

uniden®

ARX 1200/1200A/1600

ARX 1500

Milcom International Model: P15-05L1-C1 FCC ID: E675JS0016

935 MHz 13.8 VDC 500 mW In 150 W out

800MHZ POWER AMPLIFIER

uniden®

UNIDEN AMERICA CORPORATION
Commercial Communications Division
4700 Amon Carter Blvd.
Fort Worth, TX 76155
(817) 858-3300
CC SM 56

SERVICE MANUAL

SAFETY INFORMATION

Through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), the United States Department of Labor has established a safety standard which applies to the use of two-way equipment. The proper use of this transceiver will result in exposure below the OSHA limit.

The following precautions are recommended:

WARNING

DO NOT operate the transmitter of a transceiver when someone is within two feet of the antenna.

DO NOT operate the transmitter of any radio equipment unless all the RF connectors are secure and any open connectors are properly terminated.

DO NOT operate this transceiver near electrical blasting caps or in an explosive atmosphere.

DO NOT let children operate any transmitter-equipped radio equipment.

Have your radio equipment serviced by a qualified technician.

ALL radio equipment **MUST** be properly grounded.

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ARX 1200/1200A/1600

SPECIFICATIONS

This equipment meets or exceeds the following:

General

ARX 1200/1200A

ARX 1600

Size	19 in. W x 10.5 in. H x 9 in. D	19 in. W x 10.5 in. H x 9 in. D
Weight	20 lbs.	20 lbs.
Duty Cycle	100%	100%
Power Source	13.6 VDC	13.6 VDC
Current (max)	18 Amps	30 Amps
Recommended AC Power Supply	ARX 310	ARX 310
Operating Temperature Range	-20°C to +50°C	-20°C to +50°C
Cooling (carrier controlled)	Forced Air	Forced Air

Electrical

Output Power	120 W (adjustable)	80 – 150 W (adjustable)
Input Power	15 W (ARX 1200) 200 – 400 mW (ARX 1200A)	200 – 400 mW
Operating Frequency Range	870 – 950 MHz	870 – 950 MHz
Input Impedance	50 Ω	50 Ω
Output Impedance	50 Ω	50 Ω
Final Stages	2	4
VSWR Protection	100%	100%
Harmonic & Spurious Emissions	-80 dB	-80 dB

Specifications subject to change without notice.

INTRODUCTION

Scope of Manual

This service manual is intended for use by experienced technicians familiar with similar types of equipment. The manual contains all service information required for the equipment described and is current as of the printing date. Changes that occur after the printing date are incorporated by Service Manual Revisions. The revisions are added to the manual as engineering changes are incorporated into the equipment.

Licensing

Before using your amplifier, it must be properly licensed by the Federal Communications Commission (FCC) and properly installed. Your Uniden Dealer will be able to help you with any or all of these requirements and will be there to help you with all your future communications needs.

Technical Support

Milcom International, Inc., will be glad to assist you with any technical questions regarding this product as well as helping resolve any failures or warranty claims. Please identify the product by model and serial number and state that it was purchased from Uniden as part of your **F.A.S.T.**TM System. If you need further assistance, please contact Uniden **FAST Backer**TM Support Services by calling the **FAST Backer**TM **HOT LINE: 1-817-858-3304**, or writing to:

UNIDEN AMERICA CORPORATION
Commercial Communications Division
Technical Support
4700 Amon Carter Boulevard
Fort Worth, Texas 76155

Or by telephone:
1-800-445-5017 (outside Texas)
1-800-621-8527 (Texas only)
1-817-858-3304 (**FAST Backer**TM
HOT LINE)

Replacement Parts

Replacement parts are available through Milcom International, Inc. When ordering replacement parts, please use the complete identification number of the part. If the identification number is not known, the order should contain the Part Symbol Number, the Unit Model Number, and a description of the part so that the part may be properly identified. Parts orders may be placed by writing to:

Milcom International, Inc.
10891 Capital Avenue
Garden Grove, California 92643-4953

or by telephone: 1-714-554-1710

Ordering Additional Manuals

To order additional copies of this Service Manual, send order for CC SM 56 to:

UNIDEN AMERICA CORPORATION
Commercial Communications Division
Repair/Parts Department
4700 Amon Carter Boulevard
Fort Worth, Texas 76155

or by telephone: 1-817-858-3638

In Canada, write to:

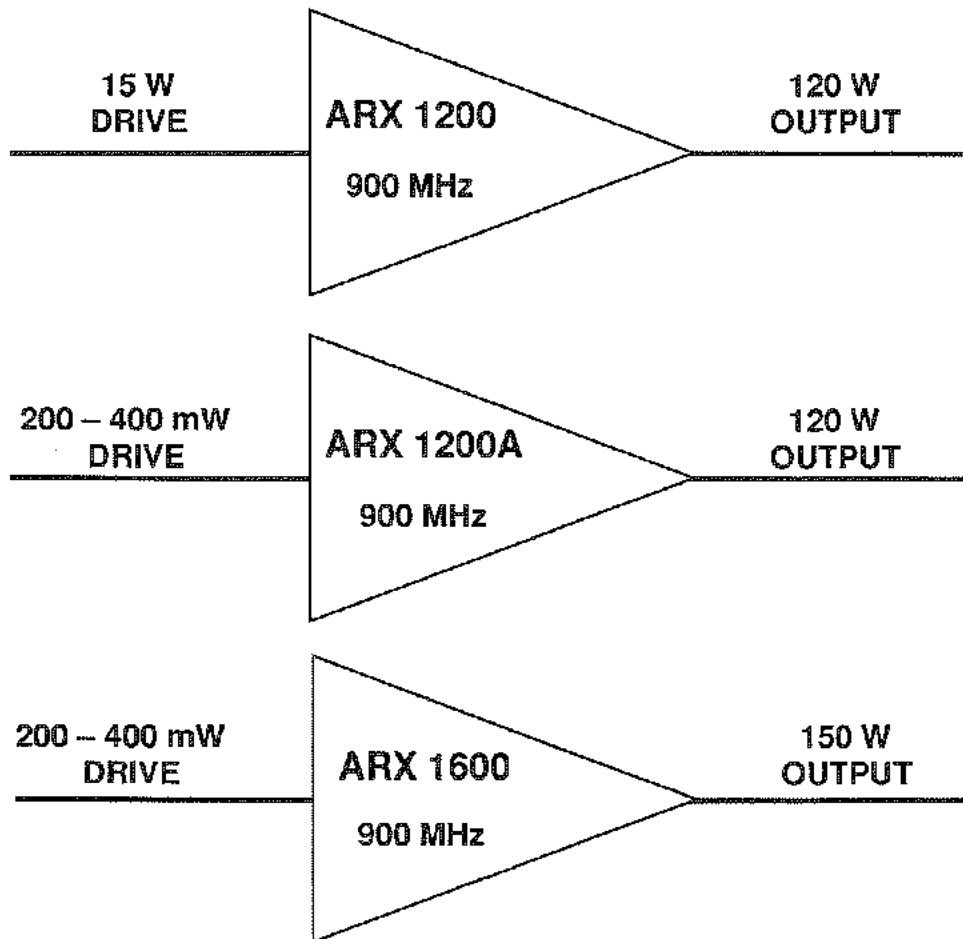
UNIDEN CANADA, INCORPORATED
11 Plateau Street
Pointe Claire, (Montreal) Quebec
Canada H9R 9Z7

or by telephone: 1-514-697-6920
or by FAX: 1-514-697-7700

OVERVIEW

The ARX 1200/1200A and ARX 1600 Power Amplifiers are designed for use with communications equipment operating in the UHF band of 935 to 941 MHz.

These power amplifiers utilize a combination of advanced technologies such as ferrite transformers, microstrip matching and quadrature combiners to provide broadband performance and high reliability.



INSTALLATION INSTRUCTIONS

1. Mount the power amplifier to a rack (such as an ARX 440) or cabinet . The power amplifier dimensions are:

Height: 10.5 in.

Width: 19 in.

Depth: 6 in.

