Welcome to Amateur Radio

A Guide for Newcomers

The Radio Amateur Society of Australia Inc

Welcome

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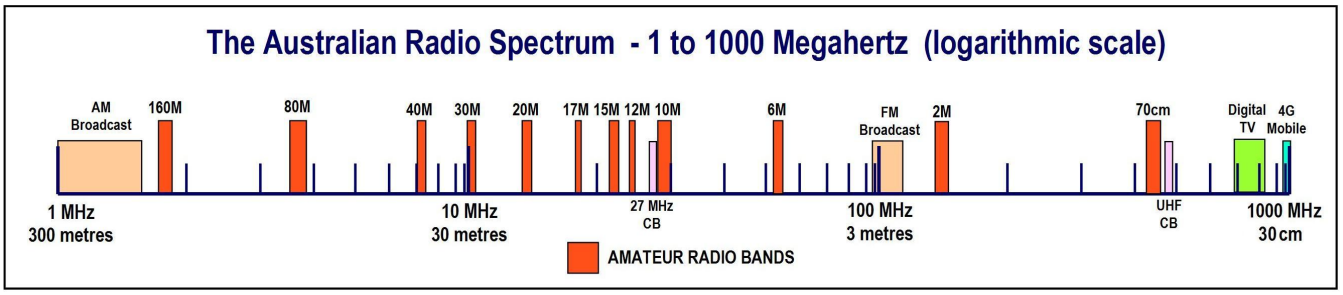
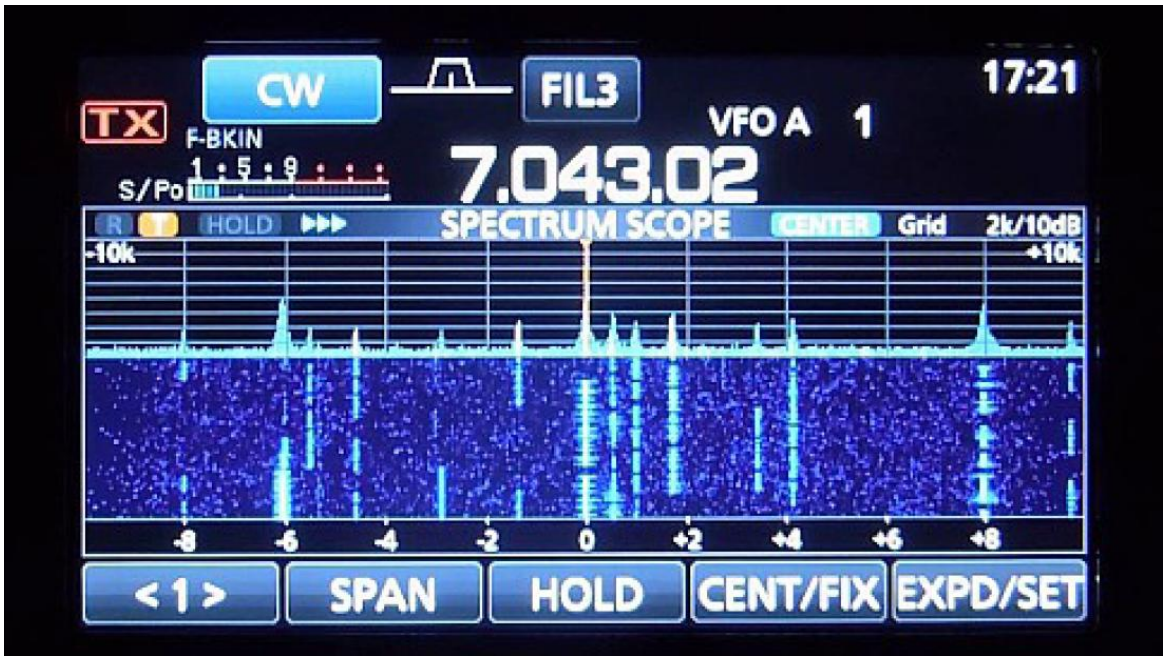
Welcome

Welcome to the wonderful hobby of Amateur Radio. This free guidebook provides an introduction primarily for newly licenced Foundation class amateurs. Our hobby provides a vast array of interests, all centred on radio communication and electronics. The chart below illustrates the broad access to the Radio Frequency spectrum enjoyed by Amateur Radio enthusiasts.



Amateur radio is a multi-faceted hobby. We encourage you to start off with the basics, and as you find areas that spark your interest, you can drill down and get more involved. Self improvement and life-long learning are important aspects of the hobby.

This guidebook is published digitally. It contains many hotlinks to external web-sites with useful and relevant information. However, you are still welcome to print it. If you find something that would add value, please send us an email.



Radio bands

Your new licence gives you access to a good selection of amateur radio bands, as follows:

3.5 MHz – 3.7 MHz - the "80 metre" band

80 metres provides good night-time coverage around your State/Territory. Antennas can be quite large. (remember antenna size is normally a function of wavelength).

7 MHz – 7.3 MHz – the "40 metre" band

Provides roughly equivalent coverage to 80 metres during daylight hours. DX stations can be worked at dusk/dawn/night.

21 MHz – 21.45 MHz – the "15 metre" band

Provides world-wide coverage, normally during daylight hours, when conditions are right.

28 MHz – 29.7 MHz – the "10 metre" band

As for 15m. When the band is open, signals can be very strong, and distant stations can be worked with simple antennas.

144 MHz – 148 MHz – the "2 metre band"

Probably the most popular amateur radio band, particularly in metropolitan areas. The 2 metre band provides roughly line of site coverage. Many repeaters are available, often linked through analogue or digital networks.

2 metres is also a popular "local club" band for local nets and contacts.

430 MHz - 450 MHz – the "70 centimetre band"

As for 2m, but coverage is lower. Often works better amongst buildings. Australia-wide digital repeater network available in most capital cities and many metro areas - https://vkdmr.com/

Join your local club….

One of the best ways to gain knowledge and experience the camaraderie of amateur radio is through your local radio club. A link to the list of Australian amateur radio clubs may be found in the "Where to next" section.

Ask lots of questions of other amateurs…it is somewhat of a cliché, but there is no such thing as a silly question. You never stop learning.

Remember, above all, have fun!

73
Glenn Dunstan VK4DU
President
The Radio Amateur Society of Australia Inc

The Radio Amateur Society of Australia

The ethos and ethics of Amateur Radio

Like many hobbies, Amateur Radio has traditions, jargon and practices that are not always apparent to the newcomer. Your licence entitles you to get on the air and transmit, but, as a newcomer, you need to familiarise yourself with the way the hobby works operationally before transmitting.

Getting to know how amateur radio stations operate will provide a smooth and stress-free entry to this great hobby of ours.

Have a listen around the bands before you first transmit (if you haven't already) – monitor typical amateur QSOs (conversations). This will give you a feel for on air practices.

Once you start transmitting, steer well clear of controversial topics including:

- religion;
- politics;
- business (you can talk about your profession/trade, but you cannot advertise your services or those of anyone else);
- derogatory remarks/observations/jokes directed at any group (gender, ethnic, religious, political, sexual orientation, etc.); and
- off-colour humour.

Above all, apply common sense and good taste.

Do NOT use CB jargon – you will annoy your fellow amateurs and will be ostracised at best or roundly criticised on air at worst... Amateur and CB radio are *different hobbies*, with different operating practices. This hobby has many participants with as many differing views.

