

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Digital audio interface –
Part 4-4: Professional applications – Physical and electrical parameters
(standards.iteh.ai)

Interface audionumérique –
Partie 4-4: Applications professionnelles – Paramètres physiques et électriques

IEC 60958-4-4:2016
<https://standards.iteh.ai/catalog/standards/sist/1d520a89-7cd9-4180-a714-bbec1748d9db/iec-60958-4-4-2016>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2016 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Digital audio interface –
Part 4-4: Professional applications – Physical and electrical parameters

Interface audionumérique –
Partie 4-4: Applications professionnelles – Paramètres physiques et électriques

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 33.160.30

ISBN 978-2-8322-3233-0

Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references.....	7
3 Terms and definitions	7
4 Common features	8
5 Jitter.....	8
5.1 Output interface jitter.....	8
5.1.1 General	8
5.1.2 Intrinsic jitter.....	8
5.1.3 Jitter gain	9
5.2 Receiver jitter tolerance	10
Annex A (informative) Symbol rates and UI	11
Annex B (normative) Balanced transmission.....	12
B.1 General characteristics.....	12
B.1.1 Configuration	12
B.1.2 Equalisation.....	12
B.1.3 Cable.....	12
B.2 Line driver characteristics.....	13
B.2.1 Output impedance.....	13
B.2.2 Signal amplitude	13
B.2.3 Balance.....	13
B.2.4 Rise and fall times.....	13
B.3 Line receiver characteristics.....	13
B.3.1 Terminating impedance.....	13
B.3.2 Maximum input signals.....	14
B.3.3 Minimum input signals.....	14
B.3.4 Receiver equalization.....	14
B.3.5 Common-mode rejection	15
B.4 Connector	15
B.4.1 XLR connector	15
B.4.2 8-way modular connector	15
Annex C (normative) Coaxial transmission	17
C.1 General.....	17
C.2 Line driver characteristics.....	17
C.2.1 General	17
C.2.2 Output impedance.....	17
C.2.3 Signal characteristics	17
C.3 Coaxial cable characteristics	18
C.4 Line receiver characteristics.....	18
C.4.1 General	18
C.4.2 Terminating impedance.....	19
C.4.3 Maximum input signals.....	19
C.4.4 Minimum input signals.....	19
C.5 Connector	20

Annex D (informative) Optical transmission	21
D.1 Short haul	21
D.2 Medium haul	21
D.3 Long haul.....	21
Bibliography	22
Figure 1 – Intrinsic-jitter measurement-filter characteristic	9
Figure 2 – Jitter transfer-function mask	10
Figure 3 – Jitter tolerance template	10
Figure B.1 – Simplified example of the configuration of the circuit (balanced).....	12
Figure B.2 – Eye diagram, balanced receiver.....	14
Figure B.3 – Suggested equalizing characteristic for a receiver operating at 48 kHz frame rate.....	15
Figure C.1 – Output signal waveform.....	17
Figure C.2 – Eye diagram, coaxial receiver.....	19
Figure C.3 – Eye pattern for long-distance transmission	20
Table A.1 – Symbol rate versus sampling frequency	11
Table A.2 – UI (ns) versus sampling frequency	11
Table C.1 – Output signal characteristics	18

ITeH STANDARD PREVIEW
(standards.iteh.ai)

[IEC 60958-4-4:2016](https://standards.iteh.ai/catalog/standards/sist/fd326a85-7ed9-4f80-a714-bbec1748d9db/iec-60958-4-4-2016)

<https://standards.iteh.ai/catalog/standards/sist/fd326a85-7ed9-4f80-a714-bbec1748d9db/iec-60958-4-4-2016>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

DIGITAL AUDIO INTERFACE –**Part 4-4: Professional applications –
Physical and electrical parameters**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60958-4-4 has been prepared by technical area 4: Digital system interfaces and protocols, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This first edition, together with IEC 60958-4-1 and IEC 60958-4-2, cancels and replaces the IEC 60958-4 published in 2003 and its Amendment 1:2008 and constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 60958-4:2003 with its Amendment 1:2008:

- a) support for a wider range of physical media;
- b) support for a wider range of audio sampling frequencies;
- c) deprecation of “minimum implementation” of channel status data.

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

CDV	Report on voting
100/2454/CDV	100/2583/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.

