Newsletter

Chesham & District Amateur Radio Society

www.g3mdg.org.uk April 2021

We meet the 2nd and 4th Wednesdays of the month at the Ashley Green Village Hall, Ashley Green, HP5 3PP

Welcome

Firstly I must thank Maty Weinberg (KB1EIB) of the ARRL (Amateur Radio Relay League) for permission to reprint an article from the November 2006 edition of QST (© ARRL) written by Darrin Walraven (K5DVW) and titled “Understanding SWR by Example”, a well written and a worthwhile read.

Having received my letter from Ofcom regarding proposed changes, I decided it was time to see what it meant, the results are reported in “Can of worms? Maybe not.”.

I’ve added another section to Air Miles, appropriately named “QSO Economy Drive”, or “QED”, it will be interesting to see who can travel furthest per Watt.

With restrictions starting to be lifted we can start to get back to some kind of normality, whatever that may be, meetings at the club maybe?

Bryan M0IHY

In this issue

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Chairman's Ramble

I am writing this on the first day of gradual easing of restrictions, 29th March.

So far, our garden has not been invaded by groups of random people wanting to meet in a private garden, though I suppose there is still time. Apparently we are asked to minimise travel, though travelling for exercise is permitted. I don't know whether putting up and taking down antennas counts as exercise, but I imagine that could be justified, depending on the size and weight of the poles. I also hear that the first National Express coach out of Manchester to London was scheduled for one minute past midnight this morning and was completely booked, but I don't know whether that says more about Manchester or London, or both.

What the easing does mean though is that we can start to plan for meetings and other activities which are not on Zoom, which will at least cut down the danger of my faux pas being recorded. The first possibility is the Windmills on the air week-end on 8th and 9th May. Restrictions will still be in place then, with groups of 6 able to meet outside, but no mixing of households inside. The Brill society have already said they would be glad for us to represent the Windmill again this year and we have the callsign of GB0BWM again. We will be contacting them after the 12th April to see what might be possible and what they are comfortable with.

If we can use the mill itself, that would be ideal, though we may have to work with a single operator on one station inside, well wrapped up, and another station outside, with an awning or gazebo. Operators can take turns, and we would need to continue with cleaning of equipment etc.

If all goes well, we are planning our first meeting back at Ashley Green on the 4th Wednesday in May, the 26th. We will also need to reposition the large storage cabinets which are now there and move our gear from the White Hill Centre, which we may be able to do before the 26th May.

Thanks to James and Guy for their presentation on the cobweb antenna and measuring with the NanoVNA and for Bryan for researching potential construction projects.

We are now getting our programme back into RadCom, and the first result is that members of MKARS have asked to join for the talk on AirScout on the 28th April. This can only help the profile of the club.

Let’s hope for some good openings next month and look forward to 50 Mhz getting going again in May, in the meantime have a great easter.

73, Jeremy.

Editor's Muse

This month I’ve been busy trying to understand the proposed changes by Ofcom, and as such have written “Can of Worms? Maybe not...”. They have a way to go as yet with only 10MHz and above catered for at the moment. I personally think it’s not all doom and gloom and like the proverbial chameleon we’ll have to adapt to our surroundings, let’s see what they have in store for us when they calculate frequencies under 10MHz..

We now have 2 large storage cupboards in Ashley Green Village Hall, the shelf brackets were missing but a quick search on eBay and suitable brackets were found, they just needed trimming slightly, these have to be fitted at some point, now it’s a case of moving the cupboards into a suitable location within the seat/table cupboard area to enable full use of them (see picture on page 8). At some point we’ll have to visit the Whitehill Centre to empty the cupboard and fill the newly acquired cupboards, that also means those of us holding club gear at our own QTH’s will now be able to move it to the village hall.

Bryan M0IHY

Understanding SWR by Example

Take the mystery and mystique out of standing wave ratio.

Darrin Walraven, K5DVW

It sometimes seems that one of the most mysterious creatures in the world of Amateur Radio is standing wave ratio (SWR). I often hear on-air discussion of guys bragging about and comparing their SWR numbers as if it were a contest. There seems to be a relentless drive to achieve the most coveted 1:1 SWR at any cost. But why? This article is written to help explain what SWR actually is, what makes it bad and when to worry about it.

What is SWR?

SWR is sometimes called VSWR, for voltage standing wave ratio, by the technical folks. Okay, but what does it really mean? The best way to easily understand SWR is by example. In the typical ham station setup, a transmitter is connected to a feed line, which is then connected to the antenna. When you key the transmitter, it develops a radio frequency (RF) voltage on the transmission line input. The voltage travels down the feed line to the antenna at the other end and is called the forward wave. In some cases, part of the voltage is reflected at the antenna and propagates back down the line in the reverse direction toward the transmitter, much like a voice echoing off a distant cliff. SWR is a measure of what is happening to the forward and reverse voltage waveforms and how they compare in size.

Let's look at what happens when a transmitter is connected to 50 ohm coax and a 50 ohm antenna. For now, pretend that the coax cable doesn't have any losses and the transmitter is producing a 1 W CW signal. If you were to look at the signal on the output of the transmitter with an oscilloscope, what you would see is a sine wave. The amplitude of the sine wave would be related to how much power the transmitter is producing. A larger amplitude waves means more power. This wave of energy travels down the transmission line and reaches the antenna. If the antenna impedance is 50 ohm, just like the cable, then all of the energy is transferred to the antenna system to be radiated. Anywhere on the transmission line you measured, the voltage waveform would measure exactly the same as the sine wave coming from the transmitter. This is called a matched condition and is what happens with a 1:1 SWR.

Table 1
SWR vs Reflected Voltage or Power

VSWR	Voltage Reflected (%)	Power Reflected (%)
1.0:1	0.0	0.0
1.1:1	5.0	0.2
1.2:1	9.0	0.8
1.3:1	13.0	1.7
1.4:1	17.0	2.8
1.5:1	20.0	4.0
1.6:1	23.0	5.3
1.7:1	26.0	6.7
1.8:1	29.0	9.2
1.9:1	31.0	9.6
2.0:1	33.0	11.0
2.5:1	43.0	18.4
3.0:1	50.0	25.0
4.0:1	56.0	36.0
5.0:1	67.0	44.4
10.0:1	82.0	67.0

For the case of resistive loads (see sidebar), the SWR can be easily calculated as equal to the (Load R)/Z0 or Z0/(Load R), whichever gives a result greater than or equal to 1.0.

The load or terminating resistance is the RF resistance of whatever is on the end of the transmission line. It could be an antenna, amplifier or dummy load. The line impedance is the characteristic impedance of the transmission line and is related to the physical construction of the line. Conductor size, space between conductors, what plastic was used in the insulation — all affect line impedance. Generally, the cable manufacturer will list the line impedance and there's nothing you, as a user, can do to change it.

