MERCURY

THE JOURNAL OF THE ROYAL SIGNALS AMATEUR RADIO SOCIETY

NUMBER 13 OCTOBER 1965

OFFICERS OF THE SOCIETY

PRESIDENT : **Brigadier R.H.E ROBINSON, OBE, ERD, Director of Telecommunications**

VICE PRESIDENT : **Major General E.S. COLE, (RETD), CB, CBE.** **CALL SIGN G2EC**

TREASURER : **Major M.H.PRIESTLEY, Royal Signals,**
School of Signals,
CATTERICK CAMP,
Yorkshire.

HQ SECRETARY : **Lieutenant Colonel (Retd) J.S. MARTINSON**
Signals 1(A),
Defence Signal Staff,
Ministry of Defence,
LONDON, S.W.1.

FIELD SECRETARY : **Mr. J.E. HODGKINS,** **CALL SIGN G3EJF**
2 Squadron,
8 Signal Regiment,
CATTERICK CAMP,
Yorkshire.

HEADQUARTER STATION - CATTERICK CAMP - GB3RCS/G3CIO

CONTENTS

EDITORIAL

Records - the word has so many meanings - the Top Ten, the first two metres QSO with ZL, those people who post you just as the vegetables you planted in the garden are nearly ready.

Like any other organisation Royal Signals Amateur Radio Society keeps records and quite a job it is. The Treasurer has his subscription book and an alphabetical card index of members while the Field Secretary has a card index, in callsign order for those with licences, and in alphabetical order for other members. Keeping these records up to date and keeping you informed as to who is a member is just one of the jobs that have to be done in running the Society.

How do we do it? Fortunately most members are very good at telling us of changes of address etc. but we also rely on reading "The Wire" each month, New QTH's in Short Wave Magazine and what can only be described as the jungle telegraph. Unfortunately our records contain several names alongside which are the words "Address Unknown". If the member is serving in Royal Signals and we have his full number we can usually trace him but if he is ex-service there is nothing we can do unless he writes to us or we hear of him by some devious route.

We have no way of checking whether any of our members have recently been licensed, there just isn't time to go through the Call Book. With nearly 400 members there will be errors.

Our friends in Ordnance cannot supply a crystal ball so please, before you move, let us know your new address.

This leaves us with the problem of keeping you informed. With this issue you will find a list of members Call Signs together with their names and membership numbers. As most people have a Call Book or can get hold of one it seemed unnecessary to list addresses. The next issue of MERCURY will contain an alphabetical list of non-licensed members complete with addresses and membership numbers. These lists will be as accurate as possible but if you spot an error please put us right.

73

ECHO JULIET FOXTROT

ANNUAL GENERAL MEETING

The Society's Annual General Meeting will be held at the Ministry of Defence on Friday October 29th at 2.30 p.m.

Items for the Agenda should reach the Field Secretary as soon as possible.

As the date is the Friday of the RSGB Exhibition it is hoped that as many members as possible will take this opportunity of attending both the A.G.M. and the Exhibition. This is your chance to express your views on how the Society should do it's job.

OUR NEWS AND YOURS

Congratulations to our member Bob Frarey on the award of the BEM in the Birthday Honours List. Bob is employed by 8th Signal Regiment and his callsign G3DMK is well known particularly on 3·5 and. 144 Mc/s.

One of the most active stations in Cyprus, ZC4CZ, has now closed down. Our member Ted Ross is now operating as GM3LWS from Cupar in the Kingdom of Fife.

The July issue of MERCURY had gone to press when the new stock of society QSL cards arrived from the printer. The design of the cards is identical but the size has been slightly reduced so as to fit standard sized envelopes. The front of the card is glossy but the reverse is unglazed so that it is easier to write on. The benefits of bulk purchase are passed on to members making this a most economical way of obtaining QSL cards. An order form is printed on the back cover of this journal. Members notepaper is also available from HQ.

The Canadian voice heard on the bands from G3CIO will be absent as Doug Yerxa, G3SJB/VE1ADQ, has returned home to operate with a VE3 call. Although officers on the T.E. course are kept busy Doug has always found time to help with the running of the Headquarters station and the Cubical Quad which overlooks the Catterick scene was designed and largely built by him. The fact that it has stood up to the worst that the climate could do pays tribute to his work.

