UNCLASSIFIED

TECHNICAL MANUAL

for

PRIMARY STANDARD MODEL CSS-1

(O-715/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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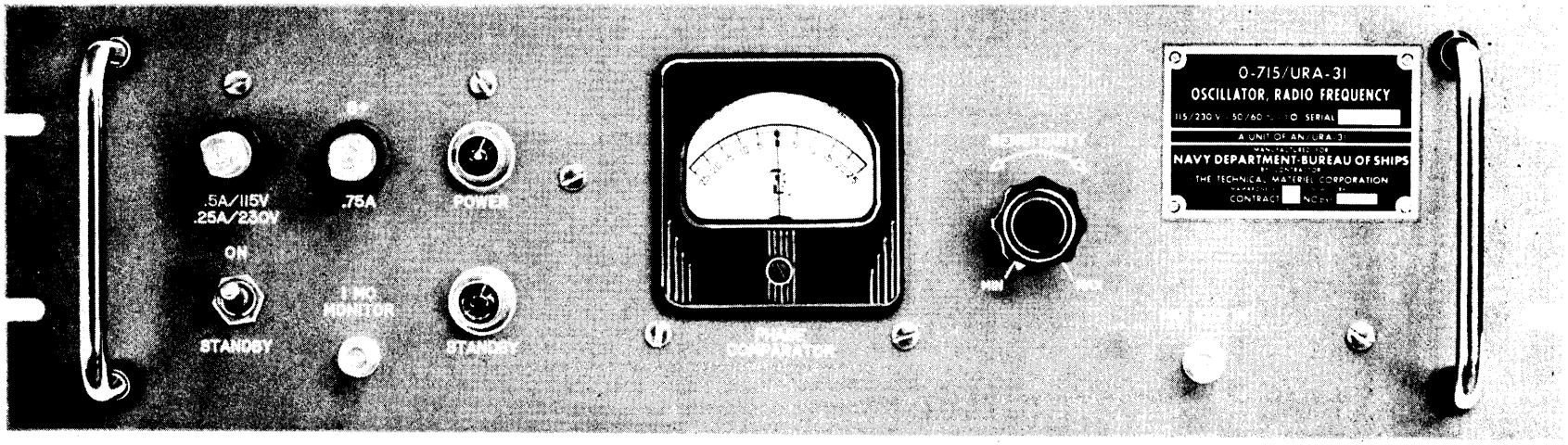


