



# **Radiocommunications Advisory Guidelines (Managing Interference to Receivers – 700 MHz Band) 2012**

*Radiocommunications Act 1992*

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The AUSTRALIAN COMMUNICATIONS AND MEDIA AUTHORITY makes these Advisory Guidelines under section 262 of the *Radiocommunications Act 1992*.

Dated 19<sup>th</sup> December 2012

*Chris Chapman*

[signed]

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[signed]

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Australian Communications and Media Authority

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## Part 1 Preliminary

### 1.1 Name of Advisory Guidelines

These Advisory Guidelines are the *Radiocommunications Advisory Guidelines (Managing Interference to Receivers – 700 MHz Band) 2012*.

### 1.2 Commencement

These Advisory Guidelines commence on the day after they are registered.

*Note* All legislative instruments and compilations are registered on the Federal Register of Legislative Instruments kept under the *Legislative Instruments Act 2003*. See <http://www.frli.gov.au>.

### 1.3 Purpose

- (1) The purpose of these Advisory Guidelines is to:
  - (a) manage in-band and out-of-band interference, by providing compatibility requirements for registered fixed receivers operating under spectrum licences issued for the 700 MHz band;
  - (b) provide protection from interference caused by fixed transmitters operated under apparatus licenses, class licenses and spectrum licenses issued after the commencement of the *Radiocommunications Spectrum Marketing Plan (700 MHz Band) 2012*; and
  - (c) provide advice on the coordination of spectrum-licensed services with television broadcast services that may be in operation following the commencement of the spectrum licence.
- (2) These Advisory Guidelines should be used by operators of spectrum-licensed services and apparatus-licensed services in the planning of services or in the resolution of an interference case.
- (3) These Advisory Guidelines do not prevent a licensee negotiating other protection requirements with another licensee.

### 1.4 Interpretation

- (1) In these Advisory Guidelines, unless the contrary intention appears:

**700 MHz band** means the frequency bands:

- (a) 703 MHz to 748 MHz (the **700 MHz lower band**); and
- (b) 758 MHz to 803 MHz (the **700 MHz upper band**).

**Act** means the *Radiocommunications Act 1992*.

**adjacent channel** means a channel with a centre frequency offset on either side of the assigned channel frequency of the occupied channel by a specific frequency relation.

**adjacent channel selectivity** means a measure of the ability of the radiocommunications receiver to receive a wanted signal without exceeding a specified degradation in output quality due to the presence of an unwanted adjacent channel signal.

**broadcasting service** has the meaning given by section 6 of the *Broadcasting Services Act 1992*.

**emission buffer zone** means a zone along the frequency or geographic boundary of a spectrum licence where emission levels of radiocommunications transmitters are reduced to ensure that significant levels of emissions stay within the geographic area and frequency band of the licence.

**in-band** means:

- (a) for a radiocommunications transmitter or radiocommunications receiver operated under a spectrum licence, the frequencies within the frequency band to which the licence relates; and
- (b) for a radiocommunications transmitter or radiocommunications receiver operating under an apparatus licence, the frequencies within the lower frequency limit and the upper frequency limit of the licence.

**intermodulation response rejection** means a measure of the ability of a radiocommunications receiver to receive a wanted signal in the presence of two or more unwanted signals with a specific amplitude and frequency relationship to the wanted signal frequency.

**out-of-band** means:

- (a) for a radiocommunications transmitter or radiocommunications receiver operated under a spectrum licence, the frequencies outside the frequency band to which the licence relates; and
- (b) for a radiocommunications transmitter or radiocommunications receiver operating under an apparatus licence, the frequencies outside the lower frequency limit and upper frequency limit of the licence.

**receiver blocking level** means a measure of the ability of a radiocommunications receiver to receive a wanted signal in the presence of a high level unwanted interferer on frequencies other than those of the adjacent channels.

**retransmission service** means a service that is referred to subsection 212(1) of the *Broadcasting Services Act 1992*.

**section 145 determination** means the *Radiocommunications (Unacceptable Levels of Interference - 700 MHz Band) Determination 2012*.

**spectrum space** means a three dimensional space consisting of a frequency band and a geographic area.

**spurious response immunity** means a measure of the ability of the radiocommunications receiver to discriminate between the wanted signal and an unwanted signal at any frequency, outside the frequency band of the licence, to which the receiver responds.

- (2) The following terms used in these Advisory Guidelines that are defined in the section 145 determination have the same meaning as in that determination:
  - (a) centre frequency;
  - (b) device boundary;
  - (c) device boundary criterion;
  - (d) effective antenna height;
  - (e) fixed receiver;
  - (f) fixed transmitter;
  - (g) geographic area;

(h) mobile transmitter.