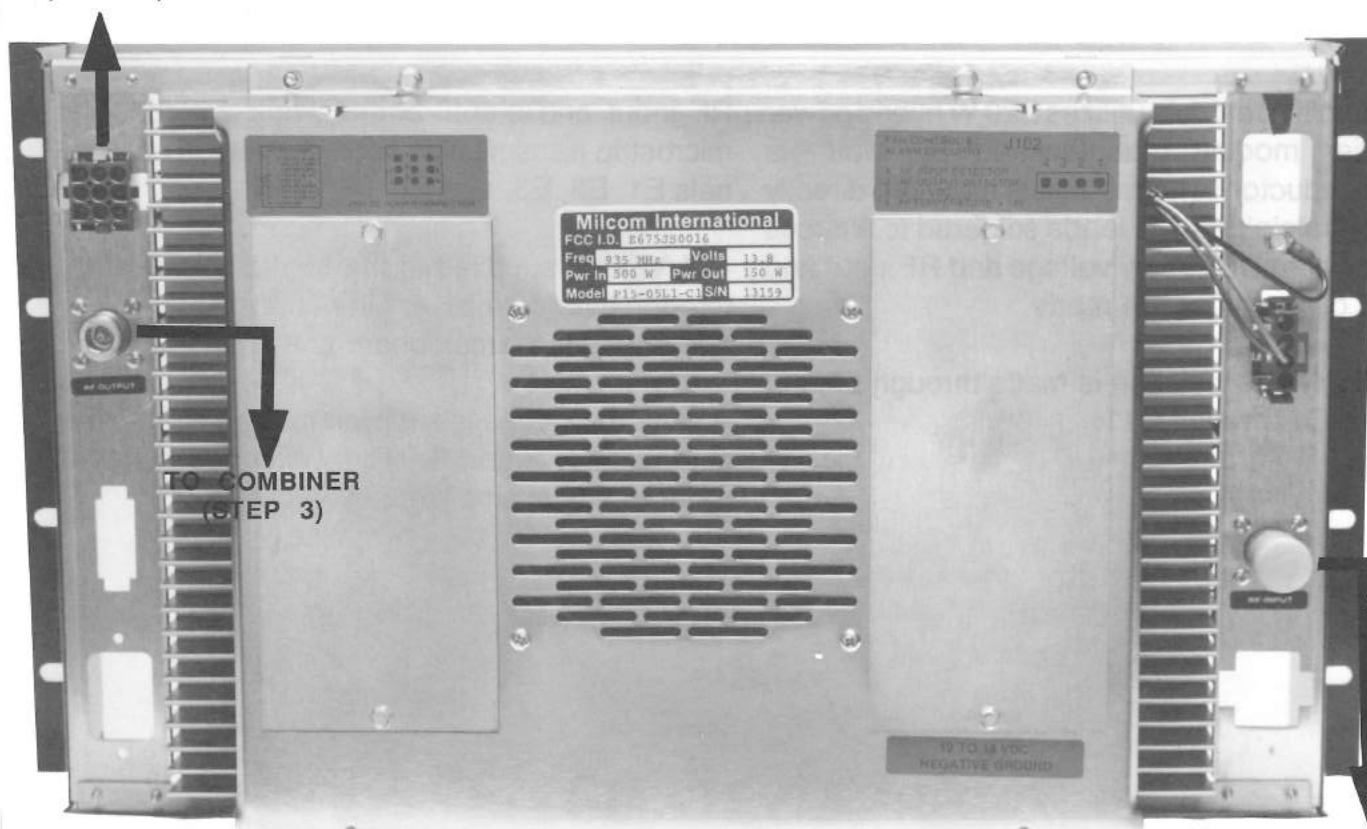
2. Secure the power amplifier to the rack or cabinet using eight (8) #12-24 screws.

3. Connect the cable from the combiner to the RF Output of the power amplifier.

4. Connect the cable from the TX output of the repeater to the RF Input of the power amplifier.

5. Connect the ARX 310 DC Switching Power Supply to the power amplifier. The DC connection is located on the back of the power amplifier at the upper, left hand corner.

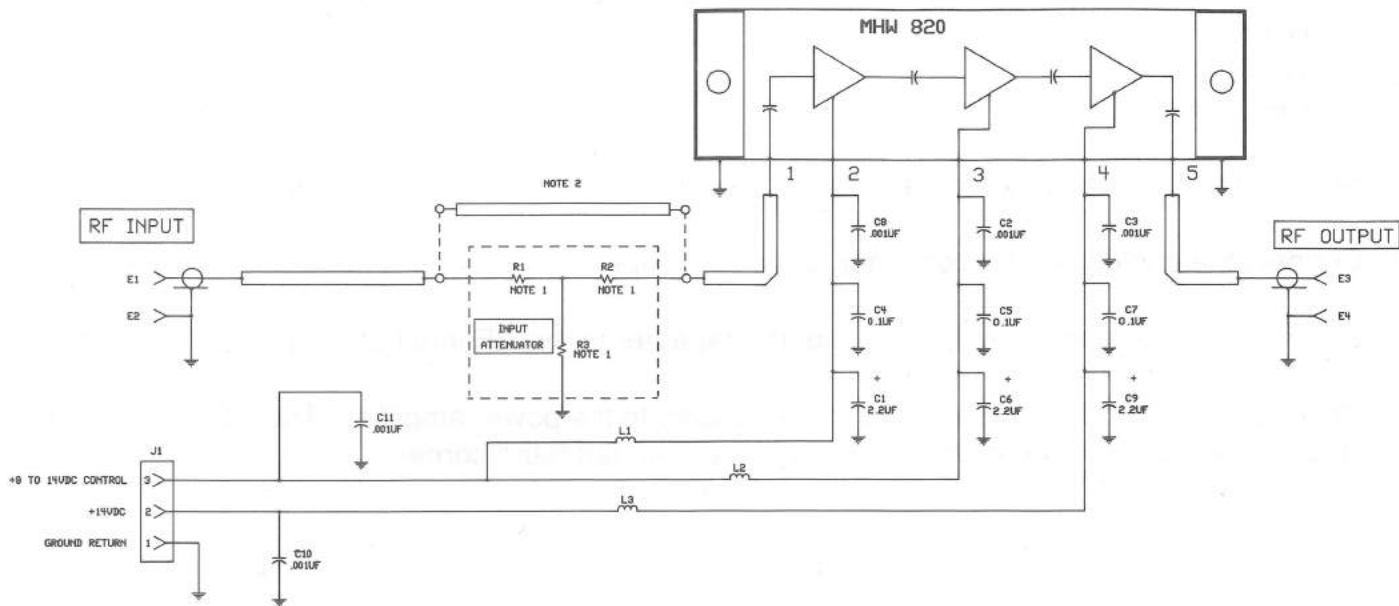
TO ARX 310
DC SWITCH
POWER SUPPLY
(STEP 5)



TO TX OUTPUT
OF REPEATER
(STEP 4)

THEORY OF OPERATION

Hybrid Power Amplifier Module (ARX 1200A and ARX 1600 only)



NOTES:

1. R1, R2 AND R3 FORM A FACTORY SELECTED ATTENUATOR FOR INPUT POWER LEVELS ABOVE 500 MW. ATTENUATOR REDUCES POWER INPUT TO THE HYBRID TO 350 MW.
2. FOR POWER INPUT LEVELS BELOW 500 MW THE ATTENUATOR IS BYPASSED.

This amplifier module utilizes a 20 W hybrid power amplifier module manufactured by Motorola Semiconductor. The module is mounted directly to the heatsink with its leads soldered to a circuit board where DC supply voltage and RF input and output connections are made.

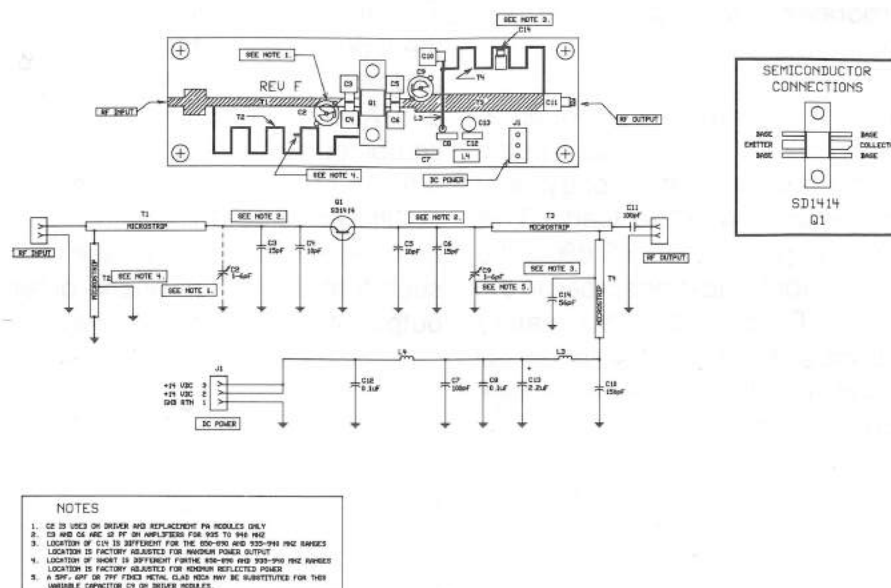
DC supply line isolation is made through L1, L2, L3, and C1 through C11.

RF input and output connections are made to microstrip transmission lines connected at terminals E1, E2, E3, and E4.

+14 VDC is supplied to the final amplifier stage through hybrid amplifier pin number 4. This voltage enters the circuit board at J1 (pin 2).

A variable voltage is supplied to the pre-amplifier pins number 2 and 3. This voltage is varied in order to adjust amplifier power output.

Common Base Amplifier



This module is common to all 14 V, 900 MHz RF power amplifiers and is used as a driver and final amplifier. The driver module and replacement final amplifier modules include a variable capacitor C15 on the base for minimizing the input VSWR.

DC voltage is supplied to the collector through tuning stub T4. The exact length of this tuning stub is adjusted by changing the location of C14. L3 and L4, along with C12, C7, C8, C13, and C10, decouple the DC supply line from the collector matching circuitry. Capacitor C11 is a DC blocking capacitor.

The collector load impedance is matched to 50 Ω through metal clad mica capacitor C5 and C6, air variable capacitor C9, microstrip transmission line T3, and microstrip matching stub T4. These microstrip transmission lines are printed on Teflon glass circuit boards.

The emitter is matched to 50 Ω through metal clad mica capacitors C3 and C4, microstrip transmission line transformer T1, and microstrip stub T2. The DC return path to the emitter is through T1 and T2.

The circuit board utilizes plated through holes for ground return and low inductance base contacts. Ground connections to the combiner and splitter are made through mechanical contact with the aluminum spacer plates. This method has proven to be highly reliable while at the same time simplifying manufacturing and field replacement. DC contact is made through two pins on J1.

Because component placement is critical to 800 MHz, these amplifier modules are manufactured on an assembly fixture to assure correct component placement and uniformity. THEREFORE, WE DO NOT RECOMMEND FIELD REPAIR OF THESE AMPLIFIER MODULES.

