Instruction Manual

Innovator™ HX Series

Digital UHF
Solid State
Transmitter

Volume 2
UHF Amplifier Cabinet

AXCERA , LLC
103 FREEDOM DRIVE • P.O. BOX 525 • LAWRENCE, PA 15055-0525 USA
(724) 873-8100 • FAX (724) 873-8105
www.axcera.com • service@axcera.com

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

CHAPTER 3 UHF AMPLIFIER ASSEMBLY & CABINET ASSEMBLIES CIRCUIT DESCRIPTIONS

TABLE OF CONTENTS (continued)

APPENDICES

LIST OF FIGURES

LIST OF TABLES

Chapter 1
Introduction

The Innovator™ HX Series UHF digital solid-state transmitter is comprised of two cabinet types: An exciter/control cabinet and a UHF amplifier cabinet. Every Innovator™ HX includes one or more of each cabinet type, dependent upon the power configuration ordered. This volume, Volume 2, of the manual describes the UHF amplifier cabinet portion of the transmitter. The system and the exciter/control assemblies are covered in Volume 1.

1.1: Manual Overview

Volume 2, of the Innovator HX Series Digital UHF Transmitter Instruction Manual, is divided into three chapters and supporting appendices. **Chapter 1**, Introduction, contains information on safety, return procedures, and warranties. **Chapter 2,** Amplifier Cabinet, describes the UHF amplifier cabinet. **Chapter 3,** UHF Amplifier Tray Assembly and Cabinet Assemblies Circuit Descriptions, contains a detailed discussion of the UHF amplifier module and power supply assemblies that are contained in the cabinet. **Appendix A** contains the RF amplifier cabinet assembly drawings and parts lists. **Appendix B** contains the UHF amplifier assembly drawings and parts lists. **Appendix C** contains the top and bottom +32VDC power supply assemblies drawings and parts lists.

1.2: Safety

The HX Series UHF transmitters manufactured by Axcera are designed to be easy to use and repair while providing protection from electrical and mechanical hazards. Listed throughout the manual are notes, cautions, and warnings concerning possible safety hazards that may be encountered while operating or servicing the transmitter. It is important that users review these warnings and become familiar with the operation and servicing procedures before working on the transmitter.

Read All Instructions – It is important that any user of this equipment read and understand all of the operating and safety instructions, especially the safety information in this chapter, before operating the Transmitter.

Retain Manuals – The manuals for the transmitter should be retained at the transmitter site for future reference. We provide two sets of manuals for this purpose; one set can be left at the office while one set can be kept at the site.

Heed all Notes, Warnings, and Cautions – All of the notes, warnings, and cautions listed in this safety section and throughout the manual must be followed.

Follow Instructions – All of the operating and use instructions for the transmitter should be followed.

Cleaning – Unplug or otherwise disconnect all power from the equipment before cleaning. Do not use liquid or aerosol cleaners. Use a damp cloth for cleaning.

Servicing – Do not attempt to service this product until becoming familiar with the equipment. If in doubt, refer all servicing questions to qualified Axcera service personnel.

Replacement Parts – When replacement parts are needed, be sure that the parts have the same functional and performance characteristics as the original part. Unauthorized substitutions may result in fire, electric shock, or other hazards. Please contact the Axcera Technical Service Department with any questions regarding service or replacement parts.

1.3: Assembly Designators

Axcera has assigned assembly numbers, Ax designations such as A1, where x=1,2,3…etc, to all assemblies, modules, and boards in the system. These designations are referenced in the text of this manual and shown on the block diagrams and interconnect drawings provided in the appendices. The Block Diagrams, Interconnects, Schematics, Assembly Drawings and Parts Lists are arranged in increasing numerical order in the appendices. Section titles in the text for assembly or module descriptions or alignment procedures contain the associated part number(s) and the relevant appendix that contains the drawings for that item.

The cables that connect between the boards within a tray or assembly and that connect between the trays, racks and cabinets are labeled using Brady markers.

Figure 1-1 is an example of a Brady marked cable. There may be as few as two or as many as four Markers on any one cable. These Brady markers are read starting farthest from the connector. If there are four Brady Markers, this marker is the transmitter number such as transmitter 1 or Transmitter 2. The next or the farthest Brady Marker is the rack or cabinet number on an interconnect cable or the board number within a tray. The next number on an interconnect cable is the Tray location or number. The Brady marker closest to the connector is the Jack or Connector number on an interconnect cable or the jack or connector number on the board within a tray.

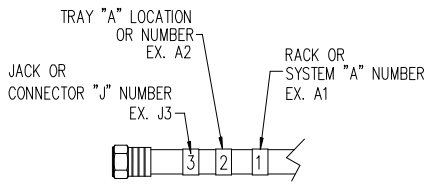


Figure 1-1: Brady Marker Identification Drawing

1.4: Material Return Procedure

To insure the efficient handling of equipment or components that have been returned for repair, Axcera requests that each returned item be accompanied by a Return Material Authorization Number (RMA#).

An RMA# can be obtained from any Axcera Service Engineer by contacting the Axcera Technical Service Department at 1-724-873-8100 or by fax at 1-724-873-8105. This procedure applies to all items sent to the Technical Service Department regardless of whether the item was originally manufactured by Axcera.

When equipment is sent to the field on loan, an RMA# is included with the unit. The RMA# is intended to be used when the unit is returned to Axcera. In addition, all shipping material should be retained for the return of the unit to Axcera.

Replacement assemblies are also sent with an RMA# to allow for the proper routing of the exchanged hardware. Failure to close out this type of RMA# will normally result in the customer being invoiced for the value of the loaner item or the exchange assembly.

When shipping an item to Axcera, please include the RMA# on the packing list and on the Axcera-provided shipping container. The packing slip should also include contact information and a brief description of why the unit is being returned.

Please forward all RMA items to:

Axcera
Customer Service Department
103 Freedom Drive
P.O. Box 525
Lawrence, PA 15055-0525 USA

For more information concerning this procedure, call the Axcera Technical Service Department.

Service can also be contacted through e-mail at **service@axcera.com** and on the Web at **www.axcera.com.**

1.5: Limited One-Year Warranty for Axcera Products

Axcera warrants each new product that it has manufactured and sold against defects in material and workmanship under normal use and service for a period of one (1) year from the date of shipment from Axcera's plant, when operated in accordance with Axcera's operating instructions. This warranty shall not apply to tubes, fuses, batteries, or bulbs.

Warranties are valid only when and if (a) Axcera receives prompt written notice of breach within the period of warranty, (b) the defective product is properly packed and returned by the buyer (transportation and insurance prepaid), and (c) Axcera determines, in its sole judgment, that the product is defective and not subject to any misuse, neglect, improper installation, negligence, accident, or (unless authorized in writing by Axcera) repair or alteration.

Axcera's exclusive liability for any personal and/or property damage (including direct, consequential, or incidental) caused by the breach of any or all warranties, shall be limited to the following: (a) repairing or replacing (in Axcera's sole discretion) any defective parts free of charge (F.O.B. Axcera's plant) and/or (b) crediting (in Axcera's sole discretion) all or a portion of the purchase price to the buyer.

Equipment furnished by Axcera, but not bearing its trade name, shall bear no warranties other than the special hours-of-use or other warranties extended by or enforceable against the manufacturer at the time of delivery to the buyer. **NO WARRANTIES, WHETHER STATUTORY, EXPRESSED, OR IMPLIED, AND NO WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR FREEDOM FROM INFRINGEMENT, OR THE LIKE, OTHER THAN AS SPECIFIED IN PATENT LIABILITY ARTICLES, AND IN THIS ARTICLE, SHALL APPLY TO THE EQUIPMENT FURNISHED HEREUNDER.**

☞ WARNING!!!

⋖ HIGH VOLTAGE ⋗

DO NOT ATTEMPT TO REPAIR OR TROUBLESHOOT THIS EQUIPMENT UNLESS YOU ARE FAMILIAR WITH ITS OPERATION AND EXPERIENCED IN SERVICING HIGH VOLTAGE EQUIPMENT. LETHAL VOLTAGES ARE PRESENT WHEN POWER IS APPLIED TO THIS SYSTEM. IF POSSIBLE, TURN OFF POWER BEFORE MAKING ADJUSTMENTS TO THE SYSTEM.

★ RADIO FREQUENCY RADIATION HAZARD ★

MICROWAVE, RF AMPLIFIERS AND TUBES GENERATE HAZARDOUS RF RADIATION THAT CAN CAUSE SEVERE INJURY INCLUDING CATARACTS, WHICH CAN RESULT IN BLINDNESS. SOME CARDIAC PACEMAKERS MAY BE AFFECTED BY THE RF ENERGY EMITTED BY RF AND MICROWAVE AMPLIFIERS. NEVER OPERATE THE TRANSMITTER SYSTEM WITHOUT A PROPERLY MATCHED RF ENERGY ABSORBING LOAD ATTACHED. KEEP PERSONNEL AWAY FROM OPEN WAVEGUIDES AND ANTENNAS. NEVER LOOK INTO AN OPEN WAVEGUIDE OR ANTENNA. MONITOR ALL PARTS OF THE RF SYSTEM FOR RADIATION LEAKAGE AT REGULAR INTERVALS.

EMERGENCY FIRST AID INSTRUCTIONS

Personnel engaged in the installation, operation, or maintenance of this equipment are urged to become familiar with the following rules both in theory and practice. It is the duty of all operating personnel to be prepared to give adequate Emergency First Aid and thereby prevent avoidable loss of life.

RESCUE BREATHING

1. Find out if the person is breathing.

You must find out if the person has stopped breathing. If you think he is not breathing, place him flat on his back. Put your ear close to his mouth and look at his chest. If he is breathing you can feel the air on your cheek. You can see his chest move up and down. If you do not feel the air or see the chest move, he is not breathing.

2. If he is not breathing, open the airway by tilting his head backwards.

Lift up his neck with one hand and push down on his forehead with the other. This opens the airway. Sometimes doing this will let the person breathe again by himself.

3. If he is still not breathing, begin rescue breathing.

-Keep his head tilted backward. Pinch nose shut.
-Put your mouth tightly over his mouth.
-Blow into his mouth once every five seconds
-DO NOT STOP rescue breathing until help arrives.

LOOSEN CLOTHING - KEEP WARM

Do this when the victim is breathing by himself or help is available. Keep him as quiet as possible and from becoming chilled. Otherwise treat him for shock.

BURNS

SKIN REDDENED: Apply ice cold water to burned area to prevent burn from going deeper into skin tissue. Cover area with a clean sheet or cloth to keep away air. Consult a physician.

SKIN BLISTERED OR FLESH CHARRED: Apply ice cold water to burned area to prevent burn from going deeper into skin tissue. Cover area with clean sheet or cloth to keep away air. Treat victim for shock and take to hospital.

EXTENSIVE BURN - SKIN BROKEN: Cover area with clean sheet or cloth to keep away air. Treat victim for shock and take to hospital.

Chapter 2
Amplifier Cabinet

2.1: Cabinet Overview

The fully populated amplifier cabinets used in Innovator HX Transmitters contain eight UHF amplifiers connected in parallel (Figure 2-1). The number of amplifiers varies according to the needed output power for the transmitter. The amplifiers operate, without the need for tuning or alignment, on the UHF channel designated.

All equipment in the cabinet is fully solid-state and designed for high-operational reliability and a service-friendly layout. The cabinet is cooled by external air cooling equipment. The cooling air is ducted into and out of the top of the cabinet.

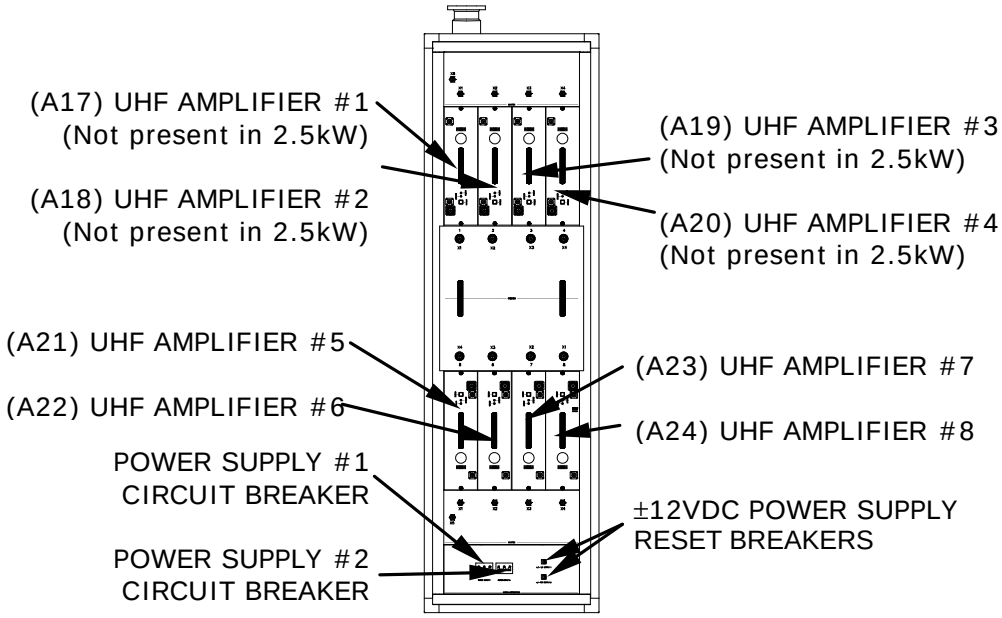


Figure 2-1: Typical 8 Way UHF Amplifier Cabinet (Front View)

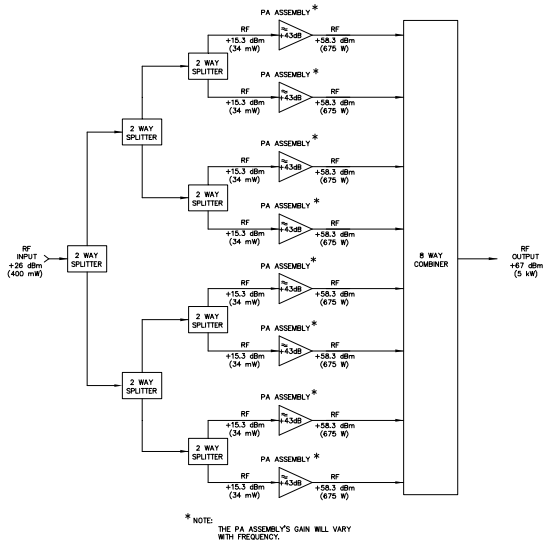


Figure 2-2: Block Diagram of the typical UHF Amplifier Cabinet 8 Way (5kW)

2.2: Description of the UHF Amplifier Cabinet

The features of the amplifier cabinet include: 1) Amplifiers that are 100% transistors. 2) High redundancy due to the parallel connection of power transistors. 3) A mean junction temperatures less than 120° C. 4) Multiple fault protection circuitry in each amplifier. 5) A power supply for Amplifiers 1 thru 3 (3.7kW) and 4 (5kW). 6) A separate power supply for Amplifiers 6 thru 8 (1.8kW) and 5 (2.5kW & 5kW). 7) Amplifiers that operate over the selected band of UHF frequencies without the need for alignment. 8) The important operating parameters are displayed in the transmitter touch screen control unit. 9) There are multiple test points in the signal path. 10) It has air cooling, with the input and output air connections on the top of the amplifier cabinet.

The amplifier assemblies in each amplifier cabinet (see Figure 2-3) are slide-in units, inserted from the front. In a 5kW cabinet, two 4 way splitters are installed, one in the top and one in the bottom half of the cabinet. In a 2.5 kW cabinet, just the bottom 4 way splitter is present. These splitters distribute the RF input to each of the amplifiers. In a 3.7kW cabinet, 3 way splitters are installed in the top and bottom half of the cabinet. In a 1.8 kW cabinet, just the bottom 3 way splitter is present. These distribute the RF input to each of the amplifiers. A 3, 4, 6 or 8 way combiner is installed in the middle of the cabinet. The lower part of the cabinet accommodates a power distribution panel that contains two 480 VAC 30 Amp 3 Phase or 208 VAC 50 Amp 3 Phase circuit breakers for 3.7 & 5 kW or one circuit breaker for 1.8 & 2.5 kW. The left breaker, if present, distributes the main AC voltage to the top power supply and the right circuit breaker controls the bottom power supply. The top power supply provides the +32 VDC to the top three or four amplifier assemblies. The bottom power supply provides the +32 VDC to the bottom three or four amplifier assemblies

There is also either one or two 1 Amp reset circuit breakers, mounted on the power distribution panel that protect the AC voltage to the switching power supply, located in the bottom and top power supply. If one breaker is present, it connects to the bottom power supply, for 1.8 & 2.5 kW. If 2 one Amp reset breakers are present, the second one amp breaker connects to the top power supply for 3.7 & 5 kW. The switching supply provides the ±12 VDC to the top and bottom amplifier assemblies.

2.2.1: 5 kW Amplifier Cabinet with 8 Amplifier Assemblies

Refer to Figure 2-2. The DTV RF signal from the exciter/control cabinet is connected through RG-55 cable through an opening in the roof in the UHF amplifier cabinet. The RF (+26 dBm, 400 mW) from the output of the exciter control cabinet connects to the SMA “S” input on (A14) a 2 way splitter with each of the two outputs connecting to a 4 way splitter panel (A15 top & A16 bottom). The four outputs of the (A15-A1) Top 4 way splitter are at the “N” connectors X1-X4.

The outputs (+15.3 dBm, 34 mW) connect to the (A17) UHF amplifier #1, (A18) UHF amplifier #2, (A19) UHF amplifier #3 and (A20) UHF amplifier #4. Each amplifier tray has a gain of approximately +40.5dB. The four outputs of the (A16-A1) Bottom 4 way splitter, at “N” connectors X1-X4, connect to the (A21) UHF amplifier #5, (A22) UHF amplifier #6, (A23) UHF amplifier #7, and (A24) UHF amplifier #8. The eight outputs of the amplifier modules at 7/16” connectors (+58.3 dBm, 675W) are cabled to the (A24) 8 way combiner. The output of the combiner connects to the (A26) RF coupler. The output of the cabinet is

approximately (+67.2 dBm, 5.2kW) at the 3-1/8" output connector of the (A26) RF Coupler Assembly.

2.2.2: 3.7 kW Amplifier Cabinet with 6 Amplifier Assemblies

The DTV RF signal from the exciter/control cabinet is connected through RG-55 cable through an opening in the roof in the UHF amplifier cabinet. The RF (+27 dBm, 500 mW) from the output of the exciter control cabinet connects to the SMA "S" input on (A14) a 2 way splitter with each of the two outputs connecting to a 3 way splitter panel (A15 top & A16 bottom). The three outputs of the (A15) Top 3 way splitter are at the "N" connectors X1-X3.

The outputs (+18 dBm, 63 mW) connect to the (A17) UHF amplifier #1, (A18) UHF amplifier #2 and (A19) UHF amplifier #3. The three outputs of the (A16) Bottom 3 way splitter, at "N" connectors X2-X4, connect to the (A22) UHF amplifier #6, (A23) UHF amplifier #7, and (A24) UHF amplifier #8. Each amplifier tray has a gain of approximately +40.5dB. The six outputs of the amplifier modules at 7/16" connectors (+58.5 dBm, 700W) are cabled to the (A24) 6 way combiner. The output of the combiner connects to the (A26) RF coupler. The output of the cabinet is approximately (+65.7 dBm, 3.7 kW) at the 3-1/8" output connector of the (A26) RF Coupler Assembly.

