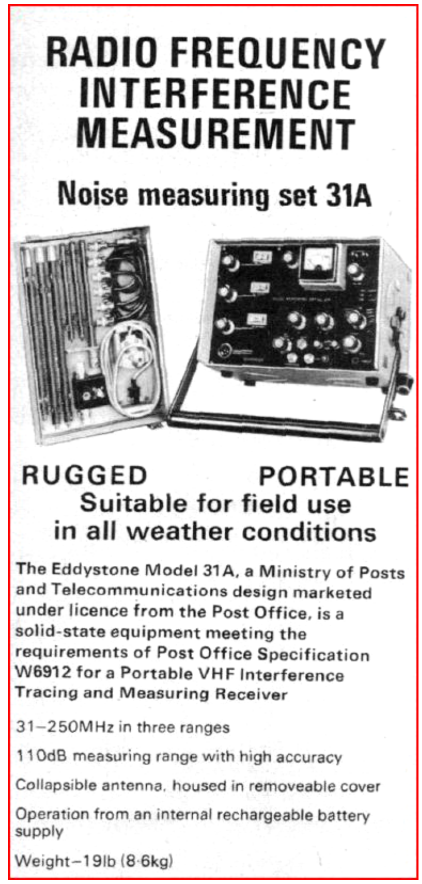
An Ebay 'Pig-in-a-Poke': Repair and Refurbishing the Elusive Eddystone Edometer, by Gerry O'Hara, VE7GUH

Introduction

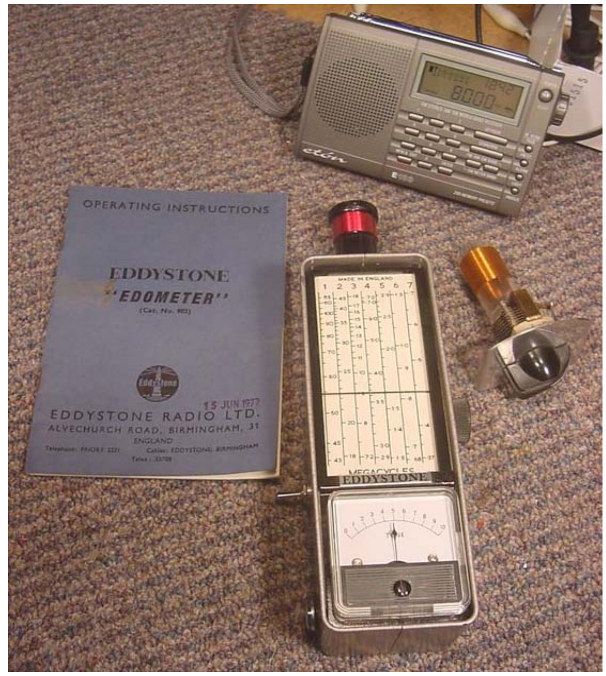
Eddystone did not make a large range of test equipment: apart from a couple of noise measuring test sets (specialty-use receivers made to MPT and Home Office designs), ie. Noise Measuring Sets 31A (advert, right) and 40A, the only real such items are the Modulation Level Indicator (Model 678), Absorption Wavemeter (Model 696), Crystal Calibrator (Model 690) and the 'Edometer' (Cat No. S.902 - MkI and MkII versions). Eddystone also manufactured a range of 'panadaptors', ie. EP14, EP15, EP17R, EPR26 and EPR27 for use with certain receivers. These could also be deployed as 'wobbulators' for aligning receiver IF stages, however these were not really marketed as 'test equipment' as they were primarily intended as an aid to receiving in the professional market.



Background

Introduced in 1965, the Edometer is a solid-state 'dip oscillator' that has a variety of uses. Two versions were manufactured, the MkII version (introduced in 1967) being very similar in appearance to the MkI version (advert, left), but having a different scale, meter and tuning knob. Electrically, it differs in having updated transistors incorporated into the design: the RF oscillator transistor, TR1, (AFZ12 in the MkI) was replaced by an FET (2N3819/TIS34) in the MkII, and the AF amplifier/oscillator, TR2, (OC71 in the MkI) changed to an NPN type (T1407), along with associated changes to the bias circuitry to suit. Both units cover the (fundamental) frequency range 390kHz to 115MHz in 7 ranges. The MkII version was supplied in a solid mahogany wood case, along with 7 coils and looks very 'traditional' – somewhat like a piece of 19th century scientific apparatus. The QRG lists the MkI as 'very rare' (and often minus coils as it was supplied in a cardboard box) and the MkII as 'rare' (but usually complete, as folks liked to look at it all in its splendid case I suppose).

General Description and Operation



Above: Testing the unit in GDO mode at 8MHz using a calibrated tuneable circuit (coil/variable capacitor unit to the right of the instrument) and a digital-readout receiver

The Edometer has three controls: a combined power/sensitivity control, a modulation switch and tuning control. These are arranged on the instrument for convenience in use (for a right-handed person at least). The manual suggests that the unit is held in the left hand, allowing the power/ sensitivity control ‘thumbwheel’ to be operated with the first or second finger of that hand. The tuning control, which is geared 4:1 to the tuning capacitor for ease of adjustment, can then be operated with the right hand.

The sensitivity control is wired such that maximum sensitivity occurs immediately after switch-on and also in the ‘off’ position - the latter needed for when the instrument is being used as an absorption wavemeter.

The ranges covered by each coil in the Edometer (MkII) are:

1. 43MHz – 115MHz
2. 18MHz – 43MHz
3. 7.2MHz – 18MHz
4. 2.9MHz – 7.2MHz
5. 1.3MHz – 2.9MHz
6. 680kHz – 1.3MHz
7. 370kHz – 700kHz

The manual notes that the MkI instrument was supplied with a small ‘drop-in’ scale for Ranges 6 and 7, which extended the coverage down to 390kHz. It is also noted that normal ‘dip’ operation is not possible on these two ranges which are ‘intended mainly for alignment purposes’ (ie. as an RF oscillator only). The MkII has all ranges marked directly on the dial, dispensing with the logging scale that was present on the MkI.

The modulation switch determines whether TR2 serves as an audio amplifier (switch in the ‘off’ position) or as a tone generator (switch in the ‘on’ position).

When the unit is deployed as a tone source, output voltage at the ‘AM Monitor’ jack is fixed at around 100mV, 5kohms impedance at a nominal 1kHz. When ‘phones are inserted into this jack, the RF oscillator is automatically disabled. The unit can be used as an AM modulation monitor with the ‘phones in this jack and the power switched ‘off’. To use the instrument as a heterodyne wavemeter, ‘phones are plugged into the ‘CW Monitor’ jack with the unit switched ‘on’ – this jack does not disable the RF oscillator.

