UNCLASSIFIED

TECHNICAL MANUAL

for

MUX CARRIER GENERATOR

MODEL MCG-1

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, CANADA

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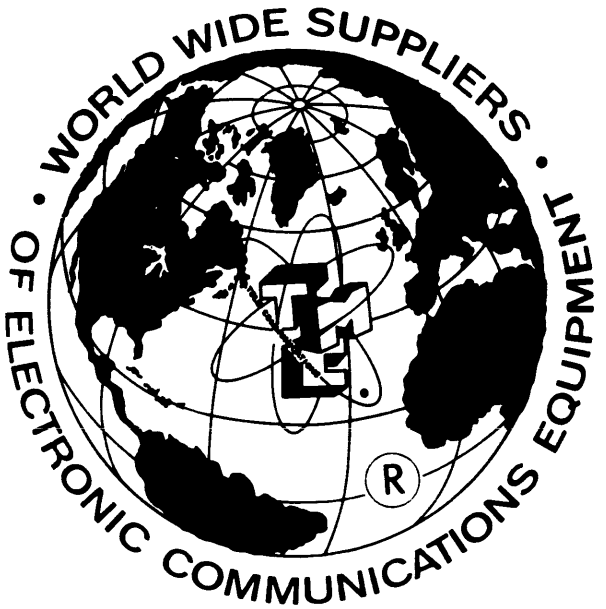

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. **OTTAWA, CANADA**

IN-4004B

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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

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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Figure 1-1. Multiple Carrier Generator Model MCG-1

SECTION 1
GENERAL INFORMATION

1-1. DESCRIPTION.

Mux Carrier Generator, Model MCG-1 (figure 1-1), is a signal generating device that supplies an i-f translating signal, a carrier injection signal, and demultiplexing carrier injection signals for use by multiple sideband detecting equipment.

Depending upon how the unit is configured within a system, the i-f translating signal and the carrier injection signal may be generated within the MCG or by external equipment, whereas the demultiplexing carrier injection signals are generated only within the MCG. When generated within the MCG, the i-f translating signal and carrier injection signal have a frequency stability of one part in 10^6 per day. Alternatively, these two signals may be supplied to the MCG by an associated synthesizer or automatic frequency control unit, such as TMC's Models HFS and AFC, when greater stability or automatic drift compensation is desired. Demultiplexing carrier injection signals, generated within the MCG, have a maximum error of ±.015 cps per day in relation to the carrier injection signal. The demultiplexing carrier injection signals are 6.29 Kc above and below the carrier injection signal to provide compatibility with the National Standard voice-channel multiplexing system.

The MCG requires +200 volts dc, 115/230-volts ac, 28-volts dc, and 6.3-volts ac, from an external power supply. Performance specifications and other reference data for the MCG are given in paragraph 1-3.

1-2. TUBE AND DIODE COMPLEMENT.

The tube and diode complement for the MCG is presented in table 1-1.

TABLE 1—1. TUBE AND DIODE COMPLEMENT

REFERENCE SYMBOL	TYPE	FUNCTION
V6001	6EU8	250 Kc Oscillator-Amplifier
V6002	6EU8	2 Mc Oscillator-Amplifier
V6003	6BA6	Amplifier
V6004, V6005	6AS6	4:1 Phantastron Dividers
V6006	12AT7	Amplifier
V6007	6CE5	Lower Sideband Amplifier
V6008	6CE5	Upper Sideband Amplifier
CR6001	1N463	Trigger Diode
CR6002	1N463	Trigger Diode
CR6003	DD-100	Balanced Modulator

1-3. TECHNICAL SPECIFICATIONS.

Technical specifications for the MCG are as follows:

Output Frequencies:	
I-F Translating Signal	2 mc
Carrier Injection Signal	250 kc
USB Demultiplexing Carrier Injection Signal	256.29 kc
LSB Demultiplexing Carrier Injection Signal	243.71 kc
Output Level (all signals):	1 volt rms
Output Impedance (for all signals):	50 ohms, unbalanced

1-3. TECHNICAL SPECIFICATIONS (CONT).

Stability:	
I-F Translating Signal and Carrier Injection Signal	1 part in 10^6 per day
Demultiplexing Carrier Injection Signals	No more than ±.015 cps per day deviation, referenced to carrier injection signal.
Environment:	0° to +50°C; up to 95% relative humidity
Input Power Requirements:	Approximately 100 watts.
Voltage Requirements: (All voltages must be furnished by an external power supply)	+28 volts dc; +200 volts dc; 115/230 VAC, 50 to 60 cps, single phase; 6.3 volts a-c
Dimensions:	3-1/2" high x 19" wide x 12" deep
Weight:	8 pounds

SECTION 2
INSTALLATION

2-1. INITIAL INSPECTION.

The MCG 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. Unpack the equipment carefully; 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 MCG is shipped with all tubes installed. Check to make sure that all tubes are seated in their sockets.

2-2. POWER REQUIREMENTS.

All operating power for the MCG is furnished by external power supplies. Refer to paragraph 1-3 for voltage requirements and power consumption.

2-3. INSTALLATION.

a. MECHANICAL. - The MCG is designed for both cabinet and rack installation. In either case, adequate ventilation, sufficient space for servicing, and sufficient clearance for access to rear-panel connections should be considered when planning equipment location. The MCG is equipped with a standard 19-inch wide front panel, and is approximately 3-1/2 inches and 12 inches deep.

When intended for rack installation, the MCG is equipped with tilt-slide mechanisms that permit the unit to be pulled out of the equipment rack and tilted to expose the top or bottom of the chassis for greater accessibility and ease of maintenance. To install the MCG in a rack, refer to figure 2-1, and proceed as follows:

(1) Set MCG chassis slide mechanisms in tracks.

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

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

(4) Make necessary cable and electrical connections as indicated in paragraph 2-3b.

b. ELECTRICAL. - All external connections are made to the jack and screw terminals located at the rear of the MCG. Refer to figures 2-2 and 2-3 and table 2-1, and make connections as indicated.

2-4. INITIAL ADJUSTMENTS.

Before any MCG unit is shipped, it is aligned and thoroughly checked against the manufacturers specifications. Hence, initial adjustments are not normally required.

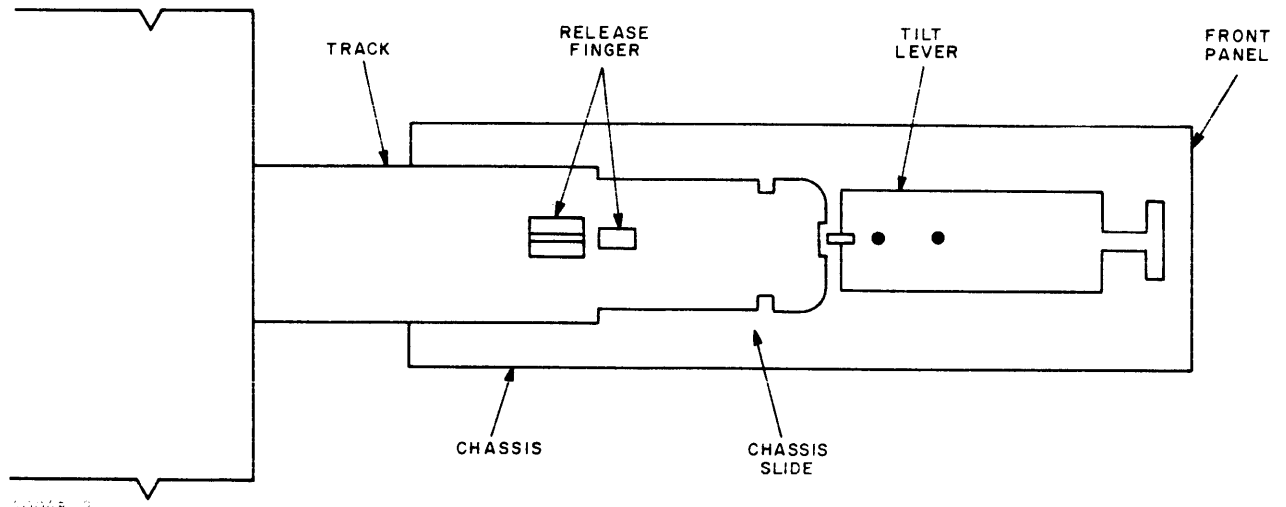
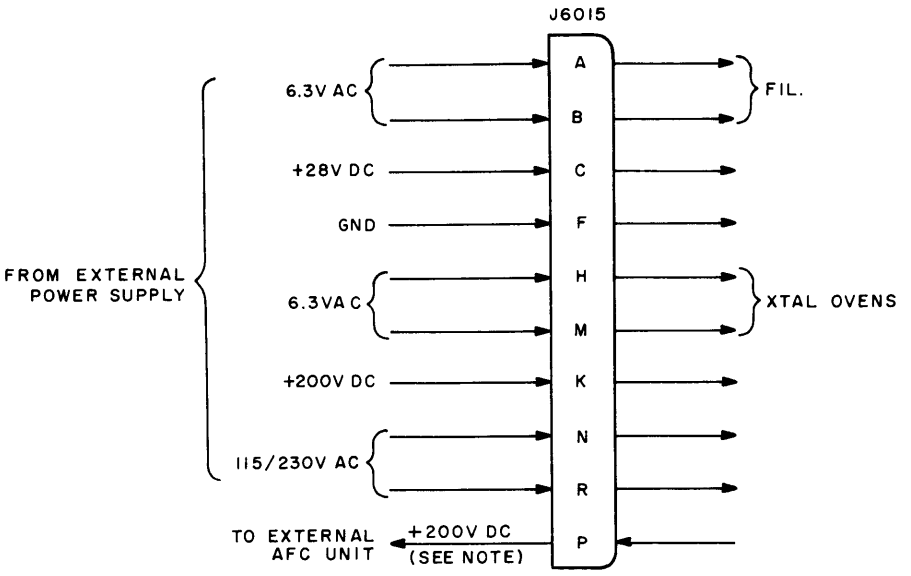


