

RECOMMENDATION ITU-R F.1190*

**PROTECTION CRITERIA FOR DIGITAL RADIO-RELAY SYSTEMS
TO ENSURE COMPATIBILITY WITH RADAR SYSTEMS
IN THE RADIODETERMINATION SERVICE**

(Question ITU-R 159/9)

(1995)

The ITU Radiocommunication Assembly,

considering

- a) that radar systems can produce interference to digital radio-relay systems (DRRS), which gives rise to regular bursts of errors related to the operational characteristics of the radar e.g. the radar antenna rotation rate;
- b) that the importance of radar systems is recognized worldwide, but that nevertheless efforts should be made to reduce the levels of spurious emissions from such systems;
- c) the importance of DRRS in telecommunication networks;
- d) that it is necessary to establish the criteria for ensuring compatibility between radar systems and DRRS;
- e) that the effects of interference from radar systems are different depending on the type of radar systems;
- f) that although the effect of radar interference on DRRS is different depending on the modulation methods employed in the interfered-with systems, provisionally it seems appropriate to define the protection threshold in terms of interference-to-thermal noise ratio in order to make the criteria applicable to any modulation method,

recommends

- 1 that the interference power should be evaluated in terms of peak envelope power over the entire necessary bandwidth of a radio channel of the interfered-with system;
- 2 that in the case of interference from fixed and transportable land based radar systems;
- 2.1 the interference-to-thermal noise ratio (referred to in *recommends* 1) should be no greater than 0 dB (see NOTES 1 and 2);
- 2.2 the interference should be evaluated in an actual or planned operational situation;
- 2.3 for the case of the main beam radio-relay antenna intercept of the interference, the power flux-density at a receiving station of radio-relay systems due to unwanted emissions should be no greater than $-127 \text{ dB(W/m}^2\text{)}$ in any 40 MHz band in the 3 400-4 200 MHz and 4 400-5 000 MHz ranges or $-130 \text{ dB(W/m}^2\text{)}$ in any 20 MHz band in the 5 925-6 425 MHz range (see Annex 2);
- 3 that in the case of interference from maritime and land mobile radar systems (see NOTE 3);
- 3.1 the interference-to-thermal noise ratio (I/N) (referred to in § 1) should be no greater than 10 dB (NOTES 1, 2 and 5);
- 3.2 the interference should be evaluated in an actual or planned operational situation. However, the condition of 20 km distance direct exposure in line-of-sight and free space propagation, should be considered representative of the maritime mobile radars for many cases;

* This Recommendation should be brought to the attention of Radiocommunication Study Group 8 (WP 8C), the International Maritime Organization (IMO) and the International Maritime Radio Association (CIRM).

3.3 the power flux-density at a receiving station of radio-relay systems due to unwanted emissions should be no greater than $-117 \text{ dB(W/m}^2\text{)}$ in any 40 MHz band in the 3 400-4 200 MHz and 4 400-5 000 MHz ranges or $-120 \text{ dB(W/m}^2\text{)}$ in any 20 MHz band in the 5 925-6 425 MHz range (see NOTE 4);

4 that the guidance contained in Annex 1 should be taken into consideration for evaluation of interference power into digital radio-relay systems due to unwanted emissions from radar systems.

NOTE 1 – This value was derived from the assumption that the interference from radar systems has an intermittent nature and occurs only with low probability. This requires further studies and tests to validate these assumptions.

NOTE 2 – For the time being, this criteria should apply only to radar interference in the frequency bands below about 7 GHz. Further studies are required.

NOTE 3 – Maritime mobile does not include high power naval radiolocation.

NOTE 4 – The power flux-density values in § 3.3 above are equivalent to the unwanted emission e.i.r.p. of a radar system of -20 dBW in a 40 MHz band and -23 dBW in a 20 MHz band, respectively, assuming a 20 km separation distance (see Annex 2).

NOTE 5 – The I/N value was derived from the assumption that the interference from mobile radar systems is temporary in nature.

ANNEX 1

Evaluation of interference power into digital radio-relay systems due to unwanted emissions from radar systems

The interference power due to unwanted emissions from radar systems into DRRS should be evaluated in terms of peak envelope power over the necessary bandwidth of a radio channel of the interfered-with system (see *recommends* 1 of this Recommendation). In evaluating the total power over the necessary bandwidth, the following factors should be taken into account:

- it is not always possible to evaluate the peak envelope power of the interference in time domain;
- when measured in frequency domain, interfering components appear with a frequency spacing equal to an inverse of the pulse width of a radar system;
- there is more or less coherence among such interfering components and, therefore, the peak envelope power of the aggregate interference depends on the degree of coherence among interfering components;
- in general, it is appropriate in the evaluation of the second or third harmonic spurious emission to assume a perfect coherence among interfering components (i.e. voltage sum);
- in general, it is appropriate in the evaluation of non-harmonic unwanted emissions to assume a partial coherence among interfering components (i.e. 1.5th power sum).

Based on the above considerations, the following methods should be employed for evaluation of interference power:

- Preferably the peak envelope power of radar interference over the entire bandwidth of a radio channel of the interfered-with system should be evaluated in time domain.
- If the data is available only in frequency domain, consisting of n interference components w_i ($i = 1, 2, \dots, n$) expressed in power unit, the overall peak envelope power W should be evaluated as follows:

$$W = (\sum w_i^{1/k})^k$$

where k should be assumed as 2.0 for the evaluation of the second or third harmonic spurious emission and 1.5 for the evaluation of non-harmonic unwanted emission. Further study of the validity of these values is required.