Above: On arrival – looks ok, but all is not what it seems…

Taking the Plunge

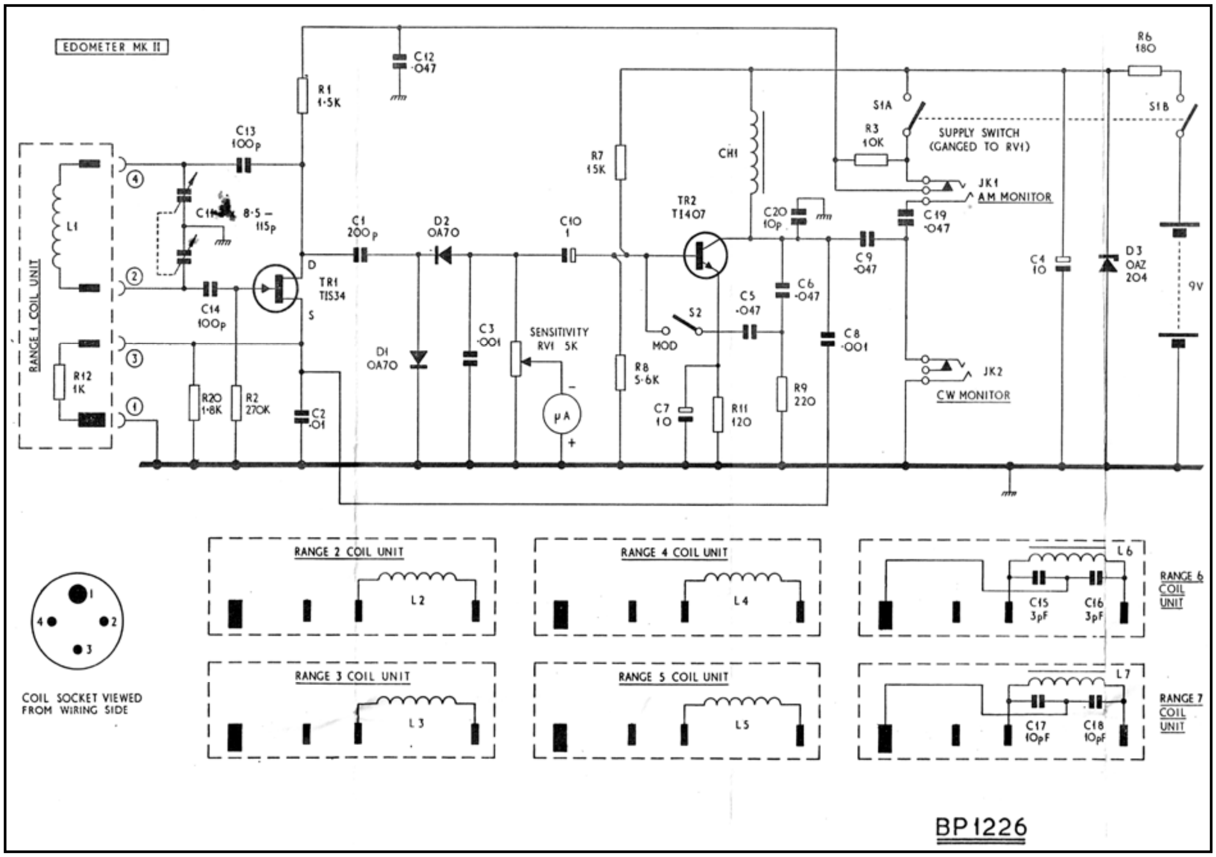
Ever since I first saw a photo of one (in my youth) I knew that I had to have one someday. In the meantime, a variety of grid dip oscillators (GDOs) and gate dip oscillators have come and gone in the G8GUH (and VE7GUH) shack. One of my later acquisitions is a very nice GDO made by Millen (Type No. 90651-A) which uses a 9002 miniature triode valve as the RF oscillator and which has coils covering ranges from 160kHz[1] to over 300MHz. So, I have been keeping an eye on Ebay for a few years and noted that Edometers only come up for sale very occasionally and when they do they usually command a fairly high price – I guess most folks like the 'traditional' look of the unit and coils in their neat little mahogany wood case – very good techie 'eye candy'.

I finally decided to take the plunge and bought one on Ebay – a complete unit in its case with all coils, in fair cosmetic condition but 'found in a shed' and electrically untested (photo, above). My conscience was saying "*Caveat Emptor* Gerry" - but hey I thought, the circuit is so simple you could build one from scratch in an hour or two… right? What could possibly be wrong with something as simple as this? Only two of the most difficult things to find or fix, that's what - yes, I had bought myself an Ebay 'pig-in-a-poke'…

Circuit

The circuit of the MKII Edometer (top of next page) uses an N-Channel JFET (2N3819) as an RF oscillator and an NPN bipolar transistor (T1497) as an AF amplifier/tone generator. Two OA70 germanium point-contact signal diodes serve in a voltage doubler circuit to detect the signal from the oscillator in GDO mode, or when using the unit as an

[1] The standard range of this instrument (using 7 coils) is 1.7MHz to 300MHz. Additional coils (5) extend the range down to 160kHz – see photo on Page 15



absorption wavemeter. The detector circuit output drives the meter via the sensitivity potentiometer. The voltage (9v) supplied by the PP3 battery is stabilized to 6.8v by an OAZ204 Zener diode.

When using the Edometer as a heterodyne wavemeter, the JFET (TR1) functions as a combined oscillator/mixer and when used as a modulation monitor it becomes a detector, coupled to the 'phones via R1/R3, the supply line being disconnected by one pole of the power switch to prevent the audio signal being grounded by C4 in this mode. In both of these applications the audio output from the detector diodes is amplified by the NPN bipolar transistor (TR2) to provide adequate volume to operate a pair of 'phones at a comfortable level via the 'CW Monitor' jack. In addition, TR2 functions as an audio oscillator (1kHz nominal frequency) to modulate the RF when the unit is used as a modulated signal generator, with S2 switching the audio feedback capacitor C5 in/out of circuit. Modulation is applied to the Source of TR1 via C8.

