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Information Technology - Intelligent Media Coding

Part 3: Immersive Audio

Information technology - Intelligent media coding - Part 3: Immersive audio

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Foreword

This document is drafted in accordance with GB/T 1.1-2020 *Directives for Standardization - Part 1: Rules for the Structure and Drafting of Standardizing Documents*.

This document is Part 3 of T/AI 109 *Information Technology - Intelligent Media Coding.* T/AI 109 has issued the following parts:

- Part 2: Video;

- Part 4: Video Conformance Testing.

This document is under the jurisdiction of Audio Video Coding Standard Workgroup of China.

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Introduction

T/AI 109 is intended to establish an intelligent media compression method, and to include the following six parts.

- Part 1: Immersive Media System;

- Part 2: Video;

- Part 3: Immersive Audio;

- Part 4: Video Conformance Testing;

- Part 5: Reference Software;

- Part 6: Intelligent Media Format.

The issuing body of this document calls for attention to the fact that the declaration of compliance with this document may involve the use of patents related to the technologies for general full-rate audio encoding and decoding, general high-rate audio encoding and decoding, lossless audio encoding and decoding, and rendering.

The issuing body of this document calls for attention to the fact that the declaration of compliance with this document may involve the use of the following 34 patents related to the technologies for audio encoding and decoding in sections 6, 7.3, 7.5, 7.6, 7.7, and 7.13. Patent names are as follows:

202110865328.X: METHOD AND APPARATUS FOR AUDIO SIGNAL ENCODING AND DECODING; 202110654037.6: ENCODING AND DECODING METHOD, APPARATUS, AND DEVICE, STORAGE MEDIUM, AND COMPUTER PROGRAM; 202110700570.1: THREE-DIMENSIONAL AUDIO SIGNAL PROCESSING METHOD AND APPARATUS; 202110680341.8: THREE-DIMENSIONAL AUDIO SIGNAL CODING METHOD AND APPARATUS, CODER, AND SYSTEM; 202110595367.2: MULTI-CHANNEL AUDIO SIGNAL CODING METHOD AND APPARATUS; 202110559102.7: ENCODING AND DECODING METHOD, APPARATUS, AND DEVICE, STORAGE MEDIUM, AND COMPUTER PROGRAM; 202110530309.1: AUDIO ENCODING AND DECODING METHOD AND APPARATUS; 202110596023.3: AUDIO DATA ENCODING AND DECODING METHOD AND RELATED APPARATUS, AND COMPUTER-READABLE STORAGE MEDIUM; 202110602507.4: THREE-DIMENSIONAL AUDIO SIGNAL PROCESSING METHOD AND APPARATUS; 202110536623.0: THREE-DIMENSIONAL AUDIO SIGNAL CODING METHOD AND APPARATUS, AND CODER; 202110536631.5: THREE-DIMENSIONAL AUDIO SIGNAL CODING METHOD AND APPARATUS, AND CODER; 202110535832.3: THREE-DIMENSIONAL AUDIO SIGNAL CODING METHOD AND APPARATUS, AND CODER; 202110536634.9: THREE-DIMENSIONAL AUDIO SIGNAL CODING METHOD AND APPARATUS, AND CODER; 202110247466.1: VIRTUAL SPEAKER SET DETERMINING METHOD AND APPARATUS; 202110246382.6: HOA COEFFICIENT OBTAINING METHOD AND APPARATUS; 202011377433.0: AUDIO ENCODING AND DECODING METHOD AND APPARATUS; 202011377320.0: AUDIO ENCODING AND DECODING METHOD AND APPARATUS; 202010699711.8: MULTI-CHANNEL AUDIO SIGNAL ENCODING AND DECODING METHOD AND APPARATUS; 202010699775.8: MULTI-CHANNEL AUDIO SIGNAL CODING METHOD AND APPARATUS; 202010699706.7: MULTI-CHANNEL AUDIO SIGNAL ENCODING AND DECODING METHOD AND APPARATUS; 200910169403.8: BANDWIDTH EXTENSION METHOD AND APPARATUS; 201010187426.4: SIGNAL PROCESSING METHOD AND SYSTEM; 201180003043.X: SOURCE SIGNAL RECONSTRUCTION METHOD AND DECODER; 201110289391.X: DOWNMIXED SIGNAL GENERATION AND RESTORATION METHOD AND APPARATUS; 201610877571.2: AUDIO SIGNAL RECONSTRUCTION METHOD AND APPARATUS; 201610879165.X: AUDIO

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SIGNAL RECONSTRUCTION METHOD AND APPARATUS; 201610252268.3: AUDIO SIGNAL SAMPLING AND RECONSTRUCTION METHOD, APPARATUS, AND SYSTEM; 200710135833.9: STEREO AUDIO ENCODING/DECODING METHOD AND ENCODER/DECODER; 200810106460.7: STEREO SIGNAL ENCODING AND DECODING METHOD AND APPARATUS, AND CODEC SYSTEM; 200980154599.1: STEREO CODING METHOD AND DEVICE; 202210699863.7: MULTI-CHANNEL SIGNAL ENCODING AND DECODING METHOD AND DEVICE, AND TERMINAL DEVICE; 200710175993.6: ENCODING AND DECODING INTEGRATION SYSTEM AND METHOD; 200710304486.8: AUDIO SIGNAL ENCODING AND DECODING METHOD AND APPARATUS; 201410573759.9: STEREO ENCODING AND DECODING METHOD.

The issuing body of this document has no position as to the authenticity, validity, and scope of the patents.

Patent holders have assured the issuing body of this document that they are willing to negotiate patent licenses under reasonable and non-discriminatory terms and conditions with any applicant. Patent holders' statements are registered with the issuing body of this document. The relevant information can be obtained using the following contact information:

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Attention is drawn to the possibility that some of the elements of this document may relate to patents other than those identified. The issuing body of this document shall not be held responsible for identifying any or all such patents.

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Information Technology - Intelligent Media Coding - Part 3: Immersive Audio

1 Scope

This document describes a decoding process for next-generation high-efficiency immersive audio compression methods for all scenarios.

This document is applicable to broadcast streaming media, network television, digital cinema, real-time communication, virtual reality, augmented reality, video surveillance, digital storage media, and other fields.

2 Normative References

The content of the following documents is normatively referenced in this document, and constitutes indispensable provisions of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced documents (including any amendments) applies.

GB/T 33475.3-2018 Information Technology - High Efficiency Media Coding - Part 3: Audio

GY/T 262-2012 Algorithms to Measure Audio Program Loudness and True-peak Audio Level

GY/T 316-2018 Advanced Sound System for Program Production

ITU-R BS.2076-2 Audio Definition Model (Audio Definition Model)

ITU-R BS.2094-1 Common Definitions for the Audio Definition Model (Common definitions for the Audio Definition Model)

3GPP TS 26.445 Codec for Enhanced Voice Services (EVS): Detailed Algorithmic Description (Codec for Enhanced Voice Services (EVS); Detailed Algorithmic Description)

3 Terms and Definitions

The terms and definitions defined in GB/T 5271.1, GB/T 5271.4, GB/T 5271.9, and GB/T 5271.34 and the following terms and definitions are applicable to this document.

3.1

Reserved reserved

A field that is temporarily not used in a definition of a coded bitstream and may be used in future standard extensions.

3.2

Bitstream bitstream

A group of bits in a specific order that are used as a coded representation of data.

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3.3

Encoding coding

Reads an audio sample stream and generates a valid bitstream that conforms to this document.

3.4

Encoder coder

An entity for encoding processing.

3.5

Coded representation coded representation

A data element represented in its coded form.

3.6

Coded bitstream coded bitstream

A coded representation of an audio signal.

3.7

Side information side information

Necessary information to control decoding in a bitstream.

3.8

Object object

A sound perceived as a whole or a sound independent of an environment emitted by a sound source.

3.9

Decoding decoding

A type of data processing defined in this document, that is, a process of reading a coded bitstream and outputting an audio sample value.

3.10

Decoder decoder

An entity for decoding processing.

3.11

Spectral coefficient spectral coefficient

Used to analyze discrete-spectrum domain data output by a filter group.

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3.12

Entropy coding entropy coding

A type of variable-length lossless coding in a digital representation of a signal, to reduce redundancy in statistical characteristics.

3.13

Channel channel

Audio signals independent of each other and captured or played back at different spatial positions during sound recording or playing.

3.14

Data element data element

A representation of data items before and after coding.

3.15

Dual-channel stereo stereo audio

An audio format in which two channels carry audio signals with a specific phase relationship, and a sense of a wider sound field is usually provided for a listener through replay by two symmetric speakers located in front of the listener (or by headphones).

3.16

Surround sound surround audio

An audio format in which a plurality of channels carry a plurality of audio signals that form complete audio content, and a sense of a surround sound field is provided for a listener through replay by a plurality of speakers surrounding the listener at an ear height layer of the listener.

3.17

3D sound 3D Audio

An audio format in which a plurality of channels carry a plurality of audio signals that form complete audio content, and a higher spatial resolution of sound image localization and a sense of an immersive sound field are provided for a listener through direct replay by a plurality of speakers surrounding the listener at different height layers, or through replay after rendering or mapping.

3.18

Metadata metadata

Data related to audio data.

3.19

Speaker rendering speaker rendering

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A process of converting audio into a playback signal of a specific configuration for a speaker.

3.20

Binaural rendering binaural rendering

A process of converting audio into a binaural playback signal.

3.21

Byte alignment byte alignment

In a coded bitstream, if a position of a bit is a multiple of 8, the bit is referred to as byte alignment.

4 Acronyms and Abbreviations

The following acronyms and abbreviations apply to this document.

AASF AVS audio storage format (AVS Audio Storage Format)

AATF AVS audio transport format (AVS Audio Transport Format)

AVS audio video coding standard (Audio Video coding Standard)

BWE bandwidth extension (Bandwidth Extension)

CNN convolutional neural network (Convolutional Neural Network)

CRC cyclic redundancy check (Cyclic Redundancy Check)

FFT fast fourier transform (Fast Fourier Transform)

FOA first order ambisonics (First Order Ambisonics)

HOA higher order ambisonics (Higher Order Ambisonics)

ILD inter-channel level difference (Inter-channel Level Difference)

IMDCT inverse modified discrete cosine transform (Inverse Modified Discrete Cosine Transform)

LFE low frequency effect (Low Frequency Effect)

LPC linear prediction coefficient (Linear Prediction Coefficients)

LSF line spectral frequencies (Line Spectral Frequencies)

LSP line spectral pairs (Line Spectral Pairs)

MCR maximum correlation rotation (Maximum Correlation Rotation)

MDCT modified discrete cosine transform (Modified Discrete Cosine Transform)

M/S middle/side stereo (Middle/Side)

SFB scale factor band (Scale Factor Band)

TNS temporal noise shape (Temporal Noise Shaping)

VQ vector quantization (Vector Quantization)

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5 Conventions

5.1 Overview

The mathematical operators and precedences used in this document are similar to those used in the C language. However, integer division and arithmetic shift operations are specifically defined. Unless otherwise specified, numbering and counting conventions generally begin from 0.

5.2 Arithmetic Operators

Definitions of arithmetic operators are shown in Table 1.

Table 1 Definitions of arithmetic operators

Arithmetic operator	Definition
+	Addition
–	Subtraction (as a binary operator) or negation (as a unary prefix operator)
×	Multiplication
*	Multiplication
ab	Exponentiation, indicating the *bth* power of *a*. It may also indicate a superscript.
pow(a, b)	Exponentiation, indicating the *bth* power of *a*
/	Division without truncation or rounding
÷	Division without truncation or rounding
$\frac{a}{b}$	Division without truncation or rounding
$\sum_{i=a}^{b} f(i)$	Cumulative sum of the function $f(i)$ when the independent variable *i* takes all integer values from a to b (including b).
$\lfloor \cdot \rfloor$	Rounding down
$\sqrt{a}$	An arithmetic square root of a
$\lVert \cdot \rVert_2$	2-norm

5.3 Logical Operators

Definitions of logical operators are shown in Table 2.

Table 2 Definitions of logical operators

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Logical operator	Definition
||	Logical OR
&&	Logical AND
!	Logical NOT

5.4 Relational Operators

Definitions of relational operators are shown in Table 3.

Table 3 Definitions of relational operators

Relational operator	Definition
>	Greater than
≥	Greater than or equal to
<	Less than
≤	Less than or equal to
==	Equal to
≠	Not equal to

5.5 Bitwise Operators

Definitions of bitwise operators are shown in Table 4.

Table 4 Definitions of bitwise operators

Bitwise operator	Definition
&	AND operation
|	OR operation
~	Negation operation
a >> b	Right shift of a two's complement integer representation of a by b digits. This operation is defined only when b is a positive number. Bits shifted into the most significant bits (MSBs) as a result of the right shift have a value equal to the MSB of a prior to the shift operation.
a << b	Left shift of a two's complement integer representation of a by b digits. This operation is defined only when b is a positive number. Bits shifted into the least significant bits (LSBs) as a result of the left shift have a value equal to 0.

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5.6 Assignment

Definitions of assignment operators are shown in Table 5.

Table 5 Definition of assignment operation

Assignment operation	Definition
=	Assignment operator
++	Auto-increment. *x*++ is equivalent to *x* = *x* + 1. When the operator is used in an array subscript, a value of a variable is calculated prior to the auto-increment operation.
+=	Auto-increment by amount specified. For example, x += 3 is equivalent to x = x + 3, and x += (–3) is equivalent to x = x + (–3).
-=	Auto-decrement by amount specified. For example, x –= 3 is equivalent to x = x + (–3), and x –= (–3) is equivalent to x = x – (–3).

5.7 Mnemonics

Definitions of mnemonics are shown in Table 6.

Table 6 Definitions of mnemonics

Mnemonic	Definition
rpchof	Polynomial remainder, higher order first.
bslbf	A bit string, left bit first. Here, "left" is an order in which a bit string is written in accordance with GB/T 17191. A bit string is written as a string of 1s and 0s with single quotation marks, for example '1000 0001'. Spaces within a bit string are for ease of reading and have no significance. (Bitstream left bit first)
uimsbf	Unsigned integer. The most significant bit first. (Unsigned integer, most significant bit first)
bsmbf	A bit string is written as a string of 1s and 0s with quotation marks, right bit first. For example, if a 5-bit value 6 and then a 3-bit value 2 are coded, the coded bit string is '010 00110'.

5.8 Mathematical Functions

For definitions of mathematical functions, refer to formula (1) to formula (2).

$$|x| = \begin{cases} x & ; \ x > 0 \\ 0 & ; \ x = 0 \\ -x & ; \ x < 0 \end{cases} \tag{1}$$

x is an independent variable.

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$$ReLu(x) = \begin{cases} x & ; \ x > 0 \\ 0 & ; \ x \leq 0 \end{cases} \tag{2}$$

x is an independent variable.

5.9 Bitstream Syntax Rules

Each data item in a bitstream is in boldface. They are described by names, bitwise lengths and types, and mnemonics of transmission orders.

An operation caused by a decoded data element in a bitstream depends on a value of the data and a previously decoded data element. The following syntax structure shows a case in which a data element appears in a standard type.

Note 1: Unless otherwise specified, the "bit" in this document indicates a binary bit.

Note 2: The syntax described in this document is specified using "C" code. A variable or an expression of a non-zero value is equivalent to a true condition. A variable or an expression of a zero value is equivalent to a false condition.

while(condition){
data_element
...
}

Note 3:

If the condition is true, a data element group is generated immediately after a data stream. This process is repeated until the condition is false.

do{
data_element
...
} while(condition)

If the condition is true, a data element group is generated immediately after a data stream. This process is repeated until the condition is false.

if(condition){
data_element
...
} else{
data_element
...

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if(condition){
}

If the condition is true, a first group of data elements is generated in a data stream. If the condition is false, a second set of data elements is generated in the data stream.

for(expr1;expr2; expr3){
data_element
...
}

The expr1 is an expression that specifies an initial state of a loop, and usually specifies an initial state of a counter. The expr2 specifies a test condition before each loop. If the condition is false, the loop stops. The expr3 is an expression executed at the end of each loop, and usually is a count-up counter.

Note 4:The most common use of this structure is as follows:

```
for(i=0;i<n;i++){
data_element
...
}
```

The data element group is generated for n times. A condition structure within the data element group may depend on a value of the loop control variable i. This field is set to '0' when it appears for the first time, increases to '1' when it appears for the second time, and the like.

```
switch(expr){
  case constcase1:
    data_element1
    break
  case constcase2:
    data_element2
    break
  ...
  case constcasen:
    data_elementn
    break
```

A corresponding data element is generated based on a value of an expression expr. When the value of expr is constcase1, a data element data_element1 is generated. When the value of expr is constcase2, a data element data_element2 is generated. The same rule applies. When the value of expr is constcasen, a data element data_elementn is generated. When the value of expr is not equal to any one of constcase1, constcase2, ..., constcasen, a data element data_elementdefault is generated.

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```
    default:
        data_elementdefault
        break
}
```

A variant of this structure is that no break occurs after a specific case, for example,

```
switch(expr){
    case constcase1:
        data_element1
    case constcase2:
        data_element2
        break
        ...
    case constcasen:
        data_elementn
        break
    default:
        data_elementdefault
        break
}
```

When the value of expr is constcasex, a data element is generated starting from a corresponding case constcasex until a break occurs.

When the value of expr is constcase1, data elements data_element1 and data_element2 are generated. When the value of expr is constcasen, a data element data_elementn is generated.

Note 5: A data element group may contain a nested structure. For simplicity, [ ] is omitted when there is only one subsequent data element.

data_element[ ]	data_element is array data. The number of data elements depends on the context.
data_element[n]	data_element[n] is an (n+1)-th element of the array data.
data_element[m][n]	data_element[m][n] is a (m+1), (n+1)-th element of a two-dimensional array.
data_element[l][m][n]	data_element[l][m][n] is a (l+1), (m+1), and (n+1)-th element of a three-dimensional array.
data_element[m...n]	data_element[m…n] is all bits included between bits m and n.

Although syntax is expressed as a process item, it cannot be considered that the clause implements a reliable decoding process. It simply defines an error-free bitstream input.

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Definition of **byte_alignment()**:

If a current position is at a byte boundary, the byte_alignment() returns '1', that is, a next bit in the bitstream is a start bit of a byte. Otherwise, '0' is returned.

Definition of **nextbits()**:

The nextbits() compares next to-be-decoded bits in the bit string and the bitstream.

6 AVS3 Audio Coding and Rendering Framework

AVS3 audio coding includes general full-rate audio coding, general high-rate audio coding, lossless audio coding, and metadata coding. For an AVS3 audio coding framework, refer to figure 1. During AVS3 audio coding, an input audio signal is divided into a channel signal, an object signal, and an HOA signal. The channel signal is a mono signal, a dual-channel stereo signal, or a multi-channel surround/3D sound signal. The general full-rate audio coding (including a basic configuration and a low-complexity configuration) or the lossless audio coding may be selected for the channel signal, the object signal, and the HOA signal. The general high-rate audio coding may also be selected for the channel signal. The metadata coding is used for metadata. An AVS3 audio coded bitstream is obtained through AVS3 audio bitstream multiplexing.

Figure 1 AVS3 audio coding framework

The general full-rate audio coding supports the following parameter configurations.

– Supported sampling rates are as follows: 32 kHz, 44.1 kHz, 48 kHz, 96 kHz, and 192 kHz.

– Supported sampling precisions are as follows: 16 bits and 24 bits.

– Supported coding bit rates are as follows:

  - mono: 32 kb/s, 44 kb/s, 56 kb/s, 64 kb/s, 72 kb/s, 80 kb/s, 96 kb/s, 128 kb/s, 144 kb/s, 164 kb/s, and 192 kb/s;
  - dual-channel stereo: 32 kb/s, 48 kb/s, 64 kb/s, 80 kb/s, 96 kb/s, 128 kb/s, 144 kb/s, 192 kb/s, 256 kb/s, and 320 kb/s;
  - 5.1 multi-channel stereo: 96 kb/s, 128 kb/s, 144 kb/s, 160 kb/s, 192 kb/s, 256 kb/s, 320 kb/s, 384 kb/s, 448 kb/s, 512 kb/s, 640 kb/s, and 720 kb/s;
  - 7.1 multi-channel: 128 kb/s, 160 kb/s, 192 kb/s, 256 kb/s, 384 kb/s, 480 kb/s, 576 kb/s, and 640 kb/s;
  - 5.1.2 multi-channel: 152 kb/s, 320 kb/s, 480 kb/s, and 576 kb/s;
  - 7.1.2 multi-channel: 216 kb/s, 384 kb/s, 480 kb/s, 576 kb/s, and 768 kb/s;
  - 5.1.4 multi-channel: 176 kb/s, 256 kb/s, 384 kb/s, 448 kb/s, 576 kb/s, and 704 kb/s;
  - 7.1.4 multi-channel: 240 kb/s, 384 kb/s, 512 kb/s, 608 kb/s, and 832 kb/s;
  - FOA: 96 kb/s, 128 kb/s, 192 kb/s, and 256 kb/s;
  - 2-order HOA: 192 kb/s, 256 kb/s, 320 kb/s, 384 kb/s, 480 kb/s, 512 kb/s, and 640 kb/s;
  - 3-order HOA: 256 kb/s, 320 kb/s, 384 kb/s, 512 kb/s, 640 kb/s, and 896 kb/s.

The syntax, semantics, and decoding processes in chapter 7 "General Audio Coding" in GB/T 33475.3-2018, except those of the high frequency bandwidth extension (BWE), are referenced for the general high-rate audio coding. The general high-rate audio coding can be enabled when the AVS3 audio bit rate is high (that is, mono: ≥128 kb/s; dual-channel stereo: >128 kb/s; multi-channel stereo: ≥35 kb/s per channel). The general high-rate audio coding supports a maximum of 128 channels, 8 kHz to 192 kHz sampling rates, and 8-bit, 16-bit, and 24-bit sampling precisions.

The lossless audio coding supports a maximum of 128 audio channels.

AVS3 audio decoding is a reverse process of AVS3 audio encoding. The AVS3 audio coded bitstream is processed by general full-rate audio decoding or lossless audio decoding to obtain a channel signal, an object signal, and an HOA signal, and metadata is obtained through metadata decoding. The decoded channel signal, object signal, and HOA signal may be rendered through speaker rendering to obtain a speaker signal for multi-sound box playing, or may be binaurally rendered to obtain a binaural signal for playing by headphones. For an AVS3 audio decoding and rendering framework, refer to figure 2.

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Figure 2 AVS3 audio decoding and rendering framework

For general full-rate audio decoding, refer to chapter 7. For lossless audio decoding, refer to chapter 8. For metadata decoding, refer to chapter 9. Bitstream syntax and semantics of the AVS3 audio coded bitstream should comply with provisions in Annex A. An audio code table related to the general full-rate audio coding should comply with provisions in Annex B. For a speaker rendering reference implementation and a binaural rendering reference implementation, refer to Annex C. For general full-rate audio coding, refer to Annex D. For a correspondence between coding metadata in this document and metadata in ITU-R BS.2076-2, refer to Annex E. The AVS3 audio coding may have different implementations for different requirements. Refer to Annex F and Annex G.

7 General Full-rate Audio Decoding

7.1 Overview

The general full-rate audio decoding includes core decoding and HOA spatial decoding. The core decoding decodes a coded bitstream into a channel signal and an object signal. The core decoding and the HOA spatial decoding decodes a coded bitstream into an HOA signal. For the general full-rate audio decoding framework, refer to figure 3. The core decoding includes bitstream demultiplexing, range decoding, inverse quantization, inverse neural network transform, spectrum inverse grouping, upmixing, and post-decoding processing. The upmixing supports stereo upmixing, multi-channel upmixing and HOA upmixing. The post-decoding processing includes bandwidth extension decoding, inverse temporal noise shaping, inverse frequency-domain noise shaping, and inverse MDCT.

For the bitstream demultiplexing, refer to section 7.2. For the range decoding, the inverse quantization, and the inverse neural network transform, refer to section 7.3. For the spectrum

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inverse grouping, refer to section 7.4. For dual-channel stereo bit allocation and upmixing, refer to section 7.5. For multi-channel bit allocation and upmixing, refer to section 7.6. For HOA bit allocation and upmixing, refer to section 7.7. For the post-decoding processing, refer to section 7.8. For the bandwidth extension decoding, refer to section 7.9. For the inverse temporal noise shaping, refer to section 7.10. For the inverse frequency-domain noise shaping, refer to section 7.11. For the inverse MDCT, refer to section 7.12. For the HOA spatial decoding, refer to section 7.13.

Figure 3 General full-rate audio decoding framework

The mono decoding includes range decoding, inverse quantization, inverse neural network transform, spectrum inverse grouping, and post-decoding processing. For a decoding framework, refer to figure 4. In a range decoding and inverse quantization process, a transform-domain coefficient corresponding to an MDCT coefficient is obtained by parsing a bitstream. A reconstructed MDCT coefficient is obtained by performing inverse neural network transform. Finally, a time-domain mono signal is obtained through post-decoding processing. For a post-decoding processing framework, refer to figure 5.

The obtaining process is as follows:

1) Range decoding and inverse quantization

Bitstream information related to coding of an MDCT spectral coefficient is obtained from the bitstream, and range decoding and inverse quantization are performed to obtain a transform-domain coefficient corresponding to the MDCT coefficient. The transform-domain coefficient corresponding to the MDCT coefficient is used as an input for inverse neural network transform. For details, refer to section 7.3.

- Input: the bitstream

- Output: the transform-domain coefficient corresponding to the MDCT coefficient

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2) Inverse neural network transform

The inverse neural network transform is performed on the transform-domain coefficient corresponding to the MDCT spectral coefficient to obtain a reconstructed MDCT coefficient. For details, refer to section 7.3.

- Input: the transform-domain coefficient corresponding to the MDCT coefficient

- Output: the reconstructed MDCT coefficient

3) Bandwidth extension decoding

A bandwidth extension decoding module performs energy adjustment and spectral detail adjustment on a low frequency part of the reconstructed MDCT coefficient based on a bandwidth extension parameter obtained by decoding the bitstream, to obtain a high-frequency spectrum component. For details, refer to section 7.9.

- Input: the reconstructed MDCT coefficient and a bandwidth extension parameter

- Output: an MDCT coefficient of the mono signal

4) Inverse temporal noise shaping

An inverse temporal noise shaping module is an inverse process at an encoder, and recovers an MDCT coefficient before temporal noise shaping. For details, refer to section 7.10.

- Input: the MDCT coefficient of the mono signal and a temporal noise shaping parameter

- Output: an MDCT coefficient of the mono signal after inverse temporal noise shaping

5) Inverse frequency-domain noise shaping

An inverse frequency-domain noise shaping module is an inverse process at an encoder, and recovers an MDCT coefficient before frequency-domain noise shaping. For details, refer to section 7.11.

- Input: the MDCT coefficient of the mono signal after inverse temporal noise shaping and a frequency-domain noise shaping parameter

- Output: an MDCT coefficient of the mono signal after inverse frequency-domain noise shaping

6) Inverse MDCT

An inverse MDCT module transforms the MDCT coefficient into a time-domain signal based on a windowed control parameter obtained by parsing the bitstream. For details, refer to section 7.12.

- Input: the MDCT coefficient of the mono signal after inverse frequency-domain noise shaping and the windowed control parameter

- Output: a time-domain mono signal

Figure 4 Mono decoding framework

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Figure 5 Post-decoding processing framework

The dual-channel stereo decoding includes range decoding, inverse quantization, inverse neural network transform, spectrum inverse grouping, dual-channel stereo upmixing, and post-decoding processing. For a decoding framework, refer to figure 6. A transform-domain coefficient corresponding to an MDCT coefficient is obtained by parsing a bitstream through range decoding and inverse quantization. A reconstructed downmixed channel MDCT coefficient is obtained through inverse neural network transform. A reconstructed left and right channel MDCT coefficient is obtained through dual-channel stereo upmixing. Finally, a time-domain dual-channel stereo signal is obtained through post-decoding processing. For a post-decoding processing framework, refer to figure 4.

The obtaining process is as follows:

1) Range decoding and inverse quantization

   - Input: the bitstream

   - Output: a downmixed channel transform-domain coefficient corresponding to the MDCT coefficient

2) Inverse neural network transform

   - Input: the downmixed channel transform-domain coefficient corresponding to the MDCT coefficient

   - Output: the reconstructed downmixed channel MDCT coefficient

3) Dual-channel stereo upmixing

   A dual-channel stereo upmixing module performs upmixing on the downmixed channel MDCT coefficient based on a downmixing parameter obtained by parsing the bitstream, to obtain a left and right channel signal. For details, refer to section 7.5.

   - Input: the reconstructed downmixed channel MDCT coefficient and the downmixing parameter

   - Output: the reconstructed left and right channel MDCT coefficient

4) Dual-channel stereo post-decoding processing

   The dual-channel stereo post-decoding processing module performs post-decoding processing for each channel.

   - Input: the reconstructed left and right channel MDCT coefficient, a bandwidth extension parameter, a temporal noise shaping parameter, a frequency-domain noise shaping parameter, and a windowed control parameter

   - Output: a time-domain dual-channel stereo signal

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Figure 6 Dual-channel stereo decoding framework

The multi-channel decoding includes range decoding, inverse quantization, inverse neural network transform, spectrum inverse grouping, multi-channel parameter decoding, multi-channel upmixing, and post-decoding processing. For a decoding framework, refer to figure 7. A transform-domain coefficient corresponding to an MDCT coefficient is obtained by parsing a bitstream through range decoding and inverse quantization. A reconstructed downmixed channel MDCT coefficient is obtained through inverse neural network transform. A multi-channel upmixing parameter is obtained by decoding a multi-channel parameter. A reconstructed multi-channel MDCT coefficient is obtained through multi-channel upmixing. Finally, a time-domain multi-channel signal is obtained through post-decoding processing.

The obtaining process is as follows:

1) Range decoding and inverse quantization

   - Input: the bitstream

   - Output: the downmixed multi-channel transform-domain coefficient corresponding to the MDCT coefficient

2) Inverse neural network transform

   - Input: the downmixed multi-channel transform-domain coefficient corresponding to the MDCT coefficient

   - Output: a reconstructed downmixed multi-channel MDCT coefficient

3) Multi-channel parameter decoding

   A multi-channel parameter decoding module parses the bitstream to obtain a multi-channel signal coding mode parameter. For details, refer to section 7.6.

   - Input: the bitstream

   - Output: the multi-channel signal coding mode parameter

4) Multi-channel upmixing

   A multi-channel upmixing module performs upmixing on the reconstructed downmixed multi-channel MDCT coefficient based on the multi-channel signal coding mode parameter to obtain the reconstructed multi-channel signal MDCT coefficient. For details, refer to section 7.6.

   - Input: the reconstructed downmixed multi-channel MDCT coefficient and the multi-channel signal coding mode parameter

   - Output: the reconstructed multi-channel signal MDCT coefficient

5) Multi-channel post-decoding processing

   The multi-channel post-decoding processing module performs post-decoding processing for each channel.

   - Input: the reconstructed multi-channel signal MDCT coefficient, a bandwidth extension parameter, a temporal noise shaping parameter, a frequency-domain noise shaping parameter, and a windowed control parameter

   - Output: a time-domain multi-channel signal

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Figure 7 Multi-channel decoding framework

HOA decoding includes range decoding, inverse quantization, inverse neural network transform, spectrum inverse grouping, transmission channel parameter decoding, HOA upmixing, transmission channel post-decoding processing, and HOA spatial decoding. For an HOA decoding framework, refer to figure 8. HOA spatial decoding includes sound field component synthesis and HOA signal synthesis. For an HOA spatial decoding framework, refer to figure 9. A transform-domain coefficient corresponding to an MDCT coefficient is obtained by parsing a bitstream through range decoding and inverse quantization. A reconstructed downmixed channel MDCT coefficient is obtained through inverse neural network transform. An HOA upmixing parameter is obtained through transmission channel parameter decoding. A reconstructed transmission channel signal MDCT coefficient is obtained through HOA upmixing. A time-domain transmission channel signal is obtained through transmission channel post-decoding processing. Finally, a reconstructed HOA signal is obtained through HOA spatial decoding.

The obtaining process is as follows:

1) Decoding and inverse quantization

   - Input: the bitstream

   - Output: a downmixed channel transform-domain coefficient corresponding to the MDCT coefficient

2) Inverse neural network transform

   - Input: the downmixed channel transform-domain coefficient corresponding to the MDCT coefficient

   - Output: the reconstructed downmixed channel MDCT coefficient

3) Transmission channel parameter decoding

   A transmission channel parameter decoding module parses the bitstream to obtain a transmission channel signal coding mode parameter. For details, refer to section 7.7.

   - Input: the bitstream

   - Output: the transmission channel signal coding mode parameter

4) HOA upmixing

   An HOA upmixing module performs upmixing on the reconstructed downmixed channel MDCT coefficient based on the transmission channel signal coding mode parameter to obtain the reconstructed transmission channel signal MDCT coefficient. For details, refer to section 7.7.

   - Input: the reconstructed downmixed channel MDCT coefficient and the transmission channel signal coding mode parameter

   - Output: the reconstructed transmission channel signal MDCT coefficient

5) Transmission channel post-decoding processing

   The transmission channel post-decoding processing module performs post-decoding processing for each path.

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- Input: the reconstructed transmission channel signal MDCT coefficient, a bandwidth extension parameter, a temporal noise shaping parameter, a frequency-domain noise shaping parameter, and a windowed control parameter

- Output: a time-domain transmission channel signal

6) Sound field component synthesis

A sound field component synthesis module configures a decoder based on a configuration parameter, determines a coefficient of a virtual speaker based on a sound field component parameter obtained by parsing the bitstream, and synthesizes a primary sound field signal based on a virtual speaker signal in the transmission channel signal. For details, refer to section 7.13.

- Input: the transmission channel signal and the sound field component parameter

- Output: the primary sound field signal

7) HOA signal synthesis

An HOA signal synthesis module synthesizes an HOA signal based on a residual signal in the transmission channel signal, a remaining component parameter obtained by parsing the bitstream, and the primary sound field signal. For details, refer to section 7.13.

- Input: the transmission channel signal, the primary sound field signal, and the remaining component parameter

- Output: the HOA signal

Figure 8 HOA decoding framework

Figure 9 HOA spatial decoding framework

7.2 Syntax, Semantics, and Decoding Process of Bitstream Demultiplexing

7.2.1 Syntax

The syntax of a general full-rate audio bitstream should comply with provisions in Table 7.

Table 7 Syntax of general full-rate audio bitstream

General full-rate audio bitstream syntax	Number of bits	Mnemonic
ga_co_raw_data_block() {		
Avs3MetadataDec()		
switch(codecFormat) {		
case 0x0: Avs3MonoDec()		
case 0x1: Avs3StereoDec()		
case 0x2: Avs3McDec()		
case 0x3: Avs3HoaDec()		
}		
}		

The syntax of mono decoding should comply with provisions in Table 8.

Table 8 Syntax of mono decoding

Syntax of mono decoding	Number of bits	Mnemonic
Avs3MonoDec() {		
DecodeCoreSideBits()		
DecodeGroupBits()		
DecodeQcBits()		
Avs3InverseQC()		
Avs3PostSynthesis()		
}		

The syntax of dual-channel stereo decoding should comply with provisions in Table 9.

Table 9 Syntax of dual-channel stereo decoding

Syntax of dual-channel stereo decoding	Number of bits	Mnemonic
Avs3StereoDec() {		
for(ch = 0; ch < 2; ch++) {		
DecodeCoreSideBits()		
}		
for(ch = 0; ch < 2; ch++) {		

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Syntax of dual-channel stereo decoding	Number of bits	Mnemonic
DecodeGroupBits()		
}		
DecodeStereoSideBits()		
StereoBitsAllocation()		
for(ch = 0; ch < 2; ch++) {		
DecodeQcBits()		

Table 9 (continued)

Syntax of dual-channel stereo decoding	Number of bits	Mnemonic
}		
Avs3InverseQC()		
StereoInvMsProcess()		
for(ch = 0; ch < 2; ch++) {		
Avs3PostSynthesis()		
}		
}		

The syntax of multi-channel decoding should comply with provisions in Table 10.

Table 10 Syntax of multi-channel decoding

Syntax of multi-channel decoding	Number of bits	Mnemonic
Avs3McDec() {		
for(ch = 0; ch < numChans; ch++) {		
DecodeCoreSideBits()		
}		
for(ch = 0; ch < numChans; ch++) {		
DecodeGroupBits()		
}		
DecodeMcSideBits()		
McBitsAllocation()		
for(ch = 0; ch < numChans; ch++) {		

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Syntax of multi-channel decoding	Number of bits	Mnemonic
DecodeQcBits()		
}		
Avs3InverseQC()		
Avs3McacDec()		
for(ch = 0; ch < numChans; ch++) {		
Avs3PostSynthesis()		
}		
}		

The syntax of HOA decoding should comply with provisions in Table 11.

Table 11 Syntax of HOA decoding

Syntax of HOA decoding	Number of bits	Mnemonic
Avs3HoaDec() {		
for(ch = 0; ch < numChans; ch++) {		
DecodeCoreSideBits()		
}		
for(ch = 0; ch < numChans; ch++) {		
DecodeGroupBits()		
}		
DecodeHoaSideBits()		
HoaSplitBytesGroup()		
for(ch = 0; ch < numChans; ch++) {		
DecodeQcBits()		
}		
Avs3InverseQC()		
Avs3HoaInverseDMX()		
for(ch = 0; ch < numChans; ch++) {		
Avs3PostSynthesis()		
}		
HoaPostSynthesisFilter()		

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Syntax of HOA decoding	Number of bits	Mnemonic
}		

The syntax of core decoder side information should comply with provisions in Table 12.

Table 12 Syntax of core decoder side information

Syntax of the core decoder side information	Number of bits	Mnemonic
DecodeCoreSideBits() {		
transformType	**2**	**uimsbf**
DecodeFdShapingSideBits()		
DecodeTnsSideBits()		
if(bwePresent == 1) {		
DecodeBweSideBits()		
}		
}		

The configuration of the windowed control parameter should comply with provisions in Table 13.

Table 13 Table of configuration of windowed control parameter

transformType	Windowed control parameter
0x0	Long window
0x1	Short window
0x2	Cut-in window
0x3	Cut-out window

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7.2.2 Semantics

Avs3MetadataDec()	Metadata decoding
Avs3MonoDec()	Mono decoding
Avs3StereoDec()	Dual-channel stereo decoding
Avs3McDec()	Multi-channel decoding
Avs3HoaDec()	HOA decoding
DecodeCoreSideBits()	Parsing core decoder side information

DecodeGroupBits()	Spectrum inverse grouping
DecodeStereoSideBits()	Parsing dual-channel stereo side information
DecodeMcSideBits()	Parsing multi-channel side information
DecodeHoaSideBits()	Parsing HOA side information
StereoBitsAllocation()	Dual-channel stereo bit allocation
McBitsAllocation()	Multi-channel bit allocation
HoaSplitBytesGroup()	HOA bit allocation
StereoInvMsProcess()	Dual-channel stereo upmixing processing
Avs3McacDec()	Multi-channel decoding processing
Avs3HoaInverseDMX()	HOA decoding processing
DecodeQcBits()	Parsing quantization coding side information
Avs3InverseQC()	Range decoding and inverse quantization
Avs3PostSynthesis()	Post-decoding processing
HoaPostSynthesisFilter()	HOA spatial decoding
codecFormat	It indicates a decoding mode, and is determined by channel_number_index (channel_number_index) in Table A.8 in Annex A. When a channel is set to mono, codecFormat is 0. When a channel is set to dual-channel stereo, codecFormat is 1. When a channel is set to a multi-channel configuration, codecFormat is 2. When a channel is set to a HOA configuration, codecFormat is 3.
numChans	The number of channels of an audio signal. When coding_profile is 0, channel_number corresponding to channel_number_index (channel_number_index) in Table A.8 in Annex A is reused.
transformType	2 bits. It indicates a windowed control parameter. The configuration of a windowed control parameter should comply with the provisions in Table 13. A short window is a sine window with a length of 256 points. A long window is a sine window with a length of 2048 points. The first 1024 points of a cut-in window are the same as the long window, and the last 1024 points are composed of 448 points of 1, a short window of 128 points, and 448 points of 0. The first 1024 points of a cut-out window are composed of 448 points of 0, a short window of 128 points, and 448 points of 1, and the last 1024 points are the same as a long window.
DecodeFdShapingSideBits()	Parsing frequency-domain noise shaping side information
DecodeTnsSideBits()	Parsing temporal noise shaping side information

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DecodeBweSideBits()	Parsing bandwidth extension decoding side information
bwePresent	bwePresent indicates whether to enable bandwidth extension. For conditions of enabling bandwidth extension, refer to section 7.9.3.5.

7.2.3 Decoding process

A general full-rate audio bitstream (ga_co_raw_data_block) is a basic unit included in AASF and AATF coded bitstreams. A sample of one frame can be obtained by decoding ga_co_raw_data_block, and a bit rate of one frame can be obtained by decoding a frame header. For details about AASF and AATF formats, refer to Annex A. The bitstream demultiplexing determines a decoding mode (one of mono decoding, dual-channel stereo decoding, multi-channel decoding, HOA decoding, object decoding, and channel and object hybrid decoding) by parsing parameters in AASF and AATF headers, and obtains side information by decoding the bitstream ga_co_raw_data_block for subsequent core decoding and HOA spatial decoding processes. The decoding processes of the ga_co_raw_data_block in different decoding modes are as follows:

The decoder first parses metadata Avs3MetadataDec(), and then parses audio data. The decoder parses parameters from aasf_frame_header() or aatf_frame_header(), and selects an audio data decoding mode. Details are as follows:

When coding_profile is 0 and channel_number_index is 0, the decoder selects mono decoding, and codecFormat is 0. Avs3MonoDec() first parses core decoder side information DecodeCoreSideBits(), performs spectrum inverse grouping DecodeGroupBits(), then parses quantization coding side information DecodeQcBits(), performs range decoding and inverse quantization Avs3InverseQC(), and finally performs post-decoding processing Avs3PostSynthesis(), to obtain a decoded mono signal.

When coding_profile is 0 and channel_number_index is 1, the decoder selects dual-channel stereo decoding, and codecFormat is 1. Avs3StereoDec() first parses core decoder side information DecodeCoreSideBits() and performs spectrum inverse grouping DecodeGroupBits() on each channel, then parses dual-channel stereo side information DecodeStereoSideBits(), performs dual-channel stereo bit allocation StereoBitsAllocation(), parses quantization coding side information DecodeQcBits() for each channel, performs range decoding and inverse quantization Avs3InverseQC(), performs dual-channel stereo upmixing processing StereoInvMsProcess(), and finally performs post-decoding processing Avs3PostSynthesis() on each channel, to obtain a decoded dual-channel stereo signal.

When coding_profile is 0 and channel_number_index is greater than 1, the decoder selects multi-channel decoding, and codecFormat is 2. Avs3McDec() first parses core decoder side information DecodeCoreSideBits() and performs spectrum inverse grouping DecodeGroupBits() on each channel, then parses multi-channel side information DecodeMcSideBits(), performs multi-channel bit allocation McBitsAllocation(), parses quantization coding side information DecodeQcBits() for each channel, performs range decoding and inverse quantization Avs3InverseQC(), performs multi-channel decoding processing Avs3McacDec(), and finally performs post-decoding processing Avs3PostSynthesis() on each channel, to obtain a decoded multi-channel signal.

When coding_profile is 1 and soundBedType is 0, the decoder selects object decoding. When object_channel_number is 0, codecFormat is 0. When object_channel_number is 1, codecFormat is 1. When object_channel_number is greater than 1, codecFormat is 2. When the object decoding is performed according to a method the same as that for channel

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decoding, that is, the number of channels of an object is 1, a method the same as that for mono decoding is used. When the number of channels of an object is 2, a method the same as that for dual-channel stereo decoding is used. When the number of channels of an object is greater than 2, a method the same as that for multi-channel decoding is used.

When coding_profile is 1 and soundBedType is 1, the decoder selects channel and object hybrid decoding, codecFormat is 2, the total number of channels for channel and object is greater than or equal to 3. The channel and object hybrid decoding is performed according to a method the same as that for multi-channel decoding.

When coding_profile is 2, the decoder selects HOA decoding, codecFormat is 3. The HOA decoding includes two parts: core decoding and spatial decoding. The core decoding obtains a virtual speaker signal and a residual signal through decoding. A spatial decoder obtains an HOA signal by decoding the virtual speaker signal and the residual signal. Avs3HoaDec() first parses core decoder side information DecodeCoreSideBits() and performs spectrum inverse grouping DecodeGroupBits() on each virtual speaker signal and residual signal, then parses side information DecodeHoaSideBits() for the virtual speaker signal and residual signal, performs bit allocation HoaSplitBytesGroup() on the virtual speaker signal and residual signal, parses quantization coding side information DecodeQcBits() for each channel, performs range decoding and inverse quantization Avs3InverseQC(), performs decoding processing Avs3HoaInverseDMX() on the virtual speaker signal and residual signal, performs post-decoding processing Avs3PostSynthesis() on each virtual speaker signal and residual signal, and finally performs HOA spatial decoding HoaPostSynthesisFilter(), to obtain a decoded HOA signal.

7.3 Syntax, Semantics, and Decoding Processes of Range Decoding, Inverse Quantization, and Inverse Neural Network Transform

7.3.1 Syntax

The syntax of quantization and encoding side information should comply with provisions in Table 14.

Table 14 Syntax of quantization and encoding side information

Syntax of quantization and encoding side information	Number of bits	Mnemonic
DecodeQcBits() {		
if (nn_type == 0){	**Note 1**	
isFeatAmplified	**1**	**uimsbf**
scaleQIdx	**7**	**uimsbf**
} else if (nn_type == 1) {		
scaleQIdxLc	**8**	**uimsbf**
}		
if(numGroups == 1) {		
nfParamQIdx[0]	**3**	**uimsbf**
}else if(numGroups == 2) {		

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Syntax of quantization and encoding side information	Number of bits	Mnemonic
nfParamQIdx[0]	**3**	**uimsbf**
nfParamQIdx[1]	**3**	**uimsbf**
}		
contextNumBytes	**8**	**uimsbf**
contextBitstream	**Note 2**	**uimsbf**
baseBitstream	**Note 3**	**uimsbf**
}		
Note 1: nn_type indicates a neural network configuration, and is obtained from aasf_header() or aatf_header(). Note 2: The number of bytes of contextBitstream is contextNumBytes. Note 3: The number of bytes of baseBitstream is channelBytes – contextNumBytes.		

7.3.2 Semantics

isFeatAmplified — 1 bit. It indicates whether a transform-domain coefficient obtained through neural network transform is scaled up or down before quantization. 0 indicates scaling down, and 1 indicates scaling up.

scaleQIdx — 7 bits. It indicates a quantization index of a scale adjustment factor of a transform-domain coefficient obtained through neural network transform. A value of an adjustment factor of inverse quantization can be obtained from this variable.

scaleQIdxLc — 8 bits. It indicates a quantization index of a scale adjustment factor of an MDCT spectral coefficient. A value of an adjustment factor of inverse quantization can be obtained from this variable.

nfParamQIdx — 3 bits. It indicates a quantization index of a noise filling parameter corresponding to each of transform-domain coefficients of two groups. The noise filling parameter of inverse quantization can be obtained from this variable.

contextNumBytes — 8 bits. It indicates the number of occupied bytes of a context part in a range coded bitstream.

contextBitstream — In a range coded bitstream, contextNumBytes indicates the number of occupied bytes of a context bitstream.

baseBitstream — In a range coded bitstream, channelBytes – contextNumBytes indicates the number of occupied bytes of a base bitstream.

numGroups — It indicates the number of groups in an MDCT spectrum. The maximum value is 2. The parsing of numGroups is shown in the syntax of DecodeGroupBits() in section 7.4.1.

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isFeatAmplified	1 bit. It indicates whether a transform-domain coefficient obtained through neural network transform is scaled up or down before quantization. 0 indicates scaling down, and 1 indicates scaling up.
channelBytes	It indicates the number of bytes allocated to the current channel bitstream.

7.3.3 Decoding Process

7.3.3.1 Overview

In the basic configuration, the decoding process includes range decoding, inverse quantization, noise filling, scale adjustment, and inverse transform using a base decoding neural network. The range decoding includes context range decoding, context inverse quantization, context inverse neural network transform, base range coding table selection, and base range decoding. For the decoding process, refer to figure 10. Range decoding relates to both the context and base parts. First, range decoding and inverse quantization are performed on the context part, and then after processing of a context decoding neural network, decoded context information is obtained. A base range coding table is selected based on the context information to perform range decoding and inverse quantization on the base part of the range coded bitstream and then obtain the decoded transform-domain coefficient. After the noise filling, scale adjustment, and inverse transform using the base decoding neural network, the decoded MDCT coefficient is obtained.

Figure 10 Decoding Processes of Range Decoding, Inverse Quantization, and Inverse Neural Network Transform

In a low-complexity configuration, the decoding process does not include a base decoding neural network, and the decoded MDCT coefficient can be obtained after range coding, inverse quantization, and scale adjustment.

7.3.3.2 Context Range Decoding

The context part of the range coded bitstream is decoded based on the context range coding table to obtain a quantization index of a transform-domain coefficient of a context neural network. The context range coding table is obtained through pre-training. Refer to Table B.1.

7.3.3.3 Inverse Quantization of the Transform-Domain Coefficient of the Context Neural Network

Inverse quantization is performed on the quantization index of the transform-domain coefficient of the context neural network to obtain a quantized transform-domain coefficient of the context neural network. Linear scalar quantization is used as the quantization method.

7.3.3.4 Context Decoding Neural Network

An inversely quantized transform-domain coefficient of the context neural network is input into the context decoding neural network for inverse transform to obtain the decoded context information. The context decoding neural network is used to perform the inverse neural network transform on the decoded and dequantized transform-domain coefficient of the context neural network to obtain selected information of the base range coding table. The decoded and dequantized transform-domain coefficient of the context neural network is input into the context decoding neural network. A transposed CNN is a composition unit of the context decoding neural network.

The configuration of the structure of the transposed CNN should comply with provisions in Table 15.

Table 15 Configuration of structure of transposed CNN

Item	Value
Number of CNN layers	3
Convolution kernel size	3, 3, 3
Stride	2, 2, 1
Number of CNN channels	16, 16, 16
Activation function	ReLu, ReLu, None
HasBias	1, 1, 1

Stride is a convoluted step parameter of CNN. HasBias indicates whether there is an offset parameter at a specific layer. "1" indicates yes. "0" indicates no. A rectified linear unit (ReLu) is used as the activation function. For the definition of the ReLU mathematical function, refer to formula (2). None indicates that there is no activation function at the specific layer.

The parameter of the transposed CNN at each layer of the context decoding neural network should comply with provisions in Table B.2 to Table B.7. The input of the context decoding neural network is a transform-domain coefficient with 16 CNN channels and 16 dimensions per CNN channel. The output is the selected information of the base range coding table with 16 CNN channels and 64 dimensions per CNN channel.

7.3.3.5 Base Range Coding Table Selection

A corresponding table is selected from several base range coding tables based on the decoded context information. A table corresponding to base range coding is selected from the several base range coding tables based on the decoded context information. Range decoding is performed on the base range coded bitstream, to obtain a quantized transform-domain coefficient of the base neural network.

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A base range coding table selection process may be represented as follows: For each dimension of the transform-domain coefficient of the base coding neural network, a minimum standard deviation greater than or equal to corresponding decoding context information is searched for in a standard deviation table corresponding to the base range coding, and an index corresponding to the standard deviation is a base range coding table index. The standard deviation table corresponding to the base range coding should comply with provisions in Table B.8.

Code tables used for the base range coding are several pre-trained fixed code tables, and should comply with provisions in Table B.9.

7.3.3.6 Base Range Decoding

The base part of the range coded bitstream is decoded based on the base coding table selected in section 7.3.3.5, to obtain a quantization index of the transform-domain coefficient of the base neural network. The quantization index of the transform-domain coefficient of the base neural network is obtained in a basic configuration, and a quantization index of an MDCT spectral coefficient is obtained in a low-complexity configuration.

7.3.3.7 Inverse Quantization of the Transform-Domain Coefficient of the Base Neural Network

Inverse quantization is performed on the quantization index of the transform-domain coefficient of the base neural network, to obtain a quantized transform-domain coefficient of the base neural network. The linear scalar quantization is used as the quantization method. Inverse quantization is performed on the quantization index of the transform-domain coefficient of the base neural network in the basic configuration, to obtain a quantized transform-domain coefficient of the base neural network. Inverse quantization is performed on the quantization index of the MDCT spectral coefficient in the low-complexity configuration, to obtain a quantized MDCT spectral coefficient.

7.3.3.8 Noise Filling

Noise filling adds noise to the quantized transform-domain coefficient of the base neural network obtained at the decoder, to compensate for quantized noise introduced in the quantization process.

For each channel of each frame, a quantization index nfParamQIdx of the noise filling parameter may have one or two values. If there is one group in the MDCT spectrum, nfParamQIdx has one value. If there are two groups in the MDCT spectrum, nfParamQIdx has two values.

The following noise filling process is performed on the transform-domain coefficient of the base neural network corresponding to each group:

generating a noise component noise randomly distributed in a range of [–1, 1];

multiplying the noise component noise by a noise filling parameter nfParamQ to obtain an adjusted noise component. The noise filling parameter nfParamQ is obtained by dequantizing the quantization index nfParamQIdx. Refer to formula (3).

$$nfParamQ = \frac{nfParamQIdx}{23.34} \tag{3}$$

If the transform-domain coefficient of the base neural network is quantized to 0, it is filled with the adjusted noise component.

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For the low-complexity configuration, noise is added to the quantized MDCT spectral coefficient obtained at the decoder, to compensate for quantized noise introduced in the quantization process.

7.3.3.9 Scale Adjustment

In the basic configuration, scale adjustment is performed on a coefficient obtained through the base neural network transform. The basic process of scale adjustment is as follows:

A dequantized scale adjustment factor featureScale is obtained based on a feature amplification flag isFeatAmplified and a scale factor quantization index scaleQIdx. Pseudocode of this process is shown as follows:

```
if (isFeatAmplified == 0){
    featureScale = scaleQIdx / 127.0
}else {
    featureScale = pow(10.0, scaleQIdx / 86.0);
}
```

The transform-domain coefficient of the base neural network is divided by the scale factor featureScale to obtain a transform-domain coefficient after the scale adjustment.

In the low-complexity configuration, scale adjustment is performed on an MDCT spectral coefficient obtained through the noise filling. The basic process of scale adjustment is as follows:

A dequantized scale adjustment factor featureScale is obtained based on a scale factor quantization index scaleQIdxLc. For details about featureScale calculation, refer to formula (4).

$$featureScale = 10^{(scaleQIdxLc - 255.0)/31.875} \quad (4)$$

A decoded MDCT coefficient obtained through the noise filling is divided by the scale factor featureScale to obtain a decoded MDCT coefficient.

7.3.3.10 Base Decoding Neural Network

The transform-domain coefficient of the base neural network obtained through the scale adjustment is input into the base decoding neural network to calculate the MDCT spectrum reconstructed at the decoder. The CNN is the basic structure of the base decoding neural network.

The structure parameter of the base decoding neural network should comply with provisions in Table 16.

Table 16 Structure parameter of base decoding neural network

Item	Value
Number of CNN layers	4
Convolution kernel size	5, 5, 5, 5

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Table 16 (continued)

Item	Value
Stride	2, 2, 2, 2
Number of channels	8, 4, 2, 1
Activation function	IGDN, IGDN, IGDN, None
HasBias	1, 1, 1, 1

Stride specifies a convoluted step parameter of the CNN. HasBias indicates whether there is an offset parameter at the specific layer. "1" indicates yes. "0" indicates no. Inverse generalized divisive normalization (IGDN) [1] is used as the activation function. None indicates that there is no activation function at the specific layer.

The parameter of the transposed CNN at each layer of the base decoding neural network should comply with provisions in Table B.10 to Table B.23.

7.4 Syntax, Semantics, and Decoding Process of Spectrum Inverse Grouping

7.4.1 Syntax

The syntax of spectrum inverse grouping should comply with provisions in Table 17.

Table 17 Syntax of spectrum inverse grouping

Syntax of spectrum inverse grouping	Number of bits	Mnemonic
DecodeGroupBits() {		
if(transformType == 0x1) {		
numGroups	**1**	**uimsbf**
numGroups += 1		
if(numGroups == 2) {		
for (i = 0; i < 8; i++) {		
groupIndicator[i]	**1**	**uimsbf**
}		
}		
} else {		
numGroups = 1		
for (i = 0; i < 8; i++) {		
groupIndicator[i] = 0		
}		

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Syntax of spectrum inverse grouping	Number of bits	Mnemonic
}		
}		

7.4.2 Semantics

numGroups — 1 bit. It indicates the number of groups in the MDCT spectrum of the current frame.

groupIndicator — 1 bit. It indicates to which group the i-th block of the current short frame belongs. 0 indicates the transient group. 1 indicates the other group.

7.4.3 Decoding Process

The basic idea of MDCT spectrum grouping is as follows: When the windowed control parameter is a short window, the MDCT spectrum corresponding to each short window is called a short block. The MDCT spectra of eight short blocks are divided into two groups: a transient group including transient short blocks and the other group excluding transient short blocks. The MDCT spectra of the two groups are separately interleaved and concentrated into a 1024-point MDCT spectrum (consistent with the length of a long-frame spectrum). Then neural network transform, quantization, and range coding are performed on it.

A process of spectrum inverse grouping at the decoder is as follows: For a short frame, if the number of groups numGroups of the current frame is equal to 2, intra-group de-interleaving is performed on the MDCT spectra of the two groups obtained through decoding (de-interleaving is performed on MDCT coefficients of the transient group and MDCT coefficients of the other group separately), to obtain MDCT spectra of the eight short blocks obtained through intra-group de-interleaving, and inverse grouping arrangement is performed on the MDCT spectra of the eight short blocks obtained through intra-group de-interleaving based on a position indicated by groupIndicator, to obtain MDCT spectra of the eight short blocks arranged according to a sequence.

The MDCT spectra obtained through spectrum inverse grouping are used as the input of the upmixing in each mode.

An example is shown as follows:

The numGroups of the current short frame is equal to 2, and groupIndicator is [1, 1, 1, 0, 0, 0, 1, 1]. In other words, the fourth, the fifth, and the sixth short blocks in the eight short blocks in the current frame are transient blocks, and the first, the second, the third, the seventh, and the eighth short blocks are other blocks.

In this case, the grouped MDCT spectra obtained through decoding are arranged according to a sequence of [4, 5, 6, 1, 2, 3, 7, 8]. The spectra of the transient group (including the fourth, the fifth, and the sixth short blocks) are placed ahead of the spectra of the other group (including the first, the second, the third, the seventh, and the eighth short blocks).

Recovering the normal spectrum sequence means to arrange the spectrum of each short block according to a time sequence. Specifically, the grouped MDCT spectra obtained through decoding are rearranged according to the sequence indicated by groupIndicator, to obtain spectral coefficients arranged according to a sequence from the first to the eighth short blocks.

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7.5 Syntax, Semantics, and Decoding Processes of Dual-channel Stereo Bit Allocation and Upmixing

7.5.1 Syntax

The syntax of dual-channel stereo side information should comply with provisions in Table 18.

Table 18 Syntax of dual-channel stereo side information

Syntax of dual-channel stereo side information	Number of bits	Mnemonic
DecodeStereoSideBits() {		
if(useMcr == 0) {		
isMs	**1**	**uimsbf**
if(isMs == 1) {		
ILD	**4**	**uimsbf**
}		
bitsRatio	**3**	**uimsbf**
}		
if(useMcr == 1) {		
for(i = 0; i < vqVecNum[isShortWin]; i++) {		
vqIdx[0][i]	**Note 1**	**uimsbf**
vqIdx[1][i]	**Note 2**	**uimsbf**
}		
}		
}		
Notes 1 and 2: The numbers of bits of vqIdx[0][i] and vqIdx[1][i] are equal to that of vqNumBits[isShortWin].		

7.5.2 Semantics

useMcr — It indicates whether MCR dual-channel stereo processing is used. When the dual-channel stereo bit rate is less than or equal to 32 kb/s, useMcr is equal to 1. When the dual-channel stereo bit rate is greater than 32 kb/s, useMcr is equal to 0.

isMs — 1 bit. It indicates whether M/S dual-channel stereo processing is enabled for the current frame.

ILD — 4 bits. It indicates an amplitude difference between the left and right channels.

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bitsRatio	3 bits. It indicates a bit allocation ratio of two downmixed channels.
isShortWin	It indicates whether the left channel is a short window. If the left channel is a short window, isShortWin is equal to 1. If not, isShortWin is equal to 0.
vqVecNum[isShortWin]	It indicates the number of sub-vectors in vector quantization of the MCR rotation angle parameters, and is determined by isShortWin that indicates whether the left channel is a short window.
vqIdx[0][i]	It indicates a vector quantization index of the i-th sub-vector in the MCR rotation angle parameter vector corresponding to the even-number MDCT spectrum.
vqIdx[1][i]	It indicates a vector quantization index of the i-th sub-vector in the MCR rotation angle parameter vector corresponding to the odd-number MDCT spectrum.

7.5.3 Decoding Process

7.5.3.1 Overview

The dual-channel stereo upmixing includes the MCR and M/S upmixing modes. The MCR upmixing mode includes MCR side information decoding and MCR upmixing. The M/S upmixing mode includes M/S bit allocation and M/S upmixing. When the MCR upmixing mode is used, MDCT spectrum information transmitted in the bitstream is only MDCT spectrum information of one channel obtained through MCR rotation processing. MDCT spectra of two channels need to be recovered based on side information of the MCR dual-channel stereo mode transmitted in the bitstream. When the M/S upmixing mode is used, the side information of the dual-channel stereo mode transmitted in the bitstream is used to obtain information such as a flag that indicates whether M/S downmixing is enabled for the current frame, an amplitude difference between left and right channels, and a bit allocation ratio of a downmixed channel. After other side information in the current frame is removed, the total number of bits of the remaining information for quantization and coding as well as the bit allocation ratio information are used to calculate the respective downmixed bit allocation results channelBytes of the two channels. Range decoding, inverse quantization, and inverse neural network transform are performed on the bit allocation results to obtain the decoded MDCT coefficients of the downmixed channels. M/S upmixing is performed based on the isMs flag, and energy adjustment is performed based on ILD information, to obtain the decoded MDCT coefficients of the left and right channels.

7.5.3.2 MCR Side Information Decoding

The MCR side information is MCR rotation angle parameters of odd and even spectra of core bands. The core band is specified as a spectrum below a start frequency of a high-frequency spectrum in section 7.9.3.6. In the MCR upmixing mode, MCR processing is performed only on the MDCT spectra of the left and right channels. The decoding process should comply with the requirements of couple_channel_element() decoding in section 7.4 in GB/T 33475.3-2018. The MDCT spectra of the left and right channels are divided into the odd and even spectra, each of which is further divided into 18 sub-bands. Definitions of sub-band boundary and the number of sub-band frequencies should comply with provisions in Table 19 and Table 20. For example, the first sub-band starts from the sequence number 0 sub-band boundary and ends

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with the sequence number 1 sub-band boundary. The corresponding sub-band boundary covers from the frequency 0 to the frequency 3, and the number of sub-band frequencies is 4.

A configuration of MCR sub-band boundaries should comply with provisions in Table 19.

Table 19 Configuration of MCR sub-band boundaries

Sub-band boundary sequence number	Sub-band boundary
0	0
1	4
2	8
3	12
4	16
5	22
6	28
7	34
8	40
9	48
10	56
11	64
12	76
13	88
14	100
15	116
16	132
17	154
18	176

The configuration of the number of MCR sub-band frequencies should comply with provisions in Table 20.

Table 20 Configuration of the number of MCR sub-band frequencies

Sub-band sequence number	Number of sub-band frequencies
1	4
2	4
3	4

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Sub-band sequence number	Number of sub-band frequencies
4	4
5	6
6	6
7	6
8	6
9	8
10	8
11	8
12	12
13	12
14	12
15	16
16	16
17	22
18	22

The MCR rotation angle parameters are obtained corresponding to odd and even spectra of each sub-band. In the vector quantization of the MCR rotation angle parameters, rotation angle parameters of 18 sub-bands are divided into 6 sub-vectors (that is, vqVecNum is equal to 6), and each sub-vector includes rotation angle parameters of 3 sub-bands.

The vector quantization of the rotation angle parameters has two configurations, which respectively correspond to a short window type and a non-short window type (such as a long window, cut-in window, and cut-out window) of the left channel of the current frame. In other words, isShortWin is equal to 1 or 0. When isShortWin is equal to 1, the number of vector quantization bits of each rotation angle parameter sub-vector is 8 (that is, the numbers of bits of vqIdx[0][i] and vqIdx[1][i] are 8). In other words, the size of the vector quantization code table is 256. The vector quantization code table should comply with provisions in B.154 in GB/T 33475.3-2018. When isShortWin is equal to 0, the number of vector quantization bits of each rotation angle parameter sub-vector is 9 (that is, the numbers of bits of vqIdx[0][i] and vqIdx[1][i] are 9). In other words, the size of the vector quantization code table is 512. The vector quantization code table should comply with provisions in B.155 in GB/T 33475.3-2018.

7.5.3.3 MCR Upmixing

The parameter stereo method is used for MCR upmixing, and only a core band MDCT coefficient of one channel obtained through MCR transform is transmitted. In the decoding process, upmixing needs to be performed based on a core band MDCT coefficient of one channel and MCR side information that are obtained through decoding, to obtain decoded MDCT coefficients of core bands of the left and right channels.

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First, an MDCT spectrum of one channel obtained through the MCR transform obtained by decoding the bitstream is replicated, to obtain the MDCT spectra of the left and right channels obtained through the MCR transform. The inverse MCR transform should comply with the requirements of couple_channel_element() decoding in section 7.4 in GB/T 33475.3-2018, to obtain the core band decoded MDCT spectra of the left and right channels.

7.5.3.4 M/S Bit Allocation

An M/S bit allocation module is mainly used to allocate the remaining available bits after other side information is removed to the two downmixed channels based on the bit allocation ratio parameter obtained by decoding the bitstream. Then, subsequent range decoding, inverse quantization, and inverse neural network transform are performed.

First, the number of remaining available bits after other side information is removed from the current frame is calculated and denoted as availableBits. The following pseudocode is commonly used to calculate availableBits:

```
if (nn_type == 0){

  availableBits = bitsPerFrame - bitsUsed - nChans × (nbits_isFeatAmplified +
nbits_featureScale + nbits_contextNumBytes)
   } else if (nn_type == 1) {

  availableBits = bitsPerFrame - bitsUsed - nChans × (nbits_featureScaleLc +
nbits_contextNumBytes)

}

for (i = 0; i < nChans; i++){

 if (numGroups[i] == 1){

    availableBits -= nbits_nfParam

  }else if (numGroups[i] == 2){

    availableBits -= 2 × nbits_nfParam

  }

}
```

bitsPerFrame indicates the total number of coding bits of the current frame. bitsUsed indicates the number of used side information bits of the current frame. nChans indicates the number of channels (in the dual-channel stereo mode, the number of channels is 2). nbits_isFeatAmplified indicates the number of bits of the isFeatAmplified parameter (fixed to 1). nbits_featureScale indicates the number of bits of the scaleQIdx parameter (fixed to 7). nbits_featureScaleLc indicates the number of bits of the scaleQIdxLc parameter (fixed to 8). nbits_contextNumBytes indicates the number of bits of the contextNumBytes parameter (fixed to 8). numGroups indicates the number of groups of the MDCT spectra of the current frame. nbits_nfParam indicates the number of bits of the noise filling parameter (fixed to 3).

Then, a bit allocation result of the downmixed channel is obtained based on availableBits and bitsRatio:

Byte is the minimum unit used in the current algorithm. Therefore, availableBits needs to be converted into available bytes availableBytes. Refer to formula (5).

$$availableBytes = floor(availableBits / 8) \quad (5)$$

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In the dual-channel stereo mode, the numbers of bytes of two downmixed channels channelBytes[0] and channelBytes[1] are calculated according to formulas (6) and (7).

$$channelBytes[0] = bitsRatio \times floor(availableBytes / (1 << 3)) \quad (6)$$

$$channelBytes[1] = availableBytes - channelBytes[0] \quad (7)$$

(1<<3) indicates the number of groups of allocated bits in the dual-channel stereo mode. In other words, the available bits are divided into eight groups, in which several groups are allocated to one of the two downmixed channels, and other bits are allocated to the other downmixed channel.

7.5.3.5 M/S Upmixing

If isMs that indicates whether M/S dual-channel stereo processing is enabled for the current frame is 1, M/S upmixing needs to be performed on the channel obtained through decoding, to obtain the decoded MDCT spectra of the left and right channels.

For the M/S upmixing, refer to formulas (8) and (9).

$$mdctSpectrum_L = \frac{\sqrt{2}}{2}(mdctSpectrum_M + mdctSpectrum_S) \quad (8)$$

$$mdctSpectrum_R = \frac{\sqrt{2}}{2}(mdctSpectrum_M - mdctSpectrum_S) \quad (9)$$

mdctSpectrum_M and mdctSpectrum_S are decoded MDCT spectra of the two downmixed channels. mdctSpectrum_L and mdctSpectrum_R are decoded MDCT spectra of the left and right channels obtained through M/S upmixing.

After M/S upmixing, inverse ILD processing needs to be performed on the MDCT spectra of the left and right channels to recover the amplitude difference between the left and right channels. The inverse ILD processing is performed as follows:

The amplitude ratio levelRatio of the left and right channels is recovered based on the ILD parameter obtained by decoding the bitstream. Refer to formula (10).

$$levelRatio = (1 << 4) / IldQIdx - 1 \quad (10)$$

(1<<4) is the maximum value range of the ILD parameter.

The amplitude adjustment of the left and right channels is shown in the following pseudocode:

```
if (levelRatio > 1.0) {
  mdctSpectrum_R = levelRatio * mdctSpectrum_R
}else {
  mdctSpectrum_L = (1.0 / levelRatio) * mdctSpectrum_L
}
```

7.6 Syntax, Semantics, and Decoding Processes of Multi-channel Bit Allocation and Upmixing

7.6.1 Syntax

The syntax of multi-channel side information should comply with provisions in Table 21.

Table 21 Syntax of multi-channel side information

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Syntax of multi-channel side information	Number of bits	Mnemonic
DecodeMcSideBits() {		
HasSilFlag	**1**	**uimsbf**
if(HasSilFlag==1) {		
for(i = 0; i < coupleChNum; i++) {		
silFlag[i]	**1**	**uimsbf**
}		
} else {		
for(i = 0; i < coupleChNum; i++) {		
silFlag[i] = 0		
}		
}		
pairCnt	**4**	**uimsbf**
for(i = 0; i < pairCnt; i++) {		
channelPairIndex	**Note**	**uimsbf**
mcIld[ch1]	**5**	**uimsbf**
mcIld[ch2]	**5**	**uimsbf**
}		
for (i = 0; i < coupleChNum; i++) {		
if(silFlag[i] == 0) {		
chBitRatios[i]	**6**	**uimsbf**
}		
}		
}		
Note: The number of bits of channelPairIndex is determined by the number of coupled channels coupleChNum. The calculation formula is: floor(log2(coupleChNum * (coupleChNum – 1)/2 – 1)) + 1. coupleChNum is the number of all channels excluding the LFE channel.		

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7.6.2 Semantics

HasSilFlag	1 bit. It indicates the silence enabling flag. "0" indicates that all channels of the multi-channel signal in the current frame are non-silent channels. "1" indicates that at least one silent channel exists in the channels of the multi-channel signal in the current frame.
silFlag[i]	1 bit. It indicates the silence flag. "0" indicates that the i-th channel of the current frame is a non-silent channel. "1" indicates that the i-th channel of the current frame is a silent channel.
pairCnt	4 bits. It indicates the number of channel pairs in the current frame.
channelPairIndex	The number of bits of channelPairIndex is related to the total number of channels. Refer to Note 1 in the preceding table. It indicates an index of a channel pair. It can be parsed to obtain index values ch1 and ch2 of two channels in the current channel pair.
mcIld	5 bits. It indicates a parameter quantization index of an inter-channel amplitude difference ILD of the first channel and the second channel in the current channel pair, and is used for inter-channel energy adjustment.
chBitRatios	6 bits. It indicates a bit allocation ratio of each channel.

7.6.3 Decoding Process

7.6.3.1 Overview

In the multi-channel mode, the steps of bitstream demultiplexing are as follows: Perform parsing to obtain a silent channel flag and multi-channel side information to guide multi-channel bit allocation, and then perform multi-channel bit allocation. Perform, based on the multi-channel bit allocation result, inverse neural network transform, inverse quantification, and range decoding on encoding information of each channel transmitted in the bitstream, to obtain a downmixed multi-channel signal. Multi-channel decoding processing (that is, multi-channel upmixing) is performed on the downmixed multi-channel signal based on the multi-channel side information, to obtain an upmixed multi-channel signal. Post-decoding processing (that is, bandwidth extension decoding, inverse temporal noise shaping, inverse frequency-domain noise shaping, upmixing, and inverse time-frequency transform) is performed on the upmixed multi-channel signal to obtain a multi-channel signal.

The silent channel flag includes the silence enabling flag and silence flag. The multi-channel side information includes the number of pairs, a pair index, side information of an inter-channel amplitude difference for energy adjustment, and bit allocation ratio information of the downmixed channel determined based on the silent channel flag.

The multi-channel mode includes a bit allocation module and a multi-channel upmixing module.

The bit allocation module is mainly used to calculate respective numbers of bit allocation bytes channelBytes of all demultiplexed channels based on the silent channel flag, the multi-channel bit allocation ratio, and the total number of remaining bits for quantization and range coding after other side information in the current frame is removed. Range decoding, inverse quantization, and inverse neural network transform are performed based on the number of bit

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allocation bytes on a coded bitstream of a downmixed channel of a plurality of channels, to obtain a decoded MDCT coefficient of the downmixed channel of the plurality of channels.

The multi-channel upmixing module is mainly used to perform multi-channel decoding processing (M/S upmixing) based on information such as the number of pairs and the pair index, to obtain an upmixed multi-channel MDCT spectrum. The energy adjustment is performed on the upmixed multi-channel MDCT spectrum based on the mcILD information to obtain a decoded MDCT coefficient of each channel.

The multi-channel bit allocation and channel upmixing module mainly includes bit allocation and multi-channel upmixing.

7.6.3.2 Bit Allocation

Multi-channel bit allocation McBitsAllocation() is mainly used to perform bit allocation on the downmixed multi-channel signal based on the silent channel flag and the bit allocation ratio parameter that are obtained by decoding the bitstream, to obtain the number of coded bits of the downmixed multi-channel signal. The remaining available bits after other side information is removed are allocated to downmixed channels in the plurality of channels. Then, subsequent range decoding, inverse quantization, and inverse neural network transform are performed.

availableBytes is used to indicate the number of remaining available bytes after other side information is removed from the current frame.

In the multi-channel mode, a silent channel may exist. The silent channel does not need to participate in the bit allocation process in the multi-channel mode. A fixed number of bytes are allocated in advance. The number of bytes is 8. If there is a silent channel, the number of pre-allocated bytes of the silent channel is deducted from the number of available bytes availableBytes. After the deduction, the remaining bytes are allocated to channels other than the silent channel.

In the multi-channel mode, an LFE channel may exist. Generally, there is little valid spectrum information of the LFE channel, and it does not need to participate in the bit allocation process in the multi-channel mode, as long as a fixed number of bits are allocated in advance. The number of pre-allocated bits of the LFE channel is related to the coding bit rate. cpeRate indicates an average bit rate of a channel pair. It is the result of converting a total coding bit rate into a channel pair. If cpeRate is less than 64 kb/s, 10 bytes are allocated to the LFE channel. If cpeRate is less than 96 kb/s, 15 bytes are allocated to the LFE channel. If cpeRate is greater than or equal to 96 kb/s, 20 bytes are allocated to the LFE channel. If there is an LFE channel, the number of pre-allocated bytes of the LFE channel is deducted from the number of available bytes availableBytes. After the deduction, the remaining bytes are allocated to channels other than the LFE channel.

The process of allocating the number of available bytes availableBytes to other channels is as follows:

a) The number of safe bytes safeBits is pre-allocated to each channel. The number of safe bytes is 6. The number of safe bytes is deducted from the number of available bytes availableBytes. After the deduction, the remaining bytes availableBytes are allocated in the subsequent steps.

b) Bits are allocated to each channel based on chBitRatios.

   The number of bytes of each channel may be represented by formula (11).

   $$channelBytes[i] = availableBytes * chBitRatios[i] / (1 << 6) \quad (11)$$

   (1<<6) indicates a maximum value range of the channel bit allocation ratio chBitRatios.

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c) If some remaining bytes are not allocated in step 1, they are allocated to each channel again based on the ratio indicated by chBitRatios[i].

d) If there are still remaining bits after step 2, the remaining bits are allocated to the channel with the most bytes allocated in step 1.

e) If the number of bytes allocated to some channels exceeds the upper limit for a single channel, the excessive bytes are allocated to other channels.

7.6.3.3 Upmixing

M/S upmixing is performed on the two coupled channels ch1 and ch2 indicated by the channel pair index channelPairIndex to obtain upmixed MDCT spectra of the coupled channels. The upmixing manner is the same as the M/S upmixing manner in the dual-channel stereo mode.

After the M/S upmixing, inverse ILD processing is performed on the upmixed MDCT spectra of the channels based on mcILD, to obtain an upmixed decoded signal for which the channel amplitude difference is recovered. To recover the channel amplitude difference, pseudocode of the inverse ILD processing is shown as follows:

factor = mcIldCodebook[mcIld[i]]

mdctSpectrum[i] = factor * mdctSpectrum[i]

factor is an amplitude adjustment factor corresponding to an ILD parameter of the i-th channel. mcIldCodebook is a quantization code table of the ILD parameter, and should comply with Table B.26. mcIld[i] indicates a quantization index corresponding to the ILD parameter of the i-th channel. mdctSpectrum[i] indicates an MDCT coefficient vector of the i-th channel.

7.7 HOA Bit Allocation and Upmixing

7.7.1 Syntax

The syntax of HOA side information should comply with provisions in Table 22.

Table 22 Syntax of HOA side information

Syntax of HOA side information	Number of bits	Mnemonic
DecodeHoaSideBits() {		
sceneType	**4**	**uimsbf**
spatialAnalysis	**1**	**uimsbf**
if(spatialAnalysis == 1) {		
numVL	**4**	**uimsbf**
for(i = 0; i < numVL; i++) {		
basisIdx[i]	**12**	**uimsbf**
}		
}		
for(groupIdx = 0; groupIdx < nTotalChanGroups; groupIdx++) {		

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Syntax of HOA side information	Number of bits	Mnemonic
pairIdx[groupIdx]	**4**	**uimsbf**
if(pairIdx[groupIdx] > 0) {		

Table 22 (continued)

Syntax of HOA side information	Number of bits	Mnemonic
for(i = 0; i < pairIdx[groupIdx]; i++) {		
chIdx[groupIdx][i]	**Note**	**uimsbf**
dmxMode[groupIdx][i]	**1**	**uimsbf**
if(dmxMode[groupIdx][i]== 1) {		
for(sfb = 0; sfb < N_SFB_HOA_LBR - 1; sfb++){		
sfbMask[groupIdx][i][sfb]	**1**	**uimsbf**
}		
}		
}		
for(i = 0; i < groupChans[groupIdx]; i++) {		
groupILD[i]	**5**	**uimsbf**
}		
}		
groupBitsRatio[groupIdx]	**4**	**uimsbf**
for(i = 0; i < groupChans[groupIdx]; i++) {		
bitsRatio[groupIdx][i]	**4**	**uimsbf**
}		
}		
}		
Note: The number of bits of chIdx is a round-down value of $(\log_{10}(\text{groupChans} \times (\text{groupChans} - 1)/2 - 1)/\log_{10}2) + 1$.		

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7.7.2 Semantics

sceneType	4 bits. It indicates the sound field type.
spatialAnalysis	1 bit. It indicates the spatial analysis type. "0" indicates that there is no HOA spatial decoding. "1" indicates that there is HOA spatial decoding.
numVL	4 bits. It indicates the number of virtual speaker signals.
basisIdx	12 bits. It indicates a virtual speaker index.
pairIdx	4 bits. It indicates the number of channel pairs.
chIdx	It indicates a channel pair index. The number of bits of chIdx is a round-down value of $(\log_{10}(groupChans \times (groupChans - 1)/2 - 1)/\log_{10}2) + 1$.
groupILD	5 bits. It indicates a quantization index of an ILD parameter in a group.
groupBitsRatio	4 bits. It indicates an inter-group bit allocation ratio parameter.
bitsRatio	4 bits. It indicates an intra-group bit allocation ratio parameter.
dmxMode	1 bit. It indicates a downmixing mode. When dmxMode is 0, it indicates full-band M/S downmixing. When dmxMode is 1, it indicates sub-band M/S downmixing.
sfbMask	1 bit. It indicates whether downmixing is performed on the current sub-band. When sfbMask is 0, it indicates that downmixing is not performed on the current sub-band. When sfbMask is 1, it indicates that downmixing is performed on the current sub-band.
nTotalChanGroups	Preset value. It indicates the number of transmission channel groups, and should comply with provisions in Table 23 to Table 25.
N_SFB_HOA_LBR	Preset value. It indicates the number of sub-bands and is defined as 22.
groupChans	Preset value. It indicates the number of channels in each group, and should comply with provisions in Table 23 to Table 25.

Definitions of values of FOA nTotalChanGroups and groupChans should comply with provisions in Table 23.

Table 23 Definitions of values of FOA nTotalChanGroups and groupChans

Bit rate (kb/s)	Value of nTotalChanGroups	Value of groupChans
96	1	4
128	1	4
192	1	4
256	1	4

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Definitions of values of 2-order HOA nTotalChanGroups and groupChans should comply with provisions in Table 24.

Table 24 Definitions of values of 2-order HOA nTotalChanGroups and groupChans

Bit rate (kb/s)	Value of nTotalChanGroups	Value of groupChans
192	1	9
256	1	9
320	1	9
384	1	9
480	1	9
512	1	9
640	1	9

Definitions of values of 3-order HOA nTotalChanGroups and groupChans should comply with provisions in Table 25.

Table 25 Definitions of values of 3-order HOA nTotalChanGroups and groupChans

Bit rate (kb/s)	Value of nTotalChanGroups	Value of groupChans
256	2	2, 6
320	2	2, 7
384	2	2, 9
512	2	2, 10
640	2	2, 12
896	1	16

7.7.3 Decoding Process

7.7.3.1 Overview

HOA bit allocation and channel upmixing are performed in the core decoder. During HOA decoding, the core decoder parses the core decoder side information from the bitstream, performs bit allocation HoaSplitBytesGroup() on the virtual speaker signal and the residual signal, and decodes the virtual speaker signal and residual signal based on the bitstream. Then, HOA decoding processing Avs3HoaInverseDMX() is performed on the virtual speaker signal and the residual signal. Finally, post-decoding processing is performed, including bandwidth extension for the virtual speaker signal and the residual signal, temporal noise shaping decoding, frequency-domain noise shaping decoding, and MDCT inverse transform, to obtain a time-domain transport channel signal. The following describes in detail the bit allocation HoaSplitBytesGroup() on the virtual speaker signal and the residual signal, and

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decoding processing Avs3HoaInverseDMX() on the virtual speaker signal and the residual signal.

7.7.3.2 Bit Allocation

The transport channel obtained through decoding by the core decoder consists of the virtual speaker signal and the residual signal, and is divided into nTotalChanGroups groups. In the decoding process, the following two parameters are obtained by parsing the bitstream: groupBitsRatio and bitsRatio. groupBitsRatio[groupIdx] occupies four bits, and indicates an inter-group bit allocation ratio parameter of the groupIdx-th group. The bit allocation ratio of the virtual speaker signal group and the bit allocation ratio of the residual signal group can be obtained through bit allocation. bitsRatio[groupIdx][i] occupies 4 bits, and indicates a bit allocation ratio parameter of the i-th channel in the groupIdx-th group. Therefore, a bit allocation ratio of each virtual speaker signal group in all virtual speaker signal groups and a bit allocation ratio of each residual signal group in all residual signal groups can be obtained.

Bit allocation is mainly used to allocate the remaining available bits after other side information is removed, to each transport channel based on the bit allocation ratio parameter obtained by decoding the bitstream. The coding of other side information also occupies bits.

First, the number of remaining available bits after other side information is removed from the current frame is calculated and denoted as availableBits. The general algorithm for calculating availableBits is expressed as availableBits = bitsPerFrame – bitsUsed. bitsPerFrame indicates the number of initial bits of each frame. bitsUsed indicates the number of occupied bits before bit allocation.

HOA bit allocation HoaSplitBytesGroup() is calculated as follows:

First, the number of bits groupBytes[groupIdx] of each group of channels is calculated based on the total number of available bits availableBits and groupBitsRatio[groupIdx]. Refer to formula (12).

$$groupBytes[groupIdx] = availableBits \times \frac{groupBitsRatio[groupIdx]}{\sum_{k=0}^{nTotalChanGroups-1} groupBitsRatio[k]} \quad (12)$$

$\frac{\mathrm{groupBitsRatio[groupIdx]}}{\sum_{\mathrm{k=0}}^{\mathrm{nTotalChanGroups-1}} \mathrm{groupBitsRatio[k]}}$ indicates a bit allocation ratio of a virtual speaker signal group in all transmission channel signals, or indicates a bit allocation ratio of a residual signal group in all transmission channel signals.

Then, the number of bits bytesChannels[groupIdx][i] of each channel is calculated based on bitsRatio[groupIdx][i]. Refer to formula (13).

$$bytesChannels[groupIdx][i] = groupBytes[groupIdx] \times \frac{bitsRatio[groupIdx][i]}{\sum_{k=0}^{groupChans[groupIdx]-1} bitsRatio[groupIdx][k]} \quad (13)$$

groupBytes[groupIdx] indicates the total number of allocated bits of the virtual speaker signal group. $\frac{\mathrm{bitsRatio[groupIdx][i]}}{\sum_{\mathrm{k=0}}^{\mathrm{groupChans[groupIdx]-1}} \mathrm{bitsRatio[groupIdx][k]}}$ indicates a bit allocation ratio of each virtual speaker signal in the virtual speaker signal group. bytesChannels[groupIdx][i] indicates the number of bits of each virtual speaker signal.

Alternatively, groupBytes[groupIdx] indicates the total number of allocated bits of the residual signal group. $\frac{\mathrm{bitsRatio[groupIdx][i]}}{\sum_{\mathrm{k=0}}^{\mathrm{groupChans[groupIdx]-1}} \mathrm{bitsRatio[groupIdx][k]}}$ indicates a bit allocation ratio of each residual signal in the residual signal group. bytesChannels[groupIdx][i] indicates the number of bits of each residual signal. Through the foregoing process, the numbers of bits of each group

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of virtual speaker signals and residual signals can be calculated, and the virtual speaker signals and the residual signals in the bitstream are decoded.

7.7.3.3 Upmixing

HOA decoding processing Avs3HoaInverseDMX() is performed by decoding the channel pair information based on chIdx. chIdx is a sequence number of an upper triangular matrix element (excluding the main diagonal element) formed by a channel pair. Therefore, chIdx can be used to determine the coupled channels. For example, when the number ch of channels is 4, for the Matrix matrix, refer to formulas (14) and (15).

$$Matrix = \begin{bmatrix} (ch0ch1) & (ch0ch2) & (ch0ch3) & (ch0ch4) \\ & (ch1ch2) & (ch1ch3) & (ch1ch4) \\ & & (ch2ch3) & (ch2ch4) \\ & & & (ch3ch4) \end{bmatrix} \tag{14}$$

$$chIdx = \begin{bmatrix} 0 & 1 & 2 & 3 \\ & 4 & 5 & 6 \\ & & 7 & 8 \\ & & & 9 \end{bmatrix} \tag{15}$$

If chIdx = 0, the result that ch0 and ch1 are coupled can be obtained through parsing.

If dmxMode is full-band M/S downmixing, the value of sfbMask of each sub-band is set to 1. If dmxMode is sub-band M/S downmixing, the value of sub-band sfbMask is obtained by parsing the bitstream. If the value of sub-band sfbMask is 1, upmixing is performed to obtain upmixed channels Y1 and Y2. For the M/S upmixing, refer to formulas (16) and (17).

$$Y1 = \frac{\sqrt{2}}{2}(ch0 + ch1) \tag{16}$$

$$Y2 = \frac{\sqrt{2}}{2}(ch0 - ch1) \tag{17}$$

Finally, inverse ILD processing is performed on the upmixed channels. The processing method is the same as that in section 7.6.3.3.

This process is repeated to obtain an upmixed virtual speaker signal obtained through the inverse ILD processing and an upmixed residual signal obtained through the inverse ILD processing. Then, post-decoding processing Avs3PostSynthesis() is performed to obtain the virtual speaker signal and the residual signal. The virtual speaker signal and the residual signal are used as inputs to the HOA spatial decoder.

7.8 Syntax, Semantics, and Decoding Process of Post-decoding Processing

7.8.1 Syntax

The syntax of post-decoding processing should comply with provisions in Table 26.

Table 26 Syntax of post-decoding processing

Syntax of post-decoding processing	Number of bits	Mnemonic
Avs3PostSynthesis() {		

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Syntax of post-decoding processing	Number of bits	Mnemonic
if(bwePresent == 1) {		
BweApplyDec()		
}		
TnsDec()		
Avs3FdInvSpectrumShaping()		
if(transformType == 0x1) {		
MdctSpectrumDeinterleave()		
}		
Avs3InverseMdctDecoder()		
}		

7.8.2 Semantics

BweApplyDec()	Bandwidth extension decoding processing
TnsDec()	Temporal noise shaping decoding processing
Avs3FdInvSpectrumShaping()	Frequency-domain noise shaping decoding processing
MdctSpectrumDeinterleave()	Short frame MDCT spectrum de-interleaving
Avs3InverseMdctDecoder()	Inverse MDCT transform

7.8.3 Decoding Process

Avs3PostSynthesis(): When bandwidth extension is enabled, bandwidth extension decoding processing is performed, and then temporal noise shaping decoding processing and frequency-domain noise shaping decoding processing are performed. When the windowed control parameter indicates a short window, MDCT spectrum de-interleaving is further performed. Finally, inverse MDCT transform is performed to obtain a time-domain reconstructed signal.

7.9 Syntax, Semantics, and Decoding Process of Bandwidth Extension Decoding

7.9.1 Syntax

The syntax of bandwidth extension decoding side information should comply with provisions in Table 27.

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Table 27 Syntax of bandwidth extension decoding side information

Syntax of bandwidth extension decoding side information	Number of bits	Mnemonic
DecodeBweSideBits() {		
for(i = 0; i < numSfb; i++) {		
sfbEnvQIdx	**7**	**uimsbf**
}		
for(i = 0; i < numTiles; i++) {		
flag_whiten_ONOFF	**1**	**uimsbf**
if(flag_whiten_ONOFF == 0) {		
whiteningLevel[i] = BWE_WHITENING_OFF		
} else {		
flag_whiten_MID_HIGH	**1**	**uimsbf**
if(flag_whiten_MID_HIGH == 0) {		
whiteningLevel[i] = BWE_WHITENING_MID		
} else {		
whiteningLevel[i] = BWE_WHITENING_HIGH		
}		
}		
}		
}		

7.9.2 Semantics

sfbEnvQIdx — 7 bits. It indicates a quantization index of an envelope parameter of each SFB in a frequency band of bandwidth extension. The envelope parameter of each SFB in the frequency band of bandwidth extension can be obtained from this variable.

flag_whiten_ONOFF — 1 bit. It indicates whether whitening is enabled for each frequency area in the frequency band of bandwidth extension. 0 indicates that whitening is disabled. 1 indicates that whitening is enabled.

flag_whiten_MID_HIGH — 1 bit. It indicates the whitening level of each frequency area in the frequency band of bandwidth extension. 0 indicates that the whitening level is medium (MID) and 1 indicates that the whitening level is high (HIGH).

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sfbEnvQIdx	7 bits. It indicates a quantization index of an envelope parameter of each SFB in a frequency band of bandwidth extension. The envelope parameter of each SFB in the frequency band of bandwidth extension can be obtained from this variable.
numSfb	It indicates the total number of SFBs in the frequency band of bandwidth extension. Refer to section 7.9.3.6 Bandwidth Extension Configuration Parameters.
numTiles	It indicates the total number of frequency areas in the frequency band of bandwidth extension.
whiteningLevel[i]	It indicates a whitening level parameter of the i-th frequency area in the frequency band of bandwidth extension.

7.9.3 Decoding Process

7.9.3.1 Overview

The bandwidth extension at the decoder is mainly used to recover the MDCT spectrum of the frequency band of bandwidth extension based on the core band MDCT spectrum and the bandwidth extension parameter obtained through decoding. The bandwidth extension algorithm at the decoder covers spectrum preparation for bandwidth extension, whitening, and envelope adjustment. The details are as follows.

7.9.3.2 Spectrum Preparation for Bandwidth Extension

The core band MDCT spectrum obtained through decoding is mdctSpectrum. The MDCT spectrum of the frequency band of bandwidth extension is bweSpectrum. The start point of the source frequency area corresponding to each target frequency area in the frequency band of bandwidth extension is srcTiles[numTiles]. The boundary of each target frequency area in the spectrum of bandwidth extension is targetTiles[numTiles+1].

The basic process of spectrum preparation: Use srcTiles as the start point, replicate the core band MDCT spectrum obtained through decoding to the frequency area (the boundary of the frequency area is targetTiles) corresponding to the high frequency band of bandwidth extension.

The process of spectrum replication is shown in the following pseudocode:

```
for (tileIdx = 0; tileIdx < numTiles; tileIdx++){
  srcLineIdx = srcTiles[tileIdx]
  for (i = targetTiles[tileIdx]; i < targetTiles[tileIdx+1]; i++){
    bweSpectrum[i] = mdctSpectrum[srcLineIdx]
    srcLineIdx++
  }
}
```

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7.9.3.3 Whitening

When spectrum features of the source and the target frequency areas are different, the replicated high-frequency spectrum component needs to be whitened to different extents, so that the spectrum features of the frequency band of bandwidth extension are more similar to those of the original high-frequency spectrum (for example, the spectrum component is closer to harmonic or noise features).

Spectrum whitening is classified into three levels: BWE_WHITENING_OFF, BWE_WHITENING_MID, and BWE_WHITENING_HIGH, respectively corresponding to the following spectrum processing methods:

whitenedSpectrum indicates the whitened MDCT spectrum.

BWE_WHITENING_OFF indicates whitening is not performed. That is, the replicated spectrum (bweSpectrum) is directly used as the whitened spectrum.

BWE_WHITENING_MID: The whitening level is medium. In a basic manner of medium spectrum whitening, the moving average algorithm is used for processing on bweSpectrum to obtain the whitened MDCT spectrum.

For the moving average algorithm, refer to formula (18).

$$whitenedSpectrum[i] = \left(\frac{1}{2*AvgSize+1}\sum_{i-AvgSize}^{i+AvgSize}(bweSpectrum[i])^2\right)^{1/2} \quad (18)$$

AvgSize indicates the size of the moving average processing neighborhood. In the moving average processing on a frequency i, the average amplitude is actually calculated for the frequency in the range of [i–AvgSize, i+AvgSize].

BWE_WHITENING_HIGH indicates that the whitening level is high. At this level, random noise of a certain amplitude is generated to replace bweSpectrum obtained through spectrum replication, so as to obtain a high-frequency spectrum component with a strong noise feature.

7.9.3.4 Envelope Adjustment

The envelope adjustment is used to adjust the amplitude of the whitened spectrum based on envelope information of each SFB in the high-frequency band obtained by decoding the bitstream, so that the energy of the high-frequency spectrum recovered by the bandwidth extension module keeps consistent with that of the original high-frequency spectrum.

For each SFB of the bandwidth extension spectrum, basic steps of the envelope adjustment algorithm are as follows:

Calculate the frequency band width sfbWidth. Refer to formula (19).

$$sfbWidth = sfbTable[sfbIdx + 1] - sfbTable[sfbIdx] \quad (19)$$

sfbTable indicates the frequency band division table of bandwidth extension and sfbIdx indicates the frequency band sequence number.

Calculate the energy currEner of the whitened spectrum of the current SFB. Refer to formula (20).

$$currEner = \frac{1}{sfbWidth}\sum_{i=sfbStart}^{sfbEnd-1}(whitenedSpectrum[i])^2 \quad (20)$$

sfbStart indicates the start point of the current SFB. sfbEnd indicates the end point of the current SFB. Values of sfbStart and sfbEnd are respectively shown in formulas (21) and (22).

$$sfbStart = sfbTable[sfbIdx] \quad (21)$$

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$$sfbEnd = sfbTable[sfbIdx + 1] \quad (22)$$

Calculate the energy $targetEner$ of the target spectrum of the current SFB based on the SFB envelope parameter transmitted in the bitstream. Refer to formula (23).

$$targetEner = 2.0^{\frac{sfbEnvQIdx[sfbIdx]}{4.24966} - 4.0} \quad (23)$$

Calculate the spectrum gain of the current SFB based on the energy of the whitened and the target spectra. The pseudocode is as follows:

```
if (currEner != 0.0){
   gainSfb = sqrt(targetEner / currEner)
}else{
   gainSfb = 1.0
}
```

Multiply the spectrum gain of the current SFB by the whitened spectrum to obtain the high-frequency spectrum recovered according to the bandwidth extension algorithm.

7.9.3.5 Conditions for Enabling Bandwidth Extension

The conditions for enabling the bandwidth extension vary depending on mono, dual-channel stereo, multi-channel, and other signal forms.

Mono mode: enabled when the coding bit rate is less than or equal to 96 kb/s.

Dual-channel stereo mode: enabled when the coding bit rate is less than or equal to 128 kb/s.

Multi-channel mode: enabled when the equivalent dual-channel stereo coding bit rate is less than or equal to 128 kb/s. The equivalent dual-channel stereo coding bit rate is calculated by multiplying the average coding bit rate by 2. The average coding bit rate is the coding bit rate divided by the number of channels (excluding LFE channels).

FOA/HOA mode: enabled when the FOA coding rate is less than or equal to 256 kb/s, enabled when the 2-order HOA coding rate is less than or equal to 480 kb/s, and enabled when the 3-order HOA coding rate is less than or equal to 896 kb/s (disabled for the virtual speaker signal group, and enabled for the residual signal group when the 3-order HOA is less than or equal to 640 kb/s).

7.9.3.6 Bandwidth Extension Configuration Parameters

Bandwidth extension divides the high-frequency spectrum into several SFBs. One frequency area is formed by one or more SFBs. Each high-frequency area, or referred to as a target frequency area, has a corresponding low-frequency area, or referred to as a source frequency area, which is used to replicate the spectrum from the low-frequency band to the high-frequency band at the decoder.

Based on this algorithm framework, the bandwidth extension configuration parameters are as follows:

a) The SFB division manner should comply with provisions in Tables 28 to 31. N_SFB indicates the number of SFBs. sfbStart n indicates the start point of the n-th SFB. sfbStart 1 indicates a frequency sequence number corresponding to the start frequency of the high-frequency spectrum.

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b) The target frequency area division manner should comply with provisions in Tables 32 to 35. N_tT indicates the number of target frequency areas. targetTile n indicates the start point of the n-th target frequency area.

c) The source frequency area division manner should comply with provisions in Tables 36 to 39. srcTile n indicates the start point of the n-th source frequency area.

d) The manner in which the high frequency band constitutes the target frequency area should comply with provisions in Tables 40 to 43. tT_SFB n is the SFB sequence number corresponding to the start point of the n-th target frequency area.

The meanings and examples of these configuration tables are explained as follows: The configuration of a mono with a bit rate of 32 kb/s or lower is used as an example.

In Table 28, the high-frequency spectrum is divided into six SFBs. The start point of the frequency range corresponding to the SFB 1 is 352 (that is, the 352nd MDCT frequency), and the end point is 415 (that is, 416 minus 1 in the table). The start point of the frequency range corresponding to the SFB 2 is 416, and the end point is 479 (that is, 480 minus 1 in the table). The remaining parameters are derived accordingly.

In Table 32, the high-frequency spectrum is divided into three target frequency areas. The start point of the frequency range corresponding to the TFA 1 is 352 (that is, the 352nd MDCT frequency), and the end point is 479 (that is, 480 minus 1 in the table). The start point of the frequency range corresponding to the TFA 2 is 480, and the end point is 607 (that is, 608 minus 1 in the table). The remaining parameters are derived accordingly.

In Table 36, the spectrum is also divided into three source frequency areas corresponding to the high-frequency areas. The start point of the SFA 1 is 64 (that is, the 64th MDCT frequency), and the start point of the SFA 2 is 96. The bandwidth of the source frequency area is the same as that of the corresponding target frequency area.

In Table 40, the correspondence between the target frequency area and the high frequency band is as follows: The TFA 1 includes the SFB 0 and the SFB 1, the TFA 2 includes the SFB 2 and the SFB 3, and the TFA 3 includes the SFB 4 and the SFB 5.

The configuration of the mono high-frequency SFB should comply with provisions in Table 28.

Table 28 Table of configuration of mono high-frequency SFB

kb/s	N_SFB	sfbStart 1	sfbStart 2	sfbStart 3	sfbStart 4	sfbStart 5	sfbStart 6	sfbStart 7
<=32	6	352	416	480	544	608	672	768
(32, 56]	6	448	496	544	608	672	736	832
(56, 72]	4	544	608	672	736	832		
(72, 96]	2	672	736	832				

The configuration of the dual-channel stereo high-frequency SFB should comply with provisions in Table 29.

Table 29 Table of configuration of dual-channel stereo high-frequency SFB

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kb/s	N_SFB	sfbStart 1	sfbStart 2	sfbStart 3	sfbStart 4	sfbStart 5	sfbStart 6	sfbStart 7
<=48	6	352	416	480	544	608	672	768
(48, 64]	6	352	416	480	544	608	672	768
(64, 96]	4	544	608	672	736	832		
(96, 128]	2	672	736	832				

The configuration of the multi-channel high-frequency SFB should comply with provisions in Table 30.

Table 30 Table of configuration of multi-channel high-frequency SFB (bit rates are converted to channel pairs)

kb/s	N_SFB	sfbStart 1	sfbStart 2	sfbStart 3	sfbStart 4	sfbStart 5	sfbStart 6	sfbStart 7
<=56	6	352	400	448	512	576	672	768
(56, 75]	5	400	448	512	576	672	768	
(75, 108]	4	544	608	672	736	832		
(108, 128]	2	672	736	832				

The configuration of the HOA high-frequency SFB should comply with provisions in Table 31.

Table 31 Table of configuration of HOA high-frequency SFB (HOA2/HOA3 is a 2-order HOA/3-order HOA)

kb/s	N_SFB	sfbStart 1	sfbStart 2	sfbStart 3	sfbStart 4	sfbStart 5	sfbStart 6	sfbStart 7
192 (HOA2)	4	352	416	480	544	736		
<=128 (FOA) 256 (HOA2) [256, 384] (HOA3)	6	384	448	512	576	672	736	832

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kb/s	N_SFB	sfbStart 1	sfbStart 2	sfbStart 3	sfbStart 4	sfbStart 5	sfbStart 6	sfbStart 7
192 (FOA) 320 (HOA2) 512 (HOA3)	4	544	608	672	736	832		
256 (FOA) [384, 480] (HOA2) [640, 896] (HOA3)	2	672	736	832				

The configuration of the mono target frequency area should comply with provisions in Table 32.

Table 32 Table of configuration of mono target frequency area

kb/s	N_tT	targetTile 1	targetTile 2	targetTile 3	targetTile 4
<=32	3	352	480	608	768
(32, 56]	3	448	544	672	832
(56, 72]	2	544	672	832	
(72, 96]	1	672	832		

The configuration of the dual-channel stereo target frequency area should comply with provisions in Table 33.

Table 33 Table of configuration of dual-channel stereo target frequency area

kb/s	N_tT	targetTile 1	targetTile 2	targetTile 3	targetTile 4
<=48	3	352	480	608	768
(48, 64]	3	352	480	608	768
(64, 96]	2	544	672	832	
(96, 128]	1	672	832		

The configuration of the multi-channel target frequency area should comply with provisions in Table 34.

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Table 34 Table of configuration of multi-channel target frequency area (bit rates are converted to channel pairs)

kb/s	N_tT	targetTile 1	targetTile 2	targetTile 3	targetTile 4
<=56	3	352	448	576	768
(56, 75]	3	400	512	672	768
(75, 108]	2	544	672	832	
(108, 128]	1	672	832		

The configuration of the HOA target frequency area should comply with provisions in Table 35.

Table 35 Table of configuration of HOA target frequency area (HOA2/HOA3 is a 2-order HOA/3-order HOA)

kb/s	N_tT	targetTile 1	targetTile 2	targetTile 3	targetTile 4
192 (HOA2)	2	352	480	736	
<=128 (FOA) 256 (HOA2) [256, 384] (HOA3)	3	384	512	672	832
192 (FOA) 320 (HOA2) 512 (HOA3)	2	544	672	832	
256 (FOA) [384, 480] (HOA2) [640, 896] (HOA3)	1	672	832		

The configuration of the mono source frequency area should comply with provisions in Table 36.

Table 36 Table of configuration of mono source frequency area

kb/s	srcTile 1	srcTile 2	srcTile 3	srcTile 4
<=32	64	96	144	
(32, 56]	96	144	192	
(56, 72]	144	192		
(72, 96]	192			

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The configuration of the dual-channel stereo source frequency area should comply with provisions in Table 37.

Table 37 Table of configuration of dual-channel stereo source frequency area

kb/s	srcTile 1	srcTile 2	srcTile 3	srcTile 4
<=48	64	96	144	
(48, 64]	64	96	144	
(64, 96]	144	192		
(96, 128]	192			

The configuration of the multi-channel source frequency area should comply with provisions in Table 38.

Table 38 Table of configuration of multi-channel source frequency area (bit rates are converted to channel pairs)

kb/s	srcTile 1	srcTile 2	srcTile 3	srcTile 4
<=56	64	96	144	
(56, 75]	64	96	144	
(75, 108]	144	192		
(108, 128]	192			

The configuration of the HOA source frequency area should comply with provisions in Table 39.

Table 39 Table of configuration of HOA source frequency area (HOA2/HOA3 is a 2-order HOA/3-order HOA)

kb/s	srcTile 1	srcTile 2	srcTile 3	srcTile 4
192 (HOA2)	64	96		
<=128 (FOA) 256 (HOA2) [256, 384] (HOA3)	96	144	192	
192 (FOA) 320 (HOA2) 512 (HOA3)	144	192		
256 (FOA) [384, 480] (HOA2) [640, 896] (HOA3)	192			

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The configuration of the SFB sequence number of the mono high frequency band constituting the target frequency area should comply with provisions in Table 40.

Table 40 Table of configuration of SFB sequence number of mono high frequency band constituting target frequency area

kb/s	tT_SFB 1	tT_SFB 2	tT_SFB 3	tT_SFB 4
<=32	0	2	4	6
(32, 56]	0	2	4	6
(56, 72]	0	2	4	
(72, 96]	0	2		

The configuration of the SFB sequence number of the dual-channel stereo high frequency band constituting the target frequency area should comply with provisions in Table 41.

Table 41 Table of configuration of SFB sequence number of dual-channel stereo high frequency band constituting target frequency area

kb/s	tT_SFB 1	tT_SFB 2	tT_SFB 3	tT_SFB 4
<=48	0	2	4	6
(48, 64]	0	2	4	6
(64, 96]	0	2	4	
(96, 128]	0	2		

The configuration of the SFB sequence number of the multi-channel high frequency band constituting the target frequency area should comply with provisions in Table 42.

Table 42 Table of configuration of SFB sequence number of multi-channel high frequency band constituting target frequency area (bit rates are converted to channel pairs)

kb/s	tT_SFB 1	tT_SFB 2	tT_SFB 3	tT_SFB 4
<=56	0	2	4	6
(56, 75]	0	2	4	5
(75, 108]	0	2	4	
(108, 128]	0	2		

The configuration of the SFB sequence number of the HOA high frequency band constituting the target frequency area should comply with provisions in Table 43.

Table 43 Table of configuration of SFB sequence number of HOA high frequency band constituting target frequency area (HOA2/HOA3 is a 2-order HOA/3-order HOA)

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kb/s	tT_SFB 1	tT_SFB 2	tT_SFB 3	tT_SFB 4
192 (HOA2)	0	2	4	
<=128 (FOA) 256 (HOA2) [256, 384] (HOA3)	0	2	4	6
192 (FOA) 320 (HOA2) 512 (HOA3)	0	2	4	
256 (FOA) [384, 480] (HOA2) [640, 896] (HOA3)	0	2		

7.10 Syntax, Semantics, and Decoding Process of Inverse Temporal Noise Shaping

7.10.1 Syntax

The syntax of temporal noise shaping side information should comply with provisions in Table 44.

Table 44 Syntax of temporal noise shaping side information

Syntax of temporal noise shaping side information	Number of bits	Mnemonic
DecodeTnsSideBits() {		
for (i = 0; i < 2; i++) {		
tnsEnable[i]	**1**	**uimsbf**
if(tnsEnable[i] == 1) {		
tnsOrder[i]	**3**	**uimsbf**
tnsOrder[i] += 1		
for (j = 0; j < tnsOrder[i]; j++) {		
tnsHuffCode[i][j]		**uimsbf**
}		
}		
}		
}		

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7.10.2 Semantics

tnsEnable[i]	1 bit. It indicates whether the i-th TNS filter is enabled. 0 indicates disabled, and 1 indicates enabled.
tnsOrder[i]	3 bits. It indicates the order of the i-th TNS filter. The maximum order of the filter is 8.
tnsHuffCode[i][j]	It indicates the Huffman coding result of the j-order filter coefficient of the i-th TNS filter. The maximum value of the maximum order (that is, tnsOrder[i]) of the tns parameter is 8. Each order of the tns parameter has a corresponding Huffman code table, that is, the Huffman code tables (including codewords and the numbers of bits) of the tns parameters from order 0 to order 7. The numbers of bits should comply with provisions for the number of bits in Tables B.25 to B.32.

7.10.3 Decoding Process

7.10.3.1 Overview

The basic process of temporal noise shaping is as follows: First, range decoding and inverse quantization are performed on a Huffman coding result of a filter coefficient to obtain the filter coefficient. Then, the frequency band corresponding to each TNS filter is filtered to obtain the MDCT spectrum after inverse temporal noise shaping.

7.10.3.2 Decoding and Inverse Quantization of Filter Coefficient

The temporal noise shaping filter is indicated by a group of reflection coefficients. The maximum order of the filter is 8. The actual order of the filter for each frame is less than or equal to the maximum order. The Huffman coding is performed on the quantized reflection coefficients at the encoder. Each dimension of the filter coefficients has a corresponding Huffman code table, and should comply with provisions of Tables B.25 to B.32.

The Huffman decoding process of the filter coefficient quantization index is as follows: The corresponding Huffman code table is selected for the j-th filter coefficient of the i-th TNS filter of the current frame. The Huffman codeword tnsHuffCode[i][j] in the bitstream is decoded as the quantization index.

The quantized filter coefficient is obtained based on the scalar quantization code table of the filter coefficient and the quantization index obtained through decoding. The scalar quantization code table used here is a non-uniform scalar quantization code table, which should comply with provisions in Table B.33.

7.10.3.3 Inverse Temporal Noise Shaping Filtering

Temporal noise shaping uses a maximum of two groups of filters. The frequency ranges corresponding to the two groups of filters are respectively [660 Hz, 5400 Hz] and [5400 Hz, 20000 Hz].

If the enabling flag tnsEnable[i] of the i-th filter group is equal to 1, inverse temporal noise shaping filtering is performed on the frequency range corresponding to the i-th filter group.

The input of the filtering algorithm is the MDCT spectrum and the corresponding filter coefficient obtained through decoding. Frequency-domain filtering is performed on the MDCT

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spectrum according to the linear prediction filtering algorithm that is based on the reflection coefficient. The filtering process is shown in the following pseudocode:

```
mdct[k] -= parCoeff[tnsOrder - 1] * tnsState[tnsOrder - 1]
for (i = tnsOrder - 2; i >= 0; i--) {
    mdct[k] -= parCoeff[i] * tnsState[i]
    tnsState[i + 1] = parCoeff[i] * mdct[k] + tnsState[i]
}
tnsState[0] = mdct[k]
```

k is the frequency sequence number. mdct[k] indicates the MDCT spectral coefficient of the k-th frequency. parCoeff is the reflection coefficient. tnsOrder is the TNS filter order. tnsState is the TNS filter history.

7.11 Syntax, Semantics, and Decoding Process of Inverse Frequency-Domain Noise Shaping

7.11.1 Syntax

The syntax of frequency-domain noise shaping side information should comply with provisions in Table 45.

Table 45 Syntax of frequency-domain noise shaping side information

Syntax of frequency-domain noise shaping side information	Number of bits	Mnemonic
DecodeFdShapingSideBits() {		
if(lsfLbrFlag == 0) {		
lsfVqIndex[0]	**8**	**uimsbf**
lsfVqIndex[1]	**8**	**uimsbf**
lsfVqIndex[2]	**7**	**uimsbf**
lsfVqIndex[3]	**7**	**uimsbf**
lsfVqIndex[4]	**6**	**uimsbf**
lsfVqIndex[5]	**5**	**uimsbf**
lsfVqIndex[6]	**5**	**uimsbf**
} else {		
lsfVqIndex[0]	**8**	**uimsbf**
lsfVqIndex[1]	**8**	**uimsbf**
lsfVqIndex[2]	**7**	**uimsbf**
lsfVqIndex[3]	**7**	**uimsbf**
lsfVqIndex[4]	**6**	**uimsbf**

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Syntax of frequency-domain noise shaping side information	Number of bits	Mnemonic
}		
}		

7.11.2 Semantics

lsfVqIndex[i] It indicates the quantization index of the i-th sub-vector in the vector quantization of LSF parameters.

lsfLbrFlag It indicates low-precision LSF quantization and coding. When the average bit rate of each channel is greater than 32 kb/s, lsfLbrFlag is 0. When the average bit rate of each channel is less than or equal to 32 kb/s, lsfLbrFlag is 1. The value 0 indicates high-precision LSF quantization and coding; and the value 1 indicates low-precision LSF quantization and coding.

7.11.3 Decoding Process

7.11.3.1 Overview

A spectral quantization noise shaping technique of an LPC-based spectral envelope is used to perform frequency-domain noise shaping. The coder calculates the LPC-based spectral envelope and shapes a to-be-coded MDCT spectrum. The decoder calculates the corresponding spectral envelope information based on the LPC parameter obtained by decoding the bitstream, and inverse shaping is performed.

Main steps of inverse frequency-domain noise shaping include dequantizing an LSF parameter, converting the LSF parameter into an LPC parameter, calculating a spectral envelope based on the LPC parameter, and performing inverse shaping. The details are described as follows.

7.11.3.2 LSF Parameter Inverse Quantization

Quantization and coding of an LSF parameter is performed by using the vector quantization technique. The structure of the vector quantization code table is multi-stage split vector quantization. For different coding bit rates, the high-precision and low-precision vector quantization code tables are used. When lsfLbrFlag is 0, the high-precision code table is used. When lsfLbrFlag is 1, the low-precision code table is used.

An LSF parameter has 16 dimensions.

The structure of the high-precision code table is as follows: In stage 1, the LSF vector is divided into two sub-vectors with dimensions of 9 and 7, and the numbers of bits in the code table of 8 and 8, and should comply with provisions in Tables B.34 to B.35. In stage 2, the residual vector quantized in stage 1 is divided into five sub-vectors with dimensions of 3, 3, 3, 3, and 4, and the numbers of bits in the code table of 7, 7, 6, 5, and 5, and should comply with provisions in Tables B.36 to B.40.

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The structure of the low-precision code table is as follows: In stage 1, the LSF vector is divided into two sub-vectors with dimensions of 9 and 7, and the numbers of bits in the code table of 8 and 8, and should comply with provisions in Tables B.41 to B.42. In stage 2, the residual vector quantized in stage 1 is divided into three sub-vectors with dimensions of 5, 4, and 7, and the numbers of bits in the code table of 7, 7, and 6, and should comply with provisions in Tables B.43 to B.45.

The stage 1 vector and the stage 2 vector can be obtained through decoding based on the lsfVqIndex parameter obtained from the bitstream and the corresponding vector quantization code table. The stage 1 vector, the stage 2 vector, and the LSF parameter mean value vector are added together, to obtain the inverse quantized LSF parameter. The LSF parameter mean value vector should comply with provisions in Table B.46.

7.11.3.3 LSF Parameter Conversion

The LSF parameter is converted to an LSP parameter, and then the LSP parameter is converted to an LPC parameter. The LSF parameter conversion should comply with provisions in section 5.1.9 in 3GPP TS 26.445 (Release 17).

7.11.3.4 Inverse frequency-domain noise shaping

The inverse frequency-domain noise shaping includes two steps: LPC spectral envelope calculation and inverse shaping. The basic process of the LPC spectral envelope calculation is as follows:

Step 1: Calculate the LPC spectral envelope of each frequency based on the LPC parameter. For the basic principle, refer to formula (24).

$$lpcEnv[k] = \frac{1}{\left|1-\sum_{i=1}^{p} a_i e^{\frac{2\pi jk}{N}i}\right|} \tag{24}$$

lpcEnv[k] is the LPC spectral envelope of the k-th frequency, and a_i is the i-th LPC coefficient.

First, the LPC coefficient is weighted. The weighting process is as follows:

An LPC weighting coefficient is obtained. The pseudocode is as follows:

```
GAMMA_LPC = 0.939999998

weightFactor[0] = 1.0

for i = 1 to lpcOrder:

  weightFactor[i] = weightFactor[i-1] * GAMMA_LPC

end
```

GAMMA_LPC is the initial value of the LPC weighting coefficient. weightFactor is the calculated LPC weighting coefficient. lpcOrder is the LPC order, and a value is 16.

The LPC weighting coefficient is multiplied by the LPC parameter to obtain a weighted LPC parameter weightedLpc.

Second, the low-precision LPC spectral envelope is calculated as follows:

The weighted LPC parameter is pre-rotated. The complex FFT is performed on the pre-rotated LPC parameter rotateLpc, and the low-precision LPC spectral envelope is calculated.

The pre-rotation of the LPC parameter is expressed as follows:

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```
for (i = 0; i < lpcOrder + 1; i++) {
    tmp = i * PI / 512
    realPart[i] = weightedLpc[i] * cos(tmp)
    imagPart[i]= -weightedLpc[i] * sin(tmp)
}
```

realPart and imagPart are respectively a real part and an imaginary part of the pre-rotated LPC parameter rotateLpc.