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

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

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

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

iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC 60958-4-4:2016](#)

<https://standards.iteh.ai/catalog/standards/sist/fd326a85-7ed9-4f80-a714-bbec1748d9db/iec-60958-4-4-2016>

INTRODUCTION

The two-channel digital audio interface has been widely used in a variety of professional audio applications that have reached beyond the vision of the original standard. In particular, applications using increased sampling frequencies and alternative physical media.

Separating the standard into independently-maintainable parts allows, for example, additional transmission media to be introduced in the future by revising IEC 60958-4-4 without affecting the other parts of the IEC 60958-4 series. The parts comprise:

- Part 4-1: Audio content: defines the format for coding audio used for the audio content. It specifies the semantics of the audio data, including the "validity" flag. It also specifies the sampling frequency by reference to AES5.
- Part 4-2: Metadata and subcode: specifies the format for information, metadata, or subcode transmitted with the audio data: principally the channel status but also user data and the auxiliary bits. Implementors will note that the current implementation options ("Standard" and "Enhanced") both require that status data be implemented correctly in compliant equipment.
- Part 4-4: Physical and electrical parameters: specifies the physical signals that convey the bit stream specified in IEC 60958-1. The transport format is intended for use with shielded twisted-pair cable of conventional design over distances of up to 100 m at frame rates of up to 50 kHz. Longer cable lengths and higher frame rates may be used, but with a rapidly increasing requirement for care in cable selection and possible receiver equalization, or the use of active repeaters. Provision is made in this standard for adapting the balanced terminals to use 75 Ω coaxial cable. Transmission by fibre-optic cable is under consideration.

[IEC 60958-4-4:2016](https://standards.iteh.ai/catalog/standards/sist/fd326a85-7ed9-4f80-a714-bbec1748d9db/iec-60958-4-4-2016)

<https://standards.iteh.ai/catalog/standards/sist/fd326a85-7ed9-4f80-a714-bbec1748d9db/iec-60958-4-4-2016>

DIGITAL AUDIO INTERFACE –

Part 4-4: Professional applications – Physical and electrical parameters

1 Scope

This part of IEC 60958 specifies the physical and electrical parameters for different media. This part together with IEC 60958-1, IEC 60958-4-1, and IEC 60958-4-2 specify an interface for the serial digital transmission of two channels of periodically sampled and linearly represented digital audio data from one transmitter to one receiver.

The transport format defined in IEC 60958-1 is intended for use with shielded twisted-pair cable of conventional design over distances of up to 100 m without transmission equalization or any special equalization at the receiver and at frame rates of up to 50 kHz. Longer cable lengths and higher frame rates may be used, but with a rapidly increasing requirement for care in cable selection and possible receiver equalization or the use of active repeaters, or both. Provision is made in this standard for adapting the balanced terminals to use 75 Ω coaxial cable, and transmission by fibre-optic cable is under consideration. This standard does not cover connection to any common carrier equipment. In this interface specification, an interface for consumer use is also mentioned. The two interfaces are not identical.

2 Normative references

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

IEC 60268-12, *Sound system equipment – Part 12: Application of connectors for broadcast and similar use*

IEC 60603-7 (all parts), *Connectors for electronic equipment – Part 7: Detail specification for 8-way, unshielded, free and fixed connectors*

IEC 60958-1:2008, *Digital audio interface – Part 1: General*
IEC 60958-1:2008/AMD1:2014

IEC 60958-4-1, *Digital audio interface – Part 4-1: Professional applications – Audio content*

IEC 60958-4-2, *Digital audio interface – Part 4-2: Professional applications – Metadata and subcode*

IEC 61169-8, *Radio-frequency connectors – Part 8: Sectional specification – RF coaxial connectors with inner diameter of outer conductor 6,5 mm (0,256 in) with bayonet lock – Characteristic impedance 50 Ω (type BNC)*

ISO/IEC 11801, *Information technology – Generic cabling for customer premises*

3 Terms and definitions

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

3.1 unit interval

UI

shortest nominal time interval in the coding scheme

Note 1 to entry: There are 128 UI in a sample frame. See Annex A.

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

3.2 interface jitter

deviation in timing of interface data transitions (zero crossings) when measured with respect to an ideal clock

3.3 intrinsic jitter

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

3.4 jitter gain

ratio of the amplitude of jitter at the synchronization input of a device to the resultant jitter at the output of the device

Note 1 to entry: This definition excludes the effect of intrinsic jitter.