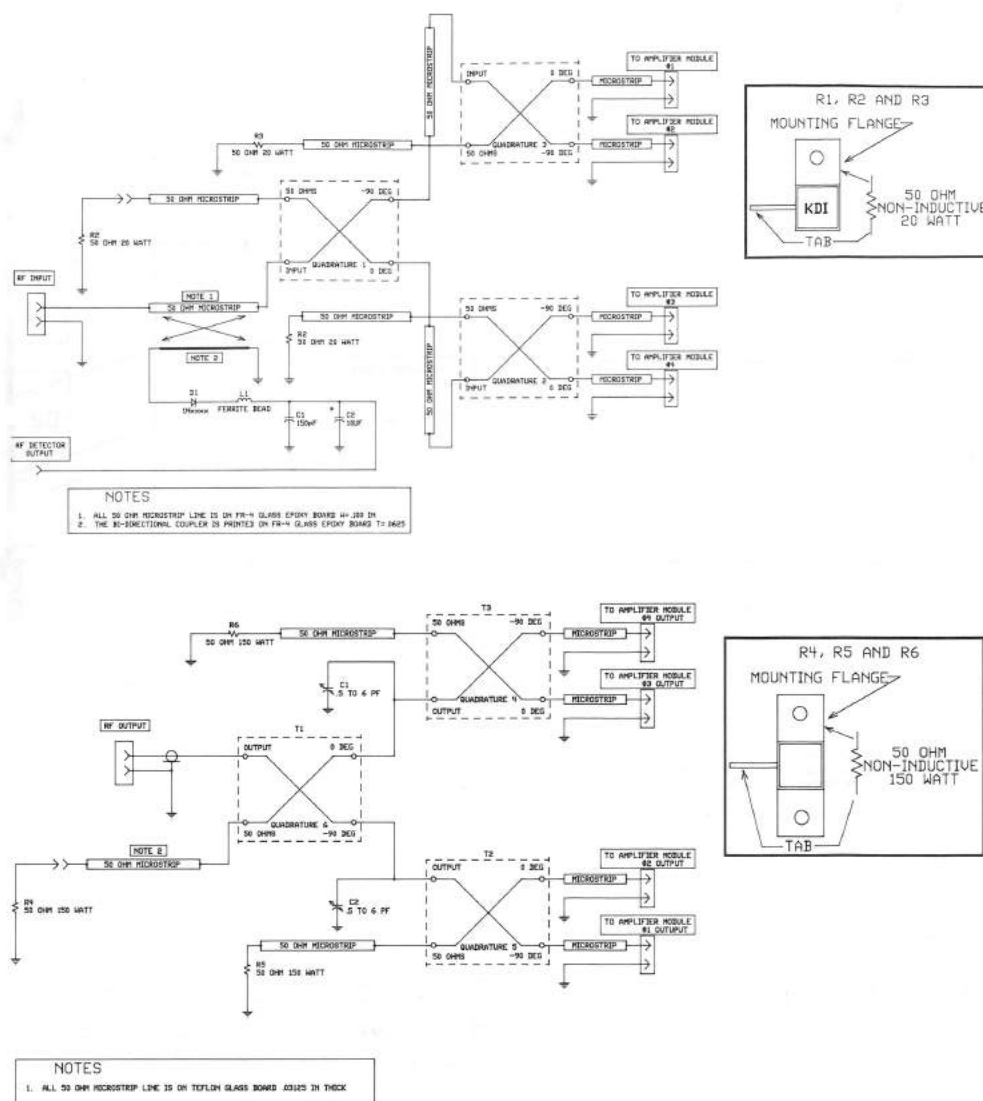
Two-Way Power Splitter and Power Combiner (ARX 1600 only)

The ARX 1600 incorporates a two-way splitter and power combiner in the dual driver stage.

The power splitter and power combiner are quadrature designs utilizing hybrid WIRELINE. This method offers the advantage of greater isolation among power amplifier modules, the source, and the load. This combiner is unique in that approximately 3 dB of the power reflected from the output load is absorbed in the port termination resistors, R1 and R2. This feature makes the amplifier unconditionally stable under all mismatch conditions and virtually immune to damage due to mismatches on the output.

The input power splitter A15 consists of T1. T1 divides the input power (which is the output power from A6) and applies the divided power equally between A5 and A5B. The output power of A5 and A5B are combined by T1 on A16. The combined output power is fed to T1 of A8. The combined output from T1 of A16 results in 40 to 45 W of output power. Combiner module A16 shifts the phase of the amplified signals such that 0 degrees phase difference results at the output of the power combiner.

Four-Way Power Splitter and Power Combiner



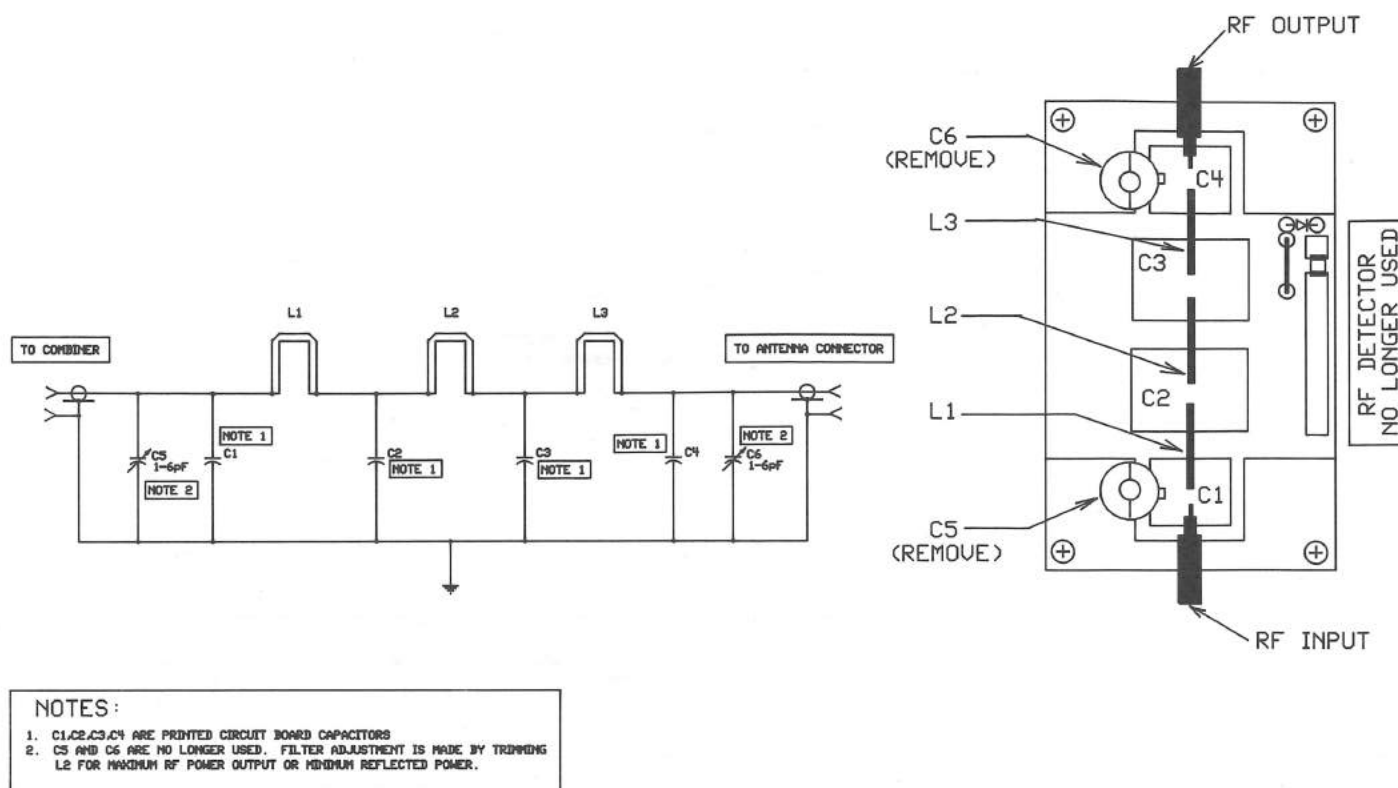
The power splitter and power combiner are quadrature designs utilizing hybrid WIRELINE. This method offers the advantage of greater isolation among power amplifier modules, the source, and the load. This combiner is unique in that approximately 3 dB of the power reflected from the output load is absorbed in the port termination resistors, R1 through R6. This feature makes the amplifier unconditionally stable under all mismatch conditions and virtually immune to damage due to mismatches on the output.

The input power splitter A8 consists of T1, T2, and T3. T1 divides the input power, 45 to 50 W, equally between T2 and T3. T2 and T3 again divide the power equally between A1, A2, A3, and A4. The amplifier modules, A1 through A4, therefore receive about 12 W each at their input terminal. A 90 degree shift

occurs between alternate modules. Amplifier module A1 is 90 degrees out of phase with A2, and A3 is 90 degrees out of phase with A4. The module pair A1 and A2 is 90 degrees out of phase with the module pair A3 and A4.

The output power combiner, A9, consists of T4, T5, and T6. Each amplifier, A1 through A4, produces 40 to 45 W. The power output of A1 and A2 is combined by T6 and the power output of A3 and A4 is combined by T5. The power combined by T5 and T6 is then combined by T4 resulting in 120 to 140 W for the ARX 1200,1200A or 150 to 170 W for the ARX 1600 of power output. The combiner also shifts the phase of the amplified signals such that 0 degree phase difference results at the output of the power combiner.

