UNCLASSIFIED

TECHNICAL MANUAL

for

CONTROLLED OSCILLATOR MODEL CLL-1

(O-717/URA-31)

COMPONENT OF

CONTROLLED PRECISION OSCILLATOR MODEL CPO-1

(AN/URA-31)

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, ONTARIO

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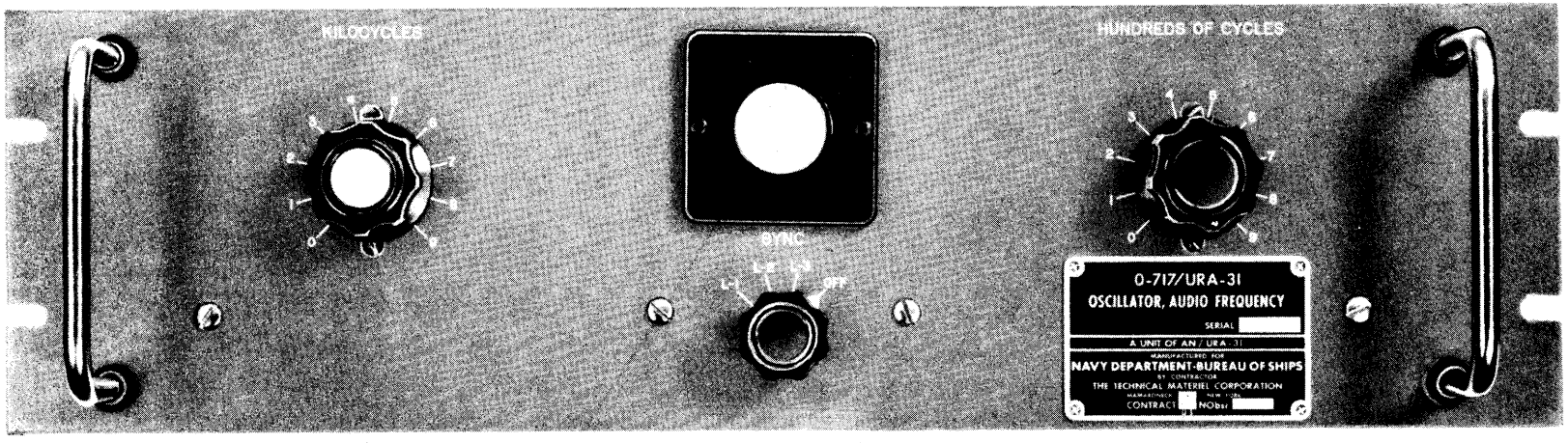


Figure III(E)-1-1a. Controlled Oscillator CLL-1, Front View

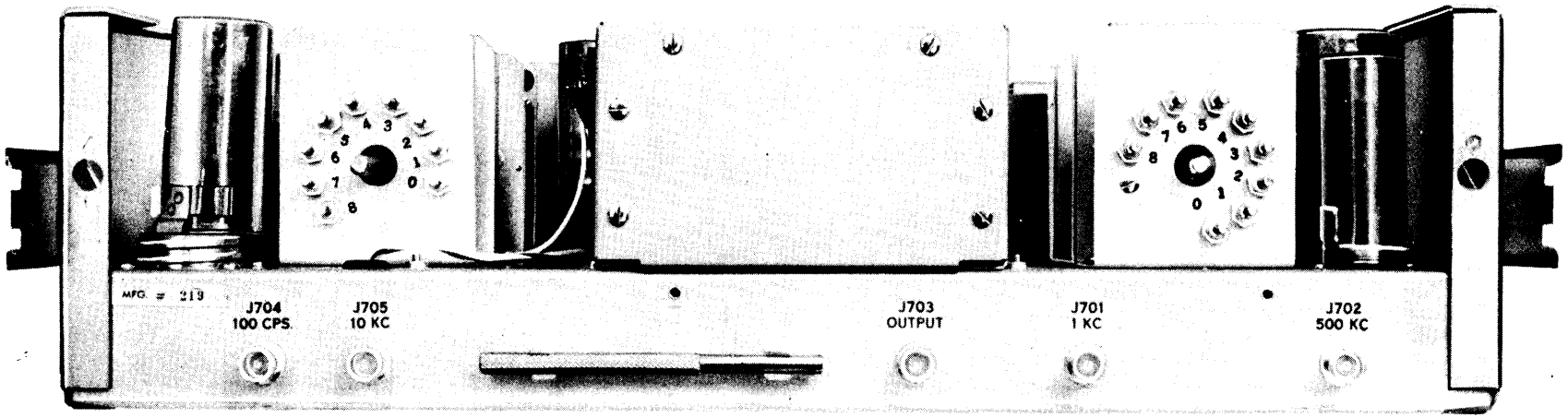


Figure III(E)-1-1b. Controlled Oscillator CLL-1, Rear View

SECTION 1
GENERAL DESCRIPTION

III(E)-1-1. PURPOSE AND BASIC PRINCIPLES.

Technical Materiel Corporation's Controlled Oscillator, CLL-1 (low frequency loop), supplies controlled frequencies in the 510- to 519.9-kc range in 100-cps steps. The frequency stability of the CLL-1 is one cycle in 100,000,000 per day.

CLL-1 is associated with three other units in the Controlled Precision Oscillator, CPO-1, as follows:

a. Divider Chain, CHL-1, provides four inputs-500-kc, 10-kc, 1-kc, and 100-cps for the CLL-1.

b. Controlled Master Oscillator, CMO-1, receives the output of the CLL-1.

c. Power Supply, CPP-2, provides +380 VDC (unregulated), -400 VDC (unregulated), +160 VDC (regulated), -75 VDC (regulated), -6 VDC (regulated), 6.3 VAC (regulated), and 115 or 230 VAC oven power for operation of the CLL-1.

CLL-1 has three loops. They function as follows:

a. Loop L1 is supplied with 100-cps from which a harmonic selector provides 1000- to 1900-cps in 100-cps steps. These frequencies control a 11- to 11.9-kc internal oscillator heterodyned with 10-kc supplied to loop L1. The final output of loop L1 (1000- to 1900-cps in 100-cps steps) is fed to loop L3.

b. Loop L2 is supplied with 1-kc from which a harmonic selector provides 9- to 18-kc in 1-kc steps. These frequencies control a 9- to 18-kc internal oscillator by phase-controlled circuits. The final output of loop L2 (9- to 18-kc in 1-kc steps) is fed to loop L3.

c. Loop L3 is supplied with 500-kc and with the outputs of loops L1 and L2. The output of loop L3 is 510- to 519.9-kc in 100-cps steps. The variation is obtained by adjustment of the harmonic selectors in loops L1 and L2. The output of loop L3 is a summation frequency of 500-kc plus the output frequencies set in loops L1 and L2.

The CLL-1 has a test oscilloscope on the front panel to visually monitor the products of the phase detectors in loops L1, L2, and L3.

III(E)-1-2. DESCRIPTION OF UNIT.

The CLL-1 is shown in figures III(E)-1-1a and III (E)-1-1b. The front panel is 3/16-inch thick by 19 inches long and 5-1/4 inches high and is finished in TMC gray enamel. The chassis extends 19 inches behind the panel and is self-supporting. The unit weighs 25 pounds.

Controls and indicators for the operation of the unit are located on the front panel. The equipment is manufactured in accordance with JAN/MIL standards, wherever practicable. All parts and assemblies meet or exceed highest quality standards.

III(E)-1-3. REFERENCE DATA.

The crated dimensions of the CLL-1 when packed with TIS-3 and CBE-1 are 32-1/2 by 23-1/8 by 27 inches. These three units weigh 194 pounds, gross, packed for shipment. Tables III(E)-1-1 through III(E)-1-4 contain additional reference data pertinent to the CSS-1.

TABLE III(E)-1-1. ELECTRICAL CHARACTERISTICS

ITEM	CHARACTERISTICS
Frequency stability:	1 part in 100,000,000 per day.
Input frequencies:	100-cps. 1-kc. 10-kc. 500-kc.
Input power:	115- or 230-volts, 60-cps, single phase.
Output frequencies:	510- to 519.9-kc in 100-cps steps.

TABLE III(E)-1-2. FRONT PANEL CONTROLS

CONTROL	FUNCTIONS
HUNDREDS OF CYCLES (0 to 9) selector switch:	Permits adjustment of output frequency.
KILOCYCLES (0 to 9) selector switch:	Permits adjustment of output frequency.
Oscilloscope:	Permits visual monitoring of the products of the phase detectors in the loops.
SYNC (L-1, L-2, L-3, OFF) selector switch:	Selects loop to be visually monitored with the front panel oscilloscope.

TABLE III(E)-1-3. CHASSIS ADJUSTMENTS

ADJUSTMENT	REFERENCE DESIGNATION	FUNCTION
	C719	9-18 kc osc adj. (0)
	C721	9-18 kc osc adj. (1)
	C723	9-18 kc osc adj. (2)
	C725	9-18 kc osc adj. (3)
	C727	9-18 kc osc adj. (4)
	C729	9-18 kc osc adj. (5)
	C731	9-18 kc osc adj. (6)
	C733	9-18 kc osc adj. (7)
	C735	9-18 kc osc adj. (8)
	C739	9-18 kc osc adj. (9)
	C772	100 cps trimmer (0)
	C773	100 cps trimmer (1)
	C774	100 cps trimmer (2)
	C775	100 cps trimmer (3)
	C776	100 cps trimmer (4)
	C777	100 cps trimmer (5)
	C778	100 cps trimmer (6)
	C779	100 cps trimmer (7)
	C780	100 cps trimmer (8)
	C782	1000 cps trimmer (0)

TABLE III(E)-1-3. CHASSIS ADJUSTMENTS (Cont.)

