

APPENDIX 3 (REV.WRC-12)

**Maximum permitted power levels for unwanted emissions
in the spurious domain** (WRC-12)

(See Article 3)

1 This Appendix derived indicates the maximum permitted power levels of unwanted emissions in the spurious domain using the values indicated in Table I. The provisions of No. 4.5 apply to unwanted emissions not covered in this Appendix. (WRC-12)

2 Spurious domain emissions¹ from any part of the installation, other than the antenna and its transmission line, shall not have an effect greater than would occur if this antenna system were supplied with the maximum permitted power at the frequency of that emission. (WRC-12)

3 These levels shall not, however, apply to emergency position-indicating radiobeacon (EPIRB) stations, emergency locator transmitters, ships' emergency transmitters, lifeboat transmitters, survival craft stations or maritime transmitters when used in emergency situations.

4 For technical or operational reasons, more stringent levels than those specified may be applied to protect specific services in certain frequency bands. The levels applied to protect these services, such as safety and passive services, shall be those agreed upon by the appropriate world radiocommunication conference. More stringent levels may also be fixed by specific agreement between the administrations concerned. Additionally, special consideration of transmitter spurious domain emissions may be required for the protection of safety services, radio astronomy and space services using passive sensors. Information on the levels of interference detrimental to radio astronomy, Earth exploration satellites and meteorological passive sensing is given in the most recent version of Recommendation ITU-R SM.329. (WRC-12)

5 Spurious domain emission limits for combined radiocommunication and information technology equipment are those for the radiocommunication transmitters. (WRC-12)

6 The frequency range of the measurement of spurious domain emissions is from 9 kHz to 110 GHz or the second harmonic if higher. (WRC-03)

¹ Spurious domain emissions are unwanted emissions at frequencies within the spurious domain.

7 Except as provided in § 8 and 9 of this Appendix, the spurious domain emission levels are specified in the following reference bandwidths:

- 1 kHz between 9 kHz and 150 kHz
- 10 kHz between 150 kHz and 30 MHz
- 100 kHz between 30 MHz and 1 GHz
- 1 MHz above 1 GHz. (WRC-03)

8 The reference bandwidth of all space service spurious domain emissions should be 4 kHz. (WRC-03)

9 For radar systems, the reference bandwidths for specifying spurious domain emission levels should be calculated for each particular system. Thus, for the four general types of radar pulse modulation utilized for radionavigation, radiolocation, acquisition, tracking and other radiodetermination functions, the reference bandwidth values are determined using the following:

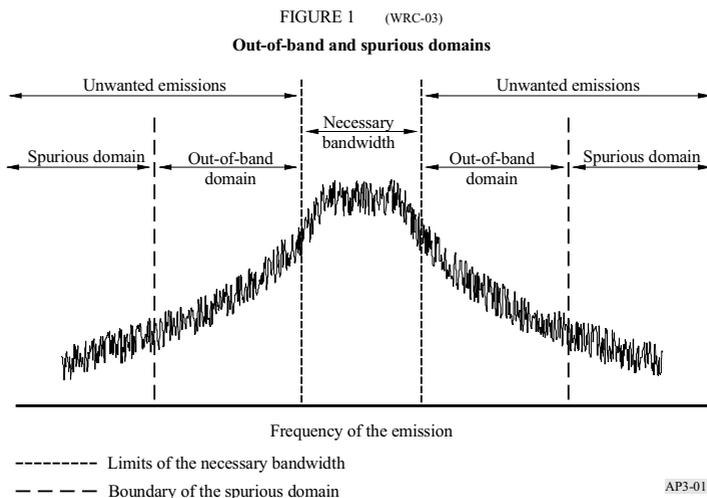
- for a fixed-frequency, non-pulse-coded radar, the reciprocal of the radar pulse length, in seconds (e.g. if the radar pulse length is 1 μ s, then the reference bandwidth is $1/(1 \mu\text{s}) = 1 \text{ MHz}$);
- for a fixed-frequency, phase-coded pulsed radar, the reciprocal of the phase chip length, in seconds (e.g. if the phase-coded chip is 2 μ s long, then the reference bandwidth is $1/(2 \mu\text{s}) = 500 \text{ kHz}$);
- for a frequency modulated (FM) or chirped radar, the square root of the quantity obtained by dividing the chirp bandwidth in MHz by the pulse length, in μ s (e.g. if the FM is from 1 250 MHz to 1 280 MHz, i.e. 30 MHz, during the pulse length of 10 μ s, then the reference bandwidth is $(30 \text{ MHz}/10 \mu\text{s})^{1/2} = 1.73 \text{ MHz}$);
- for radars operating with multiple waveforms, the reference bandwidth for specifying spurious domain emission levels is determined empirically from observations of the radar emission and is obtained following the guidance given in the most recent version of Recommendation ITU-R M.1177.

