TECHNICAL MANUAL

FOR

HIGH GAIN LINEAR POWER AMPLIFIER

MODEL HFL-100A

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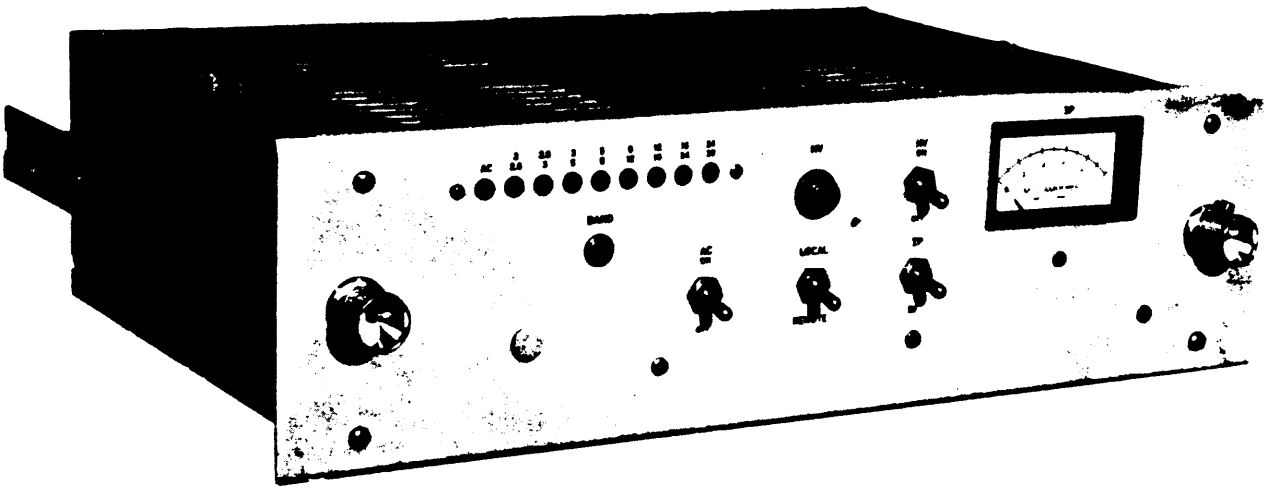

HIGH GAIN LINEAR POWER AMPLIFIER

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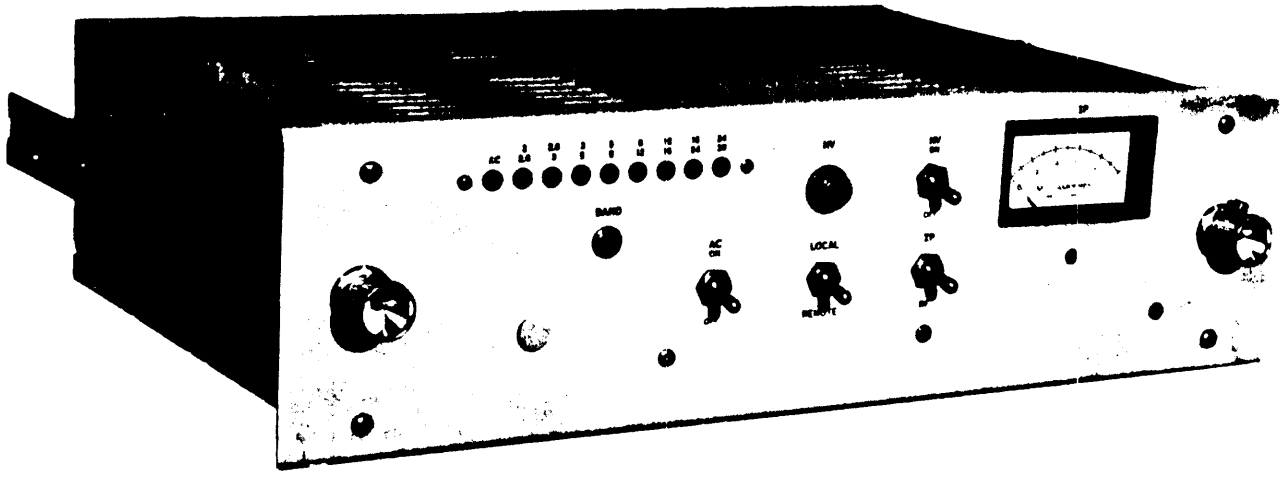


HIGH GAIN LINEAR POWER AMPLIFIER

FIGURE 1-1

SECTION 1

GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION

Designed and manufactured by The Technical Materiel Corporation (TMC) of Mamaroneck, New York, the Model HFL-100 shown in figure 1-1 is a high gain linear power amplifier. The amplifier will provide a power output of 100 watts PEP (peak envelope power) or 50 watts average when provided with an input signal of 100 milliwatts. The HFL-100 amplifier will operate satisfactorily at any frequency between 2.0 and 26.0 MHz. The current application of the HFL-100 is as the intermediate drive unit in the TMC Model GPTR-1KC kilowatt transmitter. The amplifier will operate from a single phase power source of either 110 or 220 volts.

1-2. PHYSICAL DESCRIPTION

The HFL-100 linear power amplifier is a light weight (approximately 20 lbs), comparatively small unit requiring 360 watts of input power. The eight frequency bands to which the amplifier can be bandswitched to any four channels by means of bandswitch information from the SME-5 exciter, or as a 4 channel system with SME-5 . However, band selection may be made by the operator, if required, by means of a pushbutton control. An indication of the frequency range to which the amplifier is switched is displayed on the front panel. An instrument, also on the front panel, presents an indication of either the plate current of the power amplifier tube or RF output volts of the amplifier as determined by the operator. This selection is made by operating a toggle switch on the front panel. All controls and indicators including the ac power and high voltage switches are located on the front panel.

The HFL-100 is 5.25 inches high and 19.0 inches wide. Designed to be slide mounted in a standard equipment rack or cabinet it extends only one foot into the cabinet. Panel locks and slide mount track are provided to position and secure the unit in the cabinet. All connections with associated equipment and the ac power supply are made at the rear. Protective fuses are also accessible from the rear of the unit.

1-3. REFERENCE DATA

FREQUENCY RANGE:	2.0 MHz to 26 MHz
OPERATING MODES:	Capable of all standard modes of operation (CW, AM, AME, ISB, SSB FAX and FSK), but dependent upon the exciter being used.
POWER OUTPUT:	100 watts peak envelope power or 50 watts average;
OUTPUT IMPEDANCE:	50 ohms unbalanced.
DISTORTION:	Minimum 30 db below either tone of a standard two tone test at full rated PEP.
RF INPUT:	100 milliwatts.
POWER REQUIREMENTS:	360 watts maximum.
PRIMARY POWER:	110 or 220 vac, single phase, 50 Hz.
BANDSWITCHING:	Remote or local.
ENVIRONMENTAL:	Designed to operate in ambient temperatures of 0 to 50C with humidity up to 90 per cent.
COOLING:	Forced air.
SIZE AND MOUNTING:	5.25 inches high, 19 inches wide 12 inches deep. Slide mounted in standard cabinet.

WEIGHT:	Approximately 20 lbs.
SAFETY FEATURES:	Fused input, shielded high voltage, plate overload circuit protects final power amplifier. Heat overload.

SECTION 2

INSTALLATION

2-1. UNPACKING AND INSPECTION

After successfully passing a complete operational test in the TMC test facility ensuring that all specifications have been met, the HFL-100 was carefully packed for shipment. These tests were conducted in conjunction with associated TMC equipment, but the HFL-100 is packed separately with the necessary cabling and connectors as "loose items". These "loose items" including hardware, instruction manuals, and connectors, if the HFL-100 is a part of a TMC transmitter, all may be included in the main transmitter package. Even though this may be the case, all packing material should be examined carefully so that no items are inadvertently discarded.

