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31 INTERNATIONAL ELECTROTECHNICAL COMMISSION

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33  
34 **POWER SUPPLYING SCHEME FOR WEARABLE SYSTEM AND EQUIPMENT**

35  
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72 technical committee may propose the publication of a technical report when it has collected  
73 data of a different kind from that which is normally published as an International Standard, for  
74 example "state of the art".

75 IEC/TR XXX, which is a technical report, has been prepared by IEC technical committee 100:  
76 Audio, video and multimedia systems and equipment:

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

Enquiry draft	Report on voting
XX/XX/DTR	XX/XX/RVC

78  
79 Full information on the voting for the approval of this technical report can be found in the  
80 report on voting indicated in the above table.

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

82 The committee has decided that the contents of this publication will remain unchanged until  
83 the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data  
84 related to the specific publication. At this date, the publication will be

- 85 • reconfirmed,
- 86 • withdrawn,
- 87 • replaced by a revised edition, or
- 88 • amended.

89

90 The National Committees are requested to note that for this publication the stability date  
91 is 2018.

92 THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE  
93 DELETED AT THE PUBLICATION STAGE.

95 Wearable devices are introducing to the market, each device employs each power charging  
96 method and power source device. Wearable devices are used for supporting human life and  
97 health for their active living. The duration and life of power source and easy charging or easy  
98 replacement of power source is very important factor because wearable devices are primary  
99 powered by batteries. The power generator is one solution for this power duration or life, it  
100 provides power that is generated from user activities or environmental sources. Also  
101 connectivity and compatibility of power and data transmission is important.

102 This Technical Report does not specify power generating or energy harvesting method and  
103 device themselves, the issue is interoperability and measurement method of the power  
104 supplying device and system.

105 **POWER SUPPLYING SCHEME FOR WEARABLE SYSTEM AND EQUIPMENT**  
106  
107

108 **1 Scope**

109 This Technical Report provides models and frameworks for the power supplying scheme for  
110 wearable systems and equipment. This Technical Report does not specify power generating  
111 or energy harvesting method and device themselves.

112 **2 Normative references**

113 The following documents, in whole or in part, are normatively referenced in this document and  
114 are indispensable for its application. For dated references, only the edition cited applies. For  
115 undated references, the latest edition of the referenced document (including any  
116 amendments) applies.

117 xxx

118 **3 Terms and definitions**

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

120 **3.1**

121 **energy harvest**

122 to obtain energy such as electric power from the activity of organism body

123 **3.2**

124 **kinetic generator**

125 generator that utilizes kinetic energy to generate electric power

126

127 **4 System model**

128 **4.1 General**

129 The power supplying system for audio, video and multimedia systems and equipment can be  
130 applicable to the wearable systems and equipment. Among them, the power supplying system  
131 of energy harvesting device or system is suitable for the wearable device because those  
132 generate energy.

133 Energy harvesting device or system has already been used for various equipment such as  
134 electronic wrist watch, this system is described in existent model.

135 **4.2 Existent model**

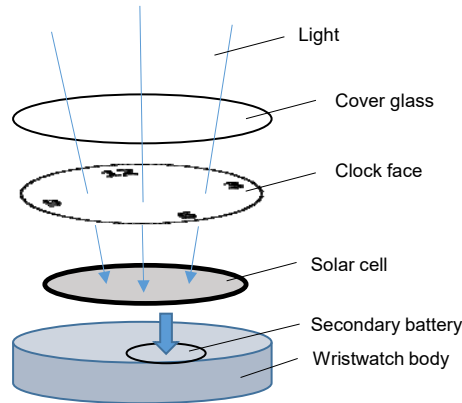
136 A major existent model of wearable equipment and power supply is electronic wristwatch.  
137 Power supply methods for electronic wristwatch are;

- 138 • Primary battery,
- 139 • Secondary battery,
- 140 • Solar cell + Secondary battery,
- 141 • Generator + Secondary battery.