Uses

The Edometer is more than a simple GDO/absorption wavemeter combo. By the addition of a couple of jacks and a switched audio amplifier/modulator stage, uses include:

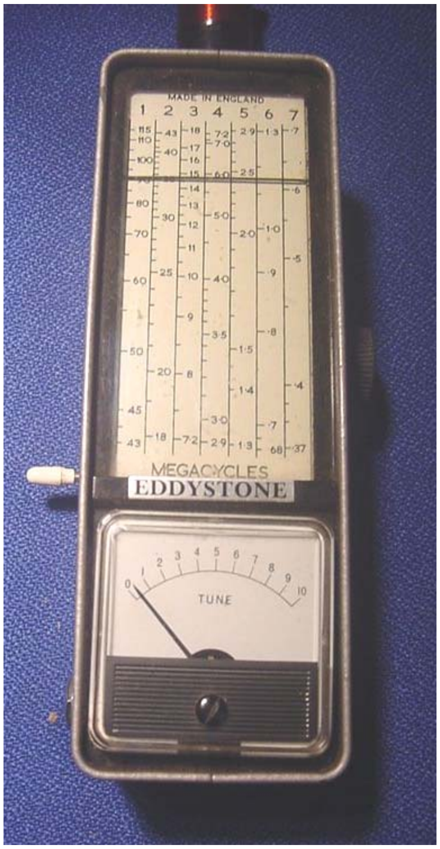
- Gate dip oscillator – used to find the resonance of an (unpowered) tuned circuit;
- Absorption wavemeter – used to find the oscillation frequency of a (powered) tuned circuit;
- AM modulation monitor;

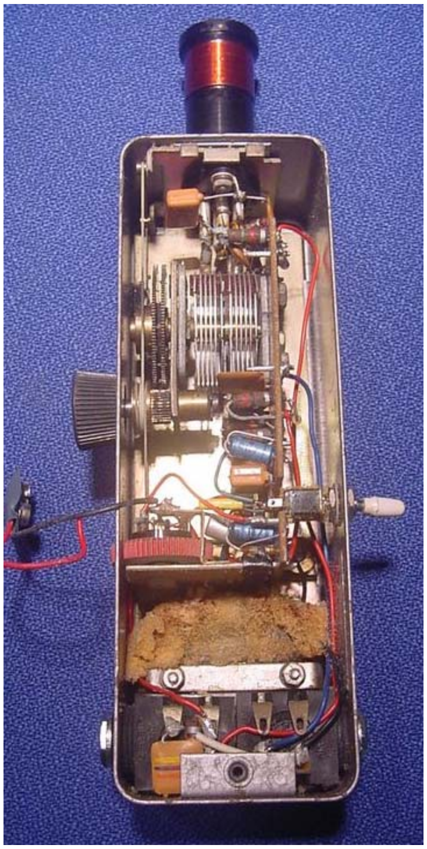
- CW transmission monitor;
- Heterodyne wavemeter - the GDO oscillator is heterodyned with the (powered) tuned circuit to determine its oscillating frequency. This can provide more accurate readings than when used as an absorption wavemeter;
- Measurement of inductance and capacitance (by calculation, using a known value inductance or capacitance) – not so useful in these days of cheap multimeters that measure these parameters;
- Modulated or un-modulated RF signal generator: 370kHz to 115MHz (230MHz on second harmonic) – can be used for aligning a receiver;
- Audio oscillator – for AF stage checking in receivers;
- Morse code practice oscillator;
- Stirring tea – with the coil… (not really).

That's a pretty versatile piece of kit that fits in the palm of your hand!

Arrival and Testing

On arrival at the VE7GUH shack (photos, right), the Edometer was eagerly unpacked, opened-up (to check for an old leaky battery – which there was none, thanks goodness – only some decomposing sponge in the battery compartment - photo, far right). I noticed a loose battery wire and this was re-soldered to the switch contacts. I popped in a coil and battery and…. nothing when tuning across its set frequency on a nearby receiver. Some hasty fiddling about revealed:



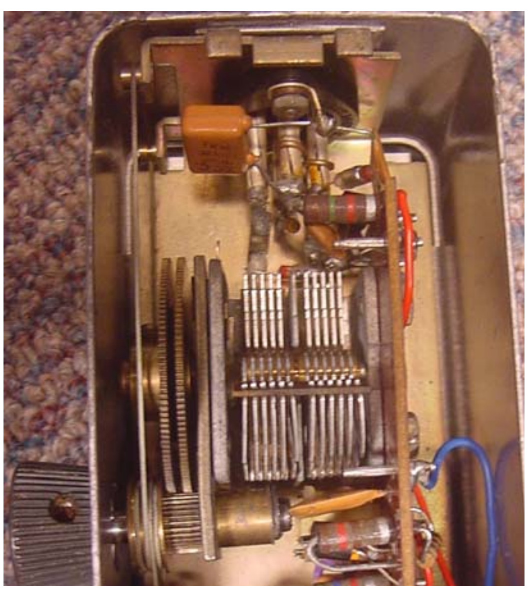


- the side-mounted potentiometer and combined on-off switch was not functioning correctly – intermittent switch and the pot was completely useless (open circuit) until it was rotated fully clockwise; and (of more concern)
- the meter movement was not working at all (oh dear – I wanted a working unit not an expensive ornament!)

I disconnected the meter from the circuit and temporarily wired-in a (large) 500uA FSD meter external to the Edometer housing. With the on-off switch by-passed and the pot advanced fully, I heard a signal on a nearby receiver when the Edometer was tuned through the set frequency on the receiver – actually quite close to the reading on the Edometer dial. Phew – at least something was working! All the coils were tested in the unit in this arrangement and all worked ok.

Construction

The unit comprises a metal (steel) box of welded-seam construction, painted in a silver-grey ('oyster' Hammerite finish) with simple white decal labels (transfers) next to each of the controls. The box houses a miniature Eddystone slide rule dial mechanism which is well-up to the usual standard of mechanical components expected of an Eddystone, a printed circuit board mounted on a small chassis that has a bracket at one end onto which is mounted the sensitivity pot/on-off switch, a meter unit, a battery connector (PP3) and two 1/4 " jack sockets (headphones and key). A miniature switch is mounted in the case to toggle the 1kHz AF modulation on/off and the tuning capacitor, along with brass reduction gearing, is mounted on the chassis. The shaft of the variable capacitor reduction gearing protrudes through a hole in the side of the case. Coils (photo, above) are plugged into a four-pin socket, fitted to the end of the chassis (top in photo, below left) and which protrudes through a hole in the end of the case. The sensitivity pot/switch is fitted with a thumbwheel that aligns with a vertical slot in the side of the case. The PP3 battery fits neatly in behind the meter, between the jack sockets and the chassis bracket. The RF oscillator circuitry is point-to-point wired directly to the coil socket and tuning capacitor to minimize stray inductance/ capacitance in the tuned circuit. Most of the remaining components are located on the printed circuit board.