Upon arrival at the installation site, the equipment should be inspected for any evidence of damage in transit. All controls should be operable and the tubes set firmly in the sockets. If transit damage is discovered a claim should immediately be filed with the carrier. Assistance in rectifying transit damage will be rendered by The Technical Material Corporation by recommending replacements parts and by describing repair methods.

2-2. POWER REQUIREMENTS

Since the HFL-100 will operate equally as well on either 110 volts or 220 volts single phase ac power at 50 or 60 Hz, it is factory wired for the power source specified by the customer. The amplifier may be rewired in the field if a decision is made to use an alternate power source. The wiring changes to the primary winding of T102, 3, 4, shown in figure 2-1 be made prior to installation to accomodate a change in source voltage.

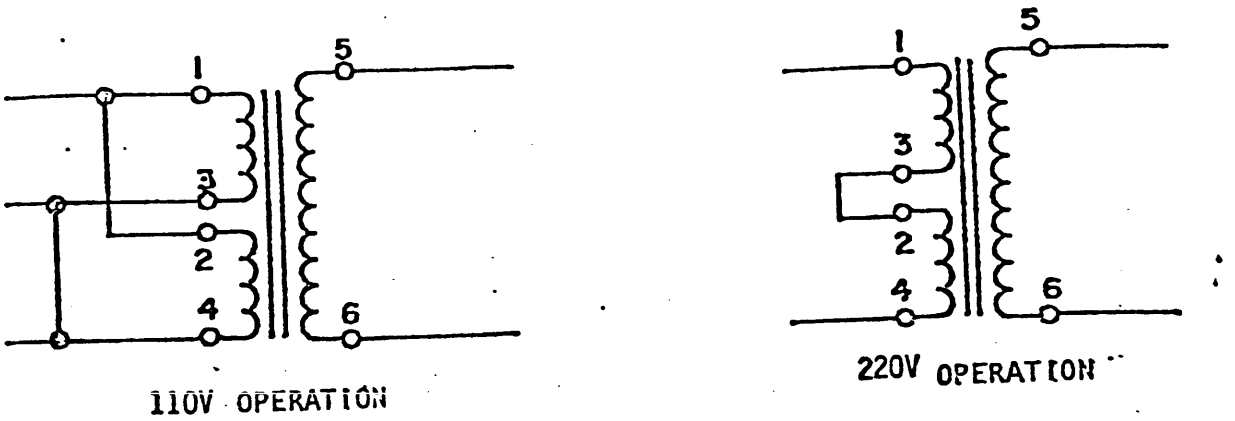


Figure 2-1. 110V to 220V TRANSFORMER WIRING DIAGRAM

WARNING

MAKE CERTAIN THAT THE WIRING IS CORRECT BEFORE SUPPLYING PRIMARY POWER.

2-3. INITIAL INSTALLATION

The HFL linear power amplifier fits easily into place in the equipment cabinet on the slide mounts provided. However, care should be taken to be sure that the coiled lead for primary power at rear of the unit does not become entangled. The panel locks on the front should be secured to hold the equipment firmly in position. All connections to associated equipment are made at the rear panel of the HFL-100 amplifier. These connecting points are clearly marked on the panel and reference to the internal interconnect diagram wiring diagram figure 2-1 and to tables 2-1 and 2-2 will enable the installer to make the proper connections. Connectors for any cable which must be fabricated by the customer are furnished as "loose items".

TABLE 2-1. REAR PANEL CONNECTIONS

REFERENCE DESIGNATION	PANEL NOMENCLATURE	FUNCTION
J101	INPUT	RF signal input from associated exciter.
J103	OUTPUT	Connects amplified rf signal to associated equipment.
TB101	TB101	Refer to table 2-2.

TABLE 2-2. TERMINAL BOARD CONNECTIONS

TERMINAL NUMBER (From left to right)	CONNECTION
1	N/C
2	Remote Reset
3	N/C
4	Stand by
5	TMA overload trip
6	N/C
7	Jumper to 13
8	Channel 4
9	Channel 3
10	Channel 2
11	Channel 1
12	N/C
13	Jumper to 7
14	Stand by
15	+24 from TMA
16	Ground from TMA

Also located on the rear panel of the HFL-100 amplifier are the protective fuses for the primary power circuit (F101) and for the switch operating power circuit (F102).

SECTION 3

OPERATION

3-1. GENERAL

The HFL-100 linear power amplifier will amplify an input signal of 100 milliwatts to a 50 watt (average), 100 watt (PEP) output signal. This amplifier will operate satisfactorily at any frequency in the 2.0 to 26.0 MHz range. Normally the amplifier is automatically channelized to correct frequency band, but if required, may be locally channelized.

3-2. OPERATING CONTROLS

All of the controls and indicators are located on the front panel illustrated in figure 3-1. They are functionally identified in Table 3-1.

TABLE 3-1. FRONT PANEL INDICATORS AND CONTROLS (Refer to figure 3-1)

INDEX NUMBER	PANEL NOMENCLATURE	NATURE AND FUNCTION
1	NONE	Panel lock (LH) - Secures unit in cabinet.
2	AC	Indicator lights (LED) - When lighted indicates AC power is applied.
3	Band Numbers	Indicator lights (LED) - Indicate frequency-band to which amplifier is tuned.
4	HV	Toggle switch - Controls primary to high voltage transformer.
5	HV ON	Indicator lamp - Indicates application of high voltage.
6	IP	Milliameter - Indication corresponds to plate current or strength of output signal.
7	NONE	Panel lock (RH) - Secures unit in cabinet.

TABLE 3-1. FRONT PANEL INDICATORS AND CONTROLS (Refer to figure 3-1) (cont)

INDEX NUMBER	PANEL NOMENCLATURE	NATURE AND FUNCTION
8	BAND	Pushbutton - Controls position of bandswitch in local position.
9	AC ON/OFF	Toggle switch - Controls line power input.
10	LOCAL/REMOTE	Toggle switch - Controls operation of bandswitch and remote HV control.
11	IP/RF	Toggle switch - Selects quantity displayed on meter. (PA plate current or rf output volts).

3-3. PRELIMINARY PROCEDURES (Refer to figure 3-1)

Set the AC switch (9) and the HV switch (4) to the OFF position prior to connecting the HFL-100 to a source of primary power. Select the operational mode by setting the LOCAL/REMOTE switch (10) to the proper position. Set meter control toggle switch (11) to the IP position. Be sure that the amplifier is held firmly in position by the panel locks (1 and 7) and recheck the interconnections with the associated equipment.

