

Revision notes for Foundation Licence Exam V4 SARC 05 NOV 2010

Notes may help for a last minute revision before sitting for the Foundation Licence Assessment.

Chapter 1 Electricity, Frequency & Wavelength

The basic Units of electricity are:

E = EMF (ElectroMotive Force) measured in Volts (V)

I = Current measured in Amps (A)

R = Resistance measured in Ohms (Ω)

P = Power measured in Watts (W)



Ohms law $E=I \cdot R$ Remember the equation and derivatives or use the E-I-R triangle

Electrical power $P=E \cdot I$ Remember the equation and derivatives or use the P-E-I triangle

Know these multipliers:

milli (m) thousandth of 10^{-3} times

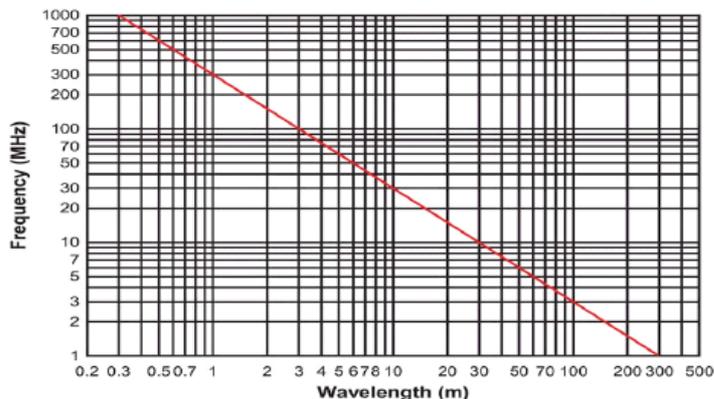
kilo (k) thousand times 10^3 times

mega (M) million times 10^6 times

Read the question carefully to look for words from ... to ... Get the direction of conversion correct.

When performing frequency (f) to wavelength (λ) conversions recall that the speed of light (C) is = 300 Million m/s which gives the formula $C=f \cdot \lambda$.

In radio this is usually expressed as $300=f(\text{in Megahertz}) \cdot \lambda(\text{metres})$ See the triangle version below or use the conversion chart.



Look out for words in the question like “**half** wavelength dipole or **quarter** wave vertical”

The chart usually appears with the relevant question and a bigger one on the last page – even if you don't have a frequency to wavelength conversion question.

Table of frequency ranges

| | | |
|----------------------|-----|-------------------|
| Audio Frequency | AF | 15 Hz to 30 kHz |
| Voice Frequency | VF | 300 Hz to 3 kHz |
| Low Frequency | LF | 30 kHz to 300 kHz |
| Medium Frequency | MF | 300 kHz to 3 MHz |
| High Frequency | HF | 3 MHz to 30 MHz |
| Very High Frequency | VHF | 30 MHz to 300 MHz |
| Ultra High Frequency | UHF | 300 MHz to 3 GHz |

If you're given a table like this then **use it**. The answer is sure to be in the reference table.

Chapter 2 Transmitters and Receivers

Receiver (RX) and Transmitter (TX) block diagrams. Which is the missing label?

The question will tell you that it's a transmitter or tell you it's a receiver.

Then:

Look for the antenna symbol. That's the RF end. Power amplifier for TX and RF amp for RX.

Look for the microphone or speaker symbol. That's the audio end. Audio amplifier for RX & TX.

You'll have to work out the middle blocks yourself. Think of Modulator, Oscillator, Detector, etc.

Know that **AM** means Amplitude Modulation

Know that **FM** means Frequency Modulation

Know that **SSB** (single sideband) is a form of amplitude modulation.

Receiver have three 'S' characteristics:

Sensitivity = Ability to pick up weak signals

Selectivity = Ability to select (or pick) one signal from another when frequencies are close

Stability = Ability of RX to remain on the required frequency even if the temperature changes

Foundation Licence power level is 10Watts pX. (PEP or Peak Envelope Power)

pX is used to express the power in a variable signal such as SSB.

pY (Mean Power) is used to express the power in a constant signal such as FM.

Modulation The way voice frequencies are converted to radio frequencies. Excessive modulation causes distortion and interference to others on adjacent frequencies.

Bandwidth The amount of frequency spectrum (space) the signal occupies.
(CW narrow band width; SSB more bandwidth; FM even more bandwidth)

Deviation A term used with FM signals describing the amount by which the voice frequency changes (deviates) the carrier frequency.

Chapter 3 Antennas & Transmission Lines

Transmission lines:

Balanced = parallel line – symmetrical – flat TV ribbon or ladder line

Unbalanced = Coaxial cable – round with an outer shield and an inner conductor.

Antennas convert electrical signals to radio waves & vice versa

Antenna **gain** is measured in **decibels** (dB also dBi and dBd)

An antenna is **resonant** when its length is related to the wavelength of operation.

