GLOUCESTER AMATEUR RADIO & ELECTRONICS SOCIETY

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RAGCHEW

QRP SPECIAL

JUNE 2021

From the Editor

Since the last issue of "Ragchew", Ofcom have issued the notices of variation of licences regarding the implementation of the measures to ensure the general public are protected from exposure to electromagnetic fields. In case any members are concerned about their situation, in the first instance **don't panic!** There are generous time-scales in which to implement any required changes to antennas. I claim no originality for the statement that for the average amateur running modest power into modest antennas, the station is **probably** compliant and no action is required other than to be able to demonstrate compliance with the relevant completed spreadsheet. Just to emphasise the last statement, please note that doing nothing is **not an option!** If any member is in doubt or concerned about their station or requires help to complete the necessary paperwork, please do email the club and help will be at hand. The only area of uncertainty at the moment is the situation regarding /M and /P operation.

Using the RSGB Calculator v0.1.2-rsgb.v9e, I've completed spreadsheets for my HF inverted V doublet, outdoor 2m ground-plane also my various loft antennas. The only adjustment required is the positioning of one arm of my HF doublet which currently terminates in a boundary hedge adjacent to a public footpath. I need to move it to a tree in the front garden, which funnily enough was where I originally terminated it when I put the antenna up some 30 years ago!

Stations running QRP (10 watts or under) are better placed to be fully compliant and it had crossed my mind that for some amateurs this may be the path they choose to enable them to continue to operate. With this in mind, the focus in this and the next few issues is **QRP.** To start the ball rolling **Richard M0HNK** has submitted details of a **QRP Power Meter** and next month will be describing a **Switched Attenuator.**

Continuing the QRP theme, I take a look at another vintage piece of Heathkit equipment namely the **HFT-9 Antenna Tuner.** Several members have expressed interest in a tuner suitable for QRP operation and I have included enough information to enable a "look-alike" to be made.

Tony G4HBV continues with part 2 of his series **"A Brief History of Radio".**

Our visit to Lundy in early May was not without incident and a report is included in this issue.

As usual, the plea for more articles for "Ragchew" - send to **g4cib@outlook.com.**

That's all for this month

73 Brian G4CIB

Contest Corner

by Brian G4CIB

The latest results in the **FMAC** series of VHF contests have been published and in the **70cm FMAC** we are in **2nd place** in the **Local Clubs** table**.** Thanks to the efforts of 11 members the club is consistently putting in a good monthly score and top place is within reach. The more logs submitted, the better we will do! On **2m** we've climbed a place to **3rd** in the **Local Clubs** table, but realistically our only target is 2nd place as the leaders **Hereford ARS** in 1st place have an overwhelming lead.

In the **UKAC Local Clubs** overall table, we are in **18th place** with everything to play for to go up a place or two.

My first /P outing was for the May 2m FMAC and UKAC whilst we were on Lundy - see later in this issue for a summary of my efforts.

In the **80m Club Championship** the club is in **10th place.**

Just a reminder of the weekly **"Club Contest Net"** hosted by **Martin G4ENZ** on **Friday afternoons at 1530 local time on 145.425 FM** . If you are unable to come on the air for this net there is an opportunity to listen-in via a live internet stream - please contact Martin G4ENZ for details.

3 element beam set up for the 2m UKAC from Lundy IO71QD

WANTED!

A club member to take over writing the "Contest Corner" feature for "Ragchew.

Please contact the editor g4cib@outlook.com

A Brief History of Radio – Part 2
by Tony G4HBV

We should first examine why it was left to a wealthy amateur experimenter, Marconi, to realise these electromagnetic waves could be used for communication and develop a practical system. It is true that a few others were attempting to do this but they had little success.

I believe that Hertz's experiments had implanted the idea that the behaviour of these waves would be optical, or at best quasi-optical and thus offered no advantage for communication. There had been a negative reaction to Professor Hughes' demonstration to the scientific community in 1879.

Before a practical radio system could be devised, two problems would have to be solved – range and interference. There was also the scientific problem of establishing whatever the transmission medium was.

It seems that at first, Marconi's experiments were only concerned with range. His methods do not compare well to those of the Wright Brothers in their experiments a few years later. The Wrights studied all existing literature before they started their step-by-step testing; each stage incorporating what they had already established. However, in contrast to the Wrights, Marconi was a good business man, who soon realised he needed to employ others in expanding the technology.

