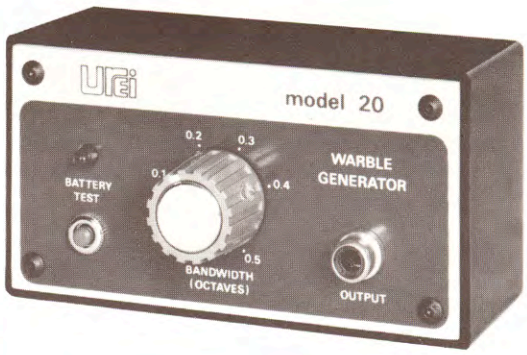
WARBLE GENERATOR
FOR MODEL 200
AUTOMATIC PLOTTING SYSTEM

MODEL 20

APPLICATIONS: (When used with Model 200/2000 Response Plotting System)



- Frequency response measurement of sound playback systems, loudspeakers, and sound reinforcement installations.
- Equalization of auditoriums, theatres and studios.
- Optimizing the location of microphones, monitors, and listening positions.
- Measurement of pressure response, and other acoustic qualities of rooms.
- Research and development, as well as manufacturing quality control of loudspeakers, microphones, and other electroacoustical devices.
- As T_{60} sound source when used with a suitable T_{60} display device.

The Model 20 is a 5 Hz sine wave generator. It is an accessory for the UREI Automatic Response Plotting System; specifically to be used with the Model 2000 plug-in to generate a warbled sweep for acoustic measurements.

The output signal of the Warble Generator is variable in amplitude from 0 to 5 V RMS. When connected to the sweep generator of the plotting system it frequency modulates the sweep signal producing what is generally known as "Warble Tone". The amount of warble, or the bandwidth, is adjustable from 0 to 0.5 octaves of the center frequency. An important feature of the system is that this bandwidth remains at a constant percentage of the send signal center frequency during the entire sweep.

Figure 1 shows two typical frequency response plots measured in the same room, maintaining fixed speaker and microphone positions. The upper trace is the response from a pure sine wave, while the lower trace is the same response with the sine wave warbled (frequency modulated) at 1/3 octave bandwidth. As can be seen, the second measurement shows reduction of the cluttering standing wave pattern, especially as the wave lengths become shorter. Averaged out are the very short and abrupt variations and anomalies, much as would be the case with a pink noise source, but with excellent repeatability.

FEATURES:

- Simple operation.
- Stable warble rate and amplitude.
- Warble bandwidth adjustable on calibrated dial.
- Self contained, battery operated.
- Built-in LED battery test.
- Interconnection with Model 200/2000 Response Plotting System through single RCA-type cable.
- Low cost.

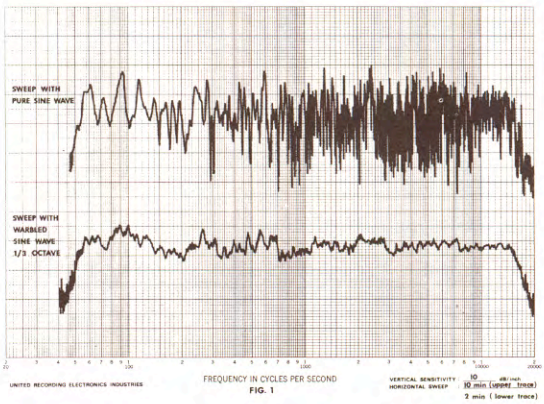


FIGURE 1

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UREI SNVY TELEX 65-1389
a UREI company

The reflections from the boundary surfaces cause unwanted variations in amplitude of two kinds: space interference, in which an interference pattern builds up during a continuous, steady-state tone, and time interference, which occurs when a tone begins or decays. Ideal measuring environment for transducers themselves is obviously in free space or an anechoic room.

In the typical room environment the warble tone introduces changing phase relationships of the direct versus the reflected sound waves. It is necessary however, that the frequency variations be at least large enough to cause a 180° phase shift at the microphone position for all possible reflections. This is achieved if the difference in distance travelled by the direct and reflected sound waves between the source and the measuring microphone, is sufficiently large.

The other parameter of importance is the bandwidth of the warble tone, or the ratio f/f_0. An analogy for the effects of the warble would be a "low pass space filter" where the cut-off frequency is determined by the bandwidth. The larger the bandwidth, the lower the cut-off frequency and vice versa. It is convenient to express the amount of warble in fractions of octaves:

$$\triangle \text{ octaves} = \frac{\log \frac{f_1}{f_2}}{\log 2}$$

Experimentation for a particular measurement is necessary. However, the practical useful range has been determined to be from 0.1 to 0.5 octaves. Depending on how much detail is desired in the frequency plot, one simply adjusts the Model 20 Warble Generator for the proper bandwidth. For example:

If a sound reinforcement system is to be corrected with a 1/3 octave filter set, the frequency response plot of the system should be measured with the warble adjusted to 1/3 octave bandwidth. This method achieves results with repeatable accuracy, and the correlation with an acoustic analysis using pink noise or Sonipulse™ is excellent. An additional advantage of the warble tone is that it significantly reduces the time required for a hard-copy plot. While a sweep with a pure tone may need from 10 to 20 minutes, the warbled sweep accurately measures the response in much less time, depending on the ratio of direct to indirect sound and the room constant. (The same principles apply in taking data by other methods.)

Basic research with warble tones was conducted as early as 1930. Since then experiments and investigation have continued, and the results are firmly substantiated by mathematical analysis. Numerous papers have been published which describe the technique and the results of the method applied to different acoustical measurements. Heretofore, however, the technique was not widely used because of the high cost and complexity of instruments which could achieve a constant percentage frequency modulation during the entire 20 Hz to 20 kHz sweep. Now, UREI has eliminated this constraint with the introduction of this inexpensive, precision accessory to its Model 200/2000 Automatic Response Plotting System — the Model 20 Warble Generator.

TECHNICAL SPECIFICATIONS:

- **Output Signal** : Sine Wave.
- **Output Level** : 0 to 5 V RMS: into $\geqq$ 10 kohm load. (1 V RMS = 0.1 octave Warble of Model 2000 Sweep Generator.)
- **Frequency** : 5 Hz, $\pm$ 10% f_0.
- **Output Connector** : RCA-type phono jack.
- **Battery** : 9 V "Transistor Radio" No. 216 or equiv. 2 batteries are needed, (current 1 ma).
- **Battery Test** : Push-button with LED indication.
- **Dimensions** : 4" wide x 2.1" deep x 2.4" high, (102 x 53 x 61 mm), with control knob pulled to ON position.
- **Weight** : net 0.5 lb (0.23 kg), batteries included, shipping 1.5 lb (0.68 kg).