IEC 62884-1

Edition 1.0 2017-06

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

colour inside

## Measurement techniques of piezoelectric, dielectric and electrostatic oscillators – Part 1: Basic methods for the measurement



## Techniques de mesure des oscillateurs piézoélectriques, diélectriques et électrostatiques – Partie 1: Méthodes fondamentales pour le mesurage



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## Techniques de mesure des oscillateurs piézoélectriques, diélectriques et électrostatiques – Partie 1: Méthodes fondamentales pour le mesurage



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## Part 1: Basic methods for the measurement

## 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.
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International Standard IEC 62884-1 has been prepared by IEC technical committee 49: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection.

This bilingual version (2019-08) corresponds to the monolingual English version, published in 2017-06.

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

| CDV | Report on voting |
|---|---|
| 49/1187A/CDV | 49/1200/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.

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

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.

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# MEASUREMENT TECHNIQUES OF PIEZOELECTRIC, DIELECTRIC AND ELECTROSTATIC OSCILLATORS –

## Part 1: Basic methods for the measurement

## 1 Scope

This part of IEC 62884 specifies the measurement techniques for piezoelectric, dielectric and electrostatic oscillators, including Dielectric Resonator Oscillators (DROs) and oscillators using FBAR (hereinafter referred to as "Oscillator").

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*. Available at http://www.electropedia.org



IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-7, *Basic environmental testing procedures – Part 2-7: Tests – Test Ga and guidance: Acceleration, steady state*

IEC 60068-2-10:2005, *Environmental testing – Part 2-10: Tests – Test J and guidance: Mould growth*

IEC 60068-2-13, *Basic environmental testing procedures – Part 2-13: Tests – Test M: Low air pressure*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-17:1994, *Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-21, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-45, *Basic environmental testing procedures – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*

IEC 60068-2-52, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium, chloride solution)*

IEC 60068-2-58, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60068-2-64, *Environmental testing – Part 2-64: Tests – Test Fh: Vibration, broadband random and guidance*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*



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

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

Where any discrepancies occur for any reason, documents shall rank in the following order of precedence:

– detail specification;
– sectional specification;
– generic specification;
– any other international documents (for example of the IEC) to which reference is made.

The same order of precedence shall apply to equivalent national documents.

## 3 Terms and definitions

### 3.1 General

Units, graphical symbols, letter symbols and terminology shall, wherever possible, be taken from the following standards:

- IEC 60027;
- IEC 60050-561;
- IEC 60469;
- IEC 60617;
- ISO 80000-1.

### 3.2 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60679-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

## 4 Test and measurement procedures

### 4.1 General

The test and measurement procedures shall be carried out in accordance with the relevant detail specification.

### 4.2 Test and measurement conditions

#### 4.2.1 Standard conditions for testing

Unless otherwise specified, all tests shall be carried out under the standard atmospheric conditions for testing as specified in 4.3 of IEC 60068-1:2013.

– Temperature: 15 °C to 35 °C;
– Relative humidity: 25 % to 75 %;
– Air pressure: 86 kPa to 106 kPa (860 mbar to 1 060 mbar).



In case of dispute, the referee conditions are the following:



– Temperature: 25 °C ± 2 °C;
– Relative humidity: 48 % to 52 %;
– Air pressure: 86 kPa to 106 kPa (860 mbar to 1 060 mbar).

Before measurements are made, Oscillator shall be stored at the measuring temperature for a time sufficient to allow Oscillator to reach thermal equilibrium. Controlled recovery conditions and standard conditions for assisted drying are given in 4.4 and 4.5 of IEC 60068-1:2013.

The ambient temperature during the measurements shall be recorded and stated in the test report.

#### 4.2.2 Equilibrium conditions

All electrical tests shall be conducted under equilibrium conditions, unless otherwise specified.

When test conditions cause a significant change with time of the characteristic being measured, means of compensation for such effects shall be specified, for example the period of time that Oscillator shall be maintained at specified test conditions before making a measurement.

#### 4.2.3 Air flow conditions for temperature tests

When devices are to be measured at temperatures other than 25 °C ± 2 °C, they shall be subjected to adequate forced air circulation to ensure close temperature control.

If heat loss due to forced air circulation affects the performance of Oscillator, still air conditions shall be simulated by enclosing Oscillator in a draught shield consisting of a thermally conducting box, having internal dimensions so that a sufficient clearance is maintained from all surfaces of Oscillator. The temperature at which measurements should be taken under these conditions is the reference point temperature on the surface of the draught shield.