Your scribe and all the gang at G3CIO will miss you Doug, gud luck es mni tnx.

Members with an eye for details will have noticed that the date on our July issue was on the inside of the cover. This has been done in order to make the printing of the blue cover easier.

Is this a record?? Desmond Barry has worked GB3RCS during Old Comrades Weekend three years running but each time with a different call sign. In 1963 he was DL2HO, last year operated VE3RCS and this year used his own call VE3CLV.

Jim Briggs, ex 5N2RSB, has been licensed as G3UDX and hopes to operate under a DL2 call in the near future from the club station of 2nd Signal Regiment. Delivery of the club's equipment is eagerly awaited.

257 Signal Squadron had a number of candidates sitting the May RAE so an increase in activity from DL2BB is likely. A QSO between the Squadron's club station DL2BB and Ted Philp 9M4MB was featured by the British Forces Broadcasting Service in a programme earlier this year.

WHAT P.E.P. ARE YOU RUNNING ?

S/Sgt (F of S) Dave Sugden

Until the advent of single sideband (SSB) and independent sideband (ISB) radio transmissions the output power of a transmitter could be very easily determined.

Under CW conditions we have: -

Power out = Va x Ia x y
where Va = anode volts
Ia = anode current
y = power conversion efficiency of PA

When amplitude modulation is applied we have: -

$$\text{Power out} = Pc\left(1+\frac{m^2}{2}\right)$$

where Pc = steady carrier power
m = modulation index

In practice these methods are accurate to about 2% when water cooled loads, flow meters, temperature measuring devices and resistive elements are used. Generally speaking any inaccuracies that do occur are human errors in taking instrument readings etc.

The introduction of SSB and ISB systems has led to difficulties in expressing the power output of transmitters employing these modes. Let us look now at the methods of measuring the output rating of SSB/ISB transmitters.

Firstly two definitions (courtesy G.P.O.)

Peak Envelope Power (PEP)

The power which would be developed by a continuous carrier, the amplitude of which is equal to the peak amplitude of a signal consisting of a pilot carrier and one or more sideband components.

Peak Sideband Power (PSP)

The power which would be developed by a continuous carrier, the amplitude of which is equal to the peak amplitude of one or more sideband components, the pilot carrier being excluded.

Why then do we quote the output of an SSB/ISB transmitter in terms of P.E.P, rather than mean power as for a DSB transmitter?

SSB/ISB transmitters may accept a modulation baseband of say, 0.3 to 6Kc/s on 2 channels of F.D.M. speech, so multichannel loading can be applied. Distortion will occur if two or more channels peak together causing overloading of the transmitter, Therefore when we consider multi-channel working with an SSB/ISB transmitter the P.E.P. is a much more realistic statement than mean power since the peak to mean ratio of a channel is normally held to 8 to 11 dB by peak clipping.

The factors which limit the output power of an SSB/ISB transmitter and what is more important, the quality of the resulting system, are the linearity of power amplifier stages and the capacity of the power supply units. Thus the output power obtained is inversely proportional to the quality of the transmission as measured by Intermodulation products resulting from non-linearity, P.E.P. should therefore be measured under conditions for which the non-linear distortion is the maximum tolerable.

We can see then that comparisons of transmitter performance should also take into account linearity (distortionlessness!) and power output together.

The usual methods of measuring output power of SSB/ISB transmitters and hence non-linearity and intermodulation products, employ the "twotone" test.

Usually the 3rd order intermodulation products are the worst and it is these that are usually specified. However, certain cases may arise where other products can be at a high level though the 3rd order products may be at a satisfactory level. It is therefore preferable that all intermodulation products are specified since it is the higher order products that give trouble as regards adjacent channel interference.

Post Office specifications state that all intermodulation products are to be not greater than -36dB with respect to one test tone. C.C.I.R. recommends a figure of -25dB with respect to only 3rd order products. It will be seen that the GPO specification is the more stringent but it must be pointed out that in this day and age using modern techniques intermodulation products should be a lot lower than the quoted specifications.

Methods of Measurement

Three methods are available for measuring output power of an SSB/ISB transmitter.

1. Output Power rating determined from measurement of Mean power.

Two tones of equal amplitude are applied to the transmitter drive and the mean power output is measured in a load at the designed full rating of the transmitter.

With two tones only

P.S.P. = 2 x mean power

With two tones plus carrier at - 26dB relative to P.E.P.

