OPERATING INSTRUCTIONS

TYPE 1115-B

STANDARD-FREQUENCY OSCILLATOR

1115-B

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GENERAL RADIO COMPANY

B

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STANDARD-FREQUENCY OSCILLATOR

Form 1115-0100-B
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GENERAL RADIO COMPANY
WEST CONCORD, MASSACHUSETTS, USA

CONDENSED OPERATING INSTRUCTIONS

1. To start unit:

a. Remove the two screws on the rear of the cabinet.
b. Slide the unit out of the cabinet.
c. Set the BATTERY switch to ON.
d. Return the unit to the cabinet and replace the screws.
e. Connect to a source of ac power – 90 to 130 volts (or 180 to 260 volts after internal changeover), 40 to 2000 c/s.

2. To check operating conditions: At each position of the METER switch, observe the meter indication.

a. At the 5 MC, 1 MC, 100 kC, and DC VOLTS positions, the indication should be within the marked sectors on the meter.
b. At the OVEN TEMP position the meter will indicate off scale to the left until the oven is close to operating temperature.
c. At the OVEN HEATER position the meter will indicate outside the OVEN HTR sector until the temperature is stabilized.
d. At the CHARGE-DISCHARGE position the meter may indicate outside the CHARGE sector for a short time after the instrument is connected to the line; then it will indicate within the CHARGE sector. If the battery is full, only a small amount of charging current will be indicated. When the unit is operating on the battery, the meter will indicate in the DISCH sector.

3. Operation. The unit is now ready for operation. Connect to the 5-Mc, 1-Mc and 100-kc output connectors as required. The warm-up time of the oven is 6 to 10 hours.

4. To take unit out of service:

a. Disconnect from the power line.
b. Remove the two screws from the rear of the cabinet and slide the unit out of the cabinet.
c. Disconnect the battery (i.e., set the BATTERY switch to BAT OFF).
d. Reinstall the unit in the cabinet.

Frequency Adjustment: Dial reads parts in 10^{10} per division. Total range is 2700 parts. Linearity is better than $\pm 20 \times 10^{-10}$. Settability is better than 2×10^{-11}.

RF Connections: 5-Mc, 1-Mc, and 100-kc output connections (in rear) supply 1 volt rms +50 -10% into 50 ohms at each frequency. Additional connectors provided for connection to Type 1112-A Standard-Frequency Multiplier and Type 1123-A Digital Syncronometer®.

Auxiliary Connections: To Amphenol connector in rear, an external dc power supply of 22 to 35 volts, 200 mA maximum, can be connected (refer to section 2.8 of the instruction manual). The negative side of this input is grounded. For external frequency control refer to section 2.9 of the instruction manual.

NOTE: Always check the meter in the CHARGE–DISCHARGE position after connecting the instrument to an ac power line. The battery switch should be ON, and the meter should read "CHARGE." If this is not the case, check the ac line.

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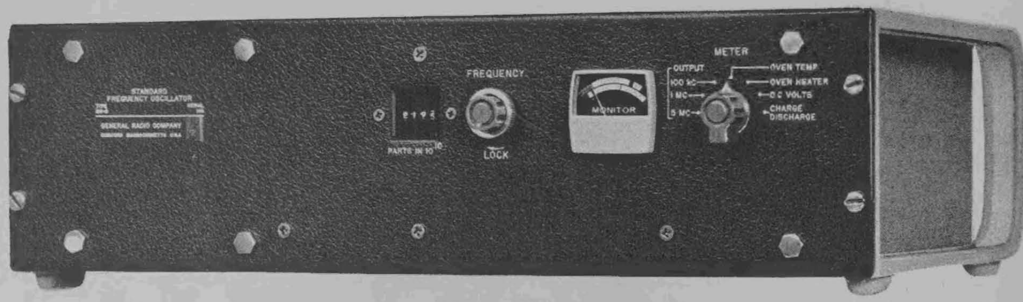


Figure 1-1. Panel view of the Type 1115-B Standard-Frequency Oscillator.

SPECIFICATIONS

Output: 5 and 1 Mc/s, 100 kc/s; 1 V, rms, +50 −10% into 50 Ω at each frequency.

Frequency Adjustment: 2700 × 10^{-10} (1 × 10^{-10} per dial division).

External Frequency Control: Dc voltage from +0.5 to +12 V can be applied. Range is at least 5 × 10^{-7} total.

Frequency Stability:

Aging: <5 × 10^{-10} per day after 30 days of operation;
<1 × 10^{-10} per day is typical after 1 year.

Short-Term Stability (5 Mc/s): Standard Deviation (sigma) is less than stated below (95% confidence):

Averaging Time	*Frequency Deviation (Sigma)*	*Phase Deviation (Radians)*
300 μs	100 × 10^{-11}	1 × 10^{-5}
1 ms	50 × 10^{-11}	1.5 × 10^{-5}
10 ms	10 × 10^{-11}	3 × 10^{-5}
100 ms	1.5 × 10^{-11}	4.5 × 10^{-5}
1 s	1 × 10^{-11}	3 × 10^{-4}
10 s	1 × 10^{-11}	3 × 10^{-3}

Temperature Effects: < ±1 × 10^{-11} per degree C between 0°C and 50°C.

Loading of Output: < ±2 × 10^{-11} open circuit to short circuit.

Supply Voltage: < ±1 × 10^{-11} for ±10% ac line-voltage changes.
< ±2 × 10^{-11} for 22 to 35 V, external dc.

Spectral Purity: Line width of 5-Mc output multiplied by 2000 times (10 Gc/s or X band) is less than 0.25 c/s.

Noise Pedestal: Less than −145 dB per $\sqrt{c/s}$ at 5 Mc/s.

Power Required (ac or dc):

Ac: 90 to 130 or 180 to 260 V, 40 to 2000 c/s, 8 W at 115 V.
Dc: 22 to 35 V, 4 W at 24 V.

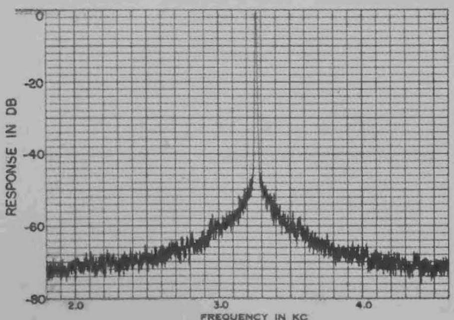
Emergency Power: Internal battery provides 24 to 35 hours depending on ambient temperature.

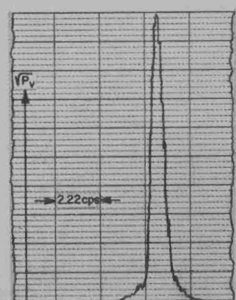
Terminals: Locking GR874, 5 Mc/s, 1 Mc/s, 100 kc/s; type BNC, 1 Mc/s and 100 kc/s for connection to TYPE 1123-A Digital SYNCRONOMETER.

Mechanical Data: Rack-Bench Cabinet.

Model	*Width*		*Height*		*Depth*		*Net Weight*		*Shipping Weight*	
	in	*mm*	*in*	*mm*	*in*	*mm*	*lb*	*kg*	*lb*	*kg*
Bench	19	485	6	155	14½	370	35	16	52	24
Rack	19	485	5¼	135	14½*	370	35	16	52	24

* Behind panel.





(Left) X-band power spectrum of two Type 1115-B Standard-Frequency Oscillators. Analyzer bandwidth is 10 c/s.

(Right) Center portion of spectrum measured with 0.54-cycle band width. Vertical scale is linear ($\sqrt{\text{power}}$).

SECTION **1**

INTRODUCTION

1.1 PURPOSE.

The Type 1115-B Standard-Frequency Oscillator (Figure 1-1) provides stable reference frequencies of 5 Mc/s, 1 Mc/s, and 100 kc/s and is an excellent working frequency and timing standard for many applications in microwave spectroscopy, in communications, and in radar.

1.2 DESCRIPTION.

Figure 1-2 is a block diagram of the Type 1115-B Standard-Frequency Oscillator. The instrument contains a 5-Mc crystal-controlled oscillator in a proportional-control oven. Amplifiers provide isolation and power for the 5-Mc output. The 5-Mc output is also divided by regenerative frequency dividers to produce outputs at 1 Mc/s and 100 kc/s.

The frequency is adjusted electrically by a potentiometer whose dial is direct reading in parts in 10^{10}. The frequency can be remote-controlled by a dc signal applied to a connector at the rear of the instrument.

The power-supply section has a line-power rectifier, battery charger, and voltage regulator. In case of power-line failure, operation for 35 hours is ensured at room temperature and up to 24 hours at 0°C. The battery is recharged rapidly after power failure and is then maintained at optimum charge.

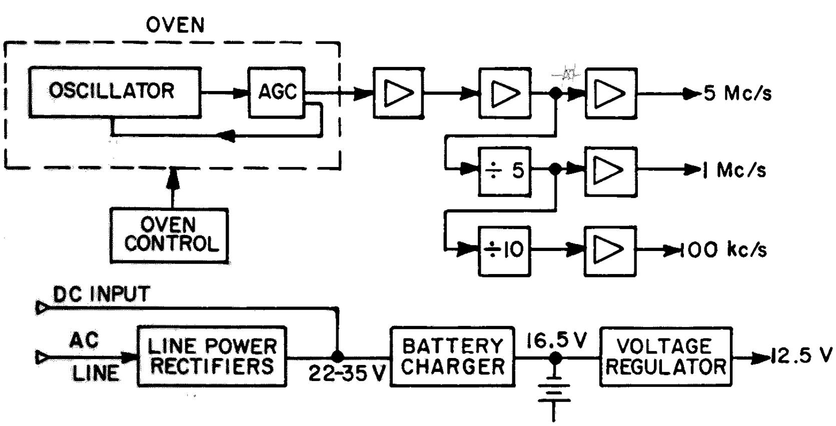


Figure 1-2. Block diagram of the Type 1115-B Standard-Frequency Oscillator.

1.3 CONTROLS AND CONNECTORS.

The controls on the Type 1115-B Standard-Frequency Oscillator are listed in Table 1-1; the connectors on the rear of the instrument are listed in Table 1-2.

TABLE 1-1
CONTROLS

Name	*Type*	*Function*	*Location*
FREQUENCY	Potentiometer	Adjusts frequency.	Panel
METER	7-position rotary switch	Selects meter function.	Panel
BATTERY	Slide switch	Connects and disconnects battery.	Internal
FREQUENCY CONTROL	Slide switch	Selects internal or remote frequency control.	Internal

TABLE 1-2
CONNECTORS

Name	*Type*	*Function*
5 MC	GR874 Connector	5-Mc rf output.
1 MC	GR874 Connector	1-Mc rf output.
100 KC	GR874 Connector	100-kc rf output.
5 MC TO 1112-A	GR874 Connector	Output to connect to General Radio Type 1112-A Standard-Frequency Multiplier.
1 MC 100 KC TO 1123-A DIGITAL SYNCRONOMETER	BNC Connectors	Output to connect to General Radio Type 1123-A Digital Syncronometer.
Auxiliary Connector - SO802	7-pin Amphenol Connector	For connection of external dc power or remote frequency-control circuits.

SECTION **2**

OPERATING PROCEDURE

2.1 MOUNTING.

This instrument is available equipped for either bench or relay-rack mounting. For bench mounting, aluminum end frames are supplied to fit the ends of the cabinet. Each end frame is attached to the instrument with two panel screws and four No. 10-32 round-head screws with notched washers.

For rack mounting, rack-mounting brackets are supplied to attach the cabinet and instrument to the relay rack (see Figure 2-1). These brackets permit either cabinet or instrument to be withdrawn independently of the other.

To install the instrument in a relay rack:

a. Attach each mounting bracket (A) to the rack with two No. 10-32 round-head screws (B). Use the inside holes on the brackets.

b. Slide the instrument onto the brackets as far as it will go.

c. Insert the four panel screws with attached washers (C) through the panel and the bracket and the bracket and thread them into the rack.

d. Toward the rear of each bracket, put a thumb screw (D) through the slot in the bracket and into the hole in the side of the cabinet.

e. On the rear of the cabinet, remove the two round-head screws that hold the cabinet to the instrument.

