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TECHNICAL SPECIFICATION

Piezoelectric and dielectric devices for frequency control and selection – Glossary – Part 1: Piezoelectric and dielectric resonators

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Piezoelectric and dielectric devices for frequency control and selection – Glossary – Part 1: Piezoelectric and dielectric resonators

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PIEZOELECTRIC AND DIELECTRIC DEVICES FOR FREQUENCY CONTROL AND SELECTION – GLOSSARY –

Part 1: Piezoelectric and dielectric resonators

FOREWORD

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IEC 61994-1, which is a technical specification, has been prepared by IEC technical committee 49: Piezoelectric and dielectric devices for frequency control and selection.

This second edition of IEC 61994-1 cancels and replaces the first edition published in 2003. This edition constitutes a technical revision.

The main changes with respect to the previous edition are listed below:

– definitions updated;
– terminology given in orderly sequence;

– drawings inserted for easier understanding.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
49/761/DTS	49/766/RVC

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

This publication has been drafted in accordance with the IS0/IEC Directives, Part 2.

IEC 61994 consists of the following parts under the general title: *Piezoelectric and dielectric devices for frequency control and selection – Glossary*:

- Part 1: Piezoelectric and dielectric resonators
- Part 2: Piezoelectric and dielectric filters
- Part 3: Piezoelectric oscillators
- Part 4-1: Piezoelectric materials – Synthetic quartz crystal
- Part 4-2: Piezoelectric and dielectric materials – Piezoelectric ceramics
- Part 4-3: Materials for dielectric devices[1]
- Part 4-4: Materials – Materials for Surface Acoustic Wave (SAW) devices

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

- transformed into an international standard;
- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

[1] To be published.

PIEZOELECTRIC AND DIELECTRIC DEVICES FOR FREQUENCY CONTROL AND SELECTION – GLOSSARY –

Part 1: Piezoelectric and dielectric resonators

1 Scope

This technical specification gives the terms and definitions for piezoelectric and dielectric resonators representing the present state-of-the-art, which are intended for use in the standards and documents of IEC technical committee 49.

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 60050(561):1991, *International Electrotechnical Vocabulary (IEV) – Chapter 561: Piezoelectric devices for frequency control and selection*
Amendment 1 (1995)

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

IEC 60642:1979, *Piezoelectric ceramic resonators and resonator units for frequency control and selection – Chapter I: Standard values and conditions – Chapter II: Measuring and test conditions*

IEC 61019-1:2004, *Surface acoustic wave (SAW) resonators – Part 1: Generic specification*

IEC 61338-1:2004, *Waveguide type dielectric resonators – Part 1: Generic specification*

3 Terms and definitions

3.1
adjustment tolerance
the maximum permissible deviation of the working frequency of a piezoelectric resonator from the nominal frequency at the reference temperature under specified conditions

[IEV 561-02-16 modified]

3.2
ageing tolerance
the maximum permissible deviation of the working frequency of a piezoelectric resonator from its initial frequency which is observed with the passage of time under specified conditions

[IEV 561-02-17 modified]

3.3
ageing – long-term parameter variation
relationship which exists between any parameter (for example resonance frequency) and time

[IEC 61019-1, 4.2.9]

3.4
apodisation (spurious suppression for SAW devices)
weighting method produced by the change in finger overlap over the length of the IDT to suppress the transverse spurious modes

[IEV 561-06-18 modified]

3.5
anti-resonance frequency

f_a

the higher of two frequencies of a piezoelectric resonator vibrating alone, under specified conditions, at which the electrical impedance of the resonator is resistive

[IEV 561-02-10]

3.6
bus bar

common electrode region of an IDT which connects individual fingers together and also connects the IDT to an external circuit (see Figure 5)

[IEV 561-06-15 modified]

3.7
capacitance ratio

$$r = \frac{C_0}{C_1}$$

where C_0 and C_1 represent the shunt capacitance and the motional capacitance respectively in the equivalent circuit (see Figure 2)

the capacitance ratio indicates one of the merits of the resonator

[IEC 61019-1, 4.2.10.9 modified]

3.8
centre frequency of a two-port SAW resonator

f_c

arithmetic mean of two frequencies at which the attenuation relative to the minimum insertion attenuation reaches a specified value

[IEC 61019-1, 4.2.11.9]

3.9
clamped capacitance (of a piezoelectric resonator)

the capacitance of a piezoelectric resonator measured at a frequency well above any pronounced resonance

NOTE In practice, the value of the capacitance is often indirectly determined, because a direct measurement is affected by the presence of factors such as lead inductance.

