BS EN 62760:2016

BSI Standards Publication

Audio reproduction method for normalized loudness level

bsi.

National foreword

This British Standard is the UK implementation of EN 62760:2016. It is identical to IEC 62760:2016.

The UK participation in its preparation was entrusted to Technical Committee EPL/100, Audio, video and multimedia systems and equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Audio reproduction method for normalized loudness level (IEC 62760:2016)

Méthode de reproduction audio pour niveau d'isosonie normalisé
(IEC 62760:2016)

Audio-Wiedergabeverfahren für normalisierten Lautstärkepegel
(IEC 62760:2016)

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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European foreword

The text of document 100/2591/FDIS, future edition 1 of IEC 62760, prepared by Technical Area 11 "Quality for audio, video and multimedia systems", of IEC/TC 100 "Audio, video and multimedia systems and equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62760:2016.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2016-12-16
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-03-16

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IEC 61672-1	NOTE	Harmonized as EN 61672-1.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 62574	-	Audio, video and multimedia systems - General channel assignment of multichannel audio	EN 62574	-
ITU-R Recommendation BS.1770-3	08/2012	Algorithms to measure audio programme loudness and true-peak audio level	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

AUDIO REPRODUCTION METHOD FOR NORMALIZED LOUDNESS LEVEL

FOREWORD

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International Standard IEC 62760 has been prepared by technical area 11: Quality for audio, video and multimedia systems, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
100/2591/FDIS	100/2635/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

The loudness level of audio reproduction varies according to the level of the input source and whether it is mono, stereo or multichannel. Without a suitable form of automatic control, users are forced to adjust the volume level of equipment to obtain an appropriate loudness level when the user selects another audio source or audio mode such as mono, stereo or downmix. There are some specific adjustment methods applied to consumer equipment but these methods are not standardized. For broadcast audio, broadcasting studios apply loudness level measurements and settle a reference level for their audio content depending on ITU-R BS.1770 and ITU-R BS.1864, the first standardisation work for loudness level in broadcasting. The audio loudness levels of other services are also expected to be standardized.

Broadcast audio with regulated loudness levels can be reproduced correctly with appropriately-configured reproduction systems and equipment. This International Standard specifies the method for reproduction with channel mode level setting and other level settings, and provides improved quality of listening for users. This method is also applicable for various audio content other than broadcasting audio. This International Standard is applicable to electrical signal levels and excludes acoustic audio levels from loudspeakers.

AUDIO REPRODUCTION METHOD FOR NORMALIZED LOUDNESS LEVEL

1 Scope

This International Standard specifies the audio reproduction method for normalized loudness level of audio sources for consumer equipment and systems.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62574, *Audio, video and multimedia systems – General channel assignment of multichannel audio*

ITU-R BS.1770-3:08/2012, *Algorithms to measure audio programme loudness and true-peak audio level*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
loudness
subjective notion describing the magnitude of the perception of the sound by the human sense of hearing

Note 1 to entry: The magnitude of the auditory sensation mainly depends on sound pressure, it differs with frequency and sustain time of sound (see ISO 226:2003).

Note 2 to entry: The loudness is based on a sound that is pure tone of 40 dB sound pressure level and 1 kHz frequency, whose level is defined as 1 sone. Its symbol is N.

3.1.2
loudness level
level of a sound equal to the sound pressure level of 1 kHz sine wave

Note 1 to entry: The loudness level is sensed by humans as equal to the subjective sound level. The reference is 1 kHz sine wave and 40 dB sound pressure level, its loudness level is 40 phon.

Note 2 to entry: The symbol for loudness level is L_N and its unit is phon.

3.1.3
gated loudness
numerical value of loudness measured according to ITU-R BS.1770-3

Note 1 to entry: Gated loudness is measured in LKFS.

3.1.4
LKFS
loudness, K-weighted, relative to nominal full scale

Note 1 to entry: LKFS is a unit whose value is defined in ITU-R Recommendation BS.1770-3.

Note 2 to entry: This note applies to the French language only.

3.1.5
monophonic
sound processing by a single channel

Note 1 to entry: Monophonic is a mode of recording audio with one microphone or an equivalent method, transferring through one channel, then reproducing with one loudspeaker.

3.1.6
dual mono
consisting of two mono signal channels

Note 1 to entry: Dual mono is a mode of recording audio with two independent monophonic sounds, transferring through two channels, then reproducing one of two signals.

3.1.7
stereophonic
sound processing by two or more related channels

Note 1 to entry: Stereophonic is a mode of recording audio with two or more microphones or an equivalent method, transferring through two or more channels, then reproducing with two or more loudspeakers.

3.1.8
5.1 channel
stereophonic with 5 full range channels and 1 channel of low frequency effect

3.1.9
22.2 channel
stereophonic with 22 full range channels and 2 channels of low frequency effect

3.2 Abbreviations

mono	monophonic
stereo	stereophonic

4 Loudness normalisation

4.1 General

A system model is defined as specified below. It is applied to the back end of source devices or the front end of amplifiers.

4.2 System model

Figure 1 describes the system model of reproduction. This model is applied to the appropriate part of audio devices. For instance, a TV set may apply this model in its final stage of audio reproduction, an audio amplifier may apply this model in its first stage of audio reproduction.

