UNCLASSIFIED

TECHNICAL MANUAL

for

LOW FREQUENCY SYNTHESIZER

MODEL LFSB-1

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

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IN-6004L

ISSUE DATE: 1 MAR, 1965

NOTICE

THE TECHNICAL MATERIEL CORPORATION
COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

Warranty

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes,* fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, F.O.B. factory, which may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction.
2. That the defect is not the result of damage incurred in shipment from or to the factory.
3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.
4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

Electron tubes*furnished by TMC, but manufactured by others, bear only the warranty given by such other manufacturers. Electron tube warranty claims should be made directly to the manufacturer of such tubes.

TMC's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

At TMC's option any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to TMC, unless a return authorization is issued by TMC.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Buyers sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of TMC Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

*Electron tubes also include semi-conductor devices.

PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT

TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

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SECTION 1

GENERAL INFORMATION

1-1. PURPOSE AND DESCRIPTION

a. PURPOSE. - The LFSB synthesizer (figure 1-1) is primarily used with communications receivers, such as the TMC Model VLRB, operating over the frequency range of 30 to 600 kilocycles. The LFSB maintains the receiver's local oscillators over the frequency range of 130 to 700 kilocycles to a high stability. To accomplish this, the LFSB requires a 6.5 megacycle signal and a bandpass signal of 5.8 to 6.37 megacycles from the external receiver; and, a 100 kilocycle and a one megacycle signal from an external frequency standard such as the TMC Model CSS. . The stability of the LFSB is equal to that of the frequency standard it is used with. The LFSB tunes between the frequencies of 30 to 99.999 kilocycles in increments of one cycle, and between the frequencies of 30 to 600 kilocycles in increments of ten cycles. The selected frequency is displayed on the front panel in one inch high illuminated numerals. A front panel switch selects the tuning increments.

The LFSB can also be used as a digital-type signal generator. To function as a signal generator, the LFSB requires 100 kilocycle and one megacycle signals from an external source. The LFSB produces sinusoidal output signals within the frequency range of 100 to 199.999 kilocycles in increments of one cycle, and 100 to 1099.990 kilocycles in

increments of ten cycles. The stability of the output signals is equal to that of the external source.

b. DESCRIPTION. - The LFSB is a completely transistorized modular constructed unit consisting of a main chassis that houses:

(1) A 1-8 Megacycle Generator Module.

(2) A Spectrum Generator Module.

(3) Five identical Spectrum Filter Assemblies.

(4) Five identical Plus Mixer Modules.

(5) Four identical Divide By Ten Modules.

(6) A 9.0 and 9.9 Megacycle Generator Module.

(7) An Output Mixer Multiplier Module.

(8) A 6.5 Megacycle I-F and Output Module.

(9) A Phase Detector Module.

(10) A Power Supply Assembly.

The modules are printed-circuit plug-in cards. All wiring in a module terminates in a multiple-conductor plug; this plug mates with a compatible jack on the main chassis when the module is properly positioned. Controls, jacks, and indicators are located on the front and rear panels of the LFSB.

The LFSB contains its own power supply which requires 115/230 volts a-c power for operation. However, in the event of a-c power failure, provisions are made (with connection of an external 24-volt battery) to automatically switch over to battery power.

1-2. TECHNICAL SPECIFICATIONS

Technical specifications of the LFSB synthesizer are listed in table 1-1.

Table 1-1. Technical Specifications

Modes	Synthesizer or signal generator.
Frequency Range:	
Synthesizer Mode	Tunable from 30 to 99.999 kilocycles in increments of 1 cycle; from 30 to 600 kilocycles in increments of 10 cycles.
Signal Generator Mode	Tunable from 100 kilocycles to 199.999 kilocycles in increments of 1 cycle; from 100 kilocycles to 1099.990 kilocycles in increments of 10 cycles.
Inputs (Synthesizer Mode):	
From External Frequency Standard	100 kilocycle and one megacycle signals may be inserted to respective BNC connectors at a level of 1 volt across 50 ohms.
From External Receiver	6.5 megacycles at a level of approximately 1 millivolt across 50 ohms (BNC connector); signals within the bandpass of 5.8 to 6.37 megacycles at a level of approximately 1 millivolt across 50 ohms (BNC connector).
Inputs (Signal Generator Mode)	External 100 kilocycle and 1 megacycle signals may be inserted to respective BNC connectors at a level of 1 volt across 50 ohms.

Table 1-1. Technical Specifications (cont)

Outputs:	
Synthesizer Mode	A d-c correction voltage available at a BNC connector may be connected to external receiver's local oscillators operating in frequency range of 130 to 700 kilocycles.
Signal Generator Mode	Sinusoidal output signals within frequency range of 100.000 to 1099.999 kilocycles are available at a BNC connector for connection to external equipment.
Stability:	
Synthesizer Mode	Equal to the stability of the external frequency standard.
Signal Generator Mode	Equal to the stability of the external input signals.
Operating Power	105, 115, 125/210, 230, 250 at 50 to 60 cycles single phase. Facilities are provided for automatic switch-over to battery operation if a-c power should fail.
Battery Power (Optional)	24-volt external battery. Battery should be selected to provide minimum of 4 hour operation of LFSB. When normal a-c operation is used, battery can be kept in a charged condition by a built-in "trickle" charger.
Battery Drain	400 milliampers, approximately.
Weight	Approximately 35 lbs.
Dimensions	7" high x 19" wide x 15" deep.

1-3. TRANSISTOR AND DIODE COMPLEMENT

Table 1-2 lists the transistor and diode complement of the LFSB.

TABLE 1-2. TRANSISTOR AND DIODE COMPLEMENT.

REFERENCE SYMBOL	TYPE	FUNCTION
1-8 MEGACYCLE GENERATOR MODULE		
Q401,Q403, Q404	2N1637	1 Mc Amplifier
Q402	2N1637	8 Mc Amplifier
CR401, CR402	1N100	Harmonic Generator
SPECTRUM GENERATOR MODULE		
Q501	2N1637	Mixer
Q502	2N2646	Locked Oscillator
Q503	2N2647	Locked Oscillator
Q504	2N1637	Spectrum Amplifier
Q505, Q506	2N706	Limiter
Q507	2N1637	Amplifier
CR502	1N3027B	Regulator
SPECTRUM FILTER ASSEMLY		
Q351	2N1637	1 Mc $+\Delta f$ Amplifier
PLUS MIXER MODULE		
Q643	2N1637	1 Mc $+\Delta f$ Amplifier with AGC
Q641, Q642	2N1637	Balanced Mixer
Q646, Q647	2N1637	Balanced Mixer

TABLE 1-2. TRANSISTOR AND DIODE COMPLEMENT (cont)

REFERENCE SYMBOL	TYPE	FUNCTION
PLUS MIXER MODULE (cont)		
Q644	2N1637	8 Mc Amplifier
Q645	2N1637	9 Mc+ f
Q648	2N1637	10 Mc+ f amplifier
CR641	1N39B	AGC Diode
DIVIDE BY TEN MODULE		
Q601	2N1637	10 Mc+ f amplifier
Q602	2N2217	1 Mc +∠f Locked Oscillator
Q603	2N1637	1 Mc +∠f Amplifier
9.0 AND 9.9 MC GENERATOR MODULE		
Q701	2N384	1.0 Mc Filter-Amplifier
Q702	2N384	1.0 Mc Amplifier
Q703,	2N384	3.0 Mc Multiplier
Q705	2N384	9.0 Mc Filter-Amplifier
Q706	2N384	1.1 Mc Filter-Amplifier
Q707	2N384	1.1 Mc Amplifier
Q708	2N384	3.3 Mc Multiplier
Q709	2N384	9.9 Mc Multiplier
Q710	2N384	9.9 Mc Filter-Amplifier
Q704	2N384	9.0 Mc Multiplier

TABLE 1-2. TRANSISTOR AND DIODE COMPLEMENT (cont)

REFERENCE SYMBOL	TYPE	FUNCTION
OUTPUT MIXER-MULTIPLIER MODULE		
Q901	2N384	Mixer
Q902	2N384	1 Mc +$\angle$f Amplifier
Q903	2N384	X5 Multiplier
Q904, Q905	2N384	5 Mc + 5$\angle$f Amplifier
CR901, CR902	1N34A	X2 Multiplier
Q906, Q907	2N384	10 Mc +10$\angle$f Amplifier
Q908, Q909	2N384	10 Mc +$\angle$f Amplifier
6.5 MC IF AN OUTPUT MODULE		
Q751	2N384	Mixer
Q752, Q756	2N384	Emitter Follower
Q753, Q754	2N384	Mixer
Q755	2N384	Amplifier
Q757	2N384	6.5 Mc Amplifier
PHASE DETECTOR MODULE		
Q801, Q802, Q803, Q804, Q805, Q806, Q807	2N384	Amplifier
CR801, CR802	1N34A	Phase Detector
CR803, CR804	1N34A	Phase Detector
CR805	1N2484	High-Voltage Rectifier
Q808, Q809	2N396A	Phase Detector
Q810, Q811	2N214	DC to DC Converter

TABLE 1-2. TRANSISTOR AND DIODE COMPLEMENT (cont)

REFERENCE SYMBOL	TYPE	FUNCTION
POWER SUPPLY		
Q1	2N1234	Series Regulator
CR1, CR2, CR3, CR4	1N2484	Rectifier
CR5	1N2484	Isolator
CR6	VR101 -24S51	Regulator
CR8	1N2976B	Regulator

SECTION 2

INSTALLATION

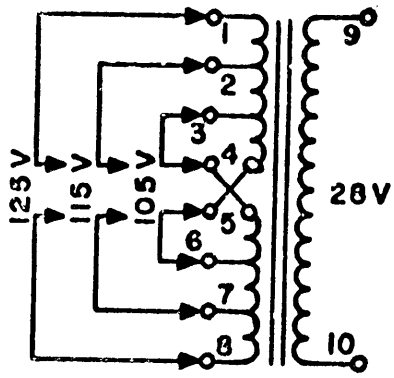
2-1. INITIAL INSPECTION.

The LFSB is calibrated and tested at the factory prior to shipment. When it arrives at the operating site, inspect the packing case and contents for possible damage. Inspect all packing material for parts which may have been shipped as "loose items." With respect to damage to the equipment for which the carrier is liable, the Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts.

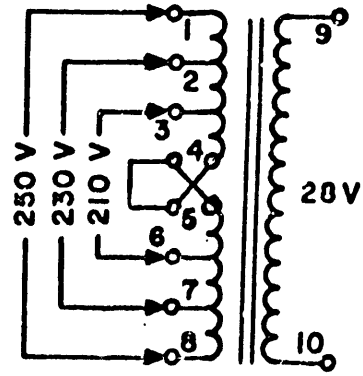
The equipment is shipped with all modules and other components installed. Check that all such components are properly positioned.

2-2. POWER REQUIREMENTS

The LFSB unit is designed for 105, 115, 125 ,10, 230, 250 volt, 50 to 60 cycles per second, single phase power. Unless specifically ordered, the unit is shipped wired for 115 volt operation. Figure 2-1 shows the power transformer primary winding connections for all of the designated power voltages. When 210, 230, or 250 volt operation is used, change AC fuse F451 located on the rear panel from 1/2 ampere to 1/4 ampere.



105/115/125 V
60/50 CPS



210/230/250 V
60/50 CPS

Figure 2-1. Transformer Wiring

2-3. INSTALLATION

a. MECHANICAL. - The LFSB is designed for both cabinet and rack installation. In either case, adequate ventilation, sufficient clearance in back of the synthesizer for access to rear panel connections, and sufficient space for withdrawal of the synthesizer from the cabinet for servicing are prime considerations when determining the synthesizer's ultimate location. The LFSB is equipped with a standard 19 inch wide front panel, and is 7 inches high and approximately 15 inches deep.

When intended for rack installation, the LFSB is equipped with slide mechanisms; to install the LFSB in a rack, proceed as follows:

(1) Set the LFSB chassis slide mechanism in tracks.

(2) Slide chassis in tracks until rearward release finger engages holes in track.

(3) Make the necessary cable and electrical connections as described in paragraph b below.

(4) Press forward release fingers and slide chassis into cabinet; secure front-panel of LFSB to rack with screws.

b. ELECTRICAL. - All external connections are made to the jacks located on the rear panel (see figure 2-2). Table 2-1 lists rear panel controls and jacks and the function of each. External connections to the LFSB are made as follows:

(1) Check that the POWER switch S452 is set to its off position (down); then connect 115 volt a-c power to the MAIN AC jack J451 pins A and C.

(2) For signal generator operation, connect external 100 kilocycle and one megacycle signals to the 100 KC IN jack J486 and to the 1 MC IN jack J452, respectively. The sinusoidal output signals are available at the SIGNAL OUT jack J450, located on the front panel, for connection to external equipment.

(3) For synthesizer operation, do the following:

(a) Connect 100 kilocycle and one megacycle signals from external frequency standard to 100 KC IN jack J486 and to the 1 MC IN jack J452, respectively.

(b) Connect 6.5 megacycle signal from external receiver to 6.5 MC IN jack J454.

(c) Connect signals in the bandwidth of 5.8 to 6.37 megacycles from external receiver to 5.8 MC IN jack J454.

(d) Connect external receiver's local oscillator control circuit to DC LOOP OUT jack J455.

(4) For automatic power switching, ensure that the BAT. switch S451 is set to OUT: then, connect the external 24-volt battery supply to the BATTERY jack J456 pins A and D (pin A is the positive terminal connection).

TABLE 2-1. REAR PANEL CONTROLS AND JACKS

REFERENCE DESIGNATION (Figure 2-2)	PANEL AND COMPONENT DESIGNATION	FUNCTION
1	BATTERY jack J456	Input receptacle for external 24-volt battery.
2	HV fuse F454	Protects dc to dc converter components from overloads.
3	SYNC ALARM, GND, Terminal board E451	Permits connection of an external alarm circuit.

TABLE 2-1. REAR PANEL CONTROLS AND JACKS (CONT)

REFERENCE DESIGNATION (Figure 2-2)	PANEL AND COMPONENT DESIGNATION	FUNCTION
4	BAT. switch S451	A 2-position switch. IN position connects external 24-volt battery to LFSB circuits; OUT position disconnects battery from LFSB circuits.
5	DC LOOP OUT jack J455	Permits connection of d-c correction voltage to control circuit of external receiver local oscillators.
6	5.8 MC IN jack J454	Input jack for external 5.8 to 6.37 megacycle signal.
7	6.5 MC IN jack J453	Input jack for external 6.5 megacycle signal.
8	1 MC jack J452	Input jack for external 1 megacycle signal.
9	B- fuse F453	Protects -12 volt power supply components from overloads.
10	B+ fuse F452	Protects +12 volt power supply components from overloads.
11	AC fuse F451	Protects power supply components from internal short circuits.
12	MAIN AC jack J451	Input receptacle for 115/230 volt ac power.
13	100 KC IN jack J486	Input jack for external 100 kilocycle signal.

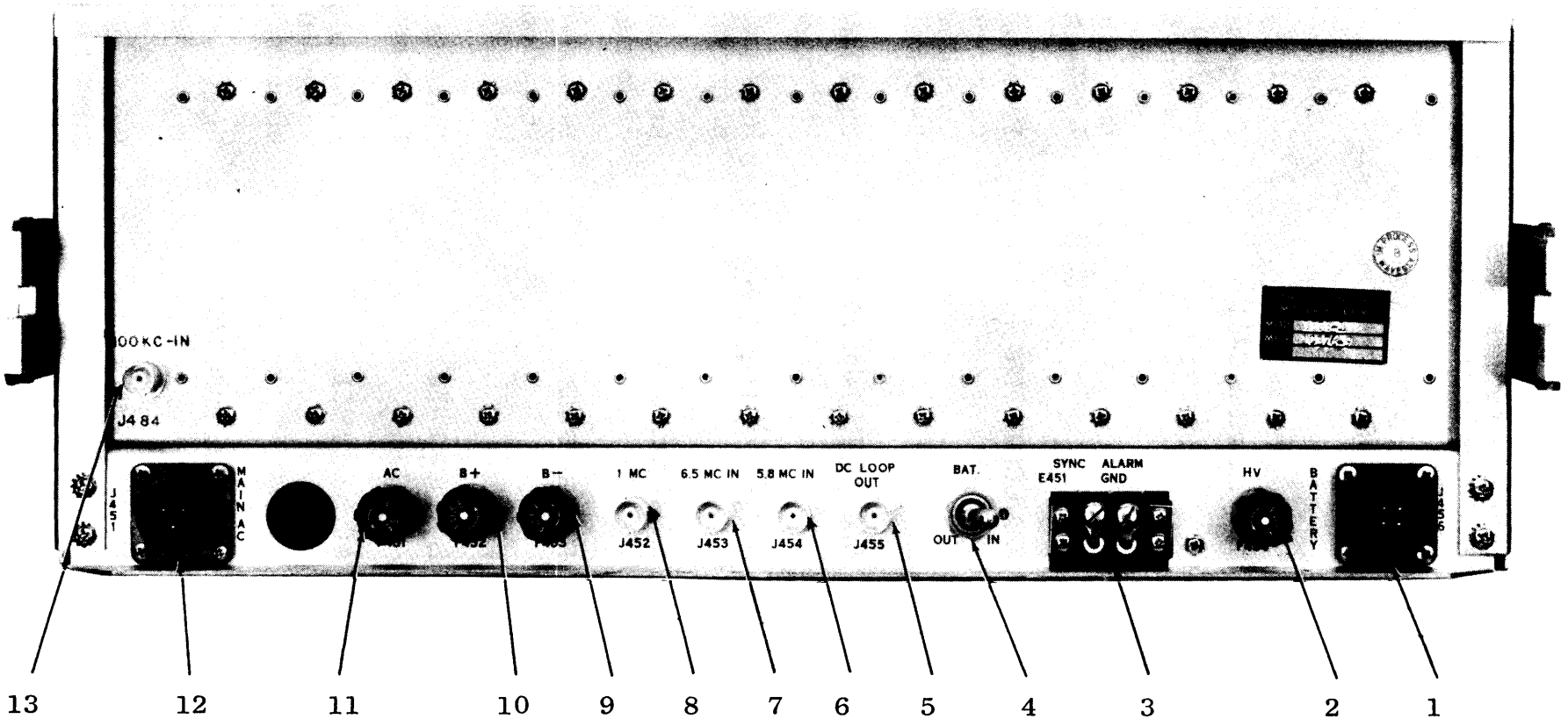


Figure 2-2. LFSB Synthesizer, Rear View

2-4. INITIAL ADJUSTMENTS.

Before any LFSB synthesizer is shpped, it is aligned and thoroughly checked against the manufacturers specification. Additional adjustments will not normally be required if the LFSB is properly installed.

SECTION 3

OPERATOR'S SECTION

3-1. CONTROLS, JACKS AND INDICATORS

Before attempting to operate the LFSB, the operator should first familiarize himself with all controls and indicators. Controls, jacks, and indicators required for operation of the LFSB synthesizer are listed in table 3-1 and illustrated in figure 3-1.

TABLE 3-1. CONTROLS, JACKS AND INDICATORS

REFERENCE DESIGNATION (Figure 3-1)	CONTROL OR INDICATOR	FUNCTION
1	Nixie indicators DS351	Displays frequency that LFSB is tuned to. However, in signal generator mode, frequency displayed is exactly 100 kilocycles lower than frequency of output signal.
2	DS454	Decimal point indicator when FREQUENCY MULTIPLIER switch is in the X1 position.
3	DS455	Decimal point indicator when FREQUENCY MULTIPLIER switch is in the X10 position.
4	SYNC ALARM lamp DS453	Functions only when LFSB is used in synthesizer mode. Indicates that system is synchronized.
5	SYNCHRONIZE meter M451	Functions only when LFSB is used in synthesizer mode. Indicates phase error of external signals.

TABLE 3-1. CONTROLS, JACKS, AND INDICATORS (cont)

REFERENCE DESIGNATION (Figure 3-1)	CONTROL OR INDICATOR	FUNCTION
6	POWER switch S452	Connects a-c power to internal power supply circuit.
7	POWER lamp DS451	Indicates when a-c power is applied to internal power supply circuit.
8	SIGNAL OUTPUT jack J450	Permits connection of sinusoidal output signals to external circuits.
9	BATTERY lamp DS452	Indicates when external battery is used to power LFSB circuits.
10	FREQUENCY MULTIPLIER switch S453	A two-position switch; in X1 position LFSB is tuned in increments of 1 cycle. In X10 position LFSB is tuned in increments of 10 cycles.
11	1 CPS switch S351	Tunes LFSB in 1 cycle steps with FREQUENCY MULTIPLIER switch S453 in X1 position. Tunes LFSB in 10 cycles steps when switch S453 is in X10 position.
12	10 CPS switch S351	Tunes LFSB in 10 cycles steps with FREQUENCY MULTIPLIER switch S453 in X1 position. Tunes LFSB in 100 cycle steps when switch S453 is in X10 position.
13	.1 KC switch S351	Tunes LFSB in 100 cycle steps with FREQUENCY MULTIPLIER switch in X1 position. Tunes LFSB in 1000 cycle steps when switch S453 is in X10 position.
14	1 KC switch S351	Tunes LFSB in 1 kc steps when FREQUENCY MULTIPLIER switch S453 is in X1 position. Tunes LFSB in 10 kc steps when switch is in X10 position.
15	10 KC switch S351	Tunes LFSB in 10 kc steps when FREQUENCY MULTIPLIER switch S453 is in X1 position. Tunes LFSB in 100 kc steps when switch S453 is in X10 position.

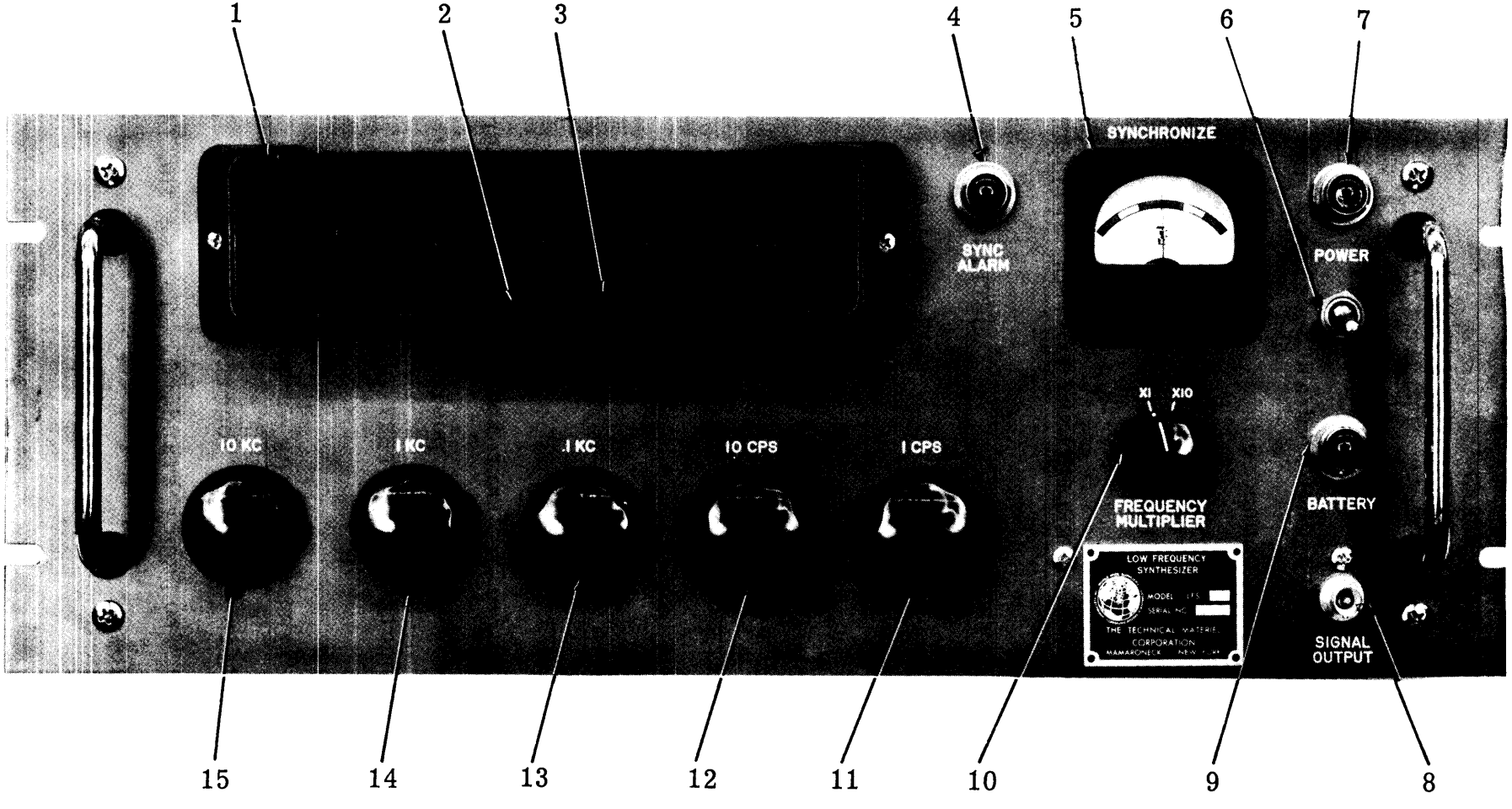


Figure 3-1. LFSB, Front Panel Controls and Indicators

3-2. OPERATING PROCEDURES

a. GENERAL. - Prior to applying power to the LFSB synthesizer, ensure that the synthesizer is installed in accordance with the instructions provided in Section 2 and that all external cables are properly connected.

b. PRELIMINARY CONTROL SETTINGS. - Preliminary control settings are given in table 3-2.

