OPERATING INSTRUCTIONS
for
TYPE 1100-A
FREQUENCY STANDARDS

Form 664-A

OPERATING INSTRUCTIONS
for
TYPE 1100-A FREQUENCY STANDARDS

SECTION 1.0
INTRODUCTION

1.1

The Type 1100-A Frequency Standard is available in two forms, a primary standard (Type 1100-AP) and a secondary standard (Type 1100-AQ). The primary standard includes a syncronometer (synchronous motor clock) for evaluating the frequency in terms of standard time. No timing means is furnished with the secondary standard, but a very satisfactory frequency check can be obtained by comparison with the standard frequency radio transmissions from the National Bureau of Standards at Washington, D.C.

1.11 The Type 1100-AP Primary Frequency Standard is composed of the following instruments:

Type 1101-A Piezo-Electric Oscillator
(with temperature control unit)
Type 1190-A 100-kc Quartz Bar and Mounting
Type 1102-A Multivibrator and Power Supply Unit
Type 1103-A Syncronometer.

Brief descriptions of these instruments are given in the following pages.

1.12 The Type 1100-AQ Secondary Standard is composed of the following instruments:

Type 1101-A Piezo-Electric Oscillator (with temperature control unit)
Type 1190-A 100-kc Quartz Bar and Mounting
Type 1102-A Multivibrator and Power Supply Unit

1.2

Interconnections between the various units are made by means of cables and plugs supplied with the equipment. Suitable patch cords are provided for connection to the frequency-measuring equipment when the standard and Type 1105-A Frequency-Measuring Equipment are purchased together.

1.3 Relay Racks

Unless otherwise specified, a bench-type rack is furnished with either standard.

SECTION 2.0
INSTALLATION

2.1

In order that the interconnecting cables will fit properly, the equipment should be mounted as follows from top to bottom of the space. ~~(see Figure 1).~~

Type 1103-A Syncronometer
Type 1102-A Multivibrator and Power Supply Unit
Type 1101-A Piezo-Electric Oscillator
Blank panels are supplied to fill the remaining spaces in the rack.

2.2

Install the power cord, the crystal oscillator cable and the temperature box cable to their respective sockets in the bottom of the Type 1102-A Unit. If a Type 1103-A Syncronometer is used, install the cable between the Type 1102-A and Type 1103-A Unit, at the upper left rear of the Type 1102-A Unit.

SECTION 3.0
OPERATION

3.1

Turn on power by throwing the "FIL-PLATE" and "HEAT" switches, on the panel of the Type 1102-A Multivibrator and Power Supply Unit, to "ON".

3.2

After the tubes have had time to warm up, all circuits are ready for use. The temperature control unit requires at least two to three hours to reach final temperature of 60°C. At normal room temperatures the thermostat cycle is approximately 20 seconds, the heat being on about 6 seconds, as indicated by the pilot light mounted over the thermometer on the panel of the Type 1101-A Piezo-Electric Oscillator Unit.

3.3

On starting, the diode meter, on the panel of the Type 1101-A Piezo-Electric Oscillator, may swing to full scale momentarily. After stabilization of the bridge, the reading should be 90 $\pm$10 µamp. If the reading is appreciably outside this range, readjustment can be made. (See Service Notes, Section 2, Oscillator).

3.4

The control voltages and frequencies of the four multivibrators, of the Type 1102-A Unit, can be adjusted from the rear of the equipment. These adjustments have been made at the factory and should not require resetting. See Service Notes, Section 2, Multivibrators, for instructions on checking and adjusting the multivibrators.

3.5

The Syncronometer motor is started by pressing the starting button on the panel of the Type 1103-A Syncronometer Unit and momentarily throwing the "PLATE" switch on the Type 1103-A Unit to "off". When the Syncronometer motor comes up to nearly synchronous speed, successive short pushes of the button are used to bring the motor into synchronism.

3.6

The Syncronometer can be set, by inserting the key into the opening at the upper left of the clock face. Each "click" advances or retards the second hand by 0.5 second. If it is necessary to reset by a considerable amount, the door may be opened and the minute hand advanced or retarded. When finishing the adjustment, be sure the minute and sweep-second hands are synchronized. Final fine setting can then be done with the key.

3.7

The microdial contactor is utilized with a time signal receiver to compare accurately the time indicated by the Syncronometer with the time signals. The contactor opens the circuit once each second for about 0.05 second. The time of the opening can be phased to occur at any instant during a second by inserting the key in the opening to the right of the microdial scale and turning the microdial housing. The microdial connections are brought out on a length of shielded cable which is a part of the cable connecting the Type 1103-A Syncronometer to the Type 1102-A Multivibrator and Power Supply Unit. The contactor is connected across the audio-frequency output of the receiver (from which any d-c has been removed) so as to short-circuit the telephones or loud-speaker at all times except when the contact opens. In use, turn the microdial toward earlier time (lower numbers on the scale) until just the nose of the time tick is audible as a very short click. The dial is calibrated in 0.01 second intervals and comparisons can be estimated to one-half division (0.005 seconds) or better. In general, the limit of accuracy of the microdial settings approximates very closely the errors in the day-to-day transmissions of the time signals.

