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Those New -*hp*- Oscillators

Much interest has been shown in the two new -*hp*- audio oscillators that have been exhibited at recent trade shows. These new oscillators represent a substantial increase in the versatility of instruments that have always been noted for versatility. For example, the frequency range of the two new oscillators is such that they replace *four* of the older oscillators. This has been accomplished without increase in price.

SEE ALSO:
"Higher Power Measurements With The 10 Kmc Test Set" *Back page*

Besides increasing the frequency range of the oscillators, advances have been made in other phases of their electrical design. Also, the cabinetry of the oscillators has been redesigned. The cabinet width has been reduced to save bench space, while the appearance has been designed to be more pleasing and to aid in operation.

Fig. 1. *New -hp- Models 200AB and 200CD. 200AB operates from 20 cps to 40 kc, 200CD from 5 cps to 600 kc. Large frequency dial is provided with 2:1 main drive and 9:1 rim drive for easy adjustment. New cabinet design requires minimum bench space.*

MODEL 200AB

The oscillator at the left in Fig. 1 is the new -*hp*- Model 200AB. It replaces the older Models 200A and 200B which have been discontinued. The frequency range of the new 200AB is 20 cps to 40 kc. This contrasts with a range for the former 200A of 35 cps to 35 kc and for the former 200B of 20 cps to 20 kc.

The 200AB delivers a maximum of at least 24.5 volts across loads of 600 or more ohms. This output corresponds to a maximum available power of 1 watt into the minimum rated load of 600 ohms. Loads significantly lower in value than rated minimum will usually result in increased distortion in the output.

One of the most popular features of -*hp*- oscillators is the quality of electrical performance. In the new oscillators, performance has been improved in almost every respect. Data typical of the new 200AB are indicated in Figs. 3 to 6.

-*hp*- oscillators have always been conservatively rated, a fact which many users have discovered. The question has frequently come up as to just how much actual performance exceeds specified performance. One phase of this question is answered by Fig. 3 which shows maximum and minimum distortion measured on a group of 20 production 200AB oscillators. The intermediate curve of Fig. 3 indicates the average distortion of the 20 instruments.

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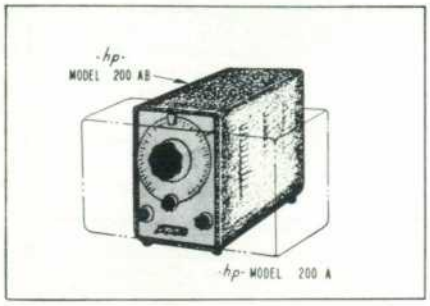

Fig. 2. *Comparison of cabinet sizes of new 200AB and former 200A. 200CD cabinet is same size as 200AB.*

The distortion in the 200AB is specified to be not more than 1% over the complete 20 cps to 40 kc range. This specification represents an advance over the former 200A and 200B where distortion was not necessarily controlled above 15 kc. Examination of Fig. 3 will indicate that over most of the frequency range actual performance exceeds guaranteed performance by a factor of more than 2:1. Even at the extremes of the oscillator frequency range, the rating is usually conservative by a factor of 20%. An occasional instrument may not conform to the data shown in Fig. 3, but of course all instruments are within specifications when shipped from the factory.

Warm-up stability of the 200AB is indicated by the curve shown in Fig. 4. The stability of a typical instrument will usually vary somewhat with operating frequency, but the curve of Fig. 4 is representative. Overall warm-up drift is typically less than 1% at normal room temperature, and it will be noted that most of the warm-up drift occurs in the first hour. Thereafter, warm-up drift is typically very small. *-hp-* oscillators are calibrated only when fully warmed so that, in general, the instruments will tend to become more accurate as warm-up occurs.

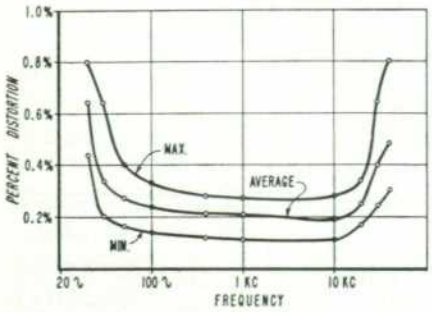

Fig. 3. *Distortion measured on 20 production 200AB's. Curves show maximum and minimum values measured and average of all measurements.*

The stability of the 200AB with respect to ambient temperature is indicated in Fig. 5. The temperature range plotted here is extremely wide: only a small portion of the curve is pertinent to an operating condition. Over the range of normal room operating temperature, the frequency stability is within a few tenths of a percent.

