Frequency assignment requirements for the point-to-multipoint service in the VHF high, 400 MHz and 800 MHz bands

Radiocommunications Assignment and Licensing Instruction

**rali: FX 16**

**date of effect:** [insert date when update finalised]

Amendment history

| Date | Comments |
| --- | --- |
| November 1999 | Initial release. |
| October 2003 | Tables B1 and B2 amended to add missing channels. |
| September 2012 | Amendments to align with 400 MHz changes. |
| January 2015 | Updated to include additional spectrum for PMP two-frequency services, as per the update to MS22. |
| May 2016 | Consultation draft for update to introduce a low power service model for use in the 400 MHz frequency band. |
| February 2018 | Inclusion of the new PMP segment in the 800 MHz band |
| December 2019 | Addition of 50 kHz channels and the VHF High band |
| July 2020 | Remove legacy 800/900MHz bands. See [IFC 12/2020](https://www.acma.gov.au/consultations/2020-05/803-960-mhz-band-implementation-arrangements-support-milestone-3-consultation-122020). |
| [insert date when update finalised] | Update to include additional criteria and guidance for coordination with spectrum licensed services. |

Suggestions for improvements to Radiocommunications Assignment and Licensing Instruction FX 16 may be addressed to:

The Manager, Spectrum Planning Section
Australian Communications and Media Authority
PO Box 78
Belconnen ACT 2616

or by email to: freqplan@acma.gov.au.

Please notify the ACMA of any inaccuracy or ambiguity found in this RALI, so that it can be investigated and appropriate action taken.

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# Introduction

## Purpose

The purpose of this Radiocommunications Assignment and Licensing Instruction (RALI) is to provide information on frequency coordination and licensing arrangements for two frequency fixed point-to-multipoint (PMP) services operating in the VHF High, 400 MHz and 800 MHz bands.

The information in this document reflects the ACMA’s statement of current policy in relation to frequency assignment requirements for PMP services in the VHF High, 400 MHz and 800 MHz bands. In making decisions, accredited frequency assigners and the ACMA’s officers should take all relevant factors into account and decide each case on its merits.

Issues relating to this document that appear to fall outside the enunciated policy should be referred to:

The Manager, Spectrum Planning Section
Australian Communications and Media Authority
PO Box 78
Belconnen ACT 2616

or by email to: freqplan@acma.gov.au.

# Service description

A two frequency PMP system consists of a single central master station communicating with a number of outlying remote fixed stations. The use of PMP services is usually for data transmission; typical applications include telemetry, supervisory control and data acquisition (SCADA) systems, computer networking and alarm systems.

The master station (base station) may also be wired as a repeater, with outlying remote-control stations (RCSs) operating in the remote frequency configuration and communicating with remote stations via the master station.

If necessary, supplementary stations may be used to improve coverage within the service area. The master station may be linked to a supplementary station via a remote station configured as a repeater or by a separate fixed link.

From an interference management perspective, a PMP system is characterised by:

* a central master station usually at a high site;
* a number of remote stations - distributed randomly throughout the service area;
* one or more RCSs that control the master station;
* no direct communication between remote stations;
* full duplex (two frequency working) or half duplex (single frequency working) operation; and

data throughput in the range 1.2kbps or greater.

#  Service models

The purpose of the service model is to define a set of characteristics for PMP services which will result in a specified (“target”) grade of service. There are two service models defined; one for large area coverage applications (High Power Service Model) and the other for small area coverage applications in the VHF High and 400 MHz bands (Low Power Service Model).

The target grade of service (TGS) is defined as a 10 dB signal to noise ratio (SNR) at the receiver input for an output bit error rate (BER) of 10-3. The service model is designed to achieve the TGS for receivers at 90% of locations within the service area.

## High Power Service Model Description

**Master Station:**

* P = 40W EIRP
* Effective antenna height = 200 m

**Service area**

**Service area**

**Remote Control Station**:

* Pt = 1W
* Directional antenna

**Remote Station**:

* P = 20W EIRP
* Effective antenna height = 5m

**Supplementary Station**

100 km minimum reuse distance

**30km**

**30km**

1. High Power PMP Service Model

Key features of the service model are:

* Transmitter power requirements:
* the maximum station EIRP (considering transmitter power, cable loss, antenna gain) for master stations shall be 40 W;
* the maximum station EIRP (considering transmitter power, cable loss, antenna gain) for remote and supplementary stations shall be 20 W.
* Minimum antenna performance characteristics for an RCS:
* in the VHF High Band: directional antenna with a mid-band gain of 6 dBi, minimum front-to-back ratio of 12 dB and a maximum beam width (in E-plane) of 75° (e.g. a 3 element Yagi);
* in the 400 MHz band: directional antenna with a mid-band gain of 13 dBi, minimum front-to-back ratio of 16 dB and a maximum beam width (in E-plane) of 47° (e.g. a 9 element Yagi);
* in the 800 MHz band: directional antenna with a mid-band gain of 16 dBi, minimum front-to-back ratio of 17 dB and a maximum beam width (in E-plane) of 30° (e.g. a 15 element Yagi).
* For a master station the antenna shall be a vertically polarised antenna with a maximum gain of 8.2 dBi. Use of a directional antenna is permitted (maximum gain 8.2 dBi).
* For a remote station use of directional antennas is encouraged but not mandatory, e.g. typical antennas used:
* in the VHF High Band: directional antenna with a mid-band gain of 6 dBi, minimum front-to-back ratio of 12 dB and a maximum beam width (in E-plane) of 75° (e.g. a 3 element Yagi);
* in the 400 MHz band directional antenna with a mid-band gain of 13 dBi, minimum front-to-back ratio of 16 dB and a maximum beam width (in E-plane) of 47° (e.g. a 9 element Yagi);
* in the 800 MHz band: directional antenna with a mid-band gain of 16 dBi, minimum front-to-back ratio of 17 dB and a maximum beam width (in E-plane) of 30° (e.g. a 15 element Yagi).
* In all bands radiated power 180 degrees from the direction of the remote station to the base shall not exceed 5 Watts, i.e. if an omnidirectional antenna is used on a remote, the EIRP shall not exceed 5 Watts.
* Remote stations transmitting on frequencies in the bands 154.65625–156 MHz, 451.5–452.5 MHz or 805.5–806 MHz are limited to a maximum transmitter output power at the input of the antenna of 5 W and in all other bands to a maximum transmitter power of 1 W, by the requirements of subsection 9(3) of the *Radiocommunications Licence Conditions (Fixed Licence) Determination 2015*[[1]](#footnote-2).
* Typical master station effective antenna height of 200 m above surrounding terrain.
* Typical remote station effective antenna height of 5 m above surrounding terrain.
* Specific requirements for RCSs to minimise their potential for causing intermodulation interference in areas having a relatively high concentration of transmitters and receivers. The model presumes the following requirements for RCSs located in central business districts:
* a 20 dB in line attenuator[[2]](#footnote-3) fitted between the transmitter output and the antenna;
* an effective antenna height limited to 30 m.
* Unwanted emission limits for transmitters are mandated in Annex A.
* Frequency coordination is performed for the master station only (interference protection for remote stations, supplementary stations and RCSs is intrinsic to the service model).
* A service area radius of 30 km. All stations must be contained within the service area.
* A co-channel minimum re-use distance of 100 km between master stations.
* Supplementary stations have no re-use distance requirements, they are included to improve the service reliability within, but not outside, the service area.

