

★
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UNCLASSIFIED

TECHNICAL MANUAL

for

FREQUENCY STANDARD

~~MODEL CSS-1B~~

and

~~MODEL CSS-1C~~

CSS-3B



THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y.

OTTAWA, ONTARIO



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IN-2010F

Issue Date: 1 Dec. 1963
Revised Date: 29 Sept. 1967



THE TECHNICAL MATERIEL CORPORATION

C O M M U N I C A T I O N S E N G I N E E R S

700 FENIMORE ROAD

MAMARONECK, N. Y.

W a r r a n t y

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 other cause.

*Electron tubes also include semi-conductor devices.

FREQUENCY STANDARD

MODEL CSS-3B

The CSS-1B is changed to a CSS-3B by the application of an audible alarm DS601 a failure light I605, and the addition of Kit 270 a 1 mc Automatic Switchover Kit. The 1 mc Automatic Switchover Kit provides automatic switching from the internal standard to an external standard upon failure of the internal standard. When the 1 mc internal standard fails to operate the audible alarm and failure light are activated. A switch S605 and terminal board TB601 are also provided for an external alarm connection if desired.

The CSS-1B instruction manual will apply as written with the following exceptions.

- (1) All references to CSS-1B should be changed to CSS-3B.
- (2) Remove Figure 1-1 - replace with New Figure 1-1 Front Panel Line Drawing of CSS-3B provided with addendum.
- (3) In paragraph 1-4, under Semi-conductor Complement, add the following
 - (a) 2N697
- (4) In paragraph 2-2c, change J602 to J2.
- (5) Remove Figure 2-2 - replace with new Figure 2-2. Rear Panel Line Drawing of CSS-3B provided with addendum.
- (6) Remove Figure 3-1 - replace with new Figure 3-1. Front panel line drawing of CSS-3B provided with addendum.
- (7) At the end of paragraph 4-1, page 4-0, add the following, An Automatic change over relay automatically connects the external frequency standard to associated equipment if the internal frequency standard fails.
- (8) Remove Figure 4-1 - replace with revised Figure 4-1 provided with addendum.

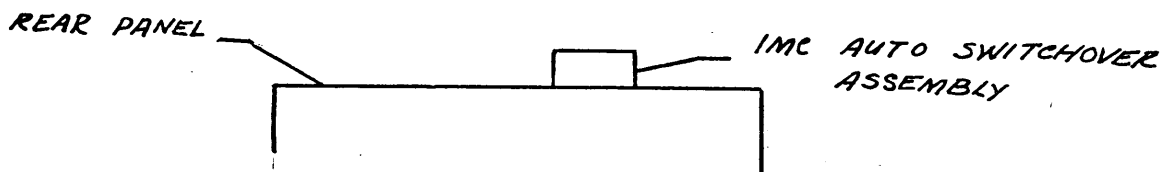
(9) At the end of first paragraph within paragraph 4-2, page 4-0, add the following:

The 1-mc output from J602 is applied to INT. 1 mc jack J3, and 1-mc from an external source may be applied to EXT STD IN jack J1; one of these two signals is coupled through relay K1 to 1-mc out jack J2.

Automatic switching occurs when the amplitude of the internal standard decreases below 0.7 volts rms. After restoration of the internal standard to at least 0.7 rms the unit will automatically switch back to the internal standard.

If a 1-mc signal is not being applied to J3, relay K1 couples the signal from J1 to J2. If a signal is being applied to J3, transistor Q1 actuates relay K1, and the 1-mc input J3 is coupled to J2. The audible alarm and failure light will activate when the internal standard fails.

(10) Figure 5-1 and 5-2 should be corrected to include the following modification to rear panel - Add 1 mc Automatic Switchover Assembly.



(11) Change paragraph 5-3d to read: Connect VTVM to 1-mc OUT jack J2. Connect a 1-mc (at 1 v.r.m.s.) signal input to J1. VTVM should indicate at least 1 v.r.m.s. If normal indication is not observed, try adjusting potentiometer R617. If trouble still exists, check for defective potentiometer R617, amplifiers Q601 or Q602 or transformer T603. Check K1, Q1, and all other components in relay switching circuits. Disconnect input to J3. There should be clicking sound and a momentary drop in the VTVM indication as relay K1 switches; VTVM indication should then return to at least 1 v.r.m.s. If normal indication is not observed, check K1, Q1, and all other components in relays switching circuit.

- (12) In paragraph 6-4a., change J602 to J2.
- (13) In paragraph 6-5c., change J606 to J2.
- (14) Replace parts list in manual with parts list provided with this addendum.
- (15) Remove figure 8-1 (pp 8-3/8-4) from CSS-1B manual and insert new figure 8-1 supplied with this addendum.