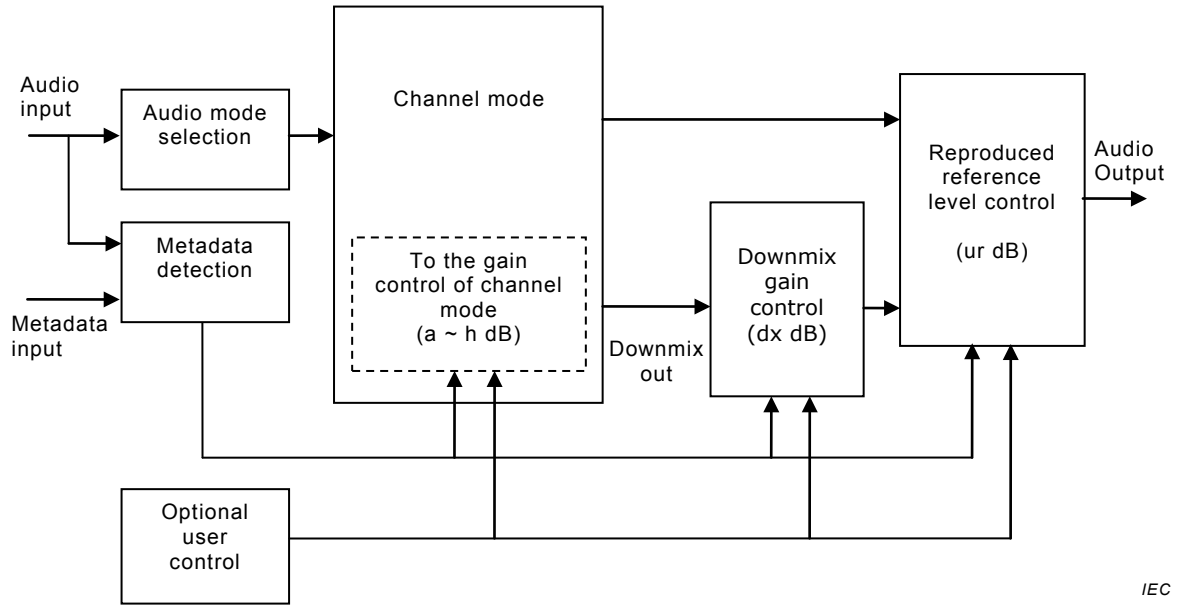

Figure 1 – System model

In this model, the channel mode applies the appropriate reproduction-level control described in Clause 5. The downmix gain control is a compensation of reproduction level of downmix. The reproduced reference level control is a final level control, it controls reproduction level to the target reproduced reference level.

Metadata of loudness or other gain control information is input to the metadata detection. They may be accompanied with audio data or separately input through other path. The detected metadata shall be input to each gain control unit to control its function and gain setting.

4.3 Control method

4.3.1 Principal control

The reproduction level of each channel mode is controlled as specified in Clauses 5 and 6.

The downmixed reproduction level is controlled by the downmix gain control. It is controlled depending on the downmix mode by the manufacturer's setting.

The reproduced reference level control controls the both downmix reproduction level and non-downmix reproduction to the same reproduced reference level. The reproduced reference level is settled by the manufacturer.

The metadata may be accompanied with audio data, or provided through other path such as Internet or data distribution. These metadata shall be used to control reproduction levels of the channel mode, downmix gain control and reproduced reference level control.

4.3.2 Optional control

For historical and practical reasons and situations in each country, it may be required to set a specific reproduction level of channel modes and downmixes. The optional user control may be applied to conform to these specific settings. The optional user control may be used by the end user and the manufacturer.

The reproduction level of each channel mode is controlled as specified in Clause 6. Some channel mode reproduction levels are not equal to the input level to the channel mode. Reproduction levels of downmixes are not equal to the input level of the downmix gain control.

Channel mode controls the reproduction level depending on the manufacturer's mode settings or the optional user control, and it can also be controlled with the metadata.

The downmixed reproduction level is controlled by the downmix gain control to be equal to the input level of the downmix gain control. It is controlled depending on the downmix mode by the manufacturer setting or by the optional user control, and it can also be controlled with the metadata.

The metadata may be accompanied with audio data, or may be provided through another path such as Internet or data distribution.

The reproduced reference level control controls the downmix reproduction level and non-downmix reproduction to be the target reproduced reference level, the target reproduced reference level is settled by the manufacturer or by the user setting the optional user control, and it can also be controlled with the metadata.

5 Channel mode

5.1 General

Channel mode defines the reproduction method and level of each channel in conjunction with the input source for each channel. Channels may range from monophonic to many channels stereophonic, and input sources may range from monophonic to many channels stereophonic.

5.2 Input source

The combination of channels and input sources is shown in Figure 2. These show sets of possible input sources for each channel mode. These input sources are identified as S1 to S5. S5 is a case of more than 5.1 channels that applies the general channel assignment defined by IEC 62574.

S1, with content A, is 1 channel input source to M1 or M2.

S2, with content AL and AR, is 2 channel input source of the stereophonic or the same input source to L and R.

S3, with content A and B, is 2 channel input source of the two independent input sources to L and R., e.g. bilingual application.

S4, with content AL, AR, AC, ALFE, ALS and ARS, is 5.1 channel input source of the 5.1 channel stereophonic input source to L to RS.

S5, with content AFL, AFR, and ABtFR, is 22.2 channel input source of the 22.2 channel stereophonic input source to FLc to BtFR.