But, what if the antenna wasn't 50 ohms? Suppose that the antenna is 100 ohms and the - (cont'd on page 6)

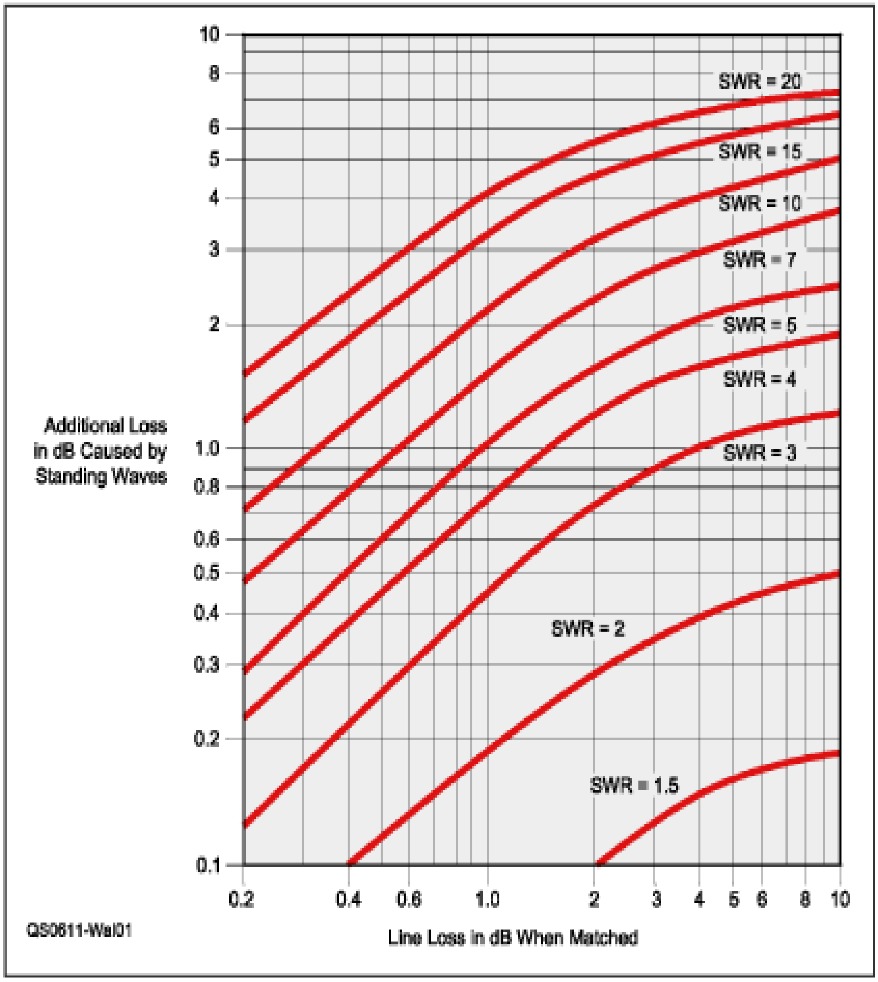


Figure 1 - A graph showing the additional loss in a transmission line due to SWR higher than 1:1.

Adding Reactance to the Picture

In the main article I used several examples of SWR based on a resistive load. A resistive load is the easiest to visualize, calculate and understand, but it's not the most common type of load. In most cases, loads have some reactive impedance as well. That is, they contain a resistive part and an inductive or capacitive part in combination. For instance, your antenna might appear as a 50 ohm resistor with a 100 nH inductor in series, or perhaps some capacitance to ground. In this situation, the SWR is not 1:1 because of the reactance. Even antennas that show a perfect 1:1 SWR in mid-band will typically have some larger SWR at the band edges, often due to the reactance of the antenna changing with frequency. Fortunately, a given SWR behaves the same on a transmission line whether it's reactive or resistive. If you have a handle on understanding the resistive case, the concept will get you pretty far.

To explore SWR further, it's useful to look at the reactive load case, or what happens under the condition that loads are not simply resistive. Complex imaginary number math is the routine way to analyze the SWR of complex loads and can be done if you have access to a calculator or computer program that will handle it. Even so, the math gets tedious in a hurry. Fortunately, there's a very easy way to analyze complex loads using graphical methods and it's called the Smith Chart. See Figure A.

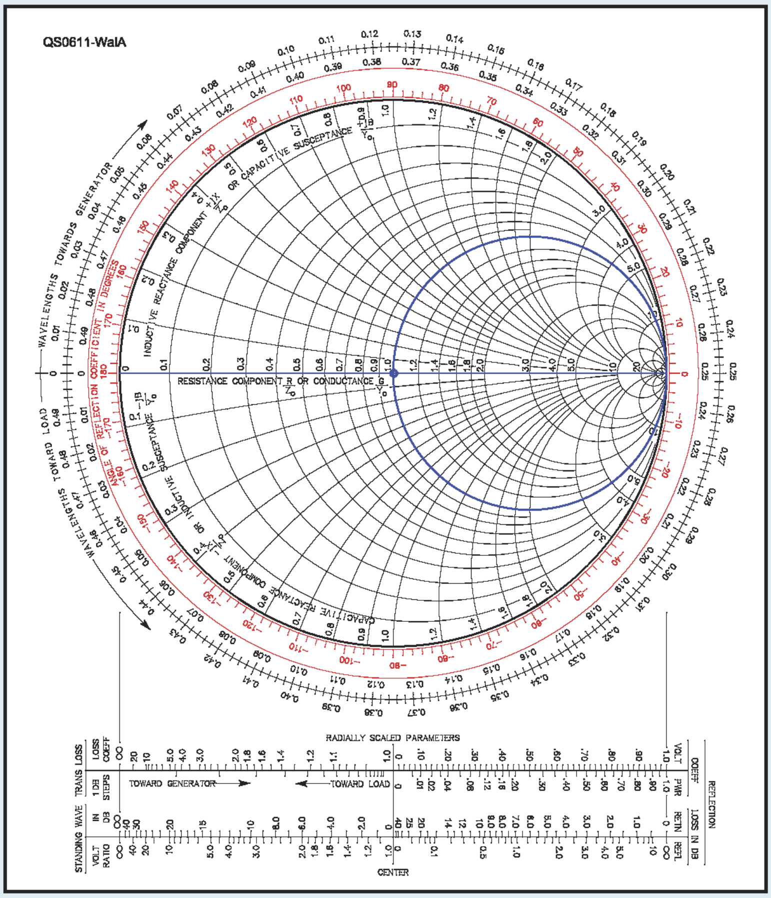


Figure A - The normalized Smith Chart, ready to simplify transmission line analysis.

The concept behind the Smith Chart is simple. There is a resistive axis that is down the middle of the chart, left to right, and a reactive axis along the outer edge of the chart's circumference. Inductive loads are plotted in the top half of the graph, and capacitive loads in the bottom. Any value of resistance and reactance in a series combination can be plotted on the chart. Then, with a ruler and compass the SWR can be determined. Advanced users of the chart can plot a load and use graphic techniques to design a matching structure or impedance transformer without rigorous math or computer. It's a very powerful tool. Here's a simple example showing how to determine SWR from a known load using the chart.

Suppose you have just measured a new antenna with an impedance bridge and you know that the input impedance is 35 ohms in series with 12 ohms reactive. The coax cable feeding it has a Z0 of 50 ohms. What is the SWR at the antenna end of the coax?

