



**SLOVENSKI STANDARD**  
**oSIST prEN IEC 62024-1:2023**  
**01-september-2023**

---

**Visokofrekvenčne induktivne komponente - Električne karakteristike in merilne metode - 1. del: Čipni induktor v območju nanohenrijev**

High frequency inductive components - Electrical characteristics and measuring methods - Part 1: Nanohenry range chip inductor

Induktive Hochfrequenz-Bauelemente - Elektrische Eigenschaften und Messmethoden - Teil 1: Chipinduktivitäten im Nanohenry-Bereich

Composants inductifs à haute fréquence - Caractéristiques électriques et méthodes de mesure - Partie 1: Inductance à puce de l'ordre du nanohenry

**Ta slovenski standard je istoveten z: prEN IEC 62024-1:2023**

---

**ICS:**

29.100.10      Magnetne komponente      Magnetic components

**oSIST prEN IEC 62024-1:2023      en**





51/1441/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER:

**IEC 62024-1 ED4**

DATE OF CIRCULATION:

**2023-07-07**

CLOSING DATE FOR VOTING:

**2023-09-29**

SUPERSEDES DOCUMENTS:

**51/1415/CD, 51/1424/CC**

IEC TC 51 : MAGNETIC COMPONENTS, FERRITE AND MAGNETIC POWDER MATERIALS	
SECRETARIAT: Japan	SECRETARY: Mr Takeshi Abe
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: <input type="checkbox"/> Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: <input type="checkbox"/> EMC <input type="checkbox"/> ENVIRONMENT <input type="checkbox"/> QUALITY ASSURANCE <input type="checkbox"/> SAFETY	
<input checked="" type="checkbox"/> SUBMITTED FOR CENELEC PARALLEL VOTING <b>Attention IEC-CENELEC parallel voting</b> 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:

**High frequency inductive components - Electrical characteristics and measuring methods - Part 1: Nanohenry range chip inductor**

PROPOSED STABILITY DATE: 2028

Copyright © 2023 International Electrotechnical Commission, IEC. All rights reserved. It is permitted to download this electronic file, to make a copy and to print out the content for the sole purpose of preparing National Committee positions. You may not copy or "mirror" the file or printed version of the document, or any part of it, for any other purpose without permission in writing from IEC.

NOTE FROM TC/SC OFFICERS:

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[oSIST prEN IEC 62024-1:2023](https://standards.iteh.ai/catalog/standards/sist/5a9a5ff5-a672-4ce9-aa95-823959cfc2f4/osist-pren-iec-62024-1-2023)

<https://standards.iteh.ai/catalog/standards/sist/5a9a5ff5-a672-4ce9-aa95-823959cfc2f4/osist-pren-iec-62024-1-2023>

## CONTENTS

1		
2		
3	FOREWORD .....	5
4	1 Scope .....	7
5	2 Normative references .....	7
6	3 Terms and definitions .....	7
7	4 Inductance, Q-factor and impedance .....	7
8	4.1 Inductance .....	7
9	4.1.1 Measuring method .....	7
10	4.1.2 Measuring circuit .....	8
11	4.1.3 Mounting the inductor for the test .....	9
12	4.1.4 Measuring method and calculation formula .....	11
13	4.1.5 Notes on measurement .....	12
14	4.2 Quality factor .....	13
15	4.2.1 Measuring method .....	13
16	4.2.2 Measuring circuit .....	13
17	4.2.3 Mounting the inductor for test .....	14
18	4.2.4 Measuring methods and calculation formula .....	14
19	4.2.5 Notes on measurement .....	14
20	4.3 Impedance .....	14
21	4.3.1 Measuring method .....	14
22	4.3.2 Measuring circuit .....	14
23	4.3.3 Mounting the inductor for test .....	14
24	4.3.4 Measuring method and calculation .....	14
25	4.3.5 Notes on measurement .....	14
26	5 Resonance frequency .....	14
27	5.1 Self-resonance frequency .....	14
28	5.2 Minimum output method .....	15
29	5.2.1 General .....	15
30	5.2.2 Measuring circuit .....	15
31	5.2.3 Mounting the inductor for test .....	15
32	5.2.4 Measuring method and calculation formula .....	16
33	5.2.5 Note on measurement .....	16
34	5.3 Measurement by analyzer .....	16
35	5.3.1 Measurement by impedance analyzer and one-port network analyzer .....	16
36	5.3.2 Measurement by two-port network analyzer .....	16
37	6 DC resistance .....	17
38	6.1 Voltage-drop method .....	17
39	6.1.1 Measuring circuit .....	17
40	6.1.2 Measuring method and calculation formula .....	17
41	6.2 Bridge method .....	17
42	6.2.1 Measuring circuit .....	17
43	6.2.2 Measuring method and calculation formula .....	18
44	6.3 Notes on measurement .....	18
45	6.4 Measuring temperature .....	18
46	7 S parameter .....	18
47	7.1 Measurement set-up and procedure .....	18

