



**SAMXON BRAND ALUMINUM ELECTROLYTIC CAPACITORS**

**PRODUCT SPECIFICATION**  
**規格書**

<b>CUSTOMER :</b> (客戶):	<b>DATE :</b> (日期):
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CATEGORY (品名)	: ALUMINUM ELECTROLYTIC CAPACITORS
DESCRIPTION (型号)	: KP SERIES
VERSION (版本)	: 01
Customer P/N	:
SUPPLIER	:

SUPPLIER	
PREPARED (拟定)	CHECKED (审核)
毛彩林	刘渭清

CUSTOMER	
APPROVAL (批准)	SIGNATURE (签名)

<b>MAN YUE ELECTRONICS COMPANY LIMITED</b>	<i>ELECTROLYTIC CAPACITOR SPECIFICATION KP SERIES</i>	<b>SAMXON</b>

SPECIFICATION					ALTERNATION HISTORY RECORDS		
KP SERIES					Purpose	Drafter	Approver
Rev.	Date	Mark	Page	Contents			

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STANDARD MANUAL						

<b>MAN YUE ELECTRONICS COMPANY LIMITED</b>	<i>ELECTROLYTIC CAPACITOR SPECIFICATION KP SERIES</i>	<b>SAMXON</b>	

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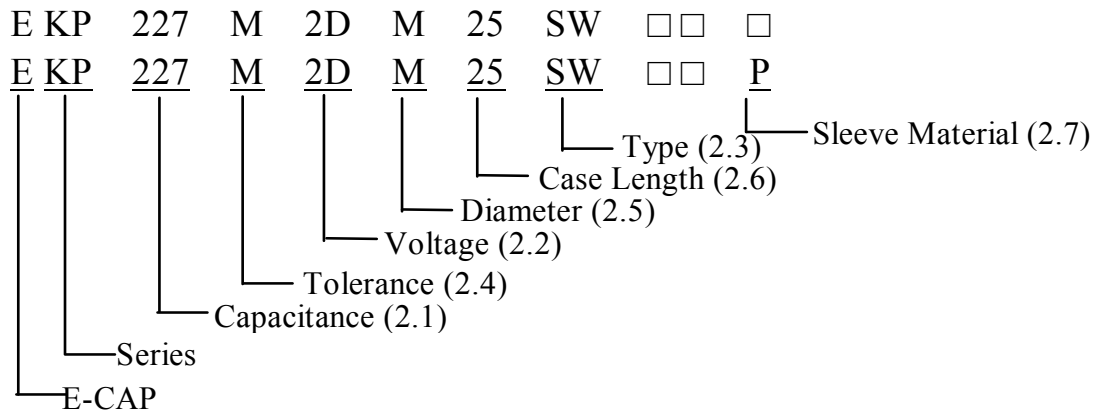
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**1. Application**

This specification applies to polar Aluminum electrolytic capacitor (foil type) used in electronic equipment. Designed capacitor's quality meets IEC60384.

**2. Part number system**



2.1 Capacitance Code

Code	684	685	686	687	688	689
Capacitance (μ F)	0.68	6.8	68	680	6800	68000

2.2 Rated Voltage Code

Part Number	1A	1C	1E	1V	1H	1J	1K	2A	2C
Rate Voltage (V d c)	10	16	25	35	50	63	80	100	160

Part Number	2P	2D	2N	2E	2F	2V	2Y	2G	2M	2W
Rate Voltage (V d c)	180	200	220	250	315	350	385	400	420	450

2.3 Type

Code	SW	SG	SZ	SX
Reference	W-TYPE	G-Type	Z-TYPE	X-Type

2.4 Capacitance Tolerance

“M” stands for -20% ~ +20% “V” stands for -10% ~ +20%

2.5 Size

Code	M	N	O	P	Q
Diameter	20	22	25	30	35

2.6 Length

“2J” stands for 29.5mm “30” stands for 30mm “33” stands for 33mm  
 “35” stands for 35mm “40” stands for 40mm “50” stands for 50mm

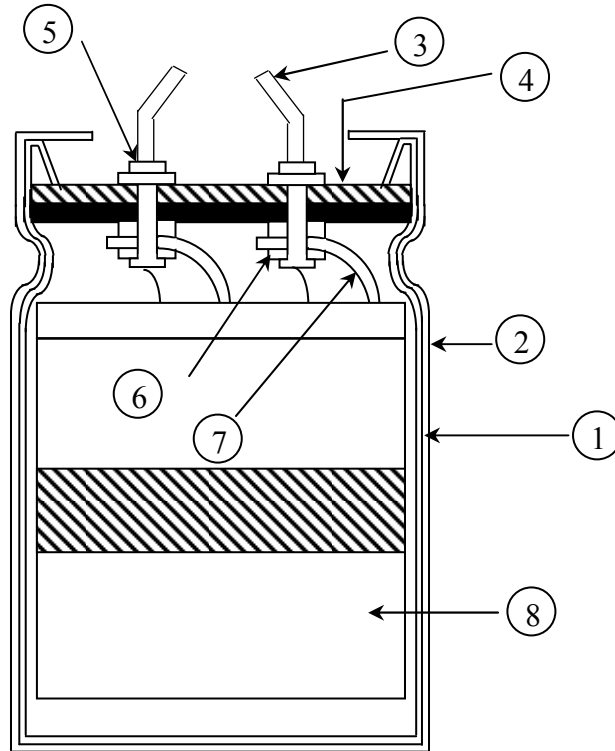
2.7 Sleeve material

Code	P	Blank
Sleeve material	PET	PVC

**Remark:** The “ □ ” in fifteenth and sixteenth digits is used for the product lines, and the “ □ ” in the seventeenth digit is used to indicate that the sleeve is the PVC material.

**3. Construction**

Single ended type to be produced to fix the terminals to anode and cathode foil, and wind together with paper, and then wound element to be impregnated with electrolyte will be enclosed in an aluminum case. Finally sealed up tightly with end seal rubber, then finished by putting on the vinyl sleeve.



No	Component	Material
1	Case	Aluminum case
2	Sleeve	PVC/PET
3	Terminal	Solder coated copper clad steel
4	Seal	Rubber-laminated bakelite
5	Rivet	Aluminum
6	Washer	Aluminum
7	Tab	Aluminum
8	Element	Aluminum foil & Electrolyte paper

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#### 4. Characteristics

##### Standard atmospheric conditions

Unless otherwise specified, the standard range of atmospheric conditions for making measurements and tests is as follows:

Ambient temperature	: 15°C to 35°C
Relative humidity	: 45% to 85%
Air Pressure	: 86kPa to 106kPa

If there is any doubt about the results, measurement shall be made within the following conditions:

Ambient temperature	: 20°C ± 2°C
Relative humidity	: 60% to 70%
Air Pressure	: 86kPa to 106kPa

##### Operating temperature range

The ambient temperature range at which the capacitor can be operated continuously at rated voltage is -40°C to 105°C(10~100WV), -25°C to 105°C(160~450WV).

