

RECOMMENDATION ITU-R RS.1029-2*

Interference criteria for satellite passive remote sensing

(1994-1997-2003)

The ITU Radiocommunication Assembly,

considering

- a) that certain frequency bands, including some absorption bands of atmospheric gases (e.g. O₂ (oxygen) and H₂O (water vapour)), have been allocated for spaceborne passive microwave remote sensing;
- b) that some of these bands are also allocated to other radio services;
- c) that performance criteria for satellite passive remote sensing are contained in Recommendation ITU-R RS.1028;
- d) that interference criteria should be compatible with performance objectives;
- e) that interference criteria are a necessary prerequisite to the establishment of sharing criteria;
- f) that interference criteria can be stated in terms of interference power within a reference bandwidth;
- g) that passive microwave remote sensing is performed in absorption bands to obtain important three-dimensional atmospheric data that are used in particular to initialize numerical weather prediction (NWP) models;
- h) that studies have established that measurements in absorption bands are extremely vulnerable to interference because, in general, there is no possibility to detect and to reject data that are contaminated by interference, and because propagation of undetected contaminated data into NWP models may have a destructive impact on the reliability/quality of weather forecasting;
- j) that three-dimensional measurements of atmospheric temperature or gas concentration are performed in the absorption bands including those in the range 52.6-59.3 GHz, 115.25-122.25 GHz, 174.8-191.8 GHz, as well as the auxiliary window channels at 23.6-24 GHz, 31.3-31.8 GHz, 50.2-50.4 GHz and 86-92 GHz;
- k) that the sensitivities of radiometric passive sensors are generally expressed as a temperature differential, ΔT_e , given by:

$$\Delta T_e = \alpha T_s / \sqrt{Bt} \quad \text{K}$$

where:

ΔT_e : radiometric resolution (r.m.s. uncertainty in estimation of total system noise, T_s)

α : receiver system constant

T_s : system noise temperature (K) (antenna temperature and receiver noise temperature)

B : spectral resolution (of spectroradiometer) or “reference bandwidth” of a single radiometric channel (Hz)

t : sensor integration time (s);

* Radiocommunication Study Group 7 made editorial amendments to this Recommendation.

- l) that the radiometer threshold, or minimum discernible power change, is given by:

$$\Delta P = k \Delta T_e B \quad W$$

where k is Boltzmann's constant = 1.38×10^{-23} J/K,

recommends

- 1 that the interference level for spaceborne passive sensors in the bands in Table 1 should be set at 20% of ΔP ;
- 2 that permissible interference levels and reference bandwidths for the frequency bands preferred for passive sensing of the Earth's land, oceans and atmosphere as specified in Table 1 should be used in any interference assessment or sharing studies;
- 3 that the interference level in Table 1 should not be exceeded for more than a percentage of sensor viewing area or a percentage of measurement time as given in column 5 of Table 1.

TABLE 1

Interference criteria for passive remote sensing of environmental data

Frequency band(s) ⁽¹⁾ (GHz)	Total bandwidth required (MHz)	Reference bandwidth (MHz)	Maximum interference level (dBW)	Percentage of area or time permissible interference level may be exceeded ⁽²⁾ (%)	Scan mode (N, L) ⁽³⁾
1.37-1.4s, 1.4-1.427P	100	27	-174	0.1	N
2.64-2.655s, 2.655-2.69s, 2.69-2.7P	45	10	-176	0.1	N
4.2-4.4s, 4.95-4.99s	200	200	-158/-166 ⁽⁴⁾	0.1	N
6.425-7.25	200	200	-158/-166 ⁽⁴⁾	0.1	N
10.6-10.68p, 10.68-10.7P	100	100	-156/-166 ⁽⁴⁾	0.1	N
15.2-15.35s, 15.35-15.4P	200	50	-169	0.1	N
18.6-18.8p	200	200	-153/-163 ⁽⁴⁾	5/0.1 ⁽⁴⁾	N
21.2-21.4p	200	100	-163/-169 ⁽⁴⁾	1/0.1 ⁽⁴⁾	N
22.21-22.5p	300	100	-160/-169 ⁽⁴⁾	1/0.1 ⁽⁴⁾	N
23.6-24P	400	200	-166	0.01	N
31.3-31.5P, 31.5-31.8p	500	200	-160/-166 ⁽⁴⁾	0.01	N

TABLE 1 (continued)

