An Amateur Radio publication for the Microwave Enthusiast

scatterpoint

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In This Issue

134GHz signal received at 52km

Low cost spectrum analyser review Bryan G8DKK

UK Microwave Group

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Application forms below should be submitted to the UKuG Secretary, after which they are reviewed/ agreed by the committee

www.microwavers.org/proj-support.htm

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By Mike Scott, G3LYP

Non-members can join the UKµG by following the non-members link on the same page and members will be able to email Mike with requests for components. All will be subject to availability, and a listing of components on the site will not be a guarantee of availability of that component.

The service is run as a free benefit to all members of the UK Microwave Group. The service may be withdrawn at the discretion of the committee if abused. Such as reselling of components.

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Minimum quantity of small components is 10.

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5.7GHz 10GHz 24GHz 76GHz 122GHz

Inverter Drive for AC Rotators

Andy Talbot G4JNT

Antenna rotators using AC synchronous motors often appear on the surplus market, frequently minus their controllers which can make them quite cheap to purchase. That shown in Photo 1 is typical. I bought three AR33 type rotators over the years from rallies and junk sales, none with their original control unit. One is doing sterling service up the mast with a homebrew control box and digital display [1] (published in RadCom January 2009). The other two units sat in my shed biding their time.

Driving Synchronous AC Motors

The motors are typically supplied with 20 - 30 V at 50/60 Hz and have two poles with a capacitor switched between them to deliver a phase shift to one winding or the other to alter the direction of rotation, as shown in Figure 1.

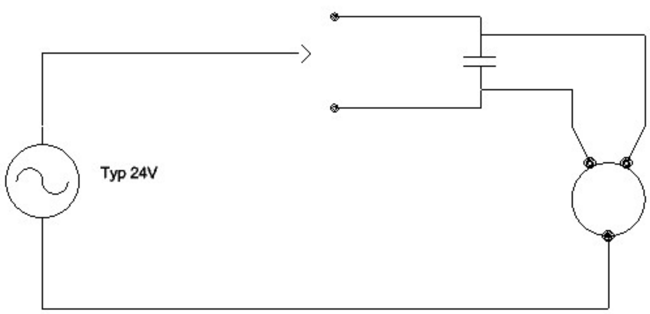


Figure 1 Conventional method of driving a two-phase reversible AC motor as used in many older antenna rotators

Measuring the parameters of one rotator showed that each winding had a DC resistance of about 2.5 Ω with a reactance at 50 Hz and no load of roughly 8-10 Ω. The reactance measurement was very vague and the value varied considerably, downwards, as the motor was loaded. The value of phase shift capacitor in most control boxes is typically in the region of 68uF and has to be a non-polarised electrolytic. The reactance of this at 50 Hz is 47 Ω so it is clear the phase shift between the two windings when the motor is running is going to be far from 90˚, and the current in each winding unequal; the motor is being driven sub-optimally. What if a true 90˚ drive could be provided to each winding, using MOSFET drivers and Pulse Width Modulation, PWM? It ought to then be possible to run these rotators from a DC supply, which in turn can be derived from a 12V battery via a boost regulator module for portable operation. With a true 90˚ phase shift it should also be more efficient.

PWM AC Source

Ideally, AC drive using PWM would use a full bridge of four MOSFETs, two top and bottom supplying each side of a winding – otherwise known as an H-bridge as shown in Figure 2. This means four FETs in total for each winding. FETs are cheap and custom FET driver ICs exist for this very job, a full H-bridge driver can be found in a single chip such as the HIP4080. Full bridge operation means the DC rail represents the peak of the AC waveform – so to get 24 V_{RMS} drive would require a 34 V DC supply rail. This is perfect for a single motor winding (or loudspeaker, or any other load you want to drive with PWM generated AC), but when driving two motor windings with a common connection the idea fails. Various ideas were tested in theory (an Excel spreadsheet) for supplying a pair of. MOSFETs on the common connection with a drive waveform formed from a hybrid of the 0/90˚ drive to each side. But no suitable solution was possible without further increasing the supply voltage or sacrificing an exact 90˚ phase shift

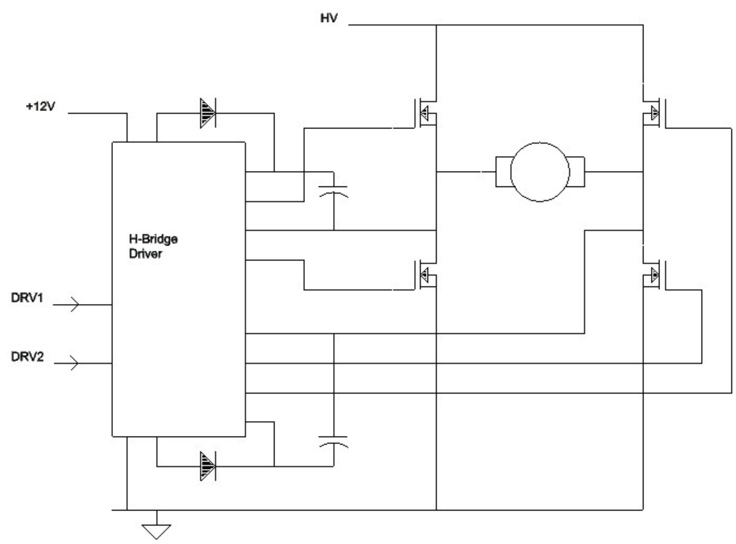


Figure 2 Full, or H-Bridge Driver suitable for PWM drive of a single phase load

What would work is a pair of half-bridge drivers with the common motor connection taken to the mid-point of a pair of capacitors across the supply rail for an AC ground. Normal electrolytics are adequate here so there is no need for the exotic non-polarised types used in the original control circuitry. The disadvantage of the half-bridge configuration is that the DC supply rail now becomes the peak-to-peak voltage of the AC drive, so that 24 V_{RMS} drive now needs to come from a 68 V DC rail. That is a bit high for comfort but does the rotator motor really need the full 24 V_{RMS} since it should now be operating with greater efficiency? The answer was to make a breadboard and try-out what actually worked.

A quadrature PWM-generated sinewave source already existed, having been intended for generating quadrature audio tones for direct upconversion to RF [2]. This uses a modern 16F1827 PIC microcontroller which has four separate on-board PWM sources, more than enough memory to implement sine lookup tables and a host of other peripherals, most of which are not needed for this application. The junk box yielded a pair of IR2104 half-bridge MOSFET driver chips [3]. This particular 8-pin chip is ideal for interfacing with the PIC as it has a common input that controls bottom and top FETs together and a separate shut down input that turns both off. Other H-Bridge driver chips like the IR2105/6 are less suitable as they have separate inputs for switching top and bottom FETs and require either individual drive for each from the controller, or a separate logic inverter in hardware to drive both from a common signal.

As the PIC 16F1827 processor has an A/D converter on board this was used to read a potentiometer allowing the drive frequency to be set arbitrarily in the range 30 to 85 Hz. It was felt that being able to alter the drive frequency at will might show if operation of the motor at other than the normal 50-60 Hz may offer any benefit. The 18 PIN chip has enough spare I/O lines left over from this relatively simple task so they were used for an LCD module so the drive frequency could be read out

in real time. Another A/D input (that had to be shared with one of the LCD data lines) was used via a potential divider to allow the bridge supply voltage to be measured without having to attach a separate DVM.
The sampling rate in the original I/Q audio source was in the tens of kilohertz region, far higher than needed here. To generate at most 85 Hz, the sampling rate used for both the PWM and the sine lookup was chosen to be little under 1 kHz (actually the processor clock of 4 MHz / 4096). This low switching frequency would minimise surface-current losses in the wires supplying the motor and reduce the potential for RF interference. To minimise the effort in re-writing the PIC code from that of the I/Q baseband source, the maximum PWM resolution used for that of 10 bits was retained, although such a high resolution sine wave is not needed here.
The four IRF640 switching MOSFETs were also taken from the junk box. These are rated at 200 V with an $R_{DS(ON)}$ of 20 mΩ so are somewhat over specified for this task delivering perhaps 1 – 2 Amps to the motor; they certainly don't need to be mounted on a heatsink.

Power Supply

Measurements on the original mains powered driver delivering 24V RMS suggested a current of up to around 2.5A was typical for the rotator up the mast, sometimes a bit lower, and closer to 3.5 A when heavily loaded or stalled. This was with the non-optimal phase shift introduced by a 68uF capacitor. Making a finger-in-the-air assumption that PWM DC-AC conversion with minimal resistive losses would be close to 100% efficient, that would mean a DC power consumption of up to 60 Watts for normal operation, about 1.2A from a 50V rail (giving effectively about 18V RMS drive). A proper 90˚ phase shift between the windings, 'ought' to lead to better motor efficiency and reduced current consumption, allowing the lower drive voltage. Being able to vary the drive frequency either side of 50 Hz might also help matters
A popular boost converter module available on eBay uses the XL6009 chip in a ready to go module, specified for up to 63 V output, adjustable with a trim-pot. Search "XL6009 Boost converter". The chip is rated for a switching current of 4A which at 12V input would yield only 48W at whatever supply voltage was selected, so barely sufficient – but a good starting point for test purposes. That chip has current limiting built in, providing protection from overload. The only other 50 V supply available was an SMPSU rated at 40 A output – not adjustable, and hardly suited for breadboard test purposes.

Speed Control

Previously, the mains powered driver offer low speed operation by pulsing the AC drive to the motor at a rate of around 2Hz with a duty cycle of around 33%. The inertia of the system smoothed this out to give an effective continuous slow turn.
Using PWM drive from a microcontroller ought to offer more possibilities for speed control, but in fact a slightly more controlled version of this method turned out to be the best. Lowering the frequency had already proved ineffective. Driving with individual cycles with a gap between was tried, but the need to do this with 90˚ shifted waveforms made it all a bit hit-and-miss.
The solution that worked was to switch the AC drive on and off in bursts of 16 cycles (0.4s). Two slower speeds were adopted, 50% and 25% with 16 cycles of AC followed by a gap of another 16 or 48 cycles. This allows a simple two-bit binary word to control speed.

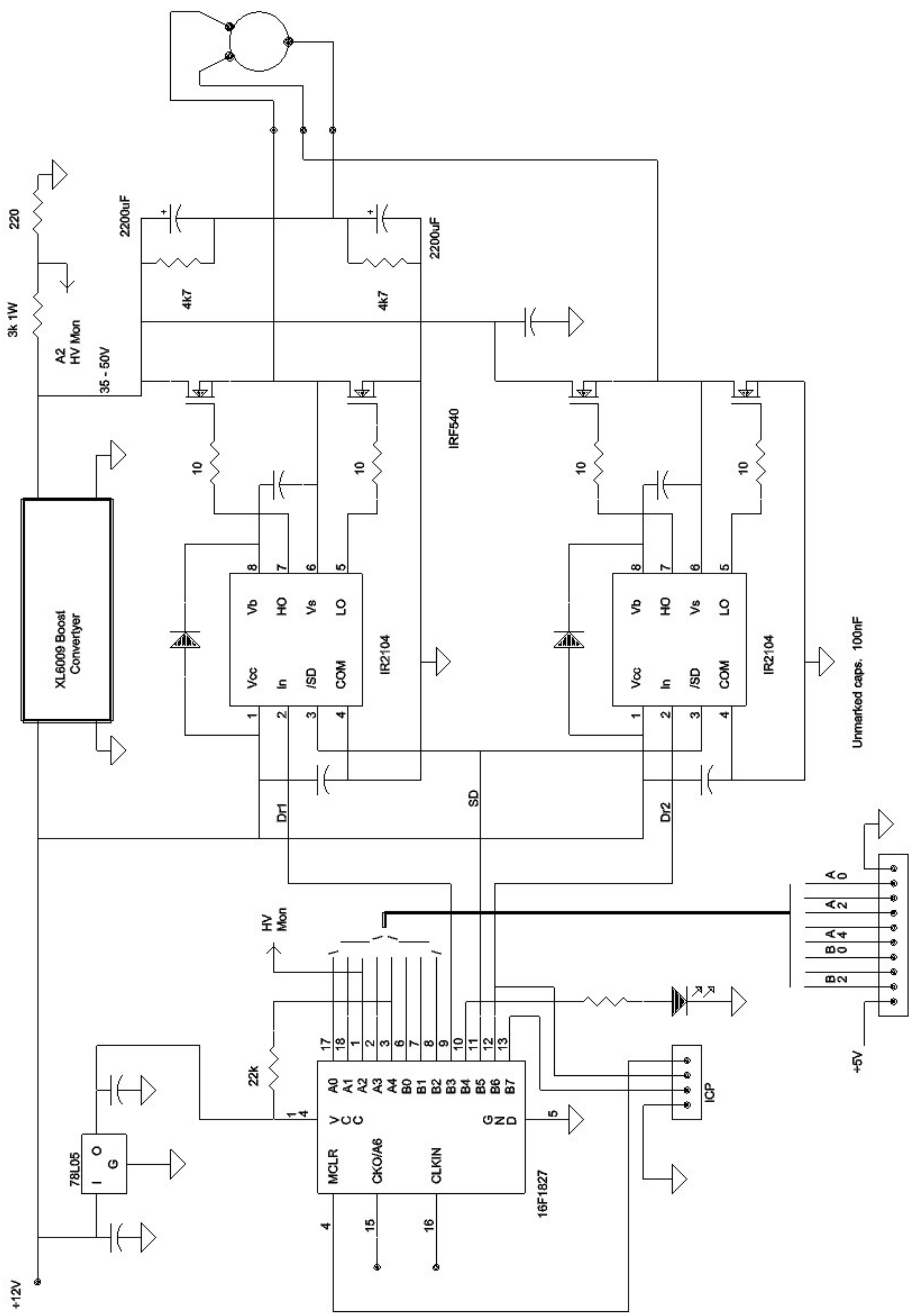


Figure 3 Complete circuit diagram of AC Rotator driver breadboard. GO-LEFT and GO-RIGHT controls are on Pins B0 and B1

Test Results

Initial tests to find the optimum drive voltage and frequency were done on a rotator with no load. Not totally unsurprisingly, the motor performed best with frequency set in the range 45 – 65Hz. Lower drive frequencies than 40Hz caused current to rise rapidly and the PSU go into limiting. Much higher than 70Hz and the current fell due to the increasing reactive component of the windings. The optimum frequency seems to be around 55 Hz. Perhaps no coincidence, as this is the average of the two mains frequencies used around the World. The unloaded rotator worked perfectly well with 35 V DC supply, drawing a current of typically around 1 to 1.5 A from the 12V input. This rose to close to 3 A with the rotator stalled against the end stops. Increasing drive voltage just caused a rise in current consumption with no obvious speeding up of the rotator. Torque, tested by grabbing hold of the moving assembly and trying to stop it by hand, was much improved by the increase from 35 to 40 V.

When used to drive the rotator up the mast, supply voltage was set at to 40 V. That rotator hasn't been serviced or lubricated for some time so may be a bit stiffer than the one used unloaded for initial testing. The antenna rotated satisfactorily with a current consumption from the 12 V input of around 2 A, and sometimes a bit higher when the wind blew or some other loading appeared. It was clear the XL6009 module was working within its capabilities, but would probably be pushed if a heavier antenna load were to be placed on it. The FETs are being very underrun in this situation. Even with no heatsink they barely rose above room temperature after several minutes of rotation testing. The 2200uF capacitors did get slightly warm. The ones used are a couple of decades old, designed for SMPSU output filtering, so are low ESR for that era, but their age makes them probably not perfect for this task. But they did the job.

PIC Code

A sine lookup table 1024 words long is accessed from a numerically controlled oscillator clocked at 976.6Hz, incremented by the value needed to generate 55Hz. The 10 bit result from the table is sent directly to one of the PWN generators. The address is incremented or decremented by 256 corresponding to 90˚ of phase shift and the table lookup done again. Increment or decrement decides the phase shift direction and hence the direction of rotation. The result from this table lookup goes to the second PWM generator.

The PWM source runs continuously. The two go-left and go-right inputs are monitored, and when either is activated the Shutdown pins on the FETs drivers are set to give MOSFET drive.

A counter is clocked at the drive frequency and this is used to control the speed in blocks of 16 cycles.

In between 976Hz sampling intervals, the A/D reads the HV supply on the PIC firmware that includes the LCD. Earlier versions monitored a potentiometer for adjusting drive frequency, but later versions fixed this at 57Hz

Conclusions and Further Development

Older style AC rotators can be driven from a quadrature synthesized sinewave generated using pulse width modulation driving a pair of half-bridge Mosfets. A higher motor efficiency is possible with the idealised 90˚ phase shift, allowing power to be supplied from a small boot regulator from a 12v supply with a current draw of just a few amps.

