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TECHNICAL MANUAL

for

LOW FREQUENCY SYNTHESIZER

MODEL LFSA-1

THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y. OTTAWA, CANADA

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COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

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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.

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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.

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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

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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 I

GENERAL INFORMATION

1-1 PURPOSE AND DESCRIPTION.

a. PURPOSE. - Low Frequency Synthesizer, Model LFSA-1 (figure 1-1) is a direct-reading digital-type signal generator that is designed to produce sinusoidal output signals within the frequency range of one cycle to 99.999 kilocycles in increments of one cycle. The selected output signal frequency is displayed on the front panel in one inch high illuminated numerals. To accomplish this, the LFSA requires external 100 kilocycle and one megacycle input signals. The sinusoidal output signals are as stable as the external input signals.

The LFSA is also designed to maintain a one megacycle frequency standard to a high stability. To accomplish this the LFSA requires 100-kilocycle and one-megacycle signals from an external frequency standard and a TRF signal with an upper frequency limit of 99.999 kilocycles from an external receiver. The LFSA compares the one megacycle frequency standard signal with the TRF signal; the resultant d-c correction voltage serves to maintain the frequency standard to a stability equal to that of the TRF signal.

b. DESCRIPTION. - The LFSA synthesizer is a completely transistorized, modular constructed unit consisting of a main chassis that principally houses:

(1) A 1-8-10 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 minus mixer module.

(7) A phase detector module.

(8) A power supply assembly.

The modules are printed-circuit plug-in cards. All wiring in a module terminates in a multipler-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 LFSA synthesizer. All connections external to the synthesizer are made to jacks mounted on the rear panel.

Front-panel switches tune the LFSA in increments of one cycle. The front panel also contains a jack that permits monitoring of the sinusoidal output signals; a meter that serves to measure phase error; a lamp that indicates when the LFSA is not synchronized.

The LFSA internal power supply requires 115/230 volts, 50-60 cycles, a-c power for operation and provides output voltages of $\pm$12 volts dc. In the case of a-c power failure, provisions are made (with the connection of an external 24-volt battery) to automatically switch over to battery power.

1-2. TECHNICAL SPECIFICATIONS.

Table 1-1 lists the technical specifications of the LFSA synthesizer.

TABLE 1-1. TECHNICAL SPECIFICATIONS

Frequency Range	Tunable from 1 cycle to 99.999 kilocycles in increments of 1 cycle; displayed in 1 inch high illuminated numerals.
Modes	Signal generator or frequency comparator.
Inputs (Frequency Comparator 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	A TRF signal with an upper frequency limit of 99.999 kilocycles may be inserted to a BNC connector at a level of .01 volts across 50 ohms.
Inputs (Signal Generator)	External 100 kilocycle and one megacycle signals may be inserted to respective BNC connectors at a level of 1 volt across 50 ohms.
Outputs:	
Frequency Comparator Mode	A d-c correction voltage available at a BNC connector may be connected to the control circuits of the external 1 megacycle frequency standard.

TABLE 1-1. TECHNICAL SPECIFICATIONS (CONT)

Signal Generator Mode	Sinusoidal output signals within frequency range of one cycle to 99.999 kilocycles available at a BNC connector (high impedance) may be connected to external equipment. A parallel connected BNC connector permits monitoring of the output signals.
Stability:	
Frequency Comparator Mode	Equal to the stability of the external TRF signal.
Signal Generator Mode	Equal to the stability of the external 100 kilocycle and 1 megacycle input signals.
Operating Power	115/230 volt ±10%, 50 to 60 cycles, single phase. Facilities are provided for automatic switching to battery operation if a-c power should fail.
Battery Power (Optional)	24-volt external battery; should provide a minimum of 4 hour operation of the LFSA. During normal a-c operation the battery can be kept in a charged condition by a built-in "trickle" charger.
Battery Drain	Approximately 400 milliamperes.
Dimensions	7" x 19" x 15"
Weight	30 lbs.

1-3. TRANSISTOR AND DIODE COMPLEMENT.

Table 1-2 lists the transistors and diodes used in the LFSA synthesizer.

TABLE 1-2. TRANSISTOR AND DIODE COMPLEMENT

REF SYMBOL	TYPE	FUNCTION
1-8-10 MEGACYCLE GENERATOR MODULE		
Q401, Q403, Q404, Q405	2N1637	1 Mc Amplifier
Q402	2N1637	8 Mc Amplifier
Q406	2N1637	10 Mc Amplifier
CR401, CR402	1N100	Harmonic Generator
CR403, CR404	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
CR501	1N277	Pulse Shaper
SPECTRUM FILTER ASSEMBLY		
Q351	2N1637	1 Mc +Δf Amplifier
PLUS MIXER MODULE		
Q643	2N1637	1 Mc +Δf Amplifier with AGC
Q641, Q642	2N1637	Balanced Mixer
Q646, Q647	2N1637	Balanced Mixer

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

REF SYMBOL	TYPE	FUNCTION
PLUS MIXER MODULE (cont)		
Q644	2N1637	8 Mc Amplifier
Q645	2N1637	9 Mc +Δf Amplifier
Q648	2N1637	10 Mc +Δf Amplifier
CR641	1N39B	AGC Diode
DIVIDE BY TEN MODULE		
Q601	2N1637	10 Mc +Δf Amplifier
Q602	2N2217	1 Mc +Δf Locked Oscillator
Q603	2N1637	1 Mc +Δf Amplifier
MINUS MIXER MODULE		
Q701	2N1637	10 Mc +Δf Amplifier
Q702	2N1637	Mixer
Q703	2N1637	10 Mc Amplifier
Q704	2N1637	Emitter Follower
PHASE DETECTOR MODULE		
Q801	2N1637	Doubler
Q802	2N1637	Emitter Follower
Q803	2N1637	Amplifier
Q804	2N1637	Phase Detector
Q805	2N1637	Amplifier
Q806	2N1637	Amplifier
Q807	2N1637	Amplifier
Q808	2N1637	Limiter
Q809	2N1637	Limiter

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

REF SYMBOL	TYPE	FUNCTION
PHASE DETECTOR MODULE (cont)		
Q810	2N396A	DC Amplifier
Q811	2N214	DC Amplifier
Q812	2N214	DC Converter
Q813	2N214	DC Converter
Q814	2N1637	Amplifier
Q815	2N1637	Phase Detector
Q816	2N1637	Amplifier
Q817	2N1637	Amplifier
CR807	1N2484	Rectifier
CR801, CR802	1N294	Doubler
CR803, CR804	1N34A	Phase Detector
CR805, CR806	1N294	Doubler
CR808, CR809	1N294	Phase Detector
POWER SUPPLY		
Q1	2N1234	Series Regulator
CR1, CR2, CR3, CR4	1N2484	Rectifier
CR5	1N2484	Isolator
CR6	VR101	Regulator
CR8	1N2976B	Regulator

SECTION 2

INSTALLATION

2-1. INITIAL INSPECTION.

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

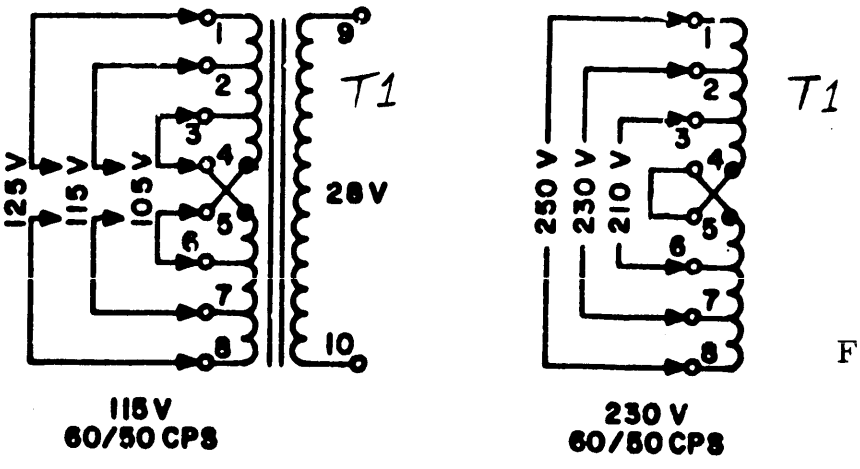

Figure 2-1. Transformer Wiring

2-3. INSTALLATION.

a. MECHANICAL. - The LFSA is designed for both fixed and mobile installation. When housed in a well-ventilated cabinet for fixed operation, place the synthesizer on any sturdy table or bench. When the synthesizer is used for mobile operation, securely bolt the cabinet to a table or shelf that is rigidly fastened to the vehicle. Allow space for ventilation, for access to the connections at the rear panel, and for widthdrawal of the synthesizer from the cabinet for servicing.

When mounted in a standard 19-inch rack, the LFSA synthesizer requires 7 inches of vertical space. The synthesizer extends approximately 15 inches behind the front face of the rack. To install the synthesizer in a rack, proceed as follows.

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

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

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

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

b. ELECTRICAL. - Figure 2-2 is a rear view of the LFSA synthesizer. All external connections are made to the jack and screw terminals located on the rear panel. Table 2-1 lists the controls, jack, and terminals mounted on the LFSA rear panel.

External connections to the LFSA synthesizer are made as follows:

(1) SIGNAL GENERATOR MODE:

(a) Connect the 115 volt a-c power source to the MAIN AC jack J451 pins A and C.

(b) Connect the external 1 megacycle standard signal to the 1 MC jack J452.

(c) The sinusoidal output signals are available at the SYN OUT jack J453 for connection to external circuits.

(2) FREQUENCY COMPARATOR MODE:

(a) Connect the 115 volt a-c power to the MAIN AC jack J451 pins A and C.

(b) Connect the 1 megacycle frequency standard signal to the 1 MC jack J452.

(c) Connect the TRF signal to the TRF IN jack J454.

(d) Connect the "varicap" or control circuit of the 1 megacycle frequency standard to the DC LOOP OUT jack J455.

(3) AUTOMATIC POWER SWITCHING:

(a) Connect the 115 volt a-c power to the MAIN AC jack J451 pins A and C.

(b) Connect the external 24-volt battery to the BATTERY jack pins A and D (pin A is the positive terminal connection).

(c) Set the BAT. switch to IN.

TABLE 2-1. REAR PANEL CONTROLS AND JACKS

REFERENCE DESIGNATION (Figure 2-2)	PANEL AND COMPONENT DESIGNATION	FUNCTION
13	BATTERY jack J456	Input receptacle for the external 24-volt battery.
12	HV fuse F454	Protects DC to DC converter components from overloads.
11	SYNC ALARM, GND, terminal board E451	Permits connection of an external alarm circuit.
10	BAT. switch S451	Two-position switch. IN position connects external 24-volt battery to LFSA circuits; OUT position disconnects battery from LFSA circuits.
9	100 KC IN jack J481	Input jack for external 100 kilocycle signal.
8	DC LOOP OUT jack J455	Permits connection of d-c error voltage from phase detector module to control circuit of external 1 megacycle frequency standard.
7	TRF IN jack J454	Permits connection of an external TRF signal to phase detector module.
5	1 MC jack J452	Input jack for external 1 megacycle standard signal.
4	B-fuse F453	Protects -12 volt power supply components from overloads.
6	SYN OUT jack J453	Permits connection of synthesizer output signals to external circuits.
3	B+ fuse F452	Protects +12 volt power supply components from overloads.
2	AC fuse F451	Protects power supply components from internal short circuits.
1	MAIN AC jack J451	Input receptacle for 115/230 volt ac power.

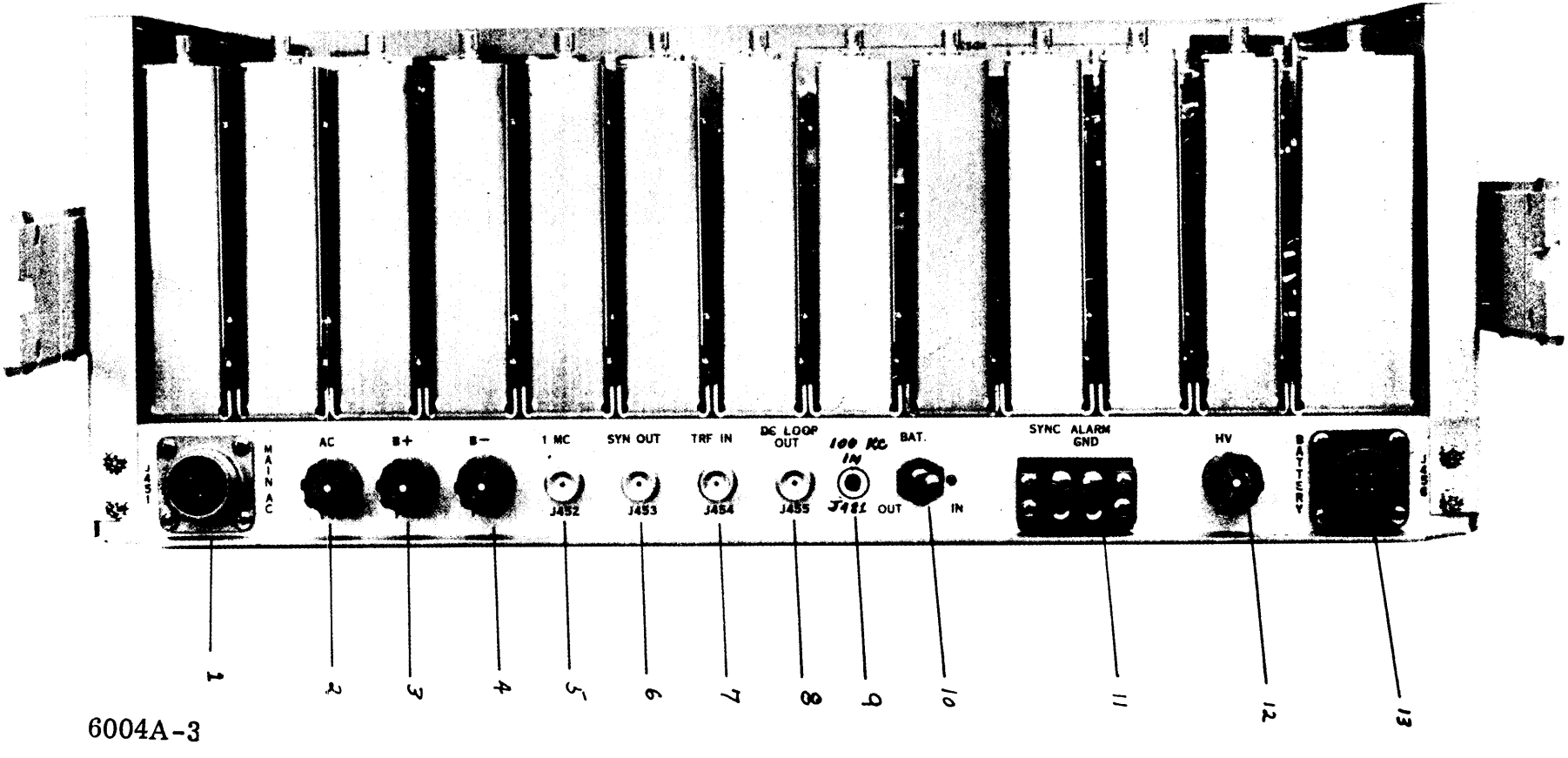

Figure 2-2. LFSA Synthesizer, Rear View

2-4. INITIAL ADJUSTMENTS.

Before any LFSA synthesizer is shipped, it is aligned and thoroughly checked against the manufacturers specifications. Hence, the synthesizer is operable after it is properly installed.

SECTION 3

OPERATOR'S SECTION

3-1. CONTROLS, JACKS, AND INDICATORS.

The controls, jacks, and indicators required for operation of the LFSA synthesizer are illustrated in figure 3-1 and listed in table 3-1.

