Radiotelephone Communications

Radio Operator Reference Manual (AROC)

CONTENTS

1. REGULATORY REQUIREMENTS AND PRIVILEGES OF A RADIO OPERATOR 3

2. RADIO WAVES, BANDS AND PROPAGAION CHARACTERISTICS 4

2.1 Introduction to Radiotelephony 4
2.2 Radio Waves and the Atmosphere 4
2.3 Measurement of a Frequency 5
2.4 Radio Interference 6
2.5 Radio Frequency Bands 7

3. THE RADIO TELEPHONE SYSTEM 9

3.1 Tower, Radio Room, Aircraft and Portable Radio Units 9
3.2 Primary Components and Functions of a Radio Unit 11

4. RADIO OPERATOR DUTIES AND RESPONSIBILITIES 12

5. PHONETIC ALPHABET, NUMERALS AND STANDARD PHRASEOLOGY 13

5.1 Transmitting Technique 13
5.2 Phonetic Alphabet and Numeral Pronunciation 14
5.3 Standard Phraseology 15
5.4 Ground Station Call signs 17
5.5 Application of Numerals in Radiotelephony 18

6. RADIO OPERATIONS & TRANSMISSIONS 20

6.1 Restrictions & Courtesy 20
6.2 Establishing and Maintaining Communications including Station Identification 20
6.3 Abbreviations 21
6.4 Radio Test Readability Scale 21
6.5 Test Transmissions 21
6.6 Simultaneous Transmissions (Over Transmissions) 22
6.7 Complying with Instructions – NOT clearances 22
6.8 Transmission of Time 23
6.9 Automatic Terminal Information Services (ATIS) 23
6.10 Ground Vehicle Callsigns 23
6.11 Special Task Callsigns 23
6.12 Position Reporting by Aircraft 24
6.13 Corrections and Repetitions 24

7. EMERGENCY CALLS AND TRANSMISSIONS 25

7.1 Declaring an Emergency – Emergency Message 25
7.2 Relayed Emergency Message 26
7.3 Emergency Call Actions 26
7.4 Termination of Distress Communications 26
7.5 Radio Silence 26
7.6 Emergency Locator Transmitter (ELT) 26

8. Communication Failure 27

9.1 Runway Nomenclature and Circuit Legs 28

1. REGULATORY REQUIREMENTS AND PRIVILEGES OF A RADIO OPERATOR

International radio regulations as guided by the International Civil Aviation Organisation (ICAO) required that all operators of radios utilising aeronautical frequencies, except those used solely for company use for Operational Control Communications (OPC), shall be in possession of a qualification recognised by the relevant government or civil aviation regulator.

In most cases, Flight Radio Operator Licences (FROL) are issued along with pilot's licence however for non-pilot flight crew and ground personnel conducting communications with aircraft, an additional licence or approval is more often required. For frequencies approved for use to provide air-ground communications, the necessary qualification in Australia is an *Aircraft Radio Operator Certificate (AROC)*.

Any persons within an organisation whom wish to participate in air-ground communications, must hold an AROC. This includes the UAV Operator. Just because the Chief Pilot holds an AROC, does not mean all UAV pilots within the organisation are approved to participate in air-ground communications. Each individual UAV Pilot must obtain an AROC to participate in air-ground communications.

2. RADIO WAVES, BANDS AND PROPAGAION CHARACTERISTICS

2.1 Introduction to Radiotelephony

Radiotelephony provides the means by which people can communicate over distances that would not normally be achieved without such equipment. Ground personnel, ship masters, aircraft pilots, and managers can all communicate with each other over vast distances using radio telephones. When used properly, the radio can provide vital information and instructions from personnel that not only can assist in safe and efficient operations, but can be a life line in any emergency. To be effective in communication, it is important to be precise and use standard procedures and phraseology so there can be no misunderstanding of any messages.

It is therefore important to point out that the use of non-standard procedures and phraseology can contribute to such misunderstandings. Incidents and accidents have occurred in which a contributing factor has been the misunderstanding caused by the use of non-standard phraseology. The important of using correct and precise standard phraseology cannot be over-emphasized.

2.2 Radio Waves and the Atmosphere

Radio waves are electromagnetic waves used to transport information through the atmosphere or outer space without the use of fixed wires. The easiest way to explain how radio waves move through the atmosphere is to compare it with dropping a stone into water and seeing the waves radiate out from the centre. This movement through the atmosphere is referred to as 'wave propagation'. As the waves move through the atmosphere, they will eventually become weaker and disappear. In addition, like waves in water, as they come in contact with obstacles, they can bounce or deviate.

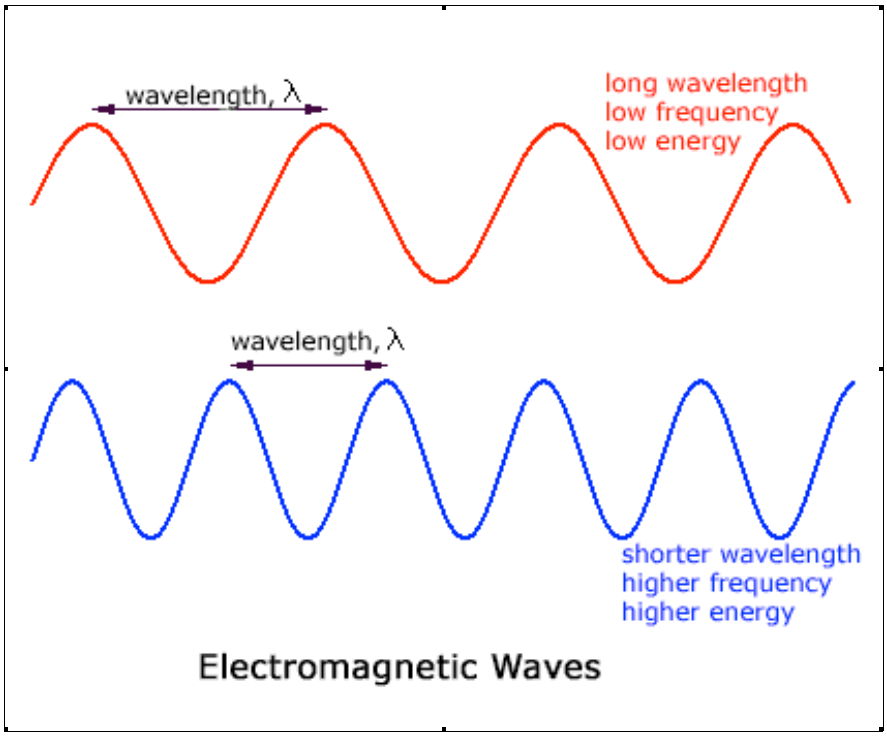
Let's look at the individual elements of radio waves and how they travel through the atmosphere.

