RALI-AA4

Radiocommunications and Assignment Licensing Instruction - Amateur Assigned 4

Amateur (Assigned) Repeater Station (438 MHz Band) Frequency Assignment Requirements

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Contents

1 Introduction

This document contains technical instructions to facilitate the selection of frequencies for the operation of amateur assigned repeater stations within the amateur service spectrum in Australia, once the need to obtain an amateur assigned licence has been determined. For any questions on whether a particular licence is required, applicants should first contact the Australian Communications and Media Authority .

Specifically, this document details frequency selection criteria for the following types of assigned frequency amateur repeater stations.

- All stations operating on the 438 MHz amateur band.

Assignment requirements for repeater stations on the following frequency bands are found in the associated corresponding RALI.

- Beacon Stations – RALI-AA1.
- Repeater Stations (including Television Repeater stations) – RALI-AA2.
- Repeater & Link Stations operating between 144 – 148 MHz – RALI-AA3.

Where interactions are required to be assessed between amateur repeater stations and amateur beacon stations, information about those beacon stations can be obtained from document RALI-AA1.

1.1 Basis for amateur service spectrum planning

The Amateur Radio Service band-plans plans are derived from international plans set down by the International Amateur Radio Union (IARU). Broad segment allocations, particularly for international activity relating to satellites and inter-continental communications, have been defined across all amateur service radio spectrum. The WIA, as the representative body of the IARU in Australia, is responsible for maintaining the amateur service band plans in Australia while ensuring they are always consistent with the Radiocommunications Licence Conditions (Amateur Licence) Determination 2015[1].

Australian Amateur Service Band plan information is available here:

- https://www.wia.org.au/members/bandplans/data/

The channel plans in this RALI for assigned amateur repeater stations are based on the Australian amateur radio band plans. They have been designed to minimise interference to both assigned and class licensed amateur radio stations. Where amateur repeater stations can be successfully coordinated using the guidance provided in this RALI, licence applications may be submitted following the standard application process. Where no assignment solution can be found or the proposed amateur assigned

1 https://www.legislation.gov.au/F2015L01113/latest/text

repeater station does not fit the service models described in this instruction, then the non-standard assignment process should be followed as described in Frequency assignment practice '**Guideline No. 10 — Application process for assigned amateur beacons and repeaters**[2]'.

Operators of amateur assigned stations should also recognise that class licenced amateur stations are not prevented from operating anywhere in the radio spectrum assigned to the amateur service (in accordance with their own licence conditions). However, class licenced amateur stations have been requested to voluntarily follow the defined amateur radio band plan to manage interference between different activities and in particular amateur assigned stations.

1.2 Grand-fathered frequency allocations

The Amateur band plans have evolved multiple times particularly over the past 30 years. This evolution has occurred in response to changing environmental conditions, particularly on spectrum bands where the amateur service has only secondary status in the Australian Radiofrequency Spectrum Plan (ARSP).

Due to the costs and disruption involved in making changes to established systems, the current practice is that those established legacy stations are not expected to change frequencies when the band plans are revised, unless:

a) They are required to make changes to their station in response to changes within the amateur radio service LCD; or

b) Wish to take advantage of the improved arrangements offered by the new band plan; or

c) Are planning other changes to services co-located with the legacy service, in which case they are encouraged to migrate their existing systems to the new channel plan at the same time.

It should be noted that that legacy band plans are not relevant when selecting frequencies for new or upgraded services. Should an assigned amateur service station operator seek to amend or change the nature of their service, they should align their service frequencies with the band plan in force on the day.

[2] https://www.acma.gov.au/frequency-assignment-practices

2 Assigned Amateur Station Classifications

2.1 Amateur Analogue Voice Repeater Station

An analogue voice repeater station in the amateur service is typically a duplex station using 16K0F3E modulation (narrowband FM) where the station is transmitting and receiving simultaneously using two frequencies, one for transmit and one for receive. These stations are usually sited at elevated locations to provide a wide area service to multiple amateur radio operators.

2.2 Amateur Digital Voice Repeater Station

A digital voice repeater station in the amateur service is typically a duplex station using 6K25F9W modulation (D-STAR[3] protocol-based systems) or 11K3F9W (C4FM[4] or DMR[5] (P25 derivative) based systems where the station is transmitting and receiving simultaneously using two frequencies, one for transmit and one for receive. These stations are usually sited at elevated locations to provide a wide area service to multiple amateur radio operators.

2.3 Amateur Mixed Analogue/Digital Voice Repeater Station

A mixed analogue/digital voice repeater system station in the amateur service is a station that can operate in both analogue and digital modes on a time-shared basis. Currently the C4FM repeater systems can also operate in analogue mode. These systems should only be assigned to operate on certain repeater sub-bands (see information below for details).

2.4 Amateur Analogue/Digital Gateway Station

An analogue gateway station in the amateur service provides a connection from a tunnelled audio link (often carried via VOIP technologies on the Internet) onto the amateur radio spectrum, typically using 16K0F3E narrowband FM modulation or 11K3F9W GMSK Digital modulation. These stations use single frequency Tx/Rx operations to relay amateur station audio from licenced radio amateurs received via commercial carriage services out onto local amateur frequencies, most typically on the 144 MHz and 432 MHz amateur bands.

[3] DSTAR system specification (Japan Amateur Radio League) https://www.jarl.com/d-star/shogen.pdf

[4] C4FM System Specification document (Yaesu) https://www.yaesu.com/downloadFile.cfm?FileID=9039&FileCatID=263&FileName=Yaesu%5FAmateur%20Radio%20Digital%20Specs%5F1V02%5FEN%2DGB.pdf&FileContentType=application%2Fpdf

[5] Amateur Radio adaptation of the commercial DMR standards https://www.dmrassociation.org/dmr-standards.html

2.5 Amateur Store and Forward Single Frequency Data Repeater Station

A store and forward single frequency repeater station is using typically AFSK, GMSK or QPSK (or similar) signals formatted to send packets of data that are stored and then on-forwarded once they are received within a single frequency network. The amateur service typically uses the Amateur (AX.25)[6] transmission protocol for this purpose. The channels are typically low-rate data (1200 bps) although some systems run much higher data rates (and hence higher bandwidths).

A particular use of this technology has been in the APRS[7] (Amateur Position Reporting System) network which is used for various information broadcast and location tracking applications within the amateur service. This, however, is not the only use of these AX.25 protocol-based store and forward repeater stations.

2.6 Amateur Repeater Link Single Frequency Station

An amateur repeater link station is used to provide a channel to carry the voice information from one repeater site to another, such that it may be transmitted on an additional amateur repeater station in addition to the one where the voice signal was originated from. These links are typically assigned on the 430 – 450 MHz amateur band, however they can also be found on the 1240 – 1300 MHz band.

A single frequency amateur repeater link station may be one of:

- TX Only – typically used at the TX site of a 29 MHz two frequency repeater station.
- RX Only – typically used at the RX site of a 29 MHz two frequency repeater station.
- TX/RX – typically used between any two amateur repeater stations on any band.

2.7 Amateur Repeater Link Two Frequency Station

An amateur repeater link station is used to provide a channel to carry the voice information from one repeater site to another, such that it may be transmitted on an additional amateur repeater station in addition to the one where the voice signal was originated from. These links are typically assigned on the 430 – 450 MHz amateur band, however they can also be found on the 1240 – 1300 MHz band.

2.8 Amateur Television Repeater Stations

Amateur Television repeater stations are described in RALI-AA2. Details of how to process these applications are found there.

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[6] The AX.25 standard is defined here: https://www.tapr.org/pdf/AX25.2.2.pdf
[7] The APRS system definition is defined here: http://www.aprs.org/doc/APRS101.PDF

3 Amateur Repeater Station Service Model

3.1 Service Model Overview

The purpose of the service model for assigned Amateur Repeater stations is to define a set of characteristics that will achieve an agreed service level and acceptable levels of short-term interference that can be tolerated by class licenced amateur radio stations using these assigned repeater services.

Class licenced amateur stations typically have several different configurations.

- Vehicle mounted mobile.
- Handheld.
- Base station – elevated omni-directional antenna.
- Base station – elevated directional antenna (up to 10-18dBi depending on the operating band).

Frequency reuse distances described in this document are defined based on notional vehicle based mobile station characteristics which have been built into the frequency reuse rules defined throughout this document. Home based fixed location and itinerant stations temporarily located on elevated terrain are not considered as their typical configurations would drive excessive frequency reuse requirements (noting home stations can operate using very high gain (10dBi+) directional antennas).

The service model also needs to consider the nature of the spectrum being used and what propagation mechanisms will affect that spectrum. On the 438 MHz band, tropospheric propagation is the dominant mode affecting mode frequency selection decisions.

The target grade of service is defined as a signal quality of 12 dB SINAD for voice systems or a bit error rate of 10^{-2} for data systems at the receiver output for a 5 dB ratio of wanted to unwanted signals at the receiver RF input terminal. The model defines values that, when satisfied, will on average achieve the expected service level while aiming to provide sufficient adjacent site interference protection for 90% of the time for vehicle mobile based stations.

3.2 Amateur Analogue / Digital (Two frequency) Voice Repeater Model 438 MHz

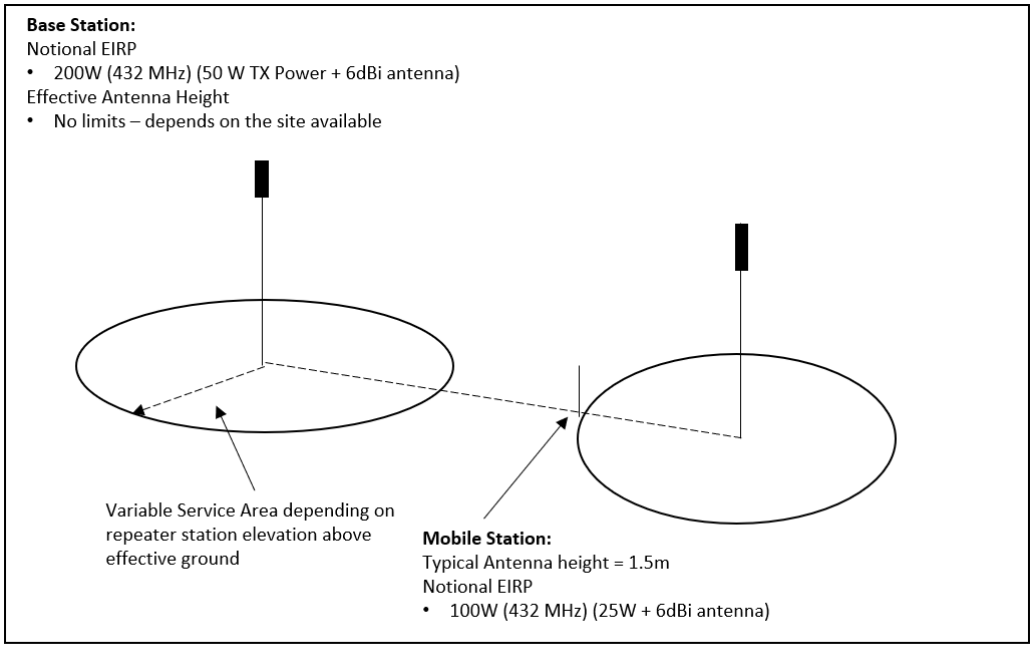


Figure – Amateur Repeater & Gateway Model – 432 MHz

The key requirements of the service model are:

- Assumed receiver blocking performance is 90dB above the minimum receiver usable sensitivity.