In the VHF High and 400 MHz bands, maximum necessary bandwidths of 12.5, 25 or 50 kHz may be used. In the 800 MHz band maximum necessary bandwidths of 12.5 and 25 kHz may be used.

## Low Power Service Model Description



1. Low Power PMP Service Model

Key features of the service model are -

* Transmitter power requirements:
* the maximum station EIRP (considering transmitter power, cable loss, antenna gain) for master stations shall be 8.3 W;
* the maximum station EIRP (considering transmitter power, cable loss, antenna gain) for remote stations shall be 8.3 W.
* While a maximum antenna gain is not specified for a master station, coordination requirements have been based on an assumption of a vertically polarised antenna with a maximum gain of 8.2 dBi. Use of higher gain antenna might result in interference levels at the master station receiver greater than those assumed in the planning modelled. No protection from interference is provided in such situations. Use of a directional antenna is permitted.
* For a remote station use of directional antennas is encouraged but not mandatory, e.g. typical antenna used:
* a directional antenna with a mid-band gain of 13 dBi, minimum front-to-back ratio of 16 dB and a maximum beam width (in E-plane) of 47° (e.g. a 9 element Yagi);
* Typical master station effective antenna height of 10 m above surrounding terrain.
* Typical remote station antenna height of 3 m above surrounding terrain.
* The reuse distance specified for the low power service is based on the maximum EIRP for the remote station (equivalent to the use of an omni directional antenna), and as such there is no need to place an additional restriction on the radiated power 180 degrees from the direction of the base station.
* Low power services typically do not use remote control stations because of the small service area, however, should they be required, they must comply with the parameters specified for remote stations.
* Unwanted emission limits for transmitters are mandated in Annex A.
* Frequency coordination is performed for the master station only (interference protection for remote stations, and RCSs is intrinsic to the service model).
* A service area radius of 2 km. All stations must be contained within the service area.
* A co-channel minimum re-use distance of 10 km between master stations.

In the VHF High and 400 MHz bands, maximum necessary bandwidths of 12.5, 25 or 50 kHz may be used.

# Frequency assignment policy

To successfully manage interference, all PMP stations (master, remote, RCS) are expected to comply with the technical constraints in this RALI.

Frequency assignment must take into consideration both inter-service and intra-service requirements consistent with the assignment philosophy promulgated in RALI MS 42, RALI MS 22, RALI MS 40 and RALI MS 41 (where applicable).

Inter-service coordination of PMP services with other radiocommunications services is not addressed in this document, with the exception of spectrum-licensed services as detailed in section 5.6. This may be addressed, in some cases, by ITU-R Recommendations. However, because of the diversity and complexity of sharing situations which may arise, it is not possible to provide rigorous and explicit procedures covering all inter-service coordination requirements. In these cases, coordination should be performed in accordance with good engineering practice based on fundamental interference mitigation principles.

Intra-service requirements form an essential element of the service model upon which frequency assignment requirements are based. They are detailed in the following paragraphs. The intra service frequency coordination procedure is also part of this policy framework and is outlined in section 5 of this RALI.

## Spectrum and channelling arrangements

All bands available for two frequency PMP data services are based on 12.5 kHz channelling arrangements.

Use of 25 kHz bandwidth, by assignment of two contiguous 12.5 kHz channels, is permitted in the VHF High Band and the 400 MHz Band provided that a data rate of at least 9.6 kbps is used. When contiguous channels are combined the lowest channel shall be an odd numbered channel (e.g. 39-40). In locations where the service area is contained entirely within Low Density and Remote Density geographic areas[[3]](#footnote-4) the data rate requirement does not need to be applied.

Use of 50 kHz bandwidth, by assignment of four contiguous 12.5 kHz channels, is permitted in the VHF High Band and the 400 MHz band where the service area is contained entirely within Low Density and Remote Density geographic areas. The aggregation scheme shall be channels 1-4, 5-8 etc.

The bands of operation, as specified in the relevant ACMA plans[[4]](#footnote-5), are:

|  |  |  |
| --- | --- | --- |
|  | **Master Transmit** | **Master Receive** |
| 1. | 150.05 – 151.39375 MHz | 154.65625 – 156 MHz |
| 2. | 461.0125 - 462.0 MHz | 451.5125 - 452.5 MHz |
| 3. | 850.5 – 851 MHz | 805.5 – 806 MHz |

1. PMP Bands of Operation

Detailed channelling arrangements are given in the appropriate RALIs.

For use of Land Mobile frequencies for PMP services refer section 5.4 of this RALI.

## Assignment strategy

The assignment strategy for dedicated PMP segments shall be as follows:

* Assign the highest available channel;
* This channel is assigned until it is fully loaded; and

Once a channel is fully loaded, the next highest available channel is assigned.

This strategy optimises the protection of services in the lower adjacent spectrum.

When PMP services are assigned in 400 MHz land mobile segments, the assignment process shall be as prescribed in RALI LM8.

## Supplementary transmitters

A supplementary station is a transmitter intended to improve the service reliability within the 30 km service area of the master station. It operates on the same frequency sense as the master station and does not require frequency/distance coordination, however it is recommended that checks to identify and mitigate against intermodulation issues should be carried out. A supplementary station must not cause interference to other radiocommunications services, and no additional level of protection from interference to a related receiver (above that offered intrinsically to a remote station) is provided.

Note that a transmitter that extends coverage beyond a 30 km radius of the master station is not a supplementary transmitter; it is another master station and must be separately licensed and coordinated in the same manner as any other master station.

Note that for the low power service model supplementary transmitters are not included due to the smaller service area radius.

Power and height constraints applying to supplementary stations are as follows:

|  |  |  |
| --- | --- | --- |
| **Distance from Master:** | **Max. EIRP** | **Effective Antenna Height** |
| < 10 km | 20 W | 100 m |
| < 20 km | 10 W | 25 m |
| < 30 km | 5 W | 5 m |

1. Height Constraints

# Frequency coordination procedure

Frequency coordination is performed only for master stations; interference protection for remote stations, supplementary stations and RCSs is intrinsic to the service model described in section 3 of this RALI.

The following section details the coordination procedure that may be applied for frequency assignment of PMP master stations.

Alternative frequency coordination procedures may be used provided they produce equivalent results, that is, the target grade of service is achieved at 90% of locations within the service area (refer to section 3 of this RALI). Accredited frequency assigners may be required to demonstrate that an alternative methodology is suitable.

## Site selection

Initial site selection is likely to be based on the client’s needs but may need to be altered dependent on the outcome of the frequency selection process outlined below.

