

GRID DIP METER DESIGN

BY GOCWA MAY 2013



This, my next offering of test equipment is an exceptionally useful item of test equipment with many uses, some are listed below.

To coin a phrase given to me by one of my friends a GDO is the radio test equipment equivalent of a Swiss army pen-knife, thanks Pete.

I have taken it several stages further than normal for a GDO and included a few more features. Although I have only made coils for use up to 70 MHz from 800 KHz by making additional coils the range can be increased to give from around 200 KHz to over 100 MHz with ease. I have owned a GDO for over 30 years and it has proven its worth many times over. I actually wanted to cover a larger low frequency range than my commercial unit would allow so decided to make another to “fill in the gaps”

The GDO uses are legion, amongst them are:

1. Measuring approximate resonant frequencies of items (antennas, traps, and tuned circuits).
2. Rough frequency and harmonic measurements
3. AM signal monitor receiver.
4. Simple RF signal generator including AM modulation if required.
5. Crystal Testing.
6. Use as a BFO for SSB and CW reception
7. Measurement of unknown capacitors and inductors

I decided to include some extra features above the normal in functionality

RF output from the oscillator enabling use of an external frequency meter and for use as a simple RF signal generator. I decided against putting an internal frequency meter in the unit as the current requirements were high and it would reduce battery life significantly.

AF output from the modulation oscillator, a point often overlooked, to enable its use as a simple fixed frequency audio source, in the case of this design around 400Hz.

A simple go/no go battery tester

The final addition is an extra meter control enabling the meters “ground reference” voltage to be adjusted. This simple addition allows measurement of any dips or peaks in the meter readings to be measured at much higher sensitivities as the “static” oscillator levels can effectively be zeroed out. The use of a centre zero meter movement would actually be a good idea instead of a standard meter, it’s easy with 20/20 hind sight to come up with these ideas !!

The method of use of a GDO is too wide to be contained within the design and build document but a wealth of information is readily available on the net and many whole books have been written on the subject.

Enough introduction now the circuit.

The GDO Circuit

The circuit can be reduced down to several main areas, identified on the circuit diagram and will be talked about as separate modules although mainly all on two PCB's. My design although called a grid dip meter is technically a transistor DIP meter, the name grid dip is historical and comes from the earliest meters of this type using valves, where the dip in a grid voltage/current was measured to indicate resonance. This name has historically been applied to instruments that do this function.

Dip oscillator

This is the main part of the instrument (many different configurations are used in practice) is a very basic Colpits RF Oscillator using a VHF/UHF transistor (An MPSH10), although any similar transistor could be used. If another is used you may have to play with the R4 C8 and R3 values to obtain reliable oscillations.

As is good normal RF practice the oscillator is fed its power through an RF choke to reduce RF feedback to the power supply, now for the clever bit! The choke coil is actually the secondary winding of an 8 ohm output transformer (eagle LT 700) the centre tapped primary forming the inductance for the modulation oscillator section. When the modulation oscillator is running the induced secondary voltage changes the supply voltage to the DIP osc., not normally an effect you want, by the nature of the circuit this varies the PTP output and frequency (slightly). Instant AM and FM modulation.

I was lucky with my tuning capacitor and got a beautiful miniature 4 gang tuning capacitor off eBay that had two 350pF and two 21pF gangs, don't worry about the exact values they only alter the tuning range, if you can only get a dual gang no problem it will at worst only mean more coils to cover the frequencies. **The important point is that the gangs are the same value or the oscillator won't oscillate !**

The next step was to make the coils themselves. The coils are wound on 20 mm OD Perspex tube using 28SWG enamelled copper wire. The windings are soldered to a 7 pin din plug keeping the wires as short as possible. The use of internal shorting links enables the variable capacitor gangs to be used in parallel for the lower frequencies.

The assembly and coil label are then covered with clear heat shrink to hold it together and give a nice professional looking and solid end product. I would suggest colour coding both the coils and tuning scales to identify the coils quickly. For ease so you can reproduce the

design yourself I have included a blank scale and coil labels later for you to copy into a drawing package to add your own numbers.

The number of turns on the coils depend on the frequency coverage required. Mine are listed in the table below and unless your capacitor is identical to mine you will have a different number of turns. The best way is to make them empirically (a posh name for trial and error!). Make a coil with say 20 turns on it, plug it in and see what the oscillation frequency is and work from there, as a rough guide, multiply the number of turns by 4 to halve the frequency and divide it by 4 to double the frequency for a given value of capacitance. It is also possible to use cores to fine tune this but this is best avoided if it can be. I have also made a “Range extender” unit which plugs between the main unit and coil to add extra capacitance so changing the coil tuning range.

