THE WEST RAND AMATEUR RADIO CLUB

May 2005
Volume 5, Issue 10

ANODE

Inside this issue:

Special points of interest:

- Contact details on back page (updated)
- New email address for Anode and ZS6WR. See back page

Editor's Comments

Project "Ham Comp"

It would appear that I got some members interested in using their old computers for Ham use. Quite a few expressed an interest at the "Bring and Fix" meeting as well as a good turn out at the Saturday get together. Several computers were tested and some even worked! Unfortunately Craig's Pentium II/III machine had been hit by a lightning induced surge. The serial and disk interface chip had been damaged and this had relegated the machine to the unrepairable pile. For more details see below.

Nice to see another hoarder of electronics magazines get his reward. Having 'acquired' the Electronics magazines from the Philips library, he proceeded to store them under floorboards in his house. Intel offered a $10,000 reward for a copy of the issue which had Dr. Moore's original article. The UK hoarder dug out the issue and claimed the reward. He apparently didn't make his XYL eat any other magazines as punishment. As I read the article on the BBC rss feed, I remembered all the times my ex urged me to get rid of all those 'old magazines'.

First 60-metre Permit

(Continued on page 2)

Project "Ham-Comp"

Objective

To assemble as many complete working computer systems with amateur radio software for distribution amongst members and interested parties. To raise the club members ability and resources level.

Method

Collect all computer hardware at the club. Use 'bring & fix' meetings to teach/train members in hardware assembly of pc's. Use volunteer members to test and report on pc based software. Schedule assembly then software installation and then test and demonstration.

Requirements

Lowest level of hardware:

80386SX with 4MB+, 80MB+ hard disk drive, 2 x Serial ports, 1 x parallel port, monochrome display & monitor. Sound card.

Software operating systems:

- Linux with DOS compatibility: to run console applications.
- Linux with WINE (Windows Emulator): to run Win 9x apps.
- Windows 98SE - if desperate.

Applications

- Morse Tx/Rx, RTTY, packet modes. Call

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Editors Comments & News

(Continued from page 1)

in Africa Issued to ZD8I

Ian Coverdale, G8WVW, operating as ZD8I, has been issued with a 60-metre permit by the Ascension Island Administrator and is believed to be the first African station operational on this band. His first contact on 5MHz was with W1JR on 22 April, with the first UK station being David, MM5DWW, on 27 April. Signals so far have been very weak. However, moderately low noise levels and a total lack of QRM has helped to establish contacts from around 2200 onwards. The ZD8I QSL manager is Mike, G4LTI.

50MHz GJ DXpedition 13-19 May

Peter, G8BCG, will be operating on 50MHz SSB and WSJT Meteor Scatter, Sporadic E and EME as GJ8BCG/P from Jersey from 13 to 19 May. Skeds are welcome, particularly for EME QSOs: e-mail sked@h-ww.co.uk More details will be posted on Peter's website.

Source - RSGB newsgroup bulletin

Main Home page:
http://www.rsgb.org
Members Only Home Page:
http://www.rsgb.org/membersonly/lo-news.htm

Digital Capacitance Meter

Easy to build digital capacitance meter for the home shop features ranges from 1000 pF to 100 uF

Amateurs who build or service electronic equipment sooner or later encounter the situation where replacing a capacitor with a larger to one produces the wrong results: power supply ripple worsens or the time constant of a timing circuit decreases when it should increase. High pass or low pass audio might have their actual 3 dB roll off points at 200 Hz instead of the intended 300 Hz point. Such differences often occur because the actual value of the capacitor used is different from its marked value. The best performance of narrow band pass filters and notch filters is obtained when matched capacitors of exactly the same value are used. There are many good "100 for a dollar" capacitor buys available, but they often included unmarked or house numbered units. Those 25 cent, 68uF capacitors 1 bought at a ham fest were actually 6.8uF, the reason, no doubt, they were only 25 cents.

Capacitors are among the most common components used in electronics. Most users assume that the value marked on the capacitor is its actual value; specifications simply guarantee a minimum value. Most electrolytics, for example, are specified to be within + 80 to 20 per cent of their indicated value. There are a few that are within ± 10 per cent of their marked value; some small capacitors are available with 1 per cent and 5 per cent tolerances. The true value of a capacitor is not important in some cases, such as audio bypass applications, while in other applications the capacitance must be accurately known to produce the desired results.