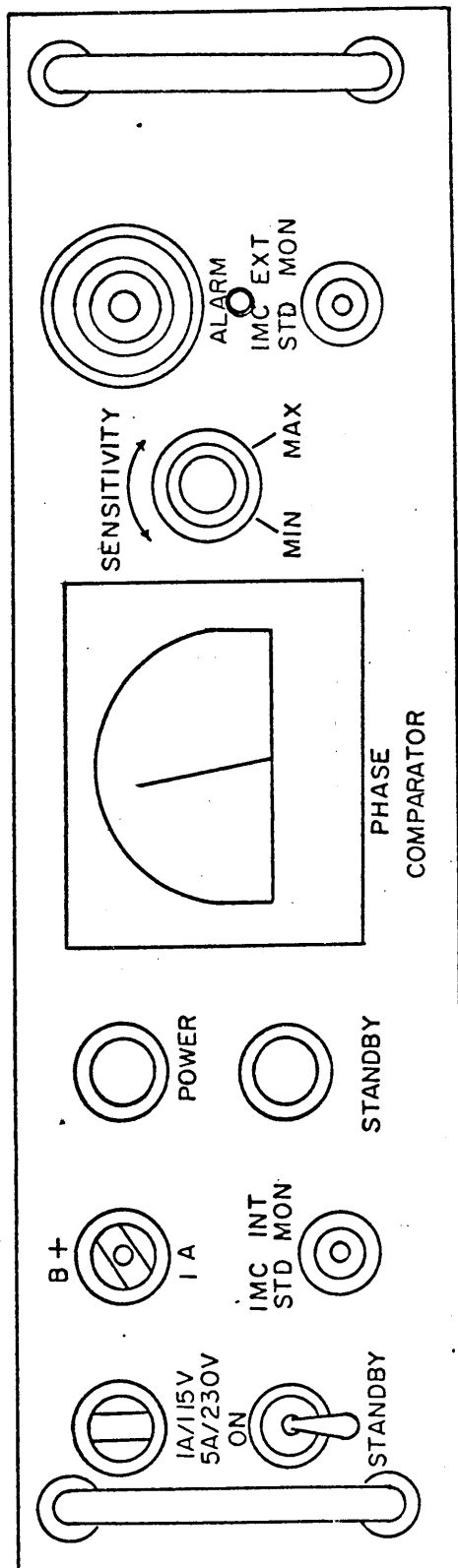


Figure 1-1. Model CSS-3B, Front Panel View

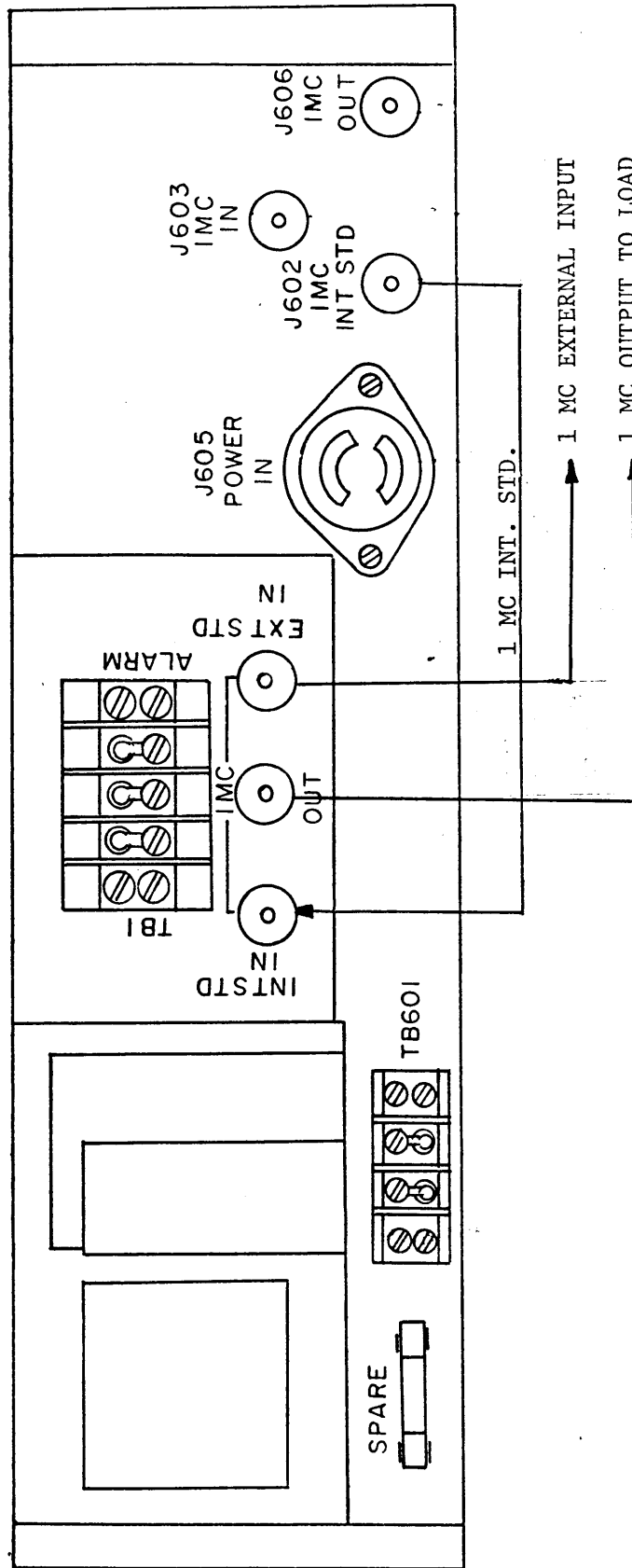


Figure 2-2. Model CSS-3B, Rear Panel View

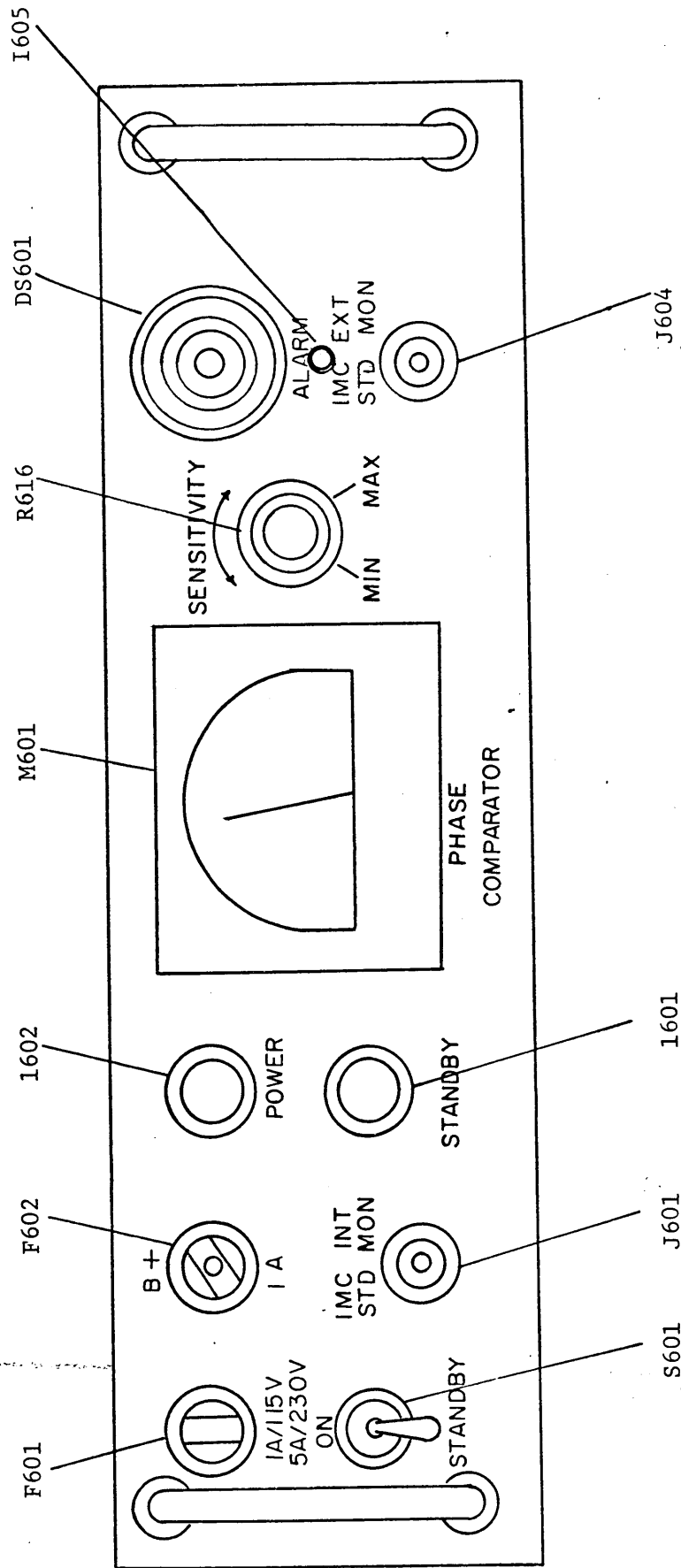


Figure 3-1. Model CSS-3B, Front Panel View

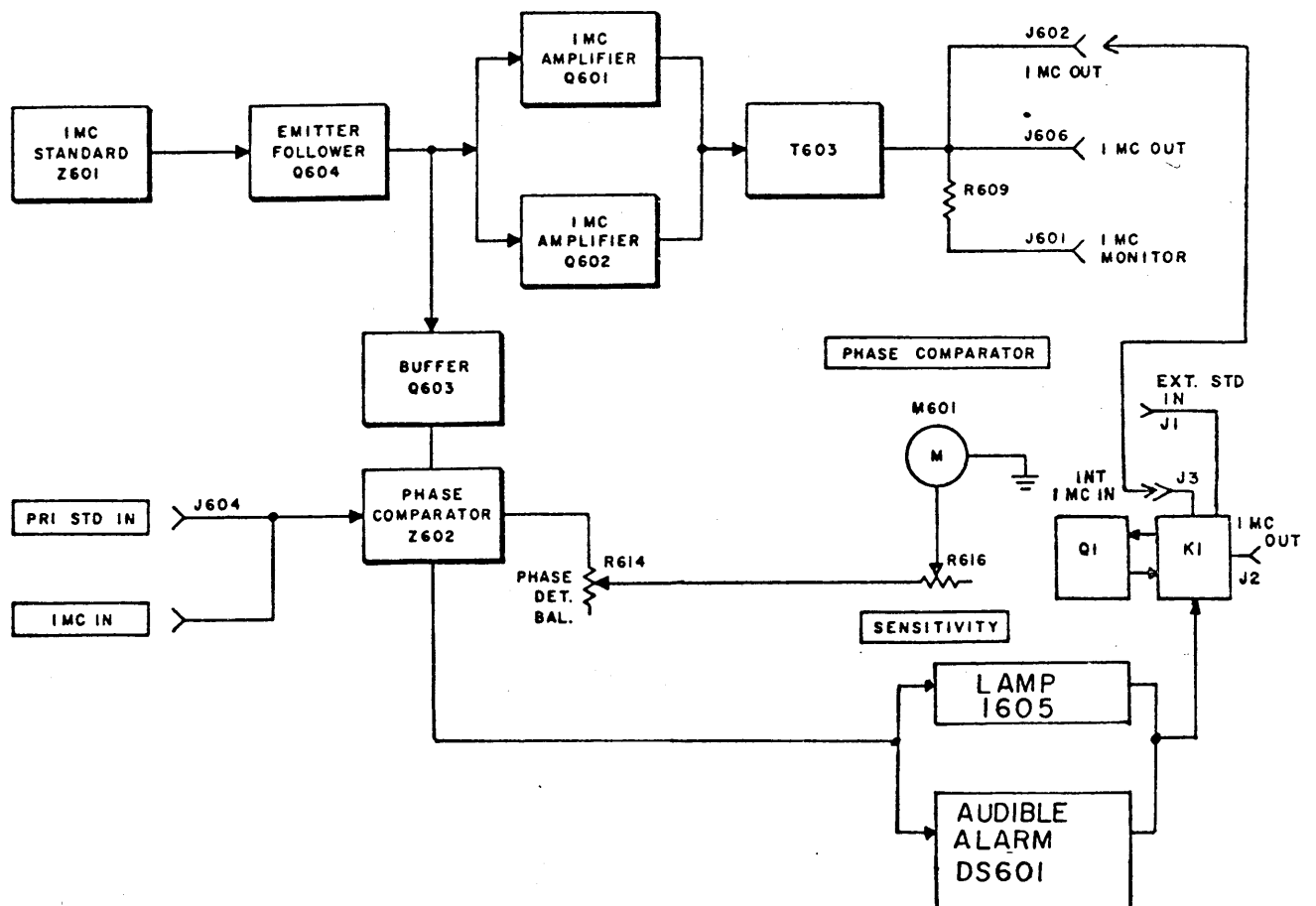


Figure 4-1. Model CSS-3B, Block Diagram

PARTS LIST

for

FREQUENCY STANDARD-BASIC, MODEL CSS-3B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
AT1	DUMMY LOAD, ELECTRICAL: 47 ohms, $\pm 10\%$; 1/2 watt; BNC series.	DL100-4
C601	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, $+80\%$ - 20% ; 100 WVDC.	CC100-28
C602	Same as C601.	
C603	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, GMV; 500 WVDC.	CC100-16
C604	Same as C603.	
C605	Same as C603.	
C606	Same as C601.	
C607	Same as C603.	
C608	CAPACITOR, FIXED, ELECTROLYTIC: 300 uf; 50 WVDC; polarized.	CE51C301G
C609	Same as C603.	
C610	Same as C601.	
C611	Same as C608.	
CP1	CONNECTOR, ADAPTER: tee type; impedance 52 ohms; 1-9/32" x 1-1/16".	UG274/U
CR601	SEMICONDUCTOR DEVICE, DIODE: silicon, zener type; 1500 ma maximum DC current; maximum forward voltage 1.5 V at 10 amps, $\pm 10\%$; standard polarity; 50 watts.	VR100-27S10
CR602	RECTIFIER, SELENIUM: output voltage \emptyset to 116 VDC; output current 1.5 ADC; stud mounted.	RX105-17
DS601	GENERATOR, AUDIBLE SIGNAL: frequency 4.0 -4.5 Kc; operating voltage 6-28 VDC; current rating 3 to 14 ma.	BZ101
F601	FUSE, CARTRIDGE: 1 amp; 1-1/4" long x 1/4" dia; slow-blow. (For 115V operation)	FU102-1
F601	FUSE, CARTRIDGE: 1/2 amp; 1-1/4" long x 1/4" dia; slow-blow. (For 230 V operation)	FU102-.5

