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THE PROPAGATOR

Sept - Nov 98

The Newsletter of the Illawarra Amateur Radio Society

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EDITORIAL

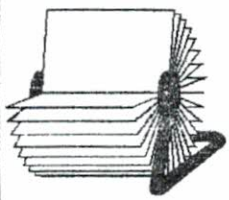
A disquieting feature of our society is the total dependence on reticulated electricity. Lighting, heating, industrial manufacturing, hospitals, commerce, banking, all the diverse arms of government and administration, every aspect of telecommunications and much else besides is totally dependent on a constant supply of electrical power - a supply so reliable we can literally take it for granted.

The common denominator in all this are tiny carriers of electric current which literally drive our civilisation - electrons. To survive in today's world we must be able to move electrons from one point to another in large quantities, under our complete control. We have no fall-back position on this - we either use electricity or our entire civilisation falls into ruin. It is fundamental to our civilisation and the way we live as individuals; our invisible servant, obedient to every command.

For a moment, consider how electricity for both domestic and commercial use is produced under existing technologies. We burn fossil-fuel (e. g. coal, oil or gas) to produce steam to drive turbines, we heat water using radioactive decay for the same purpose or we use the kinetic energy of moving water to spin turbines coupled to alternators.

In This Issue:...

Coming Events:-...



✉ The AGM: Tuesday August 11th is our Annual General Meeting, when everybody clamours to be on the committee or be President or assume some other arduous but very rewarding office. The AGM is not to be missed - by anyone. Be there - or else we'll send the Radio Police around. Remember, we know where you live - it's where we send your Propagator!

☺ **Annual subscriptions** are now due. Your outgoing committee has thoughtfully provided a membership renewal form in this issue of the Propagator. *Don't forget the $5.00 membership rebate* if you sign up additional new members. Sign up four and you're home free!

✉ **Check your mailing label!** If it has a coloured sticker attached, you've already renewed your membership and can ignore the renewal form at the back of this issue. If there is no sticker, send in your renewal ASAP, or bring it to the AGM and watch the Treasurer beam with pleasure as the IARS coffers swell replete with funds.

On a small scale we consume petrol or diesel to directly drive alternators and produce small amounts of power for domestic or light industrial use. The reliance on fossil-fuels is a real worry, but it's what we have to use - at present.

The search for alternative energy sources is, for the most part, the search for alternative ways to produce electricity. The quest for commercially-viable alternatives has so far yielded little in tangible results. Only a cynic would accuse the existing energy companies of deliberately suppressing new or alternative technologies for large-scale electrical power production, but the conspicuous lack of success in spite of massive expenditure on research is nevertheless curious. Perhaps we are better off exploring small-scale implementations on a house-by-house basis. Both wind and solar-power could prove useful here. Already people are making moves to reduce their dependence on reticulated power by interfacing solar-power systems into their household supply for use in off-peak periods. This is a damn smart move because the less one is dependent on the established utilities the better off one will be when they break down, or are privatised - or both!

Think smaller yet again - your amateur station. How much of it depends on mains power? Too much of it. What about your 2m hand-held? Could you keep the batteries charged if there was no mains power? Could you run a complete packet station for, say, two days without mains power? You'd need a laptop, a few lead-acid cells, a solar panel or two, a charging-current regulator, a transceiver and a TNC all of which work off 12 volts. That's not a big ask these days, is it? If you put all that together then at least you'd have communications when just about every other mains-powered device would be totally useless. A tiny measure of independence, yes, but potentially very useful.

Why would we be without power for more than just a few hours? Well, back in 1975 the citizens of Darwin were expecting a completely routine Christmas. Cyclone Tracey caught everyone by surprise. Who made the first contact between cyclone-ravaged Darwin and the rest of the world? Hobby radio enthusiasts, both amateur and CB.

Remember the Newcastle earthquake? It took just a few seconds and did tens of millions of dollars worth of damage. Few power lines came down but what if the earthquake occurred well away from a built-up area, toppling miles of high-voltage towers and power lines and cutting off electricity to a large geographic area including a couple of sizeable cities? Keep in mind Auckland had massive power problems not so long ago. How soon could you get a station on-air to handle traffic if you lived in one of those cities and your local WICEN group asked for assistance? A natural - or man-made - disaster will not discriminate between WICEN and non-WICEN amateurs. Come to think of it, that's a damn good reason for joining WICEN anyway. Even if you don't, at least do something to help yourself. It is better to have a plan than be a passive, willing victim.