The digital capacitor meter presented in this article was built to preclude the type of problems described above. It measures capacitors from 0.001 uF to 999 uF in six ranges, with accuracy of about 1 per cent. The three digit display has the decimal point correctly positioned as the ranges are switched. The circuit uses low cost components which are readily available. It requires no difficult adjustments for reliable operation and is easy to duplicate with the printed circuit board layout shown. The meter requires about 100 mA from a 5 volt regulated source, so it lends itself to battery operation if desired. The circuit includes a flashing overflow indicator.

circuit description

The circuit is based upon a digital counter that counts a reference oscillator. The input to the counter is gated by the Q, monostable which has its period determined by the capacitor to be measured.

The functional block diagram is

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Digital Capacitance Meter

(Continued from page 2)

shown in fig. 1. About once a second, the sample rate oscilla- tions and an input control gate. The counter chip's BCD output is applied to a single en seg-

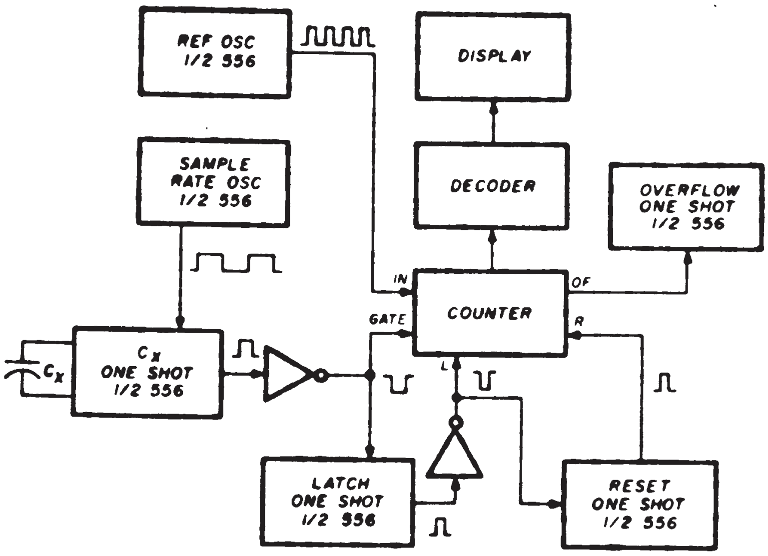

fig. 1. Functional block diagram of the digital capacitance meter. The meter is based upon the 14553 counter. The other ICs provide the necessary gating for the oscillators and display functions.

tor triggers the C monostable circuit. This monostable output is inverted and applied to the counter control gate. The duration of this control gate input is directly dependent upon the value of the capacitor being measured. If the reference oscillator input to the 14533 IC counter is at the proper frequency, the resulting display will indicate the value of the capacitor. One half of a 556 dual timer serves as the sample rate oscillator,, while another 556 dual timer is used as the C,, monostable and reference oscillator.

The 14553 counter chip contains all the circuitry to count and multiplex three digits. It has built in latch and reset functions and an input control gate. The counter chip's BCD output is applied to a single en segment decoder which drives the multiplexed LCD displays. The required latch and reset functions are provided by another 556 dual timer with each of its sections operating in the monostable mode. The latch signal is applied to the 14553 at the end of the input gate enable period to store and display the accumulated count. Immediately thereafter the reset signal is applied. The 14553 holds the outputs for the displays, even though the internal counters have been reset, until the latch signal is again low. The latch signal goes low only after the capacitor value has been measured again. This produces a constant or steady display that does not flicker or count up to the final value.

The circuit timing diagram is shown in fig. 2. The overflow signal from the 14553 is applied to one half of a 556 dual timer to provide an overflow indication. The timer is run as a monostable to produce a flashing LED overflow indicator. Fig. 1 shows wave forms at significant locations and indicates the direction of information flow in the circuit. The complete schematic diagram is shown in fig. 3.