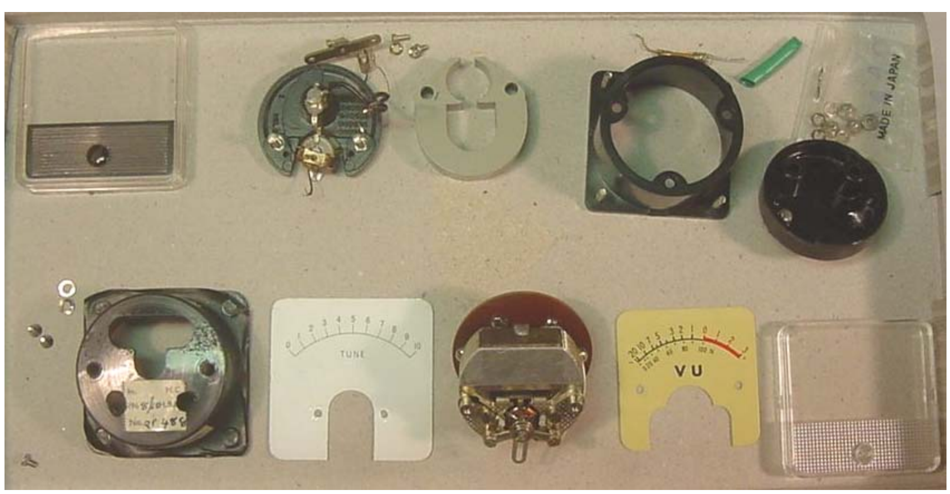
Repairs

I needed to extract the Edometer 'guts' from its case to work on the pot/switch and meter – a job easier said than done, for it would seem that the metal case was welded around the circuit board… well, maybe not quite, but a lot of careful manipulation is needed to remove it from the case. To dismantle one of these units:

- Remove the coil (if fitted);
- Remove the case back:
- Remove the tuning knob;
- Remove the battery;
- Unsolder the meter wires;
- Unsolder the ‘Modulation’ toggle switch wires;
- Remove the ‘Modulation’ toggle switch retaining nut and washer and remove the switch;
- Loosen and remove the 6BA nuts holding the meter retention bracket in place;
- Remove the meter through the front of the black meter panel and remove panel;
- Remove both jack socket nuts and spacer washers;
- Remove the two 6BA taper-head screws holding the chassis in place;
- Remove the Perspex dial cover (it is fixed in position by a sticky goo along each long edge – gentle prying with a small screwdriver will lift it away). Now the tricky part…;
- Pry-open the sides of the case and manipulate the chassis out of it. It is not easy, but can be done… (honest!!). See page 12 for more discussion on this.

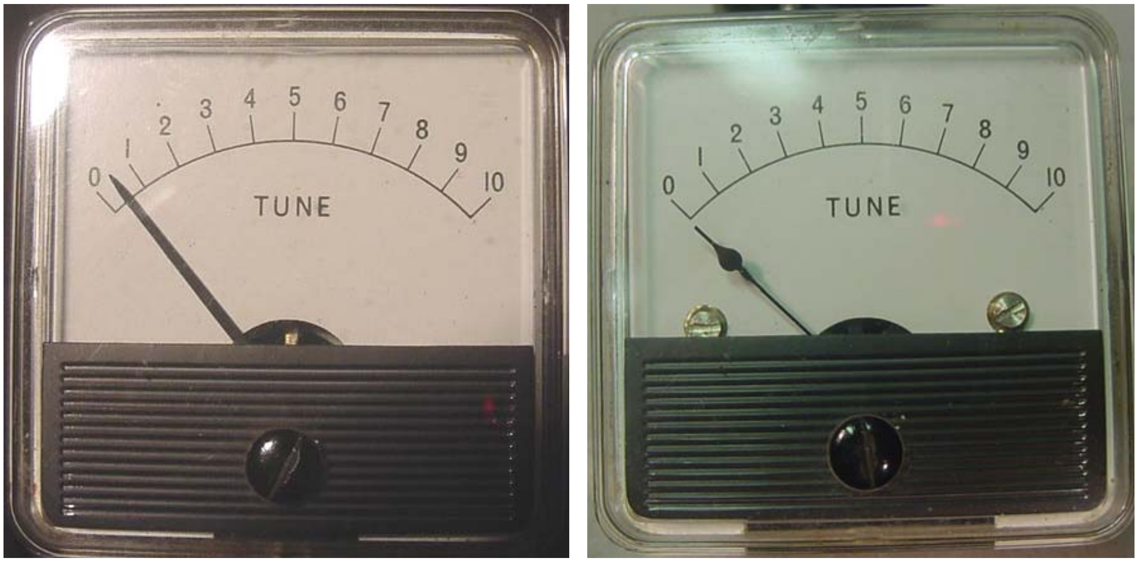
Meter

I dismantled the meter unit and found that one of the coil springs was twisted, causing the moving coil to be forced against the magnet and was thus preventing the movement from working. I played around with this for several hours and finally gave up – the mechanism was beyond repair. The meter movement is not one of the best I have ever seen – in fact I was rather disappointed in its quality considering this was an Eddystone unit. Oh, well, what to do? I searched my junk box for a similar meter but could not find anything remotely suitable. A search of the many boxes of meters at the SPARC museum identified some likely candidates, but nothing that looked ideal. I borrowed several to try. In the end I decided to undertake a transplant of a suitable mechanism



Above: Ready for the transplant operation – original meter parts on the left, donor meter parts on the right – “Pass the scalpel and make some fresh tea please nurse… and plenty of it to boot!”

