INSTRUCTION MANUAL

HAMMARLUND

FOUR·20

TRANSMITTER

SECTION 1

FOUR·11

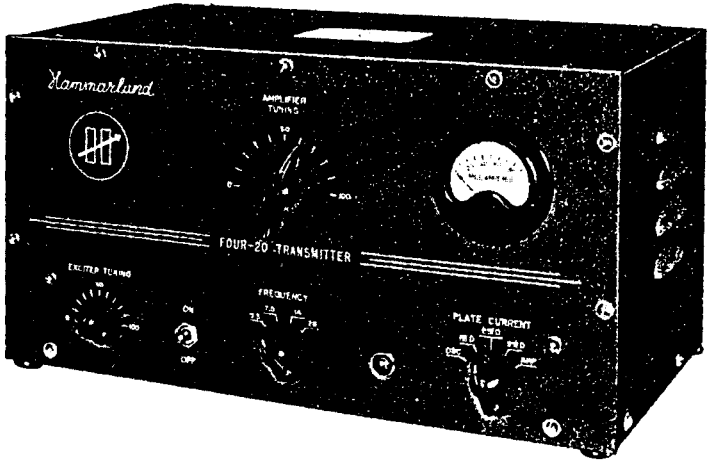
MODULATOR

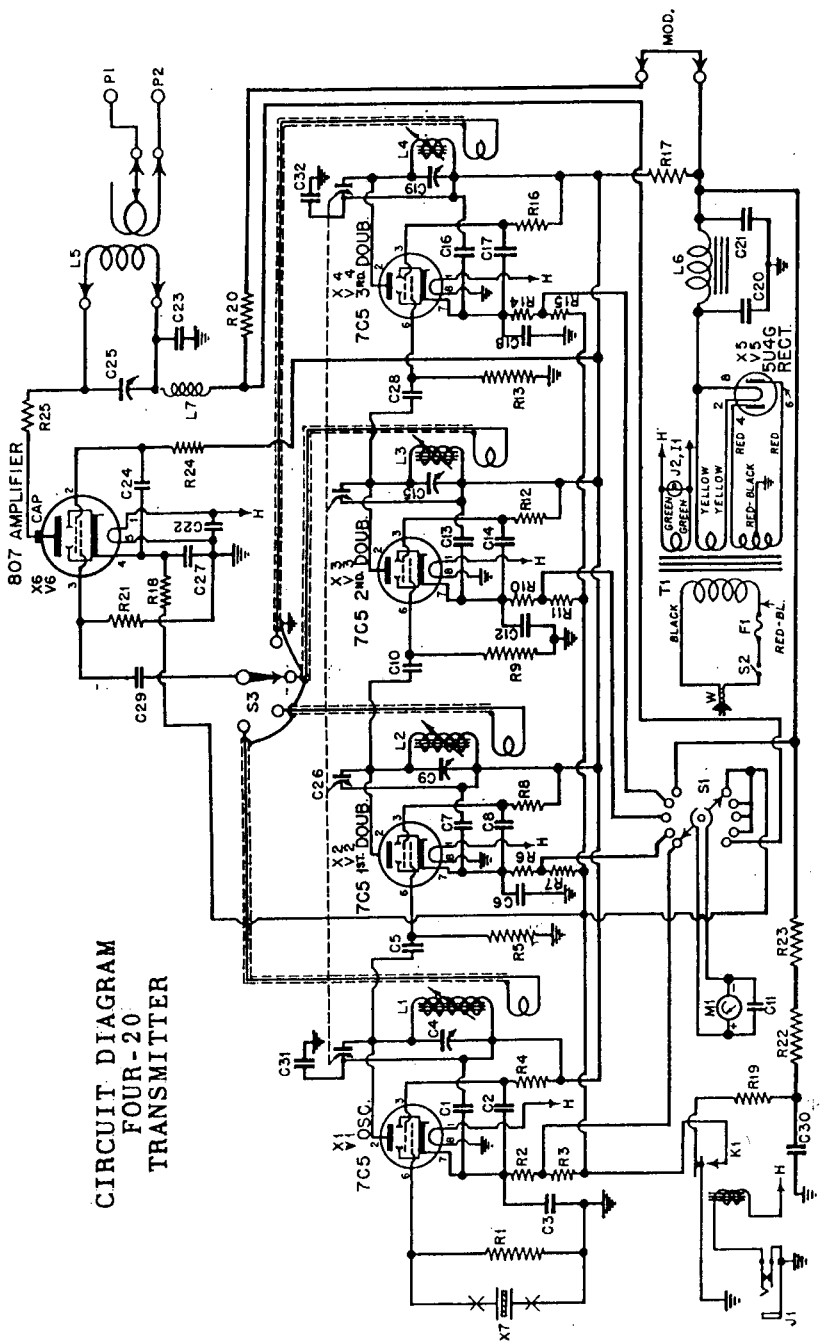
SECTION 2

HAMMARLUND MANUFACTURING CO., INC.
460 West 34th Street : : New York 1, N.Y.

FOUR·20

TRANSMITTER




CIRCUIT DIAGRAM
FOUR-20
TRANSMITTER
807 AMPLIFIER
7C5 OSC.
7C5 2ND DOUB
7C5 3RD DOUB
7C5 1ST DOUB
5U4G RECT.
MOD.
P1
P2
J1
J2
K1
L1
L2
L3
L4
L5
L6
L7
M1
S1
S2
S3
T1
X1
X2
X3
X4
X5
X6
X7
F1
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
C22
C23
C24
C25
C26
C27
C28
C29
C30
C31
C32
BLACK
RED-BL.
YELLOW
YELLOW
RED-BLACK
RED
GREEN
GREEN

INTRODUCTION

THE HAMMARLUND MODEL FOUR-20 TRANSMITTER is a completely self-contained crystal controlled unit designed for operation in any part of the 3.5, 7, 14, 27 and 28 Mc amateur bands. It has a conservative power output rating of 20 watts on all bands. Although primarily intended for crystal controlled operation with a crystal whose fundamental frequency is within the 3.5 to 4 Mc amateur bands, this unit may be excited from a variable frequency oscillator having an output in the same range and fed into the crystal socket. Provision is made for cw-telegraph keying and also for telephone modulation. When telephone modulation is used, a separate unit such as a Hammarlund Four-11 Modulator may be used. A small high-speed relay is included within the unit for telegraph keying. Operating power for this relay is supplied by the unit and it is necessary only to connect a telegraph key to the transmitter. The oscillator and multiplier circuits are of the sharply resonant type rather than the lower efficiency broad band types so commonly used. Circuits of this type assure the highest possible efficiency. Single dial control of the oscillator and multiplier circuits is possible through the use of mono-sequence tuning. (The features of this system are disclosed in U.S. Patent #2,388,233.) The oscillator portion has been carefully engineered and designed to obtain a maximum frequency stability for for a given crystal. The power required from the crystal is negligible and therefore drift due to the heating of the crystal by radio frequency currents is practically non-existent. A milliammeter is included with a switching arrangement to permit the metering of each R.F. tube.