PARTS LIST

for

FREQUENCY STANDARD-BASIC, MODEL CSS-3B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
F602	Same as F601.	
I601	LAMP, INCANDESCENT: 28 volts; 0.10 amps; bayonet base, T-3-1/4 bulb.	BI101-1820
I602	Same as I601.	
I603	Non-replaceable item. Part of XF601.	
I604	Non-replaceable item. Part of XF602.	
I605	LAMP, INCANDESCENT: 28.0 volts AC/DC; 0.20 amps; single contact, T-1-3/4 bulb.	BI110-7
J601	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 female contact; teflon dielectric; operating voltage 500 V peak; impedance 50 ohms; series BNC.	JJ325
J602	Same as J601.	
J603	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 female contact; operating voltage 500 V peak; impedance 50 ohms; beryllium copper contact; BNC series.	UG625*/U
J604	Same as J601.	
J605	CONNECTOR, RECEPTACLE, ELECTRICAL: AC power; 2 male contacts rated for 10 amps at 250 V or 15 amps at 125 V; polarized; twist lock type; black bakelite.	JJ175
J606	Same as J603.	
L601	COIL, RADIO FREQUENCY: fixed; 2.5 uh, $\pm 10\%$; current rating 110 ma; molded case.	CL140-1
L602	Same as L601.	
L603	CHOK REACTOR: voltage rating 3 V at 1.2 amps DC; approximate DC resistance .4 ohms; stud mounted.	TF221
M601	METER, PHASE , COMPARATOR: meter movement -25-0-25 micro-amps; approximate resistance 2000 ohms; spade edge pointer type; panel mounted.	MR142

PARTS LIST

for

FREQUENCY STANDARD-BASIC, MODEL CSS-3B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P601	CONNECTOR, PLUG, ELECTRICAL: 2 female contacts, rated for 10 amps at 250V; polarized; twist lock; midget size; brown bakelite. Part of W601.	PL176
P602	CONNECTOR, PLUG, ELECTRICAL: AC; 3 prong, polarized; with removeable ground connection. Part of W601.	PL218
Q601	TRANSISTOR	2N1224
Q602 thru Q604	Same as Q601.	
R601	RESISTOR, FIXED, COMPOSITION: 560 ohms, $\pm 5\%$; 1/2 watt.	RC20GF561J
R602	Same as R601.	
R603	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, $\pm 5\%$; 1/2 watt.	RC20GF223J
R604	RESISTOR, FIXED, COMPOSITION: 270 ohms, $\pm 5\%$; 1/2 watt.	RC20GF271J
R605	RESISTOR, FIXED, COMPOSITION: 1000 ohms, $\pm 5\%$; 1/2 watt.	RC20GF102J
R606	Same as R605.	
R607	Same as R604.	
R608	Same as R603.	
R609	RESISTOR, FIXED, COMPOSITION: 2200 ohms, $\pm 5\%$; 1/2 watt.	RC20GF222J
R610	Same as R603.	
R611	RESISTOR, FIXED, COMPOSITION: 680 ohms, $\pm 5\%$; 1/2 watt.	RC20GF681J
R612	Same as R605.	
R613	RESISTOR, FIXED, COMPOSITION: 5600 ohms, $\pm 5\%$; 1/2 watt.	RC20GF562J

PARTS LIST

for

FREQUENCY STANDARD-BASIC, MODEL, CSS-3B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R614	RESISTOR, VARIABLE, COMPOSITION: 5000 ohms, $\pm 10\%$; 1/2 watt.	RV106UX8B502A
R615	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, $\pm 5\%$; 1/2 watt.	RC20GF103J
R616	RESISTOR, VARIABLE, COMPOSITION: 1 meg ohm, $\pm 10\%$; 2 watts.	RV4NAYSD105A
R617	RESISTOR, VARIABLE, COMPOSITION: 2500 ohms, $\pm 10\%$; 1/2 watt.	RV106UX8B252A
R618	RESISTOR, FIXED, WIRE-WOUND: 1 ohm; current rating 5000 ma; 25 watts.	RW111-6
R619	RESISTOR, FIXED, COMPOSITION: 1000 ohms, $\pm 5\%$; 1 watt.	RC32GF102J
R620	RESISTOR, FIXED, COMPOSITION: 180 ohms, $\pm 5\%$; 2 watts.	RC42GF181J
R621	RESISTOR, FIXED, COMPOSITION: (SUPPLIED PER CUSTOMER REQUEST)	RC20GFXXXX
R622	Same as R621.	
R623	Same as R621.	
R624	Same as R620.	
R625	RESISTOR, FIXED, COMPOSITION: 180 ohms, $\pm 5\%$; 1/2 watt.	RC20GF181J
R626	RESISTOR, FIXED, COMPOSITION: 18,000 ohms, $\pm 5\%$; 1/2 watt.	RC20GF183J
R627	Same as R603.	
R628	Non-replaceable item. Part of XF601.	
R629	Non-replaceable item. Part of XF602.	
R630	RESISTOR, FIXED, COMPOSITION: 47 ohms, $\pm 5\%$; 1/2 watt.	RC20GF470J
R631	Same as R630.	
R632	Same as R630.	
S601	SWITCH, TOGGLE: DPDT; 28° angle of throw; bat type handle.	ST22N

PARTS LIST

for

FREQUENCY STANDARD-BASIC, MODEL CSS-3B

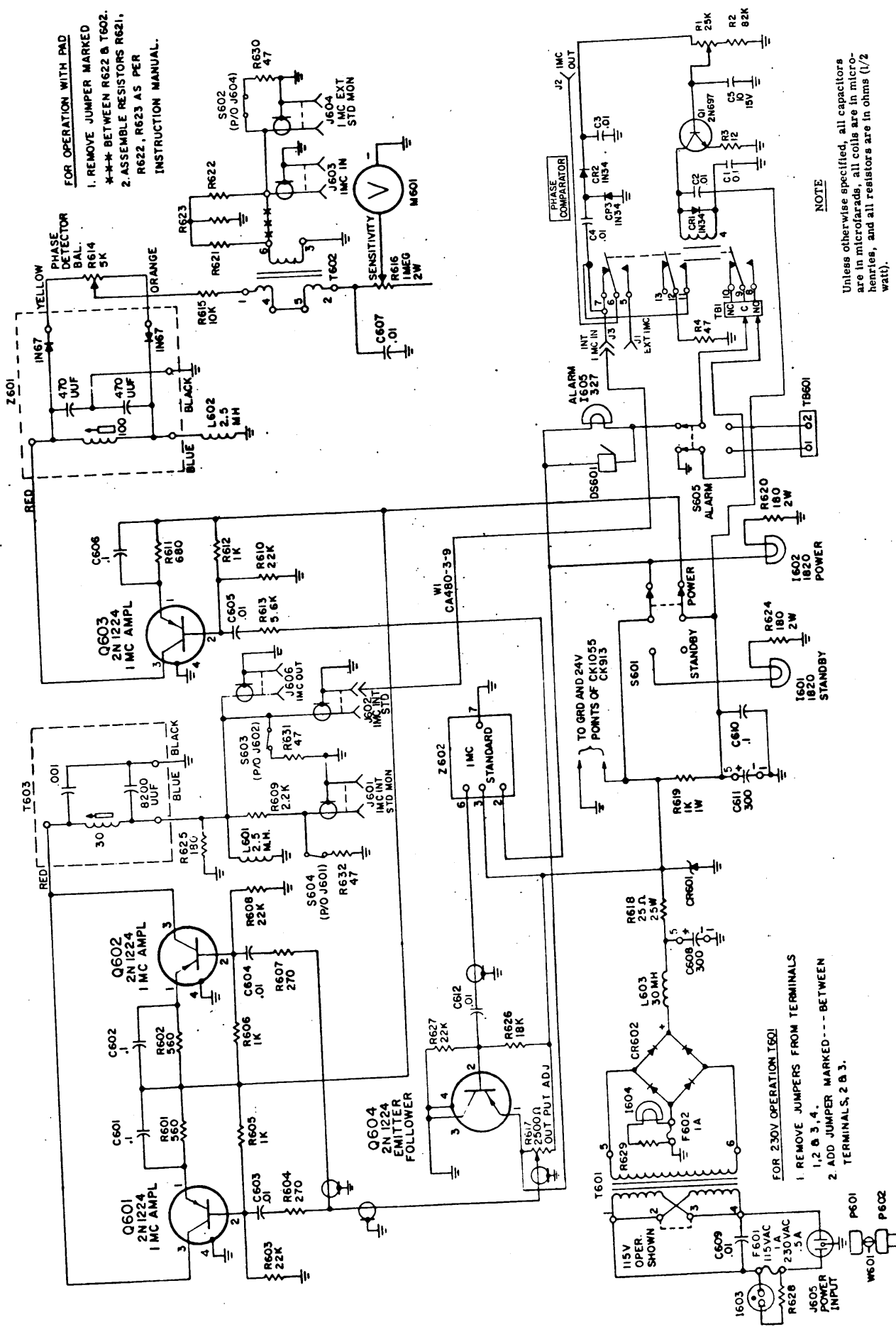
REF SYMBOL	DESCRIPTION	TMC PART NUMBER
S602 thru S604	Non-replaceable item. Part of J601.	
S605	Same as S601.	
T601	TRANSFORMER, POWER, STEP-DOWN: primary 115/230 VAC, 50/80 cps, single phase; secondary 57 VAC, 1.2 amps (intermittent), 0.9 amps (continuous); hermetically sealed rectangular steel case.	TF274
T602	TRANSFORMER, PULSE: primary inductance 4.7 mh, $\pm 20\%$; voltage rating between windings 500 VDC; metal tubular case.	TF228K15
T603	COIL, RADIO FREQUENCY: tuned; operating frequency 3 mc; inductance 25 uh, ± 3 uh.	
TB601	TERMINAL BOARD, BARRIER: two 6-32 thd. x 1/4" long binder head machine screws; black bakelite body.	TM100-2
W601	CABLE ASSEMBLY, ELECTRICAL: power; consists of 2 connectors, P601 and P602. Supplied as loose item.	CA555-4
XC601 thru XC607	NOT USED.	
XC608	SOCKET, ELECTRON TUBE: 8 contacts, phosphor bronze or beryllium copper silver plated.	TS165-P01
XC609	NOT USED.	
XC610	NOT USED.	
XC611	Same as XC608.	
XF601	FUSEHOLDER: lamp indicating; accommodates cartridge fuse 1-1/4" long x 1/4" dia; 90 to 250 volts; neon lamp type with a 220k ohm lamp resistor; flat sided, transparent clear knob; black body.	FH104-3
XF602	FUSEHOLDER: lamp indicating; accommodates cartridge fuse 1-1/4" long x 1/4" dia; 45 to 60 volts; incandescent lamp type, with a 1200 ohm lamp resistor; flat sided, transparent amber knob; brown body.	FH104-13