How many of you have a small portable generator? Do you keep, say, twenty litres of fuel ready for use? During an extended loss of mains power such an item might be a godsend. You might choose to use that power for your fridge to stop food from spoiling, as well as for some lights for a measure of home security, even as power for your station. Now that would be useful! A portable alternator, solar panels, batteries. It's not rocket science, is it? If ever our cosy world was turned upside-down for even just a few days, it might prove to be a very wise investment - even if it means burning some of that damned fossil-fuel stuff. A few days? A lot can happen in a few days. It's worth a thought.

(Well, that's it for my last editorial. It has been an honour to serve as editor and I hope the Propagator has maintained the high standard which people expect. Compiling and editing six issues has been a stimulating and challenging task, and it also has its rewards. This is the last issue before our AGM, and soon a new editor will assume the mantle. Whomsoever he may be I am sure he will have your support. His identity will be revealed at the forthcoming AGM. In the meantime, to the production team, all the contributors over the last year and, of course, our loyal readers, my sincere thanks. Without all of you the Propagator simply wouldn't exist. - Ed)

A CURIOUS SET OF NUMBERS

Take the names of the top six World War Two leaders, the year they were born, the year they took office and the number of years they served as national leader and add them up. Here's what you get:-

	ENGLAND	GERMANY	AMERICA	ITALY	SOVIET UNION	JAPAN
Name:	Churchill	Hitler	Roosevelt	Il Duce	Stalin	Tojo
Born:	1874	1889	1882	1883	1879	1884
Took Office:	1940	1933	1933	1922	1924	1941
Age in 1944:	70	55	62	61	65	60
Served:	4	11	11	22	20	3
Total:	3888	3888	3888	3888	3888	3888

Now, divide the totals by 2 and you get 1944, the most important year of the war as far as these 6 leaders were concerned.

Take the first letter of each name; they spell CHRIST. They are a most curious set of numbers and associations indeed. (all right, we used Il Duce instead of Mussolini but it's still *very* curious.)

HEARD ANY GOOD AURORAS LATELY?

An aurora, sometimes called "southern lights" is the result of interaction between charged particles emanating from the sun and the the earth's atmosphere. They are commonly seen at high latitudes in both hemispheres. In times of intense geomagnetic disturbance they are seen at more equatorial latitudes. (The editor had the good fortune to witness an impressive display one evening during a west-to-east passage of Bass Strait several years ago. For over an hour shifting columns of pale red light like slanted organ-pipes occupied the southern sky, making an impressive and unusual sight.)

Less well known are reports of sounds accompanying an auroral display. They have not yet been recorded on any equipment but these sounds have been reported by highly-credible witnesses, including technicians and scientists. Over 300 "hearings" are now documented.

Quite a degree of commonality in describing the sound is exhibited in these reports. At least 80% mention the letter "S" in the description and most reports indicate the sound is a variable or undulating hissing, swishing, whooshing or crackling noise. The sounds last from a few seconds up to some tens of minutes, mostly described as a hissing sound followed by a sharper crackling noise. The sounds are generally not loud, but clearly audible to people separated sometimes by several hundred metres. Occasionally only certain members of a group hear the sounds whilst observing the display.

The lack of recordings of these sounds makes investigation rather problematical at the present, although once they have been captured for analysis this may change. If indeed the aurora is responsible, what mechanism is involved whereby an event occurring at 60-80Km above the earth's surface generates sounds which people can hear? Just when you think scientists know it all...

(extracted from What's New in Radiocommunications, Feb-Mar 1998)

"SHOWER" RADIO KEEPS THE OUTBACK IN TOUCH.

The National Transmission Authority's (NTA) high frequency (short wave) radio service in the Northern Territory (known as Outback Radio, Bush Radio or the "shower" service,) has entered its second decade with transmitters at three locations continuing to blanket the Territory.

The service began in 1986 when identical stations were established at Alice Springs, Katherine and Tennant Creek. These delivered an ABC radio service to listeners in remote homesteads and communities who had been somewhat radio-deprived up to then.

Transmitters rated at 50Kw were installed at each location, with an approximate range of 450Km in all directions although the signals can travel much further.

The HF stations transmission technique, known as *vertical incidence transmission* led to Outback Radio being called the "shower" service because of the manner in which the signals are reflected back to earth. They are transmitted vertically upwards in a narrow conical beam into the ionosphere where they are reflected back in a more diverse spread within which they can be heard on shortwave receivers.