## Frequency selection

Perform a cull (i.e. produce a list) of existing systems which due to their frequency and distance separation from the proposed system have the potential to cause or receive interference through co-channel emissions and unwanted emissions (including transmitter broadband noise). The minimum radii and frequency ranges for this cull are:

|  |  |  |  |
| --- | --- | --- | --- |
| **Band of Operation** | **Cull Radius** | **Tx** | **Rx** |
| VHF High Band | 140 km | ±100 kHz  | ±100 kHz |
| 400 MHz Band | 120 km | ±100 kHz  | ±100 kHz |
| 800 MHz Band | 100 km | ±25 kHz  | ±25 kHz |

1. Cull Parameters

The appropriate table in Annex C of RALI LM8 shall be used to establish frequency-distance relationships for PMP master stations in the 400 MHz band. For the purposes of selecting the appropriate table a high power PMP is considered to be equivalent to a LMRS and a low power PMP is considered to be equivalent to a LPMRS.

For the 800 MHz band, channels are deemed not available if another master station of a PMP system has been assigned with any part of its channel within the proposed channel and is located within 100 km (the re‑use distance) of the proposed site. For example, if operation of a 25 kHz system is sought on channels 1 and 2, and there is an existing 12.5 kHz assignment on channel 1 then the re-use distance is 100 km.

Of the remaining channels available, the channel with the highest centre frequency should then be selected, in accordance with the vertical loading principle outlined in section 4.2 of this RALI. Note that this will involve selection of a pair of frequencies (master transmit and master receive).

## Intermodulation checks

### Introduction

Intermodulation checks are performed for two-signal 3rd order and two‑signal 5th order intermodulation, for high power PMP systems only. Typically, only existing LMS and PMP services need to be considered – although sound engineering judgement should be used to determine if other existing service types should also be considered in specific circumstances.

*Transmitter Intermodulation*

The proposed transmitter must be evaluated for the potential for its emissions to mix with emissions from other transmitters at the site, to produce 3rd or 5th order intermodulation products that have the potential to cause interference to the proposed or existing receivers.

Mixing of transmitter emissions can occur in passive components (e.g. site hardware such as couplers, isolators or mechanical/structural joints) as well as in non-linear transmitter output stages, and can result in intermodulation products that are co-channel with the proposed or existing receivers. As the characteristics of the components in which the mixing occurs cannot be known under these circumstances, the criterion for harmful interference caused by transmitter intermodulation is simply the occurrence of a ‘hit’ between co-sited systems, unless other evidence can be cited to demonstrate that the intermodulation interference is acceptable or is unlikely to cause interference.

*Receiver Intermodulation*

The proposed receiver, and existing receivers within specified frequency ranges and distances of the proposed system, must also be evaluated for their potential to receive interference due to intermodulation products caused by the mixing of transmitter emissions in proposed and existing receivers.

Intermodulation products can be generated in the **rf** input stages of receivers if sufficient signal power is applied to drive a stage into a non-linear condition. Because of this input level dependency, the ‘quality’ of a hit can be quantified and either noted as having the potential to cause harmful interference or discarded because it does not have a sufficient level to cause harmful interference.

### Cull for intermodulation checks

Perform a cull of existing systems for which the potential for intermodulation interference must be considered. The cull identifies all such systems within defined frequency and distance limits from the proposed system. The radius and frequency range for each required cull is specified in Annex B, Table B1, of this RALI.

### Performance of intermodulation checks

Perform checks for intermodulation interference between the selected assignment frequency (both transmit and receive, if they are different) and existing systems yielded by the cull, in the manner described below.

*Transmitter Intermodulation*

If the operating frequencies of any two co-sited transmitters (including the proposed transmitter) are contained in the relevant frequency range (see Annex B Table B1), and can be algebraically combined in the form shown in Table 4 to produce a 3rd or 5th order intermodulation product within the ‘hit’ range of a co-sited receiver (as defined in Annex B, Table B2, of this RALI) the proposed frequency should not be assigned, unless other evidence can be cited to demonstrate that the level of intermodulation interference is acceptable.

|  |  |
| --- | --- |
| **Frequencies of 3rd Order Products\*** | **Frequencies of 5th Order Products\*** |
| 2f1 - f2 | 3f1 - 2f2 |
| 2f2 - f1 | 3f2 - 2f1 |

\* f1 = centre frequency of first co-sited transmitter

 f2 = centre frequency of second co-sited transmitter

1. Algebraic expressions for 3rd and 5th order intermodulation
product frequencies

*Receiver Intermodulation*

All systems falling within the cull limits specified in Annex B, Table B1, of this RALI are first evaluated for the occurrence of 3rd and 5th order intermodulation product ‘hits’ as per Table 4. A ‘hit’ is deemed to occur when an intermodulation product falls within the frequency ranges from a receiver specified in Annex B, Table B2, of this RALI.

Once the existence of a ‘hit’ has been confirmed, mathematical expressions (1) and (2) shown at Annex B3 of this RALI are evaluated to determine whether unacceptable interference would be caused due to receiver intermodulation by assignment of the proposed frequency.

When equations (1) and (2) at Annex B3 of this RALI are satisfied, the level of intermodulation interference is permissible; conversely, when the equations are not satisfied the level of interference is considered harmful, and the proposed frequency should not be assigned, unless other evidence can be cited to demonstrate that the level of intermodulation interference is acceptable.

If either receiver or transmitter intermodulation checks fail against the selected frequency, select the frequency that passed the frequency-distance constraints by the next greatest margin and perform intermodulation checks on that frequency.

Continue to perform intermodulation checks on frequencies passing the frequency-distance constraints until an acceptable frequency is found.

In cases where the prospective licensee of the new assignment is also the only victim of any harmful intermodulation products, the licensee may elect to accept any interference and proceed with the assignment.

## Use of land mobile frequencies for PMP services

Under section 2.1 of RALI MS 22, a PMP service is limited to segments allocated to the fixed service (point-to-multipoint) and the upper 1.5 MHz of segments NN/SS. Segments allocated for the land mobile service may only be used for PMP services if assignments cannot be accommodated in the above-mentioned segments. Segments allocated exclusively for the land mobile service (trunked) are not to be used for the point-to-multipoint service.

Exceptions to this policy may be sought for existing two-frequency systems wishing to expand in segments other than those allocated to for PMP services, or the 1.5 MHz of segments NN/SS specified above.

For the purpose of frequency assigning of such PMP services, the principles and coordination procedure provided in RALI LM8 shall be used, except that the EIRP (Master Station and Supplementary) and antenna requirements of this RALI must be adhered to. The service area radius of a PMP system assigned in frequencies allocated for the land mobile service is 30 km for a high power system and 2 km for low power system.

The practical implementation of these out-of-band PMP services will be the same as in-band services. They will be issued with PMP licences, and still have a service model identical to the PMP service models outlined in section 3 of this RALI (i.e. the antenna and power requirements of this RALI still apply).

