how to use the GRID DIP OSCILLATOR

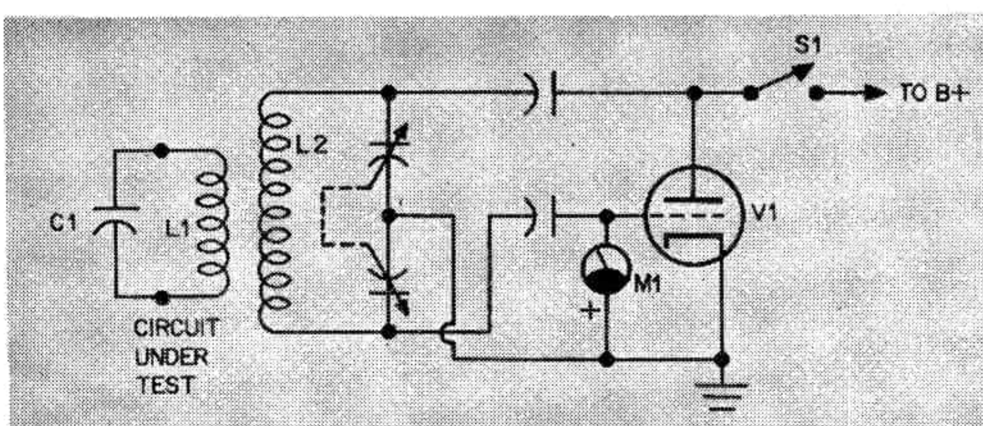
By Herb Cenan

WHENEVER an amateur or Citizens Bander compiles a list of equipment he wants to add to his test bench, a grid-dip oscillator usually ends up somewhere near the bottom of the page. Actually, a GDO is among the most valuable instruments you can put in your shack. Don't agree? Well, take a look at all the things it can do.

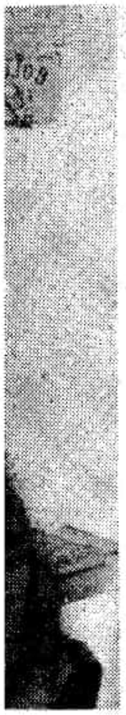
- Measure the resonant frequency of cold circuits—filters, traps, antennas, feedlines and so forth.
- Measure relative field strength.
- Serve as an oscillating detector for frequency measurements.
- Function as a local oscillator for receiver troubleshooting.
- Act as a signal generator.
- Operate as a modulation monitor.

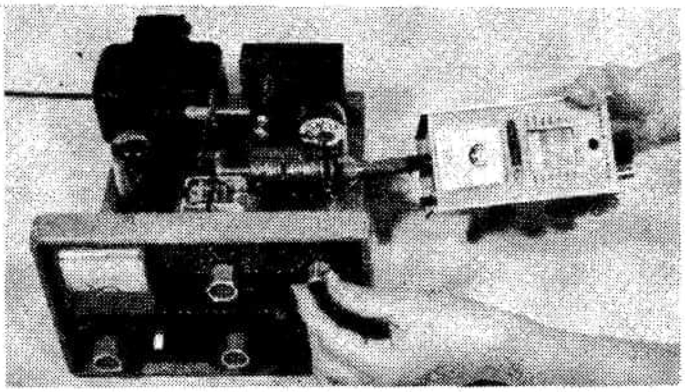
To understand exactly how a GDO can perform all these functions, let's take a minute to understand how it works. As you can see from the simplified schematic below, the GDO is a variable-frequency oscillator (VFO) with a built-in meter to indicate RF power. Meter M1 indicates grid current flowing in oscillator tube V1. Naturally, the more RF power developed, the higher the grid current and the higher the meter reading.

If an L-C circuit tuned to the VFO frequency is placed near VFO inductor L2, this L-C combination absorbs some of the RF power. Since VFO power is reduced, the grid current also is reduced

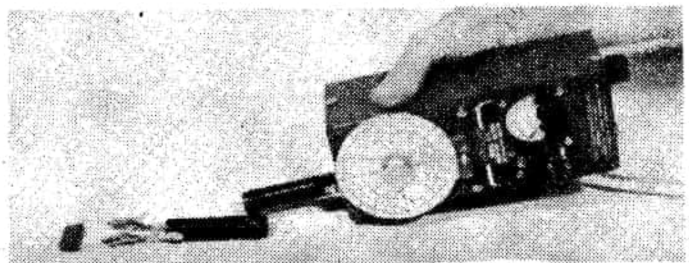


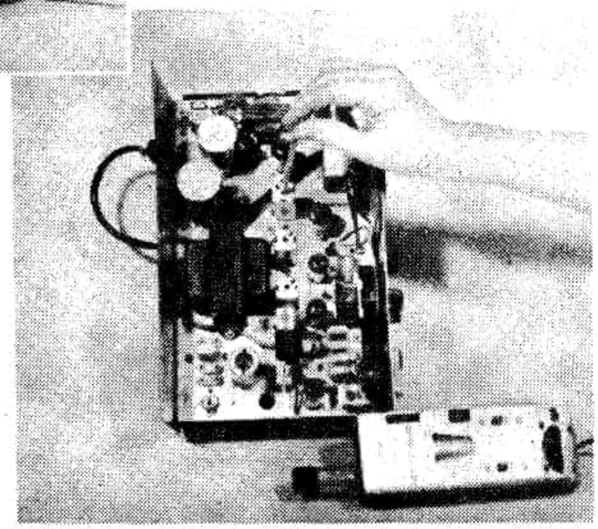
Grid-dip oscillators come in a wide variety of shapes and sizes, but all have two things in common—a tube or transistor connected as an oscillator, and a microammeter to indicate grid or base current. Simplified vacuum-tube version shown here is basically a Colpitts oscillator.