Before Outback Radio began, this type of transmission on such a scale had not been attempted in Australia although it is commonly used in tropical areas. It differs from the method used for long distance short wave broadcasting where waves are beamed at low angles above the horizon, reflected at a distant point and returned to earth at locations up to 3000 Kilometres from the transmitter.

MF broadcasting, on the other hand, relies on quite a different principle whereby the waves are transmitted radially, parallel to the earth's surface. This provides a good service close to the transmitter but in general terms coverage is restricted to an area within a 40 to 80Km radius around the transmitter.

Ionospheric changes dictate alterations in the frequency of transmission of Outback Radio on a twice-a-day basis, usually occurring about 8am and 5pm.

(extracted from "What's New In Radiocommunications", Feb-Mar 1998.)

The Dangers Of Being Helpful...A True Story.

The following item, gleaned from the Internet by Harry (VK2JHW), should serve as a cautionary tale and illustrates the dangers of being frank and candid.

The scene for this comedy in one act is the WordPerfect Helpline. A customer has just phoned in with a problem...

"Ridge Hall computer assistant, may I help you?"

"Yes, well, I'm having trouble with WordPerfect."

"What sort of trouble?"

"Well, I was just typing along and all of a sudden the words just went away."

"Went away?"

"They disappeared."

"Hmmm. So what does your screen look like now?"

"Nothing."

"Nothing?"

"It's blank. It won't accept anything when I type."

"Are you still in WordPerfect or did you get out?"

"How do I tell?"

"Can you see the C: prompt on the screen?"

"What's a sea-prompt?"

"Never mind. Can you move the cursor around on the screen?"

"There isn't any cursor. I told you, it won't accept anything I type."

"Does your monitor have a power indicator?"

"What's a monitor?"

"It's the thing with a screen on it that looks like a TV. Does it have a little light that tells you when it's on?"

"I don't know."

"Well look on the back of the monitor and find where the power cord goes into it. Can you see that?"

"Yes, I think so."

"Great! Follow the cord to the plug and tell me if it's plugged into the wall."

"Yes, it is."

"When you were behind the monitor, did you notice there were two cables plugged into it, not just one?"

"No."

"Well, there are. I need you to look back there again and find the other cable."

"Okay, here it is."

"Follow it for me and tell me if it's plugged securely into the back of your computer."

"I can't reach."

"Uh huh. Well, can you see if it is?"

"No."

"Even if you maybe put your knee on something and lean way over?"

"Oh it's not because I don't have the right angle...it's because it's dark."

"Dark?"

"Yes - the office light is off and the only light I have is coming in from the window."

"Well, turn on the office light then."

"I can't."

"No? Why not?"

"Because there's a power outage."

"A power...a power outage? Aha, okay, we've got it licked now. Do you still have the boxes and manuals and packing stuff your computer came in?"

"Well, yes...I keep them in the closet."

"Good. Go get them and unplug your system and pack it up just like it was when you got it. Then take it back to the store you bought it from."

"Really? Is it that bad?"

"Yes, I'm afraid it is."

"Well, all right then, I suppose. What do I tell them?"

"Tell them you're too stupid to own a computer."

The help-desk employee was fired and is currently suing the WordPerfect organisation for "Termination Without Cause". Keep this in mind if ever you call a computer help-line.

THE INTERNET - FRIEND OR FOE?

A little over fifteen years ago, in the days BC (before computers), operating RTTY, Packet, ASCII, Fax and AMTOR required up to five separate units, each one dedicated to a single mode and that was without a transceiver - or transceivers - interfaced to them. Remember those days?

Personal computers revolutionised, and enhanced, amateur radio. A Microlog AIR-1 terminal unit plugged into the expansion port of a Commodore 64 gave RTTY, ASCII, AMTOR and Morse functions. It copied commercial Morse transmissions (machine-generated and sent at 16-18wpm) which were transmitted at rather inconvenient times, extremely well:- just plug the receiver output into the AIR-1 and dump the output directly onto the printer. Marine TOR FEC broadcasts were decoded by slope-tuning the receiver (since commercial TOR uses slightly different tones but the same shift as AMTOR). It was crude, especially by today's standards, but it worked.

Computers moved on and so did the devices with which we interface our transceivers. These days a capable TNC such as the latest PK-232 gives the same functionality of several black boxes as well as the ability to operate what is probably the fastest-growing segment of our hobby, packet radio. A computer, a TNC and a transceiver is all it takes.

Remember when Packet was new? I used to buy 73s magazine and began reading about this new mode in the early 1980s. I skimmed the early articles, then stopped reading them entirely. The evolution of two competing standards (AX25 and the Vancouver protocol) was not encouraging. I and many others didn't think Packet would amount to much.