3-4. OPERATING PROCEDURES

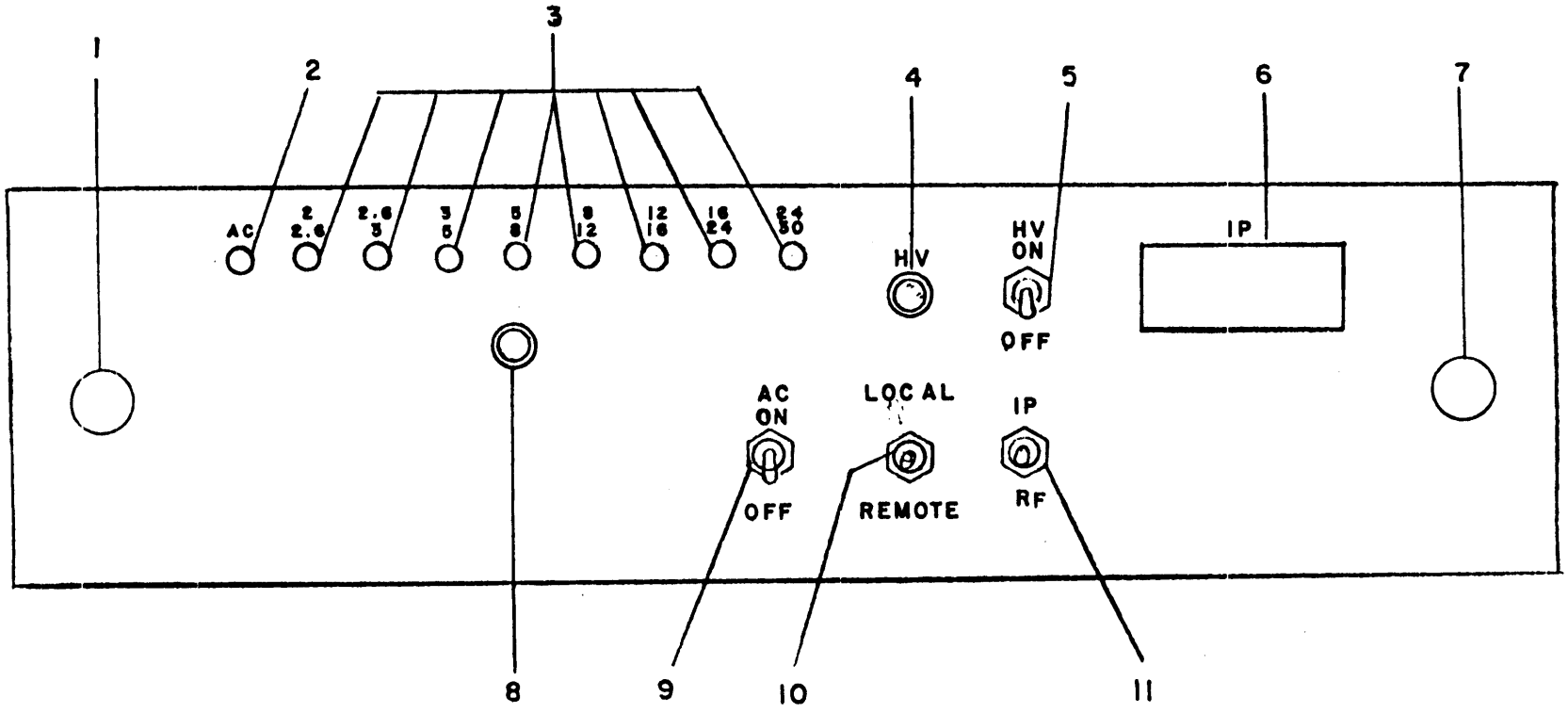
a. GENERAL. When the HFL-100 is being operated as a component of a TMC transmitter, as is most often the case, the operating procedures for the system will relate the unit to the overall system operation. In this presentation the amplifier is treated on a unit basis only.

b. LOCAL OPERATION. (Refer to figure 3-1)

(1) Connect the plug on ac power lead to a suitable power source.

CAUTION

The output circuit must be connected through J103 to an antenna system or suitable dummy load (50 ohms) before power is applied to the amplifier.



Nomenclature

Number	Name	Function
1	None	Panel lock (LH) - Secures unit in cabinet.
2	AC	Lighted when AC powers is supplied.
3	Band Numbers	Frequency band amplifier is tuned to
4	HV-ON	High Voltage control switch
5	HV	HV-Lighted when HV is applied.
6	IP	Indication of plate current.
7	NONE	Same as number 1.
8	Band	Controls position of bandswitch in local position.
9	AC ON/OFF	Controls line power input
10	Local/Remote	Controls operation of bandswitch and remote HV control.
11	IP/RF	Selects PA plate current or rf output displayed on meter.

Figure 3-1. Front Panel Indicators and Controls

(2) Set the LOCAL/REMOTE switch (10) to the LOCAL position.

CAUTION

Be sure that no input signal is applied to the INPUT jack (J101) before supplying high voltage.

(3) Set the AC switch (9) to the ON position. AC indicator lamp (2) lights. Band indicator (3) lights. Blower starts functioning.

CAUTION

Before applying high voltage allow a reasonable time (40-60 seconds) for the tube filaments to heat.

(4) When the tube filaments have heated, set the HV switch (4) to the ON position.

(5) With the IP/RF switch (11) in the IP position, check the quiescent currect of the power amplifier tube as indicated on the IP meter (6). If a reading of other than 100 milliamperes is obtained the bias control must be readjusted.

NOTE

The bias control potentiometer is located on the front left corner of the chassis behind the front panel. After adjustment retighten the locknut.

(6) Press BAND pushbutton (8) sequentially until band indicator (3) shows that the proper tuning band has been selected for the frequency of the rf signal to be used. (NOTE: HV must be on to get bandswitch change).

(7) Supply a rf signal on desired channel or frequency to the amplifier from the associated equipment through J101.

(8) Increase the rf input slowly until an indication of 120 ma plate current is observed on the IP meter (6).

(9) Set meter control toggle switch (11) to the RF position.

(10) Observe that an indication of the rf output is displayed on the meter.

c. REMOTE OPERATION. (Refer to figure 3-1)

(1) Connect the plug on the ac power lead to a suitable power source.

CAUTION

The output circuit must be connected through J103 to an antenna or suitable dummy load (50 ohms) before power is applied to the amplifier.

(2) Set the LOCAL/REMOTE switch (10) to the REMOTE position.

CAUTION

Be sure that no input signal is applied to the INPUT jack (J101) before supplying high voltage.

(3) Set the AC switch to the ON position. AC indicator lamp (2) lights. Band indicator (3) lights. Blower starts functioning.

(4) When the tube filaments have heated, before HV can be turned on, K101 must be energized. This is accomplished by TMA-1K time delay. Set the HV switch (4) to the ON position. If the band switching signal is being provided from the associated equipment, the bandswitch will now be automatically positioned to the correct band for the rf frequency to be used. Channel information in this section is obtained from the SME-5 .

(5) Check and adjust quiescent plate current if necessary as in step 5 of paragraph 3-4 b.

(6) Supply a rf signal to the amplifier from the associated equipment through J101.

(7) Increase the rf input slowly until an indication of 120 ma plate current is observed on the IP meter.

(8) Set the meter control toggle switch (11) to the RF position.

(9) Observe that an indication of the rf output is displayed on the meter.

NOTE

The milliampere indication on the meter is proportional to the rf voltage across the 50 ohm load. A reading of approximately 0.5 milliampere is the equivalent of 50 watts output.

(10) Reset the meter control toggle switch (11) to the Ip position.

NOTE

This is the usual position of the toggle switch during operation.

CAUTION

Do not allow the plate current as indicated on the meter to exceed 0.25 ma (equivalent to 250 ma actual).

3-5. OPERATOR MAINTENANCE

The operator performed maintenance on the HFL-100 amplifier consists mainly of cleaning and the replacement of blown fuses or power tubes. Internal inspection of the unit and the replacement of warn or damaged parts should be a part of the regularly scheduled preventive maintenance program of the equipment of which the HFL-100 is a component.

SECTION 4

PRINCIPLES OF OPERATION

4-1. GENERAL

The HFL-100 high-gain linear amplifier will increase a 100 mw input signal to an average power output of 50 watts. The amplifier will perform efficiently at any four channels between 2.0 MHz and 26.0 MHz. Four frequency bands may be selected locally or remotely by signal from associated equipment. The unit is completely controlled from the front panel. The HFL-100 amplifier is currently being utilized as the intermediate power amplifier in The Technical Materiel Corporation's 1KW transmitter Model GPT-1K Series. Figure 4-1 is a overall schematic diagram of the HFL-100 circuits.