[IEV 561-02-35]

3.10
coaxial dielectric resonator

dielectric resonator characterized by a TEM mode field distribution with a coaxial waveguide structure of finite length

[IEC 61338-1, 2.2.19]

3.11
coplanar resonator
dielectric resonator characterised by a TEM mode field distribution. The structure is a coplanar-line waveguide of finite length

[IEC 61338-1, 2.2.4]

3.12
coupling coefficient of SAW materials
$\boldsymbol{k_S}$
the 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

[IEC 60862-2, 3.1.8; IEC 61019-1, 4.1.12]

3.13
crystal element
piezoelectric substrate cut to a given geometric shape, size and orientation with respect to the crystallographic axes of the crystal

[IEC 60122-1, 2.2.1]

3.14
crystal resonator
the mounted crystal element that vibrates when an alternating electric field is applied between the electrodes

[IEC 60122-1, 2.2.3 modified]

3.15
crystal unit
a crystal resonator mounted in an enclosure

[IEC 60122-1, 2.2.7]

3.16
d.c. breakdown voltage
the lowest d.c. voltage which causes the destruction of the resonator

[IEC 61019-1, 4.2.8]

3.17
dielectric material
material which predominantly exhibits dielectric properties

[IEC 61338-1, 2.2.1]

3.18
dielectric resonator
resonator using dielectrics with a high dielectric constant (ε_r) and the structure of which is a dielectric waveguide of finite length as shown in Figure 1

[IEC 61338-1, 2.2.10]

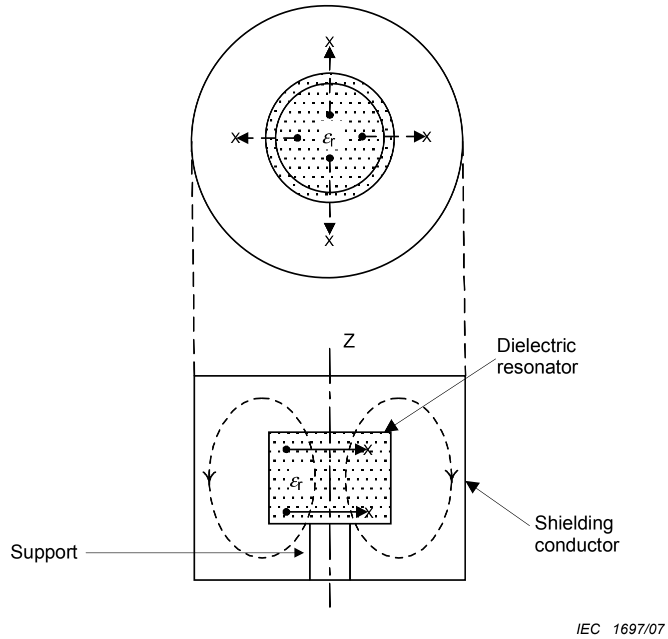


Figure 1 – Configuration of a dielectric resonator ($TE_{01\delta}$ mode type)

3.19
dielectric support
element supporting a dielectric resonator. The support is generally used for $TE_{01\delta}$ mode resonators and has a low dielectric constant (see Figure 1)

[IEC 61338-1, 2.2.11]

3.20
drive level dependency
DLD
the permissible deviation of resonance frequency due to variation of the level of drive. The effect of changes in drive level conditions upon the resonance resistance of the crystal unit

[IEC 60122-1, 2.2.37 modified]

3.21
electrode (of piezoelectric resonator)
an electrically conductive plate in proximity to or film in contact with a face of a crystal or ceramic element by means of which a polarizing or driving field is applied to the element

[IEC 60122-1, 2.2.2 modified]

3.22
electromechanical coupling factor (of piezoelectric resonator)
a certain combination of elastic, dielectric and piezoelectric constants which appears naturally in the expression of impedance of a resonator. A different factor arises in each particular family of mode of vibration. The factor is closely related to the relative frequency spacing and is a convenient measure of piezoelectric transduction.

