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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Digital audio interface –
Part 1: General

Interface audionumérique –
Partie 1: Généralités

IEC 60958-1:2008-09(en-fr)

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

DIGITAL AUDIO INTERFACE –

Part 1: General

FOREWORD

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International Standard 60958-1 has been prepared by IEC technical committee 100: Audio, video and multimedia systems and equipment.

This third edition of IEC 60958-1 cancels and replaces the second edition published in 2004 and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition.

Electrical and optical requirements are removed from IEC 60958-3; they are specified in IEC 60958-1.

This bilingual version (2014-04) corresponds to the English version, published in 2008-09.

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

CDV	Report on voting
100/1252/CDV	100/1337/RVC

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

The French version of this standard has not been voted upon.

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

A list of all parts of the IEC 60958 series, under the general title *Digital audio interface*, can be found on the IEC website.

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

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- withdrawn,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

DIGITAL AUDIO INTERFACE –

Part 1: General

1 Scope

This part of IEC 60958 describes a serial, uni-directional, self-clocking interface for the interconnection of digital audio equipment for consumer and professional applications.

It provides the basic structure of the interface. Separate documents define items specific to particular applications.

The interface is primarily intended to carry monophonic or stereophonic programmes, encoded using linear PCM and with a resolution of up to 24 bits per sample.

When used for other purposes, the interface is able to carry audio data coded other than as linear PCM coded audio samples. Provision is also made to allow the interface to carry data related to computer software or signals coded using non-linear PCM. The format specification for these applications is not part of this standard.

The interface is intended for operation at audio sampling frequencies of 32kHz and above. Auxiliary information is transmitted along with the programme.

2 Normative references

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

IEC 60268-11, *Sound system equipment – Part 11: Application of connectors for the interconnection of sound system components*

IEC 60874-17, *Connectors for optical fibres and cables – Part 17: Sectional specification for fibre optic connector – Type F-05 (friction lock)*

IEC 60958-3, *Digital audio interface – Part 3: Consumer applications*

IEC 60958-4, *Digital audio interface – Part 4: Professional applications*

3 Terms and definitions

For the purpose of this International Standard, the following terms and definitions apply.

3.1
sampling frequency
frequency of the samples representing an audio signal

NOTE When more than one signal is transmitted through the same interface, the sampling frequencies are identical.

3.2
audio sample word
value of a digital audio sample; representation is linear in 2's complement binary form

NOTE Positive numbers correspond to positive analogue voltages at the input of the analogue-to-digital converter (ADC).

3.3
auxiliary sample bit
the four least significant bits (LSBs) which can be assigned as auxiliary sample bits and used for auxiliary information when the number of audio sample bits in the main data field is less than or equal to 20

3.4
validity bit
bit indicating whether the main data field bits in the sub-frame (time slots 4 to 27 or 8 to 27, depending on the audio word length as described in 4.1.1) are reliable or not

3.5
channel status
the channel status carries, in a fixed format, information associated with each main data field channel which is decodable by any interface user

NOTE Examples of information to be carried in the channel status are: length of audio sample words, pre-emphasis, sampling frequency, time codes, alphanumeric source and destination codes.

3.6
user data
the user data channel is provided to carry any other information

3.7
parity bit
bit provided to permit the detection of an odd number of errors resulting from malfunctions in the interface

3.8
preamble
specific patterns used for synchronization

NOTE There are three different preambles (see 4.3).

3.9
sub-frame
fixed structure used to carry information (see 4.1.14.1.1 and 4.1.2)

3.10
frame
sequence of two successive and associated sub-frames

3.11
block
group of 192 consecutive frames

NOTE The start of a block is designated by a special sub-frame preamble (see 4.3).

3.12
channel coding
coding method by which the binary digits are represented for transmission through the interface

3.13
unit interval (UI)
the shortest nominal time interval in the coding scheme

NOTE There are 128 UI in a sample frame.