Coil Number	Close wound	Both Gangs	Turns	Low frequency MHz	High frequency MHz
1 and extender	Yes	Yes	140	0.8	1.06
1	Yes	Yes	140	1	3.6
2	Yes	Yes	60	1.9	6
3	Yes	Yes	20	4	12
4	Yes	Yes	12	8	19
5	Yes	No	10	18	26
6	No	No	8	23	32
7	No	Yes	3	15	70



The final part of the circuit is an optional 7806 voltage regulator if excessive drift is a problem, it shouldn't be if the oscillator is solidly made with the shortest wires possible between the circuit board and variable capacitor/coil socket.

Calibration can be done by using either a calibrated RF signal generator and using the unit as a wave meter or using a calibrated comms. receiver using the unit as a modulated oscillator to provide a signal.

Note in both cases make sure the coupling is as loose as possible so as to not load the GDO and hence distort the calibration.

AF / modulation oscillator

This is just a standard inductive feedback audio oscillator using a widely available FET and an 8 ohm output transformer. The secondary of the transformer feeds the dip oscillator and a further signal is tapped off the drain to provide an audio output. The frequency is defined by the transformer characteristics in the main and in the case of the LT700 transformer gives around 400Hz.

The oscillator is switchable depending if modulation is wanted or not.

Buffer detector

There is nothing special here a high impedance (~1 M ohm) unity gain FET buffer is coupled to the dip oscillator so as to reduce any degradation of oscillator performance due to loading.

The clever bit here is the use of a 2.2K preset to provide the "loading of the output" this enables setting of the maximum RF output level available at the output of the unit. This is needed to ensure your frequency meter etc. Is not destroyed by excessive voltages, some of the modern ones have a maximum level of 5V, in theory this circuit can produce over 9V PTP when being modulated.

Please note if intending to use as a signal generator the RF output may need a simple amplifier, based on for example a mar 1.

The other output feeds a standard diode detector which supplies both the meter and a crystal earphone output.

Meter Circuit

The level of input to this part of the circuit is controlled by VR1 a **10 K ohm linear pot** and from there to either the optional meter amplifier or meter directly.

The amplifier is only really needed for meters in the high microA and mA sensitivity range and not for low microA units, if in doubt put it in. No pcb was included as this was built on standard perf board (vero type).

The amplifier gain can be changed by altering the value of R12 as required, increasing it to decrease gain or decreasing it to increase the gain.