Considered from a cost vs. performance standpoint, a grid-dip oscillator scores so high that no ham or CBer can afford to be without one. The versatile GDO can be used to tune a transmitter (left), determine the value of an unmarked capacitor, and align receivers, converters and RF preamps (below).





and M1 dips—hence the name grid-dip oscillator. Inductor L1 and capacitor C1 form the external L-C circuit in the diagram at left.

Similarly, if an unknown tuned circuit is placed near the VFO inductor, its resonant frequency can be determined by sweeping the VFO. As in the previous examples, the grid current dips at the resonant frequency of the tuned circuit.

Cut off the B+ to the VFO (by opening switch S1) and V1 becomes a detector. The circuit now performs as a standard wavemeter, with meter M1 indicating relative field strength.

Most GDO's utilize a tube for the oscillator and are powered by an internal AC supply. They are reasonably stable and their dials can be calibrated accurately. Although their nominal frequency range is from 1 to 260 megacycles, some GDO's are supplied with inductors which extend the range down to the neighborhood of 350 kilocycles.

Until recently, the vacuum-tube GDO was the standard type for experimenters. However, because the tube GDO requires an AC power supply, it's often impossible to use such an instrument at remote locations. Not so with the semiconductor GDO that utilizes a transistor or tunnel diode for the oscillator and batteries for power. It can operate practically anywhere.

While the term GDO is not really applicable to the semiconductor versions (where there is no grid to be dipped), these devices still are tagged with the name. The limiting factor of the more inexpensive solid-state GDO's is that they do not have the required stability for precise dial calibration. A minor disadvantage with *all* solid-state GDO's is their restricted frequency range; the lower limit usually falls somewhere around 3 mc. On the other side of the ledger, the semiconductor GDO does have its advantages—portability, for example, which can be a major consideration.

Possibly the greatest asset of any GDO is its ability to indicate resonance. Let's say it's time to try out that high-power linear you've worked on for weeks. Do you hang back for fear those expensive tubes will light up the moon before you can dip the final? Do you twist the tuning controls frantically,

GRID DIP OSCILLATOR

hoping to hit resonance before the tubes become shooting stars? Not if you have a GDO.

With transmitter power off, you set your GDO to the operating frequency, place it near the grid tank and tune the grid capacitor for *dip*. Repeat the procedure with the plate tank, and you will have tuned both circuits before touching the power switch. Now when you apply power to the transmitter, it will take just a little trimming to get the rig tuned on the button.

If you roll your own coils—including traps and filters—you'll find the GDO especially handy. Instead of laboriously calculating each coil, you simply wind one that looks good. This done, you connect it across the required capacitor and measure with your GDO. Your first attempt may be considerably off-frequency, but it takes only a few seconds to trim off some turns.

For checking out antennas and feedlines, the GDO shines. Is that new antenna really resonant at your operating frequency, or have end effects, miscalculations or some nearby metal objects changed everything? Stop guessing (or hoping). Put a GDO next to the antenna, give a quick spin of the dial, and you'll know for certain whether you'll get out. How about your resonant feedlines? Are they resonant where they're supposed to be? Again, spin the GDO dial and you will know for certain.

A GDO is almost indispensable when you discover that you're producing parasitics (spurious signals). Just switch off the GDO's B+ (converting it to a wavemeter), and place the GDO near the transmitter's output. Sweep the dial until the meter indicates output at some frequency other than the one you are supposed to be on, and you've found the parasitic. Using the GDO as a probe, you now can trace the circuits to determine the origin of the spurious signal. Try doing this without a GDO!

Having outlined the major uses of the GDO, let's run through the many little kinks that it can iron out for you. For example, if you set the GDO to wavemeter and plug in a headset, you can monitor your own signals.

Grid-Dip Oscillators

Model	Freq. Range (Mc)	Tube or Semi-Conductor	Kit	Wired
Barker & Williamson 600	1.75-260	T		$45.72
EICO 710	0.4-250	T	$29.95	49.95
Heath HM-10A	3-260	S	34.95	49.95
Knight G-30	1.5-300	T	22.95	
Lafayette TE-18	0.36-220	T		29.50
Millen 90651	1.7-300	T		68.85
PEL DM201	3.1-230	S	29.90	39.90

Many GDO's come with interpolation charts which allow easy measurement of unknown capacitors. You connect the capacitor across a specified inductor, then measure the frequency of the inductor-capacitor combination. Compare the resonant frequency against the charts, and you can read off the capacitor value as easy as 1, 2, 3. In much the same way you can measure unknown inductors which are connected across known capacitors.

Since AC-powered GDO's have excellent calibration, they can be used as signal generators for aligning budget-price receivers, converters and RF preamps. Of course, there is no easy means to control the signal level, as there is with a standard signal generator. But since you wouldn't attempt to align a $400 receiver with a GDO anyway, this is hardly a handicap.

Connect a headset to the GDO while the B+ is on and the instrument becomes a heterodyne frequency meter. When the GDO is placed near a radiated signal of unknown frequency, a tone (heterodyne) will be heard in the headset as the GDO's frequency approaches the one you're trying to determine. Naturally, the pitch of the tone becomes lower as the frequency of the GDO approaches the unknown frequency. When the GDO is set precisely at the unknown frequency, the tone disappears. This is the zero-beat condition, and the unknown frequency is the same as the GDO reading.