3.14
interface jitter
deviation in the timing of interface data transitions (zero crossings) when compared with an ideal clock

3.15
intrinsic jitter
output interface jitter of a device that is either free-running or is synchronized to a jitter-free reference

3.16
jitter gain
ratio of the amplitude of jitter components at the output to their amplitude at the synchronization input to the device under test

4 Interface format

4.1 Structure of format

4.1.1 Sub-frame format

Each sub-frame is divided into 32 time slots, numbered from 0 to 31 (see Figure 1).

Time slots 0 to 3 (preambles) carry one of the three permitted preambles (see 4.1.2 and 4.3; also see Figure 2).

Time slots 4 to 27 (main data field) carry the audio sample word in linear 2's complement representation. The most significant bit (MSB) is carried by time slot 27.

When a 24-bit coding range is used, the LSB is in time slot 4 (see Figure 1).

When a 20-bit coding range is used, time slots 8 to 27 carry the audio sample word with the LSB in time slot 8. Time slots 4 to 7 may be used for other applications. Under these circumstances, the bits in the time slots 4 to 7 are designated auxiliary sample bits (see Figure 1).

If the source provides fewer bits than the interface allows (either 20 or 24), the unused LSBs are set to a logical "0".

For a non-linear PCM audio application or a data application the main data field may carry any other information.

Time slot 28 (validity bit) carries the validity bit associated with the main data field (see 4.4).

Time slot 29 (user data bit) carries 1 bit of the user data channel associated with the main data field channel transmitted in the same sub-frame. For the applications, refer to the other parts of IEC 60958.

Time slot 30 (channel status bit) carries 1 bit of the channel status information associated with the main data field channel transmitted in the same sub-frame. For details refer to the other parts of IEC 60958.

Time slot 31 (parity bit) carries a parity bit such that time slots 4 to 31 inclusive carry an even number of ones and an even number of zeroes (even parity).

NOTE The preambles have even parity as an explicit property.

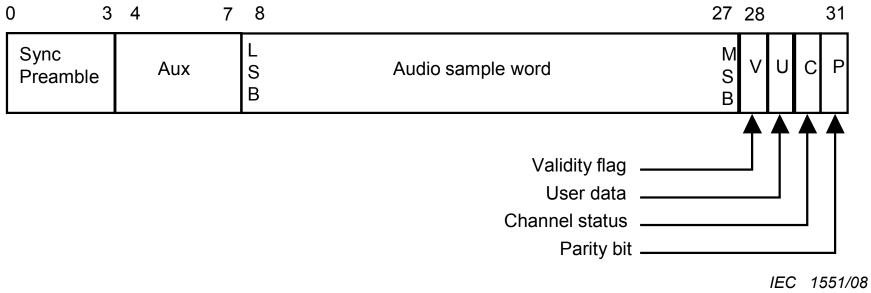

Figure 1 – Sub-frame format (linear PCM application)

4.1.2 Frame format

A frame is uniquely composed of two sub-frames (see Figure 2). For linear coded audio applications, the rate of transmission of frames normally corresponds exactly to the source sampling frequency.

In 2-channel operation mode, the samples taken from both channels are transmitted by time multiplexing in consecutive sub-frames. The first sub-frame (left or "A" channel in stereophonic operation and primary channel in monophonic operation) normally starts with preamble "M". However, the preamble changes to preamble "B" once every 192 frames to identify the start of the block structure used to organize the channel status information. The second sub-frame (right or "B" channel in stereophonic operation and secondary channel in monophonic operation) always starts with preamble "W".

In single channel operation mode in a professional application, the frame format is the same as in the 2-channel mode. Data is carried in the first sub-frame and may be duplicated in the second sub-frame. If the second sub-frame is not carrying duplicate data, then time slot 28, (validity flag) shall be set to logical "1".

NOTE For historical reasons preambles "B", "M" and "W" are, for use in professional applications, referred to as "Z", "X" and "Y", respectively.