Low Pass Filter



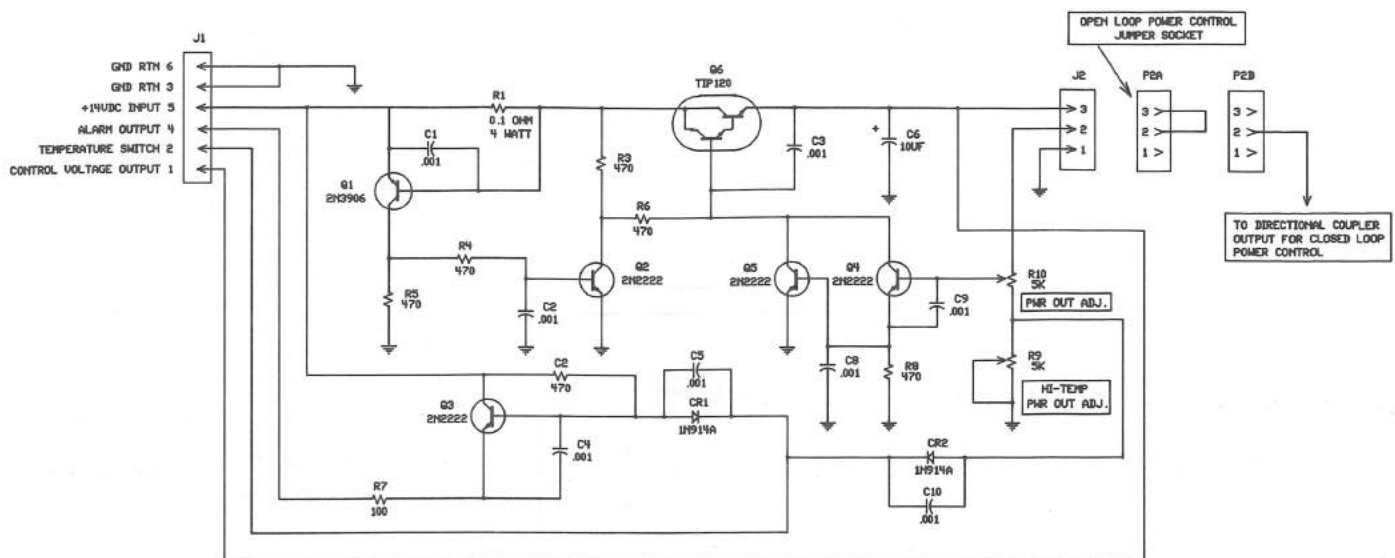
The seven pole, low pass filter is a CHEBYCHEV 0.1 dB ripple design. The filter reduces all harmonics by a minimum of 35 dB.

Inductors L1, L2, and L3 are 0.020 brass stampings for minimum loss and high repeatability. Capacitors C1, C2, C3, and C4 are printed on

Teflon glass circuit boards. Capacitors C5 and C6 are air variables. These capacitors are used to tune out mismatches in the transmission line and small variations in filter component values.

Although this filter only has 0.1 to 0.2 dB of loss, it is attached directly to the main heatsink to avoid heat build up.

Power, Temperature Control, Alarm Module



NOTES:

1. ALL CAPACITORS ARE IN UF UNLESS OTHERWISE INDICATED
2. ALL ELECTROLYTIC CAPACITORS ARE 16VDC OR GREATER
3. ALL RESISTORS ARE 1/4 WATT 5% UNLESS OTHERWISE SPECIFIED

This module controls the power output at normal and high temperatures and a +12 VDC voltage when an over temperature condition has been reached. Provisions are made for connecting the power control circuit to an external power coupler for closed loop power control. The external coupler should provide at least 1.5 VDC across a 5K load at maximum power output of the amplifier. The output of the external coupler is connected to pin 2 of J2. Under normal open loop operation, a jumper plug shorts pin 2 to pin 3. In this mode, the power control functions acts as a closed loop power supply.

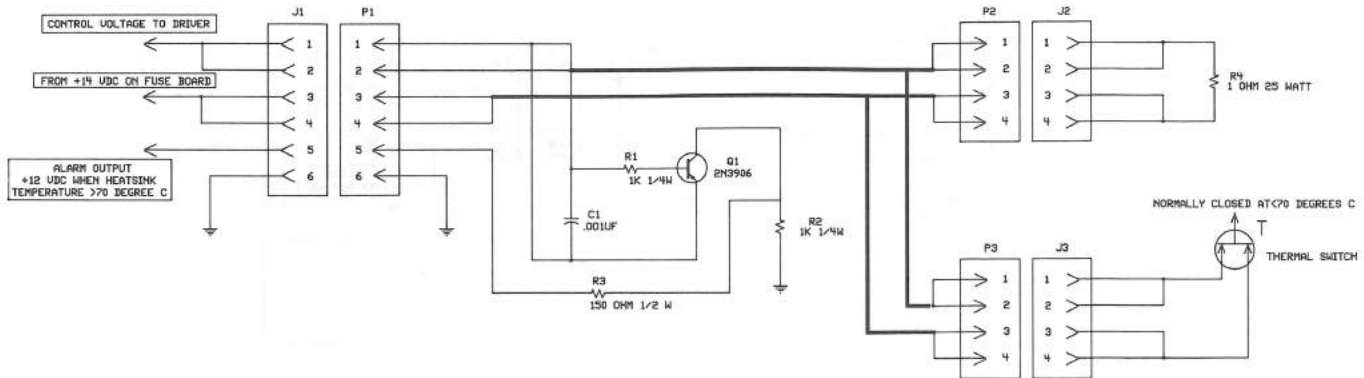
DC amplifiers Q1 and Q2 and resistor R1 limit the current. This protects the module from damage due to accidental shorts. The closed loop regulator utilizes the base emitter junctions of Q4 and Q5

and a reference potential. These transistors control the series pass transistor Q3. The loop is closed either through the voltage developed by a directional coupler on the output of the amplifier or by the output voltage of Q6. Resistor R10 controls the power voltage.

A thermal switch opens should the heatsink temperature rise above 135°F. This causes R9 to control the power output and the power output is reduced according to its setting.

Q3 conducts +12 V when the thermal switch opens. This voltage appears at a feed thru terminal and can be used to control external warning devices. The current available at this terminal is approximately 100 ma at 12 – 14 VDC.

Temperature Control and Alarm



This module reduces the power output of the amplifier if the heatsink temperature rises above 135°F. When the temperature drops below 115°F, the power is again restored to its original level. When an over temperature occurs, a +12 VDC signal appears on a feed-thru terminal for use in actuating external alarm devices of the customer's choosing or MILCOM ALARM CONTROL MODULE #540-085.

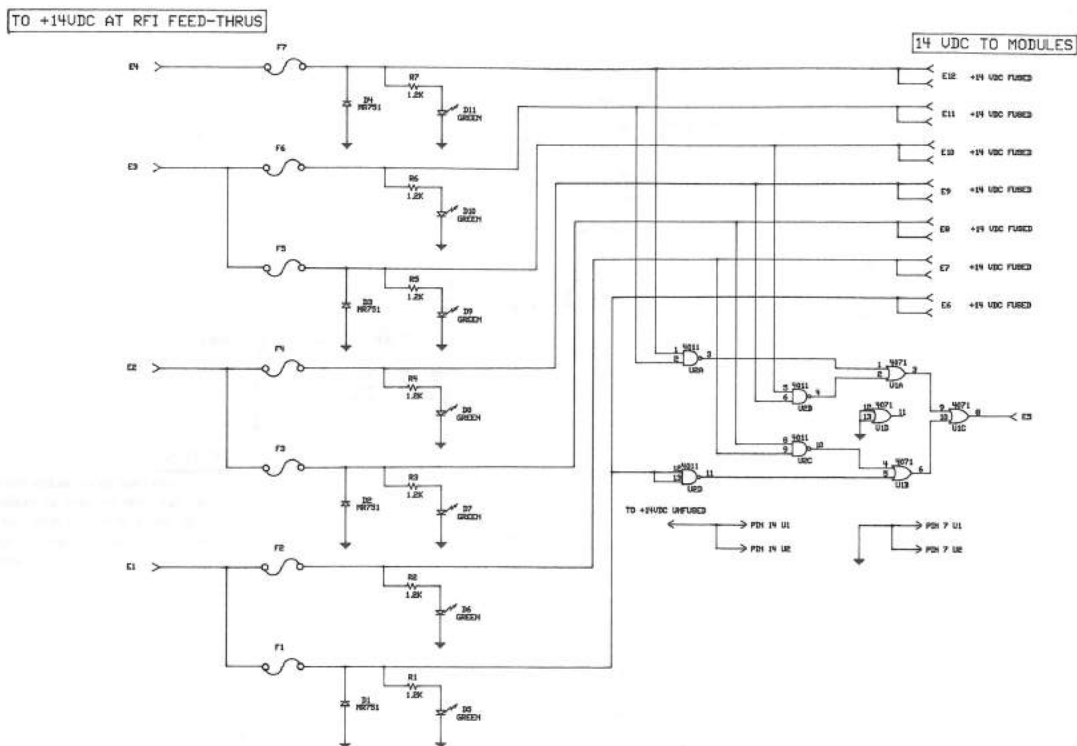
At 135°F, the thermal switch opens. Resistor R1 is then placed in series with the driver module DC supply line. The drop in voltage across this resistor decreases the power output of the amplifier by approximately 30% of its normal value. With the thermal switch open a forward bias is

placed across PNP switching transistor Q1 causing it to conduct 12 VDC through current limiting resistor R3. This 12 VDC appears at feed-thru filter FL6 and can be connected to external devices as explained above.