In his early work, Marconi had the idea of an aerial and an earth, but I have seen a photo of one of his early aerials, where it is obvious that he believed the metal sphere at the top of the aerial was the actual radiator.

His decision to come to England, after failing to interest his native country, was quite fortunate - Great Britain, an island nation and thus a maritime one, would benefit greatly from improved communication for shipping. It was perhaps fortuitous that he also became involved with an organisation which sought to control all communication in this country – the state-owned monopoly which was The General Post Office.

And so Marconi proceeded with his experiments, gradually extending the range – as yet the question of interference seeming not to bother him. This would have to be solved by another person, someone of a scientific background who had been working away out of public sight ……………………

Long before OFCOM was created GARES was aware of the dangers of RF! It's National Field Day 1986 and here we see Tony G4HBV attaching a "Danger - High Voltage" sign to the antenna open wire feeder.

The location is the Gordon League Rugby ground at Hempsted. Centre front is Frank G5BM and on Leta's left is Pat G3MA with Nick (current G3MA) on Frank's left

QRP POWER METER

by Richard Tofts M0HNK

My existing power meter (OHR WM-2) is a good quality instrument but has two disadvantages for me. The first is that it requires its own power supply and, as it is used only intermittently, I prefer to remove the PP3 battery when not in use. Fitting a battery and then removing it again after use involves unscrewing and then rescrewing the case which is a nuisance. It is sometimes even a challenge *finding* a PP3 in my household! The other disadvantage for much of my work is that the three scales run up to a maximum of 100mW, 1W and 10W respectively. Much of the time I am experimenting with power levels of around 1W - 3W so I have to use the 10W scale but a lot of this scale is then redundant. I therefore decided to build a power meter which overcame these disadvantages.

I already had an analogue meter salvaged from some old boatanchor appliance (thanks Roy!). The mounting bolts had broken off but it was otherwise in good shape. A little experimentation showed that full scale deflection occurred at the rather curious value of 3.55 mA. The meter scale itself ran from 0-100mA. I decided that I'd like two power scales, 0 – 5 W and 0 – 500 mW and that I would have separate BNC connectors for lower and higher power inputs because I had plenty of those but I didn't have a suitable spare switch. From here, the outline of what I needed to do became clear. I'd have a 50 Ohm load from each input to ground and then have a simple diode /smoothing capacitor arrangement to rectify the RF generated across the 50 Ohm load and use the DC voltage to generate the current flowing through the meter. All I'd need to do was to choose a suitable resistor in each case to scale the current appropriately so that full scale deflection occurred at 5W and 500mW respectively.

I used a 1N4148 silicon diode for the high power scale and a 1N60 germanium diode for the low power scale so I knew there would be voltage drops across the diodes in the region of 0.65 and 0.3V respectively. The diode rectifier and smoothing capacitor create a DC voltage equivalent to the peak voltage on the input. Taking the high power scale as an example, a power level of 5W across 50 Ohms corresponds to an RMS voltage of about 15.81V (power = V^2/R, so 5 = $V^2/50$ and V is therefore approximately 15.81). Assuming a sinusoidal input, an RMS voltage of 15.81 corresponds to a peak voltage of approximately 22.36V or, allowing for the voltage drop across the silicon diode, a DC voltage of about 21.71V. All that's needed now is to determine what series resistance is needed to cause full scale deflection of the meter at 21.71V. Good old Ohm's law gives us the answer. V = IR so R = V/I and we know V = 21.71 and I = 0.00355 (ie 3.55 mA). So R is approximately 6,116 Ohms. This is not a standard value and, anyway, the diode voltage drop will inevitably depart somewhat from our assumed 0.65V, the meter movement will contribute some resistance of its own and there will be other uncertainties. So I used a 5.6K standard value resistor and followed it with a 1K trimmer in series to provide some scope for adjustment. Using the same approach for the low power input, I concluded that a 1K resistor followed by a 1K trimmer would do the job. The circuit diagram is shown at Figure 1.