The Hammarlund Four-20 Transmitter is 8-1/4" high, 15-1/4" wide, and 9-1/2" deep. The total weight is 31 lbs.

DESIGN

7C5LT beam tubes are used in the oscillator and three frequency multiplier stages in a mono-sequence tuning system. An 807 tube is used as a power amplifier. Excitation to the grid of the power amplifier is taken from the oscillator or any one of the multiplier stages by means of a selector switch. Plug-in coils are used in the output circuit of the power amplifier. These plug-in coils are accessible by removing the top cover of the transmitter and are equipped with an output coupling arrangement with an adjustable tap to permit matching the output of the transmitter to any of the conventionally used antenna feeder systems. This output system will match a line of any impedance between 50 and 600 ohms. The power supply uses a 5U4G full wave rectifier tube in a conventional power supply and filter circuit and provides ripple free plate power to all stages.

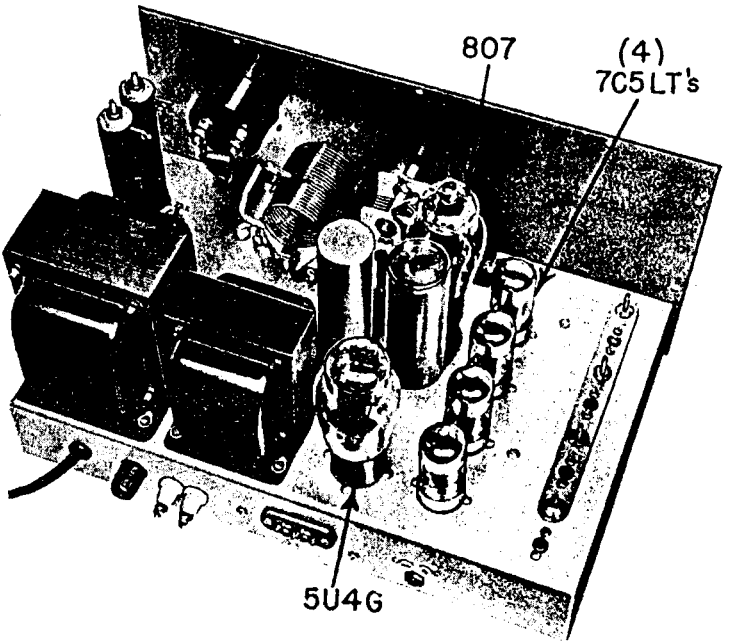
Panel controls are provided for tuning the oscillator and multiplier stages, the power amplifier output circuit, and for the metering system. A switch is provided on the front panel for turning the power on and off and a pilot light indicates when the power is on. A crystal socket on the rear of the unit is designed to accept a modern type crystal holder having a pin diameter and spacing equivalent to the Signal Corps type FT-243 holder.

A telephone jack is mounted on the rear for the purpose of plugging in a telegraph key. A termial block is provided for connections to the modulator and two feed-through bushings provide a means for connection to the R.F. transmission line.

OPERATION

After unpacking the transmitter make sure that all tubes are properly fitted into their respective sockets and that the plate cap is in place on the 807 amplifier tube. This transmitter operates on a standard 105-120 volt A.C. 50 to 60 cycle power line. If you are uncertain as to the power available, check with your local power company office.

Insert the proper output coil for the band in which you wish to operate and adjust the frequency



selector switch to a corresponding frequency. Insert the crystal in its socket at the rear of the transmitter and connect the antenna transmission line to the antenna terminals. Adjust the meter selector switch to read cathode current of the multiplier which corresponds to the frequency band you wish to use.

Note: The meter switch is marked 'osc.', '1st D', '2nd D', '3rd D', and 'amp.'. If operation is to be on 28 MC set this switch to '3rd D', if operation is to be at 14 MC set switch to '2nd D', and if operation is to be at 7 MC set the switch to '1st D', and if the operation is to be at 3.5 MC set the switch on 'osc.'.

If the transmitter is to be used for telephone modulation connect the modulator to the terminals marked 'modulator' at the rear of the chassis. If the transmitter is to be used for cw-telegraph operation be sure that these terminals are short-circuited before turning on the power.

Be sure that the cover is in place on the top of the unit, with all fasteners securely locked.

Plug in power cord, turn on power switch and allow a 20 second warm up. Adjust the exciter tuning control for minimum meter reading. (For 3.5 Mc operation adjust this control clockwise to obtain 6 ma. higher than minimum meter reading.) Next adjust plate current switch to AMP. and adjust the amplifier tuning control for minimum current.

When properly loaded, the amplifier plate current will be approximately 60 ma. If the plate current is higher than this value adjust the tap on the output coupling coil until the minimum reading is approximately 60 ma. Likewise, if the minimum current is less than the above value, an adjustment should be made on this tap. A minimum reading of more than 60 ma. generally indicates *too many* turns in the output coupling coil. A minimum reading of *less* than 60 ma. usually indicates too few turns in the output coupling coil.

The transmitter is now ready for operation and may be used for either c.w. telegraph keying or telephony. When operating the transmitter for telephony, the c.w. telegraph key may be used as a stand-by operate switch or the leads from a telephone plug may be brought out to an auxiliary switch for this purpose.

REALIGNMENT PROCEDURE

The mono-sequence tuning system has been carefully aligned at the factory and should not be tampered with unless a vital part such as a coil is replaced in which case the unit should be returned to the factory for realignment. The adjustments for this system are the screwdriver adjustments seen to the left of the 7C5LT tubes, looking down at the chassis, facing the front panel. The adjustments with the screwdriver slots surrounded by a hexagon nut are the capacity trimmers, and the screwdriver adjustments in the ends of the threaded shafts are the inductance trimmers.