ADJUSTMENT	REFERENCE DESIGNATION	FUNCTION
	C783	1000 cps trimmer (1)
	C784	1000 cps trimmer (2)
	C785	1000 cps trimmer (3)
	C786	1000 cps trimmer (4)
	C787	1000 cps trimmer (5)
	C788	1000 cps trimmer (6)
	C789	1000 cps trimmer (7)
	C790	1000 cps trimmer (8)
	C815	
	L701	
	L707 – L708 in oven	
9-18 kc balance	R712	
1-2 kc balance	R755	
Low frequency balance	R763	
Horizontal	R773	
Vertical	R774	
Focus	R781	
Intensity	R785	
	T702	

TABLE III(E)-1-4. VACUUM TUBE COMPLEMENT

SYMBOL	TYPE	FUNCTION
V701A	6U8	9-18 kc harmonic selector.
V701B		Cathode follower.
V702A	6U8	Reactance tube.
V702B		9-18 kc oscillator.
V703A	6U8	Amplifier.
V703B		Low frequency phase detector.
V704	6BA7	Converter.
V705	6AU7	1-1.9 kc harmonic selector.
V706A	6U8	Reactance tube.
V706B		11-11.9 kc oscillator.
V707	6BA7	Converter.
V708A	6U8	Reactance tube.
V708B		510-520 kc oscillator.
V709	6BA7	Converter/10-19.9 kc selector.
V710	6AU6	Amplifier.
V711	6AB4	10-kc amplifier.
V712A	12AT7	Horizontal amplifier (oscilloscope).
V712B		Vertical amplifier (oscilloscope).
V713	1EP1	Oscilloscope.

SECTION 2
INSTALLATION

III(E)-2-1. GENERAL.

Technical Materiel Corporation packages test and exciter units as follows:

a. The unit is wrapped with paper to prevent scratching and wedged in a cardboard carton with heavy cardboard corrugated fillers. Dessicant, accessories, and spare parts, if practical, are placed in the carton and it is sealed.

b. The carton is sealed in a moisture-proof barrier bag.

c. The carton in the barrier bag is placed in a waterproof outer carton and it is sealed.

d. The sealed carton is wedged to tightness in a strong wooden packing box.

e. The packing box is encircled with two steel straps. The top side of the box may be located by observing the seals on the straps. When the seals are removed, this side of the box may be readily pried open.

III(E)-2-2. INITIAL INSPECTION.

Each CLL-1 has been tested and calibrated before shipment. Only minor preparations are required to put the unit into operation.

Upon arrival at the operating site, inspect the packing case and its contents immediately for possible damage. Unpack the equipment carefully. Inspect all packing material for parts which may have been shipped as "loose items." Although the carrier is liable for any damage to the equipment, Technical Materiel Corporation will assist in describing and providing for repair or replacement of damaged items.

The equipment is shipped with plug-in components installed. Check that all such components are properly sealed in their sockets.

III(E)-2-3. 115- VS. 230-VOLT POWER SUPPLY CONNECTIONS.

CLL-1 is normally operated from 115- or 230-volt, 60-cycle, single-phase power; it is factory wired for 115-volts. If 230-volt operation is required, make the connections shown in figure III(E)-8-1.

III(E)-2-4. INTERCONNECTIONS.

Figure I-2-1 indicates the following interconnections in rack AX-239.

a. 100 CPS OUT (J106) of CHL-1 to 100 CPS IN (J704) of CLL-1 via CA572 (P3020, P3033).

b. 10 KC OUT (J113) of CHL-1 to 10 KC IN (J705) of CLL-1 via CA572 (P3021, P3031).

c. OUTPUT (J703) of CLL-1 to 510-520 KC INPUT (J308) of CMO-1 via CA572 (P3018, P3022).

d. 1 KC OUT (J105) of CHL-1 to 1 KC IN (J701) of CLL-1 via CA572 (P3023, P3032).

e. 500 KC OUT (J103) of CHL-1 to 500 KC IN (J702) of CLL-1 via CA572 (P3024, P3029).

f. Power Supply (J501) of CPP-2 to J706 of CLL-1 via CA-551-2, W3003 (P3040, P3041).

Figure I-2-2 indicates the following interconnections in rack RAK-11:

a. 100 CPS OUT (J106) of CHL-1 to 100 CPS IN (J704) of CLL-1 via CA590 (P914, P920).

b. 10 KC OUT (J113) of CHL-1 to 10 KC IN (J705) of CLL-1 via CA590 (P910, P918).

c. OUTPUT (J703) of CLL-1 to 510-520 KC INPUT (J308) of CMO-1 via CA590 (P907, P913).

d. 1 KC OUT (J105) of CHL-1 to 1 KC IN (J701) of CLL-1 via CA590 (P911, P919).

e. 500 KC OUT (J103) of CHL-1 to 500 KC IN (J702) of CLL-1 via CA590 (P912, P916).

f. Power Supply (J501) of CPP-2 to J706 of CLL-1 via CA-551-2 (P929, P930).

III(E)-2-5. INITIAL ADJUSTMENTS.

See alignment procedure contained in III(G)-8, Test Procedure for Controlled Oscillator CLL-1 (low frequency loop).

SECTION 3
OPERATOR'S SECTION

III(E)-3-1. CLL-1 (low frequency loop) is a unit of the Controlled Precision Oscillator CPO-1. The operating chart contained in table I-3-1 provides the information necessary for operation of the CLL-1 as a component of the CPO-1.

SECTION 4
PRINCIPLES OF OPERATION

III(E)-4-1. INTRODUCTION.

CLL-1 (low frequency loop) is described briefly in paragraph I-4-6 and figure I-4-9. CLL-1 has four principal circuits as follows:

a. Loop L1 with an output of 1000- to 1900-cps in 100-cps steps.

b. Loop L2 with an output of 9- to 18-kc in 1-kc steps.

c. Loop L3 with an output of 510- to 519.9-kc in 100-cps steps.

d. Monitoring oscilloscope circuit.

Figure III(E)-8-1 is a schematic diagram of the CLL-1. Figures III(E)-4-1 through III(E)-4-4 are simplified schematic diagrams associated with stage-by-stage descriptions.

III(E)-4-2. LOOP L1. (See figure III(E)-4-1).

Precise 100-cycle voltages are fed to coaxial jack J704 from CHL-1 and reach grid 1 of 1-1.9-kc harmonic selector V705. The position of the wiper on wafer A of HUNDREDS OF CYCLES selector switch S702 determines the harmonic in the 1000- to 1900-cycle range that is passed on to the phase detector consisting of T703, CR705, and CR706. For example, in position 0, the phase detector receives 1000-cycles; in position 1, 1100-cycles; in position 2, 1200-cycles; etc.

Converter V707 receives an input voltage on grid 2 from oscillator V706B, whose frequency is in the 11- to 11.9-kc range, as determined by the position of the wiper on wafer B of HUNDREDS OF CYCLES selector switch S702. For example, if the selected harmonic out of V705 is 1500-cps, the frequency output of V706B will be approximately 10-kc plus 1500 cps or 11.5-kc. Converter V707 (grid 7) also receives a precise input voltage of 10-kc from CHL-1 via coaxial jack J705, and amplifier V711. The converter's plate tank is tuned by the wiper on wafer C of HUNDREDS OF CYCLES selector switch S702, to pass the difference frequency of V706B and V711; this should be close to the selected frequency of V705.

The phase detector that consists of T703, CR705, and CR706 compares: (a) the selected harmonic frequency of V705 and (b) the difference frequency of V706 and V711. If the voltages of (a) and (b) are $V_a = V_b \angle 90$ and their frequencies are identical, no dc is fed to the reactance tube; this means that V706B can produce its synthesized frequency with action of the reactance tube. If the frequency of V_b is not identical to that of V_a, then $V_a = V_b \angle 90 \pm DX$. Dc is is fed to the reactance tube; this means that V706B cannot produce its synthesized frequency without action of the reactance tube.

The synthesized output of converter V707 is passed to V708A in Loop 3. This output is sampled by oscilloscope V713 (h-plates) and compared with V705's output (v-plates) when switch S703A is in L-1 position.

III(E)-4-3. LOOP L2. (See figure III(E)-4-2).

Precise 1000-cycle voltages are fed to coaxial jack J701 from CHL-1 and reach grid 2 of 9-18 kc harmonic selector V701A. The position of the wiper on wafer A of KILOCYCLES selector switch S701 determines the harmonic in the 9- to 18-kc range that is passed on to the phase detector consisting of T701, CR703, and CR704. For example, in position 0, the phase detector receives 9-kc; in position 1, 10-kc; in position 2, 11-kc; etc.

The output frequency of 9- to 18-kc oscillator V702B is determined by the position of the wiper on wafer B

of KILOCYCLES selector switch S701. For example; in position 0, the output frequency of V702B is 9-kc; in position 1, 10-kc; in position 2, 11-kc; etc. V702B's output voltage is amplified by V703A, whose output is fed to the phase detector consisting of T701, CR703, and CR704. This phase detector compares: (a) the 9-18-kc output of harmonic selector V701A and (b) the 9-18-kc output of oscillator B702B. If the voltages of (a) and (b) are $V_a = V_b \angle 90$ and their frequencies are identical, no dc is fed to the reactance tube; this means that V702B can produce its synthesized frequency without action of the reactance tube. If the frequency of V_b is not identical to that of V_a, then $V_a = V_b \angle 90 \pm DX$. Dc is fed to the reactance tube; this means that V702B cannot produce its synthesized frequency without action of the reactance tube.

The synthesized output of amplifier V703A is passed to converter V704 in Loop L3.

Oscilloscope V713 samples two voltages in Loop L2 when switch S703A is in L-2 position. The voltage at cathode 8 of V702 is applied to the h-plates while the voltage at plate 6 of V701 is applied to the v-plates.

III(E)-4-4. LOOP L3. (See figure III(E)-4-3).