If a draught shield is necessary, it shall be used for both high and low temperature tests.

#### 4.2.4 Power supplies

DC power sources used in the testing of crystal controlled oscillators shall not have a ripple content large enough to effect the desired accuracy of measurement; AC power sources shall be transient free. When the ripple and/or the transient content of the power sources are critical to the measurement being performed, their effects shall be fully defined in the detail specification.

#### 4.2.5 Precision of measurement

The limits given in the detail specification are true values. Measurement inaccuracies shall be taken into account when evaluating the results. Precautions should be taken to reduce measurement errors to a minimum.

#### 4.2.6 Precautions

##### 4.2.6.1 Measurements

The measurement circuits shown for specified electrical tests are the preferred circuits. Due allowance shall be made for any loading effects in cases where the measuring apparatus modifies the characteristics being examined.

##### 4.2.6.2 Electrostatic sensitive devices



Where the component is identified as electrostatic sensitive, precautions shall be taken to prevent damage from electrostatic charge before, during, and after test (see IEC 61000-4-2).

#### 4.2.7 Alternative test methods



Measurements shall preferably be carried out using the methods specified. Any other method giving equivalent results may be used, except in case of dispute.

NOTE "Equivalent" means that the value of the characteristic established by such other methods falls within the specified limits when measured by the specified method.

### 4.3 Visual inspection

#### 4.3.1 General

Unless otherwise specified, external visual examination shall be performed under normal factory lighting and visual conditions.

#### 4.3.2 Visual test A

Oscillator shall be visually examined to ensure that the condition, workmanship and finish are satisfactory. The marking shall be legible.

#### 4.3.3 Visual test B

Oscillator shall be visually examined under ×10 magnification. There shall be no cracks in the glass or damage to the terminations. Minute flaking around the further edge of a meniscus shall not be considered a crack.

#### 4.3.4 Visual test C

Oscillator shall be visually examined. There shall be no corrosion or other deterioration likely to impair satisfactory operation. The marking shall be legible.

### 4.4 Dimensions and gauging procedures

#### 4.4.1 Dimensions – Test A

The dimensions, spacing, and alignment of the terminations shall be checked and shall comply with the specified values.

#### 4.4.2 Dimensions – Test B

The dimensions shall be measured and shall comply with the specified values.

### 4.5 Electrical test procedures

#### 4.5.1 Insulation resistance

A maximum voltage of 20 V, unless otherwise stated in the detail specification, shall be applied to the specified test points using the test circuit shown in Figure 1a. The resulting current shall be measured. It shall be less than the specified maximum value.

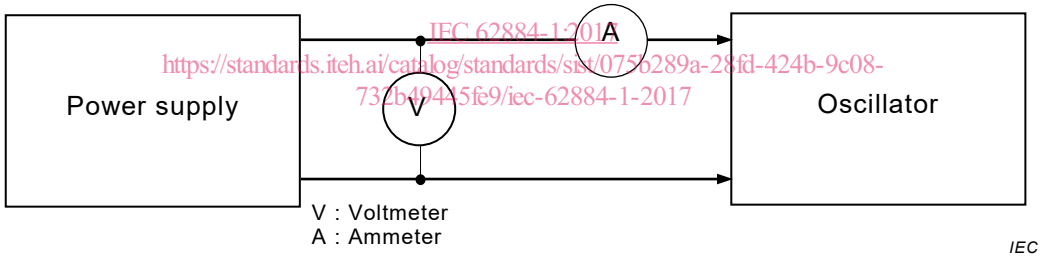
Alternatively, the resistance shall be directly measured with an ohmmeter (see Figure 1b). It shall be greater than the minimum specified.

Precautions shall be taken to ensure that measurements are made across the specified points with an applied voltage of the correct polarity and not exceeding the specified value. Failure to observe any of these conditions can result in damage to the device under test.