SECTION 4.0
DESCRIPTIONS OF INDIVIDUAL INSTRUMENTS

4.1 Type 1101-A Piezo-Electric Oscillator

This unit contains the piezo-electric oscillator, output amplifier, elementary vacuum-tube voltmeter (for indication of oscillation) and temperature-control unit. It is used with the Type 1190-A 100-kc Quartz Bar which is mounted in the temperature control unit. Figure 1 shows a simplified circuit; the complete circuit diagram is given in Figure 2. Components referred to below by symbol number are identified in the complete diagram.

The oscillator consists of a high-gain tuned amplifier stage (V-1) working into a phase inverter stage (V-2) which drives the bridge, composed of the quartz bar, Q-1 (with its series reactance L-2, C-8, C-9), the resistors R-8, R-9, and R-10, and the lamp, V-4. The output voltage of the bridge (top corner to ground) is impressed on the grid-cathode circuit of the amplifier, V-1.

The operation of the oscillator is briefly summarized here; for a more complete description and for an analysis of frequency stability, see the General Radio Experimenter, April and May, 1944. On starting the oscillator, the lamp, V-4, is cold and its resistance is low (tungsten filament). In consequence, the bridge is badly unbalanced, the bridge output voltage is relatively large and in the proper phase to produce oscillation. Oscillations build up rapidly, and the lamp begins to warm up. As the resistance of the lamp increases, the bridge is brought toward balance. This results in a decreased bridge output voltage, and decreases the amplitude of oscillation. Equilibrium is reached finally when the loss between input and output of the bridge is just equal to the gain from the output back to the input of the bridge through the amplifier. The amplitude of oscillation is thus automatically held at a small and practically constant level. No limiting or distortion takes place in the tubes.

The frequency of oscillation is fixed entirely by the quartz bar, operating at its series resonant frequency, when there is no phase shift in the amplifier and when there is no reactance added in series with the crystal. The amplifier has been checked for zero phase shift and the adjustments locked. No appreciable phase shifts should occur over long periods of time.

The temperature control unit (see General Radio Experimenter, August, 1944) consists of an aluminum casting, forming the inner controlled space in which the Type 1190 Quartz Bar is mounted; an asbestos board attenuating layer;

an outer aluminum casting, carrying heating units over all outer surfaces; a balsa wood insulating container and, finally, a metal housing.

The thermostat itself is a sensitive mercury-in-glass contacting thermometer, mounted in a thermostat heater, of very low heat capacity, on the top face of the outer aluminum casting. A very small amount of heat (which can be adjusted by a series resistor accessible under the thermostat. Properly adjusted, the compensated temperature control unit maintains the temperature of the controlled space independent of ambient temperature changes. Even if not perfectly adjusted, the changes in ambient temperature are reduced by a factor of the order of 500.

With the low temperature coefficient of frequency of the Type 1190-A Quartz Bar, the variations in frequency of the standard due to the possible changes in temperature are entirely negligible.

4.2 Type 1190-A 100-Kc Quartz Bar

The Type 1190-A 100-kc Quartz Bar includes many features of importance in maintaining the frequency as nearly constant as possible over long periods of time.

The mounting is a spring suspension, holding the quartz bar at the corners only of the long faces, in a manner such as to introduce the least damping. The spring tension maintains the mounting conditions essentially constant over long periods. Because of the mode of vibration, there are two nodal regions and supports are placed at each. The quartz bar is thus held without any tendency to twist or turn in the mounting.

The electrodes are formed directly on the surfaces of the quartz. The upper and lower electrodes are divided at the center of the bar into two sections. The connections to one section are reversed with respect to the connections of the other section. In vibration, one-half of the bar is elongating, while, at the same time, the other half is contracting. The mode of vibration is consequently the second-harmonic extensional mode.

Investigation has shown that with suitable cross-sectional dimensions, a temperature-frequency curve in the form of an inverted parabola can be obtained. At the vertex, where the slope of the curve is horizontal, zero temperature coefficient is obtained. The temperature at which this point occurs can be controlled reasonably well in the production of the quartz bars. In the Type 1190-A Quartz Bar the zero temperature coefficient point comes at, or slightly below, 60°C.

4.3 Type 1102-A Multivibrator and Power Supply Unit

The Type 1102-A Multivibrator and Power Supply Unit contains four multivibrators, for 100 kc, 10 kc, 1 kc, and 100 cycles, and the power supply for the entire frequency standard. The relay circuits and heater supply transformer for the temperature-control section of the Type 1101-A Piezoelectric Oscillator are also included.

The construction of the unit is such that the power and heater supply transformers, filters, etc., are mounted on the rear of the main panel. The multivibrator units are all mounted on the rear panel, as are the output connections from the multivibrators. All tubes are accessible and removable from the rear.

For each multivibrator two sunken screw-driver adjustments are provided, one for adjustment of the frequency and one for adjustment of the magnitude of control voltage. The latter rarely require adjustment in the field. Instructions for checking and adjusting the multivibrator frequencies are given in the Service Notes.