Boy, were we wrong! Fortunately a single communications protocol prevailed and we all bear witness to the overwhelming penetration of packet techniques into the hobby. We have all benefitted. Indeed, the advent of digital communications has revolutionised the way we go about getting messages over long-haul circuits. We have choices now we did not have previously.

Now we have the Internet. It doesn't seem all that long ago the term was rarely heard. I recall a far earlier system - the Arpanet. It was the progenitor of " the net". On the surface, it seems to be a direct competitor with amateur radio - communications with people all over the world using a computer and a modem. Instead of using radio transmissions, they are using phone lines and other computers within the Internet to relay their messages. Does it threaten us? If it does, then how can it be counteracted? If it doesn't, how can it help us? We really ought to have a hard think about what we want our hobby to do and how it can best evolve as technology replaces obsolete or obsolescent modes with more efficient ones. If possible, we ought to be at the leading edge, as well as preserving old technologies which we like to use. We can't sit back and do nothing - that way lies extinction.

We are uniquely positioned as amateurs both to retain obsolete technologies and simultaneously adopt new ones. Many analogue communications modes are now technologically obsolete but we still use them because we are exempted from the need for commercial profitability. Overall, the push seems to be for more and more digital technology to replace existing analogue modes. That means computers and radios inextricably linked. The amateur service has the choice to continue using existing modes whilst adopting new technologies it can adapt to amateur-associated pursuits. It's a luxury commercial operators can't afford but one we *can*. We may have a lot to gain.*(Ed.)*

THE BLOOPER DEPARTMENT

Did anyone spot the inadvertent error in the last issue? Well, the Propagator has often been regarded as a publication that sets the standard but even we have to admit we 're drawing a long bow trying to get our American friends to move Independence Day back ten days! In case you still haven't twigged, July 14th is Bastille Day, *not* American Independence Day. Nonetheless, that's when we are holding our July meeting. We're not sure how many readers we have in France and the USA, but we hope they were not overly offended by our error...especially since both are nuclear powers! We especially apologise to the Cajun population who may feel doubly offended. *(Ed)*

The following items, of good quality and fairly represented:-

1. **Frequency Counter,** as new, up to 1.25Ghz, manual, charger/power pack, $100.00 o.n.o.

2. **Frequency Counter,** Digitor brand, condition as new, up to 250Mhz, $50.00 o.n.o.

3. **UHF SWR/Watt Meter,** unused, as new, metal enclosure, twin scales, BNC sockets at rear, excellent unit. $45.00 o.n.o.

Interested? Contact Lyle (VK2ALU) on (02) 42296984.

Bert Stockley, VK2ZYS - A Man Of Many Talents.

Bert Stockley - VK2ZYS and member of the Illawarra Radio Society - became a Silent Key on 14th June 1998 at the age of 80.

Bert was very unassuming and anyone sitting next to him at one of our meetings would realise little of his very great knowledge and experience in the field of radio and electronics - nor of the events which had shaped his life.

He was born at Brackley near Northampton, England and grew up in nearby Banbury. As a young man he had a passion for motor bikes as well as for music - and a keen interest in photography and also radio and electronics.

His University education was interrupted when he decided, early in World War II, to join the RAF - where he completed his aircrew training as a Wireless Operator/Air Gunner and was posted to Bomber Command in 1942 in Lancasters of No. 44 Squadron. Unfortunately, during one of his operations over Germany, his aircraft was forced to crash-land in Denmark and, after a short period, he and the rest of his crew were captured and sent to the first of a number of prisoner of war camps in which they spent the remainder of the war.

Despite the rigours of POW life - and the time involved in the study of several European languages - Bert was able to exercise his talent as a saxophone player in a group which spent as much time as possible giving concerts at their own and adjacent POW camps, even changing identity with soldiers to facilitate movement to other camps to do this.

Whilst a POW, Bert's knowledge of radio and electronics was put to the test when he was asked to construct a radio receiver for the camp out of scraps of scrounged material so his comrades could keep in touch with the true war situation via BBC broadcasts. Needless to say, this set was kept well hidden and used with great discretion under the threat of severe punishment if discovered by the guards. Fortunately it was never found!

Near the end of the war, despite their very poor physical condition brought on by the cold, lack of food and other hardships, the RAF POWs were forced by the Germans to leave the camp in Poland ahead of the Russian advance and to march for hundreds of kilometres back towards southern

Germany. After existing for weeks on what food they could forage along the way, and nearly at their destination, their column was mistaken for retreating German soldiers by Allied fighter bombers and was attacked. Many were killed and wounded.