48	7.1.1	General .....	18
49	7.1.2	2-port S parameter .....	19
50	7.1.3	Test fixture .....	19
51	7.2	Calibrations and Verification of test setup .....	21
52	7.2.1	General .....	21
53	7.2.2	Calibration .....	21
54	7.2.3	De-embedding .....	24
55	7.3	Indirect Method of impedance .....	24
56	7.3.1	Measurement set-up and procedure .....	24
57	7.4	Evaluation from the 2-port S-parameter .....	24
58	Annex A (normative)	Mounting method for a surface mounting inductor .....	27
59	A.1	Overview .....	27
60	A.2	Mounting printed-circuit board and mounting land .....	27
61	A.3	Solder .....	27
62	A.4	Test condition .....	27
63	A.5	Cleaning .....	27
64			
65	Figure 1	– Example of circuit for vector voltage/current method .....	8
66	Figure 2	– Example of circuit for reflection coefficient method .....	9
67	Figure 3	– Fixture A .....	10
68	Figure 4	– Fixture B .....	10
69	Figure 5	– Fixture C .....	11
70	Figure 6	– Short device shape .....	13
71	Figure 7	– Example of test circuit for the minimum output method .....	15
72	Figure 8	– Self-resonance frequency test board (minimum output method) .....	16
73	Figure 9	– Example of test circuit for voltage-drop method .....	17
74	Figure 10	– Example of test circuit for bridge method .....	18
75	Figure 11	– Schematic diagrams of the 2-port S-parameter measurement setup and the network analyzer .....	19
76	Figure 12	– S-parameter test fixture for two-terminal devices .....	19
77	Figure 13	– Test fixture for a two-terminal device (Shunt connection) .....	20
78	Figure 14	– Test fixture for a two-terminal device (Series connection) .....	20
79	Figure 15	– Example of the standards for TRL calibration .....	22
80	Figure 16	– Example of the standards for TRL calibration with microprobes .....	23
81	Figure 17	– Example of full 2-port de-embedding with microprobes .....	24
82	Figure 18	– 2-port measurement of a two-terminal device in shunt connection .....	25
83	Figure 19	– 2-port measurement of a two-terminal device in series connection .....	25
84			
85			
86	Table 1	– Dimensions of $l$ and $d$ .....	10
87	Table 2	– Short device dimensions and inductances .....	13
88			
89			
90			
91			

92

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

93

94

95

96

97

98

99

100

**HIGH FREQUENCY INDUCTIVE COMPONENTS –  
ELECTRICAL CHARACTERISTICS AND MEASURING METHODS –****Part 1: Nanohenry range chip inductor****FOREWORD**

101 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising  
102 all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international  
103 co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and  
104 in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports,  
105 Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their  
106 preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with  
107 may participate in this preparatory work. International, governmental and non-governmental organizations liaising  
108 with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for  
109 Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

110 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international  
111 consensus of opinion on the relevant subjects since each technical committee has representation from all  
112 interested IEC National Committees.

113 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National  
114 Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC  
115 Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any  
116 misinterpretation by any end user.

117 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications  
118 transparently to the maximum extent possible in their national and regional publications. Any divergence between  
119 any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

120 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity  
121 assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any  
122 services carried out by independent certification bodies.

123 6) All users should ensure that they have the latest edition of this publication. 2023

124 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and  
125 members of its technical committees and IEC National Committees for any personal injury, property damage or  
126 other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and  
127 expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

128 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is  
129 indispensable for the correct application of this publication.

130 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent  
131 rights. IEC shall not be held responsible for identifying any or all such patent rights.

132 IEC 62024-1 has been prepared by IEC technical committee 51: Magnetic components, ferrite  
133 and magnetic powder materials. It is an international standard.

134 This fourth edition cancels and replaces the third edition published in 2017. This edition  
135 constitutes a technical revision.