142 To charge the secondary battery, wired power transfer is a common method, its connector is  
143 such as Micro USB or a dedicated connector.

144 Wireless power transfer is a rare method for wristwatch, but it is applied for health band type  
145 wearable equipment that has watch function. However, WPT is not applied when a wristwatch  
146 is worn but applied when it is took off and when it is charging.

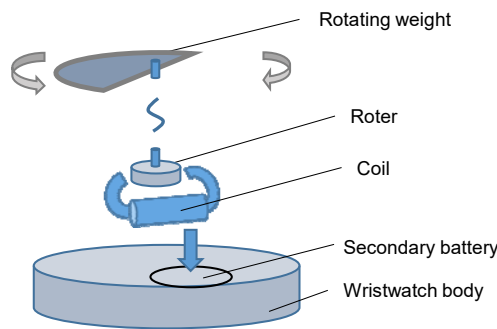
147 Figure 1 shows the example of solar cell with second battery.



148

149 **Figure 1 – Solar cell with secondary battery wristwatch**

150 Figure 2 shows the example of kinetic generator with secondary battery, the source of this  
151 generator is arm movement. A variation of this type is a stem winding, it powers a spring that  
152 rotates a rotor.



153

154 **Figure 2 – Generator with secondary battery**

### 155 **4.3 The system model of wearable device**

#### 156 **4.3.1 Wearable device types**

157 Wearable device types are;

- 158 • Wristwatch type
- 159 • Eyeglasses type
- 160 • Headset type
- 161 • Earphone type
- 162 • Garment and textile type
- 163 • Shoe and glove type
- 164 • Other

165 These wearable device are powered by primary or secondary battery, when the battery is  
166 secondary battery, it is need to be charged or supplied electric power.

#### 167 **4.3.2 Charging**

168 Charging is necessary, it is done when a wearable device is worn and when it is took off.  
169 From the case of legacy wearable wristwatch, major charging must be done when it is took off.

170 In this case, charging is the same as electronic wristwatch. The new application is charging  
171 when it is worn.

172 The charging when the wearable device is worn is required a live generating electric power  
173 and the method for providing and supplying the electric power to the client wearable device.  
174 In case of the wearable device involves the generator, the power supplying and the control  
175 are executed with internal connection, this needs no specific standard. In case of the  
176 wearable device and the power supplying device is located in the different portion of the  
177 user's body, there needs the standard to provide power and control.

178 This standard includes;

- 179 • Physical connection
  - 180 1) Wired connector, cable or wireless connection
- 181 • Logical connection
  - 182 1) Protocols for power supplying and control, and information

#### 183 **4.3.3 Generator utilized body of organism, aka energy harvesting**

184 There are types of energy source of organism body activity that is used for generating electric  
185 power.

- 186 • Natural movement
- 187 • Intentional action or movement
- 188 • Pressure
- 189 • Thermal gradient
- 190 • Perspiration
- 191 • Any phenomenon that caused by body of organism

192 The energy harvesting device or system take advantage of these body activities to convert  
193 them to electric power or other kind of energy. The energy harvesting device or systems are  
194 solar cell, Peltier element, kinetic device, chemical battery cell, MEMS device and  
195 conventional motor as generator.

196 This technical report does not mention about these energy harvesting method and device  
197 themselves. The concern is interoperability and measurement of the energy harvesting device.

#### 198 **4.3.4 Connection**

199 In case of the generator is included in the wearable device, the connection between them is  
200 internal connection. If the generator is isolated from the wearable device, the interface  
201 between them needs to be standardized.

202 The physical connection types are;

- 203 • When wearable device and generator are located in one body
  - 204 1) Wired connector and cable that can be wearable device
  - 205 2) Wireless such as BAN

- 206 • When the charger located outside of the body  
207 1) Wireless such as Wi-Fi

208 The case of charger outside is the same as the case of WPT, these existent technologies can  
209 be applied. The other case is a connection within one body. The existent technologies can be  
210 applied too, however the new dedicated connection is expected for wearable devices.

