



Report ITU-R SA.2190
(10/2010)

**Study on compatibility between the mobile
service (aeronautical) and the space
research service (space-to-Earth)
in the frequency band 37-38 GHz**

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***Note:** This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.*

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1 Introduction

Earth stations for the space research service (SRS) have very sensitive receivers. To protect these (deep-space and near-Earth) SRS earth stations from interference, the ITU has published protection criteria in Recommendation ITU-R SA.1157 for the 2 GHz, 8 GHz, 13 GHz and 32 GHz bands.

For the 37-38 GHz band, Recommendation ITU-R SA.1396 gives the SRS earth station protection criterion as -217 dBW/Hz not to be exceeded more than 0.1% of the time for unmanned missions and 0.001% of the time for manned missions. This limit is applicable for both the deep-space and near-Earth SRS missions.

The analyses in § 2 show that since the range of an aircraft transmitter is much less than the range of SRS missions (see Table 1), interference from a transmitter in the aeronautical mobile service (AMS) to an SRS earth station receiver can significantly exceed the SRS earth station protection criteria.

TABLE 1
Typical slant ranges from an earth station

	Slant range (km)	Relative inverse square loss (dB)
Aircraft at 12 km altitude, 60° elevation	14	0
LEO at 300 km altitude, 15° elevation	1 400	40
GEO	33 000	67
Deep space mission at minimum distance	2 000 000	102

Recommendation ITU-R SA.1016 provided an example of a narrow-band aeronautical mobile transmitter interfering with a space research earth station (space-to-Earth) (deep space) at frequencies up to 32 GHz. Given an aircraft transmitter with maximum e.i.r.p. density of 10 W/4 kHz (equivalent to -26 dBW/Hz), antenna gain of 0 dBi, and altitude of 12 km, the results in Annex 1 (see Table 3) of this Recommendation showed that the minimum interference received by the SRS earth station would exceed the protection criteria. Therefore, the Tables of Frequency Allocations in the ITU Radio Regulations have excluded aeronautical mobile in the frequency bands 2.29-2.3 GHz, 8.4-8.5 GHz, 22.21-22.5 GHz and 31.5-31.8 GHz, where the mobile service is co-allocated with the space research service. This Recommendation did not, however, consider very low power AMS systems.

The following sections will present the results of compatibility studies for a single AMS transmitter or multiple AMS transmitters for sharing the 37-38 GHz band by SRS and AMS.

2 Single-entry analyses

The interference from a single aeronautical mobile transmitter to the space research earth stations is analyzed for a narrow-band (NB) mode and a wideband (WB) mode.

For the narrow-band mode, the aircraft e.i.r.p. density is assumed to be 10 W/4 kHz, which is equivalent to -26 dBW/Hz. For the wideband mode, the aircraft e.i.r.p. density is assumed to be 70 W/10 MHz, which is equivalent to -51.5 dBW/Hz. For both narrow and wideband modes, two cases are analyzed:

Case 1

The aircraft altitude is 12 km and it is at 0-degree elevation relative to the SRS earth station, with a transmit antenna gain of 0 dBi towards the SRS earth station. Furthermore, the SRS earth station antenna is assumed to have a -10 dB gain in the direction of the aircraft, corresponding to a boresight separation angle greater than 48° (using the antenna gain pattern given in Recommendation ITU-R SA.509). This case represents the minimum interference from AMS transmitter to the SRS earth station.

Case 2

The aircraft altitude is 12 km and it is at 60-degree elevation relative to the SRS earth station, with a transmit antenna gain of 0 dBi towards the SRS earth station. Furthermore, the SRS earth station antenna is assumed to have a 0 dB gain in the direction of the aircraft, corresponding to a boresight separation angle of 19° (using the antenna gain pattern given in Recommendation ITU-R SA.509). This case represents a more typical interference.

Note that in Recommendation ITU-R SA.1016, the interference analyses were done using Case 1 for the narrow-band mode only. Here we have extended the link analyses in Recommendation ITU-R SA.1016 given for the frequency bands below 32 GHz to the 37-38 GHz band. Table 2 gives the results for Cases 1 and 2 using the narrow- and wideband modes.

