ARF601e RF Amplifier Upgrade Kit

QRG

Revision B

ACT ARF601e Upgrade Kit QRG

ACT Document Number: ACT ARF601e Upgrade Kit QRG

Quick Reference Guide Revision B

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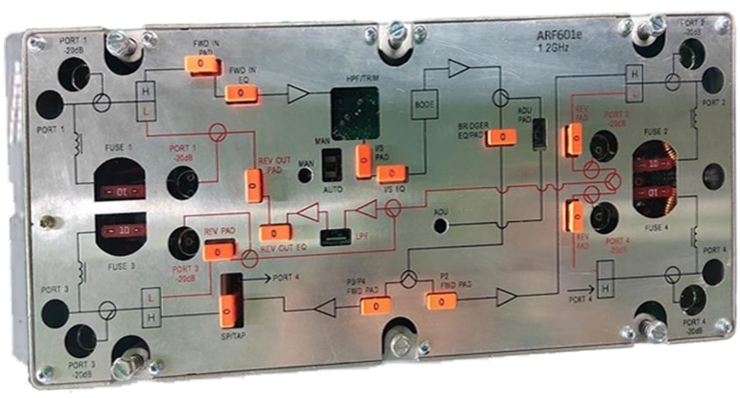


Revision History

Revision	Date	Reason for Change
A	02/27/2023	Initial release
B	07/01/2025	Update format

Table of Contents

1 Introduction

1.1 Safety Symbols

WARNING Personal injury might result if instructions are not followed.

CAUTION Equipment damage might result if instructions are not followed.

Note Read for added information and reminders, including when a service interruption could occur.

Tip Read for helpful hints.

1.2 Tools and Materials

Below table describes the tools, equipment, and materials that may be required to operate, maintain, and test the ARF601e. Anyone performing the procedures in this manual is expected to be familiar with the appropriate, safe use of these tools. Tools or equipment with superior specifications may be substituted for those listed.

Tools/Materials	**Required Characteristics**	**Uses**
Tools		
Signal Level Meter (SLM)	5MHz to 1200MHz, –35 to +60dBmV (25 to 120dBµV)	Input and output signal testing during forward and return balancing
Signal Generator	5 to 100MHz, 10 to 60dBmV (70 to 120dBµV)	Signal input during return balancing
Multimeter	True RMS, AC-coupled; ranges: 0 to 200VDC, 0 to 200VAC, and 0 to 200mVAC	Power supply testing
Flat Blade Screwdrivers	1/4 inch, 5/16 inch	May be required for small fasteners
Torque Wrench/Driver	Up to 50 in-lbs (5.6 N·m), with interchangeable 5/16 and 1/2 inch hex socket, Phillips, flat-blade, and Torx® or Torx PLUS® bits	Strand mounting, housing closing, tightening various fasteners; ARRIS recommends torquing all bolts and screws to the appropriate values whenever specified
Nutdriver	5/16, 1/2 inch	5/16 inch — Replacing lid assembly, RF module, centerseizure bolts 1/2 inch — Housing opening/closing
Hex Socket	5/16 inch	centerseizure bolts
Wire Cutters	—	Coaxial cable center conductor length adjustment
Tuning Wand	Non-conductive	Adjust ALC sensitivity and modulation depth
Fuse Puller	Non-conductive (ARRIS P/N FP-1)	Fuse removal and installation
Drill and Drill Bits	9/32 inch (7 mm)	Wall mounting
Materials		

Tools/Materials	Required Characteristics	Uses
1/4-20 UNC Bolts, Washers, and Shims		Wall mounting
Heat Gun or Approved Torch and Heatshrink Tubing, or Weathersealing Tape or Compound		Weatherproofing RF cable
Anti-Seize Compound		RF cable attachment

2 Functional Description and Physical Identification

2.1 Forward RF Signal Flow

2.1.1 Before Main & Secondary Paths Split

2.1.1.1 RF Input Port (Port 1)

The input port, port 1, routes forward incoming signal to the amplifier. (This port also routes outgoing return signal to the main cable.)

2.1.1.2 Input Testpoint

The input testpoint is a –20 dB directional coupler. Accessible through a cut-out in the module cover, this testpoint lets you verify the forward signals at the forward input port (J1) without interrupting the amplifier’s operation. (Return signal cannot be measured here.)

2.1.1.3 Input Diplex Filter

A diplex filter consists of a pair of filters, a high-pass and a low-pass, isolating forward and return bands. The high-pass filter passes forward signals but blocks return signals and AC. The low-pass filter passes return signals but blocks forward signals.

2.1.1.4 Input Attenuator

This plug-in attenuator reduces RF levels at the pre-amp input to meet design specifications. Amplifiers are shipped with the input attenuator position empty. Select and install the appropriate value based on network design.

2.1.1.5 Input Equalizer

This plug-in equalizer compensates for the effects of cable preceding the amplifier module. Amplifiers are shipped with the input equalizer position empty. Select and install the appropriate value based on network design.

2.1.1.6 Pre-Amplifier

This pre-amplifier sets the amplifier’s noise figure.

2.1.1.7 Interstage Attenuator

The interstage attenuator reduces overall amplifier gain. A “zero” attenuator or jumper is shipped in this slot for circuit continuity.

2.1.1.8 ALSC Bode Equalizer (factory-installed)

The ALSC Bode equalizer works with the ALSC Bode controller to maintain a constant RF output level, compensating for the effects of temperature on cable.

2.1.1.9 Response Equalizer

An EDB series response equalizer (debumper) flattens the forward response of cascaded amplifiers, compensating for system signature imperfections. A jumper is shipped in this slot for circuit continuity.

2.1.1.10 Interstage Equalizer (factory-installed)

The interstage equalizer is factory-installed to optimize the distortion characteristic of the amplifier and provide the desired main output slope at the specified bandwidth. Normally you will not change this plug-in. However, if you need to change the tilt of the amplifier’s outputs from the factory-set value, see the procedure under Interstage & Distribution Equalizers.

2.1.1.11 Interstage Amplifier

The RF from this hybrid goes to the two post-amplifiers.

2.1.1.12 ALSC Bode Controller (factory-installed)

The automatic level and slope control (ALSC) Bode controller works with the ALSC Bode equalizer to maintain a constant RF output level, compensating for the effects of outside temperature changes on cable. A directional coupler taps a small portion of the main output power and routes it to the ANALOG/DIGITAL switch that is used to adjust the operating level at the pilot frequency. Set to ANALOG when the operating range at the pilot frequency is between 45 and 52 dBm and set to DIGITAL when the operating level is below 45 dBmV. Output of the ANALOG/DIGITAL switch is passed to the Controller which converts it to a DC signal that controls the Bode equalizer.

2.1.1.13 Distribution Equalizer (factory-installed)

The distribution equalizer provides additional slope to all outputs. The interstage and distribution equalizers are factory-installed to set the tilt of the output signals according to the customer order. A “zero” equalizer may be shipped in the distribution equalizer position for circuit continuity if no additional slope is needed. Normally you will not change this plug-in. However, if you need to change the tilt of the amplifier’s outputs from the factory-set value, see the procedure under *Interstage & Distribution Equalizers*.

2.1.2 Main Path (after it splits from secondary path)

2.1.2.1 Main Output Attenuator

Accessible through a cut-out in the module cover, this attenuator reduces signal levels at the main output. A “zero” attenuator or jumper is shipped in this slot for circuit continuity.

2.1.2.2 Main Output Post-Amplifier

The RF from this hybrid goes to the main output port, J2.

2.1.2.3 Main Output Diplex Filter

See Input Diplex Filter.

The main output testpoint allows you to inject return test signals.

2.1.2.4 Main Output Testpoint

The main output testpoint is a –20 dB directional coupler, which isolates the measured forward signal from the effects of reflections in the cable. Accessible through a cut-out in the module cover, this testpoint lets you verify the forward signals at the main output port (J2) without interrupting the amplifier’s operation.

2.1.2.5 Main Output Port (J2)

The main output port, J2, routes forward outgoing signal to a distribution cable. (This port also routes incoming return signal to the amplifier.)

2.1.3 Secondary Path (after it splits from main path)

2.1.3.1 Secondary Output Attenuator

This attenuator reduces signal levels at the secondary output port (J3 or J4). A “zero” attenuator or jumper is shipped in this slot for circuit continuity.

2.1.3.2 Secondary Output Post-Amplifier

The RF from this hybrid goes to the secondary output port(s).

2.1.3.3 Secondary Output Port Selector

Accessible through a cut-out in the module cover, the output port selector directs signal to the secondary output port(s): J3 only, J4 only, or both J3 and J4. A jumper, or “zero” attenuator, is used when directing signal to only one port. When using both ports, this location accepts a splitter (P/N 2501157) or directional coupler (8 dB = P/N 2501158; 12 dB = P/N 2501159) plug-in.