As to the detailed information, please refer to table 1

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Table 1

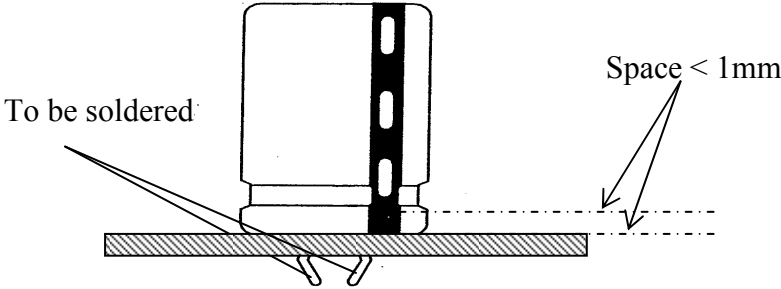
ITEM		PERFORMANCE																																	
4.1	Rated Voltage (WV)	WV (V dc)	10	16	25	35	50	63	80	100	160																								
		SV (V dc)	13	20	32	44	63	79	100	125	200																								
	Surge Voltage (SV)	WV (V dc)	180	200	220	250	315	350	385	400	420	450																							
		SV (V dc)	225	250	270	300	365	400	435	450	470	500																							
4.2	Nominal Capacitance (Tolerance)	<p><b>&lt;Condition&gt;</b>            Measuring Frequency : 120Hz ± 12Hz            Measuring Voltage : Not more than 0.5Vrms            Measuring Temperature : 20 ± 2°C</p> <p><b>&lt;Criteria&gt;</b>            Shall be within the specified capacitance tolerance</p>																																	
4.3	Leakage Current	<p><b>&lt;Condition&gt;</b>            Connecting the capacitor with a protective resistor (1KΩ ± 10Ω) in series for 5 minutes, and then, measure Leakage Current.</p> <p><b>&lt;Criteria&gt;</b>  <math>I \leq 3 \sqrt{Cv}</math>            I: Leakage current (μ A)            C: Capacitance (μ F)            V: Rated DC Working Voltage (V)</p>																																	
4.4	Dissipation Factor	<p><b>&lt;Condition&gt;</b>            See 4.2, Norm Capacitance, for measuring frequency, voltage and temperature.</p> <p><b>&lt;Criteria&gt;</b></p> <table border="1"> <tr> <td>Working Voltage(V)</td> <td>10</td> <td>16</td> <td>25</td> <td>35</td> <td>50</td> <td>63</td> <td>80</td> <td>100</td> </tr> <tr> <td>Tan δ (max)</td> <td>0.55</td> <td>0.50</td> <td>0.45</td> <td>0.40</td> <td>0.35</td> <td>0.30</td> <td>0.25</td> <td>0.20</td> </tr> </table> <table border="1"> <tr> <td>Working Voltage (V)</td> <td>160~250</td> <td>315~450</td> </tr> <tr> <td>Tan δ (max)</td> <td>0.15</td> <td>0.25</td> </tr> </table> <p>For capacitance &gt; 33000 μ F, add following calculated value:  <math display="block">\frac{(\text{rated capacitance}) - 33000 \mu F}{10000 \mu F} \times 0.1</math></p>										Working Voltage(V)	10	16	25	35	50	63	80	100	Tan δ (max)	0.55	0.50	0.45	0.40	0.35	0.30	0.25	0.20	Working Voltage (V)	160~250	315~450	Tan δ (max)	0.15	0.25
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4.5	Terminal Strength	<p><b>&lt;Condition&gt;</b> A static load of 25N (2.5kgf) shall be applied to the lead wire terminal in the axial direction away from the capacitor body for 30s</p> <p><b>&lt;Criteria&gt;</b> There shall be no intermittent contacts, open or short circuit and there shall be no mechanical damage such as terminal damage.</p>																																																	
4.6	Temperature Characteristics	<p><b>&lt;Condition&gt;</b></p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="width: 15%;">STEP</th> <th style="width: 35%;">Testing Temperature(°C)</th> <th style="width: 50%;">Time</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">20±2</td> <td>Time to reach thermal equilibrium</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">-40(-25)+3</td> <td>Time to reach thermal equilibrium</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">20±2</td> <td>Time to reach thermal equilibrium</td> </tr> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">105±2</td> <td>Time to reach thermal equilibrium</td> </tr> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">20±2</td> <td>Time to reach thermal equilibrium</td> </tr> </tbody> </table> <p>Capacitance, D.F and impedance shall be measured at 120Hz.</p> <p><b>&lt;Criteria&gt;</b></p> <p>a. At +105°C, capacitance measured shall be within ±20% of its original value at +20°C. tan δ shall be within the limit of Item 4.4 The leakage current measured shall not more than 8 times of its specified value.</p> <p>b. In step 5, tan δ shall be within the limit of Item 4.4 The leakage current shall not more than the specified value.</p> <p>c. At -40°C (-25°C), impedance (Z) ratio shall not exceed the value of the following table.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="width: 25%;">Working Voltage (V)</th> <th style="width: 5%;">10</th> <th style="width: 5%;">16</th> <th style="width: 5%;">25</th> <th style="width: 5%;">35</th> <th style="width: 5%;">50</th> <th style="width: 5%;">63</th> <th style="width: 5%;">80</th> <th style="width: 5%;">100</th> </tr> </thead> <tbody> <tr> <td>Z-25°C/Z+20°C</td> <td style="text-align: center;">6</td> <td style="text-align: center;">6</td> <td style="text-align: center;">6</td> <td style="text-align: center;">6</td> <td style="text-align: center;">4</td> <td style="text-align: center;">3</td> <td style="text-align: center;">3</td> <td style="text-align: center;">3</td> </tr> <tr> <td>Z-40°C/Z+20°C</td> <td style="text-align: center;">15</td> <td style="text-align: center;">15</td> <td style="text-align: center;">15</td> <td style="text-align: center;">10</td> <td style="text-align: center;">15</td> <td style="text-align: center;">15</td> <td style="text-align: center;">15</td> <td style="text-align: center;">15</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Working Voltage (V)</th> <th style="width: 75%;">160~450</th> </tr> </thead> <tbody> <tr> <td>Z-25°C/Z+20°C</td> <td style="text-align: center;">8</td> </tr> </tbody> </table> <p>Capacitance, tan δ , and impedance shall be measured at 120Hz.</p>	STEP	Testing Temperature(°C)	Time	1	20±2	Time to reach thermal equilibrium	2	-40(-25)+3	Time to reach thermal equilibrium	3	20±2	Time to reach thermal equilibrium	4	105±2	Time to reach thermal equilibrium	5	20±2	Time to reach thermal equilibrium	Working Voltage (V)	10	16	25	35	50	63	80	100	Z-25°C/Z+20°C	6	6	6	6	4	3	3	3	Z-40°C/Z+20°C	15	15	15	10	15	15	15	15	Working Voltage (V)	160~450	Z-25°C/Z+20°C	8
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4.7	Load Life Test	<p><b>&lt;Condition&gt;</b> According to IEC60384-4No.4.13 methods, The capacitor is stored at a temperature of <math>105 \pm 2^{\circ}\text{C}</math> with DC bias voltage plus the rated ripple current for 3000+48/0 hours. (The sum of DC and ripple peak voltage shall not exceed the rated working voltage) Then the product should be tested after 16 hours recovering time at atmospheric conditions. The result should meet the following table:</p> <p><b>&lt;Criteria&gt;</b> The characteristic shall meet the following requirements.</p> <table border="1"> <tr> <td>Leakage current</td> <td>Value in 4.3 shall be satisfied</td> </tr> <tr> <td>Capacitance Change</td> <td>Within <math>\pm 20\%</math> of initial value .</td> </tr> <tr> <td>Dissipation Factor</td> <td>Not more than 200% of the specified value.</td> </tr> <tr> <td>Appearance</td> <td>Notable changes shall not be found.</td> </tr> </table>	Leakage current	Value in 4.3 shall be satisfied	Capacitance Change	Within $\pm 20\%$ of initial value .	Dissipation Factor	Not more than 200% of the specified value.	Appearance	Notable changes shall not be found.
Leakage current	Value in 4.3 shall be satisfied									
Capacitance Change	Within $\pm 20\%$ of initial value .									
Dissipation Factor	Not more than 200% of the specified value.									
Appearance	Notable changes shall not be found.									
4.8	Shelf Life Test	<p><b>&lt;Condition&gt;</b> The capacitors are then stored with no voltage applied at a temperature of <math>105 \pm 2^{\circ}\text{C}</math> for 1000+48/0 hours. Following this period the capacitors shall be removed from the test chamber and be allowed to stabilized at room temperature for 4~8 hours. Next they shall be connected to a series limiting resistor(<math>1\text{k} \pm 100\Omega</math>) with D.C. rated voltage applied for 30min. After which the capacitors shall be discharged, and then, tested the characteristics.</p> <p><b>&lt;Criteria&gt;</b> The characteristic shall meet the following requirements.</p> <table border="1"> <tr> <td>Leakage current</td> <td>Value in 4.3 shall be satisfied</td> </tr> <tr> <td>Capacitance Change</td> <td>Within <math>\pm 15\%</math> of initial value.</td> </tr> <tr> <td><math>\tan \delta</math></td> <td>Not more than 150%of the specified value.</td> </tr> <tr> <td>Appearance</td> <td>There shall be no leakage of electrolyte.</td> </tr> </table> <p>Remark: If the capacitors are stored more than 1 year, the leakage current may increase. Please apply voltage through about 1 k<math>\Omega</math> resistor, if necessary.</p>	Leakage current	Value in 4.3 shall be satisfied	Capacitance Change	Within $\pm 15\%$ of initial value.	$\tan \delta$	Not more than 150%of the specified value.	Appearance	There shall be no leakage of electrolyte.
Leakage current	Value in 4.3 shall be satisfied									
Capacitance Change	Within $\pm 15\%$ of initial value.									
$\tan \delta$	Not more than 150%of the specified value.									
Appearance	There shall be no leakage of electrolyte.									