Precise 500-kc voltages are fed to coaxial jack J702 from CHL-1 and reach grid 7 of converter and 10-19.9-kc selector V709. The output of 510-520-kc oscillator V708B also reaches V709 on grid 2 via amplifier V710 and part of network T702. V708B's plate tank consists of components contained in an oven, components mounted on wafer D of KILOCYCLES selector switch S701, components mounted on wafer D of HUNDREDS OF CYCLES selector switch S702, and reactance tube V708A. The latter is under control of the phase detector consisting of T704, CR707, and CR708. These frequency controls enable V708B to provide a synthesized output in the range of 510- to 519.9-kc in 100-cps steps. V709's plate tank circuit is tuned by wafer C of KILOCYCLES selector switch S701 to pass the difference frequency of 510-520-kc oscillator V708B and the 500-kc input at J702. The tank has ten band settings controlled by KILOCYCLES selector switch S701.

Synthesized 9-18-kc voltages are fed to grid 2 of converter V704 from amplifier V703A in Loop L2. Converter V704 also receives the 10-19.9-kc output from V709 on grid 7. A 2-kc low pass filter in its plate circuit passes the difference frequency of V704's two grid supplies. For example, at one extreme, the difference frequency is 10-9 or 1-kc; at the other extreme, 19.9-18 or 1.9-kc.

The phase detector consisting of T704, CR707, and CR708 compares two voltages in the 1-kc to 1.9-kc range, namely (a) 2-kc low pass filter Z701's output and (b) the synthesized 1-kc to 1.9-kc input from converter V707 in Loop 1. If the voltages of (a) and (b) are $V_a = V_b \angle 90$ and their frequencies are identical, no dc is fed to the reactance tube; this means that V708B can produce its synthesized frequency without action of the reactance tube. If the frequency of V_b is not identical to that of V_a, then $V_a = V_b \angle 90 \pm DX$. Dc is fed to the reactance tube; this means that V708B cannot produce its synthesized frequency without action of the reactance tube.

V708B's frequency corresponds to:

a. A 1- to 1.9-kc synthesized voltage in 100-cps steps.

b. A 9- to 19-kc synthesized voltage in 1000-cps steps.

c. A precise 500-kc voltage from CHL-1.

Consequently V708B's frequency is synthesized by the various frequency conversions in the range 510- to 519.9-kc in 100-cps steps.

Oscilloscope V713 samples two voltages in Loop L3 when switch S703A is in L-3 position. The voltage at plate 9 of V707 is applied to the h-plates while the voltage at plate 1 of V703B is applied to the v-plates.

III(E)-4-5. MONITORING OSCILLOSCOPE (See figure III(E)-4-4).

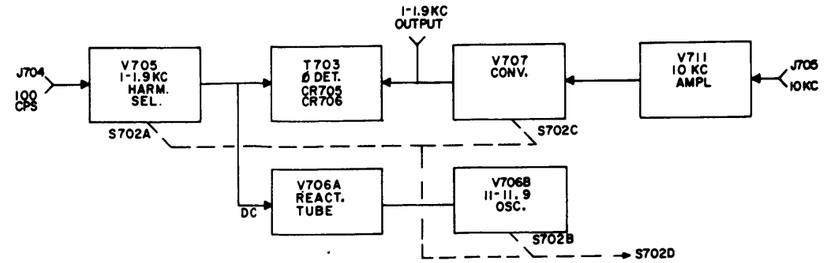
Selector switch S703 enables monitoring oscilloscope V713 to show patterns based on the quantities listed in table III(E)-4-1.

TABLE III(E)-4-1. OSCILLOSCOPE CONNECTIONS

Position	H-Plates	V-Plates
L1	Plate 9 of V707	Plate 5 of V705
L2	Cathode 8 of V702	Plate 6 of V701A
L3	Plate 9 of V707	Plate 1 of V703B

V713's vertical plates receive a square wave from diodes CR701 and CR702. The horizontal plates receive a sine wave. The two waves are approximately equal and 90 degrees apart. The resulting pattern on the CRO is a square.

In L-1 position, the CRO compares two 1- to 1.9-kc voltages; in L-2 position, the CRO compares two 9- to 18-kc voltages; in L-3 position, the CRO compares two 1- to 1.9-kc voltages. A square pattern in the L-3 position is equivalent to synthesized 1- to 1.9-kc, 9- to 18-kc, and 510- to 519.9-kc voltages.