This impedance can be written as the complex number Z=35 +j12.5 ohms. The "j" is used to indicate the reactive part from the real part and they can't simply add together. To use a "normalized" Smith Chart we divide the impedance by 50 ohms, to normalize the impedance. [Smith Charts are also available designed for 50 ohms with 50 at the center instead of the 1.0 that we show for the normalized chart. — Ed.] We now have Z=0.7 +j0.25. Smith Chart numbers are normalized, which means that they have been divided by the system impedance before being plotted. In most cases, the system impedance is the transmission line impedance and is represented on the chart by the dot in the center. Now plot Z on the chart. Along the horizontal line find the 0.7 marker and move upward (inductors or positive reactances are upward, capacitors or negative reactances are down-

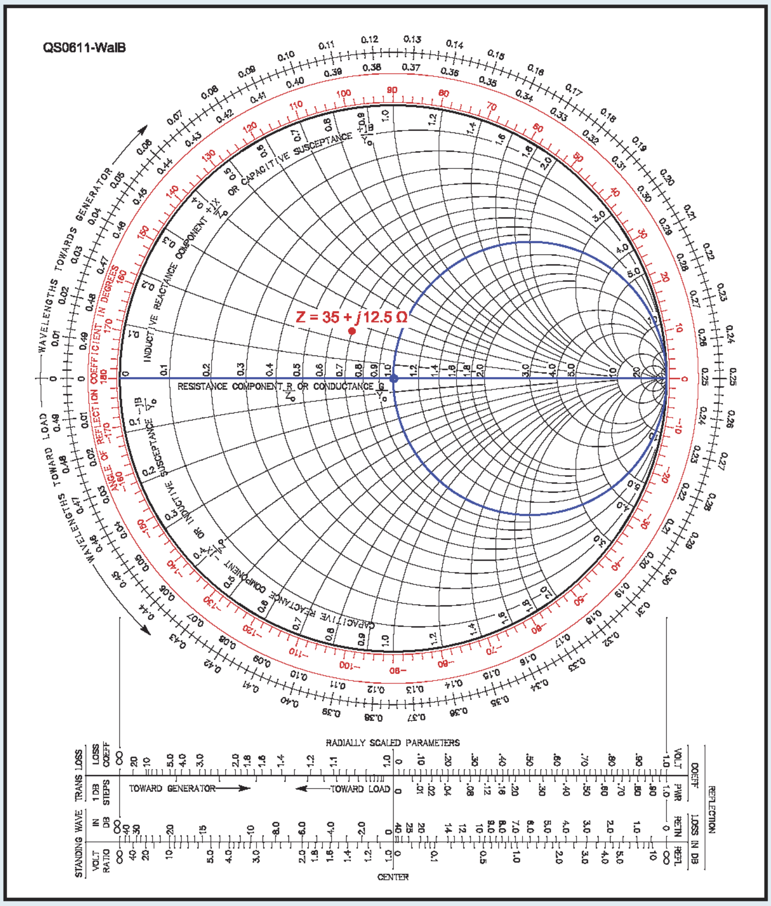


Figure B - An impedance of 35 + j12.5 ohms normalised to 0.7 + j0.25 ohms to use on the normalised chart.

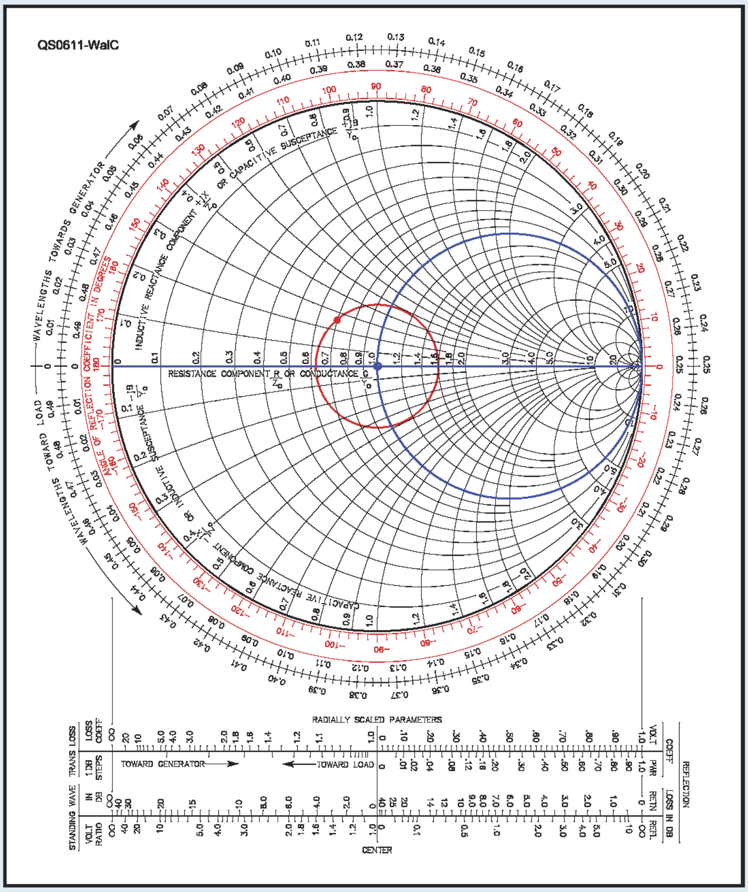


Figure C - A circle of constant SWR through the impedance of figure B. The SWR is 1.6.

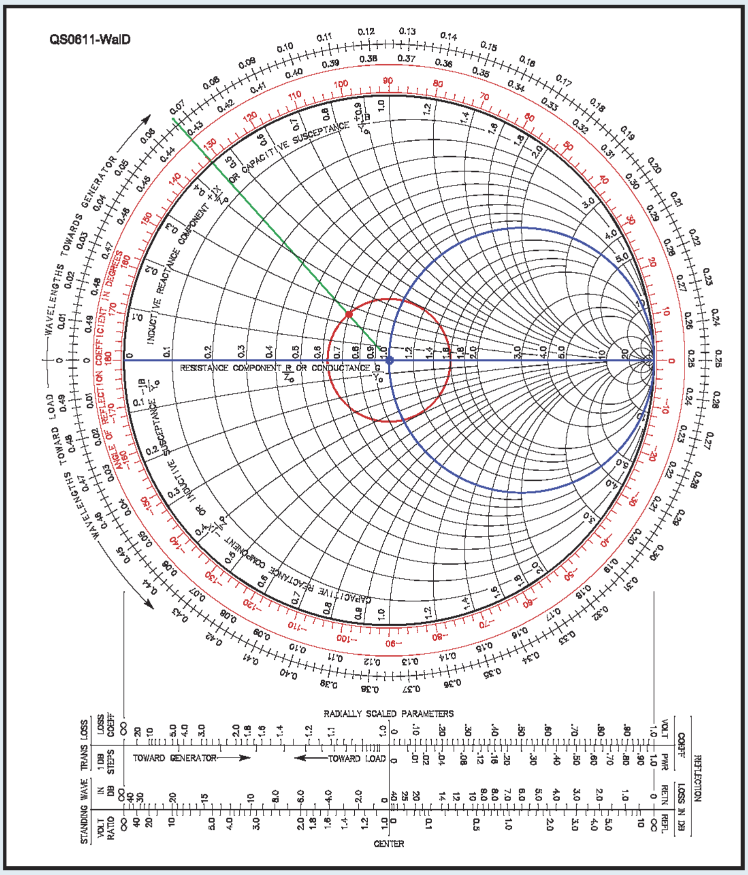


Figure D - A line drawn from the chart centre through the impedance of figure B to the edge showing the distance from the pure resistive points on the line.

ward from center) until you cross the 0.25 reactance line (see Figure B). Draw a point here that notes your impedance of 35 +j12.5 ohms. Next draw a line from the center dot of the chart to your Z point. Measure the distance of that line, then draw the same length line along the bottom SWR scale. From here you can read the SWR for this load. The SWR is 1.6:1.