The realignment procedure below must be followed carefully.

A 3400 KC crystal and a 4000 KC crystal will be required.

Turn the meter selector switch to 'osc.'.

1. Insert the 4000 KC crystal. Set the exciter tuning control to 80 on scale. Adjust the oscillator

capacity trimmer for a minimum reading, and then *reduce* the trimmer capacity until the meter reads approximately 6 MA. higher than the minimum.

2. Replace the 4000 KC crystal with a 3400 KC crystal. Set the exciter tuning control to 28[redacted] degrees. Adjust the *inductance* trimmer for a minimum plate current reading, and then rotate the inductance trimmer counter clockwise until the plate current increases approximately 6 MA.

Replace the 3400 KC crystal with the 4000 KC crystal and re-adjust the trimmer capacity as in 1 and repeat 2. Keep repeating 1 and 2 until a change is no longer necessary in either the trimmer capacity or inductance adjustment.

3. Insert the 4000 KC crystal. Set the meter selector switch to 1st D. Adjust the exciter tuning control to [redacted]80 on scale. Adjust the 1st doubler capacity trimmer for a *minimum* reading of the meter. Replace the 4000 KC crystal with a 3400 KC crystal. Rotate the exciter tuning control to 28[redacted] degrees. Adjust the first doubler *inductance* trimmer for a minimum reading of the meter.

Repeat these two procedures until the plate current in the first doubler stage is minimum on each frequency when the exciter tuning control is at the specified setting. *Check to be sure that these settings correspond to the exact position of this control which produces the correct oscillator plate current reading as described in steps 1 and 2.*

Repeat the same procedure for the second and third doubler stages. When properly aligned, the current in all multiplier stages will be at a minimum at the proper setting of the exciter tuning control, and the oscillator plate current will be approximately 6 MA. higher than its minimum.

ANTENNA SUGGESTIONS

The antenna system is perhaps one of the most important parts of any radio installation. No amount of power output from a transmitter will be useful for communication purposes unless that power is radiated. The best performance will be realized with the use of a more or less complicated array consisting of a radiator with a reflector and one or more directors, or with some other system such as a rhombic, 'V' beam, etc. Such antennae are described in various handbooks and manuals generally *available*

from your dealer. Considerable study is required in order to understand the operation of such arrays, and much care must be exercised in their erection and adjustment. The results derived from the use of such arrays will repay the user many fold for his efforts.

The output circuit of the Hammarlund 'Four-20' transmitter is capable of adjustment to match the feeder systems of all popular arrays, as well as a simple antenna system.

The more simple radiating systems comprise a dipole radiator connected to the transmitter by means of a balanced transmission line as shown in Fig. 1, a 'folded dipole' antenna as shown in Fig. 2, or even a vertical radiator as shown in Fig. 3. These systems while rather elementary, will perform quite satisfactorily.

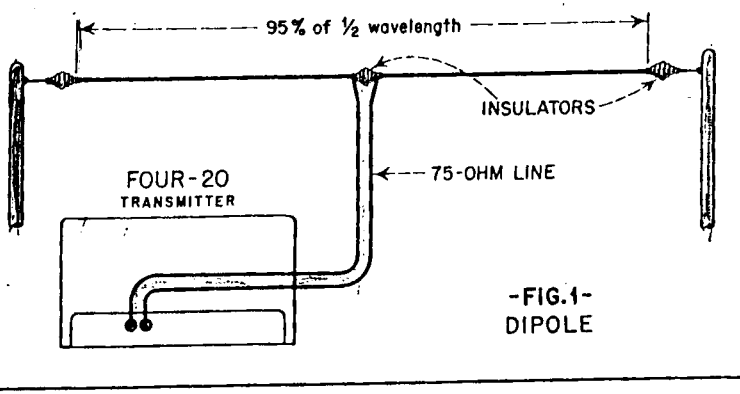
An antenna system incorporating a balanced transmission line feeder system is recommended above all others, whether the radiator is an array, a folded dipole, or a simple half wave dipole. An unbalanced feeder system will radiate a part of the energy before it reaches the radiator. This reduces the power fed to the radiator and is likely to produce feedback in the audio system, in the receiver, etc. because of radiation, from the portion of the line within the operating room.

MAINTENANCE

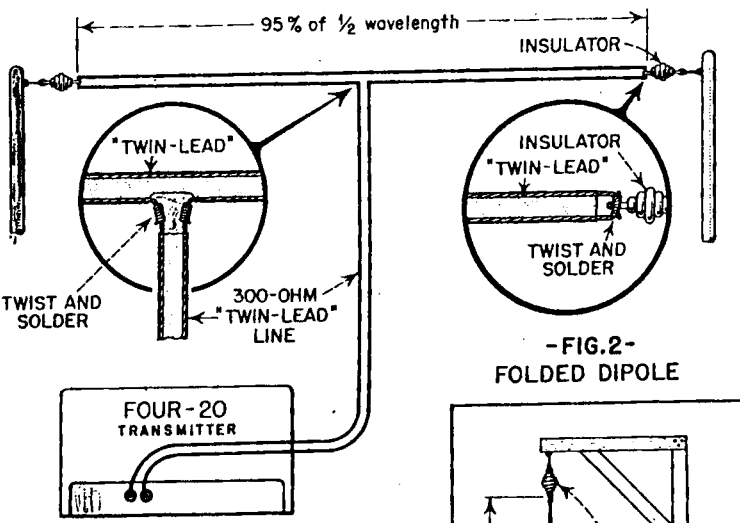
The Hammarlund Four-20 Transmitter should give long and satisfactory service without need for repair. The first source of trouble is most likely to be the tubes and in case of failure they should be checked by a reliable technician. The 2nd most common source of trouble may be found in a large assortment of small resistors and capacitors. The chart below gives the value of voltages between the tube sockets and ground or the B negative side of the circuit. These values are measured with a meter having a D.C. resistance of 1000 ohms per volt. Measurements are made with the crystal removed from this socket and with the line voltage of 117 V A.C. A chart is also included showing the approximate resistance to ground for each tube socket terminal. On measuring resistances to ground be sure that the power plug is removed from the wall socket.