*Note* A number of terms used in these Advisory Guidelines are defined in the Act and have the meanings given to them in the Act including:

- ACMA
- apparatus licence
- class licence
- frequency band
- interference
- radiocommunications receiver
- radiocommunications transmitter
- re-allocation period
- Register
- spectrum licence.

## **Part 2      Background**

### **2.1      Interference**

Interference occurring between adjacent spectrum licences consists of:

- (a) in-band interference, across the geographic boundaries; and
- (b) out-of-band interference, across the frequency boundaries.

### **2.2      Interference management**

- (1) The interference mentioned in section 2.1 is managed by creating emission buffer zones along the geographic and frequency boundaries of the licence, using a number of tools provided by the Act. These tools include:
  - (a) the core licence conditions that all spectrum licences are subject to (see section 66 of the Act), about:
    - (i) emission limits outside the geographic area; and
    - (ii) emission limits outside the frequency band;
  - (b) determinations made under subsection 145(4) of the Act about what constitutes unacceptable levels of interference; and
  - (c) advisory guidelines made under section 262 of the Act, about managing interference in specific circumstances.
- (2) These Advisory Guidelines have been made to provide recommendations on the management and settlement of interference to radiocommunications receivers operating under spectrum licences in the 700 MHz band and caused by radiocommunications transmitters operating under other licences.
- (3) Schedule 3 of these Advisory Guidelines includes provisions relating to managing interference to 700 MHz band receivers from broadcast services that may continue to operate in the 694 to 820 MHz band after the re-allocation period.
- (4) Schedule 4 of these Advisory Guidelines includes a provision relating to managing interference from frequency adjacent digital television transmitters to 700 MHz band receivers.

## Part 3 Managing interference from other services

### 3.1 In-band interference

- (1) In-band interference caused to a radiocommunications receiver operating under a spectrum licence by a radiocommunications transmitter operating under an adjacent spectrum licence is managed by the core licence conditions imposed on the spectrum licences under section 66 of the Act and by the device boundary criteria prescribed in the section 145 determination.
- (2) In-band interference caused to a radiocommunications receiver operating under a spectrum licence by a radiocommunications transmitter operating under an apparatus licence that is issued after the commencement of the *Radiocommunications Spectrum Marketing Plan (700 MHz Band) 2012*, is managed as if the transmitter is operated under a spectrum licence.
- (3) The same device boundary criteria, as applied to spectrum-licensed radiocommunications transmitters, is also applied to new apparatus-licensed radiocommunications transmitters. Therefore, spectrum licences are afforded the same level of in-band protection from new apparatus-licensed radiocommunications transmitters as they are afforded from radiocommunications transmitters operated under adjacent spectrum licences.
- (4) Application of the device boundary criteria manages in-band interference and these criteria incorporate emission limits that provide reasonable protection outside the total geographic area of a licence. Emission limits are also used to manage out-of-band interference but these do not provide protection along the frequency boundaries of a spectrum licence throughout the entire geographic area. Because of the nature of out-of-band interference, emission limits cannot be used to provide protection from out-of-band interference for devices that are located near each other, for example, at multi-operator sites.
- (5) The ACMA will not regard in-band interference to a radiocommunications receiver operating under a spectrum licence caused by a transmitter operating under a class licence as unacceptable if the operation of the transmitter complies with all relevant conditions of the class licence.

*Note* Spectrum licensees must accept any interference caused by apparatus licensed transmitters whose licences were issued before the commencement date of the *Radiocommunications Spectrum Marketing Plan (700 MHz Band) 2012*.

### 3.2 Out-of-band interference

- (1) Out-of-band interference is difficult to predict because the levels and frequencies of unwanted emissions depend on both the nearness of, and the operating frequencies of, radiocommunications transmitters and radiocommunications receivers that are close in terms of both frequency and distance. In addition, out-of-band interference:
  - (a) can extend for many megahertz either side of the frequency boundary of a spectrum licence;