The number of points of the complex FFT is 512. The low-precision LPC spectral envelope $rawLpcGain$ is $1/\|FFT(rotateLpc)\|_2$. The number of points of the low-precision LPC spectral envelope obtained is 256.

Thirdly, an interpolated LPC spectral envelope is obtained. 4-fold linear interpolation is performed on rawLpcGain, to obtain an interpolated LPC spectral envelope of 1024 frequencies.

Step 2: Calculate a sub-band LPC spectral envelope based on the frequency LPC spectral envelope.

The MDCT spectrum is divided into several sub-bands with different lengths. The average value of frequency LPC spectral envelopes is calculated in each sub-band. The result is used as the sub-band LPC spectral envelope. The number of currently used sub-bands is 49, and the sub-band configuration should comply with provisions in Table B.47.

The method of inverse shaping is as follows: The calculated LPC spectrum envelope is multiplied by the MDCT spectrum to obtain an MDCT spectrum obtained through inverse frequency-domain noise shaping.

7.12 Inverse MDCT Decoding Process

7.12.1 Overview

The inverse MDCT is performed on the windowed control parameter obtained by parsing the bitstream and the decoded MDCT coefficient of each channel, to obtain the reconstructed time-domain audio signal.

The inverse MDCT can be performed in different ways depending on different windowed control parameters:

If the windowed control parameter is equal to 0x0 or 0x2, that is, the current frame is a long window or a cut-in window, the 2048-point inverse transform is performed on the MDCT spectrum to obtain a reconstructed time-domain signal of the current frame. The first half-frame of the reconstructed time-domain signal is added to the second half-frame of the reconstructed time-domain signal of the previous frame. The result is the output signal of the current frame.

If the windowed control parameter is equal to 0x3, that is, the current frame is a cut-out window, the 2048-point inverse transform is performed on the MDCT spectrum to obtain a reconstructed time-domain signal of the current frame. The part that is in the first half-frame of the reconstructed time-domain signal and that is overlapped with the last short frame of the previous frame is added to the second half-frame of the last short frame of the previous frame. The result is the output signal of the current frame.

If the windowed control parameter is equal to 0x1, that is, the current frame is a short window, the 256-point inverse transform is performed respectively on MDCT coefficients of eight short

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frames included in the de-interleaved MDCT spectrum. The obtained eight short-window time-domain signals are overlapped and added. The result is the output signal of the current frame.

7.12.2 Definition of Windowed

Forms of window types are as follows:

a) Long window: LONG_SHORT_TRANS_WINDOW, a sine window with a length of 2048 points.

b) (2) Cut-in window: LONG_SHORT_TRANS_WINDOW, consisting of a left half sine window of 1024 points, 448 points of 1, a right half sine window of 128 points, and 448 points of 0.

c) (3) Cut-out window: SHORT_LONG_TRANS_WINDOW, consisting of 448 points of 0, a left half sine window of 128 points, 448 points of 1, and a right half sine window of 1024 points.

d) (4) Short window: ONLY_SHORT_WINDOW, a sine window with a length of 256 points. Eight short windows are added to each frame.

7.13 HOA Spatial Decoding

7.13.1 Syntax

The syntax of HOA spatial decoding should comply with provisions in Table 46.

Table 46 Syntax of HOA spatial decoding

Syntax of HOA spatial decoding	Number of bits	Mnemonic
HoaPostSynthesisFilter() {		
if(spatialAnalysis == 1) {		
HoaCoreDec()		
}		
}		

7.13.2 Semantics

spatialAnalysis It indicates the spatial analysis type. For the semantics of spatialAnalysis, refer to section 7.7.2.

HoaCoreDec() It indicates sound field component synthesis and HOA synthesis decoding

7.13.3 Decoding Process

7.13.3.1 Overview

During HOA spatial decoding, the virtual speaker signal and residual signal generated at the encoder and the target virtual speaker attribute information are reconstructed through post-decoding processing Avs3PostSynthesis(), to obtain a decoded HOA signal.

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7.13.3.2 Principle of Sound Field Reconstruction by Virtual Speakers

The HOA coefficient of the virtual speaker is used to reconstruct the sound field. It is assumed that the sound field is p. For the sound field $p(r,\theta,\varphi,k)$ in the spherical coordinate system, refer to formula (25).

$$p(r,\theta,\varphi,k) = \sum_{m=0}^{\infty} j^m j_m^{kr}(kr) \sum_{0\le n\le m,\sigma=\pm1} B_{m,n}^{\sigma} Y_{m,n}^{\sigma}(\theta,\varphi) \quad (25)$$

r indicates the radial distance. θ indicates the azimuth. φ indicates the pitch angle. k indicates the wave velocity. m indicates the HOA order number. $j^m j_m^{kr}(kr)$ indicates the spherical Bessel function, also referred to as the radial basis function. j indicates the imaginary unit. $Y_{m,n}^{\sigma}(\theta,\varphi)$ indicates the spherical harmonic function of θ and φ. $B_{m,n}^{\sigma}$ indicates" HOA coefficient. An m-order HOA coefficient can be used as an approximate description of a sound field. The spherical harmonic is overlapped based on a coefficient corresponding to a sampling point of the HOA signal. Then, a spatial sound field corresponding to the sampling point can be reconstructed.

7.13.3.3 Virtual Speaker

Non-uniform virtual speaker distribution is used in HOA spatial encoding and decoding. The virtual speaker distribution includes position information of K virtual speakers. The position information includes a pitch angle index and a horizontal angle index. K is a positive integer greater than 1. K virtual speakers are distributed on a preset sphere. The preset sphere includes X latitude circles and Y longitude circles. The virtual speakers are located at intersection points of the X latitude circles and the Y longitude circles. For area division of virtual speakers, refer to figure 11. The preset sphere includes L (L > 1) latitude areas, and the m-th latitude area includes T_m latitude circles. α_m indicates the horizontal angle difference between adjacent virtual speakers distributed on the m_i-th latitude circle in the K virtual speakers. $1 \le m \le L$. T_m is a positive integer. $1 \le m_i \le T_m$. If $T_m > 1$, α_m indicates the pitch angle difference between any two adjacent latitude circles in the m-th latitude area.

Figure 11 Division of Virtual Speaker Area

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K virtual speakers are distributed on one or more latitude circles in each latitude area. The distance between adjacent virtual speakers on a same latitude circle is indicated by a horizontal angle difference. The horizontal angle differences between all adjacent virtual speakers on the same latitude circle are equal. $\alpha_c < \alpha_m$. α_c indicates the horizontal angle difference between adjacent virtual speakers distributed on the m_c-th latitude circle in the K virtual speakers. The m_c-th latitude circle is any one of the latitude circles in the latitude area that includes the equator. In the L latitude areas, the horizontal angle difference between adjacent virtual speakers in a latitude area that includes the equator is the smallest, and the distribution of virtual speakers in this area is the densest. The virtual speaker distribution is shown in figure 12.

An index is used to indicate positions of K virtual speakers in the virtual speaker distribution table. The index can include a pitch angle index and a horizontal angle index. A horizontal angle of a virtual speaker distributed on any one of the latitude circles is set to 0. Then, the corresponding horizontal angle index is obtained through conversion according to a preset conversion formula between a horizontal angle and a horizontal angle index. Since the horizontal angle differences between any adjacent virtual speakers on the same latitude circle are equal, horizontal angles of other virtual speakers on this circle can be obtained. Therefore, the respective horizontal angle indexes of the other virtual speakers can also be obtained according to the formula (25). Similarly, respective pitch angle indexes of the virtual speakers may be obtained according to formula (24).

A pitch angle φ_k and a pitch angle index φ_k' of a k-th virtual speaker in the K virtual speakers meet the following formula (26).

$$\varphi_k' = round\left(\frac{\varphi_k}{2\pi r_{ak} \times 1024}\right) \tag{26}$$

r_k indicates the radius of the longitude circle where the k-th virtual speaker is located. round() indicates rounding.

The conversion formula between the horizontal angle and the horizontal angle index is as follows:

A horizontal angle θ_k and a horizontal angle index θ_k' of the k-th virtual speaker in the K virtual speakers meet the following formula (27).

$$\theta_k' = round\left(\frac{\theta_k}{2\pi r_{bk} \times 1024}\right) \tag{27}$$

r_k indicates the radius of the latitude circle where the k-th virtual speaker is located. round() indicates rounding.

Figure 12 Distribution view of virtual speakers

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7.13.3.4 HOA Coefficient Calculation of Virtual Speakers

First, the virtual speaker attribute information is parsed. The virtual speaker attribute information includes position information of the virtual speaker, and the position information includes pitch angle information and horizontal angle information. The position information of the virtual speaker may be indicated by a virtual speaker index, that is, the pitch angle information may be indicated by a pitch angle index, and the horizontal angle information may be indicated by a horizontal angle index. The HoaCoreDec() obtains the virtual speaker index basisIdx by parsing the bitstream, and searches the preset value of the virtual speaker for a virtual speaker angle index corresponding to the virtual speaker index basisIdx. The virtual speaker angle index includes an azimuth index θ' and a pitch angle index φ'. The preset values of virtual speakers should comply with provisions in Table B.48.

Then, HoaCoreDec() calculates the HOA coefficient of a virtual speaker based on the angle indexes of the virtual speaker. When the HOA coefficient is calculated, trigonometric function values corresponding to the azimuth index and the pitch angle index need to be obtained. A sine function value and a cosine function value corresponding to the pitch angle index of the virtual speaker are obtained based on the pitch trigonometric function table according to the following rules. Refer to formulas (28) to (31).

$$sin(\varphi) = \begin{cases} sin_table(\varphi') & \varphi' < \lfloor \frac{N}{4} \rfloor \\ sin_table\left(\frac{N}{2} - \varphi'\right) & \lfloor \frac{N}{4} \rfloor \le \varphi' < \lfloor \frac{N}{2} \rfloor \\ -sin_table(\varphi' - \frac{N}{2}) & \lfloor \frac{N}{2} \rfloor \le \varphi' < \lfloor \frac{3N}{4} \rfloor \\ -sin_table(N - \varphi') & \lfloor \frac{3N}{4} \rfloor \le \varphi' < N \end{cases} \quad (28)$$

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$$cos(\varphi) = \begin{cases} sin_table(\frac{N}{4} - \varphi') & \varphi' < \lfloor\frac{N}{4}\rfloor \\ -sin_table(\varphi' - \frac{N}{4}) & \lfloor\frac{N}{4}\rfloor \le \varphi' < \lfloor\frac{N}{2}\rfloor \\ -sin_table(\frac{3N}{4} - \varphi') & \lfloor\frac{N}{2}\rfloor \le \varphi' < \lfloor\frac{3N}{4}\rfloor \\ sin_table(\varphi' - \frac{3N}{4}) & \lfloor\frac{3N}{4}\rfloor \le \varphi' < N \end{cases} \quad (29)$$

The sine function value and the cosine function value corresponding to the horizontal angle index of the virtual speaker are obtained based on the horizontal trigonometric function table according to the following rules:

$$sin(\theta) = \begin{cases} sin_table(\theta') & \theta' < \lfloor\frac{N}{4}\rfloor \\ sin_table\left(\frac{N}{2} - \theta'\right) & \lfloor\frac{N}{4}\rfloor \le \theta' < \lfloor\frac{N}{2}\rfloor \\ -sin_table(\theta' - \frac{N}{2}) & \lfloor\frac{N}{2}\rfloor \le \theta' < \lfloor\frac{3N}{4}\rfloor \\ -sin_table(N - \theta') & \lfloor\frac{3N}{4}\rfloor \le \theta' < N \end{cases} \quad (30)$$

$$cos(\theta) = \begin{cases} sin_table(\frac{N}{4} - \theta') & \theta' < \lfloor\frac{N}{4}\rfloor \\ -sin_table(\theta' - \frac{N}{4}) & \lfloor\frac{N}{4}\rfloor \le \theta' < \lfloor\frac{N}{2}\rfloor \\ -sin_table(\frac{3N}{4} - \theta') & \lfloor\frac{N}{2}\rfloor \le \theta' < \lfloor\frac{3N}{4}\rfloor \\ sin_table(\theta' - \frac{3N}{4}) & \lfloor\frac{3N}{4}\rfloor \le \theta' < N \end{cases} \quad (31)$$

N is 1024. The pitch trigonometric function table and the horizontal trigonometric function table should comply with Table B.49. The pitch trigonometric function table and the horizontal trigonometric function table are formed by trigonometric function values corresponding to position information of intersection points of N longitude circles and N latitude circles on the preset sphere. The pitch trigonometric function table includes trigonometric function values corresponding to the pitch angle indexes of the intersection points on the longitude circles. The horizontal trigonometric function table includes trigonometric function values corresponding to the horizontal angle indexes of the intersection points on the latitude circles.

The method for calculating an HOA coefficient of a virtual speaker based on the azimuth and pitch angle of the virtual speaker should comply with Table B.47. In the table, θ indicates azimuth information of position information of the virtual speaker on the preset sphere. φ indicates pitch angle information of position information of the virtual speaker on the preset sphere. m indicates an HOA order value. n indicates a direction parameter in each order.

The HOA coefficient expression should comply with provisions in Table 47.

Table 47 1-order to 3-order HOA coefficient expressions

m	n	HOA coefficient expression
0	0	$\frac{1}{2\sqrt{\pi}}$
1	0	$\frac{1}{2}\sqrt{\frac{3}{\pi}}\cos\theta$
	+1	$\frac{1}{2}\sqrt{\frac{3}{\pi}}\sin\theta\cos\varphi$

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m	n	HOA coefficient expression
	–1	$\frac{1}{2}\sqrt{\frac{3}{\pi}}\sin\theta\sin\varphi$

Table 47 (continued)

m	n	HOA coefficient expression
2	0	$\frac{1}{4}\sqrt{\frac{5}{\pi}}(3cos^2\theta-1)$
	+1	$\frac{1}{2}\sqrt{\frac{15}{\pi}}\sin\theta\cos\theta\cos\varphi$
	–1	$\frac{1}{2}\sqrt{\frac{15}{\pi}}\sin\theta\cos\theta\sin\varphi$
	+2	$\frac{1}{4}\sqrt{\frac{15}{\pi}}sin^2\theta\cos 2\varphi$
	–2	$\frac{1}{4}\sqrt{\frac{15}{\pi}}sin^2\theta\sin 2\varphi$
3	0	$\frac{1}{4}\sqrt{\frac{7}{\pi}}(5cos^3\theta-3\cos\theta)$
	+1	$\frac{1}{4}\sqrt{\frac{21}{2\pi}}(5cos^2\theta-1)\sin\theta\cos\varphi$
	–1	$\frac{1}{4}\sqrt{\frac{21}{2\pi}}(5cos^2\theta-1)\sin\theta\sin\varphi$
	+2	$\frac{1}{4}\sqrt{\frac{105}{\pi}}\cos\theta\, sin^2\theta\cos 2\varphi$
	–2	$\frac{1}{4}\sqrt{\frac{105}{\pi}}\cos\theta\, sin^2\theta\sin 2\varphi$
	+3	$\frac{1}{4}\sqrt{\frac{35}{2\pi}}sin^3\theta\cos 3\varphi$

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m	n	HOA coefficient expression
	–3	$\frac{1}{4}\sqrt{\frac{35}{2\pi}}sin^3\theta \sin 3\varphi$

7.13.3.5 Sound Field Component Synthesis and HOA Signal Synthesis

During HOA spatial decoding, the virtual speaker signal and residual signal obtained through post-decoding processing and the calculated HOA coefficient of the virtual speaker are reconstructed, to obtain a decoded HOA signal.

HoaCoreDec() synthesizes the virtual speaker signal and the HOA coefficient of the virtual speaker into a sound field component to obtain a synthesized HOA signal recoverySignal. The recoverySignal is obtained by multiplying the HOA coefficient of the virtual speaker by the virtual speaker signal. Refer to formula (32).

$$recoverySignal = A \times w \tag{32}$$

A indicates an HOA coefficient matrix of the virtual speaker. The size of matrix A is (M × C). C indicates the number of virtual speakers. M indicates the number of N-order HOA coefficients. w indicates the virtual speaker signal vector. The dimension of w indicates the number of virtual speaker signals.

Finally, the recoverySignal is adjusted by using the residual signal, and the recoverySignal and the residual signal are added to obtain a decoded HOA signal.

8 Lossless Audio Decoding

Lossless audio decoding should comply with provisions in chapter 8 of GB/T 33475.3-2018.

9 Metadata Decoding

9.1 Syntax and Semantics of Metadata Bitstream

9.1.1 Syntax

The syntax of the metadata bitstream should comply with provisions in Table 48.

Table 48 Syntax of metadata bitstream

Syntax of metadata bitstream	Number of bits	Mnemonic
Avs3MetadataDec() {		
smFlag	**1**	**uimsbf**
if(smFlag == 1) {		
Avs3SmDec()		
}		
dmFlag	**1**	**uimsbf**

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Syntax of metadata bitstream	Number of bits	Mnemonic
if(dmFlag == 1) {		
Avs3DmDec()		
}		
}		

9.1.2 Semantics

smFlag	1 bit. It indicates whether there is a static metadata bitstream in the current frame. '0': no; '1': yes.
dmFlag	1 bit. It indicates whether there is a dynamic metadata bitstream in the current frame. '0': no; '1': yes.
Avs3SmDec()	Static metadata decoding
Avs3DmDec()	Dynamic metadata decoding

9.2 Syntax and Semantics of Static Metadata Decoding

9.2.1 Syntax

The syntax of static metadata decoding should comply with provisions in Table 49.

Table 49 Syntax of static metadata decoding

Syntax of static metadata decoding	Number of bits	Mnemonic
Avs3SmDec() {		
b_vrExt	**1**	**uimsbf**
basicLevel	**3**	**uimsbf**
if((basicLevel == 0) || (basicLevel == 1)) {		
BasicL1()		
}		

Table 49 (continued)

Syntax of static metadata decoding	Number of bits	Mnemonic
if(b_vrExt) {		
vrExtLevel	**3**	**uimsbf**
if(vrExtLevel == 0) {		

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Syntax of static metadata decoding	Number of bits	Mnemonic
VrExtL1()		
}		
}		
}		

9.2.2 Semantics

b_vrExt	1 bit. It indicates the status of extended static metadata of the current frame. '0': not existent; '1': reserved.
basicLevel	3 bits. It indicates the level of basic static metadata. '0': level 0 configuration in Table C.21; '1': level 1 configuration in Table C.21; '2' to '7': reserved.
vrExtLevel	3 bits. It indicates the level of the extended static metadata. '0': level used by the current extended metadata. The VrExtL1() function corresponds to this level. '1' to '7': reserved.
BasicL1()	It includes basic static metadata decoding at the L0 and L1 levels.
VrExtL1()	It indicates extended static metadata decoding at the L1 level.

9.3 Syntax and Semantics of Dynamic Metadata Decoding

9.3.1 Syntax

The syntax of dynamic metadata decoding should comply with provisions in Table 50.

Table 50 Syntax of dynamic metadata decoding

Syntax of dynamic metadata decoding	Number of bits	Mnemonic
Avs3DmDec () {		
dmLevel	**3**	**uimsbf**
for(i = 0; i < numDmChans; i++) {		
muteFlag	**1**	**uimsbf**
transChRef	**5**	**uimsbf**
if(dmLevel == 0) {		
Avs3DmL1Dec()		
}		
if(dmLevel == 1) {		

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Syntax of dynamic metadata decoding	Number of bits	Mnemonic
Avs3DmL1Dec()		
Avs3DmL2Dec()		
}		
}		
}		

9.3.2 Semantics

dmLevel	3 bits. It indicates the level of dynamic metadata. '0': Avs3DmL1Dec() corresponds to this level; '1': Avs3DmL1Dec() and Avs3DmL2Dec() correspond to this level.
muteFlag	1 bit. It indicates whether there is dynamic metadata. '0': yes; '1': no.
transChRef	5 bits. It indicates an index of a physical channel on which the dynamic metadata takes effect.
numDmChans	It indicates the number of object channels, and should comply with provisions for the semantics of object_channel_number in Table A.2.
Avs3DmL1Dec()	It indicates dynamic metadata decoding at the L1 level.
Avs3DmL2Dec()	It indicates dynamic metadata decoding at the L2 level.

9.4 Syntax and Semantics of Basic Static Metadata Decoding

9.4.1 Syntax

The syntax of basic static metadata decoding should comply with provisions in Table 51.

Table 51 Syntax of basic static metadata decoding

Syntax of basic static metadata decoding	Number of bits	Mnemonic
BasicL1() {		
audioProgramme()		
numOfContents	**2**	**uimsbf**
numOfContents = numOfContents + 1		
for (i = 0; i < numOfContents; i++) {		
audioContent()		
}		

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Syntax of basic static metadata decoding	Number of bits	Mnemonic
numOfObjects	**3**	**uimsbf**
numOfObjects = numOfObjects + 1		
for (i = 0; i < numOfObjects; i++) {		
audioObject()		
}		
numOfPacks	**3**	**uimsbf**
numOfPacks = numOfPacks + 1		
for (i = 0; i < numOfPacks; i++) {		
AudioPackFormat ()		
}		
numOfChannels	**5**	**uimsbf**
numOfChannels = numOfChannels + 1		
for (i = 0; i < numOfChannels; i++) {		
AudioChannelFormat ()		
}		
}		

9.4.2 Semantics

AudioProgramme()	It indicates AudioProgramme() decoding, and all AudioContent() items are combined to form complete "mixing".
AudioContent()	It indicates AudioContent() decoding, and the audio content is described, containing parameters such as language (if a dialogue exists) and loudness.
AudioObject()	It indicates AudioObject() decoding. The object is used to associate the audio content with the format.
AudioPackFormat()	It indicates AudioPackFormat() decoding, and packs one or more AudioChannelFormat() items that belong to each other (for example, a pair of stereos).
AudioChannelFormat()	It indicates AudioChannelFormat() decoding, and describes a single audio waveform.
numOfContents	2 bits. It indicates the number of audioContent() items included in BasicL1().
numOfObjects	3 bits. It indicates the number of audioObject() items included in BasicL1().

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numOfPacks	3 bits. It indicates the number of audioPackFormat() items included in BasicL1().
numOfChannels	5 bits. It indicates the number of audioChannelFormat() items included in BasicL1().

9.5 Syntax and Semantics of Decoding Program Layer in Basic Static Metadata

9.5.1 Syntax

The syntax of decoding the program layer in the basic static metadata should comply with provisions in Table 52.

Table 52 Syntax of decoding program layer in basic static metadata

Syntax of decoding program layer in basic static metadata	Number of bits	Mnemonic
AudioProgramme() {		
b_audioProgrammeLanguage	**1**	**uimsbf**
b_maxDuckingDepth	**1**	**uimsbf**
b_loudnessMetadata	**1**	**uimsbf**
b_audioProgrammeReferenceScreen	**1**	**uimsbf**
if (b_audioProgrammeLanguage) {		
audioProgrammeLanguage	**4**	**uimsbf**
}		
if (b_maxDuckingDepth) {		
maxDuckingDepth	**5**	**uimsbf**
}		
if (b_loudnessMetadata) {		
LoudnessMetadata()		
}		
if (b_audioProgrammeReferenceScreen) {		
AudioProgrammeReferenceScreen()		
}		
numContents	**2**	**uimsbf**
numContents = numContents + 1		
for (i = 0; i < numContents; i++) {		

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Syntax of decoding program layer in basic static metadata	Number of bits	Mnemonic
refContentIdx	**2**	**uimsbf**
}		
}		

9.5.2 Semantics

b_audioProgrammeLanguage	1 bit. It indicates whether the audioProgrammeLanguage field exists in AudioProgramme(). '0': no; '1': yes.
b_maxDuckingDepth	1 bit. It indicates whether maxDuckingDepth exists in AudioProgramme(). '0': no; '1': yes.
b_loudnessMetadata	1 bit. It indicates whether LoudnessMetadata() exists in AudioProgramme(). '0': no; '1': yes.
b_audioProgrammeReferenceScreen	1 bit. It indicates whether AudioProgrammeReferenceScreen() exists in AudioProgramme(). '0': no; '1': yes.
audioProgrammeLanguage	4 bits. It indicates the dialogue language in AudioProgramme(). '0': Chinese; '1': English; '2': French; '3': Spanish; '4': Portuguese; '5': German; '6' to '15': reserved.
maxDuckingDepth	5 bits. It indicates the maximum ducking depth allowed for each AudioObject() in a program. Value range: [–62, 0].
numContents	2 bits. It indicates the number of refContentIdx items referenced in AudioProgramme().
refContentIdx	2 bits. It indicates an index of content included in AudioProgramme().
LoudnessMetadata()	It indicates a loudness decoding interface, which corrects audio according to the ITU-R BS.1770 loudness algorithm.
AudioProgrammeReferenceScreen()	It indicates a screen size decoding interface, which standardizes the reference, production, and monitoring screen size of AudioProgramme().

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9.6 Syntax and Semantics of Decoding Content Layer in Basic Static Metadata

9.6.1 Syntax

The syntax of decoding the content layer in the basic static metadata should comply with provisions in Table 53.

Table 53 Syntax of decoding content layer in basic static metadata

Syntax of decoding content layer in basic static metadata	Number of bits	Mnemonic
AudioContent () {		
contentIdx	**2**	**uimsbf**
b_audioContentLanguage	**1**	**uimsbf**
b_loudnessMetadata	**1**	**uimsbf**
b_dialogue	**1**	**uimsbf**
b_numComplementaryObjectGroup	**1**	**uimsbf**
if (b_audioContentLanguage) {		
audioContentLanguage	**4**	**uimsbf**
}		
if (b_loudnessMetadata) {		
loudnessMetadata()		
}		
if (b_dialogue) {		
Dialogue()		
}		
if(b_numComplementaryObjectGroup) {		
numComplementaryObjectGroup	**2**	**uimsbf**
numComplementaryObjectGroup=numComplementaryObjectGroup + 1		
for (i=0; i < numComplementaryObjectGroup; i++) {		
numComplementaryObject	**3**	**uimsbf**
numComplementaryObject= numComplementaryObject + 1		
for (j=0; j < numComplementaryObject; j++) {		
ComplementaryObjectIdx	**3**	**uimsbf**

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Syntax of decoding content layer in basic static metadata	Number of bits	Mnemonic
}		
}		
}		
numObjects	**3**	**uimsbf**
numObjects = numObjects + 1		
for (i = 0; i < numObjects; i++) {		
refObjectIdx	**3**	**uimsbf**
}		
}		

9.6.2 Semantics

contentIdx	2 bits. It indicates a unique index value of AudioContent().
b_audioContentLanguage	1 bit. It indicates whether the audioContentLanguage field exists in AudioContent(). '0': no; '1': yes.
b_loudnessMetadata	1 bit. It indicates whether LoudnessMetadata() exists in AudioContent(). '0': no; '1': yes.
b_dialogue	1 bit. It indicates whether the dialogue field exists in AudioContent(). '0': no; '1': yes.
b_numComplementaryObjectGroup	1 bit. It indicates whether the numComplementaryObjectGroup field exists in AudioContent(). '0': no; '1': yes.
audioContentLanguage	4 bits. It indicates the dialogue language in AudioContent(). '0': Chinese; '1': English; '2': French; '3': Spanish; '4': Portuguese; '5': German; '6' to '15': reserved.
numComplementaryObjectGroup	2 bits. It indicates the number of complementary object groups in AudioContent().
numComplementaryObject	2 bits. It indicates the number of complementary object indexes ComplementaryObjectIdx included in ComplementaryObjectGroup.
ComplementaryObjectIdx	3 bits. It indicates an index value of the complementary object in the specified ComplementaryObjectGroup.
numObjects	3 bits. It indicates the number of refObjectIdx items referenced in AudioContent().

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refObjectIdx	3 bits. It indicates the index of the object included in AudioContent().
Dialogue()	It indicates a dialogue decoding interface, which details the content type.
LoudnessMetadata()	It indicates a loudness decoding interface, which corrects audio according to the ITU-R BS.1770 loudness algorithm.

9.7 Syntax and Semantics of Decoding Object Layer in Basic Static Metadata

9.7.1 Syntax

The syntax of decoding the object layer in the basic static metadata should comply with provisions in Table 54.

Table 54 Syntax of decoding object layer in basic static metadata

Syntax of decoding object layer in basic static metadata	Number of bits	Mnemonic
AudioObject() {		
objectIdx	**3**	**uimsbf**
b_audioObjectLanguage	**1**	**uimsbf**
b_dialogue	**1**	**uimsbf**
b_audioObjectImportance	**1**	**uimsbf**
b_disableDucking	**1**	**uimsbf**
b_interact	**1**	**uimsbf**
b_gain	**1**	**uimsbf**
b_headLocked	**1**	**uimsbf**
b_mute	**1**	**uimsbf**
if (b_audioObjectLanguage) {		
audioObjectLanguage	**4**	**uimsbf**
}		
if (b_dialogue) {		
Dialogue()		
}		
if (b_audioObjectImportance) {		

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Table 54 (continued)

Syntax of decoding object layer in basic static metadata	Number of bits	Mnemonic
audioObjectImportance	**4**	**uimsbf**
}		
if (b_interact) {		
for (i = 0; i < 24; i++) {		
ObjectName[i]	**8**	**uimsbf**
}		
audioObjectInteraction()		
}		
if (b_gain) {		
objectGainUnit	**1**	**uimsbf**
objectGainQFlag	**1**	**uimsbf**
objectGain	**6**	**uimsbf**
}		
numPacks	**3**	**uimsbf**
numPacks = numPacks + 1		
for (i = 0; i < numPacks; i++) {		
refPackFormatIdx	**3**	**uimsbf**
}		
}		

9.7.2 Semantics

objectIdx — 3 bits. It indicates a unique index value of AudioObject().

b_AudioObjectLanguage — 1 bit. It indicates whether the AudioObjectLanguage field exists in AudioObject(). '0': no; '1': yes.

b_dialogue — 1 bit. It indicates whether the dialogue field exists in AudioObject(). '0': no; '1': yes.

b_audioObjectImportance — 1 bit. It indicates whether the audioObjectImportance field exists in AudioObject(). '0': no; '1': yes.

b_disableDucking — 1 bit. It indicates whether AudioObject() allows automatic ducking. '1': no; '0': yes.

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b_interact	1 bit. It indicates whether the interact field exists in AudioObject(). '0': no; '1': yes.
b_gain	1 bit. It indicates whether the gain field exists in AudioObject(). '0': no; '1': yes.
b_headLocked	1 bit. It indicates whether the perception position of the audio element of AudioObject() is locked relative to the head. '0': yes; '1': no.
b_mute	1 bit. It indicates whether AudioObject() is in a playback state. '0': The object is being played back; '1': The object is muted.
audioObjectLanguage	4 bits. It indicates the dialogue language in AudioObject(). '0': Chinese; '1': English; '2': French; '3': Spanish; '4': Portuguese; '5': German; '6' to '15': reserved.
audioObjectImportance	4 bits. It indicates the importance level of AudioObject(). '10': highest importance; '0': lowest importance; '11' to '15': reserved.
ObjectName	8 bits. It indicates the name of AudioObject().
objectGainUnit	1 bit. It indicates the unit of objectGain. '0': linear; '1': dB.
objectGainQFlag	1 bit. It indicates the gain quantization interval. When gainUnit is 0 and gainQFlag is 0, the quantization interval is [0, 1]. When gainUnit is 0 and gainQFlag is 1, the quantization interval is (1, 16). When gainUnit is 1 and gainQFlag is 0, the quantization interval is [–80, 0]. When gainUnit is 1 and gainQFlag is 1, the quantization interval is (0, 24].
objectGain	6 bits. It indicates a gain value applied to all audio samples referenced by AudioObject(). Value range: linear [0, 16]/dB[–80, 24].
numPacks	3 bits. It indicates the number of refPackFormatIdx items referenced in AudioObject().
refPackFormatIdx	3 bits. It indicates an index of audioPackFormat included in AudioObject().
Dialogue()	It indicates a dialogue decoding interface, which details the content type.

9.8 Syntax and Semantics of Decoding Dialogue Field in Basic Static Metadata

9.8.1 Syntax

The syntax of decoding the dialogue field in the basic static metadata should comply with provisions in Table 55.

Table 55 Syntax of decoding dialogue field in basic static metadata

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Syntax of decoding dialogue field in basic static metadata	Number of bits	Mnemonic
Dialogue() {		
dialogueAttribute	**2**	**uimsbf**
dialogueType	**3**	**uimsbf**
}		

9.8.2 Semantics

dialogueAttribute — 2 bits. It indicates the dialogue content type, and should comply with provisions in Table 33 in ITU-R BS.2076-2.

dialogueType — 3 bits. It indicates the content type contained in the dialogueAttribute, and should comply with provisions in Table 34 in ITU-R BS.2076-2.

9.9 Syntax and Semantics of Decoding Packaging Layer in Basic Static Metadata

9.9.1 Syntax

The syntax of decoding the packaging layer in the basic static metadata should comply with provisions in Table 56.

Table 56 Syntax of packaging layer decoding in basic static metadata

Syntax of packaging layer decoding in basic static metadata	Number of bits	Mnemonic
AudioPackFormat () {		
packFormatIdx	**3**	**uimsbf**
b_audioPackFormatImportance	**1**	**uimsbf**
b_transChannelReuse	**1**	**uimsbf**
if (**b_audioPackFormatImportance**) {		
audioPackFormatImportance	**4**	**uimsbf**
}		
typeLabel	**3**	**uimsbf**
absoluteDistance	**5**	**uimsbf**
if (typeLabel == 1 || typeLabel == 2) {		
packFormatID	**6**	**uimsbf**

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Syntax of packaging layer decoding in basic static metadata	Number of bits	Mnemonic
if (typeLabel == 2) {		
numMatrixOutputChannel	**5**	**uimsbf**
numMatrixOutputChannel = numMatrixOutputChannel + 1		
for (i = 0; i< numMatrixOutputChannel; i++) {		
DirectSpeakersPosition()		
}		
}		
}		
else if (typeLabel == 4) {		
normalization	**2**	**uimsbf**
nfcRefDist	**4**	**uimsbf**
screenRef	**1**	**uimsbf**
hoaOrder	**3**	**uimsbf**
}		
if (b_transChannelReuse == 0) {		
packFormatStartIdx	**5**	**uimsbf**
}		
numChannels	**5**	**uimsbf**
numChannels = numChannels + 1		
for (i = 0; i < numChannels; i++) {		
refChannelIdx	**5**	**uimsbf**
channelTypeLabel [refChannelIdx] = typeLabel		
if (typeLabel == 1 || typeLabel == 2) {		
channelPackFormatID[refChannelIdx] = packFormatID		
}		
if (typeLabel == 2) {		
channelNumMatrixOutputChannel[refChannelIdx] = numMatrixOutputChannel		
}		

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Syntax of packaging layer decoding in basic static metadata	Number of bits	Mnemonic
if(b_transChannelReuse) {		
transChRef	**5**	**uimsbf**
}		
}		
}		

9.9.2 Semantics

packFormatIdx	3 bits. It indicates a unique index value of AudioPackFormat().
b_audioPackFormatImportance	1 bit. It indicates whether the audioPackFormatImportance field exists in AudioPackFormat(). '0': no; '1': yes.
b_transChannelReuse	1 bit. It indicates whether the channelReuse field exists in AudioPackFormat(). '0': no; '1': yes.
audioPackFormatImportance	4 bits. It indicates the importance level of audioObject. '10': highest importance; '0': lowest importance; '11' to '15': reserved.
typeLabel	4 bits. It indicates the description related to the channel type, and should comply with provisions in Table 57.
absoluteDistance	5 bits. It indicates the absolute distance. Value range: [0, 16].
packFormatID	6 bits. 0 to 31 should comply with provisions of the 5 least significant bits of AudioPackFormatID in Table 2 of ITU-R BS.2094-1. 32 to 63 are defined by users.
numMatrixOutputChannel	5 bits. It indicates the number of matrix output channels based on the matrix.
normalization	2 bits. It indicates a scene-based normalization manner. '0': SN3D; '1' to '3': reserved.
nfcRefDist	4 bits. It indicates the reference distance (in meters) that is normalized by absoluteDistance and that is used in the scene-based audio production process. The reference distance can be used for near-field compensation (NFC) audio rendering. Value range: [0, 1].
screenRef	1 bit. It indicates whether the scene-based program is related to the screen.

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hoaOrder	3 bits. It indicates the scene-based maximum order.
packFormatStartIdx	5 bits. It indicates a physical channel index corresponding to AudioChannelFormat() included in AudioPackFormat() or a start value of a plurality of consecutive physical channel indexes corresponding to a plurality of AudioChannelFormat() items.
numChannels	5 bits. It indicates the number of refChannelIdx items referenced in AudioPackFormat().
refChannelIdx	5 bits. It indicates an index of AudioChannelFormat included in AudioPackFormat().
channelTypeLabel	It indicates a local variable that maps 32 TypeLabel values. It is obtained by parsing the AudioPackFormat() function and used in the AudioChannelFormat function.
channelPackFormatID	It indicates a local variable that maps 32 PackFormatID values. It is obtained by parsing the AudioPackFormat() function and used in the AudioChannelFormat function.
channelNumMatrixOutputChannel	It indicates a local variable that maps 32 channelNumMatrixOutputChannel values. It is obtained by parsing the AudioPackFormat() function and used in the AudioChannelFormat function.
transChRef	5 bits. It indicates a physical channel index corresponding to AudioChannelFormat included in AudioPackFormat().

The definition of typeLabel should comply with provisions in Table 57.

Table 57 Definition of typeLabel

Channel type	typeLabel	Description
DirectSpeakers	1	For channel-based audio, each channel feeds a speaker directly.
Matrix	2	For all other typeLabel items, signals are matrixed together, such as the middle, left, and right signals.
Objects	3	For object-based audio, channels represent audio objects (or parts of objects), including position information.
HOA	4	For scene-based audio, high-fidelity surround stereo system and HOA are used.
Binaural	5	For dual-channel audio, playback is performed over headphones.
User Custom	Other values	User custom types.

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9.10 Syntax and Semantics of Decoding Channel Layer in Basic Static Metadata

9.10.1 Syntax

The syntax of decoding the channel layer in the basic static metadata should comply with provisions in Table 58.

Table 58 Syntax of decoding channel layer in basic static metadata

Syntax of decoding channel layer in basic static metadata	Number of bits	Mnemonic
AudioChannelFormat () {		
channelFormatIdx	**5**	**uimsbf**
b_channelGain	**1**	**uimsbf**
if(b_channelGain) {		
channelGainUnit	**1**	**uimsbf**
channelGain_QFlag	**1**	**uimsbf**
channelGain	**6**	**uimsbf**
}		
if(channelTypeLabel [channelFormatIdx]== 1) {		
if(channelPackFormatID[channelFormatIdx]== 0x3f) {		
DirectSpeakersPosition()		
}		
} else if(channelTypeLabel [channelFormatIdx]== 2) {		
for (i = 0; i< channelNumMatrixOutputChannel[channelFormatIdx] ; i++) {		
matrixCoef[i]	**8**	**uimsbf**
}		
}		
}		

9.10.2 Semantics

channelFormatIdx — 5 bits. It indicates a unique index value of AudioChannelFormat().

b_channelGain — 1 bit. It indicates whether the channelGain field exists in AudioChannelFormat(). '0': no; '1': yes.

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channelGainUnit	1 bit. It indicates the unit of channelGain. '0': linear; '1': dB.
channelGain_QFlag	1 bit. It indicates the channelGain quantization interval. When gainUnit is 0 and channelGainQFlag is 0, the quantization interval is [0, 1]. When gainUnit is 0 and channelGainQFlag is 1, the quantization interval is (1, 16]. When gainUnit is 1 and channelGainQFlag is 0, the quantization interval is [–80, 0]. When gainUnit is 1 and channelGainQFlag is 1, the quantization interval is (0, 24].
channelGain	6 bits. It indicates a gain value applied to all audio samples referenced by AudioChannelFormat().
matrixCoef	8 bits. It indicates the matrix coefficient based on the matrix type. Value range: [0.1, 10].

9.11 Syntax and Semantics of Decoding Object Interaction Field in Basic Static Metadata

9.11.1 Syntax

The syntax of decoding the object interaction field in the basic static metadata should comply with provisions in Table 59.

Table 59 Syntax of decoding object interaction field in basic static metadata

Syntax of decoding object interaction field in basic static metadata	Number of bits	Mnemonic
AudioObjectInteraction() {		
onOffInteract	**1**	**uimsbf**
gainInteract	**1**	**uimsbf**
positionInteract	**1**	**uimsbf**
if(gainInteract) {		
gainInteractionUnit	**1**	**uimsbf**
gainInteractionRange_min	**7**	**uimsbf**
gainInteractionRange_max	**7**	**uimsbf**
}		
if(positionInteract) {		
cartesianInteraction	**1**	**uimsbf**
if (cartesianInteraction == 1) {		
positionInteractionRange_Xmin	**8**	**uimsbf**
positionInteractionRange_Xmax	**8**	**uimsbf**

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Syntax of decoding object interaction field in basic static metadata	Number of bits	Mnemonic
positionInteractionRange_Ymin	**6**	**uimsbf**
positionInteractionRange_Ymax	**6**	**uimsbf**
positionInteractionRange_Zmin	**4**	**uimsbf**
positionInteractionRange_Zmax	**4**	**uimsbf**
} else {		
positionInteractionRange_azimuthMin	**8**	**uimsbf**
positionInteractionRange_azimuthMax	**8**	**uimsbf**
positionInteractionRange_elevationMin	**6**	**uimsbf**
positionInteractionRange_elevationMax	**6**	**uimsbf**
positionInteractionRange_distanceMin	**4**	**uimsbf**
positionInteractionRange_distanceMax	**4**	**uimsbf**
}		
}		
}		

9.11.2 Semantics

onOffInteract — 1 bit. If a user can switch the object on or off, this item is set to 1. Otherwise, this item is set to 0.

gainInteract — 1 bit. If a user can change the object gain, this item is set to 1. Otherwise, this item is set to 0.

positionInteract — 1 bit. If a user can change the object position, this item is set to 1. Otherwise, this item is set to 0.

gainInteractionUnit — 1 bit. It indicates the unit of gainInteractionRange. '0': linear; '1': dB.

gainInteractionRange_min — 7 bits. It indicates the minimum linear gain factor or logarithmic gain offset of a possible user gain interaction. Value range: [0, 1].

gainInteractionRange_max — 7 bits. It indicates the maximum linear gain factor or logarithmic gain offset of a possible user gain interaction. Value range: [1, 16].

cartesianInteraction — 1 bit. It indicates whether the Cartesian coordinate system is used.

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positionInteractionRange_Xmin	8 bits. It indicates the minimum X-axis normalized offset value of a possible user position interaction. Value range: [–1, 1].
positionInteractionRange_Xmax	8 bits. It indicates the maximum X-axis normalized offset value of a possible user position interaction. Value range: [–1, 1].
positionInteractionRange_Ymin	6 bits. It indicates the minimum Y-axis normalized offset value of a possible user position interaction. Value range: [–1, 1]
positionInteractionRange_Ymax	6 bits. It indicates the maximum Y-axis normalized offset value of a possible user position interaction. Value range: [–1, 1]
positionInteractionRange_Zmin	4 bits. It indicates the minimum Z-axis normalized offset value of a possible user position interaction. Value range: [–1, 1]
positionInteractionRange_Zmax	4 bits. It indicates the maximum Z-axis normalized offset value of a possible user position interaction. Value range: [–1, 1]
positionInteractionRange_azimuthMin	8 bits. It indicates the minimum azimuth offset value of a possible user position interaction. Value range: [–180, 0]
positionInteractionRange_azimuthMax	8 bits. It indicates the maximum azimuth offset value of a possible user position interaction. Value range: [0, 180]
positionInteractionRange_elevationMin	6 bits. It indicates the minimum height offset value of a possible user position interaction. Value range: [–90, 0]
positionInteractionRange_elevationMax	6 bits. It indicates the maximum height offset value of a possible user position interaction. Value range: [0, 90]
positionInteractionRange_distanceMin	4 bits. It indicates the minimum normalized distance of a possible user position interaction. Value range: [0, 1]
positionInteractionRange_distanceMax	4 bits. It indicates the maximum normalized distance of a possible user position interaction. Value range: [0, 1]

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9.12 Syntax and Semantics of Decoding Speaker Position in Basic Static Metadata

9.12.1 Syntax

The syntax of decoding the speaker position in the basic static metadata should comply with provisions in Table 60.

Table 60 Syntax of decoding speaker position in basic static metadata

Syntax of decoding speaker position in basic static metadata	Number of bits	Mnemonic
DirectSpeakersPosition() {		
azimuth	**8**	**uimsbf**
elevation	**6**	**uimsbf**
distance	**4**	**uimsbf**
DirectSpeakerScreenEdgeLock	**2**	**uimsbf**
}		

9.12.2 Semantics

azimuth — 8 bits. It indicates the exact azimuth position of a speaker. Value range: [–180, 180].

elevation — 6 bits. It indicates the exact height position of a speaker. Value range: [–90, 90].

distance — 4 bits. It indicates the exact normalized distance of a speaker from the start point. Value range: [0, 1].

DirectSpeakerscreenEdgeLock — 2 bits. It defines a speaker position at a screen edge. It includes four values: left, right, top, and bottom. '0': left; '1': right; '2': top; '3': bottom.

9.13 Syntax and Semantics of Decoding Loudness Field in Basic Static Metadata

9.13.1 Syntax

The syntax of decoding the loudness field in the basic static metadata should comply with provisions in Table 61.

Table 61 Syntax of decoding loudness field in basic static metadata

Syntax of decoding loudness field in basic static metadata	Number of bits	Mnemonic
LoudnessMetadata() {		
b_integratedLoudness	**1**	**uimsbf**
b_loudnessRange	**1**	**uimsbf**
b_maxTruePeak	**1**	**uimsbf**
b_maxMomentary	**1**	**uimsbf**

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Syntax of decoding loudness field in basic static metadata	Number of bits	Mnemonic
b_maxShortTerm	**1**	**uimsbf**
b_dialogueLoudness	**1**	**uimsbf**
if (b_integratedLoudness) {		
integratedLoudness	**5**	**uimsbf**
}		
if (b_loudnessRange) {		
loudnessRange	**5**	**uimsbf**
}		
if (b_maxTruePeak) {		
maxTruePeak	**5**	**uimsbf**
}		
if (b_maxMomentary) {		
maxMomentary	**5**	**uimsbf**
}		
if (b_maxShortTerm) {		
maxShortTerm	**5**	**uimsbf**
}		
if (b_dialogueLoudness) {		
dialogueLoudness	**5**	**uimsbf**
}		
}		

9.13.2 Semantics

b_integratedLoudness — 1 bit. It indicates whether the integratedLoudness field exists in loudness. '0': no; '1': yes.

b_loudnessRange — 1 bit. It indicates whether the loudnessRange field exists in loudness. '0': no; '1': yes.

b_maxTruePeak — 1 bit. It indicates whether the maxTruePeak field exists in loudness. '0': no; '1': yes.

b_maxMomentary — 1 bit. It indicates whether the maxMomentary field exists in loudness. '0': no; '1': yes.

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b_maxShortTerm	1 bit. It indicates whether the maxShortTerm field exists in loudness. '0': no; '1': yes.
b_dialogueLoudness	1 bit. It indicates whether the dialogueLoudness field exists in loudness. '0': no; '1': yes.
integratedLoudness	5 bits. It indicates the integrated loudness value. Value range: [–70, 0].
loudnessRange	5 bits. It indicates the loudness range. Value range: [10, 70].
maxTruePeak	5 bits. It indicates the maximum true peak. Value range: [–70, 0].
maxMomentary	5 bits. It indicates the maximum momentary loudness. Value range: [–70, 0].
maxShortTerm	5 bits. It indicates the maximum short-term loudness. Value range: [–70, 0].
dialogueLoudness	5 bits. It indicates the loudness of the average dialogue. Value range: [–70, 0].

9.14 Syntax and Semantics of Decoding Program Reference Screen Field in Basic Static Metadata

9.14.1 Syntax

The syntax of decoding the program reference screen field in the basic static metadata should comply with provisions in Table 62.

Table 62 Syntax of decoding program reference screen field in basic static metadata

Syntax of decoding program reference screen field in basic static metadata	Number of bits	Mnemonic
AudioProgrammeReferenceScreen() {		
cartesianReferenceScreen	**1**	**uimsbf**
aspectRatio	**3**	**uimsbf**
if (cartesianReferenceScreen == 0) {		
screenCentrePosition_azimuth	**8**	**uimsbf**
screenCentrePosition_elevation	**6**	**uimsbf**
screenCentrePosition_distance	**4**	**uimsbf**
screenWidth_polar	**7**	**uimsbf**
} else {		
screenCentrePosition_X	**8**	**uimsbf**
screenCentrePosition_Y	**6**	**uimsbf**

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Syntax of decoding program reference screen field in basic static metadata	Number of bits	Mnemonic
screenCentrePosition_Z	**4**	**uimsbf**
screenWidth_cartesian	**7**	**uimsbf**
}		
}		

9.14.2 Semantics

cartesianReferenceScreen	1 bit. It indicates whether the Cartesian coordinate system is used.
aspectRatio	3 bits. It indicates the mapping table of the aspect ratio of the screen. '0': 16:9; '1': 21:9; '2' to '7': reserved.
screenCentrePosition_azimuth	8 bits. It indicates the azimuth angle of the screen center. Value range: [–180, 180].
screenCentrePosition_elevation	6 bits. It indicates the height of the screen center. Value range: [0, 90].
screenCentrePosition_distance	4 bits. It indicates the normalized distance to the screen center. Value range: [0, 1].
screenWidth_polar	7 bits. It indicates the screen width in polar coordinates. Value range: [0, 180].
screenCentrePosition_X	8 bits. It indicates the normalized X coordinate of the screen center. Value range: [–1, 1].
screenCentrePosition_Y	6 bits. It indicates the normalized Y coordinate of the screen center. Value range: [–1, 1].
screenCentrePosition_Z	4 bits. It indicates the normalized Z coordinate of the screen center. Value range: [–1, 1].
screenWidth_cartesian	7 bits. It indicates the normalized screen width in the Cartesian coordinate system. The maximum value of screenWidth_cartesian should comply with the maximum value of screenWidth in the Cartesian coordinate system in ITU-R BS.2076-2. Value range: [0, 1].

9.15 Syntax and Semantics of Dynamic Metadata Level1 Decoding

9.15.1 Syntax

The syntax of dynamic metadata Level1 decoding should comply with provisions in Table 63.

Table 63 Syntax of dynamic metadata Level1 decoding

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Syntax of dynamic metadata Level1 decoding	Number of bits	Mnemonic
Avs3DmL1Dec() {		
if(muteFlag == 0) {		
cartesianDm	**1**	**uimsbf**
b_obj_extent	**1**	**uimsbf**
b_obj_gain	**1**	**uimsbf**
b_obj_diffuse	**1**	**uimsbf**
b_obj_importance	**1**	**uimsbf**
if(cartesianDm == 0) {		
obj_position_azimuth	**8**	**uimsbf**
obj_position_elevation	**6**	**uimsbf**
obj_position_distance	**4**	**uimsbf**
if(b_obj_extent) {		
obj_width_horizontal	**7**	**uimsbf**
obj_hight_vertical	**5**	**uimsbf**
obj_depth_distance	**4**	**uimsbf**
}		
} else {		
obj_position_x	**8**	**uimsbf**
obj_position_y	**6**	**uimsbf**
obj_position_z	**4**	**uimsbf**
if(b_obj_extent) {		
obj_width_x	**7**	**uimsbf**
obj_hight_y	**5**	**uimsbf**
obj_depth_z	**4**	**uimsbf**
}		
}		
if(b_obj_gain) {		
gain	**7**	**uimsbf**
}		
if(b_obj_diffuse) {		
diffuse	**7**	**uimsbf**

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Syntax of dynamic metadata Level1 decoding	Number of bits	Mnemonic
}		
jumpPosition	**1**	**uimsbf**
if(b_obj_importance) {		
importance	**4**	**uimsbf**
}		
}		
}		

9.15.2 Semantics

cartesianDm — 1 bit. It indicates the used coordinate system type. '0': polar coordinate system; '1': Cartesian coordinate system.

b_obj_extent — 1 bit. It indicates whether the obj_width, obj_hight, and obj_depth fields exist in Avs3DmL1Dec(). '0': no; '1': yes.

b_obj_gain — 1 bit. It indicates whether the gain field exists in Avs3DmL1Dec(). '0': no; '1': yes.

b_obj_diffuse — 1 bit. It indicates whether the diffuse field exists in Avs3DmL1Dec(). '0': no; '1': yes.

b_obj_importance — 1 bit. It indicates whether the importance field exists in Avs3DmL1Dec(). '0': no; '1': yes.

obj_position_azimuth — 8 bits. It indicates the horizontal angle at the position of the object when the polar coordinate system is used. Value range: [–180, 180].

obj_position_elevation — 6 bits. It indicates the pitch angle at the position of the object when the polar coordinate system is used. Value range: [–90, 90].

obj_position_distance — 4 bits. It indicates the normalized distance at the position of the object when the polar coordinate system is used. Value range: [0, 1].

obj_position_x — 8 bits. It indicates the normalized X coordinate of the left/right dimension of the object when the Cartesian coordinate system is used. Value range: [–1, 1].

obj_position_y — 6 bits. It indicates the normalized Y coordinate of the front/back dimension of the object when the Cartesian coordinate system is used. Value range: [–1, 1].

obj_position_z — 4 bits. It indicates the normalized Z coordinate of the upper/lower dimension of the object when the Cartesian coordinate system is used. Value range: [–1, 1].

obj_width_horizontal — 7 bits. It indicates the width of the object sound source when

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	the polar coordinate system is used. Value range: [0, 360].
obj_height_vertical	5 bits. It indicates the height of the object sound source when the polar coordinate system is used. Value range: [0, 360].
obj_depth_distance	4 bits. It indicates the normalized depth of the object sound source when the polar coordinate system is used. Value range: [0, 1].
obj_width_x	7 bits. It indicates the normalized width of the object sound source when the Cartesian coordinate system is used. Value range: [0, 1].
obj_height_y	5 bits. It indicates the normalized height of the object sound source when the Cartesian coordinate system is used. Value range: [0, 1].
obj_depth_z	4 bits. It indicates the normalized depth of the object sound source when the Cartesian coordinate system is used. Value range: [0, 1].
gain	7 bits. It indicates the object rendering gain information, which is linear. Value range: [0, 6].
diffuse	7 bits. It indicates the diffuse reflection of the object. Value range: [0, 1].
jumpPosition	1 bit. It indicates whether the object position in the current frame changes. '0': Interpolation is performed in the entire current frame; '1': The position changes.
importance	4 bits. It indicates the importance level of the object. '10': highest importance; '0': lowest importance; '11' to '15': reserved.

9.16 Syntax and Semantics of Dynamic Metadata Level2 Decoding

9.16.1 Syntax

The syntax of dynamic metadata Level2 decoding should comply with provisions in Table 64.

Table 64 Syntax of dynamic metadata Level2 decoding

Syntax of dynamic metadata Level2 decoding	Number of bits	Mnemonic
Avs3DmL2Dec() {		
if(muteFlag == 0) {		
hasChannelLock	**1**	**uimsbf**
if(hasChannelLock == 1) {		
channelLock	**1**	**uimsbf**
if(channelLock == 1) {		
channelLock_maxDistance	**4**	**uimsbf**

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Syntax of dynamic metadata Level2 decoding	Number of bits	Mnemonic
}		
}		
hasObjectDivergence	**1**	**uimsbf**
if(hasObjectDivergence == 1) {		
objectDivergence	**4**	**uimsbf**
if(objectDivergence != 0)		
objectDivergence_azimuthRange	**6**	**uimsbf**
}		
}		
hasObjectScreenRef	**1**	**uimsbf**
if(hasObjectScreenRef == 1) {		
obj_screenRef	**1**	**uimsbf**
}		
hasScreenEdgeLock	**1**	**uimsbf**
if(hasScreenEdgeLock == 1) {		
screenEdgeLock	**2**	**uimsbf**
}		
}		
}		

9.16.2 Semantics

hasChannelLock	1 bit. It indicates whether channelLock metadata exists. '0': no; '1': yes.
channelLock	1 bit. It indicates whether the channel is locked. '0': no; '1': yes.
channelLock_maxDistance	4 bits. It indicates the maximum distance in channel locking. Value range: [0, 2].
hasObjectDivergence	1 bit. It indicates whether objectDivergence metadata exists. '0': no; '1': yes.
objectDivergence	4 bits. It indicates the object divergence. Value range: [0, 1]
objectDivergence_azimuthRange	6 bits. It indicates the object divergence. Value range: [0, 180]

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hasObjectScreenRef	1 bit. It indicates whether screen-related metadata exists. '0': no; '1': yes.
obj_screenRef	1 bit. It indicates whether the object is related to the screen. '0': no; '1': yes.
hasScreenEdgeLock	1 bit. It indicates whether screenEdgeLock metadata exists. '0': no; '1': yes.
screenEdgeLock	2 bits. It indicates screen edge lock. '0': left; '1': right; '2': top; '3': bottom.

9.17 Extended Static Metadata Level1 Decoding

9.17.1 Syntax

The syntax of extended static metadata Level1 decoding should comply with provisions in Table 65.

Table 65 Syntax of extended static metadata Level1 decoding

Syntax of extended static metadata Level1 decoding	Number of bits	Mnemonic
VrExtL1() {		
b_acousticEnv	**1**	**uimsbf**
b_renderInfo	**1**	**uimsbf**
ambisonicOrder	**3**	**uimsbf**
if(b_acousticEnv) {		
acousticEnv()		
}		
if(b_renderInfo) {		
renderInfo()		
}		
}		

9.17.2 Semantics

b_acousticEnv	1 bit. It indicates whether the acousticEnv field exists in vrExtL1(). '0': no; '1': yes.
b_renderInfo	1 bit. It indicates whether the renderInfo field exists in vrExtL1(). '0': no; '1': yes.
ambisonicOrder	3 bits. It indicates the spherical harmonic coding order, and is used by the renderer.

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AcousticEnv()	It is an interface for decoding acoustic environment metadata.
RenderInfo()	It is an interface for decoding post effect processing metadata.

9.18 Decoding of Acoustic Environment Metadata in Extended Static Metadata

9.18.1 Syntax

The syntax of decoding acoustic environment metadata in the extended static metadata should comply with provisions in Table 66.

Table 66 Syntax of decoding acoustic environment metadata in extended static metadata

Syntax of decoding acoustic environment metadata in extended static metadata	Number of bits	Mnemonic
AcousticEnv() {		
b_earlyReflectionGain	**1**	**uimsbf**
b_lateReverbGain	**1**	**uimsbf**
reverbType	**2**	**uimsbf**
if (b_earlyReflectionGain == 1) {		
earlyReflectionGain	**7**	**uimsbf**
}		
if (b_lateReverbGain == 1) {		
lateReverbGain	**7**	**uimsbf**
}		
lowFreqProFlag	**1**	**uimsbf**
if (reverbType == 2) {		
convolutionReverbType	**5**	**uimsbf**
}		
numSurface	**3**	**uimsbf**
numSurface = numSurface + 1		
for (i = 0; i < numSurface; i++) {		
Surface()		
}		
}		

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9.18.2 Semantics

b_earlyReflectionGain	1 bit. It indicates whether the earlyReflectionGain field exists in AcousticEnv(). '0': no; '1': yes.
b_lateReverbGain	1 bit. It indicates whether the lateReverbGain field exists in AcousticEnv(). '0': no; '1': yes.
reverbType	2 bits. It indicates the type of the acoustic environment model. '0': "Physical (physical reverberation)"; '1': "Artificial (artificial reverberation)"; '2': "Sample (sample reverberation)"; '3': "extension type".
earlyReflectionGain	7 bits. It indicates the early reflection gain. Value range: [0, 1].
lateReverbGain	7 bits. It indicates the late reflection gain. Value range: [0, 1].
lowFreqProFlag	1 bit. It indicates the low-frequency separation processing. '0': Reverberation is not performed on low frequencies to maintain the definition.
convolutionReverbType	5 bits. It indicates the sample reverberation type. The options are 0, 1, 2, ..., and N. For example, '0' indicates sample reverberation in a concert hall, and '1' indicates sample reverberation in a recording studio.
numSurface	3 bits. It indicates the number of surface() items in acousticEnv(). The values are {0, 1, 2, 3, 4, 5}.
Surface()	It is an interface for decoding wall metadata of the same material.

9.19 Decoding of Wall Metadata of Same Material in Extended Static Metadata

9.19.1 Syntax

The syntax of decoding wall metadata of the same material in the extended static metadata should comply with provisions in Table 67.

Table 67 Syntax of decoding wall metadata of same material in extended static metadata

Wall metadata of same material in extended static metadata	Number of bits	Mnemonic
Surface() {		
material	**5**	**uimsbf**
if(material == 0x1f) {		
for (i = 0; i < 8; i++) {		
absorption[i]	**7**	**uimsbf**
scattering[i]	**7**	**uimsbf**
}		

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Wall metadata of same material in extended static metadata	Number of bits	Mnemonic
}		
numVertices	**5**	**uimsbf**
numVertices = numVertices + 1		
for (i = 0; i < numVerticesLimit; i++) {		
Vertex()		
}		
}		

9.19.2 Semantics

material — 5 bits. It indicates the material type in the acoustic environment. It is a sub-element of vertex. The options are 0, 1, ..., and 31. A total of 31 materials are supported, for example, brick and water. The scattering and absorption rates vary depending on materials.

absorption — 7 bits. It indicates the absorption rate of a specific bandwidth.

scattering — 7 bits. It indicates the scattering rate.

numVertices — 4 bits. It indicates the number of Vertex()s items included in Surface().

Vertex() — It indicates the coordinate of the triangle vertex composed of unified geometric material surfaces.

numVerticesLimit — When numSurface is 0, and the value of numVertices is within the range of [7, 31], numVerticesLimit = numVertices + 1. When the value of numVertices is less than 7, the value of numVerticesLimit is 8.

When numSurface is 1, and the value of numVertices is within the range of [3, 17], numVerticesLimit = numVertices + 1. When the value of numVertices is less than 3, the value of numVerticesLimit is 4. When the value of numVertices is greater than 17, the value of numVerticesLimit is 18.

When numSurface is 2, and the value of numVertices is within the range of [2, 11], numVerticesLimit = numVertices + 1. When the value of numVertices is less than 2, the value of numVerticesLimit is 3. When the value of numVertices is greater than 11, the value of numVerticesLimit is 12.

When numSurface is 3, and the value of numVertices is within the range of [1, 8], numVerticesLimit = numVertices + 1. When the value of numVertices is less than 1, the value of numVerticesLimit is 2. When the value of numVertices is greater than 8, the value of numVerticesLimit is 9.

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When numSurface is 4, and the value of numVertices is within the range of [1, 6], numVerticesLimit = numVertices + 1. When the value of numVertices is less than 1, the value of numVerticesLimit is 2. When the value of numVertices is greater than 6, the value of numVerticesLimit is 7.

When numSurface is 5, and the value of numVertices is within the range of [1, 5], numVerticesLimit = numVertices + 1. When the value of numVertices is less than 1, the value of numVerticesLimit is 2. When the value of numVertices is greater than 5, the value of numVerticesLimit is 6.

9.20 Decoding of Triangle Vertex Composed of Unified Geometric Material Surfaces in Extended Static Metadata

9.20.1 Syntax

The syntax of decoding the triangle vertex composed of unified geometric material surfaces in the extended static metadata should comply with provisions in Table 68.

Table 68 Syntax of decoding triangle vertex composed of unified geometric material surfaces in extended static metadata

Syntax of decoding triangle vertex composed of unified geometric material surfaces in extended static metadata	**Number of bits**	**Mnemonic**
Vertex() {		
x	**7**	**uimsbf**
y	**7**	**uimsbf**
z	**7**	**uimsbf**
}		

9.20.2 Semantics

x	7 bits. It indicates the x coordinate of the triangle vertex. Value range: [–100, 100].
y	7 bits. It indicates the y coordinate of the triangle vertex. Value range: [–100, 100].
z	7 bits. It indicates the z coordinate of the triangle vertex. Value range: [–100, 100].

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9.21 Decoding of Rendering Information in Extended Static Metadata

9.21.1 Syntax

The syntax of decoding the rendering information in the extended static metadata should comply with provisions in Table 69.

Table 69 Syntax of decoding rendering information in extended static metadata

Syntax of decoding rendering information in extended static metadata	Number of bits	Mnemonic
RenderInfo() {		
targetDevice	**1**	**uimsbf**
hrtfType	**4**	**uimsbf**
for (i = 0; i < 16; i++) {		
headphoneType[i]	**7**	**uimsbf**
}		
AudioEffect()		
}		

9.21.2 Semantics

targetDevice	1 bit. It indicates the production intent and playback device type. '0': headphones; '1': speaker.
hrtfType	4 bits. It indicates head related transfer function (HRTF) data complying with the spatially oriented format for acoustics (SOFA). The indexes {0, 1, ..., and 5} respectively correspond to [THK, MIT, SADIE, CIPIC, HUTUBS, custom].
headphoneType	7 bits. It indicates the monitoring headphones type. "ABCD..." indicates the character string of the monitoring headphones type.
AudioEffect()	It is the interface for decoding post processing metadata such as the equalizer (EQ) and dynamic range control (DRC).

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9.22 Decoding of Post Effect Processing in Extended Static Metadata

9.22.1 Syntax

The syntax of decoding post effect processing in the extended static metadata should comply with provisions in Table 70.

Table 70 Syntax of decoding post effect processing in extended static metadata

Syntax of decoding post effect processing in extended static metadata	Number of bits	Mnemonic
AudioEffect() {		
b_EQ_exist	**1**	**uimsbf**
b_DRC_exist	**1**	**uimsbf**
b_Gain_exist	**1**	**uimsbf**
if (b_EQ_exist || b_DRC_exist || b_Gain_exist) {		
effectChain	**3**	**uimsbf**
}		
if (b_EQ_exist) {		
numEqband	**4**	**uimsbf**
numEqband = numEqband + 1		
for (i= 0; i < numEqband; i++) {		
eqEffect ()		
}		
}		
if (b_DRC_exist) {		
attackTime	**4**	**uimsbf**
releaseTime	**4**	**uimsbf**
threshold	**7**	**uimsbf**
preGain	**7**	**uimsbf**
postGain	**7**	**uimsbf**

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Syntax of decoding post effect processing in extended static metadata	Number of bits	Mnemonic
ratio	**7**	**uimsbf**
}		
if (b_Gain_exist) {		
effectGain	**7**	**uimsbf**
}		
}		

9.22.2 Semantics

b_EQ_exist	1 bit. It indicates whether the EQ field exists in AudioEffect(). '0': no; '1': yes.
b_DRC_exist	1 bit. It indicates whether the DRC field exists in AudioEffect(). '0': no; '1': yes.
b_Gain_exist	1 bit. It indicates whether the gain field exists in AudioEffect(). '0': no; '1': yes.
effectChain	3 bits. It indicates the execution sequence of EQ, DRC, and gain. '0': Gain > EQ > DRC '1': Gain > DRC > EQ '2': EQ > DRC > Gain '3': EQ > Gain > DRC '4': DRC > EQ > Gain '5': DRC > Gain > EQ
numEqband	4 bits. It indicates the number of eqEffect items included in AudioEffect(). '0' to '11': the number of eqEffect items included in AudioEffect(); '12' to '15': reserved.
attackTime	4 bits. It indicates the triggering time. Value range: [1, 100].
releaseTime	4 bits. It indicates the release time. Value range: [50, 300].
threshold	7 bits. It indicates the trigger threshold. Value range: [–80, 10].
preGain	7 bits. It indicates the pregain. Value range: [–10, 10].
postGain	7 bits. It indicates the postgain. Value range: [0, 20].
ratio	7 bits. It indicates the compression rate. Value range: [1, 100].

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b_EQ_exist	1 bit. It indicates whether the EQ field exists in AudioEffect(). '0': no; '1': yes.
effectGain	7 bits. It indicates the pregain. Value range: [–20, 20].
EqEffect()	It indicates the interface for decoding the EQ effect parameter.

9.23 Decoding of Equalization Effect in Extended Static Metadata

9.23.1 Syntax

The syntax of decoding equalization effect in the extended static metadata should comply with provisions in Table 71.

Table 71 Syntax of decoding equalization effect in extended static metadata

Syntax of decoding equalization effect in extended static metadata	**Number of bits**	**Mnemonic**
EqEffect() {		
eqType	**3**	**uimsbf**
eqFc	**7**	**uimsbf**
eqQQFlag	**1**	**uimsbf**
eqQ	**6**	**uimsbf**
eqGain	**7**	**uimsbf**
}		

9.23.2 Semantics

eqType	3 bits. It indicates the EQ type.
eqFc	7 bits. It indicates the cut-off frequency of the filter. Value range: [20, 16000].
eqQQFlag	1 bit. It indicates the eqQ quantization interval. When eqQQFlag is 0, the quantization interval is [0.1, 1]. When eqQQFlag is 1, the quantization interval is (1, 12].
eqQ	6 bits. It indicates the quality factor. Value range: [0.1, 12].
eqGain	7 bits. It indicates the EQ gain. Value range: [–20, 20].
b_EQ_exist	1 bit. It indicates whether the EQ field exists in AudioEffect(). '0': no; '1': yes.

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eqType	3 bits. It indicates the EQ type.
b_DRC_exist	1 bit. It indicates whether the DRC field exists in AudioEffect(). '0': no; '1': yes.
b_Gain_exist	1 bit. It indicates whether the gain field exists in AudioEffect(). '0': no; '1': yes.

9.24 Decoding Process

During metadata decoding, a quantization step and a quantization offset of the metadata are set based on a value range of the metadata, to determine the quantization precision. The decoder parses a bitstream to obtain a quantization index of the metadata. The dequantized value $Qvalue$ of the metadata is calculated based on the quantization index $QIdx$, the quantization step QStep, and the quantization offset Qset. In Table 65, the metadata is dequantized according to formula (33).

$$Qvalue = QIdx \times \mathrm{QStep} + \mathrm{Qset} \tag{33}$$

The metadata quantization parameter should comply with provisions in Table 72.

Table 72 Metadata Quantization Parameters

Metadata element	**Metadata name**	**Quantization step**	**Quantization offset**
AudioProgramme()	maxDuckingDepth	2.0	0
AudioPackFormat ()	nfcRefDist	0.066666	0
LoudnessMetadata()	integratedLoudness	2.2580645	0
	loudnessRange	1.935483	10.0
	maxTruePeak	2.2580645	0
	maxMomentary	2.2580645	0
	maxShortTerm	2.2580645	0
	dialogueLoudness	2.2580645	0
AudioProgrammeReference Screen()	screenCentrePosition_azimuth	1.411764	–180.0
	screenCentrePosition_elevation	1.428571	0
	screenCentrePosition_distance	0.066666	0
	screenWidth_polar	1.417322	0
	screenCentrePosition_X	0.007843	–1.0

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Metadata element	Metadata name	Quantization step	Quantization offset
	screenCentrePosition_Y	0.031746	–1.0
	screenCentrePosition_Z	0.133333	–1.0
	screenWidth_cartesian	0.007874	0
AudioObjectInteraction()	gainInteractionRange_min (gainInteractionUnit is 0)	0.007874	0
	gainInteractionRange_min (gainInteractionUnit is 1)	0.629921	0
	gainInteractionRange_max (gainInteractionUnit is 0)	0.118110	1.0
	gainInteractionRange_max (gainInteractionUnit is 1)	0.188976	0
	positionInteractionRange_Xmin	0.007843	–1.0
	positionInteractionRange_Xmax	0.007843	–1.0
	positionInteractionRange_Ymin	0.031746	–1.0
	positionInteractionRange_Ymax	0.031746	–1.0
	positionInteractionRange_Zmin	0.133333	–1.0
	positionInteractionRange_Zmax	0.133333	–1.0
	positionInteractionRange_azimuthMin	0.705882	0
	positionInteractionRange_azimuthMax	0.705882	0
	positionInteractionRange_elevationMin	1.428571	0
	positionInteractionRange_elevationMax	1.428571	0
	positionInteractionRange_distanceMin	0.066667	0
	positionInteractionRange_distanceMax	0.066667	0

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Table 72 (continued)

Metadata element	Metadata name	Quantization step	Quantization offset
DirectSpeakersPosition()	azimuth	1.411764	0
	elevation	2.85714	0
	distance	0.066667	0
AudioObject()	objectGain (objectGainUnit is 0, objectGainQFlag is 0)	0.015873	0
	objectGain (objectGainUnit is 0, objectGainQFlag is 1)	0.238095	1.0
	objectGain (objectGainUnit is 1, objectGainQFlag is 0)	1.269841	0
	objectGain (objectGainUnit is 1, objectGainQFlag is 1)	0.380952	0
AudioChannelFormat()	channelGain (channelGainUnit is 0, channelGain_QFlag is 0)	0.015873	0
	channelGain (channelGainUnit is 0, channelGain_QFlag is 1)	0.238095	1.0
	channelGain (channelGainUnit is 1, channelGain_QFlag is 0)	1.269841	0
	channelGain (channelGainUnit is 1, channelGain_QFlag is 1)	0.380952	0
	MatrixCoef	0.038823	0.1
AcousticEnv()	earlyReflectionGain	0.007874	0
	lateReverbGain	0.007874	0
Surface()	absorption	0.007874	0
	scattering	0.007874	0
Vertex()	x	1.574803	–100.0

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Metadata element	Metadata name	Quantization step	Quantization offset
	y	1.574803	–100.0
	z	1.574803	–100.0
AudioEffect()	attackTime	6.6	1.0
	releaseTime	16.66666	50.0
	threshold	0.708661	–80.0
	preGain	0.157480	–10.0
	postGain	0.157480	0
	ratio	0.779527	1.0
	effectGain	0.314960	–20.0
eqEffect()	eqQ(eqQQFlag is 0)	0.014285	0.1
	eqQ(eqQQFlag is 1)	0.174603	1.0
	eqGain	0.314960	–20.0
Avs3DmL1Dec()	obj_position_azimuth	1.411764	–180
	obj_position_elevation	2.857142	–90
	obj_position_distance	0.066666	0
	obj_width_horizontal	2.834645	0
	obj_hight_vertical	11.612903	0
	obj_depth_distance	0.066666	0
	obj_position_x	0.007843	–1.0
	obj_position_y	0.031746	–1.0
	obj_position_z	0.133333	–1.0
	obj_width_x	0.007874	0
Avs3DmL1Dec()	obj_hight_y	0.032258	0
	obj_depth_z	0.066666	0
	gain	0.047244	0

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Metadata element	Metadata name	Quantization step	Quantization offset
	diffuse	0.007874	0
Avs3DmL2Dec()	channelLock_maxDistance	0.133333	0
	objectDivergence	0.066666	0
	objectDivergence_azimuthRange	2.857142	0

The absoluteDistance metadata is dequantized according to formula (34).

$$absoluteDistance = 10^{(QIdx \times 0.0396919)} - 1.0 \quad (34)$$

The eqFc metadata is dequantized according to formula (35).

$$eqFc = 10^{((QIdx \times 0.457179 + 20 \times log10(20))/20)} \quad (35)$$

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Annex A
(Normative)
Syntax and Semantics of AVS3 Audio Coded Bitstream

A.1 Syntax

A.1.1 Overview

According to the AVS Audio Storage Format (AASF) and AVS Audio Transport Format (AATF) specifications in GB/T 33475.3-2018, the syntax and semantics of the AVS3 AASF and AATF are provided for the format of the AVS3 audio bitstream. The AVS3 audio bitstream file extension is av3a.

AASF includes the header information of an audio sequence and the following raw data block. AASF is only applicable to systems that define the starting point without having to start decoding from the intermediate part of the audio datastream. AASF includes all the necessary information for decoding and playing audio data, which is an exchange memory format.

As a streaming format, AATF includes the synchronization word and the necessary information for decoding. The synchronization word allows the decoder to decode without a determined starting point.

A.1.2 Syntax of AASF

AASF includes the header information of an audio sequence and the following raw data block. The syntax should comply with provisions in Table A.1.

Table A.1 Syntax of aasf_sequence()

Syntax	Number of bits	Mnemonic
aasf_sequence()		
{		
aasf_header()		
if (audio_codec_id < 2) {		
if (coding_profile == 0) {		
if (audio_codec_id == 0)		
ga_raw_data_stream()		
if (audio_codec_id == 1)		
ll_raw_data_stream()		
}		
if (coding_profile == 2)		

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Syntax	Number of bits	Mnemonic
hoa_raw_data_stream()		
}		
else if (audio_codec_id == 2)		
ga_co_raw_data_stream()		
}		

The AASF header describes the header information of audio storage format, including identification and a size of a data storage format of the AASF header. The syntax of aasf_header() should comply with provisions in Table A.2.

Table A.2 Syntax of aasf_header()

Syntax	Number of bits	Mnemonic
aasf_header()		
{		
aasf_id	**32**	**bslbf**
header_size	**24**	**bslbf**
raw_stream_length	**32**	**bslbf**
audio_codec_id	**4**	**bslbf**
resolution	**2**	**bslbf**
if(audio_codec_id==2) {		
nn_type	**3**	**uimsbf**
}		
coding_profile	**3**	**bslbf**
anc_data_index	**1**	**bslbf**
if(audio_codec_id==0)		
channel_number_index	**7**	**bslbf**
if(audio_codec_id==1)		
channel_number	**{4;8}**	**bslbf**

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Syntax	Number of bits	Mnemonic
if(audio_codec_id==2){		
if(coding_profile ==0){		
channel_number_index	**7**	**bslbf**
}		
if(coding_profile ==1){		
soundBedType	**2**	**uimsbf**
if (soundBedType == 0){		
object_channel_number	**7**	**uimsbf**
bitrate_index_per_channel	**4**	**uimsbf**
} else if (soundBedType == 1){		
channel_number_index	**7**	**uimsbf**
bitrate_index	**4**	**uimsbf**
object_channel_number	**7**	**uimsbf**
bitrate_index_per_channel	**4**	**uimsbf**
}		
}		
if(coding_profile ==2){		
order	**4**	**uimsbf**
}		
}		
sampling_frequency_index	**4**	**bslbf**

Table A.2 (continued)

Syntax	Number of bits	Mnemonic
if(audio_codec_id==1){		

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Syntax	Number of bits	Mnemonic
if(sampling_frequency_index==0xf) {		
sampling_frequency	**24**	**uimsbf**
}		
}		
if(audio_codec_id==0 || (audio_codec_id==2 && coding_profile != 1)){		
bitrate_index	**4**	**bslbf**
}		
if(audio_codec_id==0){		
bitstream_type	**1**	**bslbf**
if(channel_number==2){		
supermode_flag	**2**	**bslbf**
couple_channel_config	**8**	**bslbf**
}		
if(channel_number>2){		
supermode_flag	**2**	**bslbf**
couple_channel_config	**8**	**bslbf**
PCAGroupmodeHeader	**8**	**bslbf**
}		
}		
byte_alignment()		
}		

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A.1.3 AATF Syntax

AATF includes a synchronization word and necessary information for decoding. Its syntax should comply with provisions in Table A.3.

Table A.3 Syntax of aatf_sequence()

Syntax	Number of bits	Mnemonic
aatf_sequence()		
{		
while (nextbits() == syncword) {		
aatf_frame()		
}		
}		

An AATF frame describes a bitstream sequence of an audio transmission frame. The sequence includes corresponding decoded header information, information header, error check, and raw data block. The syntax of aatf_frame() should comply with provisions in Table A.4.

Table A.4 Syntax of aatf_frame()

Syntax	Number of bits	Mnemonic
aatf_frame()		
{		
syncword	**12**	**bslbf**
audio_codec_id	**4**	**bslbf**
anc_data_index	**1**	**bslbf**
if(audio_codec_id < 3){		
aatf_frame_header()		
if (audio_codec_id == 2){		
frame_error_check()		
}		
byte_alignment()		
if (audio_codec_id < 2) {		
if (coding_profile == 0) {		

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Syntax	Number of bits	Mnemonic
if (audio_codec_id == 0)		
ga_raw_data_block()		
if (audio_codec_id == 1)		
ll_raw_data_block()		
}		
if (coding_profile == 2)		
hoa_raw_data_block()		
}		
else if (audio_codec_id == 2)		
ga_co_raw_data_block()		
}		
if (audio_codec_id == 0 || audio_codec_id == 1){		
frame_error_check()		
}		
}		

frame_error_check() is located at the end of an attf frame and is used to check integrity of a bitstream of each frame. All bits of a current frame enter a CRC algorithm according to a sequence in which the bits appear. The syntax of frame_error_check() should comply with provisions in Table A.5.

Table A.5 Syntax of frame_error_check()

Syntax	Number of bits	Mnemonic
frame_error_check()		
{		
crc_check	**8**	**rpchof**
}		

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An AATF decoded header describes decoded header information, and includes a synchronization word, a sample rate index, and the like. The syntax of aatf_frame_header() should comply with provisions in Table A.6.

Table A.6 Syntax of aatf_frame_header()

Syntax	Number of bits	Mnemonic
aatf_frame_header()		
{		
if(audio_codec_id==2) {		
nn_type	**3**	**uimsbf**
}		
coding_profile	**3**	**uimsbf**
sampling_frequency_index	**4**	**uimsbf**
if(audio_codec_id==1) {		
if (sampling_frequency_index==0xf) {		
sampling_frequency	**24**	**uimsbf**
}		
}		
if(audio_codec_id != 2){		
raw_frame_length	**16**	**bslbf**
}		
aatf_error_check()		
if(audio_codec_id==0)		
channel_number_index	**7**	**bslbf**
if(audio_codec_id==1)		
channel_number	**{4; 8}**	**bslbf**
if(audio_codec_id==2){		
if(coding_profile ==0){		
channel_number_index	**7**	**bslbf**

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Syntax	Number of bits	Mnemonic
}		
if(coding_profile ==1){		
soundBedType	**2**	**uimsbf**
if (soundBedType == 0){		
object_channel_number	**7**	**uimsbf**
bitrate_index_per_channel	**4**	**uimsbf**
} else if (soundBedType == 1){		
channel_number_index	**7**	**uimsbf**
bitrate_index	**4**	**uimsbf**
object_channel_number	**7**	**uimsbf**
bitrate_index_per_channel	**4**	**uimsbf**
}		

Table A.6 (continued)

Syntax	Number of bits	Mnemonic
}		
if(coding_profile ==2){		
order	4	uimsbf
}		
}		
resolution	2	uimsbf
if(audio_codec_id==0 || (audio_codec_id==2 && coding_profile != 1)){		
bitrate_index	4	uimsbf
}		

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Syntax	Number of bits	Mnemonic
if(audio_codec_id==0){		
bitstream_type	1	bslbf
}		
}		

The syntax of aatf_error_check() should comply with provisions in Table A.7.

Table A.7 Syntax of aatf_error_check()

Syntax	Number of bits	Mnemonic
aatf_error_check()		
{		
crc_check	**8**	**rpchof**
}		

A.2 Semantics

ll_raw_data_stream()	It indicates the sequence of ll_raw_data_block(), which is generated by a lossless audio coding tool.
ga_co_raw_data_stream()	It indicates the sequence of ga_co_raw_data_block(), which is generated by a general full-rate audio coding tool.
ga_raw_data_stream()	It indicates the sequence of ga_raw_data_block(), which is generated by a general high-rate audio coding tool.
raw_stream_length	16 bits. It indicates the length of the raw audio data stream, in bytes.
audio_codec_id	4 bits. '0': general high-rate audio coding data '1': lossless audio coding data '2': general full-rate audio coding data '3' to '15': reserved
anc_data_index	1 bit. It indicates whether an auxiliary data block exists.

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ll_raw_data_stream()	It indicates the sequence of ll_raw_data_block(), which is generated by a lossless audio coding tool.
resolution	2 bits. It indicates an index of the number of quantization bits of the input signal. '0': an 8 bits/sampling point '1': a 16 bits/sampling point '2': a 24 bits/sampling point '3': reserved
nn_type	3 bits. '0': a basic neural network configuration '1': a low-complexity neural network configuration '2' to '7': reserved
coding_profile	3 bits. '0': a basic framework '1': an object metadata coding framework '2': an HOA data coding framework '3' to '7': reserved
channel_number_index	7 bits. It indicates an index of the number of channels, and should comply with provisions in Table A.8. The spatial position of the speaker is referenced from GY/T 316-2018.
channel_number	When audio_codec_id is 1 and the number of channels is less than 16, this field contains 4 bits. 0xf indicates extension, and others indicate the number of channels. When audio_codec_id is 1 and the number of channels is not less than 16, this field contains 8 bits.
order	4 bits. (hoa_order + 1) indicates the HOA signal order.
sampling_frequency_index	4 bits. It indicates an index of the sampling frequency of the input signal, and should comply with provisions in Table A.9.
sampling_frequency	It indicates the sampling frequency value (Hz) for extension, and is a 24-bit unsigned integer. 0x000000: 0 Hz 0x000001: 1 Hz ... 0xFFFFFE: 16777214 Hz 0xFFFFFF: reserved
bitstream_type	When audio_codec_id is 0, it indicates the bitstream type and contains 1 bit.

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ll_raw_data_stream()	It indicates the sequence of ll_raw_data_block(), which is generated by a lossless audio coding tool.
	'0': a uniform bitstream, which can be uniformly transmitted through channels. '1': a non-uniform bitstream, which cannot be uniformly transmitted through channels.
bitrate_index	4 bits. It indicates an index of the bit rate, and should comply with provisions in Table A.10 to Table A.20.
ll_raw_data_block()	It indicates lossless audio coded raw bitstream data, and is generated by the lossless audio coding tool.
ga_co_raw_data_block()	It indicates general full-rate audio coded raw bitstream data, and is generated by the general full-rate audio coding tool.
ga_raw_data_block()	It indicates general audio coded raw bitstream data, and is generated by the general high-rate audio coding tool.
aasf_sequence()	It indicates a sequence in the AVS_Audio_Storage_Format format, and should comply with provisions in Table A.1.
aasf_header()	It indicates an AASF header, which is located at the beginning of aasf_sequence, and should comply with provisions in Table A.2.
aatf_sequence()	It indicates a sequence in AVS_Audio_Transport_Format format, and should comply with provisions in Table A.3.
aatf_frame()	It indicates an AATF frame, and should comply with provisions in Table A.4.
aatf_frame_header()	It indicates an AATF decoding frame header, and should comply with provisions in Table A.6.
raw_frame_length	16 bits. It indicates the total length of the current frame in the bitstream. The flag of the total length of the current frame in the bitstream is added to obtain the basic information of the bitstream.
frame_error_check()	It indicates the data generated during the CRC check. All bits in the AATF frame are checked according to the CRC algorithm and the sequence in which they appear. It should comply with provisions in Table A.5.
aatf_error_check()	It indicates the data generated during the CRC check, and should comply with provisions in Table A.7.
syncword	12 bits. It indicates the synchronization word. The bit string is '1111 1111 1111'.
soundBedType	2 bits. It indicates the sound bed type. '0': There is no sound bed, and only the object audio is

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ll_raw_data_stream()	It indicates the sequence of ll_raw_data_block(), which is generated by a lossless audio coding tool.
	available. '1': The sound bed is one of mono audio, dual-channel stereo audio, or multi-channel audio. '2' and '3': reserved
object_channel_number	7 bits. (object_channel_number + 1) indicates the number of channels for all the object audio.
bitrate_index_per_channel	4 bits. It indicates an index of the average bit rate per channel for all the object audio. channel_number_index is reused.
crc_check	CRC check

Table A.8 Channel_number configuration table

channel_number_index	Channel configuration	channel_number
0x0	Mono	1
0x1	Dual-channel stereo	2
0x2	5.1	6
0x3	7.1	8
0x4	10.2	12
0x5	22.2	24
0x6	4.0/FOA	4
0x7	5.1.2	8
0x8	5.1.4	10
0x9	7.1.2	10
0xa	7.1.4	12
0xb	3-order HOA	16
0xc	2-order HOA	9
0xd to 0x7f	Reserved	

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Table A.9 Sampling rate mapping table

sampling_frequency_index	Sampling frequency (Hz)
0x0	192000
0x1	96000
0x2	48000
0x3	44100
0x4	32000
0x5	24000
0x6	22050
0x7	16000
0x8	8000
0x9 to 0xf	Reserved

Table A.10 Mono coding bit rate index table

bitrate_index	Bit rate (kb/s)
0x0	16
0x1	32
0x2	44
0x3	56
0x4	64
0x5	72
0x6	80
0x7	96
0x8	128
0x9	144
0xa	164
0xb	192
0xc to 0xf	Reserved

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Table A.11 Dual-channel stereo coding bit rate index table

bitrate_index	Bit rate (kb/s)
0x0	24
0x1	32
0x2	48
0x3	64
0x4	80
0x5	96
0x6	128
0x7	144
0x8	192
0x9	256
0xa	320
0xb to 0xf	Reserved

Table A.12 5.1 multi-channel coding bit rate index table

bitrate_index	Bit rate (kb/s)
0x0	192
0x1	256
0x2	320
0x3	384
0x4	448
0x5	512
0x6	640
0x7	720
0x8	144
0x9	96
0xa	128
0xb	160
0xc to 0xf	Reserved

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Table A.13 7.1 multi-channel coding bit rate index table

bitrate_index	Bit rate (kb/s)
0x0	192
0x1	480
0x2	256
0x3	384
0x4	576
0x5	640
0x6	128
0x7	160
0x8 to 0xf	Reserved

Table A.14 4.0/FOA coding bit rate index table

bitrate_index	Bit rate (kb/s)
0x0	48
0x1	96
0x2	128
0x3	192
0x4	256
0x5 to 0xf	Reserved

Table A.15 5.1.2 multi-channel coding bit rate index table (Only the total bit rate is used when audio_codec_id is 2)

bitrate_index	5.1.2 total bit rate (kb/s)	5.1 bit rate (kb/s)	0.0.2 bit rate (kb/s)
0x0	152	128	24
0x1	320	256	64
0x2	480	384	96
0x3	576	448	128
0x4 to 0xf	Reserved		

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Table A.16 5.1.4 multi-channel coding bit rate index table (Only the total bit rate is used when audio_codec_id is 2)

bitrate_index	5.1.4 total bit rate (kb/s)	5.1 bit rate (kb/s)	0.0.4 bit rate (kb/s)
0x0	176	128	48
0x1	384	256	128
0x2	576	384	192
0x3	704	448	256
0x4	256	192	64
0x5	448	320	128
0x6 to 0xf	Reserved		

Table A.17 7.1.2 multi-channel coding bit rate index table (Only the total bit rate is used when audio_codec_id is 2)

bitrate_index	7.1.2 total bit rate (kb/s)	7.1 bit rate (kb/s)	0.0.2 bit rate (kb/s)
0x0	216	192	24
0x1	480	416	64
0x2	576	480	96
0x3	384	320	64
0x4	768	640	128
0x5 to 0xf	Reserved		

Table A.18 7.1.4 multi-channel coding bit rate index table (Only the total bit rate is used when audio_codec_id is 2)

bitrate_index	7.1.4 total bit rate (kb/s)	7.1 bit rate (kb/s)	0.0.4 bit rate (kb/s)
0x0	240	192	48
0x1	608	480	128
0x2	384	288	96
0x3	512	384	128
0x4	832	576	256
0x5 to 0xf	Reserved		

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Table A.19 2-order HOA coding bit rate index table

bitrate_index	Bit rate (kb/s)
0x0	192
0x1	256
0x2	320
0x3	384
0x4	480
0x5	512
0x6	640
0x7 to 0xf	Reserved

Table A.20 3-order HOA coding bit rate index table

bitrate_index	Bit rate (kb/s)
0x0	256
0x1	320
0x2	384
0x3	512
0x4	640
0x5	896
0x6 to 0xf	Reserved

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Annex B
(Normative)
Audio Code Table

The AVS3 audio code table should comply with provisions in Table B.1 to Table B.49.