Alternatively, the coupling factor may be interpreted as the square root of the ratio of the electrical or mechanical work which can be accomplished to the total energy stored from a mechanical or electrical power source for a particular set of boundary conditions

[IEC 60642, 3.2.14 modified]

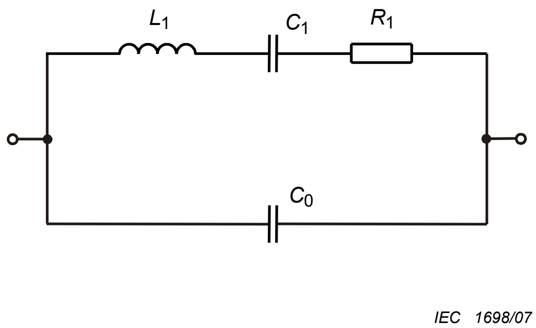
3.23
enclosure
an enclosure of specific outline dimensions and material with a defined method of sealing protecting the resonator and providing means of electrical connections to the circuit

[IEV 561-01-12 modified, IEC 60122-1, 2.2.5 modified, IEC 60642, 3.1.5 modified]

3.24
equivalent circuit (of piezoelectric resonators)
the electrical circuit which has the same characteristics as a piezoelectric resonator in the immediate neighbourhood of resonance

NOTE For example, one port piezoelectric resonator consists of series element L_1, C_1, R_1 in parallel with C_0, as shown in Figure 2 where L_1, C_1, R_1 represent the motional inductance, capacitance and resistance respectively and C_0 the shunt capacitance. The circuit of Figure 2 has the same impedance as a piezoelectric resonator in the neighbourhood of resonance.

[IEV 561-02-07 modified]



Key

L_1 motional inductance

C_1 motional capacitance

R_1 motional resistance

C_0 shunt capacitance (static capacitance)

$Z = R_e + jX_e$ impedance of the circuit

Figure 2 – Equivalent circuit of a piezoelectric vibrator (one-port resonator)

3.25
external quality factor
$\boldsymbol{Q_e}$
quality factor due to the energy loss in the external circuit, excluding the energy dissipated in the resonator

[IEC 61338-1, 2.2.27]

3.26
figure of merit

$$M = Q / r$$

where

Q is the quality factor,

r is the capacitance ratio.

the value indicates the activity of the resonator

[IEC 60122-1, IEC 61019-1, 4.2.10.10 modified]

3.27
fractional load resonance frequency offset

$$D_{\mathrm{L}} = \frac{f_{\mathrm{L}} - f_{\mathrm{r}}}{f_{\mathrm{r}}} \cong \frac{C_1}{2\,(C_0 + C_{\mathrm{L}})}$$

where

f_r is the resonance frequency;

f_L is the load resonance frequency;

C_1 is the motional capacitance;

C_0 is the shunt capacitance;

C_L is the load capacitance.

the value indicates the active frequency region ratio to the resonance frequency

[IEC 60122-1, 2.2.28 modified]

3.28
fractional pulling range
a statement of the available change in resonance frequency over a particular change of load capacitance, divided by the resonance frequency of the device alone

[IEC 60122-1, modified]

3.29
free capacitance (of a piezoelectric resonator)
the capacitance of a piezoelectric resonator measured at a frequency well below the lowest resonance frequency

NOTE Stray capacitance between resonator terminals is included in free capacitance.

[IEV 561-02-34 modified]

3.30
frequency of minimum impedance (maximum admittance)
f_m
frequency at which the resonator exhibits a minimum impedance (maximum admittance) in the immediate neighbourhood of resonance as shown in Figure 3

NOTE The equivalent circuit of the resonator is shown in Figure 2.