2.1.3.4 Secondary Output Diplex Filter

See Input Diplex Filter.RF Output Port (Port 2)

2.1.3.5 Secondary Output Testpoint

A secondary output testpoint is a –20 dB directional coupler, which isolates the measured forward signal from the effects of reflections in the cable. Accessible through a cut-out in the module cover, this testpoint lets you verify the forward signals at the secondary output port (J3 or J4) without interrupting the amplifier's operation. This testpoint is also used to inject a return test signal.

2.1.3.6 Secondary Output Port (J3 or J4)

A secondary output port routes forward outgoing signal to a distribution cable. (This port also routes incoming return signal to the amplifier.)

2.2 Return RF Signal Flow

2.2.1 Before the Return Legs Combine

2.2.1.1 Return Input Port (J2, J3, or J4)

A return input port routes incoming return signal to the amplifier. (This port also routes forward outgoing signal to distribution cables.)

2.2.1.2 Return Test Signal Injection Point (Output Testpoint)

Since the forward output testpoint allows access to the return band, you can inject return test signals here (although you can't measure return signal).

2.2.1.3 Return Input Diplex Filter

See Input Diplex Filter.

2.2.1.4 Return Input Attenuator

The return input attenuator is used in this position primarily for ingress isolation. A "zero" attenuator or jumper is shipped in this slot for circuit continuity.

2.2.1.5 Return Input Testpoint

Accessible through a cut-out in the module cover, this –20 dB resistive testpoint lets you verify the return signals at the return hybrid input. It is approximately –15dB from the testpoint's position in the circuit.

2.2.1.6 Return Combiner

Return signals from J2, J3, and J4 are combined into a single feed for the return amplifier. This three-way combiner has equal (5 dB) loss in each leg.

2.2.2 After the Return Legs Combine

2.2.2.1 Return Amplifier

This hybrid, which amplifies the combined return signal, features an improved compression point and bit error rate (BER) for digital-loaded traffic over a discrete amplifier design.

2.2.2.2 Return Output Equalizer

Accessible through a cut-out in the module cover, this equalizer provides an output tilt at the return amplifier that will provide a flat input at the next return amplifier. Amplifiers are shipped with the return output equalizer position empty. Select and install the appropriate value based on network design.

A return EDB plug-in may be installed instead of the equalizer to flatten circuitry response anomalies.

2.2.2.3 Return Output Attenuator

This attenuator reduces signal levels at the return output port (J1). Amplifiers are shipped with a “zero” return output attenuator or jumper. You may need to select and install the appropriate value based on network design.

2.2.2.4 Return Output Testpoint

This –20 dB directional coupler testpoint is used to measure the combined return signal as it will be sent to the return output port, J1. (Note that the testpoint at J1 is for forward input only; combined return signal cannot be measured at that point.)

2.2.2.5 Return Output Diplex Filter

See Input Diplex Filter.

2.2.2.6 Return Output Port (J1)

The return output port routes outgoing return signal via the cable system back to the previous amplifier. (This port also routes incoming forward signal to the amplifier.)

2.3 Return RF Signal Flow

2.3.1 Attenuator for Return Output Equalization

Accessible through a cut-out in the module cover, this attenuator for return output equalization creates an output tilt at the return amplifier that will adjust for a flat input at the next return amplifier or match the reference at the headend. Line extenders are shipped with this attenuator position empty. You'll need to select and install the appropriate value based on the station's location in your network. (See Setting Up the RF Return Plant (Flex Max321 Line Extenders) on page 6-4 and Determining Values for Attenuators to Adjust for Return Equalization on page A-10.)

Note: Line extenders are shipped with the return output attenuator and return output attenuator for equalization positions empty; you must install both plug-in circuits for the module to work.

2.3.2 Return Output Attenuator

This –20 dB resistive testpoint is used to measure the return signal as it will be sent to the return output port, that is, Port 1. (Forward input signal also can be measured here.)

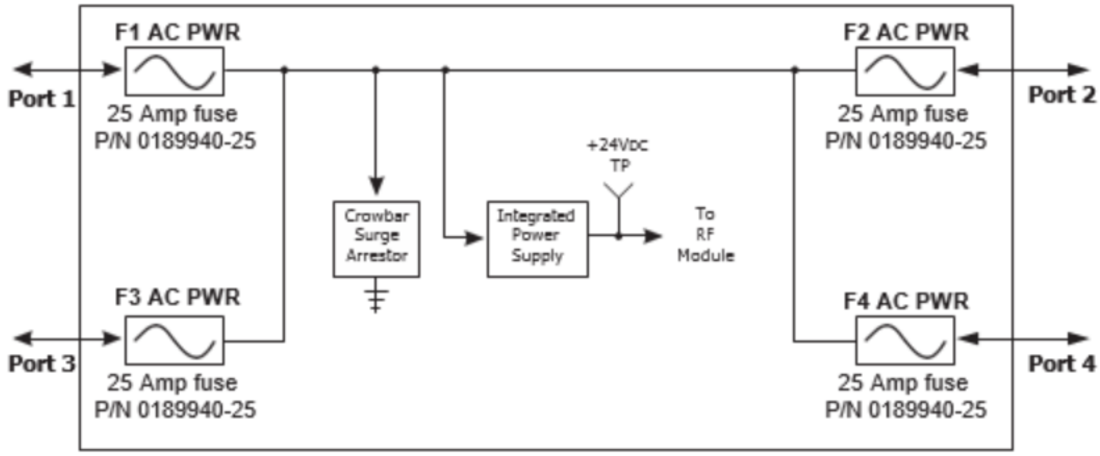
2.3.3 Return Output Port (Port 1)

The return output port routes outgoing return signal via the cable system back to the previous module. (This port also routes incoming forward signal to the line extender.)

2.4 Amplifier Powering

Refer to the power routing diagram in Figure 2.3 for the following description. AC power may enter the housing at any of the RF ports, passes through the fuse, and is then routed to the crowbar surge arrestor and integrated power supply. AC and RF separation is fixed. An AC bypass path provides high impedance to RF signals.

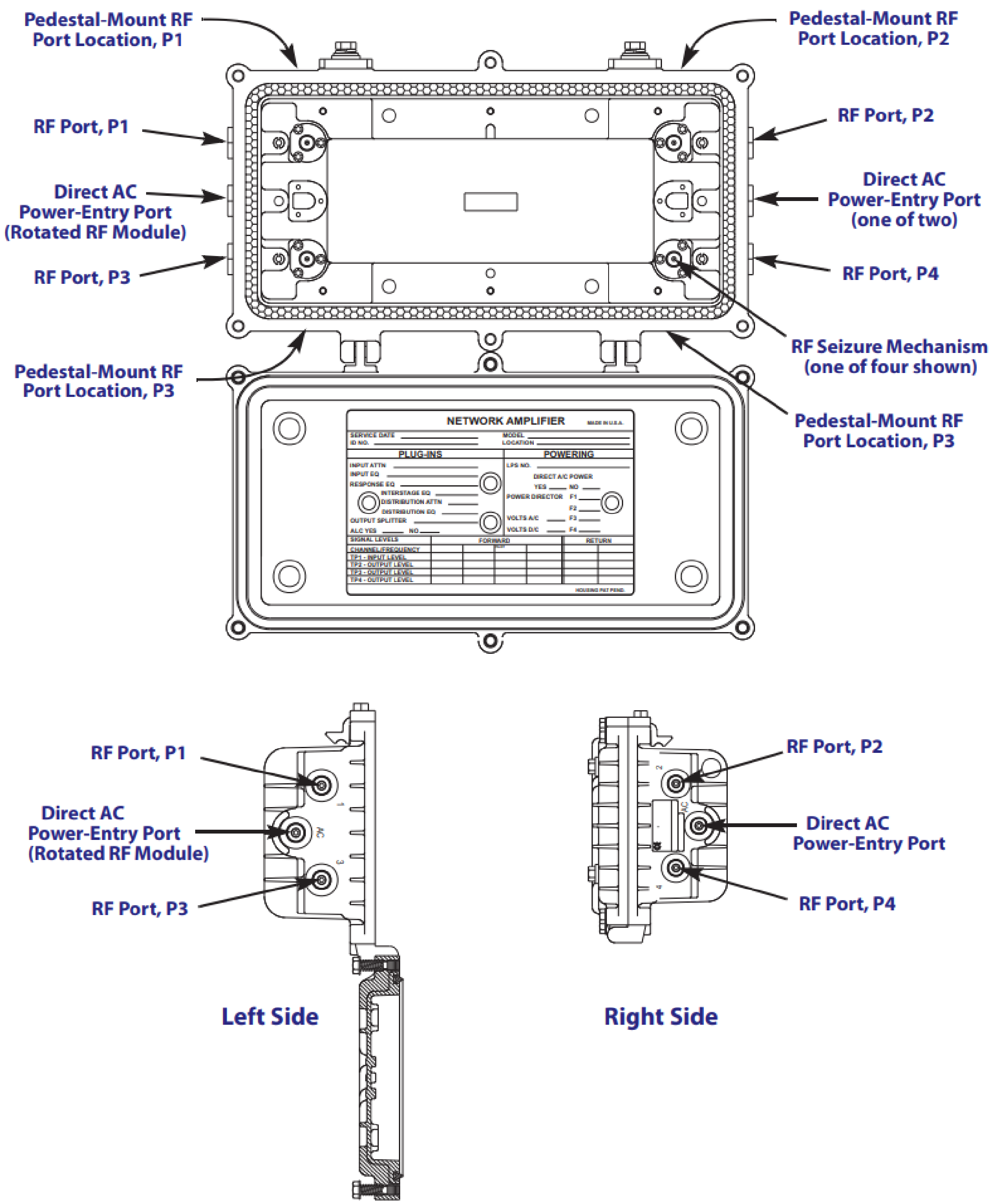
The amplifier's 2.5-ampere integrated power supply receives the incoming AC power and converts it into DC power to provide power to the RF module. For details on the power-director fuses, see Power Distribution Configuration.