Table B.1 Context range coding table

Index	Probability
1	0, 1, 65534, 65535, 65536
2	0, 1, 65534, 65535, 65536
3	0, 1, 65534, 65535, 65536
4	0, 1, 65534, 65535, 65536
5	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 16, 30, 69, 169, 405, 909, 1885, 3581, 6203, 9806, 14349, 20045, 27710, 39581, 63884, 65352, 65478, 65513, 65523, 65526, 65527, 65528, 65529, 65530, 65531, 65532, 65533, 65534, 65535, 65536
6	0, 1, 65534, 65535, 65536
7	0, 1, 65534, 65535, 65536
8	0, 1, 65534, 65535, 65536
9	0, 1, 65534, 65535, 65536
10	0, 1, 65534, 65535, 65536
11	0, 1, 65534, 65535, 65536
12	0, 1, 65534, 65535, 65536
13	0, 1, 2, 3, 4, 16, 227, 4637, 62245, 65417, 65525, 65531, 65532, 65533, 65534, 65535, 65536
14	0, 1, 65534, 65535, 65536
15	0, 1, 65534, 65535, 65536
16	0, 1, 65534, 65535, 65536

Table B.2 Layer 1 CNN (convolutional kernel parameter kernel) of context decoding neural network parameter

Parameter value
–0x1.0292f20000000p–9, –0x1.366fe00000000p–11, –0x1.87d1260000000p–10, –0x1.cc52800000000p–9, –0x1.6487740000000p–1, 0x1.828c6c0000000p–11, 0x1.0e08e00000000p–11, 0x1.b500fa0000000p–10, –0x1.2c5b220000000p–11, 0x1.1109140000000p–10, –0x1.899ed60000000p–9, –0x1.14eea20000000p–9, –0x1.3e52fe0000000p–4, –0x1.70af560000000p–10, –0x1.2668220000000p–12,

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Parameter value
0x1.c0e2fe0000000p–10,
0x1.ff18000000000p–9, 0x1.9878960000000p–10, 0x1.a7f9ec0000000p–8, 0x1.2fba2c0000000p–8, –0x1.40fa4e0000000p–2, –0x1.705e160000000p–9, –0x1.09d3900000000p–8, 0x1.c2f6460000000p–10, –0x1.5402600000000p–9, 0x1.da25b00000000p–10, –0x1.2bfaf60000000p–9, 0x1.46ced60000000p–10, –0x1.3890400000000p–1, –0x1.0021f00000000p–8, –0x1.57a5ba0000000p–10, –0x1.3e41140000000p–10,
–0x1.6a29260000000p–7, –0x1.45bb160000000p–8, –0x1.3078d00000000p–7, –0x1.53d64e0000000p–7, –0x1.d2fd4a0000000p–2, 0x1.5911c00000000p–8, 0x1.6539ca0000000p–7, –0x1.36a2e60000000p–9, 0x1.dbac1c0000000p–9, 0x1.4fc8b40000000p–9, 0x1.2cdc1e0000000p–8, –0x1.80a7f80000000p–11, –0x1.d4c0160000000p–1, 0x1.04827c0000000p–11, –0x1.12470a0000000p–10, –0x1.24878e0000000p–9,
–0x1.eb9d460000000p–7, –0x1.d1f8600000000p–9, –0x1.7db0400000000p–7, –0x1.a270a20000000p–7, –0x1.53a65a0000000p–1, 0x1.7cc2a40000000p–8, 0x1.4d8f800000000p–7, 0x1.fabc2c0000000p–15, 0x1.b9bba80000000p–8, –0x1.0820600000000p–9, 0x1.48a9ec0000000p–8, –0x1.6501ec0000000p–10, –0x1.547f9a0000000p–1, 0x1.aed1c40000000p–9, 0x1.3f92960000000p–9, –0x1.589be20000000p–10,

Table B.2 (continued)

Parameter value
0x1.55c9fc0000000p–8, 0x1.5fef600000000p–8, 0x1.5abd8a0000000p–8, 0x1.43a8580000000p–8, –0x1.a74e920000000p–2, –0x1.121cd40000000p–8, –0x1.7a86360000000p–8, –0x1.80dea20000000p–10, –0x1.631c460000000p–8, 0x1.eb8acc0000000p–10, 0x1.76a6680000000p–13, 0x1.616ffe0000000p–11, –0x1.00a68c0000000p–2, 0x1.b95ba60000000p–11, –0x1.455f8e0000000p–9, –0x1.b823ac0000000p–13,
–0x1.338c020000000p–5, –0x1.d717660000000p–7, –0x1.f4a05e0000000p–6, –0x1.06740e0000000p–5, –0x1.c5f5940000000p–1, 0x1.c7f1700000000p–7, 0x1.d753300000000p–6, –0x1.f8530e0000000p–9, 0x1.fe39c40000000p–7, –0x1.842c660000000p–10, 0x1.22700e0000000p–7, –0x1.e0d3140000000p–8, –0x1.c33e720000000p–5, 0x1.1cb7320000000p–7, 0x1.a451b80000000p–8, 0x1.226df40000000p–9,
0x1.f359840000000p–11, –0x1.104b300000000p–10, 0x1.1676a80000000p–10, 0x1.6adc2c0000000p–12, –0x1.1f921c0000000p–1, 0x1.580dc00000000p–9, 0x1.cb52920000000p–13, –0x1.6313d80000000p–12, 0x1.77a0120000000p–12,

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Parameter value
0x1.b043e60000000p–12, 0x1.5bc0320000000p–10, –0x1.3a8bee0000000p–11, –0x1.5249920000000p–5, 0x1.6a6f160000000p–10, –0x1.f626940000000p–13, –0x1.c109a80000000p–13,
0x1.4352880000000p–6, 0x1.42f98c0000000p–7, 0x1.0ff08a0000000p–6, 0x1.2a00d60000000p–6, –0x1.9dc7040000000p–1, –0x1.1645220000000p–7, –0x1.0b2c200000000p–6, 0x1.22cafc0000000p–9, –0x1.4f324e0000000p–7, –0x1.57332e0000000p–11, –0x1.c87e280000000p–8, 0x1.e999160000000p–9, 0x1.a929ce0000000p–6, –0x1.93fc580000000p–8, –0x1.31cc680000000p–8, 0x1.88ebca0000000p–10,
0x1.661a680000000p–6, 0x1.5a72120000000p–7, 0x1.51c0d40000000p–6, 0x1.4e4fba0000000p–6, –0x1.5ea56c0000000p–3, –0x1.29e23e0000000p–7, –0x1.4844440000000p–6, 0x1.c5cd260000000p–8, –0x1.1e96180000000p–7, 0x1.aa21580000000p–10, –0x1.712eba0000000p–9, 0x1.7cf6a60000000p–9, 0x1.ec5d460000000p–1, –0x1.1d7b320000000p–7, –0x1.5d53640000000p–8, –0x1.274ee20000000p–10,
–0x1.8c5efa0000000p–7, –0x1.02360a0000000p–7, –0x1.c269b80000000p–7, –0x1.0d53ce0000000p–6, 0x1.41bf9e0000000p–2, 0x1.03e8880000000p–7, 0x1.9c7f0e0000000p–7, –0x1.2fc2980000000p–8, 0x1.df16840000000p–9, 0x1.6d733a0000000p–9, 0x1.5d40fa0000000p–8, –0x1.1da57a0000000p–8, –0x1.6854200000000p–2, 0x1.35eb9e0000000p–7, 0x1.32ec120000000p–8, –0x1.ab3cf60000000p–9,
–0x1.55a11c0000000p–4, –0x1.03bede0000000p–5, –0x1.16411e0000000p–4, –0x1.23561c0000000p–4, 0x1.c07daa0000000p–8, 0x1.a8beec0000000p–6, 0x1.0314840000000p–4, –0x1.6e54b60000000p–7, 0x1.046d800000000p–5, 0x1.8d052a0000000p–10, 0x1.59b9ae0000000p–6, –0x1.9c1e260000000p–7, 0x1.13f1800000000p–3, 0x1.0cd2600000000p–6, 0x1.05ca240000000p–6, –0x1.0264e60000000p–9,
0x1.00c44c0000000p–6, 0x1.7f93a20000000p–8, 0x1.cb3f380000000p–7, 0x1.81a6ac0000000p–7, –0x1.c6a8f00000000p–4, –0x1.c6f7c00000000p–8, –0x1.a3d0840000000p–7, 0x1.0e63900000000p–8, –0x1.46a5ca0000000p–8, –0x1.2bdabe0000000p–10, –0x1.42b33e0000000p–8, 0x1.3462000000000p–10, –0x1.f8b61e0000000p–4, –0x1.0775400000000p–11, –0x1.5552b80000000p–9, 0x1.06f3f00000000p–15,
0x1.2692aa0000000p–8, 0x1.614c400000000p–10, 0x1.4396440000000p–8, 0x1.a255740000000p–8, –0x1.0ca9720000000p–3, –0x1.6093680000000p–9, –0x1.1892180000000p–8, 0x1.b350a60000000p–12, –0x1.5841fc0000000p–8, –0x1.d51fe80000000p–10, –0x1.18bb860000000p–10, –0x1.545d7a0000000p–10, –0x1.2c272a0000000p+0, –0x1.77dffa0000000p–9, 0x1.7a89d60000000p–13,

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Parameter value
0x1.7c57220000000p–11,
–0x1.8c939a0000000p–8, 0x1.0f32440000000p–10, –0x1.dfffd20000000p–8, –0x1.7aec5a0000000p–8, 0x1.eebdaa0000000p–4, 0x1.2a379c0000000p–8, 0x1.7dc1ce0000000p–8, 0x1.e6996e0000000p–13, 0x1.8a7fde0000000p–8, –0x1.a675fc0000000p–12, 0x1.1ec7420000000p–8, –0x1.e3ed200000000p–10, –0x1.1e9b840000000p+0, 0x1.e3ee460000000p–9, 0x1.15f5ba0000000p–8, –0x1.0aa18a0000000p–11,

Table B.2 (continued)

Parameter value
–0x1.edc16a0000000p–9, –0x1.6912aa0000000p–8, –0x1.ab72ee0000000p–11, –0x1.c3f94a0000000p–10, –0x1.2b77740000000p–1, 0x1.bab7f00000000p–9, 0x1.3d11d20000000p–10, –0x1.724ce80000000p–9, –0x1.3723860000000p–10, –0x1.3033f20000000p–11, 0x1.fc38020000000p–11, –0x1.93710e0000000p–10, –0x1.70a8300000000p–3, –0x1.548f100000000p–10, –0x1.970bec0000000p–10, –0x1.68d1120000000p–9,
–0x1.8e7a740000000p–8, –0x1.6c89b60000000p–9, –0x1.33e5ea0000000p–8, –0x1.01ce900000000p–9, 0x1.b8829c0000000p–3, 0x1.090e860000000p–9, 0x1.a6940e0000000p–9, –0x1.e1aaec0000000p–9, 0x1.58d3ac0000000p–11, –0x1.1bc8aa0000000p–13, 0x1.7a75ba0000000p–11, –0x1.0b5f260000000p–11, 0x1.f27c580000000p–1, 0x1.390c0c0000000p–9, 0x1.bfb8f60000000p–12, –0x1.3e35480000000p–11,
0x1.d15b6c0000000p+1, 0x1.15310a0000000p–2, 0x1.1c4af60000000p+0, 0x1.5667520000000p+0, 0x1.1318400000000p–4, –0x1.bd89b80000000p–3, –0x1.9110580000000p–1, 0x1.66adda0000000p–4, –0x1.08f7260000000p–2, –0x1.cd21920000000p–7, –0x1.2d1f4a0000000p–3, 0x1.eef6c00000000p–4, –0x1.3abeae0000000p–5, –0x1.14d6a80000000p–3, –0x1.afdb260000000p–4, –0x1.be7ee40000000p–9,
–0x1.ce70d40000000p–8, –0x1.0b4de20000000p–8, –0x1.a4a3860000000p–8, –0x1.347d5e0000000p–8, –0x1.c099ec0000000p–2, 0x1.253d7e0000000p–9, 0x1.6fd1320000000p–8, 0x1.47f58e0000000p–11, 0x1.186d2e0000000p–8, 0x1.4ae9cc0000000p–10, 0x1.061da00000000p–9, –0x1.476cc60000000p–11, 0x1.07bab00000000p–1, 0x1.ae89e80000000p–11, 0x1.125cf00000000p–8, 0x1.99ed8c0000000p–11,
–0x1.2db3540000000p–6, –0x1.e01b1a0000000p–8, –0x1.a878460000000p–7, –0x1.38785e0000000p–6, –0x1.37a3480000000p–5, 0x1.a3ba6c0000000p–8, 0x1.dcd3740000000p–7, –0x1.7185620000000p–10, 0x1.9173980000000p–8,

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Parameter value
0x1.86255c0000000p–10, 0x1.96f1ae0000000p–8, –0x1.3114340000000p–9, –0x1.6786360000000p–2, 0x1.0288e20000000p–9, 0x1.ec3e5e0000000p–15, –0x1.2a9bf40000000p–11,
0x1.469e9a0000000p–6, 0x1.7108280000000p–8, 0x1.380c340000000p–6, 0x1.1d3d340000000p–6, –0x1.0fbb9e0000000p–1, –0x1.1c55c20000000p–7, –0x1.f1f0a40000000p–7, 0x1.07f3300000000p–8, –0x1.b7fafe0000000p–8, 0x1.6255320000000p–9, –0x1.346ef00000000p–8, 0x1.a948420000000p–9, 0x1.2fb6b80000000p–2, –0x1.383ce60000000p–8, –0x1.fe50aa0000000p–9, 0x1.13ed9e0000000p–10,
0x1.edf5680000000p–11, –0x1.703e680000000p–9, 0x1.e579680000000p–16, 0x1.cdc1d00000000p–12, –0x1.2e31940000000p–2, –0x1.1b89680000000p–9, 0x1.f088ca0000000p–10, 0x1.29d3280000000p–8, –0x1.6408800000000p–8, –0x1.557a820000000p–8, –0x1.343b1a0000000p–8, 0x1.541a160000000p–10, 0x1.1db0be0000000p–1, –0x1.af98ea0000000p–10, 0x1.d4002e0000000p–12, –0x1.28a1aa0000000p–9,
–0x1.28d2080000000p–9, –0x1.8c43040000000p–10, –0x1.d78a180000000p–10, –0x1.2a1e780000000p–9, –0x1.ad8b780000000p–1, 0x1.23d41a0000000p–10, 0x1.3f14fe0000000p–9, –0x1.43261c0000000p–16, 0x1.8d18de0000000p–11, –0x1.a77a9e0000000p–14, 0x1.2dc0ba0000000p–9, –0x1.496fea0000000p–11, 0x1.ba47b40000000p–4, 0x1.0405380000000p–9, 0x1.75308e0000000p–10, –0x1.b371460000000p–12,
–0x1.dc7cc20000000p–8, –0x1.6aa8a40000000p–8, –0x1.1b499a0000000p–7, –0x1.2769c00000000p–7, 0x1.13f3440000000p–6, 0x1.9922a40000000p–8, 0x1.bff37e0000000p–8, –0x1.3d44920000000p–10, 0x1.738e6a0000000p–9, 0x1.bc8d6a0000000p–10, 0x1.24ab360000000p–8, –0x1.1316340000000p–9, –0x1.9b07ca0000000p–2, 0x1.5ab1f80000000p–9, 0x1.c169b80000000p–9, 0x1.aa58a00000000p–11,

Table B.2 (continued)

Parameter value
0x1.62cb4a0000000p–10, 0x1.26baea0000000p–8, 0x1.f935be0000000p–11, 0x1.e0f51e0000000p–10, –0x1.68083e0000000p–3, –0x1.61f0ac0000000p–10, –0x1.36c6900000000p–9, 0x1.a34f580000000p–9, –0x1.2a732e0000000p–9, 0x1.d658ce0000000p–18, –0x1.3494280000000p–10, 0x1.8a5e980000000p–10, 0x1.6f1b5c0000000p–4, –0x1.6326040000000p–9, –0x1.d2e4e20000000p–12, –0x1.376f9c0000000p–11,
–0x1.d129820000000p–7, –0x1.fb78900000000p–8, –0x1.3d01c20000000p–7,

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Parameter value
–0x1.ef6d680000000p–8, –0x1.dd48b60000000p–7, 0x1.5c15a20000000p–8, 0x1.168cf00000000p–7, –0x1.a8885c0000000p–9, 0x1.20aeda0000000p–8, 0x1.de284c0000000p–10, 0x1.2302a40000000p–8, –0x1.d9ddd20000000p–13, –0x1.42b7f00000000p–1, 0x1.db8a1c0000000p–11, 0x1.fd34240000000p–15, –0x1.b7712c0000000p–17,
0x1.6c16140000000p–6, 0x1.0a3dfa0000000p–7, 0x1.589ed20000000p–6, 0x1.539eb40000000p–6, –0x1.f728be0000000p–4, –0x1.1d15ae0000000p–6, –0x1.ee18d20000000p–7, 0x1.eecb620000000p–8, –0x1.845ecc0000000p–7, –0x1.5eec220000000p–9, –0x1.29163a0000000p–10, 0x1.b234f60000000p–8, 0x1.a24c6e0000000p–4, –0x1.9954ee0000000p–8, –0x1.b3c5f00000000p–9, –0x1.2b6d2e0000000p–9,
0x1.a56bf40000000p–6, 0x1.9fbfa40000000p–7, 0x1.5d2a140000000p–6, 0x1.5c38200000000p–6, 0x1.0ce4a40000000p–6, –0x1.3e65ec0000000p–7, –0x1.615b9c0000000p–6, 0x1.45b1680000000p–8, –0x1.9e2b3c0000000p–7, –0x1.bc51180000000p–10, –0x1.fd96da0000000p–8, 0x1.941d3c0000000p–8, –0x1.361bdc0000000p–2, –0x1.0d2d040000000p–7, –0x1.8e00440000000p–8, 0x1.946bea0000000p–11,
0x1.23504c0000000p–11, –0x1.d3783c0000000p–10, –0x1.37ffec0000000p–11, 0x1.6cade20000000p–13, –0x1.37f2540000000p–2, –0x1.dddff00000000p–11, 0x1.14dca40000000p–10, 0x1.42b2420000000p–10, 0x1.6f5aec0000000p–12, 0x1.97d85e0000000p–11, 0x1.84b9280000000p–11, –0x1.64918c0000000p–10, 0x1.18c7e00000000p–2, 0x1.491b0e0000000p–17, –0x1.f7f1300000000p–15, –0x1.21f60a0000000p–10,
–0x1.5044260000000p–7, –0x1.41fff80000000p–8, –0x1.447aa40000000p–7, –0x1.3c44560000000p–7, –0x1.ea45980000000p–3, 0x1.0fc69c0000000p–8, 0x1.27b4540000000p–7, 0x1.5c886a0000000p–11, 0x1.df79440000000p–9, –0x1.03639a0000000p–10, 0x1.966ed60000000p–10, 0x1.6ed2980000000p–10, 0x1.9d97de0000000p–1, 0x1.093cce0000000p–12, 0x1.c0992a0000000p–11, 0x1.75319c0000000p–9,
–0x1.4b50fc0000000p–8, –0x1.568b140000000p–10, –0x1.355d120000000p–9, –0x1.2109ee0000000p–8, –0x1.f4ddb40000000p–2, 0x1.3cebfe0000000p–8, 0x1.38d9a40000000p–8, –0x1.8642aa0000000p–10, 0x1.74fe040000000p–8, 0x1.c86f540000000p–10, –0x1.e6e05c0000000p–12, 0x1.2964780000000p–11, –0x1.4e58020000000p–6, 0x1.750fa40000000p–10, –0x1.733b860000000p–9, 0x1.5d6fbe0000000p–9,
0x1.9891be0000000p–4, 0x1.9082100000000p–4, –0x1.084cb40000000p–4, –0x1.a86ba60000000p–3, 0x1.42737a0000000p–3, 0x1.2a2e200000000p–3, –0x1.960aec0000000p–3, 0x1.ac39b80000000p–7, –0x1.7291fe0000000p–3,

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Parameter value
–0x1.5365d80000000p–4, –0x1.17fdea0000000p–5, 0x1.a6a4d60000000p–3, 0x1.fd811a0000000p–4, –0x1.293aa60000000p–5, –0x1.2a90740000000p–4, 0x1.52e80a0000000p–9,
0x1.ea70180000000p–10, –0x1.edc9fa0000000p–13, 0x1.be09b00000000p–9, 0x1.6fdbac0000000p–10, 0x1.2b09460000000p–1, –0x1.dfad280000000p–10, –0x1.9809e60000000p–10, –0x1.7310ba0000000p–10, –0x1.d8ecdc0000000p–9, –0x1.31f2d00000000p–9, –0x1.b5bffc0000000p–9, –0x1.2677300000000p–9, 0x1.c30c6e0000000p–2, –0x1.333edc0000000p–11, 0x1.8a138a0000000p–11, –0x1.7311d40000000p–10,
0x1.5f9de80000000p+2, 0x1.872ab80000000p–1, 0x1.6f57f00000000p+1, 0x1.a7c9d20000000p+1, 0x1.96798a0000000p–1, –0x1.4346520000000p–1, –0x1.1bf3820000000p+1, 0x1.c87f220000000p–3, –0x1.8641320000000p–1, –0x1.f366780000000p–6, –0x1.94dfe00000000p–2, 0x1.36e74a0000000p–2, –0x1.faf0c00000000p–4, –0x1.9a0c560000000p–2, –0x1.32b1e20000000p–2, 0x1.451ef20000000p–8,

Table B.2 (continued)

Parameter value
–0x1.d1346c0000000p–7, –0x1.1887c40000000p–8, –0x1.7cca660000000p–7, –0x1.c0a9c20000000p–7, –0x1.e207b80000000p–4, 0x1.ac2da20000000p–8, 0x1.2abd920000000p–7, –0x1.9cc5580000000p–10, 0x1.b7435e0000000p–9, –0x1.3cd3760000000p–8, 0x1.b721ce0000000p–13, –0x1.a595280000000p–11, 0x1.284f380000000p–4, 0x1.3d72340000000p–12, –0x1.fd135c0000000p–10, 0x1.7637720000000p–9,
0x1.5b416e0000000p–9, 0x1.609f700000000p–10, 0x1.bb98760000000p–9, 0x1.6ffa360000000p–9, 0x1.722f200000000p–7, –0x1.2f83aa0000000p–9, –0x1.1b94d60000000p–9, 0x1.20d0840000000p–11, –0x1.4496c80000000p–8, –0x1.aa35b40000000p–13, –0x1.9ce2c00000000p–10, 0x1.9aef080000000p–10, –0x1.3c07b60000000p–10, –0x1.f8ef860000000p–9, –0x1.118a7a0000000p–10, 0x1.9d75080000000p–11,
–0x1.1ecb040000000p–5, –0x1.f10fb80000000p–7, –0x1.fd35ea0000000p–6, –0x1.e8976a0000000p–6, –0x1.02c5f40000000p–4, 0x1.abe8100000000p–7, 0x1.c9c0d40000000p–6, –0x1.bba9da0000000p–9, 0x1.e1c6100000000p–7, 0x1.fe275a0000000p–10, 0x1.bf63920000000p–8, –0x1.412e2e0000000p–8, 0x1.b4e6300000000p–5, 0x1.8ee4220000000p–7, 0x1.cf3fd60000000p–9, –0x1.0619240000000p–10,
0x1.65a3b20000000p–5, 0x1.076bd40000000p–6, 0x1.2b28f80000000p–5,

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Parameter value
0x1.32b92a0000000p–5, –0x1.1e3ede0000000p–3, –0x1.3d14e00000000p–7, –0x1.01cd9a0000000p–5, 0x1.9187ac0000000p–8, –0x1.0654000000000p–6, 0x1.eb10400000000p–10, –0x1.85d4f60000000p–8, 0x1.0ef6620000000p–7, 0x1.0ac6e60000000p–6, –0x1.2494ac0000000p–7, –0x1.4200620000000p–8, –0x1.8b31420000000p–12,
–0x1.3d84140000000p–5, –0x1.fab80a0000000p–7, –0x1.03eb5a0000000p–5, –0x1.0996600000000p–5, –0x1.01dde60000000p–1, 0x1.aed93c0000000p–7, 0x1.eaba620000000p–6, –0x1.378fbe0000000p–8, 0x1.f49dd60000000p–7, –0x1.eda8c60000000p–13, 0x1.0a266a0000000p–7, –0x1.e599ea0000000p–8, –0x1.f9a9e60000000p–4, 0x1.1620020000000p–7, 0x1.a953620000000p–8, 0x1.4437fa0000000p–13,
0x1.5067920000000p–7, 0x1.f5e5760000000p–9, 0x1.3b30560000000p–7, 0x1.1978ea0000000p–7, –0x1.f5830e0000000p–2, –0x1.83560a0000000p–9, –0x1.1d93000000000p–7, 0x1.ddc9fe0000000p–13, –0x1.147f400000000p–9, 0x1.98d2ec0000000p–11, –0x1.0cc0bc0000000p–9, 0x1.3fe3240000000p–9, 0x1.038dea0000000p–6, –0x1.24b3220000000p–9, –0x1.fee3e40000000p–10, 0x1.2d1d780000000p–10,
0x1.cffa960000000p–6, 0x1.9df73a0000000p–7, 0x1.98d8c80000000p–6, 0x1.a6f13a0000000p–6, 0x1.3f5b880000000p–1, –0x1.ba056a0000000p–7, –0x1.8a052a0000000p–6, 0x1.b420fa0000000p–9, –0x1.80636c0000000p–7, –0x1.e4249c0000000p–11, –0x1.c61e300000000p–8, 0x1.cbc3c00000000p–8, 0x1.a000b40000000p–5, –0x1.eb431a0000000p–8, –0x1.94f6c80000000p–8, 0x1.302db00000000p–10,
0x1.7a26620000000p–5, 0x1.d10b640000000p–7, 0x1.3d7bd60000000p–5, 0x1.51ef300000000p–5, 0x1.50961c0000000p–2, –0x1.01cd780000000p–6, –0x1.10dc640000000p–5, 0x1.2e269e0000000p–7, –0x1.0eef620000000p–6, –0x1.03ea9a0000000p–8, –0x1.59ec400000000p–7, 0x1.3e0f720000000p–7, 0x1.ccdfba0000000p–7, –0x1.5846420000000p–7, –0x1.82822c0000000p–8, 0x1.1e4cb80000000p–9,
–0x1.360ee40000000p–6, –0x1.e31c000000000p–8, –0x1.bafb980000000p–7, –0x1.e5db8c0000000p–7, –0x1.3e66c20000000p–2, 0x1.a744e60000000p–9, 0x1.662c9e0000000p–7, 0x1.99cb0c0000000p–10, 0x1.865b080000000p–7, 0x1.eb5efa0000000p–10, 0x1.0576780000000p–7, –0x1.1dffe60000000p–11, 0x1.d011860000000p–4, 0x1.4ae8240000000p–9, 0x1.9e5a7a0000000p–8, –0x1.5069ec0000000p–9,
–0x1.a09d660000000p–4, –0x1.530d420000000p–5, –0x1.63017c0000000p–4, –0x1.7213e40000000p–4, –0x1.debafe0000000p–2, 0x1.1ecff80000000p–5, 0x1.4390d40000000p–4, –0x1.cd4d280000000p–7, 0x1.4def1a0000000p–5,

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Parameter value
–0x1.a9574e0000000p–12, 0x1.54792e0000000p–6, –0x1.22805a0000000p–6, –0x1.1d847c0000000p–2, 0x1.71cd640000000p–6, 0x1.13ccec0000000p–6, –0x1.0bf1bc0000000p–10,

Table B.2 (continued)

Parameter value
0x1.222f680000000p–6, 0x1.3d90e00000000p–7, 0x1.1e3e2e0000000p–6, 0x1.00114c0000000p–6, –0x1.031bd40000000p–3, –0x1.9cab920000000p–8, –0x1.d5c02a0000000p–7, 0x1.36afae0000000p–9, –0x1.5113e00000000p–7, 0x1.7490ba0000000p–11, –0x1.79b4380000000p–8, 0x1.91eea20000000p–9, –0x1.0fd2460000000p–5, –0x1.24c3880000000p–9, –0x1.e6d70e0000000p–9, –0x1.16d6740000000p–11,
0x1.8c2a820000000p–7, 0x1.cb8fcc0000000p–8, 0x1.376a600000000p–7, 0x1.5501ae0000000p–7, 0x1.d782640000000p–4, –0x1.5df7820000000p–8, –0x1.5f99f20000000p–7, 0x1.898a6e0000000p–9, –0x1.1fece00000000p–7, 0x1.0b0c0e0000000p–11, –0x1.9aad440000000p–11, 0x1.9b21560000000p–8, –0x1.3339cc0000000p–3, –0x1.325f160000000p–10, –0x1.24882c0000000p–9, –0x1.d7b5b60000000p–10,
0x1.6472ba0000000p–6, 0x1.65a1d20000000p–7, 0x1.2909320000000p–6, 0x1.7bb62e0000000p–6, –0x1.e5bbcc0000000p–4, –0x1.aedd740000000p–8, –0x1.37f01a0000000p–6, 0x1.5040660000000p–9, –0x1.0bb0aa0000000p–7, 0x1.4a7af00000000p–9, –0x1.d5243e0000000p–8, 0x1.c00c460000000p–9, 0x1.8f6c500000000p–2, –0x1.1527f80000000p–7, –0x1.656eaa0000000p–8, 0x1.2c8bc00000000p–10,
0x1.dce1f20000000p–5, 0x1.1e74d40000000p–5, 0x1.d4a4f60000000p–5, 0x1.aed3d20000000p–5, 0x1.ff698e0000000p–2, –0x1.3491480000000p–6, –0x1.988d380000000p–5, 0x1.52f33c0000000p–7, –0x1.87be160000000p–6, –0x1.0a44ae0000000p–12, –0x1.8123ce0000000p–8, 0x1.1df4ac0000000p–7, 0x1.e86eb60000000p–2, –0x1.1bf5a40000000p–8, –0x1.841a220000000p–7, 0x1.a8e5200000000p–11,
–0x1.3f89c20000000p–8, –0x1.9e28d80000000p–10, –0x1.7eb31e0000000p–9, –0x1.089d0c0000000p–8, –0x1.975ac60000000p–3, 0x1.fe0e6e0000000p–13, 0x1.61e1580000000p–9, –0x1.7fed040000000p–12, 0x1.0b0cec0000000p–10, 0x1.3551980000000p–16, –0x1.9df84e0000000p–11, –0x1.817b9c0000000p–10, 0x1.3e828a0000000p–7, –0x1.3533d80000000p–12, 0x1.9fd8f60000000p–16, –0x1.ebf3800000000p–9,

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Table B.3 Layer 1 CNN (bias parameter bias) of context decoding neural network parameter

Parameter value
0x1.b737080000000p–3, –0x1.635d260000000p+1, –0x1.993fd20000000p–2, –0x1.c72c020000000p+0, –0x1.63e0fa0000000p+1, 0x1.41686e0000000p–2, –0x1.f642a00000000p–3, 0x1.4067f20000000p–1, –0x1.0798e40000000p–2, –0x1.eb1dd60000000p–1, 0x1.04c7d80000000p–5, –0x1.76560e0000000p–1, –0x1.b0c64a0000000p–2, –0x1.2410f60000000p–1, –0x1.0f3c6c0000000p+0, –0x1.d71c320000000p–2,

Table B.4 Layer 2 CNN (convolutional kernel parameter kernel) of context decoding neural network parameter

Parameter value
0x1.2a9e6a0000000p–1, 0x1.acf3840000000p+1, 0x1.8011da0000000p–2, 0x1.a34f7a0000000p–1, 0x1.57683a0000000p+1, –0x1.40068e0000000p–2, 0x1.a4af4a0000000p–6, –0x1.c33c040000000p–6, –0x1.a70f300000000p–3, –0x1.9a64a80000000p–2, –0x1.50111e0000000p–1, 0x1.da8a060000000p–3, 0x1.a3f6d40000000p–4, 0x1.3059a40000000p–3, 0x1.beaa700000000p–2, –0x1.5a652a0000000p+0,
–0x1.3cb0220000000p–7, 0x1.94a3600000000p+0, 0x1.6fa2b40000000p–3, 0x1.41c3340000000p–3, 0x1.7b7b320000000p–5, 0x1.e327ea0000000p–3, –0x1.cc8d1a0000000p–3, –0x1.110b140000000p–3, 0x1.4a56680000000p–5, 0x1.d96b240000000p–4, –0x1.434bbe0000000p–3, 0x1.bb9c240000000p–4, 0x1.d2adb00000000p–2, –0x1.8218540000000p–6, –0x1.326f560000000p–11, –0x1.d9cfb00000000p–4,

Table B.4 (continued)

Parameter value
0x1.77449c0000000p–2, 0x1.d30b460000000p–1, –0x1.83be980000000p–3, 0x1.89c0e00000000p–3, 0x1.d443b20000000p–2, 0x1.fc7a820000000p–13, –0x1.d5c4100000000p–2, –0x1.2be84a0000000p–4, –0x1.2f67540000000p–3, 0x1.f10a5e0000000p–3, –0x1.7777040000000p–2, –0x1.718d460000000p–8, 0x1.457ad20000000p–3, –0x1.38cd280000000p–5, 0x1.3530880000000p–2, –0x1.dc22f20000000p–1,
0x1.2583740000000p–1, 0x1.2a62620000000p+2, 0x1.4452900000000p–3, 0x1.92e2bc0000000p+0, 0x1.c14b3e0000000p+0, –0x1.7ce9480000000p–2, –0x1.02a5fe0000000p–1, –0x1.d6e4e60000000p–2, –0x1.3687700000000p–6, –0x1.e55ad40000000p–3, –0x1.dd72760000000p–2, 0x1.cd121e0000000p–1,

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Parameter value
0x1.7ac87c0000000p–2, –0x1.4ca4f60000000p–2, 0x1.6763c00000000p–1, –0x1.3eb2900000000p+1,
0x1.bb17b60000000p–1, 0x1.73fba80000000p+0, 0x1.3c39a60000000p–5, 0x1.f4fd9e0000000p–3, 0x1.39a19e0000000p–1, –0x1.f54e040000000p–3, –0x1.5cb8760000000p–3, –0x1.da4c0c0000000p–4, –0x1.b9bda20000000p–2, –0x1.bf87ba0000000p–2, –0x1.bbb1200000000p–4, 0x1.81fb200000000p–2, –0x1.1bbf9c0000000p–3, 0x1.099bd20000000p–5, 0x1.b7b3960000000p–3, –0x1.b7951e0000000p–1,
–0x1.d6b2280000000p–8, 0x1.1f7f660000000p–2, 0x1.4550500000000p–4, 0x1.48d4d60000000p–3, –0x1.07163e0000000p–2, –0x1.2e35000000000p–3, 0x1.ff12200000000p–4, –0x1.f67c120000000p–10, –0x1.913bec0000000p–3, 0x1.9e0c420000000p–6, 0x1.075c0a0000000p–5, 0x1.eb70ec0000000p–1, 0x1.0f39060000000p–4, 0x1.af02500000000p–3, 0x1.aaa3940000000p–3, –0x1.1491200000000p–2,
0x1.53bcb40000000p–6, 0x1.efbd120000000p–1, 0x1.42dd3a0000000p–3, 0x1.7dd7be0000000p–3, 0x1.bc7f2e0000000p–2, 0x1.6d57a20000000p–3, –0x1.55391c0000000p–3, –0x1.0ff51a0000000p–3, –0x1.4aa7740000000p–2, 0x1.0bc9300000000p–2, –0x1.9300620000000p–4, 0x1.b8bfa60000000p–4, 0x1.4e46120000000p–6, 0x1.6d65fa0000000p–2, 0x1.905ee20000000p–2, –0x1.81c9f40000000p–3,
–0x1.1b3f120000000p–11, –0x1.4fbe880000000p–2, 0x1.d5deb80000000p–4, –0x1.d0931a0000000p–5, 0x1.3efb540000000p–3, 0x1.4acc940000000p–4, –0x1.1c4dee0000000p–1, –0x1.2062660000000p–4, –0x1.d5e9600000000p–3, –0x1.fdc1580000000p–2, –0x1.c340940000000p–5, –0x1.39c68a0000000p–3, 0x1.6e35f00000000p–6, 0x1.e144700000000p–6, 0x1.3c55560000000p–1, –0x1.2bf3420000000p–1,
0x1.1000100000000p–2, –0x1.b60bfa0000000p–4, –0x1.19c0f80000000p–3, 0x1.b386740000000p–5, –0x1.3e315c0000000p–2, 0x1.091b780000000p–1, –0x1.7b52a20000000p–2, 0x1.68c9f60000000p–3, –0x1.2d392a0000000p–3, 0x1.f9b3540000000p–4, –0x1.dc8a1c0000000p–3, 0x1.ed66720000000p–2, –0x1.7c633a0000000p–2, 0x1.84b7700000000p–3, 0x1.cf38fc0000000p–2, –0x1.303da40000000p–3,
0x1.8230180000000p–3, 0x1.60d3980000000p+0, –0x1.4f231e0000000p–3, 0x1.1e03b20000000p–1, 0x1.a2d0240000000p+0, –0x1.9302480000000p–4, –0x1.1a1f120000000p–2, –0x1.8a676e0000000p–4, –0x1.78ca920000000p–1, 0x1.ba15060000000p+0, –0x1.8074740000000p–3, –0x1.14e95c0000000p–3, 0x1.460d080000000p–3, 0x1.1a6d560000000p–2, 0x1.abeaae0000000p–2, –0x1.1f10ac0000000p+1,

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Parameter value
0x1.27f8fa0000000p–2, 0x1.b7753a0000000p–3, –0x1.61e35c0000000p–3, 0x1.5469780000000p–2, 0x1.dcc1d20000000p–1, –0x1.51dcd60000000p–3, 0x1.9e2fb80000000p–4, –0x1.e4e8160000000p–3, –0x1.a158700000000p–1, –0x1.3066340000000p–1, 0x1.05926a0000000p–5, –0x1.31349c0000000p–2, 0x1.62087c0000000p–6, 0x1.02b5c40000000p–2, 0x1.bebb1c0000000p–2, –0x1.9e570a0000000p–2,
–0x1.8c405c0000000p–2, 0x1.120a5a0000000p+0, 0x1.db47620000000p–5, 0x1.2fd7c80000000p–1, 0x1.38474c0000000p–1, –0x1.31069c0000000p–6, –0x1.54876e0000000p–5, 0x1.0b473c0000000p–3, –0x1.62150a0000000p–1, –0x1.5801080000000p–1, 0x1.8e8fda0000000p–4, 0x1.8db6640000000p–3, 0x1.8acaea0000000p–3, 0x1.2979f60000000p–2, 0x1.18c40a0000000p–3, –0x1.455a1c0000000p–1,

Table B.4 (continued)

Parameter value
0x1.8ea3300000000p–2, 0x1.0f30940000000p–1, 0x1.0eb5540000000p–2, 0x1.4e016c0000000p–2, –0x1.4bb0080000000p–1, –0x1.138fbe0000000p–4, –0x1.81690c0000000p–2, –0x1.b7ba600000000p–4, –0x1.d450160000000p–4, 0x1.e6eaac0000000p–3, –0x1.319b6a0000000p–3, –0x1.09c4720000000p–4, –0x1.4275720000000p–3, 0x1.88c1560000000p–4, –0x1.0f4f560000000p–1, –0x1.ee3f540000000p–3,
–0x1.0f28240000000p–3, 0x1.4869b00000000p–1, 0x1.58f72a0000000p–3, 0x1.1059460000000p–2, 0x1.d12d2e0000000p–2, 0x1.352c680000000p–3, –0x1.30f94c0000000p–4, 0x1.02b0180000000p–4, 0x1.dc1d780000000p–6, 0x1.5a10780000000p–1, 0x1.2dedfc0000000p–3, 0x1.d7e6bc0000000p–2, 0x1.85996a0000000p–3, 0x1.dcb52c0000000p–5, 0x1.5cf15a0000000p–2, –0x1.9e21580000000p–1,
0x1.db76ce0000000p–2, 0x1.0a93420000000p–1, 0x1.54dad80000000p–2, 0x1.0d613a0000000p–2, –0x1.d70bc00000000p–1, –0x1.5637700000000p–3, –0x1.065ed60000000p–2, –0x1.6a8dac0000000p–11, –0x1.df807c0000000p–4, 0x1.3fa36a0000000p–7, 0x1.dcfb120000000p–3, 0x1.0d22f40000000p–5, 0x1.7f04300000000p–3, 0x1.679f120000000p–1, –0x1.dfba660000000p–4, –0x1.09932a0000000p+0,
–0x1.67a2fc0000000p–1, –0x1.2511400000000p–4, –0x1.7b7c040000000p–2, 0x1.7519c40000000p–5, 0x1.a6e82e0000000p–2, 0x1.1c3b8e0000000p–5, –0x1.1961280000000p–3, 0x1.f94ce00000000p–3, –0x1.06b0840000000p–1, –0x1.0ccce80000000p+0, 0x1.5e820a0000000p–2, 0x1.099b300000000p–2,

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Parameter value
–0x1.a33c5c0000000p–3, –0x1.9eb9820000000p–3, –0x1.7523d80000000p–2, –0x1.0a4a160000000p+0,
0x1.cf0f780000000p–2, 0x1.2dfe800000000p–2, –0x1.1691820000000p–1, 0x1.97642c0000000p–1, 0x1.fb20900000000p–1, –0x1.03564a0000000p–3, –0x1.dbbae60000000p–4, –0x1.9717c20000000p–6, –0x1.b79acc0000000p–2, –0x1.1815c40000000p–1, 0x1.f484c80000000p–3, 0x1.b15d580000000p–4, –0x1.3f217a0000000p–3, 0x1.f24d220000000p–7, 0x1.d44eca0000000p–2, –0x1.da581e0000000p–2,
0x1.6930940000000p–3, 0x1.e5cc000000000p–3, 0x1.0a8d9e0000000p–4, 0x1.44c8120000000p–4, 0x1.afc5680000000p–3, 0x1.c969dc0000000p–4, –0x1.bf5eb00000000p–4, –0x1.7489da0000000p–4, –0x1.387fd20000000p–3, –0x1.096c660000000p–1, –0x1.e962280000000p–5, 0x1.0270020000000p–5, 0x1.afdb460000000p–3, 0x1.9272dc0000000p–4, 0x1.4ae3120000000p–3, –0x1.683b820000000p–5,
–0x1.496dfa0000000p–2, –0x1.3d3b9a0000000p–3, 0x1.8db2f00000000p–8, –0x1.9cab300000000p–6, 0x1.202afa0000000p–5, 0x1.e32d720000000p–6, –0x1.e8c76c0000000p–9, –0x1.9ccfa80000000p–3, –0x1.93ddd60000000p–7, 0x1.7336780000000p–4, –0x1.088a500000000p–5, 0x1.4aaf7e0000000p–3, –0x1.22685a0000000p–2, –0x1.93e2620000000p–4, 0x1.fdf6b80000000p–4, 0x1.87d7ee0000000p–8,
–0x1.4abd900000000p–5, 0x1.3cbb060000000p–2, 0x1.39855e0000000p–5, 0x1.56a0820000000p–1, 0x1.3589520000000p+0, –0x1.0bfe980000000p–3, –0x1.8f2b360000000p–3, –0x1.48fb160000000p–3, 0x1.465d1c0000000p–4, –0x1.848c780000000p–1, –0x1.664cd20000000p–3, 0x1.e9455e0000000p–3, 0x1.5865700000000p–3, 0x1.07b5f20000000p–3, 0x1.9b14100000000p–2, –0x1.34f4460000000p–2,
0x1.87bbba0000000p–4, 0x1.3c66d40000000p–1, –0x1.6b88620000000p–3, –0x1.5480aa0000000p–3, 0x1.26af540000000p–1, 0x1.c908e80000000p–5, –0x1.4b55820000000p–3, 0x1.5522c40000000p–5, 0x1.4787aa0000000p–4, –0x1.165e0e0000000p–3, 0x1.e8e0fa0000000p–5, –0x1.77acb80000000p–2, –0x1.25b4200000000p–1, –0x1.34e84c0000000p+0, 0x1.cb5b520000000p–5, –0x1.5da8d60000000p–3,
0x1.658d5e0000000p–1, 0x1.a245cc0000000p–3, 0x1.e4dd3e0000000p–6, –0x1.075f880000000p–6, 0x1.4604dc0000000p–2, –0x1.f3e5640000000p–6, 0x1.e5d6200000000p–6, –0x1.6f73a60000000p–1, –0x1.56278e0000000p+0, –0x1.44411c0000000p–3, 0x1.4631060000000p–4, 0x1.146eac0000000p–1, 0x1.3844200000000p–5, –0x1.2112d40000000p–4, 0x1.93d6240000000p–2, –0x1.093f660000000p–4,

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Table B.4 (continued)

Parameter value
0x1.3c669c0000000p–13, –0x1.6c2ea40000000p–8, 0x1.90a1c00000000p–4, 0x1.4e92cc0000000p–3, 0x1.3373a40000000p–1, 0x1.8762160000000p–3, –0x1.01714e0000000p–3, –0x1.3214d40000000p–3, –0x1.ca05b40000000p–5, –0x1.fa776a0000000p–3, –0x1.5d58f40000000p–4, –0x1.53f3ae0000000p–5, 0x1.251b820000000p–2, –0x1.e8d3dc0000000p–7, –0x1.62a20c0000000p–2, –0x1.0cef0a0000000p–6,
0x1.04e31c0000000p–2, –0x1.6d429a0000000p–3, –0x1.468df60000000p–7, –0x1.8506120000000p–5, –0x1.92ade00000000p–1, 0x1.a516180000000p–5, –0x1.95fcca0000000p–5, –0x1.03e9400000000p–4, –0x1.0212180000000p–3, 0x1.2e9a300000000p–6, –0x1.3c7c860000000p–5, 0x1.4da71e0000000p–3, 0x1.5529160000000p–6, –0x1.3fc3880000000p–3, 0x1.bef81a0000000p–4, 0x1.43753c0000000p–4,
0x1.eefb640000000p–2, 0x1.1fd5d40000000p–2, 0x1.128af40000000p–3, 0x1.4ed46a0000000p–5, 0x1.1d5a220000000p–4, 0x1.4e00c60000000p–4, 0x1.6356760000000p–5, 0x1.6cf0740000000p–5, –0x1.9dcca00000000p–3, –0x1.e369800000000p–4, –0x1.78bc500000000p–6, 0x1.7650c80000000p–2, –0x1.9ab98e0000000p–4, –0x1.6d33c00000000p–3, 0x1.d3bffe0000000p–2, –0x1.91dc960000000p–4,
0x1.27079a0000000p–2, 0x1.833f940000000p–2, –0x1.8b0ba60000000p–7, 0x1.08bcc80000000p–2, 0x1.2b9f560000000p–2, 0x1.65bf040000000p–5, –0x1.00c2b00000000p–3, 0x1.8051ae0000000p–9, –0x1.2138ec0000000p–3, 0x1.84b4da0000000p–3, –0x1.943db20000000p–5, 0x1.3b5aba0000000p–5, 0x1.2234840000000p–4, –0x1.0df4180000000p–3, 0x1.39fb440000000p–3, 0x1.166f3c0000000p–1,
–0x1.3a93d60000000p–6, 0x1.d181920000000p–4, –0x1.b995140000000p–8, –0x1.3d5fae0000000p–4, –0x1.bcca740000000p–4, 0x1.0cb5340000000p–5, –0x1.96a9160000000p–3, –0x1.0dc2120000000p–2, 0x1.bc2e700000000p–3, –0x1.4804b80000000p–5, –0x1.628d960000000p–5, 0x1.4c6fc60000000p–7, –0x1.babbb60000000p–4, 0x1.76a43a0000000p–4, 0x1.2ab79e0000000p–3, 0x1.866b8e0000000p–7,
0x1.4a08d80000000p–2, 0x1.37c1920000000p–2, –0x1.0ffbf40000000p–1, 0x1.be2d780000000p–1, 0x1.7e1a3a0000000p+0, –0x1.81d22e0000000p–4, –0x1.195f820000000p–2, 0x1.d980740000000p–3, –0x1.c4c8160000000p–3, –0x1.12db9a0000000p–2, –0x1.91f4a20000000p–2, –0x1.67554c0000000p–4, –0x1.6188860000000p–5, –0x1.3d8ca80000000p–3, 0x1.ec7ba00000000p–2, 0x1.1c48720000000p–3,
0x1.1fdffc0000000p–3, 0x1.a1f22a0000000p–2, 0x1.2170cc0000000p–2,

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Parameter value
0x1.8056000000000p–4, –0x1.7226440000000p–3, –0x1.8bc9040000000p–4, –0x1.89a9ac0000000p–8, –0x1.fe74120000000p–4, –0x1.53ea700000000p–4, 0x1.0866e20000000p–2, –0x1.8247180000000p–5, 0x1.328ab40000000p–2, 0x1.e6be520000000p–2, –0x1.233e3c0000000p–2, 0x1.72d6860000000p–2, –0x1.5f63aa0000000p+0,
0x1.622e380000000p–2, 0x1.6592960000000p–3, –0x1.146bc00000000p–2, 0x1.aab2a20000000p–9, 0x1.2180580000000p+0, –0x1.9ce9360000000p–3, –0x1.dd44e40000000p–3, 0x1.26b3660000000p–5, 0x1.8e204e0000000p–3, –0x1.5060de0000000p–1, 0x1.c6b1e80000000p–4, 0x1.1c8e780000000p–1, –0x1.03575c0000000p–1, 0x1.812aec0000000p–5, 0x1.ed5e5a0000000p–3, 0x1.0589b80000000p–3,
0x1.81e0a80000000p–1, 0x1.4eb3e00000000p+0, –0x1.6de4000000000p–3, 0x1.950bf20000000p–2, 0x1.1d844e0000000p+1, –0x1.a3b9c80000000p–2, –0x1.c9fb6a0000000p–4, –0x1.0c72360000000p–3, –0x1.643a060000000p–3, –0x1.5f3d340000000p+0, –0x1.ec04380000000p–3, –0x1.fb3e480000000p–1, 0x1.0951820000000p–3, –0x1.efdbdc0000000p–3, 0x1.ec84020000000p–2, –0x1.e2024c0000000p+0,
0x1.cd519e0000000p–4, 0x1.9a9ff00000000p–3, –0x1.14ba7c0000000p–2, 0x1.5bb8be0000000p–2, 0x1.f044ea0000000p–4, –0x1.34a4380000000p–6, –0x1.34cae00000000p–3, 0x1.072a100000000p–3, –0x1.d6ea840000000p–2, 0x1.be8c620000000p–2, 0x1.d09caa0000000p–10, 0x1.c6cce00000000p–3, –0x1.46a4040000000p–2, –0x1.1dcc120000000p–3, 0x1.fbab6a0000000p–3, 0x1.d03fd40000000p–3,

Table B.4 (continued)

Parameter value
0x1.40ea4e0000000p–2, –0x1.84b21a0000000p–4, –0x1.7f39b00000000p+0, –0x1.5a00d60000000p–3, –0x1.7794600000000p+1, –0x1.356e280000000p–1, –0x1.e8a7780000000p–5, –0x1.01c86c0000000p–1, –0x1.9753680000000p–3, –0x1.00776a0000000p–1, –0x1.1905a40000000p–2, –0x1.1d1c720000000p–2, –0x1.9d2c800000000p–6, –0x1.1edf1a0000000p–1, –0x1.c4bc220000000p–4, 0x1.2fe0a00000000p–3,
–0x1.8b52f00000000p–4, –0x1.25f2200000000p–2, –0x1.114e6c0000000p–4, 0x1.55bfea0000000p–6, –0x1.b32e8e0000000p–3, 0x1.52456e0000000p–4, –0x1.f3cf3a0000000p–4, –0x1.2305860000000p–5, 0x1.1ae6a60000000p–6, –0x1.bdd6aa0000000p–5, –0x1.60b7500000000p–4, –0x1.64ab1e0000000p–4, –0x1.bad3020000000p–8, 0x1.ea03bc0000000p–8, –0x1.ad39900000000p–2,

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Parameter value
0x1.cb51960000000p–3,
0x1.0bbe400000000p–1, –0x1.e077440000000p–2, –0x1.1051e60000000p–5, –0x1.62b0120000000p–7, 0x1.5d2f6e0000000p+0, –0x1.6692da0000000p–5, –0x1.7510640000000p–2, –0x1.ad2dde0000000p–9, 0x1.eb94900000000p–4, –0x1.3c7c6a0000000p–1, 0x1.f301820000000p–5, –0x1.1334c60000000p+1, 0x1.a2d5480000000p–6, 0x1.720abc0000000p–3, 0x1.3951be0000000p–3, –0x1.78ead00000000p–3,
–0x1.b27f7c0000000p–2, –0x1.40928c0000000p+0, –0x1.0a6eca0000000p+0, –0x1.a0e5080000000p–1, –0x1.de76860000000p–1, –0x1.5394760000000p+0, –0x1.011a600000000p+0, –0x1.fdbad20000000p–1, –0x1.f09e1c0000000p–1, 0x1.01c5e00000000p–9, –0x1.44a76c0000000p–1, –0x1.1e4eb00000000p+0, –0x1.23a9940000000p+0, –0x1.f643780000000p–1, –0x1.565a0a0000000p–2, –0x1.4a7abe0000000p–3,
–0x1.91f2dc0000000p–1, 0x1.54de640000000p–3, –0x1.07805e0000000p–2, 0x1.24f8820000000p–2, 0x1.e7dcac0000000p–2, 0x1.adc7d20000000p–6, –0x1.b1da960000000p–2, –0x1.d30af40000000p–3, –0x1.e61a5c0000000p–2, –0x1.4b8ed00000000p–2, 0x1.4f860e0000000p–7, 0x1.353c860000000p–2, 0x1.5c25440000000p–3, 0x1.a8cd0a0000000p–7, 0x1.9cb8f00000000p–2, –0x1.fe02240000000p–2,
–0x1.a214a60000000p–3, –0x1.ee45da0000000p–4, –0x1.a10fb00000000p–3, –0x1.cc80f40000000p–3, 0x1.7ccba00000000p–3, –0x1.6a49e20000000p–2, –0x1.8777f80000000p–3, –0x1.0af2aa0000000p–1, –0x1.1722ae0000000p–3, –0x1.da2d080000000p–4, –0x1.3ba1c40000000p–3, –0x1.17cc4e0000000p–3, –0x1.2573cc0000000p–6, 0x1.f01a200000000p–5, 0x1.6a8e360000000p–3, –0x1.65d0a60000000p–3,
0x1.a910d60000000p–3, 0x1.f18f1c0000000p–3, –0x1.ebe1fa0000000p–5, –0x1.79800e0000000p–4, –0x1.edf78c0000000p–4, 0x1.a289dc0000000p–5, –0x1.a6a7040000000p–3, –0x1.fbba620000000p–6, 0x1.22ccfa0000000p–4, –0x1.e14f4a0000000p–1, –0x1.dff9300000000p–6, –0x1.0c412a0000000p–3, 0x1.3e0c3e0000000p–4, 0x1.475afc0000000p–5, 0x1.f84be40000000p–3, –0x1.69b4cc0000000p–2,
–0x1.8659d40000000p–5, –0x1.2341860000000p–5, 0x1.2ca4800000000p–5, –0x1.b615a00000000p–5, 0x1.00bdd20000000p–3, 0x1.402ade0000000p–4, –0x1.fac57e0000000p–4, –0x1.827e9a0000000p–3, 0x1.08bc140000000p–2, –0x1.ee6fce0000000p–5, –0x1.a9fb780000000p–6, 0x1.86f0300000000p–3, 0x1.0c32b80000000p–3, 0x1.d1e0ca0000000p–4, 0x1.0e15320000000p–2, 0x1.0319060000000p–8,
0x1.20b3940000000p–2, –0x1.27e11a0000000p–3, –0x1.20d9e60000000p–3,

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Parameter value
–0x1.472f700000000p–6, 0x1.0ba4d20000000p–2, 0x1.8b75520000000p–3, –0x1.36cc700000000p–2, –0x1.f9acc20000000p–2, 0x1.53369c0000000p–2, 0x1.31814e0000000p–2, –0x1.4e83c00000000p–3, –0x1.19d2220000000p–4, 0x1.2dbd260000000p–5, –0x1.04273a0000000p–8, 0x1.b3e6480000000p–2, 0x1.3a78780000000p–2,
0x1.8381ac0000000p–2, 0x1.7d6a240000000p–1, –0x1.cd874e0000000p–2, 0x1.9c6c3c0000000p–2, 0x1.76afec0000000p–2, –0x1.1d61ac0000000p–3, –0x1.1a0c0a0000000p–3, –0x1.a028e20000000p–2, 0x1.5d2ec60000000p–1, 0x1.55cfb80000000p+0, –0x1.58ca8a0000000p–4, 0x1.3e00d80000000p–1, –0x1.025e9c0000000p–3, –0x1.86862a0000000p–2, 0x1.9147140000000p–2, –0x1.553d960000000p–1,

Table B.4 (continued)

Parameter value
0x1.6407f40000000p–1, 0x1.8349140000000p–3, –0x1.db39140000000p–3, –0x1.a666820000000p–4, 0x1.f6183c0000000p–4, 0x1.2120f40000000p–7, 0x1.00a5940000000p–2, –0x1.3f14360000000p–1, –0x1.2487f00000000p–4, –0x1.15d42c0000000p–1, 0x1.644b4c0000000p–4, 0x1.d9e87a0000000p–4, –0x1.c87fe20000000p–5, 0x1.27ac580000000p–2, 0x1.3392d40000000p–1, –0x1.1cf2b60000000p–4,
–0x1.716c940000000p–4, –0x1.1e872c0000000p–5, –0x1.43157c0000000p–2, 0x1.03161c0000000p–3, 0x1.2ee1520000000p–1, 0x1.0bae500000000p–3, –0x1.646ace0000000p–4, 0x1.af71ee0000000p–6, 0x1.a577940000000p–3, 0x1.29e12a0000000p–2, –0x1.5763400000000p–9, –0x1.d380800000000p–4, –0x1.17238e0000000p–5, –0x1.c56a060000000p–4, 0x1.4364460000000p–2, 0x1.3f1c640000000p–2,
0x1.d2b5360000000p–3, –0x1.74bb600000000p–1, 0x1.9970140000000p–6, 0x1.149fec0000000p–2, 0x1.77f11e0000000p–4, 0x1.2fc1200000000p–6, –0x1.b6d6860000000p–3, 0x1.2a68120000000p–4, 0x1.7e7dde0000000p–7, –0x1.c97b560000000p–3, –0x1.f45bc20000000p–7, 0x1.68ca3c0000000p–2, –0x1.43c6480000000p–5, 0x1.0d25040000000p–4, 0x1.0f05f60000000p–6, –0x1.ce4a380000000p–3,
0x1.89fa660000000p–4, 0x1.2e1d920000000p–1, –0x1.1028fc0000000p–2, 0x1.2810360000000p–6, –0x1.29f7ca0000000p–6, –0x1.43b4ac0000000p–2, 0x1.696b680000000p–3, –0x1.668cbc0000000p–3, 0x1.8cf46c0000000p–2, –0x1.df75ae0000000p–3, 0x1.24318c0000000p–4, –0x1.4124b80000000p–2, –0x1.8091a00000000p+0, –0x1.ae4cea0000000p–6, –0x1.4b183e0000000p–2,

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Parameter value
0x1.10c0cc0000000p–1,
–0x1.81c6c40000000p–4, 0x1.9ca85c0000000p–5, –0x1.d1bf6a0000000p–2, –0x1.f5b52e0000000p–4, –0x1.01d3ea0000000p–3, –0x1.9e98a00000000p+0, –0x1.7e3b8a0000000p+0, –0x1.5604780000000p+1, –0x1.b641ec0000000p–1, 0x1.3ededa0000000p–3, –0x1.39d6720000000p–1, –0x1.a3f40a0000000p–4, –0x1.a58ed80000000p–2, –0x1.fc9d420000000p–2, 0x1.712f6e0000000p–5, –0x1.2460b00000000p–1,
–0x1.2222be0000000p–3, 0x1.b16d520000000p–2, –0x1.ef074e0000000p–5, 0x1.68b4160000000p–3, 0x1.d32ba80000000p–1, 0x1.d988ae0000000p–5, 0x1.f532220000000p–6, –0x1.bc20c80000000p–2, –0x1.568c240000000p–2, –0x1.7b5fd40000000p–1, 0x1.cbe5560000000p–4, 0x1.afdb880000000p–1, –0x1.3c2d6a0000000p–2, –0x1.876a120000000p–5, –0x1.091e780000000p–4, 0x1.15b0d40000000p–3,

Table B.5 Layer 2 CNN (bias parameter bias) of context decoding neural network parameter

Parameter value
–0x1.8651700000000p+0, 0x1.3d20080000000p–7, –0x1.2adf2a0000000p–6, –0x1.bd9b740000000p+0, –0x1.38cc000000000p–3, –0x1.1858e00000000p–4, 0x1.4141d00000000p–6, 0x1.0ea0580000000p–10, –0x1.0c9ba60000000p–4, –0x1.acd53e0000000p–1, –0x1.8695fc0000000p–2, –0x1.63eb6e0000000p+0, –0x1.6c770e0000000p–5, –0x1.b741960000000p–4, –0x1.b0056c0000000p–1, –0x1.5847640000000p–2,

Table B.6 Layer 3 CNN (convolutional kernel parameter kernel) of context decoding neural network parameter

Parameter value
0x1.c85c500000000p–3, 0x1.a9ff920000000p–3, –0x1.216db20000000p–1, 0x1.0a1a2e0000000p–1, –0x1.9a86340000000p–1, 0x1.c22e7a0000000p–3, 0x1.ab533c0000000p–2, –0x1.fcfa9e0000000p–3, 0x1.2e4f300000000p–2, 0x1.dc9c1e0000000p–1, 0x1.9dafe80000000p–5, 0x1.354ae20000000p–2, –0x1.4881b80000000p–6, –0x1.54d7680000000p–2, 0x1.0dee8a0000000p–2, 0x1.ee0d4e0000000p–4,

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Table B.6 (continued)

Parameter value
0x1.79b3720000000p–2, –0x1.a945240000000p–10, –0x1.bb59e20000000p–2, 0x1.8f1b1c0000000p–1, –0x1.6894b40000000p+0, –0x1.97e0f40000000p–2, 0x1.7b5d2e0000000p–3, –0x1.c32bce0000000p–3, 0x1.039b1a0000000p–3, 0x1.78a7d00000000p–3, 0x1.0bc78c0000000p–4, 0x1.b196580000000p–5, 0x1.5cfa620000000p–2, –0x1.978bec0000000p–5, –0x1.474f400000000p–2, 0x1.9751880000000p–5,
0x1.0079e60000000p–2, –0x1.c738de0000000p–7, –0x1.e3e9780000000p–2, 0x1.b864800000000p–1, –0x1.71b1720000000p+0, –0x1.7773b60000000p–1, 0x1.16a8ec0000000p–3, –0x1.979a5c0000000p–3, 0x1.f2f1080000000p–4, 0x1.1b80c60000000p–3, 0x1.23e3de0000000p–4, 0x1.8f42fc0000000p–5, 0x1.bf29e40000000p–3, –0x1.906a9a0000000p–6, –0x1.7cffc60000000p–3, 0x1.4ce4800000000p–6,
0x1.8c49640000000p–2, –0x1.46ca0c0000000p–8, –0x1.294bd40000000p–1, 0x1.cab6860000000p–2, –0x1.5e67b80000000p+0, 0x1.6e8cae0000000p–1, 0x1.fdb9180000000p–3, –0x1.06736e0000000p–3, 0x1.1e4a1c0000000p–3, 0x1.1668480000000p–2, 0x1.0631500000000p–8, 0x1.239dc80000000p–5, 0x1.ebe5be0000000p–2, –0x1.3a8afe0000000p–4, –0x1.0eec320000000p–1, 0x1.022a800000000p–4,
0x1.43ac7e0000000p–1, –0x1.087bc20000000p–8, –0x1.99d48c0000000p–2, –0x1.3dc5e60000000p–1, –0x1.5bd7020000000p+0, –0x1.40ee280000000p–1, 0x1.10507e0000000p–4, –0x1.58656c0000000p–2, 0x1.ab96b00000000p–4, 0x1.b82f4a0000000p–5, –0x1.c844fa0000000p–3, 0x1.07f8880000000p–5, 0x1.a3265c0000000p–2, 0x1.fda6680000000p–7, 0x1.aecec80000000p+0, 0x1.2b29dc0000000p–4,
0x1.38274c0000000p–2, 0x1.990c100000000p–3, –0x1.01aca00000000p–1, 0x1.2c413e0000000p–1, –0x1.08fcee0000000p+0, 0x1.83d56c0000000p–3, 0x1.8f74d00000000p–2, –0x1.4a96f80000000p–2, 0x1.21b1d80000000p–2, 0x1.97360a0000000p–1, 0x1.5314c40000000p–1, 0x1.a056500000000p–3, 0x1.9a7dde0000000p–4, –0x1.5c84b80000000p–2, 0x1.bd72420000000p–3, 0x1.c1a8b40000000p–3,
0x1.c15eda0000000p–2, 0x1.cc72f20000000p–6, –0x1.4a0d460000000p–1, 0x1.1f65660000000p–1, –0x1.73f7a60000000p+0, 0x1.3f20f00000000p–1, 0x1.23fa800000000p–2, –0x1.0c8a3a0000000p–3, 0x1.61e0b80000000p–3, 0x1.ecf7420000000p–2, 0x1.4ce1ea0000000p–5, 0x1.8269060000000p–5, 0x1.d804c60000000p–2, –0x1.14ce240000000p–3, –0x1.2ccd840000000p–1, 0x1.cf523e0000000p–4,
0x1.dc1eda0000000p–2, –0x1.241edc0000000p–6, –0x1.83de640000000p–3,

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Parameter value
–0x1.0ba9060000000p–1, –0x1.2ddebe0000000p+0, 0x1.44defe0000000p–3, 0x1.1948740000000p–4, –0x1.7869360000000p–2, 0x1.85928e0000000p–4, 0x1.08bf500000000p–5, –0x1.05b6e00000000p–3, 0x1.f2c1f80000000p–7, 0x1.f3d3060000000p–5, 0x1.8fdb520000000p–6, –0x1.48723a0000000p–3, 0x1.fd51f40000000p–5,
0x1.1c16a20000000p–2, 0x1.17ac1e0000000p–3, 0x1.13018e0000000p–3, 0x1.ca7ee60000000p–1, –0x1.226e680000000p+0, –0x1.22d4ae0000000p–1, 0x1.8325bc0000000p–2, –0x1.b0f62e0000000p–3, 0x1.0a47120000000p–2, 0x1.2c199a0000000p–1, 0x1.462ca00000000p–1, 0x1.9adb1a0000000p–4, 0x1.208b020000000p–2, –0x1.3e7c960000000p–2, 0x1.52ede20000000p–4, 0x1.f0d93a0000000p–3,
0x1.3977960000000p–1, 0x1.a649ba0000000p–2, –0x1.29258a0000000p–2, 0x1.10770e0000000p–1, –0x1.5ff2f80000000p–1, –0x1.f4b3580000000p–7, 0x1.9e3eea0000000p–2, –0x1.50dfe00000000p–1, 0x1.75135e0000000p–2, 0x1.8691d60000000p–1, 0x1.a8f73a0000000p–2, 0x1.965eae0000000p–2, –0x1.86e9520000000p–3, –0x1.ebc0980000000p–3, 0x1.a3426c0000000p–2, 0x1.84c5740000000p–6,
0x1.8d17e20000000p–2, 0x1.19ada00000000p–4, –0x1.777ddc0000000p–2, 0x1.afd8d40000000p–1, –0x1.55c33e0000000p+0, –0x1.e625d20000000p–2, 0x1.49b9e40000000p–2, –0x1.bf08a40000000p–4, 0x1.b796ce0000000p–3, 0x1.2a62b20000000p–1, 0x1.9178cc0000000p–3, 0x1.126dd80000000p–4, 0x1.d336340000000p–2, –0x1.c5a2e80000000p–3, –0x1.ee30d20000000p–3, 0x1.85cbd80000000p–3,

Table B.6 (continued)

Parameter value
0x1.00e2a00000000p–1, –0x1.95745e0000000p–9, –0x1.4e2eec0000000p–1, –0x1.d76ef00000000p–4, –0x1.71dd900000000p+0, –0x1.44d2960000000p–2, 0x1.67309c0000000p–4, –0x1.b39e3c0000000p–3, 0x1.9d56400000000p–4, 0x1.08e6620000000p–3, –0x1.7c99360000000p–4, 0x1.6821cc0000000p–7, 0x1.fe93380000000p–2, 0x1.17e13e0000000p–7, 0x1.fca2a20000000p+0, 0x1.98d80e0000000p–7,
0x1.31e2540000000p–2, –0x1.1f23980000000p–5, –0x1.71bb140000000p–3, –0x1.4af0fa0000000p–2, –0x1.f5be620000000p–2, –0x1.f66a1e0000000p–3, 0x1.6aa53c0000000p–4, –0x1.6c4f700000000p–3, 0x1.e997c40000000p–5, 0x1.2f5dac0000000p–3, –0x1.3bb98e0000000p–6, –0x1.3fe01c0000000p–7, –0x1.8f07900000000p–4, 0x1.be47da0000000p–6, –0x1.cac9840000000p–2,

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Parameter value
–0x1.2a5d580000000p–6,
0x1.0fad9c0000000p–1, 0x1.619b0e0000000p–2, –0x1.5c4ff20000000p–3, 0x1.5b1f380000000p–1, –0x1.b226180000000p–2, –0x1.731eca0000000p–1, 0x1.c4cdd20000000p–2, –0x1.33e28c0000000p–1, 0x1.5cb7420000000p–2, 0x1.bfd2f40000000p–1, 0x1.25b3be0000000p–4, 0x1.8333060000000p–2, –0x1.9fc0080000000p–3, –0x1.131c580000000p–2, 0x1.7bdd3e0000000p–1, 0x1.30ee200000000p–4,
0x1.8f97700000000p–2, –0x1.1b22e60000000p–8, –0x1.6ba58a0000000p–1, 0x1.5151a20000000p–2, –0x1.4f4ebc0000000p+0, 0x1.3e472e0000000p–4, 0x1.f7fe980000000p–4, –0x1.1eeeba0000000p–2, 0x1.c154380000000p–4, 0x1.8249740000000p–4, 0x1.3733400000000p–4, 0x1.6547340000000p–6, 0x1.5364600000000p–2, –0x1.7192160000000p–7, 0x1.9874f60000000p–1, –0x1.6857a00000000p–7,
0x1.ae8d4e0000000p–2, –0x1.88e5360000000p–7, –0x1.ea85440000000p–2, –0x1.9928840000000p–3, –0x1.44527e0000000p+0, 0x1.1efc280000000p–1, 0x1.2cbe680000000p–3, –0x1.e731ec0000000p–3, 0x1.a4cce00000000p–4, 0x1.c6a9480000000p–6, –0x1.e3495e0000000p–6, 0x1.61dd7c0000000p–10, 0x1.edb8c40000000p–2, –0x1.174c7c0000000p–7, 0x1.872ed00000000p+0, –0x1.451bb60000000p–8,
0x1.508a480000000p–2, 0x1.b1236e0000000p–3, 0x1.a700e60000000p–3, 0x1.165c620000000p–4, 0x1.5ba9f00000000p–2, –0x1.5a6dc20000000p–2, 0x1.4ba5a00000000p–7, –0x1.f2aa4c0000000p–1, 0x1.3b88f00000000p–2, 0x1.35b4980000000p–4, 0x1.29e4d80000000p–1, 0x1.4a2e080000000p–2, –0x1.53f25c0000000p–2, 0x1.e6a24c0000000p–3, –0x1.988f480000000p–2, 0x1.685e8e0000000p–3,
0x1.7029860000000p–1, 0x1.e0eb060000000p–2, –0x1.f3374a0000000p–3, 0x1.21ee340000000p+0, 0x1.e2755c0000000p–5, –0x1.7d52f80000000p–3, 0x1.4fe81a0000000p–3, –0x1.6dfb980000000p–1, 0x1.72f0c60000000p–2, 0x1.02bc800000000p–2, 0x1.77b5880000000p–2, 0x1.9ac3e40000000p–2, –0x1.6f09b20000000p–1, 0x1.1ba3540000000p–2, 0x1.8a387c0000000p–3, 0x1.ae923a0000000p–4,
0x1.7ac2d20000000p–1, 0x1.f9f19e0000000p–2, –0x1.0f844c0000000p–3, 0x1.2e1d4c0000000p+0, –0x1.d1390a0000000p–4, 0x1.7cc4040000000p–4, 0x1.6d96a60000000p–3, –0x1.64aa2c0000000p–1, 0x1.5c9ddc0000000p–2, 0x1.89801a0000000p–2, 0x1.43e9400000000p–2, 0x1.8c422e0000000p–2, –0x1.3d182e0000000p–1, 0x1.00a42e0000000p–2, 0x1.fa50940000000p–3, 0x1.5957280000000p–4,
0x1.3c8b340000000p–1, 0x1.9950620000000p–2, 0x1.acd3620000000p–2,

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Parameter value
0x1.2480d80000000p+0, 0x1.80d8220000000p–4, –0x1.7a4c8c0000000p–1, 0x1.66a5b00000000p–3, –0x1.41f20a0000000p–1, 0x1.6b24d80000000p–2, 0x1.33d28c0000000p–2, 0x1.2cbfd80000000p–4, 0x1.96e4d00000000p–2, –0x1.66cbd40000000p–1, 0x1.488fca0000000p–3, 0x1.81b3440000000p–3, 0x1.c080ce0000000p–5,
0x1.aa29020000000p–2, 0x1.0f06f60000000p–1, 0x1.074a720000000p–3, 0x1.ec52660000000p+0, –0x1.5c2c680000000p–2, 0x1.67e1ee0000000p–1, 0x1.ff135e0000000p–3, –0x1.e0b4040000000p–2, 0x1.6699ca0000000p–2, 0x1.5ee4260000000p–1, 0x1.50a9de0000000p–3, 0x1.a9e7e80000000p–2, –0x1.5dce7e0000000p–2, 0x1.1916bc0000000p–3, 0x1.ad58520000000p–1, 0x1.16b7400000000p–4,

Table B.6 (continued)

Parameter value
0x1.b4c07e0000000p–3, 0x1.bc16dc0000000p–3, –0x1.4f790a0000000p–2, 0x1.3f6dc40000000p–2, 0x1.84ced80000000p–2, 0x1.d0b8980000000p–9, 0x1.286e720000000p–5, –0x1.d7dc0e0000000p–1, 0x1.34d92e0000000p–2, 0x1.731e780000000p–4, 0x1.9f49140000000p–2, 0x1.51fdbc0000000p–2, –0x1.93a95e0000000p–2, 0x1.5f13fc0000000p–3, –0x1.36c36a0000000p–2, 0x1.0c242c0000000p–3,
0x1.05cb4e0000000p–1, 0x1.4bf3180000000p–2, 0x1.b554100000000p–2, 0x1.15544a0000000p+0, 0x1.5fa0d00000000p–3, –0x1.872fc80000000p–1, 0x1.8557e80000000p–3, –0x1.d2c9560000000p–1, 0x1.65a0d20000000p–2, 0x1.9246740000000p–3, –0x1.a43c820000000p–3, 0x1.972ea60000000p–2, –0x1.9ed2b80000000p–1, 0x1.a6977c0000000p–3, –0x1.e2c05c0000000p–6, 0x1.f5a8fe0000000p–6,
0x1.be94fe0000000p–3, 0x1.09e0300000000p–1, –0x1.67b1ce0000000p–2, 0x1.780e680000000p+0, –0x1.8e78700000000p–1, 0x1.fff9180000000p–1, 0x1.1380980000000p–2, –0x1.209aec0000000p–1, 0x1.6107280000000p–2, 0x1.6325600000000p–1, 0x1.c239000000000p–2, 0x1.aa76dc0000000p–2, –0x1.17921a0000000p–2, –0x1.83956c0000000p–4, 0x1.5514720000000p–1, 0x1.2d8fa00000000p–4,
0x1.6007520000000p–2, 0x1.c11bee0000000p–3, –0x1.7d04880000000p–3, 0x1.6614dc0000000p–2, 0x1.7c07820000000p–2, 0x1.fb585e0000000p–4, 0x1.4c16c60000000p–4, –0x1.9597f40000000p–1, 0x1.430b0c0000000p–2, 0x1.622a300000000p–3, 0x1.81ed560000000p–2, 0x1.806aa80000000p–2, –0x1.bd05560000000p–2, 0x1.371e440000000p–3, –0x1.c715f00000000p–3,

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Parameter value
0x1.ec84580000000p–5,
0x1.18b8aa0000000p–6, 0x1.b72e460000000p–4, 0x1.a888fc0000000p–4, 0x1.7a0fd20000000p–6, 0x1.38f6900000000p–4, 0x1.aaa0ec0000000p–4, –0x1.d8da000000000p–8, –0x1.a8bbc00000000p–1, 0x1.216c660000000p–2, 0x1.8855aa0000000p–3, –0x1.0436d80000000p–5, 0x1.7f1fb20000000p–2, –0x1.f674800000000p–4, 0x1.5408320000000p–3, –0x1.411e260000000p–2, 0x1.e118ca0000000p–5,
0x1.a0fd580000000p–2, 0x1.1782fe0000000p–2, –0x1.4305260000000p–2, 0x1.800b240000000p–1, 0x1.70a2c00000000p–2, –0x1.558cb20000000p–2, 0x1.3392a60000000p–3, –0x1.da101e0000000p–1, 0x1.5a586e0000000p–2, 0x1.ad16760000000p–3, 0x1.80e4c00000000p–6, 0x1.92223c0000000p–2, –0x1.45ebd80000000p–1, 0x1.7035c40000000p–3, –0x1.2ea34c0000000p–3, 0x1.dac89a0000000p–6,
0x1.12cb440000000p–1, 0x1.130e4e0000000p–1, –0x1.40d6140000000p–7, 0x1.cb5bfe0000000p+0, 0x1.da584c0000000p–4, –0x1.9a421a0000000p–2, 0x1.d21efa0000000p–3, –0x1.5b7efa0000000p–1, 0x1.715e340000000p–2, 0x1.1a93600000000p–1, –0x1.2aa1ec0000000p–2, 0x1.a580de0000000p–2, –0x1.0061960000000p–1, 0x1.d67d6a0000000p–3, 0x1.2837d60000000p–1, 0x1.1490700000000p–4,
0x1.db9dc60000000p–4, 0x1.67d8fc0000000p–2, 0x1.78dc400000000p–2, 0x1.bfb1620000000p–3, –0x1.4df09e0000000p–1, –0x1.1891280000000p–1, 0x1.8668100000000p–2, –0x1.06cb8e0000000p–1, 0x1.3cbba80000000p–2, 0x1.cd35fa0000000p–1, –0x1.1cf8b00000000p–2, 0x1.a3ace60000000p–2, –0x1.f600f60000000p–3, –0x1.b85af00000000p–2, 0x1.a65e980000000p–2, 0x1.406dce0000000p–4,
0x1.4999320000000p–4, 0x1.7361a20000000p–3, –0x1.87c3c60000000p–3, –0x1.d707e80000000p–5, 0x1.0326e20000000p–1, 0x1.4243a60000000p–6, –0x1.065a420000000p–4, –0x1.04f4b00000000p+0, 0x1.3e2d040000000p–2, 0x1.0ec9c60000000p–4, –0x1.3c99920000000p–3, 0x1.8c2c240000000p–2, –0x1.6be5ec0000000p–3, 0x1.03f34c0000000p–2, –0x1.82110e0000000p–2, 0x1.3c8efc0000000p–4,
0x1.37a7ac0000000p–1, 0x1.05d0260000000p–1, –0x1.359be60000000p–3, 0x1.558e020000000p+0, 0x1.bf147c0000000p–5, –0x1.73deee0000000p–3, 0x1.35ae700000000p–3, –0x1.5614260000000p–1, 0x1.60a1520000000p–2, 0x1.9745b60000000p–2, –0x1.0d18e60000000p–5, 0x1.8ae6e00000000p–2, –0x1.1181680000000p–1, 0x1.02ac9c0000000p–2, 0x1.4020880000000p–2, 0x1.09df7e0000000p–4,

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Table B.6 (continued)

Parameter value
0x1.2a70d80000000p–1, 0x1.fd3da80000000p–2, 0x1.c3c37e0000000p–2, 0x1.6d9adc0000000p+0, 0x1.44c6160000000p–3, –0x1.2628500000000p–1, 0x1.89a6680000000p–3, –0x1.fe37ac0000000p–2, 0x1.7288400000000p–2, 0x1.0f6abc0000000p–1, –0x1.cf19300000000p–4, 0x1.923f4c0000000p–2, –0x1.e5725e0000000p–2, 0x1.88fbde0000000p–3, 0x1.98d5020000000p–2, 0x1.15db700000000p–4,
0x1.c414260000000p–8, 0x1.3df1b60000000p–6, 0x1.990bb20000000p–2, –0x1.ef4a3a0000000p–4, –0x1.be932e0000000p–2, 0x1.7331f20000000p–3, 0x1.37e11c0000000p–10, –0x1.7850660000000p–2, 0x1.bac3540000000p–4, 0x1.0b423c0000000p–3, –0x1.cf6eb40000000p–6, 0x1.5451fa0000000p–5, –0x1.340b340000000p–5, 0x1.c101980000000p–7, –0x1.29d21e0000000p–3, 0x1.6641a80000000p–4,
0x1.8aa5c20000000p–6, 0x1.271a140000000p–3, 0x1.468c440000000p–7, –0x1.29fab60000000p–2, –0x1.393fee0000000p–3, 0x1.c0ba920000000p–4, –0x1.8a51160000000p–4, –0x1.5d15260000000p–1, 0x1.08a79a0000000p–2, 0x1.71e9bc0000000p–3, –0x1.1e03960000000p–2, 0x1.5da1520000000p–2, –0x1.e3e1ba0000000p–4, 0x1.c3630a0000000p–3, –0x1.a8fdc20000000p–2, 0x1.6ad2b60000000p–4,
0x1.cfbb480000000p–5, 0x1.0047aa0000000p–3, 0x1.3f45c20000000p–2, –0x1.5191d80000000p–2, –0x1.2012500000000p–2, 0x1.1b42d00000000p–4, –0x1.0cb8980000000p–4, –0x1.86ebfa0000000p–1, 0x1.0ea05e0000000p–2, 0x1.8d7de00000000p–3, –0x1.07cc0a0000000p–2, 0x1.72c8f20000000p–2, –0x1.8d15420000000p–4, 0x1.a4325e0000000p–3, –0x1.c2dbb40000000p–2, 0x1.0fa3ce0000000p–4,
0x1.ef6c080000000p–4, 0x1.f8411c0000000p–4, –0x1.ae1c6a0000000p–2, –0x1.0f15600000000p–2, –0x1.e54e100000000p–3, –0x1.8aa93a0000000p–5, –0x1.12b1520000000p–4, –0x1.64693c0000000p–1, 0x1.e0831e0000000p–3, 0x1.9461c40000000p–3, –0x1.ecc9f00000000p–5, 0x1.3ad9ea0000000p–2, –0x1.4e7e6e0000000p–4, 0x1.b8721c0000000p–3, –0x1.4fd60c0000000p–2, 0x1.9a7bae0000000p–4,
–0x1.1e621e0000000p–4, 0x1.1cc2200000000p–4, –0x1.0823920000000p–1, –0x1.af31c80000000p–3, –0x1.31de300000000p–2, 0x1.c66ff00000000p–6, 0x1.26837a0000000p–7, –0x1.aeb1ec0000000p–1, 0x1.019a7e0000000p–2, 0x1.58eaaa0000000p–6, 0x1.131b940000000p–2, 0x1.50118a0000000p–2, –0x1.3b0ea20000000p–3, 0x1.c8b7880000000p–3, –0x1.46e72e0000000p–2, 0x1.344e580000000p–4,
0x1.c6484e0000000p–7, 0x1.b0d7380000000p–9, –0x1.5ea8ce0000000p–5,

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Parameter value
–0x1.6d1c620000000p–3, –0x1.8a60ec0000000p–2, 0x1.1b96ca0000000p–3, 0x1.a1c1ba0000000p–8, –0x1.5da19e0000000p–2, 0x1.0c88540000000p–3, 0x1.7b1a2a0000000p–4, 0x1.c662d60000000p–3, 0x1.0a8f140000000p–5, –0x1.cd8c0a0000000p–6, 0x1.dd00fa0000000p–6, –0x1.952ebe0000000p–4, 0x1.13a1e20000000p–3,
0x1.04daf20000000p–3, 0x1.0787a00000000p–4, –0x1.a827920000000p–3, –0x1.4b85cc0000000p–2, –0x1.4e0cde0000000p–2, –0x1.6332220000000p–4, –0x1.0762140000000p–5, –0x1.3528d40000000p–1, 0x1.9c05680000000p–3, 0x1.210e280000000p–3, 0x1.86aca20000000p–2, 0x1.ee49120000000p–3, –0x1.0875ce0000000p–5, 0x1.b851480000000p–3, –0x1.aa11bc0000000p–3, 0x1.ddd3500000000p–4,
–0x1.c667540000000p–5, 0x1.c5a8700000000p–5, –0x1.eeb8bc0000000p–3, –0x1.1fc4e20000000p–4, –0x1.4918560000000p–3, 0x1.fd83860000000p–3, 0x1.acd87e0000000p–5, –0x1.8b25b00000000p–1, 0x1.002e620000000p–2, 0x1.a15e640000000p–4, 0x1.9c2ffe0000000p–6, 0x1.74ab5a0000000p–2, –0x1.a084180000000p–3, 0x1.7ca24e0000000p–3, –0x1.cfd3160000000p–2, 0x1.786b1a0000000p–5,
0x1.e7ea560000000p–5, –0x1.83f7240000000p–7, –0x1.b042ba0000000p–2, –0x1.1331e20000000p–2, –0x1.c671440000000p–2, –0x1.1cbc6a0000000p–5, 0x1.99ed020000000p–9, –0x1.1b183a0000000p–2, 0x1.4865960000000p–3, 0x1.9be30a0000000p–4, 0x1.d94b700000000p–2, 0x1.0a45040000000p–4, –0x1.2862200000000p–4, 0x1.3f0b8e0000000p–4, –0x1.ef22320000000p–6, 0x1.8e9c8e0000000p–3,

Table B.6 (continued)

Parameter value
0x1.3871780000000p–5, –0x1.c192480000000p–8, –0x1.8f6fa20000000p–4, –0x1.abd61a0000000p–4, –0x1.f10d300000000p–3, –0x1.e6887a0000000p–4, 0x1.6c66f80000000p–6, –0x1.02b93e0000000p–2, 0x1.2f1e1a0000000p–4, 0x1.2189a40000000p–4, 0x1.a13b9e0000000p–3, 0x1.1213240000000p–7, 0x1.58261c0000000p–7, –0x1.3b53d20000000p–6, –0x1.713f1e0000000p–5, 0x1.0ab6bc0000000p–6,
0x1.410b900000000p–4, –0x1.0170660000000p–8, –0x1.35d91a0000000p–2, –0x1.6cd5800000000p–2, –0x1.d474b80000000p–2, –0x1.8c2b140000000p–5, –0x1.3b2f020000000p–6, –0x1.e898d20000000p–2, 0x1.878b080000000p–3, 0x1.d472c20000000p–5, 0x1.681cca0000000p–1, 0x1.dddbbc0000000p–4, –0x1.67be7e0000000p–5, 0x1.324aca0000000p–3, –0x1.17c5120000000p–4,

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Parameter value
0x1.9b021c0000000p–3,
0x1.15ebd00000000p–4, 0x1.7655400000000p–4, –0x1.ad45da0000000p–3, –0x1.196c620000000p–2, –0x1.bfeaa20000000p–2, –0x1.9f7c440000000p–4, –0x1.83b1180000000p–6, –0x1.baf1800000000p–1, 0x1.08b7cc0000000p–2, 0x1.dcfb040000000p–6, 0x1.acac080000000p–2, 0x1.5c43420000000p–2, –0x1.efc7e60000000p–4, 0x1.11859c0000000p–2, –0x1.813ebc0000000p–2, 0x1.d385d60000000p–4,
0x1.f1375e0000000p–3, 0x1.54fa780000000p–3, 0x1.32194c0000000p–3, –0x1.af0da80000000p–7, 0x1.c4b5860000000p–3, –0x1.56d6b80000000p–4, 0x1.2892b60000000p–5, –0x1.f685160000000p–1, 0x1.2441820000000p–2, 0x1.c4f3b80000000p–4, 0x1.63c2900000000p–2, 0x1.6dc7d80000000p–2, –0x1.2f4cac0000000p–2, 0x1.1dfa940000000p–2, –0x1.3f4a860000000p–1, 0x1.14d0300000000p–3,
–0x1.c625660000000p–6, 0x1.7f73120000000p–7, –0x1.8594c40000000p–3, –0x1.8f6a280000000p–5, –0x1.7be0b00000000p–3, 0x1.cc34380000000p–9, 0x1.e9d1ac0000000p–7, –0x1.2d674c0000000p–3, 0x1.757c4e0000000p–5, 0x1.f5b5280000000p–6, 0x1.8de20a0000000p–4, –0x1.b369a20000000p–8, –0x1.79cf9c0000000p–6, 0x1.3603be0000000p–6, 0x1.9ab88e0000000p–7, 0x1.a898900000000p–5,
0x1.8e0c700000000p–4, 0x1.3ce9980000000p–3, –0x1.335c940000000p–2, –0x1.5840900000000p–3, –0x1.f401200000000p–3, 0x1.5416120000000p–5, –0x1.8bc9460000000p–5, –0x1.8fdee80000000p–1, 0x1.0e92500000000p–2, 0x1.114b360000000p–3, –0x1.b339780000000p–4, 0x1.6e64b80000000p–2, –0x1.09320e0000000p–3, 0x1.123e160000000p–2, –0x1.d53e240000000p–2, 0x1.08569c0000000p–4,
0x1.46007a0000000p–3, 0x1.e455460000000p–4, –0x1.bfde1c0000000p–2, –0x1.a388000000000p–3, –0x1.0ef9c60000000p–2, –0x1.3f9b920000000p–3, –0x1.a9e4d80000000p–6, –0x1.99d9ce0000000p–1, 0x1.0d9c780000000p–2, 0x1.c9be5e0000000p–4, 0x1.4c55340000000p–3, 0x1.638db00000000p–2, –0x1.0dd39a0000000p–3, 0x1.09975a0000000p–2, –0x1.ceb3e00000000p–2, 0x1.d2f1ec0000000p–4,

Table B.7 Layer 3 CNN (bias parameter bias) of context decoding neural network parameter

Parameter value
0x1.c296300000000p–4, 0x1.c2940c0000000p–4, 0x1.c2930c0000000p–4, 0x1.c28c660000000p–4, 0x1.c28fb60000000p–4, 0x1.c287860000000p–4, 0x1.c27ef40000000p–4, 0x1.c2965a0000000p–4, 0x1.c285ec0000000p–4,

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Parameter value
0x1.c286260000000p–4, 0x1.c297720000000p–4, 0x1.c292580000000p–4, 0x1.c27c780000000p–4, 0x1.c298400000000p–4, 0x1.c28c100000000p–4, 0x1.c2999a0000000p–4,

Table B.8 Standard deviation table corresponding to base range coding

Parameter value
0x1.c28f5c0000000p–4, 0x1.fd8f280000000p–4, 0x1.20245e0000000p–3, 0x1.45df8c0000000p–3, 0x1.708b900000000p–3, 0x1.a0ce0a0000000p–3, 0x1.d762480000000p–3, 0x1.0a8e120000000p–2, 0x1.2d759a0000000p–2, 0x1.54ef340000000p–2,

Table B.8 (continued)

Parameter value
0x1.81941a0000000p–2, 0x1.b411940000000p–2, 0x1.ed2b960000000p–2, 0x1.16dfe40000000p–1, 0x1.3b64660000000p–1, 0x1.64b1100000000p–1, 0x1.93662e0000000p–1, 0x1.c8390a0000000p–1, 0x1.01fb560000000p+0, 0x1.23c3780000000p+0, 0x1.49f80c0000000p+0, 0x1.752d5c0000000p+0, 0x1.a60b1c0000000p+0, 0x1.dd4ef60000000p+0, 0x1.0de7b60000000p+1, 0x1.313f8c0000000p+1, 0x1.59382a0000000p+1, 0x1.866cb40000000p+1, 0x1.b98ca00000000p+1, 0x1.f35e5e0000000p+1, 0x1.1a612c0000000p+2, 0x1.3f5b2c0000000p+2, 0x1.692cb80000000p+2, 0x1.98781e0000000p+2, 0x1.cdf4f00000000p+2, 0x1.0539640000000p+3, 0x1.276e380000000p+3, 0x1.4e1dba0000000p+3, 0x1.79de0e0000000p+3, 0x1.ab59080000000p+3, 0x1.e34eb40000000p+3, 0x1.114c220000000p+4, 0x1.3515b00000000p+4, 0x1.5d8ee80000000p+4, 0x1.8b54e60000000p+4, 0x1.bf19500000000p+4, 0x1.f9a5160000000p+4, 0x1.1dedba0000000p+5, 0x1.435eb40000000p+5, 0x1.6db6ce0000000p+5, 0x1.9d9a5e0000000p+5, 0x1.d3c3480000000p+5, 0x1.0881e20000000p+6, 0x1.2b24c40000000p+6, 0x1.5250be0000000p+6, 0x1.7e9dd80000000p+6, 0x1.b0b8060000000p+6, 0x1.e961c00000000p+6, 0x1.14bb780000000p+7, 0x1.38f82a0000000p+7, 0x1.61f39e0000000p+7, 0x1.904ce00000000p+7, 0x1.c4b7dc0000000p+7, 0x1.0000000000000p+8,

Table B.9 Base range coding table

Index	Probability
1	0, 1, 65534, 65535, 65536
2	0, 2, 65533, 65535, 65536
3	0, 12, 65523, 65535, 65536
4	0, 55, 65480, 65535, 65536
5	0, 179, 65356, 65535, 65536

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Index	Probability
6	0, 459, 65076, 65535, 65536
7	0, 977, 64558, 65535, 65536
8	0, 1794, 63741, 65535, 65536
9	0, 2930, 62605, 65535, 65536
10	0, 4363, 61172, 65535, 65536
11	0, 2, 6036, 59499, 65533, 65535, 65536
12	0, 14, 7875, 57659, 65521, 65535, 65536
13	0, 60, 9803, 55732, 65475, 65535, 65536
14	0, 193, 11751, 53783, 65342, 65535, 65536
15	0, 486, 13662, 51872, 65047, 65533, 65536
16	0, 11, 1026, 15497, 50038, 64509, 65524, 65535, 65536
17	0, 49, 1865, 17225, 48310, 63670, 65486, 65535, 65536
18	0, 162, 3022, 18829, 46701, 62508, 65368, 65530, 65536
19	0, 413, 4460, 20292, 45210, 61042, 65089, 65502, 65536
20	0, 67, 923, 6162, 21653, 43879, 59370, 64608, 65464, 65531, 65536
21	0, 201, 1702, 7997, 22859, 42645, 57507, 63802, 65303, 65504, 65536
22	0, 61, 530, 2824, 9939, 23967, 41557, 55585, 62700, 64994, 65464, 65525, 65536
23	0, 180, 1078, 4213, 11864, 24931, 40550, 53617, 61268, 64402, 65300, 65480, 65536
24	0, 88, 502, 1967, 5882, 13783, 25824, 39680, 51721, 59622, 63537, 65002, 65416, 65504, 65536
25	0, 55, 286, 1064, 3165, 7714, 15614, 26614, 38897, 49897, 57797, 62346, 64447, 65225, 65456, 65511, 65536
26	0, 156, 637, 1884, 4605, 9595, 17291, 27272, 38156, 48136, 55832, 60822, 63543, 64790, 65271, 65427, 65536
27	0, 124, 469, 1304, 3067, 6316, 11545, 18890, 27895, 37534, 46540, 53885, 59114, 62363, 64126, 64961, 65306, 65430, 65536

Table B.9 (continued)

Index	Probability
28	0, 114, 396, 1024, 2278, 4531, 8170, 13454, 20350, 28441, 36974, 45065, 51961, 57245, 60884, 63137, 64391, 65019, 65301, 65415, 65536
29	0, 116, 373, 896, 1874, 3556, 6217, 10091, 15279, 21671, 28915, 36468, 43712,

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Index	Probability
	50104, 55292, 59166, 61827, 63509, 64487, 65010, 65267, 65383, 65536
30	0, 60, 188, 443, 917, 1743, 3091, 5153, 8106, 12068, 17049, 22914, 29382, 36065, 42533, 48398, 53379, 57341, 60294, 62356, 63704, 64530, 65004, 65259, 65387, 65447, 65536
31	0, 78, 227, 495, 953, 1698, 2849, 4538, 6893, 10013, 13940, 18637, 23975, 29739, 35652, 41416, 46754, 51451, 55378, 58498, 60853, 62542, 63693, 64438, 64896, 65164, 65313, 65391, 65536
32	0, 58, 162, 340, 633, 1097, 1804, 2838, 4291, 6253, 8798, 11970, 15767, 20136, 24964, 30091, 35322, 40449, 45277, 49646, 53443, 56614, 59159, 61121, 62574, 63608, 64315, 64779, 65072, 65250, 65354, 65412, 65536
33	0, 50, 134, 271, 486, 814, 1299, 1995, 2962, 4263, 5961, 8109, 10742, 13870, 17471, 21490, 25836, 30391, 35018, 39573, 43919, 47938, 51539, 54667, 57300, 59448, 61146, 62448, 63415, 64111, 64596, 64924, 65139, 65276, 65360, 65410, 65536
34	0, 49, 126, 245, 423, 683, 1054, 1570, 2271, 3201, 4403, 5920, 7789, 10034, 12667, 15680, 19044, 22709, 26606, 30648, 34740, 38783, 42680, 46345, 49709, 52722, 55355, 57600, 59469, 60986, 62188, 63118, 63819, 64335, 64706, 64966, 65144, 65263, 65340, 65389, 65536
35	0, 53, 131, 245, 407, 634, 945, 1364, 1917, 2634, 3545, 4680, 6068, 7734, 9694, 11957, 14521, 17370, 20475, 23795, 27278, 30863, 34483, 38068, 41551, 44871, 47976, 50825, 53389, 55652, 57612, 59278, 60666, 61801, 62712, 63429, 63982, 64401, 64712, 64939, 65101, 65215, 65293, 65346, 65536
36	0, 43, 104, 189, 306, 466, 680, 962, 1329, 1799, 2392, 3129, 4031, 5119, 6412, 7925, 9669, 11650, 13867, 16311, 18965, 21804, 24796, 27902, 31079, 34280, 37457, 40563, 43555, 46394, 49048, 51492, 53709, 55690, 57434, 58947, 60240, 61328, 62230, 62967, 63560, 64030, 64397, 64679, 64893, 65053, 65171, 65256, 65317, 65360, 65536
37	0, 39, 93, 166, 263, 390, 556, 770, 1042, 1383, 1807, 2327, 2958, 3715, 4613, 5664, 6881, 8274, 9849, 11610, 13555, 15679, 17971, 20416, 22993, 25678, 28443, 31257, 34088, 36902, 39667, 42352, 44929, 47374, 49666, 51790, 53735, 55496, 57071, 58464, 59681, 60732, 61630, 62387, 63018, 63538, 63962, 64303, 64575, 64789, 64955, 65083, 65180, 65253, 65307, 65346, 65536
38	0, 31, 71, 124, 193, 282, 395, 538, 717, 939, 1211, 1543, 1943, 2422, 2989, 3655, 4429, 5322, 6341, 7495, 8789, 10227, 11810, 13537, 15404, 17403, 19525, 21757, 24083, 26485, 28942, 31433, 33936, 36427, 38884, 41286, 43612, 45844, 47966, 49965, 51832, 53559, 55142, 56580, 57874, 59028, 60047, 60940, 61714, 62380, 62947, 63426, 63826, 64158, 64430, 64652, 64831, 64974, 65087, 65176, 65245, 65298, 65338, 65369, 65536
39	0, 27, 62, 107, 163, 234, 322, 431, 564, 726, 922, 1158, 1439, 1771, 2162, 2618, 3146, 3753, 4446, 5232, 6116, 7104, 8201, 9409, 10730, 12165, 13712, 15368, 17128, 18985, 20931, 22955, 25045, 27188, 29370, 31575, 33788, 35993, 38175, 40318, 42408, 44432, 46378, 48235, 49995, 51651, 53198, 54633, 55954, 57162, 58259, 59247, 60131, 60917, 61610, 62217, 62745, 63201, 63592, 63924, 64205, 64441, 64637, 64799, 64932, 65041, 65129, 65200, 65256, 65301, 65336, 65363, 65536

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Index	Probability
40	0, 28, 62, 104, 156, 219, 296, 389, 500, 632, 789, 974, 1192, 1446, 1740, 2080, 2470, 2914, 3418, 3987, 4625, 5337, 6127, 6998, 7953, 8995, 10125, 11344, 12651, 14045, 15524, 17084, 18720, 20426, 22195, 24020, 25891, 27800, 29736, 31688, 33645, 35597, 37533, 39442, 41313, 43138, 44907, 46613, 48249, 49809, 51288, 52682, 53989, 55208, 56338, 57380, 58335, 59206, 59996, 60708, 61346, 61915, 62419, 62863, 63253, 63593, 63887, 64141, 64359, 64544, 64701, 64833, 64944, 65037, 65114, 65177, 65229, 65271, 65305, 65333, 65536
41	0, 25, 55, 91, 135, 187, 249, 322, 408, 509, 627, 764, 923, 1107, 1318, 1559, 1833, 2144, 2494, 2888, 3328, 3818, 4361, 4960, 5619, 6339, 7124, 7975, 8894, 9882, 10939, 12065, 13260, 14522, 15850, 17240, 18689, 20193, 21748, 23347, 24986, 26657, 28354, 30070, 31797, 33528, 35255, 36971, 38668, 40339, 41978, 43577, 45132, 46636, 48085, 49475, 50803, 52065, 53260, 54386, 55443, 56431, 57350, 58201, 58986, 59706, 60365, 60964, 61507, 61997, 62437, 62831, 63181, 63492, 63766, 64007, 64218, 64402, 64561, 64698, 64816, 64917, 65003, 65076, 65138, 65190, 65234, 65270, 65300, 65325, 65536
42	0, 21, 46, 76, 111, 152, 200, 256, 320, 395, 481, 580, 693, 822, 969, 1135, 1323, 1534, 1771, 2036, 2331, 2658, 3020, 3419, 3858, 4339, 4864, 5434, 6052, 6720, 7439, 8210, 9034, 9912, 10845, 11832, 12873, 13967, 15113, 16309, 17553, 18842, 20174, 21545, 22952, 24391, 25857, 27346, 28853, 30373, 31901, 33431, 34959, 36479, 37986, 39475, 40941, 42380, 43787, 45158, 46490, 47779, 49023, 50219, 51365, 52459, 53500, 54487, 55420, 56298, 57122, 57893, 58612, 59280, 59898, 60468, 60993, 61474, 61913, 62312, 62674, 63001, 63296, 63561, 63798, 64009, 64197, 64363, 64510, 64639, 64752, 64851, 64937, 65012, 65076, 65132, 65180, 65221, 65256, 65286, 65311, 65332, 65536
43	0, 20, 44, 71, 102, 138, 180, 228, 282, 344, 414, 494, 584, 685, 799, 926, 1068, 1227, 1403, 1599, 1815, 2053, 2315, 2603, 2918, 3261, 3635, 4040, 4479, 4952, 5462, 6009, 6595, 7221, 7887, 8595, 9345, 10137, 10971, 11848, 12767, 13727, 14728, 15769, 16848, 17964, 19115, 20299, 21513, 22755, 24022, 25311, 26620, 27945, 29282, 30628, 31979, 33332, 34683, 36029, 37366, 38691, 40000, 41289, 42556, 43798, 45012, 46196, 47347, 48463, 49542, 50583, 51584, 52544, 53463, 54340, 55174, 55966, 56716, 57424, 58090, 58716, 59302, 59849, 60359, 60832, 61271, 61676, 62050, 62393, 62708, 62996, 63258, 63496, 63712, 63908, 64084, 64243, 64385, 64512, 64626, 64727, 64817, 64896, 64966, 65028, 65082, 65130, 65172, 65208, 65239, 65266, 65290, 65310, 65536

