Requirement Updates for Dolby Decoders in DVB Consumer Broadcast Receivers

Technical Bulletin 11, 2010 Update

This technical bulletin updates Dolby® requirements for consumer broadcast receivers intended for DVB markets. Requirements for all other products remain as stated in the documents relevant to those products.

The changes to requirements and recommendations described in this document are in response to revised transmission loudness recommendations.

The requirements in this document supersede certain statements in the following existing documents:

- *Technical Bulletin 11* (original), all sections
- *Dolby Licensee Information Manual: Dolby Digital Consumer Decoder,* Issue 5, sections 7.13 and 7.14
- *Dolby Digital Plus Two-Channel Consumer Decoder System Development Manual,* Issue 1, sections 4.2.1 and 5.2 (now discontinued)
- *Dolby Digital Plus Decoder for Consumer Broadcast Products Requirements,* Issue 1, sections 1 and 2
- *Dolby MS10 Multistream Decoder System Development Manual,* Issue 1, section 4.1

This document reflects requirements and recommendations included in the following documents:

- *Dolby MS11 Multistream Decoder System Development Manual*, Issue 1
- *Dolby Digital Plus Decoder for Consumer Broadcast Products System Development Manual,* Issue 1

This document includes:

- Background
- New requirements and recommendations
- Additional configurations
- Testing and Compliance

1 Background

Many high-definition TV system specifications for DVB regions require support for Dolby Digital Plus and HE AAC stereo and multichannel audio. Standard-definition DVB services commonly use MPEG-1 LII audio for stereo broadcast and Dolby Digital or Dolby Digital Plus for multichannel audio broadcasts. As a result, DVB DTV receivers often include MPEG-1 LII, Dolby Digital, Dolby Digital Plus, and HE AAC audio decoders.

When consumers switch between programs, they may be switching between audio formats and, in some cases, between analog and digital transmissions. It is important that receivers deliver consistent loudness levels regardless of audio or broadcast transmission formats.

The requirements and recommendations in this document aim to ensure that the loudness of audio broadcast using Dolby codec formats matches audio broadcast using other audio formats, such as analog, HE AAC, and MPEG-1 LII.

1.1 Transmission Loudness

Recent efforts to align loudness in content production, interchange and transmission have resulted in the following recommendations regarding transmission loudness:

- ITU-R BS.1864, *Operational Practices for Loudness in the International Exchange of Digital Television Programs*
- ATSC A/85, *Techniques for Establishing and Maintaining Audio Loudness for Digital Television*
- EBU R128, *Loudness Normalization and Permitted Maximum Level of Audio Signals*

There are some differences in measurement methods described in these documents. For example, ITU-R BS.1864 and ATSC A/85 state a program interchange average loudness of –24 LKFS (ITU-R BS.1770 ungated), ±2 dB, and EBU R128 states a program interchange average loudness of –23 LUFS (–8 LU relative gated). However, the variance in loudness level measurements using all listed methods is generally within about 2 dB.

The requirements in this document take into account differences in transmission level and loudness measurement recommendations by applying appropriate tolerances.

1.2 Dolby Digital, Dolby Digital Plus, and Dolby Pulse

Dolby Digital, Dolby Digital Plus, and Dolby Pulse bitstreams include a dialogue normalization parameter (`dialnorm`) during encoding. This parameter is used by Dolby decoders to normalize the dialogue loudness in all programs to a average level of –31 dBFS.

Dolby decoders have two dynamic range control modes, Line mode and RF mode. Line mode enables a greater dynamic range and reproduces dialogue at –31 dBFS. RF mode compresses the dynamic range and reproduces dialogue at –20 dBFS. Although the dynamic range of both RF and Line modes exceeds the capabilities of analog television broadcasting systems, the dynamic range in RF mode is closer to that of audio transmitted using other formats.

1.3　MPEG-1 LII

MPEG-1 LII audio does not include loudness normalization metadata. Dynamic range compression and loudness alignment is applied to the audio program prior to broadcasting. Broadcasts that follow ITU-R BS.1864 or EBU R128 recommendations transmit audio programs at –24 LKFS or –23 LUFS, respectively.