[IEC 61019-1, 4.2.10.3.1, IEC 60122-1, modified]

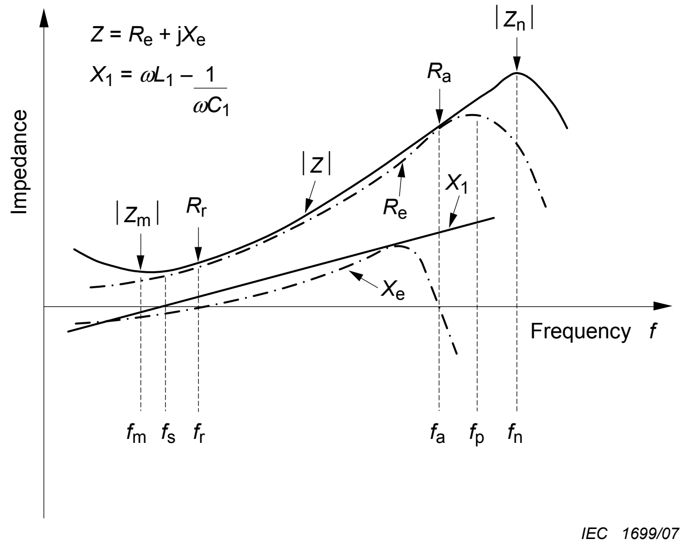


Figure 3 – Frequency characteristics of the impedance near resonance

3.31
frequency of maximum impedance (minimum admittance)
$\boldsymbol{f_n}$
frequency at which the resonator exhibits a maximum impedance (minimum admittance) in the immediate neighbourhood of resonance as shown in Figure 3

[IEC 60122-1, modified]

3.32
frequency pulling range
a statement of the available change in resonance frequency over a particular change of load capacitance

[IEC 60122-1, 2.2.29 modified]

3.33
frequency tolerance
the maximum permissible deviation of a specified characteristic frequency from the specified value due to a specific cause, or a combination of causes

[IEC 60122-1, 2.2.39 modified, IEC 60642, 3.3.2]

3.34
frequency range
range where any frequency can be assigned as nominal frequency of a resonator (unit)

[IEC 60642, 3.3.3]

3.35
fundamental crystal unit
a crystal resonator designed to operate at the lowest order of a given mode

[IEC 60122-1, 2.2.10]

3.36
fundamental mode
the lowest mode in a given family of vibration

[IEC 60642, 3.1.7]

3.37
half wavelength resonator
resonator characterised by any guided mode field distribution with standing wave of a half wavelength of TEM mode

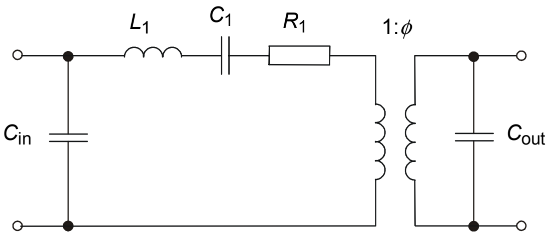
[IEC 61338-1, 2.2.21]

3.38
hybrid mode dielectric resonator
dielectric resonator characterised by a hybrid mode field distribution. Hybrid mode is the mode which has axial components both of the electric and magnetic fields

[IEC 61338-1, 2.2.16]

3.39
input capacitance (two-port SAW resonator)
C_{in}
capacitance which shunts the input port of the resonator equivalent circuit as shown in Figure 4

[IEC 61019-1, 4.2.11.2]



IEC 1700/07

Key

L_1	motional inductance	C_{in}	input capacitance
C_1	motional capacitance	C_{out}	output capacitance
R_1	motional resistance	ϕ	turns ratio

Figure 4 – Equivalent circuit for a two-port SAW resonator

3.40
insertion attenuation (of a two-port SAW resonator)
logarithmic ratio of the power delivered to the load impedance before and after insertion of the resonator

[IEC 61019-1, 4.2.11.7]

3.41
interdigital transducer
IDT
the SAW transducer. It is made of a comb-like conductive structure that is deposited on the piezoelectric substrate and consists of interleaved metal electrodes (fingers) whose function is to transform electrical energy into acoustic energy or vice versa by means of the piezoelectric effect. The typical configuration of an IDT is shown in Figure 5