Construction is uncomplicated when using the printed circuit board. Fig. 4 shows the location of components on the board. while fig. 5 shows the circuit board foil pattern. Careful examination of fig. 4 will reveal the location of the numbered and lettered points to be wired to the display and the range switch. These points are shown on the schematic for easy reference. Switch wiring is shown in fig. 6. Points X. Y, and Z are not used.

The circuit uses a common anode multiplexed display. The seven 82 ohm resistors near the 7446 decoder are the recommended value for displays that require around 10 mA per segment. The suggested value for displays rated at 5 mA per segment is 150 ohms. These values can be varied to achieve the desired display brightness. One unit was built without the seven current limiting resistors (to achieve the maximum brightness) and has worked without any LED burnout prob-

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Digital Capacitance Meter

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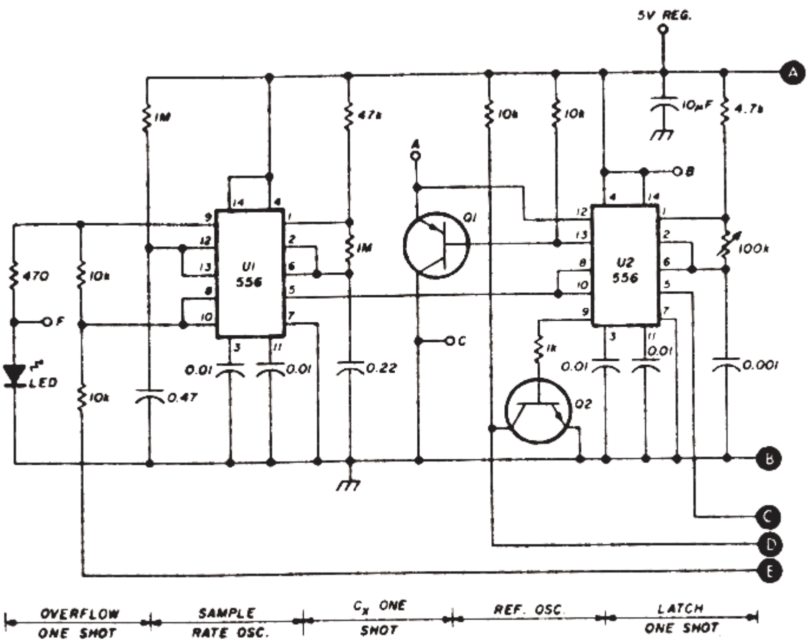
lems.

None of the circuit component values are critical, but best performance can be obtained with a good quality capacitor, preferably plastic, for the reference oscillator. This particular capacitor is the 0.001 uF capacitor located near the 100k pot and connected to pins 2 and 6 of U2. Q1 is used to boost the current handling capability of the Cx, monostable (U2) and should have low capacitance and a power rating of 1/2 to 1 watt. A 2N3906 will work with good results. Transistors 01, Q4, Q5, and Q6 are PNP transistors, while 02, 03, and Q7 are NPN transistors; 2N3906's, and 2N3904's can be used, respectively. Q4, Q5,, and Q6 should be installed so that their emitters go to the 5 volt land, bases go to the 1 kilohm resistors, and their collectors to the anodes of the display. The overflow LED is connected with its anode to point F on the circuit board and the cathode to ground.



A well regulated, 5 volt power supply capable of 100 to 150 mA is required. Fig. 7 shows a schematic for a suitable supply.

Point to point wiring on a insulated board is an easy way to build the supply.

Care should be taken to keep the wiring between Q1, the range switch, and the Cx, input jacks as short as possible and away from the 60 Hz ac line.

Checkout and calibration

The circuit board should be completed and all wiring connected to the display, overflow indicator, and range switch before starting checkout. Make sure that the power supply is delivering 5 volts and is properly connected to the circuit board. At power turn on, the display should fight and the overflow indicator should flash once. The display should show 000 or 001 with no connection at the Cx, input. With a short

