

R.S. ARAO

**POWER AMPLIFIER-POWER SUPPLY
SC-910A**

**SINGLE SIDEBAND
COMMUNICATIONS EQUIPMENT**

GENERAL DYNAMICS | ELECTRONICS

MILITARY PRODUCTS DIVISION-ROCHESTER

Operation And Service Instructions
for
POWER AMPLIFIER - POWER SUPPLY
SC-910A

GENERAL DYNAMICS | ELECTRONICS

PROPRIETARY RIGHTS

Proprietary rights of General Dynamics/Electronics Division of General Dynamics Corporation are involved in the subject matter of this material, and all manufacturing, reproduction, use, and sales rights pertaining to such subject matter are expressly reserved. It is submitted in confidence for a specified purpose, and the recipient by accepting this material agrees that this material will not be used, copied or reproduced in whole or in part nor its contents revealed in any manner or to any person except to meet the purpose for which it was delivered.

MILITARY PRODUCTS DIVISION - ROCHESTER

Copyright 1961 by
General Dynamics Corporation

TABLE OF CONTENTS

Chapter	Page	Chapter	Page
I	GENERAL DESCRIPTION	1-1	
1.1	Description	1-1	
1.2	Equipment Required but not Supplied	1-1	
1.3	Quick Reference Data	1-1	
1.4	Associated Equipment	1-1	
1.5	Installation	1-1	
1.5.1	Unpacking and Handling	1-1	
1.5.2	Power Requirements	1-1	
1.5.3	Installation Layout	1-1	
1.5.4	Inspection and Adjustments	1-2	
1.5.5	Interference Reduction	1-2	
1.5.6	Preparation for Reshipment	1-2	
II	OPERATORS SECTION	2-1	
2.1	Functional Operation	2-1	
2.1.1	General	2-1	
2.1.2	Operation	2-1	
2.1.2.4	Peak and Average Power Control Circuits	2-1	
2.1.2.6	Relay and Control Circuits	2-1	
2.1.2.9	Power Supply	2-5	
2.2	Description of Controls and Indicators	2-5	
2.3	Operating Procedures	2-7	
2.4	Shutdown Procedures	2-7	
III	PREVENTIVE MAINTENANCE	3-1	
3.1	General	3-1	
IV	TROUBLE-SHOOTING	4-1	
4.1	General	4-1	
4.2	Test Equipment and Special Tools	4-1	
4.3	Control Settings	4-1	
4.4	System Trouble-Shooting	4-1	
4.5	Functional Trouble-Shooting	4-3	
V	REPLACEABLE PARTS	5-1	
5.1	General	5-1	

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1	Power Amplifier-Power Supply SC-910A, Rear View	1-2
2-1	Power Amplifier-Power Supply SC-910A, Schematic Diagram	2-3
2-2	Power Amplifier-Power Supply SC-910A, Block Diagram	2-5
2-3	Power Amplifier-Power Supply SC-910A, Front View.	2-6
4-1	Power Amplifier-Power Supply SC-910A, Top View.	4-3

LIST OF TABLES

Table	Title	Page
2-1	Power Amplifier-Power Supply SC-910A, Controls and Indicators . .	2-6
3-1	Power Amplifier-Power Supply SC-910A, Preventive Maintenance Checks	3-1
4-1	Power Amplifier-Power Supply SC-910A, Test Equipment Required.	4-1
4-2	Power Amplifier-Power Supply SC-910A, System Trouble-Shooting Chart	4-1
4-3	Power Amplifier-Power Supply SC-910A, Functional Trouble- Shooting Chart	4-3

CHAPTER I GENERAL DESCRIPTION

1.1 DESCRIPTION

Power Amplifier-Power Supply SC-910A (Power Amplifier), is a remotely-tuned linear amplifier with a self-contained power supply. The amplifier provides 100 watts PEP or 25 watts AM output with .25 watts drive, in the 2-to-30 megacycle range.

1.1.1 Operating voltages are developed in the Power Supply from a 115 ±10% volt AC source.

1.1.2 The unit is housed in a moisture-sealed case incorporating slides which permit removal of the chassis as well as tilting forward or backward at 90 degree angles for ease in servicing. The chassis is fastened to the case by front-mounted screws and internal shock pins.

1.1.3 The vacuum tubes are mounted in a heat sink that has fins extending through the front panel. The heat, generated by the tubes is conducted to the outside of the case and dissipated upwards away from the controls.

1.1.4 The Power Amplifier weighs 65 pounds, is 7 inches high, 17-3/8 inches wide, and 15 inches deep including controls and connectors.

1.2 EQUIPMENT REQUIRED BUT NOT SUPPLIED

This equipment is designed to operate with the SC-910 system including the SC-910 E Exciter, Junction Box SC-666164-800 and either Semi-automatic Antenna Coupler SC905C or Automatic Antenna Coupler SC-909C. Also required but not suppliedL

1. BNC connectors (UG88/U), 3 required.
2. J1 connector MS 3106R28-21P.
3. J2 connector MS 3106R28-12S.
4. Coaxial cable RG58/U.