Another useful attribute of the Smith Chart is called a constant SWR circle. The SWR circle contains all the possible combinations of resistance and reactance that equal or are less than a given SWR. The circles are drawn with a compass by using the distance from the SWR linear graph at the bottom and drawing a circle with that radius from the center of the chart, or use the numbers along the horizontal axis to the right of the center point. For instance, where you see 1.6 on the horizontal line, a circle drawn with radius distance from the center to that point is SWR 1.6:1 as shown in Figure C.

Now, any combination of impedance on the circle will be equal to SWR 1.6:1 and anything inside the circle will be less than 1.6:1. The example impedance that was plotted before should lie on the 1.6:1 circle.

Also useful is to know that rotating around the outer diameter of the Smith Chart also represents a half wavelength of distance in a transmission line. That is, as you move along the outer circle it's the same as moving along a transmission line away from the load. One time around the circle and you're electrically X/2 away. This is also very powerful feature of the chart since it allows you to see how your load impedance changes along a transmission line again, without doing the math.

Here's another example. If your coax cable has a 1.6:1 terminating SWR, as you move along the transmission line away from the load, you move along the constant SWR circle on the chart. Remember from the article text that a 1.6:1 SWR can be equal to either 80 ohms or 31 ohms resistive? (1.6 = 80/50 or 50/31). From the Smith Chart, where the SWR circle crosses the horizontal axis, the impedance is purely resistive! Where the circle crosses 1.6, it's equal to 80 ohms and crossing at 0.62, it's equal to 31 ohms. This is the basis of how impedance transformers work. Remember to multiply any numbers from the chart by your working impedance (50 ohms in this example) to get their actual value.

Where do these purely resistive points lie on the transmission line? From the chart, looking at the line extended from the center dot through our Z point, find where it crosses the "wavelengths toward generator curve" on the outside of the chart as shown in Figure D. The line crosses at approximately 0.07 wavelengths on the chart, which will be the starting point. Note that the 80 ohms point (1.6) is at 0.25 X and the 31 ohms point (0.62) is at 0.50 X on the chart. Subtracting the starting point of 0.07, the chart is telling us that at 0.18 X (0.25 – 0.07) from the load, the impedance is 80 ohms and at 0.43 X away, it's 31 ohms.

To find the distance in a real piece of cable, multiply the chart wavelengths by the free space wavelength by the cable velocity factor. For example, if your frequency is 144 MHz then a full wavelength in air would be 300/144 = 2.08 meters. Multiplying by the velocity factor of 80% gives 1.67 meters. Multiplying by the chart wavelengths and then at 30 cm, you'd find 80 ohms and at 72 cm it's 31 ohms.

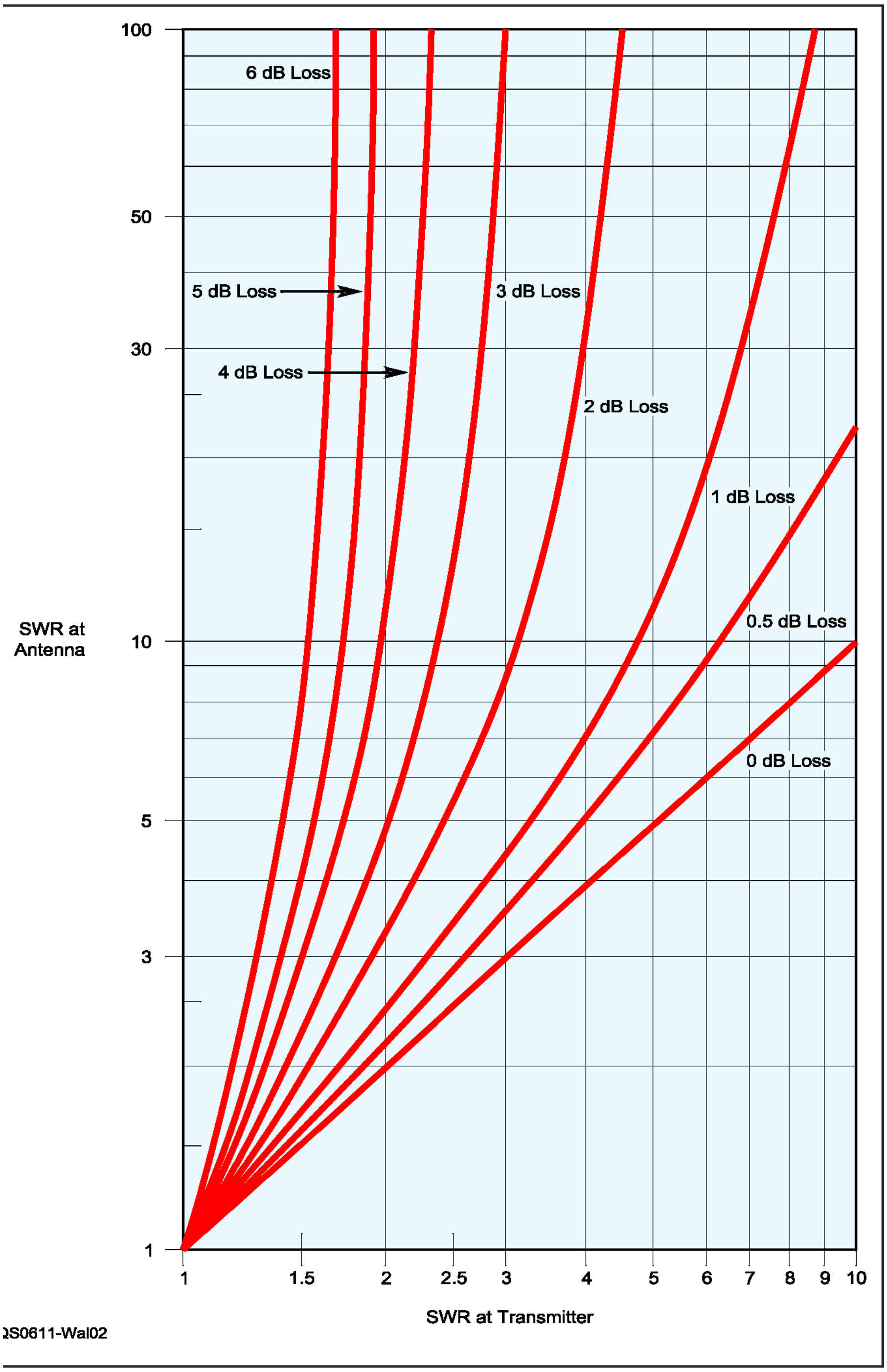


Figure 2 — A graph showing the actual SWR at an antenna based on measured SWR at the transmitter end of a transmission line with loss.

cable is still 50 ohms. The SWR for this setup is calculated as 100/50, or 2:1. Now the energy wave hits the antenna and part of it is radiated by the antenna, but part of it is reflected back down the line toward the transmitter. That is, the antenna is not matched to the line, so there is a reflection. It turns out that for a 2:1 SWR, 33 percent of the voltage wave is reflected like an echo back down the line. Table 1 lists how much voltage and power is reflected for various SWR values.

