

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Surface acoustic wave (SAW) resonators –
Part 1: Generic specification

Résonateurs à ondes acoustiques de surface (OAS) –
Partie 1: Spécification générique

ITW STANDARD PREVIEW
(standards.iteh.ai)

<https://standards.iteh.ai/catalog/standards/sist/4f01724e-30cf-40dc-a6b0-43182b615651/iec-61019-1-2004>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2004 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,...). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:

Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00



IEC 61019-1

Edition 1.0 2004-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Surface acoustic wave (SAW) resonators –
Part 1: Generic specification

Résonateurs à ondes acoustiques de surface (OAS) –
Partie 1: Spécification générique

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

W

ICS 31.140

ISBN 978-2-88912-596-8

CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references	6
3 Order of precedence.....	8
4 Terms and definitions	8
4.1 General terms	8
4.2 Operational properties.....	11
5 Preferred values for ratings and characteristics	19
5.1 Standard nominal frequency values in megahertz (MHz)	19
5.2 Standard operating temperature ranges in degrees Celsius (°C)	19
5.3 Standard values of load capacitance in picofarads (pF).....	19
5.4 Standard levels of drive in milliwatts (mW)	19
5.5 Standard values of minimum insertion attenuation in decibels (dB).....	19
5.6 Standard climatic category	20
5.7 Bump severity	20
5.8 Vibration severity	20
5.9 Shock severity.....	20
5.10 Fine leak rate.....	21
6 Marking	21
6.1 Resonator marking	21
6.2 Package marking.....	21
7 Quality assessment procedures.....	21
7.1 Primary stage of manufacture.....	21
7.2 Structurally similar components	21
7.3 Subcontracting	22
7.4 Incorporated components	22
7.5 Manufacturer's approval	22
7.6 Approval procedures	22
7.7 Procedures for capability approval	23
7.8 Procedures for qualification approval.....	23
7.9 Test procedures	24
7.10 Screening requirements	24
7.11 Rework and repair work.....	24
7.12 Certified records of released lots	24
7.13 Validity of release.....	24
7.14 Release for delivery	24
7.15 Unchecked parameters.....	24
8 Test and measurement procedures.....	24
8.1 General	24
8.2 Test and measurement conditions	25
8.3 Visual inspection	26
8.4 Dimensions and gauging procedures	26
8.5 Measurement method of one-port resonator	26
8.6 Measurement method of two-port resonator.....	28
8.7 Mechanical and environmental test procedures	32

8.8	Endurance test procedure	37
Figure 1	– Basic configurations of SAW resonators	9
Figure 2	– One-port resonator equivalent circuit	12
Figure 3	– Vector admittance diagram of a one-port SAW resonator	14
Figure 4	– Typical frequency characteristics of a one-port SAW resonator inserted into a transmission line in series (see 4.2.10.2.1 and 4.2.10.3.1)	14
Figure 5	– Resonance and anti-resonance frequencies	15
Figure 6	– Two-port resonator equivalent circuits	17
Figure 7	– Typical frequency characteristics of a two-port resonator	18
Figure 8	– Reflection measurement	27
Figure 9	– Transmission measurement	29

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[IEC 61019-1:2004](#)

<https://standards.iteh.ai/catalog/standards/sist/4f01724e-30cf-40dc-a6b0-43182b615651/iec-61019-1-2004>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SURFACE ACOUSTIC WAVE (SAW) RESONATORS –

Part 1: Generic specification

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 61019-1 has been prepared by IEC technical committee 49: Piezoelectric and dielectric devices for frequency control and selection.

This first edition of IEC 61019-1 cancels and replaces the first edition of IEC 61019-1-1 published in 1990 and the first edition of IEC 61019-1-2 published in 1993. It constitutes a technical revision.

This bilingual version (2011-07) replaces the English version.

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

FDIS	Report on voting
49/689/FDIS	49/698/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.

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

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

IEC 61019 consists of the following parts under the general title *Surface acoustic wave (SAW) resonators*:

Part 1: Generic specification

Part 2: Guide to the use (at present under revision)

Part 3: Standard outlines and lead connections

The committee has decided that the contents of this 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.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC 61019-1:2004](#)

<https://standards.iteh.ai/catalog/standards/sist/4f01724e-30cf-40dc-a6b0-43182b615651/iec-61019-1-2004>

SURFACE ACOUSTIC WAVE (SAW) RESONATORS –

Part 1: Generic specification

1 Scope

This part of IEC 61019 specifies the methods of test and general requirements for SAW resonators using either capability approval or qualification approval procedures of the IECQ system.