2.2.3: 2.5 kW Amplifier Cabinet with 4 Amplifier Assemblies

Refer to Figure 2-3. The DTV RF signal from the exciter/control cabinet is connected through RG-55 cable through an opening in the roof in the UHF amplifier cabinet. The RF (+26 dBm, 400 mW) from the output of the exciter control cabinet connects to the 4 way splitter panel (A16) mounted at the bottom of the cabinet. The four outputs of the (A16-A1) 4 way splitter, at "N" connectors X1-X4, connect to the (A21) UHF amplifier #5, (A22) UHF amplifier #6, (A23) UHF amplifier #7, and (A24) UHF amplifier #8. Each amplifier tray has a gain of approximately +40.5dB. The four outputs of the amplifier modules at 7/16" connectors (+58.5 dBm, 700W) are cabled to the (A25) 4 way combiner assembly. The combiner produces a single output that connects to the (A26) RF Coupler Assembly. The RF output for the cabinet, approximately +64.1 dBm, 2570 Watts, is at the 3-1/8" output connector of the RF Coupler Assembly.

2.2.4: 1.8 kW Amplifier Cabinet with 3 Amplifier Assemblies

The DTV RF signal from the exciter/control cabinet is connected through RG-55 cable through an opening in the roof in the UHF amplifier cabinet. The RF (+27 dBm, 500 mW) from the output of the exciter control cabinet connects to the 3 way splitter panel (A16) mounted at the bottom of the cabinet. The three outputs of the (A16) 3 way splitter, at "N" connectors X2-X4, connect to the (A22) UHF amplifier #6, (A23) UHF amplifier #7, and (A24) UHF amplifier #8. Each amplifier tray has a gain of approximately +40.5dB. The three outputs of the amplifier modules at 7/16" connectors (+58.5 dBm, 700W) are cabled to the (A25) 3 way combiner assembly. The combiner produces a single output that connects to the (A26) RF Coupler Assembly. The RF output for the cabinet, approximately +62.6 dBm, 1800 Watts, is at the 3-1/8" output connector of the RF Coupler Assembly.

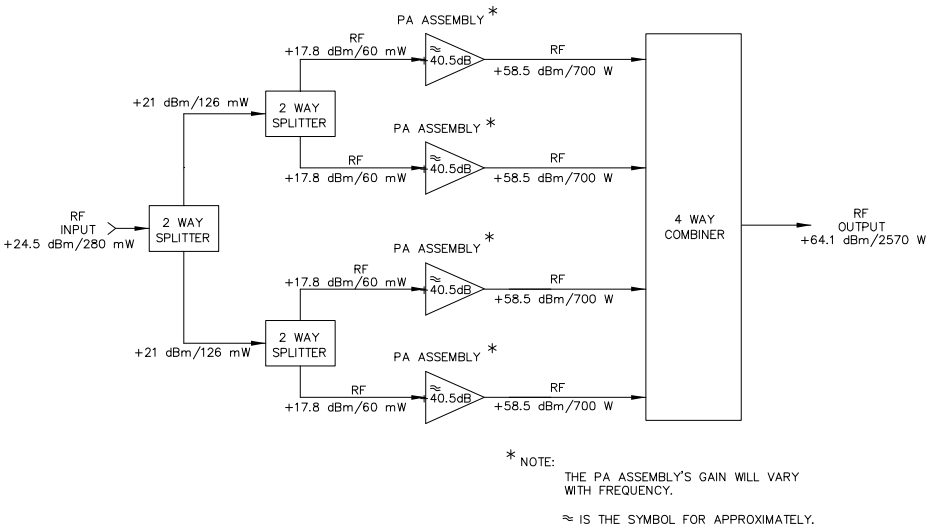


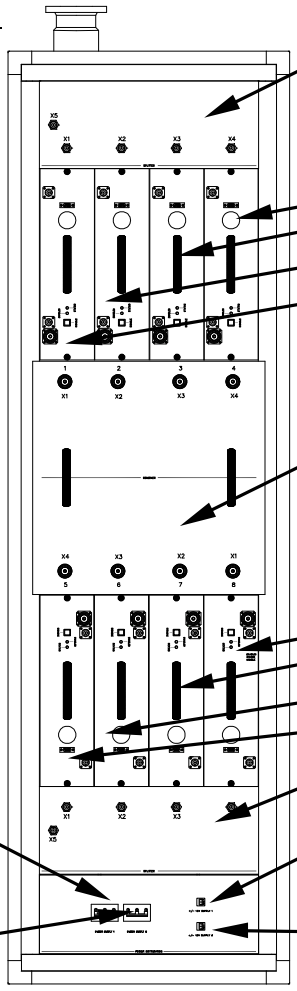
Figure 2-3: Block Diagram of the typical UHF Amplifier Cabinet 4 Way (2.5kW)

<u>Components in the Amplifier Cabinet</u>

8 UHF Amplifier Trays (5kW)
6 UHF Amplifier Tray (3.7kW)
2 Power Supply Assemblies (3.7 & 5kW)

4 UHF Amplifier Trays (2.5kW)
3 UHF Amplifier Trays (1.8kW)
1 Power Supply Assembly (1.8 & 2.5kW)

One Circuit Breaker Assembly
One 3, 4, 6 or 8 Way Combiner



Splitter 1 : 4 (5kW)
Splitter 1 : 3 (3.7kW)

UHF Amplifier Trays (A17, A18, A19 & A20) (5kW)
(A20) not used in 3.7kW

Combiner 8 : 1 (5kW)
Combiner 6 : 1 (3.7kW)
Combiner 4 : 1 (2.5kW)
Combiner 3 : 1 (1.8kW)

UHF Amplifier Trays (A21, A22, A23 & A24) (2.5kW & 5kW)
(A21) not used in 1.8 & 2.7kW

Splitter 1 : 4 (2.5kW & 5kW)
Splitter 1 : 3 (1.8kW & 3.7kW)

Circuit Breaker for Top +32VDC Power Supply (3.7kW & 5kW)

Circuit Breaker for Top 12VDC Power Supply (3.7kW & 5kW) Assembly

Circuit Breaker for Bottom +32VDC Power Supply (1.8, 2.5 3.7 & 5kW)

Circuit Breaker for Bottom 12VDC Power Supply (1.8, 2.5 & 5kW) Assembly

Figure 2-4: Components in the Amplifier Cabinet

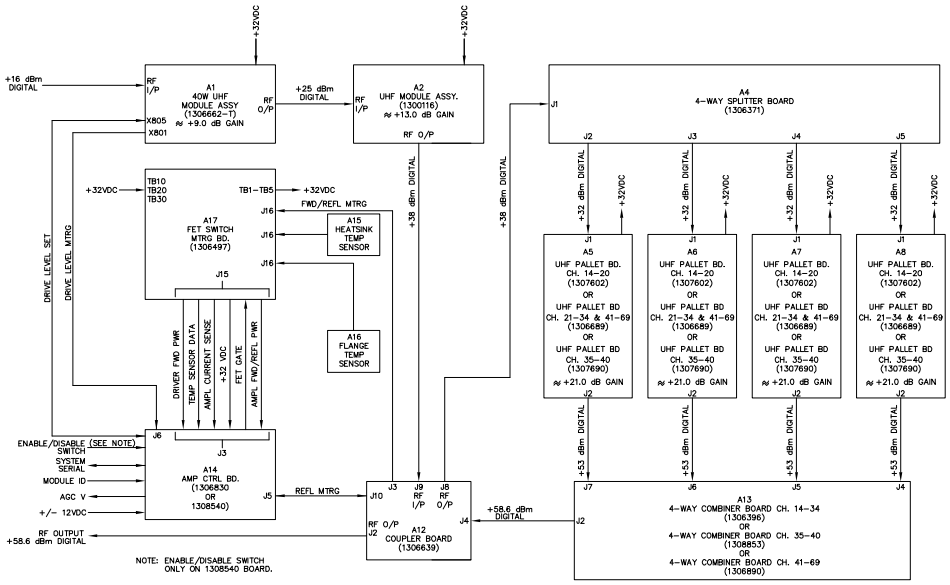


Figure 2-5: Block Diagram Typical UHF Amplifier Tray Assembly

2.3: Description of the UHF Amplifier Tray

There are eight of these trays in an 8 way Amplifier Cabinet Assembly for 5kW, six in a 6 way Amplifier Cabinet Assembly for 3.7 kW, four in a 4 way Amplifier Cabinet Assembly for 2.5 kW, or three in a 3 way Amplifier Cabinet Assembly for 1.8 kW. The Amplifier Tray has an approximate gain of +40.5 dB.

The RF input (+18 dBm) at the "N" connector J1 on each UHF amplifier assembly is fed to the RF input connections on (A1) the 40 Watt UHF Module Assembly, which is a predriver assembly with ≈9 dB gain. The output (+27 dBm) is cabled to the RF input connections on (A3) a UHF Module Pallet Assembly (1300116) with ≈13 dB gain. The UHF Module Pallet Assembly contains a RF Module Pallet w/o transistors (1152336). The output (+40 dBm) is fed to J9 on (A12) a Coupler Board (1306639) that supplies a driver forward power sample out of J3-5 to the FET switch/metering board at J1-1. The sample is not used on the FET switch/metering board; it is just fed through to J15-1 that is wired to J3-13 on the (A14) amplifier control board (1308540 or 1306830) where it is used in the amplifier protection circuitry. The output of the coupler board at J8 (+40 dBm) is fed to J1 on (A4) the 4 Way Splitter Board (1306371) where it is split. Each output of the splitter (+34 dBm) is cabled to the RF Input jack of one of the four (A5-A8), UHF dual stage pallet boards, (1307602, CH: 14-20, or 1306689, CH: 21-34 & 41-69), or 1307690, CH: 35-40). Each pallet board has ≈+21 dB of gain. The outputs of each amplifier board (+55 dBm) are combined on (A13) the 4 way combiner assembly, (1306396, CH: 14-34, or 1308853, CH: 35-40, or 1306890, CH: 41-69).

The RF output jack J2, of the 4 way combiner assembly (+58.6 dBm), is Bus wire jumpered to J4 on the (A12) Coupler Board (1306639) that supplies a RF sample out at J1. Also, the Coupler Board provides a final amp forward metering sample at J3-1 and a final amp reflected metering sample at J3-2. The samples are connected to (A17) the FET switch/metering board (1306497) at J1-6 and J1-7. The samples are not used on the FET switch/metering board, they are just fed through to J15-2 and J15-14

that are wired to J3-12 and J3-25 on the amplifier control board where they are used in the amplifier protection circuitry. The RF output of the coupler board is at J2 that is Bus wire connected to J2 the 7/16" connector RF Output Jack of the amplifier assembly. Typical output level is +58.5 dBm.

2.3.1: Description of the 8 Way Combiner Assembly (5 kW Amplifier Cabinet)

The RF outputs of the eight amplifiers are combined by means of an 8:1 combiner assembly w/circulators that is mounted in the middle of the cabinet. The 8 way combiner is made up of two identical 4 way combiners and a two way combiner. Refer to Figure 2-5.

The eight RF inputs, +58.3 dBm in level, each connect to a separate circulator. The circulators protect the amplifiers in the event of high VSWR generated by the output circuits. A reflected sample from the circulator is fed through a 30dB attenuator to one of the two Reflected Metering Boards (A80 & A81). The A80 Reflected Metering Board has the top four amplifier assemblies connected to it and the A81 Reflected Metering Board has the bottom four amplifier assemblies connected to it. If one or more of the reflected samples exceeds 10%, the affected Reflected Metering Board will shut down the associated power supply therefore removing the voltages to the four amplifier assemblies that it supplies. The power supply can only be reset by switching the transmitter to standby then operate after repair of the cause for the high VSWR. Each 4 Way combiner has three dummy loads, two 600W and a 1200W, which dissipate any power due to an imbalance or mismatch during the combining of the amplifiers. The outputs of the 4 way combiners, each +64.1 dBm, connect to the (A3) Two Way Combiner. The 2 Way combiner has a 2500W load connected to it. The output of the 2 Way Combiner, which is the output of the 8 Way Combiner Assembly is at the 3 1/8" RF output jack, typically ~ +67 dBm.

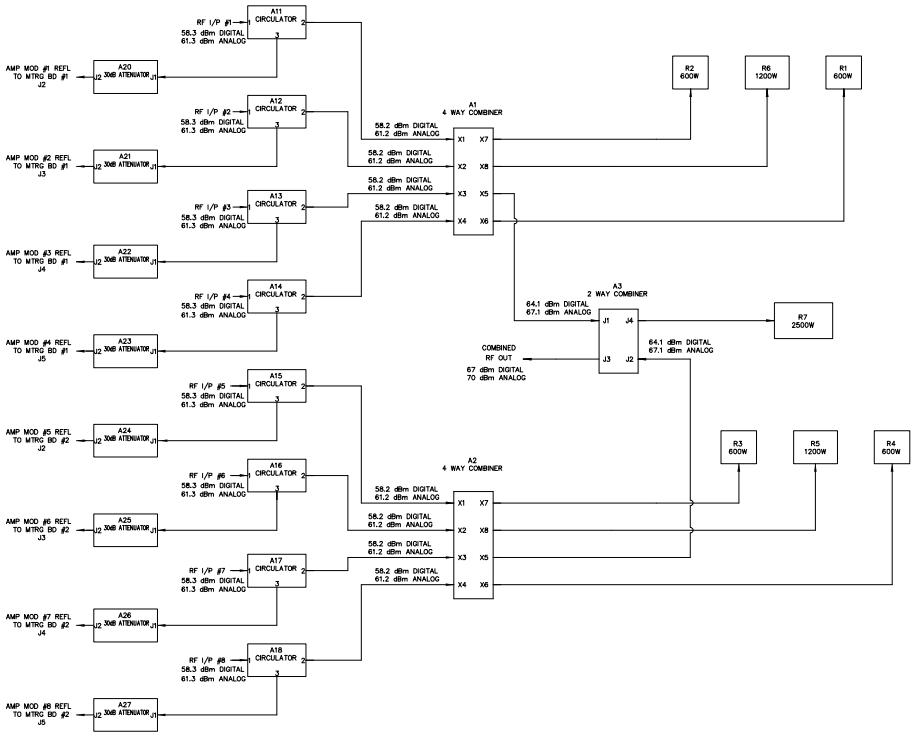


Figure 2-6: Block Diagram Typical 8 Way UHF Combiner Assembly w/Circulators

2.3.1.1: Description of the 6 Way Combiner Assembly (3.7 kW Amplifier Cabinet)

The RF outputs of the six amplifiers are combined by means of an 6:1 combiner assembly w/circulators that is mounted in the middle of the cabinet. The 6 way combiner is made up of two identical 3 way combiners and a two way combiner.

The six RF inputs, +58.5 dBm in level, each connect to a separate circulator. The circulators protect the amplifiers in the event of high VSWR generated by the output circuits. A reflected sample from the circulator is fed through a 30dB attenuator to one of the two Reflected Metering Boards (A80 & A81). The A80 Reflected Metering Board has the top three amplifier assemblies connected to it and the A81 Reflected Metering Board has the bottom three amplifier assemblies connected to it. If one or more of the reflected samples exceeds 10%, the affected Reflected Metering Board will shut down the associated power supply therefore removing the voltages to the four amplifier assemblies that it supplies. The power supply can only be reset by switching the transmitter to standby then operate after repair of the cause for the high VSWR. Each 3 Way combiner has two 600W dummy loads, which dissipate any power due to an imbalance or mismatch during the combining of the amplifiers. The outputs of the 3 way combiners, each +64.1 dBm, connect to the (A5) Two Way Combiner. The 2 Way combiner has a 2500W load connected to it. The output of the 2 Way Combiner, which is the output of the 6 Way Combiner Assembly is at the 3 1/8" RF output jack, typically ~ +65.7 dBm.

2.3.1.2: Description of the 4 Way Combiner Assembly (2.5 kW Amplifier Cabinet)

The RF outputs of the four amplifiers are combined by means of a 4:1 combiner assembly that is mounted in the middle of the cabinet. Refer to Figure 2-7.

The four RF inputs, +58.5 dBm Digital in level, each connect to a separate circulator. The circulators protect the amplifiers in the event of high VSWR generated by the output circuits. A reflected sample from the circulator is fed through a 30dB attenuator to the Reflected Metering Board #2 (A81). If one or more of the reflected samples exceeds 10%, the Reflected Metering Board will shut down the +32 VDC power supply therefore removing the voltages to the four amplifier assemblies that it supplies. The power supply can only be reset by switching the transmitter to standby then operate after repair of the cause for the high VSWR. The 4 Way combiner has three dummy loads, two 600W and a 1200W, which dissipate any power due to an imbalance or mismatch during the combining of the amplifiers. The output of the 4 Way Combiner Assembly is at the 1 5/8" RF output jack, typically ~ +64.1 dBm Digital.

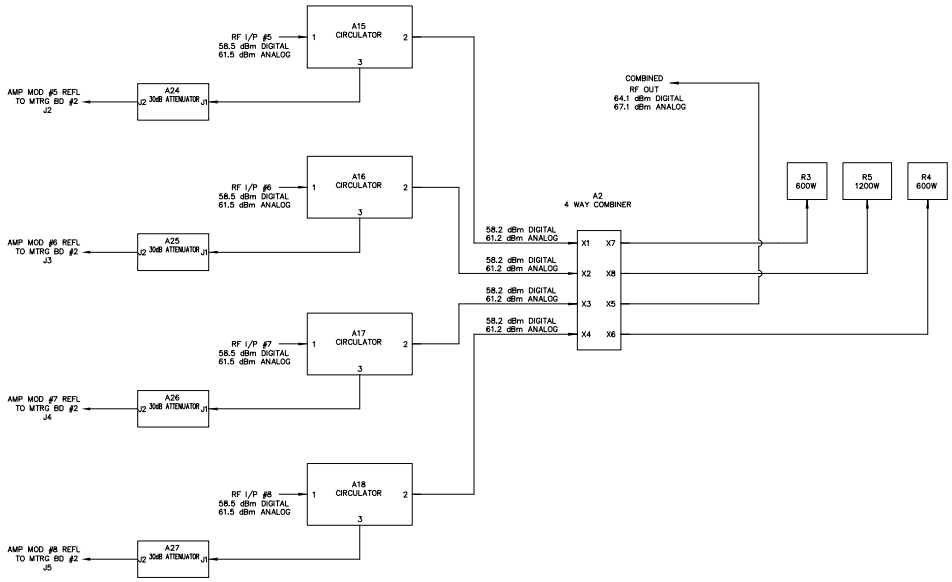


Figure 2-7: Block Diagram Typical 4 Way UHF Combiner Assembly w/Circulators

2.3.1.3: Description of the 3 Way Combiner Assembly (1.8 kW Amplifier Cabinet)

The RF outputs of the three amplifiers are combined by means of a 3:1 combiner assembly that is mounted in the middle of the cabinet.