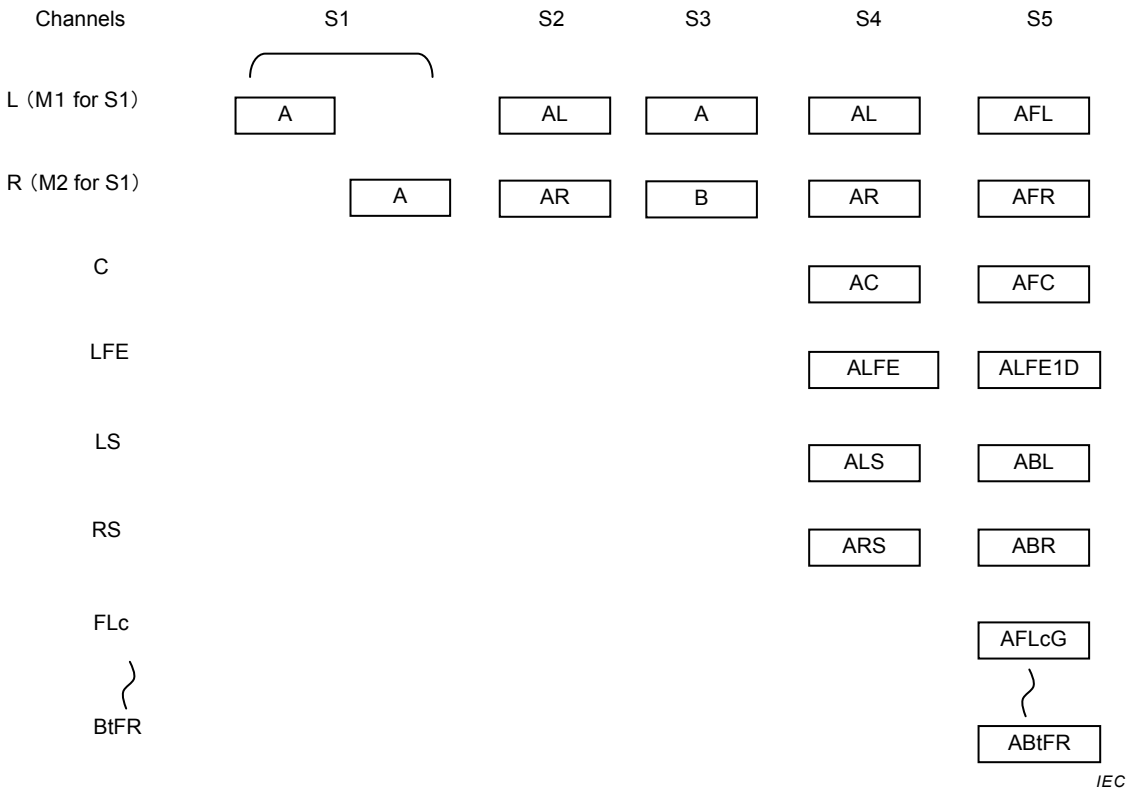

Figure 2 – Input sources

5.3 1 channel mode

In the 1 channel mode, one channel reproduces one or two input sources. Figure 3 shows various cases for 1 channel mode of reproduction.

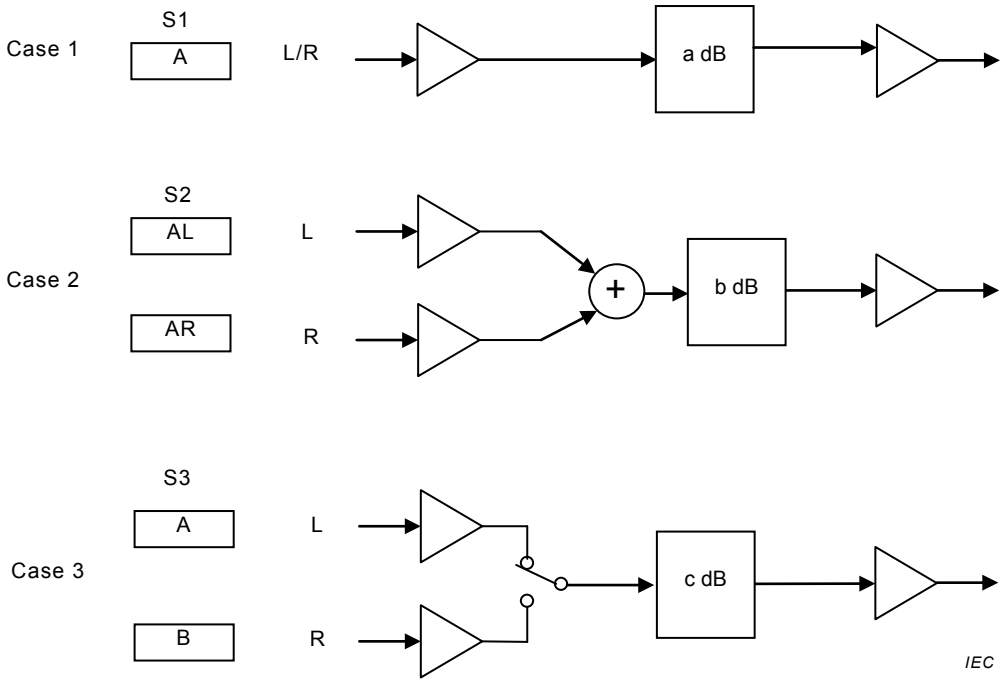

Figure 3 – 1 channel mode of reproduction

In cases where the output sound is reproduced by two or more loudspeakers, the level should be controlled to maintain the same level of reproduction as one loudspeaker.