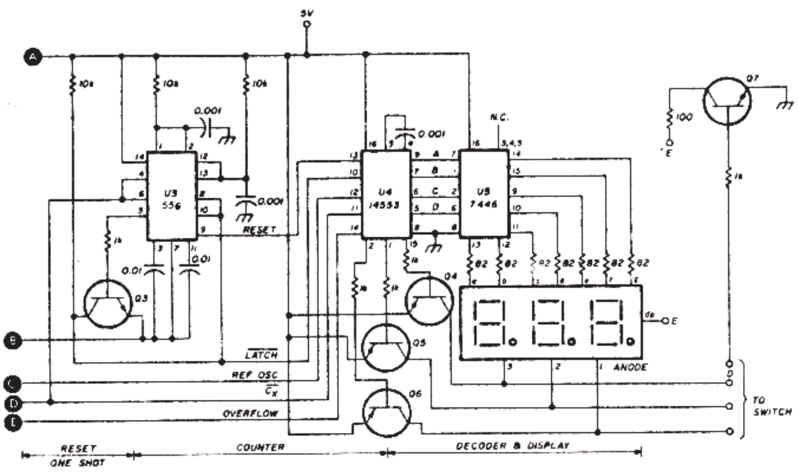


fig. 3. Complete schematic diagram of the digital capacitance meter. Suggested types for the transistors are given in the text. The current requirement of the meter is approximately 100 mA, small enough that a battery supply can be used for field use.

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Digital Capacitance Meter

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across the Cx, input, the display should show a number, say 433, and the overflow indicator will flash continuously.

This number should not change when the range switch is moved to other positions. The display should show a number of 000 to 002 with the range switch in position 1 (see fig. 6) and no connection at the Cx, input. An unsteady count ranging from 000 to about 060 indicates that the meter is picking up stray 60 Hz. If this happens, try redressing or rerouting the wiring between the circuit board, range switch, and Cx, input jacks. K4ZW found that reversing the ac line cord at the wall outlet would help with such a situation. A simple test of U5, the display, and the wiring between can be made by temporarily grounding pin 3 of U5; the display should show 888.

The unit must be calibrated before use. Capacitors of known value are required. Surplus computer and audio boards are a good source for precision capacitors. I found 1 per cent capacitors from 0.001 to 2.5 uF at local ham fests. The meter should be allowed to warm up for about 20 minutes before calibration. If precision measurements in the 10s and 100s of microfarads ranges are not required, the 2000 and 200 ohm pots at positions 5 and 6 of the range switch can be replaced with 1000 and 100 ohm fixed resistors. To calibrate the meter, connect a 0.1 to 0.3 uF capacitor of known value, and with the range switch in position 3, adjust the 100 kilohm reference oscillator pot on the circuit board so that the display indicates the correct capacitor value. This calibrates the 100k pF range (switch position 3) as well as the 10k pF (position 2) and 1 uF (position 4) ranges.

The 1k pF is range calibrated by the 1 megohm pot at switch position 1; the 10 uF and 100 uF ranges are calibrated by the 2000 and 200 ohm pots at positions 5 and 6.

Using the meter

Operation of the meter is simple. Observing proper polarity, connect the capacitor to be measured, select the largest range that does not cause an overflow, and read the capacitor value shown on the display. Table 1 shows examples of how the display indicates various capacitor values for each of the range switch positions. The first three ranges measure in thousands of pF and the last three ranges measure in uF. The decimal point is properly positioned. Note that if a 22 uF capacitor is being measured the range switch should be in position 5 and the display will show 22.0. A 0.047 uF capacitor is 47kpF, and it will be measured with the range switch in position 2. The display will show 47.0. Labelling the first three positions of the range switch as kpF (or nF for nanoFarads if preferred), and the last three positions as uF will make the meter very easy to read.

An open capacitor will cause a 000 to 001 to be displayed. A shorted capacitor will cause the overflow indicator to flash and the display to indicate a fixed number that is independent of the range switch position.

Lead lengths should be kept short when measuring small value capacitors. The photographs show a plug in device made from banana plugs, a small piece of copper clad board, and sheet brass.

Conclusion

The digital capacitor meter has been a fun project to build and it has been a time (and agony) saver around the ham shack. I hope that others who enjoy building and experimenting will find it to be the same. I will offer film negatives (or positives) so that builders can make their own circuit boards. Correspondence regarding the meter will be answered if an SASE is included.

Table 1. Switch positions for various measurement ranges showing display and associated capacitance value. In switch position 1. a display of 1. indicates a capacitance of 0.015 uF (15 pF). a reading of 2.20 indicates a capacitance of

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Digital Capacitance Meter

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0.002 uF (2200 pF). etc.