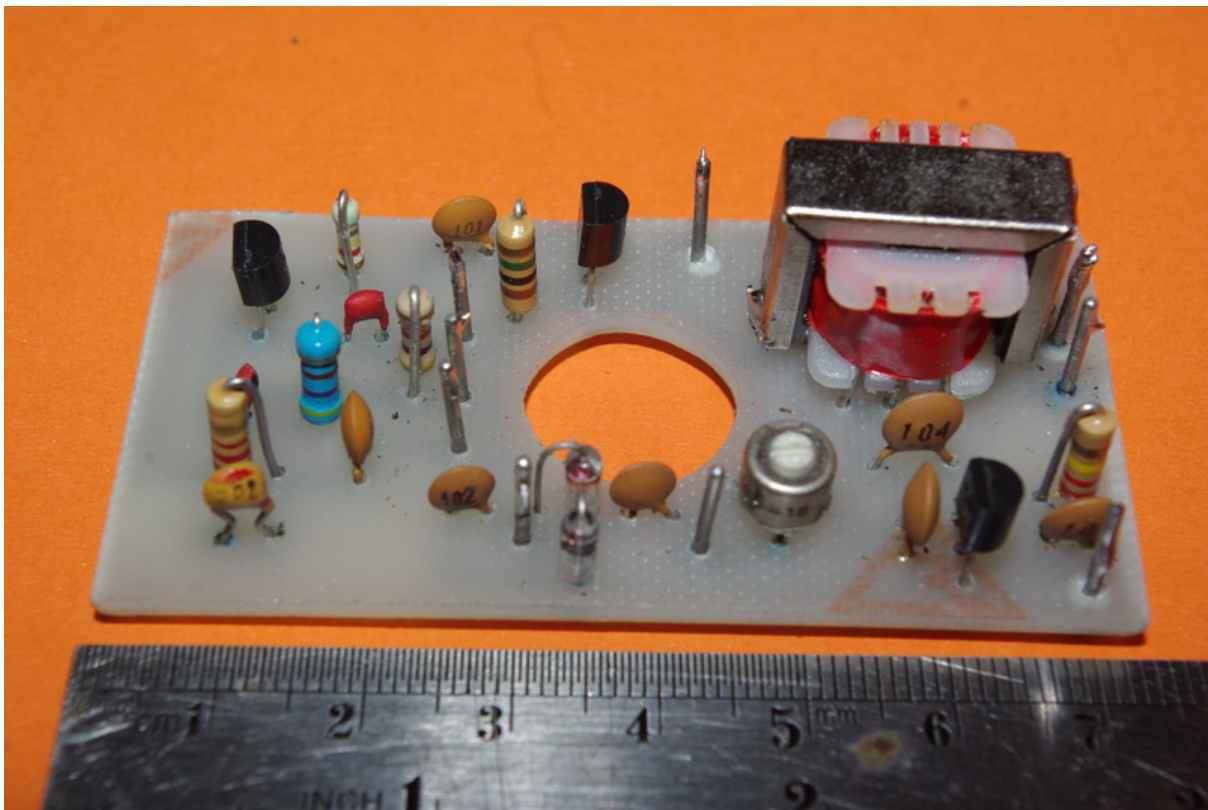
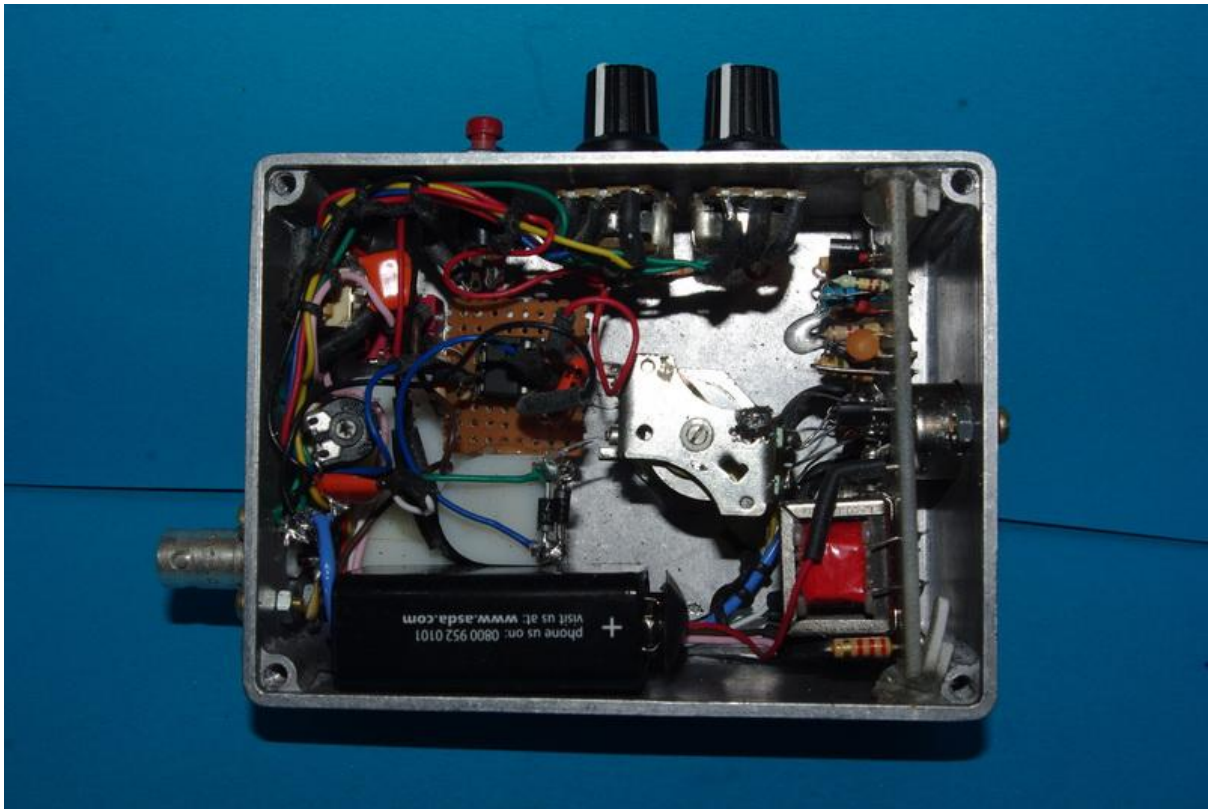
The clever bit here is not to feed the meter in a conventional manner but to make the earthy ends voltage variable by use of VR4 another **10K linear pot**, this effectively allows you to zero out most of the base signal from the oscillator while allowing measurement of any signal troughs and peaks at a much higher sensitivity, in doing so making them far more pronounced.