TABLE 3-1. CONTROLS, JACKS, AND INDICATORS

REFERENCE DESIGNATION (Figure 3-1)	PANEL AND COMPONENT DESIGNATION	FUNCTION
1	Nixie indicators, DS351	Depending upon operational mode, indicates frequency of either the synthesizer output signal or the incoming TRF signal.
2	DS454	Decimal point indicator.
3	10 KC switch S351	Tunes LFSA in 10 kc steps.
4	1 KC switch S351	Tunes LFSA in 1 kc steps.
5	.1 KC switch S351	Tunes LFSA in 100 cycle steps.
6	10 CPS switch S351	Tunes LFSA in 10 cycle steps.
7	1 CPS switch S351	Tunes LFSA in 1 cycle steps.
8	SYNC ALARM lamp DS453	Operates only when LFSA is used in the frequency comparator mode. Lights when the LFSA is not synchronized; goes off when LFSA is synchronized.
9	SYNCHRONIZE Meter M451	Operates only when in the LFSA is in the frequency comparator mode. Indicates phase error between external signals.

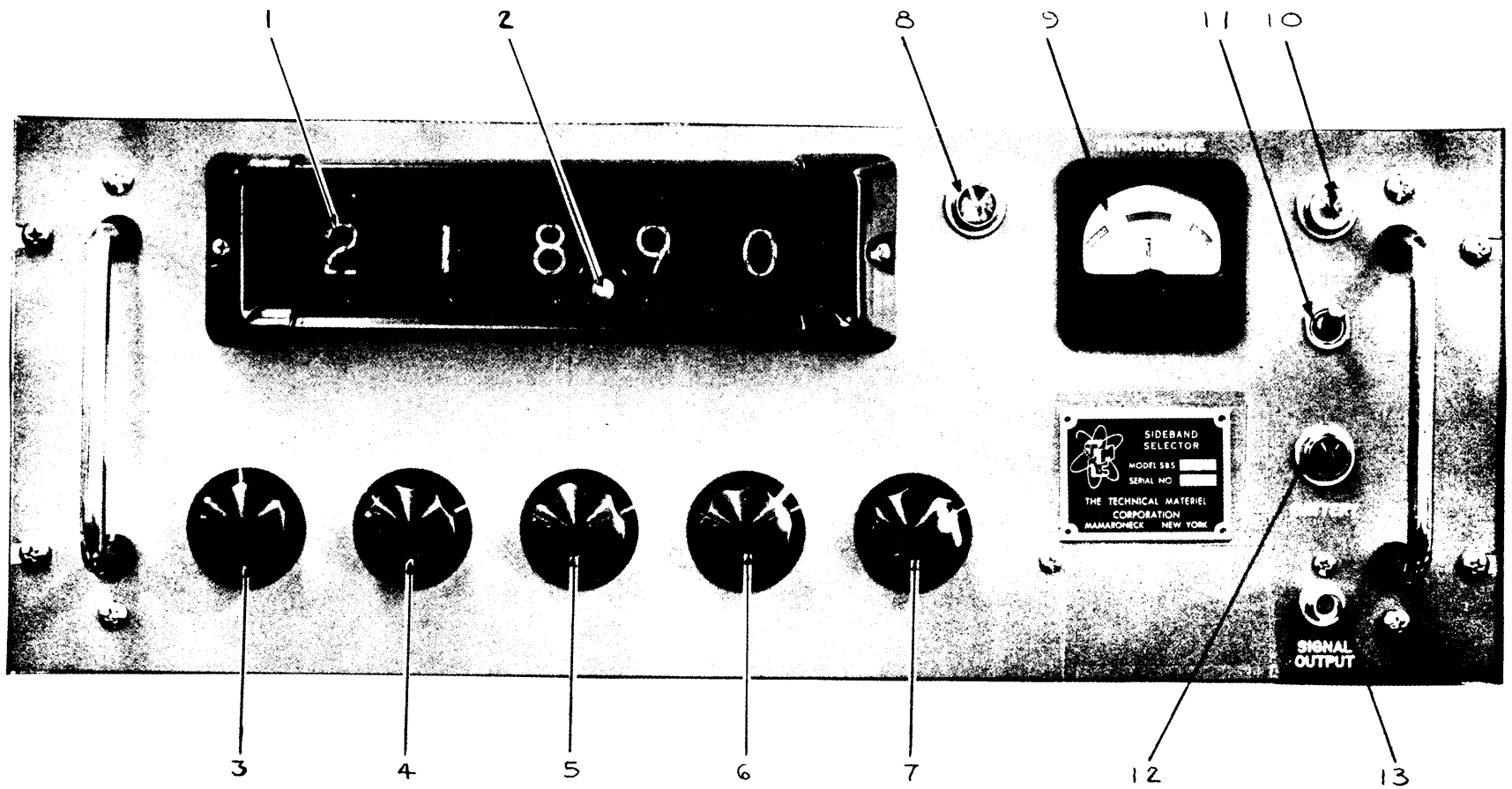

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Figure 3-1. LFSA Synthesizer, Front Panel Controls, Jacks, and Indicators.

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

REFERENCE DESIGNATION (Figure 3-1)	PANEL AND COMPONENT DESIGNATION	FUNCTION
10	POWER lamp DS451	Indicates when ac power is applied to internal power supply circuit.
11	POWER switch S452	Connects ac power to power supply circuit.
12	BATTERY lamp DS452	Indicates when battery power is applied to LFSA circuits.
13	SIGNAL OUTPUT jack J480	Permits monitoring of synthesizer output signal.
*	BAT. switch S451	A two-position (IN and OUT) switch. In IN position connects 24-volt external battery to LFSA-1 circuits; in OUT position disconnects external battery from LFSA-1 circuits.

*located on rear panel

3-2. OPERATING PROCEDURES

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

b. PRELIMINARY CONTROL SETTINGS. - The 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

c. STARTING. - To start the LFSA, set POWER switch S452 at the on position. If an external 24-volt battery is connected to BATTERY jack J456 located on the rear panel, set BAT. switch S451 at IN.

d. SIGNAL GENERATOR OPERATION. - To use the LFSA as a signal generator, rotate the 1 CPS, 10 CPS, .1KC, 1 KC, and 10 KC switches until the desired frequency (within frequency range of 1 cycle to 99.999 kilocycles) is displayed on the nixie indicator.

e. FREQUENCY COMPARATOR OPERATION. - When the LFSA is used as a frequency comparator, it must be synchronized. This is accomplished with the aid of an external frequency standard. To use the LFSA as a frequency comparator, proceed as follows:

(1) Adjust 1 CPS, 10 CPS, .1 KC, and 10 KC switches until frequency of incoming TRF signal is displayed on nixie indicators. If LFSA is synchronized, SYNCHRONIZE meter M451 pointer should swing within maximum limits of yellow or red meter areas; SYNC ALARM lamp should be lit. If LFSA is not synchronized, perform steps (2) through (4) below.

(2) Using a timing device such as a stopwatch, etc., take average reading of time it take pointer of SYNCHRONIZE meter to swing between two maximum limits.

(3) At associated external frequency standard, slowly adjust oscillator until average time it takes pointer of SYNCHRONIZE meter to swing between to maximum limits has increased.

NOTE

The longer (in time) it takes the meter pointer to swing between its maximum limits, the closer the LFSA is to synchronization.

(4) Continue to slowly adjust the external frequency standard until the maximum meter pointer swings are limited to the GREEN meter area. At this point the SYNC ALARM lamp should go off indicating that the LFSA is synchronized.

f. STOPPING. - To stop the LFSA, 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 at OUT.

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

3-3. OPERATOR'S MAINTENANCE.

There are several maintenance operations that can be performed on the LFSA synthesizer by the operator. If normal operating procedures produce unsatisfactory results, the operator should proceed as follows:

a. Check power supply by noting whether POWER lamp is lit (ac operation) or BATTERY lamp is lit (battery operation). This normally indicates whether or not power is being delivered to the LFSA.

CAUTION

When performing step b below, never replace a fuse with one of a higher rating. If a fuse burns out immediately after replacement, do not replace it a second time until the fault has been corrected.

b. If no power is evident, check fuses located on rear panel. Replace blown fuses as required.

c. Ensure that modules are properly positioned in respect to their compatible receptacles. Improper positioning of a module can prevent normal synthesizer operation.

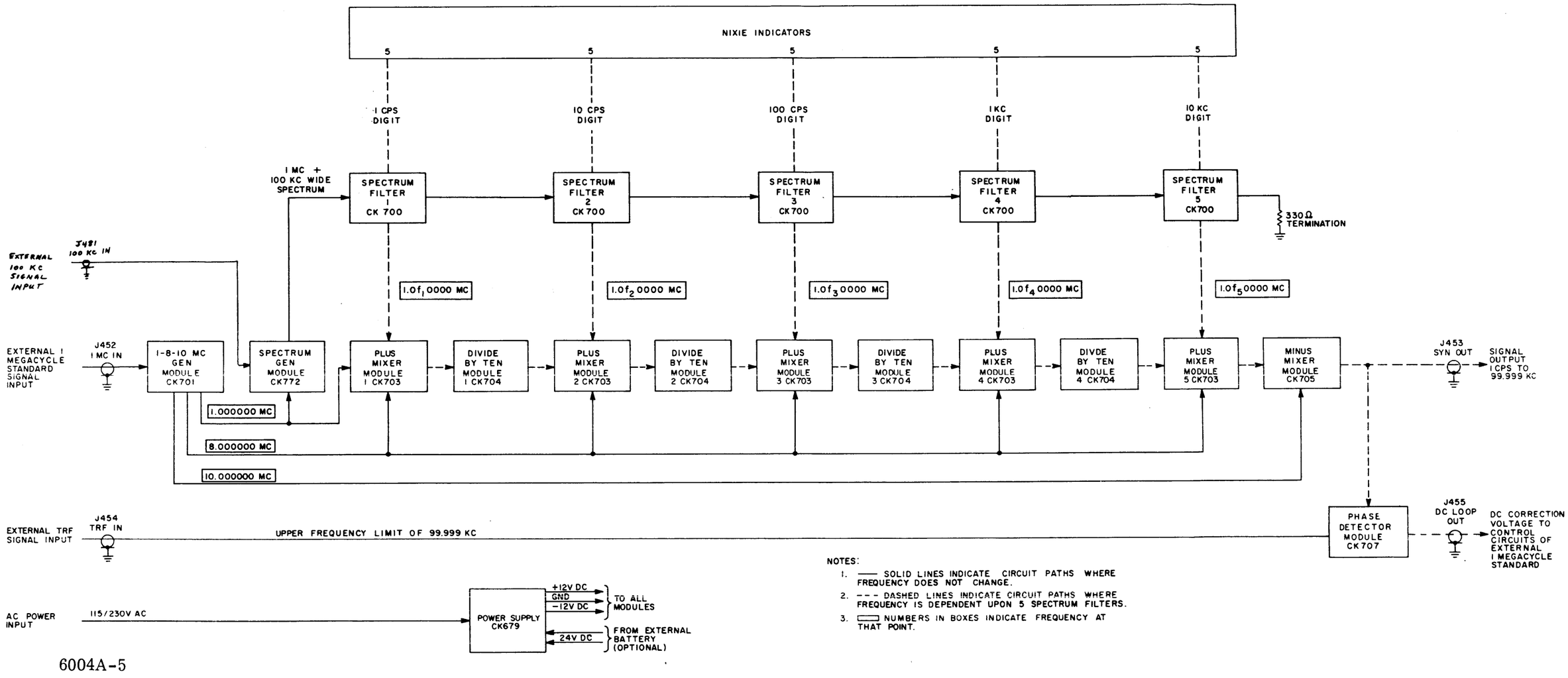
SECTION 4

PRINCIPLES OF OPERATION

4-1. OVERALL FUNCTIONAL DESCRIPTION. - Refer to figure 4-1. The LFSA is designed to function either as a synthesizer or as a signal generator. When used as a synthesizer, the LFSA is tuned to the same frequency as that of an incoming TRF signal; this frequency is displayed on front-panel nixie indicators. The LFSA processes a 1-mc signal and a 100 kc signal from an exteranl frequency standard to produce a signal within the frequency range of 1 cps to 99.999 kc. This signal is compared with the nominally identical, incoming TRF signal; a resultant d-c correction signal is applied to the control circuits of the external frequency standard, and serves to maintain the stability of the frequency standard equal to that of the incoming TRF signal.

When used as a signal generator, the LFSA utilizes one megacycle and 100 kilocycle signals from an external standard to produce output signals within the frequency range of one cycle per second to 99.999 kilocycles. The stability of the output signals are equal to the stability of the input signals from the external standard; the output signal frequency is displayed on front-panel nixie indicators.

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



NOTES:

1. —— SOLID LINES INDICATE CIRCUIT PATHS WHERE FREQUENCY DOES NOT CHANGE.
2. – – – DASHED LINES INDICATE CIRCUIT PATHS WHERE FREQUENCY IS DEPENDENT UPON 5 SPECTRUM FILTERS.
3. ▭ NUMBERS IN BOXES INDICATE FREQUENCY AT THAT POINT.

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Figure 4-1 LFSA Synthesizer, Functional Block Diagram

4-2. DETAILED BLOCK DIAGRAM DESCRIPTION.

a. 1-8-10 MEGACYCLE GENERATOR MODULE. - Refer to figure 4-2. The 1-8-10 megacycle generator module utilizes a one megacycle signal applied to its input terminals to produce 1, 8, and 10 megacycle signals at its output terminals.

The 1 megacycle signal appearing at the 1 MC IN jack is amplified by Q404 and then applied simultaneously to amplifiers Q401, Q403, and Q405. Amplifier Q403 further amplifies the 1 megacycle signal and applies it to the spectrum generator and to the first plus-mixer module.

Q401 amplifies the 1 megacycle signal received from amplifier Q404 and routes the output signal to a harmonic generator circuit. The harmonic generator circuit distorts the 1 megacycle signal to provide a large number of 1 megacycle harmonics. The harmonic generator output is applied to a crystal filter which is tuned to pass only the frequency of 8 megacycles to amplifier Q402. The amplified 8 megacycle signal output of Q402 is applied to the five plus mixer modules.

The 10 megacycle signal is produced in a manner similar to the 8 megacycle signal; therefore it need not be discussed. The 10 megacycle output signal is applied to the minus mixer module.

b. SPECTRUM GENERATOR MODULE. - Refer to figure 4-3. This module utilizes a one megacycle signal from the 1-8-10 megacycle generator module and an external 100 kilocycle signal to produce a one megacycle signal with a 100 kilocycle wide spectrum.

