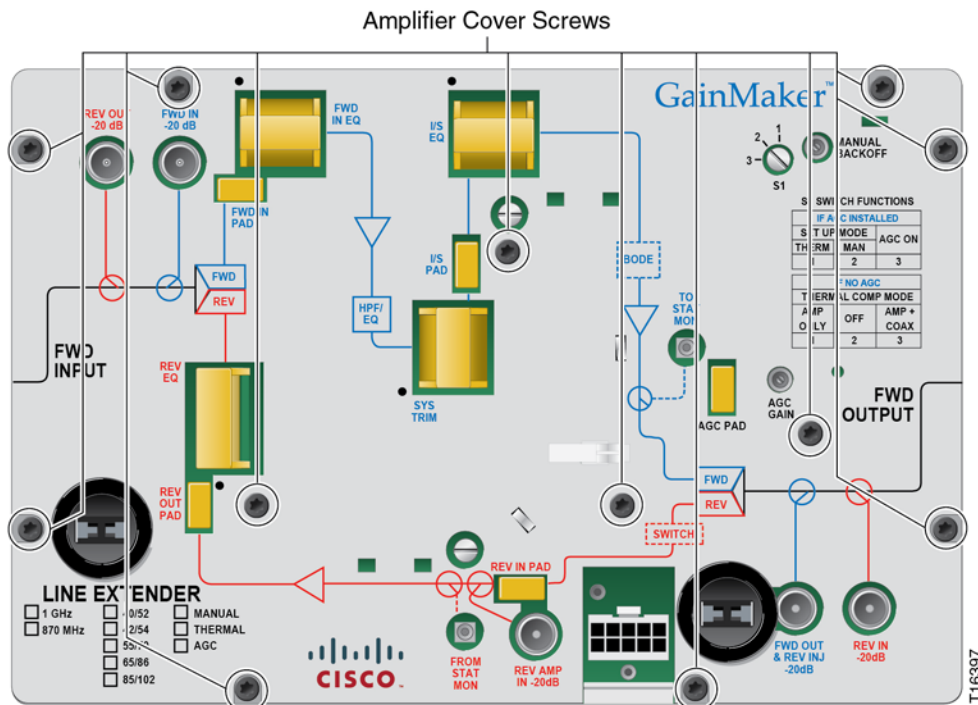
- Be sure that all the pins on the attenuator pad bottom align with the pin holes in the attenuator pad slot, allowing the attenuator pad to install flat against the amplifier module.
- The locations for attenuator pads are approximately the same for all GainMaker Line Extender amplifiers. The illustration above shows a typical example.
- The interstage pad is installed at the factory to set the operational gain of the

- The forward interstage equalizer is installed at the factory, and should not be changed in the field. While it is a 1 GHz equalizer, it is appropriate for use in both 1 GHz and 870 MHz system applications.
 - The plug-in interstage equalizer and an on-board interstage equalizer combine to produce the total internal tilt for the station. The plug-in interstage equalizer value is different from one type of amplifier to another by design, in order to achieve optimum performance.
- 3 Install the reverse equalizer specified by the design print in the reverse equalizer slot. For the exact location of the reverse equalizer, refer to the accompanying illustration. For a list of available reverse equalizers, see *Technical Information* (on page 95).
 - 4 Install other options or accessories as desired, or proceed to *Installing the Amplifier Module* (on page 32).

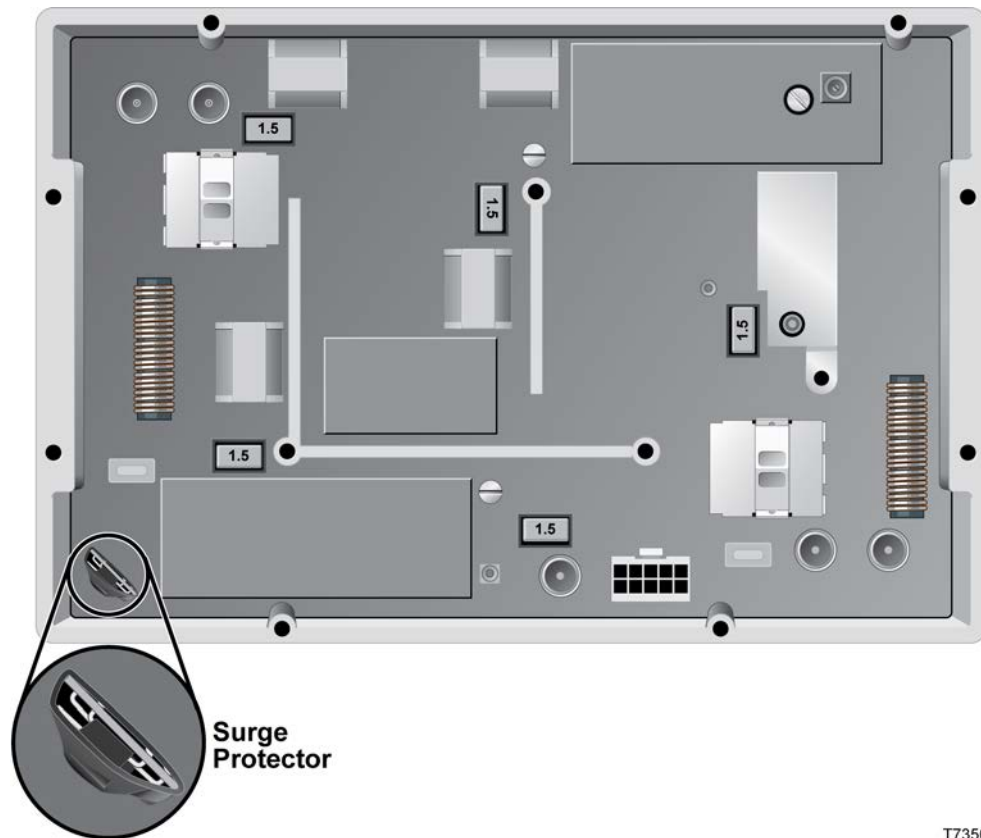
To Install the Surge Protector

Complete the following steps to install the crowbar surge protector in the amplifier.

- 1 Begin this procedure with the housing open. Refer to *To Open the Node Housing* (on page 15).
- 2 Remove the amplifier cover by loosening the amplifier cover screws.



- 3 Install the crowbar surge protector in the surge protector slot. Refer to the illustration below.



T7350

Note:

- Make sure that all pins on the crowbar surge protector bottom align with the pin holes in the surge protector slot, allowing the surge protector to install flat against the amplifier module.
 - Make sure that the components face the outside of the station (see diagram for proper positioning). Heat shrink tubing has been added to prevent shorting.
- 4 Replace the amplifier cover and tighten the amplifier cover screws from 10 in-lb to 12 in-lb (1.12 Nm to 1.35 Nm).
Important: Install the amplifier module cover properly, or RF signal degradation may result.
 - 5 Install other options or accessories as desired, or proceed to *Installing the Amplifier Module* (on page 32).

Installing the Amplifier Module

The amplifier module plugs into the strand-mounted or pedestal-mounted (bottom) of the housing via RF connectors on the bottom side of the module.

Amplifier housings and amplifier modules are designed so that you can orient the amplifier module conveniently for maintenance. Because the input and main output ports are located diagonally across from each other, the amplifier module is reversible. This allows you to orient all amplifier housings to open either to the road side or to the field side. The amplifier is then installed in the appropriate position, either right side up or upside down.

To Install the Amplifier Module

Complete the following steps to install the amplifier module.

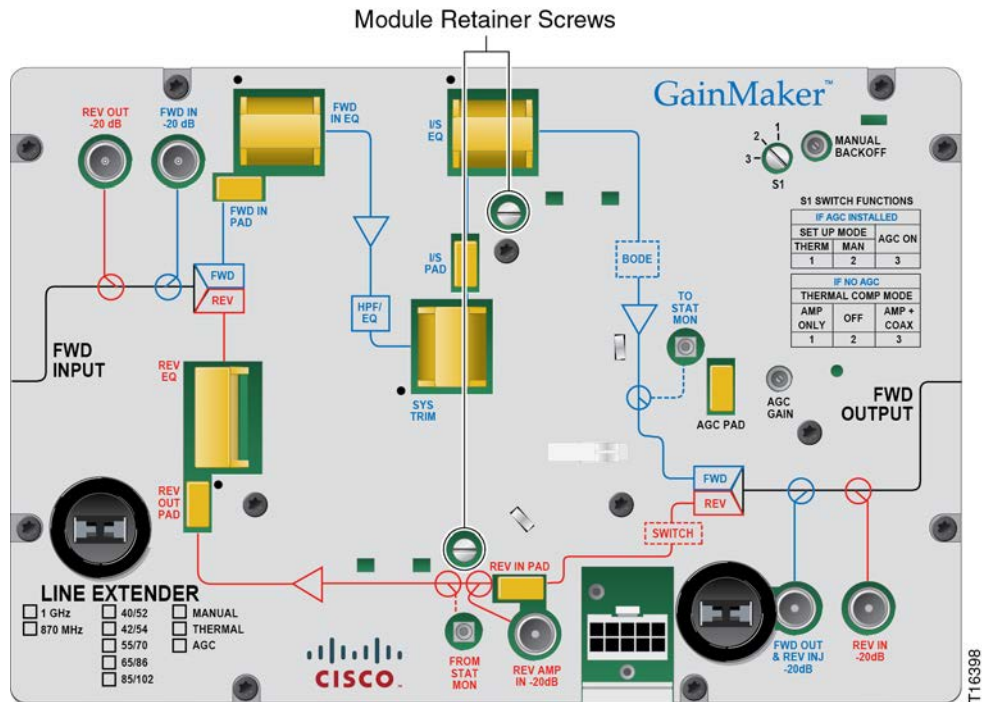
- 1 Perform the following if you are working with an amplifier station where AC is present.



CAUTION:

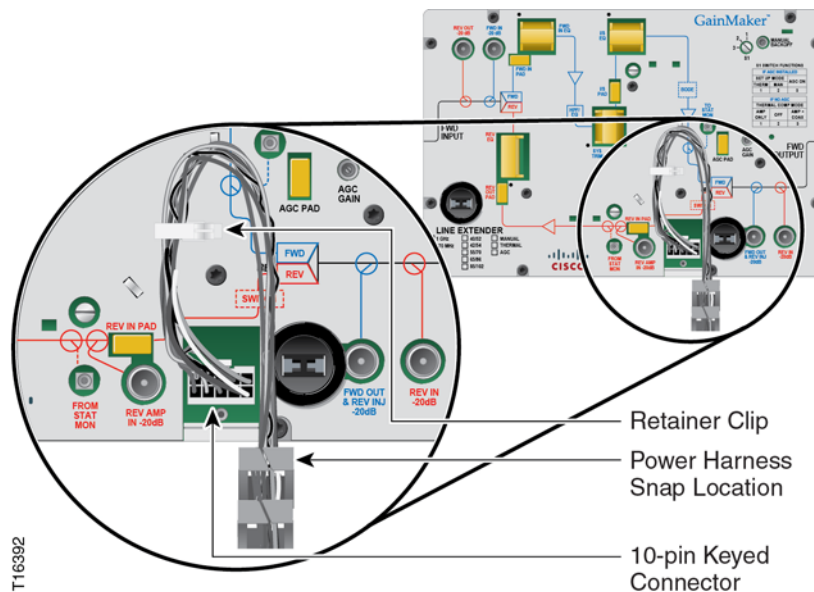
RF connectors and housing seizure assemblies can be damaged if AC shunt power directors are not removed from the amplifier before installing or removing the amplifier module from the housing.

- Install the AC shunt power directors in the amplifier *after* you install the amplifier module in the housing.
 - Remove the AC shunt power directors from the amplifier *before* you remove the amplifier module from the housing.
- 2 Orient the amplifier module so the **Input** and **Main** output ports (the locations of which are stamped on the module cover) are in the proper corners for your installation.
 - 3 Line up the RF connectors on the amplifier module and the housing, and then push the amplifier module into the housing.
 - 4 Secure the amplifier module to the housing by tightening the four system amplifier module retainer screws. Tighten slotted head screws to 6 in-lb to 9 in-lb (0.7 Nm to 1.0 Nm), or cross head screws to 18 in-lb to 20 in-lb (2.0 Nm to 2.25 Nm). See the following illustration for the location of the retainer screws.



- Snap the power cable harness into place in the holes provided.
- Attach the 10-pin keyed connector of the power cable and harness to the amplifier module.

Note: The 10-pin connector can be connected one way only. Confirm that the connector installs securely to the amplifier module.
- Route the excess cable between the end of the molded power harness and the 10-pin keyed connector into the white plastic retainer clips on the module cover.

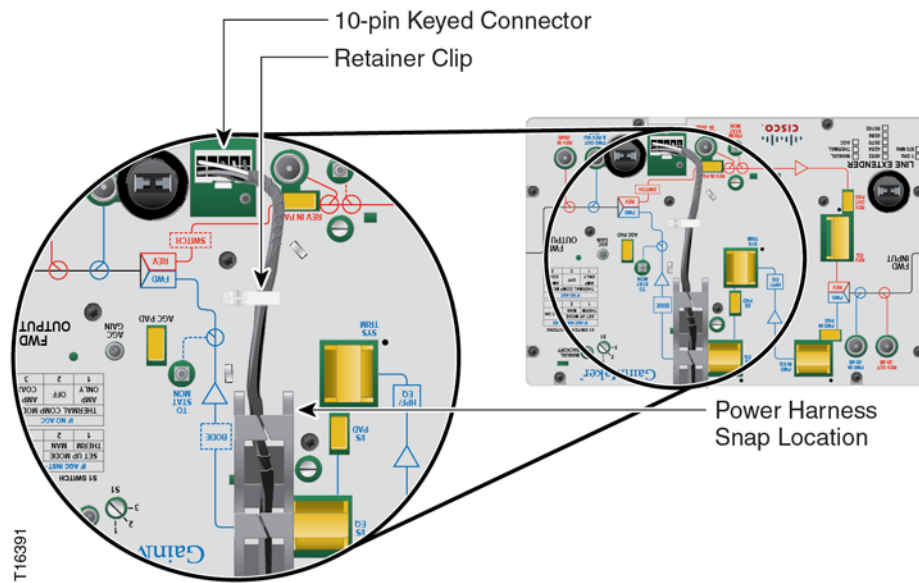


Note:

- Depending on the orientation of the amplifier module in the housing, your power harness routing should resemble either the previous or the next

illustration. Use the routing method best suited for your installation.

- Be sure that the power harness locking tabs are fully seated under the amplifier cover.



8 Proceed to *Removing and Installing AC Shunt Power Directors* (on page 37).

Removing the Amplifier Module from the Housing

To Remove the Amplifier Module

Complete the following steps to remove the amplifier module.

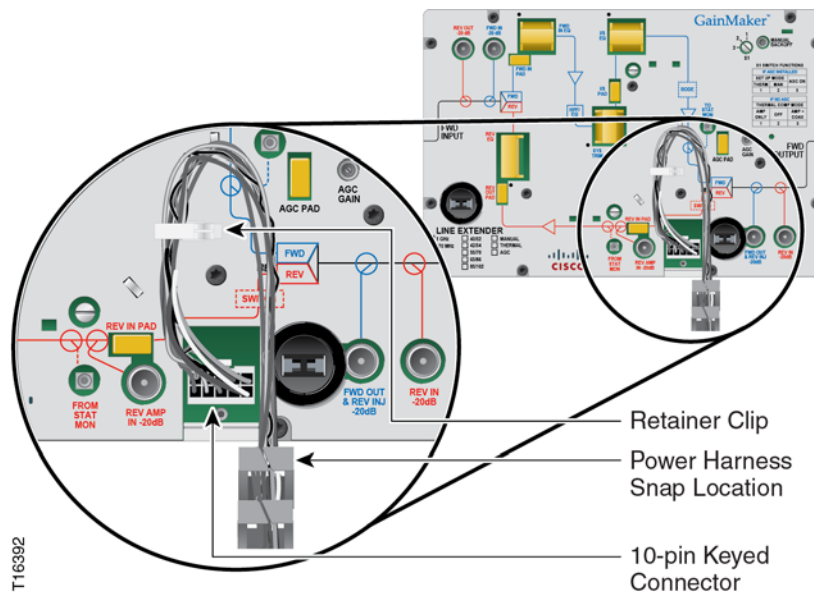
- 1 Open the housing. Refer to *To Open the Node Housing* (on page 15).
- 2 If you are working with an amplifier station in which AC is present, remove the AC shunt power directors from the amplifier before removing the amplifier module from the housing.



CAUTION:

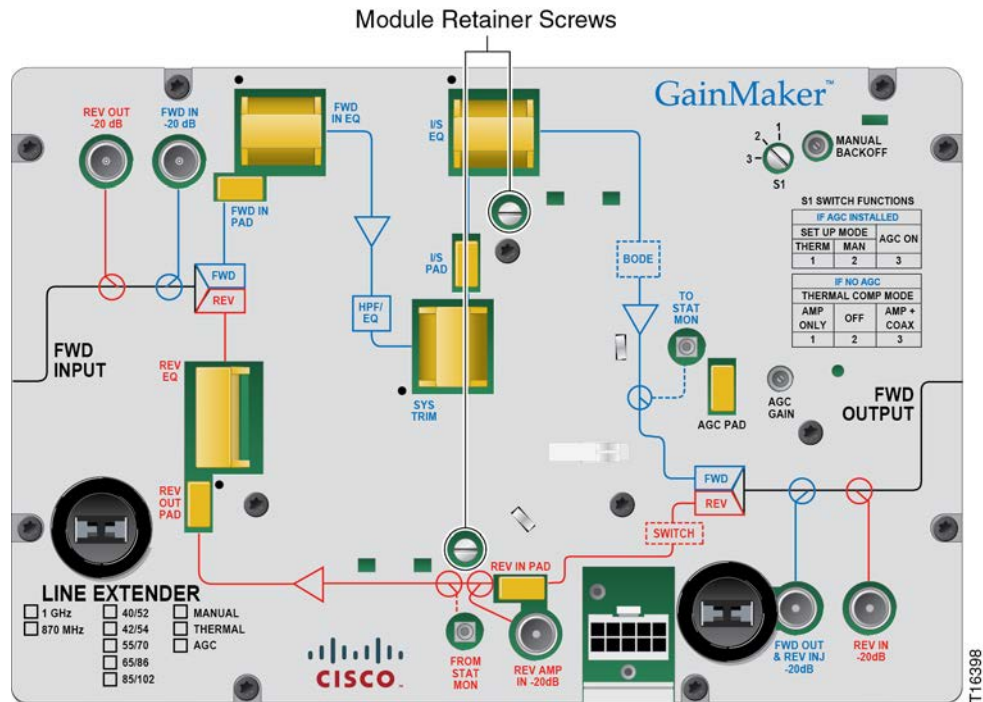
RF connectors and housing seizure assemblies can be damaged if AC shunt power directors are not removed from the amplifier before installing or removing the amplifier module from the housing.

- 3 Unplug the 10-pin keyed connector of the power cable harness from the amplifier module.



T16392

- 4 Remove the power cable harness from the white plastic retainer clips.
- 5 Unsnap the cable guide from the holes in the amplifier module cover.
Note: The cable can remain plugged into the power supply module.
- 6 Using a flat-blade screwdriver, loosen the two module retainer screws.



- Remove the amplifier module from its housing and place the amplifier module on a secure surface.



WARNING:

Avoid personal injury and damage to the amplifier module. Make sure that you place the amplifier module on a secure surface.

Removing and Installing AC Shunt Power Directors

The amplifiers draw AC power from the coaxial cable. This AC power comes from an external AC power supply.

**WARNING:**

When AC is applied from RF ports to units downstream, the downstream equipment shall also be located in a restricted access location (access restricted to service personnel).

Power can come from the input or output ports, and each amplifier can pass or block AC power flow on any port without affecting RF continuity. However, at least one port must pass AC power to bring power into the amplifier.

To set the power direction, install AC shunt power directors for the ports through which you wish to pass AC.

Note: A red AC shunt power director is included with the unit. The red shunt is used to activate the port that supplies power. The red shunt should be removed before installing or removing the amplifier module from the housing.