In the case of radars, for which the bandwidth, as determined using the method above, is greater than 1 MHz, a reference bandwidth of 1 MHz should be used. (WRC-03)

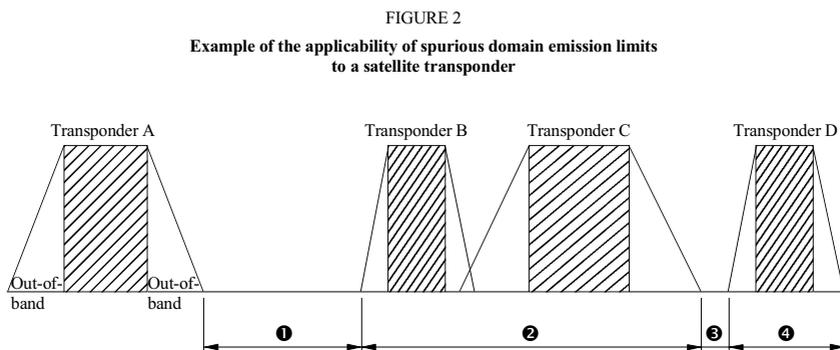
10 Guidance regarding the methods of measuring spurious domain emissions is given in the most recent version of Recommendation ITU-R SM.329. The e.i.r.p. method specified in this Recommendation should be used when it is not possible to accurately measure the power supplied to the antenna transmission line, or for specific applications where the antenna is designed to provide significant attenuation in the spurious domain. Additionally, the e.i.r.p. method may need some modification for special cases. Specific guidance regarding the methods of measuring spurious domain emissions from radar systems is given in the most recent version of Recommendation ITU-R M.1177.

To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth in which spurious domain emissions are measured can be different from the reference bandwidth used for specifying spurious domain emission levels. (WRC-03)

11 The emission limits of this Appendix apply to all emissions, including harmonic emissions, intermodulation products, frequency conversion products and parasitic emissions, at frequencies in the spurious domain (see Fig. 1). The upper and lower parts of the spurious domain extend outward from a boundary determined using Annex 1. (WRC-03)



12 For the case of a single satellite operating with more than one transponder in the same service area, and when considering the limits for spurious domain emissions as indicated in § 11 of this Appendix, spurious domain emissions from one transponder may fall on a frequency at which a second, companion transponder is transmitting. In these situations, the level of spurious domain emissions from the first transponder is well exceeded by the fundamental or out-of-band domain emissions of the second transponder. Therefore, the limits of this Appendix should not apply to those emissions of a satellite that fall within either the necessary bandwidth or the out-of-band domain of another transponder on the same satellite, in the same service area (see Fig. 2). (WRC-03)



Transponders A, B, C and D are operating on the same satellite in the same service area. Transponder A is not required to meet spurious domain emission limits in frequency ranges ② and ④, but is required to meet them in frequency ranges ① and ③. (WRC-03)

13 Examples of applying $43 + 10 \log (P)$ to calculate attenuation requirements

Where specified in relation to mean power, spurious domain emissions are to be at least x dB below the total mean power P , i.e. $-x$ dBc. The power P (W) is to be measured in a bandwidth wide enough to include the total mean power. The spurious domain emissions are to be measured in the reference bandwidths given in the relevant ITU-R Recommendations. The measurement of the spurious domain emission power is independent of the value of necessary bandwidth. Because the absolute emission power limit, derived from $43 + 10 \log (P)$, can become too stringent for high-power transmitters, alternative relative powers are also provided in Table I.

Example 1

A land mobile transmitter, with any value of necessary bandwidth, must meet a spurious domain emission attenuation of $43 + 10 \log (P)$, or 70 dBc, whichever is less stringent. The reference bandwidths used for specifying spurious domain emission levels are provided in § 8 to 10 of this Appendix. Applying this in the frequency range between 30 MHz and 1 GHz gives a reference bandwidth of 100 kHz.