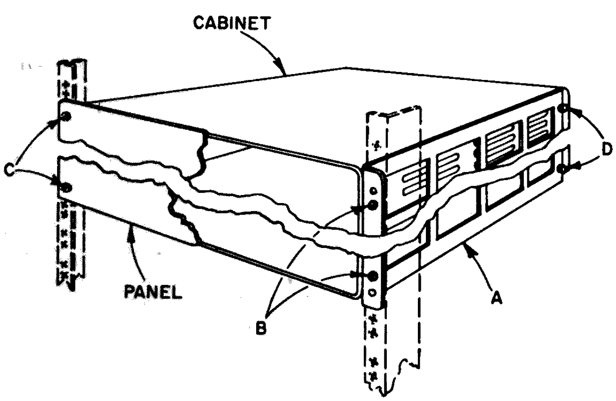


Figure 2-1. Installation of relay-rack model.

To remove the instrument from the rack, remove only the four panel screws with washers (C) and draw the instrument forward out of the rack. To remove the cabinet and leave the instrument mounted in the rack, remove only the thumb screws (D) at the rear of the brackets and pull the cabinet back off the instrument from the rear of the rack.

2.2 BATTERY.

Remove the two screws on the rear of the cabinet. Slide the unit out of the cabinet. Set the BATTERY switch on the chassis to ON. Return the unit to the cabinet and replace the screws in the rear.

2.3 CONNECTION TO POWER SUPPLY.

Connect the Type 1115-B Standard-Frequency Oscillator to a source of power as indicated by the legend at the input socket at the rear of the instrument (40 to 2000 c/s, 90 to 130 or 180 to 260 volts), using the power cord provided. While instruments are normally supplied for 115-volt operation, the power transformer can be reconnected for 230-volt service. For 115-volt service, transformer terminal 1 is connected to terminal 3 and terminal 2 to terminal 4. For 230-volt service, terminal 2 is connected to terminal 3 (refer to schematic diagram, Figure 4-9). When changing connections, be sure to replace line fuses with those of current rating for the new input voltage (0.5 ampere for 115-volt operation, 0.25 ampere for 230-volt operation). Change the legend to indicate the new input voltage. On instruments changed from 230 to 115 volts, this simply means removal of the 230-V nameplate; a 115-V legend is marked beneath. For instruments changed to 230 volts, a nameplate (Type 5590-1664) may be ordered from General Radio.

2.4 WARM-UP.

The oven in this instrument requires 6 to 10 hours of warmup before stabilization. During this time, in the OVEN HEATER position of the METER switch, the meter indication will be higher than the sector marked OVEN HTR.

2.5 CHECK FOR NORMAL OPERATION.

Observe the meter indication for each position of the METER switch. At each switch position, meter indication should be within the correspondingly marked meter sector, except during warmup, when the OVEN HTR indication will be high.

2.6 OUTPUT CONNECTIONS.

2.6.1 RF OUTPUT.

Connect to the 5-Mc, 1-Mc, and 100-kc outputs as required. Each output supplies about 1 volt, rms, into a 50-ohm load.

The output connectors are GR874 locking connectors. Adaptors are available to convert to most popular coaxial connectors (see table at the rear of this manual). The GR874 locking adaptor offers a low-leakage connection that can be wrench-tightened for semipermanent installations, yet can be quickly removed if a change of connector is desired.

2.6.2 CONNECTION TO TYPE 1112-A STANDARD-FREQUENCY MULTIPLIER.

The GR874 connector marked 5 MC TO 1112-A can be connected directly to the Type 1112-A Standard-Frequency Multiplier to produce outputs of 10 Mc/s and 100 Mc/s, and, with the addition of the Type 1112-B Multiplier, 1 Gc/s. Refer to the Appendix and to the Operating Instructions for the Type 1112 Standard-Frequency Multipliers.

2.6.3 CONNECTION TO TYPE 1123-A SYNCRONOMETER DIGITAL TIME COMPARATOR.

From BNC connectors at the rear of the instrument, 1-Mc and 100-kc signals will drive the Type 1123-A Syncronometer digital time comparator. This time comparator is a solid-state digital clock for accurate time comparisons between local standards and transmissions of standard time, such as WWV, Loran C, etc. Refer to Appendix and to the Operating Instructions for the Type 1123-A Syncronometer digital time compator.

2.7 FREQUENCY ADJUSTMENT.

Frequency can be adjusted over a range of 2700 x 10^{-10} by means of a panel control. The digital readout is direct reading in parts in 10^{10} per digit. The total range is adequate to compensate for crystal aging over the life of the instrument.

2.8 EXTERNAL POWER.

A dc source of 22 to 35 volts can be connected to the instrument at the auxiliary connector, SO802. Contact A is the positive side and contact B is the

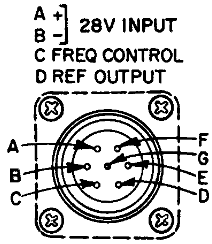


Figure 2-2. Pin numbering of SO802.

(grounded) negative side (see Figure 2-2). The current drawn varies with temperature and condition of the internal battery. At normal room temperature and trickle charge for the battery, this current is typically 150 mA.

2.9 REMOTE FREQUENCY CONTROL.

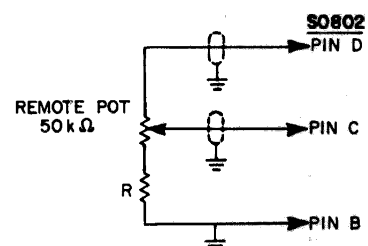
For remote control of frequency, a dc signal from +0.5 V to +12 V can be applied to the varactor CR203 in the crystal oscillator circuit through connector SO802 at the rear of the instrument. The corresponding frequency range is at least 5000 x 10^{-10}.

When the FREQUENCY CONTROL switch (on the chassis inside the cabinet) is set to REMOTE, the internal frequency adjusting circuits are disconnected and the varactor is connected to pin C of SO802. In addition, the Zener reference voltage of the power supply (about 6.2 V) is connected to pin D of SO802. This arrangement permits convenient remote-control of frequency by the following methods:

a. Potentiometer Control

The remote-control potentiometer shown in the circuit arrangement of Figure 2-3 can be used for manual control or can be part of a servo system for automatic control. The total range of the external potentiometer is 3000 to 4000 x 10^{-10}. To adjust this range, change the fixed resistor (R in Figure 2-3) in series with the potentiometer. The resistor R should be at least 5 kilohms. Moving the arm of the potentiometer towards the upper end increases the frequency.

Figure 2-3. A circuit arrangement for remote control of frequency by a potentiometer.



If a wider frequency range is required, an external dc source can be connected to the high end of the potentiometer. Figure 2-4 shows this arrangement. A total range of at least 5000 x 10^{-10} is possible. The external dc source must have a long-term stability of better than 1 mV/day and 10 mV/month. The noise must be less than 100 µV, rms. Particular attention must be paid to the wiring to avoid any possibility of ground loop pickup.

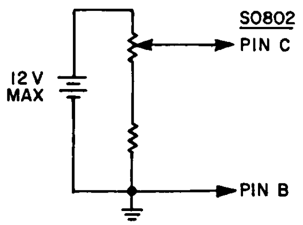


Figure 2-4. Circuit arrangement for remote control of frequency by a potentiometer with an external dc source. This circuit provides control over a wider range than that covered by the circuit of Figure 2-3.

b. Phase-Detector Control.

The high sensitivity of the varactor tuning makes possible direct drive from a phase detector without amplification. Figure 2-5 shows a simple phase detector that can be used to lock to the Standard-Frequency Oscillator. The phase lock can be operated on any one of the three output frequencies of the Type 1115-B. Potentiometer R sets the center of the detector range. The sensitivity at pin C of SO802 (the varator) is between 1 and 1.5 mV per part in 10^{10}. Contact General Radio for information on special applications.

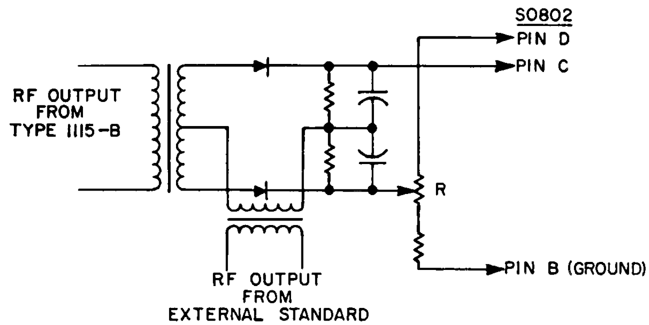


Figure 2-5. Phase-detector arrangement for locking the Type 1115-B Standard-Frequency Oscillator to an external standard.

SECTION **3**

PRINCIPLES OF OPERATION

3.1 CRYSTAL OSCILLATOR AND AGC.

The basic oscillator circuit shown in Figure 3-1 provides high input and output impedances. Its gain can be varied without any change in dc operating conditions. The voltage gain, e_L/e_o, is very nearly unity and the transconductance of the oscillator varies with the resistance of R, which represents the AGC circuit.

The AGC circuit, Figure 3-2, varies the bias current through diodes D_1 and D_2 to change their forward resistance. The rf output from the oscillator is amplified by a two-stage amplifier and rectified by D_3. As long as there is no rf voltage, Q_4 is biased on to pass a maximum current through the AGC diodes, D_1 and D_2. This results in maximum gain in the oscillator to start oscillations. As the amplitude increases, D_3 reduces the drive to Q_4 until Q_4 gets out of saturation. Any further increase in rf amplitude reduces the current through the diodes D_1 and D_2, and reduces the gain of the oscillator. R_D determines the rf amplitude at which Q_4 turns off and thus sets the rf level.

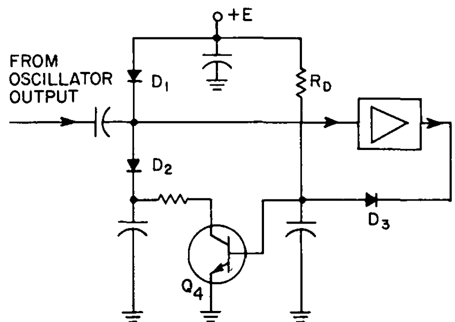


Figure 3-2. Basic AGC circuit.

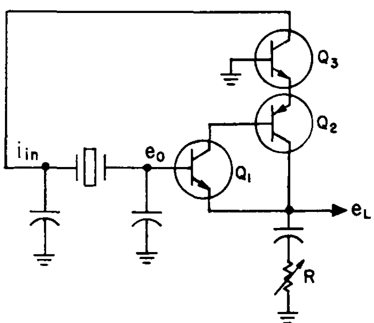


Figure 3-1. Basic Oscillator circuit.

3.2 FREQUENCY CONTROL.

A variable-capacitance diode (varactor) adjusts the frequency of the oscillator. The varactor bias is in turn controlled by a potentiometer mounted on the panel. The digital readout for this potentiometer indicates frequency increments of 1×10^{-10} per digit. The total range of frequency tuning is 2700×10^{-10}. Excellent linearity of this dial is ensured by a combination fixed-and-variable load on the arm of the potentiometer. The complete network is shown in

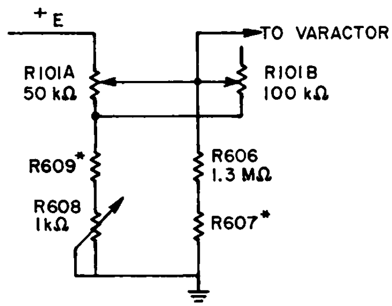


Figure 3-3. Linearizing network for the frequency-control varactor.

Figure 3-3. R609 (value selected by the calibration laboratory) and R608 set the total range of the dial. R606 and R607 affect the linearity. Typical linearity is about ±7 x 10^{-10} (out of 2700 x 10^{-10}), or about ±1/4%. Figure 3-4 shows a typical curve for the tracking error. For remote control, manual or automatic, an externally controlled dc voltage can be applied to the auxiliary connector at the rear (SO802). (Refer to paragraph 2.8.)

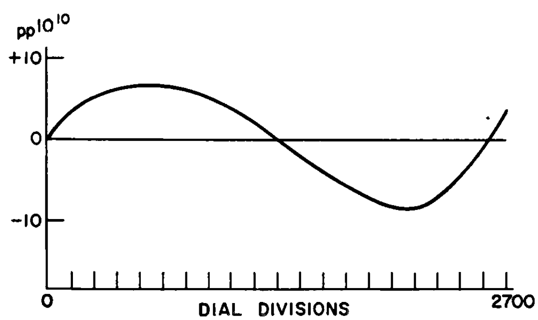


Figure 3-4. Tracking error of varactor tuning.