Firstly, radio waves are distinguished from other kinds of waves by their wavelength:

The **Wavelength** is the distance between repeating units of a propagating wave of a given frequency.

The **Frequency** is a measure of the number of occurrences of a repeating event over a unit of time.

Radio Wave Propagation is a term used to explain how radio waves behave when they are transmitted or 'propagated' from one point to another in the atmosphere.



2.3 Measurement of a Frequency

Hz a Hertz is a measure of frequency, defined as the number of events occurring per second

kHz a Kilohertz is a measurement of frequency equal to 1000 hertz (one thousand)

MHz a Megahertz is a measurement of frequency equal to 1,000,000 hertz (one million)

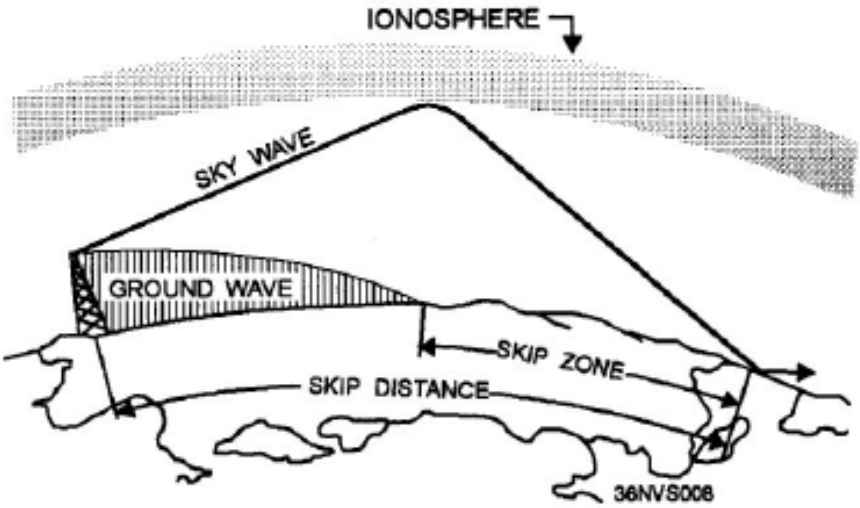
GHz a Gigahertz is a measurement of frequency equal to 1,000,000,000,000 (one billion)

The most common and relevant radio waves for the purpose of ground to aircraft radio communications include:

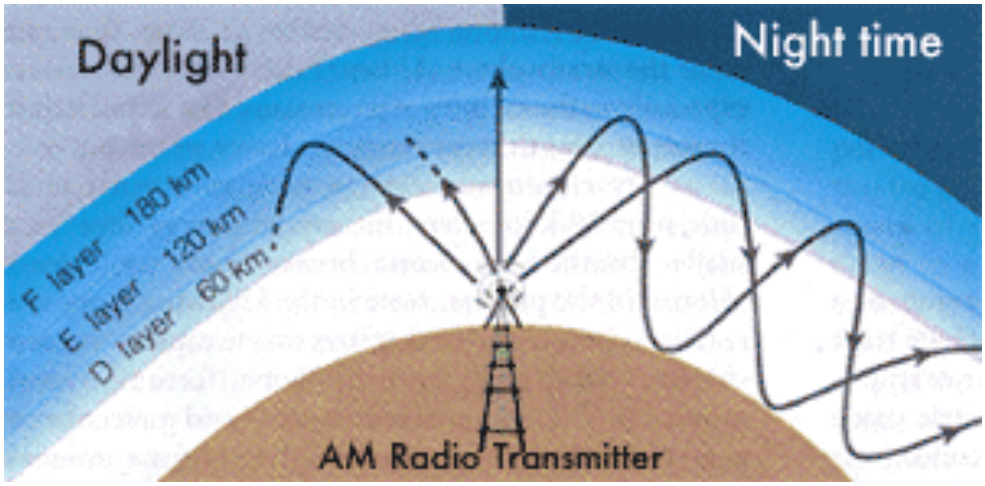
- Ground Waves – are surface waves that propagate close to the surface of the Earth
- Sky Waves – are the electromagnetic waves travelling through the atmosphere bent or refracted back to the Earth by the ionosphere.
- Space Waves (Direct Waves) – follow two (2) distinctive paths; from the transmitting antenna to the receiving antenna

Ground Waves typically cover shorter distances as they rely solely on the strength of the signal travelling through the atmosphere.

Sky Waves travel through the atmosphere (propagation) and bounce off the ionosphere back to the Earth and can continue to bounce or skip over the Earth's surface vast distances. Skip or Skip Distance is the term referred to when a radio wave reflects or bounces off the ionosphere and back to the Earth's surface. The Skip Zone is the area on the surface between the coverage of Ground Waves and Sky Waves that misses the radio signal.



The ionosphere is the upmost part of the atmosphere and is distinguished from other layers as it is ionized by solar radiation. It plays an important practical function as it influences radio propagation and can be said to be of assistance in lengthening the distance of radio waves.



The level of assistance that the ionosphere plays varies due to the sun's interaction with it. During the daytime, the sun's rays hit the ionosphere and many of the atoms lose their electrons and turn into ions. At night time, this interaction does not occur and results in the ionosphere reflecting radio waves more so, therefore resulting in a stronger signal at night. This is why radio signals can be picked up better at night than during the daytime.

2.4 Radio Interference

There are a number of factors that affect the propagation of radio waves in the atmosphere apart from the ionosphere. Other obstacles to the radio waves can include, terrain (mountains), interference from nearby electrical equipment, thunderstorms and power attenuation (reduction). All of these elements can affect signal strength and provide what is call *interference*.

Radio Operators should be aware that when using Very High Frequency (VHF) transmissions, communication is achieved over the direct line path between, for example, an aircraft and your ground station aerial (antenna) which could be a portable radio. The

radio horizon, like the visual horizon (an obstacle), will therefore increase as the aircraft's height increases. For an aircraft flying at 3,000ft, the radio horizon is 67 nautical miles (nm) which means an aircraft transmitting at that height can be heard by any ground station listening on the same frequency and located anywhere within 67nm radius of the aircraft's position.

If, on land for example, any mountain range or buildings blocking a radio wave signal will decrease its effectiveness by either not being picked up by the receiver or having the signal reflect back or refract in another direction.

