

REPORT ITU-R BS.2054-1

Audio levels and loudness

(2005-2008)

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1 Introduction

This Report describes advice for the broadcasting of television programmes which include pre-recorded television advertisements (commercials) with particular reference to audio levels and loudness. It considers the several processes of studio production, recording onto storage media, transport of the media, and broadcast via a television presentation and transmission system. This descriptive material is provided as guidance. It describes one administration's approach to dealing with the ingest and transmission of television soundtracks, in particular the factors which contribute to loudness.

Question ITU-R 2/6 *decides* the following Questions should be studied:

- a) What audio metering characteristics should be used to provide an accurate indication of signal level in order to assist the operator to avoid overload of digital media?
- b) What audio metering characteristics should be used to provide an accurate indication of subjective programme loudness?

While the work of the Rapporteur on Level Metering within Working Party 6P is progressing, some administrations are providing interim measures to address audio levels and loudness. For instance, Australian television broadcasters have established a common alignment level, -20 dBFS, in accordance with SMPTE RP155. Guidelines have been introduced specifying that volume compression where used **after the final mix** of a television commercial soundtrack, be restricted to a slope of 2:1 with an onset point of -12 dBFS.

2 Simulcasting of analogue and MPEG-1 layer II digital audio

Many administrations are currently progressing through or planning a transition to digital broadcasting. During the transition a requirement exists for simultaneous broadcasting in analogue and digital form.

Analogue and digital broadcasting systems have different parameters which in turn influence the operational characteristics of audio processors and, consequently, affect the perceived loudness of the analogue and digitally transmitted sound.

3 Loudness considerations

Within most broadcasting systems, television broadcasters transmit material of varying programme genres contiguously and interspersed with inserted material, including advertisements. There is a potential for variations in the perceived loudness of adjacent audio segments.

The factors contributing to perceived loudness are complex but the correct alignment of audio levels through the various stages of production and transmission and the careful management of dynamic range and spectral content all contribute to preventing extreme variations in perceived loudness.

4 Operating in the analogue domain

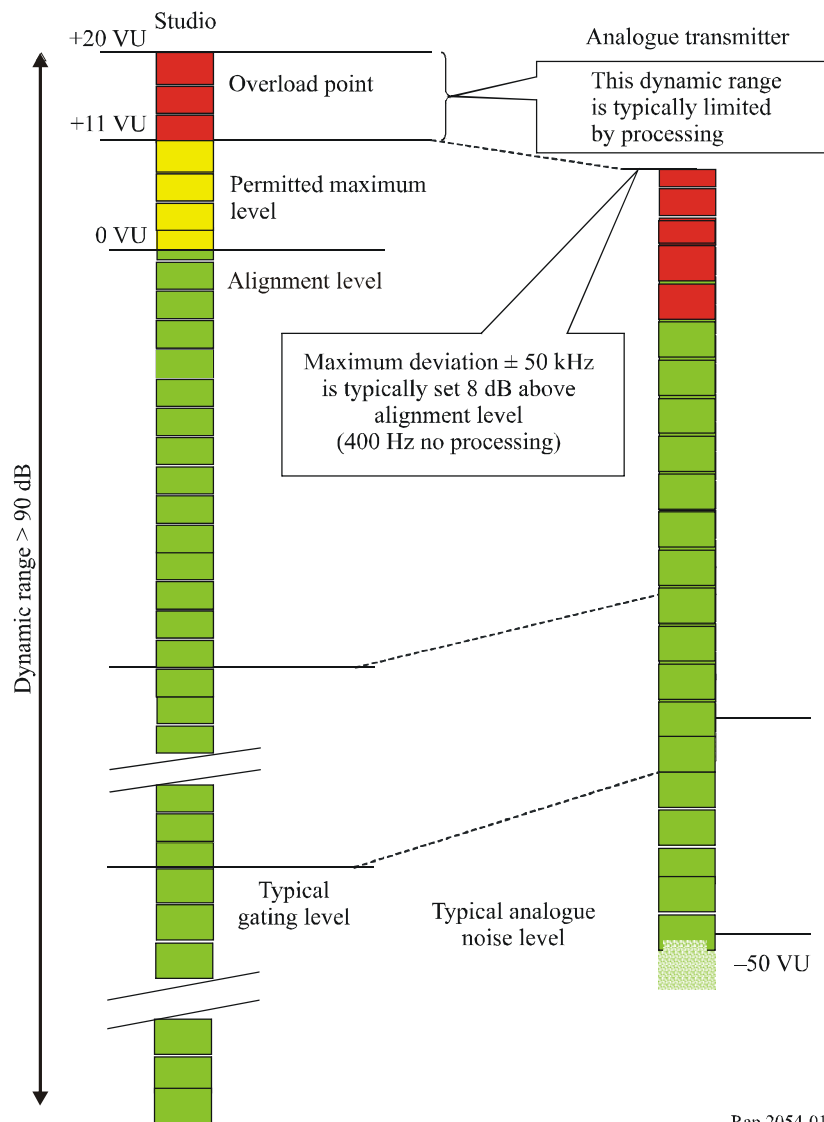
In the analogue domain, the amount of headroom available in recording devices is limited by the amount of distortion that may occur at high levels of audio.

