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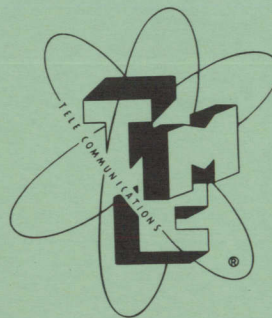
**DIVIDER CHAIN
MODEL CHL-1**

(CV-928/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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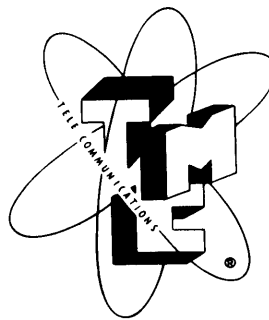
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Issue Date: 15 August 1961

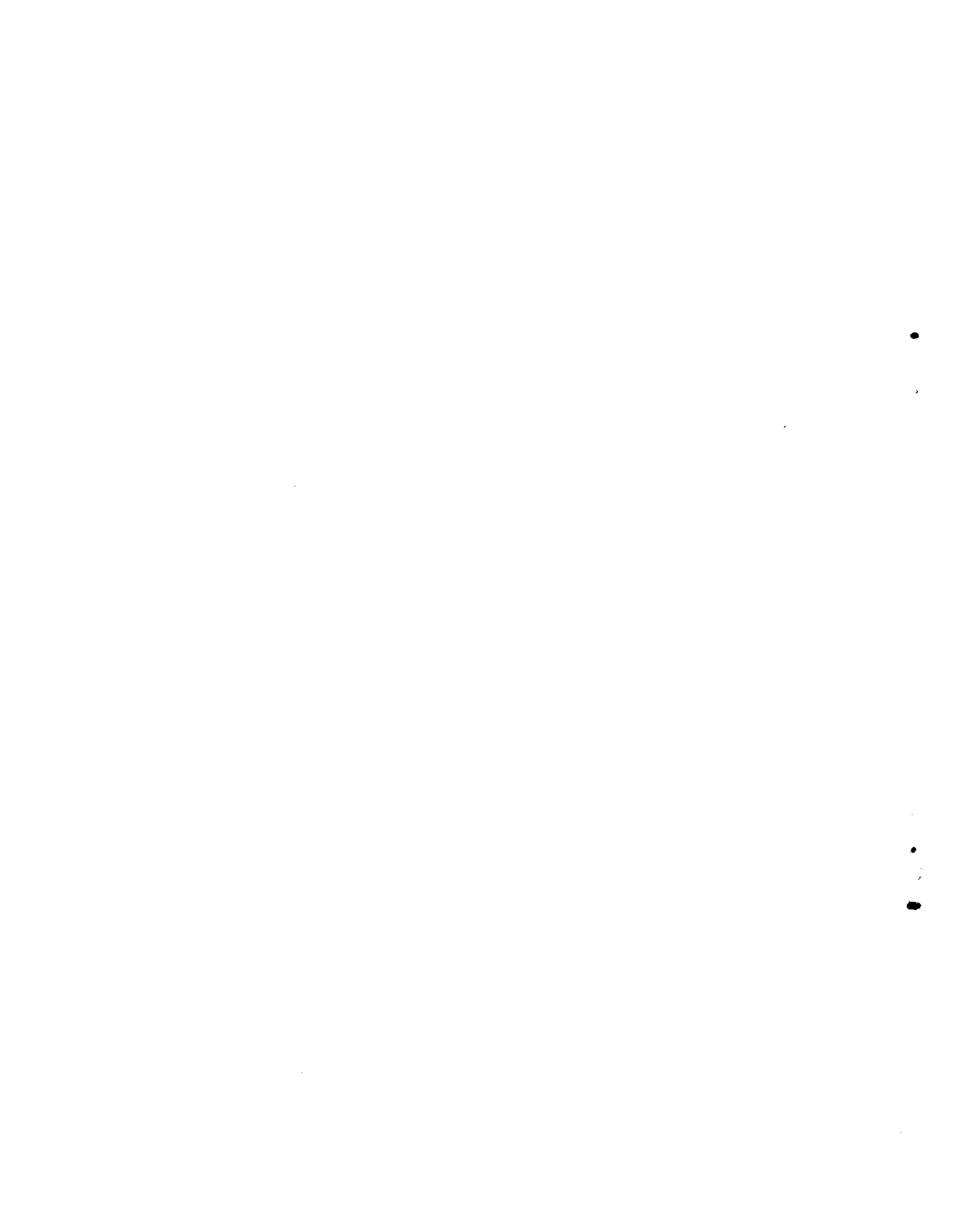


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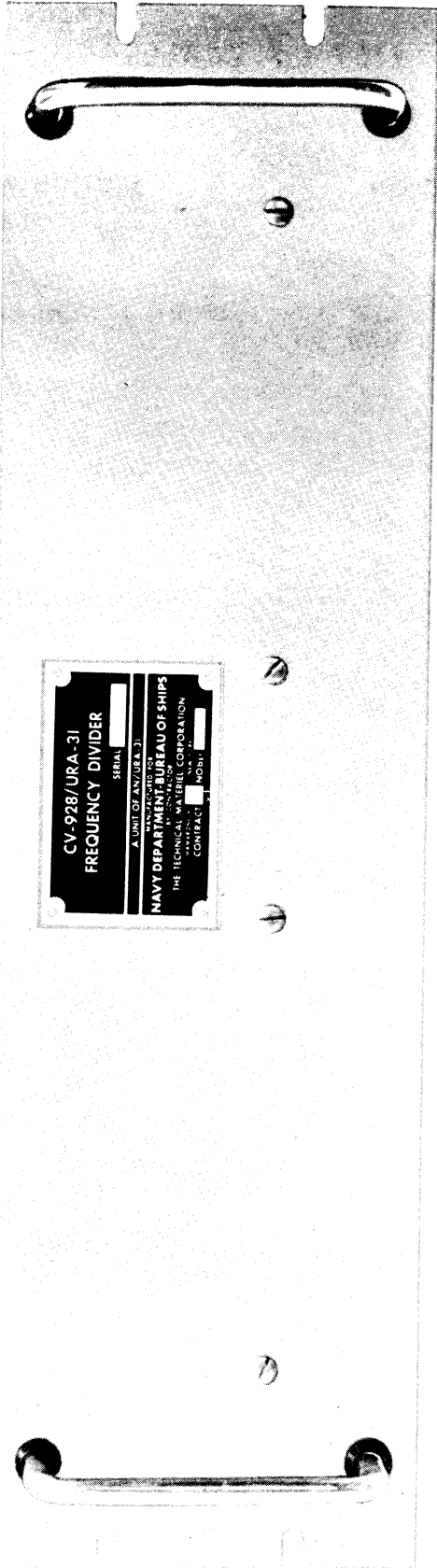


Figure III(D)-1-1a. Divider Chain CHL-1, Front View

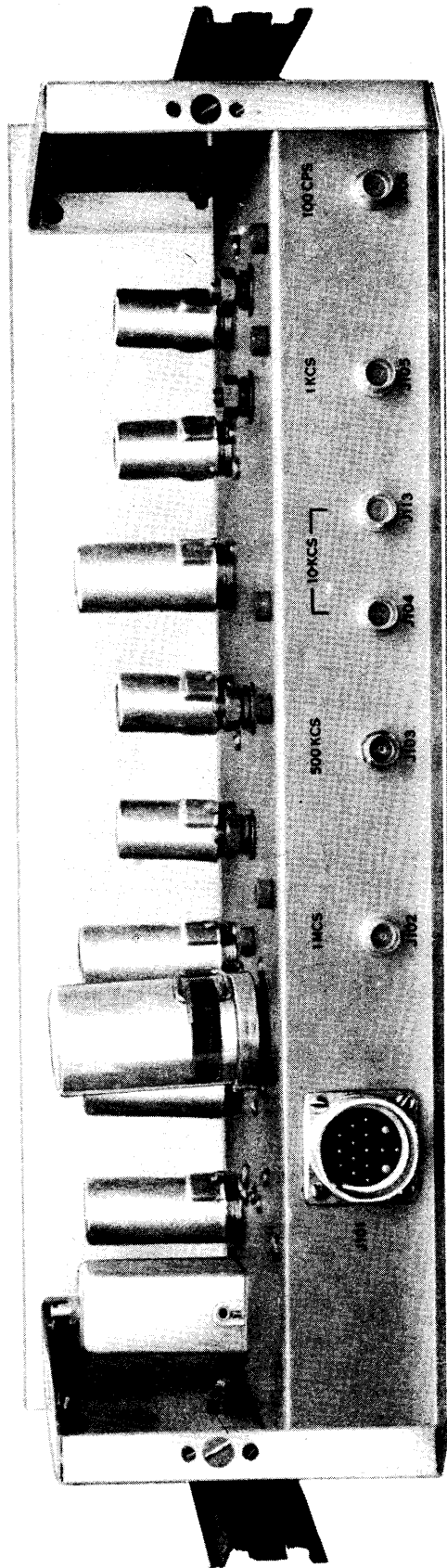


Figure III(D)-1-1b. Divider Chain CHL-1, Rear View

SECTION 1 GENERAL DESCRIPTION

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

Technical Materiel Corporation's Divider Chain, CHL-1, consists of a chain of conventional and phantatron multivibrators. It frequency divides a precise and stable one-megacycle input into four outputs -500-kc, 10-kc, 1-kc, and 100-cps. The frequency stability of the CHL-1 is one cycle in 100,000,000 per day.

CHL-1 is associated with four other units in the Controlled Precision Oscillator, CPI-1, as follows:

a. Primary Standard, CSS-1, provides the 1-mc input for the CHL-1.

b. Control Oscillator, CLL-1, receives four outputs -500-kc, 10-kc, 1-kc, and 100-cps from the CHL-1.

c. Controlled Master Oscillator, CMO-1, receives a 10-kc reference voltage from the CHL-1.

d. Power Supply, CPP-2, provides -6.3 VDC

(regulated), +160 VDC (regulated), and 6.3 VAC (regulated) for operation of the CHL-1.

