OPERATING INSTRUCTIONS

FOR

TYPE 617-C
INTERPOLATION OSCILLATOR

FORM 328-F

GENERAL RADIO COMPANY
CAMBRIDGE A, MASSACHUSETTS

GENERAL RADIO COMPANY

SHIPPING LIST

1 - Instruction Book
1 - Calibration Chart
1 - Line cord and plug
4 - Pilot Lamps (6.0-volt)
1 - Box of 5 Fuses, 1/10 a.(Bussmann 7AG)
1 - Box of 5 Fuses, 1 a. (Bussmann 7AG)
*1 - Multipoint connector

*When a connector cable for an assembly of instruments is supplied, connectors are attached to the cable.

SPECIFICATIONS

Frequency Range: 0 to 5000 cycles per second.

Accuracy: The instrument is aligned to agree with the linear direct-reading scale within ±2 cycles. A correction chart is furnished giving the deviations at 100-cycle intervals throughout the range.

The condenser is provided with a precision worm drive so that very precise frequency settings can be made. Small residual errors are easily and quickly removed in the region of any frequency in the range by fine adjustment of the zero by reference to a frequency standard having a 1-kc or 100-cycle multivibrator, or both. For evaluating very small frequency differences, a direct-reading frequency-increment dial is provided.

Output: The output voltage is approximately 7 volts across a 20,000-ohm load.

Power Supply: 105 to 125 or 210 to 250 volts, 50 to 60 cycles. A change of transformer connections provides for using 115 or 230-volt service. Other voltages or frequencies on special order only.

Power Input: 20 watts, approximately.

Controls: ON-OFF switch; STANDARDIZE switch; AMPLIFIER-INPUT switch; MIXER control, which operates also as oscillator output control; incremental frequency control and zero set; oscillator frequency control.

Meters: Output voltmeter; used also as a beat-indicator meter.

Terminals: Terminals, both on panel and at rear, are provided for both mixer input and oscillator output. Rear terminals are provided for introducing 1-kc standard frequency and its harmonics when the beat-indicator is to be used for adjusting a frequency to exact multiples of 1 kc.

Tubes: Furnished with instrument:
2—type 6J7-G R. F. Oscillators
2—type 6J5-G Detector; Amplifier
1—type 6X5-G Rectifier
1—type VR-105-30 Voltage Regulator

Mounting: Standard 19-inch relay-rack mounting. Can be supplied in walnut or oak cabinet on special order.

Dimensions: Panel, (length) 19 x (height) 14 inches; behind panel, (length) 17¼ x (height) 13⅝ x (depth) 11¾ inches.

Net Weight: 38 pounds.

This instrument is manufactured under the following U. S. Patents and license agreements:

1,542,995 1,713,146 1,744,675

Patents of the American Telephone and Telegraph Company, solely for utilization in research, investigation, measurement, testing, instruction and development work in pure and applied science.

OPERATING INSTRUCTIONS
FOR
TYPE 617-C
INTERPOLATION OSCILLATOR

PART 1
DESCRIPTION

PURPOSE The Type 617-C Interpolation Oscillator is designed for use in conjunction with standard-frequency equipment to measure the audio-frequency beat tone between a standard 10-kilocycle harmonic and an unknown frequency.

ADVANTAGES The oscillator is of the beat-frequency type, permitting rapid adjustment to any audio-frequency between zero and 5000 cycles. It has a linear scale and is direct reading in frequency, each division on the scale corresponding to an increment in frequency of one cycle. The oscillator circuits are designed to give maximum frequency stability.

Provision is made for introducing a standard calibrating frequency in order that the frequency may be adjusted to agree with the scale. When this adjustment is made, the scale is direct-reading in frequency.

The oscillator is designed for alternating-current operation, 105 to 125 volts, or 210 to 250 volts, 50 to 60 cycles. (See diagram.)

The main frequency control is a precision-type condenser, similar in construction to the General Radio Type 622 Precision Condenser.

An incremental frequency scale covering a range of plus or minus 10 cycles is provided particularly for use with the Type 698-A Duplex Multivibrator in measuring frequencies which lie very near to multiples of 10 kc.

PRINCIPLE OF OPERATION The audio-frequency output is derived from the difference of the frequencies of two oscillators in the low radio-frequency range. The frequency of one of these oscillators is fixed; that of the other is variable over a range of 5000 cycles. Voltages from these two oscillators are impressed on a vacuum-tube detector and the difference frequency component in the detector output is filtered and amplified.