Bert survived all this and was eventually returned to England. He was a Warrant Officer when discharged from the RAF.

Shortly afterwards he was invited to join a famous English band, but chose instead to enter the electronics field where he gained a background in Radar and later obtained a position in the Plessey Research Division, Research Application Laboratory. Amongst his other accomplishments while in charge of a Materials Applications Group, he found a way of modifying the properties of the newly-discovered ferrite powder so it could be formed into the now familiar ferrite cores and toroids etc.

Not to be content with his busy professional career, Bert took over a run-down pub in a nearby rural village (as a sideline!) and built it up into a thriving business - before selling out and then moving on from Plesseys into other research and management positions which took him into various areas of UK and the Continent. He also continued his spare time interests, especially of playing various musical instruments, including the piano and organ as well as his photography. However motor bikes gave way to Jaguar cars!!

In 1974 he decided to migrate to Australia to join his brother, who lived in Kiama - he then moved to Wollongong - where a little later he married Barbara, who had previously come out from England after the war.

With his professional skills not in demand locally he settled into TV and radio service work for a period - until health problems forced him to retire. Bert was then able to pursue his various hobbies and interests and soon became VK2ZYS.

As a radio amateur he was virtually never heard on the air, his big interest being that of an experimenter, where radio time was spent designing projects which made use of his extensive knowledge of basic and applied theory - and then of combining/recycling pieces of mostly second-hand transmitting, receiving and/or test equipment - to translate these designs into items of VHF, UHF and microwave gear. These he made perform functions often nothing like those envisaged by the original designers!

He sometimes tried out the various beacons and repeaters and monitored the local (and not so local) activities on the amateur and non-amateur bands in the VHF, UHF and microwave part of the spectrum. In recent months his health declined rapidly but right to the end he remained considerate to others and true to his own high ideals.

Vale, Bert VK2ZYS - A true Amateur and Gentleman.

Lyle VK2ALU.

Critical Mass and its relationship to South Coast WICEN

South Coast WICEN, with whom the IARS has close links, is approaching a size below *critical mass* - the minimum number of members required to function as an organisation.

There is a cure. New members, preferably from within the IARS. Why? Well, a number of our repeaters and the sites they are installed on are funded (partly or wholly) by South Coast WICEN. This amounts to a significant financial contribution to our operations. To fail to reciprocate this assistance would be discourteous. Just a few additional members would make all the difference. WICEN duties are not onerous, neither is the training. Please give this some urgent consideration and then **contact Chris Stevens (VK2XBC) on (02) 42565454 for further details.**

Let's Discuss IMPEDANCE (Part 1)

Probably very early in your introduction to amateur radio, you were given some of the elementary circuit theory, where you inevitably came to know of the famous Ohm's Law. Probably you were told that, according to Ohm's Law, the voltage across a resistor is equal to the current through that resistor (measured in amperes) multiplied by the value of resistance. Expressed as an equation (ie mathematically), Ohm's Law here may be written

$$V = I R$$

or in the other two forms found by rearranging terms, namely $I = V/R$ or $R = V/I$.

All well and good. Such is true. But what happens when we look at the voltage across and the current through capacitors or inductors? There is now no R term because we no longer are dealing with resistance. We need something more general, though again, it is Ohm's Law that we need. That which serves our purpose is the concept of *impedance*.

If it is time that you needed to again look at some of these concepts, then hopefully the following notes might be of some assistance.

Well, what really is impedance? I suppose that one of the best ways of describing it might be to look at it in the context of Ohm's Law. We represent impedance by the letter Z, and in Ohm's Law we write

$$Z = V / I$$

Not dramatically different from what we wrote before is it? Is it worth getting excited over? It won't really matter how you get your excitement, but what we can say is that **impedance** might be described as ***the factor which relates the voltage applied to a circuit, compared with the current flowing in that circuit.***

This idea of impedance can become rather important to us when we consider suchlike as transmission lines connecting transmitters and receivers to antennas (where we often speak of *characteristic impedance*), and also free space where the electromagnetic waves propagate from a transmitting antenna and are received by remote antennas. Free space, (including the vacuum of outer space) has a characteristic impedance of 377 ohms (can your ohmmeter measure that?!!). For these notes, we will not discuss these cases (maybe another time?).

What then is impedance made up of? Effectively, we may say that impedance is the *complex sum* of three things, namely resistance, capacitive reactance, and inductive reactance. By the term "complex sum" we mean certain mathematical manipulations which, while "complex" (actually meaning a combination of what are known as "real" numbers and others called "imaginary" numbers), can be carried out by anyone who knows or remembers some basic trigonometry.

