



SLOVENSKI STANDARD
oSIST prEN IEC 60679-2:2025
01-marec-2025

**Piezelektrični, dielektrični in elektrostatični oscilatorji ocenjene kakovosti - 2. del:
Smernice za uporabo oscilatorjev**

Piezoelectric, dielectric and electrostatic oscillators of assessed quality - Part 2:
Guidelines for the use of oscillators

Oscillateurs piézoélectriques, diélectriques et électrostatiques sous assurance de la
qualité - Partie 2: Lignes directrices pour l'utilisation des oscillateurs

Ta slovenski standard je istoveten z: prEN IEC 60679-2:2025

<https://standards.iteh.ai/catalog/standards/sist/11c296ab-69c9-4d37-8562-3d52e69c897f/osist-pren-iec-60679-2-2025>

ICS:

31.140 Piezelektrične naprave Piezoelectric devices

oSIST prEN IEC 60679-2:2025 **en**



49/1475/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: IEC 60679-2 ED2	
DATE OF CIRCULATION: 2025-01-17	CLOSING DATE FOR VOTING: 2025-04-11
SUPERSEDES DOCUMENTS: 49/1459/CD, 49/1464/CC	

IEC TC 49 : PIEZOELECTRIC, DIELECTRIC AND ELECTROSTATIC DEVICES AND ASSOCIATED MATERIALS FOR FREQUENCY CONTROL, SELECTION AND DETECTION	
SECRETARIAT: Japan	SECRETARY: Mr Masanobu Okazaki
OF INTEREST TO THE FOLLOWING COMMITTEES:	HORIZONTAL FUNCTION(S):
ASPECTS CONCERNED:	
<input checked="" type="checkbox"/> SUBMITTED FOR CENELEC PARALLEL VOTING Attention IEC-CENELEC parallel voting The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	<input type="checkbox"/> NOT SUBMITTED FOR CENELEC PARALLEL VOTING

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any relevant "In Some Countries" clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (SEE [AC/22/2007](#) OR [NEW GUIDANCE DOC](#)).

TITLE:

Piezoelectric, dielectric and electrostatic oscillators of assessed quality - Part 2: Guidelines for the use of oscillators

PROPOSED STABILITY DATE: 2028

NOTE FROM TC/SC OFFICERS:

CONTENTS

1		
2		
3	FOREWORD.....	4
4	INTRODUCTION.....	6
5	1 Scope.....	7
6	2 Normative references	7
7	3 Terms and definitions.....	7
8	4 Oscillating principle of crystal oscillators	8
9	5 Classification of crystal oscillators	11
10	5.1 General.....	11
11	5.2 SPXO	12
12	5.3 TCXO	13
13	5.4 VCXO	15
14	5.5 OCXO	16
15	5.6 DCXO (Disciplining Control Crystal oscillator).....	166
16	6 Frequency stability of crystal oscillators.....	19
17	7 Specification and measurement of oscillator performance.....	19
18	7.1 General.....	19
19	7.2 Environmental effects	20
20	7.3 Random frequency variations.....	19
21	7.4 Differential output of crystal oscillators.....	22
22	8 Key parameters of specification	22
23	8.1 General.....	22
24	8.2 Stabilization time	23
25	8.2.1 General	24
26	8.2.2 SPXO	24
27	8.2.3 TCXO	24
28	8.2.4 OCXO.....	24
29	8.2.5 DCXO	24
30	8.3 Frequency adjustment range.....	25
31	8.3.1 General	25
32	8.3.2 SPXO	25
33	8.3.3 TCXO	25
34	8.3.4 OCXO.....	25
35	8.3.5 DCXO	25
36	8.4 Frequency stability under steady-state temperature conditions	26
37	9 Characteristics to be specified in article sheets	27
38	10 Usage precautions for crystal oscillators.....	30
39	10.1 General.....	30
40	10.2 Power supply	30
41	10.2.1 Internal resistance of the power supply	30
42	10.2.2 Noise from the power supply.....	30
43	10.3 Input control voltage	31
44	10.3.1 Linearity of frequency change.....	31