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 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050-561:1991, *International Electrotechnical Vocabulary (IEC) – Chapter 561: Piezo-electric devices for frequency control and selection*

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1:1990, *Environmental testing – Part 2: Tests – Tests A: Cold*

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Tests B: Dry heat*

IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-7:1983, *Environmental testing – Part 2: Tests – Test Ga and guidance: Acceleration, steady state*

IEC 60068-2-13:1983, *Environmental testing – Part 2: Tests – Test M: Low air pressure*

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests – Test N: Change of temperature*

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

IEC 60068-2-20:1979, *Environmental testing – Part 2: Tests – Test T: Soldering*

IEC 60068-2-21:1999, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27:1987, *Environmental testing – Part 2: Tests – Test Ea and guidance: Shock*

IEC 60068-2-29:1987, *Environmental testing – Part 2: Tests – Test Eb and guidance: Bump*

IEC 60068-2-30:1980, *Environmental testing – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)*

IEC 60068-2-32:1975, *Environmental testing – Part 2: Tests – Test Ed: Free fall*

IEC 60068-2-45:1980, *Environmental testing – Part 2: Tests – Test XA and guidance: Immersion in cleaning solvents*

IEC 60068-2-52:1996, *Environmental testing – Part 2: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-58:1999, *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 60068-2-64:1993, *Environmental testing – Part 2: Tests – Test Fh: Vibration, broad-band random (digital control) and guidance*

IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60617 – DB:2001¹ *Graphical symbols for diagrams*

IEC 60122-1:2002, *Quartz crystal units of assessed quality – Part 1: Generic specification*

IEC 60444 (all parts), *Measurement of quartz crystal unit parameters*

IEC 61000-4-2:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 2: Electrostatic discharge immunity test* – Basic EMC Publication

IEC 61019-2:1995, *Surface acoustic wave (SAW) resonators – Part 2: Guide to the use*

IEC 61019-3:1991, *Surface acoustic wave (SAW) resonators – Part 3: Standard outlines and lead connections* IEC 61019-1:2004
<https://standards.iteh.ai/catalog/standards/sist/4f01724e-30cf-40dc-a6b0-43182b615651/iec-61019-1-2004>

QC 001001:2002, *IEC Quality Assessment System for Electronic Components (IECQ) – Basic Rules*

QC 001002-2:1998, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of Procedure – Part 2: Documentation*

QC 001002-3:1998, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of Procedure – Part 3: Approval procedures*

QC 001005:2003, *IEC Quality Assessment System for Electronic Components (IECQ) – Register of Firms, Products and Services approved under the IECQ System, including ISO 9000*

ISO 1000:1992, *SI units and recommendations for the use of their multiples and of certain other units*

¹ DB refers to the IEC on-line database.

3 Order of precedence

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

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

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

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

Units, graphical symbols, letter symbols and terminology shall, wherever possible, be taken from the following standards: IEC 60027, IEC 60050-561, IEC 60122-1, IEC 60617, IEC 60642, ISO 1000.

4.1 General terms

4.1.1

surface acoustic wave (SAW) (standards.iteh.ai)

acoustic wave, propagating along the surface of an elastic substrate, whose amplitude decays exponentially with substrate depth

[IEC 61019-1:2004](#)

4.1.2

surface acoustic wave resonator (SAW resonator or SAWR)

resonator using multiple reflections of surface acoustic waves

[https://standards.iteh.ai/catalog/standards/sist/4f01724e-30cf-40dc-a6b0-](https://standards.iteh.ai/catalog/standards/sist/4f01724e-30cf-40dc-a6b0-43182b615651/iec-61019-1-2004)

[43182b615651/iec-61019-1-2004](#)

4.1.3

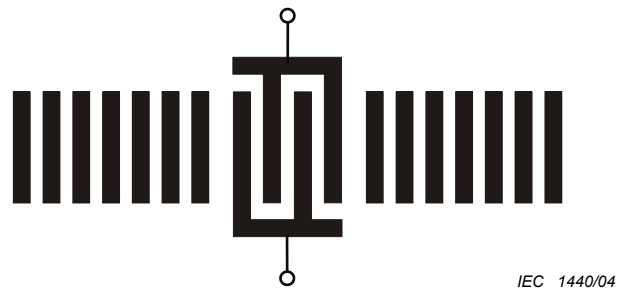
one-port resonator

SAW resonator having a pair of terminals (see 4.2.10 and Figure 1)