When the heatsink temperature drops below 115°F, the thermal switch resets and the power output of the amplifier returns to normal. The +12 VDC at FL6 also drops out.

This circuit acts as a safeguard for continuous duty amplifiers that experience a cooling fan or air conditioning failure. It is not intended as an alternative to a forced air cooling system.

DC Distribution Board



The DC distribution board serves several functions. It provides a termination point for the incoming high current DC voltage, a convenient mounting for the DC power line fuses, a mounting for the reverse protection diodes, and a distribution point for DC power to the modular sub-assemblies.

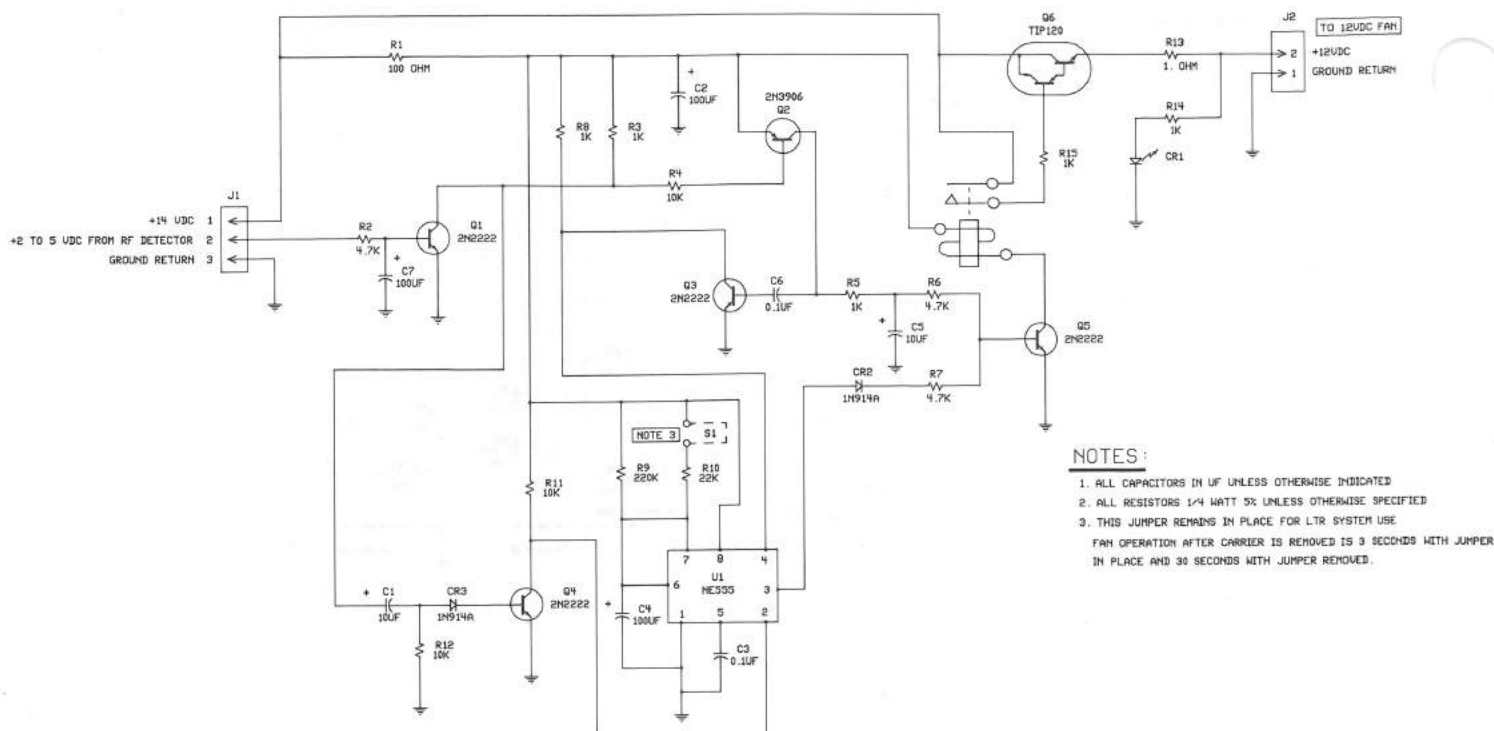
The compartment where the distribution board is mounted receives high current DC voltage from J101 through four RF feed thru filters FL1 through FL4 (not shown in schematic). This voltage is terminated at terminals E1 through E4.

Fuses F1 through F7 are provided to protect against reverse polarity and internal shorts. These fuses are not intended to protect the RF power transistors from damage due to mismatch or over drive.

Diodes D1 through D4 protect the amplifier from damage due to reverse polarity on the DC power line.

The eyelet terminals E6 through E12 are used to distribute the DC power to the amplifier and control modules.

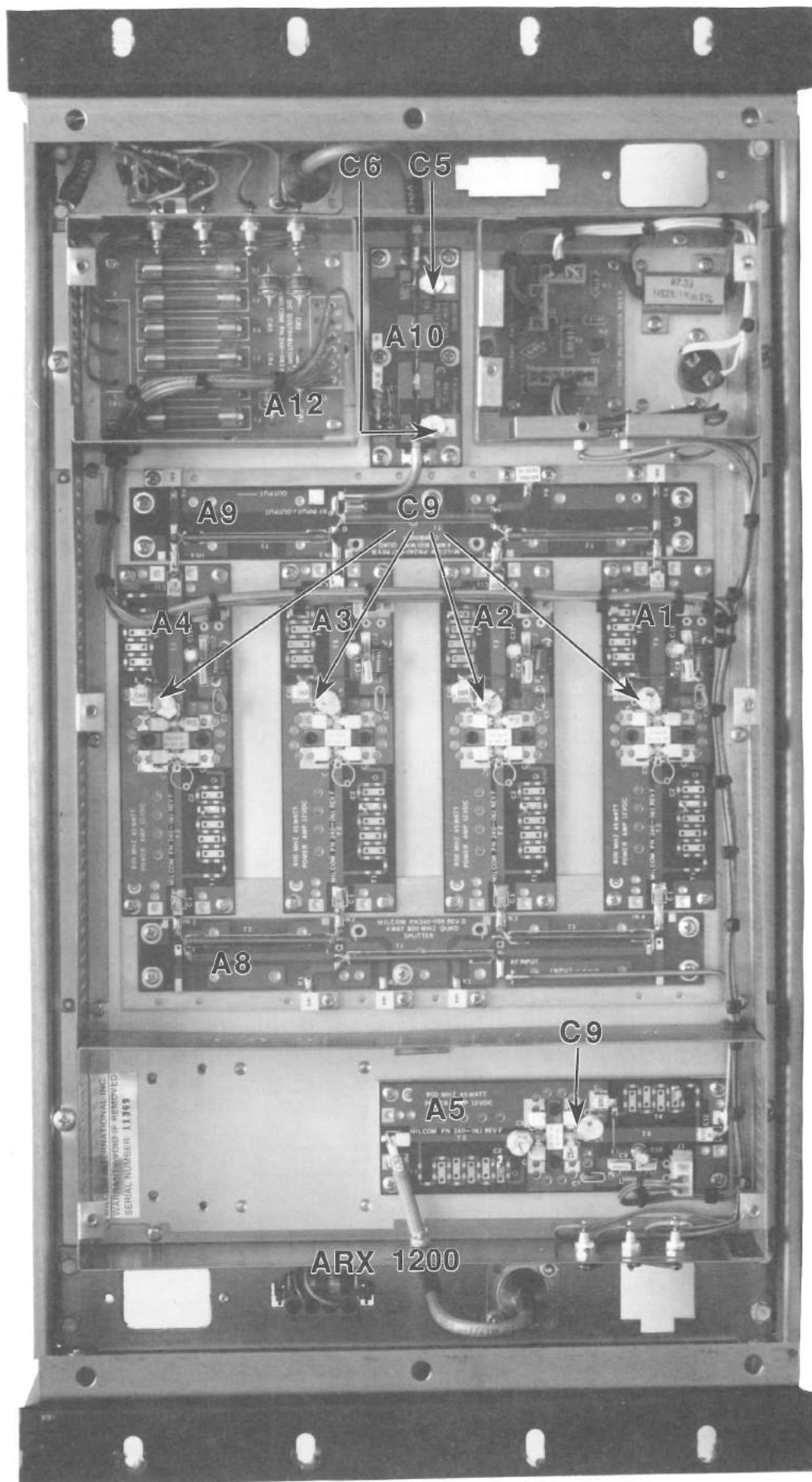
Fan Control



RF power controls the fan in the ARX 1200/1200A/1600 continuous duty amplifiers. A 555 timer and supporting circuitry activates the fan when the amplifier is turned on.

When the amplifier output coupler detects a signal, 5 V are applied through R2 to the base of Q1. The collector of Q1 drops to ground potential causing Q2 to conduct. When Q2 conducts, the collector receives 14 V. This voltage is applied through R5 and R6 to the base of Q5. Transistor Q5 is forward biased by this voltage and activates reed relay K1. Relay K1 applies forward bias to Q6, causing it to conduct. The voltage at the emitter of Q6 is 14 V. This voltage is applied to the fan and LED, CR1, through 1 Ω fuse resistor R13. When the drive is removed from the power ampli-

fier, the 5 V DC signal no longer appears through R2 at the base of Q1. The voltage at the collector of Q1 increases to 14 V. The instantaneous change creates a voltage pulse on the base of Q4 causing it to momentarily conduct. This momentary conduction of Q4 causes pin 2 of U1, the 555 timer, to drop to ground potential and start the timing cycle. When the timing cycle starts, 14 V appear at pin 3 of U1 and remain there until the cycle is complete. This voltage is applied to the base of Q5 causing it to conduct and hold in relay K1. The fan stays on for a short time after the drive is removed from the amplifier. If the drive is reapplied during this timing period, a pulse applied to the base of Q3 resets the 555 timer and the cycle begins again.



