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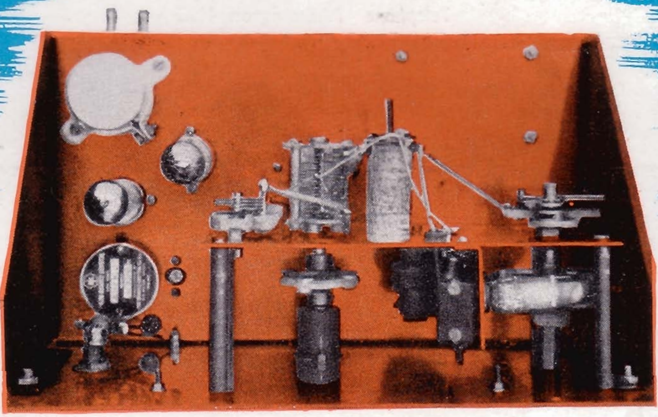
A HETERODYNE FREQUENCY METER



by D. Nobel, G3MAW
and D. M. Pratt, G3KEP

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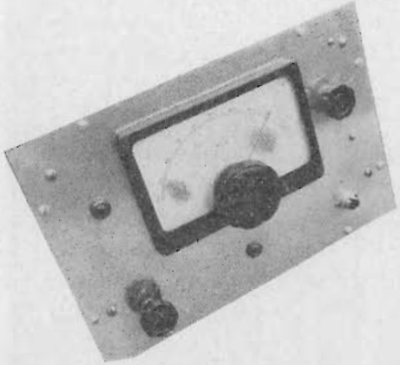


A Heterodyne Frequency Meter

By DAVID NOBLE, G3MAW
and DAVID M. PRATT, G3KEP

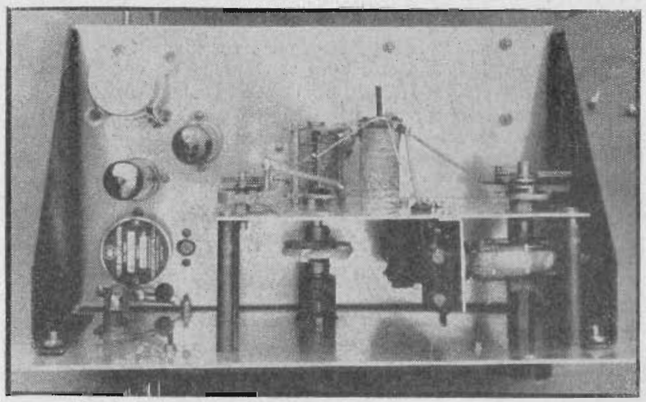
It is often desirable to be able to measure the frequency of a receiver accurately, and radio amateurs are required, by the terms of their licence, to be able to measure the frequency upon which they are operating. For accurate measurement of frequency, a simple interpolation frequency meter will give results to a very close tolerance provided that the crystal used in the unit is of sufficient accuracy. This type of frequency meter is used in conjunction with a receiver, and if it is required to measure the frequency of a transmitter, then the transmission is monitored on the receiver, and the receiver frequency measured.

A 100 kc/s crystal will produce harmonics every 100 kc/s, and these can be used to measure frequencies up to and over 30 Mc/s. However, this will not give intermediate frequencies, nor, for amateur purposes, an accurate measurement of the band edges of the 40, 20 and 15 metre bands (7.15, 14.35, 21.45 Mc/s). While all the band edges could be provided by a following multivibrator on 10 kc/s, this does not give a continuous frequency range, and by the expense of a little more with respect to valves—two pentodes instead of a twin-triode—a continuous coverage interpolation type of frequency meter can be provided.

Circuit

The first valve (V_1) operates as a Pierce crystal oscillator. The condenser C_1 (40pF) is used to adjust the crystal to exactly 100 kc/s. This may be checked by listening to the Light Programme on 200 kc/s, and tuning the condenser for exactly zero beat. An "S-meter" or "magic eye" are useful if the receiver is so fitted, a beat period of several seconds can then be observed.