An antenna that radiates (or receives) better in some directions than others has **directivity**.

ERP = Effective Radiated Power. = Transmitter power times antenna gain (less losses)

SWR = Standing wave ratio = ratio of power out to power reflected back.

Less than 1.5:1 Considered acceptable

1.5:1 to 3:1 Needs adjustment of antenna - (probably length)
or compensate using an Antenna Tuning Unit (ATU)

Greater than 3:1 Major problems. Look for short circuits, open circuits, wrong antenna etc.

A **Balun** (Balanced to Unbalanced) is used to match coax (un-balanced feeder) to a dipole (balanced antenna) to prevent currents flowing down the outside of the coax. These currents can cause unwanted radiation (eg interference).

Chapter 4 Propagation

Isotropic antenna = theoretical point source radiator that radiates equally in all directions.

Radio waves travel in free space in straight lines.

The power of a radio wave reduces in proportion to the square of the distance from the source.

Inverse square law reduction. Think of the heat from a camp fire – twice the distance back means a quarter of the heat.

Ionosphere = Upper layer of the atmosphere ionised by the sun.

VHF/UHF signals pass through the ionosphere but HF signals are refracted back down to earth.

Troposphere = Lower layer of the atmosphere where we live.

VHF/UHF signals can be trapped between different layers in the troposphere and ducted an abnormally long way.

Reflection – Signal bounced off solid material – The Ground, water, Metal objects

Refraction – Signal bent slowly & gradually – Ionosphere – HF radio propagation

Diffraction – Knife edge VHF/UHF signals fill in shadow beyond line of sight.

Sun Spot cycle – More sun spots = stronger ionosphere = better HF propagation

Chapter 5 Transceiver Controls

Usual only part of practical exam.

| Control | Function |
|-------------------------------------|---|
| Power On/Off | Master control for the whole T/R. |
| AF Volume | How loud the audio comes from the speaker. |
| Squelch or Mute | No noise from the speaker if there's no signal stronger than the level set. |
| RF Gain | Controls the sensitivity of the receiver. Used to cut reduce strong signals. |
| Band Switch | Select desired band on a multi band set ie. 80M or 40M / 2M or 70CM. |
| Frequency control (VFO) | Move to desired frequency in the selected band. |
| Mode switch | Select desired modulation SSB? LSB? FM? AM? CW? |
| RIT – (Receiver Incremental Tuning) | Change the RX frequency slightly without moving the TX frequency. |
| Selectivity (Wide / narrow) | Adjustable selectivity to cut out unwanted adjacent signals or increase the receiver bandwidth to hear more of the signal (eg when listening to an AM signal). |
| Power Output | Ability to set the output power level of the transmitter. |
| Carrier | Can be used to set CW or AM power level. |
| Microphone Gain | Matches the loudness of your voice through the microphone to the modulation stage of the transmitter. Used to prevent over modulation which causes distortion and interference. |
| Tune / Load | Sometimes present to allow the output stage to be tuned (adjusted) to match the transmitting frequency. Normally found in valve transmitters but not in modern solid state equipment. |

Chapter 6 Safety

Electrical

Electrical Safety Earth. Part of the AC mains power protection. Never remove a safety earth connection. Do not remove the covers of any mains powered equipment.

Australian mains voltage was nominally 240V until 2000. Now 230V (AS 30068:2000)

High voltages = Electrocutation risk

High Currents = Fire risk

First Aid. Do not touch the person without isolating the power off first.

Always replace **fuses** with one of the **same type and current rating**.

Electrical Safety Switch – Residual Current Detectors – Earth Leakage Circuit Breakers

Approved Appliances – Mains powered equipment must have a compliance sticker with **standards tick** and compliance number.

Only suitably qualified persons are legally permitted to work on mains powered equipment.

Battery Safety

Batteries usually contain hazardous chemicals – corrosive chemicals.

Keep away from children – Don't short circuit or burn – dispose of properly.

Some batteries need to be used in a well ventilated location.

Radiation Safety

High levels of electromagnetic radiation can be very dangerous.

The **higher** the **frequency** and the **higher** the **power**, the **higher** the **danger**

Particularly note previous section on ERP. Radiation levels are much higher in front of high gain antennas. Foundation Licence power levels and frequencies are normally considered low risk.

The best position for antennas is as high as possible out of reach of people & animals.

Cables & Leads

Keep things neat, tidy & out of the way so there are no trip hazards.

Erecting Antennas

Keep away from power lines.

Consider what may happen if the antenna falls during erection and later in use.

Working at heights has safety (fall risk) and legal issues (OH&S – insurance)

Lightning

Disconnect antennas before lightning arrives. Don't operate in an electrical storm.