The 100 kilocycle signal is applied to limiter Q505 and Q506. The limiter serves to clip the positive and negative peaks of the signal. The limiter square-wave output signal is differentiated and applied to amplifier Q507. The amplifier output

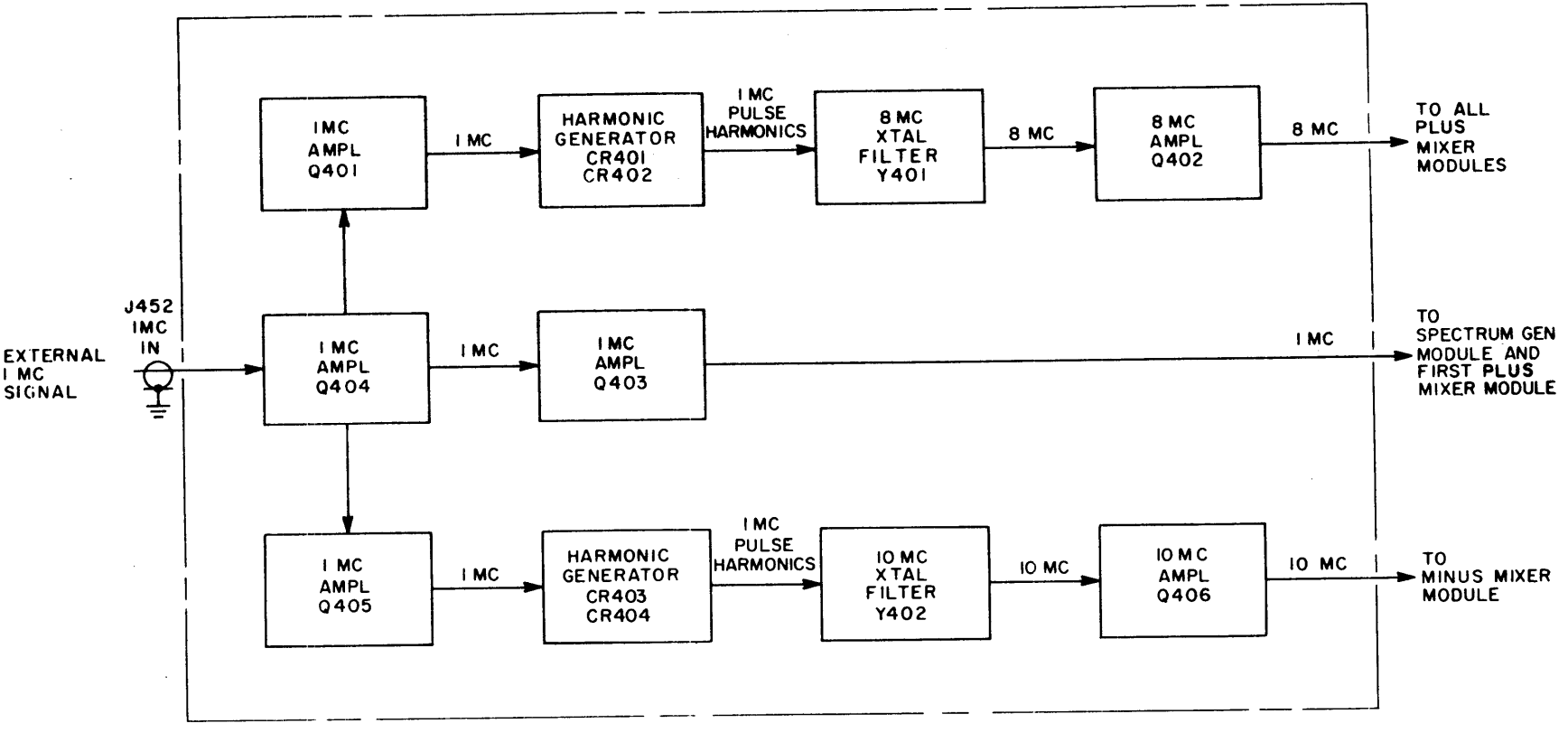

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Figure 4-2. 1-8-10 Megacycle Generator Module, Functional Block Diagram

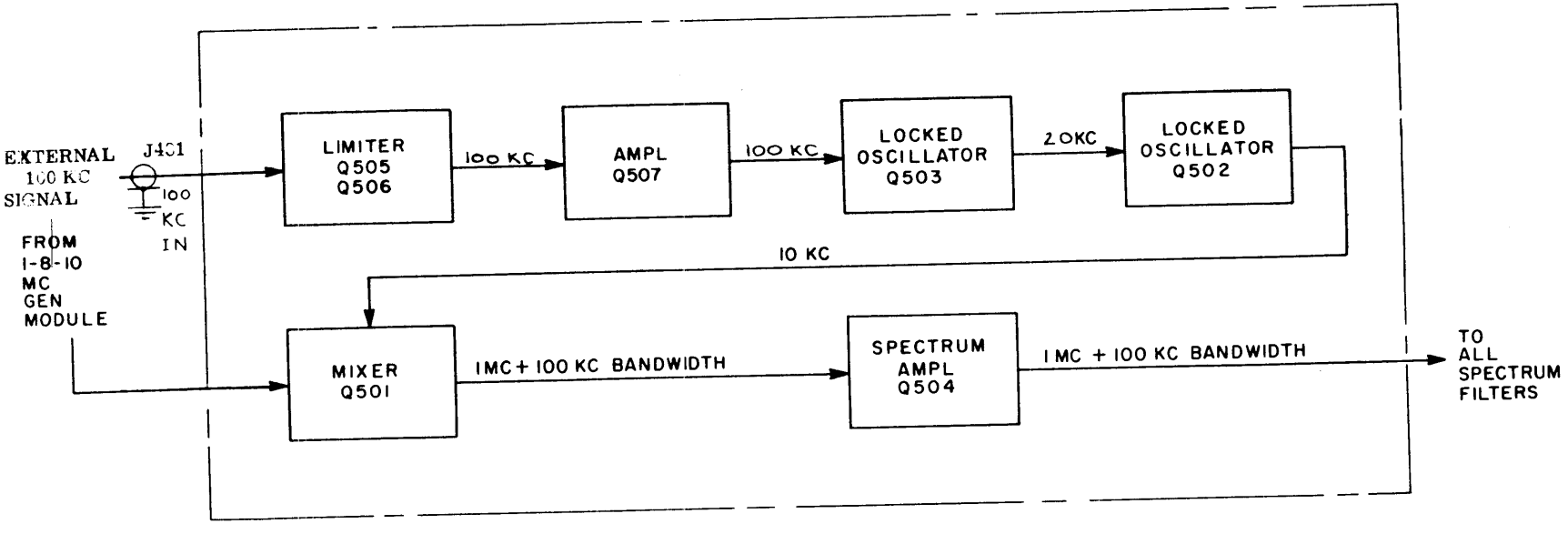

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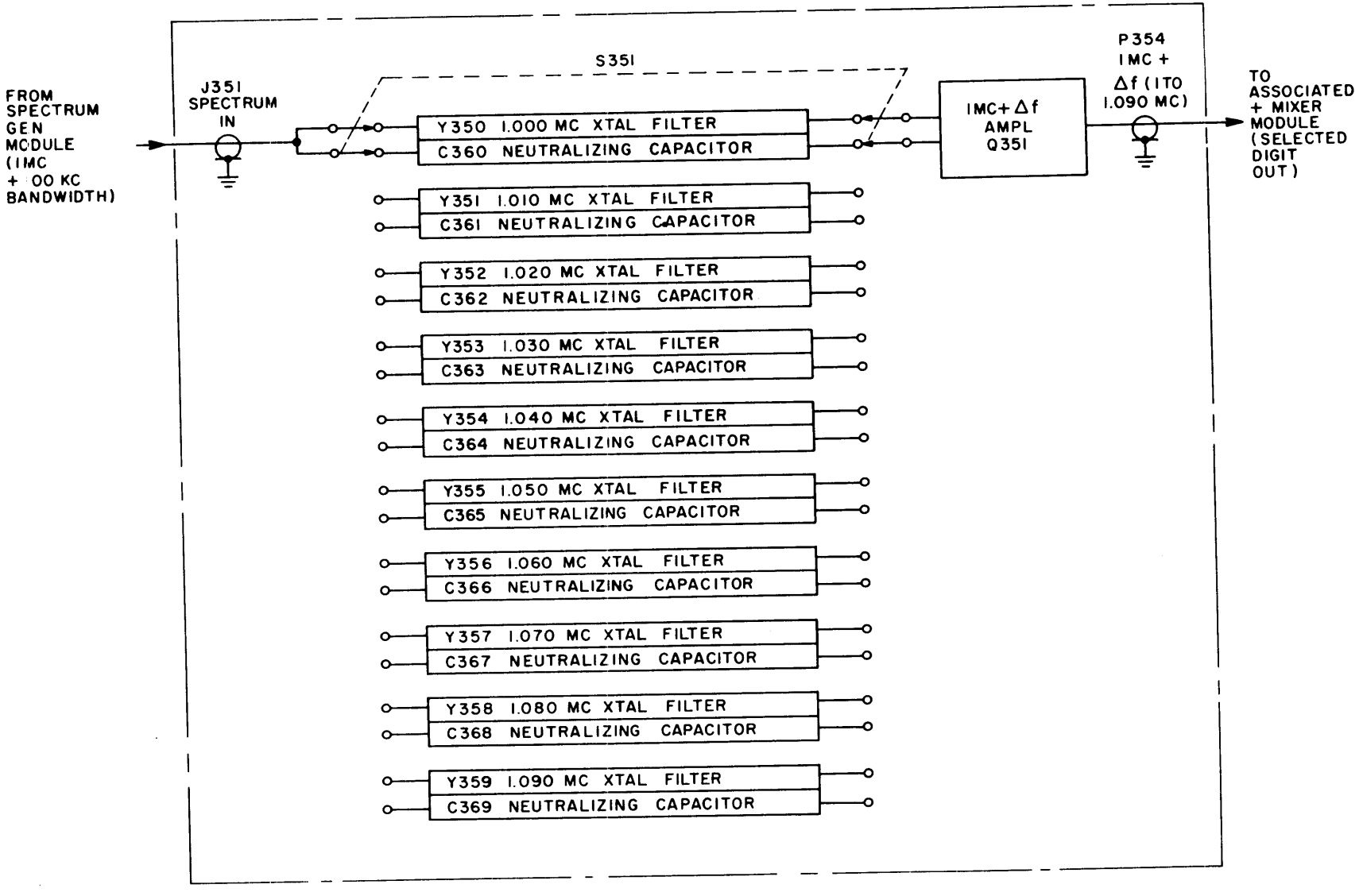
Figure 4-3. Spectrum Generator Module, Functional Block Diagram

signal is a positive-going pulse that is used to synchronize oscillator Q503 to a frequency of 20 kilocycles. The resultant 20 kilocycle signal output synchronizes oscillator Q502 to a frequency of 10 kilocycles. The output 10 kilocycle signal, rich in even harmonics, is routed to mixer Q501 together with the 1 megacycle signal. The mixer output signal, a 1 megacycle signal with an overall bandwidth of 100 kilocycles, is amplified by Q504 and applied to the fice spectrum filter assemblies.

(c) SPECTRUM FILTER ASSEMBLIES. - Figure 4-4 is a functional block diagram of a typical spectrum filter assembly. There are five identical spectrum filter assemblies in the LFSA synthesizer. Each assembly receives the 1 megacycle signal with a 100 kilocycle bandwidth from the spectrum generator module. Each assembly is equipped with 10 crystals (Y350 through Y359) and neutralizing capacitors C360 through C369. These capacitors are used to tune the crystals in 10 kilocycle increments between the frequencies of 1 and 1.090 megacycles. Switch S351 selects the desired crystal and also the nixie indicator numeral corresponding to the selected crystal frequency to be displayed. The selected signal is amplified by Q351 and applied to its associated plus mixer module.



6004A-8

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

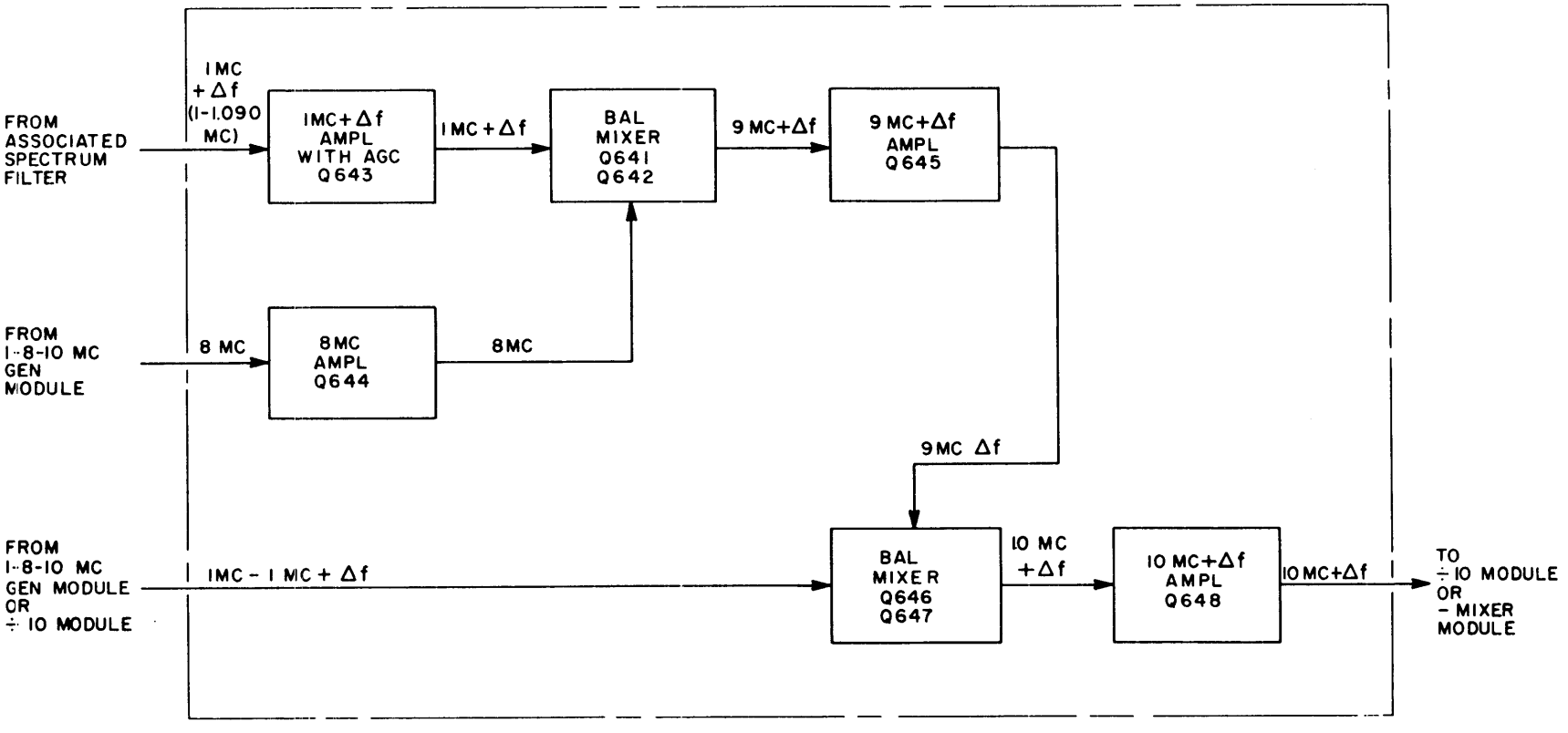
NOTE

For a better understanding of the LFSA synthesizer circuits, refer to the frequency scheme given in figure 4-5. This frequency scheme gives the frequencies applied to each module when the spectrum filter assemblies are tuned to deliver an output signal of 1.050 megacycles. This results in a final synthesizer signal of 55.555 kilocycles which should be displayed on the nixie indicator as illustrated in figure 4-1.

d. PLUS MIXER MODULES. - 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 exist 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 associated Spectrum Filter Assemblies 2 through 5, respectively; an 8 megacycle signal from the 1-8-10 megacycle generator module; and a 1 Mc $+\Delta$ f signal from an associated divide by ten module. Plus mixer module 1 receivs a 1 Mc $+\Delta$ f signal from spectrum filter assembly 1; and both 1 and 8 megacycle signals from the 1-8-10 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 passes their sum signals to associated divide by ten modules 1 through 4, respectively. Plus mixer module 5 passes its sum signal to the minus mixer module.

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	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)
Minus Mixer		10.055,555 10.000,000 .055,555 (output)
Final Output to Phase Detector		.055,555
TRF Input to Phase Detector		.055,555

Figure 4-5. LFSA Synthesizer, Typical Frequency Scheme



6004A-9

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

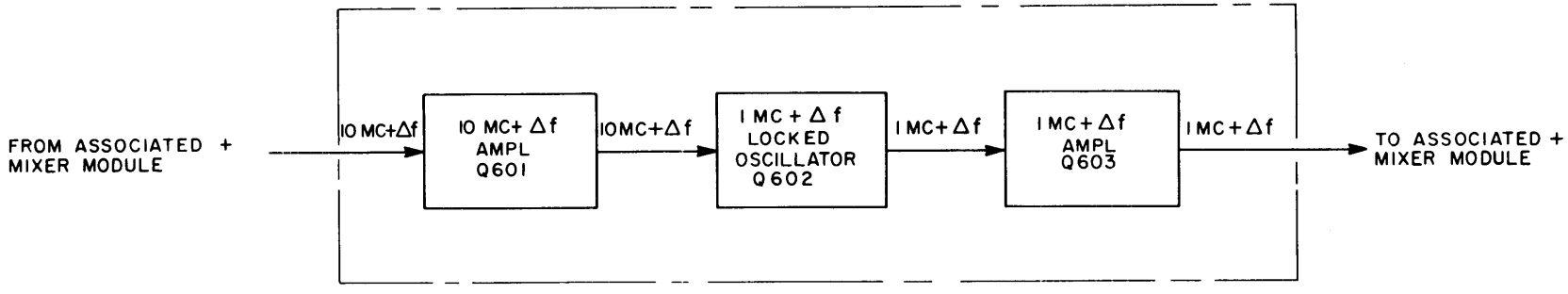
NOTE

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.