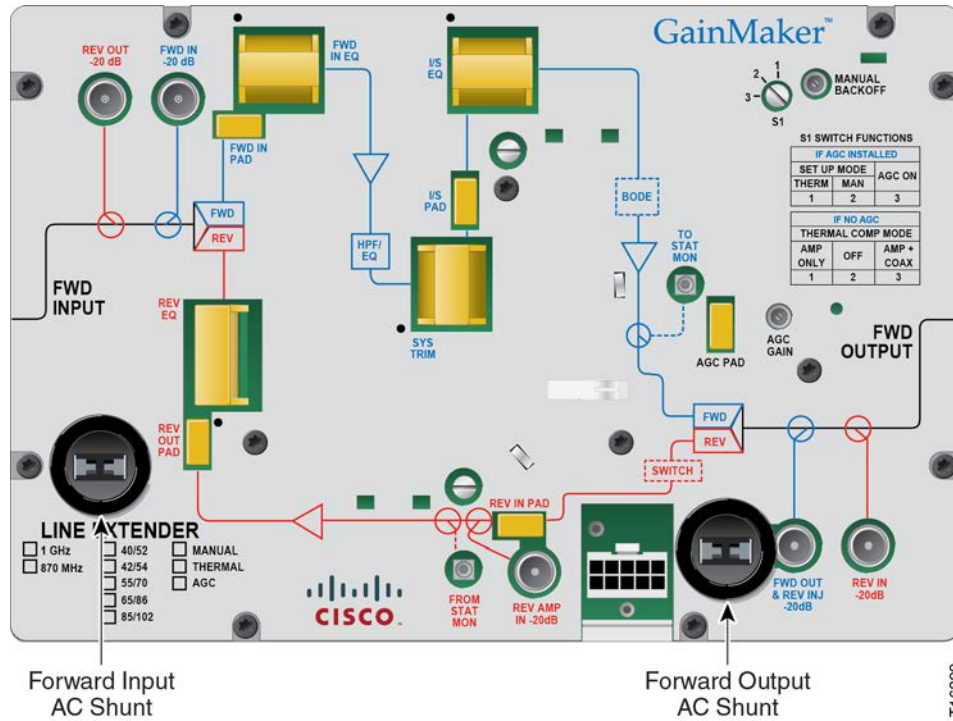
**CAUTION:**

RF connectors and housing seizure assemblies can be damaged if AC shunt power directors are not removed from the amplifier before installing or removing the amplifier module from the housing.

To Remove and Install AC Shunt Power Directors

Complete the following steps to remove and install AC shunt power directors.

- 1 Open the housing. Refer to *To Open the Node Housing* (on page 15).
- 2 To remove a power director, pull it straight out from the amplifier module.



- 3 To install a power director, refer to the systems design print to determine AC power routing and install the AC shunt power directors in the required locations.
- 4 Close the housing. Refer to *To Close the Node Housing* (on page 39).

Closing the Node Housing

To Close the Node Housing

Complete the following steps to close the node housing.



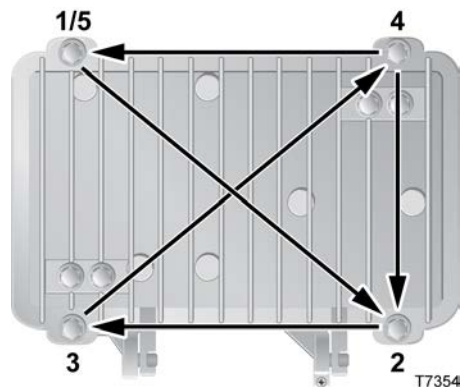
CAUTION:

Avoid moisture damage and RF leakage! Follow the procedure exactly as shown below to ensure a proper seal.

- 1 Inspect the housing gasket and all mating surfaces. Wipe off any excess dirt and debris.
- 2 Close the housing and finger-tighten all closure bolts.
- 3 Use a torque wrench with a 1/2-inch socket to tighten each closure bolt from 5 ft-lb to 12 ft-lb (6.8 Nm to 16.3 Nm) each.
- 4 The tightening sequence is shown in the following **Torquing Sequence** section. Follow the numbered sequence to tighten the closure bolts.

Torquing Sequence

The following diagram shows the proper torquing sequence for the housing closure bolts.



3

Balancing and Setup

Introduction

This chapter provides instructions for selecting and implementing the correct balancing methods for the GainMaker Line Extender in your cable system. Balancing sets the operating levels of the station to ensure proper performance.

Important: Use the information in this chapter to identify the equipment needed for balancing and to determine the correct forward path balancing method for your system installation.

In This Chapter

- Preparing for Forward Path Balancing..... 42
- Balancing the Forward Path..... 47
- Balancing the Reverse Path 74

Preparing for Forward Path Balancing

Before you begin balancing, it is important to review and understand the following information. This information will show you which balancing process is appropriate for your node.

Before balancing, make sure that you have configured the node according to the specifications in your design print and that the node has warmed up for approximately one hour.

The table below shows the items needed for balancing.

You need a ...	To ...
copy of the design print	determine expected input and output signal levels.
torque wrench with 1/2-inch socket	open and close the system amplifier housing.
spectrum analyzer or signal analysis meter capable of working with frequencies up to the highest design frequency	determine absolute and relative signal levels.
test point adapter (part number 562580) or F-81 female-to-female adapter	access the test points.
length of 75 ohm coaxial cable with F-connectors on each end	connect the test point adapter to the test equipment.
voltmeter	test the power supply AC and DC voltages.
reverse sweep receiver	test signals using a reverse sweep transmitter.
1/8-inch flat blade screwdriver	adjust switch S1, AGC Manual Backoff, and AGC Gain Control

Understanding Switch S1 Functions

Switch S1 is a multifunction, three-position switch. Switch S1 functions are determined by whether or not an AGC is installed in the station.

- When an AGC is installed in the station, it is an AGC station. In an AGC station, switch S1 provides two setup modes and one operational mode.
- When there is no AGC installed in the station, it is a thermal station. In a thermal station, switch S1 provides two operational modes.

Switch S1 Positions for AGC Stations

The mode you decide to use to balance an AGC station determines the position in which you place switch S1.

- Position 1 - Selects thermal setup mode

- Position 2 - Selects manual setup mode
- Position 3 - Selects AGC operational mode

Note: AGC operational mode is used only after the station has been initially balanced in either thermal or manual setup mode.

Bode Network

The Bode Network, or Bode, is an interstage variable attenuation and slope network whose loss characteristics are driven by DC control voltage.

The position of switch S1 sets the DC control voltage driving the Bode according to the setup mode or operational mode required for the station.

Refer to the following table for more information on choosing the correct switch position for your application.

Note: Consult your system technical supervisor or manager for more information about which choice of setup mode to use, as this may be dictated by your system or corporate engineering policy.

Switch S1 Position Information for AGC Stations

Position 1 Thermal Setup Mode	Position 2 Manual Setup Mode	Position 3 AGC Operational Mode
<p>A thermistor (thermal) driven circuit on the amplifier sets the DC control voltage that drives the Bode.</p> <p>This circuit detects the amplifier’s internal temperature and generates the proper level of DC control voltage, setting the proper loss characteristics of the Bode with respect to the current outdoor temperature.</p> <p>Note: This is the same as the “Thermal” toggle switch setting on most prior AGCs.</p>	<p>The Manual Backoff potentiometer sets the DC control voltage that drives the Bode.</p> <p>Manually adjusting the Manual Backoff potentiometer sets the proper loss characteristics of the Bode with respect to the current outdoor temperature.</p> <p>Manual adjustment is done by monitoring the amplifier RF output level and adjusting the potentiometer to reduce the gain “x” dB from the full gain (minimum loss) of the potentiometer setting.</p> <p>The value of “x” (gain reduction) is dependant upon outside temperature and is determined by consulting the Manual Backoff Chart.</p> <p>Note: This is the same as the “Manual” toggle switch setting on some prior AGCs.</p>	<p>The AGC detector circuit monitors the AGC pilot carrier level at the input to the AGC module. The detected AGC pilot carrier level variations cause a proportional variation of the DC control voltage that drives the Bode.</p> <p>Important: The switch must be left in this position after initial balancing in order for the AGC to function with the Bode properly.</p> <p>The AGC and Bode combination thus cause offsetting gain and slope variations to occur as needed, holding the actual amplifier output stable.</p> <p>Note: This is the same as the “Auto” toggle switch setting on all prior AGCs.</p>

Note: AGC operational mode is used only after the station has been initially balanced in either thermal or manual setup mode.

Switch S1 Positions for Manual Stations

The manual version of the GainMaker Line Extender does not have a Bode network installed. Therefore, switch S1 has no function in the manual version of the product.

Switch S1 Positions for Thermal Stations

The mode of thermal compensation you select for a thermal station determines the position in which you place switch S1.

- Position 1 - Selects amplifier only compensation mode
- Position 2 - Not used
- Position 3 - Selects amplifier and coax compensation mode

Bode Network

The Bode Network, or Bode, is an interstage variable attenuation and slope network whose loss characteristics are driven by DC control voltage.

The position of switch S1 sets the DC control voltage driving the Bode according to the

setup mode or operational mode required for the station.

Refer to the following table for more information on choosing the correct switch position for your application.

Note: Consult your system technical supervisor or manager for more information about which choice of setup mode to use as this may be dictated by your system or corporate engineering policy.

Switch S1 Position Information for Thermal Configured Stations

Position 1 Amplifier Only	Position 2 NOT USED	Position 3 Amplifier and Coax
A thermistor (thermal) driven circuit on the amplifier sets the DC control voltage that drives the Bode.	Important! Do not select this position. This position is reserved for stations with an AGC installed.	A thermistor (thermal) driven circuit on the amplifier sets the DC control voltage that drives the Bode.
This circuit detects the amplifier's internal temperature and generates the proper level of DC control voltage, setting the proper loss characteristics of the Bode with respect to the current outdoor temperature.	While adjustments to the Manual Backoff potentiometer will affect amplifier gain with S1 in this position, once S1 is set to position 1 or 3, the manual potentiometer setting will not affect proper thermal amplifier operation.	This circuit detects the amplifier's internal temperature and generates the proper level of DC control voltage, setting the proper loss characteristics of the bode with respect to the temperature.
Note: This switch position is meant to compensate for the temperature related level variations of the amplifier only. This switch position is normally selected when underground cable precedes the station, since such cable is subject to little temperature variation.	Leaving the switch in this position disables the thermistor (thermal) driven circuit and enables the backoff potentiometer on the amplifier. This sets the DC control voltage that drives the Bode to a constant setting, regardless of the current outdoor temperature.	Note: This switch position is meant to compensate for the temperature related level variations of both the amplifier and the coaxial cable preceding the station.
	Note: This is a factory setting used to verify proper station gain with a given amount of manual gain backoff.	This switch position is normally selected when overhead cable precedes the station, since such cable is subject to temperature variation.

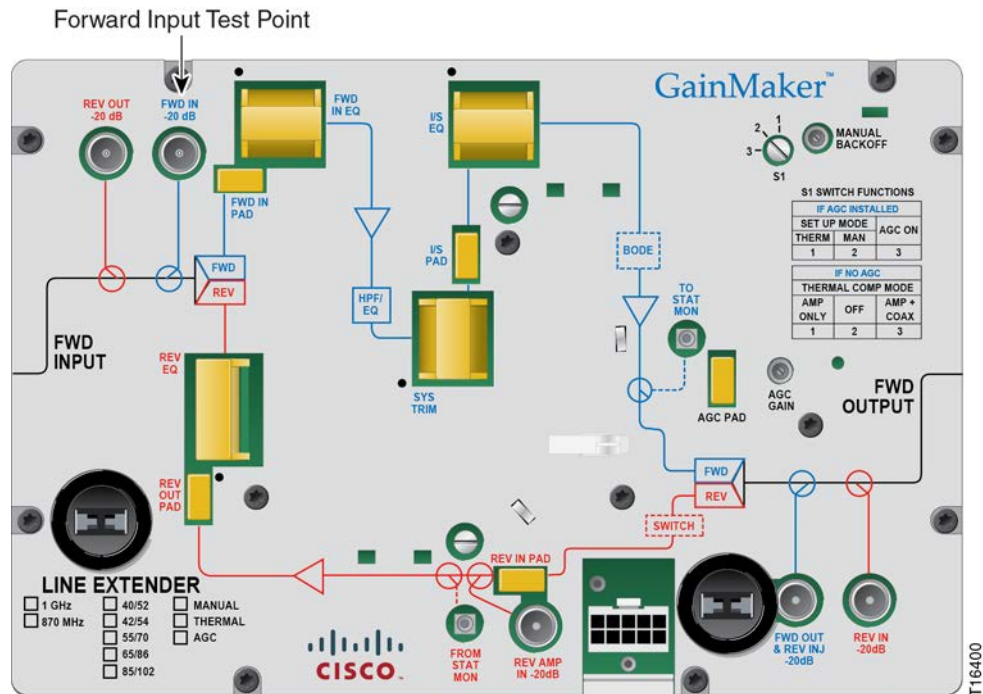
Note: Switch S1 in Position 2, and the backoff potentiometer, are used in AGC stations only.

To Verify the Input Signal Level

Complete the following steps to test the input signal level.

Important: You cannot balance the amplifier without the proper input signals.

- 1 Connect the test equipment to the forward input test point shown in the illustration below.



- 2 Measure the signal level at the following frequencies:
 - The lowest frequency specified in the system design
 - The highest frequency specified in the system design
- 3 Compare the measured levels to the design input levels on the system design print.

Note: Add 20 dB to the measured levels to find the true levels. The test point attenuates input signals by 20 dB.
- 4 Are measured levels within the desired limits?
 - If **yes**, proceed to step 5.
 - If **no**, or if no signals are present, find the problem before proceeding. You cannot balance the amplifier without the proper input signals.
- 5 Remove the test point adapter from the forward input test point, leaving other equipment connectors intact.

Balancing the Forward Path

Be sure to use the correct procedure for forward path balancing. Refer to *To Select the Forward Path Balancing Procedure* (on page 47) for help in identifying the procedure that best fits your system installation and amplifier type.

Before you begin, also make sure that the amplifier module is configured according to the specifications in the design print, and that the amplifier has warmed up for approximately one hour.

To Select the Forward Path Balancing Procedure

Refer to the following table to direct you to the proper starting point to balance your amplifier using your preferred method.

If you have ...	and you use ...	go to ...
an amplifier configured with AGC	manual mode for balancing	<i>Forward Path Balancing for AGC Stations Using Manual Setup Mode</i> (on page 47)
an amplifier configured with AGC	thermal setup mode for balancing	<i>Forward Path Balancing for AGC Stations Using Thermal Setup Mode</i> (on page 56)
a thermal amplifier (no AGC)	amplifier only compensation mode for balancing	<i>Forward Path Balancing for Thermal Stations Using Amplifier Only Compensation Mode</i> (on page 63)
a thermal amplifier (no AGC)	amplifier and coax compensation mode for balancing	<i>Forward Path Balancing for Thermal Stations Using Amplifier and Coax Compensation Mode</i> (on page 66)
a manual amplifier (no AGC)	N/A	<i>Forward Path Balancing for Manual Stations</i> (on page 70)
an amplifier configured with AGC	a trim network for balancing	<i>Forward Path Balancing Using Trim Networks</i> (on page 72)

Forward Path Balancing for AGC Stations Using Manual Setup Mode

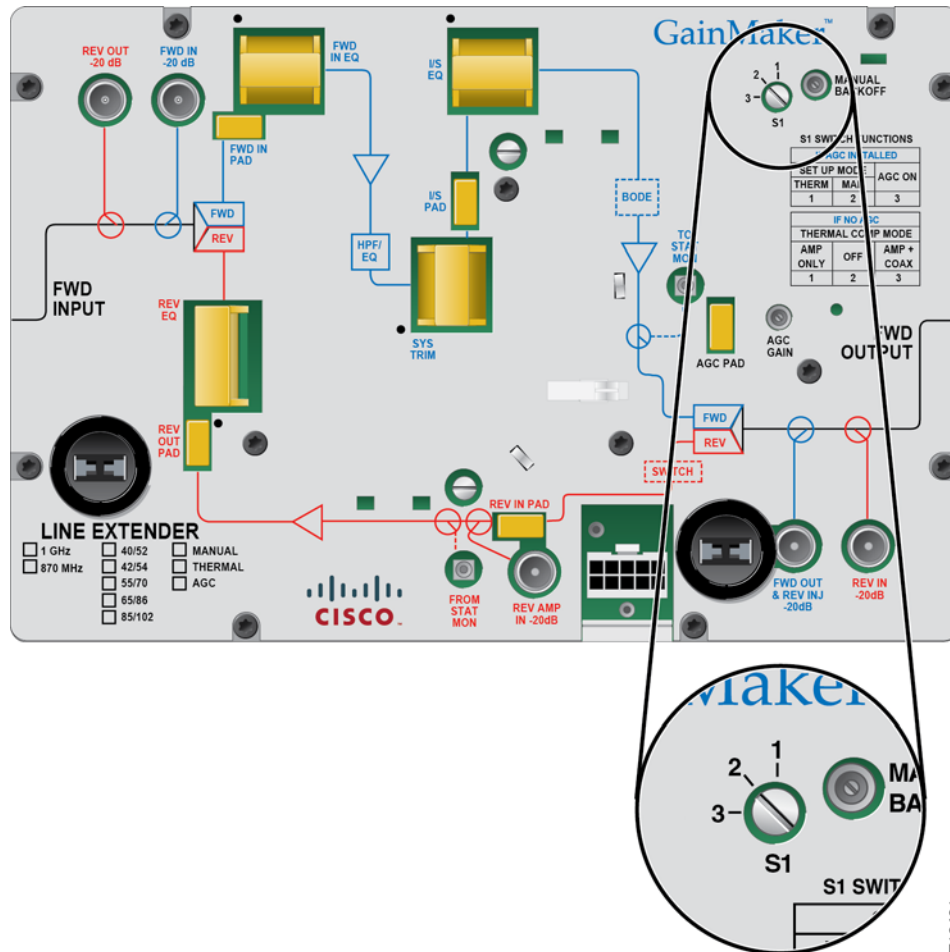
Before you begin, make sure that you have configured the amplifier module according to the specifications in the design print, and that the amplifier has warmed up for approximately one hour.

To Set the Manual Backoff Level

You must adjust the manual backoff level.

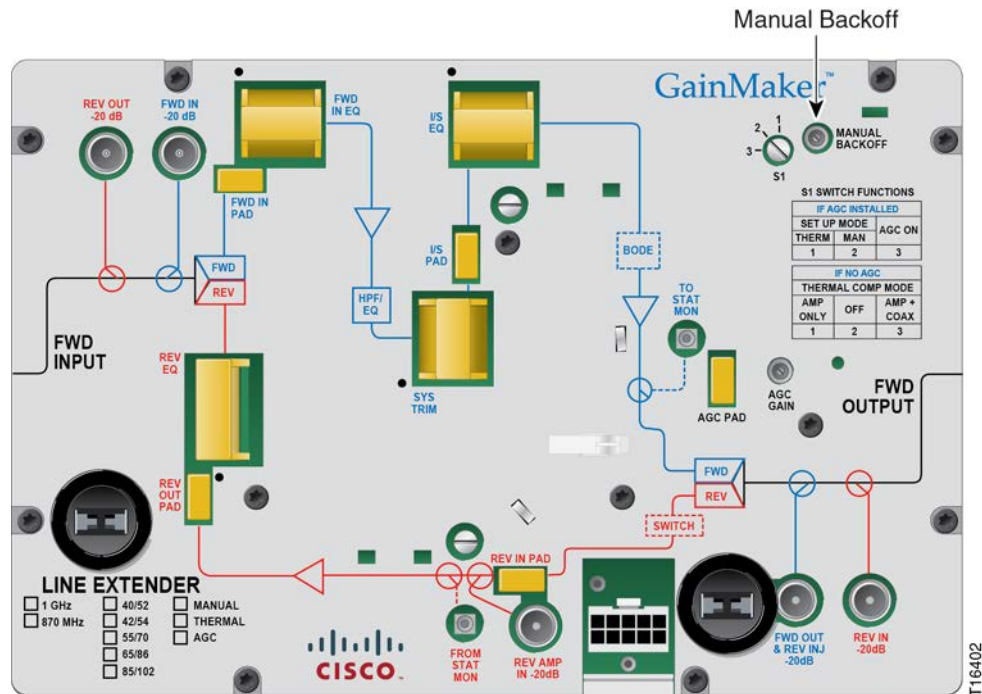
Complete the following steps to set the manual backoff level.