P.E.P. = 2·194 x mean power (see Appendix)

The levels of intermodulation products are measured at this power rating in the normal way.

2. Determination of Output Power by C.C.I.R. Method

The method recommended by CCIR is based essentially on measuring the output power when a single tone is applied to the transmitter drive. Initially two tones of equal amplitude are applied and their levels are simultaneously adjusted until the 3rd order products are -25dB relative to the output power due to either tone. One tone is then removed entirely the other being left with its level unchanged. The power in the load due to the remaining tone is measured. The required rating is then given by: -

Peak Power = 4 x power due to one tone

The factor of 4 is the 6dB increase in peak power, which would result when two tones were applied, were the transmitter linear.

3. Determination of P.E.P. Rating by GPO/Marconi Method.

The determination of P.E.P. is by measurement on an oscilloscope of waveform amplitude obtained from a pick-up situated adjacent to the transmitter feeder.

The transmitter is set up with a single tone input such that the power output approximates to the designed continuous C.W. rating. The power in the load is then measured and the amplitude of the waveform on the C.R.O. measured. Two equal tones are then applied to the transmitter together with a pilot carrier. The tone levels are increased simultaneously until the transmitter is developing its calculated full power rating as indicated by metered loading of the final amplifier. The 3rd order products are measured and the new waveform amplitude on the oscilloscope is noted.

The power rating is then given by: -

$$\text{P.E.P.} = \text{continuous C.W. rating} \times \frac{(y)^2}{(x)}$$

Where x = waveform amplitude under CW conditions
y = waveform amplitude under two tone + pilot carrier conditions

The transmitter is then checked for higher order intermodulation products.

Comparison between Methods

Each method gives closely similar results as long as measurements are made under conditions where intermodulation products are negligibly small (-36dB or better). If therefore the CCIR method were applied with IP's of -36dB instead of -25dB, then the results would agree with those obtained by the other methods.

Wide discrepancies will occur in the results obtained from the CCIR method and the GPO/Marconi method if measurements are made with intermodulation products of -25dB. This is because the CCIR method takes no account of the considerable flattening of the peak of the output

waveform of the transmitter that will occur at these intermodulation levels the factor 4 being a purely linear multiplier. In fact results from the CCIR method give power output ratings which are of the order of 75% higher than those given by the GPO/Marconi method.

It should also be noted that the GPO/Marconi method has a further advantage over other methods in as much as it gives a factual measurement of P.E.P. and a visual indication of the waveform of the transmitter output. Thus it can be seen immediately from the waveform whether there is any likelihood of serious intermodulation products being present. This is particularly important in view of what has been said on the possibility of high level products being present when particular third order products are low.

Appendix

Let I1, I2 ..... In be the peak current amplitude of the various sinusoidal components of a complex waveform in an ISB transmission in a load R.

Then mean power in $R = \left[\frac{(I1)^2}{(\sqrt{2})} + \frac{(I2)^2}{(\sqrt{2})} + \cdots\cdots\cdots \frac{(I2)^2}{(\sqrt{2})} \right] \times R$

and by defination $P.E.P. = R \left[\frac{I1 + I2 + \cdots\cdots In}{\sqrt{2}} \right]^2$

Hence $\frac{P.E.P.}{\text{Mean Power}} = \frac{(I1 + I2 + \cdots\cdots In)^2}{I1 + I2 + \cdots\cdots In} = X$

(a) With two tones of equal amplitude applied to the transmitter

$I1 = I2$ and $I3$ etc $= 0$

Hence $x = 2$

(b) Two equal tones each 6dB down and pilot carrier 26dB down on full level (i.e. pilot carrier 20dB down on either tone).

For two tones $I1 = I2 = I$

For Pilot Carrier $I3 = 0{\cdot}1\ I$

Therefore $x = \frac{(I + I + 0{\cdot}1I)^2}{I^2 + I^2 + (0{\cdot}1I)^2} = 2{\cdot}194$

TO MEASURE P.E.P. OF AN AMATEUR TRANSMITTER

G3JXL

This method whilst a little crude, in that it doesn't take distortion into consideration will satisfy the GPO inspecting officer. It should be noted that no P.E.P. would normally be given unless it was quoted with a fixed level of intermodulation distortion (e.g. 200w P.E.P. with IP 's of -33dB or better).