This module has so far been tested with just lightweight antennas, but the FETs are capable of switching a higher current if the power supply current rating is increased. A higher drive voltage up to 50 – 60V could be used if necessary, generated from a suitably rated boost converter.

The 16F1827 PIC uses only a tiny portion of its capabilities here. There is plenty of scope for reading the rotator's potentiometer and calculating and displaying a readout, but with the LCD connected, pin count for this device is getting tight and it may be more convenient to keep display and driver functionality apart, using two separate controller devices.

The breadboard test module can be seen in Photos 2 and 3

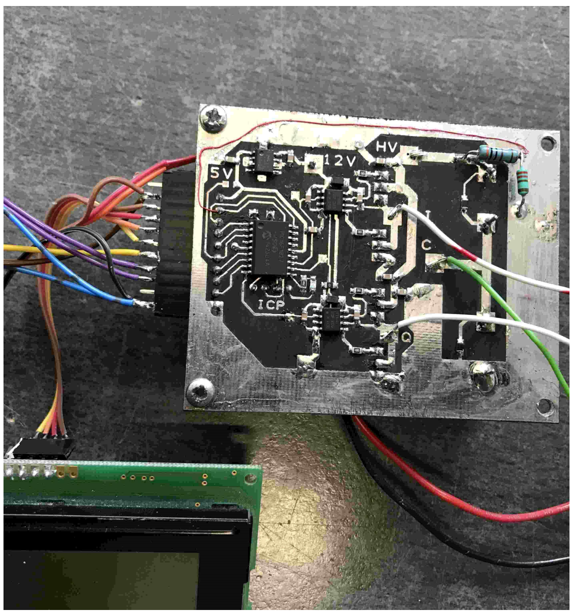
References

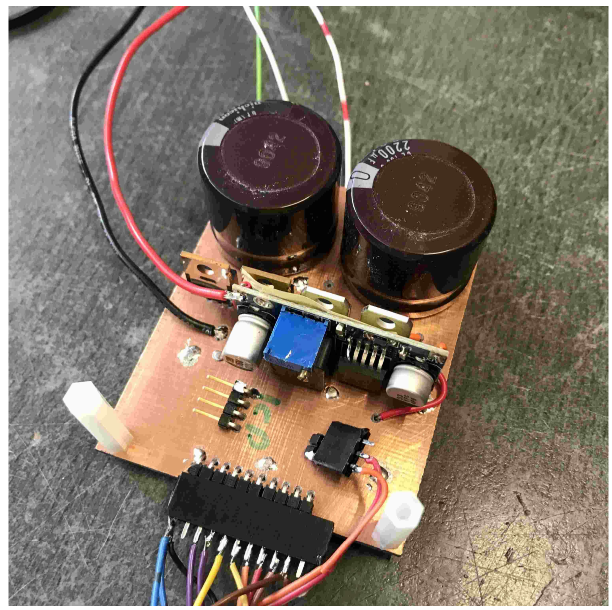
[1] Rotator Controller http://www.g4jnt.com/RotatorController.zip the full article appeared in January 2009 RadCom

[2] PIC PWM I/Q DDS Design Notes, RadCom October 2022

[3] Note that the HIP2104 device, available from the same suppliers as the IR2104, is also a half bridge driver but a completely different chip with different connections, unsuitable for use here. It is unusual to see similar type numbers used for different devices aimed at a broadly similar task.

PIC code in embryonic but useable form is available from me on request.





Top and Bottom Views of the breadboard PWM rotator drive unit. The LCD module is not required for normal operation but has been included for development purposes. The XL6009 boost converter and electrolytics forming the AC mid voltage point are mounted on the underside of the PCB

A binary-phase-modulated source for the 30THz band

Barry Chambers, G8AGN

Introduction

My interest in using binary-phase modulation on the 30THz band was aroused a few months ago by a YouTube video from Remi M0LRH, [1], in which he demonstrated such a 30THz system operating over a distance of 75m. In a more recent video, [2], he shows an improved system operating over 109m. In both cases, the transmitter employed a small-area hot plate source which was modulated via a paddle whose transverse position in front of the source was controlled by the read-write head mechanism from a salvaged 2.5-inch computer hard-drive. The paddle movement was such as to produce a 3Hz subcarrier signal whose phase could be changed from 0^0 to 180^0, depending on whether a QRSS dot or dot-length space signal was being transmitted. The signal phase angles were referenced with respect to that of a 1pps signal derived from a local GPS module. The receivers used a standard PIR sensor, as widely used in intruder alarms, but with one of the two internal piezo elements masked off. This was followed by amplification and/or other signal processing and a software-implemented phase sensitive detector (sometimes known as a lock-in amplifier) [3]. The receivers also used 1pps signals from their own local GPS module as a phase reference. The advantage of using a lock-in amplifier as a demodulator is that it is able to recover a weak signal with known characteristics (in this case with 3Hz modulation) in the presence of much stronger noise.

Transmitter design and construction

(a) Chopper wheel modulation

My first step in building a phase-modulated system was to try and replicate Remi's transmitter paddle modulator but my efforts were unsuccessful as I was unable to build a paddle which was light enough to be moved quickly and reliably by my salvaged hard-drive actuator. This led me to consider an alternative modulator approach based on a stepper motor-driven chopper wheel which was placed in front of the hot source.

Before describing the physical construction of the transmitter and its controlling software in detail, it is necessary to describe how the phase-modulated 30THz signal is derived. For initial testing, a four-bladed chopper wheel was fabricated from a 1.5mm thick, 150mm diameter, laser-cut aluminium disc, since these are readily available on eBay.

Figure 1 shows the chopper wheel, mounted on the shaft of a NEMA 17 stepper motor and located in front of a hot source comprised of two high-wattage 6R8 resistors in series. In Figure 1(a), one of the wheel's blades hides or masks the source whereas in Figure 1(b), the wheel has been rotated through an angle of 45^0 and the source is now fully visible or unmasked.

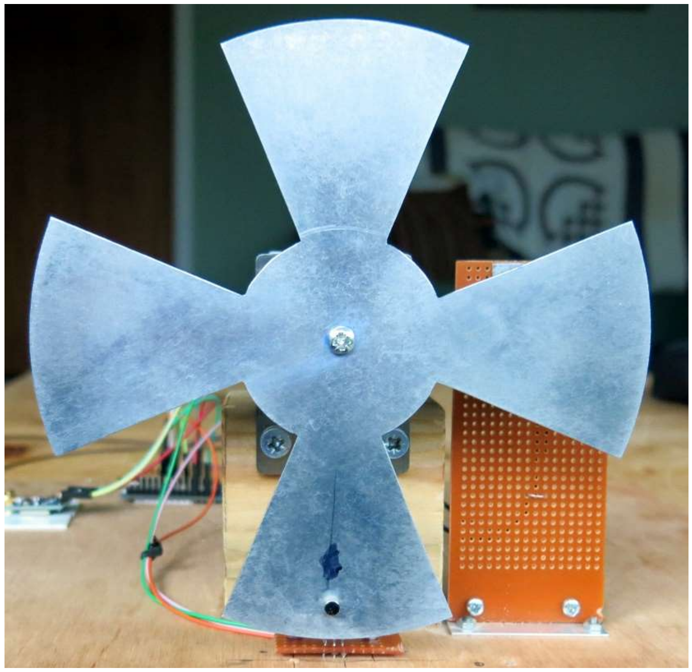


Figure 1(a) Hot source masked by a chopper wheel blade

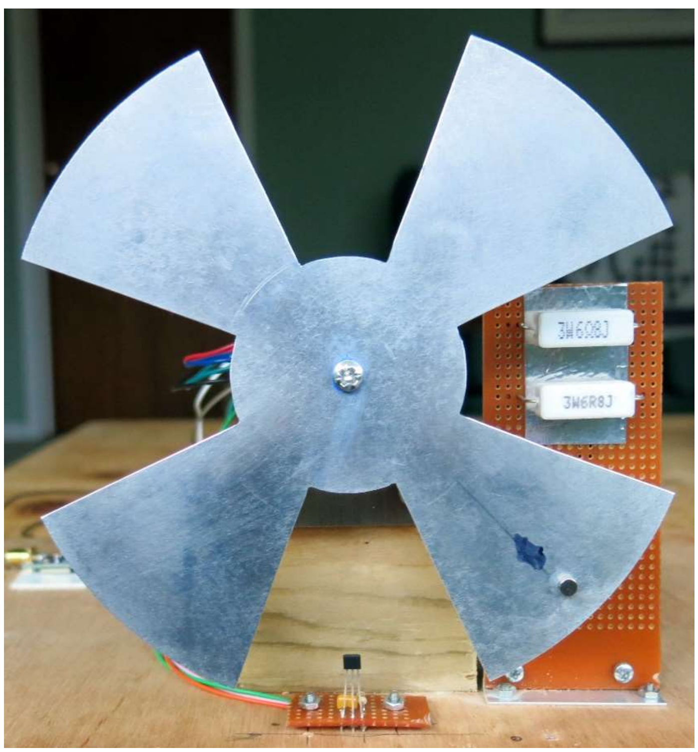


Figure 1(b) Hot source unmasked by subsequent 45^0 rotation of chopper wheel

The amplitude of the transmitted 30THz signal will be dependent on the source temperature, raised to the fourth power, and its emitting area. Hence in the case shown in Figure 1(a), the signal amplitude will be low (not zero since the chopper wheel blade will be at ambient temperature and so will itself radiate, but not much since the ambient temperature will be much lower than that of the source temperature), whereas in the case shown in Figure 1(b), the signal amplitude will be maximum. If the chopper wheel is now rotated at a constant rate of 1rpm, the result will be to produce a 30THz “on-off” signal with a trapezoidal waveform and a frequency of 4Hz. Information can then be conveyed by this 4Hz subcarrier using binary-phase modulation and the phase of the subcarrier at any particular time will be determined by whether the chopper wheel starts rotation from the rest position shown in Figure 1(a) or that in Figure 1(b) since these cases are separated by a 45^0 wheel rotation which corresponds to a phase angle of 180^0. For this system to work reliably, a phase (or equivalently, a time) reference is needed. This is provided by the rising edge of a 1pps signal obtained from a GPS module, such as a Ublox NEO-6 or NEO-8. This timing signal is used once a second to initiate rotation of the chopper wheel from a known position.

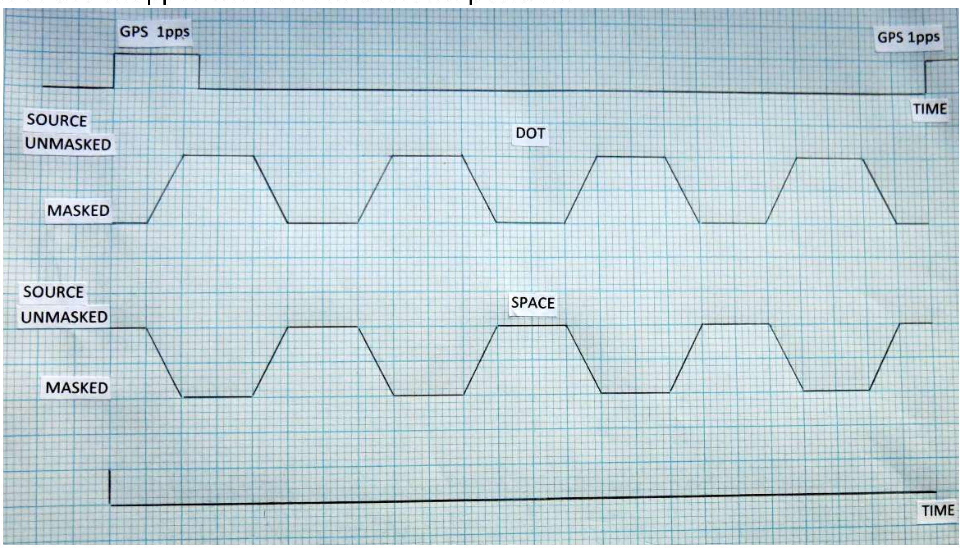


Figure 2: Idealised source output waveforms for dot and space over 1 second time interval
Top waveform: GPS signal. Phase reference is leading edge of 1pps pulse
Middle waveform: QRSS1 dot (0^0 phase shifted)
Bottom waveform: QRSS1 space (180^0 phase shifted)

Figure 2 shows the resulting 30THz source waveforms over a one second period for the two starting positions shown in Figure 1. These waveforms are used to denote the “key-down” and “key-up” states of a QRSS1 CW signal with a subcarrier frequency of 4Hz. Thus, a message can be transmitted by sending the appropriate sequence of “key-down” and “key-up” states, each one of which lasts for a period of 1 second. It can be seen from the waveforms shown in Figure 2, that the bottom one, resulting from the wheel starting position shown in Figure 1(b) is inverted with respect to that shown above it and hence the two waveforms have the required 180^0 phase relationship.

In summary, a QRSS1 dot is represented by 1 second’s worth of 4Hz subcarrier with a phase shift of 0^0 and a space is represented by one second’s worth of 4Hz subcarrier with a phase shift of 180^0. Then dashes (i.e. a sequence of three dots) or longer spaces can be represented by duplicating the waveforms shown in Figure 2 the required number of times. The transitions between a dot and a succeeding space or between a space and a succeeding dot are more complicated and are represented by the middle and bottom waveforms shown in Figure 3.

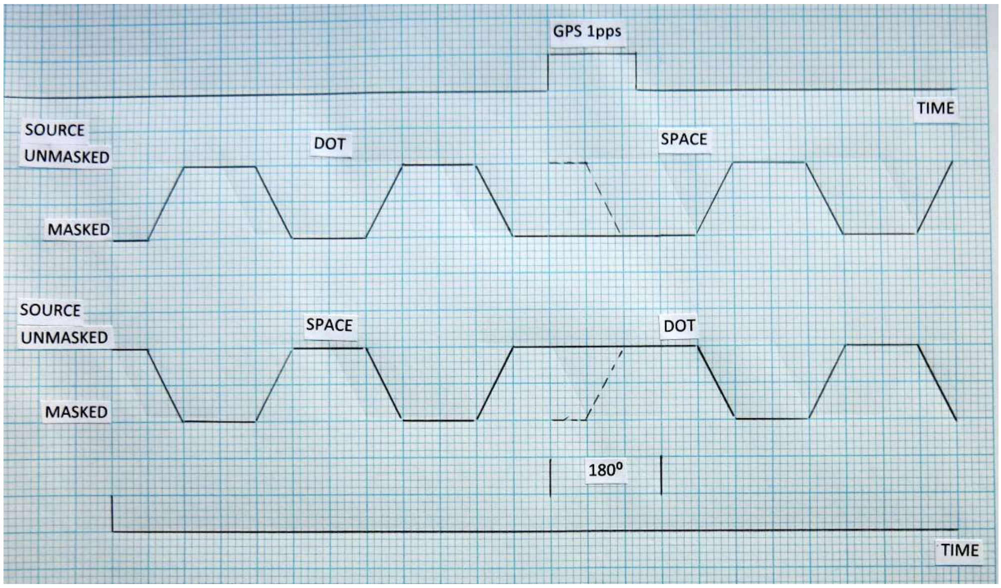


Figure 3: Idealised source output waveforms during phase transitions
Top waveform: GPS signal. Phase reference is leading edge of 1pps pulse
Middle waveform: Phase transition between a dot and a space
Bottom waveform: Phase transition between a space and a dot

The middle waveform in Figure 3 shows the signal waveform in the transition region between a dot and a space. The dot waveform finishes as normal (source masked) but from Fig 2, the space waveform should then start with the source unmasked. Obviously, the chopper wheel cannot change its position instantaneously to achieve this; instead, the chopper wheel pauses in the masked position for 125ms, corresponding to the time taken for one-half cycle at 4Hz. Then the remaining time of the one second period for the space is sufficient to produce 3.5 cycles of the space waveform with the correct 180^o phase shift with respect to that of the preceding dot. The fact that the resulting signal waveform thus appears to be "distorted" during the transition from a dot to a space does not affect the decoding process in the receiver, as will be discussed in a later article.

The bottom waveform in Figure 3 shows the signal waveform in the transition region between a space and a dot. As in the previous case, this is handled by pausing the rotation of the chopper wheel for 125ms, but this time with the source unmasked and the subsequent 3.5 cycles of the dot have the required 180^o phase shift with respect to that of the preceding space.

