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IEEE Standard Jitter and Phase Noise

IEEE Instrumentation and Measurement Society

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IEEE Standard for Jitter and Phase Noise

Developed by

Waveform Generation, Measurement, and Analysis Technical Committee
of the
IEEE Instrumentation and Measurement Society

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IEEE SA Standards Board

Abstract: This standard would fulfill the lack of uniformity by defining all terms involved in jitter definition, by identifying all jitter components and by modelling them. In this standard a new definition and modelling framework is presented with the aim to be coherent as much as possible with existent standards. In particular, models and definition are given for jitter, timing jitter, timing error, time interval error, period jitter, cycle-to-cycle jitter, random jitter, wander, deterministic jitter, data-dependent jitter, periodic jitter, bounded uncorrelated jitter, DJ model total jitter, RMS and peak-to-peak jitter; bit-error rate, phase noise.

Keywords: BER, bit-error rate, bounded uncorrelated jitter, BUJ, cycle-to-cycle jitter, data-dependent jitter, DDJ, deterministic jitter, DJ model total jitter, IEEE 2414™, jitter, periodic jitter, period jitter, phase noise, PJ, random jitter, RMS and peak-to-peak jitter; time interval error, timing error, timing jitter, wander.

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The following members of the individual Standards Association balloting committee voted on this standard. Balloters may have voted for approval, disapproval, or abstention.

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Introduction

Jitter is one of the most important specifications when measuring the performance of several types of electronic components and/or systems. That figure of merit has, in fact, a relevant impact on the design, operation, and verification of many of today products and services. At the component/systemic level, jitter measurements can lead to malfunction causes and to effectively diminish their deleterious effect on the overall system performance.

This standard defines the terms, definitions, and mathematical models used to specify and characterize jitter. It is intended for the following:

— Individuals and organizations who specify electronic devices, equipment, and systems subject to jitter to be purchased

— Individuals and organizations who purchase electronic devices, equipment, and systems subject to jitter to be applied in their products

— Individuals and organizations whose responsibility is to characterize and write reports on jitter for specific applications

— Suppliers interested in providing high-quality and high-performance electronic components devices, equipment, and systems to acquirers

This standard is designed to help organizations and individuals incorporate quality considerations during the definition, evaluation, selection, and acceptance of supplier of electronic devices for operational use in their equipment.

This standard is intended to satisfy the following objectives:

— Promote consistency within organizations in acquiring third-party electronic devices, equipment, and systems from suppliers

— Provide useful practices on including quality considerations during acquisition planning

— Provide useful practices on evaluating and qualifying supplier capabilities to meet user requirements

— Assist individuals and organizations judging the quality and suitability of devices, equipment, and systems for referral to end users

Several standards have previously been written that address the definition and modeling of jitter. These include the following standards:[1]

— IEEE Std 1139-2008, IEEE Standard Definitions of Physical Quantities for Fundamental Frequency and Time Metrology—Random Instabilities [B7]

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[1] The numbers in brackets correspond to those of the bibliography in Annex B.

- IEEE Std 802.3-2008, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications [B7]

- IEC 60469:2013, Transactions, pulses and related waveforms – Terms, definitions and algorithms [B9]

- IEC 60679-6:2011, Quartz crystal-controlled oscillators of assessed quality – Part 6: Phase jitter measurement method for quartz crystal oscillators and SAW oscillators – Application guidelines [B10]

- IEC 61280-2-3:2009, Fibre optic communication subsystem test procedures – Part 2-3: Digital systems – Jitter and wander measurements [B11]

- ITU-R Recommendation BT.1363, Jitter Specifications and Methods for Jitter Measurements of Bit-Serial Signals Conforming to Recommendations ITU-R BT.656, BT.656, ITU-R BT.799 and ITU-R BT.1120, 1998 [B12]

- ITU-T G.810, SERIES G: Transmission Systems and Media Digital Transmission Systems, Digital networks – Design objectives for digital networks – Definitions and terminology for synchronization networks, 1996 [B13]

The main aim of this standard is the harmonization of terminology and models included in these standards.

Contents

IEEE Standard for Jitter and Phase Noise

1. Overview

1.1 Scope

The standard defines specifications, modeling methods and terminology for the dispersion of specified instants of repetitive and/or periodic signals in electronics, telecommunications and measurement, which is referred to as jitter and phase noise.

1.2 Purpose

The purpose of the standard is to facilitate accurate and precise communication concerning jitter and phase noise and the models for measuring them. Because of the broad applicability of such terms in the electronics industries (such as computer, telecommunication, and measurement instrumentation industries), developing unambiguous definitions and the presentation of models for their measurement is important for communication between manufacturers, users and consumers.

2. Definitions, symbols, acronyms and abbreviations

2.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause. [1]

amplitude of the timing jitter: The range of deviations of the actual reference instants of a timing waveform from their ideal values.

bounded uncorrelated jitter (BUJ): The non-periodic contribution to the deterministic jitter in a two-level (binary) or multilevel signal that is associated with signal transitions but which shows no correlation to the signal itself.

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[1]*IEEE Standards Dictionary Online* is available at: http://dictionary.ieee.org. An IEEE Account is required for access to the dictionary, and one can be created at no charge on the dictionary sign-in page.