The procedure to be followed is tabulated below.

1. Switch final amplifier to Class C by increasing the bias.

2. Insert full carrier drive.

3. Load transmitter into aerial until running 150 watts D.C. input.

4. Couple C.R.O. to transmitter and adjust until envelope is central on screen and is of a suitable height. Using a wax crayon mark top and bottom of RF envelope on screen and measure the distance between the marks.

5. Make two further marks on the CRO screen equally spaced above and below the first pair so that they are twice as far apart.

6. Switch final amplifier back to normal linear operation and remove carrier drive.

7. Now, with normal loading and the same coupling between the CRO and the transmitter, peaks of output must not exceed the second pair of marks on the screen of the C.R.O.

Example

If 150 watts DC input produced 100 watts of RF and our two marks were one inch apart on the CRO, our second pair of marks would be two inches apart and peaks of SSB reaching these two marks would indicate a P.E.P. of 100 x 4 = 400 watts.

On the face of it, it would appear that the SSB station is "getting away with something" but in fact this is not so. The station using A3 and high level modulation at 100% depth does in fact double the voltage to the PA anode and double the anode current giving four times the power in just the same way that the A3a station does. The P.E.P. being just the same. Over any given period of time the A3 station would in fact be producing a greater amount of RF power if running the same PEP but most of it would be wasted in the carrier.

It is interesting to note that the A3a station is not regulated by input to the PA but by RF output. Providing this method of measuring the RF output is used any DC input may be run to produce this RF output, thus use may be made of Class AB1 linear amplifiers running at fairly low efficiency but free from high harmonic content.

LETTERS TO THE EDITOR

9th Signal Regiment
BFPO 53

Dear Sir,

On the subject of associated membership of the Society may I say how much I agree with your correspondent G3ADZ.

The decision taken at the A.G.M. seems to me to be rather short sighted, narrow minded, and not having details of the arguments for and against rather snobbish; i.e. "We can do without them". I won't quote the rules etc., they speak for themselves, but I could read into Rule 5(b) that the Royal Canadian Army Postal Corps could become associated. It does not specify Royal Canadian Signals. This is I suppose covered by Rule 5(c). It does however seem rather farcical. ZC4GY as an R.E. club can be affiliated but ZC4BG and ZC4KF as individuals of the same unit cannot be, although members of the club. Similarly DL2PO, a member of our Red Hatted friends cannot become a member. Gordon has been interested for some considerable time and I gather that thanks to his efforts a Royal Signals Club station in BAOR (the call escapes me) is in being. I have no reason to doubt this.

I realise that the vote was carried by a majority decision but I would be very interested to know what the two arguments were; why was it carried? Do these people have the "Dreaded Lergy" or something? What is wrong with an Army Amateur Radio organisation whatever the name?

73
Ted Rose ZC4CZ

Crail Fife

Dear OM,

Now that the Old Comrades Meeting is past I should like to record my appreciation of the way the HQ station was operated.

In spite of QRM and the occasional pile up of stations calling, every effort was made to give each of them a contact, all done in a most efficient and courteous manner.

I can't name all of those concerned but a big thank you to them for the effort made and the time given to make this event a success.

My good wishes to all those at HQ.

73
Jim Blackery GM3GFO

Letters to the Editor

Harrogate, Yorks.

Dear OM,

I was interested to read “Letters to the Editor” in the July issue of MERCURY and can only say that I agree with G4JT regarding founder members etc. Surely the credit should go to the member who does most for the Society and not necessarily to the one (or more) who started it. Although I hold a piece of paper showing “Membership No 11” from the old Catterick Radio Club, issued when the club met in the YMCA in Kemmel Lines in 1946, I do not consider that this makes me a better or more privileged member of RSARS than the chap who holds “RSARS Member No 400” or whatever the latest number is.

Regarding G2TA’s letter I well remember the rig in 2 Squadron lines, and sitting in with G2TA and G8RF, and the ragchews with G8RF on Sunday mornings in the old OWL canteen after Church Parade. Incidentally, what happened to Joe Raby G8RF?

I think it was the help and interest shown by G2TA and G8RF that made me finally apply for a ticket and set up a “QRM machine” (a 1154 - what else) as D2IZ at Vesterland on the island of Sylt, in 1947.