V_3 is the variable interpolation oscillator. The main tuning condenser is C_{15} which is arranged to tune over a range of 100 kc/s.



Plan view of the frequency meter showing the constructional method adopted with the variable oscillator section. Note the vertical panel mounted to the front panel by means of the four brass pillars. The crystal oscillator section is shown to he left of the vertical sub-chassis

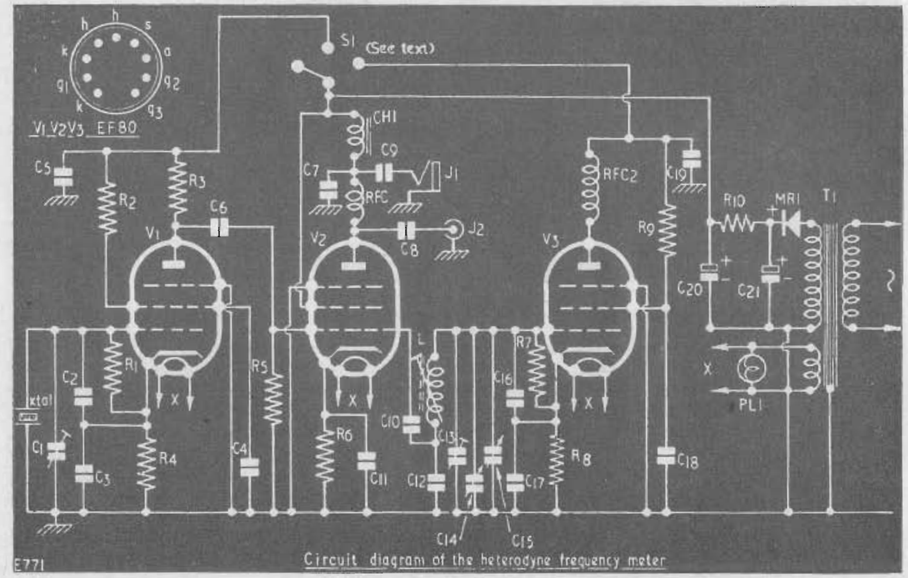
The actual frequency of operation of the oscillator is not critical. In the prototype, with the coil data given, the oscillator operated from 3.9 to 4 Mc/s. C_{13} is a fine trimmer for initially setting up the oscillator, and C_{14} is a variable condenser of very low capacity. This condenser has its spindle protruding through the front panel, its purpose being to set up the oscillator before use.

The two outputs from the oscillators are fed through 20pF condensers to the grid of V_2. The valve operates as a mixer, and r.f. output is fed to the coaxial socket via an isolating condenser, C_8. This provides an output of high harmonic content, and is coupled to the receiver with which the frequency meter is to be operated.*

Setting Up

A headphone jack is provided for setting up the equipment. As the dial is calibrated 0 to 100 kc/s, it will be necessary to ensure

* It should be noted that, at frequencies above 4 Mc/s, advancing the interpolating oscillator tuning condenser causes both a rising frequency and following frequency to appear within the 100 kc/s range under consideration. This should cause little difficulty in practice since it is almost invariably possible to use common sense and knowledge of tuning condenser direction against capacity to differentiate between the two signals.—Editor.



Circuit diagram of the heterodyne frequency meter

Components List

Resistors

- R_1 470kΩ ½W
- R_2 100kΩ ½W
- R_3 22kΩ ½W
- R_4 10kΩ ½W
- R_5, R_7 68kΩ ½W
- R_6 220Ω ½W
- R_8 8.2kΩ ½W
- R_9 33kΩ ½W
- R_{10} 1kΩ 10W wire-wound