The procedure detailed in RALI LM8 shall be applied for avoidance of intra-service intermodulation issues. Also perform inter-service checks (including intermodulation) in accordance with the approach outlined in section 4 for harmful interference between the selected frequency (both transmit and receive) and existing radiocommunications systems. If the checks fail, select another frequency as outlined above until a suitable frequency is found.

## Local environment

There may be circumstances where the channel selected using the above-mentioned procedure is not the optimal channel to be assigned due to the local environment. Examples are: a large mountain range offering additional propagation loss to/from a service in an adjacent area; a transmitter located on a site at a height much greater than the planning model assumes; or an anomalous propagation mode occurring due to a path over water.

Under such circumstances, modified frequency/distance constraints may be applied if interference to adjacent services is maintained to levels prescribed in the service model, and that service areas do not overlap[[5]](#footnote-6) (e.g. 60 km separation is maintained). Remote stations in at least 90% of the area of any adjacent cells using the same frequency shall be protected to a level of ‑120.5 dBm on channel.

Propagation path loss may be determined using any appropriate method described in section 4 of ITU-R P.526 (versions 4 through 14). All methods must use computer modelling software utilising a 9 second digital elevation model (such as RadDEM) or better. Other methods for determining the propagation path loss may also be used pending ACMA agreement.

## Coordination with spectrum licensed services

The 800 MHz PMP band is in close frequency proximity to spectrum-licensed services.

The ‘*[Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters – 700 MHz Band) 2023](https://www.legislation.gov.au/Series/F2023L00248)*’, and ‘*[Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters – 850/900 MHz Bands) 2021](https://www.legislation.gov.au/Details/F2021L01148)’* set out protection requirements for services operating frequency adjacent to spectrum licensed transmitters. In summary, these protection requirements are:

* protection of PMP radiocommunications receivers from spectrum licensed radiocommunications transmitters is on a first-in-time basis.
* any existing PMP master-station receiver licensed prior to the registration of a spectrum licensed transmitter in the Register[[6]](#footnote-7) is to be provided protection to the ratio specified in this RALI. Initial assessments can be made using the applicable protection ratio and sensitivity level by considering the unwanted emissions from a spectrum licensed transmitter that fall within the passband of the receiver. Applicable protection ratios and sensitivity levels are:
* for coordination between 700 MHz spectrum licensed transmitters and PMP receivers licensed after [insert date when this version of RALI FX16 is made] : a receiver sensitivity of -111 dBm and a 12 dB protection ratio[[7]](#footnote-8)
* in all other cases: a usable sensitivity of -119 dBm with a 10 dB protection ratio (also see Table B3).

In some scenarios, an apparatus licensee may choose to accept a higher level of interference. In these scenarios, the below advisory note is to be included on their licence to ensure that existing licensees are not negatively impacted. For example, if future modifications are made to an existing spectrum licensed transmitter, from which the apparatus licensee has accepted a higher level of interference, the spectrum licensee will only need to re-coordinate to the level accepted by the apparatus licensee (not to the level in RALI FX16).

*‘The licensee agrees to accept a level of interference which is [xx] dB higher than the level provided by RALI FX16, with respect to a transmitter operated under device registration number(s) [yyyyyy].’* [where ‘xx’ is the amount in which the receiver fails the coordination criteria in RALI FX16]

Unless otherwise stated, spectrum-licensed transmitters that are exempt from registration are not required to be coordinated with PMP services. Although these transmitters have a low risk of causing interference, spectrum licensees should use judgement to identify cases where this risk might be higher than normal, e.g., for operation of high-sited stations. In the event that interference from unregistered spectrum licensed transmitters occurs, the 850/900 MHz spectrum licence contains a condition that registration exempt transmitters must not cause harmful interference to other radiocommunications devices operated under a different spectrum licence or apparatus licence.[[8]](#footnote-9)

Out-of-band protection requirements for interference from PMP services operating in bands adjacent to spectrum-licensed services are set out in the ‘*[Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 700 MHz band) 2023](https://www.legislation.gov.au/Series/F2023L00289)*’, and ‘*[Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 850/900 MHz Bands) 2021’](https://www.legislation.gov.au/Series/F2021L01149).*

Coordination of proposed PMP transmitters with spectrum licensed receivers operating in the 703-748 MHz range or above 890 MHz is not required, as the frequency separation is considered sufficient to enable coexistence.

### Additional guidance for coordination with 700 MHz spectrum licensed base transmitters

The 805.5-806 MHz PMP master-receive segment is 2.5 MHz separated from the upper frequency limit of the 700 MHz spectrum licensed segment which is optimised for the deployment of base station transmitters. For cases where an initial coordination assessment fails, the accredited person and/or licensee may wish to undertake a more detailed assessment and/or negotiation to achieve a satisfactory outcome. This may include:

* coordination using actual unwanted emission levels from the spectrum licensed transmitter, which are likely to be less than the maximum limits specified on the licence.
* consideration of additional filtering on the spectrum-licensed transmitter to further reduce unwanted emission levels. This may be particularly relevant when a proposed spectrum-licensed transmitter is attempting to coordinate with an existing apparatus licensed receiver.
* use of actual antenna patterns, accounting the for effects of orientation and tilt.
* undertaking on-site measurements to assess the actual level of interference coming from an existing spectrum-licensed transmitter which may be impacted by higher path losses than anticipated (e.g. resulting from terrain and/or local clutter).
* engagement with the affected apparatus licensee to ascertain whether they might accept a higher level of interference than the minimum level prescribed in this RALI. For example, where PMP remote stations will always be in close proximity to the master station. This may be particularly relevant when attempting to coordinate a proposed apparatus licensed PMP receiver with an existing spectrum licensed transmitter.

Discussion and negotiation between licensees is encouraged where appropriate and may be necessary to implement some of the above suggestions.

# Exceptions

Exceptions to the requirements of this RALI for prospective assignments require case-by-case consideration by the Manager, Spectrum Planning Section.

A request for exemption from the requirements of this RALI would need to be accompanied by evidence to support the request.

All requests for exemptions should be submitted to freqplan@acma.gov.au.

# RALI Authorisation

Approved [insert date when approved]

Chris Worley
Manager
Spectrum Planning Section
Spectrum Planning and Engineering Branch

Communications Infrastructure Division
Australian Communications and Media Authority

# Bibliography

[1] SP 4/89: ‘*A Rationale for the Guidelines for the Assignment of Frequencies in the Two-Frequency Point-to-Multipoint Fixed Service using a minimum of 12.5 kHz Channelling in the 400 MHz and 900 MHz Bands -* Spectrum Planning Report No.SP 4/89, March 1990.

[2] SP 2/90: ‘*Assignment Guidelines for the Two Frequency Point-to-Multipoint Service in the 400 MHz and 900 MHz Bands’,* Spectrum Planning Report No.SP 2/90, March 1990.