Two sets of output connections are provided; one pair for 100-kc and 10-kc harmonic outputs for connection to the Type 1106 Frequency Transfer Units of the frequency measuring equipment, and one set of three for 10 kc, 1 kc, and 100 cycles for connection to the Type 1109-A Comparison Oscilloscope, or other frequency measuring equipment.

Two switches and two fuses are provided on the front panel, FIL-PLATE and HEAT switches and LINE and PLATE fuses.

4.4 Type 1103-A Synchronometer

The Type 1103-A Synchronometer contains an amplifier and a tuned output transformer for driving the 1-kc synchronous motor of the timing system. No power supply is provided, power being obtained from the Type 1102-A Multivibrator and Power Supply Unit.

The clock face is divided in 24 hours. Hour, minute, and sweep second hands are provided. Means are provided, by use of a key, to set the clock within ± 0.25 second without slipping of the hands.

For starting, an a-c motor is provided, with a push-button control on the panel. When the motor has been brought near synchronous speed, short, successive operations of the push-button will permit the 1-kc motor to be brought into synchronism.

The microdial is provided as a simple means of making accurate comparisons with time signals. This dial is operated, by means of a key, from the front of the instrument.

SERVICE NOTES
for
TYPE 1100-A PRIMARY FREQUENCY STANDARDS

Type 1101-A Piezo-Electric Oscillator

1. Checking and adjusting frequency of crystal oscillator.

With the crystal oscillator and 100-kc multivibrator in operation, harmonics of the multivibrator will fall at each of the standard frequency transmissions of the U.S. Bureau of Standards. (Station WWV). Using an oscillating detector (or a receiver with a beating oscillator), adjust to obtain an audible beat tone against the standard harmonic and the standard frequency transmission, in turn. Adjust to obtain about the same strength of signal from the two sources. Then apply both sources simultaneously to the receiver. The resulting output will be the audio beat tone, waxing and waning in intensity. The rate of the waxing and waning is the difference in frequency between the crystal oscillator and the standard frequency transmission. On adjusting C-8 on the rear panel of the Type 1101-A Piezo-Electric Oscillator, the frequency of the oscillator can be set to agree with that of the standard frequency transmission by bringing the rate of waxing and waning to zero. This adjustment is facilitated by using an output voltmeter on the receiver.

Under some conditions of transmission, the standard frequency transmission will be received with rapid changes in amplitude ("fading"), in which case some care must be taken in adjusting for zero beat. Under severe fading conditions, it is sometimes necessary to off-set the crystal oscillator frequency, first on one side and then the other of zero beat, taking the point midway between the two as the zero-beat setting.

Under some transmission conditions, a Doppler change in frequency of the standard frequency transmission can take place for periods of several minutes. Such changes in frequency are only of the orderof 1 in 10^8 at most and can usually be neglected.

If in making adjustment of C-8 for zero beat with the standard frequency transmissions, a series of zero-beat points is heard, it is a sign that the quartz crystal is short-circuited and that the oscillator is operating on the tuned-circuit L-2, C-8, C-9, instead of the quartz crystal, Q-1.

2. Adjusting the amplitude of the crystal oscillator.

When adjusted at the factory, the resistor R-9, (screw-driver adjustment on rear panel of the Type 1101-A Piezo-Electric Oscillator) is set so that the amplitude of oscillation, as indicated by the microammeter M-1 on the front panel, is 90 ±10 μa. If, with aging or changes due to shipment, etc., the resistance of the quartz crystal changes, the amplitude of socillation will change. If the microammeter reading is appreciably outside the range of 80-100 μa, R-9 should be adjusted to obtain a meter reading within the range.

When operating under the above conditions the output voltage of the crystal oscillator, as measured with a vacuum-tube voltmeter between the shielded lead connection (pin No. 1) and ground at the automatic connector plug (PL-1) should be 2.0 to 2.5 volts. See Section on Type 1102-A Multivibrator Unit for description of access to multivibrator circuits under operating conditions.

3. Adjustment of Temperature Control.

The amount of power supplied to the compensating thermostat heater is adjusted by variation of R-105, the control being a sunken screw-driver adjustment accessible under the thermometer cover plate on the main panel of the Type 1101-A Piezo-Electric Oscillator. This adjustment is made at the factory and should not require resetting. If it is necessary to make any adjustment, R-105 should be altered in small amounts only to make the thermometer read 60.0°C ±0.1°C. Turning the screw-driver adjustment of R-105 in a clockwise direction raises the operating temperature. After any adjustment of R-105, wait several hours until the temperature has fully stabilized before attempting any further adjustment.

4. Failure of Temperature Control

If the temperature control fails and the temperature drops, the cause is probably a burned-out pilot light, P-101. This light is mounted under the thermometer cover plate, and is readily replaced. The light signals the operation of the thermostat and control relay. At ordinary room temperatures the light lights about every 20 seconds and remains on for about 6 seconds, when the temperature control box is fully up to temperature.