3.3 5-MC AMPLIFIERS.

Three stages of amplification are used between the oscillator and the 5-Mc output. The first two are of the cascode type, i.e., each consists of a grounded-emitter stage driving a grounded-base stage. The third stage is the output power amplifier. A crystal filter is used between the second isolation amplifier and the output amplifier. The output stage has an automatic level-control circuit to reduce harmonic distortion. The basic circuit is shown in Figure 3-5.

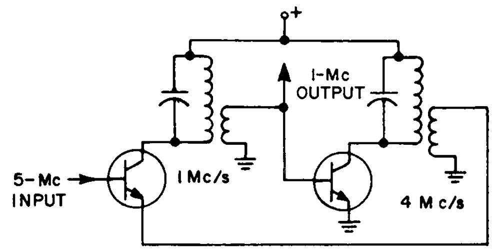


Figure 3.6. Basic circuit of the 1-Mc divider.

3.4 DIVIDERS.

A self-starting regenerative divider provides 1-Mc output from the 5-Mc input. The basic circuit is shown in Figure 3-6. The 1-Mc signal from this divider is amplified by an output amplifier similar to the one used in the 5-Mc section.

The 100-kc divider, which provides 100-kc output from the 1-Mc signal, is similar to the first divider but has an additional emitter-follower stage at the input (see Figure 3-7).

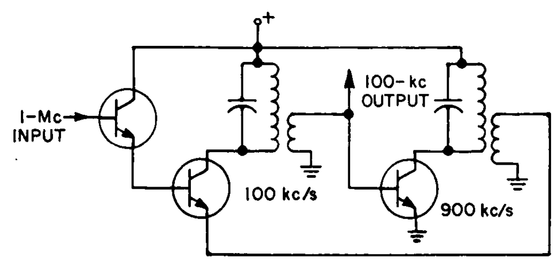


Figure 3-7. Basic circuit of the 100-kc divider.

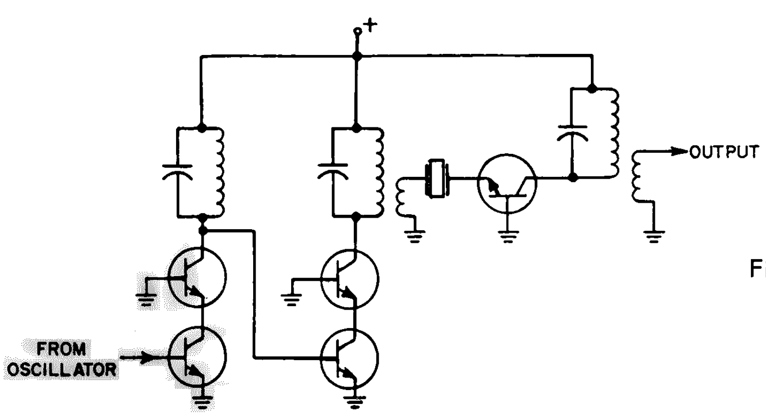


Figure 3-5. Basic circuit of the 5-Mc amplifier section.

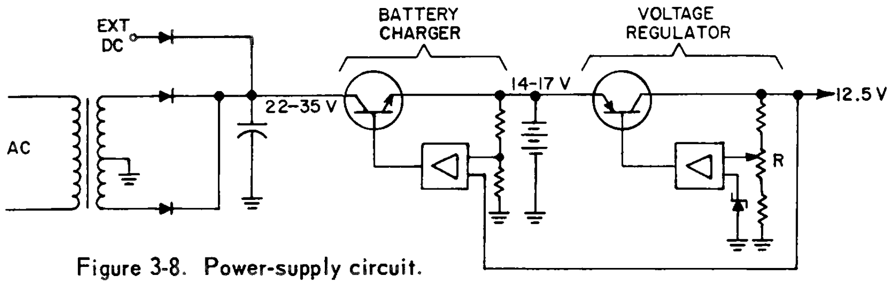


Figure 3-8. Power-supply circuit.

3.5 POWER SUPPLY.

Line power is rectified, filtered, and applied to the input of the battery charger (see Figure 3-8). The battery charger provides a current-limited voltage source to obtain a charge characteristic as shown in Figure 3-9. This arrangement results in the fastest possible recharge of the battery after power failure. The limit voltage for the battery can be adjusted by potentiometer R (see Figure 3-8) which controls the regulated B+ of the instrument. The limit voltage is set at the factory and should not be readjusted, as this affects calibration.

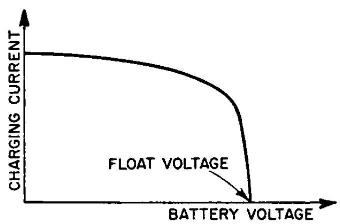


Figure 3-9. Battery recharge characteristic.

The battery voltage is regulated by a series-type voltage regulator. The reference voltage is supplied by a Zener diode, located in the oven for best temperature stability.

A 12-cell, pressure-relief-type nickel-cadmium battery powers the instrument upon line failure. At least 35 hours of operation can be expected at 25°C ambient temperature. At higher temperatures, the oven requires less power but battery capacity is less also. The worst condition exists at low ambient temperatures, where the power demand for the oven is highest and the battery has the lowest capacity.

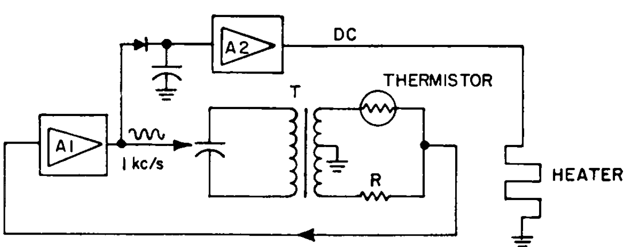


Figure 3-10. Basic circuit for oven control.

3.6 OVEN-CONTROL CIRCUITS.

As long as the oven temperature is low, positive feedback is applied around amplifier A_1 (see Figure 3-10) and the oven-control circuit oscillates at about 1 kc/s. (The frequency is determined by the tuned transformer.) This ac signal is rectified and amplified by the dc amplifier, A_2, and then applied as heater power. As the temperature increases, less signal is fed back around A_1 and the amplitude decreases, reducing the heater power so that stable operation results near the balance of the bridge. The bridge (see Figure 3-10) consists of ratio transformer T, thermistor, and fixed resistor, R.

3.7 MONITORING CIRCUITS.

Marked sectors on the monitor meter give immediate indication of operating conditions at seven points in the instrument. When the METER switch is set to one of the three OUTPUT positions, the level of that rf output is indicated by the meter. With the output unloaded, the meter indicates in the upper third of the OUTPUT sector. With 50-ohm loads, the indications are near the low end of the OUTPUT sector.

When the METER switch is set to OVEN TEMP, the meter monitors the operating temperature of the oven. The control circuits are operating properly when the indication is within the sector marked "T". The basic temperature-monitoring circuit is shown in Figure 3-11.

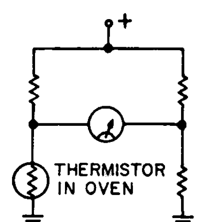


Figure 3-11. Basic circuit for monitoring operating temperature.

At the OVEN HEATER position of the METER switch, the meter indicates heater voltage. During warmup the meter indicates outside the sector marked OVEN HTR. As soon as the oven reaches operating temperature, the indication comes within the OVEN HTR sector, toward the low end at high ambient temperatures and toward the high end at low ambient temperatures.

When the METER switch is set to DC VOLTS, the meter monitors battery voltage or, if the battery is disconnected, the output from the battery charger.

When the METER switch is set to CHARGE-DISCHARGE, battery current is indicated on the meter. After power failure, the current is high until the battery is nearly full, then it drops to a low value during trickle-charge conditions.

3.8 AUXILIARY CONNECTIONS.

3.8.1 EXTERNAL POWER.

External dc power of 22 to 35 volts can be connected to the instrument at the auxiliary connector, SO802, in the rear (refer to paragraph 2.8).

3.9 REMOTE FREQUENCY CONTROL.

When the FREQUENCY CONTROL switch (internal slide switch) is set to REMOTE, the frequency-control varactor and the Zener reference voltage of the power supply are connected to the auxiliary connector, SO802. Frequency can then be adjusted by an external potentiometer or voltage source (refer to paragraph 2.9).

SECTION **4**

SERVICE AND MAINTENANCE

4.1 WARRANTY.

We warrant that each new instrument sold by us is free from defects in material and workmanship, and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards after examination by our factory, district office, or authorized repair agency personnel, will be repaired, or, at our option, replaced without charge, except for tubes or batteries that have given normal service.

4.2 SERVICE.

The two-year warranty stated above attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone our Service Department (see rear cover), giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial and type numbers of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest district office, requesting a Returned Material Tag. Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

4.3 TROUBLE-SHOOTING.

4.3.1 GENERAL.

Always check the operating conditions carefully before making any adjustments. The monitor meter can be used to determine a faulty circuit (refer to paragraph 3.7).

Trouble inside the oven assembly should be referred to the General Radio Service Department. Special test jigs are required to service the oven or any component inside the oven.

The component numbers are arranged by circuit, to help locate components in the instrument. Component numbers are identified in Table 4-1; the etched-board locations are shown in Figures 4-5 and 4-6.

NOTE

Do not adjust R532 on the power-supply board. It affects B+, the frequency, the battery-charging current, and the linearity of the frequency dial. This B+ control is factory-adjusted to meet the requirements of the individual unit.

4.3.2 BATTERY.

The trickle-charge voltage is temperature-compensated by thermistor R536 and is about 16.4 volts at room temperature. The cells of the battery are sealed and have 60-psi safety valves to prevent explosion in case of internal gas pressure. A small amount of white deposit on top of the battery (noncorrosive potassium carbonate) is not harmful. The battery needs no servicing. Neither water nor alkaline electrolyte should be added. The instrument can be operated from external dc or an ac power line with the battery disconnected.

TABLE 4-1

COMPONENT LOCATIONS

Component Numbers	*Location*
101 - 199	Panel
201 - 299	Crystal board in oven
301 - 399	Oscillator board in oven
401 - 499	RF board next to oven
501 - 599	Power-supply board next to battery
601 - 699	Meter board under battery
701 - 799	Chassis shelf
801 - 899	Rear of instrument

4.3.3 VOLTAGE MEASUREMENTS.

Table 4-2 gives the nominal voltages in a typical Type 1115-B Standard-Frequency Oscillator. The voltages are measured with a vacuum-tube voltmeter, such as the General Radio Type 1806-A. The values

TABLE 4-2

VOLTAGE MEASUREMENTS

Transistor	*E*	*B*	*C*	*Note*
Q401	4.3	4.8	9.1	
Q402	9.1	9.8	12.5	
Q403	1.7	2.6	4.9	
Q404	4.9	5.6	10.8	
Q405	1.4	2.0	12.0	5-Mc Output loaded with 50 ohms (Q405–Q406)
Q406	2.0	2.7	3.5	
Q407	1.66	1.17	12.5	
Q408	3.95	2.4	11.8	
Q409	1.4	1.9	12.5	1-Mc Output loaded with 50 ohms (Q409–Q410)
Q410	1.9	2.6	4.5	
Q411	3.9	4.6	12.8	
Q412	4.9	3.5	12.5	
Q413	4.8	4.4	12.6	100-kc Output loaded with 50 ohms (Q413–Q415)
Q414	1.7	2.4	12.5	
Q415	2.4	3.1	2.6	
Q501	0	0.55	0.6	
Q502	0	0.6	0.95	
Q503	0.3	0.9	4.8	
Q504	6.6	7.2	12.5	
Q505	0	0.65	0.7	Depends on oven operating conditions (Q505–Q508)
Q506	0	0.65	15.0	
Q507	16.3	15.6	7.1	
Q508	16.3	15.6	7.1	
Q509	18.5	19.0	36.0	Depends on line and battery conditions (Q509–Q701)
Q510	17.8	18.5	36.0	
Q511	12.4	13.0	17.0	
Q512	12.4	13.0	19.0	
Q513	17.0	17.1	19.0	
Q514	10.5	11.2	13.0	
Q515	16.3	15.6	13.0	
Q516	10.5	11.2	15.5	
Q517A	5.8	6.4	11.1	Differential Amplifier (Q517A–Q517B)
Q517B	5.8	6.4	11.1	
Q701	17.1	17.8	36.0	

