Irish Standard
I.S. EN 60444-11:2010

Measurement of quartz crystal unit parameters -- Part 11: Standard method for the determination of the load resonance frequency fL and the effective load capacitance CLeff using automatic network analyzer techniques and error correction (IEC 60444 -11:2010 (EQV))

I.S. EN 60444-11:2010

Incorporating amendments/corrigenda issued since publication:

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SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

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EN 60444-11

November 2010

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English version

Measurement of quartz crystal unit parameters - Part 11: Standard method for the determination of the load resonance frequency f_L and the effective load capacitance C_{Leff} using automatic network analyzer techniques and error correction

(IEC 60444-11:2010)

Mesure des paramètres des résonateurs à quartz -
Partie 11: Méthode normalisée pour la détermination de la fréquence de résonance à la charge f_L et de la capacité de charge efficace C_{Leff} utilisant des analyseurs automatiques de réseaux et correction des erreurs
(CEI 60444-11:2010)

Messung von Schwingquarz-Parametern - Teil 11: Standardverfahren zur Bestimmung der Lastresonanzfrequenz f_L und der effektiven Lastkapazität C_{Leff} mit automatischer Netzwerkanalysatortechnik und Fehlerkorrektur
(IEC 60444-11:2010)

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CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 60444-11:2010 E

Foreword

The text of document 49/852/CDV, future edition 1 of IEC 60444-11, 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 was approved by CENELEC as EN 60444-11 on 2010-11-01.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

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)	2011-08-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2013-11-01

Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 60444-11:2010 was approved by CENELEC as a European Standard without any modification.

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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.

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 60122-1	2002	Quartz crystal units of assessed quality - Part 1: Generic specification	EN 60122-1	2002
IEC/TR 60444-4	-	Measurement of quartz crystal unit parameters by zero phase technique in a pi-network - Part 4: Method for the measurement of the load resonance frequency fL, load resonance resistance RL and the calculation of other derived values of quartz crystal units, up to 30 MHz	EN 60444-4	-
IEC 60444-5	1995	Measurement of quartz crystal unit parameters - Part 5: Methods for the determination of equivalent electrical parameters using automatic network analyzer techniques and error correction	EN 60444-5	1997

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 60444-11 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 standard is based on the following documents:

CDV	Report on voting
49/852/CDV	49/883/RVC

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

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

A list of all parts of the IEC 60444 series under the general title *Measurement of quartz crystal unit parameters* can be found on the IEC website.

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

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.

MEASUREMENT OF QUARTZ CRYSTAL UNIT PARAMETERS –

Part 11: Standard method for the determination of the load resonance frequency f_L and the effective load capacitance C_{Leff} using automatic network analyzer techniques and error correction

1 Scope

This part of IEC 60444 defines the standard method of measuring load resonance frequency f_L at the nominal value of C_L, and the determination of the effective load capacitance C_{Leff} at the nominal frequency for crystals with the figure of merit $M > 4$.

M, according to Table 1 of IEC 60122-1:2002, is expressed in the following equation:

$$M = \frac{Q}{r} = \frac{1}{\omega C_0 R_1} \tag{1}$$

This gives good results in a frequency range up to 200 MHz. This method allows the calculation of load resonance frequency offset Δf_L, frequency pulling range $\Delta f_{L1,L2}$ and pulling sensitivity S as described in 2.2.31 of IEC 60122-1:2002. In contrary to the simple method of IEC 60444-4, this measurement technique avoids the use of physical load capacitors, and allows higher accuracy, better reproducibility and correlation to the application. It extends the upper frequency limit from 30MHz by the method of IEC 60444-4 to 200MHz approximately. This method is based on the error-corrected measurement technique of IEC 60444-5:1995, and therefore allows the measurement of f_L and C_{Leff} together with the determination of the equivalent crystal parameters in one sequence without changing the test fixture.

With this method the frequency f_L is searched where the reactance X_C of the crystal has the opposite value of the reactance of the load capacitance.

$$X_C = -X_{CL} = \frac{1}{\omega_L C_L} \tag{2}$$

Furthermore this method allows to determine the effective load capacitance C_{Leff} at the nominal frequency f_{nom}.

2 Normative references

The following referenced documents are indispensable for the application 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 60122-1:2002, *Quartz crystal units of assessed quality – Part 1: Generic specification*

IEC/TR 60444-4, *Measurement of quartz crystal unit parameters by zero phase technique in a π-network – 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*

IEC 60444-5:1995, *Measurement of quartz crystal units parameters – Part 5: Methods for the determination of equivalent electrical parameters using automatic network analyzer techniques and error correction*