With a measured total mean power of 10 W:

- Attenuation relative to total mean power = $43 + 10 \log (10) = 53$ dBc.
- The 53 dBc value is less stringent than the 70 dBc, so the 53 dBc value is used.
- Therefore: Spurious domain emissions must not exceed 53 dBc in a 100 kHz bandwidth, or converting to an absolute level, they must not exceed $10 \text{ dBW} - 53 \text{ dBc} = -43 \text{ dBW}$ in a 100 kHz reference bandwidth.

With a measured total mean power of 1 000 W:

- Attenuation relative to total mean power = $43 + 10 \log (1\ 000) = 73$ dBc.
- The 73 dBc value is more stringent than the 70 dBc limit, so the 70 dBc value is used.
- Therefore: Spurious domain emissions must not exceed 70 dBc in a 100 kHz bandwidth, or converting to an absolute level, they must not exceed $30 \text{ dBW} - 70 \text{ dBc} = -40 \text{ dBW}$ in a 100 kHz reference bandwidth. (WRC-03)

Example 2

A space service transmitter with any value of necessary bandwidth must meet a spurious domain emission attenuation of $43 + 10 \log (P)$, or 60 dBc, whichever is less stringent. To measure spurious domain emissions at any frequency, Note 10 to Table I indicates using a reference bandwidth of 4 kHz.

With a measured total mean power of 20 W:

- Attenuation relative to total mean power = $43 + 10 \log (20) = 56$ dBc.
- The 56 dBc value is less stringent than the 60 dBc limit, so the 56 dBc value is used.
- Therefore: Spurious domain emissions must not exceed 56 dBc in a 4 kHz reference bandwidth, or converting to an absolute level, they must not exceed $13 \text{ dBW} - 56 \text{ dBc} = -43 \text{ dBW}$ in a 4 kHz reference bandwidth. (WRC-03)

TABLE I (WRC-12)

**Attenuation values used to calculate maximum permitted
spurious domain emission power levels for
use with radio equipment**

Service category in accordance with Article 1, or equipment type ¹⁵	Attenuation (dB) below the power supplied to the antenna transmission line
All services except those services quoted below:	$43 + 10 \log (P)$, or 70 dBc, whichever is less stringent
Space services (earth stations) ^{10, 16}	$43 + 10 \log (P)$, or 60 dBc, whichever is less stringent
Space services (space stations) ^{10, 17}	$43 + 10 \log (P)$, or 60 dBc, whichever is less stringent
Radiodetermination ¹⁴	$43 + 10 \log (PEP)$, or 60 dB, whichever is less stringent
Broadcast television ¹¹	$46 + 10 \log (P)$, or 60 dBc, whichever is less stringent, without exceeding the absolute mean power level of 1 mW for VHF stations or 12 mW for UHF stations. However, greater attenuation may be necessary on a case by case basis
Broadcast FM	$46 + 10 \log (P)$, or 70 dBc, whichever is less stringent; the absolute mean power level of 1 mW should not be exceeded
Broadcasting at MF/HF	50 dBc; the absolute mean power level of 50 mW should not be exceeded
SSB from mobile stations ¹²	43 dB below <i>PEP</i>
Amateur services operating below 30 MHz (including those using SSB) ¹⁶	$43 + 10 \log (PEP)$, or 50 dB, whichever is less stringent

TABLE 1 (end) (WRC-12)

Service category in accordance with Article 1, or equipment type ¹⁵	Attenuation (dB) below the power supplied to the antenna transmission line
Services operating below 30 MHz, except space, radiodetermination, broadcast, those using SSB from mobile stations, and amateur ¹²	43 + 10 log (<i>X</i>), or 60 dBc, whichever is less stringent, where <i>X</i> = <i>PEP</i> for SSB modulation, and <i>X</i> = <i>P</i> for other modulation
Low-power device radio equipment ¹³	56 + 10 log (<i>P</i>), or 40 dBc, whichever is less stringent
Emergency transmitters ¹⁸	No limit

P: mean power in watts supplied to the antenna transmission line, in accordance with No. 1.158. When burst transmission is used, the mean power *P* and the mean power of any spurious domain emissions are measured using power averaging over the burst duration.