In the case of a mismatched condition, something interesting happens along the transmission line. Before, with the matched antenna, the same voltage existed anywhere along the line. Now as you move along the distance of the line, the voltage will change. It now has peaks and valleys. The 33 percent reflection from the antenna alternately adds to and subtracts from the forward voltage wave. At some places on the cable the reflected voltage adds to 133 percent, and others it subtracts to 66 percent of the matched transmitter output. The voltage ratio is 133/66 or 2.0. That voltage ratio defines the SWR. The fact that the voltage along the line changes with position and is different from what the transmitter would produce is called a standing wave. Standing waves are only present when the line is mismatched.

Does Higher SWR Lead to Lower Power Being Transmitted?

Not always so dramatically. Believe it or not, 100 percent of the power is actually transmitted in both of the previous examples. In the first case, with a 50 ohm antenna, it's easy to see how all the power is transferred to the antenna to be radiated since there are no reflections. In the second case, the 33 percent voltage reflection travels back down to the transmitter where it doesn't stop but is re-reflected from the transmitter back toward the antenna along with the forward wave. The energy bounces back and forth inside the cable until it's all radiated by the antenna for a lossless transmission line. An important point to realize is that with extremely low loss transmission line, no matter what the SWR, most of the power can get delivered to the antenna. A later example will show how this can happen.

Is High SWR Bad, or Not?

Now that you have a sense of what SWR is, a few examples can show why under some conditions, high SWR can lead to less power radiating and in other cases, it's no big deal. The easiest way to see how SWR affects an antenna system is to use a set of charts. Figures 1 and 2 are taken from The ARRL Handbook in the chapter discussing transmission lines. There is much more theory in the Handbook than I'm presenting here, so if you want to be an expert on transmission lines, that's one place to learn more.

In the previous examples, the transmission line had no loss and all our power was being delivered to the antenna. That's a nice way to visualize what is happening with the reflections, but it doesn't match the real world because all transmission lines have some loss. Here's a more practical, straightforward situation. This time we have a length of 50 ohm cable with a total loss of 3 dB (50 percent power), and a 50 ohms antenna. SWR is therefore 1:1. Transmitting 1W would result in 0.5W applied to the antenna. Since the SWR is 1:1 there is no mismatch loss to worry about. A very simple situation and no charts are needed. If life were only that simple!

Next try the 100 ohm antenna with the same coax. The SWR is then 2:1 at the antenna since 100/50 = 2.0. According to Figure 1, expect a mismatch loss of 0.35 dB in addition to the cable loss. In this case we lose a total of 3.35 dB of our signal and send the antenna 0.46W. Not much difference from a perfect SWR of 1:1.

How about a SWR of 3:1 with the same cable? According to Figure 1 again, we would have an additional loss of 0.9 dB, which makes a total loss of 3.9 dB and 0.41 W to the antenna. This is still not a lot of additional loss even with an SWR of 3:1. Under most conditions a power reduction of 0.9 dB is not noticeable over the air. Even at a 3:1 SWR, the signal it not significantly reduced.

The SWR vs loss tables make it easy to figure out what your additional loss might be for any given antenna system, as long as you know the matched cable loss.

Is that the Whole Story?

No, not exactly. There's even more to explore in the world of SWR. One very strange situation occurs on a long and lossy transmission line, which causes your SWR to appear good at your transmitter even if it's terrible at the antenna. It's entirely possible to have a good measured SWR, huge losses in your feed line and no power getting out. Here's an example.

You've just set up your new 2 meter antenna and are feeding it with 120 feet of RG-8X cable. The manufacturer's data says you should expect 4.5 dB of cable loss for this length of cable at 2 meter frequencies. Not great, but you accept it. You measure the SWR at your transmitter and record a 2:1, which isn't great but not too terrible either. But wait — how bad is it? Remember all those reflections bouncing back and forth in the cable? Earlier I told you that they eventually radiate, but that was without cable loss. The story is different now - we have loss. Each one of the reflections is attenuated in the cable by 4.5 dB every time it goes from one end to the other or 9 dB round trip. The cable loss is attenuating the reflections and they die out in the cable instead of being radiated.

So, how bad is it really? Take a look at Figure 2. With a SWR at the transmitter of 2:1, and a 4.5 dB cable loss, the chart shows a 20:1 SWR at the antenna! Wow! That's much worse than the 2:1 measured at the transmitter. Looking back at Figure 1, that 20:1 SWR at your antenna is costing you another 7 dB of mismatch loss. In reality, the antenna system that you thought has only 4 dB of loss has 11 dB. Less than 1/10th of your transmitter power is being radiated! Good grief!

If this same cable had an open circuit instead of an antenna, and was several hundred feet long, the SWR meter at the transmitter would read 1:1. Why? Because cable loss tends to make a very long cable appear like a virtual resistance to the transmitter as the reflections die out in the cable. Remember, no reflections looks like a SWR of 1:1. The value of that virtual resistance in this case is 50 ohms which is the definition of characteristic impedance, or why some cables are called 50 ohms and some are 75 or 300 ohms. That number is the impedance the RF would see if the cable were infinitely long. Or, it is also the resistance of the load needed in order to cause no reflected energy and match the cable.

The moral of this story is to measure the SWR at the antenna, especially if you have a long cable run. SWR measurements at the transmitter can be deceiving. The second moral is to know that when a cable manufacturer quotes loss numbers, they are based on an SWR of 1:1, or a perfect match. Anything less than a perfect match can cause additional losses.

Why Ladder Line Works for High SWR

Open wire line, window line or ladder line has been used since the early days of radio. There is a good reason, since the loss of this type of cable is quite low at HF frequencies — lower than all but the very best coax cable. For instance, 300 feet of 450 ohm ladder line has a loss of less than 0.5 dB at 30 MHz when matched. A good quality expensive coax might have 1 dB of loss in the same length, but most high end amateur coax cable will have more than 2 dB attenuation under those conditions. It is because of this low loss that air dielectric (or mostly air in the case of window line) line can be used effectively on antennas that have high SWR, if the matching is provided at the transmitter. The lower loss of this type of line allows most of the reflections to radiate instead of being lost within the cable.

One last example shows how this works. You have just installed a full wave HF dipole. To feed it, you use 300 feet of 450 ohm ladder line with a loss of 0.5 dB at 30 MHz. You've modelled your antenna for 10 meters and you just happen to know that the impedance is 4500 ohms. That corresponds to a SWR of 4500/450 or 10:1 on your ladder line. Pretty bad, right? Not so fast. Consulting Figure 1 and knowing your matched loss is 0.5 dB shows an additional loss of 0.9 dB at an SWR of 10:1. The total loss of this antenna system is 1.4 dB. Not bad. Toss in a balanced line tuner and you're ready to go!