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

The CHL-1 is shown in figures III(D)-1-1a and III(D)-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 15 inches behind the panel and is self-supporting. The unit weighs 20 pounds.

The equipment is manufactured in accordance with JAN/MIL standards, whenever practicable. All parts and assemblies meet or exceed the highest quality standards.

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

The crated dimensions of the CHL-1 when packed with CSS-1 and CPP-1 are 28-3/4 by 23-1/4 by 23-1/4 inches. These three units weigh 165, gross, packed for shipment. Tables III(D)-1-1 and III(D)-1-2 contain additional reference data pertinent to the CHL-1.

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

ITEM	CHARACTERISTICS
Frequency stability:	1 part in 100,000,000 per day.
Input frequency:	One megacycle.
Input power:	-6.3 VDC. 6.3 VAC. +160 VDC.
Multivibrators:	
2:1 (conventional)	1000- to 500-cps.
5:1 (phantastron)	500- to 100-kc.
10:1 (phantastron)	100- to 10-kc.
10:1 (phantastron)	10- to 1-kc.
10:1 (phantastron)	1000- to 100-cps.
Output frequencies:	500-kc. 10-kc. 1-kc. 100-cps.

TABLE III(D)-1-2. VACUUM TUBE COMPONENT

SYMBOL	TYPE	FUNCTION
V101	6U8	500-kc amplifier.
V102	5814A	2:1 divider.
V103(A & B)	5814A	Isolating amplifiers.
V104	5725	5:1 divider.
V105	5725	10:1 divider.
V106(A & B)	5814A	Isolating amplifiers.
V107	5725	10:1 divider.
V108	5725	10:1 divider.

SECTION 2 INSTALLATION

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

Each CHL-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 seated in their sockets.

III(D)-2-3. INTERCONNECTIONS.

Figure I-2-1 indicates the following interconnections:

a. 1 MC OUT (J606) of CSS-1 to 1 MC IN (J102) of CHL-1 via CA572 (P3027, P3028).

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

c. 10 KC OUT (J104) of CHL-1 to 10 KC IN (J307) of CMO-1 via CA572 (P3017, P3030).

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

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

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

g. Power supply (J101) of CHL-1 to Power Supply (J503) of CPP-2 via CA-551-4 (P3044, P3045).

III(D)-2-4. INITIAL ADJUSTMENTS.

See alignment procedure contained in III(G)-6, Test Procedure for Divider Chain CHL-1.

SECTION 3 OPERATOR'S SECTION

Not Applicable

SECTION 4

PRINCIPLES OF OPERATION

III(D)-4-1. INTRODUCTION.

Figure III(D)-8-1 is a schematic diagram of the CHL-1. The unit consists of a string of multivibrators and amplifiers as listed in table III(D)-1-1. The chain performs as described in Section I-4-8. The straight line delay characteristic of the phantastron multivibrators, as explained in Section I-4-1.d, makes them excellent frequency dividers.

III(D)-4-2. 2:1 FREQUENCY DIVIDER.

V102 functions in a conventional "flip-flop" circuit. CR101/R102, which interconnect grid 7 with plate 1, and CR103/R108, which interconnect grid 2 with plate 6, have a time constant of 1.12 microseconds. The rate of discharge of C101 and C103 is longer than the

intervals between negative pulses of the 1-mc frequency standard. CR101 and CR102 prevent positive pulse of the 1-mc frequency standard from reaching V102. CR102 bypasses RF and cathodes 3 and 8 are dc stabilized by R104/R105.

In its quiescent state, V102 is conducting. Assume that the parameters of the two halves of V102 are not exactly equal. On the first negative pulse, one half of V102 takes control and drives the tube to cutoff. Recovery time, as stated above, is too long for the following negative pulse to drive the tube to cutoff. On the next negative pulse the other half of V102 takes control and drives the tube to cutoff. The two halves of V102 alternately, on every second negative pulse, drive the tube beyond cutoff. The end result is to halve the frequency of the 1-mc standard.

SECTION 5 TROUBLE-SHOOTING

III(D)-5-1. INTRODUCTION.

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

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

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

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

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

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

Refer to III(G)-6.