4-2. FUNCTIONAL ANALYSIS

The following paragraphs discuss the manner in which the various circuits of the amplifier operate.

a. General - Primary power for the amplifier may be supplied from either a 110 or 220 volt source of either 50 or 60 Hz. For each installation this source is specified by the customer, and the unit is factory wired to accommodate it. Input requires approximately 360 watts.

b. Power Distribution - (Refer to figure 4-1)

The amplifier is connected to the primary power supply through P101. When switch S104 is closed primary power is supplied to the low voltage transformer T104 and to the motor of blower B101. The operation of B101 provides cooling air for the power amplifying tube V103. Fuse F101 protects this primary power circuit. The secondary of transformer T104 provides filament voltage for the three amplifying tubes and for the light emitting diodes which indicate the frequency band selected.

Primary power for the high voltage transformer T102 is supplied when switch S103 is closed if the protective relay K101 is energized or in a local position. This relay is used as remotely controlled high voltage switch by controlling the input signals to terminals 15 and 16 of TB101 (24 vdc and ground). When the LOCAL/REMOTE switch, S105, is in the LOCAL position, the relay is functionally by-passed through this switch. There are three secondary windings in transformer T102. The output of one secondary (280 volts) is directed through a diode rectifier CR7 and furnishes the plate voltage and screen for the first stage amplifier tubes V101 and V102 and also supplies screen for V103. Diode rectifier CR8 rectifies the 27 volt secondary of transformer T102 to provide +29 vdc voltage for the amplifier control circuits. The high voltage (580 ac volts) secondary of transformer raised to the 1250 volt level in a voltage doubler circuit and rectified before being directed to the plate circuit of the tube. The negative output of CR9 is used for bias of the power amplifier tube V103 so that the proper operating bias is obtained. Diode rectifier CR9 operates from the 35 volt secondary winding of transformer T103.

c. Standby - To prevent the emission of background noise when the associated equipment (i.e. - the exciter) is in a standby mode, the tubes of the HFL-100 are switched to an off state by the removal of the screen voltage and the biasing off of V103. A ground signal is routed to relay K101 causing the normally closed contacts of the relay to open.

d. Automatic Bandswitching Circuit - The position of the rotary bandswitch S106 is controlled by the operation of the Ledex motor which is attached to the shaft of the switch. The switch consists of five wafers. Each plate supports twelve contacts to which the rotary portion of the wafer may be positioned. Only eight of these twelve are used in the HFL-100 . Wafer A controls the automatic positioning of the switch when S105 is in the REMOTE position.

A signal voltage is received from the associated equipment at terminal board TB101. The terminal at which this voltage is received is indicative of the frequency band selected at the associated equipment. Table 4-1 relates the terminal numbers to the channel.

Channel Control:

A voltage is fed to one of 4 channels originating from program at exciter SME-5 . This voltage feed to TB101 terminals 8, 9, 10, 11, depends on channel selected (See chart). This voltage then is fed to notch homing wafer S106A, which will now program Ledex to correct notch or position.

Ledex is controlled by Q1 (2N1776) scr. When a trigger voltage is applied to pin 2 of Q1, scr is turned on and conducts Ledex current to ground contacts of S106 and are mechanically tied to Ledex switch, and switch Off and on with each 30°rotation (1 position). This removes voltage to scr for automatic turn off.

When in local position (S105), Q1 scr is fired, (triggered) by voltage supplied from charged capacitor C133 by depressing S107 band button.

TABLE 4-1. TERMINAL NUMBER VS FREQUENCY BAND

TB101 Terminal Number	Frequency Band Selected
11	Channel 1
10	Channel 2
9	Channel 3
8	Channel 4

e. Manual Control of Bandswitching - When the LOCAL/REMOTE switch S105 is in the LOCAL position, the setting of the bandswitch is controlled by the operation of the BAND pushbutton S107. Pressing the button of switch S107 causes the Ledex motor to rotate switch S106 one position at a time. The proper positioning of the bandswitch is indicated by illumination of the LED indicators energized through wafer B of the switch. With switch S105 in the LOCAL position, wafer A of the bandswitch S106 has no effect on the switch action. The function of the other wafers is, however, the same as in the automatic mode of operation.

f. RF Signal Circuit - The HFL-100C is a two stage amplifier. The first stage consists of two 12HG7 pentodes V101 and V102 operated in parallel; the second is a single 4CX350 power amplifier tube. The rf signal from the associated exciter enters the circuit through jack J101 and is applied to the control grids of the first stage amplifying tubes. In this stage the 100 mw signal is raised to a 15 - 25 volt rf level. The plate circuit of the pentodes is connected to the grid circuit of the final amplifier through an adjustable output transformer T101. The power amplifer tube V103 amplifies the signal strength to the 50 watt output level. After passing through the impedance matching network the amplified rf signal is transmitted to the associated equipment in the transmitter through output jack J103.

T105 broadband transformer is used for lower frequency, 2-8 MHz. T106 broadband transformer is used for upper frequencies, 8-30 MHz. C138, C139, C140 are used as peaking capacitors for lower frequencies 2-5 MHz. L108, L109, and L110 are used as peaking coils in 8-12, 12-16, 16-24 bands.

g. Rf Meter - There are no adjustments for Rf meter readings. DC for meter operation is derived from rectifier CR10, (IN100). Rf is divided down by C141, C13 CAPS and then rectified by CR10.

Rf meter reading is just a relative monitoring of RF output of HFL-100 . It us useful to operator for determining operating status of HFL-100 .

OVERLOAD ADJUSTMENT AND PC753 OPERATION

Overload adjustment R4 (PC753) sets up threshold level (DC trigger) to fire Q1 1595. DC voltage is derived across R114 the cathode resistor of V103. This voltage is proportional to Ip current of 4CX350.

1. Adjust R121 bias adjust (No Rf drive) so M101 Ip reads 300 ma. Carefully adjust R4 overload adjust to obtain overload (K102 energized DS101 lite). Recheck overload by readjusting 121 bias to normal 100 ma and back again to 300 ma overload.

CAUTION

Do not leave idle current at high levels for extended periods. To reset overload, turn HV OFF and then back ON. It is normal for DS101 overload light to be on in standby operation.

h. Ip Meter Calibration - It is important that the calibration of M101 meter be checked (plate current 4cx350). Care must be taken when this is done as there is 1200 DC present on plate circuits. Make sure unit is OFF and HV line has been shorted to ground before attempting this procedure.

1. Adjust bias adjust R121 ccw for 0 idle current. HFL must be in operating condition, not standby. (K102 not energized)

2. Turn HFL OFF (discharge HV line to ground with insulated screwdriver). Remove red wire going to L101 from C129 and insert Simpson meter or equivalent 100 ma full scale. Make sure meter polarity is correct. Do not

attempt reversing leads with power ON.

3. Readjust R121 bias adjust clockwise until Simpson meter reads 100 ma. Compare this reading with front panel meter M101. If they are not in accord, adjust R1 meter calibration on PC753 until meter is properly calibrated. Before removing Simpson meter from circuit, turn HFL-100 OFF and discharge HV line.

i. Heat Overload - Heat overload S101 is normally closed thermostat. In the event of excessive heat, (approx. 70°C), this circuit will open allowing voltage at E3 to fire overload scr Q1. Heat overload condition will show up as overload, but overload condition will remain until S101 cools off below operating temperature.