1.4　HE AAC

1.4.1　Encoding

Dolby Pulse (HE AAC encoded using a Dolby Pulse encoder) includes loudness normalization metadata (`dialnorm`). Audio programs encoded with other HE AAC encoders may include loudness normalization metadata.

1.4.2　Dolby Multistream Decoders

Dolby multistream decoders use loudness normalization metadata contained in Dolby Pulse and possibly other HE AAC streams to determine the output gain. The result is that dialogue is reproduced at –31 dBFS when the decoder dynamic range control is operating in Line mode, and at –20 dBFS in RF mode.

Dolby multistream decoders apply a default dialogue normalization value when loudness normalization metadata is not present. The default value represents the assumed loudness and may be based on a regional target loudness level.

1.4.3　HE AAC Decoders That Do Not Support Loudness Normalization Metadata

In cases where decoders do not support loudness normalization metadata, a program loudness level is assumed based on transmission loudness practices. This document assumes that the loudness of HE AAC broadcasts is similar to the loudness of MPEG1 LII, and recommends that the same gain-matching strategy is applied.

1.5　Analog Broadcasts

Many DTV receivers also receive analog broadcasts. This document assumes that the loudness of analog broadcasts is similar to the loudness of MPEG-1 LII, and we recommend applying the same gain-matching strategy.

2   New Requirements and Recommendations

The new requirements and recommendations listed in this document are issued in response to the revised transmission loudness recommendations.

2.1   Assumptions

The requirements and recommendations described in this document assume that broadcasting practices will ensure the following:

- Loudness normalization metadata accurately indicates program loudness.
- Programs without loudness normalization metadata are rendered at –23 LUFS.

Some of the following requirements may be waived in certain cases, such as regional standards not compliant with ITU-R BS.1864 or EBU R128 recommendations.

2.2   Requirements

- **Include RF mode:** Consumer broadcast receivers containing a Dolby Digital, Dolby Digital Plus, or Dolby Pulse decoder, and intended for DVB markets, must provide RF mode dynamic range compression at the two-channel output. If Line mode is also implemented, RF mode is the default setting.
- **Align loudness to –23 LUFS at the two-channel outputs:** Two-channel outputs of DVB products in RF mode match the level of –31 LUFS program output from Dolby decoders to the level of a –23 LUFS program output from MPEG 1 LII decoders within +1/–2 dB. This tolerance accommodates products intended for regions that may adopt a –24 LKFS ungated measurement loudness specification.

Tip: You can achieve level matching by setting the dynamic range control to RF mode (providing 11 dB gain, which boosts the –31 LUFS program to –20 LUFS) and then attenuating the output by 3 dB, resulting in a loudness of –23 LUFS.

The EBU recommendation for the level-matching method is shown in Figure 1.

- **Dolby multistream decoders set default dialogue normalization value to –23:** Dolby multistream decoders intended for DVB regions set the default dialogue normalization (`dialnorm`) value to –23. (Refer to Dolby multistream decoder system development manuals for additional guidance.)

2.3   Recommendations

These recommendations represent our best-practice advice.

2.3.1   Level Matching at All Outputs

We strongly recommend applying level matching at all available outputs.

2.3.2   PCM Level: Broadcast Sources

Digital output interfaces (such as HDMI™ and S/PDIF) provide for direct pass-through of Dolby bitstreams to a downstream decoder. Because loudness carried in Dolby bitstreams is normalized to –31 LUFS, we recommend introducing a user-switchable attenuation stage that adjusts the PCM audio output from broadcast source decoders that do not apply loudness normalization (such as MPEG-1 LII and some HE AAC decoders) by 8 dB, prior to routing to the digital output.

Tip: PCM attenuation is not necessary when a connected HDMI sink device indicates that it accepts PCM only.

Note: This recommendation applies to PCM audio originating from broadcast sources only. It does not address matching levels with PCM audio input from other sources.