2.5 Radio Frequency Bands

Radio Frequency (RF) is a frequency or rate of oscillations in a signal wave. We already know that the *Frequency* is a measure of the number of occurrences of a repeating event over a unit of time.

Band Name	Abbreviation	ITU*	Frequency and Wavelength in air**	Example of uses
			<3Hz >100,000km	
Extremely low frequency	ELF	1	3 – 30Hz 100,000km – 10,000km	Communication with submarines
Super low frequency	SLF	2	30 - 300Hz 10,000km – 1000km	Communication with submarines
Ultra low frequency	ULF	3	300 – 3000Hz 1000km – 100km	Communication within mines
Very low frequency	VLF	4	3 – 30kHz 100km – 10km	Submarine communication, avalanche beacons, wireless heart rate monitors, geophysics
Low frequency	LF	5	30 – 300kHz 10km – 1km	Navigation, time signals, AM long wave broadcasting
Medium frequency	MF	6	300 – 3000kHz 1km – 100m	AM (Medium-wave) broadcasts
High frequency	HF	7	3 – 30 MHz 100m – 10m	Shortwave broadcasts, amateur radio and over-the-horizon aviation communication
Very high frequency	VHF	8	30 – 300MHz 10m – 1m	FM, television broadcasts and line-of-sight ground-to-aircraft and aircraft-to-aircraft communication
Ultra high frequency	UHF	9	300 – 3000MHz 1m – 100mm	Television broadcasts, microwave ovens, mobile phones, wireless LAN, Bluetooth, GPS and 2-way radios (e.g. RFS and GMRS radios)
Super high frequency	SHF	10	3 – 30GHz 100mm – 10mm	Microwave devices, wireless LAN, most modern radars
Extremely high frequency	EHF	11	30 – 300GHz 10mm – 1mm	Radio astronomy, high-speed microwave radio relay
			Above 300GHz <1mm	

* ITU Band – International Telecommunication Union

** Note: This distance is the wavelength itself and not the distance the signal has travelled

In aviation, the aviation band radio frequencies used are VHF and where VHF coverage is not available such as remote areas, HF is used. UFH is also used but to a lesser extent and found in military use and in some ground/surface to air communications.

The frequencies in use within any given region will vary and will be published in various operational documents. For example, within Australia, they are published in the En-route Supplement Australia (ERSA) for airport frequencies and for area frequencies, they are shown on aeronautical maps such as Planning Chart Australia, Visual Terminal Charts, En-route Low Charts, etc. These details will be found in similar places in other operating regions worldwide.

3. THE RADIO TELEPHONE SYSTEM

Two-way radio systems are the most commonly used communications systems for many industries. This is due to not only its effectiveness, but cost, as 2 way communications can be established with very little investment in time and money. Regardless, the system enables the delivery of essential voice communications where and when it's needed most. These situations can include normal operations but they play a more vital role during emergencies.

The radio unit itself, whether it be a base unit or portable unit, is essentially made up of:

- base unit (VHF, HF, UHF or portable VHF)
- a microphone
- headphones and/or speaker
- cabling (for fixed base units)
- power supply (electrical or battery), and
- an antenna

There can be any number of stations (or units) that can make up a network. They can include:

- Base Station (radio room)
- Portable Handsets
- Helicopters
- Planes
- Vessels
- Vehicles

All stations on the same frequency within range will be able to hear and transmit within this network.

3.1 Tower, Radio Room, Aircraft and Portable Radio Units

A Control Tower or company operations radio room could be said to be the focal point of communications for all relevant operations. They are usually equipped with an array of communications equipment, including radios. Other forms of communication equipment and operations material may include:

- standard telephones
- satellite telephone(s)
- facsimile machine
- perhaps computer(s) with Flight Following Software (which can transmit data to an aircraft)
- portable radios and accessories such as portable radio rechargers
- lights (to transmit light signals)

A tower or company radio room will need to be equipped with the necessary tools for the Flight Controller or Radio Operator to achieve their duties effectively.

A typical base radio unit may look like the following which is a mounted radio device.

Portable handheld transceivers have similar characteristics.

A typical VHF aircraft radio unit will have face characteristics similar to the following.

3.2 Primary Components and Functions of a Radio Unit

Power/Battery and Power Switch	When turned to the ON position, provides power to the unit. A radio system may include a Master Switch if the unit itself is left on.
Transmitter	An electronic device that generates a radio frequency alternating current to the antenna creating radio waves. Can be separate to a radio device or integrated with a receiver with called a *transceiver*. Is symbolised as 'TX'.
Receiver	An electronic device that receives radio waves and converts the information to a usable form. It receives radio waves via an antenna. Information produced by the receiver may be in sound, image or data form.
Microphone	Converts sound into an electrical signal.
Speaker (also within headphones)	Produces sound in response to an electrical audio signal input.
Squelch	Is a function that suppresses the audio output of a receiver when the input signal strength is low. In two-way radios it suppresses frequency noise when the radio is not receiving a transmission.
Frequency Change Selector	Outer (larger) knob changes main channel; Inner (smaller) knob changes the decimal numbers.
Antenna	Works with the transmitter and receiver where it radiates the energy from the alternating current as electromagnetic waves or *radio waves*.

4. RADIO OPERATOR DUTIES AND RESPONSIBILITIES

The qualifications and experience required of someone operating a radio will vary from company to company depending on individual requirements. However, persons operating a radio on aeronautical frequencies are only allowed to do so if they have an approval from the relevant aviation regulatory whether that is by way of a pilot licence, air traffic controller license or a certificate of proficiency or competency. The duties of ground-air radio operators will also vary depending on the station they are manning, such as an offshore oil rig radio operator or helicopter landing officer (HLO), emergency services personnel at the scene of an incident or a staff member communicating with a company aircraft from their base. Regardless of the circumstances, all operators are responsible for correct usage of the equipment and to conduct themselves on the radio in a professional manner. This means that no offensive or personal details are transmitted and that standard phraseology is used wherever possible. Transmissions are also needed to be concise and clear to ensure that the frequency is not tied up for other users and that messages are clearly understood by others, particularly when transmitting an emergency message.

Generally, when operating a radio, radio operators are communicating with others for a purpose whether that be for work or during emergency situations. Communications could be used to pass on information from management to the flight crew and/or boat crew, conduct flight following checks, gain mission status and, if required, coordinate support services for crews such as calling for emergency services back up during an emergency. The radio can be a very important lifeline in many cases and therefore whenever an operator is not transmitting or receiving a message they should maintain a 'listening watch' on the frequency just in case another station broadcasts an emergency message.