Table B.9 (continued)

Index	Probability
44	0, 16, 35, 56, 80, 108, 139, 174, 214, 259, 309, 365, 428, 498, 577, 664, 761, 868, 986, 1116, 1260, 1418, 1591, 1780, 1986, 2210, 2453, 2717, 3002, 3310, 3642, 3999, 4381, 4790, 5227, 5693, 6189, 6715, 7273, 7862, 8484, 9139, 9827, 10548, 11302, 12089, 12909, 13761, 14645, 15560, 16505, 17480, 18483, 19512, 20566, 21644, 22743, 23862, 24999, 26151, 27317, 28494, 29679, 30871, 32066, 33263, 34458, 35650, 36835, 38012, 39178, 40330, 41467, 42586, 43685, 44763, 45817, 46846, 47849, 48824, 49769, 50684, 51568, 52420, 53240, 54027, 54781, 55502, 56190, 56845, 57467, 58056, 58614, 59140, 59636, 60102, 60539, 60948, 61330, 61687, 62019, 62327, 62612, 62876, 63119, 63343, 63549, 63738, 63911, 64069, 64213, 64343, 64461, 64568, 64665, 64752, 64831, 64901, 64964, 65020, 65070,

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Index	Probability
	65115, 65155, 65190, 65221, 65249, 65273, 65294, 65313, 65329, 65536
45	0, 15, 32, 51, 72, 96, 123, 153, 186, 223, 264, 309, 359, 414, 475, 542, 616, 697, 786, 883, 989, 1105, 1231, 1368, 1516, 1676, 1849, 2036, 2238, 2455, 2688, 2938, 3205, 3490, 3795, 4119, 4464, 4830, 5218, 5629, 6063, 6521, 7003, 7509, 8040, 8597, 9180, 9788, 10422, 11082, 11768, 12480, 13217, 13980, 14767, 15579, 16414, 17272, 18152, 19053, 19974, 20915, 21873, 22848, 23838, 24842, 25859, 26886, 27923, 28967, 30017, 31072, 32129, 33187, 34244, 35299, 36349, 37393, 38430, 39458, 40475, 41479, 42469, 43444, 44402, 45343, 46264, 47165, 48045, 48903, 49738, 50550, 51337, 52100, 52837, 53549, 54235, 54895, 55529, 56137, 56720, 57277, 57808, 58314, 58796, 59254, 59688, 60099, 60487, 60853, 61198, 61522, 61827, 62112, 62379, 62629, 62862, 63079, 63281, 63468, 63641, 63801, 63949, 64086, 64212, 64328, 64434, 64531, 64620, 64701, 64775, 64842, 64903, 64958, 65008, 65053, 65094, 65131, 65164, 65194, 65221, 65245, 65266, 65285, 65302, 65317, 65536
46	0, 14, 30, 47, 66, 87, 110, 136, 164, 195, 229, 266, 307, 351, 399, 452, 510, 573, 641, 715, 795, 881, 974, 1075, 1184, 1301, 1427, 1562, 1707, 1862, 2028, 2205, 2394, 2595, 2809, 3036, 3277, 3533, 3804, 4090, 4392, 4711, 5047, 5400, 5771, 6160, 6568, 6995, 7441, 7907, 8393, 8899, 9425, 9971, 10537, 11124, 11731, 12358, 13005, 13672, 14358, 15063, 15787, 16529, 17289, 18066, 18860, 19670, 20495, 21335, 22188, 23054, 23932, 24820, 25718, 26625, 27539, 28460, 29386, 30316, 31249, 32184, 33120, 34055, 34988, 35918, 36844, 37765, 38679, 39586, 40484, 41372, 42250, 43116, 43969, 44809, 45634, 46444, 47238, 48015, 48775, 49517, 50241, 50946, 51632, 52299, 52946, 53573, 54180, 54767, 55333, 55879, 56405, 56911, 57397, 57863, 58309, 58736, 59144, 59533, 59904, 60257, 60593, 60912, 61214, 61500, 61771, 62027, 62268, 62495, 62709, 62910, 63099, 63276, 63442, 63597, 63742, 63877, 64003, 64120, 64229, 64330, 64423, 64509, 64589, 64663, 64731, 64794, 64852, 64905, 64953, 64997, 65038, 65075, 65109, 65140, 65168, 65194, 65217, 65238, 65257, 65274, 65290, 65304, 65536
47	0, 12, 25, 39, 55, 72, 91, 111, 133, 157, 183, 212, 243, 277, 313, 352, 395, 441, 491, 544, 601, 663, 729, 800, 876, 958, 1045, 1138, 1238, 1344, 1457, 1578, 1706, 1842, 1987, 2141, 2304, 2476, 2658, 2850, 3053, 3267, 3492, 3729, 3978, 4239, 4513, 4800, 5100, 5414, 5742, 6084, 6441, 6812, 7198, 7600, 8017, 8449, 8897, 9361, 9841, 10337, 10848, 11375, 11918, 12477, 13051, 13641, 14246, 14866, 15501, 16150, 16813, 17490, 18181, 18884, 19600, 20328, 21067, 21817, 22577, 23347, 24126, 24913, 25707, 26508, 27315, 28128, 28945, 29766, 30590, 31416, 32243, 33070, 33897, 34723, 35547, 36368, 37185, 37998, 38805, 39606, 40400, 41187, 41966, 42736, 43496, 44246, 44985, 45713, 46429, 47132, 47823, 48500, 49163, 49812, 50447, 51067, 51672, 52262, 52836, 53395, 53938, 54465, 54976, 55471, 55951, 56415, 56863, 57295, 57712, 58114, 58500, 58871, 59228, 59570, 59898, 60212, 60512, 60799, 61073, 61334, 61583, 61820, 62045, 62259, 62462, 62654, 62836, 63008, 63171, 63325, 63470, 63606, 63734, 63855, 63968, 64074, 64174, 64267, 64354, 64436, 64512, 64583, 64649, 64711, 64768, 64821, 64871, 64917, 64960, 64999, 65035, 65069, 65100, 65129, 65155, 65179, 65201, 65221, 65240, 65257, 65273, 65287, 65300, 65312, 65536
48	0, 11, 23, 35, 49, 64, 80, 97, 115, 135, 156, 179, 204, 231, 260, 291, 324, 359, 397, 437, 480, 526, 575, 628, 684, 744, 808, 876, 948, 1024, 1105, 1191, 1282, 1378, 1480, 1587, 1700, 1820, 1946, 2079, 2219, 2366, 2521, 2683, 2854, 3033, 3220, 3416, 3621, 3835, 4059, 4293, 4537, 4791, 5055, 5330, 5616, 5913, 6221, 6541, 6872, 7215, 7570, 7937, 8316, 8707, 9110, 9526, 9954, 10394, 10847, 11312, 11790, 12280, 12782, 13296, 13822, 14360, 14910, 15471, 16044, 16628, 17223,

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	97, 100, 103, 106, 109, 112, 115, 118, 121, 124, 127, 130, 133, 136, 139, 142, 145, 148, 151, 154, 157, 160, 163, 166, 169, 172, 175, 178, 181, 184, 188, 192, 196, 200, 204, 208, 212, 216, 220, 224, 228, 232, 236, 240, 244, 248, 252, 256, 260, 264, 268, 272, 276, 280, 284, 289, 294, 299, 304, 309, 314, 319, 324, 329, 334, 339, 344, 349, 354, 359, 364, 369, 374, 379, 384, 389, 395, 401, 407, 413, 419, 425, 431, 437, 443, 449, 455, 461, 467, 473, 479, 485, 491, 497, 504, 511, 518, 525, 532, 539, 546, 553, 560, 567, 574, 581, 588, 595, 602, 610, 618, 626, 634, 642, 650, 658, 666, 674, 682, 690, 698, 706, 714, 722, 731, 740, 749, 758, 767, 776, 785, 794, 803, 812, 821, 830, 839, 849, 859, 869, 879, 889, 899, 909, 919, 929, 939, 949, 960, 971, 982, 993, 1004, 1015, 1026, 1037, 1048, 1059, 1070, 1082, 1094, 1106, 1118, 1130, 1142, 1154, 1166, 1178, 1190, 1202, 1215, 1228, 1241, 1254, 1267, 1280, 1293, 1306, 1319, 1333, 1347, 1361, 1375, 1389, 1403, 1417, 1431, 1445, 1459, 1474, 1489, 1504, 1519, 1534, 1549, 1564, 1579, 1595, 1611, 1627, 1643, 1659, 1675, 1691, 1707, 1723, 1740, 1757, 1774, 1791, 1808, 1825, 1842, 1859, 1877, 1895, 1913, 1931, 1949, 1967, 1985, 2004, 2023, 2042, 2061, 2080, 2099, 2118, 2137, 2157, 2177, 2197, 2217, 2237, 2257, 2277, 2298, 2319, 2340, 2361, 2382, 2403, 2424, 2446, 2468, 2490, 2512, 2534, 2556, 2579, 2602, 2625, 2648, 2671, 2694, 2717, 2741, 2765, 2789, 2813, 2837, 2861, 2886, 2911, 2936, 2961, 2986, 3011, 3037, 3063, 3089, 3115, 3141, 3167, 3194, 3221, 3248, 3275, 3302, 3329, 3357, 3385, 3413, 3441, 3469, 3498, 3527, 3556, 3585, 3614, 3643, 3673, 3703, 3733, 3763, 3793, 3823, 3854, 3885, 3916, 3947, 3978, 4010, 4042, 4074, 4106, 4138, 4171, 4204, 4237, 4270, 4303, 4337, 4371, 4405, 4439, 4473, 4508, 4543, 4578, 4613, 4648, 4684, 4720, 4756, 4792, 4828, 4865, 4902, 4939, 4976, 5013, 5051, 5089, 5127, 5165, 5203, 5242, 5281, 5320, 5359, 5398, 5438, 5478, 5518, 5558, 5599, 5640, 5681, 5722, 5763, 5805, 5847, 5889, 5931, 5973, 6016, 6059, 6102, 6145, 6189, 6233, 6277, 6321, 6365, 6410, 6455, 6500, 6545, 6591, 6637, 6683, 6729, 6776, 6823, 6870, 6917, 6964, 7012, 7060, 7108, 7156, 7205, 7254, 7303, 7352, 7402, 7452, 7502, 7552, 7602, 7653, 7704, 7755, 7806, 7858, 7910, 7962, 8014, 8067, 8120, 8173, 8226, 8280, 8334, 8388, 8442, 8496, 8551, 8606, 8661, 8716, 8772, 8828, 8884, 8940, 8997, 9054, 9111, 9168, 9226, 9284, 9342, 9400, 9459, 9518, 9577, 9636, 9696, 9756, 9816, 9876, 9936, 9997, 10058, 10119, 10180, 10242, 10304, 10366, 10428, 10491, 10554, 10617, 10680, 10744, 10808, 10872, 10936, 11001, 11066, 11131, 11196, 11262, 11328, 11394, 11460, 11527, 11594, 11661, 11728, 11795, 11863, 11931, 11999, 12067, 12136, 12205, 12274, 12343, 12413, 12483, 12553, 12623, 12694, 12765, 12836, 12907, 12979, 13051, 13123, 13195, 13267, 13340, 13413, 13486, 13559, 13633, 13707, 13781, 13855, 13930, 14005, 14080, 14155, 14230, 14306, 14382, 14458, 14534, 14611, 14688, 14765, 14842, 14920, 14998, 15076, 15154, 15232, 15311, 15390, 15469, 15548, 15628, 15708, 15788, 15868, 15948, 16029, 16110, 16191, 16272, 16353, 16435, 16517, 16599, 16681, 16764, 16847, 16930, 17013, 17096, 17180, 17264, 17348, 17432, 17516, 17601, 17686, 17771, 17856, 17941, 18027, 18113, 18199, 18285, 18371, 18458, 18545, 18632, 18719, 18806, 18894, 18982, 19070, 19158, 19246, 19335, 19424, 19513, 19602, 19691, 19780, 19870, 19960, 20050, 20140, 20230, 20320, 20411, 20502, 20593, 20684, 20775, 20867, 20959, 21051, 21143, 21235, 21327, 21419, 21512, 21605, 21698, 21791, 21884, 21977, 22071, 22165, 22259, 22353, 22447, 22541, 22635, 22730, 22825, 22920, 23015, 23110, 23205, 23300, 23396, 23492, 23588, 23684, 23780, 23876, 23972, 24069, 24166, 24263, 24360, 24457, 24554, 24651, 24748, 24845, 24943, 25041, 25139, 25237, 25335, 25433, 25531, 25629, 25727, 25826, 25925, 26024, 26123, 26222, 26321, 26420, 26519, 26618, 26717, 26817, 26917, 27017, 27117, 27217, 27317, 27417, 27517, 27617, 27717, 27817, 27917, 28017, 28118, 28219, 28320, 28421, 28522, 28623, 28724, 28825, 28926, 29027, 29128, 29229, 29330, 29431, 29532, 29633, 29734, 29836, 29938, 30040, 30142, 30244, 30346, 30448, 30550,

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Index	Probability
	30652, 30754, 30856, 30958, 31060, 31162, 31264

Table B.9 (continued)

Index	Probability
64	31366, 31468, 31570, 31672, 31774, 31876, 31978, 32080, 32182, 32284, 32386, 32488, 32590, 32692, 32794, 32896, 32998, 33100, 33202, 33304, 33406, 33508, 33610, 33712, 33814, 33916, 34018, 34120, 34222, 34324, 34426, 34528, 34630, 34732, 34834, 34936, 35038, 35140, 35242, 35344, 35446, 35548, 35649, 35750, 35851, 35952, 36053, 36154, 36255, 36356, 36457, 36558, 36659, 36760, 36861, 36962, 37063, 37164, 37265, 37365, 37465, 37565, 37665, 37765, 37865, 37965, 38065, 38165, 38265, 38365, 38465, 38565, 38664, 38763, 38862, 38961, 39060, 39159, 39258, 39357, 39456, 39555, 39653, 39751, 39849, 39947, 40045, 40143, 40241, 40339, 40437, 40534, 40631, 40728, 40825, 40922, 41019, 41116, 41213, 41310, 41406, 41502, 41598, 41694, 41790, 41886, 41982, 42077, 42172, 42267, 42362, 42457, 42552, 42647, 42741, 42835, 42929, 43023, 43117, 43211, 43305, 43398, 43491, 43584, 43677, 43770, 43863, 43955, 44047, 44139, 44231, 44323, 44415, 44507, 44598, 44689, 44780, 44871, 44962, 45052, 45142, 45232, 45322, 45412, 45502, 45591, 45680, 45769, 45858, 45947, 46036, 46124, 46212, 46300, 46388, 46476, 46563, 46650, 46737, 46824, 46911, 46997, 47083, 47169, 47255, 47341, 47426, 47511, 47596, 47681, 47766, 47850, 47934, 48018, 48102, 48186, 48269, 48352, 48435, 48518, 48601, 48683, 48765, 48847, 48929, 49010, 49091, 49172, 49253, 49334, 49414, 49494, 49574, 49654, 49734, 49813, 49892, 49971, 50050, 50128, 50206, 50284, 50362, 50440, 50517, 50594, 50671, 50748, 50824, 50900, 50976, 51052, 51127, 51202, 51277, 51352, 51427, 51501, 51575, 51649, 51723, 51796, 51869, 51942, 52015, 52087, 52159, 52231, 52303, 52375, 52446, 52517, 52588, 52659, 52729, 52799, 52869, 52939, 53008, 53077, 53146, 53215, 53283, 53351, 53419, 53487, 53554, 53621, 53688, 53755, 53822, 53888, 53954, 54020, 54086, 54151, 54216, 54281, 54346, 54410, 54474, 54538, 54602, 54665, 54728, 54791, 54854, 54916, 54978, 55040, 55102, 55163, 55224, 55285, 55346, 55406, 55466, 55526, 55586, 55646, 55705, 55764, 55823, 55882, 55940, 55998, 56056, 56114, 56171, 56228, 56285, 56342, 56398, 56454, 56510, 56566, 56621, 56676, 56731, 56786, 56840, 56894, 56948, 57002, 57056, 57109, 57162, 57215, 57268, 57320, 57372, 57424, 57476, 57527, 57578, 57629, 57680, 57730, 57780, 57830, 57880, 57930, 57979, 58028, 58077, 58126, 58174, 58222, 58270, 58318, 58365, 58412, 58459, 58506, 58553, 58599, 58645, 58691, 58737, 58782, 58827, 58872, 58917, 58961, 59005, 59049, 59093, 59137, 59180, 59223, 59266, 59309, 59351, 59393, 59435, 59477, 59519, 59560, 59601, 59642, 59683, 59724, 59764, 59804, 59844, 59884, 59923, 59962, 60001, 60040, 60079, 60117, 60155, 60193, 60231, 60269, 60306, 60343, 60380, 60417, 60454, 60490, 60526, 60562, 60598, 60634, 60669, 60704, 60739, 60774, 60809, 60843, 60877, 60911, 60945, 60979, 61012, 61045, 61078, 61111, 61144, 61176, 61208, 61240, 61272, 61304, 61335, 61366, 61397, 61428, 61459, 61489, 61519, 61549, 61579, 61609, 61639, 61668, 61697, 61726, 61755, 61784, 61813, 61841, 61869, 61897, 61925, 61953, 61980, 62007, 62034, 62061, 62088, 62115, 62141, 62167, 62193, 62219, 62245, 62271, 62296, 62321, 62346, 62371, 62396, 62421, 62445, 62469, 62493, 62517, 62541, 62565, 62588, 62611, 62634, 62657, 62680, 62703, 62726, 62748, 62770, 62792, 62814, 62836, 62858, 62879, 62900, 62921, 62942, 62963, 62984, 63005, 63025, 63045, 63065, 63085, 63105, 63125, 63145, 63164, 63183, 63202, 63221, 63240, 63259, 63278, 63297, 63315, 63333, 63351, 63369, 63387, 63405, 63423, 63440, 63457, 63474, 63491, 63508, 63525, 63542, 63559, 63575, 63591, 63607, 63623,

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Index	Probability
	63639, 63655, 63671, 63687, 63703, 63718, 63733, 63748, 63763, 63778, 63793, 63808, 63823, 63837, 63851, 63865, 63879, 63893, 63907, 63921, 63935, 63949, 63963, 63976, 63989, 64002, 64015, 64028, 64041, 64054, 64067, 64080, 64092, 64104, 64116, 64128, 64140, 64152, 64164, 64176, 64188, 64200, 64212, 64223, 64234, 64245, 64256, 64267, 64278, 64289, 64300, 64311, 64322, 64333, 64343, 64353, 64363, 64373, 64383, 64393, 64403, 64413, 64423, 64433, 64443, 64452, 64461, 64470, 64479, 64488, 64497, 64506, 64515, 64524, 64533, 64542, 64551, 64560, 64568, 64576, 64584, 64592, 64600, 64608, 64616, 64624, 64632, 64640, 64648, 64656, 64664, 64672, 64680, 64687, 64694, 64701, 64708, 64715, 64722, 64729, 64736, 64743, 64750, 64757, 64764, 64771, 64778, 64785, 64791, 64797, 64803, 64809, 64815, 64821, 64827, 64833, 64839, 64845, 64851, 64857, 64863, 64869, 64875, 64881, 64887, 64893, 64898, 64903, 64908, 64913, 64918, 64923, 64928, 64933, 64938, 64943, 64948, 64953, 64958, 64963, 64968, 64973, 64978, 64983, 64988, 64993, 64998, 65002, 65006, 65010, 65014, 65018, 65022, 65026, 65030, 65034, 65038, 65042, 65046, 65050, 65054, 65058, 65062, 65066, 65070, 65074, 65078, 65082, 65086, 65090, 65094, 65098, 65101, 65104, 65107, 65110, 65113, 65116, 65119, 65122, 65125, 65128, 65131, 65134, 65137, 65140, 65143, 65146, 65149, 65152, 65155, 65158, 65161, 65164, 65167, 65170, 65173, 65176, 65179, 65182, 65185, 65188, 65191, 65194, 65197, 65200, 65202, 65204, 65206, 65208, 65210, 65212, 65214, 65216, 65218, 65220, 65222, 65224, 65226, 65228, 65230, 65232, 65234, 65236, 65238, 65240, 65242, 65244, 65246, 65248, 65250, 65252, 65254, 65256, 65258, 65260, 65262, 65264, 65266, 65268, 65270, 65272, 65274, 65276, 65278, 65280, 65282, 65536

Table B.10 Layer 1 CNN (convolutional kernel parameter kernel) of base decoding neural network parameter

Parameter value
0x1.59e8d00000000p–11, –0x1.303e2e0000000p–6, 0x1.f808ac0000000p–8, 0x1.d4da920000000p–7, –0x1.19255a0000000p–6, 0x1.a818920000000p–15, 0x1.7a2b560000000p–9, 0x1.15338c0000000p–5, 0x1.7ff9e80000000p–11, –0x1.1db39a0000000p–14, –0x1.b576c40000000p–10, –0x1.32a3780000000p–7, 0x1.076a0a0000000p–4, 0x1.2927b60000000p–10, –0x1.a75d660000000p–8, 0x1.503bf00000000p–5,

Table B.10 (continued)

Parameter value
0x1.0ec3560000000p–10, 0x1.b544240000000p–7, 0x1.74d22a0000000p–6, –0x1.f3dc660000000p–7, 0x1.9fc23e0000000p–6, –0x1.536ec40000000p–11, –0x1.6218060000000p–9, 0x1.e1a0a60000000p–7, –0x1.884efa0000000p–10, –0x1.ac084c0000000p–10, –0x1.d28be60000000p–10, 0x1.40c1ba0000000p–6, –0x1.77cdb80000000p–1, 0x1.8542020000000p–12, –0x1.44e1de0000000p–5, –0x1.dce52c0000000p–7,

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Parameter value
0x1.2bb7900000000p–10, 0x1.19f6360000000p–4, –0x1.a6dfaa0000000p–5, –0x1.6664d40000000p–5, 0x1.2117500000000p–4, 0x1.3a65380000000p–12, –0x1.0562320000000p–7, –0x1.6691ce0000000p–3, –0x1.a74f300000000p–9, 0x1.27394e0000000p–12, 0x1.1631760000000p–8, 0x1.ca4b820000000p–7, 0x1.1731260000000p–3, –0x1.229d140000000p–8, 0x1.5bd2480000000p–4, –0x1.dc34380000000p–4,
0x1.4c296c0000000p–10, –0x1.2356aa0000000p–6, 0x1.b709080000000p–7, 0x1.29d4dc0000000p–7, –0x1.333e580000000p–6, –0x1.3b4c180000000p–11, 0x1.009dcc0000000p–9, 0x1.a80dec0000000p–5, –0x1.efade20000000p–12, –0x1.b7aca60000000p–12, –0x1.b43cba0000000p–12, 0x1.68897a0000000p–7, –0x1.66d2320000000p–5, –0x1.6f6ca80000000p–11, –0x1.772ab80000000p–7, 0x1.724c820000000p–5,
0x1.42e0c20000000p–11, 0x1.163a640000000p–6, –0x1.85e8060000000p–6, –0x1.7c34180000000p–7, 0x1.774b600000000p–7, 0x1.e969a80000000p–10, 0x1.3cbab60000000p–9, –0x1.f24c1a0000000p–5, –0x1.0250100000000p–9, –0x1.5c73840000000p–11, –0x1.c3f3480000000p–11, –0x1.53a6cc0000000p–6, 0x1.3ce0760000000p–16, 0x1.1f97fc0000000p–10, 0x1.66122c0000000p–6, –0x1.0567e00000000p–6,
0x1.f09be60000000p–11, 0x1.e149060000000p–6, –0x1.23bf360000000p–5, –0x1.21e62e0000000p–6, 0x1.bd17b80000000p–8, 0x1.88a32c0000000p–9, 0x1.5c065e0000000p–13, –0x1.7b61600000000p–4, –0x1.bd8f7c0000000p–9, –0x1.0fe26c0000000p–12, 0x1.6490360000000p–10, –0x1.9a43800000000p–6, 0x1.5f6e080000000p–2, –0x1.de432c0000000p–12, 0x1.e4ad080000000p–5, –0x1.4fac560000000p–6,
–0x1.cd39b00000000p–10, –0x1.e16f580000000p–8, 0x1.abe0640000000p–7, 0x1.7f62a00000000p–8, 0x1.21d3660000000p–6, –0x1.2241fa0000000p–8, –0x1.d583ee0000000p–11, 0x1.3ce7480000000p–5, 0x1.0fa3120000000p–9, –0x1.6282d20000000p–11, –0x1.8c524a0000000p–10, 0x1.912d4e0000000p–6, –0x1.f7aee00000000p–2, 0x1.e4505e0000000p–11, –0x1.8708360000000p–5, –0x1.7e5ace0000000p–5,
0x1.355c680000000p–13, 0x1.5522a60000000p–5, –0x1.06f7b00000000p–6, –0x1.bf1a9a0000000p–6, 0x1.ecaeac0000000p–8, 0x1.605c700000000p–8, –0x1.a0040c0000000p–10, –0x1.3c05b40000000p–4, –0x1.41cb120000000p–9, 0x1.6bd0c20000000p–12, 0x1.ffd6a20000000p–10, –0x1.e283600000000p–7, 0x1.2473880000000p–3, 0x1.1c161a0000000p–12, 0x1.45797e0000000p–5, –0x1.0235900000000p–5,
0x1.1343040000000p–7, –0x1.474ab40000000p–3, –0x1.72bd740000000p–5, –0x1.5625d20000000p–5, 0x1.2a6b000000000p–5, –0x1.94492c0000000p–5,

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Parameter value
–0x1.6469a40000000p–5, –0x1.beeb820000000p–4, 0x1.dc5b440000000p–7, –0x1.7b40020000000p–7, 0x1.91742e0000000p–6, 0x1.4603940000000p–3, –0x1.22f7140000000p–3, 0x1.1b42460000000p–6, –0x1.4c612e0000000p–2, –0x1.3658be0000000p–5,
0x1.da2c6e0000000p–7, 0x1.3c2a900000000p–3, 0x1.8121480000000p–1, 0x1.dede740000000p–2, –0x1.d6ae0c0000000p–4, 0x1.83cb8c0000000p–8, –0x1.a9e4a40000000p–7, 0x1.ab9e660000000p–3, –0x1.d9e9fc0000000p–7, –0x1.a8fb320000000p–8, –0x1.f48fd60000000p–8, 0x1.a520ba0000000p–2, –0x1.31f3880000000p–2, 0x1.4b74e40000000p–9, 0x1.8a7d540000000p–6, –0x1.52c7680000000p–2,

Table B.10 (continued)

Parameter value
–0x1.1468960000000p–4, 0x1.77f6520000000p–3, –0x1.2ef9680000000p–3, 0x1.177af20000000p–4, –0x1.8ba6980000000p–2, 0x1.fd51000000000p–4, 0x1.848b840000000p–3, 0x1.f84fe00000000p–2, –0x1.03f5ca0000000p–7, 0x1.66fc6a0000000p–5, –0x1.6592ce0000000p–4, –0x1.5e32080000000p–2, 0x1.309e0e0000000p–4, –0x1.4bd0380000000p–4, 0x1.16ed760000000p–1, –0x1.acd88c0000000p–4,
0x1.ee11ee0000000p–7, –0x1.e4f7720000000p–4, 0x1.76eb5a0000000p–5, 0x1.0d6ca40000000p–6, 0x1.04805c0000000p–2, –0x1.261a440000000p–5, –0x1.514d700000000p–5, 0x1.7549c00000000p–1, 0x1.307a000000000p–8, –0x1.a21c920000000p–7, 0x1.7dcb500000000p–6, 0x1.8dae920000000p–3, 0x1.1af0700000000p–2, 0x1.3d308a0000000p–6, –0x1.a4f4880000000p–3, 0x1.32d5780000000p–3,
–0x1.ab05320000000p–6, –0x1.2e86be0000000p–2, 0x1.52c3da0000000p–5, 0x1.720a380000000p–3, –0x1.5803de0000000p–1, 0x1.25f59a0000000p–9, 0x1.dd26c60000000p–5, –0x1.1d495e0000000p–3, 0x1.61892a0000000p–6, 0x1.5df5860000000p–7, –0x1.e6c5b60000000p–8, 0x1.36e0340000000p–5, 0x1.3086fa0000000p–1, –0x1.3606ea0000000p–6, –0x1.551fd20000000p–2, 0x1.b2ce540000000p–6,
–0x1.91011c0000000p–5, –0x1.3be3760000000p–3, –0x1.5f919c0000000p–2, –0x1.170c220000000p–4, –0x1.11cec00000000p–2, 0x1.d384340000000p–7, 0x1.4e515e0000000p–4, 0x1.6ed4900000000p–4, 0x1.f3f3e20000000p–6, 0x1.588fce0000000p–6, –0x1.2f0c780000000p–6, –0x1.aa2b960000000p–8, –0x1.31315a0000000p–1, –0x1.23a2720000000p–5, –0x1.38940a0000000p–3, –0x1.b95d240000000p–3,

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Parameter value
0x1.1fff4e0000000p–5, 0x1.de7e2c0000000p–3, 0x1.d96dec0000000p–2, 0x1.865a1a0000000p–3, –0x1.9c60840000000p–5, 0x1.4641600000000p–5, –0x1.01b9560000000p–6, –0x1.a008180000000p–2, –0x1.7070c20000000p–5, –0x1.00f29c0000000p–7, –0x1.6bd2ec0000000p–7, –0x1.b9a4e00000000p–3, 0x1.8f2e040000000p–4, 0x1.906a940000000p–7, 0x1.8288900000000p–2, 0x1.155f9a0000000p–2,
–0x1.49d4ce0000000p–5, 0x1.ccf8100000000p–3, –0x1.3c0b7a0000000p–3, –0x1.d2c6ec0000000p–5, 0x1.0ee7680000000p–3, 0x1.97b0c80000000p–6, 0x1.a15dfc0000000p–5, –0x1.6a5cca0000000p–4, 0x1.e6f8d40000000p–7, 0x1.2395280000000p–6, –0x1.dbe67c0000000p–6, 0x1.0d2a000000000p–3, 0x1.02eff00000000p–1, –0x1.0aecec0000000p–5, 0x1.7681c00000000p–3, –0x1.52a75c0000000p–1,
0x1.39c67a0000000p–2, 0x1.99a6c60000000p–2, 0x1.677eca0000000p–3, –0x1.210f5a0000000p–7, –0x1.7dc66c0000000p–7, 0x1.56a8240000000p–5, 0x1.93cd7a0000000p–4, 0x1.c68bb00000000p–6, –0x1.58f8de0000000p–3, 0x1.61164a0000000p–5, –0x1.cc95c60000000p–6, –0x1.3238b60000000p–1, 0x1.729dea0000000p–5, 0x1.435e9e0000000p–3, –0x1.574bf60000000p–1, –0x1.ff5c220000000p–4,
0x1.8dd84a0000000p–6, 0x1.f8e1c00000000p–8, 0x1.2cb7d40000000p–2, –0x1.c7bd5c0000000p–6, –0x1.abe2cc0000000p–6, 0x1.540ba40000000p–2, –0x1.dbd9e20000000p–3, –0x1.0951f40000000p–6, –0x1.a9e5f80000000p–2, –0x1.ed7d000000000p–2, 0x1.1739e20000000p–3, 0x1.11220c0000000p–8, 0x1.44b9a60000000p–5, –0x1.14f44c0000000p–3, 0x1.08c0dc0000000p–3, –0x1.7ca5240000000p–4,
–0x1.19e74e0000000p–1, –0x1.6199140000000p–5, –0x1.1b37120000000p–4, 0x1.c101700000000p–4, –0x1.790a200000000p–4, 0x1.8c918a0000000p–4, –0x1.f7ca9c0000000p–2, 0x1.eb0af20000000p–6, 0x1.6a11a40000000p–2, –0x1.3f8b2e0000000p–4, 0x1.853cbc0000000p–2, –0x1.31116a0000000p–2, –0x1.5e73d60000000p–8, –0x1.89e9040000000p–3, –0x1.00a79e0000000p–2, –0x1.05c19e0000000p–5,
0x1.9eac9e0000000p–3, 0x1.67defa0000000p–3, –0x1.083a4a0000000p–2, 0x1.86b6ba0000000p–5, –0x1.802d760000000p–2, –0x1.32cc600000000p–3, –0x1.6baad00000000p–1, 0x1.5ef5d80000000p–4, –0x1.6d150c0000000p–3, –0x1.076e540000000p–7, –0x1.0511e60000000p–2, 0x1.cb45820000000p–3, –0x1.b1a08a0000000p–4, 0x1.dfc21e0000000p–4, –0x1.867ada0000000p–3, 0x1.59579c0000000p–2,

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Table B.10 (continued)

Parameter value
0x1.4be16e0000000p–2, –0x1.3813860000000p–5, –0x1.3323f80000000p–1, 0x1.81acb80000000p–3, 0x1.8f04240000000p–4, –0x1.81e8ce0000000p–5, 0x1.300bf00000000p–3, –0x1.4c7f420000000p–5, –0x1.b738a20000000p–6, –0x1.6640a60000000p–3, 0x1.54b7920000000p–1, 0x1.4848940000000p–3, –0x1.233cd00000000p–4, 0x1.356d420000000p–2, –0x1.9e7de80000000p–3, 0x1.754c0c0000000p–3,
0x1.2078780000000p–3, 0x1.a2bf820000000p–2, 0x1.24cf1c0000000p–1, –0x1.a50eb60000000p–2, –0x1.5ab4700000000p–2, 0x1.c5951e0000000p–3, –0x1.a748f80000000p–4, 0x1.4472ec0000000p–6, –0x1.7669a00000000p–7, 0x1.2c32f80000000p–4, 0x1.09aad60000000p–2, 0x1.b8fa340000000p–3, 0x1.c642b40000000p–4, 0x1.37af460000000p–3, 0x1.0d3e5e0000000p–3, –0x1.8375d60000000p–5,
–0x1.75dc4a0000000p–2, 0x1.cc3bc00000000p–2, –0x1.3100700000000p–4, –0x1.0b73de0000000p–2, –0x1.e2111a0000000p–3, –0x1.0612ec0000000p–2, 0x1.9338380000000p–2, 0x1.254d2c0000000p–5, 0x1.9132e20000000p–3, –0x1.9574160000000p–3, 0x1.2c819c0000000p–4, 0x1.1dd2b20000000p–2, 0x1.5b4d300000000p–9, –0x1.e655480000000p–3, –0x1.273e560000000p–2, 0x1.a0512a0000000p–3,
–0x1.9726500000000p–3, 0x1.15dc980000000p–2, –0x1.07ed280000000p–1, –0x1.0686120000000p–10, 0x1.4a5fcc0000000p–4, 0x1.4ce72a0000000p–1, 0x1.8f08380000000p–4, –0x1.34d79a0000000p–5, –0x1.1454340000000p–3, 0x1.d163120000000p–5, –0x1.0d35440000000p–3, 0x1.d399860000000p–3, –0x1.442b6c0000000p–6, –0x1.ca9b040000000p–3, –0x1.e1a5620000000p–4, 0x1.4ed30e0000000p–3,
0x1.55cdca0000000p–1, 0x1.a038300000000p–5, –0x1.dbb8f00000000p–6, 0x1.db47260000000p–6, –0x1.82f09c0000000p–6, 0x1.ead8a00000000p–4, –0x1.1947a40000000p–6, –0x1.026a5a0000000p–5, 0x1.2fae0a0000000p–1, 0x1.a209040000000p–7, 0x1.bf47a00000000p–7, 0x1.69331a0000000p–5, –0x1.9cf3a60000000p–8, –0x1.95c1f80000000p–2, –0x1.22086c0000000p–5, 0x1.de2d7e0000000p–5,
–0x1.e5fbf60000000p–4, 0x1.5a7aac0000000p–5, –0x1.29f7b60000000p–5, –0x1.3ec9cc0000000p–6, –0x1.fa24140000000p–7, 0x1.c4ab820000000p–4, 0x1.82e2b20000000p–10, –0x1.ac17fe0000000p–9, 0x1.47e5e80000000p–8, 0x1.c2a7d00000000p–5, 0x1.223a260000000p–4, 0x1.456c8c0000000p–4, –0x1.f213ec0000000p–10, –0x1.3a72960000000p–7, 0x1.236af20000000p–7, 0x1.1872600000000p–5,
0x1.181c7c0000000p–2, –0x1.869c840000000p–9, 0x1.3d2e280000000p–8,

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Parameter value
0x1.2ef4140000000p–7, –0x1.7a23960000000p–7, 0x1.4d9e760000000p–5, –0x1.47ba5c0000000p–6, –0x1.a791d00000000p–8, 0x1.24b8f00000000p–2, –0x1.e7bd920000000p–4, 0x1.3d99140000000p–4, –0x1.2f5f420000000p–6, –0x1.662e3a0000000p–10, 0x1.1c0c520000000p–5, –0x1.de8e480000000p–9, 0x1.34843c0000000p–8,
0x1.7a98ca0000000p–3, –0x1.feaf640000000p–4, 0x1.931a9c0000000p–4, 0x1.0595760000000p–4, 0x1.390eec0000000p–10, –0x1.33f9360000000p–2, –0x1.44fb8c0000000p–4, 0x1.178a7a0000000p–6, –0x1.c7e0380000000p–3, –0x1.583d140000000p–9, 0x1.7f94020000000p–2, –0x1.27719a0000000p–3, –0x1.f3c76a0000000p–11, –0x1.4701ce0000000p–3, –0x1.2ba7920000000p–9, –0x1.31c0340000000p–4,
0x1.7036e00000000p–3, –0x1.25467a0000000p–5, 0x1.e412c00000000p–5, 0x1.1750a40000000p–8, 0x1.9c7bce0000000p–6, –0x1.9328e40000000p–3, 0x1.760b340000000p–5, 0x1.b8e8200000000p–7, –0x1.58c8460000000p–3, –0x1.7816f80000000p–3, –0x1.d8ef200000000p–4, –0x1.c533920000000p–4, 0x1.017fc20000000p–8, 0x1.4930740000000p–5, –0x1.1c4fc60000000p–8, –0x1.c3a7120000000p–5,
–0x1.888c7a0000000p–4, 0x1.5ffae00000000p–4, –0x1.bc7c780000000p–4, –0x1.2fb71a0000000p–6, –0x1.edbd5a0000000p–5, 0x1.5fa2d20000000p–5, –0x1.dd639a0000000p–6, –0x1.764c980000000p–8, –0x1.bf212c0000000p–3, 0x1.9f69460000000p–2, 0x1.53fc460000000p–2, 0x1.a838c40000000p–3, –0x1.01993e0000000p–7, –0x1.98d9180000000p–2, 0x1.0c22b00000000p–7, 0x1.612eba0000000p–4,

Table B.10 (continued)

Parameter value
0x1.1f1ed60000000p–2, –0x1.3e483a0000000p–7, –0x1.4447000000000p–9, 0x1.31a5ec0000000p–5, –0x1.9899000000000p–6, –0x1.b246900000000p–3, –0x1.918f480000000p–5, 0x1.07bb740000000p–8, –0x1.1d63a00000000p–2, 0x1.e700460000000p–3, 0x1.070bac0000000p–2, 0x1.68bfac0000000p–7, –0x1.4235b80000000p–8, –0x1.ccebb60000000p–2, –0x1.b6a7180000000p–7, 0x1.7a2f320000000p–8,
0x1.79271c0000000p–4, –0x1.5c37a80000000p–9, 0x1.a0e4840000000p–7, –0x1.e0532e0000000p–8, 0x1.35e3500000000p–7, –0x1.696bca0000000p–3, 0x1.19a6a00000000p–5, 0x1.7c86460000000p–7, –0x1.ce37860000000p–3, 0x1.813cda0000000p–6, –0x1.9d4bbe0000000p–4, –0x1.2b4f560000000p–5, 0x1.3444160000000p–9, –0x1.21c4fc0000000p–2, 0x1.1324de0000000p–8,

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Parameter value
–0x1.6fc7a60000000p–6,
0x1.1770880000000p–6, 0x1.abcd320000000p–15, 0x1.ab025a0000000p–9, –0x1.69ca560000000p–9, –0x1.17e9c60000000p–10, –0x1.87b26e0000000p–5, 0x1.26d7b00000000p–9, 0x1.7967780000000p–9, –0x1.dddfa60000000p–6, –0x1.31d51e0000000p–11, 0x1.28dbc20000000p–5, –0x1.f0a34c0000000p–9, –0x1.fe5e600000000p–14, –0x1.8e34840000000p–6, –0x1.a6da4c0000000p–10, –0x1.47fd440000000p–8,
–0x1.3232c20000000p–7, –0x1.de6f460000000p–17, 0x1.ccd8c60000000p–15, –0x1.1e01be0000000p–13, –0x1.65c4560000000p–10, –0x1.1382320000000p–5, –0x1.85048c0000000p–10, 0x1.b096dc0000000p–9, –0x1.36d4b20000000p–4, 0x1.bda6060000000p–6, 0x1.a820ac0000000p–6, –0x1.f54d6c0000000p–13, 0x1.1cfe700000000p–13, –0x1.5555780000000p–5, 0x1.cf99660000000p–10, –0x1.15cde80000000p–9,
0x1.6d70020000000p–8, –0x1.f393d00000000p–15, 0x1.5ca03a0000000p–12, –0x1.c293ca0000000p–13, 0x1.8272300000000p–16, –0x1.2a73c80000000p–8, –0x1.b3f7720000000p–12, 0x1.6bb13e0000000p–12, 0x1.f3d3de0000000p–7, –0x1.c03a620000000p–8, 0x1.4560ce0000000p–8, –0x1.0574280000000p–9, 0x1.c25e980000000p–13, 0x1.2c5b5c0000000p–7, –0x1.e850700000000p–14, –0x1.6952960000000p–10,
0x1.05436a0000000p–6, 0x1.229a720000000p–9, 0x1.5c89680000000p–10, –0x1.03d07a0000000p–13, 0x1.7565c40000000p–14, 0x1.1a7bea0000000p–4, –0x1.bf93500000000p–10, –0x1.1d9d140000000p–8, 0x1.24db940000000p–3, –0x1.183e580000000p–4, –0x1.5dd3e00000000p–8, –0x1.ba19fe0000000p–9, 0x1.76c2ec0000000p–13, 0x1.0074620000000p–3, –0x1.d24c100000000p–10, 0x1.48cd580000000p–9,
0x1.57b3e80000000p–7, –0x1.ae09c60000000p–12, –0x1.2703400000000p–10, 0x1.9652900000000p–10, 0x1.9918e80000000p–9, 0x1.72f5060000000p–5, 0x1.0e55ca0000000p–8, –0x1.5e03820000000p–8, 0x1.9d14ac0000000p–4, –0x1.5da8d00000000p–6, –0x1.c008200000000p–5, 0x1.899aec0000000p–10, 0x1.5c1c8e0000000p–13, 0x1.10c86a0000000p–5, –0x1.cea7a80000000p–9, 0x1.05f70e0000000p–8,
–0x1.d84bc20000000p–7, –0x1.72bda80000000p–12, 0x1.7028a20000000p–9, –0x1.2af6440000000p–9, –0x1.9034ae0000000p–8, –0x1.958a300000000p–4, –0x1.fe77280000000p–11, 0x1.28d2e80000000p–7, –0x1.95f5860000000p–3, 0x1.922b940000000p–5, 0x1.76d3040000000p–4, –0x1.ebff3e0000000p–9, –0x1.7154380000000p–12, –0x1.6660300000000p–4, 0x1.4a0cfe0000000p–8, –0x1.3059420000000p–7,
0x1.d5885a0000000p–7, 0x1.0a90780000000p–11, 0x1.76068e0000000p–9,

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Parameter value
–0x1.8f2d620000000p–10, –0x1.bd5bd60000000p–10, –0x1.e41c7c0000000p–7, 0x1.b683640000000p–9, 0x1.e6cb860000000p–11, –0x1.0cef940000000p–8, –0x1.417d000000000p–6, 0x1.e5d1820000000p–6, –0x1.8a17720000000p–9, –0x1.218aee0000000p–12, 0x1.48fd140000000p–6, –0x1.6b766a0000000p–11, –0x1.582b660000000p–9,
0x1.e08a3a0000000p–10, –0x1.6f23560000000p–11, –0x1.4ed4540000000p–10, 0x1.7043c80000000p–13, 0x1.3213a60000000p–10, 0x1.6bc5540000000p–7, 0x1.7e4b0e0000000p–10, –0x1.03ee660000000p–9, 0x1.37c9600000000p–5, 0x1.0110ac0000000p–10, –0x1.cc9fee0000000p–6, 0x1.4a8fd40000000p–11, 0x1.7581960000000p–13, –0x1.70e2de0000000p–9, –0x1.d36e520000000p–10, 0x1.505c960000000p–10,

Table B.11 Layer 1 CNN (bias parameter bias) of base decoding neural network parameter

Parameter value
–0x1.eb5fae0000000p–9, –0x1.9feb3e0000000p–10, 0x1.adfcfe0000000p–7, 0x1.09e3760000000p–10, –0x1.4e5c400000000p–8, 0x1.3030800000000p–9, 0x1.587aa60000000p–10, 0x1.1136a60000000p–9,

Table B.12 Layer 1 CNN (IGDN activation function beta parameter) of base decoding neural network parameter

Parameter value
0x1.75b7a60000000p+1, 0x1.f8ee3e0000000p+1, 0x1.c093e20000000p+1, 0x1.b223300000000p+1, 0x1.bfa5ca0000000p+1, 0x1.c8cf660000000p+1, 0x1.e3f8880000000p+1, 0x1.b99eba0000000p+1,

Table B.13 Layer 1 CNN (IGDN activation function gamma parameter) of base decoding neural network parameter

Parameter value
0x1.423ea80000000p–23, 0x1.0fbbb80000000p–20, 0x1.323ad60000000p–26, 0x1.2b173c0000000p–20, 0x1.d4079e0000000p–27, 0x1.71b1280000000p–20, 0x0.0p+0, 0x1.c2c1e60000000p–22,
0x1.e4bdec0000000p–20, 0x1.8649d60000000p–20, 0x1.0ee6240000000p–21, 0x1.b89fb80000000p–21, 0x1.54ae100000000p–21, 0x1.fe03300000000p–20, 0x1.844cf60000000p–22, 0x1.330ee00000000p–22,

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Parameter value
0x1.539eae0000000p–21, 0x1.2e78960000000p–21, 0x1.89f0cc0000000p–20, 0x1.1b027a0000000p–20, 0x1.b696820000000p–24, 0x1.e2a72c0000000p–21, 0x1.d5564a0000000p–21, 0x1.46a55c0000000p–25,
0x0.0p+0, 0x1.569d220000000p–19, 0x1.1ea8720000000p–19, 0x1.c135700000000p–20, 0x0.0p+0, 0x1.3b9fe20000000p–19, 0x1.2a67e80000000p–20, 0x1.f72f720000000p–23,
0x1.6286ca0000000p–24, 0x1.1e50920000000p–21, 0x1.09ff880000000p–20, 0x1.743d620000000p–21, 0x1.a07fac0000000p–21, 0x1.1cd0fe0000000p–23, 0x1.371da20000000p–20, 0x1.dff2c00000000p–24,
0x1.60e7c80000000p–19, 0x1.43dd440000000p–19, 0x1.1aafba0000000p–19, 0x1.9caf300000000p–20, 0x1.76cdca0000000p–20, 0x1.37c2820000000p–20, 0x1.1b7b5a0000000p–22, 0x1.60ce4a0000000p–19,
0x1.b27f140000000p–30, 0x1.5b16c60000000p–20, 0x1.3ace560000000p–25, 0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x1.e3ffb00000000p–20, 0x1.d07f2a0000000p–33,
0x0.0p+0, 0x0.0p+0, 0x1.e0580a0000000p–21, 0x0.0p+0, 0x1.f4b2e20000000p–22, 0x1.093efc0000000p–20, 0x1.ad02020000000p–20, 0x1.ad60fa0000000p–20,

Table B.14 Layer 2 CNN (convolutional kernel parameter kernel) of base decoding neural network parameter

Parameter value
–0x1.8080960000000p–1, –0x1.af34300000000p–7, –0x1.1dc0200000000p–2, 0x1.0db8120000000p–5, 0x1.3e01f40000000p–4, 0x1.3237c80000000p–3, –0x1.4519c00000000p–5, 0x1.8875fc0000000p–4,
–0x1.68d4780000000p–1, –0x1.06cbb60000000p–3, –0x1.1ac34e0000000p–2, 0x1.ef616a0000000p–3, 0x1.32e3e60000000p–3, 0x1.da977e0000000p–3, 0x1.d3c9a20000000p–3, 0x1.aa7b2e0000000p–3,
–0x1.207ae60000000p–4, 0x1.2219e20000000p–4, 0x1.acb9760000000p–4, –0x1.a4f0000000000p–2, –0x1.94c1820000000p–4, –0x1.7183d60000000p–2, –0x1.8e0bd00000000p–2, –0x1.cbbc5e0000000p–3,
0x1.c1c5a20000000p–3, –0x1.680e680000000p–3, –0x1.4dc3900000000p–5, –0x1.6eb7d80000000p–5, 0x1.234d1a0000000p–4, –0x1.fcd0940000000p–3, 0x1.8e84180000000p–3, 0x1.cd8d1c0000000p–2,

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Table B.14 (continued)

Parameter value
–0x1.ee98ba0000000p–2, 0x1.74d2a00000000p–2, 0x1.0517440000000p–8, –0x1.b1489c0000000p–3, –0x1.3056d20000000p–1, 0x1.0e99300000000p–2, –0x1.2dd36c0000000p–1, –0x1.0e6a2e0000000p–1,
–0x1.2291c60000000p–3, –0x1.2e55160000000p–3, 0x1.d3da260000000p–3, 0x1.01296a0000000p–1, 0x1.76677e0000000p–2, –0x1.d4a8200000000p–1, –0x1.54a83a0000000p–2, 0x1.31d0a00000000p–2,
0x1.1d3ec00000000p–2, 0x1.1a7bfe0000000p–4, 0x1.3e4ba60000000p–2, 0x1.58cb4c0000000p–1, –0x1.be652c0000000p–2, 0x1.03497c0000000p–2, 0x1.0c41860000000p–4, –0x1.42167a0000000p–3,
0x1.181dac0000000p–2, –0x1.2f9db60000000p–4, –0x1.1ee1f40000000p–3, –0x1.aa883c0000000p–1, 0x1.2a88e00000000p–3, –0x1.a4ad000000000p–3, 0x1.c424ea0000000p–6, 0x1.2cd3160000000p–3,
0x1.ebcf2a0000000p–4, 0x1.09e1d20000000p–1, –0x1.2fb1bc0000000p–2, 0x1.4d2f420000000p–5, –0x1.7cb27c0000000p–2, 0x1.bda4be0000000p–4, –0x1.9ffd380000000p–3, 0x1.b32a620000000p–2,
–0x1.5ba4ec0000000p–3, –0x1.43d97a0000000p–4, 0x1.1ee4fe0000000p–5, –0x1.dac2b20000000p–4, 0x1.8a33e80000000p–2, –0x1.13d6740000000p–2, 0x1.e9bf800000000p–2, –0x1.79d25e0000000p–1,
–0x1.d6520e0000000p–3, –0x1.095d6e0000000p–2, 0x1.32106e0000000p–4, 0x1.3ce10c0000000p–4, –0x1.7468e00000000p–1, –0x1.0463500000000p–1, 0x1.63b5e60000000p–2, –0x1.53df8e0000000p–5,
0x1.df30d40000000p–3, –0x1.0aa7b60000000p–3, –0x1.c6243e0000000p–1, 0x1.5628e00000000p–4, –0x1.606d3e0000000p–2, –0x1.72e9500000000p–2, 0x1.e2d9b00000000p–4, –0x1.895dba0000000p–3,
0x1.6e2d2a0000000p–2, –0x1.a606800000000p–2, –0x1.74de1c0000000p–2, 0x1.601aec0000000p–3, 0x1.b70ca20000000p–3, 0x1.1e1d5c0000000p–2, –0x1.196e640000000p–1, –0x1.ea98820000000p–3,
–0x1.0401800000000p–3, 0x1.1a0c260000000p–1, –0x1.016c140000000p–3, 0x1.d58bb20000000p–4, 0x1.9967ca0000000p–2, 0x1.a8e3540000000p–4, 0x1.fd6cc80000000p–3, 0x1.76fb920000000p–3,
0x1.0c56f20000000p–4, 0x1.e9de5c0000000p–2, –0x1.45d4aa0000000p–3, –0x1.30c3500000000p–8, –0x1.37da420000000p–2, –0x1.5d21980000000p–2, 0x1.cf72860000000p–3, 0x1.77bb6c0000000p–3,

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Parameter value
0x1.915e400000000p–3, 0x1.74ecf80000000p–1, –0x1.1f2a360000000p–2, 0x1.2aff840000000p–4, 0x1.cd33e40000000p–2, –0x1.438fee0000000p–3, 0x1.5486b20000000p–4, –0x1.eec7a20000000p–2,
0x1.373a040000000p–4, –0x1.ae6ab40000000p–3, –0x1.25897e0000000p–5, –0x1.5437fe0000000p–7, 0x1.c309020000000p–6, 0x1.b0fcfc0000000p–5, –0x1.0f23200000000p–3, –0x1.2679520000000p–3,
–0x1.bdc3220000000p–6, 0x1.a39eb40000000p–17, –0x1.986b960000000p–5, 0x1.fdee220000000p–9, –0x1.3891ec0000000p–8, 0x1.931a540000000p–7, 0x1.cb77380000000p–5, 0x1.2271300000000p–4,
–0x1.1e5d600000000p–6, –0x1.f977400000000p–4, –0x1.ce4b0a0000000p–5, 0x1.5189860000000p–7, 0x1.c9fd7c0000000p–7, 0x1.3289980000000p–4, –0x1.0e84da0000000p–8, 0x1.2ff7920000000p–4,
0x1.29f4480000000p–5, –0x1.ac52340000000p–5, –0x1.dd0e2a0000000p–4, 0x1.4dba520000000p–6, 0x1.b02ef20000000p–4, 0x1.fe13f00000000p–5, –0x1.54f1560000000p–6, –0x1.b37cf80000000p–5,

Table B.15 Layer 2 CNN (bias parameter bias) of base decoding neural network parameter

Parameter value
0x1.7c47e60000000p–8, –0x1.7c8f440000000p–8, 0x1.3c2ee60000000p–7, 0x1.5192020000000p–8,

Table B.16 Layer 2 CNN (IGDN activation function beta parameter) of base decoding neural network parameter

Parameter value
0x1.f377ac0000000p+3, 0x1.33e7f40000000p+4, 0x1.116c040000000p+4, 0x1.33c9640000000p+4,

Table B.17 Layer 2 CNN (IGDN activation function gamma parameter) of base decoding neural network parameter

Parameter value
0x1.8d38dc0000000p–24, 0x0.0p+0, 0x1.87aa380000000p–21, 0x1.86341c0000000p–34,
0x0.0p+0, 0x1.aff7280000000p–24, 0x0.0p+0, 0x0.0p+0,

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Parameter value
0x1.b5a80c0000000p–29, 0x0.0p+0, 0x0.0p+0, 0x1.14e17c0000000p–30,
0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x1.40acb60000000p–22,

Table B.18 Layer 3 CNN (convolutional kernel parameter kernel) of base decoding neural network parameter

Parameter value
–0x1.b8e81e0000000p–3, –0x1.5958ce0000000p–5, –0x1.1584300000000p–2, –0x1.8a80b40000000p–2,
0x1.0494b00000000p–1, –0x1.f36b9e0000000p–2, 0x1.dd89840000000p–1, 0x1.ff75620000000p–1,
–0x1.5c91720000000p+0, –0x1.05b4b40000000p–2, 0x1.3ad1ee0000000p–1, –0x1.36be5e0000000p–2,
0x1.a9fa840000000p–1, –0x1.9be53c0000000p+0, 0x1.c2e5120000000p–7, –0x1.e7ea940000000p–2,
0x1.6053300000000p–1, 0x1.283cd00000000p–1, 0x1.78c36a0000000p–1, –0x1.973f980000000p–1,
–0x1.a0ce1c0000000p–7, –0x1.9b70f60000000p–3, 0x1.a71f340000000p–2, –0x1.88e55a0000000p–2,
0x1.57e9a40000000p–5, –0x1.63deb60000000p–3, –0x1.a95f460000000p–5, 0x1.0bfc700000000p–3,
0x1.a008a20000000p–4, –0x1.5de1f80000000p–7, –0x1.2492880000000p–2, 0x1.2f429e0000000p–2,
–0x1.629b440000000p–3, 0x1.57a2a40000000p–8, 0x1.c4069e0000000p–5, 0x1.19454e0000000p–2,
0x1.2414120000000p–4, –0x1.87f62e0000000p–5, –0x1.53d83c0000000p–4, 0x1.38ac100000000p–5,

Table B.19 Layer 3 CNN (bias parameter bias) of base decoding neural network parameter

Parameter value
–0x1.49a5f80000000p–4, –0x1.6ea38e0000000p–5,

Table B.20 Layer 3 CNN (IGDN activation function beta parameter) of base decoding neural network parameter

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Parameter value
0x1.03ca7e0000000p+8, 0x1.38580e0000000p+8,

Table B.21 Layer 3 CNN (IGDN activation function gamma parameter) of base decoding neural network parameter

Parameter value
0x1.ebbe640000000p–34, 0x1.5e6fec0000000p–36,
0x0.0p+0, 0x0.0p+0,

Table B.22 Layer 4 CNN (convolutional kernel parameter kernel) of base decoding neural network parameter

Parameter value
–0x1.04527a0000000p+1, –0x1.4c0b340000000p–4,
0x1.a286c20000000p–4, –0x1.872ccc0000000p+0,
–0x1.3a54b80000000p–3, 0x1.295ea60000000p–7,
0x1.2f833a0000000p–2, 0x1.dae1dc0000000p–2,
0x1.ebc0880000000p–9, –0x1.cf3be20000000p–4,

Table B.23 Layer 4 CNN (bias parameter bias) of base decoding neural network parameter

Parameter value
0x1.a12a9e0000000p–2,

Table B.24 mcILD code table

Index	Index value
0	1.777777778
1	0.750000000
2	0.562500000
3	3.200000000
4	5.333333333
5	0.812500000
6	1.066666667

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Index	Index value
7	4.000000000
8	0.187500000
9	1.142857143
10	0.437500000
11	1.454545455
12	0.125000000
13	0.625000000
14	2.285714286
15	0.500000000
16	16.00000000
17	2.000000000
18	0.875000000
19	0.250000000
20	1.333333333
21	0.375000000
22	1.600000000
23	8.000000000
24	0.687500000
25	0.062500000
26	1.230769231
27	0.312500000
28	0.937500000
29	2.666666667

Table B.25 Dimension 1 Huffman codebook tnsCodingTable0 for TNS reflection coefficient quantization indexes

Index	Codeword	Number of bits
1	4053	12
2	1012	10
3	507	9
4	127	7

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Index	Codeword	Number of bits
5	30	5
6	0	3

Table B.25 (continued)

Index	Codeword	Number of bits
7	1	3
8	2	3
9	2	2
10	3	3
11	6	3
12	14	4
13	62	6
14	252	8
15	2027	11
16	8105	13

Table B.26 Dimension 2 Huffman codebook tnsCodingTable1 for TNS reflection coefficient quantization indexes

Index	Codeword	Number of bits
1	15360	15
2	7681	14
3	3841	13
4	961	11
5	241	9
6	61	7
7	14	5
8	2	3
9	2	2
10	3	2
11	0	2

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Index	Codeword	Number of bits
12	6	4
13	31	6
14	121	8
15	481	10
16	1921	12

Table B.27 Dimension 3 Huffman codebook tnsCodingTable2 for TNS reflection coefficient quantization indexes

Index	Codeword	Number of bits
1	27136	15
2	27137	15
3	3393	12
4	425	9
5	107	7
6	52	6
7	12	4
8	7	3
9	0	1
10	2	2
11	27	5
12	213	8
13	849	10
14	1697	11
15	6785	13
16	27138	15

Table B.28 Dimension 4 Huffman codebook tnsCodingTable3 for TNS reflection coefficient quantization indexes

Index	Codeword	Number of bits
1	8708	14
2	8709	14

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Index	Codeword	Number of bits
3	8710	14
4	1089	11
5	273	9
6	137	8
7	35	6
8	5	3
9	0	1
10	3	2
11	9	4
12	16	5
13	69	7
14	545	10
15	8711	14
16	4352	13

Table B.29 Dimension 5 Huffman codebook tnsCodingTable4 for TNS reflection coefficient quantization indexes

Index	Codeword	Number of bits
1	4100	14
2	4101	14
3	4102	14
4	257	10
5	65	8
6	17	6
7	5	4
8	0	2
9	1	1
10	3	3
11	9	5
12	33	7
13	129	9

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Index	Codeword	Number of bits
14	513	11
15	4103	14
16	2048	13

Table B.30 Dimension 6 Huffman codebook tnsCodingTable5 for TNS reflection coefficient quantization indexes

Index	Codeword	Number of bits
1	8272	14
2	8273	14
3	2069	12
4	516	10
5	128	8
6	65	7
7	17	5
8	5	3
9	0	1
10	3	2
11	9	4

Table B.30 (continued)

Index	Codeword	Number of bits
12	33	6
13	259	9
14	1035	11
15	8274	14
16	8275	14

Table B.31 Dimension 7 Huffman codebook tnsCodingTable6 for TNS reflection coefficient quantization indexes

Index	Codeword	Number of bits
1	13312	14

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Index	Codeword	Number of bits
2	13313	14
3	3329	12
4	833	10
5	209	8
6	53	6
7	12	4
8	2	2
9	0	1
10	7	3
11	27	5
12	105	7
13	417	9
14	1665	11
15	13314	14
16	13315	14

Table B.32 Dimension 8 Huffman codebook tnsCodingTable7 for TNS reflection coefficient quantization indexes

Index	Codeword	Number of bits
1	10490	14
2	2625	12
3	657	10
4	165	8
5	83	7
6	21	5
7	4	3
8	3	2
9	10497	14
10	0	1
11	11	4
12	40	6

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Index	Codeword	Number of bits
13	329	9
14	1313	11
15	10498	14
16	10499	14

Table B.33 TNS reflection coefficient scalar quantization codebook tnsCoeff4

Index	Codeword
1	–0.9957341763
2	–0.9618256432
3	–0.8951632914
4	–0.7980172227
5	–0.6736956436
6	–0.5264321629
7	–0.3612416661
8	–0.1837495178
9	0.0000000000
10	0.2079116908
11	0.4067366431
12	0.5877852523
13	0.7431448255
14	0.8660254038
15	0.9510565163
16	0.9945218954

Table B.34 Stage 1 first sub-vector codebook lsf_stage1_CB1_hbr of high-precision LSF vector quantization codebook

Index	Codeword
1	12.532774, –294.914795, –839.115295, –1283.263306, –1366.740234 –1291.976929, –889.037109, –662.501465, –394.010132
2	7.659530, 64.449364, –429.962616, –159.504883, –127.081932 –528.241577, –898.911499, –1261.207764, –1585.741333

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Index	Codeword
3	–265.316223, –1177.764160, –1719.669189, –2321.858154, –2539.730713 –1376.201050, –393.688843, –135.207047, 153.807602
4	–429.040771, 1138.646240, 1062.909912, 1183.278198, 1069.893311 1066.192871, 987.967041, 938.215393, 848.846802
5	–259.962219, –841.635864, –792.817505, –1015.578674, –1039.584106 –1190.869629, –1251.823975, –1344.401611, –1400.721069
6	–255.383240, –340.604065, –225.726089, –194.386597, –82.405243 –87.643135, 83.903320, 127.325462, 214.289505
7	–292.835663, –1187.095581, –1540.663330, –946.716309, –604.317749 –340.563690, –148.200073, –110.725548, –88.781868
8	–66.158363, 288.254822, 52.301933, –176.605835, –372.656982 –638.140747, –765.024902, –1038.674561, –1158.282227
9	–294.390991, –419.236633, 164.241470, 72.962151, 184.964706 –5.999948, 18.262583, –294.669708, –360.836609
10	–354.790070, –980.296875, –664.455078, 154.531082, 347.748291 –81.605064, –166.168503, –575.064392, –619.221313
11	–51.074921, –590.091919, –995.163879, –1449.023193, –1636.229980 –1833.939575, –2052.215088, –2393.046387, –2492.594238
12	–756.212219, 607.650330, 1362.533325, 1448.326538, 1708.366821 1743.075806, 1864.355957, 1851.665405, 1904.776489
13	–268.823273, –670.716125, –729.266479, –1178.513184, –717.594543 1188.218018, 973.420044, 669.331726, 253.003632
14	–380.711853, –880.759583, 437.412231, 377.531342, 279.782745 –164.422226, –350.319489, –689.558228, –759.321899
15	199.626038, 259.191193, –255.783997, –712.039185, –1172.695801 –1557.458618, –1920.221191, –2091.199219, –2199.324707
16	–45.761089, 121.817169, –221.829346, –605.307129, 50.221458 –352.458374, –718.818115, –1095.817383, –1017.988525
17	–324.111664, –1289.777954, –1839.569458, –2347.638672, –1012.049316 –69.315178, 187.488708, 379.120422, 501.824005
18	–297.901764, –1236.970581, –1812.303833, –2200.946045, –986.018372 –547.798462, –307.574707, –199.468140, –167.143997

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Table B.34 (continued)

Index	Codeword
19	–107.839973, –595.928772, –649.595825, –1203.271484, –417.419617 –843.091003, –1060.114380, –1251.820312, –790.997131
20	–202.438538, –1077.976929, –1395.944458, –1834.929443, –1851.974121 –475.270538, 147.567062, 405.381622, 628.118896
21	–140.992111, –243.299820, –374.084686, –761.737305, 379.897888 146.736359, –218.489792, –693.225525, –1122.441040
22	298.091644, 165.684982, –229.728912, –676.614502, –41.712887 –241.386246, –313.544312, –564.628601, –634.669128
23	–339.094910, –932.599060, –810.994873, –1159.873413, –139.622528 –477.156525, –791.750977, –613.249939, 193.185974
24	192.596329, –448.119476, –199.818085, –711.967346, –599.650146 –906.385376, –844.235535, –1146.109009, –1127.517456
25	–153.114761, –477.945557, –842.755737, –1287.280884, –868.664062 –659.642517, –409.744415, –252.595947, –137.149399
26	468.480865, 188.345016, –232.100403, –407.251648, –446.181030 –654.295837, –737.947449, –982.220154, –1033.285034
27	–127.511642, –746.018372, –1140.810181, –1449.175049, –1522.306641 –1604.072266, –1617.172607, –1747.286011, –1815.891724
28	–670.408997, 573.691101, 818.152100, 1135.519531, 1336.889160 1511.981445, 1608.480469, 1687.401001, 1774.689819
29	167.956970, 304.036682, –168.396362, –614.536133, –1020.216125 –1307.400024, –1464.742065, –1539.064941, –1679.836670
30	–286.643921, –820.866394, –919.530457, –1296.737915, –321.350098 –247.957581, –74.895782, –46.720711, –16.407169
31	177.128052, –597.696228, –1405.832397, –661.515259, –1250.172363 –1315.480957, –1228.537109, –1394.990479, –1568.131226
32	–110.358360, 228.341812, –54.777168, –180.577560, 17.660156 –109.016502, –293.451660, –733.721802, –1050.250854
33	–155.538376, –889.169373, –1357.671143, –1947.136353, –2360.618164 –2616.920898, –2678.006104, –2436.539795, –1598.749878
34	–243.543640, –406.297119, –323.730835, –427.441620, –504.955658 –723.262573, –574.874329, –697.197388, –441.316406
35	–248.952698, –476.071716, –109.808342, –350.722839, 1045.941162 772.961060, 494.033112, –5.088210, –161.959808

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Index	Codeword
36	151.197754, –438.898071, –938.110779, –479.895996, –675.861450 –705.350769, –794.681152, –874.259277, –977.368958
37	228.726776, –288.248199, –45.990913, –358.880219, –273.076996 –574.781677, –553.036743, –901.941895, –933.009277
38	76.154396, –272.780579, –790.993469, –1419.796875, –1771.096313 –1205.924927, –1421.059082, –1131.960205, –634.587891
39	–176.957001, –998.468262, –1355.086548, –1801.816040, –1972.916626 –2021.075684, –1891.074829, –1003.528870, –271.320404
40	–318.367218, –1027.510376, –1053.401367, –1400.671631, –688.487488 –59.555279, 173.477051, 293.360443, 413.468353
41	–31.048168, –539.577820, –779.418274, –1198.360352, –1667.825073 –1355.676392, –248.139374, –578.224731, –848.542908
42	243.113541, –271.529938, 75.644211, –120.757767, –23.166691 –275.094727, –270.071869, –566.301392, –527.317078
43	209.083649, –86.944138, –171.801407, –309.664154, –601.843628 –1093.211426, –1161.305298, –629.750732, –553.044739
44	50.228077, 260.481262, –176.737579, –563.293579, –836.673584 –983.849121, –900.034058, –1054.167847, –1024.612671
45	–217.254745, –1059.019897, –1551.903564, –2159.453125, –2555.874512 –2660.438965, –1700.472412, –939.193237, –491.305817
46	–109.810867, –139.434006, –212.173462, 189.489395, 433.778625 328.265594, 316.352631, 29.588856, –62.139759
47	–122.472839, –77.221489, –139.844727, –493.818024, –217.068741 444.526581, 186.679306, –248.982697, –697.615417

Table B.34 (continued)

Index	Codeword
48	–283.886810, –634.963989, –187.824463, –160.884415, 225.083527 –196.268967, –448.745483, –961.819641, –1293.330566
49	–205.688416, –818.517212, –1049.939453, –1471.114380, –1637.467896 569.867554, 289.272095, 33.614040, –107.433998
50	–470.968445, 74.234940, –189.621552, 93.866119, 712.355530 1110.288940, 1314.786499, 1475.519287, 1557.706787
51	–258.598328, –1029.964111, –1337.363525, –1035.258911, –921.234985

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Index	Codeword
	–896.027100, –776.560547, –744.058167, –680.859985
52	–304.905701, –1248.585083, –1799.832031, –2462.894287, –2100.090576 –516.581787, –119.507423, 130.499710, 273.351562
53	234.289627, 1074.261353, 614.698914, 125.832085, –265.399841 –442.323151, –487.567566, –416.854156, –340.315491
54	125.100708, –360.461273, –764.823303, –1421.218750, –967.333435 –1095.811401, –1196.823486, –1400.642334, –1383.499878
55	–133.548233, –617.994385, –312.143127, –710.831909, 79.074684 –298.849487, –592.688049, –1062.510376, –562.840149
56	–468.169861, 1446.408569, 1413.416870, 1576.199707, 1347.820801 1305.200928, 1179.695923, 1049.632812, 898.322266
57	–274.492950, –345.295959, –346.863892, –393.565643, –159.954437 –288.083282, –280.803223, –615.538269, –798.523987
58	414.343719, –33.507385, –560.052307, –877.893921, –936.769043 –889.978210, –848.494446, –983.392456, –1004.623169
59	–127.857430, 10.724673, –503.393402, –1047.103760, –1597.348145 23.368412, 119.567314, –27.045931, –122.189880
60	50.129940, –513.716614, –175.773712, –814.073059, –183.152222 –398.482635, –736.121338, –1233.094971, –1505.156860
61	–192.924240, –1000.330994, –1506.831055, –2159.660400, –2665.731934 –3122.868652, –3047.991943, –1299.960693, –665.220581
62	–229.910477, 371.929138, 198.593094, 147.880417, 147.134155 59.440495, 74.496574, –130.838730, –153.672745
63	31.351290, –454.428986, –421.578094, –1073.841797, –293.511871 –674.466675, –667.398499, –510.883423, –513.513489
64	1165.111938, 1601.962036, 1369.250000, 1091.164673, 806.724060 592.549011, 437.339203, 274.545990, 130.017639
65	–391.330902, –1148.816284, –703.030945, –919.529114, –682.469421 –552.763611, –389.571045, –372.423248, –269.741028
66	–415.906036, –1370.143433, –467.918060, 400.263123, 538.698425 626.269958, 628.958679, 609.006653, 555.666260
67	–211.888199, –304.512207, –574.377808, –763.588745, –798.061340 –969.718689, –1008.344788, –1133.811157, –1208.669189
68	387.929260, –384.363983, –491.873169, –1177.873779, –2040.045410 –2299.358643, –879.417908, –600.336487, –538.996033

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Index	Codeword
69	–194.664413, –432.293304, –354.330627, –721.107178, 220.619720 –28.813951, –13.943194, –279.962128, –211.170929
70	–254.518509, –1089.525269, –1553.118164, –1953.478149, –1708.065063 –1163.100708, –875.388916, –675.993652, –554.956543
71	45.468208, –177.159286, –486.094971, –971.243835, –326.891663 –774.877563, –1253.826904, –1702.123291, –1697.666016
72	–617.304138, 1302.192261, 1183.291016, 1409.274414, 1356.658203 1509.198608, 1565.556396, 1796.875854, 2312.282715
73	–318.085754, –294.912109, –243.064804, 294.789520, 587.472717 685.794067, 779.710144, 827.043884, 850.107422
74	–675.562988, 1130.372803, 1039.005249, 1216.456055, 1123.337158 1227.838257, 1186.562622, 1320.220581, 1376.252319
75	–155.287216, –653.789795, –979.381104, –1584.975708, –907.041931 –791.481995, –893.957764, –690.019653, –588.572449
76	1085.995117, 433.405426, 23.847609, –363.684875, –394.045135 –519.063965, –459.017670, –605.080383, –566.073059

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78	–157.645782, –441.672302, 196.467331, –31.353685, –266.225250 –728.974548, –1055.533203, –1360.301636, –1394.537109
79	–302.830658, –981.803101, –1199.857910, –1471.296997, –406.638672 –282.785950, –374.713959, –592.583313, –744.692444
80	–414.440247, –1089.211548, –650.316528, –1022.616089, –497.021057 257.376678, 508.734467, 967.452759, 1139.718262
81	629.385315, 46.781452, –475.762695, –1036.605469, –1335.133911 –1327.513062, –1000.840942, –768.826721, –775.389404
82	–14.132797, 483.183777, 1040.778809, 889.231567, 552.954224 70.982803, –318.060852, –793.120911, –1011.159302
83	135.842896, 114.402382, –402.932617, –912.733643, –456.571472 –654.064758, –907.594116, –1166.712891, –1294.101074
84	–405.660950, 650.800964, 390.291229, 402.028564, 397.279541

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86	–505.712128, –1306.856934, –302.960205, –50.899620, 724.131470 892.069763, 1116.432861, 1241.490356, 1347.699341
87	–185.285233, 637.581787, 570.410583, 573.242920, 520.846680 458.776489, 506.174042, 430.875732, 434.773529
88	1638.158081, 1885.557617, 1226.245117, 752.522339, 329.570221 –7.930009, –429.244537, –698.395142, –824.893433
89	67.108162, 145.657013, –310.819153, –690.611633, –588.102966 –149.363922, –405.786072, –809.160034, –1272.879028
90	–585.281555, 595.188293, 708.387085, 891.753052, 958.253723 1118.726318, 1189.508423, 1320.166870, 1432.868286
91	–149.615555, –240.052521, –648.237000, –988.918823, –466.479462 –76.178154, –229.023560, –486.511444, –608.023254
92	–430.823914, –1171.099731, –536.025940, –441.452942, 255.522385 338.995361, 481.303986, 464.989960, 568.602966
93	–324.765167, –1047.405151, –1045.352539, –363.335541, –84.914948 –66.833885, 30.027208, –15.760809, 12.066683
94	–175.676392, –408.857758, –583.354431, –648.645386, –479.757019 –418.775604, –267.904999, –147.864532, –25.590437
95	–208.584457, –939.634705, –1357.809814, –1543.731812, –1245.787964 –1208.176758, –1149.390625, –1191.954224, –1206.649658
96	–104.840843, 131.496292, –209.161987, –429.285919, –443.612244 190.636688, 472.597717, 768.328491, 861.614197
97	–407.797485, –1443.926514, –1661.918823, 207.416931, 534.250854 731.394470, 835.406738, 833.161926, 767.225098
98	1845.772217, 1309.853271, 668.536926, 343.226593, 143.572464 –49.394199, –113.645187, –29.705999, 13.073053
99	56.131977, –152.148804, –464.899872, –1033.450439, –1184.909790 –460.081299, –810.854675, –1229.766235, –1627.935913
100	–452.430084, –1235.425537, –176.435577, –54.552139, 201.717514 89.107384, 104.389801, –15.340947, 55.963818
101	–294.794617, –982.590759, –1157.254761, –1552.222290, –1173.347168 –776.471863, –508.820099, –345.842194, –264.661591

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Index	Codeword
102	422.903564, –77.037788, –533.205566, –1148.150024, –1583.096802 –1563.172607, –1482.618774, –1418.075928, –1232.485107
103	349.948730, –169.888306, –473.498138, –799.142944, –1174.529297 –1534.228882, –856.638062, –1243.882568, –1346.036865
104	331.781677, –83.041771, –525.813416, –1026.352173, –1185.363159 –1167.713379, –1430.438721, –1703.381348, –1894.847290
105	–163.386047, –482.613098, –367.271667, –620.273438, –823.262390 –1089.952515, –1272.664673, –1561.849487, –1797.645264

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106	–94.470627, –55.125443, –547.598450, –970.332947, –1201.722412 –1190.345947, –1261.533813, –1256.466187, –1336.214600
107	–280.255554, –122.187737, 222.988007, –0.161418, –149.800110 –457.114594, –539.179016, –763.223145, –744.701721
108	–226.694626, 146.819641, 99.686066, 156.132889, 264.517853 255.099182, 390.046783, 413.388489, 484.449554
109	–193.396912, –668.117432, –935.539307, –1391.381470, –1675.302490 257.404022, 755.294250, 780.717102, 659.994995
110	–351.291901, –1336.534912, –1761.683838, –812.096375, 147.030319 253.470673, 430.642029, 409.021210, 470.170197
111	–334.503387, –847.869446, –543.447876, –818.843140, –453.180328 –681.399109, –369.549103, –800.736877, –985.739807
112	–169.888916, 188.977081, 38.719604, –193.778885, 663.089172 407.570740, 102.907455, –395.730255, –696.857788
113	–597.549011, 11.597784, 173.840820, 871.852783, 1169.863525 1430.254272, 1538.062988, 1649.076782, 1709.838135
114	110.810623, –260.302307, –717.694092, –1216.236084, –1650.935913 –1598.782959, –1049.980835, –991.954529, –953.349915
115	–149.068253, –724.761475, –1071.322144, –1674.264038, –2245.992676 –310.163513, –453.569458, –402.124115, –212.454956
116	–53.550934, –631.069824, –720.459900, –1071.667725, –1272.118164 –1691.381958, –1747.413452, –887.452759, –563.786804

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Index	Codeword
117	93.887642, –169.664261, –540.245117, –1219.269531, –823.180481 –1033.660400, –1287.411987, –699.180481, –743.583679
118	106.536568, 131.629593, –247.396606, –506.335999, –527.198425 –326.019135, 14.460602, 319.439056, 400.146210
119	345.794647, –128.985657, –553.267151, –1045.432983, –1151.686646 –834.284668, –627.922363, –414.898682, –315.911713
120	16.523335, –81.917313, –481.277618, –28.254915, 41.456417 –76.575104, –110.086128, –321.329346, –374.198547
121	25.006420, 2178.584473, 2119.460693, 1804.463623, 1368.770874 973.360657, 580.718323, 271.132294, 10.037239
122	–207.521225, –389.666595, –658.753906, –1088.745239, –147.729385 –409.515961, –591.869751, –895.262207, –1240.875854
123	431.983582, 279.939575, –40.320492, –317.882599, –521.578796 –840.770447, –1032.591431, –1336.981812, –1490.085083
124	–6.341250, 951.111572, 1478.494995, 1295.491821, 970.222351 504.117615, 163.589752, –330.766846, –542.744446
125	–275.387726, –907.883240, –428.596405, –844.338684, –750.426392 520.789246, 191.068069, –101.187233, –342.247009
126	–66.128357, –356.209076, –771.646179, –1201.168701, –840.965698 –289.156830, 20.764372, 132.631866, 253.929382
127	566.312805, 529.282288, 382.089203, 246.211899, 92.596085 –190.611786, –343.605133, –657.513916, –751.330872
128	–89.353828, –615.056641, –164.835449, –727.441833, –718.769043 95.425873, –281.069977, –664.238403, –1059.275757
129	–246.166534, –842.018738, –1040.614258, –406.870605, –277.347656 –449.857819, –463.342133, –622.325012, –565.881592
130	–326.831329, –787.752136, –173.408951, –412.883850, 580.736755 336.680817, 40.913807, –444.342743, –772.719482
131	9.320523, 332.287872, 385.677032, 785.866394, 891.927979 525.718018, 197.978317, –313.102997, –582.461182
132	929.624023, 297.050354, –158.697464, –666.646606, –876.853760 –1016.439880, –1018.763245, –1223.214111, –1140.760864
133	140.714645, –163.534546, –663.564331, –1197.529541, –1644.409424 –1826.487671, –1873.009277, –1903.410522, –1918.154663

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134	129.709396, 1713.367920, 1161.276245, 707.854980, 299.398163 162.641678, –26.087206, –77.141838, –171.849213

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137	–161.529800, –873.052002, –820.817627, –1312.994629, –1011.838318 –781.103821, –1038.130737, 533.575745, 471.384552
138	–374.898529, –888.264526, –167.955841, –273.180542, –202.054932 –368.927612, –237.626297, –390.566956, –269.131531
139	194.377274, 436.584747, 307.389587, 374.059601, 419.120728 301.247375, 322.779480, 77.648521, 34.339844
140	–77.034248, 685.388672, 415.089294, 122.450302, –161.383041 –452.515381, –613.104004, –873.833557, –951.395569
141	–386.433350, –1145.266479, –1259.791016, –1136.691406, 545.907166 747.837524, 923.854492, 916.237183, 975.617310
142	–247.674072, –890.098083, –707.935608, –1260.291138, –1387.769531 –469.448212, –107.897461, 29.525518, 187.592911
143	75.124016, –594.743408, –319.550049, –1086.576904, –1389.873901 –1009.383911, –1102.857422, –1238.913208, –1034.670898
144	–213.455551, –1097.307861, –1620.846313, –2178.167725, –2369.833252 –1891.464478, –1046.413208, –597.500854, –269.395081
145	–120.505707, –545.911987, –856.895325, –1281.255371, –1845.679321 –1432.887329, 619.328125, 417.883484, 233.810257
146	–15.592245, –329.802032, –900.705811, –1522.858643, –2115.699707 –2749.846924, –3296.389648, –3688.250977, –3953.603027
147	–82.807320, –749.621643, –1257.475830, –1907.140503, –2538.343750 –3129.432129, –3701.928955, –3864.471191, –1477.994141
148	–452.950867, –441.102600, 869.980042, 831.790283, 1031.825684 875.656311, 909.180115, 737.284363, 744.969055
149	–148.392014, –888.583252, –1215.410522, –1655.602417, –2103.372803

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151	–256.370544, –1082.097290, –1411.395996, –1818.622192, –1726.187256 –1003.165771, –337.975769, –137.042953, 38.859200
152	–366.040039, –1343.038208, –1263.489624, –12.731862, 325.425690 409.669739, 441.824127, 415.941864, 374.911804
153	–112.508049, 54.832523, 231.882675, 534.124878, 808.231689 746.702209, 716.196777, 473.386963, 386.079987
154	–375.002533, –1194.725464, –1038.355469, –1037.824829, –11.491217 117.387360, 292.925751, 285.436829, 373.991669
155	–110.031464, 402.007935, 218.209946, 103.379486, 8.490447 –179.653946, –258.198151, –527.337402, –586.289978
156	97.160622, 1709.108643, 1261.806885, 869.773987, 438.982056 32.777740, –373.052063, –746.220032, –967.538818
157	–47.745808, 137.209152, 168.656677, 88.941284, –78.959335 –387.421143, –421.709259, –261.284119, –19.217987
158	525.404297, 244.304626, –157.482239, –522.035645, –503.885803 –472.361633, –211.423141, –210.994324, –100.604553
159	–64.922203, –577.785645, –692.792053, –977.476746, –1072.638306 –1360.974854, –1721.664429, –2073.228027, –2290.486816
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161	–171.140884, –654.061401, –598.868103, –1201.529785, –1382.656372 –849.022766, –794.400818, –573.129028, –378.523499
162	1585.175171, 1531.839478, 1551.516235, 1452.569946, 1442.305908 1338.680786, 1311.629150, 1214.936279, 1141.125244
163	–15.817514, –411.485168, –394.904633, –753.658813, –597.352112 –668.474182, 116.694031, –271.499939, –593.399780

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166	396.746063, 360.242676, 2.003803, –101.434189, –69.522614 –177.138092, –174.745331, –394.647644, –427.269562
167	–199.146637, –455.867065, –788.567322, –982.193665, –794.411926 –802.438049, –647.405396, –676.345154, –567.256836
168	–431.786865, 62.282070, 216.347824, 678.388000, 795.189697 954.403870, 1031.630981, 1167.656860, 1262.549561
169	708.548950, 192.753342, –206.201889, –693.366821, –838.465393 –1190.832153, –358.575958, –655.519409, –667.919006
170	–24.659691, 646.923035, 357.575531, 42.665451, –318.174011 –703.991577, –1065.087036, –1389.942993, –1617.854614
171	–457.514343, 523.834534, 812.696045, 919.779358, 959.375000 926.008667, 893.313049, 813.890991, 772.358887
172	–252.229111, –205.577118, –99.335968, –261.883484, 477.315582 0.361599, –358.287689, –819.807617, –474.220642
173	–53.019951, –151.925522, –92.089211, 110.928047, –146.320724 –725.104370, –78.699577, –230.563110, –788.255493
174	–165.916931, –780.054993, –682.217590, –808.404785, –1022.207703 –1302.715820, –362.507385, –233.079498, –63.115982
175	–293.424652, –879.620972, –768.047363, –469.037689, –368.898315 –681.270874, –910.819763, –1210.304688, –1444.320190
176	–70.139114, –411.455475, –836.225708, –1157.311279, –1184.458862 –1145.269043, –1037.999146, –1040.423218, –917.642273
177	458.907898, 239.671219, –274.590546, –997.059631, –456.334076 –879.237061, –834.715515, –929.808228, –453.293610
178	–201.639328, –373.349304, –552.528625, –328.857635, 297.073822 401.934570, 530.450989, 488.733856, 495.095428
179	368.688141, 1257.926880, 814.361023, 495.116058, 46.022434 –361.370819, –752.548462, –1097.315186, –1236.272583

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182	2364.062988, 2268.497803, 1553.899414, 1021.092712, 683.231995 391.977448, 151.044174, 16.674553, –95.852577
183	–118.223747, –668.176819, –1049.796265, –1510.749268, –1862.077271 –1833.617554, –1126.837524, –915.571106, –646.829102
184	81.282196, –137.213165, –536.142334, –1273.106079, –744.081238 –1123.636353, –557.924438, –875.544250, –944.424561
185	–146.028366, 965.887390, 669.985779, 441.832611, 227.827728 –48.675701, –282.892731, –611.419556, –752.563721
186	–215.103439, –891.118774, –1128.932861, –1478.110840, –1518.857300 –1391.129761, –784.654297, –464.452179, –218.385284
187	–104.318695, –755.709900, –1227.947144, –1774.801636, –2108.293213 –2460.826416, –2636.740479, –2869.123779, –2697.159424
188	374.387817, 305.442200, 17.710152, –78.148804, –160.953735 –425.886536, –515.567261, –755.588318, –765.299072
189	–25.625576, 344.318176, –43.530491, –324.637817, –482.693909 –559.479553, –535.363708, –679.792480, –645.745972
190	–722.385986, 1108.328003, 1432.110596, 1615.616211, 1747.338501 1839.730713, 1887.988037, 1897.838745, 1882.956177
191	–216.053711, –774.596313, –807.091064, –1286.393799, –868.596130 –644.140198, –719.721497, –999.943665, –1312.422852
192	347.996399, –73.063454, –430.095886, –405.626465, –424.762238 –505.689728, –474.230194, –602.869690, –516.047668

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Table B.34 (continued)

Index	Codeword
193	–121.138519, 599.921997, 1637.786133, 1673.657104, 1515.356201 1099.747314, 782.899292, 290.842285, 50.356499
194	–479.236481, –1292.459961, 486.444305, 617.295349, 807.077637 742.250183, 786.319092, 690.602112, 686.478699
195	–384.315399, –1041.603760, –388.681671, –720.672424, –491.007507 –261.076233, 70.605843, 193.263412, 359.707428
196	726.636963, 1068.222656, 835.229492, 646.974976, 372.526855 81.769661, –155.821640, –467.406036, –609.194092
197	1011.585083, 1131.065430, 551.508789, 84.949585, –427.427521 –899.412659, –1345.255493, –1725.048218, –1932.867798
198	–104.705009, –570.926758, –903.287659, –1329.082520, –1503.404053 –1593.681519, –1433.338745, –1354.490723, –1103.630737
199	684.434998, 2677.031738, 2640.076416, 2477.602783, 2097.601562 1757.809448, 1344.368896, 984.018860, 607.138794
200	–275.864197, 29.051449, –274.191254, –358.941620, 46.813194 657.108032, 913.113220, 1191.818359, 1285.592896
201	617.544373, 809.540405, 751.557190, 656.415466, 539.906250 344.674286, 311.402069, 104.217766, 43.276100
202	–570.533142, –1292.932617, 781.957703, 861.536133, 1279.650024 1209.266235, 1395.982300, 1345.671509, 1472.285889
203	613.478943, 498.496368, 221.305801, –10.624701, –228.434753 –553.930908, –738.420349, –1059.372314, –1161.117065
204	–99.197083, –364.513275, –658.022156, –1038.899536, –1296.954346 –1541.067017, –1558.542969, –1601.610840, –1636.576050
205	1902.935669, 2657.081543, 2283.650879, 1829.887695, 1418.237427 1029.569336, 635.649658, 348.315186, 57.349442
206	–169.365402, –779.464294, –807.007690, –1272.415161, –1381.448120 –31.502048, –271.029419, –526.351501, –776.372559
207	–372.196869, –999.805115, –67.133698, –185.357285, –272.310028

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Index	Codeword
	–589.583923, –690.671143, –871.234436, –813.840027
208	780.040894, 540.443909, 272.137726, 127.595924, 103.035805 –7.213268, 33.308098, –92.559692, –86.642143
209	–43.860863, –75.046074, –498.833160, 79.453178, –48.209049 –427.222076, –640.230713, –834.722412, –843.463928
210	–84.002121, –803.222839, –903.731995, –1555.773071, –1820.684082 –645.273804, –843.073975, –983.579224, –1107.764282
211	287.774628, –39.120178, –597.361511, –1199.857666, –1640.720093 –873.398071, –894.083130, –927.508362, –891.872498
212	–189.896698, 782.072388, 781.725647, 674.643738, 497.708771 241.687012, 148.634705, –93.176682, –177.620422
213	–121.669731, –873.069214, –1265.429932, –1776.589233, –2045.400513 –2201.425537, –2075.754150, –2074.478760, –1888.381592
214	–169.272018, 30.012857, –109.015106, 465.255615, 453.288849 40.586933, –249.114258, –631.611816, –837.331116
215	–362.530945, –801.328735, 282.536194, 243.578491, 390.871216 297.866333, 479.047913, 369.696472, 405.338074
216	–238.607315, –852.011536, –964.665527, –1365.129395, –1391.019897 –1305.390503, –1077.980591, –937.738281, –683.551453
217	–85.789406, 182.220551, 330.619476, 318.162048, 156.505722 –267.389893, –595.257080, –1019.441650, –1273.395508
218	–187.219238, –403.721039, –729.755493, –965.228516, –133.767776 126.393250, 296.895660, 303.930176, 363.149719
219	310.347870, –47.092258, –511.695251, –1076.267456, –986.932312 –1167.762695, –1244.994751, –1354.601929, –820.385315
220	–97.799355, 442.941376, 811.982605, 957.969604, 918.645081 678.298462, 573.526001, 214.357635, 77.677307
221	–179.466064, –953.375244, –1399.735840, –1847.744751, –1956.635498 –1822.329590, –1526.700073, –1380.293213, –1160.773560

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Table B.34 (continued)

Index	Codeword
222	–653.149902, 1254.798218, 1124.465698, 1332.852051, 1239.890015 1379.581177, 1360.235107, 1535.566772, 1697.100464
223	–264.660797, 86.838188, 638.347168, 474.387848, 295.338104 –62.242229, –152.140320, –451.995605, –545.072205
224	–294.116180, –926.886108, –564.997986, –810.562195, –823.729614 –1049.912598, –951.003418, –904.211121, –781.321716
225	23.488888, –412.369110, –441.759216, –691.951904, –884.265442 –1368.422485, –1694.430542, –1727.004883, –1126.412109
226	–34.125507, –201.101593, –432.403564, –877.453430, –1181.488647 –619.693298, –423.591156, –702.601868, –1005.619995
227	–100.312309, –673.506653, –981.401489, –1410.046509, –1695.960571 –1886.820923, –2109.124023, –1959.750244, –1201.863892
228	–346.761017, –884.866821, –900.544067, –1077.662720, 619.997192 543.461304, 242.865036, –100.780441, –286.818024
229	–200.410614, 109.605659, –170.653717, –421.138000, –651.408691 –912.773987, –1131.077881, –1341.235229, –1498.216187
230	572.233276, 755.728027, 730.481140, 826.995178, 843.460083 827.285400, 823.618469, 699.820312, 607.336975
231	–19.294380, –195.121170, –463.009827, –795.654175, –981.652588 –1232.025391, –832.356018, –925.299133, –594.547485
232	–406.959015, –1069.484375, –700.927673, –869.769348, 138.809525 –27.963032, –146.023773, –592.793091, –904.695923
233	358.704681, 2203.979248, 1786.071411, 1356.908936, 891.832825 512.293335, 67.515404, –327.043518, –622.445557
234	300.532776, 129.682983, 149.795502, 261.271667, 280.571259 67.060669, 35.455791, –271.818146, –376.685242
235	–201.779694, –71.861748, 512.022095, 501.403564, 545.430664 269.734314, 290.257141, 20.506559, –9.238894
236	220.352310, 646.220276, 485.153656, 378.431824, 239.117081

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Index	Codeword
	30.119192, –48.385849, –281.666260, –321.418243
237	–37.013084, –12.237608, –445.684906, –694.351868, –519.398560 –689.213684, –619.480469, –789.566101, –831.354065
238	–311.697540, –1214.498779, –1629.167725, –1667.692383, –252.691345 –41.316105, 138.973297, 128.725128, 171.948929
239	–177.504532, –999.752441, –1437.215332, –2003.558228, –2320.895508 –2459.510742, –2212.731934, –1705.895630, –941.731689
240	–64.721283, 798.213867, 379.698395, 88.914154, –168.081284 –58.058834, 73.794998, 323.422882, 401.970367
241	124.400887, –86.299744, –713.425903, –1270.068115, –1901.768066 –2410.684326, –2521.028076, –2378.131104, –2131.198730
242	–246.546921, –936.140015, –666.568726, –711.366394, –604.071777 –503.898346, 1039.701782, 805.238953, 313.919495
243	–288.440033, –241.610382, –246.760681, –401.584534, –492.142914 –692.678162, –740.253235, –969.517273, –1111.669189
244	–357.615021, –505.923218, 1234.285034, 1028.074219, 764.083801 298.424377, 180.949036, –154.882401, –236.654190
245	–159.627060, 1235.245239, 1178.883301, 1088.014160, 860.808533 636.503967, 566.731140, 383.741333, 251.244156
246	–54.214455, –417.550842, –859.441040, –1392.187866, –1611.388672 –927.907532, –386.700897, –194.817215, 14.651560
247	–742.290100, –15.748692, 1266.636108, 1328.531128, 1668.744019 1669.059204, 1832.402100, 1788.834961, 1862.470825
248	–343.283539, –1302.701172, –1851.272339, –1961.326782, –130.270493 248.502701, 551.546631, 607.094482, 766.398682
249	107.124557, –148.659027, –554.413086, –982.619141, –1348.362915 –1730.620483, –2168.555664, –2596.479980, –2861.052490
250	–418.114899, –961.129211, –17.794352, 661.979614, 851.078003 437.627960, 205.163864, –273.702789, –388.516815

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Table B.34 (continued)

Index	Codeword
251	275.978882, 184.001373, –100.555817, –225.438446, 74.304443 22.188887, 179.736740, 0.251966, 10.995980
252	1615.943481, 1123.951782, 539.817871, 175.317184, –110.204140 –465.569305, –681.310852, –827.931396, –798.271057
253	580.269958, 370.878906, 110.667450, 134.644119, 306.276093 418.459473, 557.146606, 516.662964, 507.707855
254	36.891468, –515.519226, –762.948547, –1508.485718, –1802.767700 –1083.640381, –1172.074219, –1403.558838, –1596.932861
255	383.148956, –26.410944, –467.441589, –667.710754, –780.453552 –992.135803, –1154.880615, –1385.698730, –1454.032837
256	153.504349, –389.179504, –746.059998, –1376.398071, –2047.961426 –2373.300781, –1687.155884, –1366.466553, –1077.949463

Table B.35 Stage 1 second sub-vector codebook lsf_stage1_CB2_hbr of high-precision LSF vector quantization codebook

Index	Codeword
1	–2.419283, 160.314499, –65.667160, 145.171967, –234.788620 58.263897, –857.876892
2	–1078.523315, –1171.671143, –1471.139771, –1721.603516, –2394.023438 –3054.640137, –371.735413
3	–1384.490234, –722.422668, –1254.738892, –1515.970703, –1980.408691 –1571.614868, –2312.044922
4	–1211.196167, –1535.960938, –1990.369141, –1961.203735, –1703.231079 –1067.977661, –1775.004883
5	–1028.398438, –939.567017, –1238.632568, –1016.474548, –1560.545044 –1644.496826, –2429.453613
6	–1490.962769, –1297.616699, –1220.265747, –988.459229, –1302.738037 –1197.546387, –1958.636597
7	463.516296, 493.455872, 55.139450, 115.217438, –464.511414

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Index	Codeword
	–580.085999, –1564.193848
8	–1785.097778, –1858.684814, –2109.224365, –2145.851074, –2486.418213 –2603.061768, –3070.082275
9	–1086.836304, –1152.029175, –1538.223999, –1379.222656, –1861.346191 –1678.717773, –2455.295898
10	–1128.577026, –1054.297852, –974.278442, –911.481689, –875.174438 –844.964905, –1078.336792
11	–469.022614, –829.216492, –1263.203735, –1220.989136, –1111.808350 –834.006348, –1571.638306
12	–1552.077637, –1593.502808, –1913.150513, –1876.412720, –2260.737793 –1906.382080, –2539.385986
13	–46.287777, 76.654182, –390.476898, –316.844574, –910.179382 –908.117615, –1883.781006
14	–352.165497, –324.392731, –374.813843, –377.579254, –412.347839 –616.016418, –1052.164185
15	2562.200684, 2434.767578, 2081.610840, 1673.590088, 1283.249878 942.633057, 707.649902
16	–503.909973, –505.138428, –966.220215, –990.389893, –1561.319458 –1457.232422, –2308.474365
17	–1655.097412, –1696.792847, –1498.722900, –1659.318237, –1431.109619 –1221.678345, –1568.875122
18	–721.078979, –461.355804, –801.716370, –720.517578, –1222.670288 –1142.029541, –2031.396606
19	–1293.315674, –873.878784, –679.288696, 31.862846, –228.983414 –440.117798, –1383.703369
20	595.191284, 568.244507, 557.998779, 649.209656, 584.837952 555.886047, 474.990448

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Table B.35 (continued)

Index	Codeword
21	811.444946, 775.415100, 772.300293, 550.483521, 392.688019 –140.597336, –225.270554
22	–887.068237, –1424.254639, –2049.020752, –1434.494263, –1748.213257 –1317.314209, –2176.650635
23	–616.794067, –1045.691406, –1647.098145, –1025.717041, –1460.346680 –1325.690430, –2155.200195
24	–635.036682, –836.133301, 446.604218, 574.536316, 437.461243 360.389191, 355.061340
25	1443.341187, 1918.654541, 1750.556519, 1440.371948, 1099.758789 820.523560, 634.274231
26	–372.092194, –290.193817, –417.522156, –456.368469, –676.214355 –1011.395630, –1729.396240
27	–1407.802124, –1410.329712, –1326.036133, –1297.428345, –1112.815430 –1066.590942, –1198.377930
28	–1155.173584, –470.017883, –875.280945, –991.236267, –1473.512573 –1466.203979, –2238.273926
29	–1100.306641, –265.063721, –716.102051, –924.100891, –1284.598145 –869.538757, –1762.164185
30	–1201.742798, –1308.445068, –1072.893188, –1381.481323, –1818.513550 –1411.241333, –2124.507324
31	–1093.597290, –1401.546509, –1534.675781, –1167.730591, –1508.403564 –1272.788940, –2043.262451
32	–754.049805, –706.918457, –1074.583252, –1259.205933, –2180.911133 –1706.644531, 1.634244
33	–1318.558105, –1511.099365, –1847.709717, –1602.843018, –1996.738037 –1653.422607, –2384.769775
34	–1110.535645, –1422.926270, –1907.578003, –2039.082153, –2278.691650 –1397.641602, –2057.705566
35	–297.689423, –405.208588, –590.064941, –701.502441, –636.377380 –546.131653, –241.727249
36	–473.099213, –404.824402, –347.584503, –261.104828, –228.279114 –188.513779, –20.013456
37	–1784.105713, –1652.451172, –1898.372681, –1465.228760, –1634.671509 –1010.233643, –1834.144043

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Index	Codeword
38	–1227.201172, –1219.217651, –1632.298462, –1706.958496, –2169.429443 –1836.036255, –2525.359375
39	–706.488342, –746.910095, –1253.204346, –1326.531860, –1862.745117 –1672.360107, –2445.018555
40	854.645203, 292.497955, –411.134827, –850.383911, –1575.365845 –1757.057251, –2767.714600
41	–1319.187622, –1640.014404, –1963.474976, –1162.507080, –1304.337158 –958.915283, –1782.987671
42	–1232.779175, –1079.236206, –1447.466187, –1258.913452, –1644.954712 –1100.258301, –1906.573486
43	–847.552856, –713.231628, –752.985596, –389.162506, –754.285461 –648.719849, –1566.578369
44	–1708.502441, –1424.723267, –1653.111572, –1522.201782, –1966.691406 –2173.961670, –2931.311035
45	–1751.297852, –1319.098145, –1734.377686, –1953.311157, –2216.190430 –1501.015137, –2159.846436
46	–858.159241, –429.482086, –517.704590, –187.014236, –571.912231 –561.262939, –1495.169434
47	–1599.613403, –1549.241089, –1734.210693, –1790.577881, –2356.241211 –1012.164307, 8.991084
48	–1529.388672, –1403.281006, –1647.208618, –1530.277222, –2019.098633 –204.429886, –1181.068848
49	–739.415649, –794.005127, –1411.415649, –1707.639160, –2181.610107 –2057.284912, –2670.123291

Table B.35 (continued)

Index	Codeword
50	–670.362915, 142.910156, –360.664429, –494.088745, –1075.005737 –949.166016, –1895.671509
51	–1492.212524, –1310.221436, –1528.393799, –1207.413574, –1402.620728 –877.879089, –1732.826782
52	–1899.612915, –1946.405640, –2189.999756, –2077.627197, –2337.402832 –1881.988037, –2417.630859
53	–443.188019, –565.652710, –618.054932, –1095.713745, –1577.799927

