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Newsletter of The New Zealand Association of Radio Transmitters, Upper Hutt Branch 63, Inc.

OCTOBER 2008

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President's Report

Hi all... with daylight saving now upon us, its time to turn our heads towards the first working bee of the new season at Mt Climie. With most of the hard work done, with the trench digging, feed lines replacements the next jobs should be easier to do. Watch your emails for upcoming information as the work schedule is sorted out, and the dates are posted on the whiteboard at the clubrooms and/or via emails. The more people help on the days up the hill the lighter workload is for all.

A group of amateurs from both upper and lower valley clubs, plus a couple from other clubs from the greater Wellington area have approached the club to build and place on Mt Climie a 23CM Repeater. Many of you will recall that we had a "paper licence" for such a repeater a few years ago when the intention to build one was first proposed. The licence was cancelled as the new fees were imposed on us, but the new group has decided to re-start the project. Therefore the first working bee (date/time yet to be set) will include some preparation work for the siting of the 23CM repeater in to the old Climie hut. Cable runs of coax, AC power, Ethernet (Cat 5) and the like will need to run, as well as power boards in both huts. Also the old Climie hut will need a new rack and some shelving or woodwork to support the new hardware. There will also be some pole climbing and antenna work the north most pole, replacing feed lines with heliax and the like.

Thanks to those members who assisted with the NZART move on Friday 26 September 2008 - many hands made light work of the process of clearing out the store room, and setting up the office for Debby - thanks to ZL2ADP, ZL2AH, ZL2MUI, ZL2TNG, ZL2UX and ZL2WOL. 73's......Mark, ZL2UFI

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Kapiti ARS [Branch 69]: Postpones Annual Sale

Hi all,

The committee of the Kapiti ARS [Branch 69] has decided to postpone our annual Social and Sale till 2009.

We would like to express our thanks for the support we have had from your members over the past years.

If any of your members are up in Paraparaumu on a Saturday morning they are welcome to drop into our clubrooms for a chat and a cup of tea/coffee and a biscuit from around 9.30 to 10.30 (or probably later).

Bill ZL2BIL [Secretary]

73 de ZL2KB

Jamboree on the Air (JOTA)

51st jota

18 - 19 October 2008

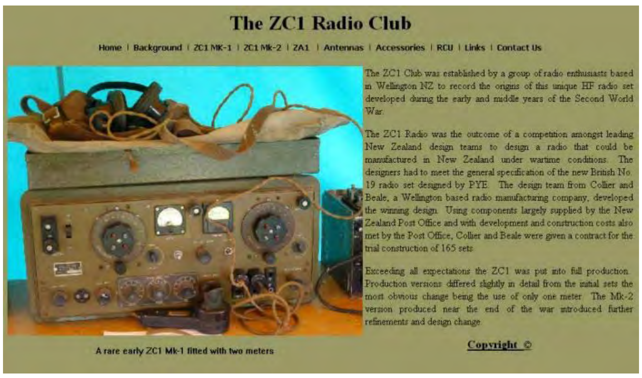
The Jamboree on the Air (JOTA) is an annual international scouting and guiding activity in which scouts and guides talk to each other from amateur radio stations. JOTA provides an excellent opportunity to meet Scouts and Guides from many countries and other parts of New Zealand.

The Jamboree on the Internet (JOTI) is held at the same time as JOTA, but it is an internet activity. Find out about JOTI pages by going to the New Zealand Scouting website, http://www.scouts.org.nz/ and click on "JOTI" on "events" in the home page main menu.

Decision has yet to made if the branch will assist this year, having been approached late in September 2008 by the local scout troop.