(b) Building and testing the chopper wheel transmitter

As mentioned above, Figure 1 shows a frontal view of the chopper wheel attached to the shaft of a NEMA 17 stepper motor. The latter is placed on a wooden pedestal of sufficient height to allow clearance for the chopper wheel rotation. A small PCB containing a non-latching Hall sensor, A3144 or similar, is mounted on the baseboard, between the pedestal and the plane of the chopper wheel. The sensor is triggered by a small neodymium magnet which is held on the inner face of one of the chopper wheel blades by means of a companion magnet which is mounted on the outer face of the blade. This arrangement makes it easy to adjust the position of the inner magnet correctly so that the Hall sensor is triggered when the hot source is masked by a blade, as shown in Figure 1(a). Since the attractive force between the two magnets is so strong, moving the outer magnet then results in the inner magnet moving accordingly. Once their positions have been optimised, the magnets are fixed to the chopper wheel by small dabs of adhesive. Since a message always starts with the source masked, on system power-up the chopper wheel is rotated automatically until the Hall sensor is triggered and thus this ensures the correct starting position of the wheel.

Although not implemented at present, it would be advantageous to increase the number of hot sources from one to a maximum of four since this would increase the effective output power of the transmitter by the same factor. The blades are spaced at angular intervals of 90^o and so the four discrete hot sources should also be spaced apart by 90^o. All the individual sources would then be masked/unmasked simultaneously by the rotating blades and the effective source area would thus be four times that of a single source. This idea would not work with a continuous ring source, since then some parts of the latter would always be visible and so on-off modulation would not be achievable.

The circuit diagram of an updated version of the phase modulated transmitter is shown in Figure 4. The original 6R8 resistor hot source has been replaced by a 40mm x 40mm MCH (metal-ceramic heater) plate which is powered from 12v via a switch-mode buck downconverter to facilitate adjustable hot source temperature.

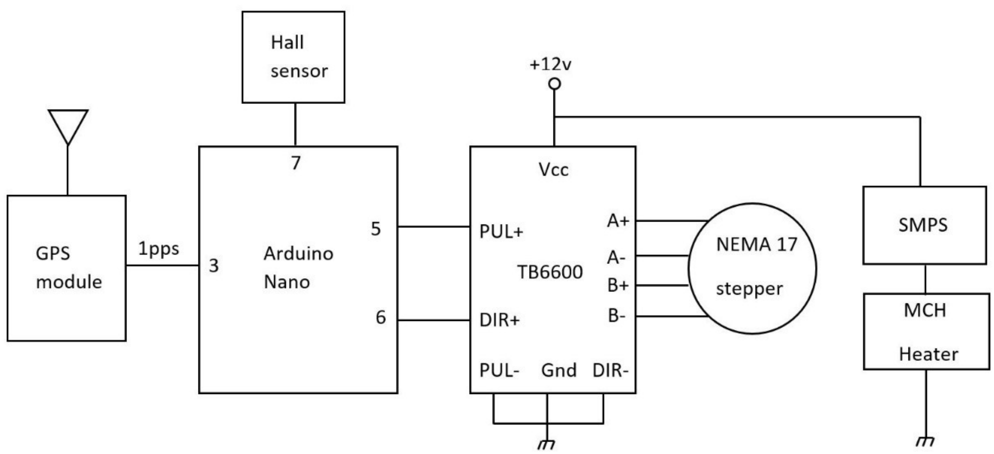


Figure 4: Circuit schematic of 30THz binary-phase-modulated transmitter

The MCH heater and stepper motor are powered from a 12v supply; the rest from 5v.

The stepper motor is controlled using a TB6600 driver module. This receives information from an Arduino Nano about the required direction of motor rotation and the number of angular steps to be made in a given time. The standard NEMA 17 motor requires 200 steps to rotate its shaft through one revolution. As presently configured, when producing QRSS1 dots or spaces, the motor is actually required to make one revolution in approximately 992ms; this slow rotation speed results in a certain amount of vibration which is reduced by using x2 micro-stepping (400 steps per revolution). The TB6600 thus produces 400 cycles of square stepping waveform every 992ms (corresponding to a carrier frequency slightly higher than 4Hz) and the time for one half-cycle of the waveform is 992/800 = 1.24ms. These time estimates do not include the additional time needed to actually process the Arduino commands for wheel rotation and so in practice the half-cycle stepping waveform time increment is 1.23ms.

In summary, the stepper motor rotation is not continuous for two reasons. Firstly, when producing waveforms corresponding to dots or spaces, the motor is stationary for approximately 8ms at the end of each one second transmission period. This “dead” time may be used in the receiver to implement a phase-sensitive demodulator in software. In addition, when there is a transition between a dot and a space or between a space and a dot, the required 180^{o} phase shift in the 4Hz subcarrier is achieved by pausing the motor for 123ms, which is the time for one half cycle. The motor pauses produce a characteristic sound and with practice it is possible to "read" the message which is being transmitted. This provides a useful audible check when trouble shooting during software development.

To conclude this description of my transmitter, it is necessary to give a brief description of the key portions of the transmitter sketch which is executed on an Arduino Nano. The message is stored as a string of 1s and 0s, where a 1 indicates a dot and a 0 a space. Since conversion of a "real" message such as "G8AGN/P" into a string of 1s and 0s is tedious if done by hand, the Arduino sketch contains a table of letters, numbers and special characters/test sequences and their string representations. Hence "G8AGN/P" is converted into the appropriate "super" string of 1s and 0s using the command

String message = G+n8+A+G+N+slash+P;

where, for example, **String G = "111011101000";**

The coding for G shown above is for a QRSS1 character (i.e. with one second dots and spaces). To transmit at the QRSS3 rate (i.e. with three second dots and spaces), it is merely necessary to replace each 1 or 0 in the G string with 111 or 000, respectively; Hence the coding system is very flexible.

When the rising edge of a 1pps pulse from the GPS module is detected by the appropriate Arduino digital input pin, this initiates transmission of the next dot or space character and this is finished just before the next GPS 1pps pulse is expected, when the process is repeated for the next message character. Before doing so, however, it is necessary to know whether the next character is of the same type as the preceding one (if not, the stepper motor will need a 123ms rotation pause to effect a change in the transmitted carrier phase by 180^{o}). The Arduino is then able to generate the appropriate stepper motor rotation pulses. The dot() function is shown below; the dotSpace() function is almost identical.

```
void dot()
{
 if (prevChar == 1)
 {
  // Case 1: dot following on from previous dot
  // step NEMA 17 to generate 4 cycles with 0-degree phase shift
  for ( int i = 0; i < 400; i++)
  {
   digitalWrite(PUL, 1); // pulse rising edge
   delayMicroseconds(1230);
   digitalWrite(PUL, 0); // pulse falling edge
   delayMicroseconds(1230);
  }
 }
 else
 {
  // Case 2: dot following on from previous space
  // pause of 123ms  (approx. 180-degree phase shift)
  delay(123);
```

```
  // step NEMA 17 to generate 3.5 cycles with 0-degree phase shift
   for ( int i = 0; i < 350; i++)
   {
     digitalWrite(PUL, 1); // pulse rising edge
     delayMicroseconds(1230);
     digitalWrite(PUL, 0); // pulse falling edge
     delayMicroseconds(1230);
   }
 }
 prevChar = 1; // make a note of the last character type for future reference
}
```

Overall control of message transmission is handled by the Arduino **loop()** function, as shown below.

```
void loop()
{
 for(int i = 0; i < mSize; i++)     // mSize is total number of dots and spaces in the message
 {
//wait for 1pps signal from GPS to go HIGH before transmitting a character
 while (digitalRead(GPS) == LOW) {}   // GPS defines the digital pin for GPS 1pps input
  if(message[i]== '1') {dot();}
  else {dotSpace();}
 }
// while(1);      // if uncommented, the message will only be transmitted once
}
```

As mentioned earlier, when power is first applied to the transmitter, the chopper wheel is automatically rotated to its home position, where the hot source is masked by a blade. This is achieved using a function called **home()**, which is listed below.

```
void home()
{
 // rotate chopper wheel until source is covered by a chopper blade
 while (digitalRead(hall) == HIGH)  //hall defines the digital pin for the Hall sensor input
 {
   digitalWrite(PUL, 1); // pulse rising edge
   delay(2);
   digitalWrite(PUL, 0); // pulse falling edge
   delay(2);
 }
}
```

Initial testing of the transmitter was carried out without requiring a GPS 1pps signal. This was done by commenting out the following line in the **loop()** function.

```
while (digitalRead(GPS) == LOW) {}
```

and uncommenting the line

```
while(1);
```

These changes have the effect of allowing the chopper wheel to start rotating as soon as the system is powered up, but the message is only transmitted once rather than continuously. The following test messages were then run:

(a) **String message = allOnes;** where **String allOnes = "11111";**

This should result in the chopper wheel making five complete rotations, so that the hot source starts and finishes being masked by a blade.

(b) **String message = allZeros;** where **String allZeros = "00000";**

This should result in the chopper wheel making 4 and 7/8ths rotations, so that the hot source starts masked and ends unmasked. The deficiency of 1/8th rotation corresponds to a 180^0 phase shift at the beginning of the transmission, since a transmission is always assumed to start with a 1.

(c) **String message = altOneZero;** where **String altOneZero = "1010101010";**

Transmitting this message results in a succession of 180^0 phase shifts being produced by a $1/8^{th}$ rotation pause every revolution of the chopper wheel. This may be seen by closely monitoring the position of the neodymium magnet on the outer face of the chopper wheel which shifts its position by 45^0 after every wheel rotation.

The final transmitter test was to connect the GPS module to the Arduino and to restore the Arduino sketch to its original state. On system power-up, the chopper wheel should then rotate to its home position where the source is masked by a blade. The wheel will then only start to rotate and transmit the message after a valid GPS fix has been obtained and the message will then be transmitted repeatedly until the system is powered down.

Acknowledgement

I would like to acknowledge the many informative discussions I have had with Remi, M0LRH, and Bob, G4APV, during this project.

References

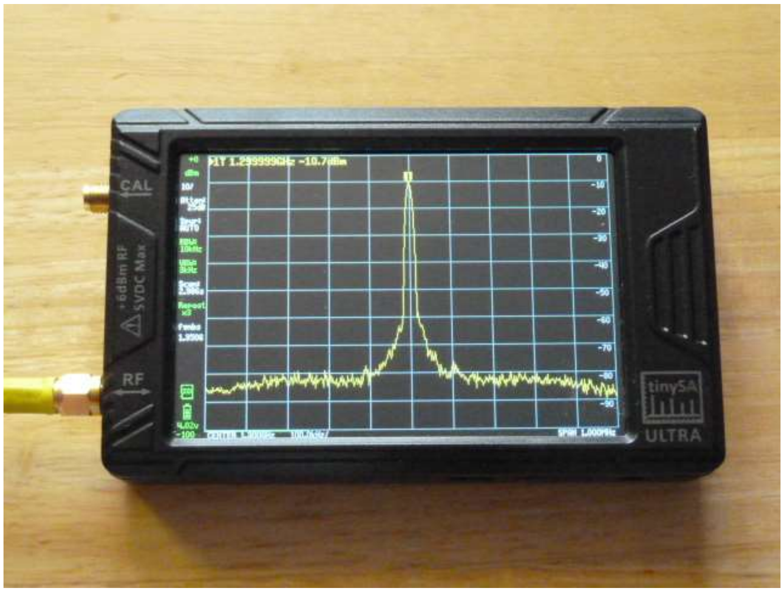
https://www.youtube.com/watch?v=GKiRo0Hqu04

https://www.youtube.com/watch?v=Coo5u3XPHcs

LLS - Appendix D: the Phase Sensitive (Lock-In) Detector | Advanced Lab (berkeley.edu)

A Low Cost Microwave Spectrum Analyser

Bryan Harber G8DKK



1.3GHz fundamental

Is this too good to be true?

Over the last year or so eBay has been showing a small handheld, battery powered spectrum analyser the “tiny Spectrum Analyser”, tinySA for short.
This unit has a 2.8” display and operates up to a maximum frequency of 800MHz.
I had noted these units but had no interest as I find the 2.8” displays too small from experience of the nanoVNAs with the same displays. A spectrum analyser typically has more information around the periphery of the display than does a VNA.

Towards the autumn of last year (2022) I became aware of the existence of a similar spectrum analyser product named “tiny Spectrum Analyser Ultra” (tiny SA Ultra for short). Although not appearing following an eBay search I managed to track down this unit from the Chinese site AliExpress.

Key Features:
Two immediately stood out:

1. It has a 4” display which, again from my nanoVNA experience is more easily readable.
2. It has two operating modes: normal mode that is limited to 800MHz by an input low pass filter and “Ultra” mode where the input filter is bypassed and operation is quoted up to 6GHz. I suspect there may be a different front end mixer and LO compared with the original low frequency unit as it uses fundamental mixing up to 4.4GHz and harmonic mixing above 4.4GHz.

I decided to purchase a unit from AliExpress in early December with a forecast delivery of 14th January 2023, the unit arrived in the week before Xmas. A customs declaration sticker on the package described the contents as “Spectrum” with a value of £20 so no duty to pay.

There was no manual with the unit but the box directs the user to [1] https://tinysa.org

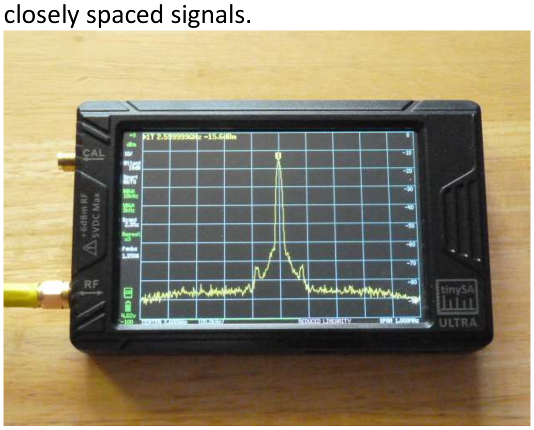
This website shows comprehensive lists of the menus and also the product specifications. The unit has a plastic case and is packaged in a sturdy cardboard box containing the spectrum analyser, a USB C cable to charge the internal lithium battery, two short SMA to SMA cables, an elasticated lead with a small plastic plectrum to tap the touch screen and a small telescopic antenna fitted with a SMA male connector to fit the tinySA Ultra's SMA female input connector.
The unit also has a SMA connector labelled CAL that is used to provide a level calibration signal for the spectrum analyser input.
The unit can be switched between spectrum analyser mode and signal generator mode where the SMA input connector also provides a signal generator output between 100kHz and 800MHz with a level range of -20dBm to -110dBm in 1dB steps. Above 800MHz the signal generator operates up to 4.4GHz with coarser steps and lower output accuracy. The signal can be swept and in single output can be amplitude or frequency modulated.

Abridged Specifications: (see website for full specifications [1])

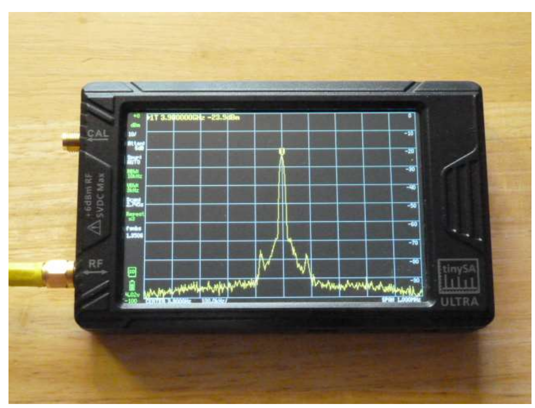
Input frequency range: 100kHz to 800MHz in normal mode
800MHz to 6GHz in Ultra mode
Maximum input level: +10dBm with 0dB internal attenuation
Absolute maximum short term peak input power: +20dBm with 30dB internal attenuation
Input Intercept Point (IIP3) of third order modulation products: +15dBm with 0dB internal attenuation
1dB compression point (P1dB): -1dBm with 0dB internal attenuation
Detector resolution: 0.5dB with linearity versus frequency +/-2dB
Power level accuracy after power level calibration: +/- 2dB
Frequency accuracy equal to selected resolution bandwidth
Resolution BW filters of 0.2, 1, 3, 10, 30, 100, 300, 600 and 850 kHz.
Spurious free dynamic range with 30kHz resolution bandwidth: 70dB
Phase noise: -90dBc/Hz at 100kHz offset and -120dBc/Hz at 1MHz offset

On screen resolution: 51, 101, 145, 290 or 450 measurement points.
Scan speed: over 1000 points/second using largest resolution filters.

Note the narrowest resolution bandwidth filter (RBW) is 200Hz this limits the displayed separation of closely spaced signals.



