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**Transmission and Multiplexing (TM);
Fixed radio link equipment for the transmission of
analogue video signals operating in the
frequency range 24,25 to 29,50 GHz**

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Foreword

This European Telecommunication Standard (ETS) has been prepared by the Transmission and Multiplexing (TM) Technical Committee of the European Telecommunications Standards Institute (ETSI) and is now submitted for the Public Enquiry phase of the ETSI standards approval procedure.

This ETS specifies the minimum performance parameters for radio relay equipment operating in the frequency range 24,25 GHz to 29,50 GHz.

| Proposed transposition dates | |
|---|---------------------------------|
| Date of latest announcement of this ETS (doa): | 3 months after ETSI publication |
| Date of latest publication of new National Standard or endorsement of this ETS (dop/e): | 6 months after doa |
| Date of withdrawal of any conflicting National Standard (dow): | 6 months after doa |

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1 Scope

This European Telecommunication Standard (ETS) covers the minimum technical requirements for terrestrial analogue radio relay systems operating in bands in the frequency range 24,25 to 29,50 GHz.

Such systems are intended to be used for Point-to-Point (P-P) connections and video distribution (Point-to-Multipoint (P-MP)).

Typical applications include:

- a) TV of contribution quality;
- b) TV of distribution quality;
- c) TV of surveillance quality;
- d) Radar remoting.

2 Normative references

This ETS incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate place in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

- [1] CCIR Recommendation 748 (1992): "Radio frequency channel arrangements for radio relay systems operating in the 25,25 to 27,5 GHz and 27,5 to 29,5 GHz bands".
- [2] CEPT Recommendation T/R 13-02: "Preferred channel arrangements for fixed services in the range 22,0 - 29,5 GHz".
- [3] ETS 300 019 (1994): "Electrical Equipment (EE); Environmental conditions and environmental tests for telecommunications equipment".
- [4] ETS 300 339 (1993): "Radio Equipment and Systems (RES); General Electromagnetic Compatibility (EMC) for radio equipment".
- [5] prETS 300 132: "Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment" (DE/EE-02001).
- [6] CCIR Recommendation 567-3 (1990): "Transmission performance of television circuits designed for use in international connections".
- [7] CCIR Recommendation 505-4 (1990): "Performance characteristics of 15 kHz-type sound programme circuits".
- [8] CCIR Recommendation 403-3 (1990): "Intermediate-frequency characteristics for the interconnection of analogue radio-relay systems".

3 Abbreviations and symbols

3.1 Abbreviations

For the purpose of this ETS, the following abbreviations apply:

| | |
|------|----------------------------|
| C/N | Carrier to Noise ratio |
| CW | Continuous Wave |
| FM | Frequency Modulation |
| IF | Intermediate Frequency |
| PAL | Phase Alternate Line |
| P-MP | Point-to-Multipoint |
| P-P | Point-to-Point |
| RF | Radio Frequency |
| RSL | Receive Signal Level |
| S/N | Signal to Noise ratio |
| XPD | Cross-Polar Discrimination |

3.2 Symbols

For the purpose of this ETS, the following symbols apply.

| | |
|-----------------|---|
| dB | decibel |
| dBc | decibel relative to mean carrier power |
| dB _i | decibel relative to an isotropic radiator |
| dBm | decibel relative to 1 mW |
| dBW | decibel relative to 1 W |
| GHz | Giga Hertz |
| km | kilometre |
| Mbit/s | Mega-bits per second |
| MHz | Mega Hertz |
| ppm | parts per million |
| ns | nanosecond |
| mW | milli Watt |
| W | Watt |

4 General characteristics

4.1 Frequency bands and channel arrangements

4.1.1 Channel plan

The frequency range is 24,25 to 29,50 GHz. The channel plan is in accordance with CCIR Recommendation 748 [1] with a basic raster of 3,5 MHz and a reference frequency 24,248 GHz.

The centre gap is a multiple of the basic raster distance of 3,5 MHz. The channel arrangements are given by CEPT Recommendation T/R 13 - 02 [2].