3 Housing Instructions

3.1 Field Installation

A 9-NH series housing with a standard lid shows the access ports and points of connection between the housing and the amplifier module in below figure. Any port not in use must be terminated. Refer to below table for a description of the callouts in below figure.



Designation	Description
RF Ports: P1, P2, P3, P4	Accept an RF connector from a coaxial cable carrying signals to and from the housing. These four standard ports are for horizontal connections. All ports are tapped and have seizure mechanisms.
Pedestal-Mount RF Ports: P1, P2, P3, P4	5 to 100MHz, 10 to 60dBmV (70 to 120dBμV)
Direct AC Power-Entry Ports (two)	Available for PED housing models only. Used with Diamond Line I and II amplifiers as well as legacy GNA/TNA series amplifiers. Accepts direct AC power via the NH/PED-Direct Power Kit (P/N 2100860). Refer to document 0877456-2. Contact ARRIS for availability with the ARF601e bridger amplifier.
RF Seizure Mechanisms	Route forward and return RF signals between the housing's RF ports and the amplifier.

3.2 Housing Opening

The electronic components of the ARF601e are enclosed in a diecast aluminum housing. Proper installation and other housing related operations are important to ensure the integrity of the contained electronics.

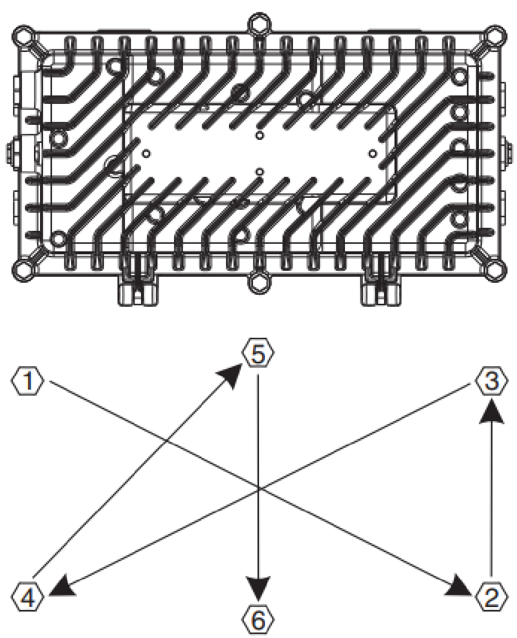
WARNING If the ARF601e has already been installed and activated, hazardous voltages are present. Use approved safety equipment and procedures.

CAUTION: Housing damage may result if the lid bolts are not loosened or tightened in the pattern shown in below figure.

CAUTION: Node electronic components can be damaged by the environment. Close the housing whenever it is left unattended to keep moisture out of the station and to protect the network from RF interference.

To open the housing

1. Loosen the six captive lid bolts with a 1/2 inch nutdriver according to the pattern in below figure.
2. Hand loosen and release the three bolts next to the lid hinges.
3. While holding the lid closed with one hand, release the last three bolts, and lower or open the lid.



3.3 Housing Mounting

Depending on the requirements of the system, the ARF601e can be mounted in any one of the following ways:

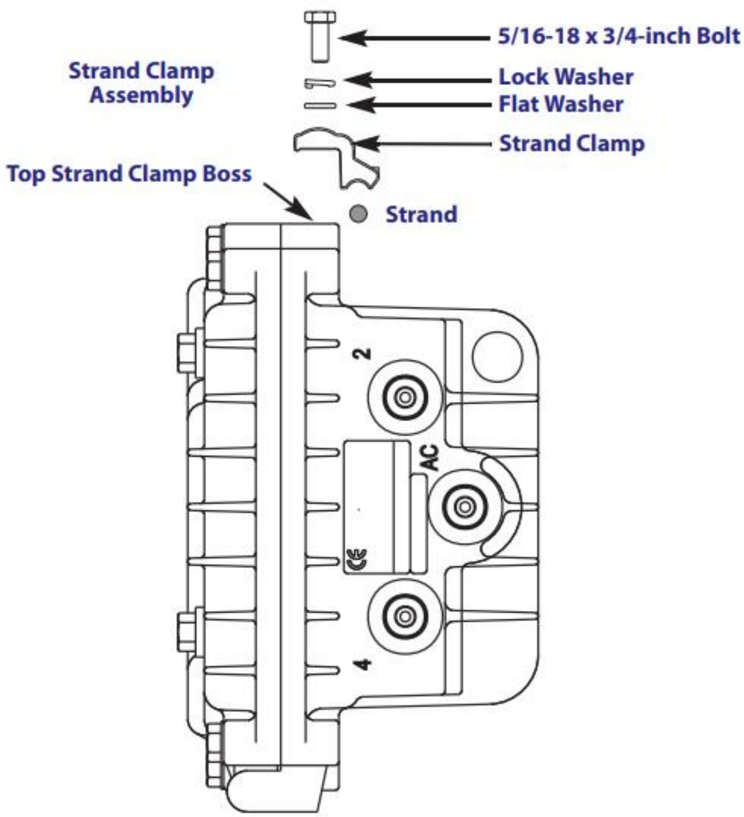
strand/pedestal mount

wall mount

3.3.1 Strand/Pedestal Mounting

To strand/pedestal mount

1. Loosen the bolts holding the strand clamps in place.
2. Hoist the housing to the strand, and hang it in position.
3. Tighten the clamp bolts so that the housing cannot come off of the strand, but is still free for adjustment.
4. Position the housing at a location on the strand that is accessible for attaching cables and performing maintenance and balancing, and that complies with the requirements of the system.
5. Torque the clamp bolts to between 40 and 66 in-lbs (4.5 to 7.5 N·m) to tighten them securely.



3.4 Wall Mounting

WARNING: ARF601es are heavy. Ensure that ARF601es are properly installed to avoid equipment damage or personal injury.

Use the wall mount bosses (mounting surfaces) when mounting the ARF601e to a wall.

To wall mount

1. Measure the thickness of the structure or wall where the housing will be located.
2. Plan the installation with enough clearance to install the cable and cable connectors and to ensure access to internal electronic components. You may need to shim, drill access holes, or provide cutouts.
3. Drill mounting holes 10 inches (25.4 cm) apart in the mounting surface if required. Refer to below figure for the location of the wall mount bosses. Use a 9/32-inch diameter drill bit for 5/16 bolts.