Figure III(C)-1-1a. Primary Standard CSS-1, Front View

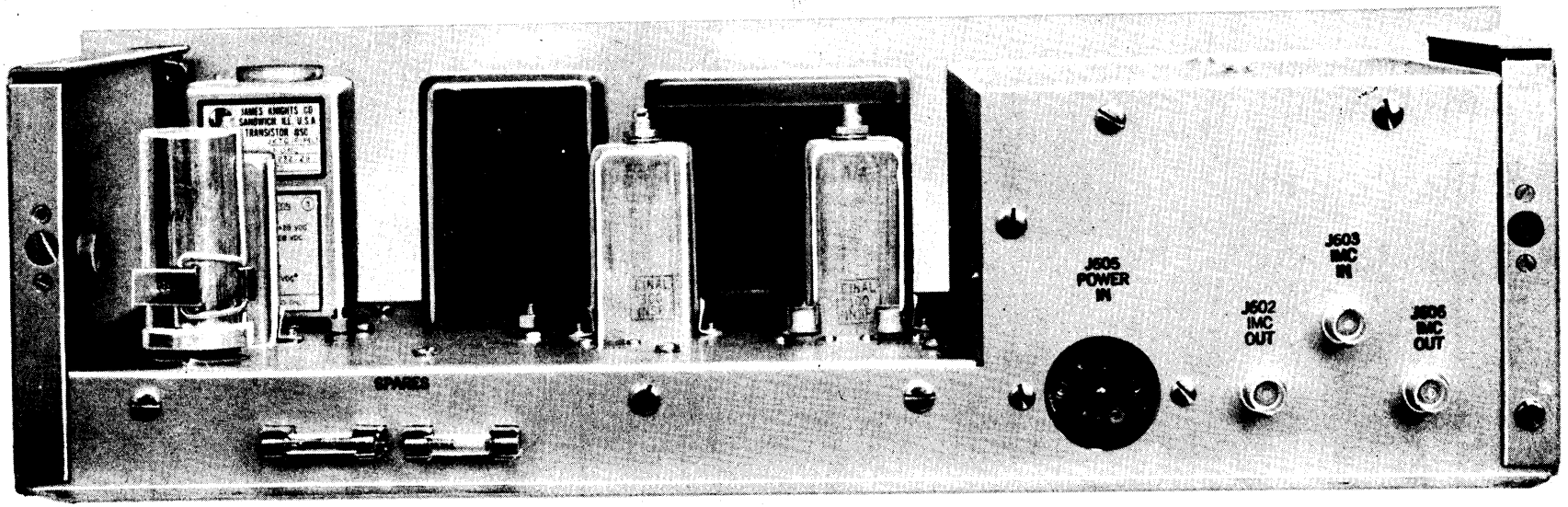


Figure III(C)-1-1b. Primary Standard CSS-1, Rear View

SECTION 1
GENERAL DESCRIPTION

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

Technical Materiel Corporation's Primary Standard, CSS-1, is a precise and stable one-megacycle standard. Its basic crystal transistor oscillator is contained in a hermetically-sealed temperature-stabilized oven. The CSS-1 has a comparator circuit that permits its output frequency to be compared with an external primary frequency standard. The frequency stability of the CSS-1 is one cycle in 100,000,000 per day.

CSS-1 is associated with one other unit in the Controlled Precision Oscillator, CPO-1. Divider Chain, CHL-1, receives the output from the CSS-1.

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

The CSS-1 is shown in figures III(C)-1-1a and III(C)-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 14-3/4 inches behind the panel and is self-supporting. The unit weighs 30 pounds.

Controls and indicators for the operation of the unit are located on the front panel. The CSS-1 contains its own power supply. The equipment is manufactured in accordance with JAN/MIL standards, whenever practicable. All parts and assemblies meet or exceed the highest quality standards.

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

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

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

ITEM	CHARACTERISTICS
Crystal oven operation:	Proportional heat supply; heat varying with deviation from proper crystal temperature.
Frequency adjustment:	Trimmer capacitor accessible from top of primary oscillator can.
Frequency stability:	1 part in 100,000,000 per day.
Input power:	115- or 230-volts, 60-cps, single phase, 50-watts (cold oven), 30-watts (warm oven).
Output frequency:	One megacycle.
Output power:	1-volt at 72-ohms.

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

CONTROL	FUNCTIONS
B+ . 75A fuseholder:	Contains B+ fuse. Glows when fuse is blown.
ON-STANDBY switch: ON position: STANDBY position:	 Supplies 28-volt power to entire CSS. Supplies 28-volt power only to oven of CSS.
PHASE COMPARATOR meter:	Indicates phase difference between CSS output and externally generated input.
POWER indicator:	Lights when ON-STANDBY switch is in ON position.
PRI STD IN jack:	Permits connection of externally generated input for frequency comparison.
SENSITIVITY (MIN-MAX) control:	Regulates PHASE COMPARATOR meter sensitivity.
STANDBY indicator:	Lights when ON-STANDBY switch is in STANDBY position.
1 MC MONITOR jack:	Permits monitoring of CSS output.
.5A/115V .25A/230V fuseholder:	Contains input power fuse. Glows when fuse is blown.

TABLE III(C)-1-3. TRANSISTOR COMPLEMENT

SYMBOL	TYPE	FUNCTION
Q601	2N1224	Amplifier
Q602	2N1224	Amplifier
Q603	2N1224	Isolation Amplifier

SECTION 2
INSTALLATION

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

Each CSS-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(C)-2-3. 115- VS. 230-VOLT POWER SUPPLY CONNECTIONS.

CSS-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(C)-8-1.

III(C)-2-4. INTERCONNECTIONS.

Figure I-2-1 indicates the following interconnections:

a. 115-volt power cord to J605 of CSS-1.

b. 1 MC OUT (J602) of CSS-1 to 1 MC INPUT (J1301) of CHG-1 via CA572 (P3025, P3011).

c. 1 MC IN (J603) of CSS-1 to EXTERNAL 1 MC IN (J3004) of center shield assembly via CA572 (P3026, J3004).

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

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

The CSS-1 is a highly precise standard which has been verified against a precise factory standard. Make no frequency adjustments. Frequency adjustments are practicable only where special frequency standards exist-such as in the National Bureau of Standards, Washington, D. C.

SECTION 3
OPERATOR'S SECTION

III(C)-3-1. GENERAL INSTRUCTIONS.

The oven of the CSS-1 must warm up for one hour prior to operation to ensure oscillator stability. During this hour POWER IN jack J605 on the rear of the chassis must be fed with 115- or 230-volt, 60-cycle power and the ON/STANDBY switch on the front panel should be in STANDBY position.

III(C)-3-2. OPERATION OF THE PHASE COMPARATOR CIRCUIT.

The phase comparator circuit is used to compare a secondary external 1-mc standard with the precise 1-mc standard of the CSS-1. The secondary 1-mc standard's frequency should be adjusted to align the secondary's frequency with that of the CSS-1; never the reverse. Adjustment of the CSS-1's frequency is a maintenance problem; never an operator's problem.