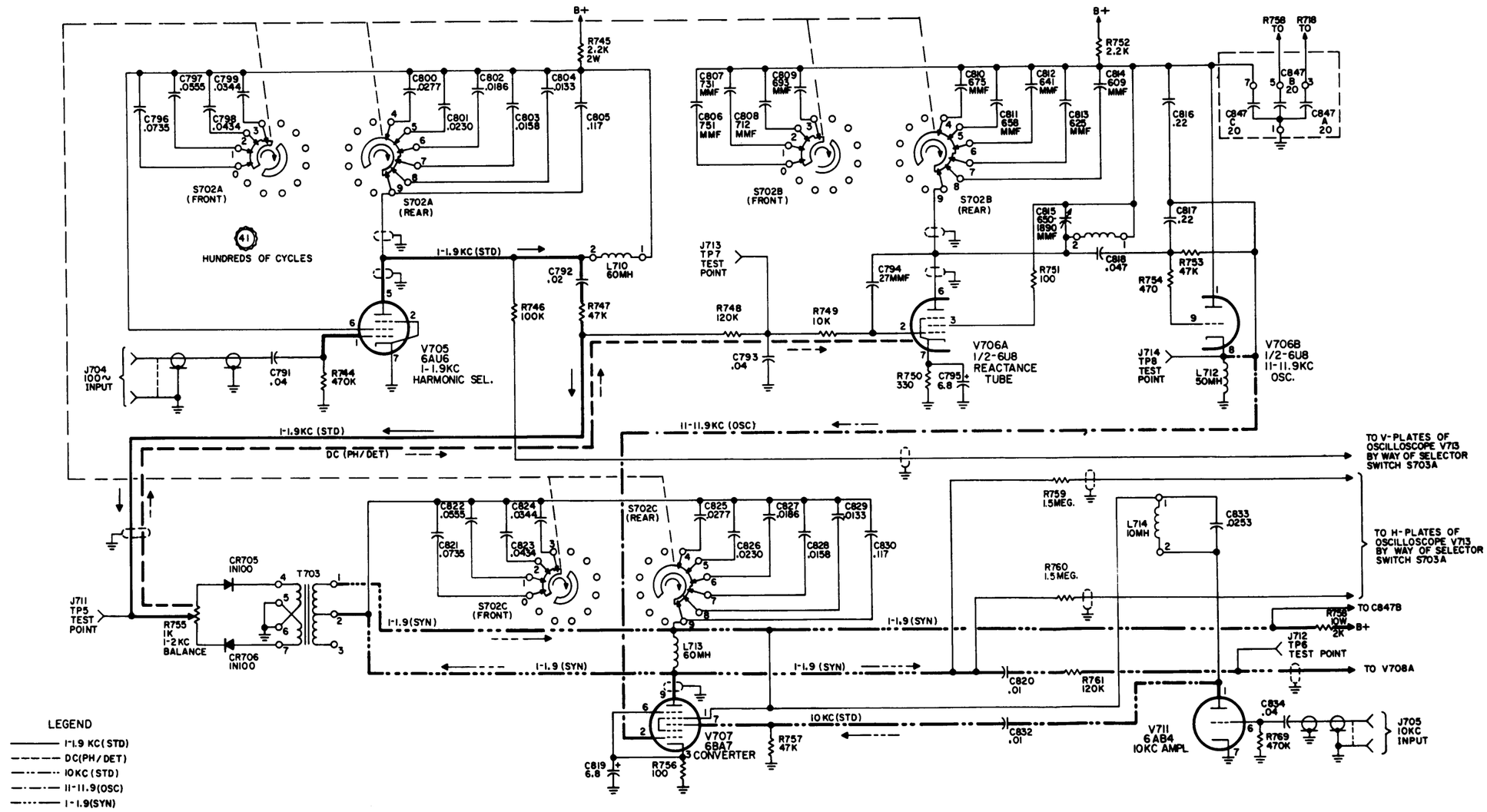


Figure III(E)-4-1. Loop L1, Controlled Oscillator CLL-1

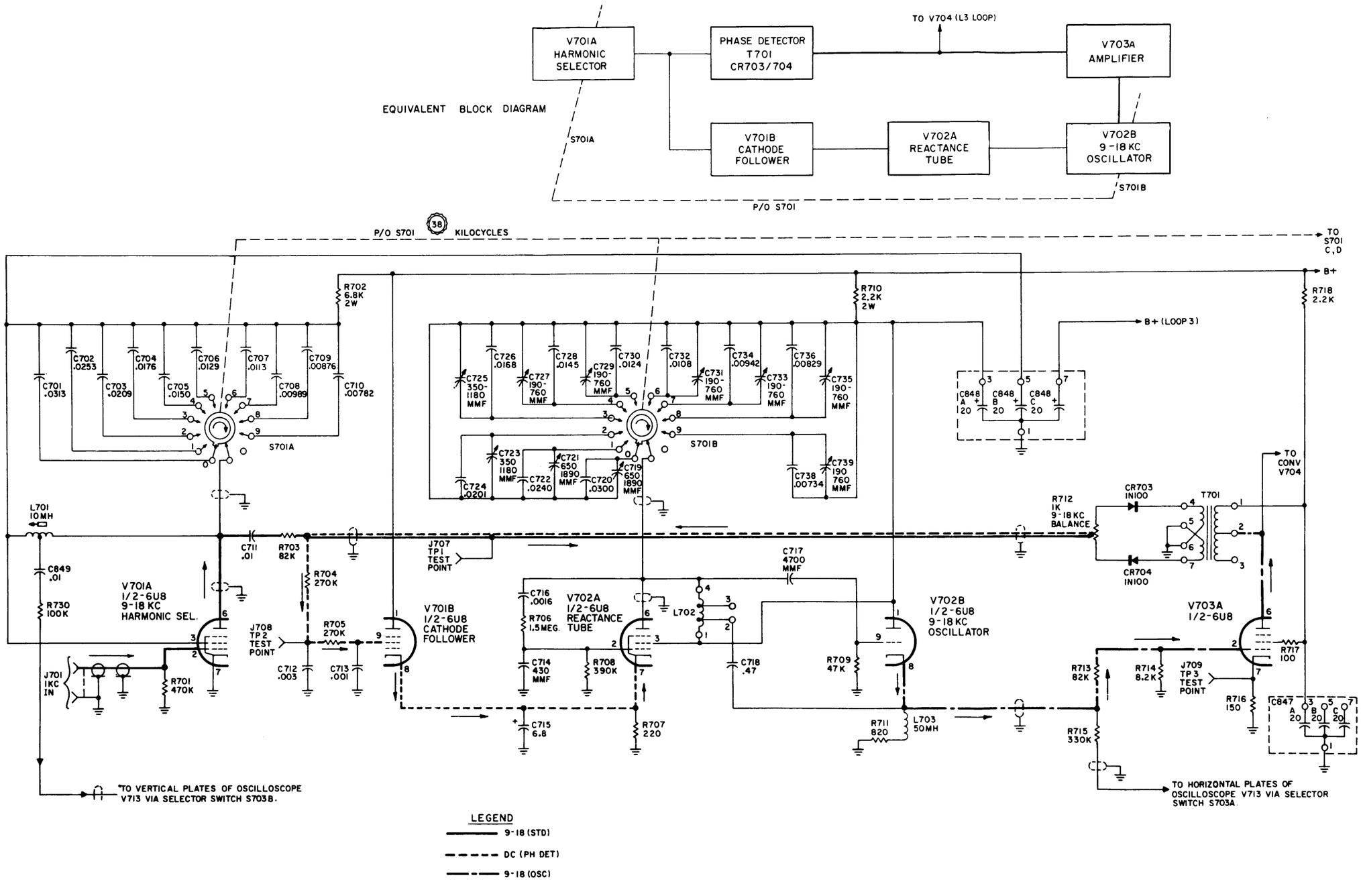


Figure III(E)-4-2. Loop L2, Controlled Oscillator CLL-1

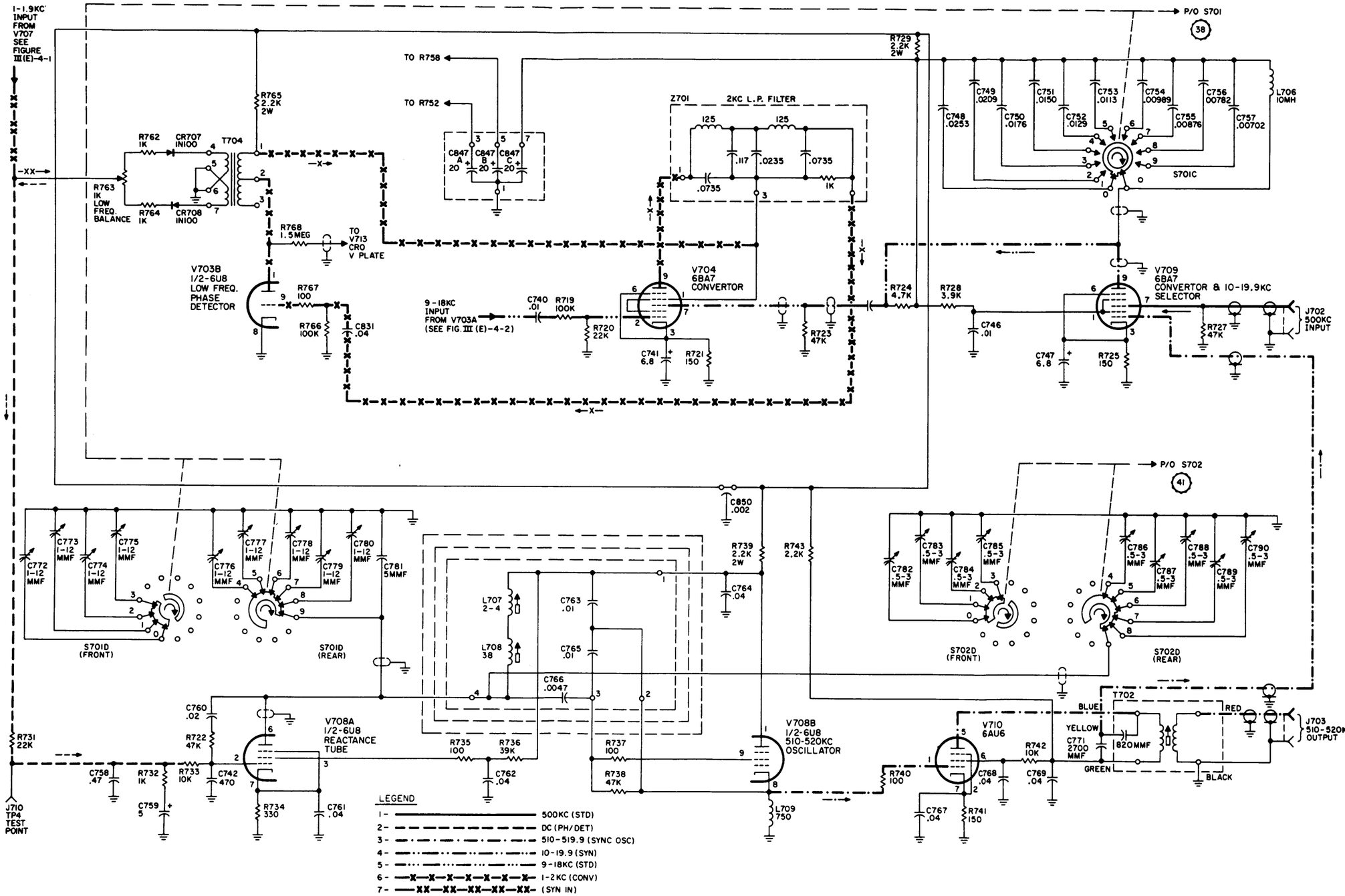


Figure III(E)-4-3. Loop L3, Controlled Oscillator CLL-1

S703A, S703B	
POS.	FUNCTION
1	L1
2	L2
3	L3
4	OFF

CATHODE V702B 9-18 KC OSC

PLATE V701A 9-18 KC HARM. SEL.

C835 300 MMF

S703A (FRONT)

S703B (FRONT)

S703A (REAR)

S703B (REAR)

V712A 1/2-12AT7 HORIZONTAL

C837 .04

R770 39K

R771 560

C841 6.8

C838 .04

R792 33K

V712B 1/2-12AT7 (VERTICAL)

CR701 IN100

CR702 IN100

R790 180

R789 180

R791 33K

R787 470K

R786 560

R788 15K

C839 6.8

C836 .0016

TO PLATE V707 IF-1.9/10 CONV

TO PLATE V7038 (LF PH DET)

TO PLATE V705 1-1.9 KC HARM SEL

TO R765

TO L710

R772 22K

R794 2.2K

R795 2.2K

R780 22K

C842 .1

C840 .1

C846 8 20

C846A 20

C846C 20

R773 1.0 MEG

R774 1.0 MEG

R775 820K

R778 560K

R776 820K

R779 560K

R777 68K

CRO 39

V713 1 EPI

R781 500K FOCUS

R782 68K

R783 100K INTENSITY

R784 33K

R785 120K

C843 .01

C580 TO

C845 8 20

C845A 20

C845C 20

FOR 230V AC OPERATION OF E701:

1- REMOVE JUMPERS MARKED ~~XXX~~ FROM TERMINAL 2,7 & 5,6.

2- ADD JUMPERS MARKED - - - BETWEEN TERMINALS 2 & 6

E701

R796 20W

R797 20W

R793 120

C844 .05

S705

L715 2.5MH

L717 4

V708

C851 .02

V713

V710 V712 V711 V709 V707 V706 V705 V704 V703 V702 V701

L718 4

C852 .02

L719 4

C853 .02

L716 2.5MH

UNLESS OTHERWISE SPECIFIED

ALL CAP. ARE IN UF

ALL RESISTORS ARE 1/2 WATT

ALL COILS ARE IN MH

ALL SWITCHES ARE SHOWN IN POSITION (1)

Figure III(E)-4-4. Monitoring Oscilloscope, Controlled Oscillator CLL-1

SECTION 5
TROUBLE-SHOOTING

III(E)-5-1. INTRODUCTION.

General trouble-shooting involving CLL-1 is discussed in I-5. Detailed trouble-shooting involving CLL-1 is discussed below.

III(E)-5-2. VOLTAGES AND RESISTANCES.

Table III(E)-5-1 lists voltages and resistance measurements at tube pins in the CLL-1.

III(E)-5-3. PARTS LOCATION DATA.

Figures III(E)-5-1 and III(E)-5-2 locate major electronic components in the CLL-1.

III(E)-5-4. TROUBLE-SHOOTING BASED ON CIRCUIT SECTIONALIZATION.

Refer to III(G)-6.

TABLE III(E)-5-1. VOLTAGE AND RESISTANCE MEASUREMENTS

DC VOLTAGES (MAIN POWER ON-RF INPUTS SUPPLIED)

TUBE	PIN NO.											
	1	2	3	4	5	6	7	8	9	10	11	12
V701	160	-4	150	FIL	FIL	150	-	2.8	.1	-	-	-
V702	130	0	130	FIL	FIL	130	6	6	-32	-	-	-
V703	105	.5	130	FIL	FIL	120	1.8	0	-1.7	-	-	-
V704	110	-1.7	2.5	FIL	FIL	2.5	-.1	-	110	-	-	-
V705	-9	0	FIL	FIL	150	150	0	-	-	-	-	-
V706	130	0	130	FIL	FIL	130	3	.6	5	-	-	-
V707	110	0	3	FIL	FIL	3	-5	-	110	-	-	-
V708	120	0	75	FIL	FIL	120	2	0	-2	-	-	-
V709	100	-14	-	FIL	FIL	-	-	-	135	-	-	-
V710	.1	2	FIL	FIL	140	115	2	-	-	-	-	-
V711	110	-	FIL	FIL	-	-1.25	0	-	-	-	-	-
V712	225	-	2.5	FIL	FIL	215	0	2.8	-	-	-	-
V713	FIL	FIL	-320	-320	-210	175	150	175	175	165	-	-

TABLE III(E)-5-1. VOLTAGE AND RESISTANCE MEASUREMENTS (Cont.)