The three RF inputs, +58.5 dBm Digital in level, each connect to a separate circulator. The circulators protect the amplifiers in the event of high VSWR generated by the output circuits. A reflected sample from the circulator is fed through a 30dB attenuator to the Reflected Metering Board #2 (A81). If one or more of the reflected samples exceeds 10%, the Reflected Metering Board will shut down the +32 VDC power supply therefore removing the voltages to the three amplifier assemblies that it supplies. The power supply can only be reset by switching the transmitter to standby then operate after repair of the cause for the high VSWR. The 3 Way combiner has two 600W dummy loads, which dissipate any power due to an imbalance or mismatch during the combining of the amplifiers. The output of the 3 Way Combiner Assembly is at the 1 5/8" RF output jack, typically ~ +62.6 dBm Digital.

2.3.2: Removal of an Amplifier Assembly

The amplifiers are of broadband design and cover the frequency for the desired UHF channel without the need for alignment or adjustment.

For reasons of safety, amplifier modules **MUST** be in standby (RF disabled) before any connections are removed. If the amplifier control board is loaded with software version 2.4 or higher, an Axcera Amplifier disable plug (1308219) can be used to place an individual module in standby. If your amplifier module has a front panel disable switch, this switch can be used to disable the amplifier. Regardless of the version of code, any power amplifier may safely be removed by disabling its power supply. The power supply, either the top power supply #1 for the top four Amplifier assemblies, or the bottom power supply #2 for the bottom three Amplifier assemblies, may be isolated from main AC power by switching off the appropriate front panel circuit breaker. This is accomplished by tripping the respective breaker located on the circuit breaker assembly panel, at the bottom of the amplifier cabinet.

To remove a disabled amplifier assembly, first remove the input cable connected to the top connector then the output cable connected to the bottom connector on the front panel of the assembly. They must be removed in this sequence to prevent damage to the amplifier assemblies. Then loosen the two fixing screws, one located at the top, middle and one at the bottom, middle of the assembly. The amplifier can then be pulled from the cabinet. To replace the assembly, insert the assembly into the slots and replace the two fixing screws. Then connect the RF output cable first and the RF input cable last, they must be replaced in this sequence to prevent damage to the amplifier assemblies.

The paralleling network of the amplifier cabinet with its load balancing resistors is designed so that operation continues at reduced power when one or more amplifiers are removed or failed.

All RF cables from the outputs of the first splitter up to the output of the output combiner assembly are phase matched (in phase) to the particular frequency and their lengths must again be determined when a change in operating frequency is made. All amplifier cabinets of a transmitter, from cabinet input to cabinet output, are also aligned to the same phase with equal length cables.

2.3.3: Amplifier Cabinet Power Supply Assemblies

The voltages to the UHF Amplifier Trays are supplied by two +32 VDC power supply assemblies. One supply, the top power supply #1, provides the +32 VDC to the three or four UHF amplifier assemblies mounted at the top of the cabinet (3.7 or 5kW). The other supply, the bottom power supply #2, provides the +32 VDC to the three or four UHF amplifier assemblies mounted at the bottom of the cabinet (1.8 kW, 2.5 kW, 3.7 kW, & 5 kW).

The AC input voltages to the power supplies are controlled through two 480 VAC 30 Amp 3 Phase or two 208 VAC 50 Amp 3 Phase circuit breakers located on the AC distribution panel mounted at the bottom of the cabinet (3.7 & 5 kW). There is only one 480 VAC or 208 VAC circuit breaker in a 1.8 & 2.5 kW amplifier cabinet.

2.3.4: Control and Monitoring

Each amplifier has multiple-fault protection circuitry that prevents damage to or destruction of the power transistors during critical operating conditions, such as high reflected power, overtemperature, overcurrent, or overvoltage. Furthermore, the operating voltages and currents of the amplifiers are monitored in the power supply units as well as the mains voltage. All important amplifier operating parameters, such as drain currents, RF power, and heat sink temperatures, are connected to the control unit.

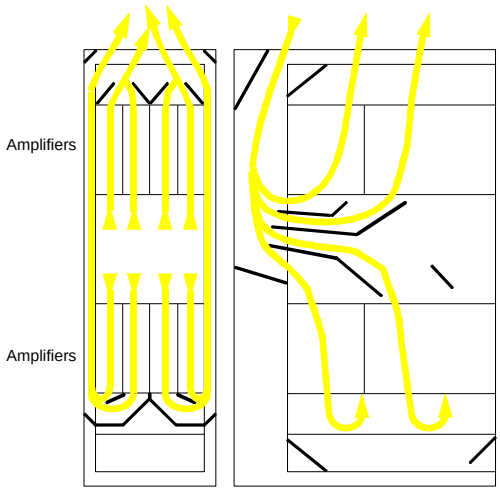
2.3.5: Cabinet Cooling

The amplifier cabinet is exclusively air cooled as shown in Figure 2-8. The cooling system is exemplified by low airflow requirements, low noise levels, and high efficiency. With an inlet air temperature of +25° C, the junction temperatures of the RF power transistors remain under 120°C, resulting in a high amplifier service life.

A major fraction of the heat is dissipated by the amplifiers and their power supplies. This heat is carried away by an external cooling system. Connections are available on the top of the amplifier cabinet for the intake and exhaust of the air. The amplifiers are equipped with highly efficient finned heat sinks, which radiate, into the vertically flowing air stream, the heat generated by the power transistors. By utilizing special construction techniques in the cabinet, as well as employing conservatively dimensioned ducting, a uniform distribution of cooling air over the

various heat sinks is achieved. This ensures that all of the power transistors are at essentially the same temperature. Temperature test points connected to special monitoring circuits are located in the amplifiers and power supply units. Under over temperature conditions, the monitoring circuits respond and switch off the respective unit. In addition, a fault indication and the measured value are passed to the control unit.

Control connections to the Blower is through the terminal block TB1 located at the rear upper right of the amplifier cabinets. TB1-1 is +12 VDC and TB1-3 is Blower Control that connect to the Fan Control in the Blower Cabinet.



Example for the connection of air ducting to the roof of the cabinet

Figure 2-8: Air Flow in the Amplifier Cabinet

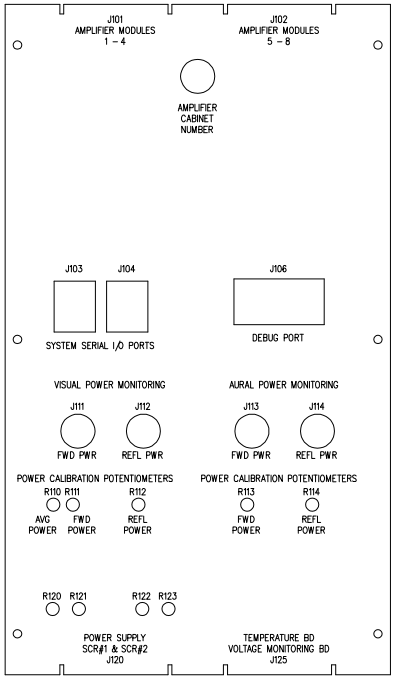


Figure 2-9A: Full Cabinet Controller Assembly

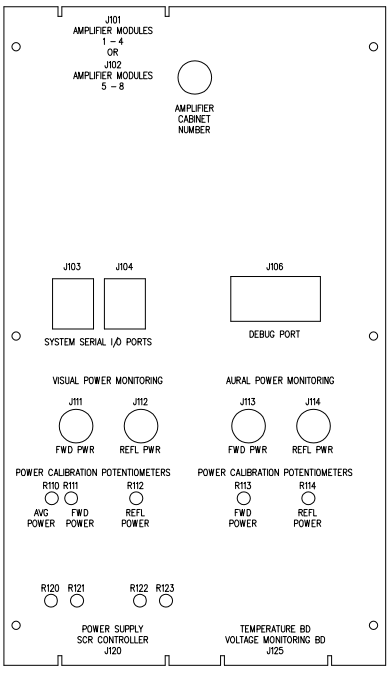


Figure 2-9B: Half Cabinet Controller Assembly

2.4: Cabinet Controller Assembly

The Innovator HX cabinet controllers are designed to control and monitor components contained in the amplifier cabinet. The cabinet controller is either a full or half cabinet design as shown in Figures 2-9A and 2-9B. A full cabinet controller monitors and controls all components of the amplifier cabinet while a half cabinet controller monitors and controls only half of the cabinet.

Two half cabinet controller assemblies are used in single amplifier cabinet configurations to give the transmitter redundancy by allowing the top or the bottom amplifiers to operate if the other half cabinet controller assembly should malfunction. When two half cabinet controller assemblies are needed, they are mounted on the power supply covers in the rear of the amplifier cabinet. The wire harness connection of J120 pin 8 is used by the half cabinet controller to determine if it is installed as an upper half cabinet controller or a lower half cabinet controller.

Status and control of each amplifier cabinet is implemented through serial commands that are transferred between the transmitter's system controller and the amplifier cabinet controller(s). Both types of cabinet controller assemblies contain two UARTs, Universal Asynchronous Receiver-Transmitter ICs. One of the controller's UARTs is used exclusively to communicate with amplifiers within the cabinet. The second UART provides status and control of the cabinet to the transmitter's control system. Serial debug port J108 is a standard read only RS-232 serial port that is designed only for use with Axcera factory test software.

Status and control of devices within the amplifier cabinet is implemented through discrete wired connections and serial messages sent between the amplifier control boards, located in the individual amplifier modules, and the cabinet controller(s).

The full cabinet controller obtains +15VDC and -15VDC from one or two switching power supplies located in the lower front portion of the amplifier cabinet. The half cabinet controller obtains +15VDC and -15VDC from either the top or bottom power supply assembly in the amplifier cabinet Cabinet controllers contain linear voltage regulators that convert the ±15 VDC to ±12 VDC. The ±12 VDC power is supplied to each of the amplifier modules through self-resetting fuses.

The top and bottom high voltage power supplies of the power amplifier cabinet are regulated by SCR controllers located in the lower front area of the cabinet. The cabinet controller monitor the AC supply voltage to the SCR controllers and the health of the controllers. Half cabinet controllers monitor the AC supply to the upper or lower SCR controller and the health of the specific SCR controller.

Early systems used potentiometers located in the cabinet controller assembly to set the voltage output of the high power supplies. Later systems have the voltage level adjust potentiometers located within the power supply assembly. If voltage adjust potentiometers are located within the power supply, adjustment holes will be visible through the rear cover of the power supply assembly labeled, R120-123.

RF power monitoring of the amplifier cabinet is monitored through detectors located on the cabinet controller board. Separate aural and visual detectors are available for externally diplexed systems, however in earlier models of the cabinet controller, the forward/visual reflected power detection was obtained using the aural reflected power port. In systems with half cabinet controllers, RF

samples are first split before they are routed to each half cabinet controller.

Power amplifier modules mounted in the amplifier cabinet are number referenced in this document and the transmitter control system from left to right and top to bottom as observed from the front of the amplifier cabinet. The number one high voltage power supply is located in the top of the amplifier chassis. It is controlled by SCR #1, and circuit protected by the left breaker located on the power distribution assembly, in the lower front of the cabinet. The High voltage power supply number two is located in the bottom of the amplifier cabinet. It is controlled by SCR #2, and circuit protected by the right breaker located on the power distribution assembly. Power supply one, top supply, feeds amplifiers one through four while power supply two, bottom supply, powers amplifiers five through eight.

2.4.1: Controller Connections to the Transmitter's System Controller

Each cabinet controller has a unique serial address that is determined by the setting of a rotary switch that is centrally located at the top of the cabinet controller assembly. The RS-485 serial address of the cabinet controller is the switch position times ten plus nine. I.E. Amplifier Cabinet Number 1 uses serial address 19.

Serial messages between the cabinet controller(s) and the transmitter's system controller are transported over a CAT-5 twisted pair cable using serial ports J103 and J104. Either port can be used as an input or output to the next amplifier cabinet. The wiring of the CAT-5 cables is a simple pin x to pin x connection. If a replacement cable or patch cable are needed, a simple straight-thru Ethernet cable with two RJ45 plugs can be used.

Table 2-1: Serial Cable Pin out

Pin	Function
1	System Visual AGC #2
2	Ground
3	No Connection
4	System Serial +
5	System Serial -
6	No Connection
7	System Aural AGC #2
8	Ground

The CAT-5 cable is also used to transport two analog reference voltages: Aural AGC #2 and Visual AGC #2. Each amplifier module produces a reference voltage that is proportional to the power output of the module. The amplifier circuits and amplifier cabinet wiring are configured such that the highest measured reference voltage is selected and wired to the amplifier cabinet controller. The cabinet controller board has circuitry that presents the highest measured reference voltage to the transmitter's system controller and upconverter. In multiple amplifier cabinet systems, the highest measured amplifier reference voltage is the voltage on the CAT-5 cable. In analog systems, the aural amplifier reference voltages are separate from the reference voltage of the visual amplifier modules.

2.4.2: Controller Connections to Amplifier Cabinet Components

2.4.2.1: Power Amplifiers

Power connections, serial connections and reference voltage signals are sent from the cabinet controller to each of the amplifier modules through one of two DB25 connectors. J101 is used to interface through the amplifier wiring harness to amplifiers one through four. J102 is used to interface to amplifiers five through eight.

Status and control of each amplifier module is implemented through serial messages sent between the amplifier's control board and the cabinet controller

assembly. The serial address of each amplifier module is determined by the wiring of the amplifier chassis. The module knows which serial address to use based on where it is located within the system. The cabinet controller board provides +12VDC and -12VDC to each of the amplifier modules through individual self-resetting fuses. The +12VDC supplies of the first four amplifiers are powered from one voltage regulator (U14) that is supplied by +15VDC. A separate voltage regulator (U17) is used to power the +12VDC lines of the last four amplifiers. U19 is used to generate the -12VDC supply to all of the amplifier positions.

Since some systems have separate aural and visual power amplifiers, the chassis wiring of position four and eight can be wired for either an aural or a visual amplifier. The reference AGC#2 voltage of amplifier position four and eight is wired through pin 22 of J101 / J102 in digital systems or through pin 25 in analog systems, where this amplifier position is used for aural power amplification. Amplifier modules are enabled and disabled using a general broadcast serial message. If an amplifier does not properly receive the message or for any other reason it is not in the desired state, the controller will individually command the amplifier into the desired state.

2.4.2.2: High Power Supply Controllers

The power amplifier high power supplies of the amplifier cabinet are regulated with SCR controllers located in the lower front area of the cabinet. The cabinet controller monitors the AC supply voltage to the SCR controllers and the health of the controllers. Early systems used potentiometers located in the cabinet controller to set the voltage output of the high power supplies. Later systems have the voltage level adjust potentiometers located within the power supply assembly. If the voltage adjust potentiometers are located within the power supply, adjustment holes are visible through the rear cover of the power supply assembly.

The amplifier cabinet wire harness connects J120 of the cabinet controller assembly to the power supply SCR controllers. If the cabinet controller is not enabled, the SCR controllers are held Off with a logic low on position nine of their terminal block. If the SCR controller detects an output short, has an over current fault, or is otherwise not ready for operation, the specific SCR controller is held Off. **NOTE**: Do not remove power from the cabinet controllers or disconnect J120 from the cabinet controller with power applied to the power amplifier high power supplies.

To allow the power supply to stabilize, an amplifier module is not enabled until five seconds after their associated high voltage power supply has been enabled.

2.4.2.3: Low Power Supply and AC Line Monitoring

The cabinet controller obtains its power and power for operation of the amplifier modules from a $\pm$15 VDC power supply located in the lower front area of the control cabinet. This supply also contains a +5 VDC output, however this supply tap does not have any significant use. If redundant power supplies are installed, the system will operate if only one supply is operational. Diodes located in the cabinet controller prevent one supply from disabling the second power supply. **WARNING**: THE HIGH VOLTAGE SUPPLY LINES ARE ALSO LOCATED BEHIND THE FRONT COVER. REMOVE POWER FROM THIS AREA BY LOCKING OUT THE HIGH VOLTAGE FEEDS TO THE AMPLIFIER CABINET.

The cabinet controller obtains AC line monitoring samples from a circuit board located in the front of the amplifier chassis. These signals are line to

ground samples obtained by resistor dividers. Two unique board assemblies are used: one for systems that operate around 220VAC input and another for systems that are operating around 440VAC. An internal DIP switch located on the cabinet controller board is used to scale the input values from the AC monitoring board. Switch 2 position four needs to be OFF for 220 VAC systems and ON for 440 VAC systems.

When a system is configured to operate around 220 VAC, a phase loss fault is generated if one or more input phases measure less than 176 VAC. For systems operating around 440 VAC, a phase loss fault is generated if one or more input phases measure less than 353 VAC.

2.4.2.4: Air Temperature and Amplifier Temperature Monitoring

The amplifier cabinet inlet air temperature is monitored by a thermistor located in the cabinet controller. A small remote circuit board is used to monitor the exhaust temperature of the amplifier chassis. The exhaust temperature is measured in the front top center of the amplifier chassis. At this time, neither the inlet air temperature nor exhaust air temperature is used for fault detection.

A cabinet cooling fault is only generated by the detection of an over temperature fault in two or more modules of the amplifier chassis. If an over temperature fault occurs, all amplifiers are placed in standby and the fault is latched. The fault is only cleared when the amplifier cabinet is placed into standby mode.

2.4.2.5: RF Power Monitoring

The separate amplifiers modules of the cabinet are combined prior to connection to couplers that measure the cabinet's RF output power. Separate aural and visual detectors are available, however in early models of the cabinet controller, visual reflected power detection was implemented using aural reflected power port J114 instead of J112. Please refer to cabinet controller settings section, for proper setting of the DIP switch two position five.

Sample ports are available to monitor the RF output energy and the energy reflected back into the cabinet. Digital systems monitor forward power on J111 and reflected power on J112. In analog systems, the aural forward power is measured on J113, the visual forward power detection uses J111, and the visual reflected power is measured using J112. If an aural system is externally diplexed, the aural reflected power is monitored using J114.

Table 2-2: Cabinet Controller DIP Switch Settings

Switch Number	Function	Position	Normal Operating Position
SW2-1	Reserved for Factory Test	0 = Off 1 = On	Off - Must be Off
SW2-2	Allow Power Supply Enable on Cooling FLT	0 = Off 1 = Allow	Off - Must be Off
SW2-3	Allow Power Supply Enable on RFL PWR FLT	0 = Off 1 = Allow	Off
SW2-4	High Voltage Supply Range	0 = 220 1 = 440	System dependent
SW2-5	Reflected Power RF Source	0 = J112 1 = J114 (If not Externally Diplexed)	System dependent

Switch Number	Function	Position	Normal Operating Position
SW2-6	Allow Power Supply Enable on Reject Load Faults	0 = Off 1 = Allow	Off
SW2-7	Reserved for Factory Test	0 = Off 1 = On	Off - Must be Off
SW2-8	Reserved for Factory Test	0 = Off 1 = On	Off - Must be Off

NOTE: These switch positions are factory set and should not be changed.

2.4.2.6: Reject Load Monitoring

Select UHF amplifier systems require the use of circulators within the amplifier cabinet combiner. The reject loads of these circulators have a limited power rating therefore the energy into these loads is monitored. **NOTE**: VHF amplifier modules do not require circulators thus reject load monitoring is not required.