4.1.2 Co-polar channel spacing for systems operating on different antennas

Table 1

| | | |
|------------------------|--|--|
| Video baseband | up to 10 MHz (standard frequency deviation) | up to 10 MHz (wide frequency deviation) |
| Channel spacing | 35 MHz | 42 MHz |

4.2 Compatibility requirements between systems

Equipment conforming with this ETS is not guaranteed to operate together across the radio interface (mid-air compatibility) with similar equipment provided by another manufacturer.

4.3 Environmental conditions

The equipment shall meet the environmental conditions set out in ETS 300 019 [3] which defines weather protected and non-weather protected locations, classes and test severities.

4.3.1 Equipment within weather protected locations

Equipment intended for operation within temperature controlled locations or partially temperature controlled locations shall meet the requirements of ETS 300 019 [3] classes 3.1 and 3.2 respectively.

Optionally, the more stringent requirements of ETS 300 019 [3] classes 3.3 (Non temperature controlled locations), 3.4 (Sites with heat trap) and 3.5 (Sheltered locations) may be applied.

4.3.2 Equipment for non-weather protected locations

Equipment intended for operation within non-weather protected locations shall meet the requirements of ETS 300 019 [3], class 4.1 or 4.1E.

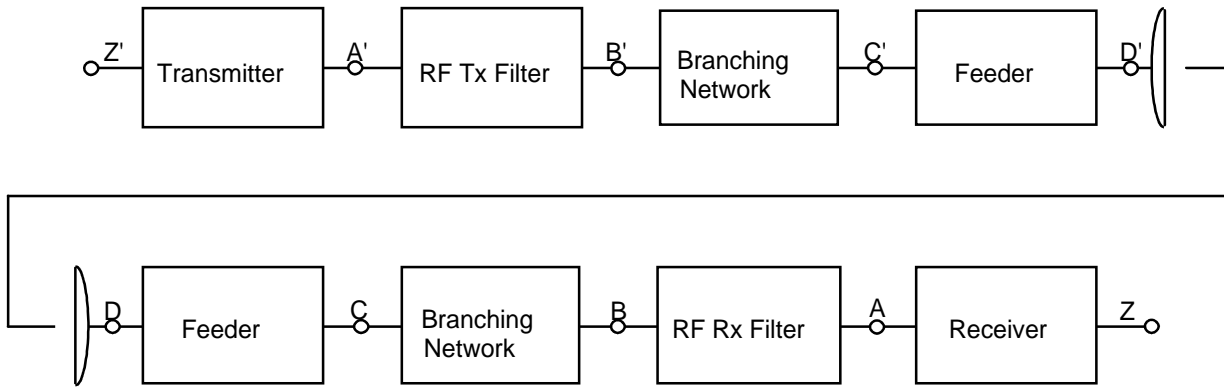
Class 4.1 applies to many ETSI countries and class 4.1E applies to all ETSI countries.

Weather protected equipment conforming to classes 3.3, 3.4 and 3.5, together with an enclosure or cabinet may fulfil the requirements for operating in a non-weather protected environment, but this is outside the scope of this ETS.

4.4 Electromagnetic compatibility

Equipment shall operate under the conditions specified in ETS 300 339 [4] for fixed radio links and ancillary equipment.

4.5 System block diagram



NOTE 1: The points listed above are reference points only.
NOTE 2: Points B and C, B' and C' may coincide.

Figure 1: System block diagram

4.6 Branching / feeder / antenna requirements

4.6.1 Antenna radiations patterns

For equipment of which the antenna forms an integral part, the antenna radiation pattern shall be within one of the envelopes given in figures 2a, 2b and 2c. Type B antennas are intended for applications where high nodal capacity is required, and type C antennas are intended for distribution (P-MP) applications.