73

Jack Cooper G3DPS
ex D2IZ, ZC4XX, GM3DPS

GOT AN NCX 3 ??

One of our members has found that the life of the 6GJ5 valves used in the final linear amplifier of the transmitter section of the NCX3 transceiver is very short.

His answer to the problem has been to change over to 6146B's. This entails changing the valve holders but no other circuit changes are necessary, the bias adjust control taking care of any change in the bias voltage required.

Even if you have had no trouble with 6GJ5's going soft this change is to be recommended, one knows that the 6146B's are working well within their capabilities whereas the 6GJ5's are at the limit of their tolerance and will blow if misused such as off resonance operation.

SIMPLE GDO

By

Barrie Clark ex - 5B4CL

(reprinted from the Cyprus ARS Newsletter)

The Grid Dip Oscillator is one of the most useful test instruments that the average amateur can possess and the following design covers the H.F. bands. Most GDO designs utilise the Colpitts circuit and while this is a balanced to earth oscillator, the availability of 50 + 50pF, 75 + 75 or even 100 + 100pF variable capacitors is not very pronounced. The circuit to be described uses an Inverted Hartley circuit, which has the advantage of requiring only a single gang variable capacitor.

The circuit is given in Fig 1 and the components are as follows: -

C1 & C2	100pF (mica)	R4	20 ohms 5watt
C3	0.02 microfarads	RV1	25K ohms wire wound pot.
C4 & C5	50 microfarads 250v wkg	VC1	50pF variable
R1	22k ohms ½ watt	V1	6C4
R2	1K ohms 3 watts	D1	Silicon diode (Radiospares type REC 51)
R3	100K ohms ½ watt		