TABLE 3-2. PRELIMINARY CONTROL SETTINGS

CONTROL	SETTING
10 KC	Any position
1 KC	Any position
.1 KC	Any position
10 CPS	Any position
1 CPS	Any position
POWER (switch)	Off position
FREQUENCY MULTIPLIER	X1

c. STARTING. - To start the LFSB synthesizer, set the POWER switch S452 to its on position. If an external 24-volt battery is connected to BATTERY jack J456 set BAT. switch S451 to IN.

d. SYNTHESIZER OPERATION. - When the LFSB is used as a synthesizer, it is operated together with an external receiver. and an external frequency standard. To use the LFSB as a synthesizer, proceed as follows:

(1) At the external receiver, tune to a selected station within the frequency range of 30 to 600 kilocycles.

(2) At the LFSB, set FREQUENCY MULTIPLIER switch S453 to either X1 to cover tuning range of 30 to 99.999 kilocycles or to X10 to cover tuning range of 30 to 600 kilocycles.

NOTE

When the FREQUENCY MULTIPLIER switch is in the X1 position, the LFSB will tune in increments of one cycle. When the switch is in the X10 position, the LFSB will tune in increments of ten cycles.

(3) Set the 1 CPS, 10 CPS, .1 KC, 1 KC, and the 10 KC switches until the LFSB is tuned to the same frequency as the external receiver. The SYNCHRONIZE meter M451 should read in the green area; the SYNC ALARM lamp DS453 should be on.

e. SIGNAL GENERATOR OPERATION. - To use the LFSB as a signal generator, proceed as follows:

NOTE

In this mode of operation, the frequency displayed on the front panel is exactly 100 kilocycles lower than the output signal frequency. For example, with the FREQUENCY MULTIPLIER switch S453 set to X1 and the LFSB tuned to one cycle as displayed on the front panel, the output signal frequency will be 100.001 kilocycles.

(1) Set FREQUENCY MULTIPLIER switch S453 to X1 to cover the frequency range of 100.000 to 199.999 kilocycles or to X10 to cover the frequency range of 100.000 to 1099.990 kilocycles.

(2) Rotate 1 CPS, 10 CPS, .1 KC, 1 KC, and 10 KC switches for desired output signal within the selected tuning range.

f. STOPPING. - To stop the LFSB synthesizer, proceed as follows:

(1) If an external 24-volt battery is connected to BATTERY jack J456 located on the rear panel, set BAT. switch S451 to OUT.

(2) Set POWER switch S452 to its off position.

3-3. OPERATOR'S MAINTENANCE.

The operator may at times be required to perform operator's maintenance. This consists of merely observing for unit cleanliness, condition and connection of interconnecting cables, and replacement of defective fuses and indicator lamps. See figures 3-1 and 2-2 for identification and location of the various LFSB controls, indicators, fuses, and jacks.

SECTION 4

TROUBLESHOOTING

4-1. OVERALL FUNCTIONAL DESCRIPTION.

Refer to figure 4-1. The LFSB functions either as a synthesizer or as a signal generator. When used as a synthesizer, the LFSB utilizes a 100 kilocycle signal and a one megacycle signal from an external frequency standard to produce a signal in the frequency range of 130 to 700 kilocycles. This signal is mixed with a 5.8 to 6.37 megacycle signal supplied by an external receiver; the resultant 6.5 megacycle signal is compared with a 6.5 megacycle signal also supplied by the external receiver. This action furnishes a d-c correction voltage which maintains the external receiver local oscillators to a high stability. During synthesizer operation, the LFSB is tuned to the same frequency as the external receiver. This frequency is displayed on the front panel in one inch high illuminated numerals. The LFSB synthesizer can be used with communication receivers covering the frequency range of 30 to 600 kilocycles.

When used as a signal generator, the LFSB utilizes 100 kilocycle and one megacycle signals from an external source to produce sinusoidal output signals within the frequency range of 100.000 to 1099.990 kilocycles. The stability of the output signals are equal to the stability of the external source. The LFSB tunes from one cycle to 999.990 kilocycles. As a result, the frequency

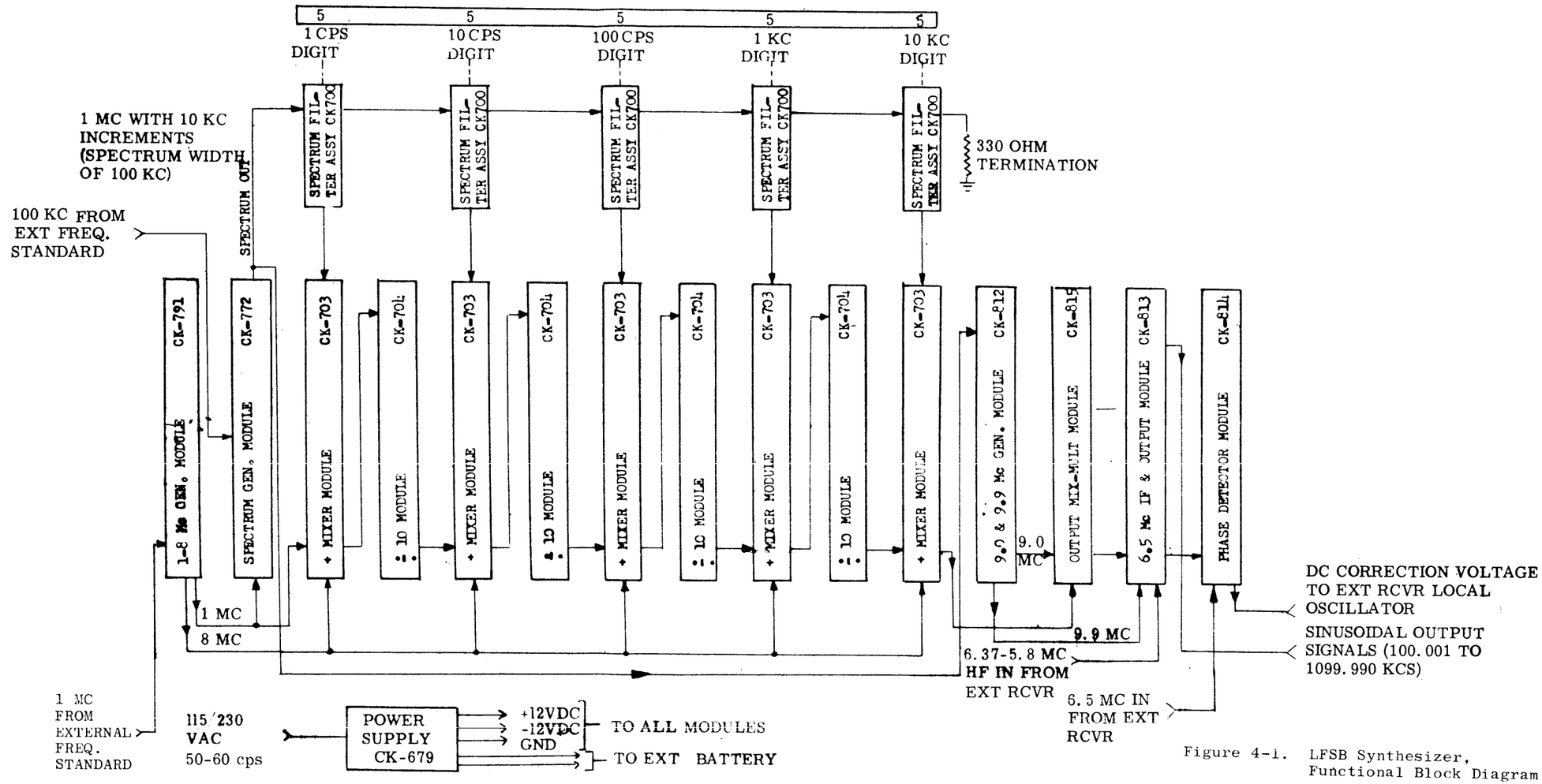


Figure 4-1. LFSB Synthesizer, Functional Block Diagram

displayed on the front panel is always 100 kilocycles lower than the frequency of the output signals.

The LFSB internal power supply operates with an input of 115/230 volts ±10%, 50 to 60 cycles per second, single phase power and furnishes ±12 volts at its output terminals. Facilities are provided for connection of an external 24-volt rechargeable battery, and for automatic switchover to battery power, if a-c power should fail.

4-2. DETAILED BLOCK DIAGRAM DESCRIPTION.

a. 1-8 MEGACYCLE GENERATOR MODULE. - Refer to figure 4-2. The 1-8 megacycle Generator Module utilizes a 1 megacycle signal applied to its input terminals to produce 1 and 8 megacycle signals at its output terminals.

The 1 megacycle signal appearing at the 1 MC IN jack is amplified by Q404 and then applied to parallel-connected amplifiers Q401 and Q403. The amplified 1 megacycle output signal of Q403 is applied to the Spectrum Generator Module and to the first Plus Mixer Module.

Q401 amplifies the 1 megacycle signal received from amplifier Q404 and routes it to a harmonic generator circuit. This circuit distorts the 1 megacycle signal to provide a large number of 1 megacycle harmonics. The harmonic generator output signal is applied to a crystal filter that is tuned to pass only the frequency of 8 megacycles to amplifier Q402. The amplified 8 megacycle output signal of Q402 is applied to the five Plus Mixer Modules.

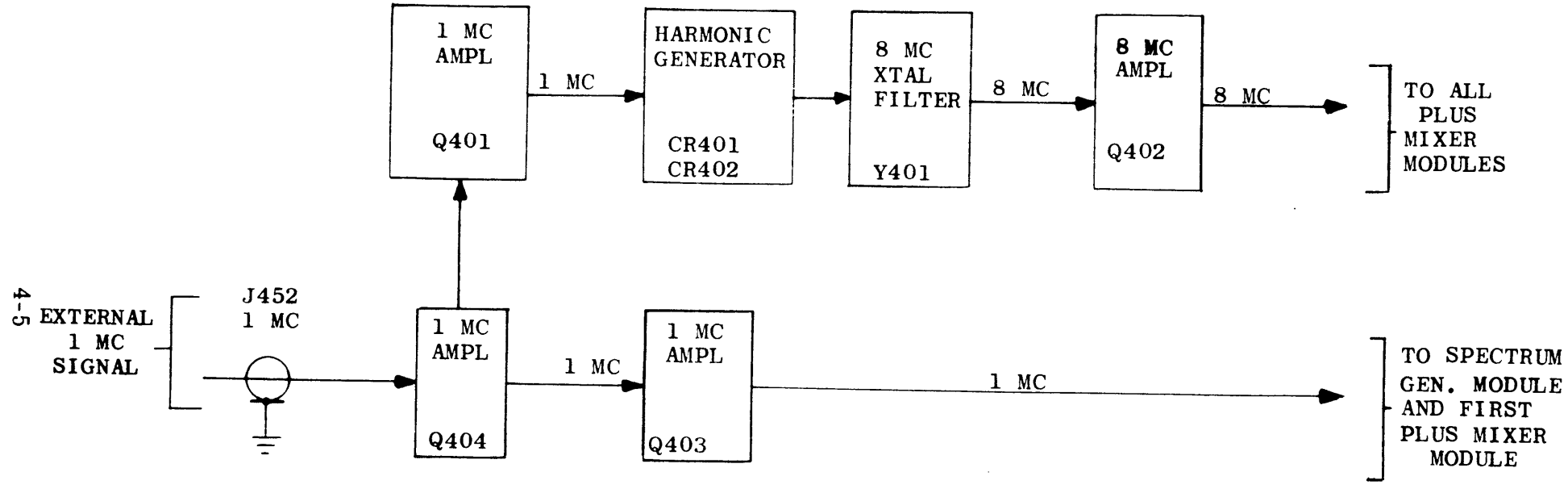


Figure 4-2. 1-8 Megacycle Generator Module, Functional Block Diagram

b. SPECTRUM GENERATOR MODULE. - Refer to figure 4-3. The Spectrum Generator Module utilizes a one megacycle signal from the 1-8 Megacycle Generator Module and a 100 kilocycle signal from an external source to produce a one megacycle signal with a 100 kilocycle wide spectrum in 10 kilocycle increments. The 100 kilocycle signal is applied to limiter Q505 and Q506. The limiter clips the positive and negative peaks of the signal; the square-wave output signal is differentiated and applied to amplifier Q507. The amplifier produces a positive-going pulse that synchronizes oscillator Q503 to a frequency of 20 kilocycles. The resultant 20 kilocycle output signal of Q503 synchronizes oscillator Q502 to a frequency of 10 kilocycles. The 10 kilocycle output signal, rich in harmonics, is routed to mixer Q501 together with the 1 megacycle signal. The mixer output signal is 1 megacycle with an overall bandwidth of 100 kilocycles. The mixer output signal is amplified by Q504 and applied to the Five Spectrum Filter Assemblies and to the 9.0 and 9.9 Megacycle Generator Module.

c. SPECTRUM FILTER ASSEMBLY. - Figure 4-4 is a functional block diagram of a typical Spectrum Filter Assembly. There are five identical Spectrum Filter Assemblies in the LFSB synthesizer; each assembly receives the 1 megacycle signal with a 100 kilocycle bandwidth from the Spectrum Generator Module. Each spectrum filter assembly is equipped with 10 crystals (Y350 to Y359) and neutralizing capacitors C360 through C369. Capacitors C360 through C369 tune crystals Y350 through Y359 respectively in 10 kilocycle increments between the frequencies

of 1 and 1.090 megacycles. Switch S351 selects the desired crystal and the nixie indicator numeral to be displayed. The selected signal between the limits of 1 and 1.090 megacycles is amplified by Q351 and applied to its associated plus mixer module.

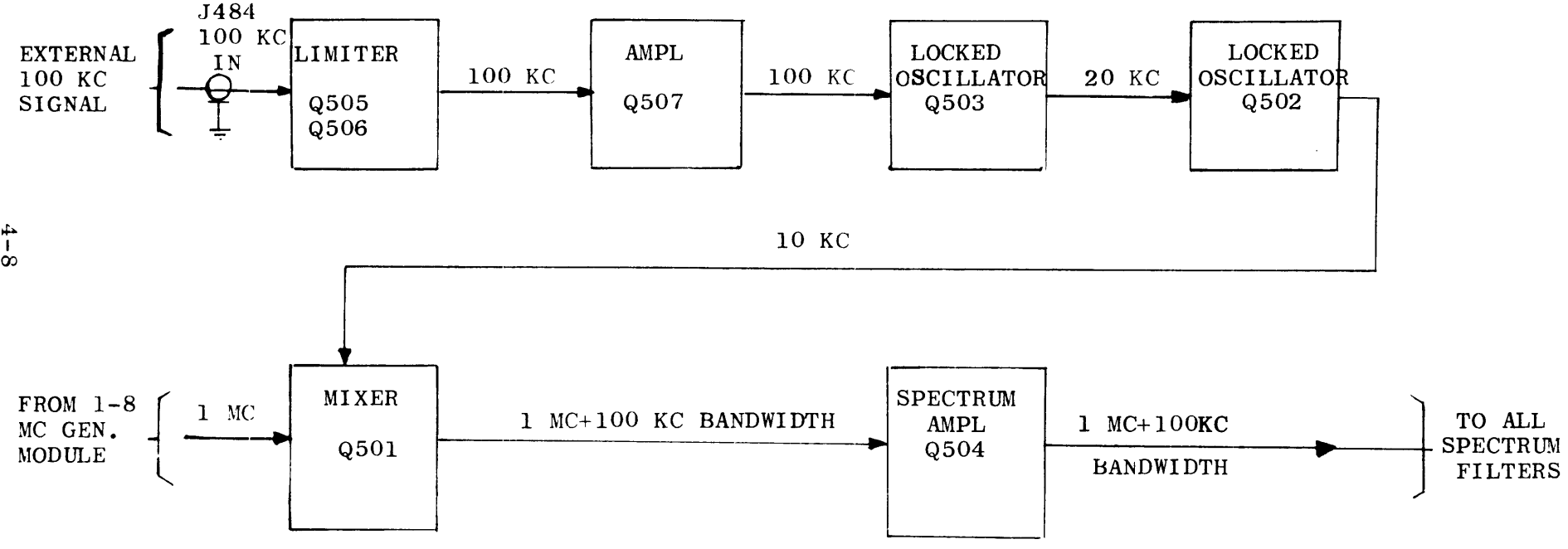


Figure 4-3. Spectrum Generator Module, Functional Block Diagram

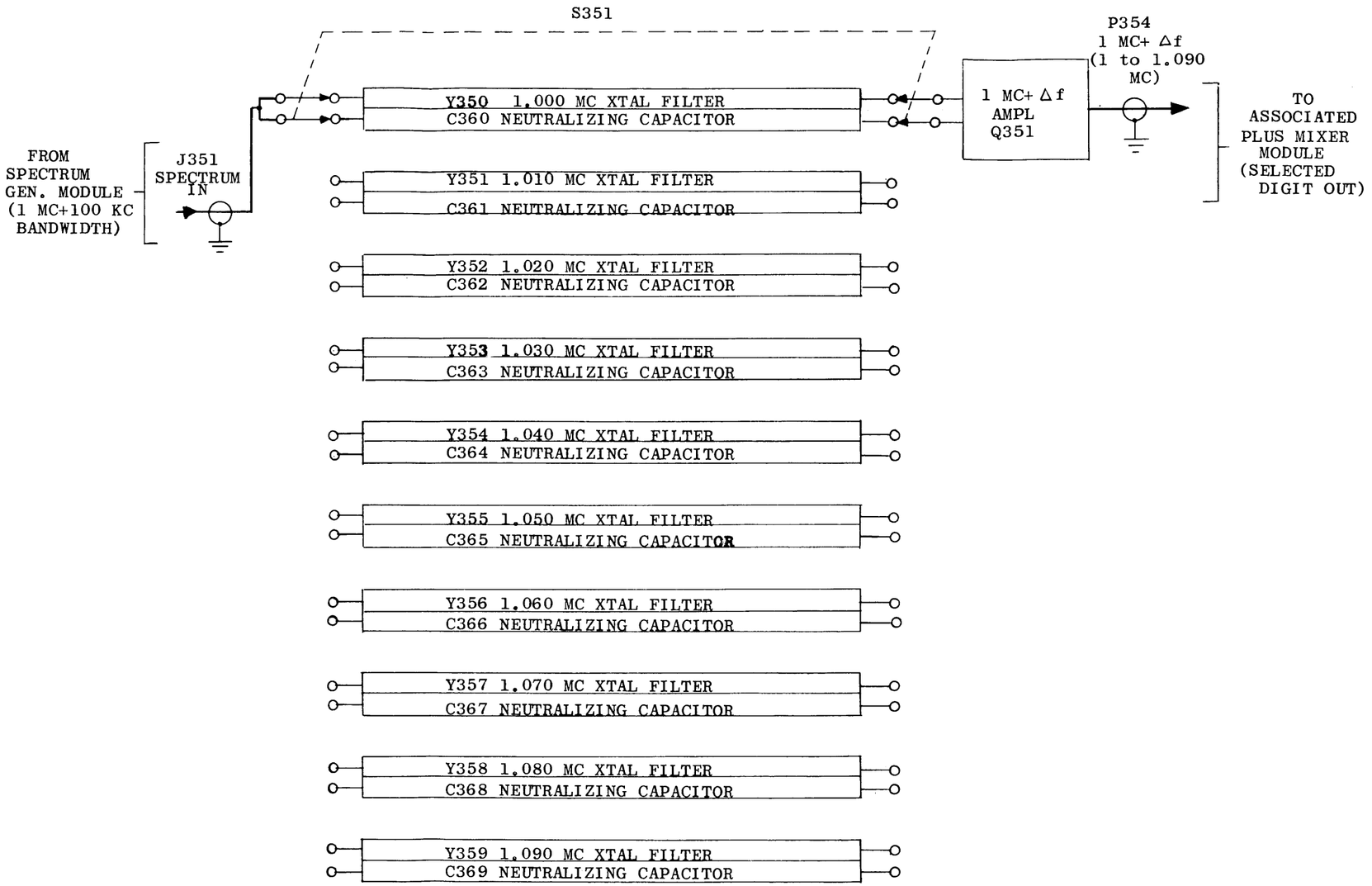


Figure 4-4. Spectrum Filter Assembly, Functional Block Diagram

NOTE

For a better understanding of the LFSB synthesizer circuits, refer to the frequency scheme given in figure 4-5. This scheme gives the frequencies applied to each module when the Spectrum Filter Assemblies are tuned to deliver an output signal of 1.050 megacycles.

d. PLUS MIXER MODULE. - Figure 4-6 is a functional block diagram of a typical Plus Mixer Module. There are five identical Plus Mixer Modules. The only difference between these modules exists in the signal frequencies delivered to and from the module input and output terminals. Plus Mixer Modules 2 through 5 receive a 1 Mc $+\Delta f$ signal from Spectrum Filter Assemblies 2 through 5 respectively, an 8 megacycle signal from the 1-8 Megacycle Generator Module; and a 1 Mc $+.1\Delta f$ signal from an associated Divide By Ten Module. Plus Mixer Module 1 receives a 1 Mc $+\Delta f$ signal from Sprectrum Filter Assembly 1; and both 1 and 8 megacycle signals from the 1-8 Megacycle Generator Module. Essentially, the primary function of each of the Plus Mixer Modules is to pass only the sum frequency of the three applied input signals. Plus Mixer Modules 1 through 4 pass their sum signals to Divide-By-Ten Modules 1 through 4 respectively. Plus Mixer Module 5 passes its sum signal to the Output Mixer-Multiplier Module.

NOTE

Refer to the frequency scheme given in figure 4-5 for the input and output signal frequencies of each Plus Mixer Module when the five spectrum filters are tuned to deliver a 1.050 megacycle signal.

