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Radiocommunication Sector of ITU

Recommendation ITU-R BT.1702-1
(07/2018)

**Guidance for the reduction of photosensitive
epileptic seizures caused by television**

BT Series
Broadcasting service
(television)

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RA	Radio astronomy
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S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
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Note: This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.

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RECOMMENDATION ITU-R BT.1702-1

Guidance for the reduction of photosensitive epileptic seizures caused by television

(2005-2018)

Scope

Extensive studies on the subject of photosensitive epilepsy, which have taken place around the world, have led to formulation of this Recommendation. The guidance proposed in this Recommendation is for the protection of the vulnerable section of the viewing population who have photosensitive epilepsy, and who are therefore prone to seizures triggered by flashing lights, including certain types of flashing television images. Broadcasting organizations are encouraged to raise awareness among programme producers of the risks of creating television image content which may induce photosensitive epileptic seizures in susceptible viewers. Annexes 1 to 5 provide additional information on this subject.

Keywords

Photosensitive, epilepsy, seizures, flashing images

The ITU Radiocommunication Assembly,

considering

- a) that several cases of individual or collective photosensitive epileptic seizures in vulnerable persons, in particular children, induced by flickering television images have been reported from various parts of the world;
- b) that while television images displayed on television receivers do not themselves cause photosensitive epilepsy, they can be a trigger of seizures in individuals who happen to be prone to photosensitive epilepsy;
- c) that it is useful to identify measures to help avoid the inadvertent creation of material for transmission on broadcast television that would be likely to induce photosensitive epileptic seizures;
- d) that measures should be proportionate to the risks and should not place undue burdens on broadcasting organizations or programme producers;
- e) that the impact of measures on broadcasters or programme producers may vary with their programme genres;
- f) that, to be applied effectively, such measures should be simple and easy to understand by non-technical programme producers:
 - that in the case of some live programming, such as news, programme production is often beyond the control of the broadcaster;
 - that measurement results to check compliance with the guidelines depend on a number of measurement parameters;
 - that the viewing environment and the display device, which can affect the likelihood of problems arising in susceptible viewers, may be different depending on a style of living around the world;
- g) that the risk of seizures cannot be eliminated for the most susceptible viewers:
 - that a small number of highly susceptible viewers may benefit from protection by means of filtering applied in the receiver;

- that due to the complexity of the end-to-end broadcast chain that involves many organizations and technologies, from capture, through production, mastering, broadcast, reception to display, and considering the viewing environment, no single organization has end-to-end control over this effect,

recommends

1 that broadcasting organizations should be encouraged to provide guidance to programme producers of the risks of creating television image content which may induce photosensitive epileptic seizures in susceptible viewers of television broadcasts;

2 that producers of programme material for television broadcasting, consumer equipment manufacturers, and viewers, should refer to the technical guidance information provided in the Annexes,

further recommends

1 that further studies are required recognizing that different programme genres exist in broadcasting environments;

2 that due to the complexity of the issues involved, appropriate international medical organizations (e.g. World Health Organization) should be consulted, and routinely informed on this issue.

Annex 1

Guidelines for production organizations on flashing images in television

Flickering or intermittent images and certain types of regular pattern can cause problems for some viewers who have photosensitive epilepsy. Consideration of information from leading medical opinion in this area [1] [2] [3] [4] [5] [6] [7] [8] and the experience of broadcasting organizations have led to drawing up guidelines aimed at reducing the risk of exposure to potentially harmful stimuli.

Television is by nature a flickering medium. Transmitted pictures are refreshed at typically 50 or 60 times each second, in which case interlaced scanning generates flicker 25 or 30 times each second. It is therefore impossible to eliminate the risk of flashing images on television causing convulsions in viewers with photosensitive epilepsy. To reduce risk, the following guidelines on visual content should be applied when flashing or regular patterns are clearly discernible in normal domestic viewing conditions. It should be noted that the level of any cumulative risk arising from successive sequences of “potentially harmful” flashes over a prolonged period is unknown. If, as medical opinion suggests, the risk of seizures increases with the duration of flashing, it has been calculated that a sequence of flashing images lasting more than 5 s might constitute a risk even when it complies with the guidelines below.

A potentially harmful flash occurs when there is a pair of opposing changes in luminance (i.e. an increase in luminance followed by a decrease, or a decrease followed by an increase) of 20 cd/m² or more (see Notes 1 and 2). This applies only when the screen luminance of the darker image is below 160 cd/m². Irrespective of luminance, a transition to or from a saturated red is also potentially harmful.

