



TYPE HO 32

BEAT-FREQUENCY OSCILLATOR

0 to 21 kc

RADIOMETER

GENERAL

The type HO32 Beat-Frequency Oscillator is an improved successor to the very popular type HO31. It incorporates all the favourable characteristics of the earlier model and many new features have been added: higher output power, wider voltage range from the attenuator, reduced distortion and hum, and provisions for use as an audio frequency amplifier and a frequency meter.

With the B.F.O. principle employed in this instrument, the entire audio frequency range is covered in a single sweep of the main dial, a convenience for measurements of amplifier response.

For easy calibration of the frequency dials, a built-in electron ray indicator is used to show the zero-frequency beat.

Careful construction and advanced design have reduced the frequency drift from warm-up and line voltage fluctuations to a minimum.

The type HO32 offers a favourable combination of high quality, versatility, and moderate price.

SPECIAL FEATURES

- 0 to 20.5 kc in a single sweep.
- Calibrated outputs from 300 μ V to 100 V.
- Distortion and hum about 0.03%.
- 2.5 to 4 watt output to 5 optimal load impedances.
- Frequency response within 0.3 dB from 20 cps to 21 kc.
- Output voltage and frequency independent of line voltage variations.
- Small size, easy to operate.

APPLICATIONS

- General-purpose audio frequency signal source.
- Amplifier testing.
- Loudspeaker testing.
- Can be used as an audio-frequency power-amplifier.
- Can be used as a frequency meter up to 21 kc.

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DESCRIPTION

The Beat-Frequency Oscillator type HO32 operates on the conventional heterodyne principle as may be seen from the block diagram of figure 1.

The "fixed" frequency oscillator operates at 200 kc with provisions for 0 to + 500 cps change in the frequency, while the variable oscillator covers the range from 179.5 to 200 kc. The signals from both oscillators pass buffer amplifiers before they are fed to a mixer, which is connected to a low-pass filter. The filter suppresses all unwanted frequency components and leaves only the difference frequency which enters an output amplifier with strong negative feedback.

The 0 to 20.5 kc and 0 to 500 cps dials are directly coupled to the tuning condensers of the variable and "fixed" frequency oscillators thus providing for a total frequency range from 0 to 21 kc. Zero adjustment is made with both scales reading zero (turned to the dial stops) and is accomplished by setting the frequency of the variable oscillator until a zero beat is observed on an electron ray indicator. The zero adjustment can be carried out independent of the output level setting. The buffer amplifiers, which are inserted between the oscillators and the mixer, prevent locking phenomena and subsequent distortion at low frequencies. The sepa-



ration is so efficient that the waveform remains practically sinusoidal down to 1 cps. A frequency stability, which exceeds that of many higher-priced instruments, has been attained by advanced design. A stabilized power supply reduces the influence from line voltage variations to a minimum. An output selector switch tells whether

the output terminals are connected to the output transformer or to the attenuator. If transformer output is selected, a range of 5 positions corresponding to optimum load impedances from 5 ohms to 5000 ohms allows the maximum power of 2.5 to 4 watts to be drawn from the type HO32 with varying loads. 1 watt

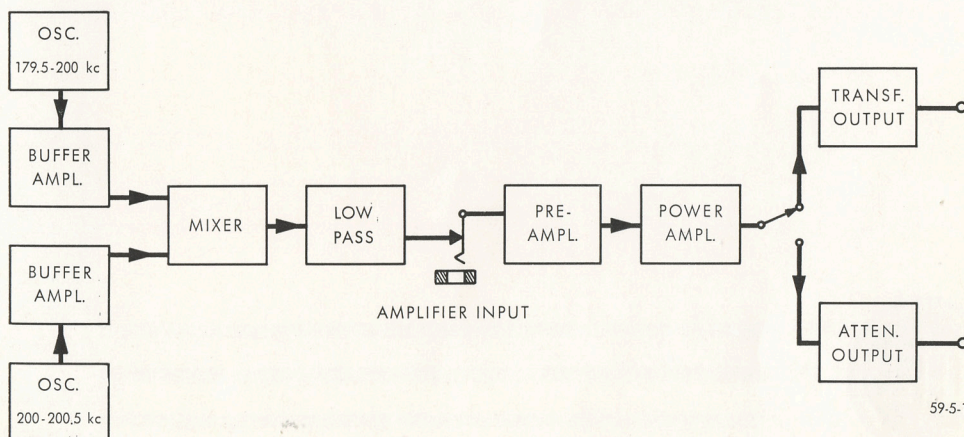


Figure 1. Simplified block diagram of the type HO32 Beat-Frequency Oscillator.

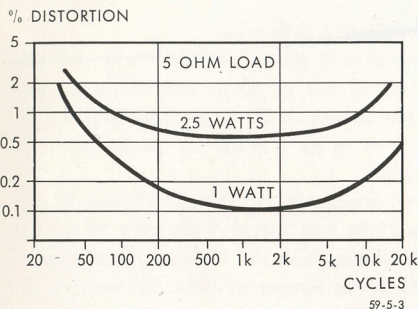


Figure 2. The graphs show the typical distortion of the type HO32 with 5-ohm and 5-kilohm loads. With loads of 25, 500, and 2000 ohms, the distortion is less than indicated for a 5-ohm load.

can be delivered to any load from 2.5 ohms to 25 kilohms with less than 2% distortion.