Balanced Mixer Q641 and Q642 receive a 1 Mc +Δf signal from its associated spectrum filter through amplifier Q643, and a 8 megacycle signal from the 1-8-10 megacycle generator module through amplifier Q644. AGC is employed by amplifier Q643 to ensure reasonably constant signal amplitude regardless of frequency changes. The mixer output signal produces sum and difference frequencies; however, only the sum frequency of 9 Mc +Δf is passed and amplified by amplifier Q645.

Balanced mixer Q646 and Q647 in plus mixer module 1 receives the amplified 9 Mc + Δf signal from amplifier Q645 and a 1 megacycle signal from the 1-8-10 Megacycle Generator Module. The balanced mixer in Plus Mixer Modules 2 through 5 receive the amplified 9 Mc + Δ f signal from amplifier Q645 and a 1 Mc + Δ f signal from associated divide by ten modules 2 through 5, respectively. The balanced mixer, in all cases, produces the original, sum, and difference frequencies at its output terminals; however, only the sum frequency of 10 Mc +Δf is passed and amplified by amplifier Q648.

e. DIVIDE BY TEN MODULES. - 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 LFSA synthesizer. Each divide by ten module receives 10 Mc+Δf signals from an associated plus mixer module



6004A-10

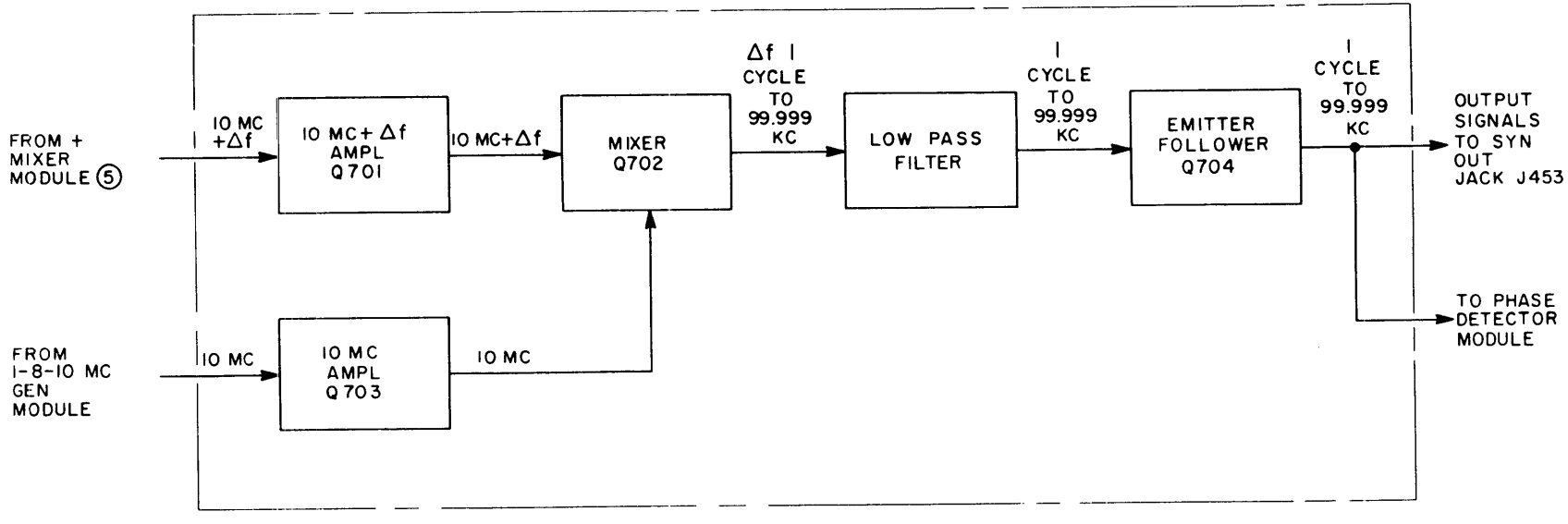
Figure 4-7. Divide By Ten Module, Functional Block Diagram

The 10 Mc +Δf signal is amplified by amplifier Q601 and applied to oscillator Q602. This oscillator is locked to the frequency of the 10 Mc +Δf signal and produces an output signal 1 Mc +Δf that is a division of the input signal by a factor of ten. The 1 Mc +Δf signal is amplified and applied to an associated plus mixer module.

f. MINUS MIXER MODULE. - Figure 4-8 is a functional block diagram of the minus mixer module. This moudule utilizes a 10 Mc +Δf signal applied from plus mixer module 5 and a 10 megacycle signal from the 1-8-10 megacycle generator module to produce an output signal in the range of 1 cycle to 99.999 kilocycles.

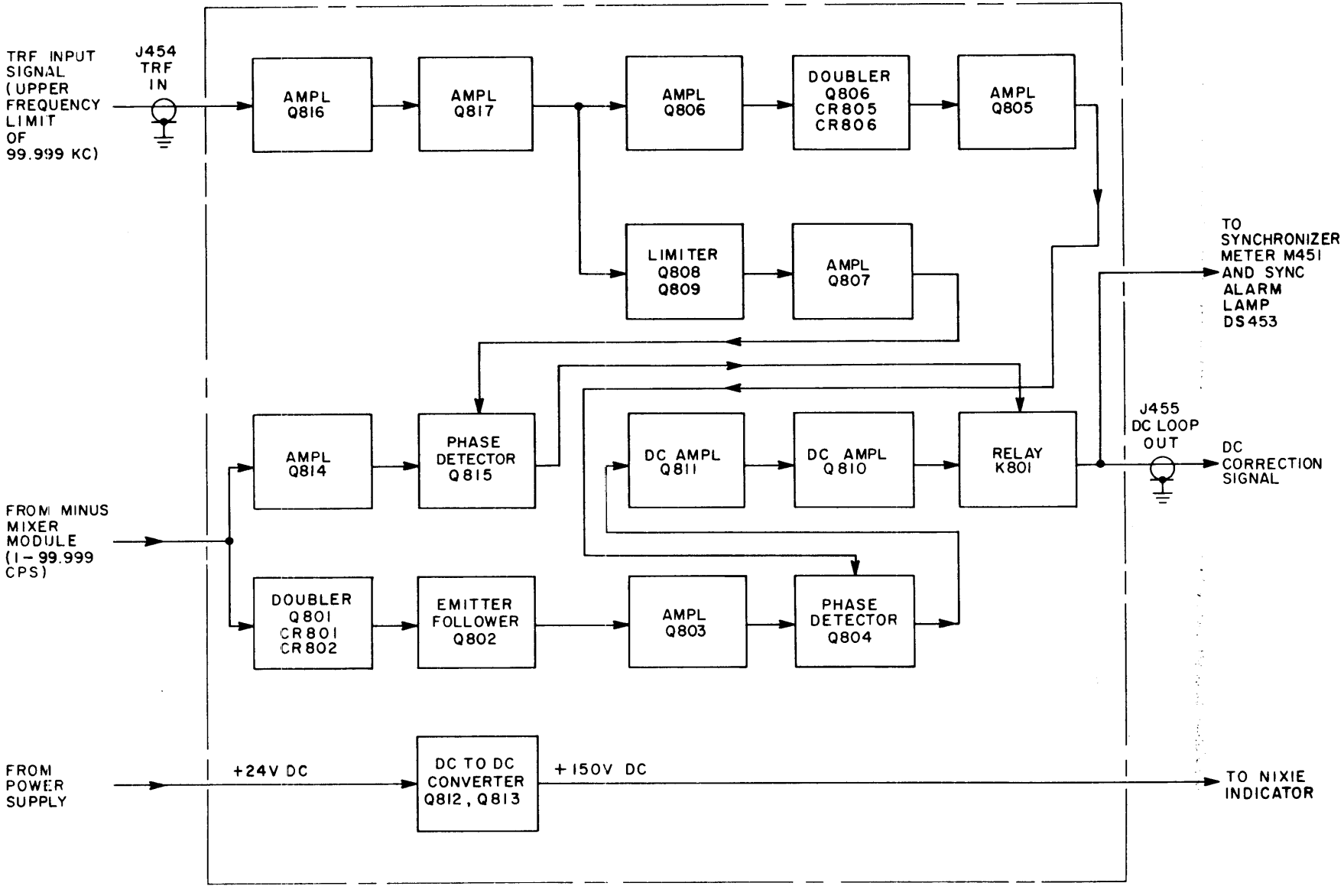
The mixer Q702 receives an amplified 10 Mc +Δf signal from amplifier Q701 and a 10 megacycle signal from amplifier Q703. The mixer produces the original, sum, and the difference frequencies of 1 cycle to 99.999 kilocycles to the emitter follower Q704. The emitter follower provides a low impedance output signal that is available at the SYN OUT jack J453. This output signal is also applied to the phase detector module.

g. PHASE DETECTOR MODULE. - Figure 4-9 is a functional block diagram of the phase detector module. This module contains the dc-to-dc converter circuit and the phase detector circuts The phase detector circuits function only when they receive both a synthesizer signal from the minus mixer module and a TRF signal from the TRF IN jack J454. The two signals should be identical and within the frequency range of 1 cycle to 99.999 kilocycles. The phase detector module compares



6004A-11

Figure 4-8. Minus Mixer Module, Functional Block Diagram



6004A-12

Figure 4-9. Phase Detector Module, Functional Block Diagram

the phase of the two signals and produces a d-c voltage that corrects the error of the 1 megacycle frequency standard. The amplitude and polarity of the d-c correction signal is determined by the phase difference between the synthesizer signal and the TRF signal.

The TRF signal appearing at the TRF IN jack J454 is amplified by amplifiers Q816 and Q817. The amplified signal is applied to amplifier Q806 and to limiter Q808 and Q809. Amplifier Q806 further amplifies the TRF signal; the output signal is applied to a doubler stage consisting of transistor Q806 and diodes CR805 and CR806. The doubler stage produces positive-going pulses that are twice the frequency of the incoming TRF signal. These pulses are amplified and inverted by amplifier Q805; the resultant negative-going pulses are applied to phase detector Q804.

Limiter Q808 and Q809 serve to clip the positive and negative peaks of the TRF signal; the clipped output signal is applied to phase detector Q815 through amplifier Q807.

The output signal from the minus mixer module is applied to amplifier Q814 and to a doubler circuit consisting of Q801 and diodes CR801 and CR802. Amplifier Q814 serves to increase the level of the signal applied to phase detector Q804.

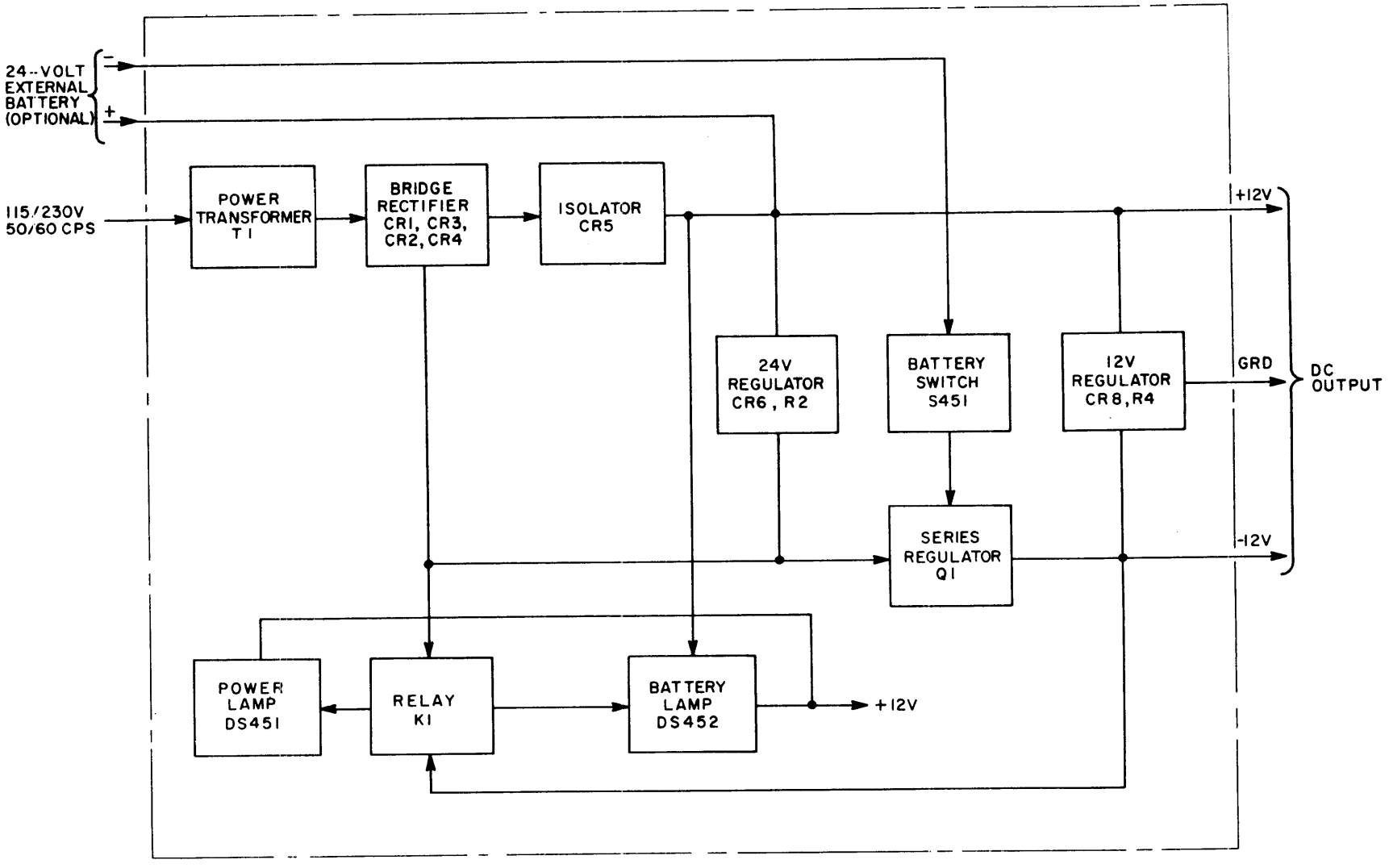
The doubler circuit produces positive-going pulses that are twice the frequency of the incoming signal. These positive-going pulses are passed through emitter follower Q802 in their original state to amplifier Q803. Here, they are amplified and inverted; the resultant negative-going pulses are applied to phase detector Q804.

Phase detector Q815 receives TRF and synthesizer signals. These signals should be identical; however, the synthesizer signal contains the error of the 1 megacycle standard input signal. A phase-shift network shifts the phase of one signal relative to the other by 90 degrees. Therefore, when the phase difference between the two signals is plus or minus 90 degrees, the average d-c voltage produced is zero. When the phase of the synthesizer signal drifts by an extremely small amount from 90 degrees, the phase detector produces a d-c voltage to correct the drift. Although the phase difference between the two signals is continuously changing by small increments, the average frequency of the corrected 1 megacycle input signal is maintained constant. The d-c correction voltage is applied to the control circuits of the 1 megacycle input signal via the contacts of relay K801 and DC LOOP OUT jack J455. The d-c correction voltage is also applied to the front panel SYNCHRONIZE meter M451 which indicates phase error. In this manner, the stability of the frequency standard is maintained equal to that of the TRF signal.

Phase detector Q804 utilizes identical TRF and synthesizer negative-going pulses to produce a dc voltage whose negative level is dependent upon the error between the two signals. When the phase error is extremely small, the d-c voltage produced is negligible; however, when the phase error is large, the d-c voltage is high. This voltage is amplified by d-c amplifier Q810 and Q811 which results in operating relay K801. When relay K801 is operated, the front panel SYNC ALARM lamp DS453 turns on indicating that the 1 megacycle frequency standard has drifted beyond tolerance. Simultaneously the dc loop which passes the d-c correction voltage to the control circuits of the 1 megacycle oscillator is opened.

The DC to DC converter consisting of Q812 and Q813 operates with an input voltage of 24 volts dc and provides an output voltage of approximately +200 volts dc. This output voltage is applied to the nixie indicator and is used to illuminate the 1 inch numerals and the decimal point indicator DS454.

h. POWER SUPPLY. - Figure 4-10 is a functional block diagram of the power supply. 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, 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 at 24 volts dc. Zener diode CR8 and resistor R4 regulates the positive output voltage to 12 volts dc.