- 1 Connect an RF meter or spectrum analyzer to the forward main output test point.
- 2 Set switch S1 to position number 2.



- 3 Turn the MANUAL BACKOFF potentiometer fully **counterclockwise** for maximum gain.

Balancing the Forward Path



- 4 Determine the outside temperature at the amplifier location.
- 5 Refer to the Manual Backoff Chart to find the proper manual backoff level for the current temperature and reference frequency.
- 6 Turn the MANUAL BACKOFF potentiometer **clockwise** to reduce the output level by the amount specified in the Manual Backoff Chart.
Note: After making this adjustment, do not adjust the MANUAL BACKOFF potentiometer again.
- 7 Proceed to the next section, **To Determine the Output Tilt.**

Manual Backoff Chart

The following table displays the manual backoff level for selected frequencies and various temperatures.

Temperature		445.25 MHz Backoff level	547.25 MHz Backoff level	870 MHz Backoff level	1 GHz Backoff level
60°C	140°F	0.0 dB	0.0 dB	0.0 dB	0.0 dB
55°C	131°F	0.4 dB	0.4 dB	0.5 dB	0.6 dB
50°C	122°F	.7 dB	0.8 dB	1.1 dB	1.2 dB
45°C	113°F	1.1 dB	1.2 dB	1.6 dB	1.7 dB
40°C	104°F	1.4 dB	1.5 dB	2.1 dB	2.3 dB
35°C	95°F	1.8 dB	1.9 dB	2.7 dB	2.9 dB
30°C	86°F	2.1 dB	2.3 dB	3.1 dB	3.5 dB
25°C	77°F	2.5 dB	2.7 dB	3.7 dB	4.0 dB

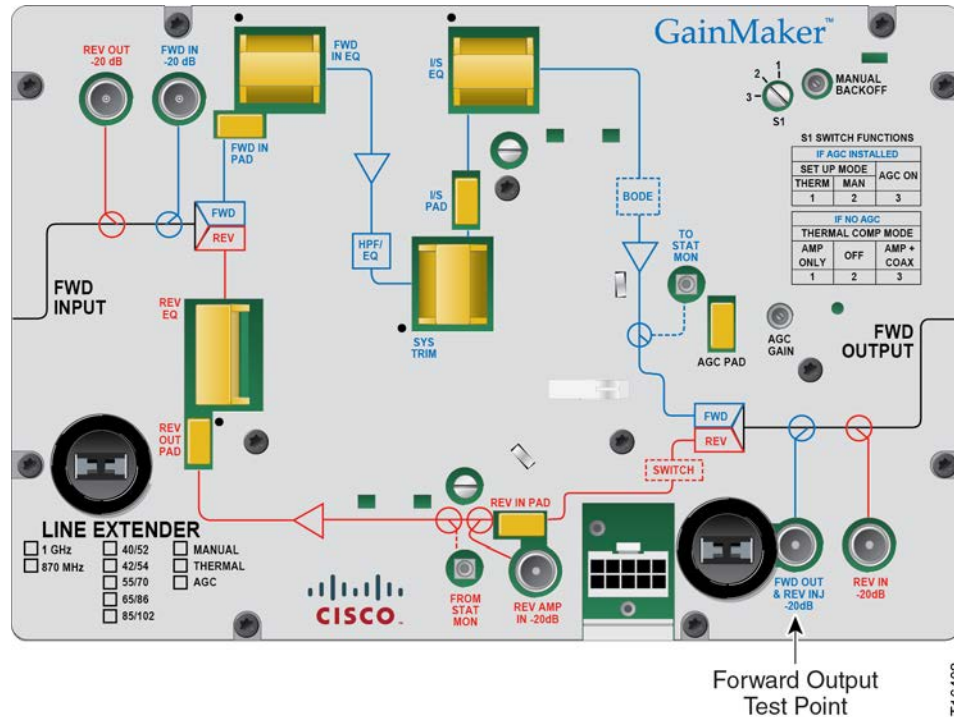
Chapter 3 Balancing and Setup

Temperature		445.25 MHz Backoff level	547.25 MHz Backoff level	870 MHz Backoff level	1 GHz Backoff level
20°C	68°F	2.8 dB	3.1 dB	4.2 dB	4.6 dB
15°C	59°F	3.1 dB	3.4 dB	4.7 dB	5.0 dB
10°C	50°F	3.3 dB	3.7 dB	5.1 dB	5.6 dB
5°C	41°F	3.6 dB	4.1 dB	5.6 dB	6.0 dB
0°C	32°F	3.9 dB	4.4 dB	6.0 dB	6.5 dB
-5°C	23°F	4.1 dB	4.7 dB	6.5 dB	7.0 dB
-10°C	14°F	4.4 dB	5.0 dB	7.0 dB	7.5 dB
-15°C	5°F	4.6 dB	5.4 dB	7.4 dB	7.9 dB
-20°C	-4°F	4.9 dB	5.7 dB	7.8 dB	8.4 dB
-25°C	-13°F	5.1 dB	6.0 dB	8.2 dB	8.9 dB
-30°C	-22°F	5.4 dB	6.3 dB	8.7 dB	9.4 dB
-35°C	-31°F	5.7 dB	6.6 dB	9.1 dB	9.8 dB
-40°C	-40°F	5.9 dB	7.0 dB	9.6 dB	10.3 dB

To Determine the Output Tilt

Complete the following steps to determine the output tilt of the amplifier.

- 1 Connect the test point adapter to the forward main output test point.



- 2 Consult the design print to find the proper output tilt.
- 3 Measure the output signal levels at the frequencies you used in *To Verify the Input Signal Level* (on page 45).
- 4 To determine the actual output tilt, calculate the difference (in dB) between the levels of the lowest and highest specified frequencies.
- 5 Proceed to the next section, **To Set the Output Tilt**.

To Set the Output Tilt

Equalizers (EQs) are available in 1.5 dB (equivalent) increments. A 1.5 dB change in value changes the difference between low and high frequencies by approximately 1 dB generally, or 1.2 dB for AGC stations in manual setup mode.

- Increasing the equalizer value *reduces* the level at lower frequencies, relative to the level at 870 MHz/1 GHz.
- Decreasing the equalizer value *increases* the level at lower frequencies, relative to the level at 870 MHz/1 GHz.

Complete the following steps to select the proper forward input equalizer value.

- 1 Compare the calculated output tilt in step 4 of **To Determine the Output Tilt** with the design tilt (on the design print).
- 2 Is the output tilt within ± 0.5 dB of the design tilt?

- If the output tilt is within ± 0.5 dB of the design tilt, proceed to the next section, **To Set the Output Level**.
 - If the output tilt is more than design tilt, replace the forward input EQ with a lower value.
 - If the output tilt is less than design tilt, replace the forward input EQ with a higher value.
- 3 Measure the output tilt again, and then return to step 1.

To Set the Output Level

After setting the tilt, complete the following steps to select the proper pad values for the amplifier. The output level of the amplifier is set by selecting the proper pad value.

- 1 Connect the test probe to the forward main output test point.
- 2 Measure the output level at the highest design frequency, and compare this level with the design level (on the design print).
- 3 Is the measured output level within ± 0.5 dB of the design level?
 - If the output level is within ± 0.5 dB of the design output level, proceed to step 5.
 - If the output level is more than the design output level, replace the forward input pad with a higher value pad.
 - If the output level is less than the design level, replace the forward input pad with a lower value pad.
- 4 Repeat steps 2 and 3 until the output level is correct.

Note: On the High Gain Dual, the type of plug-in signal director installed directly affects the signal level measured at the Aux RF output test points. This is because the Aux RF output test points are located *after* the signal director in the forward RF signal path instead of *before* as in previous versions of system amplifiers (II, II+, and III). The test points now reflect the actual output of the port.

It is important to determine if the Aux output level specified on the design print is the level before or after the signal director.

- If it is the level *after* the signal director (port output level), the test point should match the print design level.
 - If it is the level *before* the signal director, the test point level should be “x” dB lower than the print design level, where “x” is the insertion loss of the signal director feeding the particular Aux port being balanced.
- 5 Proceed to the next section, **To Set Up Automatic Gain Control**.

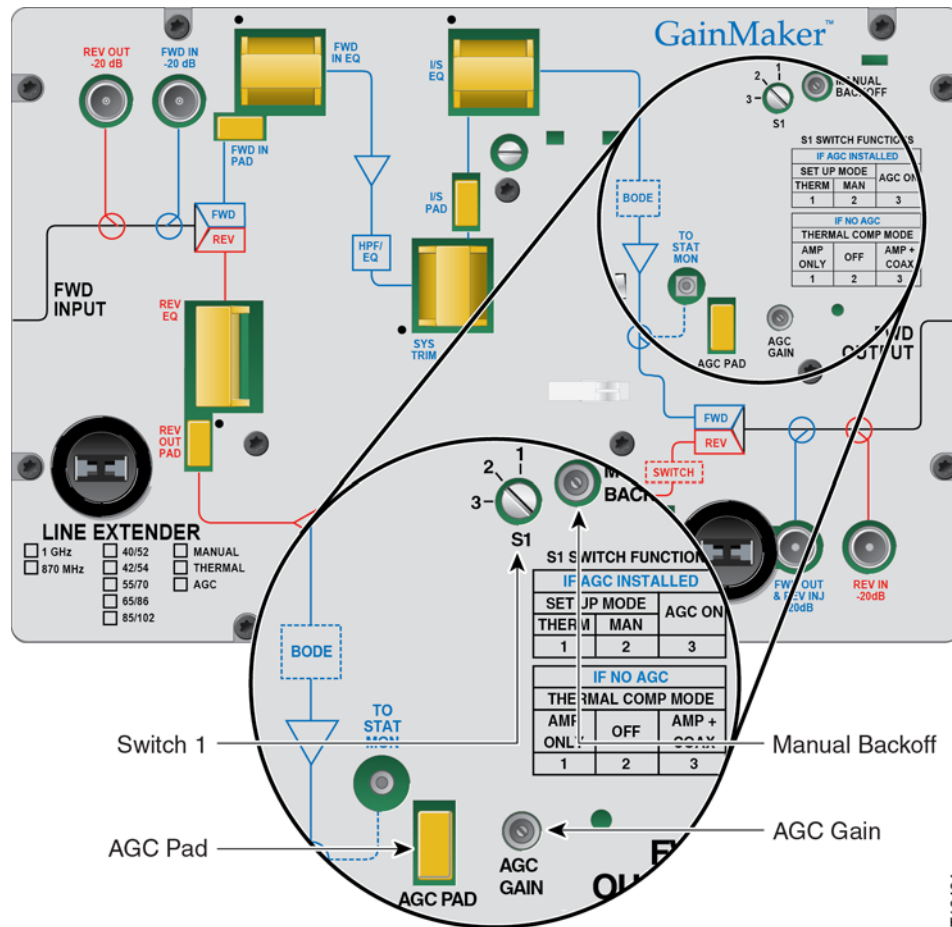
To Set Up Automatic Gain Control

This section provides procedures and tables for configuring and aligning the AGC in the GainMaker Line Extender. AGC attenuator values are required to select the proper AGC attenuator value based upon actual AGC pilot carrier output level. See **To Select the AGC Pad Value**.

Note:

- Output levels are measured at the pilot frequency.
- The standard single-pilot AGC makes amplifier output adjustments based on the level of the pilot frequency carrier. Activate the pilot carrier with its final unscrambled video source before beginning balance and alignment.

The following diagram shows the location of the AGC related switch, controls, and AGC pad.



To Select the AGC Pad Value

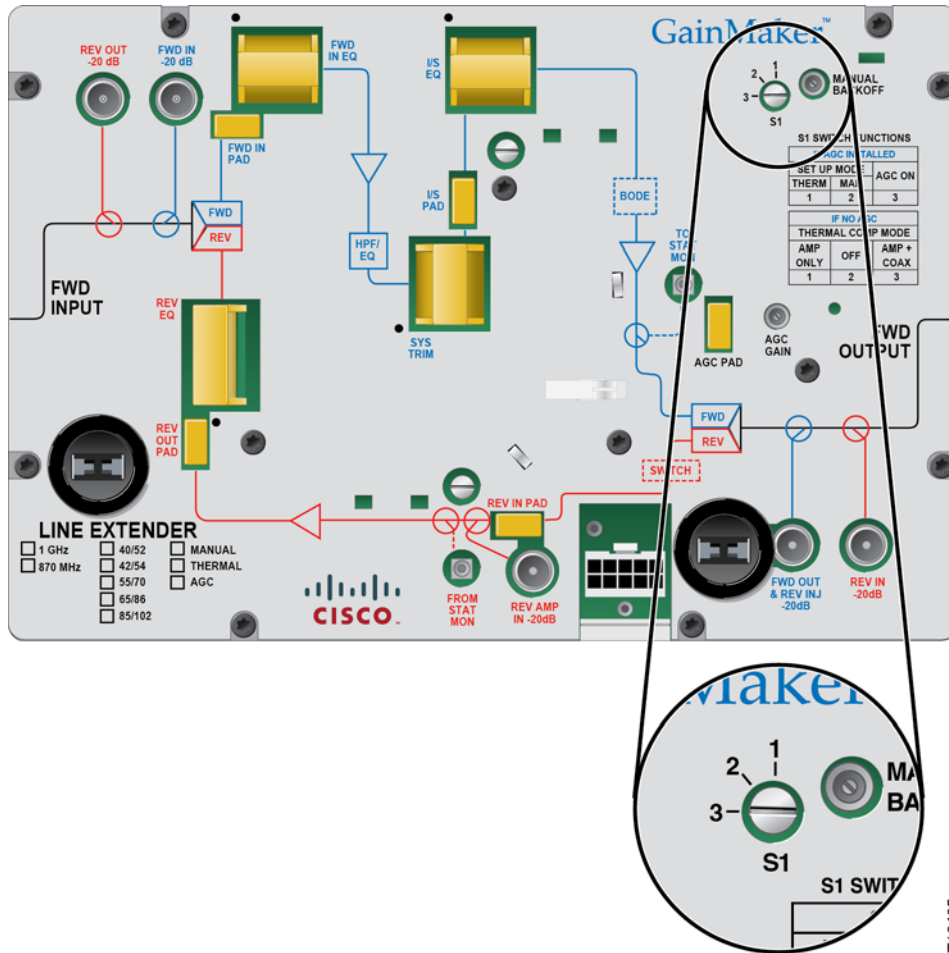
Use the following formula to determine the correct AGC pad value.

- $\text{AGC pad value} = \text{RF output level at pilot frequency (output port)} - 29 \text{ dB}$

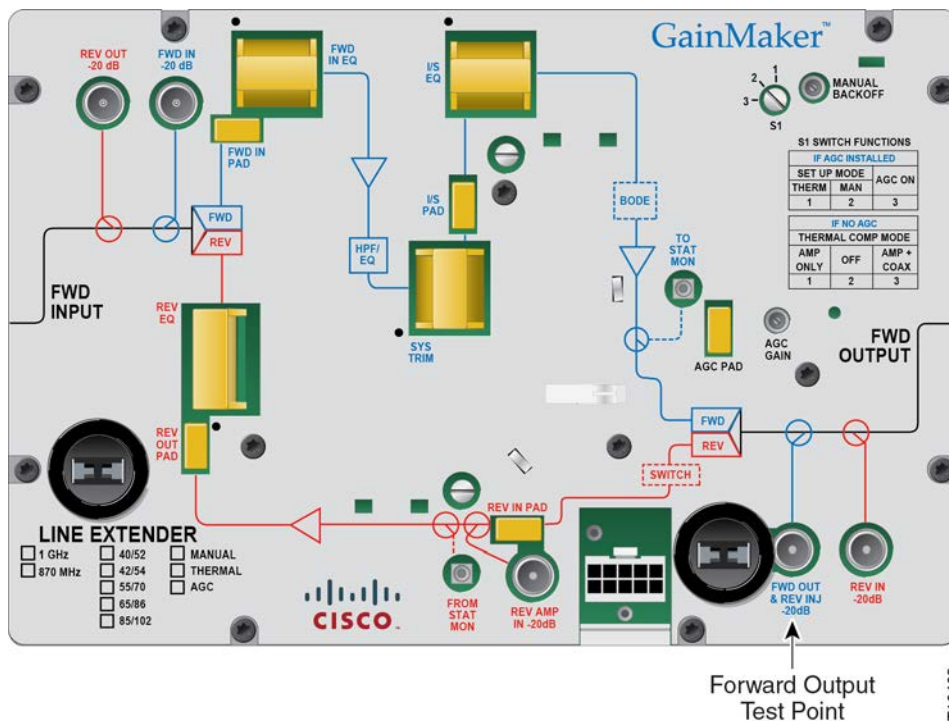
To Align the AGC Module

Complete the following steps to align the AGC module.

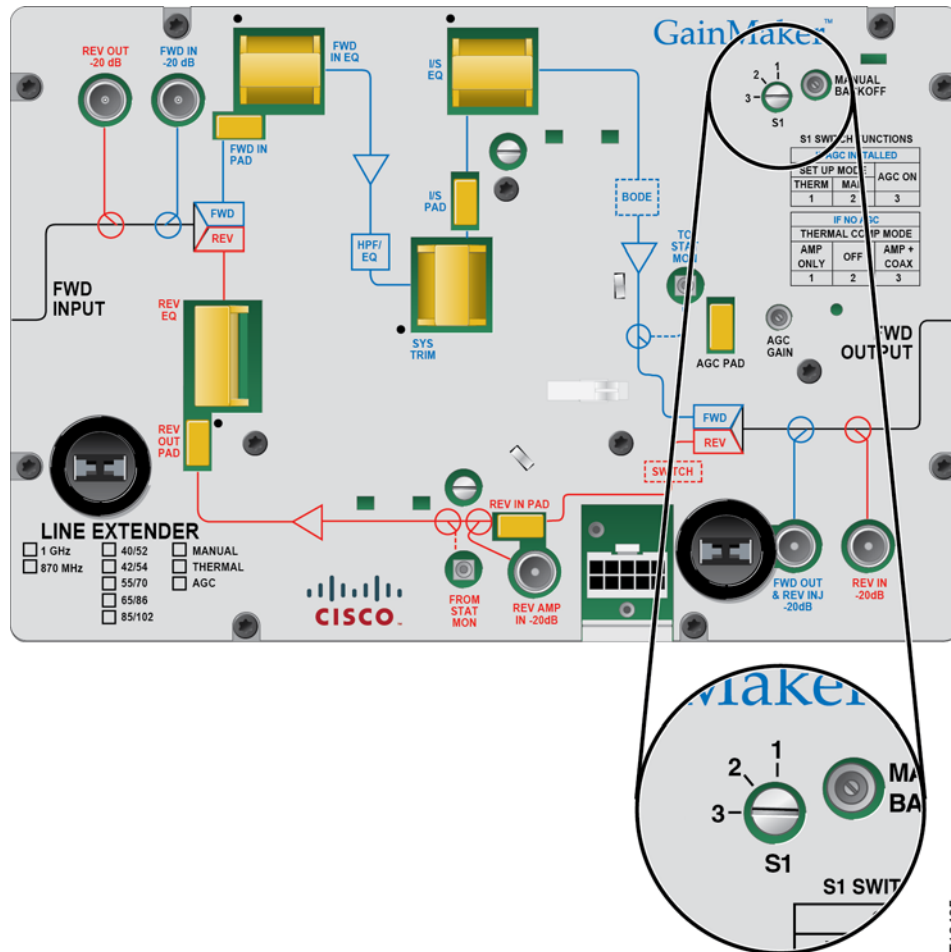
- 1 Make sure that switch S1 is set to position 2.