Battery test

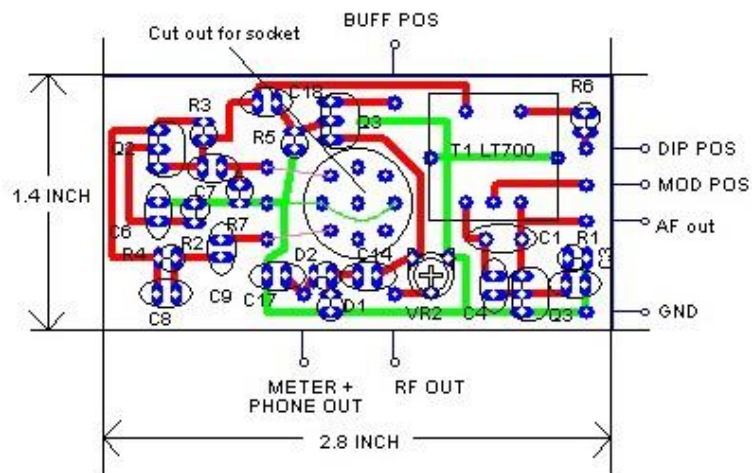
This is the final part and is simple enough in its operation if the combined voltage drops across the LED and zener diodes is less than the supply voltage the LED lights saying the battery voltage is ok.

Finally please note any components not shown on the circuit boards are mounted elsewhere eg VR3 and C20 are mounted on the AF output socket.