For adjusting the scale to its calibrated condition, a standard frequency can be introduced and beats indicated on a rectifier-type output meter. This beat indicator arrangement can also be used in comparing unknown frequencies with the oscillator.

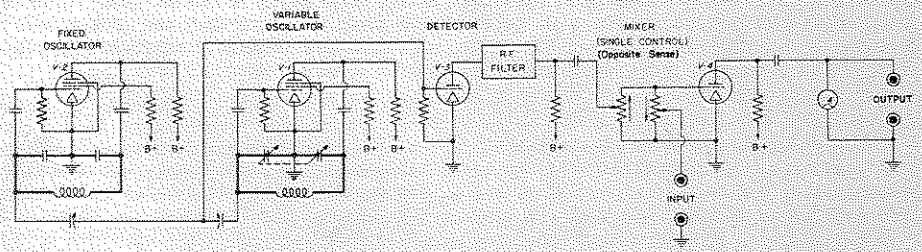


FIGURE 1. Elementary schematic diagram of Type 617-C Interpolation Oscillator

The AUDIO AMPLIFIER INPUT switch is arranged to switch the input of the audio amplifier from the detector output to terminals 9 and 12 on the plug connector at the rear. When used with a Type 614-B Selective Amplifier, harmonics of one kilocycle are introduced at these terminals. Beats between these harmonics and unknown frequencies introduced at the INPUT terminals can then be obtained on the output meter.

This arrangement permits the frequency of the unknown to be adjusted with high precision to any integral multiple of 1 kc.

ACCURACY When adjusted to agree with a standard frequency, the scale is accurate to ±2 cycles. A correction chart is supplied by means of which the scale can be corrected to obtain an accuracy of better than ±1 cycle.

Where a frequency standard is available, it is most accurate to correct the interpolation oscillator to read correctly in terms of the standard, in which case the correction chart is usually not necessary.

PART 2
INSTALLATION

TUBES The following tubes are furnished:

2 - Type 6J7G
2 - Type 6J5G
1 - Type 6X5G
1 - Type VR-105-30

Insert in sockets marked to correspond.

CONNECTIONS After installing the tubes, connect the line plug to the supply and throw the switch to the ON position. When this is done, the red bull's-eye should glow, indicating that the power supply is connected. A reading of the output voltmeter indicates that the instrument is operating.

If a pair of telephones or a loudspeaker is connected to the OUTPUT terminals, an audio-frequency tone will be heard.

PART 3
OPERATION

CALIBRATION Where a frequency standard, such as the Class C-21-HLD, is available, having 100-cycle or 1-kc outputs, these may be used for checking the calibration of the interpolation oscillator. Connect the standard frequency source to the terminals marked INPUT; throw the STANDARDIZING SWITCH to STANDARDIZE; throw the AUDIO AMPLIFIER INPUT SWITCH to DETECTOR OUTPUT. (All necessary connections are made in the cables supplied with the Class C-21-HLD Primary Frequency Standard and Frequency Measuring Equipment).

Set the frequency control so that the dial reads 1000 cycles (or the value recommended in the correction table), then vary the ZERO ADJUSTMENT dial until zero beat is indicated on the output meter. Adjust the MIXER control to obtain maximum beat amplitude on the output meter (see below).

Where no standard-frequency assembly is available, a few volts from the a-c supply line may be used in a similar way. The zero-beat setting may also be used. For the latter, set the main scale at the value given in the scale correction data and vary the FREQUENCY ADJUST dial until the output meter shows zero beat. If the zero-beat condition covers a few divisions of the scale, set to the center of the range.

SCALE CORRECTIONS The scale correction data is furnished to allow the user to correct for the inaccuracies in the scale. When no corrections are made, the scale is direct-reading to within ±2 cycles. If, however, a correction, as determined by the data furnished, is made, an accuracy of better than ±1 cycle is possible. The data may be plotted in the form of a curve, if desired.

In using this data, positive corrections are added to the scale reading, and negative corrections are subtracted. For example, if the correction at 1000 cycles is +2, the scale is set at 1002 to obtain 1000 cycles. Note that the scale reading corresponding to zero frequency may not be zero.