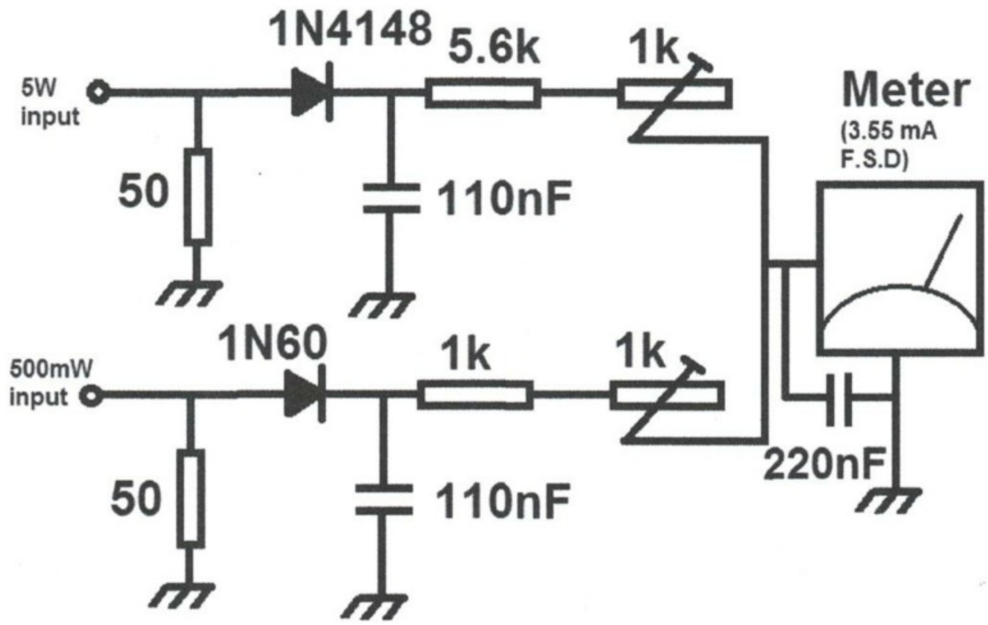


Figure 1: Power meter circuit diagram. The unusual capacitor values of 110nF arose because I first tried 10nF but found a distinct ripple on lower frequencies so I added 100nF capacitors to provide better smoothing but left the original ones in situ. The 50 Ohm input resistor on the 5W scale is formed by two 100 Ohm resistors in parallel, each rated at 2W (so application of the full 5W needs to be for a short time only). The '50 Ohm' input resistor on the low power scale is actually a 51 Ohm resistor rated at 0.5W – the slight discrepancy in value makes no practical difference. The 220nF capacitor is soldered directly across the meter terminals as an anti-rf precaution.

I could have marked off various power levels on the ammeter scale, calculating them on the basis of the theory outlined above. But there would be a level of inaccuracy that is hard to quantify on account of diode non-linearity etc and I wanted to avoid this if possible. So I decided to use power levels of 5W and 0.5W to set the upper limit of the two scales, apply known levels of attenuation to reduce the power level in stages and plot a curve of the results. I then used this curve as a basis for calibrating the scale. I used an HF transciever which allowed power output to be varied incrementally and I measured the voltage across the 50 Ohm load as a check on accuracy. It turned out that the closest I could get to 5W was 5.16W using my rig so I used this as my upper limit and adjusted the trimmer until it corresponded with maximum deflection (100mA on the scale) before introducing various levels of attenuation. Inevitably this procedure provided the amount of meter deflection for some rather odd power values (2.62W, 1.59W and so on) so I needed to work out the level of deflection that would be caused by more convenient power levels (5W, 4.5W, 4W and so on). This can be done by interpolation between the recorded values. It is perfectly possible to do this from a hand drawn graph but I used Excel both to plot the data and to fit a curve (a polynomial with terms up to x^4 provided a good fit) which automated the calculations and made life easy. The plot of power vs deflection on the original 0-100mA meter scale is shown at Figure 2.