Either both output terminals are free or one is grounded.

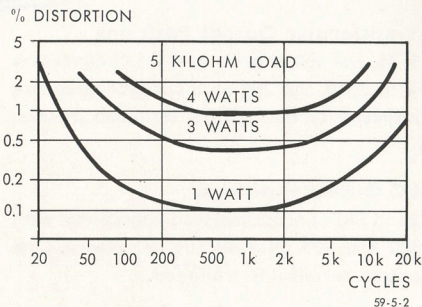
In the 2000 and 5000 ohm positions, L-C coupling is used by connecting the output terminals through coupling condensers to suitable tapings on the transformer primary.

In the attenuator positions, the output tube is RC-coupled, and the output transformer is disconnected, which ensures low harmonic distortion and good frequency response down to 10 cps. The output control is provided with a 0 to 10 scale and the output selector with positions corresponding to multipliers of 0.3mV, 1mV, 3mV, ..., 10V. As the actual output voltage is determined as the product of the two readings, accurate emf's from about 300 microvolts to 100 volts are available.

When the attenuator output is used, one terminal is always grounded.

As an extra feature, the type HO32 can be used as an audio-frequency amplifier with the same output power and output facilities as in oscillator operation.

Finally, the type HO32 can be used as a frequency meter covering the range from 0 cps to 21 kc. The built-in electron ray indicator is used to show the zero beat.



SPECIFICATIONS

FREQUENCY

Range

0 to 21 kc.

Main dial: 0 to 20.5 kc.

Incremental dial: 0 to 500 cps.

The useful frequency range is 10 cps to 21 kc in all attenuator positions except the 100 V position where it is 20 cps to 21 kc. In the power output position, the graphs of figure 2 should be consulted.

Accuracy of Calibration

Better than 2% of reading or 2 cps, whichever is the greater.

Stability

After an initial warm-up period of 15 minutes the drift is less than 15 cps during the first hour, and less than 2 cps per hour after one hour.

The stabilities stated above are maintained provided the ambient temperature remains reasonably constant.

A line voltage variation of 5% will cause a frequency drift of about 1 cps.

OUTPUT

Power

The maximum output power is 4 watts. About 2.5 watts can be supplied with low distortion (see graphs) to any of the five optimal load resistances listed below.

With an arbitrary load resistor between 2.5 ohms and 25 kilohms, an output power of 1 watt is available.

Transformer Output Positions

5, 25, and 500 ohm optimal load impedances with 3, 10, and 200 ohm output impedance respectively. Both output terminals are free.

LC Output Positions

2 and 5 kilohm optimal load impedances with 300 and 400 ohm output impedance. One output terminal is grounded.

Attenuator Output

300 μ volts to 100 volts in 10 ranges, one terminal grounded. The following relationships are between the output voltage ranges and the output impedances:

Range		Output Imped.
0-3 mV	emf	3 ohms
0-10 mV	emf	10 ohms
0-30 mV	emf	30 ohms
0-100 mV	emf	100 ohms
0-300 mV	emf	300 ohms
0-1 V	emf	900 ohms
0-3 V	emf	2000 ohms
0-10 V	emf	30 ohms
0-30 V	emf	90 ohms
0-100 V	emf	300 ohms

The accuracy is better than 5% of full scale reading, provided the level is correctly adjusted at one full scale value.

Waveform

Transformer and LC output: Less than 0.2% harmonic distortion at 1000 cps when 1 watt is delivered to an optimal load impedance.

Attenuator output: Less than 0.1% harmonic distortion from 50 cps to 10 kc and at levels below 10 volts. The distortion increases to about 0.1% at 100 volts.

See graphs for typical distortion versus frequency relationships.

Hum

Transformer and LC output: Less than 0.1% (typically 0.03%) at 1 watt.

Attenuator output: Less than 0.1% (typically 0.03%) or 10 μ V whichever is the greater.

Frequency response

Transformer and LC output: Within 0.3 dB from 50 cps to 10 kc and within 1.5 dB from 30 cps to 20 kc with unloaded output or with 1 watt fed to an optimal load.

Attenuator output: Within 0.3 dB from 20 cps to 21 kc and within 1 dB from 10 cps to 21 kc except at the 100 volt range where the lower frequency limit increases to 30 cps at 100 volts.

Stability

A 5% line voltage variation will cause a change in the output voltage of about 0.5%.

USED AS AMPLIFIER

With an undistorted signal of 1 volt to the 50 kilohm amplifier input, the maximum outputs are available with the distortion and frequency response as specified above (in the attenuator positions up to max. 10 V, the response is almost flat up to 100 kc). The maximum voltage gain available is 150.

POWER SUPPLY

Voltages: 110, 115, 127, 200, 220, 240 volts.

Line Frequencies: 50 to 60 cps.

Consumption: 60 watts.

TUBES

1 ECF80 (6BL8)	3 ECH81 (6AJ8)
1 EL84 (6BQ5)	1 EM84
1 150B2	

MOUNTING

Steel cabinet finished in grey enamel.

OVER-ALL DIMENSIONS

Height	Width	Depth
260	400	180 mm
10 $\frac{1}{4}$	15 $\frac{3}{4}$	7 inches

WEIGHT

11 kilos net (23 lbs.).

ACCESSORIES SUPPLIED

1 power cord, code 615-300.

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