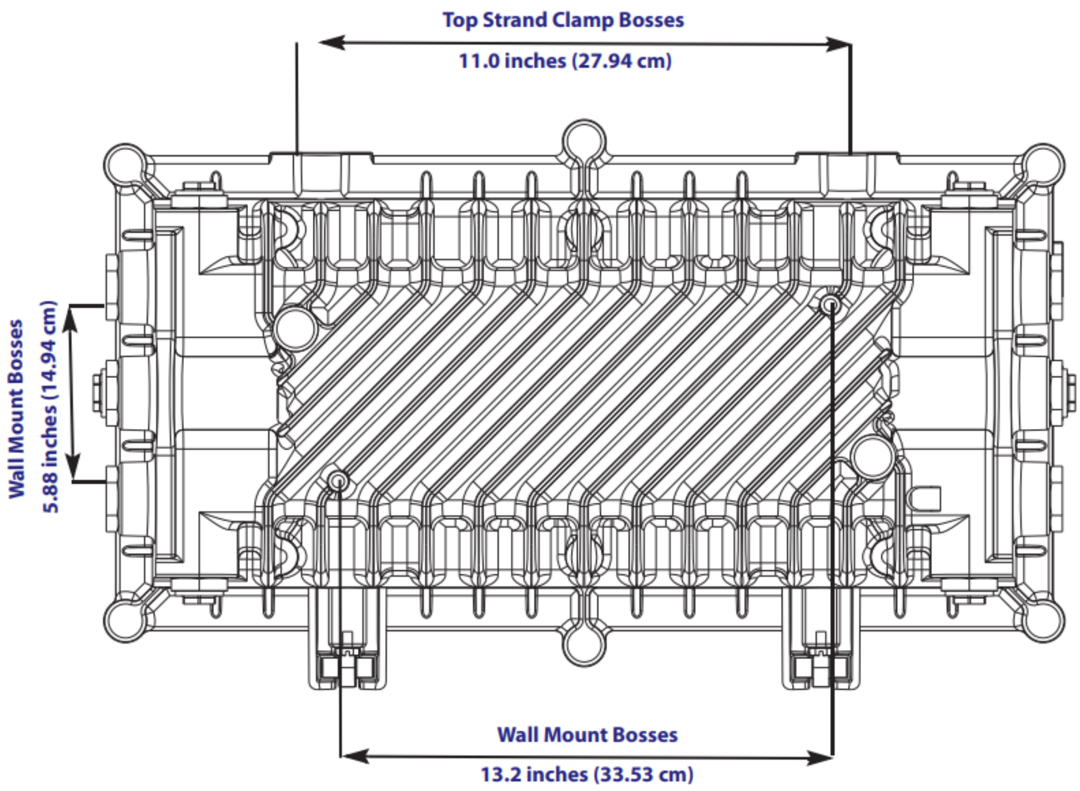
   Tip Use flat washers with a large outside diameter (not supplied) on any walls that are made of compressible material.

4. Select appropriate length 5/16 mounting bolts (not supplied) and washers to allow a threaded bolt length of 3/8 to 1/2 inch (10 to 13 mm) to extend into the housing. Table 3.4 lists three examples.

Minimum Wall	Bolt Length
1/16 inch (1.6mm)	1/2 inch (13mm)
5/16 inch (8mm)	3/4 inch (19mm)
9/16 inch (14mm)	1 inch (25mm)

CAUTION Bolts must be installed with at least 3/8 inch (10 mm) of thread engagement. Any less and the bolts may not hold. Bolts extending more than 3/4 inch (19 mm) into the housing could damage the housing. Do not torque mounting bolts more than 66 in-lbs (7.5 N·m).

5. Install as shown in below figure.
6. Tighten the mounting bolts. The amount of torque required will depend on the mounting surface used, but use no more than 66 in-lbs (7.5 N·m) of torque.



4 Configuration

This chapter provides instructions for the initial setup of ARF601e 1 GHz Bridger Amplifier.

4.1 Before You Start

Review all procedure(s) and gather all necessary tools and equipment before beginning the installation.

Configuring a ARF601e amplifier includes installing the designed plug-ins and fuses into the amplifier module, then installing the module into a 9-NH series housing in the field.

Before you begin, review the system design maps, design calculations, and bills of material for the following information:

- Cable and passive losses preceding the amplifier location
- Required gain of the amplifier
- ALSC requirements
- Operating levels
- System operating tilt
- Output port(s) used

The following tools and materials may be used to complete the procedures in this chapter.

Tools/Equipment	Required Specifications	Uses	Note
Signal Level Meter (SLM)	5MHz to 1218MHz, –35 to +60dBmV (25 to 120dBµV)	Input and output signal testing during forward and return balancing	
Signal Generator	5 to 100MHz, 10 to 60dBmV (70 to 120dBµV)	Signal input during return balancing	
Multimeter	True RMS, AC-coupled; ranges: 0 to 200VDC, 0 to 200VAC, and 0 to 200mVAC	Power supply testing	
Flat Blade Screwdrivers	1/4 inch, 5/16 inch	May be required for small fasteners	
Wire Cutters	—	Jumper cutting	
Nutdriver or Wrench	1/2 inch	Housing opening and closing	
Nutdriver	5/16 inch	Centerseizure bolts, RF module	
Torque Wrench/Driver	Up to 66 in-lbs (7.5N·m), with interchangeable 1/2 inch hex socket, Phillips, flat blade, and Torx® or Torx PLUS® bits	Strand mounting, housing closing, tightening various fasteners	1
Tuning Wand	Non-conductive	Adjust ALC sensitivity and modulation depth	
Fuse Puller	Non-conductive (ARRIS P/N FP-1)	Fuse removal and installation	

Note1: Recommends torquing all bolts and screws to the specified values.

4.2 Installing the Designed Equalizers and Attenuators

Install equalizers and attenuators specified by the system design (or according to the formulas given in Appendix C), as follows:

Note: For plug-in locations in ARF601e series amplifiers, see ARF601e User-changeable Plug-ins.

1. Install the user-changeable equalizers and attenuators. If factory-installed jumpers or zero-value circuits are installed in these positions, remove them as you go. In some locations, the system design may call for reduced output at specific ports. Change the values of the corresponding output attenuators accordingly. (In ARF601e bridger amplifiers, you could also change the values of the secondary output port selectors. See *Installing the Output Port Selector*.)

Note: Because the system design is normally based on the same gain at each amplifier station, you will normally install the same value interstage attenuator in all amplifiers in the system.

2. Verify that the amplifier gain (per amplifier specifications) matches the designed gain. If the gains don't match, use an interstage attenuator. (Interstage attenuators reduce the signal between amplifier stages to minimize the effect on carrier-to-noise, allowing you to customize the amplifier gain to match your system's designed gain.)

interstage attenuator value	=	operating gain (from amplifier specifications)	–	designed gain (system-wide)

Because field conditions may vary from system design assumptions, you may need to change plug-in values during setup.

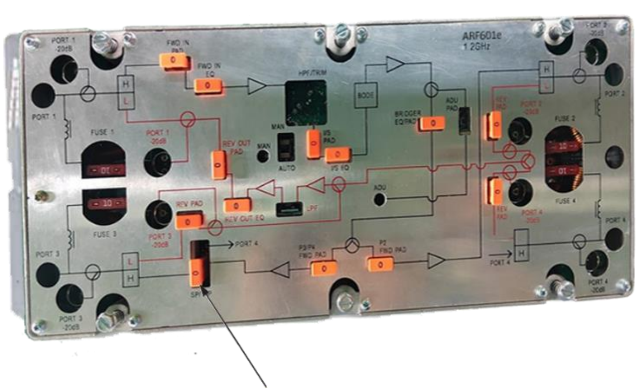
4.3 Installing the Output Port Selector

The ARF601e bridger amplifier may be configured to use either or both distribution output ports: J4 and/or J3.

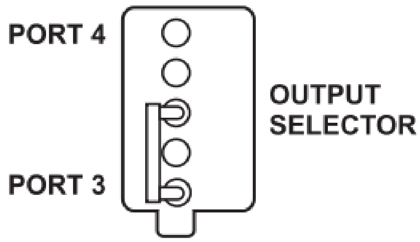
4.3.1 Using Only One Output (J3 or J4)

ARF601e bridger amplifiers are shipped with a jumper in the J4 output selector position, as shown in below figure. To switch to J3, move the 9-A0 plug-in or jumper into the position shown in below figure.

Secondary Output Selector Set for J4 Only



Secondary Output Selector Set for J3 Only



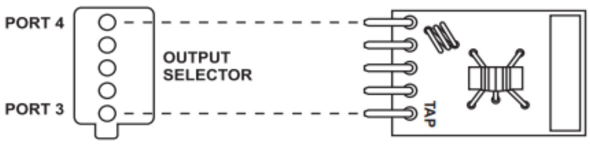
4.3.2 Using Both Outputs (J3 and J4)

To use both secondary ports, install the appropriate 7-DC series plug-in:

Model	P/N	Description	Insertion Loss (dB, max. at 1002 MHz)
7-DC-4-5-862 7-DC-4-5-1000	2501157	two-way splitter	4.5 each leg
7-DC-8-5-862 7-DC-8-5-1000	2501158	directional coupler	Thru: 2.6 Tap: 8.0 ±0.5
7-DC-12-5-862 7-DC-12-5-1000	2501159	directional coupler	Thru: 1.8 Tap: 11.9 ±0.5

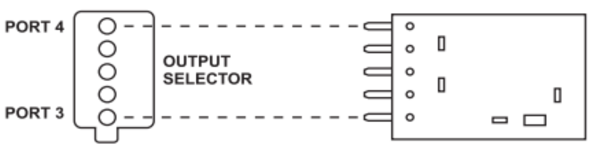
Note*:* The models ending with 862 are also specified up to 1002MHz.