In each case, the level attenuator should be set as follows:

Case 1, a = 0 dB

Case 2, b = –3 dB

Case 3, c = 0 dB

Case 2 should consider headroom when each input reference is over –24 LKFS.

5.4 2 channel mode

In the 2 channel mode, stereophonic or monophonic content and channel mode of reproduction is defined, as shown below. Figure 4 shows various cases for 2 channel mode of reproduction.

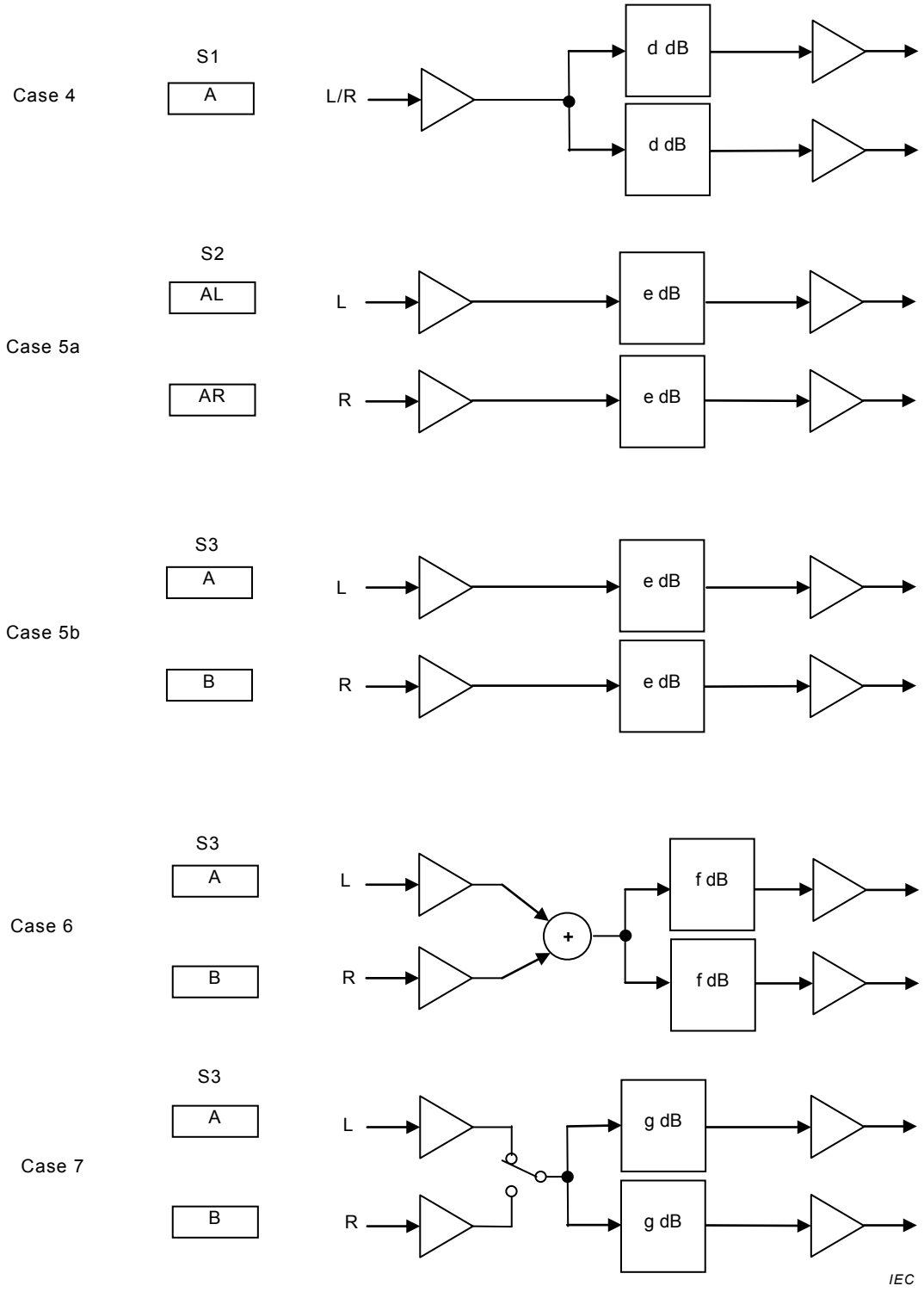

Figure 4 – 2 channel mode of reproduction

In each case, the level attenuator should be set as follows:

Case 4, d = –3 dB

Case 5a, e = 0 dB

Case 5b, e = 0 dB

Case 6, f = –5 dB

Case 7, g = –3 dB

NOTE 1 Case 5b level is defined considering a hearing level of content A and B from two loudspeakers.

NOTE 2 Case 6 mostly reproduces content A and B with a correlation coefficient from 1 to 0, see Annex E.

5.5 5.1 multichannel stereophonic

5.1 channels content and channel modes of reproduction are defined, as shown below. Figure 5 shows channel mode of reproduction.