Acknowledgments

Several hams have been of great assistance in developing the digital capacitor meter, in particular WA0VN, K4UU, and W4PVA. MZK11 provided valuable information on driving the display to full brightness, and W4PVA helped with the information on the 14553 counter chip without which the project could not have been undertaken. WA4WN built his meter according to this article to verify the construction and check-out notes.

From ham radio 1980

Project "Ham-Comp"

(Continued from page 1)

book/Log database.

- We shall explore the use of Windows apps running under the Linux emulator. This cuts the cost and problems with legal versions of Windows.
- Use of pc for test equipment. Measurement of Voltage & Current. The Oscilloscope. Signal generation.
- We should also explore the software development tools available to provide innovation and amateur generation of usable software and systems.

Cost implications

Virtually nil for both hardware or software. We will 'scrounge' most of the hardware. The software we can install from the clubs Linux box. CD's can easily be created for use by members.

Saturday at the Club House

switch position	display		Capacitance range
1	1.00	0.001	1000 pF (1 nF)
2	10.0	0.010	10k pF (10 nF)
3	100.00	0.100	100k pF (100 nF)
4	1.00	1.000	1 uF
5	10.00	10.000	10 uF
6	100.00	100.0M	100 uF

Transformer Ratio Analyser

By S. L. Martin

An inexpensive item of test gear which measures the turns ratios of small a.f., transformers

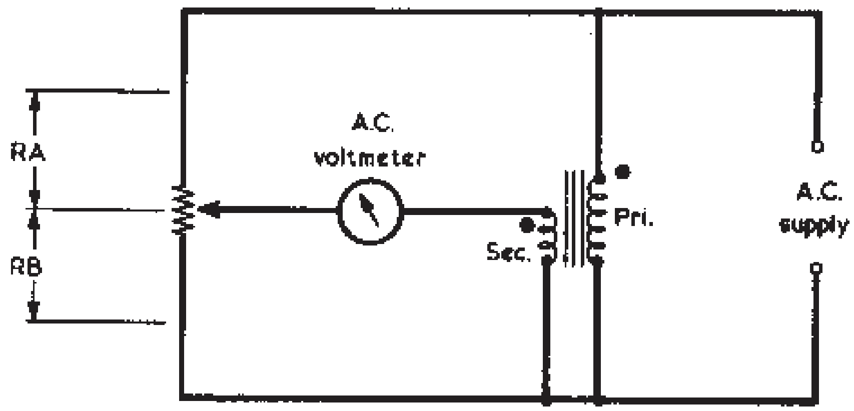
Saddled recently with a large batch of small unmarked transistor a.f. amplifier transformers, the writer devised the item of test equipment described here to sort them out in terms of turns ratio. The circuit to be described has its limitations and would not qualify as an item of laboratory equipment. On the other hand it gives reasonably accurate measurements of turns ratio as well as determining the phase relationship between two windings on a transformer. The components needed are standard types and the more experienced constructor may well have all that is required already to hand in his spares box. A 0-50uA meter movement is employed, and this is provided by a multi test meter switched to read this range of current.

Basic Operation

The basic mode of operation is illustrated by the circuit given in Fig. 1. Here, an a.c. supply is applied to the primary of a step-down transformer. Also. connected across the supply is a potentiometer, the slider of which connects via an a.c. voltmeter to the upper end of the secondary. The two large dots alongside the upper ends of the primary and secondary indicate similar winding ends. That is to say, the two ends indicated by the dots. could both be winding 'starts' or could both be winding 'finishes'. in consequence the induced alternating voltage at the upper end of the secondary is in phase with the applied alternating voltage at the upper end of the primary.

The potentiometer is adjusted for a null, or zero, reading in the a.c. voltmeter. The voltage tapped off by the potentiometer slider will also be in phase with that at the upper end of the primary so that, when the voltage at the potentiometer slider is equal to that at the upper end of the secondary winding, the a.c. voltmeter gives the null reading. At all other settings of the potentiometer there will be an alternating voltage difference between the potentiometer 'slider and the upper end of the secondary winding, and this will be indicated by the a.c. voltmeter. As may be seen, the circuit is one step removed from the familiar Wheatstone bridge.