Remember, you are also prohibited from transmitting any form of entertainment.

The American Radio Relay League has, for many years, published a guide for new amateurs, known as The Amateurs Code:

The Radio Amateur is:

CONSIDERATE...He/she never knowingly operates in such a way as to lessen the pleasure of others.

LOYAL...He/She offers loyalty, encouragement and support to other amateurs.

PROGRESSIVE...He/She keeps his/her station up to date. It is well-built and efficient. His/Her operating practice is above reproach.

FRIENDLY...He/She operates slowly and patiently when requested; offers friendly advice and counsel to beginners; kind assistance, cooperation and consideration for the interests of others. These are the marks of the amateur spirit.

BALANCED...Radio is a hobby, never interfering with duties owed to family, job, school or community.

(adapted from the original Amateur's Code, written by Paul M. Segal, W9EEA, in 1928)

Getting On-air

You've got your licence and you want to get on air. If you haven't already, review your station and make sure everything is in order. Read the Amateur's Code and DX Code of Conduct. If you're on voice digital radio or repeaters make sure you're familiar with the correct protocols. Spend some time listening to other stations and "learn the lingo".

You will gain a lot of experience by listening on your preferred bands, be it DX (long distance), or local FM repeaters.

Know the Q-code. Nearly every Amateur will use this code. Please, use the correct international phonetic alphabet when on-air.

https://tinyurl.com/y8c2qz85

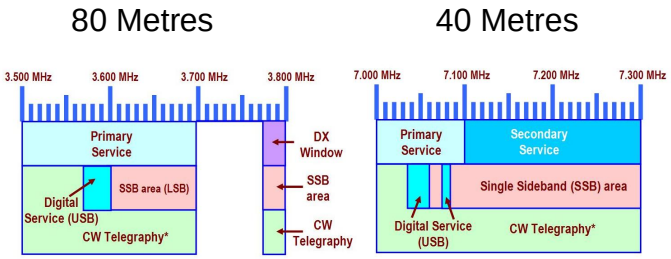
The most common Q-codes you'll hear are presented on the next page..
Peter VK3YE has written a very useful article to help you get started with your first QSOs.

It's worth having a read of Peter's articles.

https://tinyurl.com/u6kdewb

Spend some time listening to QSOs on the bands. You should also be aware that Amateur Radio Bands are divided into segments. These are described in the Band Plan and conforming with the Band Plan helps ensure harmony.

The Amateur Radio Band Plan



The Band Plan provides a set of guidelines that define which modes are used on which sections of each Band. For example, Morse code (CW) can be used almost anywhere on most bands, but its use is generally confined the bottom 30-50kHz. Allocations are also made for SSB, Digital, Repeaters and Beacons.

A handy copy of the Band Plan is available from this link:

https://tinyurl.com/trzh93n

Q-Code - commonly used codes

QRL is the frequency busy?

QRM interference from other signals

QRN interference from natural noise

QRO shall I increase power? High power

QRP shall I decrease power? Low power

QRS shall I send more slowly? Send slower

QRT shall I stop sending? Stop sending

QRU have you anything more for me? Nothing further

QRV are you ready? I am ready

QRX standby

QRZ who is calling me?

QSB fading signals

QSL received and understood

QSO a radio contact

QST a message for all listeners

QSX I am listening on xxxkHz

QSY change frequency

QTH what is you location? My location is…

Sideband conventions

Lower Sideband (LSB) is used on all bands below 10MHz. Upper Sideband (USB) is used on all bands 10MHz and above. USB is used for data modes on all bands.

Setting up your first HF Station

If you don't already have your first HF radio, you're probably wondering where to start. Your decision will largely be driven by your budget. You can find good basic HF radios on the second hand market starting at $400-600. New radios start at $850. Do some research, join a club and see if you can try out a few different radios before parting with your hard-earned. Some links are provided in the "Where to next" section.

Note – Unless you are a collector, avoid older radios that use valves. Solid state radios will generally have more features, are lighter and easier to use. Generally, they are also more reliable for a beginner.

Design and setup your station with good housekeeping practices from the outset. You'll end up with a better radio station and will make more contacts.

Basic guidelines for establishing your first radio station:

☑ location of shack/radio – you need to be practical, but the further you can be from the "living/entertainment room and kitchen", the less likely you are to suffer Radio Frequency Interference (RFI or QRM) from nearby electrical appliances;

☑ good RF earthing is vital. Ideally as close to the station as possible;

☑ avoid an upstairs shack if possible;

☑ ensure there is adequate air Flow around all radios, power supplies, computers etc;

☑ antenna location – high and as far away from the house as possible;

☑ keep wires, patch leads and antenna feeders as short as practical;

☑ ensure all wires, antenna feeders and connectors are in good repair;

☑ test all electrical equipment for RFI/QRM. e.g. computers, power supplies, desk lamp etc. Choose appliances that emit the least amount of noise, or have a plan to minimise or eliminate the noise;

☑ make sure you can easily earth your antennas when you're away from home or expecting storms.

Once your station is set-up:

☑ listen on all your favourite bands. Check for unwanted QRM;

☑ transmit on your favourite bands and modes. Check for QRM to devices in your home;

☑ if possible, turn off your mains power supply and use a car battery to confirm you aren't suffering unwanted RFI/QRM;

☑ even though it's no longer required, keep a log for the first month or two of operation, in case neighbours complain you're causing interference.

Establish a maintenance plan. For example:

☑ Check all connections once a week

☑ Inspect antennas monthly

☑ Inspect and check your station RF earth quarterly.

Once you're up and running, ask other amateurs (both on-air and in person) what they do to maintain their radio station.

Consider keeping a journal of your radio setup and antennas. Make notes on what worked well, what didn't work so well, and things you might try differently next time.

Using a computer application like OneNote or EverNote can be useful, as you can link in handy websites, photos, documents and hand-written notes.

Understanding your HF radio

Depending on your selection of transceiver (TXCVR), you may have many controls to aid in reception and transmission of RF signals. These controls may be accessed by front panel knobs and buttons, or via a menu system. Each of the common functions are described below. Spend some time adjusting these settings to get a feel for the receiver's response under varying conditions. More modern radios will offer more complex features and functions. Please refer to your radio's manual for further details.

The Receiver (RX)

Let's start by looking at basic RX features you'll find on most modern radios.

Audio Frequency (AF) Gain

Most simply, this Is the volume control. However, when listening to (especially) noisy and/or weak signals, you may balance between AF and RF gain to achieve the best resolution of the desired signal.

You should also be careful when wearing headphones not to set the AF gain too high as this may lead to long term hearing loss.

Radio Frequency (RF) Gain

The RF Gain controls the sensitivity of the receiver. When you have strong noise levels (i.e. static) or nearby signals, reducing the RF gain may assist in copying your preferred signal. Very strong signals may also overload your receiver, so reducing RF gain may assist.

Receiver Incremental Tuning (RIT) or Clarifier

The RIT (or Clarifier) allows you to adjust the RX frequency without changing your TX frequency. This feature is generally limited to no more than +/-5kHz from your main frequency. It may assist if the other station is slightly o frequency. Refer to your radio's manual for more information.

Noise Blanker (NB)

The NB is designed to eliminate unwanted pulse type noises, such as noise from car ignitions or electric fences. More complex receivers may offer a variable depth of NB.

Noise Reduction (NR)

The NR is very effective at eliminating unwanted random noise components, such as low level "hash" sounding noise from man-made or natural sources.