4.6.2 Waveguide flanges

Where integral antennas are not used, one of the following flange types shall be used:

- UBR/PBR/CBR 260, for the complete frequency range 24,25 to 29,5 GHz;
- UBR/PBR/CBR 220, may be used for the lower part of the band, from 24,25 to 26,5 GHz;
- UBR/PBR/CBR 320, may be used for the higher part of the band, from 26,5 to 29,5 GHz.

4.6.3 Cross-Polar Discrimination (XPD)

The antenna XPD value within the 1 dB beamwidth shall not be less than 24 dB.

4.7 Power supply

The power supply interface shall be in accordance with ETS 300 132 [5].

4.8 Safety considerations

Maximum radiated power density under normal operating conditions shall be in accordance with current World Health Organisation figures.

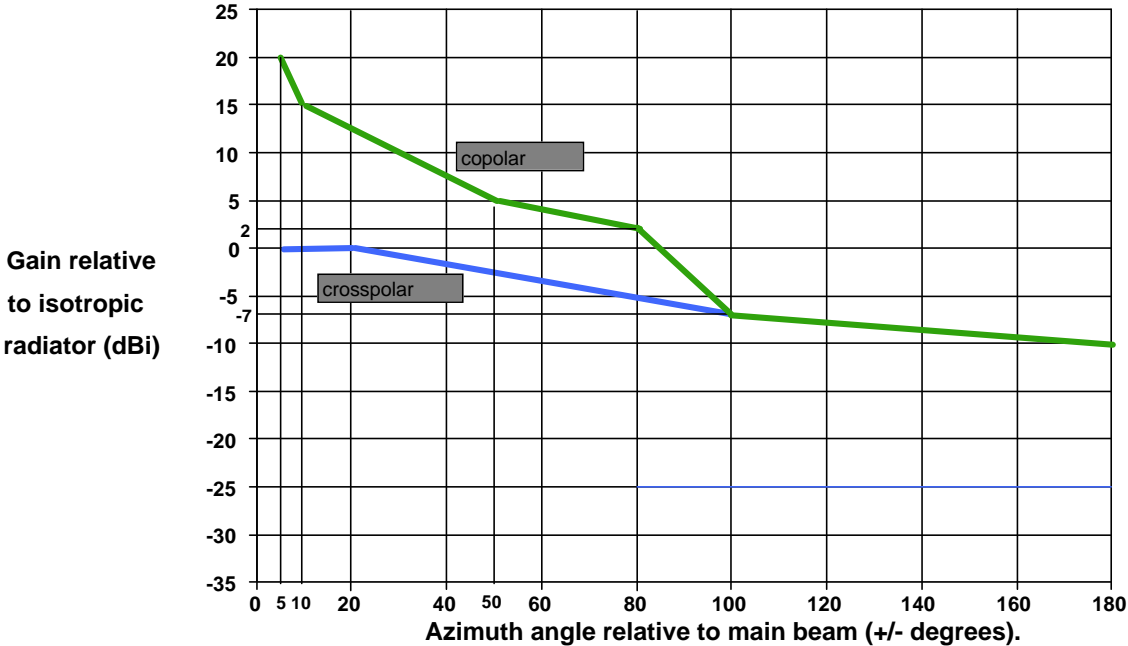


Figure 2a: Standard performance (Type A) antenna radiation pattern (under test conditions)