Some of the duties and responsibilities of radio operators include:

- conducting normal radio communications
- coordinating emergency situations; providing information for inbound or outbound flightcrews and assisting in coordinating help and managing a response
- maintaining a 'listening watch' to recognise distress calls such as a PAN or MAYDAY call and noting the details broadcast by the station in distress
- relay a distress call (if required) to base or a contracting SAR/Medivac service
- maintain radio log books (perhaps at base)
- conduct daily radio equipment tests, including portable radios (especially battery charging), and
- basic maintenance of radio equipment

5. PHONETIC ALPHABET, NUMERALS AND STANDARD PHRASEOLOGY

5.1 Transmitting Technique

Communication success and clear understanding between all parties depends highly on the proper use of the radio. The effectiveness of such communications depends, to a great extent, on the method of speaking and on the articulation of speech by the operator. The distinctive sounds of consonants are liable to become blurred in the transmission of speech by radio and as words of similar length containing the same vowels are apt to sounding alike; special care is necessary in the pronunciation.

All words should be spoken plainly and each word ended clearly to avoid running consecutive words together. *Any tendency to shout, to accentuate syllables artificially or to talk rapidly should be avoided*.

The following points should be observed when using the radio:

- *Speed* – rate of speech should be constant, neither too fast nor too slow
- *Pitch* – high pitched voices transmit better than low pitched voices
- *Rhythm* – natural rhythm of ordinary conversation should be preserved
- *Microphone* – maintain at all times a constant distance as close as possible between mouth and microphone

The following transmitting techniques will assist in ensuring that transmitted speech is clear and satisfactorily received:

- Before transmitting check that the receiver volume is set at the optimum level and listen out on the frequency to be used to ensure that there will be no interference with a transmission from another station (talk over someone). Pause before commencing.
- Be familiar with microphone operating techniques and do not turn your head away from it whilst talking or vary the distance between it and your mouth. Severe distortion of speech may arise from:
    a. talking too close to the microphone
    b. touching the microphone with the lips, or
    c. holding the microphone or boom (of a combined headset/microphone system)

    Microphone Technique

    Apart from push to talk operated microphones, microphones have a diaphragm inside it which is actuated by pressure waves of the voice so if the microphone is too far away from the mouth, the pressure waves will not be intense enough to activate the microphone. If too close, it could distort the voice sounds. The optimum distance from the mouth a microphone needs to be is approximately 2 to 4cm.
- Use a normal conversation tone, speak clearly and distinctly
- Maintain an even rate of speech not exceeding 100 words per minute. When it is known that elements of the message will be written down by the recipients, speak at a slightly slower rate
- Maintain the speaking volume at a constant level

- A slight pause before and after numbers will assist in making them easier to understand
- Avoid using hesitation sounds or words, such as “err”, “ah”, “right”
- Depress the transmit switch fully before speaking and do not release it until the message is complete. This will ensure that the entire message is transmitted. However, do not depress transmit switch until ready to speak.
- Be aware that the mother tongue of the person receiving the message may not be English. Therefore, speak clearly and use standard radiotelephony (RTF) words and phrases wherever possible.
- After a call has been made, a period of at least 10 seconds should elapse before a second call is made. This should eliminate unnecessary transmissions or over transmitting while the receiving station is getting ready to reply or is relying to the initial call.

Finally, one of the most irritating and potentially dangerous situations in radiotelephony is a stuck microphone button. Operators should always ensure that the button is released after a transmission and the microphone placed in an appropriate place that will ensure that it will not inadvertently be switched on.

5.2 Phonetic Alphabet and Numeral Pronunciation

The Phonetic Alphabet, also known as the NATO Phonetic Alphabet, is the international radiotelephony spelling alphabet. The alphabet assigns code words to the letters of the English alphabet so that critical combinations of letters and numbers can be pronounced and understood, particularly when being communicated via radio or telephone where interference may occur.

5.2.1 The Phonetic Alphabet

Letter	Code Word	Pronunciation
A	Alpha	AL-FAH
B	Bravo	BRAH-VOH
C	Charlie	CHAR-LEE
D	Delta	DELL-TAH
E	Echo	ECK-OH
F	Foxtrot	FOKS-TROT
G	Golf	GOLF
H	Hotel	HOH-TELL
I	India	IN-DEE-AH
J	Juliet	JEW-LEE-ETT
K	Kilo	KEY-LOW
L	Leema	LEE-MAH
M	Mike	MIKE
N	November	NO-VEM-BER
O	Oscar	OSS-CAR
P	Papa	PAH-PAH
Q	Quebec	KEY-BECK
R	Romeo	ROW-ME-OH
S	Sierra	SEE-AIR-RAH
T	Tango	TANG-GO

Letter	Code Word	Pronunciation
U	Uniform	YOU-KNEE-FORM
V	Victor	VIK-TAH
W	Whiskey	WISS-KEY
X	X-ray	ECKS-RAY
Y	Yankee	YANG-KEE
Z	Zulu	ZOO-LOO

Numerals are pronounced as follows:

Numeral	Pronunciation
0	ZEE-ROH
1	WUN
2	TOO
3	TREE
4	FOW-ER
5	FIFE
6	SIX
7	SEV-URN
8	AIT
9	NINER

Other words associated with numerals and their context in the aviation industry include:

Word	Pronunciation
Decimal	DAY-SEE-MAL
Hundred	HUN-DRED
Thousand	TOUS-AND

5.3 Standard Phraseology

The use of standard words and phrases assists all users of radiotelephones to be able to communicate effectively and without taking up too much air time when speaking. This makes the communication precise and kept at a minimum.