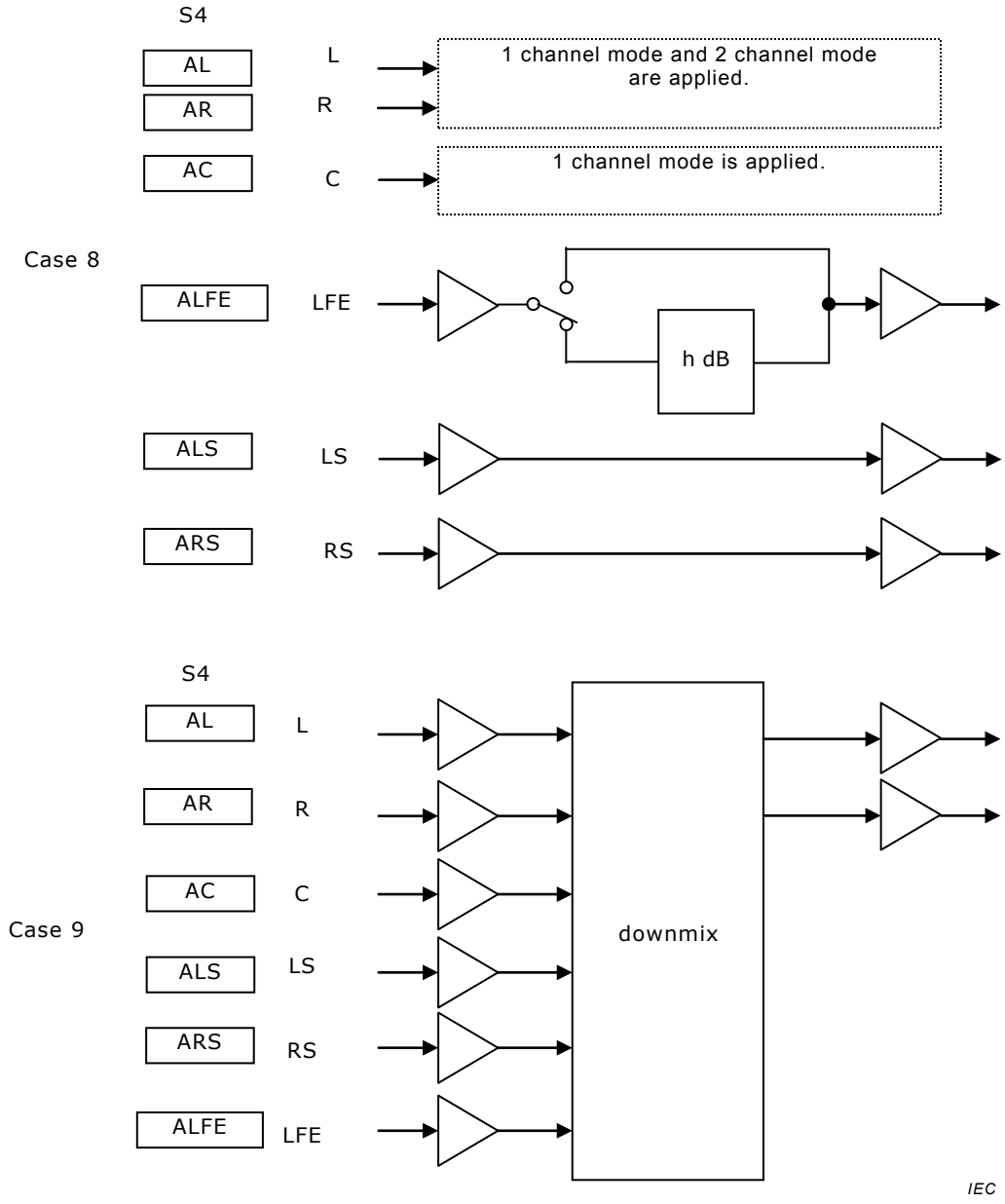

Figure 5 – 5.1 channel mode of reproduction

In Case 8, the level attenuator should be set as follows:

Case 8, h = +10 dB

5.6 More than 5.1 channels

22.2 channels content and channel mode of reproduction is defined as shown below. Figure 6 shows channel mode of reproduction.