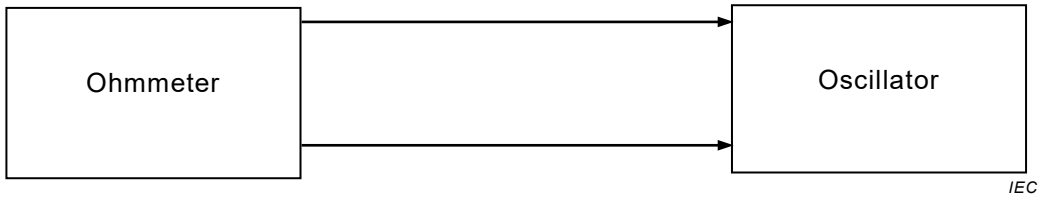


After the test, measurements shall be made to ensure that Oscillator is still functional.






**a) – Voltage-current method**




**b) – Ohmmeter method**

**Figure 1 – Test circuits for insulation resistance measurements**

#### 4.5.2 Voltage proof

The specified voltage shall be applied only across the designated terminals, using the test circuit shown in Figure 2, after any specified preconditioning procedures have been applied. The source resistance and maximum permissible current flow shall be stated in the detail specification.

There shall be no arcing or other evidence of electrical breakdown.

After the test, measurements shall be made to ensure that Oscillator is still functional.

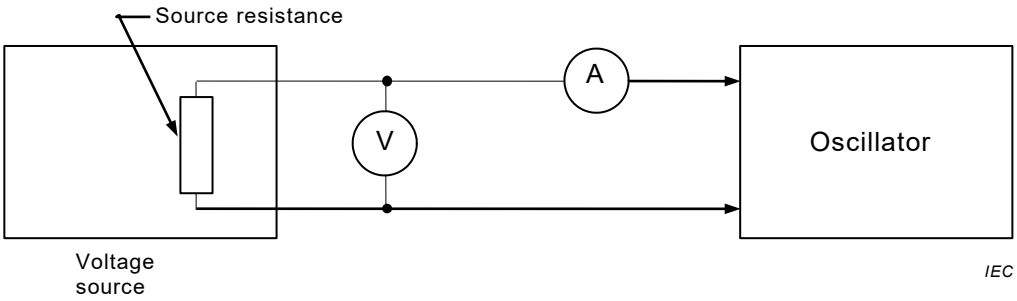



**Figure 2 – Test circuit for voltage proof test**

### 4.5.3 Input power

#### 4.5.3.1 Oscillator input power

Oscillator shall be connected to the power supply and specified load as shown in Figure 3. The specified voltage shall be applied and allowed to stabilize for the specified time. Measurements of the voltage and current shall be made at the reference temperature, unless otherwise stated in the detail specification. The input power shall be calculated using these measurements.

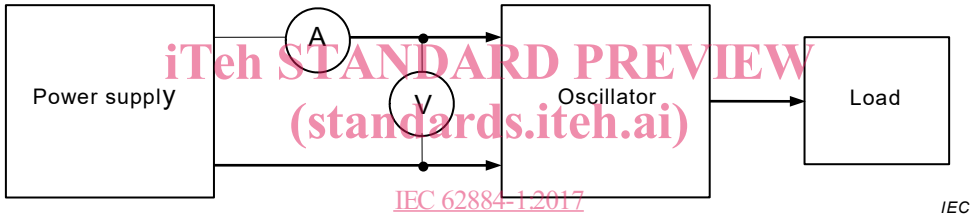





**Figure 3 – Test circuit for oscillator input power measurement**

#### 4.5.3.2 Oven and oscillator input power

Oscillator shall be connected to the test circuit (see note to Figure 4) and placed in the environmental chamber as shown in Figure 4. The load and supply voltage(s) shall be as specified in the detail specification. Where the input power to Oscillator will be affected by forced air circulation, still air conditions shall be simulated by enclosing Oscillator in a draught shield, as described in 4.2.3. Readings of voltage and current shall be taken at the specified temperatures as stated in the detail specification (usually at the minimum and maximum of the operating temperature range, as well as at the reference temperature).

The temperature will normally be taken as the reference point temperature on the surface of the draught shield, when used. If peak power is specified, the transient values of voltage and current shall be measured when the environmental chamber is adjusted to each of the specified temperatures. In this case, it can be necessary to attach a recording meter to the ammeter and/or voltmeter, so as to measure adequately the transient values.

Oscillator and oven shall be allowed to reach thermal equilibrium at the operating temperature, while unenergized, prior to any measurement of peak power. Should peak power be required, the environmental chamber shall have a thermal time constant significantly less than that of the oven-oscillator combination being measured.

The input power is calculated using the measured values of voltage and current.