PARTS LIST

for

FREQUENCY STANDARD-BASIC, MODEL, CSS-3B

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XI601	LIGHT INDICATOR: w/clear unfrosted lens; for miniature bayonet base T-3-1/4 bulb.	TS106-2
XI602	LIGHT INDICATOR: w/green frosted lens; for miniature bayonet base T-3-1/4 bulb.	TS106-3
XI603	NOT USED.	
XI604	NOT USED.	
XI605	LIGHT INDICATOR: w/red lens, sub-miniature type.	TS153-1
XQ601	SOCKET, TRANSISTOR: 4 silver plated beryllium copper contacts; mica filled molded phenolic socket.	TS147
XQ602 thru XQ604	Same as XQ601.	
XZ601	NOT USED.	
XZ602	SOCKET, ELECTRON TUBE: 8 contacts, phosphor bronze or beryllium copper silver plated.	
z601	NETWORK COUPLING: operating frequency 1 mc; inductance 85 uh, <u>+10</u> uh.	NF106
z602	NETWORK COUPLING: frequency 1 mc; plug in type.	NF105-1



FOR OPERATION WITH PAD
 1. REMOVE JUMPER MARKED
 *** BETWEEN R622 & T602.
 2. ASSEMBLE RESISTORS R621,
 R622, R623 AS PER
 INSTRUCTION MANUAL.

NOTE

Unless otherwise specified, all capacitors are in microfarads, all coils are in microhenries, and all resistors are in ohms (1/2 watt).

FOR 230V OPERATION T601
 1. REMOVE JUMPERS FROM TERMINALS 1, 2 & 3, 4.
 2. ADD JUMPER MARKED --- BETWEEN TERMINALS 2 & 3.

Figure 8-1. Frequency Standard CSS-3B, Schematic Diagram

AX619

IMC Switchover Kit-270

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	Capacitor, Fxd, Ceramic	CC-100-37
C2	Capacitor, Fxd, Ceramic	CC100-16
C3	Same as C2	
C4	Same as C2	
C5	Capacitor, Fxd, Electrolytic	CE105-10-15
CR1	S;cond Dev. Diode	1N34
CR2	Same as CR1	
CR3	Same as CR1	
J1	Conn. Recp., BNC	UG-625/U
J2	Same as J1	
J3	Same as J1	
K1	Relay, DPDT	RL156-16
Q1	Transistor	2N697
R1	Res. Var, Comp	RV106UX8B253A
R2	Res. Fxd, Comp	RC20GF823J
R3	Res. Fxd, Comp	RC20GF120J
R4	Res. Fxd, Comp	RC20GF470J
TB1	Term Bd, Barrier	TM100-3
XK1	Socket, Relay (with retainer)	TS171-3

CHANGE NO. 1



INSTRUCTION BOOK CHANGE NOTICE

Date January 17, 1964

Manual affected: Frequency Standard, Model CSS-1B IN 2010F

1 Megacycle Standard

The 1 megacycle standard Z602 may, after a period of normal aging, approach or pass the limit of the trim range (+1.4, -.4 cps). When it is found that the 1 megacycle standard cannot be set on exactly 1 megacycle with the trimmer, it is advisable to return the CSS to the Technical Materiel Corporation for recalibration.

For a further discussion and procedure regarding recalibration of the 1 megacycle standard, refer to TMC Field Engineering Bulletin 21.

Parts List - Section 7 - Change to read:

Page 7-1, CR601 - DIODE, zener, 27 volts, temperature range -
65 to +175°C, .052" dia. pins, tolerance \pm 10%.

Page 7-2, J601 - TMC Part No. UG-625B/U

Page 7-4, T604 - Not Used.

XC608 - TMC Part No. TS165P01

SHOULD ADDITIONAL COPIES OF THIS CHANGE NOTICE BE REQUIRED, PLEASE CONTACT:

THE TECHNICAL MATERIEL CORP., 700 Fenimore Road, Mamaroneck, New York.

Attn.: Director of Eng. Services.

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Figure 1-1. Frequency Standard, Model CSS-1B

SECTION 1

GENERAL INFORMATION

1-1. GENERAL

FREQUENCY STANDARD, MODELS CSS-1B and CSS-1C (see figure 1-1) are highly stable frequency standards capable of generating two 1 mc reference frequencies, with a long term stability of 1 part in 10^8 per day at a level of 1 v rms.

Frequency Standard CSS-1C is the same as frequency standard CSS-1B except that CSS-1C has provisions for automatically connecting the associated equipment to the CSS-1C Frequency Standard when the external frequency standard fails.

The CSS-1B and CSS-1C (hereafter referred to as the CSS) were designed to be used in conjunction with synthesized exciters and controlled oscillators manufactured by TMC, and with any piece of equipment requiring a stable 1 mc source.

1-2. FUNCTIONAL DESCRIPTION

The CSS is functionally comprised of a sealed 1 mc standard enclosed in a proportional oven, two tuned amplifiers, a sealed phase comparator and a 28 volt power supply.

The proportional oven maintains the sealed standard at its optimum operating temperature.

The 1 mc reference frequency generated by the internal standard is coupled by an isolation stage to

two tuned amplifier stages and applied by the output jacks on the rear panel to the load.

The phase comparator is used to check the output frequency standard with an equal or superior long term stability factor. The phase difference is monitored directly on the front panel PHASE COMPARATOR meter, and can be corrected by means of a trimmer capacitor provided on the top of the internal standard.

The power supply is comprised of a selenium rectifier, a chock input filter and a zener diode. The line voltage is stepped down to 28 volts and rectified and provides power for the proportional oven and transistorized amplifiers.

1-3. PHYSICAL DESCRIPTION

The CSS is a compact, transistorized unit, containing its own power supply. It has been designed to be mounted into any standard 19 inch equipment rack.

The CSS measures 5-1/4 inches high by 14-3/4 inches deep on a 19 inch wide front panel weighing approximately 30 lbs net. Top and bottom dust covers are also supplied.

All operatin controls and indicating devices are readily accessible on the front panel with jacks and spare fuses located at the rear of the panel.

1-4. TECHNICAL SPECIFICATIONS

Crystal Oven Temperature:	Proportional heat supply varying inversely with changes in ambient temperature.
Frequency Stability:	1 part in 10^8 per day.
Output:	1 mc at 1 v rms when terminated with a 72 ohm load.
Power Requirements:	115/230 volts ac, 50/60 cps, single phase power, 50 watts (cold oven), 30 watts (warm oven).
Semiconductor Complement:	(4) 2N1224 Amplifiers (1) 1N2822 Zener Diode (1) Selenium Rectifier Bridge (assembly CR602) (1) 2N 1308
Components and Construction:	Equipment is manufactured in accordance with JAN/MIL specifications whenever practicable.

SECTION 2 INSTALLATION

2-1. INITIAL INSPECTION.

Each CSS has been calibrated and tested at the factory before shipment. 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.

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.

2-2. INITIAL INSTALLATION.

Installation of the CSS into a 19 inch wide equipment rack may be made by use of the outline dimensions listed in paragraph 1-3 and performing the following steps: (See figure 2-2.)

- a. Install unit in rack and secure front panel to rack with four suitable bolts and washers.
- b. Connect power cable from jack J605 (rear panel) to nearest ac receptacle.
- c. Connect a coaxial cable from 1 MC OUT jack J602 to load (J2 in CSS-1C).
- d. Set ON/STANDBY switch (front panel) to ON and make certain that POWER indicator glows.
- e. Set ON/STANDBY switch to STANDBY and make certain STANDBY indicator glows.

NOTE

Unless otherwise specified, the CSS is factory wired for 115 volts, 50/60 cycle, single phase power. For 230 volts operation, make necessary wiring changes shown in figure 2-1.

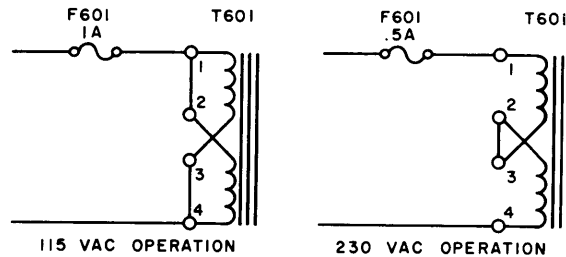


Figure 2-1. Power Supply Changeover Connections

2-3. PRE-OPERATIONAL CHECK.

To make certain the unit is operating properly, perform the following steps:

- a. Connect a 1 mc frequency counter (Hewlett-Packard Model 512C or equivalent) to 1 MC MONITOR jack J601. Frequency counter should indicate 1 MC exactly. If not, internal standard needs adjustment. (Refer to Section 6.)