Voltage on E7, (2V), when HFL-100 is in overload condition, is a feed from TB101 terminal 5 to overload circuits of TMA. This results in HFL overload causing TMA overload, or system overload.

Terminal E5 PC753 is routed to TB101 terminal 2 to TMA overload. Reset circuits to provide system overload reset line.

ADJUSTMENT OF T101, L108, L109, L110

T101 is adjusted for maximum Rf output, a 12 MHz for full frequency coverage. In cases where channel frequencies are close together this adjustment should be optimized on operating frequencies.

L108 is normally adjusted for maximum at 10 MHz.

L109 is normally adjusted for maximum at 14 MHz.

L110 is normally adjusted for maximum at 20 MHz.

In cases where frequencies are close, or only 1 frequency is used on band, these coils are set up for optimum operation.

j. Channelizing to New Frequency Band - To channelize HFL-100 to new frequency band, it is only necessary to change electrical connection on diodes CR1, CR2, CR3, CR4 to new frequency band required. It is normal to set up channel 1 on lowest operating frequency and following channels to progressively

higher frequencies. (Example: if channel 1 is 2 MHz, connect CR1 to 2-2.6 MHz band, channel 2 is 4 MHz, connect CR2 to 3-5 MHz band, channel 3 is 8 MHz, connect CR3 to 8-12 MHz band, channel 4 is 16 MHz, connect CR4 to 16-24 MHz band.

All readings taken with Simpson 260 with 220 vac Input 100 ma Idle current with no drive.

PIN NO.	V101 12HG7	V102 12HG7	V103 4CX350	
1	3vdc	3vdc	360vdc	Reading taken to ground.
2	0	0	.5vdc	
3	NC	NC	6 vac	
4	6vac	6vac	.5vdc	
5	-	-	-	
6	-	-	.5vdc	
7	280	280	-	
8	280	280	.5vdc	
9	-	-	-	
Anode			1200DC	Caution when making measurement.
Grid Ring			-20DC	

Voltage readings PC722/A5609

E1 to ground	580AC
E2 to ground	1200DC
E4 to E5	24vac
E6 to E8	20vac
E7	Ground
E9 to E9	230vac
E11	290vdc
E12	29vdc
E13	-30vdc

SECTION 5

MAINTENANCE AND TROUBLESHOOTING

5-1. GENERAL

Trouble-free operation under continous duty conditions is inherent in the design of the HFL-100 amplifier. Regularly scheduled preventive maintenance will optimize this design characteristic. Periodic inspections and checks will minimize the possibility that the most probable causes of equipment malfunction will interrupt service.

5-2. PREVENTIVE MAINTENANCE

WARNING

Source power should be removed and the connector tagged before initiating inspection procedures.

The HFL-100 amplifier should be thoroughly inspected and cleaned on a weekly basis. Early detection on minor problems allows corrective action to be taken before major trouble shooting and test is necessary. Any evidence of component deterioration should be noted and corrected by cleaning, repair or replacement. Only the same or equivalent replacement parts should be used. Section 6 of this manual presents a list of components by part number and should be consulted when repairs are being made. All electrical and mechanical connections must be secure. Tighten or resolder any which have been loosened. Remove dust or other foreign matter from printed circuit boards with a soft brush or low pressure (under 20 ps i) compressed air. Greasey substances may be removed from the unit with any good dry cleaning solvent, but adequate ventilation must be provided.

WARNING

Avoid prolonged in inhalation of solvent vapors or solvent contact with the skin. Volatile solvents should not be used in the presence of spark producing equipment or open flame.

5-3. CORRECTIVE MAINTENANCE

Corrective maintenance is that which must be performed if a failure occurs. No complex circuitry is involved in the HFL-100 amplifier, therefore the nature of the failure and logical reasoning by a competent technician should suffice to isolate the location of the failure. Paragraph 4-2 and 5-4 describe the operation of several of the circuits in the HFL-100C. Reference to this information and to the schematic diagram, figure 4-1 combined with normal troubleshooting techniques will enable the technician to locate the failed component.

5-4. PERFORMANCE TESTS

At least every six months the HFL-100 should be isolated from the equipment with which it is associated and tested for proper operation. This test should form a part of the regularly scheduled check of the transmitter of which it is a component. The technician should be familiar with the equipment and know the locations within the unit where high potentials will be encountered.

Only a multimeter such as the Simpson Model 260 and a vacuum tube voltmeter such as the Hewlett-Packard Model 4108 to check the rf circuits are needed to test the HFL-100 amplifier.

a. Power Distribution. Primary power for the HFL-100 may be supplied at either 110 or 220 volts ac depending on the installation requirements. The transformers of each equipment are wired to meet the specific local need. This primary power will be found between terminals 1 and 4 of the low voltage transformers T102, T103, and T104 when AC switch S104 is in the ON position. It will also appear at terminals 1 and 4 of the high transformer T102 when HV switch S103 is also in the ON position.

WARNING

Potentials as high as 1250 volts are present when the HV switch S103 is actuated. Excercise extreme caution.

Fuse F101 should be checked if the primary voltage is not present at the low voltage transformer T104. This fuse is rated at 3 amp. (2 amp. for a 220 volt installation) The secondary voltage of transformer T104 is 6.3 volts ac.

SECTION 6

PARTS LIST

The parts lists presented in this section provide a cross reference between the reference designation of the part and the TMC part number. The reference designation is used to identify a part on assembly drawings and schematic diagrams. Wherever practical, they are also marked on the equipment adjacent to the part.

The letter of the reference designator identifies the generic group to which the part belongs; eg: resistor (R), capacitor (C), switch (S).

Complete identification will expedite delivery when ordering renewal parts. The following information should be given for each part:

Description
* Reference designation
TMC part number
* Assembly number
Equipment model number
Equipment serial number

This information is available from the equipment nameplate, and the parts lists in this section.

To simplify the task of ordering renewal parts, an order from has been included at the end of this section. The information requested in the preceding list which has been marked with an asterisk should be included in the description column.

PARTS LIST

for

HFL-100

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
B101	FAN, VANEAXIAL	BL-128-1
C101	CAPACITOR, FIXED, CERAMIC	CC109-38
C102	SAME AS C101	
C103	CAPACITOR, FIXED, CERAMIC	CC100-43
C104	SAME AS C103	
C105	SAME AS C103	
C106	CAPACITOR, FIXED, CERAMIC	CC100-32
C107	CAPACITOR, FIXED, MICA	CM111E220J5S
C108	CAPACITOR, FIXED, CERAMIC	CC131-39
C109	SAME AS C103	
C110	CAPACITOR, FIXED, MICA	CM111E301J5S
C111	SAME AS C110	
C112	SAME AS C103	
C113	SAME AS C108	
C114	SAME AS C108	
C115	SAME AS C108	
C116	SAME AS C103	
C117	SAME AS C108	
C118	SAME AS C108	
C119	CAPACITOR, ELECTROLYTIC	CE102-1
C120	CAPACITOR, ELECTROLYTIC	CE116-3V
C121	CAPACITOR, ELECTROLYTIC	CE116-10VN
C122	SAME AS C108	
C123	SAME AS C108	
C124	SAME AS C108	
C125	SAME AS C108	
C126	CAPACITOR, ELECTROLYTIC	CE105-100-75
C127	SAME AS C108	
C128	SAME AS C108	
C129	CAPACITOR, ELECTROLYTIC	CE108-1
C130	SAME AS C129	
C131	SAME AS C129	
C132	SAME AS C129	
C133	CAPACITOR, ELECTROLYTIC	CE105-50-50
C134	SAME AS C108	
C135	SAME AS C108	
C136	SAME AS C108	
C137	SAME AS C108	
C138	CAPACITOR, ELECTROLYTIC	CC109-19
C139	CAPACITOR, ELECTROLYTIC	CC109-13
C140	SAME AS C139	
C141	CAPACITOR, FIXED, MICA	CM111050J3S
C142	CAPACITOR, FIXED, ELECTROLYTIC	CE105-100-50
C143	SAME AS C103	
CR1	SEMICONDUCTOR, DEVICE DIODE	1N645