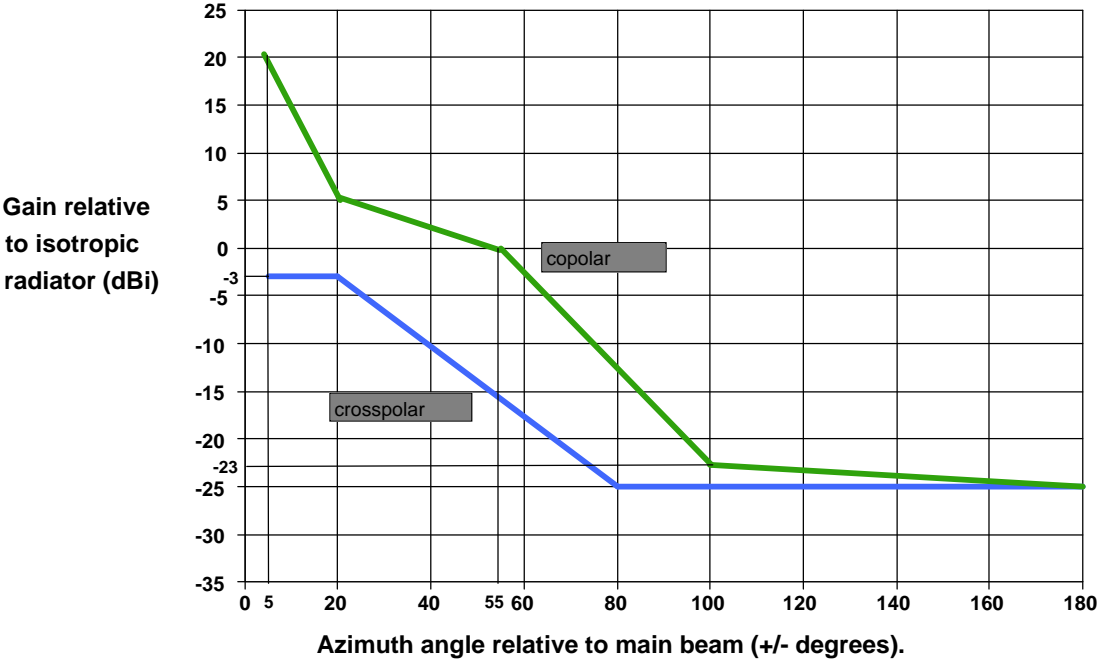


Figure 2b: High performance (Type B) antenna radiation pattern (under test conditions)

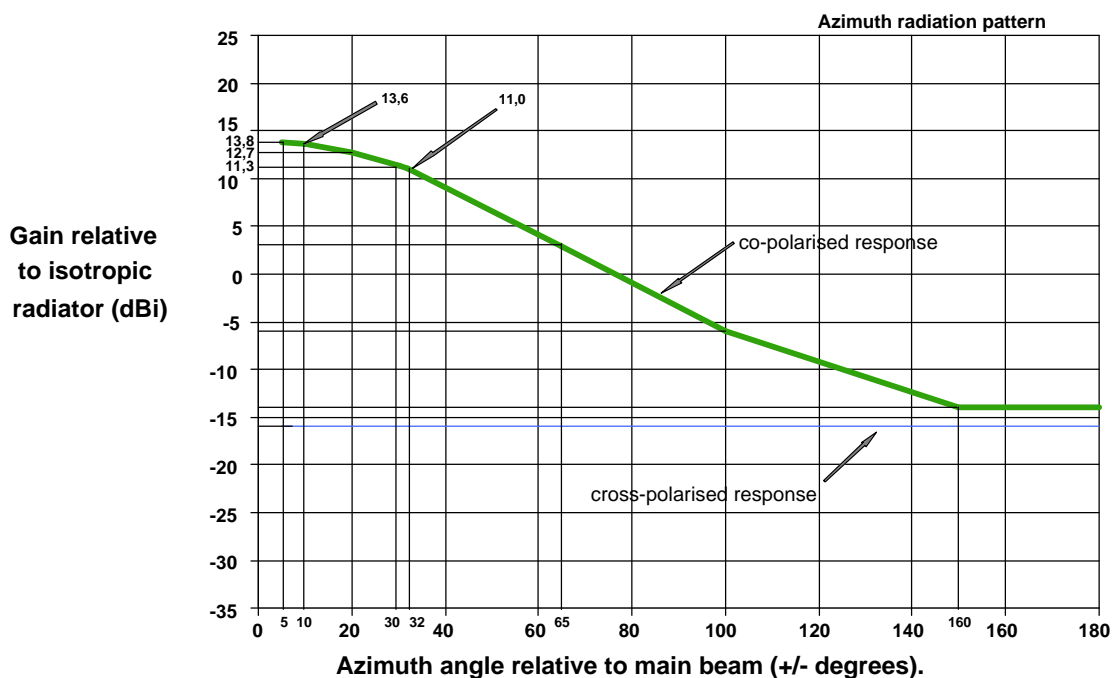


Figure 2c: Sector coverage (Type C) antenna radiation pattern for TV distribution (under test conditions)