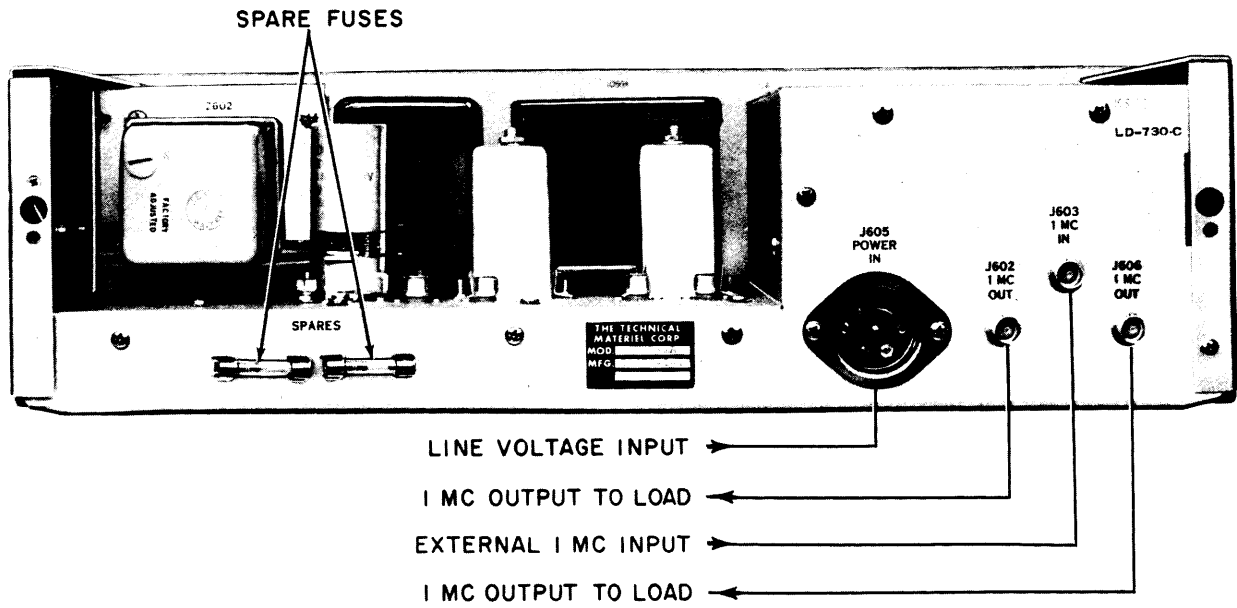
NOTE

A frequency counter may be used only for a quick check. Alignment of the CSS requires the use of 1 mc r-f source with a higher stability than that of the CSS. Such stability can be obtained by use of TMC model VLFC-1, VLF Frequency Standard Comparison System.

- b. Disconnect frequency counter and connect a VTVM (Hewlett-Packard Model 410B or equivalent) to 1 MC OUT jack (rear panel). VTVM should indicate 1.7 v rms minimum. If not, tuned amplifiers are out of adjustment. (Refer to Section 6.)

- c. Disconnect VTVM.

Model CSS-1B



Model CSS-1C

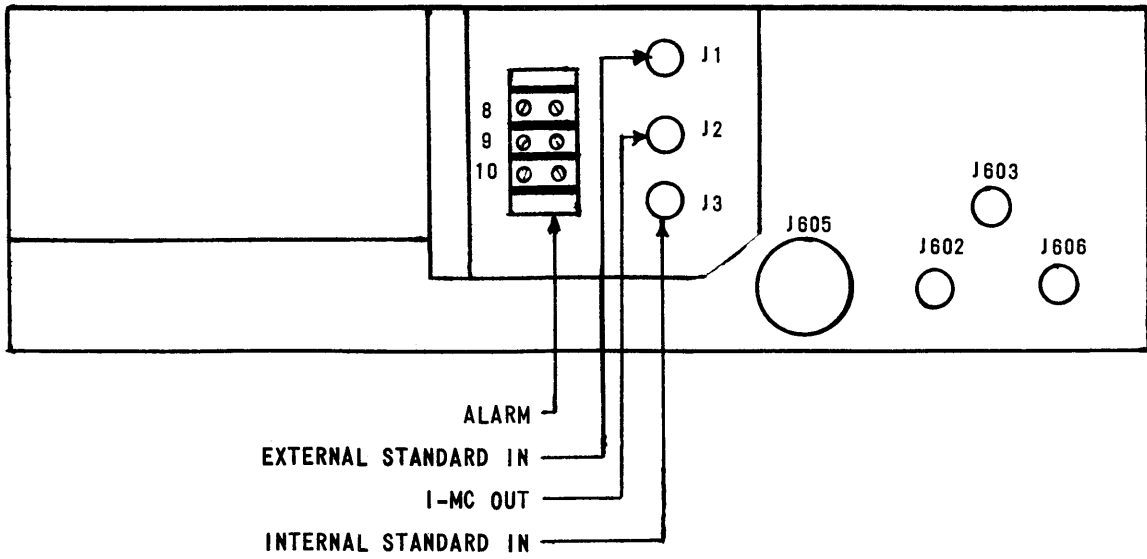


Figure 2-2. Rear Panel Connections

SECTION 3 OPERATOR'S SECTION

3-1. GENERAL.

Operation of the CSS has been designed for a high degree of simplicity and versatility. All necessary operating controls and indicating devices are readily accessible on the front panel.

3-2. OPERATOR'S INSTRUCTIONS.

To operate the CSS, connect unit as shown in paragraph 2-2 and set ON/STANDBY switch ON.

Refer to table 3-1 for a descriptive list of the CSS operating controls and indicators.

3-3. OPERATOR'S MAINTENANCE.

The operator may at times be required to perform operator's maintenance. This may consist of merely observing for unit cleanliness, condition and connection of interconnecting cables and replacement of defective fuses and indicator lamps. See figures 3-1 and 2-2 for identification and location of the various controls, indicators, spare fuses and connectors on the CSS.

TABLE 3—1. OPERATING CONTROLS

CONTROL OR INDICATOR	FUNCTION
ON/STANDBY, switch S601	When in ON position, B+ is applied to CSS circuitry. When in STANDBY position, power is applied to proportional oven only.
POWER, indicator I602	Indicates B+ is applied to CSS circuitry.
STANDBY, indicator I601	Indicates B+ is removed from CSS circuitry and power applied to proportional oven.
IMC MONITOR jack J601	For sampling internal standard with external frequency counter.
PRI STD IN jack J604	Input jack for external 1 MC frequency standard.
SENSITIVITY, potentiometer R616	Sensitivity adjustment for PHASE COMPARATOR meter.
PHASE COMPARATOR, meter M601	Indicates phase difference of internal and external frequency standards.
1A/115 V, fuse F601 .5A/230 V	Protects unit from current overloads.
B+, fuse F602	Protects oven and amplifiers from current overloads.

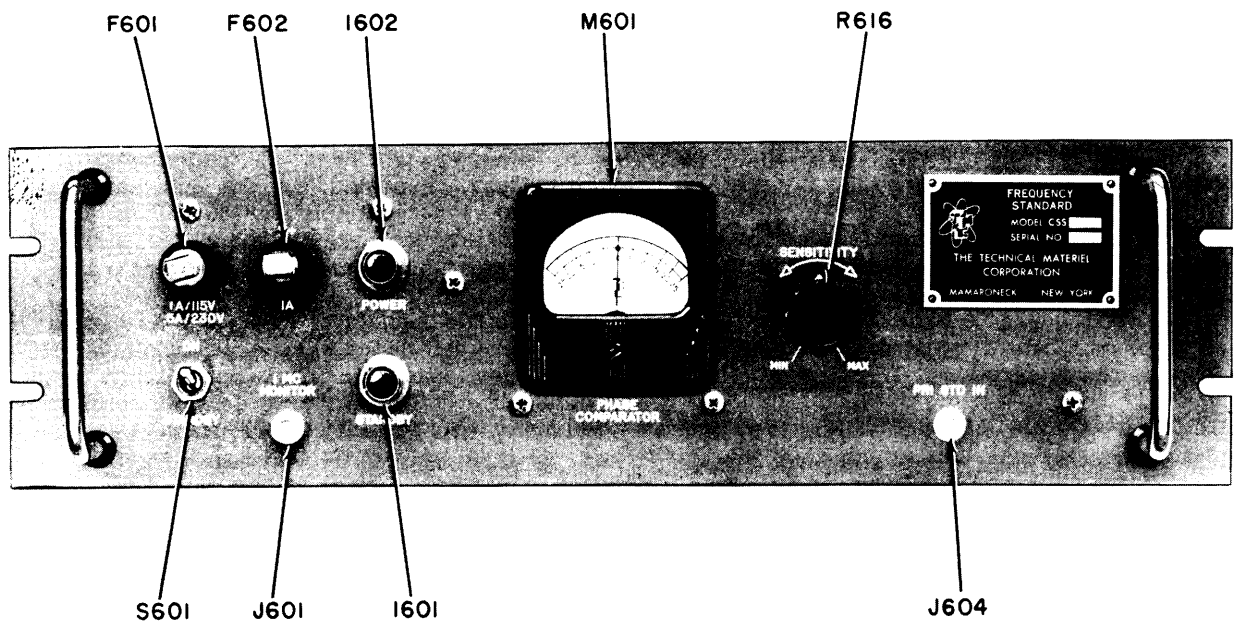


Figure 3-1. Model CSS-1B, Front Panel View

SECTION 4 PRINCIPLES OF OPERATION

4-1. INTRODUCTION

The CSS is a transistorized unit, comprised of a sealed 1 mc frequency standard enclosed in a proportional oven (assembly Z602), two tuned 1 mc amplifiers (Q601 and Q602), a buffer amplifier (Q603), a sealed phase comparator network (assembly Z601) and a 28 volt power supply.

An automatic change-over relay automatically connects the CSS-1C as a frequency standard, to associated equipment if an external frequency standard input to the equipment fails.

4-2. BLOCK DIAGRAM DESCRIPTION. (See figure 4-1).

The internal frequency standard of the CSS generates a 1 mc reference frequency with a long term stability of 1 part in 10^8 per day, at a level of 2.5 to 3.0 v rms. This reference frequency is coupled by the emitter follower isolating stage Q604 to amplifiers Q601 and Q602. The combined outputs of the tuned amplifiers is applied directly to the 1 MC OUTPUT jacks J602 and J606 on the rear panel.

The 1-mc output from J602 is applied to INT 1-mc jack J3, and 1-mc from an external source may be applied to EXT STD IN jack J1. One of these two signals is coupled through relay K1 to 1-mc out jack J2.

If a 1-mc input is being applied to J1, relay K1 couples the signal from J1 to J2. If an input is not being applied to J1, transistor Q1 actuates relay K7, and the 1-mc input to J3 is coupled to J2.