4.1.4

two-port resonator

SAW resonator having input and output ports (see 4.2.11 and Figure 1)



IEC 1440/04

a) One-port resonator with opened arrays



IEC 1441/04

b) Two-port resonator with shorted arrays

IEC 61019-1:2004

Figure 1. Basic configurations of SAW resonators-
43182b615651/iec-61019-1-2004

4.1.5

SAW resonator oscillator

oscillator that uses a SAW resonator as the main frequency controlling element

4.1.6

interdigital transducer (IDT)

SAW transducer made of a comb-like conductive structure deposited on a piezoelectric substrate transforming electrical energy into acoustic energy or vice versa

4.1.7

finger

element of the IDT comb electrode

4.1.8

dummy finger

passive finger which may be included in order to suppress wave-front distortion

4.1.9

bus bar

common electrode which connects individual fingers together and also connects the resonator to an external circuit

4.1.10

shorting bar

common electrode which interconnects individual metal strips (see Figure 1)

4.1.11

apodization (spurious suppression for SAW resonator)

weighting produced by the change in finger overlap over the length of the IDT to suppress the transverse spurious modes

4.1.12

SAW coupling coefficient

$$k_S^2$$

SAW electromechanical coupling coefficient is defined as follows:

$$k_S^2 = 2 \left| \frac{\Delta v}{v} \right|$$

where $\Delta v/v$ is the relative velocity change produced by short-circuiting the surface potential from the open-circuit condition

4.1.13

grating reflector

SAW reflecting array that normally makes use of the periodic discontinuity provided by metal strips, grooves or ridges

4.1.14

metal strip array

periodic discontinuity realised by electrically short- or open-circuit metal strips providing electrical and mass-loaded perturbations

4.1.15

grooved array

periodic discontinuity realized by topographic perturbation on a surface having shallow grooves

4.1.16

ridge array

periodic discontinuity realized by the mass-loaded perturbation of the surface having thin layer strips

4.1.17

shorted array

metal strip array interconnected with a shorting bar (see Figure 1b))

4.1.18

opened array

metal strip array without a metal strip array interconnection (see Figure 1a))

4.1.19

mass loading

perturbation in the SAW propagation caused by the mass of an overlay on the substrate surface

4.1.20

IDT aperture

maximum IDT finger overlap length which approximately corresponds to the SAW beamwidth, where the aperture may be expressed in length units or normalized term of wavelength

4.2 Operational properties

4.2.1

nominal frequency

frequency given by the manufacturer or the specification to identify the resonator

4.2.2

working frequency

f_w

operational frequency of the resonator together with its associated circuits

4.2.3

frequency tolerance

4.2.3.1

overall tolerance

maximum permissible deviation of the working frequency from the nominal frequency due to a specific cause or a combination of causes

4.2.3.2

adjustment tolerance

permissible deviation of the working frequency from the nominal frequency at the reference temperature under specified conditions

4.2.3.3

ageing tolerance

permissible deviation due to time under specified conditions

4.2.3.4

tolerance over the temperature range

permissible deviation over the temperature range with respect to the frequency at the specified reference temperature

4.2.3.5

tolerance due to level of drive variation

permissible deviation due to the level of drive variation

4.2.4

operating temperature range

range of temperatures as measured on the enclosure over which the resonator must function within the specified tolerances

4.2.4.1

operable temperature range

range of temperatures as measured on the enclosure over which the resonator must function though not necessarily within the specified tolerances

4.2.4.2

storage temperature range

range of temperatures over which the resonator can be stored without causing permanent change in the performance beyond the specified tolerances

4.2.4.3

reference temperature

temperature at which certain resonator measurements are made. For controlled temperature resonators, the reference temperature is the mid-point of the controlled temperature range. For non-controlled temperature resonators, the reference temperature is normally $25\text{ °C} \pm 2\text{ °C}$

iTeh STANDARD PREVIEW
(standards.iteh.ai)

IEC 61019-1:2004

<https://standards.iteh.ai/catalog/standards/sist/4f01724e-30cf-40dc-a6b0-451826615651/iec-61019-1-2004>

4.2.5

spurious resonance

state of resonance of a resonator other than that frequency associated with the working frequency

4.2.6

transverse spurious resonance

spurious resonance caused by excitation of higher order transverse modes which appear at slightly higher frequencies. It is desirable to apodize the interdigital transducer to match the desired transverse mode profile

4.2.7

level of drive

measure of the operating conditions imposed upon the resonator expressed in terms of power dissipated

NOTE In special cases the level of drive may be specified in terms of resonator current or voltage.