USE In matching an unknown frequency with the interpolation oscillator, it is generally most convenient to use telephones, or loudspeaker, while watching the beats on the output meter. Connect the source, the frequency of which is to be measured, to the INPUT terminals; throw the STANDARDIZING SWITCH to STANDARDIZE; throw AUDIO AMPLIFIER INPUT switch to DETECTOR OUTPUT. Adjust the MIXER control to give about equal outputs from the source being measured and the oscillator.

This control operates on the two outputs in opposite senses, so that turning the single control will permit the operator to quickly arrive at the adjustment giving maximum beat amplitude. Adjust the frequency control to obtain a very slow beat, as indicated by a very slowly changing reading on the output meter. The frequency of the source being measured is then read directly from the scale.

To use the interpolation oscillator as a source, throw the STANDARDIZING SWITCH to OPERATE. The output is then free of any frequencies introduced at the INPUT terminals. The output may be adjusted by means of the MIXER control, operating in the sense indicated by the arrow marked OUTPUT.

It is many times desirable to adjust a frequency to a value which is an integral number of kilocycles. The resulting beat against the frequency standard is then an integral number of kilocycles. This beat may be checked exactly as any other beat frequency, by standardizing the interpolation oscillator at the appropriate multiple of 1 kc and then measuring the frequency which is to be adjusted. If the indicated frequency is not exactly the multiple of 1 kc, it is altered until the reading of the interpolation oscillator comes exactly at the desired setting.

This result may also be accomplished, without reference to the interpolation oscillator, directly against the 1-kc harmonic output of the frequency standard, obtained from the Type 614-B Selective Amplifier. Throw AUDIO AMPLIFIER INPUT switch to 1 KC HARMONICS position. The beat between the frequency to be adjusted and the appropriate 1-kc harmonic selected by the Type 614-B Selective Amplifier then appears on the output meter. Adjust the frequency until a very slow motion of the meter pointer is obtained. (Connections for this purpose are provided in the cables furnished with the measuring equipment for use with Class C-21-HLD Frequency Standards).

In measuring radio frequencies, it may happen that the frequency to be measured falls very near a 10-kc harmonic of the frequency standard. If the resulting beat frequency is very low, it is difficult to measure, and it is rather difficult to determine whether the frequency being measured is above or below the standard frequency. When the Type 698-A Duplex Multivibrator is available, the standard frequency may be chosen to be a harmonic of 9, 10 or 11 kc. When a very low beat is obtained against a 10-kc harmonic, changing to 9 or 11 kc will result in a beat tone of very nearly 1 kc, or a multiple of 1 kc, for all frequencies except multiples of 990 kc.

The incremental frequency dial should be set to zero. The interpolation oscillator should then be carefully adjusted to zero beat against the appropriate multiple of 1 kc obtained from the frequency standard. For quick results, this is done by very carefully adjusting the main frequency control. For the best possible accuracy, this adjustment is completed by use of the fine zero control, reached by removing the cap on the panel just to the right of the incremental frequency dial. While it is necessary to remove the cap and use a screw-driver for the adjustment, the finer zero control affords a much easier adjustment than that obtained on the main frequency control, and the additional time is well justified where the most accurate results are required.

The beat tone, obtained between the 9 or 11 kc harmonic and the frequency being measured, is then matched on the interpolation oscillator, by use of the incremental frequency dial only. The reading of this dial gives the amount by which the measured beat differs from the 1-kc multiple, which is the same amount that the frequency being measured differs from the 10-kc standard harmonic frequency.

The sense of this small frequency difference is determined when it is known whether the frequency being measured is above or below the 9 or 11 kc standard harmonic frequency. This is determined by tests made on the Type 619 Heterodyne Detector (or oscillating receiver). Set the heterodyne detector to zero audible beat against the unknown frequency. Turn on the 9 or 11 kc standard frequency harmonic, used in the measurement, and note the direction in which the tuning dial of the heterodyne detector must be moved to obtain zero beat against this harmonic. If the dial is moved to higher readings, the unknown is below the standard; if moved to lower readings, the unknown is above the standard.

The final sense of the frequency increment then depends on whether the measured beat frequency is more or less than a multiple of 1 kc. If the unknown is above the 9 or 11 kc standard frequency, a positive increment means that the unknown is above the 10-kc harmonic by the amount of the increment; a negative increment means that the unknown is below the 10-kc harmonic by the amount of the increment. If the unknown is below the 9 or 11 kc standard frequency, a positive increment means that the unknown is below the 10-kc harmonic by the amount of the increment; a negative increment means that the unknown is above the 10-kc harmonic by the amount of the increment.

