

GENERAL RADIO COMPANY

CAMBRIDGE A, MASSACHUSETTS

OPERATING INSTRUCTIONS FOR TYPE 213-B AND TYPE 213-C AUDIO OSCILLATORS

1. Description

Both the TYPE 213-B and the TYPE 213-C Audio Oscillators are combinations of mechanical and electrical circuits using tuning forks as the frequency-controlling elements. The circuit diagram is shown in Figure 1.

F is a tuning fork which vibrates at its natural frequency (determined by its dimensions), and causes the diaphragm of the microphone button M , which is mechanically coupled to the fork, to vibrate at the same frequency. The resistance of the microphone button varies in accordance with the motion of its diaphragm and causes a corresponding variation in the current which flows in a circuit consisting of the microphone button M , the battery B , and the primary of the output transformer T_1 . An alternating voltage of the fork frequency is then produced at the secondary terminals of T_1 , and alternating current flows around the circuit consisting of the secondary of T_1 , the drive coil D , the condenser C_1 , and the primary of the output transformer T_2 .

A portion of the available energy is fed back through the drive coil to keep the fork in motion, and the rest is supplied to the load at the secondary terminals of the output transformer T_2 . The condenser C_1 is used to shift the phase of the current through the drive coil to the value necessary to drive the fork. Since the fork is not permanently magnetized, a polarizing coil P is required to supply a constant magnetic bias. Without this, the fork would be driven at twice its natural frequency.

The condenser C_2 and the primary of the output transformer T_2 form a parallel tuned circuit shunted across the load. This circuit is tuned to resonance at the fundamental oscillator frequency and acts as a filter to prevent harmonics from reaching the load.

2. Characteristics

Output data for a typical TYPE 213-B 1000-cycle and a TYPE 213-C

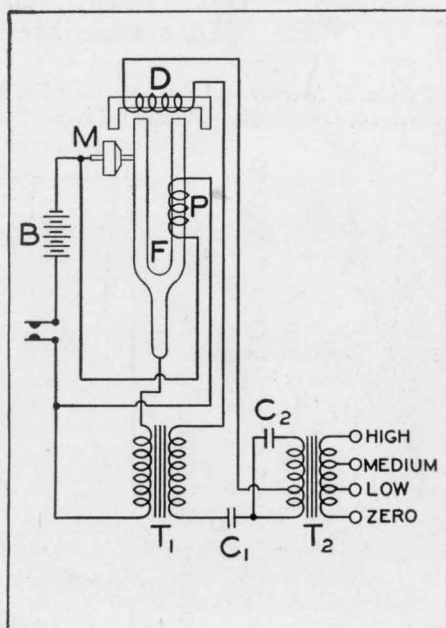


FIGURE 1. Circuit Diagram

400-cycle Audio Oscillator are shown in Figure 2. These curves are for resistive loads. Reactive loads will change both output and waveform. Two factors tend to change the output; first, the