PEP: peak envelope power in watts supplied to the antenna transmission line, in accordance with No. 1.157.

dBc: decibels relative to the unmodulated carrier power of the emission. In the cases which do not have a carrier, for example in some digital modulation schemes where the carrier is not accessible for measurement, the reference level equivalent to dBc is decibels relative to the mean power *P*.

- 10 Spurious domain emission limits for all space services are stated in a 4 kHz reference bandwidth.
- 11 For analogue television transmissions, the mean power level is defined with a specified video signal modulation. This video signal has to be chosen in such a way that the maximum mean power level (e.g. at the video signal blanking level for negatively modulated television systems) is supplied to the antenna transmission line.
- 12 All classes of emission using SSB are included in the category “SSB”.
- 13 Low-power radio devices having a maximum output power of less than 100 mW and intended for short-range communication or control purposes; such equipment is in general exempt from individual licensing.
- 14 For radiodetermination systems (radar as defined by No. 1.100), spurious domain emission attenuation (dB) shall be determined for radiated emission levels, and not at the antenna transmission line. The measurement methods for determining the radiated spurious domain emission levels from radar systems should be guided by the most recent version of Recommendation ITU-R M.1177. (WRC-03)
- 15 In some cases of digital modulation (including digital broadcasting), broadband systems, pulsed modulation and narrow-band high-power transmitters for all categories of services, there may be difficulties in meeting limits close to ±250% of the necessary bandwidth.
- 16 Earth stations in the amateur-satellite service operating below 30 MHz are in the service category “Amateur services operating below 30 MHz (including those using SSB)”. (WRC-2000)
- 17 Space stations in the space research service intended for operation in deep space as defined by No. 1.177 are exempt from spurious domain emission limits. (WRC-03)
- 18 Emergency position-indicating radio beacon, emergency locator transmitters, personal location beacons, search and rescue transponders, ship emergency, lifeboat and survival craft transmitters and emergency land, aeronautical or maritime transmitters. (WRC-2000)

ANNEX 1 (WRC-03)

Determination of the boundary between the out-of-band and spurious domains

1 Except as provided below, the boundary between the out-of-band and spurious domains occurs at frequencies that are separated from the centre frequency of the emission by the values shown in Table 1. In general, the boundary, on either side of the centre frequency, occurs at a separation of 250% of the necessary bandwidth, or at $2.5 B_N$, as shown in Table 1. For most systems, the centre frequency of the emission is the centre of the necessary bandwidth. For multichannel or multicarrier transmitters/transponders, where several carriers may be transmitted simultaneously from a final output amplifier or an active antenna, the centre frequency of the emission is taken to be the centre of the -3 dB bandwidth of the transmitter or transponder, and the transmitter or transponder bandwidth is used in place of the necessary bandwidth for determining the boundary. For multicarrier satellite systems, guidance on the boundary between the out-of-band and spurious domains is provided in the most recent version of Recommendation ITU-R SM.1541. Some systems specify unwanted emissions relative to channel bandwidth, or channel spacing. These may be used as a substitute for the necessary bandwidth in Table 1, provided they are found in ITU-R Recommendations.

TABLE 1

Values for frequency separation between the centre frequency and the boundary of the spurious domain

Frequency range	Narrow-band case		Normal separation	Wideband case	
	for $B_N <$	Separation		for $B_N >$	Separation
$9 \text{ kHz} < f_c \leq 150 \text{ kHz}$	250 Hz	625 Hz	$2.5 B_N$	10 kHz	$1.5 B_N + 10 \text{ kHz}$
$150 \text{ kHz} < f_c \leq 30 \text{ MHz}$	4 kHz	10 kHz	$2.5 B_N$	100 kHz	$1.5 B_N + 100 \text{ kHz}$
$30 \text{ MHz} < f_c \leq 1 \text{ GHz}$	25 kHz	62.5 kHz	$2.5 B_N$	10 MHz	$1.5 B_N + 10 \text{ MHz}$
$1 \text{ GHz} < f_c \leq 3 \text{ GHz}$	100 kHz	250 kHz	$2.5 B_N$	50 MHz	$1.5 B_N + 50 \text{ MHz}$
$3 \text{ GHz} < f_c \leq 10 \text{ GHz}$	100 kHz	250 kHz	$2.5 B_N$	100 MHz	$1.5 B_N + 100 \text{ MHz}$
$10 \text{ GHz} < f_c \leq 15 \text{ GHz}$	300 kHz	750 kHz	$2.5 B_N$	250 MHz	$1.5 B_N + 250 \text{ MHz}$
$15 \text{ GHz} < f_c \leq 26 \text{ GHz}$	500 kHz	1.25 MHz	$2.5 B_N$	500 MHz	$1.5 B_N + 500 \text{ MHz}$
$f_c > 26 \text{ GHz}$	1 MHz	2.5 MHz	$2.5 B_N$	500 MHz	$1.5 B_N + 500 \text{ MHz}$