Stability of the oscillator with respect to line voltage is somewhat a function of oscillator operating frequency. Over most of the operating frequency range, the effect of variations in line voltage is too small to be measured readily. At the higher output frequencies the effect of line voltage increases (Fig. 6), but this effect is still within approximately 0.25% for a 10-volt variation from the 115-volt center value.

OUTPUT SYSTEM

The output system in the 200AB is balanced and floating. A convenient grounding terminal is provided for grounding either output terminal. The internal impedance of the output system has been made low so that variations in load impedance will not result in large variations in output voltage. The variation of output voltage across fixed loads is less than 1 db over the complete frequency range. This specification represents an advance over the 200A and 200B where response was not necessarily controlled above 15 kc.

The output terminals are isolated from the oscillator portion of the circuit by a three-stage amplifier which uses generous stabilizing feedback. The conservative design of the overall amplifier is emphasized by the low distortion and constancy of frequency response of the instrument.

The degree to which the oscillator section is isolated from the load is indicated in the accompanying table. The figures in the table indicate frequency deviation between no load and full 600-ohm load on the output terminals. Typically, load changes will result in only one to three cycles change in frequency, the effect being most pronounced at high frequencies.

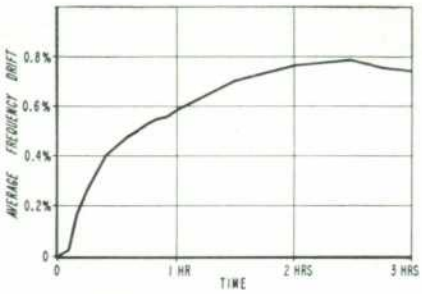

Fig. 4. *Typical warm-up drift of new -hp- Model 200AB.*

OPERATING FREQ.	LOAD-NO LOAD FREQ. SHIFT
100 cps	0 cps
1 kc	0-1 cps
10 kc	0-1 cps
40 kc	1-3 cps

NEW 200CD

The second of the new oscillators is the Model 200CD which appears at the right in Fig. 1. This instrument replaces the older Models 200C and 200D which have now been discontinued. The cabinet and general physical characteristics of the 200CD are the same as those of the 200AB.

The frequency coverage of the new 200 CD is extremely wide—from 5 cps to 600 kc. The instrument is therefore very valuable as a general purpose oscillator. To compare with the

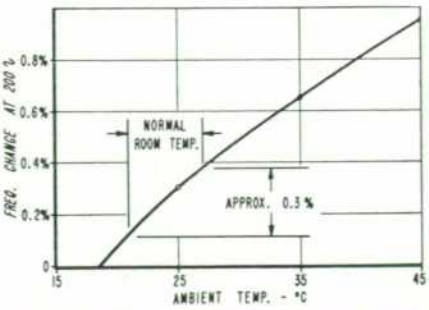

Fig. 5. *Stability of typical 200AB with respect to ambient temperature.*

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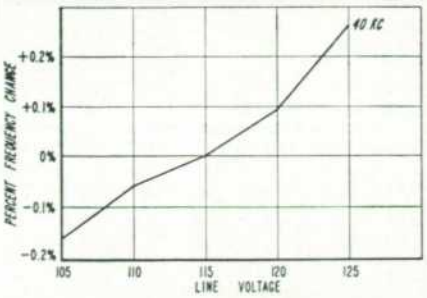

Fig. 6. *Over most of frequency range line voltage effects are negligible. Above curve shows line voltage effect at highest operating frequency of 200AB where effect is most pronounced.*

instruments it replaces, the older 200C operated from 20 cps to 200 kc and the 200D from 7 cps to 70 kc.

The 200CD provides a maximum of at least 10 volts across its rated load of 600 ohms and at least 20 volts open circuit. A special feature of the 200CD is that its waveform purity does not depend on load. Specified output waveform will be obtained even with loads of only a few ohms, although available output voltage will be decreased when using low-value loads.

The basic output circuit of the 200CD is shown in Fig. 7. The circuit has a nominal source impedance of 600 ohms so as to be suitable for use with audio equipment as well as carrier applications. Since a single output transformer will operate suitably over only a part of the complete 5 cps to 600 kc frequency range of the instrument, the frequency band switch is arranged to select automatically the proper transformer for the band in use.

The output circuit is arranged to accommodate different types of applications. For unbalanced applications, a simple bridged-T attenuator which uses potentiometers in the variable arms and composition resistors in the fixed arms is provided to control output power. A convenient panel grounding terminal is provided to ground one of the output terminals for unbalanced use.