WARNING

These measurements should be made by an experienced technician using the proper precautions to



-FIG.1-
DIPOLE



-FIG.2-
FOLDED DIPOLE

SIMPLE RADIATING SYSTEMS SUGGESTED FOR USE WITH FOUR-20 TRANSMITTER

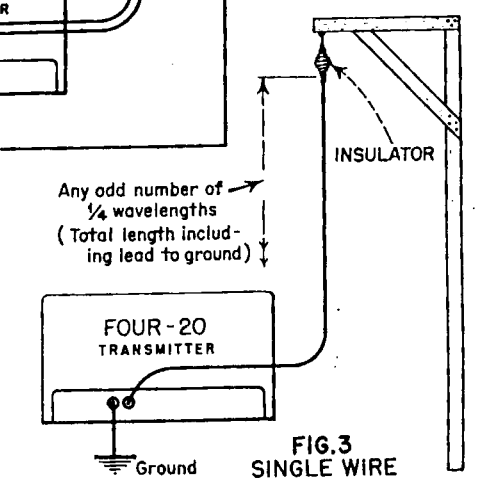


FIG.3
SINGLE WIRE

prevent accidental bodily contact with any of the electrical circuits. While the potentials in this unit may not be extremely high, accidental contact with a 'live' circuit could be dangerous. The unit should be returned to the factory for all such checks, as the manufacturer can not assume any responsibility for accidental electrical shock to persons making 'live' circuit checks.

RESISTANCE MEASUREMENTS BETWEEN SOCKET TERMINALS AND GROUND USING A 1000 OHM PER VOLT METER

Plate current switch to AMP. "ON"-"OFF" switch "OFF".

Tube	7C5 Osc.	7C5 1st. D.	7C5 2nd D.	7C5 3rd D.	807 Amp.	5U4G Rect.
Pin 1						
Pin 2	6700	6700	6700	6700	21700	
Pin 3	28700	28700	28700	28700	18000	
Pin 4						
Pin 5						
Pin 6	22000	270,000	270,000	270,000		
Pin 7	*415	*415	*415	*415		
Pin 8						
CAP				5300		

*With the relay armature held by hand in the operate position. (Key closed).

Line voltage 117 V.A.C. Key closed. No crystal plugged in.

1000 ohm per volt voltmeter used to measure all D. C. voltages.

Tube	7C5 Osc.	7C5 1st. D.	7C5 2nd D.	7C5 3rd D.	807 Amp.	5U4G Rect.
Pin 1	6.3 A.C.	6.3 A.C.	6.3 A.C.	6.3 A.C.	6.3 A.C.	
Pin 2	270	270	270	270	200	500
Pin 3	210	210	210	210		
Pin 4					7.5	485 A.C.
Pin 5						
Pin 6						485 A.C.
Pin 7	11	11	11	11		
Pin 8						
Plate Cap					470	

NOTE: A license from the Federal Communications Commission is required to operate a transmitter.

TABLE OF REPLACEABLE PARTS

SCHEMATIC DESIG.	NAME OF PART & DESCRIP.	FUNCTION	PART NUMBER
C1	CAPACITOR, Fixed mica, 2700 mmf. ±10%, 500WVDC.	Oscillator plate by-pass	23009-19
C2	CAPACITOR, Same as C1	Oscillator screen by-pass	23009-19
C3	CAPACITOR, Fixed mica, 5000 mmf. ±20%, 500WVDC	Oscillator cathode by-pass	23069-9
C4	CAPACITOR, Variable, 25 mmf. (APC)	Oscillator padding	11725-G1
C5	CAPACITOR, Fixed mica, 100 mmf. ±10%, 500WVDC.	1st doubler grid coupling	23001-23
C6	CAPACITOR, Same as C1	1st doubler cathode by-pass	23009-19
C7	CAPACITOR, Same as C1	1st doubler plate by-pass	23009-19
C8	CAPACITOR, Same as C1	1st doubler screen by-pass	23009-19
C9	CAPACITOR, Same as C4	1st doubler padding	11725-G1
C10	CAPACITOR, Same as C5	2nd doubler grid coupling	23001-23
C11	CAPACITOR, Same as C1	Meter by-pass	23009-19
C12	CAPACITOR, Same as C1	2nd doubler cathode by-pass	23009-19
C13	CAPACITOR, Same as C1	2nd doubler plate by-pass	23009-19
C14	CAPACITOR, Same as C1	2nd doubler screen by-pass	23009-19
C15	CAPACITOR, Same as C4	2nd doubler padding	11725-G1
C16	CAPACITOR, Same as C1	3rd doubler plate by-pass	23009-19
C17	CAPACITOR, Same as C1	3rd doubler screen by-pass	23009-19
C18	CAPACITOR, Same as C1	3rd doubler cathode by-pass	23009-19
C19	CAPACITOR, Same as C4	3rd doubler padder	11725-G1
C20	CAPACITOR, Dykanol 4 mfd. ±10% 600WVDC	Power supply filter	23843-3
C21	CAPACITOR, Dry electrolytic 16 mfd. 600WVDC.	Power supply filter	23842-13

TABLE OF REPLACEABLE PARTS

SCHEMATIC DESIG.	NAME OF PART & DESCRIP.	FUNCTION	PART NUMBER
C22	CAPACITOR, Fixed mica, 10,000 mmf. ±10%, 300WVDC	P. A. Heater by-pass	23015-13
C23	CAPACITOR, Fixed mica, 1000 mmf. ±10%, 1200WVDC	P. A. Plate supply by-pass	23040-235
C24	CAPACITOR, Same as C22	P. A. Screen by-pass	23015-13
C25	CAPACITOR, Spec. HFA, Variable 50 mmf.	P. A. Tuning	11033-G25
C26	CAPACITOR, Variable, 4-gang, 35 mmf., 600VRMS	Oscillator multiplier tuning	11738-1
C27	CAPACITOR, Same as C22	P. A. Cathode by-pass	23015-13
C28	CAPACITOR, Same as C5	3rd doubler grid coupling	23001-23
C29	CAPACITOR, Same as C1	P. A. Grid coupling	23009-19
C30	CAPACITOR, Tubular paper, Waxed, .05 mfd. +30-10%, 600WVDC	Keying click filter	23912-2
C31,32	CAPACITOR, Molded mica 8200 mmf. ±10%, 500WVDC	By-pass	23019-11
E1	FUSEHOLDER, Bakelite body, for panel mtg.	Holder for F1	15923-1
F1	FUSE, 3 amp. 250 Volt	Overload protection	15928-8
I1	LAMP, 6-8 V., 0.15 amp., single contact, min. bayonet base, Mazda #47	Pilot light	16004-1
J1	JACK, Phone, 3 circuit	Telegraph Key connection	6087-1