[3] ETSI EN 302 561 V2.1.1, Radio equipment using constant or non-constant envelope modulation operating in a channel bandwidth of 25 kHz, 50 kHz, 100 kHz or 150 kHz

# Appendix A: Unwanted Emission Limits

## A.1 12.5 kHz PMP systems

Unwanted emission limits for 12.5 kHz point to multipoint transmitters in the VHF High, 400 MHz and 800 MHz bands are as follows[[9]](#footnote-10):

* Over the temperature range 0oC to 60 oC, taking into consideration the transmitters frequency stability, the level of any unwanted emissions shall be attenuated below the unmodulated carrier power as follows:
* On any frequency removed from the assigned frequency by more than 6.25 kHz and up to 7.5 kHz - at least 23 dB linear to 50 dB.
* On any frequency removed from the assigned frequency by more than 7.5 kHz and up to 20 kHz - at least 50 dB.
* On any frequency removed from the assigned frequency by more than 20 kHz - at least 60 dB.

These unwanted emission limits are shown graphically in Figure A1 below.

NOTE: For non-continuous envelope emissions, where there is no provision for unmodulated carrier power transmission and for TDMA services, the reference level shall be established from the RMS power level during the period of transmission.



Figure A1: Emission Mask for 12.5 kHz PMP Systems

## A.2 25 kHz PMP systems

Unwanted emission limits for 25 kHz point to multipoint transmitters in the VHF High, 400 MHz and 800 MHz band are as follows[[10]](#footnote-11):

* Over the temperature range 0oC to 60oC, taking into consideration the transmitters frequency stability, the power of any unwanted emissions shall be attenuated below the unmodulated carrier power as follows:
* On any frequency removed from the assigned frequency by more than 12.5 kHz and up to 13.75 kHz - at least 23 dB linear to 50 dB.
* On any frequency removed from the assigned frequency by more than 13.75 kHz and up to 26.25 kHz - at least 50 dB.
* On any frequency removed from the assigned frequency by more than 26.25 kHz - at least 60 dB.

These unwanted emission limits are shown graphically in Figure A2 below.

NOTE: For non-continuous envelope emissions, where there is no provision for unmodulated carrier power transmission and for TDMA services, the reference level shall be established from the RMS power level during the period of transmission.



Figure A2: Emission Mask for 25 kHz PMP Systems

## A.3 50 kHz PMP systems

Unwanted emission limits for 50 kHz point-to-multipoint transmitters in the VHF High and 400 MHz bands are as specified in ETSI EN 302 561 V2.1.1 [3].

# Appendix B: Intermodulation checks

Receiver and transmitter intermodulation checks are required to be performed for two-signal 3rd order and two-signal 5th order products. These intermodulation products have the potential to cause interference as a result of:

1. Emissions from two existing transmitters mixing and falling within the ‘hit’ range of an existing (Scenario 1) or proposed receiver (Scenario 2); or
2. Emissions from the proposed transmitter mixing with emissions from an existing transmitter and falling within the ‘hit’ range of an existing (Scenario 3) or proposed receiver (Scenario 4).

Scenarios 2, 3 and 4 are required to be assessed using the applicable frequency-distance constraints detailed in Table B1.

## B1. Cull Limits Applicable to Intermodulation Checks

|  |  |
| --- | --- |
|  | Frequency - Distance Cull Range |
| **Receiver Intermodulation** |
| Description | Third Order Intermodulation | Fifth Order Intermodulation |
| **Scenario 2** *- caused in proposed receiver by existing transmitters* | Transmitters within 2 km & 2.25 MHz of proposed receiver frequency | Transmitters within 0.2 km & 0.375 MHz of proposed receiver frequency |
| **Scenarios 3 and 4** *-caused in proposed or existing receiver by proposed transmitter as Outer* | Transmitters within 4 km & 1.125 MHz of proposed transmitter frequencyReceivers within 2 km & 2.25 MHz of proposed transmitter frequency | Transmitters within 0.4 km & 0.125 MHz of proposed transmitter frequencyReceivers within 0.2 km & 0.375 MHz of proposed transmitter frequency |
| **Scenarios 3 and 4***- caused in proposed or existing receiver by proposed transmitter as Inner* | Transmitters within 4 km & 1.125 MHz of proposed transmitter frequencyReceivers within 2 km & 1.125 MHz of proposed transmitter frequency | Transmitters within 0.4 km & 0.125 MHz of proposed transmitter frequencyReceivers within 0.2 km & 0.25 MHz of proposed transmitter frequency |
| **Transmitter Intermodulation** |
| **Scenarios 2, 3 and 4** *- caused by proposed or existing transmitters* | Transmitters and receivers within 0.2 km & within the band 20 MHz above and 20 MHz below the proposed transmitter frequency |

Table B1: Cull Limits Applicable to Intermodulation Checks

## B2. Frequency Offset from Victim Receiver Within Which an Intermodulation ‘Hit’ is Deemed to Occur

|  |
| --- |
| **Frequency offset from receiver centre frequency (± kHz)** |
| Interferer channel width\* | Receiver channel width / Intermodulation Order |
|  | 6.25 kHz | 12.5 kHz | 25 kHz | 50 kHz |
|  | 3rd order | 5th order | 3rd order | 5th order | 3rd order | 5th order | 3rd order | 5th order |
| 6.25 kHz | **9.375** | **12.5** | **12.25** | **15.5** | **18.5** | **22** | **30.5** | **34** |
| 12.5 kHz | **15.125** | **21.125** | **18** | **24** | **24.5** | **30.5** | **37** | **42** |
| 25 kHz | **28** | **40** | **30.5** | **43** | **37** | **49** | **49** | **60** |
| 50 kHz | **53** | **75** | **56** | **80** | **62** | **90** | **74** | **95** |

Table B2: Frequency Offset from Victim Receiver within which an Intermodulation ‘Hit’ is Deemed to Occur

\* The interferer channel width is taken as the wider of the two intermodulation-producing interferers

## B3. Expressions for Evaluating Intermodulation Interference

The following equations should be used to evaluate receiver generated intermodulation interference. When the equations are satisfied, the level of the intermodulation product is not high enough[[11]](#footnote-12) to cause harmful interference.

The equation for two signal 3rd order receiver intermodulation is:

PR + 2\*( EIRPdBm - Lb inner + Lc - RFinner) + (EIRPdBm - Lb outer + Lc - RFouter) + ECR 2/3 < RS...........**(1)**

The equation for two signal 5th order receiver intermodulation is:

PR + 3\*(EIRPdBm- Lb inner + Lc - RFinner) + 2\*(EIRPdBm- Lb outer + Lc - RFouter) + ECR 2/5 < RS….......**(2)**

The parameter values applicable to equations (1) and (2) above are specified in Table B3.