In assessing frequency re-use for the amateur repeater stations on this band, the following system characteristics should be considered.

Characteristic	Value
TX Power	50 W Py (47dBm)
TX Antenna Gain	6.0dBi
Polarisation	Vertical
Feeder / Filter Losses	3 dB
Notional Receiver Sensitivity	1.0 µV @ 20 dB SINAD (-107 dBm)
RX Antenna Gain	6.0 dBi
Maximum Allowable Path Loss	161 dB

3.3 Amateur Analogue / Digital (Single Frequency) Voice Gateway Station Model (438 MHz)

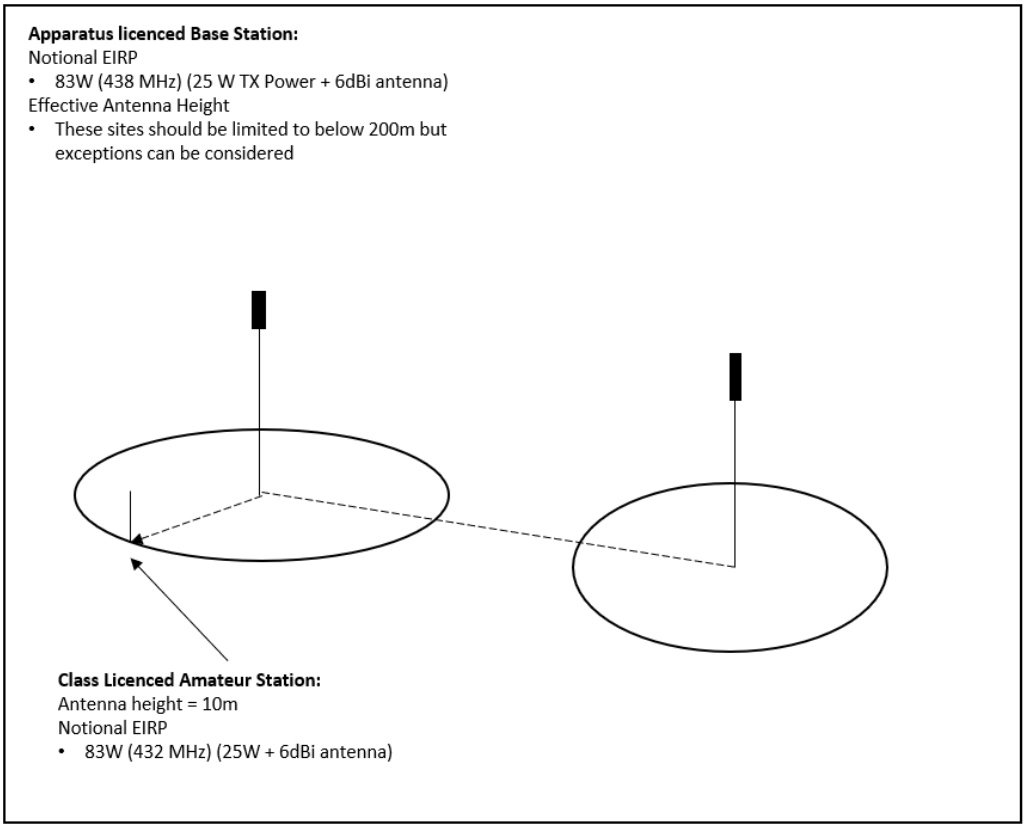


Figure – Amateur Gateway Model – 432 MHz

- Gateway stations do not repeat signals that they receive over the air. They only relay those signals to another gateway linked station connected by an off-band telecommunications carriage service. Transmissions from Gateway stations originate from remote amateur stations that have connected to the gateway transmitter via the same telecommunications carriage service.
- So that users of gateway stations are aware when the channel is in use, the operational footprint of the gateway station should be defined by the applicant as the expected area where 90% of the class licensed amateur stations accessing the system are able to not only hear the gateway station but also hear each other. This will reduce the risk of collisions where multiple stations are attempting (unknowingly) to access the gateway station at the same time. The applicant should try to ensure excessive coverage is avoided.
- Gateway stations are designed mostly to be accessed by class licensed itinerant amateur base stations. As such, they may not provide reliable mobile communications access over more than 30-50% of their footprint.

- These stations are not expected to be provided on elevated sites and should as far as possible be limited to locations where the effective height about average terrain (H_{eff}) is kept below 200m

The notional specifications of the station are as follows:

Characteristic	Value
TX Power	50W Py (47dBm)
TX Antenna Gain	2.2dBi
Polarisation	Vertical
Feeder / Filter Losses	3dB
Notional Receiver Sensitivity	1.0uV @ 20dB SINAD (-107dBm)
RX Antenna Gain	0dBi
Maximum Allowable Path Loss	157dB

3.4 Amateur Store and Forward Data Repeater Station Model

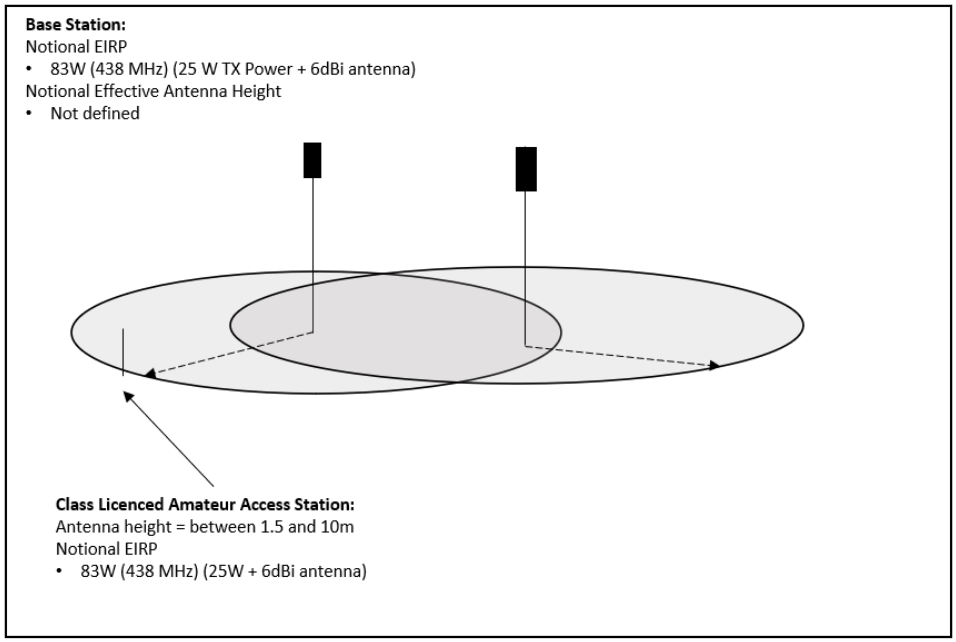


Figure – Amateur Store and Forward Single Frequency Data Model – 432 MHz

- Store and forward data repeaters in the amateur service are required to use the same transmission protocol that is already in use on a given frequency to prevent inter-station interference. Typically store and forward data stations in the amateur service are using the AX.25 protocol with CSMA channel access technology.
- These repeaters have no frequency re-use limitations and in fact require a degree of overlapping coverage in order to correctly function.
    - Overlapping coverage facilitates effectively linking of repeaters so that data can be relayed over multiple hops from Station A via Station B then via Station C to Station D.
    - One of the specific uses of store and forward data repeaters involves the provision of wide area networks designed to relay position and other tactical and telemetry data, known as the Amateur Position Reporting System (APRS). These networks operate on a single frequency nationwide and hence do not need inter-site co-channel coordination from an ACMA perspective.

Typical TX Power	Typical Antenna Gain	Emission	Polarisation
50W	3dBi	16K0F2D	Vertical

3.5 Dedicated Repeater Link Transmitter Station Model (430 – 450 MHz Band)

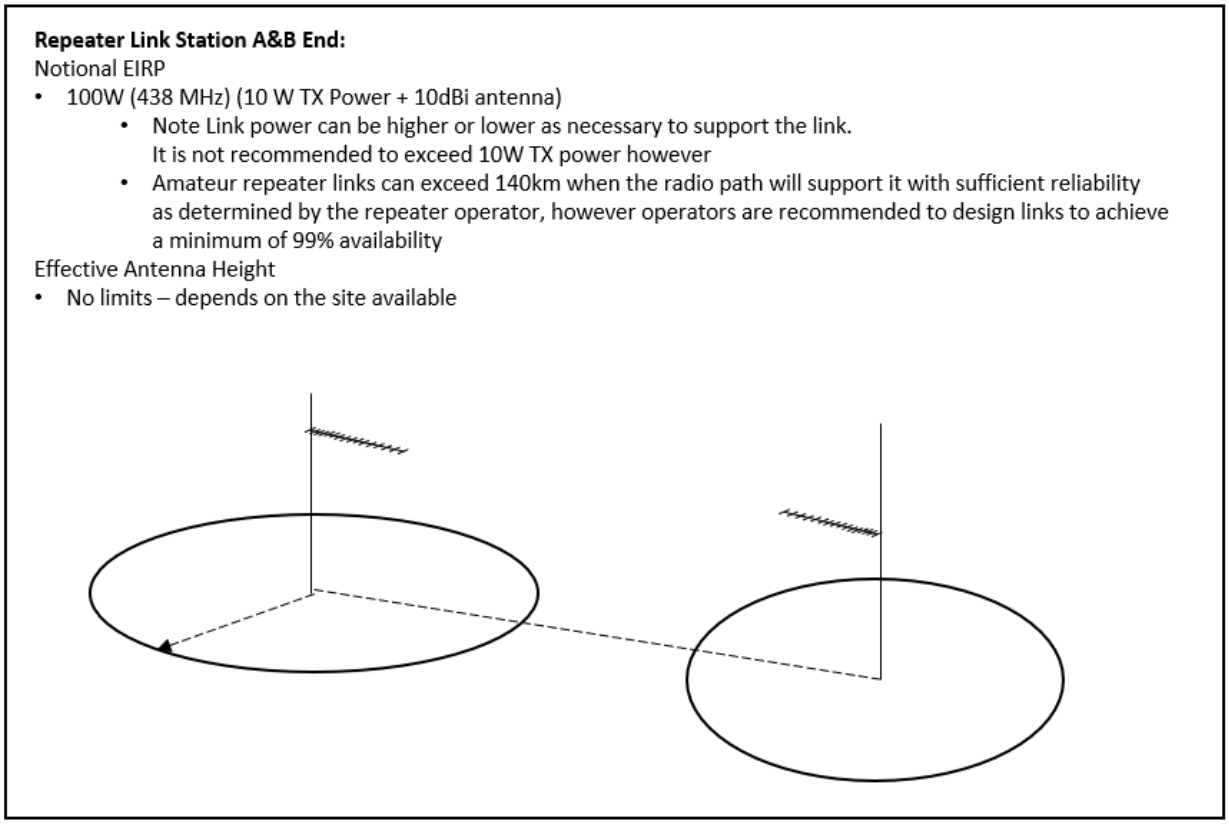


Figure – Amateur Repeater Dedicated Link Model

Amateur Repeater stations may be linked together to form networks of stations covering a wide area.