Website Dedicated to The ZC1

The ZC1 Club was established by a group of radio enthusiasts based in Wellington NZ to record the origins of this unique HF radio set developed during the early and middle years of the Second World War. The ZC1 Radio was the outcome of a competition amongst leading New Zealand design teams to design a radio that could be manufactured in New Zealand under wartime conditions. The designers had to meet the general specification of the new British No. 19 radio set designed by PYE. The design team from Collier and Beale, a Wellington based radio manufacturing company, developed the winning design. Using components largely supplied by the New Zealand Post Office and with development and construction costs also met by the Post Office, Collier and Beale were given a contract for the trial construction of 165 sets. http://www.zc1-radioclub.wellington.net.nz/index.html



Old Break-In's required:

We are presently looking for the following copies of Break-In to complete the Branch 63 collection. Those marked with an * are damaged and need replacing.

1929 All 12 copies
1930 All 11 copies
1931 Jan April June Oct
1932 Nov*
1933 Feb* Sept*
1934 May* July* Sept* Dec*
1935 Feb Oct* Nov*
1936 Jan* Feb*
1937 Sept*
1939 Feb*
1940 All 12 copies
1941 Mar Apr May July* Nov* Dec*
1942 All 12 copies
1943 Jan Feb Mar*
1944 Jan March Oct
1957 Feb
1966 Nov
1983 Jan Callbook
1997 Oct*

If any anybody can help please contact Morrie ZL2ADP Ph 976 9022

AREC Report

No AREC activities to report this month but Kapi-Mana will be starting up again in October.

Morrie ZL2ADP

What does "SOS "stand for?

Nothing. The letters "SOS" are an international distress signal, especially by ships and aircraft, represented by the Morse Code signal (· · · - - - · · ·). It was first adopted by Germany in 1905. Many believe "SOS" signifies "Save Our Ship" or "Save Our Souls." However, these phrases were a later development, most likely to help remember the correct letters -- a backronym.

Club HF Net 3.715 MHz every Tuesday at 0800 UTC
listen for ZL2VH and *join in*.

The Effects of VSWR on Transmitted Power

No matter how long you have been a ham, sooner of later you will be involved in at least one discussion of something called the Voltage Standing Wave Ratio, or VSWR, of an antenna system. There is a lot of good information available on VSWR as well as a lot misconceptions about what it is and what it signifies. Probably the most often misconception is that your VSWR should be as close to 1:1 as possible, otherwise " you won't get out very well." A 1:1 VSWR implies a perfect match between all elements of the antenna system. The only problem is that it is possible to have a low VSWR and still have some very serious things wrong with your antenna system. Other misconceptions such as a high VSWR causing television interference, or other unwanted problems are often heard and can cause unnecessary worry. The concept of VSWR is easy to grasp and its importance in an antenna system does not require an engineering degree to understand.

WHY VSWR EXISTS

Early in electronics you learned that to get maximum power into a load required that the load impedance match the generator impedance. Any difference, or mismatching, of these impedance would not produce maximum power transfer. This is true of antennas and transmitters as well but, except for handie-talkies, most antennas are not connected directly to a transmitter. The antenna is usually located some distance from the transmitter and requires a feedline to transfer power between the two. If the feedline has no loss, and matches BOTH the transmitter output impedance AND the antenna input impedance, then - and only - then will maximum power be delivered to the antenna. In this case the VSWR will be 1:1 and the voltage and current will be constant over the whole length of the feedline. Any deviation from this situation will cause a "standing wave" of voltage and current to exist on the line.

There are a number of ways VSWR or its effects can be described and measured. Different terms such as reflection coefficient, return loss, reflected power, and transmitted power loss are but a few. They are not difficult concepts to understand, since in most instances they are different ways of saying the same thing. The proportion of incident (or forward) power which is reflected back toward the transmitter by a mismatched antenna is called reflected power and is determined by the reflection coefficient at the antenna. The reflection coefficient "p" is simply a measure of this mismatch seen at the antenna by the feedline and is equal to:

$$P = (Z1 - Z_o) / (Z_1 + Z_o)$$

Here $\mathbf{Z_1}$ is the antenna impedance and $\mathbf{Z_o}$ is the feedline impedance. Both $\mathbf{Z_1}$ and $\mathbf{Z_o}$ are complex numbers so "p" is also a complex number.