4.9	Surge Test	<p><b>&lt;Condition&gt;</b>          Applied a surge voltage to the capacitor connected with a <math>(100 \pm 50)/C_R</math> (k<math>\Omega</math>) resistor.          The capacitor shall be submitted to 1000 cycles, each consisting of charge of 30 <math>\pm 5</math>s, followed discharge of 5 min 30s.          The test temperature shall be 15~35<math>^{\circ}</math>C.  <math>C_R</math> :Nominal Capacitance ( <math>\mu</math> F)</p> <p><b>&lt;Criteria&gt;</b></p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:40%;">Leakage current</td> <td>Not more than the specified value.</td> </tr> <tr> <td>Capacitance Change</td> <td>Within <math>\pm 15\%</math> of initial value .</td> </tr> <tr> <td>Dissipation Factor</td> <td>Not more than the specified value.</td> </tr> <tr> <td>Appearance</td> <td>Notable changes shall not be found.</td> </tr> </table> <p>Attention:          This test simulates over voltage at abnormal situation, and not be hypothesizing that over voltage is always applied.</p>	Leakage current	Not more than the specified value.	Capacitance Change	Within $\pm 15\%$ of initial value .	Dissipation Factor	Not more than the specified value.	Appearance	Notable changes shall not be found.
Leakage current	Not more than the specified value.									
Capacitance Change	Within $\pm 15\%$ of initial value .									
Dissipation Factor	Not more than the specified value.									
Appearance	Notable changes shall not be found.									
4.10	Vibration Test	<p><b>&lt;Condition&gt;</b>          The following conditions shall be applied for 2 hours in each 3 mutually perpendicular directions. During the last 30 minutes of each direction, 3 to 5 measurements shall be taken.          Frequency : 10Hz ~ 55Hz ~ 10Hz in 1 minute          Total excursion amplitude : 1.5mm          Amplitude tolerance : <math>\pm 15\%</math></p> <p><b>&lt;Criteria&gt;</b>          After the test, the following items shall be tested:</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:30%;">Appearance</td> <td>No mechanical damage in terminal. No leakage of electrolyte or swelling of the case. The markings shall be legible.</td> </tr> <tr> <td>Inner construction</td> <td>No intermittent contact, open or short circuit. No damage of tab terminals or electrodes.</td> </tr> </table> <p>Mounting method: The capacitor must be fixed in place with a bracket.</p> <div style="text-align: center;">  </div>	Appearance	No mechanical damage in terminal. No leakage of electrolyte or swelling of the case. The markings shall be legible.	Inner construction	No intermittent contact, open or short circuit. No damage of tab terminals or electrodes.				
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Inner construction	No intermittent contact, open or short circuit. No damage of tab terminals or electrodes.									