6004A-13

Figure 4-10. Power Supply, Functional Block Diagram

Series regulator Q1, which is in series with the negative supply voltage, regulates the negative output voltage to 12 volts dc.

In the event of ac power failure, provisions are made for automatic switch-over to battery power. The positive leg of a 24-volt external battery is directly connected to the positive 12 volt output terminal. The negative leg is connected to the negative 12 volt output terminal via the 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.

4-3. TROUBLESHOOTING.

a. GENERAL. - Since the LFSA synthesizer is comprised principally of modules, troubleshooting consists of sectionalizing the malfunction to a particular module. Once a module 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 DATA. - The following aids for troubleshooting are provided:

(1) Functional block diagrams (figures 4-1 through 4-4 and 4-6 through 4-10).

(2) A typical frequency scheme (figure 4-5).

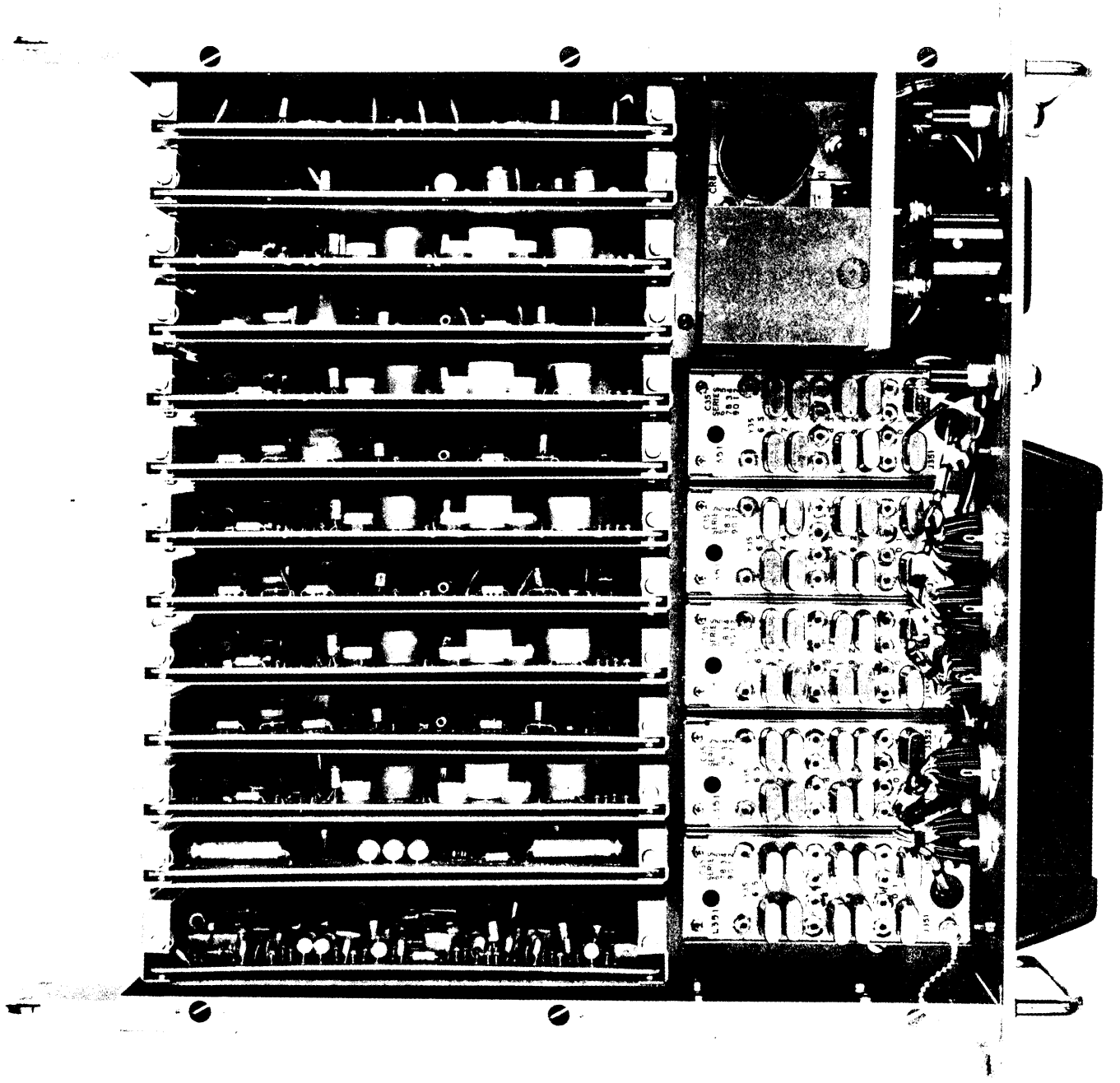
(3) Top and bottom chassis views locating unit components (figures 4-11 and 4-12).

(4) Schematic diagrams (figures 7-1 through 7-9).

c. 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 third short cut is to examine the equipment, module by module, 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.



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6004A-14

Figure 4-11. LFSA Synthesizer, Parts Location, Top View

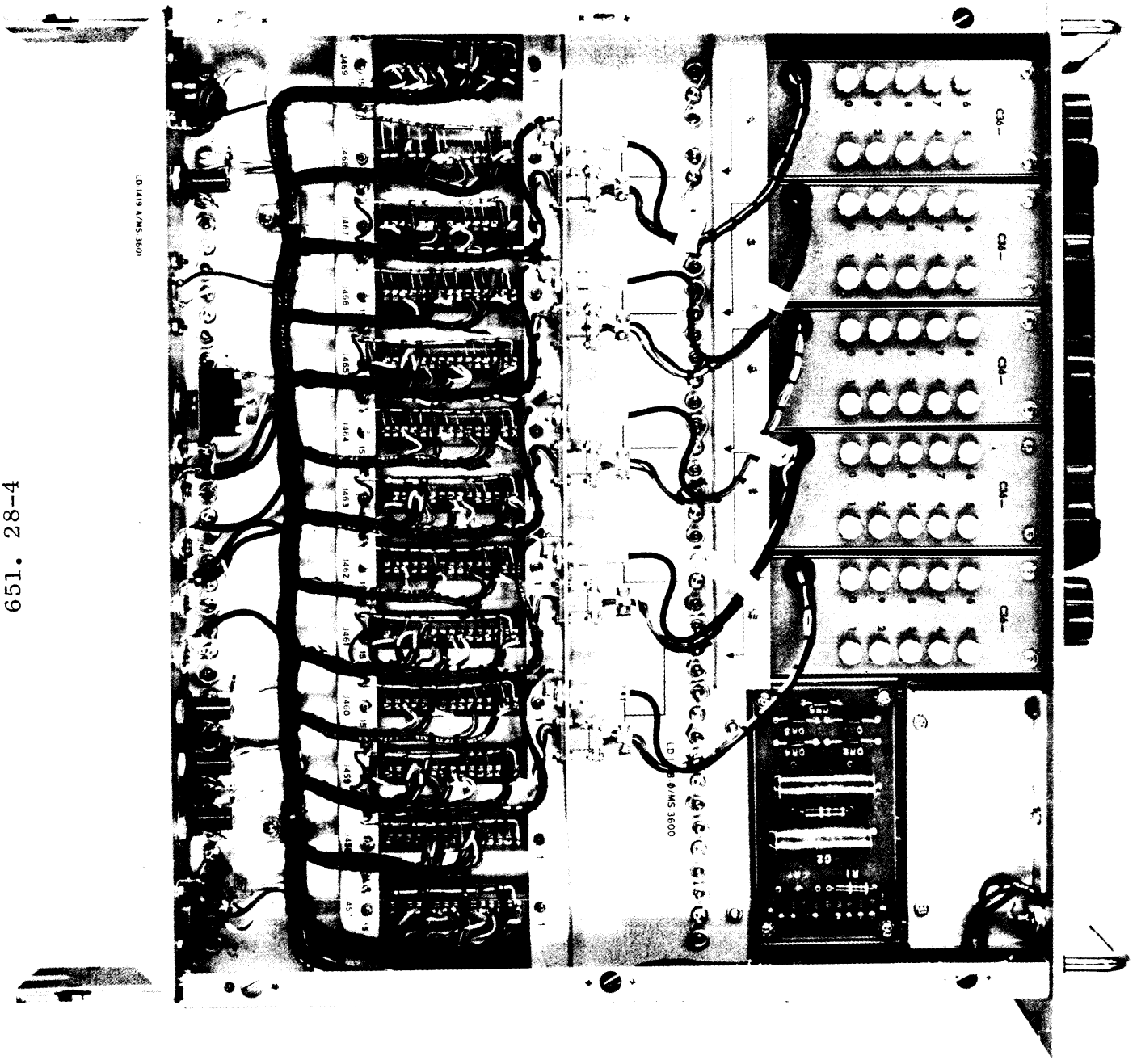


Figure 4-12. LFSA Sythesizer, Parts Location, Bottom View

SECTION 5

MAINTENANCE

5-1. PREVENTIVE MAINTENANCE

a. GENERAL. - The LFSA 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, tube failure, 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. Trichlorethylene or methyl chloroform may be used, providing the necessary precautions are observed.

NOTE

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 procedure 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 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.

To check out 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 tests, using

needle point probes. Insert one point into the conducting strip, close to the end of terminal, and place the other probe on the terminal or opposite end of the conducting strip. The multimeter should indicate continuity. If the multimeter indicates an open circuit, drag the probe along the strip (or 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.

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.

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 length 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 throughly, 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 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 a stiff brush. If this does not remove it, 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.

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: 5 sections, 10 positions, 36° angle of throw; 5 non-shorting and 5 silver alloy type contacts; rated at 2 amps 28 VDC or 1 amp 110 VAC.	SW342

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XDS351	SOCKET, ELECTRON TUBE: 13 pin contact.	TS157
XY350A, B	JACK, TIP: nominal voltage 1,250 V RMS at 60 cps; 0.4 uuf; with white teflon body.	JJ219-1-9
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	NOTE 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.	CA480-68-2.625
W452	Same as W451. Consists of two connectors, P351-3, P452-2.	
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 LFSA-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 amps; miniature bayonet base T-3-1/4 bulb.	BI101-1819
DS452	Same as DS451.	
DS453	Same as DS451.	
DS454	LAMP, GLOW: 110/125 volts AC or DC; nominal current rating 0.6 ma; 1/15 watt; midget flange base T-2 bulb.	BI111-1
E451	TERMINAL BOARD, BARRIER: 2 terminals; solderlug type; phenolic black bakelite.	TM100-2
E452	TERMINAL BOARD, FANNING: 10 terminals; angle type.	TM105-10
F451	FUSE, CARTRIDGE: 1 amp; time lag; 1-1/4" long x 1/4" dia.; slow blow.	FU-102-1
F452	Same as F451.	
F453	Same as F451.	
F454	FUSE, CARTRIDGE: 1/8 amp; time delay; 1-1/4" long x 1/4" dia.; slow blow.	FU102-.125
J451	CONNECTOR, RECEPTACLE, ELECTRICAL: 3 number 16 male contacts; straight type.	MS3102A14S-1P
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.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J455	Same as J452.	
J456	CONNECTOR, RECEPTACLE, ELECTRICAL: 4 number 16 male contacts; straight type.	MS3102A14S-2P
J457	CONNECTOR, RECEPTACLE, ELECTRICAL: 15 female, flat solid face contacts; for single sided 3/32" PC boards; continuous current rating 5 amps; 1800 V RMS; float bushing; 3.20" lg. x 0.440"w x 0.75" h dim. o/a.	JJ293-15S
J458 thru J469	Same as J457.	
J470	CONNECTOR, RECEPTACLE, ELECTRICAL: miniature female; 5 male round pin type contacts, rated at 3 amps, 375 V RMS; polarized; snap-on locking type.	JJ308-1
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	Same as J452.	
M451	METER, INDICATING: 25 - 0 - 25 ua movement; approximate resistance 2,000 ohms; black rectangular case.	MR180

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P352-5	CONNECTOR, PLUG, ELECTRICAL: RF; 1 round female coaxial contact; straight type; miniature bayonet lock series.	PL204
S451	SWITCH, TOGGLE: DPST; 2 amps rated at 250 volts; bat type handle.	ST22K
S452	SWITCH, TOGGLE: DPDT; 6 amps rated at 250 volts AC; 28° angle of throw; solder lug terminals, (one pole unused).	ST22N
XDS451	LIGHT, INDICATOR: with green frosted lens; for miniature bayonet 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	Same as XDS452.	
XDS454	LAMPHOLDER: sub-miniature; accommodates midget flange base, T-2 bulb.	TS159
XF451	FUSEHOLDER: extractor post type; accomodates cartridge fuse 1/4" dia. x 1-1/4" long; 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	Same as C401.	
C426	Same as C415.	
C427	Same as C410.	
C428	Same as C415.	
C429	Same as C410.	
C430	Same as C410.	
C431	Same as C401.	
C432	Same as C401.	
C433	Same as C403.	
C434	Same as C410.	
C435	Same as C401.	
C436	Same as C405.	
C437	Same as C404.	
C438	Same as C403	
C439	CAPACITOR, FIXED, MICA DIELECTRIC: 24 uuf, ±5%; 500 WVDC; char. B.	CM15B240J
C440	Same as C401.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C441	Same as C413.	
C442	CAPACITOR, FIXED, MICA DIELECTRIC: 320 uuf, ±3%; 500 WVDC; straight wire leads.	CM111E321H 5S
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.	
CR403	Same as CR401.	
CR404	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.	
L404	Same as L401.	
Q401	TRANSISTOR: germanium: PNP; JEDEC type 2N1637 with a controled hfe limit of 85-105 at 1 KC; TO9 case.	TX105
Q402 thru Q406	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	RESISTOR, FIXED, COMPOSITION: 3,900 ohms, ±10%; 1/2 watt.	RC20GF392K
R418	Same as R402.	
R419	Same as R403.	
R420	Same as R402.	
R421	Same as R403.	
R422	Same as R402.	
R422	Same as R402.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R123	Same as R103.	
R124	Same as R402.	
R125	Same as R401.	
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.	TX169
T404	Same as T401.	
T405	Same as T402.	
T406	Same as T403.	
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
XY402	Same as XY401.	
Y401	CRYSTAL, QUARTZ: operating frequency 8.000000 Mc; bandwidth suppression ±100 Kc; resistance 400 ohms or less; operating temperature range 0^{o} to 55^{o}C; HC-6/U holder.	CR113-14
Y402	CRYSTAL, QUARTZ: operating frequency 10.000000 Mc; bandwidth suppression ±100 Kc; resistance 400 ohms or less; operating temperature range 0^{o} to 55^{o}C; HC-6/U holder.	CR113-15

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	CAPACITOR, FIXED, MICA DIELECTRIC: 150 uuf, ±5%; 500 WVDC; char. B.	CM15B151J
*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: 15 uuf, ±5%; 500 WVDC; char. B.	CM15B150J
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, ±10%; 1/2 watt.	RC20GF680K
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	kESISTOR, FIXED, COMPOSITION: 39,000 ohms ±5%; 1/2 watt.	RC20GF393J
R144	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	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±5%; 1/2 watt.	RC20GF222J
R529	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J
R530	Same as R528.	
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 R528.	
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.	