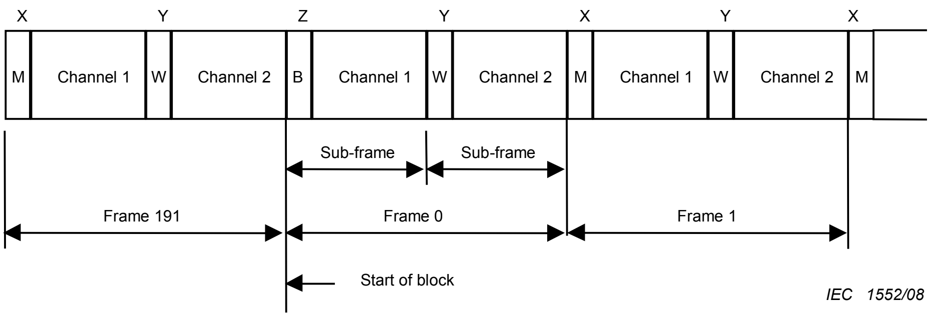

Figure 2 – Frame format

4.2 Channel coding

To minimize the direct current (d.c.) component on the transmission line, to facilitate clock recovery from the data stream and to make the interface insensitive to the polarity of connections, time slots 4 to 31 are encoded in biphase-mark.

Each bit to be transmitted is represented by a symbol comprising two consecutive binary states. The first state of a symbol is always different from the second state of the previous

symbol. The second state of the symbol is identical to the first if the bit to be transmitted is logical "0". However, it is different if the bit is logical "1" (see Figure 3).

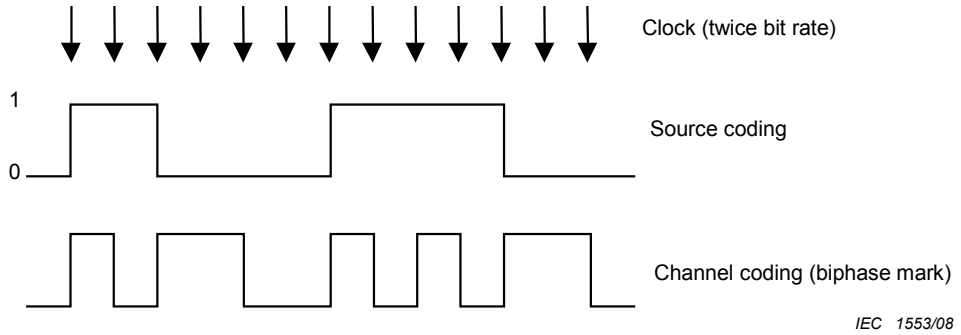

Figure 3 – Channel coding

4.3 Preambles

Preambles are specific patterns providing synchronization and identification of the sub-frames and blocks.

To achieve synchronization within one sampling period and to make this process completely reliable, these patterns violate the biphase-mark code rules, thereby avoiding the possibility of data imitating the preambles.

A set of three preambles is used. These preambles are transmitted in the time allocated to four time slots at the start of each sub-frame (time slots 0 to 3), and are represented by eight successive states. The first state of the preamble is always different from the second state of the previous symbol (representing the parity bit). Depending on this state the preambles are as shown in Table 1.

Table 1 – Preamble coding

Preceding state	**0**	**1**	
Preamble code	**Channel coding**		
“B” or “Z” (see note to 4.1.2)	11101000	00010111	Sub-frame 1 and the start of the block
“M” or “X”	11100010	00011101	Sub-frame 1
“W” or “Y”	11100100	00011011	Sub-frame 2

Like biphase code, these preambles are d.c. free and provide clock recovery. They differ in at least two states from any valid biphase sequence.

Figure 4 represents preamble "M".

NOTE Owing to the even-parity bit in time slot 31, all preambles start with a transition in the same direction (see 4.1.1). Thus, only one of these sets of preambles is, in practice, transmitted through the interface. However, it is necessary for both sets to be decodable because either polarity is possible in a connection.