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4.11	Solder ability Test	<p><b>&lt;Condition&gt;</b> The capacitor shall be tested under the following conditions: Soldering temperature : 245 ±3°C Dipping depth : 2mm Dipping speed : 25±2.5mm/s Dipping time : 3±0.5s</p> <p><b>&lt;Criteria&gt;</b></p> <table border="1"> <tr> <td>Coating quality</td> <td>A minimum of 95% of the surface being immersed</td> </tr> </table>	Coating quality	A minimum of 95% of the surface being immersed						
Coating quality	A minimum of 95% of the surface being immersed									
4.12	Resistance to Solder Heat Test	<p><b>&lt;Condition&gt;</b> Terminals of the capacitor shall be immersed into solder bath at 260 ± 5°C for 10 ± 1 seconds or 400 ± 10°C for 3<sup>+1</sup><sub>-0</sub> seconds to 1.5~2.0mm from the body of capacitor .</p> <p>Then the capacitor shall be left under the normal temperature and normal humidity for 1~2 hours before measurement.</p> <p><b>&lt;Criteria&gt;</b></p> <table border="1"> <tr> <td>Leakage current</td> <td>Not more than the specified value.</td> </tr> <tr> <td>Capacitance Change</td> <td>Within ± 10% of initial value .</td> </tr> <tr> <td>Dissipation Factor</td> <td>Not more than the specified value.</td> </tr> <tr> <td>Appearance</td> <td>Notable changes shall not be found.</td> </tr> </table>	Leakage current	Not more than the specified value.	Capacitance Change	Within ± 10% of initial value .	Dissipation Factor	Not more than the specified value.	Appearance	Notable changes shall not be found.
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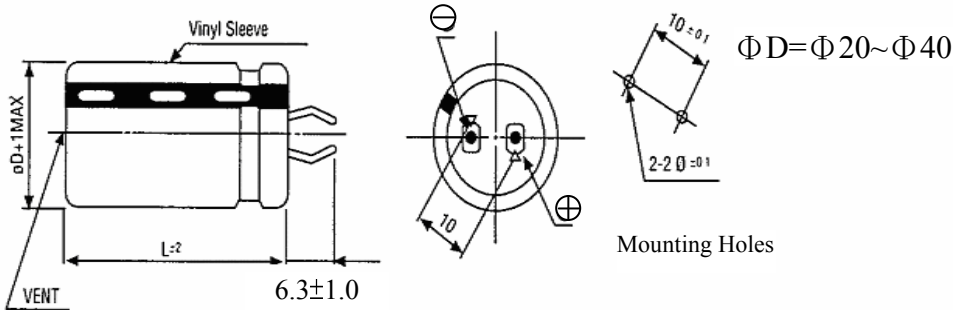
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4.13	Change of Temperature Test	<p><b>&lt;Condition&gt;</b> Temperature cycle: According to IEC60384-4 No.4.7 methods, capacitor shall be placed in an oven, the condition according as below:</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="width: 70%;">Temperature</th> <th style="width: 30%;">Time</th> </tr> </thead> <tbody> <tr> <td>(1)+20℃</td> <td>≤3 Minutes</td> </tr> <tr> <td>(2)Rated low temperature (- 40℃) (-25℃)</td> <td>30±2 Minutes</td> </tr> <tr> <td>(3)Rated high temperature (+105℃)</td> <td>30±2 Minutes</td> </tr> <tr> <td colspan="2">(1) to (3)=1 cycle, total 5 cycle</td> </tr> </tbody> </table> <p><b>&lt;Criteria&gt;</b> The characteristic shall meet the following requirement.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 40%;">Leakage current</td> <td>Not more than the specified value.</td> </tr> <tr> <td>tan δ</td> <td>Not more than the specified value.</td> </tr> <tr> <td>Appearance</td> <td>There shall be no leakage of electrolyte.</td> </tr> </tbody> </table>	Temperature	Time	(1)+20℃	≤3 Minutes	(2)Rated low temperature (- 40℃) (-25℃)	30±2 Minutes	(3)Rated high temperature (+105℃)	30±2 Minutes	(1) to (3)=1 cycle, total 5 cycle		Leakage current	Not more than the specified value.	tan δ	Not more than the specified value.	Appearance	There shall be no leakage of electrolyte.
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(1) to (3)=1 cycle, total 5 cycle																		
Leakage current	Not more than the specified value.																	
tan δ	Not more than the specified value.																	
Appearance	There shall be no leakage of electrolyte.																	
4.14	Damp Heat Test	<p><b>&lt;Condition&gt;</b> Humidity test: According to IEC60384-4 No.4.12 methods, capacitor shall be exposed for 500±8 hours in an atmosphere of 90~95%R H .at 40±2℃, the characteristic change shall meet the following requirement.</p> <p><b>&lt;Criteria&gt;</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 40%;">Leakage current</td> <td>Not more than the specified value.</td> </tr> <tr> <td>Capacitance Change</td> <td>Within ±20% of initial value.</td> </tr> <tr> <td>tan δ</td> <td>Not more than 120% of the specified value.</td> </tr> <tr> <td>Appearance</td> <td>There shall be no leakage of electrolyte.</td> </tr> </tbody> </table>	Leakage current	Not more than the specified value.	Capacitance Change	Within ±20% of initial value.	tan δ	Not more than 120% of the specified value.	Appearance	There shall be no leakage of electrolyte.								
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Appearance	There shall be no leakage of electrolyte.																	

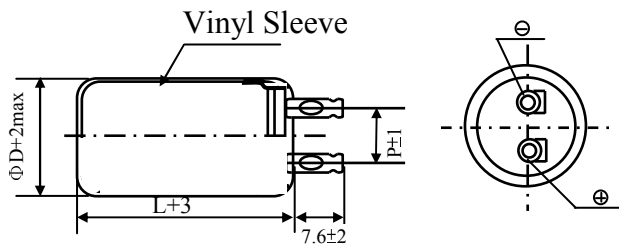
4.15	Vent test	<p><b>&lt;Condition&gt;</b> The following test only apply to those products with vent products at diameter <math>\geq \varnothing 6.3</math> with vent. D.C. test The capacitor is connected with its polarity reversed to a DC power source. Then a current selected from Table 2 is applied.</p> <p><b>&lt;Table 2&gt;</b></p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Diameter (mm)</th> <th style="width: 50%;">DC Current (A)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Over 22.4</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">22.4 or less</td> <td style="text-align: center;">1</td> </tr> </tbody> </table> <p><b>&lt;Criteria&gt;</b> The vent shall operate with no dangerous conditions such as flames or dispersion of pieces of the capacitor and/or case.</p>	Diameter (mm)	DC Current (A)	Over 22.4	10	22.4 or less	1														
Diameter (mm)	DC Current (A)																					
Over 22.4	10																					
22.4 or less	1																					
4.16	Maximum Permissible (Ripple Current)	<p><b>&lt;Condition&gt;</b> The maximum permissible ripple current is the maximum A.C current at 120Hz and can be applied at maximum operating temperature Table-4 The combined value of D.C voltage and the peak A.C voltage shall not exceed the rated voltage and shall not reverse voltage. Frequency Multipliers:</p> <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">Frequency (Hz)</th> <th style="width: 10%;">60</th> <th style="width: 10%;">120</th> <th style="width: 10%;">1k</th> <th style="width: 10%;">10~50k</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">10~100V</td> <td style="text-align: center;">0.90</td> <td style="text-align: center;">1.00</td> <td style="text-align: center;">1.15</td> <td style="text-align: center;">1.25</td> </tr> <tr> <td style="text-align: center;">160~250V</td> <td style="text-align: center;">0.80</td> <td style="text-align: center;">1.00</td> <td style="text-align: center;">1.25</td> <td style="text-align: center;">1.47</td> </tr> <tr> <td style="text-align: center;">315~450V</td> <td style="text-align: center;">0.80</td> <td style="text-align: center;">1.00</td> <td style="text-align: center;">1.30</td> <td style="text-align: center;">1.47</td> </tr> </tbody> </table>	Frequency (Hz)	60	120	1k	10~50k	10~100V	0.90	1.00	1.15	1.25	160~250V	0.80	1.00	1.25	1.47	315~450V	0.80	1.00	1.30	1.47
Frequency (Hz)	60	120	1k	10~50k																		
10~100V	0.90	1.00	1.15	1.25																		
160~250V	0.80	1.00	1.25	1.47																		
315~450V	0.80	1.00	1.30	1.47																		