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Index	Codeword
	–258.012268, 195.130524
54	–1586.906616, –919.452026, –1106.189697, –755.043091, –1071.426147 –833.499817, –1684.316284
55	–1143.235718, –936.594666, –1197.897095, –1033.911987, –1462.376709 –1257.573853, –2066.716797
56	–536.623352, –206.564285, –343.659088, –62.936752, –504.874664 –529.995789, –1492.665894
57	–635.089966, –626.647522, –1009.990417, –1018.424805, –1485.962158 –1090.072388, –1937.496460
58	–620.463623, –633.232483, –1289.380615, –1406.137085, –2240.552490 –2669.604736, –3655.253418
59	385.163025, 235.010010, 109.594536, –140.336746, –343.256104 –936.745605, –1449.994995
60	–1792.394043, –1997.911011, –2452.838379, –2765.314941, –3405.402344 –3936.408936, –4873.289551
61	–1154.483887, –1268.832031, –1734.370239, –1847.437744, –2347.112793 –2373.519043, –3009.969238
62	–627.695007, –288.654572, –112.204475, 34.272385, 176.012314 283.529846, 305.059326
63	–1217.558350, –1120.316528, –1583.846558, –784.825684, –1247.993896 –1176.566162, –2005.552856
64	–910.307007, –771.879333, –654.502563, –518.989929, –393.384796 –309.178009, –177.891571
65	–2529.651855, –2346.246338, –2178.039307, –1941.845825, –2070.227295 –800.921936, –31.894379
66	–3132.030029, –3499.226318, –2046.768066, –1019.603027, –549.786011 –104.957031, 167.858231
67	–474.505066, –509.255920, –905.583496, –815.027100, –1272.156982 –819.950623, –1736.453125
68	–172.418259, –211.089874, –379.782471, –747.982300, –954.582886 –1373.502441, –363.987579
69	–2398.576416, –2511.631104, –2776.724854, –2771.916748, –3270.471924 –3033.739258, –508.376343
70	–1303.360962, –1687.757080, –1746.616455, –2382.338379, –2609.013184 –3633.147461, –1998.025391

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Index	Codeword
71	–952.940369, –987.538635, –1416.463867, –1309.199341, –1750.525146 –1389.113770, –2180.002197
72	–574.681458, –562.496338, –678.858276, –728.855408, –818.664185 –756.459534, –1134.977417
73	–412.590485, 448.910034, –602.397278, –842.126648, –489.682098 –746.656067, –1191.718628
74	152.910690, 247.706787, 214.242065, 260.911499, 232.637787 236.632812, 182.894653
75	–1539.218384, –1439.939575, –1750.878662, –1712.403442, –2418.214600 –2109.415771, –92.771507
76	–269.296265, –194.720230, –660.341675, –704.296448, –1362.437866 –1454.097656, –2336.554688
77	–717.084900, –772.887573, –1189.133179, –1135.438721, –1627.112549 –1386.582886, –2218.122070
78	–105.389801, –78.868919, –62.281616, –27.662807, –34.128387 –25.283138, 105.283974

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Index	Codeword
79	–103.275963, –120.688072, –213.694702, –342.597443, –543.487488 –995.674866, –1635.099976
80	1009.061951, 609.200684, –465.664246, 30.097935, –210.724548 –536.370544, –807.965881
81	–1385.402832, –1392.083252, –1377.516113, –832.042542, –1012.094482 –767.382751, –1628.946655
82	–1500.500488, –846.375916, –895.946228, –1546.125366, –1017.199158 –895.583435, –1452.323242
83	1122.770508, 1670.907715, 1631.485596, 1352.043579, 1042.138550 780.370483, 613.057800
84	531.805969, 18.100105, –1.253166, 522.595703, 462.182434 442.523926, 430.177887
85	–670.851379, –733.118835, –1088.392700, –611.241272, –1116.670410 –934.079407, –1845.358521
86	82.398796, 412.937378, –409.110931, –275.867157, –172.803696

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Index	Codeword
	–533.976257, –666.394287
87	543.545166, 607.136230, 301.981262, 172.075729, 113.461922 –367.959656, –589.366028
88	–46.647766, –158.918213, –854.853210, –1275.315552, –1905.142456 –1610.375366, –2407.119385
89	521.322937, 241.396042, 453.540802, 341.791687, 266.615082 –259.359222, –238.219513
90	–3024.762939, –3473.895752, –3734.945068, –4403.958984, –2253.765869 –701.315063, –197.920502
91	–2045.555664, –2459.894775, –2769.943604, –3419.300781, –3497.661865 –956.672546, –174.634003
92	108.707832, 252.321487, –208.273285, –93.021729, –641.800171 –682.776855, –1663.273682
93	–1423.165039, –1088.585571, –1452.920044, –1146.858765, –1597.936279 –1454.332642, –2243.208496
94	–2298.474854, –1807.991699, –1828.818726, –1534.023926, –1638.536865 –1291.564331, –1974.960815
95	96.640167, 112.615158, 138.253311, 75.827415, 79.389519 –317.291626, –423.935577
96	–2190.903564, –2466.402344, –2937.284424, –3436.668213, –1297.438965 –498.876495, –27.772251
97	–243.354324, –515.297729, –1009.140625, –799.371338, –1319.890137 –1174.466919, –2037.242920
98	–1041.807251, –1027.113037, –1163.923096, –1349.724854, –1977.282715 –652.251343, 115.361565
99	–1354.297119, –562.692932, –753.652527, –413.559052, –754.919495 –635.021240, –1544.279419
100	–1668.864868, –1325.623413, –1609.677124, –1448.219360, –1860.879028 –1637.513184, –2361.399902
101	–347.324158, –75.992462, –131.846283, 291.220245, 162.089828 388.920471, –653.307129
102	–2050.590332, –2310.230957, –2291.951904, –2675.141113, –2778.385986 –3633.289307, –1146.127441
103	–1614.307007, –663.231628, –1097.481689, –1164.423218, –1516.326782 –1110.013550, –1895.555176

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Index	Codeword
104	–319.394135, –225.083298, –154.588684, –149.742538, –115.347519 –371.147858, –522.308655
105	–859.840576, –938.111267, –1020.927307, –1169.248535, –1277.663086 –1379.227295, –1146.013184
106	–1326.813721, –1601.993652, –1752.636230, –2242.349609, –2609.572266 –3539.369629, –913.157288
107	–2168.114014, –2284.954102, –2477.869629, –2073.338623, –2052.058105 –1417.045776, –2028.703491

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Index	Codeword
108	–1867.457886, –1809.243896, –1990.184448, –1686.044189, –1962.137573 –1634.547119, –2286.456299
109	–1081.580444, –196.722565, –694.187744, –1347.482910, –605.154907 –826.458252, –1013.666016
110	–919.857666, –1200.682861, –1102.610352, –927.558167, –1131.861206 –1148.240112, –1908.182495
111	–440.644104, 597.595337, 1034.048462, 968.113770, 761.715088 594.234375, 512.320557
112	391.910309, 563.187866, 992.584900, 989.100708, 791.781616 635.883789, 524.414001
113	–1439.674683, –432.677399, 805.322449, 1533.820435, 1271.657715 1052.136719, 766.054626
114	743.810669, 1176.505127, 1493.295532, 1480.138062, 1338.440552 1121.954712, 834.426086
115	–1309.833740, –1543.746216, –2007.929199, –2380.663330, –2985.001221 –3658.058105, –4591.415039
116	–1922.901245, –1399.050415, –1030.848633, –619.000916, –646.067261 –641.641907, –1374.606079
117	–1196.555542, –973.870911, –1342.077759, –1283.749268, –1889.687012 –2061.299561, –2908.992432
118	–980.406311, –728.974548, –885.837646, –752.803345, –1042.341309 –745.296265, –1563.498047

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Index	Codeword
119	–1263.167725, –1426.673706, –1675.168213, –1466.998169, –1760.544067 –1011.527344, –1834.742432
120	–751.732178, –818.037720, –1138.700195, –342.462280, –658.276855 –1265.891968, –2143.573486
121	–1062.747192, –1031.713623, –1468.429077, –1521.497925, –1117.125610 –1381.837769, –2174.170410
122	–727.855774, –761.253967, –860.535095, –1033.114380, –965.472717 –817.884644, –371.561340
123	2878.902344, 2563.296875, 2195.727051, 1742.656860, 1348.161011 980.504700, 733.287659
124	541.978516, 672.371216, 416.751801, 434.956940, –161.895126 –387.416565, –1383.375610
125	273.264313, 421.542664, 200.308136, 299.106689, –225.245010 –408.481689, –1372.519531
126	1209.753784, 1304.036499, 1377.753174, 1216.187012, 969.355408 773.580505, 594.077393
127	21.863016, 1291.028809, 1398.661255, 1895.399658, 2431.829102 2305.669922, 1364.550049
128	1303.329468, 1405.020874, 1302.691284, 1044.241333, 482.370239 –99.826935, –742.828918
129	–243.456650, 19.171192, –169.918671, 41.986885, –427.325165 –493.024017, –1455.053223
130	–1885.273560, –1884.482178, –1712.416626, –1577.402344, –1217.507446 –1040.416504, –771.315369
131	–353.943054, –561.155701, –838.340637, –301.564575, –768.600586 –660.318481, –1599.372559
132	–596.970764, –412.483307, –497.547699, –143.599548, –386.428436 59.043865, –814.205750
133	–224.299942, –247.268860, 146.163208, 623.048340, 533.660522 471.134277, 421.878693
134	–1553.117188, –1283.806396, –911.148193, –677.186279, –274.994110 51.233665, 148.706848
135	–2115.568604, –2261.006104, –2324.882812, –1577.229004, –1470.652100 –1025.168945, –1738.755493

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Index	Codeword
136	–167.383331, –12.103893, 73.544403, 159.821869, 283.711426 364.061676, 391.078552

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Index	Codeword
137	–1912.710205, –1896.303101, –1644.200806, –1082.829590, –1104.169800 –869.738037, –1651.942749
138	–1340.277466, –1241.133667, –1657.185791, –1511.284302, –2178.502197 1093.690063, 45.818890
139	–1570.591797, –1679.194092, –1796.852661, –2047.197021, –2285.650879 –2350.982910, –1454.589722
140	–1231.343994, –824.596130, –996.815735, –746.322632, –1122.684814 –1111.156372, –1945.990845
141	–591.877258, 516.155334, –489.766815, –64.764053, 152.845764 333.220337, 62.063614
142	15.653727, 224.633698, 17.151478, 178.893738, –337.240814 –462.331940, –1436.735352
143	–880.164734, –1290.051636, –1623.288086, –1078.399658, –1245.619141 –837.299866, –1683.115723
144	–381.960052, –284.937103, –677.927490, –490.750854, –1093.306274 –1053.094482, –2001.423950
145	539.515076, 387.047943, 101.081024, –7.919919, –134.106995 –150.895966, 135.475677
146	1593.414062, 1659.969238, 1600.840820, 1375.510620, 1092.070435 869.114746, 646.936401
147	–787.252808, –1061.453613, –1590.851074, –1673.327759, –2047.322632 –1546.440063, –2271.757812
148	–876.749084, –45.474106, 644.229065, 755.632751, 620.382935 499.973053, 440.885681
149	–1919.868652, –2080.363770, –1926.503418, –2014.912842, –1927.411865 –1671.540894, –1158.850708
150	–1218.003174, –1076.153198, –932.393799, –782.836609, –592.775208 –526.451233, –449.310181
151	–2234.837158, –2223.677734, –2711.080322, –1939.675659, –578.922241

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Index	Codeword
	–171.547806, 191.678024
152	–515.611633, 583.618469, 401.767639, 306.167664, 320.778778 322.591461, 361.566620
153	–184.567017, –207.550415, –637.447937, –573.346252, –1081.125610 –787.249268, –1735.852539
154	227.247940, 444.299164, 297.879089, 608.798340, 334.543396 427.894012, –635.143921
155	–1812.030884, –1838.233154, –2065.830566, –1949.772827, –2039.627563 –1210.980957, –1901.968018
156	1436.209717, 735.195618, –322.993958, 678.544128, 432.665771 592.310730, 166.796082
157	–2169.908936, –2414.579346, –2538.250488, –2509.250000, –2578.761475 –2044.640625, –2299.136719
158	–1557.501587, –1493.935425, –1315.934204, –1132.046143, –782.128296 –679.114502, –560.047363
159	15.841063, 1116.713013, 1351.467651, 1158.964600, 898.157715 685.430969, 553.459656
160	–1616.942993, –617.771545, –350.499329, –60.721684, 76.723930 237.614853, 156.796127
161	–876.453308, 166.194077, –586.573547, –950.025879, –162.685486 –11.021299, –74.673676
162	–933.958252, –792.638428, –681.551208, –596.130432, –585.906128 –594.729431, –936.187195
163	–1208.862915, –1227.308350, –1181.368286, –1337.841309, –948.802124 –172.173843, 113.793404
164	47.086929, 9.638669, –28.048338, –108.225067, –177.868164 –537.585083, –921.853699
165	2227.242676, 2299.043213, 1983.756958, 1611.156250, 1230.987183 910.737427, 687.558899

Table B.35 (continued)

Index	Codeword
166	–2634.895264, –1341.407104, –655.939148, –435.204132, –138.849350 109.223824, 175.581787

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Index	Codeword
167	381.176819, 172.363068, –181.324799, –255.549347, 88.474831 314.105194, 349.051849
168	–942.328003, –727.934448, –1051.050659, –895.382385, –1331.618530 –949.222717, –1827.845581
169	1050.846069, 960.810059, 899.902222, 918.711304, 741.007629 642.515076, 427.510681
170	–1923.227295, –2332.062744, –2334.375244, –2903.227539, –2950.154785 –3899.762695, –2456.197754
171	–1321.074463, –1645.838745, –1858.400757, –2214.028320, –1537.176392 –342.966125, 61.078449
172	794.880249, 930.161804, 695.314148, 628.398499, 40.544762 –332.564636, –1304.538208
173	–1196.832886, –1046.309692, –974.942627, –507.224152, –811.209106 –686.430359, –1591.003418
174	–1766.451294, –1068.532959, –1442.078491, –1631.367676, –1790.646729 –1115.237061, –1888.490234
175	–2597.554443, –3010.818359, –3857.105469, –4409.147461, –5543.684570 –5077.316406, –969.496399
176	686.251831, 616.379700, 427.633118, 373.425873, 278.641876 251.032150, 277.012299
177	–938.053894, –423.530273, –804.657959, –1640.446411, –1215.777222 –1003.299316, –1671.776978
178	222.797958, 344.567383, 353.334686, 417.572205, 452.120239 471.539337, 452.700836
179	–193.654877, 486.405945, 1418.244995, 1514.918335, 1254.049561 1046.550415, 773.944763
180	–1542.704712, –1538.845825, –1861.758179, –1613.740601, –1869.317993 –1350.750854, –2065.242920
181	–1929.660034, –1931.505859, –2094.259277, –2162.314209, –2643.336426 –3044.777344, –388.269257
182	2023.152832, 2168.609131, 1901.014771, 1566.093262, 1199.623291 905.672363, 677.364563
183	–1454.306519, –1817.152954, –2259.534668, –1921.817383, –2116.793457 –1604.087891, –2239.123047
184	–2059.189697, –1293.733521, –1435.723511, –1025.210571, –1308.423828

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Index	Codeword
	–1063.895020, –1869.822754
185	1757.312622, 2066.028564, 1840.750732, 1509.043823, 1156.838501 859.446899, 657.098877
186	–1604.242920, –1782.429321, –2060.613525, –989.568481, –304.592560 52.363155, 261.436890
187	–790.060547, –677.193604, –854.483887, –1002.869568, –1361.044922 187.528214, –758.687378
188	–850.720215, –815.171509, –782.120972, –750.712524, –930.394592 –1100.443970, –1842.617432
189	–1013.528564, –619.302734, –1039.494873, –1345.197998, –1822.371460 –1228.573486, –1966.074951
190	–890.626709, –1002.113586, –1763.994995, 44.655560, –635.783936 –1296.306763, –1941.137939
191	–2550.192383, –3048.042969, –3690.282471, –4373.286133, –5208.394531 –1917.806274, –581.258240
192	–46.051090, –444.285278, –621.605347, 218.354416, 294.350952 309.784790, 355.443756
193	–832.117493, –659.459045, –481.507568, –341.173279, –48.068172 158.933624, 259.165100
194	–723.183533, –566.399109, –422.477692, –387.357666, –312.310120 –495.552063, –642.440918

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Index	Codeword
195	–3213.293945, –3731.129150, –3566.625977, –1970.124390, –969.271667 –349.031250, 88.375351
196	–1493.730713, –1925.979980, –2232.583740, –1535.923706, –1746.921387 –1267.045776, –1990.320190
197	–931.412964, –793.034607, –1133.670776, –1261.493530, –1737.755371 –699.421814, –1597.601440
198	–802.901489, –780.312927, –1156.061279, –814.251770, –1303.202515 –1265.482178, –2118.627930
199	1859.657349, 1899.714355, 1752.933350, 1489.179077, 1168.854858 923.944519, 675.960144

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Index	Codeword
200	–758.564758, –1219.479126, –1183.540894, –239.990875, –2.090081 238.982742, 254.410858
201	–654.688660, –1015.827209, –1190.445923, –605.556641, –856.632019 –642.030579, –1519.150391
202	1119.471191, 858.251709, 249.507751, 471.759491, 265.540253 –206.793472, –294.015991
203	–1211.920776, –1029.572876, –1262.090942, –1054.197144, –1343.196411 –919.689575, –1749.811035
204	–610.228638, –286.711029, –544.461487, –354.503784, –793.421814 –698.029663, –1636.272949
205	–1988.942139, –2270.791504, –2623.452881, –3106.659668, –3696.352295 –4359.229980, –1231.581909
206	–769.379578, –1117.632202, –1622.923950, –1560.120117, –1645.681274 –1032.027710, –1828.624878
207	–214.166290, 389.766052, 490.709106, 845.222534, 281.663879 –253.058563, –1178.845459
208	–1189.373657, –1266.664551, –1796.728516, –1872.993408, –2566.956055 –2864.288330, –3873.072998
209	–752.549072, –213.618332, –171.188766, 526.129272, 59.229225 –384.757385, –1381.908691
210	589.618896, 958.856995, 1043.165405, 1143.152832, 1853.732544 2285.578369, 1410.694824
211	–1040.660400, –1191.703125, –654.014648, –941.981873, –1474.148315 –921.510010, –1640.542358
212	–1563.276001, –1639.329346, –2228.906738, –2306.195312, –2921.983398 –2888.887939, –3908.613770
213	–1378.559082, –1430.042114, –1700.228394, –53.977154, –540.871887 –542.380432, –1553.821655
214	–1160.307495, –1163.990601, –1185.203003, –1398.706299, –1303.736572 –987.148376, –471.440216
215	–1030.117188, –972.643860, –1276.948486, –738.906311, –1100.516724 –795.453491, –1693.452637
216	–468.792480, –450.322815, –974.565002, –1008.784973, –1696.910156 –1940.522095, –2817.710938

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Index	Codeword
217	–838.831787, 274.059998, –663.343933, –1405.616699, –877.030273 –879.753784, –1595.256836
218	137.608704, 69.000343, –47.363461, –233.584244, –445.194702 –970.103699, –1565.977539
219	–1042.776245, –477.652252, –729.477844, –454.572510, –946.314819 –931.773499, –1823.560181
220	42.125374, 35.638535, 740.415527, 843.886780, 668.383301 543.146301, 472.985168
221	392.935059, 653.371216, –448.405304, 375.040161, 295.584198 471.666870, 103.572754
222	–154.301132, –306.378052, –466.394440, –551.980957, –192.136795 165.342453, 298.238892
223	–2925.972656, –2523.248535, –1111.652954, –685.163635, –275.557953 25.750113, 194.467148

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Index	Codeword
224	–1574.326416, –1417.313110, –1626.486328, –1278.805542, –1589.582886 –1240.964600, –2012.671753
225	594.715515, 1486.845581, 1531.019653, 1274.003052, 970.901367 732.011169, 579.845337
226	137.167023, 36.624592, –517.013245, –589.374573, –1265.440552 –1145.184204, –2051.384277
227	–26.435886, –56.422054, –404.378052, –394.194000, –813.856628 –314.063995, –1064.395996
228	–1260.744629, –1497.010498, –2024.455566, –2299.268555, –2770.762207 –2045.283081, –2527.341797
229	–359.603333, –176.854752, –683.117859, –981.453491, –1492.026001 –1031.153564, –1905.748535
230	–1651.876099, –1859.713501, –2263.955811, –2451.694580, –2612.706787 –1484.526978, –2041.182739
231	–597.484070, –370.993713, –597.899780, 472.524628, –203.220230 –1188.975708, –2064.148193
232	–626.137695, –534.148499, –583.699036, –581.131592, –782.097595

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Index	Codeword
	–1054.995117, –1791.960815
233	–1330.559326, –1746.493286, –1845.468750, –2474.347168, –2675.653564 –3675.258301, –3224.888184
234	–350.680878, –649.529663, –1278.257690, –1429.337891, –1821.152344 –1156.966309, –1977.541138
235	–1108.990601, –980.478210, –1450.680420, –1764.365967, –2155.622559 –1117.615234, –1904.928223
236	–731.516907, –960.150146, –368.916779, 237.534698, 298.949432 354.164429, 369.252014
237	726.680481, 970.058655, 1240.952026, 1122.956055, 901.566833 712.591248, 579.026184
238	–1509.388062, –1746.989380, –1382.398804, –1719.351562, –2064.650879 –1278.447510, –1975.246460
239	414.816895, 535.429321, –51.128113, –234.962631, –1016.078186 –1202.653809, –2175.594971
240	–759.597778, –960.860474, –1123.675293, –1550.068359, –1919.764771 –2633.365967, –1350.687866
241	–1151.824707, –1196.646729, –1087.567993, –1698.596680, –1496.082275 –1052.537354, –1673.215332
242	–1385.504883, –1422.370239, –1487.047119, –1680.568115, –1802.940796 –1530.545532, –793.454041
243	1013.024414, 923.160645, 798.228455, 699.183228, 541.279236 341.881500, 412.349915
244	–2169.254883, –1868.476440, –1482.921021, –1427.902588, –1178.953979 –290.343079, 48.260975
245	–2174.610840, –2151.178711, –2372.573730, –2247.478760, –2823.552979 –1877.511353, –206.024292
246	1082.607422, 2064.338379, 2365.753174, 2626.614014, 2299.045410 2062.203125, 1200.084229
247	144.305130, –24.135992, –270.347900, –433.131073, –458.793701 –345.861237, 27.411316
248	–1911.949707, –2278.694824, –2423.027588, –2859.584961, –3014.995117 –3781.610840, –3822.277100
249	–836.404602, –933.741699, –1307.806152, –1098.735352, –1511.847290 –1059.338257, –1894.064087

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Index	Codeword
250	–640.583130, –440.947906, –751.173767, –560.251831, –1045.903076 –798.479858, –1751.981079
251	–2256.432617, –1674.571045, –700.385254, 756.211304, 1299.046753 1050.701660, 726.589233
252	–722.514709, –774.690674, –832.236450, –947.848145, –522.118652 7.550344, 214.319077

Table B.35 (continued)

Index	Codeword
253	–1925.266357, 238.258560, –597.768127, –720.570435, 15.188728 186.199814, 8.823078
254	–1493.605347, –1635.037720, –1872.133667, –1141.085938, –1540.600220 –1550.948486, –2279.032471
255	–250.391434, –80.652458, –379.481018, –217.784698, –719.979736 –681.776978, –1644.389404
256	–1256.465210, –1254.223389, –1621.097778, –1516.847778, –1851.374390 –1392.915283, –2135.959473

Table B.36 Stage 2 first sub-vector codebook lsf_stage2_CB1_hbr of high-precision LSF vector quantization codebook

Index	Codeword
1	–713.785767, 168.407120, 153.748795
2	36.340725, 90.616714, –32.429771
3	52.624313, –38.090992, –364.945282
4	154.185974, 109.762367, 355.092072
5	–375.530365, –62.235508, –134.981415
6	115.415070, –699.178345, 276.090454
7	–363.505493, –245.460114, –404.869843
8	–102.644508, 121.746376, –52.143639
9	250.990021, –180.223267, –60.538208
10	2.304316, 254.452957, –118.709351
11	–64.000519, –172.352188, –549.504944

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Index	Codeword
12	145.008041, –198.819794, 74.863930
13	–319.988373, 62.626167, –325.089386
14	–288.144287, –715.401611, –396.285156
15	–211.637512, –4.421244, –14.446482
16	82.578644, 123.950401, –213.957626
17	–164.570007, 844.651917, 255.872421
18	–247.887390, 55.306465, 200.785889
19	–215.868759, –609.106079, –63.238937
20	392.302124, 42.328953, 249.753616
21	–184.973984, –69.296509, 118.628799
22	51.923347, –142.208099, 177.060547
23	53.448772, –305.917572, –103.890076
24	229.675934, 0.439482, 122.373756
25	–277.801453, 166.968170, 733.307129
26	170.546982, 339.845001, 31.960520
27	64.136490, –25.794970, 65.980400
28	–43.597557, –34.969471, –37.739056
29	–212.885864, 507.455505, 437.958435
30	–493.030060, –311.711365, 187.651596
31	–354.960724, 144.233612, 368.872223
32	81.155983, 198.582993, –361.475037
33	–57.561897, –190.277390, –40.531013
34	225.483200, 184.535919, 145.773300
35	37.873772, –300.896942, 273.377380
36	–161.762527, –104.531548, –353.909149
37	437.577271, –248.396957, –118.537544
38	95.924393, –536.217834, –123.140144
39	–116.965042, 137.023346, –432.474640
40	–401.308441, –316.035950, –124.605537
41	265.316132, 7.975056, –193.403076
42	–10.286757, –256.780396, –308.450928

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Index	Codeword
43	286.242706, 221.018967, –186.312241

Table B.36 (continued)

Index	Codeword
44	231.734329, –155.717773, 278.019806
45	–344.505493, –185.656815, 515.490845
46	–210.659317, –371.243408, 298.229218
47	–55.369648, –502.107391, 166.864746
48	–237.739120, 449.408295, 71.104065
49	–197.362518, 292.102844, 232.818176
50	–244.392792, 154.775345, 58.205173
51	266.715729, 694.912415, 70.328987
52	–204.886414, –186.953674, –33.269745
53	119.856064, –148.999146, –212.473984
54	–96.027031, –133.978561, 283.992157
55	–277.930481, 14.714230, –619.926331
56	108.560051, 381.440857, –174.843597
57	–532.884521, 158.514374, –200.185989
58	–14.112489, 326.978088, 130.464569
59	–101.656219, 31.647610, –269.940765
60	–144.576035, –422.618805, –323.873138
61	65.474930, –420.618225, –505.687775
62	209.829102, –387.511017, 94.998833
63	–172.908279, –60.086086, –150.022415
64	–46.326584, 260.807922, 452.773834
65	279.548889, –141.048431, –322.010864
66	393.468262, 8.009486, –42.706268
67	–81.231201, 45.355511, 65.719444
68	222.150711, –141.217514, –564.965637
69	346.164856, 434.299622, –66.598831

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Index	Codeword
70	568.707031, –159.705505, 544.176575
71	–211.341019, –216.253036, –211.727448
72	224.405930, 357.485809, 257.797882
73	553.497620, 31.112984, –678.450806
74	82.964523, 135.422699, –656.731628
75	175.658020, –128.771088, 503.778290
76	14.064637, 492.906281, 239.662155
77	472.926147, –403.081818, –391.692749
78	–292.928436, –699.444397, 353.090057
79	72.990135, –133.231140, –53.157795
80	–52.832638, –117.261017, 69.052734
81	426.745056, 201.403336, 31.993965
82	223.471848, 449.586548, –409.097839
83	–74.437065, 170.063431, 109.249542
84	94.061584, –8.890752, –155.487183
85	181.220139, –12.836661, –26.633982
86	–257.568481, 404.635712, –478.268524
87	–118.702698, –1.801430, 436.133667
88	–328.992798, –148.799011, 49.605450
89	685.787781, –5.360787, 84.299042
90	–92.548859, –405.149048, –942.782654
91	545.499023, 378.187408, 237.816772
92	223.737640, 689.972900, 549.611572
93	–402.027008, 256.815186, 47.899891
94	198.374649, –338.206146, –228.664978
95	–74.177917, –279.765411, 485.423126
96	592.158936, 327.568512, –262.079163
97	–97.092148, 110.176552, 270.185944
98	–134.869324, 293.152802, –12.102485

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Table B.36 (continued)

Index	Codeword
99	196.897675, 149.523315, –40.585079
100	974.516663, 442.782013, 130.876434
101	–119.678520, 183.199692, –210.154816
102	520.430542, –462.481323, 137.886856
103	64.144768, –24.995043, 303.479828
104	–65.387932, 380.154449, –306.889679
105	312.868439, 105.024971, –392.744720
106	–42.009869, –144.065552, –184.797028
107	–286.622528, –143.909866, 256.411652
108	361.120209, 194.673004, 488.534027
109	608.696533, –6.981796, –274.527039
110	45.004539, 218.194778, 28.713619
111	–256.952240, –384.646057, 64.113510
112	–488.355804, 532.116638, 224.472809
113	–128.912506, –241.478180, 128.511200
114	–272.429382, 330.666290, –179.248230
115	33.182674, 226.608612, 254.291412
116	–439.983124, 8.855278, 102.383743
117	53.941254, 37.994209, 697.273926
118	–128.799225, –350.602203, –105.367256
119	–11.603866, –330.001129, 57.193336
120	–109.075554, –486.121399, 795.247375
121	–183.717377, 632.973999, –138.407562
122	–6.666337, 486.127014, –17.339613
123	389.025299, –181.146561, 137.332169
124	–271.502441, 115.163071, –122.910507
125	–39.242790, 21.079741, –150.635345
126	257.078369, –403.075104, 437.620300
127	–45.516216, –8.866961, 180.737320
128	70.438759, 98.982910, 139.766769

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Table B.37 Stage 2 second sub-vector codebook lsf_stage2_CB2_hbr of high-precision LSF vector quantization codebook

Index	Codeword
1	20.507162, 117.254471, 308.534973
2	167.627548, –284.581360, 35.337910
3	–50.533733, 262.051270, –222.744385
4	213.973526, –192.300507, 227.454147
5	324.752869, 154.691422, 142.521759
6	–302.892273, 22.365881, –268.279053
7	384.219574, –46.759758, 295.384735
8	–326.932983, –142.875214, 123.286591
9	462.440582, 30.680933, –644.826782
10	75.870522, 100.746597, –229.091095
11	–184.132187, –518.547424, –105.319809
12	–128.916153, –172.195633, 83.659973
13	63.237682, –497.342957, 72.141266
14	274.313446, 167.584351, –33.896770
15	–596.630493, 8.026925, –321.141144
16	50.223522, –16.749166, –83.381676
17	44.889523, –767.325989, –139.284637
18	224.780106, 352.491333, 75.805626
19	–33.128654, 305.753296, –601.859070
20	115.771713, –93.239197, 107.058525

Table B.37 (continued)

Index	Codeword
21	–148.837738, 183.316940, 413.980072
22	–182.227646, –697.383789, 278.016632
23	445.581207, 256.918182, –61.204651
24	707.401611, 599.105469, 466.282776
25	172.835205, –255.287506, –399.850555

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Index	Codeword
26	–182.281845, 185.917496, 198.393707
27	–354.348358, 77.655319, 121.351845
28	165.057236, –250.012955, –153.211365
29	15.198963, –101.545570, 337.992859
30	635.096924, –22.253139, –276.124939
31	–174.264359, 306.408936, –30.304029
32	63.197758, 65.521347, 148.829025
33	–565.097168, –720.727173, 95.707863
34	173.535858, 4.769509, 226.110519
35	–302.163788, –364.092468, 40.338612
36	322.009796, –130.186035, –257.399811
37	–143.584061, 432.809937, 187.272064
38	–8.131482, 172.260559, 72.100441
39	–69.128052, –15.661174, –246.318619
40	141.381821, 678.433350, 463.580078
41	205.150635, 60.560955, –127.768204
42	–396.496399, 355.075836, 271.316498
43	–16.061943, 261.906860, 182.079605
44	119.859367, –86.526634, –181.600311
45	–278.325073, 273.584839, –346.330780
46	–848.170715, –77.039818, 206.621765
47	–20.108572, –224.001541, –248.247284
48	–152.951675, 146.029510, 4.365578
49	62.817871, 353.723999, 343.701416
50	–436.317230, –275.409271, 341.552063
51	147.565918, 230.680481, 166.706573

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Index	Codeword
52	–34.370865, –308.244354, –41.257004
53	–241.203552, –430.650146, 813.072693
54	368.040619, –410.771362, 232.966476
55	51.651077, –146.025299, –22.975538
56	–282.722992, –620.837402, –850.400146
57	–165.943176, –55.919006, 572.439575
58	–103.814415, –227.512253, –490.515442
59	124.234863, –193.956253, –844.806152
60	–505.521362, 82.886086, 466.838531
61	148.491516, –239.119812, 546.069153
62	63.785629, –80.139122, –321.356995
63	564.061768, 129.677856, 165.186554
64	158.311157, 128.742462, 70.707832
65	316.238434, –27.633970, 86.694901
66	–175.450073, –93.772957, –166.443024
67	–142.252975, –157.993195, 255.044876
68	–313.525330, 13.380783, –652.654724
69	–241.896759, 28.034353, –57.149029
70	–190.798920, 0.189457, 116.813072
71	844.387390, 337.000793, –19.824232
72	–564.077698, 500.165619, –415.747192
73	213.419327, –91.672638, –57.745274
74	–99.660248, 74.968384, –407.527557
75	–29.572922, –96.862167, –131.641983

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Table B.37 (continued)

Index	Codeword
76	–135.936050, –355.414703, 151.864426
77	222.614548, –673.049561, 517.544067
78	111.716286, 204.121689, –51.537071
79	80.887352, 35.771717, 2.501737
80	–370.751129, –221.242981, –170.055420
81	–549.659729, –200.956406, 12.992573
82	59.403713, –418.178558, –191.717911
83	–52.472393, 56.039600, 70.462021
84	–88.299973, –178.931824, –61.182095
85	125.889633, 580.681763, –326.664459
86	–592.087524, 160.197723, 37.150238
87	362.081543, 337.822754, 311.010651
88	186.879440, 331.649445, –169.341782
89	–238.267609, 783.910889, 138.339188
90	–5.536943, –490.727203, –455.820465
91	349.078400, –449.050262, –113.857185
92	524.526978, –149.489349, 603.087891
93	470.803162, 318.161041, –352.185669
94	–166.528366, –349.740906, 415.440033
95	159.741531, 26.906466, 458.308716
96	123.212921, –21.127138, –508.872711
97	–239.674759, –150.437744, –346.729095
98	300.417145, 81.030838, –299.241089
99	–400.569550, –31.321560, –64.911179
100	–329.600861, 264.643341, 72.342133

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Index	Codeword
101	–76.098831, 23.414692, 223.034027
102	410.300262, 545.022339, 14.200037
103	64.472435, –380.021576, 299.929443
104	–276.012024, –14.363681, 307.793549
105	458.341339, –364.150879, –473.549255
106	–134.677811, –57.834167, –0.576738
107	–138.862488, 111.922058, –166.296036
108	–390.244507, 475.571930, –62.043774
109	146.384476, 230.729202, –393.689453
110	216.011246, 162.604935, 315.091980
111	371.276337, –198.172241, –7.094508
112	–412.132812, –448.155182, –344.452454
113	21.202076, –217.792053, 148.690628
114	–239.708435, –178.662338, –46.387856
115	–372.993713, 190.326294, –134.271698
116	78.791969, 546.357361, 89.262733
117	108.147072, 201.503693, 691.316589
118	–295.153564, 468.795502, 587.713989
119	11.740393, 334.976410, –1.581412
120	–170.412354, –303.384949, –200.288986
121	3.908800, 121.635567, –68.972488
122	183.778122, 8.971548, 47.254635
123	–62.340725, 12.960299, –53.699871
124	422.356262, 21.269390, –79.914871
125	–10.798393, –58.968788, 82.892532
126	–110.142456, 493.066437, –173.040512

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Index	Codeword
127	–762.578003, 593.424316, 203.118790
128	648.862854, –213.159912, 89.717255

Table B.38 Stage 2 third sub-vector codebook lsf_stage2_CB3_hbr of high-precision LSF vector quantization codebook

Index	Codeword
1	61.442013, 88.865410, –6.914186
2	–189.400803, 183.880447, 453.544067
3	119.694290, 122.304260, –185.256332
4	185.325165, 257.642426, 21.324890
5	176.223907, 376.925690, 276.048035
6	44.387566, –336.891266, –287.661438
7	364.234314, –399.658417, 453.150360
8	309.771759, –396.966858, –246.510818
9	–98.734177, –268.355042, 117.649399
10	68.921753, 181.501190, 315.960663
11	–16.736830, –112.308594, 57.227196
12	–191.615204, –370.536560, –89.005638
13	–635.830200, –111.513008, 426.530273
14	133.312378, –378.453064, 44.851124
15	–247.431152, 145.292679, 33.881779
16	702.903503, 405.354767, –185.583740
17	55.931442, –52.922546, 225.309769
18	–329.518463, 23.220282, 207.375168
19	–81.797279, 61.733788, 214.160568
20	–333.189178, –366.966156, 253.709396

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Index	Codeword
21	300.709991, 191.407745, 190.362869
22	–54.259617, 292.960663, –166.641479
23	207.949539, –137.050339, 90.344116
24	292.658539, 413.935455, –165.154205
25	43.520733, –285.075592, 348.921387
26	–173.507782, –407.853882, –702.097595
27	576.308167, 110.584236, –7.069339
28	583.669678, 2.836300, –559.254211
29	331.974945, 23.614412, –271.937256
30	275.383270, –28.569506, 282.474884
31	311.056641, 79.100693, –21.822622
32	–192.355347, –147.341660, –184.034576
33	–439.608124, 448.283508, 603.143738
34	–201.011368, 21.700256, –159.099167
35	135.237228, 2.610675, 35.422089
36	–19.653358, –37.952515, –95.742783
37	–74.458069, 109.526535, –83.227531
38	–335.823456, 744.129639, 38.045818
39	466.931183, –218.274597, 4.676877
40	–13.563426, 208.090698, 87.632927
41	119.996140, 111.237968, 156.117310
42	–259.981445, 466.053467, –437.298828
43	–84.826576, 11.426362, 51.927937
44	–158.319885, 331.992126, 210.548325
45	494.739502, 174.590012, 389.298523
46	–27.986452, –202.765732, –108.582108

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Index	Codeword
47	–81.897018, –700.229736, 150.311615
48	–441.722595, –63.444637, –332.879852
49	87.043427, 43.144299, 555.890503
50	–174.406799, –471.973938, 753.418884
51	154.363052, –138.182922, –528.208679
52	–610.850464, 358.816376, 115.910812
53	–172.365845, –105.489944, 361.526398
54	–500.688629, –436.756714, –99.204269
55	156.351166, 236.082245, –466.519012

Table B.38 (continued)

Index	Codeword
56	–179.466690, –272.355408, –352.192108
57	383.152679, 591.679932, 542.802246
58	164.616272, –115.712784, –131.835144
59	–373.097534, 293.575073, –173.105423
60	–251.338821, –126.143494, 19.707720
61	–147.272232, 61.723743, –422.298248
62	3.450175, 514.963806, 16.579840
63	–531.877258, –14.696597, –27.526365
64	12.894713, –64.106720, –285.631409

Table B.39 Stage 2 fourth sub-vector codebook lsf_stage2_CB4_hbr of high-precision LSF vector quantization codebook

Index	Codeword
1	92.195709, –173.186340, –76.764999

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Index	Codeword
2	–42.733780, 402.076965, –167.067413
3	216.264893, 102.677452, 168.312927
4	–180.997543, 162.147827, –134.432327
5	67.712898, 258.969391, 239.192825
6	–170.611481, 256.868103, 173.602570
7	–8.513791, –111.140099, 92.899986
8	327.391144, 205.558334, –102.128365
9	244.509750, –137.128418, –470.007751
10	–305.208832, 85.310158, 56.496731
11	180.332489, –404.626892, 35.443607
12	–89.915100, –413.847076, 440.065216
13	–49.306343, 63.195087, 62.291702
14	–56.507740, –124.494896, –224.872910
15	–117.042595, –206.133224, –17.508348
16	–199.800507, –28.671963, –490.060699
17	57.166000, 181.844971, 14.875186
18	–11.494995, –12.210985, –83.709663
19	83.800140, 98.593323, –225.477493
20	130.287781, 5.693187, 39.476902
21	128.140930, –135.807297, 296.940247
22	–112.687485, –389.502289, –221.875732
23	–157.652573, –37.295250, 11.366231
24	–496.884033, –539.886902, –120.588898
25	–78.960876, 34.301903, 287.433350
26	269.951935, –62.663803, –131.213440
27	–538.176331, 470.946381, 245.755112

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Index	Codeword
28	–265.331299, –83.310402, –141.434708
29	436.499817, 440.873291, 263.916779
30	–631.545959, –29.409035, –72.509338
31	–294.762054, –158.774612, 187.861343
32	453.967224, –94.971153, 122.421051

Table B.40 Stage 2 fifth sub-vector codebook lsf_stage2_CB5_hbr of high-precision LSF vector quantization codebook

Index	Codeword
1	–446.630402, 640.495911, 268.249786, –67.830261
2	34.200180, 144.016098, 43.309258, 28.019665
3	122.397560, 413.036896, 108.406776, 21.556137
4	–291.235809, –590.999878, –4.219362, –29.149132
5	–182.353165, 247.858917, –82.613281, –248.262726
6	11.704876, –19.809439, 175.695541, 109.505432
7	–199.381882, –162.686661, 116.547264, 96.769501
8	85.434540, –28.285826, 18.597948, –23.235142
9	112.726555, –284.508789, –29.389679, 257.062927
10	–253.303757, –54.471107, –98.781433, –31.290049
11	–28.797440, –6.548668, –64.319229, 103.122360
12	102.159714, –280.140747, 276.293243, –38.849163
13	–184.768158, –482.613373, –769.700989, –47.989521
14	–223.921066, 166.102005, 120.577484, 120.780533
15	58.940697, 148.444000, 49.055420, 347.937683
16	–194.453476, –55.881226, –203.431305, 440.613892
17	271.730316, 37.378754, –396.253754, 157.584000

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Index	Codeword
18	–125.173019, 240.714401, –231.325714, 77.097366
19	245.718994, 72.768524, 112.223206, 59.880192
20	–58.394215, –204.128754, –21.877651, –69.457428
21	198.198151, 152.518585, –76.095955, –92.793144
22	5.645205, –2.743056, –126.321007, –129.334778
23	140.627350, 39.890167, 114.086823, –290.992889
24	129.491241, 165.633606, 406.660248, 150.717422
25	–606.185791, –12.697894, 7.033066, –27.042786
26	585.682068, 260.057220, 63.060730, –9.845518
27	254.377533, –187.517456, –100.691185, –109.688454
28	–81.884468, –167.102570, –333.533386, –11.585288
29	216.725479, 93.283714, –303.676849, –367.260162
30	–95.634460, –174.039597, –142.232117, –356.129242
31	–83.721230, –3.592948, 37.293602, –44.416279
32	–173.826035, –209.999924, 505.608887, 329.540344

Table B.41 Stage 1 first sub-vector codebook lsf_stage1_CB1_lbr of low-precision LSF vector quantization codebook

Index	Codeword
1	–350.459351, –1110.657715, –1039.387939, –307.705811, –81.258949 –67.539551, 27.608225, –15.766386, 26.909994
2	830.518982, 1316.991455, 969.974976, 701.664673, 395.667511 140.679199, –86.249687, –326.514038, –441.620605
3	875.874268, 300.750061, –135.191727, –749.033386, –624.504944 –977.145691, –270.945770, –528.141113, –484.400909
4	–37.185486, –438.739746, –198.407791, –716.461426, 25.968819 –322.178650, –642.945679, –1081.934448, –619.731140

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Index	Codeword
5	8.619967, –325.081543, –537.529907, –906.260193, –1086.351807 –1269.749512, –990.259827, –1082.904907, –659.676147
6	1975.103882, 1380.655762, 714.073425, 323.243988, 40.096863 –340.828369, –585.161987, –748.583984, –674.141174
7	–149.657196, –842.284973, –991.205566, –1085.922729, –1127.279663 –1483.629272, –1023.704834, –461.994324, –253.976318
8	–18.673189, 189.549789, –168.876450, –405.123322, –453.465790 –77.701363, 268.827789, 600.122742, 675.741089
9	–481.714874, –1312.720947, 497.238983, 617.127869, 809.172363 738.139771, 787.788086, 698.119446, 695.123840

Table B.41 (continued)

Index	Codeword
10	165.517990, 463.347443, 161.873764, –94.733566, –408.583618 –801.933167, –1183.599121, –1549.846436, –1829.587524
11	–54.419785, –532.895569, –852.639648, –1328.288696, –1952.080444 –2071.530518, –92.382095, –203.139877, –186.850891
12	183.861481, –367.273651, –851.810547, –411.512238, –523.118713 –562.440063, –624.123779, –710.631714, –784.563538
13	–177.176773, –521.651245, –243.776535, –638.196167, –178.797272 619.959656, 324.879456, –91.975945, –505.510773
14	–257.685272, –815.271667, –835.617249, –1264.782471, –1022.726257 1117.330078, 928.825928, 663.468262, 264.610596
15	25.521532, 100.323082, –382.839996, –812.957520, –1234.972046 –1564.814453, –1898.064453, –1977.380615, –2026.754517
16	–176.444000, –438.630615, –730.473633, –1083.432129, –1262.495728 –1234.185547, –1185.764893, –1210.682739, –1209.831421
17	–360.419434, –785.268372, –865.262695, –1157.854126, 766.852356 969.479614, 737.747498, 532.021301, 313.538544

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Index	Codeword
18	73.917870, –175.426498, –555.667419, –1068.706665, –1075.443237 –587.874329, –348.189636, –173.672394, –40.342525
19	–171.413345, 57.096062, –278.747833, –399.241699, –545.361328 –765.097778, –964.719727, –1209.839111, –1428.539917
20	–357.214722, –896.660034, –37.925079, –239.189606, –322.952301 –631.056213, –714.007874, –913.038513, –878.441833
21	1577.066040, 1529.908569, 1551.067139, 1455.275879, 1443.303467 1338.591675, 1316.248779, 1216.262451, 1138.473267
22	–409.347382, –896.647339, 645.859741, 732.300842, 705.857483 302.651703, 108.818642, –286.890961, –332.548187
23	–245.251160, –851.509521, –998.825500, –1403.856812, –688.652405 –72.345734, –200.590012, –436.256897, –716.309570
24	–330.863983, –905.250244, –375.980499, –700.450745, –352.954773 –106.922882, –215.295853, –600.505005, –879.973511
25	–414.539246, –976.347595, 90.056046, 24.310310, 12.638400 –256.423431, –215.814499, –414.811096, –375.642853
26	–407.677155, 67.193260, –239.487579, –109.491417, 505.456665 979.732239, 1202.223755, 1395.712646, 1486.746216
27	–103.741013, 419.907928, 320.453217, 215.451691, 83.301155 –252.383514, –505.506042, –914.186646, –1144.382202
28	22.720533, –186.878723, –341.957092, –498.801239, –536.332214 –952.614136, –1357.851318, –1808.392944, –2053.646729
29	–26.351635, –744.136047, –797.139587, –1550.414185, –1788.882568 –811.625061, –984.366882, –1143.760254, –1279.114746
30	–107.477005, –773.448425, –1269.981323, –1817.958374, –2156.203369 –2516.463135, –2683.684570, –2863.591309, –2623.000488
31	–95.678566, 204.781097, –189.688644, –453.370697, –564.583740 –524.080322, –323.315308, –217.640259, –82.427811
32	304.838196, 198.058044, 26.587915, 227.075500, 279.514038 90.428169, 25.509212, –293.474701, –421.430298

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Index	Codeword
33	705.637146, 193.382828, –315.379425, –720.216431, –1010.554382 –368.707733, –478.114960, –653.081177, –744.303284
34	–124.040001, –617.344604, –750.567200, –1259.906250, –1586.850342 –129.100784, –301.769806, –535.021301, –797.296326
35	–120.237625, 945.004333, 1023.360596, 1063.863770, 923.643372 722.150696, 610.020325, 326.225830, 204.115326
36	–242.126205, –1014.856384, –1121.360840, –1530.979004, –1499.600098 2.104447, 449.181427, 711.969604, 828.493713
37	–87.722557, –762.384583, –1226.589966, –839.319092, –951.323608 –971.707947, –973.453064, –954.515076, –996.160034
38	–168.498444, –970.490906, –1430.185791, –1907.497803, –2064.904053 –2020.493530, –1702.496704, –1505.148682, –1141.392456

Table B.41 (continued)

Index	Codeword
39	235.255157, –214.254913, –735.741943, –1327.962769, –1079.209229 –1155.385376, –1207.560913, –1325.105225, –1136.770874
40	489.040497, 379.885406, 126.575279, 166.232132, 351.813141 480.143921, 609.508545, 543.443359, 531.942444
41	–153.286011, –209.206512, –534.360840, –915.646362, 70.271286 –16.743921, –169.522858, –503.006714, –716.120972
42	–345.934845, –1309.356201, –1890.006348, –2248.306396, –439.151978 92.394310, 370.706940, 471.791962, 618.747803
43	–310.524963, –842.749207, –696.589539, –105.589561, 71.578148 –348.991364, –368.559540, –730.835938, –645.298462
44	–306.158356, –1102.411255, –1307.940552, –1490.519287, –1121.813599 –795.747864, –604.703613, –509.754211, –467.392792
45	–279.305969, –1188.364014, –1767.922607, –2403.655518, –2683.665283 –1444.281616, –463.252106, –212.524490, 61.606976

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Index	Codeword
46	647.597961, 8.382929, –398.628387, –858.689392, –1196.260742 –1258.485107, –1150.217529, –1349.348267, –1085.179932
47	–449.228638, 1142.992554, 1064.484375, 1191.123779, 1070.723755 1070.619873, 986.951904, 948.657349, 863.388184
48	–254.184570, 69.529388, 958.512634, 839.154419, 698.573792 330.158081, 380.084473, 116.397308, 39.122948
49	–247.474976, –291.702637, –560.705872, –726.362122, –712.323059 –847.740417, –819.774109, –972.264526, –1000.929565
50	–102.649529, –744.442200, –1258.676880, –1895.340088, –2534.861816 –3116.099365, –3649.456787, –3755.880127, –1480.863159
51	–224.878769, –868.444153, –1144.696777, –1584.141479, –1576.102783 –1216.113770, –629.454285, –408.229340, –209.635284
52	–222.695526, 203.857239, 149.654663, 180.832245, 239.630402 195.768661, 296.441437, 316.698608, 426.070404
53	121.947586, –357.326324, –682.028442, –1382.699463, –1620.812744 –1094.719849, –1241.071045, –1532.304321, –1752.286865
54	–403.487427, –1423.419800, –1591.178345, 245.310394, 599.750122 789.179199, 882.052734, 882.112976, 816.936096
55	–36.153755, –279.553741, –632.521973, –8.765594, 35.625114 –69.890617, 16.580078, –204.663498, –340.181366
56	–199.492142, 81.513809, 32.626942, –178.653061, –278.078857 –547.297485, –676.165894, –952.851868, –1025.475952
57	237.930984, –243.357269, –671.658203, –733.092896, –758.623291 –951.332397, –1087.989868, –1268.829590, –1280.351929
58	–227.537750, –287.850098, –292.606018, –429.307404, –253.741806 –301.787720, –203.673462, –411.002045, –375.994415
59	–231.314774, 6.343965, 1509.542236, 1552.771118, 1414.968018 1010.981384, 781.095398, 288.140961, 64.403107
60	–273.534241, –1185.445679, –1731.143311, –2246.872070, –1664.682007 –876.096619, –482.111023, –280.437042, –194.066895

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Index	Codeword
61	–59.669891, –437.954163, –952.351013, –1369.370361, –1366.131226 –1311.555176, –1082.967407, –927.321472, –682.334717
62	684.509644, 105.415596, –391.989441, –928.875854, –1156.915527 –1280.749268, –705.104919, –712.426208, –747.950562
63	21.285646, 850.948059, 1489.332886, 1323.255493, 997.157410 536.696960, 184.663040, –327.162109, –538.481995
64	–672.908691, 1205.853271, 1076.858276, 1270.047241, 1163.228638 1278.610229, 1231.399780, 1384.312500, 1458.875610
65	1123.680298, 1195.730835, 596.091187, 120.459366, –367.943024 –844.443298, –1278.164551, –1673.333130, –1885.995850
66	272.514954, –301.388336, –37.983318, –253.615463, –214.135483 –513.741882, –462.207184, –767.507812, –831.534363
67	87.529411, –284.147980, –737.057129, –1398.583252, –1831.413574 –1200.515869, –1424.156372, –1247.542358, –695.322876

Table B.41 (continued)

Index	Codeword
68	190.618988, –83.082245, –404.415741, –902.791565, –341.542328 –531.072021, –452.109833, –526.579529, –438.453522
69	–356.549683, –1249.736206, –1552.698242, –1509.339844, 96.601120 463.938782, 772.470825, 876.086670, 1027.148193
70	–251.656082, –741.916626, –800.877991, –1204.293213, –898.387207 –536.743469, –540.424072, –951.805664, –1371.296997
71	–16.392891, –341.709778, –903.738708, –1518.366821, –2100.664795 –2723.664795, –3262.568848, –3655.256592, –3920.665039
72	–284.557129, –626.414917, –170.010101, –351.521912, 993.011292 707.154114, 430.032684, –56.580963, –208.748627
73	–63.585968, –276.151489, –456.599518, –256.501343, –333.562897 –755.818237, –1020.620972, –1435.192871, –740.306030

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Index	Codeword
74	1629.834961, 1146.042969, 539.183167, 225.645462, 43.176285 –56.714531, –61.315525, 51.049088, 105.315742
75	–257.347992, –949.083496, –514.112061, –946.301208, –1061.262451 423.505493, 64.353943, –184.519806, –310.060455
76	601.338196, 730.051941, 529.544189, 350.136139, 123.053047 –167.247162, –385.363373, –718.114075, –827.812866
77	957.477234, 1673.412354, 1102.213501, 726.657349, 193.804886 –166.666946, –647.636536, –933.063171, –1035.739258
78	–177.455978, –666.090027, –713.341553, –1062.997437, –483.726715 –690.400879, –933.267517, –1214.673828, –318.606110
79	–189.500244, –405.898071, –668.867981, –764.180420, –19.830473 181.539169, 350.049530, 341.817993, 381.419586
80	58.198463, 87.016228, –470.353455, –1019.402344, –505.580994 –476.027191, –643.724976, –953.289673, –1218.301025
81	–9.731637, 35.897629, –398.662964, 108.671082, –30.824179 –403.612305, –511.957275, –623.195251, –685.248840
82	–157.306366, –553.577942, –975.876953, –1460.082764, –992.205627 –776.317871, –511.261353, –326.743317, –198.921204
83	–662.229797, 337.577576, 714.611816, 1115.122437, 1346.081543 1525.260742, 1630.367676, 1702.934814, 1783.298096
84	–96.698639, 476.073669, 356.679108, 307.013367, 275.333221 144.351913, 131.806870, –89.757820, –125.505257
85	96.625595, –234.501587, –735.064636, –1204.421265, –1373.773438 –1125.901245, –666.270874, –459.149506, –250.652649
86	169.706879, –187.591034, –705.413025, –1239.362549, –1701.577881 –1862.408569, –1851.633179, –1883.478271, –1916.869873
87	–64.554306, –62.929207, –407.237640, 103.524368, 40.249016 –404.697784, –763.795471, –1124.062500, –1390.584351
88	–141.843674, –793.938049, –1194.776245, –1549.655762, –1645.277832 –1719.506592, –1687.905640, –1854.041382, –1926.495483

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Index	Codeword
89	–194.186035, –903.843506, –790.955811, –1279.267334, –942.369080 –715.308228, –985.681213, 525.467102, 483.847260
90	2144.286133, 2143.108154, 1424.848999, 907.611938, 586.665710 307.282593, 24.629150, –128.423553, –254.069794
91	–168.323730, –977.983582, –1317.796509, –1770.269409, –1939.598022 –2061.373291, –1970.316895, –1014.373840, –266.364838
92	–14.177239, –456.114960, –698.976685, –1179.255615, –1664.940552 –1250.903931, –484.642120, –708.259399, –900.153687
93	–243.909988, –627.637512, –352.178253, –584.734863, 317.760437 –84.799057, –425.512421, –952.116028, –1349.741211
94	84.997139, –326.942902, –436.166351, –822.967712, –793.385132 –1216.504883, –1579.634766, –1824.714111, –1103.522095
95	–78.882149, 557.116882, 243.507629, –59.426495, –326.818054 –656.480164, –882.566284, –1162.840576, –1292.122192
96	472.399078, 324.246429, 123.760132, 107.621017, 172.215866 100.703049, 220.447205, 70.769211, 93.025391

Table B.41 (continued)

Index	Codeword
97	–279.016632, 319.207550, –34.997967, –125.365486, –3.664740 454.022797, 673.832275, 971.419556, 1070.634033
98	–86.031052, –99.652267, –551.247314, –880.790283, –1066.362305 –1154.501709, –1332.679810, –1483.808594, –1698.237671
99	139.571533, –74.816330, –730.456421, –1296.350708, –1943.886841 –2471.267334, –2555.464111, –2359.309814, –2118.012939
100	–232.477631, –323.773041, –457.001678, –708.959167, –360.985809 484.481323, 753.548096, 1113.769897, 1170.534302
101	–96.813431, –683.746643, –784.213257, –1114.412476, –1279.278809 –1705.722290, –1768.958984, –1196.400635, –768.627014

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Index	Codeword
102	–234.763580, –1016.336548, –1436.150757, –1801.835938, –1697.735352 –1363.577026, –1055.104492, –852.366211, –672.977417
103	423.673950, 204.145523, –80.427010, –237.875229, –397.674561 –692.070435, –832.088562, –1137.829102, –1263.773438
104	504.952789, 140.112259, –276.739960, –574.314697, –427.731293 –264.691650, –6.429366, 59.627628, 128.354279
105	181.932892, –406.816956, –736.782471, –1377.915894, –2054.307373 –2382.816895, –1719.648071, –1395.232666, –1084.625366
106	89.986191, 1808.005493, 1425.416870, 1018.296204, 603.047913 200.996918, –203.648102, –614.505920, –859.780212
107	25.575348, –491.275757, –169.827484, –756.985229, –510.820648 –271.569244, –627.316101, –1105.351074, –1497.432861
108	–0.721510, 752.166748, 412.833252, 60.089832, –264.969238 –507.899292, –573.338013, –668.694214, –629.476257
109	–157.224030, –924.664978, –1350.100952, –1907.713013, –2248.231201 –2433.884766, –2367.341064, –2260.742920, –1727.894043
110	–312.066467, –1067.247803, –1253.844849, –1673.790649, –1243.493896 –606.165710, –238.625320, –74.536827, 29.102182
111	188.922134, –387.703766, –181.650040, –684.412659, –465.589478 –816.664978, –761.582275, –1098.897217, –1035.031494
112	–502.310791, –1291.180786, –377.128448, –356.472809, 549.371277 798.475464, 1053.768799, 1193.387329, 1321.974854
113	120.875381, –86.850357, –507.376892, –934.800537, –1352.639282 –1755.437500, –2217.682129, –2608.354004, –2838.226074
114	–28.809593, –518.338684, –698.639709, –1113.990356, –1242.462402 –1523.905029, –1635.930420, –1677.925537, –1646.178345
115	–2.076617, 351.878967, 417.553589, 814.712280, 924.905518 541.083313, 210.906433, –301.686249, –554.606995
116	–174.367935, –101.753105, 506.573730, 213.724670, –62.353058 –467.419281, –549.319031, –683.690430, –647.043274

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Index	Codeword
117	359.021729, 415.796295, 73.191391, –83.700104, –112.212723 –194.968842, –109.225288, –253.853516, –208.237640
118	–610.554260, 678.981201, 786.243042, 980.827698, 1033.276733 1177.275757, 1230.203247, 1353.269897, 1464.978394
119	–422.542664, –1154.585815, –685.516357, –561.854980, 237.946915 312.140289, 475.985229, 467.722260, 577.558716
120	–303.906586, –299.817566, –38.045284, –111.681908, –18.812908 –235.245544, –267.668060, –654.276001, –863.731628
121	–307.668579, –1263.498169, –1795.801514, –2345.257080, –1378.010864 –224.626175, 76.730064, 291.228607, 412.261261
122	–159.790817, –357.482483, 245.199310, –26.278240, –233.085129 –694.296326, –1010.374084, –1348.147705, –1435.401978
123	–341.661224, –972.107300, –596.526306, –812.299072, –721.850769 –892.498962, –719.133484, –799.860718, –747.034363
124	208.944168, –571.758667, –1403.062866, –698.768188, –1295.974854 –1408.635620, –1278.894287, –1461.294312, –1620.020142
125	2016.535767, 2583.699951, 2156.421387, 1682.253540, 1306.288452 930.015930, 575.535400, 332.289062, 81.306969

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Index	Codeword
126	–481.642883, 767.079956, 478.750885, 549.838379, 567.944458 842.335510, 934.838013, 1140.607788, 1189.669922
127	–651.013611, 1213.169678, 1114.427612, 1324.416138, 1282.206177 1429.387817, 1446.570801, 1614.566772, 1816.776367
128	30.436600, –268.822021, –520.411560, –1239.242188, –502.846497 –964.426086, –957.118896, –648.420837, –727.841003
129	–67.992126, –398.622040, –443.123474, –723.682251, –735.579407 –836.367432, –9.895487, –451.035370, –848.732605

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Index	Codeword
130	270.295380, –93.148148, –561.977783, –1183.561768, –1104.187744 –1177.850220, –1397.009399, –728.114258, –721.127014
131	–568.377502, 1.897134, –48.158859, 682.458374, 1064.579224 1367.183472, 1499.239258, 1623.660278, 1682.907227
132	–332.755524, –1277.148193, –1741.189209, –1430.306396, –47.963100 90.906227, 290.168091, 258.427002, 330.425507
133	–157.008728, –29.765123, –517.562866, –1025.533936, –1501.759155 172.473587, 378.613739, 263.816620, 157.555740
134	373.106750, 553.056580, 50.987843, –386.420197, –904.769958 –1344.794800, –1750.855347, –2064.066650, –2277.853027
135	–425.244843, –1345.192139, –378.066376, 387.963837, 549.967407 625.941589, 644.349915, 621.692932, 584.571045
136	–16.541977, 138.275986, –180.281464, –352.161438, 132.832703 87.394142, 201.175293, –36.061161, –62.357914
137	–618.062744, 1298.624023, 1185.361084, 1413.948364, 1361.496704 1514.361084, 1570.251099, 1806.322876, 2337.903564
138	–357.054291, –1350.821655, –1671.045654, –585.366516, 200.789124 301.339294, 449.095581, 433.317352, 471.774445
139	–108.307884, –546.904785, –848.436340, –1438.375000, –1839.243286 –789.302368, –314.564728, –132.880920, 70.787682
140	–308.546326, –210.140747, –150.658768, 375.302368, 643.934448 749.838379, 835.551147, 891.345764, 908.518005
141	–467.672546, 66.437386, 352.558075, 733.662537, 851.549316 1012.505676, 1108.903809, 1238.738037, 1367.354126
142	–225.670258, –176.692368, –139.687531, –297.688843, 484.590149 –12.994805, –385.974274, –824.333435, –420.143768
143	–321.209778, –609.134277, 326.301758, 326.337311, 475.917419 347.087677, 517.783081, 389.418243, 412.928894
144	304.724731, 317.969849, 168.403549, 88.447319, 16.958170 –236.259430, –315.584869, –580.212830, –623.322693

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Index	Codeword
145	–224.797653, –70.260223, 609.323975, 491.570801, 339.155457 –11.061495, –53.120930, –337.209778, –425.730225
146	1121.619385, 1424.637451, 1250.940796, 1042.490601, 812.568176 620.814148, 503.227112, 336.917236, 223.762650
147	–301.173950, –982.761230, –689.736267, –1041.371948, –1144.856323 –886.875671, –277.517120, –220.478470, –55.952248
148	1.571693, 303.673279, –95.214012, –438.626190, –701.699219 –824.135132, –750.147827, –931.409912, –964.330688
149	360.211334, 2345.139160, 1970.203003, 1550.722778, 1044.960815 669.019226, 233.912216, –111.696175, –383.211975
150	–198.679718, –459.207184, –647.677734, –856.236145, –497.603973 –371.051819, –88.504814, –52.162579, –3.863596
151	–234.505722, –1106.629150, –1637.704224, –2245.764404, –2716.826416 –2709.702393, –860.633789, –364.690216, –3.835027
152	433.529449, 360.604156, 53.111431, –97.453865, –204.377487 –441.845123, –556.891479, –850.518005, –914.695190
153	–94.201759, –682.459534, –1009.064270, –1450.390747, –1754.623047 –1931.054321, –2161.267090, –2073.351562, –1264.456177
154	158.497513, –39.482288, –491.640747, –1033.636963, –1495.640747 –1644.056763, –1503.796021, –1429.203735, –1311.148682

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Index	Codeword
155	–37.986122, 49.700111, 122.811394, 363.070068, 539.050903 389.771210, 358.130951, 42.615650, –54.583321
156	–190.028824, 35.819481, –72.171303, 416.761719, 468.406982 48.947430, –217.165985, –629.450134, –855.864807
157	690.035156, 678.191345, 374.738464, 116.511391, –177.495270 –559.347290, –781.556396, –1086.437988, –1198.095215

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Index	Codeword
158	982.496399, 394.303375, –71.543907, –523.927917, –677.260681 –894.055725, –894.495422, –1078.243774, –1019.578369
159	–59.720707, –615.157593, –1011.128235, –1471.507812, –1689.347046 –1918.099365, –2118.354004, –2456.670654, –2522.051758
160	–19.764742, –471.573608, –823.959961, –1426.643921, –1940.420166 –1354.637817, –1006.084229, –600.211182, –315.964661
161	451.760864, –386.723450, –443.880493, –1157.029419, –2024.143433 –2307.281494, –988.382568, –643.842834, –581.822632
162	29.281801, –474.824768, –717.323547, –1104.237671, –1173.256714 –1403.408569, –1757.094482, –2137.989014, –2409.224121
163	–126.811966, –660.853577, –1009.586609, –1468.573242, –1837.390503 –1873.889648, –1122.959351, –944.855286, –682.774719
164	–201.716019, –376.240814, –457.417786, –95.987808, 325.228302 398.688049, 527.887512, 476.375580, 496.663727
165	–243.958618, –349.740448, –196.670685, –205.858994, –178.919907 –210.137161, –34.842102, 96.661407, 234.190201
166	–22.390350, 489.585999, 985.910645, 861.128479, 541.654785 74.230301, –314.271606, –788.963013, –999.877136
167	222.074677, –287.362183, 74.757889, –117.507614, 15.699092 –264.202545, –159.531601, –392.734039, –338.009735
168	–181.277679, –638.428589, –680.598938, –1230.816284, –1306.731812 –876.499939, –893.502136, –641.560120, –465.425415
169	45.706028, –187.878601, –227.202896, –348.698608, –655.258301 –1177.003418, –1363.528564, –834.438538, –787.763733
170	538.307739, 95.790123, –343.766388, –791.648621, –1077.554932 –1263.006348, –1397.224121, –1605.978027, –1821.339966
171	–284.588654, –921.890015, –737.540161, –840.388123, –948.210571 –1147.289307, –1362.922241, –1606.361816, –1775.419800
172	–8.925940, 1316.169312, 874.871948, 478.259766, 134.867432 –152.284210, –396.394501, –642.910522, –747.362061

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Index	Codeword
173	–570.521057, –1320.476807, 680.706299, 816.224182, 1261.479004 1220.774414, 1413.046021, 1383.548584, 1500.537842
174	–376.266327, –1358.371704, –1142.299683, 117.106003, 372.370209 457.582367, 465.587280, 445.678497, 394.158661
175	–171.539291, –748.739136, –1096.384766, –1554.841553, –1886.605469 336.762848, 160.452591, 4.648007, –53.059750
176	57.858696, –230.532944, –734.336426, –1199.881348, –1048.929321 –844.434143, –756.553528, –898.697021, –814.052979
177	102.989395, –343.258972, –396.959747, –646.421448, –774.568970 –1126.143433, –563.837280, –424.341248, –188.013916
178	–146.991638, –804.075195, –1119.743408, –1683.964355, –2263.950439 –503.006744, –721.959473, –673.123291, –445.826538
179	–395.988495, –1070.903198, –590.672363, 382.879913, 644.958984 241.903732, 46.419594, –411.099579, –550.546265
180	–157.615616, –459.796967, –879.255615, –1276.781128, –463.483490 –34.213669, 160.186905, 225.185394, 315.109528
181	–193.233856, –983.809692, –1439.684448, –2042.781250, –2454.115234 –2739.922119, –2691.471436, –1722.092529, –884.103638
182	–209.261917, –1071.798706, –1602.855591, –2159.484375, –2374.191406 –1981.226807, –1148.103149, –682.483826, –329.949249
183	–112.721451, 202.234741, 2.389480, –264.000092, –27.009350 202.602722, 26.050808, –430.921570, –765.662109

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Index	Codeword
184	397.861053, 182.528809, –235.648392, –405.027954, –136.935242 –235.972595, –246.528183, –481.237274, –535.715332
185	–278.234009, –827.781128, –752.883911, –466.989594, –320.336670 –672.032898, –863.731323, –1161.255981, –1400.910889

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Index	Codeword
186	–40.973869, –131.660767, –299.178619, –742.490723, –771.245972 113.764877, –196.912857, –561.841675, –982.662415
187	–404.340363, –1134.885864, –1034.914307, –997.058594, 267.367828 173.992477, –1.694684, –464.673004, –770.912231
188	–253.682114, –217.055069, –450.508270, –521.870178, –282.631500 –517.459839, –495.103638, –834.461365, –1062.342529
189	–249.738586, –937.397705, –640.001892, –675.438660, –570.580078 –407.106415, 1070.533203, 836.401245, 326.148163
190	527.339905, 719.609558, 720.028137, 822.540894, 849.751709 825.033508, 828.729248, 717.622009, 636.672119
191	–456.071869, –1250.948975, –104.695229, –75.758865, 139.109131 132.780731, 210.528854, 168.443298, 271.893005
192	–217.989136, –1060.941772, –1543.470825, –2165.294434, –2583.753662 –2728.703125, –1856.940430, –1027.727783, –544.276062
193	–474.045319, 458.974854, 837.952820, 943.188660, 1000.440247 950.523865, 926.026123, 833.391296, 796.308044
194	–90.405281, –689.172913, –543.798401, –1191.090942, –779.600403 –1011.817810, –1103.439209, –1140.771606, –1069.512573
195	654.475708, 1470.965454, 1283.830566, 1355.302246, 1215.090698 1242.490967, 1179.114990, 1123.327759, 975.381287
196	221.189468, –193.926590, –671.781799, –1185.121460, –1651.171631 –1605.885986, –1099.926270, –1008.106689, –976.504089
197	302.228058, 166.080658, –291.596680, –514.976562, –334.636627 –519.004272, –632.970520, –862.890137, –927.529724
198	–304.122864, –994.066772, –893.892944, –1265.938599, –1306.123413 –1279.007935, –1051.650269, –1009.602112, –776.189697
199	398.439453, –20.591383, –555.842163, –1159.980835, –1624.051880 –894.125793, –949.559753, –885.922180, –814.496460
200	92.801064, 1164.293945, 802.599792, 479.609894, 40.354275 –409.047546, –837.928162, –1215.925171, –1403.282349

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Index	Codeword
201	–103.158302, 900.035217, 838.126953, 700.942932, 490.099823 215.066879, 54.649097, –221.317123, –332.887360
202	–316.185150, –795.790527, –465.281952, –823.125916, 279.398102 4.969502, –111.705475, –293.041595, –71.397591
203	–208.605103, –930.010925, –1317.236084, –1524.382568, –1237.802368 –1231.182373, –1223.147705, –1303.267090, –1338.722656
204	–306.984497, 524.299561, 496.007812, 554.238037, 526.116821 552.875793, 621.609985, 647.903809, 648.063293
205	–191.399063, 106.350975, –10.322931, –235.823715, 781.303772 475.559570, 138.095871, –381.311462, –703.843323
206	427.002899, 193.730301, –249.266571, –576.741150, –672.449402 –905.434448, –1067.168945, –1354.593628, –1497.148926
207	–470.544312, 1433.881592, 1415.007812, 1581.021729, 1347.515015 1305.963989, 1181.518433, 1046.481812, 899.044922
208	–280.197632, –426.098328, 67.108482, 72.767601, 313.018188 100.961258, 144.139343, –174.612595, –228.310028
209	11.646732, 964.122498, 523.617188, 150.000824, –173.893707 –157.686981, –103.815186, 156.810150, 247.870422
210	–332.143280, –1160.115356, –1280.343750, –767.366089, –498.519501 –533.037537, –494.996948, –569.730042, –518.864563
211	433.381531, 15.187217, –449.491577, –703.293030, –803.316833 –835.974365, –792.097107, –951.533813, –945.431335
212	–749.471924, 13.263083, 1330.948242, 1355.199341, 1704.749146 1687.224976, 1855.235474, 1803.945068, 1879.865356

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Index	Codeword
214	–76.864571, 1566.287720, 1979.153564, 1816.987061, 1480.883545 1051.511841, 680.155212, 283.731506, 49.960445
215	–398.984741, –1099.112671, –441.023163, –865.695312, –596.991150 –165.189606, 145.491440, 313.867889, 534.415955
216	–344.061218, –787.391846, 314.467285, 335.746521, 330.660370 –155.917572, –427.322876, –874.026428, –1033.887695
217	–218.076859, –471.678925, –740.102173, –963.206055, –691.495605 –631.507080, –526.847839, –547.032471, –472.381805
218	–65.633423, 1715.546143, 1273.253662, 891.733337, 491.938904 317.231781, 236.129700, 258.489990, 122.087456
219	–182.897858, –635.679382, –839.284912, –1327.341187, –1097.753052 –407.501709, –31.804829, 98.519104, 220.063461
220	–272.900055, –1190.943359, –1664.515991, –2272.859375, –2254.459961 –658.264221, –92.030678, 162.460190, 371.485138
221	110.549355, –97.581825, –448.147552, –1003.613464, –1313.954224 –490.750549, –771.622314, –1146.729614, –1488.419556
222	–15.722897, –343.917999, –623.659790, –1222.161865, –525.122131 –746.976440, –1098.472656, –1486.665894, –1646.623291
223	–27.274996, 110.961189, –360.191864, –839.653381, –959.202759 –1052.568970, –1121.710815, –1161.902222, –1138.799072
224	2.914193, 183.097900, –369.737396, –906.104187, –865.116028 –992.003296, –587.679138, –629.010742, –564.785950
225	–199.768204, –522.689270, –259.972870, –581.607056, –790.009460 –1049.283936, –1102.648071, –1337.240479, –1395.463989
226	66.927528, –428.277649, –187.231018, –836.323792, –1125.244873 –458.102875, –647.304199, –886.505554, –638.468018
227	–94.328537, 261.429749, –97.315033, –452.707825, –832.687073 –1155.034424, –1376.725220, –1519.680664, –1655.947266
228	403.557434, 222.425934, –116.075737, –299.235687, –451.025604 –742.190613, –672.085266, –684.950989, –390.703125

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Index	Codeword
229	–77.066376, 77.830589, 277.074188, 636.396851, 923.212097 808.036011, 707.707886, 389.819733, 273.664062
230	–233.448212, –258.093109, –270.512939, –414.142883, –485.810974 –690.496765, –622.794006, –712.351135, –551.438660
231	571.873657, 673.336548, 634.134155, 580.569336, 501.235016 329.346832, 329.521454, 114.622795, 51.585625
232	–101.469490, 666.245056, 543.401917, 582.935486, 546.431091 420.524933, 404.157104, 195.331772, 161.434845
233	–176.970886, –737.287842, –1058.790771, –1613.152466, –855.213684 –747.337891, –887.670715, –818.685181, –779.836792
234	–374.160767, –992.195374, –447.817047, –538.550659, –421.040131 –537.537476, –373.479462, –352.113800, –141.020050
235	–754.974487, 635.823425, 1339.891724, 1442.483521, 1692.018677 1734.460083, 1852.739746, 1843.592163, 1893.666260
236	–158.565567, 610.178833, 436.004883, 295.670258, 169.214249 –54.113548, –182.365295, –487.801361, –587.581665
237	–238.826248, 200.013123, 110.359848, 71.252274, –9.610732 –190.478989, –175.310699, –294.996704, –249.046890
238	156.508057, –156.490112, –465.772675, –913.607361, –1022.254211 –1363.447388, –615.717407, –1028.598267, –1266.942139
239	–356.656403, –1146.559814, –1022.871277, –1108.460815, –90.339676 72.129295, 232.148758, 237.532684, 313.416077
240	–297.429688, –711.554810, –216.735733, –505.421326, 551.118713 250.093857, –38.674564, –525.157959, –849.864563
241	–295.815125, –1209.349854, –1776.149536, –1998.250122, –592.952271 –384.668030, –185.576477, –164.222015, –136.108200

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Table B.41 (continued)

Index	Codeword
242	–132.807831, –638.202820, –917.321838, –1318.292114, –1810.082275 –1220.721802, 685.909424, 556.612610, 370.619812
243	–197.379715, –1072.747314, –1440.673584, –1876.071411, –2089.344238 –1721.490356, –494.098083, –140.939713, 217.494400
244	508.745697, 620.538208, 498.007721, 371.627930, 241.868118 6.471931, –64.585320, –294.206207, –329.333954
245	–461.752197, –504.665894, 834.920532, 809.721191, 1020.176880 871.390442, 903.949707, 739.781250, 752.165588
246	68.185127, –25.366402, –289.149689, –775.257812, –47.512859 –551.142700, –992.717712, –1406.638184, –1423.804077
247	1074.732666, 523.538391, 143.826492, –187.822311, –245.405121 –337.596924, –392.422150, –526.609680, –543.828674
248	–121.817963, 286.786957, –32.153019, –268.764130, –310.116547 –382.739136, –381.658600, –611.214905, –667.152649
249	368.183838, 129.406418, –327.912201, –1042.670898, –555.348694 –921.933716, –976.043030, –1177.621948, –504.788055
250	–243.511139, –747.707458, –671.397400, –1178.495239, –75.772865 –466.295319, –582.133057, –871.793884, –1050.080688
251	–106.184364, –608.038757, –968.961609, –1434.189453, –1641.399658 –1630.353271, –1443.817383, –1404.703247, –1230.599854
252	718.401611, 2704.733887, 2630.791748, 2413.644775, 2020.989502 1672.132812, 1268.989136, 930.174011, 549.528198
253	–280.844727, –837.520813, –893.299866, –1385.495483, –334.480225 –482.172333, –454.969421, –286.658356, –111.712273
254	–294.975677, –1109.926758, –1316.428345, –987.775269, –629.906128 –331.063782, –88.151436, –42.998192, –9.167728
255	–720.846436, 1115.457275, 1445.276978, 1626.742798, 1758.635132 1845.389893, 1893.553589, 1901.911011, 1885.918091
256	–10.630882, 173.645126, –194.461044, –520.689392, 145.682388

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Index	Codeword
	–76.744125, –411.265472, –869.935303, –1199.078491

Table B.42 Stage 1 second sub-vector codebook lsf_stage1_CB2_lbr of low-precision LSF vector quantization codebook

Index	Codeword
1	–1025.445557, –1558.926147, –2144.454346, –1791.063965, –1952.295288 –1405.597290, –2150.003418
2	–954.523376, –818.689392, –1113.715698, –887.345154, –1365.084351 –1268.915771, –2110.815186
3	–619.806885, –685.579651, –746.767395, –691.805176, –616.305969 –647.728027, –512.941956
4	–59.775761, 22.873430, –414.587616, –322.859131, –903.828430 –888.348755, –1863.307739
5	–1225.429932, –1281.655762, –1576.963623, –1762.252441, –2420.828369 –2961.331543, –318.643402
6	–847.398743, –1271.069458, –1061.816650, –168.675690, 50.615589 259.891388, 311.872589
7	1678.143066, 1741.549927, 1650.775269, 1412.182495, 1118.326782 889.213501, 657.603821
8	–1893.017090, –2061.548584, –1934.615967, –2040.489502, –1998.668701 –1757.438721, –1278.423218
9	–1981.158325, –2000.392334, –1779.247070, –1688.792236, –1332.873413 –1121.153931, –940.593201
10	–1115.811279, –1152.664795, –1552.353027, –1439.754517, –1908.486694 –1673.207275, –2451.110107
11	–379.387024, –26.146738, 41.422009, 164.160645, 123.430641 175.891678, 62.278313

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Table B.42 (continued)

Index	Codeword
12	–2213.671631, –1141.692993, –609.784058, –353.606750, –85.206703 148.116455, 181.632812
13	–1154.319214, –1227.523071, –1489.456421, –1601.720459, –2058.670654 –814.973206, –1702.502808
14	–918.795044, –1343.674194, –1183.565918, –950.312866, –1186.982422 –1103.976562, –1854.349609
15	227.948730, 1136.904053, 1219.321167, 1506.619507, 2232.180908 2348.839111, 1403.756592
16	–2236.907715, –2289.355713, –2560.764893, –2482.412842, –3092.014160 –2176.867676, –317.259705
17	–1555.807617, –501.324615, –1023.675842, –1040.626343, –1486.283691 –1266.904053, –2026.519897
18	–1669.823242, –1464.875244, –1696.568970, –1326.180298, –1452.729004 –840.359619, –1714.870850
19	–1532.789062, –1729.420166, –2049.086426, –1779.276611, –1770.308472 –1014.531860, –1772.082520
20	–1528.967285, –1655.654541, –1899.280884, –1819.910645, –2133.318115 –1590.653442, –2254.575684
21	–1144.653076, –948.210571, –870.286560, –501.640564, –793.606384 –671.439697, –1547.295288
22	–461.364410, 682.552795, 461.194458, 359.740967, 362.942017 339.776062, 376.410309
23	–1149.120239, –1575.110596, –1927.880615, –1335.437256, –1518.165649 –1044.578857, –1843.897095
24	2135.116699, 2256.741455, 1956.162842, 1594.127441, 1218.817749 904.284485, 682.448364
25	–1041.697021, –1173.235107, –633.627747, –966.614746, –1525.846680 –983.940491, –1708.915771
26	–1837.993042, –2091.420898, –2478.027588, –2809.757080, –3339.826416

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Index	Codeword
	–3897.479736, –4707.816406
27	–445.076660, –157.336899, 0.462463, 312.914917, 378.175018 418.287964, 437.912292
28	–439.980408, –449.660858, –1115.516235, –1478.943726, –2040.065186 –1754.303345, –2473.741211
29	183.339447, 101.839279, –21.999655, –217.910965, –431.363098 –963.968079, –1546.019775
30	–1504.246826, –1618.718872, –1747.502930, –2033.336304, –2296.113037 –2512.910645, –1610.453125
31	–917.428162, –986.813293, –1067.608032, –1200.509155, –1362.467285 –1514.312012, –1158.368652
32	1395.400391, 1494.203003, 1504.630981, 1298.671509, 1035.527832 821.061829, 624.906738
33	–448.509827, –513.075562, –838.923401, –349.190704, –993.107971 –1118.479248, –2049.759033
34	–612.845703, –1007.675659, –1485.587158, –1165.256592, –1222.697632 –840.847656, –1658.234619
35	–1450.915405, –1349.162354, –1323.501709, 74.000221, –380.690308 –498.892334, –1499.937378
36	–2156.536133, –2291.489014, –2427.126465, –1819.702637, –1754.847168 –1190.418701, –1890.954834
37	–1499.903687, –444.774536, 768.410950, 1536.175415, 1272.848511 1048.861816, 772.685303
38	–887.627563, –822.545837, –998.152100, –562.538330, –786.750061 –142.196915, –868.241516
39	1133.573730, 1022.729675, 933.447632, 929.575195, 746.131165 643.459045, 421.243073
40	–594.492798, 448.852051, 1012.362915, 956.231873, 752.287537 587.962708, 512.185059

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Table B.42 (continued)

Index	Codeword
41	–1410.218628, –1474.849854, –1449.908081, –1601.166992, –1158.019897 –255.972961, 72.685135
42	–1266.662720, –1197.473999, –1101.059326, –1019.961609, –935.622437 –897.695129, –1165.877075
43	–1161.196167, –1358.582031, –1438.956055, –1154.027466, –1487.140015 –1287.429932, –2068.938477
44	–1951.491943, –2276.684082, –2605.463135, –3121.375732, –3703.884521 –4444.492188, –1389.477295
45	513.975647, 12.077785, –122.189568, 475.613800, 431.415344 426.029419, 416.788300
46	–847.774170, –475.462006, –815.791504, –800.997925, –1365.104858 –1477.232422, –2320.281250
47	264.021484, 246.813354, 64.843918, 40.896435, –145.363602 –482.314117, –1039.475708
48	–855.705627, –193.679138, 587.207397, 741.479309, 611.131592 490.605042, 419.768677
49	–904.709534, –993.312683, –997.528381, –1657.625854, –1188.919189 –997.200623, –1495.383057
50	–931.204895, –1047.634766, –1584.752808, –1791.148193, –2180.735107 –1455.360474, –2169.037109
51	–1015.164124, –1246.681641, –1685.658813, –1876.436157, –1603.031738 –1116.275635, –1803.888672
52	–851.682434, –633.694946, –451.774994, –389.725128, –313.773590 –480.187469, –692.924622
53	–712.982483, –691.948669, –657.795349, –648.190430, –834.174927 –1056.077148, –1796.616211
54	1951.557739, 2124.905762, 1876.367065, 1546.324097, 1187.195190 894.609985, 670.870239
55	73.852234, 65.499107, 665.957153, 829.415833, 664.944092

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Index	Codeword
	553.647522, 477.308777
56	–225.363541, 470.226196, 1420.814209, 1524.770996, 1257.211914 1054.867676, 779.712891
57	–3066.772217, –3320.171875, –1755.439575, –913.461670, –465.759613 –57.672546, 181.598816
58	394.747803, 543.978943, 301.814484, 373.118195, –203.041214 –410.210175, –1401.083496
59	–254.991013, 6.490180, –86.547020, 334.854797, 192.452530 419.970276, –669.483948
60	–853.813477, –937.095398, –1324.438965, –1171.276611, –1614.367432 –1207.909180, –2010.941772
61	–79.464409, –308.357544, –878.415833, –1053.853882, –1480.095215 –1042.867920, –1868.481201
62	1119.224121, 2373.954834, 2685.428467, 2891.306641, 2396.660889 2056.481934, 1200.541382
63	714.623291, 438.046265, 73.563614, –58.022953, –9.994848 127.793358, 296.390991
64	–672.743042, –884.477173, –1117.022827, –1600.467896, –2110.626709 –2974.947021, –1047.465210
65	–1300.258667, –1228.864258, –1260.032227, –648.009460, –942.031982 –747.062378, –1653.133667
66	2883.623047, 2563.917480, 2196.644043, 1742.524658, 1349.104370 980.756714, 733.060547
67	–1098.610962, –1080.493530, –1496.681274, –1381.791016, –1795.001709 –1327.081787, –2094.705811
68	198.491592, 526.795959, 1006.147949, 980.373901, 778.986816 607.859619, 511.755981
69	–1.237812, 160.743134, 234.740402, 367.119659, 406.874481 440.592163, 422.110687

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Table B.42 (continued)

Index	Codeword
70	–1550.515137, –851.167358, –1311.250366, –1574.810425, –1835.150879 –1107.781616, –1898.006836
71	–284.272217, –433.876221, –428.981812, –981.543457, –1270.818359 –40.644142, 220.977402
72	1028.936279, 1198.602417, 1347.095581, 1191.527466, 947.432373 748.339233, 588.323792
73	–527.319885, –372.557434, –520.435181, –530.666870, –745.792786 –1036.270386, –1784.524292
74	–1261.415161, –1271.482300, –1285.284912, –1491.556152, –1492.168945 –1121.455566, –542.928772
75	–1051.774536, –575.885498, –880.983459, –893.896545, –1280.546509 –1003.587708, –1856.981445
76	–1484.438599, –1497.676758, –1417.937378, –1478.414917, –1270.368530 –1210.548706, –1377.488403
77	–2284.488281, –2475.568848, –2549.678711, –2380.119385, –2334.494873 –1691.260498, –2079.139648
78	–849.849915, –808.925293, –1187.607544, –1324.695801, –2218.496094 –1798.911377, –7.794962
79	–1739.335327, –1621.678223, –1923.265503, –1880.257202, –2534.694092 –1862.062500, –86.207451
80	–2400.431152, –2023.654663, –1612.980591, –1507.007935, –1438.144409 –414.243439, 18.127321
81	1379.186890, 734.271179, –343.965485, 666.540344, 418.169128 586.979736, 159.339020
82	–1327.495117, –1011.947632, –1257.065674, –1106.393188, –1519.401245 –1203.832642, –1988.876465
83	–2900.826904, –2071.155273, –931.973999, –620.055481, –238.298386 51.354084, 185.485703
84	1416.857788, 1443.416748, 1396.016602, 1061.671143, 539.757629

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Index	Codeword
	–57.588993, –529.872070
85	–1381.020996, –1011.073425, –1117.733521, –799.515869, –1151.570068 –1151.280762, –1968.326904
86	–664.578979, –340.874969, –581.869263, –385.350647, –855.842957 –723.654907, –1668.381348
87	–239.082840, –358.530243, –462.077606, –755.325012, –1069.406006 –1435.389771, –362.738647
88	–2198.786377, –2450.488281, –2962.151123, –3407.308594, –1153.890381 –478.794434, –34.776772
89	–1491.307373, –1808.472168, –2021.277832, –2369.602783, –2064.542236 –511.397156, –23.106594
90	1012.056763, 930.190796, 809.964172, 712.060120, 556.017761 356.482849, 418.835175
91	–223.605896, –162.689224, –623.514648, –634.457458, –1285.401611 –1279.381470, –2197.202148
92	–2013.476807, –1931.635864, –2086.846191, –1884.910889, –2132.437012 –1781.376221, –2355.531250
93	–1478.611694, –1502.686279, –1579.426392, –1776.563843, –1922.639282 –1700.766479, –863.249451
94	399.884247, 1336.809937, 1467.834839, 1231.440308, 944.319824 714.730347, 566.275085
95	–1909.513794, –1941.199341, –2085.629395, –2205.229248, –2642.804443 –3147.793457, –475.752045
96	649.063477, 491.458344, –353.614777, –123.980179, –189.024261 –512.889526, –374.362457
97	–255.760773, –218.515747, –651.565857, –579.347717, –1121.250610 –875.253906, –1822.844360
98	–356.398987, –322.802887, –341.252716, –337.389313, –368.309387 –564.473328, –961.036682

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Table B.42 (continued)

Index	Codeword
99	–628.832153, –520.285034, –588.919617, –597.740173, –655.028503 –689.380981, –1164.055420
100	–715.569885, –1016.947021, –1246.564453, –613.046509, –899.559570 –700.425415, –1602.584961
101	–495.605225, –498.591705, –890.112549, –794.450500, –1308.796021 –1155.602417, –2031.677734
102	–875.373779, –971.543274, –1524.570923, –1737.737549, –2204.225342 –2113.908936, –2749.268311
103	–1709.141968, –1925.645508, –2331.198242, –2283.702637, –2462.921387 –1692.611084, –2252.493164
104	720.386292, 1149.667725, 1467.922485, 1450.620361, 1317.223022 1116.553223, 841.229187
105	885.497620, 1587.753906, 1888.884277, 2303.653809, 2150.790527 2051.243652, 1198.554810
106	–13.404860, –174.803833, –402.282806, –536.339722, –521.674011 –470.419830, –92.618591
107	212.016647, 135.590973, –435.995789, –544.691711, –1228.437378 –1122.961548, –2034.787964
108	–125.149994, –583.985229, –662.346069, 246.242020, 307.632996 329.847107, 357.718689
109	751.541626, 577.168945, –540.336487, 58.593849, –367.797974 –486.880280, –1335.964600
110	–771.941772, –908.973206, –1379.661743, –1369.286865, –1839.978516 –1582.273926, –2354.780518
111	2588.802734, 2444.061523, 2091.616943, 1677.830322, 1289.599731 942.811218, 707.786316
112	483.501984, 217.483292, 386.499664, 296.597534, 220.394058 –279.699463, –232.500107
113	750.680847, 671.408386, 492.794983, 466.070251, 331.014160

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Index	Codeword
	265.037689, 262.980225
114	–931.252686, –739.344910, –479.008026, –292.997284, –39.842056 155.129913, 252.702530
115	–699.944885, –320.508942, –448.116058, –140.793747, –555.594910 –550.571533, –1499.539185
116	–3182.762207, –3706.974365, –3368.149658, –1724.299561, –899.661133 –304.383423, 102.869270
117	–2198.285400, –2661.550781, –2924.803711, –3695.177734, –3522.947998 –893.561279, –200.487762
118	–1914.781372, –2263.327148, –2204.333252, –2708.312744, –2737.251709 –3691.747559, –1746.551514
119	–1176.847168, –1399.460693, –1944.353516, –2252.302734, –2727.296387 –1979.486816, –2509.687744
120	–617.079163, –400.202545, –169.513504, –64.215126, 141.336349 273.932709, 350.984192
121	–146.712021, 29.761538, –185.886520, 36.444355, –317.681915 –9.635806, –882.568787
122	–853.681030, –618.070862, –848.745422, –567.171326, –964.919678 –700.323547, –1625.511230
123	–1866.847534, –1855.031616, –2043.105835, –1959.685913, –2075.854004 –1290.863892, –1966.472046
124	–1240.036987, –1385.001587, –1153.131470, –1487.872192, –1927.276245 –1474.927979, –2165.958252
125	–1160.221924, –1394.681763, –1689.331177, –963.545776, –1117.765137 –785.958801, –1655.615601
126	–2506.828857, –2412.121826, –2366.885010, –2094.813232, –2321.790039 –1103.879517, –68.931801
127	116.747658, 309.537476, 102.929665, 244.603302, –300.030518 –443.569061, –1433.695190

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Table B.42 (continued)

Index	Codeword
128	–311.663879, 326.289520, 452.395294, 832.174316, 276.240356 –265.085205, –1203.591797
129	–312.455383, –534.556335, –898.104919, –421.191711, –870.713501 –686.010254, –1610.913574
130	–2223.857178, –1749.410156, –732.078979, 776.504517, 1279.655273 1057.796753, 730.522949
131	–1278.438965, –1337.653198, –1735.267212, –1699.908691, –2139.395508 –1795.072876, –2496.341064
132	1878.921997, 1922.607544, 1767.357666, 1498.063232, 1173.502563 926.899414, 677.734863
133	–860.766418, –959.988586, –1574.841675, –130.846207, –605.896606 –1274.775879, –2029.413574
134	672.132080, 784.561218, 542.281128, 505.435944, –81.187279 –364.267731, –1346.734863
135	–679.825806, –396.701569, –747.309204, –612.425232, –1114.258667 –951.520203, –1883.500000
136	273.454254, 505.299377, 380.777863, 720.950867, 446.219635 470.014709, –593.205750
137	–552.414307, –614.149353, –771.000549, –820.348267, –315.271545 76.449310, 226.295868
138	–1588.281372, –1638.489868, –1975.302124, –1913.472290, –2280.515137 –2005.639771, –2615.034180
139	–1591.169922, –903.552734, –947.961975, –1538.241333, –1246.838745 –920.043213, –1608.986206
140	933.789246, 1132.058594, 909.458252, 843.237366, 217.935349 –259.025299, –1224.878418
141	–819.524170, –796.189087, –839.038879, –872.878601, –965.350586 –881.141785, –1175.653076
142	–985.351685, –982.313110, –1018.421204, –1146.665039, –1041.144531

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Index	Codeword
	–862.111694, –429.493561
143	–2147.105469, –2150.295898, –2634.779297, –1851.966553, –574.587769 –173.353073, 201.615067
144	808.396484, 711.239441, 766.214478, 544.480957, 387.048828 –159.360245, –213.043732
145	–835.451721, –901.315674, –1511.963867, –1617.422241, –2408.831055 –2809.031738, –3807.552979
146	–681.278564, –663.108459, –1050.592529, –1039.863647, –1489.105103 –1050.743896, –1903.991455
147	–1231.333252, –1653.905273, –1746.697510, –2400.019775, –2611.556152 –3640.648193, –2618.129395
148	–823.225830, –994.271667, 34.345436, 465.466858, 403.638428 371.257141, 349.227234
149	–308.299561, –348.854034, –380.349731, –274.439667, –135.211472 29.159761, 168.604477
150	189.439529, –19.790514, –354.154694, –546.065247, –146.602478 230.009827, 295.738068
151	461.968658, 626.050415, 47.854416, –136.378067, –974.916626 –1239.504639, –2210.014404
152	–146.661850, 514.339966, –594.032837, –584.835510, –429.045593 –687.339600, –1210.203613
153	–36.429043, –63.248245, –169.160934, –306.868805, –515.846008 –979.940063, –1618.352295
154	–1450.773315, –1292.733765, –1625.638428, –1334.478027, –1652.320068 –1156.253296, –1948.120972
155	–1609.528809, –1748.195923, –1849.325317, –902.303650, –317.236542 59.964432, 245.630280
156	–478.842133, –551.974731, –931.206116, –845.584106, –1238.124756 –782.011475, –1684.930542

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Table B.42 (continued)

Index	Codeword
157	–1868.412720, –2019.276978, –2302.041748, –2320.242676, –2630.770020 –2504.333252, –2883.652832
158	–1334.282593, –1380.305420, –1712.473755, –1599.545898, –1922.840820 –1364.126953, –2102.723389
159	674.909668, 593.001526, 632.620483, 739.557922, 647.171631 598.846130, 504.963593
160	–1293.485718, –1619.509521, –1743.204712, –2296.322266, –2625.175537 –3608.674561, –1111.967285
161	–1551.716309, –1261.823730, –1537.043457, –1439.098389, –1946.865112 –2143.446289, –2936.749756
162	–1865.563477, –2266.884277, –2327.579102, –2886.662109, –2986.587402 –3896.322510, –3199.838867
163	–1297.908936, –1507.185547, –2026.442505, –2387.808105, –3053.241699 –3704.563477, –4686.282227
164	–1578.633423, –1579.114258, –1440.448486, –1311.780762, –939.062073 –843.284424, –714.103027
165	1687.707886, 2044.316162, 1825.541992, 1497.671753, 1145.952026 849.316101, 651.482178
166	–1009.696899, –222.117264, –771.609741, –1619.151855, –1208.036255 –1003.212463, –1714.239868
167	–1810.316895, –1231.567627, –1636.892090, –1864.545288, –2074.797607 –1385.536133, –2063.006836
168	–710.491760, 492.150574, –503.805817, –229.187119, 110.906113 282.697723, 55.507629
169	–1055.189941, –1082.506836, –1631.291016, –832.915344, –1290.385132 –1288.410645, –2099.172119
170	–677.468689, –1213.786987, –1832.875732, –1311.399902, –1655.118896 –1257.517700, –2133.393066
171	439.705566, 475.338715, 70.628548, 94.696815, –488.101837

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Index	Codeword
	–589.449707, –1577.500610
172	–1090.651245, –966.298645, –1281.871216, –1071.899048, –1602.906494 –1546.179932, –2356.489746
173	–176.466660, –259.544586, –842.928284, –904.868774, –1627.998169 –1901.671753, –2790.327637
174	–465.968689, –549.631042, –734.263306, –1057.186890, –976.384277 –689.167419, –222.912125
175	–1158.937134, –119.719742, –646.479370, –644.535522, –933.463501 –792.865967, –1670.845459
176	–750.801086, –706.406555, –713.155640, –272.636993, –658.693359 –627.088867, –1560.627197
177	–1711.215698, –1495.088745, –1775.548950, –1505.336792, –1877.358032 –1675.769531, –2388.443604
178	–1407.030518, –739.424866, –1274.515137, –1506.798096, –1997.677368 –1659.833252, –2381.872070
179	–1128.046753, –615.983215, –803.808105, –489.734253, –953.664368 –980.357361, –1857.874634
180	1321.423096, 1831.520020, 1710.042847, 1410.556519, 1080.634644 804.950562, 626.732788
181	–1208.621948, –1512.455566, –1852.088623, –1282.296753, –1691.754395 –1564.541748, –2293.062256
182	–130.666595, 106.064713, –89.260017, 103.645401, –379.526367 –480.569031, –1442.557129
183	–846.357117, –764.076843, –1203.165894, –1197.817749, –1811.429077 –1983.140259, –2796.902344
184	–46.024593, –110.736679, –447.505859, –469.773193, –874.538391 –402.937805, –1133.668335
185	–1509.996582, –1677.197876, –2105.592041, –2329.006592, –2809.195801 –3156.773926, –3939.870605

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Table B.42 (continued)

Index	Codeword
186	–1452.266235, –1189.537476, –1349.120117, –1023.163513, –1286.727051 –908.575500, –1733.368286
187	53.716125, 98.533348, 124.961006, 58.117867, 82.433022 –320.471771, –455.971619
188	–1663.746948, –1640.456543, –1816.988037, –1481.121338, –1737.681274 –1288.965454, –2014.165039
189	–1192.195312, –1001.089722, –831.286682, –678.389160, –372.874237 –121.623199, 6.853171
190	–593.864868, 172.604919, –302.387390, –386.411194, –1001.882935 –940.392395, –1903.361816
191	–2012.852295, –1209.255737, –1386.427612, –1058.992920, –1368.542480 –1097.503174, –1899.640991
192	–1302.134644, –1512.447388, –1917.826904, –2187.393311, –2412.989014 –1257.125000, –1899.332275
193	–662.509155, –142.376114, –597.944763, –952.603516, –1486.605835 –941.209778, –1875.773926
194	–766.835876, –813.700745, –965.409729, –1245.255371, –1896.465210 –555.912415, 139.788239
195	–53.709496, –24.457977, –27.835449, –9.611705, 202.381714 296.835175, 376.950104
196	–1525.039551, –1650.326904, –1216.550537, –1621.969482, –1727.015625 –1065.248413, –1784.243774
197	–813.587952, –693.967896, –843.175720, –1081.308472, –1468.924072 210.317993, –761.495422
198	105.552757, 71.800415, –42.032394, –72.381523, –146.560120 –183.135468, 85.448723
199	265.414490, 642.176758, –456.374176, 320.947174, 278.549408 459.789032, 103.696960
200	220.106293, 364.429077, 130.036377, 291.826294, –106.766251

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Index	Codeword
	113.313423, –802.879395
201	–3134.160400, –3552.298096, –3854.004883, –4320.645508, –1937.848022 –665.023315, –176.597946
202	–1004.107605, –1031.160889, –1016.486206, –1210.363159, –849.197205 –107.791985, 161.588196
203	–693.122864, 325.670166, –643.304443, –1307.331299, –789.680725 –839.081665, –1511.067627
204	–391.568237, –99.078201, –259.886230, –22.610729, –472.509125 –513.719727, –1472.088257
205	–1575.965454, –1609.202637, –1605.129883, –1001.017700, –1327.703369 –1221.082031, –2007.426270
206	–354.735535, –381.940735, –894.146545, –998.646545, –1582.024902 –1441.162598, –2270.900391
207	–750.359741, –745.182007, –1095.111572, –693.184387, –1186.341431 –954.111694, –1859.068237
208	250.793350, 308.514526, 257.658905, 259.137177, 223.083923 209.800003, 187.700897
209	–398.730713, –282.424469, –167.861862, –148.836700, –112.436821 –333.931335, –371.274994
210	1144.176147, 854.793945, 247.951218, 476.229004, 262.055573 –210.412064, –311.474915
211	549.641846, 657.539246, 324.278534, 175.408035, 147.500793 –372.890747, –527.594421
212	–1552.106812, –1189.027100, –1516.479858, –1235.234619, –1642.160400 –1497.831909, –2275.606689
213	–1900.223633, –1642.089966, –1345.290283, –844.898010, –877.631287 –742.815796, –1521.429077
214	–1037.835571, –656.155457, –1014.410461, –1315.275879, –1811.045044 –1302.612793, –2036.575439

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Table B.42 (continued)

Index	Codeword
215	–1133.035889, –952.475220, –746.429382, –676.345276, –574.932373 –664.157715, –847.545410
216	–277.608704, –261.225098, –345.695862, –430.000031, –623.311157 –1011.414001, –1672.150635
217	–624.576355, –378.763763, –600.394714, 450.444885, –208.235550 –1186.607300, –2060.245605
218	–1379.375122, –1278.502930, –1671.380737, –1521.290283, –2184.201172 1036.537231, 14.498406
219	830.555298, 273.704865, –430.866608, –879.656616, –1596.880859 –1735.605835, –2732.404785
220	–862.293884, –338.837738, –256.978302, 453.634369, 21.184637 –388.895355, –1367.653931
221	–1692.275391, –837.354309, –996.297546, –650.886047, –921.391785 –735.284485, –1599.094971
222	–1439.049561, –403.948120, –264.716797, 34.880165, 133.721527 270.342712, 130.799301
223	–1024.433105, –954.402954, –1288.265259, –1510.096436, –1241.741699 –1407.657593, –2138.514893
224	–451.752625, –810.942505, –1316.806030, –927.019775, –1375.180420 –1263.507812, –2100.465088
225	–1834.794678, –2015.035034, –2055.714844, –1205.373779, –1243.619385 –921.998596, –1739.512573
226	–653.094360, 321.666351, –575.164124, –1054.779297, –423.627563 –749.007141, –649.139587
227	–1019.843872, –932.372925, –1270.553223, –954.567322, –1360.970947 –982.806152, –1841.252563
228	656.237000, 825.421204, 1135.276611, 1071.027466, 868.291321 698.187012, 569.556580
229	–164.890488, 1052.856323, 1300.618042, 1116.814819, 866.946289