Figure 2-1. Tilting Slide Mechanisms



NOTE

+200 volts dc available at pin P only when switch S6001 is set at AFC.

Figure 2-2. Power Connections, J6015

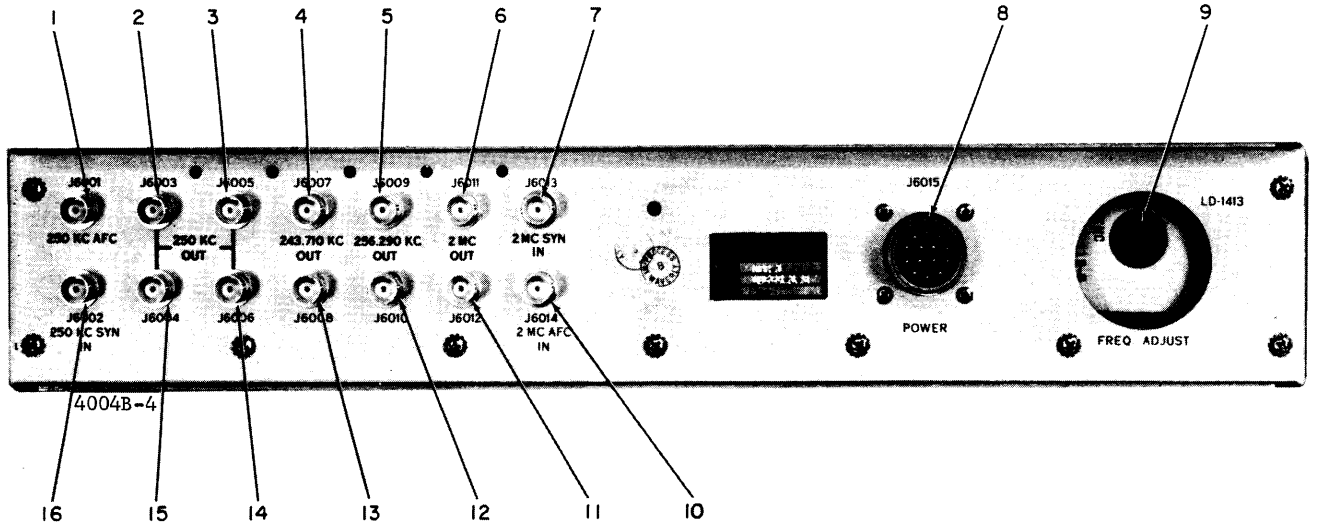


Figure 2-3. MCG, Rear View

TABLE 2-1. REAR PANEL CONNECTIONS

ITEM NO. (Figure 2-3)	PANEL DESIGNATION	FUNCTION
1	J6001 250 KC AFC jack	Input jack for 250 kilocycle standard signal from external AFC unit.
2	J6003 250 KC OUT jack	Output jack for 250 kilocycle carrier signal. Permits connection of carrier signal to external equipment.
3	J6005 250 KC OUT jack	Same as item 2.
4	J6007 243.710 KC OUT jack	Output jack for 243.71 kilocycle lower sideband carrier signal. Permits connection of lower sideband carrier signal to external equipment.
5	J6009 256.290 KC OUT jack	Output jack for 256.29 kilocycle upper sideband carrier signal. Permits connection of upper sideband carrier signal to external equipment.
6	J6011 2 MC OUT jack	Output jack for 2 megacycle carrier signal. Permits connection of carrier signal to external equipment.
7	J6013 2 MC SYN IN jack	Input jack for 2 megacycle standard signal from external synthesizer equipment.
8	J6015 POWER jack	Input jack for power connections from external power supplies. In addition, +200 volts dc available at pin P for connection to external equipment.
9	FREQ. ADJUST	Permits adjustment of 100.64 kilocycle crystal.
10	J6014 2 MC AFC IN jack	Input jack for 2 megacycle signal from external AFC unit.
11	J6012 2 MC OUT jack	Same as 6.
12	J6010 256.290 KC OUT jack	Same as 5.
13	J6008 243.710 KC OUT jack	Same as 4.
14	J6006 250 KC OUT jack	Same as 2.
15	J6004 250 KC OUT jack	Same as 2.
16	J6002 250 KC SYN IN jack	Input jack for 250 kilocycle standard signal from external synthesizer unit.

SECTION 3
OPERATOR'S SECTION

3-1. CONTROLS AND INDICATORS.

Before attempting to operate the MCG, the operator should familiarize himself with the controls and indicators. The controls and indicators are listed in table 3-1 and are illustrated in figure 3-1.

3-2. OPERATING PROCEDURES.

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

b. STARTING. - The MCG does not contain any power controls. Therefore, to start the MCG, turn on the associated external power supplies. At the MCG, OVENS heater lamps HR6001, HR6002, and HR6003 should light. The lamps should go off when the associated oven temperature rises above 70°C.

c. OPERATING. - Selector switch S6001 is the only MCG operating control; this control selects either the internal or external 250-kc and 2-mc signals (refer to table 3-1).

d. STOPPING. - To stop the MCG merely turn off the external power supplies.

TABLE 3—1. CONTROLS AND INDICATORS

FRONT PANEL DESIGNATION (Figure 3-1)	FUNCTION
Selector Switch, S6001	A 3-position rotary switch; when set at INT, connects internally generated 250-kc and 2-mc signals to their respective output jacks; when set at AFC, connects drift-compensated 250-kc and 2-mc signals from associated automatic frequency control unit to their respective output jacks, routes B+ voltage to associated automatic frequency control unit; when set at SYN, connects stabilized 250-kc and 2-mc signals from associated synthesizer to their respective output jacks.
OVENS HR6001, heater lamp	Indicates periods of oven heating for the 100. 64 kilocycle crystal. Goes on when the oven temperature drops below 75°C. Goes off when oven temperature rises above 75°C.
OVENS HR6002, heater lamp	Same as 2 except that lamp indicates oven temperature for the 2 megacycle crystal.
OVENS HR6003, heater lamp	Same as 2 except that lamp indicates oven temperature for the 250 kilocycle crystal.