**5. Product Dimensions**

**W-TYPE**

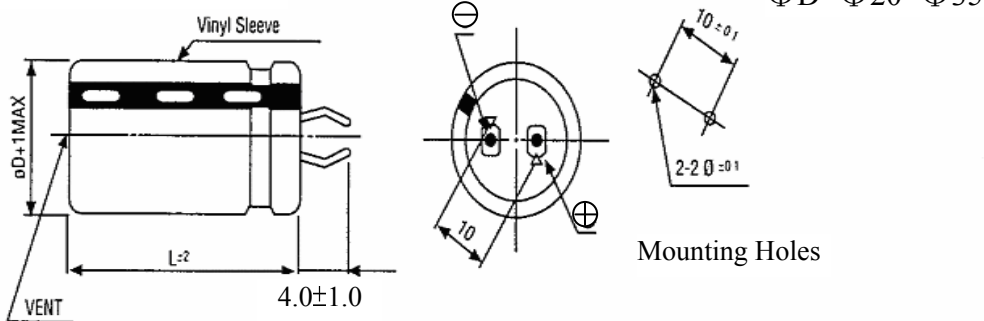


**G-Type**

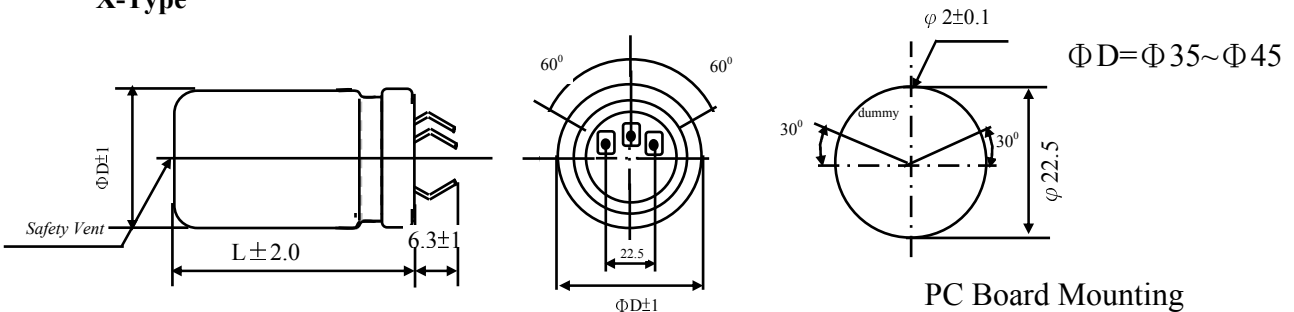


$\phi D$	35	40	50	63	76
P	14	14	18	25	25

**Z-TYPE**



**X-Type**



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## 6. Dimension & Maximum Permissible Ripple Current

Table 4 Ripple Current (A rms) at 105 °C 120Hz (Dimension in mm)

Voltage		10V(1A)									
Cap ( $\mu$ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
6800	688	20x25	1.41								
8200	828	20x30	1.67								
10000	109	20x30	1.88	22x25	1.80						
12000	129	20x35	2.23	22x30	2.20	25x25	2.20				
15000	159	20x40	2.31	22x35	2.30	25x25	2.30				
18000	189			22x40	2.52	25x30	2.40	30x25	2.49		
22000	229			22x45	2.60	25x35	2.60	30x25	2.60		
27000	279			22x50	3.19	25x40	3.10	30x30	3.10		
33000	339					25x45	3.40	30x35	3.40	35x30	3.40
39000	399							30x40	3.79	35x30	3.70
47000	479							30x45	4.26	35x35	4.20
56000	569									35x40	5.00

Ripple Current (A rms) at 105 °C 120Hz (Dimension in mm)

Voltage		16V(1C)									
Cap ( $\mu$ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
5600	568	20x25	1.89								
6800	688	20x30	2.25	22x25	2.20						
8200	828	20x35	2.43	22x30	2.40						
10000	109	20x40	2.79	22x30	2.60	25x25	2.60				
12000	129			22x35	2.90	25x30	2.90				
15000	159			22x40	3.20	25x35	3.20	30x25	3.11		
18000	189			22x45	3.50	25x40	3.50	30x30	3.50		
22000	229					25x45	3.80	30x30	3.80	35x30	3.80
27000	279					25x50	4.20	30x35	4.20	35x30	4.20
33000	339							30x40	4.70	35x35	4.70
39000	399							30x45	4.90	35x40	5.10
47000	479							30x50	5.27	35x45	5.50

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Ripple Current (A rms) at 105 °C 120Hz (Dimension in mm)											
Voltage		25(1E)									
Cap ( μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
3900	398	20x25	1.72								
4700	478	20x30	2.04	22x25	2.00						
5600	568	20x35	2.23	22x30	2.20						
6800	688	20x40	2.72	22x30	2.40	25x25	2.40				
8200	828			22x35	2.70	25x30	2.70	30x25	2.70		
10000	109			22x40	3.00	25x35	3.00	30x30	3.00		
12000	129			22x50	3.20	25x40	3.20	30x30	3.20		
15000	159					25x45	3.60	30x35	3.60	35x30	3.60
18000	189							30x40	3.90	35x35	3.90
22000	229							30x45	4.30	35x35	4.30
27000	279									35x45	4.80
33000	339									35x50	5.55

Ripple Current (A rms) at 105 °C 120Hz (Dimension in mm)											
Voltage		35V(1V)									
Cap ( μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
2700	278	20x25	1.62								
3300	338	20x30	1.94	22x25	1.90						
3900	398	20x35	2.02	22x30	2.00						
4700	478	20x40	2.21	22x35	2.20	25x25	2.20				
5600	568			22x35	2.40	25x30	2.40				
6800	688			22x40	2.60	25x35	2.60	30x25	2.78		
8200	828			22x50	2.90	25x40	2.90	30x30	2.90		
10000	109					25x45	3.20	30x35	3.20		
12000	129					25x50	3.50	30x40	3.50	35x30	3.50
15000	159							30x45	3.90	35x35	3.90
18000	189									35x40	4.51
22000	229									35x45	5.24

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Ripple Current (A rms) at 105°C 120Hz (Dimension in mm)											
Voltage		50(1H)									
Cap (μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
1500	158	20x25	1.29								
1800	188	20x30	1.53	22x25	1.50						
2200	228	20x35	1.72	22x30	1.70						
2700	278	20x35	1.82	22x30	1.80	25x25	1.80				
3300	338	20x40	2.01	22x35	2.00	25x30	2.00				
3900	398			22x40	2.23	25x30	2.20	30x25	2.20		
4700	478			22x45	2.50	25x35	2.43	30x30	2.50		
5600	568			22x50	2.80	25x40	2.80	30x30	2.76		
6800	688					25x45	3.30	30x35	3.30	35x30	3.30
8200	828							30x40	3.71	35x35	3.85
10000	109							30x50	4.51	35x40	4.49
12000	129									35x45	4.56
15000	159									35x50	4.80