FREQUENCY SCHEME

MODULE		FREQUENCY (MC)
Spectrum Filter	1	1.050,000 (output)
Plus Mixer	1	1.000,000 8.000,000 1.050,000 10.050,000 (output)
Divide By Ten	1	1.005,000 (output)
Spectrum Filter	2	1.050,000 (output)
Plus Mixer	2	1.005,000 8.000,000 1.050,000 10.055,000 (output)
Divide By Ten	2	1.005,500 (output)
Spectrum Filter	3	1.050,000 (output)
Plus Mixer	3	1.005,500 8.000,000 1.050,000 10.055,500 (output)
Divide By Ten	3	1.005,550 (output)
Spectrum Filter	4	1.050,000 (output)
Plus Mixer 4	4	1.005,550 8.000,000 1.050,000 10.055,550 (output)
Divide By Ten	4	1.005,555 (output)
Spectrum Filter	5	1.050,000 (output)
Plus Mixer	5	1.005,555 8.000,000 1.050,000 10.055,555 (output)

Figure 4-5. LFSB Synthesizer, Typical Frequency Scheme

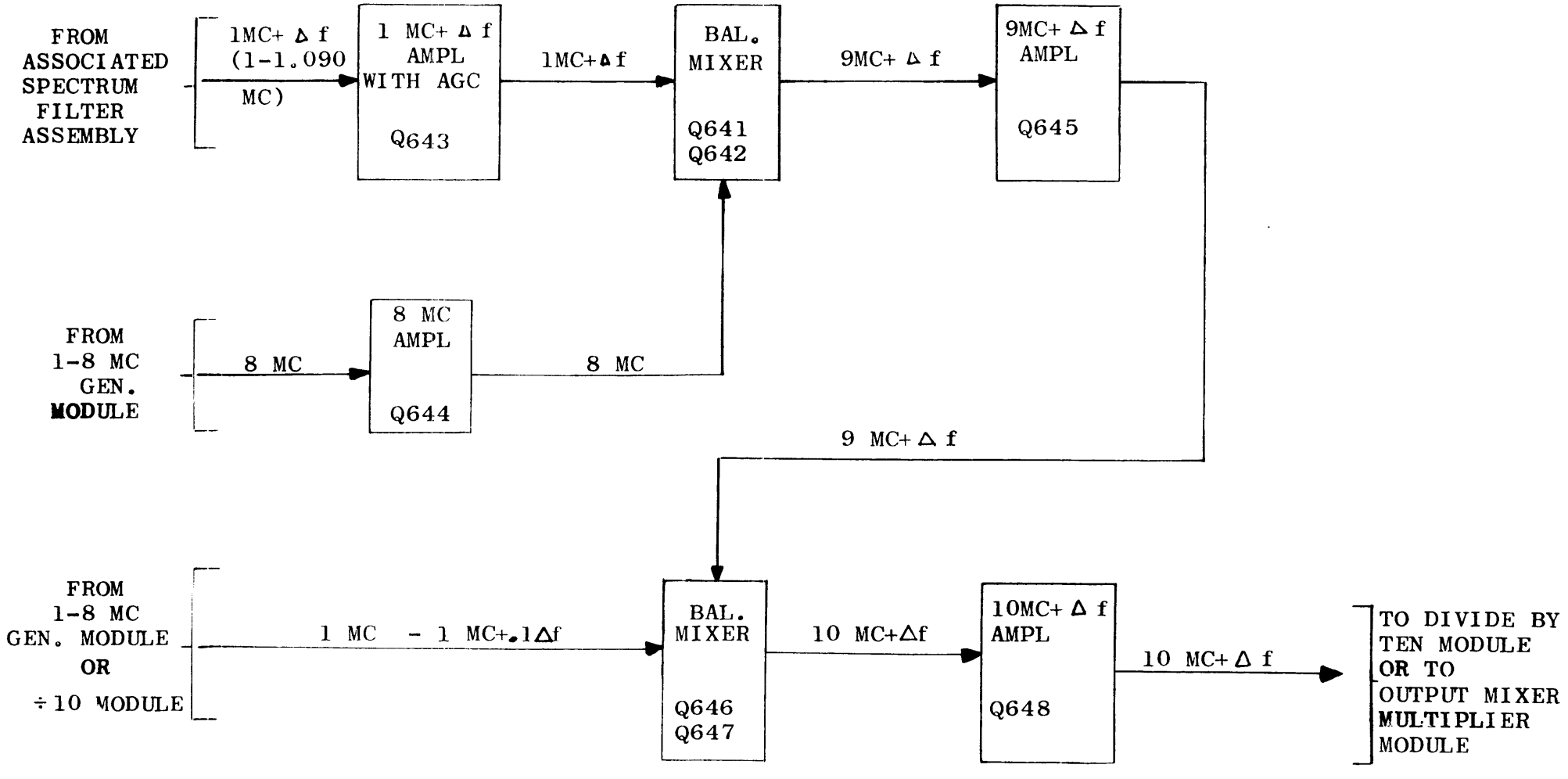


Figure 4-6. Plus Mixer Module, Functional Block Diagram

The balanced mixer comprising Q641 and Q642 receives a 1 Mc +Δf signal from its associated spectrum filter through amplifier Q643, and an 8 megacycle signal from the 1-8 Megacycle Generator Module through amplifier Q644. The mixer procuces output signals containing sum and difference frequencies however, only the sum frequency of 9 Mc +Δf is passed and amplified by Q645. AGC is employed by amplifier Q643 to ensure reasonably constant signal output amplitude regardless of frequency changes in the 1 Mc +Δf signal.

The balanced mixer (Q646 and Q647) in Plus Mixer Module 1 receives the amplified 9 Mc +Δf signal from Q645 and a 1 megacycle signal from the 1-8 Megacycle Generator Module. The balanced mixer in Plus Mixer Modules 2 through 5 receives the amplified 9 Mc +Δf signal from amplifier Q645 and a 1 Mc + .1Δf signal from Divide By Ten Modules 2 through 5 respectively. The balanced mixer, in all cases, produces sum and difference frequencies at its output terminals; however, only the sum frequency of 10 Mc +Δf is passed and amplified by Q648.

e. DIVIDE BY TEN MODULE. - Figure 4-7 is a functional block diagram of a typical Divide By Ten Module. There are four identical Divide By Ten Modules in the LFSB synthesizer. Each module utilizes a 10 Mc +Δf signal from an associated Plus Mixer Module to produce a 1 Mc + .1Δf output signal.

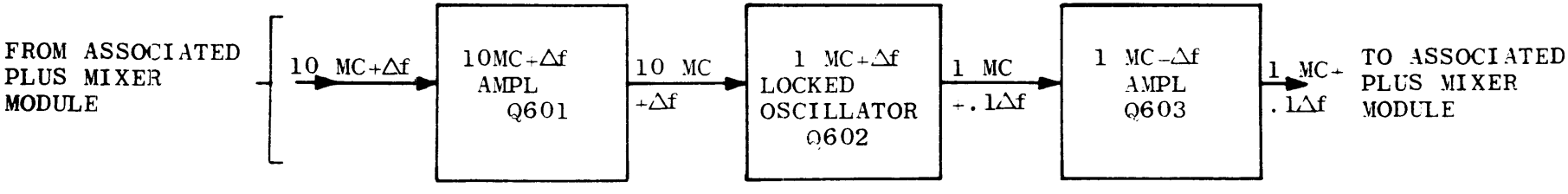


Figure 4-7. Divide By Ten Module, Functional Block Diagram

The 10 Mc +Δf signal is amplified by Q601 and applied to oscillator Q602. Oscillator Q602 is locked to the frequency of the 10 Mc +Δf signal and produces an output signal 1 Mc +.1Δf that is a division of the input signal by a factor of ten. The 1 Mc +.1Δf signal from Q602 is amplified by Q603 and applied to an associated Plus Mixer Module.

f. 9.0 AND 9.9 MEGACYCLE GENERATOR MODULE. - Refer to figure 4-8. The 9.0 and 9.9 Megacycle Generator Module utilizes a 1 megacycle signal from the Spectrum Generator Module to produce 9.9 megacycle signals at its output terminals.

NOTE

The 9.0 megacycle signal is produced at the module output terminals only when the FREQUENCY MULTIPLIER switch is set at X10 (see figure 4-9). The 9.0 megacycle circuit is operative when it is connected through the switch contacts to +12 volts dc; the circuit is inoperative when it is connected to ground.

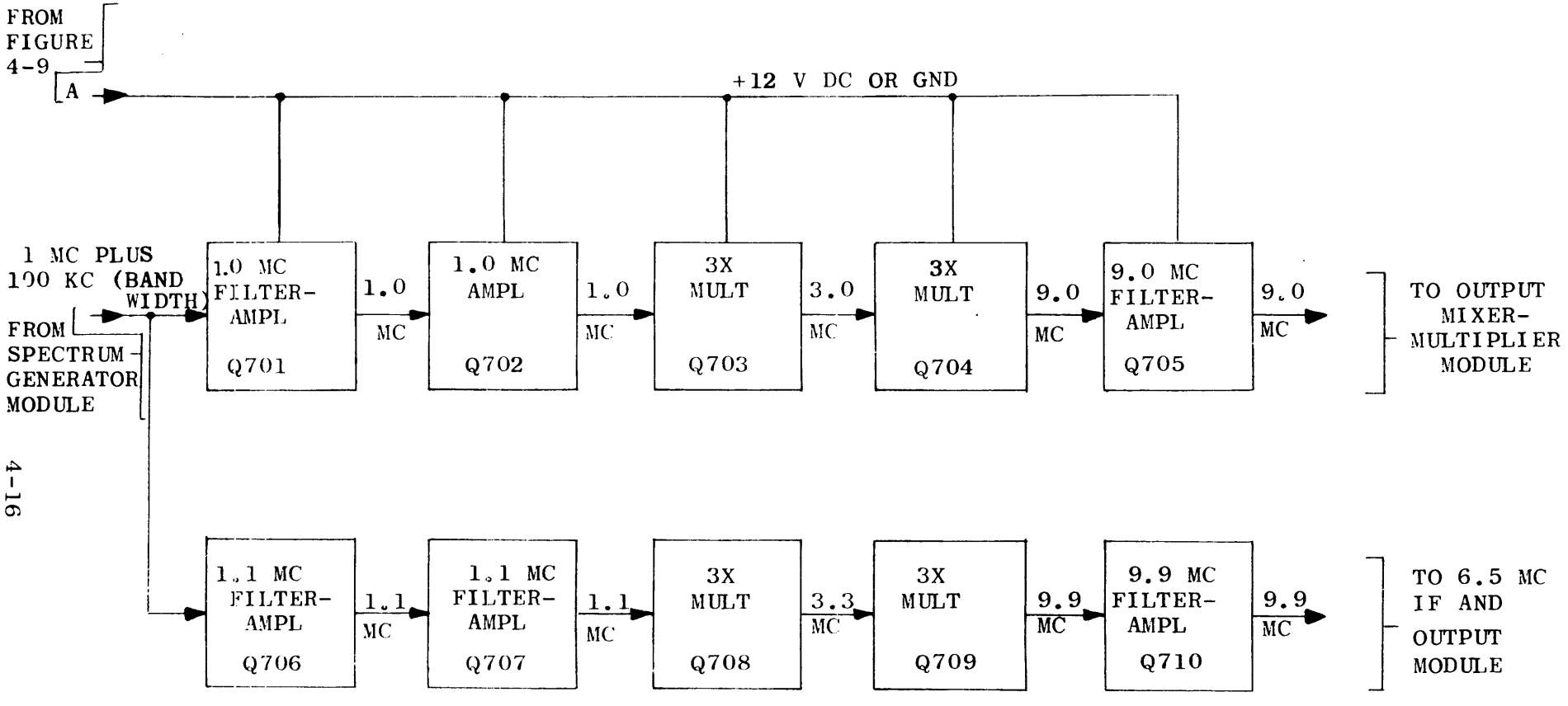


Figure 4-8. 9.0 and 9.9 Megacycle Generator Module, Functional Block Diagram

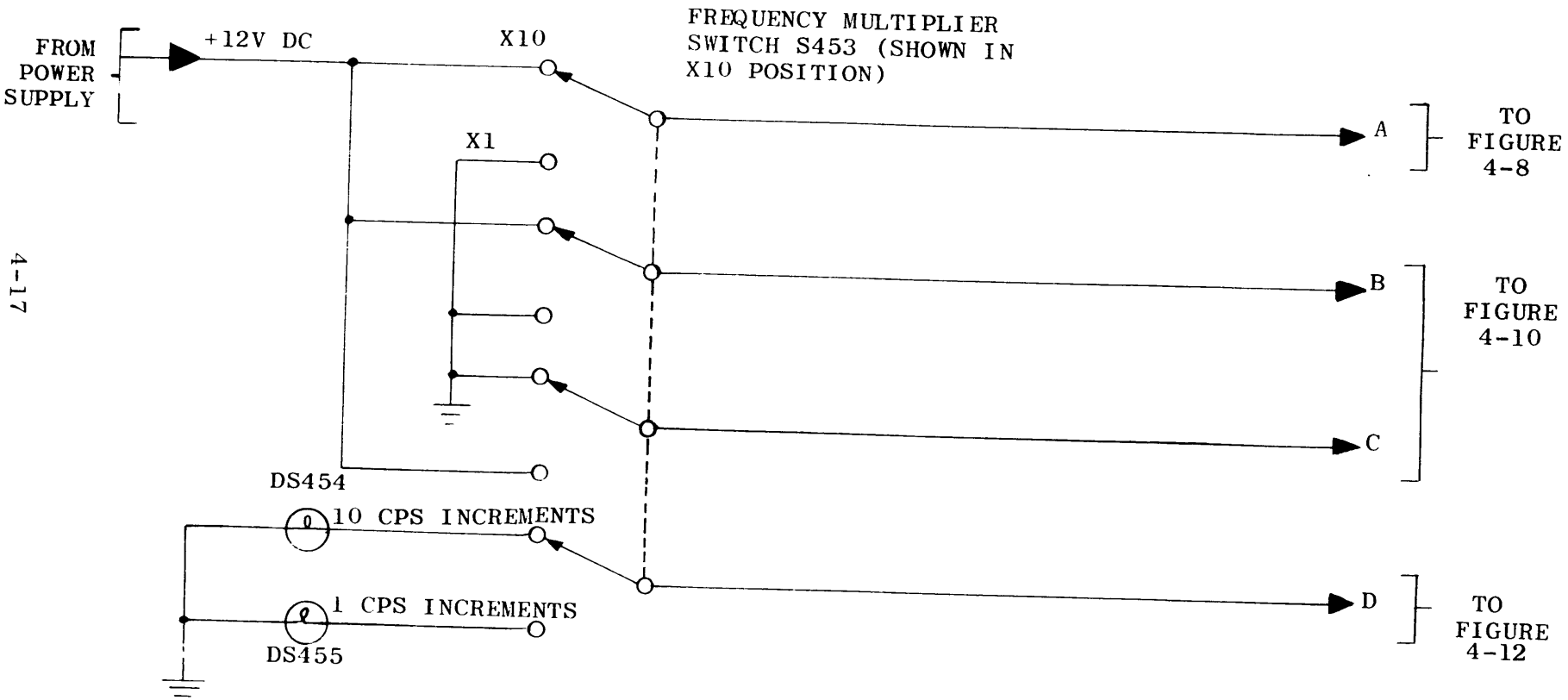


Figure 4-9. Frequency Multiplier Switch, Functional Schematic Diagram

The spectrum signal appearing at the module input terminals is applied to both the 1.0 and 1.1 megacycle filter-amplifiers (Q701 and Q706). Amplifier Q701 passes only the 1 megacycle component of the spectrum signal which is then amplified by Q702.

The 1.0 megacycle output signal of Q702 is applied to Q703 and Q704 where it is multiplied by a factor of nine; the resultant 9.0 megacycle signal is amplified by Q705 and then routed to the Output Mixer-Multiplier Module when the FREQUENCY MULTIPLIER switch is set at X10.

The 9.9 megacycle signal is produced in a manner similar to the 9.0 megacycle signal; therefore, it need not be discussed. The 9.9 megacycle output signal is applied to the 6.5 Megacycle I-F and Output Module.

g. OUTPUT MIXER-MULTIPLIER MODULE. - Figure 4-10 is a functional block diagram of the Output-Mixer-Multiplier Module. The module input and output signals depend upon the position of FREQUENCY MULTIPLIER switch S453. When switch S453 is set at X10, the module receives a 9.0 megacycle signal from the 9.0 and 9.9 megacycle generator and produces a 10 Mc + 10Δf output signal. When switch S453 is set at X1, the module provides amplification of the 10 Mc +Δf output signal.

Mixer Q901 receives the 9.0 megacycle signal from the 9.0 and 9.9 Megacycle Generator Module and the 10 megacycle +Δf signal from the Plus Mixer Module via amplifier Q908. The mixer output signal consists of the original, sum, and difference frequencies; however only the difference frequencies consisting of

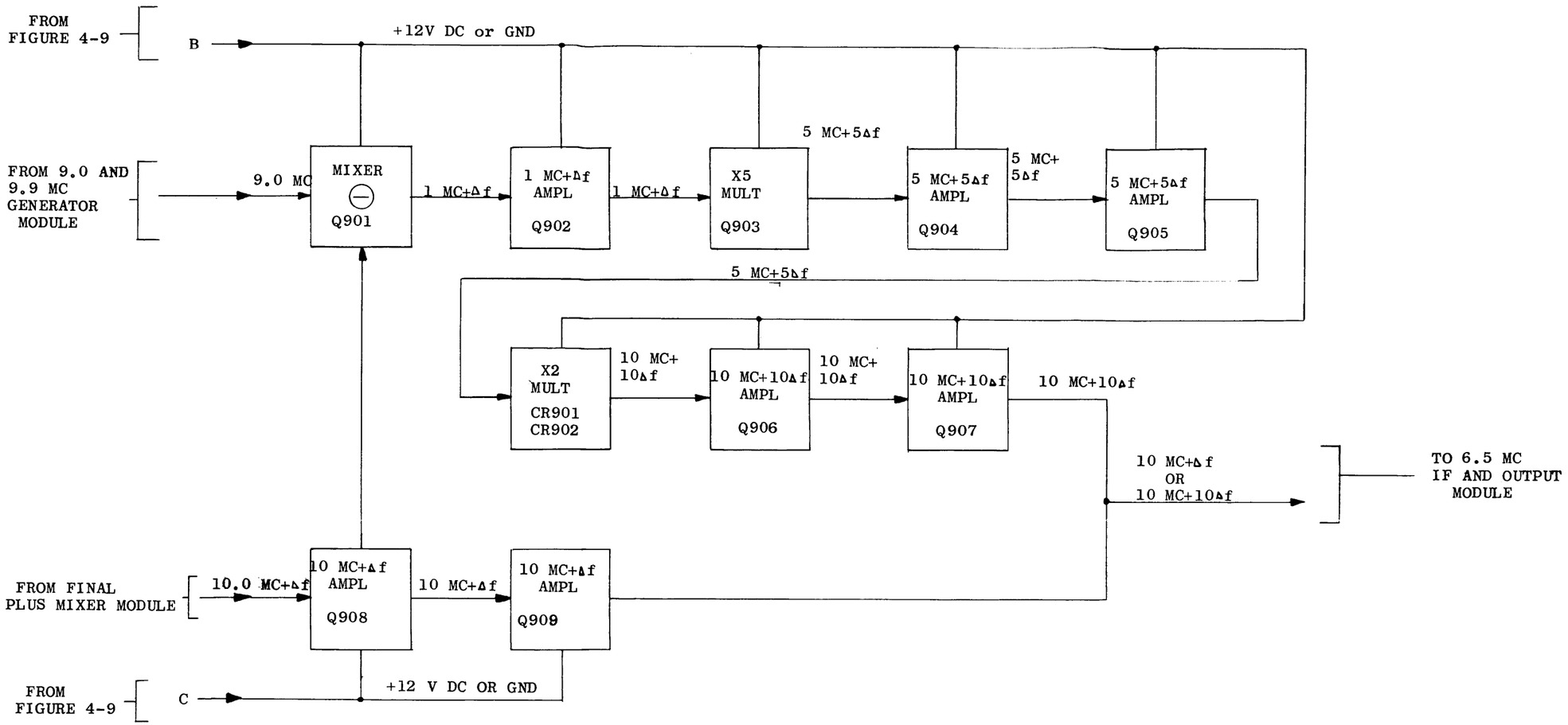


Figure 4-10. Output Mixer-Multiplier Module, Functional Block Diagram

1 megacycle +Δf are passed to amplifier Q902. The output signal of amplifier Q902 is multiplied in frequency (by a factor of five) by multiplier Q903; the resultant 5 megacycle +5Δf signal is amplified by Q904 and Q905 and then multiplied in frequency (by a factor of two) by diodes CR901 and CR902. The resultant 10 megacycle +10Δf signal is amplifed by Q906 and Q907; the output signal is applied to the 6.5 Mc I-F and Output Module when the FREQUENCY MULTIPLIER switch is set at X10.

The 10 mc +Δf signal is amplifed by Q908 and Q909 and then applied to the 6.5 Mc I-F and Output Module when the FREQUENCY MULTIPLIER switch is set at X1.

h. 6.5 MEGACYCLE IF AND OUTPUT MODULE. - Refer to figure 4-11. The 6.5 Megacycle I-F and Output Module receives: a 9.9 megacycle signal from the 9.0 and 9.9 Megacycle Generator Module, a 10 megacycle +Δf or a 10 megacycle +10Δf (depending upon the position of the FREQUENCY MULTIPLIER switch) from the Output Mixer-Multiplier Module, and a signal in the frequency range of 5.8 to 6.37 megacycles from an associated receiver. In turn, the module produces a 6.5 megacycle signal, and sinusoidal output signals within the frequency range of 100.000 to 199.999 kilocycles (100 KC +Δf) or within the frequency range of 100.000 to 1099.990 kilocycles (100 KC +10Δf).

The 9.9 megacycle signal and either the 10 megacycle +Δf signal or the 10 megacycle +10Δf signal are applied to Mixer Q751. The mixer output consists of the original, sum, and difference frequencies; however, only the difference frequencies of 100 KC

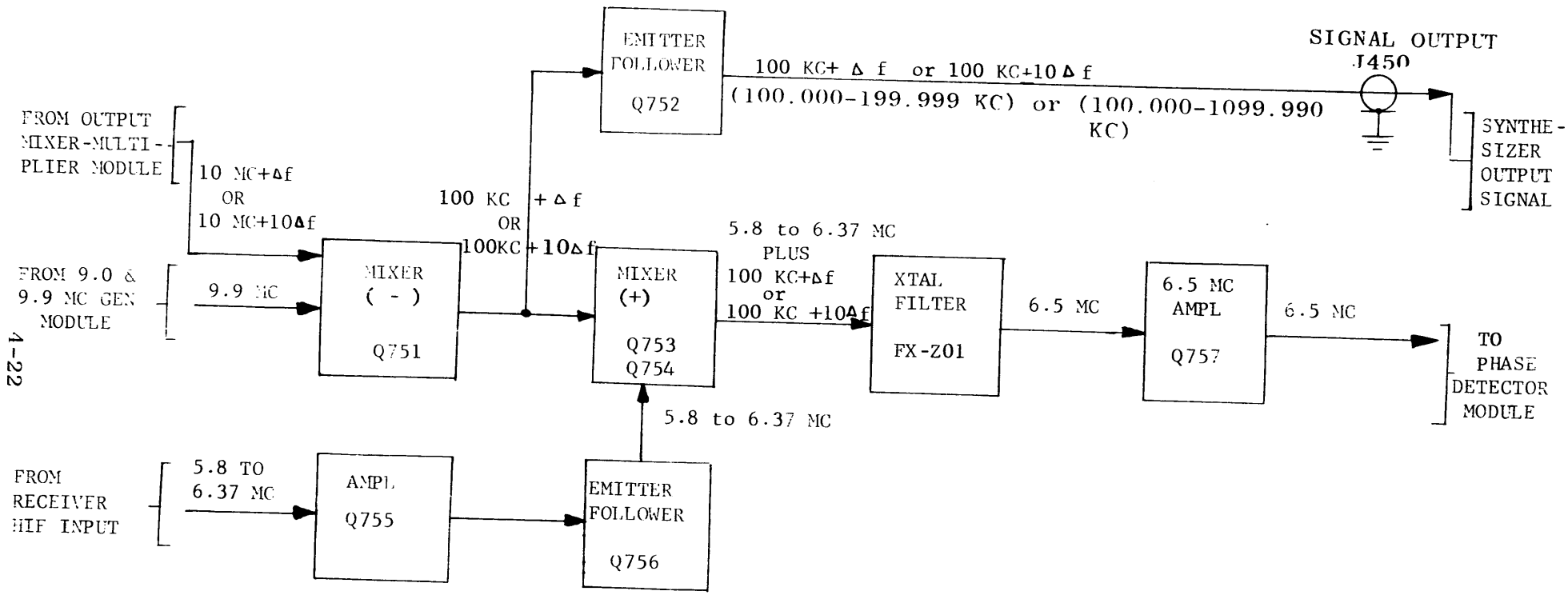


FIGURE 4-11. 6.5 MC IF AND OUTPUT MODULE, FUNCTIONAL BLOCK DIAGRAM

+10Δf are routed via emitter follower Q752 to SIGNAL OUTPUT jack J450 located on the front panel. Here, the sinusoidal output signals are available for connection to external equipment. Due to the design of the LFSB synthesizer, the output signals are always 100 kilocycles higher in frequency than the frequency displayed on the front panel.

The mixer comprising Q753 and Q754 receives either the 100 kilocycle +Δf signal or the 100 kilocycle + 10Δf signal from mixer Q751, and a signal in the frequency band of 5.8 to 6.37 megacycles from the external receiver via amplifier Q755 and emitter follower Q756. The mixer output signal consists of the sum, difference, and original frequecies; however, only the sum frequency of 6.5 megacycles is passed via crystal filter FX-Z01 and amplifier Q757 to the Phase Detector Module.

i. PHASE DETECTOR MODULE. - Refer to figure 4-12. The Phase Detector Module contains the dc to dc converter circuit and the phase detector circuits. The phase detector circuits function only when they receive identical 6.5 megacycle signals from the 6.5 megacycle i-f and output module and from an external receiver. In turn, the phase detector produdes a d-c correction voltage that is used to maintain the external receiver local oscillators to a high stability.

