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**Polprevodniški elementi - Mehanske in klimatske preskusne metode - 34-1. del:  
Preskus močnostnega polprevodniškega modula s cikliranjem električnega  
napajanja**

Semiconductor devices - Mechanical and climatic test methods - Part 34-1: Power  
cycling test for power semiconductor module

Dispositifs à semiconducteurs - Méthodes d'essais mécaniques et climatiques - Partie 34  
-1: Essai de cycles en puissance pour modules de puissance à semiconducteurs

**Ta slovenski standard je istoveten z: prEN IEC 60749-34-1:2023**

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**ICS:**

31.080.01	Polprevodniški elementi (naprave) na splošno	Semiconductor devices in general
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# 47/2823/CDV

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OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

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TITLE:

**Semiconductor devices - Mechanical and climatic test methods - Part 34-1: Power cycling test for power semiconductor module**

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**SEMICONDUCTOR DEVICES –  
MECHANICAL AND CLIMATIC TEST METHODS –****Part 34-1: Power cycling test for power semiconductor module****FOREWORD**

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

Draft	Report on voting
47/XX/FDIS	47/XX/RVD

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

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

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at

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## INTRODUCTION

123 A power semiconductor module is affected by thermal and mechanical stress due to the power  
124 dissipation of the internal semiconductor dies and connectors. This occurs when low-voltage operating  
125 bias for forward conduction is periodically applied and removed, causing rapid changes in temperature.  
126 The power cycling test is intended to simulate the temperature swing in typical power electronics  
127 applications, which is different from the stable temperatures reached under the HTOL test (High  
128 Temperature Operating Life) (see IEC 60749-23). Exposure to the power cycling test may not induce  
129 the same failure mechanisms as exposure to the thermal cycling test, or thermal shock test. The power  
130 cycling test is a destructive test that will cause wear-out failure of the DUT if it is driven above the  
131 specification of the device.

132 The power cycling test is applied to general power semiconductor modules such as for example those  
133 used for motor control, robots, and renewable energy generation. The power cycling test has two modes:  
134 a short-time test (based on a short cycle time) that simulates rapid acceleration and deceleration of the  
135 equipment, and a long-time test (based on a long cycle time) that simulates repeated operation and stop  
136 of the equipment. The short-time test mainly verifies the effect of the temperature change of  $T_{vj}$ , and  
137 causes the deterioration of the joint between the semiconductor die and the wire, and that of the die  
138 attach under the semiconductor die. The long-time test verifies the effect of the temperature change of  
139  $T_c$ , and causes the deterioration of the joining layer between the metallic base plate and the insulating  
140 substrate, and the deterioration of the die attach under the semiconductor die.

141 The power cycling test is performed in two cases: as a certification test for the products whose power  
142 cycling lifetime model has already been confirmed, and as a lifetime model validation test for the  
143 products whose lifetime model has not been confirmed. The purpose of the certification test is to verify  
144 that the product has a longer life than the specified number of cycles.

145 Moreover, the purpose of the lifetime model validation test is to statistically estimate the power cycling  
146 lifetime model from the test results, and obtain the expected lifetime model of power modules. This is  
147 required when customers design the lifetime of their products.

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# SEMICONDUCTOR DEVICES – MECHANICAL AND CLIMATIC TEST METHODS –

## Part 34-1: Power cycling test for power semiconductor module

### 1 Scope

This part of IEC 60749 describes a test method that is used to determine the capability of power semiconductor modules to withstand thermal and mechanical stress resulting from cycling the power dissipation of the internal semiconductors and the internal connectors. It is based on IEC 60749-34, Power cycling, but is developed specifically for silicon-based power semiconductor module products.

This test causes wear-out and is considered destructive.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60191-4, Mechanical standardization of semiconductor devices - Part 4: Coding system and classification into forms of package outlines for semiconductor device packages

IEC 60747-2, Semiconductor devices – Part 2: Discrete devices – Rectifier diodes

IEC 60747-6, Semiconductor devices – Part 6: Discrete devices – Thyristors

IEC 60747-8, Semiconductor devices – Discrete devices – Part 8: Field-effect transistors

IEC 60747-9, Semiconductor devices – Discrete devices – Part 9: Insulated-gate bipolar transistors (IGBTs)

IEC 60747-15, Semiconductor devices – Discrete devices – Part 15: Isolated power semiconductor devices

IEC 60749-34, Semiconductor devices – Mechanical and climatic test methods – Part 34: Power cycling

### 3 Terms and definitions

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

NOTE Further terms and definitions pertaining to semiconductor devices can be found in the IEC 60747 and IEC 60749 series.

#### 3.1 power semiconductor module

isolated or non-isolated semiconductor module with two or more semiconductor dies according to the package outline style code “MP” specified in IEC 60191-4

Note 1 to entry: The predominantly used package body material is plastic (including epoxy) according to IEC 60191-4 and both the frame based and resin based embodiment are possible.

#### 3.2 device under test DUT

188 device to be teste

189 **3.3**  
190 **case temperature**  
191  $T_c$

192 case surface temperature directly below the power semiconductor module under test

193 **3.4**  
194 **junction temperature excursion**  
195  $\Delta T_{vj}$

196 difference between virtual maximum and minimum junction temperature of the DUT during one power  
197 cycle

198 **3.5**  
199 **case temperature excursion**  
200  $\Delta T_c$

201 difference between maximum and minimum case temperature during one power cycle

202 **3.6**  
203 **minimum virtual junction temperature**  
204  $T_{vj,min}$

205 minimum virtual junction temperature of the DUT

206 **3.7**  
207 **maximum virtual junction temperature**  
208  $T_{vj,max}$

209 maximum virtual junction temperature of the DUT

210 **3.8**  
211 **minimum case temperature**  
212  $T_{c,min}$

213 minimum case surface temperature directly below the power semiconductor module under test

214 **3.9**  
215 **maximum case temperature**  
216  $T_{c,max}$

217 maximum case surface temperature directly below the power semiconductor module under test

218 **3.10**  
219 **on-time**  
220  $t_{on}$

221 time interval during which the DUT under test is conducting load current

222 **3.11**  
223 **off-time**  
224  $t_{off}$

225 time interval for cooling down

226 **3.12**  
227 **cycle period**  
228 sum of on-time and off-time