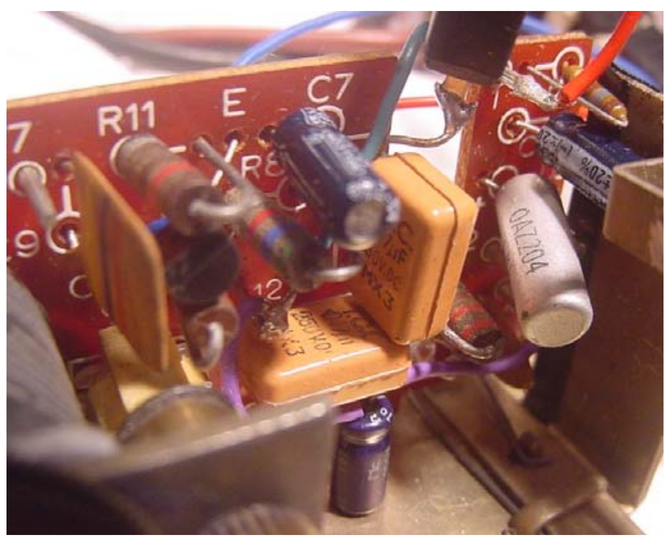
(150uA FSD sensitivity) from a 1960's vintage tape recorder VU meter into the original meter case – this took some doing as I had to drill new holes in the case, trim the aperture on the scale plate where the needle moves in an arc and drill two new holes in the scale plate to mount it on the transplanted mechanism. This does not sound too difficult, but it is very fiddly work that has to be undertaken with precision. Several hours later, the transplant was complete and I now had a functioning meter unit – thank goodness!



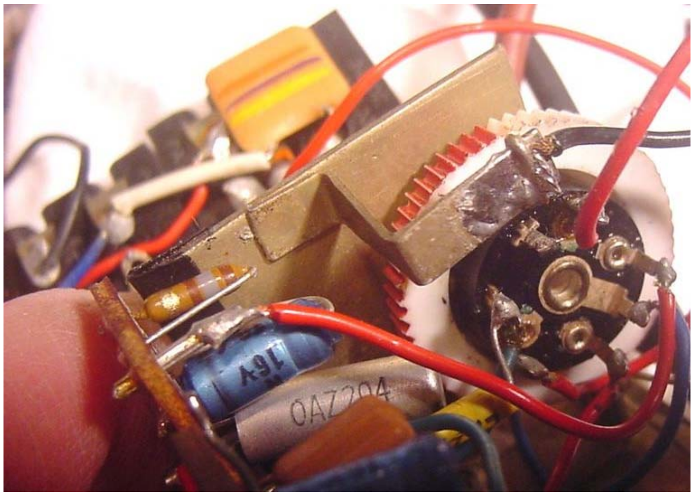
Above left: the original meter. Above right: transplanted meter movement in the original case. The dial is also the original – note the two screws holding it in place

Circuit board and Sensitivity Switch

I had contacted Ian Nutt regarding the meter and also the thumbwheel pot (5kohm log law) and integral dpst switch. Ian did not have a meter in stock but he had a small (RS) potentiometer/switch that he thought may fit with some adaptive work - I ordered the pot and switch. While I was waiting for this to arrive, I checked out some of the other components – for a start, the small electrolytics looked suspect. I checked them with my new PEAK ESR meter – the two 10uF ones were within capacity tolerance, but were leaky and had high ESR. The 1uF unit measured very low capacitance and had an ESR over 40ohms. I changed-out all three electrolytics. I checked some resistors at random and they were all within tolerance – so I left them all in place.



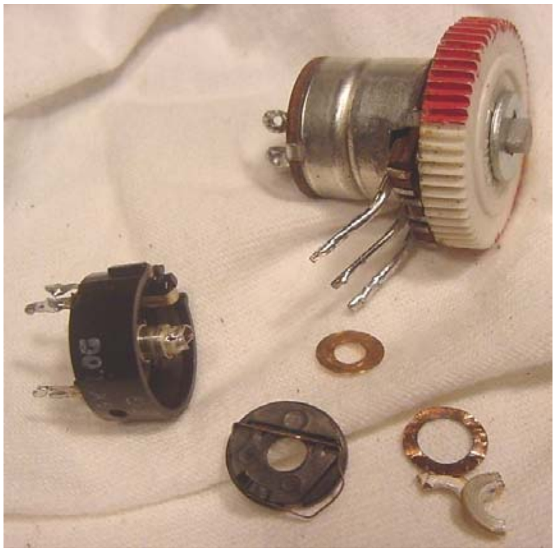
Above: The circuit board sporting its three new electrolytic capacitors



Above: The original thumbwheel pot/switch

The replacement pot/switch unit was a little larger than I expected and at first glance I could not see how I could make it fit and still retain the functionality and original (external) looks of the unit. At this juncture (October, 2010) the project was put in a shoebox on a shelf in the shack as I had a few other things to deal with in my life – I also thought that I would be able to find a more suitable thumbwheel pot/switch unit if I looked a bit harder/longer… Almost three months later, and with no sign of a more suitable thumbwheel pot/switch unit turning up at the VE7GUH shack, I decided to see what I could do with the original pot/switch, and if that could not be repaired, see what could be done with the one that Ian had provided:

- I tried some De-Oxit in the original pot with it in-situ – no difference: it still acted more like a switch than a pot;
- I removed the pot/switch unit: de-soldered the dpst switch and pot connections, then unscrewed the 8BA mounting screw;
- With the unit removed from the chassis, I again tried De-Oxit – no joy;
- I snipped the retaining rivet on the thumbwheel end of the unit and the pot/switch came apart. I decided at this point that it would be a fruitless exercise to try repairing the unit and discarded it, retaining only the thumbwheel.

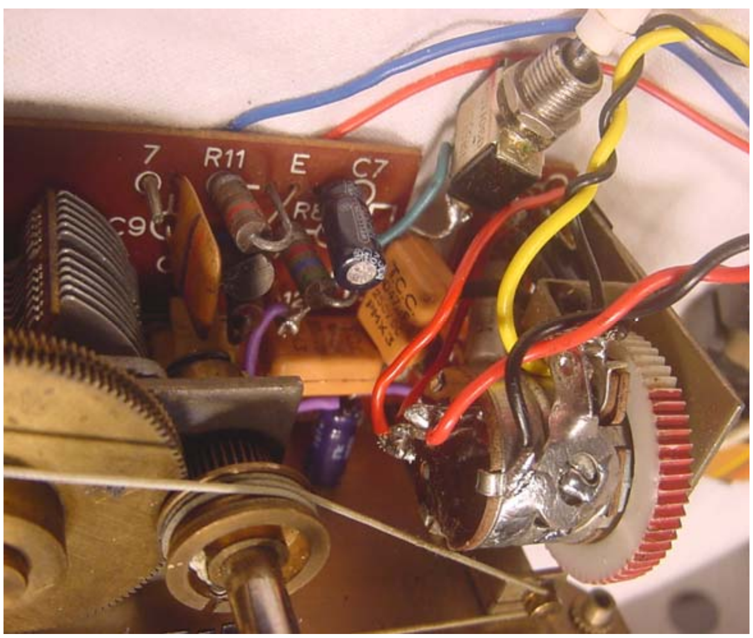


Above: The original thumbwheel pot/switch innards (below), with the modified new pot/switch (above)

Hmmm, would this Edometer ever work again and still retain its looks? Given the effort I had already expended in re-building the meter I decided to persevere. First, the replacement pot/switch was temporarily wired into the circuit on flying leads and the Edometer tested – it worked perfectly. I then test-fitted the pot/switch unit into the small space vacated by the original thumbwheel pot – to my surprise it just fit.