Ripple Current (A rms) at 105°C 120Hz (Dimension in mm)											
Voltage		63V(1J)									
Cap (μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
1000	108	20x25	1.21								
1200	128	20x30	1.43	22x25	1.40						
1500	158	20x35	1.52	22x30	1.50						
1800	188	20x35	1.72	22x30	1.70	25x25	1.70				
2200	228	20x40	2.01	22x35	2.00	25x30	2.00				
2700	278			22x40	2.20	25x35	2.20	30x25	2.20		
3300	338			22x45	2.60	25x35	2.39	30x30	2.50		
3900	398					25x40	2.57	30x35	2.70		
4700	478					25x50	3.00	30x40	3.00	35x30	3.00
5600	568							30x40	3.22	35x35	3.30
6800	688							30x50	3.86	35x40	3.84
8200	828									35x45	4.43
10000	109									35x50	5.11

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Ripple Current (A rms) at 105°C 120Hz (Dimension in mm)											
Voltage		80(1K)									
Cap (μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
820	827	20x25	1.04								
1000	108	20x30	1.24	22x25	1.19						
1200	128	20x35	1.43	22x30	1.50						
1500	158	20x35	1.57	22x30	1.59	25x25	1.59				
1800	188	20x40	1.77	22x35	1.79	25x30	1.71				
2200	228			22x40	2.03	25x35	2.10	30x25	1.98		
2700	278			22x45	2.39	25x40	2.35	30x30	2.35		
3300	338					25x45	2.64	30x35	2.61	35x30	2.60
3900	398					25x50	2.92	30x40	2.82	35x30	2.97
4700	478							30x45	3.34	35x35	3.38
5600	568							30x50	3.80	35x40	3.80
6800	688									35x45	3.90
8200	828									35x50	4.20

Ripple Current (A rms) at 105°C 120Hz (Dimension in mm)											
Voltage		100V(2A)									
Cap (μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
560	567	20x25	0.95								
680	687	20x30	1.15	22x25	1.09						
820	827	20x35	1.31	22x30	1.40						
1000	108	20x35	1.43	22x30	1.47	25x25	1.45				
1200	128	20x40	1.61	22x35	1.69	25x30	1.68				
1500	158			22x40	1.97	25x35	1.98	30x25	1.95		
1800	188			22x45	2.23	25x40	2.20	30x30	2.20		
2200	228					25x45	2.53	30x35	2.55	35x30	2.60
2700	278					25x50	2.82	30x40	2.86	35x35	2.90
3300	338							30x45	3.30	35x35	3.25
3900	398									35x40	3.67
4700	478									35x45	3.80
5600	568									35x50	4.05

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Ripple Current (A rms) at 105 °C 120Hz (Dimension in mm)											
Voltage		160(2C)									
Cap ( μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
270	277	20x25	1.10								
330	337	20x30	1.20	22x25	1.20						
390	397	20x35	1.42	22x30	1.30						
470	477	20x40	1.34	22x30	1.55	25x25	1.55				
560	567			22x35	1.67	25x30	1.67				
680	687			22x40	1.82	25x35	1.85	30x25	1.82		
820	827			22x45	2.04	25x40	2.04	30x30	2.04		
1000	108					25x45	2.40	30x25	2.25		
1200	128					25x50	2.62	30x40	2.49	35x30	2.49
1500	158							30x45	2.84	35x35	2.84
1800	188							30x50	3.32	35x40	3.00
2200	228									35x45	3.50

Ripple Current (A rms) at 105 °C 120Hz (Dimension in mm)											
Voltage		180V(2P)									
Cap ( μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
220	227	20x25	1.00								
270	277	20x30	1.10	22x25	1.00						
330	337	20x35	1.20	22x30	1.20						
390	397	20x35	1.35	22x30	1.35	25x25	1.35				
470	477	20x40	1.34	22x30	1.55	25x25	1.55				
560	567			22x40	1.67	25x30	1.67	30x25	1.67		
680	687			22x45	1.78	25x35	1.78	30x30	1.78		
820	827			22x50	2.04	25x40	2.04	30x30	2.04		
1000	108					25x45	2.30	30x35	2.30	35x30	2.30
1200	128							30x40	2.55	35x35	2.55
1500	158							30x45	2.90	35x40	2.90
1800	188									35x45	3.30
2200	228									35x50	3.65

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Ripple Current (A rms) at 105°C 120Hz (Dimension in mm)											
Voltage		200(2D)									
Cap (µ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
220	227	20x25	1.00								
270	277	20x30	1.10	22x25	1.10						
330	337	20x35	1.20	22x30	1.25	25x25	1.25				
390	397	20x40	1.31	22x35	1.35	25x30	1.35				
470	477			22x40	1.50	25x30	1.50	30x25	1.50		
560	567			22x45	1.67	25x35	1.70	30x25	1.67		
680	687			22x50	1.78	25x40	1.82	30x30	1.78		
820	827					25x45	2.10	30x35	2.04	35x30	2.04
1000	108					25x50	2.42	30x40	2.30	35x35	2.30
1200	128							30x45	2.65	35x35	2.65
1500	158									35x40	3.08
1800	188									35x45	3.48

Ripple Current (A rms) at 105°C 120Hz (Dimension in mm)											
Voltage		220V(2N)									
Cap (µ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
180	187	20x25	0.90								
220	227	20x30	1.00	22x25	1.00						
270	277	20x35	1.15	22x30	1.15						
330	337	20x40	1.25	22x35	1.25	25x25	1.25				
390	397	20x45	1.40	22x35	1.40	25x25	1.40				
470	477			22x40	1.51	25x30	1.44	30x25	1.50		
560	567			22x45	1.70	25x35	1.64	30x30	1.70		
680	687					25x40	1.84	30x35	1.93	35x30	1.89
820	827					25x45	2.08	30x40	2.19	35x30	2.16
1000	108							30x45	2.50	35x35	2.44
1200	128									35x40	2.79
1500	158									35x45	3.22

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Ripple Current (A rms) at 105 °C 120Hz											(Dimension in mm)
Voltage		250(2E)									
Cap ( μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
150	157	20x25	0.79								
180	187	20x30	0.90	22x25	0.88						
220	227	20x35	1.00	22x30	1.00	25x25	1.08				
270	277	20x40	1.10	22x35	1.18	25x30	1.27				
330	337			22x40	1.30	25x30	1.30	30x25	1.35		
390	397			22x45	1.49	25x35	1.49	30x30	1.49		
470	477			22x50	1.65	25x40	1.65	30x30	1.65		
560	567					25x45	1.80				
								30x35	1.80		
680	687					25x50	2.03	30x40	2.00	35x30	2.00
820	827							30x45	2.30	35x35	2.30
1000	108							30x50	2.70	35x40	2.69
1200	128									35x45	3.09

Ripple Current (A rms) at 105 °C 120Hz											(Dimension in mm)
Voltage		315V(2F)									
Cap ( μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
82	826	20x25	0.64								
100	107	20x30	0.69								
120	127	20x30	0.75	22x25	0.75						
150	157	20x35	0.82	22x30	0.82	25x25	0.82				
180	187	20x40	0.90	22x35	0.92	25x30	0.93				
220	227			22x40	1.04	25x30	1.04	30x25	1.04		
270	277			22x45	1.16	25x35	1.16	30x25	1.16		
330	337			22x50	1.33	25x40	1.33	30x30	1.33		
390	397					25x45	1.47	30x35	1.47	35x30	1.47
470	477							30x40	1.70	35x30	1.70
560	567							30x45	2.05	35x35	2.05
680	687									35x40	2.17
820	827									35x45	2.20