[IEV 561-06-09 modified]

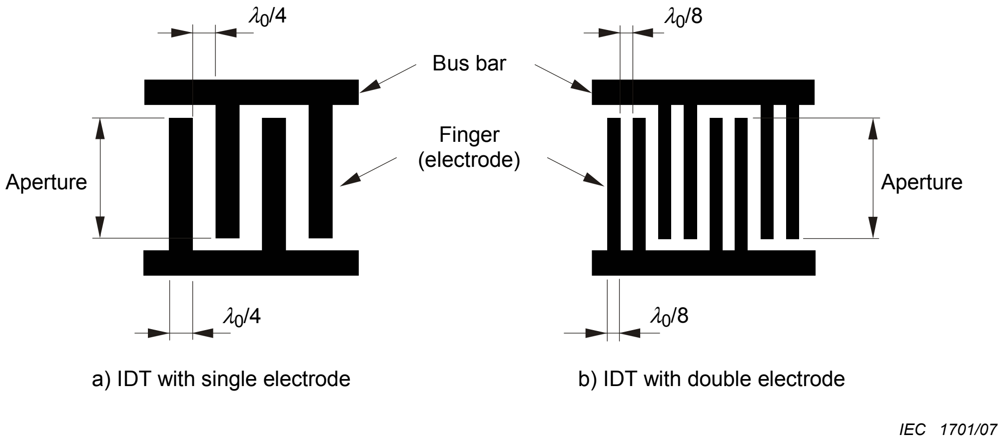


Figure 5 – Configuration of an interdigital transducer (IDT)

3.42
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.

[IEC 61019-1, 4.2.7]

3.43
load capacitance
$\boldsymbol{C_L}$
the effective external capacitance associated with the resonator, which determines the load resonance frequency f_L

[IEC 60122-1, 2.2.22 modified]

3.44

load resonance resistance

$\boldsymbol{R_L}$
the equivalent resistance of a piezoelectric resonator in series with a stated load capacitance at the load resonance frequency f_L

[IEV 561-02-30]

3.45
load resonance frequency
$\boldsymbol{f_L}$
one of the two frequencies of a piezoelectric resonator in association with a series or parallel load capacitance, under specified conditions, at which the electrical impedance of the combination is resistive

NOTE This frequency is the lower of the two frequencies when the load capacitance is in series and the higher when it is in parallel.

[IEV 561-02-12, IEC 60122-1, 2.2.23 modified]

3.46
load resonance frequency offset

$$\Delta f_L \cong f_L - f_r$$

where

f_r is the resonance frequency

f_L is the load resonance frequency

the value indicates the active frequency region

[IEC 60122-1, 2.2.27 modified]

3.47
loaded quality factor
Q_L
actual quality factor for an entire circuit, including all energy losses both in the resonator and in the external circuit

[IEC 61338-1, 2.2.28 modified]

3.48
mass loading (of a SAW device)
perturbation in the SAW propagation caused by the mass of an overlay on the substrate surface

[IEC 61019-1, 4.1.19]

3.49
metal strip array
periodic discontinuity realised by electrically short- or open-circuit metal strips providing electrical and mass-loaded perturbations (see Figures 6 and 7)

[IEC 61019-1, 4.1.14]

3.50
microstripline resonator
dielectric resonator characterised by a TEM mode field distribution. The structure is a microstripline waveguide of finite length

[IEC 61338-1, 2.2.23]

3.51
mode of vibration
the pattern of motion in a vibrating body resulting from stresses applied to the body, the frequency of oscillation and the existing boundary conditions

NOTE The most commonly used modes of vibration are:

1) for crystal resonators
   – flexural
   – twist
   – extensional
   – face shear
   – thickness shear
2) for ceramic resonators
   – radial (expander)
   – thickness shear

[IEV 561-02-01 modified]

3.52
motional capacitance
C_1
the capacitance of the motional or series arm of the equivalent circuit (see Figure 2)

[IEV 561-02-31]

3.53
motional inductance
L_1
the inductance of the motional or series arm of the equivalent circuit (see Figure 2)

[IEV 561-02-32]