I decided to 'go for it' – if it did not work (or I wrecked the pot/switch in the process) I would just have to spend the rest of my life scouring old transistor portables for a suitable thumbwheel pot/switch…

- The threaded metal ‘neck’ of the new pot/switch unit was (very carefully) cut away with a small hacksaw to reduce the length of the unit and to allow the thumbwheel to be mounted close to the pot body;
- The flat (key) surface on the pot/switch shaft was extended to where it entered the (modified) pot body as noted above;
- A thin metal washer (shim) was placed on the pot shaft;
- The (Nylon) thumbwheel from the original (Welwyn) pot/switch was cleaned-up and the area around the central hole roughened;
- The thumbwheel was placed onto the pot shaft;
- A metal washer was carefully filed such that it fitted the pot shaft keyed surface;
- With the thumbwheel in place, the filed washer was placed onto the shaft and held against the thumbwheel;
- A drop of Superglue was applied to the thumbwheel/filed washer interface to lock them together;
- The modified thumbwheel/pot/switch assembly (photo, base of previous page) was located into the space in the chassis and held in place with a solder-lug soldered to the chassis bracket and to the pot/switch body (photo, below);
- A small nick was filed into the rear endplate (Paxolin) of the switch to provide a little more clearance for the dial cord;
- The switch and pot were wired into the circuit;
- To my amazement it worked and did not look too out of place. Externally the Edometer looks just as it did before the repair.



Above: The modified new pot/switch fitted into the Edometer chassis. Note the mounting is a large solder lug soldered to the angle bracket on the chassis

The only difference with this particular pot/switch is that it is a spst unit (the original switch is a dpst unit - one pole switching the power on/off to the entire unit, the other pole disconnecting the supply line to the RF oscillator FET when the power is off). Without the second pole being switched, use of the unit as an AM Modulation monitor with the power off is affected[2], however this does not affect the operation of the unit otherwise.

A new PP3 battery connector was fitted as the old one was intermittent in operation.

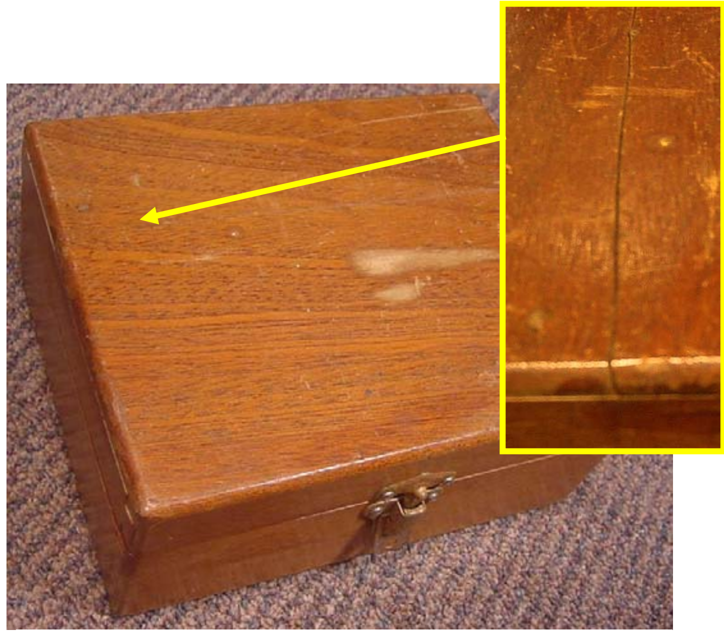
[2] This is not how its use as an AM modulation monitor is described in the manual anyway – the unit is powered-on in this mode. It is also possible to use the unit to monitor AM transmissions with the power switched ‘on’ by connecting the ‘phones to the CW jack with the Edometer Modulation switch set to ‘off’

The dial glass was cleaned with Novus #1 and the grub screw in the tuning knob given a drop of thin oil. Repair job done.

Case

The solid mahogany case had a split on its upper surface (likely caused by forcing the lid shut with the manual placed on the wrong side if the sponge padding) and several scratches/scuff marks present. I decided to effect repairs and then re-finish the case externally (the inside was in good shape). This work comprised:

- Removal of the hinges and catch (woodscrews);
- With the lid detached, the ends were re-glued into place and the split repaired by gluing and filling;
- The case body components were also re-glued;
- The old finish was removed (scraping) from the outer surfaces of the case and lid;
- After sanding with 600-grade paper lubricated with lemon oil (and leaving to dry for a week), several coats of clear lacquer were applied to the outer surfaces of the case;
- The lid was re-attached;
- The catch and the hinges were cleaned, lacquered, and re-fitted to the case.



Above: The case on arrival. Most of the glued-joints were coming apart and a split was present across the lid. Below: Internally the case was in good condition and was therefore not re-finished – just given a good clean-up

Checking calibration and the Edometer in Use

The Edometer functioned well after the repairs were carried out. Its accuracy was checked on all ranges in both GDO and absorption wavemeter modes and found to be reasonably accurate (for an instrument of this type, which is meant for indication purposes, rather than a precision measuring device). The audio tone is clear and the RF stability good, even at on Range 1.

Closure

The Edometer is a very nice GDO – it works well, is versatile and is smart-looking with its trademark Eddystone-style sliderule dial, however, in some ways I also like my trusty old Millen GDO in use. Not that there is anything intrinsically wrong with the Edometer – and it has the very useful advantage of being fully portable (being battery-powered) and lightweight, but the Millen is also a very nice unit with the advantage of an extended frequency coverage at both ends of the spectrum and, of course, it uses a valve oscillator (maybe I am a bit biased… or is that the valve?). Or maybe it's because the Millen unit only cost me $12 at a local fleamarket and worked right out of the box! - I must admit though, it doesn't look anything like as good as the Edometer in its swanky mahogany case.