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.	CM111E102H1 S
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.	CM111E101 G5S
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.	CM111E201H 5S

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.	
1606	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**

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.	EM111E321H 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	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±2%; 500 WVDC; straight wire leads.	CM111E101 G5S
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
R366	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; inductance 2.5 uh; staked lug type terminals; potted yellow case.	TZ170
T645	TRANSFORMER1 RADIO FREQUENCY: fixed; primary nom. inductance 2.8 uy; staked lug type terminals; potted orange case.	TZ166
T646	TRANSFORMER, RADIO FRQQUENCY: fixed; prinom. 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.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C701	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +60% -40%; 150 WVDC.	CC100-35
C702	CAPACITOR, FIXED, MICA DIELECTRIC: 510 uuf, ±5%; 500 WVDC; char. B.	CM15B511J
C703	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1,000 uuf; GMV; 500 WVDC.	CC100-29
C704	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
C705	Same as C701.	
C706	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±2%; 500 WVDC; straight wire leads.	CM111E101 G5S
C707	Same as C701.	
C708	Same as C701.	
C709	Same as C701.	
C710	CAPACITOR, FIXED, ELECTROLYTIC: 200 uuf, -10% +150% at 120 cps, at 25°C; 15 WVDC; polarized; insulated tubular case.	CE105-200-15
C711	Same as C710.	
C712	Same as C701.	
C713	Same as C710.	
C714	Same as C701.	
C715	Same as C701.	
C716	Same as C701.	
C717	Same as C704.	
C718	Same as C710.	
C719	Same as C701.	
C720	Same as C706.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C721	Same as C701.	
C722	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±5%; 500 WVDC; char. B.	CM15B101J
C723	Same as C701.	
C724	Same as C701.	
C725	Same as C701.	
C726	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±3%; 300 WVDC; straight wire leads.	CM112E102 H3S
C727	Same as C710.	
C728	Same as C726.	
C729	Same as C701.	
C730	CAPACITOR, FIXED, ELECTROLYTIC: 50 uuf, -10% +150% at 120 cps, at 25°C; 15 WVDC; polarized; insulated tubular case.	CE105-50-15
C731	Same as C710.	
C732	Same as C701.	
C733	Same as C710.	
C734	Same as C710.	
C735	Same as C701.	
C736	Same as C710.	
C737	Same as C701.	
L701	COIL, RADIO FREQUENCY: fixed; 100 uf, ±5%; 2.6 ohms DC resistance; current rating 345 ma; molded case.	CL275-101

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L702	Same as L701.	
L703	COIL, RADIO FREQUENCY: fixed; 47,000 uh, ±5%; 452 ohms DC resistance; current rating 27 ma; molded case.	CL275-473
L704	Same as L703.	
L705	Same as L703.	
L706	Same as L703.	
L707	Same as L703.	
L708	COIL, RADIO FREQUENCY: fixed; inductance 2.5 uh, ±5%; resistance 8.3 ohms, ±20%; current rating 200 ma; Q-115, ferrite core.	CL226-1
L709	Same as L703.	
Q701	**TRANSISTOR: germanium: PNP; JEDEC type 2N1637 with a controled hfe limit of 85-105 at 1 KC; TO9 case.**	**TX105**
Q702	Same as Q701.	
Q703	Same as Q701.	
Q704	Same as Q701.	
R701	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF102J
R702	RESISTOR, FIXED, COMPOSITION: 390 ohms, ±10%; 1/2 watt.	RC20GF391K
R703	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF101J
R704	RESISTOR, FIXED, COMPOSITION: 3,300 ohms: ±10%; 1/2 watt.	RC20GF332K

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R705	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, ±10%; 1/2 watt.	RC20GF273K
R706	RESISTOR, FIXED, COMPOSITION: 15,000 ohms, ±10%; 1/2 watt.	RC20GF153K
R707	RESISTOR, FIXED, COMPOSITION: 6,800 ohms, ±5%; 1/2 watt.	RC20GF682J
R708	Same as R701.	
R709	Same as R701.	
R710	Same as R704.	
R711	Same as R705.	
R712	Same as R703.	
R713	RESISTOR, FIXED, COMPOSITION: 8,200 ohms, ±10%; 1/2 watt.	RC20GF822K
R714	Same as R701.	
R715	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±5%; 1/2 watt.	RC20GF222J
R716	Same as R701.	
T701	TRANSFORMER, RADIO FREQUENCY: fixed; primary nom. inductance 1.75 uh; secondary nom. inductance .7 uh; staked lug type terminals; potted blue case.	TZ165
T702	Same as T701.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C801	CAPACITOR, FIXED, CERAMIC DIELECTRIC: rated at 470,000 uuf, ±20%; radial type lead terminals.	CC112R474M
C802	CAPACITOR, FIXED, ELECTROLYTIC: 10 uf, -10% +150% at 120 cps, 25°C; 15 WVDC; polarized; insulated tubular case.	CE105-10-15
C803	Same as C802.	
C804	Same as C801.	
C805	Same as C802.	
C806	Same as C801.	
C807	Same as C801.	
C808	Same as C801.	
C809	Same as C802.	
C810 thru C823	Same as C801.	
C824	Same as C802.	
C825 thru C834	Same as C801.	
C835	CAPACITOR, FIXED, ELECTROLYTIC: tantalum; 6.8 uf, ±20%; 6 volts DC surge; insulated, hermetically sealed metal case.	CE106
C836	Same as C835.	
C837	CAPACITOR, FIXED, ELECTROLYTIC: tantalum; 6.8 uf, ±20%; 6 volts DC surge; insulated; hermetically sealed metal case.	CE107-1
C838	Same as C801	
C839	Same as C801.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C840	Same as C801.	
C841	Same as C837.	
C842	Same as C801	
C843	Same as C801.	
C844	CAPACITOR, FIXED, ELECTROLYTIC: 50 uuf, -10% +150% at 120 cps, at 25°C; 15 WVDC; polarized; insulated tubular case.	CE105-50-15
C845	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 3,000 uuf; GMV; 2,000 WVDC.	CC100-31
C846	CAPACITOR, FIXED, METALIZED PLASTIC: mylar; 1.0 uf, ±10%; 200 WVDC.	CN112A105K2
C847	Same as C837.	
C848	Same as C837.	
C849 thru C860	Same as C801.	
CR801	SEMICONDUCTOR DEVICE, DIODE: germanium; min. peak inverse voltage for zero dynamic impedance 70 V; continuous reverse working voltage 60 V; average forward current 60 ma; recurrent peak forward current 150 ma; forward surge current (1 sec.) 500 ma.	1N294
CR802	Same as CR801.	
CR803	SEMICONDUCTOR DEVICE, DIODE: germanium; max. peak inverse voltage 60 V; continuous average forward current 50 ma; max. peak forward current 150 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
CR804	Same as CR803.	
CR805	Same as CR801.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
CR806	Same as CR801.	
CR807	SEMICONDUCTOR DEVICE, DIODE: silicon; 600 volts; max. continuous DC current .50 amps at 100°C; surge current peak 75 amps; max. operating temperature 150°C; max. forward voltage drop 1.0 V; max. reverse current 1,000 cps. ua	1N2484
CR808	Same as CR801.	
CR809	Same as CR801.	
K801	RELAY ARMATURE: coil operating voltage 12.6 VDC; coil resistance 200 ohms DC; min. operating amps .034; current rating 26.5 VDC, 3 amps, non-inductive; double pole double throw; operating temperature range -65°C to +125°C; hermetically sealed metal case.	RL143-3
L801	COIL, RADIO FREQUENCY: fixed; 100 uf, +5%; 2.6 ohms DC resistance; current rating 345 ma; molded case.	CL275-101
L802	COIL, RADIO FREQUENCY: fixed; 47,000 uh, +5%; 452 ohms DC resistance; current rating 27 ma; molded case.	CL275-473
L803	Same as L802.	
L804	COIL, RADIO FREQUENCY: fixed; inductance 2.5 uh, +5%; resistance 0.3 ohms +20%; current rating 200 ma; Q-115; ferrite core.	CL226-1
L805	COIL, RADIO FREQUENCY: fixed; 470 ohms, +5%; 100 ohms DC resistance; current rating 180 ma; molded case.	CL275-471
L806	Same as L802.	
L807	Same as L801.	
L808	Same as L804.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
Q801	**TRANSISTOR: germanium: PNP; JEDEC type 2N1637 with a controled hfe limit of 85-105 at 1 KC; TO9 case.**	**TX105**
Q802 thru Q809	Same as Q801.	
Q810	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
Q811	TRANSISTOR: germanium; junction type contact; NPN configuration; collector to base 40 volts; collector to emitter 25 volts; collector to current 100 ma; (ratings at 25°C); wire lead type terminals; hermetically sealed metal case; .190" x .320" x .340" dim. o/a.	2N214
Q812	Same as Q811.	
Q813	Same as Q811.	
Q814 thru Q817	Same as Q801.	
R801	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±5%; 1/2 watt.	RC20GF103J
R802	RESISTOR, FIXED, COMPOSITION: 3,900 ohms, ±5%; 1/2 watt.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R803	Same as R801.	
R804	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±5%; 1/2 watt.	RC20GF222J
R805	RESISTOR, FIXED, COMPOSITION: 12,000 ohms, ±5%; 1/2 watt.	RC20GF123J
R806	Same as R801.	
R807	Same as R802.	
R808	Same as R801.	
R809	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±5%; 1/2 watt.	RC20GF100J
R810	RESISTOR, FIXED, COMPOSITION: 2,700 ohms, ±5%; 1/2 watt.	RC20GF272J
R811	Same as R810.	
R812	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF822J
R813	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	RC20GF101J
R814	Same as R812.	
R815	RESISTOR, VARIABLE, COMPOSITION: 1,000 ohms, ±10%; 0.25 watts at 70°C; operating temperature range -55°C to +120°C; linear taper.	RV111U102A
R816	RESISTOR, FIXED, COMPOSITION: 1,200 ohms, ±5%; 1/2 watt.	RC20GF122J
R817	Same as R812.	
R818	RESISTOR, FIXED, COMPOSITION: 6,800 ohms, ±5%; 1/2 watt.	RC20GF682J
R819	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R820	Same as R816.	
R821	Same as R815.	
R822	Same as R815.	
R823	Same as R818.	
R824	Same as R812.	
R825	Same as R816.	
R826	Same as R815.	
R827	Same as R804.	
R828	Same as R819.	
R829	RESISTOR, FIXED, COMPOSITION: 470 ohms, ±5%; 1/2 watt.	RC20GF471J
R830	Same as R805.	
R831	Same as R802.	
R823	Same as R819.	
R833	Same as R802.	
R834	Same as R819.	
R835	Same as R810.	
R836	Same as R829.	
R837	RESISTOR, FIXED, COMPOSITION: 5,600 ohms, ±5%; 1/2 watt.	RC20GF562J
R838	RESISTOR, FIXED, COMPOSITION: 150 ohms, ±5%; 1/2 watt.	RC20GF151J
R839	RESISTOR, FIXED, COMPOSITION: 15,000 ohms, ±5%; 1/2 watt.	RC20GF153J
R840	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF102J

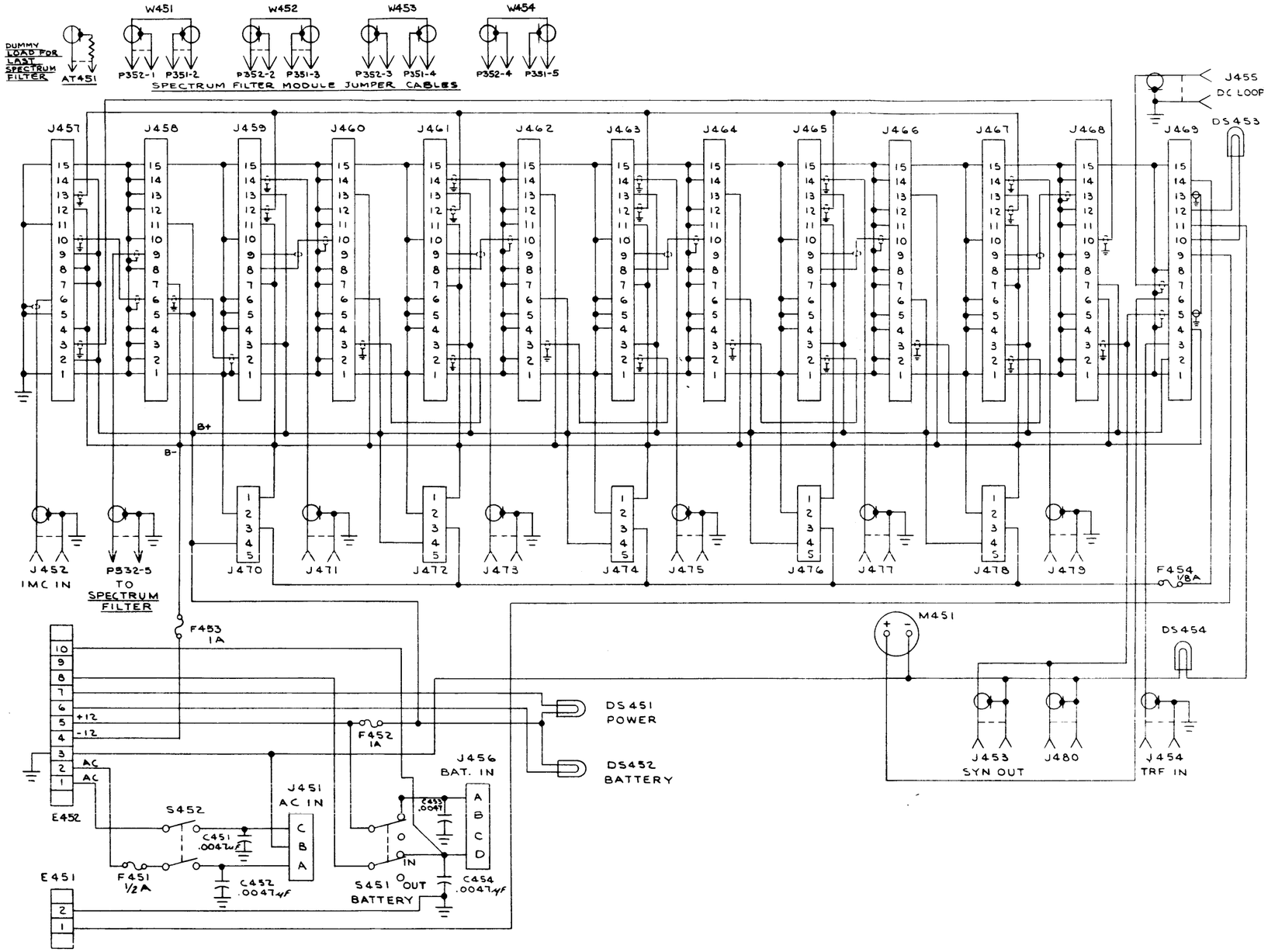
REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R841	Same as R829.	
*R842	RESISTOR, FIXED, COMPOSITION: _____ohms, ±5%; 1/2 watt.	RC20GF___J
R843	Same as R819.	
R844	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J
R845	Same as R816.	
R846	Same as R801.	
R847	RESISTOR, FIXED, COMPOSITION: 47 ohms; ±5%; 1/2 watt.	RC20GF470J
R848	RESISTOR, FIXED, WIREWOUND: 40 ohms; current rated at 353 ma; 5 watts.	RW107-15
R849	RESISTOR, FIXED, COMPOSITION: 220,000 ohms, ±5%; 1/2 watt.	RC20GF224J
R850	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±5%; 1/2 watt.	RC20GF473J
R851	RESISTOR, FIXED, COMPOSITION: 39,000 ohms, ±5%; 1/2 watt.	RC20GF393J
R852	Same as R844.	
R853	Same as R804.	
R854	Same as R844.	
R855	Same as R819.	
R856	Same as R812.	

*Value to be determined in test, optimun value 8.2K.