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

DC VOLTAGES (MAIN POWER ON - 1 MC INPUT SUPPLIED)

TUBE	PIN NO.							
	1	2	3	4	5	6	7	8
V101	-	.9	75	FIL	FIL	100	1.1	-
V102	125	45	50	FIL	FIL	115	45	50
V103	105	.33	-	FIL	FIL	130	-10	68
V104	5.5	6.2	FIL	FIL	110	80	4	-
V105	12	6.8	0	FIL	130	100	4	-
V106	135	-18	.25	FIL	FIL	135	-10	5
V107	15	6	FIL	FIL	130	115	4	-
V108	1.5	5	FIL	FIL	70	115	4	-

RESISTANCES (MAIN POWER OFF)

TUBE	PIN NO.							
	1	2	3	4	5	6	7	8
V101	-	100K	60K	FIL	FIL	32K	30K	-
V102	38K	65K	2K	FIL	FIL	40K	350K	2K
V103	30K	1M	0	FIL	FIL	28K	1.1M	300
V104	1.5M	2.2K	FIL	FIL	18K	20K	7.5K	-
V105	2.2M	3.7K	0	FIL	40K	10K	7K	-
V106	5K	2.2M	300	FIL	FIL	5K	1.2M	300
V107	2.2M	3.7K	FIL	FIL	20K	14K	7K	-
V108	2.2M	3.7K	FIL	FIL	50K	1.7K	7.5K	-

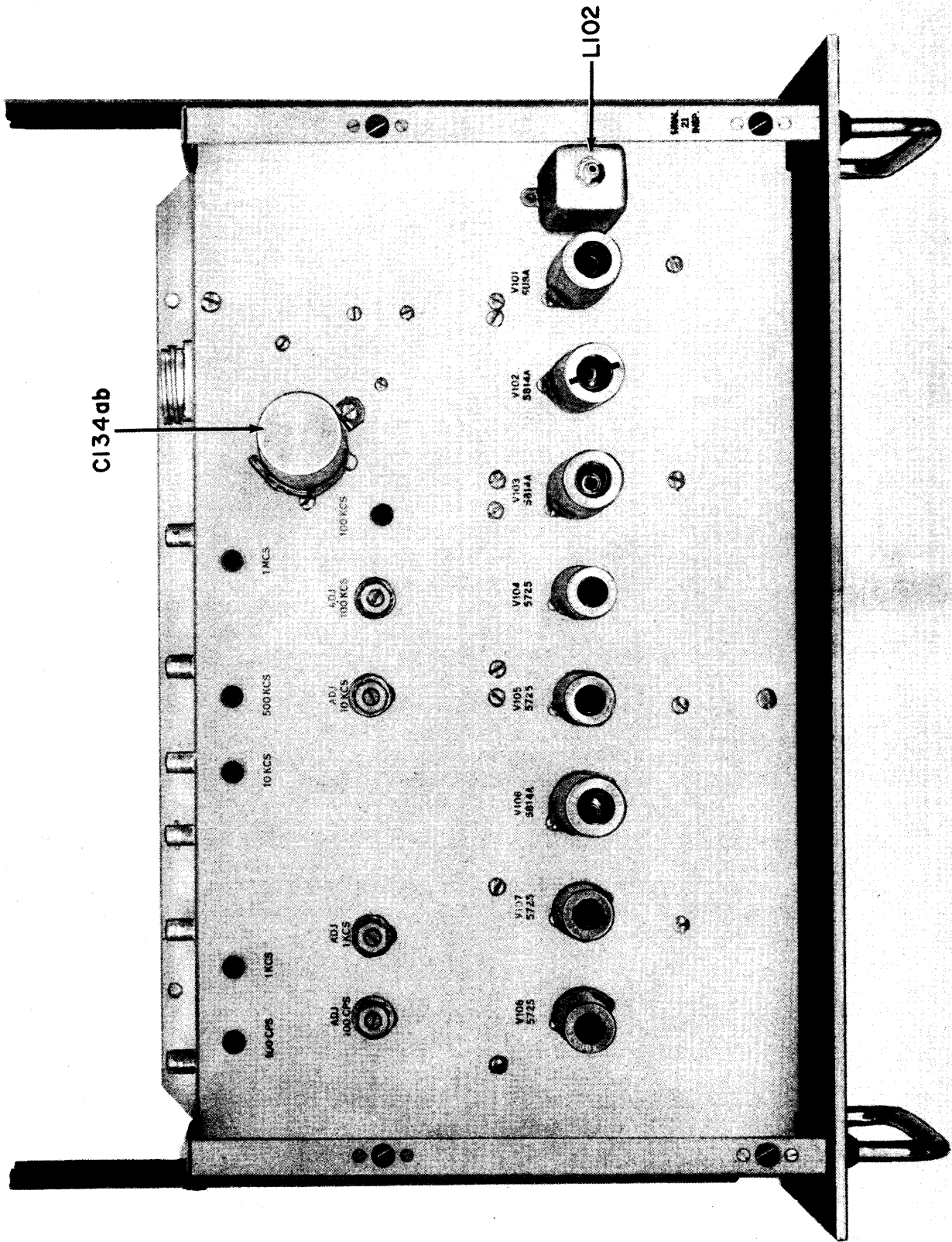


Figure III(D)-5-1. Location Diagram of Major Electronic Equipment Components, Top View