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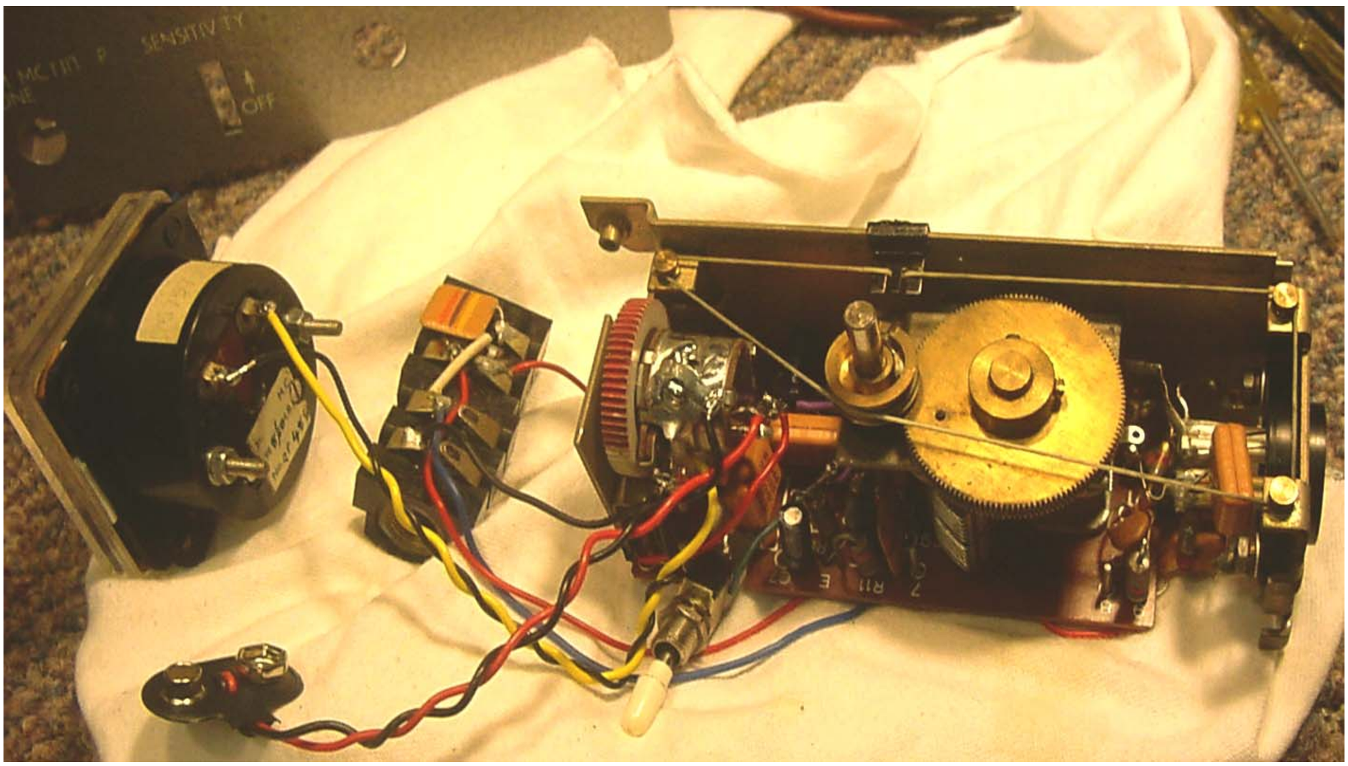

Above: The repaired Edometer 'guts' set-up for testing prior to shoe-horning back into its case (not an easy task). I managed this by (quite forcefully) prying the sides of the case apart, dropping the guts in at an angle such that the tuning knob entered the corresponding hole in the case and then easing the opposite (long) side of the chassis in. A suggestion from another Eddystone enthusiast to make this task easier was to make a jig to assist in this: place the case loosely between the jaws of a large opened vise and attach four strong metal U-shaped clips (maybe the sort you can buy in hardware stores for strengthening corners on wood cabinets - bent to suit) between the case and vise jaws (two either side, gripped at one end between the jaws and the vise body), then slowly opening the vise to open-up the case slightly, thus allowing the guts to be more easily manipulated into the case (as you would have both hands free) – maybe risks breaking the case along its seams though.

Bibliography

- The Ultimate Quick Reference Guide (QRG), 2nd Ed. 2002, Graeme Wormald, G3GGL
- 'Lighthouse'

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Appendices

- Appendix 1: Frontispiece from MkII manual (with errata)

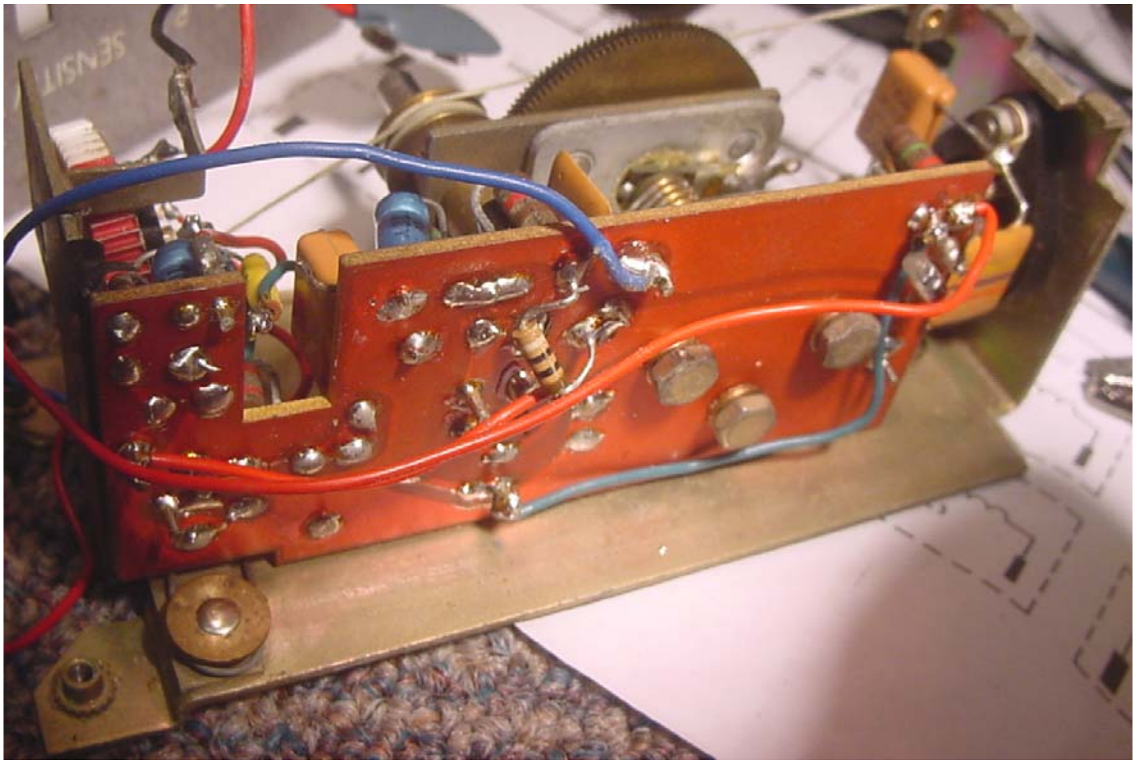
Above: The re-finished mahogany case – looking rather better than it did on arrival