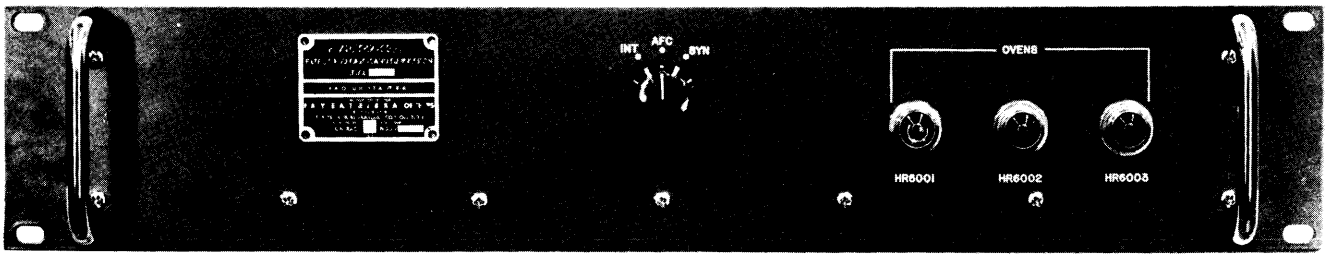


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Figure 3-1. MCG, Front Panel Control and Indicators

3-3. OPERATOR'S MAINTENANCE.

The operator should observe that the operating control and indicator lamps are in good condition and functioning properly (see figure 3-1 and table 2-1). Any noticeable irregularity could be an indication of trouble.

The MCG does not contain any power fuses. However, fuses associated with MCG circuits should be located in the external power supplies. Refer to the service manual for the external power supplies for fuse locations.

CAUTION

Do not 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 trouble has been located and corrected.

SECTION 4
PRINCIPLES OF OPERATION

4-1. BLOCK DIAGRAM ANALYSIS.

Refer to figure 4-1. The MCG consists of an i-f translating signal generator, a carrier signal generator, and a demultiplexing carriers signal generator. The i-f translating signal generator, consists of a 2-mc crystal-controlled oscillator and an amplifier. The carrier signal generator consists of a 250-kc crystal-controlled oscillator and an amplifier. The demultiplexing carriers signal generator consists of a 100.64-kc crystal-controlled oscillator operating at 100.64 kc, a divider chain, a balanced modulator, filters, and amplifiers.

The 2-mc oscillator consists of crystal Y6002 (contained in OVEN Z6002) and the triode section of V6002. The 2-mc oscillator signal is amplified by the pentode section of V6002 and applied to the contacts of switch S6001. When S6001 is set at INT, the 2-mc signal is routed to parallel-connected 2 MC OUT jacks J6011 and J6012. When S6001 is set at AFC, a 2-mc signal applied to the 2 MC AFC IN jack J6014 from an external automatic frequency control unit is routed through the switch contacts to jacks J6011 and J6012. When S6001 is set at SYN, a 2-mc signal applied to 2 MC SYN IN jack J6013 from an external synthesizer is routed through the switch contacts to jacks J6011 and J6012.

The 250-kc oscillator consists of crystal Y6003 (contained in OVEN Z6003) and the triode section of V6001. The 250-kc signal is amplified by the pentode section of V6001 and applied to contacts of switch S6001. When S6001 is set at INT, the 250-kc signal is routed to V6006A and also to the 250 KC OUT jacks J6003 through J6006. The 250-kc signal applied to V6006 is used to derive the demultiplexing carriers of 243.71 and 256.29 kc. When S6001 is set at AFC, a 250-kc signal applied to the 250 KC AFC IN jack J6001 from an external automatic frequency control unit is routed through the switch contacts to jacks J6003 through J6006. When S6001 is set at SYN, a 250-kc signal applied to the 250 KC SYN IN jack J6002 from an external synthesizer is routed through the switch contacts to jacks J6003 through J6006.

The output of the 100.64-kc oscillator, Z6001 is amplified by V6003 and applied to divider V6004 where it is divided by a factor of 4. The resultant 25.16 kc signal is then divided down to 6.29 kc by V6005. The 6.29 kc signal is amplified by V6005B and applied to balanced modulator CR6003. The outputs of the balanced modulator, the sum and difference products of the 250-kc signal from V6006A and of the 6.29-kc signal from V6006B, are applied to filters FL6001 and FL6002. The filters separate the sum and difference product outputs, the 256.29-kc signal from FL6001 is amplified by V6008 and applied to paralleled jacks J6009 and J6010. The 243.71-kc signal from FL6002 is amplified by V6007 and applied to paralleled jacks J6007 and J6008.

4-2. 2-MEGACYCLE GENERATOR, CIRCUIT ANALYSIS.

Refer to figure 7-1. The heart of the 2-mc circuitry is the 2-mc crystal (Y6002) contained in a temperature regulated oven. The oven maintains the 2-mc signal to a high stability. The oven is heated by applying 6.3 volts across heater element HR6002. A temperature sensitive switch closes the heater circuit when the temperature drops below 73°C and opens the heater circuit when the temperature rises above 77°C. Heater lamp I6002 (marked OVENS HR6002 on the front panel) cycles on and off indicating periods of oven heating.

The 2-mc crystal and the triode section of V6002 are connected together as a Vacker-type (modified Colpitts) oscillator. The oscillator signal output of 2 megacycles is coupled via potentiometer R6014 to the control grid of the pentode section of V6002. Transformer T6002 connected in the plate circuit of V6002 provides a highly tuned 2-megacycle sinusoidal output signal which is coupled to wafer switch S6001A. With S6001 set at INT, the 2-megacycle signal is coupled directly to the 2 MC OUT jacks J6011 and J6012. Plate voltage is applied to V6002 only when S6001 is set at INT.

4-3. 250-KC GENERATOR, CIRCUIT ANALYSIS.

Refer to figure 7-1. The heart of the 250-kc carrier circuitry is the 250-kc crystal (Y6003) contained in a temperature regulated oven. The oven maintains the 250-kc signal to a high stability. The oven is heated by applying 6.3 volts across heater element HR6003. A temperature sensitive switch closes the heating circuit when the temperature drops below 73°C. Heater lamp I6003 cycles on and off indicating periods of oven heating.

The 250-kc crystal and the triode section of V6001 are connected together as a Vacker-type (modified Colpitts) oscillator. The oscillator output signal of 250-kc is coupled via potentiometer R6001 to the control grid of the pentode section of V6001. Transformer T6001 connected in the plate circuit of V6001 provides a highly tuned 250-kc sinusoidal output signal that is coupled to wafer switch S6001B. With S6001 set at INT, the 250-kc signal is routed to amplifier V6006A and also to the 250-KC OUT jacks J6003 through J6006. Plate voltage is applied to V6001 only when S6001 is set at INT.