## B4. Parameter Values Applicable to Intermodulation Checks

|  |  |
| --- | --- |
| **Parameter** | **Assumed Value** |
| RS (Master Station Usable Sensitivity[[12]](#footnote-13)) | -119 dBm (800 MHz Trunking Band)-116 dBm (400 MHz Band)-112 dBm (VHF High Band)  |
| PR (Protection Ratio) | 10 dB |
| EIRPdBm (Transmitter EIRP) | 30 + 10\*log[EIRPwatts] (typically 46 dBm for high power PMP and 39.2 dBm for 8.3 W low power PMP) |
| Lb (propagation loss: from ‘inner’ or ‘outer’ transmitter to victim receiver) | Free Space Loss + 10 dB |
| Lc (antenna gain and feeder loss) | 2 dBi (VHF High Band)6.2 dBi (400 MHz & 800 MHz Bands) |
| RF (receiver front-end response: achieved by the RF selectivity of a receiver in conjunction with a cavity filter) | **For the VHF High and 400 MHz Band:****5 dB** for Freq Offset <=0.1 MHz**5 + 60 log [1+ (2 × (Freq Offset - 0.1)/1.5)0.8 ]dB** for 0.1 < Freq Offset <= 15 MHz**70 dB** for Freq Offset > 15 MHz**For the 800 MHz Band:****2 + 60\*log[1 + (2\*Freq Offset/5)1.5] dB**for Freq Offset <= 2.5 MHz**2 + 60\*log[1 + (2\*Freq Offset/5)2] dB**for 2.5 < Freq Offset <= 9 MHz**70 dB** for Freq Offset > 9 MHz |
| ECR (effective conversion ratio of intermodulation products) | 2 Signal Third Order: ECR 2/3 = -9 dB2 Signal Fifth Order: ECR 2/5 = -28 dB |

Table B3: Parameter Values Applicable to Intermodulation Checks

# Appendix C: Channel Tables

|  |  |  |
| --- | --- | --- |
|  | **Master Transmit** | **Master Receive** |
| **Channel** | **12.5 kHz Centre Frequency** | **25 kHz Centre Frequency** | **50 kHz Centre Frequency** | **12.5 kHz Centre Frequency** | **25 kHz Centre Frequency** | **50 kHz Centre Frequency** |
| 1 | 150.0625 | 150.06875 | 150.08125 | 154.6625 | 154.66875 | 154.68125 |
| 2 | 150.075 | 154.675 |
| 3 | 150.0875 | 150.09375 | 154.6875 | 154.69375 |
| 4 | 150.1 | 154.7 |
| 5 | 150.1125 | 150.11875 | 150.13125 | 154.7125 | 154.71875 | 154.73125 |
| 6 | 150.125 | 154.725 |
| 7 | 150.1375 | 150.14375 | 154.7375 | 154.74375 |
| 8 | 150.15 | 154.75 |
| 9 | 150.1625 | 150.16875 | 150.18125 | 154.7625 | 154.76875 | 154.78125 |
| 10 | 150.175 | 154.775 |
| 11 | 150.1875 | 150.19375 | 154.7875 | 154.79375 |
| 12 | 150.2 | 154.8 |
| 13 | 150.2125 | 150.21875 | 150.23125 | 154.8125 | 154.81875 | 154.83125 |
| 14 | 150.225 | 154.825 |
| 15 | 150.2375 | 150.24375 | 154.8375 | 154.84375 |
| 16 | 150.25 | 154.85 |
| 17 | 150.2625 | 150.26875 | 150.28125 | 154.8625 | 154.86875 | 154.88125 |
| 18 | 150.275 | 154.875 |
| 19 | 150.2875 | 150.29375 | 154.8875 | 154.89375 |
| 20 | 150.3 | 154.9 |
| 21 | 150.3125 | 150.31875 | 150.33125 | 154.9125 | 154.91875 | 154.93125 |
| 22 | 150.325 | 154.925 |
| 23 | 150.3375 | 150.34375 | 154.9375 | 154.94375 |
| 24 | 150.35 | 154.95 |
| 25 | 150.3625 | 150.36875 | 150.38125 | 154.9625 | 154.96875 | 154.98125 |
| 26 | 150.375 | 154.975 |
| 27 | 150.3875 | 150.39375 | 154.9875 | 154.99375 |
| 28 | 150.4 | 155 |
| 29 | 150.4125 | 150.41875 | 150.43125 | 155.0125 | 155.01875 | 155.03125 |
| 30 | 150.425 | 155.025 |
| 31 | 150.4375 | 150.44375 | 155.0375 | 155.04375 |
| 32 | 150.45 | 155.05 |
| 33 | 150.4625 | 150.46875 | 150.48125 | 155.0625 | 155.06875 | 155.08125 |
| 34 | 150.475 | 155.075 |
| 35 | 150.4875 | 150.49375 | 155.0875 | 155.09375 |
| 36 | 150.5 | 155.1 |
| 37 | 150.5125 | 150.51875 | 150.53125 | 155.1125 | 155.11875 | 155.13125 |
| 38 | 150.525 | 155.125 |
| 39 | 150.5375 | 150.54375 | 155.1375 | 155.14375 |
| 40 | 150.55 | 155.15 |
| 41 | 150.5625 | 150.56875 | 150.58125 | 155.1625 | 155.16875 | 155.18125 |
| 42 | 150.575 | 155.175 |
| 43 | 150.5875 | 150.59375 | 155.1875 | 155.19375 |
| 44 | 150.6 | 155.2 |
| 45 | 150.6125 | 150.61875 | 150.63125 | 155.2125 | 155.21875 | 155.23125 |
| 46 | 150.625 | 155.225 |
| 47 | 150.6375 | 150.64375 | 155.2375 | 155.24375 |
| 48 | 150.65 | 155.25 |
| 49 | 150.6625 | 150.66875 | 150.68125 | 155.2625 | 155.26875 | 155.28125 |
| 50 | 150.675 | 155.275 |
| 51 | 150.6875 | 150.69375 | 155.2875 | 155.29375 |
| 52 | 150.7 | 155.3 |
| 53 | 150.7125 | 150.71875 | 150.73125 | 155.3125 | 155.31875 | 155.33125 |
| 54 | 150.725 | 155.325 |
| 55 | 150.7375 | 150.74375 | 155.3375 | 155.34375 |
| 56 | 150.75 | 155.35 |
| 57 | 150.7625 | 150.76875 | 150.78125 | 155.3625 | 155.36875 | 155.38125 |
| 58 | 150.775 | 155.375 |
| 59 | 150.7875 | 150.79375 | 155.3875 | 155.39375 |
| 60 | 150.8 | 155.4 |
| 61 | 150.8125 | 150.81875 | 150.83125 | 155.4125 | 155.41875 | 155.43125 |
| 62 | 150.825 | 155.425 |
| 63 | 150.8375 | 150.84375 | 155.4375 | 155.44375 |
| 64 | 150.85 | 155.45 |
| 65 | 150.8625 | 150.86875 | 150.88125 | 155.4625 | 155.46875 | 155.48125 |
| 66 | 150.875 | 155.475 |
| 67 | 150.8875 | 150.89375 | 155.4875 | 155.49375 |
| 68 | 150.9 | 155.5 |
| 69 | 150.9125 | 150.91875 | 150.93125 | 155.5125 | 155.51875 | 155.53125 |
| 70 | 150.925 | 155.525 |
| 71 | 150.9375 | 150.94375 | 155.5375 | 155.54375 |
| 72 | 150.95 | 155.55 |
| 73 | 150.9625 | 150.96875 | 150.98125 | 155.5625 | 155.56875 | 155.58125 |
| 74 | 150.975 | 155.575 |
| 75 | 150.9875 | 150.99375 | 155.5875 | 155.59375 |
| 76 | 151 | 155.6 |
| 77 | 151.0125 | 151.01875 | 151.03125 | 155.6125 | 155.61875 | 155.63125 |
| 78 | 151.025 | 155.625 |
| 79 | 151.0375 | 151.04375 | 155.6375 | 155.64375 |
| 80 | 151.05 | 155.65 |
| 81 | 151.0625 | 151.06875 | 151.08125 | 155.6625 | 155.66875 | 155.68125 |
| 82 | 151.075 | 155.675 |
| 83 | 151.0875 | 151.09375 | 155.6875 | 155.69375 |
| 84 | 151.1 | 155.7 |
| 85 | 151.1125 | 151.11875 | 151.13125 | 155.7125 | 155.71875 | 155.73125 |
| 86 | 151.125 | 155.725 |
| 87 | 151.1375 | 151.14375 | 155.7375 | 155.74375 |
| 88 | 151.15 | 155.75 |
| 89 | 151.1625 | 151.16875 | 151.18125 | 155.7625 | 155.76875 | 155.78125 |
| 90 | 151.175 | 155.775 |
| 91 | 151.1875 | 151.19375 | 155.7875 | 155.79375 |
| 92 | 151.2 | 155.8 |
| 93 | 151.2125 | 151.21875 | 151.23125 | 155.8125 | 155.81875 | 155.83125 |
| 94 | 151.225 | 155.825 |
| 95 | 151.2375 | 151.24375 | 155.8375 | 155.84375 |
| 96 | 151.25 | 155.85 |
| 97 | 151.2625 | 151.26875 | 151.28125 | 155.8625 | 155.86875 | 155.88125 |
| 98 | 151.275 | 155.875 |
| 99 | 151.2875 | 151.29375 | 155.8875 | 155.89375 |
| 100 | 151.3 | 155.9 |
| 101 | 151.3125 | 151.31875 | 151.33125 | 155.9125 | 155.91875 | 155.93125 |
| 102 | 151.325 | 155.925 |
| 103 | 151.3375 | 151.34375 | 155.9375 | 155.94375 |
| 104 | 151.35 | 155.95 |
| 105 | 151.3625 | 151.36875 |  | 155.9625 | 155.96875 |  |
| 106 | 151.375 | 155.975 |
| 107 | 151.3875 |  | 155.9875 |  |