The alternating voltages across the primary and secondary windings are proportional to the turns ratio. If the transformer has a turns ratio of 2:1 the alternating voltage at the upper end of the secondary, with respect to the lower circuit rail, will be half that at the upper end of the primary. The voltage at the slider will similarly be half that at the upper end of the primary when the potentiometer slider is half-way up the track. So, a 2:1 transformer ratio will be indicated, after adjustment for a null reading in the a.c., voltmeter, by a 2:1 ratio between the total track re-



$$\frac{\text{Pri. turns}}{\text{Sec. turns}} = \frac{RA + RB}{RB}$$

Fig. 1. Illustrating the basic mode of operation of the transformer ratio analyser

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Transformer Ratio Analyser

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sistance and the track resistance below the potentiometer slider.

If the transformer. has a turns ratio of 4:1, then the null indication will be given when the potentiometer slider is quarter-way up the track. Other turns ratios will have corresponding track resistance ratios in the potentiometer, and the overall situation is indicated by the equation which appears below the circuit in Fig. 1. It is an easy matter to provide the potentiometer with a scale calibrated in terms of turns ratio, whereupon the circuit becomes suitable for measuring this property of an a.f. transformer.

Finally, it should be noted that the circuit will not give a null reading if the secondary of the transformer it connected with opposite phase to that shown in Fig. 1, or if it is connected as a step-up transformer. Also, the potentiometer ' slider can only approach, but not pass through, a null indication if the transformer has a turns ratio of 1:1.

Working Circuit

A practical working circuit is shown in Fig. 2. Comparing this with Fig. 1, the primary of the transformer being checked connects to terminals B and C, and the secondary to terminals D and E. This method of connection is illustrated in Fig. 3(a). The a.c. supply of Fig. 1 is now the alternating voltage appearing across the 100 resistor, R3, in Fig. 2. Due to the presence of R2, this voltage is approximately one-tenth of the 6.3 volts obtained from transformer T1, which is a standard 6.3 volt heater transformer. Thus, the alternating frequency applied to the transformer being checked is that of the a.c. mains supply, i.e. 50Hz. The voltage across R3 is only 0.63, whereupon there is little risk of damage to a small transistor a.f. transformer.