136 This edition includes the following significant technical changes with respect to the previous  
137 edition:

138 a) addition of S parameter measuring;

139 b) addition of the inductance, Q-factor and impedance of an inductor is measured by the  
140 reflection coefficient method with network analyzer.

141 c) addition of the resonance frequency of an inductor is measured by 2 port network analyzer

142 d) addition of the mounting method for a surface mounting inductor with Pb-free solder

143

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

CDV	Report on voting
51/xxx/FDIS	51/xxx/RVD

145  
146 Full information on the voting for its approval can be found in the report on voting indicated in  
147 the above table.

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

149 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in  
150 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available  
151 at [https://www.iec.ch/members\\_experts/refdocs](https://www.iec.ch/members_experts/refdocs). The main document types developed by IEC  
152 are described in greater detail at <https://www.iec.ch/standardsdev/publications>.

153 A list of all parts of the IEC 62024 series, published under the general title *High frequency*  
154 *inductive components – Electrical characteristics and measuring methods*, can be found on the  
155 IEC website.

156 The committee has decided that the contents of this document will remain unchanged until the  
157 stability date indicated on the IEC website under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the  
158 specific document. At this date, the document will be

- 159 • reconfirmed,
- 160 • withdrawn,
- 161 • replaced by a revised edition, or
- 162 • amended.

163

164



# HIGH FREQUENCY INDUCTIVE COMPONENTS – ELECTRICAL CHARACTERISTICS AND MEASURING METHODS –

## Part 1: Nanohenry range chip inductor

165  
166  
167  
168  
169  
170  
171

### 1 Scope

173 This part of IEC 62024 specifies electrical characteristics and measuring methods for the  
174 nanohenry range chip inductor that is normally used in high frequency (over 100 kHz) range.

### 2 Normative references

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

180 IEC 61249-2-7, *Materials for printed boards and other interconnecting structures – Part 2-7:*  
181 *Reinforced base materials clad and unclad – Epoxide woven E-glass laminated sheet of defined*  
182 *flammability (vertical burning test) copper-clad*

183 IEC 62025-1, *High frequency inductive components – Non-electrical characteristics and*  
184 *measuring methods – Part 1: Fixed, surface mounted inductors for use in electronic and*  
185 *telecommunication equipment*

186 IEC 62674-1, *High frequency inductive components - Part 1: Fixed surface mount inductors for*  
187 *use in electronic and telecommunication equipment*

188 ISO 6353-3, *Reagents for chemical analysis – Part 3: Specifications – Second series*

189 ISO 9453, *Soft solder alloys – Chemical compositions and forms*

### 3 Terms and definitions

191 No terms and definitions are listed in this document.

192 ISO and IEC maintain terminological databases for use in standardization at the following  
193 addresses:

- 194 • IEC Electropedia: available at <http://www.electropedia.org/>
- 195 • ISO Online browsing platform: available at <http://www.iso.org/obp>

### 4 Inductance, Q-factor and impedance

#### 4.1 Inductance

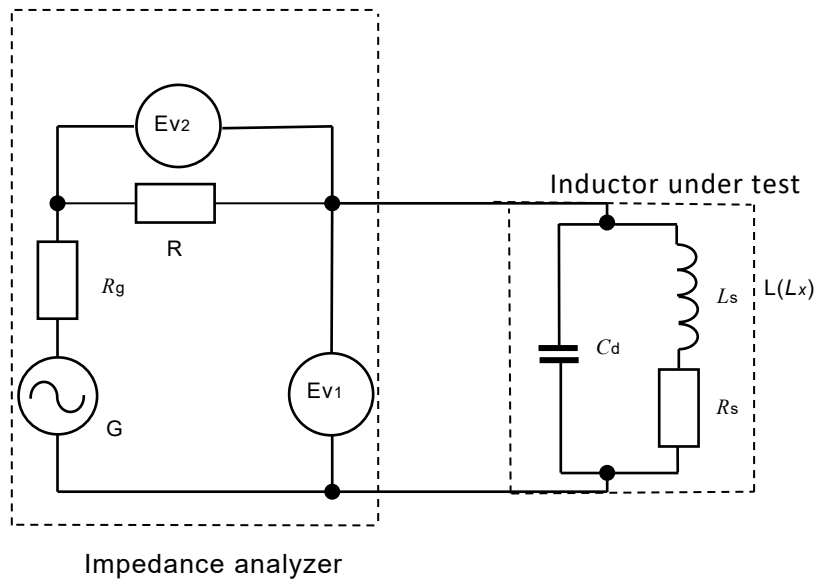
##### 4.1.1 Measuring method

199 The inductance of an inductor is measured by either the vector voltage/current method  
200 (impedance analyzer) or the reflection coefficient method (network analyzer).