When an external 1 mc frequency standard is connected to PRI STD IN jack J604 (front panel) or to 1 MC INPUT jack J603 (rear panel), the reference frequency generated by the internal standard is coupled by buffer amplifier Q603 to the sealed phase comparator network Z604 and compared in phase with the output of the external standard.

If the two signals are out of phase, a varying dc voltage is developed across potentiometer R614 that is proportional in amplitude and polarity to the phase difference. This varying dc voltage is then read directly on PHASE COMPARATOR meter M601.

The internal frequency standard is provided with a screwdriver adjustment (trimmer capacitor) that can be used to lock the internal standard on the output of a more stable external standard. In addition, the output frequency of the internal standard can be monitored by connecting a frequency counter to 1 MC MONITOR JACK J601 on the front panel.

The power supply consists of an isolation step-down transformer T601, a selenium rectifier bridge CR602, a choke input filter and a zener diode CR601 voltage regulator.

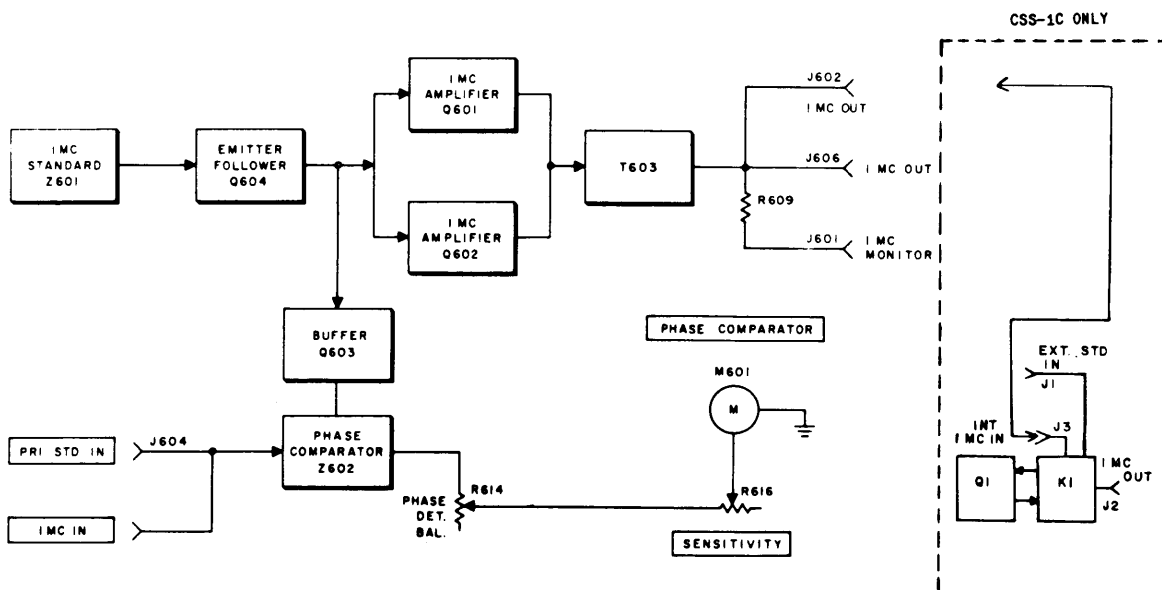


Figure 4-1. Model CSS Block Diagram

SECTION 5 TROUBLESHOOTING

5-1. INTRODUCTION.

This section explains how to locate and diagnose equipment troubles and maladjustments. Information necessary to remedy the troubles and maladjustments will be found in Section 6, Maintenance.

The following aids for troubleshooting are provided:

- a. Block diagram (figure 4-1).
- b. Schematic diagram (figure 8-1).
- c. Top and bottom chassis view locating unit components (figures 5-1 and 5-2).
- d. Troubleshooting procedure (paragraph 5-3).

5-2. PRELIMINARY INSTRUCTIONS.

Prior to troubleshooting the CSS, perform the following steps:

- a. Make certain line voltage at POWER IN jack J605 is of proper value.

- b. Check condition of fuses and indicator lamps.

- c. Check for proper connection and operation of interconnecting cables and associated equipment.

- d. Remove bottom dust cover (after removing power) and inspect for charred components, frayed insulation and loose connections.

- e. Check transistors using the substitution method.

5-3. TROUBLESHOOTING PROCEDURE.

When all other attempts to locate the troubles have failed, proceed as follows:

- a. Connect a VTVM (Hewlett-Packard model 410B or equivalent) across zener diode CR601. Indication on VTVM should read 27 vdc \pm 10%. If normal indication is not observed, check conditions of zener diode CR601 and output of rectifier CR602.

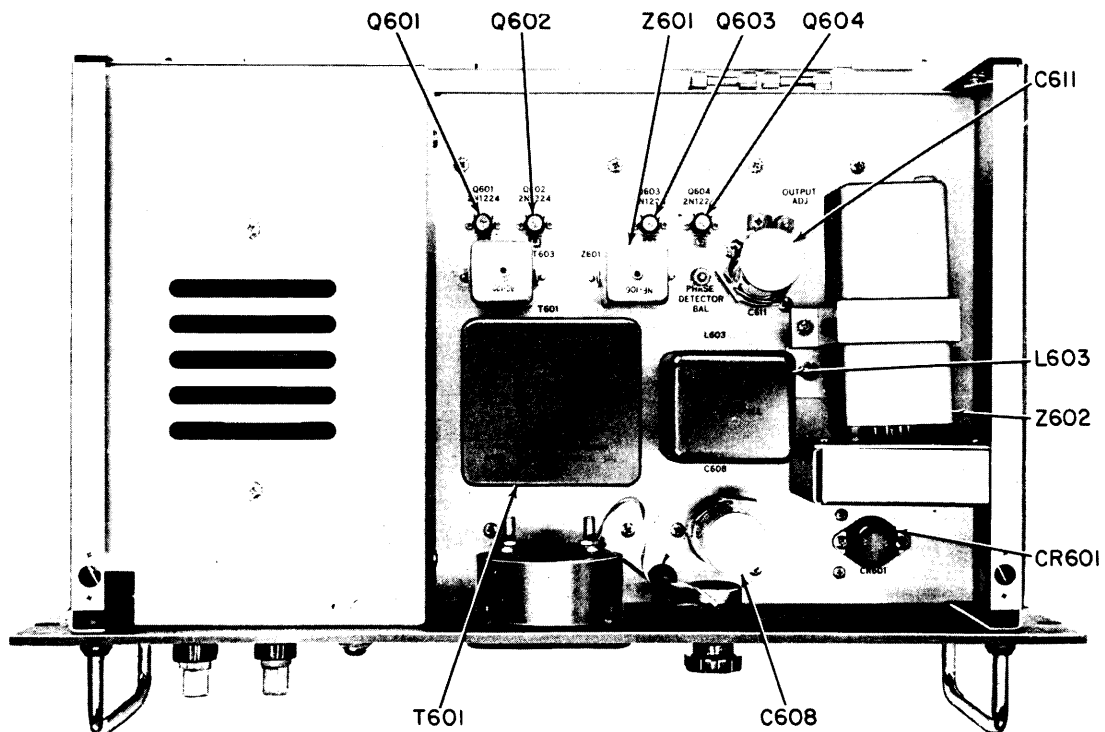


Figure 5-1. Location Diagram of Major Electronic Components, Top View

b. Connect VTVM to pin 6 of assembly Z602. VTVM should indicate 2.5 to 3.0 (2.3 vdc minimum). If normal indication is not observed, check condition of assembly Z602.

c. Connect VTVM to B3 of 1 mc amplifier Q603. VTVM should indicate at least 0.8 v rms. If normal indication is not observed, check condition of emitter follower Q604.

d. In CSS-1B, connect VTVM to 1 MC OUT jack J602. VTVM should indicate at least 1 v rms. If normal indication is not observed, try adjusting potentiometer R617. If trouble still exists, check for defective potentiometer R617, amplifier's Q601 or Q602 or transformer T603.

e. In CSS-1C, connect VTVM to 1-mc OUT jack J2. Connect a 1-mc (at 1 v. r. m. s.) signal input to J1. VTVM should indicate at least 1 v. r. m. s. If normal indication is not observed, check K1, Q1 and all other components in relay switching circuit. Disconnect input to J1. There should be a clicking sound and a momentary drop in the VTVM indication as relay K1 switches; VTVM indication should then return to at least 1 v. r. m. s. If normal indication is not observed,

try adjusting potentiometer R617. If trouble still exists, check for defective potentiometer R617, amplifiers Q601 or Q602 or transformer T603. Check K1, Q1, and all other components in relay switching circuit.

f. Using VTVM, compare B1 and B2, and E1 and E2 voltages of amplifiers Q601 and Q602. Voltages should be within 0.1 v of each other. If normal indication is not observed, check resistance at B1, B2, E1 and E2. Resistance at each point should be approximately 7000 ohms.

g. Connect VTVM to red terminal of assembly Z601. VTVM should indicate 1 v rms minimum. If normal indication is not observed, check condition of amplifier Q603.

h. Turn SENSITIVITY control R616 fully counter-clockwise.

i. Zero-center PHASE COMPARATOR meter M601 using PHASE DETECTOR BAL potentiometer R614. If meter can not be zeroed, trouble is in potentiometers R614 or R616.

j. Disconnect VTVM.