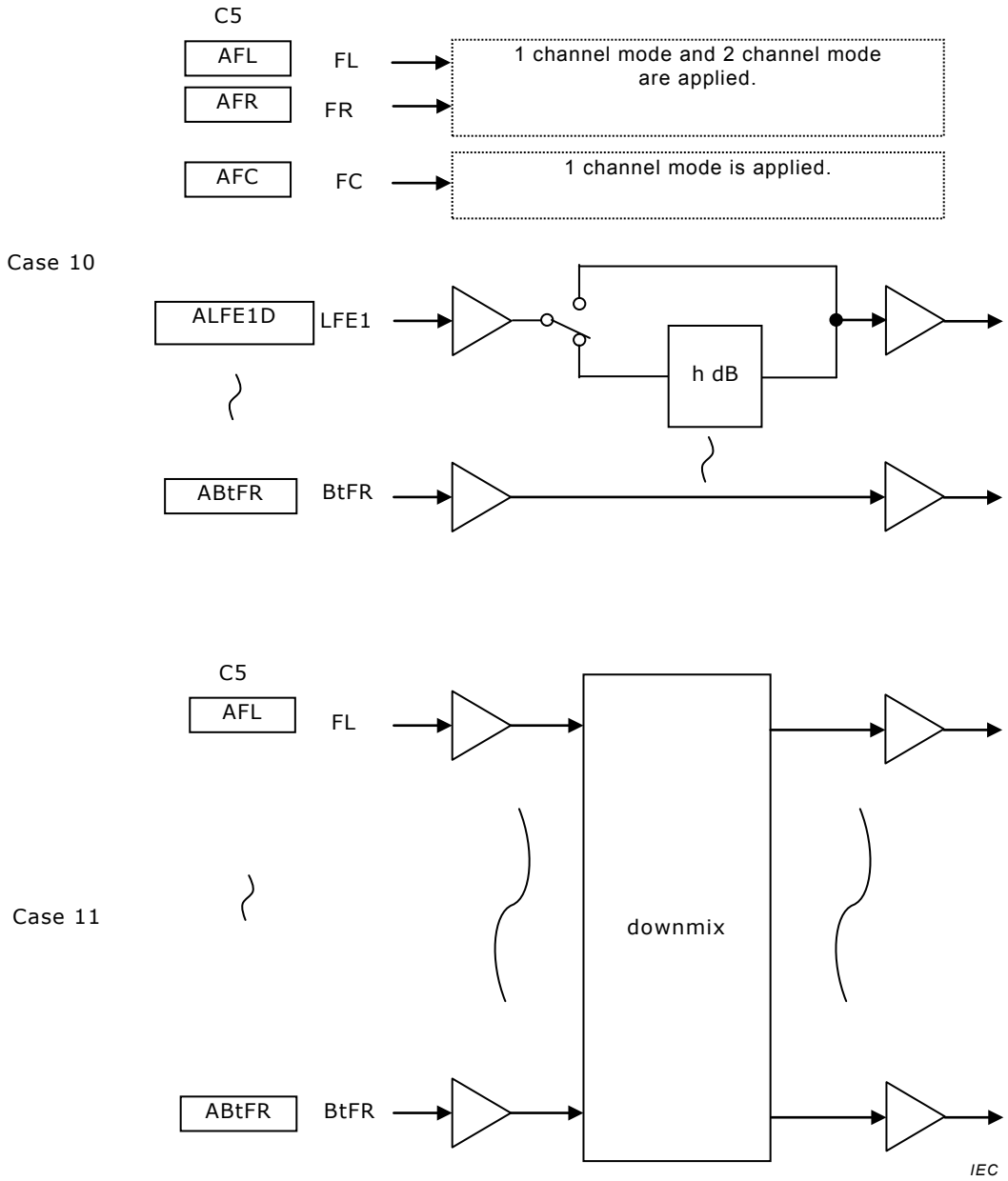

Figure 6 – 22.2 channel mode for reproduction

In Case 10, the level attenuator should be set as follows:

h = +10 dB

6 Loudness level diagram

6.1 General

This clause specifies the audio reproduction level of the system model. The reference gated loudness of the audio input source is –24 LKFS (see Annex A), the target reproduced reference level is specified depending on that input reference.

6.2 Reproduction level

In each channel mode, the input source and reference gated loudness and target reproduced reference level is shown in Table 1.

Table 1 – Reproduction level

Input source and reference gated loudness	Transfer / channel mode	Reproduction of 2 channel stereo	Target reproduced reference level
Monophonic –24 LKFS	1 channel / mono	Case 1 Case 4	–24 LKSF
Dual mono –24 LKFS per channel	2 channel / dual mono	Case 3 Case 5b Case 6 Case 7	–24 LKFS
2 channel stereophonic –24 LKFS	2 channel / stereo	Case 2 Case 5a	–24 LKFS
5.1 channel –24 LKFS	5.1 channel / 5.1 channel	Case 8	–24 LKFS
	5.1 channel / downmix	Case 9	–24 LKFS
22.2 channel –24 LKFS	22.2 channel / 22.2 channel	Case 10	–24 LKFS
	22.2 channel / downmix	Case 11	–24 LKFS

In each mode, target reproduced reference levels are specified as follows:

a) Mono –24 LKFS
b) Dual mono L = –24 LKFS, R = –24 LKFS
c) Stereo L + R = –24 LKFS
d) 5.1 channel 5 channel total = –24 LKFS
e) 22.2 channel 22 channel total = –24 LKFS

NOTE For historical reasons mono has another setting. This setting is described in Annex D.

Annex A
(informative)

Loudness unit

A.1 General

The sense of hearing has a frequency characteristic as defined by ISO 226:2003. Loudness is a quantity name of that sense of hearing, the unit name is sone.

1 sone = 40 phon = 40 dB (sound pressure level) at 1 kHz pure tone

Loudness level means a level on a logarithmic scale of loudness. This specification uses the unit name LKFS that is defined in Recommendation ITU-R BS.1770-3. ISO 226:2003 has a different measurement, and uses the unit name phon for the quantity name loudness level.

The LKFS is used for the measurement of recorded loudness of broadcast audio programme materials. It uses gated loudness as its quantity name. A recorded audio signal loudness level is measured by the algorithm defined by Recommendation ITU-R BS.1770-3 which is based on subjective loudness.

A.2 Loudness quantity and unit

The terms loudness and loudness level are used for the two cases. The first is used for general terms of the expression of sound level, the second is used for a quantity name of the kind of sound level. A numerical amount should identify what kind of amount it expressed, for instance, sone, phon and unit name LKFS. Though dB is used for many kinds of amounts, it should be used with the quantity name or quantity symbol. In case of using LKFS or phon, it should be used with conformance to the quantity name or quantity symbol.