More complex receivers may offer a variable depth of NR.

Notch Filter

The Notch Filter can be very effective in attenuating unwanted beat tones or tuning signals

Depending on your radio, Notch Filters may be manual and/or automatic. In e□ect, the Notch Filter acts as a frequency agile narrow pass attenuator eliminating unwanted signals in your receiver bandpass.

Attenuator

The attenuator helps stop extremely strong signals from becoming distorted on or close to your operating frequency. It can also assist if you suffer from a very strong radiated signal such as a nearby broadcast station.

Automatic Gain Control (AGC)

The AGC controls receiver gain to produce a relatively even audio output. This can assist when signal strengths vary considerably. A “slow” setting works well if signal strengths are constant. However, signals suffering heavy or fast fading may benefit from a “faster” setting. Most radios offer a Slow, Mid or Fast setting. The slow setting is normally used for SSB and the fast setting for CW/digital.

Digital Signal Processing (DSP)

DSP reduces unwanted noise characteristics on received signals. DSP will usually have levels (0-10) to apply stronger noise reduction. However, strong DSP settings will also reduce received audio quality. But, if this makes the difference between an unreadable signal and a readable signal, then the compromise may be acceptable.

The Transmitter (TX)

Every modern commercial transmitter (TX) has been designed and constructed to transmit a signal that complies with the Amateur Radio regulations. It is important to learn how to use the radio’s settings to ensure your signal is “clean”. There are a few settings you must understand properly.

RF Power (RF)

Irrespective of your licence class, it is generally regarded as good practice to use only the power required to make the contact. When setting up your TX, you must ensure you are aware of how much power you are transmitting. You can do this best with a tone transmitted into a dummy load. Most modern radios will have an acceptably accurate power meter. Otherwise, you might consider using an external power/SWR meter.

If you don't have this equipment, a local ham or club might loan you a dummy load and power meter.

Microphone Gain (mic gain)

Mic gain will adjust how much audio is applied to your RF signal for amplification and transmission. If you set the Mic Gain too high, you will overdrive the audio amplifier and transmit a distorted signal. At best, your audio may sound quite distorted or unclear to other stations; at worst you will create unwanted interference (splatter) to other services; perhaps even your own TV or home appliances. Typically, set the mic gain between 30-50% of maximum. Conduct on-air tests with a friend who can provide feedback, or maybe even record your signals so you can hear first-hand what happens when you set the mic gain too high or too low. Do not assume that “all dials to the right” will result in the most powerful signal. Your signal will be distorted and may cause interference.

Speech Compression

The Speech Compressor will increase your average power output, which may improve readability at the receiving end. However, when adjusted too high, your signal will be overdriven and distorted. The speech compressor is best used when propagation conditions are poor. As with other functions, it is a good idea to experiment with a friend to get a sense of how your settings impact on your signal.

Antennas - an Introduction

There are many sizes and shapes of antennas and often they appear to be quite complex. This can be extremely confusing to the newcomer. In this section we touch on four key principles.

1. Size

The perception that a large antenna works better than a small antenna is not strictly true. There is a relationship between antenna size, where in the radio spectrum you are operating and the speed of radio waves through the air. (This speed is a constant, often rounded to **300,000,000 metres per second**)

If you take a common amateur radio frequency, such as **7.110 Megahertz** shown on the front cover of this guide, then divide it into the speed of a radio wave, you get an answer of Wavelength in Metres.

300,000,000 / 7,110,000 Hz = 42.1 metres

This calculation is rounded somewhat to say that 7.11 MHz is in the 40 Metre band. A practical antenna is going to be based on that wavelength.

Using the same formula, an antenna on **146 MHz** will have a wavelength of around 2 Metres. A one-quarter wavelength antenna placed on a car for the 2 Metre band would be about 50 cm long.

The most important fact to take away here is that antenna size is linked to your operating frequency.

Generally, the higher the frequency, the smaller the antenna needs to be.

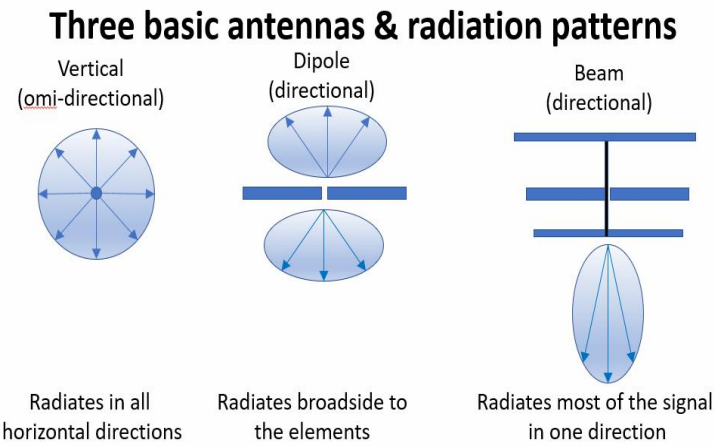
There are designs that enable antenna size to be reduced for reasons of structural practicality and installation limitations. Designs that enable the effective shortening of antenna elements include inductive loading, as often found in verticals and beam antennas.

2. Directivity and Gain

All antennas exhibit characteristics of directivity and gain. Directivity and gain affect both the transmit and receive performance of an antenna.

The reference antenna is an isotropic antenna – a theoretical antenna that radiates equally in all directions. In practice, and for the purposes of this introductory guide, we will present two basic types of antenna. These are usually referred to as **omnidirectional** and **directional**.

Omnidirectional antennas will work equally in all directions. An example of this would be a vertical antenna on the roof of a car that can maintain a contact with a distant station, regardless of what direction the car is pointing. At home, an omnidirectional antenna has the advantage of hearing stations from any direction.



Directional antennas (typically) focus all their radiation in a single direction. Their effectiveness in focussing a signal in a desired direction is referred to as directivity and gain. The gain of an antenna is measured in Decibels and will usually reference the gain relative to an isotropic (ideal) antenna (dBi).

The exception to the “one direction” is the dipole. Broadly speaking, simple dipoles (if at a minimum height) will be bidirectional and exhibit a figure 8 radiation pattern broadside to the wire elements.
There will also be a null off each end of the dipole. A dipole typically has a bidirectional gain over an isotropic antenna of about 2.5dBi.

The advantage of directional antennas is that they perform optimally in the desired direction. A directional antenna on a car would be a poor choice, as every time you turned a corner, you would lose an established signal. At home, a directional antenna could require the addition of an Antenna Rotator. This way, you can point your antenna at a target town or country of interest and achieve optimal performance in that one direction.

Probably the most popular directional antenna is the Yagi Beam Antenna.

3. Polarisation

Antenna polarisation is an important concept. In essence it means that the transmit and receive antennas should have matching orientation. Vertical antennas will perform best when in contact with other vertical antennas. Horizontal antennas will perform best with other horizontal antennas.

If one antenna is vertical and the other horizontal, the signal losses between the two antennas can be significant. However, it is worth noting that long distance signals that skip around the world can change polarisation with each reflection/refraction. For this reason, some stations use both horizontal and vertical antennas, switching between them to find the best signal for a given path.

4. Matching antennas to radios

This is a complex topic and only the basics will be introduced here. Matching an antenna to your radio comes down to two important characteristics, which apply to every single antenna: resonance and impedance.
If you are transmitting into an antenna and either of these characteristics are not right for your TX frequency, your signal won’t radiate efficiently and a certain amount of RF energy will be reflected from the antenna back to the radio. If the reflection of transmitted RF energy is too high, signal reports will be poor, you may be causing interference, and you could damage your radio.