4.2.8

d.c. breakdown voltage

lowest d.c. voltage which causes the destruction of the resonator

4.2.9

ageing (long-term parameter variation)

relationship which exists between any parameter (for example, resonance frequency) and time

NOTE Such a parameter variation is due to long-term changes in the resonator and is usually expressed in fractional parts per period of time.

4.2.10

one-port SAW resonator

IEC 61019-1:2004

[https://standards.iteh.ai/catalog/standards/sist/4f01724e-30cf-40dc-a6b0-](https://standards.iteh.ai/catalog/standards/sist/4f01724e-30cf-40dc-a6b0-43182b615651/iec-61019-1-2004)

[43182b615651/iec-61019-1-2004](https://standards.iteh.ai/catalog/standards/sist/4f01724e-30cf-40dc-a6b0-43182b615651/iec-61019-1-2004)

4.2.10.1

one-port resonator equivalent circuit

electrical circuit which has the same impedance as the resonator in the immediate neighbourhood of resonance. It is usually represented by a parallel capacitance shunted by a motional (series) arm. The motional (series) arm, in its turn, is represented by an inductance, capacitance and resistance in series. The parameters of the motional (series) arm of inductance, capacitance and resistance are usually given by L_1 , C_1 and R_1 respectively. The shunt capacitance is given by C_0 (see Figure 2)

NOTE The characteristic frequencies which occur in the resonance neighbourhood can be completely defined by considering the resistance and the reactance of the resonator as a function of frequency and from the impedance and admittance diagrams described in Figure 3, and IEC 60122-1, to which reference should be made.

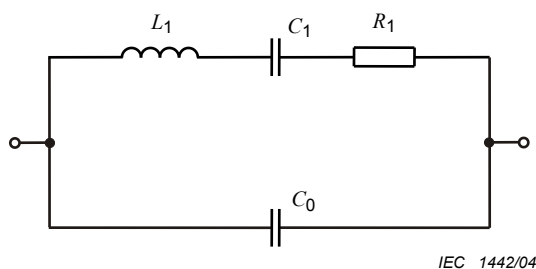


Figure 2 – One-port resonator equivalent circuit

4.2.10.2 resonance frequencies

4.2.10.2.1 frequency of maximum admittance (minimum impedance)

f_m
frequency at which the resonator exhibits a maximum admittance in the immediate neighbourhood of resonance (see Figures 3 and 4)

4.2.10.2.2 motional (series) resonance frequency

f_s
resonance frequency of the motional (series) arm of the equivalent circuit of the resonator (see Figure 3)

4.2.10.2.3 resonance frequency of zero susceptance

f_r
lower of the two frequencies of the resonator alone, under specified conditions at which the electrical impedance of the resonator is resistive (see Figure 3)

4.2.10.3 anti-resonance frequencies

4.2.10.3.1 frequency of minimum admittance (maximum impedance)

f_n
frequency at which the resonator exhibits a minimum admittance in the immediate neighbourhood of resonance (see Figures 3 and 4)

4.2.10.3.2 parallel resonance frequency (lossless)

f_p
frequency of parallel resonance of the motional (series) arm and the shunt capacitance (see Figure 3)

4.2.10.3.3 anti-resonance frequency of zero susceptance

f_a
higher of the two frequencies of a resonator alone, under specified conditions at which the electrical impedance of the resonator is resistive (see Figure 3)

4.2.10.4 motional resistance

R_1
resistance of the motional (series) arm of the equivalent circuit (see Figure 2)

4.2.10.5 motional capacitance

C_1
capacitance of the motional (series) arm of the equivalent circuit (see Figure 2)

4.2.10.6 motional inductance

L_1
inductance of the motional (series) arm of the equivalent circuit (see Figure 2)