3.54
motional resistance
R_1
the resistance of the motional or series arm of the equivalent circuit (see Figure 2)

[IEV 561-02-26]

3.55
motional (series) resonance frequency
f_s
the resonance frequency of the motional or series arm of the equivalent circuit of the resonator (see Figure 2). It is defined by the formula

$$f_s = \frac{1}{2\pi\sqrt{L_1 C_1}}$$

where L_1 and C_1 represent the motional inductance and capacitance respectively

[IEV 561-02-09 modified, IEC 61019-1, 4.2.10.2.2 modified]

3.56
mounting system
the means by which the resonator is supported in its enclosure

[IEV 561-01-11]

3.57
multimode dielectric resonator
dielectric resonator characterised by the existence of several orthogonal resonance modes, the resonance frequencies of which coincide in such a way that any particular one cannot be obtained by the superposition of others. Any electromagnetic field perturbation affects independence of certain of these modes and causes energy coupling between them. This allows realisation of reduced volume filters

[IEC 61338-1, modified]

3.58
nominal frequency
f_{nom}
the frequency assigned by the specification of the resonator

[IEC 60642, 3.3.1 modified, IEC 60122-1, 2.2.5 modified]

3.59
one-port SAW resonator
a SAW resonator having a pair of terminals as shown in Figure 6

[IEC 61019-1, 4.1.3]

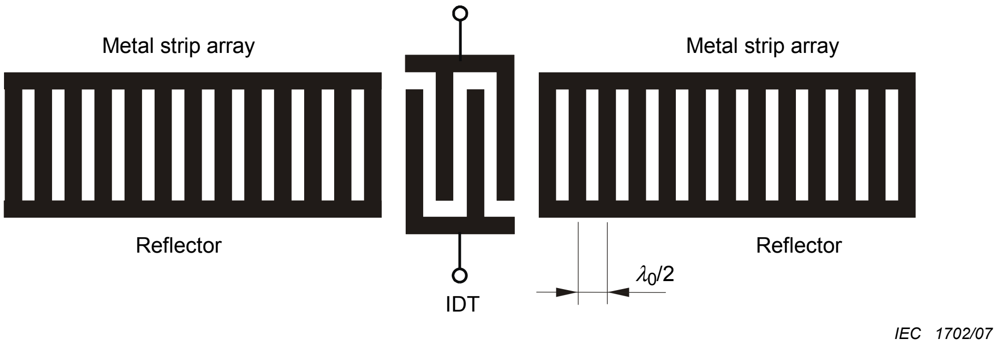


Figure 6 – Configuration of a one port SAW resonator

3.60
operable temperature range
the range of temperatures as measured on the enclosure over which the resonator will not sustain permanent damage through not necessarily functioning within the specified tolerances

[IEV 60122-1, 2.2.33 modified]

3.61
operating phase shift
phase shift between input and output terminals at the centre frequency. SAW resonators can be designed to provide a nominal zero or 180° phase shift

[IEC 61019-1, 4.2.11.11]

3.62
operating temperature range
the range of temperature as measured on the enclosure over which the piezoelectric resonator must function within the specified tolerances

[IEC 60122-1, 2.2.32 modified, IEV 561-02-21 modified]

3.63
output capacitance (of a two-port SAW resonator)
C_{out}
capacitance which shunts the output port of the resonator equivalent circuit (see Figure 4)

[IEC 61019-1, 4.2.11.3]

3.64
overall tolerance
maximum permissible deviation of the working frequency of the resonator from the nominal frequency due to a specific cause or a combination of causes

[IEV 561-02-15 modified, IEC 61019-1, 4.2.3.1 modified]

3.65
overtone crystal unit
crystal resonator designed to operate at a higher order than the lowest of the given mode

[IEC 60122-1, 2.2.11]

3.66
overtone mode
mode higher than the fundamental one in a given family of vibration

[IEC 60642, 3.1.8]

3.67
overtone order
the integral numbers given to the successive overtones of a given mode of vibration, in order of increasing frequency commencing with the fundamental as unity

NOTE For shear and extension modes, the overtone order is the quotient of the frequency of the overtone by the fundamental frequency rounded to the nearest whole number.