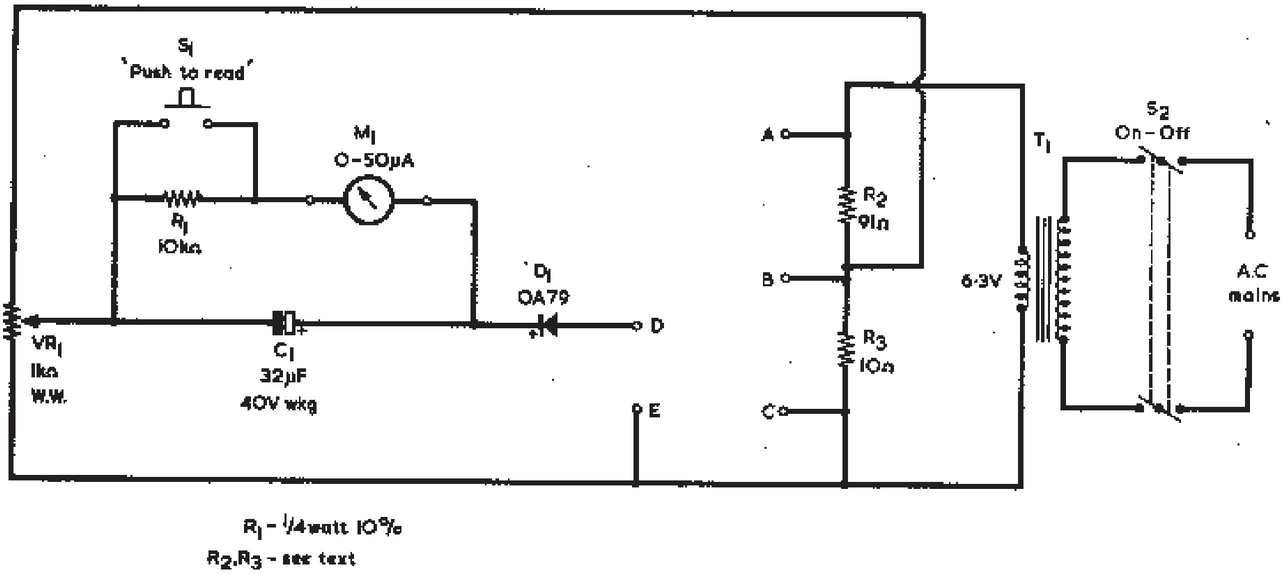

Fig. 2. The practical circuit of the ratio analyser

The a.c. voltmeter incorporates the rectifying and smoothing circuit given by D] and Cl, whilst the meter proper is the 0-50pA movement shown as M1. In practice this is a multimeter switched to read 50pA f.s.d., and connected to the circuit by way of two suitably positioned terminals. The limited capabilities of the circuit do not really warrant the expense of a, permanently installed panel-mounting meter. Normally SI, a push-to-close press button, is left in the open condition'. This allows R1 to remain in series with the meter, where-

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Transformer Ratio Analyser

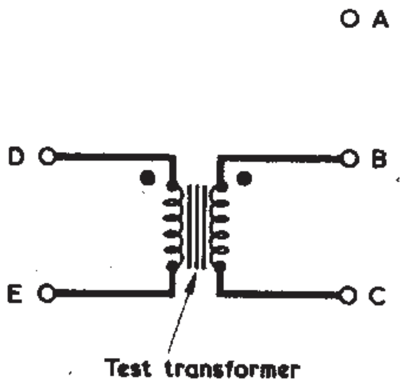
(Continued from page 8)

upon it limits the current input which can flow when VRI slider is away from the zero voltage setting. VR1 is initially adjusted to give a rough zero indication, after which S1 is pressed and a final fine setting in VR1 can then be achieved.

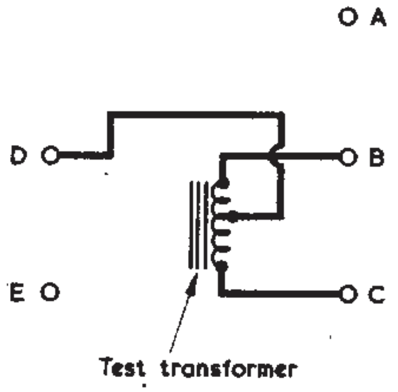
To use the device, the transformer being checked is connected to terminals B, C, D and E with on-off switch S2 open. S2 is then closed and VRI adjusted for a null reading in the meter, remembering that meter indication is a little sluggish due to the presence of Cl. If a null indication cannot be obtained, the connections to the transformer are changed to obtain correct phasing or to ensure that it is functioning as a step-down instead of a step-up component. As soon as a rough null indication is obtained in the meter, S1 is pressed and a final null setting obtained in VRI. The transformer turns ratio is then read from a scale fitted to VRI.

The circuit will also check tapped transformer windings, these being connected to terminals B, C and D as shown in Fig. 3(b). The turns ratio found is then the ratio between the turns in the total winding and, the turns in the section connected to terminals D and C. This facility is helpful when dealing with components such as driver transformers which may have a centre tapped winding and an overall 4:1 ratio. The presence of the centre-tap may be found with the circuit of Fig. 3(b), and the overall ratio determined by checking the remaining winding against half the centre-tapped winding. During checks, any windings which are not connected to the test terminals are left open-circuit.

small transistor transformers may give a balance null reading which is not zero but is a little above zero. This is due to losses in the transformer which result in a small phase shift at 50Hz, and the effect is not important.