TABLE OF REPLACEABLE PARTS

SCHEMATIC DESIG.	NAME OF PART & DESCRIP.	FUNCTION	PART NUMBER
J2	LAMPHOLDER, Panel Mtg., min. bayonet base, ruby jewel, for 7/16" mtg. hole	Holder for I1	16093-2
K1	RELAY, Continuous duty, 6 V A.C. supply, 10 ohm coil resist.	Telegraph keying	15875-1
L1	COIL, Assembly, 80 Meter	Oscillator Tank	29812-G1
L2	COIL Assembly, 40 Meter	1st Doubler Tank	29812-G2
L3	COIL Assembly, 20 Meter	2nd Doubler Tank	29812-G3
L4	COIL Assembly, 10 Meter	3rd Doubler Tank	29812-G4
* L5	TANK COIL, with 5-pin base, Coil inductance- 34 to 44 uh. Link inductance- 9.7 to 11.88 uh	P.A. Tank 80 Meter	29829-1
	Coil induct.- 9.8 to 11 uh. Link induct. - 6.84 to 8.36 uh.	P.A. Tank 40 Meter	29829-2
	Coil induct.- 3.4 to 3.9 uh. Link induct.- 3.06 to 3.74 uh.	P.A. Tank 20 Meter	29829-3
	* Coil induct.- 0.9 to 1.15 uh. Link induct.- 1.17 to 1.44	P.A. Tank 10 Meter	29829-4

* 10 Meter coil furnished with transmitter. 20, 40 and 80 Meter coils may be purchased from your dealer.

TABLE OF REPLACEABLE PARTS

SCHEMATIC DESIG.	NAME OF PART & DESCRIP.	FUNCTION	
L6	FILTER REACTOR, 15 hen. @160 MA.DC. 160 ohms DC, Chicago Transf. spec. #3405	Power Supply filtering	2981
L7	CHOKE COIL, 5 pie, 2.1 ±10% MH, 35 ohm DC resist., Dist. Cap. 1 mmf. Current 125 MA.	Power Supply filtering	609-G1
M1	METER, Panel type, 0-100 MA.DC. with 50 division scale	Indicator	16344-1
	KNOB, bar, black phenolic with white indicator line, for 1/4" shaft	For C25	16166-1
	KNOB, bar, black pheno.; white indicator line, for 1/4" shaft	For S1,S3 & C26	K26083-1
P1	INSULATOR, Feed-thru, 6-32 x 1-1/4" stud, for 5/16" mtg. hole, porcelain bushings		16133-1
P2	INSULATOR, Same as P1		16133-1
R1	RESISTOR, Fixed composition, 22000 ohm ±10%, 1/2 W	Oscillator grid resistor	19309-81
R2	RESISTOR, Fixed composition, 390 ohm ±10%, 1 W	Cathode biasing	19310-39
R3	RESISTOR, Fixed composition, 27 ohm ±10%, 1/2 W	Oscillator meter shunt	19309-11

TABLE OF REPLACEABLE PARTS

SCHEMATIC DESIG.	NAME OF PART & DESCRIP.	FUNCTION	
R4	RESISTOR, Fixed composition, 22000 ohm ±10%, 1 W	Oscillator screen dropping	19310-81
R5	RESISTOR, Fixed composition, 270,000 ohm, ±10%, 1/2 W	1st Doubler grid resistor	19309-107
R6	RESISTOR, Same as R2	1st Doubler Cathode resistor	19310-39
R7	RESISTOR, Same as R3	1st Doubler Meter shunt	19309-11
R8	RESISTOR, Same as R4	1st Doubler screen dropping	19310-81
R9	RESISTOR, Same as R5	2nd Doubler grid resistor	19309-107
R10	RESISTOR, Same as R2	2nd Doubler Cathode biasing	19310-39
R11	RESISTOR, Same as R3	2nd Doubler meter shunt	19309-11
R12	RESISTOR, Same as R4	2nd Doubler screen dropping	19310-81
R13	RESISTOR, Same as R5	3rd Doubler grid resistor	19309-107
R14	RESISTOR, Same as R2	3rd Doubler cathode biasing	19310-39
R15	RESISTOR, Same as R3	3rd Doubler meter shunt	19309-11
R16	RESISTOR, Same as R4	3rd Doubler screen dropping	19310-81
R17	RESISTOR, Fixed, Wirewound, 1500 ohm ±10%, 25 W	Oscillator Mult. plate dropping	19429-22

TABLE OF REPLACEABLE PARTS

SCHEMATIC DESIG.	NAME OF PART & DESCRIP.	FUNCTION	
R18	RESISTOR, Fixed, Wirewound, 100 ohm ±10%, 5 W	P.A. Cathode biasing	19431-17
R19	RESISTOR, Fixed, Wirewound, 200 ohm ±10%, 10 W	Key click filter	19430-20
R20	RESISTOR, Fixed composition, 27 ohm ±10%, 1 W	P.A. Meter shunt	19310-11
R21	RESISTOR, Fixed composition, 8200 ohm ±10%, 2W	P.A. Grid resistor	19304-40
R22	RESISTOR, Assembly with thru-bolt mtg. hdwre., 2500 ohm ±10%, 50 W	Artificial Power Supply load	19433-224
R23	RESISTOR, Same as R22	Artificial Power Supply load	19433-224
R24	RESISTOR, Fixed, Wirewound, 15,000 ohm ±10%, 10 W	P.A. Screen dropping	19430-58
R25	RESISTOR, Wirewound, 4 ohm ±5%, 5W	Parasitic suppression	15277-1
S1	SWITCH, Wafer, 1-gang, 2 pole, 2-5 position	Meter selector switch	15809-2
S2	SWITCH, Toggle, SPST, 3 amp. 250 V.; panel mtg.	Power On-Off switch	15807-2
S3	SWITCH, Wafer, 1-gang, 1 pole, 4 position	Band switch	15829-2