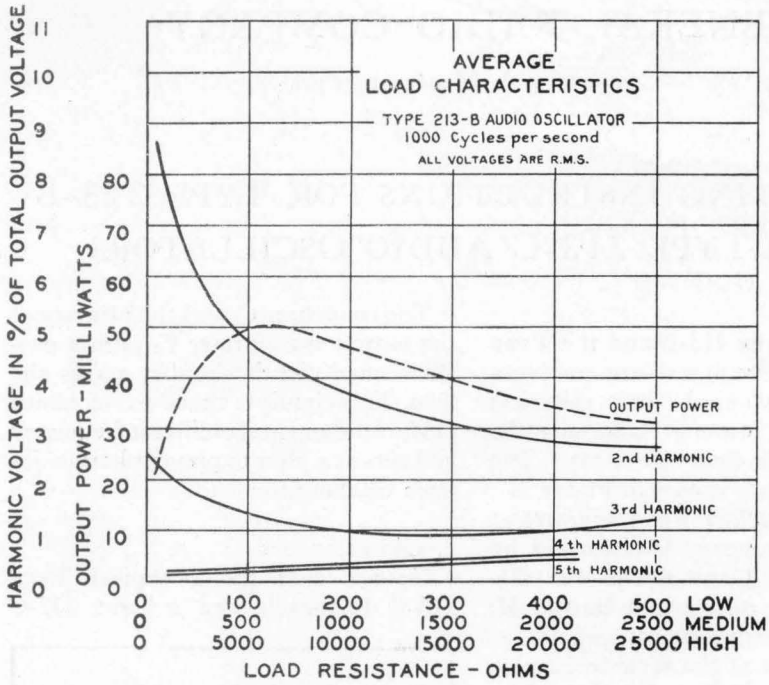
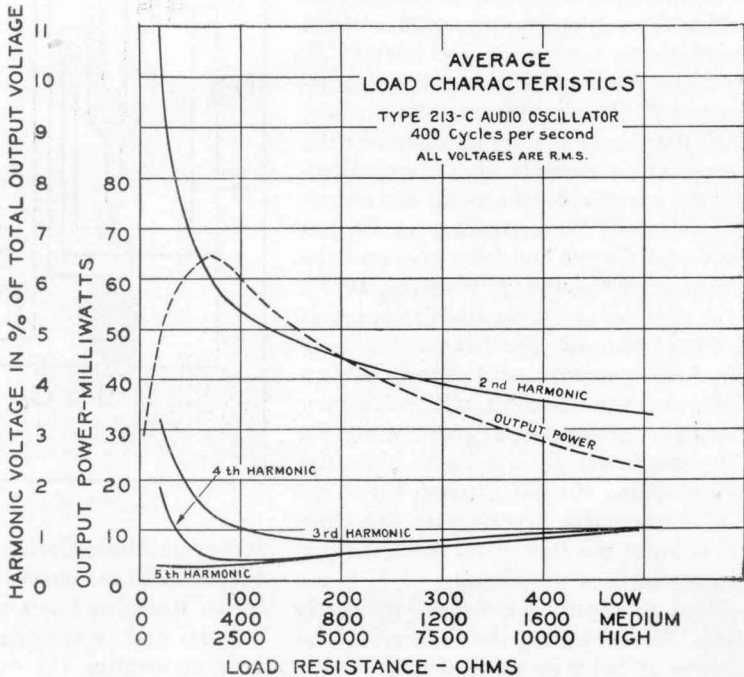


FIGURE 2. Average load characteristics: Upper left—TYPE 213-B Audio Oscillator, 1000 cycles per second; Lower right—TYPE 213-C Audio Oscillator, 400 cycles per second



fact that pure reactances cannot absorb power, and second, the shift in impedance of the tuned circuit due to the reflected load reactance. This change in tuning will, of course, change the waveform, but since the tuned circuit impedance is low, only loads of low reactance and low power factor will produce an appreciable change. For most bridge measurements, the waveform will be as good as that shown by the curves of Figure 2. For inductance and capacitance measurements on the ordinary impedance bridge, the small amount of harmonic voltage present in the oscillator output is not great enough to cause an appreciable error in the measurements, if the bridge is balanced by setting to the point where the fundamental frequency actually drops out. Somewhat greater care must be used when the bridge is one whose balance point varies greatly with frequency.

When the oscillator is used to supply a timing wave on an oscillograph, the load resistance should be as high as possible in order to secure best waveform.

The oscillator is self-starting on open circuit and short circuit. Its frequency change is 0.1 per cent. between open and short circuit. Its temperature coefficient is approximately -0.006 per cent. change in frequency per degree change in temperature between 70°F . and 100°F . It is not intended to be a precision frequency standard, and its actual frequency may differ from its nominal value by as much as 0.5 per cent. due to the mechanical load on the tuning fork.

3. Adjustments, stability, etc.

This type of oscillator is quite rugged, but is not built to stand abuse. Both the output and waveform can be materially changed by an improper adjustment of the microphone button.

