RECOMMENDATION ITU-R BO.600-1*

Standardized set of test conditions and measurement procedures for the subjective and objective determination of protection ratios for television in the terrestrial broadcasting and the broadcasting-satellite services

(1982-1986)

The ITU Radiocommunication Assembly,

considering

a) that several experiments have been carried out for the determination of protection ratios for television;

b) that some of these experiments have been carried out using different test conditions and measurement procedures, so that the results cannot be readily interpreted and compared;

c) that the values of subjectively measured protection ratios depend on a large number of factors;

d) that it is desirable to establish a standardized set of test conditions and measurement procedures in order that the results of subjective measurements of protection ratios for television made by different administrations may be properly interpreted and applied,

recommends

that the following set of test conditions and measurement procedures described in Annex 1 should be used for the subjective and objective determination of protection ratios for television, whenever possible.

ANNEX 1

1 Introduction

The protection ratio is the minimum value of the wanted-to-unwanted signal ratio, usually expressed in decibels, at the receiver input determined under specified conditions such that a specified reception quality of the wanted signal is achieved at the receiver output (Note 1). The protection ratio is useful in planning and operations where multiple transmissions require frequency and orbit sharing between similar or dissimilar transmissions.

Protection ratios for monochrome television systems and for colour television systems using vestigial sideband amplitude-modulation are found in Recommendation ITU-R BT.655. For satellite

* Radiocommunication Study Group 6 made editorial amendments to this Recommendation in 2001 in accordance with Resolution ITU-R 44.

broadcasting, a summary of results of protection ratio tests made by several administrations in cases where the wanted and unwanted signals are modulated by colour television signals or other transmissions such as multiple sound channels are found in Report ITU-R BO.634.

The assessment of protection ratios for television signals is made following the method established in Recommendation ITU-R BT.500 and taking into consideration Report 405. Procedures can entail absolute or comparative methods of assessment depending on the specific investigations being carried out.

NOTE 1 – This definition is in line with the definition of protection ratio found in No. 1.170 of the Radio Regulations.

2 Measurement procedure and laboratory assessment of protection ratios

2.1 Reference case conditions

The values of subjectively measured protection ratios depend on a number of factors.

In order to allow that the results of subjective measurements of the protection ratio made by different administrations may be properly interpreted and applied, tests should be performed under a set of reference case conditions for the factors affecting these subjective measurements (see Table 1).

2.2 Test pictures

The test pictures used (see Recommendation ITU-R BT.500) should be chosen from a set available to all administrations, so as to allow comparisons of results. Not only is the subjective evaluation of the interference dependent upon the test picture, but also the amount of baseband interference is dependent upon the modulated spectral densities of both signals, and the spectral densities depend on the video content. Test slides generally available are those of the Society of Motion Picture and Television Engineers (SMPTE) subjective colour reference slide series and the Philips test slides for colour television. The test slides from the SMPTE series are selected stills from the SMPTE reference test film. Two slides from each series are recommended for the wanted signal during tests on the impairments caused by interference. These are:

I. SMPTE	II. PHILIPS
Colour television test slides	Colour television test slides
Slides Cat. TV CS-3	
No. 1 Beach scene	No. 8 Basket of fruit
No. 14 Girl in green dress	No.14 Make-up scene

The means used to provide the television picture signal (which might include the use of a frame-store synchronizer or similar technique) should ensure that the picture displayed in the absence of interference is of high quality; in particular any impairment should be insignificant compared with the grade of impairment used for determining the protection ratio.