Type 1102-A Multivibrator and Power Supply Unit

1. Servicing of Multivibrator Circuits.

Supplied with the equipment are four spacer studs with wing nuts and a servicing cable. If it is necessary to service the multivibrator unit proceed as follows: Remove

the four corner screws of the multivibrator rear panel. Withdraw the panel from the cabinet, breaking the connections at the automatic connector plug under the handle at the top of the panel. Insert the four spacer studs in the four corner posts. Plug in the servicing cable at the connector under the top of the case. REVERSE the multivibrator panel so that the tube side is toward the cabinet and mount on the spacer studs using the wing nuts. Plug in the end of the service cable to the connector at top of multivibrator panel. The multivibrator circuits are now entirely exposed and can be operated in the normal manner. Point-to-point tests with ohmmeter or voltmeter are then very easily made.

2. Checking adjustment of Multivibrators.

The adjustment of the multivibrators can be checked with the multivibrator panel in the normal operating position. These checks should be made with all normal output multivibrator connections in place.

To check the 100-kc Multivibrator.

This multivibrator is located in the lower right-hand corner of the multivibrator panel as seen from the rear. Two sunken screw-driver controls are provided: (1) frequency adjustment (R-6 and R-10), marked "100 kc" and located near the right edge of the panel and (2) control voltage adjustment (R-1), unmarked and located toward the center of the panel. The control voltage adjustment is normally at the maximum in the clockwise direction.

Using a communications-type receiver which may be tuned to a harmonic of the 100-kc multivibrator, preferably the 200-kc harmonic, obtain a beat with the harmonic (200 kc) signal by using the beat frequency oscillator (or oscillating detector) of the receiver. Set to a convenient beat frequency, say 500 cycles. Operate the frequency adjustment of the 100-kc multivibrator in both directions until the beat tone suddenly becomes unsteady or jumps to another value. Note the spread between these two points on the frequency control, and take a point midway between as the final adjustment.

The open-circuit output voltage of the 100-kc multivibrator, as measured with a vacuum-tube voltmeter between the output terminal and ground, should be about 8 volts.

To check the 10-kc multivibrator.

Using a cathode-ray oscilloscope, the checking of the lower frequency multivibrators is relatively simple. For the 10-kc multivibrator, it is possible to check the

frequency directly against the 100-kc multivibrator by connecting the 10-kc output into the horizontal deflection plates of the oscilloscope and then connecting the output of the 100-kc multivibrator to the vertical deflection terminals of the oscilloscope. Adjust amplitude of pattern as necessary. The pattern should be stationary and consist of a 10:1 Lissajous figure. The frequency control of the 10-kc multivibrator is marked "10 kc" and is located at the upper right edge of the multivibrator panel, as seen from the rear. Check to be sure the input control (potentiometer R-16) is at full clockwise position.

Vary the frequency control in both directions until the pattern suddenly blurs or changes character. Note the spread between these two points on the frequency control and take a point midway between them as the final adjustment.

The open circuit output voltage of the 10-kc multivibrator, as measured with a vacuum-tube voltmeter between the output terminal (at right, seen from rear) and ground, should be about 25 volts.

To check the 1-kc multivibrator.

Connect the output of the 10-kc multivibrator to the vertical deflection terminals of the oscilloscope and the output of the 1-kc multivibrator to the horizontal deflection terminals. Adjust amplitude, shape, etc., of pattern as necessary. The pattern should be stationary and consist of a 10:1 Lissajous figure similar to that obtained on the 10-kc test above.

The frequency control (R-38 and R-43) of the 1-kc multivibrator is marked "1 kc" and is located at the upper left edge of the multivibrator panel as seen from the rear. The input control voltage adjustment (R-33) is unmarked and is located toward the center of the panel. Check that this input control is in the full clockwise position.

Vary the frequency control in both directions until the pattern suddenly blurs or changes character. Note the spread between these two points on the frequency control and take a point midway between them as the final adjustment.

In the primary standard (Type 1100-AP), the 1-kc multivibrator can be checked by comparing the time indicated by the Type 1103-A Syncronometer with a clock. If the frequency is correct, no difference will be noted in any period of several minutes; if incorrect, the Syncronometer reading will gain or lose appreciably in a few minutes.

The 1-kc multivibrator can also be checked by use of the Type 617-C Interpolation Oscillator. Using the 10-kc standard frequency, set the interpolation oscillator at a

low submultiple, say 2 kc, and make the pattern stand still. Switch to the 1-kc standard frequency, whereupon the pattern should change to a multiple, 2:1, and be stationary.

The open-circuit output voltage of the 1-kc multivibrator, as measured with a vacuum-tube voltmeter between the output terminal and ground, should be about 45 volts.

To check the 100-cycle multivibrator.

Connect the output of the 1-kc multivibrator to the vertical deflection terminals of the oscilloscope and the 100-cycle output to the horizontal deflection terminals. The pattern should be stationary and consist of a 10:1 Lissajous figure.