PART 4
MAINTENANCE

DIRECTIONS FOR REALIGNMENT

The interpolation oscillator is aligned at the factory so that the frequency is within ±2 cycles of the scale value throughout the range of the instrument. Ageing and temperature effects, or displacements caused by shipping, may change the calibration.

Using the correction data, set the oscillator to 1 kc by setting the main scale at the corrected setting and moving the zero adjustment dial for zero beat against the frequency standard. Leaving the zero adjustment in this position, obtain the scale readings at every 1-kc interval.

If the number of divisions, on the main scale, to cover the range from 1 to 5 kc is greater than the number given in the correction data, it indicates that the span of the variable condenser is too small, and the zero capacity of the circuit should consequently be reduced slightly. This is done by adjusting either the COARSE zero capacity control (under cap just to left of output meter) or the FINE zero capacity control (just above the main scale). The adjustment is best made on the FINE control; if the range of adjustment is not enough, then a change in the COARSE control may be made, and the FINE adjustment continued.

Having made a change in setting of the zero capacity, reset the oscillator to 1 kc using the corrected setting; readjust to zero beat by using the zero adjustment dial; then check the scale readings obtained at every 1 kc from 1 kc to 5 kc. Readjust again, if necessary, until the readings agree as closely as possible with the correction data.

If the number of divisions on the main scale, to cover the range from 1 kc to 5 kc is less than the number given in the correction data, it indicates that the span of the variable condenser is too great, and the zero capacity of the circuit should consequently be increased slightly. This is done by the COARSE or FINE zero capacity adjustments previously mentioned, but in the opposite sense. The remaining steps are carried out just as described above.

VACUUM-TUBE DATA

Voltages are measured between terminals shown with meter of 20,000 ohms per volt (d-c); 1000 ohms per volt (a-c).

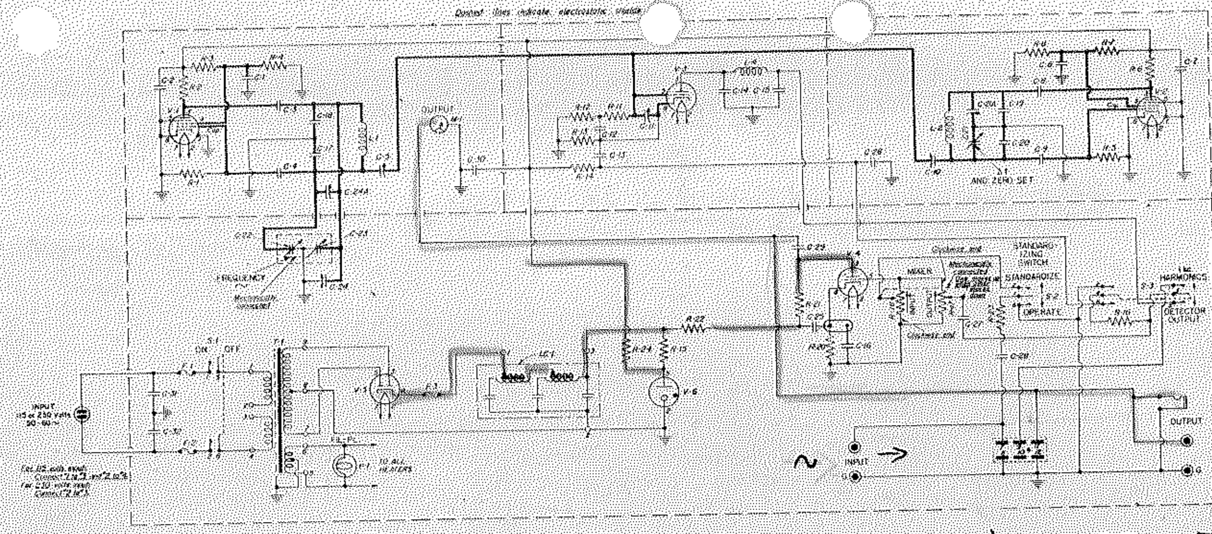
Currents are measured in series with terminal shown.