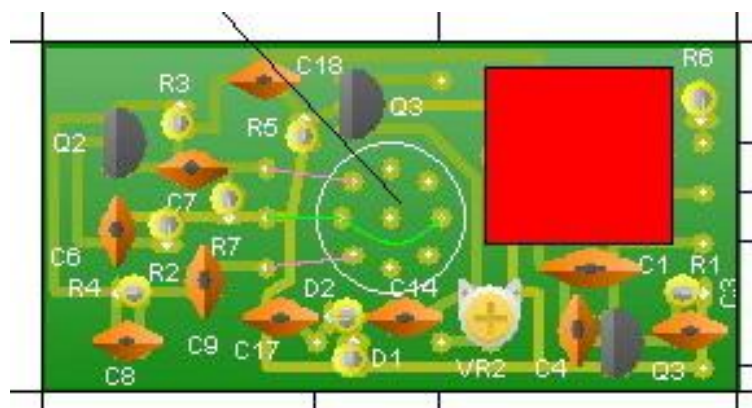




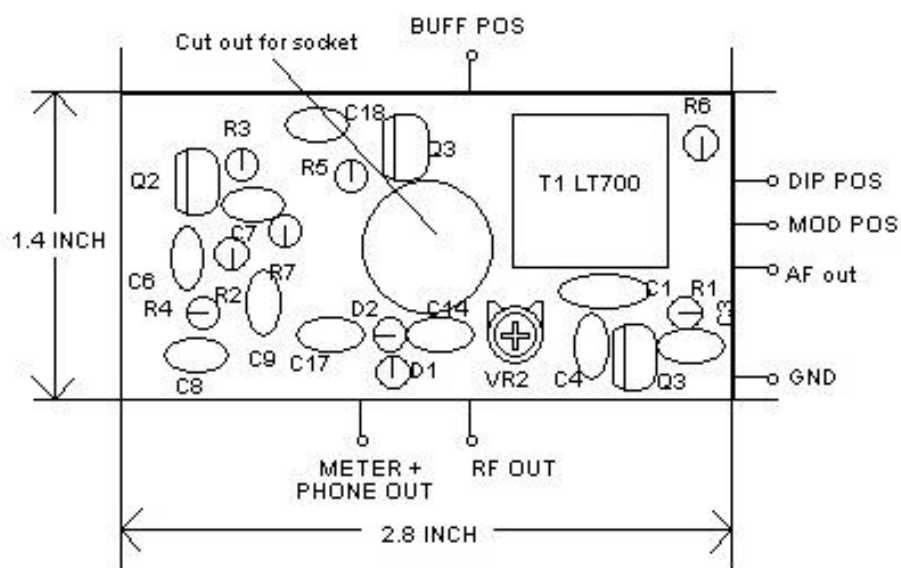
Completed main board



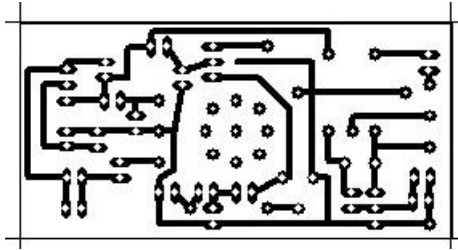
Component placement



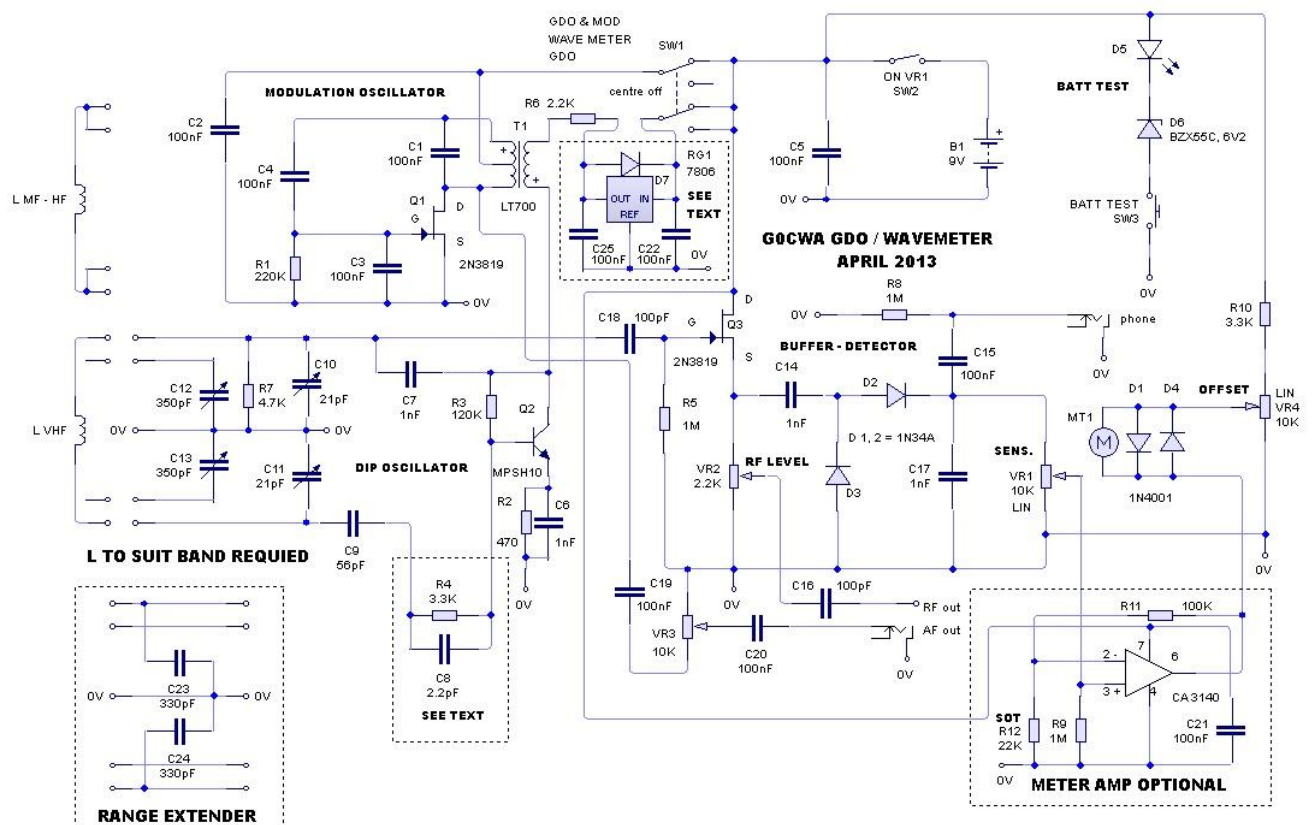
Real World



Silk screen



Track layout (Xray view)



Circuit diagram

Hope you find this is a useful design and enjoy building it, 73 for now de Nick G0CWA

Any comments will be gratefully received and as usual I can be contacted by e-mail at n.strong@hotmail.co.uk or via the Radio Board and QRZ forums as G0CWA.

I cannot guarantee to see your questions if posted elsewhere

REMEMBER TO CHECK THE PCB TRACK LAYOUTS AND MIRROR THEM IF NEEDED. I HAVE PRESENTED THEM AS "X-RAY" VIEWS OF THE FINAL BOARD !!!!

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Coil labels



Tuning Scale