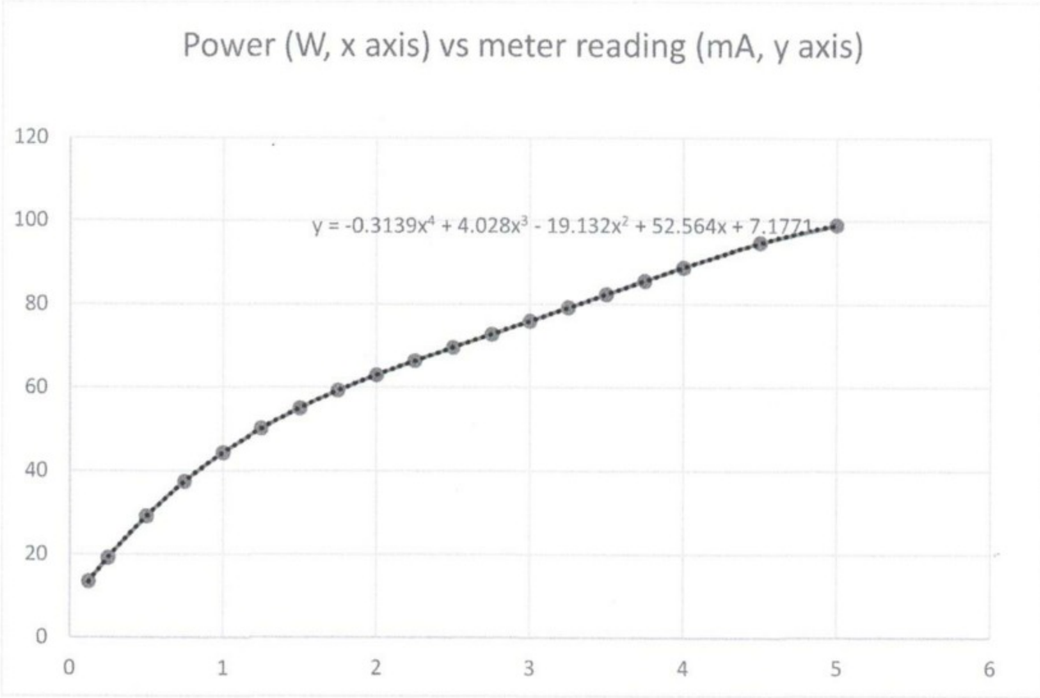


Figure 2: Measured data (blue circles) and fitted curve (black dots).

Based on the results shown at Figure 2, the new dial face was drawn using the 'Paint' program on my computer by means of scanning in the old face, overdrawing it and cleaning it up (Figure 3). The upper limit is set at 5W (and 0.5W) by design and thus uses about 99% of the original scale (because 100% deflection occurred at 5.16W (and 0.516W). But I only labelled it up to 4W as a reminder that the high power input was only rated at 4W although a brief excursion to 5W is unlikely to do any harm. Another thing to note is that the two end points of the scales (0W at the bottom and 5W/0.5W at the top) align with one another because zero power is just that (no needle deflection) and the upper markers are set by design. But looking closely, the intermediate levels don't correspond perfectly (e.g. the 1W and 100mW are slighly out of alignment). This is deliberate and reflects the measured data which in turn reflect differences in diode behaviour.

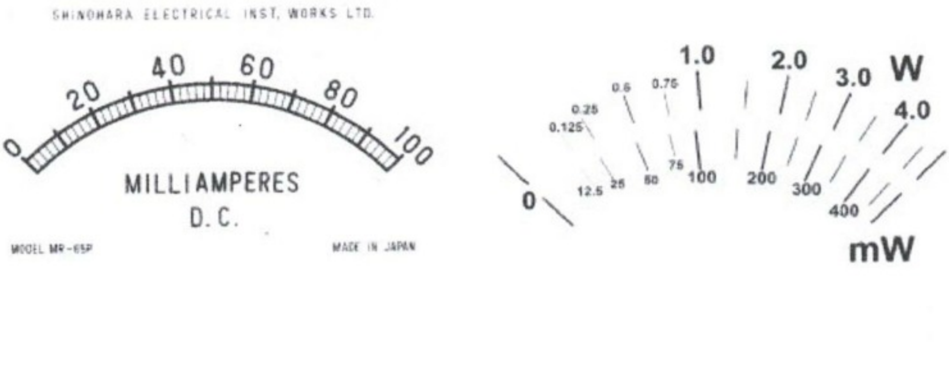


Figure 3: Original scale (mA) and new scale (power).

The inside and outside of the finished meter are shown at Figure 4.