The legacy 7-DC plug-ins do not have a cover and can fit into the main board facing either direction. If using a 7-DC-4-5 splitter, which has equal loss in both legs, it doesn't matter which way you install it. However, if using a 7-DC-8-5 or 7-DC-12-5 directional coupler, proper orientation is critical. To determine which orientation is correct for a given amplifier, check the system design to see whether J3 or J4 should be the tap (high-loss) leg. Install the directional coupler accordingly, as shown in Figure 4.4. The tap leg, which may be identified on some plug-ins as either "TAP" or "T", is the far right leg when you view the labeled (component) side. The new 7-DC-xx-5-1000-WC directional couplers have a removable cover with guides that orient Port 3 as the tap leg. The cover must be removed to configure Port 4 as the tap leg.



Legacy 7-DC directional coupler oriented with port 3 as the tap leg.

7-DC-xx-5-1000-WC directional coupler with cover has guides that only allow it to be oriented with port 3 as the tap leg. Remove the cover (blue) and rotate 180° as shown below to orient port 4 as the tap leg.



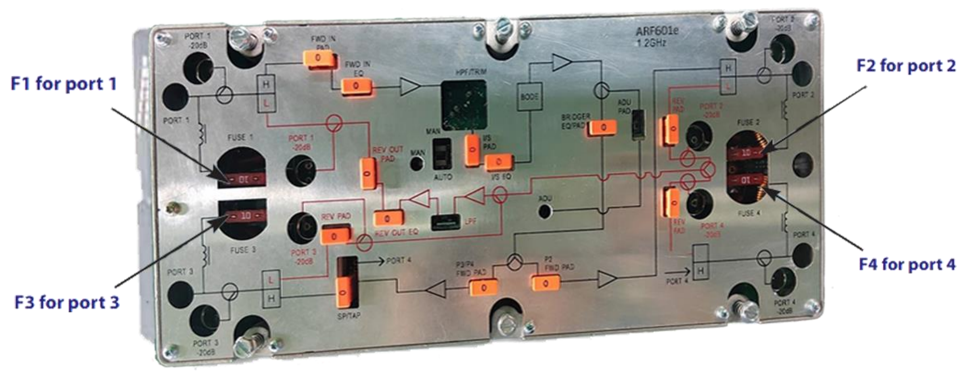
Legacy 7-DC directional coupler or 7-DC-xx-5-1000-WC with cover removed oriented with port 4 as the tap leg

4.3.3 Power Distribution Configuration

WARNING: Hazardous voltages are present. Use approved safety equipment and procedures.

CAUTION: To prevent hybrid damage, ARRIS recommends that all amplifiers in a power supply group have PADs and Equalizers installed in the forward RF path before energizing. The initial recommended accessory values are shown on the system map.

ARF601e bridger offer flexible power routing through 25-amp automotive-style fuses ("power directors"): F1, F2, F3, and F4. These fuses do not provide overcurrent protection; they direct power to the appropriate legs.



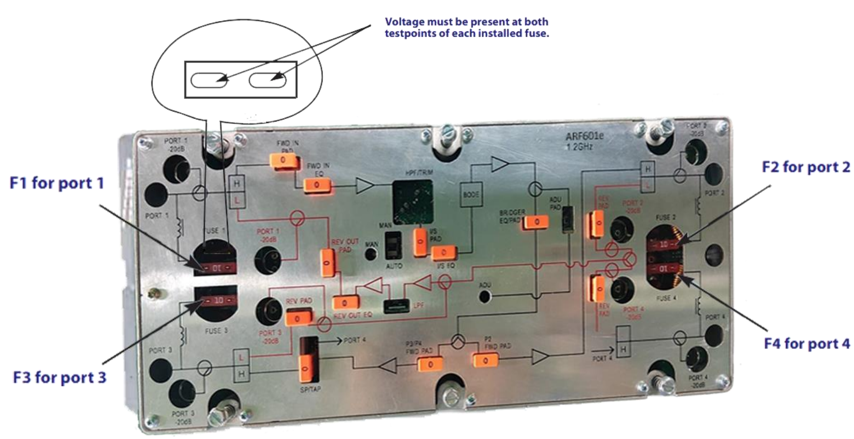
WARNING: Power may be applied to the RF amplifier housings. Before inserting amplifiers into housings, make sure the proper fuses are installed only in the port positions where power is to be directed.

To configure power distribution:

1. Open the amplifier housing. (Refer to Housing Opening.)
2. Determine from the system design which legs should have power applied.
3. Install fuses in the corresponding locations. (See above figure.)

4.3.3.1 Checking AC Power

Each power-director fuse has two testpoints. The testpoint closest to the edge of the amplifier cover is connected to the nearest port. The testpoint closest to the center of the amplifier cover passes AC power within the station.



To check AC power:

1. Ensure that the appropriate fuses are installed.
2. Verify AC continuity at both testpoints. (See above figure.) If there's no AC at one testpoint, the fuse is probably blown; replace it and recheck.

4.3.4 Terminating Ports

To prevent ingress and reflection-induced ringing, which can alter readings during setup, you should terminate all unused ports. You can terminate ports in two ways:

- You may install line terminators in the output ports to terminate them externally.
  Note: If you terminate the ports with plug-in terminators, you will also need to install port plugs in the unused ports.
- Or, install a 9-A-TERM 75-ohm plug-in terminator in the return input attenuator position of any leg not being used for return signal. For location of return input attenuators, see Plug-in Circuits chapter.

4.3.5 Calculating Balancing Carrier Levels

Typically, only the Forward High Balancing Carrier level will need to be calculated (if it is not provided by the system manager). All other balancing carrier levels are near enough to the signal levels of the bandedge carriers that bandedge levels may be used for balancing.

Perform this calculation only when the Forward High Balancing Carrier is not at the high bandedge frequency. This calculation method can speed up the process of balancing and needs to be done only once for all similar amplifiers within a cascade.

1. Obtain a copy of the Amplifier Data Sheet from the system manager or make a copy from the sample at the end of this manual.
2. Calculate the Forward High Balancing Carrier level using the following equation.

$$L_C = \left[\frac{L_H - L_L}{F_H - F_L}\right] \times (F_C - F_L) + L_L$$

L_C = Forward High Balancing Carrier level (dBmV)

L_H = system output level at the high bandedge frequency (dBmV)

L_L = system output level at the low bandedge frequency (dBmV)

F_H = system high bandedge frequency (MHz)

F_L = system low bandedge frequency (MHz)

F_C = Forward High Balancing Carrier frequency (MHz)

3. Copy the Forward High Balancing Carrier level to the appropriate box in the Map Signal Information section of the Amplifier Data Sheet.

4.3.6 Temperature Compensation

Note: Temperature correction only applies to aerial cable. Use a 0 dB Temperature Correction Value for all underground cable.

Tip: To compensate for cable loss due to temperature change, you can remember that the percentage of change of cable loss is measured 1% for every 10° F (5.5° C) of temperature change, or you can complete the procedure that follows.

Typically, only the forward balancing carriers require temperature compensation. The effect of temperature on the cable attenuation associated with the low frequency return balancing carriers is minimal except in extreme conditions.

When the temperature surrounding an amplifier is between 50 and 90• F (10 and 32• C), balancing carrier levels do not require temperature compensation.

If the temperature is less than 50• F (10• C) or greater than 90• F (32• C), perform temperature compensation as follows:

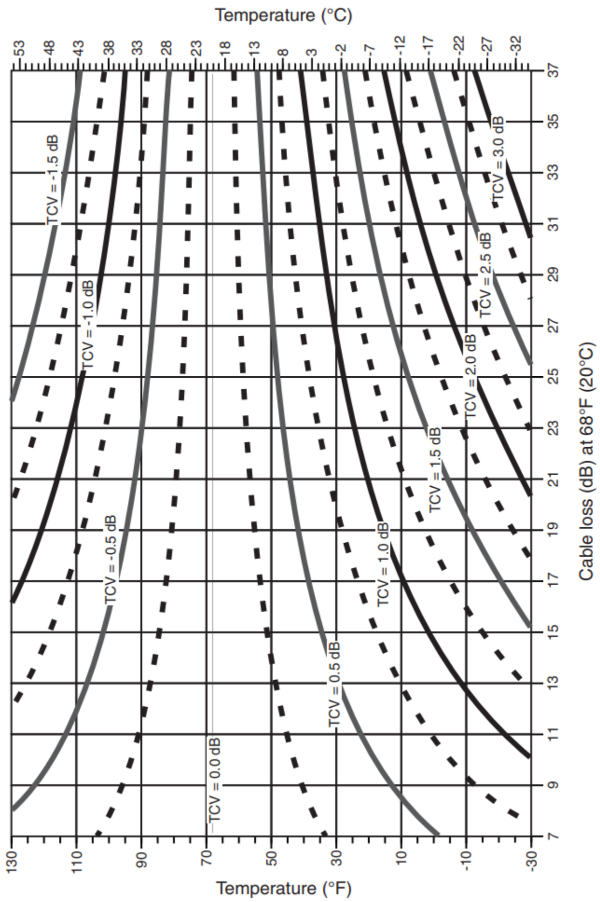
To perform temperature compensation

1. For both forward balancing carriers, note the loss (in dB at the carrier frequency) due to the cable preceding the unit under test. Note the temperature of the air surrounding the preceding cable.
2. Using Figure 4.7 on page 4-11, obtain a Temperature Compensation Value (TCV) for that section of cable for each carrier.
   a. Find the intersecting point on the chart corresponding to your cable loss and temperature values.
   b. Find the TCV line nearest this point. The dB value label on that line is your TCV.
   c. Record both TCVs in the calculation box below and on the ARF601e Data Sheet.