RESISTANCES (MAIN POWER OFF)

TUBE	PIN NO.											
	1	2	3	4	5	6	7	8	9	10	11	12
V701	3.5K	500K	7K	FIL	FIL	7K	0	200	500K	-	-	-
V702	4.5K	350K	4.5K	FIL	FIL	4.5K	200	900	50K	-	-	-
V703	5K	7K	4.5K	FIL	FIL	5K	120	0	100K	-	-	-
V704	4K	22K	140	FIL	FIL	140	50K	-	4.5K	-	-	-
V705	500K	0	FIL	FIL	4.5K	4.5K	0	-	-	-	-	-
V706	4K	25K	4.5K	FIL	FIL	4K	350	120	50K	-	-	-
V707	4K	120	100	FIL	FIL	100	45K	-	4K	-	-	-
V708	4K	35K	30K	FIL	FIL	4.5K	350	15	4.5K	-	-	-
V709	6.5K	20K	140	FIL	FIL	140	50K	-	4.5K	-	-	-
V710	120	140	FIL	FIL	4.5K	10K	140	-	-	-	-	-
V711	4K	-	FIL	FIL	-	450K	-	-	-	-	-	-
V712	700K	4.2K	500	FIL	FIL	700K	420	600		-	-	-
V713	FIL	FIL	200K	200K	250K	500K	1M	500K	500K	1M	200K	-

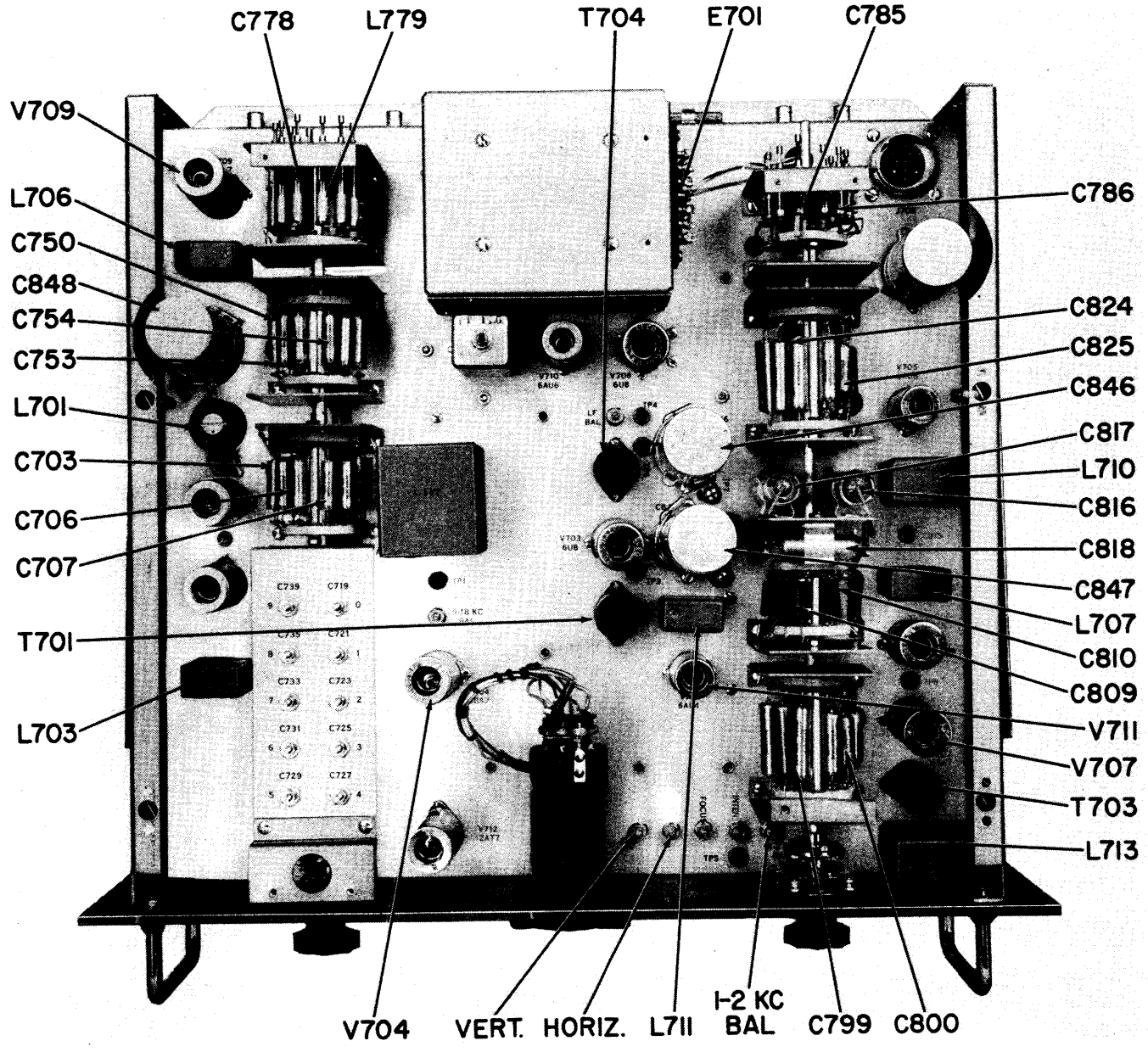


Figure III(E)-5-1. Location Diagram of Major Electronic Equipment Components, Top View

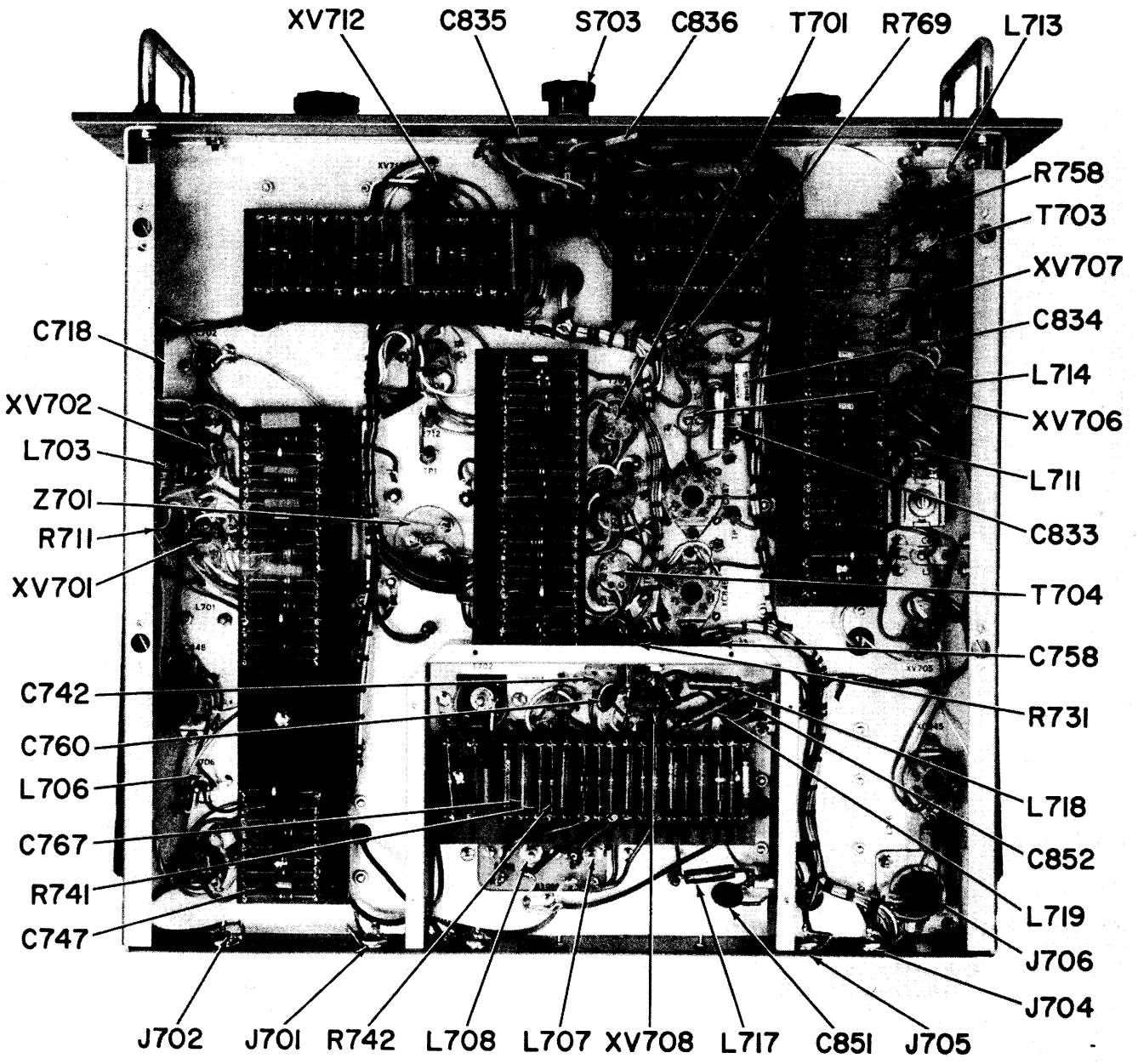


Figure III(E)-5-2. Location Diagram of Major Electronic Equipment Components, Bottom View

SECTION 6
MAINTENANCE

III(E)-6-1. INTRODUCTION.