2.6GHz 2nd harmonic



3.9GHz 3rd harmonic

Measurements

I have made a number of measurements that may be of interest.
In order to show the frequency range capability I measured the fundamental and harmonic output from my 15GHz Chinese signal generator. The signal generator has no output filters and harmonics were measured of a 1.3GHz fundamental signal at 2.6GHz, 3.9GHz, 5.2GHz and 6.5GHz. These were measured separately with each set as a centre frequency in a 1MHz span and the levels in dBm noted at each frequency then compared with the level of the fundamental at 1.3GHz. This is the most accurate way of measuring harmonics rather than trying to display a very wide span to show everything on one screen.

Here are the signal generator harmonic measurements relative to the fundamental at 1.3GHz:
2nd harmonic: -4.8dB, 3rd harmonic: -13.1dB, 4th harmonic: -11.8dB, 5th harmonic: -12.6dB

I have checked the level accuracy specification up to 1GHz by comparison with the output level from my Marconi 2022D signal generator. I check the signal generator from time to time with one of my Marconi or HP power meters that have 10MHz to 18GHz thermal sensors.
At frequencies of: 10MHz, 30MHz,.50MHz, 145MHz, 433MHz, at levels of -10dBm and -70dBm the levels were within ±0.5dB of my signal generator. At 1GHz the levels were within 1.1dB of the signal generator so all well within the claimed ±2dB specification.

The provision of a small telescopic antenna with the spectrum analyser coupled with the portability of the analyser has allowed the tracking down of noise sources within my house plus finding the expected WiFi outputs from the router at 2.4GHz and 5GHz. Not wishing to scare readers of this article it was quite instructive to hold the analyser and antenna approximately 50mm from the door of our microwave oven when in operation and note the modulated output from the magnetron, modulation I think from the switched mode PSU.

A measurement I particularly wanted to make was the noise output from an after market power supply for my Toshiba laptop PC. This replacement PSU marked with the Toshiba name was purchased after the original was damaged – the dog ran into the DC lead and bent the connector!

I have provided two photos with a frequency range set from 20MHz to 150MHz, one showing the analyser noise floor with the PSU unplugged from the 240V supply for comparison with the noise floor with the telescopic antenna placed 2cm above the casing when powered and connected to the PC as a load. The largest hump in the display is some 25dB above the baseline reference.

Summary

Although low priced this small spectrum analyser has enough features and general level and frequency accuracy to be useful for examining microwave signals up to and above 6GHz. Setting up and checking microwave frequency multiplier chains for example. Searching for spurious oscillations when these are far from the intended frequency of operation of a unit is a further application.

Price: The price listed on AliExpress when I purchased this unit was £105 but this is an ex-VAT price. When placed in the shopping basket it is then shown with UK VAT at 20% added which brings it to £126. Shipping to UK is shown as free. As previously, a customs docket affixed to the package listed the item description as "Spectrum" and the goods value as £20. There was no duty to pay.
So a 6GHz capable spectrum analyser for not much over £100 is a reality.
The unit was designed in the Netherlands, I do not recognise the name but maybe our Dutch members know of him.

[1] https://tinysa.org

Bryan, G8DKK January 2023

HB100 Oscillator

Archie Murray GM4FIZ

I was experimenting with the HB100 oscillator as found on eBay etc. The nominal frequency is on 10.4 GHz. I am interested in 3 cm EME, so wanted 9.936Ghz LO for 432 MHz if receive system. These dro oscillators can be pulled down with glass put in proximity to the dielectric puck. In particular blue glass seemed to work best. I was able to move the frequency down about a Gig!

Anyway it occurred to me that a LNB with its dro oscillator would be a good thing to modify, I had a Cambridge LNB there which seemed quite lively.

But how to keep the frequency stable, well what was needed was a means to move the tuning slud in and out of the housing.

From my days as tv/ video engineer I had a CD player laser mechanism lying around. These are very common under the pt.no.

KSS210. These mechanisms have two coils in them, one to move the laser sideways (tracking coil) and one to move the laser lens in out to focus the laser on the cd disc. Both coils are controlled by a servo system.

The coil resistance is about 6 ohms and +&- about 1.5v will give the full travel of the lens carriage.

So I set about modifying the unit by removing the laser bottom half to leave the coil part, this was superglued to the LNB housing after removing the tuning slug and opening up the threaded hole to accept the new slug with clearance.

The new slug was a piece of brass tube from an old telescopic aerial, these are made of very thin wall brass tube. I used 5mm diameter tube about 16 mm long. Thin wall tube would be best as the new tuning slug needs to be as light as possible.

This was glued into place so that when the carriage was fully inserted the slug was also fully inserted into the chamber.

This gave a tuning range of about 740Mhz up to 10.3Ghz

Next a pickup wire was set in place into the oscillator chamber, I used a piece of semi ridged cable and left the Teflon on the centre core just in case of a s.c. This gave me about -8 dBm at 9936Mhz, this was enough to drive a Hittite pre-scaler.

I have not incorporated this into pll yet as I am still working on the pfd. It’s going to be referenced to a Leo Bodner gps unit!

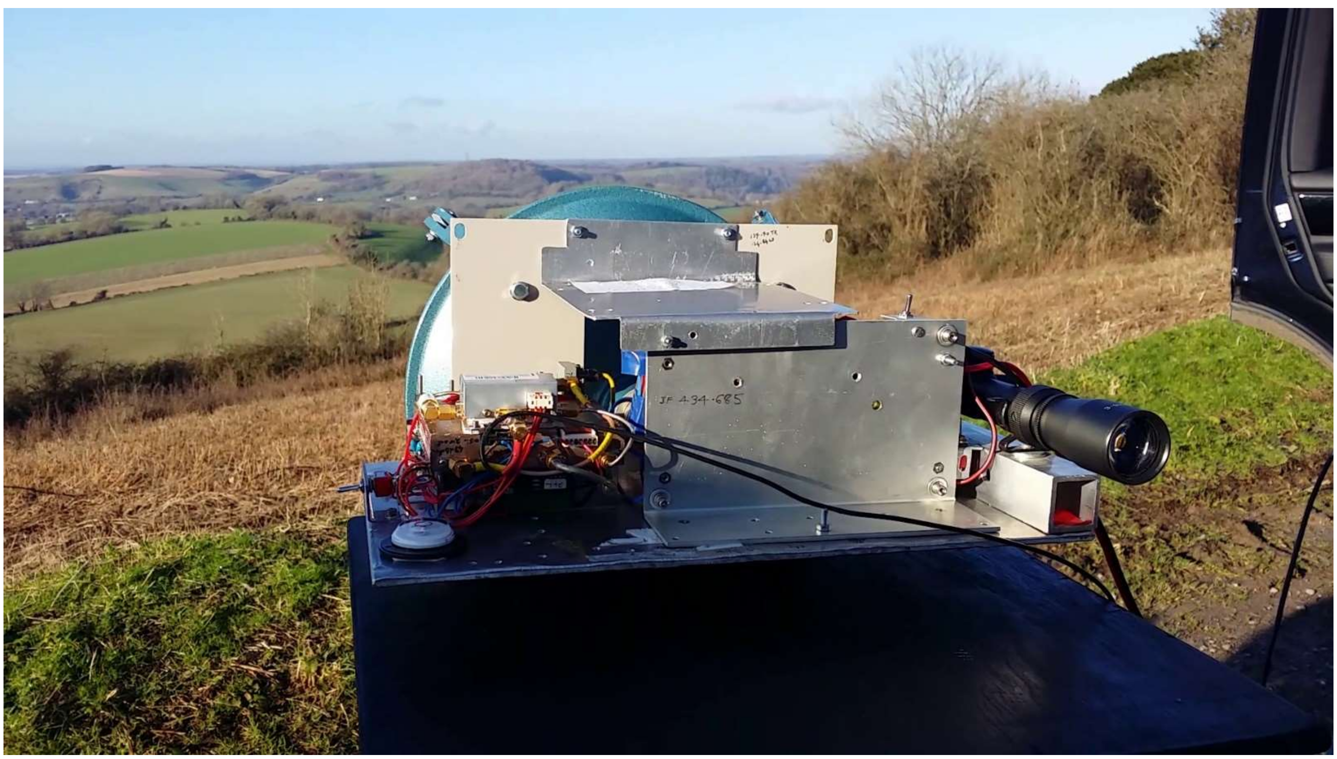
New UK Record of 51.9km on 122 & 134GHz in January 2023

Taking advantage of another cold weather spell with low humidity. John G8ACE, Noel G8GTZ, Dave G1EHF and Roger G8CUB, took to the Berkshire hills.
This time the path to try was from Walbury pmr (IO91GI61) to Butser hill (IO90MX14). Enroute the patches of ice proved the temperature was low enough. The predicted humidity should drop throughout the day.
Arriving at Walbury pmr (next to a pmr tower), the angle was quite narrow so Dave and I were quite bunched up at one end of the gate. The visibility was not great. We could not see the mast on Butser, which did not bode well for pointing the dish.
Will the calculated loss over the 52km path, being around 10dB lower on 134 than 122. We started with 134GHz.
I was uncertain of the exact heading. Fortunately the haze cleared for a few minutes, and Dave spotted the Butser mast. A bit of dish adjustment, and I could hear the carrier from John G8ACE.
Once it was realised that the telescopic sight was way off of the 134G receiver at the Butser end. Good signals were being received in both directions. Plugging in the microphones allowed easy FM qso's, between G8CUB/P and Noel G8GTZ/P, and John G8ACE/P. Reports were 58/54 on FM. Transmit powers circa 4mW each way.

https://youtu.be/6-ooidYodlE
122 reception of G8ACE/P at G8CUB/P. Copied after a few repeats. The contact was reinforced with a contact over Opera as well. 134GHz was much easier!
Videos on YouTube search for: UKG8ACE.

John G8ACE at Butser with array of gear and Phatlight

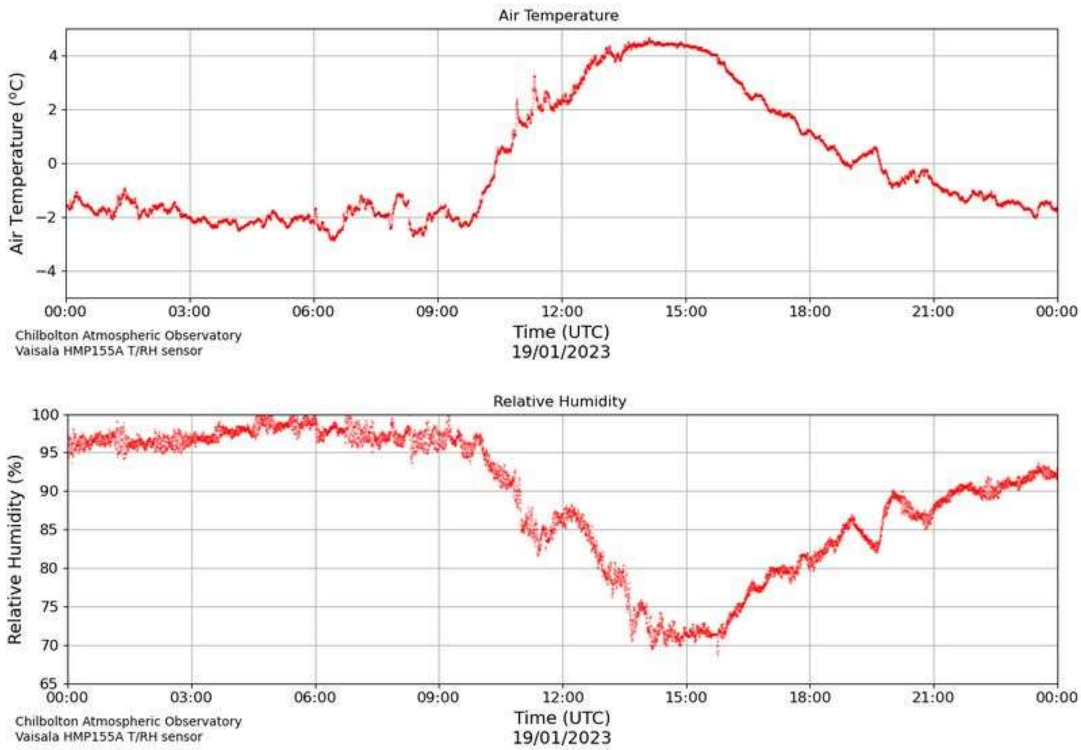
Noel G8GTZ transmitting FM on 134GHz



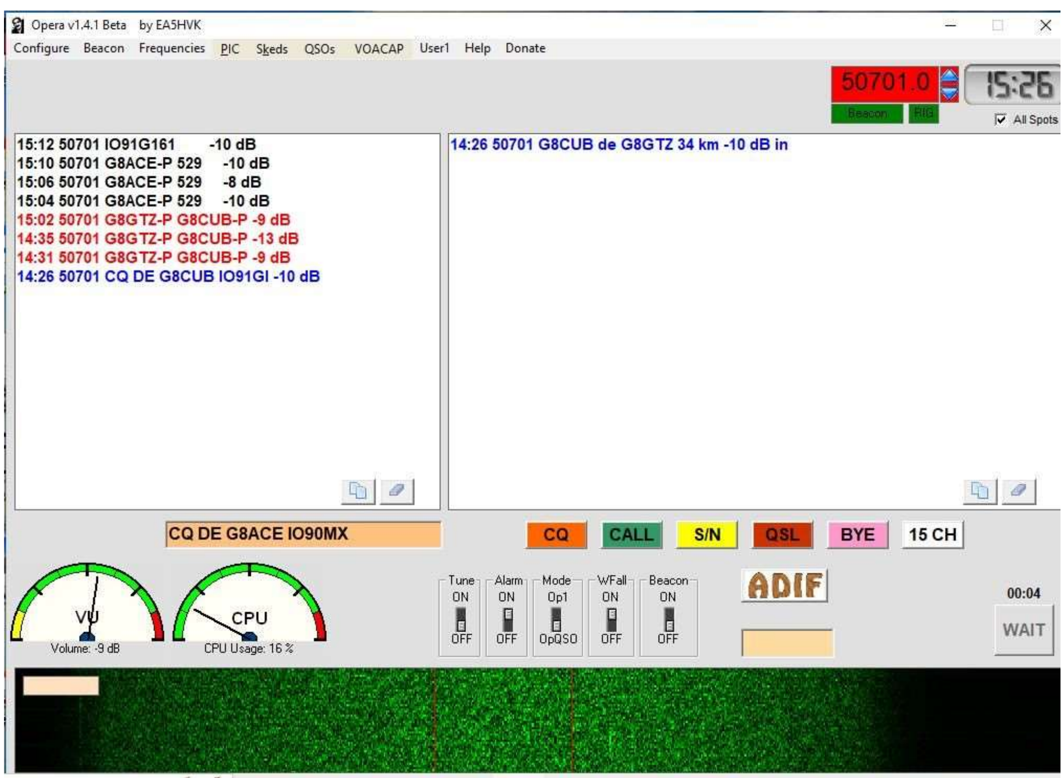
134GHz receiver. IF is 24GHz then converted to 434.688MHz.

134GHz signal being received from G8CUB/P on 134GHz. That's pretty loud at 52km!