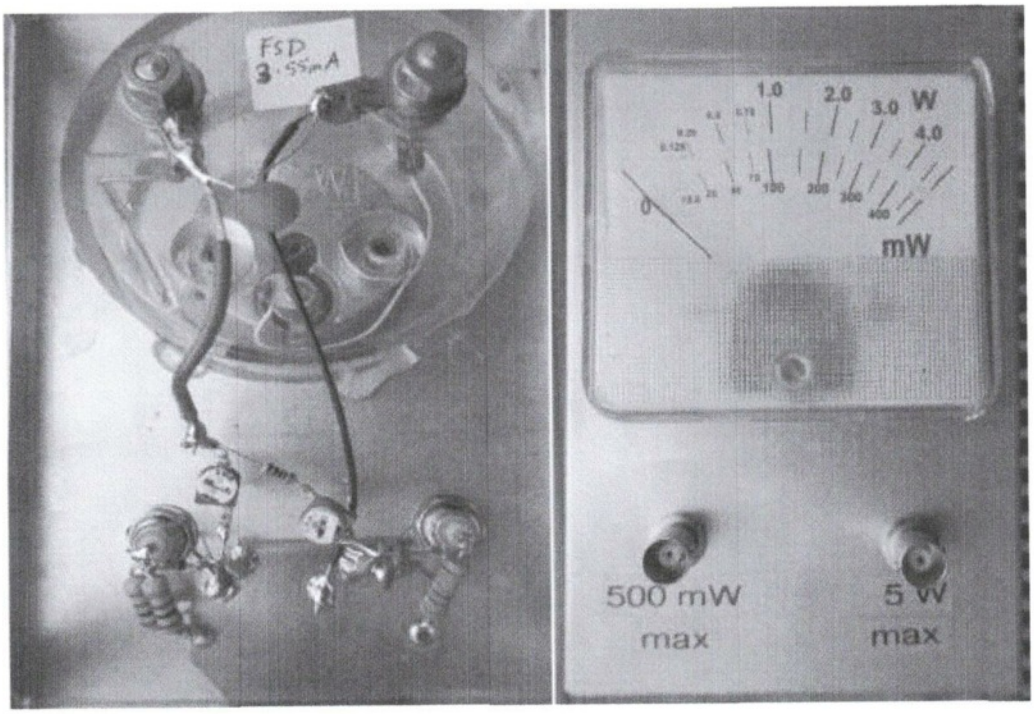


Figure 4: Internal and external view of meter.

This was a simple project but a very useful one which provides calibrated readings from 12.5mW up to 5W. I've been using it a lot recently. There's nothing magic about using a meter with 3.55mA full scale deflection and a more standard value (e.g. 1mA or 10mA) would work perfectly well with appropriate series resistors. I have provided an approximate calibration table for a 0-1mA movement below because this is a widely available scale which would be very suitable.

A note for potential builders:

I have found this meter to give good results over the HF bands. I calibrated it on 7MHz because that was a good choice for my experiments at the time, but the power readings appear consistent (within around 5%) from 3.5MHz through to 30 MHz. I haven't tested it beyond those limits.

Should you wish to build a similar meter but don't have a switched attenuator, you should build one first! (See my other article). Or, failing that, you could use the table below which gives generic calibration values for a meters with a 1mA full scale deflection. Calibrating the meter in this way won't be as accurate, but will be good enough for many purposes and, with the use of a trimmer potentiometer, a more accurate calibration would be possible when the opportunity arises.

Calibration of milliammeter scale (assuming the meter has a 0-1mA scale)			
5W scale		500mW scale	
Power	Reading	Power	Reading
5W	1mA	500mW	1mA
4.5W	0.95mA	450mW	0.95mA
4W	0.89mA	400mW	0.89mA
3.5W	0.83mA	350mW	0.83mA
3W	0.77mA	300mW	0.76mA
2.5W	0.70mA	250mW	0.69mA
2W	0.62mA	200mW	0.62mA
1.5W	0.53mA	150mW	0.53mA
1W	0.43mA	100mW	0.42mA
0.75W	0.37mA	75mW	0.36mA
0.5W	0.30mA	50mW	0.29mA
0.25W	0.20mA	25mW	0.19mA
0.125W	0.13mA	12.5mW	0.12mA

Calibration table for milliammeter with 0-1mA scale.