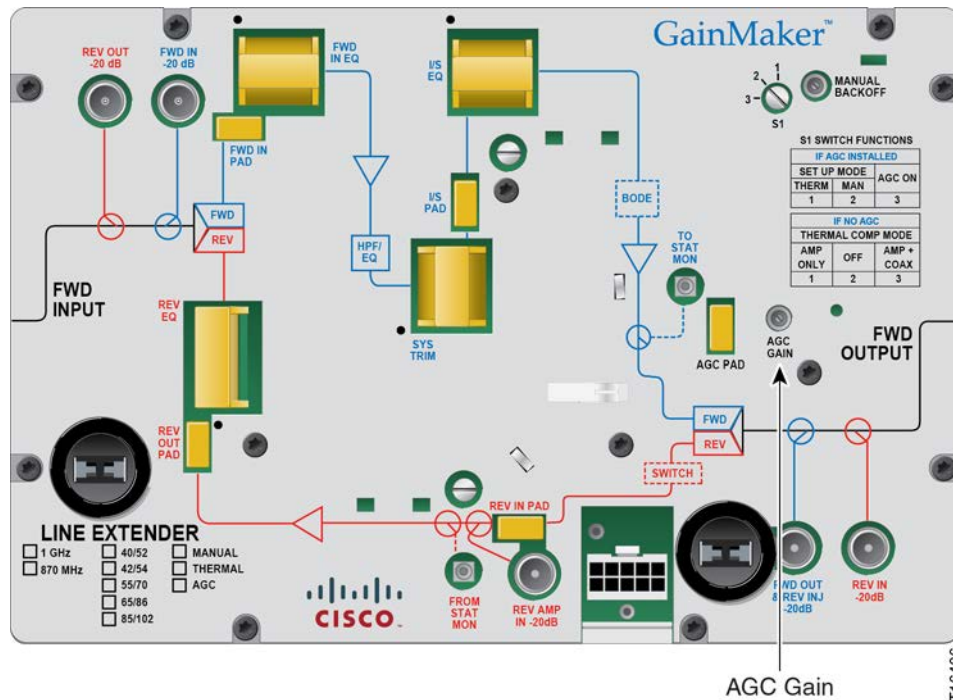
2 Insert the test probe into the -20 dB forward main output test point on the amplifier.



- 3 Measure and note the RF output level at the AGC pilot frequency.
Note: Remember to add 20 dB to compensate for the test point loss.
- 4 Set switch S1 to position 3 for AGC operation.



- 5 Adjust the AGC gain control potentiometer to match the level you measured in step 3.



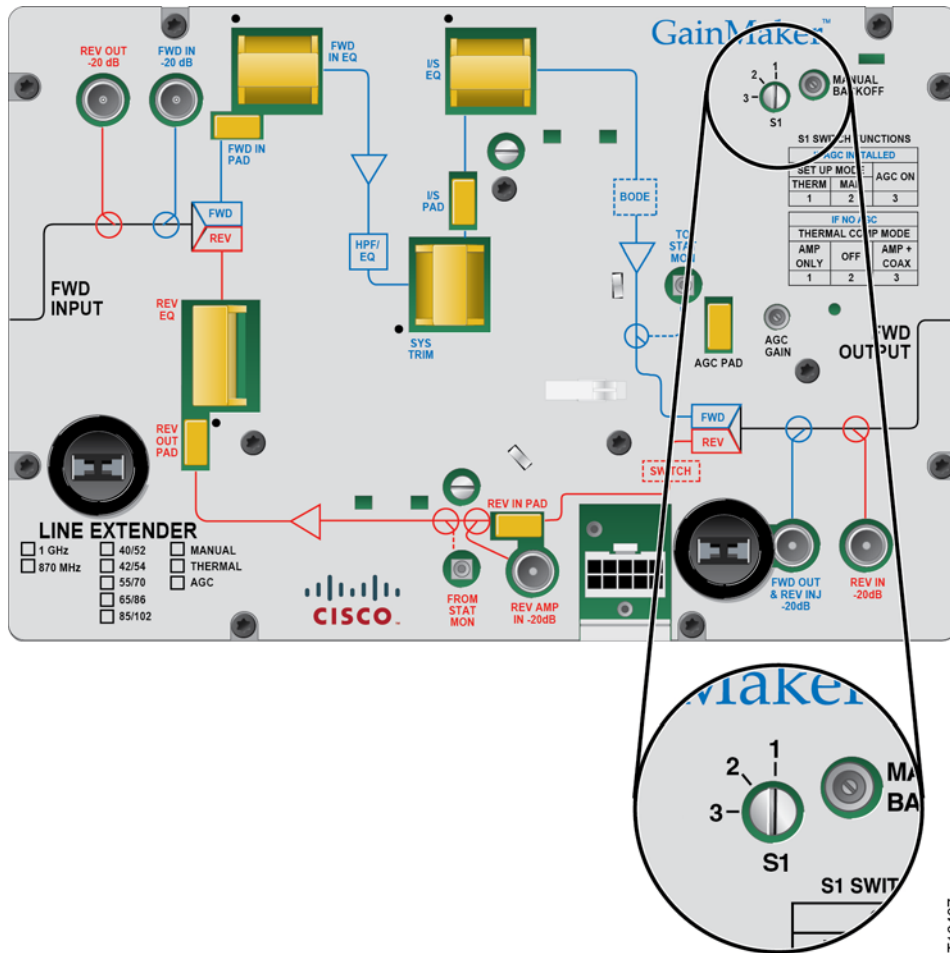
- 6 Move switch S1 back and forth between position 2 and position 3.
Important: Let the amplifier module settle before reading signal levels.
 The signal level should not vary when you switch between positions 2 and 3. If the signal level does vary, repeat steps 4 through 6 as needed until the signal level does not vary between switch positions 2 and 3.
- 7 Set switch S1 to position 3 for AGC operation mode.
- 8 Proceed to *Balancing the Reverse Path* (on page 74).

Forward Path Balancing for AGC Stations Using Thermal Setup Mode

Before you begin, make sure that you have configured the amplifier module according to the specifications in the design print, and that the amplifier has warmed up for approximately one hour.

To Set Switch S1 for Thermal Setup Mode

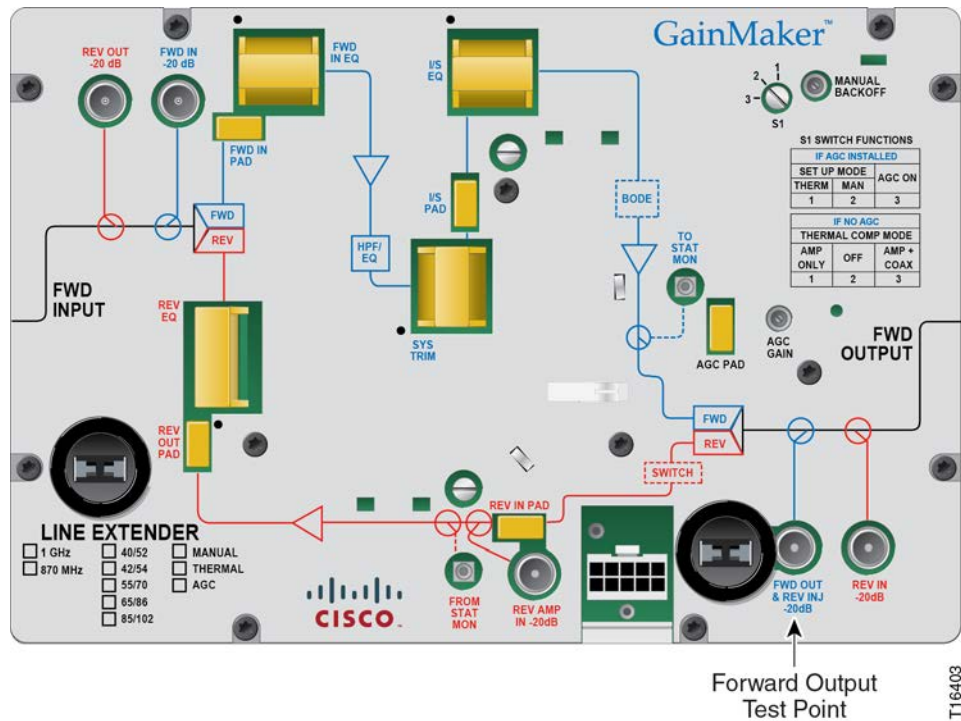
You must set switch S1 to position number 1 to use thermal setup mode.



To Determine the Output Tilt

Complete the following steps to determine the output tilt of the amplifier.

- 1 Connect the test point adapter to the forward main output test point.



- 2 Consult the design print to find the proper output tilt.
- 3 Measure the output signal levels at the frequencies you used in *To Verify the Input Signal Level* (on page 45).
- 4 To determine the actual output tilt, calculate the difference (in dB) between the levels of the lowest and highest specified frequencies.
- 5 Proceed to the next section, **To Set the Output Tilt**.

To Set the Output Tilt

Equalizers (EQs) are available in 1.5 dB (equivalent) increments. A 1.5 dB change in value changes the difference between low and high frequencies by approximately 1 dB generally, or 1.2 dB for AGC stations in manual setup mode.

- Increasing the equalizer value *reduces* the level at lower frequencies, relative to the level at 870 MHz/1 GHz.
- Decreasing the equalizer value *increases* the level at lower frequencies, relative to the level at 870 MHz/1 GHz.

Complete the following steps to select the proper forward input equalizer value.

- 1 Compare the calculated output tilt in step 4 of **To Determine the Output Tilt** with the design tilt (on the design print).
- 2 Is the output tilt within ± 0.5 dB of the design tilt?
 - If the output tilt is within ± 0.5 dB of the design tilt, proceed to the next section, **To Set the Output Level**.
 - If the output tilt is more than design tilt, replace the forward input EQ with a lower value.

- If the output tilt is less than design tilt, replace the forward input EQ with a higher value.
- 3 Measure the output tilt again, and then return to step 1.

To Set the Output Level

After setting the tilt, complete the following steps to select the proper pad values for the amplifier. The output level of the amplifier is set by selecting the proper pad value.

- 1 Connect the test probe to the forward main output test point.
- 2 Measure the output level at the highest design frequency, and compare this level with the design level (on the design print).
- 3 Is the measured output level within ± 0.5 dB of the design level?
 - If the output level is within ± 0.5 dB of the design output level, proceed to step 5.
 - If the output level is more than the design output level, replace the forward input pad with a higher value pad.
 - If the output level is less than the design level, replace the forward input pad with a lower value pad.
- 4 Repeat steps 2 and 3 until the output level is correct.

Note: On the High Gain Dual, the type of plug-in signal director installed directly affects the signal level measured at the Aux RF output test points. This is because the Aux RF output test points are located *after* the signal director in the forward RF signal path instead of *before* as in previous versions of system amplifiers (II, II+, and III). The test points now reflect the actual output of the port.

It is important to determine if the Aux output level specified on the design print is the level before or after the signal director.

- If it is the level *after* the signal director (port output level), the test point should match the print design level.
 - If it is the level *before* the signal director, the test point level should be “x” dB lower than the print design level, where “x” is the insertion loss of the signal director feeding the particular Aux port being balanced.
- 5 Proceed to the next section, **To Set Up Automatic Gain Control**.

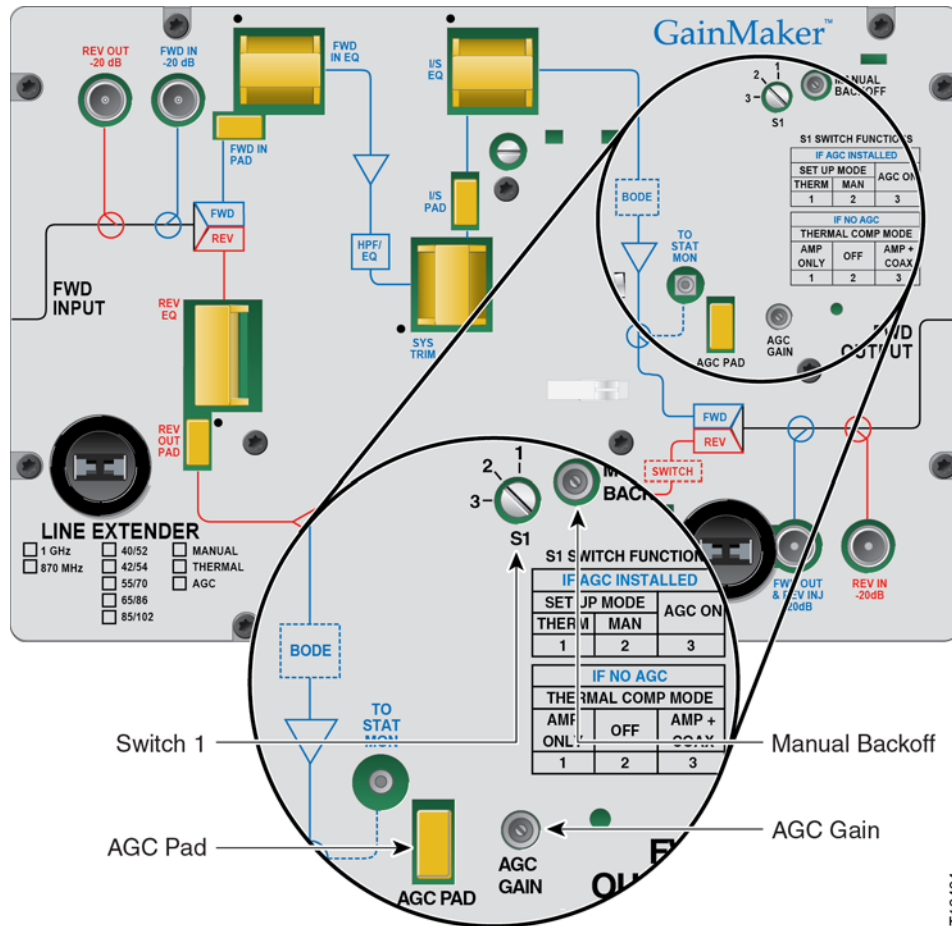
To Set Up Automatic Gain Control

This section provides procedures and tables for configuring and aligning the AGC in the GainMaker Line Extender. AGC attenuator values are required to select the proper AGC attenuator value based upon actual AGC pilot carrier output level. See **To Select the AGC Pad Value**.

Note:

- Output levels are measured at the pilot frequency.
- The standard single-pilot AGC makes amplifier output adjustments based on the level of the pilot frequency carrier. Activate the pilot carrier with its final unscrambled video source before beginning balance and alignment.

The following diagram shows the location of the AGC related switch, controls, and AGC pad.



To Select the AGC Pad Value

Use the following formula to determine the correct AGC pad value.

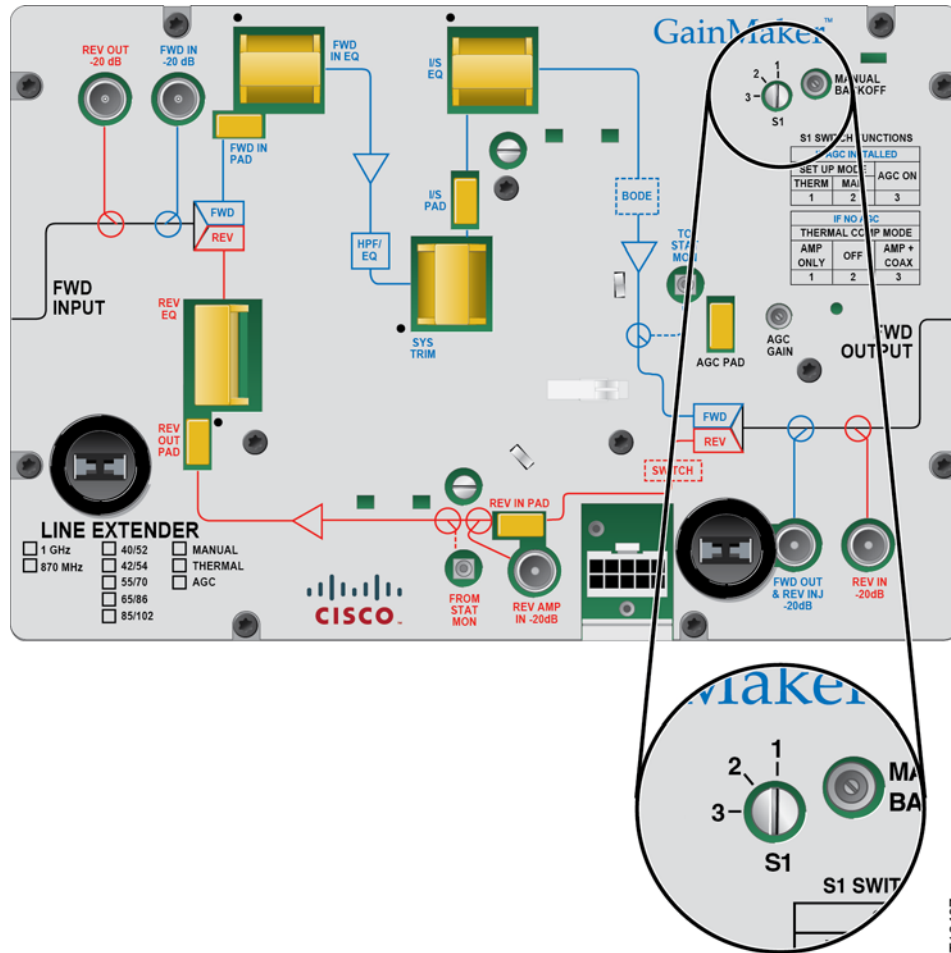
- $AGC\ pad\ value = RF\ output\ level\ at\ pilot\ frequency\ (output\ port) - 29\ dB$

To Align the AGC Module

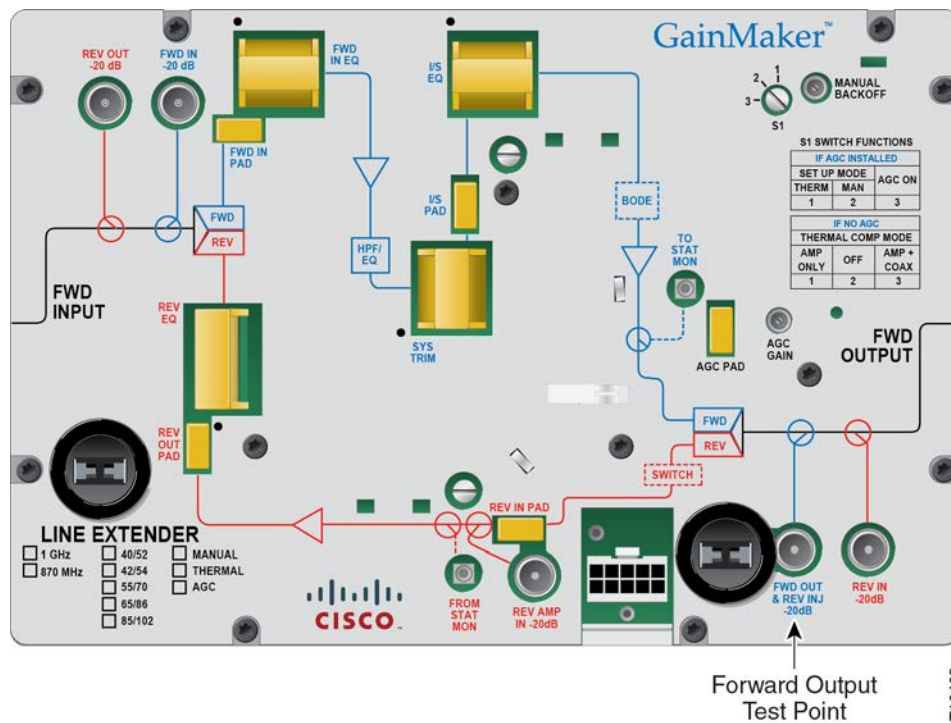
Complete the following steps to align the AGC module.

- 1 Make sure that switch S1 is set to position 1.