211 The elements are;

- 212 • Power transmission protocol, format and control  
213 • Data transmission protocol, format and control  
214 • Each for wired and wireless scheme

## 215 5 Use case

### 216 5.1 General

217 Any device of TC 100 that forms to wearable device is the object of power supplying system.  
218 The existent major power supplying device is a primary or secondary battery, it needs  
219 changing battery or charging. The wearable device that needs to work continuously as  
220 standalone and autonomous device requires energy harvesting power supplying device.

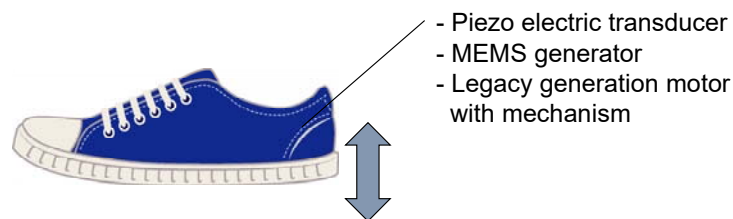
221 The use case types are;

- 222 a) Watch, eyeglass and earphone types and sensor type wearable devices that involves  
223 power supplying device  
224 b) Power supplying device that is a part of element of wearable device  
225 c) Standalone power supplying device with wired or wireless connection to wearable device  
226 d) Garment or texture type power supplying device with surface or membrane connection

### 227 5.2 Use case examples

#### 228 5.2.1 Generator in shoe

229 How to connect, transmit, control could be the items of standardization.



230

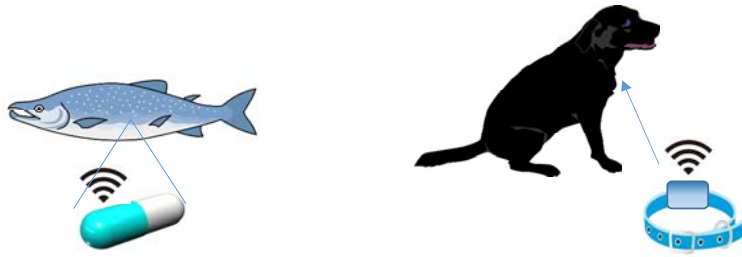
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**Figure 3 – Shoe case**

#### 232 5.2.2 Animal tracking

233 Not for human but for animals, wearable devices can be used for research of their life and  
234 support. This case the generator is involved in wearable device because animals manage no  
235 device.





236

237

**Figure 4 – Animal use**

238 **6 Interface**

239 Interface specification for information, control and power transmission should be standardized.  
 240 Connector, cable and other physical connectors are preferred to be standardized but it  
 241 depend on the market. USB is a wide used specification for power transfer, control and  
 242 information, it can be used for wearable device however its physical dimension of connector  
 243 and cable is not suitable for all of wearable devices.

244 Wearable device should be able to use many kinds of energy harvesting device, the following  
 245 items should be standardized.

- 246 • Power control protocol and format  
 247 • Information of providing power device and its power characteristics, and information of  
 248 client device and its power characteristics

249 **7 Measurement method**

250 The measurement items are also the items of specification of the energy harvesting device.  
 251 To connect any energy harvesting device to any wearable device, the standard is required,  
 252 also the measurement method is required. Energy harvesting device may not provide always  
 253 stable or continuous power.

254 Items are;

- 255 a) Generation power measurement  
 256 1) Average power  
 257 2) Intermittent power  
 258 3) Power delivery schedule  
 259 4) Environment condition that appropriate for each energy harvesting method  
 260 b) Generation power characteristics  
 261 1) Voltage, current, power  
 262 c) Power duration and fluctuation  
 263 1) In short term  
 264 2) In long term  
 265 d) Life  
 266 1) In various environment  
 267 e) Power efficiency  
 268 1) In various environments

269

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