The following words and phrases should be used in radiotelephony communications as appropriate and have the meaning given below:

Word or Phrase	Meaning
ACKNOWLEDGE	Let me know that you have received and understood this message
AFFIRM or A-FIRM	Yes
APPROVED	Permission for proposed action granted
BREAK	Indicates the separation between messages
BREAK BREAK	Indicates the separation between messages transmitted to different aircraft or stations/units in a busy working environment
CANCEL	Annul the previously transmitted message

Word or Phrase	Meaning
CHANGING TO	I intend to call … [*unit name*] on …. *frequency* […]
CHECK	Examine a system or procedure (Not to be used in any other context. No answer is normally expected)
CLEARED	Authorised to proceed under the agreed conditions specified
CLIMB	Climb and maintain the climb *(*i.e *"climb to 1500")*
CONFIRM	I request verification that you received the message correctly … *(a clearance, instruction, action, information)*
CONTACT	Establish communications with … (i.e "*contact tower 132.8*) *[your details have been passed to another unit]*
CORRECT	True or accurate
CORRECTION	An error has been made in this transmission or message. The correct information is … […]
DESCEND	Descend and maintain descent (i.e "*descend to 1500*")
DISREGARD	Ignore the last transmission
HOLD SHORT	Stop before reaching the specified location. Note: only used in limited circumstances where no defined stopping point exists (used mostly at a land based heliport)
HOW DO YOU READ	What is the readability of my transmission? (as per readability scale)
I SAY AGAIN	I repeat for clarity or emphasis
MAINTAIN	Continue in accordance with the instructions specified or in its literal sense, i.e *"Maintain 1500"*
MAYDAY	My aircraft and its occupants are in grave or imminent danger and I require immediate assistance
MONITOR	Listen out on frequency (a 'Listening Watch')
NEGATIVE	"No" or "Permission is not granted" or "That is not correct" or "Not capable of meeting the requirements"
OUT	This exchange of transmissions is ended and no response is expected
OVER	My transmission is ended and I expect a response from you (not normally used in VHF communication; more common in UHF transmissions)
PAN PAN	I have an urgent message to transmit concerning the safety of the aircraft or similar but I don't require immediate assistance
PASS YOUR MESSAGE	Proceed with your message
READ BACK	Repeat all, or the specified part, of this message back to me exactly as received
RECLEARED	A change has been made to your last clearance and this is a superseded clearance or part thereof

Word or Phrase	Meaning
REPORT	Pass requested information (such as weather conditions, etc)
REQUEST	I would like to know … […] or wish to obtain … […]
ROGER	I have received all your last transmission Note: Under no circumstances to be used in reply to a question requiring a direct answer in the affirmative (AFFIRM) or negative (NEGATIVE)
SAY AGAIN	Repeat all, or the nominated part of your last transmission
SPEAK SLOWER	Reduce your rate of speech
STANDBY	Wait and I will call you Note: No approval has been given and not to be assumed. The caller would normally re0establish contact if the delay is lengthy. (STANDBY is not an approval or denial)
UNABLE	I cannot comply with your request or instruction. "*Unable*" is normally followed by what is not being able to be complied with and a reason
VERIFY	Check and confirm
WILCO	I understand your message and will comply with it. Is an abbreviation for "*Will Comply*"
WORDS TWICE	As a request: Communication is difficult. Please send every word twice. As information: Since communication is difficult, every word in this message will be sent twice.

5.4 Ground Station Call signs

ATC ground stations or units are identified by the name of their location followed by their service available, such as:

Ground Station	Service Delivery
CENTRE	En-route area control, SIS or FIS; i.e "*Brisbane Centre*"
APPROACH	Approach control where provided as a separate function; i.e "*Sydney Approach*"
DEPARTURES	Departure control where provided as a separate function; i.e "*Sydney Departure*"
FINAL/DIRECTOR	Surveillance control providing vectors onto final approach
TOWER	Aerodrome control or aerodrome and approach control where these services are provided from an aerodrome control tower
GROUND	Surface movement control
DELIVERY	Clearance Delivery to departing aircraft; i.e "*Sydney Clearance Delivery*"
FLIGHTWATCH	Flight Information Service (FIS)

5.5 Application of Numerals in Radiotelephony

Radio operators may find themselves reading out weather conditions such as cloud height, or aircraft standoff distances, and frequency channel changes, so it is important to use the appropriate words and pronunciation. Numbers transmitted and pronounced would include:

Altitudes	Spoken as:	Pronounced as:
50	Five Zero	FIFE–ZERO
100	One Hundred	WUN–HUN–DRED
2,500	Two Thousand Five Hundred	TOO–TOUSAND–FIFE-HUNDRED
6,715	Sixe Seven One Five	SIX–SEV–VERN–WUN-FIFE
10,000	One Zero Thousand	WUN-ZERO-TOUS-AND
25,000 / FL 250	Flight Level Two Five Zero	FLIGHT-LEVEL-TOO-FIFE-ZERO
Runway	**Spoken as:**	**Pronounced as:**
20	Runway Two Zero	RUNWAY-TOO-ZERO
15R	Runway One Five Right	RUNWAY-ONE-FIFE-RIGHT
Cloud Height	**Spoken as:**	**Pronounced as:**
1,000	One Thousand	WUN-TOUSAND
4,500	Four Thousand Five Hundred	FOW-ER-TOUSAND-FIFE-HUNDRED
Headings	**Spoken as:**	**Pronounced as:**
150	One Five Zero	WUN-FIFE-ZERO
080	Zero Eight Zero	ZERO-AIT-ZERO
300	Three Zero Zero	TREE-ZERO-ZERO
Wind Direction	**Spoken as:**	**Pronounced as:**
020o	Zero Two Zero Degrees	ZERO-TOO-ZERO-DEE-GREES
100o	One Zero Zero Degrees	WUN-ZERO-ZERO-DEE-GREES
210o	Two One Zero Degrees	TOO-WUN-ZERO-DEE-GREES
Wind Speed	**Spoken as:**	**Pronounced as:**
30 Knots	Three Zero Knots	TREE-ZERO-NOTS
30 Knots; gusting 45	Three Zero Knots Gusting Four Five	TREE-ZERO-NOTS-GUST-TING-FOW-ER-FIFE

For altitudes, pronunciations will differ above the *Transition Layer* of 10,000 feet with higher altitudes recorded and announced as *Flight Levels*. Therefore 25,000 feet will be pronounced as "*Flight Level Two Fife Zero"*.

For numbers containing a decimal point, such as those of radio frequency channels, they shall be transmitted with the decimal point in the appropriate sequence being indicated by the word "*decimal*". For example:

Number	Spoken as:	Pronounced as:
118.25	One One Eight Decimal Two Five	WUN-WUN-AIT-DAY-SEE-MAL-TOO-FIFE

It should be noted that when the final two digits of the frequency are both zero, only the first four digits need be given, i.e 118.200 would be given as 118.2 and pronounced as: *"WUN-WUN-AIT-DAY-SEE-MAL-TOO*".

6. RADIO OPERATIONS & TRANSMISSIONS

The phraseology detailed in this manual is compliant to international radio standards and civil aviation radiotelephony requirements and has been established for the purpose of ensuring uniformity in all relevant radio communications. Regulations state where circumstances warrant, and no phraseology is available, clear and concise plain language should be used to indicate intensions.