J120 Pin 10, on the amplifier cabinet controller, is used to monitor a signal that is proportional to the highest reject load energy of amplifier positions one through four. Pin 13 is used to monitor the highest reject load energy of amplifier positions five through eight.

If the reject load voltage of a set of amplifiers exceeds a preset that is typically 0.8 VDC, the power supply of the associated amplifiers and the amplifiers themselves will be disabled. **NOTE**: Reject load faults can only be cleared by placing the amplifier cabinet in standby.

2.4.3: Cabinet Controller Settings

Within the cabinet controller assembly is an eight position DIP switch, SW2 that is used to enable select features. See Table 2-2.

2.4.4: Cooling Blower Control

The cabinet controller board provides signals that can be used to operate a cabinet cooling blower relay. On the board, Pin 16 provides +5VDC through a 0.5 amp self-resetting fuse. J125 pin 20, on the board, provides an open-drain connection for cabinet cooling blower control. Pin 19 provides +12VDC through a 0.5 amp self-resetting fuse. These two connections are wired to the Terminal Block TB1 located in the rear, right side, near the top of the amplifier cabinet. TB1-1, +12VDC, and TB1-3, Blower Control, need to be connected by 22AWG wire to the Fan Control Board mounted in the blower cabinet to operate the Blower. **NOTE:** If multiple cabinets are connected to one blower relay, diodes need to be added to the +12V and +5V lines for isolation of the cabinet power supplies. When the cabinet is enabled, the drain of the FET connected to J125 pin 20 is pulled low to ground. Use this signal to control the DC coil of a cooling blower relay.

2.4.5: Cabinet Controller Problem Resolution Guide

Table 2-3: Cabinet Controller Assembly Problem Resolution Guide

Condition	Possible Cause
Transmitter is enabled but either the Amplifier(s) and or the Power Supplies are not enabled.	• One of the three AC input phases may not be present or at least one may be low in voltage. • Serial communication with the cabinet controller may not be operational thus, the amplifiers and power supplies are remaining in their last state. • Reject load levels of an UHF system may be greater than the programmed fault threshold. • If two or more amplifier modules report an over temperature condition, all amplifiers are placed into standby and the fault is latched until the cabinet is placed into standby mode. • High voltage power supply SCR controller(s) may not be operational. • Amplifiers are not enabled until the power supplies are enabled for five seconds. • Cabinet Controller internal DIP switch position one may be in the on position. This position causes the controller to ignore serial communication commands thus the amplifiers and power supplies are remaining in their last state.
All LEDs of Amplifier Modules are Off.	• If tripped, reset the 110 VAC circuit breaker(s) of the ±15 VDC supply(s) located in the lower front of the control cabinet. If redundant power supplies are installed, the system will operate if only one supply is operational. Diodes located in the cabinet controller prevent one supply from disabling the second power supply. • Determine if the ±15 VDC supply located in the lower front of the control cabinet has valid input and output levels. **WARNING:** THE HIGH VOLTAGE SUPPLY LINES ARE LOCATED BEHIND THE FRONT COVER. REMOVE POWER FROM THIS AREA BY LOCKING OUT THE HIGH VOLTAGE FEEDS TO THE AMPLIFIER CABINET. • Disconnect and pull each amplifier module forward a few inches to disengage it from the supply connector. Determine if one amplifier may be the source of the problem. Each amplifier is powered through a self-resetting 0.5 amp fuse.

Table 2-3: Cabinet Controller Assembly Problem Resolution Guide - Continued

<table>
<tr><th>Condition</th><th>Possible Cause</th></tr>
<tr><td>Amplifier Module Status LED is blinking. (LED located nearest to the amplifier handle.)</td><td>
• The module status LED is blinked to show various fault states:
<table>
<tr><th>Blinks</th><th>Fault</th><th>Type</th></tr>
<tr><td>1</td><td>Pallet(s) Over Current</td><td>3 Fault w/ 5 second min and 5 Minute Retest</td></tr>
<tr><td>2</td><td>Over Temperature</td><td>1 Fault with 5 Minute Retest</td></tr>
<tr><td>3</td><td>High Power Supply Over Voltage</td><td>1 Fault without retest. Requires standby to clear.</td></tr>
<tr><td>4</td><td>High Power Supply Under Voltage</td><td>3 Fault w/ 5 second min and 5 Minute Retest</td></tr>
<tr><td>5</td><td>Reflected Power Fault</td><td>3 Fault w/ 5 second min and 5 Minute Retest</td></tr>
<tr><td>6</td><td>±12 VDC Supply Fault</td><td>Faulted only while supply is out of range</td></tr>
<tr><td>7</td><td>Overdrive Fault</td><td>3 Fault w/ 5 second min and 5 Minute Retest</td></tr>
</table>
Notes: 3 Fault means that if the fault occurs three times within 30 seconds, the fault is latched.

A 5 Minute Retest means that the fault is held active for five minutes. After five minutes, the fault is cleared and the amplifier is re-enabled.

If the amplifier module is placed in standby, fault counters and latched states are immediately cleared thus allowing the system to return to operate mode.
</td></tr>
<tr><td>Amplifiers or Cabinet Controller not reporting on transmitter's System Controller</td><td>
• Verify amplifier module is fully seated in amplifier chassis.
• If entire amplifier cabinet is not responding, check serial cable between the amplifier cabinet and transmitter system controller.
• If multiple amplifier cabinets are present, disconnect cable from first amplifier cabinet to second cabinet. If communication resumes, reconnect the serial cable and remove the next amplifier cabinet serial cable. Continue through the system until the source of communication error is identified.
• Exchange amplifier module with another position in the system. If the error travels with the amplifier module, it needs serviced. If the error remains in the same position, either the amplifier cabinet wire harness has been damaged or the cabinet controller board has been damaged. If the problem does not return when the amplifier modules are exchanged, a software update may be needed for either the cabinet controller or the amplifier module(s).
• Does amplifier respond to serial operate and standby commands. If so, a software update may be needed for the amplifier module(s).
</td></tr>
<tr><td>Cabinet Controller reports a reflected power fault.</td><td>
• Verify that the cabinet reflected power fault threshold is not set too low.
• If possible, use J114 for visual reflected power fault monitoring. This problem should only occur on cabinet controller boards 1305306 version A and B.
</td></tr>
</table>

2.5: Functional Description of the Amplifier Cabinet

2.5.1: Signal Path

The RF signal delivered by the exciter (+27 dBm) is connected through RG-55 cable to the amplifier cabinet and distributed to the inputs of the power amplifiers (PAs) through one 1:2 splitter, then two 3 or 4 way splitter panels. The top 3 or 4 way panel supplies the RF to the top 3 or 4 amplifier trays and the bottom 3 or 4 way panel supplies RF to the bottom 3 or 4 amplifier trays.

The power amplifier tray is a three-stage design comprised of a predriver (≈9 dB gain), a driver (≈13 dB gain), and the final stage (≈21 dB gain). The RF signal (≈18 dBm) is first preamplified in the predriver (≈24 dBm) and driver (≈37 dBm) before it is passed through a coupler board to the splitter where it is split four ways (≈34 dBm) and distributed to the four final-stage modules. The outputs of the final stages (≈55 dBm) are summed in a combiner. The output of the combiner (≈58.6 dBm) connects to a directional coupler that couples out voltages proportional to the forward power at the output of the amplifier, as well as a voltage proportional to the reflected power at the output of the amplifier. The output of the amplifier tray is typically +58.5 dBm. The coupler also provides a signal proportional to the forward power at the output of the amplifier that is passed to J3 on the front panel to provide an RF sample for test purposes. The same coupler also supplies a voltage proportional to the forward power from the driver stage, which is used in the monitoring and control circuitry. In addition, the reflected power at the amplifier output is monitored in the control board of the amplifier and, if the set threshold value is exceeded, the operating voltages for the predriver and driver are switched off and a fault indication of the high reflected condition is stored.

2.5.2: Test Signal Evaluation

The RF samples test voltages are passed to the control board of the amplifier for internal evaluation and partly for interrogation by the control unit. The test values for the forward power at the amplifier outputs are passed to the control unit.

The following test points are available for external measuring equipment or transmitter control equipment:

- RF test point at the amplifier outputs at “N” connector (J3).
- RF test points at the output side of the amplifier through (A41) a directional coupler downstream of the cabinet combiner.

2.5.3: Regulation of Transmitter Output Power

The regulation of output power takes place in the Digital Exciter. The actual value for the automatic level control (ALC) is taken from test voltages in the amplifiers that are dependent on the output power.

If an amplifier fails, transmitter operation continues at reduced power. In order to prevent the ALC from correspondingly increasing the output power of the Digital Exciter during reduced power operation, the test outputs of the individual amplifiers are circuited in parallel so that only the test voltage of the amplifier that delivers the highest output power is used in the control loop.

2.5.4: Fault Protection Circuitry

The amplifiers possess fault protection circuitry, which, if necessary, initiates the switching Off, of the respective unit

and simultaneously issues a fault indication to the control unit.
The protective circuits in the amplifiers monitor the following values:

- Drain currents of the final stage transistors
- Operating voltage
- Temperature
- Reflected power at the output

If a threshold value is exceeded, the amplifier shuts down. Following a one-off fault, the amplifier automatically switches on again after a delay of about 1 second. When repeated faults occur (more than 5 within 10 seconds), the amplifier switches on again after a delay of 5 minutes. In addition, the amplifier can be switched on, at any time, by a command from the transmitter control.

The protective circuits in the power supply units monitor the following values:

- 480/208 VAC Mains voltage
- 480/208 VAC Mains phase
- Primary voltage
- Primary current
- Output voltage
- Temperature

2.5.5: Capture of Operating Values in the Amplifiers

The following operating values are captured and processed in the amplifier control board and prepared for transmission to the exciter/control cabinet controller.

- Drain currents of the final-stage transistors
- Operating voltage
- Temperature
- Forward power at the output
- Reflected power at the output

2.5.6: Amplifier Cabinet Connections

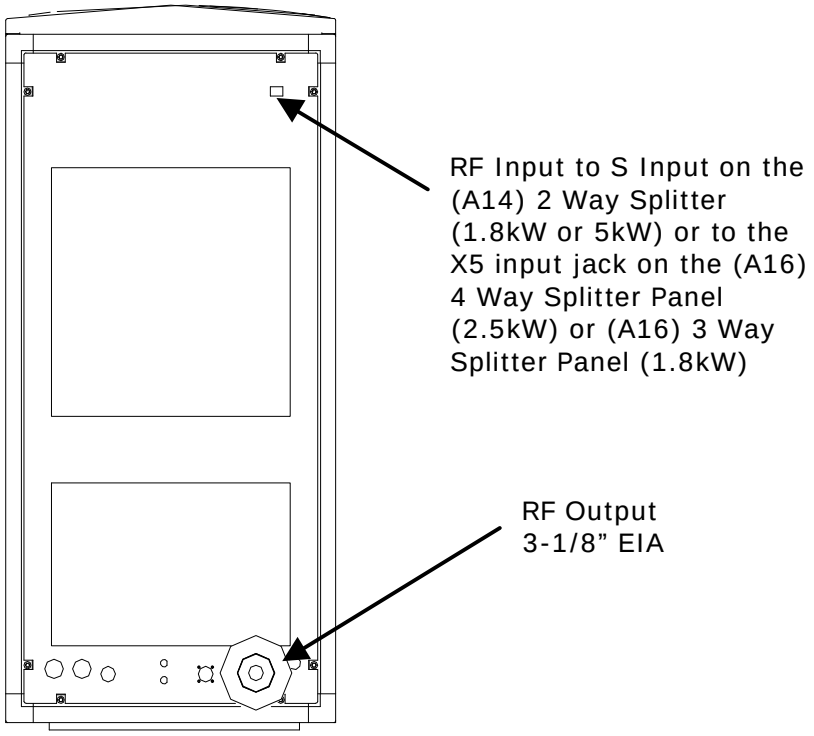


Figure 2-10: Amplifier Cabinet Connections

Table 2-4: Amplifier Cabinet Connections

Connector	Assignment	Type
S on (A14) 2 Way Splitter (1.8kW or 5kW) or to the X5 input jack on the (A16) 4 Way Splitter Panel (2.5kW) or (A16) 3 Way Splitter Panel (1.8k)	RF Input	RF SMA-type female connector
RF O/P of (A25) Combiner	RF Output	$3\text{-}^{1}/_{8}$ EIA

2.6: Service

The amplifier cabinet is user-friendly and designed for operational safety. The paralleling networks in the cabinet ensure that if an amplifier fails or is removed, transmitter operation continues at reduced power without degradation of performance.

The amplifiers are factory aligned and can be inserted in the cabinet without the need for retuning or adjustment.

2.6.1: Safety Information

The amplifier cabinet is maintenance free; however, in order to ensure trouble-free operation, it must be checked and serviced at regular intervals, taking into account the local environmental conditions. Operational reliability depends on proper service. This is especially relevant when checking grounding and power connections.

Work on the amplifier cabinet must only be performed by trained personnel. Take note of the following precautions:

- Before working on or removing a component, make sure that it is isolated from power.
- Carry out all work with extreme caution.

2.6.1.1: Labeling of Dangerous Substances

Components containing substances dangerous to health are labeled as such. The label is either glued on the component itself or in its immediate vicinity.

In drawings (e.g., component layouts of PC boards) and circuit diagrams, parts containing toxic substances, such as beryllium oxide (BeO), are labeled as shown in Figure 2-11.

Figure 2-11: Labeling of Toxic Substances in Drawings

2.6.2: Test Point Evaluation

Various RF test points in the signal path in the amplifier cabinet are available for evaluation and can be polled and displayed through the control unit. RF test points for external measuring equipment are also available at the amplifiers and the directional coupler at the output of the amplifier cabinet.

2.6.3: Display of Operating Values

Aside from RF powers, the following operating values can be polled and displayed in the transmitter control unit:

- Forward & Reflected power at the output of the amplifiers
- Amplifier operating voltage
- Amplifier currents
- Amplifier temperatures
- Forward power at the output of the amplifier cabinet

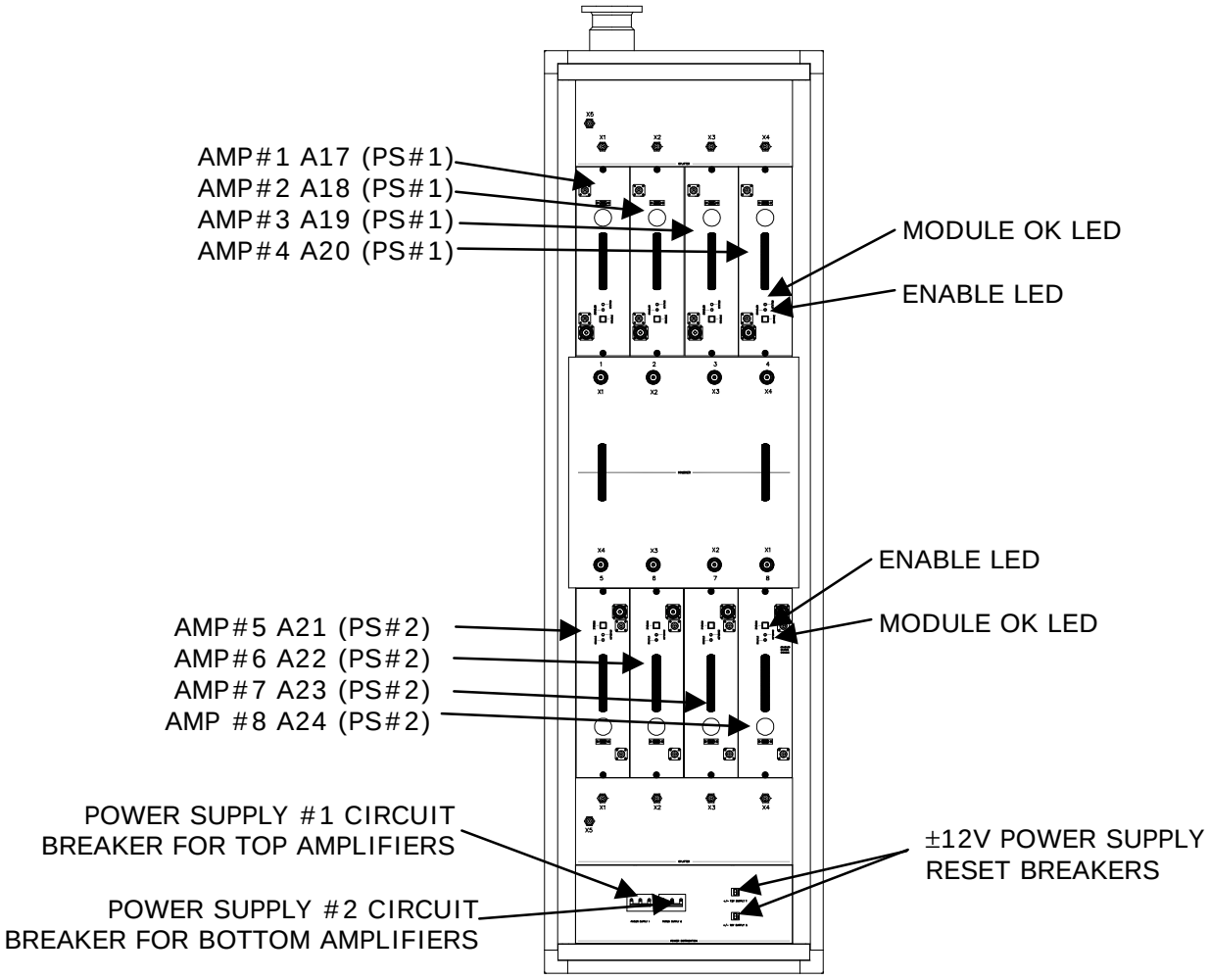


Figure 2-12: Location and Assignment of the Circuit Breakers and LEDs

2.7: Exchange of an Amplifier Module

For reasons of safety, amplifier modules **MUST** be in standby (RF disabled) before any connections are removed. If the amplifier control board is loaded with software version 2.4 or high, an Axcera Amplifier disable plug (1308219) can be used to place an individual module in standby. If your amplifier module has a front panel disable switch, this switch can be used to disable the amplifier. Regardless of the version of code, any power amplifier may safely be removed by disabling its power supply. The power supply, either the top power supply #1 for the top four Amplifier assemblies, or the bottom power supply #2 for the bottom four Amplifier assemblies, may be isolated from main AC power by switching off the appropriate front panel circuit breaker. This is accomplished by tripping the respective breaker located on the circuit breaker assembly panel, at the bottom of the amplifier cabinet.

Disconnect the RF cables. **NOTE:** To prevent damage to the module, first disconnect the Input Cable and then disconnect the Output Cable.

Undo the two holding, fixing, screws and pull the amplifier out to the end stop. Find and release the mechanical lock,

located on the bottom of the top four amplifier trays and on the top of the bottom four amplifier trays. See Figure 2-13. Pushing the release down on bottom amps and up on top amps releases the catch. Pull the amplifier completely out of the cabinet assembly.