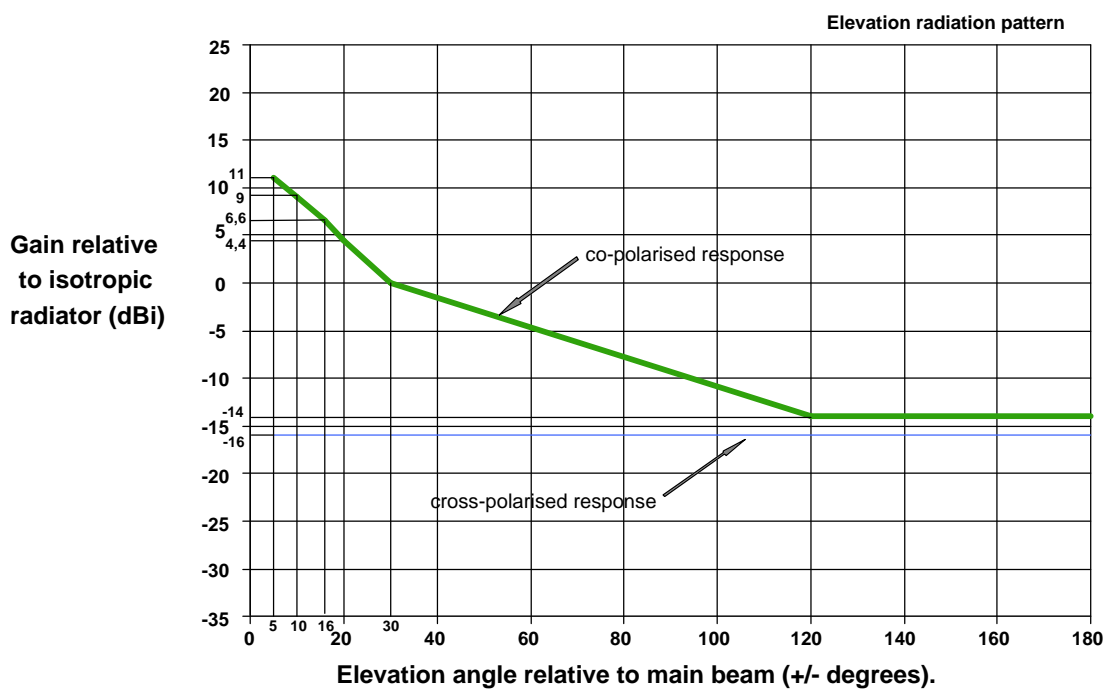


Figure 2d: Sector coverage (Type C) antenna radiation pattern for TV distribution (under test conditions)

5 Baseband characteristics

5.1 Transmit/receive capacity

A video baseband bandwidth of up to 10 MHz may be used. This may have subcarriers associated with it.

It is recognised that subcarriers will be used to carry four distinct traffic types:

- Continuous Wave (CW) (e.g. continuity pilot);
- low frequency analogue (e.g. audio);
- wideband analogue (e.g. secondary video);
- digital signals.

5.2 Baseband parameters

5.2.1 Video interfaces

The video interface shall be in accordance with CCIR Recommendation 567 [6].

5.2.2 Audio interface

If an audio interface is implemented, then it shall be in accordance with CCIR Recommendation 505 [7].

5.2.3 IF interface

If an IF interface is implemented, then it shall be in accordance with CCIR Recommendation 403 [8].

6 Transmitter characteristics

6.1 Transmitter power range

Transmitter output power at point C' of the system block diagram (figure 1) shall be in the range +5 to +27 dBm.