1.3 QUICK REFERENCE DATA

Frequency Range	2 to 30 Megacycles.	
Modes of Operation	Upper Sideband, Lower Sideband, Independent Sideband, Frequency Shift Keying, CW and AM.	
Power Requirements	115±10% volts AC, single phase, 48-1000 CPS, 3 amperes.	
	Transmit-standby	47 watts.
	Transmit-SSB	225 watts.
	Transmit-AM	225 watts.
	Transmit-FSK/CW	275 watts.
Power Output	SSB	100 watts PEP.
	AM	25 watts carrier.
	CW	50 watts.
	FSK	50 watts.

Output Impedance	50 ohms.
Transmitter spurious	-60 db.
Transmitter 2nd harmonic	-50 db.
SSB Carrier Suppression	-50 db.
Intermodulation Distortion	-35 db.
Recommended Antennas (with couplers)	35-foot whip, 15-foot probe, 25-foot center-fed whip.

1.4 ASSOCIATED EQUIPMENT

The Power Amplifier is designed to operate in the SC-910 Receiver and 100-watt Transmitter System. This system includes Radio Receiver SC-910R, Exciter 910E, Semi-automatic Antenna Coupler SC-905C or Automatic Antenna Coupler SC-909C, and the Power Amplifier. This System is designed for fixed station use.

1.5 INSTALLATION

1.5.1 Unpacking and Handling. Because the Power Amplifier is an accurately calibrated piece of precision equipment, rough handling should be avoided. Extreme caution should be exercised when removing the unit from the packing container to prevent damage to the controls or connectors. Handles are provided on the front panel for lifting or carrying the equipment.

1.5.2 Power Requirements. The Power Amplifier is designed for operation from 115±10% volts AC, single phase, 48-1000 CPS. The unit requires 3 amperes.

1.5.3 Installation Layout. The Power Amplifier should be installed as close to the Exciter-Receiver-Antenna Coupler combination as possible to minimize RF cable lengths. It may be table or rack mounted in a standard 19-inch relay rack using adapter plates (not furnished). AC power and control data connections are made to the unit via J1 and J2 using the connectors listed in paragraph 1.2. Signal cables made up of RG58/U with UG88/U connectors are connected as illustrated in figure 1-1. See figure 2-1 for additional interconnection information.

NOTE

The Power Amplifier case should be connected to the system ground using braided or buss wire to insure minimum radiation of internal frequencies.

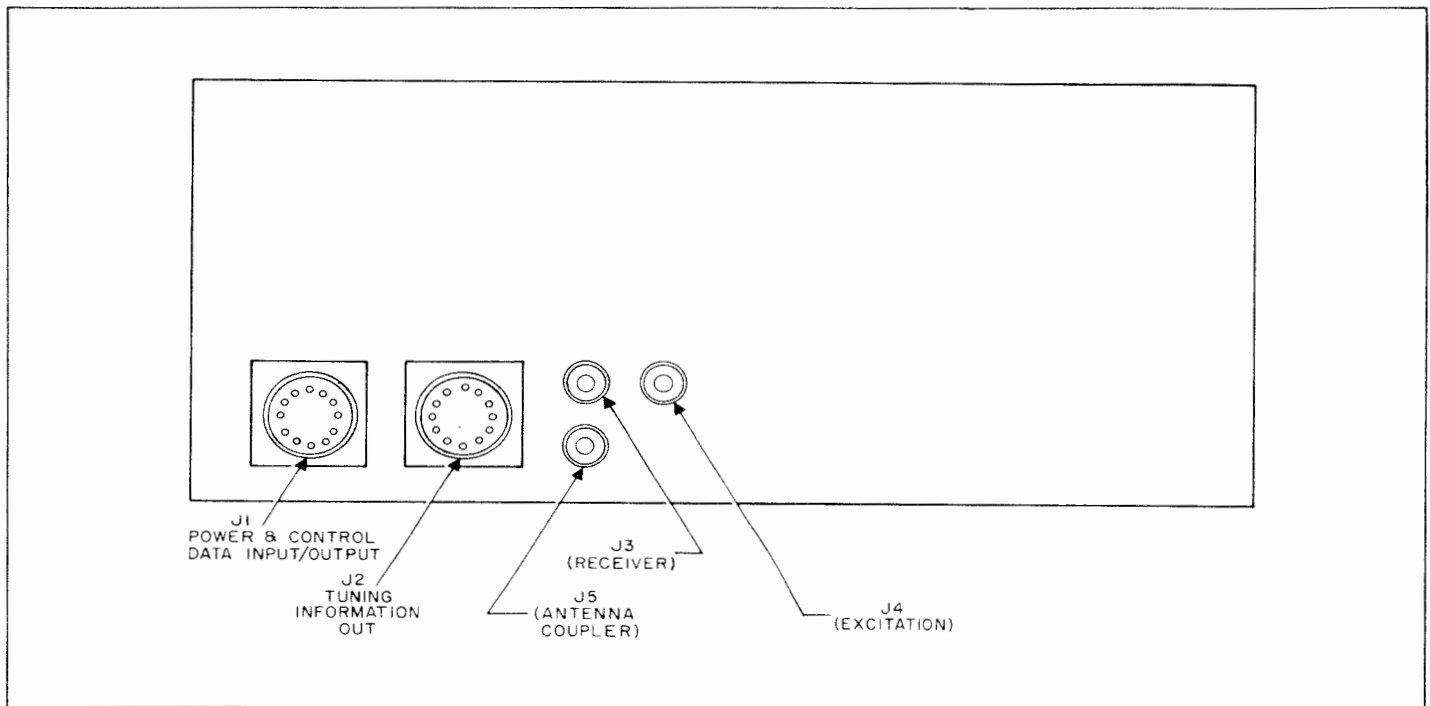


Figure 1-1. Power Amplifier-Power Supply SC-910A, Rear View

1.5.4 Inspection and Adjustments. Because of the nature of the equipment, relocation should have no effect on adjustment. With the equipment in operating condition before being packed, the only points to check before applying power are as follows:

1. Check for external damage to the controls, indicators or connectors,
2. Verify that all electronic plug-in assemblies are secured in their respective sockets.
3. Check that tubes V1 and V2, in the RF Amplifier, are secure in their respective sockets.

1.5.5 Interference Reduction. As a precaution against possible interference either with or from the Power Amplifier, operate the unit with the chassis fully inside the case and the captive screws run-up-tight. Verify that the Power Amplifier is properly grounded. The use of shielded cables on all connections to J1 and J2 is recommended for maximum interference reduction.

1.5.6 Preparation for Reshipment. To prepare the Power Amplifier for reshipment, check that the vacuum tubes are mounted using the vibration-proof shields provided. Place the POWER switch to OFF. If the original packing container is available, repack-age the unit in the reverse order of unpacking.

1.5.6.1 If the original container is not available, proceed as follows:

1. Enclose the unit in a cardboard container using shock pads between connectors and front panel controls to protect from pressure. Use shock pads to protect the front, back and side panels.
2. Place the unit in a packing crate on a shock pad. Place shock pads around the unit so it cannot move. Place a shock pad on top of the unit and secure the crate cover.
3. Mark crate cover "OPEN THIS END".

CHAPTER II

OPERATORS SECTION

2.1 FUNCTIONAL OPERATION

2.1.1 General. Power Amplifier-Power Supply SC-910A is an automatically-tuned, linear power amplifier with a self-contained power supply. Tuning is accomplished by switching various combinations of broadband circuit components.

When excited by .25 watts of power input, SSB, CW or AM signals may be amplified.

2.1.1.1 The unit consists of a power supply assembly, a motor-driven turret assembly, and two vacuum tubes.

2.1.1.2 All controls required for normal operation are mounted on the front panel. Power, control and signal information cables are connected to connectors mounted on the rear of the case.

2.1.2 Operation. Excitation is applied to the Power Amplifier (see figures 2-1 and 2-2), via P1 into a unity-coupled 50-ohm input RF transformer, T1. From the secondary winding of transformer T1, the signal is applied to the grid of the driver tube, V1. From V1, where it is amplified to an adequate level suitable for driving the Power Amplifier, V2, the signal is applied to one of the bandpass driver transformers, T2 through T20, which is located in the turret of the Power Amplifier chassis. The output of the secondary winding of the driver transformer is applied to the grid of the Power Amplifier, V2, which amplifies the signal on its grid to a maximum of 100 watts peak envelope power.

2.1.2.1 The signal is then passed to one of the Power Amplifier filters, FL1 through FL19, also located in the turret assembly. This filter is of the broadband type with a 50-ohm output impedance.

2.1.2.2 The signal is then sent through the transmit/receive relay, contacts 12 and 15 of relay K2, and out to the antenna.

2.1.2.3 The Power Amplifier, which operates in class AB1, employs RF feedback for more linear operation. A portion of the output signal from V2 is fed back to the grid of V1 by coupling capacitor C9 through capacitance bridge C1, C2, C3, and the input capacitance of the driver stage. This bridge circuit serves to isolate the input signal from the feedback signal eliminating interaction.

2.1.2.4 Peak and Average Power Control Circuits. The Power Amplifier employs a peak power control (PPC) and an average power control (APC) to prevent overdriving the driver and Power Amplifier stages, V1 and V2.

When the Power Amplifier is driven very slightly into drawing grid current, the PPC circuit senses this and

feeds back a DC level to the Exciter, causing a reduction in the Exciter output.