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Ripple Current (A rms) at 105°C 120Hz											(Dimension in mm)
Voltage		350(2V)									
Cap (μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
68	686	20x25	0.47								
82	826	20x30	0.54								
100	107	20x30	0.60	22x25	0.69						
120	127	20x35	0.68	22x30	0.75	25x25	0.75				
150	157	20x40	0.78	22x35	0.82	25x30	0.83				
180	187			22x40	0.92	25x30	0.92	30x25	0.90		
220	227			22x45	1.05	25x35	1.04	30x30	1.02		
270	277			22x50	1.16	25x40	1.18	30x30	1.17		
330	337					25x45	1.29	30x35	1.34	35x30	1.22
390	397					25x50	1.51	30x40	1.51	35x35	1.47
470	477							30x45	1.65	35x35	1.69
560	567							30x50	1.85	35x40	1.90
680	687									35x45	2.20

Ripple Current (A rms) at 105°C 120Hz											(Dimension in mm)
Voltage		385V(2Y)									
Cap (μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current
56	566	20x25	0.37								
68	686	20x30	0.44	22x25	0.45						
82	826	20x30	0.50	22x30	0.52						
100	107	20x35	0.56	22x30	0.58	25x25	0.57				
120	127	20x40	0.66	22x35	0.68	25x30	0.68				
150	157			22x40	0.79	25x30	0.78	30x25	0.75		
180	187			22x45	0.89	25x35	0.86	30x30	0.88		
220	227			22x50	1.01	25x40	1.00	30x30	1.00		
270	277					25x45	1.13	30x40	1.14	35x30	1.10
330	337							30x45	1.31	35x35	1.32
390	397							30x50	1.48	35x40	1.48
470	477									35x45	1.76
560	567									35x50	1.95

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Ripple Current (A rms) at 105 °C 120Hz											(Dimension in mm)	
Voltage		400(2G)										
Cap ( μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	
56	565	20x25	0.51									
68	686	20x30	0.56	22x25	0.50							
82	826	20x30	0.64	22x25	0.64							
100	107	20x35	0.70	22x30	0.70	25x25	0.70					
120	127	20x40	0.75	22x35	0.75	25x30	0.76					
150	157			22x40	0.88	25x30	0.83	30x25	0.88			
180	187			22x45	0.98	25x35	0.98	30x30	0.98			
220	227			22x50	1.10	25x40	1.10	30x30	1.10			
270	277					25x50	1.29	30x35	1.22	35x30	1.22	
330	337							30x45	1.55	35x30	1.44	
390	397							30x45	1.60	35x35	1.60	
470	477									35x40	1.90	
560	567									35x45	2.12	

Ripple Current (A rms) at 105 °C 120Hz											(Dimension in mm)	
Voltage		420V(2M)										
Cap ( μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	
56	565	20x25	0.51									
68	686	20x30	0.56	22x25	0.55							
82	826	20x35	0.64	22x25	0.64	25x25	0.58					
100	107	20x35	0.70	22x30	0.70	25x25	0.70					
120	127	20x40	0.75	22x35	0.75	25x30	0.76	30x25	0.78			
150	157			22x40	0.88	25x35	0.83	30x25	0.88			
180	187			22x45	0.95	25x40	0.97	30x30	0.96	35x25	0.94	
220	227					25x45	1.13	30x35	1.10	35x25	1.10	
270	277					25x50	1.37	30x40	1.25	35x30	1.22	
330	337							30x45	1.49	35x35	1.45	
390	397									35x40	1.66	
470	477									35x45	1.90	

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Ripple Current (A rms) at 105°C 120Hz												(Dimension in mm)	
Voltage		450(2W)											
Cap (μ F)	Code	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current	Case Size	Ripple Current		
47	476	20x25	0.39										
56	565	20x30	0.51	22x25	0.50								
68	686	20x35	0.56	22x30	0.53	25x25	0.53						
82	826	20x35	0.64	22x30	0.64	25x25	0.64						
100	107			22x35	0.69	25x25	0.65	30x25	0.72				
120	127			22x40	0.80	25x30	0.80	30x25	0.80				
150	157			22x45	0.88	25x35	0.88	30x30	0.88				
180	187					25x40	1.00	30x30	1.00				
220	227					25x45	1.12	30x35	1.12	35x30	1.12		
270	277							30x40	1.28				
										35x35	1.28		
330	337							30x50	1.45	35x40	1.45		
390	397									35x40	1.55		
470	477									35x50	1.85		

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### 8. List of “Environment-related Substances to be Controlled (‘Controlled Substances’)”

The latest version of <Substances Prohibited as per Sony-SS-00259>

Substances	
Heavy metals	Cadmium and cadmium compounds
	Lead and lead compounds
	Mercury and mercury compounds
	Hexavalent chromium compounds
Chloinated organic compounds	Polychlorinated biphenyls (PCB)
	Polychlorinated naphthalenes (PCN)
	Polychlorinated terphenyls (PCT)
	Short-chain chlorinated paraffins(SCCP)
	Other chlorinated organic compounds
Brominated organic compounds	Polybrominated biphenyls (PBB)
	Polybrominated diphenylethers(PBDE) (including decabromodiphenyl ether[DecaBDE])
	Other brominated organic compounds
Tributyltin compounds(TBT)	
Triphenyltin compounds(TPT)	
Asbestos	
Specific azo compounds	
Formaldehyde	
Beryllium oxide	
Beryllium copper	
Specific phthalates (DEHP, DBP, BBP, DINP, DIDP, DNOP, DNHP)	
Hydrofluorocarbon (HFC), Perfluorocarbon (PFC)	
Perfluorooctane sulfonates (PFOS)	
Specific Benzotriazole	

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## Attachment: Application Guidelines

### 1. Circuit Design

#### 1.1 Operating Temperature and Frequency

Electrolytic capacitor electrical parameters are normally specified at 20°C temperature and 120Hz frequency. These parameters vary with changes in temperature and frequency. Circuit designers should take these changes into consideration.

- (1) Effects of operating temperature on electrical parameters
  - a) At higher temperatures, leakage current and capacitance increase while equivalent series resistance (ESR) decreases.
  - b) At lower temperatures, leakage current and capacitance decrease while equivalent series resistance (ESR) increases.
- (2) Effects of frequency on electrical parameters
  - a) At higher frequencies capacitance and impedance decrease while  $\tan \delta$  increases.
  - b) At lower frequencies, ripple current generated heat will rise due to an increase in equivalent series resistance (ESR).