Isolated single, double, or triple flashes are acceptable, but a sequence of flashes is not permitted when both the following occur:

- the combined area of flashes occurring concurrently occupies more than one quarter of the displayed (see Note 3) screen area; and
- there are more than three flashes (i.e. six changes in luminance as described above) within any one-second period. For clarification, successive flashes for which the leading edges are separated by nine frames or more are acceptable in a 50 Hz environment, or separated by ten frames or more are acceptable in a 60 Hz environment, irrespective of their brightness or screen area.

Rapidly changing image sequences (for example, fast cuts) are provocative if they result in areas of the screen that flash, in which case the same constraints apply as for flashes.

NOTE 1 – Video waveform luminance is not a direct measure of display screen brightness. Not all domestic display devices have the same gamma characteristic, but a display with a gamma of 2.2 may be assumed for the purpose of determining electrical measurements made to check compliance with these guidelines (see Annex 2).

NOTE 2 – For the purpose of measurements made to check compliance with these guidelines, pictures are assumed to be displayed in accordance with the “home viewing environment” described in Recommendation ITU-R BT.500 in which peak white corresponds to a screen illumination of 200 cd/m².

NOTE 3 – It may be assumed that overscan on modern domestic television receiver displays will normally be in the range 3.5% to $\pm 1\%$ of the overall picture width or height (as indicated in European Broadcasting Union Technical Recommendation R952000).

NOTE 4 – The use of automatic video analysers to help alert production staff to potential guideline violations in video material can be beneficial.

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Annex 2

Guidelines for luminance measurement

Screen luminance may be measured using a hand-held spot photometer with an ICI (International Commission on Illumination) characteristic designed for making measurements from a television screen. The display conditions are those of the “home viewing environment” described in Recommendation ITU-R BT.500. For accurate results, the display brightness and contrast should first be set up using PLUGE (See Recommendation ITU-R BT.814) with peak white corresponding to a screen illumination of 200 cd/m^2 .

As an alternative, Fig. 1 and Table 1 may be consulted if electrical measurements are more convenient. This shows the typical relationship between luminance (monochrome) signal level and the emitted light output of a television display.

There are measurement uncertainties associated with both methods. Nevertheless, flashing images or regular patterns described as being potentially harmful can be expected to be obviously discernible. Such potentially harmful images occur only rarely during the course of programme material with scenes that appear natural or represent real life; examples include photographers’ flashlights or strobe lights in a disco. Part of the purpose of this guidance is to assist programme producers to avoid inadvertently creating video effects that contain flashing images or patterns likely to be harmful.