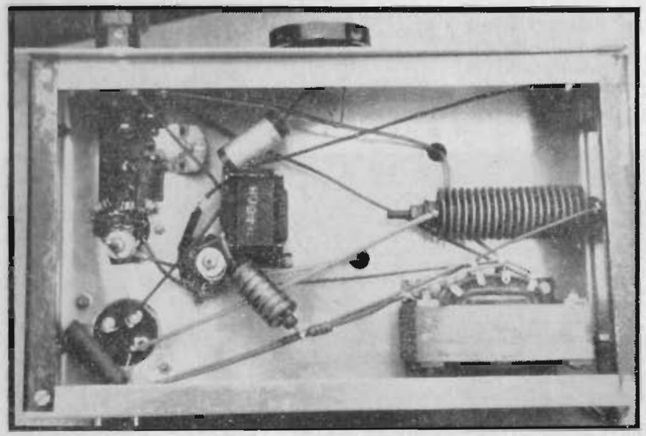
Condensers

- C_1 40pF air-spaced preset trimmer
- C_2 100pF silvered mica
- C_3, C_{12} 1,000pF silvered mica
- C_4, C_5, C_{19} 0.01μF 400V paper
- C_6, C_{10} 20pF silvered mica
- C_7, C_{11}, C_{18} 0.002μF 350V paper
- C_8 470pF silvered mica
- C_9 0.1μF 400V paper
- C_{13} 20pF preset trimmer
- C_{14} 8pF variable
- C_{15} 25pF variable
- C_{16}, C_{17} 390pF silvered mica
- C_{20} 32μF 350V electrolytic
- C_{21} 16μF 500V electrolytic

Miscellaneous

- RFC_1, RFC_2 2.5mH r.f. choke
- Ch_1 L.F. choke
- L 25 turns, 24 s.w.g. enamelled copper wire, close spaced on ⅜in former with dust iron core
- V_1, V_2, V_3 EF80
- MR_1 250V, 40mA metal rectifier
- S_1 3 position progressively shorting wafer switch
- T_1 250V, 40mA and 6.3V, 1A mains transformer
- PL_1 6.5V, 60mA pilot bulb
- J_1 Headphone jack
- J_2 Coaxial output socket
- Xtal 100 kc/s quartz crystal

that the position of the condenser C_{15}, when its pointer is at 0 and 100 kc/s, produces a zero beat. This requirement is necessitated, of course, so that the variable oscillator will approximately 200 volts, and l.t. of 6.3 volts a.c. The h.t. switch is of the progressively shorting type. Thus, in the first position neither of the oscillators are operat-



Under-chassis view of the frequency meter showing the position of the power supply and other components

be at zero beat with the harmonics from the crystal oscillator at these two positions. C_{14} is provided, therefore, to compensate for any drift in the instrument after it has been on for a considerable period.

Power Supply and Switching

An integral power supply employing a simple half-wave metal rectifier circuit is used. This provides an h.t. voltage of ing; in the second position, only the crystal oscillator is working, and therefore the 100 kc/s harmonics will be detected; lastly in the third position, both oscillators are operating.

The unit was built on a chassis 10 x 6 x 2in, and fitted into a metal cabinet of proportionate dimensions. Screening is desirable with this unit in order to prevent any unwanted radiation and for that reason it is recommended that it be built into a metal case.

THE PHONE-GUARD by R. M. SUMMERS

The Phone-Guard is a device which gives visual warning of the ringing of a telephone bell. Its sensitive circuit is capable of responding also to any other sound of reasonable intensity

A DEVICE WHICH GIVES VISUAL INDICATION when a bell is rung can be extremely useful in a household wherein any member happens to be hard of hearing or where it is occasionally necessary to occupy a room in which the bell cannot normally be heard. The Phone-Guard has been developed to meet this situation, and it employs an inexpensive amplifier and relay energising circuit which causes the actuation of the relay contacts whenever the associated microphone picks up the sound of the bell. With the application described in this article the relay causes a lamp, or lamps, to be illuminated. The relay contacts can, of course, cause any other electrical operation to take place, should this be desired, on the ringing of the bell. The device is sensitive; and it may be employed to give visual warning of the presence of sounds other than that given by a bell. It would, for instance, be perfectly suitable for use as a baby alarm, the crying of the baby causing the warning lamps to light. Other applications may readily suggest themselves to the reader.

The component values employed in the relay energising circuit of the Phone-Guard have been chosen to give optimum performance with G.P.O. bells. They will also prove adequate if the unit is employed to