**Table C1: Channels for the VHF High Band Segments E/J**

|  |  |  |
| --- | --- | --- |
|  | **Master Transmit** | **Master Receive** |
| **Channel** | **12.5 kHz Centre Frequency** | **25 kHz Centre Frequency** | **50 kHz Centre Frequency** | **12.5 kHz Centre Frequency** | **25 kHz Centre Frequency** | **50 kHz Centre Frequency** |
| 1 | 461.01875 | 461.025 | 461.0375 | 451.51875 | 451.525 | 451.5375 |
| 2 | 461.03125 | 451.53125 |
| 3 | 461.04375 | 461.05 | 451.54375 | 451.55 |
| 4 | 461.05625 | 451.55625 |
| 5 | 461.06875 | 461.075 | 461.0875 | 451.56875 | 451.575 | 451.5875 |
| 6 | 461.08125 | 451.58125 |
| 7 | 461.09375 | 461.1 | 451.59375 | 451.6 |
| 8 | 461.10625 | 451.60625 |
| 9 | 461.11875 | 461.125 | 461.1375 | 451.61875 | 451.625 | 451.6375 |
| 10 | 461.13125 | 451.63125 |
| 11 | 461.14375 | 461.15 | 451.64375 | 451.65 |
| 12 | 461.15625 | 451.65625 |
| 13 | 461.16875 | 461.175 | 461.1875 | 451.66875 | 451.675 | 451.6875 |
| 14 | 461.18125 | 451.68125 |
| 15 | 461.19375 | 461.2 | 451.69375 | 451.7 |
| 16 | 461.20625 | 451.70625 |
| 17 | 461.21875 | 461.225 | 461.2375 | 451.71875 | 451.725 | 451.7375 |
| 18 | 461.23125 | 451.73125 |
| 19 | 461.24375 | 461.25 | 451.74375 | 451.75 |
| 20 | 461.25625 | 451.75625 |
| 21 | 461.26875 | 461.275 | 461.2875 | 451.76875 | 451.775 | 451.7875 |
| 22 | 461.28125 | 451.78125 |
| 23 | 461.29375 | 461.3 | 451.79375 | 451.8 |
| 24 | 461.30625 | 451.80625 |
| 25 | 461.31875 | 461.325 | 461.3375 | 451.81875 | 451.825 | 451.8375 |
| 26 | 461.33125 | 451.83125 |
| 27 | 461.34375 | 461.35 | 451.84375 | 451.85 |
| 28 | 461.35625 | 451.85625 |
| 29 | 461.36875 | 461.375 | 461.3875 | 451.86875 | 451.875 | 451.8875 |
| 30 | 461.38125 | 451.88125 |
| 31 | 461.39375 | 461.4 | 451.89375 | 451.9 |
| 32 | 461.40625 | 451.90625 |
| 33 | 461.41875 | 461.425 | 461.4375 | 451.91875 | 451.925 | 451.9375 |
| 34 | 461.43125 | 451.93125 |
| 35 | 461.44375 | 461.45 | 451.94375 | 451.95 |
| 36 | 461.45625 | 451.95625 |
| 37 | 461.46875 | 461.475 | 461.4875 | 451.96875 | 451.975 | 451.9875 |
| 38 | 461.48125 | 451.98125 |
| 39 | 461.49375 | 461.5 | 451.99375 | 452 |
| 40 | 461.50625 | 452.00625 |
| 41 | 461.51875 | 461.525 | 461.5375 | 452.01875 | 452.025 | 452.0375 |
| 42 | 461.53125 | 452.03125 |
| 43 | 461.54375 | 461.55 | 452.04375 | 452.05 |
| 44 | 461.55625 | 452.05625 |
| 45 | 461.56875 | 461.575 | 461.5875 | 452.06875 | 452.075 | 452.0875 |
| 46 | 461.58125 | 452.08125 |
| 47 | 461.59375 | 461.6 | 452.09375 | 452.1 |
| 48 | 461.60625 | 452.10625 |
| 49 | 461.61875 | 461.625 | 461.6375 | 452.11875 | 452.125 | 452.1375 |
| 50 | 461.63125 | 452.13125 |
| 51 | 461.64375 | 461.65 | 452.14375 | 452.15 |
| 52 | 461.65625 | 452.15625 |
| 53 | 461.66875 | 461.675 | 461.6875 | 452.16875 | 452.175 | 452.1875 |
| 54 | 461.68125 | 452.18125 |
| 55 | 461.69375 | 461.7 | 452.19375 | 452.2 |
| 56 | 461.70625 | 452.20625 |
| 57 | 461.71875 | 461.725 | 461.7375 | 452.21875 | 452.225 | 452.2375 |
| 58 | 461.73125 | 452.23125 |
| 59 | 461.74375 | 461.75 | 452.24375 | 452.25 |
| 60 | 461.75625 | 452.25625 |
| 61 | 461.76875 | 461.775 | 461.7875 | 452.26875 | 452.275 | 452.2875 |
| 62 | 461.78125 | 452.28125 |
| 63 | 461.79375 | 461.8 | 452.29375 | 452.3 |
| 64 | 461.80625 | 452.30625 |
| 65 | 461.81875 | 461.825 | 461.8375 | 452.31875 | 452.325 | 452.3375 |
| 66 | 461.83125 | 452.33125 |
| 67 | 461.84375 | 461.85 | 452.34375 | 452.35 |
| 68 | 461.85625 | 452.35625 |
| 69 | 461.86875 | 461.875 | 461.8875 | 452.36875 | 452.375 | 452.3875 |
| 70 | 461.88125 | 452.38125 |
| 71 | 461.89375 | 461.9 | 452.39375 | 452.4 |
| 72 | 461.90625 | 452.40625 |
| 73 | 461.91875 | 461.925 | 461.9375 | 452.41875 | 452.425 | 452.4375 |
| 74 | 461.93125 | 452.43125 |
| 75 | 461.94375 | 461.95 | 452.44375 | 452.45 |
| 76 | 461.95625 | 452.45625 |
| 77 | 461.96875 | 461.975 |  | 452.46875 | 452.475 |  |
| 78 | 461.98125 | 452.48125 |
| 79 | 461.99375 |  | 452.49375 |  |