The 6.5 megacycle signal from the associated receiver is amplified by Q801, Q802, Q803, Q804, and Q805. The output signal of amplifier Q804 is applied to the phase detector Q808, whereas the output signal of amplifier Q805 is applied to phase detector Q809. The 6.5 megacycle signal from the 6.5 Megacycle I-F and Output Module is applied to a phase splitter network consisting of

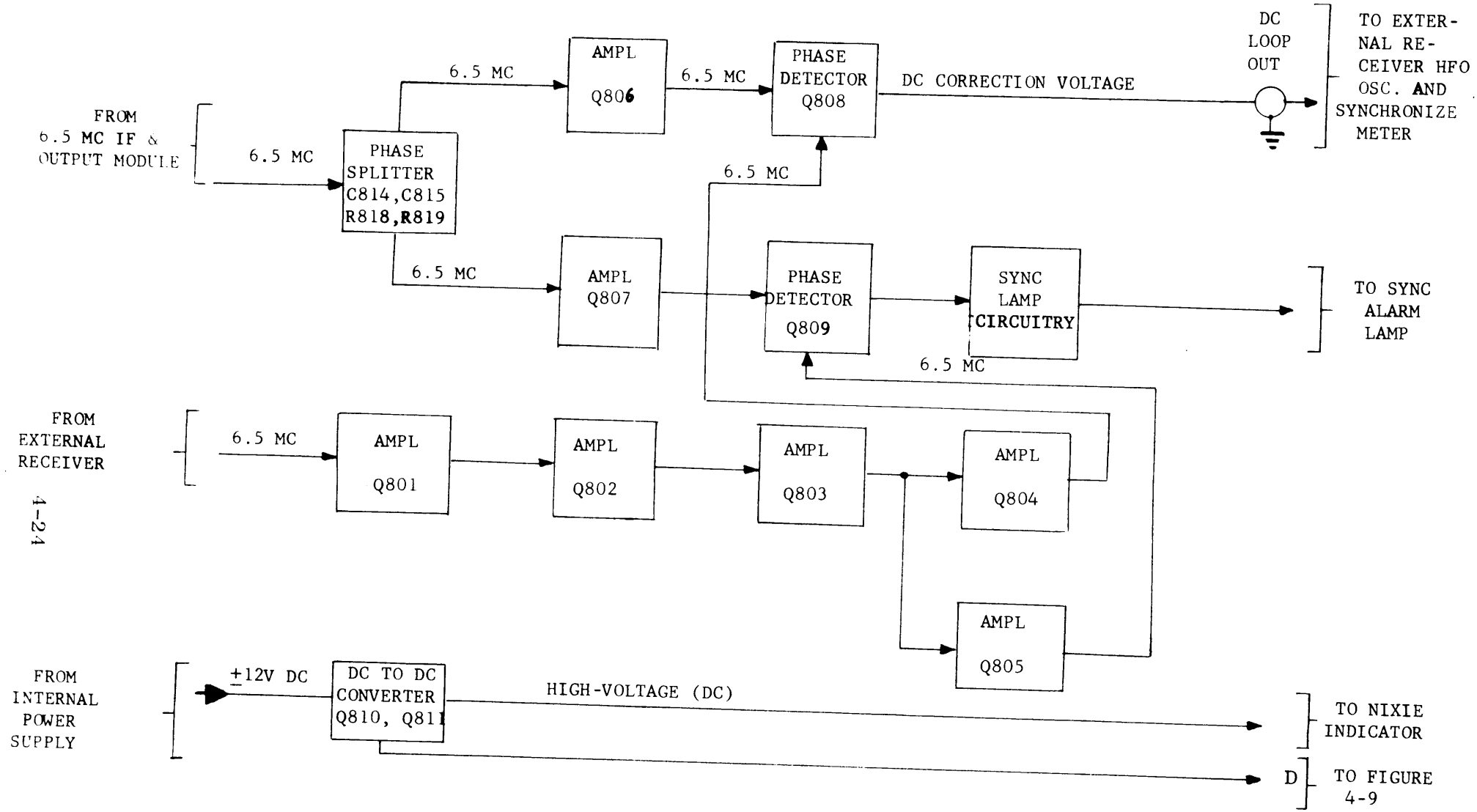


Figure 4-12. Phase Detector Module, Functional Block Diagram

capacitors C814 and C815 and resistors R818 and R819. The output of the phase splitter network consists of two 6.5 megacycle signals which are applied to associated phase detectors via coupling amplifiers Q806 and Q807.

Phase detector Q808 compares the phase difference between the 6.5 megacycle signals from Q806 and Q804 and produces a d-c voltage that maintains the local oscillators of the external receiver to a high stability. The amplitude and polarity of the d-c voltage is determined by the phase error between the two 6.5 megacycle signals applied to Q805 and Q807. Although the phase difference between the two signals is continuously changing by small amounts, the average frequency of the external local oscillators is maintained constant. The d-c correction voltage is also applied to the SYNCHRONIZE meter which provides a front panel indication of the amount of the phase error between the two signals.

Phase detector Q809 produces a d-c voltage corresponding to the difference in phase between the 6.5 megacycle signals from Q807 and Q805. This dc voltage output of Q809 is applied to the LFSB SYNC lamp circuitry. When the phase error of the two 6.5 megacycle input signals is small, the phase detector d-c output voltage is large; hence the SYNC ALARM lamp should remain lit. When the phase error is large, the phase detector d-c output voltage is low and the SYNC lamp is turned on. When the lamp is turned off, this normally indicates that the system is synchronized.

The dc to dc converter consisting of Q810 and Q811 operates with an input voltage of 24 volts dc and provides the high-voltage requeired to illuminate the 1 inch high nixie indicator numerals. The converter also supplies the voltage required to light decimal point indicator lamps DS454 and DS455 located on the nixie indicator. The decimal point indicator is selected by the FREQUENCY MULTIPLIER switch (see figure 4-9).

j. POWER SUPPLY ASSEMBLY. - Figure 4-13 is a functional block diagram of the Power Supply Assembly. The incoming a-c line voltage is stepped down to 28 volts ac by power transformer T1 and rectified by bridge rectifiers CR1, CR2, CR3, and CR4. The filtered rectified dc output voltage is passed through isolator diode CR5 to the regulator circuit. Zener diode CR6 and resistor R2 regulate the rectifier output voltage at 24 volts DC. Zener diode CR8 and resistor R4 regulate the positive supply output voltage to 12 volts.

In the event of a-c power failure, provisions are made for automatic switchover to battery power. The positive leg of an external 24-volt battery is directly connected to the positive 12 volt output terminal. The negative battery leg is connected to the negative 12 volt output terminal via contacts of BAT. switch S451 and series regulator Q1. BATTERY lamp DS452 indicates when battery power is being used; POWER lamp DS451 indicates when ac power is being used. Both lamps are individually operated through the contacts of relay K1.

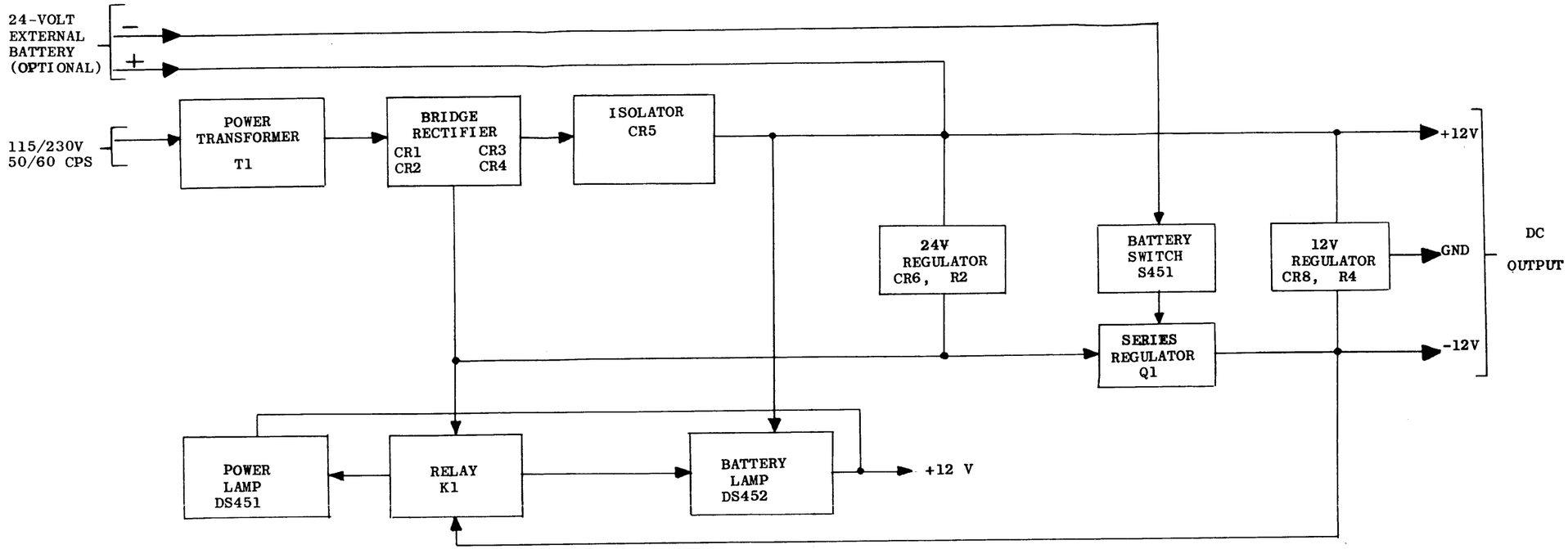


Figure 4-13. Power Supply, Functional Block Diagram

4-3. TROUBLESHOOTING.

a. GENERAL. - Since the LFSB synthesizer is built on a modular basis, troubleshooting consists of sectionalizing the malfuction to a particular module or assembly (refer to figures 4-14 and 4-15 for module and assembly locations). Once a module or assembly is found to be defective, it should be replaced with a spare one, if available, so that normal operation can be resumed with a minimum time delay.

b. TROUBLESHOOTING TECHNIQUES. - When a piece of equipment has been working satisfactorily and suddenly fails, the cause of failure may be apparent either because of circumstances occurring at the time of failure or because of symptoms analogous to past failures. In this case, it is unnecessary to follow a lengthy and orderly course of trouble-shooting in order to localize and isolate the faulty part.

A second short cut in trouble-shooting is to ascertain that all transistors and fuses are in proper working order; also that the equipment receives proper supply voltages. Many times this will eliminate further investigation.

A thir short cut is to examine the equipment for burned out elements, charring, corrosion, arcing, excessive heat, dirt, dampness, etc. It is important to recognize that defective elements may have become defective due to their own weakness or to some contributing cause beyond their control.

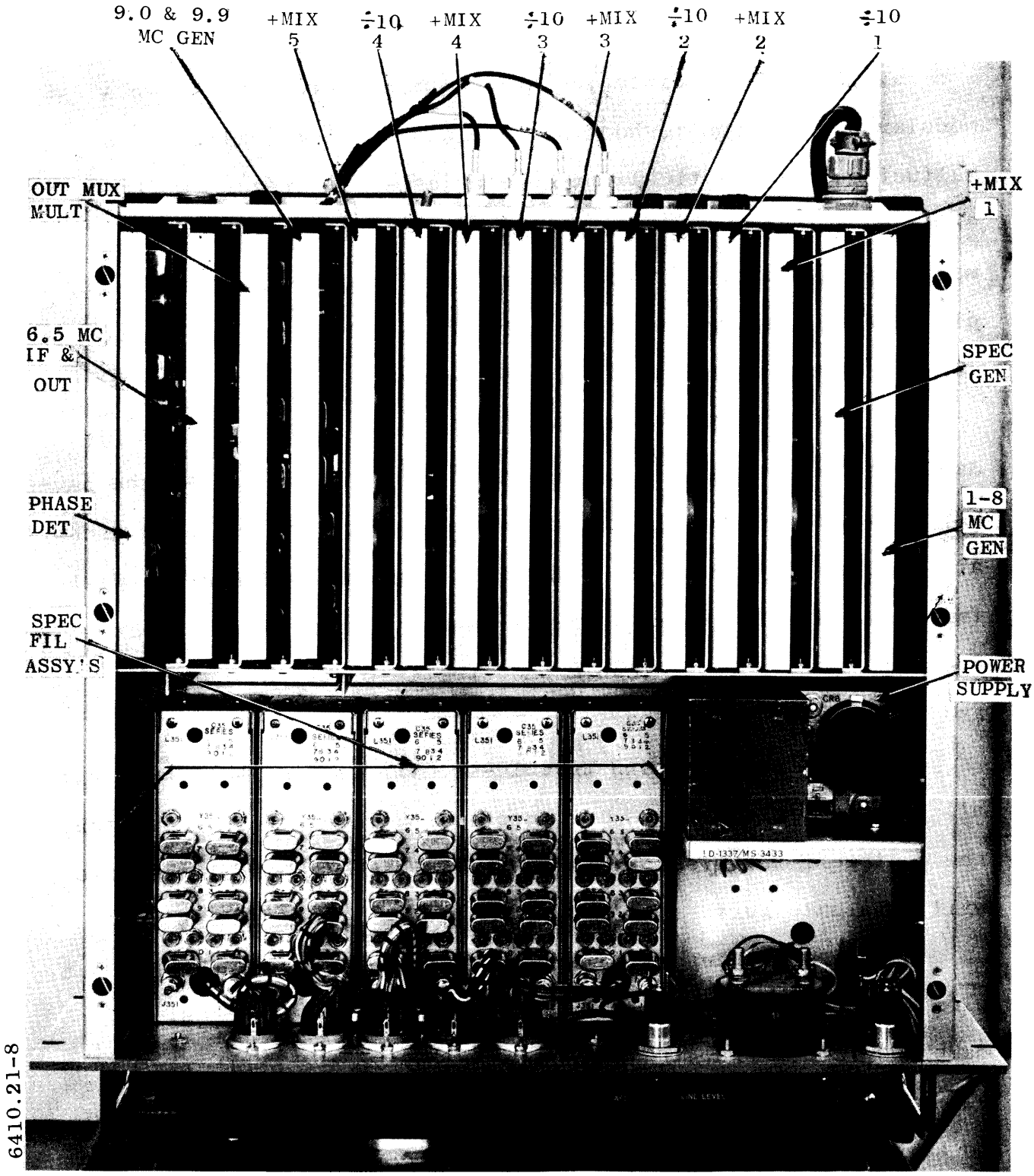


Figure 4-14. LFSB Synthesizer, Top View

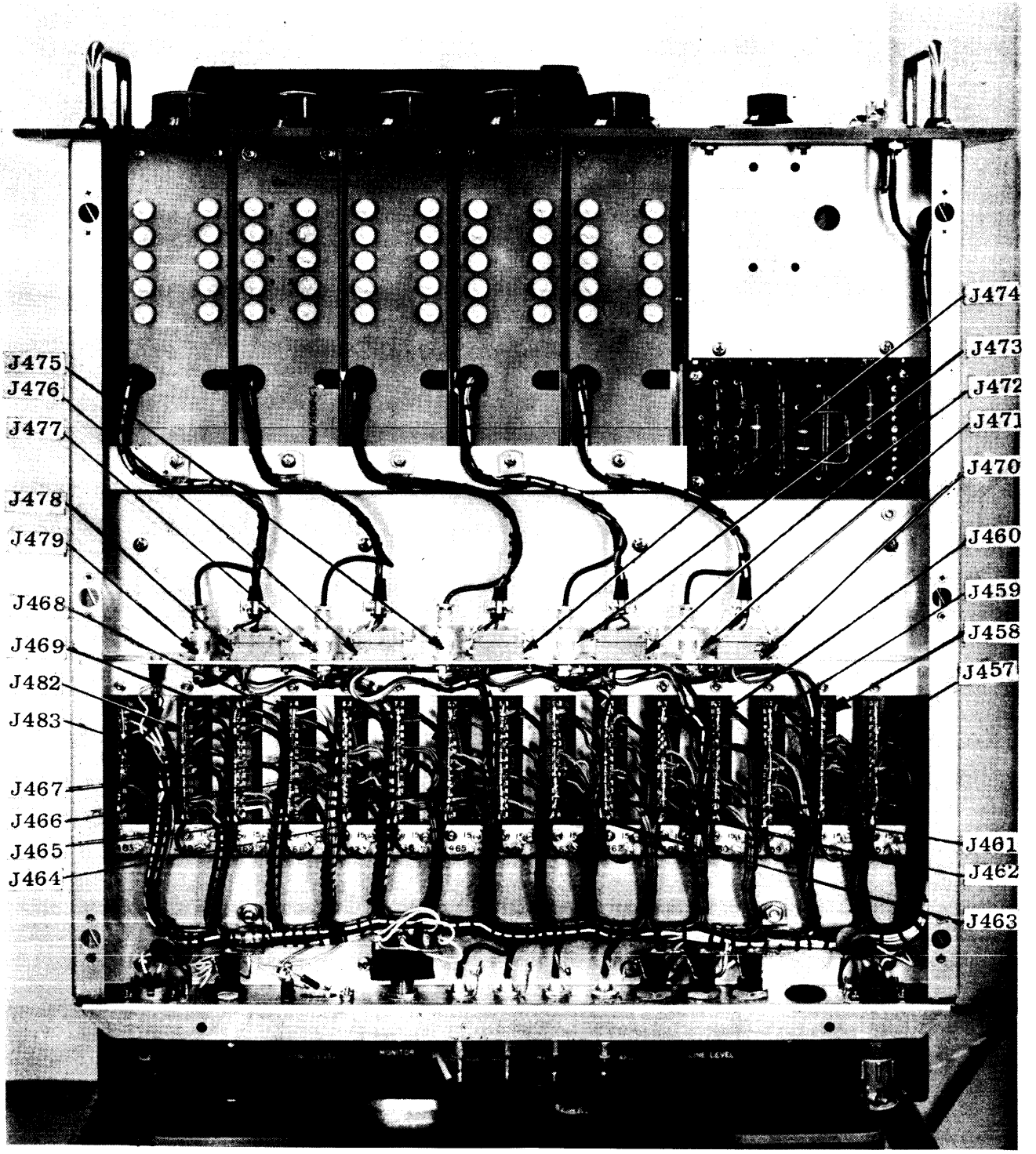


Figure 4-15. LFSB Synthesizer, Bottom View

SECTION 5

MAINTENANCE

5-1. PREVENTIVE MAINTENANCE.

a. GENERAL. - Low Frequency Synthesizer LFSB has been designed to provide long-term, trouble-free operation under continuous duty conditions. However, in order to prevent failure of the equipment due to corrosion, dust, or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

b. At periodic intervals, the equipment should be removed from its mounting for cleaning and inspection. All accessible covers should be removed and the wiring and all components inspected for dirt, corrosion, charring, discoloring or grease. Remove dust with a soft brush or vacuum cleaner. Remove dirt or grease from other parts with any suitable cleaning solvent. Use of carbon tetrachloride should be avoided due to its highly toxic effects. Trichloroethylene or methyl chloroform may be used, providing the necessary precautions are observed.

WARNING

When using toxic solvents, make certain that adequate ventilation exists. Avoid prolonged or repeated breathing of the vapor. Avoid prolonged or repeated contact with skin. Flammable solvents shall not be used on energized equipment or near any equipment from which a spark may be received. Smoking, "hot work", etc. is prohibited in the immediate area.

CAUTION

When using trichlorethylene, avoid contact with painted surfaces due to its paint removing effects.

5-2. REPAIR OF PRINTED CIRCUITS.

a. GENERAL. - Although the troubleshooting procedures for printed circuits are similar to those for conventional circuits, the repair of printed circuits requires considerably more skill and patience. The printed circuits are small and compact; therefore, personnel should become familiar with the special servicing techniques required.

The defective part should be pinpointed by a study of the symptoms and by careful and patient analysis of the circuit before attempting to trace trouble on a printed circuit board. Ascertain whether the conducting strips are coated with a protective lacquer, epoxy resin, or similar substance. If so, carefully scrape it away.

Breaks in the conducting strip (foil) can cause permanent or intermittent trouble. In many instances, these breaks will be small so that they cannot be detected by the naked eye. These almost invisible cracks (breaks) can be located only with the aid of a powerful hand-or stand-held magnifying glass.

b. MULTIMETER CHECKOUT. - The most common cause of an intermittent condition is poorly soldered connections. Other causes are: broken boards, broken conducting strips, fused conducting strips; arc-over, loose terminals, etc.

CAUTION

Before using an ohmmeter for testing a circuit containing transistors or other voltage-sensitive semiconductors, check the current it passes under test on all ranges. DO NOT use a range that passes more than 1 ma.

To check and locate trouble in the conducting strips of a printed circuit board, set up a multimeter (one which does not use a current in excess of 1 ma) for making point-to-point resistance test, using needle point probes. Insert one probe into the condcting strip at the terminal end, and place the other probe on the opposite end of the conducting strip. The multimeter should indicate continuity. If the multimeter indicates an open circuit, drag the probe along the strip (if the conducting strip is coated, puncture the coating at intervals) until the multimeter indicates continuity. Mark this area then use a magnifying glass to locate the fault in the conductor.

c. HOW TO REPAIR THE BREAK. - If the break in the conducting strip is small, lightly scrape away any coating covering the area of the conducting strip to be repaired. Clean the area with a firm-bristle brush and approved solvent. Then repair the cracked or broken area of the conducting strip by flowing solder over the break. Considerable care must be exercised to keep the solder from flowing onto an adjacent strip.

If a strip is burned out, or fused, cut and remove the damaged strip. Connect a lenth of insulated wire across the breach or from solder-point to solder-point.

After the repairs are completed, clean the repaired area with a stiff brush and solvent. Allow the board to dry thoroughly, and then coat the repaired area with an epoxy resin or similar compound. This coating not only will protect the repaired area but will help to strengthen it.

CAUTION

After making repairs, always scrutinize the board for solder droppings that may cause possible shorts.

Frequently, a low-resistance leakage path will be created by moisture and/or dirt that has carbonized onto the phenolic board. This leakage can be detected by measuring the suspected circuit with a multimeter. To overcome this condition, thoroughly clean the carbonized area with solvent and stiff brush. If this does not remove the carbon, use a scraping tool (spade end of a solder-aid tool or its equivalent) to remove the carbon, or drill a hole through the leakage path to break the continuity of the leakage. When the drilling method is used, be careful not to drill into a part mounted on the other side.

SECTION 6

PARTS LIST

6-1. INTRODUCTION. Reference designations have been assigned to identify all component parts of the equipment. They are used for marking the equipment (adjacent to the part they identify) and are included on drawings, diagrams and the parts list. The letters of a reference designation indicate the kind of part (generic group), such as resistor, capacitor, transistor, etc. The number differentiates between parts of the same generic group. Sockets associated with a particular plug-in device, such as a transistor or fuse, are identified by a reference designation which includes the reference designation of the plug-in device. For example, the socket for fuse F401 is designated XF401. The parts of each major unit are grouped together. Column 1 lists the reference designations of the various parts in alphabetical and numerical order. Column 2 gives the name and description of the various parts. Column 3 lists each Technical Materiel Corporation part number.