Your smart aleck buddy decides to install the same antenna but he springs for the best and most expensive coax figuring his antenna is only 40 feet away from his radio and he doesn't like the look of ladder line. He boasts that his coax loss is specified at 0.25 dB, which is half that of your ladder line. He figures he can also use a tuner to take care of the mismatch. You quietly smile at him because you know that the 4500 ohms of the antenna will present an SWR of 90:1 on his 50 ohm cable resulting in a mismatch loss of 12 dB beyond the 0.25 dB cable loss. Sure he can tune his SWR to 1:1 with the tuner at his radio, but guess who will be working the DX?

Conclusion

I hope I have been able to show by example that SWR can be a serious issue, or something not so important. With the help of the graphs and a little information about your transmission line and antenna, it's easy to determine how much of your signal is actually getting on the air or how much is being lost in the transmission line.

Darrin Walraven, K5DVW, has been licensed since 1986 at the age of 18. He enjoys DX, CW and SSB. He has an engineering degree from Texas A&M University and is employed as an RF design engineer. You may contact him at k5dvw@hotmail.com.

If you've had problems viewing the Smith Charts, go to:
http://www.arrl.org/files/file/Technology/tis/info/pdf/q1106037.pdf

Club storage

On Thursday the 4th of March I ran Angie to our local doctors surgery and while waiting outside noticed workmen removing what appeared to be metal cabinets, Angie had been close-by while waiting in the socially distanced queue and was paying attention to what the workmen were doing, on her return to the car she suggested the club might be interested in the cabinets for storage and as such I spoke to the workmen.

The steel cabinets were being removed as part of the upgrade to the surgery and were destined for the skip, at this point I spoke to the building site manager and asked if he could put two to one side and that we'd pick them up the next day, this he agreed to do.

Friday the 5th of March we arranged for Nigel and his Renault van to pick up the cabinets, 2 in all with 12 drawers and 2 shelves with their runners and 3 fixed shelves, in as many pieces as they could have been broken down into! Malcolm (G3ZNU) and Jeremy (G3XZG) arrived shortly and between the 5 of us we unloaded the van and moved the items into the village hall lobby.

It took around 2 hours to reassemble the 2 cabinets, all that is left is to fit the metal clips that support the shelves, these will be fitted on my next visit to the hall.

As can be seen from the picture below the cabinets are huge, they have 6 deep drawers each on runners (ideal for what we need), the cabinet to the left of the refrigerator will have 2 fixed shelves, the other cabinet has 1 sliding shelf and one fixed shelf, both have roller fronts.

Can of worms? Maybe not...

I recently received my letter from Ofcom (as I suspect you all have) and thought it was about time I checked out what it really meant.

Whilst I've always been mindful of my next door neighbours (our garden is less than 6 metres wide so you're almost on top of them to start with) I've kept transmitting on my vertical to a minimum during the day and have used our cobweb and roof top antenna's instead.

The only way I would understand the changes was to create a spreadsheet, this I've done below, the main difference is a default distance from the lowest power up to a point instead of an initial incrementing distance.

Power (Watts)		Full Licence	10MHz	14MHz	18MHz	21MHz	24MHz	28MHz	50MHz	70MHz	144MHz	432MHz
EIRP	ERP	Calculation (m)	<--				Proposed distances (m)					-->
10	6.09	0.63	4.77	3.41	2.65	2.27	1.99	1.71	1.01	1.01	1.01	0.97
15	9.15	0.77	4.77	3.41	2.65	2.27	1.99	1.71	1.24	1.24	1.24	1.19
20	12.20	0.88	4.77	3.41	2.65	2.27	1.99	1.71	1.43	1.43	1.43	1.37
25	15.24	0.99	4.77	3.41	2.65	2.27	1.99	1.71	1.60	1.60	1.60	1.54
30	18.29	1.08	4.77	3.41	2.65	2.27	1.99	1.75	1.75	1.75	1.75	1.68
35	21.34	1.17	4.77	3.41	2.65	2.27	1.99	1.89	1.89	1.89	1.89	1.82
40	24.39	1.25	4.77	3.41	2.65	2.27	2.02	2.02	2.02	2.02	2.02	1.94
45	27.44	1.33	4.77	3.41	2.65	2.27	2.14	2.14	2.14	2.14	2.14	2.06
50	30.49	1.40	4.77	3.41	2.65	2.27	2.26	2.26	2.26	2.26	2.26	2.17
100	60.98	1.98	4.77	3.41	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.07
200	121.95	2.80	4.77	4.51	4.51	4.51	4.51	4.51	4.51	4.51	4.51	4.34
400	243.90	3.95	6.38	6.38	6.38	6.38	6.38	6.38	6.38	6.38	6.38	6.14

HF lower frequencies have the greater changes.

Please note: The calculations (Full Licence) above are based on antenna's with a gain of 1, for every 3dB of gain you must double the distance.

Who will it affect?
Nobody using less than 10W EIRP (6.25W ERP by my calculation (ERP = EIRP/1.64)), Ofcom sees this as a level not likely to cause problems.

Those using more than 10W EIRP, and yes, that includes QRP too (I understand QRP SSB is done at 10W ERP, but CW at only 5W ERP).

I've included the "Full Licence" calculations to compare with Ofcom's proposed changes, it can be seen that Ofcom's proposed distances are initially greater, although as the frequency increases the changes are less.

Does this mean you can't operate? No, if you have an antenna that is 4.77 metres clear in all directions it would suggest you can operate at up to 200W on 10MHz and above, what the restrictions are on 7MHz and below, I don't know at this time.

Example
I have my cobweb, which is mounted about 5 metres above the ground, meaning I'm good to go at up to the rigs power limit (100W) on 14MHz and above.

What about?
NVIS dipoles (a.k.a. 'cloud warmers'), they have a high angle of radiation, is this taken into account when calculating the safe distances and if so, what are they?

Verticals, how do they calculate the distance with inverted-L's and the like, surely there can't be a "one calculation fit's all" (see Stage 1 - Screening by configuration on the following page) scenario here?

Another example
In my case our vertical is an 'unknown', however, if I wind the power down to 5W ERP I don't have to comply,

so... My garden is almost 6 metres wide, the vertical is therefore approximately 3 metres from our garden boundary on either side, meaning I can operate on 14MHz and below on 5W but 18MHz and above on 50W, assuming of course there's nobody in the gardens.

What next?
As reported in the March edition of RadCom

Stage 1 - Screening by configuration:
In an effort to make compliance simple for as many people as possible, RSGB and ARRL are developing guidance by identifying typical station configurations that will comply with exposure limits on each of the amateur bands. If you can match your station to one of these pre-assessed configurations on the amateur band in question, that will be the simplest way to demonstrate compliance. Little or no calculation will be required by the end user.

To make that possible, a wide range of different station configurations are being evaluated using advanced modelling techniques. An example for HF is shown in Figure 2. This is part of a programme to determine the minimum compliant height for various antennas, for a given transmitted power on each HF band. Similar work is underway for a range of VHF and UHF station configurations.

Stage 2 - Simple calculation:
The next level of complexity involves some calculation by you. For example, Ofcom has developed a simple spreadsheet tool and RSGB is working with Ofcom to clarify and improve this method. The output from the Ofcom calculator is a so-called "safe separation distance" for the power level, antenna configuration, etc that you are using. If you can be sure that nobody is present within that zone while you are transmitting, then RSGB's understanding is that you will be deemed compliant.

