

Measurement of quartz crystal unit parameters - Part  
6: Measurement of drive level dependence (DLD)

## EESTI STANDARDI EESSÕNA

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See Eesti standard EVS-EN IEC 60444-6:2021 sisaldab Euroopa standardi EN IEC 60444-6:2021 ingliskeelset teksti.	This Estonian standard EVS-EN IEC 60444-6:2021 consists of the English text of the European standard EN IEC 60444-6:2021.
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English Version

**Measurement of quartz crystal unit parameters - Part 6:  
Measurement of drive level dependence (DLD)  
(IEC 60444-6:2021)**

Mesure des paramètres des résonateurs à quartz - Partie 6:  
Mesure de la dépendance du niveau d'excitation (DNE)  
(IEC 60444-6:2021)

Messung von Schwingquarz-Parametern - Teil 6: Messung  
der Belastungsabhängigkeit (DLD)  
(IEC 60444-6:2021)

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## European foreword

The text of document 49/1374/FDIS, future edition 3 of IEC 60444-6, prepared by IEC/TC 49 "Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60444-6:2021.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2022-07-06 level by publication of an identical national standard or by endorsement
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IEC 60444-1 NOTE Harmonized as EN 60444-1

## Annex ZA (normative)

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NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60444-5	-	Measurement of quartz crystal units parameters - Part 5: Methods for the determination of equivalent electrical parameters using automatic network analyser techniques and error correction	EN 60444-5	-
IEC 60444-8	-	Measurement of quartz crystal unit parameters - Part 8: Test fixture for surface mounted quartz crystal units	EN 60444-8	-

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

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**Measurement of quartz crystal unit parameters –  
Part 6: Measurement of drive level dependence (DLD)**

**Mesure des paramètres des résonateurs à quartz –  
Partie 6: Mesure de la dépendance du niveau d'excitation (DNE)**



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# INTERNATIONAL STANDARD

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**Mesure des paramètres des résonateurs à quartz –  
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## CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references.....	6
3 Terms and definitions .....	6
4 DLD effects .....	6
4.1 Reversible changes in frequency and resistance .....	6
4.2 Irreversible changes in frequency and resistance .....	7
4.3 Causes of DLD effects.....	7
5 Drive levels for DLD measurement .....	7
6 Test methods.....	8
6.1 Method A (fast standard measurement method) .....	8
6.1.1 Testing at two drive levels .....	8
6.1.2 Testing according to specification .....	9
6.2 Method B (Multi-level reference measurement method) .....	10
Annex A (normative) Relationship between electrical drive level and mechanical displacement of quartz crystal units.....	12
Annex B (normative) Method C: DLD measurement with oscillation circuit.....	15
Bibliography .....	20
Figure 1 – Maximum tolerable resistance ratio $\gamma$ for the drive level dependence as a function of the resistances $R_{12}$ or $R_{13}$ .....	9
Figure B.1 – Insertion of a quartz crystal unit in an oscillator .....	15
Figure B.2 – Crystal unit loss resistance as a function of dissipated power.....	16
Figure B.3 – Behaviour of the $R_r$ of a quartz crystal unit.....	17
Figure B.4 – Block diagram of circuit system .....	17
Figure B.5 – Installed $-R_{osc}$ in scanned drive level range.....	18
Figure B.6 – Drive level behaviour of a quartz crystal unit if $-R_{osc} = 70 \Omega$ is used as test limit in the Annex B test.....	18
Figure B.7 – Principal schematic diagram of the go/no-go test circuit .....	19

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IEC 60444-6 has been prepared by IEC technical committee 49: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection. It is an International Standard.

This third edition cancels and replaces the second edition published in 2013. This edition constitutes a technical revision.

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

- a) some equations have been removed and corrected;
- b) it has been specified in the note of the Scope that the measurement methods specified in this document are not only applicable to AT-cut but also to other crystal cuts and vibration modes.

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

FDIS	Report on voting
49/1374/FDIS	49/1377/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

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## INTRODUCTION

The drive level (expressed as power/voltage across or current through the crystal unit) forces the resonator to produce mechanical oscillations by way of piezoelectric effect. In this process, the acceleration work is converted to kinetic and elastic energy and the power loss to heat. The latter conversion is due to the inner and outer friction of the quartz resonator.

The frictional losses depend on the velocity of the vibrating masses and increase when the oscillation is no longer linear or when critical velocities, elongations or strains, excursions or accelerations are attained in the quartz resonator or at its surfaces and mounting points (see Annex A). This causes changes in resistance and frequency, as well as further changes due to the temperature dependence of these parameters.

At “high” drive levels (e.g. above 1 mW or 1 mA for AT-cut crystal units) changes are observed by all crystal units and these also can result in irreversible amplitude and frequency changes. Any further increase of the drive level may could destroy the resonator.

Apart from this effect, changes in frequency and resistance are observed at “low” drive levels in some crystal units (e.g. below 1  $\mu$ W or 50  $\mu$ A for AT-cut crystal units). In this case, if the loop gain is not sufficient, the start-up of the oscillation is difficult. In crystal filters, the transducer attenuation and ripple will change.

Furthermore, the coupling between a specified mode of vibration and other modes (e.g. of the resonator itself, the mounting and the back-fill gas) also depends on the level of drive.

Due to the differing temperature response of these modes, these couplings give rise to changes of frequency and resistance of the specified mode within narrow temperature ranges. These changes increase with increasing drive level. However, this effect will not be considered further in this part of IEC 60444.

In this new edition, the concept of DLD in IEC 60444-6:2013 is maintained. However, the more suitable contents for the user’s severe requirements have been introduced.