FIGURE 1
Screen Light Output vs Video Signal Level – Gamma = 2.2

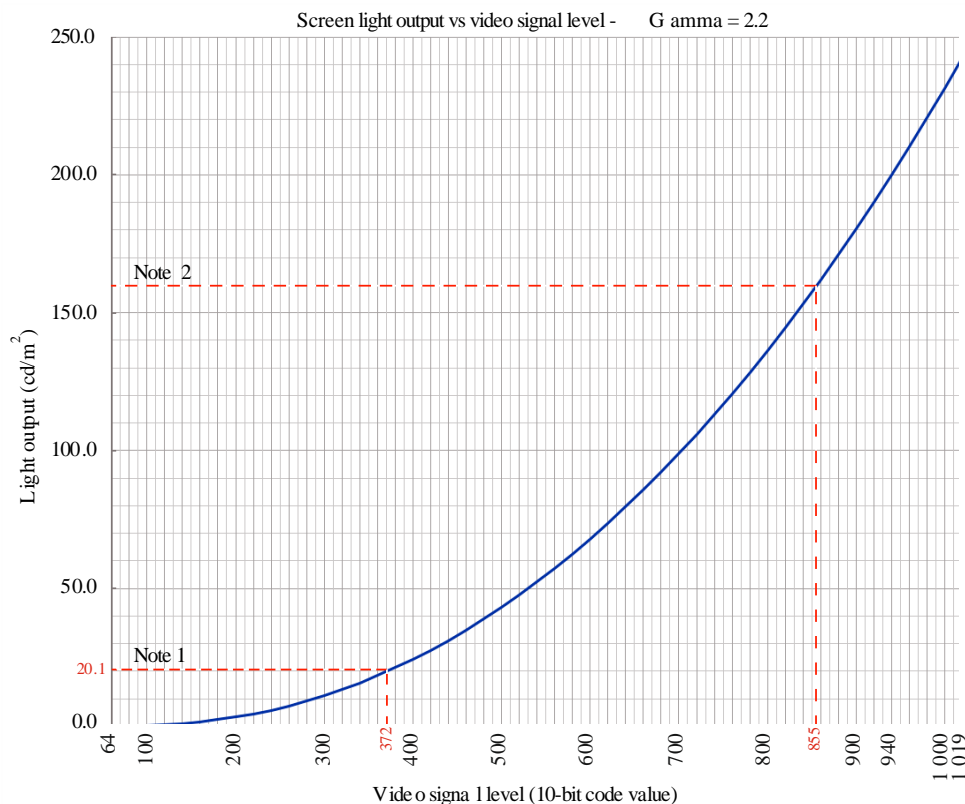


TABLE 1
Display gamma 2.2 – Nominal peak 200 cd/m²

10-bit code value (D)	Normalised Video (V)*	Light cm/m ²	10-bit code value (D)	Normalised Video (V)*	Light cd/m ²
64	0.00	0.00	540	0.54	52.27
80	0.02	0.03	560	0.57	57.22
100	0.04	0.18	580	0.59	62.42
120	0.06	0.47	600	0.61	67.87
140	0.09	0.92	620	0.63	73.57
160	0.11	1.54	640	0.66	79.52
180	0.13	2.34	660	0.68	85.72
200	0.16	3.32	680	0.70	92.17
220	0.18	4.49	700	0.73	98.88
240	0.20	5.86	720	0.75	105.85
260	0.22	7.42	740	0.77	113.08
280	0.25	9.19	760	0.79	120.58
300	0.27	11.17	780	0.82	128.33
320	0.29	13.36	800	0.84	136.35
340	0.32	15.76	820	0.86	144.63
360	0.34	18.38	840	0.89	153.19
372	0.35	20.06	855	0.90	159.78
380	0.36	21.22	860	0.91	162.01
400	0.38	24.29	880	0.93	171.10
420	0.41	27.59	900	0.95	180.46
440	0.43	31.11	920	0.98	190.09
460	0.45	34.87	940	1.00	200.00
480	0.47	38.86	960	1.02	210.18
500	0.50	43.09	980	1.05	220.64
520	0.52	47.56	1 000	1.07	231.38
			1 020	1.09	242.40

* Video signal level normalized, black at V = 0, to white at V = 1 (Recommendation ITU-R BT.1886). For content mastered per Recommendation ITU-R BT.709 10-bit serial code values (D) map to V as per the following equation: $V = (D-64)/876$.

NOTE 1 – A luminance signal level with the 10-bit code value of 372 results in light output of 20.1 cd/m². If the brighter image of a flash is above this level, then it is potentially harmful if the light output between the brighter and darker images differs by 20 cd/m² or more.

NOTE 2 – A luminance signal level with the 10-bit code value of 855 results in light output of 160 cd/m². If the darker image of a flash is below this level, then it is potentially harmful if the light output between the darker and brighter images differs by 20 cd/m² or more.