Stage 3 - Further measures:
If you cannot initially demonstrate compliance using these first two stages, then you will need to do some more work. You have considerable control over this - for example, you could revisit stages 1 and 2 and look at the effects of changing the antenna configuration, limiting transmit power and/or beam directions, taking measures to ensure that no-one is present in high-exposure locations when transmitting, and so on. If you then are able to demonstrate compliance, the problem is solved. Examples will be discussed in future articles.

Stage 4 - Advanced methods:
If you are not able to work within such limitations, it may still be possible that more advanced assessment methods could be applied to your particular circumstances to provide a more accurate exposure estimation; and in some cases that might then demonstrate compliance. RSGB-ARRL team members are already developing advanced computation methods as part of the programme to define the pre-assessed configurations for Stage 1 (see above).

How are they going to enforce this?
I don't know and I doubt they do either, it's almost unenforceable, like most things (I.M.H.O.) I think it'll go away after a while!

Conclusion
I would be more than interested in why 160m-40m have not been included in the calculations, from what is reported in RadCom (March edition) it may go part way to explaining: "*In addition to thermal effects, currents and voltages induced in the body by strong external EMF's at frequencies below 10MHz may interact with the electrical nerve pathways and effect the body's 'internal signalling'. To protect against that, there are limits on peak (maximum) exposure that may be more restrictive below 10MHz than the more familiar limits for thermal effects*." Does this mean that these frequencies will out of reach for people with small gardens and fall into the domain of those who have some serious real-estate?

Panic not!
I understand after talking to a friend from the RSGB that they've been inundated with calls regarding Ofcom's proposals and when they actually come into force, it was felt from the volume of calls people misunderstood

Can of worms? Maybe not...

and assumed they had to comply immediately, this is not the case.

RadCom (April, page 6) reports "The licence variation will come into effect in May 2021. After that date we will have up to 6 months to complete the assessments for frequencies above 10MHz; and up to 12 months for frequencies below 10MHz. Six options for compliance assessments are named, but there is still lots of work to do for us to define some methods, and for you to conduct your assessments.", so... we have to have our houses in order for 10MHz and above by November 2021 and below 10MHz by May 2022.

Please remember nothing is 'cast in stone' until November this year at the earliest, so it's 'business as usual' until then.

Changes to Air Miles

As there may be changes in the power we output due to the Ofcom proposals I thought we could add a twist to the statistics provided every month, the new category will be appropriately named "QSO Economy Drive" and will be the number of miles achieved per Watt of transmitted power. Hopefully some of you QRP guys might join in, it's fun, and should add an element of competitiveness amongst you, it will be interesting to see exactly how far you can get out with minimum power.

I know FT8 users will be able to indicate their power in the logs, how other logging programs work, I'm not sure. The fairest way I can think of doing this is to suggest including the power used within your email to me, this would cover every single QSO in your attached log file that does not have a power figure, if your software gives the power used in the log file, that will be used instead. For those not providing a power and having no power figure in the log record, they will have an arbitrary figure of 400W (the maximum legal) used in the calculation.

Bryan M0IHY

April

HF

Day	Date (2021)	Time UTC	Contest Name
Wed	07 Apr	1900-2030	RSGB FT4 Contest
Sun	11 Apr	1900-2030	RoLo SSB (HF Championship)
Mon	12 Apr	1900-2030	80m CC CW
Wed	21 Apr	1900-2030	80m CC SSB
Thu	29 Apr	1900-2030	80m CC Data

VHF

Day	Date (2021)	Time UTC	Contest Name
Sun	04 Apr	0900-1200	First 70MHz Contest
Tue	06 Apr	1900-1955	144MHz FMAC
Tue	06 Apr	2000-2230	144MHz UKAC
Wed	07 Apr	1900-2100	144MHz FT8 AC
Thu	08 Apr	2000-2230	50MHz UKAC
Sun	11 Apr	0900-1200	First 50MHz Contest
Tue	13 Apr	1900-1955	432MHz FMAC
Tue	13 Apr	2000-2230	432MHz UKAC
Thu	15 Apr	2000-2230	70MHz UKAC
Tue	20 Apr	2000-2230	1.3GHz UKAC
Tue	27 Apr	1930-2230	SHF UKAC

May

HF

Day	Date (2021)	Time UTC	Contest Name
Wed	05 May	1900-2030	RSGB FT4 Contest
Mon	10 May	1900-2030	80m CC SSB
Wed	19 May	1900-2030	80m CC DATA
Thu	27 May	1900-2030	80m CC CW

VHF

Day	Date (2021)	Time UTC	Contest Name
Sat	01 May	1400-2200	432MHz Trophy Contest
Sat-Sun	01-02 May	1400-1400	May 432MHz-245GHz Contest
Sun	02 May	0800-1400	10GHz Trophy Contest
Tue	04 May	1900-1955	144MHz FMAC
Tue	04 May	2000-2030	144MHz UKAC
Wed	05 May	1900-2100	144MHz FT8 AC
Sun	09 May	0900-1400	70MHz Contest CW
Tue	11 May	1900-1955	432MHz FMAC
Tue	11 May	2000-2230	432MHz UKAC
Thu	13 May	2000-2230	50MHz UKAC
Sat-Sun	15-16 May	1400-1400	144MHz May Contest
Sun	16 May	1100-1500	1st 144MHz Backpackers
Tue	18 May	2000-2230	1.3GHz UKAC
Thu	20 May	2000-2230	70MHz UKAC
Sun	23 May	1400-1600	70MHz Cumulatives #3
Tue	25 May	1930-2230	SHF UKAC

'Air Miles', how far have we gone? / results

With the addition of "QSO Economy Drive" and "This month at a glance" you have even more to see!

This month has seen just FT8 and CW as the favoured modes.

So, how have we done this month?

(Running totals in red)

General

Most Miles

G3ZNU	120,663	249,400
G3XZG	98,983	230,474

Most QSO's

G3ZNU	88	213
G3XZG	47	124

Longest QSO

G3ZNU	LU8HH (6918)	LU8HH (6918)
G3ZNU	E29TGW (5973)	E29TGW (5973)

Shortest QSO (miles)

G3ZNU	G4WJS (7)	G4WJS (7)
G3XZG	DL1LQZ (454)	DL2IAD (382)

Average per QSO (miles)

G3XZG	2,106	1,859
G3ZNU	1,371	1,171

Maidenhead Squares

G3ZNU	48	135
G3XZG	46	114

QSO Economy Drive

High miles per Watt

G3ZNU	69.18 (100W)	69.18 (100W)
G3XZG	59.37 (100W)	59.37 (100W)

Low miles per Watt

G3ZNU	0.07 (100W)	0.07 (100W)
G3XZG	5.16 (100W)	5.16 (100W)