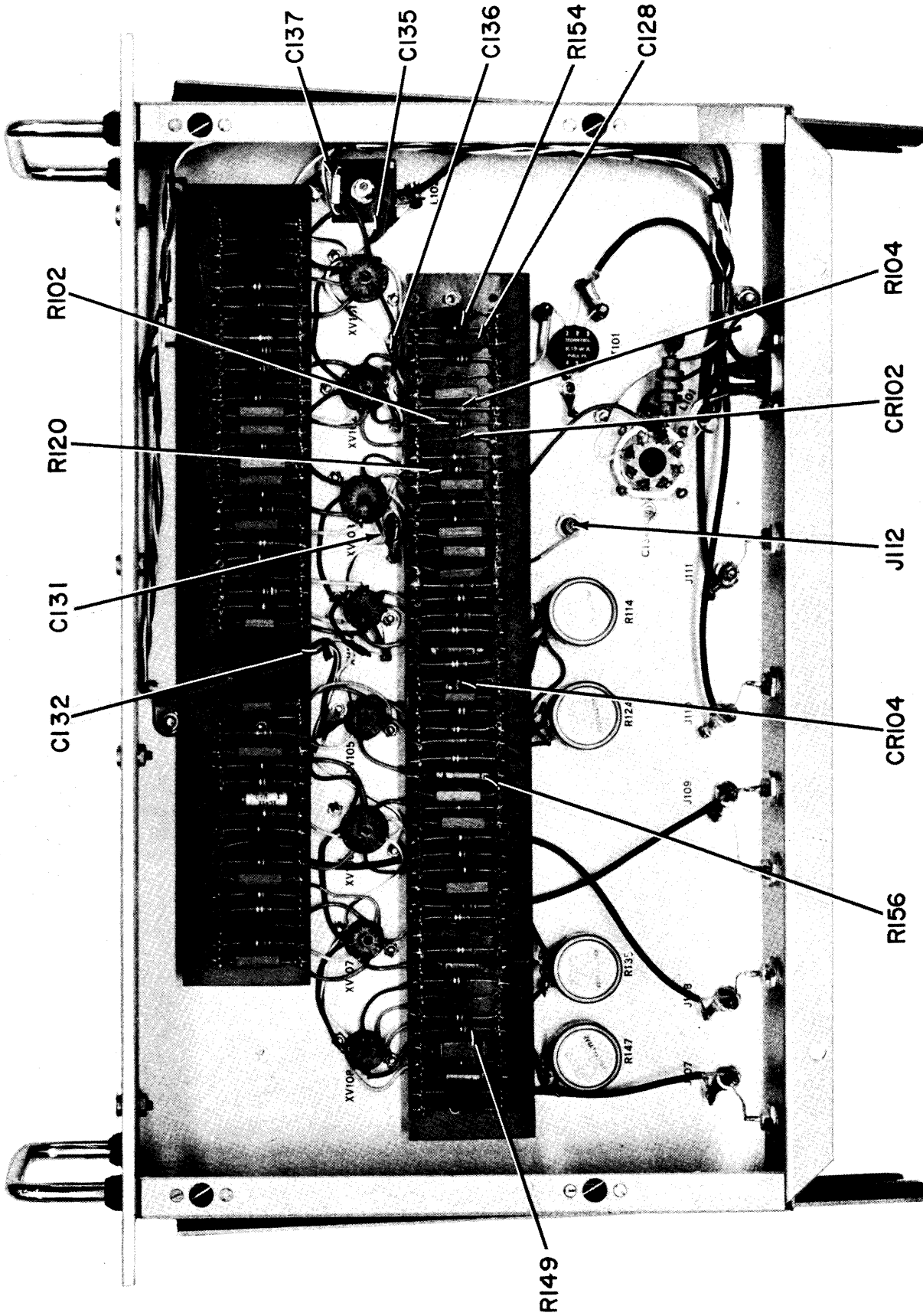


Figure III(D)-5-2. Location Diagram of Major Electronic Equipment Components, Bottom View

SECTION 6 MAINTENANCE

III(D)-6-1. INTRODUCTION.

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

III(D)-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 V101 is designated XV101. 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.

DIVIDER CHAIN CHL-1

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
C101	CAPACITOR, fixed: mica; 20 ufd, $\pm 5\%$; char. C; 500 wvdc.	Coupling, V102	CM20C200J
C102	CAPACITOR, fixed: ceramic; .01 ufd, GMV; 500 wvdc.	Cathode Bypass, V102	CC-100-16
C103	Same as C101.	Coupling, V102	
C104	Same as C102.	RF Bypass, V102	
C105	CAPACITOR, fixed: mica; 10 uufd, $\pm 10\%$; char. B; 500 wvdc.	Coupling, V103A	CM20B100K
C106	CAPACITOR, fixed: mica; 100 uufd, $\pm 10\%$; char. C; 500 wvdc.	Same as C105	CM20C101K
C107	CAPACITOR, fixed: ceramic; .02 ufd, $+80\%$ -20% , disc type; 500 wvdc.	Cathode Bypass, V101	CC-100-24
C108	Same as C106.	Same as C105	
C109	CAPACITOR, fixed: mica; 27 ufd, $\pm 5\%$; char. C; 300 wvdc.	Coupling, V104	CM15C270J
C110	CAPACITOR, fixed: mica; 33 ufd, $\pm 10\%$; char. C; 500 wvdc.	Decoupling, V104	CM20C330K
C111	CAPACITOR, fixed: mica; 1000 uufd, $\pm 10\%$; char. C; 500 wvdc.	Coupling, V103B	CM20C102K
C112	Same as C106.	Same as C111	
C113	Same as C106.	Same as C111	
C114	CAPACITOR, fixed: mica; 56 ufd, $\pm 5\%$; char. C; 300 wvdc.	Coupling, V105	CM15C560J
C115	CAPACITOR, fixed: mica; 470 uufd, $\pm 10\%$; char. C; 500 wvdc.	Same as C114	CM20C471K
C116	Same as C111.	Same as C114	
C117	Same as C107.	Decoupling, V101	
C118	Same as C106.	Coupling, V106A	
C119	Same as C111.	Same as C118	
C120	CAPACITOR, fixed: mica; 560 uufd, $\pm 2\%$; char. E; 500 wvdc.	Coupling, V107	CM20E561G
C121	Same as C111.	Same as C120	
C122	Same as C102.	Same as C120	
C123	Same as C107.	Same as C117	
C124	Same as C106.	Coupling, V106B	