Title

Power Supply Module
Spectrum Filter Module
LFSB-1 Sub-assembly
Main Chassis Assembly
1-8 MC Generator Module
Spectrum Generator Module
Divide By Ten Module
Plus Mixer Module
9.0 and 9.9 MC Generator Module
6.5 MC IF and Output Module
Phase Detector Module
Output Mixer Multiplier Module

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
A1	PRINTED CIRCUIT BOARD ASSEMBLY: power supply.	A3211-3
C1	CAPACITOR, FIXED, ELECTROLYTIC: rated at 2,000 uf; 50 WVDC; max. operating temperature -20 to +85°C; polarized; metal case.	CE117-1
C2	CAPACITOR, FIXED, ELECTROLYTIC: polarixed; 500 uf; 15 VDCW; max. temp. range 0 - 85°C; hermetically sealed aluminum case w/clear vinyl plastic sleeve.	CE116-6VN
C3	Same as C2.	
CR1	SEMICONDUCTOR DEVICE, DIODE: silicon; 600 volts, max. continuous DC current .50 amp at 100°C; surge current peak 75 amps; max. operating temp. 150°C; max. forward voltage drop 1.0 V; max. reverse current 1000 ua.	1N2484
CR2 thru CR5	Same as CR1.	
CR6	SEMICONDUCTOR DEVICE, DIODE: silicon; nom. Zener voltage 24V; standard anode-to-stud polarity, negative-grounded application; tolerance ±5%; junction and storage temperature rating -65°C to +175°C; power dissipation 10 watts DC; solder terminals; hermetically sealed metal and glass case.	VR101-24S51
CR7	NOT USED.	
CR8	SEMICONDUCTOR DEVICE, DIODE: silicon; 12 volts nom., ±1%; 10 watts max. dissipation at 25°C; max. current rating 210 ma; max. impedance 3.0 ohms; storage temperature 175° C.	1N2976B
E1	TERMINAL BOARD: barrier type; ten 6-32 x 1/4" binding head machine screws.	TM100-10

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
K1	RELAY ARMATURE: DPDT; 700 ohms, +10% DC resistant; operating voltage 24 VDC; current rating 35 ma, 700 MW at 25°C; contacts rated for 5 amps at 29 VDC; clear high impact styrene dust cover base.	RL156-1
Q1	TRANSISTOR: germanium; pnp; collector-base, and emitter voltage 45 VDC at 300 ma; 30 VDC at 500 ma; emitter base voltage 25V; collector current 3 amps; power dissipation 62.5 watts at 25°C; junction temperature range -65 to +100°C.	2N2143
R1	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±10%; 1 watt.	RC32GF471K
R2	NOT USED	
R3	RESISTOR, FIXED, WIREWOUND: 100 ohms, current rating 223 ma; 5 watts.	RW107-18
R4	RESISTOR, FIXED, COMPOSITION: 150 ohms, ±10%; 2 watts.	RC42GF151K
*T1	TRANSFORMER, POWER, ISOLATION, STEP-DOWN: primary input 105, 115, 125 or 210, 230, 250 V; frequency 50/60 cps, phase 1, secondary 28V, rated at 500 ma; 2-13/16" lg. x 2-11/16" wide x 2-3/8" high; hermetically sealed steel case.	TF269

*For 115 VAC operation use jumper between pins 2 and 4 and 5 and 7.
For 230 VAC operation use jumper between pins 4 and 5 only.

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C350	CAPACITOR, VARIABLE, GLASS DIELECTRIC: 0.8 - 18 uuf; 1,000 WVDC; piston type.	CV108-5
C351 thru C359	Same as C350.	
C360	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: miniature disc type, 5.5 - 18 uuf; 200 WVDC; operating temperature range -55°C - +125°C; silver plated terminals; steatite ceramic base.	CV112-1
C361 thru C369	Same as C360.	
C370	NOT USED.	
C371	CAPACITOR, FIXED, MICA DIELECTRIC; 470 uuf ±1%; 500 WVDC, straight wire leads.	CM111E471F 5S
C372	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±5%; 500 WVDC; straight wire leads.	CM112D102J 5S
C373	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 150 WVDC.	CC100-35
C374	CAPACITOR, FIXED, CERAMIC DIELECTRIC: rated at 470,000 uuf, ±20%; radial lead type terminals.	CC112R474M
C375	Same as C374.	
C376	Same as C373.	
DS351	For reference see Final Assembly A3545.	
J351	CONNECTOR, RECEPTACLE, ELECTRICAL: RF; 1 round male contact; straight type; series BNC to BNC.	JJ211
J352	Same as J351.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER.
L351	COIL, RADIO FREQUENCY, FIXED: tuned; 14.2 uh, +10%; 1.2 to 1.4 ohms DC resistance; adjustable ferrite core; solder lug type terminals.	CL327
P351	For reference see Final Assembly A3545.	
P352	For reference see Final Assembly A3545.	
P353	CONNECTOR, RECEPTACLE, ELECTRICAL: micro-miniature male; 5 female round pin type contacts; rated at 3 amps, 375 V RMS: polarized; snap-on locking type.	PL241-1
P354	CONNECTOR, PLUG, ELECTRICAL: RF; 1 round female coaxial contact; straight type; miniature bayonet lock series.	PL204
Q351	TRANSISTOR: germanium: PNP; JEDEC type 2N1637 with a controled hfe limit of 85-105 at 1 KC; TO9 case.	TX105
R351	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%; 1/2 watt.	RC20GF103J
R352	RESISTOR, FIXED, COMPOSITION: 560 ohms, ±10%; 1/2 watt.	RC20GF561K
R353	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±10%; 1/2 watt.	RC20GF470K
R354	RESISTOR, FIXED, COMPOSITION: 1,000 ohms ±10%; 1/2 watt.	RC20GF102K
R355	RESISTOR, FIXED, COMPOSITION: 12,000 ohms, ±5%; 1/2 watt.	RC20GF123J
S351A, B, C, D, E	SWITCH, ROTARY: no stop, 360° rotation (index-dual ball): 5 section, 10 position, 30° angle of throw: 5 shorting and 5 silver alloy type contacts rated at 1 amp 28 VDC or 5 amps 100 VAC.	SW369

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XDS351	SOCKET, ELECTRON TUBE: 13 pin contact.	TS157
XY350A, B	SOCKET, CRYSTAL: 2 silver plated beryllium copper contacts; 0.050" pin dia. spaced 0.486" c to c.	TS104-2
XY351A, B thru XY359A, B	Same as XY350A, B	
Y350	CRYSTAL, QUARTZ: operating frequency 1.000000 Mc; bandwidth suppression +100 Kc; resistance 400 ohms or less; operating temperature range 0° to 55°C; HC-6/U holder.	CR113-1
Y351	CRYSTAL, QUARTZ: operating frequency 1.010000 Mc; bandwidth suppression +100 Kc; resistance 400 ohms or less; operating temperature range 0° to 55°C; HC-6/U holder.	CR113-2
Y352	CRYSTAL, QUARTZ: operating frequency 1.020000 Mc; bandwidth suppression +100 Kc; resistance 400 ohms or less; operating temperature range 0° to 55°C; HC-6/U holder.	CR113-3
Y353	CRYSTAL, QUARTZ: operating frequency 1.030000 Mc; bandwidth suppression +100 Kc; resistance 400 ohms or less; operating termperature range 0° to 55°C; HC-6/U holder.	CR113-4
Y354	CRYSTAL, QUARTZ: operating frequency 1.040000 Mc; bandwidth suppression +100 Kc; resistance 400 ohms or less; operating temperature range 0° to 55°C; HC-6/U holder.	CR113-5
Y355	CYRSTAL, QUARTZ: operating frequency 1.050000 Mc; bandwidth suppression +100Kc; resistance 400 ohms or less; operating temperature range 0° to 55°C; HC-6/U holder.	CR113-6
Y356	CRYSTAL, QUARTZ: operating frequency 1.060000 MC; bandwidth suppression +100 kc; resistance 400 ohms or less; operating temperature range 0° to 55°C; HC-6/U holder.	CR113-7

REF SYMBOL	DESCRIPTION	TMC PART NUMBER.
Y357	CRYSTAL, QUARTZ: operating frequency 1.070000 Mc; bandwidth suppression ±100 Kc; resistance 400 ohms or less; operating temperature range 0° to 55°C; HC-6/U holder.	CR113-8
Y358	CRYSTAL, QUARTZ: operating frequency 1.080000 Mc; bandwidth suppresssion ±100 Kc; resistance 400 ohms or less; operating temperature range 0° to 55°C; HC-6/U holder.	CR113-9
Y359	CRYSTAL, QUARTZ: operating frequency 1.090000 Mc; bandwidth suppression ±100 Kc; resistance 400 ohms or less; operating temperature range 0° to 55°C; HC-6/U holder.	CR113-10

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
AT451	DUMMY LOAD, ELECTRICAL: 330 ohms, ±5%; 1/2 watt; DM connector type; 2-1/2" chain with cap.	DL100-16
DS351-1	INDICATOR, DIGITAL DISPLAY: ionization voltage 170 VDC min.; anode current 4.0 ma; individual cathode wattage 0.4 watts max.; plug-in type; 13 pin contact.	BI109-2
DS351-2 thru DS351-5	Same as DS351-1	
J1	CONNECTOR, RECEPTACLE, ELECTRICAL: 15 female, flat solid face contacts; for single sided 3/32" printed circuit board; continuous current rating 5 amps; 1800 V RMS; float bushing; 3.20" long x 0.440" wide x 0.75" high dim. o/a. (Part of test card assembly, TMC part number A3304-4 (see note)).	JJ293-15S
P351-1	NOT USED.	
P351-2	CONNECTOR PLUG, ELECTRICAL: RF; 1 round female coaxial contact: straight type: miniature bayonet lock series. Used on cable, W451.	PL204
P351-3	Same as P351-2. Used on Cable, W452.	
P351-4	Same as P351-2. Used on Cable, W453.	
P351-5	Same as P351-2. Used on Cable, W454.	
P352-1	Same as P351-2. Used on Cable, W451.	
P352-2	Same as P351-2. Used on Cable, W452.	
P352-4	Same as P351-2. Used on Cable, W453.	
P352-3	Same as P351-2. Used on Cable, W454.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
W451	CABLE ASSEMBLY, ELECTRICAL: consists of 2.625" RG174/U cable and two connectors, P351-2, P352-1.	CA480-68 - 3 500
W452	Same as W451. Consists of two connectors, P351-3, P352-2.	
W453	Same as W451. Consists of two connectors, P351-4, P352-3.	
W454	Same as W451. Consists of two connectors, P351-5, P352-4.	

NOTE

A3304-4 Test Card Assembly to be supplied as loose item when the LFSB-1 is sold as a single unit.

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C451	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 4,700 uuf; GMV: 500 WVDC.	CC100-14
C452	Same as C451.	
C453	Same as C451.	
C454	Same as C451.	
DS451	LAMP, INCANDESCENT: 28 volts; 0.04 amp; miniature bayonet base T-3-1/4 bulb.	BI101-1819
DS452	Same as DS451.	
DS453	Same as DS451.	
DS454	LAMP, GLOW: cartridge type; 1/15 watt nom.; starting voltage 65 VAC or 90 VDC; circuit voltage 100-125 VAC/VDC; 100K ohms resistance; long cylindrical red lens.	BI112-1
DS455	Same as DS454.	
F451	FUSE, CARTRIDGE: 1/2 amp; quick-acting; AGC 1/2.	FU100-.500
F452	Same as F451.	
F453	Same as F451.	
F454	FUSE, CARTRIDGE: 1/8 amp; time delay; 1-1/4" lg. x 1/4" dia.; slow blow.	FU102-.125
J451	CONNECTOR, RECEPTACLE, ELECTRICAL: 3 number 16 male contacts; straight type.	MS3102A14S1P
J452	CONNECTOR, RECEPTACLE, ELECTRICAL: RF; 1 round female contact; straight type; 52 ohms; series BNC to BNC.	UG625B/U
J453	Same as J452.	
J454	Same as J452.	
J455	Same as J452.	
J456	CONNECTOR, RECEPTACLE, ELECTRICAL: 4 number 16 male contacts; straight type.	MS3102A14S2P

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J457	CONNECTOR, RECEPTACLE, ELECTRICAL: 15 female, flat, solid face contacts; for single sided printed circuit board; continuous current rating 5 amps; 1800 V RMS; float bushing.	JJ293-15S
J458 thru J469	Same as J457.	
J470	CONNECTOR, RECEPTACLE, ELECTRICAL: micro-miniature female; 17 male round pin type contacts, rated at 3 amps, 375 V RMS; polarized; snap-on locking type.	JJ308-2
J471	CONNECTOR, RECEPTACLE, ELECTRICAL: RF; 1 round male contact; straight type; series BNC to BNC.	JJ211
J472	Same as J470.	
J473	Same as J471.	
J474	Same as J470.	
J475	Same as J471.	
J476	Same as J470.	
J477	Same as J471.	
J478	Same as J470.	
J479	Same as J471.	
J480	CONNECTOR, RECEPTACLE, BULKHEAD, ELECTRICAL: pressurized; 1-5/16" long; series BNC.	UG657*/U
J481	NOT USED	
J482	Same as J457.	
J483	Same as J457.	
J484	Same as J452.	
M451	METER, INDICATING: 25-0-25 ua movement; approximate resistance 2,000 ohms; black rectangular case.	MR180
R451	RESISTOR, FIXED, COMPOSITION: 68,000 ohms, ±5%; 1/2 watt.	RC20GF683J

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R452	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±5%; 1/2 watt	RC20GF470J
R453	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±5%; ½ watt.	RC20GF100J
S451	SWITCH, TOGGLE: DPST; 6 amps rated at 250 volts; bat type handle.	ST22K
S452	Same as S451.	
S453	SWITCH, ROTARY: no stop, 360° rotation (index-dual ball); 1 section, 2 position, 30° angle of throw; non-shorting type silver alloy contacts rated at 1 amp 28 VDC or 5 amps 110 VAC.	SW370
TB451	TERMINAL BOARD: barrier type; 2 solder lug type terminals; phenolic black bakelite.	TM100-2
XDS451	LIGHT, INDICATOR: with green frosted lens; for miniature bayont base T-3-1/4 bulb.	TS106-3
XDS452	LIGHT, INDICATOR: with red frosted lens; for miniature bayonet base T-3-1/4 bulb.	TS106-1
XDS453	LIGHT, INDICATOR: with white, clear unfrosted lens; for miniature bayonet base T-3-1/4 bulb.	TS106-2
XDS454	LAMPHOLDER: solder lug terminals; molded phenolic body; for use with cartridge type BI112 bulb.	TS174
XDS455	Same as XDS454.	
XF451	FUSEHOLDER: extractor post type; accommodates cartridge fuse 1-1/4" lg. x 1/4" dia.; rated at 15 amps, 250 V max.; o/a length 1-3/4"; bushing mounted.	FH103
XF452	Same as XF451.	
XF453	Same as XF451.	
XF454	Same as XF451.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C401	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 150 WVDC.	CC100-35
C402	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±5%; 500 WVDC; char. B.	CM15B101J
C403	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 10-75 uuf; 400 min. Q at 1 Mc; 350 WVDC; operating temperature range -55°C to +85°C.	CV109-8
C404	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 2-8 uuf; 200 WVDC; low loss steatite ceramic base.	CV112-4
C405	CAPACITOR, FIXED, MICA DIELECTRIC: 47 uuf, ±5%; 500 WVDC: char. B.	CM15B470J
C406	Same as C401.	
C407	Same as C401.	
C408	Same as C403.	
C409	Same as C401.	
C410	CAPACITOR, FIXED, CERAMIC DIELECTRIC: rated at 470,000 uuf, ±20%; radial lead type terminals.	CC112R474M
C411	Same as C410.	
C412	CAPACITOR, FIXED, MICA DIELECTRIC: 470 uuf, ±3%; 500 WVDC; straight wire leads.	CM111E471H 5S
C413	CAPACITOR, FIXED, MICA DIELECTRIC: 6,200 uuf, ±5%; 300 WVDC; straight wire leads.	CM112E622J 3S
C414	Same as C410.	
C415	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1,000 uuf; GMV; 500 WVDC.	CC100-29
C416	Same as C410.	
C417	CAPACITOR, FIXED, MICA DIELECTRIC: 1,500 uuf, +1/2% or 5 uuf, whichever is greater; 500 WVDC; straight wire leads.	CM112E152D 5S

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C418	Same as C412.	
C419	Same as C410.	
C420	Same as C401.	
C421	Same as C410.	
C422	Same as C417.	
C423	CAPACITOR, FIXED, MICA DIELECTRIC: 330 uuf, ±5%; 500 WVDC; char. B.	CM15B331J
C424	Same as C410.	
C425	NOT USED	
C426	Same as C415.	
C427	Same as C410.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR401	SEMICONDUCTOR DEVICE, DIODE: germanium; 100 V min. peak inverse voltage; 60 ma at 250°C; axial wire lead type terminals; hermetically sealed glass case.	1N100
CR402	Same as CR401.	
L401	COIL, RADIO FREQUENCY, FIXED: tuned; 14.2 uh, ±10%; 1.2 to 1.4 ohms DC resistance; adjustable ferrite core; solder lug type terminals.	CL327
L402	Same as L401.	
L403	Same as L401.	
Q401	TRANSISTOR: germanium; PNP; JEDEC type 2N1637 with a controled hfe limit of 85-105 at 1 KC; JEDEC type TO9 case.	TX105
Q402 thru Q404	Same as Q401.	
R401	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±10%; 1/2 watt.	RC20GF101K
R402	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±10%; 1/2 watt.	RC20GF102K

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R403	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 1/2 watt.	RC20GF103K
R404	Same as R402.	
R405	Same as R403.	
R406	Same as R402.	
R407	Same as R402.	
R408	Same as R402.	
R409	RESISTOR, FIXED, COMPOSITION: 8,200 ohms, ±10%; 1/2 watt.	RC20GF822K
R410	Same as R403.	
R411	Same as R402.	
R412	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±10%; 1/2 watt.	RC20GF332K
R413	RESISTOR, FIXED, COMPOSITION: 330 ohms, ±10%; 1/2 watt.	RC20GF331K
R414	Same as R412.	
R415	Same as R403.	
R416	Same as R402.	
R417	NOT USED	
R418	Same as R402.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T401	TRANSFORMER, RADIO FREQUENCY: fixed, primary nom. inductance 15.1 uh; secondary nom. inductance 62 uh; staked lug type terminals; potted orange case.	TZ164
T402	TRANSFORMER, RADIO FREQUENCY: fixed, primary nom. inductance .7 uh; secondary nom. inductance 2.85 uh; staked lug type terminals; potted red case.	TZ171
T403	TRANSFORMER, RADIO FREQUENCY: fixed; primary nom. inductance 7.0 uh; secondary nom. inductance .7 uh; staked lug type terminals; potted green case.	TZ169
XY401	SOCKET, CRYSTAL: standard 9 pin stand-off socket with bayonet shield base, center shield and ground tab; for use with 1/16" printed circuit board.	TS167-1
Y401	CRYSTAL, QUARTZ: operating frequency 8.000000 Mc; bandwidth suppression ±100 Kc; resistance 400 ohms or less; operating temperature range 0 to 55 C; HC-6/U holder.	CR113-14

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C501	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 150 WVDC.	CC100-35
C502	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 4,700 uuf; GMV; 500 WVDC.	CC100-14
C503	CAPACITOR, FIXED, MICA DIELECTRIC: 200 uuf, ±3%; 500 WVDC; straight wire leads.	CM111E201 H5S
C504	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±3%; 100 WVDC; straight wire leads.	CM111E102 H1S
C505	Same as C501.	
C506	Same as C501.	
C507	Same as C501.	
C508	Same as C501.	
C509	CAPACITOR, FIXED, ELECTROLYTIC: 125 uf, -10% +150% at 120 cps, 25°C; 15 WVDC; polarized; insulated tubular case.	CE105-125 15
C510	Same as C501.	
C511	Same as C502.	
C512	CAPACITOR, FIXED, MICA DIELECTRIC: 2,000 uuf, ±2%; 300 WVDC; straight wire leads.	CM112D202 G3S
*C513	CAPACITOR, FIXED, MICA DIELECTRIC:	CM15Bxxxx
C514	Same as C504.	
*C515	Same as C513.	
C516	Same as C501.	
C517	CAPACITOR, FIXED, MICA DIELECTRIC: 600 uuf, ±5%; 300 WVDC; straight wire leads.	CM111E601 J3S
C518	CAPACITOR, FIXED, MICA DIELECTRIC: 320 uuf, ±3%; 500WVDC; straight wire leads.	CM111E321H 5S

*Capacitance optional, to be determined in test.

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C519	Same as C501.	
C520	Same as C501.	
C521	Same as C501.	
C522	Same as C509.	
C523	Same as C501.	
C524	Same as C501.	
C525	Same as C501.	
C526	CAPACITOR, FIXED, MICA DIELECTRIC: 470 uuf, ±5%; 500 WVDC; char. B.	CM15B471J
C527	Same as C501.	
C528	CPAPACITOR, FIXED, MICA DIELECTRIC: 47 uuf, ±5%; 500 WVDC; char. B.	CM15B470J
C529	Same as C509.	
C530	Same as C501.	
CR501	NOT USED	
CR502	SEMICONDUCTOR DEVICE, DIODE: silicon; diffused junction; voltage range 6.8 to 200 V; nom. rating 20 V, ±5% at 12.5 ma; 22 ohms max. impedance; 1 watt; max. operating temperature -65°C to +175°C; DC power dissipation 3/4 watt; polarized; hermetically sealed metal and glass welded case.	1N3027B
L501	COIL, RADIO FREQUENCY, FIXED: tuned; 14.2 uh, ±10%; 1.2 to 1.4 ohms DC resistance adjustable ferrite core; solder lug type terminals.	CL327
L502	Same as L501.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Q501	TRANSISTOR: germanium: PNP; JEDEC type 2N1637 with a controled hfe limit of 85-105 at 1 KC; TO9 case.	TX105
Q502	TRANSISTOR: PNP silicon, unijunction power dissipation 300 mw; RMS emitter current 50 ma; peak emitter current 2 amps; emitter reverse voltage 30 volts; interbase voltage 35 volts; operating temperature range -65°C to +125°C; storage temperature range -65°C to +150°C.	2N2646
Q503	TRANSISTOR: PNP silicon, unijuction; power dissipation 300 mw; RMS emitter current 50 ma; peak emitter current 2 amps; emitter reverse voltage 30 volts; interbase voltage 35 volts; operating temperature range -65°C C to +125°C; storage temperature range -65°C to +150°C.	2N2647
Q504	Same as Q501.	
Q505	TRANSISTOR: NPN diffused silicon; collector to base voltage 25 volts; collector to emitter voltage 20 volts; emitter to base voltage 3 volts; collector current 200 ma; power dissipation 1 watt at 25°C; junction temperature -65°C to +175°C; metal case.	2N706
Q506	Same as Q505.	
Q507	Same as Q501.	
R501	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±5%; 1/2 watt.	RC20GF471J
R502	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±5%; 1/2 watt.	RC20GF103J

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R503	RESISTOR, FIXED, COMPOSITION: 150,000 ohms, ±5%; 1/2 watt.	RC20GF154J
R504	RESISTOR, FIXED, COMPOSITION: 4,700 ohms ±5%; 1/2 watt.	RC20GF472J
R505	RESISTOR, FIXED, COMPOSITION: 150 ohms, ±5%; 1/2 watt.	RC20GF151J
R506	Same as R501.	
R507	Same as R501.	
R508	RESISTOR, FIXED, COMPOSITION: 68 ohms, ± 5%; 1/2 watt.	RC20GF680J
R509	RESISTOR, FIXED, COMPOSITION: 220,000 ohms, ±5%; 1/2 watt.	RC20GF224J
R510	Same as R501.	
R511	RESISTOR, FIXED, COMPOSITION: 56 ohms, ±5%; 1/2 watt.	RC20GF560J
R512	RESISTOR, VARIABLE, COMPOSITION: 10,000 ohms, ±10%; 0.25 watt at 70°C; operating temperature range -55°C to +120°C; linear taper.	RV111U103A
R513	RESISTOR, FIXED, COMPOSITION: 39,000 ohms ±5%; 1/2 watt.	RC20GF393J
R514	RESISTOR, FIXED, COMPOSITION: 680 ohms, ±5%; 1/2 watt.	RC20GF681J
R515	Same as R501.	
R516	RESISTOR, VARIABLE, COMPOSITION: 5,000 ohms ±10%; 0.25 watt at 70 C; operating temperature range -55 C to 120 C; linear taper.	RV111U502A
R517	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, +_5%; 1/2 watt.	RC20GF273J

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R518	Same as R511.	
R519	NOT USED	
R520	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±5%; 1/2 watt.	RC20GF470J
R521	Same as R501.	
R522	RESISTOR, FIXED, COMPOSITION: 8,200 ohms, ±5%; 1/2 watt.	RC20GF822J
R523	Same as R502.	
R524	Same as R501.	
R525	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF101J
R526	Same as R525.	
R527	RESISTOR, FIXED, COMPOSITION: 330 ohms, ±5%; 1/2 watt.	RC20GF331J
R528	NOT USED FIXED, COMPOSITION: 2,200 ohms, watt.	RC20GF222J
R529	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J
R530	RESISTOR, FIXED, COMP 2,200 ohms, ±5%; 1/2 watt	RC20GF222J
R531	Same as R520.	
R532	RESISTOR, FIXED, COMPOSITION: 3,900 ohms, ±5%; 1.2 watt.	RC20GF392J
R533	RESISTOR, FIXED, COMPOSITION: 1,800 ohms, ±5%; 1/2 watt.	RC20GF182J
R534	RESISTOR, FIXED, COMPOSITION: 820 ohms, ± 5%; 1/2 watt	RC20GF821J

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R535	RESISTOR, FIXED, COMPOSITION: 6,800 ohms, ±5%; 1/2 watt.	RC20GF682J
R536	Same as R529.	
TP501	TERMINAL, STUD: 3/32" board mounting; brass.	TE127-3
TP502	Same as TP501.	
TP503	Same as TP501.	
TP504	Same as TP501.	
TP505	Same as TP501.	