45	10.3.2	Polarity of control voltage	31
46	10.4	EMC (Electromagnetic Compatibility)	30
47	10.5	Selecting bypass capacitors	30
48	10.6	PLL oscillators	33
49	10.7	ESD (Electric-Static Discharge)	332
50	Annex A (informative)	Differential output of crystal oscillators	35
51	A.1	Clock rate and signal level	35
52	A.2	Features of differential output wave	36
53	A.3	Advantage and precaution of differential signal	36
54	A.4	Advantage of differential output oscillator	37
55	A.5	Differential output signal evaluation	37
56	Bibliography	38
57			
58	Figure 1	– Swinging pendulum motion	10
59	Figure 2	– Colpitts oscillator circuit	10
60	Figure 3	– Equivalent circuit of a Colpitts oscillation circuit	10
61	Figure 4	– Basic diagram of a crystal oscillator	11
62	Figure 5	– Frequency-temperature characteristics of typical AT-cut crystals with 63 different orientation angles	13
64	Figure 7	– Block diagrams of various TCXO	15
65	Figure 8	– VCXO oscillator circuit and equivalent circuit	15
66	Figure 9	– VCXO with added circuits for improved bandwidth and linearity	16
67	Figure 11	– Crystal oscillator type and frequency stability	19
68	Figure 12	– Typical output power spectrum of a crystal oscillator	20
69	Figure 13	– Dependence of the standard deviation of frequency measurements on the 70 sample averaging for a typical crystal oscillator	22
71	Figure 14	– Typical frequency stabilization behavior of an OCXO following initial 72 switching on	26
73	Figure 15	– Output waveform	30
74	Figure 16	– Phase Noise Characteristics	30
75	Figure 17	– Example of positive polarity VCXO input circuit	31
76	Figure 18	– Control voltage-frequency change characteristics (positive polarity)	31
77	Figure 19	– Control voltage-frequency change characteristics (negative polarity)	32
78	Figure 20	– Example of input circuit for negative polarity VCXO	32
79	Figure 21	– Simulation of Frequency Response of Bypass Capacitor	33
80	Figure 22	– Distance between crystal oscillator and bypass capacitor	33
81	Figure 23	– Jitter amplification image by PLL cascade connection	34
82	Figure A.1	– Clock rate signal vs. level (constant edge rate)	35
83	Figure A.2	– Effect of noise (single output)	36
84	Figure A.3	– Effect of noise (differential output)	36
85	Figure A.4	– Common mode noise	37
86	Figure A.5	– eye pattern (eye diagram)	37
87			

88 Table 1 – List of typical oscillator parameters 23

89 Table 2 – OCXO stabilization parameters 24

90 Table 3 – The check list of parameters 27

91 Table A.1 – Clock Waveforms and Specifications 35

92

93

94

95

96

97

98

99

100

101

102

103

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[oSIST prEN IEC 60679-2:2025](https://standards.iteh.ai/catalog/standards/sist/11c296ab-69c9-4d37-8562-3d52e69c897f/osist-pren-iec-60679-2-2025)

<https://standards.iteh.ai/catalog/standards/sist/11c296ab-69c9-4d37-8562-3d52e69c897f/osist-pren-iec-60679-2-2025>

105

106

107

108

109

110

111

112

113

114

115

116

INTERNATIONAL ELECTROTECHNICAL COMMISSION

117

118

119

**PIEZOELECTRIC, DIELECTRIC AND ELECTROSTATIC OSCILLATORS OF
ASSESSED QUALITY**

120

121

122

Part 2: Guidelines for the use of oscillators

123

124

FOREWORD

125

126

127

128

129

130

131

132

133

134

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.

135

136

137

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.

138

139

140

141

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.

142

143

144

145

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.

146

147

148

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.

149

6) All users should ensure that they have the latest edition of this publication.

150

151

152

153

154

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.

155

156

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.

157

158

159

160

161

162

163

9) IEC draw attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC take no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch> [and/or] www.iso.org/patents. IEC shall not be held responsible for identifying any or all such patent rights.

164

165

IEC 60679-2 has been prepared by IEC technical committee 49: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection.

166

167

This second edition cancels and replaces the first edition published in 1981. This edition constitutes a technical revision.

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

- 170 a) Some new contents that reflect the latest manufacturing technologies;
- 171 b) Added contents about the operating principle of crystal oscillators;
- 172 c) Added contents about usage precautions for crystal oscillators.

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

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

174
175 Full information on the voting for its approval can be found in the report on voting indicated in
176 the above table.

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

178 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in
179 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available
180 at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are
181 described in greater detail at www.iec.ch/publications.

182 The committee has decided that the contents of this document will remain unchanged until the
183 stability date indicated on the IEC website under webstore.iec.ch in the data related to the
184 specific document. At this date, the document will be

- 185 • reconfirmed,
- 186 • withdrawn,
- 187 • replaced by a revised edition, or
- 188 • amended.