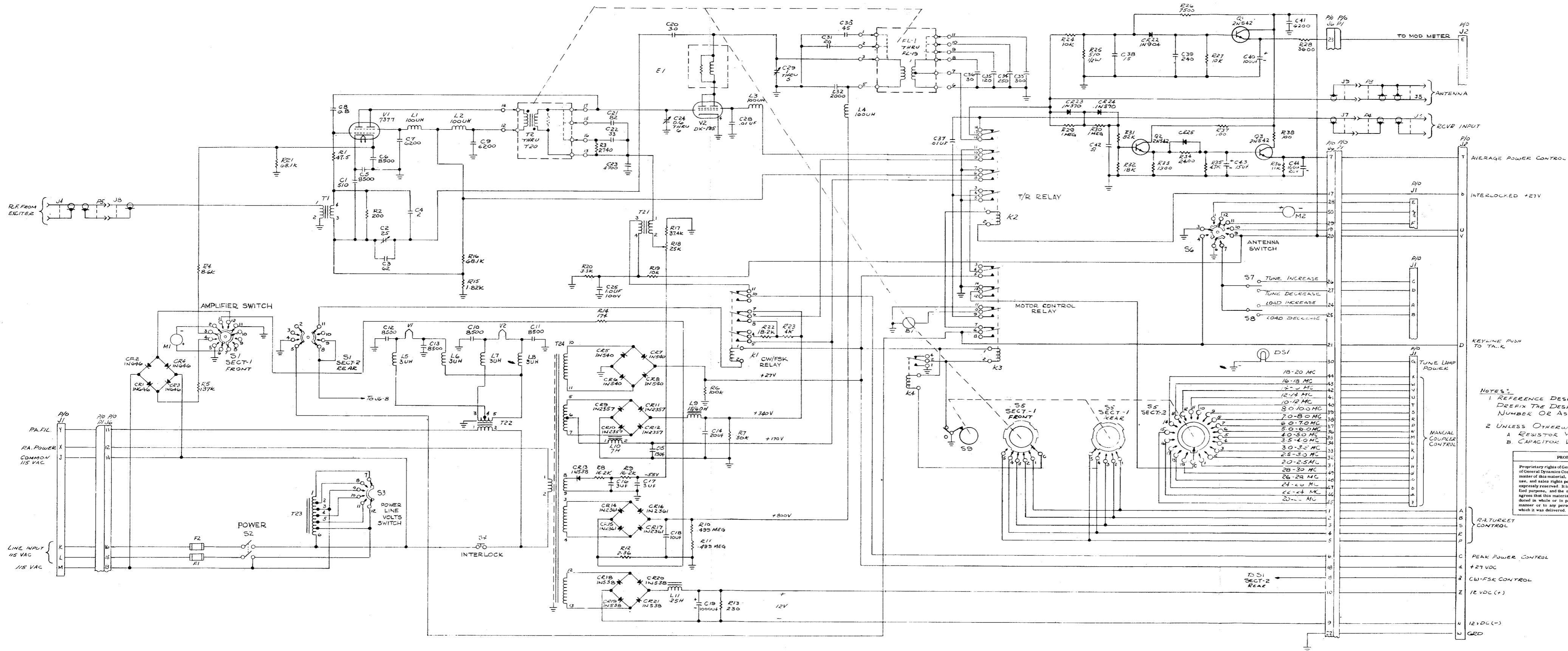
2.1.2.5 When the output of the Power Amplifier reaches a level corresponding to 50 watts average power, the APC circuit feeds back a DC level to the Exciter that maintains the level of excitation. In addition, this circuit detects the power output of the Power Amplifier permitting the RF Power Meter on the Exciter front panel to indicate peak power output.

2.1.2.6 Relay and Control Circuits. Relay K1 is energized only when the radio set is used in the CW or FSK position. This relay causes the screen voltage for Power Amplifier V2 to be reduced. Thus, the Power Amplifier operates in a condition much closer to class C than previously described. When relay K1 is energized, the PPC circuit is broken since its use is not required for CW or FSK operation. Relay K1 is automatically energized when the MODE SELECTOR switch on the Exciter front panel is positioned to CW or FSK. The transmit-receive relay K2 serves several functions:

1. It switches the antenna from the output of the Power Amplifier to the input of the receiver.
2. It turns the screen voltage of the Power Amplifier stage on and off.
3. It turns the screen and plate voltages of the driver stage on and off, and it acts as an interlock to prevent the motor, which operates the turret, from running when the set is in the transmit mode of operation.

2.1.2.7 Motor relay K3 serves primarily to turn motor B1 on and off when a frequency change is desired. Terminals 3, 4, and 5 are part of the interlock that prevents the turret motor from operating when the set is transmitting. Contacts 12, 13 and 14 act as an interlock that prevents the Semi-Automatic Antenna Coupler from rough tuning before the Power Amplifier turret is stopped. Terminals 9, 10, and 11 operate the turret motor, turning it on and off.

2.1.2.8 In the ON position, the 'hot' side of the motor is connected to the 27-volt DC from the Power Supply. When the turret reaches its proper position, the motor relay K3 (contacts 9 and 10) will open up, and the back contacts 10 and 11 will short the motor windings causing the motor to act as a dynamic brake. The motor, shorted out, comes to a quick stop. The last set of relay contacts 6, 7 and 8 are used to open the key line when the turret is running. This action prevents the radio set from transmitting until the turret is stopped. Relay K3 is operated through the smaller relay K4. When a new frequency is desired, the digital tuning knobs on the front panel of the Exciter are positioned to a new frequency. This causes a certain combination of the 5-wire coding system to automatically position the turret. When a new frequency is selected, relay K4 is energized; it then energizes motor relay



NOTES:
 1. REFERENCE DESIGNATIONS ARE ABBREVIATED
 PREFIX THE DESIGNATION WITH THE UNIT
 NUMBER OR ASSY. DESIGNATION OR BOTH.
 2. UNLESS OTHERWISE SPECIFIED
 A. RESISTOR VALUES IN OHMS
 B. CAPACITOR VALUES IN MICRONICSEAL

PROPRIETARY RIGHTS
 Proprietary rights of General Dynamics/Electronics Division of General Dynamics Corporation are involved in the subject matter of this material, and all manufacturing, reproduction, use, and sales rights pertaining to such subject matter are expressly reserved. It is submitted in confidence for a specified purpose, and the recipient by accepting this material agrees that this material will not be used, copied or reproduced in whole or in part nor its contents revealed in any manner or to any person except to meet the purpose for which it was delivered.