The preferred method for interlinking two repeaters is using a dedicated channel independent of the main repeater service area transmitters.

These links may be created using either bi-directional single frequency systems (not recommended when linking more than 3 repeater stations together) or preferably by utilising two frequency duplex systems.

The notional specifications of the station are as follows:

Characteristic	Value
TX Power	<10W Py (47dBm)
TX Antenna Gain	10dBi
Polarisation	Horizontal preferred
Feeder / Filter Losses	3dB
Notional Receiver Sensitivity	1.0uV @ 20dB SINAD (-107dBm)
RX Antenna Gain	10dBi

3.6 In-Band Repeater Link Transmitter Station Model (430 – 450 MHz Band)

Repeater Link Station B End: (A end is the main repeater transmitter)

Notional EIRP

- 10W EIRP (432 MHz) (1 W TX Power + 10dBi antenna)
    - Note Link system using on-frequency transmitters to the adjacent repeater must use the minimum power possible in order to avoid causing interference to the next adjacent co-channel main repeater. Directional antennas are a must in this case.

Effective Antenna Height

- No limits – depends on the site available

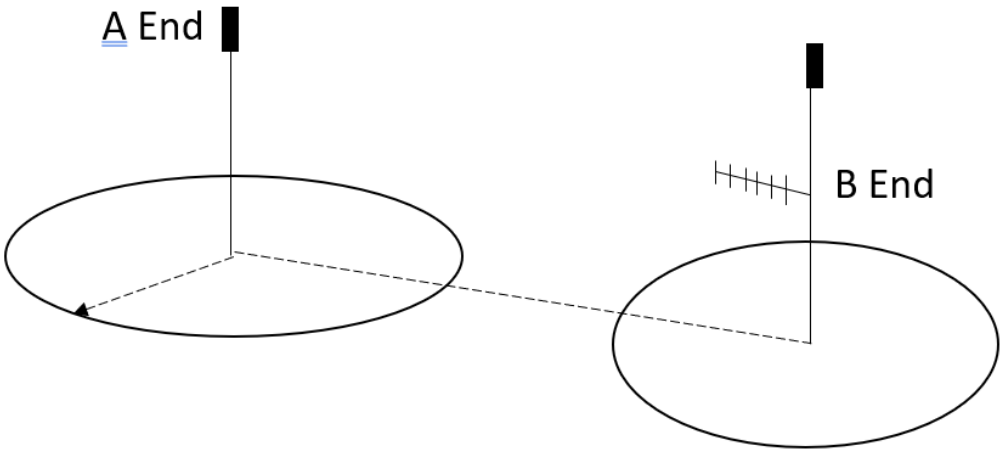


Figure – Amateur Repeater Off Air Link Model

Amateur Repeater stations may be linked together to form networks of stations covering a wide area.

The secondary method for interlinking two repeaters is using a link at site B that transmits on repeater A's receive frequency and a receives on repeater A's transmit frequency.

This type of linking requires that the link transmitter at site B use low power and directional antennas so that the risk of interference to other co-channel repeaters is minimised.

The decision on whether to use off air linking is very dependent on the main repeater frequency pairs used at Site B, as the station will need to transmit and receive in the lower 431-435 MHz band.

- 'If the transmit frequency allocated to the repeaters that are to be linked are separated by less than 1.6 MHz then it is unlikely that off air linking can be successfully employed..

The notional specifications of the station are as follows:

Characteristic	Value
TX Power	<1W Py (30dBm)
TX Antenna Gain	10dBi
Polarisation	Vertical (required to match source repeater)
Feeder / Filter Losses	3dB
Notional Receiver Sensitivity	1.0uV @ 20dB SINAD (-107dBm)
RX Antenna Gain	10dBi

4 Frequency Assignment Policy Guidelines

4.1 Overview

Assigned amateur repeater stations can take on several forms.

- Duplex (two frequency operation) repeater stations often located on elevated sites targeting mobile and / or portable amateur station activity.
- Simplex (single frequency operation) repeater stations used to either provide:
  - store and forward data relay services (such as the Amateur Position Reporting System (APRS) based on AX.25 1200 bps data transmissions) or;
  - single frequency “gateway” stations which facilitate access to global voice relay networks (often internet based).
- Inter-repeater dedicated links (using either one or two frequency configurations) used to connect multiple repeater stations together into larger regional networks.

Frequency planning for the wide variety of services, where certain combinations of these services are requested in the same locality or region, can therefore be complex.

It should be noted that amateur radio repeater station frequency assignments do not consider the full range of station types found in the amateur service that would wish to access these assigned repeater stations. Amateur VHF/UHF/SHF activity can be carried out under a wide range of circumstances including from home stations with high gain elevated antennas or portable stations located atop terrain prominences etc. Interference protection for these additional types of stations uses is not required to be provided, nor is it practical given the limited channel capacity available on some frequency bands.

Assigned amateur stations are also not provided interference protection from class licensed amateur station activity, which is permitted to occur across any spectrum allocated to the amateur service in the ARSP. It should be noted, however, that class licensed amateur stations are encouraged globally to confine their operating in certain segments of the amateur spectrum to transmission modes that are broadly compatible with each other, through being asked to follow the published amateur radio band plans that are sanctioned by the IARU representative bodies in each country.

4.2 Special Use Channel Management

Within the channel plans for this band, some channels are reserved for particular use cases. Typically, these are to support portable repeater stations that can be deployed anywhere in the named state or territory for periods of less than 7 days at a time, typically to support community events or emergency services support communications.

When presented with a request to licence a new portable repeater, one of the channel plan's nominated state or territory based portable use channels (see the channel plans below) should be assigned on an area wide basis.

The following channels are reserved for portable repeaters:

- Portable (National) 438.050, 438.275, 438.625.
- Portable (NSW) 439.625.
- Portable (WA) 438.025, 438.925, 439.8875.

Sited repeater stations should not be allocated to those frequencies (which are defined in the band plans state by state or territory) although exceptions can be made when the sited repeater is predominantly intended to facilitate emergency communications over a given area. Should an applicant wish to proceed with such an application, it should be referred to ACMA using the non-standard application process.

4.3 Legacy 438 - 440 MHz repeater systems licenced prior to 2015.

Amateur assigned repeater stations prior to 2015 operating between 438.050 – 439.800 MHz used uplink (receive frequencies) that were subsequently included in the 433 MHz Low Interference Potential Device (LIPD) Class Licence sub-band. With the increasing density of LIPD devices, this led to substantial interference to several of the amateur assigned repeater networks. As a result (and following the withdrawal of the 420-430 MHz sub-band from the amateur service in Australia), the repeater channel plans were amended in 2015 to adopt a new 7MHz offset between the transmitter and receiver frequencies.

Amateur assigned repeater stations that operated within the segment 438.025 – 438.725 MHz and 439.275 – 439.775 MHz have since 2015 been encouraged to seek to vary their licences and migrate to the new 7 MHz channels. While this has not been compulsory, should a repeater owner seek to modify their existing system, they should be asked to move to the new band plan at that time.

4.3.1 -5 MHz to -7 MHz offset Migration Arrangements

Should an applicant seek to migrate an existing amateur assigned repeater station from the 5.0 to the 7.0 MHz 438 MHz repeater channel plan and they:

- operated in the segments 438.025 – 438.725 MHz
    - then they automatically have a reservation in the 431.025 – 431.725 repeater receive frequency sub-bands.
- operated in the segments 439.275 – 439.600 MHz
    - then they are required to move both their receiver and transmitter to a new repeater frequency pair within the available 7 MHz channel plan.
- operated in the segments 439.625 – 439.9875 MHz

- then they automatically have a reservation in the 432.625 – 432.9875 MHz repeater receive frequency sub-bands **unless** there is a repeater operating with a -5.4 MHz offset within the 438.000- 438.400 MHz sub-band in the same region (see 4.3.2 below).

4.3.2 -5.4 MHz Offset Legacy Repeater Management vs 439.6-440.0 MHz repeaters

Between 2002 – 2015, digital only repeaters were permitted to use a -5.4 MHz offset for their receive frequencies when operating in the 438.0 – 438.4 MHz sub-band.

These systems may continue to operate on their licensed frequencies until the licensee decides to migrate to the newer arrangements.

Should a repeater with a TX allocation in the 438.0 – 438.4 MHz sub-band that is currently using -5.4 MHz receive offsets wish to update their system, they are automatically entitled to a reservation on the equivalent -7.0 MHz repeater receive segment.

NOTE: this means that any repeater transmitting in the 439.6-439.9875 MHz sub-band is NOT entitled to an automatic -7.0 MHz frequency assignment. Should a repeater in the 439.6-440.0 MHz band segment wish to move to a -7.0 MHz offset channel, and their corresponding receive frequency aligns with the equivalent 5.4 MHz offset repeater, the channel is deemed unavailable (until that repeater also moves to a 7 MHz offset).

If a 5.4 MHz offset repeater is active on one of the channels listed, then the future RX channel for that system in the -7.0 MHz plan and the blocked TX Channel for an adjacent repeater in the 439 MHz band are both listed.