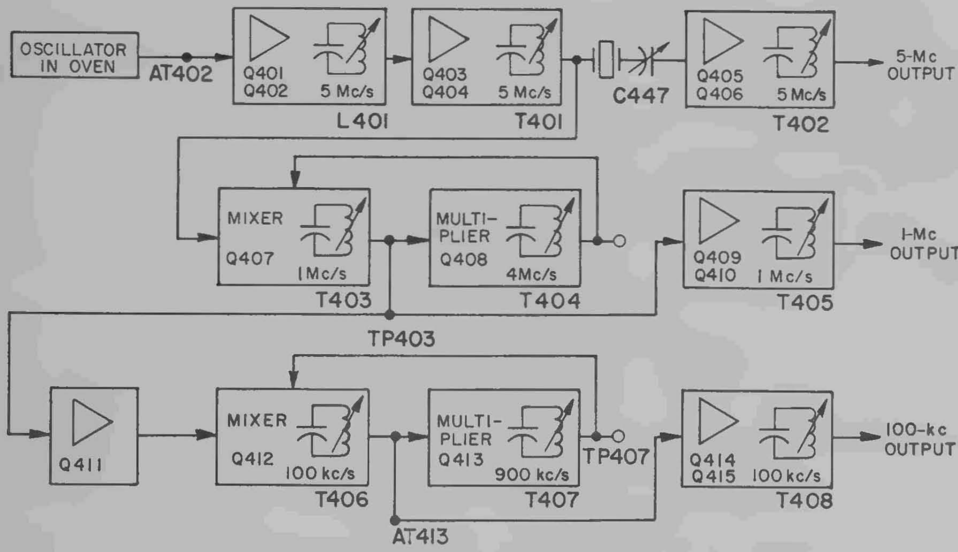


Figure 4-1. Block diagram showing locations of rf adjustments in the Standard-Frequency Oscillator.

are for operating conditions as specified but may depart widely under different operating conditions. In case of difficulties, ac conditions can be checked to aid in locating the fault.

4.4 ALIGNMENT.

4.4.1 RF SECTION.

Figure 4-1 shows the adjustments in the rf section of the Type 1115-B Standard-Frequency Oscillator. Figure 4-2 shows the waveform at AT402. The tuning of the 5-Mc circuits (L401, T401, and T402) is not critical. Capacitor C447 must be adjusted with the 5-Mc output loaded with 50 ohms. Use a low-capacitance tuning wand. All adjustments are for maximum 5-Mc output into 50 ohms.

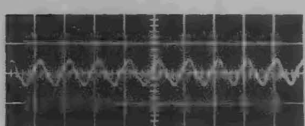


Figure 4-2. Waveform at AT402. Vertical scale is 50mV/cm; horizontal scale, 0.2 μs/cm.

To tune the 1-Mc divider, connect an oscilloscope to TP404 and adjust T403 and T404 for a waveform of maximum amplitude as shown in Figure 4-3. Then turn the slug of T404 clockwise about one half turn or until the amplitude at TP404 begins to drop. Load the 1-Mc output with 50 ohms and short-circuit TP403 to ground. The 1-Mc output should disappear. Remove the short at TP403. The divider should start and the 1-Mc output should be restored. If the divider fails to start after the short at TP403 is removed, turn the slug of T404 further clockwise (about 1/8 turn each time). When starting is satisfactory, remove the 50-ohm load on the 1-Mc output. If the waveform is blurred, the divider is oscillating. Adjust the slug of T403 to prevent this condition and repeat the starting test.

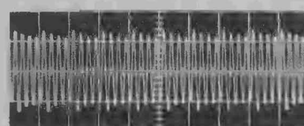


Figure 4-3. Waveform at TP404. Vertical scale is 0.5 V/cm; horizontal scale, 1 μs/cm.

To tune the 100-kc divider, connect the oscilloscope probe to TP407 and adjust T406 and T407 for the waveform shown in Figure 4-4 and maximum amplitude. Then turn the slug of T407 clockwise until the amplitude just begins to drop. Load the 1-Mc and 100-kc outputs with 50 ohms each. Short AT413 to ground with a screwdriver. Remove the short. The 100-kc output should be restored as soon as the short is removed. Remove the 50-ohm loads. The waveform at TP407 should remain clean. Blurring indicates oscillation of the divider and must be removed by retuning of T406. If necessary, repeat the com-

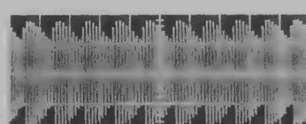


Figure 4-4. Waveform at TP407. Vertical scale is 0.5 V/cm; horizontal scale, 10 μs/cm.

plete procedure. When the slugs are properly adjusted, secure with wax, nail polish, or a like substance to prevent detuning due to vibration.

The 1-Mc and 100-kc output stages can be readjusted for maximum output (use monitor meter) into 50-ohm loads. Tuning is not critical.

4.4.2 POWER SUPPLY AND OVEN CONTROL.

The B+ control is factory-adjusted to meet the the requirements of the individual instrument. This voltage is between 12 and 13 volts. DO NOT ADJUST R532.

The voltage reference diode for the power supply is in the oven and is connected to AT508 on the power-supply board. The nominal voltage is 6.2 volts.

The oven-control circuit oscillates at approximately 1 kc/s. The amplitude at AT514 depends on oven power and is from 6 to 8 volts peak-to-peak at room temperature. Large fluctuations of this amplitude (from second to second) indicate a defective thermistor, R319. The value of R319 is about 20 kilohms at room temperature and between 2.5 and 3.5 kilohms at the operating temperature of the crystal.

4.4.3 FREQUENCY ADJUSTMENT.

The frequency of the oscillator is controlled by a varactor diode. The bias voltage is obtained from a two-gang 10-turn potentiometer on the panel (R101A and R101B). A linearizing network makes the dial direct reading in parts per 10^{10}. R609 is selected to set the proper span of the dial, and R608 provides fine adjustment of this span. The span adjustment affects the frequency at the low end (0000) of the dial, but not at the high-frequency end (2700).

4.4.4 TEMPERATURE MONITOR.

In the OVEN TEMP position of the monitor meter, a thermistor bridge indicates proper operation when the meter indication is within the "T" sector. If the meter reading is slightly outside the T sector and operation of the instrument is normal, the thermistor bridge can be reset to the center of the T sector by adjustment of R602. Large deviation indicates faulty temperature-control circuit.

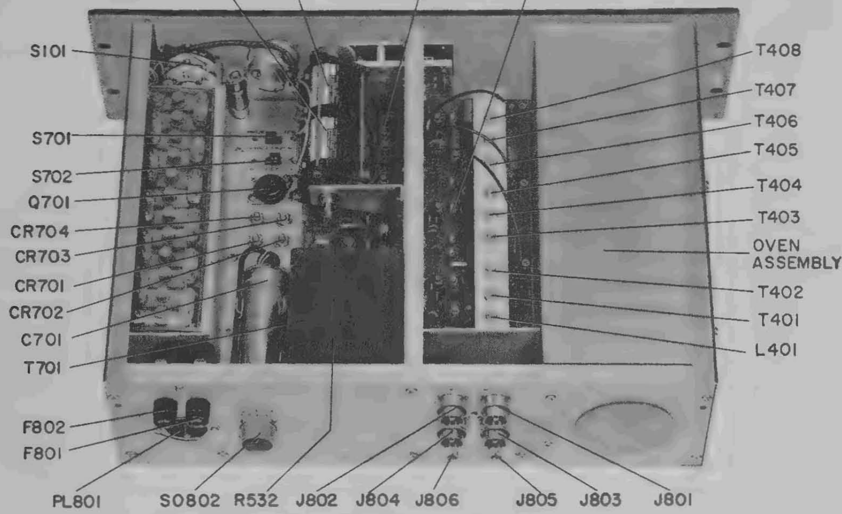


Figure 4-5. Top interior view of the Standard-Frequency Oscillator.

Do not adjust R532 (on the power-supply board, behind the transformer).

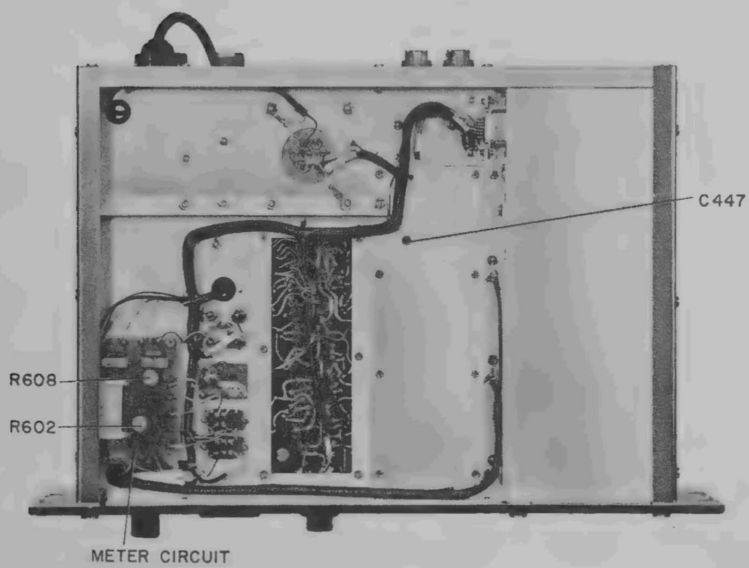


Figure 4-6. Bottom interior view of the Standard-Frequency Oscillator.

PARTS LIST

POWER SUPPLY

REF NO	CAPACITORS	PART NO
C501	Ceramic, 0.001 µF ±10% 500 V	4406-2108
C502	Electrolytic, 47 µF ±20% 6 V	4450-5500
C503	Plastic, 0.047 µF ±10% 100 V	4860-8200
C504	Ceramic, 1.0 µF ±20% 25 V	4400-2070
C505	Ceramic, 1.0 µF ±20% 25 V	4400-2070
C506	Ceramic, 1.0 µF ±20% 25 V	4400-2070
C507	Ceramic, 0.1 µF +80 -20% 50 V	4403-4100
C508	Electrolytic, 6.8 µF ±20% 35 V	4450-5000
C509	Electrolytic, 22 µF ±20% 15 V	4450-5300
C510	Electrolytic, 22 µF ±20% 15 V	4450-5300

RESISTORS

R501	Precision, 75 kΩ ±1%	6730-3750
R502	Precision, 2.37 kΩ ±1%	6730-1237
R503	Precision, 75 kΩ ±1%	6730-3750
R504	Film, 1 MΩ ±1% 1/2 W	6450-4100
R505	Film, 150 kΩ ±1% 1/8 W	6250-3150
R506	Film, 11 kΩ ±1% 1/8 W	6250-2110
R507	Film, 100 kΩ ±1% 1/8 W	6250-3100
R508	Film, 2 kΩ ±1% 1/8 W	6250-1200
R509	Film, 15 kΩ ±1% 1/8 W	6250-2150
R510	Film, 8.25 kΩ ±1% 1/8 W	6250-1825
R511	Composition, 330 Ω ±5% 1/2 W	6100-1335
R512	Precision, Value determined by Laboratory	1115-2201
R513	Composition, 47 kΩ ±5% 1/2 W	6100-3475
R514	Composition, 47 kΩ ±5% 1/2 W	6100-3475
R515	Film, 487 kΩ ±1% 1/4 W	6350-3487
R516	Film, 1.29 MΩ ±1% 1/2 W	6450-4129
R517	Composition, 24 kΩ ±5% 1/2 W	6100-3245
R518	Composition, 1 kΩ ±5% 1/2 W	6100-2105
R519	Composition, 1 kΩ ±5% 1/2 W	6100-2105
R520	Composition, 1 kΩ ±5% 1/2 W	6100-2105
R521	Wire-wound, 1 Ω ±10% 1/2 W	6760-9109
R522	Composition, 2 kΩ ±5% 1/2 W	6100-2205
R523	Film, 10 kΩ ±1% 1/8 W	6250-2100
R524	Film, 4.02 kΩ ±1% 1/8 W	6250-1402
R525	Film, 7.87 kΩ ±1% 1/8 W	6250-1787
R526	Composition, 13 kΩ ±5% 1/2 W	6100-3135
R527	Composition, 8.2 kΩ ±5% 1/2 W	6100-2825
R528	Composition, 2.7 kΩ ±5% 1/2 W	6100-2275
R529	Film, 10 kΩ ±1% 1/8 W	6250-2100
R530	Film, 10 kΩ ±1% 1/8 W	6250-2100
R531	Precision, 3.57 kΩ ±1%	6730-1357
R532	POTENTIOMETER, Wire-wound, 500 Ω ±5%	6058-1505
R533	Film, 20 kΩ ±1% 1/8 W	6250-2200
R534	Precision, 3.57 kΩ ±1%	6730-1357
R535	Composition, 20 kΩ ±5% 1/2 W	6100-3205
R536	Thermistor	6740-1602
R537	Film, 3.01 kΩ ±1% 1/8 W	6250-1301
R538	Composition, 270 Ω ±5% 1/2 W	6100-1275