DIVIDE BY 10 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C601	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 150 WVDC.	CC100-35
C602	Same as C601.	
C603	Same as C601.	
C604	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 10 - 75 uuf; 400 min. Q at 1 Mc; 350 WVDC; operating temperature range -55°C to +85°C.	CV109-8
C605	CAPACITOR, FIXED, MICA DIELECTRIC: 510 uuf, ±5%; 500 WVDC; char. B.	CM15B511J
C606	Same as C601.	
C607	Same as C601.	
C608	Same as C601.	
C609	CAPACITOR, FIXED, MICA DIELECTRIC: 120 uuf, ±5%; 500 WVDC; char. C.	CM15C121J
C610	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±3%; 100 WVDC; straight wire leads.	CM111E102H1S
C611	Same as C601.	
C612	CAPACITOR, GIXEC, CERAMIC DIELECTRIC: temperature compensating; 100 uuf; ±5%; 500 WVDC; char. SH.	CC32SH101J
C613	Same as C610.	
C614	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±2%; 500 WVDC; straight wire leads.	CM111E101G5S
C615	Same as C601.	
C616	Same as C601.	
C617	Same as C610.	
C618	CAPACITOR, FIXED, MICA DIELECTRIC: 200 uuf, ±3%; 500 WVDC; straight wire leads.	CM111E201H5S

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C619	Same as C601.	
C620	CAPACITOR, FIXED, MICA DIELECTRIC: 470 uuf, ±3%; 500 WVDC; straight wire leads.	CM111E471 H5S
C621	CAPACITOR, FIXED, MICA DIELECTRIC: 320 uuf, ±3%; 500 WVDC; straight wire leads.	CM111E321 H5S
C622	Same as C610.	
C623	Same as C601.	
C624	Same as C601.	
L601	COIL, RADIO FREQUENCY: fixed; 100 uf, +5%; 2.6 ohms DC resistance; current rating 345 ma; molded case.	CL275-101
L602	Same as L601.	
L603	Same as L601.	
L604	COIL, RADIO FREQUENCY, FIXED: tuned; 14.2 uh, ±10%; 1.2 to 1.4 ohms DC resistance adjustable ferrite core; solder lug type terminals.	CL327
L605	Same as L601.	
L606	Same as L604.	
L607	Same as L601.	
L608	Same as L601.	
Q601	**TRANSISTOR**: germanium: PNP; JEDEC type 2N1637 with a controled hfe limit of 85-105 at 1 KC; TO9 case.	TX105

DIVIDE BY 10 MODULE

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Q602	TRANSISTOR: NPN epilaxial diffused-base silicon; collector to base voltage 60 volts; collector to emitter voltage 30 volts; emitter to base voltage 5 volts; collector current 800 ma; power dissipation 3 watts at 25°C; storage temperature -65°C to +300° C; junction temperature -65°C to +175°C; metal case.	2N2217
Q603	Same as Q601.	
R601	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±10%; 1/2 watt.	RC20GF102K
R602	RESISTOR, FIXED, COMPOSITION: 330 ohms, ±10%; 1/2 watt.	RC20GF331K
R603	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 1/2 watt.	RC20GF103K
R604	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±10%; 1/2 watt.	RC20GF332K
R605	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±10%; 1/2 watt.	RC20GF472K
R606	Same as R601.	
R607	Same as R602.	
R608	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±10%; 1/2 watt.	RC20GF222K
R609	Same as R601.	
R610	Same as R603.	
R611	Same as R601.	
*R612	RESISTOR, FIXED, COMPOSITION:	RC20GF
T601	TRANSFORMER, RADIO FREQUENCY: fixed: primary nom. inductance 1.75 uh; secondary nom. inductance .7 uh; staked lug type terminals; potted blue case.	TZ165

*Value to be determined in test, optimum value 27K, ±5%.

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C641	CAPACITOR, FIXED, MICA DIELECTRIC· 320 uuf, ±3%; 500 WVDC; straight wire leads.	CM111E321H 5S
C642	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 150 WVDC.	CC100-35
C643	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±5%: 500 WVDC: char. B.	CM15B101J
C644 thru C655	Same as C642.	
C656	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1,000 uuf; GMV: 500 WVDC.	CC100-29
C657	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 10-75 uuf; 400 min. Q at 1 Mc; 350 WVDC; operating temperature range -55°C to +85°C.	CV109-8
C658	Same as C642.	
C659	Same as C642.	
C660	Same as C657.	
C661	Same as C642.	
C662	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±3%; 300 WVDC; straight wire leads.	CM112E102H 3S
C663	Same as C642.	
C664	Same as C642.	
C665	Same as C642.	
C666	Same as C657.	
C667	CAPACITOR, FIXED, MICA DIELECTRIC: 47 uuf, ±3%; 500 WVDC; straight wire leads.	CM111E470H 5S
C668	Same as C667 .	
C669	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 2.2 uuf, ±.1%; non-insulated.	CC101-9

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C670	Same as C642.	
C671	Same as C657.	
C672	Same as C642.	
C673	Same as C642.	
C674	Same as C642.	
C675	Same as C642.	
C676	Same as C657.	
C677	SAME AS C643	
C678	Same as C669.	
C679	Same as C642.	
C680	Same as C656.	
C681	Same as C656.	
C682	Same as C642.	
C683	Same as C657.	
C684	Same as C642.	
C685	Same as C642.	
C686	Same as C677.	
C687	Same as C657.	
C688	Same as C642.	
C689	Same as C642.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR641	SEMICONDUCTOR DEVICE, DIODE: germanium; max. peak reverse voltage 200 V; max. continuous forward current, 5 amps at 25°C; two axial wire lead type terminals; hermetically sealed glass case.	1N39B
L641	COIL, RADIO FREQUENCY: fixed; 100 uf, ±5%; 2.6 ohms DC resistance; current rating 345 ma; molded case.	CL275-101
L642	COIL, RADIO FREQUENCY: fixed; 820 uh, ±5%; 13.8 ohms DC resistance; current rating 150 ma; molded case.	CL275-821
L643 thru L652	Same as L641.	
Q641	**TRANSISTOR: germanium: PNP; JEDEC type 2N1637 with a controled hfe limit of 85-105 at 1 KC; TO9 case.**	TX105
Q642 thru Q648	Same as Q401.	
R641	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±10%; 1/2 watt.	RC20GF102K
R642	Same as R641.	
R643	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, ±10%; 1/2 watt.	RC20GF273K
R644	RESISTOR, FIXED, COMPOSITION: 330 ohms, ±10%; 1/2 watt.	RC20GF331K
R645	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R646	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 1/2 watt.	RC20GF103K
R647	Same as R646.	
R648	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF101J
R649	RESISTOR, FIXED, COMPOSITION: 680 ohms ±10%; 1/2 watt.	RC20GF681K
R650	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, ±10%; 1/2 watt.	RC20GF223K
R651	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±10%; 1/2 watt.	RC20GF470K
R652	Same as R651.	
R653	Same as R641.	
R654	Same as R641.	
R655	Same as R646.	
R656	Same as R644.	
R657	RESISTOR, FIXED, COMPOSITION: 820 ohms, ±5%; 1/2 watt.	RC20GF821J
R658	Same as R648.	
R659	RESISTOR, FIXED, COMPOSITION: 6,800 ohms, ±5%; 1/2 watt.	RC20GF682J
R660	Same as R648.	
R661	Same as R641.	
R662	RESISTOR, FIXED, COMPOSITION: 5,600 ohms, ±10%; 1.2 watt.	RC20GF562K
R663	Same as R651.	
R664	Same as R651.	
R665	Same as R641.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R666	Same as R659.	
T641	TRANSFORMER, RADIO FREQUENCY: tuned; primary nom. inductance 14.2 uh, ±10%; 1.2 to 1.4 ohms DC resistance; secondary not rated; adjustable ferrite core; solder lug type terminals.	TT200
T642	TRANSFORMER, RADIO FREQUENCY: fixed; primary nom. inductance 7.0 uh; secondary nom. inductance .7 uh; staked lug type terminals; potted green case.	TZ169
T643	TRANSFORMER, RADIO FREQUENCY: fixed; primary nom. inductance 4.4 uh; secondary nom. inductance .7 uh; staked lug type terminals; potted red case.	TZ167
T644	TRANSFORMER, RADIO FREQUENCY: fixed; in ductance 2.5 uh; staked lug type terminals; potted yellow case.	TZ170
T645	TRANSFORMER, RADIO FREQUENCY: fixed; primary nom. inductance 2.8 uy; staked lug type terminals; potted orange case.	TZ166
T646	TRANSFORMER, RADIO FREQUENCY: fixed; primary nom. inductance 15.1 uh; secondary nom. inductance 62 uh; staked lug type terminals; potted orange case.	TZ164
T647	TRANSFORMER, RADIO FREQUENCY: fixed; primary nom. inductance 1.75 uh; secondary nom. inductance .7 uh; staked lug type terminals; potted blue case.	TZ165
T648	TRANSFORMER, RADIO FREQUENCY: fixed; inductance 1.57 uh; staked lug type terminals; potted red case.	TZ168
T649	Same as T643.	

P A R T S L I S T

9.0 & 9.9 MC GENERATOR Model IFSB-1

C701	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, +80% -20%; 100 WVDC.	CC100-28
C702	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±5%; 300 WVDC; straight wire leads.	CM112F102 J3S
C703	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: miniature disc type; 5.5 - 18 uuf; 200 WVDC; operating temperature range -55°C - +125°C; silver plated terminals; steatite ceramic base.	CV112-1
C704,	Same as C703.	
C705, C706	Same as C701.	
C707	Same as C702.	
C708	Same as C701.	
C709	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 150 WVDC.	CC100-35
C710	CAPACITOR, FIXED, MICA DIELECTRIC: 130 uuf, ±5%; 500 WVDC; straight wire leads.	CM111F131 J5S
C711, C712	Same as C709.	
C713	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±5%; 500 WVDC; straight wire leads.	CM111F101 J5S
C714, C715	Same as C709.	
C716	Same as C713.	
C717	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 8-50 uuf; operating temperature range -55°C to +85°C; 350 WVDC.	CV109-9
C718	Same as C703.	
C719	Same as C709.	
C720	Same as C701.	
C721	CAPACITOR, FIXED, MICA DIELECTRIC: 820 uuf, ±5%; 500 WVDC, straight wire leads.	CM111F821 J5S
C722	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 1.5-7 uuf; operating temperature range -55°C to +85°C; 350 WVDC.	CV109-1
C723	CAPACITOR, VARIABLE, MICA DIELECTRIC: 900 uuf min. when tight, 190 uuf max. at 3 turns; 175 WVDC.	CV113-3
C724, C725	Same as C701.	
C726	Same as C721.	

C727	Same as C701.	
C728	Same as C709.	
C729	CAPACITOR, FIXED, MICA DIELECTRIC: 82 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E820 J5S
C730	Same as C709.	
C731	Same as C709.	
C732	CAPACITOR, FIXED, MICA DIELECTRIC: 68 uuf, ±5%; 500 WVDC; straight wire leads.	CM111F68Q J5S
C733	Same as C709.	
C734	Same as C709.	
C735	Same as C729.	
C736	Same as C703.	
C737	Same as C717.	
C738	Same as C709.	
C739	Same as C709.	
C740	Same as C709.	
C741	Same as C709.	
C742	Same as C709.	
C743	Same as C709.	
C744	Same as C709.	
C745	Same as C709.	
L701	COIL, RADIO FREQUENCY: fixed; 220 uh; 4.1 ohms DC resistance; current rating 280 ma; molded case.	CL275-221
L702	Same as L701.	
L703,L704	Same as L701.	
Q701	TRANSISTOR: PNP germanium drift field; collector to base and collector to emitter voltage 40 volts; emitter to base voltage 0.5 volts; collector and emitter current 10 ma; power dissipation 240 mw at 25°C; storage temperature -65° C to +100°C; hermetically sealed metal case.	2N384
Q702 thru Q710	Same as Q701.	

R701	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±10%; 1/2 watt.	RC20GF102K
R702	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±10%; 1/2 watt.	RC20GF470K
R703	RESISTOR, FIXED, COMPOSITION: 560 ohms, ±10%; 1/2 watt.	RC20GF561K
R704	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 1/2 watt.	RC20GF103K
R705	Same as R701.	
R706	RESISTOR, FIXED, COMPOSITION: 330 ohms, ±10%; 1/2 watt.	RC20GF331K
R707	Same as R704.	
R708	Same as R701.	
R709	RESISTOR, FIXED, COMPOSITION: 82,000 ohms, ±10%; 1/2 watt.	RC20GF823K
R710	Same as R701.	
R711	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±10%; 1/2 watt.	RC20GF473K
R712	Same as R701.	
R713	Same as R702.	
R714	Same as R703.	
R715	Same as R704.	
R716	Same as R701.	
R717	Same as R702.	
R718	Same as R703.	
R719	Same as R704.	
R720	Same as R701.	
R721	Same as R706.	
R722	Same as R704.	
R723	Same as R701.	
R724	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±10%; 1/2 watt.	RC20GF104K
R725	Same as R701.	
R726	Same as R724.	
R727	Same as R701.	
R728	Same as R702.	
R729	Same as R703	
R730	Same as R704	

T701	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT240
T702	Same as T701	
T703	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT241
T704	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT242
T705	Same as T704.	
T706	Same as T701.	
T707	Same as T701.	
T708	Same as T703.	
T709	Same as T704.	
T710	Same as T704.	
TP701	TERMINAL STUD: 9/64" board mounting; brass.	TS127-3
TP702 thru TP709	Same as TP701.	
XY701	SOCKET, CRYSTAL: clip type; 2 cadmium plated contacts; 3/64" x 5/32" tail slots.	TS157-1
XY703	Same as XY701.	
Y701	CRYSTAL, QUARTZ: operating frequency 1 MC; bandwidth suppression ±100 KC; resistance 400 ohms or less; operating temperature range 0°C to 55°C; HC-6/U holder.	CR114-16
Y702	CRYSTAL UNIT, QUARTZ: 9.0 MC	CR111-1
Y703	CRYSTAL, QUARTZ: operating frequency 1.1 MC; bandwidth suppression +100 KC; resistance 400 ohms or less; operating temperature range 0°C to 55°C; HC-6/U holder.	CR111-17
Y704	CRYSTAL UNIT, QUARTZ: 9.9 MC	CR111-2

Schematic Diagram CK813

P A R T S L I S T

6.5 MC IF & OUTPUT Model LFSB-1

C751	CAPACITOR, FIXED, ELECTROLYTIC: 1 uf, -10% +150% at 120 cps at 25°C; 25 WVDC; polarized; insulated tubular case.	CE105-1-25
C752	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 150 WVDC.	CC100-35
C753	Same as C752.	
C754	Same as C751.	
C755	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, +80% -20%; 100 WVDC.	CC100-28
C756	Same as C751.	
C757	Same as C752.	
C758	CAPACITOR, FIXED, MICA DIELECTRIC: 68 uuf, ±5%; 500 WVDC; straight wire leads.	CM11E68J5S
C759	Same as C758.	
C760	Same as C752.	
C761	Same as C752.	
C762	Same as C752.	
C763	Same as C752.	
C764	Same as C755.	
C765	Same as C751.	
C766	Same as C751.	
C767	Same as C755.	
C768	Same as C751.	
C769	Same as C755.	
C770	Same as C755.	
C771	Same as C752.	
C772	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±5%; 500 WVDC; straight wire leads.	CM11E101J5S
C773 thru C786	Same as C752.	

C787	CAPACITOR, FIXED, MICA DIELECTRIC: 220 uuf, ±5%; 500 WVDC; straight wire leads.	CM111F221-J5S
FL751	FILTER, CRYSTAL: 6 KC; BW	FX201
L751	COIL, RADIO FREQUENCY: fixed, 330 uh; 5.6 ohms DC resistance; current rating 240 ma; molded case.	CL275-331
L752	COIL:	AC206
L753	COIL, RADIO FREQUENCY: fixed; 680 uh; 12.0 ohms DC resistance; current rating 160 ma; molded case.	CL275-681
L754 thru L756	Same as L753.	
L757	COIL, RADIO FREQUENCY: fixed; 220 uh; 4.1 ohms DC resistance; current rating 280 ma; molded case.	CL275-221
L758	Same as L757.	
Q751	TRANSISTOR: PNP germanium drift field; collector to base and collector to emitter voltage 40 volts; emitter to base voltage 0.5 volt; collector and emitter current 10 ma; power dissipation 240 mw at 25°C; storage temperature -65°C to +100°C; hermetically sealed metal case.	2N384
Q752 thru Q757	Same as Q751.	
R751	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±10%; 1/2 watt.	RC20GF470K
R752	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±10%; 1/2 watt.	RC20GF102K
R753	RESISTOR, FIXED, COMPOSITION: 1,500 ohms, ±10%; 1/2 watt.	RC20GF152K
R754	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±10%; 1/2 watt.	RC20GF101K
R755	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 1/2 watt.	RC20GF103K
R756 thru R759	Same as R753.	
R760	Same as R752.	
R761	RESISTOR, FIXED, COMPOSITION: 220 ohms, ±10%; 1/2 watt.	RC20GF221K
R762	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±10%; 1/2 watt.	RC20GF332K
R763	Same as R752.	
R764	RESISTOR, VARIABLE, COMPOSITION: 500 ohms, ±10%; nom. power rating 0.25 watt at 70°C; linear taper.	RV111U501A

R765	Same as R751.	
R766	Same as R752.	
R767	Same as R754.	
R768	Same as R755.	
R769	Same as R762.	
R770	Same as R752.	
R771	RESISTOR, FIXED, COMPOSITION: 150 ohms, ±10%; 1/2 watt.	RC20GF151K
R772	Same as R753.	
R773	RESISTOR, FIXED, COMPOSITION: 2,700 ohms, ±10%; 1/2 watt.	RC20GF272K
R774	Same as R752.	
R775	Same as R771.	
R776	Same as R752.	
R777	Same as R754.	
R778	Same as R755.	
T751	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT243
TP751	TERMINAL STUD: 9/16" board mounting; brass.	TE127-3
TP752 thru TP758	Same as TP751.	

Schematic Diagram CK814

P A R T S L I S T

PHASE DETECTOR MODULE

Model LFSB-1

C801	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 150 WVDC.	CC100-35
C802	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±5%; 500 WVDC; straight wire leads.	CM111D101J5S
C803	Same as C801.	
C804	Same as C801.	
C805	Same as C802.	
C806	Same as C801.	
C807	Same as C801.	
C808	Same as C802.	
C809	Same as C801.	
C810	Same as C801.	
C811	CAPACITOR, FIXED, MICA DIELECTRIC: 47 uuf, ±5%; 500 WVDC; straight wire leads.	CM111D470J5S
C812	Same as C801.	
C813	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, +80% -20%; 100 WVDC.	CC100-28
C814	Same as C811.	
C815	Same as C811.	
C816	Same as C802.	
C817	Same as C801.	
C818	Same as C801.	
C819	Same as C801.	
C820	Same as C801.	
C821	Same as C801.	
C822	Same as C801.	
C823	Same as C811.	
C824	Same as C801.	
C825	Same as C801.	
C826	Same as C813.	
C827	Same as C802.	
C828	Same as C801.	
C829	Same as C801	
C830	CAPACITOR, FIXED, ELECTROLYTIC: 20 uf, -10% +150% at 120 cps at 25°C; 25 WVDC; polarized; insulated tubular case.	CE105-20-25
C831	Same as C830	
C832	CAPACITOR, FIXED, METALIZED PLASTIC DIELECTRIC: 1,000,000 uf, ±10%; 200 WVDC.	CN112A105K2

C833	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 3,000 uuf, GMC; 2000 WVDC.	CC100-31
C834	CAPACITOR,FIXED, CERAMIC DIELECTRIC: 470,000 uuf, ±20%; 25 WVDC from -55°C to +85°C; radial lead type.	CC112R474M
C835	Same as C834.	
C836	CAPACITOR, FIXED, ELECTROLYTIC: tantalum; 50 uf, +50%; -15%; 60 WVDC; polarized, tubular case.	CE107-1
C837	CAPACITOR, FIXED, ELECTROLYTIC: 50 uf, -10% +150% at 120 cps at 25°C; 25 WVDC; polarized; insulated tubular case.	CE105-50-25
C838	Same as C834.	
CR801	SEMICONDUCTOR DEVICE; DIODE: germanium; max. peak inverse voltage 60 V; continuous average forward current 50 ma; max. peak forward current 150 ma; max. surge current 500 ma; max. inverse current 500 ua at 50 volts or 30 us at 10 volts.	1N34A
CR802, CR803, CR804	Same as CR801.	
CR805	SEMICONDUCTOR DEVICE, DIODE: silicon, 600 volts; mas. continuous DC current .50 amps at 100 C; surge current peak 75 amps; max. operating temp. 150°C; max. forward voltage drop 1.0 V; max. reverse current 1000 ua.	1N2484
L801	COIL, RADIO FREQUENCY: fixed; 680 uh; 12.0 ohms DC resistance; current rating 160 ma; molded case.	CL275-681
L802	Same as L801.	
L803	COIL, RADIO FREQUENCY: fixed; 2.50 uh, ±5%; 8.3 ohms, ±20% resistance; current rating 200 ma max.; ferrite core.	CL226-1
L804	Same as L801.	
Q801	TRANSISTOR: PNP germanium drift field; collector to base and collector to emitter voltage 40 volts; emitter to base voltage 0.5 volt; collector and emitter current 10 ma; power dissipation 240 mw at 25°C; storage temperature -65°C to +100°C; hermetically sealed metal case.	2N384
Q802 thru Q807	Same as Q801.	
Q808	TRANSISTOR: PNP, germanium, alloy junction; collector to base voltage 30 volts; collector to emitter, and emitter to base voltage 20 volts; collector current 200 ma; power dissipation 200 mw; storage temperature -65°C to +100°C; metal case.	2N396A
Q809	Same as Q808.	
Q810	TRANSISTOR: germanium, NPN alloy junction; collector to base and emitter to base voltage 25 volts; collector current 300 ma; power dissipation 150 mw at 25°C; storage temperature range -65°C to +100°C operating temperature(junction) -65°C to +85°C; hermetically sealed metal case.	2N1308
Q811	Same as Q810.	

R801	RESISTOR, FIXED, COMPOSITION : 47 ohms, ±5%; 1/2 watt.	RC20GF470J
R802	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±10%; 1/2 watt	RC20GF1C
R803	RESISTOR, FIXED, COMPOSITION: 220 ohms, ±5%; 1/2 watt.	RC20GF221J
R804	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 1/2 watt.	RC20GF103K
R805	Same as R802.	
R806	Same as R802.	
R807	Same as R803.	
R808	Same as R804.	
R809	Same as R802.	
R810	Same as R802.	
R811	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF102J
R812	Same as R804.	
R813	RESISTOR, FIXED, COMPOSITION: 560 ohms, ±5%; 1/2 watt.	RC20GF561J
R814	Same as R802.	
R815	Same as R803.	
R816	Same as R804.	
R817	RESISTOR, VARIABLE, COMPOSITION: 10,000 ohms, ±10%; nom. power rating 0.25 watt at 70°C; linear taper.	RV111U103A
R818	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±5%; 1/2 watt.	RC20GF471J
R819	Same as R818.	
R820	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R821	Same as R802.	
R822	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±5%; 1/2 watt.	RC20GF100J
R823	Same as R804.	
R824	Same as R801.	
R825	Same as R803.	
R826	Same as R804.	
R827	Same as R817.	
R828	Same as R801.	
R829	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF101
R830	Same as R804	
R831	Same as R804.	

R832	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J
R833	Same as R801.	
R834	RESISTOR, FIXED, COMPOSITION: 5,600 ohms, ±10%; 1/2 watt.	RC20GF562K
R835	Same as R829.	
R836	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±5%; 1/2 watt.	RC20GF473J
R837	Same as R804.	
R838	RESISTOR, FIXED, WIREWOUND: 40 ohms; current rating 353 ma; 5 watts.	RW107-15
R839	Same as R801.	
T801	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT244
T802	Same as T801.	
T803	Same as T801.	
T804	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT245
T805	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT246
T806	Same as T804.	
T807	Same as T805.	
T808	TRANSFORMER, RADIO FREQUENCY: fixed;	TR184
TP801	TERMINAL STUD: 9/16" board mounting; brass.	TE127-3
TP802 thru TP808	Same as TP801.	