DIVIDER CHAIN CHL-1

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
C125	CAPACITOR, fixed: mylar dielectric; .1 ufd, ±10%; 200 wvdc.	Same as C124	CN106C104K
C126	CAPACITOR, fixed: mica; 5000 uufd, ±5%, 500 wvdc; char. C.	Coupling, V108	CM35C502J
C127	CAPACITOR, fixed: ceramic; .005 ufd, GMV, 500 wvdc, disc type.	Same as C126	CC-100-15
C128	Same as C106.	Coupling, T101	
C129	Same as C106.	Coupling, V101	
C130	Same as C102.	RF Bypass, V105	
C131	Same as C102.	Decoupling, V103	
C132	Same as C102.	Decoupling, V104	
C133	CAPACITOR, fixed: mica; 5 uufd, ±5%; char. B; 300 wvdc.	Decoupling, V105	CM15B050J
C134	CAPACITOR, fixed: electrolytic; 2 sections; 20 ufd; 450 wvdc each section.	DC Filter	CE52F200R
C135	Same as C102.	Decoupling, V101	
C136	Same as C102.	Decoupling, V102	
C137	CAPACITOR, fixed: mica; .01 uf, ±10%; char. B; 500 wvdc.	Plate Tank, V101	CM35B103K
CR101	DIODE, germanium.	Divider Rectifier V102	1N100
CR102	Same as CR101.	Same as CR101	
CR103	DIODE, silicon.	Divider Rectifier V104	1N463
CR104	Same as CR103.	Divider Rectifier V103B	
CR105	Same as CR103.	Divider Rectifier V107	
CR106	Same as CR103.	Divider Rectifier V108	
J101	CONNECTOR, receptacle: male; aluminum shell, cadmium plated; 16 contacts brass, silver plated.	Power Input	JJ-183
J102	CONNECTOR, receptacle: electrical; 1 female contact; 52 ohms; BNC type.	1 Mc Input	UG-625/U
J103	Same as J102.	500 Kc Output	

DIVIDER CHAIN CHL-1

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
J104	Same as J102.	10 Kc Output	JJ-114-2
J105	Same as J102.	1 Kc Output	
J106	Same as J102.	100 cps Output	
J107	JACK, tip: red body; silver plated contacts.	100 cps Test Point	
J108	Same as J107.	1 Kc Test Point	
J109	Same as J107.	10 Kc Test Point	
J110	Same as J107.	500 Kc Test Point	
J111	Same as J107.	1 Mc Test Point	
J112	Same as J107.	100 Kc Test Point	
J113	Same as J102.	10 Kc Output	
L101	COIL, R. F. : ferrite core; 2.5 uh, 200 ma, Q = 115.	R. F. Choke	
L102	COIL, R. F. : tuned; 500 kc, Q = 80, frequency range 790 kc.	Plate Tank, V101	AC-114
R101	RESISTOR, fixed: composition; 5600 ohms, $\pm 10\%$; 1/2 watt.	Plate Load, V102	RC20GF562K
R102	RESISTOR, fixed: composition; 56,000 ohms, $\pm 5\%$; 1/2 watt.	Voltage Divider, V102	RC20GF563J
R103	Same as R102.	Same as R102	
R104	RESISTOR, fixed: composition; 10,000 ohms, $\pm 10\%$, 1/2 watt.	Cathode, V102	RC20GF103K
R105	Same as R104.	Same as R104	
R106	Same as R101.	Plate, V102	
R107	Same as R102.	Grid, V102	
R108	Same as R102.	Grid Leak, V102	
R109	Same as R104.	Grid, V103A	
R110	RESISTOR, fixed: composition; 1 megohm, $\pm 10\%$; 1/2 watt.	Same as R109	RC20GF105K
R111	RESISTOR, fixed: composition; 100,000 ohms, $\pm 10\%$; 1/2 watt.	Voltage Divider, V103A	RC20GF104K
R112	RESISTOR, fixed: composition; 2.2 megohms, $\pm 10\%$; 1/2 watt.	Same as R111	RC20GF225K