438 MHz repeater (-5.4 MHz plan) Existing TX Frequency	438 MHz repeater (-5.4 MHz plan) Existing RX Frequency	438 MHz repeater (-7.0 MHz plan) Future RX Frequency	439 MHz repeater (-7.0 MHz plan) Blocked TX Frequency
438.0125	432.6125	431.0125	439.6125
438.0250	432.6250	431.0250	439.6250
438.0375	432.6375	431.0375	439.6375
438.0500	432.6050	431.0500	439.6500
438.0625	432.6625	431.0625	439.6625
438.0750	432.6750	431.0750	439.6750
438.0875	432.6875	431.0875	439.6875
438.1000	432.7000	431.1000	439.7000
438.1125	432.7125	431.1125	439.7125
438.1250	432.7250	431.1250	439.7250
438.1375	432.7375	431.1375	439.7375
438.1500	432.7500	431.1500	439.7500
438.1625	432.7625	431.1625	439.7625

438 MHz repeater (-5.4 MHz plan) Existing TX Frequency	438 MHz repeater (-5.4 MHz plan) Existing RX Frequency	438 MHz repeater (-7.0 MHz plan) Future RX Frequency	439 MHz repeater (-7.0 MHz plan) Blocked TX Frequency
438.1750	432.7750	431.1750	439.7750
438.1875	432.7875	431.1875	439.7875
438.2000	432.8000	431.2000	439.8000
438.2125	432.8125	431.2125	439.8125
438.2250	432.8250	431.2250	439.8250
438.2375	432.8375	431.2375	439.8375
438.2500	432.8500	431.2500	439.8500
438.2625	432.8625	431.2625	439.8625
438.2750	432.8750	431.2750	439.8750
438.2875	432.8875	431.2875	439.8875
438.3000	432.9000	431.3000	439.9000
438.3125	432.9125	431.3125	439.9125
438.3250	432.9250	431.3250	439.9250
438.3375	432.9375	431.3375	439.9375
438.3500	432.9500	431.3500	439.9500
438.3625	432.9625	431.3625	439.9625
438.3750	432.9750	431.3750	439.9750
438.3875	432.9875	431.3875	439.9875
438.4000	433.0000	431.4000	

4.4 438 MHz band intermodulation management with external services

The 438 MHz band repeater channels which use a 5.0 MHz Tx/Rx offset may be compromised in the presence of trunked land mobile services in the 400 – 430 MHz band within 200m of sites with assignments in that band. Where these commercial or government networks are located within 200 m of the proposed amateur repeater site and have 2 or more land mobile transmitters separated by 5.0 MHz, intermodulation products if they are generated, have a reasonable probability of mixing with the proposed amateur repeater transmitter, and then generating an intermodulation interference product directly on the proposed amateur repeater receive frequency (via a 2A – B mixing mechanism).

Heavily loaded trunked mobile sites have been registered with transmitters spaced at 5.0 MHz intervals through a combination of allocations in ACMA RALI MS 22 Appendix A Table 1.

For example:

- Commercial Channel Block I (Ch 1 – 50) + Block M (Ch 153 – 202).
- Commercial Channel Block K (Ch 1 – 43) + Block N (Ch 111 – 152).

Where this condition is found, the Amateur Repeater operating frequencies should preference channel blocks that support a 7.0 MHz Tx/Rx frequency separation (although they will not be completely immune as 7 MHz separation LMR channels are also permitted).

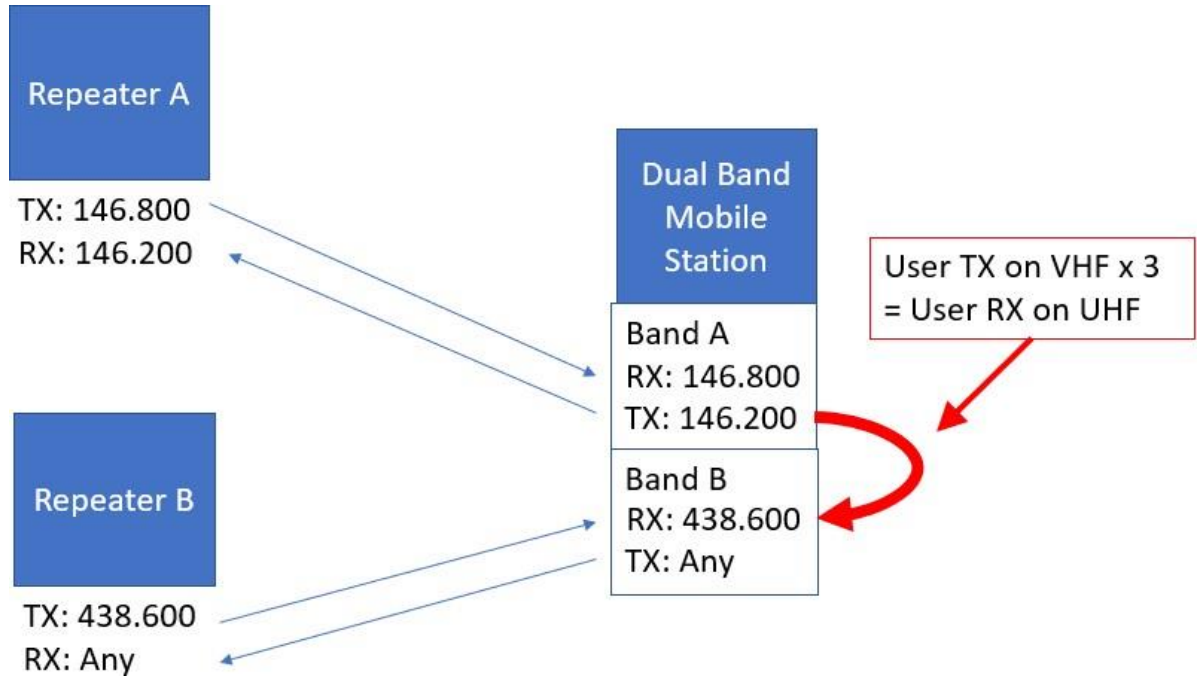
It should be noted that good site engineering can often be used to overcome these problems, hence this is only a guideline.

4.5 Restrictions on harmonically related 146 / 438 MHz services within 80 km.

The amateur radio spectrum bands are historically harmonically related. This poses an additional frequency coordination constraint when selecting amateur repeater frequencies.

The mode of interference occurs in the amateur non-assigned station when transmitting to a repeater in the VHF segment and simultaneously listening to a repeater in the UHF segment. The interference that results is generated in the non-assigned mobile/portable station internally and follows the equation:

F(UHF Harmonic) = (F(VHF Repeater TX) MHz -0.6 MHz) x 3



This local 3rd harmonic interference problem is not easily solved at the affected station, and so it is preferable that the problem be avoided at the frequency assignment stage.

The following specific 146 MHz / 438 MHz band channel pairs should be avoided within the same 80km radius locality as an assigned 430-440 MHz repeater station inside that area. In addition, the 12.5 kHz

channel above and below the impacted 430-440 MHz repeater transmitter should also be avoided (as the harmonic interference is up to 48 kHz wide).

144 MHz Repeater RX	144 MHz Repeater TX	Impacted 430-440 MHz Repeater TX	144 MHz Repeater RX	144 MHz Repeater TX	Impacted 430-440 MHz Repeater TX
146.0125	146.6125	438.0375	146.1625	146.7625	438.4875
146.0250	146.6250	438.0750	146.1750	146.7750	438.5250
146.0375	146.6375	438.1125	146.1875	146.7875	438.5625
146.0500	146.6500	438.1500	146.2000	146.8000	438.6000
146.0625	146.6625	438.1875	146.2125	146.8125	438.6375
146.0750	146.6750	438.2250	146.2250	146.8250	438.6750
146.0875	146.6875	438.2625	146.2375	146.8375	438.7125
146.1000	146.7000	438.3000	146.2500	146.8500	438.7500
146.1125	146.7125	438.3375	146.2625	146.8625	438.7875
146.1250	146.7250	438.3750	146.2750	146.8750	438.8250
146.1375	146.7375	438.4125	146.2875	146.8875	438.8625
146.1500	146.7500	438.4500	146.3000	146.9000	438.9000

4.6 438 MHz Band Compatibility between Repeater and Linking sub-bands.

There are 4 dedicated link sub-bands available for allocation within the 430-450 MHz band. These diverse combinations have arisen following multiple replanning activities carried out in response to the loss of amateur access to the 420 – 430 MHz band and the introduction of LIPD devices into the 434.050 – 434.790 MHz sub-band.

Link Band	Frequency Range
Link Band A	430.000-431.000 MHz
Link Band B	440.000-441.000 MHz
Link Band C	449.000-450.000 MHz
Link Band D	434.000-434.800 MHz

The channel plans for each of these bands is included in APPENDIX A.

The following compatibility matrix provides a guide to consider which repeater and which link transmitter frequencies are compatible at any given site. When selecting these frequencies, it must be noted that the arrangements at both ends of the link need to be considered (and potentially across multiple sites if there are more than 2 repeaters linked together in a network).

Co-Site Link/Repeater Compatibility	Repeater Band A2 TX With -5 MHz RX	Repeater Band A1 TX With -7 MHz RX	Repeater Band B2 TX With -5 MHz RX	Repeater Band B1 TX With -7 MHz RX
Link Band A TX	Prefer allocations below 430.5 MHz	Not compatible DO NOT ALLOCATE	Full Access Link Band A for TX	Full Access Link Band A for TX
Link Band A RX	No restriction	No Restriction	No Restriction	No Restriction
Link Band B TX	No Restriction	No Restriction	No Restriction	No Restriction
Link Band B RX	Marginal Link RX isolation. Limit link RX to 440.6-441.0 MHz	Marginal Link RX isolation. Limit link RX to 440.6-441 MHz	Not Compatible DO NOT ALLOCATE	Not Compatible DO NOT ALLOCATE
Link Band C TX	No restriction Notes (1) (2)	No restriction Notes (1) (2)	No restriction Notes (1) (2)	No restriction Notes (1) (2)
Link Band C RX	No restriction Notes (1) (4)	No restriction Notes (1) (4)	No restriction Notes (1) (4)	No restriction Notes (1) (4)
Link Band D TX	Not Compatible DO NOT ALLOCATE	No Restriction Note (5)	Not Compatible DO NOT ALLOCATE	Prefer allocations above 434.5 MHz. Note (5)
Link Band D RX	No restriction Notes (2) (5)	No restriction Notes (2) (5)	No restriction Notes (2) (5)	No restriction Notes (2) (5)

(1) Subject to verification of commercial / radiolocation use of the band. (In some locations wind profiler radars are active in the top 2MHz of the 430 – 440 MHz amateur band. These services are primary and amateur radio stations may not cause them interference.

(2) If single frequency links are requested, then Link Band C should be considered first, provided the links are single hop. If both repeaters are using -7 MHz offset receivers, then Link Band D can also be considered for single frequency links.

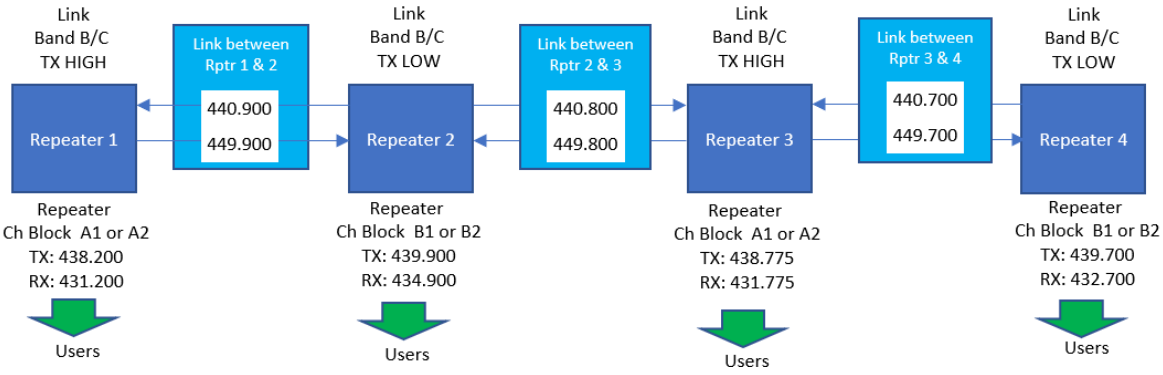
(3) Link Band A/B frequency pairs should be avoided where one or both repeaters are collocated with commercial land mobile services due to the inter-modulation problems caused by the 5 MHz TX-TX channel spacing used in the land mobile service.