- (b) is dependent on the quality of the radiocommunications receiver, as well as the levels of radiocommunications transmitter emission; and
  - (c) is very difficult to model accurately.
- (2) Because out-of-band interference from unwanted intermodulation products, harmonic and parasitic signals and other spurious signals may extend over a wide frequency range outside the licensed frequency band, it is possible for devices operating under non-adjacent spectrum licences to interfere with each other.
  - (3) If emission limits were used to manage out-of-band interference for devices in close proximity, the interference modelling inaccuracy would require large probability margins to be added to those limits. These margins would place severe constraints on use of the spectrum because the frequency boundaries of a licence extend throughout the entire geographic area of a licence.
  - (4) Therefore, emission limits that manage out-of-band interference throughout the entire geographic area of a spectrum licence cannot be used because they would lead to a severe loss of utility of the spectrum on both sides of the frequency boundary.
  - (5) Instead of making large tracts of spectrum space unusable through the imposition of emission limits, out-of-band interference is managed through interference management procedures based on a compatibility requirement for radiocommunications receivers. Because the performance level of receivers affects the level of interference and is likely to vary widely for receivers operating under spectrum licences, a minimum level of receiver performance is specified in conjunction with the compatibility requirement. The use of a minimum standard for receiver performance avoids placing an excessive mitigation burden on adjacent services that are coordinated with spectrum-licensed receivers when these receivers have poorly performing characteristics.

*Note* Spectrum licensees must accept any interference caused by apparatus licensed transmitters whose licences were issued before the commencement date of the *Radiocommunications Spectrum Marketing Plan (700 MHz Band) 2012*.



## **Part 4 Requirements for receiver protection**

### **4.1 Recording radiocommunications receiver details in the Register**

For a radiocommunications receiver to be afforded protection in accordance with these Advisory Guidelines, the details of the receiver must be recorded in the Register.

### **4.2 Mobile and nomadic devices**

The compatibility requirement in Part 5 of these Advisory Guidelines does not apply to mobile or nomadic devices because the transient nature of their location prevents the use of this requirement as an interference management procedure. Mobile and nomadic radiocommunications receivers have, by their nature, the ability to avoid an interference source, unlike a fixed receiver.

### **4.3 Notional receiver performance**

- (1) The level of interference caused by out-of-band emissions depends on the interference susceptibility of a radiocommunications receiver and the level of the unwanted signal. Emission levels from radiocommunications transmitters should not have to be reduced below a point where the poor performance of the receiver is the main cause of the problem.
- (2) It is necessary to establish a benchmark notional receiver performance level when setting a compatibility requirement for receivers.
- (3) The recommended notional receiver performance level is set out in Schedule 1. A radiocommunications receiver must meet the notional level of performance to gain protection from interference from radiocommunications transmitters.

*Note* Schedule 1 specifies the anticipated receiver performance based on available information at the time that these Advisory Guidelines were made.

## Part 5                      Compatibility requirement

### 5.1              Compatibility

- (1) The performance of a fixed radiocommunications receiver operated under a spectrum licence in the 700 MHz band meets the compatibility requirement if the receiver:
  - (a) has at least the notional level of receiver performance set out in Schedule 1;
  - (b) meets the compatibility requirement of the minimum wanted signal level set out in Schedule 2;
  - (c) has its details included in the Register before the date that the radiocommunications transmitter with which compatibility is sought has its details recorded in the Register; and
  - (d) operates under a spectrum licence:
    - (i) in the 700 MHz lower band, with an effective antenna height (for any increment 1,  $he_1(\phi_n)$ ) greater than 20 metres; or
    - (ii) in the 700 MHz upper band, with an effective antenna height (for any increment 1,  $he_1(\phi_n)$ ) less than 10 metres.

*Note 1* The effective antenna height (in each increment 1,  $he_1(\phi_n)$ ) for a receiver is calculated in accordance with the formula specified in the section 145 determination, as if the receiver is a transmitter.

*Note 2* The effective antenna height limit is chosen to be consistent with common deployment practice.

# Schedule 1 Notional receiver performance level

(section 4.3)

## 1 Notional receiver performance level

(1) The notional level of performance for a radiocommunications receiver operating under a spectrum licence issued for the 700 MHz band in relation to interfering signals from a radiocommunications transmitter operated under an apparatus licence is:

(a) an adjacent channel selectivity (ACS) greater than or equal to the following relative figures for respective channel bandwidths;

Channel Bandwidth	Relative ACS
≤5 MHz	46 dB
>5 MHz	42 dB

(b) an intermodulation response rejection greater than or equal to the following figures for frequency offsets between the edge of the wanted channel and the centre of the interfering intermodulation product bandwidth;

Frequency Offset from Wanted Channel Edge to Centre Frequency of IM Product Bandwidth (MHz)	Intermodulation Performance Requirement (dB)
2.5 MHz	50 dB
7.5 MHz	50 dB
12.5 MHz	54 dB
17.5 MHz	54 dB
22.5 MHz	80 dB

(c) a receiver blocking level greater than or equal to the following figures for interfering signals in the frequency ranges set out below;

Frequency range of interfering signals	Relative Blocking Requirements (dB)
1 MHz to 683 MHz	85 dB
683 MHz to 768 MHz	55 dB
768 MHz to 12750 MHz	85 dB

(d) a spurious response immunity greater than or equal to 65 dB for a receiver operating in the 700 MHz lower band.