Note 2 to entry: The ratio is expressed in decibels.

3.5 frame rate

frequency at which frames are transmitted

IEC 60958-4-4:2016
<https://standards.iteh.ai/catalog/standards/sist/fd326a85-7ed9-4f80-a714-bbec1748d9db/iec-60958-4-4-2016>

4 Common features

All interfaces shall be subject to the common jitter requirements in accordance with Clause 5. Other parameters shall comply with the transmission type specified.

The interface should use the balanced transmission format specified in Annex B. The interface may use the format specified in Annex C or one of the alternative transmission formats to be specified in a future edition (see Annex D).

5 Jitter

5.1 Output interface jitter

5.1.1 General

Jitter at the output of a device shall be measured as the sum of the jitter intrinsic to the device and jitter being passed through from the timing reference of the device.

5.1.2 Intrinsic jitter

The peak value of the intrinsic jitter at the output of the interface, measured at all the transition zero crossings shall be less than 0,025 UI when measured with the intrinsic-jitter measurement filter.

The following aspects have to be considered.

- This jitter may be strongly asymmetric and the deviation from the ideal timing should meet the specification in either direction.
- This requirement applies both when the equipment is locked to an effectively jitter-free timing reference, which may be a modulated digital audio signal, and when the equipment is free-running.
- The intrinsic-jitter measurement-filter characteristic is shown in Figure 1. It shows a minimum-phase high-pass filter with 3 dB attenuation at 700 Hz, a first order roll-off to 70 Hz and with a pass-band gain of unity.

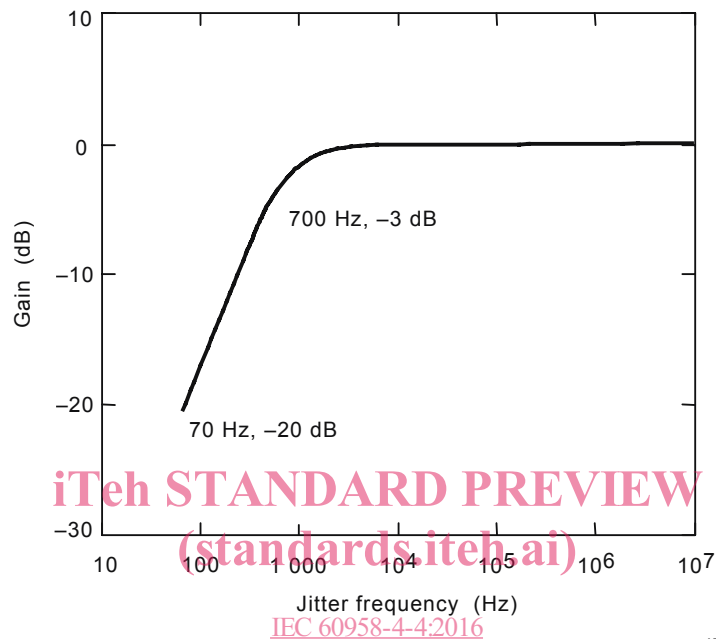


Figure 1 – Intrinsic-jitter measurement-filter characteristic

5.1.3 Jitter gain

The sinusoidal jitter gain from any timing reference input to the signal output shall be less than 2 dB at all frequencies.

If jitter attenuation is provided and it is such that the sinusoidal jitter gain falls below the jitter transfer function mask of Figure 2 then the equipment specification should state that the equipment jitter attenuation is within the specification of this standard. The mask imposes no additional limit on low-frequency jitter gain. The limit starts at the input-jitter frequency of 500 Hz where it is 0 dB, and falls to -6 dB at and above 1 kHz.

