

## RECOMMENDATION ITU-R M.1639-1\*

**Protection criterion for the aeronautical radionavigation service with respect to aggregate emissions from space stations in the radionavigation-satellite service in the band 1 164-1 215 MHz**

(2003-2005)

**Scope**

This Recommendation gives the equivalent power flux-density (epfd) level which protects stations of the aeronautical radionavigation service (ARNS) from emissions of radionavigation satellites of all radionavigation-satellite service (RNSS) systems operating in the 1 164-1 215 MHz band.

The ITU Radiocommunication Assembly,

*considering*

- a) that in accordance with the Radio Regulations (RR), the band 960-1 215 MHz is allocated on a primary basis to the aeronautical radionavigation service (ARNS) in all the ITU Regions;
- b) that analyses show that radionavigation-satellite service (RNSS) signals in the 1 164-1 215 MHz band can be designed to not cause interference to the distance measuring equipment (DME)/tactical air navigation (TACAN) ARNS receivers operating in this band;
- c) that the equivalent power flux-density (epfd) method assesses interference from multiple RNSS space stations into ARNS receivers more accurately than the aggregate pfd method;
- d) that the signal paths of the planned RNSS (space-to-space and space-to-Earth) signals in the 1 164-1 215 MHz band will originate from the same transmission from the RNSS satellites, and thus RNSS (space-to-space) service on such systems will not increase the epfd level above that of RNSS (space-to-Earth) service;
- e) that there are no known plans for any RNSS systems providing exclusively RNSS (space-to-space) service in the 1 164-1 215 MHz band, and the likelihood of such systems being developed in the future is considered to be very low;
- f) that Recommendation ITU-R M.1642 contains the methodology and the reference ARNS station characteristics to be used to calculate the aggregate epfd produced by emissions from all the space stations of all radionavigation-satellite systems at any aeronautical radionavigation station,

*recognizing*

- a) that WRC-2000 introduced a co-primary allocation for the RNSS in the frequency band 1 164-1 215 MHz, subject to conditions that require the RNSS to protect the ARNS from harmful interference;
- b) that WRC-03 determined that protection of the ARNS from RNSS can be achieved if the value of the epfd produced by all the space stations of all RNSS (space-to-Earth) systems in the band 1 164-1 215 MHz does not exceed the level of  $-121.5 \text{ dB (W/m}^2\text{)}$  in any 1 MHz band, and adopted Resolution 609 (WRC-03) in order to ensure that this level is not exceeded;

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\* This Recommendation should be brought to the attention of the International Civil Aviation Organization (ICAO).

c) that the ARNS is a safety service in accordance with RR No. 1.59 and special measures need to be taken by administrations to protect these services from harmful interference in accordance with RR No. 4.10.

*recommends*

1 that the maximum allowable epfd level from all space stations of all RNSS systems should not exceed  $-121.5 \text{ dB(W/(m}^2 \cdot \text{MHz))}$  as derived in Annex 1, in order to protect the ARNS in the band 1 164-1 215 MHz.

## Annex 1

### Aggregate protection criterion determination

This Annex addresses epfd level for all space-based RNSS emissions in the band 1 164-1 215 MHz, whether space-to-Earth or space-to-space RNSS, which protects the ARNS.

#### 1 Definition of epfd

The definition is based upon RR No. 22.5C.1 as adopted at WRC-2000.

When an antenna receives power, within its reference bandwidth, simultaneously from transmitters at various distances, in various directions and at various levels of incident pfd, the epfd is that pfd which, if received from a single transmitter in the far field of the antenna in the direction of maximum gain, would produce the same power at the input of the receiver as is actually received from the aggregate of the various transmitters.

The instantaneous epfd is calculated using the following formula:

$$epfd = 10 \log_{10} \left[ \sum_{i=1}^{N_a} 10^{\frac{P_i}{10}} \cdot \frac{G_t(\theta_i)}{4\pi d_i^2} \cdot \frac{G_r(\phi_i)}{G_{r,max}} \right]$$

where:

- $N_a$ : number of space stations that are visible from the receiver
- $i$ : index of the space station considered
- $P_i$ : RF power at the input of the antenna (or RF radiated power in the case of an active antenna) of the transmitting space station (dB(W/MHz))
- $\theta_i$ : off-axis angle between the boresight of the transmitting space station and the direction of the receiver
- $G_t(\theta_i)$ : transmit antenna gain (as a ratio) of the space station in the direction of the receiver
- $d_i$ : distance (m) between the transmitting station and the receiver
- $\phi_i$ : off-axis angle between the pointing direction of the receiver and the direction of the transmitting space station
- $G_r(\phi_i)$ : receive antenna gain (as a ratio) of the receiver, in the direction of the transmitting space station (see Recommendation ITU-R M.1642)
- $G_{r,max}$ : maximum gain (as a ratio) of the receiver