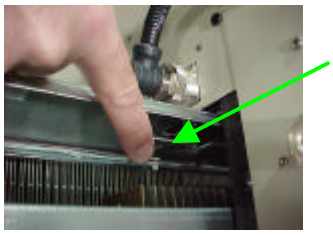


Figure 2-13: Amplifier Tray Lock Location

Caution: The amplifier weighs approximately 60 pounds. Use extreme care when removing it from the cabinet.

Caution: After the amplifier is pulled out, a high voltage may still be present at its output.

Insert and secure the new amplifier. Note the vertical position of the amp tray, do not try to insert upside down. Carefully push the amplifier into the rear connectors making certain that solid connection is made.

NOTE: If a replacement amplifier is not available, then the Air Blocking Plate should be installed in the slot where the amplifier assembly was removed and a fake front panel should be installed on the cabinet. This is to insure proper air flow through the cabinet and cooling of the remaining amplifier trays.

Connect the RF cables. **NOTE:** First connect the Output Cable and then connect the Input Cable.

Engage the respective circuit breaker, Power Supply #, 1 for amplifiers (1-4, A17-A20) or Power Supply #2, for amplifiers (5-8, A21-A24).

Amplifier Adjustments

There are no customer adjustments.

Information on a Change of Channel Frequency

The following work must be carried out at the amplifier cabinet when changing the channel frequency:

- The length of RF cables between the splitters and the amplifiers have to be altered.
- The coupling attenuation needs to be checked.
- The output powers of the amplifiers must also be checked.

NOTE: It may be necessary to make further adjustments at other cabinets and assemblies in the transmitter when a change in channel frequency is made.

Chapter 3
UHF Amplifier Tray Assembly and Cabinet Assemblies Circuit Descriptions

3.1: Amplifier Overview

Each UHF amplifier tray assembly serves to amplify the RF signal delivered by the exciter to the power level needed to attain the full rated output power of the transmitter. Nominal transmitter output power is achieved by adding the parallel connection of individual amplifier assemblies, within a cabinet assembly, and then the adding of a number of multiple amplifier cabinet assemblies.

The amplifier operates over the portion of the UHF Low, Medium or High Band TV frequency spectrum without any special tuning requirements. It is a three-stage amplifier design formed by a predriver, driver, and final stage as shown in Figure 3-1. The driver is a single stage amplifier module whose output is split four ways. The final stage is made up of four identical power modules. The four outputs are connected to a 4-way combiner assembly whose output is the RF output of the individual amplifier assembly.

The features of the UHF amplifier assembly include:

- All amplifying stages are equipped with transistors
- Operates over the designated portion of the UHF frequency band without special tuning requirements
- High redundancy due to the parallel connection of many power transistors
- Mean junction temperature <120° C
- Important operating parameters displayed in the transmitter control assembly
- Multiple fault protection circuitry against mismatch, overvoltage, overcurrent and overtemperature conditions

The amplifier possesses multiple fault-protection circuits that prevent damage to the power transistors during critical operating conditions, such as high mismatch, overtemperature, overcurrent, or overvoltage. Important operating parameters, such as drain currents, operating voltages, RF powers, and temperatures are polled and displayed in the transmitter control assembly.

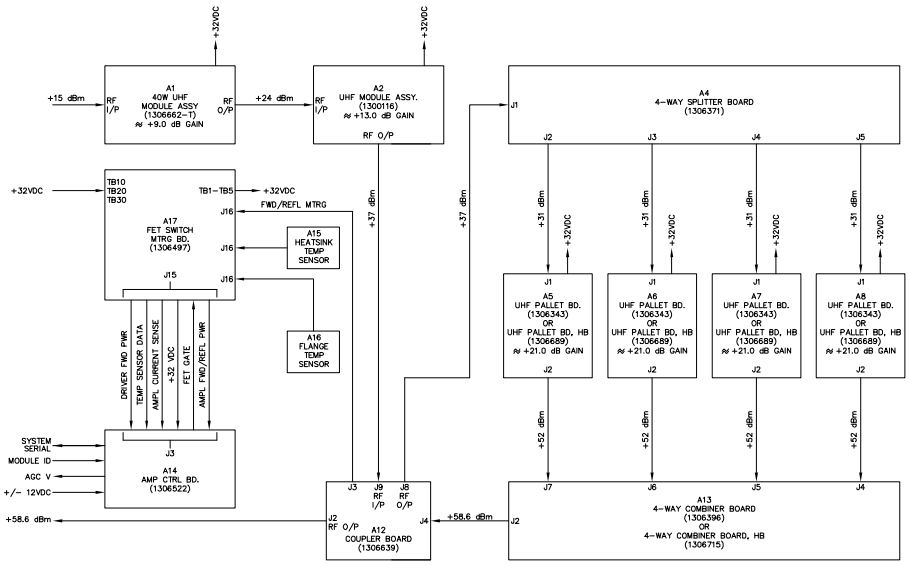


Figure 3-1: UHF Amplifier Assembly

The paralleling network of the amplifier is arranged so that it continues to operate at reduced power if a module fails. The remaining available power is given by:

$$P_{rem} = P_{nom} \cdot ([m - n] / m)^2$$

where:

P_{rem} = remaining power
P_{nom} = nominal power
m = number of modules
n = number of failed modules

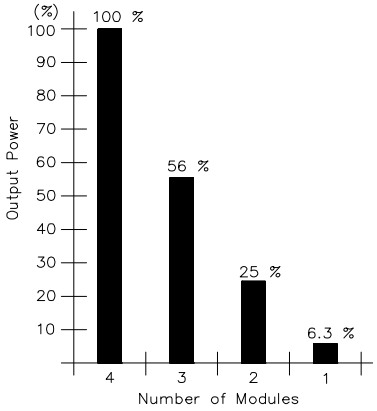


Figure 3-2: Remaining Power after Failure of Amplifier Modules

3.2: Design of the UHF Amplifier

The amplifier is designed as a slide-in unit. The mechanical support structure is formed by a finned heat sink on which the individual assemblies are mounted. The amplifier assemblies are listed in Table 3-1.

All RF connectors are located on the front panel, while the control and power connectors are mounted at the rear. The control board is mounted behind the front panel. Two LEDs on the control board (visible through the front panel) signal the operating status of the amplifier, Module OK and Enable LEDs.

Table 3-1: Assemblies in the UHF Amplifier

Position	Assembly	Remarks
A14	Amp Control Board	For control, monitoring, and test signal capture
A1	40 Watt UHF Module Assembly	Predriver (≈9 dB gain)
A2	UHF Module Assembly	IPA, Driver, to the splitter (≈13 dB gain)
A12	Coupler	Provides Driver forward, and final amplifier forward an reflected power samples
A4	Splitter (1:4)	Distributes the RF input power to the final amplifier boards A5 to A8. (≈34 dBm)
A5 to A8	UHF Dual Stage Pallet Boards	Four final amplifier boards (≈21 dB gain) (≈55 dBm O/P)
A13	Combiner (4:1)	Sums the output powers of the 4 UHF Pallet Boards. (≈58.6 dBm Output)
A17	FET Switch/Metering Board	Takes the three +32VDC inputs and switches them to the predriver, driver and the amplifier pallets. In addition, the metering samples connect through the board.

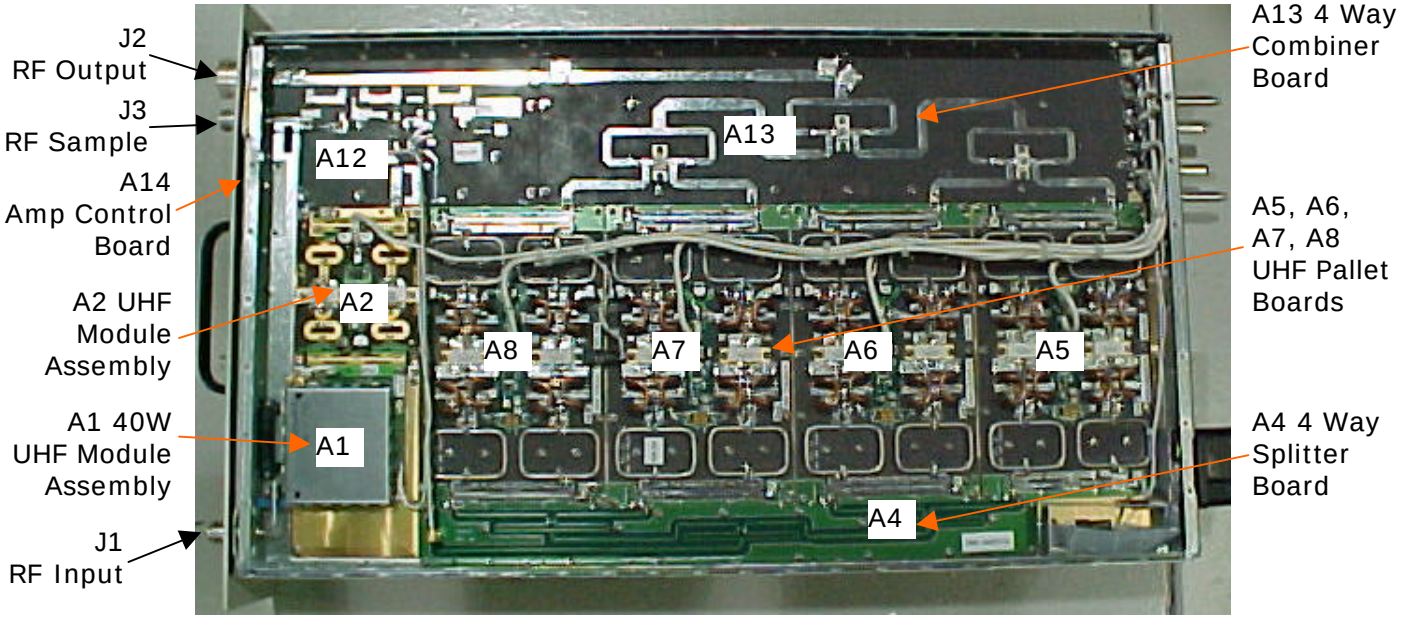


Figure 3-3: Location of the Assemblies in the UHF Amplifier

The amplifier is a three-stage design with a 40 Watt UHF low level predriver, a UHF module single amp driver and four UHF pallet final amplifier stages.

The RF input signal (+18 dBm) is fed to the amplifier through connector J1 on the front panel. The signal is preamplified by the 40W UHF module assembly A1 (predriver) (+27 dBm), amplified by the UHF single stage module A2 (driver) (+40 dBm) before it is passed through A12 the coupler assembly to the 4 way splitter A4 (+40 dBm). The outputs (+34 dBm) are distributed to the four UHF dual final stage modules A5 to A8. The outputs of each of the final stage modules (+55 dBm) are combined in the 4 way combiner A13 and the resultant signal is passed to RF output connector J2 (≈+58.5 dBm).

The predriver and the 4 way combiner incorporate the A12 directional coupler to supply output voltages proportional to the forward powers at the input to the 4 way splitter and at the output of the 4 way combiner. They also couple out voltages proportional to the reflected power at the output of the 4 way combiner. These test voltages are passed to the amp control board, mounted, behind the front panel, for internal evaluation and partly for interrogation by the control unit. In addition, the reflected power at the amplifier output is monitored in the control board and, if the threshold value is exceeded, the operating voltages for the predriver and driver are switched off and a fault indication is stored. A directional coupler in the combiner also couples out a signal proportional to the forward power at the output of the 4 way combiner. This signal is passed to connector J3 on the front panel to provide the RF test signal.

Test voltages derived from the forward power of the amplifier are generated in the amp control board to provide automatic level control (ALC) in the exciter stage of the transmitter. The ALC is a function of the rms value of the output power.

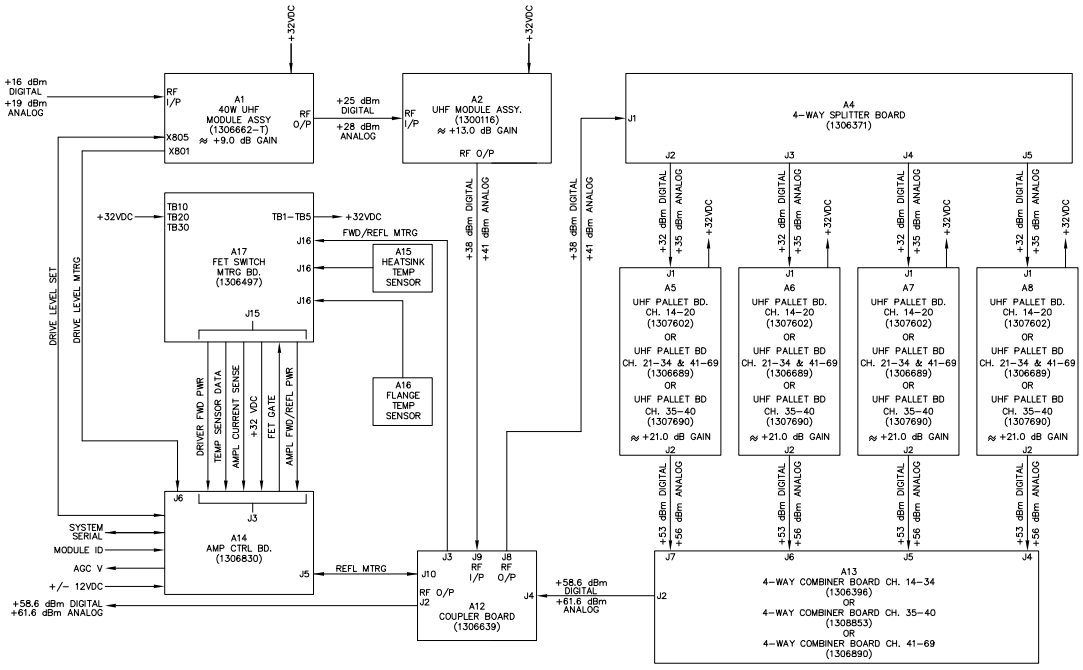


Figure 3-4: Block Diagram of the UHF Amplifier

Amplifiers can be replaced during transmitter operation. No new alignment work is necessary. The frequency-dependent operating parameters for the complete frequency range are stored in the controller and are automatically enabled by the frequency setting of the exciter. The RS 232 port is used for the factory alignment of operating parameters, e.g., calibration of RF and drain current test values.

The operating voltage U_{op} of +32 volts is distributed to the final amplifier modules by a current bus underneath the combiner. In addition to U_{op} for the modules, the amplifier requires auxiliary voltages of ±12 volts for the control board. The operating voltage and current consumption of the individual modules are captured in the combiner board and passed to the control board where they are available for interrogation by the control unit. Furthermore, threshold values are monitored in the control board and, if a fault condition arises, the operating voltage for predriver A1 and driver A2 is disconnected by the action of field effect transistor mounted on the A17 FET Switch regulator board. The fault indication is stored and passed to the control unit.

The measured values of the temperature sensors A15, mounted on driver front, and A16, mounted on final rear, are passed to the control board where they are monitored and available for interrogation by the control unit.

The control board possesses a number of LEDs that indicate the status of the amplifier. Two of these LEDs are visible through the front panel. The green Module OK LED indicates fault-free operation. The Green Enable LED indicates that the enable is applied to that assembly. It will not be lit if the Enable is removed. It will be lit Amber if the Enable is applied but the amplifier is not operating.

A fault condition is indicated by a Red Module OK, either continuously illuminated or flashing Red. The flashing Red LED interprets as follows:

Table 3-2: Module OK LED Red and Blinking interpretation

Red LED Blinking	Meaning
1 Blink	Indicates Amplifier Current Fault
2 Blinks	Indicate Temperature Fault
3 Blinks	Indicate Power Supply Over Voltage Fault
4 Blinks	Indicate Power Supply Under Voltage Fault
5 Blinks	Indicate Reflected Power Fault
6 Blinks	Indicate +12V or –12V Power Supply Fault
7 Blinks	Indicate AGC Overdrive

3.2.1: Capture of Test Values in the UHF Amplifier

The following test values are passed the transmitter control unit:

- Forward power at the amplifier output – rms output power
- Reflected power at the transmitter output – peak level
- Operating voltage
- Current consumption of the modules
- Temperatures

The following test values are used only for internal purposes on the control board:

- Forward power behind drive module A3 (not displayed in the control unit)

The following test points are available for external equipment:

- RF test connector J3 on the front panel
- Output power behind drive module A3 (this test point is exclusively intended for factory measurements)

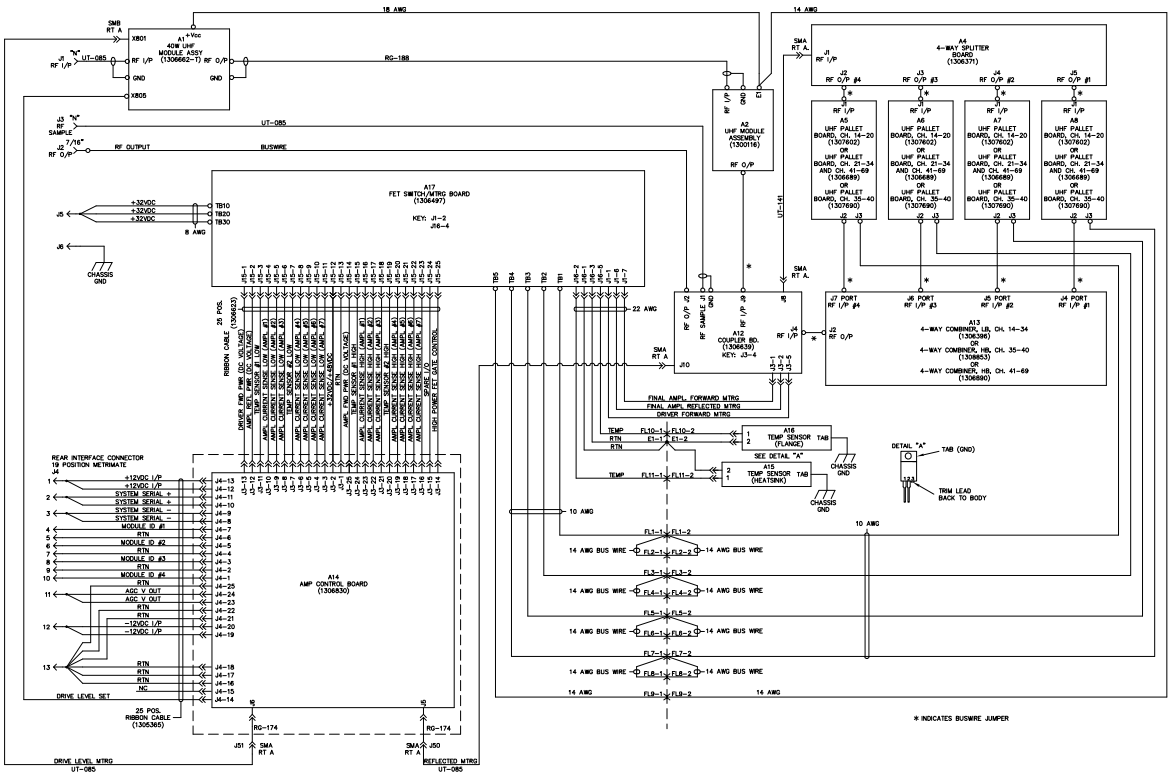


Figure 3-5: Interconnect Typical UHF Amplifier Assembly

3.2.2: Functional Description of the Boards in the UHF Amplifier Tray Assembly

3.2.2.1: (A1) 40 Watt UHF Module Assembly (1306662; Appendix B)

The RF Input from the splitter assembly (+18 dBm) is connected to the RF input connection on (A1) the 40 Watt UHF amplifier assembly, which has a gain of approximately 9 dB. The assembly, which operates class AB, is a highly linear broadband amplifier for the portion of the UHF band in which it is operating. With a typical input of +18 dBm an output of +27 dBm is expected. The output is set as needed to provide the drive level to the UHF Module Assembly that follows.