AMPLIFIER ADJUSTMENT PROCEDURE

Your power amplifier is preadjusted in the factory. However, if your amplifier is not functioning properly, follow this procedure to realign your unit. If your amplifier still does not function properly, refer to the troubleshooting chart on page 17 of this manual, or call Uniden Technical Support for technical assistance.

Test Equipment Required

14 VDC, 50 A Regulated Power Supply
200 – 400 mW RF Source
Non-conducting Tuning Tool

150 W RF Coaxial Termination
150 W Wattmeter

Adjustment Sequence

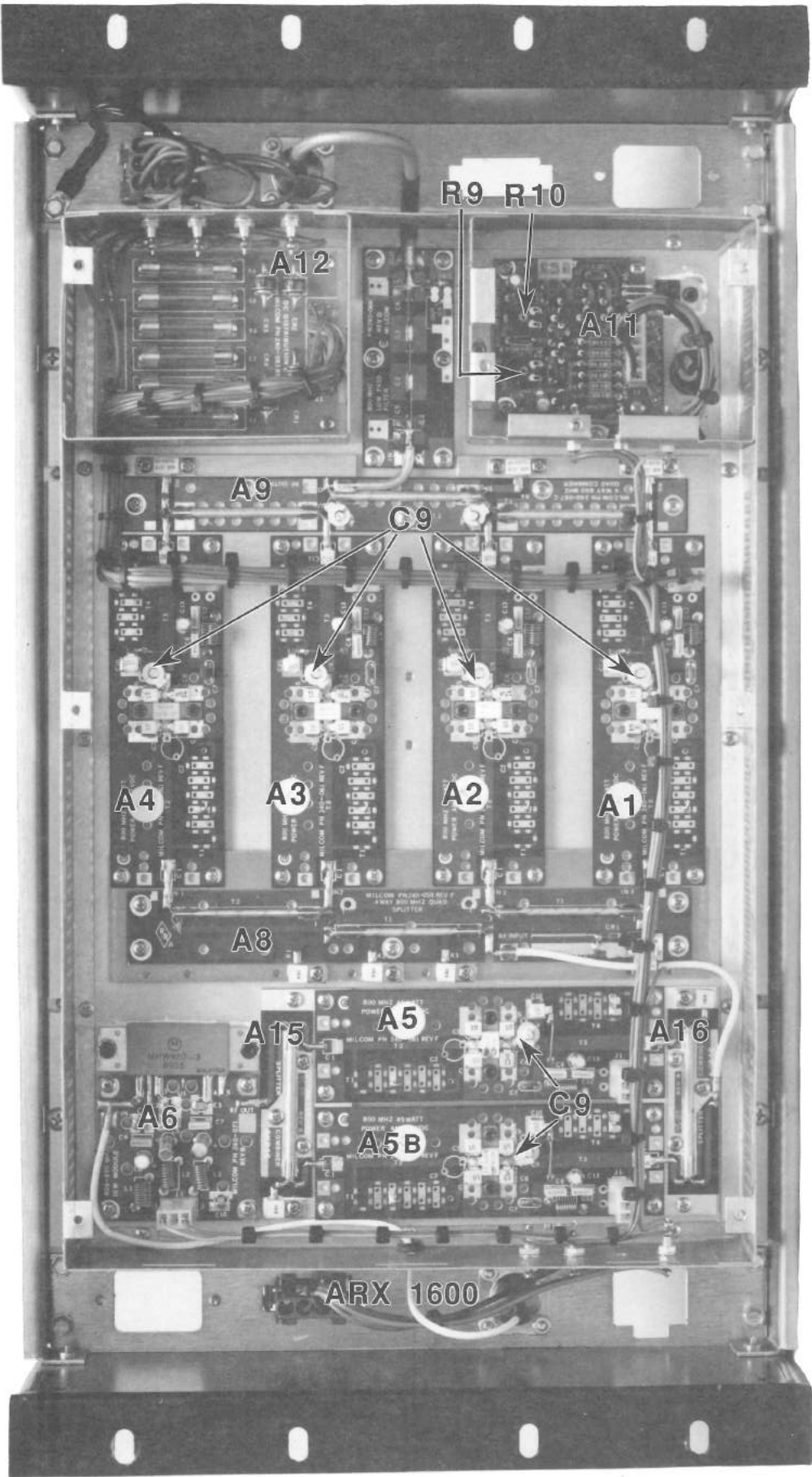
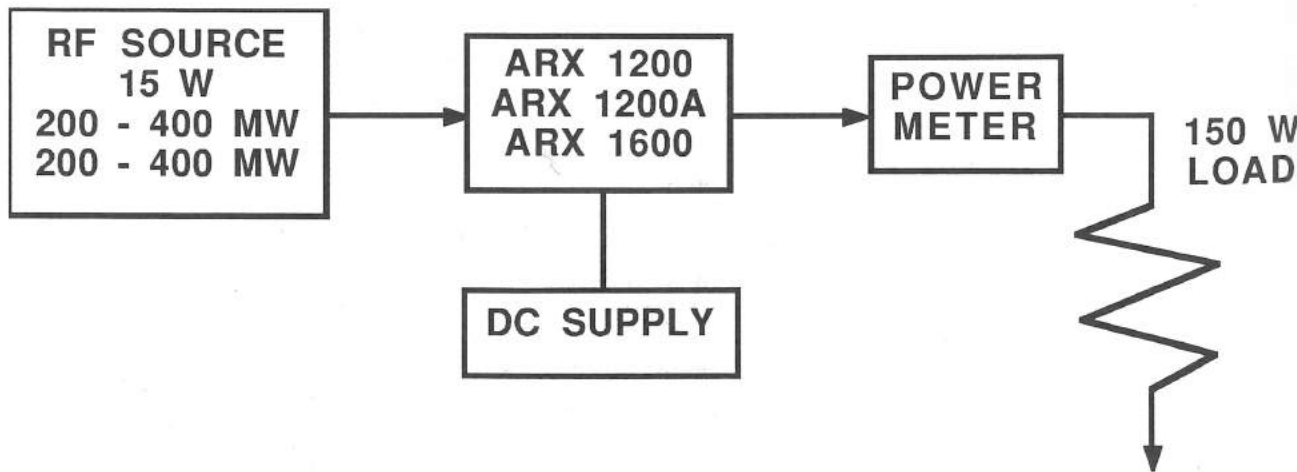
NOTE: Use a non-conducting (ceramic or plastic) tuning tool when adjusting high power capacitors.

STEP	ADJUSTMENT	PROCEDURE
1	R10, R9, on A11 (ARX 1600 only)	Set both potentiometers fully clockwise.
2	C9 on A1, A2, A3, A4,A5, and A5B*	Adjust all C9's for maximum power output at J104.
3	C5 and C6 on A10 (ARX 1200 only)	Adjust C5 and C6 for maximum power output at J104.
4	R10 on A11 (ARX 1600 only)	Adjust R10 for rated power output at J104.
5	R9 on A11 (ARX 1600 only)	Remove the power to the cooling fan. Turn on the RF Power source and wait until the heat sink exceeds 135°F. Adjust R9 so that the power output is –3 dB at J104.