Resonance and impedance are not something that can be seen with the naked eye. While these characteristics are invisible, their effects are real and can be easily measured with the right tools.

The meter above shows power going to the antenna on the left and power reflecting back on the right. The reflected power is expressed as a Standing Wave Ratio (SWR). Ideally the SWR should be a very low value on your operating frequency.

Resonance

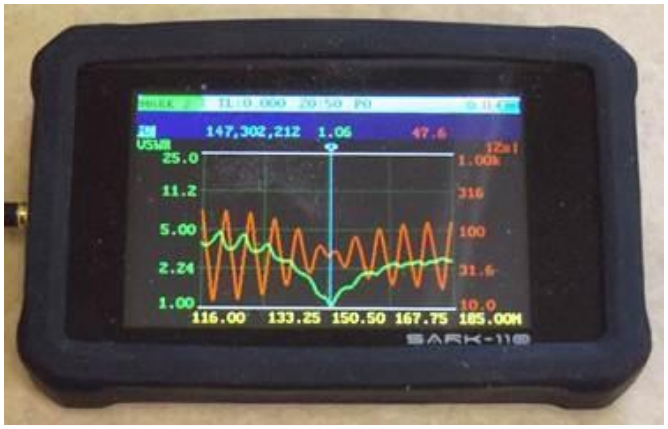
Resonance is the frequency at which your antenna works best. Previously we mentioned that the size of the antenna is related to the frequency of operation. There will always be a relationship between the wavelength and the physical antenna size. For example, a half-wavelength antenna for the 20 metre band is going to be around ten metres long.

This is still a pretty big antenna to fit within a standard home site, so sometimes coils and capacitors are added to a compact antenna to imitate the resonance of a longer antenna. Such coils are often called ‘traps’. There will be a loss In efficiency by using such methods, but it can help to keep antennas down to a manageable size at the lower end of the radio spectrum.

Impedance

Impedance is the sum of all things that affect the energy path out of your radio. While there are exceptions, most radios are engineered to match a 50 ohm impedance. The radio will need to be connected to a feedline with a matching 50 ohm impedance. In turn, your feedline is going to want to see an antenna that provides a 50 ohm impedance.

Anything that upsets that balance, (for example, water seeping into a damaged antenna cable) will create a mismatch and the reflected power (SWR) will begin to rise. A good antenna will be both resonant where you are transmitting and will provide an impedance of close to 50 ohms.
The image below shows a useful tool called an **Antenna Analyser**, that sweeps a selected part of the radio spectrum and displays both the impedance and resonance of an antenna.



With this unit the green line shows a sharp dip where the antenna is resonant, and the red line shows the impedance value.

In this example we are testing an antenna for the 2 metre band (144-148 MHz). The green dip shows resonance at 147.3 MHz, and it has an impedance of about 47 ohms.

This is only a brief introduction to antennas. There are a wide variety of antenna designs from which to chose, and many factors that will influence your choice. Antennas are a part of your overall radio station that you can construct and experiment with yourself.

Antennas are a complex and fascinating topic. An important part of amateur radio is the process of working out what type of antenna is going to work best for you.

Simple HF Antennas

Antennas at HF frequencies are relatively large. An 80 metre half-wave dipole will be 40 metres long: 20 metres either side of the feedline. As you increase your frequency, the antenna size will decrease. At 28MHz, a half –wave dipole is only 5 metres long. There are exceptions to these basic rules, such as when using loading coils or other designs to achieve a smaller footprint.

Antennas can be simple and straight-forward, or complex, mechanically demanding and highly technical. Start off with something simple that will get you on the air. As you gain experience you can experiment with alternative designs.

Join your local radio club or contact a local radio amateur to talk about your interests and limitations. Your house block size may limit your options. Of course, you'll also need to consider how you intend to get the antenna up in the air. Simple options include a mast, conveniently placed trees or a ground mounted vertical antenna.

80 metre half-wave dipole

Cheap and easy to construct. It will require some space, but the elements (or legs can be bent if required.

40 metre half-wave dipole

Cheap and easy to construct. A good all-rounder and easy to install at a reasonable height (say 10 metres off the ground).

40 metre quarter-wave vertical

Cheap and easy to construct. Requires very little space. Very good for DX contacts, but may be more prone to noise.

15 and 10 metre half-wave dipoles

Cheap and easy to construct. Good all-rounder.

15 and 10 metre verticals

Cheap and easy to construct. Requires very little space and good for DX. Omni-directional and more prone to noise.

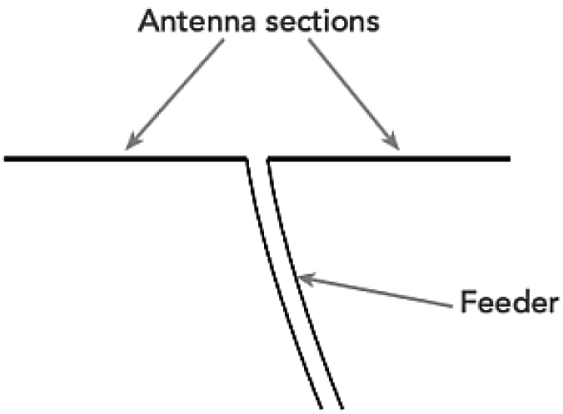
Beam antennas

More expensive and complex and will require a rotator, mast or tower. Will provide directivity and gain; great for working DX.

You can use Google to find some simple designs and construction notes for dipoles and verticals. If you don't have much experience in construction but you're keen to try out a beam, check the second hand market or see what on-line stores offer.

Dipole Antenna

A half-wave dipole antenna is perhaps the most simple antenna a newcomer can start with. It is efficient and easy to construct. It is a total of one half wave-length of the desired frequency of resonance. Each "side" of the dipole will be a quarter wave-length in length.



Each of the antenna sections will be 1/4 of a wavelength. Your individual dipole lengths will need to be fine-tuned based on your installation characteristics; but the below table provides a good starting point.

Freq	Wavelength (m)	Dipole lengt (m)
3.5MHz	80	40
7.1MHz	40	20
21.2MHz	15	8
28.5Mhz	10	5
146Mhz	2	1

Vertical Antennas

The above table will also work for a quarter-wave vertical. A quarter wave vertical will be 1/4 the length of the wave-length. The radials will also be 1/4 the length of a wave-length.
Anything lower than 40m becomes unwieldy for a vertical antenna in most scenarios.

The internet is a great resource for researching antennas. We encourage you to use your preferred search engine to investigate various antenna designs and how to make these work for you.

We also encourage you to reach out to fellow hams and clubs to seek advice and counsel.

If you need further advice, please send us an email.

Peter Parker, VK3YE also provides some great introductory articles and videos on simple antennas. Check out his website and You Tube channel.

Beam Antennas

Beam antennas are what many keen DX'ers aspire to operate. They offer considerable gain on TX and RX, as well as directivity. They offer an array of advantages over dipoles and verticals, but will be more complex and expensive. You'll also require a mast or tower, as well as a rotator. Beams also come with added maintenance and risk of failure than a simple wire antenna.

For the purposes of this guidebook, we'd recommend you start with one of the other antennas and as you gain confidence and knowledge you can investigate upgrading to a beam antenna.