Figure 2-1. Power Amplifier-Power Supply SC-910A, Schematic Diagram

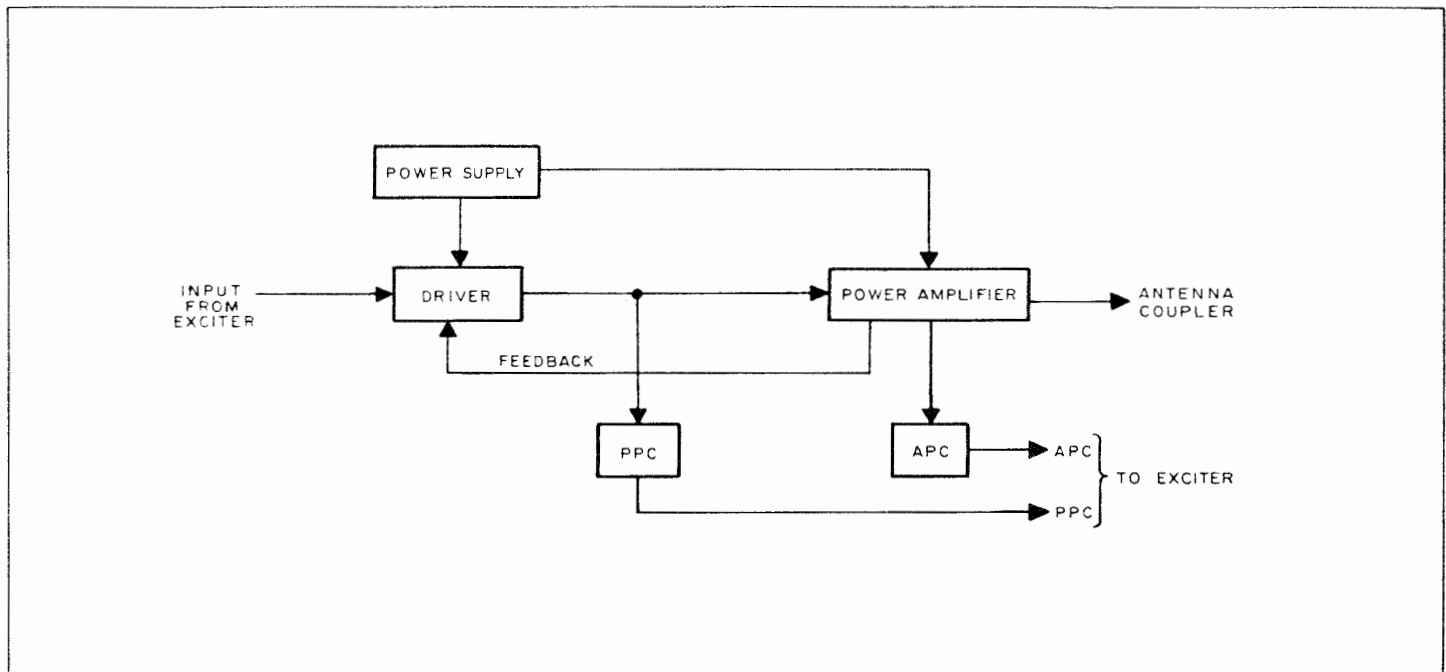


Figure 2-2. Power Amplifier-Power Supply SC-910A, Block Diagram

K3, which operates the motor. The microswitch is part of the turret control circuit and is used to position the turret precisely. This is accomplished by means of a cam arrangement on the edge of the turret, which operates the microswitch.

2.1.2.9 Power Supply. The 115-volt AC line voltage is applied to the primaries of filament transformer T22, and power transformer T24, via auto-transformer T23. A tap switch, S3, provides for adjustment of the line voltage from 95 to 135 volts in 10-volt steps. Meter M1, connected across the primary of the auto-transformer line at S1, monitors the line voltage level. The AC-line voltage is converted to DC for use by the meter by a bridge rectifier, CR1 through CR4.

2.1.2.10 Multiple secondary windings on the power transformer provide AC input voltage of the proper value to five sets of silicon diode rectifiers:

1. Windings 8 and 9 feed the + 55 volts DC grid bias rectifier.
2. Windings 5 and 6 feed the +340 volt DC power amplifier, screen supply rectifier, and the +170 volts DC driver plate and screen supply rectifier.

3. Windings 10 and 11 feed the +27 volts DC relay supply rectifier.

4. Windings 3 and 4 feed the +800 volt Power Amplifier plate supply rectifier.

5. Windings 12 and 13 feed a +12 volts DC control voltage rectifier.

2.1.2.11 Interlock switch, S4, disables the power transformer primary, when the chassis is extended from the case.

2.1.2.12 The AC input voltage to the unit is controlled by the POWER ON/OFF switch, S2. Filament and power transformer primary voltage is controlled by the MODE SELECTOR switch on the Exciter front panel.