When the output frequencies of the external 1-mc standard and the CSS-1 are identical, the needle of the PHASE COMPARATOR meter will remain stationary at some point on its scale (not necessarily zero). If the output frequencies of the external 1-mc standard and the CSS-1 are not identical, the needle of the PHASE COMPARATOR meter will move.

The voltage input level of the external primary standard should not exceed 1 volt. When much greater voltages occur, use CSS-1's pad (R621, R622, R623) to avoid pinning the needle of the PHASE COMPARATOR meter.

SECTION 4
PRINCIPLES OF OPERATION

III(C)-4-1. INTRODUCTION.

CSS-1 has four principal circuits as follows:

a. Standard crystal oscillator.

b. Amplifier.

c. Phase comparator.

d. Power supply.

Figure III(C)-8-1 is a schematic diagram of the CSS-1. The circuit descriptions below are based on this diagram.

III(C)-4-2. STANDARD CRYSTAL OSCILLATOR.

The standard crystal oscillator is a sealed unit consisting of crystal oscillator and an enclosing proportional oven.

The crystal oscillator is a James Knights Co. transistor oscillator circuit. A hatch at the top of the can permits access to a trimmer capacitor. This capacitor is factory set so that the oscillator frequency is precisely 1-mc.

CAUTION

Do not tamper with the trimmer capacitor. Readjustment requires an extremely accurate 1-mc standard generally unavailable in the field.

The proportional oven enclosing the oscillator varies its heat in inverse proportion to the deviation from the proper temperature. The oven creeps up to a stabilized temperature and maintains that temperature within close limits.

III(C)-4-3. AMPLIFIER.

The amplifier circuit consists of two 2N1224 transistors connected in parallel with tuning network T603, three sets of 1-mc output coaxial jacks, and an output adjust potentiometer R617.

III(C)-4-4. PHASE COMPARATOR.

The phase comparator circuit consists of an isolation amplifier Q603; a phase detector Z601 as described in Section I-4-1b; two coaxial input jacks J603 and J604; a resistance pad R621, R622, and R623; and a microammeter M601, shunted by sensitivity potentiometer R616.

III(C)-4-5. POWER SUPPLY.

The power supply circuit consists of a "dry" (bridge) selenium rectifier equipped with a choke filter, Zener diode CR601, and auxiliary components (switch, pilot lamps, etc.). The voltage at the Zener diode is 28-volts.

SECTION 5
TROUBLE-SHOOTING

III(C)-5-1. INTRODUCTION.

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

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

Table III(C)-5-1 lists voltage and resistance measurements at transistor pins in the CSS-1.

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

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

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

Refer to III(G)-7.

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

MEASUREMENT	INDICATION
DC VOLTAGE TO GROUND AT TERMINAL 3 OF Z602.	25 vdc.
RF VOLTAGE TO GROUND AT TERMINAL 6 OF Z602.	2.5-3.0 vrf.
DC RESISTANCE TO GROUND AT EMITTERS AND COLLECTORS OF Q601, Q602, Q603 (LINE POWER OFF).	7000 ohms.
RF VOLTAGE TO GROUND AT YELLOW LEAD OF Z601.	Tune Z601 for peak rf indication.
RF VOLTAGE TO GROUND AT J601 (R617 AT MAXIMUM).	1.0 vrf.