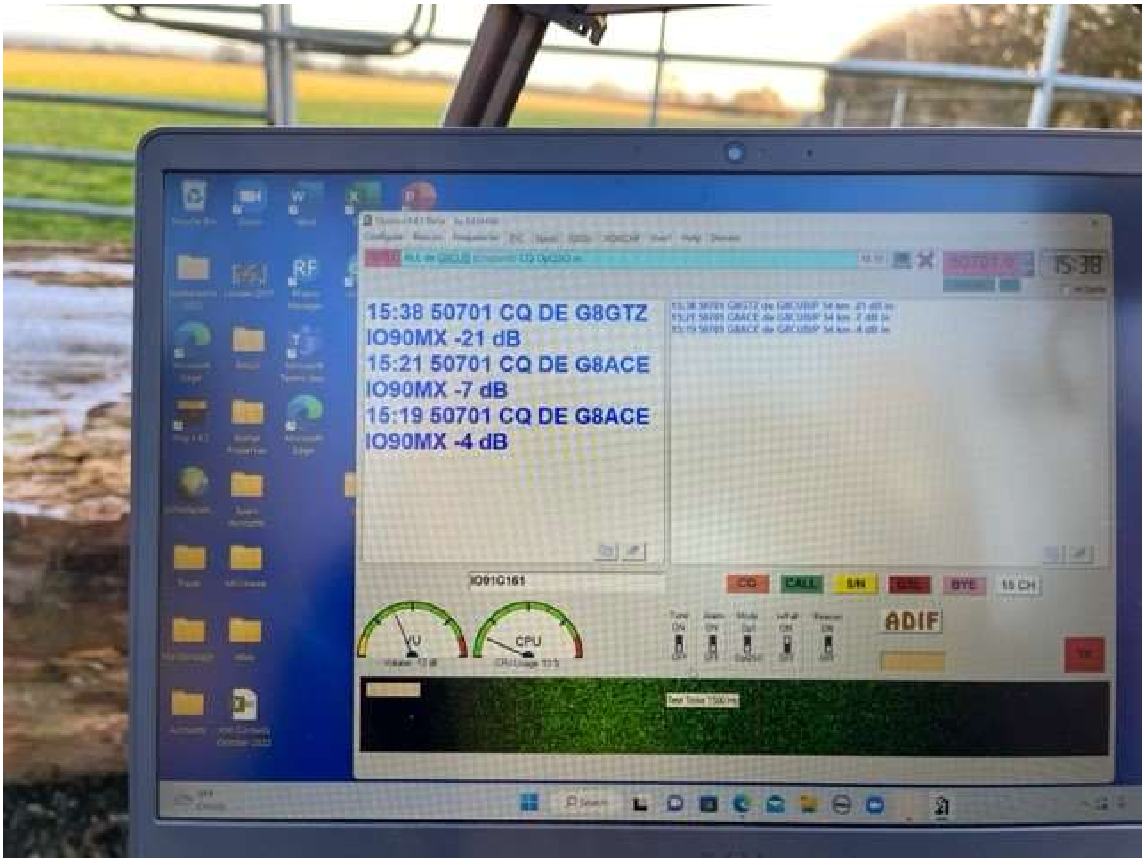
G8CUB's dual band transverter at Walbury pmr.



Interesting graphs of temperature and humidity from Chilbolton, just down the road



Opera received at Butser on 122GHz



Opera received at Walbury pmr, G8ACE's 122GHz was strong but not always decoding due to spreading. G8GTZ's VK system was a very thin line on the display, but decoded fine at -21dB.


Dave G1EHF received a good signal from G8ACE, but struggled to get a decode on 122 and the FM was just too weak. Later in the day his Phlatlight was visible at Butser.

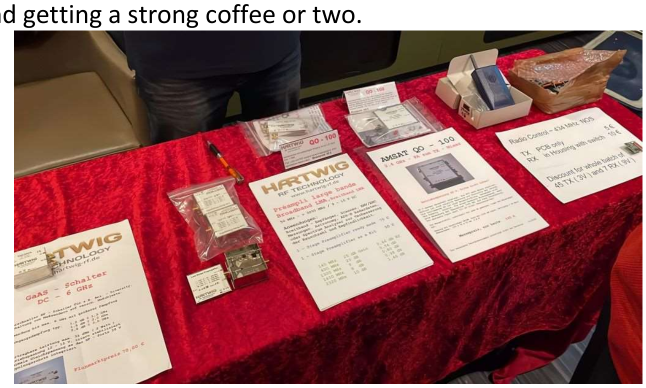
Heelweg Microwave Meeting 2023 report

Sam G4DDK

Heelweg is a small town in the eastern part of the Netherlands, very near to the German border. The nearest, larger, towns are Varsseveld and Doetinchem.
Although I have been going to the Heelweg Microwave meetings for more than 10 years and possibly as many as 15, I've never actually been into Heelweg. The reason is that the meeting is held in nearby Westendorp! It was held previously in Heelweg before moving to the Kulturehus de Vos in Westendorp. The Café Vos was owned by a Dutch radio amateur and he kindly allowed the use of the Café for this annual meeting.

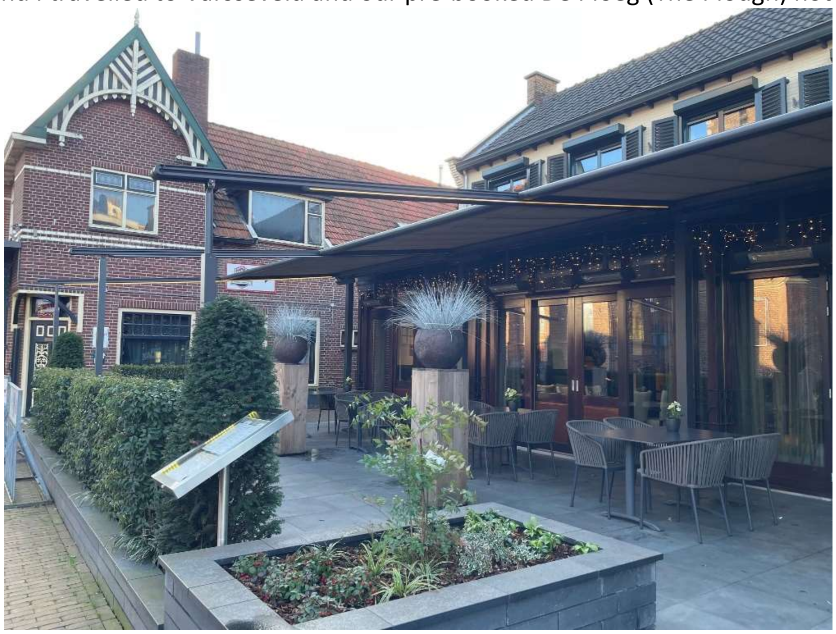
The Heelweg meetings are centred around measurement, with a wide variety of test equipment (mostly quite modern) being brought along by a number of amateurs and set up in a number of bays in the spacious hall that is part of the Café Vos building. As well as the many test equipment facilities being used, the event has gradually grown into an indoor flea market with a wide variety of microwave items for sale. In the early days I was one of the few traders present. Not this time as bringing items into the EU for sale is now a lot more complicated.

Above all else, the Heelweg meeting is a social occasion, where I can meet my amateur friends from across much of nearby Europe and sit and chat over a beer or coffee and eat lunch (although, see later).
John, G4BAO and I travelled over on the Friday 13 January on the night Harwich to Hoek Van Holland Stena Hollandica car ferry. We were to be accompanied by Simon, G7SOZ, but unfortunately Simon was unwell and unable to travel. On Saturday morning John drove us to Westendorp in the pouring rain. The rain lasted all day, but since the meeting was held inside the hall, it didn't spoil the occasion at all.
We arrived around 11am, after a 2 hour drive, and immediately set to looking for bargains, searching for friends we hadn't seen since pre covid and getting a strong coffee or two.



Some of the items for sale

I have to admit I spent most of my time just chatting and not enough time looking around. When I did it seemed to me that there was a lot of amateur microwave gear also being demonstrated. The quality and quantity of gear present was very impressive and made me very envious.
All too soon the microwave meeting was over, and everyone started to pack up around 3pm (it doesn't do to arrive too late to Heelweg).
However, the day was far from over. It has been traditional for 20 or so of the group, including the UK contingent, to go for a Chinese meal at the Fu King restaurant in nearby Varsseveld. Sadly, this restaurant closed during the covid years. Gerard, PA0BAT, found an even better Chinese restaurant in nearby Zeddam. The Sin Chen is obviously a very popular restaurant with Dutch families, especially on a Saturday evening. I can honestly say that they served the best Chinese food I have tasted since I was in Hong Kong. It was an unlimited buffet style for E42.85 and that included unlimited drinks as well as just about any Chinese dish you could think of. Superb!
After the meal, John and I travelled to Varsseveld and our pre-booked De Ploeg (The Plough) hotel.



De Ploeg hotel, Varsseveld

The Dutch hotel bar was a chance to consume a little more Dutch beer. After a good night's sleep, it was a continental style breakfast (can you see a theme developing here?) before setting off for a date with the Dwingeloo 'old lady'. The drive was another few hours to the National Park Dwingelderveld in which the dish is located. Of course, after two hours a coffee was required, together with Dutch Apple Cake and cream in the Spier hotel lounge. The hotel is located right at the park entrance.   Theme continues!
We were met at the Astron/Dwingeloo car park (in the rain) by Jan, PA0FXB and Peter, PA0PZD and later joined by Tammo-Jan, one of the Astron Astro physicists.
The dish focus box had been removed from the dish ready for a refurbishment. This was a great opportunity to see the inside of the box that is normally way up at the dish focus. The 23cm W2IMU feed horn is located behind the radome, so that only the rear part, together with the VLNA isolation relay and the PA and power supplies could clearly be seen. The massive box also houses the VK3UM style 70cm dipoles arranged the outside of the W2IMU horn. On top there is an LPD antenna, used for some other observation purposes. Finally there is a 13cm W2IMU feed, VLNA and relay etc, all mounted slightly to one side of the 23cm horn.

The dish focus box radome cover with the LPD antenna on top

Particularly noticeable was the large 70cm PA box with its heatsink and multiple cooling fans. Below that there are a number of PSU units. Altogether, a very impressive and heavy focus box.

Inside the control room of the dish it was clear that much had been updated since our last visit in 2018 and Jan gave us a great guided tour. This was topped off with the story and video of the transmission, narrated by Marc Okrand, and beamed towards Arcturus, home star of the Klingons. The transmission was of a Klingon language invite to representatives of Qo'Nos (Klingon home world) to attend the premier of the Klingon Opera 'u'. That transmission is now half way to Arcturus, but by the advances in travel technology, it is hoped that the Klingon representatives will still be able to arrive in time for the performance. The video can be found under YouTube for anyone interested. Before leaving I paid my respects to the ashes of Grote Reber, some of which are interred at Dwingeloo. Grote was, of course, one of the great radio astronomers.

There was much more to the visit than I can do justice to in these few lines.
We drove several hours back to the Hoek in order to catch the overnight Stena Britannica ferry back home.
John and I hope that these words will encourage a few more Brits to visit the Heelweg microwave meeting in future years.
Our thanks to all the organisers of the Heelweg Microwave meeting and to Jan, Peter and Tammo-Jan at Dwingeloo.
Qapla'   Sam, G4DDK   John, G4BAO

Editors Comments

Thanks for all the contributions this month. It is certainly good to have several articles at last. It is also good to see that some good propagation occurred across the North sea, and that there was a brief low dew point window for millimetre as well.
Martlesham registration should be nearly open by the time you read this.
Before that I hope to get to Micromeet in Spain, and will report back, if I can make it.
Roger G8CUB

Next Event

Micromeet 2023 3rd – 5th March
URE Sierra de Guadarrama, Madrid, Spain

Micromeet 2023

The Annual meeting for those passionate about Microwaves and Experimentation

PROGRAM

MARCH 3rd (Friday)

11:00 Meeting Point: Parking of Kinépolis Ciudad de la Imagen. Pozuelo de Alarcón. (GPS: 40.39468, -3.79234)
11:30 Visit to OVERON Teleport *
13:45 End of visit
14:00 Lunch at Kinépolis Restaurant Ciudad de la Imagen**
16:00 Meeting at Sección Local Sierra de Guadarrama. (GPS: 40.66889, -4.08675)
- *Assembly of measurement equiment*
- *Measurements*

21:00 "Gunnplexers" Dinner **

MARCH 4th (Saturday)

08:30 Breakfast at Hotel Piquio Guadarrama
09:00 Welcome
09:30 Talks 1 & 2 (Streamed by Zoom)
11:30 Coffee Break
12:00 Talks 3 & 4 (Streamed by Zoom)
14:30 Lunch at Rte. del Hotel Piquio **
16:00 Measurements / Flea market / Experience exchange
20:30 End of the Day
21:00 "TWT's" Farewell Dinner **

MARCH 5th (Sunday)

08:30 Breakfast at Hotel Piquio Guadarrama
09:00 Equipment gathering
12:30 Farewell

* The visit to OVERON Teleport requires attendees to communicate in advance their name, surname and DNI by sending an email to [illegible]

** Those attending the group lunches and dinners on March 3 and 4 must indicate in advance their attendance to make the appropriate reservations.

MicroMeet2023_EN.pdf

Info from Maximo EA1DDO / M0HAO

For those not wishing to travel to Spain
The Saturday talks will be streamed by Zoom (note Spain is 1 hour ahead of GMT)

Fog and Mist on 10GHz.

Dave G4GLT

When I first got on to 10ghz I got the distinct impression that dense fog was a pretty good attenuator on 10ghz. There were numerous situations when conditions were significantly down in dense fog.
During a very stable high pressure ducting system in September 2020
which produced an opening to OZ, there was definitely a distant horizon haze in the daytime. However, haze is a slightly different phenomenon as it is due to a suspension of extremely small particles in the air, not water droplets. These particles give the air an opalescent appearance.
I have on occasion heard GB3LEX beacon in Leicestershire on 10GHz during widespread fog with strong signals, but these conditions are usually short lived (probably radiation fog).

<u>Severity of Fog</u>

Mist is obscurity when the visibility is equal to or greater than 1000 metres. Fog is defined for aviation purposes as the obscurity where visibility is less than 1000 metres. For public forecasts fog generally refers to visibility less than 180 metres.(1)

The risk of fog depends on locality, time of day and time of the year.
For fog to form we need moisture, light winds and a certain temperature called the 'fog point'(2). Fog is essentially low lying cloud, and that for clouds to form the air must be cooled to a point where its moisture condenses out into a visible cloud.
The main types of fog are:

1. Radiation fog.
2. Valley fog.
3. Advection fog.
4. Upslope fog.
5. Evaporation fog.

<u>Radiation Fog</u>

This usually occurs in the winter, aided by clear skies and calm conditions. The cooling of the land overnight cools the air close to the surface. This reduces the ability of the air to hold moisture, allowing condensation and fog to appear. The conditions for radiation fog are a clear sky, the evening air should be moist, there should be adequate time for the air to cool to the dew point and there should be a light wind (3). Radiation fog usually dissipates after sunrise as the ground warms.
Being at over a thousand feet portable is not always optimal, as one often cannot access low lying inversions and the lack of propagation then is quite noticeable. At height I think that you really need high level inversions to get good tropo conditions.
The Hepburn chart will certainly give a guide as to the quality of the conditions likely to be present, but at altitude fog can give variable results even when things look good on paper.

<u>Advection Fog</u>

This usually forms when warm, moist air flows over a very cold surface (usually the sea) and is cooled. Very extensive areas of sea fog may result , and is then blown or advected on to neighbouring coastal land areas. During the day such fog may burn off over land but persist over the sea. At night , when the land cools, the fog may return.
Coastal fog is a regular occurrence along the east coast of the UK and is most common in spring and summer. In Scotland it is known as Haar and as Fret in eastern England. It is usually due to advection fog, which forms when warm air moves over the cool surface of the North Sea.

<u>Valley Fog</u>

This forms where cold dense air settles into the lower parts of a valley, and is often the result of a temperature inversion and is confined by local topography.

<u>Upslope Fog</u>

This occurs where winds blow air up a slope. The air cools as it rises, allowing the moisture in it to condense.

<u>Evaporation Fog</u>

This is caused by cold air passing over warmer air or moist land.
This can also occur in the autumn as cold fronts or cool air masses move over the still relatively warm seas.

When there are tropo conditions caused by fog it can sometimes be localised to one direction , such as in the dense fog of the evening of 11th November 2022 at 1900Z when, apart from local beacons, all I could hear was GB3SEE and PA3GCO beacons on 10GHz.
On 13th November 2022 I was out early and the fog was very dense with visibility down to less than 50 metres. Just after 0600Z I was hearing ON0VHF , F1ZUQ, F5ZBB, F5ZTR, F5ZVV and GB3SEE beacons on 10GHz. Soon F9ZG, F1BQ and ON0HVL beacons came in as well. QSO's were had with F6DKW in JN18CS near Paris. He reported that it was bright sunshine there with no fog at all. Also contacted were
F8DLS in JN19SE. There were no beacons heard from central France so this pattern certainly fits into the picture of advection fog with some spill over on to nearby land. The isobar map below shows a familiar pattern of high pressure over central Europe during the fog DX of 13/11/2022. As high pressure circulates clockwise, then the warm air form central Europe circulates towards the southern UK.
Later that morning just after 1000Z the 10ghz beacon HB9BBD was also received at good strength.
It will be interesting in the future to see if there is an optimum height for reception during fog by listening at different levels and trying other bands. Certainly, it is a bonus to have any good conditions in November.