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Index	Codeword
	658.868591, 540.566589
230	406.070679, 248.316833, 124.479065, –133.411728, –337.961334 –940.607117, –1446.928711
231	–2312.506348, –2472.395020, –2646.736816, –2790.495605, –3112.582520 –3451.777344, –701.623169
232	–1843.943604, 176.875397, –623.110596, –896.002991, –45.831070 140.156006, –0.054655
233	–932.922363, –900.730530, –913.869141, –806.471497, –986.032654 –1149.484009, –1910.793213
234	–133.844696, –514.168762, 390.051361, 641.783997, 484.533081 417.025787, 398.798676
235	–459.463898, –717.394775, –1327.284668, –1522.364502, –1866.756714 –1091.245850, –1919.993530
236	–1220.196655, –560.840759, –629.177979, –229.373505, –581.638794 –572.932739, –1513.422974
237	2318.115723, 2330.241455, 2003.659424, 1627.261719, 1242.322510 922.694458, 694.189758
238	–2558.335205, –3061.049561, –3702.576660, –4377.168945, –5217.957520 –1919.715210, –578.802551
239	–1606.604858, –1942.337036, –2280.985107, –1590.558960, –1840.323120 –1495.487305, –2178.358887
240	47.630093, 198.778152, –192.687698, –91.508957, –656.806152 –685.909973, –1680.821411
241	–1399.591064, –1436.676147, –1885.677856, –1912.264404, –2472.140137 –2558.057861, –3365.300781
242	–1179.167236, –329.757782, –726.824158, –1418.054688, –688.230408 –842.688477, –1137.900513
243	–1112.851807, –863.788086, –1080.140869, –825.756531, –1136.570923 –786.616638, –1648.041382

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Table B.42 (continued)

Index	Codeword
244	–662.255981, –671.808655, –1132.820679, –1111.957642, –1657.906616 –1473.291992, –2316.884277
245	–58.572517, –21.614277, –155.525177, –194.482086, –169.745590 –534.487610, –758.021912
246	–2220.477051, –1790.342407, –1814.036011, –1498.163818, –1578.185303 –1200.352905, –1899.312378
247	–996.253418, –764.938782, –1122.369385, –1230.562012, –1659.632324 –761.955811, –1652.573120
248	897.895508, 1630.975220, 1602.244385, 1327.910034, 1011.544312 757.971924, 595.457275
249	–1431.946777, –1347.628540, –1499.096924, –1541.816772, –2171.504150 –898.291260, 66.963020
250	–312.534912, –152.314102, –438.497650, –254.288010, –734.177368 –682.732117, –1636.434814
251	–1506.427002, –1305.687256, –1081.984497, –917.416138, –629.043396 –482.883453, –376.623718
252	–672.532898, –546.122559, –512.605530, –442.461212, –371.147522 –294.251678, –130.954529
253	–616.184143, –447.972778, –481.961853, –102.225723, –291.078766 145.353958, –757.344055
254	383.866699, 442.064697, 416.969147, 467.443085, 480.903381 487.482300, 455.388672
255	–1118.679810, –1169.146851, –1470.901733, –1265.922729, –1537.622925 –955.582031, –1795.824219
256	–2596.727295, –3005.560547, –3863.063232, –4400.398926, –5535.787598 –5088.401367, –931.938293

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Table B.43 Stage 2 first sub-vector codebook lsf_stage2_CB1_lbr of low-precision LSF vector quantization codebook

Index	Codeword
1	125.176781, 97.578979, –336.364807, 137.200378, 596.080078
2	–65.084419, 60.324146, 216.620468, 217.536072, –1.865530
3	–271.406830, –56.965103, –308.899261, –197.953033, –211.553497
4	–53.075191, 110.288887, –125.435249, –134.959381, 106.253815
5	–208.034668, –478.204865, –54.979763, –170.765671, 56.116074
6	–351.061218, –100.707382, 4.522793, –203.290604, –63.801029
7	–15.212132, –196.821518, –594.479004, –396.369141, 340.373474
8	233.424438, –0.900044, –146.513824, 45.203060, 199.356506
9	–175.750717, –504.816986, –123.821861, 272.267731, 17.651171
10	56.609001, –164.182388, 282.474365, –167.583649, –611.753967
11	–115.305000, –410.567474, –245.159256, 32.249302, 472.335541
12	–395.985168, –152.604843, –179.300735, 98.311966, 40.804863
13	–58.728832, –182.516876, –255.976562, –256.143646, 22.885551
14	316.159882, 151.374481, –191.210144, 7.382407, –124.037529
15	267.551727, –143.205856, –556.498352, 10.446942, –139.945602
16	–59.872601, –218.755066, –135.179184, 17.986374, 126.528053
17	–167.446899, 404.004425, 89.689842, 215.293472, 99.381721
18	23.880964, 436.191742, –66.432892, 294.669983, –230.850113
19	–97.411232, –77.451683, –39.728432, 151.893845, 400.719330
20	–189.941666, –360.634338, 305.063385, –129.827194, –229.681717
21	147.476151, –121.121750, 123.489090, 198.466431, 133.996948
22	168.695541, –282.628235, 57.746059, –110.763184, 256.777191
23	466.524017, 48.549519, 3.054227, –309.880829, 455.355286
24	–96.707848, –226.300293, –348.300476, 437.114319, –237.053360

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Index	Codeword
25	–159.994415, 266.700043, 385.393860, –41.254078, 155.542038

Table B.43 (continued)

Index	Codeword
26	124.722549, 68.716454, 374.974396, –59.638531, –5.237550
27	765.235229, 351.720734, 289.651245, 234.858963, 174.149719
28	241.708282, –199.616089, 212.995590, –351.008759, –104.327087
29	1.665737, –141.787033, –396.943237, 249.341492, 187.570786
30	–58.401596, –344.893921, 223.540710, 343.499237, 307.385132
31	–53.936222, 375.296906, –315.383698, 102.585754, 150.957932
32	21.016300, 155.413589, –21.852629, 207.617325, 200.649414
33	10.351093, 92.124763, –347.863464, –212.420975, –146.219879
34	3.016294, 200.229645, 119.715279, –4.462936, 58.314323
35	–63.068295, –357.047424, 646.101807, 171.314423, –429.449341
36	177.134491, 163.830048, 123.773827, –95.167198, –304.159729
37	46.081257, 204.553513, –387.171906, 633.753296, 87.968590
38	–169.514145, 252.454620, –264.691772, –435.691376, 153.001617
39	120.640579, 405.465973, –192.274933, –221.965805, –202.758636
40	100.166435, –400.800293, –40.715820, –107.465210, –118.487724
41	45.016270, 65.268402, 171.456894, 302.890778, –417.200684
42	347.150360, –242.992111, –209.205505, –246.726746, 38.139465
43	194.945053, 351.289307, –99.387756, –158.804657, 213.550888
44	–129.357178, –340.776123, –39.346504, –359.011292, –283.851349
45	31.403564, –107.484909, 242.595520, 21.619331, –228.102585
46	–262.826965, –117.488831, –73.219154, –197.742828, 284.209808
47	–60.193638, –38.268238, 159.151459, –35.138390, 194.001358

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Index	Codeword
48	–317.376831, –240.991592, 144.735809, 76.405945, 161.191895
49	–194.797623, –231.669067, –88.555389, 1.277639, –171.221588
50	–252.915497, 141.291977, –215.599533, 349.899689, 233.891418
51	–216.871674, 19.676451, –397.275146, –56.477779, 232.499542
52	–85.279602, 84.387878, –18.888111, –115.487076, –158.464539
53	245.224274, –426.197693, 303.512543, 63.986469, –74.643738
54	–236.141190, 103.960800, –59.016613, 284.933868, –190.134613
55	34.146214, 243.138809, –90.727913, 53.836540, –75.016983
56	–270.712738, –726.983887, 315.456696, 119.656967, –48.197346
57	–31.662683, 5.897125, 3.455140, 53.694481, –2.451202
58	729.026001, 175.908218, –257.285645, –153.161713, 41.570004
59	–80.404160, 261.090393, 192.832947, 51.316048, –202.484619
60	–158.006607, 145.411636, 565.739990, 175.046204, –235.165543
61	310.425751, –37.598225, 47.160507, 402.864685, 373.127075
62	50.817093, –32.576046, –161.691788, –209.549042, 349.112793
63	–279.980255, 181.749924, 117.845192, –292.787567, 156.011307
64	237.036133, 177.224197, 174.540649, 30.305742, 297.236847
65	358.010071, –172.392334, –15.699339, 31.589804, –312.457031
66	539.975342, 455.723785, 92.737114, –77.091827, –409.111603
67	–45.966713, –147.063065, 34.420399, –154.320145, –20.449684
68	429.404053, –49.871758, 462.804718, 47.656757, –296.449646
69	486.055054, –2.306022, –436.431915, 346.355042, 134.472702
70	–93.373451, –316.287323, –203.803635, 731.280029, 355.487061
71	–309.597534, 214.576782, –197.971817, –42.248268, –97.342346
72	315.710754, 365.675140, –113.759560, 257.418457, 151.386566
73	–54.277527, 575.995667, 116.280495, –313.935638, 326.100006

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Index	Codeword
74	–2.422986, 157.679749, –178.431274, 21.119404, –412.958069
75	265.604034, 144.857193, 114.580612, 191.633926, –72.416084
76	45.641788, 312.367981, 157.248138, –349.953979, –87.191002
77	–65.918320, 150.779114, –131.731110, –531.736023, 662.466064
78	–159.697388, –246.035385, 244.156631, 381.940033, –146.819397
79	230.185669, –366.364471, –172.252045, 174.231308, 92.061836
80	–76.539986, –14.540029, –51.299156, –457.502167, –38.845375
81	–118.276863, –387.540985, –433.180511, –33.551891, –79.331772

Table B.43 (continued)

Index	Codeword
82	–61.141945, 508.815582, 467.931915, 527.722839, 420.139313
83	–131.588577, –167.306580, 485.843109, 63.184635, 89.237114
84	94.761421, 97.921158, 179.863037, –344.325256, 229.774002
85	520.248596, –109.993576, 51.674213, 101.569778, 76.834473
86	24.268560, –203.155319, –323.396484, –30.644506, –457.271484
87	–111.438065, –399.305115, –865.804260, 309.888092, 138.058884
88	–82.622826, –54.742317, 254.196701, –139.716690, 566.830811
89	29.335989, –128.033279, –40.821259, 172.080994, –200.548294
90	–233.433609, –12.658308, 46.226269, –44.890251, –430.050598
91	40.063583, –70.127205, –63.214340, –248.680176, –306.242096
92	–40.049488, –286.559692, 141.962418, 62.360870, 34.843357
93	189.553772, 74.619942, –83.881447, –261.958984, –27.939610
94	403.209381, 68.722786, –173.985245, –335.583771, –369.518097
95	457.780670, 167.100967, 149.813095, –182.236130, –8.315154
96	203.499512, 111.717392, –456.987671, –102.090157, 163.226791

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Index	Codeword
97	–101.386177, –25.736250, –280.759399, 72.861252, –55.210712
98	–103.929649, –491.284943, 291.325806, –111.859535, 334.475250
99	–144.490921, 281.077942, –23.609737, –27.741974, 417.479828
100	264.139496, 186.067474, –222.433640, –646.080383, 103.886513
101	377.383392, 131.654785, –307.225342, 329.011566, –396.618927
102	–173.476822, 472.666779, –5.357996, –132.365311, –48.892284
103	245.283829, –84.957413, 457.927094, 321.619659, 42.520683
104	–131.979996, –138.226730, –30.602535, 320.700684, 101.862259
105	–6.157870, 97.928215, –209.740662, –431.855286, –817.070190
106	–3.690514, –179.861206, –476.954803, –632.629822, –250.939194
107	–66.380966, 170.722198, –530.042786, 177.100327, –181.131012
108	–128.159744, 55.080872, 308.354065, –254.569229, –221.356033
109	–201.901703, 242.691742, –86.607887, –396.883148, –314.213501
110	205.063766, 462.954620, 155.144760, –16.457201, –29.848045
111	327.753082, –196.080566, 433.168854, –82.308937, 279.670837
112	–25.943148, 122.535789, 106.418846, 524.088684, 64.240387
113	126.005486, 57.947956, –185.083878, 293.347504, –32.417767
114	204.149628, –38.046509, 58.536194, –31.194141, –16.386127
115	–86.873398, –414.818848, 21.891113, 142.845123, –476.217682
116	117.195274, –132.432159, –209.501282, –48.684799, –105.391930
117	–282.344055, –42.621487, 202.447464, 49.988632, –101.511032
118	–149.238113, –321.226227, 742.572449, 467.619019, 257.926819
119	–55.879326, 65.658493, 287.207520, 217.585556, 307.118652
120	243.938828, –203.829315, 10.253199, 480.966309, –107.561493
121	–268.738800, 92.606926, 8.622302, 64.133263, 114.917183
122	–90.888931, 497.001007, 161.134674, –130.725739, –558.346558

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Index	Codeword
123	–467.650482, 288.785370, 160.522598, –0.405135, –159.286697
124	–399.703735, 89.198013, 259.508423, 295.884003, 167.580093
125	–146.541641, –195.395798, 298.586151, –316.311310, 100.641792
126	–148.101120, 743.981140, 366.386505, 121.370277, –161.657700
127	134.723831, 320.460175, 349.293152, 238.967743, 33.517555
128	–35.735043, –292.962158, –26.472088, –518.628357, 271.610901

Table B.44 Stage 2 second sub-vector codebook lsf_stage2_CB2_lbr of low-precision LSF vector quantization codebook

Index	Codeword
1	–243.409409, –116.480858, 389.801025, 181.432846
2	–696.340149, –287.063507, 446.367493, 236.489014
3	–393.174835, 117.744064, –62.679790, –412.519104
4	–74.848740, 27.573660, 285.320068, –59.181179
5	116.752983, –1.356940, –109.929138, 113.496178
6	–225.366104, –189.137146, –44.427967, –286.845917
7	242.165924, 287.599548, –181.383621, –330.778229
8	–179.347458, 66.509262, 109.463470, 87.632050
9	–253.711777, 323.794830, 338.500244, –337.053680
10	160.067596, –163.665115, 6.405066, –264.836487
11	–60.688374, –185.087067, –191.619583, –197.485458
12	21.429399, –370.080780, –42.411572, –108.452370
13	–52.254684, –23.956074, –313.852173, –7.787478
14	12.098438, 230.482193, –478.094971, –100.934822
15	–37.458061, 288.877838, 10.201681, 475.521515
16	2.881128, 343.488373, 450.687256, –47.208767

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Index	Codeword
17	–83.777214, 151.401154, 322.103760, 253.128464
18	–316.890259, 28.818686, –616.391968, 192.355240
19	511.084839, –133.957230, 361.529755, 198.506775
20	72.080055, 199.831650, –108.111671, –84.174294
21	–98.012787, –39.761772, –68.415688, 178.787384
22	–265.631104, 164.766037, –440.029663, 823.557129
23	–168.251541, 702.906860, 207.797424, –79.284523
24	305.986115, 272.766815, 292.596832, –235.731766
25	–788.239197, 239.276917, 113.054337, –212.844467
26	258.902313, –333.383759, –243.586655, –307.619171
27	–121.466507, 174.642380, –293.016357, 272.726562
28	39.102711, –165.410400, –337.241791, 313.644287
29	–10.405048, –185.301270, –512.177002, –270.207581
30	101.790581, 11.252160, –62.398804, 392.750671
31	–239.751587, –471.905090, –310.683197, –300.936493
32	–155.268570, 119.035522, 79.837418, –192.250656
33	131.482040, 86.621811, 93.051872, –150.859161
34	200.261765, 223.326935, –433.248749, 433.448395
35	–94.155045, –43.422302, 131.647949, 330.752167
36	311.755371, 50.656456, 49.977379, –428.572540
37	–312.415009, –121.180763, –232.275406, 138.695938
38	209.342743, 687.162781, 184.681885, –401.803741
39	114.690254, 171.625977, 181.704712, 260.692871
40	–381.737579, –85.716354, 179.320496, –116.409515
41	90.773277, –43.356819, 633.900757, 6.079812
42	671.235840, 336.139923, –112.772232, –600.057617

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Index	Codeword
43	371.775330, –1.344244, 163.382965, –95.445984
44	–193.736588, –71.884460, –77.847572, –49.722527
45	–141.227814, –446.522247, 236.406113, 184.287979
46	–268.798889, 352.709106, 39.056961, –68.754677
47	–221.551651, –119.258545, –121.718758, 479.259888
48	676.735718, 194.002365, –362.131866, 175.913193
49	50.821251, –591.166016, 616.756592, –97.901886
50	382.693909, –181.652420, –680.908813, 676.854553
51	–80.215393, –282.486908, –509.045990, –791.799927
52	53.088028, 499.772308, –195.334656, 77.658592
53	17.863188, 292.266754, 71.577980, –618.104736
54	120.337517, –7.530244, –264.265137, –287.812256
55	–394.066956, 219.687286, 295.375671, 72.552650
56	179.996841, –192.677536, –261.940826, –25.612436

Table B.44 (continued)

Index	Codeword
57	58.660305, 336.429840, 100.187775, –220.980881
58	42.412331, 13.519630, 112.433083, 138.155304
59	266.368958, 21.970327, –107.287674, –144.994812
60	78.719635, –430.507874, 168.567307, –456.712982
61	–411.224457, 74.529732, –57.504768, –21.765814
62	196.090912, 137.380432, 57.631134, 50.901695
63	–123.902313, –284.127167, 288.213501, –152.852875
64	–302.251831, –356.747955, 204.819641, 551.967896
65	–393.012970, –43.004662, 636.058228, –192.525909

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Index	Codeword
66	–127.849014, 434.849792, –159.721878, –301.210571
67	21.238861, –452.225281, –153.344681, 734.341736
68	10.870827, 185.948196, –6.938921, 175.038879
69	–432.968109, –610.992554, –137.377045, 243.536591
70	180.154404, 423.220062, 163.796448, 72.456429
71	–452.403168, 175.101013, 299.354309, 512.337463
72	38.909637, –7.877390, 262.278534, 613.609680
73	–47.382046, –109.140800, 42.966789, –158.798386
74	–425.121552, –512.733276, 249.457809, –226.062881
75	182.071060, –206.442108, –688.257446, 108.594162
76	2.062111, 224.044220, 155.120468, 19.599276
77	38.487358, –31.999537, –109.859627, –119.361366
78	162.551880, 67.492264, 290.018524, 45.786263
79	436.423676, –43.198994, –77.049904, 569.098450
80	363.950043, 281.895386, –25.208874, –89.876564
81	–248.373856, –321.788391, –56.249428, –39.337593
82	425.436371, –16.661833, –59.625412, 116.543587
83	–82.381096, –163.117569, 114.577087, 70.018883
84	253.342102, –523.466125, 201.246658, 378.887482
85	–131.377869, 66.285393, –167.358292, –217.760086
86	–566.463745, –226.344803, –157.164017, –86.413437
87	390.181671, –371.196930, 13.734019, –36.191559
88	446.689575, –241.156555, –321.963715, 233.878906
89	77.666321, –131.525879, 320.331818, 256.978943
90	367.632355, 216.511093, 243.643234, 123.523415
91	–657.771362, 41.172512, –83.689575, 283.212250

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Index	Codeword
92	–460.604584, 638.931152, 35.756577, –559.100403
93	–226.586746, –80.584587, 233.980896, –493.453033
94	417.722504, –1.672927, –464.180389, –184.742569
95	167.272629, –281.216431, 276.785431, –22.157265
96	–284.334778, –108.795586, –299.789734, –209.318359
97	–132.045181, 395.118500, 158.724670, 211.790054
98	301.987091, –0.899439, –280.349152, –661.502075
99	578.751221, 626.476074, 518.695251, 378.556610
100	257.378601, –25.404896, 135.438293, 242.261215
101	132.840515, –251.884521, –2.454656, 241.139893
102	22.451145, 63.981472, –25.862547, –355.621521
103	–132.091568, –329.954651, –77.058594, 239.968750
104	–34.870598, –171.217773, –174.181763, –465.647217
105	449.525177, –237.710693, 438.640564, –306.627014
106	–20.192402, –701.768494, 79.301132, –45.662354
107	–29.979303, –361.198029, 703.003723, 443.174042
108	591.450317, –28.069363, –93.527534, –223.932785
109	–472.069946, –989.679260, 528.279358, 340.102905
110	114.742538, –549.570740, –281.955597, 145.624893
111	–292.186951, 138.453705, 13.866644, 271.594849

Table B.44 (continued)

Index	Codeword
112	307.743439, 269.438049, –34.875519, 267.321228
113	–33.110497, –172.138855, –109.525803, 26.296240
114	246.703857, 123.510437, –305.353668, 83.845627

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Index	Codeword
115	–102.935699, 587.943848, 636.555054, 524.072510
116	–145.242615, –315.349030, –352.720276, 21.209959
117	142.747467, –102.298622, 50.486584, –9.182832
118	234.382019, 261.100342, 365.964935, 399.349396
119	684.732361, 396.310455, 181.284805, –108.301056
120	–241.690918, –467.369324, –675.536865, 491.443207
121	–100.938423, 147.491653, –313.448547, –511.904236
122	–698.902588, 653.364136, 431.230652, –23.328299
123	–15.995284, 31.354193, 3.822088, –5.892229
124	–432.100098, 260.371490, –357.567444, –122.324028
125	–354.313080, –164.696030, 75.725403, 181.991409
126	–447.009247, 496.912720, –161.698349, 245.110306
127	77.673477, –7.057706, 335.725311, –319.795929
128	–162.106491, 166.707016, –136.834305, 26.008549

Table B.45 Stage 2 third sub-vector codebook lsf_stage2_CB3_lbr of low-precision LSF vector quantization codebook

Index	Codeword
1	–120.858948, –66.756027, 54.656181, 64.874451, 124.259438 20.630352, 458.284790
2	54.381855, 279.556610, –216.506119, –67.174606, 1.014068 17.655251, 6.228757
3	–28.685160, 154.050797, –48.445076, –277.829315, 285.749939 195.247452, 132.268265
4	–141.355896, –64.183372, –85.978325, 75.814301, 73.956757 249.112961, 100.836151
5	–395.490082, 105.968681, –137.138885, –185.565430, –4.196878

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Index	Codeword
	9.040785, 9.331719
6	297.102386, –264.661957, –128.039383, –27.582905, –86.045662 –90.526764, –60.119183
7	174.266235, –103.852974, –37.978733, 31.690355, 302.096497 135.048508, 114.836746
8	–101.046234, –23.895374, –147.228592, 31.045322, –344.268677 149.099213, –37.257492
9	–61.336628, 37.914291, 10.385083, 105.648895, 6.490855 109.133385, –364.720398
10	–57.522472, –73.206619, –200.797119, –141.121109, –115.150620 650.165649, 423.394958
11	–73.722351, –140.067551, 140.425919, –391.595581, –5.604278 –10.986897, –15.726768
12	–108.406639, –6.762465, –37.700020, –6.168937, –11.448340 0.249742, 0.123609
13	152.156693, 28.136551, –168.495224, 65.982376, –84.628181 –83.325134, –141.856110
14	486.470673, 77.363564, –187.013657, 136.576614, 96.876122 25.852430, 7.105801
15	–983.513672, 399.680298, 283.328339, 145.344055, 54.366695 –53.572399, 39.212997
16	–220.661285, –47.986832, 179.123917, 401.111053, 340.343872 159.414078, 69.568336
17	–105.138153, 51.941540, 56.188911, –144.363174, –119.869408 141.778366, 128.125656

Table B.45 (continued)

Index	Codeword
18	–263.076965, 254.405991, 333.602570, –42.307457, –451.265350

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Index	Codeword
	–73.605690, 22.996130
19	–29.157436, 69.872826, 346.867462, –87.169640, 26.287106 –3.849262, 4.497209
20	–24.435114, –195.265182, –99.388878, 206.267960, 83.080887 –0.377817, –45.230667
21	–187.647476, 181.213882, –273.944153, 255.762146, –67.340736 23.068657, 10.287804
22	–172.619736, –140.707123, –190.551239, –6.177309, –41.383221 –111.614410, –169.822540
23	27.315220, –127.491776, –76.529587, –380.704071, 712.483704 168.066162, –282.497314
24	144.456070, 74.449486, 73.299232, –89.281288, –230.136108 –50.344418, –61.720192
25	71.039864, 16.484489, –81.132729, –146.860245, –239.453995 –276.474915, –495.753235
26	–6.601482, –6.596558, –135.847580, –200.303955, –149.754517 –46.271084, –42.693810
27	114.541161, 96.925179, –62.422073, 267.284790, 92.719643 138.007202, 0.382021
28	39.763325, –115.202148, –418.437439, –42.130184, 56.940830 87.226730, 38.288715
29	21.468893, –166.728149, –67.645279, –66.803993, –17.396999 36.986813, 13.436744
30	4.862719, –45.827774, –68.863770, –164.614624, –305.732239 –554.339478, 19.752028
31	6.885021, –95.595200, –104.018166, –184.963974, 31.702078 –84.178284, 256.128448
32	–192.003845, –394.069550, –488.481445, –438.397797, –190.934586 –44.327446, –26.086609
33	–125.266785, 137.131226, 39.229233, –10.948144, –105.625397

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Index	Codeword
	–123.229942, –139.748444
34	184.016785, 264.055878, 123.471939, –34.399540, –232.265396 397.860321, 90.333214
35	80.903946, –43.319683, 180.592911, –59.142773, 138.443069 –390.676544, 205.455032
36	–132.122040, –139.576950, 106.337486, –21.377464, 174.604553 16.855715, 61.933849
37	88.327904, –498.666840, 137.356384, 33.944885, 67.351425 20.773945, 24.755754
38	–345.485718, –27.660803, 67.980339, 83.968163, 23.501289 –11.475863, –47.268600
39	178.483002, –24.934628, –96.635849, –13.439441, –88.224274 176.098663, 124.763161
40	–26.483379, 21.979994, –20.658539, 330.616333, –43.313259 –384.421143, 48.723835
41	62.266487, –44.714783, –115.789307, –188.385208, 183.125153 –185.326904, –155.693787
42	53.820332, 81.532997, 98.294876, 40.696548, 98.454292 119.502266, 147.300720
43	254.267975, 70.164246, 47.383190, –142.257462, 37.144730 –19.954918, 38.457348
44	–82.691055, –20.630274, 185.650543, 180.139053, –90.897530 109.889763, 58.255798
45	244.058670, –122.199280, 189.862457, 132.944275, 46.770733 22.384722, –2.599370
46	–236.754898, –243.830826, –54.952366, –73.321976, –94.426300 –12.912512, 69.587036

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Table B.45 (continued)

Index	Codeword
47	91.892441, –262.573792, 314.933350, –58.419174, –324.563995 88.949524, 50.423519
48	417.443909, 69.775948, –251.358078, –512.123352, 4.932464 –0.540782, 29.553900
49	–150.129364, –145.058929, 114.207970, 211.513779, 194.664597 –268.673645, –373.467438
50	66.813667, 16.556433, 26.886477, 15.414439, 15.461973 –7.944495, –0.863844
51	302.242676, 324.145844, 329.172577, 244.085281, 176.245163 87.874321, 56.691006
52	–36.683731, –139.869324, 80.175735, –27.114138, –77.579376 –157.658203, –124.447487
53	108.132103, 97.285461, 7.401071, –2.834207, –210.823380 –171.585175, 446.059509
54	–244.690735, –307.984222, 598.741272, 230.457870, –28.186348 –101.380302, –8.740450
55	–70.319702, 127.248039, –167.226410, 85.655022, 303.577606 –59.247124, –66.811310
56	–215.468704, 348.959717, 98.189171, 90.742363, 79.830116 84.431984, 36.955971
57	–36.783245, 69.040504, 133.008469, 157.655502, 128.536774 –34.705322, –65.879082
58	–73.992271, 343.438080, 48.778431, –304.844391, 57.568405 –77.251152, –63.522530
59	200.285736, 120.431190, 115.817978, 93.692749, 40.653152 –164.645035, –240.228683
60	110.406593, 221.153152, 92.144363, 56.062359, –36.240662 27.389029, –19.072336
61	–588.968384, –505.493042, –121.743179, 46.453411, 157.052521

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Index	Codeword
	44.954498, 34.388012
62	526.978088, 425.036041, 189.527222, –62.570236, –241.602249 –253.744858, –42.391441
63	239.768356, 44.924934, –128.932877, –433.974670, –694.861633 37.230545, 13.897585
64	32.482452, –241.068497, –579.445068, 523.904236, 267.373016 4.412733, –53.777256

Table B.46 LSF parameter mean value vector table

Index	Index value
1	816.510986
2	2231.826660
3	3647.142334
4	5062.458008
5	6477.773682
6	7893.089355
7	9308.405029
8	10723.720703
9	12139.036377
10	13554.352051
11	14969.667725
12	16384.983398
13	17800.299072
14	19215.614746
15	20630.930420
16	22046.246094

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Table B.47 Frequency-domain noise shaping sub-band division table

Start/end point of sub-band division
0, 4, 8, 12, 16, 20, 24, 28, 32, 36,
40, 48, 56, 64, 72, 80, 88, 96, 108, 120,
132, 144, 160, 176, 196, 216, 240, 264, 292, 320,
352, 384, 416, 448, 480, 512, 544, 576, 608, 640,
672, 704, 736, 768, 800, 832, 864, 896, 928, 1024

Table B.48 Table of preset values of virtual speakers

Index	Index value
0	2, 768
1	2, 791
2	146, 791
3	293, 791
4	439, 791
5	585, 791
6	731, 791
7	878, 791
8	2, 815
9	79, 815
10	158, 815
11	236, 815
12	315, 815
13	394, 815
14	473, 815
15	551, 815
16	630, 815

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Index	Index value
17	709, 815
18	788, 815
19	866, 815
20	945, 815
21	2, 838
22	54, 838
23	108, 838
24	162, 838
25	216, 838
26	269, 838
27	323, 838
28	377, 838
29	431, 838
30	485, 838
31	539, 838
32	593, 838
33	647, 838

Table B.48 (continued)

Index	Index value
34	701, 838
35	755, 838
36	808, 838
37	862, 838
38	916, 838
39	970, 838

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Index	Index value
40	2, 861
41	41, 861
42	82, 861
43	123, 861
44	164, 861
45	205, 861
46	246, 861
47	287, 861
48	328, 861
49	369, 861
50	410, 861
51	451, 861
52	492, 861
53	532, 861
54	573, 861
55	614, 861
56	655, 861
57	696, 861
58	737, 861
59	778, 861
60	819, 861
61	860, 861
62	901, 861
63	942, 861
64	983, 861
65	2, 884

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Index	Index value
66	34, 884
67	68, 884
68	102, 884
69	137, 884
70	171, 884
71	205, 884
72	239, 884
73	273, 884
74	307, 884
75	341, 884
76	375, 884
77	410, 884

Table B.48 (continued)

Index	Index value
78	444, 884
79	478, 884
80	512, 884
81	546, 884
82	580, 884
83	614, 884
84	649, 884
85	683, 884
86	717, 884
87	751, 884
88	785, 884

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Index	Index value
89	819, 884
90	853, 884
91	887, 884
92	922, 884
93	956, 884
94	990, 884
95	2, 908
96	29, 908
97	59, 908
98	88, 908
99	117, 908
100	146, 908
101	176, 908
102	205, 908
103	234, 908
104	263, 908
105	293, 908
106	322, 908
107	351, 908
108	380, 908
109	410, 908
110	439, 908
111	468, 908
112	497, 908
113	527, 908
114	556, 908

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Index	Index value
115	585, 908
116	614, 908
117	644, 908
118	673, 908
119	702, 908
120	731, 908

Table B.48 (continued)

Index	Index value
121	761, 908
122	790, 908
123	819, 908
124	848, 908
125	878, 908
126	907, 908
127	936, 908
128	965, 908
129	995, 908
130	2, 931
131	27, 931
132	54, 931
133	81, 931
134	108, 931
135	135, 931
136	162, 931
137	189, 931

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Index	Index value
138	216, 931
139	243, 931
140	269, 931
141	296, 931
142	323, 931
143	350, 931
144	377, 931
145	404, 931
146	431, 931
147	458, 931
148	485, 931
149	512, 931
150	539, 931
151	566, 931
152	593, 931
153	620, 931
154	647, 931
155	674, 931
156	701, 931
157	728, 931
158	755, 931
159	781, 931
160	808, 931
161	835, 931
162	862, 931
163	889, 931

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Index	Index value
164	916, 931

Table B.48 (continued)

Index	Index value
165	943, 931
166	970, 931
167	997, 931
168	2, 954
169	25, 954
170	50, 954
171	75, 954
172	100, 954
173	125, 954
174	150, 954
175	175, 954
176	200, 954
177	225, 954
178	250, 954
179	275, 954
180	300, 954
181	325, 954
182	350, 954
183	375, 954
184	400, 954
185	425, 954
186	450, 954

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Index	Index value
187	475, 954
188	500, 954
189	524, 954
190	549, 954
191	574, 954
192	599, 954
193	624, 954
194	649, 954
195	674, 954
196	699, 954
197	724, 954
198	749, 954
199	774, 954
200	799, 954
201	824, 954
202	849, 954
203	874, 954
204	899, 954
205	924, 954
206	949, 954
207	974, 954

Table B.48 (continued)

Index	Index value
208	999, 954
209	2, 977

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Index	Index value
210	23, 977
211	47, 977
212	70, 977
213	93, 977
214	116, 977
215	140, 977
216	163, 977
217	186, 977
218	209, 977
219	233, 977
220	256, 977
221	279, 977
222	303, 977
223	326, 977
224	349, 977
225	372, 977
226	396, 977
227	419, 977
228	442, 977
229	465, 977
230	489, 977
231	512, 977
232	535, 977
233	559, 977
234	582, 977
235	605, 977

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Index	Index value
236	628, 977
237	652, 977
238	675, 977
239	698, 977
240	721, 977
241	745, 977
242	768, 977
243	791, 977
244	815, 977
245	838, 977
246	861, 977
247	884, 977
248	908, 977
249	931, 977
250	954, 977
251	977, 977

Table B.48 (continued)

Index	Index value
252	1001, 977
253	2, 1001
254	23, 1001
255	46, 1001
256	68, 1001
257	91, 1001
258	114, 1001

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Index	Index value
259	137, 1001
260	159, 1001
261	182, 1001
262	205, 1001
263	228, 1001
264	250, 1001
265	273, 1001
266	296, 1001
267	319, 1001
268	341, 1001
269	364, 1001
270	387, 1001
271	410, 1001
272	432, 1001
273	455, 1001
274	478, 1001
275	501, 1001
276	523, 1001
277	546, 1001
278	569, 1001
279	592, 1001
280	614, 1001
281	637, 1001
282	660, 1001
283	683, 1001
284	705, 1001

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Index	Index value
285	728, 1001
286	751, 1001
287	774, 1001
288	796, 1001
289	819, 1001
290	842, 1001
291	865, 1001
292	887, 1001
293	910, 1001
294	933, 1001

Table B.48 (continued)

Index	Index value
295	956, 1001
296	978, 1001
297	1001, 1001
298	2, 256
299	2, 230
300	128, 230
301	256, 230
302	384, 230
303	512, 230
304	640, 230
305	768, 230
306	896, 230
307	2, 205

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Index	Index value
308	73, 205
309	146, 205
310	219, 205
311	293, 205
312	366, 205
313	439, 205
314	512, 205
315	585, 205
316	658, 205
317	731, 205
318	805, 205
319	878, 205
320	951, 205
321	2, 179
322	49, 179
323	98, 179
324	146, 179
325	195, 179
326	244, 179
327	293, 179
328	341, 179
329	390, 179
330	439, 179
331	488, 179
332	536, 179
333	585, 179

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Index	Index value
334	634, 179
335	683, 179
336	731, 179
337	780, 179
338	829, 179

Table B.48 (continued)

Index	Index value
339	878, 179
340	926, 179
341	975, 179
342	2, 154
343	38, 154
344	76, 154
345	114, 154
346	152, 154
347	190, 154
348	228, 154
349	265, 154
350	303, 154
351	341, 154
352	379, 154
353	417, 154
354	455, 154
355	493, 154
356	531, 154

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Index	Index value
357	569, 154
358	607, 154
359	645, 154
360	683, 154
361	721, 154
362	759, 154
363	796, 154
364	834, 154
365	872, 154
366	910, 154
367	948, 154
368	986, 154
369	2, 2
370	11, 2
371	23, 2
372	34, 2
373	45, 2
374	56, 2
375	68, 2
376	79, 2
377	90, 2
378	101, 2
379	113, 2
380	124, 2
381	135, 2

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Table B.48 (continued)

Index	Index value
382	146, 2
383	158, 2
384	169, 2
385	180, 2
386	191, 2
387	203, 2
388	214, 2
389	225, 2
390	236, 2
391	248, 2
392	259, 2
393	270, 2
394	281, 2
395	293, 2
396	304, 2
397	315, 2
398	326, 2
399	338, 2
400	349, 2
401	360, 2
402	371, 2
403	383, 2
404	394, 2
405	405, 2
406	416, 2

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Index	Index value
407	428, 2
408	439, 2
409	450, 2
410	461, 2
411	473, 2
412	484, 2
413	495, 2
414	506, 2
415	518, 2
416	529, 2
417	540, 2
418	551, 2
419	563, 2
420	574, 2
421	585, 2
422	596, 2
423	608, 2
424	619, 2
425	630, 2

Table B.48 (continued)

Index	Index value
426	641, 2
427	653, 2
428	664, 2
429	675, 2

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Index	Index value
430	686, 2
431	698, 2
432	709, 2
433	720, 2
434	731, 2
435	743, 2
436	754, 2
437	765, 2
438	776, 2
439	788, 2
440	799, 2
441	810, 2
442	821, 2
443	833, 2
444	844, 2
445	855, 2
446	866, 2
447	878, 2
448	889, 2
449	900, 2
450	911, 2
451	923, 2
452	934, 2
453	945, 2
454	956, 2
455	968, 2

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Index	Index value
456	979, 2
457	990, 2
458	1001, 2
459	1013, 2
460	2, 12
461	11, 12
462	23, 12
463	34, 12
464	46, 12
465	57, 12
466	68, 12
467	80, 12
468	91, 12

Table B.48 (continued)

Index	Index value
469	102, 12
470	114, 12
471	125, 12
472	137, 12
473	148, 12
474	159, 12
475	171, 12
476	182, 12
477	193, 12
478	205, 12

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Index	Index value
479	216, 12
480	228, 12
481	239, 12
482	250, 12
483	262, 12
484	273, 12
485	284, 12
486	296, 12
487	307, 12
488	319, 12
489	330, 12
490	341, 12
491	353, 12
492	364, 12
493	375, 12
494	387, 12
495	398, 12
496	410, 12
497	421, 12
498	432, 12
499	444, 12
500	455, 12
501	466, 12
502	478, 12
503	489, 12
504	501, 12

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Index	Index value
505	512, 12
506	523, 12
507	535, 12
508	546, 12
509	558, 12
510	569, 12
511	580, 12
512	592, 12

Table B.48 (continued)

Index	Index value
513	603, 12
514	614, 12
515	626, 12
516	637, 12
517	649, 12
518	660, 12
519	671, 12
520	683, 12
521	694, 12
522	705, 12
523	717, 12
524	728, 12
525	740, 12
526	751, 12
527	762, 12

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Index	Index value
528	774, 12
529	785, 12
530	796, 12
531	808, 12
532	819, 12
533	831, 12
534	842, 12
535	853, 12
536	865, 12
537	876, 12
538	887, 12
539	899, 12
540	910, 12
541	922, 12
542	933, 12
543	944, 12
544	956, 12
545	967, 12
546	978, 12
547	990, 12
548	1001, 12
549	1013, 12
550	2, 23
551	11, 23
552	23, 23
553	34, 23

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Index	Index value
554	46, 23
555	57, 23

Table B.48 (continued)

Index	Index value
556	68, 23
557	80, 23
558	91, 23
559	102, 23
560	114, 23
561	125, 23
562	137, 23
563	148, 23
564	159, 23
565	171, 23
566	182, 23
567	193, 23
568	205, 23
569	216, 23
570	228, 23
571	239, 23
572	250, 23
573	262, 23
574	273, 23
575	284, 23
576	296, 23

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Index	Index value
577	307, 23
578	319, 23
579	330, 23
580	341, 23
581	353, 23
582	364, 23
583	375, 23
584	387, 23
585	398, 23
586	410, 23
587	421, 23
588	432, 23
589	444, 23
590	455, 23
591	466, 23
592	478, 23
593	489, 23
594	501, 23
595	512, 23
596	523, 23
597	535, 23
598	546, 23
599	558, 23

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Table B.48 (continued)

Index	Index value
600	569, 23
601	580, 23
602	592, 23
603	603, 23
604	614, 23
605	626, 23
606	637, 23
607	649, 23
608	660, 23
609	671, 23
610	683, 23
611	694, 23
612	705, 23
613	717, 23
614	728, 23
615	740, 23
616	751, 23
617	762, 23
618	774, 23
619	785, 23
620	796, 23
621	808, 23
622	819, 23
623	831, 23
624	842, 23

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Index	Index value
625	853, 23
626	865, 23
627	876, 23
628	887, 23
629	899, 23
630	910, 23
631	922, 23
632	933, 23
633	944, 23
634	956, 23
635	967, 23
636	978, 23
637	990, 23
638	1001, 23
639	1013, 23
640	2, 35
641	12, 35
642	23, 35

Table B.48 (continued)

Index	Index value
643	35, 35
644	47, 35
645	58, 35
646	70, 35
647	81, 35

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Index	Index value
648	93, 35
649	105, 35
650	116, 35
651	128, 35
652	140, 35
653	151, 35
654	163, 35
655	175, 35
656	186, 35
657	198, 35
658	209, 35
659	221, 35
660	233, 35
661	244, 35
662	256, 35
663	268, 35
664	279, 35
665	291, 35
666	303, 35
667	314, 35
668	326, 35
669	337, 35
670	349, 35
671	361, 35
672	372, 35
673	384, 35

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Index	Index value
674	396, 35
675	407, 35
676	419, 35
677	431, 35
678	442, 35
679	454, 35
680	465, 35
681	477, 35
682	489, 35
683	500, 35
684	512, 35
685	524, 35
686	535, 35

Table B.48 (continued)

Index	Index value
687	547, 35
688	559, 35
689	570, 35
690	582, 35
691	593, 35
692	605, 35
693	617, 35
694	628, 35
695	640, 35
696	652, 35

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Index	Index value
697	663, 35
698	675, 35
699	687, 35
700	698, 35
701	710, 35
702	721, 35
703	733, 35
704	745, 35
705	756, 35
706	768, 35
707	780, 35
708	791, 35
709	803, 35
710	815, 35
711	826, 35
712	838, 35
713	849, 35
714	861, 35
715	873, 35
716	884, 35
717	896, 35
718	908, 35
719	919, 35
720	931, 35
721	943, 35
722	954, 35

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Index	Index value
723	966, 35
724	977, 35
725	989, 35
726	1001, 35
727	1012, 35
728	2, 47
729	12, 47

Table B.48 (continued)

Index	Index value
730	24, 47
731	35, 47
732	47, 47
733	59, 47
734	71, 47
735	82, 47
736	94, 47
737	106, 47
738	118, 47
739	129, 47
740	141, 47
741	153, 47
742	165, 47
743	177, 47
744	188, 47
745	200, 47

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Index	Index value
746	212, 47
747	224, 47
748	235, 47
749	247, 47
750	259, 47
751	271, 47
752	282, 47
753	294, 47
754	306, 47
755	318, 47
756	330, 47
757	341, 47
758	353, 47
759	365, 47
760	377, 47
761	388, 47
762	400, 47
763	412, 47
764	424, 47
765	435, 47
766	447, 47
767	459, 47
768	471, 47
769	483, 47
770	494, 47
771	506, 47

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Index	Index value
772	518, 47
773	530, 47

Table B.48 (continued)

Index	Index value
774	541, 47
775	553, 47
776	565, 47
777	577, 47
778	589, 47
779	600, 47
780	612, 47
781	624, 47
782	636, 47
783	647, 47
784	659, 47
785	671, 47
786	683, 47
787	694, 47
788	706, 47
789	718, 47
790	730, 47
791	742, 47
792	753, 47
793	765, 47
794	777, 47

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Index	Index value
795	789, 47
796	800, 47
797	812, 47
798	824, 47
799	836, 47
800	847, 47
801	859, 47
802	871, 47
803	883, 47
804	895, 47
805	906, 47
806	918, 47
807	930, 47
808	942, 47
809	953, 47
810	965, 47
811	977, 47
812	989, 47
813	1000, 47
814	1012, 47
815	2, 58
816	12, 58

Table B.48 (continued)

Index	Index value
817	24, 58

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Index	Index value
818	36, 58
819	48, 58
820	60, 58
821	72, 58
822	84, 58
823	96, 58
824	108, 58
825	120, 58
826	133, 58
827	145, 58
828	157, 58
829	169, 58
830	181, 58
831	193, 58
832	205, 58
833	217, 58
834	229, 58
835	241, 58
836	253, 58
837	265, 58
838	277, 58
839	289, 58
840	301, 58
841	313, 58
842	325, 58
843	337, 58

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Index	Index value
844	349, 58
845	361, 58
846	373, 58
847	386, 58
848	398, 58
849	410, 58
850	422, 58
851	434, 58
852	446, 58
853	458, 58
854	470, 58
855	482, 58
856	494, 58
857	506, 58
858	518, 58
859	530, 58
860	542, 58

Table B.48 (continued)

Index	Index value
861	554, 58
862	566, 58
863	578, 58
864	590, 58
865	602, 58
866	614, 58

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Index	Index value
867	626, 58
868	638, 58
869	651, 58
870	663, 58
871	675, 58
872	687, 58
873	699, 58
874	711, 58
875	723, 58
876	735, 58
877	747, 58
878	759, 58
879	771, 58
880	783, 58
881	795, 58
882	807, 58
883	819, 58
884	831, 58
885	843, 58
886	855, 58
887	867, 58
888	879, 58
889	891, 58
890	904, 58
891	916, 58
892	928, 58

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Index	Index value
893	940, 58
894	952, 58
895	964, 58
896	976, 58
897	988, 58
898	1000, 58
899	1012, 58
900	2, 70
901	12, 70
902	25, 70
903	37, 70

Table B.48 (continued)

Index	Index value
904	50, 70
905	62, 70
906	75, 70
907	87, 70
908	100, 70
909	112, 70
910	125, 70
911	137, 70
912	150, 70
913	162, 70
914	175, 70
915	187, 70

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Index	Index value
916	200, 70
917	212, 70
918	225, 70
919	237, 70
920	250, 70
921	262, 70
922	275, 70
923	287, 70
924	300, 70
925	312, 70
926	325, 70
927	337, 70
928	350, 70
929	362, 70
930	375, 70
931	387, 70
932	400, 70
933	412, 70
934	425, 70
935	437, 70
936	450, 70
937	462, 70
938	475, 70
939	487, 70
940	500, 70
941	512, 70

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Index	Index value
942	524, 70
943	537, 70
944	549, 70
945	562, 70
946	574, 70
947	587, 70

Table B.48 (continued)

Index	Index value
948	599, 70
949	612, 70
950	624, 70
951	637, 70
952	649, 70
953	662, 70
954	674, 70
955	687, 70
956	699, 70
957	712, 70
958	724, 70
959	737, 70
960	749, 70
961	762, 70
962	774, 70
963	787, 70
964	799, 70

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Index	Index value
965	812, 70
966	824, 70
967	837, 70
968	849, 70
969	862, 70
970	874, 70
971	887, 70
972	899, 70
973	912, 70
974	924, 70
975	937, 70
976	949, 70
977	962, 70
978	974, 70
979	987, 70
980	999, 70
981	1012, 70
982	2, 81
983	13, 81
984	26, 81
985	39, 81
986	52, 81
987	65, 81
988	78, 81
989	91, 81
990	104, 81

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Table B.48 (continued)

Index	Index value
991	117, 81
992	130, 81
993	143, 81
994	156, 81
995	169, 81
996	181, 81
997	194, 81
998	207, 81
999	220, 81
1000	233, 81
1001	246, 81
1002	259, 81
1003	272, 81
1004	285, 81
1005	298, 81
1006	311, 81
1007	324, 81
1008	337, 81
1009	350, 81
1010	363, 81
1011	376, 81
1012	389, 81
1013	402, 81
1014	415, 81
1015	428, 81

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Index	Index value
1016	441, 81
1017	454, 81
1018	467, 81
1019	480, 81
1020	493, 81
1021	506, 81
1022	518, 81
1023	531, 81
1024	544, 81
1025	557, 81
1026	570, 81
1027	583, 81
1028	596, 81
1029	609, 81
1030	622, 81
1031	635, 81
1032	648, 81
1033	661, 81
1034	674, 81

Table B.48 (continued)

Index	Index value
1035	687, 81
1036	700, 81
1037	713, 81
1038	726, 81

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Index	Index value
1039	739, 81
1040	752, 81
1041	765, 81
1042	778, 81
1043	791, 81
1044	804, 81
1045	817, 81
1046	830, 81
1047	843, 81
1048	855, 81
1049	868, 81
1050	881, 81
1051	894, 81
1052	907, 81
1053	920, 81
1054	933, 81
1055	946, 81
1056	959, 81
1057	972, 81
1058	985, 81
1059	998, 81
1060	1011, 81
1061	2, 93
1062	13, 93
1063	27, 93
1064	40, 93

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Index	Index value
1065	54, 93
1066	67, 93
1067	81, 93
1068	94, 93
1069	108, 93
1070	121, 93
1071	135, 93
1072	148, 93
1073	162, 93
1074	175, 93
1075	189, 93
1076	202, 93
1077	216, 93

Table B.48 (continued)

Index	Index value
1078	229, 93
1079	243, 93
1080	256, 93
1081	269, 93
1082	283, 93
1083	296, 93
1084	310, 93
1085	323, 93
1086	337, 93
1087	350, 93

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Index	Index value
1088	364, 93
1089	377, 93
1090	391, 93
1091	404, 93
1092	418, 93
1093	431, 93
1094	445, 93
1095	458, 93
1096	472, 93
1097	485, 93
1098	499, 93
1099	512, 93
1100	525, 93
1101	539, 93
1102	552, 93
1103	566, 93
1104	579, 93
1105	593, 93
1106	606, 93
1107	620, 93
1108	633, 93
1109	647, 93
1110	660, 93
1111	674, 93
1112	687, 93
1113	701, 93

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Index	Index value
1114	714, 93
1115	728, 93
1116	741, 93
1117	755, 93
1118	768, 93
1119	781, 93
1120	795, 93
1121	808, 93

Table B.48 (continued)

Index	Index value
1122	822, 93
1123	835, 93
1124	849, 93
1125	862, 93
1126	876, 93
1127	889, 93
1128	903, 93
1129	916, 93
1130	930, 93
1131	943, 93
1132	957, 93
1133	970, 93
1134	984, 93
1135	997, 93
1136	1011, 93

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Index	Index value
1137	2, 105
1138	14, 105
1139	28, 105
1140	42, 105
1141	56, 105
1142	70, 105
1143	84, 105
1144	98, 105
1145	112, 105
1146	126, 105
1147	140, 105
1148	154, 105
1149	168, 105
1150	182, 105
1151	196, 105
1152	210, 105
1153	224, 105
1154	238, 105
1155	252, 105
1156	267, 105
1157	281, 105
1158	295, 105
1159	309, 105
1160	323, 105
1161	337, 105
1162	351, 105

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Index	Index value
1163	365, 105
1164	379, 105

Table B.48 (continued)

Index	Index value
1165	393, 105
1166	407, 105
1167	421, 105
1168	435, 105
1169	449, 105
1170	463, 105
1171	477, 105
1172	491, 105
1173	505, 105
1174	519, 105
1175	533, 105
1176	547, 105
1177	561, 105
1178	575, 105
1179	589, 105
1180	603, 105
1181	617, 105
1182	631, 105
1183	645, 105
1184	659, 105
1185	673, 105

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Index	Index value
1186	687, 105
1187	701, 105
1188	715, 105
1189	729, 105
1190	743, 105
1191	757, 105
1192	772, 105
1193	786, 105
1194	800, 105
1195	814, 105
1196	828, 105
1197	842, 105
1198	856, 105
1199	870, 105
1200	884, 105
1201	898, 105
1202	912, 105
1203	926, 105
1204	940, 105
1205	954, 105
1206	968, 105
1207	982, 105
1208	996, 105

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Table B.48 (continued)

Index	Index value
1209	1010, 105
1210	2, 116
1211	15, 116
1212	30, 116
1213	45, 116
1214	59, 116
1215	74, 116
1216	89, 116
1217	104, 116
1218	119, 116
1219	134, 116
1220	148, 116
1221	163, 116
1222	178, 116
1223	193, 116
1224	208, 116
1225	223, 116
1226	237, 116
1227	252, 116
1228	267, 116
1229	282, 116
1230	297, 116
1231	312, 116
1232	326, 116
1233	341, 116

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Index	Index value
1234	356, 116
1235	371, 116
1236	386, 116
1237	401, 116
1238	416, 116
1239	430, 116
1240	445, 116
1241	460, 116
1242	475, 116
1243	490, 116
1244	505, 116
1245	519, 116
1246	534, 116
1247	549, 116
1248	564, 116
1249	579, 116
1250	594, 116
1251	608, 116

Table B.48 (continued)

Index	Index value
1252	623, 116
1253	638, 116
1254	653, 116
1255	668, 116
1256	683, 116

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Index	Index value
1257	698, 116
1258	712, 116
1259	727, 116
1260	742, 116
1261	757, 116
1262	772, 116
1263	787, 116
1264	801, 116
1265	816, 116
1266	831, 116
1267	846, 116
1268	861, 116
1269	876, 116
1270	890, 116
1271	905, 116
1272	920, 116
1273	935, 116
1274	950, 116
1275	965, 116
1276	979, 116
1277	994, 116
1278	1009, 116
1279	2, 128
1280	16, 128
1281	32, 128
1282	48, 128

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Index	Index value
1283	64, 128
1284	80, 128
1285	96, 128
1286	112, 128
1287	128, 128
1288	144, 128
1289	160, 128
1290	176, 128
1291	192, 128
1292	208, 128
1293	224, 128
1294	240, 128
1295	256, 128

Table B.48 (continued)

Index	Index value
1296	272, 128
1297	288, 128
1298	304, 128
1299	320, 128
1300	336, 128
1301	352, 128
1302	368, 128
1303	384, 128
1304	400, 128
1305	416, 128

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Index	Index value
1306	432, 128
1307	448, 128
1308	464, 128
1309	480, 128
1310	496, 128
1311	512, 128
1312	528, 128
1313	544, 128
1314	560, 128
1315	576, 128
1316	592, 128
1317	608, 128
1318	624, 128
1319	640, 128
1320	656, 128
1321	672, 128
1322	688, 128
1323	704, 128
1324	720, 128
1325	736, 128
1326	752, 128
1327	768, 128
1328	784, 128
1329	800, 128
1330	816, 128
1331	832, 128

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Index	Index value
1332	848, 128
1333	864, 128
1334	880, 128
1335	896, 128
1336	912, 128
1337	928, 128
1338	944, 128

Table B.48 (continued)

Index	Index value
1339	960, 128
1340	976, 128
1341	992, 128
1342	1008, 128

Table B.49 Pitch trigonometric function table and horizontal trigonometric function table

Index	Index value
0	0.000000
1	0.006136
2	0.012272
3	0.018407
4	0.024541
5	0.030675
6	0.036807
7	0.042938
8	0.049068

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Index	Index value
9	0.055195
10	0.061321
11	0.067444
12	0.073565
13	0.079682
14	0.085797
15	0.091909
16	0.098017
17	0.104122
18	0.110222
19	0.116319
20	0.122411
21	0.128498
22	0.134581
23	0.140658
24	0.146730
25	0.152797
26	0.158858
27	0.164913
28	0.170962
29	0.177004
30	0.183040
31	0.189069
32	0.195090,
33	0.201105
34	0.207111

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Table B.49 (continued)

Index	Index value
35	0.213110
36	0.219101
37	0.225084
38	0.231058
39	0.237024
40	0.242980
41	0.248928
42	0.254866
43	0.260794
44	0.266713
45	0.272621
46	0.278520
47	0.284408
48	0.290285
49	0.296151
50	0.302006
51	0.307850
52	0.313682
53	0.319502
54	0.325310
55	0.331106
56	0.336890
57	0.342661
58	0.348419
59	0.354164

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Index	Index value
60	0.359895
61	0.365613
62	0.371317
63	0.377007
64	0.382683,
65	0.388345
66	0.393992
67	0.399624
68	0.405241
69	0.410843
70	0.416430
71	0.422000
72	0.427555
73	0.433094
74	0.438616
75	0.444122
76	0.449611
77	0.455084

Table B.49 (continued)

Index	Index value
78	0.460539
79	0.465977
80	0.471397
81	0.476799
82	0.482184

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Index	Index value
83	0.487550
84	0.492898
85	0.498228
86	0.503538
87	0.508830
88	0.514103
89	0.519356
90	0.524590
91	0.529804
92	0.534998
93	0.540171
94	0.545325
95	0.550458
96	0.555570,
97	0.560662
98	0.565732
99	0.570781
100	0.575808
101	0.580814
102	0.585798
103	0.590760
104	0.595699
105	0.600616
106	0.605511
107	0.610383
108	0.615232

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Index	Index value
109	0.620057
110	0.624860
111	0.629638
112	0.634393
113	0.639124
114	0.643832
115	0.648514
116	0.653173
117	0.657807
118	0.662416
119	0.667000
120	0.671559
121	0.676093

Table B.49 (continued)

Index	Index value
122	0.680601
123	0.685084
124	0.689541
125	0.693971
126	0.698376
127	0.702755
128	0.707107,
129	0.711432
130	0.715731
131	0.720003

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Index	Index value
132	0.724247
133	0.728464
134	0.732654
135	0.736817
136	0.740951
137	0.745058
138	0.749136
139	0.753187
140	0.757209
141	0.761202
142	0.765167
143	0.769103
144	0.773010
145	0.776888
146	0.780737
147	0.784557
148	0.788346
149	0.792107
150	0.795837
151	0.799537
152	0.803208
153	0.806848
154	0.810457
155	0.814036
156	0.817585
157	0.821102

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Index	Index value
158	0.824589
159	0.828045
160	0.831470,
161	0.834863
162	0.838225
163	0.841555
164	0.844854

Table B.49 (continued)

Index	Index value
165	0.848120
166	0.851355
167	0.854558
168	0.857729
169	0.860867
170	0.863973
171	0.867046
172	0.870087
173	0.873095
174	0.876070
175	0.879012
176	0.881921
177	0.884797
178	0.887640
179	0.890449
180	0.893224

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Index	Index value
181	0.895966
182	0.898674
183	0.901349
184	0.903989
185	0.906596
186	0.909168
187	0.911706
188	0.914210
189	0.916679
190	0.919114
191	0.921514
192	0.923880,
193	0.926210
194	0.928506
195	0.930767
196	0.932993
197	0.935184
198	0.937339
199	0.939459
200	0.941544
201	0.943593
202	0.945607
203	0.947586
204	0.949528
205	0.951435
206	0.953306

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Index	Index value
207	0.955141
208	0.956940

Table B.49 (continued)

Index	Index value
209	0.958703
210	0.960431
211	0.962121
212	0.963776
213	0.965394
214	0.966976
215	0.968522
216	0.970031
217	0.971504
218	0.972940
219	0.974339
220	0.975702
221	0.977028
222	0.978317
223	0.979570
224	0.980785,
225	0.981964
226	0.983105
227	0.984210
228	0.985278
229	0.986308

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Index	Index value
230	0.987301
231	0.988258
232	0.989177
233	0.990058
234	0.990903
235	0.991710
236	0.992480
237	0.993212
238	0.993907
239	0.994565
240	0.995185
241	0.995767
242	0.996313
243	0.996820
244	0.997290
245	0.997723
246	0.998118
247	0.998476
248	0.998795
249	0.999078
250	0.999322
251	0.999529

Table B.49 (continued)

Index	Index value
252	0.999699

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Index	Index value
253	0.999831
254	0.999925
255	0.999981
256	1.000000

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Annex C
(Informative)
AVS3 Audio Rendering

C.1 Metadata Restrictions

For the metadata used in this Annex, the attributes and elements defined in ITU-R BS.2076-2 for content and format are used, and some attributes or sub-elements defined in ITU-R BS.2076-2 are restricted as follows.

For restrictions on audioProgramme, refer to Table C.1.

Table C.1 Restrictions on audioProgramme

Attribute/Sub-element	Restrictions	Mandatory/optional
audioProgrammeName	The value contains a maximum of 32 bytes. Otherwise, the value is truncated.	Mandatory
start	The duration defined by the start and end fields needs to be the same as that of the audio file. Otherwise, the duration of the audio file is used.	Optional
end		Optional

For restrictions on audioContent, refer to Table C.2.

Table C.2Restrictions on audioContent

Attribute/Sub-element	Restrictions	Mandatory/optional
audioContentName	The value contains a maximum of 32 bytes. Otherwise, the value is truncated.	Mandatory

For restrictions on audioObject, refer to Table C.3.

Table C.3Restrictions on audioObject

Attribute/Sub-element	Restrictions	Mandatory/optional
audioObjectName	The value contains a maximum of 24 bytes. Otherwise, the value is truncated.	Mandatory

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Attribute/Sub-element	Restrictions	Mandatory/optional
audioObjectIDRef	It indicates the ID of another nested audioObject. A maximum of four layers are supported.	Optional

For restrictions on audioStreamFormat, refer to Table C.4.

Table C.4 Restrictions on audioStreamFormat

Attribute/Sub-element	Restrictions	Mandatory/optional
audioStreamFormatName	The value contains a maximum of 32 bytes. Otherwise, the value is truncated.	Mandatory
formatLabel	0001: PCM stream	Mandatory

For restrictions on audioTrackFormat, refer to Table C.5.

Table C.5 Restrictions on audioTrackFormat

Attribute/Sub-element	Restrictions	Mandatory/optional
audioTrackFormatName	The value contains a maximum of 32 bytes. Otherwise, the value is truncated.	Mandatory
formatLabel	0001: PCM stream	Mandatory

For restrictions on audioPackFormat, refer to Table C.6.

Table C.6 Restrictions on audioPackFormat

Attribute/Sub-element	Restrictions	Mandatory/optional
audioPackFormatName	The value contains a maximum of 32 bytes. Otherwise, the value is truncated.	Mandatory

For restrictions on audioChannelFormat, refer to Table C.7.

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Table C.7 Restrictions on audioChannelFormat

Attribute/Sub-element	Restrictions	Mandatory/optional
audioChannelFormatName	The value contains a maximum of 32 bytes. Otherwise, the value is truncated.	Mandatory

For restrictions (HOA) on audioBlockFormat, refer to Table C.8.

Table C.8 Restrictions on audioBlockFormat

Attribute/Sub-element	Restrictions	Mandatory/optional
order	A maximum of seven orders are supported.	Mandatory

For restrictions on extended metadata, refer to Table C.9.

Table C.9 Restrictions on extended metadata

<vrExt>	Description	Example
version	Version number of the extended metadata	0.0.1
name	Name of the extended metadata	vrExt
level	Priority of the extended metadata	1
presenceInfo	Content-related part of the extended metadata	
staticControl	Static content of the extended metadata	
dynamicControl	Dynamic content of the extended metadata	

For restrictions on presenceInfo, refer to Table C.10.

Table C.10 Restrictions on presenceInfo

Attribute	Description	Specifications
descriptor	Description of presenceInfo.	The value can contain a

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Attribute	Description	Specifications
		maximum of 32 characters.
sampleRate	Audio sampling rate.	The value is an integer, for example, 44100.
audioProgrammeReferID	It is associated with an AudioProgramme item in ITU-R BS.2076-2.	APR_1001
instanceReferID	It is associated with an AudioChannelFormat item in ITU-R BS.2076-2.	INS_00010001
isEncoded	It indicates whether the process is an encoding process.	0/1, optional
avdataAligned	It indicates whether to align with the video frame.	0/1, optional
frameRate	A frame rate used for video synchronization	int, optional
renderMode	It indicates whether to overwrite the related parts in ITU-R BS.2076-2. 0 indicates discard, and 1 indicates overwrite.	0/1
loudnessGain	Loudness linear gain	0 to 16, optional

For restrictions on instance, refer to Table C.11.

Table C.11 Restrictions on instance

Attribute	Description	Specifications
id	It uniquely identifies the instance.	INS_0001_0001
type	Corresponding audio type code	{0001, 0003, 0004}
typeLabel	A corresponding audio type name	{DirectSpeaker, Objects, HOA}
audioChannelFormatRefID	ID indexes used to match the ITU-R BS.2076-2 elements	AC_00010001

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Attribute	Description	Specifications
unitInfo	It corresponds to audioChannelFormat. A plurality of values are supported.	

For restrictions on unitInfo, refer to Table C.12.

Table C.12 Restrictions on unitInfo

Attribute	Description	Specifications
id	It uniquely identifies the unit.	UNI_00010001
start	It indicates the start time of the unit. This field is valid only when typeLabel is Objects.	00:00:00.00000
duration	It indicates the duration of the unit. This field is valid only when typeLabel is Objects.	00:00:00.00000
When typeLabel is DirectSpeakers:		
azimuth	Horizontal angle, in degrees	–180 to 180
elevation	Elevation angle, in degrees	–90 to 90
distance	Distance, in meters	0 to 50
gain	Linear gain	0 to 16
When typeLabel is Objects:		
azimuth	Horizontal angle, in degrees	–180 to 180
elevation	Elevation angle, in degrees	–90 to 90
distance	Distance, in meters	0 to 50
gain	Linear gain	0 to 16
When typeLabel is HOA:		
order	Corresponding channel order	0 to 7

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Attribute	Description	Specifications
degree	An angle of a corresponding channel	–7 to +7
normalization	Normalization manner	{0, 1, ...}
gain	Linear gain	0 to 16

For restrictions on staticControl, refer to Table C.13.

Table C.13 Restrictions on staticControl

Attribute	Description	Specifications
ambisonicOrder	Spherical harmonic coding order	1 to 7
acousticEnv	Related to Acoustic environment	
rendererInfo	Post-processing related to rendering	

For restrictions on acousticEnv, refer to Table C.14.

Table C.14 Restrictions on acousticEnv

Attribute	Description	Specifications
type	Acoustics environment type	{0, 1, 2}
typeLabel	Acoustics environment type label	{Physical/Artificial/Sample}
earlyReflectionGain	Early reflection gain	[0.0, 1.0]
lateReverbGain	Late reverberation gain	[0.0, 1.0]
lowFreqProFlag	Low-frequency separation processing	The options include 0 and 1. Reverberation processing is optional for low frequencies.

Table C.14 (continued)

Attribute	Description	Specifications
convolutionReverbType	Sampling reverberation type	{0, 1, 2, ...}

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Attribute	Description	Specifications
surface	Reflective surface of geometric space	A space model can consist of an unlimited number of reflectors.

For restrictions on surface, refer to Table C.15.

Table C.15 Restrictions on surface

Attribute	Description	Specifications
material	Material type in the acoustic environment. In total, 25 types of materials are supported.	{0, 1, 2, ..., 24}
materialLabel	Material type label in the acoustic environment	{brick, water, ...}
vertex	Geometric model vertices. Three vertices form a triangle. An unlimited number of triangles are supported.	[x1, y1, z1], [x2, y2, z2]...
absorption	Absorption rates of different bandwidths. This field is optional.	[0.0, 1.0]
scattering	Absorption rates of different bandwidths. This field is optional.	[0.0, 1.0]

For restrictions on rendererInfo, refer to Table C.16.

Table C.16 Restrictions on rendererInfo

Attribute	Description	Specifications
targetDevice	Playback device type	{0, 1, 2, ...}
hrtfType	HRTF type that complies with the SOFA standard	The options are 0, 1, ..., and N. For example, 0 indicates THK and 1 indicates MIT.
headphoneType	Headphone type	{0, 1, 2, ...}
audioEffect	Post-processing audio effect	

For restrictions on audioEffect, refer to Table C.17.

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Table C.17 Restrictions on audioEffect

Attribute	Description	Specifications
EQ	Post-EQ processing	
DRC	Post-DRC processing	
Gain	Post-gain processing	

For restrictions on EQ, refer to Table C.18.

Table C.18 Restrictions on EQ

Attribute	Description	Specifications
index	Sequence of sound effect links	{0, 1, 2, ...}
type	Filter type	{0, 1, 2, ...}
typeLabel	Filter type label	{LowPass, HighPass, BandPass, BandReject, AllPass, LowShelving, HighShelving, Peaking, ...}
frequency	Cut-off frequency	20 to 16000
gain	Gain	[–40, –40]dB
Q	Quality factor	0.1 to 12

For restrictions on DRC, refer to Table C.19.

Table C.19 Restrictions on DRC

Attribute	Description	Specifications
index	Sequence of sound effect links	{0, 1, 2, ...}
attackTime	Start time	[0 to 100]ms
releaseTime	Release time	[50 to 300]ms
threshold	Threshold	[–80 to 10]dB
preGain	Pregain	[–10 to 10]dB
postGain	Postgain	[0 to 20]dB

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Attribute	Description	Specifications
ratio	Compression ratio	1 to 100

For restrictions on gain, refer to Table C.20.

Table C.20 Restrictions on gain

Attribute	Description	Specifications
index	Sequence of sound effect links	{0, 1, 2, ...}
gain	Gain	–20 dB to 20 dB

To ensure device compatibility, content interoperability, and controllable complexity of encoding, decoding, and rendering systems, a level-based control mechanism is used for the number and combination of metadata. Five levels are defined: level 0 to level 4. Level 0 is used to maintain interoperability with existing audio content. This level supports "typeDefinitions = DirectSpeakers" and "SpeakerLabel = M + 000/M + 022/M – 022". Level 1 to level 3 limit the maximum number of audio content elements. Level 4 supports an unlimited number of audio content elements.

For restrictions on level classification, refer to Table C.21.

Table C.21 Level classification table

<audioformatExtended> Element	Description	Level				
		0	1	2	3	4
audioProgramme	Number of audio programs in an audio file or an audio stream	1	1	4	8	Unlimited
audioContent	Number of program audio content items in a file or a stream	2	4	8	16	Unlimited
audioObject	An audio source in a file or a stream	2	8	64	128	Unlimited
concurrentAudioObject	Number of concurrent audio sources in a time segment	2	8	16	32	Unlimited
audioPackFormat	Number of audio format groups in a file (excluding audio streams)	1	8	32	64	Unlimited

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<audioformatExtended> Element	Description	Level				
		0	1	2	3	4
audioChannelFormat	Number of audio formats in a file (excluding audio streams)	2	32	64	128	Unlimited
audioStreamFormat	Number of track group formats in a file (excluding audio streams)	2	32	64	128	Unlimited
audioTrackFormat	Number of audio track formats in a file (excluding audio streams)	2	32	64	128	Unlimited
audioTrackUID	Number of unique identifiers in an audio file or an audio stream	2	32	64	128	Unlimited

C.2 Speaker Rendering

C.2.1 Speaker Rendering System Framework

The speaker rendering system renders input metadata and audio data based on a specified replay configuration to obtain an audio signal for replaying. Speaker rendering is classified into channel-based rendering, object-based rendering, and HOA-based rendering. Channel-based rendering converts an input channel signal into a signal required by the target speaker layout, and object-based rendering and HOA-based rendering use metadata and replay configurations to reproduce object-based and HOA-based audio data. The three rendering manners may be used in a combination or separately based on actual application requirements.

A speaker rendering system framework is shown in Figure C-1. The metadata is converted based on typeDefinition in the metadata to obtain metadata required by different speaker rendering types. Then, a rendering element item determining module is used to obtain paths of rendering items. Corresponding metadata and audio data are sent to different rendering modules, and then rendered based on a target speaker layout. Finally, a rendered signal is processed by a gain mixing module to obtain a signal finally used for replaying.

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Figure C-1 Overall architecture of speaker rendering system

(1) Metadata conversion

The metadata required for speaker rendering is saved as metadata type items through metadata conversion to correspond to audio types. The metadata types are classified into three types: channel type metadata, object type metadata, and HOA type metadata. According to different audio types, the track index information track index corresponding to the channel in the audio data is reserved, and is combined with the metadata type item to generate a rendering element item for rendering different types of audio in a next phase.

- Channel type

  Channel type metadata contains an audioBlockFormat item. If there is general data, it further contains general data collected from external data, and is constructed as channel type metadata DirectSpeakersTypeMetadata in the metadata.

  Each piece of channel type metadata can be independently processed. Therefore, the rendering item contains only one piece of track index information, and is constructed as the channel type rendering item DirectSpeakersRenderingItem.

- Object type

  The object type metadata ObjectTypeMetadata contains one audioBlockFormat item. If there is general data, it further contains one piece of general data collected from external data.

  Similar to the channel type metadata, each piece of object type metadata can be independently processed. Therefore, the rendering item also contains only one piece of track index information, and is constructed as the object type rendering item ObjectRenderingItem.

- HOA type

  The HOA type metadata is different from the channel type metadata and the object type metadata. The system needs to process a group of audioChannelFormats at the same time (for example, in the case of order 1, the system needs to process a group of four channels). The metadata does not contain audioBlockFormat or external data. Necessary information (such as the start time, end time, order, and degree) is extracted from audioBlockFormats and directly stored in the HOA type metadata HOATypeMetadata.

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(2) Rendering element item determining

The rendering element item RenderingItem indicates a to-be-rendered metadata element item, and also includes all information required for performing this operation. The rendering element item is a single audioChannelFormat or a group of audioChannelFormats. Because each audio type has different requirements, different metadata types need to be used to meet rendering requirements of corresponding types.

The HOA rendering element item HOARenderingItem constructed by the system is different from that of the other two types. The HOA rendering element item includes one piece of track index information and a vector including the track.

To determine and construct various types of rendering element items, a structure analysis needs to be performed on the metadata to finally determine a rendering path, as shown in Figure C-2.

Figure C-2 Path of rendering item determining

The start point of rendering item determining is generally an audioProgramme element. If data includes a plurality of audioProgramme elements, the program with the lowest ID is used by default. The audioProgramme element can also be selected based on audioProgrammeID. If there is no audioProgramme element, a set of all audioObject items are used as the start point, and other audioObject do not reference these audioObject items.

During the determining process, the audioPackFormats referenced by each audioObject item and the audioTrackUID referenced by each audioObject item are cross-checked to verify the consistency and integrity of metadata elements.

When a reference loop is detected, audioObjects can be nested.

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As reference from audioTrackFormats back to audioStreamFormat is optional, the mapping from audioTrackFormat to audioStreamFormats is done reversely from audio StreamFormation.

C.2.2 Channel-based rendering

C.2.2.1 Overview

A block diagram of channel-based rendering is shown in Figure C-3:

Figure C-3 Block diagram of channel-based rendering

The speaker position corresponding to the input channel signal is determined based on metadata **speakerLable**. The gain of each channel signal is determined according to the target speaker layout. During gain calculation, when the number of input channels is less than the number of channels in the target speaker layout, the upmixing gain is calculated, and then the output signal is obtained through point sound source positioning. When the number of input channels is greater than the number of channels in the target speaker layout, the downmixing gain is calculated, and then, the output signal is obtained through point sound source positioning. When the number of input channels is the same as the number of channels in the target speaker layout, the channel signal is directly sent to the corresponding speaker.

The screen position corresponding to the audio signal when the terminal replays the audio signal is determined based on the metadata **screenEdgeLock** screen edge lock. If the speaker coordinates corresponding to the input channel signal are Cartesian coordinates (x, y, z), the speaker coordinates are first converted into polar coordinates (d, φ, θ). Refer to formula (C.1).

$$d = \sqrt{x^2 + y^2 + z^2}$$

$$\varphi = \cos^{-1}\frac{z}{d} \qquad \text{(C.1)}$$

$$\theta = \tan^{-1}\frac{y}{x}$$

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The screen edge lock is divided into lock in the horizontal direction and lock in the vertical direction.

Horizontal direction: When the left is locked, the left is set as a replay sound source point for the azimuth. When the right is locked, the right is set as a sound source point for the azimuth. If the lock is disabled, the azimuth of the sound source point remains unchanged.

Vertical direction: When the top is locked, the top is set as a replay sound source point for the azimuth. When the bottom is locked, the bottom is set as a sound source point for the azimuth. If the lock is disabled, the azimuth of the sound source point remains unchanged.

C.2.2.2 Gain Calculation

When the number of input channels does not match the number of sound boxes in the target speaker layout, the gain of each input channel is calculated according to section C.2.2.3.

When the input is 5.1 channel and the number of sound boxes in the target speaker layout is less than 3, the 5.1 channel signal is downmixed into a stereo signal in the stereo downmixing manner. The steps are as follows:

(a) A sound source position of 0+5+0 is used as an input direction, and a sequence is M+030, M–030, M+000, M+110, and M–110. A corresponding gain vector is g', and a range of each gain value is 0 to 1.

(b) Stereo gains g'' corresponding to M+030 and M–030 are calculated according to formula (C.2):

$$g'' = \begin{bmatrix} 1 & 0 & \sqrt{\frac{1}{3}} & \sqrt{\frac{1}{2}} & 0 \\ 0 & 1 & \sqrt{\frac{1}{3}} & 0 & \sqrt{\frac{1}{2}} \end{bmatrix} \cdot g' \tag{C.2}$$

(c) The g'' power is normalized according to formula (C.3) to a value determined by balancing the front and rear speakers a_{front} and a_{rear} in g', so that the source between M+030 and M–030 is not attenuated, and the source between M–110 and M+110 is attenuated by 3 dB:

$$\begin{aligned} a_{\text{front}} &= \max\{g'_1, g'_2, g'_3\} \\ a_{\text{rear}} &= \max\{g'_4, g'_5\} \\ r &= \frac{a_{\text{rear}}}{a_{\text{front}} + a_{\text{rear}}} \\ g &= g'' \frac{r^{\frac{1}{2}}}{\|g''\|_2} \end{aligned} \tag{C.3}$$

$\max\{g'_1, g'_2, g'_3\}$ indicates the maximum value in g'_1, g'_2, g'_3, and $\max\{g'_4, g'_5\}$ indicates the maximum value in g'_4, g'_5.

C.2.2.3 Point sound source positioning

If the number of input channels M is not equal to the number of output channels N, it means that the position of the input signal speaker may not match the position of the actual replay speaker. In this case, point sound source positioning needs to be performed, and the actual speaker virtualizes positions corresponding to the N outputs. Point sound source positioning is performed by using a triangular area method. Basic VBAP is implemented in a spherical triangular area formed by three speakers to obtain a position of a virtual speaker. A direction of the virtual speaker is defined as a three-dimensional unit vector shown in formula (C.4):

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$$P = \begin{bmatrix} p_1 \\ p_2 \\ p_3 \end{bmatrix} \tag{C.4}$$

P is the virtual speaker position, and p_1, p_2, p_3 are positions of three target speakers closest to P. The three positions with the minimum distance d between the target speaker and P are calculated. If the nearest speakers cannot be determined from d, the positions are compared according to the sequence of azimuth and pitch angle $\{|\theta|, \theta, |\varphi|, \varphi\}$.

The speakers p_1, p_2, p_3 are set on the surface of the sphere. The three-dimensional vector $l_1 = \begin{bmatrix} l_{11} \\ l_{12} \\ l_{13} \end{bmatrix}$. Its origin is the center of the sphere, and the vector points to the direction of the speaker p_1. The three-dimensional vector $l_2 = \begin{bmatrix} l_{21} \\ l_{22} \\ l_{23} \end{bmatrix}$. Its origin is the center of the sphere, and the vector points to the direction of the speaker p_2. The three-dimensional vector $l_3 = \begin{bmatrix} l_{31} \\ l_{32} \\ l_{33} \end{bmatrix}$. Its origin is the center of the sphere, and the vector points to the direction of the speaker p_3. The virtual speaker vector P is represented as a linear combination of three speaker vectors l_1, l_2, l_3, and is represented in a matrix form. Refer to formula (C.5):

$$P^T = g_1 l_1 + g_2 l_2 + g_3 l_3 = g L_{123} \tag{C.5}$$

g_1, g_2, g_3 are gain factors, $g = [g_1 \quad g_2 \quad g_3]$, and $L_{123} = \begin{bmatrix} l_1 \\ l_2 \\ l_3 \end{bmatrix}$. The virtual speaker P corresponds to the gain vector g. Refer to formula (C.6):

$$g = P^T L_{123}^{-1} = [p_1 \quad p_2 \quad p_3] \begin{bmatrix} l_{11} & l_{12} & l_{13} \\ l_{21} & l_{22} & l_{23} \\ l_{31} & l_{32} & l_{33} \end{bmatrix}^{-1} \tag{C.6}$$

For example, the input is 5.1.4, the LFE channel is not considered, and the three-dimensional vectors are defined for nine channels: $p_{i1}, p_{i1,\cdots} p_{i9}$. The target speaker layout is 5.1. The three-dimensional vectors for 5 actual channels are defined as $p_{r1}, p_{r2,\cdots} p_{r5}$. In this case, each virtual gain vector g_{i9} needs to be virtualized for the nine input channels one by one by using an actual three-dimensional vector in a point sound source positioning manner. Refer to formula (C.7):

$$g_{i1} = P_{i1}^T L_{r123}^{-1} = [p_{r1} \quad p_{r2} \quad p_{r3}] \begin{bmatrix} l_{r11} & l_{r12} & l_{r13} \\ l_{r21} & l_{r22} & l_{r23} \\ l_{r31} & l_{r32} & l_{r33} \end{bmatrix}^{-1} \tag{C.7}$$

C.2.3 Object-based Rendering

C.2.3.1 Overview

Different objects of object-based audio content data are rendered. typeDefinition provides the input of metadata and audio data. The metadata enters the renderer in an input form of an object-based metadata type. An output of metadata and audio data based on object content is obtained through processing by the metadata pre-processing module and object gain calculation. A signal flow process of gain calculation between metadata elements of non-LFE content is shown in Figure C-4.

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Figure C-4 Signal flow process of gain calculation between metadata elements

C.2.3.2 Coordinate Conversion

If the position coordinates of the input object are spherical coordinates, formula (C.8) is used to convert spherical coordinates (d, θ, φ) into Cartesian coordinates (x, y, z):

$$x = \sin\left(-\frac{\pi}{180}\varphi\right)\cos\left(\frac{\pi}{180}\theta\right)d$$

$$y = \cos\left(-\frac{\pi}{180}\varphi\right)\cos\left(\frac{\pi}{180}\theta\right)d \qquad \text{(C.8)}$$

$$z = \sin\left(-\frac{\pi}{180}\varphi\right)d$$

C.2.3.3 Screen Zooming

If Sreen_ref exists in the metadata, screen zooming is used to convert the screen into a Cartesian central position and two vectors (in the x and z directions). The position is updated according to formula (C.9):

$$centre = cart(\varphi, \theta, d)$$

$$\mathrm{width} = \mathrm{w}/2 \qquad \text{(C.9)}$$

$$\mathrm{height} = \mathrm{width}/a$$

w is the width of the display screen, and a is the width-to-height ratio of the display screen. The default value of w is 3840 × 2160, and the default value of a is 1.78.

For calculation of x and z vectors of the screen, refer to formula (C.10):

$$v_x = \{\mathrm{width}, 0, 0\}$$
$$v_z = \{0, 0, \mathrm{height}\} \qquad \text{(C.10)}$$

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C.2.3.4 Screen Edge Lock

If ScreenEdgeLock exists in the metadata, screen edge lock is used, and the object position is updated based on the screen edge parameter position.

C.2.3.5 Channel Lock

If ChannelLock exists in the metadata, channel lock is used to update the position. When the Cartesian coordinate position or the width, height, and depth of the spherical coordinates of the metadata is or are received, and the channel lock is enabled, the system compares and calculates the speakers in a group of possible speakers and locks the speaker closest to the position as the output channel. If the nearest speaker cannot be obtained from the distance, the positions are compared according to the sequence $\{|\theta|, \theta, |\varphi|, \varphi\}$ based on the azimuth and pitch angle.

C.2.3.6 Diffuse

The azimuthRange or positionRange are used to obtain a diffuse value. This is implemented by adding two additional source positions P_l and P_r to the left and right sides of the original sound source position P_c.Each position is associated with gains g_c, g_l and g_r.For calculation of g_c, refer to formula (C.11). For calculation of g_l and g_r, refer to formula (C.12):

$$g_c = \frac{1-x}{x+1} g \tag{C.11}$$

$$g_l = g_r = \frac{x}{x+1} \tag{C.12}$$

x is the diffuse value, and $0 \leq x \leq 1$.

C.2.3.7 Sound Image Extension

The sound image extension is applicable to each position p corresponding to diffuse. A gain vector $gains_for_each_pos$ of each speaker is generated for each position p. The gain is mixed with power determined based on the diffuse gain $diverged_gains$ to form the sum of power. For the sum of power, refer to formula (C.13):

$$gains[i] = \sqrt{\sum_j diverged_gains\,[j] \times gains_for_each_pos[j,i]^2} \tag{C.13}$$

The point sound source positioning used in the channel-based rendering may be used for the sound image extension. The virtual speaker gain of the corresponding object is calculated based on the position, width, height, and depth of the object metadata.

C.2.3.8 Downmixing area exclusion

Downmixing area are determined by excluding a speaker. Only the nominal position of the speaker is considered in the calculation. A slight change of the position of the speaker does not affect the behavior of the area exclusion.

For the CartesianZone object, the following formula is used to determine whether the speaker is in the area. $\{x, y, z\}$ is the nominal position of the speaker, and is converted from polar coordinates with a radius of 1. Refer to formula (C.14):

$$\begin{aligned} \mathrm{minX} - \epsilon < \quad & x < \mathrm{maxX} + \epsilon \\ \mathrm{minY} - \epsilon < \quad & y < \mathrm{maxY} + \epsilon \\ \mathrm{minZ} - \epsilon < \quad & z < \mathrm{maxZ} + \epsilon \end{aligned} \tag{C.14}$$

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$\epsilon = 10^{-6}$ is a safety margin that allows a rounding error during conversion between polar coordinates and Cartesian coordinates. $\mathtt{minX}$, $\mathtt{maxY}$, and $\mathtt{maxZ}$ indicates corner vertices of a cuboid in the three-dimensional space. These corner vertices are excluded from rendering of Cartesian coordinates. A value of the attribute of each corner vertex is a floating point value, and ranges from –1.0 to 1.0.If coordinate values of a speaker are within this range, the speaker is excluded from this area.

The gain vector generated after the area exclusion is extended by adding the LFE channel gain with the value of 0. After the processing in Figure C-4, all gains $gains_full$ are generated. One gain value is obtained for each speaker.

C.2.3.9 Separation of direct sound and diffuse sound

All gains are divided into a direct sound vector $direct$ and a diffuse sound vector $diffuse$ to control the direct and divergence paths, depending on the diffuse metadata diffuse parameter. For the calculation process, refer to formula (C.15).

$$\begin{aligned} direct &= gains_full \times \sqrt{1 - diffuse} \\ diffuse &= gains_full \times \sqrt{diffuse} \end{aligned} \tag{C.15}$$

C.2.4 HOA-based Rendering

A block diagram of HOA-based rendering is shown in Figure C-5:

Figure C-5 Block diagram of HOA-based rendering

In this rendering system, the HOA signal can be rendered at a maximum of six orders. The HOA signal is represented by a normalized HOA type sub-element. The rendering system supports three normalization manners: N3D, SN3D, and FuMa. The same normalization manner needs to be used for all HOA channels in audioBlockFormat. The FuMa supports only 3-order normalization. The HOA rendering process is as follows:

The HOA object format is determined by parsing the metadata, and whether the signal can be rendered is checked. It is determined that the same normalization and screenRef sub-element values are used by all HOA channels in audioBlockFormat. Then, the speaker decoding matrix is calculated, and the HOA signal rendering output is obtained according to the formula (C.16):

$$S_{spk} = DS_{HOA} \tag{C.16}$$

S_{spk} is a target speaker signal matrix, and has $N_{\mathrm{spk}} \times N_{\mathrm{samp}}$ dimensions;

S_{HOA} is an HOA audio signal matrix, and has $N_{\mathrm{HOA}} \times N_{\mathrm{samp}}$ dimensions;

D is an HOA decoding matrix, and has $N_{\mathrm{spk}} \times N_{\mathrm{HOA}}$ dimensions;

N_{HOA}, N_{spk}, and N_{samp} respectively indicates the HOA signal, the speaker signal, and the number of samples.

The AllRAD-based HOA decoding method is used for rendering. The decoder D of the HOA calculates the gain value HOAnspN_gain of each HOA track for each sound box, and outputs the multi-track HOA signal to an independent sound box. The decoding matrix D calculated for the HOA channel through the HOA gain calculation is directly applied to the input audio channel to produce the output audio channel.

AllRAD describes the Ambisonic gain $g_{AllRAD}(\theta) = D_{y_N}(\theta)$ by using the decoder D. The result of D is the most matching gain $g_{\mathrm{VBAP}}(\theta)$ of VBAP-based point sound source positioning. If there is no maximum weight, D is used to define AllRAD for rendering. The integral of D indicates the minimum mean square error of the integral in all directions θ. For specific calculation, refer to formula (C.17):

$$\min_{D} \int_{S^2}' \left\| g_{VBAP}(\theta) - D_{y_N}(\theta) \right\|^2 d\theta \tag{C.17}$$

When the sampling function $g_{AMBI}(\theta) = y_N(\theta) diag\{a_N\} y_N(\theta_s)$ at the optimal layout of the virtual speaker is used as a plurality of virtual source inputs, AllRAD may be defined as a VBAP synthesis on a physical speaker. The VBAP synthesis g is an integral on an infinite plurality of virtual speakers θ. For specific calculation, refer to formula (C.18):

$$g = \int g_{VBAP}(\theta) g_{AMBI}(\theta)\, d\theta = \int g_{VBAP}(\theta) y_N(\theta) diag\{a_N\} y_N(\theta_s)\, d\theta$$

$$= \underbrace{\int g_{VBAP}(\theta) y_N^T(\theta)\, d\theta}_{D}\, diag\{a_N\} y_N(\theta_s) \tag{C.18}$$

The item $diag\{a_N\} y_N(\theta_s)$ is extracted from the integral. The remaining integral defines the matrix D of AllRAD, which is used as the transform of the VBAP speaker gain function $g_{\mathrm{VBAP}}(\theta)$ to the polar coordinate coefficient. This method may provide the most matching HOA decoding on an irregular speaker layout. The HOA signal may be decoded based on the matrix D of AllRAD to virtual speakers evenly distributed on the sphere, and virtual speaker signals can be generated on actual speakers through point sound source positioning.

C.3 Binaural Rendering

C.3.1 Binaural Rendering System Framework

The binaural rendering system mainly includes a metadata system and a core rendering system. The metadata system parses and converts the metadata. The metadata includes control information that describes audio content and the rendering system, for example, whether an input audio format is channel audio, object audio, or HOA, and sound source position information of the object audio. If the input audio is in the interleaved format, the audio track further needs to be divided based on the audio track index in the metadata.. The core rendering system performs binauralizing rendering on different audio signals and corresponding metadata to output binaural audio. For the system framework, refer to Figure C-6:

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Figure C-6 Binaural rendering system framework

C.3.1.1 Binaural Rendering System Input

The input of the rendering system includes audio data and metadata. The audio data supports channel audio, object audio, and HOA audio. The audio data and the metadata may be read from a local file, or may be read from a decoded bitstream. The former is applicable to an offline production scenario, and the latter is applicable to a streaming rendering scenario.

The metadata includes audioProgramme, audioContent, audioObject, audioTrackUID, audioPackFormat, audioTrackFormat, audioStreamFormat, audioChannelFormat and audioBlockFormat. The first four are content-related metadata, and the rest are format-related metadata.

When a file is input for binaural rendering, the file needs to include both audio data and metadata. Generally, a file in a BW64 format is used as a carrier, the metadata is stored in axmlChunk, and a correspondence between an audio track index and the metadata is stored in chnaChunk. For details about how to parse a file in the BW64 format, refer to ITU-R BS.2088.

When a real-time decoded bitstream is input for binaural rendering, the decoded metadata is required to indicate the correspondence between the audio track and the metadata.

C.3.1.2 Metadata Parsing and Conversion

After the metadata is read from the BW64 file or the decoded bitstream, the metadata needs to be further parsed. To adapt to use of the renderer, metadata conversion usually needs to be further performed, to convert the metadata obtained through parsing into a format that can be supported by the renderer. The metadata obtained from the decoded bitstream does not need to be parsed additionally, but metadata conversion also needs to be performed to meet requirements in different scenarios.

The BW64 file or decoding bitstream is parsed into an element consistent with the metadata definition. Some metadata that cannot be readily used by the renderer, such as speakerLabel,

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needs to be converted into metadata that can be readily used by the renderer. For dynamic metadata, such as position information of the object audio, interpolation needs to be further performed to prevent audio jump or break after rendering.

Elements of the metadata have a mutual inclusion relationship and a mutual dependency relationship. During parsing, the zeroth audioProgramme element is used as an entry by default. For a metadata parsing process, refer to Figure C-7.

Figure C-7 Metadata parsing process

The following should be specially noted during metadata parsing:

(a) The default value of audioProgramme is allowed. In this case, audioObject is used as the metadata parsing entry.

(b) Check whether the reference of audioPackFormat in audioObject is the same as that in audioTrackUID.

(c) The audioTrackFormats referenced in audioStreamFormat is optional. The mutual reference between audioTrackFormat and audioStreamFormat is reverse to each other.

If audioChannelFormat in the channel audio includes only speakerLabel but does not include the speaker layout position of the corresponding channel, the corresponding sound source position parameter needs to be found based on speakerLabel for rendering. For the conversion method, refer to GY/T 316-2018. The following is an example of the conversion method:

```
convert_label_to_positiion() {
   switch speaker_label:
      case FrontLeft:
         return {30, 0, 1};
      case Center:
       return {0, 0 , 1};
      ......
```

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}

When a file is input, interpolation needs to be performed for dynamic metadata, for example, object audio position parameters, to ensure the rendering effect. This is because the frame length of the renderer is different from the duration of audioBlockFormat. When the duration of two adjacent blocks is greater than the frame length T_d, a break or jump may occur in the auditory sense. The frame length is determined according to section C.3.2 Core Rendering Engine.To obtain the continuous auditory effect, interpolation needs to be performed on the dynamic metadata. The linear interpolation method is used, and the main steps are divided into framing and interpolation.

(1) Framing

Each frame of data includes N sampling points, and the sampling rate is f_s. For the number T_d of milliseconds corresponding to the duration of each frame of data, refer to the formula (C.19):

$$T_d = 1000\frac{N}{F_s} \tag{C.19}$$

The block 1 and the block 2 are two consecutive blocks. A relative start time and duration of the block 1 are T_1 and D_1, and a relative start time and duration of the block 2 are T_2 and D_2.

The number of frames in block 1 is $\frac{D_1}{T_d}$. If D_1 cannot be exactly divided by T_d, the block 1 is split into two segments. The duration of the first segment can be exactly divided by T_d to obtain the largest value. For the corresponding number N_1 of frames, refer to formula (C.20):

$$N_1 = \lfloor\frac{D_1}{T_d}\rfloor \tag{C.20}$$

The remaining part and the block 2 are combined into a new block, and this framing operation is repeated. For a relative start time T_2' of the new block, refer to formula (C.21):

$$T_2' = T_2 - (D_1 - T_d * N_1) \tag{C.21}$$

For calculation of the duration D_2', refer to formula (C.22):

$$D_2' = D_2 + (D_1 - T_d * N_1) \tag{C.22}$$

Each block is framed according to a sequence until all blocks are processed.

(2) Interpolation

The position parameter of audioBlockFormat1 is p_1, and the position parameter of audioBlockFormat2 is p_2. The start point position of interpolation is the block1(x_1, y_1, z_1), and the end point position is the block2(x_2, y_2, z_2). The start point and end point of interpolation are determined by the values of jumpPosition and interpolationLength in the metadata.

When jumpPosition is 0, interpolation is performed on the entire data block. The start point block 1 of interpolation is the same as that of p_1, and the end point block 2 is the same as that of p_2.If the length of interpolationLength is 0, interpolation is not performed. The duration of p_1 is the same as the duration of audioBlockFormat1. When interpolationLength is greater than 0, interpolation is performed only on the first interpolationLength-th samples of audioBlockFormat1, and interpolation is not performed on the remaining part.It can be learned from framing that the block 1 is divided into N1 frames. For an x-coordinate linear interpolation step Δx from the block 1 to the block 2, refer to formula (C.23):

$$\Delta x = \frac{x_2 - x_1}{N_1} \tag{C.23}$$

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It is assumed that the x coordinate of the block 1 is x_0. For the coordinates $x_1, x_2, x_3 \ldots x_n$ after interpolation, refer to the formula (C.24):

$$x_{n+1} = x_n + \Delta x \tag{C.24}$$

$n \in [0, N_1)$.

Coordinates of the block 1 after interpolation are (x_n, y_n, z_n), and n∈ $[0, N_1)$.

The method for calculating the step of the y coordinate and the z coordinate is the same as that for calculating the step of the x coordinate.

For the process of framing and interpolation, refer to Figure C-8.

Figure C-8 Flowchart of dynamic metadata framing and interpolation

The value range of the horizontal azimuth is [0, ±180]. There is a critical point of ±180. When the horizontal azimuth increases continuously, the horizontal azimuth returns to the origin. The interpolation calculation uses the proximity principle. For example, the interpolation is performed from azimuth 1 = 170 to azimuth 2 = –170. If counterclockwise interpolation is performed, the absolute difference between two points is 20. If clockwise interpolation is performed, the absolute difference between two points is 340. Therefore, the counterclockwise difference is selected, and the interpolation is performed according to a sequence of 170–180–(–170).

C.3.1.3 Track division

When the input audio data is in the interleaved format, the audio data of the channels is aliased together. Because metadata needs to be associated and rendered by channel during rendering, the audio in the interleaved format needs to be separated into audio in the tiled form. In this way, each channel has a one-to-one correspondence to an audio track index in the metadata.

The dual-channel audio is used as an example. Figure C-9 shows the principle of audio separation. The upper part of the figure is the audio in the interleaved format. The odd-numbered unit and even-numbered unit respectively indicate the sampling points of the two

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channels. The lower part is the separated audio in the tiled format. After the separation, the sampling points of each channel are stored in the same audio data block.

Figure C-9 Audio separation principle

The following is an example of the track division code:

```
convert_interleave_to_plannar() {
    for (int i = 0; i < channel; ++i) {
        for (int j = 0; j < sample; ++j) {
            plannar_audio[i][j] = interleave_audio[j * channel + i];
        }
    }
}
```

After track division, the channel audio, the object audio, and the HOA audio can be separated based on the track index in the metadata. An example of the method is as follows:

```
get_channel_base_audio() {
  return pannar_audio[channels_index];
}
get_object_base_audio() {
  return pannar_audio[objects_index];
}
get_hoa_base_audio() {
return pannar_audio[hoa_index];
}
```

C.3.1.4 Rendering Control

Rendering control controls the renderer behavior based on the parameters provided in the metadata, adds sound sources based on the audio track index in the metadata, audio type, and position parameters of channels of the channel audio and object audio, and adds the HOA audio based on the type, order, and degree of the HOA audio.

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The following is an example of adding various types of sound sources:

```
if (type == DirectSpeaker) {
    add_channel_base_audio_by_index()
} else if (type == Object) {
    add_object_base_audio_by_index()
} else if (type == HOA) {
    add_hoa_base_audio_by_index()
}
```

Rendering control updates the position information of the object audio in real time based on the dynamic metadata, and obtains the audio effect of the motion in the space through rendering. An example of the method for setting the real-time position parameter of the object audio is as follows:

```
set_object_base_audio_position() {
    update_source_position_by_index()
}
```

Other functions of rendering control, such as controlling program switching, are implemented by using a similar method.

C.3.1.5 Rendering Engine

The rendering engine implements binaural rendering on the input audio based on the metadata, and outputs the binaural audio. Content of the core rendering engine is described in detail in section C.3.2.

C.3.1.6 Post-rendering Processing

During post-rendering processing, the output binaural audio is corrected, for example, dynamic range control and loudness control. After binauralizing rendering, the amplitude and loudness of the binaural audio obtained through rendering change due to the gain of the header transmission function. When the dynamic and loudness differences between the output audio and the input audio are great, dynamic control and loudness control should be used for adjustment to accurately recover the expression intention of the rendering sequence. Otherwise, extreme cases such as crackle and crack sound may occur. For the loudness control, refer to ITU-R BS.1770. Dynamic control uses a limiter to ensure the dynamic range of the output audio.

C.3.2 Principle of Binaural Rendering Engine

C.3.2.1 Overview

The binaural rendering engine uses the sound field reconstruction technology based on the Ambisonic kernel, uses the spherical harmonic function to code input audio to the spherical harmonic domain based on metadata, and stores the input audio in the Ambisonic format as an intermediate medium signal. Spatial encoding includes spatial coding of channel audio and spatial coding of object audio. Because the HOA audio is in the Ambisonic format, it only needs to be superimposed on the intermediate medium signal without spatial coding. During spatial coding, coordinate transform needs to be performed on the sound source position

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parameter before the parameter is used. In addition, spatial coding also needs to respond to the control parameter in the metadata and the user interaction. Finally, the binaural audio is output after spatial decoding is performed on the Ambisonic signal. Parameter calculation indicates calculation and conversion of control parameters, for example, coordinate system conversion of position parameters and object audio position update. For the flowchart of the binaural rendering engine, refer to Figure C-10.

Figure C-10 Principle diagram of binaural rendering engine

C.3.2.2 Position parameter coordinate conversion

The coordinate system used by metadata supports the Cartesian coordinate system and the spherical coordinate system. The metadata spherical coordinate system is shown in (a) in Figure C-11, and the metadata Cartesian coordinate system is shown in (b) in Figure C-11. The audio coordinate system shown in (d) in Figure C-11 is used during spatial encoding. The external interface of the renderer provides the function of setting the position information of multi-channel audio and object audio. This function uses the world coordinate system shown in (c) in Figure C-11. The coordinate systems are described as follows:

Metadata Cartesian coordinate system: X points to the right, Y points to the inside of the screen, Z points to the sky, and a human view direction is the positive direction of the Y axis.

Metadata spherical coordinate system: θ is an angle between a projection of the target point on the xy plane and a positive direction of the x axis. φ is an angle between a connection line

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between the target point and the origin and a positive direction of the z axis. r is a distance from the target point to the origin.

World coordinate system: X points to the right, Y points to the sky, Z points to the outside of the screen, and a human view direction is the positive direction of the Z axis.

Audio coordinate system: X points to the inside of the screen, Y points to the left, Z points to the sky, and a human view direction is the positive direction of the X axis.

Figure C-11 Definitions of coordinate systems

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The method for converting the metadata spherical coordinates (r, azimuth, elevation) into the metadata Cartesian coordinates (x, y, z) is as follows:

```
polar_to_cartisian() {
        x = r * sin(-azimuth) * cos(elevation)
```

```
        y = r * cos(-azimuth) * sin(elevation)
        z = r * sin(elevation)
    return {x, y, z}
                }
```

The method for converting the metadata Cartesian coordinates (x, y, z) into the world coordinates (x', y', z') is as follows:

```
        cartisian_to_world() {
    x' = -x
            y' = z
                z'= y
return { x', y' ,z' }
        }
```

The method for converting the world coordinates (x', y', z') into the audio coordinates (x'', y'', z'') is as follows:

```
        world_to_audio() {
    x'' = z'
        y'' = x'
        z'' = y'
        return { x'', y'', z''}
    }
```

C.3.2.3 Spatial Coding

The Ambisonic technology is used for spatial coding. The spherical harmonic function is used to perform spatial coding on the channel audio and object audio. The coded intermediate media are uniformly in the ACN SN3D format. The HOA audio is in the Ambisonic format. It only needs to be superimposed on the intermediate media signals obtained through spatial coding. The input HOA audio supports two formats: ACN SN3D and ACN N3D. The format of the input HOA audio is determined through parameter setting. For the spherical harmonic function Y_n^m, refer to formula (C.25):

$$Y_n^m = (-1)^m \sqrt{\frac{(2n+1)(n-|m|)!}{4\pi(n+|m|)!}} P_n^m(cos\theta)e^{im\varphi} \quad \text{(C.25)}$$

n is an order of the spherical harmonic function, and m is a degree of the spherical harmonic function. In subsequent content of this chapter, n is used as an order, and m is used as a degree by default. θ and φ describe the horizontal azimuth and pitch angle of the spatial position information of the sound source. In an actual application, a real number form of the spherical harmonic function is usually used, and $e^{im\varphi}$ is replaced with $\Phi_m(\varphi)$. Refer to formula (C.26):

$$\Phi_m(\varphi) = \begin{cases} \sqrt{2}sin(|m|\varphi) & m < 0 \\ 1 & m = 0 \\ \sqrt{2}cos(|m|\varphi) & m > 0 \end{cases} \quad \text{(C.26)}$$

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P_n^m is an accompanying Legendre polynomial. Refer to formula (C.27):

$$P_n^m(x) = (1-x^2)^{|m|/2}\frac{d^{|m|}}{dx^{|m|}}P_n(x) \quad \text{(C.27)}$$

$P_n(x)$ is n-order Legendre polynomial. Refer to formula (C.28):

$$P_n(x) = \frac{1}{2^n n!}\frac{d^n}{dx^n}(x^2-1)^n \quad \text{(C.28)}$$

Y_n^m supports the order 1 to order 7, that is, $N \in [1,7]$. For the N-order spherical harmonic function, $n \in [0,\mathrm{N}]$, and $m \in [-N,N]$. The higher order of the spherical harmonic function indicates the higher precision and a better sense of space and surrounding after binauralization.