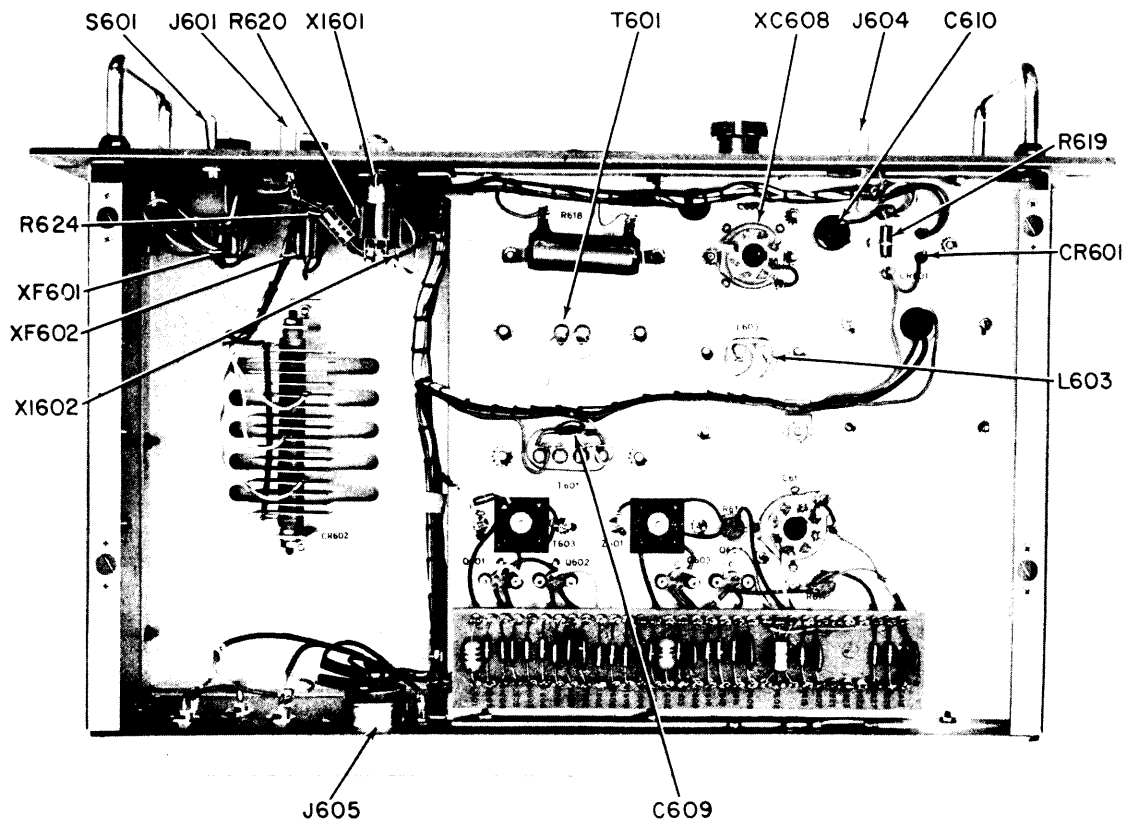


Figure 5-2. Location Diagram of Major Electronic Components, Bottom View

SECTION 6 MAINTENANCE

6-1. GENERAL.

Maintenance may be divided into three categories: operator's maintenance, preventive maintenance and corrective maintenance. Corrective maintenance is sometimes considered as consisting of information useful in locating and diagnosing equipment troubles and maladjustments, existing and/or pending, and information necessary to remedy the equipment troubles and maladjustments. Corrective procedures in this section are those necessary to correct a trouble due to a maladjustment of a control or adjustment. By using these procedures with those presented in Section 5, a trouble may also be localized to a particular section. Operator's maintenance is included in Section 3, Operator's Section.

The CSS has been designed to provide long-term, trouble-free operation under continuous duty conditions. It is recommended that any necessary maintenance be done by a competent maintenance technician familiar with troubleshooting techniques. If the trouble cannot be corrected by following the procedure presented in this section and Section 5, it is recommended that the CSS be returned to The Technical Materiel Corporation.

6-2. PREVENTIVE MAINTENANCE.

a. In order to prevent failure of the equipment due to corrosion, tube failure, dust or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

b. At periodic intervals (at least every 6 months) the equipment should be removed from the rack for cleaning and inspection. All accessible covers should be removed and the wiring and all components inspected for dirt, corrosion, charring, discoloring or grease, in particular, the transistor sockets should be carefully inspected for deterioration. Dust may be removed with a soft brush or vacuum cleaner. Remove dirt or grease from other parts with any good dry cleaning fluid.

WARNING

When using trichlorethylene, make certain that adequate ventilation exists. Avoid prolonged contact with skin.

c. Carefully inspect for loose solder connections or screws, especially those on solder lugs. Recommended time interval is every 6 to 12 months, depending on the amount of vibration encountered in service.

6-3. CORRECTIVE MAINTENANCE.

The corrective maintenance procedure is essentially Technical Materiel Corporation's factory alignment procedures modified for use in the field. Table 6-1 lists the test equipment necessary for alignment and testing.

TABLE 6-1. TEST EQUIPMENT

ITEM	DESCRIPTION
Vacuum Tube Voltmeter (vtvm)	Hewlett-Packard 410B or equivalent equipped with rf probe
1 Mc Counter (counter)	Hewlett-Packard 5246 or equivalent
Load	Non-inductive 70 ohm resistor
Insulated Screwdriver	
1 Mc Primary Standard	Any unit with a long term frequency stability of better than 1 part in 10^8 per day (such as TMC Model VLFC-1, VLF Frequency Standard Comparison System)

6-4. PRELIMINARY INSTRUCTIONS.

Prior to aligning the CSS, perform the following:

NOTE

This procedure assumes that the unit has just been repaired. Therefore, the unit should be on a work bench, with the top and bottom covers removed, and all cables to the rear panel disconnected.

- a. Connect 70 ohm load to 1 MC OUT jack J602 (J2 on CSS-1C) on rear panel.
- b. Connect power cable from POWER IN jack J605 on rear panel to any convenient ac receptacle providing desired line voltage.
- c. Turn ON/STANDBY switch to STANDBY and permit unit to operate continuously for at least 24 hours.

6-5. ALIGNMENT PROCEDURE. (See figure 8-1.)

To align the CSS, proceed as follows:

- a. Connect vtm to red terminal of transformer T603, and using insulated screwdriver, adjust OUTPUT ADJ potentiometer R617 (on top of chassis) for a maximum indication on vtm.
- b. Connect vtm to blue terminal of transformer T603 and tune slug for a maximum indication on vtm.
- c. Connect vtm to 1 MC OUT jack J606 (J2 on CSS-1C) on rear panel and adjust OUTPUT ADJ potentiometer R617 for an indication of 1 v rms on vtm.
- d. Connect vtm to yellow terminal of assembly Z601 and tune slug for maximum indication on vtm.
- e. Disconnect vtm but do not disconnect load.
- f. Turn SENSITIVITY control R616 fully counterclockwise.
- g. Using PHASE DETECTOR BAL potentiometer R614 (on top of chassis) center PHASE COMPARATOR meter M601.

NOTE

The T-pad attenuator on the comparison standard input consisting of resistors R621, R622 and R623, is selected in the field in order to match the input impedance of the external standard as well as to assure that the external 1 mc signal injected across the primary of T602 does not exceed 1 volt rms. The values of these resistors may be readily determined in the field by referring to any standard engineering reference book such as the "Reference Data for Radio Engineers". It is important that the input signal be approximately 1 volt rms in order to obtain proper action from the phase comparator circuits. The resistive network is shown in figure 8-1.

Adjustment of SENSITIVITY control may be necessary to prevent meter needle pegging.

- h. Connect primary standard to PRI STD IN jack J604.

- i. If the two 1 mc signals are at coincidence, the meter should remain centered. If there is a phase difference, meter M601 will sweep back and forth, the number of sweeps per second being the difference between the two signals in cycles per second. Assuming the primary standard to be of superior stability, use an insulated screwdriver and tune the adjustment on top of assembly Z602 (internal 1 mc standard) so that PHASE COMPARATOR meter M601 remains stationary in the center. The internal 1 mc standard has now been adjusted to the exact frequency of the external standard.

NOTE

The 1 megacycles standard Z602 may, after a period of normal aging, approach or pass the limit of the trim range (+1.4, -.4 cps). When it is found that the 1 megacycle standard cannot be set on exactly 1 megacycle with the trimmer, it is advisable to return the CSS to the Technical Materiel Corporation for recalibration.

- j. Disconnect primary standard and load connected 1 MC OUT jack J602.

- k. Replace top and bottom covers and install unit in rack in accordance with paragraph 2-2.

SECTION 7 PARTS LIST

7-1. 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 transistor Q601 is designated XQ601. Column 1 of the parts list 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.

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C601	CAPACITOR, fixed: ceramic; .1 uf, +80%, -20%, 500 wvdc.	Emitter Bypass	CC-100-28
C602	Same as C601		
C603	CAPACITOR, fixed: ceramic; 10,000 uuf, GMV; 500 wvdc.	Coupling	CC-100-16
C604	Same as C603		
C605	Same as C603		
C606	Same as C601	Rf Bypass	
C607	Same as C603	Rf Bypass	
C608	CAPACITOR, fixed: dry electrolytic; polarized, 300 uf; 500 wvdc.	Filter	CE51C301G
C609	Same as C603	Filter	
C610	Same as C601	Rf Bypass	
C611	Same as C608	Filter	
CR601	DIODE, zener: 28 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; 1.0 amp.	Main Power	FU-102-1
F602	FUSE, cartridge: slo-blo; 1.0 amp.	Rectifier	FU-102-1
I601	LAMP, incandescent: 28 v; 0.10 amp, clear, T-3-1/4.	Standby Indicator	BI-101-1820
I602	Same as I601	Power Indicator	