INTERPRETING WHAT YOU HAVE READ

Many VSWR meters are calibrated to read FORWARD power as well as REFLECTED power. They may actually be measuring voltage, and simply have the scales calibrated in power. The important point is to understand what the meter is actually telling you. Assuming for the moment that the VSWR meter contributes no errors, the FORWARD reading is the SUM of the forward power and the reflected power. As a result, it is greater than your actual power output. The REFLECTED power reading is that amount of power which was not initially absorbed by the antenna and has been sent back down the feedline. At the transmitter end it encounters the transmitter output circuitry and is re-reflected back towards the antenna. This happens because you do, in fact, have a VSWR greater than 1:1 as seen by the transmitter. When the re-reflected power encounters the antenna, a portion of it is absorbed and the whole process starts over again.

Ultimately then, most of your signal is eventually absorbed by the antenna. You might be tempted to think that all of this bouncing back and forth would cause "smearing or blurring " of your signal but this is not so. The average transmitted signal appears as a "steady-state" signal to the feedline and antenna. Remember your signal is travelling at a significant fraction of the speed of light. For instance, the velocity of propagation of RG-8/A is 0.66 or 2/3 the speed of light. The speed of light is close to 1000 feet per microsecond, and a dot or voice peak takes milliseconds to complete. If the speed of light were 20 miles-per-hour then the situation would be completely different and we probably wouldn't have radio transmission at all. (Ed. Note, it would be as fast as the mail then.)

Given the reality then that almost all power launched down a feedline reaches and absorbed by the antenna, one has to wonder why VSWR is all that important. The importance is due to the fact that feedlines have losses and, antennas have something called radiation efficiency. They are what make proper interpretation of VSWR important. Power is lost due to feedline attenuation and this loss goes up as the VSWR goes up. The efficiency of an antenna is determined by the ratio of its "radiation resistance" to its "loss resistance". Antenna efficiency can simply described by the following equation:

$$\% \text{ Efficiency} = [R_a / (R_a + R_{loss})] \times 100$$

The radiation resistance is R_a, and R_{loss} is made up of any associated losses of the antenna such as loading coils and ground systems. How well you "get out" therefore depends more on low losses and efficient antennas than on what your actual VSWR is as the following example will show.

THE EFFECTS OF ATTENUATION ON VSWR

Early in this discussion the statement was made that your VSWR may appear to be very low and yet there could be serious things wrong with your antenna system. Figure 1 shows how this can happen. The curves in the figure represent the forward and the reflected voltage on an antenna which has a feedline loss of 3 dB. and a reflection coefficient of p=0.5. In this example the actual value of voltage is inconsequential and can be considered to be "E". We are only interested in relative values of "E" in any case. The length of the feedline is also arbitrary since we are only concerned with its total loss between transmitter and antenna.