As it turns out, we often consider resistance to be "real" impedance, whilst capacitive and inductive reactances are considered to be "imaginary" impedances. Regardless, whether we deal with resistance, reactance or impedance, the unit is the same ie all are measured in "ohms".

How would you describe **resistance**? I mean, if you went home to Mum and tried to tell her about resistance, what would you say? (How would you answer such a question in a physics exam, eh?!!). We might try to describe resistance by its major properties, a salient one of which is that ***resistance may be seen if the circuit consumes electrical energy***. Not only do "resistors" in their many and varied forms present resistance in an electric circuit, but so also do electric motors under load, antennas, speakers, and in fact any circuit which takes electrical energy and converts it to another form whether it be heat, mechanical or chemical energy. A **pure resistance** is not practically obtainable, because as it turns out, circuits will contain some measure of inductive and capacitive reactance -- yes even in d.c. circuits!

Many, but by no means all, d.c circuits neglect the reactive components of impedance. Examples of d.c. circuits that cannot neglect reactance include power inverters and d.c. motors.

Before considering both forms of **reactance**, let us consider inductance and capacitance.

Whilst most inductors will be formed from coils of conductors, we might be able to say that inductance is present in an electric circuit under the following conditions. ***Inductance may be seen if a circuit opposes changes to circuit current***. The opposition to current change manifests itself as voltage. With typical coils, this voltage is often referred to as "back emf". Inductors store energy in the magnetic field that they create.

Capacitors are usually made by separating parallel conductors (often in sheet form) by a layer of non-conducting "dielectric". ***Capacitance may seen if a circuit is able to store electric charge.*** It turns out that capacitance exists even between adjacent turns on coils. This latter phenomenon can be critical above vhf frequencies.

Again, from above, impedance relates the voltage across a circuit to the current flowing through it. The form of impedance that arises when dealing with inductance is of course inductive reactance, whilst when dealing with capacitance we have capacitive reactance.

The most common way of examining reactance is to consider the case where capacitors and inductors are subject to **sinusoidal voltages** ie sine waves. Reactance will apply with other waveshapes (triangular, square, sawtooth etc) but is most easily analysed with sine waves, perhaps our most common periodic waveshape.

Inductive reactance may be calculated from the following equation

$$X_l = 2 \pi f L$$

and *capacitive reactance* from the following equation

$$X_c = 1 / (2 \pi f C)$$

where X_l is inductive reactance in ohms

X_c is capacitive reactance, also in ohms

f is the frequency in Hertz

L is the inductance in Henrys

C is the capacitance in farads

Now, lets try to tie in **resistance** and **reactance** so as to give us **impedance**. This requires the use of "complex arithmetic". Don't worry about the wording, it is only a name and in reality uses little more than basic trigonometry.

Effectively, when we look at impedance ie the relationship between the applied voltage and the current in a circuit we need two factors, namely the magnitude of the relationship, and the phase angle. Note that a voltage peak does not always (rarely in fact!) coincide with the current peak, and we need to take account of this with a so-called "phase angle".

The magnitude of the impedance may be found by the following equation

$$Z = \sqrt{(R^2 + (X_l - X_c)^2)}$$

The phase angle is a little more difficult at first sight, but is nothing to any more than a four function calculator (which you now might only see if it comes as a freebee after you've had some photos processed!). The phase angle is found by the equation

$$\theta = \tan^{-1} ((X_l - X_c) / R)$$

Some calculators use the term "arctan" for $\tan^{-1}$, but both may be verbalized as "inverse tan", where of course "tan" means tangent.

So strictly spoken, impedance contains a magnitude and a phase angle and therefore impedance, whilst still being the relationship between voltage and current as before, should really be written as that ie magnitude and phase angle. We do this as shown below.

Impedance => $Z \angle \theta$ also measured in ohms.

where Z is the magnitude of impedance

and $\angle \theta$ is a symbol to indicate a phase angle of θ degrees.

A slight confusion should be avoided with the phase angle normally expressed in degrees, whilst some calculators and computer programmes only work with radian measure instead of degrees. Many a calculation has fallen over here.

Now, if we know the magnitude and phase angle of the impedance, we can calculate the resistance and reactance from the following.

$$R = Z \cos \theta$$

$$X = Z \sin \theta$$

R is always positive in our calculations, but X can be positive *or* negative. If it is positive, it is inductive reactance. If it is negative, it is capacitive reactance.