Table A.1 – Loudness quantity and unit

Measurement of loudness					
Quantity			Unit		Description
Name	Symbol	Definition	Name	Symbol	
Loudness	N	L_N > 40 phon $N = \left(10^{\frac{L_N - 40}{10}}\right)^{0,3} \approx 2^{\frac{L_N - 40}{10}}$	sone	—	The sound level that the human hearing perceives, mainly depends on sound pressure. It differs with frequency and length of time of the sound (see ISO 226:2003). The loudness is based on a sound that is a pure tone of 40 dB sound pressure level and 1 kHz frequency, whose level is defined as 1 sone as its unit and its quantity symbol is N. A sound of 2 sone is sensed as subjectively twice as loud as a sound of 1 sone. The method for calculation of loudness of a steady tone (steady sound) is defined by ISO 532. The method utilizes a 1/3 octave analyser and a chart.
Gated loudness	L_{KG}	$L_{KG} = -0,691 + 10\lg\sum_i G_i \times \left(\frac{1}{\lvert J_g \rvert} \times \sum_{J_g} Zij\right)$ $i \in I, I = \{L, R, C, Ls, Rs\}$ G_i: weighting coefficient for channels J_g: gating threshold Z_{ij}: gating block loudness for channels	a	LKFS	ITU-R BS.1770-3: Method of measurement of recorded loudness of broadcast audio programme material. The gated loudness level (L_{KG}) is a K-weighted and time-weighted sound level with gated loudness (400 ms windows, absolute and relative threshold) and channel gain weighting. 1 LKFS is equal to 1 dB.
Loudness (non- gated loudness)	L_K	$L_K = -0,691 + 10\lg\sum_i G_i \times Z_i$ $i \in I, I = \{L, R, C, Ls, Rs\}$ G_i: weighting coefficient for channels Z_i: loudness for channels	a	LKFS	ITU-R BS.1770-3: Method of measurement of recorded loudness of broadcast audio programme material. The non-gated loudness level (L_K) is a K-weighted and time-weighted sound level with channel gain weighted. 1 LKFS is equal to 1 dB.
Loudness level	L_N	$L_N = \ln\left(\frac{P_{eff}}{P_0}\right) 1 \quad \text{kHz}$ p_0= 20 μPa p_{eff}: root-mean-square value of the sound pressure of a pure tone of 1 kHz	phon	—	The value equal to the sound pressure level of 1 kHz sine wave, is sensed by a human as equal to the subjective sound level. Symbol is L_N; unit is phon. The reference is a 1 kHz sine wave at 40 dB sound pressure, its loudness level is 40 phon. The graph of each frequency that is sensed as the same sound level as a 1 kHz sine wave, is given in ISO 226:2003, Normal equal-loudness level contours.

Measurement of loudness					
Quantity			Unit		Description
Name	Symbol	Definition	Name	Symbol	
Loudness equivalent level	$L_{eq(M)}$	$L_{eq(M)} = 20\lg\left(\frac{P}{P_0}\right)$ p_0= 20 µPa p: root-mean-square value of the sound pressure, of the M-weighted measurement	decibel	dB	ISO 21727: Method of measurement of perceived loudness of motion-picture audio material. Measure the mean of the scalar sum over the duration of the sound recording. M-weighted is a curve of the ITU-R BS.468-4 with 5,6 dB offset weighting.
A-weighted and time-average sound level	$L_{Aeq,T}$	$L_{AT} = 20\lg \times \left(\frac{\left[\frac{1}{T}\int_{t-T}^{t} P_A^2(\xi)d\xi\right]^{1/2}}{P_0}\right)$ ξ : variable of integration p_0 = 20 µPa p_A: measured value of A-weighted sound pressure	decibel	dB	IEC 61672-1: This standard is intended to measure sounds generally in the range of human hearing. Equivalent continuous A-weighted sound pressure level.
[a] Loudness, K-weighted, relative to nominal full scale.					

Annex B
(informative)

Terms related to audio reproduction

Additional terms and definitions regarding loudness are listed below.

B.1
equal-loudness contours
graph of each frequency that is sensed as the same loudness of 1 kHz sine wave, as specified in ISO 226:2003

B.2
phon
unit of loudness level, judged or calculated as specified in the definition of "loudness level" or "calculated loudness level" defined in ISO 532

B.3
sone
unit of loudness, equal to the loudness of a pure tone presented frontally as a plane wave of frequency 1 000 Hz and a sound pressure level of 40 dB, with a reference of 20 μPa

Note 1 to entry: Any other than sine wave sound is calculated by the method defined in ISO 532.

Note 2 to entry: The loudness of a sound judged by the listener to be n times that of the 1-sone tone is n sones.

B.4
integrated loudness
calculated loudness of a given period of digital recording data depending on the algorithm defined in ITU-R Recommendation BS.1770-3

B.5
programme loudness
integrated loudness on full programme duration

B.6
target loudness
target level of programme loudness used to keep the hearing level of a programme

B.7
LU
loudness (level) unit for differences between loudness levels

B.8
dialogue level
loudness level of a typical dialogue contained in a programme

Note 1 to entry: A "typical" dialogue is that spoken in a normal tone of voice, i.e. neither shouted or whispered. The average loudness level of all dialogue in a programme can be considered the "dialogue level", from which the "typical" dialogue can be isolated and measured.

B.9
normalize
adjust various loudness values of a programme to a reference level

B.10
downmix
render over three channels of audio signals on two or one channel(s)

Note 1 to entry: Generally, it is used to render a 5.1 channel surround sound on 2 channel stereo.