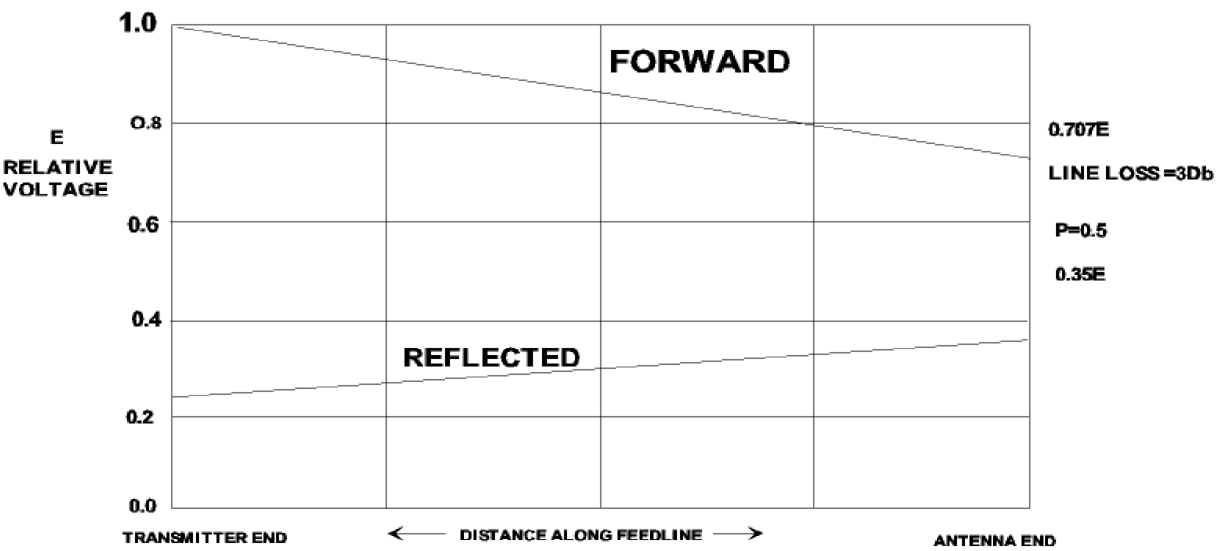


FIGURE 1: EFFECT OF LINE LOSS ON SIGNAL AMPLITUDE

The signal voltage "E" starts out at full value -1.0 E - on the feed line and is attenuated at a 3-dB rate. This means that the voltage will only be 71% - or 0.707E - when it reaches the antenna terminals. Remember that while 3-dB is a factor of two for power considerations, power is proportional to E-squared, consequently E will be only 0.71e when it arrives at the antenna input. The top curve in Figure 1 shows the FORWARD voltage decay as it travels down the feedline to the antenna input.

Since the antenna in this example has a reflection coefficient of 0.5, this means that 1/2 of the incident voltage will be reflected back down the feedline. This value is (0.5 X 0.71E) or 0.35E volts. The feedline has no way of knowing which way signals are traveling, so this reflected voltage will suffer the same 3-dB attenuation on the return trip. When it arrives back at the transmitter end of the feedline its value is only (0.71 X 0.35E) or 0.25 volts. The VSWR meter sees this value and since

$$\mathbf{VSWR = (E_{fwd} + E_{ref}) / (E_{fwd} - E_{ref})}$$

the VSWR meter will read 1.67:1

That value of VSWR is guaranteed is to make almost everyone happy, but your antenna system is not very good. The 3-dB loss down the feedline means only 1/2 of your output power reaches the antenna, and if your antenna has significant losses, something less than 1/2 of your power will be radiated depending upon how bad the losses really are. If for instance, the loss resistance equals your radiation resistance, the antenna is only 50% efficient meaning only 1/4 of your output power is actually radiated. Yet that reading of 1.67:1 looks fine. A reflection coefficient of p =0.5 means your antenna is not well matched to the feedline. VSWR can be calculated from the reflection coefficient by the following:

$$\mathbf{VSWR = (1+p) / (1-p)}$$

Using this formula shows your VSWR <u>at the antenna</u> is 3:1, quite a different value than your VSWR meter reads. The difference in the input and output VSWR values is due to the loss introduced by the feedline. Figure 2 shows how this loss can cause you to get a different VSWR depending upon where you measure VSWR in a feedline. You can measure VSWR at the antenna end of the feedline, but it is usually impractical to do.