PARTS LIST (cont)

FOR

HFL-100

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR2	SEMICONDUCTOR, DEVICE, DIODE	1N1822
CR3	SEMICONDUCTOR, DEVICE, DIODE	1N3022B
CR4	SEMICONDUCTOR, DEVICE, DIODE	1N547
DS101	LAMP, INCANDESCENT	BI101-1819
DS102	LMAP, INCANDESCENT	BI102-1820
F101	FUSE CART.	FU100-3
F102	FUSE CART.	FU100-2
J101	CONNECTOR, RECEPTACLE, RF	UG625B/U
J102	CONNECTOR, RECEPTACLE	JJ319-A15DPE
J103	SAME AS J101	
K101	RELAY, ARM	
K102	SAME AS K101	
L101	COIL, RF, FIXED	CL178
L102	COIL, RF, FIXED	CL459
L103	COIL, RF, FIXED	CL240-1.5
L104	COIL, RF, FIXED	C140-6
L105	SAME AS L104	
L106	COIL, RF, FIXED	CL240-1.2
L107	COIL, RF, FIXED	CL101-4
L108	COIL, RF, FIXED	CL475-12
L109	COIL, RF, FIXED	CL475-11
L110	COIL, RF, FIXED	CL475-10
M101	METER	MR137-1
P101	PLUG	PL218
R101	RESISTOR, FIXED, COMP.	RC32GF470J
R102	SAME AS R101	
R103	RESISTOR, FIXED, COMP.	RC42GF332J
R104	SAME AS R103	
R105	SAME AS R103	
R106	RESISTOR, FIXED, COMP.	RC07GF222J
R107	RESISTOR, FIXED, COMP.	RC32GF680J
R108	SAME AS R106	
R109	SAME AS R107	
R110	RESISTOR, FIXED, COMP.	RC32GF391J
R111	RESISTOR, FIXED, COMP.	RC32GF222J
R112	RESISTOR, FIXED, COMP.	RC42GF473J
R113	SAME AS R101	
R114	RESISTOR, FIXED, COMP.	RW107-6
R115	RESISTOR, FIXED, COMP.	RW107-20

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R116	RESISTOR, FIXED, COMP.	RC32GF682J
R117	RESISTOR, FIXED, COMP.	RC32GF474J
R118	RESISTOR, FIXED, COMP.	RC32GF101J
R119	RESISTOR, FIXED, COMP.	RC42GF152J
R120	MISSING SYMBOL	
R121	RESISTOR, VAR, COMP.	RV4 LAYSA502B
R122	RESISTOR, FIXED, COMP.	RW111-35
R123	RESISTOR, FIXED, COMP.	RW109-38
R124	RESISTOR, FIXED, COMP.	RC42GF104J
R125	SAME AS R112	
R126	SAME AS R112	
R127	SAME AS R112	
R128	SAME AS R112	
S101	SWITCH, HEAT SENSITIVE	SS100
S102	SWITCH, TOGGLE	ST22N
S103	SWITCH, TOGGLE	ST22K
S104	SAME AS S103	
S105	SAME AS S102	
S106	SWITCH, ROTARY A, B	SW561
S106	SWITCH, WAFER C, D, E	WS115
S107	SWITCH, PUSHBUTTON	SW296-1
T101	COIL RF, FIXED	CL488
T102	TRANSFORMER	TF382
T103	TRANSFORMER	TF10065
T104	TRANSFORMER	TF239
T105	TRANSFORMER	TR200
T106	TRANSFORMER	TR207
V101	TUBE	12HG7
V102	SAME AS V101	
V103	TUBE	4CX350
XDS101	LIGHT INDICATOR	TS107-2
XDS102	LAMP HOLDER	TS106-1
XDF101	FUSEHOLDER	FH103
XDF102	SAME AS XDF101	
XV101	SOCKET, ELECTRON TUBE	TS103P01
XV102	SAME AS XV101	
XV103	SOCKET, ELECTRON TUBE	TS197
Z101	INDICATOR, BOARD ASSEMBLY	*A5604
Z102	LEDEX CONTROL BOARD ASSEMBLY	*A5608
Z103	DC RECTIFIER BOARD ASSEMBLY	*A5609
Z104	OVERLOAD CIRCUIT BOARD ASSEMBLY	*A5651

*Parts breakdown for this assembly supplied on a separate list.

PARTS LIST

FOR

INDICATOR BOARD ASSEMBLY Z101

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1 thru C9	CAPACITOR, FIXED, CERAMIC	CC100-44
DS1 thru DS9	LED	BI132

PARTS LIST
FOR

LEDEX CONTROL BOARD ASSEMBLY Z102

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1 thru C8	Capacitor, Fixed, Ceramic	CC100-44
C9	Not Used	
C10	Same as C1	
C11	Same as C1	
C12	Same as C1	
C13	Capacitor, Fixed, Mica	CM111E101J5S
CR1	Semiconductor, Device, Diode	1N100
Q1	Transistor	2N1776
R1	Resistor, Fixed, Composition	RC20GF152J
R2	Resistor, Fixed, Composition	RC20GF222J
R3	Same as R2	
R4	Resistor, Fixed, Composition	RC20GF471J

PARTS LIST
FOR

DC RECTIFIER BOARD ASSEMBLY Z103

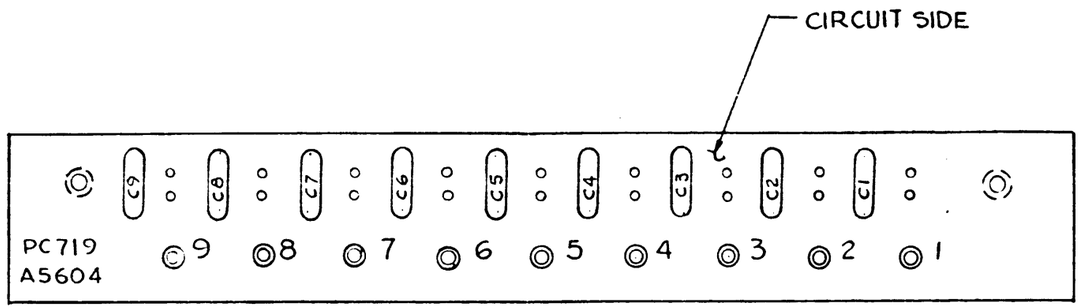
REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR1 thru CR6	Semiconductor, Device, Diode	IN2071A
CR7	Bridge, Rectifier	DD130-600-1.5
CR8	Bridge, Rectifier	DD130-200-3
CR9	Same as CR7	
R1	Resistor, Fixed, Wirewound	RW107-6
R2	Same as R1	
R4	Same as R1	
R3	Resistor, Fixed, Wirewound	RW107-8
R5	Resistor, Fixed, Wirewound	RW107-16