Above: The re-finished mahogany case – hinge side. Below left: re-finished case waiting for its occupant. Below right – restored Edometer in the re-finished case

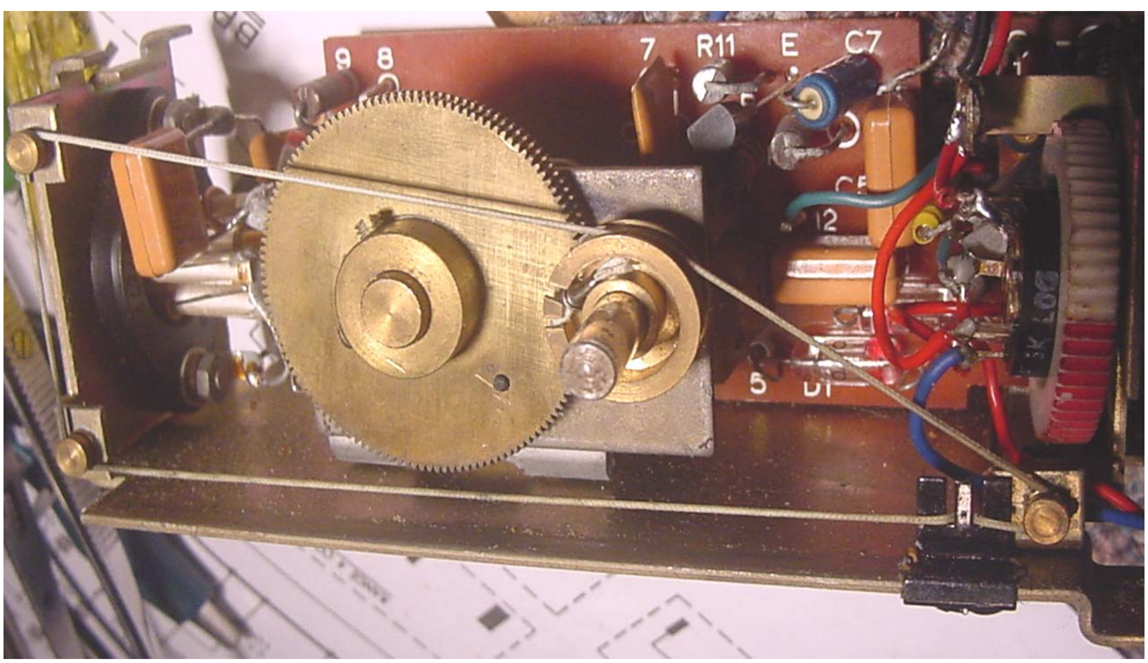

MEGACYCLES
EDDYSTONE
TUNE
OPERATING INSTRUCTIONS
EDDYSTONE
"EDOMETER"
(Cat. No. 902)
15 JUN 1977
EDDYSTONE RADIO LTD.
ALVECHURCH ROAD, BIRMINGHAM, 31
ENGLAND

Above: The repaired Edometer ‘guts’ back in the box and raring to go… Note the Serial No. is ‘AT0496’, which dates it at January 1968. However, the moving-coil meter case is dated ‘1968/10’ and the wood case and manual are both stamped ‘15 June 1972’ (oh, and the battery is ‘March 2014’ – well, ok, I can explain that!). Hmmm… what does all this mean? It is possible that the Edometer was manufactured in early-1968 per the Serial No. prefix, placing it as an early production MkII – 496th in the 1968 batch according to the Serial No. (now, that’s a lot of Edometers for January!). If so, then the ‘10’ in the moving-coil meter case date cannot stand for ‘October’(or even ‘week 10’ of 1968). It is also unlikely that a meter manufactured by a sub-contractor anytime in 1968 would end up in an Edometer manufactured in January 1968. So, did this unit sit on a shelf in the Bath Tub stock room for almost four years until mid-1972, when it was finally placed in a wood case along with the manual and both the case and manual then date-stamped ‘June 15 1972’ before dispatch to a dealer? Or, maybe I have a cobbled-together set of Edometer, case and manual? – or maybe the Serial No. prefix is incorrect, or maybe the meter was replaced at some time?

Above: 'Battle of the GDO's'? – no, just checking one with the other in alternate GDO/ absorption wavemeter modes. Overall, pretty good correlation on all frequencies common to both instruments and with a digital-readout radio. The manual is correct: you can forget using the Edometer as a GDO on Ranges 6 and 7 – the sensitivity is just not there (works ok as a signal generator and absorption wavemeter on these ranges though)



Two more photos of the Edometer 'guts' (before repairing). Above: Underside of the printed circuit board – note C20 (10pf) lurks under here (this component looks like a small resistor in this Edometer). Below: Detail of the dial-drive mechanism. I thought this may be useful for anyone faced with re-stringing one of these – a bit fiddly but should be straightforward (also, check the photos on pages 6, 10, 12 and 14 for more angles).



Appendix 1: Frontispiece from MkII manual (with Page 3 erratum)

EDOMETER Mk. II

The Mk. II edition of the EDOMETER is an improved version of its predecessor from which it differs in that silicon transistors are used in both stages. The oscillator employs a field-effect transistor (Texas 2N3819) while the audio oscillator/amplifier becomes a bi-polar planar transistor (T1407) in place of the original OC71.

Seven coils are used as on the earlier version, Ranges 6 and 7 now covering the band 380 kc/s to 1.25 Mc/s. Normal “dip” operation is available at all frequencies above 1.25 Mc/s (Ranges 1–5). **All** ranges are marked on the unit and the “drop-in” frequency scale previously used for Ranges 6 and 7 is not now required. The calibrated logging scale has been omitted.

The instrument can be used as before in any of the varied applications described in the Operating Manual. Tone Output is 1000 c/s and not 100 c/s as stated in error on page 3.

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