[IEV 561-02-04]

3.68
parallel resonance frequency (lossless)
***f*p**
the frequency where the admittance value of a lossless resonator becomes zero

NOTE When the electromechanical coupling factor is low, an approximate value of the frequency is given by the expression;

$$f_{\mathrm{p}} = \frac{1}{2\pi\sqrt{L_1 \dfrac{C_1 C_0}{C_1 + C_0}}}$$

where C_0 represents the shunt capacitance and L_1 and C_1 the motional inductance and capacitance respectively. The expression can be derived from Figure 2 by letting $R_1 = 0$.

[IEV 561-02-11]

3.69
partially clamped capacitance
capacitance of a resonator measured at a frequency well above the main resonance frequency of the given family of vibration. The value of the capacitance is usually directly determined.

[IEV 561-02-36 modified]

3.70
piezoelectric ceramic element
element of piezoelectric ceramic material made to a given geometric shape, size and orientation with respect to the polarizing axis

[IEV 561-01-03]

3.71
piezoelectric ceramic resonator
ceramic element with electrode capable of vibrating in a specific mode. Leads may be attached to the electrodes.

[IEC 60642, 3.1.2]

3.72
piezoelectric resonator unit
unit comprizing a piezoelectric crystal or piezoelectric ceramic resonator in its enclosure

[IEV 561-01-09 modified]

3.73
piezoelectric stiffened mode of vibration
mode of vibration in which, in the ideal stiffened mode, the electric field is parallel to the direction of elastic wave motion and influences the pattern of the motion through the electrical boundary conditions

[IEV 561-02-06 modified]

3.74
piezoelectric unstiffened mode of vibration
mode of vibration, in which in the ideal unstiffened mode, the electric field is perpendicular to the direction of elastic wave motion and has no influence on the pattern of motion

[IEV 561-02-05]

3.75
pulling sensitivity
S
statement of the change of load resonance frequency divided by the change in load capacitance required to produce that change

[IEC 60122-1, 2.2.31 modified]

3.76
quality factor for a series resonance circuit (of a resonator)
$\boldsymbol{Q_s}$

$$Q_S = \frac{\omega_r L_1}{R_1}$$

where

$\omega_r = 2\pi f_r$ is the angular resonance frequency

f_r is the resonance frequency;

L_1 is the motional inductance;

R_1 is the motional resistance.

The value shows the sharpness of the resonance and is a commonly used representation for the merit of the resonator.

[IEC 60122-1]

3.77
quarter wavelength resonator
resonator characterised by any guided mode field distribution with standing wave of a quarter wavelength

[IEC 61338-1, 2.2.20]

3.78
reference temperature
the temperature, as measured on the enclosure, at which certain resonator measurements are made

NOTE 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 °C ± 2 °C.

[IEV 561-02-24 modified, IEC 60122-1, 2.2.35 modified, IEC 61019-1, 4.2.4.3 modified]

3.79
relative frequency spacing
$\boldsymbol{B_s}$

$$B_s = \frac{f_p - f_s}{f_s}$$

where

f_p is the parallel resonance frequency and f_s is the series resonance frequency in a given mode of vibration. The value indicates the inductive region of the resonance.

[IEV 561-02-20 modified]

3.80
resonance frequency
f_r
lower of the two frequencies of a piezoelectric resonator vibrating alone under specified conditions, at which the electrical impedance of the resonator is resistive

[IEV 561-02-08]

3.81
resonance frequency (of a dielectric resonator)
frequency at which the average electric energy stored in the resonator is equal to the average magnetic energy stored in the resonator

[IEC 61338-1, 2.2.29]

3.82
resonance resistance
R_r
equivalent resistance of the piezoelectric resonator alone at its resonance frequency, f_r

[IEV 561-02-25]

3.83
shunt capacitance
C_0
capacitance in parallel with the motional arm of the equivalent circuit (see Figure 2)

[IEV 561-02-33]

3.84
socket
component into which a resonator is inserted to hold the unit and to provide electrical connection

[IEC 60122-1 modified]

3.85
spurious resonance
a state of resonance of a resonator other than that frequency associated with the working frequency

[IEC 61019-1, 4.2.5]

3.86
spurious resonance rejection
difference between the maximum level of spurious resonances and the minimum insertion attenuation

[IEC 61019-1, 4.2.11.10]

3.87
storage temperature range
range of temperature within which the resonator can be stored, without causing any permanent deviation in the performance beyond the specified limits

[IEV 561-02-23 modified]

3.88
stripline resonator
dielectric resonator characterised by a TEM mode field distribution. The structure is a stripline waveguide of finite length.