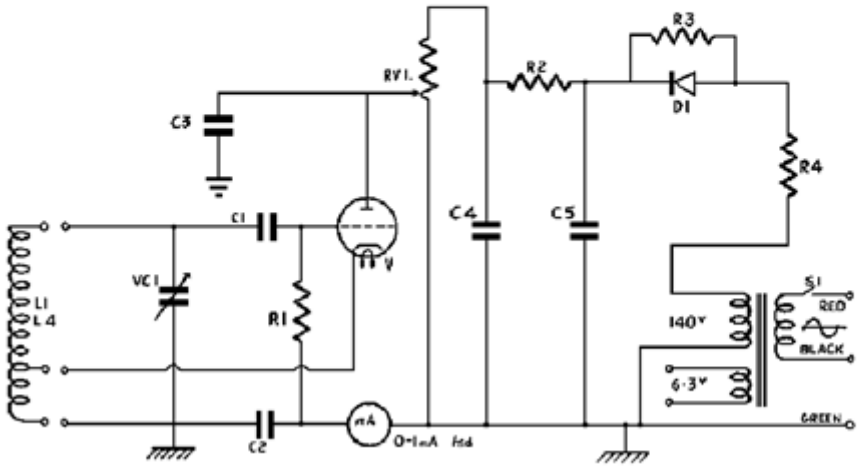
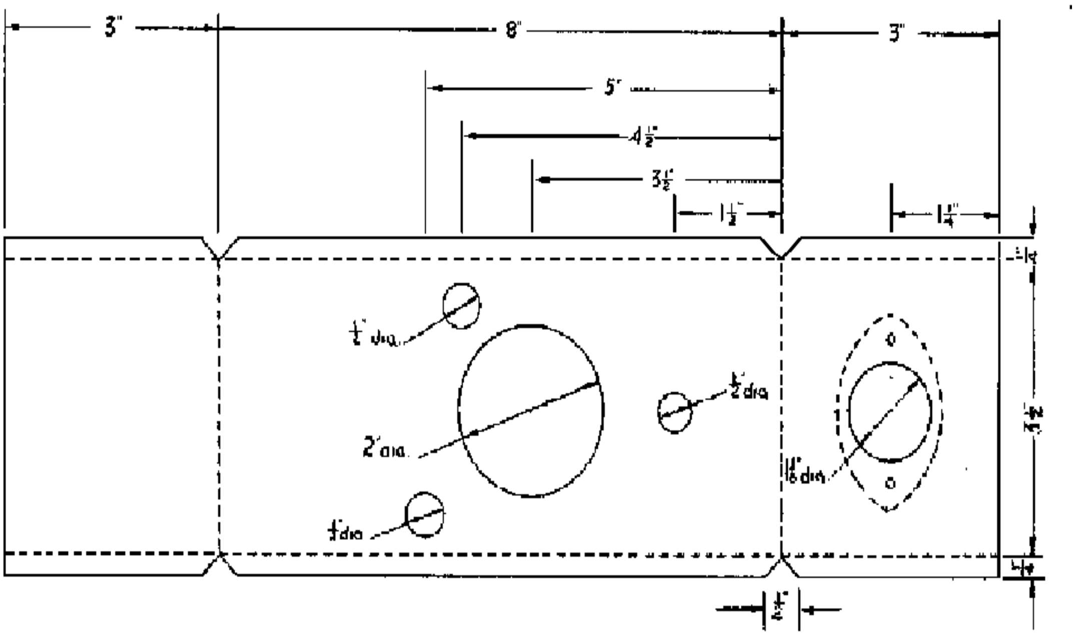
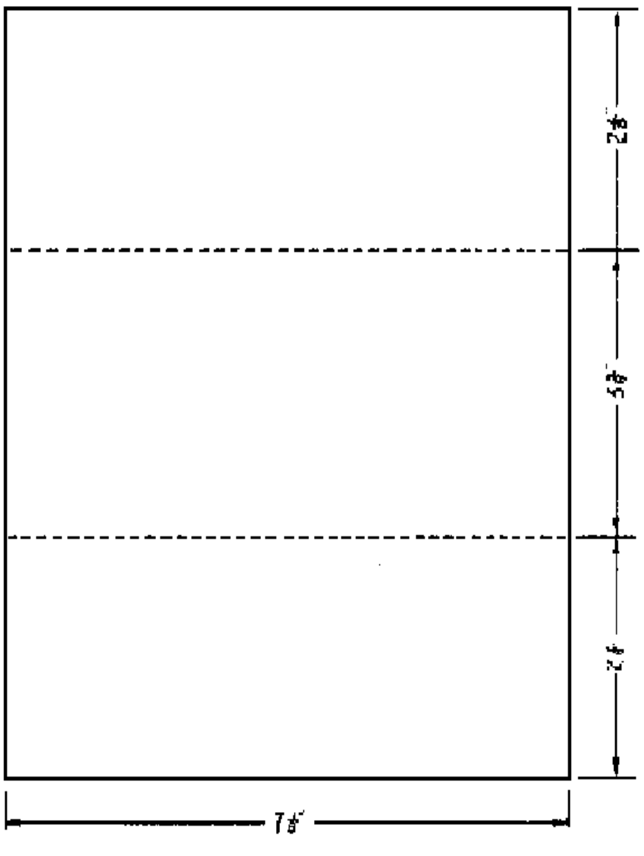