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R857	Same as R844.	
R858	Same as R844.	
R859	Same as R819.	
R860	Same as R819.	
R861	Same as R815.	
R862	RESISTOR, FIXED, COMPOSITION: 330 ohms, ±5%; 1/2 watt.	RC20GF331J
R863	Same as R804.	
R864	Same as R839.	
R865	Same a R829.	
R866	Same as R804.	
R867	Same as R801.	
R868	Same as R801.	
R869	Same as R804.	
R870	RESISTOR, FIXED, COMPOSITION: 27,000 ohms, ±5%; 1/2 watt.	RC20GF273J
R871	Same as R818.	
R872	Same as R850.	
R873	RESISTOR, FIXED, COMPOSITION: 1,000,000 ohms, ±5%; 1/2 watt.	RC20GF105J
T801	TRANSFORMER, RADIO FREQUENCY: fixed.	TR184

SECTION 7

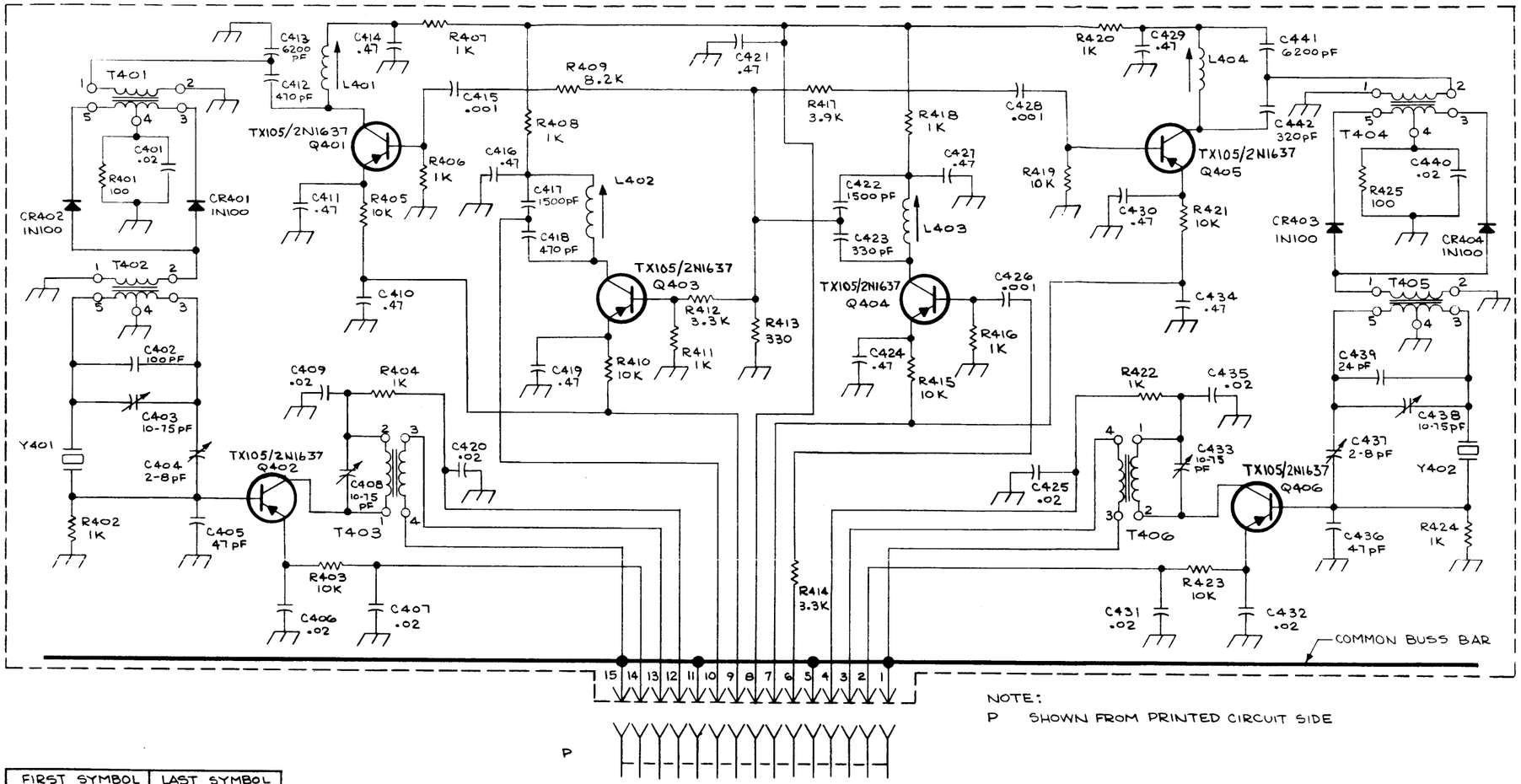
Schematic Diagrams



6004A-16

CK-778 A

Figure 7-1. LFSA Main Chassis , Schematic Diagram



NOTE:
P SHOWN FROM PRINTED CIRCUIT SIDE

FIRST SYMBOL	LAST SYMBOL
R401	R425
C401	C442
CR401	CR404
T401	T406
L401	L404
Q401	Q406
Y401	Y402

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

6004A-17

CK-701 B

Figure 7-2. 1-8-10 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

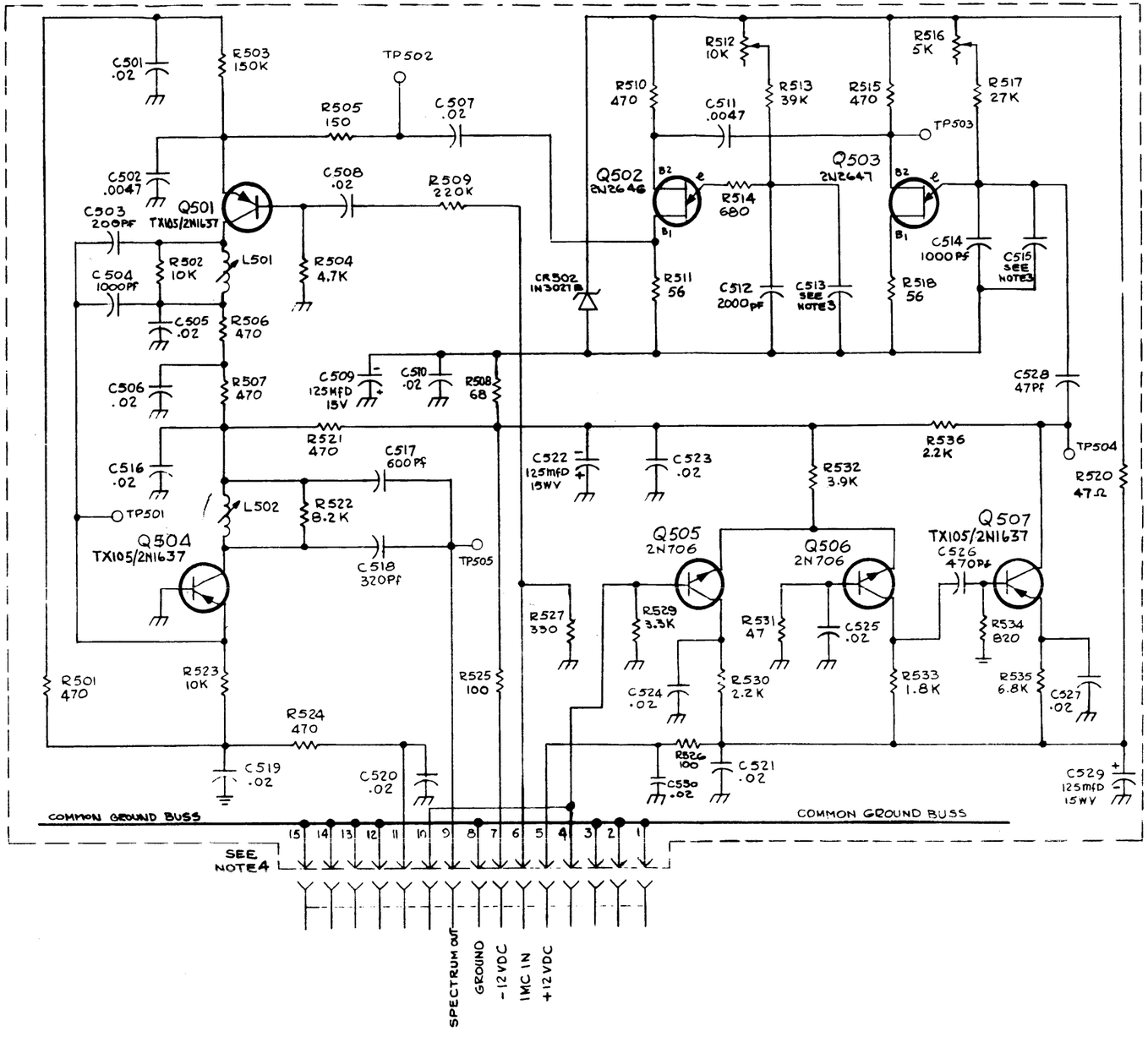
—UNLESS OTHERWISE SPECIFIED—

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.

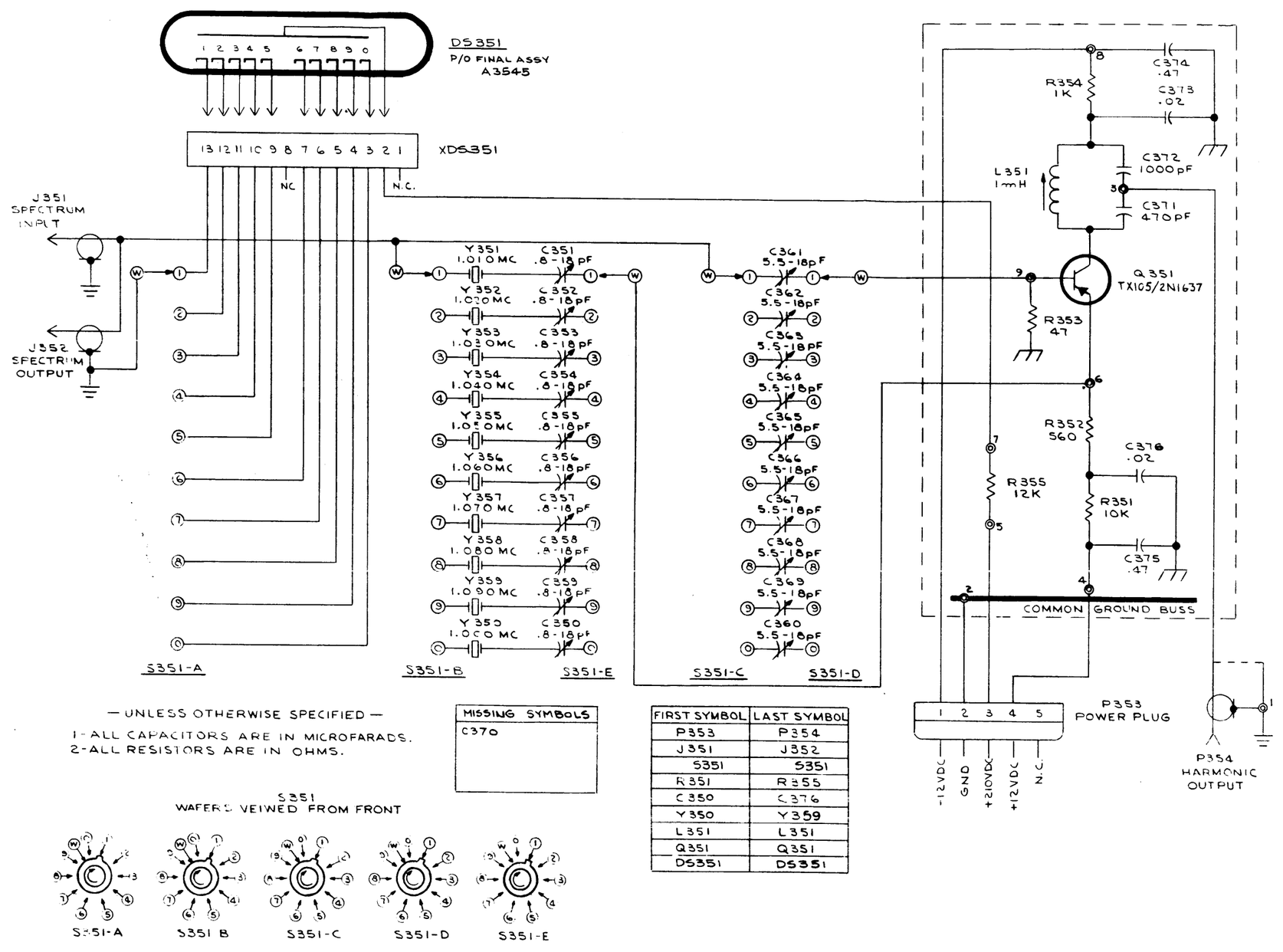
4- PC BOARD CONNECTOR SHOWN FROM PRINTED CIRCUIT SIDE



6004A-18

CK-772 E

Figure 7-3. Spectrum Generator Module, Schematic Diagram



— UNLESS OTHERWISE SPECIFIED —

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

MISSING SYMBOLS
C370

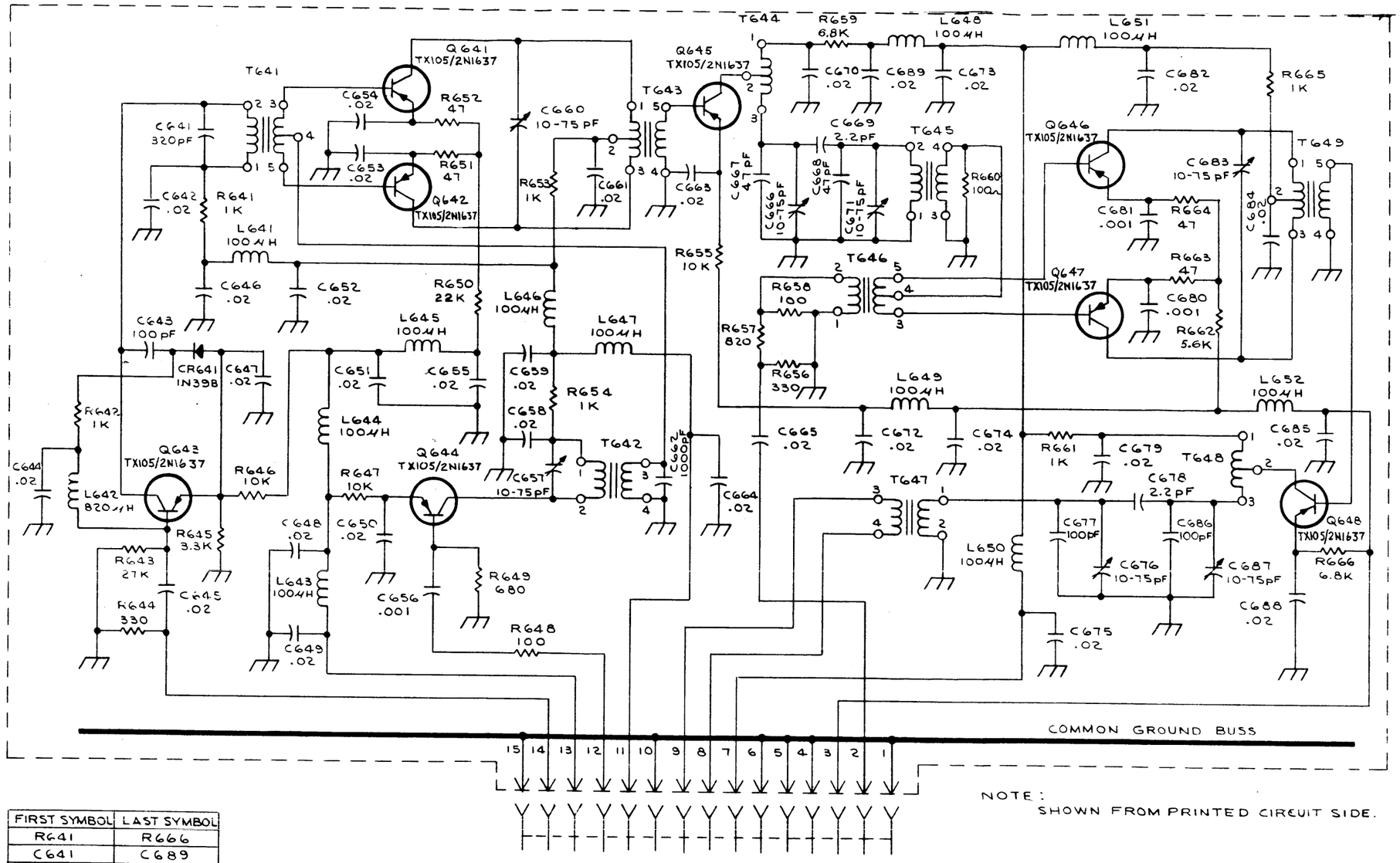
FIRST SYMBOL	LAST SYMBOL
P353	P354
J351	J352
S351	S351
R351	R355
C350	C376
Y350	Y359
L351	L351
Q351	Q351
DS351	DS351