In general, communications shall be concise and unambiguous, using standard phraseology for situations where appropriate. Obviously, it is not practicable to use standard phraseology in all situations nor can we detail all examples of phraseology for every situation. However, if standard phrases are adhered to when composing a message, any possible ambiguity will be reduced to a minimum. When standard phraseology terms do not serve a purpose for the intended message then plain language should be used.

It should also be noted at this time that some abbreviations, which by their common usage have become part of aviation terminology over the years and are approved to be spoken using their constituent letters rather than the spelling alphabet meaning, such as, ILS approach (Instrument Landing System) QNH (code for Hectopascal pressure reading), etc.

6.1 Restrictions & Courtesy

To avoid tying up air time, it is important to be precise with any radio transmission so to not restrict other users of the radio network. To assist in achieving shorter transmission times the excessive use of courtesies should be avoided when conducting radio transmissions. Furthermore, public correspondence messages are not permitted on any of the VHF frequencies in the aeronautical telephony network. Restrict these types of messages to UHF channels and intercompany channels.

Personnel providing ground to air communications MUST ENSURE that they DO NOT pass a message which could be construed to be an air traffic control instruction.

6.2 Establishing and Maintaining Communications including Station Identification

The responsibility of establishing communications rests with the station having information to transmit. When initiating a transmission to Air Traffic Services (ATS) pilots will commence the transmission with the callsign of the unit being addressed followed by the aircraft callsign. Radio operators must ensure that the full identification or callsign of their station (facility) is used in response to the initial call from an aircraft, vessel or ATS and on any other occasion that there is any doubt.

The use of the calling station's callsign and the receiving station's callsign is considered an 'invitation' to proceed with the transmission, therefore phrases such as "*Go Ahead*" is not used. After contact has been established, continuous two-way communication is permitted without further identification or callsign unless there is a break in communication, i.e "*Standby by for Details"* then callsigns will be sued to continue with the transmission when recommencing communications.

For aircraft, the name of the aircraft manufacturer or the name of the aircraft model, or category (i.e helicopter) must be used to prefix the aircraft's callsign (AIP Australia GEN 3.4 – 4.21.4). For example, for a helicopter with the callsign VH-AMB:

"*Brisbane Centre, Helicopter Alpha Mike Bravo requesting airways clearance…"*

If operating aircraft which are not locally registered aircraft (in the country of operation) they will use their full registration callsign when initiating communications. For example, an Australian registered aircraft (VH-AMB) operating in a foreign country, the transmission would be:

"Brisbane Centre, Helicopter Victor Hotel Alpha Mike Bravo requesting airways clearance…"

6.3 Abbreviations

After initial transmission and effective communication has been established, with no confusion likely to occur, the stations involved are permitted to abbreviate callsigns if suitable. A pilot of an aircraft on the other hand may only abbreviate the callsign of his aircraft if it has first been abbreviated by the transmitting or receiving station for example:

"Alpha Mike Bravo, Tower, standby"

6.4 Radio Test Readability Scale

When testing or checking the serviceability of the radio equipment, a station may broadcast on a frequency requesting a radio check. Any other station that cares to respond, or is required to respond, such as Air Traffic Control, etc, will provide a response as to the readability of the message. The readability scale is out of five (5) with each number meaning the following:

1 Unreadable
2 Readable now and then
3 Readable but with difficulty
4 Readable
5 Perfectly readable

6.5 Test Transmissions

All radio transmissions for test purposes shall be of the minimum duration necessary for the test and shall not continue for more than 10 seconds. The recurrence of such transmissions shall be kept to the minimum necessary for the test. The nature of the test shall be such that it is identifiable as the test transmission and cannot be confused with other communications.

The achieve this, the following format should be used:

- call sign of the station being used
- your station callsign or name
- the words "*REQUEST RADIO CHECK*"
- the frequency being used (if applicable)

An example of this transmission would be:

"Ground, this is Helicopter Alpha Mike Bravo on VHF 118.2, requesting radio check, over"

The operator of the radio station being called will assess the transmission and will advise the station making the test transmission in terms of the readability scale together with a comment on the nature of any abnormality noted, i.e excessive noise, using the following format:

"Alpha Mike Bravo, this is Ground, readability is TREE by FIFE with static interference, over"

For readability reasons, a listening or receiving station may reply with:

"Station calling VHF 118.2, unreadable"

NOTE: *"118.2*" in the example above would be read out as "WUN-WUN-AIT-DAY-SEE-MAL-TOO"

6.6 Simultaneous Transmissions (Over Transmissions)

Direct communications between stations can be adversely affected by simultaneous transmissions that effectively block all or part of the intended transmissions. Whilst the situation may be apparent to other stations listening, the station that inadvertently makes such a transmission may be unaware. On hearing a simultaneous transmission, it can be helpful for a radio operator to draw attention of the situation to those concerned. This can by done by calling:

"two stations in together, blocked transmission"

In these situations, it is best to pause and wait until free air time is available and re-broadcast your message. To avoid this occurring, operators should listen out on the frequency for a few seconds before transmitting to ensure that there will be no interference with a transmission from other stations. Be sure to depress the transmit switch fully before speaking and do not release it until the message is completed. This will ensure that the entire message is transmitted. If a transmission is cut off or 'clipped', the full extent of the information being provided will be missed and therefore could lead to misunderstandings or incomplete information. This can be serious in circumstances where aircraft are arranging altitudes for collision avoidance or when receiving an airways clearance as an example.

6.7 Complying with Instructions – NOT clearances

When communicating with aircraft from your ground station, you do not give clearances to aircraft, but communicate helpful information to the flightcrew to assist them in their tasks. Therefore, if for any reason, a pilot does not wish to comply with an instruction given by you, the pilot should advise you as to why they do not intend to comply and/or give an indication of when he intends to comply if at all. When communicating ground-to-air, you are not to give information or instructions that could be deemed as air traffic control instructions.

6.8 Transmission of Time

For time broadcast in radio communications in aviation, Coordinated Universal Time (UTC) is used for all operations. The term "ZULU" is used when Air Traffic Control (ATC) procedures require a reference to UTC, such as 0920 UTC – is indicated as 'ZERO – NINE – TWO – ZERO – ZULU". For 24 hours time, the hour is indicated in the first two digits with the minutes indicated in the last two digits, i.e. 0001 (midnight) would be "ZERO – ZERO – ZERO – ONE". Time can also be stated in minutes only, i.e two figures, when no misunderstanding is likely in relation to what hour the time is. For example, 0934 would be communicated as "TIME - THREE – FOUR". This is usually communicated by Air Traffic Control at the time of taxi clearance.