TABLE 2

Aeronautical mobile interference to space research service for narrow-band and wideband modes at 38 GHz

	Narrow-band (NB) mode		Wideband (WB) mode	
	Case 1	Case 2	Case 1	Case 2
Aeronautical mobile space station				
Transmitter power (W)	10		70	
Reference bandwidth (kHz)	4		10 000	
Aircraft antenna gain toward victim (dBi)	0		0	
Aircraft e.i.r.p. (dBW)	10		18.5	
e.i.r.p. density (dBW/Hz)	-26		-51.5	
Altitude (km)	12		12	
Elevation (degrees)	0	60	0	60
Slant range (km)	391	14	391	14
Space loss (dB)	176	147	176	147

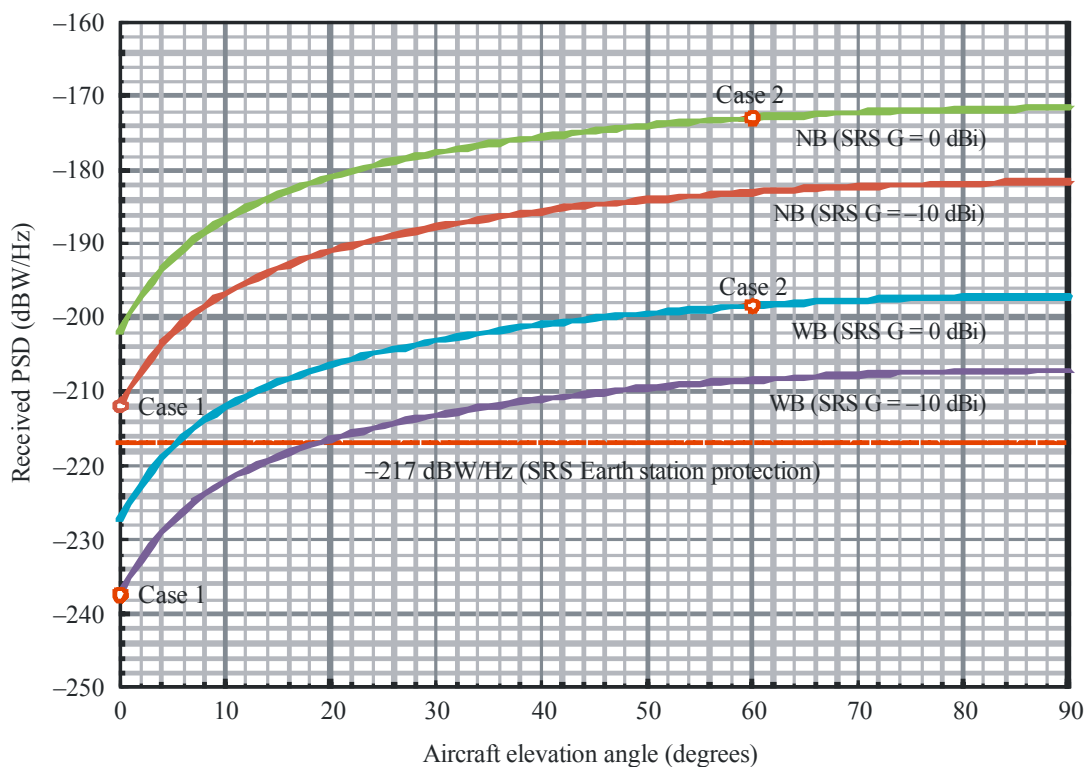
TABLE 2 (end)

	Narrow-band (NB) mode		Wideband (WB) mode	
	Case 1	Case 2	Case 1	Case 2
SRS earth station				
Victim antenna off-boresight angle (degrees)	≥ 48	19	≥ 48	19
Victim antenna gain toward interferer (Recommendation ITU-R SA.509) (dBi)	-10	0	-10	0
Maximum received PSD (dBW/Hz)	-212	-173	-237.5	-198.5
Protection criterion (deep-space and near-Earth) (Recommendation ITU-R SA.1396) (dBW/Hz)	-217			
Max received PSD exceedance above SRS protection criterion (deep-space and near-Earth) (dB)	5	44	-20.5	18.5

In Fig. 1, the received interference power spectral densities are plotted with respect to the aircraft elevation angle for narrow- and wideband modes. The figure also shows the Cases 1 and 2 points, which are analyzed in detail in Table 2.

FIGURE 1

Received power spectral density vs. aircraft elevation angle
for the narrow-band and wideband modes



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