

# INTERNATIONAL STANDARD



---

**Measurement techniques of piezoelectric, dielectric and electrostatic  
oscillators –  
Part 2: Phase jitter measurement method**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 31.140

ISBN 978-2-8322-4762-4

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references .....	7
3 Terms and definitions .....	7
4 Test and measurement procedures.....	8
4.1 General.....	8
4.2 Test methods of phase jitter .....	8
4.2.1 General .....	8
4.2.2 Measurement in the time domain .....	8
4.2.3 Measurement in the data domain .....	9
4.2.4 Measurement in the frequency domain .....	9
4.3 Input and output impedances of the measurement system .....	13
4.4 Measurement equipment.....	13
4.4.1 General .....	13
4.4.2 Jitter floor .....	13
4.4.3 Output wave form .....	13
4.4.4 Output voltage .....	14
4.5 Test fixture.....	14
4.6 Cable, tools and instruments, and so on .....	14
5 Measurement and the measurement environment.....	14
5.1 Set-up before taking measurements.....	14
5.2 Points to be considered and noted at the time of measurement.....	14
5.3 Treatment after the measurement .....	14
6 Measurement.....	15
6.1 Reference temperature .....	15
6.2 Measurement of temperature characteristics.....	15
6.3 Measurement under vibration.....	15
6.4 Measurement at the time of impact .....	15
6.5 Measurement in accelerated ageing.....	15
7 Other points to be noted .....	15
8 Miscellaneous.....	15
Annex A (normative) Calculation method for the amount of phase jitter.....	16
A.1 General.....	16
A.2 Explanation .....	16
A.3 Relations between phase noise and phase jitter.....	16
A.4 Commentary on theoretical positioning of phase jitter .....	18
A.5 Description .....	18
A.5.1 General .....	18
A.5.2 RMS jitter .....	19
A.5.3 Peak-to-peak jitter .....	19
A.5.4 Random jitter .....	20
A.5.5 Deterministic jitter.....	20
A.5.6 Period (periodic) jitter .....	20
A.5.7 Data-dependent jitter .....	20
A.5.8 Total jitter .....	21

A.6 Points to be considered for measurement ..... 21

    A.6.1 Measurement equipment ..... 21

    A.6.2 Factors of measurement errors ..... 22

Bibliography..... 24

  

Figure 1 – Phase jitter measurement with sampling oscilloscope ..... 9

Figure 2 – Block diagram of a jitter and wander analyser according to ITU-T O.172 ..... 11

Figure 3 – Equivalent block diagram ..... 13

Figure A.1 – Concept diagram of SSB phase noise ..... 18

Figure A.2 – Voltage versus time ..... 19

Figure A.3 – Explanatory diagram of the amount of jitter applied to RMS jitter ..... 21

Figure A.4 – Explanatory diagrams of random jitter, deterministic jitter, and total jitter ..... 22

  

Table 1 – Fourier frequency range for phase noise test..... 10

Table 2 – Standard bit rates for various applications ..... 12

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MEASUREMENT TECHNIQUES OF PIEZOELECTRIC,  
DIELECTRIC AND ELECTROSTATIC OSCILLATORS –****Part 2: Phase jitter measurement method**

## 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 62884-2 has been prepared by IEC technical committee 49: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection.

The text of this International Standard is based on the following documents:

CDV	Report on voting
49/1212/CDV	49/1243/RVC

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

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

A list of all parts in the IEC 62884 series, published under the general title *Measurement techniques of piezoelectric, dielectric and electrostatic oscillators*, can be found on the IEC website.

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

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

A bilingual version of this publication may be issued at a later date.

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

A crystal oscillator as a highly efficient and highly precise source of a frequency oscillation is widely used for fields such as the electronic equipment, communication equipment, measurement equipment and a clock. Also recently, digitalization of these equipments is advancing rapidly. In this situation, the frequency of crystal oscillator requires high precision and high stability and reduction of noise with oscillating phenomenon. A phase jitter is one of the noise characteristic in oscillation characteristic and precise measurement which is needed when shipping a component to a customer.

For advance application in electronic information and communication technology, (e.g. advanced satellite communications, control circuits for electric vehicle (EV)), necessity arises for the measurement method for common guidelines of phase jitter. In these days, measurement method of phase jitter also becomes more important from the electromagnetic influence (EMI) point of view.

This document has been restructured from IEC 60679-1:2007 (third edition) and IEC 60679-6:2011 (first edition). The test methods for oscillators have been separated from IEC 60679-6:2011 into IEC 62884 (all parts). This document covers the phase jitter measurement.

# MEASUREMENT TECHNIQUES OF PIEZOELECTRIC, DIELECTRIC AND ELECTROSTATIC OSCILLATORS –

## Part 2: Phase jitter measurement method

### 1 Scope

This part of IEC 62884 specifies the methods for the measurement and evaluation of the phase jitter measurement of piezoelectric, dielectric and electrostatic oscillators, including dielectric resonator oscillators (DROs) and oscillators using a thin-film bulk acoustic resonator (FBAR) (hereinafter referred to as an "Oscillator") and gives guidance for phase jitter that allows the accurate measurement of RMS jitter.

In the measurement method, phase noise measurement equipment or a phase noise measurement system is used.

NOTE Dielectric resonator oscillators (DROs) and oscillators using FBAR are under consideration.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050-561, *International Electrotechnical Vocabulary – Part 561: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection*

IEC 60679-1:2017, *Piezoelectric, dielectric and electrostatic oscillators of assessed quality – Part 1: Generic specification*

IEC 60469, *Transitions, pulses and related waveforms – Terms, definitions and algorithms*

IEC 60617, *Graphical symbols for diagrams (available at <http://std.iec.ch/iec60617>)*

IEC 62884-1:2017, *Measurement techniques of piezoelectric, dielectric and electrostatic oscillators – Part 1: Basic methods for the measurement*

ISO 80000-1, *Quantities and units – Part 1: General*