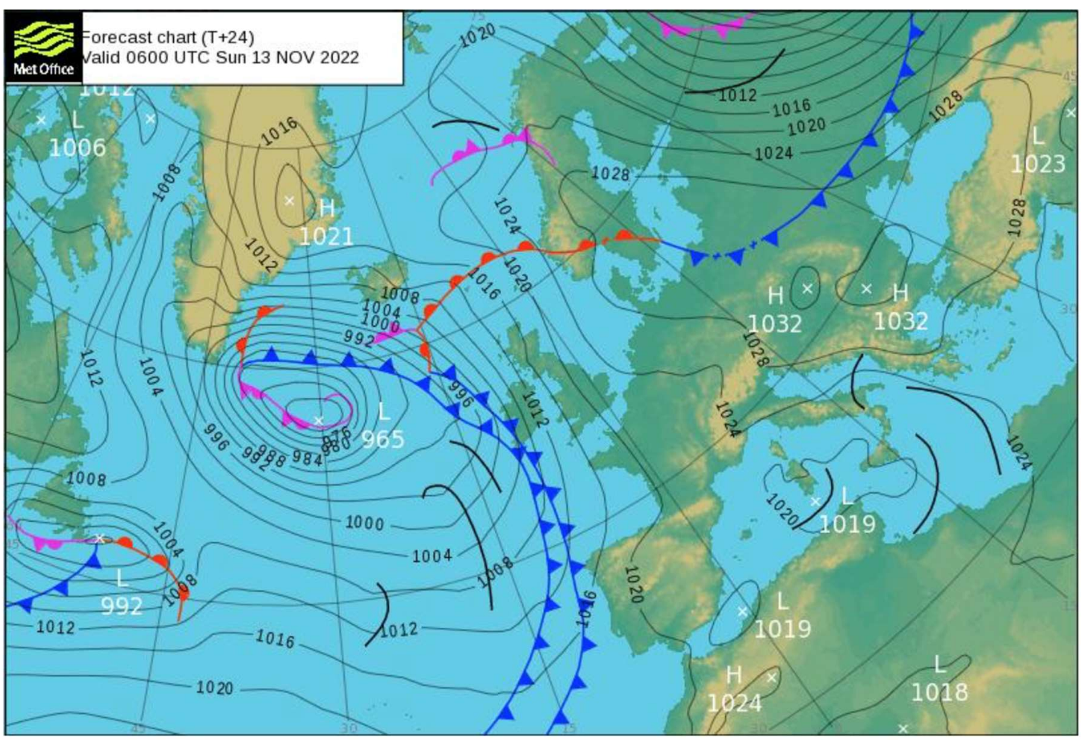
Summary

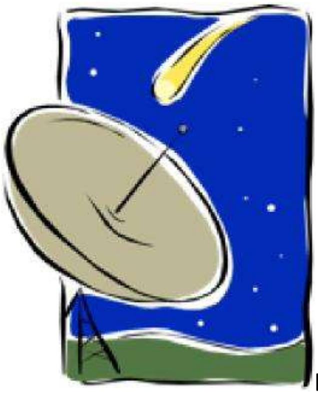
Fog, as has been shown, can be a very useful means of microwave propagation. There are different types of fog, and my experience listening has led me to think that fog associated with warm air from the southerly directions is most likely to give good microwave conditions. Monitoring often involves negative results and this is certainly true of fog. The use of the Hepburn chart and an isobar map are likely to improve the chances of success. Good luck.

Dave G4GLT (IO80DO) 9/2/2023

References:

(1) Met Office website https://www.metoffice.gov.uk
(2) Weather Handbook by Alan Watts.
(3) Meteorology Manual by Storm Dunlop.

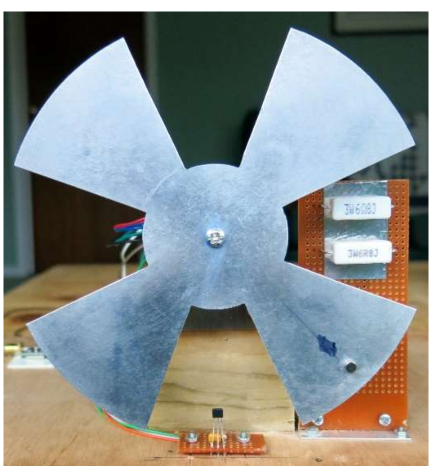
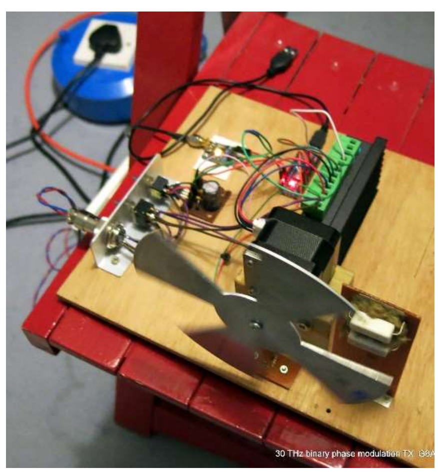



By John G4BAO

Please send your activity news to: scatterpoint@microwavers.org

From Barry G8AGN

Following two recent YouTube videos by Remi M0LRH in which he demonstrated a 30THz system based on binary-phase modulation, I have been building my own version of such a system, with a lot of advice from Remi. My Tx uses a MCH (metal-ceramic heater) source and a 4 bladed chopper wheel, rotated by an Arduino controlled stepper motor which produces a 4Hz sub-carrier. The latter is binary-phase modulated with a message to form a QRSS1 signal which is locked to GPS 1pps pulses. See attached photos. The first one is slightly blurred as the wheel is rotating at 4 rpm. The second one shows the source from the front but using an older hot source made from two 6R8 resistors. The Rx uses a small Celestron reflector telescope fitted with a PIR sensor (as used in burglar alarms etc) in place of the normal optical eyepiece. The PIR forms one arm of a Wheatstone bridge with a pot as the other half.
The output from the bridge is fed into a NAU7802 which is a low noise 24 bit ADC (usually found in electronic weighing scales). The Rx which is also locked to GPS 1pps pulses, samples the received signal at 40 samples/sec and sends them to a file which is processed off-line to recover the original message. The off-line digital signal processing involves band-pass filtering and applying a phase-sensitive detector. The end result is a file containing readable morse in the form of a string of characters where 0 = dot and space = space. See attached photo of the Rx and a small sample of a received signal


From Graham G3YJR

Due to more magpie damage, I have had to take down the 13cm box (relay, pre-amp and BPF) so I am off the 13cm band for the moment. Also, the 3cm box behind the dish has an intermittent fault which will have to wait for better weather. I think 23cm is still going! I received a High Quality Raspberry Pi Camera for Christmas, so mostly this month I have been tinkering with that, with a view to producing DATV with Portsdown4. I am using an HDMI cable to the HQ PiCam. The results of transmission across the bench on 2.4 GHz to Minitioner/MiniTioune look encouraging.

From Roger G8CUB

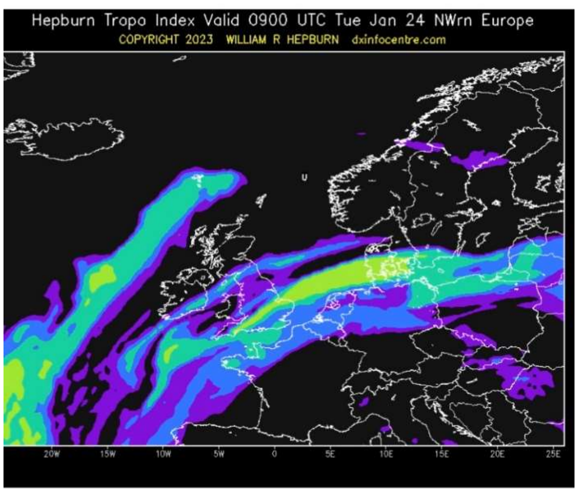
On Thursday 19th January, we again increased the UK 122/134GHz record.
I worked both John G8ACE/P, and Noel G8GTZ/P. IO91GI61AQ (G8CUB/P) to IO90MX14KB 51.879km 134GHz FM.
122GHz FM/Opera – *see separate report*

From Dave G4GLT

10GHz opening to OZ/SM on 24th January 2023. (my portable location IO80DO- 363 metres ASL- my station 5Watts to 50cm dish)

I had seen the Hepburn and was out early at 0600GMT . I knew fairly soon that conditions were good as GB3LEX and GB3CAM became very strong around 0700GMT and remained strong all day.
Just after 0800GMT I heard OZ5SHF (JO45VX)(1078km) beacon at good strength and it continued like this all day till midnight , at times peaking well over S9. Other European beacons were heard in passing, but all fleetingly and fairly weak, such as DB0GHZ, DB0MU PE9GHZ and ON0VHF.
Visibly, there was an obvious inversion on the horizon (see photo below), with mist present in the distance later in the day. The weather forecast was for balmy temperatures over 10 degrees C in northern England and very low temperatures in southern UK with freezing temperatures overnight and only 1-2 degrees C in the daytime. It must have been ideal conditions for an inversion at the interface of these differing air masses where they overlapped.
I did not actually receive any other OZ beacons, though I have to say that some UK beacons are co-channel with some OZ beacons making them difficult to hear (i.e. GB3SCX and GB3LEX). Looking at the Hepburn below, the predicted level in the duct was light green (or high), so it looks like given a sufficient temperature difference between air masses, in winter the Hepburn doesn't have to be so strong. Also, the all-day conditions must be a winter thing as in the summer conditions have usually gone an hour or two after sunrise. The curving of the duct in this case would also tend to narrow the possibilities.

QSO's were had with Kjeld OZ1FF (JO48BO)(965km) at 0840GMT (CW), Anders SM7ECM (JO65PU)(1268km) at 1208GMT (CW) , Ole OZ2OE (JO45FV)(998km) at 1615GMT (CW and SSB) and Kjeld OZ1FF again on CW at 2125GMT. I have to add that it looks like this opening was very localised as I tried for several hours on and off to work Peter OZ1LPR (JO44UW) but though he heard me very weakly sometimes, no QSO resulted.
So thanks to all stations for their input and for an amazing day. I only left at midnight as the freezing conditions made portable operating difficult, but the conditions were still there.
Dave G4GLT. (davidnewman55@icloud.com)



From john G4BAO

The GB3CAM 24GHz beacon outdoor unit is still off the air until we can arrange to get on the roof of the Water Tower, hopefully in the better weather in the Spring.
Sam and I had an excellent trip to the Netherlands in January, visiting PA-Microwaves and the Dwingeloo radio Telescope. Sam's report on the former is in this issue, and the latter is in the next RadCom GHz Bands Column.

Operating is currently proving difficult for me! I'm still "doing battle" with Kuhne over my new MKU10 G5 transverter ordered in September received end of October last year. I initially discovered, characterised and reported a bug in their firmware around the linking for the various TX RX frequency combinations. It was broken in firmware v1.1 and 1.2. I found this after a whole day of chasing my tail trying to configure mine for split 10368/10450. I reported it to Kuhne, but it took a while, and not until I checked all linking combinations then sent them my results, did they acknowledge fault. They eventually installed me a "v1.3" which is still not currently downloadable from their site.
I tested the new firmware and confirmed that v1.3 corrected the original issue of it not selecting the correct frequencies with linking.
I then tried to change the D1 to D4 port timing sequences to suit my relay timings on my EME system. Using both the Kuhne Suite and with their documented serial commands such as "99D1" to select 99ms, the timing did change to a measured 99ms as expected. So far so good! On removing and replacing the 12V supply to the transverter (power recycle) The timing reverted to factory default of 50ms! The change seems not to be stored in non-volatile memory.
I have now asked Kuhne's technical team to look into this and repeat my tests on a lab unit with my v1.3 firmware to confirm that they have the same faulty operation. We will see what happens.
My faith in those who write software has taken yet another bashing. I've been in contact with several other amateur radio customers who have v1.2 to tell them that their 1.2 software is faulty.
So far, I've not had a QSO with the new transverter since it arrived in October.
Very frustrating.

From Murray G6JYB

We are starting to go thru the UK Beacon NoV renewals - a handful already done and others stretching thru to around March.
One simple thing that is a common cause of delay is that the ETCC database used for this largely doesn't have records of keepers having revalidated their own Ofcom licences. For renewals we need a copy of your own Ofcom Amateur Radio Licence with a date visible from within the last 5 years. (i.e. you have to be valid so it can then be varied/renewed for the beacon). A tip to save time (or if you want to operate abroad): If your licence is older than 5 years, logon to Ofcom Spectrum Licensing, select Changes -make a small alteration like a space char, Save, and a new pdf document for your own licence will be generated! More advice on that is here:

https://rsgb.org/main/operating/licensing-novs-visitors/uk-licensing/revalidation/

In due course we will advise more publicly re which unviable or lapsed beacons have occurred

Martlesham 2023

The Round Table proper will be a one day event on Sunday 16th April, with doors opening at 09:30 for an 09:50 start, and concluding at about 16:00. There will be the usual test lab with measurements including noise figure and power to 10GHz lined up so far, refreshments will be available from our usual team of helpers including sandwiches, biscuits and hot/cold drinks.

The talks programme is being assembled by Sam G4DDK, and will include an update on the latest position on 1.3GHz from Barry G4SJH who is leading the IARU Region 1 team on this important topic. The UK Microwave Group AGM will take place in the early afternoon, volunteers for committee roles will be very welcome.

The evening before the main event, on the 15th, there will be an informal meal/gathering at the Ipswich Swallow Chef and Brewer at 7.15 for 7.30pm. There is an on-site Premier Inn offering accommodation for those staying overnight, please book direct with them. The meal will be on a "pay as you go" basis on the night, but please register if you wish to attend, as space is limited.

The online booking system will be up soon to book your entry to the Martlesham site and to register for the Saturday evening meal, details will be published shortly.

122GHz Activity Contest July-December 2022

The second half year period saw activity recorded on five dates, mainly in November and December when lower temperatures reduce losses at these elevated frequencies. In addition to the stations listed in the tables, G8ACE/P was also active.

On this occasion it was Noel G8GTZ/P who triumphed on 122GHz, with contacts on four dates towards the end of the year. Dave G1EHF/P was also active on four dates and took the runner up spot. A few QSOs have been discounted as some activity periods were less than 2 weeks apart.

134GHz activity also took place this time, with G8GTZ/P working G8CUB/P at 37.5km. This QSO and that on 122GHz briefly held the UK distance records, until G8CUB/P worked G8ACE/P at 40.50km a little later on. Congratulations to all those mentioned, let us hope for good conditions in 2023.

John G3XDY

122GHz Activity Contest July-December 2022

Pos	Callsign	Locator(s)	QSOs	Score	ODX Call	ODX Kms
1	G8GTZ/P	IO91KF42/IO91GI25	5	97	G8CUB/P	37.5
2	G1EHF/P	IO91GI44/IO91JH01/IO91GI25	4	71	G8GTZ/P	26.5
3	G8CUB/P	IO91GI25	3	47	G8GTZ/P	26.5
4	G4SJH/P	IO91IB50	1	19	G8CUB/P	37.5

134GHz Activity Contest July-December 2022

Pos	Callsign	Locator(s)	QSOs	Score	ODX Call	ODX Kms
1	G8GTZ/P	IO91IB50	1	38	G8CUB/P	37.5

November 2022 Lowband Contest Results

Some reasonable tropo was to be found at the start of the contest, mainly in the south, with DX out to 700+km worked. Otherwise, aircraft scatter provided reliable DX.

On 1296MHz The Combe Gibberlets, M0HNA/P worked DK7QX for their best DX at 713km and took first place. The runner up was Mike G8CUL.

M0HNA/P also won the 2300MHz band, with Mike G8CUL as runner up. Best DX was from M0HNA/P to G3XDY at 200km..

Mike G8CUL took the top spot on 2320MHz, with M0HNA/P in second place. Best DX was from M0GHZ to ON4CJQ/P at 497km.

David M0GHZ was the winner on 3400MHz, with M0HNA/P in the runner up spot.
Best DX was 246km from M0GHZ to G3XDY.