6.9 Automatic Terminal Information Services (ATIS)

ATIS is a recorded information service broadcast on a discrete frequency which is on a continual loop providing flight planning information for the specific airport it services. Information includes wind direction and strength, cloud cover and height, runway in use, etc and is tracked by each change by using the phonetic alphabet. For example, the first ATIS broadcast for the day would start at "ALPHA" and with the next change in weather or information, it would be become "BRAVO". "ZULU" is not used. A typical ATIS broadcast would read:

"Bankstown Terminal Information Charlie – Runway 11 right for arrivals and departure;, frequency 132.8; wind 330 15 knots; crosswind maximum 10 knots; visibility greater than 10 kilometres; cloud few 4500; temperature 16; QNH 1010, on first contact with Bankstown Ground or Tower notify receipt of Charlie"

Pilots use these details at aircraft start up and before taxiing so that all aircraft are aware of the same information before flight. The ATIS can also be accessed on the IDENT channel on the VOR or NDB frequency for the airport.

6.10 Ground Vehicle Callsigns

For ground vehicles used at airports, callsigns when using radios will be identified by their type followed by their assigned number. For example:

Vehicle Type	Spoken as:	Pronounced as:
Truck 23	Truck 23	TRUCK-TWENTY-THREE
Tractor 5	Tractor 5	TRACK-TAR-FIFE
Tug 12	Tug 12	TUG – TWELVE
Fire Pump 4	Fire Pump 4	FIRE – PUMP – FOW - ER

6.11 Special Task Callsigns

In some cases, registered aircraft operate under special task callsigns. These can include:

Type of Operation	Callsign Designation example:
Police	POLAIR 2
Ambulance	AMBULANCE 23
Fire intelligence gathering	FIRE SPOTTER 5
Rescue	RESCUE 19
Media	MEDIA 12
Remote sensing fire operations	FIRESCAN 5

6.12 Position Reporting by Aircraft

When communicating with an aircraft and requesting a position report, the appropriate response would contain the following elements of information:

- Station call sign calling
- Aircraft identification
- Position
- Level and intension
- Time (for IFR)
- Next position and ETA

"Base, Helicopter Alpha Mike Bravo, 25 miles to the south east of the [name] airport, cruising 4500, inbound, estimate overhead 35"

6.13 Corrections and Repetitions

When an error is made in a transmission you should use the word "CORRECTION" at the last correct group or phrase and then the correct version transmitted. For example:

"Base, this is Helicopter Alpha Mike Bravo, 25 miles south east, time 25, cruising 4500, inbound, estimate overhead 35, correction 40"

If a correction can best be made by repeating the entire message, the operator shall use the phrase "CORRECTION, I SAY AGAIN" before transmitting the message a second time. If there is doubt that a message has been correctly received, a repetition of the message shall be requested either in full or in part.

7. EMERGENCY CALLS AND TRANSMISSIONS

When it comes to radio operations, an emergency transmission has absolute priority over all other transmissions. All stations hearing it must immediately cease any transmission likely to interfere with the emergency transmission. It is critical that the emergency message be acknowledged by a receiving unit radio operator once complete, so that the station transmitting knows someone has been alerted to the emergency and has taken the details. The emergency calls consist of either a PAN or MAYDAY call.

The classification of emergency calls includes:

Type of Call	Meaning
Distress	A condition of being threatened by a serious and/or imminent danger and requiring immediate assistance. A Distress Call commences with the words "MAYDAY, MAYDAY, MAYDAY"
Urgency	A condition concerning the safety of an aircraft, vehicle or of a person but does not require immediate assistance. An Urgency Call commences with the words "PAN, PAN, PAN"

A **PAN call** is for an emergency situation not requiring immediate assistance, such as the illumination of a caution light in the cockpit. Note: this level of emergency may develop into a Mayday call very quickly.

A **MAYDAY call** is a situation of grave or imminent danger such as complete loss of power to the engines, or loss of control of the aircraft.

7.1 Declaring an Emergency – Emergency Message

If required to declare an emergency, the emergency message shall contain the following information (time and circumstance permitting) and, whenever possible, should be passed in the following order. Radio Operators hearing an emergency declaration will need to record these details to pass them onto authorities. You may be the only station that has heard the distress call.

Subject	Message
Declaration of Emergency	*'MAYDAY, MAYDAY, MAYDAY"*
Station Callsign	*"Helicopter WHISKEY TANGO FOXTROT "*
Aircraft Details	*"AN AS365N3 DAUPHIN"*
Nature of Emergency	*"I HAVE SEVERE MAIN ROTOR VIBRATION"*
Pilot Intentions	*"I AM INTENDING TO DITCH"*
Present or last known position and heading/track	*"20 MILES SOUTH EAST OF PORT SMITH" (or GPS coordinates "HEADING 240"*
Number of persons onboard	*"12 POB"*
Any other useful information	*"WE HAVE AIRCRAFT FLOATION, LIFE RAFTS AND SURVIVAL EQUIPMENT"*

7.2 Relayed Emergency Message

Any station or aircraft knowing of an emergency incident occurring and have heard a distress call may transmit a distress message whenever such action is necessary to obtain assistance for the aircraft, vessel or person in distress. In such circumstances, it should be made clear that the station transmitting is not itself in distress.

7.3 Emergency Call Actions

The station controlling communications during an Emergency Call period should alert all stations that it is managing or rendering assistance to the distressed station or unit. Any station which has knowledge of distress traffic and which cannot itself assist the station in distress shall nevertheless continue listening to such traffic until it is evident that assistance is being provided. Stations should take care not to interfere with the transmission of urgency calls and if required, transfer to another frequency.

7.4 Termination of Distress Communications

When a station is no longer in distress it shall transmit a message cancelling the emergency condition. An example may be:

"All stations, Helicopter Foxtrot Uniform Kilo, rotor vibration has ceased however making a precautionary landing at [name of] airport, cancel MAYDAY at this time."

7.5 Radio Silence

Radio silence occurs during an emergency situation or where you are operating near an area where explosives are being used. In either circumstances, all stations must maintain radio silence on that frequency until radio silence has been lifted (in the case of explosives or airport emergency) or the distress call is cancelled, or distress radio traffic has been completed or has been transferred to another frequency.