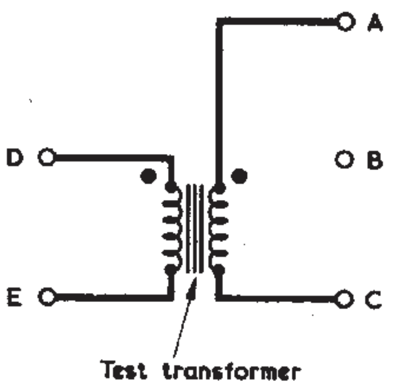


(a)



(b)

Fig. 3 (a). Transformers having ratios of 10:1 or less are connected in the manner shown here (b). Circuit connections for a tapped transformer winding (c). Transformers having ratios in excess of 10:1 are connected to test terminal 'A'



(c)

In Fig. 1 reference was made to the 'primary' and secondary' of the transformer. This was for convenience in explanation and, so far as using the test device is ,concerned, the 'primary' is the winding having the greater number of turns. A few Valve speaker transformers having step-down ratios from some 30:1 to 90:1 can also be checked, and they are connected to terminals A, Q D and E, as illustrated in Fig. 3(c). The alternating voltage across ter-

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Transformer Ratio Analyser

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minals A and C is about 10 times that across terminals B and C, and the ratio indicated at the null setting of VR1 is then multiplied by 10. Thus, a ratio of 4:1 on VR1 scale corresponds to a transformer ratio of 40; 1. Before checking, the primary of the valve speaker transformer can be identified by an ohmmeter, and it will have much higher resistance than the secondary. It is this high resistance winding which connects to terminals A and C.

When checking any unknown transformer which may have a high turns ratio, initially set the test meter to read 0-1mA, or similar. This gives an additional protection against possible excess current in the meter.

Components

As mentioned, the components are all standard types. T1 is any 6.3 volt heater transformer having a secondary current rating of 0.5 amp or more. R2 and R3 may have ratings of 1 watt or more. For precise readings with valve output transformers, R2 should be exactly 9 times the value of R3, but in practice the nearest preferred value of 91n will be satisfactory. Both R2 and R3 should, preferably, be 2% or 1 % in tolerance on value. Incidentally, the combined value of R3 and VR1 in parallel is only marginally lower than the value of R3 on its own.

D1 is specified as an 0A79, but most germanium diodes of similar type could be employed in its place. A 0-100uA meter could be used, if desired, for M I, but the null sensitivity will, of course, be somewhat lower. Since D1 becomes nearly non-conductive at forward voltages below about 0.1 volt, the null obtained when checking efficient transformers which give a true null zero may be determined by swinging VR1 slightly on either side of the central null position.

VR1 is wire-wound since components of this type are normally capable of a high level of resolution. An important point here is to ensure that when the slider is at the end-stops there is very little resistance between the slider and the adjacent end-of-track terminal. This is, a function of potentiometer mechanical design and the ideal condition is given when there is very nearly zero resistance at the track ends.

A few wire-wound potentiometers, particularly in the lower resistance values, have quite high 'end-hop' resistances, and a potentiometer of this type would not enable the higher turns ratios to be indicated. It is for this reason that the potentiometer consists of VRI connected across R3, instead of using a 10n potentiometer to carry out the function of both components.

The potentiometer is calibrated by disconnecting the lower end of its track from the rest of the circuit, and then connecting an ohmmeter between the track lower end and the slider. Calibration in terms of turns ratio may then be carried out with the aid of the accompanying table.

RB (Ohms)	Turns Ratio
100	10:1
125	8:1
167	6:1
200	5:1
250	4:1
333	3:1
500	2:1
667	1.5:1
833	1.2:1
1000	1:1

From

RADIO & ELECTRONICS CONSTRUCTOR
NOVEMBER 1974

The West Rand Amateur Radio Club
26.14122 South - 27.91870 East

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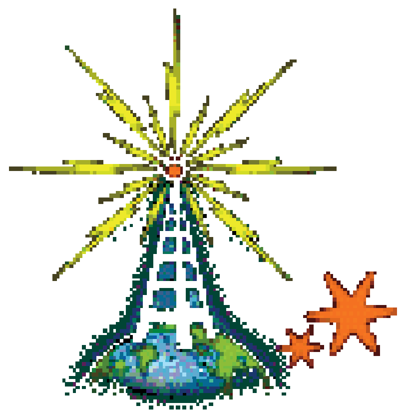
West Rand members - we need your input!

To make this the best ham radio magazine in South Africa we need your input. Please submit articles, comments, suggestions etc.

Please send plain text with no formatting to the email address below.

In July 2003, we re-published an Anode Compendium on CD. It has the issues from July 2000 until June this year. This included the new Adobe reader. It has been updated, check with the chairman for details.



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