(4) Is not compatible if an amateur TV repeater transmitter is collocated at the same site.

(5) Link Band D allocations must consider legacy two frequency amateur repeaters which may still be operating with their receivers on frequencies between 434.275 – 434.775 MHz. The re-use distance rules that apply to these link transmitters are defined by the reuse distances between co-channel repeaters on 438 MHz (calculated the same way) plus an additional 100 km buffer zone (to account for link transmitter antenna gain).

To help guide the assignment process, the following examples show how link band pairs can be allocated depending on whether there are -5 MHz or -7 MHz offset main repeaters involved in a linked repeater system.

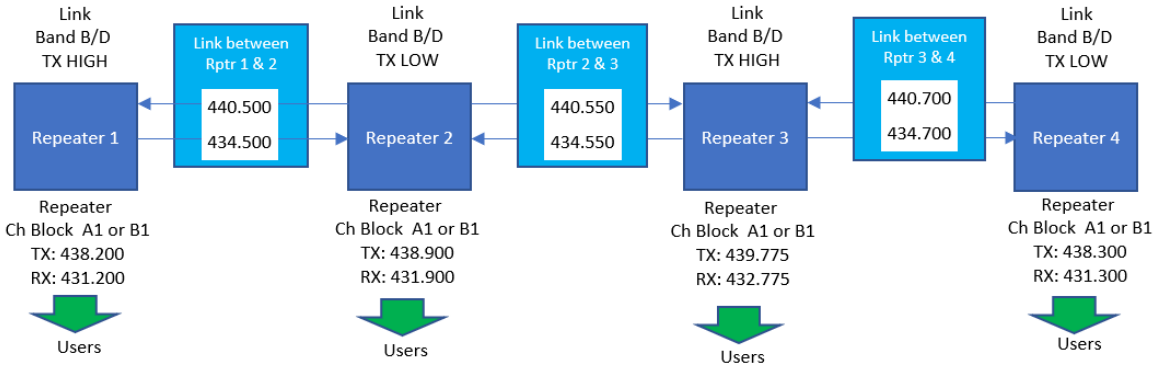
4.6.1.1 Example 1 - Link band B & C serving both Band A1, B1 & B2 repeaters



Note:

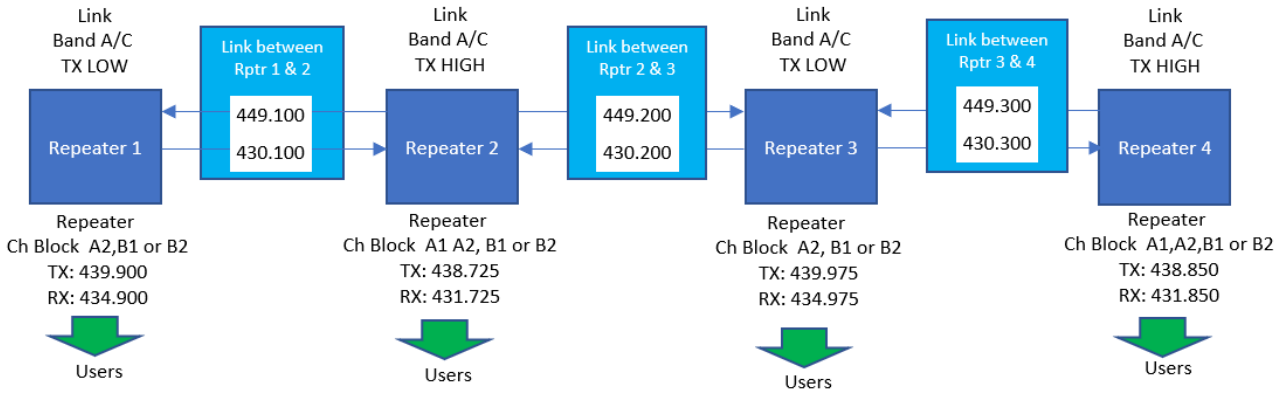
(1) when using Repeater Channel Block A1/A2 and there are link transmitters assigned to Link Band B, ensure that intermodulation (2A – B) products are avoided by not allocating combinations of link and repeater transmitters that are either 600 kHz or 1.6 MHz apart if there are 146 MHz band repeater stations co-sited.

4.6.1.2 Example 2 - Link band B & D serving Band A1 & B1 repeaters



Note: Link Block D frequency allocation should start from the highest available Link Band D frequency.

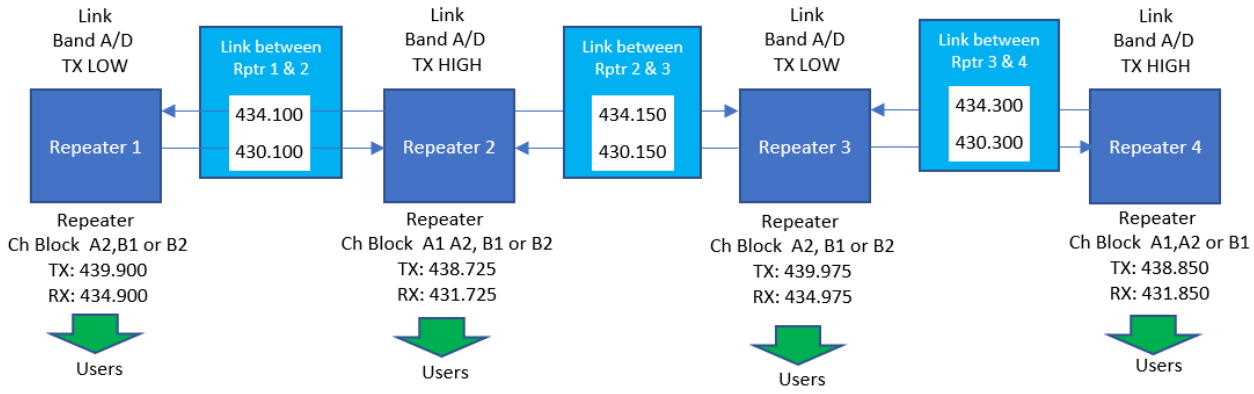
4.6.1.3 Example 3 - Link band A & C serving Band A1, A2, B1 & B2 repeaters



Note:

(1) Link Block A frequency allocation should start from the lowest available Link Band A frequency first.
(2) Repeater Block B1 frequency allocation should start from the highest available repeater band block B1 frequency.

4.6.1.4 Example 4 - Link band A & D serving Band A1, A2, B1 & B2 repeaters



Note:

(1) This is the least preferred repeater / link band combination as it presents complex filtering problems (due to the relative frequency proximity between Link band D transmitters and Repeater band A1 or B1 receivers).

(2) Proposed frequencies in link band D also need to be coordinated against legacy two frequency repeaters operating in the 439.275 – 439.775 MHz frequency range which have receivers operating between 434.275-434.775 MHz.

(3) Link band D should only be used as a last resort where all other band combinations fail coordination.

4.7 438 MHz Band compatibility between Two Frequency and Single Frequency Stations

The frequencies available for consideration when planning a new Single Frequency assignment or a new Two Frequency assignment for a new service, depend on the existing services already operating at a site. Due to the band plan arrangement, certain two frequency channel blocks are not available for consideration at a site if there is a single frequency system already present. Likewise, a planned single frequency system may not be possible if an existing two frequency station is already present and is not within a compatible frequency block.

As a result, where a new single frequency system is requested in this band, and an existing two frequency services is collocated on the site, it will only be possible to proceed with the single frequency allocation if the two frequency services are operating in one of the following frequency blocks

- 438 MHz Repeater Block A2.
- 438 MHz Repeater Block B2.
- 438 MHz Repeater Block A1 between 438.050 MHz and 438.400 MHz.

Likewise, if an existing single frequency service is already present on a site, then only the frequency blocks above are available for consideration for the new proposed two frequency service.

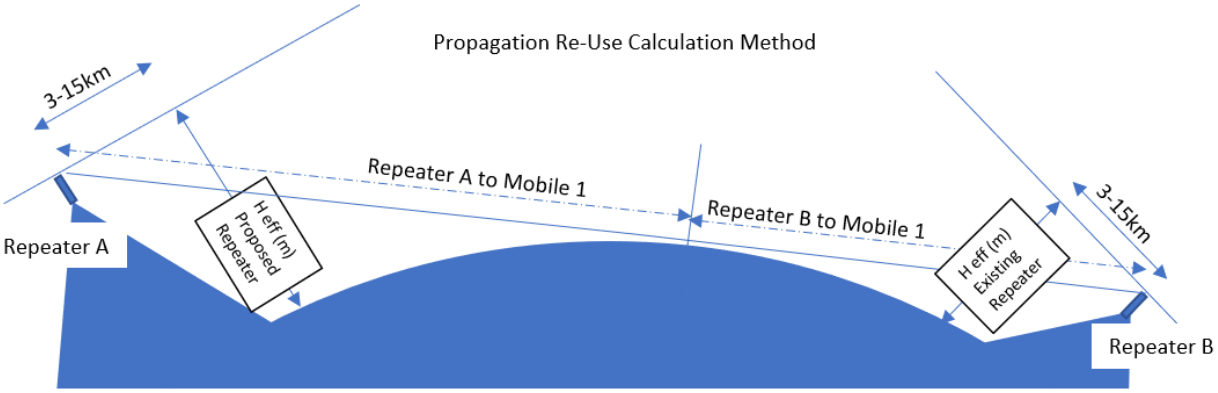
4.8 Frequency Re-use (Tropospheric Propagation) on the 430-450 MHz band

In assessing frequency re-use for tropospheric based propagation effects within the amateur repeater station network, a simplified approach has been developed based on ITU-R P.1546-6.

The design of inter-site distance has also discounted any assessment of home-based class licensed amateur stations where the station antenna height is usually much more than 1.5m above ground and the station antenna gain is typically > 10dBi (using directional antennas). In this sense, inter-site interference is not precluded but is managed within the very diverse portfolio of usage within the amateur radio service.

To simplify frequency reuse assessment, tables have been developed that define the minimum acceptable reuse distance for a co-channel repeater given the calculated effective height of the proposed new station and a potential co-channel frequency candidate.

The value for the effective height h_{eff} is defined (in ITU-R.1546-6 Annex 5 Section 3) as its height in metres over the average level of the ground between distances of 3 and 15 km from the transmitting/base antenna in the direction of the receiving/mobile antenna. Where the value of effective transmitting/base antenna height, h_{eff}, is not known it should be estimated from available topographic information.



To use the tables, take the value determined for H_{eff} for each site, add the tower height to the H_{eff} value and then round up to the next highest pre-determined height bracket in the re-use table. Do this for each of the two sites in each reuse distance check. Then, using the matrix, new site on the horizontal axis, existing site on the vertical axis, determine the minimum acceptable reuse distance for that pair.