7.6 Emergency Locator Transmitter (ELT)

Aircraft are required to be fitted or carry an Emergency Locator Transmitter (ELT). Radio operators, wherever possible, should monitor VHF frequency 121.5MHz (and now 406MHz) MHz in case of ELT activation by another station. If you receive a signal you must report it to the Air Traffic Service (ATS) applicable to the region you are located. If an ELT has accidently or inadvertently activated for more than 10 seconds, it must be reported to ATS or the regional Rescue Coordination Centre. In Australia, the number is 1800 815 275.

ELT's are life saving devices that alert emergency coordination centres to your emergency so the sooner it is activated, the sooner satellites and/or other aircraft will pick up the signal and hone in on our position with medical and rescue response. Procedures for use and instructions in their use can be found on the devices themselves or further procedures can be found in the Aeronautical Information Manual (AIM), Chapter 6 (FAA) or the En-Route Supplement Australia (ERSA).

8. Communication Failure

If you encounter a problem with your radio and/or you are unable to communicate with an inbound aircraft, for example, you obviously have a problem. In the event that you believe you have lost communication capabilities or power, you should:

1. Check for power, i.e cable connections, master switch, fuses, circuit breakers and overall facility power (building power).
2. Check frequency setting is correct.
3. Check volume control is turned up.
4. Check the antenna connections and cabling.

If these steps do not fix the problem, a radio technician may be required to fix the unit if you do not have the skills and expertise to do it yourself. You may also have to use an alternative radio such as a portable handheld unit. Keep in mind that you will have to leave the radio room or vehicles, etc. in order to achieve a stronger signal due to radio wave interference. If this the case, ensure you are standing away from vehicles, obstacles, et to ensure the strongest and least interfered with signal is transmitted. Also, the distance you are able to achieve will be greatly reduced due to the lack of power or strength of the signal from the hand held unit. If this solution doesn't work then alternative communications will need to be established.

It may be that operationally you have no alternative but to continue as normal and that the best solution is to proceed by transmitting blind. In this circumstance it is usually in cases where an aircraft has encountered a radio failure in flight and the aircraft still needs to land at a suitable airport safely. When transmitting blind you should assume the radio is working however prefix your broadcast with "TRANSMITTING BLIND…". As a higher collision risk exists, all personnel on board would be required to keep a good lookout for other aircraft. The pilot would also undertake any approach to the airport and landing according to published procedures for the specific airport.

Other alternatives to establishing or re-establishing communications might be to request other stations, i.e. aircraft, to attempt to communicate with the aircraft to which you have failed to make contact with. If still unable to establish communication with the station, you should continue to transmit messages by blind transmission on the frequency on which the aircraft is believe to be listening and commence a company alert sequence as the aircraft could have encountered trouble.

If you are in the aircraft as a crewmember, the pilot in command will take control of the situation. There are aeronautical procedures for aircraft communication failure, details of which are found in the En-route Supplement Australia (ERSA) or Aeronautical Information Manual (FAA). In Australia, for example, the ERSA is a required document for cross country flights.

For reference, the Transponder Codes for Emergency Situations are as follows:

Emergency	7700
Radio Failure	7600
Pilot subjected to unlawful interference	7500

If a radio failure has occurred in flight, then the aircraft will squawk (transmit) CODE 7600.

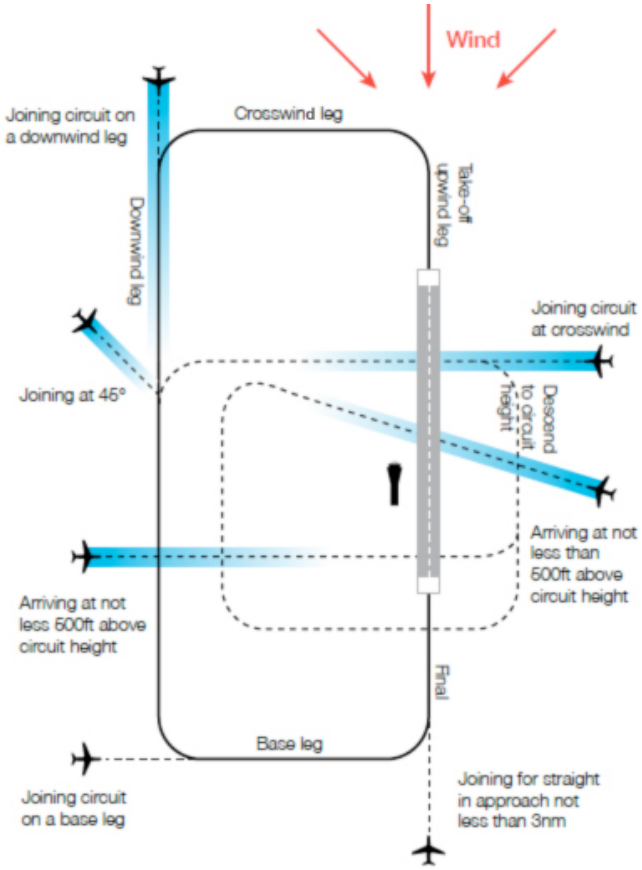
9. RADIO USE FOR THE UAV PILOT

As a UAV pilot, you are in a unique position when it comes to the use of an air-band radio - in that you will be given approval to use this radio without ever having to step foot into an aircraft or airfield. And with this approval, comes responsibility, and the following should be noted.

1. **DO NOT** broadcast unnecessarily. Keep the airways clear, and only transmit when absolutely required.
2. Only holders of an AROC in your organisation transmit on an air-band radio.
3. A good majority of the time you will be required to transmit only when requested to do so.
4. Do not contact an ATC Tower on the radio, unless specifically requested to do so by ATC. Control Towers can be contacted via telephone.
5. Always maintain a listen and watch.

9.1 Runway Nomenclature and Circuit Legs

As a UAV Pilot operating near an airfield, it is vital that you have an understanding of aircraft movements, and the terms you may hear when operating near such airfields. Terms such as Circuit, Downwind, Crosswind, Base and Final may be heard, and it is important to understanding their meaning.



All airfields have a set circuit around the airfield. The direction of the circuit will depend on things like local terrain, and position of the runways etc. See the image below.

This image shows a left hand circuit depicting aircraft turning left in an anti-clockwise direction. Knowing how these circuits work will help you understand where an aircraft may be when you hear a transmission describing an aircraft as "turning on base". The 5 legs of a basic circuit are Take-off/Upwind, Crosswind, Downwind, Base and Final.

An air-band radio can be a very useful tool to the UAV pilot. However, please respect other users and be a responsible radio operator.