   Example: Your cable loss is 23 dB. The air temperature is 25° F (–5° C). The point on the graph corresponding to these two values is between the 0.75 and 1.0 dB lines, but closer to the 1.0 dB line. (The dotted lines mark the halfway-between-lines points on the graph.) The TCV is then 1.0 dB.
3. Record the System Forward High and Low Balancing Carrier levels from the Flex Max601 Data Sheet into the following calculation box. Perform the calculation to get the adjusted output levels.

________	+	________	=	________
System Forward High Balancing Carrier Level		TCV For High Carrier (from Figure 4.7)		Adjusted Forward High Balancing Carrier Level
________	+	________	=	________
System Forward Low Balancing Carrier Level		TCV For Low Carrier (from Figure 4.7)		Adjusted Forward Low Balancing Carrier Level

4. Use the temperature compensated forward balancing carrier levels in Forward Balancing Requirements and Forward Field Testing.
5. Repeat Steps 1 and 2 for the return balancing carriers. Use these temperature compensated levels in Return Balancing and Return Field Testing.



4.4 Forward Balancing

4.4.1 Forward Balancing Requirements

CAUTION: RF input signal levels greater than +45 dBmV @ 1 NTSC channel loading can damage amplifier active components. Derate maximum input level according to actual channel loading (for example, +26 dBmV @ 79 NTSC channel loading)

(+26 dBmV = +86 dBµV).

Note: “System” values are those recommended values shown on the system map. “Measured” values are the signal levels actually measured at the amplifier.

Make sure that the following requirements are met before you start to balance:

- The system map is marked with amplifier output levels for bandedge frequencies.
- Forward balancing carriers, set at the proper levels, are injected into the cable network from the headend.

- One forward balancing carrier is available at a lower bandedge.
- One forward balancing carrier is available at a higher bandedge.
- All tap outlets, ends of feeder cables, and unused active RF ports are terminated with a 75 impedance.
- Unscrambled ALC carriers are injected into the system at the assigned frequency for the amplifier (if ALC is to be used).
- Preceding amplifiers have been properly balanced and provide the desired forward band signals to the amplifier for forward balancing.
- ARF601e bridgers amplifiers can be configured with the appropriate plug-in accessories for 1.2GHz operation or for use as spares in 750/870MHz systems.

4.4.2 Forward Balancing Procedure

Refer to figure and Table in Plug-in Circuits chapter for control and accessory locations.

To balance the forward path

1. Determine the System Forward High and Low Balancing Carrier Levels:
   - If bandedge carriers are used for balancing, copy the amplifier bandedge carrier output levels from the system map to the Map Signal Information table on the Amplifier Data Sheet.
   - If other than the bandedge carriers are used for balancing, calculate the balancing carrier levels (see Calculating Balancing Carrier Levels on page 4-9 if not already done). Record these levels in the Map Signal Information table on the Amplifier Data Sheet.
2. Temperature compensate the System Forward High and Low Balancing Carrier Levels:

Temperature	Need Compensation	Procedure
Below 50° F (10°C) or Above 90° F (32°C)	Yes	Record the current air temperature on the Amplifier Data Sheet. Perform temperature compensation according to Temperature Compensation on page 4-9. Record the compensated values in the System High and Low Balancing Carrier Levels calculation boxes as shown in Steps 4 and 5. If the air temperature changes more than 20•F (11•C) while balancing the amplifier, recalculate the temperature compensation.
Between 50 and 90°F (10 and 32°C)	No	Record the current air temperature on the Amplifier Data Sheet. Copy the Forward High/Low Balancing Carrier Levels from the Map Signal Information table on the Amplifier Data Sheet to the calculation boxes in Steps 4 and 5.

Note: Distribution accessories are reversible. The recessed groove on the top of a directional coupler indicates the high-loss leg. Ensure that the accessory is installed with the correct orientation to get the required level at each port.

3. Set the amplifier to factory-aligned condition as follows:

   a. Set the MANUAL/ALSC switch to the MANUAL position.

   b. Ensure that a 10-A0.0-WC or 9-A0-WC 0 dB attenuator is installed in the INPUT ATTENUATOR location and that a jumper is installed in the INPUT EQUALIZER location.

   c. Install the INTERSTAGE ATTENUATOR and INTERSTAGE EQUALIZER as specified by the system design specifications (available from the system manager).

   d. Install the distribution accessories as specified on the system map. Refer to the distribution accessories in Appendix C as needed.

   e. If no distribution accessories are to be installed, ensure that factory-installed jumper wires are present. Install jumper wires if absent.

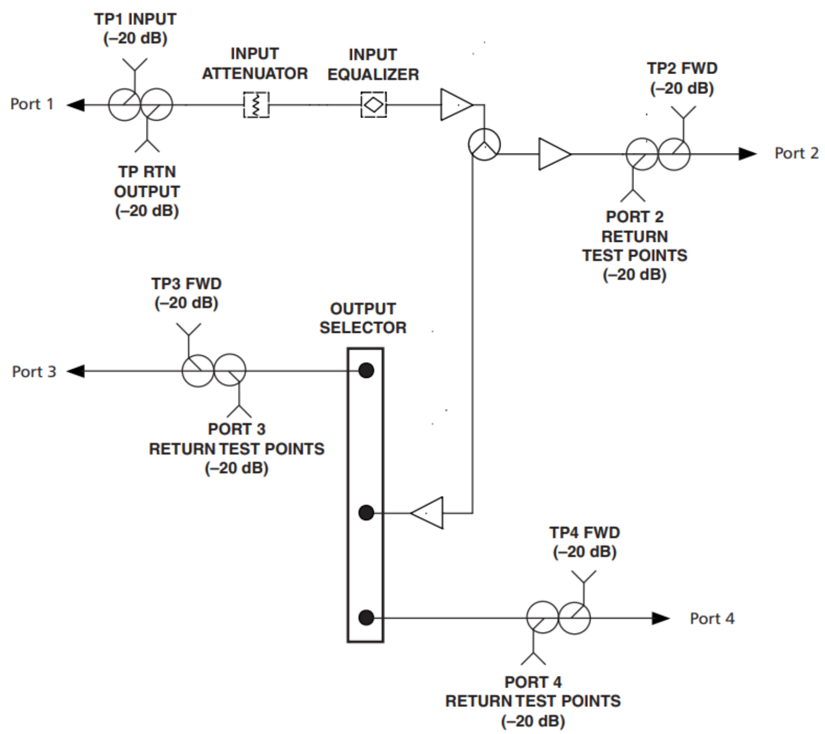
   f. Ensure that all unused, active ports are terminated with a 75Ω impedance.

Note: Testpoints are –20 dB referenced to the associated port input or output level.

Note: Do not terminate the unused port testpoint as it can affect testpoint accuracy.

4. Equalize the RF signal:

   a. Connect the signal level meter to the TP2 FWD (–20dB) testpoint:



b. Measure the signal levels of both forward balancing carriers. These levels will be referred to as the Measured High and Low Balancing Carrier Levels. Record these levels as shown in the box that follows. Calculate System Tilt, Measured Tilt, and Equalization Value.

______	–	______	=	______
System Forward High Balancing Carrier Level		System Forward Low Balancing Carrier Level		System Tilt
______	–	______	=	______
Measured Forward High Balancing Carrier Level		Measured Forward Low Balancing Carrier Level		Measured Tilt
______	–	______	=	______
System Tilt		Measured Tilt		Equalization Value

c. If the Equalization Value is positive, a PEQ-1.2G (equalizer) is needed. If the value is negative, a PCS-1.2G-xx (cable simulator) is needed. Using the appropriate tables in Appendix C, select an accessory with a tilt as close to the Equalization Value as possible.

d. Remove the accessory from the INPUT EQUALIZER location and install the selected cable equalizer or cable simulator.