The amplification circuit consists of LDMOS FET transistors V804 and V805 connected in parallel and operating in class AB. The paralleling network is achieved with the aid of 3 dB couplers Z802 and Z803. A further 3 dB coupler Z801, in conjunction with capacitors C800 and C819, serves as a phase shifter. Phase alignment, for the complete amplifier, as well as quiescent current settings are achieved by means of potentiometers R807 and R808. The settings are factory implemented and should not be altered.

PIN diodes V810 & V811 form a variable dampening circuit that is used to adjust the amplification of the 40-watt module. The adjustment is accomplished with the Gain potentiometer R838. A readjustment of the amplification may be required, after repair work is completed to ensure that the PAs in the multiple PA transmitter delivers the same output power.

3.2.2.2: (A2) UHF Module Assembly (1300116; Appendix B)

The UHF Module Assembly, 250-watt module is a broadband amplifier for the portion of the UHF band in which it is operating. The amplifier has approximately 13 dB of gain. With a typical input of +27 dBm an output of +40 dBm is expected.

The amplification circuit consists of the parallel-connected push-pull amplifier blocks V1 and V2 operating in class AB. In order to match the transistor impedance to the characteristic impedance of the input and output sides, matching networks are placed ahead and behind the amplifier blocks. Transformers Z3 to Z6 serve to balance the input and output signals. The paralleling circuit is achieved with the aid of 3-dB couplers Z1 and Z2.

The working point setting is factory implemented by means of potentiometers R9, R11, and R12 and should not be altered.

3.2.2.3: (A12) Coupler Board (1306639; Appendix B)

The UHF coupler board assembly provides forward and reflected power samples of the output to (A2) UHF module assembly and also the output of the 4 way combiner. The samples connect through the FET Switch board to the amplifier control board where it connects to the input of the overdrive protection circuit.

The RF input to the UHF coupler assembly, from the UHF module assembly, 250 Watt, connects to jack J9. The RF is connected by a strip line track to the RF Output jack J8 that is cabled to the 4 way splitter. A hybrid coupler circuit picks off a power sample that is connected to J3-5 as the forward driver power sample.

Another RF input from the 4 way combiner board, which is the RF output for the tray, connects to jack J4. The RF is connected by a strip line track to the RF Output jack J2 that connects to the front panel Jack J2, which is the RF output for the UHF amplifier assembly. Three hybrid coupler circuits pick off power samples, two forward samples and one reflected sample. One forward

sample and the reflected sample connect through the FET Switch board to the amplifier control board. The other forward sample connects to the RF sample jack J3 located on the front panel fro test purposes.

3.2.2.4: (A4) 4 Way Splitter Board (1306371; Appendix B)

The (A4) 4-way splitter distributes the output signal (+40 dBm) of the UHF module assembly (A2) that was coupled through the (A12) coupler board to the splitter board, that connect to the four parallel UHF Pallet Boards (A5 to A8).

The splitter circuit is in the form of micro strips mounted on a Teflon board. The actual splitter network does not incorporate tuning elements. The network provides for an equal splitting, over the desired frequency range in the UHF band, of the input at connector J1. The input signal is first split in a ratio of 1:2. After this, both partial powers are split in a second stage in the ratio of 1:2. The load (balancing) resistor of the 1:2 stage is formed by the series connection of a 100Ω/10W power resistor. The balancing resistors of both 1:2 stages are also in the form of 100Ω/10W resistors. Each output of the splitter board is typically +34 dBm.

3.2.2.5: (A5-A8) UHF Dual Stage Pallets (1307602, CH: 14-20 or 1306689, CH: 21-34 & 41-69, or 1307690,CH: 35-40; Appendix B)

The (A5, A6, A7 & A8) UHF Pallet Dual Stage Amplifier Boards provide approximately 21 dB of gain through each of the boards. The RF input at a level of approximately +34 dBm connects to J1 on the board. The input is applied to a hybrid splitter that produces two outputs, one at 0° and one at -90°. Each output connects to identical circuits. The -90° signal is applied to a 9:1 transformer assembly that produces two 180° out of phase outputs. The two outputs connect to Q1 a dual FET, configured in a push pull arrangement, with approximately 16 dB of gain. The amplified outputs of the FETs connect to a 1:9 Balun assembly that combines the two 180° out of phase signals into a single -90° output. The -90° output connects to one input of a hybrid combiner circuit.

The 0° signal is applied to a 9:1 transformer assembly that produces two 180° out of phase outputs. The two outputs connect to Q2 a dual FET, configured in a push pull arrangement, with approximately 16 dB of gain. The amplified outputs of the FETs connect to a 1:9 Balun assembly that combines the two 180° out of phase signals into a single 0° output. The 0° output connects to one input of a hybrid combiner circuit.

The 0° and the -90° signals are combined by a hybrid combiner circuit and connected to J2 the RF output jack on the board (≈+55 dBm).

The +32 VDC, from the 4-way combiner, connects to J3 on the board. The voltage is applied through the resistors R3 and R9 and the transformers to the drains of Q1 and Q2. The +32 VDC is also connected to the regulator U1 that supplies the source voltages through the transformers to Q1 and Q2. R5, R6 and R7 are adjusted at the factory to set up the drain current of the devices and should not be readjusted.

3.2.2.6: (A13) 4 Way Combiner Board (1306396, CH: 14-34, or 1308853, CH: 35-40, or 1306890, CH: 41-69; Appendix B)

The (A13) 4-way combiner combines the output signals of the UHF pallet boards+55 dBm into a single output typically +58.6 dBm, that connects through the coupler board to the output jack for the tray.

The combiner circuit is in the form of Baluns mounted on a Teflon board. The actual combiner network does not incorporate tuning elements. The network provides for equal combining,

over the desired frequency range in the UHF band, of the four inputs at connectors J1-J4. The signals at J1 and J2 are combined at a ratio of 2:1 and the signals at J3 and J4 are combined at a ratio of 2:1. After this, both combined powers are combined again in a second stage in the ratio of 2:1. The load (balancing) resistors of all three 2:1 stages are 50Ω/250W power resistors, a total of six. The combined RF output of the board is at J5 and is typically +58.6 dBm 724 Watts in level.

3.2.2.7: (A17) FET Switch/Metering Board (1306497; Appendix B)

The FET switch/metering board provides protection of the +32 VDC to the amplifier modules in the tray, feed through connection of the forward and reflected power samples and feed through connections of the temperature sensors A15 and A16 mounted on the heatsink assembly.

The (A12) coupler board provides voltages proportional to the forward and reflected output power of the 4 way combiner. These test voltages are coupled through and passed to the amplifier control board through J15-2 for reflected power and J15-14 for forward power. A sample of the (A2) UHF module assembly forward power connects through the FET Switch/Metering Board at J15-1 that is supplied as a driver sample to the amplifier control board.

3.2.2.7.1: Operating Voltages for the Amplifier Boards

The operating voltage of +32 volts is distributed to each of the UHF pallet amplifier boards, TB4 to A8, TB3 to A7, TB2 to A6, and TB1 to A5. The +32 volts is also distributed to the A2 UHF Module assembly and the (A1) 40 Watt UHF Module Assembly through TB5.

The FET switch/metering board will remove the +32 VDC from the amplifier boards during hot replacement of the UHF Amplifier Assembly. The FETs Q1, Q2 and Q3 are controlled by the high power gate control that is applied to J15-25 from the Amplifier Control Board. The drain currents of the power transistors on the UHF pallet boards are captured by .05? precision resistors connected to their supply lines. The voltage drops across these resistors are passed to the amplifier control board through 43.2k? bleeder resistors in parallel. In addition, the operating voltage is also passed to the control board for monitoring purposes.

Critical operating parameters, including current high or low and temperature, of the amplifiers are monitored on the amplifier control board through the FET board. If threshold values are exceeded, the amplifier control board switches off the operating voltages for the predriver, driver and final amplifiers through the FETs Q1, Q2 and Q3 on the FET switch/metering board.

3.2.2.8: (A14) Amplifier Control Board (1308540 or 1306830; Appendix B)

All protective, switching, display, and monitoring functions required for the operation of the UHF amplifier assembly are realized by the amplifier control board. The control board is mounted in a RF enclosure behind the front panel of the amplifier and performs the following tasks:

- Capture and processing of test values
- Fault protection for the amplifier modules
- Generating the actual value for transmitter ALC
- Communication with the transmitter control unit

The circuits in the control board do not contain elements that can be adjusted. All of the required settings are software implemented in the factory through an RS 232 port and must not be altered.

3.2.2.8.1: Schematic Page 1

Upper center of page one is U2, which is the microcontroller. This in-circuit Atmel microcontroller is operated at 3.6864 MHz. Programming of this device is performed through J2. PF4 and PF5 are analog inputs for ICs U33 and U34 on page 4. The desired analog channels of U33 and U34 are selected by the setting of PA0, PA1, & PA2. PA3 of U2 drives a processor operating LED that can be flashed to show continued operation. PF0 and PF1 are used to monitor the +12V and -12V supplies to the board. PF3 is connected to a via for future access. PB3,4,5,6 and 7 are used to indicate different hardware revisions to the operating software.

U6 is our standard serial to RS-485 driver IC. Resistor R25 sets U6 to transmit mode when the micro is held in reset or PE2 is configured as an input.

U4 is a watchdog IC used to hold the microcontroller in reset if the supply voltage is less than 4.21 VDC; (1.25 VDC < Pin 4 (IN) < Pin 2 (Vcc)). U4 momentarily resets the microcontroller if Pin 6 is not clocked every second.

U3 is a RS-232 serial port on UART 1 of the micro controller. J1 is used to provide front panel RS-232 access (without hardware handshaking). A standard NULL modem cable is needed to connect to a PC. For test and debug, all data into and out of the RS-485 interface of UART0 is transmitted out through a pin of J1 (this pin is usually not used unless hardware handshaking is implemented).

U1, located in the Upper left corner, is used to determine where the amplifier control board is located. Module ID 1, 2 and 3 inputs require an external pull-down to ground to set the logic state but Module ID 4 requires an external pull-up. Diodes such as CR1 prevent un-powered modules from pulling down the Module ID lines of other installed modules. The external pull-down to ground connections are made in the amplifier cabinet wiring harness.

U36 below U1 is used to reset faults that are detected on pages 2 and 5. Circuits of page 2 and 5 hold a fault condition so that the microcontroller has enough time to detect the fault and operate accordingly.

U5 is below U36 and is used to control the board's status LEDs, DS3 Amplifier Enabled and DS4 Module OK (See Table 3-3), and other circuits that are not allowed to change state during a microcontroller reset. The LEDs are controlled by a FET that is turned on to shut current away from the LED to turn it off.

U7 is located below U5. U7 is used transfer the latched fault conditions into the microcontroller U2.

Table 3-3: Module OK LED Red and Blinking interpretation

Red LED Blinking	Meaning
1 Blink	Indicates Amplifier Current Fault
2 Blinks	Indicate Temperature Fault
3 Blinks	Indicate Power Supply Over Voltage Fault
4 Blinks	Indicate Power Supply Under Voltage Fault
5 Blinks	Indicate Reflected Power Fault
6 Blinks	Indicate +12V or –12V Power Supply Fault
7 Blinks	Indicate AGC Overdrive Fault

3.2.2.8.2: Schematic Page 2

In the upper center section of page 2 are circuits with U35, U11 and U12. When the cabinet high power supply is enabled, U35A generates a regulated voltage that is about 7.5 Volts less than the +32 / +48 Volt high power supply. U11 and U12 generate a regulated voltage that is about 10 Volts more than the high power supply. This voltage is regulated to produce a signal that is about 4.4 VDC above the high voltage supply. The PS +4.4VDC regulated power is used to power the unity gain op-amp circuits located on page 3.

The PS +10VDC output is also used to drive the gate of two external power

FETs. These FETs are located within the amplifier module and are used to control the high power supply current to the amplifier pallets. Since the high power supply can be +48 Volts and the 2N7002LT1 is rated for a maximum Drain to Source voltage of 60 Volts, Q9 along with Q8 make a circuit that controls the high power supply control voltage of the two external power FETs. Q13 allows the hardware to automatically disable the external power FETs on detection of a critical fault. Q19 quickly reduces the drive level when a fault is detected.

U50 detects the high power supply voltage. U51 indicates that the power supply voltage is too low. U58 is a digital potentiometer that sets the over voltage and under voltage fault thresholds. U37 latches the fault so that the microcontroller can observe the fault condition even after the cause of the fault is removed.

3.2.2.8.3: Schematic Page 3

Current Monitoring Circuits:
A 0.01 ohm resistor is used within the amplifier module for monitoring the current through several sections of the amplifier. The voltage developed across this resistor is provided to the control board through current limiting resistors. The control board also has current limiting resistors and filtering capacitors on the input circuits. Due to the input bias current of the Linear Technology LT1787HVCS8 precision high side current sense amplifiers, the current sense amplifiers can not be directly connected to the resistive components. A unity gain low input offset op-amp is used in both the high and low side sense lines. Voltage supplied to these parts must be above the high voltage supply rail and the V- pin must be less than the high voltage supply but not as for down as ground. The 43.2 Kohm resistor from Pin 5 to ground sets the gain of the current sense amplifiers to about 17.28. This value is not set with much accuracy since the manufacture internally matches the resistors of this part but their actual resistance value is not closely defined. A digital potentiometer is connected to each of the high current monitoring circuits to allow for calibration of the measured current prior to the over current detection circuits.

3.2.2.8.4: Schematic Page 4

The upper left corner contains U33 and U34. These are the analog multiplexer IC that are used to route select analog signals into the microcontroller.

U32B converts the detected forward power level into a module AGC output voltage. CR51 allows the module's AGC output voltage to be connected to other module AGC voltages. If this module has the highest detected forward power in a multi-amplifier system, it will have the highest forward power signal. This signal level into U32B pin 5 will be used to set the AGC output voltage of the system. If another amplifier has a higher forward power, the level into U32B pin 6 will be higher than pin 5 and this amplifiers output signal will not be used to set the AGC voltage level.

High speed comparators U52, 53, 54, and 55 monitor the current of the RF amplifier pallets. If any level is greater than the fault level set by the digital potentiometer U43, the fault is detected and held by U41.

Other digital potentiometers on this page set the reflected power fault threshold, over drive fault threshold and the drive level.

3.2.2.8.5: Schematic Page 5

The modules reflected power and driver input forward power are monitored through RF detection circuits of the control board on this schematic page. If the reflected power is greater than the fault threshold set by U43 pin 5, located on page 4, U56 will indicate a reflected power fault. If the drivers input power is greater than the fault threshold set by

U44 pin 13, located on page 4, U57 will indicate an over drive fault. These faults are latched for detection by the microcontroller and they are also used by CR66 and CR67, located on page 2, to immediately remove the supply voltage of the main control FETs.

The RF forward power detection circuits are calibrated on the combiner board and the DC output voltages of these circuits are passed to the control board over the ribbon cable connection between the boards.

In the lower right corner of the page are voltage regulator circuits. U29 is rated for 0.14 amps of power using its 92 C/W rating if Ta = 60C max and Tj = 125C max. 0.26 amps can be obtained from U29 if the mounting pad is 0.5 square inches. The controller does not typically need this much current. U30 and U31 are low drop-out voltage regulators with a tolerance greater than or equal to 1%. 100 mA is available from each of the devices.

3.3: Troubleshooting and Repair of the Amplifier

3.3.1: Safety Information

Work on the amplifier must only be carried out by qualified personnel according to good electrical engineering practice, taking into account all relevant safety precautions. Furthermore, the following should be noted:

- Before working on an amplifier, e.g., removing cables, removing the front panel etc., ensure that the amplifier is disconnected from the operating voltages. Carry out all work with extreme caution.

3.3.2: Troubleshooting

3.3.2.1: Front Panel LEDs

A visual indication of the operating status of the UHF amplifiers is signaled by front panel LEDs. Fault-free operation is signaled by the lit Green Module OK LED, located nearest the handle. A fault condition is indicated by a Module OK, either continuously illuminated Red or flashing Red.

The flashing Red Module OK LED interprets as follows:

Table 3-4: Module OK LED Red and Blinking interpretation

Red LED Blinking	Meaning
1 Blink	Indicates Amplifier Current Fault
2 Blinks	Indicate Temperature Fault
3 Blinks	Indicate Power Supply Over Voltage Fault
4 Blinks	Indicate Power Supply Under Voltage Fault
5 Blinks	Indicate Reflected Power Fault
6 Blinks	Indicate +12V or –12V Power Supply Fault
7 Blinks	Indicate AGC Overdrive

The other LED is the Enable LED, located nearest the edge. It is Green when an Enable is applied to that amplifier and it is operating. It will not be lit if the Enable is removed. It will be lit Amber if the Enable is applied but the amplifier is not operating.

3.3.2.2: Polling Fault Indications

Detected fault conditions are passed to the control unit. The fault indications are entered in a list and can be viewed at any time during transmitter operation.

The system control unit is used for polling stored fault indications and reading actual operating parameters.

3.4: Exchanging Amplifiers

For reasons of safety, amplifier modules **MUST** be in standby (RF disabled) before any connections are removed. If the amplifier control board is loaded with software version 2.4 or high, an Axcera Amplifier disable plug (1308219) can be used to place an individual module in standby. Regardless of the version of code, any power amplifier may safely be removed by disabling its power supply. The power supply, either the top power supply #1 for the top four

Amplifier assemblies, or the bottom power supply #2 for the bottom four Amplifier assemblies, may be isolated from main AC power by switching off the appropriate front panel circuit breaker. This is accomplished by tripping the respective breaker located on the circuit breaker assembly panel, at the bottom of the amplifier cabinet.

3.4.1: Exchange of a Module

Caution: The load (balancing) resistors in the modules contain Beryllium Oxide.

Remove the amplifier from the cabinet as described in the Chapter 2 section 2.5.3 of this volume.

Undo the side panel of the amplifier.

Unsolder the connections for the operating voltage as well as the RF input and output connections of the defective module.

NOTE: The temperature sensors A15 or A16 may need to be unscrewed to remove the module.

After undoing the screws, the module can be lifted from the heat sink. Remove the old heat-transfer paste from the heat sink.

NOTE: In order to ensure proper heat conduction, the contact surface of the heat sink must be clean and free of foreign particles.

3.4.2: Mounting a New Module

Apply a thin film of heat-transfer paste to the contact surface.

Fix the module into position with the mounting screws. At first, only tighten the screws by hand.

Next, tighten the screws, in repeated steps, to a torque of 0.8 Nm (7 in/lb).