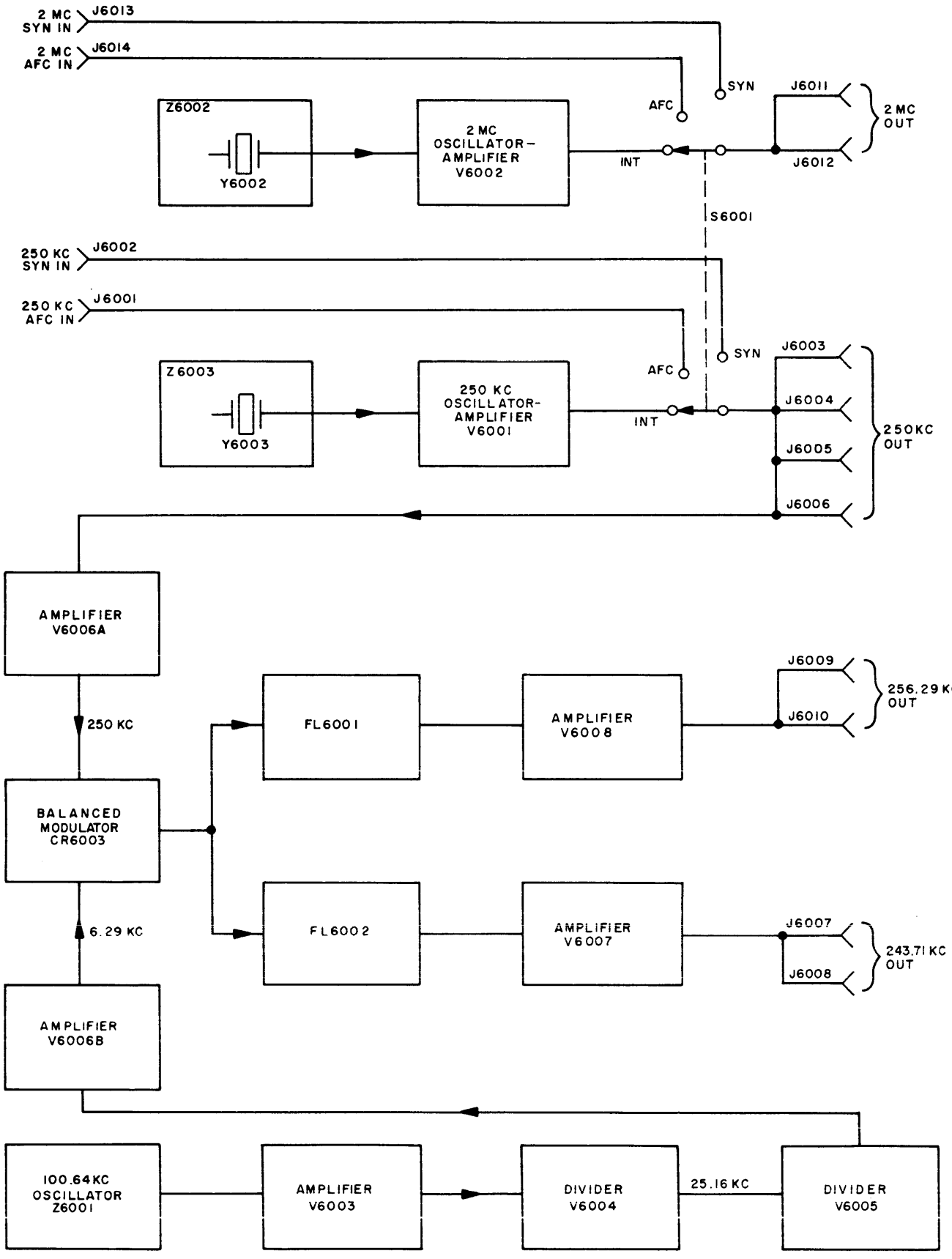

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Figure 4-1. Functional Block Diagram, MCG

4-4. DEMULTIPLEXING CARRIERS, CIRCUIT ANALYSIS.

Refer to figure 7-1. The demultiplexing carriers circuit produces the lower and upper sideband carrier injection signals. These signals are removed 6.29 kc above and below the carrier injection signal (250-kc), and provide compatibility with the National Standard voice-channel multiplexing system.

The heart of the demultiplexing carriers circuitry is the 100.64 kc crystal oscillator contained in a temperature regulated oven. The oven is heated by applying 115 volts across heater element HR6001. Heater lamp I6001 (marked OVENS HR6001 on the front panel) cycles on and off indicating periods of oven heating.

The 100.64-kc oscillator signal is amplified by V6003 and applied to diode CR6001. CR6001 passes only the negative-going portions of the signal to the plate and control grid of phantastron divider V6004. The phantastron circuit divides the 100.64-kc signal by four to produce a 25.16-kc signal. The phantastron divider circuit operates as follows:

Initially, the bias between the control grid (pin 1) and the cathode is such that current flows through the tube. However, the suppressor grid (pin 7) is sufficiently negative with respect to the cathode so that plate current is zero. Therefore the total tube current is drawn by the screen grid (pin 6). Incoming negative-going pulses passed by diode CR6001 momentarily drop the plate voltage. Feedback capacitor C6049 attempts to discharge and drives the control grid voltage in a negative direction and reduces screen-grid conduction considerably. This action causes the screen-grid voltage to rise and the cathode voltage to fall. As a result, the suppressor grid is no longer negative with respect to the cathode, and plate current starts to flow. As the feedback capacitor discharges, the control-grid voltage rises and the plate current increases. At a time determined by the discharge time constant of the feedback capacitor, the cathode voltage rises to a point where the suppressor grid is again negative with respect to the cathode. Plate current again cuts off; plate voltage rises to the B+ potential, and the feedback capacitor quickly discharges through the now positive control grid. The time required for the stopped phantastron to complete a cycle is determined primarily by the values of feedback capacitor C6049 and resistor R6024. Capacitor C6049 is variable and is adjusted so that the phantastron responds to each fourth pulse thus providing a 4:1 divided output.

The 25.16 kc signal of V6004 is taken from across cathode resistor R6023 and passed through a differentiator circuit consisting of resistor R6027 and capacitor C6025 to diode CR6002. The diode passes only negative-going portions of the differentiated signal to the plate of phantastron divider of V6005. The operation of V6005 is the same as that of V6004. As a result, a 6.29 kc signal taken from the screen grid is amplified by V6006B and then applied to the balanced modulator CR6003.

The balanced modulator utilizes the 250-kc carrier signal and the 6.29 kc signal to produce lower and upper sideband signals, 243.71 and 256.29 kc, with suppressed carrier (250-kc). The lower sideband signal, 243.71 kc, is applied through filter FL6002 and amplifier V6007 to parallel-connected 243.710 KC OUT jacks J6007 and J6008. The upper sideband signal, 256.29 kilocycles, is applied through filter FL6001 and amplifier V6008 to paralleled-connected 256.290 KC OUT jacks J6009 and J6010.

SECTION 5
MAINTENANCE

5-1. PREVENTIVE MAINTENANCE.

a. GENERAL. - The MCG 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 tube failure, 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 unit 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. TROUBLESHOOTING.

a. GENERAL. - Paragraphs d, e, f, and g, below, present troubleshooting procedures useful in localizing a malfunction to a particular section of the MCG. The test equipment required for troubleshooting or alignment is listed in paragraph b, below. The procedures described in paragraph c are to be performed prior to troubleshooting or aligning the unit. Refer to table 5-1, for voltage and resistance data. Refer to figures 5-1 and 5-2 for component locations.

b. TEST EQUIPMENT.

(1) Oscilloscope, Tektronix Model 545A, or equivalent.

(2) Frequency Counter, Hewlett-Packard Model 524C, or equivalent.

(3) Volt-ohm-milliammeter, Simpson Model 260, or equivalent.

(4) Vacuum tube voltmeter, Hewlett-Packard Model 410B, or equivalent.

c. PRELIMINARY.

(1) Disconnect all coaxial cables from jacks J6001 through J6014. Connect 47-ohm dummy loads (AT6001 through AT6005) to jacks J6003, J6005, J6007, J6009 and J6011.

(2) Set switch S6001 at INT.

NOTE

The MCG must be connected to the power supplies with which it normally operates.

(3) Check for the following power supply voltages at jack J6015:

(a) Across pins N and R; 115 vac.

(b) Across pins H and M; 6.3 vac.

(c) From pin A to ground; 6.3 vac.

(d) From pin C to ground; +28 vdc.

(e) From pin K to ground; +200 vdc.

d. 2 MEGACYCLE CIRCUITS. - Connect oscilloscope and frequency counter to jack J6011. Signal should be 2.000 mc ±2 cps at 1 v rms (2.8 v peak-to-peak). If signal is incorrect in frequency or level, perform alignment of 2-mc circuits, check V6002, and measure voltages and resistances at V6002 socket.

e. 250 KC CIRCUIT. - Connect oscilloscope and frequency counter to jack J6003. Signal should be 250.00 kc ±.2 cps at 1 v rms (2.8 v peak-to-peak). If signal is incorrect in frequency or level, perform alignment of 250-kc circuits, check V6001, and measure voltages and resistances at V6001 socket.

f. DEMULTIPLEXING CARRIERS CIRCUIT.

(1) Connect frequency counter to oscilloscope vertical amplifier output.