Frequency band(s) ⁽¹⁾ (GHz)	Total bandwidth required (MHz)	Reference bandwidth (MHz)	Maximum interference level (dBW)	Percentage of area or time permissible interference level may be exceeded ⁽²⁾ (%)	Scan mode (N, L) ⁽³⁾
36-37p	1 000	100	-156/-166 ⁽⁴⁾	0.1	N
50.2-50.4P	200	200	-166	0.01	N
52.6-54.25P, 54.25-59.3p	6 700 ⁽⁵⁾	100	-161/-169 ⁽⁴⁾	0.01	N
86-92P	6 000	100	-169	0.01	N
100-102P	2 000	10	-189	1	L
109.5-111.8P	2 000	10	-189	1	L
114.25-116P	1 750	10	-189	1	L
115.25-116P, 116-122.25p	7 000 ⁽⁵⁾	200/10 ⁽⁶⁾	-166/-189 ⁽⁶⁾	0.01/1 ⁽⁶⁾	N, L
148.5-151.5P	3 000	500/10 ⁽⁶⁾	-159/-189 ⁽⁶⁾	0.01/1 ⁽⁶⁾	N, L
155.5-158.5 ⁽⁷⁾ p	3 000	200	-163	0.01	N
164-167P	3 000 ⁽⁵⁾	200/10 ⁽⁶⁾	-163/-189 ⁽⁶⁾	0.01/1 ⁽⁶⁾	N, L
174.8-182p, 182-185P, 185-190p, 190-191.8P	17 000 ⁽⁵⁾	200/10 ⁽⁶⁾	-163/-189 ⁽⁶⁾	0.01/1 ⁽⁶⁾	N, L
200-209P	9 000 ⁽⁵⁾	3	-194	1	L
226-231.5P	5 500	200/3 ⁽⁶⁾	-160/-194 ⁽⁶⁾	0.01/1 ⁽⁶⁾	N, L
235-238p	3 000	3	-194	1	L
250-252P	2 000	3	-194	1	L
275-277	2 000 ⁽⁵⁾	3	-194	1	L
294-306	12 000 ⁽⁵⁾	200/3 ⁽⁶⁾	-160/-194 ⁽⁶⁾	0.01/1 ⁽⁶⁾	N, L
316-334	18 000 ⁽⁵⁾	200/3 ⁽⁶⁾	-158/-194 ⁽⁶⁾	0.01/1 ⁽⁶⁾	N, L
342-349	7 000 ⁽⁵⁾	200/3 ⁽⁶⁾	-158/-194 ⁽⁶⁾	0.01/1 ⁽⁶⁾	N, L
363-365	2 000	3	-194	1	L
371-389	18 000 ⁽⁵⁾	200	-158	0.01	N
416-434	18 000 ⁽⁵⁾	200	-157	0.01	N
442-444	2 000 ⁽⁵⁾	200/3 ⁽⁶⁾	-157/-194 ⁽⁶⁾	1	N, L

TABLE 1 (*end*)

Frequency band(s) ⁽¹⁾ (GHz)	Total bandwidth required (MHz)	Reference bandwidth (MHz)	Maximum interference level (dBW)	Percentage of area or time permissible interference level may be exceeded ⁽²⁾ (%)	Scan mode (N, L) ⁽³⁾
496-506	10 000 ⁽⁵⁾	200/3 ⁽⁶⁾	-156/-194 ⁽⁶⁾	0.01/1 ⁽⁶⁾	N, L
546-568	22 000 ⁽⁵⁾	200/3 ⁽⁶⁾	-156/-194 ⁽⁶⁾	0.01/1 ⁽⁶⁾	N, L
624-629	5 000 ⁽⁵⁾	3	-194	1	L
634-654	20 000 ⁽⁵⁾	200/3 ⁽⁶⁾	-156/-194 ⁽⁶⁾	0.01/1 ⁽⁶⁾	N, L
659-661	2 000	3	-194	1	L
684-692	8 000 ⁽⁵⁾	3	-194	1	L
730-732	2 000 ⁽⁵⁾	3	-194	1	L
851-853	2 000	3	-194	1	L
951-956	5 000 ⁽⁶⁾	3	-194	1	L

- (1) P: Primary allocation, shared only with passive services (No. 5.340 of the Radio Regulations); p: primary allocation, shared with active services; s: secondary allocation.
- (2) For a 0.01% level, the measurement area is a square on the Earth of 2 000 000 km², unless otherwise justified; for a 0.1% level, the measurement area is a square on the Earth of 10 000 000 km² unless otherwise justified; for a 1% level, the measurement time is 24 h, unless otherwise justified.
- (3) N: Nadir, Nadir scan modes concentrate on sounding or viewing the Earth's surface at angles of nearly perpendicular incidence. The scan terminates at the surface or at various levels in the atmosphere according to the weighting functions. L: Limb, Limb scan modes view the atmosphere "on edge" and terminate in space rather than at the surface, and accordingly are weighted zero at the surface and maximum at the tangent point height.
- (4) First number for sharing conditions circa 2003; second number for scientific requirements that are technically achievable by sensors in next 5-10 years.
- (5) This bandwidth is occupied by multiple channels.
- (6) Second number for microwave Limb sounding applications.
- (7) This band is needed until 2018 to accommodate existing and planned sensors.