How do we know what quantity -- resistance or reactance -- are we looking at with impedance? We now use the "complex" arithmetic. Mathematicians have devised a number which called "i" which is defined as the square root of -1. Now you can't have a negative square root! So, to get around this problem, this little impossibility, the mathematicians called "i" an *imaginary number*. Now that is an easy way to get around something that doesn't exist! None the less, this number, called "j" by electrical engineers because of possible confusion with electric current (and the convention to be followed henceforth) has some very interesting and useful properties.

It turns out that we may regard resistance as a **real impedance** whilst both reactances may be regarded as **imaginary impedance**, not that there is anything unreal about the latter either! The addition of real and imaginary impedance gives us a **complex impedance**.

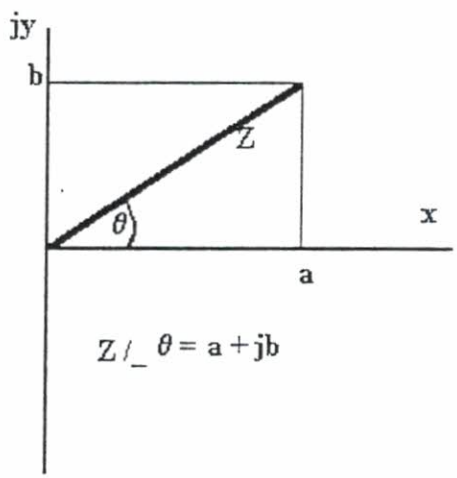


Figure showing the geometry of "complex numbers".

In the figure above, the resistance is "a", the reactance is "b", and the magnitude of the impedance is "Z". These are all measured in units of "ohms". The phase angle is θ, (usually in degrees) and the imaginary operator (the thing that separates resistance from reactance) is "j". Also, in this figure, we are representing inductive reactance as Z points upwards, and we are adding the "jb" term. This also represents a positive phase angle. If Z pointed downward, we would have capacative reactance in the circuit, and the "jb" term would be subtracted from the "a" term, as well as the phase angle being negative.

Alright now, time to take a breather and review what we have covered with an example or two. Eg1. A 530 R resistor is in series with a 60mH coil operating at 300 Hz. Find the impedance magnitude and phase.
Ans. Xl =2*pi*f*L (ok, so my word processing is getting lazy and not dredging up the "pi" symbol.....). Therefore Xl = 2* pi * 300 * 0.06 = 113 ohms.

Thus the magnitude of Z is sqrt (R * R + Xl *Xl) = sqrt (530*530 + 113*113) = 542 ohms. The phase is theta (ie the oval with a slash through it!) = arctan (Xl / R) = arctan (113 / 530) = 12 °. So Z is 541/_ 12 ° ohms. !!

Eg2. Find the resistance and reactance of an impedance 53 /_ -60° ohms. Now
R = Z cos θ = 53 cos (-60°) = 26.5 ohms
X = Z sin θ = 53 sin (-60) = - j 46 ohms. Note that a negative phase angle gives a negative reactance, and also note that we insert "j" to indicate we are dealing with reactance (the "imaginary" impedance). Being a negative reactance, we can say that we are dealing with capacitive reactance. To find the capacitance, we would need to know the frequency which we were not told.

One more thing to note about eg2. and that is that we have the **equivalent circuit** of a resistor in series with a capacitor as a) impedances add in series, and b) the circuit could be a far more complex network for which we can only determine an equivalent. Circuits and their theory can become quite involved, but using the idea of equivalences makes life a lot easier.

Now learning is an active process, and so let us ask some questions and see how you go. No, I am not going to supply answers, until either later, or if you ask me. You should have a "feel" as to whether you are grasping the ideas correctly!

Review Questions

1. How do you know if a circuit has i)resitance, ii)inductance and iii) capacitance in it?

2. What do we mean by a "real" and an "imaginary" impedance?

3. True or False? "The equivalent circuit of an impedance contains parallel elements."

4. A series circuit contains an inductor and a capacitor. At a certain frequency, the "resonant frequency" both have the same magnitude of reactance. What is the **total** reactance of the circuit? Why?

5. Determine the impedance of a series RLC circuit with R = 10R, L = 10mH and C = 1uF at a frequency of 1kHz.

6. Find the equivalent capacitance or inductance of a two element RC or RL circuit at 1kHz using the result from Q5. (What happened to the actual values?)

Have fun, 73's

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70cm, The Olympic Games & The Amateur Service.

