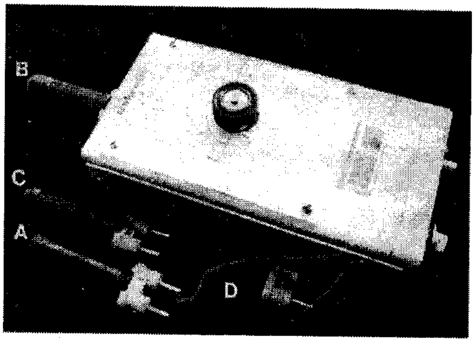
TINKERDIP-A HOMEBBREW BEGINNING

-Ranjan Chakrabarty

Amateur Radio has slowly emerged in India from a totally unknown hobby to a stage where it finds occasional space in literature devoted to the electronics hobbyist. Ham radio, as it is popularly known, is operated by two kinds of people worldwide: one who opt for readymade equipment and the others who prefer to build their own. It is the latter group that is severely handicapped in our country because of inadequate literature adaptable to local conditions. This article reveals that it is perfectly possible to make and operate amateur radio gear with little money and of course a large measure of zeal.



To operate an amateur radio successfully, it is necessary to make measurements at all stages. With a home-built gear it is practically impossible to do without measurements at all stages from start till the finished piece of equipment reaches the operating table.

Though quite crude methods often suffice, one must appreciate that the more refined the measuring instruments and methods, the more information can be obtained. Hence a piece of equipment can be adjusted for optimum performance more quickly and surely. " The regulations governing amateur radio operations require that the transmitted serial be maintained within the limits of the bands of frequencies allotted to the service. Consequently, it is imperative that homebrew gear be built to abide by such regulations. For the homebrewer, a dip meter is one of the most useful instruments to possess. Fortunately, it is also one of the (comparatively) easier projects to start with.

The instrument The 'Tinkerdip' is a solidstate FET GDO./Wave meter (acronym for Gate Dip Oscillator) calibrated to operate from 4.9 MHz to 88 MHz in four ranges. The circuit is based on data published in several amateur radio journals and is not original. However the entire approach has been to enable the use of locally available components and therefore suitable modifications have been made as shown in Fig. 1. These include the addition of a DC amplifier and the ability of the instrument is doubled as a sensitive wave meter. The reason it is called the Tinkerdip is personal and arose from the fact that all homebrewing involves a lot of tinkering. The 'tinker' series of homebrew gear started a long while ago in my ham radio career, graduating from simple code practice oscillators to fully solidstate SSB generators and frequency counters etc.