MISCELLANEOUS

CR501	DIODE, Type 1N695	6082-1014
CR502	DIODE, Type 1N457	6082-1009
CR503	DIODE, Type 1N457	6082-1009
CR504	DIODE, Type 1N645	6082-1016
Q501 through Q505	TRANSISTOR, Type 2N2511	8210-1064
Q506	TRANSISTOR, Type 2N708	8210-3089

REF NO	MISCELLANEOUS (cont)	PART NO
Q507	TRANSISTOR, Type 2N1131	8210-1025
Q508	TRANSISTOR, Type 2N1131	8210-1025
Q509	TRANSISTOR, Type 2N708	8210-3089
Q510	TRANSISTOR, Type 2N697	8210-1040
Q511 through Q514	TRANSISTOR, Type 2N708	8210-3089
Q515	TRANSISTOR, Type 2N1131	8210-1025
Q516	TRANSISTOR, Type 2N708	8210-3089
Q517	TRANSISTOR, Type 2N2453	8210-1046
T501	TRANSFORMER	1115-2011

METER CIRCUIT

RESISTORS

R601	Precision, 10 kΩ ±1%	6730-2100
R602	POTENTIOMETER, Wire-wound, 10 kΩ ±5%	6058-3105
R603	Composition, 3 kΩ ±5% 1/2 W	6100-2305
R604	Precision, 10 kΩ ±1%	6730-2100
R605	Precision, 10 kΩ ±1%	6730-2100
R606	Film, 1.29 MΩ ±1% 1/2 W	6450-4129
*R607	Film, 1.29 MΩ ±1% 1/2 W	6450-4129
R608	POTENTIOMETER, Wire-wound, 1 kΩ ±5%	6058-2105
R609	Wire-wound, value determined by Laboratory	1115-2210
R610	Film, 499 kΩ ±1% 1/8 W	6250-3499
R611	Film, 604 kΩ ±1% 1/8 W	6250-3604
R612	Resistance wire, 0.1 Ω, between AT601 and AT602	

*May be altered at the factory.

MISCELLANEOUS

CR601	DIODE, Type 1N695	6082-1014

GENERAL

MISCELLANEOUS

B701	BATTERY	8410-1060
C701	CAPACITOR, Electrolytic 1400 µF +100 -10% 50 V	8420-3550
C801	CAPACITOR, Ceramic 0.01 µF +80 -20%	4406-3109
C802	CAPACITOR, Ceramic 0.0068 µF +80 -20%	4406-2689
CR701 through CR704	DIODE, Type 1N1613	6081-1012
F801	FUSE, 115 V, 0.5 A	5330-1000
	230 V, 0.25 A	5330-0700
F802	FUSE, 115 V, 0.5 A	5330-1000
	230 V, 0.25 A	5330-0700
F803	FUSE, 1 A	5330-1400
M101	METER, -10 to 0 to +40 µA, 2000 Ω, ±2%	5730-1381
PL801	PLUG, Power	4240-0702
Q701	TRANSISTOR, Type 2N1702	8210-1065
R101	HELIPOT	1115-4040
S701	SWITCH, Slide, FREQUENCY CONTROL	7910-0774
S702	SWITCH, Slide, BATTERY	7910-0774
SO702	SOCKET, on outside of oven assembly	4230-5004
SO802	SOCKET, Auxiliary Connector	8420-3410
T701	TRANSFORMER	0485-4040

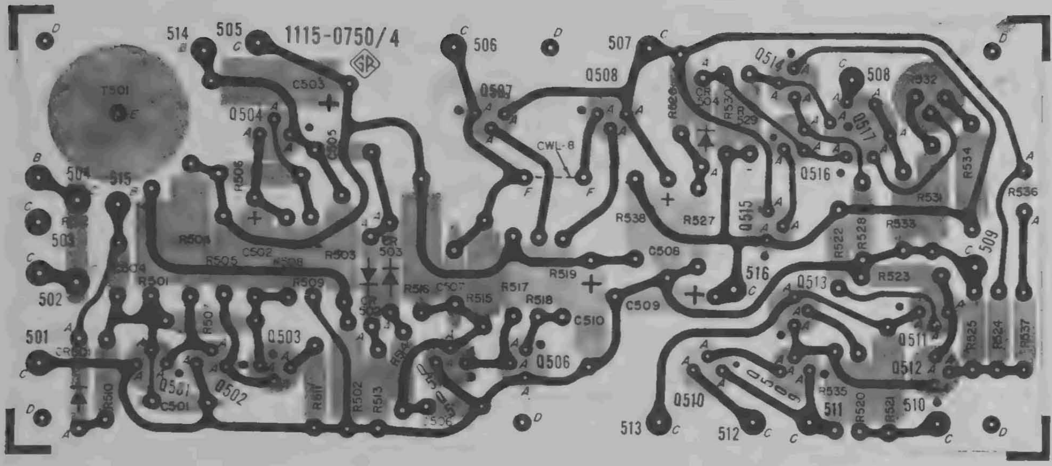


Figure 4-7. Power-supply etched board.

Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.

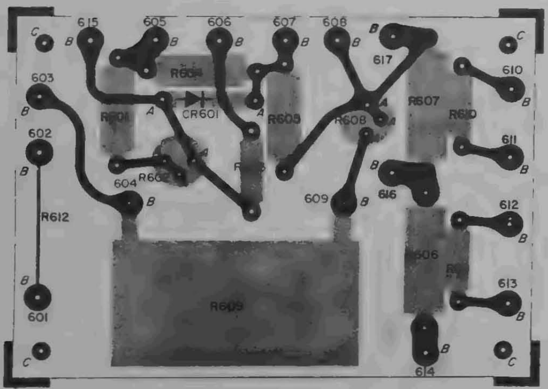


Figure 4-8. Meter-circuit etched board.

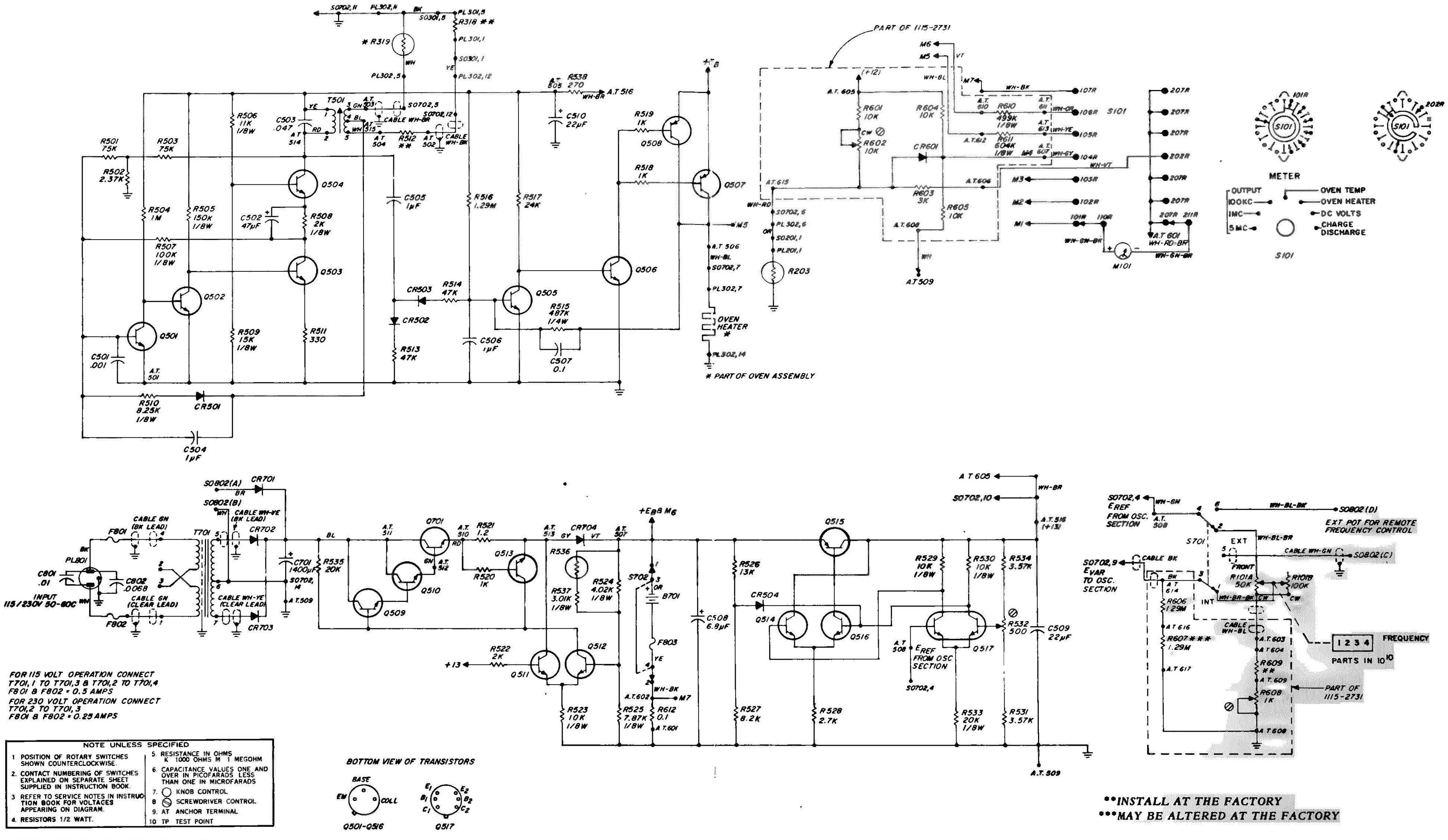


Figure 4-9. Schematic diagram of the power-supply and meter circuits of the Type 1115-B Standard-Frequency Oscillator.