When shipped, this button is adjusted for optimum operating conditions, but a severe mechanical shock or mishandling may change the adjustment so that the oscillator does not perform satisfactorily.

It is recommended that the user attempt to make no adjustment of the microphone button. If, however, the output falls very low, or a large amount of voltage of one-half the fundamental frequency appears in the output, conditions may be improved by moving the flat spring on the side of the fork up or down a small amount. *If this is done, extreme care must be used not to injure the diaphragm of the microphone button.* The adjustment may be best made with a pair of thin flat pliers. Whenever possible, return the instrument to the General Radio Company for adjustment. The button will wear out in time, and can be replaced at small cost if the oscillator is returned to the factory. It will expedite matters to write for shipping instructions before making shipment.

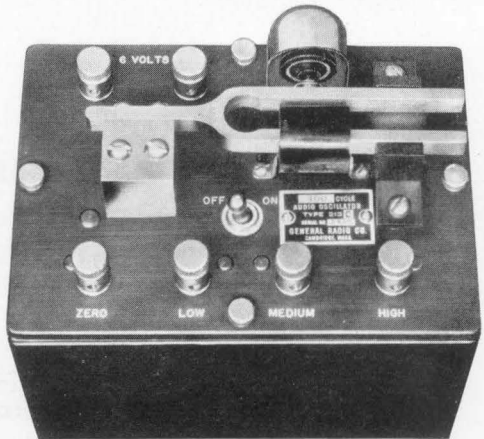


FIGURE 3. TYPE 213-C Audio Oscillator

4. Operation

The TYPES 213-B and 213-C Audio Oscillators are designed to operate from a 6-volt source. They can be made to operate on 4 volts with a reduced

output, although at this voltage the fork may have to be plucked to start it. *Voltages greater than 6 volts should not be used* because the excess current will overheat the microphone button. The input current is approximately 0.13 ampere at 6 volts.

The 6-volt battery or other source should be connected to the posts marked 6 Volts on the oscillator panel. The output is taken from the posts marked ZERO and LOW, MEDIUM, and HIGH. For outputs corresponding to the scale marked LOW in Figure 2, for instance, the output is taken from terminals ZERO and LOW.

When running, the oscillator may be heard for a distance of several feet. If this interferes with measurements, it

may be placed in a soundproof box. A simple box made of Celotex or balsa-wood is quite satisfactory. When the oscillator is used in close proximity to the bridge or other apparatus, it will be found advisable to shield the oscillator to prevent pickup in other circuits.

If a greater power is desired than that which the fork will deliver, a vacuum-tube amplifier may be used. The oscillator will deliver about 20 volts across the ZERO and HIGH terminals on open circuit, and this is ample to excite the grid of a tube such as one of the 245-type. If the amplifier tube is properly biased, very good waveform may be expected, since the waveform of the oscillator is best on open circuit.

| Type | Frequency | Operated | Depth | Weight | Code Word | Price |
|--------|-----------|---------------|-----------|-----------|-----------|---------|
| *213-B | 1000 cps | 6 volts, d.c. | 5 in. | 5 lb. | ANGEL | \$34.00 |
| *213-C | 400 cps | 6 volts, d.c. | 6 1/8 in. | 5 3/4 lb. | AMUSE | 42.00 |

*Both TYPE 213-B and TYPE 213-C are built on special order for any 100-cycle multiple in the 400- to 1500-cycle frequency range. Oscillators for frequencies of 400, 500, and 600 cycles are TYPE 213-C; for frequencies from 700 to 1500 cycles, inclusive, TYPE 213-B. Code words and prices apply only to frequencies here listed.

PREPARING INSTRUMENT FOR SHIPMENT

This instrument is mechanically rugged, but it will not withstand rough handling in transit unless protected by a wooden packing case and substantial pads of excelsior or some other material.

When returning instrument to the General Radio Company for recalibration and repair, it will expedite matters to write for instructions before making shipment to

Service Department
GENERAL RADIO COMPANY
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