Regulatory Administrations may define sub-ranges within the above range.

6.2 Transmitter output power tolerance

The tolerance of the output power shall be within:

- nominal output power ± 3 dB for systems operating within non-weather protected locations;
- nominal output power ± 2 dB for systems operating within weather protected locations.

6.3 Radiated spectrum

6.3.1 Frequency deviation

With the limited system gain available in this band, predominantly due to economic limits on the transmit power available, relatively narrow frequency deviations (e.g. 8 MHz peak to peak) will have rather low ranges. Wide deviation systems (e.g. 16 MHz peak to peak for Phase Alternate Line (PAL) video signals) can provide lower receiver sensitivity levels and thus result in longer ranges being obtained. Therefore this specification includes two spectral masks, one for standard frequency deviation systems, and the other for wide frequency deviation systems.

The frequency deviation of the primary traffic and sub-carriers shall be limited to a level that will ensure that the spectrum masks are not exceeded when the carrier is modulated with the relevant standard test signals. For television this will be 100% colour bars.

NOTE: The mask also contains the maximum allowable centre frequency tolerance and this should be taken into consideration when setting up the deviation.

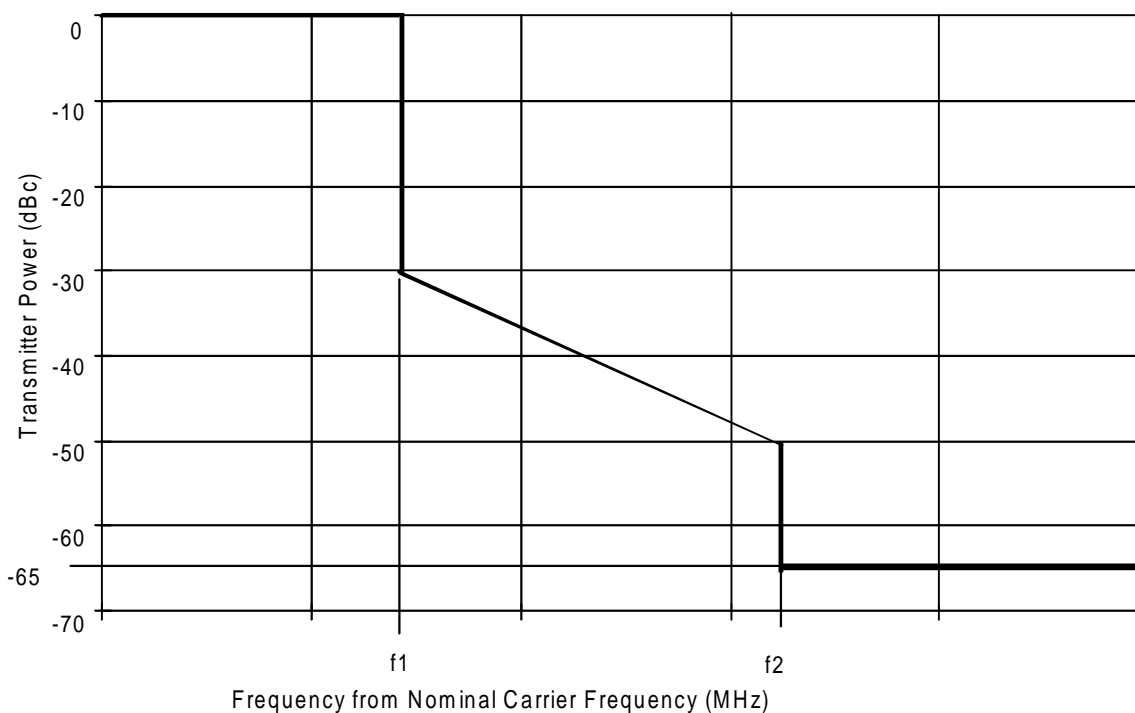
6.3.2 Spectrum masks

The radiated spectrum of the composite wideband signal shall fall within the spectrum masks given in figure 3a (for standard frequency deviation) or figure 3b (for wide frequency deviation). The masks take into account an allowance for short term frequency tolerance.