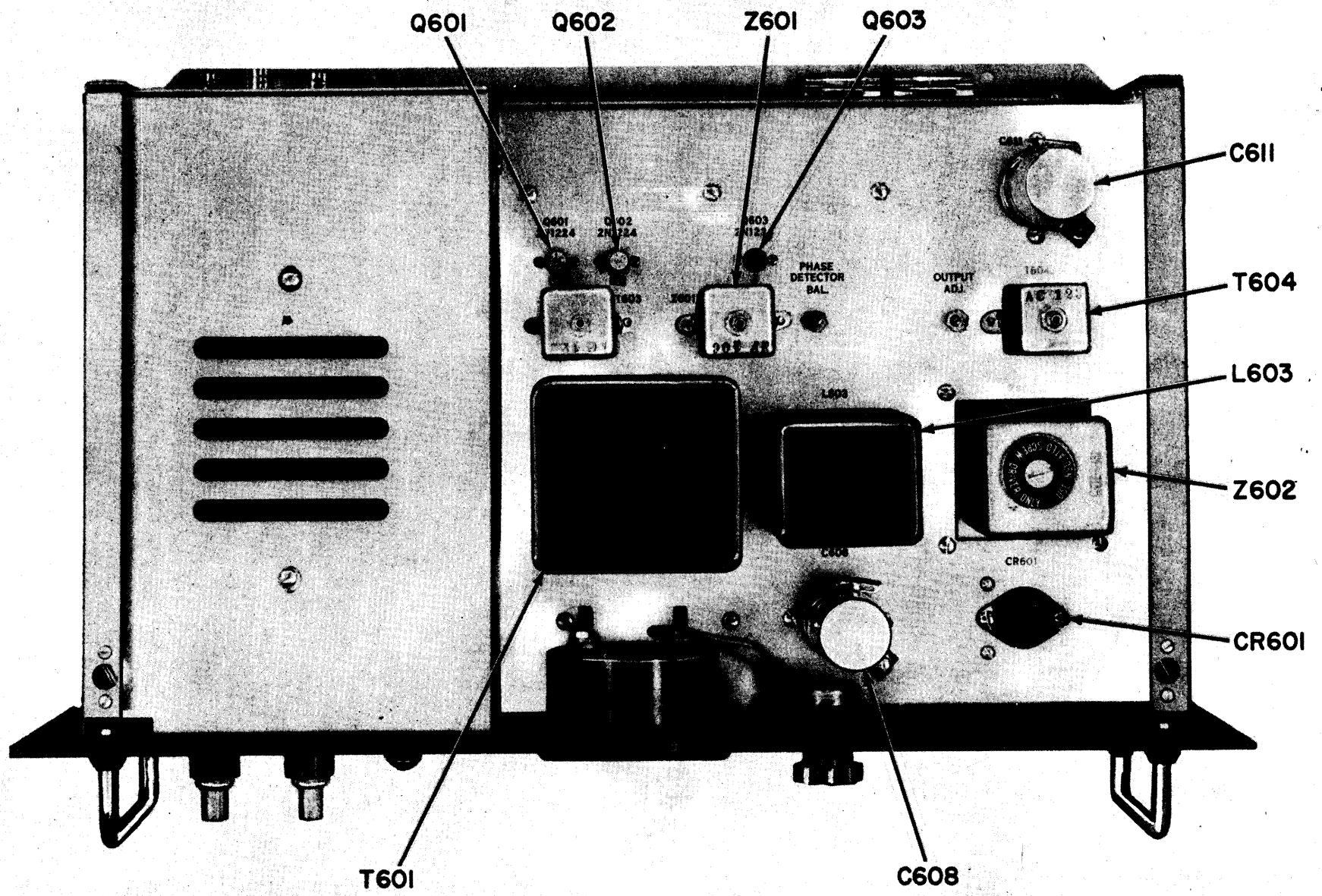
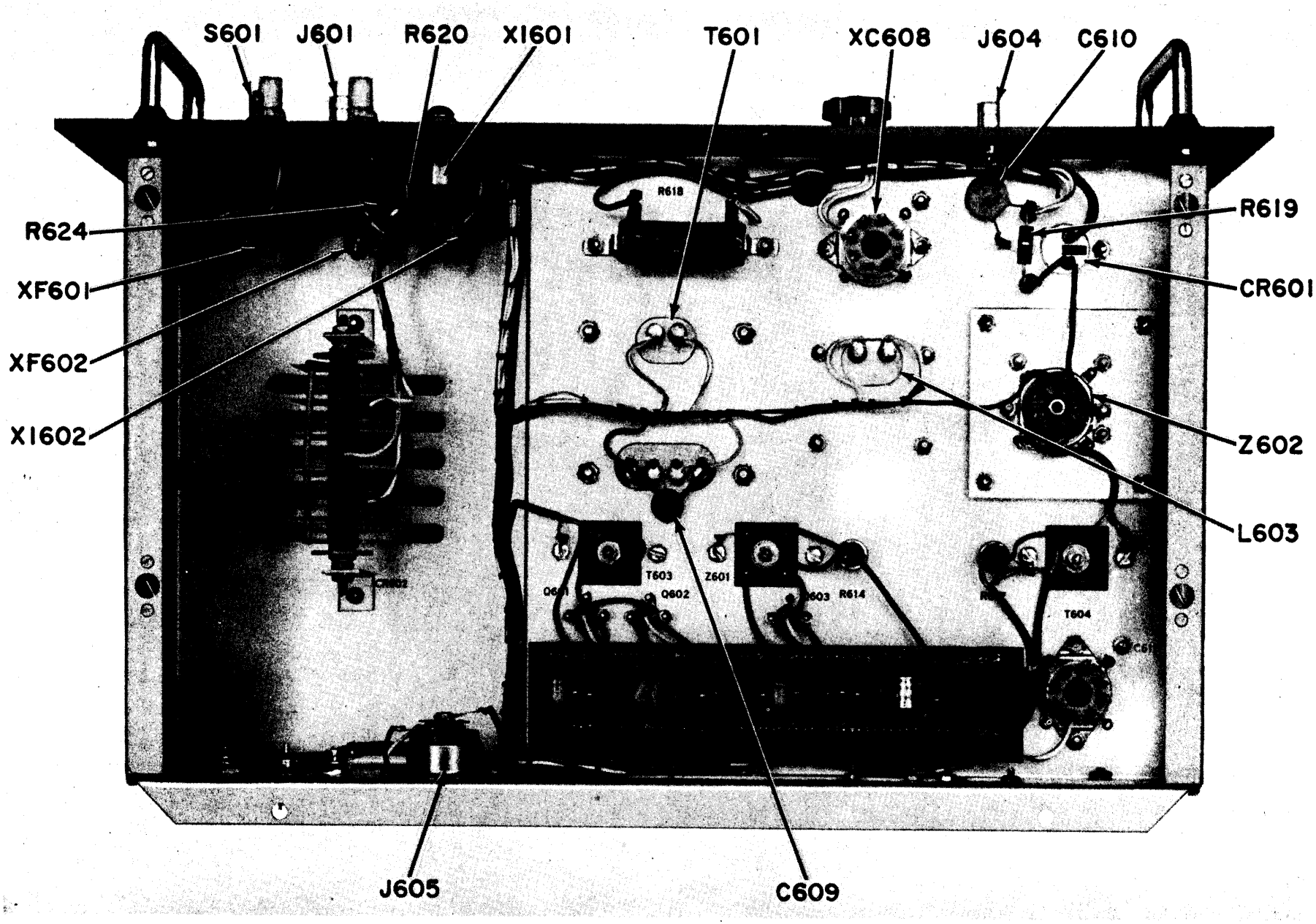