TABLE 5-1. VOLTAGE AND RESISTANCE MEASUREMENTS

TUBE	MEASUREMENT	PIN 1	2	3	4	5	6	7	8	9
V6001	DC	160	0	80	0	FIL	0.3	0	0	25
	ohms	6.5K	100K	25K	0	0	35	*	150	15K
V6002	DC	155	-1.7	120	0	FIL	0.1	0	1.5	0
	ohms	6K	100K	9K	0	0	K	**	150	18K
V6003	DC	0	8	FIL	0	150	150	8	NC	NC
	ohms	4.7K	1K	0	0	8K	185K	1K	NC	NC
V6004	DC	5	8.5	FIL	0	100	135	15	NC	NC
	ohms	1 MEG	3.3K	0	0	50K	12K	7K	NC	NC
V6005	DC	9.5	11.5	FIL	0	20	110	1.4	NC	NC
	ohms	1 MEG	3.3K	0	0	50K	12K	-8K	NC	NC
V6006	DC	200	0	2.8	0	0	185	-2.2	1.5	FIL
	ohms	7K	220K	2.2K	0	0	7K	120K	680	0
V6007	DC	0	2.5	0	FIL	175	175	2.75	NC	NC
	ohms	2.5	390	0	0	7K	12K	390	NC	NC
V6008	DC	0	2.75	0	FIL	180	180	2.75	NC	NC
	ohms	25	390	0	0	7K	12K	390	NC	NC

NOTES:

1. All dc voltages and resistance measurements were taken with respect to ground and with switch S6001 set to INT.
2. All dc voltage readings were taken with a Hewlett Packard, Model 410B; all resistance measurements were taken with a Simpson, Model 260.
3. *Reading depends on setting R6001.
4. **Reading depends on setting of R6014.

(2) Connect oscilloscope to pin 8 of Z6001 socket. Signal should be 100.64 kc +.01 cps at 1 v rms. If signal level is incorrect, C6020, R6016, or V6003 may be shorted; if these components are not defective, and voltage at pin 6 of Z6001 socket is 28 v dc ±1%, Z6001 is defective.

(3) Connect oscilloscope to pin 2 of V6004. Signal should be 25.16 kc at approximately 20 v peak-to-peak. If this signal is not obtained, check V6003 and V6004; capacitor C6049 may be incorrectly adjusted if frequency is incorrect or unstable.

(4) Connect oscilloscope to pin 2 of V6005. Signal should be 6.29 kc at approximately 20 v peak-to-peak. If this signal is not obtained, check V6005; capacitor C6050 may be incorrectly adjusted if frequency is incorrect or unstable.

(5) Connect oscilloscope to ungrounded end of resistor R6042 (secondary of T6004). Note signal level, and then remove V6005. If signal level does not decrease at least 20 db (10:1 voltage ratio), CR6003 is defective or R6045 is incorrectly adjusted. Replace V6005.

(6) Connect oscilloscope and frequency counter to jack J6009. Signal should be 256.29 kc ±.2 cps at 1 v rms (2.8 v peak-to-peak). If this level is not obtained, FL6001 or V6008 may be defective.

(7) Connect oscilloscope and frequency counter at jack J6009. Signal should be 243.70 kc ±.2 cps at 1 v rms. If this level is not obtained, FL6002 or V6007 may be defective.

5-3. ALIGNMENT.

The MCG must be set up as described in paragraph 5-2c prior to alignment.

a. TWO MEGACYCLE CIRCUITS. - Connect oscilloscope and frequency counter to jack J6011. Adjust R6014 to obtain level of 2.8 v peak-to-peak; adjust C6010 until output frequency is 2.000 mc ±2 cps.

b. 250 KILOCYCLE CIRCUIT. - Connect oscilloscope and frequency counter to jack J6003. Tune T6001 to obtain maximum output as indicated by oscilloscope; adjust R6001 until output level is 2.8 v