End Fed Half Wave (EFHW) Antenna

The EFHW antenna is included in this Guidebook as it is an effective and simple antenna to erect if you have a small yard but access to a tree or other similar tall structure.

Steve Ellington N4LQ has created a Facebook group dedicated to this antenna. It's well worth while following this group to learn about how you can use this antenna. Or, here is a link to a handy document by Steve.

Working DX

For many Radio Amateurs, chasing HF DX (long distance) is what the hobby is all about. Your licence gives you access to some great DX bands. Start by reading a little about propagation and what you can expect on each of the bands. Set realistic targets – DX might mean working the other side of the Pacific, Australia, or maybe New Zealand.

Some useful links about DX

http://www.dxing.info/introduction.dx

https://dxnews.com/dxnews/

https://www.425dxn.org/

Bob Locher W9KNI has written a great book on DX'ing. It's entertaining and instructional.

https://w9kni.net/operating/

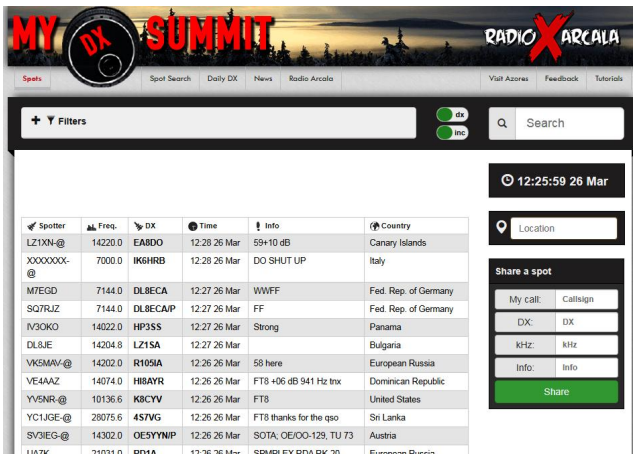
If you're keen, you can subscribe to on-line DX newsletters. The Daily DX is popular.

https://www.dailydx.com/

https://www.dx-world.net/

DX Summit

DX Summit provides online real-time DX reporting. Amateurs post real-time observations of interesting DX that they are hearing or working. It is a great resource to assist in your DX hunting; BUT it does not replace scanning the bands and developing good listening skills



http://www.dxsummit.fi/#/

Online International Directory of Amateur Radio Operators

https://www.qrz.com/

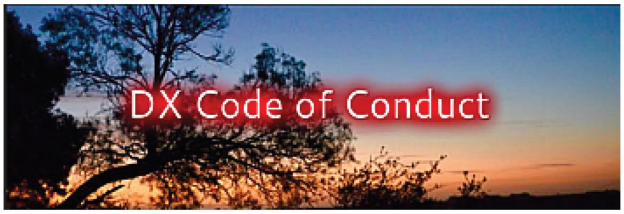
This is a global on-line database. Nearly all active amateurs will have an entry. You should set up your own entry. This is how you □nd others, their QTH and contact details and usually a little bit about their station. You can also upload you log to qrz.com for confirmation of QSOs with other stations.

DX Code of conduct

A little like The Amateur's Code, the DX Code of conduct provides a set of guidelines for working. We encourage you to read this Code, listen to their DX'ers and practice the Code. You'll get better results and greater enjoyment out of the hobby. You can read the Code in full by following this link

https://vkradioamateurs.org/dx-code-of-conduct/

The DX Code of Conduct provides some very good general guidelines about Amateur Radio ethos and conduct; not just DX. Please read and apply this code to your on-air operation.



1. **I will listen, and listen, and then listen again before calling.**
2. **I will only call if I can copy the DX station properly.**
3. **I will not trust the DX cluster and will be sure of the DX station's call sign before calling.**
4. **I will not interfere with the DX station nor anyone calling and will never tune up on the DX frequency or in the QSX slot.**
5. **I will wait for the DX station to end a contact before I call.**
6. **I will always send my full call sign.**
7. **I will call and then listen for a reasonable interval. I will not call continuously.**
8. **I will not transmit when the DX operator calls another call sign, not mine.**
9. **I will not transmit when the DX operator queries a call sign not like mine.**
10. **I will not transmit when the DX station requests geographic areas other than mine.**
11. **When the DX operator calls me, I will not repeat my call sign unless I think he has copied it incorrectly.**
12. **I will be thankful if and when I do make a contact.**
13. **I will respect my fellow hams and conduct myself so as to earn their respect.**

Setting up your first VHF/UHF Station

Foundation licencees have a VHF and a UHF allocation: 144-148 – 2m and 430-450 MHz – 70cm. These bands are very popular, particularly in capital cities and major regional centres.

Radios

Broadly, there are two types of radio you will use on VHF/UHF: a mobile/base radio or a portable handheld ("walkie talkie").

Many different types of radios are available – from cheap Chinese portables to high end Japanese multi-mode base radios.

Whilst the Chinese portables may look tempting because of their low price, a good second-hand Japanese radio (Kenwood, Icom, Yaesu) will often be a better long-term proposition.

If you plan to operate mobile, invest in a quality Japanese mobile rig. Portables can be used in cars, but they will not perform well inside the car's metal body.

Also, they may be confused for a mobile phone by authorities….which could result in serious fines.

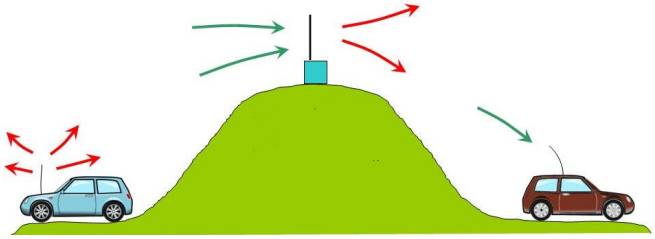
Although two-way radios are exempted from the prohibitions on mobile telephone use in cars, if you are mistakenly fined for using a portable radio, you will have to appeal the infringement notice….

There are two broad types of operation on VHF/UHF:

- SSB and data, which normally operate in simplex (direct) mode, analogue;
- FM and digital voice, which normally operate via repeaters.

FM and digital voice

Most FM/digital voice operation uses repeaters. Repeaters are designed to receive signals and rebroadcast them, thereby allowing stations who might normally be out of range to communicate. The higher the repeater is above the surrounding area, the greater the range.



Typical repeater arrangement

There are dozens of 2m and 70cm repeaters across Australia, often located on mountain tops. Some repeaters provide coverage over hundreds of square km.

You don't normally call CQ on repeaters, rather simply announce that you are listening – i.e. VK2FXYZ listening

Repeaters are a shared resource - once you have established contact with another station, always leave pauses between overs to allow other stations to break in. If you can hear the other station directly, you should QSY (change frequency) to a simplex (direct) channel if possible.

Maps of repeater locations may be found at
https://www.onlinerepeatermap.com/
and
VK DMR repeaters
Antennas for FM and digital voice are vertically polarised. Dual band vertical base station antennas are available from numerous manufacturers, covering both the 2m and 70cm bands.

Typical vertical base station antenna

Most SSB activity is centred around the calling frequencies of 144.1 and 432.1 MHz.

Digital modes may now be used by any licenced amateur in Australia. These modes have become incredibly popular, especially as the sunspot cycle is at its low point.

Digital modes are developing rapidly, with the most used mode, FT8, accounting for nearly **40% of all amateur radio traffic in 2019**

As a rule of thumb, the higher the VHF/UHF antenna, the better.