2.2 DESCRIPTION OF CONTROLS AND INDICATORS

All controls and indicators necessary to the normal operation of the Power Amplifier are located on the front panel. (See figure 2-3.) The controls and indicators are listed in table 2-1.

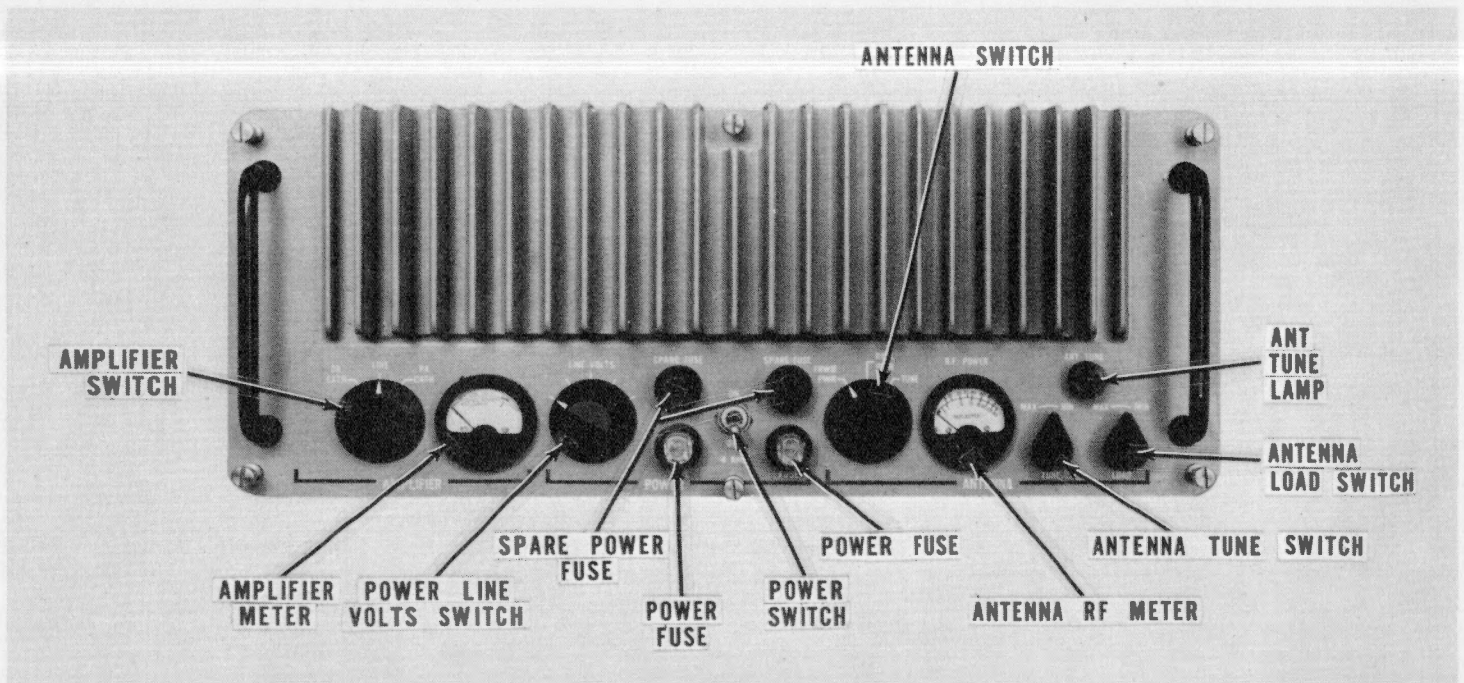


Figure 2-3. Power Amplifier-Power Supply SC-910A, Front View

TABLE 2-1

POWER AMPLIFIER-POWER SUPPLY SC-910A, CONTROLS AND INDICATORS

Control	Nomenclature	Function
AMPLIFIER SWITCH	S1	Selects circuit to be metered DR CATH (driver cathode), LINE, PA CATH (power amplifier cathode).
AMPLIFIER meter	M1	Monitors circuit selected by AMPLIFIER switch.
POWER LINE VOLTS switch	S3	Adjusts line voltage from 95 to 135 volts in steps of 10 volts.
POWER FUSE	F1	Protects primary circuit against overload.
POWER FUSE indicator	-	Lights when fuse is blown.
POWER FUSE	F2	Protects primary circuit against overload.
POWER FUSE indicator	-	Lights when fuse is blown.
POWER SPARE FUSE holders	-	Contains spare fuses for F1 and F2.

TABLE 2-1 (Cont.)

POWER AMPLIFIER-POWER SUPPLY SC-910A, CONTROLS AND INDICATORS

Control	Nomenclature	Function
POWER ON/OFF switch	S2	Controls 115 volts AC power input.
ANTENNA switch	S6	Selects circuit to be metered, FRWD POWER, REFL POWER or TUNE.
ANTENNA RF POWER meter	M2	Reads circuit selected ANTENNA switch.
ANTENNA TUNE switch*	S7	Activates motor in Semi-automatic Coupler SC-905C.
ANTENNA LOAD switch*	S8	Activates motor in the Semi-automatic Coupler SC-905C.
ANTENNA TUNE lamp*	DS1	Lights when Semi-automatic Coupler is rough tuning after a frequency change. When lamp extinguishes, Coupler is rough tuned and may be final tuned.