Figure III(C)-5-1. Location Diagram of Major Electronic Equipment Components, Top View



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

SECTION 6
MAINTENANCE

III(C)-6-1. INTRODUCTION.

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

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

Refer to III(G)-7.

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 light I101 is designated XI101. 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.
C601	CAPACITOR, fixed: ceramic; .1 uf, +80%, -20%, 500 wvdc.	Emitter Bypass Q601	CC-100-28
C602	Same as C601.	Emitter Bypass Q602	
C603	CAPACITOR, fixed: ceramic; 10,000 uuf, GMV; 500 wvdc.	Coupling,Q601	CC-100-16
C604	Same as C603.	Coupling,Q602	
C605	Same as C603.	Coupling,Q603	
C606	Same as C601.	RF Bypass, Q603	
C607	Same as C603.	RF Bypass	
C608	CAPACITOR, fixed: dry electrolytic; polarized, 300 uuf; 500 wvdc.	Filter	CE51C301G
C609	Same as C603.	Same as C608	
C610	Same as C601.	RF Bypass	
C611	Same as C608.	RF Bypass	
C612	Same as C603. (Model CSS-1A only)	Coupling, Q604	
CR601	DIODE, zener: 27 volts, temperature range -- 65 to +175°C, .052" dia. pins, tolerance-5%.	Clamper	VR-100-27-S-10
CR602	RECTIFIER, selenium: single phase bridge; 1.5 dc amp output, max. input 144 vac.	Bridge Rectifier	RX-105-17
F601	FUSE, cartridge: slo-blo; .5 amp.	Main Power Fuse	FU-102-.500
F602	FUSE, cartridge: slo-blo; .75 amp.	Rectifier Fuse	FU-102-.750
I601	LAMP, incandescent: 28 v; 0.10 amp, clear.	Standby Indicator	BI-101-1820
I602	Same as I601.	Power Indicator	
J601	CONNECTOR, receptacle: electrical; 1 female contact; 52 ohms; BNC type.	1 MC MONITOR Connector	UG-625/U
J602	Same as J601.	1 mc Out Connector	
J603	Same as J601.	1 mc In Connector	
J604	Same as J601.	PRI STD IN Connector	
J605	RECEPTACLE, plug: twist lock type, male.	Power in Receptacle	JJ-175
J606	Same as J601.	1 Mc Out Connector	
L601	COIL, R.F.: fixed; 2.5 mhy, 100 ma, molded.	RF Choke	CL-140-1
L602	Same as L601.	RF Choke, Z601	