SSB/digital

SSB and digital modes are also popular on VHF/UHF bands. Operation is simplex - direct – there are no repeaters used.

These modes are often used for long distance contacts, as they perform much better with weak signals than FM.

Antennas for SSB/digital are horizontally polarised and often directional – if they are directional, they need to be mounted on a rotator, which is a small electric motor that turns the antenna to the desired direction.

Horizontal yagi antenna for 2m SSB

Introduction to Digital Modes

Digital Text

The original digital and data mode was continuous wave (CW) as transmitted with telegraphic Morse code. In the 20th century advances were made in sending digital data in both text and voice modes.

Amateurs have developed technology for global positioning using the Amateur Packet Reporting System (APRS) technology.
http://www.aprs.net.au/

Radio pictures can be sent by Slow Scan Television (SSTV) arrl.org/sstv modes and this is frequently utilised by astronauts on the international space station. Amateurs also transmit full digital TV.

The most recent developments in the field have been produced by a team from Princeton University led by the Nobel laureate, Dr Joe Taylor (W1JT). He has developed a series of modes for moon bounce operations (Earth-Moon-Earth), radio sport, radio expedition stations (dxpeditions), or plain amateur radio contacts. All the modes are designed to decode very weak signals, thereby allowing the use of relatively inefficient antennas and low power. The basic reference for all of these modes is
https://www.physics.princeton.edu/pulsar/K1JT/

Joe Taylor and his team's most popular mode is FT8. princeton.edu/pulsar/K1JT/wsjtx

A complete QSO (contact and exchange of signal reports) can be made in less than one minute. All you need is a radio, a PC, a compatible sound card and an accurate time clock. Some modern radios allow direct connection to the PC without a sound card.

The mode has taken off because it works so well with weak signals. It allows an amateur to work the world when propagation conditions are poor and when there is local interference. Critics of the system declare that is it just a computer connecting to another, or that it is boring to use. This seems to be countered by its very high world-wide uptake. As for all things in AR, if you don't like it, do something else, there is so much to do in this hobby…

Finally, from Joe Taylor's team is the fascinating Weak Signal Propagation Reporter (WSPR) wspr which is a system that probes propagation paths with low power transmissions containing the transmitter's call sign and location.

This allows an assessment of propagation conditions, very much as Morse code beacons do, and provides a mass of data showing patterns worldwide. http://wsprnet.org/drupal/

When you are running digital modes, the radio's transmitter is on full time for the length of the transmission.

This is known as a 100% duty cycle. SSB has a far lower duty cycle, as the transmitter is only producing full power at the voice peaks.

Digital Voice

Development of reliable digital voice systems has been a source for much experimentation over the years both in the commercial and the amateur radio sectors. The aim is to improve both quality and reliability of transmission and reception. If you have listened to DAB broadcasts, then you will appreciate the high quality that can be achieved but also the lack of intelligibility if there are issues with the signal. https://www.digitalradioplus.com.au/what-is-digital-radio

There are a number of digital voice systems available:

One of the earliest systems developed by radio amateurs in Japan but taken over by the Icom Company was Digital Smart Technology for Amateur Radio. (Dstar). http://www.dstar.org.au/

As parts of the codec are proprietary, other manufacturers have developed similar systems, for example, Yaesu's Fusion.
what-is-system-fusion

The two systems will not intercommunicate.
Receivers are available that will decode all the various types of systems.

The most popular VHF/UHF digital voice system is Digital Mobile Radio (DMR) – see https://vkdmr.com/

The following images show a DMR handheld with access to the DMR network via a low power RF link to an internet connected hotspot.

An example of a DMR radio connecting to an internet linked DMR Hot Spot

In terms of HF digital voice there are some open source developments of interest to amateurs.
FreeDV is a Digital Voice mode for HF radio. You can run it using a free GUI application for Windows, Linux and OSX that allows any SSB radio to be used for low bit rate digital voice.

FreeDV is being developed by an international team of radio amateurs working together on coding, design, user interface and testing.
https://freedv.org/

In Summary

- Digital data and voice modes are available for all Australian Licenced Amateurs;
- This is an exciting time as developments are occurring all the time in an expanding field;
- Remember that HF digital modes have a very high duty cycle and careless use can cause expensive damage to your transceiver.

Software Defined Radio

"Software-defined radio (SDR) is a radio communication system where components that have been traditionally implemented in hardware (e.g. mixers, filters, amplifiers, modulators /demodulators, detectors, etc.) are instead implemented by means of software on a personal computer or embedded system."
a-review-of-software-defined-receiver/

Many SDRs are simply a black box that connects to a PC, but more recently, SDR technology has been incorporated into "traditional" transceivers technology. Perhaps the most well known and popular "conventional" looking SDR radio is the Icom IC-7300. .

Entry level SDRs represent very good value for money and open a whole new world of operational capability and functionality.

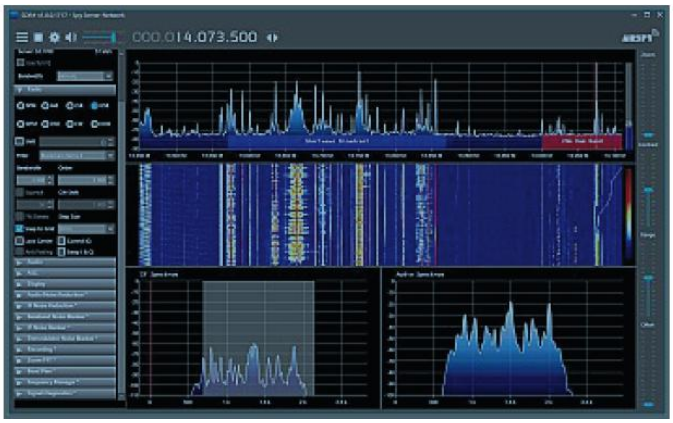
The benefits of Software Defined Radios

Software Upgrades

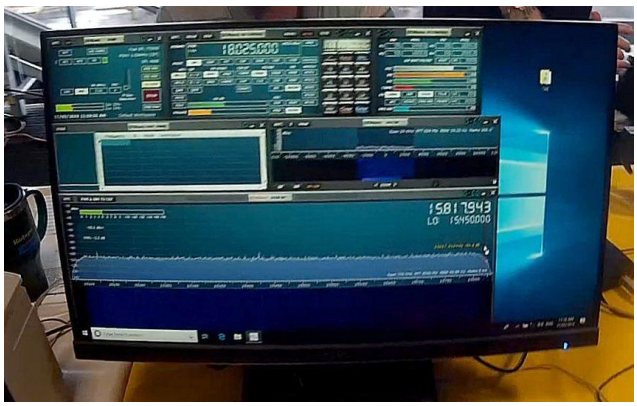
Being a Software Defined Radio means that most of the functionality is written in code. The code is always under development; patches, new features and improvements to performance. Software also allows an incredible range of features and options.

Spectrum display

SDRs have a spectrum display. Spectrum displays allow you to view an entire band, or just a segment of the band you are interested in. This "window" is displayed on a computer screen or on an inbuilt screen on the radio.



Spectrum displays have opened a whole new paradigm in allowing amateurs to visualise a section of the RF spectrum. You can "see" radio signals, interference and noise up and down the band; you have a visual window into the radio spectrum. Once you've used a spectrum scope, you'll always want to have one in the shack.



SDRs are feature rich

SDRs have an incredible selection of features and options. Receivers offer sophisticated DSP, noise blankers, pass band filters and specialised software to improve signal reception.