[IEC 61338-1, 2.2.22]

3.89
surface acoustic wave
SAW
acoustic wave, propagating along the surface of an elastic substrate, the amplitude of which decays exponentially with substrate depth

[IEV 561-06-01]

3.90
surface acoustic wave resonator
SAWR
resonator using multiple reflections of surface acoustic waves (see Figures 6 and 7)

[IEC 61019-1, 4.1.2]

3.91
tolerance over the temperature range
maximum permissible deviation of the working frequency of a piezoelectric resonator within a specified temperature range from its working frequency at the specified reference temperature

[IEV 561-02-18 modified]

3.92
transverse spurious resonance (of a SAW device)
spurious resonance caused by excitation of higher order transverse modes which appear at slightly higher frequencies. It is desirable to apodise the interdigital transducer to match the desired transverse mode profile.

[IEC 61019-1, 4.2.6]

3.93
transverse electric mode dielectric resonator
TE mode dielectric resonator
dielectric resonator characterised by a transverse electric mode (TE mode) field distribution and usually having a high unloaded quality factor Q_u

[IEC 61338-1, 2.2.12]

3.94
transverse electromagnetic mode dielectric resonator
TEM mode dielectric resonator
the dielectric resonator characterised by a transverse electromagnetic mode (TEM mode) field distribution causing significant size reduction effect

[IEC 61338-1, 2.2.18]

3.95
tuning inductance (of a two-port SAW resonator)
inductance which is attached at the input or output terminal for tuning at the desired oscillation frequency

[IEC 61019-1, 4.2.11.12]

3.96
two-port SAW resonator
a SAW resonator having input and output ports as shown in Figure 7.

[IEC 61019-1]

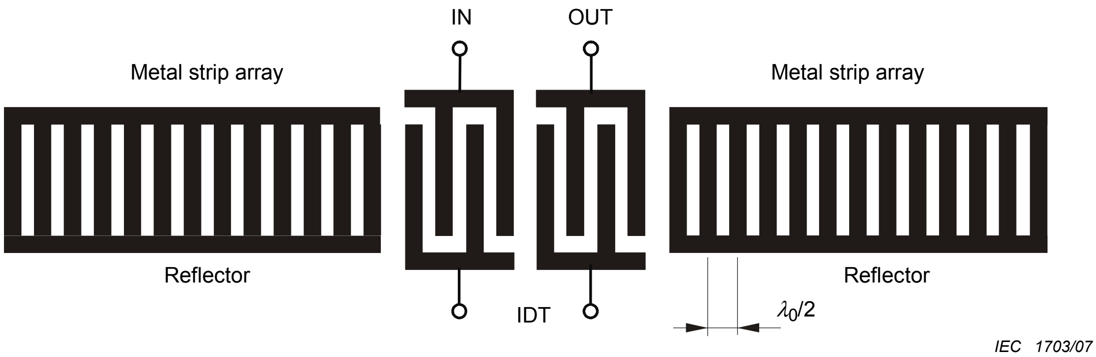


Figure 7 – Configuration of a two port SAW resonator

3.97
unloaded quality factor (of a dielectric resonator)
$\mathbf{Q_u}$
the quality factor for the dielectric resonator with support and shielding conductors, excluding the energy dissipated in the external circuits

[IEC 61338-1, 2.2.26 modified]

3.98
unwanted response
a state of resonance of a resonator other than that associated with the mode of vibration intended for the application

[IEV 561-02-28 modified, IEC 60642, 3.1.12 modified]

3.99
working frequency
f_w
frequency of vibration of the resonator together with its associated circuit in the intended sate of resonance

[IEV 561-02-14 modified]

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