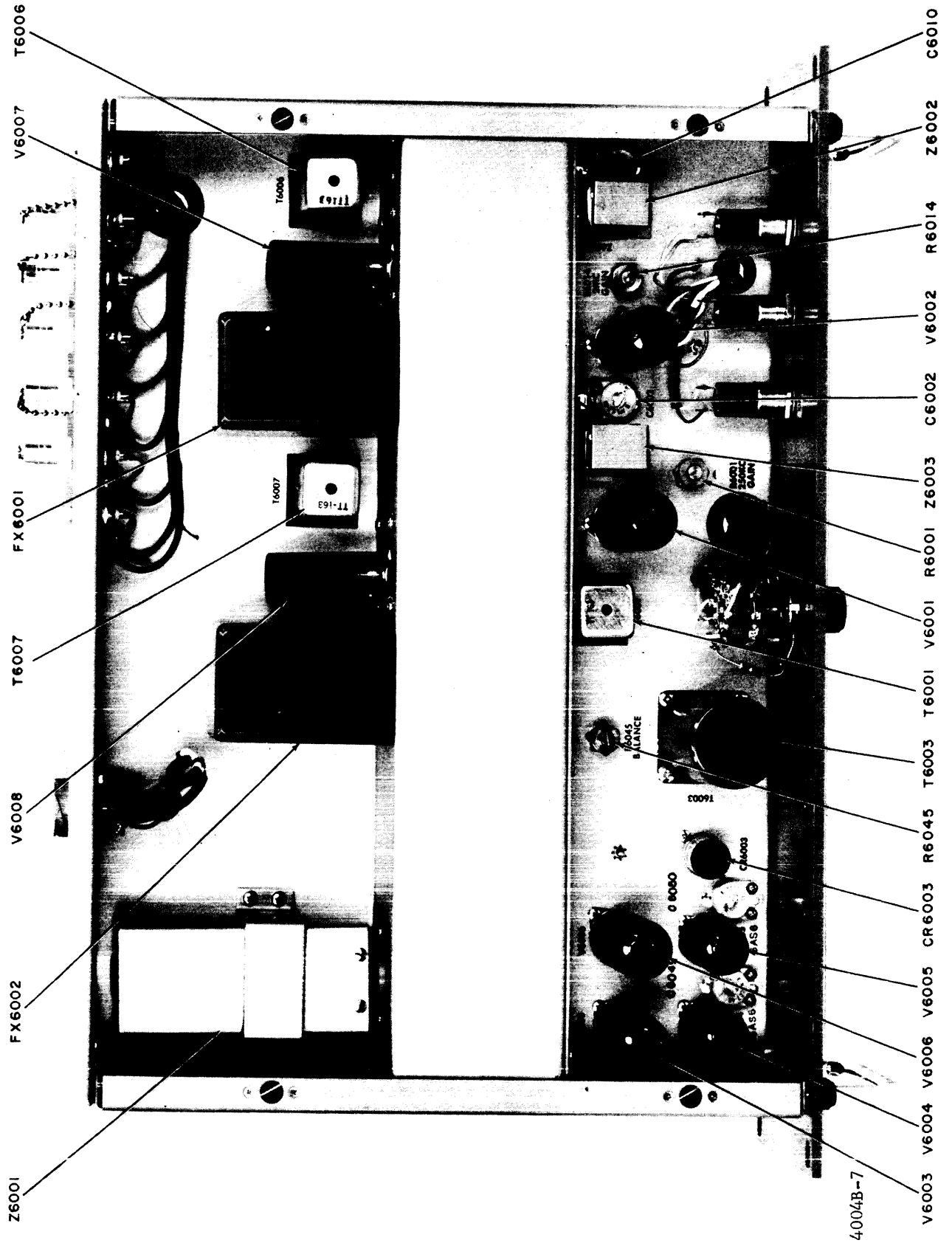

Figure 5-1. MCG, Top View

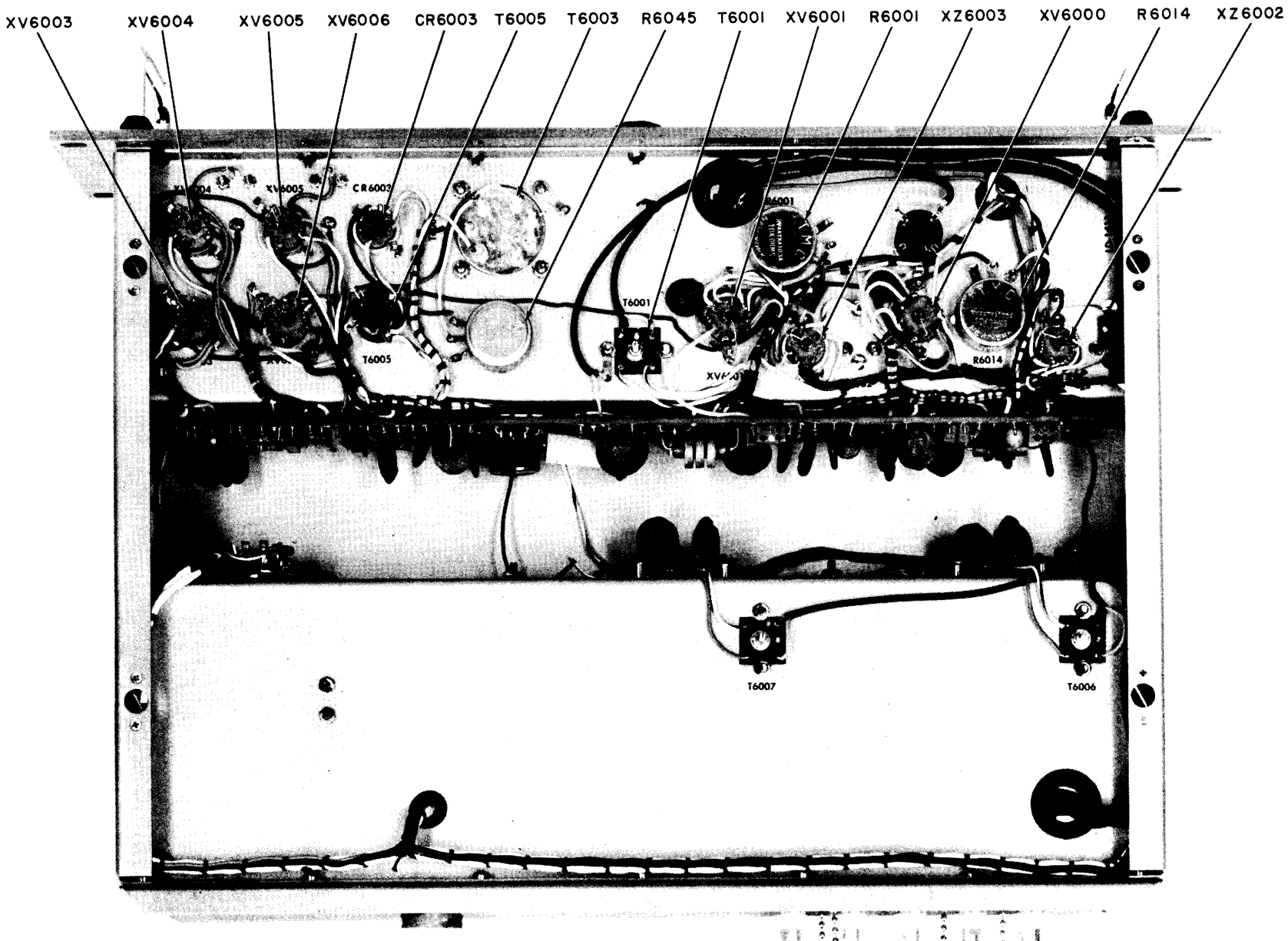

Figure 5-2. MCG, Bottom View

peak-to-peak. Adjust C6002 until output frequency is 250-kc ±0.2 cps.

c. DEMULTIPLEXING CARRIERS CIRCUITS.

(1) Connect frequency counter to plate (pin 5) of V6003. Remove V6004. Adjust trimmer of Z6001 until counter indicates 100.640 kc ±0.01 cps. Replace V6004.

(2) Connect oscilloscope to cathode (pin 2) of V6004. Adjust C6049 to obtain pattern shown in figure 5-3(a).

(3) Connect oscilloscope to cathode (pin 2) of V6005. Adjust C6050 to obtain pattern shown in figure 5-3(b).

(4) Remove V6005. Connect oscilloscope to arm of R6045. Adjust R6045 to obtain minimum 250-kc signal as indicated by oscilloscope. Replace V6005.

(5) Connect oscilloscope to jack J6009. Tune T6007 until output level as indicated by oscilloscope is 2.8 v peak-to-peak.

(6) Connect oscilloscope to jack J6011. Tune T6006 until output level as indicated by oscilloscope is 2.8 v peak-to-peak.

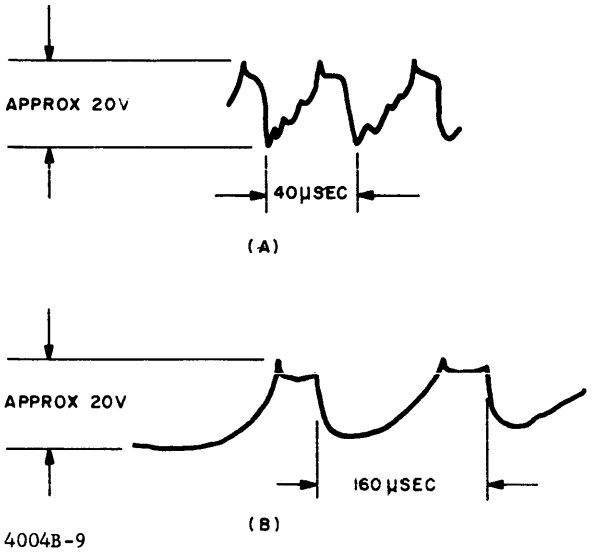

Figure 5-3. Phantastron Divider Waveforms

PARTS LIST

6-1. INTRODUCTION.

Reference designations have been assigned to identify all electrical parts of the equipment. These designations 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 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 F101 is designated XF101. To expedite delivery, when ordering replacement parts, specify the TMC part number and the model number of the equipment.

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
AT6001	DUMMY LOAD, ELECTRICAL: 47 ohms, ±10%; 1/2 watt; twist lock; BNC type.	DL100-4
AT6002 thru AT6005	Same as AT6001.	
C6001	CAPACITOR, FIXED, MICA DIELECTRIC: 10 uuf, ±10%; 300 WVDC; char. C.	CM15C100K
C6002	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 4.5-25.0 uuf; 500 WVDC.	CV11A250
C6003	CAPACITOR, FIXED, MICA DIELECTRIC: 510 uuf, ±5%; 300 WVDC; char. B.	CM15B511J
C6004	Same as C6003.	
C6005	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .1 uf, +80% -20%; 500 WVDC.	CC100-32
C6006 thru C6009	Same as C6005.	
C6010	Same as C6002.	
C6011	CAPACITOR, FIXED, MICA DIELECTRIC: 10 uuf, ±5%, 500 WVDC; char. B.	CM15B100J
C6012	CAPACITOR, FIXED, MICA DIELECTRIC: 240 uuf, ±5%; 300 WVDC; char. B.	CM15B241J
C6013	CAPACITOR, FIXED, MICA DIELECTRIC: 220 uuf, ±5%; 500 WVDC; char. B.	CM15B221J
C6014 thru C6019	Same as C6005.	
C6020	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +80% -20%; 500 WVDC.	CC100-24
C6021	Same as C6005.	
C6022	Same as C6005.	
C6023	CAPACITOR, FIXED, MICA DIELECTRIC: 47 uuf, ±5%; 300 WVDC; char. B.	CM15B470J
C6024	CAPACITOR, FIXED, MICA DIELECTRIC: 5 uuf, ±20%; 300 WVDC; char. B.	CM15B050M
C6025	CAPACITOR, FIXED, MICA DIELECTRIC: 270 uuf; ±5%; 500 WVDC; char. B.	CM15B271J
C6026	Same as C6023.	
C6027	Same as C6005.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C6028	Same as C6020.	
C6029	Same as C6020.	
C6030	CAPACITOR, FIXED, PLASTIC DIELECTRIC: mylar; 1.0 uf; ±10%; 200 WVDC.	CN112A105K2
C6031 thru C6036	Same as C6005.	
C6037	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100, 000 uuf; +80% -20%; 100 WVDC.	CC100-28
C6038	Same as C6037.	
C6039 thru C6042	Same as C6005.	
C6043	Same as C6037.	
C6044	Same as C6037.	
C6045	Same as C6005.	
C6046	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10, 000 uuf; GMV; 500 WVDC.	CC100-16
C6047	Same as C6001.	
C6048	Same as C6001.	
C6049	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 7 - 45 mmfd; 500 WVDC: char. C.	CV11C450
C6050	Same as C6049.	
C6051	Same as C6046.	
C6052	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 200, 000 uuf, +80%, -20%; 25 WVDC.	CC100-33
C6053	Same as C6052.	
CR6001	SEMICONDUCTOR DEVICE, DIODE: silicon; 175 V max. peak inverse voltage; 30 ma at 25°C and 15 ma at 150°C; two axial wire lead type terminals; hermetically sealed glass case.	1N463
CR6002	Same as CR6001.	
CR6003	DIODE ASSEMBLY: germanium; four diodes; hermetically sealed.	DD100
EV6001	SHIELD, ELECTRON TUBE: heat dissipating; type D; 2-1/16" height; black cadmium plated.	TS128-5
EV6002	Same as EV6001.	
EV6003	SHIELD, ELECTRON TUBE: heat dissipating; type C; 2-1/16" height; black cadmium plated.	TS128-2