The screen can be configured to suit the user, the mode and the functions being used. Changing configuration settings is easier and individual settings can be tailored to suit the operator's preferences.

Most SDRs will allow you to operate digital modes without a separate computer. All you need is the digital mode software; it will integrate seamlessly with your SDR radio.

You can very easily record a QSO, take a digital photo of your Spectrum Scope, use recorded messages to call CQ, hand out contest exchanges and see all your settings at a glance.

Finally, most SDRs will allow remote operation. This is a fantastic feature if you travel a lot, or would like to set up a station in a nice quiet location but still operate from your home QTH.

Multiple receivers

Traditional transceivers have one receiver. You may be able to switch between VFOs, but you've only got one receiver. Many SDRs provide multiple virtual receivers. This means you can listen to both sides of a pileup at the same time, monitor more than one band at a time and very quickly switch between bands to monitor signals of interest.

SDRs offer a broad range of functionality and entry level models have become quite affordable in recent years.

Popular examples of SDR radios include:

The ICOM IC7300 SDR

Traditional stand-alone SDR are available in popular models:

- ICOM IC-7300
- Yaesu FT-DX101D
- Elecraft K4

Examples of black boxes requiring a computer or screen:

- Flexradio (Full featured high end)
- SDR Play (great low cost receiver)
- Apache Labs Anan

Remote SDR

You can test-drive some remote SDR radios http://kiwisdr.com/ Be careful… you could end up making these remote SDRs your favourite "go-to" web sites. Not only do you get to use some great gear, you also get to experience radio propagation conditions from all around the globe.

Shack Accessories

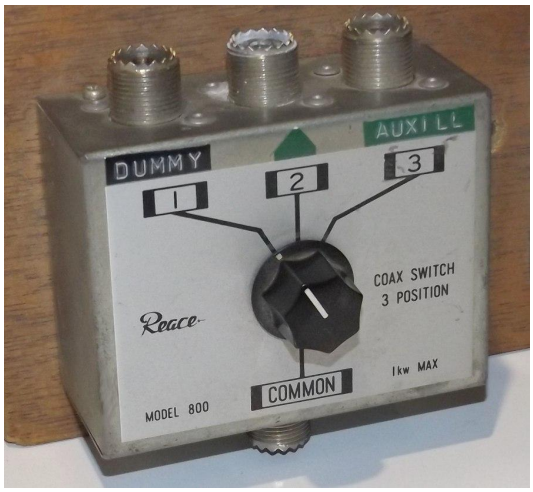
SWR Meter

The Voltage Standing Wave Ratio (VSWR) meter is used to measure the standing waves present on your feedline. This meter is used to ensure you have a suitable match between your transmitter and antenna system.

Antenna Analyser

Modern antenna analysers have become reasonably affordable. You'll find good second hand ones from time to time. Experimenting with an antenna analyser is a great way to tune your antenna and also learn more about antenna and feedline theory.

Antenna switch



A quality antenna switch makes switching between more than one antenna very handy. You will find good second hand switches for sale from time to time. For up to 100W on HF, most commercial switches will work fine. If in doubt, ask around.

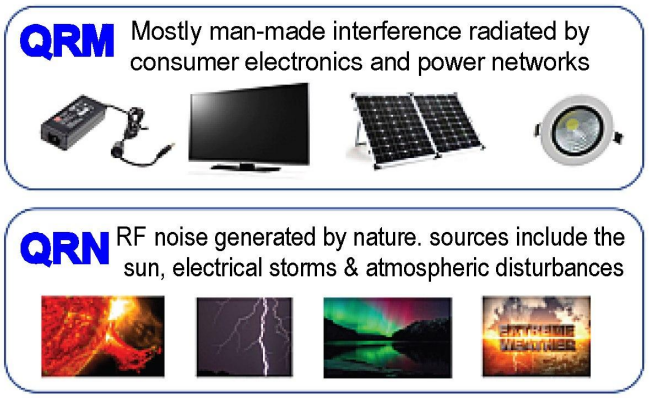
Antenna Matching Unit (or Antenna Tuner)

An antenna matching unit (also called an Antenna Tuner) helps you match your antenna to your transmitter. There is a lot of theory behind matching units. Efficiency is key; a "low VSWR" may not mean that you are radiating all your power. Peter Parker provides good advice on ATU's and how to home brew; especially for lower power stations. Links are provided in the "Where to next" section of this Guidebook.

Dealing with Interference

You're new to Amateur Radio and possibly overwhelmed with information and options on where to start. More than likely, if you live near a city or in the suburbs, and you operate on HF, you will suffer some level of noise that interferes with your receiver.

The good news is that as you are running relatively low power, it is most likely that your transmissions will not interfere with TVs, radios or other household appliances.



There are basically two types of noise that can create interference.

QRM is man made noise - usually from electrical appliances in your home, or the mains power lines.

QRN is noise made by nature. Most typical are thunder storms.

Sometimes, most noise that impacts your radio will be generated inside your own home. This will be relatively easy to resolve (unless it's your solar inverter system – but that's another story).

Noise can also be generated from poor quality appliances nearby, for example in your neighbours' houses - examples include LED lights and garage door openers.. Mains power line noise is also not uncommon.

If you find noise is interfering with your station, head over to QRM Guru and learn about the process of locating and eliminating noise. If you need help, please send us an email.

Website: https://qrm.guru/

QRM Guru offers a rich cache of educational material, tools, techniques, instructional videos and case studies to help you locate and resolve your QRM problems.

If you have trouble understanding the processes or working through your issues just send an email. feedback@qrm.guru

Safe electrical practices

Introduction

This chapter is not a complete reference and we strongly advise that you seek information from suitability qualified people when engaging in activities where there is the potential of significant risk. Your local radio club may be of assistance.

Amateur Radio activities are not inherently hazardous, but like many things in life, there are some risks. Safety is about taking steps to understand, avoid, reduce or manage risk.

We all perform a ***Risk Analysis*** subconsciously when presented with everyday tasks. With new activities we perform a more formal Risk Analysis where we think carefully about the task. We consider our approach, identify the potential risks followed up with ways to eliminate, minimise or manage risk to an acceptable level.

Electrical Safety

Risks are not limited to but include; Electrocution, Shock, Burns and Fire. The Amateur License Assessment covers some important aspects of electrical theory and safety, but does not qualify you as an Electrician or Electrical Engineer.

- **Do not work on mains voltages (230V AC) unless you are suitably qualified.**
- **Avoid valve equipment – this can be very dangerous to repair, as the high tension voltages used with valves are lethal**
- **Do not substitute fuses with the wrong type or rating. The fuse blew for a good reason!**

Battery Safety

Today's batteries are capable of supplying large currents and use chemistry that may produce heat and toxic gasses during normal charge and discharge use. Exceeding the battery's specification or damaging its casing will likely result in excessive heat, fire, explosion and emission of toxic gasses.

- Ensure that the terminals of a battery are not in risk of short circuit.
- Read the specifications and do not exceed the rated discharge current and in the case of rechargeables, the charging current and voltage.
- Do not attempt to charge non rechargeable batteries.
- Use fuses in both the positive and negative leads attached to a battery.
- Small button cells must be kept secure and away from children!
- Dispose of spent or defective batteries in accordance with local laws and manufactures recommendations.