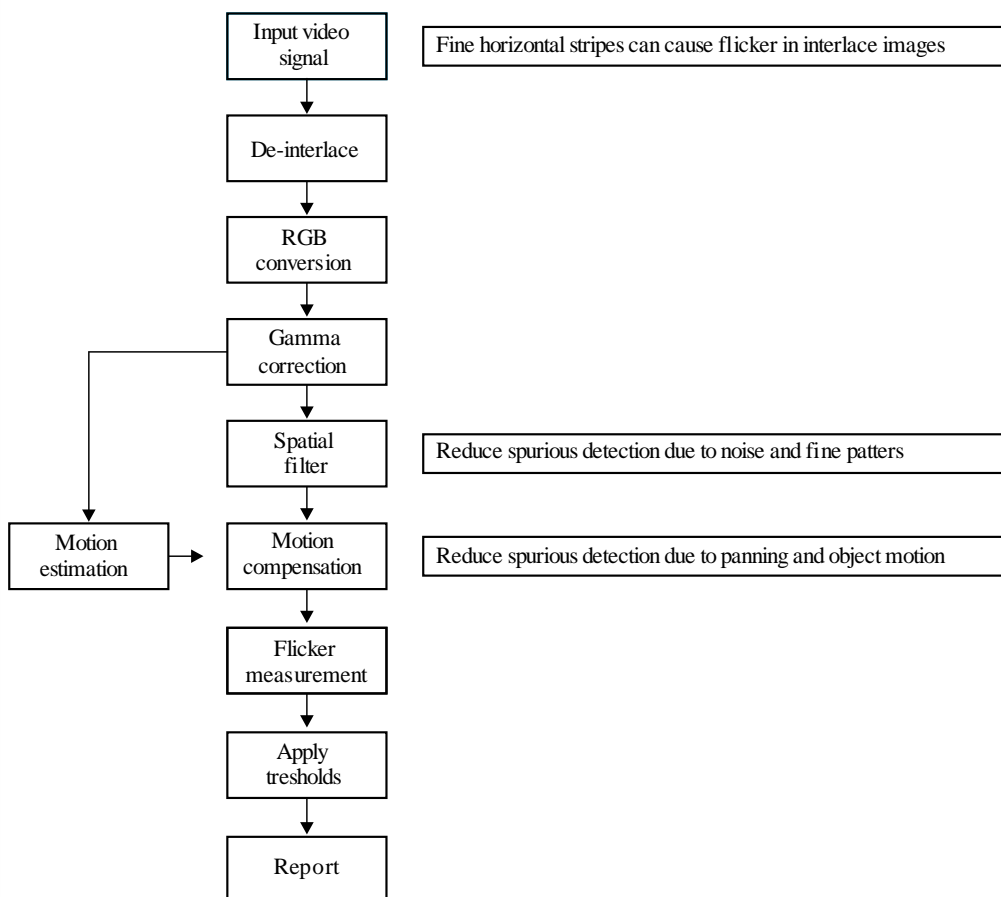
Annex 3

Example framework for a unified measurement specification

Measurement results to check compliance with the guidelines depend on a number of measurement parameters. Since it is desirable for international programme exchange that consistent measurement specification be applied uniformly worldwide, it needs further study to develop a unified specification conforming to the guidance. The flowchart in Fig. 2 illustrates an example framework for such a measurement specification. Schematics and detailed definitions for each block will be required. It is likely that more explicit definitions and detection criteria will also be required in specifying guidance on the use of saturated red colour.

FIGURE 2

Example framework for unified measurement specification



Annex 4

Guidelines for filtering techniques to reduce flashing images in television

Measures to reduce the risk of the transmission of potentially harmful stimuli, as described in Annex 1, can be expected to provide a high degree of protection for the overwhelming majority of individuals with photosensitivity.

However, for a very small number of highly susceptible individuals, measures to reduce temporal stimuli prior to transmission would place unacceptable constraints on the quality of the images broadcast, to the disbenefit of the majority of viewers. In order to make it possible for such highly susceptible individuals to be able to watch television without significant risk of seizure, filtering techniques may be applied in the receiver.

The optional inclusion of measures in receivers has the advantage of providing protection against flashing images that may from time to time arise inadvertently from a range of possible video sources.

Two types of measures have been identified.

Adaptive temporal filtering

Adaptive temporal filtering should reduce the frame-to-frame or field-to-field stimuli in the region 10-30 Hz. The exact parameters of such filtering are left to manufacturers to devise, but could typically be expected to provide a 20 dB or more reduction at temporal frequencies of 10 Hz or greater. There will be trade-offs between the effectiveness of protection, and image blur.

Compound optical filters

For a small number of extremely photosensitive viewers, a compound optical filter may be used to effect a substantial reduction in photoparoxysmal response. Such a filter can allow highly susceptible viewers to continue to watch television or computer displays who would otherwise be unable to do so.

An effective filter is likely to comprise a compound optical filtering arrangement, one filter reflecting long-wavelength red light selectively, and the other absorbing light evenly in the visible spectrum (neutral density).

Annex 5

Technical guidance information on viewing environments

While the implementation of technical guidance to limit potentially provocative flicker in television images is valuable in reducing the number of television-induced cases of photosensitive epilepsy, other factors in addition to programme content also affect the likelihood of problems arising:

- Viewing environment: a given section of programme material is more likely to cause problems for photosensitive viewers if viewed in a darker room; on a brighter or larger screen; or if the viewer is closer to the screen.
- Viewer age profile: photosensitivity is reported as most prevalent among children and young people below the age of 20 years, the prevalence falling with increasing age.

A combination of these factors may further exacerbate the likelihood of problems arising, and the provision of advice to viewers (and the parents of younger viewers) on appropriate viewing environments may be a valuable preventative measure in itself.

Accordingly, consideration should be given on providing advice for watching television in a well-lit room from a distance of at least two metres, particularly regarding programmes aimed at younger viewers such as animations.