This table provides a 'quick and dirty' means of calibrating a 0-1mA scale so that it indicates RF power output. I have assumed a 0-1mA scale because this is a popular and easily obtainable type of meter. If you follow this option, the circuit shown at Figure 1 will work fine **as long as you make the following changes**. The 5.6k fixed and 1k trimmer pot on the 5W circuit should be changed to provide a total resistance of approximately 21.7K (e.g. 18k fixed resistor plus 5k trimmer). The 1k fixed and 1k trimmer pot on the 500mW scale should be changed to provide a total resistance of approximately 6.8k (e.g. 5.6k fixed plus 5k trimmer). I have assumed a silicon diode with nominal voltage drop of 0.65V in the 5W circuit and a germanium diode with a nominal 0.3V drop in the 500mW circuit. There is no need to use a 10nF capacitor in parallel with the 100nF one and using the latter value alone should work perfectly well.

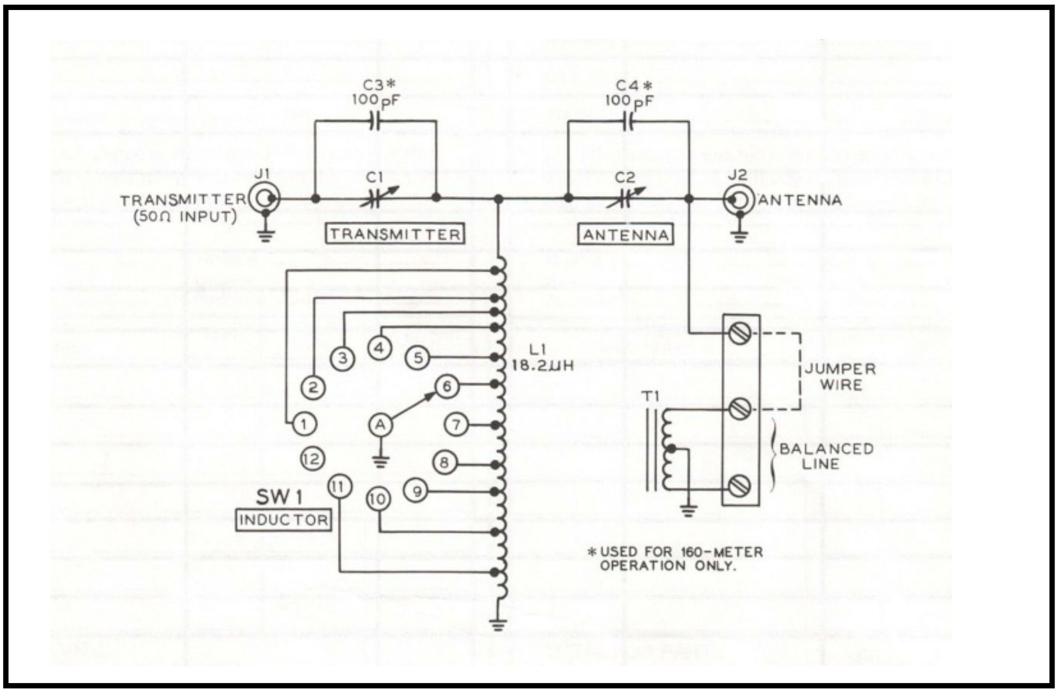
Vintage Column by Brian G4CIB

During the mid-1970s Heathkit recognised the popularity of the growing QRP movement and introduced the HW7 transceiver which I described in the Spring 2016 issue of “Ragchew”. Improvements to the original design especially on the receive side (a direct conversion receiver) resulted in the HW8. In the mid-1980s Heathkit introduced the HW-9 which was a radical redesign featuring a superhet receiver with a balanced mixer and broadband design covering 80m through to 10m. To support this transceiver they offered the HFT-9 Antenna Tuner and HM-9 SWR Bridge/Power Meter. This month I will be describing the HFT-9 which I acquired once again on a business trip to the USA.

The circuit is basically an adjustable RF transformer that matches an unknown load (the antenna and feed line) to the 50 ohm transmitter impedance. Interestingly in both the schematic (shown below) and in the parts list in the assembly manual, no value is given for the 2 variable capacitors but I would estimate they are 500pF.

Interior view of the HFT-9 showing the tapped inductor coil. The unit is rated at 50W but user reviews on eHam.net report that it will handle 100W, the conservative rating being due to the single core 4:1 balun.

The dark brown colour scheme of the HFT-9 and HM-9 along with the HW-9 transceiver were a departure from the green equipment cases associated with Heathkit amateur radio equipment.



The HFT-9 schematic - note the optional addition of two 100pF fixed capacitors to extend the range of the matching unit to cover 160m, at the expense, however of coverage of 10m.