5. Attenuate the RF input:

a. Measure the new Forward High Balancing Carrier Level and record the adjusted value as shown in the box that follows. Calculate the PAD Value.

______	–	______	=	______
Measured Forward High Balancing Carrier Level		System Forward High Balancing Carrier Level		PAD Value

b. Select an 10-A-WC PAD that has a flat loss within ± 0.5 dB of the PAD Value.

c. Remove the accessory from the INPUT ATTENUATOR location and install the selected attenuator (PAD).

6. Measure and record balancing levels and RF output for future reference:

a. Measure both forward balancing carrier levels and verify that the signal level of the Forward High Balancing Carrier is within acceptable tolerance (typically ± 0.5 dB) of the specified system level. If the signal level is not within tolerance, rebalance or troubleshoot the amplifier.

b. Record both forward balancing carrier levels in the Balancing TP (MAN) box of the Forward Signal Levels table on the Amplifier Data Sheet. Record the INPUT EQUALIZER and INPUT ATTENUATOR values on the Amplifier Data Sheet.

Note: Because the ALSC SENSITIVITY control has a limit of about 20 turns, the change in output level may not be proportional to the size of adjustment using the control. Several complete rotations of the control may be required to observe a change in the output level. Clockwise decreases, counterclockwise increases the signal level. When the control is near the operating range, small adjustments will produce large changes in the output level. The control will click when you reach the limit in each direction.

7. Adjust the ALSC:

   a. Set the MANUAL/ALSC switch to the ALSC position. Wait 30 seconds.

   b. Adjust the ALSC SENSITIVITY control while observing the system high carrier on the SLM. Clockwise decreases, counterclockwise increases the signal level. Stop adjusting when the output at the high carrier reaches the Forward High Balancing Carrier Level. If Temperature Compensation was used, balance in ALSC mode for the levels calculated before Temperature Correction Values were determined.

   c. Record both forward balancing carrier levels in the Balancing TP (ALSC) box of the Forward Signal Levels table on the Amplifier Data Sheet.

8. Measure the signal levels of both forward balancing carriers at all internal/external testpoints and record these levels in the Forward Signal Levels table on the Amplifier Data Sheet.

9. Close the housing and replace the caps on all external testpoints. (Refer to Housing Closing and Tightening.)

4.5 Return Balancing

For signals on the return path to arrive at the headend at the correct level and with as little distortion as possible, the return path must be properly balanced. Properly balanced means that the return signals on each leg arrive at each succeeding amplifier at the same level and tilt; this is called unity gain. Balancing with unity gain ensures that all return signals, regardless of point of origination, arrive at the headend at the same signal level. This keeps signal distortion at the lowest possible level. In most systems, the return band will have a tilt of 0 dB between the low and high return bandedges. The following sections cover the single person and the two person return balancing procedures.

These procedures assume the requirements listed in Forward Balancing Requirements on page 4-12 are met. When balancing the return path keep in mind the following:

- The forward path must be balanced first and be trouble free.
- The network must be free of ingress.
- You are trying to achieve constant inputs at the return input port of each amplifier. To do this you must adjust signal level and tilt in the return path through the use of return port PADs, equalizers, and distribution accessories.
- When using the single-person method, turn off the ALSC, if present, in the return rack mount receiver at the headend.

The following sections cover the single and two person balancing procedures.

4.5.1 Single Person Return Balancing Procedure

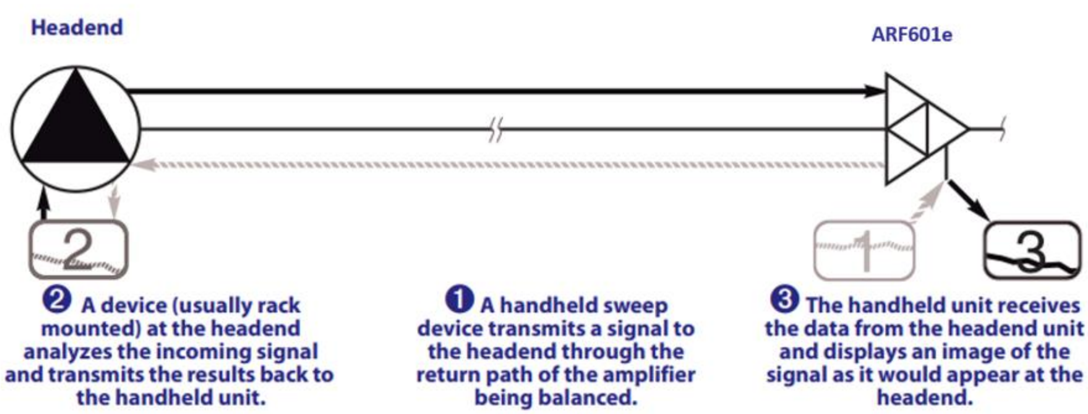
Single person return balancing requires the use of more sophisticated equipment than does two person return balancing. Below figure shows the typical single person configuration of the test equipment used in the single person return balancing procedure.

For single person return balancing, proper balancing of each unit depends on all preceding units being properly balanced. It is particularly critical that the first amplifier or node be balanced correctly since, if balanced incorrectly, all succeeding units will also be affected. For this reason, when initially balancing, start at the unit closest to the headend and work outward.

Because these are sweep systems, ingress may effect the outcome. Terminating return ports or keeping all amplifiers terminated until activation will limit ingress. Standard sweep equipment also has a “noise/ingress” feature that can be used for troubleshooting. This displays the noise seen in the headend.

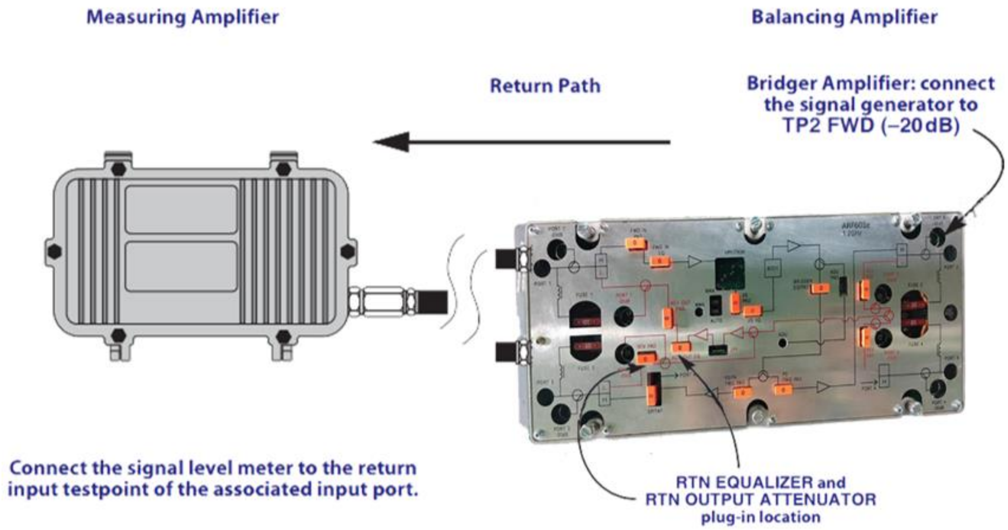
Tech Note TD0079 provides the generalized procedure using Wavetek Stealth® equipment (3ST/3HRV and 3SRV), Hewlett-Packard CaLan equipment (3010H and 3010R), and the method using relatively inexpensive video equipment (spectrum analyzer, signal generator, video camera, video signal modulator, and TV monitor). For specific instructions on operation of this equipment, refer to the manufacturer’s user manual.

Note: If a unit closer to the headend is balanced incorrectly, all succeeding amplifiers will not be balanced correctly using the single person method.



4.5.2 Two Person Return Balancing

Note: This method of return balancing requires two technicians communicating between two successive amplifier locations. Balancing signals are injected into a forward path output testpoint of the Balancing Amplifier and measured at the return input testpoint of the Measuring Amplifier.



CAUTION: RF signal levels greater than +45 dBmV @ 1 NTSC channel loading at the hybrid can damage amplifier active components. Derate maximum input level according to actual channel loading (for example, +26 dBmV @ 79 NTSC channel loading) (+26 dBmV = +86 dBµV).

Note: The return path is not active until the PADs and return EQ accessories are installed.

Note: Testpoints are –20 dB referenced to the associated port input or output level. Refer to the housing label for testpoint loss.