DIVIDER CHAIN CHL-1

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
R113	RESISTOR, fixed: composition; 4700 ohms, $\pm 10\%$; 1/2 watt.	Plate Load, V103A	RC20GF472K
R114	RESISTOR, variable: composition; 100,000 ohms, $\pm 10\%$; 2 watts	100 Kc Adjustment, V104	RV4ATXA104A
R115	Same as R111.	Voltage Divider, V104	
R116	RESISTOR, fixed: composition; 6800 ohms, $\pm 10\%$, 1/2 watt.	Same as R115	RC20GF682J
R117	RESISTOR, fixed: composition; 39,000 ohms, $\pm 10\%$; 1/2 w.	Plate Load, V104	RC20GF393K
R118	RESISTOR, fixed: composition; 2200 ohms, $\pm 10\%$; 1/2 watt	Cathode, V104	RC20GF222K
R119	RESISTOR, fixed: composition; 22,000 ohms, $\pm 10\%$; 1/2 watt.	Screen Load, V104	RC20GF223K
R120	Same as R104.	Grid, V103B	
R121	Same as R110.	Same as R120	
R122	RESISTOR, fixed: composition; 1500 ohms, $\pm 10\%$, 1/2 watt.	Plate Load, V103B	RC20GF152K
R123	Same as R111.	Voltage Dropping, V103B	
R124	Same as R114.	10 Kc Adjustment, V105	
R125	Same as R111.	Voltage Divider, V105	
R126	Same as R116.	Same as R125	
R127	Same as R111.	Plate Load, V105	
R128	RESISTOR, fixed: composition; 3300 ohms, $\pm 10\%$; 1/2 watt.	Cathode, V105	RC20GF332K
R129	Same as R119.	Screen Load, V105	
R130	Same as R104.	Voltage Divider	
R131	Same as R110.	Grid, V106A	
R132	RESISTOR, fixed: composition; 1000 ohms, $\pm 10\%$; 1/2 watt.	Plate Load, V106A	RC20GF102K
R133	RESISTOR, fixed: composition; 270 ohms, $\pm 10\%$; 1/2 watt.	Cathode, V106A	RC20GF271K
R134	Same as R111.	Voltage Dropping, V106A	