TABLE OF REPLACEABLE PARTS

SCHEMATIC DESIG.	NAME OF PART & DESCRIP.	FUNCTION	PART NUMBER
T1	TRANSFORMER, Power, Electro-static shielding, 115 V. Pri., Sec. 6.6V.-3 amp. max., 5V.-3 amp., 475V.-0.170 MA	Power supply	4801-2
V1	VACUUM Tube, 7C5	Oscillator	16265-1
V2	VACUUM Tube, 7C5	1st Doubler	16265-1
V3	VACUUM Tube, 7C5	2nd Doubler	16265-1
V4	VACUUM Tube, 7C5	3rd Doubler	16265-1
V5	VACUUM Tube, 5U4G	Power rectifier	16215-1
V6	VACUUM Tube, 807	Power amplifier	16230-1
X1	SOCKET, Locktal, Mtg. plate molded in bakelite	For V1	15944-30
X2	SOCKET, Same as X1	For V2	15944-30
X3	SOCKET, Same as X1	For V3	15944-30
X4	SOCKET, Same as X1	For V4	15944-30
X5	SOCKET, Octal, molded in bakelite mtg. plate with 4 gnd. ears.	For V5	16083-1
X6	SOCKET, 5 prong, mtg. plate molded in mica-bakelite	For V6	15944-11
X7	SOCKET, for crystal, ceramic base, contact centers 1/2"	Crystal Holder	16092-1
X8	SOCKET, Wafer, 5-prong, Steatite base	For L5	16137-2

TABLE OF REPLACEABLE PARTS

SCHEMATIC DESIG.	NAME OF PART & DESCRIP.	FUNCTION	PART NUMBER
	TERMINAL STRIP, Bakelite base 1-1/2" mtg. centers, 2 screw terminals	Modulator input connection	K4904-2
(qty.2)	TERMINAL, Insulated	Transmission line insulators	6284-1
	LINE CORD, with plug, 2 #18 conductors, rubber insulated, with pronged rubber plug attached, cable 7-1/2 ft. long.	Primary Power Connection	K6143-1

FOUR·11

MODULATOR

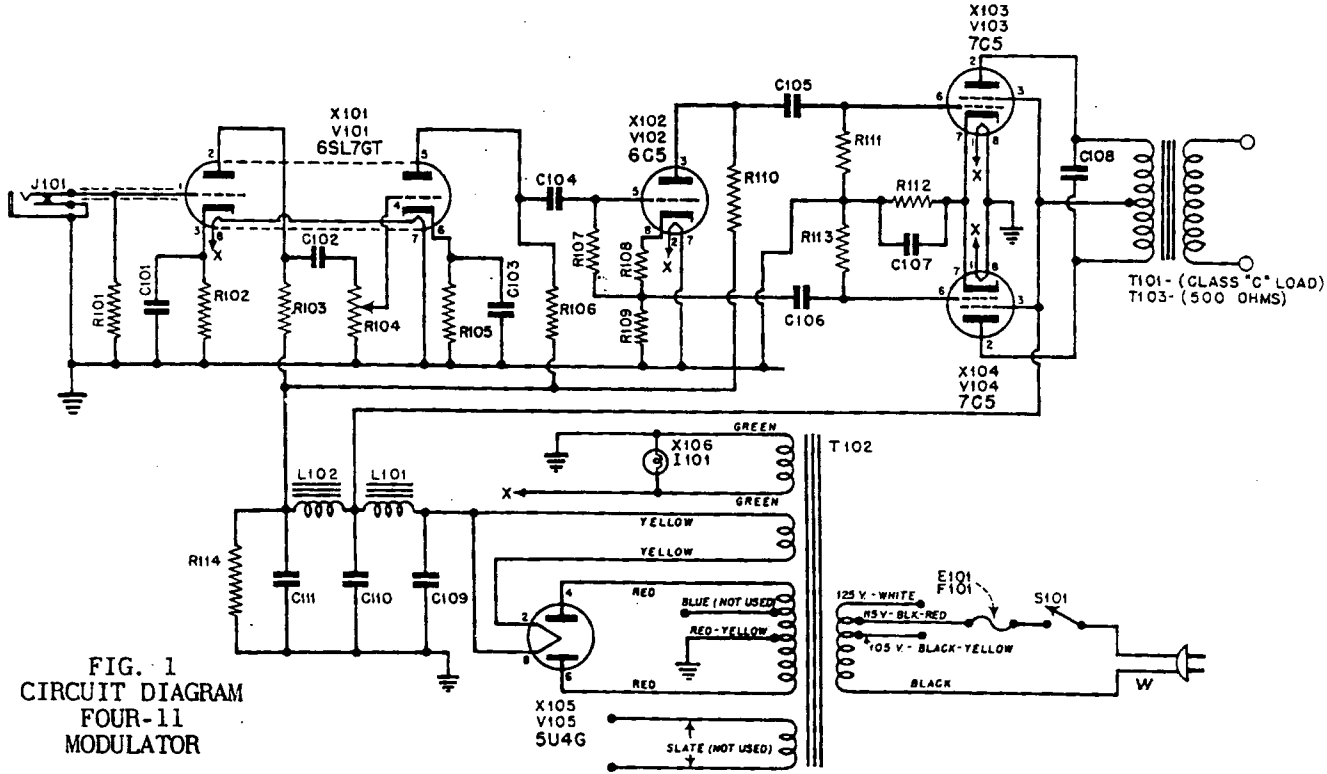


FIG. 1
CIRCUIT DIAGRAM
FOUR-11
MODULATOR

INTRODUCTION

THE HAMMARLUND TYPE FOUR-11 MODULATOR is a completely self-contained amplifier unit, equipped with an output transformer designed to modulate a Class "C" R.F. amplifier having an input power rating up to 28 watts. The unit is also available with an output impedance of 600 ohms for use as a microphone pre-amplifier.

The power gain is greater than 110 db, with an output of over 11 watts with less than 5% distortion. The over-all noise level inherent within the amplifier is at least 43 db below the maximum undistorted output with the gain full on. The frequency response is shown in Fig. 2 . The amplifier is designed to have a 'flat response between 200 and 3000 cycles, with the output dropping off rapidly above 3000 cycles. The output also drops off at the low frequency end of the spectrums being approximately -9 db at 100 cycles.