The instrument can also be used with balanced loads. The output transformers are balanced within 0.1% at the lower frequencies and within approximately 1% at the higher frequencies. In addition, the attenuator is constructed so that, when set for zero attenuation, the shunt arm opens while the series arm shorts. The attenuator is therefore effectively removed from the circuit, resulting in a balanced, nominal 600-ohm source. This arrangement permits use of an external balanced-H attenuator when a well-balanced variable source is desired. However, the balance of the T-pad is usually sufficient for moderate attenuations at audio frequencies.

The performance of the new 200-CD exceeds that of the older 200C and 200D in almost every respect. For example, distortion in a representative 200CD is less than 1% over the entire 5 cps to 600 kc range and usually less than 0.5% from 20 cps to 200 kc. Also, frequency shift with output level or with line voltage variation is less in the 200CD. Further, the use of an attenuator in the output circuit keeps hum at a fixed level below the output signal. Finally, output power is increased.

LONG LIFE COMPONENTS

One of the important features of *-hp-* oscillators is that high quality components are used throughout. This applies not only to the use of major components but also to more subtle applications. For example, best long-time performance is obtained

Fig. 8. *Frequency dial of -hp- Model 200AB.*

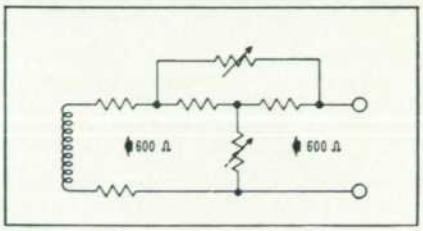

Fig. 7. *Basic output circuit of -hp- 200CD.*

in the resistance-capacity oscillator when ceramic insulation is used in certain places. Observance of precautions of this type leads to the long, trouble-free performance obtained with *-hp-* oscillators. Practically speaking, every *-hp-* oscillator ever manufactured can still be used and can still be adjusted to meet original specifications.

Another important feature of the new oscillators is that a new type of electrolytic capacitor is used. This type is known as the "long life" capacitor and is manufactured at premium price especially for *-hp-*. As far as is known, *-hp-* is the first to incorporate these capacitors in its regular commercial equipment. The "long life" electrolytic capacitor is considered to have a useful life approaching ten years. The capacitors have also been used in a number of other *-hp-* instruments in recent months.

GENERAL

For ease in tuning and resetting, the new oscillators are provided with a large six-inch tuning dial. The 200-AB dial is calibrated with approximately 90 points for each of the four bands of the instrument. The effective dial length for the complete range is in excess of 60 inches.

The dial on the 200CD is calibrated from 5 to 60 cps. A five-position band switch multiplies the dial reading in decade steps. The dial is calibrated with approximately 85 calibration points over an arc of approximately 300 degrees, giving an effective dial length for the five bands of approximately 75 inches.

— *Brunton Bauer*
and *B. M. Oliver*

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SPECIFICATIONS

-hp-
MODEL 200AB
AUDIO OSCILLATOR

FREQUENCY RANGE: 20 cps to 40 kc in 4 bands.

ACCURACY: Within 2% including calibration error and warm-up drift.

OUTPUT: 24.5 volts maximum (1 watt into 600 ohms).

LOAD IMPEDANCE: 600 or more ohms.

INTERNAL IMPEDANCE: Approx. 75 ohms below 20 kc.

DISTORTION: Not more than 1% when operated into loads of 600 or more ohms.

NOISE: 75 db or more below maximum output.

FREQUENCY RESPONSE: Within 1 db.

LINE VOLTAGE STABILITY: Line voltage changes of ±10 volts cause less than 0.2% frequency change over most of the frequency range.

POWER: Operates from nominal 115-volt, 50/60 cycle supply. Requires approx. 60 watts.

DIMENSIONS: Approx. 7" w, 10¾" h, 10½" d.

PRICE: $120.00 f.o.b. Palo Alto, Calif.

-hp-
MODEL 200CD
AUDIO OSCILLATOR

FREQUENCY RANGE: 5 cps to 600 kc in 5 bands.

ACCURACY: Within 2% including calibration error and warm-up drift.

OUTPUT: 10 volts across 600 ohms, 20 volts open circuit.

INTERNAL IMPEDANCE: Approx. 600 ohms.

Other specifications same as 200AB above.

PRICE: $150.00 f.o.b. Palo Alto, Calif.

Data subject to change without notice.