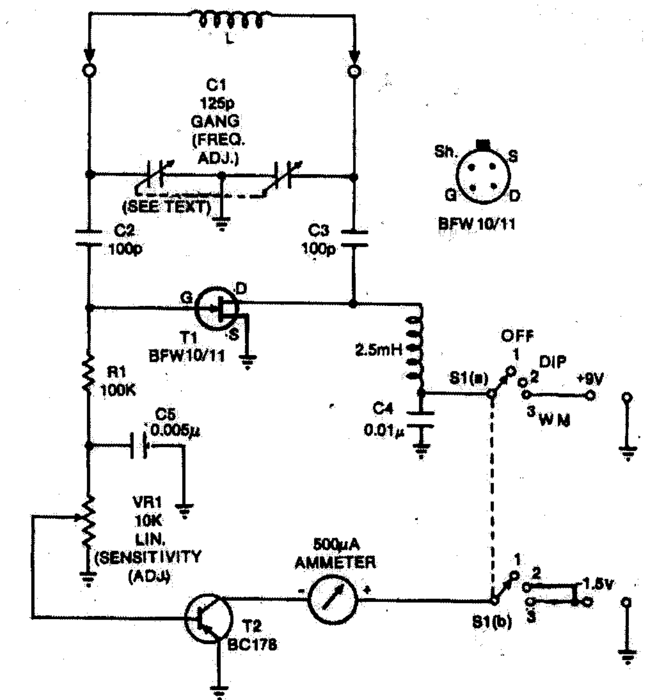
Principle of operation

One must understand that a meter is simply a stable calibrated oscillator operating over a desired range, to which a meter has been added to indicate the amount of bias current (gate current). When the oscillator is coupled to a tuned circuit and tuned through resonance with it, the meter will indicate a fall or 'DIP' in gate current. The reason is the unknown external circuit which absorbs energy from the oscillator when both are tuned to the same frequency, resulting in decreased feed-back in the oscillator and a consequent drop in gate current. If the unknown circuit has a reasonably high 'Q', the dip is quite pronounced. The circuit to be tested need not be energised. Obviously, a GDO can be useful only if it is compact and can be easily coupled to circuits under test. The Tinkerdip was thus conceived alonglhe following lines:

1. Must be conveniently hand-held.
2. Must have a wide tuning range.
3. Must have a direct reading calibration.
4. Must have a neat professional appearance.

Construction

Considering these conditions the AUGUST 1987 Tinkerdip was made in an aluminium box measuring 5x8.5x16 cms (HWD), fashioned entirely at home from a 18 SWG sheet: A thicker gauge and any other material is difficult to work with while a thinner gauge neither lends the desired strength nor can be tapped for machine screws. In case a similar readymade box is available, use it by all means since that saves a lot of sweat. The box is composed of two 'U' sections, the electronics being assembled in the broader 'U' while the other is used as the bottom/side cover.



L—15mm (OUTER DIAMETER) PHENOLIC FORMERS/26 SWG ENAMELLED COPPER WIRE
A—71 TURNS
B—20 TURNS
C—8 TURNS
D—1¼ TURNS 17mm (INNER DIAMETER) AIR CORE/18 SWG ENAMELLED COPPER WIRE
S1—2-POLE, 3-WAY MINIATURE SLIDE SWITCH

The plug-in coil forms are made from quality IV antenna connectors(male) and phenolic formers. The latter, cut to 6cm lengths, are notched at one end to accommodate the connector, force fit and epoxied to the former. Ceramic connectors, if available,should certainly be used instead.

The calibrated dial is made from 3mm thick 10.5 x7.5 cms Perspex sheet, requiring careful working with hand tools. A little carelessness can easily result in unsightly scratches, marring the looks of an otherwise well made instrument; The actual calibrations are written carefully with a drawing pen on snow white bond paper, cut to size and held in place by the perspex sheet that a~ts as a protective cover. The pointer is made from a 1cm wide strip of perspex
epoxied to the bottom of a small knob. While doing this, it is wise to check that with the capacitor fully meshed, the hairline on the pointer aligns with the calibration.

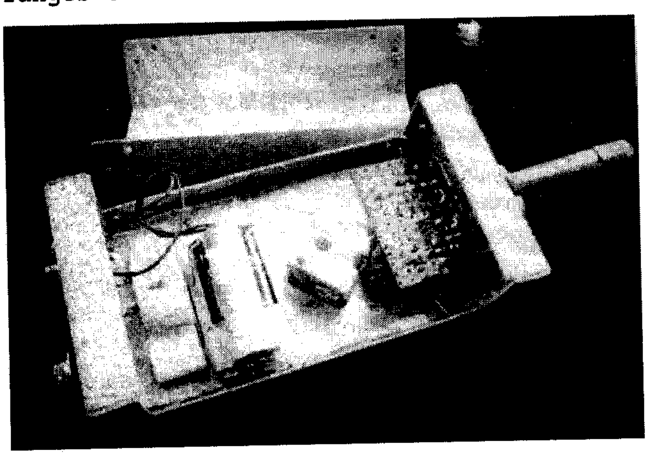
The TV antenna connector that acts " as the socket for the plug-in coils is mounted on the top lip of the U chassis. Since not much circuitry is involved, no PCB pattern was made; the components were mounted on a piece of veroboard, which was then mounted across the lugs of the TV connector and those of the variable capacitor. Sufficient mechanical rigidity is thus achieved. All RF wiring is kept as short as possible.