General maintenance involving CLL-1 is discussed in I-6. Detailed maintenance involving CLL-1 is discussed below.

III(E)-6-2. CORRECTIVE MAINTENANCE.

Refer to III(G)-6.

SECTION 7
PARTS LIST

INTRODUCTION

Reference designations have been assigned to identify all maintenance 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 a resistor, amplifier, electron tube, etc. The number differentiates between parts of the same generic group. Sockets associated with a particular plug-in device, such as electron tube or fuse, are identified by reference designations which include the reference designations of the plug-in device. For example, the socket for tube V701 is designated XV701. Column 1 of the parts lists gives reference designations of the parts in alphabetical and numerical order. Column 2 gives the name and describes the various parts. Major part assemblies are listed in their entirety; subparts of a major assembly are listed in alphabetical and numerical order with reference to its major assembly. Column 3 indicates how the part is used within a major component. Column 4 lists each Technical Materiel Corporation part number.

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
C701	CAPACITOR, fixed: polystyrene; .0313 uf, ±1%; 100 wvdc.	Plate Tank, V701A	CX-104-3
C702	CAPACITOR, fixed: polystyrene; .0253 uf, ±1%; 100 wvdc.	Same as C701	CX-104-4
C703	CAPACITOR, fixed: polystyrene; .0209 uf, ±1%; 100 wvdc.	Same as C701	CX-104-5
C704	CAPACITOR, fixed: polystyrene; .0176 uf, ±1%; 100 wvdc.	Same as C701	CX-104-6
C705	CAPACITOR, fixed: polystyrene; .0150 uf, ±1%; 100 wvdc.	Same as C701	CX-104-7
C706	CAPACITOR, fixed: polystyrene; .0129 uf, ±1%; 100 wvdc.	Same as C701	CX-104-8
C707	CAPACITOR, fixed: polystyrene; .0113 uf, ±1%; 100 wvdc.	Same as C701	CX-104-9
C708	CAPACITOR, fixed: polystyrene; .00989 uf, ±1%; 100 wvdc.	Same as C701	CX-104-10
C709	CAPACITOR, fixed: polystyrene; .00876 uf, ±1%; 100 wvdc.	Same as C701	CX-104-11
C710	CAPACITOR, fixed: polystyrene; .00782 uf, ±1%, 100 wvdc.	Same as C701	CX-104-25
C711	CAPACITOR, fixed: ceramic; .01 uf, GMV; 500 wvdc.	Coupling, V701A	CC-100-16
C712	CAPACITOR, fixed: mica; .003 uf, ±5%; 300 wvdc.	Grid, V701B	CM35C302F
C713	CAPACITOR, fixed: ceramic; .001 uf, ±10%; 500 wvdc, disc type.	Same as C712	CC-100-9
C714	CAPACITOR, fixed: silvered mica; precision, 430 uuf, ±.5%; 500 wvdc.	Grid, V701B	CM200E430F
C715	CAPACITOR, fixed: tantalum; 6.8 uf, ±20%.	Cathode Bypass, V702A	CE-106
C716	CAPACITOR, fixed: mica; 1600 uuf, ±10%; char. D, 500 wvdc	Coupling, V702A	CM20D162K
C717	CAPACITOR, fixed: mica; 4700 uuf, ±10%; 300 wvdc.	Coupling, V702B	CM35B472K
C718	CAPACITOR, fixed: metalized paper; high temperature, .47 uf, ±10%; 200 wvdc.	Same as C717	CP106C474-2
C719	CAPACITOR, variable: 350-1180 uuf, 10 plates; 250 wvdc.	Trimmer, V702A	CV-103-310
C720	CAPACITOR, fixed: polystyrene; .0300 uf, ±2%; 100 wvdc.	Plate Tank, V702A	CX-104-23
C721	Same as C719.	Same as C720	

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
C722	CAPACITOR, fixed: polystyrene; . 0240 uf, ±2%; 100 wvdc.	Plate Tank, V702A	CX-104-24
C723	CAPACITOR, variable: 350-1180 uuf, 7 plates; 250 wvdc.	Trimmer, V702A	CV-103-307
C724	CAPACITOR, fixed: polystyrene; . 0201 uf, ±2%; 100 wvdc.	Same as C722	CX-104-26
C725	Same as C723.	Same as C723	
C726	CAPACITOR, fixed: polystyrene; . 0168 uf, ±2%; 100 wvdc.	Same as C722	CX-104-27
C727	CAPACITOR, variable: 190-760 uuf, 5 plates; 250 wvdc.	Same as C723	CV-103-305
C728	CAPACITOR, fixed: polystyrene; . 0145 uf, ±2%; 100 wvdc.	Same as C722	CX-104-28
C729	Same as C727.	Same as C723	
C730	CAPACITOR, fixed: polystyrene; . 0142 uf, ±2%; 100 wvdc.	Same as C722	CX-104-29
C731	Same as C727.	Same as C723	
C732	CAPACITOR, fixed: polystyrene; . 0108 uf, ±2%; 100 wvdc.	Same as C722	CX-104-30
C733	Same as C727.	Same as C723	
C734	CAPACITOR, fixed: polystyrene; . 00942 uf, ±2%; 100 wvdc.	Same as C722	CX-104-31
C735	Same as C727.	Same as C723	
C736	CAPACITOR, fixed: polystyrene; . 00829 uf, ±2%; 100 wvdc.	Same as C722	CX-104-32
C738	CAPACITOR, fixed: polystyrene; . 00734 uf, ±2%; 100 wvdc.	Same as C722	CX-104-33
C739	Same as C727.	Same as C723	
C740	Same as C711.	Coupling, V704	
C741	Same as C715.	Cathode Bypass, V704	
C742	CAPACITOR, fixed: silvered mica; precision; 470 uuf, ±1%; 500 wvdc.	High Pass Filter, V708A	CM200E470F
C745	Same as C711.	Coupling, V704	
C746	Same as C711.	Decoupling, V709	
C747	Same as C715.	Cathode Bypass, V709	

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
C748	Same as C702.	Plate Tank, V709	
C749	Same as C703.	Same as C748	
C750	Same as C704.	Same as C748	
C751	Same as C705.	Same as C748	
C752	Same as C706.	Same as C748	
C753	Same as C707.	Same as C748	
C754	Same as C708.		
C755	Same as C709.	Same as C748	
C756	Same as C710.	Same as C748	
C757	CAPACITOR, fixed: polystyrene; .00702 uf, ±1%; 100 wvdc.	Same as C748	CX-104-12
C758	Same as C718.	Decoupling, V708A	
C759	CAPACITOR, fixed: tantalum; 5 uf, ±15%; 25 wvdc.	Phase Shift, V708A	CX-105
C760	CAPACITOR, fixed: mica; .02 uf, +80% -20%; 500 wvdc.	Coupling, V708A	CC-100-24
C761	CAPACITOR, fixed: metallized paper; .04 uf, ±10%; 400 wvdc.	Cathode Bypass	CP106C403-4
C762	Same as C761.	Same as C758	
C763	CAPACITOR, fixed: polystyrene; .01 uf, ±1%; 200 wvdc.	Series Tank, V708A	CX-104-34
C764	Same as C761.	Same as C758	
C765	Same as C763.	Plate Tank, V708B	
C766	CAPACITOR, fixed: polystyrene; .0047 uf, ±1%; 200 wvdc.	Coupling, V708A	CX-104-35
C767	Same as C761	Cathode Bypass, V710	
C768	Same as C761	Decoupling, V710	
C769	Same as C761	Same as C768	
C771	CAPACITOR, fixed: mica; 2700 uuf, ±5%, char. C; 500 wvdc.	Series Tank, T702	CM30C272J
C772	CAPACITOR, variable: glass, 1.0-12.0 uuf, operating temperature -55°C to 125°C; 500 wvdc.	Trimmer, S701D	CV-101-3

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
C773	Same as C772.	Same as C772	
C774	Same as C772.	Same as C772	
C775	Same as C772.	Same as C772	
C776	Same as C772.	Same as C772	
C777	Same as C772.	Same as C772	
C778	Same as C772.	Same as C772	
C779	Same as C772.	Same as C772	
C780	Same as C772.	Same as C772	
C781	CAPACITOR, fixed: ceramic; 5 uuf, ±.5 uuf; 500 wvdc.	Same as C772	CC21SL050D
C782	CAPACITOR, variable: glass; 0.5-3 uuf, operating temperature -55°C to 125°C, 500 wvdc.	Trimmer, S702D	CV-101-2
C783	Same as C782.	Same as C782	
C784	Same as C782.	Same as C782	
C785	Same as C782.	Same as C782	
C786	Same as C782.	Same as C782	
C787	Same as C782.	Same as C782	
C788	Same as C782.	Same as C782	
C789	Same as C782.	Same as C782	
C790	Same as C782.	Same as C782	
C792	Same as C760.	Coupling, V706A	
C793	Same as C761	Decoupling, V706A	
C794	CAPACITOR, fixed: silvered mica; precision; 27 uuf, ±1%; 500 wvdc.	Same as C792	CM200E027F
C795	Same as C715.	Cathode Bypass, V706A	
C796	CAPACITOR, fixed: polystyrene; .0735 uf, ±1%; 100 wvdc.	Plate Tank, V705	CX-104-13
C797	CAPACITOR, fixed: polystyrene; .0555 uf, ±1%; 100 wvdc.	Same as C796	CX-104-14
C798	CAPACITOR, fixed: polystyrene; .0434 uf, ±1%; 100 wvdc.	Same as C796	CX-104-15