The frequency control (R-55 and R-60) of the 100-cycle multivibrator is marked "100~" and is located at the lower left edge of the multivibrator panel as seen from the rear. The input control voltage adjustment (R-50) is unmarked and is located toward the center of the panel. Check that this input control is in the full clockwise position.

Vary the frequency control in both directions until the pattern suddenly blurs or changes character. Note the spread between these two points on the frequency control and take a point midway between them as the final adjustment.

The 100-cycle multivibrator can also be checked by use of the Type 617-C Interpolation Oscillator and a cathode-ray oscilloscope. Using the 1-kc standard frequency, set the interpolation oscillator at a low submultiple, say 200 cycles, and make the pattern stand still. Switch to the 100-cycle standard frequency, whereupon the pattern should change to a multiple 2:1 and be stationary.

The open circuit output voltage of the 100-cycle multivibrator, as measured with a vacuum-tube voltmeter between the output terminal and ground, should be about 40 volts.

Type 1103-A Syncronometer.

The Type 1103-A Syncronometer requires little attention. The bearings are all sealed ball-bearings requiring no lubrication. A very small amount of light oil may be placed on the vertical and horizontal worm gears about once a year. Occasionally, a squeak may develop at the cam shoe of the microdial, in which case a very little light oil may be placed on the cam face.

FIGURE 2.3 View of the TYPE 1190-A Quartz Bar used in TYPE 1100-A Frequency Standard, with cover removed, showing the spring suspension.

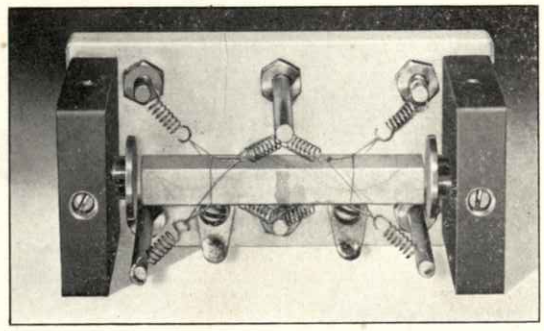


Figure 3. Photograph of Mounting

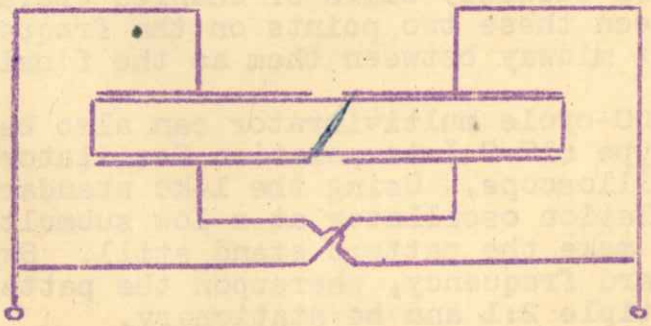


Figure 4. Electrode System

.01%

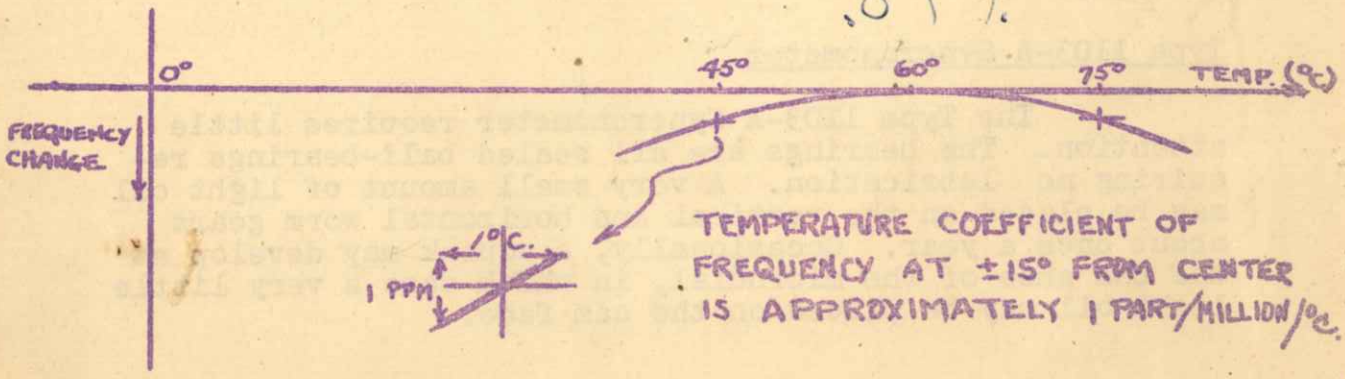


Figure 5. Temperature-Frequency Characteristic

TEST DATA
on
1100-~~AG~~ AP FREQUENCY STANDARD

R. Paul Bryant, Jr.,
Columbia, S.C.
WCOS
O.O. 2834

Type 1103-A Syncronometer
Serial No. —

Type 1102-A Multivibrators and Power Supply Unit
Serial No. 111

Type 1101-A Piezo Electric Oscillator
Serial No. 107
Frequency Adjust 62.0 div.
Temperature 60.0 °C.
Diode Meter Reading 90 μa.