4.8.1 438 MHz Repeater Reuse Distances for Co-Channel repeaters - inland

The following table provides the specific tropospheric based minimum Co-Channel Reuse Distance between co-channel amateur repeater stations on the 438 MHz band when the coverage area of each repeater is contained over land.

Distance Between Sites (km)		New site effective height				
	Effective Height (m)	37.5m	150m	300m	600m	1200m
Existing Site effective height	37.5m	100 km	125 km	140 km	170 km	200 km
	150m	125 km	150 km	165 km	195 km	225 km
	300m	140 km	165 km	180 km	210 km	240 km
	600m	170 km	195 km	210 km	240 km	270 km
	1200m	200 km	225 km	240 km	270 km	300 km

Should a reuse distance combination not be able to be found, then follow the non-standard process outlined in FAP 10.

4.8.2 438 MHz Repeater Reuse Distances for Co-Channel repeaters – coastal

Where the line between two repeaters crosses coastal waters, the enhanced tropospheric ducting found in these regions greatly increases the probability of interference. When evaluating frequency reuse over coastal regions, particularly where the paths between two stations cross coastal water bodies, the reuse distances quoted should have an additional 80km added.

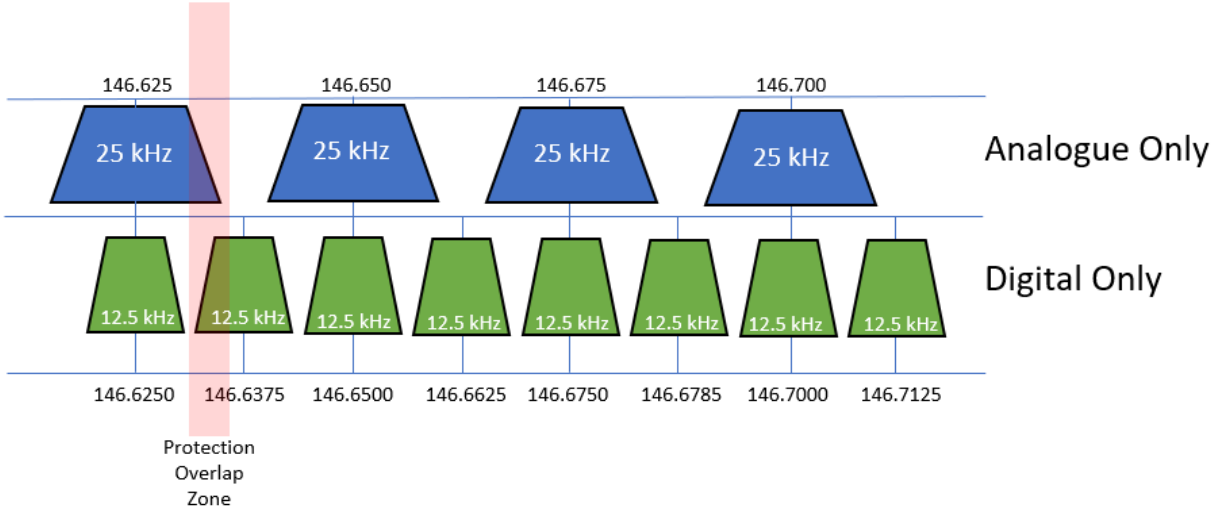
Should a reuse distance combination not be able to be found, then follow the non-standard process outlined in FAP 10.

4.9 Frequency re-use for 12.5/25 kHz overlapping adjacent channel 438 MHz services.

On the 438 MHz amateur bands, the amateur repeater channel plan operates using two different channel rasters.

1. There is a primary 25 kHz channel raster that is applied to all analogue capable (including mixed analogue/digital repeater stations).
2. For digital only repeater stations there is an additional overlapping 12.5 kHz channel plan designed to provide some increase in channel capacity.

Due to the differences in modulation bandwidth on the 25 kHz channels (using 16K0F3E or 16K0F9W modulation) versus the 12.5 kHz channels which only use 9K00F9W modulation), the amount of frequency reuse protection required in the 25 kHz channel is governed by the amount of energy from the adjacent digital channel transmission that will still be present in an adjacent 16kHz wide analogue receiver operating on the 25 kHz channel raster.



This VHF example applies equally to the 438 MHz amateur band.

When considering adjacent channel reuse in this case, a reduction of 26dB in the required protection can be applied when comparing the co-channel case to the adjacent channel case. This translates into a corresponding reduction of required the inter-site frequency reuse distance.

For example, on the 430 – 450 MHz band:

- A proposed 12.5 kHz channel digital repeater on 438.4000 MHz co-channel with a 25 kHz analogue repeater also on 438.4000 MHz will follow the inter-repeater spacing calculated values according to section 4.7.

Whereas:

- A proposed 9 kHz transmitter occupied bandwidth digital repeater using a 12.5 kHz raster channel on 438.4125 MHz adjacent to a 16 kHz bandwidth analogue repeater on a 25 kHz raster channel on 438.4000 MHz can use a minimum inter-site spacing value that is derived below.

To simplify this assessment, when considering channels which have overlapped 12.5 / 25 kHz channels, the following inter-site reuse distance tables can be used in place of the co-channel ones for the relevant bands.

4.9.1 438 MHz Repeater Reuse Distances for 12.5/25 kHz Adjacent-Channel repeaters - inland

Distance Between Sites (km)		New site effective height				
	Effective Height (m)	37.5m	150m	300m	600m	1200m
Existing Site effective height	37.5m	50 km	70 km	85 km	270 km	300 km
	150m	70 km	90 km	105 km	300 km	330 km
	300m	85 km	105 km	120 km	140 km	160 km
	600m	105 km	125 km	140 km	160 km	180 km
	1200m	125 km	145 km	160 km	180 km	200 km

Should a reuse distance combination not be able to be found, then follow the non-standard process outlined in FAP 10.

4.9.2 438 MHz Repeater Reuse Distances for 12.5/25 kHz Adjacent-Channel repeaters – coastal

As was the case for the co-channel inter-site distance matrix, this table assumes the path between the repeaters is totally over land. When more than 20% of the path is over water, an additional 80 km should be added to the value referenced from the chart below to account for the significantly higher probably of tropospheric ducting affecting the path.

Should a reuse distance combination not be able to be found, then follow the non-standard process outlined in FAP 10.

5 Amateur Repeater, Link & Gateway Station Frequency Coordination Procedure

5.1 Amateur Two Frequency Repeater Station Assignment Process

Step 1 – is this an application for a special use / portable system operating on area wide basis?

a) determine if the applicant qualifies for access to one of the special use channels (i.e., is it a portable repeater that will be used for emergency service communications by the nominated organisation).

b) If it is, then it should be licenced such that "Area Wide" usage is provided within the state or territory the licence applies to. (National Area Wide allocations are permitted on the nationally assigned channels).

c) Proceed to registration. (As these are itinerant and self-managed regarding interference no further assessment is required).

Step 2 – is this an existing 438 MHz repeater service that requires modifications to the licence conditions.

a) If the application is to change the receive frequency from the -5.0 or -5.4 MHz offset allocations to the current -7.0 MHz offset channel block, then follow section 4.3.1 to understand the available reservations on the new channel plan for legacy repeaters (noting the exception between 439.6 – 440.0 MHz). Proceed then to step 3.

b) If the applicant is seeking to convert from a -5.0 to a -7.0 MHz offset channel and the current repeater transmitter is allocated between 439.6125-439.9875 MHz, then section 4.3.2 needs to be considered to ensure that the new receive allocation does not clash with the reserved receive allocation for an existing -5.4 MHz receive offset based repeater station that is within the co-channel frequency re-use of the subject site and is currently licenced.

c) If there is no available reserved receive channel for a repeater in the situation described in Step 2b) above, then inform the applicant that a completely new TX/RX allocation will be required. Then proceed to step 3.

Step 3 – select which channel blocks are valid for use by the proposed service based on co-located and nearby services.

a) obtain a list of all UHF services within 1km of the proposed new amateur assigned service within the 400 – 480 MHz band and determine if there is a risk of commercial intermodulation

products that would preference selecting a -5 or -7 MHz offset channel pair. (refer to section 4.4). Preference the block with the least number of potential intermodulation products.

b) Proceed to Step 4

Step 4 – conduct a 3rd order Harmonic check against existing licenced amateur 146 MHz repeaters.

a) obtain a list of all licenced amateur 146 MHz repeaters within 80 km of the proposed site that are operating on frequencies between 146.6125 MHz and 146.900 MHz in accordance with Section 4.5.
b) add any frequency identified to a cull list for 438 MHz repeater channels that should not be allocated to this proposed site. Proceed to Step 5.

Step 5 – Compatibility check between 438 MHz repeater frequencies and 430 – 450 MHz band amateur link transmitters as per section 4.6.

a) Identify if there are any existing repeater link transmitters or receivers on the band at the proposed new repeater station site (or within 300m of it).
b) Note from the application of the new repeater site is also requesting new repeater linking frequencies associated with it. If no links are requested then proceed to Step 6, otherwise;
c) Add to a site frequency cull list any repeater transmitter sub-bands that would not be compatible with the matrix presented in section 4.6
d) Maintain awareness that if the application also includes a repeater link frequency request that the link frequency requests (and details of any existing network or site it is interacting with) will need to be considered when assessing this request. Selection of link frequencies may be bound to constraints coming from other sites which may determine which sub-bands can ultimately be considered for the primary repeater service on the new site.
e) add any frequency or frequency block that would fail to a cull list for, so that those frequencies are no longer considered in further assessment for this site.

Step 6 – compatibility check between 438 MHz repeater frequencies and Single Frequency Assigned amateur stations as per section 4.7.

a) if there is a single frequency assigned service within 300m of the proposed site, note which repeater channel blocks remain available and place all other channels into the cull list. Then proceed to Step 7.

Step 7 – determine whether the proposed repeater requires a 25 kHz bandwidth channel or a 12.5 kHz channel.

a) If it is operating either part time or full time using analogue modulation, then a 25 kHz channel will be required. This will exclude channels listed on the 12.5 kHz channel plan. Only 25kHz channel plan frequencies will be valid.

b) Otherwise, if it is a digital only service, then it can consider using a 12.5 kHz bandwidth channel from any channel block not already blocked in the proceeding steps (including channel block C)

Step 8 – co-channel frequency reuse assessment (refer section 4.8).

a) conduct a search of the ACMA RRL[8] and create a list of all services in the remaining assignable frequency blocks that are currently active within 500 km.

b) inspect the list of sites gathered and compare against the available channels in the channel blocks available for consideration at this site. If there is a clear frequency, then select the lowest available channel pair and proceed to step 9.

c) if there are no clear frequencies identified, follow the frequency reuse calculation method outlined in section 4.8 to determine, based on the effective height of each system, whether a channel is available that has a reuse distance greater than the minimum specified in the section 4.8 processes. Note the different requirements for coastal vs inland systems.

d) Add to the frequency cull list any frequency where the reuse distance is less than the minimum.

e) Allocate the lowest available frequency in the block.

f) If no frequencies are available, proceed to refer the application to the ACMA for a non-standard allocation process where more detailed scrutiny of the re-use distance requirements can be conducted using more detailed terrain modelling.