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
J601	CONNECTOR, receptacle: electrical; 1 female contact; 52 ohms; BNC type.	1 MC MONITOR	UG-625/U
J602	Same as J601	1 mc Out	
J603	Same as J601	1 mc In	
J604	Same as J601	PRI STD IN	
J605	RECEPTACLE, plug: twist lock type, male.	Power In	JJ-175
J606	Same as J601	1 Mc Out	
L601	COIL, R. F. : fixed; 2.5 mhy, 100 ma, molded.	Rf Choke	CL-140-1
L602	Same as L601	Rf Choke	
L603	CHOKER, 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 COM- PARATOR	MR-142
Q601	TRANSISTOR, drift: germanium p-n-p type; alpha cutoff frequency - 30 mc.	1 mc ampli- fier	2N1224
Q602	Same as Q601	Same as Q601	
Q603	Same as Q601	Isolation Amplifier	
Q604	Same as Q601	Emitter Follower	
P601	CONNECTOR, plug: twist lock; female (polarized) midget size, black bakelite. Part of W601.	Power Con- nector	PL-176
P602	CONNECTOR, plug: male; AC two prong. Part of W601.	Power Con- nector	PL-171
R601	RESISTOR, fixed: composition; 560 ohms, $\pm 10\%$, 1/2 watt.	Equalizing	RC20GF561K
R602	Same as R601	Equalizing	
R603	RESISTOR, fixed: composition; 22,000 ohms, $\pm 10\%$, 1/2 watt.	Voltage Divider Network	RC20GF223K
R604	RESISTOR, fixed: composition; 270 ohms, $\pm 10\%$, 1/2 watt.	Equalizing	RC20GF271K
R605	RESISTOR, fixed: composition; 1000 ohms, $\pm 10\%$, 1/2 watt.	Voltage Divider Network	RC20GF102K
R606	Same as R605	Voltage Divider Network	
R607	Same as R604	Equalizing	
R608	Same as R603	Voltage Divider Network	

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R609	RESISTOR, fixed: composition; 2200 ohms, $\pm 10\%$, 1/2 watt.	Terminating	RC20GF222K
R610	Same as R603	Series Base	
R611	RESISTOR, fixed: composition; 680 ohms, $\pm 10\%$, 1/2 watt.	Emitter	RC20GF681K
R612	Same as R605	Series Bias	
R613	RESISTOR, fixed: composition; 5600 ohms, $\pm 10\%$, 1/2 watt.	Equalizing	RC20GF562K
R614	RESISTOR, variable: composition; 5000 ohms, $\pm 10\%$, 1/2 watt.	Phase Detector	RV106UX8B-502A
R615	RESISTOR, fixed: composition; 10,000 ohms, $\pm 10\%$, 1/2 watt.	Voltage Dropping	RC20GF103K
R616	RESISTOR, variable: composition; 1 megohm, $\pm 10\%$, 2 watts, linear taper.	SENSITIVITY	RV4ATRD105A
R617	RESISTOR, variable: composition; 2.5k, 1/2 watt.	Output Adjustment	RV105UX8B252A
R618	RESISTOR, fixed: wire wound; 25 ohms, 25 watts.	Load	RW-111-6
R619	RESISTOR, fixed: composition; 1000 ohms, $\pm 10\%$, 1 watt.	Bleeder	RC32GF102K
R620	RESISTOR, fixed: composition; 180 ohms, $\pm 10\%$, 2 watts.	Voltage Dropping	RC42GF181K
R621	Supplied at customer's request. (See para. 6-5)	Input Balancing	
R622	Same as R621		
R623	Same as R621		
R624	Same as R620		
R625	RESISTOR, fixed: composition; 180 ohms, $\pm 10\%$, 1/2 watt.	Load Compensator	RC20GF181K
R626	RESISTOR, fixed: composition; 18,000 ohms, $\pm 10\%$; 1/2 watt.	Volt. Div. Ntwk.	RC20GF183K
R627	Same as R603	Volt. Div. Ntwk.	
R628	Part of XF601		
R629	Part of XF603		
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 - 57 vac, 1/2 amp at input to filter.	Power Supply	TF-274

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
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, $Q \geq 40$; frequency range test - 2.5 mc.	Output	AC-122
T604	COIL, R. F. : tuned; 85 ± 10 uhy, ≥ 50 ; frequency test - 790 kc.	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 2-13/16 in.	Main Power	FH-104-3
XF602	Same as XF601	Rectifier	
XI601	LIGHT, indicator: clear white lens; for miniature bayonet base, T-3-1/4 bulb.	STANDBY Indicator	TS-106-2
XI602	Same as XI601	POWER Indicator	
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	
XZ602	SOCKET, electron tube: octal; high crown.	Socket for Z602	TS101P01/A
Z601	NETWORK, coupling: 100 uhy; $Q \geq 50$; 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.	1 mc Standard	NF-105-1

ADDITION COMPONENTS IN CSS-1C

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100,000 uuf, +80% -20%; 300 WVDC.	CC100-37
C2	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, GMV; 500 WVDC.	CC100-16
C3	Same as C2.	
C4	Same as C2.	
*	CABLE ASSEMBLY, ELECTRICAL; RF; consists of 9-inch length of RG-174/U coaxial cable and two BNC cable connectors, TMC part number PL-244-1.	CA-480-3-9
CR1	SEMICONDUCTOR DEVICE, DIODE: germanium; max. peak inverse volts 60 V; continuous average forward current 50 ma; max. peak forward recurrent 150 ma; max. surge current 800 ua at 50 V or 50 ua at 10 V.	IN34
CR2	Same as CR1.	
CR3	Same as CR1.	
J1	CONNECTOR, RECEPTACLE, ELECTRICAL: RF; 1 round female contact; straight type; 52 ohms; series BNC to BNC.	UG625B/U
J2	Same as J1.	
J3	Same as J1.	
K1	RELAY, ARMATURE: DPDT; 5,000 ohms DC resistance +10%; 20.5 volts DC operating voltage; operating current 4.1 ma; power rated at 85 mw at 25°C; 8 contacts rated at 1 amp at 29 VDC resistance; clear high impact styrene dust cover case.	RL156-4
Q1	TRANSISTOR: NPN; silicon mesa; collector to base voltage 60 V; collector to emitter voltage 40 V; emitter to base voltage 5 V; collector current 175 ma; power dissipation 2 watts at 25°C; junction temperature 175°C; hermetically sealed metal case.	2N697
R2	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, +5%; 1/2 watt. 1/2 watt.	RC20GF104J
R3	RESISTOR, FIXED, COMPOSITION: 12 ohms, +5% 1/2 watt.	RC20GF120J
TB1	TERMINAL BOARD, BARRIER: 3 terminals; 6-32 thd. x 1/4" long binder head screws; phenolic black bakelite.	TM100-3
XK1	SOCKET, RELAY: with retainer; 6 beryllium copper gold plated contacts; black phenolic socket.	TS171-1
	* Supplied as loose item with modification kit.	

SECTION 8
SCHEMATIC DIAGRAMS

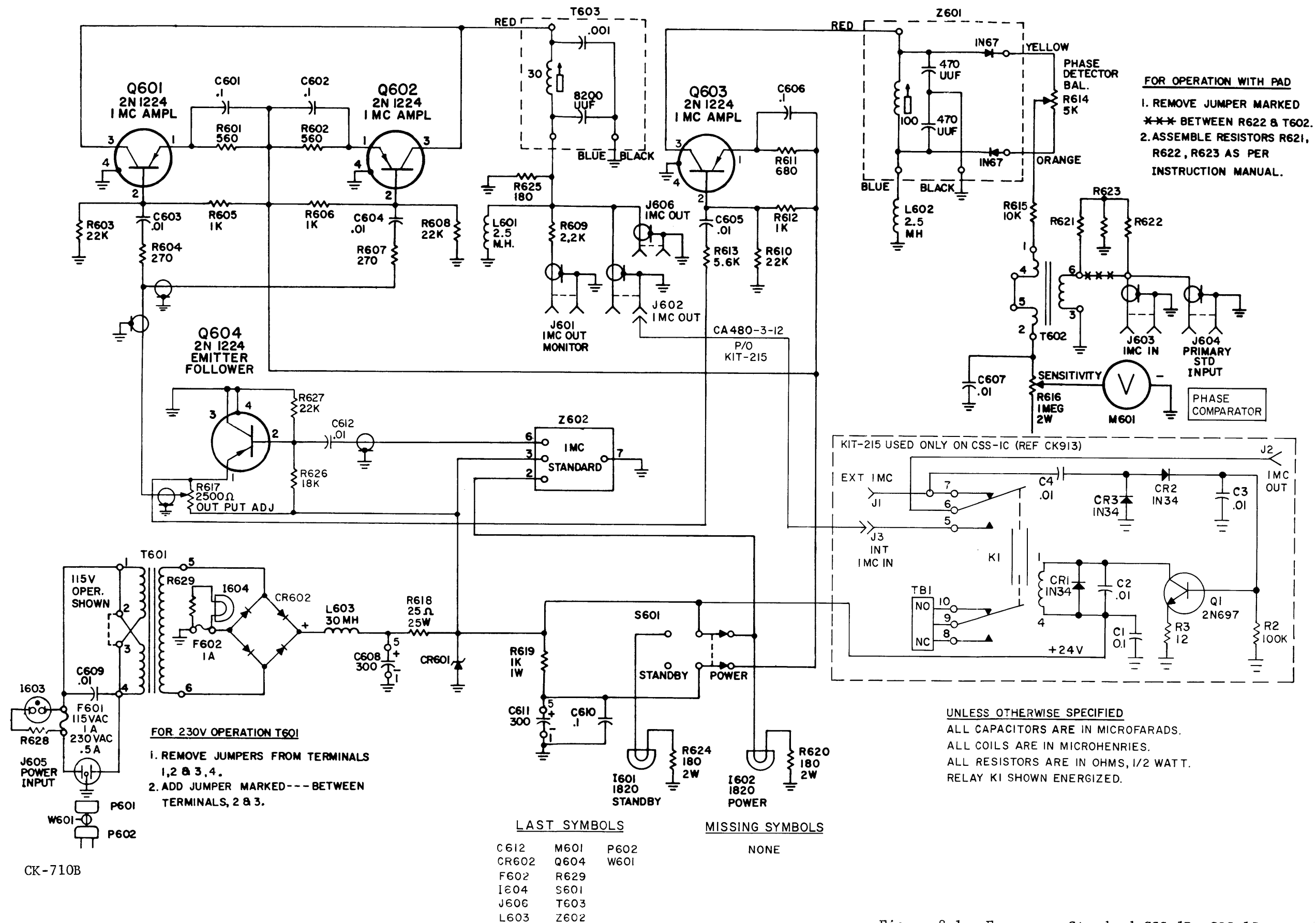


Figure 8-1. Frequency Standard CSS-1B, CSS-1C Schematic Diagram