Balancing the Forward Path

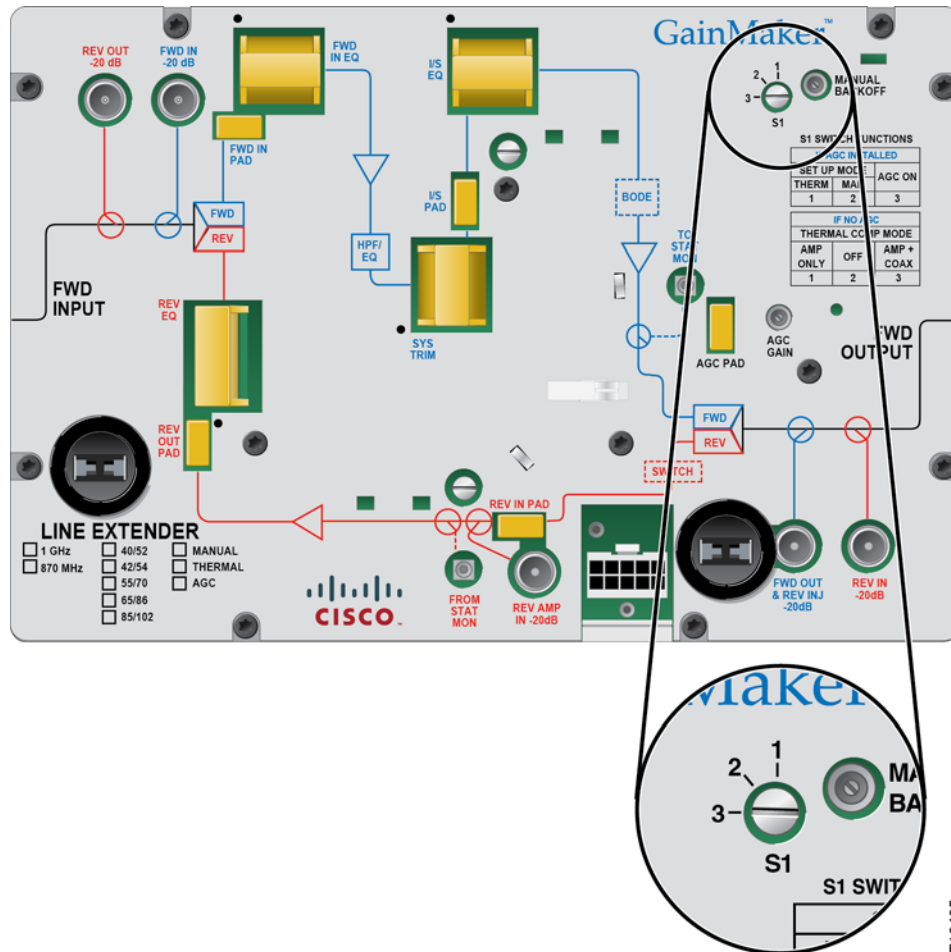


- 2 Insert the test probe into the -20 dB forward main output test point on the amplifier.

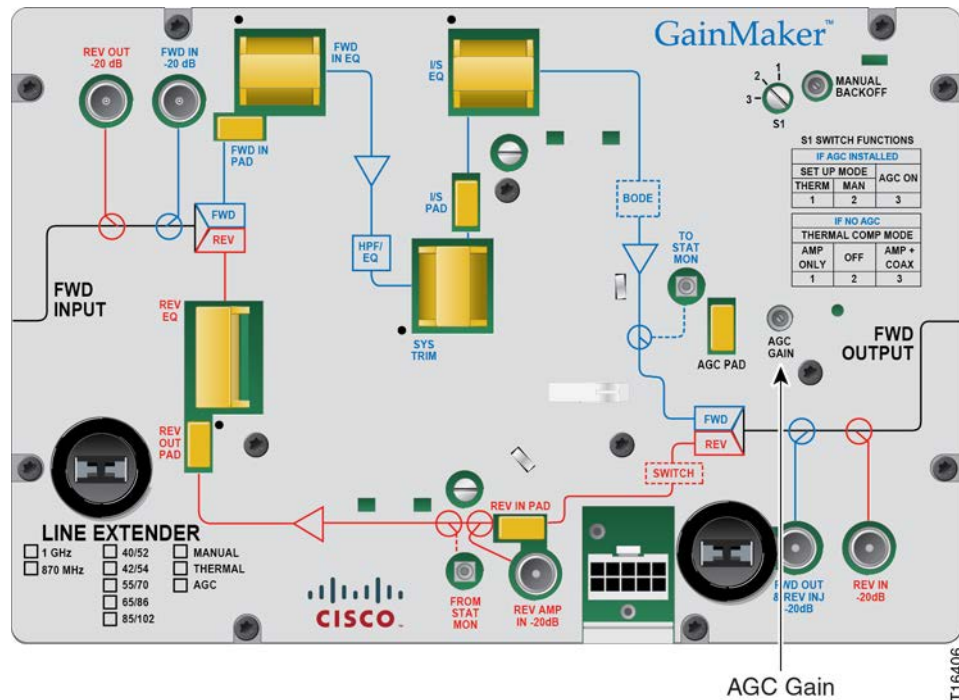


Chapter 3 Balancing and Setup

- 3 Measure and note the RF output level at the AGC pilot frequency.
Note: Remember to add 20 dB to compensate for the test point loss.
- 4 Set switch S1 to position 3 for AGC operation.



- 5 Adjust the AGC gain control potentiometer to match the level you measured in step 3.



- 6 Move switch S1 back and forth between position 1 and position 3.

Important: Let the amplifier module settle before reading signal levels.

The signal level should not vary when you switch between positions 1 and 3. If the signal level does vary, repeat steps 4 through 6 as needed until the signal level does not vary between switch positions 1 and 3.

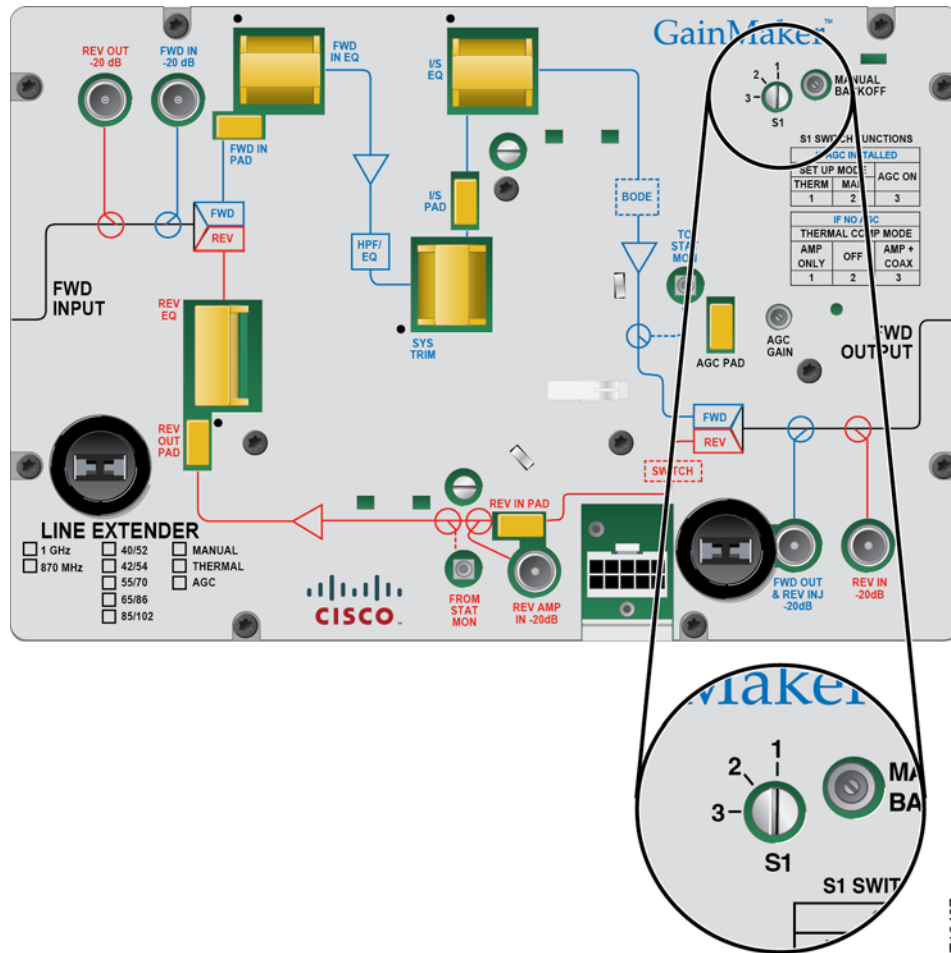
- 7 Set switch S1 to position 3 for AGC operation mode.
- 8 Proceed to *Balancing the Reverse Path* (on page 74).

Forward Path Balancing for Thermal Stations Using Amplifier Only Compensation Mode

Before you begin, make sure that you have configured the amplifier module according to the specifications in the design print, and that the amplifier has warmed up for approximately one hour.

To Set Switch S1 for Amplifier Only Compensation Mode

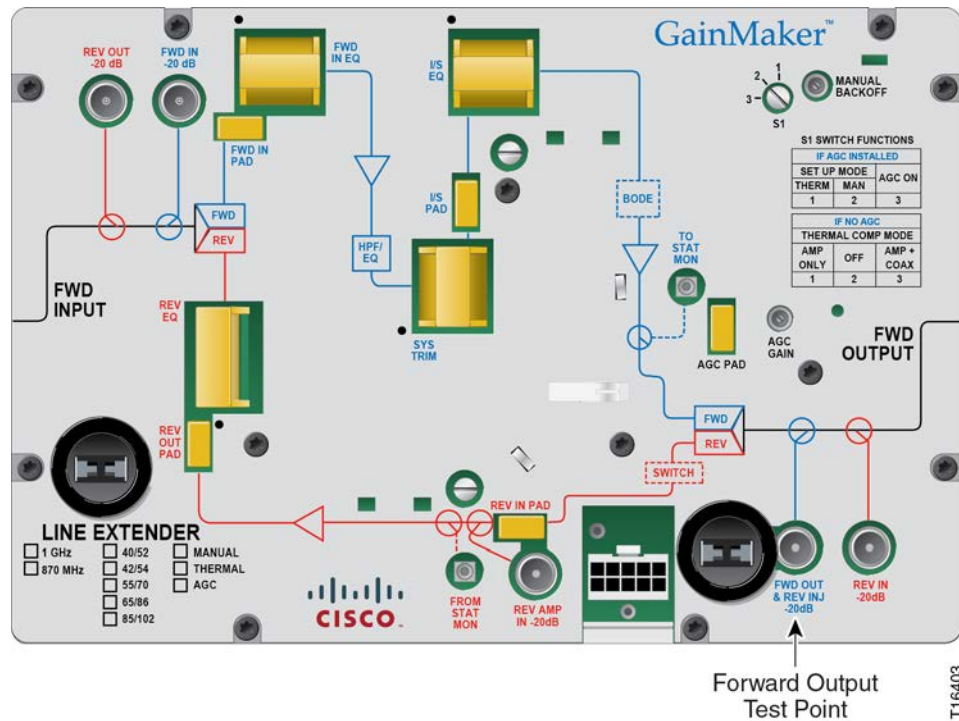
You must set switch S1 to position number 1 to use amplifier only compensation mode.



To Determine the Output Tilt

Complete the following steps to determine the output tilt of the amplifier.

- 1 Connect the test point adapter to the forward main output test point.



- 2 Consult the design print to find the proper output tilt.
- 3 Measure the output signal levels at the frequencies you used in *To Verify the Input Signal Level* (on page 45).
- 4 To determine the actual output tilt, calculate the difference (in dB) between the levels of the lowest and highest specified frequencies.
- 5 Proceed to the next section, **To Set the Output Tilt**.

To Set the Output Tilt

Equalizers (EQs) are available in 1.5 dB (equivalent) increments. A 1.5 dB change in value changes the difference between low and high frequencies by approximately 1 dB generally, or 1.2 dB for AGC stations in manual setup mode.

- Increasing the equalizer value *reduces* the level at lower frequencies, relative to the level at 870 MHz/1 GHz.
- Decreasing the equalizer value *increases* the level at lower frequencies, relative to the level at 870 MHz/1 GHz.

Complete the following steps to select the proper forward input equalizer value.

- 1 Compare the calculated output tilt in step 4 of **To Determine the Output Tilt** with the design tilt (on the design print).
- 2 Is the output tilt within ± 0.5 dB of the design tilt?
 - If the output tilt is within ± 0.5 dB of the design tilt, proceed to the next section, **To Set the Output Level**.
 - If the output tilt is more than design tilt, replace the forward input EQ with a lower value.

- If the output tilt is less than design tilt, replace the forward input EQ with a higher value.
- 3 Measure the output tilt again, and then return to step 1.

To Set the Output Level

After setting the tilt, complete the following steps to select the proper pad values for the amplifier. The output level of the amplifier is set by selecting the proper pad value.

- 1 Connect the test probe to the forward main output test point.
- 2 Measure the output level at the highest design frequency, and compare this level with the design level (on the design print).
- 3 Is the measured output level within ± 0.5 dB of the design level?
 - If the output level is within ± 0.5 dB of the design output level, proceed to step 5.
 - If the output level is more than the design output level, replace the forward input pad with a higher value pad.
 - If the output level is less than the design level, replace the forward input pad with a lower value pad.
- 4 Repeat steps 2 and 3 until the output level is correct.

Note: On the High Gain Dual, the type of plug-in signal director installed directly affects the signal level measured at the Aux RF output test points. This is because the Aux RF output test points are located *after* the signal director in the forward RF signal path instead of *before* as in previous versions of system amplifiers (II, II+, and III). The test points now reflect the actual output of the port.

It is important to determine if the Aux output level specified on the design print is the level before or after the signal director.

- If it is the level *after* the signal director (port output level), the test point should match the print design level.
 - If it is the level *before* the signal director, the test point level should be “x” dB lower than the print design level, where “x” is the insertion loss of the signal director feeding the particular Aux port being balanced.
- 5 Proceed to *Balancing the Reverse Path* (on page 74).

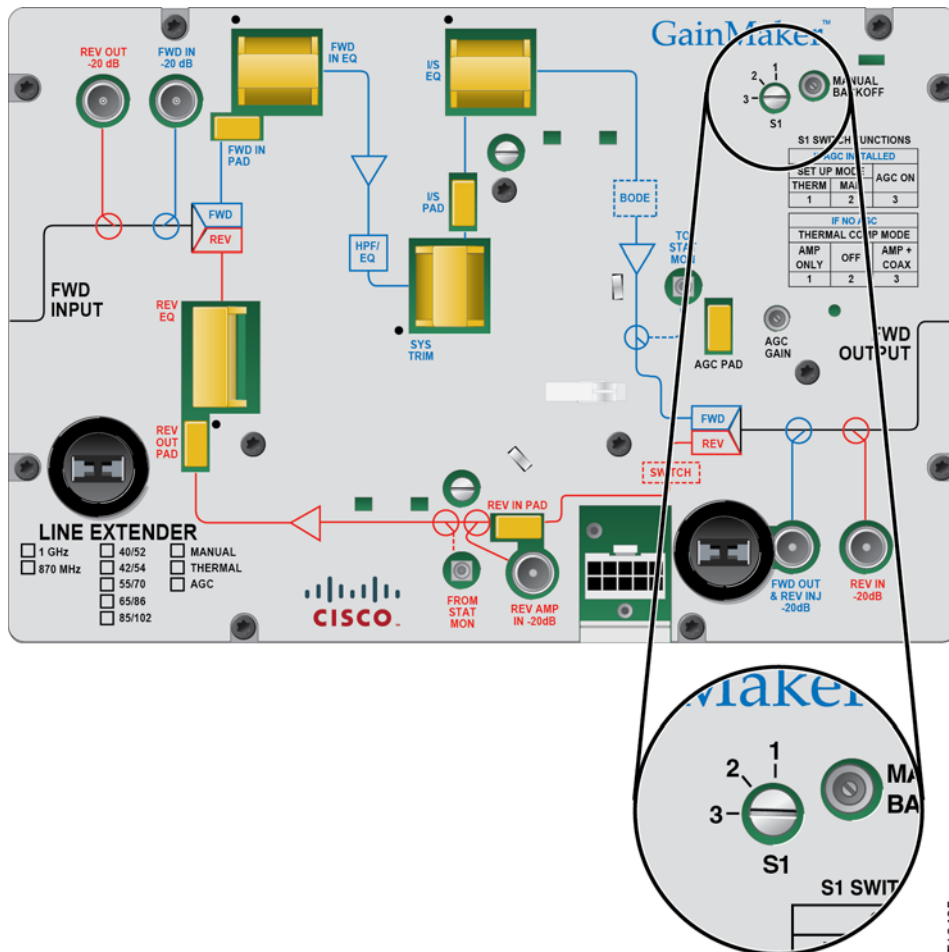
Forward Path Balancing for Thermal Stations Using Amplifier and Coax Compensation Mode

Before you begin, make sure that you have configured the amplifier module according to the specifications in the design print, and that the amplifier has warmed up for approximately one hour.

Note: If it is necessary to balance a thermal station using amplifier and coax compensation mode immediately after module installation (with little or no warm-up period), the output level should be set 1 dB lower than specified by the design print. This reduction in output level will be offset by an increase in internal amplifier gain as the thermal circuit in the amplifier warms up.

To Set Switch S1 for Amplifier and Coax Compensation Mode

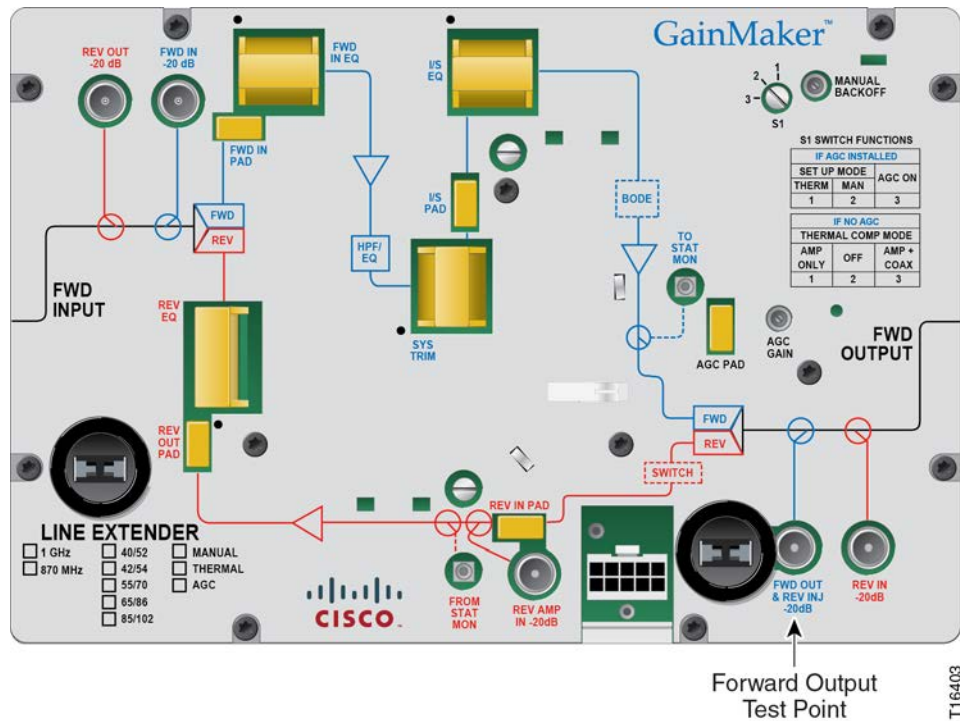
You must set switch S1 to position number 3 to use amplifier and coax compensation mode.



To Determine the Output Tilt

Complete the following steps to determine the output tilt of the amplifier.

- 1 Connect the test point adapter to the forward main output test point.



- 2 Consult the design print to find the proper output tilt.
- 3 Measure the output signal levels at the frequencies you used in *To Verify the Input Signal Level* (on page 45).
- 4 To determine the actual output tilt, calculate the difference (in dB) between the levels of the lowest and highest specified frequencies.
- 5 Proceed to the next section, **To Set the Output Tilt**.

To Set the Output Tilt

Equalizers (EQs) are available in 1.5 dB (equivalent) increments. A 1.5 dB change in value changes the difference between low and high frequencies by approximately 1 dB generally, or 1.2 dB for AGC stations in manual setup mode.

- Increasing the equalizer value *reduces* the level at lower frequencies, relative to the level at 870 MHz/1 GHz.
- Decreasing the equalizer value *increases* the level at lower frequencies, relative to the level at 870 MHz/1 GHz.