TABLE 1

Factors affecting subjectively measured protection ratios and a set of reference case conditions for these factors

Factor	Reference case condition	
	Terrestrial	**Satellite**
Picture impairment assessment scale	(See Rec. ITU-R BT.500)	(See Rec. ITU-R BT.500)
Number of levels	5	5
Definition of levels (perceptibility, annoyance, quality)	Impairment	Impairment
Fraction of time interference effects are visible	Continuous	Continuous
Impairment level for tests	Note 14	4.5
Viewers	(See Rec. ITU-R BT 500)	(See Rec. ITU-R BT.500)
Number	10-20 minimum	10-20 minimum
Expertise	Note 1	Note 1
Receivers	Note 2a	Note 2b
Number and types Performance parameters (selectivity, sensitivity, overload characteristics, etc.)		
Viewing conditions	(See Rec. ITU-R BT.500)	(See Rec. ITU-R BT.500)
Distance to screen Brightness of picture Brightness of background		
Wanted signal characteristics		
Colour or monochrome	Note 3	Note 3
Television standard (M, G, I, L, . . .)	Variable	Variable
Colour system (NTSC, PAL, SECAM, . . .)	Variable	Variable
Accompanying sound	Note 4a	Note 4b
Line synchronization	Note 5	Note 5
Picture type (still, moving) and content	Note 6	Note 6
Amount of detail in picture	Note 6	Note 6
Type of modulation (AM/VSB, FM, digital)	Variable, Note 7	Variable, Note 7
Modulation index	–	Note 8
Pre-emphasis characteristics for FM	–	Rec. ITU-R F.405
Energy dispersal characteristics	–	Nil
Fading	Nil	Nil
Unwanted signal characteristics	Note 9	Note 9
Carrier frequency offset	Note 14	Note 10
Frequency of operation	Note 11	Note 11
Video signal-to-noise ratios	Note 12	Note 12
Receiver noise Man-made noise Picture source noise		
Other interferences and sources of picture degradation	Note 13	Note 13
Other interfering signals Multipath Receiver distortion		

Notes relative to Table 1:

NOTE 1 – Both expert and non-expert viewers may be used. Tests with non-expert viewers are representative of the general population but tend to be quite lengthy. A great number of variables can be examined by using a small group of expert viewers. For the particular interference being examined, the relationship between expert and non-expert opinion should be investigated.

NOTE 2a – The receivers used in the test should represent equipment which is fairly sensitive to the type of impairment being investigated. Full account should be taken of the performance of domestic receivers, and measurements of the RF/IF response characteristics should be made to assist in the interpretation of the results. Account should also be taken of the type of receiver which may be used at re-broadcast relay stations.

NOTE 2b – The receivers used in the test should represent equipment which is fairly sensitive to the particular type of impairment being investigated. Account should be taken of domestic receivers, and the type of receivers which may be used at re-broadcast relay stations. It is important to indicate the type of discriminator used (staggered-circuit or phase-locked loop) as well as the bandwidth characteristics of the receiver (IF filter characteristics or equivalent characteristics in the case of a loop discriminator). Measurement of RF and IF filter characteristics should be made to assist in the interpretation of the results obtained when there are frequency offsets between the wanted and unwanted signals. As far as possible, filter characteristics should be adjusted to the standards applicable to the wanted signal. Baseband output frequencies should be limited to the minimum required for the television standard used for the wanted signal. Excessive filter bandwidths permit the observation of noise and interferences that would not be encountered with properly adjusted receivers.

NOTE 3 – Subjective tests should be based on colour pictures, unless there is reason to suppose that monochrome pictures would result in more stringent requirements.

NOTE 4A – If applicable standards exist for the accompanying sound channel(s), those standards should be used and the modulation characteristics noted. If no existing standards are applicable, full details of the characteristics of any sound signal(s) present should be given.

NOTE 4B – If applicable standards exist for the accompanying sound channel(s), those standards should be used and the main carrier deviation caused by the sound sub-carrier(s) should be noted. If no standards exist one should additionally indicate the sound sub-carrier frequency(ies) and the deviation of the sound sub-carrier(s).

NOTE 5 – The timing of the vertical and horizontal synchronization of the unwanted television signal should be such that when interference is visible, the interfering vertical and horizontal synchronizing bars are near the centre of the wanted picture.