This is a desirable feature for voice communication. The response is flat over the most usable voice frequencies. Both the very low and very high frequencies, are attenuated so that the power is concentrated in the most useful part of the frequency spectrum. The attenuation of the higher frequencies also aids materially in reducing the higher sidebands in radio telephony which are a cause of cross modulation between adjacent signals, commonly referred to as 'splatter'.

A standard telephone jack is conveniently located in the front panel to receive the microphone plug. This is a high impedance input, to be used with a standard crystal microphone.

The volume control, on-off switch, and pilot light are also located on the front panel. The power cord is brought out through a grommet on the rear skirt of the chassis, and the output terminals are also in the rear, adequately covered to guard against accidental contact with dangerous potentials.

The Hammarlund Four-11 Modulator is 8-1/4" high, 15-1/4" wide, and 9-1/2" deep. The total weight is 41 lbs.

DESIGN

The schematic diagram of the Four-11 Modulator is shown in Fig. 1. A 6SL7 twin triode tube is used in a cascaded amplifier circuit, followed by a 6C5 triode in a special single tube phase inverter system. The power stage consists of two 7C5LT beam power tubes in push-pull.

The R-C network in the cascaded amplifier stage is arranged to discriminate against the very low frequencies, and the 8200 uuf capacitor across the output transformer reduces the high frequency response.

A 5U4G rectifier tube in a conventional power supply system provides plate power for the entire amplifier. The power supply system provides ample filtering to assure hum-free operation.

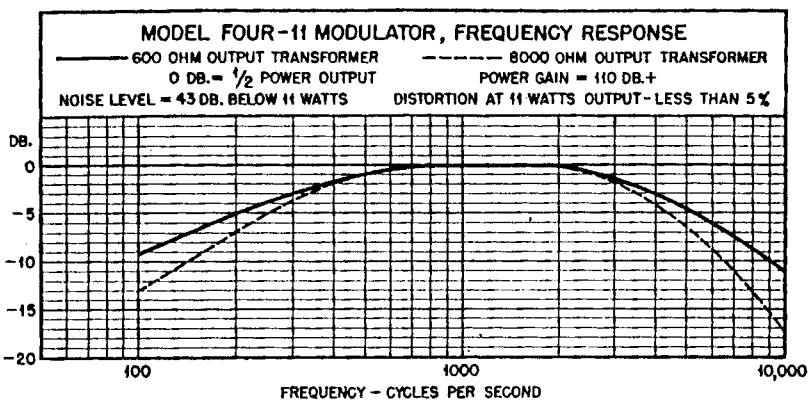


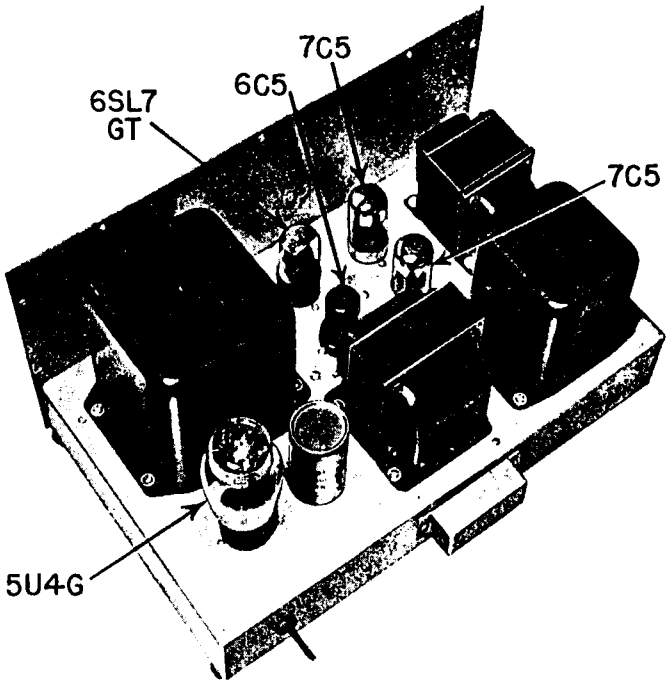
Fig. 2

OPERATION

Carefully remove the Four-11 Unit from its carton, and be sure that all tubes are properly seated in their respective sockets. Be sure that all packing is removed from around the tubes.

If the unit is equipped with an output transformer for modulating a transmitter direct, the nameplate will read Class 'C' Load. If the unit is equipped with a 600 ohm output, the nameplate will be marked 600 ohm load. In either case, connect the amplifier into its normal load.

Be sure that the cover is in place on top of the unit, with the fasteners securely locked. Plug



the line cord into a 115 V A.C. 60 cycle power outlet, and plug a crystal microphone cord into the microphone socket. Turn the unit on and allow about 15 seconds for the tubes to heat up.

The unit is now in working condition.

Caution - This equipment is designed to operate from a standard 105-120 volt 50 or 60 cycle A.C. power system. If in doubt as to the type of power available, consult your local power company.

MAINTENANCE

There are no adjustments to be made to the Four-11 Modulator unit except the gain control, which is an operating adjustment. This equipment has been carefully manufactured in accordance with the highest standards and should give long trouble-free service.

In the event of improper operation, first test all tubes and replace those which may be weak or faulty. If trouble still persists, check resistance values. Values should be as indicated in the chart

Fig. 4 . Do this with the power plug removed from the wall socket.

The voltages between each tube socket terminal and ground (chassis) are shown in Fig. 3 .

WARNING

These measurements should be made only by an experienced technician using the proper precautions to prevent accidental bodily contact with any of the electrical circuits. While the potentials in this unit may not be extremely high, accidental contact with a 'live' circuit could be dangerous. The unit should be returned to the factory for all such checks, as the manufacturer can not assume any responsibility for accidental electrical shock to persons making 'live' circuit checks.