NOTE – In Table 1, f_c is the centre frequency of the emission and B_N is the necessary bandwidth. If the assigned frequency band of the emissions extends across two frequency ranges, then the values corresponding to the higher frequency range shall be used for determining the boundary.

Example 1: The necessary bandwidth of an emission at 26 MHz is 1.8 kHz. Since B_N is less than 4 kHz, the minimum separation of 10 kHz applies. The spurious domain begins 10 kHz each side of the centre of the necessary bandwidth.

Example 2: The necessary bandwidth of an emission at 8 GHz is 200 MHz. Since the wideband case applies for $B_N > 100$ MHz at that frequency, the spurious domain begins 1.5×200 MHz + 100 MHz = 400 MHz each side of the centre of the necessary bandwidth. Using the general separation formula, the out-of-band domain would have extended to 2.5×200 MHz = 500 MHz either side of the centre frequency.

2 Tables 2 and 3 show exceptions to Table 1 for narrow-band and wideband cases, respectively, applicable to particular systems or services and frequency bands.

TABLE 2

Narrow-band variations for particular systems or services and frequency bands

System or service	Frequency range		Narrow-band case	
			for $B_N <$ (kHz)	Separation (kHz)
Fixed service	14 kHz-1.5 MHz		20	50 ⁽¹⁾
	1.5-30 MHz	$P_T \leq 50$ W	30	75 ⁽²⁾
		$P_T > 50$ W	80	200 ⁽²⁾

⁽¹⁾ The separation value is based on an assumption that the maximum value of the necessary bandwidth is about 3 kHz for the frequency range 14 kHz-1.5 MHz. The separation value of 50 kHz is extremely large as compared with the necessary bandwidth. This is because unwanted emissions of high power transmitters under modulated conditions have to be below the spurious limit (70 dBc) at the boundary between the out-of-band and spurious domains.

⁽²⁾ P_T is the transmitter power. The separation values are based on an assumption that the maximum value of the necessary bandwidth is about 12 kHz for the frequency range 1.5-30 MHz. The separation value of 200 kHz for $P_T > 50$ W is extremely large as compared with the necessary bandwidth. This is because unwanted emissions of high power transmitters under modulated conditions have to be below the spurious limit, 70 dBc, at the boundary between the out-of-band and spurious domains. Also, if future systems in the fixed service operating in this frequency range require a necessary bandwidth larger than 12 kHz, it may become necessary to review the 200 kHz separation.

TABLE 3

Wideband variations for particular systems or services and frequency bands

System or service	Frequency range	Wideband case	
		For $B_N >$	Separation
Fixed service	14-150 kHz	20 kHz	$1.5 B_N + 20$ kHz
Fixed-satellite service (FSS)	3.4-4.2 GHz	250 MHz	$1.5 B_N + 250$ MHz
FSS	5.725-6.725 GHz	500 MHz	$1.5 B_N + 500$ MHz
FSS	7.25-7.75 GHz and 7.9-8.4 GHz	250 MHz	$1.5 B_N + 250$ MHz
FSS	10.7-12.75 GHz	500 MHz	$1.5 B_N + 500$ MHz
Broadcasting-satellite service	11.7-12.75 GHz	500 MHz	$1.5 B_N + 500$ MHz
FSS	12.75-13.25 GHz	500 MHz	$1.5 B_N + 500$ MHz
FSS	13.75-14.8 GHz	500 MHz	$1.5 B_N + 500$ MHz

3 For primary radar, the boundary between the out-of-band and spurious domains is the frequency at which the out-of-band domain limits specified in the applicable ITU-R Recommendations are equal to the spurious domain limit defined in Table I of this Appendix. Further guidance on the boundary between the out-of-band and spurious domains for primary radar is provided in the most recent version of Recommendation ITU-R SM.1541.