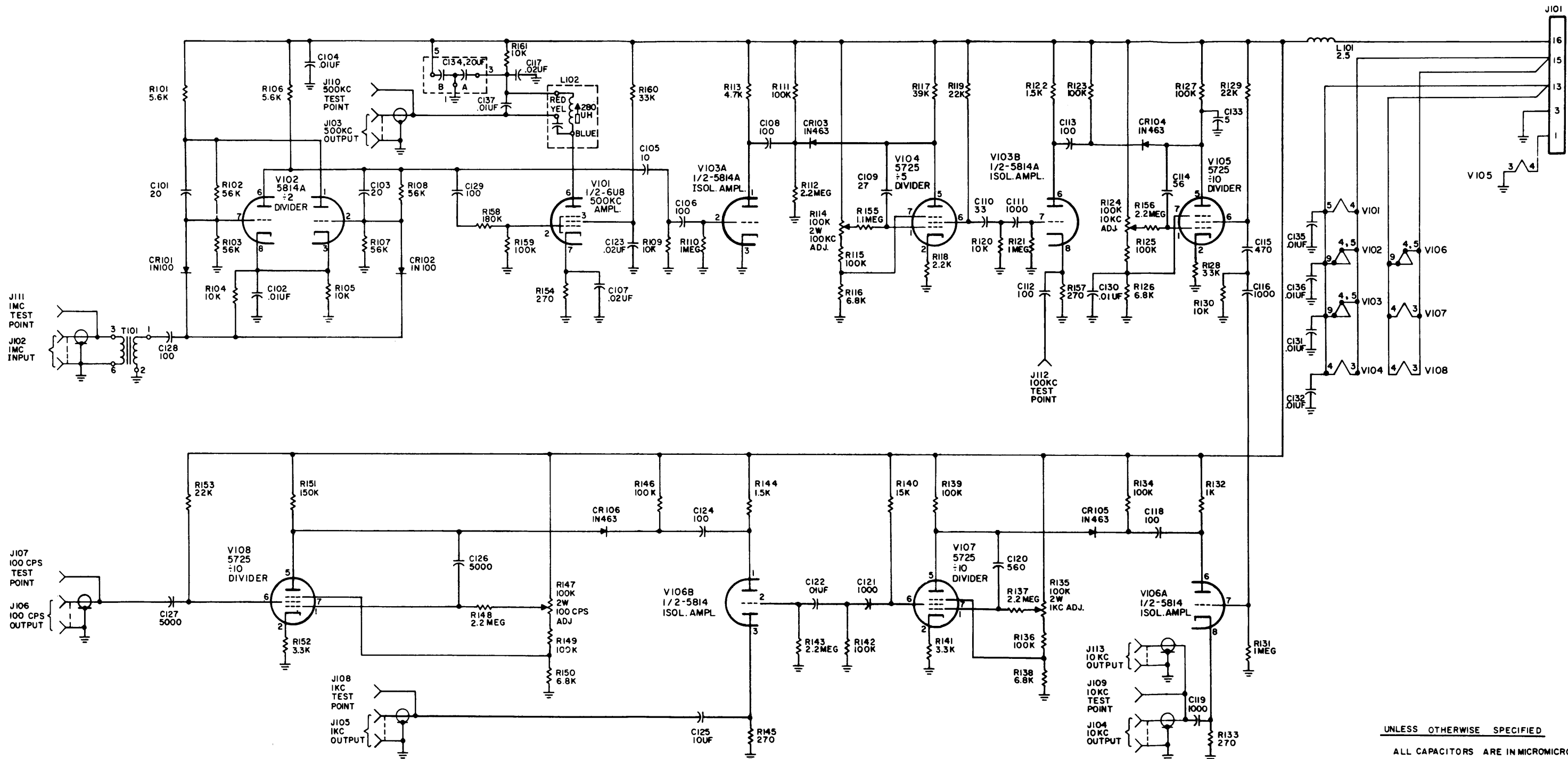
DIVIDER CHAIN CHL-1

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
R135	Same as R114.	1 Kc Adjustment, V107	
R136	Same as R111.	Voltage Divider, V107	
R137	RESISTOR, precision: carbon film; resin coated, 2.2 megohms, $\pm 1\%$, 1 watt, temperature coefficient -0.08% ; 500 wvdc.	Series Grid, V107	RN25X2204F
R138	Same as R116.	Same as R136	
R139	Same as R111.	Plate Load, V107	
R140	RESISTOR, fixed: composition; 15,000 ohms, $\pm 10\%$; 1/2 watt.	Screen Load, V107	RC20GF153K
R141	Same as R128.	Cathode, V107	
R142	Same as R111.	Voltage Divider	
R143	Same as R112.	Same as R142	
R144	Same as R122.	Plate Load, V106B	
R145	Same as R133.	Cathode, V106B	
R146	Same as R111.	Voltage Dropping, V106B	
R147	Same as R114.	100 cps Adjustment	
R148	Same as R137.	Series Grid, V108	
R149	Same as R111.	Voltage Dropping, V108	
R150	Same as R116.	Same as R149	
R151	RESISTOR, fixed: composition: 150,000 ohms, $\pm 10\%$; 1/2 watt.	Plate Load, V108	RC20GF154K
R152	Same as R128.	Cathode, V108	
R153	Same as R119.	Screen Load, V108	
R154	Same as R133.	Cathode, V101	
R155	RESISTOR, precision: carbon film; resin coated, 1.1 megohms, $\pm 1\%$, 1 watt; temperature coefficient -0.08% ; 500 wvdc.	Series Grid, V104	RN25X1104F
R156	Same as R137.	Series Grid, V105	
R157	Same as R133.	Cathode, V103B	

DIVIDER CHAIN CHL-1

SYM.	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
R158	RESISTOR, fixed: composition; 180,000 ohms, $\pm 10\%$; 1/2 watt.	Series Grid, V101	RC20GF184K
R159	Same as R111.	Grid, V101	
R160	RESISTOR, fixed: composition; 33,000 ohms, $\pm 10\%$; 1/2 watt.	Screen Load, V101	RC20GF333K
R161	Same as R104.	Plate Load, V101	
T101	TRANSFORMER, pulse: three windings; primary inductance 4.7 mhy; pulse width -0.05 to 5 micro-seconds; 500 volts rms.	Input Matching	TF-228K15
V101	TUBE, electron: 9 pin miniature, triode.	500 Kc Amplifier	6U8
V102	TUBE, electron: twin triode.	2:1 Divider	5814A
V103 A, B	Same as V102.	Isolation Amplifier	
V104	TUBE, electron: pentode.	5:1 Divider	5725
V105	Same as V104.	10:1 Divider	
V106 A, B	Same as V102.	Same as V103	
V107	Same as V104.	Same as V105	
V108	Same as V104.	Same as V105	
XC134	SOCKET, electron tube: octal.	Socket for C134	TS101P01
XV101	SOCKET, tube: 9 pin miniature.	Socket for V101	TS103P01
XV102	Same as XV101.	Socket for V102	
XV103	Same as XV101.	Socket for V103	
XV104	SOCKET, electron tube: 7 pin miniature.	Socket for V104	TS102P01
XV105	Same as XV104.	Socket for V105	
XV106	Same as XV101.	Socket for V106	
XV107	Same as XV104.	Socket for V107	
XV108	Same as XV104.	Socket for V108	

SECTION 8
SCHEMATIC DIAGRAMS



UNLESS OTHERWISE SPECIFIED
 ALL CAPACITORS ARE IN MICROMICROFARADS
 ALL COILS ARE IN MILLIHENRIES.
 ALL RESISTORS ARE 1/2 WATT.

Figure III(D)-8-1. Divider Chain CHL-1, Schematic Diagram