2.3.3   Dynamic Range Control Mode Selector

If a dynamic range control mode selector is provided, allowing the user to select Line mode (rather than the default RF mode), we strongly recommend the following:

- Apply 8 dB attenuation to decoded PCM from broadcast sources that do not provide loudness normalization metadata so that the audio is reproduced at –31 LUFS.
- Apply 11 dB attenuation to decoded PCM from Dolby decoders operating in RF mode so that the audio is reproduced at –31 LUFS.

2.3.4   Examples

Loudness matching may be achieved by various methods. The best-suited method may vary, based on product configuration, available outputs, and provided user options.

Figure 1, based on a draft by the EBU, shows an example of matching loudness from Dolby Digital and Dolby Digital Plus programs with MPEG-1 LII programs. (Note that the diagrams are based on a draft revision of EBU Tech 3333 not yet published at the publication date of this document.)
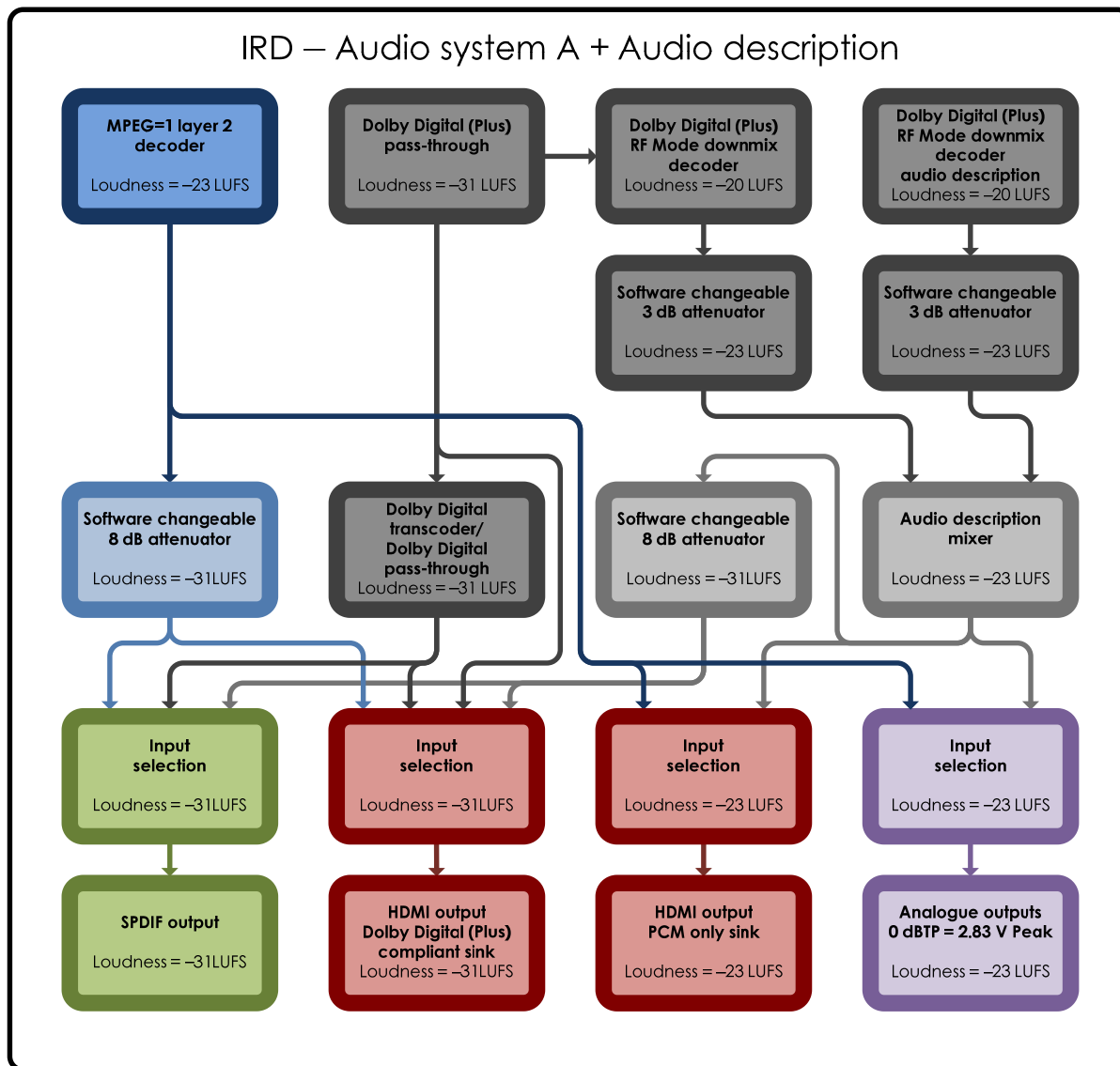
IRD — Audio system A + Audio description