SYM	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
L603	CHOKE, reactor: .03 hy; 1.2 amps dc, approximately .4 ohm dc resistance; insulation test-1000v.	Filter	TF-221
M601	METER, dc milliamperes, 0-25 centering.	PHASE COMPARATOR	MR-142
Q601	TRANSISTOR, drift: germanium p-n-p type; alpha cutoff frequency - 30 mc.	1 mc amplifier	2N1224
Q602	Same as Q601.	Same as Q601	
Q603	Same as Q601.	Isolation amplifier	
Q604	Same as Q601. (Model CSS-1A only)	Emitter Follower	
P601	CONNECTOR, plug: twist lock; female (polarized) midget size, black bakelite. Part of W601.	Power Connector	PL-176
P602	CONNECTOR, plug: male; AC two prong. Part of W601.	Power Connector	PL-171
R601	RESISTOR, fixed: composition; 560 ohms, ±10%, 1/2 watt.	Equalizing, Q601	RC20GF561K
R602	Same as R601.	Equalizing, Q602	
R603	RESISTOR, fixed: composition; 22,000 ohms, ±10%, 1/2 watt.	Voltage Divider Network	RC20GF223K
R604	RESISTOR, fixed: composition; 270 ohms, ±10%, 1/2 watt.	Equalizing, Q601	RC20GF271K
R605	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1/2 watt.	Voltage Divider Network	RC20GF102K
R606	Same as R605.	Voltage Divider Network	
R607	Same as R604.	Equalizing, Q602	
R608	Same as R603.	Voltage Divider Network	
R609	RESISTOR, fixed: composition; 2200 ohms, ±10%, 1/2 watt.	Terminating	RC20GF222K
R610	Same as R603.	Series Bias	
R611	RESISTOR, fixed: composition; 680 ohms, ±10%, 1/2 watt.	Emitter, Q603	RC20GF681K
R612	Same as R605.	Series Bias, Q603	
R613	RESISTOR, fixed: composition; 5600 ohms, ±10%, 1/2 watt.	Equalizing, Q603	RC20GF562K
R614	RESISTOR, variable: composition; 5000 ohms, ±10%, 1/2 watt.	Phase Detector Balance	RV106UX8B-502A

SYM	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
R615	RESISTOR, fixed: composition; 10,000 ohms, ±10%, 1/2 watt.	Voltage Dropping	RC20GF103K
R616	RESISTOR, variable: composition; 1 megohm, ±10%, 2 watts, linear taper.	SENSITIVITY (MAX-MIN) Adjustment	RV4ATRD105A
R617	RESISTOR, variable: composition; 1000 ohms, ±10%, 1/2 watt.	Output Adjustment	RV106UX8B-102A
R618	RESISTOR, fixed: wire wound; 50 ohms, 25 watts.	Load	RW-111-7
R619	RESISTOR, fixed: composition; 1000 ohms, ±10%, 1 watt.	Bleeder	RC32GF102K
R620	RESISTOR, fixed: composition; 180 ohms, ±10%, 2 watts.	Voltage Dropping	RC42GF181K
R621	Supplied at customer's request.	Input Balancing	
R622	Same as R621.		
R623	Same as R621.		
R624	Same as R620.	Voltage Dropping	
R625	RESISTOR, fixed: composition; 180 ohms, ±10%, 1/2 watt.	Load Compensator	RC20GF181K
R626	RESISTOR, fixed: composition; 18,000 ohms, ±10%, 1/2 watt. (Model CSS-1A only)	Voltage Divider Network	RC20GF183K
R627	Same as R603. (Model CSS-1A only)	Same as R626	
S601	SWITCH, toggle: dpdt; 3 amp, 250 v.	ON-STANDBY Switch	ST-22N
T601	TRANSFORMER, power: step down; primary - 115/230 vac, 50/60 cps, single phase; secondary - 47 vac, 1/2 amp at input to filter.	Power Supply	TF-222
T602	TRANSFORMER, pulse: three windings; primary inductance - 4.7 mhy; pulse width 0.05 to 5 microseconds; 500 v rms.	Input Coupling	TF-228K15
T603	COIL, R.F.: tuned; 25 uhy, Q greater than or equal to 40; frequency range test - 2.5 mc.	Output	AC-122