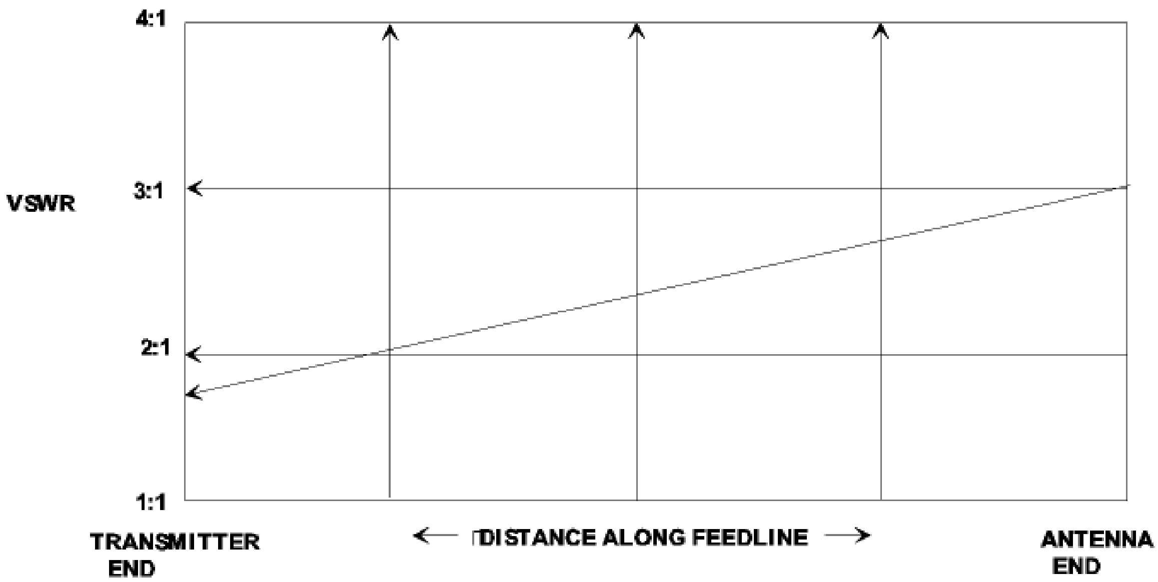


FIGURE 2 EFFECT OF LINE LOSS ON VSWR

You can use 1/2 wavelengths of coax between your VSWR meter and the antenna because a 1/2 wavelength of cable repeats the impedance it sees. The only problem is that you are introducing other possible elements into your measurements. But let's assume that your VSWR measurement at the feedline is reasonably close to what is actually occurring on the feed line, and that your feedline losses are not great. The burning question still is "how good or bad is the VSWR reading?"

VSWR AND TRANSMITTED POWER

Let's assume you have an efficient antenna, fed with a low-loss feedline so that the VSWR meter at the transmitter gives you a true reading of 1.65:1. There is no real reason to try to lower it, in fact the same would hold true if the reading were 2:1. Figure 3 is a chart showing the equivalence of VSWR to RETURN LOSS(dB), REFLECTED POWER (%) and TRANSMISSION LOSS(dB). Return loss is related to reflection coefficient by the equation:

$$\text{Return Loss} = -20\log_{10}(p)$$

It is just another way of measuring VSWR. For example, with a perfect 1:1 VSWR there would be no reflected power consequently the return loss on the feedline would appear to be infinite. A short or open circuit at the antenna is the worst case scenario since the reflection coefficient would be p =1.0. All incident power would be reflected, and with a lossless feedline the return loss would be 0-dB. this is what the RETURN LOSS (dB) column refers to

The most informative columns in Figure 3 are the REFLECTED POWER(%) and the TRANSMISSION LOSS(dB) columns since they provide an answer to our question of whether further reduction of VSWR is worthwhile. Figure 3 shows that for a VSWR of 1.65:1 the reflected power is only 6.2% of the incident power, and the transmission loss is only 0.27 dB. In more familiar terms, if you count an S-unit as 6 dB, then the 0.27 dB loss is only 1/22 of an S-unit. A reduction of the VSWR to 1.5:1 would provide only a 0.09 dB reduction in transmission loss. This is not worth the effort it would take to achieve such a miniscule increase in power.

Further examination of the chart shows that a VSWR of 2.6:1 results in only about 1 dB of transmission loss. A high VSWR of 6:1 shows just a 3 dB transmission loss, but this is 1/2 an S-unit. You will still be getting out but this is becoming a significant loss. Your feedline will be dissipating more power than it should, and there may be other serious things wrong with your antenna system.

Throughout this article you've noticed the use of the term "antenna system". The word "system" means you must pay attention to other things besides just the VSWR and your power output. Each component of your antenna system must be optimized to get the best results. Many factors must be considered such as operating frequencies, bandwidth requirements of the antenna system, heights, and directivity, all of which affect its efficiency. Since the height of your antenna, and your operating frequency determine both the length of the feedline and its losses the interfaces become very important. So there are a number of trade-offs which must be considered when you contemplate putting up a good antenna system, but these are tales for other times.