The maximum power handling of the unit was specified at 50 watts

G4CIB/P and G4RHK/P on Lundy – May 2021

With Government restrictions still in place in early May regarding B & B, guest houses and hotels we had no alternative but to rise very early on Saturday 1st May to enable us to get to Bideford in time for the 08.30 sailing. With the M5 and North Devon link road deserted, we arrived with plenty of time in hand and a gloriously sunny morning bode well for the crossing which was indeed a millpond, a rare event for the Bristol Channel.

Our property, Castle Cottage, on the south east tip of the island is well elevated at 100m ASL with a good clear take-off to the east through to north. With this in mind 2m operation was planned using a home-made three element beam and my FT857D with an FT817ND as a back-up rig. Because of the very limited space at the property, HF operation is restricted to a vertical antenna and I took a recently acquired SOTA Beams Tactical-Mini compact ultra-portable mast. With a collapsed length of just 22 inches it fitted easily into my holdall.

The glorious weather on the Sunday 2nd May tempted me to operate 2m ssb outdoors in a small paddock adjacent to Castle Cottage and I was pleased to work **Ian M0IRP/P** on Clee Hill in Shropshire using just my FT817ND. Lundy weather on the May Day Bank Holiday Monday was awful with ferociously high winds and rain which prevented me from putting up the HF vertical and fulfilling a QRP 80m sked with **Richard M0HNK.**

The following day 80m and 2m skeds had been arranged with **Jim 2E0GKN.** 80m conditions were not good but I did manage to get **G0NXA Giles** in the log early in the morning on 80m and later on 2m SSB qsos with **Jim 2E0GKN** along with **Gary M0XAC, Dave G4BCA, Les G0ULH.** I was also delighted to work **Simon G6AHX** in Twyning. During the week a few forays on 30m and 40m produced a handful of QRP European QSOs.

The highlight of the week was participating in the **2m FMAC** and **2m UKAC.** Luckily by the Tuesday evening the wind had dropped so I was able to put up my home-made beam confident that it would stay up. I was surprised by the lack of local activity on the FMAC, only working 4 stations, the upside being that they were all in different locator squares (IO70, IO71, IO81, IO82), best dx being 2W0BML at 188km. The UKAC proved to be far busier, notching up 29 qsos in 11 squares, best dx being GM4YXI (IO87WK) at 719km.

Whilst on Lundy we usually monitor marine channel 16 on a little scanner to keep track of the maritime weather information broadcasts and any other traffic. A minor drama played out on the Thursday when Milford Haven Coastguard repeatedly called fishing vessel "Ichthus" with no response. The "Oldenburg" just leaving Lundy was given a detailed description of the vessel and asked to look out for it. On hearing this I realised I had seen this vessel anchored up in the Landing Bay earlier in the day. After a few more calls from Milford Haven, another fishing vessel "Delta Dawn" radioed that he knew the skipper and would try and contact him on his mobile phone. It transpired that the inverter on "Ichthus" has blown up and the vessel had lost its mains power resulting in the AIS beacon not functioning and of course disappearing off the Coastguard's radar screen. All was well in the end when the vessel was spotted heading round the north of Lundy.

Later that day I attempted to join in the club 80m COTA net. I could hear with difficulty most of the stations but the band was extremely noisy. I struggled on and towards the end of the net unplugged the antenna from my FT857D (powered with a Watson "Powermite" SMPS) and plugged it into my FT817ND (running on internal batteries). The difference in noise level was incredible. The Watson "Powermite" works fine on domestic mains but on the Lundy "mains" supply the noise is enough to wipe out 80m. I have ascertained that the island supply is generated with a straight 3-phase 415V alternator. Having discussed the problem with **Les G0ULH**, we've come to the conclusion that with the absence of any transformers in the supply network which would smooth out the waveform the island 240V supply is very noisy and when powering the SMPS even more noise is being generated.

The rest of the week was spent mainly on 2m working stations along the South and West Wales coast and North Devon. As the end of our week approached the weather forecast became increasingly dire and on the Friday evening we were informed that the "Oldenburg" would not be sailing the following day and as the cloud base was forecast to be low, the helicopter would not be able to fly. By Sunday the weather had cleared enough for the helicopter to be drafted in to fly us off the island.

Date for the diary – we will be on Lundy next year 3rd - 13th September