Caution: A torque of 1.2 Nm (10 in/lb) must not be exceeded. (1.2 NM ~ 10 in/lb) (0.8 Nm ~ 7 in/lb)

3.4.3: Final Steps

Replace the cover on the amplifier, insert the module into the transmitter cabinet, and make the RF input and output connections as described in Chapter 2 section 2.5.3 of this volume.

NOTE: Alignment work on the amplifier is not required. They are set at the factory for both phase and gain control and provide less than 0.5 dB difference between the amplifiers. The exchange of a module should be reported to Axcera with information on the cause of the fault, module location, identification number of the amplifier, and the type of transmitter.

3.4.4: External Connections to Amplifier Assembly

Table 3-5: RF Connectors on the Front Panel

Connector	Assignment	Type
J1	RF Input	Female N-type
J2	RF Output	Female HF 7/16”
J3	RF Test Point	Female N-type
RS 232 C	**reserved for factory alignment only!**	

Table 3-6: Operating Voltage Connection (Rear Panel)

Pin	Assignment
J5	+32 V
J6	Ground

3.5: Power Supply Assembly

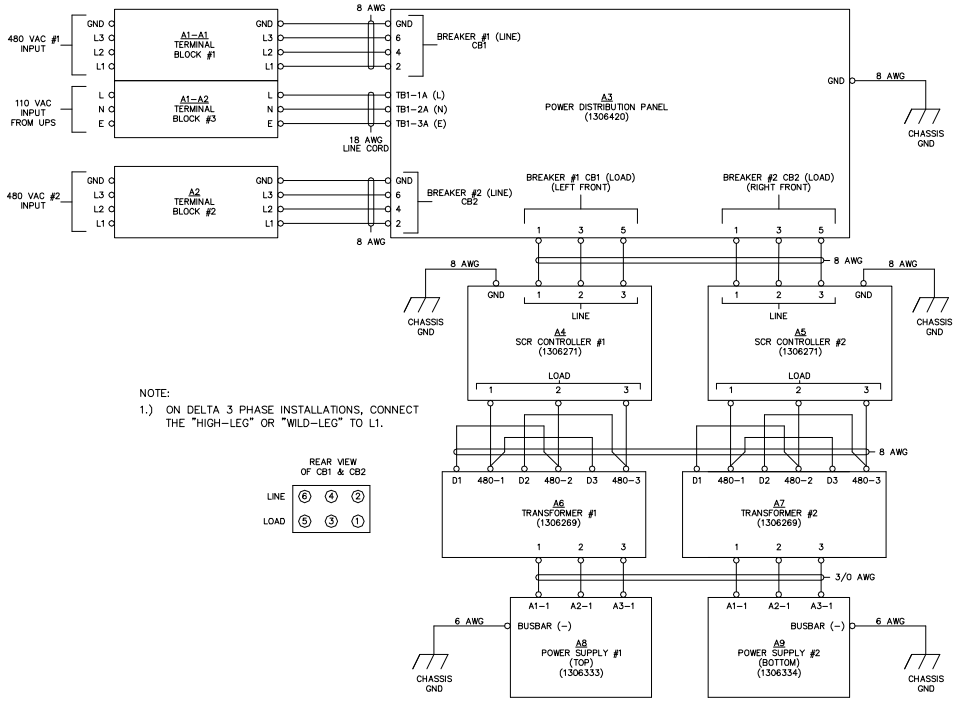


Figure 3-6: AC Wiring Harness UHF Amplifier Cabinet

3.5.1: +32 VDC Power Supplies Overview

The DC voltages to the UHF amplifier assemblies mounted in each UHF amplifier cabinet are supplied by either one or two linear power supply assemblies. One supply, titled the top power supply #1, provides +32 VDC to the four UHF amplifier assemblies mounted at the top of the cabinet for 5 kW amplifier cabinets or three UHF amplifier assemblies mounted at the top of the cabinet for 3.7 kW amplifier cabinets. The other supply, titled the bottom power supply #2, provides +32 VDC to the four UHF amplifier assemblies mounted at the bottom of the cabinet for 2.5 & 5 kW amplifier cabinets or to three UHF amplifier assemblies mounted at the bottom of the cabinet for 1.8 or 3.7 kW amplifier cabinets.

(Refer to Figure 3-6) Two input AC connections of 480 VAC, 3 phase or 208 VAC 3 phase and one 110 VAC input connection are needed to operate each UHF Amplifier Cabinet. The 110 VAC input connects to the (A1-A2) Terminal Block #3 mounted at the top left side, at the rear of the cabinet. The 110 VAC is wired directly to a terminal block TB1 located in the AC power distribution panel mounted at the bottom of the cabinet. One of the 480/208 VAC, 3 phase inputs connects to the (A1-A1) Terminal Block #1 and the other to the (A2) Terminal Block #2 mounted top left side, at the rear of the cabinet. The two 480/208 VAC inputs are wired directly to each of the circuit breakers located in the AC power distribution panel mounted at the bottom of the cabinet. The AC input voltages to the two power supplies are controlled through the two 480 VAC 30 Amp or 208 VAC 50 Amp 3 Phase circuit breakers located on the (A3) AC power distribution panel. The left front circuit breaker controls the voltage to power supply #1 and the right front circuit breaker controls the voltage to power supply #2.

The two +32 VDC power supplies, (A8) #1 and (A9) #2, are identical with each

containing a SCR Controller, a transformer and a linear power supply.

3.5.2: SCR Controllers

The two SCR controllers, (A4) SCR Controller #1 and (A5) SCR Controller #2, Model #3629C, are manufactured by Control Concepts, Inc. The SCR controller is of a phase angle, pulse width, control design. The output power is regulated by varying the point at which the SCR is turned on within each half cycle. **NOTE:** More detailed information is supplied in the manufacturer instruction manual that is supplied with the SCR Controller.

3.5.3: Step Down Transformers

The outputs of the two SCR controllers connect to one of the two three phase 480/208 VAC step down transformers. The (A6) Transformer #1 or (A7) Transformer #2, whose input connections are set at the factory depending on the input voltage provided and supplies three outputs that connect directly to the input of the linear power supply assemblies.

3.5.4: Linear Power Supply Assemblies (1306333 Top, 1306334 Bottom; Appendix C)

(Refer to Figures 3-7 & 3-8) Both of the Power Supply Assemblies, Top #1 and Bottom #2, are identical, electrically, in operation, the only differences are in the physical assembly itself.

The three stepped down outputs of the transformer, approximately 100 VAC, connect to one of the three Rectifier Modules. The rectifier modules are full wave rectifiers that each produce +32 VDC that are summed in parallel at the Bus Bars A and B. The +32 VDC outputs are filtered by the eight A4-A11 220,000µF capacitors. Capacitors A4-A7 through Bus Bar C are for Amps #1 and #2 and capacitors A8-A11 through Bus Bar E are for Amps #3 and 4.

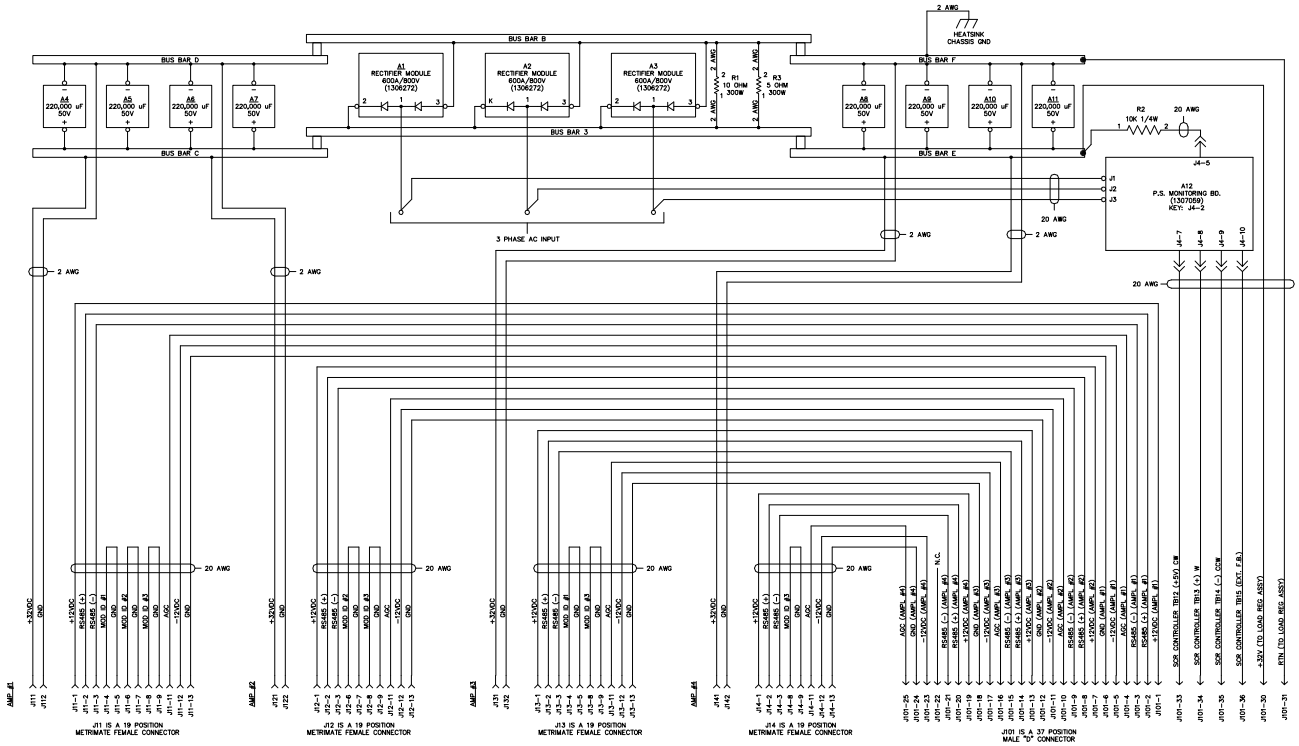


Figure 3-7: Linear Power Supply #1, Top

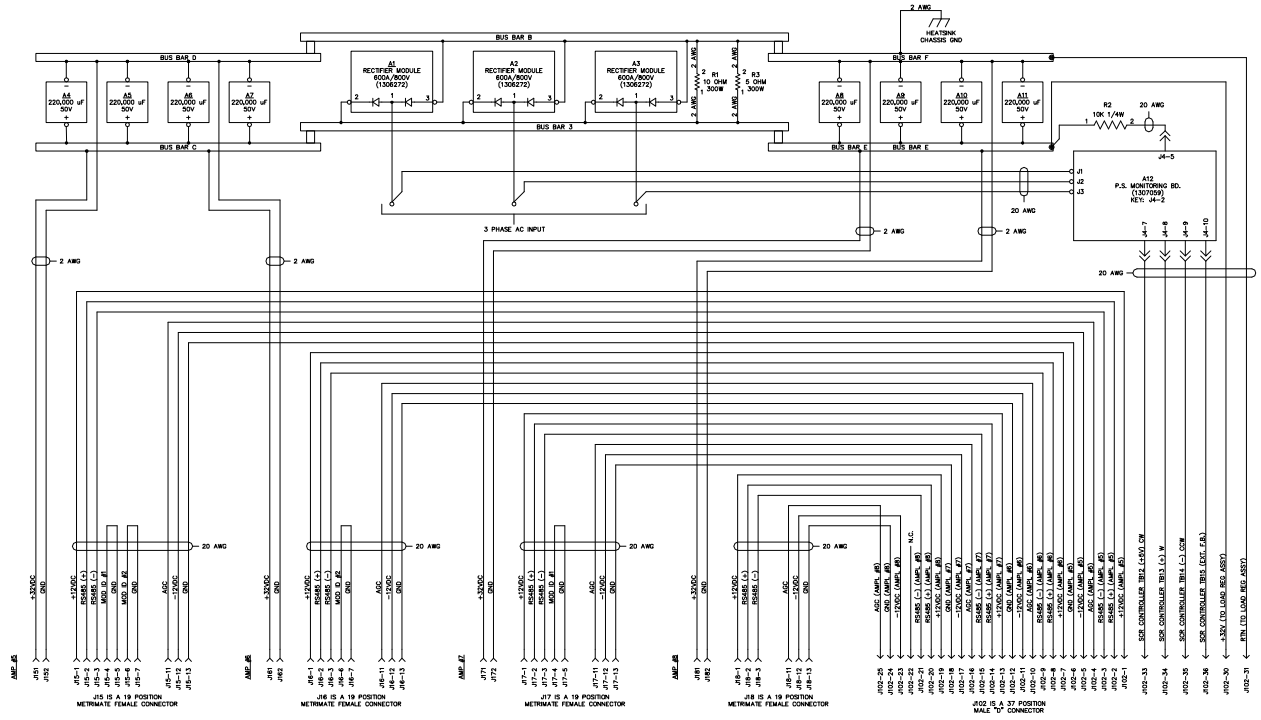


Figure 3-8: Linear Power Supply #2, Bottom

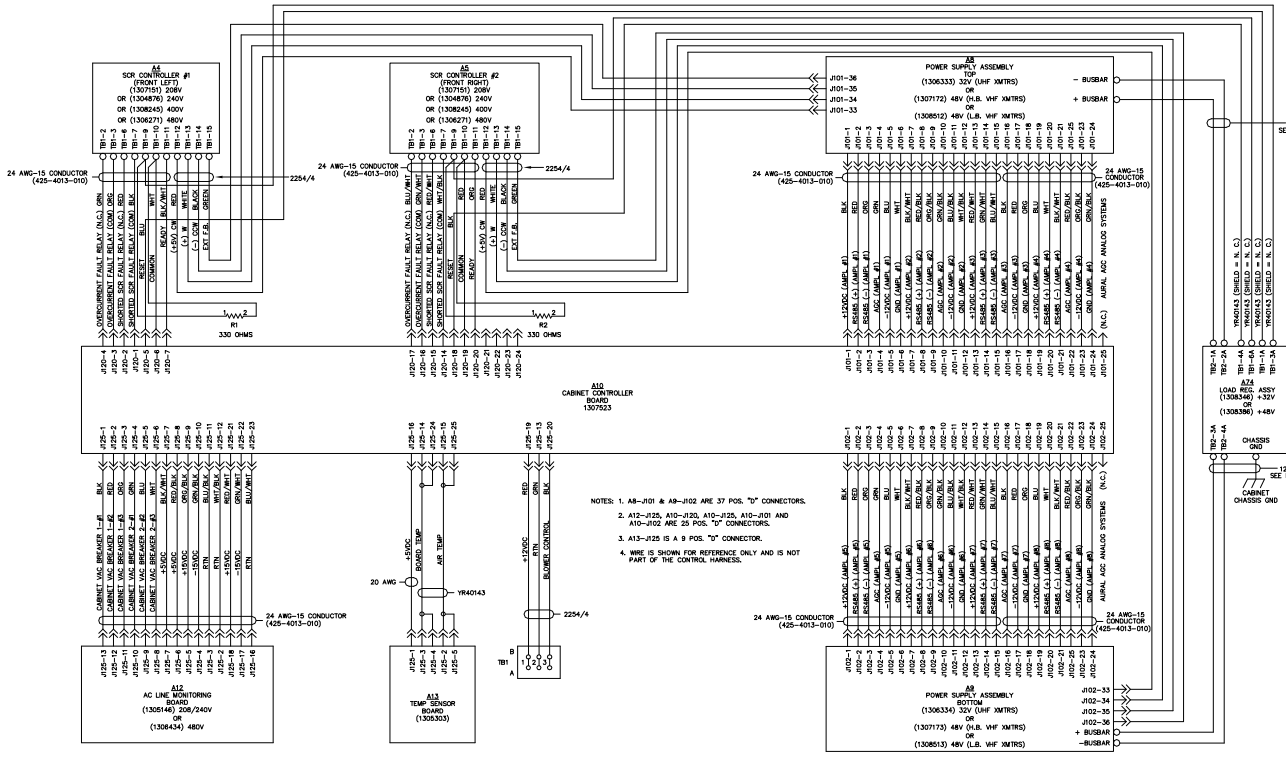


Figure 3-9: Control Interconnect Cabinet Full Controller System

3.6: Full Amplifier Cabinet Controller Board (1307523; Appendix A)

Your amplifier cabinet will contain the full amplifier cabinet controller assembly or the half amplifier cabinet controller assembly. The half amplifier cabinet controller assembly is described in the next section.

The full amplifier cabinet controller board is mounted in the Full Amplifier Cabinet Controller Assembly (1305453). The assembly is located facing the back of the cabinet mounted on the rear of the top combiner assembly and controls the entire amplifier cabinet.

3.6.1: Page 1 of the Schematic Drawing (1307524; Appendix A):

Centered in page one is the microcontroller (U6). This in-circuit programmable Atmel microcontroller is operated at 3.6864 MHz. Programming of this device is performed through J105. PF2 is an analog input that connects to a multiplexer U9 and PF3 is another analog input that connects to the multiplexer U5. The desired multiplexer analog channels are selected by the setting of PA0, PA1, & PA2. PF0 and PF1 are used to monitor the +12V and -12V supplies to the board.

(U12) is a watchdog IC that is used to hold the microcontroller in reset if the supply voltage is less than 4.21 VDC; (1.25 VDC < Pin 4 (IN) < Pin 2 (Vcc)). U12 will momentarily reset the microcontroller if Pin 6 is not clocked every second.

The (U6) Microcontroller UART 0 is used to communicate with each of the amplifier modules, Cabinet Serial. U10 is a RS-485 transceiver IC for cabinet serial communication to the amplifier modules.

The (U6) Microcontroller UART 1 is used to communicate with the transmitter's exciter or exciter switcher, System Serial. U8 is a RS-485 transceiver IC.

The IC U2, Serial Address, located in the Upper left corner, is used to determine where the amplifier control board is located. Rotary switch SW1 determines the cabinet number and thus the cabinet's serial address. The upper three bits of U2 can be used to determine physical board characteristics. Bit 6 will be reserved for a half cabinet controller to determine if the controller is the top half controller or the bottom half controller.

The IC U3, SCR Controllers, below U2, is used to monitor the status of the SCR controllers. U7 below U3 is connected to an 8 position DIP switch, SW2, which can be used to enable select firmware options. See Table 3-7.

U11, below U7, is used to control the SRC controller, the cabinet's cooling blower FET, and the Processor Operating LED, DS2. The use of this IC allows these circuits to remain stable during a microcontroller reset.

3.6.2: Page 2 of the Schematic Drawing (1307524; Appendix A):

In the upper left section of Page 2 are circuits that interface with the exhaust air temperature board and the low power $\pm$15VDC switching supply. Control of an external cooling blower relay is available through J125 pin 20. When the cabinet's RF output is enabled, the external blower relay is energized by the enabling of Q3 on page 1.

Voltage samples of the cabinet's high power AC inputs are monitored through inputs of J125.

On the upper right side of the schematic, the Power Supply SCR Controller interface section routes signals need to control the high power supply. R120, R121, R122, and R123 are used to set the output voltage of the high power supply.

Amplifier module interfaces are routed through J101, for modules 1-4, and

J102, for modules 5-8. Each amplifier module has independent RS-485 transceivers and power sources that are current limited with self-resetting fuses.