SYM	DESCRIPTION	FUNCTION	TMC DWG. OR PART NO.
T604	COIL, R.F.: tuned; 85 ±10 uhy, Q greater than or equal to 50; frequency test - 790 kc. (Model CSS-1 only)	Filter	AC-123
W601	CABLE ASSEMBLY, power: ac.	Power Supply	CA-555-1
XC608	SOCKET, electron tube: octal.	Socket for C608	TS101P01
XC611	Same as XC608.	Socket for C611	
XF601	FUSEHOLDER, bayonet base: neon lamp, clear knob, black plastic body, 13/16 x 2-13/16in.	Main Power Fuseholder	FH-104-3
XF602	Same as XF601. (Model CSS-1 only)	Rectifier Fuseholder	
XF602	FUSEHOLDER, bayonet base: incandescent lamp, amber knob, brown plastic body 13/16 x 2-13/16in. (Model CSS-1A only)	Rectifier Fuseholder	FH-104-13
XI601	LIGHT, indicator: clear white lens; for miniature bayonet base, T-3-1/4 bulb.	STANDBY Indicator	TS-106-2
XI602	Same as XI601. (Model CSS-1 only)	POWER Indicator	
XI602	LIGHT, indicator: red frosted lens; for miniature bayonet base, T-3-1/4 bulb. (Model CSS-1A only)	POWER Indicator	TS-106-1
XQ601	SOCKET, transistor: contacts - silver plated beryllium, copper with gold flash; socket, molded of mica filled phenolic.	Socket for Q601	TS-147
XQ602	Same as XQ601.	Socket for Q602	
XQ603	Same as XQ601.	Socket for Q603	
XQ604	Same as XQ601. (Model CSS-1A only)	Socket for Q604	
XZ602	SOCKET, electron tube: octal; high crown.	Socket for Z602	TS101P01/A
Z601	NETWORK, coupling: 100 uhy; Q greater than or equal to 50; frequency test - 2.5 mc.	Coupling Network	NF-106
Z602	FREQUENCY STANDARD, 1 mc; internal impedance - 5000 ohms, output volts across 10,000 ohms - 1-2v. (Model CSS-1 only)	1 mc Standard	NF-105-1
Z602	FREQUENCY STANDARD, 1 mc; internal impedance - 5000 ohms, output volts across 10,000 ohms - 1-2v. (Model CSS-1A only)	1 mc Standard	NF-105-1 NF-105-2 NF-109-1 NF-109-2