During spatial coding, an audio signal $\omega(\theta,\varphi)$ is coded to a spherical harmonic domain according to a spherical harmonic function Y_n^m, to generate an n-order Ambisonic signal S_{HOA}. Refer to formula (C.29):

$$S_{HOA}(\theta,\varphi) = Y_n^m \cdot \omega(\theta,\varphi) \quad \text{(C.29)}$$

$\omega(\theta,\varphi)$ indicates input audio at a certain position of the space, and includes audio data and metadata.

After spatial coding is performed by channel, all input signals are superimposed on S_{HOA} for storage as intermediate medium signals $S_{HOA}(n)$. Refer to formula (C.30):

$$S_{HOA}(n) = \sum_{i=0}^{L-1} S_{HOA}(\theta,\varphi)_i \quad \text{(C.30)}$$

L is the number of sound sources participating in spatial coding.

C.3.2.4 Spatial Decoding

The intermediate medium signal $S_{HOA}(n)$ obtained through spatial coding indicates the Ambisonic signal reconstructed by the AVS3 audio field of the input audio. Based on this, the $S_{HOA}(n)$ signal is filtered according to the spherical harmonic domain header transmission function h_s to obtain the binaural output signal b_ω. Refer to formula (C.31):

$$b_\omega(n) = \sum_{m=0}^{M-1} S_{HOA}(n) \cdot h_s(n-m) \quad \text{(C.31)}$$

M is a length of the header transmission function h_s, and is fixed at 256, and n is a length of binauralized data.

The spherical harmonic domain header transmission function h_s is obtained by converting the time-domain header transmission function h. The least square method is used to obtain the error of h_s and h. When the error reaches the minimum, the rendering effect of h_s and h is considered to be the same. For the definition of the error e, refer to formula (C.32):

$$e = min \sum_{\Omega \in S^2} |h_s \cdot Y_n^m(\Omega) - h(\Omega)|^2 \quad \text{(C.32)}$$

Ω is the angle at any position on the sphere. The h_s calculated at the minimum error e is the header transmission function in spherical harmonic domain.

Because the length of the header transmission function is fixed, the length of the data for each binauralization is also fixed. Therefore, the lengths of the input and output data of each frame of the renderer should be determined during renderer initialization. Typical frame lengths (numbers of sampling points) supported by the renderer are 128, 256, 512, 1024, and 2048. The frame length is also used for framing and interpolation of dynamic metadata.

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C.3.2.5 LFE Channel Processing

The multi-channel audio usually has an LFE bass channel. During speaker rendering, the bass channel can be rendered by using a high-power subwoofer to obtain the stunning effect. The binaural rendering uses headphones as a playback device. Because the power of the headphones is low, and the low-frequency effect is not obvious, the bass LFE channel may be ignored during binaural rendering.

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Annex D
(Informative)
General Full-rate Audio Coding

D.1 Coding Framework

The general full-rate audio coding includes core coding and HOA spatial coding. The core coding includes coding pre-processing, downmixing, spectrum grouping, neural network transform, quantization, and range coding. Coding pre-processing includes transient detection, window type determining, MDCT, frequency-domain noise shaping, temporal noise shaping, and bandwidth extension coding. A channel signal and an object signal are coded into bitstreams through core coding, and an HOA signal is coded into a bitstream through HOA spatial coding and the core coding. Figure D-1 is a schematic diagram of the coding framework.

Figure D-1 General full-rate audio coding framework

Each channel signal is transformed from time domain to frequency domain and pre-processed through coding pre-processing. The pre-processed frequency-domain signal is downmixed through signal downmixing in different coding modes to remove the correlation between channels. During neural network transform, quantization, and range coding, a neural network is used to transform and code each downmixed channel. The HOA signal is converted through HOA spatial coding into a transmission channel signal. The following describes each mode coding module.

a) General full-rate audio mono coding

Figure D-2 and Figure D-3 are schematic diagrams of basic structures of the general full-rate audio mono coding. The mono coder performs coding pre-processing on the time-domain

mono signal to obtain a processed MDCT coefficient, performs neural network transform to obtain a transform-domain coefficient, and finally performs quantization and range coding to obtain a bitstream. The coding pre-processing module includes a transient detection and window type determining module, a frequency-domain noise shaping module, a temporal noise shaping module, and a bandwidth extension coding module.

1) Transient detection and window type determining

   The transient detection module determines, based on the energy of the input time-domain signal, whether there is a transient signal in the current frame. The window type determining module obtains a windowed control parameter of the current frame based on the transient signal detection result. The windowed control parameter includes a 2048-point sine window, a 256-point sine window, and a 2048-point switching window.

   - Input: the time-domain mono signal
   - Output: the windowed control parameter

2) MDCT

   The MDCT module performs windowing and MDCT on the input time-domain signal based on the windowed control parameter.

   - Input: the mono time-domain signal and the windowed control parameter
   - Output: an MDCT coefficient of the mono signal

3) Frequency-domain noise shaping

   The frequency-domain noise shaping module obtains quantized spectral envelope information based on the input time-domain signal, and adjusts the MDCT coefficient based on the quantized spectral envelope information to implement MDCT spectrum shaping, thereby controlling distribution of quantized noise in frequency domain.

   - Input: the windowed time-domain signal and the MDCT coefficient of the mono signal
   - Output: an MDCT coefficient of the mono signal after frequency-domain noise shaping and a frequency-domain noise shaping parameter

4) Temporal noise shaping

   The temporal noise shaping module obtains a temporal noise shaping parameter based on the MDCT coefficient after frequency-domain noise shaping, and shapes the MDCT coefficient based on the temporal noise shaping parameter, to control distribution of quantized noise in time domain.

   - Input: the MDCT coefficient of the mono signal after frequency-domain noise shaping
   - Output: an MDCT coefficient of the mono signal after temporal noise shaping and the temporal noise shaping parameter

5) Bandwidth extension coding

   The bandwidth extension coding module obtains a bandwidth extension parameter based on the MDCT coefficient obtained after temporal noise shaping, to indicate a correlation between high and low frequencies of the MDCT spectrum of the signal, so as to assist the decoder in recovering the high frequency component.

   - Input: the MDCT coefficient of the mono signal after temporal noise shaping
   - Output: a bandwidth extension parameter

6) Neural network transform

   The neural network transform module transforms, by using a neural network, the MDCT coefficient after coding pre-processing, to further remove information redundancy in the spectral coefficient. An output of the neural network is referred to as a transform-domain coefficient, and the transform-domain coefficient is used for quantization and range coding.

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- Input: the pre-processed MDCT coefficient of the mono signal
- Output: the transform-domain coefficient

7) Quantization and range coding

The quantization module performs linear scalar quantization on the transform-domain coefficient obtained through neural network transform, and the coding module performs range coding on a quantization result to obtain a bitstream.

- Input: the transform-domain coefficient
- Output: a bitstream

Figure D-2 General full-rate audio mono coder

Figure D-3 General full-rate audio coding pre-processing

b) General full-rate audio dual-channel stereo coding

Figure D-4 is a schematic diagram of a basic structure of the general full-rate audio dual-channel stereo coding. The dual-channel stereo coder performs dual-channel stereo coding pre-processing on a time-domain dual-channel stereo signal to obtain a processed dual-channel stereo MDCT coefficient, obtains a downmixed dual-channel stereo MDCT coefficient through a dual-channel stereo downmixing and bit allocation module, obtains a transform-domain coefficient through neural network transform, and finally obtains a bitstream through quantization and range coding. The dual-channel stereo coding pre-processing module includes a transient detection and window type determining module, a frequency-domain noise shaping module, a temporal noise shaping module, and a bandwidth extension coding module.

1) Dual-channel stereo coding pre-processing

The dual-channel stereo coding pre-processing module performs coding pre-processing on each channel of the dual-channel stereo, and includes a transient detection and window type determining module, a frequency-domain noise shaping module, a temporal noise shaping module, and a bandwidth extension coding module.

- Input: a time-domain dual-channel stereo signal
- Output: an MDCT coefficient of the pre-processed dual-channel stereo signal, a windowed control parameter, a frequency-domain noise shaping parameter, a temporal noise shaping parameter, and a bandwidth extension parameter

2) Dual-channel stereo downmixing and bit allocation

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The dual-channel stereo downmixing and bit allocation module performs MCR or M/S downmixing and bit allocation on the left and right channel MDCT coefficient based on the dual-channel stereo signal feature.

- Input: the MDCT coefficient of the pre-processed dual-channel stereo signal
- Output: a downmixed channel MDCT coefficient and a bit allocation parameter

3) Neural network transform
   - Input: the downmixed channel MDCT coefficient
   - Output: a downmixed channel transform-domain coefficient
4) Quantization and range coding
   - Input: the downmixed channel transform-domain coefficient
   - Output: a bitstream

Figure D-4 General full-rate audio dual-channel stereo coder

c) General full-rate audio multi-channel coding

Figure D-5 is a schematic diagram of a basic structure of the general full-rate audio multi-channel coding. The multi-channel coder performs coding pre-processing on a time-domain multi-channel signal to obtain a processed MDCT coefficient, obtains a multi-channel downmixing parameter through the multi-channel mode determining module, obtains a downmixed multi-channel MDCT coefficient through a multi-channel downmixing and bit allocation module, obtains a transform-domain coefficient through neural network transform, and finally obtains a bitstream through quantization and range coding. The coding pre-processing module includes a transient detection and window type determining module, a frequency-domain noise shaping module, a temporal noise shaping module, and a bandwidth extension coding module.

1) Multi-channel coding pre-processing

   The multi-channel coding pre-processing module performs coding pre-processing on each channel.
   - Input: the time-domain multi-channel signal
   - Output: an MDCT coefficient of the pre-processed multi-channel signal, a windowed control parameter, a frequency-domain noise shaping parameter, a temporal noise shaping parameter, and a bandwidth extension parameter
2) Multi-channel mode determining

   The multi-channel mode determining module determines a multi-channel signal coding mode parameter based on the multi-channel signal features and the signal correlation.
   - Input: the MDCT coefficient of the pre-processed multi-channel signal
   - Output: the multi-channel signal coding mode parameter
3) Multi-channel downmixing and bit allocation

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The multi-channel signal downmixing module performs multi-channel downmixing on the MDCT coefficient of the pre-processed multi-channel signal based on the multi-channel signal coding mode parameter, and performs M/S downmixing on MDCT coefficients of two channels in each group based on a pair parameter. The bit allocation module is configured to determine a bit allocation parameter.

- Input: the MDCT coefficient of the pre-processed multi-channel signal and the multi-channel signal coding mode parameter
- Output: a downmixed multi-channel MDCT coefficient and the bit allocation parameter

4) Neural network transform
   - Input: the downmixed multi-channel MDCT coefficient
   - Output: a downmixed multi-channel transform-domain coefficient
5) Quantization and range coding
   - Input: the downmixed multi-channel transform-domain coefficient
   - Output: a bitstream

Figure D-5 General full-rate audio multi-channel coder

d) General full-rate audio HOA coding

Figure D-6 and Figure D-7 are schematic diagrams of basic structures of the general full-rate audio HOA coding. HOA spatial coding is performed on the HOA signal to obtain a transmission channel signal, and then transmission channel coding pre-processing is performed to obtain a processed MDCT coefficient. The HOA downmixing and bit allocation module obtains a downmixed transmission channel MDCT coefficient. Neural network transform is performed to obtain a transform-doamin coefficient. Finally, quantification and coding are performed to obtain a bitstream. HOA spatial coding includes a sound field component analysis module, a sound field component synthesis module, and an other component calculation module. The coding pre-processing module includes a transient detection and window type determining module, a frequency-domain noise shaping module, a temporal noise shaping module, and a bandwidth extension coding module.

1) Sound field component analysis

   The sound field component analysis module performs sound field component analysis on an HOA signal through linear decomposition to determine the sound field distribution features, such as the number of sound sources, directivity of sound sources, and dispersion of sound sources.
   - Input: the HOA signal
   - Output: a sound field analysis parameter
2) Sound field component synthesis

   The sound field component synthesis module configures the coder based on the sound field analysis parameters and other configuration parameters, determines a sound field component parameter based on the main sound field component of the HOA signal, and synthesizes a transmission channel signal through linear reversible conversion. The

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sound field component parameter includes virtual speaker attribute information, and the transmission channel signal includes a virtual speaker signal.

- Input: the HOA signal and the sound field analysis parameter
- Output: a sound field component parameter and a transmission channel signal

3) Other component calculation

The remaining component calculation module configures the encoder based on the sound field analysis parameter and other configuration parameters, and determines a transmission channel signal and an other component parameter based on the HOA signal, the virtual speaker signal, and the sound field component parameter. The transmission channel signal includes a residual signal.

- Input: the HOA signal, the sound field analysis parameter, and the sound field component parameter
- Output: the transmission channel signal and the other component parameter

4) Transmission channel coding pre-processing

The transmission channel coding pre-processing module performs coding pre-processing on each channel, including a transient detection and window type determining module, a frequency-domain noise shaping module, a temporal noise shaping module, and a bandwidth extension coding module.

- Input: the time-domain transmission channel signal
- Output: an MDCT coefficient of the pre-processed transmission channel signal, a windowed control parameter, a frequency-domain noise shaping parameter, a temporal noise shaping parameter, and a bandwidth extension parameter

5) Transmission channel mode determining

The transmission channel mode determining module determines the transmission channel signal coding mode parameter based on the transmission channel signal features and the sound field analysis parameter, for example, the grouping parameter, the bandwidth parameter, the downmixing parameter, and the initial bit allocation parameter.

- Input: the MDCT coefficient of the pre-processed transmission channel signal and the sound field analysis parameter
- Output: a transmission channel coding mode parameter

6) HOA downmixing and bit allocation

The HOA downmixing and bit allocation modules perform downmixing and bit allocation on the transmission channel MDCT coefficient.

- Input: the MDCT coefficient of the pre-processed transmission channel signal and the transmission channel coding mode parameter
- Output: a downmixed channel MDCT coefficient and a bit allocation parameter

7) Neural network transform

- Input: the downmixed channel MDCT coefficient
- Output: a downmixed channel transform-domain coefficient

8) Quantization and coding

- Input: the downmixed channel transform-domain coefficient
- Output: a bitstream

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Figure D-6 General full-rate audio HOA spatial coding

Figure D-7 General full-rate audio HOA coder

D.2 Coding Pre-processing

D.2.1 Transient Detection and Window Type Determining

To better code audio signals with different characteristics, a transform-domain coder needs to add a short window to a transient signal to ensure a good time-domain resolution, and needs to add a long window to a steady signal to ensure a good frequency-domain resolution.

Therefore, before the window type determining is performed, transient detection needs to be performed on the input audio signal first. The transient detection determines whether the current frame is a transient signal.

The basic principle of the transient detection algorithm is as follows:

错误!未找到引用源。 is a schematic diagram of signal framing in the transient detection algorithm.

Figure D-8 Schematic diagram of signal framing in the transient detection algorithm

The length of the input audio signal of the previous frame is 1024 sampling points. The length of the input audio signal of the current frame is also 1024 sampling points. The length of the transient detection section is 1024 sampling points. The first 512 sampling points are the last 512 sampling points of the input audio signal of the current frame, and the last 512 sampling points are the 512 sampling points of the future frame, that is, the lookahead length is 512 points. The transient detection of the current frame is performed in the transient detection section. The basic process is as follows:

Step 1: Perform high-pass filtering on a signal in the transient detection section.

The energy of an audio signal is usually concentrated in a low-frequency part, and a signal whose high-frequency energy changes suddenly may be missed when transient detection is performed directly on the input audio signal.

Therefore, before the transient detection, high-pass filtering may be performed on the audio signal in the transient detection section, to suppress a low-frequency signal component to some extent, thereby facilitating detection of the transient signal.

Step 2: Divide the signal in the transient detection section into blocks, and calculate block energy and a corresponding energy threshold.

The signal in the transient detection section is divided into eight equal-length blocks. A length of the signal in the transient detection section is 1024 sampling points, and a length of a block is 128 sampling points. After the signal is divided into blocks, the energy blockEner of the signal block may be calculated, and is represented by formula (D.1):

$$blockEner[\mathrm{i}] = \sum_{n=blockStart}^{blockEnd} signal^2[n] \quad \text{(D.1)}$$

i is a sequence number of a signal block, n is a sampling point sequence number, blockStart is a sequence number of a start point of the signal block, blockEnd is a sequence number of an end point of the signal block, and signal[n] is an audio signal of the n-th sampling point.

The transient detection requires a signal energy threshold parameter corresponding to each signal block, and a calculation process of the signal energy threshold parameter is described as follows:

It is assumed that signal energy of eight blocks is blockEner[8], a corresponding signal energy threshold is enerThresh[8], and a signal energy threshold history is enerThreshHist (initialized to a preset minimum energy value 103.37).

A manner of calculating the signal energy threshold is as follows:

```
for i = 0 to 7:
  enerThresh[i] = enerThreshHist
  enerThreshHist *= 0.8125
  if blockEner[i] > enerThreshHist:
    enerThreshHist = blockEner[i]
  end
end
```

That is, for each signal block, the signal energy threshold history enerThreshHist is used as a signal energy threshold of the current i-th block. Then, the signal energy threshold is attenuated. An attenuated signal energy threshold is compared with energy of the current block. If the energy of the current block is large, the signal energy threshold is updated.

Step 3: Perform transient detection on the current frame

Based on the signal energy blockEner of each block in the current frame and the corresponding signal energy threshold enerThresh, logic of determining the transient identifier curIsTransient of the current frame is as follows:

```
if initFrame:
  curIsTransient = 0
else:
```

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```
  for i = 0 to 7:
    if blockEner[i] > 8.0 * enerThresh[i]:
      curIsTransient = 1
      break
    end
  end
end
```

That is, the transient detection result of the first frame is 0, and if a block exists in subsequent frames, and the signal energy of the block is greater than several times the signal energy threshold, it is considered that the transient signal exists, and the transient identifier is set to 1.

The window type of the current frame may be determined based on the transient detection results of the current frame and the previous two frames.

If the current frame is the i-th frame, a transient detection result of the (i–2)-th frame is denoted as preIsTransient[0], and a transient detection result of the (i–1)-th frame is denoted as preIsTransient[1].

There are four windows types windowType: a long window ONLY_LONG_WINDOW, a cut-in window LONG_SHORT_TRANS_WINDOW, a cut-out window SHORT_LONG_TRANS_WINDOW, and a short window ONLY_SHORT_WINDOW.

```
if preIsTransient[0] == 0 && preIsTransient[1] == 0 && curIsTransient == 0:
  windowType = ONLY_LONG_WINDOW
else if preIsTransient[0] == 0 && preIsTransient[1] == 0 && curIsTransient == 1:
  windowType = LONG_SHORT_TRANS_WINDOW
else if preIsTransient[0] == 1 && preIsTransient[1] == 0 && curIsTransient == 0:
    windowType = SHORT_LONG_TRANS_WINDOW
else:
  windowType = ONLY_SHORT_WINDOW
end
```

D.2.2 MDCT

Windowing and MDCT may be performed on the input audio signal of the current frame based on the window type.

The definition of each window type is as follows:

a) Long window: LONG_SHORT_TRANS_WINDOW, a sine window with a length of 2048 points.

b) 2. Cut-in window: LONG_SHORT_TRANS_WINDOW, consisting of a left half sine window of 1024 points, 448 points of 1, a right half sine window of 128 points, and 448 points of 0

c) 3. Cut-out window: SHORT_LONG_TRANS_WINDOW, consisting of 448 points of 0, a left half sine window of 128 points, 448 points of 1, and a right half sine window of 1024 points

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d) 4. Short window: ONLY_SHORT_WINDOW, a sine window with a length of 256 points. Eight short windows are added to each frame.

The object of windowing and MDCT processing is a 2048-point audio signal constituted by the previous frame input signal frame_past and the current frame input signal frame_curr. The time-frequency transform is MDCT transform.

Short frame MDCT spectrum interleaving: If the window type of the current frame is ONLY_SHORT_WINDOW, interleaving needs to be performed on the MDCT spectra of eight subframes of the current frame (the length of the MDCT spectrum of each subframe is 128 frequencies) to perform subsequent coding pre-processing.

Figure D-9 is a schematic diagram of spectrum interleaving.

Figure D-9 Schematic diagram of spectrum interleaving

D.2.3 Frequency-domain Noise Shaping

The frequency-domain noise shaping algorithm is an MDCT spectrum shaping technology based on the LPC parameter, and may include: signal pre-emphasis, autocorrelation coefficient calculation, LPC parameter solving, conversion from LPC to LSF, LSF parameter quantization coding, spectrum shaping, and the like.

Pre-emphasis:

The pre-emphasis coefficient is 0.9.

The length of the windowed audio signal is 2048. The pseudocode of the pre-emphasis process is as follows:

```
for i = 2047 to 1
  preemphWinSignal[i] = winSignal[i] – preemphFactor * winSignal[i-1]
end
preemphWinSignal[0] = winSignal[0]
```

winSignal is the windowed audio signal, preemphWinSignal is the pre-emphasis audio signal, and preemphFactor is the pre-emphasis coefficient.

Autocorrelation coefficient calculation:

The LPC parameter order lpcOrder is 16, and the autocorrelation coefficient of the input signal whose length is 17 needs to be calculated. The signal used for the autocorrelation calculation is the audio signal obtained through the pre-emphasis processing.

LPC parameter solving:

The Wiener-Levinson-Durbin iterative algorithm is used to calculate the LPC parameter with the autocorrelation coefficient as the input. The parameter order is 16.

Conversion from LPC to LSF:

The LSP parameter is solved by using Chebyshev polynomial method with 16-order LPC parameter as the input.

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The LSP parameter is converted to the LSF parameter. The value range of the LSF parameter is [0, samplingRate/2]. samplingRate is fixed at 48 kHz.

The conversion from the LPC parameter to the LSF parameter must comply with section 5.1.9 in 3GPP TS 26.445 (Release 17).

LSF parameter quantization coding:

The LSF parameter quantization coding uses a vector quantization technology, and the LSF parameter has 16 dimensions.

The structure of the VQ codebook is multi-stage split vector quantization. For different coding rates, two sets of vector quantization codebooks are used: high-rate vector quantization codebook and low-rate vector quantization codebook.

The method for determining whether to use the high-rate or low-rate vector quantization codebook is as follows: If the average coding rate of each channel is greater than 32 kb/s, the high-rate VQ codebook is used; otherwise, the low-rate VQ codebook is used. The average coding rate of the channels is equal to the total coding rate divided by the number of channels of the input signal.

For the structure of the high-rate codebook and the low-rate codebook, refer to section 7.11.3.

The LSF VQ process is as follows:

Step 1: mean subtraction of LSF vector

The LSF mean value is subtracted from the LSF parameter calculated for the current frame to obtain a residual LSF vector, which is used as an input vector of the VQ algorithm.

Step 2: stage 1 vector quantization

The LSF vector is divided through stage 1 vector quantization into two sub-vectors respectively having 9 and 7 dimensions. VQ codebooks respectively corresponding to the two sub-vectors are searched for to obtain several candidate stage 1 quantization results with the minimum error.

In addition, there are four candidate stage 1 quantization results.

Step 3: stage 2 vector quantization

The high rate mode is used as an example, in two stage 1 VQ sub-vectors, a sub-vector having 9 dimensions is further divided into three stage 2 sub-vectors (respectively have 3, 3, and 3 dimensions).

In the stage 2 VQ, a stage 2 residual vector is first separately calculated for the four candidate quantization results of the stage 1 VQ. Then, split vector quantization is performed on the stage 2 residual vectors to obtain stage 2 VQ errors corresponding to the four candidate quantization results. A stage 1 VQ index with a minimum stage 2 VQ error and three stage 2 VQ indexes are used as a final vector quantization result.

Spectrum shaping:

Spectrum shaping includes three steps: conversion from LSF to LPC, spectrum shaping gain calculation, and spectrum shaping.

Step 1: conversion from LSF to LPC

The quantized LSF parameter obtained through vector quantization is converted to obtain the quantized LPC parameter.

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The conversion from the LSF parameter to the LPC parameter includes two steps: conversion from the LSF parameter to the LSP parameter and conversion from the LSP parameter to the LPC parameter.

Step 2: spectrum shaping gain calculation

First, weighting is performed on the quantized LPC parameter. A weighting process is as follows:

An LPC weighting coefficient is obtained. The pseudocode is as follows:

```
GAMMA_LPC = 0.939999998

weightFactor[0] = 1.0

for i = 1 to lpcOrder:

  weightFactor[i] = weightFactor[i-1] * GAMMA_LPC

end
```

GAMMA_LPC is the initial value of the LPC weighting coefficient, and weightFactor[lpcOrder+1] is the calculated LPC weighting coefficient.

The LPC weighting coefficient is multiplied by the quantized LPC parameter to obtain a weighted LPC parameter weightedLpc.

Second, the low-precision LPC spectrum shaping gain is calculated:

Pre-rotation is performed on the weighted LPC parameter, complex FFT is performed on the pre-rotated LPC parameter rotateLpc, and the low-precision spectrum shaping gain is calculated.

The pre-rotation of the LPC parameter is the same as that in the FFT-based MDCT implementation. The pseudocode is as follows:

```
for (i = 0; i < lpcOrder + 1; i++) {

    tmp = i * PI / 512

    realPart[i] = weightedLpc[i] * cos(tmp)

    imagPart[i]= -weightedLpc[i] * sin(tmp)

}
```

The number of complex FFT points is 512. For the low-precision spectrum shaping gain calculation, refer to formula (D.2):

$$rawLpcGain = \frac{1}{\|FFT(rotateLpc)\|_2} \tag{D.2}$$

The number of points of the obtained low-precision spectrum shaping gain is 256.

Thirdly, a spectrum shaping gain of interpolation is obtained.

4-fold linear interpolation is performed on rawLpcGain to obtain the 1024-point interpolation spectrum shaping gain, which is denoted as interpretLpcGain.

Finally, intra-subband averaging is performed on the interpolation spectrum shaping gain to obtain the final LPC shaping gain.

Step 3: spectrum shaping

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The MDCT spectrum isdivided by the LPC spectrum shaping gain lpcGain to obtain the shaped MDCT spectrum.

D.2.4 Temporal Noise Shaping

The temporal noise shaping reduces a dynamic range of a to-be-coded MDCT spectrum through linear prediction processing in the MDCT domain, thereby improving quantization coding efficiency.

The input of the temporal noise shaping module is the MDCT spectrum after the temporal noise shaping.

TNS filter configuration:

TNS processing is performed on the MDCT spectrum. The entire MDCT spectrum is divided into two filters, respectively covering [660 Hz, 5400 Hz] and [5400 Hz, 20000 Hz].

Both the two TNS filters can be disabled or enabled, or only one of the two TNS filters is enabled. This is determined according to the TNS filter enabling algorithm.

TNS parameter calculation:

The parameter used by the TNS filter is the reflection coefficient parcor (the maximum order is 8), which is an equivalent representation of parameters such as LPC and LSF. The reflection coefficient is separately calculated for the two TNS filters.

The basic calculation process is as follows:

Step 1: Calculate a band-based normalized frequency-domain autocorrelation coefficient.

A frequency range corresponding to each TNS filter is divided into three frequency bands with an equal width, and spectrum energy in the three frequency bands is separately calculated.

Autocorrelation coefficients in the three frequency bands are separately calculated, and corresponding spectrum energy is used to perform normalization.

The sum of the normalized autocorrelation functions in the three frequency bands is used as the autocorrelation coefficient of the frequency range of the current filter.

Step 2: Calculate the reflection coefficient.

The autocorrelation coefficients corresponding to the frequency ranges of the two TNS filters are used as the inputs, and the LeRoux-Gueguen algorithm is used to calculate the reflection coefficient parcor.

TNS filter enabling determining

The TNS filter is enabled based on the following conditions:

Condition 1: The filter order is greater than 0.

Condition 2: The mean square value of the Parcor parameter is greater than a threshold (set to 0.06), and the predicted gain of the filter is greater than a threshold (set to 1.35).

Condition 3: The current frame is a short frame.

When condition 1 is met and either condition 2 or 3 is met, the TNS filter is enabled.

TNS parameter quantization coding:

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The bitstream parameters of the TNS module include the TNS filter enabling flag, filter order, and reflection coefficient.

The non-uniform scalar quantization is used as the reflection coefficient. The number of quantization orders is 16. For details, refer to Table B.33.

Huffman coding is performed on the quantization index of the reflection coefficient, and each dimension of the reflection coefficient has a corresponding Huffman code table.

TNS filtering:

In a frequency range corresponding to the TNS filter, if the TNS filter is enabled, linear prediction analysis filtering based on a reflection coefficient is performed on the MDCT spectrum within the frequency range, to obtain the MDCT spectrum after the TNS processing.

Short frame TNS processing method:

If the frame type of the current frame is ONLY_SHORT_WINDOW, inverse interleaving processing needs to be performed before the foregoing TNS processing, and interleaving processing is performed again after the TNS processing.

D.2.5 Bandwidth Extension Coding

At the encoder, the bandwidth extension algorithm is used to calculate a bandwidth extension parameter based on the correlation between high and low frequencies of an MDCT spectrum, so as to reconstruct a high-frequency spectrum at the decoder based on a core band spectrum obtained through decoding.

The enabling conditions and configuration parameters of bandwidth extension are determined by the input signal format and coding rate.

The parameters extracted through bandwidth extension coding include the high-frequency band envelope and whitening level. For details about the bitstream syntax, refer to the descriptions of the decoder.

Calculation of high-frequency envelope parameters:

High-frequency band (SFB) division manner is used to calculate the MDCT spectrum energy of each SFB in the high frequency band, which is used as the high-frequency sub-band envelope parameter of bandwidth extension.

For the calculation method, refer to formula (D.3):

$$sfbEnvelope = \frac{1}{sfbWidth}\sum_{i=sfbStart}^{sfbEnd-1}(mdctSpectrum[i])^2 \quad \text{(D.3)}$$

sfbStart and sfbEnd are the start frequency sequence number and end frequency sequence number of the current sfb, and sfbWidth is the width of the current sfb (that is, the number of frequencies), which is represented as sfbWidth = sfbEnd – sfbStart + 1.

A non-uniform scalar quantization manner is used for quantization of the high-frequency envelope parameter. For the quantization manner, refer to formula (D.4):

$$sfbEnvQIdx = floor\big(0.5 + 4.24966 * (log2(sfbEnvelope) + 4.0)\big) \quad \text{(D.4)}$$

floor indicates rounding down.

The value of the envelope parameter quantization index sfbEnvQIdx is limited within the range of [0, 127], and 7-bit transmission is used.

High-frequency spectrum whitening level determining:

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The whitening level of the high-frequency spectrum is determined within each target frequency area (target tile).

The whitening level indicates a type of post-processing that needs to be performed after the decoder copies the spectrum from the source frequency area (source tile). Whitening levels are classified into BWE_WHITENING_OFF, BWE_WHITENING_MID, and BWE_WHITENING_HIGH, corresponding to different post-processing manners. For details, refer to the description of the decoder algorithm.

The high-frequency spectrum whitening level is determined based on spectrum features of the source frequency area and the target frequency area, and the spectrum features include a spectrum flatness measure (Spectral Flatness Measure, SFM) parameter and a spectrum peak-to-average ratio (Peak-to-Average Ratio, PAR) parameter.

The method for calculating the spectrum flatness measure SFM parameter is described as follows:

First, an average value of the log energy spectrum logEnerSpec and the energy spectrum enerSpec in the frequency band is calculated. A value of each frequency of the energy spectrum is energy of each frequency of the MDCT spectrum, and a value of each frequency of the log energy spectrum is a logarithm of energy of each frequency of the MDCT spectrum.

An average value of the log energy spectrum is denoted as avgLogEnerSpec, and an average value of the energy spectrum is denoted as avgEnerSpec.

For calculation of the SFM parameter, refer to formula (D.5):

$$sfm = min\,(1.0, pow(2.0, avgLogEnerSpec + 0.5)/avgEnerSpec) \quad \text{(D.5)}$$

The spectrum peak-to-average ratio PAR parameter is defined as a ratio of the maximum value maxLogEnerSpec to the average value avgLogEnerSpec of the log energy spectrum logEnerSpec in the current frequency band. Refer to formula (D.6):

$$par = \frac{maxLogEnerSpec}{avgLogEnerSpec} \quad \text{(D.6)}$$

The spectrum flatness measure parameter and the spectrum peak-to-average ratio parameter are separately calculated for each frequency band (SFB) of the source frequency area and the target frequency area to obtain the following parameters:

SFM and PAR parameters of each frequency band in the source frequency area, that is, sfmSrcSfb and parSrcSfb;

SFM and PAR parameters of each frequency band in the target frequency area, that is, sfmTarSfb and parTarSfb.

These parameters are averaged in each frequency band of the frequency area to obtain:

SFM and PAR parameters of the source frequency area, that is, sfmSrcTile and parSrcTile;

SFM and PAR parameters of the target frequency area, that is, sfmTarTile and parTarTile.

The normalized SFM parameter used for determining the final whitening level is expressed as follows:

Source frequency area: sfmSrcTileNorm = sfmSrcTile/parSrcTile

Target frequency area: sfmTarTileNorm = sfmTarTile/parTarTile

In the standard, a condition for determining a whitening level of a frequency area is as follows:

a) BWE_WHITENING_OFF, that is, the condition for no whitening is as follows:

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sfmTarTileNorm < sfmSrcTileNorm or sfmTarTileNorm < 0.19

b) BWE_WHITENING_MID, that is, the condition for the medium whitening level is as follows:

sfmTarTileNorm >= sfmSrcTileNorm && sfmTarTileNorm < (sfmSrcTileNorm + 0.15)

or

sfmTarTileNorm >= 0.19&& sfmTarTileNorm < 0.3

c) BWE_WHITENING_HIGH, that is, the condition for the high whitening level is as follows:

sfmTarTileNorm >= (sfmSrcTileNorm + 0.15) or sfmTarTileNorm > 0.4

D.3 Downmixing

D.3.1 Stereo Downmixing and Bit Allocation

M/S downmixing determining:

The M/S downmixing manner is used for the stereo mode. Before downmixing, whether to perform downmixing is determined based on the correlation between the MDCT spectra of the left and right channels.

M/S downmixing is determined based on the normalized cross-correlation coefficient crossCorr of the MDCT spectra of the left and right channels to the ratio lrRatio of the energy of the MDCT spectra of the left and right channels.

For a method for calculating the normalized cross-correlation coefficient, refer to formula (D.7):

$$crossCorr = \frac{<mdctSpecL, mdctSpecR>}{\sqrt{\|mdctSpecL\|_2 * \|mdctSpecR\|_2}} \quad (D.7)$$

<, > indicates an inner production operation, $\| \|_2$ indicates a two-norm, and MdctSpecL and MdctSpecR are respectively the MDCT spectra of the left and right channels.

For the method for calculating the ratio of the energy of the MDCT spectra of the left and right channels, refer to formula (D.8):

$$lrRatio = \sqrt{\frac{\|mdctSpecL\|_2}{\|mdctSpecR\|_2}} \quad (D.8)$$

The M/S downmixing is determined based on the window types of the left and right channels, the normalized cross-correlation coefficient, and the energy ratio, and is represented as the following pseudocode:

```
isMs = 0
if transformTypeL == transformTypeR && crossCorr > 0.3:
  if lrRatio < 3.0 && lrRatio > 1/3:
    isMs = 1
  end
end
```

transformTypeL and transformTypeR are the window types of the left and right channels, or referred to as transform types.

M/S downmixing:

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When the M/S flag isMs is 1, the M/S downmixing is required.

Before M/S downmixing, energy equalization needs to be performed on the MDCT spectra of the left and right channels. The energy balancing is implemented based on the ILD parameter. For the ILD parameter calculation expression, refer to formula (D.9):

$$energyRatio = \frac{\sqrt{\|mdctSpecL\|_2}}{\sqrt{\|mdctSpecL\|_2}+\sqrt{\|mdctSpecR\|_2}} \quad (D.9)$$

4-bit uniform quantization is performed on the ILD parameter. For the quantization manner, see formula (D.10):

$$energyRatioQIdx = max(1, min\,(15{,}16 * energyRatio + 0.5)) \quad (D.10)$$

For calculation of the quantized ILD parameter, refer to formula (D.11):

$$energyRatioQ = \frac{16}{energyRatioQIdx} - 1 \quad (D.11)$$

Energy equalization is performed based on the quantized ILD parameter. The pseudocode is as follows:

```
if energyRatioQ > 1.0:
  mdctSpecR *= 1.0/energyRatioQ
else:
  mdctSpecL *= energyRatioQ
end
```

M/S downmixing is performed on the MDCT spectra of the left and right channels after the energy equalization. For a method, refer to formulas (D.12) and (D.13):

$$mdctSpecM = \frac{\sqrt{2}}{2}(mdctSpecL + mdctSpecR) \quad (D.12)$$

$$mdctSpecS = \frac{\sqrt{2}}{2}(mdctSpecL - mdctSpecR) \quad (D.13)$$

mdctSpecM and mdctSpecS are respectively the M and S spectra obtained through downmixing.

Before bits are allocated to the MDCT spectra of the two downmixed channels, a bit allocation ratio parameter bitsRatio needs to be determined. The bit allocation ratio is calculated based on the energy ratio energyRatioDownMix of the MDCT spectra of the two downmixed channels.

The 3-bit uniform quantization is performed on the bitsRatio. The calculation pseudocode is as follows:

```
bitsRatioQIdx = 4
if energyRatioDownMix>= 0:
   bitsRatioQIdx = floor(8 * bitsRatio + 0.5)
   if isMs == 0:
     if bitsRatioQIdx <= 3:
       bitsRatioQIdx += 1
     else if bitsRatioQIdx >= 5:
```

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```
        bitsRatioQIdx -= 1
      end
    end
  end
```

When the M/S downmixing is not performed, if the bit allocation ratio is too large or too small, the bit allocation ratio is adjusted to be more even. For the quantized bit allocation ratio parameter bitsRatioQ, refer to formula (D.14).

$$bitsRatioQ = bitsRatioQIdx \,/\, 8 \tag{D.14}$$

The remaining bits can be allocated based on the quantized bit allocation ratio parameter bitsRatioQ to the two downmixed channels. The allocation ratio of the downmixed channel 1 is bitsRatioQ, and the allocation ratio of the downmixed channel 2 is (1 – bitsRatioQ).

D.3.2 Multi-channel Downmixing and Bit Allocation

Channel coupling algorithm

The channel coupling algorithm used in the multi-channel mode is referred to as the MCAC (Multi-channel Adaptive Coupling) algorithm. The MCAC algorithm is used to determine the multi-channel signal coding mode parameter based on the signal correlation, including the pair parameter and the downmixing parameter, to effectively reduce the redundancy between channels and improve the multi-channel coding efficiency.

A multi-channel signal usually includes a low-frequency effect channel (that is, an LFE channel), and the low-frequency effect channel has a valid audio component only at a low frequency. The LFE channel does not participate in the queuing algorithm and the bit allocation algorithm in the multi-channel mode.

The basic principle of the multi-channel coupling algorithm is to maximize the sum of the normalized cross-correlation of the coupled channels.

The basic steps of the coupling algorithm are as follows:

Step 1: Calculate a normalized cross-correlation matrix of all channels participating in coupling.

In a 5.1 multi-channel example, there are five channels participating in coupling, and a size of a normalized cross-correlation matrix is 5×5.

The symmetry of the cross-correlation matrix is considered, and the autocorrelation values on the diagonal are excluded. The effective cross-correlation information is the upper triangular part of the cross-correlation matrix.

Each value of the normalized cross-correlation matrix corresponds to a channel pair, and a channel pair that meets a certain condition may participate in a subsequent channel coupling algorithm.

The filtering condition includes: 1. The normalized cross-correlation coefficient of the channel pair is greater than 0.5; 2. The energy difference between the MDCT spectra of two channels in a channel pair is less than a threshold. The default threshold is 2.

Step 2: Determine several coupled start channel pairs.

It is assumed that the number of channel pairs with the largest cross-correlation coefficient used in the search is numPairCondidate, and the value of numPairCondidate is related to the number of channels. Refer to formula (D.15).

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$$numPairCondidate = (numChannels - 1)/2 \quad (D.15)$$

numChannels indicates the total number of channels. If the value is decreased by 1, the LFE channel is excluded.

numPairCondidate channel pairs with a largest cross-correlation coefficient are selected from the normalized cross-correlation matrix obtained after screening, and are used as the coupled start channel pairs.

Step 3: Determine the coupling manner.

A channel pair with the largest correlation in the numPairCondidate coupled start channel pairs is used as an example. For example, in the 5.1 mode, the channel pair with the largest correlation is (0, 2). In a subsequent search process, all matrix elements related to the channel 0 and the channel 2 are excluded, and then a channel pair with the largest correlation value is found and used as a second channel pair, for example, (1, 4). The entire search process is completed by analogy, and the first group coupling manner is obtained.

It is assumed that the channel pair with the second largest cross-correlation is (0, 1). All matrix elements related to the channel 0 and the channel 1 are excluded in the subsequent search process, and then a channel pair with a largest correlation value is found as a second channel pair, for example, (2, 4), and so on, the entire search process is completed, and the second group of pair manners are obtained.

This search process is repeated, and numPairCondidate coupling manners may be obtained. A coupling manner with a largest cross-correlation sum is a finally determined channel coupling manner.

The content of object signals differs greatly between channels. Therefore, MCAC coupling is not performed for object signals.

Channel pair downmixing

In the multi-channel mode, intra–channel pair equalization is performed for energy equalization. The target amplitude value of the intra–channel pair equalization algorithm is an average value of amplitudes of two channels. The intra–channel pair equalization algorithm is implemented by performing ILD processing on the MDCT spectrum of the downmixed channel. In the ILD processing, the ratio of the MDCT spectrum amplitude to the equalization amplitude of the downmixed channel is used as an input to search for the ILD parameter in the quantization code table. The index mcIld[i] corresponding to the matched codeword is found based on the principle of minimum distance. Then, the spectrum is equalized. The pseudocode for equalization is as follows:

factor = mcIldCodebook[mcIld[i]]

mdctSpectrum[i] = factor * mdctSpectrum[i]

factor is the amplitude adjustment factor corresponding to the ILD parameter of the i-th channel, mcIldCodebook is the quantization code table of the ILD parameter, mcIld[i] indicates the quantization index corresponding to the ILD parameter of the i-th channel, and mdctSpectrum[i] indicates the MDCT coefficient vector of the i-th channel.

Silencing

Step 1: silent channel detection

a) The average energy of each channel signal of the current frame is calculated.

It is assumed that the frame length is FRAME_LEN, and the energy of the ch-th channel of the current frame is shown in formula (D.16):

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$$energy(ch) = \frac{1}{FRAME_LEN} \cdot \sum_{i=0}^{FRAME_LEN-1} (orig_{ch}(i))^2 \quad \text{(D.16)}$$

$orig_{ch}$ is the input signal of the ch-th channel of the current frame, and energy(ch) is the energy of the ch-th channel of the current frame.

b) A silence detection parameter of each channel of the current frame is determined based on energy of each channel signal of the current frame.

The silence detection parameter of each channel of the current frame is calculated, and the silence detection parameter of each channel of the current frame meets formula (D.17):

$$energyDB[ch] = 10 * log10(energy[ch] / Bit_Depth / Bit_Depth) \quad \text{(D.17)}$$

energyDB[ch] is the silence detection parameter of the ch-th channel of the current frame, energy(ch) is the energy of the ch-th channel of the current frame, and Bit_Depth is the full offset value of the bit width. For example, if the sampling bit depth is 16 bits, the full offset value of the bit width is $2^{16} = 65536$.

c) The silence flag of each channel of the current frame is determined based on the silence detection parameter and the silence detection threshold g_MuteThrehold of each channel of the current frame.

The silence detection parameter of each channel of the current frame is compared with the silence detection threshold. If the silence detection parameter of the ch-th channel of the current frame is less than the silence detection threshold, the ch-th channel of the current frame is a silent frame, that is, the ch-th channel is a silent channel at the current moment, and the silence flag silFlag [ch] of the ch-th channel of the current frame is 1. If the silence detection parameter of the ch-th channel of the current frame is greater than or equal to the silence detection threshold, the ch-th channel of the current frame is a non-silent frame, that is, the ch-th channel of the current frame is a non-silent frame, and the silence flag silFlag [ch] of the ch-th channel of the current frame is 0.

The pseudocode for determining the silence flag of the ch-th channel of the current frame based on the silence detection parameter and the silence detection threshold of the ch-th channel of the current frame is as follows:

```
silFlag [ch] = 0;
    if (energyDB[ch] < g_MuteThrehold)
{  silFlag [ch] = 1; }
```

Step 2: silence side information coding

The side information of the silent frame includes silence enabling flag HasSilFlag and the silence flag silFlag[ch].

a) When the silent channel processing function is disabled, only the silence enabling flag HasSilFlag needs to be coded and the value of HasSilFlag is 0. The silence flag silFlag[ch] does not need to be coded.

b) When the silent channel processing function is enabled and the silence flags silFlag[ch] of all channels participating in coupling are 0, it indicates that all the channels participating in coupling are non-silent channels. In this case, only the silence enabling flag HasSilFlag needs to be coded and the value of HasSilFlag is 0, and the silence flag silFlag[ch] does not need to be coded.

c) When the silent channel processing function is enabled and the silence flags silFlag[ch] of all channels participating in coupling are not all 0, it indicates that there is a non-silent channel in the channels participating in coupling. In this case, the silence enabling flag

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HasSilFlag needs to be coded and the value of HasSilFlag is 1, and the silence flag silFlag[ch] needs to be coded.

Step 3: bit allocation of silent channel

Silent frames are not involved in the bit allocation algorithm. Eight bytes are fixedly allocated to the channel of the silent frames.

Bit allocation algorithm

The bit allocation algorithm supports three types of input: a sound bed signal, an object signal, and a sound bed and object mixed signal. In the bit allocation algorithms for the sound bed signal and the object signal, only some steps of the bit allocation algorithm for the sound bed and object mixed signal need to be performed.

Step 1: Obtain the ratio factor bedBitsRatio of the sound bed to the total number of bits (only for the mixed signal).

Case 1: When the total bit rate is 384 kb/s, the value of bedBitsRatio is fixed at 0.583335280.

Case 2: When the total bit rate is 768 kb/s, the value of bedBitsRatio is fixed at 0.507143021.

Case 3: Except for case 1 and case 2, the value of the ratio factor bedBitsRatio of the sound bed to the total number of bits is calculated based on the number of sound bed signal channels bedChNum and the number of object signal channels objChNum. Refer to formula (D.18).

$$bedBitsRatio = bedChNum / (bedChNum + objChNum) \quad \text{(D.18)}$$

Step 2: Update the allocation strategy mixAllocStrategy for mixed signal (only for the mixed signal).

mixAllocStrategy is used to identify the allocation direction of the number of bits reduced by the silent channel of the object signal. There are two allocation strategies for the mixed signal: MIX_ALLOC_STRATEGY_INTERNAL indicates that the number of bits is allocated to another object signal, and MIX_ALLOC_STRATEGY_OBJ2BED indicates that the number of bits is allocated to the sound bed signal. The details are listed below:

When the MIX_ALLOC_STRATEGY_INTERNAL strategy is used:

a) The silent frame processing function is disabled.

b) The input is a non-mixed signal, that is, there is only a sound bed signal or only an object signal.

c) The number numBedNoSil of non-silent channels of the sound bed signal is less than the number safetyChNum of safety channels.

When the MIX_ALLOC_STRATEGY_OBJ2BED strategy is used:

The number numBedNoSil of non-silent channels of the sound bed signal is greater than or equal to the number safetyChNum of safety channels.

The number numBedNoSil of non-silent channels of the sound bed signal is the number of channels whose silent flag silFlag[ch] is 0 in the channels participating in coupling. The number safetyChNum of safety channels is calculated based on the total bit rate totalBitrate, the frame length FRAME_LEN, and the sampling rate AVS3_SAMPLING_48KHZ.

Step 3: Pre–bit allocation processing

The pre–bit allocation processing is used to calculate the bit allocation ratio factor chBitRatios of the mixed signal and the non-mixed signal. The following steps are performed:

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a) The energy ratio chBitRatiosFloat[ch] of each channel is calculated based on the channel energy.

b) The total number objBits of bits of the object is calculated based on the total number totalBits of bits and the ratio factor bedBitsRatio of the sound bed to the total number of bits (only for the mixed signal).

c) The estimated number objAvgBytes[ch] of bits of the object signal is calculated based on the total number objBits of bits of the object, the number objNum of object signals, the allocation strategy mixAllocStrategy, and the silence flag silFlag[ch] (for the mixed signal and the object signal).

d) The estimated number bedChBytes[ch] of bits of the sound bed signal is calculated based on the total number totalBits of bits, the total number objBits of bits of the object, the channel energy ratio chBitRatiosFloat[ch], and the silence flag silFlag[ch] (for the mixed signal and the sound bed signal).

e) The bit allocation ratio factor chBitRatios is calculated based on the ratios of the estimated number bedChBytes[ch] of bits of the sound bed signal and the estimated number objAvgBytes[ch] of bits of the object signal to the total number of bits. The value of the bit allocation ratio parameter ranges from 0 to 1. The 6-bit even quantization is performed on the parameter.

D.3.3 HOA Downmixing and Bit Allocation

The coder determines the HOA downmixing configuration based on the HOA signal order and the bit rate. For related information, refer to Table 23 to Table 25. For example, when the coded signal is a 3-order HOA and the bit rate is 512 kb/s, the value of nTotalChanGroups is 2, indicating that the downmixed HOA channel is divided into two groups, and the value of groupChans is 2, 10, indicating that the number of channels in the downmixed channels of the virtual speaker signal group is 2, and the number of channels in the downmixed channels of the residual signal group is 10. The inter-group bit allocation ratio parameter and intra-group bit allocation ratio parameter of the downmixed channel may be calculated by using a method similar to that of multi-channel bit allocation.

D.4 Neural Network Transform, Quantization, and Range Coding

D.4.1 MDCT Quantization Coding based on Neural Network

The MDCT quantization coding based on the neural network includes spectrum grouping, neural network transform, entropy coding, noise filling parameter extraction, and quantization.

错误!未找到引用源。 is a schematic principle diagram of MDCT quantization coding based on the neural network.

The basic process is as follows:

In the basic configuration, the MDCT spectrum after spectrum grouping is input to the base coding neural network to obtain a transform-domain parameter of the base coding neural network, and scale adjustment is performed on the transform-domain parameter. The transform-domain parameter after scale adjustment is input to the context coding neural network. Context information quantization and range coding are performed on the transform-domain coefficient output by the context coding neural network to obtain a context range coded bitstream. After the context range coded bitstream is decoded and dequantized, code table selection information of base range coding is obtained through context decoding neural network transform. Quantization and range coding are performed on the transform-domain

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parameter after scale adjustment based on the code table selection information and the base range coding table, to obtain a base range coded bitstream.

In a low-complexity configuration, scale adjustment is performed on an MDCT spectrum after spectrum grouping. An MDCT spectrum obtained through scale adjustment is input to a context coding neural network. Context information quantization and range coding are performed on a transform-domain coefficient output by the context coding neural network, to obtain a context range coded bitstream. After the context range coded bitstream is decoded and dequantized, code table selection information of base range coding is obtained through context decoding neural network transform. Quantization and range coding are performed on the MDCT spectrum after scale adjustment based on the code table selection information and the base range coding table, to obtain a base range coded bitstream.

In an MDCT quantization coding process based on the neural network, a scale factor needs to be updated based on the target number of coding bits, the number of base range coding bits, and the number of context range coding bits. This coding process is repeated until the number of coding bits is less than or equal to the target number of coding bits.

Figure D-10 Schematic principle diagram of MDCT quantization coding based on neural network

D.4.2 Spectrum Grouping

A basic processing manner of spectrum grouping is: If the window type of the current frame is a short window, grouping is determined on MDCT spectra of eight short frames of the current frame. If grouping is required, the MDCT spectra are divided into a transient group and a non-transient group. Spectrum interleaving is performed in each group, and an MDCT spectrum

with a length of 1024 is obtained through concatenation and input into the neural network transform algorithm.

The spectrum grouping can effectively improve the coding efficiency of the spectra of several subframes belonging to the transient group in the eight subframes of the short frame, and can respectively extract the noise filling parameters from the transient group and the non-transient group to improve the noise filling effect.

The coding parameter of the spectrum grouping includes two parts: the number of groups and the grouping flag information. The number of groups indicates the number of spectrum groups of the current frame, and the grouping flag information indicates the groups to which the respective spectra of the eight subframes of the current frame belong.

Method for obtaining spectrum grouping information:

If the window type of the current frame is a long window, a cut-in window, or a cut-out window, the group number parameter numGroups is set to 1, and the grouping flag information of all the eight subframes is 0.

If the window type of the current frame is a short window, the number of groups and the grouping flag parameter need to be determined based on the MDCT spectra of the eight subframes. The obtaining method is described as follows:

The MDCT spectra of the eight interleaved short frames of the current frame are de-interleaved, to obtain de-interleaved MDCT spectra.

Whether the MDCT spectra of the eight subframes should be divided into two groups, and the group to which each subframe belongs are determined based on the de-interleaved MDCT spectra.

First, spectrum energy of the de-interleaved MDCT spectra of eight subframes is calculated, and is denoted as blockEner[8].

Secondly, the sum sumBlockEner of spectrum energy and the maximum value maxBlockEner of each subframe are calculated, and the average spectrum energy avgBlockEner with the maximum subframe energy removed is obtained accordingly, that is, the subframe with the maximum energy is excluded from the calculation of the average spectrum energy, which is expressed as formula (D.19):

$$avgBlockEner = \frac{sumBlockEner - maxBlockEner}{numBlock - 1} \quad \text{(D.15)}$$

numBlock is number of subframes (or referred to as sub-blocks) in a short frame, and is set to 8.

Thirdly, the spectrum energy of each subframe is compared with the average spectrum energy, and the subframe whose spectrum energy is more than several times greater than the average spectrum energy belongs to the transient group; otherwise, the subframe belongs to the non-transient group.

if all subframes belong to the transient group or all subframes belong to the non-transient group, a group number parameter numGroups is set to 1, and grouping flag parameters of all eight subframes are set to 0.

Otherwise, the group number parameter numGroups is set to 2, the grouping flag parameter of the subframe belonging to the transient group is set to 0, and the grouping flag parameter of the subframe belonging to the non-transient group is set to 1.

Short frame MDCT spectrum grouping:

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If the current frame is a short frame and the group number parameter numGroups = 2, the MDCT spectra of the eight subframes in the short frame need to be grouped.

Step 1: Group and arrange the de-interleaved MDCT spectra to obtain the grouped and arranged MDCT spectrum with the length of 1024 frequencies. The MDCT spectrum of the subframe belonging to the transient group is placed before the MDCT spectrum of the subframe belonging to the non-transient group.

For example, it is assumed that the grouping flag information of the eight subframes is 1 0 0 0 1 1 0 0, that is, spectra of subframes 1, 5, and 6 belong to the non-transient group, and spectra of subframes 2, 3, 4, 7, and 8 belong to the transient group. Therefore, the MDCT spectra after grouping and arrangement may be represented as 2 3 4 7 8 1 5 6, that is, the spectra of subframes 2, 3, 4, 7, and 8 are placed in the front part of the spectra after grouping and arrangement, and the spectra of subframes 1, 5, and 6 are placed in the rear part of the spectra after grouping and arrangement.

Step 2: Perform intra-group interleaving on the grouped and arranged MDCT spectra. In the example in section D.2.2, interleaving needs to be performed on spectra of subframes 2, 3, 4, 7, and 8, and interleaving needs to be performed on spectra of subframes 1, 5, and 6.

D.4.3 Base Coding Neural Network

The base coding neural network (BaseEncoder) performs the neural network transform on the input MDCT spectral coefficient to obtain the transform-domain coefficient for subsequent quantization and coding.

The basic composition unit of the base coding neural network is a CNN. For the model structure related information, refer to Table D.1.

Table D.1 Structure configuration of base coding neural network

Item	Value
Number of CNN layers	4
Convolution kernel size	5, 5, 5, 5
Stride	2, 2, 2, 2
Number of channels	2, 4, 8, 16
Activation function	GDN, GDN, GDN, None
HasBias	1, 1, 1, 0

In the table, Stride is the CNN convolutional step parameter, HasBias indicates whether there is an offset parameter, and None in the activation function indicates that there is no activation function at the current layer.

For related information of parameters of each CNN layer of the base coding neural network, refer to Table D.3 to Table D.15. The 1024-point MDCT spectrum is input into the base coding neural network. The dimension of the output transform coefficient obtained through neural network transform is 16 channels, and each channel has 64 coefficients.

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D.4.4 Scale Adjustment

The scale adjustment module performs scale adjustment on the transform coefficient output by the base coding neural network, to enlarge or narrow a dynamic range of the transform coefficient, and adjust the number of bits required by range coding.

The parameter of the scale adjustment module is the feature scale adjustment factor (featureScale). The value range of featureScale is [0, 29.97].

The scale adjustment factor is multiplied by the transform coefficients output by the neural network one by one. If featureScale is less than 1, it is equivalent to performing amplitude attenuation on the transform coefficient. If featureScale is greater than 1, it is equivalent to performing amplitude amplification on the transform coefficient.

D.4.5 Context Coding Neural Network

The context coding neural network (ContextEncoder) extracts the context information (referred to as the base range coding table selection information) of range coding from the transform coefficient obtained through scale adjustment, to guide range coding of the transform coefficient output from the base coding neural network.

The input of ContextEncoder is the absolute value of the base coding neural network transform coefficient obtained through scale adjustment.

The composition unit of ContextEncoder is a CNN. For the model structure information, refer to Table D.2.

Table D.2 Structure configuration of context coding neural network

Item	Value
Number of CNN layers	3
Convolution kernel size	3, 3, 3
Stride	1, 2, 2
Number of channels	16, 16, 16
Activation function	ReLu, ReLu, None
HasBias	1, 1, 0

For the parameters of CNNs at each layer of the context coding neural network, refer to Table D.16 to Table D.20. The input of the context coding neural network is the transform coefficient with 16 channels, and each channel has 64 dimensions. The transform coefficient of the context coding neural network obtained through the neural network transform still has 16 channels, and each channel has 16 dimensions.

D.4.6 Context Quantization and Range Coding

The scalar quantization manner is used for the transform coefficient of the context coding neural network.

Range coding of the transform coefficient quantization index is performed based on several groups of pre-trained range coding tables, and each channel of the transform coefficient of the

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context coding neural network corresponds to one range coding table. For the code table used for context range coding, refer to Table B.1.

The bitstream obtained through range coding is referred to as the context coded bitstream, and the number of bits occupied by the bitstream is referred to as the number contextNumBytes of context coding bits. (Note: A byte is used as the minimum unit for range coding in the standard.)

D.4.7 Base Quantization and Range Coding

The scalar quantization manner is used for the transform coefficient of the base coding neural network obtained through scale adjustment.

The range coding is performed based on several preset groups of range coding tables. For the code tables used in base range coding, refer to Table B.9. The range coding tables used here are a series of cumulative probability density tables (CDF) of Gaussian distribution with different standard deviation information. The number of range coding tables is numContextScale = 64, and a corresponding standard deviation is denoted as contextScale.

Base range coding table selection information obtained through decoding is used to determine which one of these groups of range coding tables is used to code each dimension of the transform coefficient of the base coding neural network, that is, to determine a CDF index.

The CDF index of the base range coding is denoted as baseCdfIndex, and its determining process is described as the following pseudocode:

```
for i = 0 to baseNumLatentEncode-1:
  for j = 0 to baseNumLatentChannels-1:
    for index = 0 to numContextScale – 1:
      if contextScale[index] >= ctxDecOutput[i][j]
        baseCdfIndex[i][j] = index
        break
      end
    end
    if index == numContextScale:
      baseCdfIndex[i][j] = numContextScale - 1
    end
  end
end
```

ctxDecOutput is base range coding table selection information obtained through decoding, baseNumLatentEncode is a dimension of the transform-domain coefficient of the base neural network, and baseNumLatentChannels is the number of channels of the transform-domain coefficient of the base neural network.

This pseudocode means that, for each dimension of the transform coefficient of the base coding neural network, a standard deviation that is greater than the base range coding table selection information is searched for in a variance table of the base range coding, and an index corresponding to the standard deviation is an index of the code table used by the range coding.

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The decoder also obtains the range coding table index from the output of the context decoding neural network in a same manner.

A bitstream obtained through range coding is referred to as a base coded bitstream, and the number of bits occupied by the bitstream is referred to as the number baseNumBytes of base coded bits.

D.4.8 Scale Factor Update and Quantization

Scale factor update strategy:

A final objective of iterative update of the scale factor is to adjust the transform coefficient of the base coding neural network, so that the number of context coding bits and the number of base coding bits are less than or equal to the target number of coding bits.

The target number of coding bits is denoted as targetBytes, and a target of scale factor update may be represented as: $(contextNumBytes + baseNumBytes) < targetNumBytes$.

In the iterative update of the scale factor, the following needs to be recorded: the upper limit (upBoundBytes) of the number of coding bits and the corresponding upper limit (upBoundScale) of the scale factor, and the lower limit (lowBoundBytes) of the number of coding bits and the corresponding lower limit (lowBoundScale) of the scale factor. The dichotomy is used to update the scale factor.

It is assumed that the current number of coding bits is currBytes, and the current scale factor is currScale. In this case, the update manners for the upper limit and the lower limit are shown in the following pseudocode:

```
if currBytes < targetBytes:
  if lowBoundBytes < currBytes:
    lowBoundScale = currScale
    lowBoundBytes = currBytes
  else if lowBoundBytes == currBytes:
    lowBoundScale = max(lowBoundScale, currScale)
  end
else if currBytes > targetBytes:
  if upBoundBytes > currBytes:
    upBoundScale = currScale
    upBoundBytes = currBytes
  else if upBoundBytes == currBytes:
    upBoundScale = min(upBoundScale, currScale)
  end
end
```

This pseudocode may be explained as follows:

a) If the current number of coding bits is less than the target number of bits: if the lower limit of the number of bits is less than the current number of bits, the lower limit of the scale factor is updated to the current scale factor, and the lower limit of the number of bits is

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updated to the current number of bits. If the lower limit of the number of bits is equal to the current number of bits, the lower limit of scale factor is updated to a larger value of the current scale factor and the lower limit of scale factor.

b) If the current number of coding bits is greater than the target number of bits: if the upper limit of the number of bits is greater than the current number of bits, the upper limit of the scale factor is updated to the current scale factor, and the upper limit of the number of bits is updated to the current number of bits. If the upper limit of the number of bits is equal to the current number of bits, the upper limit of the scale factor is updated to a smaller value of the current scale factor and the upper limit of the scale factor.

In conclusion, the foregoing strategy is: the upper limit and the lower limit of the scale factor are updated, so that the upper limit and the lower limit of the number of bits are close to the target number of bits.

The adjustment of the scale factor is divided into two phases. In phase 1, the current number (currBytes) of coding bits does not reach the target number (targetBytes) of coding bits. In phase 2, the current number of encoding bits has passed through the target number of coding bits.

If the target number of coding bits is not reached, it indicates that: (1) the number of coding bits is greater than the target number of coding bits (currBytes > targetBytes) at all times from the start of scale factor iteration to the current iteration; or (2) the number of coding bits is less than the target number of coding bits (currBytes < targetBytes) at all times from the start of iteration to the current iteration.

In phase 1, only one of the upper limit and the lower limit exists. In the phase 2, both the upper limit and the lower limit exist.

A method for updating the scale factor in phase 1 is formula (D.20):

$$newScale = currScale * \left(\frac{targetBytes}{currBytes}\right)^2 \quad \text{(D.16)}$$

newScale is the updated scale factor.

The purpose of updating the scale factor in phase 1 is to enable the current number of bits to pass through the target number of bits as soon as possible.

A method for updating the scale factor in phase 2 is formula (D.21):

$$newScale = lowBoundScale + lowerFac\frac{targetBytes - lowBoundBytes}{upBoundBytes - lowBoundBytes}(upBoundScale - lowBoundScale) \quad \text{(D.17)}$$

The purpose of update in phase 2 is to enable the current number of bits to converge between the upper limit and the lower limit of the number as soon as possible.

Quantization method of scale factor:

In the basic configuration, the segmented quantization method is used for the scale factor based on different values of the scale factors.

If the value of the scale factor is within the range of [0, 1], 7-bit uniform quantization is performed, and the quantization index is expressed as formula (D.22):

$$scaleQIdx = floor(0.5 + 127.0 * featureScale) \quad \text{(D.18)}$$

The scale factor of quantization is expressed as formula (D.23):

$$featureScaleQ = scaleQIdx/127.0 \quad \text{(D.19)}$$

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If the value of the scale factor is greater than 1, 7-bit non-uniform quantization is performed, and the quantization index is expressed as formula (D.24).

$$scaleQIdx = floor(0.5 + 86.0 * log10(featureScale)) \quad (D.20)$$

The value of the quantization index is limited to [0, 127].

The scale factor of quantization is expressed as formula (D.25):

$$featureScaleQ = 10.0^{scaleQIdx/86.0} \quad (D.21)$$

The value range of the scale factor is specified by the isFeatAmplified parameter. The value 0 of the parameter indicates that featureScale is less than or equal to 1.0. Otherwise, featureScale is greater than 1.0.

In the low-complexity configuration, a logarithm domain uniform quantization method is used for quantization of the scale factor, and a quantization index is expressed as formula (D.26):

$$scaleQIdxLc = \lfloor 31.875 * log10(featureScale) + 255 + 0.5 \rfloor \quad (D.26)$$

The value of the quantization index is limited to [0, 255].

The scale factor of quantization is expressed as formula (D.27):

$$featureScale = 10^{(scaleQIdxLc - 255.0) / 31.875)} \quad (D.27)$$

The updated and quantized scale factor is used for scale adjustment in the next rate iteration.

The maximum number of rate iterations is set to 5. If the number of bits in the last iteration is greater than the target number of bits, a scale factor that is closest to and less than the target number of bits, a corresponding base coded bitstream, and a corresponding context coded bitstream are used.

D.4.9 Noise Filling Parameter Extraction

The noise filling parameter indicates an average error between the transform coefficients of the base coding neural network after scale adjustment and the quantized transform coefficients.

Before the noise filling parameter is extracted, the number of transform coefficients for noise filling needs to be determined, which is denoted as numLatentNF, and is determined based on the number numLinesNonZero of valid spectral lines input through quantization coding. The number of valid spectral lines is equal to the number of spectral lines of the core frequency band except the BWE frequency band.

In the main profile, the pseudocode for calculating numLatentNF is as follows:

```
numLatentNF = numLinesNonZero
for i = 0 to baseNumLayers-1:
  numLatentNF /= stride[i]
end
```

baseNumLayers indicates the number of layers of the base coding neural network (baseEncoder), and stride[i] indicates the stride parameter of the CNN at the i-th layer of the baseEncoder.

That is, the number numLatentNF of transform coefficients that require noise filling is equal to the number numLinesNonZero of spectral lines of the core band divided by the stride parameter of the CNN at each layer.

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In the low-complexity configuration, for calculation of numLatentNF, refer to formula (D.28):

$$numLatentNF = numLinesNonZero / numLatentChannels \quad \text{(D.28)}$$

numLatentChannels indicates the number of channels of the neural network transform-domain coefficient.

The range of the transform coefficient that requires noise filling is determined based on the spectrum grouping information.

If the spectrum group number parameter numGroups is 1, the start point startIdx of noise filling is 0, and the end point endIdx is numLatentNFC.

If the spectrum group number parameter numGroups is 2, noise filling is performed in two segments, one segment corresponds to the spectral coefficients in the transient group of the short frame, and the other segment corresponds to the spectral coefficients in the non-transient group of the short frame.

The number of subframes in the transient group is denoted as numTransientBlock, and the number of subframes in the non-transient group is denoted as numOtherBlcok. Therefore, the pseudocode of the transform coefficient range corresponding to the spectral coefficient of the transient group is:

startIdx[0] = 0

endIdx[0] = numTransientBlock * (numLatentNF / N_BLOCK_SHORT)

N_BLOCK_SHORT is the number of subframes in the short frame, and a value is 8.

The transform coefficient range corresponding to the spectral coefficient of the non-transient group is as follows:

startIdx[1] = numTransientBlock * (numLatentDim / N_BLOCK_SHORT)

endIdx[1] = startIdx[1] + numOtherBlock * (numLatentNF / N_BLOCK_SHORT)

numLatentDim is the dimension of each channel of the transform coefficient output by the base coding neural network, and is 64 in the current configuration.

The process of calculating the noise filling parameter is as follows:

First, for each channel of the transform coefficient of the base coding neural network, within the calculated transform coefficient range, an average value of absolute values of quantization errors of transform coefficients quantized to 0 is calculated.

Then, an average value of these quantization errors in all channels is calculated, and is used as the noise filling parameter nfParam.

Quantization of noise filling parameter:

3-bit uniform scalar quantization is performed, and the quantization index is expressed as formula (D.29):

$$nfParamQIdx = floor(0.5 + nfParam * 23.34) \quad \text{(D.22)}$$

The value of the quantization index is limited to [0, 7].

For the quantized noise filling parameter, refer to formula (D.30):

$$nfParamQ = nfParamQIdx/23.34 \quad \text{(D.23)}$$

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D.5 HOA Spatial Coding

The HOA spatial coder may include sound field component analysis, sound field component synthesis, and other component calculation, and conversion from the HOA signal into a transmission channel signal and side information.

The sound field component analysis includes virtual speaker configuration, virtual speaker set generation, coding analysis, and virtual speaker selection.

The virtual speaker configuration is used to generate virtual speaker configuration parameters based on the coder configuration information, to obtain a plurality of virtual speakers. The coder configuration information includes but is not limited to an HOA order, a coding bit rate, and the like. The virtual speaker configuration parameters include but are not limited to: the number of virtual speakers, the orders of the virtual speakers, and the position coordinates of the virtual speakers. The position coordinates of the virtual speakers include the horizontal angles and the pitch angles. For the position coordinates in a non-uniform distribution of virtual speakers, refer to Table B.48.

The coding analysis is used to perform coding analysis on the HOA signal, and analyze a sound field distribution feature of the HOA signal, including features such as number of of sound sources of the HOA signal, directivity of the sound sources, and diffuseness. Singular value decomposition method can be used for coding analysis to analyze the sound sources based on the singular values. For example, a ratio temp[i] between singular values is used, and the value of temp[i] is sequentially determined from i=0. When the m-th sound field classification parameter meets temp[m] ≥ TH1, the sound field is directional and there are (m+1) sound sources; if temp[m] ≥ TH1 does not exist, the sound field type is a diffuse sound field, and TH1 is a preset sound source determining threshold, which may be a constant, for example, a value of TH1 may be 30.

The virtual speaker selection is used to determine a target virtual speaker matching the HOA signal and attribute information of the target virtual speaker based on the HOA signal, the sound field distribution feature of the HOA signal, and the coefficients of the plurality of virtual speakers. A common method is to perform a projection operation based on the HOA signal and the HOA coefficient of the virtual speaker, and screen the main virtual speakers used to represent the sound field components. Refer to formula (D.31).

$$P_{jil} = B_{ji}(\theta, \varphi) \times B_l(\theta, \varphi) \tag{D.24}$$

θ indicates a horizontal angle of the virtual speaker, φ indicates a pitch angle of the virtual speaker, $B_{ji}(\theta,\varphi)$ indicates the j-th Ambisonic coefficient of the HOA signal in the i-th round of screening, and $B_l(\theta,\varphi)$ indicates the Ambisonic coefficient of the l-th virtual speaker. When the maximum value of P_{jil} is obtained, the l virtual speakers are the target virtual speakers of the HOA signal, and the horizontal angle information and the azimuth information of the virtual speakers are the attribute information of the target virtual speakers. The number of initial target virtual speakers may be set to 2.

The sound field component synthesis is mainly used to generate virtual speaker signals in the transmission channels. The virtual speaker signal is generated based on the HOA signal and the attribute information of the target virtual speakers. For details about the synthesis of virtual speaker signals, refer to formula (D.32).

$$w = A^{-1}X \tag{D.25}$$

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w indicates a virtual speaker signal, a matrix A indicates a coefficient of a target virtual speaker, A^{-1} indicates an inverse matrix of the matrix A, a matrix X indicates a coefficient of an HOA signal, a size of the matrix A is $(\mathrm{M} \times \mathrm{C})$, C indicates the number of target virtual speakers, M indicates the number of channels of an N-order HOA signal, a size of the matrix X is $(\mathrm{M} \times \mathrm{L})$, and L indicates the number of coefficients of the HOA signal.

The other component calculation is used to obtain the residual signal in the transmission channel. The residual signal may be obtained based on a difference between the HOA signal and the reconstructed sound field signal. The reconstructed sound field signal is a sound field signal reconstructed based on the virtual speaker signal and the target virtual speaker. For implementation steps, refer to the HOA spatial decoding process in section 7.13. Finally, the virtual speaker signal and the residual signal form a transmission channel signal. The transmission channel signal and the side information represented by the virtual speaker are jointly coded by the core coder to obtain a coded bitstream.

D.6 Tables of Parameters of Coding Neural Network

Table D.3 Layer 1 CNN (convolutional kernel parameter kernel) of base coding neural network parameter

Parameter value
0x1.653c4a0000000p–7, –0x1.2df6900000000p–6,
–0x1.ea704a0000000p–7, 0x1.4e0c2c0000000p–6,
0x1.08852c0000000p–8, –0x1.d873b40000000p–11,
0x1.f20f720000000p–6, 0x1.34c98e0000000p–6,
0x1.7285d80000000p–9, 0x1.f5d3720000000p–10,

Table D.4 Layer 1 CNN (bias parameter bias) of base coding neural network parameter

Parameter value
0x1.1c2e720000000p–4, –0x1.9981880000000p–6,

Table D.5 Layer 1 CNN (GDN activation function beta parameter) of base coding neural network parameter

Parameter value
0x1.c855b20000000p+3, 0x1.2c9cc00000000p+4,

Table D.6 Layer 1 CNN (GDN activation function gamma parameter) of base coding neural network parameter

Parameter value
0x0.0p+0, 0x0.0p+0,

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Parameter value
0x0.0p+0, 0x0.0p+0,

Table D.7 Layer 2 CNN (convolutional kernel parameter kernel) of base coding neural network parameter

Parameter value
0x1.22a83c0000000p–3, 0x1.6042960000000p–3, 0x1.132b3a0000000p–3, 0x1.1510840000000p–2,
0x1.9c67040000000p–2, –0x1.ad7f9e0000000p–6, 0x1.f6abb60000000p–4, 0x1.3d6d2c0000000p–7,
0x1.5e1a420000000p–3, 0x1.78d15c0000000p–4, –0x1.7c56060000000p–3, 0x1.bd23b40000000p–3,
–0x1.74cd8c0000000p–2, –0x1.4a11720000000p–2, –0x1.fad6c00000000p–3, 0x1.6e17b60000000p–4,
0x1.5807d80000000p–4, –0x1.24e5620000000p–4, –0x1.691da40000000p–4, 0x1.0f94c20000000p–4,

Table D.7 (continued)

Parameter value
0x1.7c700e0000000p–6, –0x1.ce30300000000p–11, 0x1.705f660000000p–3, –0x1.ee89be0000000p–3,
0x1.5406560000000p–4, 0x1.17d8f80000000p–7, –0x1.c443700000000p–6, 0x1.337cb80000000p–5,
–0x1.90a85e0000000p–5, 0x1.4a2aa60000000p–6, –0x1.43d3be0000000p–5, –0x1.8259300000000p–4,
–0x1.6e82060000000p–7, –0x1.41b5e60000000p–7, –0x1.8236620000000p–6, –0x1.7b40a40000000p–7,
–0x1.1a9c1e0000000p–4, –0x1.633cb40000000p–6, 0x1.0e4cf80000000p–4, 0x1.3e03da0000000p–5,

Table D.8 Layer 2 CNN (bias parameter bias) of base coding neural network parameter

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Parameter value
–0x1.5894220000000p–8, –0x1.5b11d80000000p–9, –0x1.783dc80000000p–9, –0x1.f69d920000000p–10,

Table D.9 Layer 2 CNN (GDN activation function beta parameter) of base coding neural network parameter

Parameter value
0x1.cfa2680000000p+0, 0x1.425d460000000p+0, 0x1.a1cc0c0000000p–1, 0x1.84e8f40000000p+0,

Table D.10 Layer 2 CNN (GDN activation function gamma parameter) of base coding neural network parameter

Parameter value
0x1.bc167e0000000p–31, 0x0.0p+0, 0x1.1976f80000000p–32, 0x1.0926de0000000p–30,
0x1.4e9dd00000000p–28, 0x0.0p+0, 0x1.9fac280000000p–38, 0x1.3399c20000000p–34,

Table D.11 Layer 3 CNN (convolutional kernel parameter kernel) of base coding neural network parameter

Parameter value
–0x1.3a932a0000000p–6, 0x1.ccae2e0000000p–10, 0x1.80cb680000000p–3, –0x1.714d440000000p–3, 0x1.8b8fd20000000p–10, –0x1.21c3800000000p–3, 0x1.308c720000000p–5, 0x1.7912dc0000000p–3,
–0x1.a6d08c0000000p–3, –0x1.23c6820000000p–8, –0x1.7ec64a0000000p–6, –0x1.8153da0000000p–3, –0x1.aae2920000000p–3, –0x1.5f67600000000p–4, –0x1.17b5520000000p–5, 0x1.8767a20000000p–5,
–0x1.2d0b740000000p–4, –0x1.760afe0000000p–4, 0x1.5cfdac0000000p–3, –0x1.84ef860000000p–5, –0x1.2a88fc0000000p–5, –0x1.49c2280000000p–3, 0x1.f163660000000p–6, 0x1.c563100000000p–4,
0x1.14d6d60000000p–3, 0x1.9056aa0000000p–7, 0x1.edead60000000p–5, 0x1.6c1f340000000p–5, 0x1.9b6a780000000p–4, –0x1.0dd4180000000p–5, 0x1.ddbee20000000p–6, 0x1.65926e0000000p–3,

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Parameter value
–0x1.0ee9b60000000p–3, –0x1.8619380000000p–2, 0x1.c987ae0000000p–2, 0x1.aba5660000000p–3, 0x1.0212e40000000p–2, –0x1.98908e0000000p–2, 0x1.8b95f40000000p–3, 0x1.2cc4920000000p–4,
–0x1.c696c20000000p–2, –0x1.2a94460000000p–4, –0x1.28236c0000000p–4, –0x1.7fe2b00000000p–3, –0x1.2b63f40000000p–2, –0x1.27f4ec0000000p–3, 0x1.f764180000000p–4, –0x1.18befc0000000p–1,
0x1.2526900000000p–1, 0x1.d5aa580000000p–3, 0x1.0e85320000000p–4, –0x1.51ccac0000000p–5, 0x1.a18ec20000000p–4, 0x1.79064e0000000p–7, 0x1.1892980000000p–2, –0x1.8da1ce0000000p–3,

Table D.11 (continued)

Parameter value
–0x1.cce77c0000000p–7, –0x1.b948520000000p–3, –0x1.5b65280000000p–3, 0x1.565d960000000p–1, 0x1.d700c00000000p–3, 0x1.130b120000000p–3, –0x1.04d9b20000000p–3, –0x1.20eb620000000p–4,
0x1.abac260000000p–4, –0x1.c8eb980000000p–5, 0x1.e836580000000p–2, 0x1.6b4d740000000p–4, –0x1.10469e0000000p–1, 0x1.2c9fd40000000p–3, –0x1.ec69e00000000p–3, –0x1.e710920000000p–3,
0x1.bca5460000000p–3, 0x1.af19540000000p–3, –0x1.7a2a400000000p–2, –0x1.8c92660000000p–4, –0x1.95c20e0000000p–2, –0x1.824db80000000p–2, –0x1.c3643c0000000p–5, 0x1.7982980000000p–3,
–0x1.1b89220000000p–6, –0x1.4515580000000p–3, –0x1.bce3640000000p–4, –0x1.05f2dc0000000p–2, 0x1.57e9f60000000p–1, –0x1.53536c0000000p–3, –0x1.9cfed40000000p–3, –0x1.86c4e80000000p–4,
0x1.ea45a20000000p–3, –0x1.0d6ca40000000p–1, –0x1.1697ac0000000p–2, –0x1.0c642c0000000p–2, –0x1.29bf060000000p–3, 0x1.0901940000000p–3, 0x1.9251f80000000p–5, –0x1.fb8f980000000p–6,
0x1.d793880000000p–5, 0x1.ac848c0000000p–5, –0x1.5319f80000000p–3, 0x1.9100a40000000p–3, –0x1.fa51a80000000p–2, 0x1.c7a96a0000000p–5, 0x1.baa0b80000000p–2, 0x1.7bdbe00000000p–4,
0x1.ad0e440000000p–4, –0x1.3e29d20000000p–3, 0x1.ca83760000000p–4, 0x1.2454300000000p–4, –0x1.8ddfb60000000p–3, 0x1.395a2e0000000p–3, 0x1.9464fc0000000p–4, –0x1.2e13ce0000000p–6,
0x1.47e46e0000000p–3, –0x1.5c4f700000000p–4, –0x1.9f047c0000000p–4, 0x1.d5a4ee0000000p–4, –0x1.8b86ee0000000p–2, –0x1.7adf100000000p–3,

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Parameter value
–0x1.c4431e0000000p–5, –0x1.3bf2d40000000p–8,
0x1.b1b58e0000000p–3, –0x1.868ece0000000p–3, –0x1.3e04f80000000p–3, 0x1.8bbb9a0000000p–5, –0x1.161a460000000p–2, –0x1.08bfd00000000p–2, –0x1.d921240000000p–4, –0x1.467dda0000000p–6,
0x1.cf2d060000000p–7, –0x1.d6af500000000p–4, –0x1.eeeb480000000p–5, 0x1.04faa40000000p–3, –0x1.65ed500000000p–3, –0x1.37d4200000000p–5, –0x1.025d1c0000000p–7, 0x1.0f25b60000000p–5,
–0x1.8b21400000000p–3, 0x1.88fe340000000p–6, 0x1.45ddca0000000p–4, –0x1.da07560000000p–4, 0x1.a477480000000p–2, 0x1.e68c760000000p–4, –0x1.8524540000000p–4, –0x1.f7db780000000p–11,
–0x1.9377920000000p–5, –0x1.c9b9380000000p–4, 0x1.2947920000000p–7, 0x1.1c3d700000000p–3, –0x1.1d80e80000000p–3, 0x1.466b920000000p–7, –0x1.5890960000000p–4, 0x1.d99ca00000000p–6,
0x1.1f5e7a0000000p–6, –0x1.5ba5b80000000p–5, –0x1.4490840000000p–4, –0x1.cebfa60000000p–6, 0x1.71ce4a0000000p–4, –0x1.725bec0000000p–4, –0x1.6c43600000000p–5, 0x1.454cba0000000p–8,

Table D.12 Layer 3 CNN (bias parameter bias) of base coding neural network parameter

Parameter value
0x1.1020de0000000p–10, 0x1.0a7c0c0000000p–7, 0x1.e1953e0000000p–9, –0x1.2de4e20000000p–8, 0x1.9fa7720000000p–8, –0x1.a156500000000p–11, –0x1.b491540000000p–18, –0x1.27bb900000000p–10,

Table D.13 Layer 3 CNN (GDN activation function beta parameter) of base coding neural network parameter

Parameter value
0x1.d0d8fc0000000p–1, 0x1.becb2e0000000p–1, 0x1.3b81b00000000p–1, 0x1.dca0400000000p–1, 0x1.66fece0000000p+0, 0x1.b422b60000000p–2, 0x1.a465040000000p–1, 0x1.34fb960000000p–2,

Table D.14 Layer 3 CNN (GDN activation function gamma parameter) of base coding neural network parameter

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Parameter value
0x1.94d3c00000000p–41, 0x0.0p+0, 0x0.0p+0, 0x1.34ee820000000p–24, 0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x0.0p+0,

Table D.14 (continued)

Parameter value
0x0.0p+0, 0x1.040c120000000p–23, 0x0.0p+0, 0x1.3924620000000p–23, 0x1.43042c0000000p–21, 0x1.d3232a0000000p–28, 0x1.8898000000000p–30, 0x0.0p+0,
0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x1.8a89340000000p–30, 0x1.f394900000000p–39,
0x1.3ed34a0000000p–26, 0x1.9681e60000000p–29, 0x0.0p+0, 0x0.0p+0, 0x1.c2da620000000p–23, 0x0.0p+0, 0x1.75d6240000000p–31, 0x0.0p+0,
0x0.0p+0, 0x1.1e513a0000000p–32, 0x0.0p+0, 0x1.59a2b00000000p–25,
0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x0.0p+0,
0x1.f72bfc0000000p–34, 0x1.40ffd60000000p–34, 0x1.ccc9100000000p–26, 0x1.2ca0c20000000p–22, 0x0.0p+0, 0x0.0p+0, 0x1.579bee0000000p–24, 0x1.a591000000000p–35,
0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x0.0p+0, 0x1.92c9240000000p–36, 0x1.2e93800000000p–34, 0x0.0p+0,

Table D.15 Layer 4 CNN (convolutional kernel parameter kernel) of base coding neural network parameter

Parameter value
0x1.3397da0000000p–10, 0x1.8433d00000000p–7, 0x1.152e8a0000000p–5, –0x1.7766a20000000p–6, 0x1.93eb580000000p–7, 0x1.1427ac0000000p–10, 0x1.05abea0000000p–10, 0x1.7f9d400000000p–5, –0x1.0359920000000p–11, –0x1.947a260000000p–12, –0x1.11a51a0000000p–8, –0x1.e55b720000000p–7, –0x1.2146160000000p–3, 0x1.d1846e0000000p–12, –0x1.1ad2a20000000p–6, 0x1.435bce0000000p–5,
–0x1.8a68160000000p–11, 0x1.19dd6e0000000p–8, –0x1.3494720000000p–6, –0x1.4db3f00000000p–7, 0x1.4748b20000000p–8, 0x1.65ed780000000p–9, –0x1.9ddc5e0000000p–9, –0x1.df5c880000000p–6, 0x1.441fb60000000p–11, –0x1.b8a4880000000p–12, 0x1.7beae20000000p–8, 0x1.c24f640000000p–6,

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Parameter value
–0x1.faf3bc0000000p–5, –0x1.336ac00000000p–11, 0x1.12ce740000000p–5, –0x1.85e6180000000p–6,
0x1.30544a0000000p–15, –0x1.e1fec60000000p–7, –0x1.32b0a40000000p–5, 0x1.accf460000000p–8, 0x1.ffbc080000000p–9, –0x1.0a3a0e0000000p–9, –0x1.ab52d00000000p–12, –0x1.94515e0000000p–5, 0x1.07e5600000000p–13, –0x1.42eaae0000000p–11, 0x1.5551ec0000000p–8, 0x1.0c170c0000000p–5, 0x1.3aea700000000p–6, –0x1.a182540000000p–13, –0x1.1f6a7a0000000p–9, –0x1.a9b0d20000000p–7,
–0x1.95b1f60000000p–13, 0x1.433bf40000000p–8, –0x1.1e17b00000000p–6, –0x1.ab7f420000000p–9, –0x1.a150400000000p–6, 0x1.e8e83c0000000p–10, –0x1.5ede280000000p–11, –0x1.1a5c220000000p–5, –0x1.2991fc0000000p–12, 0x1.f2f0080000000p–11, 0x1.da6c8e0000000p–9, 0x1.824a7a0000000p–7, 0x1.bef4ac0000000p–3, –0x1.3e62ee0000000p–11, –0x1.4feb900000000p–8, –0x1.a7842e0000000p–6,
–0x1.b8c0080000000p–10, –0x1.1eb5b60000000p–7, –0x1.74100e0000000p–9, 0x1.18e7740000000p–7, 0x1.d5fd860000000p–5, 0x1.d36b7c0000000p–14, 0x1.2297700000000p–9, 0x1.d4a7d40000000p–6, 0x1.496fe00000000p–14, –0x1.a955ac0000000p–12, –0x1.c510820000000p–10, –0x1.b2d8120000000p–6, –0x1.c5aafe0000000p–2, –0x1.62bfe40000000p–13, 0x1.1d88ac0000000p–5, 0x1.d4ccc20000000p–11,
0x1.894ee40000000p–12, –0x1.60a90c0000000p–6, –0x1.09ad1e0000000p–5, 0x1.2249460000000p–5, –0x1.54ec660000000p–6, –0x1.17b76a0000000p–8, –0x1.106ffe0000000p–12, –0x1.d640e00000000p–5, 0x1.2513b00000000p–10, 0x1.4354760000000p–14, 0x1.f1c07c0000000p–9, 0x1.74f8f60000000p–5, 0x1.2047ec0000000p–2, 0x1.9ff14c0000000p–12, 0x1.50efc00000000p–10, –0x1.7839a20000000p–6,

Table D.15 (continued)

Parameter value
0x1.f0e0940000000p–12, –0x1.5e23640000000p–8, –0x1.9a4a040000000p–10, 0x1.50d2920000000p–5, –0x1.4651ae0000000p–4, –0x1.3da02a0000000p–9, –0x1.2dab180000000p–9, –0x1.c69d120000000p–5, 0x1.58fcac0000000p–9, 0x1.37bb140000000p–10, 0x1.179b060000000p–8, 0x1.dea4360000000p–5, 0x1.5bc8700000000p–1, 0x1.9a5c8c0000000p–11, 0x1.2d66920000000p–7, –0x1.d576020000000p–6,
–0x1.678a720000000p–17, 0x1.08afcc0000000p–9, –0x1.3369200000000p–8, 0x1.c1164a0000000p–8, –0x1.96a1a80000000p–6, 0x1.45053c0000000p–13,

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Parameter value
0x1.8d1c620000000p–12, –0x1.72d4040000000p–7, 0x1.70bbb00000000p–12, 0x1.0b3f960000000p–11, 0x1.b0f29a0000000p–11, 0x1.e9c99e0000000p–12, 0x1.4299f40000000p–3, 0x1.21b6a80000000p–12, –0x1.c71b0e0000000p–10, –0x1.16d3d40000000p–6,
0x1.37f0d60000000p–8, –0x1.6f3c040000000p–5, 0x1.4b46820000000p–3, 0x1.687f480000000p–3, 0x1.03c9860000000p–1, –0x1.338c640000000p–5, –0x1.3e1ece0000000p–5, 0x1.8db7140000000p–2, 0x1.d79fc40000000p–6, 0x1.8233b40000000p–7, 0x1.3fe3460000000p–9, 0x1.2d59ca0000000p–2, 0x1.9206000000000p–2, –0x1.eebc3e0000000p–11, –0x1.395c9e0000000p–2, 0x1.33c3760000000p–4,
–0x1.6884be0000000p–6, 0x1.3f046c0000000p–3, 0x1.8099680000000p–5, 0x1.011a8a0000000p–3, 0x1.84a9560000000p–4, 0x1.d6456a0000000p–6, 0x1.97cfdc0000000p–6, 0x1.12a13c0000000p–1, –0x1.26537e0000000p–7, –0x1.dc2e560000000p–10, –0x1.aa300a0000000p–6, 0x1.2da42c0000000p–5, 0x1.ac2e480000000p–3, –0x1.c3a01a0000000p–11, 0x1.21f5f20000000p–1, –0x1.35c6e60000000p–1,
0x1.0e068a0000000p–7, 0x1.a488da0000000p–7, –0x1.db32a60000000p–9, –0x1.1c951a0000000p–5, –0x1.12c25c0000000p–1, 0x1.5ffc2c0000000p–6, 0x1.9526040000000p–5, 0x1.2cc3b40000000p–1, –0x1.af202e0000000p–6, –0x1.ce0ac60000000p–8, –0x1.fc51b80000000p–8, –0x1.564fa00000000p–4, 0x1.f164140000000p–4, 0x1.09213c0000000p–8, –0x1.2a6c080000000p–3, 0x1.be0dd00000000p–8,
0x1.0a9de00000000p–11, 0x1.69a44c0000000p–6, –0x1.acf6700000000p–3, 0x1.8926020000000p–4, –0x1.3d15360000000p–2, 0x1.0a34f00000000p–7, 0x1.e752380000000p–7, –0x1.1f9a820000000p–2, –0x1.57c61c0000000p–7, –0x1.8e738e0000000p–9, 0x1.c1fd1c0000000p–7, 0x1.dece720000000p–3, –0x1.c39f1a0000000p–5, –0x1.68dfee0000000p–12, 0x1.ec5ed20000000p–5, –0x1.e80e6c0000000p–2,
–0x1.b2428c0000000p–6, 0x1.cf2ad20000000p–4, 0x1.ae13000000000p–2, –0x1.32397c0000000p–3, –0x1.5f9d2e0000000p–4, 0x1.5bc4060000000p–7, –0x1.5da6d60000000p–7, –0x1.babeb60000000p–3, 0x1.afebf00000000p–8, 0x1.6cf7f40000000p–10, –0x1.c35d7c0000000p–5, –0x1.e1d99e0000000p–2, 0x1.7015360000000p–6, –0x1.0ba0720000000p–9, 0x1.0b3ca60000000p–1, 0x1.b1b4a40000000p–2,
0x1.2bbdf20000000p–6, –0x1.1e856c0000000p–4, –0x1.0696ea0000000p–2, –0x1.4243ec0000000p–2, –0x1.8805720000000p–2, 0x1.f1fc980000000p–6, 0x1.ba14fe0000000p–5, 0x1.82d4e80000000p–3, –0x1.899a800000000p–5, –0x1.45f58a0000000p–6, 0x1.2db58a0000000p–6, –0x1.7a29520000000p–2,

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Parameter value
0x1.12b36e0000000p–3, 0x1.fee1a60000000p–9, –0x1.1ac2180000000p–2, 0x1.efab1e0000000p–3,
0x1.d876200000000p–7, –0x1.9b38aa0000000p–4, –0x1.6b4d960000000p–1, –0x1.a00dae0000000p–2, 0x1.1387b20000000p–1, 0x1.495d6e0000000p–5, 0x1.3292380000000p–5, –0x1.64d4680000000p–6, –0x1.c5a1b80000000p–5, –0x1.e02e1e0000000p–6, 0x1.c6cea80000000p–5, –0x1.a62fc20000000p–2, –0x1.4431920000000p–3, 0x1.bd31520000000p–11, 0x1.90772c0000000p–5, –0x1.8757b00000000p–3,
0x1.330b020000000p–9, –0x1.411fe80000000p–6, –0x1.51f92c0000000p–3, –0x1.8ef5040000000p–5, –0x1.1adcc60000000p–4, 0x1.d778280000000p–8, 0x1.f07dc40000000p–9, –0x1.55bfd80000000p–2, –0x1.d30fac0000000p–8, –0x1.216baa0000000p–8, 0x1.11243a0000000p–6, –0x1.10456a0000000p–8, 0x1.4d9eb00000000p–1, –0x1.5892900000000p–13, –0x1.1d39880000000p–8, –0x1.7cb6e80000000p–4,

Table D.15 (continued)

Parameter value
0x1.2878da0000000p–2, 0x1.2821560000000p–2, –0x1.75ff440000000p–2, 0x1.2b22a00000000p–1, –0x1.3c61660000000p–6, –0x1.57fc0a0000000p–4, –0x1.6b9b100000000p–2, 0x1.0645aa0000000p–3, –0x1.20d40a0000000p–2, –0x1.6ddafe0000000p–3, –0x1.0257a20000000p–1, –0x1.51bd780000000p–3, –0x1.c6879e0000000p–6, 0x1.a935e80000000p–5, –0x1.6e84d60000000p–3, 0x1.2865a80000000p–2,
–0x1.2066320000000p–1, 0x1.cfbdbe0000000p–3, –0x1.c4400e0000000p–3, –0x1.6690540000000p–3, 0x1.802e220000000p–3, 0x1.3ba2c80000000p–1, –0x1.1c9e100000000p–1, –0x1.8e6c160000000p–4, –0x1.489bdc0000000p–5, –0x1.0f74ba0000000p–3, –0x1.92ab800000000p–4, –0x1.31bdfa0000000p–9, 0x1.5a54f20000000p–10, –0x1.3ab7fa0000000p–3, –0x1.2324180000000p–3, –0x1.f8f89e0000000p–4,
0x1.3f70240000000p–3, –0x1.7fc8520000000p–3, –0x1.357b100000000p–3, 0x1.841eb80000000p–3, –0x1.8177080000000p–3, –0x1.115a160000000p–6, –0x1.2265fc0000000p–1, 0x1.2904680000000p–4, 0x1.982ea80000000p–4, 0x1.4d03100000000p–5, 0x1.0ed69e0000000p–1, 0x1.5943620000000p–3, –0x1.03bb300000000p–5, –0x1.59fa9c0000000p–7, 0x1.fb3b600000000p–2, 0x1.654bd20000000p–2,
–0x1.4193500000000p–4, –0x1.c9aa5c0000000p–4, 0x1.35537e0000000p–5, 0x1.0eb11a0000000p–1, –0x1.25d1d80000000p–3, 0x1.da35bc0000000p–2,

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Parameter value
0x1.42572a0000000p–2, –0x1.07df960000000p–3, –0x1.ec34700000000p–3, –0x1.7e9d320000000p–4, 0x1.44ca300000000p–2, –0x1.99a3b80000000p–2, –0x1.23c90c0000000p–8, –0x1.351ed60000000p–6, 0x1.8d28620000000p–3, 0x1.25a1b60000000p–2,
–0x1.0989be0000000p–1, –0x1.76f8f80000000p–5, –0x1.48face0000000p–8, 0x1.812cdc0000000p–2, 0x1.135a220000000p–6, –0x1.b475dc0000000p–2, 0x1.f354040000000p–3, –0x1.b03c5a0000000p–5, 0x1.e5e2e00000000p–2, 0x1.0a565e0000000p–3, 0x1.ad21140000000p–4, –0x1.86160e0000000p–3, –0x1.5e14940000000p–6, –0x1.f3eeac0000000p–4, 0x1.47928c0000000p–3, 0x1.1336b60000000p–2,
0x1.f3e7d60000000p–3, 0x1.18edb20000000p–2, –0x1.cf80ea0000000p–4, 0x1.7167640000000p–3, –0x1.ad45220000000p–7, –0x1.074e300000000p–2, –0x1.79c60e0000000p–3, –0x1.778d6c0000000p–7, 0x1.86c7760000000p–2, 0x1.3de1280000000p–2, 0x1.8293ee0000000p–2, –0x1.1166d40000000p–3, 0x1.54cc3c0000000p–7, 0x1.1250cc0000000p–4, –0x1.f87c160000000p–2, –0x1.300bee0000000p–3,
–0x1.504e520000000p–4, –0x1.2e863a0000000p–2, 0x1.39b1ba0000000p–3, 0x1.24ef040000000p–3, –0x1.7787820000000p–2, 0x1.7604fe0000000p–3, 0x1.fdeee00000000p–5, –0x1.2e887c0000000p–3, 0x1.a680f40000000p–2, 0x1.a968900000000p–2, –0x1.1df04e0000000p–1, 0x1.2828a00000000p–7, –0x1.3948ac0000000p–6, 0x1.45dd540000000p–4, 0x1.622e880000000p–2, 0x1.0ee7320000000p–2,
–0x1.18119c0000000p–6, 0x1.be7d060000000p–2, –0x1.537fb20000000p–1, –0x1.4fc14c0000000p–5, 0x1.70fc1c0000000p–9, 0x1.64217c0000000p–4, 0x1.69514a0000000p–2, –0x1.3813660000000p–6, –0x1.01da880000000p–10, 0x1.c7f2760000000p–5, 0x1.fb9be60000000p–5, 0x1.dcf3f40000000p–2, –0x1.1ac8200000000p–4, 0x1.4c9ff60000000p–6, 0x1.3ffdd40000000p–5, 0x1.a525940000000p–3,
0x1.3b1f640000000p–3, –0x1.0d64900000000p–6, 0x1.9c622a0000000p–6, 0x1.0715d80000000p–9, –0x1.b36d540000000p–4, –0x1.0d7bd80000000p–2, –0x1.e518440000000p–4, –0x1.3e434c0000000p–7, 0x1.55027a0000000p–3, –0x1.144ca00000000p–1, 0x1.c09af20000000p–6, –0x1.15937c0000000p–6, –0x1.4ffbcc0000000p–11, –0x1.22db9a0000000p–2, –0x1.0f5cb80000000p–5, 0x1.a042740000000p–6,
0x1.24dd560000000p–3, –0x1.b8e4820000000p–9, 0x1.f9557c0000000p–12, 0x1.e310b60000000p–5, –0x1.6d8f300000000p–5, 0x1.20e5e20000000p–3, 0x1.b364b20000000p–4, –0x1.41d4900000000p–5, –0x1.2797da0000000p–9, 0x1.93833c0000000p–3, –0x1.8ba3cc0000000p–3, 0x1.f655f00000000p–7,

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Parameter value
–0x1.ca9fde0000000p–9, –0x1.f56a980000000p–3, –0x1.4ae2380000000p–6, 0x1.2e31520000000p–7,

Table D.15 (continued)

Parameter value
–0x1.f04fb40000000p–2, –0x1.8ac6e80000000p–6, 0x1.fa11ea0000000p–7, –0x1.8a2f6a0000000p–4, 0x1.d5006a0000000p–5, –0x1.54b5bc0000000p–2, –0x1.3cb5340000000p–4, 0x1.98a5ac0000000p–4, –0x1.5d29340000000p–3, –0x1.4e841e0000000p–3, 0x1.77a26c0000000p–3, –0x1.2b3fc20000000p–5, 0x1.279e9c0000000p–7, 0x1.93cc0e0000000p–3, 0x1.9a10720000000p–5, –0x1.dde7aa0000000p–6,
–0x1.79f6d80000000p–3, 0x1.2274aa0000000p–9, 0x1.5044800000000p–10, –0x1.4360420000000p–4, –0x1.905db80000000p–8, –0x1.45ee160000000p–2, 0x1.08c0a60000000p–3, –0x1.817fb20000000p–5, 0x1.95fd1e0000000p–2, –0x1.1327840000000p–1, 0x1.0c0f5a0000000p–3, –0x1.1c646c0000000p–8, –0x1.5dde460000000p–8, 0x1.8e1ff80000000p–4, 0x1.1676b60000000p–6, 0x1.2fb4380000000p–7,
–0x1.434d3c0000000p–3, –0x1.07eafa0000000p–8, 0x1.75a4700000000p–6, –0x1.16a0160000000p–4, –0x1.459f920000000p–7, –0x1.162e820000000p–2, 0x1.99efc20000000p–5, –0x1.0d59a80000000p–7, 0x1.76a9140000000p–3, –0x1.a3c98a0000000p–2, 0x1.f42cc80000000p–9, –0x1.d1afea0000000p–7, –0x1.eeddc60000000p–10, 0x1.394b240000000p–5, 0x1.6b8a400000000p–7, 0x1.9ab77c0000000p–7,
0x1.0143900000000p–1, 0x1.fa47cc0000000p–8, –0x1.a168260000000p–8, 0x1.0189a00000000p–4, –0x1.51e7f80000000p–4, 0x1.271c540000000p–3, 0x1.492ce40000000p–6, –0x1.d0488a0000000p–5, 0x1.f464280000000p–4, –0x1.6e44ee0000000p–3, –0x1.7fcec60000000p–12, 0x1.9a63ca0000000p–9, –0x1.f7bf460000000p–9, –0x1.0861300000000p–2, –0x1.5369940000000p–5, 0x1.01a3c20000000p–6,
–0x1.5948fe0000000p–2, –0x1.c24d160000000p–9, 0x1.4de2d20000000p–7, –0x1.70ddfc0000000p–4, 0x1.4cceb20000000p–4, –0x1.154d020000000p–2, 0x1.170b260000000p–3, 0x1.5097a80000000p–5, –0x1.93dc0a0000000p–7, –0x1.4410020000000p–3, 0x1.58f5f40000000p–2, –0x1.99e6aa0000000p–7, 0x1.bfd2f60000000p–9, 0x1.34d5ce0000000p–2, 0x1.6222e40000000p–5, –0x1.bdfeb40000000p–6,
–0x1.2be4c80000000p–4, –0x1.9b64100000000p–5, 0x1.c891c00000000p–5, 0x1.1d8f6c0000000p–5, –0x1.420cbe0000000p–4, –0x1.d74a620000000p–3,