PARTS LIST

CRYSTAL CIRCUIT

REF NO	MISCELLANEOUS	PART NO
C201	CAPACITOR, Ceramic 0.01 µF +80 -20% 50 V	4401-3100
C202	CAPACITOR, Ceramic 560 pF ±5% 100 V	4392-1565
C203	CAPACITOR, Ceramic 0.01 µF +80 -20% 50 V	4401-3100
C204	CAPACITOR, Ceramic 0.01 µF +80 -20% 50 V	4401-3100
C205	CAPACITOR, Ceramic 330 pF ±5% 50 V	4391-1335
R201	RESISTOR, Film 100 kΩ ±1% 1/8 W	6250-3100
R202	RESISTOR, Film 100 kΩ ±1% 1/8 W	6250-3100
R203	Thermistor	1115-0440
CR203	DIODE, Type V968A	6084-1008
L201	INDUCTOR	1115-2042
L202	INDUCTOR	1115-2043
L203	INDUCTOR	1115-2070
PL201	PLUG, mates with socket in oven	4220-5309
SO201	SOCKET, mounted in oven, accepts crystal board	4230-5006
X201	CRYSTAL	1115-0450

OSCILLATOR

CAPACITORS

REF NO	DESCRIPTION	PART NO
C307	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C308	Ceramic, 22 pF ±5% N750	4417-0225
C309	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C310	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C311	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C312	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C313	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C314	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C315	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C316	Electrolytic, 0.47 µF ±20% 75 V	4450-4310
C317	Electrolytic, 0.47 µF ±20% 75 V	4450-4310

RESISTORS

REF NO	DESCRIPTION	PART NO
R303	Film, 10 kΩ ±1% 1/10 W	6245-2100
R304	Film, 3.92 kΩ ±1% 1/10 W	6245-1392
R305	Film, 383 Ω ±1% 1/10 W	6245-0383
R306	Film, 1 kΩ ±1% 1/10 W	6245-1100
R307	Composition, 22 Ω ±5% 1/4 W	6099-0225
R308	Film, 1.21 kΩ ±1% 1/10 W	6245-1121
R309	Composition, 4.7 kΩ ±5% 1/4 W	6099-2475
R310	Composition, 4.7 kΩ ±5% 1/4 W	6099-2475
R311	Composition, 3.3 kΩ ±5% 1/4 W	6099-2335
R312	Composition, 6.8 kΩ ±5% 1/4 W	6099-2685
R313	Composition, 47 Ω ±5% 1/4 W	6099-0475
R314	Film, 150 kΩ ±1% 1/8 W	6250-3150
R315	Composition, 4.7 kΩ ±5% 1/4 W	6099-2475
R316	Composition, 100 Ω ±5% 1/4 W	6099-1105
R317	Composition, 15 Ω ±5% 1/4 W	6099-0155
R318	Wire-wound, value determined by Laboratory	1115-2200
R319	Thermistor Assembly	1115-2060

REF NO	MISCELLANEOUS	PART NO
CR301	DIODE, Type 1N3604	6082-1001
CR302	DIODE, Type 1N3604	6082-1001
CR303	DIODE, Type 1N3604	6082-1001
CR304	DIODE, Type 1N821A	6083-1007
CR305	DIODE, Type 1N3604	6082-1001
PL301	PLUG, mates with socket in oven	4220-5309
PL302	PLUG, mates with socket on outside of oven assembly	4220-5307
Q301	TRANSISTOR, Type 2N917	8210-1062
Q302	TRANSISTOR, Type 2N2411	8210-1063
Q303	TRANSISTOR, Type 2N917	8210-1062
Q304	TRANSISTOR, Type 2N708	8210-3089
Q305	TRANSISTOR, Type 2N708	8210-3089
Q306	TRANSISTOR, Type 2N2511	8210-1064
SO301	SOCKET, mounted in oven, accepts oscillator board	4230-5006

RF AMPLIFIER and DIVIDER

CAPACITORS

REF NO	DESCRIPTION	PART NO
C401	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C402	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C403	Mica, 68.1 pF ±1% 500 V	4710-0005
C404 through C408	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C409	Mica, 88.7 pF ±1% 500 V	4710-0008
C410	Ceramic, 18 pF ±5% NPO 500 V	4410-0185
C411 through C413	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C414	Mica, 464 pF ±1% 500 V	4710-0535
C415 through C418	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C419	Mica, 0.00121 µF, selected	1115-0435
C420	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C421	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C422	Mica, 140 pF ±1% 500 V	4710-0140
C423	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C425 through C427	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C428	Mica, 0.00121 µF, selected	1115-0435
C429	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C430	Ceramic, 470 pF ±10% 500 V	4404-1478
C431	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C432	Mica, 0.01 µF, selected	1115-0430
C433	Ceramic, 0.1 µF +80 -20% 50 V	4403-4100
C434	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C435	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C436	Mica, 0.0015 µF, selected	1115-0436
C437	Ceramic, 1 µF 25 V	4400-2070
C438	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C439	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C440	Ceramic, 0.1 µF +80 -20% 50 V	4403-4100
C441	Ceramic, 0.1 µF +80 -20% 50 V	4403-4100

REF NO	CAPACITORS (cont)	PART NO
C442	Mica, 0.01 µF, selected	1115-0430
C443	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C444	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C445	Electrolytic, 6.8 µF ±20% 35 V	4450-5000
C446	Ceramic, 0.01 µF +80 -20% 50 V	4401-3100
C447	Trimmer, 7-25 pF 350 V	4910-2043

RESISTORS

REF NO	DESCRIPTION	PART NO
R401	Composition, 3 kΩ ±5% 1/4 W	6099-2305
R402	Composition, 10 kΩ ±5% 1/4 W	6099-3105
R403	Composition, 220 Ω ±5% 1/4 W	6099-1225
R404	Composition, 150 Ω ±5% 1/4 W	6099-1155
R405	Composition, 2 kΩ ±5% 1/4 W	6099-2205
R406	Composition, 13 kΩ ±5% 1/4 W	6099-3135
R407	Composition, 6.8 kΩ ±5% 1/4 W	6099-2685
R408	Composition, 5.6 kΩ ±5% 1/4 W	6099-2565
R409	Composition, 220 Ω ±5% 1/4 W	6099-1225
R410	Composition, 100 Ω ±5% 1/4 W	6099-1105
R411	Composition, 1 kΩ ±5% 1/4 W	6099-2105
R413	Composition, 180 Ω ±5% 1/4 W	6099-1185
R414	Composition, 1 kΩ ±5% 1/4 W	6099-2105
R415	Composition, 4.3 kΩ ±5% 1/4 W	6099-2435
R416	Composition, 100 kΩ ±5% 1/4 W	6099-4105
R417	Composition, 100 Ω ±5% 1/4 W	6099-1105
R418	Composition, 47 kΩ ±5% 1/4 W	6099-3475
R419	Composition, 470 Ω ±5% 1/4 W	6099-1475
R420	Composition, 36 kΩ ±5% 1/4 W	6099-3365
R421	Composition, 27 kΩ ±5% 1/4 W	6099-3275
R422	Composition, 100 Ω ±5% 1/4 W	6099-1105
R423	Composition, 5.1 kΩ ±5% 1/4 W	6099-2515
R424	Composition, 36 kΩ ±5% 1/4 W	6099-3365
R425	Composition, 27 kΩ ±5% 1/4 W	6099-3275
R426	Composition, 100 Ω ±5% 1/4 W	6099-1105
R427	Composition, 5.1 kΩ ±5% 1/4 W	6099-2515
R428	Composition, 620 Ω ±5% 1/4 W	6099-1625
R429	Composition, 300 Ω ±5% 1/4 W	6099-1305
R430	Composition, 1 kΩ ±5% 1/4 W	6099-2105
R431	Composition, 4.3 kΩ ±5% 1/4 W	6099-2435
R432	Composition, 100 kΩ ±5% 1/4 W	6099-4105
R433	Composition, 100 Ω ±5% 1/4 W	6099-1105
R434	Composition, 47 kΩ ±5% 1/4 W	6099-3475
R435	Composition, 36 kΩ ±5% 1/4 W	6099-3365
R436	Composition, 27 kΩ ±5% 1/4 W	6099-3275
R437	Composition, 1 kΩ ±5% 1/4 W	6099-2105
R438	Composition, 36 kΩ ±5% 1/4 W	6099-3365
R439	Composition, 27 kΩ ±5% 1/4 W	6099-3275
R440	Composition, 100 Ω ±5% 1/4 W	6099-1105
R441	Composition, 1.5 kΩ ±5% 1/4 W	6099-2155
R442	Composition, 36 kΩ ±5% 1/4 W	6099-3365
R443	Composition, 27 kΩ ±5% 1/4 W	6099-3275
R444	Composition, 100 Ω ±5% 1/4 W	6099-1105
R445	Composition, 2.7 kΩ ±5% 1/4 W	6099-2275
R446	Composition, 300 Ω ±5% 1/4 W	6099-1305
R447	Composition, 300 Ω ±5% 1/4 W	6099-1305
R448	Composition, 1 kΩ ±5% 1/4 W	6099-2105
R449	Composition, 4.3 kΩ ±5% 1/4 W	6099-2435
R450	Composition, 100 kΩ ±5% 1/4 W	6099-4105
R451	Composition, 100 Ω ±5% 1/4 W	6099-1105
R452	Composition, 47 kΩ ±5% 1/4 W	6099-3475
R453	Composition, 36 kΩ ±5% 1/4 W	6099-3365
R454	Composition, 27 kΩ ±5% 1/4 W	6099-3275
R455	Composition, 1 kΩ ±5% 1/4 W	6099-2105

REF NO	MISCELLANEOUS	PART NO
CR401 through CR406	DIODE, Type 1N191	6082-1008
L401	INDUCTOR, 5-Mc	1115-2100
Q401 through Q415	TRANSISTOR, Type 2N708	8210-3089
T401	TRANSFORMER, 5-Mc	1115-2110
T402	TRANSFORMER, 5-Mc	1115-2120
T403	TRANSFORMER, 1-Mc	1115-2130
T404	TRANSFORMER, 4-Mc	1115-2150
T405	TRANSFORMER, 1-Mc	1115-2130
T406	TRANSFORMER, 100-kc	1114-2220
T407	TRANSFORMER, 900-kc	1115-2130
T408	TRANSFORMER, 100-kc	1115-2140
X401	CRYSTAL	1213-0440

GENERAL

REF NO	MISCELLANEOUS	PART NO
C702	CAPACITOR, Ceramic 0.001 µF -0 +100% 500 V	4400-1800
C703	CAPACITOR, Ceramic 0.001 µF -0 +100% 500 V	4400-1800
C704	CAPACITOR, Ceramic 0.001 µF -0 +100% 500 V	4400-1800
J801	COAXIAL CONNECTOR, 5 MC TO 1112	0874-4502
J802	COAXIAL CONNECTOR, 5 MC OUT	0874-4502
J803	COAXIAL CONNECTOR, 100 KC OUT	0874-4502
J804	COAXIAL CONNECTOR, 1 MC OUT	0874-4502
J805	BNC CONNECTOR, 100 KC CLOCK OUT	4230-2300
J806	BNC CONNECTOR, 1 MC CLOCK OUT	4230-2300
R801	RESISTOR, Composition 56 Ω ±5% 1/2 W	6100-0565
R802	RESISTOR, Composition 75 Ω ±5% 1/2 W	6100-0755
R803	RESISTOR, Composition 1 kΩ ±5% 1/2 W	6100-2105
R804	RESISTOR, Composition 2.2 kΩ ±5% 1/2 W	6100-2225
S101	SWITCH, Rotary Wafer, METER	7890-3690
Z701	FILTER, 0.1 A, 125 V dc	5284-0400

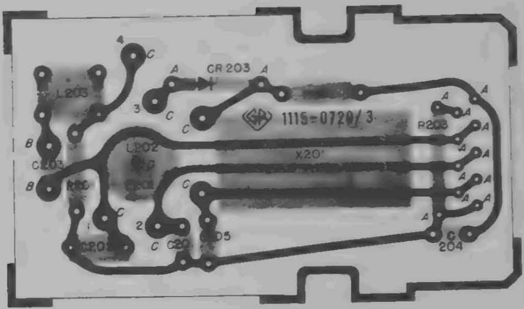


Figure 4-10. Crystal-circuit etched board.

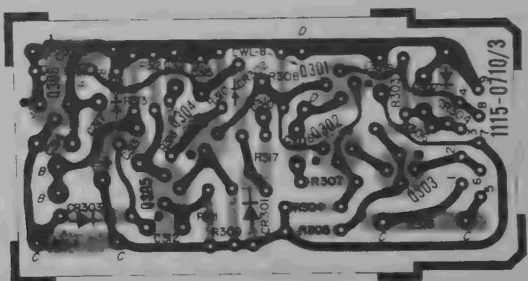


Figure 4-11. Oscillator-circuit etched board.