Type 1190-A Quartz Bar
Serial No. 103

Type 1107-A Interpolation Oscillator
Serial No. —

Type 1109-A Comparison Oscilloscope
Serial No. —

Type 1106-A Frequency Transfer Unit
Serial No. —

Type 1106-B Frequency Transfer Unit
Serial No. —

Type 1106-C Frequency Transfer Unit
Serial No. —

Type 1108-A Coupling Panel
Serial No. —

Radiation Standards Laboratory
RADIO ENGINEERING MEASUREMENT SERVICE
915 LAURENS STREET
COLUMBIA, SOUTH CAROLINA

DATE: 11/12/47 No. 224 OBSERVER: A.M. Weatherly

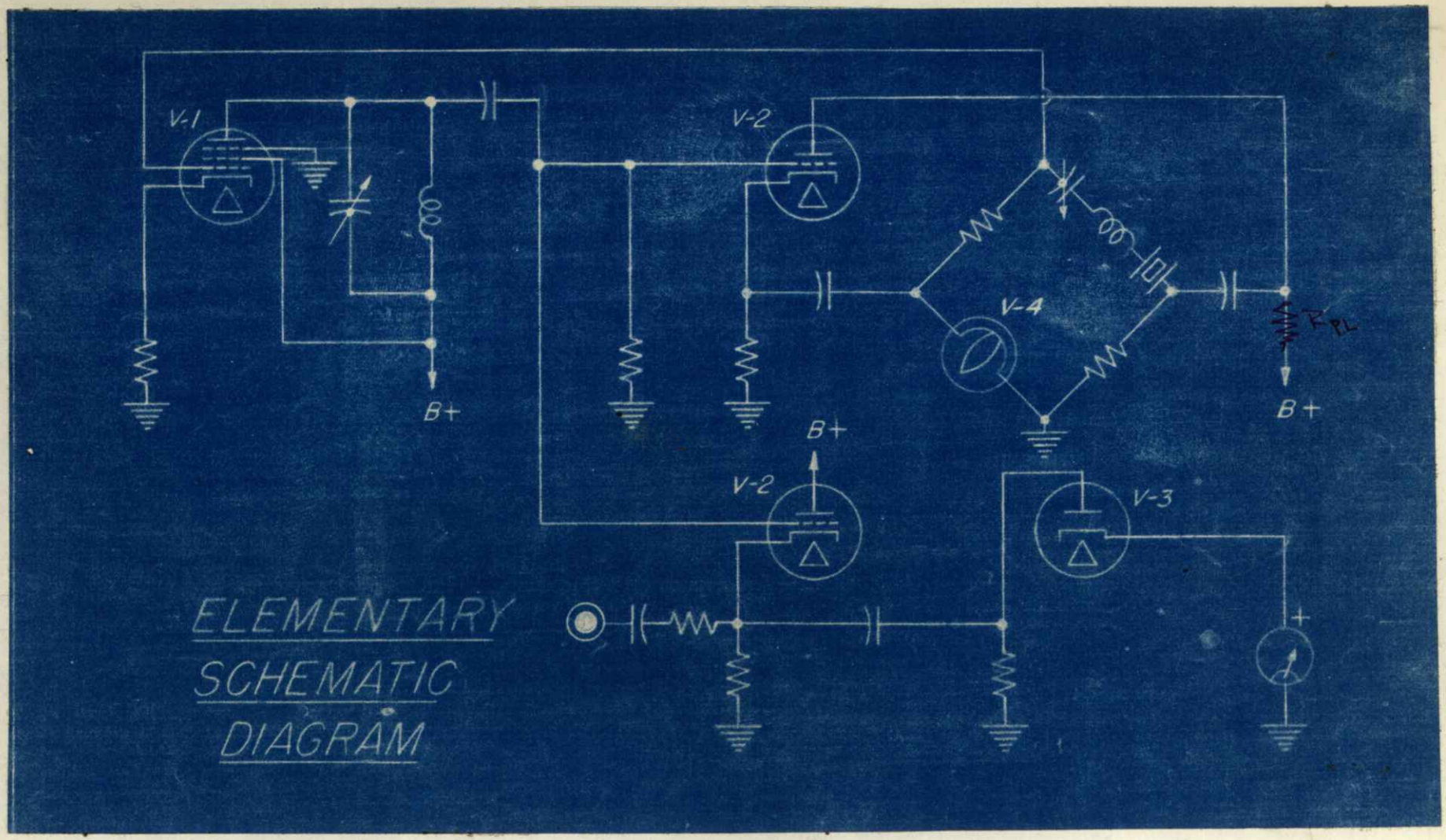
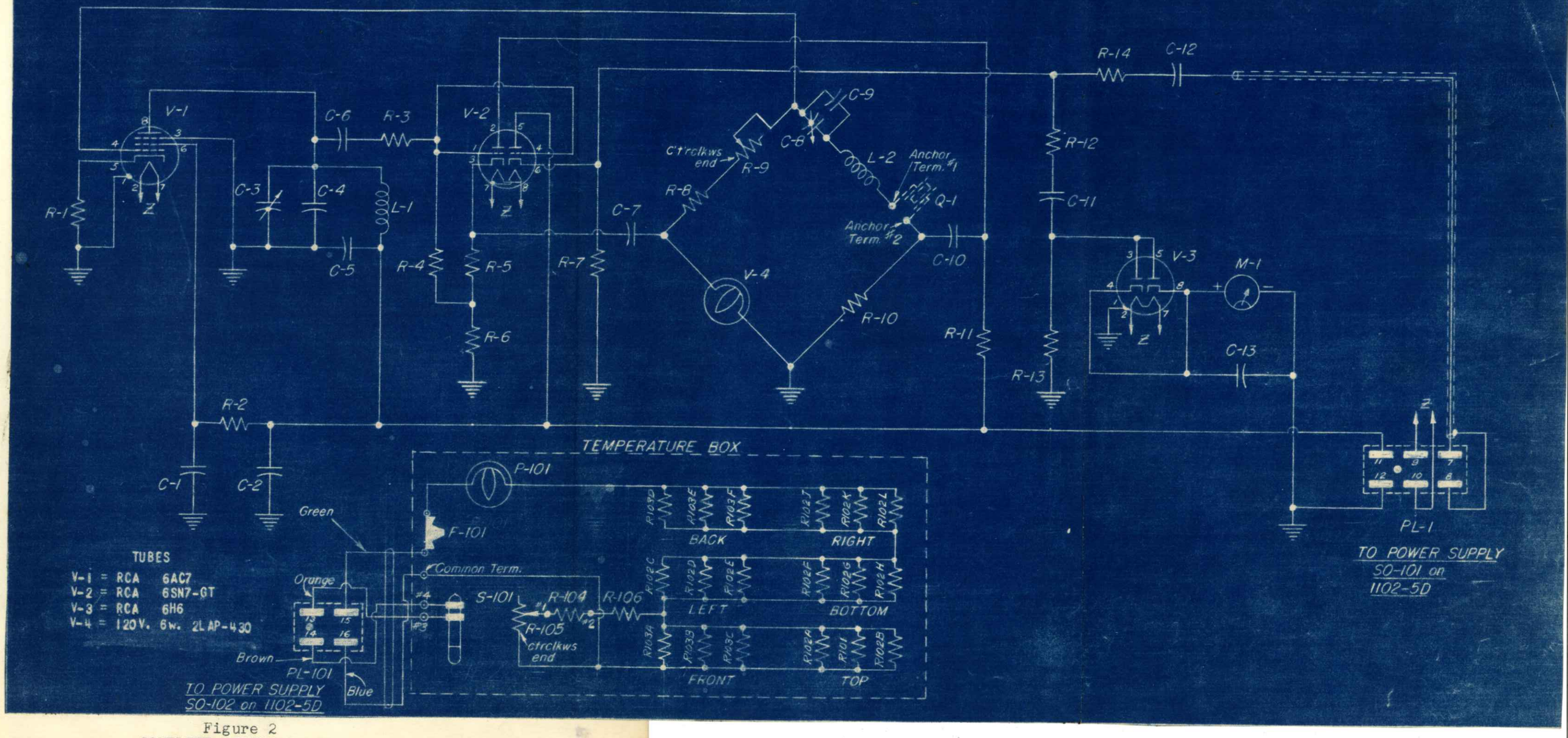