Complete the following steps to select the proper forward input equalizer value.

- 1 Compare the calculated output tilt in step 4 of **To Determine the Output Tilt** with the design tilt (on the design print).
- 2 Is the output tilt within ± 0.5 dB of the design tilt?
 - If the output tilt is within ± 0.5 dB of the design tilt, proceed to the next section, **To Set the Output Level**.
 - If the output tilt is more than design tilt, replace the forward input EQ with a lower value.

- If the output tilt is less than design tilt, replace the forward input EQ with a higher value.
- 3 Measure the output tilt again, and then return to step 1.

To Set the Output Level

After setting the tilt, complete the following steps to select the proper pad values for the amplifier. The output level of the amplifier is set by selecting the proper pad value.

Note: If you are setting the output level of an amplifier that has not warmed up for approximately one hour, skip to the **To Set the Output Level for a Cold Amplifier** procedure below.

To Set the Output Level for a Warm Amplifier

- 1 Connect the test probe to the forward output test point.
- 2 Measure the output level at the highest design frequency, and compare this level with the design level (on the design print).
- 3 Is the measured output level within ± 0.5 dB of the design level?
 - If the output level is within ± 0.5 dB of the design output level, proceed to *Balancing the Reverse Path* (on page 74).
 - If the output level is more than the design output level, replace the forward input pad with a higher value pad.
 - If the output level is less than the design output level, replace the forward input pad with a lower value pad.

To Set the Output Level for a Cold Amplifier

After setting the tilt, complete the following steps to select the proper pad values for the amplifier. The output level of the amplifier is set by selecting the proper pad value.

Note: Using this procedure will result in a more accurate output level setting when balancing an amplifier using amplifier and coax compensation mode if the amplifier has had little or no warm-up period.

Important! For the most accurate output level setting, allow the amplifier to warm up for approximately one hour and use the **To Set the Output Level for a Warm Amplifier** procedure above.

- 1 Connect the test probe to the forward output test point.
- 2 Measure the output level at the highest design frequency, and compare this level with the design level (on the design print), *minus 1 dB*.

The station output level must be 1 dB lower than the output level specified by the design print. This reduction in output level will be offset by an increase in internal amplifier gain as the thermal circuit in the amplifier warms up.
- 3 Is the measured output level within ± 0.5 dB of the design level *minus 1 dB*?
 - If the output level is within ± 0.5 dB of the design output level *minus 1 dB*, proceed to step 5.
 - If the output level is more than the design output level *minus 1 dB*, replace the

forward input pad with a higher value pad.

- If the output level is less than the design level *minus 1 dB*, replace the forward input pad with a lower value pad.
- 4 Repeat steps 2 and 3 until the output level is correct.
 - 5 Proceed to *Balancing the Reverse Path* (on page 74).

Forward Path Balancing for Manual Stations

Before you begin, make sure that you have configured the amplifier module according to the specifications in the design print, and that the amplifier has warmed up for approximately one hour.

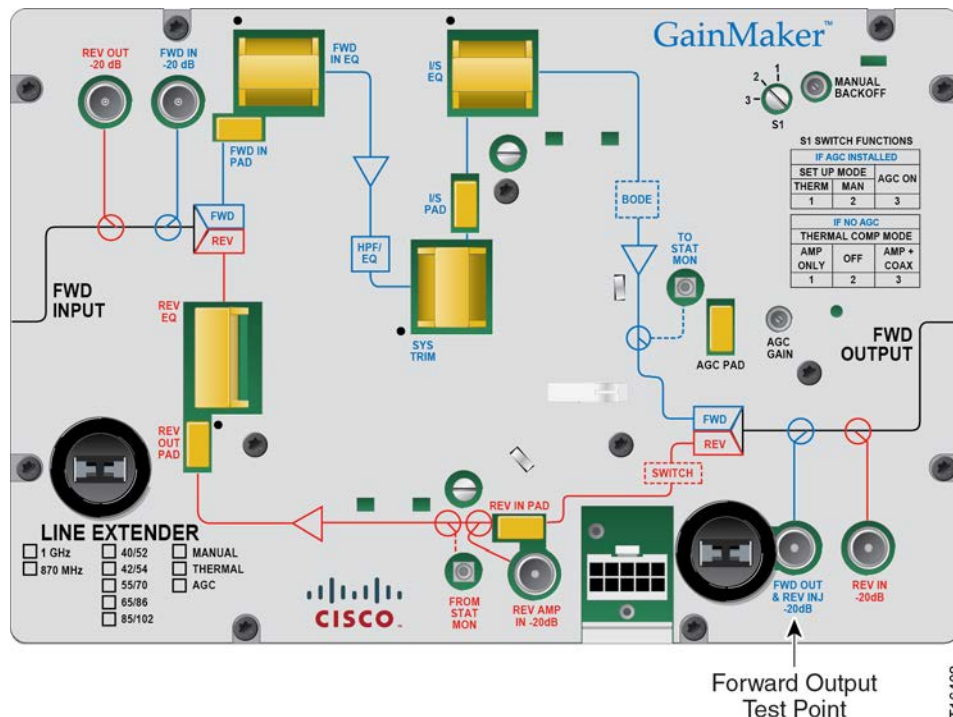
No Switch 1 Setting for Manual Stations

A manual station is a station that has no Bode network installed. Therefore, there is no interstage level correction, and Switch 1 has no effect on station operation.

To Determine the Output Tilt

Complete the following steps to determine the output tilt of the amplifier.

- 1 Connect the test point adapter to the forward main output test point.



- 2 Consult the design print to find the proper output tilt.
- 3 Measure the output signal levels at the frequencies you used in *To Verify the Input Signal Level* (on page 45).
- 4 To determine the actual output tilt, calculate the difference (in dB) between the levels

of the lowest and highest specified frequencies.

- 5 Proceed to the next section, **To Set the Output Tilt**.

To Set the Output Tilt

Equalizers (EQs) are available in 1.5 dB (equivalent) increments. A 1.5 dB change in value changes the difference between low and high frequencies by approximately 1 dB generally, or 1.2 dB for AGC stations in manual setup mode.

- Increasing the equalizer value *reduces* the level at lower frequencies, relative to the level at 870 MHz/1 GHz.
- Decreasing the equalizer value *increases* the level at lower frequencies, relative to the level at 870 MHz/1 GHz.

Complete the following steps to select the proper forward input equalizer value.

- 1 Compare the calculated output tilt in step 4 of **To Determine the Output Tilt** with the design tilt (on the design print).
- 2 Is the output tilt within ± 0.5 dB of the design tilt?
 - If the output tilt is within ± 0.5 dB of the design tilt, proceed to the next section, **To Set the Output Level**.
 - If the output tilt is more than design tilt, replace the forward input EQ with a lower value.
 - If the output tilt is less than design tilt, replace the forward input EQ with a higher value.
- 3 Measure the output tilt again, and then return to step 1.

To Set the Output Level

After setting the tilt, complete the following steps to select the proper pad values for the amplifier. The output level of the amplifier is set by selecting the proper pad value.

- 1 Connect the test probe to the forward main output test point.
- 2 Measure the output level at the highest design frequency, and compare this level with the design level (on the design print).
- 3 Is the measured output level within ± 0.5 dB of the design level?
 - If the output level is within ± 0.5 dB of the design output level, proceed to step 5.
 - If the output level is more than the design output level, replace the forward input pad with a higher value pad.
 - If the output level is less than the design level, replace the forward input pad with a lower value pad.
- 4 Repeat steps 2 and 3 until the output level is correct.

Note: On the High Gain Dual, the type of plug-in signal director installed directly affects the signal level measured at the Aux RF output test points. This is because the Aux RF output test points are located *after* the signal director in the forward RF signal path instead of *before* as in previous versions of system amplifiers (II, II+, and III). The test points now reflect the actual output of the port.

It is important to determine if the Aux output level specified on the design print is the level before or after the signal director.

- If it is the level *after* the signal director (port output level), the test point should match the print design level.
- If it is the level *before* the signal director, the test point level should be “x” dB lower than the print design level, where “x” is the insertion loss of the signal director feeding the particular Aux port being balanced.

5 Proceed to *Balancing the Reverse Path* (on page 74).

Forward Path Balancing Using Trim Networks

This section describes the procedure to follow when installing a trim network.

A trim network allows you to adjust amplifier frequency response to make it as uniform as possible across the entire output spectrum. The trim network can be adjusted within limits to cover a wide range of individual requirements. Type and use factor are determined by evaluating actual system frequency response.

Refer to the frequency response plots in *System Amplifier and Line Extender including GainMaker® Products Trim Networks Installation Instructions*, part number 741338.

To Install a Trim Network

Complete the following steps to install a trim network.

- 1 Open the node housing. Refer to *To Open the Node Housing* (on page 15).
- 2 Switch the AGC to **THERMAL**.
- 3 Record the RF output levels.

Note: The trim network location is labeled **SYS TRIM** on the module cover. Refer to the following illustration.

Balancing the Reverse Path

This section covers reverse RF amplifier cascade balancing. Balancing refers to the process of individually aligning reverse amplifier station gain and tilt characteristics to achieve reverse amplifier cascades that have optimum, repeatable transmission characteristics.

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.

About Reverse Path Balancing

Balancing should be completed in the following order.

- 1 Balance the reverse fiber link, i.e., the path from the node reverse optical transmitter to the headend or hub reverse optical receiver.
- 2 Balance the individual reverse amplifier cascades that combine at the node. Start with the amplifier closest to the node, and work from that point outward towards the first reverse amplifier in each upstream cascade.

Injection of Test Signal(s)

During the balancing process, a reverse RF test signal or signals of known amplitude are injected into the reverse RF input path of the amplifier station prior to the reverse amplification circuit. The injected signals are amplified and routed out the station reverse RF output port in the upstream direction. The injected test signals pass through any previously balanced amplifiers in the reverse cascade, as well as the reverse fiber link, and arrive at the node reverse optical receiver, which typically is located in the headend or hub.

Monitoring and Adjusting Received Amplitude and Tilt

The amplitude and tilt associated with the received signals are monitored at the headend or hub at an RF test point on the output of the reverse optical receiver associated with the particular node. The received amplitude and tilt of the test signals are compared to the desired (reference value) amplitude and tilt. Any deviations from reference value amplitude or tilt are then minimized by altering the (dB) value of the output pad or equalizer in the amplifier being balanced. This process is completed for each amplifier in the reverse cascade, working outward from the node.

Methods of Generating and Monitoring Test Signals

The reverse RF test signals to be injected into the reverse path of the amplifier being balanced may be generated by the following.

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

The amplitude and tilt 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)

Communicating Test Results

The variance in relative amplitude and tilt 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 or 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 or 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 or data receiver that is injecting the test signals into the reverse path in the field is simultaneously receiving the incoming data carrier via the forward RF path, and converting it back to a sweep display which represents what is being received by the headend unit.

While one technician in the field can monitor the received amplitude and determine whether it deviates from reference or not, any variation in amplitude required at the output of the receiver in the headend would typically be accomplished by a second technician in the headend, who is in communication with the technician in the field.

Note: When using a reverse sweep system such as this, be sure to consult the manufacturer's guide to determine proper headend combining and to ensure proper telemetry levels.

To Prepare the Amplifier for Reverse Path Balancing

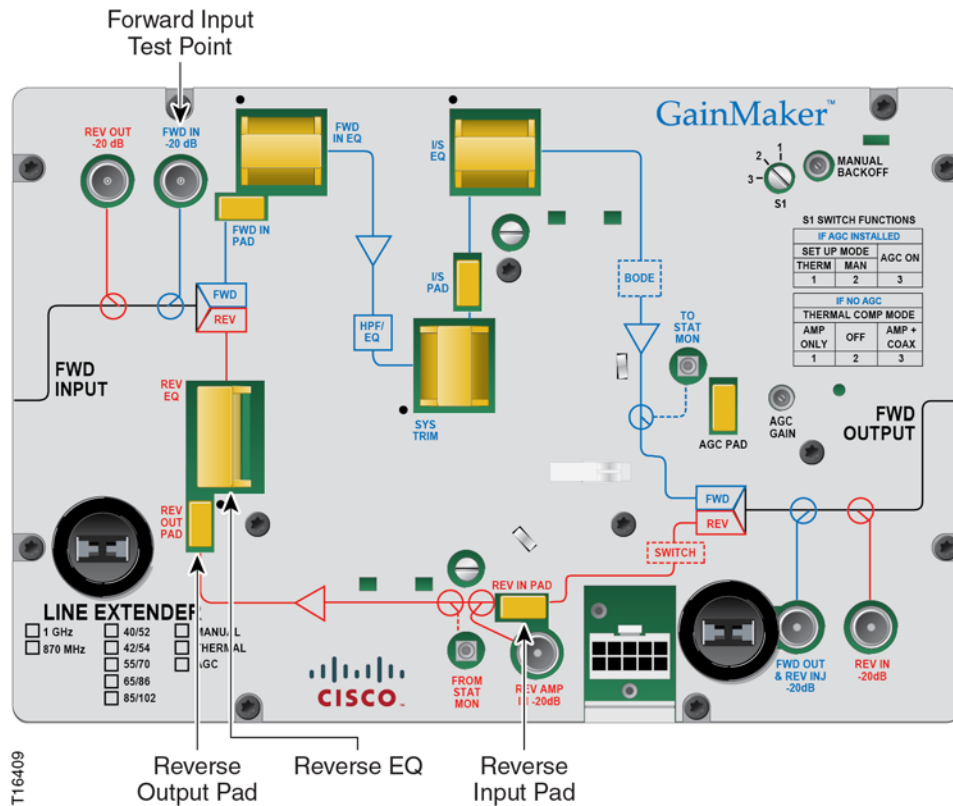
Complete the following steps for initial reverse path balancing.

- 1 Balance all of the reverse amplifiers off a given reverse input port for the node being worked on. The reverse amplifiers should be balanced sequentially from the node outward.

Note: Make sure the reverse fiber link has been properly balanced before proceeding.

- 2 Ensure that the design value reverse output equalizer and reverse pads are installed in the appropriate reverse slots in the amplifier. Refer to the following diagram.

Note: Record the pad values for each input port for later use.



- 3 Proceed to *To Calculate the Proper RF Signal Level* (on page 76).

To Calculate the Proper RF Signal Level

In order to calculate the correct RF signal level to inject, you must know the following.

- Design Reverse Port Input Level from the design print
- Total Injection Insertion Loss (20 dB)

To calculate the correct signal level to inject, add the total injection insertion loss to the design port input level.

Example

- Design amplifier reverse port input level = 19 dBmV
- Total injection insertion loss = 20 dB

The design amplifier reverse port input level plus injection insertion loss equals correct RF signal level to inject.

In the example shown above, 19 dBmV + 20 dB = 39 dBmV. Therefore, you would set the

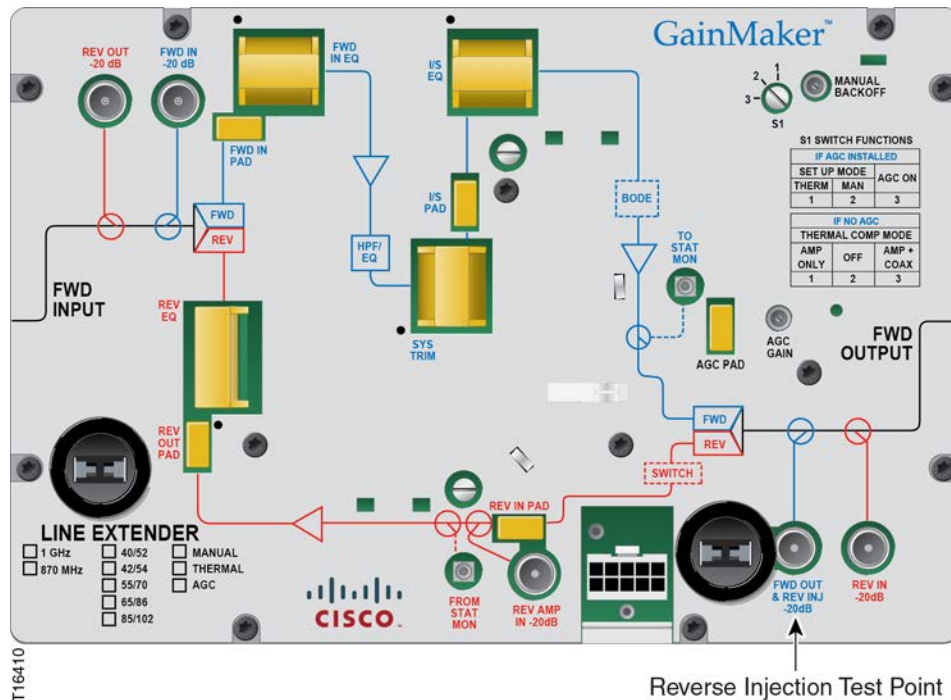
signal generator output for + 39 dBmV.

Important:

- When using a CW signal generator, inject at least two carriers, one at the low end and one at the high end of the reverse bandpass. In a reverse system with a 5 MHz to 40 MHz bandpass, the low frequency carrier should be in the 5 MHz to 10 MHz range and the high frequency carrier should be in the 35 MHz to 40 MHz range.
- The amplitude of the signal generator output can be set higher or lower than the level specified by the calculation above, but the difference between the actual output level and the level calculated above must be known. If the generator output is x dB higher (or lower) than the level calculated, then the reference (desired) level received at the headend or hub should also be x dB higher (or lower) than the original headend reference level.
- The station reverse input pad values are selected during the reverse system design and are based on the need to minimize variations in return path losses for the various reverse inputs. Do not permanently alter the values of the reverse input pads without consulting a system designer.
- In the GainMaker Line Extender, the reverse input comes after the reverse injection point in the reverse path. Temporarily replacing the design value reverse input pad on the port being balanced with a 0 dB pad allows the reverse injection level and the receive levels at the monitoring end to remain constant from amplifier to amplifier and from port to port.

An alternative to this method is to expect a receive level that is x dB lower than normal, where x is the value of the reverse input pad on the port being balanced, which you noted earlier in the reverse path balancing procedure.

Insert the appropriate signal amplitude into the reverse injection point. Refer to the following illustration.



Proceed to *To Complete Reverse Path Balancing* (on page 78).

To Complete Reverse Path Balancing

Complete the following steps to finish the amplifier setup.

- 1 Monitor the tilt of the signals being received at the headend or hub reverse optical receiver RF output test point.

Note:

- The tilt is the difference in signal level between the highest and lowest frequencies in the reverse passband, or between the highest and lowest frequency CW test signals.
 - Most systems prefer to have minimal reverse tilt (flat levels) at the headend.
 - To minimize tilt, change the value of the amplifier reverse output equalizer.
- 2 Monitor the amplitude (level) of the signals being received at the headend or hub reverse optical receiver RF output testpoint.
 - a Compare the received level to the reference level desired.
 - b If using a sweep system that is x dB below standard CW carrier levels, be sure to consider that the receive level should also be x dB below the CW reference level.
 - c To adjust the receive level to make it match the desired reference level, alter the value of the amplifier reverse output pad. Each 1 dB increase in pad value should result in a corresponding 1 dB decrease in receive level, and each 1 dB decrease in pad value should give a 1 dB increase in receive level.
 - 3 Once the proper receive level and tilt of the test signals have been achieved, properly close the amplifier housing and repeat the process at the next reverse amplifier in the downstream cascade.

Important:

- Reinstall design print value reverse input pads for any port whose input pad may have been temporarily replaced with a 0 dB value pad for reverse path balancing purposes.
- Work outward from the node, and outward from each external split in the coaxial plant, until all amplifiers in the cascade have been balanced.
- Repeat the process for all of the reverse amplifier cascades off any remaining active node ports until all reverse amplifiers feeding into the node have been balanced.

4

Troubleshooting

Introduction

The GainMaker Line Extender is configured with modules that support different functions. This modular design approach provides the following benefits:

- The housing design has the flexibility to accept a variety of modules.
- The modules contain few user serviceable parts. This provides ease of troubleshooting and minimal downtime during repairs.

This chapter describes the steps you may take to troubleshoot the GainMaker Line Extender.