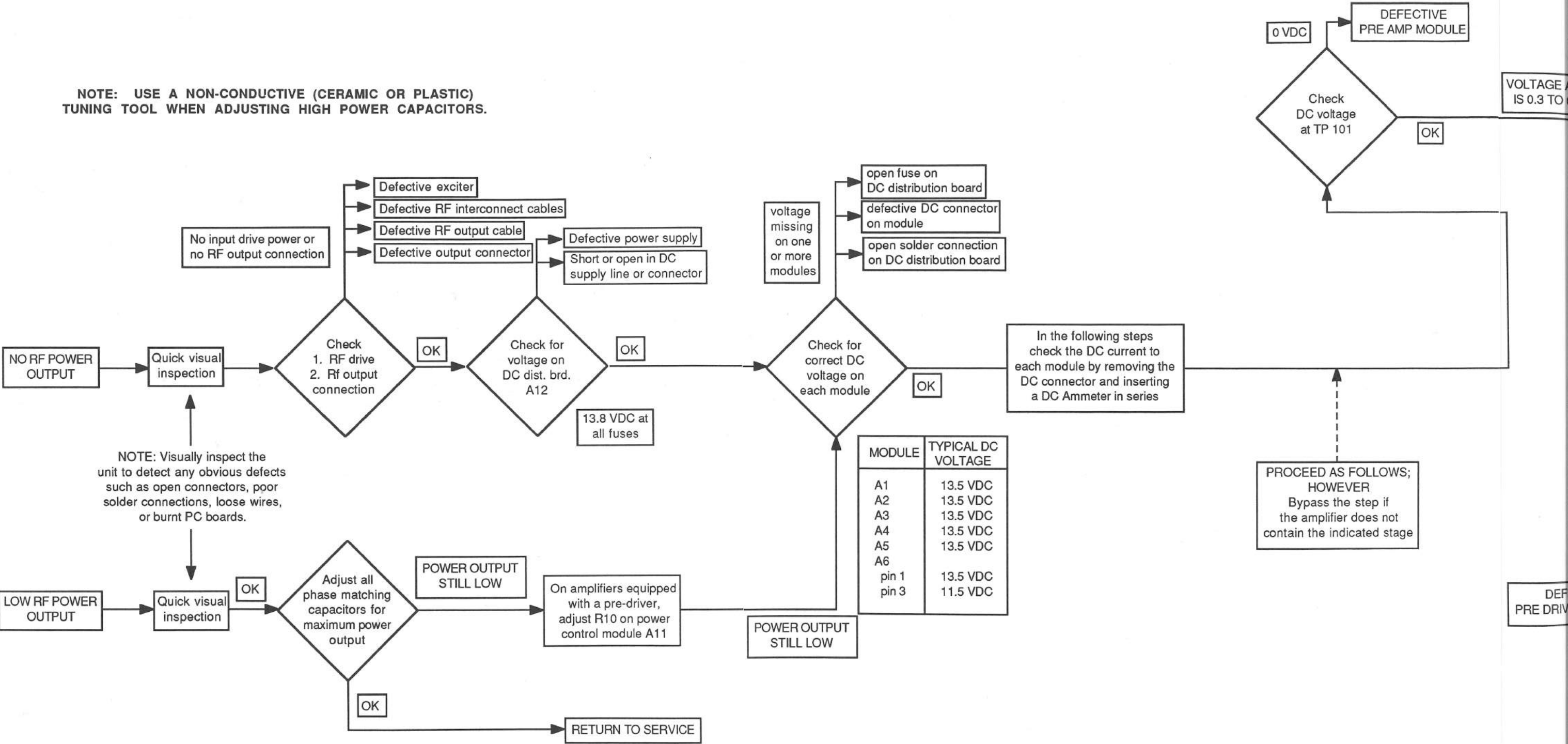
Power = 75 W for ARX 1600

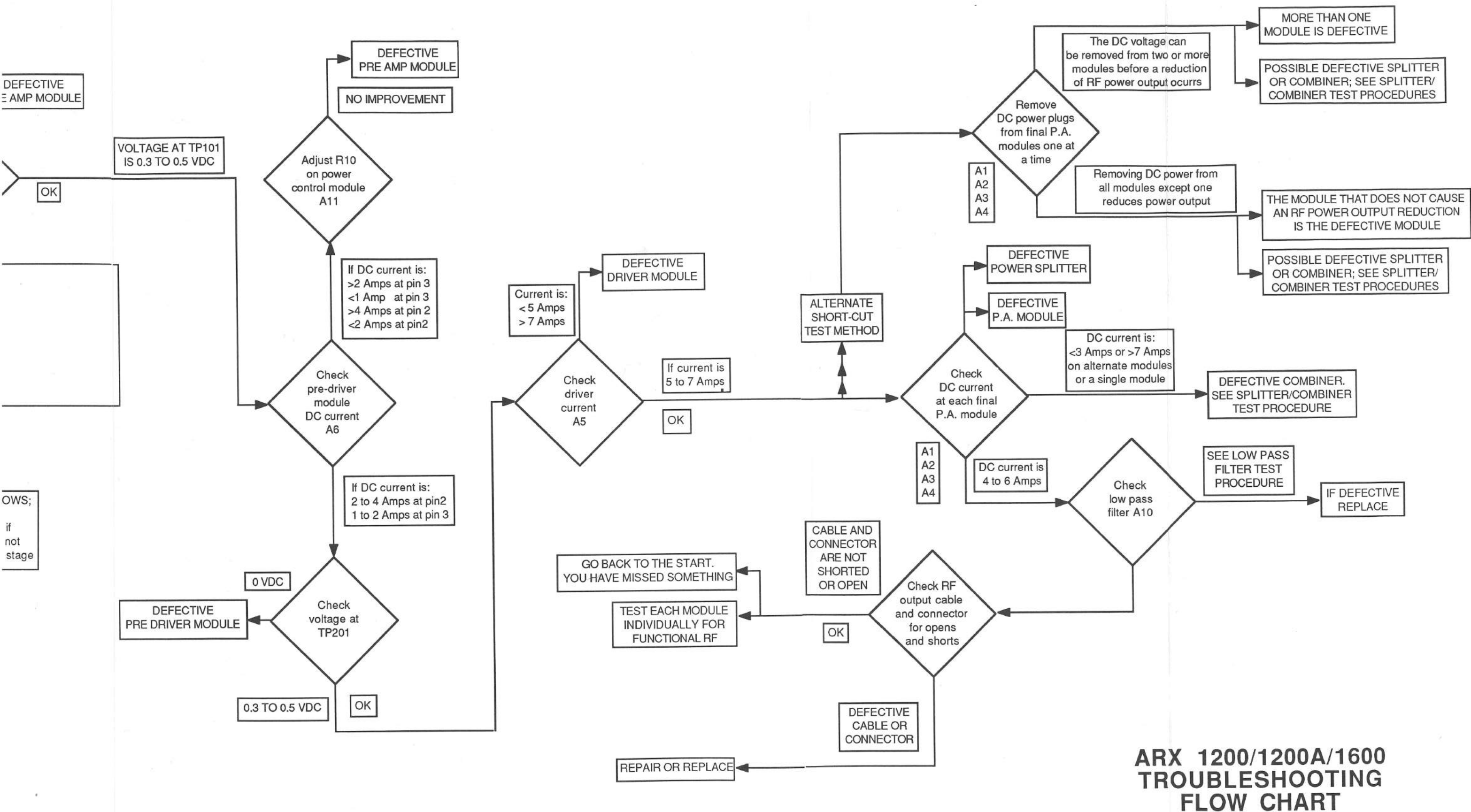
* A5B is in the ARX 1600 only.

SUGGESTED TEST SETUP



NOTE: USE A NON-CONDUCTIVE (CERAMIC OR PLASTIC) TUNING TOOL WHEN ADJUSTING HIGH POWER CAPACITORS.





ARX 1200/1200A/1600

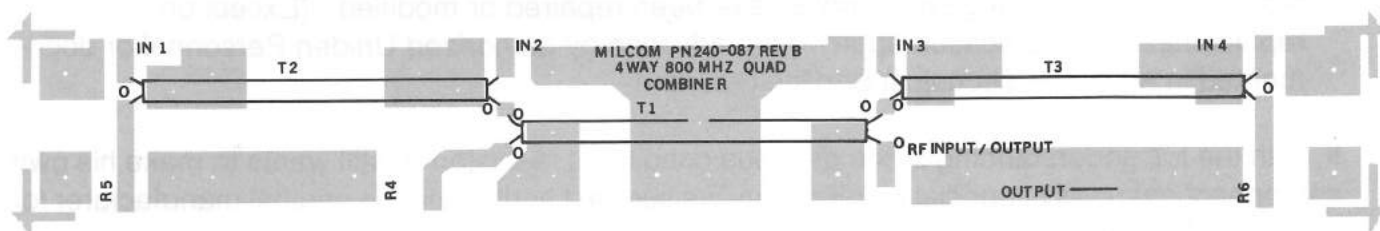
PARTS LIST

Policies: Uniden America Corporation does not recommend that customers replace component parts in these power amplifier units. Instead, Uniden will exchange complete units under its **FASTBacker™ System** Support Program. Uniden will not accept units for warranty replacement or exchange if the units have been repaired or modified. (Exception: Parts replacement or modification approved in advance by authorized Uniden Personnel or documented in a Uniden Technical Service Bulletin.)

If, with the full understanding of the previous conditions, a customer still wants to make his own component changes or special modification, we suggest contacting the original manufacturer for assistance. Write or call:

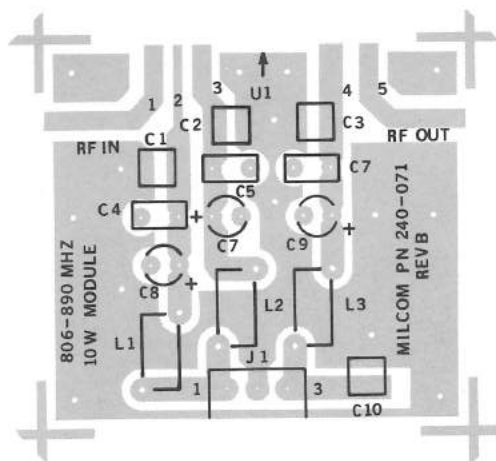
Milcom International, Inc.
10891 Capital Avenue
Garden Grove, California 92643