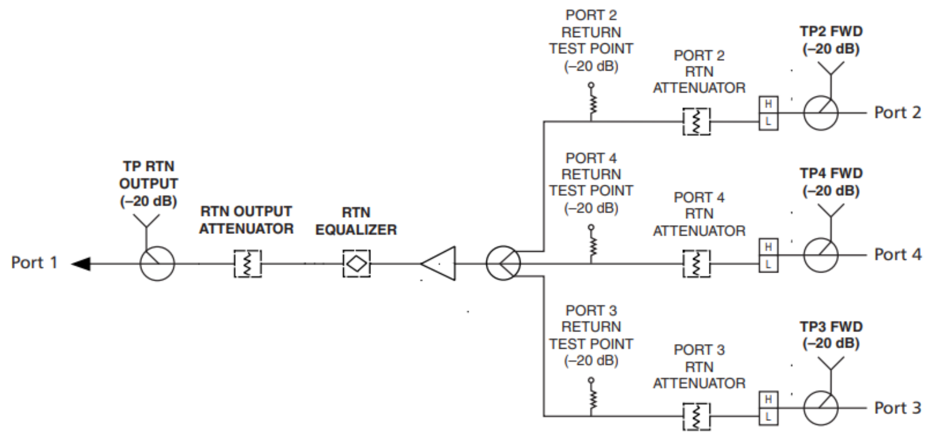
To balance the return path

1. Obtain the Return High and Low Balancing Carrier Levels from the System Map for both amplifiers. Record these levels in the corresponding boxes on the Amplifier Data Sheet and as shown in the following boxes in Steps 3c and 4a. (Return input levels may vary depending upon the input port.)

2. Set the ARF601e as follows:

   a. At the Balancing Amplifier, ensure that a jumper is installed in the RTN EQUALIZER location and that a 0 dB jumper (P/N 0625726-1) is installed in the RTN OUTPUT ATTENUATOR locations.

   b. If the system calls for one, install an 10-A series PAD in the RTN OUTPUT ATTENUATOR location in the Balancing Amplifier.



Note: Do not terminate the unused port testpoint as it can affect testpoint accuracy.

3. Equalize the RF signal:

   a. At the Balancing Amplifier, connect a signal generator to TP2 FWD (–20dB) testpoint.

   b. Set the Signal Generator to output the system Return High and Low Balancing carriers (plus 20 dB to compensate for the RF module testpoint loss).

   c. At the Measuring Amplifier, connect a signal level meter to the return input testpoint of the associated port. Measure the Return High and Low Balancing Carrier Levels and record them as shown in the following calculation box.

______	–	______	=	______
System Return High Balancing Carrier Level (Measuring Amp)		System Return Low Balancing Carrier Level (Measuring Amp)		System Tilt of Measuring Amp
______	–	______	=	______
Measured Return High Balancing Carrier Level (Measuring Amplifier)		Measured Return Low Balancing Carrier Level (Measuring Amplifier)		Measured Tilt
______	–	______	=	______
System Tilt		Measured Tilt		Equalization Value

   d. Calculate the Equalization Value. Using the appropriate table in Appendix C select a 7-REF42/x-WC return equalizer plug-in accessory that has a tilt as close to the Equalization Value as possible.

   e. At the Balancing Amplifier, remove the jumper from the RTN EQUALIZER plug-in location and install the selected 7-REF42/x-WC.

4. Attenuate the RF outputs:

   a. At the Measuring Amplifier, measure the adjusted Return High Balancing Carrier Level and record it as shown in the box below. Calculate the PAD Value.

Measured Return High Balancing Carrier Level	–	System Return High Balancing Carrier Level	=	PAD Value

   b. Select an 10-A PAD that has a flat loss within ± 0.5 dB of the PAD Value.

   c. At the Balancing Amplifier, remove the 0 dB plug-in (P/N 0625726-1) or factory installed jumper from the RTN OUTPUT ATTENUATOR plug-in location and install the selected PAD.

   d. At the Measuring Amplifier, measure both return balancing carrier levels and verify that they are within acceptable tolerance (typically ± 1.0 dB) of the specified system levels. If not, rebalance or troubleshoot the amplifier.

   e. At the Balancing Amplifier, connect a signal level meter to the TP RTN OUTPUT (–20dB) testpoint and measure the signal levels of both return balancing carriers. Record these levels on the Amplifier Data Sheet.

   f. Close the housing and replace the caps on all external testpoints. (Refer to Housing Closing and Tightening.)

5 Maintenance

This chapter provides instructions on installing and/or replacing fuses and the housing.

Note: All of the procedures in this section interrupt service.

5.1 General Inspection

Inspect the entire unit for the following each time maintenance and adjustments are done:

- Damaged or missing gaskets (rubber in the lid and metal mesh in the base)
- Loose modules or assemblies
- Missing, open (blown), loose, or misaligned fuses
- Heat damage (burn marks, charred components)
- Water damage

5.2 Fuse Replacement

WARNING: Hazardous voltages are present. Use approved safety equipment and procedures. Do not energize any station until all other stations in the power supply group have been installed.

CAUTION Improper fuse installation can:

- Damage the node
- Fail to power the node
- Fail to distribute through power

CAUTION Damaged fuse holders or misaligned fuses can cause heat damage. Do not force or misalign the fuse when installing.

5.2.1 Fuse Removal

1. Remove the fuse using a standard blade-type fuse puller.
2. Inspect for the following:
    - Fatigue cracks or corrosion in the fuse holder
    - Broken connections between the fuse holder and the circuit board
    - Heat damage on the circuit board
3. If damage is evident, contact ARRIS.

5.2.2 Fuse Installation

1. Using a standard blade-type fuse puller, center the 25 A blade-type fuse over the fuse holder.
2. Apply even pressure to the tool until the fuse snaps into the holder.

5.3 Power Supply Replacement

The ARF601e 1 GHz Bridger Amplifier has an integrated power supply that cannot be replaced. If the power supply fails, the RF module must be replaced.

5.4 RF Module Replacement

WARNING: Hazardous voltages are present. Use approved safety equipment and procedures.

CAUTION: Arcing between the RF module and centerseizure assemblies will damage the unit. Remove all 25 A port blade-type fuses before removing the RF module from the housing.

To replace the RF module

1. Open the ARF601e housing. Refer to Housing Opening.
2. Remove fuses.

3. Use a flat-blade screwdriver or 5/16 inch nutdriver to loosen and release the six captive module hold-down screws.

Note: Observe the orientation of the RF module before removing it.

4. Carefully use two flat-blade screwdrivers to simultaneously pry both ends of the RF module on the port sides and pull the RF module straight out of the housing.
5. Remove the plug-in accessories from the old RF module, and install them into the replacement RF module.
6. Orient the replacement RF module appropriately.
7. Align the RF module back pins with the receptacles located on the centerseizure assemblies.
8. Firmly press the replacement RF module into the housing until the back of the RF module contacts the inside of the housing.
9. Using a flat-blade screwdriver or 5/16 inch nutdriver, start the captive module hold-down screws into the threaded receptacles in the housing. Alternately tighten the screws to prevent stressing the module or housing. Torque to between 38 and 42 in-lbs (4.3 and 4.7 N·m).
10. Reinstall fuses.
11. Perform the Forward and Return Field Tests. (Refer to Forward Field Testing and Return Field Testing.)
12. Close the ARF601e housing. Refer to Housing Closing and Tightening.

5.5 Housing Replacement

WARNING: Hazardous voltages are present. Use approved safety equipment and procedures. Sheath currents may flow through the amplifier housing. Establish a second current path around the housing before disconnecting any cables. Automotive jumper cables are recommended.

CAUTION: Amplifier electronic components can be damaged by the environment. Close the housing whenever it is left unattended to keep moisture out of the amplifier and to protect the network from RF interference.

To replace the housing

1. Disconnect all power to the unit, then remove the RF module as described in RF Module Replacement.

CAUTION: Centerseizure screws may not be captive. Modules manufactured after June 1999 have either captive boots over these screws or captive screws that cannot be backed out completely. Do not back out non-captive screws more than two full turns, because they can fall out into the housing and under the RF module where they can cause short circuits requiring removal of the RF module and service interruption.

2. Beginning at Port 1, use a 5/16 in. hex socket to loosen the centerseizure screw no more than two full turns.
3. Loosen the connector back nut and main nut on the external cable connector. Refer to Figure Cable Connector Assembly.
4. Pull the cable with connector main nut straight out of the connector body.

5. Loosen and remove the connector body from the housing cable entry port.
6. Disconnect the remaining ports by repeating Steps 2 through 5.
7. When all cabling is disconnected, close the housing and finger tighten the bolts.
8. Loosen the bolts that secure the housing to the strand, or remove bolts for housings mounted to EMBs, a pedestal, or a wall.
9. Install the replacement housing to the strand, EMBs, pedestal, or wall.
10. Refer to Coaxial Cable Attachment to install the coaxial cables to the housing.
11. Install the RF module as described in RF Module Replacement.

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