**Table C2: Channels for 400 MHz Segments R/V**

|  |  |
| --- | --- |
| **Centre Frequency (MHz)** | **Centre Frequency (MHz)** |
| **Channel Number** | **Master transmit** | **Master Receive** | **Channel Number** | **Master transmit** | **Master Receive** |
| 1 | 850.50625 | 850.5125 | 805.50625 | 805.5125 | 21 | 850.75625 | 850.7625 | 805.75625 | 805.7625 |
| 2 | 850.51875 | 805.51875 | 22 | 850.76875 | 805.76875 |
| 3 | 850.53125 | 850.5375 | 805.53125 | 805.5375 | 23 | 850.78125 | 850.7875 | 805.78125 | 805.7875 |
| 4 | 850.54375 | 805.54375 | 24 | 850.79375 | 805.79375 |
| 5 | 850.55625 | 850.5625 | 805.55625 | 805.5625 | 25 | 850.80625 | 850.8125 | 805.80625 | 805.8125 |
| 6 | 850.56875 | 805.56875 | 26 | 850.81875 | 805.81875 |
| 7 | 850.58125 | 850.5875 | 805.58125 | 805.5875 | 27 | 850.83125 | 850.8375 | 805.83125 | 805.8375 |
| 8 | 850.59375 | 805.59375 | 28 | 850.84375 | 805.84375 |
| 9 | 850.60625 | 850.6125 | 805.60625 | 805.6125 | 29 | 850.85625 | 850.8625 | 805.85625 | 805.8625 |
| 10 | 850.61875 | 805.61875 | 30 | 850.86875 | 805.86875 |
| 11 | 850.63125 | 850.6375 | 805.63125 | 805.6375 | 31 | 850.88125 | 850.8875 | 805.88125 | 805.8875 |
| 12 | 850.64375 | 805.64375 | 32 | 850.89375 | 805.89375 |
| 13 | 850.65625 | 850.6625 | 805.65625 | 805.6625 | 33 | 850.90625 | 850.9125 | 805.90625 | 805.9125 |
| 14 | 850.66875 | 805.66875 | 34 | 850.91875 | 805.91875 |
| 15 | 850.68125 | 850.6875 | 805.68125 | 805.6875 | 35 | 850.93125 | 850.9375 | 805.93125 | 805.9375 |
| 16 | 850.69375 | 805.69375 | 36 | 850.94375 | 805.94375 |
| 17 | 850.70625 | 850.7125 | 805.70625 | 805.7125 | 37 | 850.95625 | 850.9625 | 805.95625 | 805.9625 |
| 18 | 850.71875 | 805.71875 | 38 | 850.96875 | 805.96875 |
| 19 | 850.73125 | 850.7375 | 805.73125 | 805.7375 | 39 | 850.98125 | 850.9875 | 805.98125 | 805.9875 |
| 20 | 850.74375 | 805.74375 | 40 | 850.99375 | 805.99375 |

 **Table C3: Channels for 800 MHz**

1. <https://www.legislation.gov.au/Details/F2018C00890> [↑](#footnote-ref-2)
2. The model allows for the use of other devices such as isolators which give intermodulation performance equivalent to or better than that achieved by a 20 dB in-line attenuator. [↑](#footnote-ref-3)
3. As defined in the ACMA’s Apparatus Licence Fee Schedule. [↑](#footnote-ref-4)
4. The “400 MHz Plan” - RALI MS 22, the “800 MHz Band Plan” – RALI MS41, and the “900 MHz Band Plan” – RALI MS 41. [↑](#footnote-ref-5)
5. The distance will depend on the power of the systems and whether both are PMP systems or one is a land mobile service (LMS). The coverage area of a high power LMS is 40 km. [↑](#footnote-ref-6)
6. Register has the same meaning as in the *Radiocommunications Act 1992*. [↑](#footnote-ref-7)
7. This relaxed criteria is based on receiver performance requirements in ETSI EN 302 561 V2.1.1 (2016-03) and is intended to enhance coexistence between PMP and 700 MHz spectrum licensed services. [↑](#footnote-ref-8)
8. [Radiocommunications Spectrum Marketing Plan (850/900 MHz Band) 2021](https://www.legislation.gov.au/Details/F2021L01150). [↑](#footnote-ref-9)
9. The limits beyond the +/-7.5 kHz frequency offsets apply to noise and modulation components summed in any 4 kHz bandwidth [↑](#footnote-ref-10)
10. The limits beyond the +/-13.75 kHz frequency offsets apply to noise and modulation components summed in any 4 kHz bandwidth [↑](#footnote-ref-11)
11. It is assumed that harmful interference will occur if the level of the intermodulation product is greater than the usable sensitivity level (RS). [↑](#footnote-ref-12)
12. These are static usable sensitivity levels assumed by the service model for base receivers in built up areas and take into consideration man made noise levels. It is expected that receivers will have bench measured sensitivity levels at their rf input terminals better than those specified. [↑](#footnote-ref-13)