NOTE

*Controls used only with Semi-Automatic Coupler SC-905C.

2.3 OPERATING PROCEDURES

To operate the Power Amplifier, proceed as follows:

1. Turn POWER switch ON. Check that POWER fuse lamps are not illuminated.
2. Place AMPLIFIER switch in LINE position.
3. Adjust LINE switch until meter reads in green area on upper scale.
4. Place Exciter SC-910E into operation by selecting a mode of operation.

NOTE

Allow a two-minute warmup period before operating the equipment.

5. Operate AMPLIFIER switch to DR CATH and PA CATH position. Verify that meter reads to black line on lower scale.

6. Check that ANT TUNE lamp is extinguished. If lamp is illuminated, Antenna Coupler is retuning. Proceed with following steps.

7. Place ANTENNA switch in TUNE position.
8. Operate TUNE switch. Tune for minimum on RF POWER meter.
9. Operate LOAD switch. Tune for minimum on RF POWER meter.
10. Place ANTENNA switch in FWD PWR position. Note reading.
11. Place ANTENNA switch in REFL PWR position. Note reading. VSWR will be 1.3:1 or less.

2.4 SHUTDOWN PROCEDURES

To shutdown the Power Amplifier for intermittent use, place the MODE SELECTOR switch on the Exciter to STD BY.

To shutdown the equipment for an extended time, place the POWER switch to OFF.

CHAPTER III

PREVENTIVE MAINTENANCE

3.1 GENERAL

Power Amplifier-Power Supply SC-910A is a precision instrument and will require very little maintenance. Table 3-1 lists the preventive maintenance checks that should be performed on a regular monthly basis.

TABLE 3-1

POWER AMPLIFIER-POWER SUPPLY SC-910A,
PREVENTIVE MAINTENANCE CHECKS

Inspect for	Remedy
Dust.	Clean exterior with soft-lintless cloth. Clean interior with brush, cloth or suction.
Nicks, burrs, dents, scratches or rust spots.	Smooth burrs with a file. Sandpaper rust or scratches and repaint.
Smooth operation of drawer slides and cams.	Clean with trichlorethylene.
Loose or broken hardware, handles or mounting screws.	Tighten loose hardware. Replace defective parts.
Broken lugs, frayed leads, split, chipped or broken components.	Repair or replace defective parts.
Solder joints.	Resolder.
Cable assemblies broken, frayed or damaged.	Repair or replace.
Interlock switches broken or bent.	Repair or replace.
Circuit boards cracked.	Repair or replace.
Wiring damaged.	Replace.
Check tubes.	Replace if necessary.

CHAPTER IV TROUBLE-SHOOTING

4.1 GENERAL

This chapter contains information pertinent to trouble-shooting the Power Amplifier-Power Supply SC910A. Test equipment required, control setting, system trouble-shooting and functional trouble-shooting data is presented in tabular form.

4.2 TEST EQUIPMENT AND SPECIAL TOOLS

Test equipment required for trouble-shooting the Power Amplifier is listed in table 4-1. No special tools are required.

TABLE 4-1

POWER AMPLIFIER-POWER SUPPLY SC-910A,
TEST EQUIPMENT REQUIRED

Common Name	Model and Manufacturer	Alternate
Multimeter	Triplett	Yes
50-ohm load	Bird Mfg., Model 32	Yes
RF Generator	Hewlett-Packard, Model 606A	Yes
RF Voltmeter	Hewlett-Packard, Model 410B with Model probe 455A.	Yes

TABLE 4-2

POWER AMPLIFIER-POWER SUPPLY SC-910A, SYSTEM TROUBLE-SHOOTING CHART

Step	Action	Normal Indication	Abnormal Indication Procedure
1.	Disconnect coaxial cable to J4. Connect RF meter T connector to J4 and re-connect cable. Connect RF meter to T connector. Place Mode Selector switch to LSB. Press push-to-talk button and speak into microphone.	Meter will fluctuate with voice peaks.	If normal indication is present, proceed to next step. If abnormal reading is obtained, Exciter is at fault.
2.	Connect RF meter T connector between J5 and coaxial cable to Antenna Coupler. Connect RF meter to T connector. Press push-to-talk button and speak into microphone.	Meter will fluctuate with voice peaks.	If normal indication is present, system is operative. If abnormal indication is present, trouble is in Power Amplifier. If indication is normal, but trouble is reported by operator, malfunction is in Antenna Coupler.

4.3 CONTROL SETTINGS

Make the following control settings prior to system trouble-shooting the Power Amplifier:

1. Place Power Amplifier POWER switch to ON position, Exciter MODE SELECTOR switch to STD BY.

NOTE

When operating the unit with the chassis extended from the case, cheat the interlock by hooking the vertical arm to the wiper and pulling the wiper up.

CAUTION

Do not operate the Power Amplifier unless a load is connected to the RF output jack.

4.4 SYSTEM TROUBLE-SHOOTING CHART

Use table 4-2 to determine if trouble exists in the Power Amplifier.

NOTE

Verify the Power Amplifier is receiving the proper power and signal inputs before attempting to trouble-shoot the unit.

