SLOVENSKI STANDARD
SIST EN 60444-6:2002

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Measurement of quartz crystal unit parameters - Part 6: Measurement of drive level dependence (DLD) (IEC 60444-6:1995)

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

Messung von Schwingquarz-Kennwerten -- Teil 6: Messung der Belastungsabhängigkeit (DLD)

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

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English version

Measurement of quartz crystal unit parameters
Part 6: Measurement of drive level dependence (DLD)
(IEC 444-6:1995)

Mesure des paramètres des résonateurs à quartz
Partie 6: Mesure de la dépendance du niveau d'excitation (DNE)
(CEI 444-6:1995)

Messung von Schwingquarz-Kennwerten
Teil 6: Messung der Belastungsabhängigkeit (DLD)
(IEC 444-6:1995)

This European Standard was approved by CENELEC on 1997-03-11. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of the International Standard IEC 444-6:1995, prepared by IEC TC 49, Piezoelectric and dielectric devices for frequency control and selection, was submitted to the formal vote and was approved by CENELEC as EN 60444-6 on 1997-03-11 without any modification.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-12-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1997-12-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annexes A and ZA are normative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 444-6:1995 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE: When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 444-1	1986	Measurement of quartz crystal unit parameters by zero phase technique in a pi-network Part 1: Basic method for the measurement of resonance frequency and resonance resistance of quartz crystal units by zero phase technique in a pi-network	EN 60444-1	1997

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Mesure des paramètres des résonateurs à quartz –

Partie 6:
Mesure de la dépendance du niveau d'excitation (DNE)

Measurement of quartz crystal unit parameters –

Part 6:
Measurement of drive level dependence (DLD)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

MEASUREMENT OF QUARTZ CRYSTAL UNIT PARAMETERS –

Part 6: Measurement of drive level dependence (DLD)

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international cooperation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. 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. The 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 the IEC on technical matters, prepared by technical committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.

3) They have the form of recommendations for international use published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.

International Standard IEC 444-6 has been prepared by IEC technical committee 49: Piezoelectric and dielectric devices for frequency control and selection.

It forms part 6 of a series of publications dealing with the measurement of quartz crystal unit parameters.

Part 1: *Basic method for the measurement of resonance frequency and resonance resistance of quartz crystal units by zero phase technique in a π-network*, is issued as IEC 444-1 (second edition, 1986).

Part 2: *Phase offset method for measurement of motional capacitance of quartz crystal units*, is issued as IEC 444-2 (1980).

Part 3: *Basic method for the measurement of two-terminal parameters of quartz crystal units up to 200 MHz by phase technique in a π-network with compensation of the parallel capacitance C_o*, is issued as IEC 444-3 (1986).

Part 4: *Method for the measurement of the load resonance frequency f_L, load resonance resistance R_L, and the calculation of other derived values of quartz crystal units, up to 30 MHz*, is issued as IEC 444-4 (1988).

Part 5: *Reference method of the measurement of crystal units, using automatic network analyzer techniques for the determination of equivalent electrical parameters,* will be issued as IEC 444-5.

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

DIS	Report on voting
49(CO)273	49/284/RVD

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

Annex A forms an integral part of this standard.

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 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 µW or 50 µA 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 444.