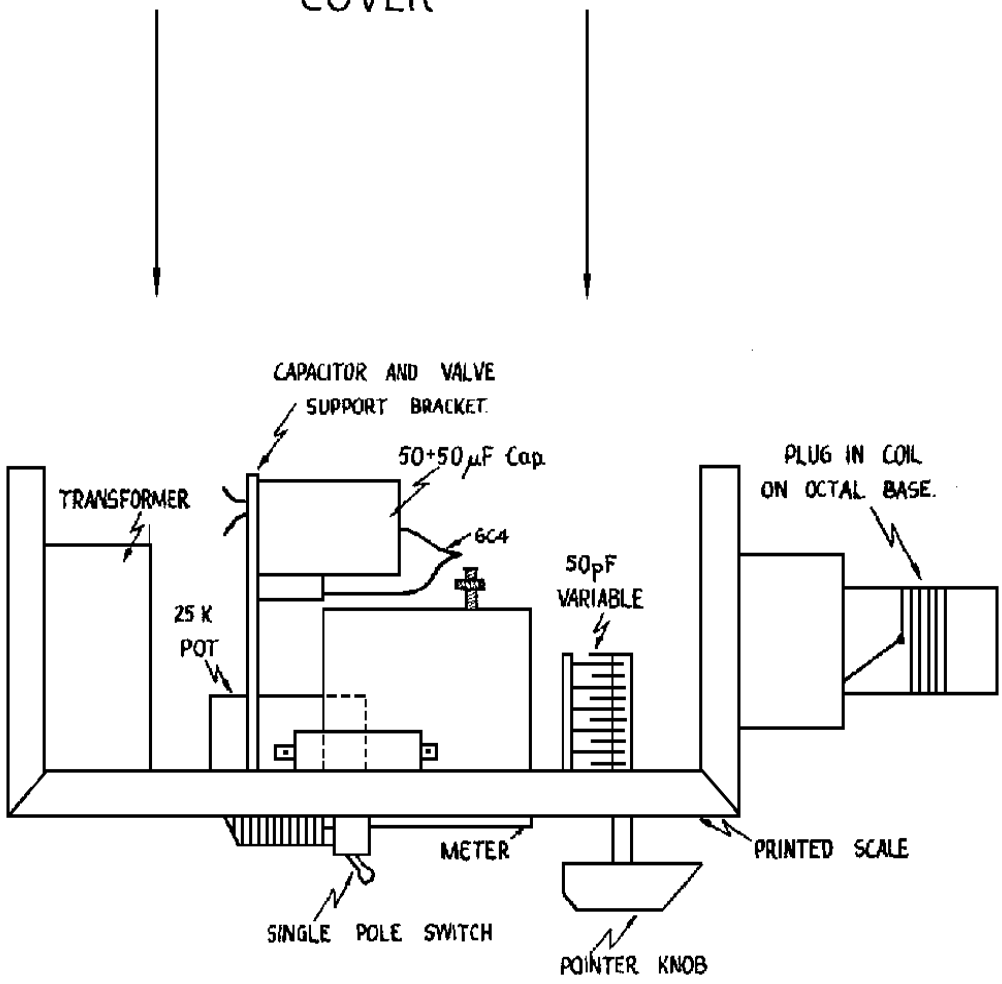
Fig 1

The transformer T1. should be as small as possible and give 1amp at 6·3v and about 20mA at 140V. These ratings will be ample, suitable mains transformers are available from several suppliers. Originality in the power supply enables the whole instrument to be built into a fairly small box, the worry of drift due to a hot rectifier is entirely gone using this very small silicon diode which has a very small heat dissipation. R3 & R4 are transient and surge limiting resistors for the diode - an extremely necessary precaution, as sudden voltage spikes could destroy the junction and render the junction useless.


3"
8"
3"
5"
4 1/2"
3 1/2"
1 1/2"
1 1/4"
1/4" dia.
2" dia.
1/2" dia.
1 1/8" dia.
1/4" dia



COVER


CAPACITOR AND VALVE
SUPPORT BRACKET.
50+50 μF Cap.
PLUG IN COIL
ON OCTAL BASE.
TRANSFORMER
6C4
50pF
VARIABLE
25 K
POT
METER
PRINTED SCALE
SINGLE POLE SWITCH
POINTER KNOB

BODY

The rectified input from the rectifier flows through the smoothing circuit of R2, C4 and C5 and onto the potentiometer RV1, where the HT to the oscillator valve is varied, the anode being decoupled by C3.

The Inverted Hartley oscillator itself is complete except for the plug-in coils, which are built on one inch diameter paxolin tube. These tubes are glued with "Araldite" into an old octal valve base. The valve bases chosen at 4CL were from 5Z4 valves that had gone kaput - the 5Z4 having only five pins thus making the eventual wiring up of the valveholder (fitted in the oscillator box much simpler. Details of the coils are as follows: -

Frequency Range	No of turns	Tapped at	Wire Gauge
1·5 - 3 Mc/s	40	15	32 swg
3 - 6 Mc/s	20	8	28 swg
6 - 11 Mc/s	15	6	28 swg
11 - 20 Mc/s	10	4	26 swg
20 - 40 Mc/s	6	2	20 swg

The wire should be enamelled copper and a1l except the highest range should be close wound. On the highest range there should be single turn spacing.

The chassis and cover of the GDO were made of 18 SWG aluminium and the large holes for the meter etc. were cut before bending the aluminium sheet utilising a series of blocks of wood in the jaws of the vice. The dimensions of the metalwork are given in Fig. 2.

All the dotted lines shown are the lines upon which the chassis should be bent when all the holes have been cut. The screw holes used to fix the transformer; capacitor and valve supporting bracket are not shown, as these will vary in individual cases.

Straight edges were obtained by marking out with a sharp scriber and cutting to that line with a pair of tin snips, the edges being finished with a file.