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Equipment

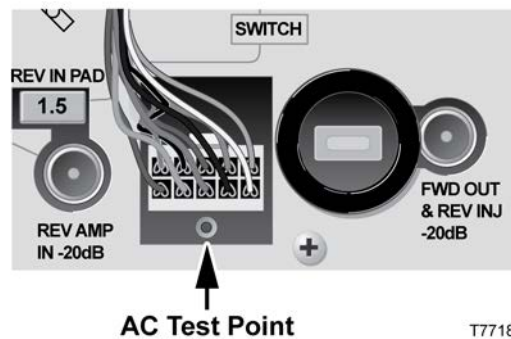
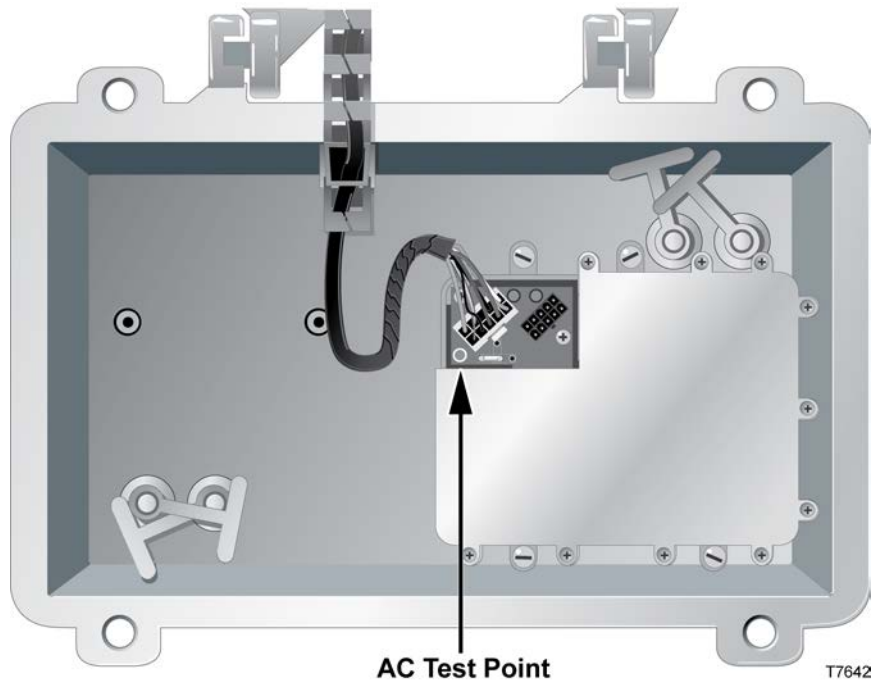
The following equipment may be necessary to perform some troubleshooting procedures.

- 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
- 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
- Test point probe, part number 562580, to access test points

No AC Power

AC power can be measured at the amplifier seizure screws, AC shunt power directors, power supply harness, and AC test points.

The following diagram illustrates the AC test point locations for the GainMaker Line Extender.



No AC Power Troubleshooting Table

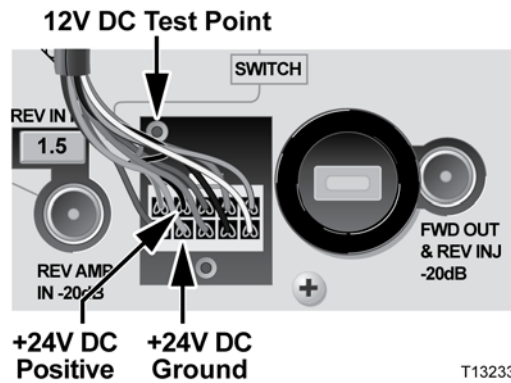
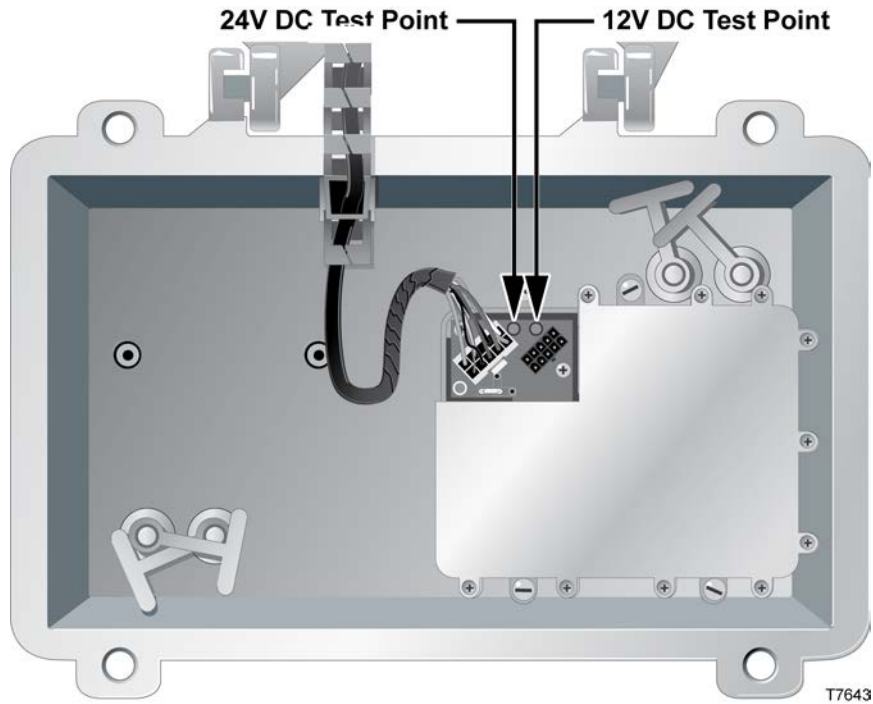
Before you begin troubleshooting for no AC power, verify that there is proper AC power input coming into the amplifier and that the AC voltage lockout threshold is set to your system's power requirements.

Possible cause	Solution
No AC at the housing seizure.	<ul style="list-style-type: none">■ Check the AC source.■ Check the AC shunt power director configuration at the amplifier feeding AC to this amplifier.■ Make sure that the housing seizure is properly tightened.
AC at the housing seizure but not at the AC shunt power director.	<ul style="list-style-type: none">■ Check and/or replace the AC shunt power director.■ Check and/or replace the amplifier module.
AC at the amplifier test point but not at the power supply test point.	<ul style="list-style-type: none">■ Check and/or replace the power supply wiring harness.■ Check and/or replace the power supply.

No DC Power

DC power can be measured at the DC power supply test points and power wiring harness.

The following diagram illustrates the DC test point locations for the GainMaker Line Extender.



No DC Power Troubleshooting Table

Before you begin troubleshooting for no DC power, verify that there is proper AC power input coming into the DC power supply and that the AC voltage lockout threshold is set to your system's powering requirements.

Possible cause	Solution
No DC power at the power supply.	■ Check and/or replace the power supply.
DC at the power supply but not at the amplifier module.	■ Check and/or replace the power wiring harness and/or the amplifier module. ■ Check and/or replace the power supply.

No Forward RF Signal

The forward RF signal can be measured at the amplifier module forward input and forward output test points.

No Forward RF Signal Troubleshooting Table

Before you begin troubleshooting for no forward RF signal, verify that the amplifier is receiving the proper forward RF input signal from the upstream amplifier.

Important: You cannot balance the amplifier without the proper forward RF input signal.

Possible cause	Solution
No forward RF signal at the forward input test point.	<ul style="list-style-type: none"> ■ Verify that the amplifier is receiving the proper forward RF input signal from the upstream amplifier. <p>Important: You cannot balance the amplifier without the proper forward RF input signal.</p>
There is forward RF signal at the forward input test point, but no signal at one or all of the forward output test points.	<ul style="list-style-type: none"> ■ Verify that the amplifier module is receiving the proper AC and DC voltages. Refer to <i>No AC Power</i> (on page 83) and <i>No DC Power</i> (on page 85). ■ Verify that all the proper accessories, pads, EQs, and signal directors (if applicable) are firmly installed in the correct locations. ■ Verify that the factory installed accessories are firmly installed in the correct locations. <p>Note: Verifying factory installations involves removing the amplifier module cover. Reinstall the amplifier module cover properly or RF signal degradation may result.</p> <ul style="list-style-type: none"> ■ Replace the amplifier module.

Low or Degraded Forward RF Signal

The forward RF signal can be measured at the amplifier module forward input and forward output test points.

Low or Degraded Forward RF Signal Troubleshooting Table

Before you begin troubleshooting for a low or degraded forward RF signal, verify that the amplifier is receiving the proper forward RF input signal from the upstream amplifier.

Important: You cannot balance the amplifier without the proper forward RF input signal.

Make sure you have configured the amplifier module according to the specifications in the design print, and that the amplifier has warmed up for approximately one hour.

Make sure you are using the proper tilt reference when setting levels. An 870 MHz or 1 GHz design balanced at 550 MHz requires a corrected tilt reference to compensate for the difference in carrier levels between 550 MHz and 870 MHz or 1 GHz. The tilt reference at 550 MHz is lower than the tilt reference at 870 MHz or 1 GHz. Refer to the tilt charts in *Technical Information* (on page 95) for more information.

Important: If the amplifier cover was ever removed, make sure it was properly reinstalled. Improperly reinstalling the amplifier module cover may result in RF signal degradation.

Possible cause	Solution
Low or degraded forward RF signal at the forward input test point.	<ul style="list-style-type: none"> ■ Verify that the amplifier is receiving the proper forward RF input signal from the upstream amplifier. <p>Important: You cannot balance the amplifier without the proper forward RF input signal.</p>

Possible cause	Solution
There is a proper forward RF signal at the forward input test point, but a low or degraded signal at one or all of the forward output test points.	<ul style="list-style-type: none"><li data-bbox="792 275 1406 373">■ Verify that the amplifier module is receiving the proper DC voltages. Refer to <i>No DC Power</i> (on page 85).<li data-bbox="792 390 1406 516">■ Verify that switch S1 is in the proper position for your amplifier module configuration. Refer to <i>Balancing and Setup</i> (on page 41) for more information.<li data-bbox="792 533 1406 632">■ Verify that all the proper accessories, pads, EQs, and signal directors (if applicable) are firmly installed in the correct locations.<li data-bbox="792 648 1406 716">■ Verify that the factory installed accessories are firmly installed in the correct locations. Note: Verifying factory installations involves removing the amplifier module cover. Reinstall the amplifier module cover properly or RF signal degradation may result.<li data-bbox="792 873 1406 909">■ Replace the amplifier module.

No Reverse RF Signal

The reverse RF signal can be measured at the amplifier module reverse input and reverse output test points.

No Reverse RF Signal Troubleshooting Table

Before you begin troubleshooting for no reverse RF signal, verify that the amplifier is receiving the proper reverse RF input signals from the downstream amplifiers at the amplifier reverse input test point.

Important! You cannot balance the amplifier without the proper reverse RF input signals.

Possible cause	Solution
No reverse RF signal at the reverse input test point.	<ul style="list-style-type: none"> ■ Verify that the amplifier is receiving the proper reverse RF input signals from the downstream amplifiers. <p>Important! You cannot balance the amplifier without the proper reverse RF input signals.</p>
There is a proper reverse RF signal at the reverse input test point, but no signal at the reverse output test point.	<ul style="list-style-type: none"> ■ Verify that the amplifier module is receiving the proper AC and DC voltages. Refer to <i>No AC Power</i> (on page 83) and <i>No DC Power</i> (on page 85). ■ Verify that the amplifier module is receiving the proper forward RF signal. Refer to <i>No Forward RF Signal</i> (on page 87). ■ Verify that all the proper accessories, pads, and EQs are firmly installed in the correct locations. ■ Verify that the factory installed accessories are firmly installed in the correct locations. ■ Verify that the reverse switch (if applicable) or its jumpers are properly and firmly installed. <p>Note: Verifying factory installations involves removing the amplifier module cover. Reinstall the amplifier module cover properly or RF signal degradation may result.</p> <ul style="list-style-type: none"> ■ Replace the amplifier module.

Low or Degraded Reverse RF Signal

The reverse RF signal can be measured at the amplifier module reverse input and reverse output test points.

Low or Degraded Reverse RF Signal Troubleshooting Table

Before you begin troubleshooting for a low or degraded reverse RF signal, verify that the amplifier is receiving the proper reverse RF input signals from the downstream amplifiers at the amplifier reverse input test point.

Important! You cannot balance the amplifier without the proper reverse RF input signals.

Make sure you have configured the amplifier module according to the specifications in the design print, and that the amplifier has warmed up for approximately one hour.

Make sure you are using the proper total tilt reference when setting receive levels. Refer to the reverse equalizer charts in *Technical Information* (on page 95) for more information.

Important! If the amplifier cover was ever removed, make sure it was properly reinstalled. Improperly reinstalling the amplifier module cover may result in RF signal degradation.

Possible cause	Solution
Low or degraded reverse RF signal at the reverse input test point.	<ul style="list-style-type: none"> ■ Verify that the amplifier is receiving the proper reverse RF input signals from the downstream amplifiers. <p>Important! You cannot balance the amplifier without the proper reverse RF input signals.</p>

Possible cause	Solution
There are proper reverse RF signals at the reverse input test point, but a low or degraded signal at the reverse output test point.	<ul style="list-style-type: none"> ■ Verify that the amplifier module is receiving the proper DC voltages. Refer to <i>No DC Power</i> (on page 85). ■ Measure the main reverse input test point and the reverse output test point. Subtract the reverse amplifier gain and add the pad values and EQ insertion loss to verify proper reverse amplifier gain. ■ Verify that all the proper accessories, pads, EQs, and signal directors (if applicable) are firmly installed in the correct locations. ■ Verify that the factory installed accessories are firmly installed in the correct locations. ■ Verify that the reverse switch and its jumpers are properly and firmly installed. <p>Note: Verifying factory installations involves removing the amplifier module cover. Reinstall the amplifier module cover properly or RF signal degradation may result.</p>
Reverse RF signal still low or degraded.	<ul style="list-style-type: none"> ■ Use a spectrum analyzer to look at the reverse RF input signal spectral quality at each reverse input test point and compare it to the reverse RF output signal spectral quality. <ul style="list-style-type: none"> – If degradation is generated in the reverse amplifier, replace the reverse amplifier. – If degradation is generated by the downstream amplifier reverse RF signal, troubleshoot the RF amplifier feeding this station. ■ Replace the amplifier module.

5

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.

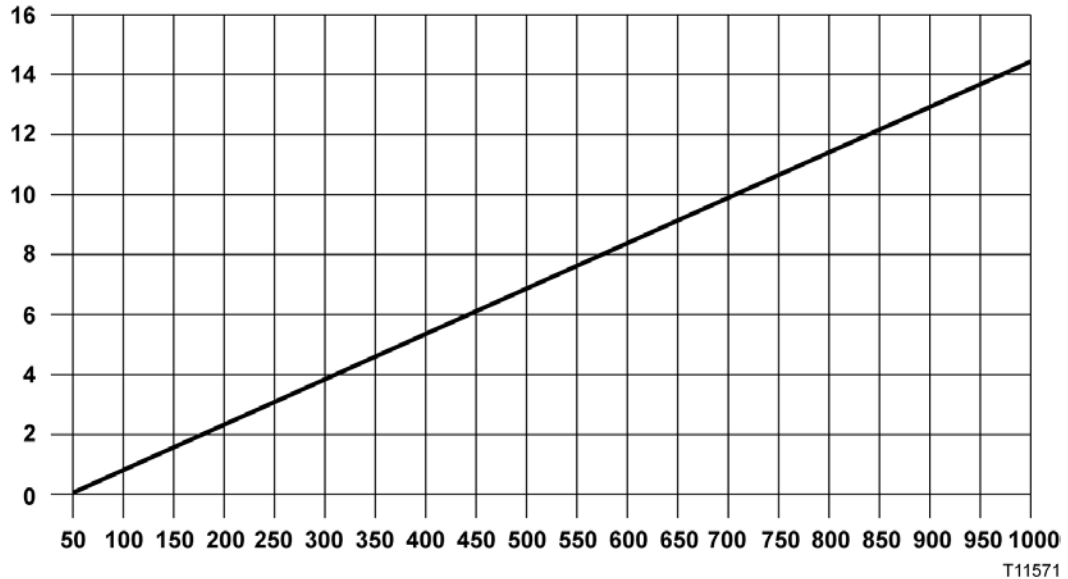
In This Appendix

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■ Forward Cable Equalizer Charts	98
■ Reverse Cable Equalizer Charts	100
■ GainMaker Amplifier Accessory Part Numbers	103
■ Specifications	107

“Linear” Tilt Charts

Amplifier Output “Linear” Tilt Chart for 1 GHz

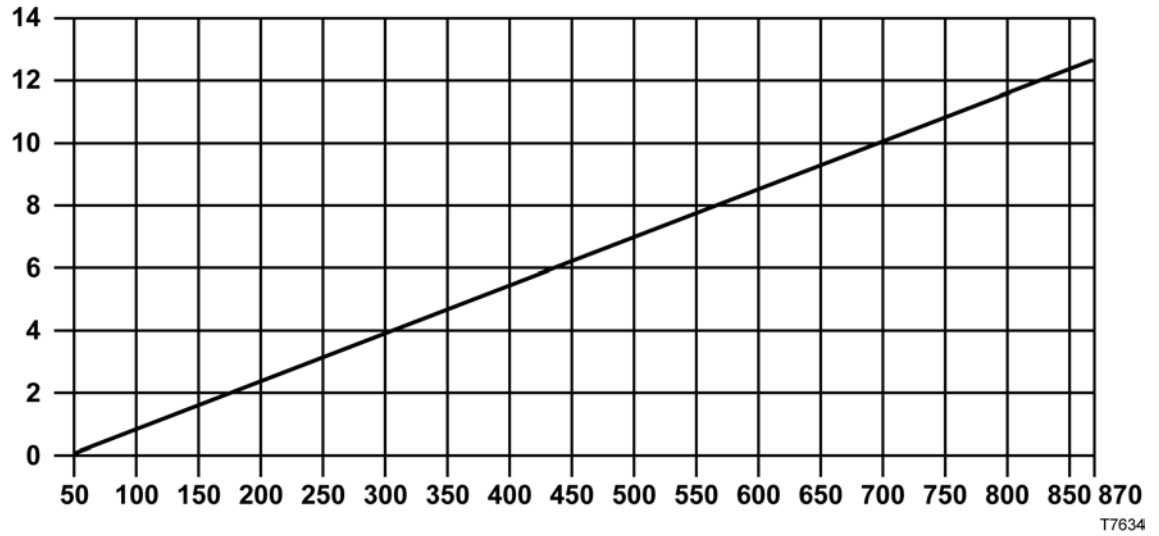
The following chart can be used to determine the operating level at a particular frequency considering the operating linear tilt.



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).

Amplifier Output “Linear” Tilt Chart for 870 MHz

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 870 MHz output level is 47.5 dBmV with a linear operating tilt of 12.5 dB (from 50 to 870 MHz), the corresponding output level at 650 MHz would be 44 dBmV. This was found by taking the difference in tilt between 870 and 650 MHz (12.5 - 9 = 3.5 dB). Then subtract the difference in tilt from the operating level (47.5 - 3.5 = 44 dBmV).

Forward Cable Equalizer Charts

1 GHz Forward Cable Equalizer Loss Chart

The following chart shows the 1 GHz forward cable equalizer loss.