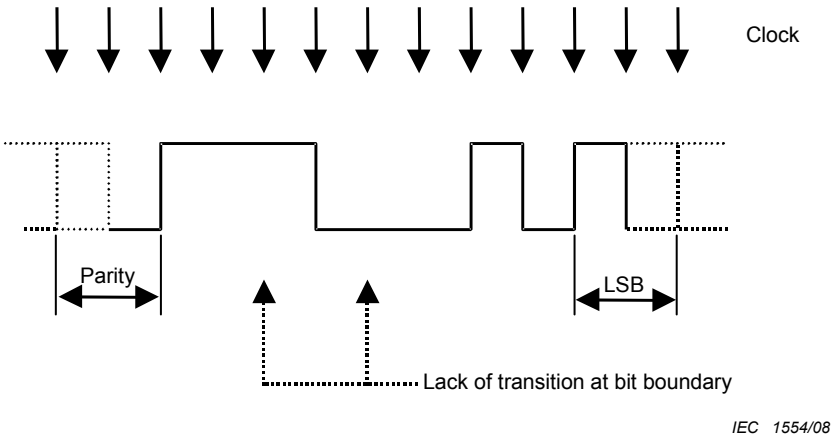

Figure 4 – Preamble M (shown as 11100010)

4.4 Validity bit

The validity bit is logical "0" if the information in the main data field is reliable, and it is logical "1" if it is not. There is no default state for the validity bit.

NOTE For transmissions not using a linear PCM coding, this bit may be set. This is intended to prevent accidental decoding of non-audio data to analogue before a complete channel status block is received. See annex A.

5 Channel status

5.1 General

For every sub-frame the channel status provides information related to the data carried in the main data field of that same sub-frame.

Channel status information is organised in a 192-bit block, subdivided into 24 bytes. The first bit of each block is carried in the frame with preamble "B". The channel status data format is defined in Table 2.

The specific organisation depends on the application. In the descriptions, the suffix "0" designates the first byte or bit. Where channel status bits are combined to form non-binary values, the least significant bit should be transmitted first, unless otherwise indicated.

5.2 Applications

The primary application is indicated by the first channel status bit (bit 0) of a block as defined in clause 5.3.

For professional applications refer to IEC 60958-4.

For consumer applications refer to IEC 60958-3.

Secondary applications may be defined within the framework of these primary applications.

Application documents or specifications are listed in Annex B.

5.3 General assignment of the first and second channel status bits

The first and second channel status bits (bit 0 and bit 1) are specified as follows.

Byte 0

Bit 0	"0"	Consumer use of channel status block.
	"1"	Professional use of channel status block.
Bit 1	"0"	Main data field represents linear PCM samples.
	"1"	Main data field used for other purposes.

5.4 Category code

Channel status including category code is defined in IEC 60958-3 for consumer applications, these category codes are used for other variations of IEC 60958 for consumer use such as IEC 61937.

Also channel status is defined in IEC 60958-4 for professional applications, these channel status are used for other variations for professional use such as SMPTE 337M and others.

Table 2 – Channel status data format

Byte									
0		a	b						
	bit	0	1	2	3	4	5	6	7
1									
	bit	8	9	10	11	12	13	14	15
2									
	bit	16	17	18	19	20	21	22	23
3									
	bit	24	25	26	27	28	29	30	31
4									
	bit	32	33	34	35	36	37	38	39
5									
	bit	40	41	42	43	44	45	46	47
6									
	bit	48	49	50	51	52	53	54	55
7									
	bit	56	57	58	59	60	61	62	63
8									
	bit	64	65	66	67	68	69	70	71
9									
	bit	72	73	74	75	76	77	78	79
10									
	bit	80	81	82	83	84	85	86	87
11									
	bit	88	89	90	91	92	93	94	95
12									
	bit	96	97	98	99	100	101	102	103
13									
	bit	104	105	106	107	108	109	110	111
14									
	bit	112	113	114	115	116	117	118	119
15									
	bit	120	121	122	123	124	125	126	127
16									
	bit	128	129	130	131	132	133	134	135
17									
	bit	136	137	138	139	140	141	142	143
18									
	bit	144	145	146	147	148	149	150	151
19									
	bit	152	153	154	155	156	157	158	159
20									
	bit	160	161	162	163	164	165	166	167
21									
	bit	168	169	170	171	172	173	174	175
22									
	bit	176	177	178	179	180	181	182	183
23									
	bit	184	185	186	187	188	189	190	191
		a: use of channel status block. b: linear PCM identification.							