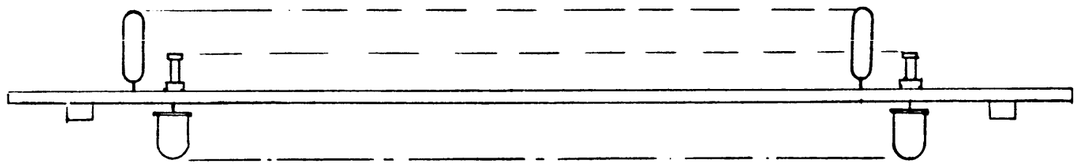
Z104

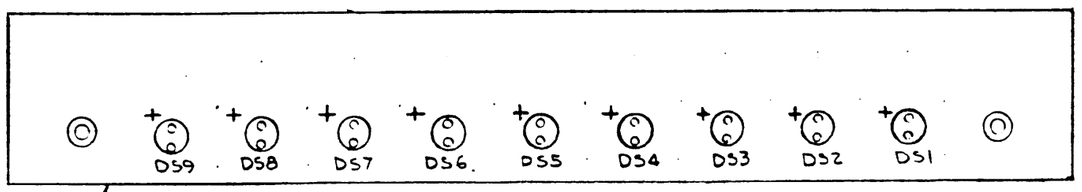
ASS'Y METER OVLD, ADJUST

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, CER.	CC131-39
C2	SAME AS C1	
C3	CAPACITOR, FIXED, ELEC.	CE105-100-25
C4	SAME AS C1	
C5	SAME AS C1	
C6	SAME AS C3	
CR1	SCOND, DEV, DIO.	1N5061
CR2	SAME AS CR1	
CR3	SAME AS CR1	
CR4	SAME AS CR1	
CR5	SAME AS CR1	
R1	Res, var, COMP	RV111-U-101A
R2	RES, FXD, COMP.	RC07GF220J
R3	SAME AS R2	
R4	SAME AS R1	
R5	RES, FXD, COMP.	RC07GF332J
R6	RES, FXD, COMP.	RC07GF680J
R7	RES, FXD, COMP.	RC07GF822J
R8	RES, FXD, COMP.	RC07GF683J
R9	RES, FXD, COMP.	RC42GF681J
R10	SAME AS R9	
Q1	TRANSISTOR	2N1595
Q2	TRANSISTOR	2N1711

REVISIONS							
ZONE	LTR	DESCRIPTION	DATE	E M N NO	DRAFT	CHKD	APPD
	X	EXP. RELEASE	4/71				
		ORIGINAL RELEASE FOR PRODUCTION	11/75		0		







ASSEMBLY NOTES

1. TO MOUNT COMPONENTS INSERT LEADS THROUGH HOLES.
2. CAUTION, WHEN APPLYING HEAT & SOLDER TO LEAD & FOIL.
3. CLEAN & INSPECT AS PER SPEC S676.
4. FOR ELECTRICAL COMPONENT PART NUMBERS REFER TO NPL A5604
5. USE SYMBOL NUMBERS FOR ASSY. REF.

Z101

QTY REQ	ITEM	PART NO.	DESCRIPTION	SYMBOL
X	2	BS100	SOLDER TIN ALLOY	
1	1	PC719	PRINTED CIRCUIT BOARD	

LIST OF MATERIAL

REF CK 2084

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES	FINAL APPROVAL
TOLERANCES ON DECIMALS: A ± 05, XX ± 01, XXX ± 005; FRACTIONS: ± 1/64; ANGLES: ± 0° 30'	MECH DES FIANNUZ
MATERIAL	ELECT DES
FINISH	CHECKED
	DRAWN G.D.L.

A5604
ASSY PRINTED CIRCUIT BD.
INDICATOR CIRCUIT

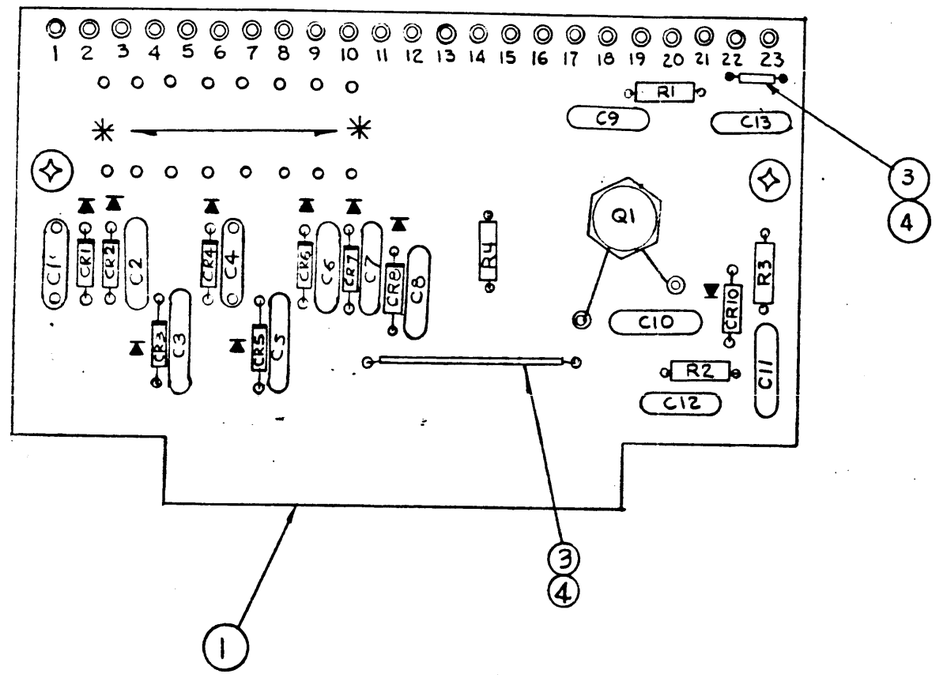
Figure 6-1

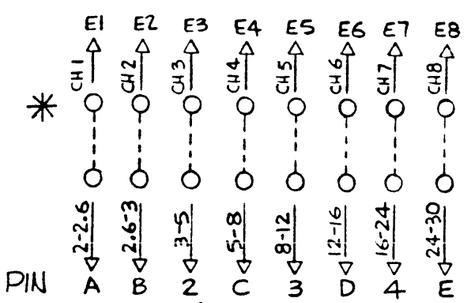
QTY / UNIT	MODEL USED ON	ASS'Y NO.
1	HFL-100( )	

APPLICATION

CODE

REVISIONS								
ZONE	LTR	DESCRIPTION	DATE	E.M.N.O.	DRAFT	CHKD	APPD
	X	EXP. RELEASE	11-6-74		GDL		
	X1	R4 ADDED	2-18-75		FI		
	2	ORIGINAL RELEASE FOR PRODUCTION	3-4-75		a		
	A	ITEM 4 ADDED	6-30-76	[illegible]	GDL	CL	CL
	B	CHAN/FREQ METRIX Added CR9 Deleted	1-25-77	21501	[illegible]		
	C	CHAN/FREQ METRIX Modified	2-22-77		[illegible]		





*NOTE:
WHEN USED FOR AN AUTOMATIC SYSTEM ALL CONNECTIONS MUST BE MADE. IF USED WITH A CHANNELIZED SYSTEM THE CHANNEL CONNECTION MUST BE MADE TO THE FREQ REQUIRED.

ASSEMBLY NOTES

1. TO MOUNT COMPONENTS INSERT LEADS THROUGH HOLES.
2. CAUTION, WHEN APPLYING HEAT & SOLDER TO LEAD & FOIL.
3. CLEAN & INSPECT AS PER SPEC S676.
4. FOR ELECTRICAL COMPONENT PART NUMBERS REFER TO NPL A
5. USE SYMBOL NUMBERS FOR ASSY. REF.