What to do in case of Electric Shock

- Check for danger to yourself, bystanders and the patient.
- Switch off power, if possible, before helping the patient. Don't be the second victim.
- If power cannot be switched off quickly, remove the patient from the electrical supply without directly touching them. Use a non-conductive, dry material (eg a dry wooden broom handle)
- Commence CPR and call 000.

Safe Electrical Practices include:

- Make sure all power points in your house are protected by a residual current device (RCD – fitted to all new houses)
- Do not work alone.
- Learn CPR. Enrol in a First Aid Course

Electromagnetic radiation

The ACMA has a requirement that all transmitting stations assess the risk that a station presents in relation to human exposure to radiofrequency electromagnetic fields, generally termed electromagnetic radiation (EMR) or electromagnetic emissions (EME).

Electromagnetic radiation in amateur radio is generally not a major issue if you follow safe practices.

- Locate antennas away from where people can get close to them. This is always a good idea since touching an antenna radiating even low-power signals can result in an RF burn.
- Raise the antenna. This is another good idea because it usually improves your signal in distant locations.
- Limit the average power of your transmissions by transmitting for shorter periods or even using a mode with a lower duty cycle.
- Again, seek the assistance of a knowledgeable club member or professional.

Some other safety risks to consider

- Erection or climbing of towers should be left to suitably experienced and qualified people.
- When erecting antennas – "Look up and live", Be aware of any nearby overhead power service.
- Beware of cables becoming a trip hazard.
- Disconnect antennas when there is a possibility of lightning.
- Investigate RF earthing requirements.
  Grounding systems in Ham Shacks

Think first before attempting any activity.

There is no substitute for common sense and there is no second chance with 230 volts….

Where to next?

We hope this Guidebook provides a pathway as you commence your journey into the magical hobby of Amateur Radio. This final chapter provides some useful references and links to information and websites that we think you'll find useful.

The ACMA

The Australian Communications and Media Authority Information regulates our hobby. You can read more about the ACMA here:

https://www.acma.gov.au/amateur-radio-licences

https://www.acma.gov.au/amateur-radio-operating-procedures

Where to buy equipment

For second-hand equipment:
http://vkclassifieds.net.au/

and of course, you have eBay and various Facebook pages to search.

Some Australian suppliers of new equip:

http://rippletech.com.au/

https://tetemtron.com/

Antenna & mast supplies

https://www.nbsantennas.com.au/

Communications equipment suppliers:

http://www.andrewscom.com.au/

https://futuresystems.com.au/communications-solutions/future-systems-amateur-radio/

http://rfsolutions.com.au/

https://www.secomms.com.au/

https://www.strictlyham.com.au/

Some useful links about radio propagation

Propagation is a subject all its own. You can study and experiment with propagation, and in preparing for your exam you would have touched on the basics. Some further references are provided as you get more active and take an interest in what makes radio waves travel beyond line of sight.

http://www.arrl.org/propagation-of-rf-signals

https://dx.qsl.net/propagation/

The Australian Bureau of Meteorology provides some very good services and their web-site is quite comprehensive.

https://www.sws.bom.gov.au/Educational/5/2/2

Other links of general interest:

we provide the following useful links as you navigate your way into the hobby.

PSK Reporter monitors real time radio traffic and plots these onto a map. This is an interesting and informative service to help understand how the ionosphere is performing.
https://www.pskreporter.info

Keeping a Log of your radio contacts

It is no longer a legislative requirement to maintain a log book. However, many Radio amateurs like to maintain a log book as they work towards awards and participate in contests. Paper log books are rarely used these days.

Integrated Logging software offers many functions, including radio control, data transfer and various other tools.

If you intend to keep a log or integrate a computer into your operations, you should investigate various software options and see what others are using.

Two very popular options are:

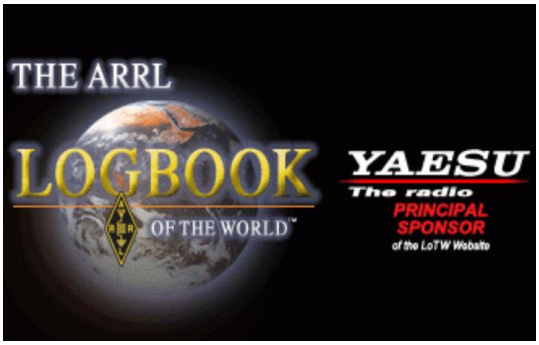
DX Lab Suite
https://www.dxlabsuite.com/

Ham Radio Deluxe
https://www.hamradiodeluxe.com/

And for Apple users:
MacLogger
https://www.dogparksoftware.com/MacLoggerDX.html
A global database containing millions of logs from all around the world.

Clublog:
https://clublog.org

And ARRL's **Logbook of the World** (LoTW) is very popular for Award hunters
http://www.arrl.org/logbook-of-the-world



Other useful links to get you started:

Online lookup database of callsigns, AR News, Forums, and also an online log and Award system.
https://www.qrz.com/

An online QSL system. Very popular for Award chasers.
http://eqsl.cc

Articles, Forums, News, Product reviews,
https://www.eham.net/

Useful calendar of nearly all AR Contests
https://contestcalendar.com/

Portable operation – great reference if you intend to work portable
https://parksnpeaks.org/

Morse Code

Morse code is no longer a requirement to obtain your licence. However, many radio amateurs around the world keep "the code" alive and obtain great satisfaction from the "original digital mode".

If you have an interest and would like to know more, visit the local Chapter of the International Morse Preservation Society,
http://www.fdu.org.au/

Syncing your computer's clock

Most text digital modes (e.g. FT8) require your computer's clock to be very accurate. Here are some reference sites:

http://www.thinkman.com/dimension4/

https://www.maniaradio.it/en/bkttimesync.html

https://www.meinbergglobal.com/

Join your local Club

Clubs represent the grass roots of our hobby. Find a club close to you and head to a meeting. Don't be shy. Introduce yourself and ask for help.

https://vkradioamateurs.org/list-of-vk-amateur-radioclubs/

Australian Amateur Radio Handbook

Peter Parker, VK3YE is a very well-known VK amateur. He has produced dozens of YouTube instructional videos, articles and books on how to get started and get the most out of the hobby. And all in a friendly, laid back style. Visit Peter's http://vk3ye.com/ for more information.

We recommend Peter's Australian Amateur Radio Handbook. You can buy it as a hardcopy or an ebook

Further Education

As you get more involved in the hobby, you may want to learn more and upgrade your licence. Many local clubs provide training courses. The Radio and Electronic School http://res.net.au/ run by Ron Bertrand VK2DQ provide a great service.

RES
Radio & Electronics School
Established 1997

Ron has also authored a very popular book covering all the topics you'll need to upgrade your licence.

Australian Maritime College (AMC)

The AMC administer Examination and Callsign services on behalf of the ACMA. Visit their web-site for more information.

https://amc.edu.au/industry/amateur-radio

AMC Australian Maritime College | UNIVERSITY of TASMANIA

Amateur radio provides a vast range of activities and interests. Think about what attracted you to the hobby and start there. Do your best to meet others, join a club and start to investigate the many facets that make Amateur Radio one of the most diverse and interesting hobbies in the world.

Experiment, operate and have fun.
73,

Radio Amateur Society of Australia inc

The Radio Amateur Society of Australia

The content of this guidebook is provided in good faith. If you find errors or have suggestions for improvements please send us an email.

As this is an e-book we intend to publish updates based on readers' feedback.

Version 1.2
12th May 2021