B.11
audio mode
type of audio recording or transmission

EXAMPLES Mono, stereo and surround.

B.12
2 channel stereophonic with mono source
mono-stereophonic
mode of recording audio with one microphone or equivalent method, by dividing it into two channels with the same phase and level, transferring through two channels, then reproducing with two loudspeakers

B.13
dual mono
mode of recording audio of two independent monophonic sounds, transferring through two channels, then reproducing one of two signals

B.14
bi-lingual
transfer two different language contents at the same time in one programme

Note 1 to entry: In case of dual-mono mode, two independent channels are carried in one audio stream. In case of 2ADTS (Audio Data Transport Stream) mode, each channel is carried by each audio stream.

B.15
monaural
sound reception by one ear

Annex C
(informative)

Loudness metadata

Loudness metadata is information on the loudness of audio content. Information on loudness is specified by EBU – TECH 3285, Specification of the Broadcast Wave Format (BWF) – A format for audio data files in broadcasting, Version 2.0.

Metadata is defined as follows:

LoudnessValue	A 16-bit signed integer, equal to *round*(100x the Integrated Loudness Value of the file in LUFS)
LoudnessRange	A 16-bit signed integer, equal to *round*(100x the Loudness Range of the file in LU)
MaxTruePeakLevel	A 16-bit signed integer, equal to *round*(100x the Maximum True Peak Value of the file in dBTP)
MaxMomentaryLoudness	A 16-bit signed integer, equal to *round*(100x the highest value of the Momentary Loudness Level of the file in LUFS)
MaxShortTermLoudness	A 16-bit signed integer, equal to *round*(100x the highest value of the Short-term Loudness Level of the file in LUFS)

NOTE LUFS is specified by EBU, it is a synonym for LKFS.

Annex D
(informative)

Exception to loudness level diagram

Clause 5 described a loudness level diagram for reproduction level. However, in some broadcasting cases within a region, a practical level is applied to content reference loudness level.

Table D.1 shows that the 1- and 2-channel mono content is levelled to a practical level. In this case, the target reproduction level should be the same reference level as –24 LKFS.

To obtain the same reference level, the optional control method can be applied.

Table D.1 – Reproduction level

Input source and reference loudness level	Transfer / channel mode	Reproduction of 2 channel stereo	Target reproduced reference level
1 channel mono (M) –27 LKFS as practical	1 channel / mono	Case 1 Case 4	–24 LKFS
2 channel mono (M) –27 LKFS as practical	2 channel / –	Case 2 Case 5a	–24 LKFS

NOTE Broadcast audio in Japan has 2 channel mono mode which provides the same mono content in both channels.

Annex E
(informative)

Example of case 6

When case 6 reproduces dual-mono content, the reproduction loudness level varies depending on its content.

For example, the following contents are reproduced.

– Sample 1, includes an in-phase piano sound component, different language bilingual
– Sample 2, includes an in-phase piano sound component, different language bilingual
– Sample 3, includes an in-phase piano sound component, same language independent
– Sample 4, includes an in-phase piano sound component, same language independent
– Sample 5, excludes an in-phase component, same content as sample 1
– Sample 6, excludes an in-phase component, same content as sample 3

Piano sound level of each sample 1 to 4 is set as sample 1 > sample 2 > sample 3 > sample 4.

Each sample's loudness level is shown in Table E.1.

Table E.1 – Loudness level of samples

	Sample 1 LKFS	**Sample 2** LKFS	**Sample 3** LKFS	**Sample 4** LKFS	**Sample 5** LKFS	**Sample 6** LKFS
L channel	–24,0	–24,0	–24,0	–24,0	–24,0	–24,0
R channel	–24,0	–24,0	–24,0	–24,0	–24,0	–24,0
Stereo	–21,0	–21,0	–21,0	–21,0	–21,4	–21,4
Mono mix	–19,1	–20,1	–19,8	–20,1	–21,4	–21,4

Each reproduction result with Case 6 is shown in Figure E.1.

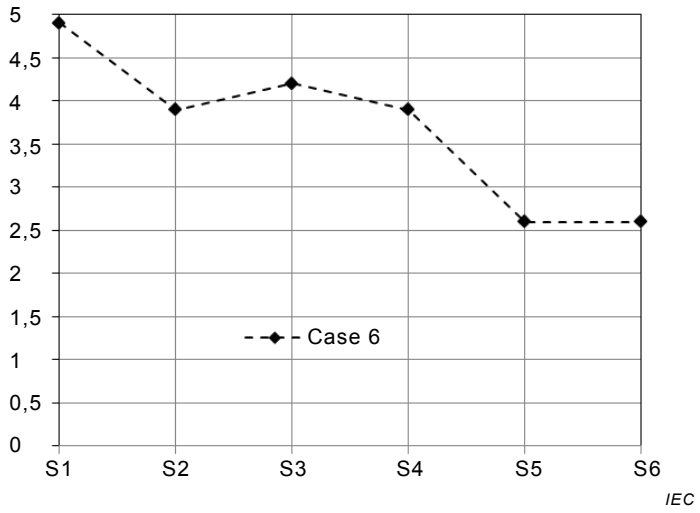

Figure E.1 – Reproduction level with respect to reference loudness level

Maximum level with respect to the reference loudness level is 5 dB.

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