EQ Value (dB)	Insertion Loss at (MHz)									Total Tilt (52-1000 MHz)
	1000	870	750	650	600	550	86	70	52	
1.5	1.0	1.1	1.2	1.3	1.4	1.4	2.1	2.2	2.2	1.2
3.0	1.0	1.2	1.5	1.7	1.8	1.9	3.2	3.3	3.4	2.4
4.5	1.0	1.4	1.7	2.0	2.1	2.3	4.3	4.4	4.6	3.6
6.0	1.0	1.5	1.9	2.3	2.5	2.7	5.4	5.6	5.8	4.8
7.5	1.0	1.6	2.1	2.6	2.9	3.2	6.5	6.7	7.0	6.0
9.0	1.0	1.7	2.4	3.0	3.3	3.6	7.7	7.9	8.2	7.2
10.5	1.0	1.8	2.6	3.3	3.7	4.0	8.8	9.0	9.4	8.4
12.0	1.0	1.9	2.8	3.6	4.0	4.5	9.9	10.2	10.6	9.6
13.5	1.0	2.0	3.1	3.9	4.4	4.9	11.0	11.3	11.8	10.8
15.0	1.0	2.2	3.3	4.3	4.8	5.3	12.1	12.5	13.0	12.0
16.5	1.0	2.3	3.5	4.6	5.2	5.8	13.2	13.6	14.2	13.2
18.0	1.0	2.4	3.7	4.9	5.5	6.2	14.3	14.8	15.4	14.4
19.5	1.0	2.5	4.0	5.3	5.9	6.6	15.4	15.9	16.6	15.6
21.0	1.0	2.6	4.2	5.6	6.3	7.1	16.5	17.1	17.8	16.8
22.5	1.5	3.2	4.9	6.4	7.2	8.0	18.1	18.7	19.5	18.0
24.0	1.5	3.4	5.2	6.7	7.6	8.4	19.2	19.9	20.7	19.2
25.5	1.5	3.5	5.4	7.1	7.9	8.8	20.3	21.0	21.9	20.4
27.0	1.5	3.6	5.6	7.4	8.4	9.3	21.5	22.2	23.1	21.6
28.5	1.5	3.7	5.8	7.7	8.7	9.7	22.6	23.3	24.3	22.8
30.0	1.5	3.8	6.1	8.0	9.1	10.1	23.7	24.5	25.5	24.0

870 MHz Forward Cable Equalizer Loss Chart

The following table shows the 870 MHz forward cable equalizer loss.

EQ Value (dB)	Insertion Loss at (MHz)									Total Tilt (52-870 MHz)
	870	750	600	550	450	300	216	108	52	
1.5	1.0	1.1	1.3	1.3	1.5	1.7	1.8	2.0	2.2	1.2
3.0	1.0	1.2	1.6	1.7	1.9	2.3	2.6	3.0	3.3	2.3
4.5	1.0	1.4	1.9	2.0	2.4	3.0	3.4	4.1	4.5	3.5
6.0	1.0	1.5	2.1	2.4	2.9	3.7	4.2	5.1	5.7	4.7
7.5	1.0	1.6	2.4	2.7	3.3	4.4	5.0	6.1	6.9	5.9
9.0	1.0	1.7	2.7	3.1	3.8	5.0	5.8	7.1	8.1	7.1
10.5	1.0	1.8	3.0	3.4	4.3	5.7	6.6	8.1	9.2	8.2
12.0	1.0	2.0	3.3	3.7	4.7	6.4	7.5	9.2	10.4	9.4
13.5	1.0	2.1	3.6	4.1	5.2	7.0	8.3	10.2	11.6	10.6
15.0	1.0	2.2	3.8	4.4	5.6	7.7	9.1	11.2	12.8	11.8
16.5	1.0	2.3	4.1	4.8	6.1	8.4	9.9	12.2	13.9	12.9
18.0	1.0	2.5	4.4	5.1	6.6	9.1	10.7	13.3	15.1	14.1
19.5	1.0	2.6	4.7	5.5	7.0	9.7	11.5	14.3	16.3	15.3
21.0	1.0	2.7	5.0	5.8	7.5	10.4	12.3	15.3	17.5	16.5
22.5	1.0	2.8	5.3	6.1	8.0	11.1	13.1	16.3	18.6	17.6
24.0	1.0	2.9	5.6	6.5	8.4	11.7	13.9	17.3	19.8	18.8
25.5	1.0	3.1	5.8	6.8	8.9	12.4	14.7	18.4	21.0	20.0
27.0	1.0	3.2	6.1	7.2	9.4	13.1	15.5	19.4	22.2	21.2

Reverse Cable Equalizer Charts

42 MHz and 40 MHz Reverse Cable Equalizer Loss Chart

The following table shows the 42 MHz reverse cable equalizer loss.

Note: The 42 MHz reverse equalizer also works as a 40 MHz reverse equalizer in systems that use 5-40 MHz reverse amplifiers.

EQ Value (dB) 42 MHz	EQ Value (dB) 40 MHz	Insertion Loss at (MHz)									Total Tilt (5-42 MHz)	Total Tilt (5-40 MHz)
		42	40	35	30	25	20	15	10	5		
1	1	1.0	1.0	1.1	1.1	1.2	1.3	1.4	1.5	1.7	0.7	0.7
2	2	1.0	1.0	1.1	1.3	1.4	1.6	1.8	2.0	2.3	1.3	1.3
3.1	3	0.9	1.0	1.2	1.4	1.6	1.9	2.2	2.5	3.0	2.1	2.0
4.1	4	0.9	1.0	1.3	1.6	1.9	2.2	2.6	3.0	3.6	2.7	2.6
5.1	5	0.9	1.0	1.3	1.7	2.1	2.5	3.0	3.5	4.3	3.4	3.3
6.1	6	0.9	1.0	1.4	1.8	2.3	2.8	3.4	4.1	4.9	4.0	3.9
7.2	7	0.8	1.0	1.5	2.0	2.5	3.1	3.8	4.6	5.6	4.8	4.6
8.2	8	0.8	1.0	1.5	2.1	2.7	3.4	4.2	5.1	6.2	5.4	5.2
9.2	9	0.8	1.0	1.6	2.2	2.9	3.7	4.6	5.6	6.9	6.1	5.9
10.2	10	0.8	1.0	1.7	2.4	3.2	4.0	5.0	6.1	7.5	6.7	6.5
11.3	11	0.7	1.0	1.7	2.5	3.4	4.3	5.4	6.6	8.2	7.5	7.2
12.3	12	0.7	1.0	1.8	2.7	3.6	4.6	5.8	7.1	8.9	8.2	7.9

55 MHz Reverse Cable Equalizer Loss Chart

The following table shows the 55 MHz reverse cable equalizer loss.

EQ Value (dB)	Insertion Loss at (MHz)											Total Tilt (5-55 MHz)
	55	50	45	40	35	30	25	20	15	10	5	
1	1	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.5	1.6	1.7	0.7
2	1	1.1	1.2	1.3	1.4	1.5	1.7	1.8	2.0	2.2	2.4	1.4
3	1	1.1	1.3	1.4	1.6	1.8	2.0	2.2	2.4	2.7	3.1	2.1
4	1	1.2	1.4	1.6	1.8	2.1	2.3	2.6	3.0	3.3	3.8	2.8
5	1	1.2	1.5	1.7	2.0	2.3	2.6	3.0	3.4	3.9	4.5	3.5
6	1	1.3	1.6	1.9	2.3	2.6	3.0	3.4	3.9	4.5	5.2	4.2
7	1	1.3	1.7	2.0	2.5	2.9	3.3	3.8	4.4	5.1	5.9	4.9
8	1	1.4	1.8	2.2	2.7	3.2	3.7	4.3	4.9	5.7	6.7	5.7
9	1	1.4	1.9	2.3	2.9	3.4	4.0	4.7	5.4	6.2	7.4	6.4
10	1	1.5	2.0	2.5	3.1	3.7	4.3	5.1	5.9	6.8	8.1	7.1
11	1	1.5	2.1	2.6	3.3	3.9	4.7	5.5	6.4	7.4	8.8	7.8
12	1	1.6	2.2	2.8	3.5	4.2	5.0	5.9	6.9	8.0	9.5	8.5

65 MHz Reverse Cable Equalizer Loss Chart

The following table shows the 65 MHz reverse cable equalizer loss.

EQ Value (dB)	Insertion Loss at (MHz)													Total Tilt (5-65 MHz)
	65	60	55	50	45	40	35	30	25	20	15	10	5	
1	1	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.7	0.7
2	1	1.1	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.9	2.0	2.2	2.5	1.5
3	1	1.1	1.3	1.4	1.5	1.7	1.8	2.0	2.2	2.4	2.6	2.9	3.2	2.2
4	1	1.2	1.4	1.5	1.7	1.9	2.1	2.3	2.6	2.8	3.1	3.5	3.9	2.9
5	1	1.2	1.4	1.6	1.9	2.1	2.4	2.7	3.0	3.3	3.7	4.1	4.7	3.7
6	1	1.3	1.5	1.8	2.0	2.3	2.7	3.0	3.3	3.7	4.2	4.7	5.4	4.4
7	1	1.3	1.6	1.9	2.2	2.5	2.9	3.3	3.6	4.2	4.7	5.3	6.1	5.1
8	1	1.3	1.7	2.0	2.4	2.8	3.2	3.6	4.1	4.7	5.2	5.9	6.9	5.9
9	1	1.4	1.8	2.2	2.6	3.0	3.5	4.0	4.5	5.1	5.8	6.6	7.6	6.6
10	1	1.4	1.8	2.3	2.7	3.2	3.7	4.3	4.9	5.5	6.3	7.2	8.3	7.3
11	1	1.4	1.9	2.4	2.9	3.5	4.0	4.6	5.3	6.0	6.8	7.8	9.0	8.0
12	1	1.5	2.0	2.5	3.1	3.7	4.3	5.0	5.7	6.5	7.4	8.4	9.8	8.8

GainMaker Amplifier Accessory Part Numbers

Attenuator Part Numbers

The following table provides part numbers and pad values for the GainMaker Node attenuators.

Attenuator Pad Value	Part Number	Legacy Part Number (Reference Only)
0 dB - 870 MHz/1 GHz	GM-PAD-1G-00=	589693
0.5 dB - 870 MHz/1 GHz	GM-PAD-1G-0.5=	589694
1.0 dB - 870 MHz/1 GHz	GM-PAD-1G-1.0=	589695
1.5 dB - 870 MHz/1 GHz	GM-PAD-1G-1.5=	589696
2.0 dB - 870 MHz/1 GHz	GM-PAD-1G-2.0=	589697
2.5 dB - 870 MHz/1 GHz	GM-PAD-1G-2.5=	589698
3.0 dB - 870 MHz/1 GHz	GM-PAD-1G-3.0=	589699
3.5 dB - 870 MHz/1 GHz	GM-PAD-1G-3.5=	589700
4.0 dB - 870 MHz/1 GHz	GM-PAD-1G-4.0=	589701
4.5 dB - 870 MHz/1 GHz	GM-PAD-1G-4.5=	589702
5.0 dB - 870 MHz/1 GHz	GM-PAD-1G-5.0=	589703
5.5 dB - 870 MHz/1 GHz	GM-PAD-1G-5.5=	589704
6.0 dB - 870 MHz/1 GHz	GM-PAD-1G-6.0=	589705
6.5 dB - 870 MHz/1 GHz	GM-PAD-1G-6.5=	589706
7.0 dB - 870 MHz/1 GHz	GM-PAD-1G-7.0=	589707
7.5 dB - 870 MHz/1 GHz	GM-PAD-1G-7.5=	589708
8.0 dB - 870 MHz/1 GHz	GM-PAD-1G-8.0=	589709
8.5 dB - 870 MHz/1 GHz	GM-PAD-1G-8.5=	589710
9.0 dB - 870 MHz/1 GHz	GM-PAD-1G-9.0=	589711
9.5 dB - 870 MHz/1 GHz	GM-PAD-1G-9.5=	589712
10.0 dB - 870 MHz/1 GHz	GM-PAD-1G-10.0=	589713
10.5 dB - 870 MHz/1 GHz	GM-PAD-1G-10.5=	589714
11.0 dB - 870 MHz/1 GHz	GM-PAD-1G-11.0=	589715
11.5 dB - 870 MHz/1 GHz	GM-PAD-1G-11.5=	589716
12.0 dB - 870 MHz/1 GHz	GM-PAD-1G-12.0=	589717
12.5 dB - 870 MHz/1 GHz	GM-PAD-1G-12.5=	589718

Appendix A
 Technical Information

Attenuator Pad Value	Part Number	Legacy Part Number (Reference Only)
13.0 dB - 870 MHz/1 GHz	GM-PAD-1G-13.0=	589719
13.5 dB - 870 MHz/1 GHz	GM-PAD-1G-13.5=	589720
14.0 dB - 870 MHz/1 GHz	GM-PAD-1G-14.0=	589721
14.5 dB - 870 MHz/1 GHz	GM-PAD-1G-14.5=	589722
15.0 dB - 870 MHz/1 GHz	GM-PAD-1G-15.0=	589723
15.5 dB - 870 MHz/1 GHz	GM-PAD-1G-15.5=	589724
16.0 dB - 870 MHz/1 GHz	GM-PAD-1G-16.0=	589725
16.5 dB - 870 MHz/1 GHz	GM-PAD-1G-16.5=	589726
17.0 dB - 870 MHz/1 GHz	GM-PAD-1G-17.0=	589727
17.5 dB - 870 MHz/1 GHz	GM-PAD-1G-17.5=	589728
18.0 dB - 870 MHz/1 GHz	GM-PAD-1G-18.0=	589729
18.5 dB - 870 MHz/1 GHz	GM-PAD-1G-18.5=	589730
19.0 dB - 870 MHz/1 GHz	GM-PAD-1G-19.0=	589731
19.5 dB - 870 MHz/1 GHz	GM-PAD-1G-19.5=	589732
20.0 dB - 870 MHz/1 GHz	GM-PAD-1G-20.0=	589733
20.5 dB - 870 MHz/1 GHz	GM-PAD-1G-20.5=	589734

1 GHz/870 MHz Forward Cable Equalizer Part Numbers

The following table provides part number and pad values for the GainMaker Node 1 GHz and 870 MHz forward cable equalizers.

Value	1 GHz Forward EQ		870 MHz Forward EQ
	Part Number	Legacy Part Number (Reference Only)	Part Number
0 dB	GM-EQCBL-0-1G=	4007228	589260
1.5 dB	GM-EQCBL-1.5-1G=	4007229	589261
3.0 dB	GM-EQCBL-3-1G=	4007230	589262
4.5 dB	GM-EQCBL-4.5-1G=	4007231	589263
6.0 dB	GM-EQCBL-6-1G=	4007232	589264
7.5 dB	GM-EQCBL-7.5-1G=	4007233	589265
9.0 dB	GM-EQCBL-9-1G=	4007234	589266
10.5 dB	GM-EQCBL-10.5-1G=	4007235	589267
12.0 dB	GM-EQCBL-12-1G=	4007236	589268
13.5 dB	GM-EQCBL-13.5-1G=	4007237	589269
15.0 dB	GM-EQCBL-15-1G=	4007238	589270
16.5 dB	GM-EQCBL-16.5-1G=	4007239	589271
18.0 dB	GM-EQCBL-18-1G=	4007240	589272
19.5 dB	GM-EQCBL-19.5-1G=	4007241	589273
21.0 dB	GM-EQCBL-21-1G=	4007242	589274
22.5 dB	GM-EQCBL-22.5-1G=	4007243	589275
24.0 dB	GM-EQCBL-24-1G=	4007244	589276
25.5 dB	GM-EQCBL-25.5-1G=	4007245	589277
27.0 dB	GM-EQCBL-27-1G=	4007246	589278
28.5 dB	GM-EQCBL-28.5-1G=	4007247	-
30.0 dB	GM-EQCBL-30-1G=	4007248	-

1 GHz/870 MHz Forward Inverse Equalizer Part Numbers

The following table shows the part number and pad values for the GainMaker Node 1 GHz/870 MHz forward inverse equalizers.

Inverse EQ	Part Number	Legacy Part Number (Reference Only)
1.6/1.5 dB - 1 GHz/870 MHz	GM-EQINV-1.6-1G=	4007486
3.3/3.0 dB - 1 GHz/870 MHz	GM-EQINV-3.3-1G=	4007487
4.9/4.5 dB - 1 GHz/870 MHz	GM-EQINV-4.9-1G=	4007488
6.5/6.0 dB - 1 GHz/870 MHz	GM-EQINV-6.5-1G=	4007489
8.1/7.5 dB - 1 GHz/870 MHz	GM-EQINV-8.1-1G=	4007490
9.8/9.0 dB - 1 GHz/870 MHz	GM-EQINV-9.8-1G=	4007491
11.4/10.5 dB - 1 GHz/870 MHz	GM-EQINV-11.4-1G=	4007492
13.0/12.0 dB - 1 GHz/870 MHz	GM-EQINV-13-1G=	4007493
14.6/13.5 dB - 1 GHz/870 MHz	GM-EQINV-14.6-1G=	4007494
16.2/15.0 dB - 1 GHz/870 MHz	GM-EQINV-16.2-1G=	4007495

Reverse Cable Equalizer Part Numbers

The following table shows the part number and pad values for the GainMaker reverse cable equalizers.

Value	40/42 MHz		55 MHz	
	Legacy	New	Legacy	New
0 dB	712719	GM-EQREV-0=	712719	GM-EQREV-0=
1 dB	589628	GM-EQREV-1-40M=	712679	GM-EQREV-1-55M=
2 dB	589629	GM-EQREV-2-40M=	712680	GM-EQREV-2-55M=
3 dB	589630	GM-EQREV-3-40M=	712681	GM-EQREV-3-55M=
4 dB	589631	GM-EQREV-4-40M=	712682	GM-EQREV-4-55M=
5 dB	589632	GM-EQREV-5-40M=	712683	GM-EQREV-5-55M=
6 dB	589633	GM-EQREV-6-40M=	712684	GM-EQREV-6-55M=
7 dB	589634	GM-EQREV-7-40M=	712685	GM-EQREV-7-55M=
8 dB	589635	GM-EQREV-8-40M=	712686	GM-EQREV-8-55M=
9 dB	589636	GM-EQREV-9-40M=	712687	GM-EQREV-9-55M=
10 dB	589637	GM-EQREV-10-40M=	712688	GM-EQREV-10-55M=
11 dB	589638	GM-EQREV-11-40M=	712689	GM-EQREV-11-55M=
12 dB	589639	GM-EQREV-12-40M=	712690	GM-EQREV-12-55M=

Value	65 MHz		85 MHz	
	Legacy	New	Legacy	New
0 dB	712719	GM-EQREV-0=	712719	GM-EQREV-0=
1 dB	589736	GM-EQREV-1-65M=	4036769	GM-EQREV-1-85M=
2 dB	589737	GM-EQREV-2-65M=	4036770	GM-EQREV-2-85M=
3 dB	589738	GM-EQREV-3-65M=	4036771	GM-EQREV-3-85M=
4 dB	589739	GM-EQREV-4-65M=	4036772	GM-EQREV-4-85M=
5 dB	589740	GM-EQREV-5-65M=	4036773	GM-EQREV-5-85M=
6 dB	589741	GM-EQREV-6-65M=	4036774	GM-EQREV-6-85M=
7 dB	589742	GM-EQREV-7-65M=	4036775	GM-EQREV-7-85M=
8 dB	589743	GM-EQREV-8-65M=	4036776	GM-EQREV-8-85M=
9 dB	589744	GM-EQREV-9-65M=	4036777	GM-EQREV-9-85M=
10 dB	589745	GM-EQREV-10-65M=	4036778	GM-EQREV-10-85M=
11 dB	589746	GM-EQREV-11-65M=	4036779	GM-EQREV-11-85M=
12 dB	589747	GM-EQREV-12-65M=	4036780	GM-EQREV-12-85M=

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.

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.

CW

continuous wave.

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.

dBm

decibels relative to 1 milliwatt.

dBmV

decibels relative to 1 millivolt.

dBW

decibels relative to 1 watt.

dc, DC

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

Glossary

value.

EMC

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

EQ

equalizer.

equalization

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

FCC

Federal Communications Commission. Federal organization set up by the Communications Act of 1934 which has authority to regulate all inter-state (but not intra-state) communications originating in the United States (radio, television, wire, satellite, and cable).

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.

GHz

Gigahertz. A unit of frequency equal to one billion cycles per second.

Hertz

A unit of frequency equal to one cycle per second.

I/O

input/output.

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.

LE

line extender.

LED

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

Mbps

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

MHz

megahertz. A unit of measure representing one million cycles per second; measures bandwidth.

N-cm

Newton centimeter

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)

PWB

printed wiring board.

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.

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.

Glossary

SA

system amplifier.

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.

V

volt.

V AC

volts alternating current.

V DC

volts direct current.

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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