Step 9 – adjacent-channel frequency reuse assessment (refer section 4.9).

a) For the identified frequency candidate in step 8, inspect the ACMA RRL on the corresponding frequency 12.5 kHz above and below the proposed channel and conduct a frequency reuse assessment in accordance with section 4.9.
b) If the adjacent channel reuse fails, repeat step 8 for the next available frequency and continue until all frequency options have been exhausted.

Step 10 – if you have exhausted all available frequencies and not been able to identify a suitable option, refer the application to the ACMA for assessment using the non-standard frequency assignment process outlined in FAP 10.

[8] ACMA RRL https://web.acma.gov.au/rrl/register_search.main_page

5.2 Amateur Single Frequency Block C or D Gateway/Data repeater Station assignment Process

Step 1 –Determine if there are any duplex assigned amateur repeater stations within 1km of the proposed site licenced in any one of channel Blocks A1, A2, B1, B2 based on the contents of the ACMA RRL.

Step 2 – Subject to the results of step 1, then:

(a) If there are no two frequency duplex repeaters operating on the band within 1km then proceed to Step3
(b) If the repeaters that exist are only in Block A2, B2 or channels 438.050 – 438.400 in Block B1 then proceed to Step 3
(c) If there are any repeaters operating in Block B1 or above 438.400 MHz in Block A1 then the site is not compatible for single frequency services and the applicant should be notified of the assignment failure.

Step 3 – within the valid gateway frequency block, obtain a list from the ACMA RRL of all existing licenced amateur single frequency assigned stations within 400 km.

Step 4 – if there is a frequency available that has no services licenced on it within 400 km then select the first frequency available and proceed to Step 7.

Step 5 – for each frequency, determine the distance between the two sites and the effective height Heff above average terrain (as per section 4.7). Select the minimum allowed co-channel reuse distance from the table in section 4.8.1 for co-channel stations and determine if the proposed frequency meets or exceeds that requirement. If it does, then proceed to Step 6 else select the next channel option and repeat Step 5.

Step 6 – for the selected frequency, check the adjacent frequency 12.5 kHz above and below for an existing assigned amateur station and after determining its effective height Heff use the adjacent frequency re-use table in section 4.8.1 to determine if the distance is greater than the allowed minimum. If it is, then proceed to Step 7.

Step 7 – assess the selected frequency against the intermodulation requirements of ACMA RALI LM8. If it passes, then proceed to Step 8 else return to Step 5

Step 8 – proceed to submit the application.

5.3 Amateur Repeater Link Transmitter Stations

Link planning and guidance:

Repeater link frequency selection is as much about network design as it is about selecting actual frequencies. Prior to commencing to process a link application the AP should ensure that they have received the following from the applicant:

- Applicants should make an application that includes a map of the network and the preferred sub-band, transmitter/receiver sense at a minimum. Applicants should take into account the advice in this RALI when preparing their submission for assessment.
- Likewise, the applicant must have conducted their own study on whether the link will actually function with the required reliability and should provide the AP with details of the antennas and expected signal levels (in dBm) of each link using transmitter powers that are in accordance with this RALI.

Applicants requiring design assistance should contact their preferred representative body. Alternatively, they can request at the beginning to have the application handled through the non-standard application process described in FAP 10, which will lead to the engagement of the IARU representative body in Australia who can provide technical assistance as required.

Once all the required technical input parameters have been supplied, an AP should follow the process below:

Step 1 – obtain a list of all VHF/UHF amateur repeater sites from the ACMA RRL and compile a list of all repeater link band assignments, their antennas, bearings, transmitter power, polarisation and destination sites within an area defined by the maximum re-use distance for the subject site prescribed in section 4.8. (Note the link bands are described in APPENDIX A section 6.2.4).

Step 2 – validate the proposed link bands vs compatibility with any 438 MHz main repeater channels or single frequency gateway channels located within 300m of the proposed site (See section 4.6).

a) Confirm that the repeater main transmitter/receiver to repeater link transmitter/receiver frequency segments pass the requirements described in section 4.6.

b) Create a full list of any frequency segments or partial segments that would fail the compatibility matrix in section 4.6 and add them to a frequency cull list.

c) Note the ATV repeater compatibility requirements outlined in RALI AA2 and determine if they place any additional restrictions on what sub-bands can be used at a site.

d) If the compatibility matrix check fails, refer the application back to the applicant for design review. If the applicant does not wish to vary the design then refer to the non standard allocation process described in FAP 10.

Step 3 – identify all the existing link transmitters and receivers registered within the frequency re-use distance requirement of both link sites (see section 4.8 for references of how to calculate minimum re-use).

a) Add each identified frequency that fails the frequency re-use criteria to a band-segment frequency cull list.

Step 4 – review the remaining list of available frequencies and starting with the lowest frequency available first and identify if a free channel can be found for both transmit and/or receive (as required).

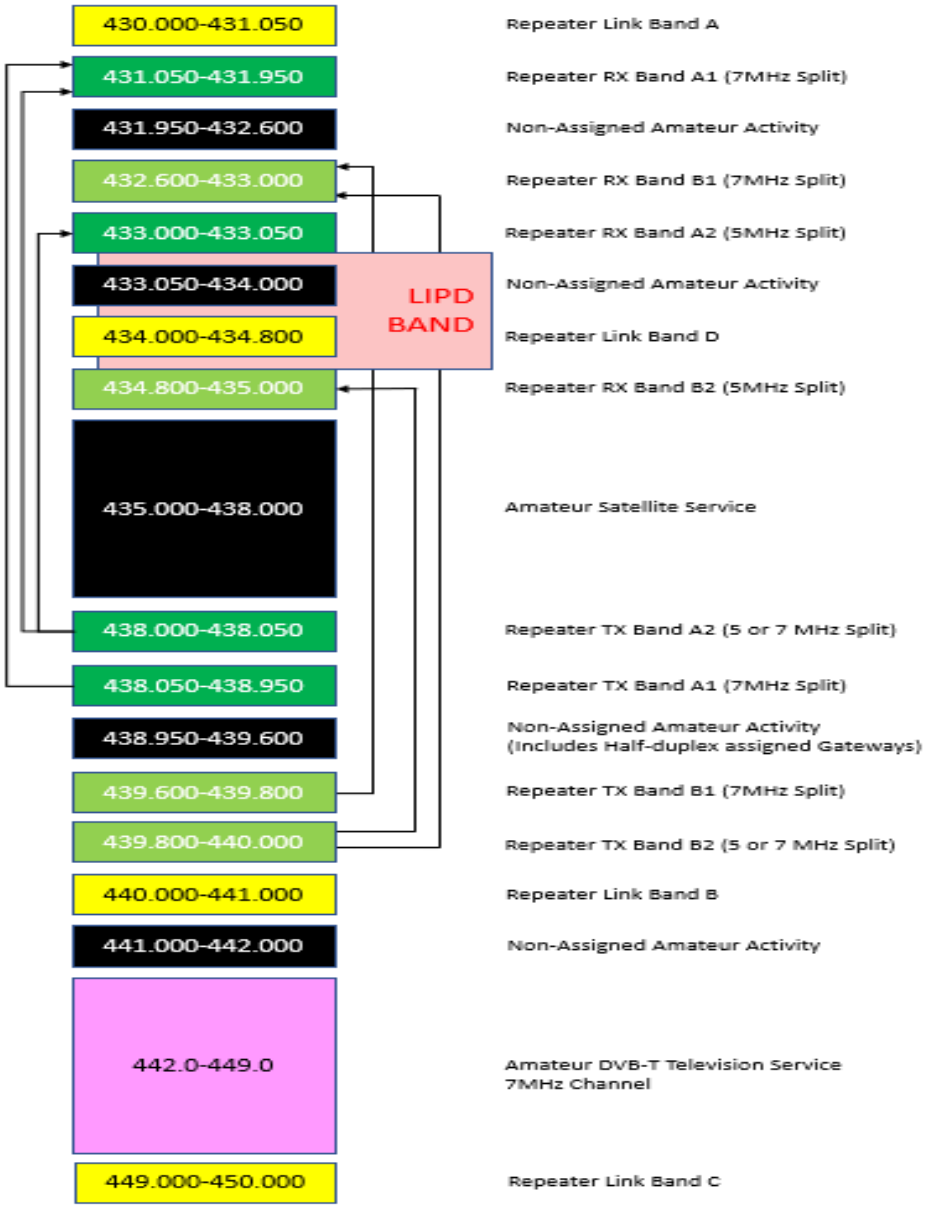
Step 5 – for each free channel, conduct site compatibility checks with co-sited non-amateur services in accordance with the standards set forth in ACMA RALI LM8.

Step 6 – proceed to submit the application. If no solution was found, refer the application to ACMA for non-standard processing in accordance with the procedures in the relevant FAP.

6 APPENDIX A – 430 – 450 MHz band / channel plans

The amateur service has established a set of guiding band plans to manage interference between different types of activities. These plans form the foundation of the frequency assignment policies for these amateur spectrum bands.

6.1 Amateur 438 MHz Band Plan



Notes:

(1) Amateur class licensed stations have access to the full band to conduct transmissions. The identified "class licensed amateur activity" segments above are sub-bands where this activity is simply not sharing with amateur assigned services.
(2) Assignments within the amateur 430 – 450 MHz band should conform to this band plan as far as possible.
(3) Terrestrial assignments must not be made within the Amateur Satellite Service band segment.
(4) The Amateur Television channel can still be used in analogue VSB mode if desired with a vision carrier of 443.25 MHz and a sound carrier of 448.75 MHz.

6.2 Repeater & Gateway Channel Plans

Within each repeater sub-band, specific channel arrangements have been developed. Repeater, store and forward data and gateway stations should be assigned channels only from these channel plans.