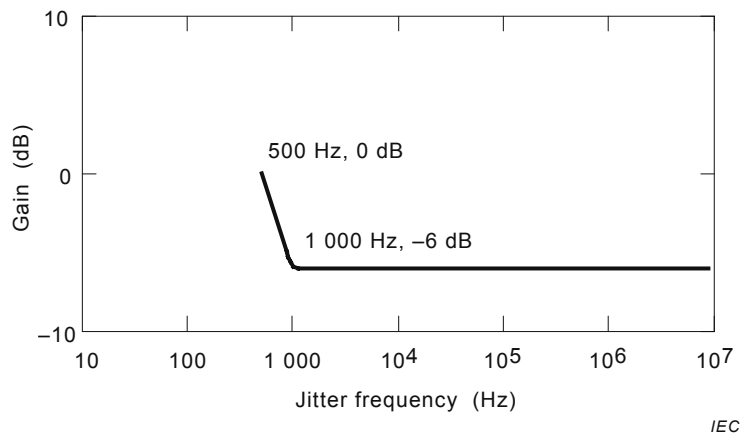


Figure 2 – Jitter transfer-function mask

5.2 Receiver jitter tolerance

An interface data receiver should correctly decode an incoming data stream with any sinusoidal jitter defined by the jitter tolerance template of Figure 3.

The template requires a jitter tolerance of 0,25 UI peak-to-peak at high frequencies, increasing with the inverse of frequency below 8 kHz to level off at 10 UI peak-to-peak below 200 Hz.

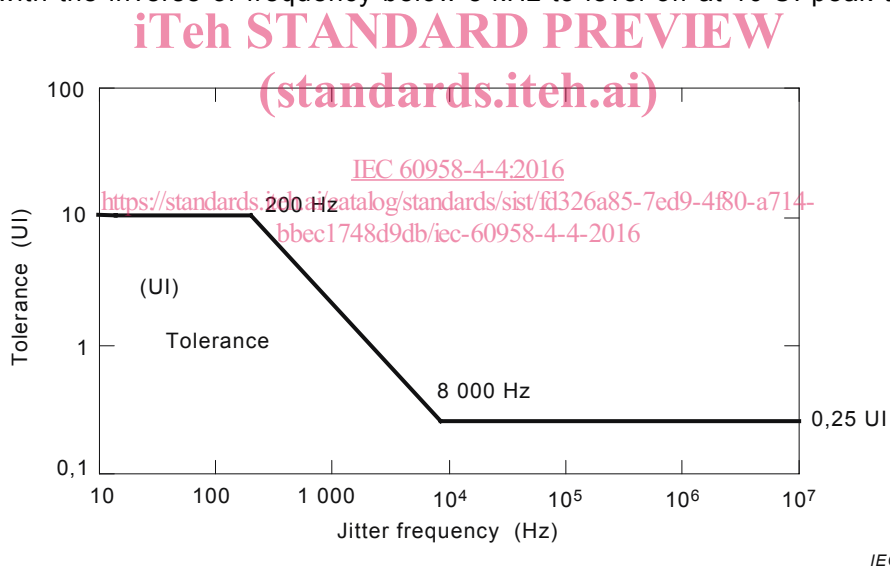


Figure 3 – Jitter tolerance template

Annex A (informative)

Symbol rates and UI

Demands on the performance of the interface are determined by the frame rate, which is in turn determined by the audio sampling frequency. AES5 recommends a set of sampling frequencies referred to a basic rate of 48 kHz with options to use 44,1 kHz or 32 kHz. These basic rates may be scaled by certain multiples to achieve higher or lower sampling frequencies.

Table A.1 and Table A.2 illustrate how the symbol rate at the interface, and the UI, change with different sampling-frequency multiples.

Table A.1 – Symbol rate versus sampling frequency

Multiple	Sampling frequency (F_s) kHz		
	32	44,1	48
0,25	1,024	1,411 2	1,536
0,5	2,048	2,822 4	3,072
1	4,096	5,644 8	6,144
2	8,192	11,289 6	12,288
4	16,384	22,579 2	24,576
8	32,768	45,158 4	49,152

<https://standards.iteh.ai/catalog/standards/sist/1d326a85-7ed9-4180-a714-bbec1748d9db/iec-60958-4-4-2016>

Table A.2 – UI (ns) versus sampling frequency

Multiple	Sampling Frequency (F_s) kHz		
	32	44,1	48
0,25	976,56	708,62	651,04
0,5	488,28	354,31	325,52
1	244,14	177,15	162,76
2	122,07	88,58	81,38
4	61,04	44,29	40,69
8	30,52	22,14	20,35

NOTE As the sampling frequency is increased, the demand on jitter performance will also increase. For example: a sampling frequency of 8×48 kHz (384 kHz) will require an intrinsic jitter of $0,025 \times 20,35$ ns, or 0,51 ns (see 5.1.2)