201

202 **4.1.2 Measuring circuit**

203 An example of the circuit for the vector voltage/current method is shown in Figure 1 and an  
 204 example of the circuit for the reflection coefficient method is shown in Figure 2.



205

206 **Key**

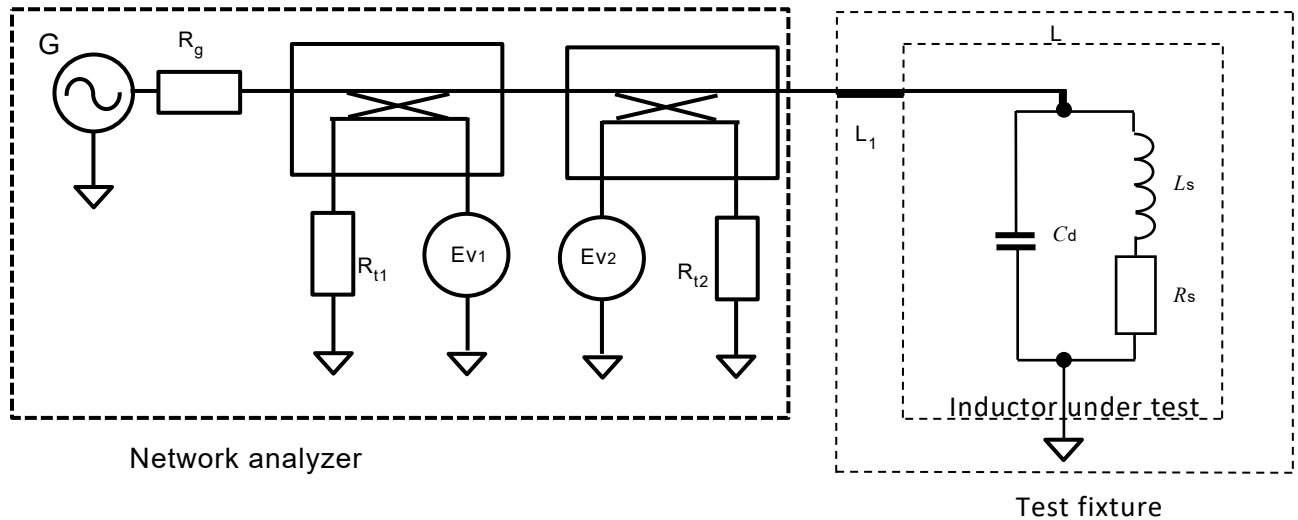
207	$R_g$	source resistance (50 $\Omega$ )
208	R	resistor
209	L	inductor under test
210	$L_x$	inductance of inductor under test
211	$C_d$	parallel capacitance of inductor under test
212	$L_s$	series inductance of inductor under test
213	$R_s$	series resistance of inductor under test
214	EV <sub>1</sub> , EV <sub>2</sub>	vector voltmeter
215	G	signal generator

216

**Figure 1 – Example of circuit for vector voltage/current method**

217

218



219

220 **Key**221  $R_g$  source resistance (50  $\Omega$ )222  $R_{t1}, R_{t2}$  termination resistor (50  $\Omega$ )223  $L$  inductor under test224  $C_d$  parallel capacitance of inductor under test225  $L_s$  series inductance of inductor under test226  $R_s$  series resistance of inductor under test227  $Ev_1, Ev_2$  vector voltmeter228  $G$  signal generator229  $L_1$  50  $\Omega$  micro-strip line or equivalent transmission line

230

**Figure 2 – Example of circuit for reflection coefficient method**

231

232 **4.1.3 Mounting the inductor for the test**233 **4.1.3.1 General**

234 The inductor shall be mounted in a test fixture as specified in the relevant standard. If no fixture  
 235 is specified, one of the following test fixtures A, B or C shall be used. The fixture used shall be  
 236 reported.

237 **4.1.3.2 Fixture A**

238 The shape and dimensions of fixture A shall be as shown in Figure 3 and Table 1.

239