Telephone: (714) 554-1710
Fax: (714) 554-3090



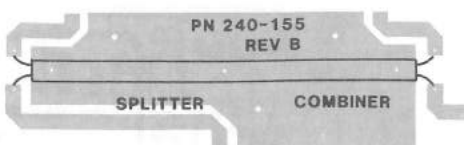
COMPONENT SIDE

ARX 1200/1200A 4-WAY, 800 MHz QUAD COMBINER

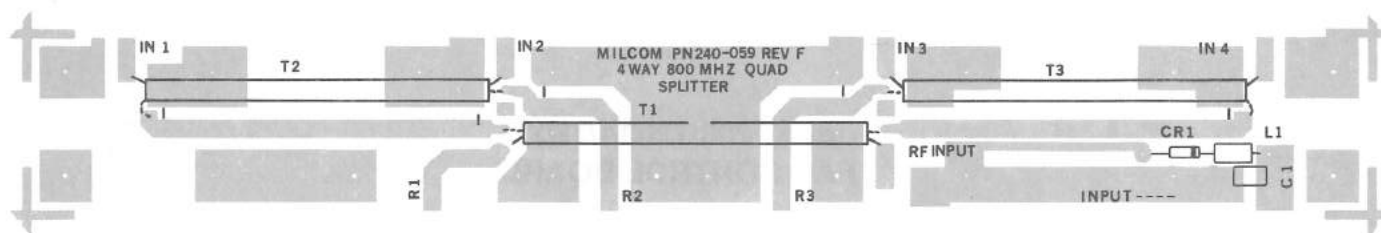


COMPONENT SIDE

ARX 1200A/1600 806 - 890 MHz 10 W MODULE

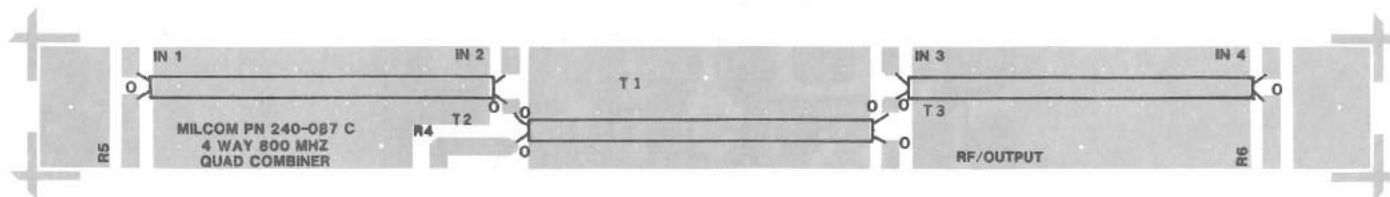


ARX 1600 2-WAY SPLITTER



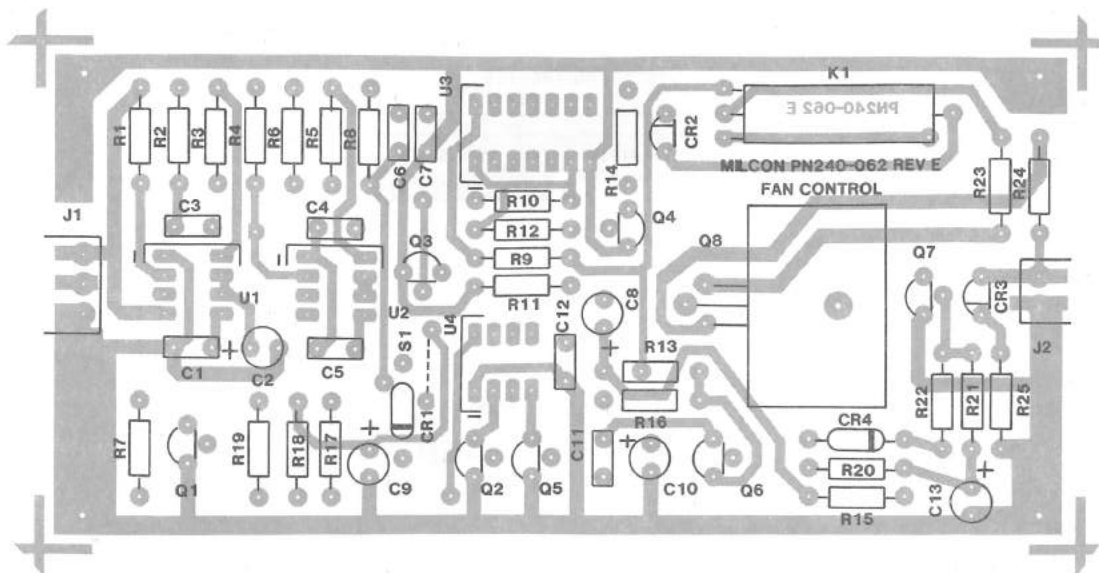
COMPONENT SIDE

ARX 1600 4-WAY, 800 MHz QUAD SPLITTER

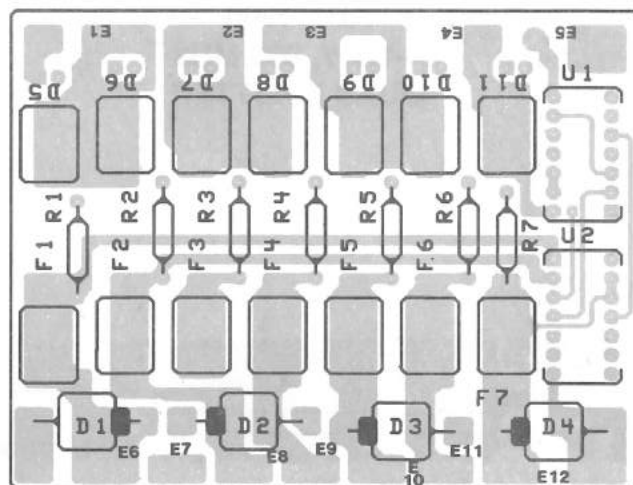


COMPONENT SIDE

ARX 1600 4-WAY, 800 MHz QUAD COMBINER

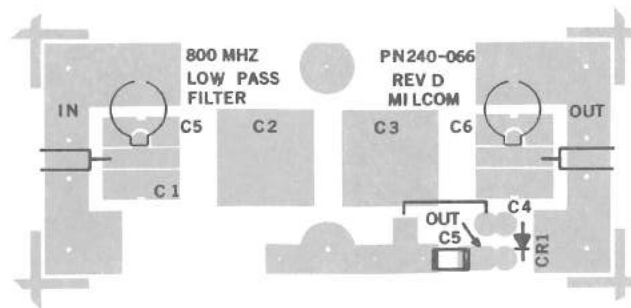


**ARX1200/1200A/1600
FAN CONTROL BOARD**



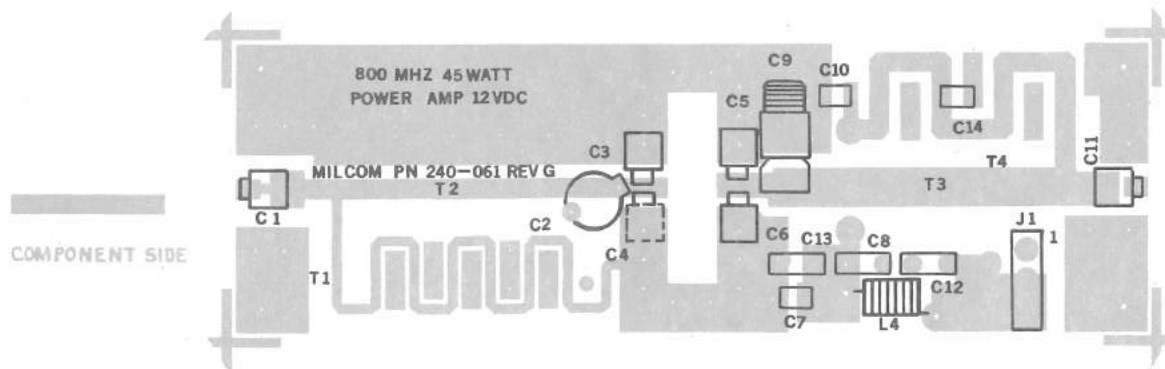
**ARX 1200/1200A/1600
DC DISTRIBUTION
BOARD**

COMPONENT SIDE



COMPONENT SIDE

ARX 1200/1200A/1600 HARMONIC FILTER



COMPONENT SIDE

ARX 1200/1200A/1600 800 MHz, 45 W POWER AMP BOARD

UNIDEN AMERICA CORPORATION COMMERCIAL COMMUNICATIONS ONE YEAR LIMITED WARRANTY

WARRANTOR: UNIDEN America Corporation ("UNIDEN" or "Warrantor")

ELEMENTS OF WARRANTY: UNIDEN warrants to the purchaser that all new Commercial Radio equipment of UNIDEN's manufacture (the Product) shall be free of defects in material and workmanship. Equipment and accessory items not manufactured by UNIDEN carry the warranty, if any, of the manufacturer thereof.

WARRANTY DURATION: The warranty period shall commence upon installation of the equipment or two (2) months from date of shipment from the factory, whichever occurs first. This Warranty shall terminate and be of no further effect one (1) year from commencement of the warranty period or at the time the Product is (a) damaged or not maintained as reasonable, (b) modified, (c) improperly installed, (d) is repaired by someone other than Warrantor or Authorized Warranty Repair Station for a defect or malfunction covered by this Warranty, or (e) used in a manner or purpose for which the Product was not intended or in an environmental condition for which the Product was not intended.

STATEMENT OF REMEDY: In the event that the product does not conform to this Warranty at any time while this Warranty is in effect, Warrantor will repair the defect and return the Product without charge for parts, service, or any other cost incurred by Warrantor or its representatives in connection with the performance of this Warranty. **This Warranty does not cover or provide for the reimbursement of payment of incidental or consequential damages. Any and all implied warranties, including, but not limited to, warranties of merchantability and/or fitness for any particular use, are expressly disclaimed.** Some states do not allow this exclusion or limitation of incidental or consequential damages such limitation or exclusion may not apply to you.

WARRANTY REGISTRATION CARD: In order to facilitate service under this Warranty, the Customer should return the Warranty Registration Card to Warrantor. However, return of Warranty Registration Card is not a precondition of this Warranty. This Warranty will be observed by Warrantor whether or not the Warranty Registration Card is returned, on the condition that other evidence, satisfactory to UNIDEN, of the date of the original installation or purchase is provided to the Warrantor.

PROCEDURE FOR OBTAINING PERFORMANCE OF WARRANTY: To obtain Warranty repair, the Customer must return the Product properly packed, freight prepaid, to Warrantor or any Authorized Warranty Repair Station. It will be returned freight prepaid.