189

(<https://standards.iteh.ai>)
Document Preview

[oSIST prEN IEC 60679-2:2025](https://standards.iteh.ai/catalog/standards/sist/11e296ab-69c9-4d37-8562-3d52e69c897f/osist-pren-iec-60679-2-2025)

<https://standards.iteh.ai/catalog/standards/sist/11e296ab-69c9-4d37-8562-3d52e69c897f/osist-pren-iec-60679-2-2025>

190

INTRODUCTION

191 Crystal controlled oscillators are commonly used to provide the stable frequencies required for
192 telecommunications, navigations and data processing systems. Depending upon the frequency
193 of operation, ambient conditions and specific oscillator design, crystal oscillators are capable
194 of providing frequency stability varying from 1×10^{-4} to 1×10^{-10} .

195 This guideline describes the general properties, performance characteristics and usage
196 precautions for crystal oscillators.

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[oSIST prEN IEC 60679-2:2025](https://standards.iteh.ai/catalog/standards/sist/11c296ab-69c9-4d37-8562-3d52e69c897f/osist-pren-iec-60679-2-2025)

<https://standards.iteh.ai/catalog/standards/sist/11c296ab-69c9-4d37-8562-3d52e69c897f/osist-pren-iec-60679-2-2025>

197 **PIEZOELECTRIC, DIELECTRIC AND ELECTROSTATIC OSCILLATORS OF**
198 **ASSESSED QUALITY**

199

200

Part 2: Guidelines for the use of oscillators

201

202

203

204 **1 Scope**

205 This part of IEC 60679 describes the general properties, performance characteristics and usage
206 precautions for quartz crystal oscillators. This content mainly describes crystal oscillators, but
207 some descriptions also apply to oscillators other than crystal units (e.g. MEMS resonators).

208 **2 Normative references**

209 The following documents are referred to in the text in such a way that some or all of their content
210 constitutes requirements of this document. For dated references, only the edition cited applies.
211 For undated references, the latest edition of the referenced document (including any
212 amendments) applies.

213 IEC 60027 (all parts). Letter symbols to be used in electrical technology.

214 IEC 60050-561, International electrotechnical vocabulary – Part 561 Piezoelectric, dielectric
215 and electrostatic devices and associated materials for frequency control, selection and
216 detection. Available at www.electropedia.org

217 IEC60068 Environmental testing.

218 IEC 60679-1, Piezoelectric, dielectric, and electrostatic oscillators of assessed quality – Part 1:
219 Generic specification

220 IEC 62884-1, Measurement technologies of piezoelectric, dielectric and electrostatic oscillators
221 – Part 1: Basic methods for the measurement

222 IEC 62884-2, Measurement technologies of piezoelectric, dielectric and electrostatic oscillators
223 – Part 2: Phase jitter measurement method

224 IEC 62884-3, Measurement technologies of piezoelectric, dielectric and electrostatic oscillators
225 – Part 3: Frequency Aging test methods

226 IEC 62884-4, Measurement technologies of piezoelectric, dielectric and electrostatic oscillators
227 – Part 4: Short-term frequency stability test methods

228 **3 Terms and definitions**

229 For the purposes of this document, the terms and definitions given in IEC 60679-1 and the
230 following apply.

231 ISO and IEC maintain terminology databases for use in standardization at the following
232 addresses:

- 233 • IEC Electropedia: available at <https://www.electropedia.org/>
- 234 • ISO Online browsing platform: available at <https://www.iso.org/obp>

235

236 4 Oscillating principle of crystal oscillators

237 The operating principle of crystal oscillators is easier to understand when compared with that
 238 of a pendulum. To maintain the swing of a pendulum, the position and time point of maximum
 239 amplitude of the pendulum should be detected, and the operation of pushing the pendulum back
 240 should be repeated so that the time point and position are maintained. The pendulum
 241 corresponds to a crystal unit which comprises an amplifier with a feedback circuit that provides
 242 the detection and push-back force (See Figure 1).

243 A typical feedback amplifier (Colpitts circuit) is shown in Figure 2, where the signals at both
 244 terminals of the crystal unit are divided at capacitors C_A , C_B , one connected to the input side
 245 and the other to the output side. It can be considered that the "detection" in the case of the
 246 pendulum is on the input side of the feedback amplifier and the "push-back force" is given on
 247 the output side. Here, R_A and R_B are bleeder resistance to provide a fixed bias to the base
 248 terminal of the oscillation transistor, R_E is negative feedback resistance connected to the
 249 emitter and R_C is load resistance connected to the collector.