By Band

40m

G3XZG	3	7
M0IHY	0	2

20m

G3XZG	32	87
G3ZNU	25	32
M0JCQ	0	196

6m

G3ZNU	2	57
M0JCQ	0	3

30m

G3XZG	10	22

17m

G3ZNU	12	30
G3XZG	2	8
M0JCQ	0	84

2m

G3ZNU	49	77
M0JCQ	0	7

'Air Miles', how far have we gone? / results

By Mode

CW

G3XZG	47	124
G3ZNU	0	3

FT8

G3ZNU	88	201
M0JCQ	0	136

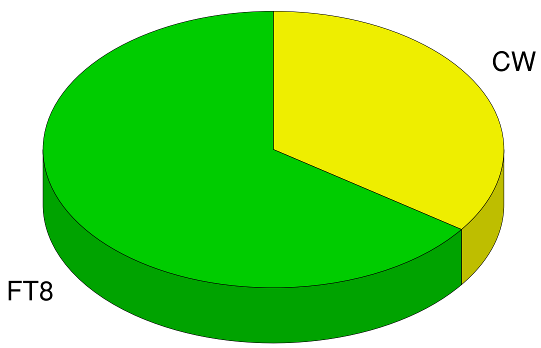
By Country

G3ZNU	24	68
G3XZG	23	61
M0JCQ	0	74

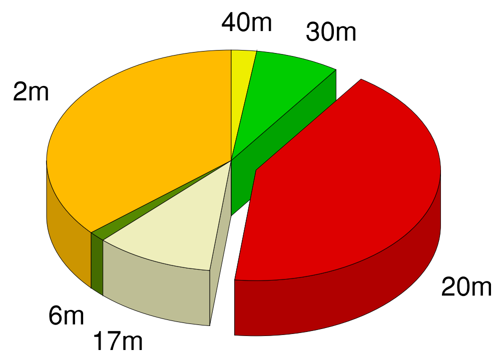
This month's totals

Countries visited	-	37
Most visited country	-	England, 38 times
Total Mileage	-	219,646
Total QSO's	-	135
Average miles per QSO	-	1,627.01
Total locators visited	-	92
Most visited locator	-	IO91, 14 times

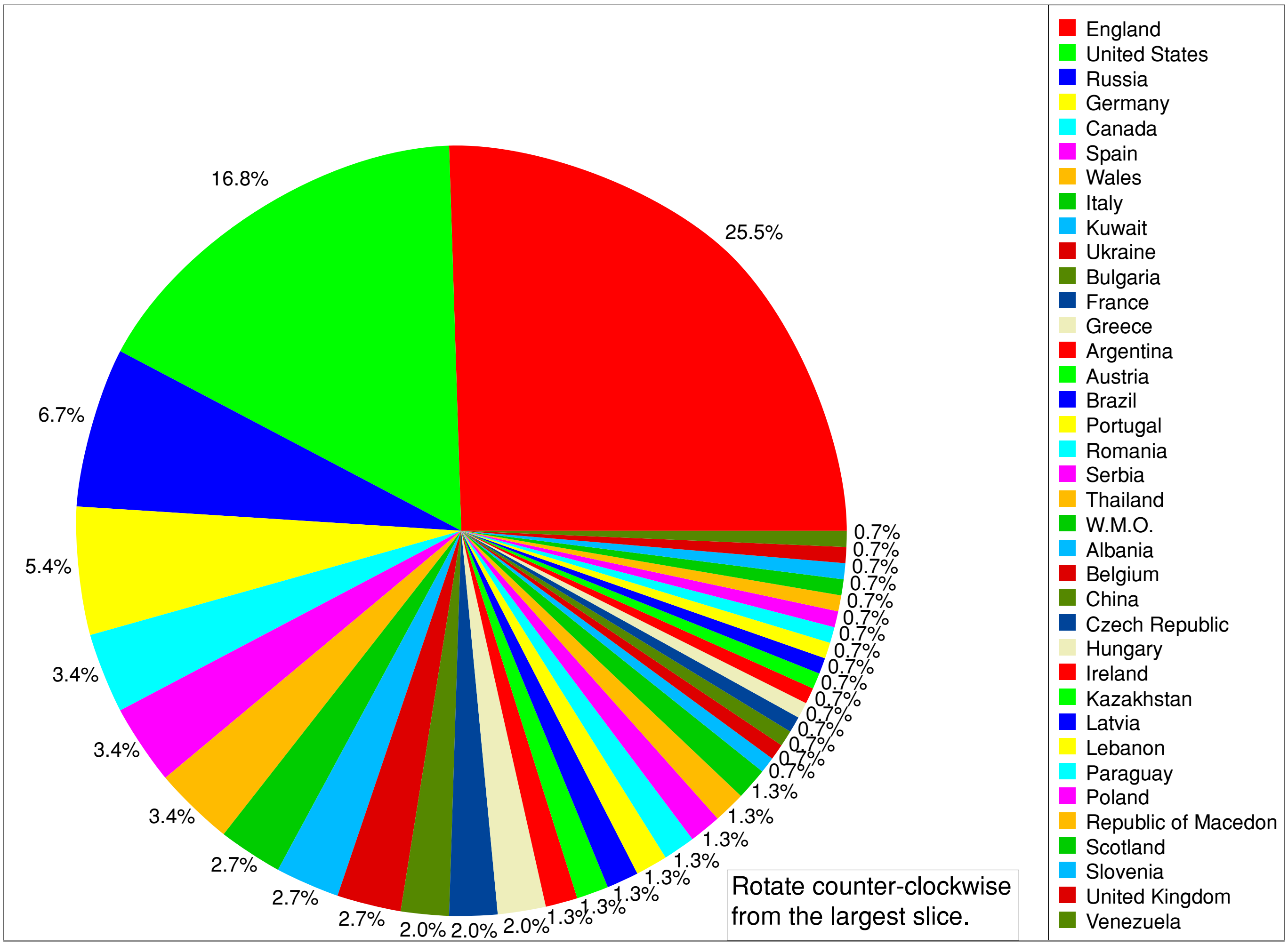
This month at a glance



By Mode



By Band



QSO Countries

Windmills on the Air

We now have our callsign for the occasion, GB0BWM. How we're operating is something we have to determine in the next couple of weeks. At the moment I believe up to 6 people may meet outside, so the plan might be to have a station inside the windmill (ground floor) operated by one person only, a second station might be possible with it operating either outside under a gazebo, or on the first floor of the windmill.

Freedom of Information

As I've mentioned before, I subscribe to AmateurRadio.com (<newsletter@amateurradio.com>), a daily newsletter. The 31st of March edition contained an article about someone requesting information about the age of Amateur Radio Licensees under the Freedom of Information act from Ofcom, they asked:

> *Please can you supply information showing a breakdown of the age of issued amateur radio licensees. Preferably by banding, license type and also all license types combined.*
>
> *Foundation, Intermediate, Full*
>
> *Under 25*
> *26-40*
> *41-50*
> *51-60*
> *61-70*
> *71+*

Ofcom responded with the following data:

	Foundation	**Intermediate**	**Full**
Under 25	118	16	14
26-40	2,170	871	515
41-50	773	546	2,568
51-60	1,556	1,016	7,306
61-70	1,154	692	12,277
71+	1,541	963	22,264
Total	**7,312**	**4,104**	**44,944**

What surprised me (it shouldn't have!) are the Full License figures, the older the age range the more licensed people in that range. The Foundation and Intermediate don't quite follow that linear route.

This was them followed by the total number of licenses including those of unknown age:

	Foundation	**Intermediate**	**Full**
Total	28,845	12,127	54,072