MPEG=1 layer 2 decoder

Loudness = –23 LUFS

Dolby Digital (Plus) pass-through

Loudness = –31 LUFS

Dolby Digital (Plus) RF Mode downmix decoder
Loudness = –20 LUFS

Dolby Digital (Plus) RF Mode downmix decoder audio description
Loudness = –20 LUFS

Software changeable 3 dB attenuator

Loudness = –23 LUFS

Software changeable 3 dB attenuator

Loudness = –23 LUFS

Software changeable 8 dB attenuator

Loudness = –31LUFS

Dolby Digital transcoder/ Dolby Digital pass-through
Loudness = –31 LUFS

Software changeable 8 dB attenuator

Loudness = –31LUFS

Audio description mixer

Loudness = –23 LUFS

Input selection

Loudness = –31LUFS

Input selection

Loudness = –31LUFS

Input selection

Loudness = –23 LUFS

Input selection

Loudness = –23 LUFS

SPDIF output

Loudness = –31LUFS

HDMI output Dolby Digital (Plus) compliant sink
Loudness = –31LUFS

HDMI output PCM only sink

Loudness = –23 LUFS

Analogue outputs 0 dBTP = 2.83 V Peak

Loudness = –23 LUFS

Figure 1 Dolby Digital and Dolby Digital Plus in RF Mode (Draft Courtesy of EBU)