250 Next, in the state of oscillation, as shown in Figure 3, the oscillator circuit side which is viewed
 251 from the crystal unit terminals can be represented by a series circuit of equivalent input
 252 capacitance C_i and equivalent input resistance R_i . In this case, the crystal unit side is
 253 equivalently an inductive effective inductance L_e and an effective resistance R_e and the crystal
 254 oscillation conditions are as follows:

255 Frequency condition $\omega L_e - \frac{1}{\omega C_i} = 0$

256 Amplitude condition $R_e \leq |R_i|$, (R_i : negative resistance)

257 The frequency condition determines the oscillation frequency. For the amplitude condition,
 258 equivalent input resistance on the circuit side shall be negative value in the vicinity of the
 259 oscillation frequency and at the small signal on the start-up, then this is called negative
 260 resistance. This negative resistance can be obtained with active circuits such as transistors and
 261 operational amplifiers. The absolute value of the negative resistance $|R_i|$ shall be designed to
 262 be sufficiently larger than R_e in order to ensure oscillation at the start-up of the oscillator,
 263 meaning that $R_e = |R_i|$ in the steady-state following the end of the start-up and the oscillation
 264 becomes the steady-state amplitude.

265

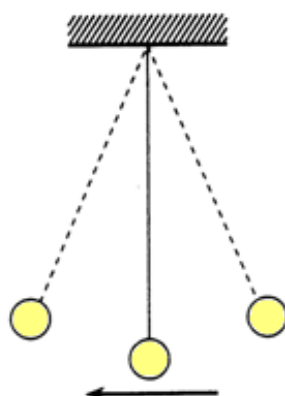
266

267

268

269

270

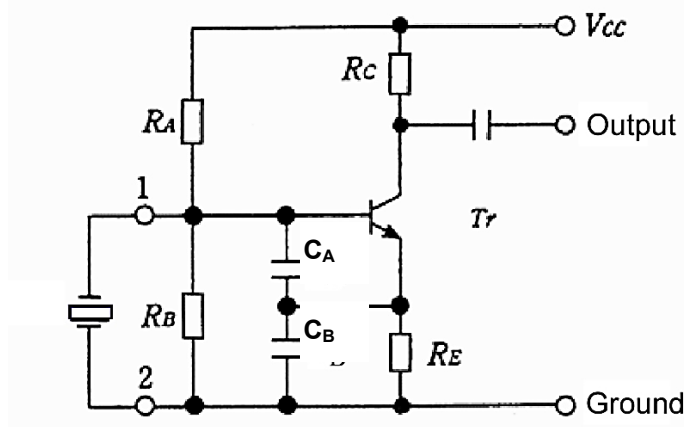


271

272

273

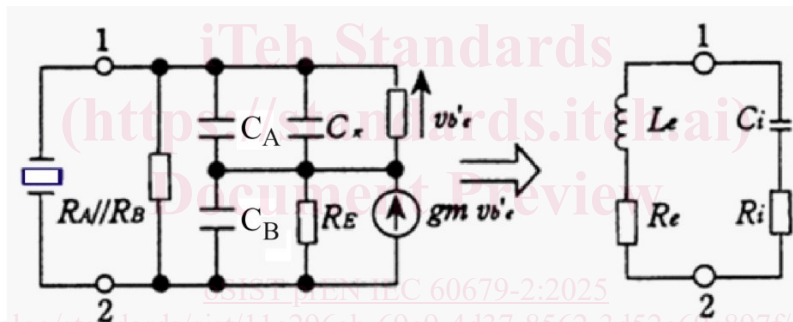
Figure 1 – Swinging pendulum motion



274

275

Figure 2 – Colpitts oscillator circuit



276

Figure 3 – Equivalent circuit of a Colpitts oscillation circuit

277

278

279 The circuit side capacitance C_i is called the load capacitance (C_L) with respect to the unit and
 280 is an important parameter that determines the frequency change amount from the series
 281 resonance frequency, variable sensitivity and frequency stability, etc. The relational equation
 282 is as follows:

283 Fractional load resonance frequency offset (D_L) =
$$\frac{1}{2r \left(1 + \frac{C_L}{C_0} \right)}$$

284 Pulling sensitivity (S) =
$$\frac{-1}{2rC_0 \left(1 + \frac{C_L}{C_0} \right)^2}$$

285 Where

286 C_0 : Shunt capacitance of the crystal unit,

287 C_L : Motional capacitance of the crystal unit,