NOTE: Spectrum analyser settings for RF power spectrum measurements should be as shown in table 2.

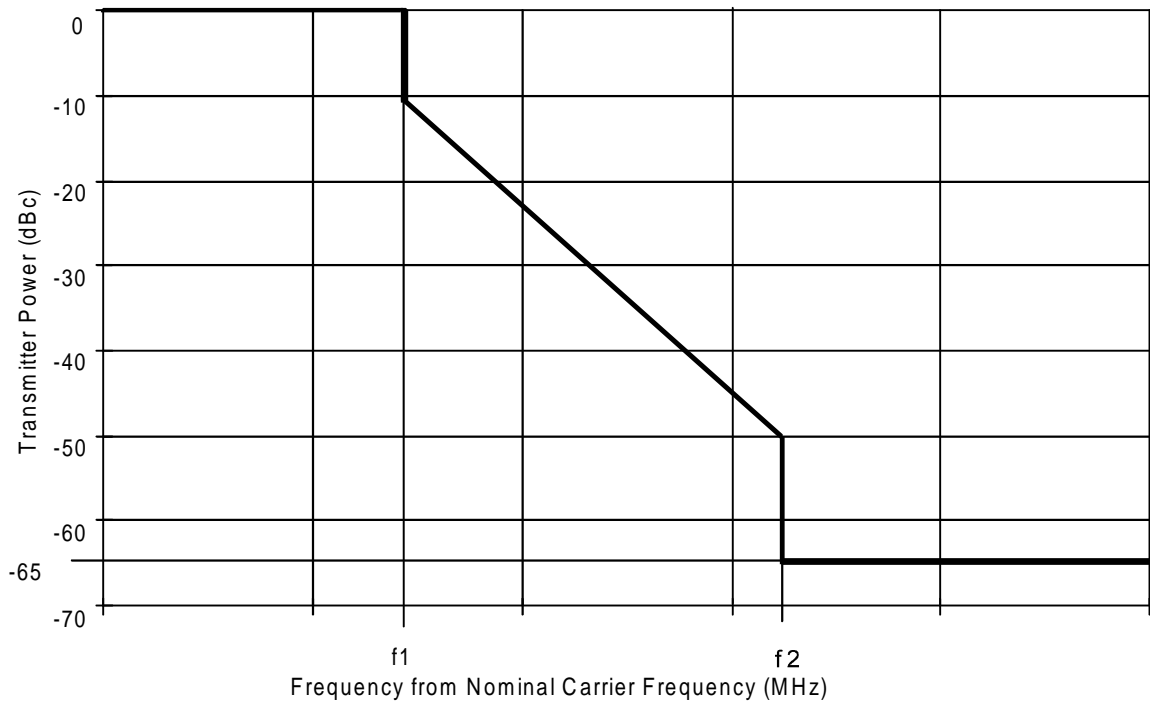
Table 2: Spectrum analyser settings

| | |
|---------------------|-------------------------------|
| RF centre frequency | Transmitter carrier frequency |
| IF bandwidth | 30 kHz |
| Total sweep width | 100 MHz |
| Amplitude scale | Logarithmic, 10 dB / division |
| Video filter | 300 Hz |
| Total scan time | 50 seconds |



| Baseband | f1 | f2 | Channel spacing |
|--------------|----------|--------|-----------------|
| Up to 10 MHz | 10,5 MHz | 21 MHz | 35 MHz |

Figure 3a: Limits of spectral power density for video, standard frequency deviation



| Baseband | f1 | f2 | Channel spacing |
|----------|--------|--------|-----------------|
| 10 MHz | 15 MHz | 28 MHz | 42 MHz |

Figure 3b: Limits of spectral power density for video, wide frequency deviation

6.4 Spurious emissions

For the purposes of this ETS, the spurious emissions are defined as emissions which are outside the nominal carrier frequency $\pm 2,5$ times the relevant channel spacing.