A small edgewise meter (500u AFSD) used to indicate the gate current via the PC amplifier is epoxied with thermocole brackets to a slot that clears the meter face. Enough space is left for the battery power sources (9V and 1.5V). The sensitivity control (VR1) and the Off/Dip/WM switch are mounted on the bottom lip of the U chassis. 3mm and 6mm brass machine screws are used throughout as standard fasteners and the chassis is tapped wherever necessary to accept them. The complete chassis is painted pale-green and the controls labelled with dry transfers.

The electronics

The colpitts oscillator is simple, requires a minimum number of components and is exceptionally stable when carefully made. The 125pF split stator variable is not critical and can easily be substituted. Decreasing or increasing the value of capacitance will directly lead" to a slower or faster tuning rate respectively. A capacitor with a large value can easily be tailored; the thumb rule is to divide the total capacitance per section by the number of rotor plates (in that section) to obtain the capacitance per plate. One now has only to remove the number of plates required to obtain the desired value. In the interest of stability, always pick a double bearing capacitor. A 500A FSD meter was used because it was readily available; any other movement between 250uA and 1 mA is suitable. The most-inexpensive-kinds are the 'VU' meters used in hi-fi systems; they generally have a 500uA scale.

The coils are wound with a 26 SWG enamelled copper wire except coil 'D' which is made from 16 SWG stock. All the coils wound on formers are weatherproofed by dipping them in a solution of NC paint thinner and 'Quickfix (or any other epoxy based adhesive}. The novice homebrewer should keep in mind that changes in coil dimension! will alter inductance, thereby affection! the ranges covered.



Testing and calibration

Once the instrument is complete(and the batteries installed, it is ready fo preliminary check before calibration Plug in a coil, advance the sensitivity control by about one-forth of its full trajectory and then switch to the 'DIP' position. The meter should instantly register a gate current; grip the coil in the palm of your hand and a dip in gate current should be noticed. Once this has been achieved the 'Tinkerdip. Is ready for calibration.

It is ideal to have access to a digital frequency counter, but failing this, most ham rigs that are commercially made these days have a general coverage receiver going up to 30 MHz. Assuming that neither is available with the builder, the easiest place to locate them is the nearest engineering college and the nearest radio ham who operates a commercial rig (in that order).

To calibrate the dip meter, switch it on to the 'DIP' position with a coil plugged in and sweep it through its range till a tone is heard on the receiver. Once a tone is heard, sweep it to the maximum capacitance (lowest frequency) position and then mark the g dial at 1 MHz intervals, noting that at the exact 1

MHz points, the tone heard from the receiver decreases in pitch from a high to a low to zero beat. All d four coils may thus be calibrated, provided the receiver tuning covers the entire range.

When using a counter, the moment the test signal is fed into the entry port a readout is available on the display. Use as loose a coupling as possible that permits a legitimate display; overloading the entry port will give false readings.

Usage

The dip meter is normally used to measure the resonant frequencies of unknown LC circuits but may also e used otherwise. It can be used as a variable signal source where the degree of coupling wlIl vary the desired signal e level. With a standard L and C, unknown values of C and L can be found respectively. It may also be used as a quartz crystal activity checker by plugging in the crystal in place of the it coil; the amount of deflection indicating the strength of oscillation.

In conclusion, it would be a betrayal of the legacy handed down by radio hams of yesteryears when homebrewing was the rule rather than the exception, if we cease to continue. I would it like to thank VU2EM (Avinash Missra, my guru), VU2ATN, VU2DB, VU2LL, VU2PB, VU2ALP and VU2TKS, who have all been my major source of inspiration and encouragement over the years making possible more than a decade's operation of ham radio with a 100 per cent homebrew a station.

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