Congratulations the following winners and runners up.
1296MHz M0HNA/P, G8CUL, G3SQQ (Low Power)
2300MHz M0HNA/P, G8CUL
2320MHz G8CUL, M0HNA/P, G3SQQ (Low Power)
3400MHz M0GHZ, M0HNA/P, 2E0TXQ (Low Power)

1296MHz Low Band Contest Nov 2022

Pos	Callsign	Locator	QSOs	Score	ODX Call	ODX Kms
1	M0HNA/P	IO91GI	33	7973	DK7QX	718
2	G8CUL	IO91JO	21	5079	GM4JTJ	568
3	G4ZTR	JO01KW	21	4778	GM4JTJ	569
4	M0GHZ	IO81VK	19	4345	GM4JTJ	580
5	PE1EWR	JO11SL	8	2637	G1ILJ	401
6	G3SQQ	IO93JC	6	1384	GM4JTJ	403
7	G6GVI	IO83SN	4	821	G4ZTR	289
8	MW0OMB	IO81HN	4	687	G3XDY	320
9	G0NZI	IO92GM	4	457	G4ZTR	172
10	M0FXX	IO91NM	3	376	PE1EWR	306
11	G4LDR	IO91EC	4	374	G3SQQ	225
12	G8AIM	IO92FH	2	278	G4ZTR	171
13	GM8IEM	IO78HF	1	144	GM0ONN	144
14	GM4DIJ	IO85IW	2	75	GM4CXM	68

2300MHz Low Band Contest Nov 2022

Pos	Callsign	Locator	QSOs	Score	ODX Call	ODX Kms
1	M0HNA/P	IO91GI	4	446	G3XDY	200
2	G8CUL	IO91JO	4	389	G3XDY	174
3	G4LDR	IO91EC	2	63	G8CUL	32

2320MHz Low Band Contest Nov 2022

Pos	Callsign	Locator	QSOs	Score	ODX Call	ODX Kms
1	G8CUL	IO91JO	14	2663	F8DLS	431
2	M0HNA/P	IO91GI	13	2339	ON4CJQ/P	445
3	M0GHZ	IO81VK	11	2050	ON4CJQ/P	497
4	G4ZTR	JO01KW	11	1912	ON4CJQ/P	299
5	G3SQQ	IO93JC	7	1261	G4LDR	225
6	G0HIK/P	IO84JE	3	913	M0HNA/P	337
7	PE1EWR	JO11SL	3	809	G8CUL	329
8	G4LDR	IO91EC	7	802	G3SQQ	225
9	GW4MBS	IO71XW	1	199	G8CUL	199
10	G8AIM	IO92FH	1	171	G4ZTR	171

3400MHz Low Band Contest Nov 2022

Pos	Callsign	Locator	QSOs	Score	ODX Call	ODX Kms
1	M0GHZ	IO81VK	9	1084	G3XDY	246
2	G4ZTR	JO01KW	6	1026	M0GHZ	220
3	M0HNA/P	IO91GI	9	909	G3XDY	200
4	G8CUL	IO91JO	8	793	G3XDY	174
5	G4LDR	IO91EC	7	619	G4ODA	212

6	2E0TXQ	IO92JO	2	288	M0GHZ	147
7	G8AIM	IO92FH	1	171	G4ZTR	171

Low Band Championship 2022

The entry level for this year's event was almost unchanged from 2021, with 37 entrants.
Most events have experienced flat conditions, with the occasional aircraft scatter DX to enliven proceedings.
The November session did have some tropo which benefitted a few stations mainly in the South.

1.3GHz

On this band the Combe Gibberlets (M0HNA/P) won the four sessions they entered to take top place, and are therefore winners of the G4EAT Memorial Trophy. In second place is Neil G4BRK with one session win and second and third places in the other two sessions entered.

2.30GHz

A clean sweep by M0HNA/P saw maximum points obtained from five session wins. Runner up in three sessions was Mike G8CUL who therefore takes the runner up position on this band. A slight uptick in activity was apparent this year.

2.32GHz

M0HNA/P took the lead with a strong performance but did not have it all their own way, with two session wins and two second places. Neil G4BRK was close behind with two sessions in top spot and one as runner up.

3.4GHz

Two session wins and two second places gave M0HNA/P the top slot on 3.4GHz this year, with M0GHZ as runner up with one session win and three third places.

Overall

Another strong performance from the Combe Gibberlets group sees them take the overall championship by a good margin having won all four bands. The overall runner up is Mike G8CUL, who was aided by having the 2300MHz band available to boost his score.
Congratulations to the winners and runners up mentioned above.
73
John G3XDY
UKuG Contest Manager

2022 Lowband Contest Overall Results

Final results, best three overall count to the total.

1.3 GHz

Pos	Call	06/03/2021	10/04/2021	08/05/2021	05/06/2021	13/11/2021	Total
1	M0HNA/P	0	1000	1,000	1,000	1,000	3,000
2	G4BRK	1000	754	559	0	0	2,313
3	G4ZTR	0	735	0	703	599	2,037
4	G7LRQ (G7L)	0	727	514	688	0	1,929
5	G8CUL	0	656	0	452	637	1,745
6	M0GHZ	564	438	472	0	544	1,580
7	G3SQQ	329	459	327	169	173	1,115
8	GW4JQP	318	490	183	171	0	991
9	G4KUX	0	857	0	0	0	857
10	G3TCT	524	0	0	181	0	705
11	GI6ATZ	0	661	0	0	0	661
12	G3UKV	309	343	0	0	0	652

13	G0HIK/P	0	448	0	178	0	626
14	GM4BYF	241	0	153	160	0	554
15	G6GVI	176	185	72	137	102	498
16	G4BAO	128	363	0	0	0	491
17	G3SED	485	0	0	0	0	485
18	PE1EWR	0	135	0	0	330	465
19	G0DJA	412	0	0	38	0	450
20	GM4DIJ(/P)	74	355	0	0	9	438
21	G8DOH	0	283	0	0	0	283
22	G3YJR	105	0	0	133	0	238
23	G0NZI	0	163	0	0	57	220
23	MW0OMB	0	0	0	126	86	212
25	G4LDR	0	0	115	0	46	161
26	G8AIM	97	0	0	0	34	131
27	GM8IEM	66	0	35	18	18	119
28	G4KZY	0	0	0	94	0	94
29	G4EPA	91	0	0	0	0	91
30	G5RS/P	0	0	86	0	0	86
31	G8DMN/P	0	57	0	0	0	57
32	M0FXX	0	0	0	0	47	47
33	M0IAM	0	0	0	10	0	10
34	2E0GTD	0	0	1	1	0	2

2.30GHz

Pos	Call	06/03/2021	10/04/2021	08/05/2021	05/06/2021	13/11/2021	Total
1	M0HNA/P	1000	1,000	1,000	1,000	1,000	3,000
2	G8CUL	0	743	0	888	872	2,503
3	G4LDR	0	0	75	0	141	216

2.32GHz

Pos	Call	06/03/2021	10/04/2021	08/05/2021	05/06/2021	13/11/2021	Total
1	M0HNA/P	476	998	1000	1000	878	2,998
2	G4BRK	1000	1,000	888	0	0	2,888
3	G8CUL	0	694	0	925	1000	2,619
4	G7LRQ (G7L)	0	581	767	884	0	2,232
5	G4ZTR	0	890	0	512	717	2,119
6	M0GHZ	560	569	533	0	769	1,898
7	G3SQQ	579	502	398	351	473	1,554
8	G3UKV	385	480	0	0	0	865
9	G4LDR	0	0	380	0	301	681
10	GM4DIJ/P	0	606	0	0	0	606
11	G1DFL/P	0	353	0	0	0	353
12	G0HIK/P	0	0	0	0	342	342
13	PE1EWR	0	0	0	0	303	303
14	G8AIM	138	0	0	0	64	202
15	GW4MBS	0	72	0	0	74	146
16	G0NZI	0	84	0	0	0	84
17	GM8IEM	0	0	0	66	0	66

3.4 GHz

Pos	Call	06/03/2021	10/04/2021	08/05/2021	05/06/2021	13/11/2021	Total
1	M0HNA/P	0	1000	824	1,000	838	2,838
2	M0GHZ	550	785	413	0	1,000	2,335
3	G4ZTR	0	826	0	521	946	2,293
4	G4BRK	1,000	214	1,000	0	0	2,214
5	G8CUL	0	383	0	265	731	1,379
6	G3UKV	629	458	0	0	0	1,087
7	G4LDR	0	0	219	0	571	790
8	G0HIK/P	0	726	0	0	0	726
9	G4BAO	413	0	0	261	0	674
10	G8AIM	118	0	0	0	157	275
11	2E0TXQ	0	0	0	0	265	265
12	G6GVI	12	4	3	4	0	20

Overall

Pos	Call	1296MHz	2300MHz	2320MHz	3400MHz	Total
1	M0HNA/P	3000	3000	2998	2838	11836
2	G8CUL	1745	2503	2619	1379	8246
3	G4BRK	2313	0	2888	2214	7415
4	G4ZTR	2037	0	2119	2293	6449
5	M0GHZ	1580	0	1898	2335	5813
6	G7LRQ (G7L)	1929	0	2232	0	4161
7	G3SQQ	1115	0	1554	0	2669
8	G3UKV	652	0	865	1087	2604
9	G4LDR	161	216	681	790	1848
10	G0HIK/P	626	0	342	726	1694
11	G4BAO	491	0	0	674	1165
12	GM4DIJ(/P)	438	0	606	0	1044
13	GW4JQP	991	0	0	0	991
14	G4KUX	857	0	0	0	857
15	PE1EWR	465	0	303	0	768
16	G3TCT	705	0	0	0	705
17	GI6ATZ	661	0	0	0	661
18	G8AIM	131	0	202	275	608
19	GM4BYF	554	0	0	0	554
20	G6GVI	498	0	0	20	518
21	G3SED	485	0	0	0	485
22	G0DJA	450	0	0	0	450
23	G1DFL/P	0	0	353	0	353
23	G0NZI	220	0	84	0	304
25	G8DOH	283	0	0	0	283
26	2E0TXQ	0	0	0	265	265
27	G3YJR	238	0	0	0	238
28	MW0OMB	212	0	0	0	212
29	GM8IEM	119	0	66	0	185
30	GW4MBS	0	0	146	0	146
31	G4KZY	94	0	0	0	94
32	G4EPA	91	0	0	0	91
33	G5RS/P	86	0	0	0	86
34	G8DMN/P	57	0	0	0	57
35	M0FXX	47	0	0	0	47
36	M0IAM	10	0	0	0	10
37	2E0GTD	2	0	0	0	2

Aims and comments:
For 2023 events on 122GHz and above will continue to be run on a flexible basis where entrants organise activity in their own groups (publishing their plans) and operate on up to six days during the year, with the results adjudicated at the end of June and end of December. This is intended to allow operators to choose days when conditions are favourable for mm-wave contacts.
As in 2022 there will be four 24/47/76GHz events during the year, in May, July, September and October, with the G0RRJ Memorial Trophy awarded to the overall winner on 24GHz, the 47GHz Trophy awarded to the overall winner on 47GHz, and the 24GHz Trophy awarded to the leading station in the September event. The overall positions will be based on the best three scores from the four possible events.
The low band event dates will be similar to last year, with the March, May and June sessions running on IARU coordinated dates. Stations wishing to take part on 2300MHz are reminded that they must be in possession of the relevant Notice of Variation, and to take part on 2320MHz that they should register their station with Ofcom by emailing pssramateurs@ofcom.org.uk to provide the following information:
1. Name
2. Address
3. Call sign
4. Location of use
5. Frequency range used
6. Type of use
7. Regularity of use (e.g. evenings and weekends; 24/7; occasional)
8. Transmit power (i.e. EIRP) .

The high band events will continue on 5.7 and 10GHz, the dates will continue to be on the last Sunday of May, June, July, August and September. The sessions will run between 0600 to 1800 UTC, with operators able to choose any 8 hour slot (or two slots with at least a 1 hour gap). As in previous years the overall table and trophies will be determined using the best three scores made by each station across the five events. The high band events usually coincide with the French Journée d'activité dates.
Microwavers outside the UK are most welcome to join in our contests. There is already a core of French, Dutch and Belgian stations that appear regularly in our summer contests. We would like many more to do the same!

THE RULES listed below are final and binding for 2023.

The following contests are scheduled for 2023:

- Low Microwave Bands - 1.3GHz/2.30GHz/2.32GHz/3.4GHz (5 contest days). An overall championship will be decided on the best three scores out of five.
- 5.7GHz (5 contest days with 3 to count for the championship), on the same days as the 10GHz contests.
- 10GHz (5 contest days with 3 to count for the championship), on the same days as the 5.7GHz contests.
- 24GHz G0RRJ Memorial Trophy Contests (4 contest days with 3 to count for the championship).
- 24GHz Trophy awarded to the leading station on 24GHz in the event in September.
- 47GHz Trophy (4 contest days with 3 to count for the championship)
- 76GHz (4 contest days with 3 to count for the championship)
- 122GHz and up held on up to 6 days per year with at least 2 weeks elapsed between activity dates for any individual station. Logs to be submitted by email at the end of June and end of December.

The full contest program and rules are published in the January 2023 issue of the Scatterpoint Microwave Newsletter and are also available on the Internet on the UKuG website at http://www.microwavers.org

General Rules (applicable to all events)

The Contests are open to all comers (you do not have to be an RSGB or UK Microwave Group member). Stations located outside the UK (G, GW, GM, GI, GD, GU, GJ) may enter a contest, and will be tabulated within the overall results tables, but will not be eligible for UK Microwave Group awards.
Contestants are expected to enter in the true spirit of the event and to adhere strictly to any equipment or power restrictions that apply to the particular contest.

Operators may enter as home station or portable (either mixed or separately in the championships) unless specified in the rules for a specific event. In multi-band contests, single-band entries are always acceptable.
Stations: Entrants must not change their location or callsign during the contest, unless the Rover rule is invoked. In multi-band events, all stations forming one entry must be located within a circle of 1000m radius. An operator may reside outside the station's area ("remote station"), connected to the station via a "remote control terminal". In such a case, the Locator for the contest is the Locator of the station's position. An operator may only operate one single station, regardless if it is locally or remotely operated, during the same event.
Contacts: Only one scoring contact may be made with a given station on each band, regardless of suffix (/P, /M, etc) during an individual contest or cumulative activity period, unless the station worked is a Rover when each QSO from a different location may be counted. When operating as a Rover, a maximum of one scoring QSO can be made with any given station from each location visited. Contacts made using repeaters or satellites will not count for points. Contacts with callsigns appearing as operators on any of the cover sheets forming an entry will not count for points or multipliers.
Scoring: Contacts are scored on the basis of 1 point per kilometre (rounded up to the nearest kilometre) for full, two-way microwave contacts and at half points for one-way (i.e. crossband) contacts. Any contacts made by EME are scored at 1 point per kilometre up to 1000km, and will be scored at 1000 points above that distance.
Exchanges: Contest exchanges on the microwave bands consist of RS(T) + serial number (starting at 001). In addition, the six (or eight) figure QTH Locator must be exchanged either via the microwave band or on the talkback medium. In multiband contests, the serial number will start at 001 for each band (i.e. a common sequence across the bands is NOT to be used). No points will be lost if a non-competing station cannot provide an IARU locator, serial number, or any other information that may be required. However, the receiving operator must receive and record sufficient information to be able to calculate the score.
Talkback: Talkback can be used to assist in setting up a QSO, but note that the contest exchange must be made via the microwave band. It is not permissible to use the talkback as a means of checking the report or serial number – they must be copied via microwaves – and after the QSO is complete, care should be taken to avoid accidentally repeating the exchange via talkback. There is no restriction on the talkback methods that can be used – other amateur band, internet, phone, etc. In setting up the QSO, it is also permissible to send back received audio to the other station, for example to help with antenna alignment. An exception is that our contests do allow one way (cross-band) QSOs for half points, and in this case, the other band can be used by one of the stations.
Log entries must be submitted via the online log portal at http://microwave.rsgbcc.org/cgi-bin/vhfenter.pl. When uploading electronic logs, the format should be one of the following: ASCII text, RSGB Standard Format, Cabrillo, SDV and G0GJV log outputs, and IARU REG1TEST format (preferred). Paper logs may be entered using the online log editor at http://microwave.rsgbcc.org/cgi-bin/cover.pl. Entries must be submitted no later than 7 days after the conclusion of the contest session. Rover stations should list which contacts were made from each location in their logs.
Awards: Certificates will be awarded to overall contest winners and individual section leaders and their runners up. Additional Certificates of Merit will be awarded to stations in certain categories, as indicated in the rules for each event. With these, as with the logs, the adjudicator's decision is final.
Special Rules: Applicable if called up for the specific contest:
Rover Concept: The 'Rover' concept is to encourage lightweight, low power portable activity. This allows the location of the station to be moved as many times as desired and by a minimum of 5 linear kilometres, at any time during the contest period. From each new location, stations worked from any of the previous locations during the event may be worked again, both stations involved in the contact gaining points. The serial number, however, will not revert to 001 each time a move is made but will carry on consecutively from the previous contact.

Low Band Microwave Contest Rules

First introduced in 2004, these contests aim to encourage operation on the lower microwave bands. There are five of these events, in March, April, May, June, and November. The March, May and June events are timed to overlap with UHF/SHF events in some other IARU Region 1 countries. The times for the November event are shortened to make portable operation more practical.