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Parameter value
0x1.1bc7fe0000000p–6, 0x1.89dca60000000p–4, –0x1.e4499c0000000p–2, 0x1.45b6de0000000p–5, –0x1.81cb0a0000000p–6, –0x1.2f70500000000p–5, 0x1.7162580000000p–7, –0x1.c4e78c0000000p–2, –0x1.69e43c0000000p–6, –0x1.2bf70e0000000p–6,
0x1.53d2ce0000000p–5, 0x1.bb17b20000000p–11, –0x1.0954a40000000p–14, 0x1.2f784a0000000p–9, 0x1.1db78e0000000p–9, –0x1.d435f60000000p–7, 0x1.6358400000000p–7, 0x1.fb23860000000p–13, 0x1.2f22120000000p–6, –0x1.1588d00000000p–6, 0x1.7b11aa0000000p–4, –0x1.2f661a0000000p–9, –0x1.a403d40000000p–15, 0x1.a979a00000000p–6, 0x1.6114040000000p–12, 0x1.c897920000000p–13,
0x1.464d940000000p–6, –0x1.78e9d60000000p–13, 0x1.3e25bc0000000p–9, –0x1.ada1700000000p–9, –0x1.07289c0000000p–10, –0x1.6d324e0000000p–6, 0x1.20aa300000000p–5, 0x1.6bdd380000000p–11, –0x1.0347660000000p–7, –0x1.9307060000000p–5, 0x1.4148160000000p–5, –0x1.15c1ee0000000p–9, 0x1.b93f760000000p–13, 0x1.0715080000000p–8, 0x1.57d9820000000p–12, –0x1.2dcf3a0000000p–9,
–0x1.e280b80000000p–6, 0x1.2f9ddc0000000p–10, –0x1.e863e60000000p–8, 0x1.516b5e0000000p–8, 0x1.1bc7ea0000000p–9, 0x1.80e7a00000000p–6, –0x1.3d1ec20000000p–4, –0x1.0618a20000000p–10, 0x1.2779d40000000p–6, 0x1.eb05980000000p–5, –0x1.21eada0000000p–4, 0x1.8cbf640000000p–9, –0x1.c48cde0000000p–12, 0x1.b88f640000000p–8, 0x1.b5f23e0000000p–12, 0x1.f5575e0000000p–8,
–0x1.382ec20000000p–7, 0x1.89194e0000000p–13, 0x1.c090620000000p–8, –0x1.595d840000000p–11, 0x1.b016c60000000p–12, –0x1.46502e0000000p–7, 0x1.7106820000000p–5, –0x1.06197e0000000p–10, –0x1.0a06f60000000p–7, 0x1.2dcfb80000000p–5, 0x1.c500d00000000p–11, –0x1.75ec400000000p–11, 0x1.6918d20000000p–13, –0x1.40a0d20000000p–7, –0x1.a934860000000p–11, –0x1.0f46ce0000000p–10,

Table D.15 (continued)

Parameter value
–0x1.b29f020000000p–8, 0x1.1075040000000p–10, 0x1.4808a20000000p–9, 0x1.da1f480000000p–10, 0x1.9d197a0000000p–10, –0x1.dd81220000000p–10, 0x1.12819c0000000p–7, –0x1.0ae4b60000000p–10, 0x1.68f3dc0000000p–8, 0x1.360b740000000p–5, 0x1.ecb9aa0000000p–8, 0x1.8240760000000p–10, 0x1.fcb0320000000p–14, 0x1.1795b20000000p–8, –0x1.fcb58a0000000p–11, 0x1.81e9740000000p–10,

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Parameter value
0x1.1e0aea0000000p–5, 0x1.eb29dc0000000p–13, 0x1.c2784a0000000p–10, –0x1.4b65860000000p–9, –0x1.33f54a0000000p–9, –0x1.2304cc0000000p–6, 0x1.72ce620000000p–5, 0x1.aa09680000000p–10, –0x1.2ea3aa0000000p–9, –0x1.6cbd040000000p–5, 0x1.54c66e0000000p–4, –0x1.6ae3520000000p–9, 0x1.7b98bc0000000p–12, 0x1.9b9de20000000p–8, 0x1.d738ec0000000p–12, –0x1.9c14760000000p–8,
–0x1.1ff94e0000000p–5, 0x1.6765c60000000p–14, –0x1.78521c0000000p–10, 0x1.5412620000000p–9, 0x1.1221ca0000000p–12, 0x1.67aea40000000p–6, –0x1.23eb0a0000000p–5, –0x1.d0af120000000p–11, 0x1.2140c80000000p–9, 0x1.cb77860000000p–5, –0x1.3c430e0000000p–4, 0x1.484ab40000000p–10, –0x1.793a120000000p–14, –0x1.a82c960000000p–7, –0x1.90b2ac0000000p–12, 0x1.f26f880000000p–9,
0x1.3e4fc40000000p–5, –0x1.c629ba0000000p–13, –0x1.6b53920000000p–7, 0x1.012f2e0000000p–8, 0x1.6b9d200000000p–9, –0x1.4fb38e0000000p–9, –0x1.3f13960000000p–4, 0x1.9a47680000000p–11, 0x1.1e548c0000000p–5, –0x1.904d6c0000000p–5, 0x1.9c929e0000000p–5, –0x1.896a7e0000000p–9, 0x1.6ffe540000000p–15, 0x1.5ce2280000000p–5, 0x1.ddb7460000000p–11, 0x1.2786760000000p–8,

Table D.16 Layer 1 CNN (convolutional kernel parameter kernel) of context coding neural network parameter

Parameter value
0x1.082fb40000000p–4, 0x1.80aa080000000p–3, –0x1.33c5d40000000p–4, –0x1.5ad6000000000p–5, 0x1.52699c0000000p–4, 0x1.1b68400000000p–3, –0x1.b676280000000p–6, –0x1.e9dc7a0000000p–5, –0x1.43a4880000000p–7, –0x1.91d32e0000000p–8, –0x1.2c6fe80000000p–4, –0x1.b4aa720000000p–4, –0x1.ab04400000000p–5, –0x1.9412920000000p–8, 0x1.4641cc0000000p–3, –0x1.06cd7a0000000p–5,
0x1.634b1c0000000p–4, –0x1.a6ba9a0000000p–3, –0x1.37ad280000000p–5, –0x1.2aacac0000000p–7, –0x1.36fc220000000p–6, 0x1.31406c0000000p–4, –0x1.7d49b80000000p–7, –0x1.513a6e0000000p–7, –0x1.c372ee0000000p–7, 0x1.baa7f00000000p–10, 0x1.d77d3c0000000p–10, –0x1.be4ab40000000p–4, –0x1.6708bc0000000p–6, 0x1.a224a80000000p–9, 0x1.2529640000000p–3, –0x1.9535ae0000000p–6,
0x1.8b756e0000000p–4, 0x1.a4c2040000000p–3, –0x1.044a140000000p–6, 0x1.bbee820000000p–10, –0x1.1de1140000000p–7, 0x1.3854880000000p–5, –0x1.aee8400000000p–7, –0x1.088cbc0000000p–4, –0x1.0990940000000p–7,

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Parameter value
0x1.398f740000000p–9, –0x1.c38e5c0000000p–8, –0x1.d661e80000000p–4, –0x1.fbc7540000000p–7, –0x1.7e3fa00000000p–9, 0x1.10c3580000000p–3, –0x1.e3a0ec0000000p–7,
0x1.4475c80000000p–4, –0x1.8dfabc0000000p–3, –0x1.90d80c0000000p–5, –0x1.77bb8e0000000p–8, –0x1.26b2ac0000000p–7, 0x1.f66ef40000000p–5, –0x1.3dfe6a0000000p–8, 0x1.a1ea8e0000000p–11, –0x1.14db860000000p–9, –0x1.6c95cc0000000p–8, 0x1.5033d40000000p–9, –0x1.1231200000000p–3, –0x1.8bc5a60000000p–7, –0x1.00ba3a0000000p–8, 0x1.f49d6c0000000p–4, –0x1.7484b80000000p–7,
0x1.45edbc0000000p–4, –0x1.8dd5940000000p–3, –0x1.00e3c80000000p–5, –0x1.82afde0000000p–7, –0x1.20cb3e0000000p–6, 0x1.2af7500000000p–5, –0x1.057ebe0000000p–10, –0x1.bfd61a0000000p–6, –0x1.8ba1b40000000p–8, –0x1.c078000000000p–8, 0x1.b0b1060000000p–9, –0x1.1b97920000000p–3, –0x1.c6e1260000000p–7, –0x1.e76ef20000000p–13, 0x1.df21bc0000000p–4, –0x1.5845b60000000p–8,

Table D.16 (continued)

Parameter value
0x1.4f28900000000p–5, –0x1.3f9c0a0000000p–3, –0x1.0cf4a20000000p–4, 0x1.4428d60000000p–3, 0x1.7a85040000000p–4, 0x1.c4df120000000p–4, –0x1.ceea5e0000000p–6, –0x1.a2dec40000000p–6, –0x1.e993a20000000p–5, –0x1.0cc9f20000000p–6, –0x1.0e28760000000p–4, –0x1.bea5b80000000p–4, –0x1.e97f1a0000000p–8, –0x1.465c5c0000000p–7, 0x1.768d940000000p–4, –0x1.7077740000000p–5,
0x1.23c3fe0000000p–4, 0x1.a546d80000000p–3, –0x1.9c30ae0000000p–5, –0x1.e0ff9c0000000p–7, –0x1.673d440000000p–7, 0x1.8336c80000000p–4, –0x1.0f00d60000000p–7, –0x1.df60ce0000000p–8, –0x1.d2b4c80000000p–7, 0x1.bec3720000000p–9, –0x1.5447a60000000p–8, –0x1.79e6040000000p–4, –0x1.60c3b80000000p–6, –0x1.cdb5620000000p–7, 0x1.11d58c0000000p–3, –0x1.c4f9a80000000p–6,
0x1.92efb60000000p–4, –0x1.075b800000000p–3, –0x1.2183f40000000p–6, 0x1.e77bc00000000p–10, –0x1.4b942c0000000p–6, 0x1.a592ea0000000p–7, –0x1.a52ca00000000p–7, –0x1.c287540000000p–5, –0x1.3467e40000000p–9, 0x1.7a0b380000000p–8, 0x1.f1c2e00000000p–9, –0x1.38e8980000000p–3, –0x1.7dc61c0000000p–7, –0x1.0a4dee0000000p–8, 0x1.047b580000000p–3, –0x1.25beb60000000p–7,
–0x1.6c68c80000000p–8, –0x1.dc6c240000000p–3, –0x1.8e72f00000000p–4,

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Parameter value
–0x1.c778e60000000p–6, –0x1.68d5dc0000000p–9, 0x1.3fda4e0000000p–3, –0x1.6dac040000000p–7, 0x1.08142e0000000p–3, –0x1.86d4ee0000000p–6, –0x1.7e4e9c0000000p–5, –0x1.aaf6b00000000p–6, –0x1.6dfa040000000p–4, –0x1.f6d9cc0000000p–9, –0x1.21e3340000000p–9, 0x1.c844200000000p–5, –0x1.4bbde60000000p–5,
0x1.c4b8220000000p–5, –0x1.017f360000000p–3, –0x1.a5b44c0000000p–4, –0x1.bef33c0000000p–4, –0x1.14750e0000000p–7, 0x1.cd268c0000000p–5, –0x1.9daf580000000p–6, 0x1.b20d840000000p–3, 0x1.cd3fb20000000p–4, –0x1.0b3f440000000p–4, –0x1.0276d20000000p–6, –0x1.2a5e600000000p–3, –0x1.857e720000000p–10, –0x1.bdbe4e0000000p–6, 0x1.3b7f200000000p–4, 0x1.bd11420000000p–4,
0x1.f8b2b20000000p–9, –0x1.45b3d60000000p–3, –0x1.18aaa80000000p–4, –0x1.17b3720000000p–5, –0x1.25b0260000000p–5, 0x1.5a88c00000000p–3, –0x1.c81af40000000p–8, –0x1.e108080000000p–6, –0x1.8b571e0000000p–5, 0x1.d45bfe0000000p–9, –0x1.4c26420000000p–8, –0x1.a8836a0000000p–4, –0x1.f7ab420000000p–6, –0x1.51045e0000000p–6, 0x1.8324be0000000p–4, –0x1.edaef60000000p–5,
0x1.3a0eb40000000p–4, –0x1.5e3fdc0000000p–3, –0x1.c1d2ec0000000p–5, –0x1.8672100000000p–6, –0x1.0444700000000p–6, 0x1.7a56300000000p–5, 0x1.5373b60000000p–9, –0x1.dc1a5e0000000p–6, –0x1.c0eb580000000p–7, 0x1.07d1da0000000p–11, –0x1.61f14a0000000p–11, –0x1.e07dae0000000p–4, –0x1.3172fc0000000p–6, 0x1.2281e00000000p–12, 0x1.e566360000000p–4, –0x1.5bfbd20000000p–6,
0x1.c6cd660000000p–4, –0x1.95ab020000000p–3, –0x1.3217b40000000p–5, –0x1.280e540000000p–6, –0x1.27d4de0000000p–7, 0x1.72563c0000000p–6, –0x1.74690e0000000p–8, –0x1.167f980000000p–4, –0x1.219b500000000p–9, –0x1.fa63c00000000p–8, 0x1.add2160000000p–8, –0x1.b0f6fe0000000p–3, –0x1.26a0660000000p–7, 0x1.bccc680000000p–9, 0x1.1ce4a60000000p–3, –0x1.a432ba0000000p–6,
0x1.55d7280000000p–5, –0x1.acfdf60000000p–4, –0x1.2851de0000000p–3 0x1.ac136e0000000p–3, 0x1.bc0eea0000000p–4, 0x1.06379c0000000p–4, –0x1.89d3280000000p–5, –0x1.42ab3e0000000p–4, 0x1.4e3ff20000000p–4, –0x1.4a687e0000000p–5, –0x1.97cc1c0000000p–7, –0x1.41a9a20000000p–3, 0x1.93cea60000000p–8, –0x1.adacee0000000p–6, 0x1.c96c580000000p–5, 0x1.05de880000000p–10,
0x1.39abc00000000p–4, –0x1.b284420000000p–3, –0x1.3de8520000000p–5, –0x1.b577a40000000p–8, –0x1.319d680000000p–8, 0x1.e04c760000000p–6, –0x1.64e2700000000p–10, –0x1.bcf5b20000000p–5, 0x1.078b0c0000000p–8,

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Parameter value
–0x1.2efaca0000000p–9, 0x1.27fb460000000p–9, –0x1.f5eff00000000p–5, –0x1.d8f8c40000000p–8, –0x1.4cb75a0000000p–8, 0x1.ae8e640000000p–4, –0x1.03083e0000000p–8,

Table D.16 (continued)

Parameter value
0x1.2fbaea0000000p–4, 0x1.50ee5e0000000p–3, –0x1.1b99100000000p–4, –0x1.a7e8840000000p–7, –0x1.944db40000000p–6, 0x1.9139420000000p–5, –0x1.27fc4a0000000p–8, –0x1.c7282a0000000p–5, –0x1.7093300000000p–9, 0x1.31318a0000000p–12, –0x1.a596d60000000p–9, –0x1.afb6880000000p–4, –0x1.4521180000000p–7, –0x1.dc89780000000p–9, 0x1.c63e2c0000000p–4, –0x1.5c1efc0000000p–6,
0x1.1ce2040000000p–5, –0x1.6d8f2c0000000p–5, –0x1.1a19000000000p–3, –0x1.3a03780000000p–4, –0x1.7d7aa00000000p–7, 0x1.22c25c0000000p–5, –0x1.d3693e0000000p–6, –0x1.2c51720000000p–2, –0x1.4ab0960000000p–6, 0x1.a82bf40000000p–9, –0x1.2354820000000p–4, –0x1.a5db080000000p–5, 0x1.d9c9ce0000000p–5, –0x1.06da060000000p–5, –0x1.c0bde80000000p–7, –0x1.f7f40c0000000p–6,
0x1.62b1240000000p–5, –0x1.ec00060000000p–4, –0x1.03936c0000000p–3, –0x1.6a6a2c0000000p–4, –0x1.3834520000000p–5, 0x1.0dbee00000000p–8, 0x1.bf3f960000000p–4, –0x1.2c29b40000000p–3, –0x1.0ba6220000000p–4, 0x1.172d8c0000000p–4, –0x1.51357a0000000p–4, –0x1.04fcec0000000p–4, 0x1.e7078e0000000p–5, –0x1.ec8e940000000p–6, –0x1.3e372e0000000p–6, –0x1.00c1be0000000p–4,
0x1.71e79a0000000p–5, –0x1.7e65aa0000000p–4, –0x1.f580200000000p–4, –0x1.aadddc0000000p–4, 0x1.c075420000000p–4, –0x1.a987f40000000p–10, 0x1.cc86ce0000000p–4, –0x1.a530760000000p–3, –0x1.33fd500000000p–4, –0x1.2985b80000000p–7, –0x1.35119c0000000p–4, –0x1.33bb540000000p–3, 0x1.db97780000000p–5, –0x1.75b26a0000000p–5, –0x1.feb5440000000p–7, –0x1.1e5d180000000p–8,
0x1.5b73140000000p–5, –0x1.5725920000000p–5, 0x1.1ec2d40000000p–2, –0x1.7ef67e0000000p–4, –0x1.f87df80000000p–6, –0x1.fbbb040000000p–5, 0x1.a92e8a0000000p–4, –0x1.2903000000000p–3, 0x1.b253f00000000p–4, 0x1.1217aa0000000p–4, –0x1.5f47ee0000000p–4, –0x1.5a6ee00000000p–4, 0x1.68ffd60000000p–6, –0x1.afc9d40000000p–6, –0x1.209d7a0000000p–7, –0x1.99342c0000000p–6,
0x1.7463da0000000p–5, –0x1.5129460000000p–3, –0x1.38a8140000000p–3,

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Parameter value
–0x1.34f9e00000000p–4, –0x1.ee5e540000000p–7, 0x1.0f8a000000000p–7, –0x1.b114080000000p–5, –0x1.31d7560000000p–3, –0x1.b1ba220000000p–5, 0x1.117a840000000p–4, –0x1.12334e0000000p–4, –0x1.2b20120000000p–4, 0x1.f8cc8c0000000p–5, –0x1.243acc0000000p–5, –0x1.eb23660000000p–7, 0x1.ada34e0000000p–4,
0x1.6e922c0000000p–6, –0x1.be28fe0000000p–6, –0x1.11431e0000000p–3, 0x1.6d4b000000000p–3, –0x1.311e280000000p–7, 0x1.864c3c0000000p–5, –0x1.05542a0000000p–5, –0x1.b36c480000000p–4, 0x1.be2bc20000000p–8, –0x1.41d4c40000000p–6, –0x1.cdc33e0000000p–4, –0x1.de19940000000p–5, 0x1.9440040000000p–5, –0x1.fe42e40000000p–6, –0x1.8a8ee00000000p–7, –0x1.b1b4400000000p–6,
–0x1.66e9060000000p–7, –0x1.13902e0000000p–4, –0x1.43a2ec0000000p–3, –0x1.689a860000000p–4, –0x1.9ab1c00000000p–6, 0x1.d2c81e0000000p–5, 0x1.b9d0040000000p–4, –0x1.07448e0000000p–2, 0x1.353ebe0000000p–4, –0x1.92c95a0000000p–5, –0x1.faa7460000000p–4, –0x1.75000a0000000p–4, 0x1.9d94bc0000000p–7, –0x1.1813fe0000000p–5, –0x1.be11ce0000000p–7, –0x1.47cab40000000p–6,
0x1.19529e0000000p–4, –0x1.8fcc420000000p–4, 0x1.2979560000000p–2, –0x1.3c0c800000000p–4, –0x1.8278fe0000000p–8, –0x1.2a22060000000p–4, –0x1.be40920000000p–6, –0x1.191bac0000000p–3, 0x1.0d84c00000000p–3, 0x1.20d67e0000000p–4, –0x1.ddc8d60000000p–5, –0x1.dae8b60000000p–4, 0x1.8fe30a0000000p–6, –0x1.37693e0000000p–5, 0x1.8608900000000p–7, 0x1.7fa4a60000000p–4,
0x1.6fef940000000p–4, –0x1.96f3ce0000000p–5, –0x1.00b56a0000000p–4, –0x1.c5bc2e0000000p–4, –0x1.27dd340000000p–6, –0x1.1d2a580000000p–5, –0x1.1a26d80000000p–6, 0x1.3c4aa80000000p–3, 0x1.08fb920000000p–4, –0x1.918f820000000p–5, –0x1.9b36b80000000p–4, –0x1.2a54960000000p–4, 0x1.97de940000000p–4, –0x1.33fedc0000000p–5, –0x1.1d1e300000000p–6, –0x1.c27ee40000000p–6,

Table D.16 (continued)

Parameter value
0x1.059e540000000p–5, 0x1.2a6b440000000p–6, –0x1.0243060000000p–3, –0x1.6292ba0000000p–4, –0x1.5c43380000000p–6, 0x1.6e7d6a0000000p–7, –0x1.54eb240000000p–6, –0x1.5abb7a0000000p–3, –0x1.6f13b00000000p–8, –0x1.c5aad80000000p–8, –0x1.8f73560000000p–4, –0x1.88adc80000000p–5, 0x1.8bbe260000000p–5, –0x1.17e8720000000p–5, –0x1.b75f940000000p–7,

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Parameter value
–0x1.1c10280000000p–6,
0x1.8e6acc0000000p–5, –0x1.56ed7a0000000p–6, –0x1.db2f0a0000000p–4, –0x1.3387ea0000000p–4, –0x1.6b42f00000000p–5, 0x1.bad01e0000000p–6, –0x1.3af65e0000000p–7, –0x1.7b687e0000000p–3, 0x1.68f8260000000p–4, –0x1.9e6f2e0000000p–5, 0x1.dc9fc80000000p–3, –0x1.32d9e60000000p–4, 0x1.18646e0000000p–4, –0x1.ef8ef20000000p–6, –0x1.47fac60000000p–6, –0x1.a94b360000000p–5,
–0x1.29b3fe0000000p–11, –0x1.2c623e0000000p–3, –0x1.8507b40000000p–3, –0x1.2fa6060000000p–4, –0x1.4d10c20000000p–5, 0x1.4cc2820000000p–4, –0x1.8a4e420000000p–5, –0x1.70dde80000000p–3, –0x1.92b8b60000000p–4, 0x1.19f9e00000000p–5, –0x1.3480ba0000000p–4, –0x1.7e90aa0000000p–4, 0x1.3899f80000000p–5, –0x1.22d7ee0000000p–5, –0x1.5dd8c40000000p–6, 0x1.0d503e0000000p–3,
0x1.00c1ce0000000p–3, –0x1.5669780000000p–3, 0x1.0ba81e0000000p–2, –0x1.fa70fc0000000p–4, 0x1.584ac20000000p–4, –0x1.21b81e0000000p–4, –0x1.4543800000000p–5, –0x1.88d2220000000p–4, 0x1.378e520000000p–4, 0x1.5ecde80000000p–4, –0x1.7b51a60000000p–4, –0x1.a43c760000000p–4, 0x1.b95e240000000p–6, –0x1.b30d260000000p–6, 0x1.0cd4a40000000p–4, –0x1.268ede0000000p–6,
0x1.21187e0000000p–5, 0x1.094aae0000000p–5, –0x1.4e29100000000p–4, –0x1.cfb1580000000p–4, –0x1.cdf7ce0000000p–7, –0x1.19b14a0000000p–6, –0x1.82dd8a0000000p–6, –0x1.a06a9c0000000p–4, –0x1.dd95ac0000000p–7, –0x1.65edc60000000p–14, –0x1.0e03340000000p–3, –0x1.cc372a0000000p–7, 0x1.91decc0000000p–5, –0x1.ab2fb00000000p–5, –0x1.a084460000000p–6, –0x1.4025640000000p–8,
–0x1.556ed40000000p–7, –0x1.26d3b00000000p–4, –0x1.3c92100000000p–3, –0x1.5ec60c0000000p–4, –0x1.913b8c0000000p–8, 0x1.97091a0000000p–5, 0x1.0ba3340000000p–3, 0x1.d7cfb80000000p–3, –0x1.4af7f00000000p–5, –0x1.86a8c00000000p–5, –0x1.a60e200000000p–4, –0x1.b22df80000000p–4, 0x1.0d7a7e0000000p–6, –0x1.2d89600000000p–5, –0x1.038e120000000p–6, 0x1.93aea60000000p–4,
–0x1.3c64540000000p–6, –0x1.7860fa0000000p–3, –0x1.9731640000000p–3, –0x1.9637de0000000p–5, –0x1.05cf860000000p–6, 0x1.d648100000000p–4, –0x1.4ead220000000p–8, –0x1.ae310e0000000p–3, –0x1.13f9400000000p–4, –0x1.1374c20000000p–4, –0x1.1f64620000000p–4, –0x1.56afb00000000p–4, 0x1.b917fc0000000p–6, –0x1.d6a0e20000000p–6, –0x1.f6b39a0000000p–8, 0x1.1ef8420000000p–3,
0x1.2030720000000p–8, 0x1.a067aa0000000p–9, –0x1.1f86f20000000p–4,

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Parameter value
–0x1.0788b40000000p–4, –0x1.09f2ec0000000p–11, 0x1.c102720000000p–6, –0x1.34cb8e0000000p–7, 0x1.a42d540000000p–7, –0x1.0034a80000000p–7, –0x1.34f5620000000p–11, –0x1.5cf3f20000000p–5, 0x1.c230d20000000p–6, 0x1.5636a40000000p–6, –0x1.0325e80000000p–5, –0x1.51c8ea0000000p–7, –0x1.d6a1360000000p–7,
0x1.6345540000000p–9, –0x1.8006800000000p–8, –0x1.44c6680000000p–4, –0x1.d60c280000000p–5, –0x1.2df8a80000000p–8, 0x1.568fcc0000000p–5, –0x1.3dda180000000p–6, –0x1.35e64c0000000p–4, –0x1.7575180000000p–8, –0x1.2e07820000000p–7, 0x1.fa101e0000000p–3, 0x1.8c251e0000000p–6, 0x1.bba0d40000000p–6, –0x1.1fbcfa0000000p–5, –0x1.1771ba0000000p–6, –0x1.8e2de00000000p–6,
0x1.690a500000000p–9, –0x1.3c17a80000000p–7, –0x1.15fe8c0000000p–4, –0x1.6655140000000p–5, –0x1.678bee0000000p–9, 0x1.21c8a20000000p–7, –0x1.1418200000000p–9, –0x1.3e2fe00000000p–4, –0x1.69db940000000p–7, 0x1.ea940a0000000p–10, –0x1.fa845e0000000p–4, 0x1.2c2a200000000p–5, 0x1.02a29c0000000p–6, –0x1.898c460000000p–5, –0x1.277a6e0000000p–6, –0x1.68fa380000000p–9,

Table D.16 (continued)

Parameter value
0x1.2a78240000000p–9, –0x1.04caf00000000p–5, –0x1.062bea0000000p–4, –0x1.acc2920000000p–4, –0x1.10bf100000000p–7, 0x1.e11e560000000p–7, –0x1.c01fa20000000p–8, –0x1.1dd91e0000000p–5, 0x1.3360b80000000p–12, –0x1.d0f45a0000000p–9, –0x1.a30c080000000p–4, 0x1.97452e0000000p–6, 0x1.5e585e0000000p–7, –0x1.f4d4420000000p–6, –0x1.39df140000000p–6, –0x1.5b41d00000000p–6,
–0x1.6094880000000p–6, –0x1.b2a0700000000p–6, –0x1.dd05560000000p–4, 0x1.a0f8ac0000000p–3, –0x1.79bf020000000p–8, 0x1.c015e80000000p–5, –0x1.ca39200000000p–7, –0x1.c129180000000p–5, 0x1.6a68420000000p–9, –0x1.09d2e20000000p–8, –0x1.d55a600000000p–5, 0x1.c551900000000p–6, 0x1.8f712c0000000p–11, –0x1.6a69dc0000000p–5, –0x1.2b25ec0000000p–7, –0x1.21ace60000000p–7,
–0x1.459faa0000000p–6, –0x1.22e8ae0000000p–6, –0x1.6095340000000p–5, –0x1.ca95060000000p–5, –0x1.2e1a860000000p–8, 0x1.7f89720000000p–5, –0x1.9d620e0000000p–8, –0x1.0e15980000000p–8, 0x1.62f9740000000p–10, 0x1.0a58d40000000p–11, –0x1.be50d00000000p–6, 0x1.e6052e0000000p–6, –0x1.c33fd20000000p–11, –0x1.f2ca5e0000000p–6, –0x1.ecf48c0000000p–9,

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Parameter value
–0x1.561ad20000000p–8,
0x1.621eb00000000p–6, –0x1.4af4200000000p–5, –0x1.abe6ec0000000p–6, –0x1.61de920000000p–4, –0x1.5c90480000000p–9, 0x1.56e8ba0000000p–8, –0x1.7ded500000000p–8, 0x1.9dfe3c0000000p–7, –0x1.1a5b520000000p–8, 0x1.8087f20000000p–9, –0x1.8f47160000000p–4, 0x1.0b31860000000p–5, 0x1.188fa40000000p–5, –0x1.bdc5080000000p–5, –0x1.12e67c0000000p–6, –0x1.1dad2a0000000p–6,
–0x1.b4a34c0000000p–6, –0x1.e554cc0000000p–8, –0x1.cdf63a0000000p–4, –0x1.fe23d80000000p–4, –0x1.7ca1dc0000000p–7, 0x1.8fd6660000000p–5, –0x1.537a140000000p–8, –0x1.8021b00000000p–4, 0x1.b5522e0000000p–9, –0x1.7a6d8a0000000p–7, –0x1.539b480000000p–4, 0x1.1905840000000p–6, –0x1.a8027c0000000p–7, –0x1.80b6060000000p–5, –0x1.ce2c720000000p–8, –0x1.a6fee20000000p–9,
–0x1.f5255c0000000p–6, –0x1.36b70c0000000p–7, –0x1.287a9e0000000p–5, –0x1.dc9e920000000p–5, –0x1.b76bc20000000p–8, 0x1.93fd8a0000000p–5, –0x1.70f7600000000p–8, –0x1.fcfa5e0000000p–6, 0x1.2ead9c0000000p–8, 0x1.e467120000000p–10, –0x1.e9c09e0000000p–5, 0x1.aa06620000000p–6, –0x1.2489000000000p–7, –0x1.31ffa00000000p–6, –0x1.1db7480000000p–8, –0x1.40b2fe0000000p–11,
–0x1.25db920000000p–6, –0x1.402a260000000p–5, –0x1.3d69d80000000p–5, –0x1.05d7d20000000p–6, –0x1.0a8fba0000000p–9, 0x1.6519600000000p–5, –0x1.13d6300000000p–7, –0x1.6c9ee00000000p–7, –0x1.f65d760000000p–9, 0x1.dfe9420000000p–11, –0x1.68db6a0000000p–6, 0x1.e870540000000p–7, 0x1.2dd32a0000000p–10, –0x1.33d8e60000000p–5, –0x1.2196500000000p–11, –0x1.0b791c0000000p–8,
0x1.6fc12e0000000p–10, –0x1.2173700000000p–6, –0x1.13c6ce0000000p–6, –0x1.1b88c20000000p–4, –0x1.1f5ff80000000p–8, 0x1.dbbd900000000p–6, –0x1.35f8ce0000000p–7, 0x1.0694be0000000p–5, –0x1.bcf91a0000000p–10, 0x1.1bc4b00000000p–11, –0x1.c030280000000p–5, 0x1.6dd8c20000000p–5, 0x1.769b360000000p–6, –0x1.89f0800000000p–5, –0x1.9817780000000p–7, –0x1.a1dff60000000p–7,
0x1.c040ce0000000p–6, –0x1.1c113c0000000p–6, –0x1.63879e0000000p–4, –0x1.b8a3dc0000000p–4, –0x1.762c2a0000000p–8, 0x1.1061f00000000p–6, –0x1.36b44e0000000p–6, –0x1.1fed9e0000000p–5, –0x1.5647020000000p–7, 0x1.e5067e0000000p–9, –0x1.94f9ba0000000p–4, 0x1.e1e6b20000000p–6, 0x1.6d6a940000000p–5, 0x1.1ea1080000000p–3, –0x1.bb4f4a0000000p–7, –0x1.2eff3a0000000p–6,
0x1.fa152c0000000p–5, –0x1.564c960000000p–7, –0x1.5dc22c0000000p–4,

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Parameter value
–0x1.3d4ebc0000000p–4, –0x1.906be20000000p–7, –0x1.25e1880000000p–5, –0x1.a0f35c0000000p–6, 0x1.1371de0000000p–4, –0x1.cf73240000000p–8, 0x1.b08fbc0000000p–8, –0x1.684aca0000000p–4, –0x1.13640c0000000p–6, 0x1.193a080000000p–4, –0x1.09591e0000000p–5, –0x1.7a8a320000000p–6, –0x1.15eb3a0000000p–6,

Table D.16 (continued)

Parameter value
–0x1.e6d41a0000000p–9, 0x1.3eba4c0000000p–10, –0x1.7012720000000p–7, –0x1.87d5500000000p–7, –0x1.3138b60000000p–8, 0x1.1ef4580000000p–6, –0x1.7f9c0a0000000p–7, –0x1.eea4c20000000p–10, –0x1.c3fbc40000000p–12, –0x1.49fe360000000p–9, –0x1.aed1500000000p–6, 0x1.8067960000000p–6, 0x1.96b6320000000p–8, –0x1.2009220000000p–5, –0x1.065e8a0000000p–7, –0x1.ecea9c0000000p–9,
–0x1.60def20000000p–7, –0x1.27d12a0000000p–6, –0x1.8fb8060000000p–5, –0x1.197d120000000p–4, –0x1.7d01420000000p–9, 0x1.bbbe540000000p–5, –0x1.a3a28c0000000p–8, –0x1.96f7000000000p–4, –0x1.32d5f80000000p–8, 0x1.a35dca0000000p–10, –0x1.4563ce0000000p–3, 0x1.f6c0ce0000000p–6, 0x1.9086dc0000000p–7, –0x1.1d31260000000p–4, –0x1.c276da0000000p–7, –0x1.9a875a0000000p–8,
0x1.971ed20000000p–8, –0x1.6cd2080000000p–5, –0x1.6590d80000000p–4, –0x1.8e7f480000000p–4, 0x1.1ecd780000000p–10, 0x1.217d8a0000000p–5, –0x1.b8141e0000000p–8, 0x1.6e57620000000p–4, –0x1.413bde0000000p–7, 0x1.71d7a00000000p–10, –0x1.8adda20000000p–3, 0x1.18eb2a0000000p–5, 0x1.1ba6a40000000p–5, –0x1.001ef00000000p–4, –0x1.6411980000000p–6, –0x1.c9c70c0000000p–8,

Table D.17 Layer 1 CNN (bias parameter bias) of context coding neural network parameter

Parameter value
0x1.f3f7b00000000p–2, 0x1.df46de0000000p–3, –0x1.012fc00000000p–2, 0x1.6736900000000p–7, –0x1.e9370a0000000p–6, 0x1.28ba000000000p–3, –0x1.5de3e20000000p–5, 0x1.0bbf240000000p–2, –0x1.3300f20000000p–5, 0x1.4df4960000000p–7, 0x1.0308060000000p–9, 0x1.f9de120000000p–2, –0x1.2999fa0000000p–3, –0x1.28c7c20000000p–3, –0x1.a76dc40000000p–7, –0x1.8955f20000000p–5,

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Table D.18 Layer 2 CNN (convolutional kernel parameter kernel) of context coding neural network parameter

Parameter value
–0x1.be1bc60000000p–5, 0x1.3cecd80000000p–4, –0x1.9f21ec0000000p–2, –0x1.c220f00000000p–5, –0x1.22cf7e0000000p–2, 0x1.58eb760000000p–4, –0x1.8336c40000000p–6, –0x1.059aba0000000p–2, –0x1.8743b20000000p–3, 0x1.aa892c0000000p–9, 0x1.1808de0000000p–5, –0x1.58c7b20000000p–3, 0x1.168df00000000p–3, 0x1.0285c40000000p–5, –0x1.aa26b40000000p–4, 0x1.96d7da0000000p–4,
–0x1.df167c0000000p–5, –0x1.340a500000000p–6, 0x1.3407000000000p–6, –0x1.8c78160000000p–3, –0x1.a307bc0000000p–3, –0x1.8c2cba0000000p–6, –0x1.8d89960000000p–4, 0x1.925f800000000p–3, –0x1.22feae0000000p–3, –0x1.219f6a0000000p–7, –0x1.eb1b380000000p–4, 0x1.5555b40000000p–3, –0x1.34073e0000000p–5, –0x1.57e9080000000p–7, 0x1.0120920000000p–5, –0x1.38da300000000p–7,
–0x1.ed4a7e0000000p–3, –0x1.9b46180000000p–4, 0x1.21a4c20000000p–3, –0x1.fb89a80000000p–4, –0x1.dd40ee0000000p–6, –0x1.e367d20000000p–4, 0x1.78ab620000000p–3, –0x1.786bbc0000000p–4, 0x1.33b6860000000p–3, –0x1.419b380000000p–6, 0x1.1484ce0000000p–1, –0x1.d36e760000000p–3, –0x1.7be8300000000p–3, –0x1.6fef520000000p–5, –0x1.9ca19e0000000p–3, –0x1.a7e6ce0000000p–4,
–0x1.126cc60000000p–2, –0x1.e0c56a0000000p–4, 0x1.07b4120000000p–3, 0x1.a35e1a0000000p–5, 0x1.cb87280000000p–4, –0x1.1b48780000000p–3, 0x1.a71d7c0000000p–2, 0x1.69a3880000000p–4, 0x1.6cefec0000000p–4, –0x1.7dbca20000000p–6, –0x1.0fa1180000000p+1, –0x1.9707c00000000p–3, –0x1.bd459c0000000p–3, –0x1.ade2880000000p–5, 0x1.deebf60000000p–4, –0x1.eebd940000000p–4,
0x1.5cd8ca0000000p–3, 0x1.30288a0000000p–4, –0x1.37ab720000000p–4, –0x1.e38cfe0000000p–9, –0x1.9c21b20000000p–4, 0x1.65ff260000000p–4, –0x1.4a2ab80000000p–2, 0x1.d1330a0000000p–7, –0x1.e1b03c0000000p–3, 0x1.e105b20000000p–7, –0x1.153dba0000000p–1, –0x1.e2d13c0000000p–3, 0x1.1856620000000p–3, 0x1.0b30a80000000p–5, 0x1.fbf7140000000p–2, 0x1.36bc460000000p–4,

Table D.18 (continued)

Parameter value
0x1.4675920000000p–4, 0x1.1c736e0000000p–4, –0x1.9b6e780000000p–3, 0x1.0bd8580000000p–11, –0x1.5affc20000000p–5, 0x1.47bb540000000p–4,

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Parameter value
–0x1.09c2f40000000p–3, –0x1.5cfe000000000p–8, –0x1.b98d740000000p–4, 0x1.6ffe380000000p–7, –0x1.224d9e0000000p–2, –0x1.1e8e760000000p–2, 0x1.040c340000000p–3, 0x1.f3617e0000000p–6, 0x1.b091020000000p–6, 0x1.34b07a0000000p–4,
0x1.3ff67c0000000p–3, 0x1.00d86e0000000p–4, –0x1.4c0aa60000000p–4, –0x1.3e27480000000p–5, –0x1.105eca0000000p–3, 0x1.23c2040000000p–4, –0x1.963bbc0000000p–1, –0x1.91059e0000000p–3, 0x1.45e5bc0000000p–4, 0x1.3c04580000000p–7, –0x1.eb39720000000p–2, 0x1.887fb20000000p–3, 0x1.d12ab20000000p–4, 0x1.bb0e880000000p–6, –0x1.128f3e0000000p–2, 0x1.19d9660000000p–4,
–0x1.2eff920000000p–3, –0x1.ab7bde0000000p–5, 0x1.4044660000000p–3, –0x1.74188e0000000p–7, 0x1.7178020000000p–3, –0x1.dea97a0000000p–5, 0x1.0f09f00000000p–4, 0x1.9796bc0000000p–4, –0x1.0e10580000000p–2, –0x1.a973e00000000p–8, –0x1.dcd1c40000000p–1, –0x1.91ab880000000p–3, –0x1.807d480000000p–4, –0x1.68e7180000000p–6, 0x1.f50a860000000p–4, –0x1.f06d440000000p–5,
0x1.0b00940000000p–3, 0x1.ad8c8a0000000p–5, –0x1.04800a0000000p–4, 0x1.43b4620000000p–5, 0x1.e81d140000000p–6, 0x1.0e55800000000p–4, –0x1.5e9b040000000p–2, –0x1.b1a97e0000000p–4, 0x1.7771e00000000p–5, 0x1.2760ce0000000p–6, –0x1.88f0fe0000000p–2, –0x1.df76c60000000p–3, 0x1.9ec9000000000p–4, 0x1.9e6aa00000000p–6, –0x1.1fd3a00000000p–6, 0x1.5065e20000000p–5,
0x1.568aac0000000p–3, 0x1.14fdb40000000p–4, –0x1.fde6d20000000p–4, 0x1.2944440000000p–3, 0x1.8a00620000000p–3, 0x1.433fb20000000p–4, –0x1.ef94940000000p–2, 0x1.2b0aea0000000p–4, –0x1.02163c0000000p–3, 0x1.b455600000000p–7, –0x1.2a367e0000000p–1, –0x1.b90ea60000000p–3, 0x1.fda4b40000000p–4, 0x1.eba1a80000000p–6, –0x1.283d400000000p–9, 0x1.19f0420000000p–4,
–0x1.13954a0000000p–2, –0x1.d29e980000000p–4, 0x1.cb144c0000000p–4, 0x1.57351e0000000p–3, 0x1.53d7d80000000p–3, –0x1.0797220000000p–3, –0x1.e3d0a20000000p–3, 0x1.3baf300000000p–3, –0x1.adf81a0000000p–6, –0x1.b691ae0000000p–7, –0x1.f13a0e0000000p+0, –0x1.3e31de0000000p–3, –0x1.a315c00000000p–3, –0x1.913f460000000p–5, 0x1.9d7c560000000p–4, –0x1.0dfdd80000000p–3,
–0x1.01fcc60000000p–4, 0x1.5974e40000000p–5, 0x1.84d9e80000000p–2, 0x1.b7040e0000000p–3, –0x1.1e075c0000000p–5, –0x1.0298460000000p–5, 0x1.a74b2a0000000p–3, –0x1.9dc0a40000000p–6, 0x1.7faf580000000p–3, –0x1.2407de0000000p–3, –0x1.bf46f40000000p–2, 0x1.ad69720000000p–3,

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Parameter value
–0x1.0f83780000000p–8, –0x1.25ffd40000000p–6, 0x1.d155a60000000p–4, 0x1.33ffa40000000p–2,
0x1.97c8dc0000000p–3, 0x1.1217800000000p–7, 0x1.abebbe0000000p–3, –0x1.3786520000000p–3, 0x1.42cb280000000p–5, 0x1.86de420000000p–7, –0x1.81f9c80000000p–2, –0x1.7ea9da0000000p–4, –0x1.33b1440000000p–4, 0x1.6160140000000p–8, –0x1.19a66a0000000p–1, 0x1.10aa9e0000000p–4, 0x1.2174cc0000000p–6, 0x1.3757e40000000p–8, –0x1.34c6440000000p–2, 0x1.2c665e0000000p–9,
–0x1.cb0f220000000p–3, –0x1.bcf2980000000p–4, 0x1.0d6bdc0000000p–2, 0x1.0d08440000000p–3, 0x1.e67cae0000000p–5, –0x1.b03fc00000000p–4, –0x1.91d9ac0000000p–1, 0x1.37cf6e0000000p–6, –0x1.6e9a160000000p–3, 0x1.291f700000000p–6, 0x1.591ef20000000p+0, –0x1.88e0b40000000p–3, –0x1.6ca9840000000p–3, –0x1.30bd660000000p–5, 0x1.01af5e0000000p–3, –0x1.6f0e200000000p–3,
0x1.3329680000000p–4, –0x1.2af6220000000p–4, 0x1.6a2d520000000p–2, 0x1.70f01c0000000p–5, –0x1.7b469e0000000p–4, –0x1.3346e20000000p–4, 0x1.020f8c0000000p–3, –0x1.2b48ea0000000p–4, –0x1.1683f80000000p–5, 0x1.304ca80000000p–8, –0x1.0b54580000000p–5, –0x1.8427060000000p–3, –0x1.fcffda0000000p–4, –0x1.cb3c360000000p–6, –0x1.2c45820000000p–2, –0x1.b77f720000000p–4,

Table D.18 (continued)

Parameter value
0x1.21c60c0000000p–3, 0x1.b4540c0000000p–5, –0x1.69cf360000000p–4, 0x1.e129840000000p–5, –0x1.64843e0000000p–3, 0x1.ef9d1a0000000p–5, –0x1.52e2dc0000000p–1, 0x1.f573e20000000p–4, –0x1.5ba5b00000000p–5, 0x1.f1c46a0000000p–8, –0x1.b8d2d00000000p–2, –0x1.f647580000000p–4, 0x1.8a5f540000000p–4, 0x1.7853b00000000p–6, –0x1.53b8ce0000000p–3, 0x1.e737940000000p–5,
0x1.7b6ff40000000p–7, 0x1.212c0c0000000p–6, 0x1.c08f000000000p–4, –0x1.f000700000000p–5, –0x1.68b6540000000p–4, 0x1.14f9460000000p–6, –0x1.d4e8840000000p–4, –0x1.21782a0000000p–2, –0x1.9c94cc0000000p–3, –0x1.0385260000000p–8, 0x1.7ce1a20000000p–5, –0x1.97db220000000p–3, 0x1.cc862e0000000p–6, 0x1.7fbc740000000p–8, 0x1.92f2e20000000p–4, 0x1.ee6b060000000p–6,
–0x1.6b59520000000p–2, –0x1.2a58b00000000p–3, 0x1.b3fb6a0000000p–4, –0x1.ca12720000000p–3, –0x1.b72ef40000000p–4, –0x1.64b6f40000000p–3,

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Parameter value
–0x1.b9e7ae0000000p–7, –0x1.e2b3680000000p–4, –0x1.d29a680000000p–6, –0x1.1ae9cc0000000p–5, –0x1.f21b600000000p–1, 0x1.12b6760000000p–3, –0x1.1709100000000p–2, –0x1.0da0a80000000p–4, –0x1.593a520000000p–3, –0x1.1d7b1c0000000p–3,
–0x1.0e49980000000p–2, –0x1.db5e9e0000000p–4, 0x1.46c4060000000p–4, –0x1.9b3f800000000p–4, 0x1.936a2e0000000p–4, –0x1.07d32a0000000p–3, –0x1.6422880000000p+0, 0x1.4499400000000p–4, 0x1.45a9980000000p–5, –0x1.6588b60000000p–7, –0x1.3329e00000000p+1, 0x1.0491ee0000000p–3, –0x1.a6e5100000000p–3, –0x1.9393740000000p–5, –0x1.ef36ae0000000p–5, –0x1.1a3f8e0000000p–3,
–0x1.000eec0000000p–4, –0x1.16a2a80000000p–5, 0x1.0345d80000000p–6, –0x1.b7c69c0000000p–5, 0x1.5e1f000000000p–4, –0x1.2c69fe0000000p–5, –0x1.243ef00000000p–1, 0x1.63b35c0000000p–3, 0x1.430ecc0000000p–3, 0x1.4c37020000000p–11, –0x1.9330820000000p–3, –0x1.e6c98a0000000p–4, –0x1.dce9aa0000000p–5, –0x1.d3a0c80000000p–7, 0x1.715b760000000p–2, –0x1.7fd7320000000p–5,
0x1.6a1d7e0000000p–3, 0x1.37156e0000000p–4, –0x1.1123820000000p–4, –0x1.9472860000000p–5, 0x1.ec36e80000000p–4, 0x1.5966c20000000p–4, –0x1.cce5c40000000p–1, –0x1.63de540000000p–7, 0x1.4ac0920000000p–4, 0x1.ecb01a0000000p–8, –0x1.23de2c0000000p–1, –0x1.338d960000000p–3, 0x1.142aee0000000p–3, 0x1.02978a0000000p–5, –0x1.4fc06c0000000p–3, 0x1.7252da0000000p–4,
0x1.ada25c0000000p–4, 0x1.92f7b80000000p–5, 0x1.7d53300000000p–6, –0x1.3c28700000000p–5, 0x1.8dc9c80000000p–5, 0x1.b51cbc0000000p–5, –0x1.4aa39a0000000p–2, 0x1.f453b20000000p–6, –0x1.3a2d340000000p–2, 0x1.13c70a0000000p–9, –0x1.4226dc0000000p–3, –0x1.20792a0000000p–4, 0x1.6002cc0000000p–4, 0x1.45672a0000000p–6, 0x1.1b0d860000000p–4, 0x1.01a8960000000p–4,
0x1.aba4260000000p–3, 0x1.55d17a0000000p–4, –0x1.a969200000000p–5, 0x1.5b02200000000p–3, –0x1.bb941a0000000p–4, 0x1.7fc7aa0000000p–4, –0x1.9e6bdc0000000p–1, –0x1.a7facc0000000p–4, –0x1.02da2a0000000p–5, 0x1.2e28d00000000p–7, –0x1.f1cca00000000p–2, 0x1.0217f00000000p–5, 0x1.340b0c0000000p–3, 0x1.22138e0000000p–5, –0x1.3c0ac60000000p–2, 0x1.9316f80000000p–4,
–0x1.8115160000000p–5, –0x1.4071b60000000p–5, 0x1.72eca80000000p–4, –0x1.40d6800000000p–5, 0x1.b0e5500000000p–4, –0x1.7fd9180000000p–5, –0x1.a33da20000000p–4, –0x1.139b280000000p–3, 0x1.1054460000000p–4, –0x1.50616e0000000p–7, –0x1.a2d9100000000p–2, –0x1.617ed20000000p–3,

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Parameter value
–0x1.280eaa0000000p–4, –0x1.2294280000000p–6, 0x1.9e1d660000000p–8, –0x1.21e9320000000p–5,
0x1.198a320000000p–3, 0x1.dc54800000000p–5, –0x1.31b3660000000p–5, 0x1.92e9600000000p–3, –0x1.0f19aa0000000p–2, 0x1.04da2c0000000p–4, –0x1.42d7640000000p–1, 0x1.0be8c60000000p–4, 0x1.d790ba0000000p–7, 0x1.a1fc220000000p–9, –0x1.98bbe40000000p–2, 0x1.73d4d60000000p–5, 0x1.a739940000000p–4, 0x1.883e5c0000000p–6, 0x1.9597c20000000p–6, 0x1.2e04980000000p–4,

Table D.18 (continued)

Parameter value
0x1.be469c0000000p–3, 0x1.762ae20000000p–4, –0x1.1a6ea80000000p–4, 0x1.f0c6300000000p–4, –0x1.123f1a0000000p–3, 0x1.8fca0c0000000p–4, –0x1.864ee40000000p–1, –0x1.3fefa60000000p–3, 0x1.9bd24e0000000p–3, 0x1.b546380000000p–10, –0x1.dfdf400000000p–2, –0x1.22a9ac0000000p–4, 0x1.465a620000000p–3, 0x1.2d34660000000p–5, –0x1.e995340000000p–3, 0x1.f1a8500000000p–4,
–0x1.5831c20000000p–4, –0x1.69c1de0000000p–5, 0x1.28b2a00000000p–6, –0x1.2f6ed80000000p–6, –0x1.9a14a80000000p–7, –0x1.6d79920000000p–6, –0x1.945c700000000p–1, –0x1.40b58e0000000p–3, –0x1.81fab00000000p–3, 0x1.6f01520000000p–5, –0x1.f774e60000000p–5, –0x1.4e923e0000000p–3, –0x1.add6d60000000p–5, –0x1.c5e2500000000p–8, 0x1.f654ca0000000p–2, –0x1.156c7e0000000p–3,
0x1.5f1d680000000p–3, 0x1.a920940000000p–5, 0x1.76a7540000000p–3, –0x1.85a6e20000000p–3, –0x1.9ccb760000000p–4, 0x1.48e5ca0000000p–5, 0x1.12d67a0000000p–7, 0x1.7fa6640000000p–4, –0x1.eda2500000000p–6, –0x1.cc404a0000000p–6, 0x1.2269f60000000p–1, 0x1.2dd8820000000p–4, 0x1.2f8c6e0000000p–4, 0x1.d8c8380000000p–7, 0x1.8939560000000p–6, 0x1.e423300000000p–4,
0x1.ed3a3a0000000p–4, 0x1.4952ae0000000p–5, –0x1.4ccc8c0000000p–3, 0x1.0e7dfc0000000p–2, 0x1.40bb2c0000000p–4, 0x1.fb3dca0000000p–5, –0x1.3463520000000p+0, –0x1.0519f40000000p–3, –0x1.34dcc40000000p–2, 0x1.25f21e0000000p–5, –0x1.b0bf5e0000000p–2, 0x1.ceb69c0000000p–4, 0x1.6efa3e0000000p–4, 0x1.97d7980000000p–6, 0x1.8f11980000000p–1, –0x1.970f9c0000000p–8,
0x1.be5d980000000p–10, –0x1.2acc1a0000000p–6, –0x1.bcfebe0000000p–7, –0x1.557fb60000000p–3, –0x1.2a6a280000000p–3, 0x1.e31e1a0000000p–5,

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Parameter value
–0x1.adb2c40000000p–3, 0x1.6f90f40000000p–5, 0x1.0f6d620000000p–4, 0x1.2d925a0000000p–3, 0x1.63acf20000000p–3, 0x1.5778ce0000000p–3, 0x1.891f220000000p–5, 0x1.bfd8860000000p–6, 0x1.2fc5b80000000p–5, –0x1.1a6e560000000p–2,
0x1.0c54960000000p–5, –0x1.0502180000000p–8, –0x1.79aa560000000p–4, 0x1.1a29040000000p–5, –0x1.2f98560000000p–5, 0x1.417ede0000000p–8, 0x1.7ef1040000000p–2, –0x1.39fc800000000p–3, 0x1.191d3c0000000p–3, 0x1.1c68980000000p–6, 0x1.4ac3680000000p–6, –0x1.8a89a20000000p–4, 0x1.75dbf20000000p–9, 0x1.8af1c40000000p–9, 0x1.108e300000000p–3, –0x1.1b6f280000000p–5,
0x1.5f68a20000000p–3, 0x1.26c0600000000p–4, –0x1.f42e960000000p–5, –0x1.e7f6ee0000000p–6, 0x1.c6ef460000000p–4, 0x1.4f5a6e0000000p–4, –0x1.7c83680000000p–1, 0x1.2b340c0000000p–4, –0x1.0a27dc0000000p–2, 0x1.4085bc0000000p–7, –0x1.b693ec0000000p–2, –0x1.ed6a120000000p–3, 0x1.0b71680000000p–3, 0x1.fd5cd60000000p–6, –0x1.f076620000000p–3, 0x1.4c2bec0000000p–4,
0x1.127dee0000000p–5, –0x1.c30c340000000p–6, 0x1.d228060000000p–3, –0x1.f742860000000p–3, –0x1.b124b80000000p–3, –0x1.248ac40000000p–6, –0x1.1eff5e0000000p–2, –0x1.eb49f20000000p–3, –0x1.a88bf20000000p–6, 0x1.348bcc0000000p–6, 0x1.f464520000000p–3, –0x1.f136120000000p–3, –0x1.2ec4740000000p–5, –0x1.0732540000000p–7, –0x1.7dc5140000000p–1, –0x1.1cf6380000000p–4,
–0x1.8e075a0000000p–3, –0x1.7a28420000000p–4, 0x1.73dbda0000000p–4, 0x1.e76aa80000000p–4, –0x1.2567ec0000000p–3, –0x1.8dd6060000000p–4, –0x1.1e17840000000p–3, 0x1.517f260000000p–4, 0x1.f3e0700000000p–5, 0x1.0ed76a0000000p–9, –0x1.b5e4000000000p–2, 0x1.de30f20000000p–7, –0x1.457ad00000000p–3, –0x1.2abe620000000p–5, –0x1.f2e8da0000000p–2, –0x1.093dc00000000p–3,
–0x1.8e89e60000000p–6, –0x1.7304b40000000p–7, –0x1.3d6e320000000p–7, 0x1.5beae40000000p–4, –0x1.bf515a0000000p–5, –0x1.0d18420000000p–6, –0x1.935c280000000p–1, –0x1.ddca960000000p–4, –0x1.cce85a0000000p–4, –0x1.954e720000000p–8, 0x1.97d78a0000000p–6, –0x1.1e9a7a0000000p–5, –0x1.7d61fc0000000p–6, –0x1.8943060000000p–8, 0x1.1d73820000000p–3, –0x1.210b1c0000000p–8,

Table D.18 (continued)

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Parameter value
–0x1.47da340000000p–5, –0x1.083ec60000000p–6, –0x1.0172600000000p–8, –0x1.c71c980000000p–4, –0x1.57a88c0000000p–3, –0x1.381ff40000000p–6, 0x1.8f009c0000000p–3, 0x1.afd7240000000p–3, 0x1.6f2fde0000000p–4, –0x1.b31be60000000p–9, –0x1.7090720000000p–4, –0x1.59da560000000p–3, –0x1.e4863a0000000p–6, –0x1.f8f0960000000p–8, –0x1.23d4f80000000p–9, –0x1.1a852c0000000p–6,
0x1.2d7d000000000p–6, 0x1.0ef25a0000000p–7, –0x1.149dfe0000000p–6, 0x1.7bb0ae0000000p–6, –0x1.4938be0000000p–4, 0x1.5dff440000000p–6, –0x1.e205000000000p–1, –0x1.4c7e1a0000000p–3, –0x1.7ea91a0000000p–4, 0x1.9234c40000000p–6, –0x1.f94cfe0000000p–3, 0x1.6dcaec0000000p–4, 0x1.b472680000000p–6, 0x1.250a820000000p–7, –0x1.3fb4a60000000p–3, –0x1.0796b80000000p–5,
–0x1.33ae4e0000000p–5, –0x1.b9781e0000000p–6, 0x1.6c3fe60000000p–4, –0x1.54a6ae0000000p–3, –0x1.1966a40000000p–3, –0x1.edb9940000000p–6, –0x1.9102220000000p–2, –0x1.191eb60000000p–2, 0x1.aed68a0000000p–6, –0x1.ccef9c0000000p–9, 0x1.556c840000000p–3, –0x1.037ff20000000p–3, –0x1.8e627c0000000p–5, –0x1.8cda080000000p–7, –0x1.b376740000000p–1, –0x1.f7d1500000000p–6,
–0x1.3144620000000p–6, –0x1.b42fd20000000p–8, 0x1.73f4380000000p–9, –0x1.ac832e0000000p–3, 0x1.65b6980000000p–3, –0x1.4c95340000000p–7, –0x1.2fa9000000000p–2, 0x1.c6d3000000000p–5, –0x1.61c9820000000p–4, –0x1.72ddb00000000p–8, 0x1.f03a640000000p–4, –0x1.a2a4380000000p–6, –0x1.dbd2480000000p–7, –0x1.b9cc720000000p–9, 0x1.864d3c0000000p–3, 0x1.9eee740000000p–11,
–0x1.2ef2c00000000p–4, –0x1.24f5e80000000p–5, –0x1.b49dac0000000p–7, –0x1.e964380000000p–3, –0x1.ee7ba80000000p–3, –0x1.2bcc380000000p–7, 0x1.96cca00000000p–4, 0x1.2851820000000p–3, 0x1.7d7e960000000p–3, 0x1.b497e60000000p–5, –0x1.2474aa0000000p–3, –0x1.431cb20000000p–3, –0x1.11e7640000000p–5, –0x1.881d880000000p–11, –0x1.824e1c0000000p–2, –0x1.1d943a0000000p–3,
–0x1.8195c20000000p–7, –0x1.1e0db80000000p–11, –0x1.2e26160000000p–7, 0x1.1faba80000000p–8, –0x1.e4e1740000000p–5, –0x1.7007e80000000p–10, –0x1.2e25dc0000000p–1, 0x1.94c9340000000p–7, –0x1.3e95860000000p–2, –0x1.bd377e0000000p–10, –0x1.d64f260000000p–5, –0x1.dd50240000000p–7, –0x1.e6d9c80000000p–10, –0x1.be536a0000000p–15, –0x1.9732340000000p–2, 0x1.9481940000000p–10,
–0x1.3b94560000000p–8, 0x1.964b1c0000000p–9, –0x1.b7ed800000000p–7, 0x1.9c5f640000000p–4, –0x1.6687220000000p–3, –0x1.c544900000000p–11,

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Parameter value
–0x1.e4c7da0000000p–3, –0x1.041d980000000p–5, –0x1.43a4a20000000p–3, –0x1.70d74a0000000p–8, –0x1.c83f6e0000000p–6, –0x1.c1cb1c0000000p–4, 0x1.f1ecf60000000p–10, –0x1.4aff3c0000000p–11, –0x1.aa2cae0000000p–3, 0x1.b2ca200000000p–7,
0x1.6094080000000p–6, 0x1.43e11a0000000p–8, –0x1.208d080000000p–6, –0x1.1ae7a80000000p–3, 0x1.96359a0000000p–5, 0x1.c54bde0000000p–6, 0x1.bea1c00000000p–3, –0x1.a7d3ca0000000p–3, –0x1.3de3280000000p–5, 0x1.4bad560000000p–5, –0x1.af75fa0000000p–7, –0x1.3cd84e0000000p–4, 0x1.04bb300000000p–5, 0x1.77b5b80000000p–7, 0x1.8150740000000p–4, –0x1.f5e5480000000p–5,
0x1.0f2b9c0000000p–2, 0x1.0d95f20000000p–5, –0x1.3bc8000000000p–4, –0x1.48a3d60000000p–3, –0x1.be65020000000p–3, 0x1.fefafa0000000p–6, 0x1.8610860000000p–3, –0x1.0a93ea0000000p–4, –0x1.4ade8c0000000p–4, –0x1.eff9f60000000p–8, 0x1.638a760000000p–3, 0x1.9900b40000000p–4, 0x1.b1e2400000000p–5, 0x1.6d48620000000p–7, –0x1.123b160000000p–2, 0x1.d660560000000p–5,
–0x1.b48b320000000p–4, –0x1.13cbc20000000p–7, –0x1.787cde0000000p–3, –0x1.04b6780000000p–2, –0x1.20e36e0000000p–4, –0x1.06acea0000000p–10, 0x1.190f860000000p–2, 0x1.0e42100000000p–5, –0x1.a9c9b80000000p–5, 0x1.0ce2760000000p–6, –0x1.408e800000000p–4, 0x1.0c2cbe0000000p–4, –0x1.86e8e00000000p–8, 0x1.4dc4d60000000p–9, –0x1.3acc240000000p–2, –0x1.4044280000000p–5,

Table D.18 (continued)

Parameter value
0x1.848fce0000000p–6, 0x1.e48f140000000p–8, –0x1.6ee7120000000p–6, 0x1.8abe280000000p–6, –0x1.f0c4c60000000p–4, 0x1.6e83bc0000000p–5, 0x1.73edb40000000p–2, –0x1.9709240000000p–3, 0x1.d274960000000p–4, 0x1.2c14180000000p–4, –0x1.1380c00000000p–3, –0x1.ff261e0000000p–3, 0x1.a344360000000p–5, 0x1.527b420000000p–6, –0x1.7f902a0000000p–3, –0x1.da980e0000000p–4,
–0x1.91dcc20000000p–6, 0x1.d193500000000p–6, –0x1.748a520000000p–3, –0x1.d5338c0000000p–4, –0x1.95d5880000000p–3, 0x1.6ee9160000000p–8, 0x1.e366fc0000000p–2, –0x1.43ae980000000p–5, 0x1.06ba340000000p–3, –0x1.6647a00000000p–5, –0x1.04eb8e0000000p–3, –0x1.7d341e0000000p–3, 0x1.98b6740000000p–6, 0x1.0fa1140000000p–9, –0x1.8752f60000000p–1, 0x1.cf6efa0000000p–4,

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Parameter value
–0x1.1ac8860000000p–8, –0x1.21737a0000000p–10, 0x1.a174960000000p–10, –0x1.a6b3fa0000000p–3, 0x1.9d8d720000000p–6, –0x1.5779380000000p–9, –0x1.43b12e0000000p–2, –0x1.89e7520000000p–4, 0x1.5719ce0000000p–5, –0x1.63dec00000000p–9, 0x1.9177a80000000p–5, 0x1.54c06e0000000p–5, –0x1.a7adda0000000p–9, –0x1.1893720000000p–10, –0x1.a9421c0000000p–9, 0x1.73f4140000000p–9,

Table D.19 Layer 2 CNN (bias parameter bias) of context coding neural network parameter

Parameter value
–0x1.e93a5a0000000p–1, 0x1.20d5680000000p–1, 0x1.4360d60000000p+0, 0x1.3302100000000p–6, –0x1.19b6760000000p–5, 0x1.6ef2000000000p–6, 0x1.0e89020000000p–1, –0x1.dae8fa0000000p–5, –0x1.2e19580000000p–3, 0x1.828eea0000000p–1, 0x1.1e9b100000000p–1, –0x1.a1aba40000000p–6, 0x1.e97bb40000000p–3, 0x1.96cef80000000p–1, –0x1.15e39a0000000p–6, 0x1.88d3740000000p–1,

Table D.20 Layer 3 CNN (convolutional kernel parameter kernel) of context coding neural network parameter

Parameter value
0x1.776cdc0000000p–13, 0x1.2d54bc0000000p–14, 0x1.ee43440000000p–15, 0x1.d0f0f20000000p–14, 0x1.029d440000000p+0, –0x1.828bbe0000000p–14, –0x1.3fb09e0000000p–14, 0x1.203b6a0000000p–14, 0x1.a43e940000000p–16, –0x1.1d505c0000000p–14, –0x1.596b880000000p–17, 0x1.72c4de0000000p–15, 0x1.862c3e0000000p–1, 0x1.5399ae0000000p–16, 0x1.10935a0000000p–14, –0x1.6bc7fe0000000p–15,
0x1.a49b9a0000000p–5, –0x1.51880a0000000p–3, 0x1.99b6120000000p–5, 0x1.e9ae800000000p–5, –0x1.09e4560000000p–2, –0x1.6e3a160000000p–4, 0x1.21c6320000000p–4, 0x1.ccee6e0000000p–6, 0x1.ae2d720000000p–4, –0x1.7d4eb20000000p–3, 0x1.faf2880000000p–5, –0x1.c392580000000p–5, –0x1.43d7700000000p–3, –0x1.d0e4e60000000p–6, –0x1.1867f60000000p–5, –0x1.fcb3c40000000p–4,
–0x1.e8158a0000000p–13, –0x1.24c26c0000000p–15, –0x1.f38de80000000p–16, –0x1.5a531a0000000p–14, 0x1.03659e0000000p+0, 0x1.5619d40000000p–14, 0x1.284dd80000000p–13, –0x1.54dcce0000000p–14, 0x1.46049e0000000p–13, 0x1.5b05c00000000p–15, 0x1.1b3bfe0000000p–14, –0x1.7340460000000p–14, 0x1.f859620000000p–1, –0x1.42e9160000000p–14, –0x1.337c220000000p–13,

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Parameter value
0x1.2db4760000000p–16,
0x1.5db3a80000000p–3, 0x1.99dcd00000000p–5, –0x1.a0a4560000000p–5, 0x1.10d6a40000000p–3, 0x1.ef17540000000p–3, –0x1.77060e0000000p–5, –0x1.50b30e0000000p–4, 0x1.7e6e600000000p–5, –0x1.2375d60000000p–3, 0x1.caf4f60000000p–4, 0x1.b31f4c0000000p–3, 0x1.f058420000000p–6, –0x1.2f4ec60000000p–3, 0x1.7027740000000p–3, –0x1.b5fa6c0000000p–7, 0x1.c3b51e0000000p–4,

Table D.20 (continued)

Parameter value
0x1.13c71e0000000p–3, –0x1.42e6ee0000000p–3, 0x1.820c420000000p–3, 0x1.46da540000000p–3, –0x1.25af2c0000000p–1, –0x1.24f1ac0000000p–11, –0x1.f7579e0000000p–4, –0x1.a124dc0000000p–7, 0x1.69b8d80000000p–3, 0x1.d2814c0000000p–7, –0x1.bfb3760000000p–5, 0x1.9ea47e0000000p–5, –0x1.2007640000000p–3, 0x1.6718160000000p–3, –0x1.a25cb40000000p–4, –0x1.4f07a60000000p–4,
0x1.bd90700000000p–6, 0x1.1980580000000p–4, –0x1.d4cdc00000000p–7, –0x1.2862380000000p–3, –0x1.733a780000000p–2, –0x1.fde1080000000p–5, –0x1.4618ea0000000p–5, 0x1.b723100000000p–4, 0x1.185f980000000p–11, 0x1.dec2920000000p–6, –0x1.9e9da40000000p–6, 0x1.7351da0000000p–5, –0x1.e5d3ca0000000p–2, 0x1.a0aab20000000p–5, 0x1.7af3a00000000p–5, –0x1.1c7dbe0000000p–7,
–0x1.4f7ec00000000p–15, –0x1.9e0c540000000p–13, 0x1.1a3d3c0000000p–17, 0x1.cfea120000000p–12, 0x1.ce459a0000000p+0, 0x1.06ef3c0000000p–14, –0x1.0b775e0000000p–12, 0x1.b5fa9e0000000p–13, –0x1.435a460000000p–14, 0x1.823c9a0000000p–17, –0x1.cd4eac0000000p–14, 0x1.e28a4e0000000p–13, 0x1.bbb7a40000000p–2, –0x1.c2a8b60000000p–14, –0x1.f692700000000p–20, –0x1.3ab5740000000p–15,
0x1.44f4e00000000p–4, –0x1.4d32a00000000p–3, 0x1.a3e4ee0000000p–4, –0x1.c5591c0000000p–5, –0x1.34bfbc0000000p–10, –0x1.ca7ff00000000p–5, –0x1.80fdfe0000000p–4, 0x1.0456840000000p–5, –0x1.035dfa0000000p–3, 0x1.e869da0000000p–3, 0x1.60a9da0000000p–5, –0x1.0a3bfc0000000p–5, –0x1.d1dff20000000p–5, –0x1.f343320000000p–5, –0x1.4f46d40000000p–4, –0x1.be75380000000p–3,
0x1.3d87d80000000p–3, –0x1.05d9100000000p–3, –0x1.78eaf00000000p–3, –0x1.3dd8540000000p–3, –0x1.0da3660000000p–1, –0x1.e7ed240000000p–5, 0x1.687ca40000000p–3, –0x1.441d200000000p–3, –0x1.c5df420000000p–5,

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Parameter value
0x1.ad379e0000000p–4, –0x1.0e6fe60000000p–5, –0x1.4843e20000000p–4, –0x1.402d1a0000000p–1, –0x1.44df160000000p–5, 0x1.01734a0000000p–4, 0x1.4c4c560000000p–4,
–0x1.3314c20000000p–2, 0x1.23f38e0000000p–7, –0x1.72a6ea0000000p–4, –0x1.ad644a0000000p–3, 0x1.79e03c0000000p–8, 0x1.cf43b40000000p–3, 0x1.95f07c0000000p–3, –0x1.a9966a0000000p–6, 0x1.bd50ec0000000p–4, 0x1.2c4b280000000p–4, 0x1.23b6480000000p–6, –0x1.49c0d20000000p–4, –0x1.0d285a0000000p–1, 0x1.49fb9e0000000p–3, –0x1.2097920000000p–6, –0x1.18e8e00000000p–6,
–0x1.0bac2a0000000p–12, 0x1.e682060000000p–13, –0x1.7e6a340000000p–13, –0x1.134f280000000p–13, 0x1.15e42c0000000p+0, –0x1.287d860000000p–13, 0x1.17d6ce0000000p–13, –0x1.1446540000000p–13, 0x1.6f54440000000p–17, –0x1.2998880000000p–14, –0x1.918a760000000p–16, –0x1.c6dbf80000000p–14, 0x1.ac971c0000000p–1, 0x1.5650d80000000p–15, 0x1.c5d4ce0000000p–14, 0x1.cf77220000000p–16,
0x1.020fc20000000p–3, 0x1.514a9a0000000p–3, –0x1.0eb98a0000000p–4, –0x1.7b3da20000000p–5, –0x1.77790e0000000p–3, –0x1.e5cbf40000000p–3, –0x1.eb18600000000p–4, –0x1.5431d20000000p–3, –0x1.7551260000000p–4, 0x1.ae58960000000p–3, –0x1.d97cbe0000000p–3, –0x1.fb0c280000000p–7, 0x1.e3d4fa0000000p–3, –0x1.cb830a0000000p–3, 0x1.a873000000000p–5, 0x1.d2afca0000000p–6,
0x1.989a060000000p–4, 0x1.06c3140000000p–5, 0x1.604fc40000000p–6, 0x1.86390a0000000p–3, –0x1.06904c0000000p–1, 0x1.d278a80000000p–9, –0x1.fd7b600000000p–4, –0x1.3eb03e0000000p–4, –0x1.73e3b60000000p–4, 0x1.e0e46e0000000p–6, –0x1.f5318e0000000p–6, 0x1.fc42120000000p–6, –0x1.32195a0000000p–1, –0x1.1811080000000p–4, –0x1.e27b560000000p–6, 0x1.eee9900000000p–5,
–0x1.dec0120000000p–4, –0x1.9a232a0000000p–6, –0x1.8bb8540000000p–8, –0x1.349a980000000p–3, –0x1.2c6e440000000p–1, –0x1.3455a40000000p–7, 0x1.5c8f240000000p–3, 0x1.390aae0000000p–9, 0x1.ada89e0000000p–8, 0x1.17073a0000000p–5, 0x1.83651e0000000p–5, –0x1.b5eb040000000p–6, –0x1.4836a40000000p–2, –0x1.815aae0000000p–5, 0x1.2738060000000p–4, 0x1.0d5aea0000000p–5,

Table D.20 (continued)

Parameter value
–0x1.edf9340000000p–5, –0x1.0240400000000p–6, –0x1.f664860000000p–6,

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Parameter value
–0x1.489e4a0000000p–5, 0x1.ef5b0a0000000p–3, 0x1.75b8220000000p–3, –0x1.fbccf40000000p–5, –0x1.b799840000000p–7, –0x1.0c2b8a0000000p–4, –0x1.3e45780000000p–6, 0x1.4388420000000p–9, –0x1.e264820000000p–8, –0x1.1783480000000p–1, 0x1.7f94200000000p–5, 0x1.148da00000000p–4, –0x1.84d3680000000p–7,
–0x1.38099c0000000p–3, 0x1.1470da0000000p–5, –0x1.a4ef4e0000000p–5, –0x1.09f9080000000p–3, –0x1.01b5b80000000p+0, 0x1.cd66880000000p–4, 0x1.6a8bbc0000000p–4, –0x1.7803040000000p–8, 0x1.26ef820000000p–5, 0x1.1167140000000p–4, –0x1.4fd1980000000p–11, –0x1.b6251a0000000p–6, –0x1.2d48860000000p–4, 0x1.500db60000000p–4, 0x1.5e80920000000p–8, 0x1.6f82480000000p–7,
0x1.c28c020000000p–14, 0x1.0c130c0000000p–14, –0x1.5f46aa0000000p–16, 0x1.b49a440000000p–14, 0x1.2a07c20000000p+0, 0x1.5b18aa0000000p–17, –0x1.127c300000000p–12, 0x1.f621ae0000000p–14, 0x1.9df7020000000p–13, 0x1.2d23000000000p–14, –0x1.dd205e0000000p–14, –0x1.ba04200000000p–16, –0x1.9bc80a0000000p–1, –0x1.f744520000000p–14, –0x1.0474d40000000p–19, –0x1.d37cde0000000p–15,
–0x1.e415520000000p–3, 0x1.fd75cc0000000p–4, –0x1.0a47c60000000p–3, –0x1.acd9bc0000000p–4, –0x1.80a6ea0000000p–1, 0x1.0b7b8a0000000p–7, –0x1.e1351c0000000p–6, –0x1.7493980000000p–7, 0x1.54398c0000000p–3, 0x1.f83f160000000p–4, 0x1.286e840000000p–6, 0x1.27e8660000000p–3, 0x1.1384680000000p–2, 0x1.a5fa3c0000000p–5, –0x1.b0650a0000000p–8, –0x1.3ef8c40000000p–4,
–0x1.3c42ec0000000p–12, 0x1.f2c54a0000000p–16, –0x1.4304040000000p–15, –0x1.da34580000000p–13, 0x1.1d2d940000000p+0, 0x1.8f11c60000000p–14, 0x1.49b9da0000000p–13, –0x1.9f56500000000p–15, 0x1.08f82a0000000p–12, –0x1.c23050000000p–17, 0x1.8277da0000000p–14, –0x1.ef67900000000p–15, –0x1.c089bc0000000p–1, 0x1.b2c78a0000000p–15, –0x1.a9076c0000000p–19, –0x1.31c98a0000000p–17,
0x1.9936a20000000p–9, 0x1.b5ab8c0000000p–11, –0x1.bb04d40000000p–12, 0x1.49419e0000000p–9, –0x1.3d1ce60000000p+0, –0x1.ea420a0000000p–13, –0x1.f6256e0000000p–10, –0x1.3253040000000p–10, –0x1.4fa75c0000000p–10, –0x1.e4d5ba0000000p–11, 0x1.0cc3ea0000000p–10, 0x1.10273c0000000p–9, 0x1.b428480000000p–1, 0x1.2d4c560000000p–12, –0x1.4e92460000000p–11, 0x1.7288d80000000p–9,
0x1.9187ee0000000p–11, –0x1.0f908e0000000p–3, 0x1.3f89020000000p–4, 0x1.c533940000000p–3, 0x1.ea923c0000000p–6, 0x1.dc91440000000p–4, 0x1.72e4960000000p–5, –0x1.70c28e0000000p–3, –0x1.2c67c60000000p–3,

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Parameter value
–0x1.79dfae0000000p–4, 0x1.4ae9820000000p–3, 0x1.9ec0da0000000p–3, –0x1.3982f60000000p–3, –0x1.23c1800000000p–3, 0x1.c890a80000000p–5, 0x1.81ce460000000p–3,
0x1.a458940000000p–4, 0x1.4f44c20000000p–4, 0x1.26ee020000000p–3, 0x1.0baa380000000p–3, –0x1.8602f60000000p–2, –0x1.21f83c0000000p–7, –0x1.e442580000000p–7, –0x1.b4bfd40000000p–4, –0x1.6f73780000000p–4, –0x1.4b3bd00000000p–4, –0x1.c1dca80000000p–6, –0x1.0336640000000p–3, 0x1.1810a00000000p–1, 0x1.5f7fc80000000p–5, –0x1.2b34400000000p–5, 0x1.c9a6ac0000000p–4,
–0x1.53c7c00000000p–12, –0x1.f766e40000000p–13, –0x1.1e3c1e0000000p–12, –0x1.80f1ae0000000p–13, 0x1.f03b540000000p–1, 0x1.352c1c0000000p–18, –0x1.28ddca0000000p–13, 0x1.089a300000000p–15, 0x1.87802c0000000p–14, 0x1.b4b7720000000p–16, –0x1.1116120000000p–12, –0x1.417dc80000000p–18, –0x1.94fc060000000p–1, 0x1.103f4c0000000p–16, 0x1.27d0600000000p–14, –0x1.c8bce80000000p–13,
0x1.007f2e0000000p–3, 0x1.8d798c0000000p–4, 0x1.934ea60000000p–3, 0x1.edbe520000000p–4, –0x1.3c1e100000000p–3, 0x1.5a13c00000000p–4, 0x1.16f4fc0000000p–3, 0x1.abd4a60000000p–3, 0x1.394ba40000000p–7, –0x1.1f74bc0000000p–4, 0x1.e26f0c0000000p–4, –0x1.ccd18e0000000p–5, –0x1.87ffac0000000p–3, –0x1.173be80000000p–4, –0x1.0474340000000p–3, –0x1.e4bc3a0000000p–3,

Table D.20 (continued)

Parameter value
0x1.8cc47a0000000p–4, –0x1.b2bd580000000p–3, –0x1.7d15640000000p–3, 0x1.93e30a0000000p–3, 0x1.04c6800000000p–3, –0x1.75409a0000000p–7, 0x1.3ee17e0000000p–3, –0x1.ab17ee0000000p–4, 0x1.c304660000000p–6, –0x1.0ecba20000000p–5, –0x1.9c9f020000000p–5, 0x1.3b39f80000000p–3, –0x1.07113e0000000p–3, 0x1.014dbe0000000p–3, 0x1.38e1180000000p–3, –0x1.298ebc0000000p–6,
–0x1.d7ec500000000p–5, –0x1.71324c0000000p–4, –0x1.99310c0000000p–3, –0x1.9b746c0000000p–4, –0x1.8432aa0000000p–2, 0x1.2a466c0000000p–6, 0x1.0b087c0000000p–4, –0x1.3ad6660000000p–4, –0x1.9040f40000000p–6, –0x1.b284620000000p–5, –0x1.fa54480000000p–5, 0x1.d6446a0000000p–7, 0x1.0047060000000p–2, –0x1.f804aa0000000p–6, 0x1.5c756a0000000p–4, 0x1.cb99ac0000000p–5,
–0x1.0a26800000000p–12, 0x1.00bc600000000p–15, –0x1.c614ce0000000p–14,

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Parameter value
–0x1.e22b380000000p–19, 0x1.1653780000000p+0, 0x1.2d3d340000000p–14, 0x1.7edc4a0000000p–13, 0x1.0a2e8c0000000p–16, –0x1.bec9fc0000000p–13, –0x1.6dc5fa0000000p–15, 0x1.0afae60000000p–15, –0x1.2601bc0000000p–13, –0x1.cabb220000000p–1, 0x1.73c6280000000p–14, 0x1.128e6c0000000p–14, 0x1.8e4af00000000p–15,
–0x1.fed4500000000p–3, 0x1.51c8040000000p–5, –0x1.b8b9f00000000p–4, 0x1.c4cd9a0000000p–5, 0x1.a0f5c40000000p–5, 0x1.dc8b500000000p–4, –0x1.67df6a0000000p–4, 0x1.5f8abe0000000p–7, 0x1.4f8b8a0000000p–5, –0x1.c4fd180000000p–4, 0x1.ea2ce80000000p–5, –0x1.0544da0000000p–6, –0x1.2018400000000p–4, 0x1.cd7c8a0000000p–4, 0x1.a19ac00000000p–4, –0x1.b1a2080000000p–3,
0x1.8a2d9a0000000p–5, –0x1.97e10a0000000p–5, 0x1.0c95d00000000p–4, –0x1.e4d72c0000000p–8, –0x1.2e96640000000p–1, 0x1.1be06e0000000p–7, 0x1.1246460000000p–7, 0x1.8759e20000000p–4, –0x1.c328640000000p–7, 0x1.9eb0b60000000p–6, –0x1.78b3140000000p–11, 0x1.e37b820000000p–6, 0x1.2d7fc60000000p–1, –0x1.9657f20000000p–5, 0x1.6245740000000p–9, –0x1.07cdae0000000p–4,
0x1.5032300000000p–5, –0x1.ce7e300000000p–4, –0x1.d923d20000000p–4, 0x1.2906fc0000000p–7, –0x1.8500420000000p–1, –0x1.83c1660000000p–5, –0x1.0207ce0000000p–5, 0x1.594d860000000p–5, 0x1.f5afc60000000p–6, –0x1.9a87460000000p–6, 0x1.fc75e20000000p–4, –0x1.a710600000000p–5, –0x1.6df2be0000000p–9, 0x1.b47d760000000p–6, –0x1.4a76c20000000p–6, 0x1.1da58a0000000p–7,
–0x1.abda9e0000000p–12, 0x1.5aa4140000000p–16, –0x1.2450c00000000p–10, –0x1.34c4cc0000000p–16, –0x1.b0bae20000000p+0, 0x1.4ffcea0000000p–10, –0x1.84679c0000000p–11, 0x1.59f2d40000000p–11, –0x1.422d860000000p–10, –0x1.b96ca60000000p–14, –0x1.3648d60000000p–12, 0x1.6c7e880000000p–11, 0x1.85a63c0000000p–3, 0x1.38500a0000000p–11, 0x1.475f400000000p–11, –0x1.3347780000000p–11,
0x1.4a21d60000000p–6, –0x1.e35e720000000p–5, –0x1.12e4740000000p–4, –0x1.3325aa0000000p–6, –0x1.79cda00000000p–1, 0x1.de5a080000000p–9, 0x1.049ef00000000p–5, –0x1.5a90740000000p–5, –0x1.5ee4fc0000000p–5, –0x1.ab85b20000000p–5, –0x1.ba515c0000000p–6, –0x1.eb079c0000000p–6, 0x1.2ce6360000000p–2, –0x1.09ae860000000p–6, 0x1.28d9fe0000000p–5, 0x1.916fa60000000p–5,
–0x1.adab320000000p–13, 0x1.01ab520000000p–14, –0x1.2a942a0000000p–13, –0x1.dc1f8a0000000p–14, –0x1.737a400000000p–6, 0x1.0486700000000p–13, 0x1.0a0dbc0000000p–15, 0x1.52a1640000000p–14, 0x1.c904f80000000p–15,

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Parameter value
0x1.3db2b20000000p–13, 0x1.0eec840000000p–14, –0x1.6a1d980000000p–13, –0x1.34644e0000000p–9, –0x1.9c9d9e0000000p–14, –0x1.680fb40000000p–13, –0x1.bc87080000000p–13,
–0x1.6629440000000p–3, –0x1.8d81e20000000p–4, –0x1.fb5efe0000000p–4, –0x1.8fc7e20000000p–8, –0x1.38387a0000000p–5, –0x1.a0903a0000000p–4, 0x1.3569ec0000000p–4, 0x1.ba10ce0000000p–5, 0x1.219e840000000p–4, 0x1.7d39d40000000p–6, 0x1.e2ca740000000p–5, 0x1.b38c7e0000000p–3, –0x1.7d84860000000p–6, –0x1.6483d60000000p–4, –0x1.7581640000000p–4, 0x1.807f5c0000000p–3,

Table D.20 (continued)

Parameter value
0x1.12c8200000000p–12, 0x1.0a01a20000000p–14, 0x1.d272c60000000p–13, 0x1.b238ea0000000p–15, 0x1.3b54860000000p–4, 0x1.67e85c0000000p–15, –0x1.9fb3740000000p–15, –0x1.942ad40000000p–14, 0x1.ea9b9e0000000p–14, –0x1.3e88140000000p–13, 0x1.d0887e0000000p–15, –0x1.492f3a0000000p–14, –0x1.1fb5ea0000000p–6, –0x1.57bfd00000000p–16, 0x1.abd8880000000p–14, –0x1.8317b80000000p–16,
0x1.046b780000000p–5, 0x1.35f2ea0000000p–7, 0x1.716ce80000000p–4, 0x1.cba37c0000000p–3, –0x1.4ea90c0000000p–3, 0x1.a5bce80000000p–3, 0x1.f62ab00000000p–5, –0x1.5f17780000000p–5, 0x1.2dc8d80000000p–4, 0x1.d973200000000p–3, –0x1.38b9e40000000p–3, 0x1.fab0de0000000p–3, –0x1.833a780000000p–3, 0x1.d38ee80000000p–6, 0x1.61edda0000000p–4, 0x1.3640020000000p–5,
0x1.a14d320000000p–4, 0x1.d115960000000p–3, –0x1.8f5d000000000p–3, 0x1.944e1c0000000p–4, 0x1.052fb20000000p–16, –0x1.c0d73c0000000p–4, 0x1.ae2a980000000p–3, 0x1.93e4c00000000p–8, 0x1.97d5040000000p–3, 0x1.3210700000000p–3, –0x1.ac534a0000000p–4, –0x1.8829a20000000p–9, 0x1.5afac00000000p–3, 0x1.887a740000000p–4, 0x1.284cb00000000p–5, 0x1.aae2ec0000000p–3,
–0x1.56dbac0000000p–4, 0x1.b6c3e40000000p–4, –0x1.081bf40000000p–3, –0x1.f52fac0000000p–4, 0x1.f7a9e00000000p–4, 0x1.5296200000000p–6, 0x1.11c1ea0000000p–3, –0x1.44c1760000000p–5, –0x1.4ca4dc0000000p–3, 0x1.283e3e0000000p–4, 0x1.2f24a00000000p–5, –0x1.06edfc0000000p–4, –0x1.39de4e0000000p–3, 0x1.f9610a0000000p–5, 0x1.76c06e0000000p–5, –0x1.5ca87a0000000p–4,
–0x1.f6e0cc0000000p–18, –0x1.9a24ea0000000p–13, 0x1.e45cce0000000p–13,

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Parameter value
0x1.4d39740000000p–12, –0x1.3627620000000p–5, –0x1.9552ce0000000p–12, –0x1.fbfa420000000p–13, –0x1.9b47200000000p–15, 0x1.791dfa0000000p–12, 0x1.7a82760000000p–16, –0x1.7674860000000p–15, 0x1.57340c0000000p–13, –0x1.2815240000000p–7, 0x1.32605a0000000p–13, –0x1.1f2b4e0000000p–13, –0x1.ac63860000000p–13,
–0x1.be21240000000p–3, 0x1.c0c0400000000p–4, –0x1.0093780000000p–8, –0x1.0cd1900000000p–3, 0x1.d507e20000000p–4, 0x1.3c03960000000p–3, –0x1.6f38a20000000p–5, 0x1.cc12900000000p–3, –0x1.516a860000000p–3, –0x1.4b4dc40000000p–3, 0x1.4c2fc00000000p–5, 0x1.d1097e0000000p–3, 0x1.fcd2bc0000000p–3, –0x1.e3e4f00000000p–4, 0x1.0e0ccc0000000p–4, –0x1.7d9a0a0000000p–7,
0x1.94e0ba0000000p–3, 0x1.cbac700000000p–4, 0x1.2008380000000p–4, 0x1.bfbfa80000000p–3, 0x1.0053a40000000p–3, –0x1.f4a76e0000000p–4, 0x1.01297a0000000p–3, 0x1.62bb500000000p–3, 0x1.b60ac00000000p–4, –0x1.0e43540000000p–5, –0x1.75ad9e0000000p–3, 0x1.0a5f6a0000000p–3, –0x1.48d9fa0000000p–3, –0x1.5280300000000p–4, –0x1.68eb180000000p–5, –0x1.6891820000000p–6,
–0x1.ae0ea80000000p–7, –0x1.42e21a0000000p–5, 0x1.fe90520000000p–5, –0x1.9eea3c0000000p–5, –0x1.0ad2b20000000p–2, 0x1.d55a400000000p–7, –0x1.a32f3c0000000p–4, –0x1.e587be0000000p–8, 0x1.573f4a0000000p–5, –0x1.e69eb00000000p–7, 0x1.fd85800000000p–5, –0x1.967dd60000000p–6, 0x1.23c11c0000000p–4, 0x1.8f86940000000p–5, 0x1.e656c80000000p–6, –0x1.c1efd00000000p–4,
–0x1.d327d20000000p–14, 0x1.e6b2480000000p–17, 0x1.0336ce0000000p–13, 0x1.36571e0000000p–14, –0x1.4caa1c0000000p–5, 0x1.53ba9c0000000p–16, –0x1.1369360000000p–13, 0x1.e3b7f80000000p–16, –0x1.40c00e0000000p–16, –0x1.a4d1ac0000000p–15, 0x1.750cc60000000p–17, –0x1.1e82880000000p–13, 0x1.0312140000000p–5, 0x1.05a3c20000000p–15, 0x1.11c31c0000000p–14, 0x1.3a6a740000000p–16,
0x1.f8a0640000000p–4, 0x1.70a21e0000000p–4, –0x1.13e8c40000000p–4, 0x1.984e760000000p–3, 0x1.ab042a0000000p–3, 0x1.702faa0000000p–6, –0x1.f2dcea0000000p–3, 0x1.5172e20000000p–4, –0x1.edc9180000000p–3, –0x1.44fc820000000p–3, 0x1.b868b40000000p–4, –0x1.0d201c0000000p–4, 0x1.c96d4c0000000p–4, –0x1.8f41620000000p–6, –0x1.8e12940000000p–4, –0x1.44f6660000000p–4,

Table D.20 (continued)

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Parameter value
0x1.e97fbe0000000p–4, –0x1.62608e0000000p–5, 0x1.129df60000000p–3, 0x1.7003d00000000p–4, 0x1.e639260000000p–6, 0x1.44df2a0000000p–6, –0x1.eee2160000000p–4, 0x1.4733780000000p–7, 0x1.75ff860000000p–4, –0x1.e82ef00000000p–5, –0x1.7fb0680000000p–5, –0x1.b2b6800000000p–6, 0x1.cb094a0000000p–5, –0x1.dc3e1e0000000p–7, –0x1.e3d82e0000000p–10, –0x1.869b540000000p–9,
0x1.65aa2a0000000p–4, 0x1.a9ff120000000p–4, –0x1.4742e00000000p–5, 0x1.e3d9c60000000p–5, –0x1.9777c80000000p–3, 0x1.bee9900000000p–6, 0x1.d4845c0000000p–4, –0x1.18d1dc0000000p–6, –0x1.9df9e20000000p–4, 0x1.056ef40000000p–6, –0x1.afbffa0000000p–4, –0x1.0f363c0000000p–4, 0x1.ace6640000000p–4, –0x1.58e6ee0000000p–6, 0x1.3006580000000p–8, 0x1.c944da0000000p–5,
0x1.53f07c0000000p–5, 0x1.4aaaba0000000p–5, –0x1.7e1e560000000p–7, 0x1.d959b40000000p–4, 0x1.013dd00000000p–4, –0x1.22d3000000000p–3, –0x1.c76bd20000000p–8, 0x1.9bdc6e0000000p–3, –0x1.0b51a80000000p–7, –0x1.09d9180000000p–3, 0x1.7550940000000p–4, 0x1.7ce65a0000000p–6, 0x1.701d280000000p–6, 0x1.70df240000000p–7, –0x1.c81be20000000p–5, –0x1.a3c1920000000p–5,
0x1.0ba3820000000p–6, 0x1.9259980000000p–7, 0x1.0ba80c0000000p–5, –0x1.ffe6440000000p–6, –0x1.d515840000000p–4, 0x1.a2d04c0000000p–6, –0x1.44b43e0000000p–5, –0x1.087e640000000p–6, –0x1.9056040000000p–7, –0x1.29f58a0000000p–9, 0x1.2acef40000000p–6, –0x1.b341060000000p–5, 0x1.b276180000000p–5, 0x1.4adf040000000p–5, 0x1.06bc0c0000000p–5, –0x1.58b5ee0000000p–4,

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Annex E
(Informative)
Correspondence between Coding Metadata in this Document and Metadata in ITU-R BS.2076-2

Table E-1 shows the correspondence between the coding metadata in chapter 9 and the ITU-R BS.2076-2.

Table E.1 Metadata correspondence

Metadata element in ITU-R BS.2076-2	Sub-element and attribute in ITU-R BS.2076-2	Coding metadata in chapter 9 in this document	Correspondence to metadata in ITU-R BS.2076-2
audioTrackFormat	All sub-elements and attributes	None	—
audioStreamFormat	All sub-elements and attributes	None	—
audioChannelFormat	audioChannelFormatID	None	In this document, channelFormatIdx has the same meaning as audioChannelFormatID.
	typeLabel	None	In this document, the typeLabel in the audioChannelFormat metadata is consistent with the typeLabel in the audioPackFormat metadata at its upper layer.
	typeDefinition	None	—
	frequency	None	—
audioBlockFormat	audioBlockFormatID	None	—
	rtime	None	—
	duration	None	—
	gain	channelGainUnit, channelGain_QFlag, and channelGain	Consistent
	importance	importance	Consistent
	headLocked	b_headLocked	Consistent
	headphoneVirtualise: bypass	None	—
	headphoneVirtualise: DRR	None	—

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Metadata element in ITU-R BS.2076-2	Sub-element and attribute in ITU-R BS.2076-2	Coding metadata in chapter 9 in this document	Correspondence to metadata in ITU-R BS.2076-2
	speakerLabel (typelabel=directSpeakers)	None	When the value of packFormatID is 0 to 31, the packFormatID metadata is used in the ITU-R BS.2094-1 standard to obtain the speakerLabel described in GY/T 316-2018. When the value of packFormatID is 32 to 63, for a non-standard speaker layout, position metadata (the azimuth and the elevation) is used in GY/T 316-2018 to obtain the corresponding speakerLabel.
	position (typelabel=directSpeakers)	DirectSpeakersPosition	Consistent
	outputChannelFormatIDRef	None	—
	jumpPosition(typelabel=matrix)	None	—
	interpolationLength(typelabel=matrix)	None	—
	coefficient (typelabel=matrix)	None	In this document, matrixCoef metadata is used to adjust the linear gain in coefficient metadata.
	position (typelabel=object polar)	obj_position_azimuth, obj_position_elevation, obj_position_distance, obj_width_horizontal, obj_hight_vertical, and obj_depth_distance	Consistent
	position(typelabel=object Cartesian)	obj_position_x, obj_position_y, obj_position_z, obj_width_x, obj_width_y, and obj_width_z	Consistent

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Table E.1 (continued)

Metadata element in ITU-R BS.2076-2	Sub-element and attribute in ITU-R BS.2076-2	Coding metadata in chapter 9 in this document	Correspondence to metadata in ITU-R BS.2076-2
audioBlockFormat	cartesian	cartesianDm	Consistent
	diffuse	diffuse	Consistent
	channelLock	channelLock	Consistent
	maxDistance	channelLock_max Distance	Consistent
	objectDivergence	objectDivergence	Consistent
	azimuthRange	objectDivergence_ azimuthRange	Consistent
	positionRange	None	—
	jumpPosition (typelabel=object)	jumpPosition	Consistent
	interpolationLength (typelabel=object)	None	In this document, the dynamic metadata in frames contains the result obtained through interpolationLength interpolation.
	zoneExclusion	None	—
	screenRef (typelabel=object)	obj_screenRef	Consistent
	equation	None	—
	order	hoaOrder	Consistent
	degree	None	This document uses the ACN SN3D manner.
	normalization	normalization	Consistent
	nfcRefDist	nfcRefDist	Consistent
	screenRef (typelabel=HOA)	screenRef	Consistent
audioPackFormat	audioPackFormatID	packFormatIdx	In this document, packFormatIdx has the same meaning as audioPackFormatID.
	audioPackFormat Name	None	—
	typeLabel	typeLabel	Consistent
	typeDefinition	None	—

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Metadata element in ITU-R BS.2076-2	Sub-element and attribute in ITU-R BS.2076-2	Coding metadata in chapter 9 in this document	Correspondence to metadata in ITU-R BS.2076-2
	importance	audioPackFormatImportance	Consistent
	audioChannelFormatIDRef	None	In this document, refChannelIdx has the same meaning as audioChannelFormatIDRef.
	audioPackFormatIDRef	None	In this document, audioPackFormat metadata is converted by referencing another audioPackFormat format into two independent audioPackFormat formats.
	absoluteDistance	absoluteDistance	Consistent
	encodePackFormatIDRef (typelabel=Matrix)	None	—
	decodePackFormatIDRef (typelabel=Matrix)	None	—
	inputPackFormatIDRef (typelabel=Matrix)	None	—
	outputPackFormatIDRef (typelabel=Matrix)	None	—
	normalization	normalization	Consistent
	nfcRefDist	nfcRefDist	Consistent
	screenRef (typelabel=HOA)	screenRef	Consistent
audioObject	audioObjectID	None	In this document, objectIdx has the same meaning as audioObjectID.
	audioObjectName	ObjectName	The character coding format is not limited in this document, and can be automatically identified based on coded binary data. However, the GB2312 or GBK character coding format is recommended for Chinese and English characters.
	language	audioObjectLanguage	Consistent
	start	None	—

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Metadata element in ITU-R BS.2076-2	Sub-element and attribute in ITU-R BS.2076-2	Coding metadata in chapter 9 in this document	Correspondence to metadata in ITU-R BS.2076-2
	duration	None	—

Table E.1 (continued)

Metadata element in ITU-R BS.2076-2	Sub-element and attribute in ITU-R BS.2076-2	Coding metadata in chapter 9 in this document	Correspondence to metadata in ITU-R BS.2076-2
audioObject	dialogue	Dialogue	Consistent
	importance	audioObjectImportance	Consistent
	interact	b_interact	Consistent
	disableDucking	b_disableDucking	Consistent
	audioPackFormatIDRef	None	In this document, refPackFormatIdx has the same meaning as audioPackFormatIDRef.
	audioObjectIDRef	None	In this document, audioObject metadata is converted by referencing another audioObject format into two independent audioObject formats.
	audioComplementaryObjectGroupLabel	ComplementaryObjectIdx	Consistent
	audioComplementary ObjectIDRef		
	audioTrackUIDRef	None	—
	audioObjectInteraction	audioObjectInteraction	Consistent
	gain	objectGainQFlag and objectGain	Consistent
	gainUnit	objectGainUnit	Consistent
	headLocked	b_headLocked	Consistent
	positionOffset	None	—
	mute	b_mute	Consistent
	alternativeValueSet	None	—

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Metadata element in ITU-R BS.2076-2	Sub-element and attribute in ITU-R BS.2076-2	Coding metadata in chapter 9 in this document	Correspondence to metadata in ITU-R BS.2076-2
audioContent	audioContentID	None	In this document, contentIdx has the same meaning as audioContentID.
	audioContentName	None	—
	language	audioContentLanguage	Consistent
	audioObjectIDRef	None	In this document, refObjectIdx has the same meaning as audioObjectIDRef.
	loudnessMetadata	loudnessMetadata	Consistent
	dialogue	Dialogue	Consistent
	alternativeValueSetIDRef	None	—
audioProgramme	audioProgrammeID	None	—
	audioProgrammeName	None	—
	language	audioProgrammeLanguage	Consistent
	start	None	—
	end	None	—
	maxDuckingDepth	maxDuckingDepth	Consistent
	audioContentIDRef	refContentIdx	In this document, refContentIdx has the same meaning as audioContentIDRef.
	loudnessMetadata	loudnessMetadata	Consistent
	audioProgrammeReferenceScreen	b_audioProgrammeReferenceScreen	Consistent
	authoringInformation	None	—
	alternativeValueSetIDRef	None	—
audioTrackUID	All Sub-element and Attribute	None	—

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Metadata element in ITU-R BS.2076-2	Sub-element and attribute in ITU-R BS.2076-2	Coding metadata in chapter 9 in this document	Correspondence to metadata in ITU-R BS.2076-2
loudnessMetadata	loudnessMethod	None	—
	loudnessRecType	None	—
	loudnessCorrectionType	None	—
	integratedLoudness	integratedLoudness	Consistent
	loudnessRange	loudnessRange	Consistent
	maxTruePeak	maxTruePeak	Consistent
	maxMomentary	maxMomentary	Consistent
	maxShortTerm	maxShortTerm	Consistent

Table E.1 (continued)

Metadata element in ITU-R BS.2076-2	Sub-element and attribute in ITU-R BS.2076-2	Coding metadata in chapter 9 in this document	Correspondence to metadata in ITU-R BS.2076-2
loudnessMetadata	dialogueLoudness	dialogueLoudness	Consistent

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Annex F
(Informative)
Standard Implementation 1

For descriptions of the standard implementation 1 of the AVS3 audio, refer to Table F.1.

Table F.1 Standard implementation 1 of AVS3 audio

Technical module	**Standard Implementation Mode 1**
General full-rate audio coding (refer to chapter 7 and Annex D)	**X**
General high-rate audio coding	
Lossless audio coding (refer to chapter 8)	**X**
Metadata coding (refer to chapter 9)	**X**
Renderer (refer to Annex C)	**X**

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Annex G
(Informative)
Standard Implementation 2

For descriptions of the standard implementation 2 of the AVS3 audio, refer to Table G.1.

Table G.1 Standard implementation 2 of AVS3 audio

Technical module	**Standard implementation 2**
General full-rate audio coding (refer to chapter 7 and Annex D)	**X**
General high-rate audio coding	**X**
Lossless audio coding (refer to chapter 8)	**X**
Metadata coding (refer to chapter 9)	**X**
Renderer (refer to Annex C)	**X**

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References

[1] J. Ballé, V. Laparra, and E. P. Simoncelli, "Density modeling of images using a generalized normalization transformation," in Proc. Int. Conf. Learn. Represent., 2016, pp. 1–14.

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