You can build or buy your own VSWR meter, but make sure that you understand what it is measuring and what it is really telling you. Then once you are satisfied that you have put up a really efficient antenna, fed with a low loss feedline, you can sleep well knowing that to try to reach the ultimate 1:1 VSWR is only an ego trip.

As a rule of thumb, any accurate VSWR reading under 2:1 is probably not worth the effort to achieve if the other elements of your antenna system are the best you can make them. In fact you might be surprised to find that you really do have a low VSWR when you put up the best antenna and feedline you can. There is an old saying in ham radio that "a dime in the antenna is worth a dollar in the transmitter any day".

Try it and see if you don't agree.

VSWR	Return Loss (dB)	Reflected Power (%)	Transmiss. Loss (dB)	VSWR	Return Loss (dB)	Reflected Power (%)	Transmiss. Loss (dB)
1.00	oo	0.000	0.000	1.38	15.9	2.55	0.112
1.01	46.1	0.005	0.0002	1.39	15.7	2.67	0.118
1.02	40.1	0.010	0.0005	1.40	15.55	2.78	0.122
1.03	36.6	0.022	0.0011	1.41	15.38	2.90	0.126
1.04	34.1	0.040	0.0018	1.42	15.2	3.03	0.132
1.05	32.3	0.060	0.0028	1.43	15.03	3.14	0.137
1.06	30.7	0.082	0.0039	1.44	14.88	3.28	0.142
1.07	29.4	0.116	0.0051	1.45	14.7	3.38	0.147
1.08	28.3	0.144	0.0066	1.46	14.6	3.50	0.152
1.09	27.3	0.184	0.0083	1.47	14.45	3.62	0.157
1.10	26.4	0.228	0.0100	1.48	14.3	3.74	0.164
1.11	25.6	0.276	0.0118	1.49	14.16	3.87	0.172
1.12	24.9	0.324	0.0139	1.50	14.0	4.00	0.18
1.13	24.3	0.375	0.0160	1.55	13.3	4.8	0.21
1.14	23.7	0.426	0.0185	1.60	12.6	5.5	0.24
1.15	23.1	0.488	0.0205	1.65	12.2	6.2	0.27
1.16	22.6	0.550	0.0235	1.70	11.7	6.8	0.31
1.17	22.1	0.615	0.0260	1.75	11.3	7.4	0.34
1.18	21.6	0.682	0.0285	1.80	10.9	8.2	0.37
1.19	21.2	0.750	0.0318	1.85	10.5	8.9	0.40
1.20	20.8	0.816	0.0353	1.90	10.2	9.6	0.44
1.21	20.4	0.90	0.0391	1.95	09.8	10.2	0.47
1.22	20.1	0.98	0.0426	2.00	09.5	11.0	0.50
1.23	19.7	1.08	0.0455	2.10	09.0	12.4	0.57
1.24	19.4	1.15	0.049	2.20	08.6	13.8	0.65
1.25	19.1	1.23	0.053	2.30	08.2	15.3	0.73
1.26	18.8	1.34	0.056	2.40	07.7	16.6	0.80
1.27	18.5	1.43	0.060	2.50	07.3	18.0	0.88
1.28	18.2	1.52	0.064	2.60	07.0	19.5	0.95
1.29	17.9	1.62	0.068	2.70	06.7	20.8	1.03
1.30	17.68	1.71	0.073	2.80	06.5	22.3	1.10
1.31	17.4	1.81	0.078	2.90	06.2	23.7	1.17
1.32	17.2	1.91	0.083	3.00	06.0	24.9	1.25
1.33	17.0	2.02	0.087	3.50	05.1	31.0	1.61
1.34	16.8	2.13	0.092	4.00	04.4	36.0	1.93
1.35	16.53	2.23	0.096	4.50	03.9	40.6	2.27
1.36	16.3	2.33	0.101	5.00	03.5	44.4	2.56
1.37	16.1	2.44	0.106	6.00	02.9	50.8	3.08