4.5 FUNCTIONAL TROUBLE-SHOOTING

NOTE

Use table 4-3 to localize trouble in the Power Amplifier. (See figure 4-1 for physical location of components).

If vacuum tube V2 is changed, make the following adjustment before operation:

Operate the AMPLIFIER switch to the PA CATH position. Adjust R4 until meter reads to black line on the lower scale.

TABLE 4-3

POWER AMPLIFIER-POWER SUPPLY SC-910A, FUNCTIONAL TROUBLE-SHOOTING CHART

Step	Preliminary Action	Normal Indication	Next Step
1a.	Place AMPLIFIER switch in PA CATH position.	Meter will read to black line on lower scale.	If indication is normal, proceed to next step. If abnormal, check V2 and associated circuit. Check relay K2.
b.	Place MODE SELECTOR switch to FSK position. Verify that relay K2 energizes and de-energizes when switch is returned to USB.		
2.	Place AMPLIFIER switch in DR CATH position. Press push-to-talk button.	Meter will read to black line on lower scale.	If indication is normal, unit is operative. If abnormal, reading is obtained, check V1 and associated circuit.

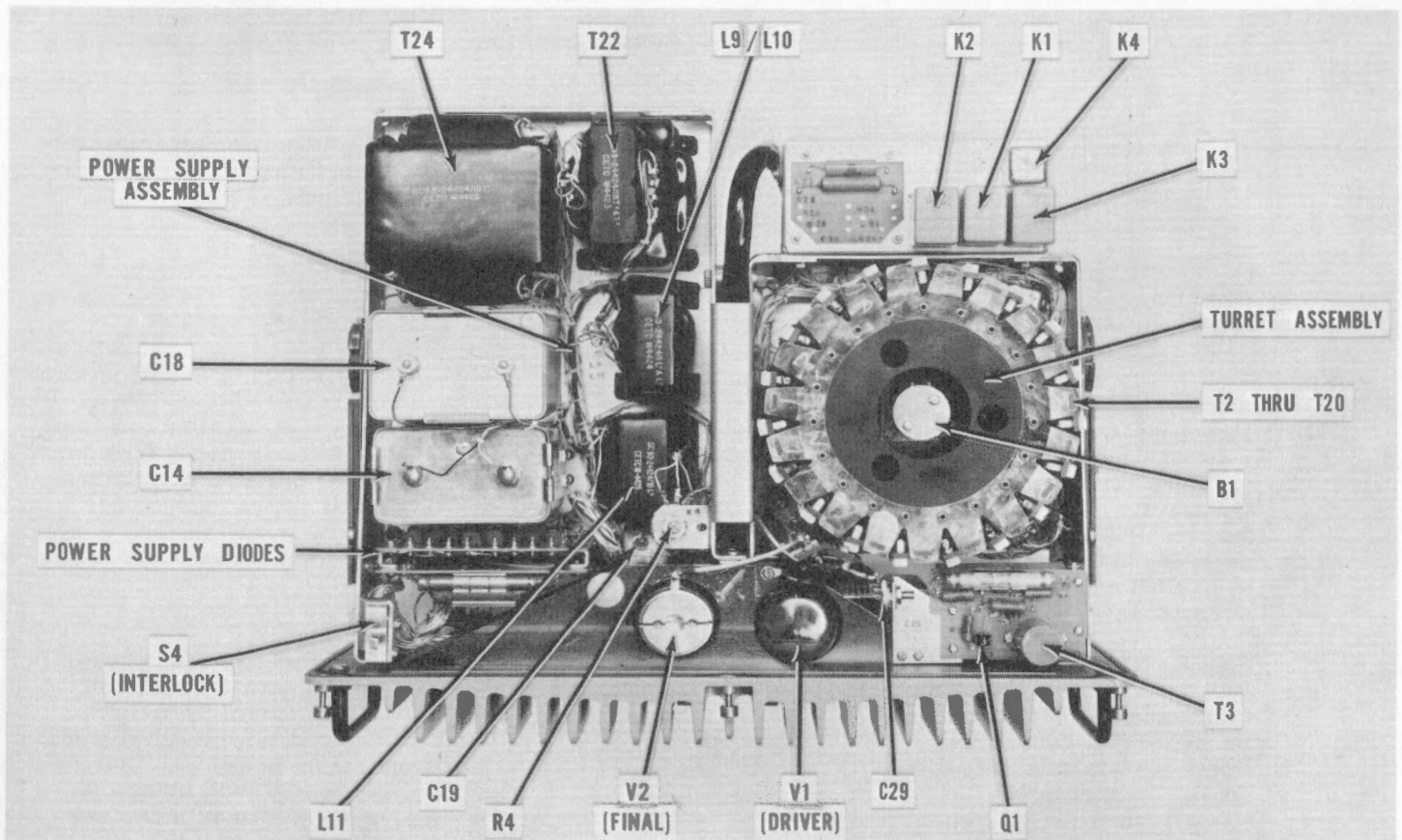


Figure 4-1. Power Amplifier-Power Supply SC910A, Top View

CHAPTER V
REPLACEABLE PARTS

(Replaceable Parts List to be supplied at a latter date.)