The RS485 interface section, located in the lower right section of the schematic, defines the RS-485 loop through connections that also contain the system's AGC signals. Circuitry in the lower portion of this block is used to convert cabinet AGC voltages into system AGC voltages. If the cabinet level voltages are greater than the system levels, U13 increases its output to drive the system level to match the cabinet level. Cabinet AGC levels are set by the highest AGC voltage of the install amplifier modules.

3.6.3: Page 3 of the Schematic Drawing (1307524; Appendix A):

In the upper left portion of the schematic, R125 is used to measure the cabinet's inlet air temperature. Also defined on this page are the board's voltage regulators. The cabinet's +15V supply is used by U14 and U17 to generate +12V for all of the amplifier modules. The cabinet's -15V supply is used by U19 to generate -12V for all of the amplifier modules. The +12V signal is further regulated by U16 to +7 VDC then regulated again to separate digital +5V by U18 and analog +5V by U15. The digital +5V regulator U18 is not as precise as the analog +5V regulator U15 but it is capable of high current loads.

3.6.4: Page 4 of the Schematic Drawing (1307524; Appendix A):

These circuits take the forward and reflected RF power samples and converts the signals to DC values used to provide power levels for the cabinet monitoring. The RF detection circuits are made up of diodes and separate op-amps. Once the detected voltages are amplified, the signals are fed through power calibration potentiometers, R110, R11, R112, R113 or R114, before they are fed through unity gain amplifiers, U20, U23A, U23B, U24A or U24B to the microcontroller's multiplexer.

3.6.5: Page 5 of the Schematic Drawing (1307524; Appendix A):

These eight circuits are individual RS-485 transceiver ICs for serial communication with the amplifier modules. The RS-485 transceiver ICs contain components that maintain the receive channel in a high output state when the inputs are left open, shorted together or terminated with no signal. The transmit and receive channels of each transceiver are individually controlled by the microcontroller. During reset or programming of the microcontroller, pull-up and pull-down resistors are used to place the transceivers in a tri-state condition. Each amplifier RS-485 connection is terminated with a 120 ohm resistor.

Table 3-7: Firmware Configuration of SW2 on Full Amplifier Cabinet Controller Board

Switch Number	**Function**	**Position**	**Normal Operating Position**
SW2-1	Reserved for Factory Test	0 = Off 1 = On	Off - Must be Off
SW2-2	Allow Power Supply Enable on Cooling FLT	0 = Off 1 = Allow	Off - Must be Off
SW2-3	Allow Power Supply Enable on RFL PWR FLT	0 = Off 1 = Allow	Off
SW2-4	High Voltage Supply Range	0 = 220 1 = 440	System dependent

Switch Number	Function	Position	Normal Operating Position
SW2-5	Reflected Power RF Source	0 = J112 1 = J114 (If not Externally Diplexed)	System dependent
SW2-6	Allow Power Supply Enable on Reject Load Faults	0 = Off 1 = Allow	Off
SW2-7	Reserved for Factory Test	0 = Off 1 = On	Off - Must be Off
SW2-8	Reserved for Factory Test	0 = Off 1 = On	Off - Must be Off

NOTE: These switch positions are factory set and should not be changed.

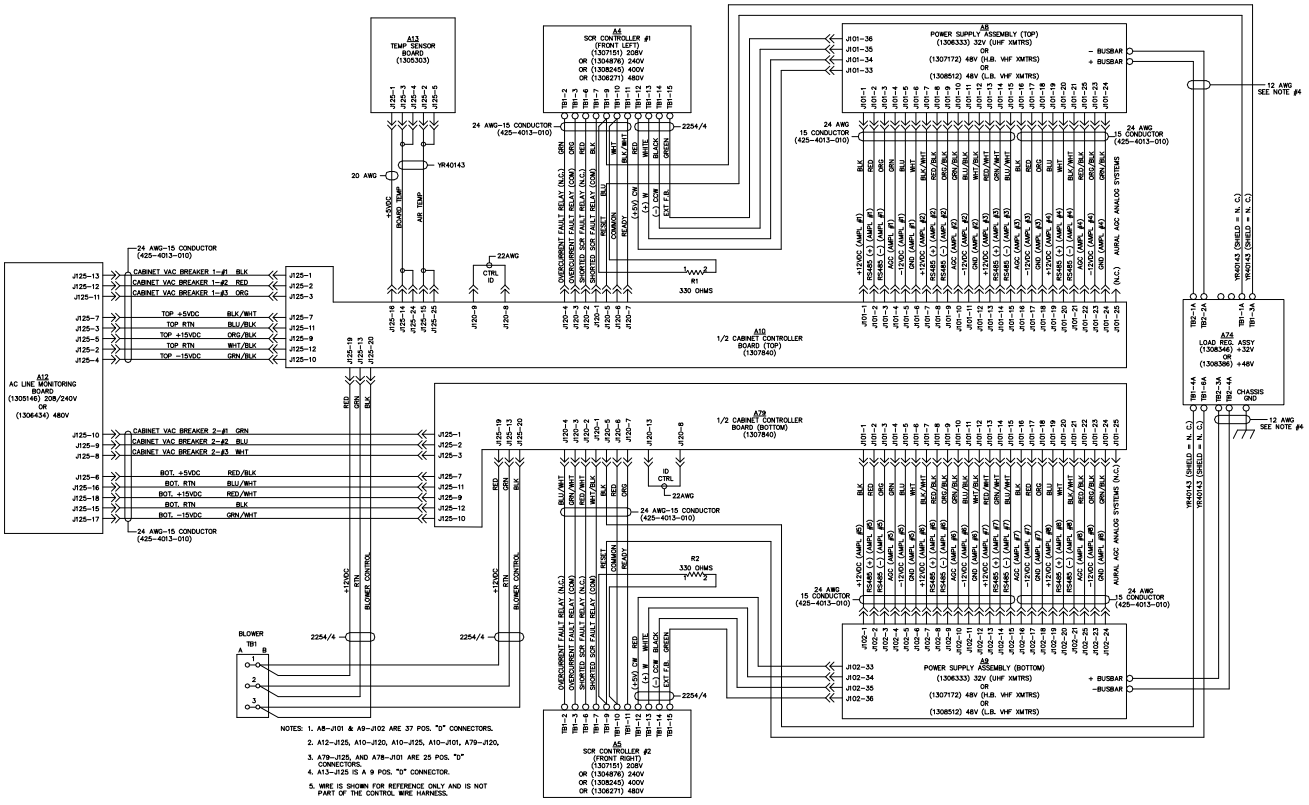


Figure 3-10: Control Interconnect Cabinet Half Controller System

3.7: Half Amplifier Cabinet Controller Board (1307840; Appendix A)

The half amplifier cabinet controller board is mounted in the Half Amplifier Cabinet Controller Assembly (1307847). There are typically two assemblies, which are mounted facing the rear of the cabinet. One controller is mounted on the rear of the top combiner assembly, which controls the top power supply and amplifier module assemblies and one mounted on the rear of the bottom combiner assembly which controls the bottom power supply and amplifier module assemblies.

3.7.1: Page 1 of the Schematic Drawing (1307841; Appendix A):

Centered in page one is the microcontroller (U6). This in-circuit programmable Atmel microcontroller is operated at 3.6864 MHz. Programming of this device is performed through J105. PF2 is an analog input that connects to a multiplexer U9. PF3 is another analog input that connects to the multiplexer U5. The desired multiplexer analog channels are selected by the setting of PA0, PA1, & PA2. PF0 and PF1 are used to monitor the +12V and -12V supplies to the board.

(U12) is a watchdog IC that is used to hold the microcontroller in reset if the supply voltage is less than 4.21 VDC; (1.25 VDC < Pin 4 (IN) < Pin 2 (Vcc)). U12 will momentarily reset the microcontroller if Pin 6 is not clocked every second.

The Microcontroller UART 0 is used to communicate with each of the amplifier modules, Cabinet Serial. U10 is a RS-485 transceiver IC for cabinet serial communication to the amplifier modules.

The Microcontroller UART 1 is used to communicate with the transmitter's exciter or exciter switcher, System Serial. U8 is a RS-485 transceiver IC. The IC U2, Serial Address, located in the Upper left corner, is used to determine where the amplifier control board is located. Rotary switch SW1 determines the cabinet number and thus the cabinet's serial address. The upper three bits of U2 can be used to determine physical board characteristics.

The IC U3, SCR Controllers, is located below U2. U3 is used to monitor the status of the SCR controllers. U7 below U3 is connected to an 8 position DIP switch, SW2, which can be used to enable select firmware options. See Table 3-7.

U11, below U7, is used to control the SRC controller, the cabinet's cooling blower FET, and the Processor Operating LED, DS2. The use of this IC allows these circuits to remain stable during a microcontroller reset.

3.7.2: Page 2 of the Schematic Drawing (1307841; Appendix A):

In the upper left section of Page 2 are circuits that interface with the exhaust air temperature board and the low power $\pm$15VDC switching supply. Control of an external cooling blower relay is available through J125 pin 20. When the cabinet's RF output is enabled, the external blower relay is energized by the enabling of Q3 on page 1.

Voltage samples of the cabinet's high power AC inputs are also monitored through inputs of J125.

Power Supply SCR Controller interfaces are documented in the upper right side of the schematic. This section routes signals need to control and monitor one of the high power supply SCR controllers. Supply voltage and reject load monitoring signals are also routed through J120.

The four amplifier module interfaces are routed through J101. Each amplifier module has independent RS-485 transceivers and power sources, that are current limited with self-resetting fuses.

The RS485 interface section, located in the lower right section of the schematic, defines the RS-485 loop through connections and contains the system's AGC signals. Circuitry in the lower portion of this block is used to convert cabinet AGC voltages into system AGC voltages. If the cabinet level voltages are greater than the system levels, U13 increases its output to drive the system level to match the cabinet level. Cabinet AGC levels are set by the highest AGC voltage of the installed amplifier modules.

3.7.3: Page 3 of the Schematic Drawing (1307841; Appendix A):

In the upper left portion of the schematic, R125 is used to measure the cabinet's inlet air temperature. Also defined on this page are the board's voltage regulators. The cabinet's +15V supply is used by U14 to generate +12V for all of the amplifier modules. The cabinet's -15V supply is used by U19 to generate -12V for all of the amplifier modules. The +12V signal is further regulated by U16 to +7 VDC then regulated again to separate digital +5V by U18 and analog +5V by U15. The digital +5V regulator U18 is not as precise as the analog +5V regulator U15 but it is capable of high current loads.

3.7.4: Page 4 of the Schematic Drawing (1307841; Appendix A):

These circuits take the forward and reflected RF power samples and converts the signals to DC values used to provide power levels for the cabinet monitoring. The RF detection circuits are made up of diodes and separate op-amps. Once the detected voltages are amplified, the signals are fed through power calibration potentiometers, R110, R11, R112, R113 or R114, before they are fed through unity gain amplifiers, U20, U23A, U23B, U24A or U24B to the microcontroller's multiplexer.

3.7.5: Page 5 of the Schematic Drawing (1307841; Appendix A):

These four circuits are individual RS-485 transceiver Ics for serial communication with the amplifier modules. The RS-485 transceiver ICs contain components that maintain the receive channel in a high output state when the inputs are left open, shorted together or terminated with no signal. The transmit and receive channels of each transceiver are individually controlled by the microcontroller. During reset or programming of the microcontroller, pull-up and pull-down resistors are used to place the transceivers in a tri-state condition. Each amplifier RS-485 connection is terminated with a 120? resistor.

Table 3-8: Firmware Configuration of SW2 on Half Amplifier Cabinet Controller Board

Switch Number	Function	Position	Normal Operating Position
SW2-1	Reserved for Factory Test	0 = Off 1 = On	Off - Must be Off
SW2-2	Allow Power Supply Enable on Cooling FLT	0 = Off 1 = Allow	Off - Must be Off
SW2-3	Allow Power Supply Enable on RFL PWR FLT	0 = Off 1 = Allow	Off
SW2-4	High Voltage Supply Range	0 = 220 1 = 440	System dependent
SW2-5	Reflected Power RF Source	0 = J112 1 = J114 (If not Externally Diplexed)	System dependent
SW2-6	Allow Power Supply Enable on Reject Load Faults	0 = Off 1 = Allow	Off
SW2-7	Reserved for Factory Test	0 = Off 1 = On	Off - Must be Off
SW2-8	Reserved for Factory Test	0 = Off 1 = On	Off - Must be Off

NOTE: These switch positions are factory set and should not be changed.

3.8: Temperature Sensor Board (1309460; Appendix A)

The temperature sensor board is mounted at the top of the amplifier cabinet in the airflow path inside the exhaust plenum. The board monitors the temperature of the exhausted air and reports it to the cabinet controller board.

3.9: Reflected Metering Board (1306988; Appendix A)

The reflected metering board is part of the metering module assembly mounted on the rear middle, left side of the amplifier cabinet. The board monitors the reflected power samples of up to four circulators of the output combiner assembly. Two reflected metering boards are needed when two output combiners are in the amplifier cabinet. The board sends the reject levels to the cabinet controller board.

3.10: Serial Loop-Thru Board (1307811; Appendix A)

The serial loop-thru board is mounted on the metering module assembly located on the rear middle, left side of the amplifier cabinet.

The function of the serial loop-thru board is to provide an extra serial loop-thru that connects to the second amplifier cabinet. This prevents the system controller from not recognizing any amplifier cabinets if one system controller is removed.

NOTE: In a multiple amplifier cabinet system, there will not be a serial loop-thru board in the last amplifier cabinet in the system.

3.11: Load Regulator Assembly, +32 VDC (1308346; Appendix A)

The load regulator assembly contains a load regulator board, +32 VDC. The Load Regulator Assembly (A74) is designed to temporarily activate and maintain a constant load on the output of the power supply assembly due to

load changes, which can cause the DC output from the power supplies to rise. There are four versions of this assembly. They are:

Load Regulator Assembly, Single Power Supply, +32V, UHF Transmitters, (1308396).
Load Regulator Assembly, Dual Power Supplies, +32V, UHF Transmitters, (1308346)
Load Regulator Assembly, Single Power Supply, +48V, VHF Transmitters, (1308397)
Load Regulator Assembly, Dual Power Supplies, +48V, VHF Transmitters, (1308386)

The Load Regulator Assembly monitors the DC output from the power supply and adds in additional load resistance if the power supply DC voltage rises above a given threshold level. The threshold level is factory pre-set on the Load Regulator Board.

3.11.1: Load Regulator Board, +32 VDC (1308279; Appendix A)

The load regulator board is mounted in the load regulator assembly.

There are two versions of the Load Regulator Board:

Load Regulator Board, +32V (1308279)
Load Regulator Board, +48V (1308393)

The Load Regulator Board receives a sample of the DC voltage from the power supply. The power supply voltage is then regulated down to a lower voltage by varistors, VR1-VR5 and VR6-VR10 and powers two +12V regulators, U1 and U2. U1 and U2 supply +12VDC to power the rest of the board.

The trip thresholds are adjusted by R16 and R35. The thresholds are set as follows:

For +32V power supplies, the threshold is set to +32.5 VDC.
For +48V power supplies, the threshold is set to +50.0 VDC.

When the power supply voltage exceeds the above levels the FET switches Q3 and Q6 are biased on and provide a contact closure. This contact closure adds in additional load resistance across the DC output of the power supply. Once the DC voltage returns to normal, the FET switches are biased off and the switches open, thereby removing the additional load resistance.

There are thermal switches mounted on the FETS (S1 and S2) and power resistors (S3 and S4) that will shut down the associated power supply should an over temperature fault occur.

This completes the description of the UHF Amplifier Assembly and Cabinet Assemblies.

Appendix A

RF Amplifier Cabinet Assembly,
HX Series
Drawings

Appendix A
Drawing List

UHF Amplifier Cabinet, HX Series, UHF, 208VAC, Two Power Supplies (Maximum of 5 kW Digital Output)

UHF Amplifier Cabinet Block Diagram 1306714
RF Signal Interconnect 1306574
Control Interconnect 1306573
AC Interconnect 1307335
Metering Interface, 8 Way Combiner w/Circulators Interconnect 1307042

AC Line Monitoring Board, HX Series, 208/240V (Used the Power Distribution Panel 1306667)
Schematic 1305147

Temperature Sensor Board, HX Series
Schematic 1305304

Power Distribution Panel, UHF Amplifier Cabinet, HX Series, 208VAC/240VAC, (Used with Two Power Supplies in 5 kW Amplifiers
(Contains an AC Line Monitoring Board, HX Series, 208/240V (1305146).
Interconnect 1306681

Reflected Metering Board (Mounted in a UHF Metering Assembly (1307034)
Schematic 1306989

8 Way UHF Combiner w/Circulators, CH: 14-26 (Used in 5 kW Amplifier Cabinets)
Interconnect 1307020

8 Way UHF Combiner w/Circulators, CH: 26-44 (Used in 5 kW Amplifier Cabinets)
Interconnect 1307066

8 Way UHF Combiner w/Circulators, CH: 44-69 (Used in 5 kW Amplifier Cabinets)
Interconnect 1307067

Full Amplifier Cabinet Controller Board, HX Series (Mounted in the Full Amplifier Cabinet Controller Assembly, 1305453)
Schematic 1307524

Serial Loop-Thru Board
Schematic 1307812

Half Amplifier Cabinet Controller Board, HX Series (Mounted in the Half Amplifier Cabinet Controller Assembly, HX Series, 1307847)
Schematic 1307841

Load Regulator Board, +32VDC (Mounted in the Load Regulator Assembly, 1308346)
Schematic 1308280

Load Regulator Assembly, +32VDC (Contains a Load Regulator Board, 1308279)
Interconnect 1308391

Appendix B

UHF Amplifier Assembly, HX Series Drawings

Appendix B
Drawing List

UHF Amplifier Module Assembly, HX Series (Maximum of Eight used in each Amplifier Cabinet)

Block Diagram 1306712
Interconnect 1306504

RF Module Pallet w/o Transistors (Made into a RF Module Pallet, Philips 1300116)
Schematic ..... 51-5379-309-00 WSP

UHF Low Band Pallet Board Assembly, HX Series (Four used in each Amplifier Assembly)
Schematic 1306344

4 Way Splitter Assembly, UHF
Schematic 1306372

4 Way Combiner Assembly, UHF
Schematic 1306397

FET Switch/Metering Board, UHF, HX Series
Schematic 1306498

Coupler Board, UHF Amplifier
Schematic 1306640

40W UHF Module, HX Series
Schematic 1306663

UHF High Band Dual Stage Pallet Assembly, HX Series
Four used in each Amplifier Assembly
Schematic 1306690

Amplifier Control Board, UHF, HX Series
Schematic 1306831

4 Way Combiner Assembly, UHF
Schematic 1306891

UHF High Band Dual Stage Pallet Assembly, HX Series
Four used in each Amplifier Assembly
Schematic 1306690

Appendix C

Power Supply Assemblies, Top and Bottom, HX Series, +32V Drawings

Appendix C
Drawing List

Power Supply Assembly, Top, HX Series, +32V O/P (Used in the 5 kW Amplifier Cabinet)

Interconnect 1306331

Power Supply Assembly, Bottom, HX Series, +32V O/P (Used in Both the 2.5kW and 5kW Amplifier Cabinets)

Interconnect 1306332

Power Supply Monitoring Board, HX Series (One mounted in each Power Supply Assembly, Top and Bottom

Schematic 1307060