The synchronizing signal of the wanted signal should be locked to the synchronizing signal of the unwanted signal, but with fields displaced so that sync bars from the unwanted signal are visible as interference on the wanted picture. Greatly different sync frequencies cause flicker in the picture and produce subjectively more noticeable interference.

NOTE 6 – The test pictures used should be reasonably critical still pictures, as they may occur fairly frequently in practice. The scenes should contain bright, saturated colours. Slides suggested for tests are described in § 2.2. Colour bar modulation is often used as the unwanted signal.

NOTE 7 – If applicable standards exist for the characteristics of either the wanted or unwanted signals, those standards should be used. If no standards exist, as for a frequency-modulation television signal for broadcasting, then the succeeding entries in Table 1 should be used. The sense of modulation should be such that a black-to-white transition corresponds to an increase in the instantaneous frequency.

NOTE 8 – A peak-to-peak frequency deviation sensitivity of 12 MHz/V should be used, if applicable. When other values are used, the peak-to-peak deviation should be indicated.

NOTE 9 – In most cases the unwanted signal has the same characteristics as the wanted signal. There is, however, also a need for the determination of protection ratios between dissimilar systems. In these cases the unwanted signal can have characteristics different from the wanted signal or can be another type of transmission such as multiple sound channels.

Notes relative to Table 1 (cont.):

NOTE 10 – For co-channel protection ratio measurements there is no carrier frequency offset: carrier frequency offset is defined as the difference between the unmodulated carrier frequencies of the unwanted and wanted signals, ($f_{wanted} - f_{unwanted}$), if the same type of modulator is used in both channels. However, if the interference is sensitive to particular offset frequencies, these should be identified by the testing programme. For adjacent-channel protection ratios, a series of measurements should be made for frequencies of the unwanted signal varying approximately ±30 MHz from the wanted signal.

NOTE 11 – Tests may be conducted at either radio – or intermediate – frequencies. Protection ratios between wanted and unwanted signals are affected by the types of signal, their frequency separations, and other factors which do not depend on the frequency range used.

NOTE 12 – As far as possible, the only noise which should be present on the picture when assessing protection ratios is that of thermal noise in the receiver. The protection ratios should be measured for pictures having a signal-to-unweighted-noise ratio of not less than 36 dB, in order that system performance should not be limited by possible masking of interference by noise.

NOTE 13 – No account should be taken of other sources of interference, etc. (except thermal noise, as mentioned above), when assessing the protection ratio.

NOTE 14 – For 625-line systems, the reference impairment levels are those which correspond to wanted-to-unwanted signal-to-noise ratios of 30 dB and 40 dB with a frequency offset between vision carriers of two-thirds of the line frequency but adjusted within a plus and minus 25 Hz range to produce maximum impairment, the precise frequency difference being 10.416 kHz. These conditions are approximate to mean impairment grades 3 and 4 and are respectively applicable to short-term (tropospheric) and continuous interference.

2.3 Other conditions

In performing television protection ratio measurements, highest priority should be given to tests at the “reference case” conditions given in § 2.1. If other test conditions and parameters must be used, they should be defined and correction factors given so that results applicable to the reference test conditions may be deduced.

When the use of a video tape recorder will not add to the interference present or will not diminish or mask those interferences, and where the experiment design allows repetitive signals and sequences, it is recommended that presentations to viewers be made from video tapes. The use of video tape permits presentation to large numbers of viewers with comparative ease, guarantees duplication of test conditions and accompanying commentary, and permits post-test verification of the conditions shown.

For protection ratio measurements, interference should be evaluated on the five grade impairment scale given in Recommendation ITU-R BT.500 using the viewing conditions and presentation in § 2.4 and 2.5 of that Recommendation. Wherever possible, information should be provided on the variation of protection ratio with the subjective grade. For the purpose of comparing results, it is desirable to provide the subjective grades together with the corresponding standard deviation for different values of C/I.