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
EV6004	SHIELD, ELECTRON TUBE: heat dissipating; type C; 1-1/2" height; black cadmium plated.	TS128-1
EV6005	Same as EV6004.	
EV6006	Same as EV6001.	
EV6007	Same as EV6004.	
EV6008	Same as EV6004.	
FL6001	FILTER, BANDPASS, CRYSTAL: operating frequency 243.710 Kc; bandwidth 243.660 Kc, ±5 cps to 243.760 Kc, ±5 cps; input impedance 300 ohms; output impedance 47,000 ohms; operating temperature range 0°C to 70°C; hermetically sealed steel case.	FX192
FL6002	FILTER, BANDPASS, CRYSTAL: operating frequency 256.290 Kc; bandwidth 256.240 Kc, ±5 cps to 256.340 Kc, ±5 cps; input impedance 300 ohms; output impedance 47,000 ohms; operating temperature range 0°C to 70°C; hermetically sealed steel case.	FX193
HR6001	Non-replaceable item. Part of Z6001.	
HR6002	Non-replaceable item. Part of Z6002.	
HR6003	Non-replaceable item. Part of Z6003.	
I6001	LAMP, NEON: miniature; 105/125 V, 1/25 watt; T-3-1/4 clear bulb, bayonet base.	BI100-51
I6002	LAMP, INCANDESCENT: 6-8 volts, 0.25 amps; bayonet base; T-3-1/4 bulb.	BI101-44
I6003	Same as I6002.	
J6001	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 female contact; 52 ohms; BNC type.	UG625B/U
J6002 thru J6014	Same as J6001.	
J6015	CONNECTOR, RECEPTACLE, ELECTRICAL: 14 male contacts; rated at 17.0 amps.	JJ200-2
L6001	COIL, RADIO FREQUENCY: fixed; 2.5 uhy; 100 ma max. current; DC resistance approx. 40 ohms; bakelite body.	CL101-3
L6002	COIL, RADIO FREQUENCY: fixed; 10 uhy; 100 ma max. current; DC resistance approx. 30 ohms; bakelite body.	CL101-4
L6003	Same as L6001.	
L6004	COIL, RADIO FREQUENCY: fixed; .820 mh ±10%; 100 ma; iron core coil.	CL140-8
L6005	COIL, RADIO FREQUENCY: fixed; 47,000 uh, ±5%; 452 ohms DC resistance, 27 ma current rating; molded case.	CL275-473

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L6006	COIL, RADIO FREQUENCY: fixed; inductance, 50.0 uh; resonant frequency, 40 mc; max. DC resistance 110 ohms.	CL226-5
R6001	RESISTOR, VARIABLE, COMPOSITION: 10,000 ohms, ±10%; 2 watts; with locking bushing.	RV4LAYSA103A
R6002	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±5%; 1/2 watt.	RC20GF104J
R6003	RESISTOR, FIXED, COMPOSITION: 6,800 ohms, ±5%; 1/2 watt.	RC20GF682J
R6004	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, ±5%; 1/2 watt.	RC20GF223J
R6005	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 2 watts.	RC42GF472J
R6006	RESISTOR, FIXED, COMPOSITION: 15,000 ohms, ±5%; 1/2 watt.	RC20GF153J
R6007	RESISTOR, FIXED, COMPOSITION: 150 ohms, ±5%; 1/2 watt.	RC20GF151J
R6008	Same as R6002.	
R6009	RESISTOR, FIXED, COMPOSITION: 3,900 ohms, ±5%; 1/2 watt.	RC20GF392J
R6010	RESISTOR, FIXED, COMPOSITION: 8,200 ohms, ±5%; 1/2 watt.	RC20GF822J
R6011	Same as R6005.	
R6012	Same as R6006.	
R6013	Same as R6007.	
R6014	Same as R6001.	
R6015	Same as R6004.	
R6016	RESISTOR, FIXED, COMPOSITION: 4,700 ohms, ±5%; 1/2 watt.	RC20GF472J
R6017	Same as R6003.	
R6018	RESISTOR, FIXED, COMPOSITION: 1,000 ohms, ±5%; 1/2 watt.	RC20GF102J
R6019	Same as R6004.	
R6020	RESISTOR, FIXED, COMPOSITION: 82,000 ohms, ±5%; 1/2 watt.	RC20GF823J
R6021	RESISTOR, FIXED, COMPOSITION: 12,000 ohms, ±5%; 1/2 watt.	RC20GF123J
R6022	Same as R6002.	
R6023	RESISTOR, FIXED, COMPOSITION: 3,300 ohms, ±5%; 1/2 watt.	RC20GF332J
R6024	RESISTOR, FIXED, COMPOSITION: 390,000 ohms, ±5%; 1/2 watt.	RC20GF394J
R6025	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±5%; 1/2 watt.	RC20GF473J
R6026	RESISTOR, FIXED, COMPOSITION: 120,000 ohms, ±5%, 1/2 watt.	RC20GF124J
R6027	RESISTOR, FIXED, COMPOSITION: 1.8 megohms, ±5%; 1/2 watt.	RC20GF185J
R6028	Same as R6002.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R6029	Same as R6004.	
R6030	Same as R6020.	
R6031	Same as R6021.	
R6032	Same as R6002.	
R6033	Same as R6023.	
R6034	RESISTOR, FIXED, COMPOSITION: 2.2 megohms, ±5%; 1/2 watt.	RC20GF225J
R6035	Same as R6018.	
R6036	Same as R6004.	
R6037	Same as R6006.	
R6038	RESISTOR, FIXED, COMPOSITION: 150,000 ohms, ±5%; 1/2 watt.	RC20GF154J
R6039	Same as R6026.	
R6040	Same as R6016.	
R6041	RESISTOR, FIXED, COMPOSITION: 680 ohms, ±5%; 1/2 watt.	RC20GF681J
R6042	RESISTOR, FIXED, COMPOSITION: 47 ohms, ±5%; 1/2 watt.	RC20GF470J
R6043	Same as R6042.	
R6044	Same as R6042.	
R6045	RESISTOR, VARIABLE, COMPOSITION: 100 ohms, ±10%; 2 watts.	RV4LAYSA101A
R6046	Same as R6016.	
R6047	RESISTOR, FIXED, COMPOSITION: 2,200 ohms, ±5%; 1/2 watt.	RC20GF222J
R6048	RESISTOR, FIXED, COMPOSITION: 220,000 ohms, ±5%; 1/2 watt.	RC20GF224J
R6049	RESISTOR, FIXED, COMPOSITION: 270 ohms, ±5%; 1/2 watt.	RC20GF271J
R6050	Same as R6049.	
R6051	Same as R6006.	
R6052	Same as R6025.	
R6053	RESISTOR, FIXED, COMPOSITION: 390 ohms, ±5%; 1/2 watt.	RC20GF391J
R6054	Same as R6016.	
R6055	Same as R6006.	
R6056	Same as R6025.	
R6057	Same as R6016	
R6058	Same as R6053.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R6059	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±10%; 1/2 watt.	RC20GF101K
R6060	Same as R6059.	
R6061	Same as R6018.	
R6062	Same as R6034.	
R6063	Same as R6002.	
R6064	Same as R6006.	
R6065	Same as R6004.	
R6066	RESISTOR, FIXED, WIREWOUND: 1,200 ohms, ±5%; current rating 130 ma; 20 watts.	RW110-21
R6067	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±10%; 1/2 watt.	RC20GF100K
S6001	SWITCH, ROTARY: 2 section, 3 positions, 30° angle of throw; 1 amp, 28 VDC or 5 amp 110 VAC; 2 non-shorting contacts, 2 silver plated brass contacts; 2 bakelite wafers.	SW343
T6001	TRANSFORMER, RADIO FREQUENCY: tuned; 250 Kc operating frequency; consists of one capacitor, 1500 uuf.	TT163
T6002	TRANSFORMER, RADIO FREQUENCY: tuned; operating frequency range 200 Kc to 2 Mc; primary 50 ohms, secondary 5,000 ohms; black rectangular case.	TZ107
T6003	TRANSFORMER, AUDIO FREQUENCY: primary 30,000 ohms, secondary 50,200, 500 ohms; 2-1/4" x 1-5/8" x 1-5/8" o/a dia.	TF114
T6004	TRANSFORMER, RADIO FREQUENCY: fixed, operating frequency 250 Kc; nominal inductance 2.2 ±20% min. Q = 30; blue or black potted case.	TZ172
T6005	Same as T6002.	
T6006	Same as T6001.	
T6007	Same as T6001.	
V6001	TUBE, ELECTRON: triode pentode; 9 pin miniature.	6EU8
V6002	Same as V6001.	
V6003	TUBE, ELECTRON: remote cutoof RF pentode; 7 pin miniature.	6BA6
V6004	TUBE, ELECTRON: RF amplifier pentode; 7 pin miniature.	6AS6
V6005	Same as V6004.	
V6006	TUBE, ELECTRON: duo triode; 9 pin miniature.	12AT7
V6007	TUBE, ELECTRON: pentode; sharp cutoff; 7 pin miniature.	6CE5
V6008	Same as V6007.	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XCR6001	NOT USED.	
XCR6002	NOT USED.	
XCR6003	SOCKET, ELECTRON TUBE: 7 pin miniature; button mounting, bakelite, mica filled insulation, with center shield.	TS130-MPW
XIS6001	LIGHT, INDICATOR: with clear white lens; for miniature bayonet base T-3-1/4 bulb.	TS106-2
XIS6002	LIGHT, INDICATOR: with red frosted lens; for miniature bayonet base T-3-1/4 bulb.	TS106-1
XIS6003	LIGHT, INDICATOR: with green frosted lens; for miniature bayonet base T-3-1/4 bulb.	TS106-3
XV6001	SOCKET, ELECTRON TUBE: 9 pin miniature.	TS103-P01
XV6002	Same as XV6001.	
XV6003	SOCKET, ELECTRON TUBE: 7 pin miniature.	TS102-P01
XV6004	Same as XV6003.	
XV6005	Same as XV6003.	
XV6006	Same as XV6001.	
XV6007	SOCKET, ELECTRON TUBE: 7 pin miniature stand-off; bayonet shield base, ground tab and center shield.	TS160-1
XV6008	Same as XV6007.	
XZ6001	SOCKET, ELECTRON TUBE: octal, high crown.	TS101-P01
XZ6002	Same as XCR6003.	
XZ6003	Same as XCR6003.	
Y6001	Non-replaceable item. Part of symbol Z6001.	
Y6002	CRYSTAL UNIT, QUARTZ: 2.000 mc, ±.002%; 75° to 90°C operating temperature range, parallel resonance, 32.0 uuf ±0.5 load capacitance; fundamental operation; type HC-6/U holder. Part of symbol Z6002.	CR27A/U 2.000 000MC
Y6003	CRYSTAL UNIT, QUARTZ: 250 Kc, ±.002%; 75° to 80°C operating temperature range, parallel resonance, 20 uuf ±0.5 uuf load capacitance; fundamental operation; type HC-6/U holder. Part of symbol Z6003.	CR47A/U 250.0 00KC
Z6001	OSCILLATOR, CRYSTAL, PLUG-IN: 115 V AC or DC oven operating voltage; 28 ±4 VDC oscillator operating voltage; oven power 11 watts; 4-21/64" high x 1-17/32" wide x 1-7/8" long; octal base. Consists of symbol No's HR6001 and Y6001.	NF112-2
Z6002	OVEN, CRYSTAL: temperature setting 75°C; stability ±2°C; accommodates on HC-6/U holder; 7 pin miniature plug in case. Consists of symbol No's HR6002 and Y6002.	PO214
Z6003	Same as Z6002. Consists of symbol No's HR6003 and Y6003.	