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
C799	CAPACITOR, fixed: polystyrene; .0344 uf, ±1%; 100 wvdc.	Same as C796	CX-104-16
C800	CAPACITOR, fixed: polystyrene; .0277 uf, ±1%; 100 wvdc.	Same as C796	CX-104-17
C801	CAPACITOR, fixed: polystyrene; .0232 uf, ±1%; 100 wvdc.	Same as C796	CX-104-18
C802	CAPACITOR, fixed: polystyrene; .0186 uf, ±1%; 100 wvdc.	Same as C796	CX-104-19
C803	CAPACITOR, fixed: polystyrene; .0158 uf, ±1%; 100 wvdc.	Same as C796	CX-104-20
C804	CAPACITOR, fixed: polystyrene; 0133 uf, ±1%; 100 wvdc.	Same as C796	CX-104-21
C805	CAPACITOR, fixed: polystyrene; .117 uf, ±1%; 100 wvdc.	Same as C796	CX-104-22
C806	CAPACITOR, fixed: silvered mica; precision, 751 uuf; ±1%, 500 wvdc.	Plate Tank, V706A	CM200E751F
C807	CAPACITOR, fixed: silvered mica; precision, 731 uuf, ±1%; 500 wvdc.	Same as C806	CM200E731F
C808	CAPACITOR, fixed: silvered mica; precision, 712 uuf, ±1%; 500 wvdc.	Same as C806	CM200E712F
C809	CAPACITOR, fixed: silvered mica; precision, 693 uuf, ±1%; 500 wvdc.	Same as C806	CM200E693F
C810	CAPACITOR, fixed: silvered mica; precision, 675 uuf, ±1%; 500 wvdc.	Same as C806	CM200E675F
C811	CAPACITOR, fixed: silvered mica; precision, 658 uuf, ±1%; 500 wvdc.	Same as C806	CM200E658F
C812	CAPACITOR, fixed: silvered mica; precision, 641 uuf, ±1%; 500 wvdc.	Same as C806	CM200F641F
C813	CAPACITOR, fixed: silvered mica; precision, 625 uuf, ±1%; 500 wvdc.	Same as C806	CM200F625F
C814	CAPACITOR, fixed: silvered mica; precision, 609 uuf, ±1%; 500 wvdc.	Same as C806	CM200F609F
C815	Same as C719	Trimmer, V706B	
C816	CAPACITOR, fixed: polystyrene; .22 uf, ±2%; 200 wvdc.	Series Tank, V706B	CX-104-2
C817	Same as C816.	Same as C816	
C818	CAPACITOR, fixed: polystyrene; .0470 uf, ±2%; 200 wvdc.	Coupling, V706B	CX-104-1

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
C819	Same as C715.	Cathode Bypass, V707	
C820	Same as C711.	Coupling, J212	
C821	Same as C796	Plate Tank, V707	
C822	Same as C797.	Same as C821	
C823	Same as C798.	Same as C821	
C824	Same as C799.	Same as C821	
C825	Same as C800	Same as C821	
C826	Same as C801.	Same as C821	
C827	Same as C802.	Same as C821	
C828	Same as C803.	Same as C821	
C829	Same as C804.	Same as C821	
C830	Same as C805.	Same as C821	
C831	Same as C761	Coupling, V703B	
C832	Same as C711.	Coupling, V711	
C833	Same as C702.	Plate Tank, V711	
C834	Same as C761.	Same as C832	
C835	CAPACITOR, fixed: mica-dielectric; 300 uuf, ±10%, char. B; 500 wvdc.	Decoupling, S703A	CM20B301K
C836	Same as C716.	Same as C835	
C837	Same as C761	Coupling, V712A	
C838	Same as C761.	Coupling, S703B	
C839	Same as C715.	Cathode Bypass, V712B	
C840	CAPACITOR, fixed: ceramic; disc type, .1 uf, +80% -20%; 500 wvdc.	Coupling, V712B	CC-100-32
C841	Same as C715.	Cathode Bypass, V712A	
C842	Same as C840.	Coupling, V712A	
C843	Same as C711.	Decoupling, V713	

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
C844	CAPACITOR, fixed: mylar dielectric; .05 uf, ±5%; 400 wvdc.	Thermostat Arc Suppression S705	CN-113-1
C845	CAPACITOR, fixed: electrolytic; 20-20-20 uf, char. F; 450 wvdc.	Filter Network	CE-108-1
C846 A, B, C	Same as C845.	Sawtooth Generator, V713	
C847 A, B, C	Same as C845.	Same as C845	
C848 A, B, C	Same as C845.	Same as C845	
C849	Same as C711.	Coupling, L701	
C850	CAPACITOR, fixed: feed-thru; 2000 uuf, ±20%, char. A; 500 wvdc.	RF Bypass, V708B	CK70A202M
C851	Same as C760.	Filament Filter	
C852	Same as C760.	Same as C851	
C853	Same as C760.	Same as C851	
CR701	DIODE, germanium: subminiature glass; high inductance; 20 ma.	Rectifier, V712B	1N100
CR702	Same as CR701.	Same as CR701	
CR703	Same as CR701.	Rectifier, T701	
CR704	Same as CR701.	Same as CR703	
CR705	Same as CR701.	Rectifier, T703	
CR706	Same as CR701.	Same as CR705	
CR707	Same as CR701.	Rectifier, T704	
CR708	Same as CR701.	Same as CR707	
E701	TERMINAL BOARD ASSEMBLY: oven heater; consists of C844, R793, R796, R797, S705.	Heater Assembly	A-1907
J701	CONNECTOR, receptacle: electrical; 1 female contact , 52 ohms; BNC type.	1 Kc Input, V701A	UG-625/U
J702	Same as J701.	500 Kc Input, V709	
J703	Same as J701.	510-520 Kc Output, T702	
J704	Same as J701	100 cps Input, V705	
J705	Same as J701.	10 Kc Input, V711	

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
J706	CONNECTOR, receptacle: male; 16 contacts, aluminum alloy cadmium plated; mates with PL-186.	Power Connector	JJ-183
J707	JACK, tip, red body; contacts beryllium copper plated silver.	Test Point 1, T701	JJ-114-2
J708	Same as J707.	Test Point 2, V701B	
J709	Same as J707.	Test Point 3, V703A	
J710	Same as J707.	Test Point 4, V708A	
J711	Same as J707.	Test Point 5, T703	
J712	Same as J707.	Test Point 6, R761	
J713	Same as J707.	Test Point 7, V706A	
J714	Same as J707.	Test Point 8, V706B	
L702	COIL, R. F. : fixed; 10.5 uhy tapped, hermetically sealed.	Tank, V702A	CL-233-4
L703	COIL, R. F. : fixed; 50 mhy, dc resistance 110 ohms, 75 ma.	RF Choke, V702B	CL-232-1
L706	COIL, R. F. : fixed; 10 uhy, hermetically sealed.	Plate Tank, V709	CL-233-2
L707	COIL, R. F. : variable; 2-4 uhy, Q = 40 at 570 kc.	Series Tank, V708A	CL-234
L708	COIL, R. F. : variable: 38 uhy, Q = 75 at 510 kc.	Series Tank, V708A	CL-235
L709	COIL, R. F. : 750 microhenries, ±20%; 100 ma max. current; DC resistance approximately 17 ohms; bakelite body.	RF Choke	CL-100-5
L710	COIL, R. F. : fixed; 60 uhy, hermetically sealed.	Plate Tank, V705	CL-233-3
L711	COIL, R. F. : fixed; 5 uhy, hermetically sealed.	Plate Tank, V706A	CL-233-1
L712	Same as L703.	RF Choke, V706B	
L713	Same as L710.	Plate Choke, V707	

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
L714	Same as L706.	Plate Tank, V711	
L715	COIL, R. F. : fixed; 2. 5 mh.	Filter Choke	CL-140-1
L716	Same as L715.	Same as L715	
L717	COIL, R. F. : fixed; 4 uhy.	Same as L715	CL-105-2
L718	Same as L717.	Same as L715	
L719	Same as L717.	Same as L715	
R701	RESISTOR, fixed: composition; 470, 000 ohms, ±10%; 1/2 watt.	Grid Leak, V701A	RC20GF474K
R702	RESISTOR, fixed: composition; 6800 ohms, ±10%; 2 watts.	Plate Load, V701A	RC42GF682K
R703	RESISTOR, fixed: composition; 82, 000 ohms, ±10%; 1/2 watt.	Voltage Divider, V701A	RC20GF823K
R704	RESISTOR, fixed: composition; 270, 000 ohms, ±10%; 1/2 watt.	Series Grid, V701B	RC20GF274K
R705	Same as R704.	Grid Limiter, V701B	
R706	RESISTOR, fixed: composition; 1. 5 megohms, ±10%; 1/2 watt.	Voltage Divider, V702A	RC20GF155K
R707	RESISTOR, fixed: composition; 220 ohms, ±10%; 1/2 watt.	Cathode, V702A	RC20GF221K
R708	RESISTOR, fixed: composition; 390, 000 ohms, ±10%; 1/2 watt.	Grid, V702A	RC20GF394K
R709	RESISTOR, fixed: composition; 47, 000 ohms, ±10%; 1/2 watt.	Grid, V702B	RC20GF473K
R710	RESISTOR, fixed: composition; 2200 ohms, ±10%; 2 watts.	Plate Load, V702B	RC42GF222K
R711	RESISTOR, fixed: composition; 820 ohms, ±10%; 1/2 watt.	Cathode, V702B	RC20GF821K
R712	RESISTOR, variable: composition; 1, 000 ohms, ±10%; 1/2 watt.	Balance Adjustment T1	RV106UX10C-102A
R713	Same as R703.	Voltage Dropping, V703A	
R714	RESISTOR, fixed: composition; 8200 ohms, ±10%; 1/2 watt.	Grid, V703A	RC20GF822K
R715	RESISTOR, fixed: composition; 330, 000 ohms, ±10%; 1/2 watt.	Voltage Divider, V703A	RC20GF334K
R716	RESISTOR, fixed: composition; 150 ohms, ±10%; 1/2 watt.	Cathode, V703A	RC20GF151K