6.2.1 438 MHz Two Frequency Repeater Channel Plan – Block A1, A2, B1 and B2

Sub-band	Repeater Transmit		Repeater Receive (-5.0 MHz offset)		Repeater Receive (-7.0 MHz offset)		Allocation Notes	Special Use Allocation
	25 kHz Raster	12.5 kHz Raster (Digital Only)	25 kHz Raster	12.5 kHz Raster (Digital Only)	25 kHz Raster	12.5 kHz Raster (Digital Only)		
A1		438.0125		433.0125		431.0125	2,5	
	438.025	438.0250	433.025	433.0250	431.0250	431.0250	2, 5	PORTABLE (WA)
		438.0375		433.0375		431.0375	2, 5	
B1	438.050	438.0500			431.0500	431.0500	1,2	PORTABLE
		438.0625				431.0625	1,2	
	438.075	438.0750			431.0750	431.0750	1,2	
		438.0875				431.0875	1,2	
	438.100	438.1000			431.1000	431.1000	1,2	
		438.1125				431.1125	1,2	
	438.125	438.1250			431.1250	431.1250	1,2	
		438.1375				431.1375	1,2	
	438.150	438.1500			431.1500	431.1500	1,2	
		438.1625				431.1625	1,2	
	438.175	438.1750			431.1750	431.1750	1,2	
		438.1875				431.1875	1,2	
	438.200	438.2000			431.2000	431.2000	1,2	
		438.2125				431.2125	1,2	
	438.225	438.2250			431.2250	431.2250	1,2	
		438.2375				431.2375	1,2	
	438.250	438.2500			431.2500	431.2500	1,2	
		438.2625				431.2625	1,2	
	438.275	438.2750			431.2750	431.2750	1,2	PORTABLE
		438.2875				431.2875	1,2	
	438.300	438.3000			431.3000	431.3000	1,2	
		438.3125				431.3125	1,2	
	438.325	438.3250			431.3250	431.3250	1,2	
		438.3375				431.3375	1,2	
	438.350	438.3500			431.3500	431.3500	1,2	
		438.3625				431.3625	1,2	
	438.375	438.3750			431.3750	431.3750	1,2	
		438.3875				431.3875	1,2	
	438.400	438.4000			431.4000	431.4000	1,2	
		438.4125				431.4125	1,2	

Sub-band	Repeater Transmit		Repeater Receive (-5.0 MHz offset)		Repeater Receive (-7.0 MHz offset)		Allocation Notes	Special Use Allocation
	25 kHz Raster	12.5 kHz Raster (Digital Only)	25 kHz Raster	12.5 kHz Raster (Digital Only)	25 kHz Raster	12.5 kHz Raster (Digital Only)		
B1	438.425	438.4250			431.4250	431.4250	1	
		438.4375				431.4375	1	
	438.450	438.4500			431.4500	431.4500	1	
		438.4625				431.4625	1	
	438.475	438.4750			431.4750	431.4750	1	
		438.4875				431.4875	1	
	438.500	438.5000			431.5000	431.5000	1	
		438.5125				431.5125	1	
	438.525	438.5250			431.5250	431.5250	1	
		438.5375				431.5375	1	
	438.550	438.5500			431.5500	431.5500	1	
		438.5625				431.5625	1	
	438.575	438.5750			431.5750	431.5750	1	
		438.5875				431.5875	1	
	438.600	438.6000			431.6000	431.6000	1	
		438.6125				431.6125	1	
	438.625	438.6250			431.6250	431.6250	1	PORTABLE
		438.6375				431.6375	1	
	438.650	438.6500			431.6500	431.6500	1	
		438.6625				431.6625	1	
	438.675	438.6750			431.6750	431.6750	1	
		438.6875				431.6875	1	
	438.700	438.7000			431.7000	431.7000	1	
		438.7125				431.7125	1	
	438.725	438.7250			431.7250	431.7250	1	
		438.7375				431.7375		
	438.750	438.7500			431.7500	431.7500		
		438.7625				431.7625		
	438.775	438.7750			431.7750	431.7750		
		438.7875				431.7875		
	438.800	438.8000			431.8000	431.8000		
		438.8125				431.8125		
	438.825	438.8250			431.8250	431.8250		

Sub-band	Repeater Transmit		Repeater Receive (-5.0 MHz offset)		Repeater Receive (-7.0 MHz offset)		Allocation Notes	Special Use Allocation
	25 kHz Raster	12.5 kHz Raster (Digital Only)	25 kHz Raster	12.5 kHz Raster (Digital Only)	25 kHz Raster	12.5 kHz Raster (Digital Only)		
B1		438.8375				431.8375		
	438.850	438.8500			431.8500	431.8500		
		438.8625				431.8625		
	438.875	438.8750			431.8750	431.8750		
		438.8875				431.8875		
	438.900	438.9000			431.9000	431.9000		
		438.9125				431.9125		
	438.925	438.9250			431.9250	431.9250		WA PORTABLE
		438.9375				431.9375		
B2		439.6125				432.6125	3	
	439.625	439.6250			432.6250	432.6250	3	NSW PORTABLE
		439.6375				432.6375	3	
	439.650	439.6500			432.6500	432.6500	3	
		439.6625				432.6625	3	
	439.675	439.6750			432.6750	432.6750	3	
		439.6875				432.6875	3	
	439.700	439.7000			432.7000	432.7000	3	
		439.7125				432.7125	3	
	439.725	439.7250			432.7250	432.7250	3	
		439.7375				432.7375	3	
	439.750	439.7500			432.7500	432.7500	3	
		439.7625				432.7625	3	
	439.775	439.7750			432.7750	432.7750	3	
		439.7875				432.7875	3	
A2	439.800	439.8000	434.8000	434.8000	432.8000	432.8000	3	
		439.8125		434.8125		432.8125	3	
	439.825	439.8250	434.8250	434.8250	432.8250	432.8250	3	
		439.8375		434.8375		432.8375	3	
	439.850	439.8500	434.8500	434.8500	432.8500	432.8500	3	
		439.8625		434.8625		432.8625	3	
	439.875	439.8750	434.8750	434.8750	432.8750	432.8750	3	
		439.8875		434.8875		432.8875	3	
	439.900	439.9000	434.9000	434.9000	432.9000	432.9000	3	

Sub-band	Repeater Transmit		Repeater Receive (-5.0 MHz offset)		Repeater Receive (-7.0 MHz offset)		Allocation Notes	Special Use Allocation
	25 kHz Raster	12.5 kHz Raster (Digital Only)	25 kHz Raster	12.5 kHz Raster (Digital Only)	25 kHz Raster	12.5 kHz Raster (Digital Only)		
A2	439.900	439.9000	434.9000	434.9000	432.9000	432.8000	3	
		439.9125		434.9125		432.9125	3	
	439.925	439.9250	434.9250	434.9250	432.9250	432.9250	3	
		439.9375		434.9375		432.9375	3	
	439.950	439.9500	434.9500	434.9500	432.9500	432.9500	3	
		439.9625		434.9625		432.9625	3	
	439.975	439.9750	434.9750	434.9750	432.9750	432.9750	3	
		439.9875		434.9875		432.9875	3	WA PORTABLE

Note 1:- repeaters on this TX output frequency that were operating with a -5.0 MHz receive offset prior to 2015 can continue to do so until there is a requirement to amend the licence for any other reason.

Note 2:- repeaters on this TX output frequency that are using digital modulation and -5.4 MHz receive offset prior to 2015 can remain on -5.4 MHz offset until such time as the repeater licence needs to be amended when they should be changed to include -7.0 MHz offset.

Note 3:- These repeaters share receive frequencies with legacy -5.4 MHz offset repeater channels allocations. Frequency reuse coordination with -5.4 MHz repeaters allocated between 438.0125 MHz and 438.4000 MHz (TX frequencies) needs to be also assessed against repeaters on 439.6125-439.9975 as they share uplink frequencies.

6.2.2 438 MHz Single Frequency Voice Gateways (Analogue or Digital)

The available channels for assigned voice gateway stations on the 438 MHz band are as follows:

UHF 430-450 MHz Segment		
Channel Block	Transmit / Receive Frequency	Type of Modulation
C	439.125	Digital/Analog
	439.1375	Digital
	439.175	Digital/Analog
	439.1875	Digital

Support is not provided in the band plan to provide adequate isolation between single frequency gateway stations and two frequency duplex repeater stations on a co-site basis. Single frequency gateway stations on the 438 MHz band should be sited no closer than 1km to an existing two frequency repeater station.

6.2.3 438 MHz Single Frequency Store and Forward Data Repeaters

The available channel for assigned APRS store and forward data relay repeaters is as follows:

UHF 430-450 MHz Segment			
Channel Block	Transmit / Receive Frequency	Type of Modulation	Channel Use
D	439.100	Data 1200 bps AFSK using AX.25 coding	APRS

Support is not provided in the band plan to provide adequate isolation between single frequency store and forward data stations and two frequency duplex repeater stations on a co-site basis. Single frequency store and forward data stations on the 438 MHz band should be sited no closer than 1km to an existing two frequency repeater station.

6.2.4 430 – 450 MHz Band Link transmitter channel plan – Block A, B, C and D

The following are the amateur link sub-band channel plans. 25kHz channel spacing is used for all services.

Subband	Link TX/RX
LINK A	430.025
	430.050
	430.075
	430.100
	430.125
	430.150
	430.175
	430.200
	430.225
	430.250
	430.275
	430.300
	430.325
	430.350
	430.375
	430.400
	430.425
	430.450
	430.475
	430.500
	430.525
	430.550
	430.575
	430.600
	430.625
	430.650
	430.675
	430.700
	430.725
	430.750
	430.775
	430.800
	430.825
	430.850
	430.875
	430.900
	430.925
	430.950
	430.975
	431.000

Subband	Link TX/RX
LINK B	440.025
	440.050
	440.075
	440.100
	440.125
	440.150
	440.175
	440.200
	440.225
	440.250
	440.275
	440.300
	440.325
	440.350
	440.375
	440.400
	440.425
	440.450
	440.475
	440.500
	440.525
	440.550
	440.575
	440.600
	440.625
	440.650
	440.675
	440.700
	440.725
	440.750
	440.775
	440.800
	440.825
	440.850
	440.875
	440.900
	440.925
	440.950
	440.975
	441.000

Subband	Link TX/RX
LINK C	449.025
	449.050
	449.075
	449.100
	449.125
	449.150
	449.175
	449.200
	449.225
	449.250
	449.275
	449.300
	449.325
	449.350
	449.375
	449.400
	449.425
	449.450
	449.475
	449.500
	449.525
	449.550
	449.575
	449.600
	449.625
	449.650
	449.675
	449.700
	449.725
	449.750
	449.775
	449.800
	449.825
	449.850
	449.875
	449.900
	449.925
	449.950
	449.975

Subband	Link TX/RX
LINK D	434.000
	434.025
	434.050
	434.075
	434.100
	434.125
	434.150
	434.175
	434.200
	434.225
	434.250
	434.275
	434.300
	434.325
	434.350
	434.375
	434.400
	434.425
	434.450
	434.475
	434.500
	434.525
	434.550
	434.575
	434.600
	434.625
	434.650
	434.675
	434.700
	434.725
	434.750
	434.775

7 APPENDIX B - Distribution Rights

8 APPENDIX C - Document Control

Date	Version	Change Description
19-June-2022	0.1	First Draft for internal Review
19-June-2022	0.2	1. Added application process. 2. expanded 3rd harmonic considerations between 144 and 432 MHz bands. 3. Added 28 MHz Repeater frequency reuse determination section
Late 2022	0.3	Issued to ACMA for initial comment
10th March 2023	0.4	Revised following industry feedback
30th April 2023	0.5	Revised/restructured following industry feedback – Preliminary draft not for public distribution
23 February 2024	0.6	ACMA reviewed draft
17th March 2024	1.0	Final Exposure Draft version ready for ACMA review
1st June 2024	2.0	Exposure Draft version for public release
25th September	4.0	Final Release
23rd October 2024	5.0	Public Release – ACMA Endorsed

Feedback on this document can be made by contacting the WIA National Office via email with the subject "Attention Repeater Coordinator".

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