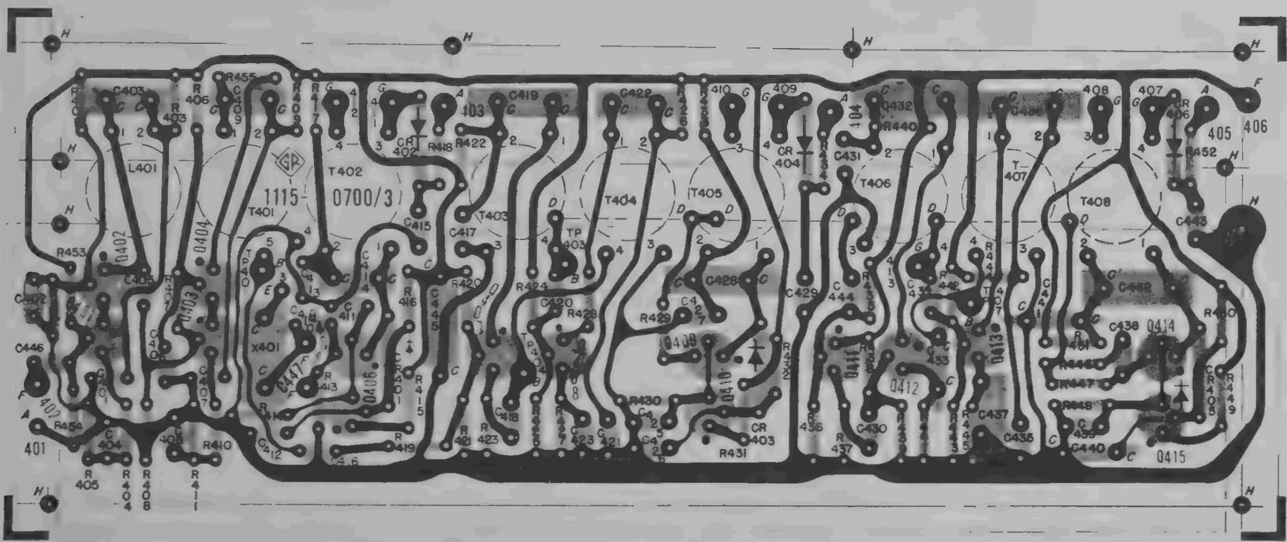
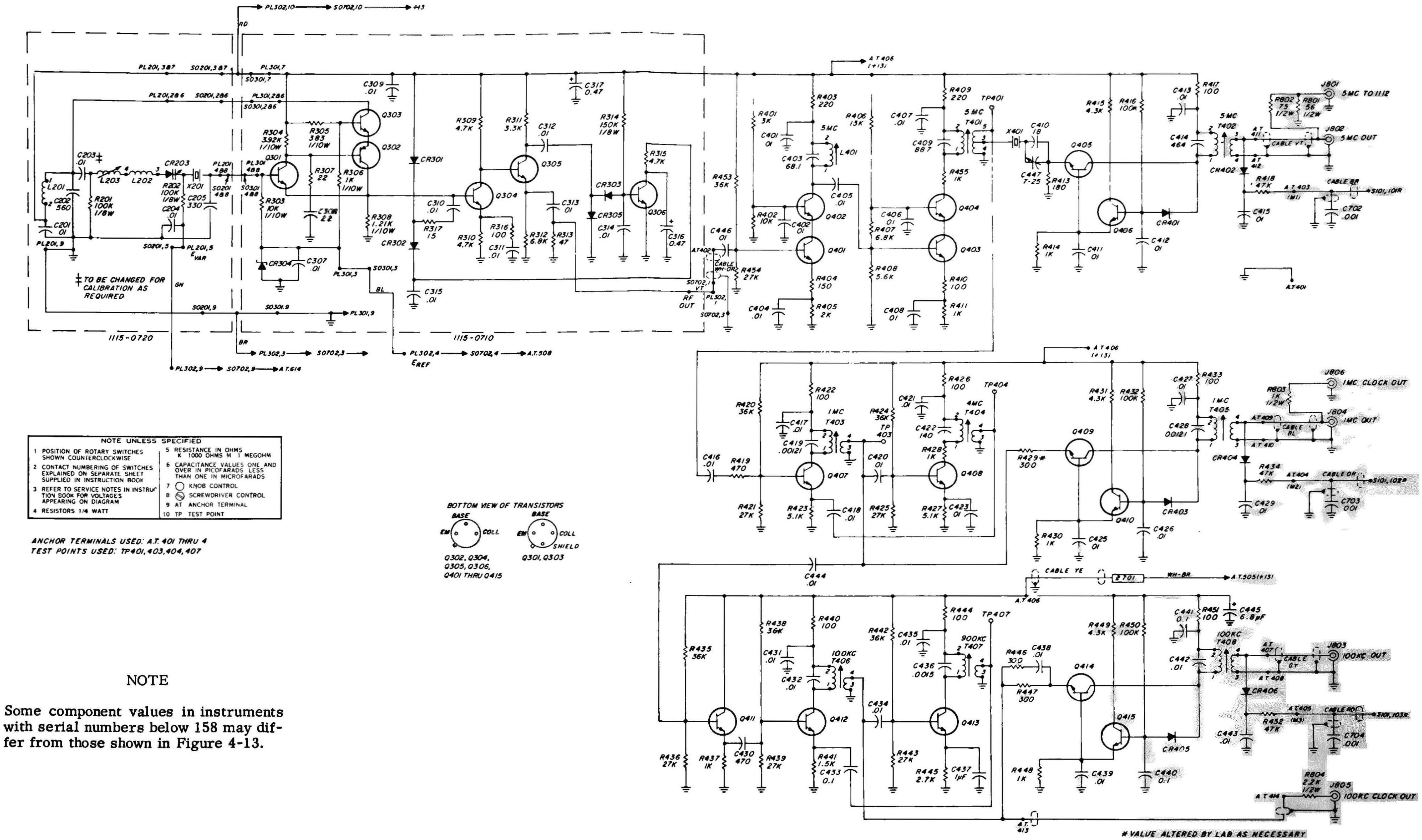


Figure 4-12. Etched-board layout for rf-amplifier and divider circuit.



NOTE

Some component values in instruments with serial numbers below 158 may differ from those shown in Figure 4-13.

Figure 4-13. Schematic diagram for the Type 1115-B Standard-Frequency Oscillator, including crystal circuit, oscillator circuit, and rf-amplifier and divider circuits.

Accessory Instruments for Use with the Type 1115-B Standard-Frequency Oscillator

Type 1123-A DIGITAL SYNCRONOMETER

PRECISION, SOLID-STATE, DIGITAL CLOCK

FEATURES:
- All-solid-state logic circuitry — no moving parts.
- Internal nickel-cadmium battery for approximately 24-hour emergency operation.
- Bright, 6-digit indication of hours/minutes/seconds.
- Any digit can be changed manually without disturbance to timing.
- Time comparisons to 20 ns.
- Manual start, fail-safe, regenerative circuits stop clock if input fails for even one cycle.
- BCD 1-2-4-2 (1-2-4-8 optional at extra cost) output data — 10-μs resolution.
- Low-jitter, standard, timing pulses at 100, 10, and 1 kc/s, 100, 10, 1, and 0.1 c/s.

USES: The Type 1123-A Digital Syncronometer® time comparator is a solid-state digital clock for the calibration of frequency and time standards. It provides precise time-of-day information, both visually and in BCD (1-2-4-2) form, and permits accurate comparisons between local standards and the transmission of standard time (WWV, Loran C, etc.). The clock can compare its own time with standard time without disturbance of its internal time. Clock's internal time can be automatically synchronized (within 10 μs) to standard time.

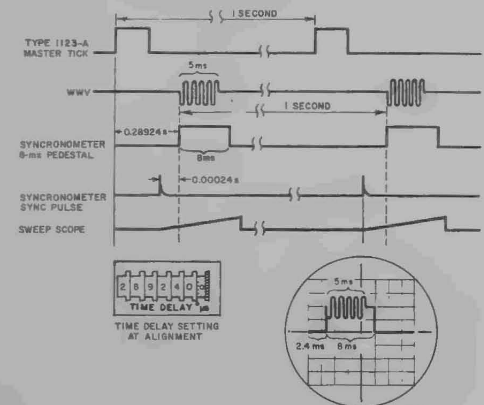
Any number of clocks can be started simultaneously from one location — remote clocks can be started from and synchronized to a local clock (without interruption of local clock). Time can be transferred from one location to another. One sets the clock at the master station and actually carries the standard time to remote locations.

DESCRIPTION:

Circuit functions in the Syncronometer may be divided into four general parts: starting, timekeeping, synchronizing, and readout.

Starting is accomplished either by a front-panel push-button or by a pulse (from an external source or another Syncronometer). With either method any number of clocks can be started simultaneously, and remote units can be started in synchronism with an operating master clock, without disturbance of the master time indication.

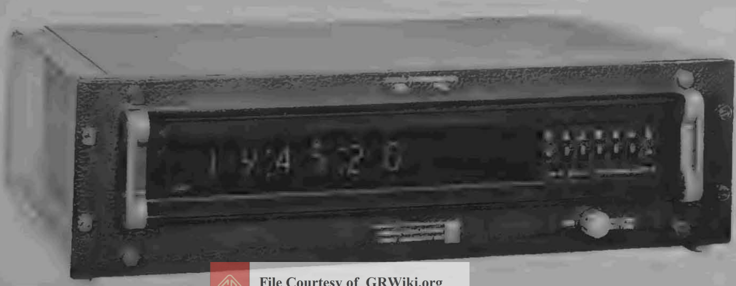
Timekeeping A pulse train derived from the 100-kc input is fed through fail-safe, regenerative-gate circuits. The pulses in the train, 10 microseconds apart, are then divided in five anti-time-delay decade dividers to produce a 1-pps master tick. All timekeeping circuits use silicon transistors operated at low-power levels. In the event of power failure, the built-in battery will automatically sustain the timekeeping operation for approximately 24 hours.



To determine the precise time relationship of the Digital Syncronometer's master tick to WWV standard timing bursts, both the time transmission and the clock's 8-millisecond pedestal are displayed on a CRO screen. By means of front-panel thumbwheels, successive amounts of delay are introduced until the pedestal is exactly aligned with the WWV bursts. When the delay is determined, the Type 1123-A need only be switched to self-sync operation, and the master tick will be shifted to synchronism with the transmission. The sync pulse retains oscilloscope synchronism and keeps the pedestal in view throughout the operation.

Where the characteristics of the standard-time transmission permit greater resolution than that provided by the 8-ms pedestal, the 0.2-μs marker can be used. With this marker, time comparisons with a precision of better than ± 20 ns are possible.

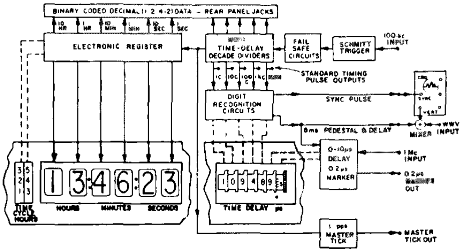
Time Comparison and Synchronization The decade dividers of the timekeeping circuits provide, at output jacks, low-jitter, timing pulses at 100 kc/s, 10 kc/s, 1 kc/s, 100 c/s, 10 c/s, 1 c/s, and 0.1 c/s. These signals also operate a five-digit recognition circuit to produce



an 8-millisecond pedestal, occurring at 1 pps. This pedestal can be delayed a precise amount of time with respect to the master tick (delay time of 0.00000 through 0.99999 second is selected by front-panel thumbwheels). Pedestal and a sync pulse are provided for comparisons of the master tick with WWV-type transmissions on a CRO screen.

For intercomparisons where greater time resolution is possible (e.g., Loran C), a 1-Mc input is used to drive a delay circuit (0 to 9 microseconds in 1-microsecond steps, 0 to 1 microsecond continuously), which produces a 0.2-microsecond marker controlled by the last two front-panel thumbwheels.

The thumbwheels used in measuring the time interval between the master tick of the SYNCRONOMETER and the standard transmissions serve in *synchronizing* the master tick as well.



Timekeeping, readout, and comparison circuits of the Type 1123-A Digital Syncronometer.

Readout is both visual and electrical. The clock's 1-pps master ticks are accumulated and displayed in a six-digit bank of illuminated indicators, which can be preset to re-cycle at any number of hours from 1 to 99. The indication of each digit may be changed without carrying to the next digit or interrupting the master tick. An output plug provides BCD data from each digit of the visual bank and from each of the five decade dividers (0.1 second through 10 microseconds). This data is in parallel (1-2-4-2) form, an invaluable aid in providing real-time information for time-dependent measurements.

SPECIFICATIONS

Input: BNC connectors.
0.5 V at 100 kc/s (sinusoid or square wave).
0.5 V at 1 Mc/s (sinusoid or square wave).
Normally provided from TYPE 1115-B Standard-Frequency Oscillator (1 V into 50 Ω).

Outputs:

Time of Day: From all decades, parallel 1-2-4-2 BCD. 1-2-4-8 BCD available at extra cost; write for price and delivery.
Logical 0: Approx 0.5 V.
Logical 1: Approx +15 V (open circuit).
Logical Line Source Impedance: 100 kΩ.

Timing Pulses: 10 kc/s, 100, 10, 1, and 0.1 c/s are available at output fittings on rear. These outputs are +15-V pulses with approx 100-Ω source impedance and a duty ratio of 0.2. In addition, a 100-kc pulse signal is available.