The frequency range in which the spurious emissions specifications apply is 30 MHz to 60 GHz. The limit values measured at point C' are:

- 30 MHz to 21,2 GHz: -60 dBm;
- 21,2 GHz to 60 GHz: -30 dBm.

6.5 RF frequency tolerance

RF frequency tolerances are included in the spectrum masks. Short term radio frequency tolerance shall be less than 20 ppm.

7 Receiver characteristics

All levels are referenced to point C on the block diagram.

7.1 Input level range

The input level range shall extend from the upper limit of - 20 dBm to the limit specified in subclause 7.4.

7.2 Spurious emissions

For the purposes of this ETS, the spurious emissions are defined as emissions which are outside the nominal carrier frequency $\pm 2,5$ times the relevant channel spacing.

The frequency range in which the spurious emissions specifications apply is 30 MHz to 60 GHz. The limit values referred at point C are:

- 30 MHz to 21,2 GHz: -60 dBm;
- 21,2 GHz to 60 GHz: -30 dBm.

7.3 Noise figure

The receiver noise figure shall not exceed 11 dB.

7.4 Receiver sensitivity

The receiver sensitivity is defined as the receive signal level referred to point C of the System block diagram (see figure 1) at which a certain minimum performance is reached. The receiver sensitivity which corresponds to ITU-R picture quality grade 5 shall not be worse than -56 dBm for standard frequency deviation equipment and -70 dBm for wide frequency deviation equipment.

8 System performance

8.1 Performance characteristics

In view of the varied and numerous potential applications for analogue links it is not practical to specify the overall performance characteristics for individual applications.

The receiver sensitivities given in subclause 7.4 for ITU-R picture quality grade 5 are based on the Carrier to Noise (C/N) ratios given in table 4. Other picture grades for a typical wide deviation system can be obtained at lower sensitivities, as shown in table 3.

Table 3: Typical minimum C/N requirements for different picture qualities

| Picture quality | Minimum video Signal to Noise (S/N) ratio (dB) | Minimum Carrier to Noise (C/N) ratio dB |
|-----------------|--|---|
| Grade 5 | 48 | 18 |
| Grade 4 | 42 | 12 |
| Grade 3 | 38 | 8 |

8.2 Interference sensitivity

a) Co-channel interference

The IF C/N ratio shall be measured for a receiver operating with a wanted signal, the level of which at the receiver input port shall be the reference sensitivity input level given in subclause 7.4. The value of that C/N ratio shall not be less than the value given in table 4.

Table 4: Specified C/N ratios

| Video bandwidth (MHz) | C/N ratio (dB) |
|--|-----------------------|
| Up to 10 MHz, standard frequency deviation | 32 |
| Up to 10 MHz, wide frequency deviation | 18 |

An interfering test signal shall then be added, the frequency of which shall also be at the nominal frequency of the wanted signal and at a level of -97 dBm. The IF C/N ratio of the wanted signal shall again be measured. The IF C/N shall not be less than the C/N ratio given in table 5 minus 1 dB.

b) Adjacent channel interference

For a receiver operating with a wanted signal of nominal level, the introduction at point C of a like modulated interferer at the level and frequency separation given in table 5 shall not result in a degradation of the output signal/noise ratio of more than 1 dB.

Table 5: Adjacent channel separation and interference levels

| Separation of wanted and interfering signal (MHz) | Interference level (carrier/interference (dB)) |
|--|---|
| 35 | 0 |
| 42 | 0 |

c) CW spurious interference

For a receiver operating with a wanted signal at the level of sensitivity given in subclause 7.4, the introduction at point C of a CW interferer at a level of +30 dB with respect to the wanted signal and at any frequency up to 60 GHz, excluding frequencies either side of the wanted signal by up to twice the relevant co-polar spacing, shall not result in a degradation of any output S/N of more than 1 dB.

History

| Document history | |
|------------------|---|
| July 1995 | Public Enquiry PE 88: 1995-07-24 to 1995-11-17 |
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