Schematic Diagram CK815

P A R T S L I S T

OUTPUT MIXER MULTIPLIER Model LFSB-1

C901	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, +80% -20%; 100 WVDC.	CC100-28
C902	CAPACITOR, FIXED, MICA DIELECTRIC: 750 uuf, ±5%; 500 WVDC; straight wire leads.	CM111F751J5S
C903	CAPACITOR, FIXED, MICA DIELECTRIC: 22 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E220J5S
C904	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 150 WVDC.	CC100-35
C905	Same as C901.	
C906	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±5%; 500 WVDC; straight wire leads.	CM111F101J5S
C907	Same as C902.	
C908	Same as C904.	
C909	Same as C901.	
C910	CAPACITOR, FIXED, MICA DIELECTRIC: 470 uuf, ±5%; 500 WVDC; straight wire leads.	CM111F471J5S
C911	Same as C904.	
C912	Same as C901.	
C913	CAPACITOR, FIXED, MICA DIELECTRIC: 200 uuf, ±10%; 500 WVDC; straight wire leads.	CM111C201K5S
C914	Same as C904.	
C915	Same as C901.	
C916	CAPACITOR, FIXED, MICA DIELECTRIC: 120 uuf, ±5%; 500 WVDC; straight wire leads.	CM111F121J5S
C917	CAPACITOR, FIXED, MICA DIELECTRIC: 680 uuf, ±5%; 500 WVDC; straight wire leads.	CM111F681J5S
C918	Same as C904.	
C919	Same as C901.	
C920	CAPACITOR, FIXED, MICA DIELECTRIC: 10 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E100J5S
C921	Same as C906.	
C922	CAPACITOR, FIXED, MICA DIELECTRIC: 82 uuf, ±5%; 500 WVDC; straight wire leads.	CM111E820J5S
C923	Same as C904.	
C924	Same as C904.	
C925	CAPACITOR, FIXED, MICA DIELECTRIC: 180 uuf, ±5%; 500 WVDC; straight wire leads.	CM111F181J5S
C926	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±5%; 500 WVDC; straight wire leads.	CM111F102J5S
C927	Same as C904.	
C928	Same as C904.	
C929	Same as C920	
C930	CAPACITOR, FIXED, MICA DIELECTRIC: 150 uuf, ±5%; 500 WVDC; straight wire leads	CM111E151J5S
C931	CAPACITOR, FIXED, MICA DIELECTRIC: 270 uuf, ±5%; 500 WVDC; straight wire leads.	CM111F271J5S

L904	COIL, INTERMEDIATE FREQUENCY: adjustable;	AC203
L905	COIL, INTERMEDIATE FREQUENCY: adjustable;	AC204
L906	COIL, INTERMEDIATE FREQUENCY: adjustable;	AC205
L907	COIL, RADIO FREQUENCY: fixed; 220 uh; 4.1 ohms DC resistance; current rating 280 ma; molded case.	CL275-221
L908	Same as L907.	
L909	COIL, RADIO FREQUENCY: fixed; 2,200 uh; 33.7 ohms DC resistance; current rating 99 ma; molded case.	CL275-222
L910	Same as L909.	
L911 thru L915	Same as L907.	
Q901	TRANSISTOR: PNP germanium drift feild; collector to base and collector to emitter voltage 40 volts; emitter to base voltage 0.5 volts; collector and emitter current 10 ma; power dissipation 240 mw at 25°C; storage temperature range -65°C to + 100°C; hermetically sealed metal case.	2N384
Q902 thru Q909	Same as Q901.	
R901	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±10%; 1/2 watt.	RC20GF102K
R902	RESISTOR, FIXED, COMPOSITION: 2,700 ohms, ±10%; 1/2 watt.	RC20GF272K
R903	RESISTOR, FIXED, COMPOSITION: 1,500 ohms, ±10%; 1/2 watt.	RC20GF152K
R904	Same as R901.	
R905	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±10%; 1/2 watt.	RC20GF101K
R906	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 1/2 watt.	RC20GF103K
R907	Same as R901.	
R908	RESISTOR, FIXED, COMPOSITION: 6,800 ohms, ±10%; 1/2 watt.	RC20GF682K
R909	RESISTOR, FIXED, COMPOSITION: 220 ohms, ±10%; 1/2 watt.	RC20GF221K
R910	Same as R906.	
R911	Same as R901	
R912	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±10%; 1/2 watt	RC20GF222K
R913	Same as R905	
R914	RESISTOR, VARIABLE, COMPOSITION: 50,000 ohms, ±10%; nom. power rating 0 25 watt at 70°C; linear taper.	RV111U503A

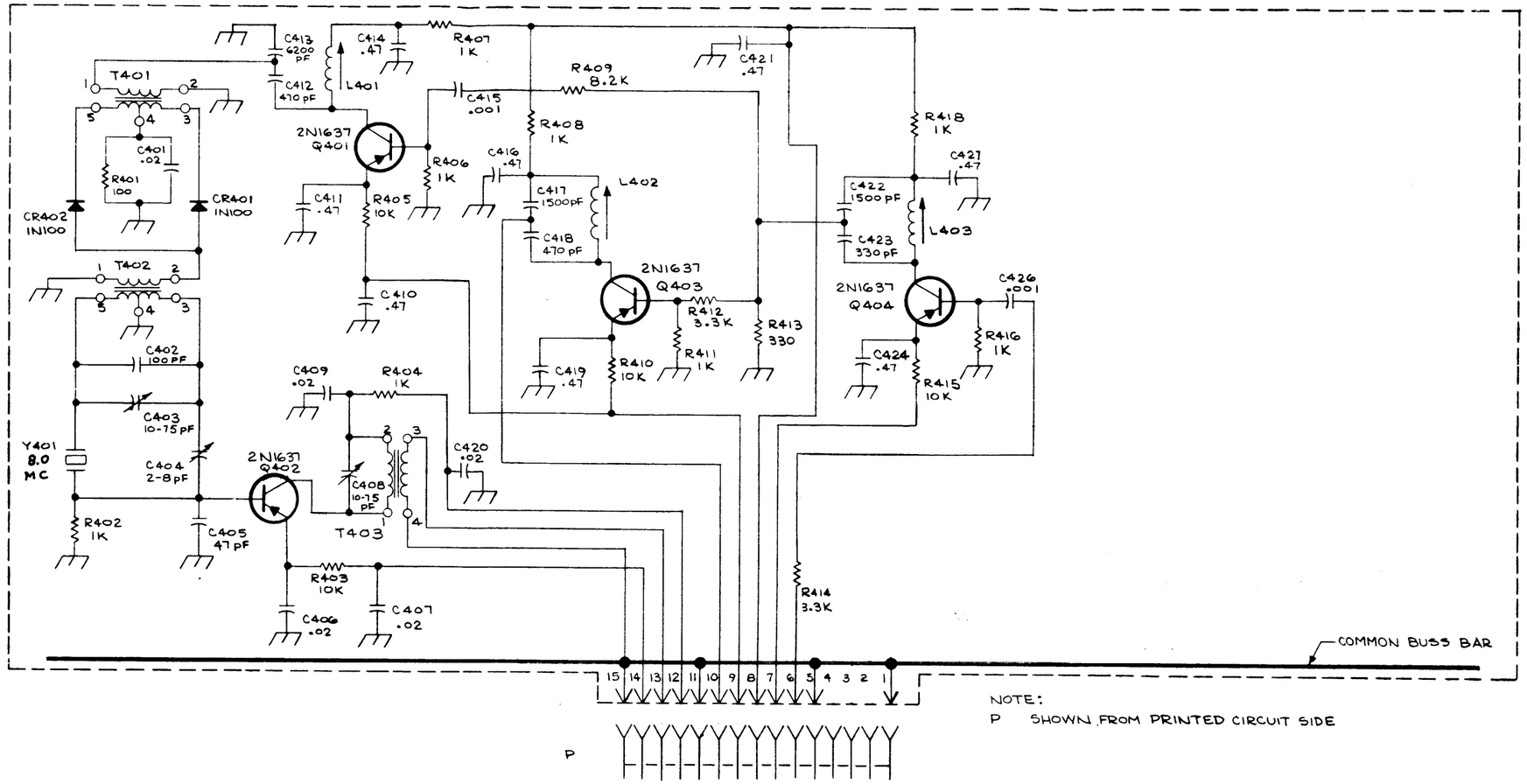
C932	Same as C904	
C933	Same as C925	
C934	Same as C904.	
C935	Same as C916.	
C936	Same as C904.	
C937	Same as C916.	
C938	Same as C917.	
C939	Same as C904.	
C940	CAPACITOR, FIXED, MICA DIELECTRIC: 12 uuf, ±10%; 500 WVDC; straight wire leads.	CM11C120K5S
C941	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 2.2 uuf, ±.1 uuf; 500 WVDC	CC101-9
C942	CAPACITOR, FIXED, MICA DIELECTRIC: 130 uuf, ±5%; 500 WVDC; straight wire leads.	CM11F131J5S
C943	Same as C904.	
C944	Same as C904.	
C945	Same as C904.	
C946	Same as C904.	
C947	Same as C904.	
C948	Same as C904.	
C949	Same as C904.	
C950	Same as C906.	
C951	Same as C904.	
C952	Same as C916.	
C953	Same as C904.	
C954	Same as C904.	
C955	Same as C916.	
C956 thru C958	Same as C904.	
CR901	SEMICONDUCTOR DEVICE, DIODE: germanium; max. peak inverse voltage 60 V; continuous average forward current 50 ma; max. peak forward current 150 ma; max. surge current 500 ma; max. inverse current 500 ua at 50 volts or 30 ua at 10 volts.	1N34A
CR902	Same as CR901.	
L901	COIL, INTERMEDIATE FREQUENCY: adjustable;	AC201
L902	Same as L901	
L903	COIL, INTERMEDIATE FREQUENCY: adjustable;	AC202

R915	Same as R903	
R916	Same as R901.	
R917	Same as R912.	
R918	Same as R905.	
R919	Same as R906.	
R920	Same as R909.	
R921	Same as R901.	
R922	Same as R905.	
R923	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±10%; 1/2 watt.	RC20GF472K
R924	Same as R901.	
R925	Same as R912.	
R926	Same as R905.	
R927	Same as R906.	
R928	Same as R912.	
R929	Same as R905.	
R930	Same as R906.	
R931	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±10%; 1/2 watt.	RC20GF471K
R932	Same as R901.	
R933	Same as R901.	
R934	Same as R909.	
R935	Same as R906.	
R936	Same as R901.	
R937	Same as R909.	
R938	Same as R906.	
R939	Same as R901.	
T901	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT233
T902	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT234
T903	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT235
T904	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT236
T905	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT237
T906	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT238
T907	TRANSFORMER, RADIO FREQUENCY: adjustable;	TT239

TP901	TERMINAL STUD: 9/16" board mounting; brass.	TE127-3
TP902 thru TP913	Same as TP901	

SECTION 7

SCHEMATIC DIAGRAMS



NOTE:
P SHOWN FROM PRINTED CIRCUIT SIDE

FIRST SYMBOL	LAST SYMBOL	MISSING SYMBOL
R401	R418	R417
C401	C427	C425
CR401	CR402	
T401	T403	
L401	L403	
Q401	Q404	
Y401	Y401	

UNLESS OTHERWISE SPECIFIED:
1~ ALL CAPACITORS ARE IN μf
2~ALL RESISTORS ARE IN Ω

CK-791 (B)

Figure 7-1. 1-8 Megacycle Generator Module, Schematic Diagram

FIRST SYMBOL	LAST SYMBOL
R501	R536
C501	C530
CR502	CR502
L501	L502
Q501	Q507
TP501	TP505

MISSING SYMBOLS
CR501
R519
R528

—UNLESS OTHERWISE SPECIFIED —

1- ALL RESISTORS ARE IN OHMS

2- ALL CAPACITORS ARE IN MICROFARAD

3- THE VALUES OF C513 AND C515 WILL BE DETERMINED BY TEST DEPARTMENT.

4- PC BOARD CONNECTOR SHOWN FROM PRINTED CIRCUIT SIDE

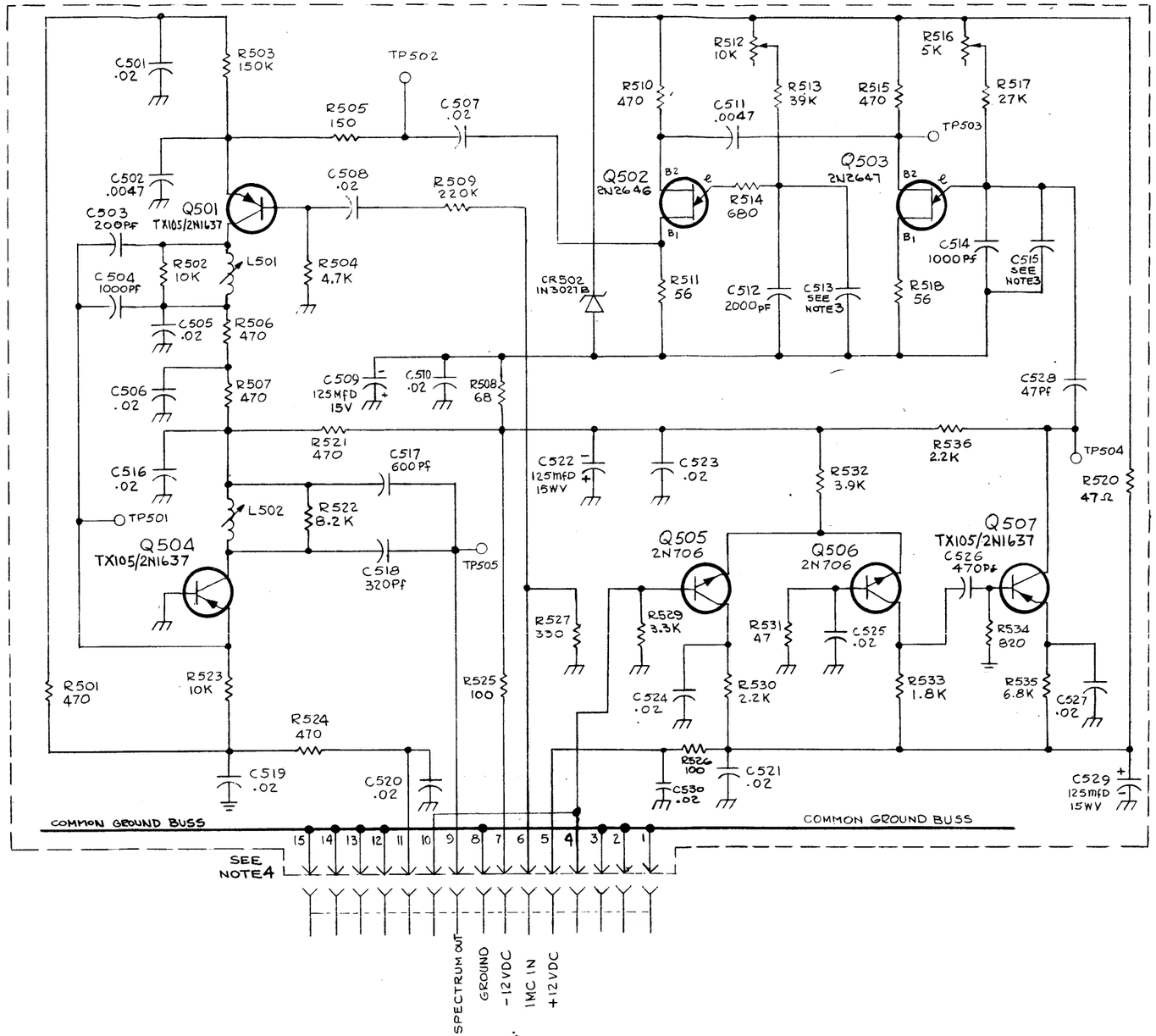
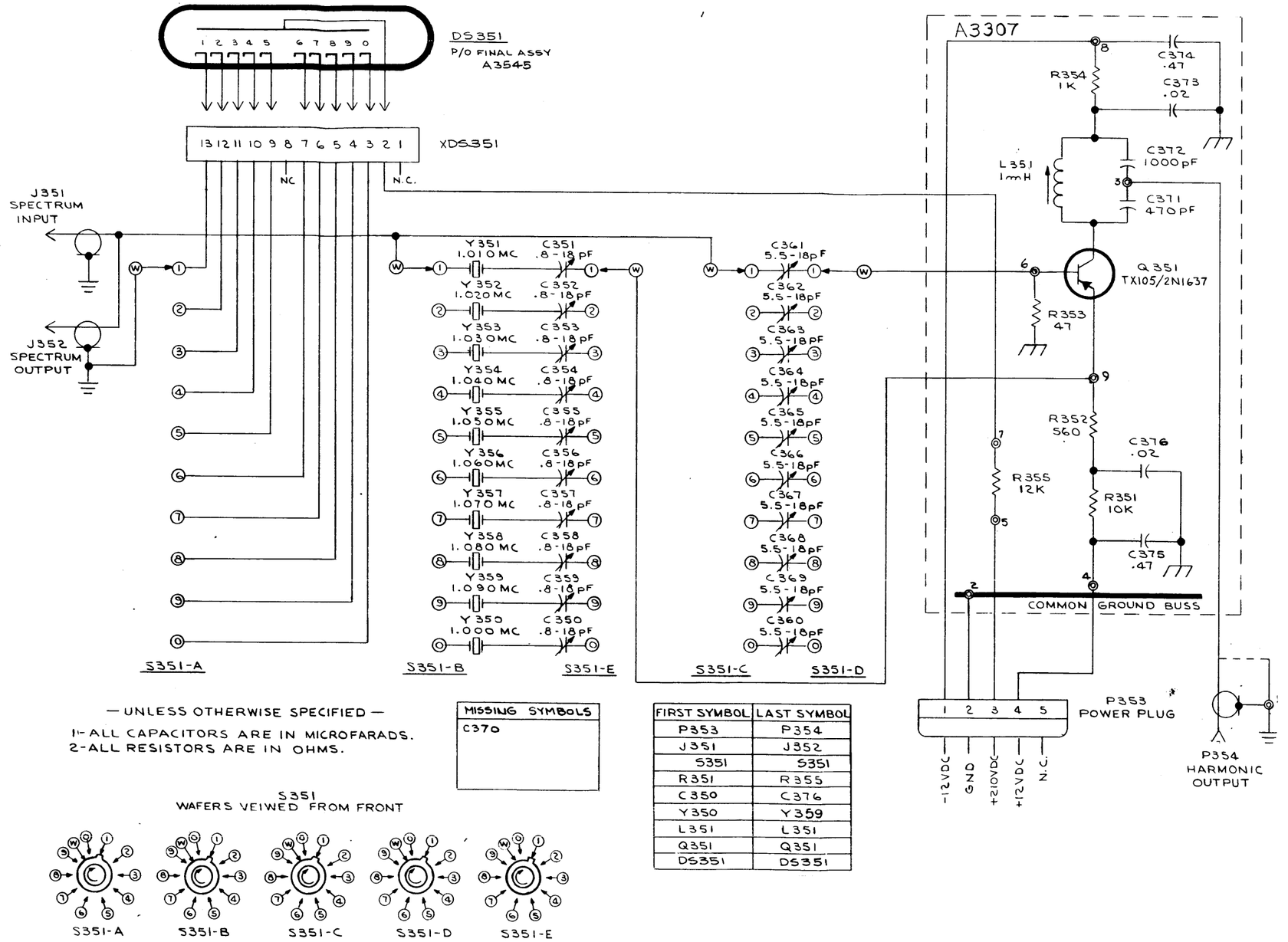


Figure 7-2. Spectrum Generator Module, Schematic Diagram



— UNLESS OTHERWISE SPECIFIED —

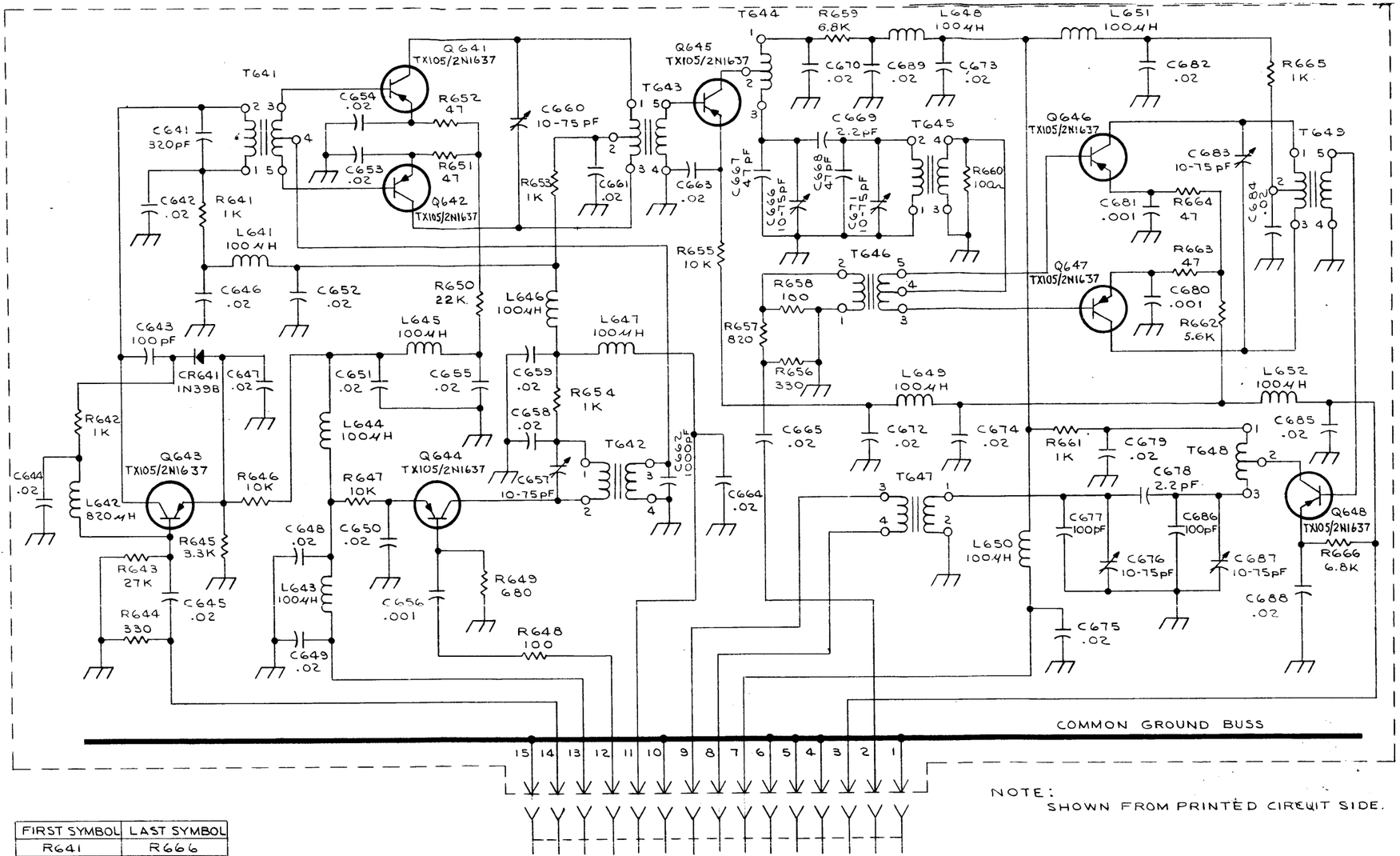
1- ALL CAPACITORS ARE IN MICROFARADS.
2- ALL RESISTORS ARE IN OHMS.