1. The General Rules listed above apply except as modified by these rules.
2. There are five contests, one each in March, April, May, June and November. The March, April and June events run from 1000 to 1600 UTC. The May event runs from 0800 to 1400 UTC to coincide with the RSGB UHF Contest. The November event is from 1000 to 1400 UTC.
3. Entrants in the May event need not start serial numbers from 001 if they are also participating in the RSGB UHF Contest.

4. Operation may take place on the following bands: 1240-1325MHz, 2300 – 2302MHz, 2310 – 2350MHz, 3400 – 3410MHz. The same station may be contacted for points on each of the four bands.
5. Each event will be scored and tabulated separately. There is an annual championship determined by taking the best three normalized scores from each entrant across the five events for each band. The overall champion will be declared based on the normalized championship scores from each band.
6. For each session, certificates will be awarded to the leading entry plus runner-up on each band, the overall leading entry and runner-up across the four bands, plus for each band the leading stations in each of the following categories: home station, portable station, station running less than 10 watts output. Championship certificates will be awarded to the winners and runners up for each band, and to the overall championship winner and runner up.

5.7GHz Contest Rules
The 5.7GHz and 10GHz contests are being run concurrently to grow activity on 5.7GHz. Although they are on the same days, they are completely separate contests. Any band or both bands can be used on any of the 5 days.
1. The general rules shown above apply.
2. There are five, monthly, events from May to September inclusive, and the events run from 0600 to 1800 UTC on a Sunday. Entrants can operate for a period of up to eight hours during each event, either as a single period or two separate periods with a minimum off time of 1 hour between.
3. Moving location during the contest is allowed - the Rover concept is applicable.
4. Certificates will be awarded to the leading station and runner-up, and to the leading fixed, portable and low power (<1W) stations.
5. The G3KEU Memorial Trophy will be awarded to the leading entry in the championship, determined from the best three normalized scores during the series of events.

10GHz Contest Rules
The 5.7GHz and 10GHz contests are being run concurrently to grow activity on 5.7GHz. Although they are on the same days, they are completely separate contests. Any band or both bands can be used on any of the 5 days.
1. The general rules shown above apply.
2. There are five, monthly, events from May to September inclusive, and the events run from 0600 to 1800 UTC on a Sunday. Entrants can operate for a period of up to eight hours during each event, either as a single period or two separate periods with a minimum off time of 1 hour between.
3. Contestants may submit logs for any one of the following sections:

Open
No power or antenna restrictions (other than those laid down in the amateur licence).
The 'Rover' concept does not apply to this section.

Restricted
10GHz transmit output not to exceed 1.0 watt to the antenna.
Moving location during the contest is allowed - the Rover concept is applicable.
4. Certificates will be awarded to the leading station and runner-up in each section, and to the leading portable and fixed stations.
5. The 10GHz championship will be determined based on the best three normalized scores from each entrant over the five sessions. In addition to winners and runners-up certificates for each section, the following certificates/trophies will be awarded:
- Leading entry in the Open section - The G3RPE Memorial Trophy
- Leading entry in the Restricted section - The G3JMB Memorial Trophy
- Certificates to the leading home station and portable station in each section.

24GHz G0RRJ Contest Rules
The 24GHz G0RRJ Contest will take place over four sessions, coincident with 47/76GHz events.
1. The general rules shown above apply. Eight character locators must be used in this contest.
2. There are four events from May to October inclusive, and the events run from 0900 to 1700 UTC on a Sunday.
3. Moving location during the contest is allowed - the Rover concept is applicable. Please provide a list of which contacts took place from each locator used (this can be in the soapbox area of the log).

4. Certificates will be awarded to the leading station and runner-up in each section, plus the leading home and portable stations.
5. The G0RRJ Memorial Trophy will be awarded to the leading entry in the championship, determined from the best three normalized scores during the series of events.

24GHz Trophy Rules

1. The general rules shown above apply. Eight character locators must be used in this contest.
2. The contest will run from 0900 to 1700 UTC on a Sunday in September.
3. Moving location during the contest is allowed - the Rover concept is applicable. Please provide a list of which contacts took place from each locator used (this can be in the soapbox area of the log).
4. Certificates will be awarded to the leading station and runner-up, and the winner will receive the 24GHz Trophy.

47GHz Contest Rules

The 47GHz contest will take place over four sessions, coincident with 24/76GHz events.

1. The General Rules listed above apply. Eight character locators must be used in this contest.
2. The contest will run from 0900 to 1700 UTC on a Sunday.
3. Moving location during the contest is allowed - the Rover concept is applicable. Please provide a list of which contacts took place from each locator used (this can be in the soapbox area of the log).
4. Certificates will be awarded to the leading station and runner-up.
5. The 47GHz Trophy will be awarded to the leading entry in the championship, determined from the best three normalized scores during the series of events.

76GHz Contest Rules

The 76GHz contest will take place over four sessions, coincident with 24/47GHz events.

1. The General Rules listed above apply. Eight character locators must be used in this contest.
2. The contest will run from 0900 to 1700 UTC on a Sunday.
3. Moving location during the contest is allowed - the Rover concept is applicable. Please provide a list of which contacts took place from each locator used (this can be in the soapbox area of the log).
4. Certificates will be awarded to the leading station and runner-up.

122GHz – 248GHz Contest Rules

The 122GHz – 248GHz contest will take place in two phases, one in the period January to June, the second from July to December. Entrants can choose up to three dates in each half year to operate, coordinating with others to find common dates to take advantage of good conditions. Each day used must be separated by at least two weeks from preceding or following activity dates.

1. The General Rules listed above apply. Eight character locators must be used in this contest.
2. Moving location during the contest is allowed - the Rover concept is applicable. Please provide a list of which contacts took place from each locator used (this can be in the soapbox area of the log).
3. The overall score will be determined by adding together the normalized scores from all bands entered.
4. Entrants should publish details of planned activity in time for others to join in. Posting in the UKMicrowaves io group is recommended.
5. Entries should be submitted by email to g3xdy@btinternet.com by 8th July for the January – June period, and by 8th January for the July – December period
6. Certificates will be awarded to the leading stations in each period, and to runners-up if there are more than five entrants.

Other Microwave Contests

The first weekend of May sees the RSGB 432MHz -248GHz Multiband Contest staged in parallel with the RSGB UHF/SHF Contest. The 10GHz Trophy is run in parallel by the RSGB VHF Contest Committee on the Sunday of that weekend.

BATC run the UK section of the IARU ATV contest on the second weekend in June, plus other ATV events, see http://www.batc.org.uk/contests/contest_news.html

The first weekend in July is RSGB VHF National Field Day which includes 1.3GHz as one of the bands.

The first weekend of October sees the RSGB 432MHz -248GHz Multiband Contest staged in parallel with the Region 1 IARU UHF/SHF Contest. The 1.3GHz Trophy and the 2.3GHz Trophy are run in parallel by the RSGB VHF Contest Committee on the Saturday.

The RSGB runs cumulative UK Activity Contests on 1.3GHz on the third Tuesday from 2000-2230 local time, and on 2.3GHz – 10GHz on the fourth Tuesday of every month, from 1930 – 2230 local time.

In addition there are other Continental UHF/SHF Contests held during the year and interested UK microwavers are urged to be active during these. Their details may be found on the Internet.

UKuG MICROWAVE CONTEST CALENDAR 2023

Dates, 2023	Time UTC	Contest name
5-Mar	1000 - 1600	1st Low band 1.3/2.3/3.4GHz
2-Apr	1000 - 1600	2nd Low band 1.3/2.3/3.4GHz
7-May	0800 - 1400	3rd Low band 1.3/2.3/3.4GHz
14-May	0900 – 1700	1st 24GHz Contest
14-May	0900 – 1700	1st 47GHz Contest
14-May	0900 – 1700	1st 76GHz Contest
28-May	0600 - 1800	1st 5.7GHz Contest
28-May	0600 - 1800	1st 10GHz Contest
4-Jun	1000 - 1600	4th Low band 1.3/2.3/3.4GHz
25-Jun	0600 - 1800	2nd 5.7GHz Contest
25-Jun	0600 - 1800	2nd 10GHz Contest
9-Jul	0900 – 1700	2nd 24GHz Contest
9-Jul	0900 – 1700	2nd 47GHz Contest
9-Jul	0900 – 1700	2nd 76GHz Contest
30 -Jul	0600 - 1800	3rd 5.7GHz Contest
30 -Jul	0600 - 1800	3rd 10GHz Contest
27-Aug	0600 - 1800	4th 5.7GHz Contest
27-Aug	0600 - 1800	4th 10GHz Contest
10-Sep	0900 - 1700	3rd 24GHz Contest & 24GHz Trophy
10-Sep	0900 - 1700	3rd 47GHz Contest
10-Sep	0900 - 1700	3rd 76GHz Contest
24 -Sep	0600 - 1800	5th 5.7GHz Contest
24 -Sep	0600 - 1800	5th 10GHz Contest
15 -Oct	0900 - 1700	4th 24GHz Contest
15 -Oct	0900 - 1700	4th 47GHz Contest
15 -Oct	0900 - 1700	4th 76GHz Contest
12 -Nov	1000 - 1400	5th Low band 1.3/2.3/3.4GHz

UKuG MICROWAVE CONTEST CALENDAR 2023

Month	Contest name	Certificates	Date 2023	Time GMT	Notes
Jan	1.3GHz Activity Contest	*Arranged by RSGB*	17-Jan	2000 - 2230	RSGB Contest
Jan	2.3GHz+ Activity Contest	*Arranged by RSGB*	24-Jan	1930 - 2230	RSGB Contest
Feb	1.3GHz Activity Contest	*Arranged by RSGB*	14-Feb	2000 - 2230	RSGB Contest
Feb	2.3GHz+ Activity Contest	*Arranged by RSGB*	21-Feb	1930 - 2230	RSGB Contest
Mar	REF/DUBUS EME 3.4GHz	*Arranged by REF/DUBUS*	4-Mar to 5-Mar	0000 - 2400	REF/DUBUS EME 3.4GHz
Mar	Low Band 1296/2300/2320/3400MHz	F, P,L	5-Mar	1000 - 1600	First 4 hours coincide with IARU
Mar	1.3GHz Activity Contest	*Arranged by RSGB*	14-Mar	2000 - 2230	RSGB Contest
Mar	2.3GHz+ Activity Contest	*Arranged by RSGB*	21-Mar	1930 - 2230	RSGB Contest
Jun	REF/DUBUS EME 2.3GHz	*Arranged by REF/DUBUS*	25-Mar to 26-Mar	0000 - 2400	REF/DUBUS EME 2.3GHz
Apr	Low Band 1296/2300/2320/3400MHz	F, P,L	2-Apr	1000 - 1600	
Apr	1.3GHz Activity Contest	*Arranged by RSGB*	18-Apr	1900 - 2130	RSGB Contest
Apr	REF/DUBUS EME 1.2GHz	*Arranged by REF/DUBUS*	22-Apr to 23-Apr	0000 - 2400	REF/DUBUS EME 1.2GHz
Apr	2.3GHz+ Activity Contest	*Arranged by RSGB*	25-Apr	1830 - 2130	RSGB Contest
May	*432MHz & up*	*Arranged by RSGB*	6-May to 7-May	1400 -1400	RSGB Contest
May	*10GHz Trophy*	*Arranged by RSGB*	7-May	0800 - 1400	Sunday, to coincide with IARU
May	Low Band 1296/2300/2320/3400MHz	F, P,L	7-May	0800 - 1400	Aligned with IARU event
May	24GHz/47/76GHz		14-May	0900-1700	
May	1.3GHz Activity Contest	*Arranged by RSGB*	16-May	1900 - 2130	RSGB Contest
May	REF/DUBUS EME 10GHz & Up	*Arranged by REF/DUBUS*	20-May to 21-May	0000 - 2400	REF/DUBUS EME 10GHz & up
May	2.3GHz+ Activity Contest	*Arranged by RSGB*	23-May	1830 - 2130	RSGB Contest
May	5.7GHz/10GHz	F, P,L	28-May	0600-1800	
Jun	Low Band 1296/2300/2320/3400MHz	F, P,L	4-Jun	1000 - 1600	Aligned with some Eu events
Jun	1.3GHz Activity Contest	*Arranged by RSGB*	20-Jun	1900 - 2130	RSGB Contest
Jun	5.7GHz/10GHz	F, P,L	25-Jun	0600-1800	
Jun	2.3GHz+ Activity Contest	*Arranged by RSGB*	27-Jun	1830 - 2130	RSGB Contest
Jul	VHF NFD (1.3GHz)	*Arranged by RSGB*	1-Jul to 2-Jul	1400 - 1400	RSGB Contest
Jul	24GHz/47/76GHz		9-Jul	0900-1700	
Jul	REF/DUBUS EME 5.7GHz	*Arranged by REF/DUBUS*	15-Jul to 16-Jul	0000 - 2400	REF/DUBUS EME 5.7GHz
Jul	1.3GHz Activity Contest	*Arranged by RSGB*	18-Jul	1900 - 2130	RSGB Contest
Jul	2.3GHz+ Activity Contest	*Arranged by RSGB*	25-Jul	1830 - 2130	RSGB Contest
Jul	5.7GHz/10GHz	F, P,L	30-Jul	0600-1800	
Aug	ARRL Microwave EME	*Arranged by ARRL*	12-Aug to 13-Aug	0000 - 2359	ARRL EME 2.3GHz & Up
Aug	1.3GHz Activity Contest	*Arranged by RSGB*	15-Aug	1900 - 2130	RSGB Contest
Aug	2.3GHz+ Activity Contest	*Arranged by RSGB*	22-Aug	1830 - 2130	RSGB Contest
Aug	5.7GHz/10GHz	F, P,L	27-Aug	0600-1800	
Sep	ARRL Microwave EME	*Arranged by ARRL*	9-Sep to 10-Sep	0000 - 2359	ARRL EME 2.3GHz & Up
Sep	24GHz/47/76GHz		10-Sep	0900-1700	
Sep	1.3GHz Activity Contest	*Arranged by RSGB*	19-Sep	1900 - 2130	RSGB Contest
Sep	5.7GHz/10GHz	F, P,L	24-Sep	0600-1800	
Sep	2.3GHz+ Activity Contest	*Arranged by RSGB*	26-Sep	1830 - 2130	RSGB Contest
Oct	*432MHz & up*	*Arranged by RSGB*	7-Oct to 8-Oct	1400 - 1400	IARU/RSGB Contest
Oct	*1.3 & 2.3GHz Trophies*	*Arranged by RSGB*	7-Oct	1400 - 2200	RSGB Contest
Oct	24GHz/47/76GHz		15-Oct	0900-1700	
Oct	1.3GHz Activity Contest	*Arranged by RSGB*	17-Oct	1900 - 2130	RSGB Contest
Oct	2.3GHz+ Activity Contest	*Arranged by RSGB*	24-Oct	1830 - 2130	RSGB Contest
Oct	ARRL EME 50-1296MHz	*Arranged by ARRL*	28-Oct to 29-Oct	0000 - 2359	ARRL EME Contest
Nov	Low Band 1296/2300/2320/3400MHz	F, P,L	12-Nov	1000 - 1400	
Nov	1.3GHz Activity Contest	*Arranged by RSGB*	21-Nov	2000 - 2230	RSGB Contest
Nov	ARRL EME 50-1296MHz	*Arranged by ARRL*	25-Nov to 26-Nov	0000 - 2359	ARRL EME Contest
Nov	2.3GHz+ Activity Contest	*Arranged by RSGB*	28-Nov	1930 - 2230	RSGB Contest
Dec	1.3GHz Activity Contest	*Arranged by RSGB*	19-Dec	2000 - 2230	RSGB Contest

EVENTS 2023

March 3-5	Micromeet 2023, Madrid, Spain	https://micromeet.org
April 1	CJ-2023, Seigy	cj.r-e-f.org
April 14-15	Microwave Update, Windsor CT, USA	microwaveupdate.org
April 16	Martlesham RT / AGM	www.microwavers.org
May 19-21	Hamvention, Dayton	www.hamvention.org
June 23-25	Ham Radio, Friedrichshafen	www.hamradio-friedrichshafen.de
August 6	BATC Convention, Midlands Air Museum, Coventry	www.batc.org.uk
September 8-10	68.UKW Tagung Weinheim, Germany	www.ukw-tagung.de

80m UK Microwavers net

Tuesdays 08:30 local on 3626 kHz (+/- QRM)

73 Martyn Vincent G3UKV