SECTION 7
SCHEMATIC DIAGRAMS

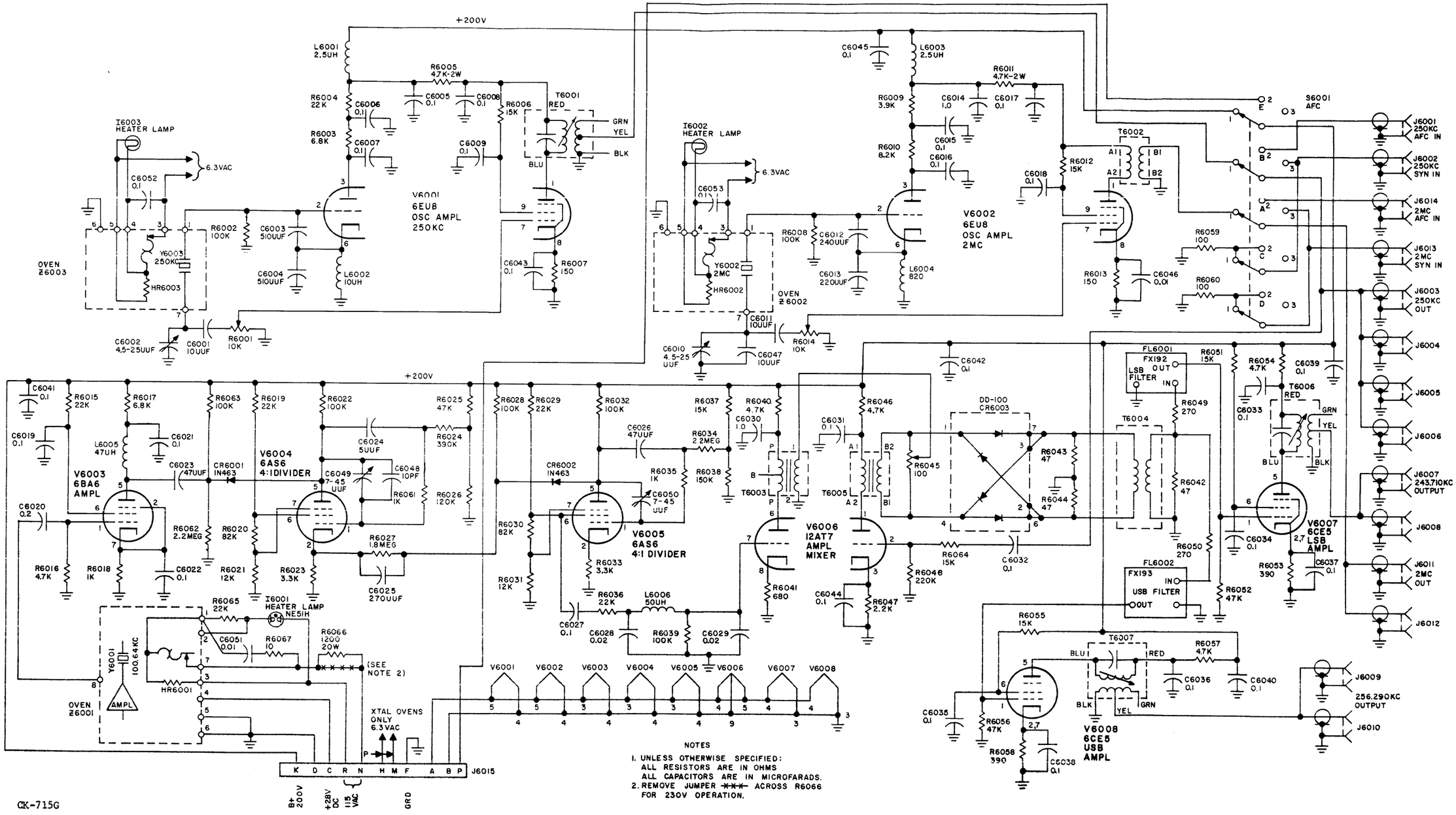

Figure 7-1. Multiplex Carrier Generator, Schematic Diagram