Z102
(CK2112 HFL100A)

QTY REQ	ITEM	PART NO.	DESCRIPTION	SYMBOL
X	4	PX 104-1-034	INSULATION SLEEVING	
X	3	WL 100-8	WIRE BUS	
X	2	BS100	SOLDER TIN ALLOY	
1	1	PC 721	PRINTED CIRCUIT BOARD	

LIST OF MATERIAL

A5608
ASSY PRINTED CIRCUIT BD.
LEDEX CONTROL

1	HFL-100( )	A5608
QTY / UNIT	MODEL USED ON	ASSY NO

APPLICATION

CODE

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOLERANCES ON

DECIMALS	FRACTIONS
.X ± .05	± 1/64
.XX ± .01	ANGLES
.XXX ± .005	± 0° 30'

MATERIAL

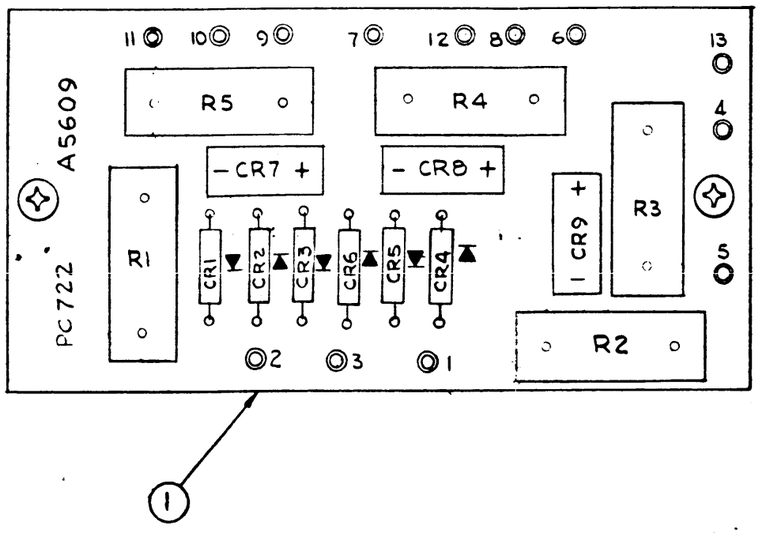
FINISH

FINAL APPROVAL	[illegible]
MECH. DES	F IANNU
ELECT. DES.	
CHECKED	[illegible]
DRAWN	G.D.

A5608 C

Figure 6-2

REVISIONS							
ZONE	LTR	DESCRIPTION	DATE	E.M.N.NO	DRAFT	CHKD	APPD
	E	ORIGINAL RELEASE -	1/0/15		GDL		



1. TO MOUNT COMPONENTS INSERT LEADS THROUGH HOLES.
2. CAUTION, WHEN APPLYING HEAT & SOLDER TO LEAD & FOIL.
3. CLEAN & INSPECT AS PER SPEC S676.
4. FOR ELECTRICAL COMPONENT PART NUMBERS REFER TO NPL A5609
5. USE SYMBOL NUMBERS FOR ASSY. REF.

Z103

QTY REQ.	ITEM	PART NO.	DESCRIPTION	SYMBOL
X	2	BS100	SOLDER TIN ALLOY	
1	1	PC 722	PRINTED CIRCUIT BOARD	

(REF) CK 2084

1	HFL-100( )	
QTY / UNIT	MODEL USED ON	ASS'Y NO.
APPLICATION		
	CODE	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

TOLERANCES ON

DECIMALS	FRACTIONS
.X ± .05	± 1/64
.XX ± .01	ANGLES
.XXX ± .005	± 0° 30'

MATERIAL

FINISH

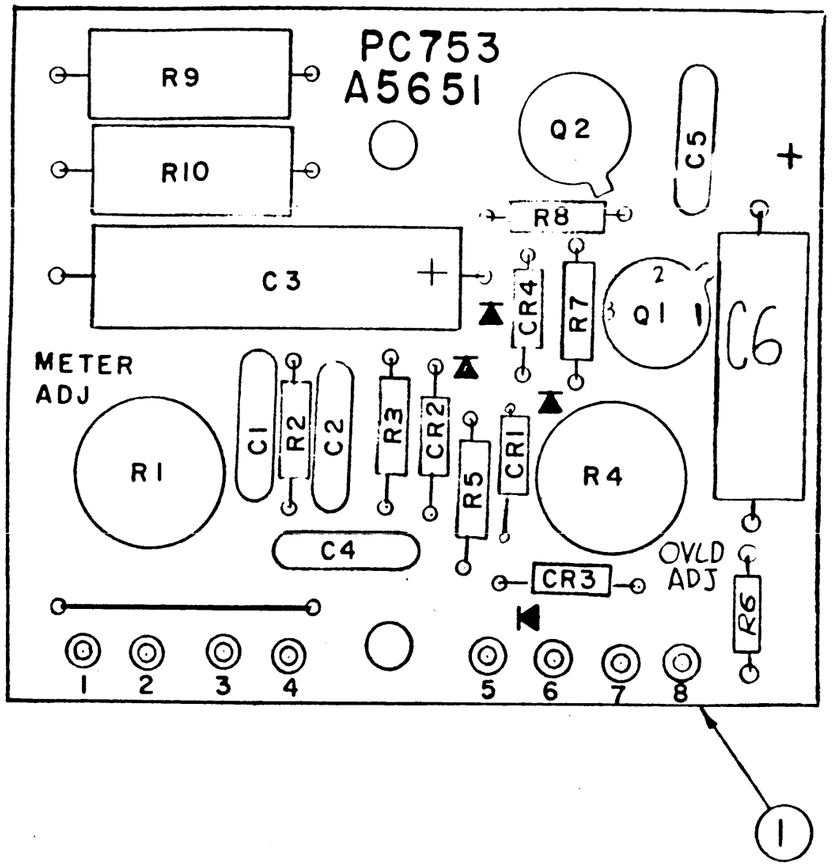
FINAL APPROVAL	OK
MECH DES	F IANNUZ
ELECT DES	
CHECKED	
DRAWN	G. DE LU

A5609
ASSY PRINTED CIRCUIT BD.
DC RECTIFIER

Figure 6-3

A5602 Ø

REVISIONS							
E.M.N. NO	DRAFT	CHKD	ZONE	LTR	DESCRIPTION	DATE	APPROVED



ASSEMBLY NOTES

1. TO MOUNT COMPONENTS INSERT LEADS THROUGH HOLES.
2. CAUTION, WHEN APPLYING HEAT & SOLDER TO LEAD & FOIL.
3. CLEAN & INSPECT AS PER SPEC S676.
4. FOR ELECTRICAL COMPONENT PART NUMBERS REFER TO NPL A
5. USE SYMBOL NUMBERS FOR ASSY. REF.

REQ'D	ITEM	PART NUMBER	DESCRIPTION	SYM.
X	2	BS100	SOLDER TIN ALLOY	
1	1	PC753	PRINTED CIRCUIT BD	

LIST OF MATERIAL

Z104

QTY / UNIT	MODEL USED ON	ASS'Y NO.
1	HFL-100( )	

APPLICATION

CODE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND INCLUDE CHEMICALLY APPLIED OR PLATED FINISHES

DECIMALS: .X ± .05, .XX ± .01, XXX ± 005 — TOLS. — FRACTIONS 1/64 — ANGLES 0° 30'

MATERIAL

FINISH

	APPROVAL	DATE
FIN		
MECH. ENGS.		
ELECT. DES.		
CHECKED		
DRAWN	G.D.L	11-8-76

A5651
ASS'Y PRINTED CIRCUIT BD.
METER, OVLD ADJUST

Figure 6-4

PCI 10 170 10 66

5 4 3 2 1

D C B A