Oscilloscope Sync Pulse: Settable in 1-ms steps 0.000 to 0.999 s.
Positive pulse, 13 V, Z_o = 2.2 kΩ.
Duration, ≈7.5 μs.

Time Comparison Pedestal: Follows oscilloscope sync by 000 to 990 μs (100- and 10-μs steps).
Positive pulse, 10 V from emitter follower.
Duration, ≈8 ms.
T_r = 0.5 μs, T_f = 0.5 μs.

0.2-μs Marker: 10-V positive pulse, 0.2-μs duration, with approximately 20-ns rise and fall times, and 100-Ω source impedance. This marker is variable in 1-μs steps and a continuous 0- to 1-μs range from 0 to 10 μs after the 8-ms pedestal.

1-s Master Tick Output: Positive pulse from emitter follower.
Amplitude: 10 V. Duration, ≈7.5 ms. T_r = 2 μs, T_f = 2 μs.

Input Start Pulse: Logical 0 (0 V) to 1 (+15 V) holding for > 10 μs. May come from second clock or external system.

Output Start Pulse: 11 μs, 0 to +15 V, from emitter follower.

Inhibit Pulse Output: Logical 1 (+15 V) to 0 (0 V); lasting approx 9 to 11 time units at lower frequencies, established by setting internal links for desired inhibit rate (no print on carry).

Visual Indication: 6 dimmable digital indicators for h, m, s.

Delay Setting for Time Measurement: 6 digital thumbwheel switches and 1 continuous (0-1 μs) control calibrated in 20-ns increments.

Visual Register Setting: Direct access to all six visual decades, carries inhibited.

Clock Functions: All control and setting functions are operated by a single pushbutton and are normally locked out and covered.

1. Operate: All program controls locked out.

2. Start: Clock will be started by 11-μs start pulse from pushbutton or from external source (BNC connector on rear). Start pulse produced and fed from instrument.

3. Stop: Clock will be stopped and all counting decades from 100 kc/s to 1 c/s will be set to zero by pushbutton. Zero will hold until start command is received.

4. Set: Permits setting visual register. All-visual register carries interrupted; 100-kc to 1-cycle dividers not affected. Selected decade is advanced by 1 count for each push of the initiate pushbutton.

5. Self Sync: Permits synchronizing master tick to within 10 μs of a measured time in another time system, as WWV on UT-2.

6. Start-Slave: Permits setting a second clock from the first. After the initiate button is pushed, a start pulse will be produced when the count reaches the setting of the time-delay switches of the first clock.

Measurement Rate: Switch permits oscilloscope sync at 10-cycle rate rather than the standard one-cycle rate.

Power Required: 90 to 130 or 180 to 260 V, 50 to 60 c/s, 32 W approx. Self-contained, pressure-relief, nickel-cadmium battery for approx 24-hour off-line operation is supplied.

Accessories Supplied: Digital-output plug assembly, TYPE CAP-22 Power Cord, spare fuses.

Mechanical Data: Rack-Bench Cabinet

Model	*Width*		*Height*		*Depth*		*Net Weight*		*Shipping Weight*	
	in	*mm*	*in*	*mm*	*in*	*mm*	*lb*	*kg*	*lb*	*kg*
Bench	19	485	6	155	14½	370	30	14	40	18.5
Rack	19	485	5¼	135	12*	305	30	14	40	18.5

* Behind panel.

For a more detailed description, see *General Radio Experimenter*, February 1965.

Catalog Number	*Description*
1123-9801	**Type 1123-A Digital Syncronometer, Bench Model**
1123-9811	**Type 1123-A Digital Syncronometer, Rack Model**

Type 1112 STANDARD-FREQUENCY MULTIPLIERS

FEATURES: ■ Provides microwave-range standard frequencies — 250-milliwatt output at 1000 Mc/s. ■ Excellent phase stability. ■ Extremely low noise.

USES: The Type 1112 Standard-Frequency Multipliers generate sine-wave signals of 1, 10, 100, and 1000 Mc/s when driven from a 100-kc or 1-Mc source or, when driven from a 1-, 2.5-, or 5-Mc source, outputs of 10, 100, and 1000 Mc/s.

The output provides standard frequencies in the microwave region for precise frequency measurements. The unusually low noise and excellent phase stability of output signals permit intercomparison of lower-frequency, standard-frequency oscillators and comparison of crystal with atomic standards.

DESCRIPTION: The phase stability and low noise of the multiplier outputs result from the use of a narrow-band filter, which selects only the desired harmonic at each output frequency.

In the Type 1112-A Multiplier, the 100-kc input signal is multiplied to 1, 10, and 100 Mc/s. Quartz-crystal filters are used, each in an oscillator circuit whose frequency is phase-locked to the desired harmonic frequency.

In the Type 1112-B Multiplier, which operates from a separate 100-Mc output of the Type 1112-A, a phase-locked klystron oscillator is used as a selective filter. Phase-modulation noise inherent in klystrons is minimized by negative feedback. The reference standard is the multiplied harmonic of the crystal-controlled 100-Mc driving signal.

SPECIFICATIONS

Type	*Input* Freq in Mc/s	*Input* Volts	*Output* Residual FM Noise	*Output* Locking Range	*Output* Bandwidth† Decade	*Output* Bandwidth† c/s	*Output* Power	*Output* Open-Circuit Volts
1112-A	0.1 1 2.5 5	1 1.5 0.4 0.4	$< \pm 1 \times 10^{-9}$	± 15 in 10^6	0.1–1 Mc/s 1–10 Mc/s 10–100 Mc/s	50 500 5000	20 mW into 50Ω 4 channels: 1 at 1 Mc/s 1 at 10 Mc/s 2 at 100 Mc/s	2
1112-B	100	20 mW* (50Ω)	$< \pm 1 \times 10^{-9}$	±100 kc‡	100 kc/s‡		1000 Mc/s, 250 mW, 50Ω sine wave	>3

* From Type 1112-A. † Expressed as allowable frequency deviation rate. ‡ At input frequency.

Spurious Signals: At least 100 dB below output level.

Terminals: Locking GR874 Coaxial Connectors; adaptors are available to all commonly used types.

Accessories Supplied: Type 1112-A — Type CAP-22 Power Cord, Type 874-R22LA Patch Cord, spare fuses; Type 1112-B — Type CAP-22 Power Cord, two Type 874-R22LA Patch Cords, spare fuses.

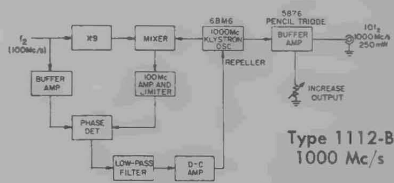
Power Required: 105 to 125 or 210 to 250 V, 50 to 60 c/s. Type 1112-A, 110 W; Type 1112-B, 125 W.

Dimensions: Relay-rack panel, 19 by 12¼ in (485 by 330 mm); depth behind panel, 11 in (280 mm).

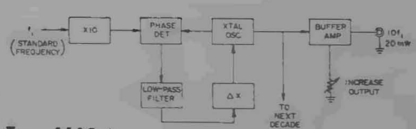
Net Weight: Type 1112-A, 25 lb (11.5 kg); Type 1112-B, 35 lb (16 kg).

Shipping Weight: Type 1112-A, 40 lb (18.5 kg); Type 1112-B, 50 lb (23 kg).

Catalog No.	Description
1112-9701	**Type 1112-A Standard-Frequency Multiplier**
1112-9702	**Type 1112-B Standard-Frequency Multiplier**



Type 1112-B
1000 Mc/s



Type 1112-A
1, 10, 100 Mc/s

TYPE 874 COAXIAL COMPONENTS

TYPE 874 CABLE CONNECTORS

APPLICABLE CABLE TYPES	CONNECTOR TYPE	CABLE	CABLE LOCKING	PANEL FLANGED	PANEL LOCKING	PANEL LOCKING RECESSED
50-OHM	874-A2	-CA	-CLA	-PBA	-PLA	-PRLA
50-OHM	RG-8A/U RG-9B/U RG-10A/U RG-87A/U RG-116/U RG-156/U RG-165/U RG-166/U RG-213/U RG-214/U RG-215/U RG-225/U RG-227/U	-C8A	-CL8A	-PB8A	-PL8A	-PRL8A
NON-50-OHM	RG-11A/U RG-12A/U RG-13A/U RG-63B/U RG-79B/U RG-89/U RG-144/U RG-146/U RG-149/U RG-216/U					
50-OHM	874-A3 RG-29/U RG-55/U (Series) RG-58/U (Series) RG-141A/U RG-142A/U RG-159/U RG-223/U	-C58A	-CL58A	-PB58A	-PL58A	-PRL58A
NON-50-OHM	RG-59/U RG-62/U (Series) RG-71B/U RG-140/U RG-210/U	-C62A	-CL62A	-PB62A	-PL62A	-PRL62A
50-OHM	RG-174/U RG-188/U RG-316/U	-C174A	-CL174A	-PB174A	-PL174A	-PRL174A
NON 50-OHM	RG-161/U RG-187/U RG-179/U					

Example: For a locking cable connector for RG-8A/U, order Type 874-CL8A.

TYPE 874 ADAPTORS

TO TYPE		874-
BNC	plug	QBJA QBJL*
	jack	QBPA
C	plug	QCJA QCJL*
	jack	QCP
HN	plug	QHJA
	jack	QHPA
LC	plug	QLJA QLPA
LT	plug	QLTJ
	jack	QLPT
Microdot	plug	QMDJ QMDJL*
	jack	QMDP
N	plug	QNJA QNJL*
	jack	QNP QNPL*
OSM/BRM	plug	QMMJ QMMJL*
	jack	QMMP QMMPL*
SC (Sandia)	plug	QSCJ QSCJL*
	jack	QSCP
TNC	plug	QTNJ QTNJL*
	jack	QTNP
UHF	plug	QUJ QUJL*
	jack	QUP
UHF 50-Ω Air Line	7/8-in.	QU1A
	1-5/8-in.	QU2
	3-1/8-in.	QU3A

*Locking Type 874 Connector

Example: To connect Type 874 to a type N jack, order Type 874-QNP.

CONNECTOR ASSEMBLY TOOLS

TYPE 874–	FUNCTION
TOK	Tool Kit
TO58	Crimping Tool
TO8	Crimping Tool

OTHER COAXIAL ELEMENTS

TYPE 874-		TYPE 874-	
A2	50 Ω cable (low loss)	ML	component mount
A3	50 Ω cable	MB	coupling probe
D20L, D50L	20-, 50-cm adjustable stubs	MR, MRL	mixer-rectifier
EL, EL-L	90° ell	R20A, R20LA	patch cord, double shield
F185L	185-Mc/s low-pass filter	R22A, R22LA	patch cord, double shield
F500L	500-Mc/s low-pass filter	R33, R34	patch cord, single shield
F1000L	1000-Mc/s low-pass filter	T, TL	tee
F2000L	2000-Mc/s low-pass filter	TPD, TPDL	power divider
F4000L	4000-Mc/s low-pass filter	U	U-line section
FBL	bias insertion unit	UBL	balun
G3, G3L, G6, G6L G10, G10L G20, G20L	3-, 6-, 10-, and 20-dB attenuators	VCL VI VQ, VQL	variable capacitor voltmeter indicator voltmeter detector
GAL	adjustable attenuator	VR, VRL	voltmeter rectifier
JR	rotary joint	W100	100-Ω termination
K, KL	coupling capacitor	W200	200-Ω termination
L10, L10L L20, L20L L30, L30L	10-, 20-, and 30-cm rigid air lines	W50B, W50BL WN, WN3 WO, WO3	50-Ω termination short-circuit terminations open-circuit terminations
LAL	33-58 cm adjustable line	X	insertion unit
LK10L, LK20L	constant-Z adjustable lines	XL	series inductor
LR	radiating line	Y	cliplock
LTL	trombone constant-Z line	Z	stand

MISCELLANEOUS COAXIAL CONNECTORS

CONNECTOR TYPE	TYPE NO.	USED WITH
Basic	874-B	50-ohm Air Line
Basic Locking	874-BBL	50-ohm Air Line
Panel Locking	874-PLT	Wire Lead
Panel Locking Recessed	874-PRLT	Wire Lead
Panel Locking Feedthrough	874-PFL	Type 874 Patch Cords

L suffix indicates locking Type 874 Connector.

FOR COMPLETE DETAILS, REFER TO THE GENERAL RADIO CATALOG.

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