A significant body of evidence is accumulating which suggests the amateur service may lose part, if not all, of the existing 70cm band. The reason given is that short-range communications around the Olympic Centre will require far more frequencies than can be handled by existing UHF commercial allocations and a major communications company (no names, no pack drill) has made a very determined push behind the scenes for a sizeable segment of the amateur 70cm band, ostensibly for the Olympics but almost certainly with a longer-term future in mind.

Gentlemen, we are faced with a real dilemma. We are not the *primary* service in this band, so we cannot legally claim any rights of occupancy. However, the IARS (amongst others) has a couple of repeaters operating in this band, linked to other repeaters operating in the same band. The value of this network is difficult to accurately quantify. We can set a dollar figure on the hardware, we can even make a reasonable guess as to the cost of installing and maintaining it, but as for its value for communications during an emergency, that's far more difficult to ascertain. However, we should also realise the loss of 70cm will not be merely confined to the Sydney area, or even to just the state of NSW. The long term plan of at least one major communications company calls for a national approach.

The problem is 70cm is now "prime real estate", and has increased in value enormously as low and high-band VHF frequencies become unavailable and existing UHF allocations likewise become filled to capacity. Our thirty Megahertz of UHF has enormous potential for commercial users. No wonder envious eyes have been cast in our direction. The communication giants are in a position to offer governments (at all levels) contra deals, sweeteners, "agents fees, commissions, establishment co-payments, contractual service rebates" and so on. We, on the other hand, have very little to offer which can directly influence a government. In fact, many bureaucrats could argue the eviction of the amateur service from the entire 70cm band would be ultimately beneficial and reduce their workload.

At this stage there is little we can do. Perhaps the decision has already been made and we can all expect an announcement sometime in the not-too-distant future requiring us to quit the band and (presumably) dispose of any equipment capable of transmitting on it. Do we fight tooth-and-nail, or do we slink away into the radio darkness? Your guess is as good as mine. As for the WIA, well we need some policy and action on this - and we need it NOW! *(Ed)*

The Illawarra Amateur Radio Society Inc.

PO Box 1838 WOLLONGONG NSW 2500

VOICE REPEATERS:-

Callsign	Freq	Site	Area	Linked to:
VK2RUW	29.620	Knights Hill	Illawarra	(off-air)
VK2RBT	146.675	Mt Boyne	Batemans Bay/Ulladulla	VK2RMP
VK2RMP	146.850	Maddens Plains	Illawarra/Sydney	VK2RBT
VK2RIS	146.975	Saddleback Mtn	Wollongong/Nowra	
VK2RUW	438.225	Knights Hill	Illawarra	VK2RGN, VK1RGI
VK2RMP	438.725	Maddens Plains	Illawarra/Sydney	

PACKET REPEATERS:- (Digi's/Nodes/Gateways/BBS's)				Type
VK2AMW-6	144.700	Maddens Plains	Illawarra/Sydney	Node/Digi
VK2XGJ	147.575	Dapto	Wollongong	BBS
VK2AMW-9	144.925	Mt Murray	Illawarra	Node/Digi
VK2AMW-5	147.575	Mt Boyne	Batemans Bay/Ulladulla	Node/Digi
VK2AMW-7	147.575	Mt Murray	Illawarra	Node/Digi
VK2XGJ	147.575	Dapto	Wollongong	BBS

Membership:- $20.00 per annum. $15.00 concession (enquiries to the Treasurer). Memberships expire immediately after the AGM in August.

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VK2ZLJ - John Lodding, VK2TKE - Ken Goodhew

PUBLICITY: VK2UBF - Brian Farrar

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LIFE MEMBERS: VK2CAG Graeme Dowse, VK2OB Keith Curle, VK2ALU Lyle Patison

Club Meetings: The second Tuesday of every month (except January) in the SES Building, Montague St, North Wollongong, commencing approximately 7.30pm.

Annual General Meeting for 1998: Tuesday August 11th commencing at 7.30pm

AN INVITATION

Dear Member,

You are cordially invited to renew membership of the IARS for the 1998-99 financial year. Please return this completed form with your remittance to:-

The Treasurer
Illawarra Amateur Radio Society
PO Box 1838
WOLLONGONG NSW 2500

If you are paying at the meeting, kindly bring the completed form with you.

NAME: _____

ADDRESS: _____

_____

CALLSIGN: _____

WIA Member? **Yes/No** **(Please circle correct choice)**

Membership: $20.00 **Pensioners $15.00**

10 x FM900 4 2m's TUNED

@ AGM $65 To MEMBERS