Provide a lightning earth for towers, antennas etc. This earth may also double as a signal earth for better antenna performance. Don't use gas pipes for an earth.

Headphones

Loud noises – both wanted signals and unwanted 'noise' in headphones can damage your hearing.

Chapter 7 Electromagnetic Compatibility, Immunity & Interference

EMC = Electromagnetic Compatibility = Ability of sensitive electronic equipment to operate in close proximity to other sensitive electronic equipment.

EMI = Electromagnetic Immunity = Ability of electronic equipment to operate in strong electromagnetic fields.

Interference = Reception of unwanted signals.

Radiated interference Usually from your antenna into the other equipment (Is your antenna near or in the path of the TV antenna?) Move the antenna.

Conducted interference Conducted through mains wiring, speaker wires etc.

Cures for interference.

Reduce power

Move Antenna

Avoid problem frequencies

Fit RF filters to antenna feed line

Fit a balun to your antenna

Fit (build) a filter on the stereo speaker leads

Install a mains filter

A good signal earth helps reduce interference.

Ensure you are operating correctly (especially avoid over modulating) and your equipment is not producing spurious signals or harmonics.

You **must not transmit** if you are causing **harmful interference**

The ACMA can impose restrictions on your licence and even tell you to shut down.

Chapter 8 Regulations

Amateur radio is a **hobby**, for **self-training** – **no commercial purpose or entertainment**.

Used for experiments and to talk to other amateurs – nobody else (except in an emergency)

The use of secret codes (Morse code & Q codes aren't secret) is not permitted except in an emergency or emergency training.

Amateur radio licences are issued in Australia to holders of appropriate certificates of proficiency.

An amateur radio licence is subject to:

Radiocommunications Act 1992

Radiocommunications Regulations 1993

Radiocommunications Licence conditions (Amateur Licence) Determination No1. 1997 (known as the **LCD**)

Radiocommunications Licence Conditions (Apparatus Licence Determinations 2003)

Bands Set by the ACMA as part of an international agreement.

| Frequency | Allowed modulation |
|-------------------|--------------------|
| 3.5 – 3.7 MHz | AM, SSB, CW |
| 7.0 – 7.3 MHz | AM, SSB, CW |
| 21.0 – 21.45 MHz | AM, SSB, CW |
| 28.0 – 29.7 MHz | AM, SSB, CW, FM |
| 144 – 148 MHz | AM, SSB, CW, FM |
| 430.0 – 450.0 MHz | AM, SSB, CW, FM |

Foundation licensees can't use digital modes including D-Star.

Foundation licensees can't establish an IRLP or Echolink node. However they can use IRLP and Echolink via a repeater or computer terminal.

Foundation Licensee stations must not operate in automatic or computer controlled mode.

Foundation (and all other) licensees must not permit an unqualified person to operate their station.

Foundation Licensee stations must not operate when directly connected to the public telecommunications network – this includes the internet.
Foundation licensees must only use commercially manufactured transmitting equipment.
Making your own antennas is permitted.

Third Party Traffic Australian amateur stations can pass third party traffic provided:

No financial gain.

The third party message does not relate to the business or otherwise commercial traffic and is not an advertisement or entertainment.

Overseas third party traffic can only be conducted with countries that have an agreement with Australia.

Emergency signals made up of Mayday (distress) and Pan Pan (urgency)

If you hear an Emergency call: First listen to see if some authority responds. Then respond if nobody else does. Convey the message to the appropriate authority. Continue listening and assist as required.

Station Identification

You must **identify your station by using your call sign at the beginning of a transmission or a series of transmissions and at least every 10 minutes during a series of transmissions.** That's it!

Australian Amateur Radio Call Signs Be able to identify them.

Especially be able to identify the state by number EG 2=NSW, 3=Victoria etc.

Also have a knowledge of the licence level as determined by the letter after the number.

EG. F+3 more letters = Foundation licence,

Standard licence call signs have 3 letters and start with N, M, L etc. (not a complete list)

Advanced licence call signs have 2 or 3 letters. The 3 letter call signs start with A-E, J-N, X-Z etc. (not a complete list).

Don't be fooled by call signs implying other countries (eg VK2USA)

or misleading suffixes (eg VK4NSW is a Queensland station NOT a station in New South Wales.)

The ACMA inspector can ask to see your licence.

The ACMA can impose restrictions on the operation of your station. Including the need to keep a log book of your transmissions.

Station security

Your amateur radio station must be kept secure to prevent unlawful and unlicensed operation.

Note: the method of securing your station is not specified.

You must inform the ACMA of changes to your address.

Chapter 9 On Air Mainly part of the practical assessment.

The phonetic alphabet is used to improve clarity and understanding.

The 'Q' codes are used to improve clarity and understanding.

Listen before you transmit

See the regulations section (Chapter 8)