Figure 2 shows an example implementation for HE AAC (without metadata) recommended by the draft revision of EBU Tech 3333.
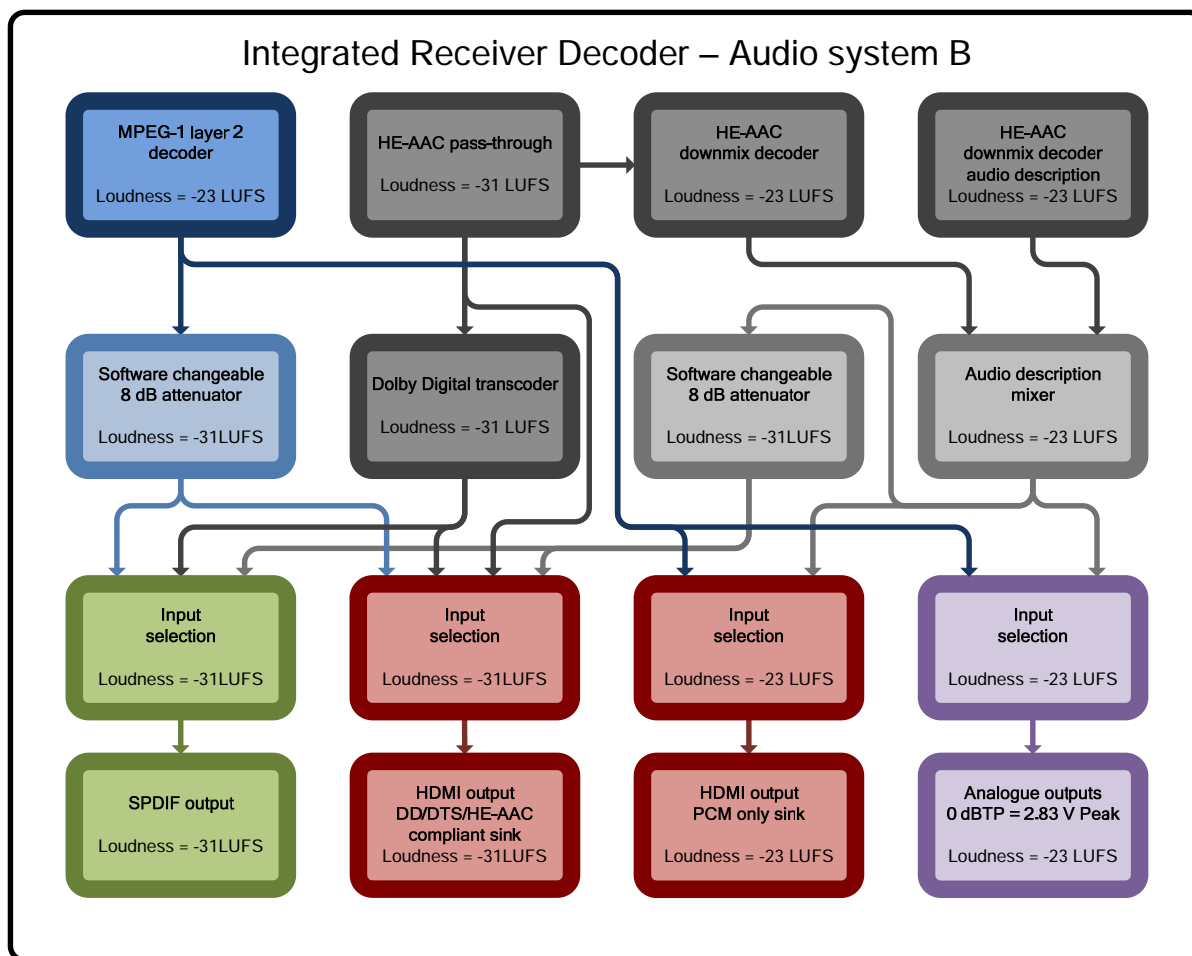
Figure 2 HE AAC Decoding (Draft Courtesy of EBU)

Figure Notes

1. The Software changeable 3dB attenuator block in Figure 1 can be located after audio description (main/associated program) mixer.

2. Loudness = –31 LUFS in the Dolby Digital transcoder and Dolby Digital pass-through blocks (Figures 1 and 2) indicates a decoder operating in Line mode and applying dialogue normalization metadata (`dialnorm`) to normalize the output level to –31 LUFS.

3. Loudness = –23 LUFS in the HE AAC downmix decoder block in Figure 2 is achieved in Dolby Multistream MS10 decoders by setting the default `dialnorm` value to –23, applying RF mode dynamic range compression, and subsequently applying 3 dB attenuation (as in Figure 1).

3 Additional Configurations

A PCM level control may also be offered in a service or setup menu, enabling the matching of audio levels from various PCM inputs to the audio levels from Dolby bitstreams when decoded on an external home theater A/V receiver.

The PCM audio delivered to the digital outputs should not be affected by a product master volume control.

4 Testing and Compliance

Products will be tested to ensure they meet these new requirements beginning May 1, 2011. Products submitted to Dolby Laboratories for approval before that date will not be held to this requirement; we recommend, however, that products meet this standard—regardless of submission date—to ensure consistency in the broadcast product market.

A simple verification test consists of playing a 997 Hz tone at –23 dBFS, encoded in MPEG-1 LII, and noting the output level, then playing a 997 Hz tone at –31 dBFS, encoded in a Dolby format (with `dialnorm` set to –31), and noting the output level. The level produced by the Dolby bitstream should be within +1/–2 dB of the level produced by the MPEG-1 LII bitstream.

The requirements described in this document are supported in the following system development kits:

- *Dolby MS11 Multistream Decoder System Development Kit*

- *Dolby Digital Plus Decoder for Consumer Broadcast Products System Development Kit,* Issue 2.0

Compliance verification test materials are also available separately upon request. Contact Dolby Laboratories at systemsupport@dolby.com for those materials.