INSTRUMENT	SOCKET TERMINAL NOS.	V-1	V-2	V-3	V-4	V-5	V-6	NOTES
617-C		6J7G	6J7G	6J5G	6J5G	6X5G	VR-105-30	A,C
	2-7 v ac	5.8	5.8	5.8	5.8	5.8	—	
	8-Gnd v dc	0	0	5	2	—	—	
	8-5 v dc	0	0	5	2	—	—	
	3-8 v dc	5	5	83	80	—	—	
	3-3 ma dc	1.1	1.1	.2	3.4	—	—	
	4-8 v dc	30	30	—	—	—	—	
	4 ma dc	.5	.5	—	—	—	—	
	5-Gnd v ac	—	—	—	—	160	—	
	3-Gnd v ac	—	—	—	—	160	—	
	8-Gnd v ac	—	—	—	—	187	—	
	3-3 ma dc	—	—	—	—	8.9	—	
	5 ma dc	—	—	—	—	8.9	12 (0-50)	
	5-2 v dc	—	—	—	—	—	103	

Notes

A. Remove signal cable plug when taking readings.

C. Remove grid lead from tube, taking care clip does not touch circuits. Ground cap of tube when taking readings on V-1, V-2. When measuring one tube, leave the other in normal circuit.



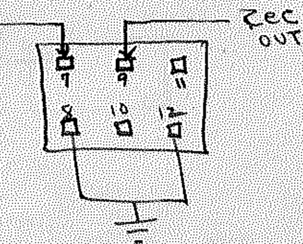


FIGURE 2. Wiring diagram of Type 617-C Interpolation Oscillator

PARTS LIST

Resistors

R-1 = 1 MΩ	R-14 = 50 kΩ
R-2 = 100 kΩ	R-15 = 5 kΩ
R-3 = 40 kΩ	R-16 = ~~30~~ kΩ 3.3
R-4 = 20 kΩ	R-17 = 50 kΩ
R-5 = 1 MΩ	R-18 = 50 kΩ
R-6 = 100 kΩ	R-20 = ~~500~~ Ω 470
R-7 = 40 kΩ	R-21 = 20 kΩ
R-8 = 20 kΩ	R-22 = 10 kΩ
R-11 = 100 kΩ	R-23 = 5 kΩ
R-12 = 50 kΩ	R-24 = 500 Ω 470
R-13 = 20 kΩ	

Tubes

V-1 = RCA Type 6J7G
V-2 = RCA Type 6J7G
V-3 = RCA Type 6J5G
V-4 = RCA Type 6J5G
V-5 = RCA Type 6X5G
V-6 = RCA Type VR-105-30

Condensers

C-1 = 0.25 μf	C-18 = 0.002 μf
C-2 = 0.25 μf	C-19 = 0.00288 μf
C-3 = 0.01 μf	C-20 = 0.00293 μf
C-4 = 0.001 μf	C-21 =
C-5 = 3-20 μμf	C-21A = 40-100 μμf
C-6 = 0.25 μf	C-22 =
C-7 = 0.25 μf	C-23 =
C-8 = 0.01 μf	C-24 =
C-9 = 0.001 μf	C-24A = 140 μμf
C-10 = 3-20 μμf	C-25 = 1 μf
C-11 = 10-70 μμf	C-26 = 1 μf
C-12 = 1 μf	C-27 = 1 μf
C-13 = 1 μf	C-28 = 1 μf
C-14 = 0.001 μf	C-29 = 1 μf
C-15 = 0.001 μf	C-30 = 2 μf
C-16 = 32 μf	C-31 = 0.01 μf
C-17 = 0.002 μf	C-32 = 0.01 μf

Switches

S-1 = 139-333
S-2 = 139-320
S-3 = 139-335

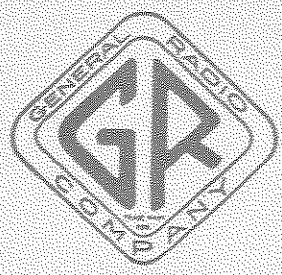
Inductors

L-1 = 617-320
L-2 = 617-320
L-4 = 250 mh 119-A

Fuses

F-1 = 1 amp. Type 7AG
F-2 = 1 amp. Type 7AG
F-3 = 0.1 amp. Type 7AG
} For 115-volt operation

F-1 = 0.5 amp. Type 7AG
F-2 = 0.5 amp. Type 7AG
F-3 = 0.1 amp. Type 7AG
} For 230-volt operation



BLANKOGRAPH PRINTED BY GAULDING-MOSS COMPANY
BOSTON, MASSACHUSETTS, U. S. A.