SECTION 8
SCHEMATIC DIAGRAMS

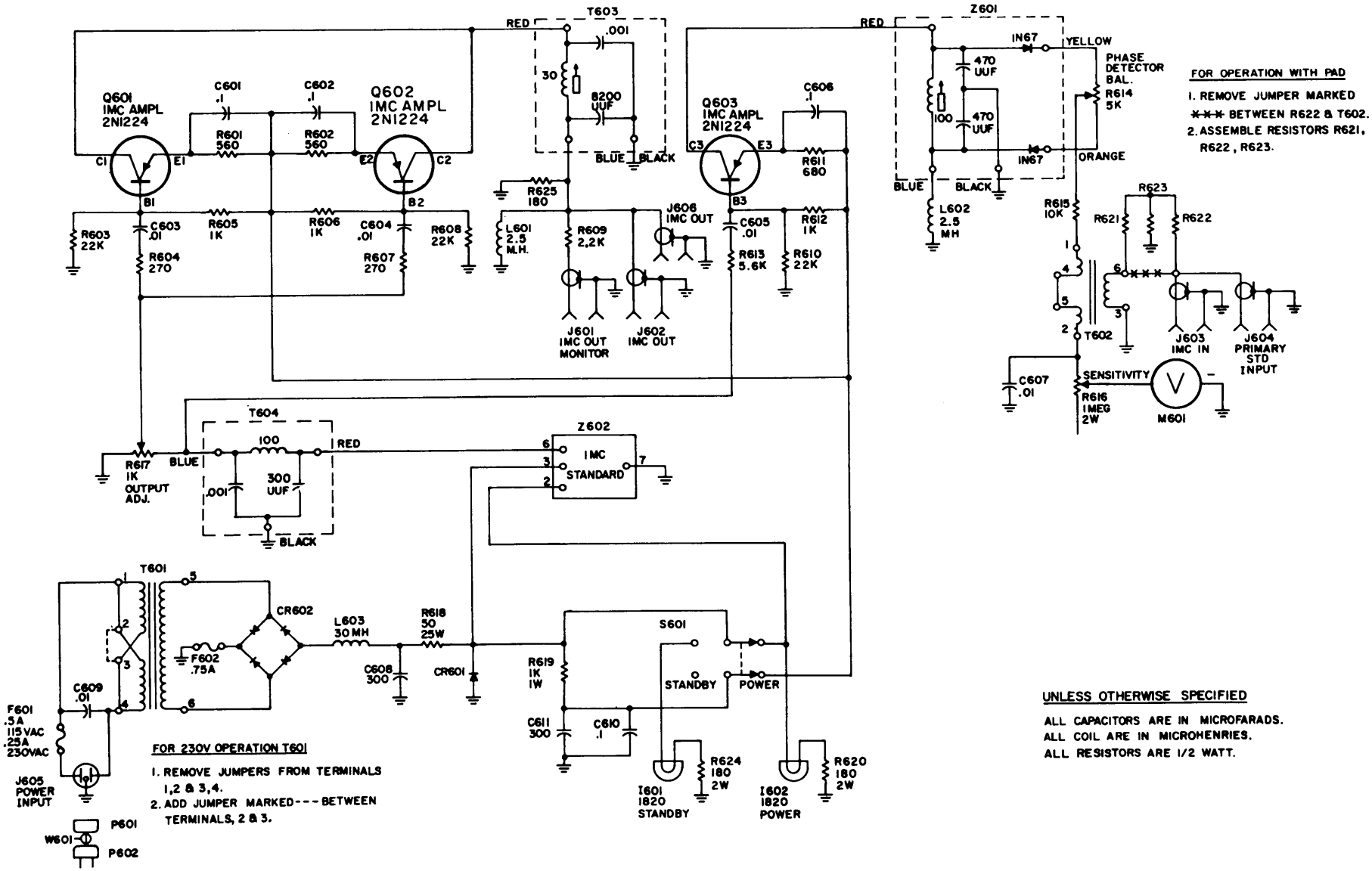


Figure III(C)-8-1. Primary Standard CSS-1, Schematic Diagram

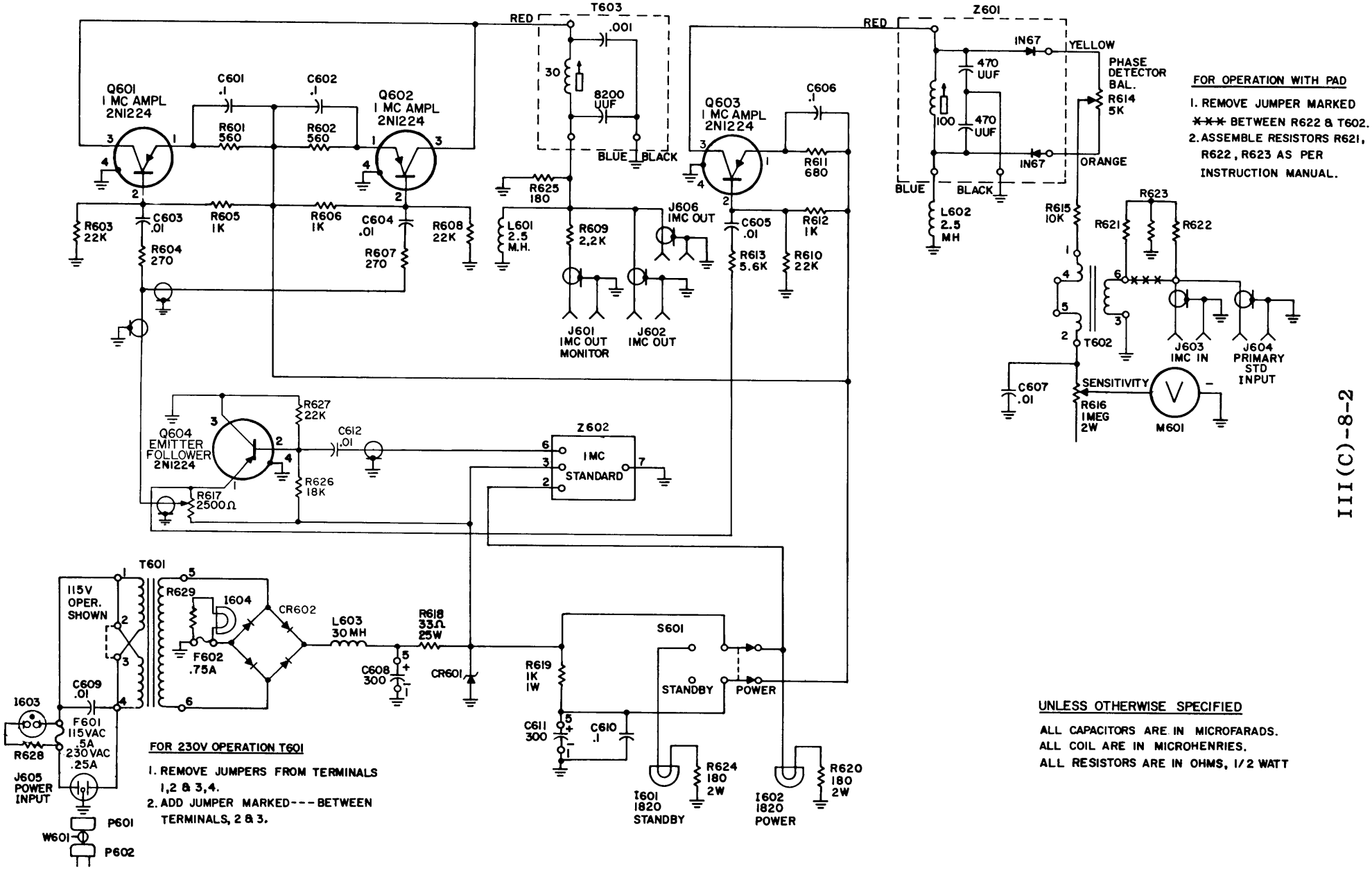


Figure III(C)-8-1A. Primary Standard CSS-1A, Schematic Diagram