MISSING SYMBOLS
C370

FIRST SYMBOL	LAST SYMBOL
P353	P354
J351	J352
S351	S351
R351	R355
C350	C376
Y350	Y359
L351	L351
Q351	Q351
DS351	DS351

S351
WAFERS VEIWED FROM FRONT

Figure 7-3. Spectrum Filter Assembly, Schematic Diagram

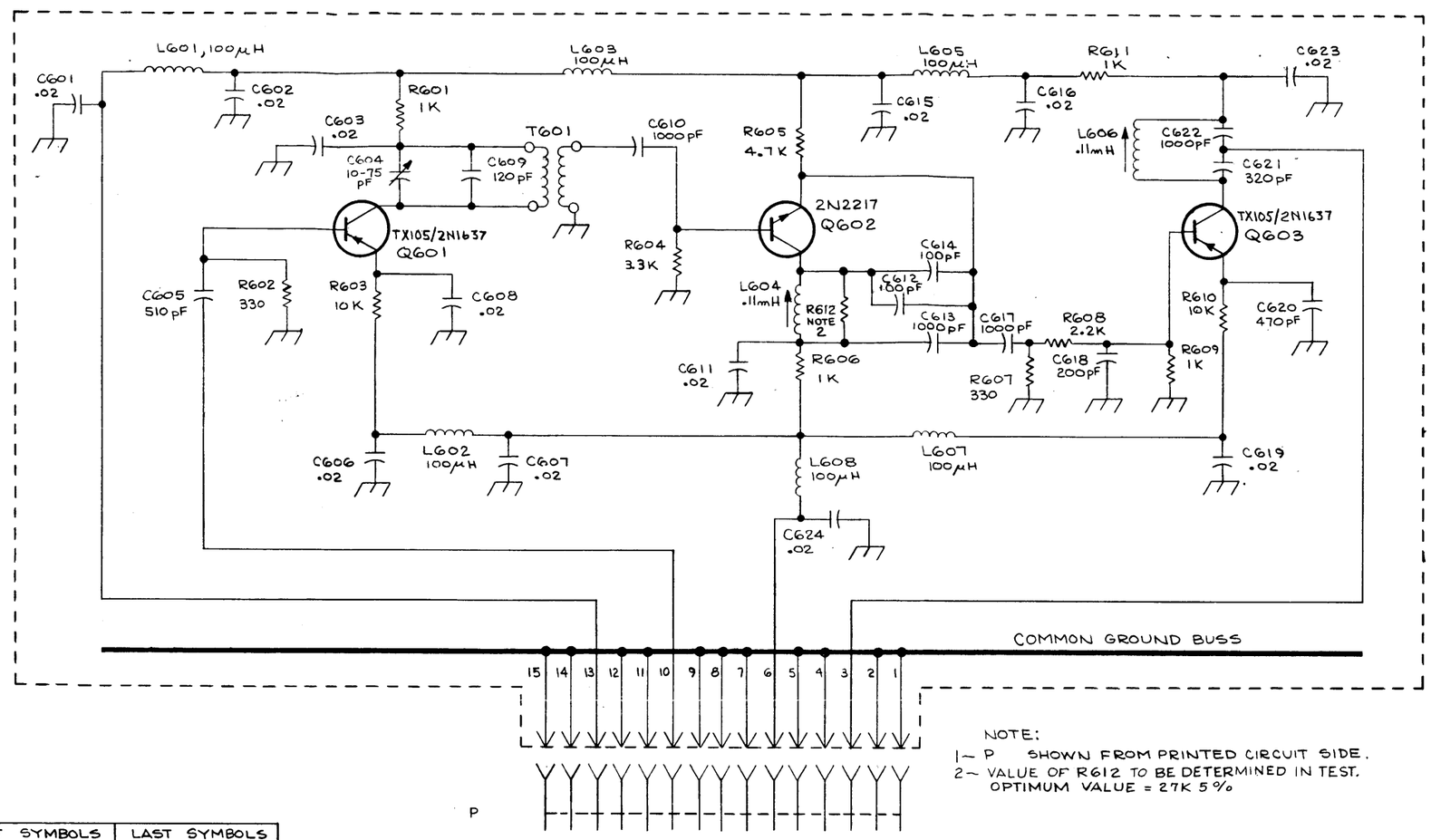


FIRST SYMBOL	LAST SYMBOL
R641	R666
C641	C689
CR641	CR641
L641	L652
T641	T649
Q641	Q648
P	

— UNLESS OTHERWISE SPECIFIED —
1 - ALL CAPACITORS ARE IN MICROFARADS
2 - ALL RESISTORS ARE IN OHMS.

CK-703 (C)

Figure 7-4. Plus Mixer Module, Schematic Diagram



NOTE:
1– P SHOWN FROM PRINTED CIRCUIT SIDE.
2– VALUE OF R612 TO BE DETERMINED IN TEST. OPTIMUM VALUE = 27K 5%

FIRST SYMBOLS	LAST SYMBOLS
R601	R612
T601	T601
L601	L608
C601	C624
Q601	Q603
P	P

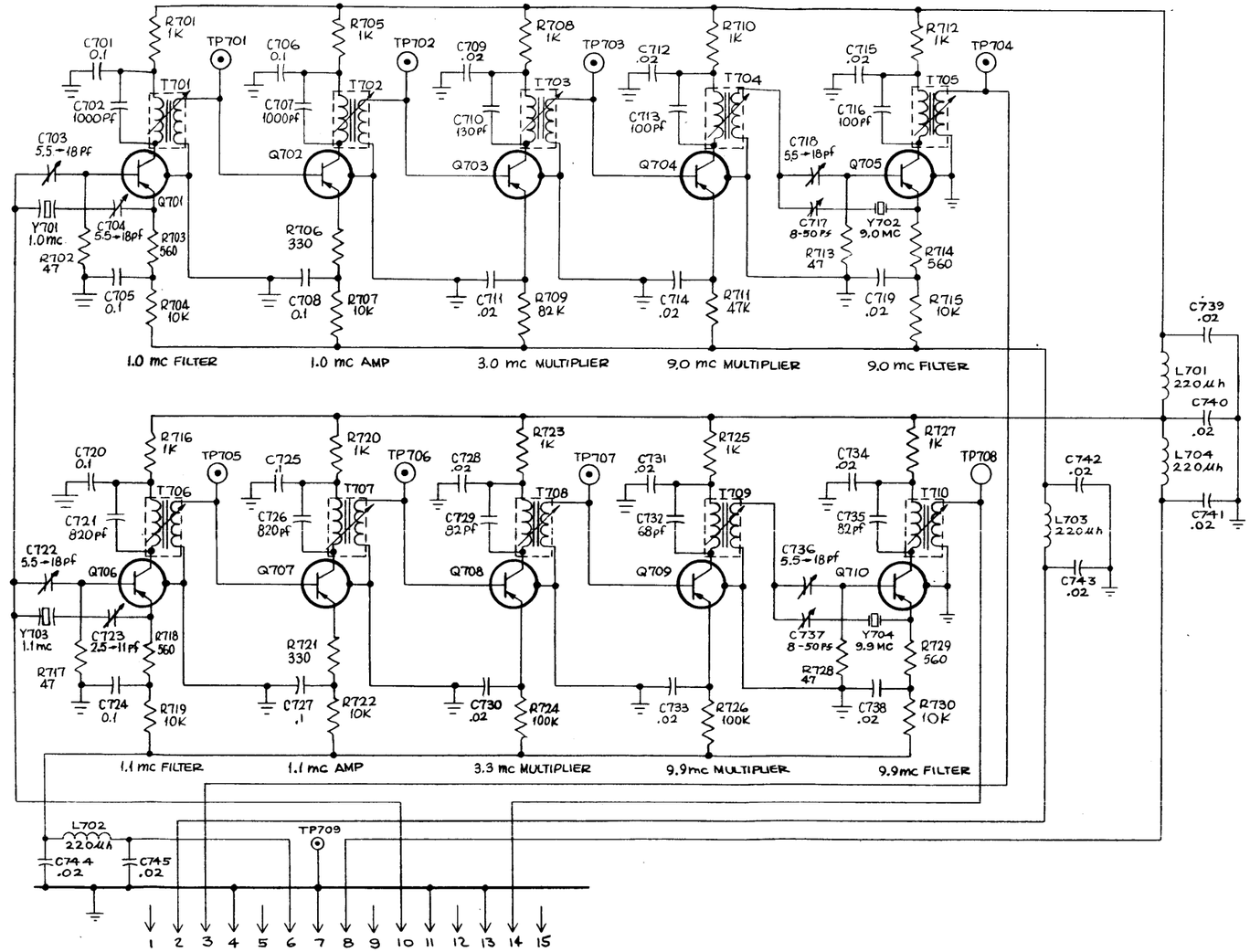
— UNLESS OTHERWISE SPECIFIED —

1- ALL CAPACITORS ARE IN µf UNLESS OTHERWISE NOTED.
2- ALL RESISTORS ARE IN Ω UNLESS OTHERWISE NOTED.

CK-704 (C)

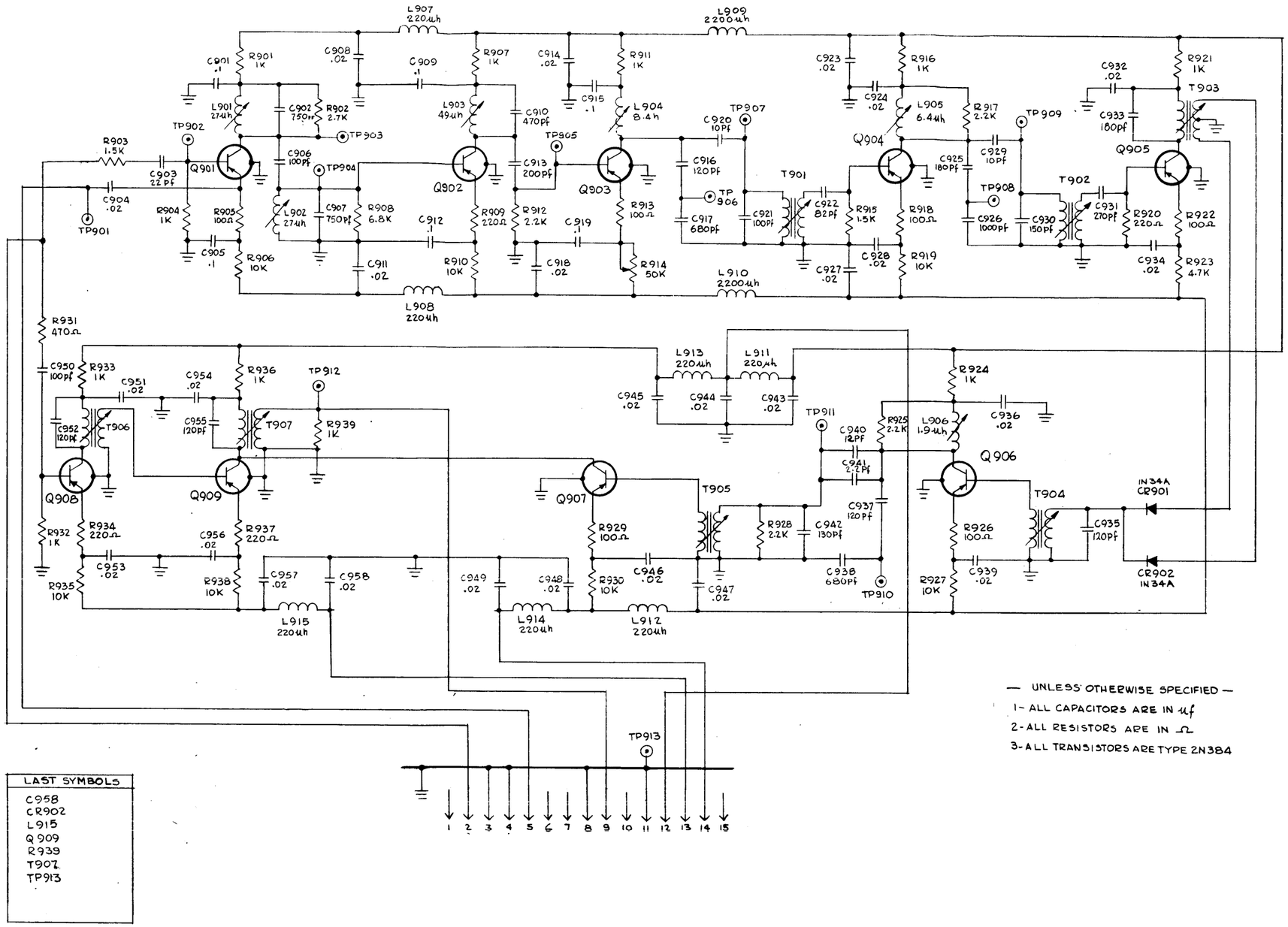
Figure 7-5. Divide By Ten Module, Schematic Diagram

NOTE UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE 1/2 WATT, 10%.
2. ALL RESISTORS ARE IN OHMS
3. ALL CAPACITORS ARE IN μf
4. ALL TRANSISTORS ARE 2N384



LAST SYMBOLS
C745
L704
Q710
R730
T710
TP709
Y704

Figure 7-6. 9.0 and 9.9 Megacycle Generator Module, Schematic Diagram

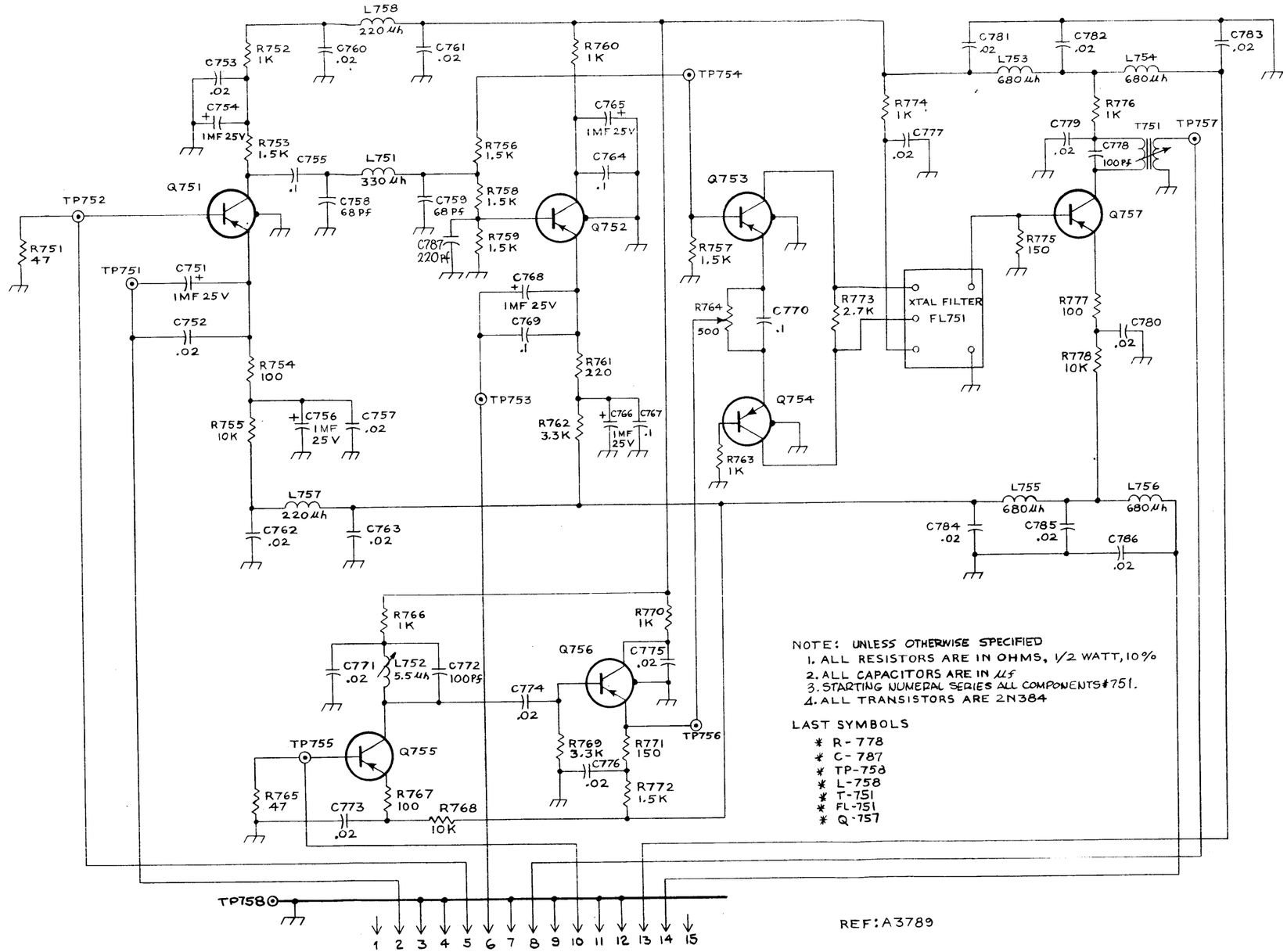


— UNLESS OTHERWISE SPECIFIED —
1- ALL CAPACITORS ARE IN uf
2- ALL RESISTORS ARE IN Ω
3- ALL TRANSISTORS ARE TYPE 2N384

LAST SYMBOLS
C958
CR902
L915
Q909
R939
T907
TP913

CK-815 Ø

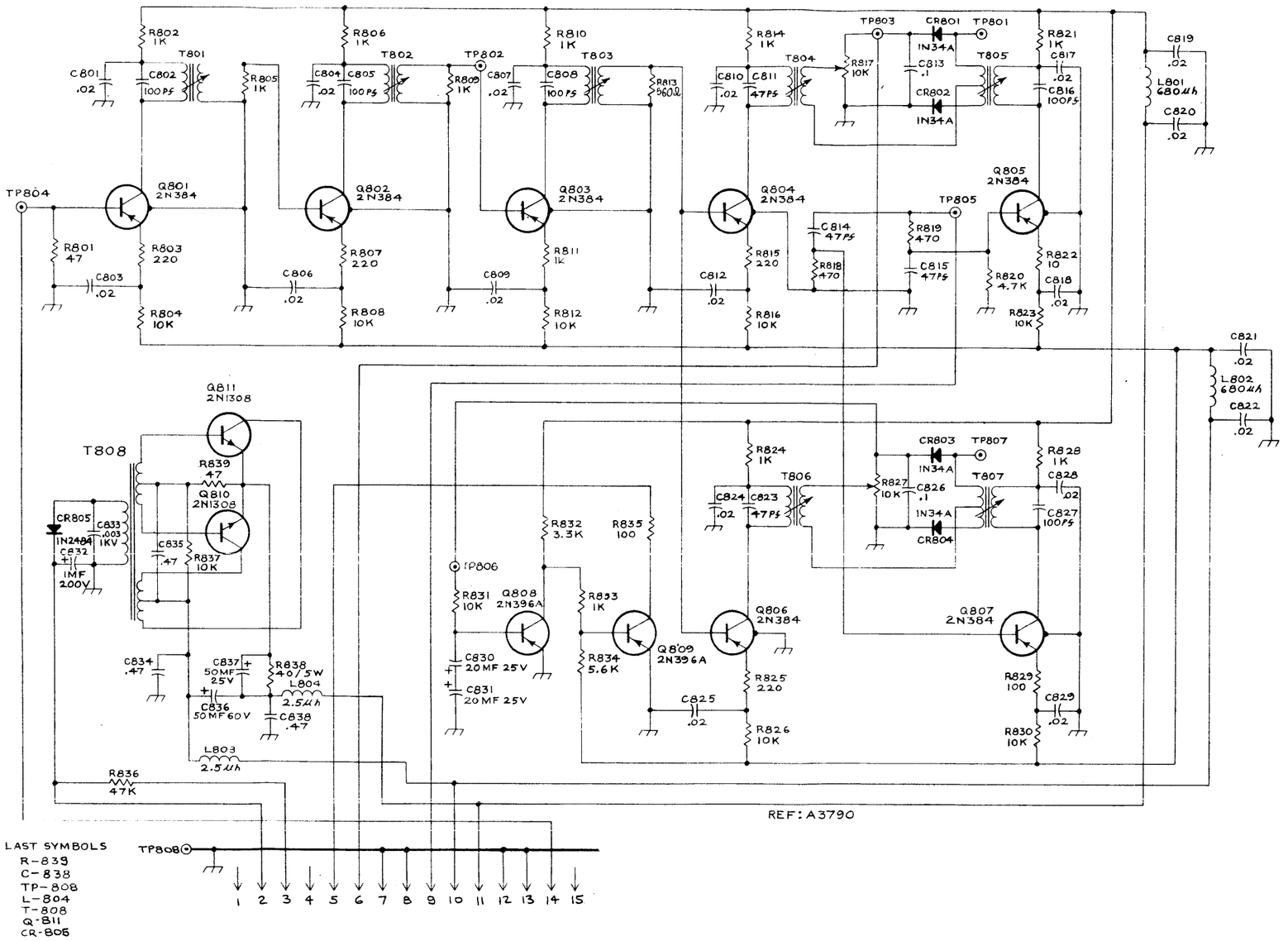
Figure 7-7. Output Mixer-Multiplier Module, Schematic Diagram



CK-813 (Ø)

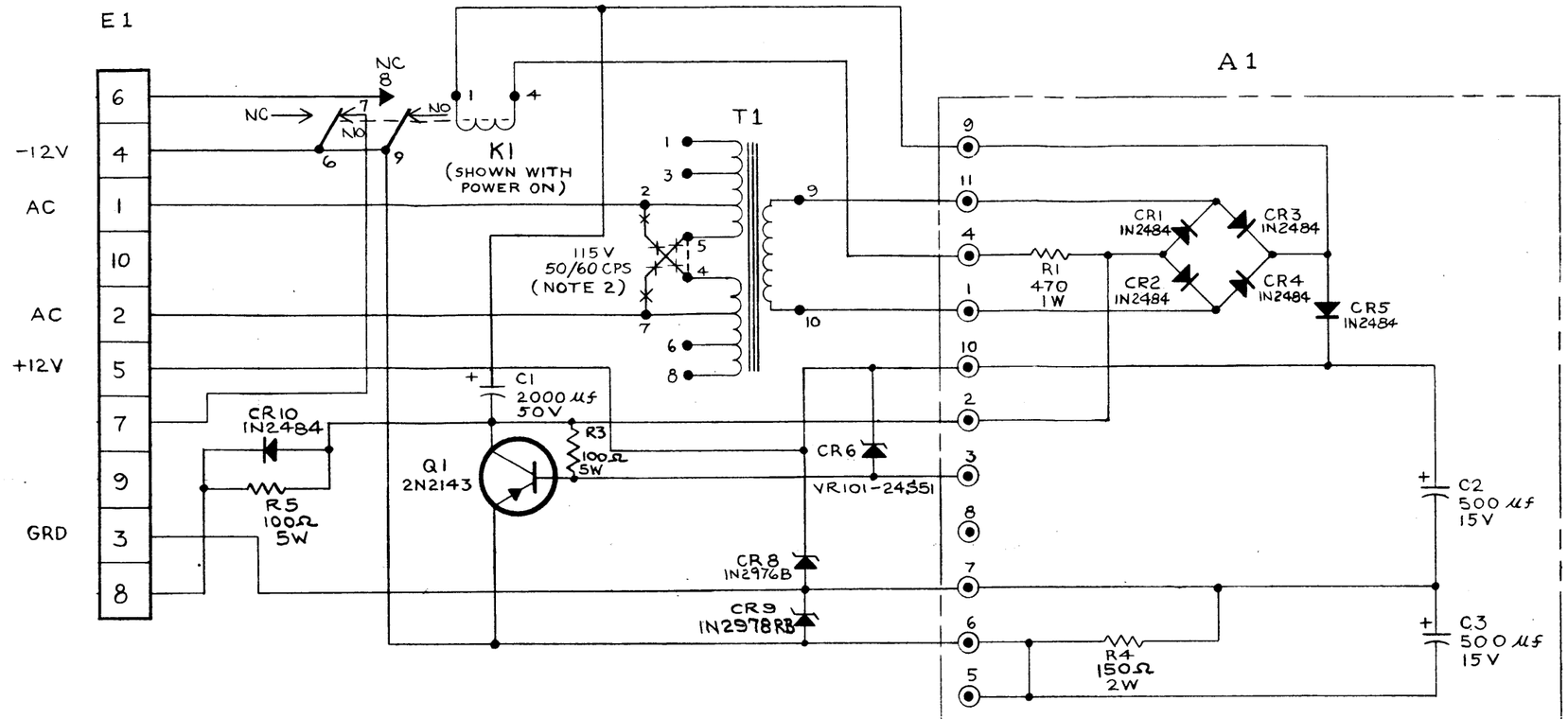
Figure 7-8. 6.5 Megacycle IF and Output Module, Schematic Diagram

NOTE: UNLESS OTHERWISE NOTED
1. ALL RESISTORS ARE IN OHMS, 1/2 WATT, 10%.
2. ALL CAPACITORS ARE IN μf



CK-814 (Ø)

Figure 7-9. Phase Detector Module, Schematic Diagram



NOTE:
1. ALL RESISTORS IN Ω UNLESS OTHERWISE NOTED.
2. FOR 230V AC OPERATION, REMOVE JUMPERS MARKED ✕✕✕, AND ADD JUMPER MARKED - - -

LAST SYMBOLS USED	
R	5
C	3
T	1
Q	1
E	1
K	1
D	1
CR	10

MISSING SYMBOLS
R2
CR7

CK-679 D

Figure 7-10. Power Supply, Schematic Diagram