(2) This level of performance is taken to be a notional level of performance with reference to a radiocommunications receiver sensitivity level of -101 dBm

measured within a 5 MHz rectangular bandwidth that is within the frequency band of the spectrum licence.

- (3) A notional radiofrequency selectivity for the receiver (between the antenna and the antenna connector of the equipment) may be assumed to be at least equal to:
- (a)  $2 + 70 \cdot \log_{10}[1+(2 \cdot \text{FreqOffset}/5)^{1.5}]$  dB for  $\text{FreqOffset} = 2.5$  MHz;
  - (b)  $2 + 70 \cdot \log_{10}[1+(2 \cdot \text{FreqOffset}/5)^2]$  dB for  $2.5 < \text{FreqOffset} = 9$  MHz; and
  - (c) 82 dB for  $\text{FreqOffset} > 9$  MHz,

where *FreqOffset* is the smallest frequency difference between either the upper or lower limits of the frequency band of the spectrum licence under which the receiver operates and any frequency outside that frequency band.

- (4) These performance parameters of the notional radiocommunications receiver are defined at the antenna connector port of the receiver unit, or in the case where additional devices such as filters or amplifiers are installed in the signal path ahead of the receiver, then the values are defined at the outer antenna connector port.
- (5) The notional antenna system for a radiocommunications receiver has an antenna gain of 15.7 dBi and a feeder loss of 3 dB.

## Schedule 2    Compatibility requirement

(section 5.1)

### 1    Compatibility requirement

- (1) The compatibility requirement for a fixed receiver, operating under a spectrum licence, to be provided by a radiocommunications transmitter operating under an apparatus licence is:
  - (a) a wanted to unwanted ratio of 24 dB corresponding to a bit error rate of 0.001; and
  - (b) a minimum wanted signal level of -83 dBm/5MHz for an annual availability of 99.99 percent.
- (2) The minimum wanted signal level includes a 1 dB increase in the receiver noise floor. Logarithmic scaling should be used to find the appropriate level in alternative bandwidths.

*Note* Application of the compatibility requirement is related solely to management of out-of-band interference and does not apply to in-band interference (e.g. from in-band emission from a co-channel transmitter operating under an area-adjacent licence or non-spurious out-of-band emission from a transmitter operating under a frequency-adjacent licence).

## **Schedule 3     Managing interference to 700 MHz band receivers from broadcast services that may continue to operate in the 694-820 MHz band after the re-allocation period**

(section 2.2)

### **1     Background**

Some broadcasting and retransmission services may continue to operate in the 694-820 MHz band after the re-allocation period.

### **2     Receivers in the 700 MHz lower and upper bands**

- (1) Where a broadcasting service or retransmission service continues to operate in the 694 to 820 MHz band after the end of the re-allocation period, there is potential for interference from digital television transmitters to radiocommunications receivers operating in either the 700 MHz lower band or the 700 MHz upper band.
- (2) The ACMA will publish a set of coordination maps showing exclusion zones required for the protection of digital television receivers. These maps, and information on currently operating digital television transmitters, will be made available on the ACMA website. The number of operating digital television transmitters will reduce over time as those transmitters are “restacked” to channels below 694 MHz.
- (3) The exclusion zone maps will not define the separation distance required to protect spectrum licensed receivers. However, it is expected that spectrum licensees will be able to use the information on operating digital television transmitters to determine separation zones that they may wish to implement to protect their receivers operating under their spectrum licence.

## **Schedule 4    Managing interference from frequency adjacent digital television transmitters to 700 MHz band receivers**

(section 2.2)

### **1    Protection of spectrum-licensed receivers**

Digital television services will operate on UHF channels in the 520 to 694 MHz frequency range. A minimum separation of 9 MHz exists between spectrum-licensed receivers operating in the 700 MHz lower band and digital television transmitters. In these circumstances, appropriate mitigation techniques should be employed by spectrum licensees to manage any potential interference to a spectrum-licensed receiver. Information on the location and characteristics of the digital television transmitters is provided in the Register and in the planning documents associated with the television licence area plans, which are available on the ACMA website.