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
R717	RESISTOR, fixed: composition; 100 ohms, ±10%; 1/2 watt.	Series Screen, V703A	RC20GF101K
R718	RESISTOR, fixed: composition; 2200 ohms, ±10%; 1/2 watt.	Same as R717	RC20GF222K
R719	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	Series Grid, V704	RC20GF104K
R720	RESISTOR, fixed: composition; 22,000 ohms, ±10%; 1/2 watt.	Grid, V704	RC20GF223K
R721	Same as R716	Cathode Bias, V704	
R722	Same as R709	Voltage Dropping, V708A	
R723	Same as R709	Grid Detector, V704	
R724	RESISTOR, fixed: composition; 4700 ohms, ±10%; 1/2 watt.	Plate Load, V709	RC20GF472K
R725	Same as R716	Cathode Bias, V709	
R726	Same as R720	Grid Detector, V709	
R727	Same as R709	Grid, V709	
R728	RESISTOR, fixed: composition; 3900 ohms, ±10%; 1/2 watt.	Screen, V709	RC20GF392K
R729	Same as R710	Voltage Dropping	
R730	Same as R719.	Same as R729	
R731	Same as R720.	Series Grid, V708A	
R732	RESISTOR, fixed: composition; 1000 ohms, ±10%; 1/2 watt.	Differentiate, V708A	RC20GF102K
R733	Same as R732.	Series Grid Limiter, V708A	
R734	RESISTOR, fixed: composition; 330 ohms, ±10%; 1/2 watt.	Cathode, V708A	RC20GF331K
R735	Same as R717.	Series Screen, V708A	
R736	RESISTOR, fixed: composition, 39,000 ohms, ±10%; 1/2 watt.	Same as R735	RC20GF393K
R737	Same as R717.	Grid, V708B	

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
R738	Same as R709.	Phase Comparator V708B	
R739	Same as R710.	Plate Load, V708B	
R740	Same as R717.	Grid Detector, V710	
R741	Same as R716.	Cathode Bias, V710	
R742	RESISTOR, fixed: composition; 10,000 ohms, ±10%, 1/2 watt.	Screen Load, V710	RC20GF103K
R743	Same as R718.	Voltage Dropping	
R744	Same as R701.	Grid, V705	
R745	Same as R710.	Same as R743	
R746	Same as R719.	Voltage Dropping, V705	
R747	Same as R709.	Same as R743	
R748	RESISTOR, fixed: composition; 120,000 ohms, ±10%; 1/2 watt.	Series Grid Limiter, V706A	RC20GF124K
R749	Same as R742.	Same as R748	
R750	Same as R734.	Cathode Bias, V706A	
R751	Same as R717	Screen Load, V706A	
R752	Same as R718.	Same as R743	
R753	Same as R709.	DC Control Voltage, V706B	
R754	RESISTOR, fixed: composition; 470 ohms, ±10%; 1/2 watt.	Grid Limit, V706B	RC20GF471K
R755	Same as R712.	1-2 Kc Balance	
R756	Same as R717.	Cathode Bias, V707	
R757	Same as R709.	Grid Detector, V707	
R758	RESISTOR, fixed: wire wound; 2000 ohms, ±5%; 10 watts.	Plate Load, V707	RW-109-28
R759	Same as R706.	Same as R743	
R760	Same as R706.	Same as R743	

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
R761	Same as R748.	Same as R743	
R762	Same as R732.	Equalizing, CR707	
R763	Same as R712.	Low Frequency Balance	
R764	Same as R732	Equalizing, CR708	
R765	Same as R710.	Same as R743	
R766	Same as R719.	Grid Detector, V703B	
R767	Same as R717.	Grid Limit, V703B	
R768	Same as R706.	Voltage Dropping, V703B	
R769	Same as R701.	Grid Detector, V711	
R770	Same as R736.	Grid, V712A	
R771	RESISTOR, fixed: composition; 560 ohms, ±10%; 1/2 watt.	Cathode, V712A	RC20GF561K
R772	Same as R720.	Series Plate Load V712A	
R773	RESISTOR, variable: slotted locking, 1 megohm, ±10%, 350 v rms; 1/2 watt.	Horizontal Adjustment	RV106UX10C-105A
R774	Same as R773.	Vertical Adjustment	
R775	RESISTOR, fixed: composition; 820,000 ohms, ±10%, 1/2 watt.	Voltage Divider V713	RC20GF824K
R776	Same as R775.	Voltage Dropping, V713	
R777	RESISTOR, fixed: composition; 68,000 ohms, ±10%; 1/2 watt.	Same as R775	RC20GF683K
R778	RESISTOR, fixed: composition; 560,000 ohms, ±10%; 1/2 watt.	Same as R776	RC20GF564K
R779	Same as R728.	Same as R775	
R780	Same as R720	Voltage Divider	
R781	RESISTOR, variable: composition; 500K ohms, ±10%, 350 v rms; 1/2 watt.	Focust Adjustment V713	RV106UX10C-504A
R782	Same as R777.	Same as R775	

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
R783	RESISTOR, variable: composition; slotted locking, 100 K, ±10%, 350 v rms; 1/2 watt.	Intensity Adjustment V713	RV106UX10C-104A
R784	RESISTOR, fixed: composition; 33,000 ohms, ±10%, 1/2 watt.	Grid, V713	RC20GF333K
R785	Same as R748.	Series Bias, V713	
R786	Same as R771.	Cathode Bias, V712B	
R787	Same as R701.	Grid Detector, V712B	
R788	RESISTOR, fixed: composition; 15,000 ohms, ±10%; 1 watt.	Same as R780	RC32GF153K
R789	RESISTOR, fixed: composition; 180 ohms, ±10%; 1/2 watt.	Equalizing, CR702	RC20GF181K
R790	Same as R789.	Equalizing, CR701	
R791	Same as R784.	Series Bias	
R792	Same as R784.	Grid Limiter, V712B	
R793	RESISTOR, fixed: composition; 120 ohms, ±10%; 1/2 watt. Part of E701.	Voltage Dropping	RC20GF121K
R794	Same as R718.	Series Plate Load, V712B	
R795	Same as R718.	Same as R794	
R796	RESISTOR, fixed: wire wound; cartridge heater type; 20 watts, at 115 volts AC ±10%; 1,000 v insulated to shell.	Heater Element	RR-102-1
R797	Same as R796.	Same as R796.	
S701A	WAFER, switch: rotary; shorting, silver plated brass, ceramic insulation.	p/o KILOCYCLES Select Switch	WS-114
S701B	WAFER, switch: rotary; shorting, silver plated brass, ceramic insulation.	Same as S701A	WS-115
S701C	WAFER, switch: rotary; shorting, silver plated brass, ceramic insulation.	Same as S701A	WS-116
S701D	WAFER, switch: rotary; shorting, silver plated brass, ceramic insulation.	Same as S701A	WS-113
S702A	WAFER, switch: rotary; shorting, silver plated brass, ceramic insulation.	p/o HUNDREDS OF CYCLES Select Switch	WS-112

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
S702B	WAFER, switch: rotary; shorting, silver plated brass, ceramic insulation	Same as S702A	WS-111
S702C	Same as S702A.	Same as S702A	
S702D	WAFER, switch: rotary; shorting, silver plated brass, ceramic insulation.	Same as S702A	WS-110
S703	SWITCH, rotary: shorting; silver plated brass, insulation 1/8 mycalex.	SYNC L-1, L-2, L-3, OFF Switch	SW-274
S705	SWITCH, thermostatic: operates at 70 ±2°C.	Thermostat	SS-100-2
T701	TRANSFORMER, audio: primary 20, 000 ohms CT; secondary 150, 600 ohms; 4 ma DC in primary; ±2 db; 200 to 10, 000 cps.	Coupling Transformer	TF-138
T702	TRANSFORMER, R. F. : tuned.	Output Transformer	TT-110
T703	Same as T701.	Coupling Network	
T704	Same as T701.	Same as T703	
V701	TUBE, electron: 9 pin miniature.	1 Kc Oscillator	6U8
V702	Same as V701.	9-18 Kc Oscillator	
V703	Same as V701.	Low Frequency Phase Detector	
V704	TUBE, vacuum: pentagrid converter.	Converter	6BA7
V705	TUBE, electron: sharp cutoff RF pentode, 7 pin miniature.	1-2 Kc Harmonic	6AU6
V706	Same as V701.	11-12 Kc Oscillator	
V707	Same as V704.	Converter	
V708	Same as V701.	510-520 Kc Oscillator	
V709	Same as V704.	Converter and 10-20 Kc Oscillator	
V710	Same as V705.	Output Amplifier	
V711	TUBE, electron: RF triode; 7 pin miniature	10 Kc Amplifier	6AB4
V712	TUBE, electron: duo triode; 9 pin miniature.	Horizontal and Vertical Deflection Amplifier	12AT7

CONTROLLED OSCILLATOR CLL-1

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
V713	TUBE, cathode ray.	Display	1EP1
XC845	SOCKET, tube: octal.	Socket, C845	TS101P01
XC846	Same as XC845.	Socket, C846	
XC847	Same as XC845	Socket, C847	
XC848	Same as XC845.	Socket, C848	
XV701	SOCKET, electron tube: 9 pin miniature.	Socket, V701	TS103P01
XV702	Same as XV701.	Socket, V702	
XV703	Same as XV701.	Socket, V703	
XV704	Same as XV701.	Socket, V704	
XV705	SOCKET, electron tube: 7 pin miniature.	Socket, V705	TS102P01
SV706	Same as XV701.	Socket, V706	
XV707	Same as XV701.	Socket, V707	
XV708	Same as XV701.	Socket, V708	
XV709	Same as XV701.	Socket, V709	
XV710	Same as XV705.	Socket, V710	
XV711	Same as XV705.	Socket, V711	
XV712	Same as XV701.	Socket, V712	
XV713	SOCKET, tube: 11 pin.	Socket, V713	TS-152
Z701	FILTER, low pass, 2 Kc.	2 Kc Low Pass	FX-162

SECTION 8
SCHEMATIC DIAGRAMS