VOLTAGE MEASUREMENTS TO GROUND

	Pin 1	2	3	4	5	6	7	8
X101	0	+124V	+2.5	0	+120V	+2.4V	0	6.3V A.C.
X102	0	6.3V A.C.	+180V		0.05V		0	+88
X103	6.3V A.C.	+334V	+336V			0	+17.5V	0
X104	6.3V A.C.	+334V	+336V			0	+17.5V	0
X105		+355V		405V A.C.		405V A.C.		+355V

Across terminals of: C111 ------ +330V
R108 ------ +3.75V

Fig. 3

RESISTANCE MEASUREMENT TO GROUND
(With Standard Ohm Meter)

	Pin 1	2	3	4	5	6	7	8
X101	5.0 meg	285K	5.6K	1.6 meg	320K	5.6K	0	0
X102	0	0	120K		2 meg		0	105K
X103	0	20K	20K			260K	200	0
X104	0	20K	20K			260K	200	0
X105		20K		470		400		20K

Resistance across R114: 20K

Fig. 4

TABLE OF REPLACEABLE PARTS

SCHEMATIC DESIG.	NAME OF PART & DESCRIP.	FUNCTION	PART NUMBER
C101	CAPACITOR, Tubular paper, .25 mfd. +30-10%, 200WVDC	Cathode resistor by-pass	23912-20
C102	CAPACITOR, Fixed mica, 2500 mmf. ±20%, 500WVDC	Amplifier grid coupling	23069-6
C103	CAPACITOR, Same as C101	Cathode resistor by-pass	23912-20
C104	CAPACITOR, Same as C102	Phase reversing tube grid coupling	23069-6
C105	CAPACITOR, Tubular paper, .02 mfd. +30-10%, 400WVDC	P.A. grid coupling	23912-24
C106	CAPACITOR, Same as C105	P.A. grid coupling	23912-24
C107	CAPACITOR, Dry electrolytic metal tube, 8 mfd. -0% +100%, 150WVDC	P.A. Cathode resistor by-pass	23073-11
C108	CAPACITOR, Fixed mica, 8200 mmf. ±10%, 500WVDC	Audio padding	23019-11
C109	CAPACITOR, Dykanol, 1.0 mfd. ±10%, 1000WVDC	Power supply filter capacitor	23843-4
C110	CAPACITOR, Dry electrolytic, metal tube, 16 mfd. -0% +75%, 450WVDC	Power supply filter	23073-33
C111	CAPACITOR, Same as C110	Power supply filter capacitor	23073-33
E101	FUSEHOLDER, for 3AG fuse.	Holder for F101	15923-1
F101	FUSE, 2 amp., (3AG)	Overload protection	15928-7

TABLE OF REPLACEABLE PARTS

SCHEMATIC DESIG.	NAME OF PART & DESCRIP.	FUNCTION	PART NUMBER
I101	LAMP, 6-8 V., .25 amp., min. bayonet base, blue bead	Pilot light	16026-1
J101	JACK, three circuit	Microphone connection	6087-1
L101	CHOKE, 15 henries, 160MADC, 160 ohms.	Power supply filter reactor	4994 or 2981
L102	CHOKE, Same as L101	Power supply filter reactor	4994 or 2981
N101	KNOB	For R104	26083-1
R101	RESISTOR, 0.5 watt, 4.7 megohm ±10%, fixed composition	Input grid resistor	19309-137
R102	RESISTOR, Fixed composition, 5600 ohm ±10%, 0.5 watt	Cathode biasing	19309-67
R103	RESISTOR, Fixed composition 270,000 ohm ±10%, 0.5 W.	Plate resistor	19309-107
R104	POTENTIOMETER 'Log' curve, no switch, 2 meg. ±20%	Volume control	15359-4
R105	RESISTOR, Same as R102	Cathode biasing	19309-67
R106	RESISTOR, Same as R103	Plate resistor	19309-107
R107	RESISTOR, Fixed composition, 2.2 megohm ±10%, 0.5 W.	Grid resistor	19309-129

TABLE OF REPLACEABLE PARTS

SCHEMATIC DESIG.	NAME OF PART & DESCRIP.	FUNCTION	PART NUMBER
R108	RESISTOR, Fixed composition, 4700 ohm ±10%, 0.5 W	Cathode biasing	19309-65
R109	RESISTOR, Fixed composition, 100,000 ohm ±10%, 0.5 W	Phase reversing	19309-197
R110	RESISTOR, Fixed composition, Same as R109	Phase reversing	19309-97
R111	RESISTOR, Same as R103	P.A. Grid resistor	19309-107
R112	RESISTOR, Wirewound, fixed 300 ohm ±10%, 5 W.	P.A. Cathode biasing	19431-23
R113	RESISTOR, Same as R103	P.A. Grid resistor	19309-107
R114	RESISTOR, Fixed, wirewound, 20,000 ohm ±10%, 10W.	Power supply bleeder	19430-62
S101	SWITCH, Toggle, SPST, 3a. 250V.	On-Off power switch	15807-2
T101	TRANSFORMER, Audio, Pri. 8500 ohm. 100 DC MA., 8000 ohm. Secondary 100 DC MA., Max. of 25 watts	Output transformer. (Used on Class 'C' Unit).	15743-1
T102	TRANSFORMER, Power, 6.3V. @7.0 amp.	Power supply	4998 or 4801
T103	TRANSFORMER, Audio, 600 ohms.	Output transformer (Used on 500 ohm Unit).	4845
V101	VACUUM Tube 6SL7GT	Voltage amplifier tube	16213-3
V102	VACUUM Tube, 7C5	Power amplifier	16265-1
V103	VACUUM Tube, 7C5	Power amplifier	16265-1

TABLE OF REPLACEABLE PARTS

SCHEMATIC DESIG.	NAME OF PART & DESCRIP,	FUNCTION	PART NUMBER
V104	VACUUM Tube, Same as V103	Power amplifier	16265-1
V105	VACUUM Tube, 5U4G	Power rectifier	16215-1
X101	SOCKET, Tube, octal, saddle mtg. with ground ears	Tube socket for V101	16083-1
X102	SOCKET, Same as X101	Socket for V102	16083-1
X103	SOCKET, Tube, Locktal, mtg. plate molded in bakelite	Socket for V103	15944-30
X104	SOCKET, Same as X103	Socket for V104	15944-30
X105	SOCKET, Same as X101	Socket for V105	16083-1
X106	SOCKET, Lampholder & jewel, min. bayonet base	Pilot light	16093-5
W	LINE CORD AND PLUG	Primary power connection	6143-1

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