Both models available for relay rack mounting at $5.00 additional.

GREATER POWER CAPACITY FOR THE 8.5-10 KMC TEST SET

About a year ago the *-hp-* Model 624A 8500 to 10,000 megacycle test set was announced.* This instrument is basically a combination of three separate instruments: a signal generator, a power meter for measuring power from external sources, and a precision frequency meter for measuring external frequencies (Fig. 1). The principal characteristics of the instrument were that it:

1. Generated a full milliwatt of power
2. Included a direct-reading cut-off type attenuator to permit accurate attenuation of the output down to -100 dbm.
3. Included a quality pulser to provide r-f pulses adjustable in width down to ¼ microsecond (Fig. 2).
4. Measured external power levels up to 2 milliwatts (+3 dbm).

The instrument has found wide use in applications such as testing radar equipment, microwave relay equipment, and in general laboratory use. The popularity of the instrument is indicated by the fact that it is being used by more than fifty different firms, some of which are using more than 10 of the instruments and a few more than 20.

To increase the flexibility of the test set even more, the power meter section has now been arranged to be capable of measuring powers up to 0.5 watt (+27 dbm). Thus, the output of transmitters having average power levels in the order of a hundred watts can be measured by use of a 20 or 30 db directional coupler.

The basic power meter in the instrument consists of a thermistor bridge which is direct-reading from -6 to +3 dbm. Ahead of the power meter is now located the 0.5 watt attenuator. The attenuator is direct-reading, being calibrated in 5 db steps.

The model designation for the test set with the new attenuator has been changed from 624A to 624B. Other specifications for the 624B are the same as for the discontinued 624A.

— *P. D. Lacy*

*"Two New Test Sets for SHF Measurements," Hewlett-Packard Journal, Vol. 3, No. 2, Oct., 1951.

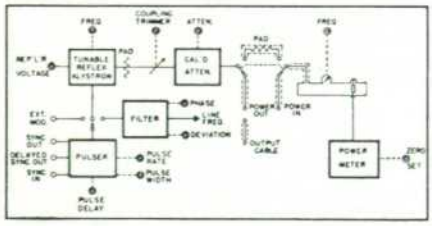

Fig. 1. *Circuit block diagram of -hp- Model 624.*

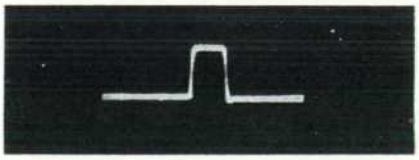

Fig. 2. *Quality of short r-f pulses from Model 624 is indicated by above oscillogram of rectified ¼-microsecond output pulse.*

SPECIFICATIONS

-hp-
MODEL 624B
TEST SET

FREQUENCY RANGE: 8,500 to 10,000 megacycles. Frequency dial provided with approximate calibrations.

OUTPUT RANGE: 0 dbm (1 mw) to −100 dbm into 50-ohm load. Type N coaxial output jack.

OUTPUT ACCURACY: Within 2 db from −10 to −100 dbm into matched load.

INTERNAL MODULATION: Pulse or f-m.

PULSE MODULATION: Pulse length variable from approx. 0.25 to 10 microseconds. Pulse rate variable from 35 to 3500 pps.

EXTERNAL SYNCHRONIZATION: Internal pulser operates either free-running or synchronized from external pulses of 5 volts peak, positive or negative, or sine waves of 5 volts rms. Type BNC panel jack provided for external sync pulse.

F-M: Internal f-m at power line frequency. ±7.5 mc deviation obtainable. Can also be f-m modulated by external voltages from 35 to 3500 cps.

TRIGGER PULSES: Two provided; one coincident with start of output r-f pulse; second is from 3 to 250 microseconds ahead of output r-f pulse as determined by panel control. Both pulses are positive and provided at BNC panel jacks.

POWER METER: Range from −6 dbm to +27 dbm. Accurate within 2 db. Type N input jack provided.

FREQUENCY METER: Covers complete range of set. Accurate within 0.03% at 25° C. ambient. Temperature correction data supplied.

POWER SOURCE: Operates from nominal 115-volt, 50/60 cps supply. Requires approx. 200 watts.

ACCESSORIES SUPPLIED: 1" x ½" waveguide to type N adapter having VSWR less than 1.25. Special 6' measured output cable and detachable power cable also supplied.

WEIGHT: Approx. 56 lbs.; shipping weight, approx. 92 lbs.

PRICE: $2250.00 f.o.b. Palo Alto, Calif.

Data subject to change without notice.

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