Figure 1
ELEMENTARY SCHEMATIC DIAGRAM
TYPE 1101-A PIEZO-ELECTRIC OSCILLATOR

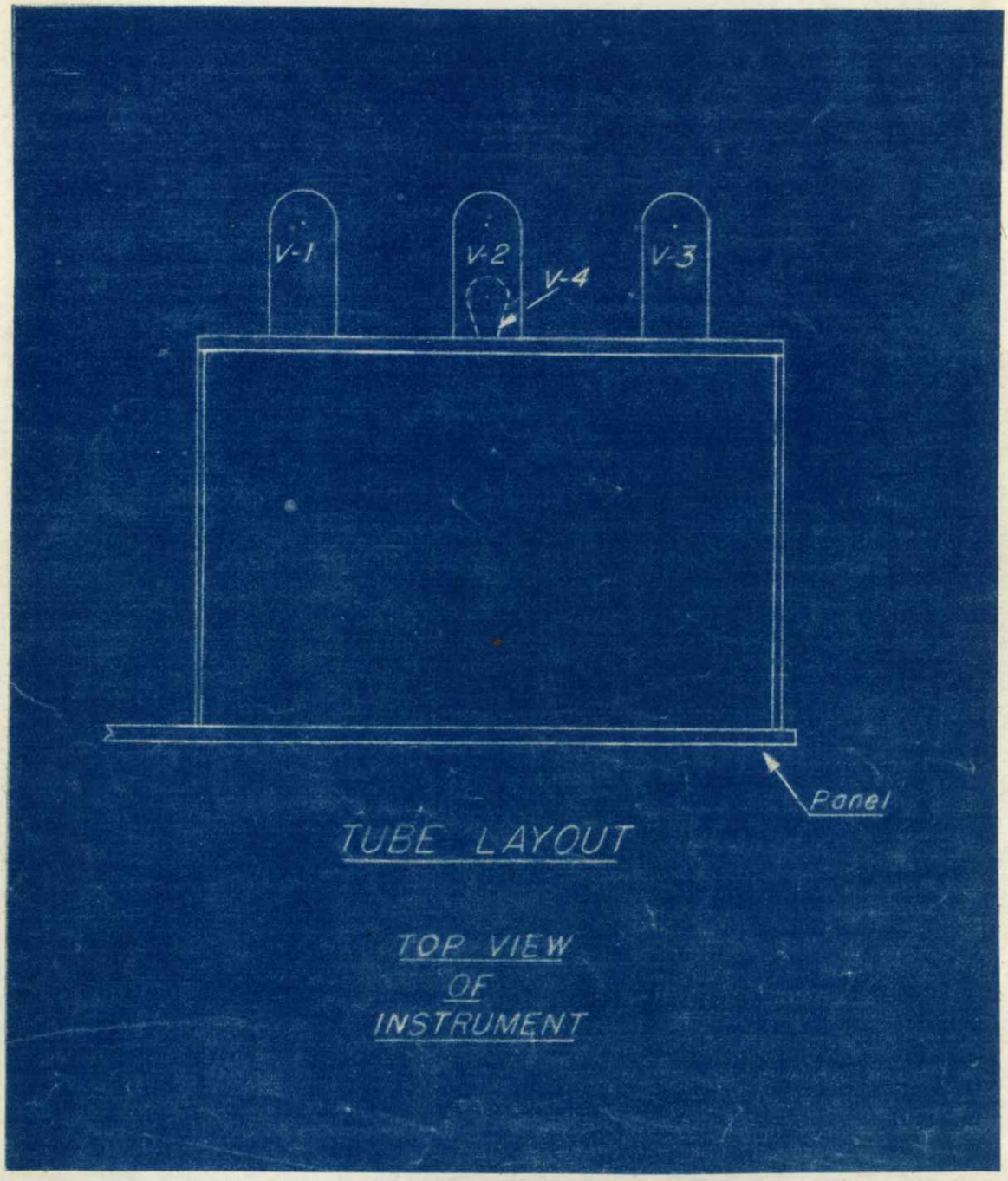
WIRING DIAGRAM
FOR
1101A PIEZO ELECTRIC OSCILLATOR



TUBES

V-1 = RCA 6AC7
V-2 = RCA 6SN7-GT
V-3 = RCA 6H6
V-4 = 120V. 6w. 2LAP-430

Figure 2
COMPLETE WIRING DIAGRAM
TYPE 1101-A PIEZO-ELECTRIC OSCILLATOR



TUBE LAYOUT

TYPE 1101-A PIEZO-ELECTRIC OSCILLATOR

COMPONENTS FOR OSCILLATOR

RESISTORS

R-1	= 220	Ohms	±10%	IRC	TYPE BT-1/2
R-2	= 47	K Ohms	±10%	IRC	TYPE BT-1 or BT-1/2
R-3	= 390	Ohms	±10%	IRC	TYPE BT-1/2
R-4	= 1.0	Megohms	±10%	IRC	TYPE BT-1/2
R-5	= 560	Ohms	±10%	IRC	TYPE BT-1/2
R-6	= 2200	Ohms	±10%	IRC	TYPE BT-1
R-7	= 2700	Ohms	±10%	IRC	TYPE BT-1
R-8	= ✳	Ohms	±5%	IRC	TYPE BT-1/2
R-9	= 2000	Ohms			301-465-2
R-10	= 370	Ohms	±1%	CCC	TYPE X-½
R-11	= 2700	Ohms	±10%	IRC	TYPE BT-1
R-12	= 4700	Ohms	±10%	IRC	TYPE BT-1
R-13	= 15	K Ohms	±10%	IRC	TYPE BT-1
R-14	= 4700	Ohms	±10%	IRC	TYPE BT-1

✳ For values of R-8 see Miscellaneous below

CONDENSERS

C-1	= 1.0 μf			COL-5
C-2	= 0.6 μf			COL-4
C-3	= 7-140 μμf			COA-5L
C-4	= 0.0003 μf	±2%	DUB	TYPE 4LTS
C-5	= 0.02 μf	±10%	DUB	TYPE 4

R-102A-L = REPO-6, 11 Req. } 6 resistors in parallel.
R-103A-F = REPO-7, 6 Req. } Three sets in series.

R-104	= 260 Ohms	±5%	1101-26
R-105	= 2000 Ohms		POSW-3
R-106	= 1000 Ohms	±10%	IRC TYPE BW-1/2

F-101 = Fuse 547-50

S-101 = Thermostat TH-503, 60°

P-101 = Pilot light 6.3 volts 2LAP-939

PL-101 = Plug CDMP-465-4

PARTS LIST

TYPE 1101-A PIEZO-ELECTRIC OSCILLATOR