S351
WAFERS VEIWED FROM FRONT

6004A-19

CK-700 C

Figure 7-4. Spectrum Filter Assembly, Schematic Diagram



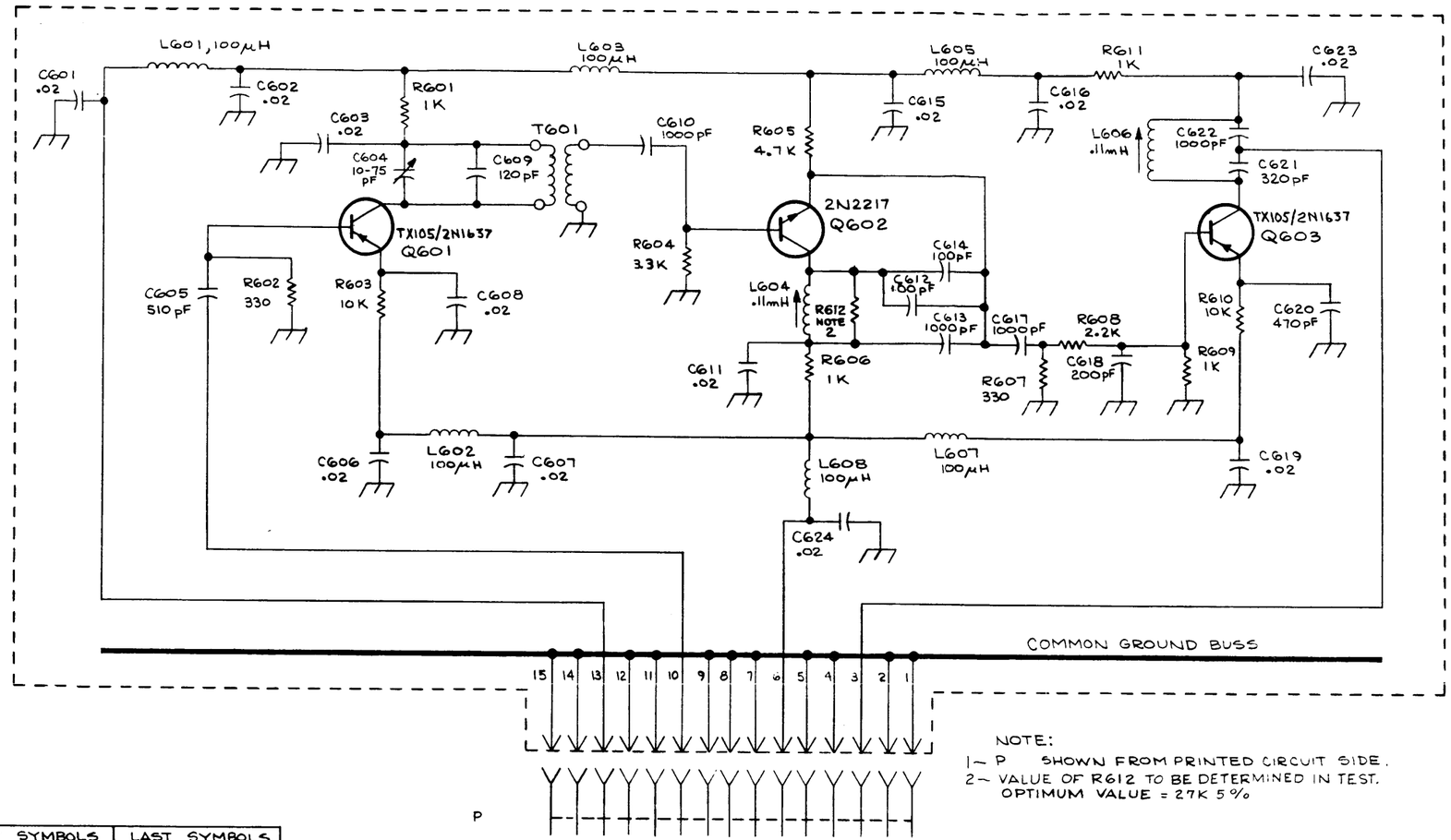
FIRST SYMBOL	LAST SYMBOL
R641	R666
C641	C689
CR641	CR641
L641	L652
T641	T649
Q641	Q648
P	

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

6004A-20

CK-703 C

Figure 7-5. 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

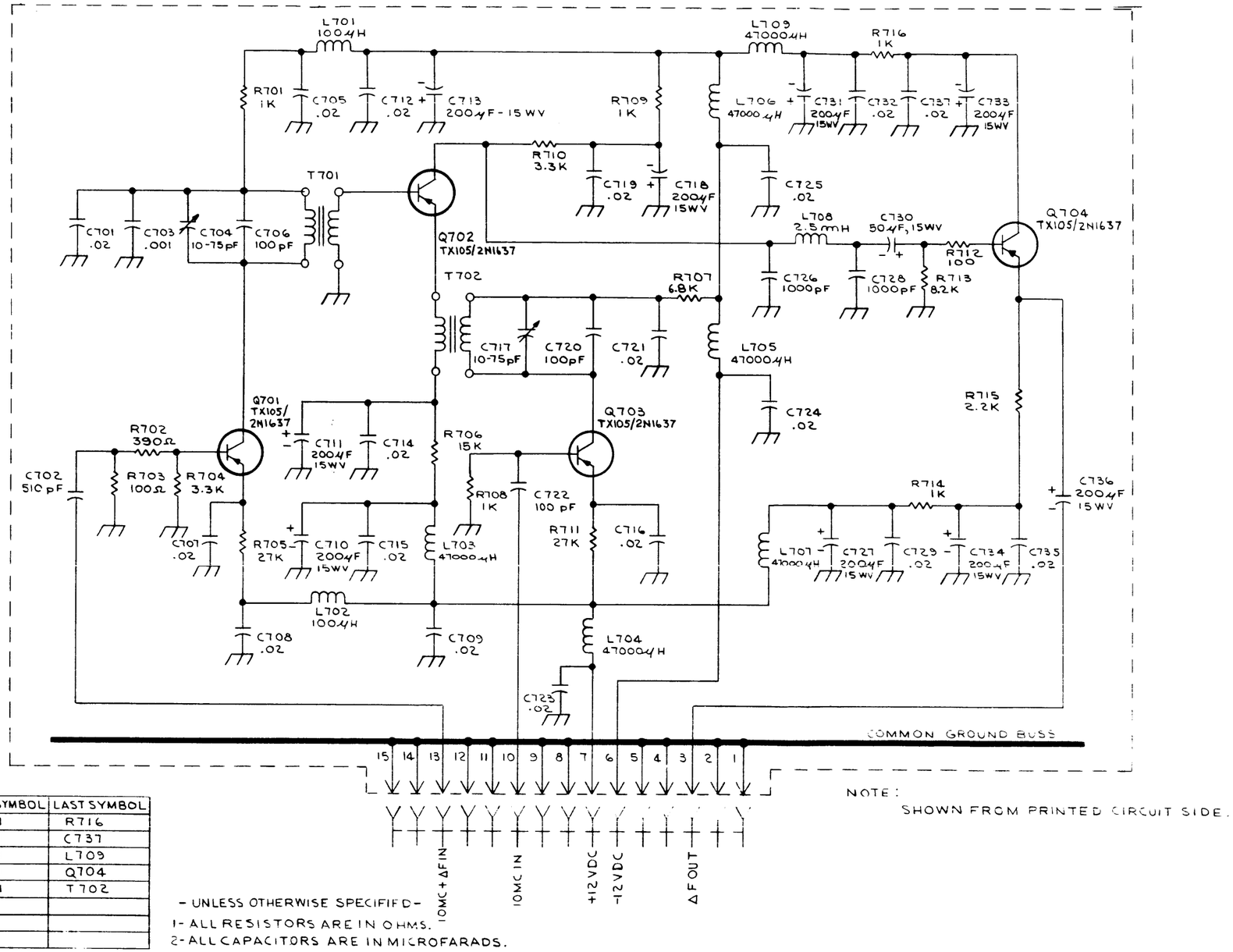
—UNLESS OTHERWISE SPECIFIED—

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

6004A-21

CK-704 C

Figure 7-6. Divide By Ten Module, Schematic Diagram



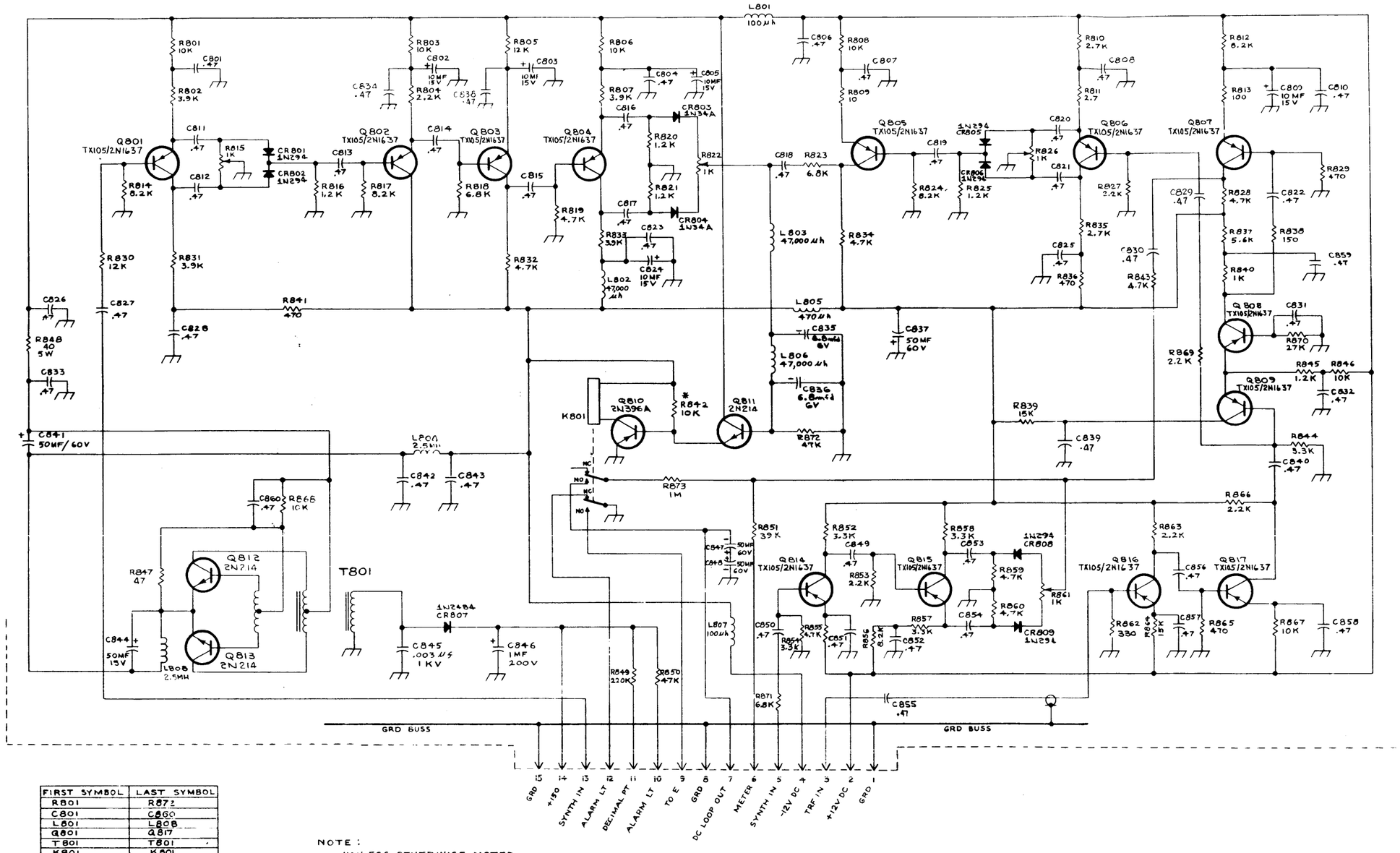
FIRST SYMBOL	LAST SYMBOL
R701	R716
C701	C737
L701	L709
Q701	Q704
T701	T702
P	

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

6004A-22

CK-705 C

Figure 7-7. Minus Mixer Module, Schematic Diagram



FIRST SYMBOL	LAST SYMBOL
R801	R872
C801	C860
L801	L808
Q801	Q817
T801	T801
K801	K801
CR801	CR809

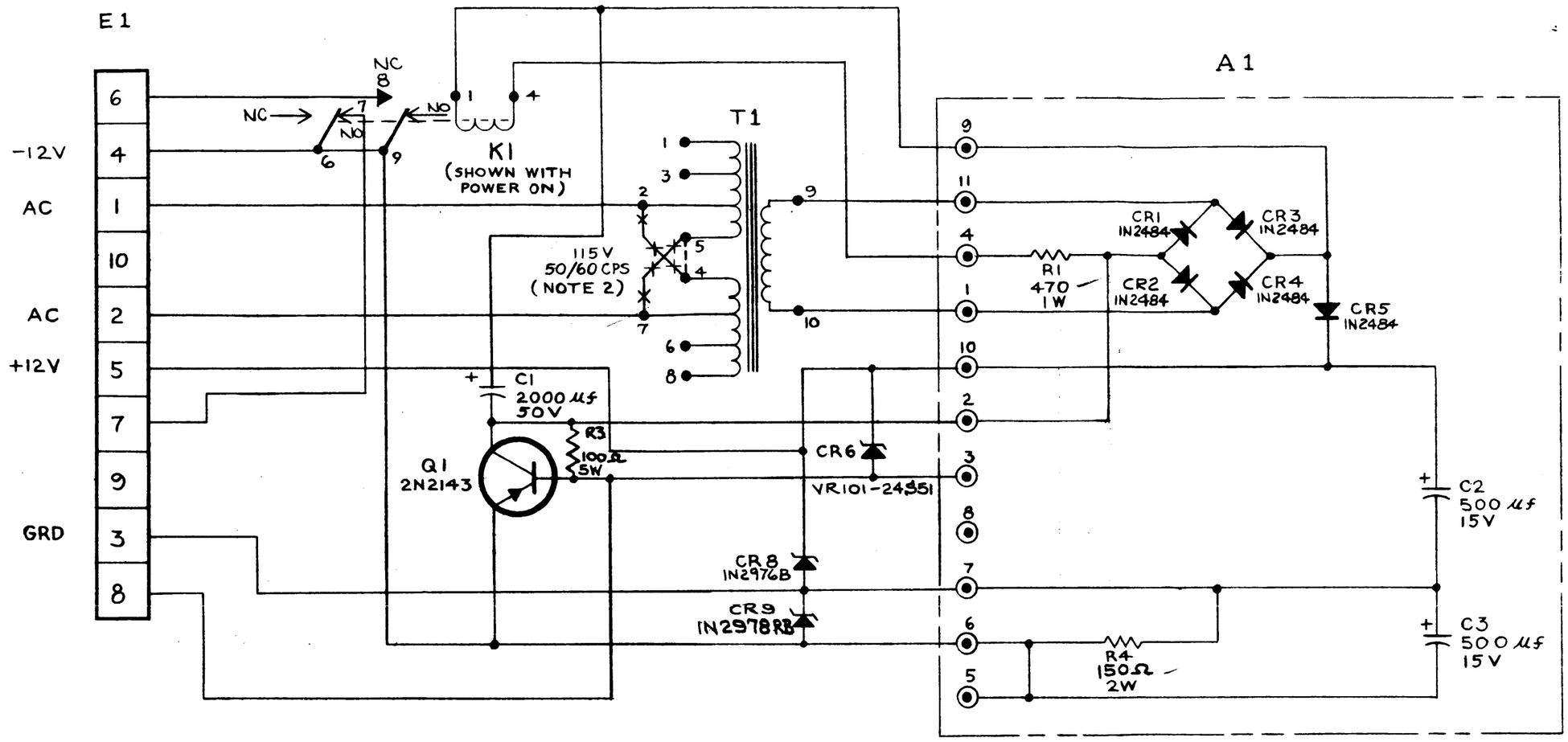
NOTE:

UNLESS OTHERWISE NOTED
ALL CAPACITORS ARE IN MICROFARADS
ALL RESISTORS ARE IN OHMS
* VALUE OF R842 IS NOMINAL AND MAY CHANGE IN TEST

6004A-23

CK-707 B

Figure 7-8. Phase Detector Module, Schematic Diagram



LAST SYMBOLS USED	
R	4
C	3
T	
Q	
E	
K	
A	
D	
C	
R	8

MISSING SYMBOLS
R2
CR 7

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

CK-679C

Figure 7-9. Power Supply, Schematic Diagram