The assembled GDO is shown in Fig. 3. The wire wound potentiometer used was larger than is necessary but was all I had on hand at the time. Any suitable 1mA meter can be used; I used an old RF thermocouple type whose thermocouple had burnt out, making the necessary soldered connections inside the meter case to convert it into a normal moving coil instrument.

Calibration was carried out using a pointer knob against a stuck-on linear scale and graphs for each coil drawn. Finish of the case can be in any suitable gloss enamel or hammer finish according to taste.

The mains lead was cleated to the back of the case to protect the connections to the transformer should the lead be inadvertently pulled. The majority of the small components and wiring were accommodated between the mains transformer and the bracket supporting the valve and smoothing capacitor.

In use a slight drift was encountered due to the heat from the valve but a few holes drilled in the cover in the appropriate place will help this.

SOCIETY NEWS

There have been a number of technical difficulties in producing this issue of MERCURY. This is the reason why it is thinner than usual and why we have had to omit a number of items including a full account of our activities during Old Comrades Weekend. We hope members will bear with us and hope that the next issue will be more its usual self.

The Field Secretary would like to thank all those members who took the trouble to return the voting forms enclosed with our July issue. Your votes were fairly evenly distributed but two articles were well ahead in the final count.

The article you enjoyed most was "The How and Why of the Reflectometer" by G5YN closely followed by 9M4MB's "View from the Other End".

Arrangements are in hand to deliver Marconi HR51 receivers to the authors and a further two receivers will be awarded for contributions appearing in the four issues October 65 - July 66.

The club station of the Royal Engineers (Cyprus) Amateur Radio Society uses the call ZC4GY and is usually operated by Barry ZC4BG or Tony ZC4KF. One of these callsigns can be found on the bands at most times but operation is usually as follows: -

ZC4GY 14 Mc/s CW in the mornings.
ZC4KF 28 Mc/s CW and Telephony in the afternoons.
ZC4BG 21 Mc/s CW and Telephony in the evenings.

The membership list (licensed members only) enclosed with this issue of MERCURY is correct as at 1 Sep 65. any errors should be notified to the Field Secretary. A list of non-licensed members will appear with our January issue.

Conditions during Old Comrades Weekend were far from good and GB3RCS had to struggle to work members of the Corps outside the U.K. However 315 contacts were made by the four transmitters in use. Although we had long contacts on both the Saturday and Sunday with 9M2GF in Kuala Lumpur no other Far East stations were heard and one letter from Singapore queried whether GB3RCS was on the air.

Despite the poor conditions all continents were worked during the weekend. Members of the Corps in Malaya, Cyprus, Canada, and the UK were contacted, as were members of Royal Canadian Signals in Germany and Canada.

During the weekend the Society's Vice President, Major General E.S. Cole CB, CBE paid two visits to the HQ Station. Several Old Comrades also called in to see what went on.

The usual G3CIO operators were greatly assisted by three Old Comrades, G3EMO, G5PX and G3SZQ, who spent a large proportion of their weekend operating GB3RCS.

AVAILABLE FROM HEADQUARTERS

SOCIETY NOTEPAPER

This is a good quality 10 x 8 inch white paper bearing the figure of Mercury , and the words "Royal Signals Amateur Radio Society - Members Correspondence". The price is 8/4d. per 100 sheets post paid.

SOCIETY QSL CARDS

A new stock of Society QSL cards is now available. The design of the cards has not been changed but the size has been reduced slightly so as to fit standard postcard size envelopes.

Due to the increased cost of printing and postage we regret that the price of the basic cards has had to be raised. For the benefit of members unable to arrange over-printing we can print callsign, name and address on the cards. Basic cards are despatched by return of post, overprinting takes two to three weeks.

The prices are now 35/- for 500 basic cards and 50/- for 500 cards overprinted with callsign, name and address, both prices include postage.

PLEASE USE THE ORDER FORM

ORDER FORM
(Block letters please)

Name .....Callsign .....

Address .....
.....

I enclose Cheque/Postal Order for .....Please supply :-

.....sheets of Members Notepaper at 8/4d per 100

.....Basic QSL cards at 35/- per 500

.....QSL cards overprinted in .....(state colour) at 50/- per 500

Cheques and Postal Orders to be crossed and made payable to
Royal Signals Amateur Radio Society.