Magnetic recordings will be limited by the integrity of the magnetic image at high levels of coercion.

The analogue television transmission system is limited by the allowable deviation of the FM sound carrier.

Figure 1 describes the parameters and limits of the analogue television transmission audio system as adopted in Australia.

FIGURE 1



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The lower limit of the analogue studio audio system is determined by the level of the system noise. Typically, this is maintained at least 50 dB below the alignment level providing some 70 dB of dynamic range. Although a studio analogue system and recording devices may provide adequate headroom for dynamic production, the limiting factor in an analogue broadcasting chain is the allowable deviation of the FM transmitter and broadcasters have to apply some compression and limiting of the audio level at the transmitter input to avoid over deviation, particularly at high frequencies where pre-emphasis can reduce the clipping level significantly compared to that at 400 Hz.

It is necessary to define the nature of peak level. Peak level in this context and as used throughout this document, really means what is commonly called “quasi peak” levels – the levels as measured by a PPM type meter having (typically) an integration time of 10 ms.

True peak level of programme content is usually not measured in the context of analogue audio systems.

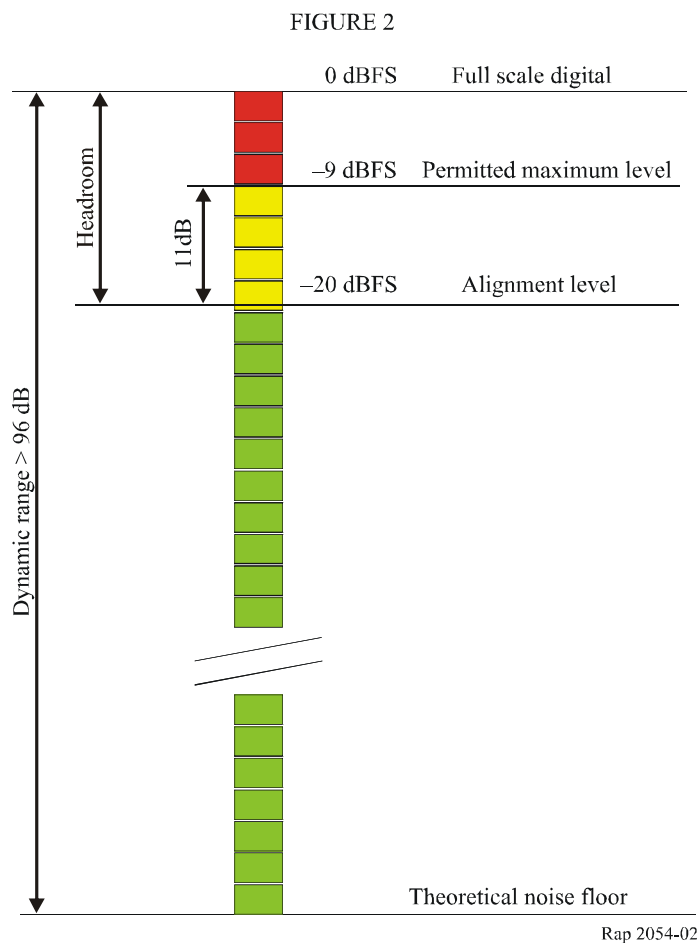
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5 Operating in the digital domain

Where production, post-production, switching and mixing of television programmes and advertisements is carried out in the digital domain, the digital audio system is aligned using a 1 kHz sine wave reference signal 20 dB below full-scale digital “0 dBFS” (i.e. 20 dB below the level at which digital clipping of the sine wave signal commences).

The alignment level –20 dBFS is usually equated to zero on the station’s VU meters or “4” or “TEST” on PPM metres.

Figure 2 describes the parameters and limits of the digital audio system as adopted by Australia.



In a 16-bit digital audio system where there is a theoretical dynamic-range of some 96 dB, if the average audio level is zero VU and the quasi peak level is some 11 dB above alignment level then there will be some 9 dB range before digital clipping occurs.

6 Use of audio meters

6.1 VU meters

Standard VU (Volume Unit) meters are commonly used in television facilities in many administrations to adjust audio levels during the recording, playback and transmission of audio material. A VU meter will indicate an “average” audio level, but cannot indicate the instantaneous level of audio peaks. The standard VU meter has an integration time of 300 ms and thus its “average” reading relates to that particular integration time.