#### 1.2 Operating Temperature and Life Expectancy

See the file: Life calculation of aluminum electrolytic capacitor

#### 1.3 Common Application Conditions to Avoid

The following misapplication load conditions will cause rapid deterioration to capacitor electrical parameters. In addition, rapid heating and gas generation within the capacitor can occur causing the pressure relief vent to operate and resultant leakage of electrolyte. Under Leaking electrolyte is combustible and electrically conductive.

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(1) Reverse Voltage

DC capacitors have polarity. Verify correct polarity before insertion. For circuits with changing or uncertain polarity, use DC bipolar capacitors. DC bipolar capacitors are not suitable for use in AC circuits.

(2) Charge / Discharge Applications

Standard capacitors are not suitable for use in repeating charge / discharge applications. For charge / discharge applications consult us and advise actual conditions.

(3) Over voltage

Do not apply voltages exceeding the maximum specified rated voltage. Voltages up to the surge voltage rating are acceptable for short periods of time. Ensure that the sum of the DC voltage and the superimposed AC ripple voltage does not exceed the rated voltage.

(4) Ripple Current

Do not apply ripple currents exceeding the maximum specified value. For high ripple current applications, use a capacitor designed for high ripple currents or contact us with your requirements.

Ensure that allowable ripple currents superimposed on low DC bias voltages do not cause reverse voltage conditions.

1.4 Using Two or More Capacitors in Series or Parallel

(1) Capacitors Connected in Parallel

The circuit resistance can closely approximate the series resistance of the capacitor causing an imbalance of ripple current loads within the capacitors. Careful design of wiring methods can minimize the possibility of excessive ripple currents applied to a capacitor.

(2) Capacitors Connected in Series

Normal DC leakage current differences among capacitors can cause voltage imbalances. The use of voltage divider shunt resistors with consideration to leakage current can prevent capacitor voltage imbalances.

1.5 Capacitor Mounting Considerations

(1) Double Sided Circuit Boards

Avoid wiring pattern runs, which pass between the mounted capacitor and the circuit board.

When dipping into a solder bath, excess solder may collect under the capacitor by capillary action and short circuit the anode and cathode terminals.

(2) Circuit Board Hole Positioning

The vinyl sleeve of the capacitor can be damaged if solder passes through a lead hole for subsequently processed parts. Special care when locating hole positions in proximity to capacitors is recommended.

(3) Circuit Board Hole Spacing

The circuit board holes spacing should match the capacitor lead wire spacing within the specified tolerances.

Incorrect spacing can cause excessive lead wire stress during the insertion process. This may result in premature capacitor failure due to short or open circuit, increased leakage current, or electrolyte leakage.

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(4) Clearance for Case Mounted Pressure Relief vents

Capacitors with case mounted pressure relief vents require sufficient clearance to allow for proper vent operation. The minimum clearances are dependent on capacitor diameters as proper vent operation. The minimum clearances are dependent on capacitor diameters as follows.

$\phi$  6.3~ $\phi$  16mm:2mm minimum,  $\phi$  18~ $\phi$  35mm:3mm minimum,  $\phi$  40mm or greater:5mm minimum.

(5) Clearance for Seal Mounted Pressure Relief Vents

A hole in the circuit board directly under the seal vent location is required to allow proper release of pressure.

(6) Wiring Near the Pressure Relief Vent

Avoid locating high voltage or high current wiring or circuit board paths above the pressure relief vent. Flammable, high temperature gas exceeding 100°C may be released which could dissolve the wire insulation and ignite.

(7) Circuit Board patterns Under the Capacitor

Avoid circuit board runs under the capacitor as electrolyte leakage could cause an electrical short.

(8) Screw Terminal Capacitor Mounting

Do not orient the capacitor with the screw terminal side of the capacitor facing downwards.

Tighten the terminal and mounting bracket screws within the torque range specified in the specification.

1.6 Electrical Isolation of the Capacitor

Completely isolate the capacitor as follows.

(1) Between the cathode and the case (except for axially leaded B types) and between the anode terminal and other circuit paths

(2) Between the extra mounting terminals (on T types) and the anode terminal, cathode terminal, and other circuit paths.

1.7 The Product endurance should take the sample as the standard.

1.8 If conduct the load or shelf life test, must be collect date code within 6 months products of sampling.

1.9 Capacitor Sleeve

The vinyl sleeve or laminate coating is intended for marking and identification purposes and is not meant to electrically insulate the capacitor.

The sleeve may split or crack if immersed into solvents such as toluene or xylene, and then exposed to high temperatures.

**CAUTION!**

Always consider safety when designing equipment and circuits. Plan for worst case failure modes such as short circuits and open circuits which could occur during use.

(1) Provide protection circuits and protection devices to allow safe failure modes.

(2) Design redundant or secondary circuits where possible to assure continued operation in case of main circuit failure.

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## 2.Capacitor Handling Techniques

### 2.1 Considerations Before Using

- (1) Capacitors have a finite life. Do not reuse or recycle capacitors from used equipment.
- (2) Transient recovery voltage may be generated in the capacitor due to dielectric absorption. If required, this voltage can be discharged with a resistor with a value of about  $1k\ \Omega$ .
- (3) Capacitors stored for long periods of time may exhibit an increase in leakage current. This can be corrected by gradually applying rated voltage in series with a resistor of approximately  $1k\ \Omega$ .
- (4) If capacitors are dropped, they can be damaged mechanically or electrically. Avoid using dropped capacitors.
- (5) Dented or crushed capacitors should not be used. The seal integrity can be compromised and loss of electrolyte / shortened life can result.

### 2.2 Capacitor Insertion

- \* (1) Verify the correct capacitance and rated voltage of the capacitor.
- \* (2) Verify the correct polarity of the capacitor before inserting.
- \* (3) Verify the correct hole spacing before insertion (land pattern size on chip type) to avoid stress on the terminals.
- (4) Ensure that the auto insertion equipment lead clinching operation does not stress the capacitor leads where they enter the seal of the capacitor.

For chip type capacitors, excessive mounting pressure can cause high leakage current, short circuit, or disconnection.

### 2.3 Manual Soldering

- (1) Observe temperature and time soldering specifications or do not exceed temperatures of  $400\ ^\circ\text{C}$  for 3 seconds or less.
- (2) If lead wires must be formed to meet terminal board hole spacing, avoid stress on the lead wire where it enters the capacitor seal.
- (3) If a soldered capacitor must be removed and reinserted, avoid excessive stress to the capacitor leads.
- (4) Avoid touching the tip of the soldering iron to the capacitor, to prevent melting of the vinyl sleeve.

### 2.4 Flow Soldering

- (1) Do not immerse the capacitor body into the solder bath as excessive internal pressure could result.
- (2) Observe proper soldering conditions (temperature, time, etc.) Do not exceed the specified limits.
- (3) Do not allow other parts or components to touch the capacitor during soldering.

### 2.5 Other Soldering Considerations

Rapid temperature rises during the preheat operation and resin bonding operation can cause cracking of the capacitor vinyl sleeve.

For heat curing, do not exceed  $150\ ^\circ\text{C}$  for a maximum time of 2 minutes.

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### 2.6 Capacitor Handling after Solder

- (1). Avoid movement of the capacitor after soldering to prevent excessive stress on the lead wires where they enter the seal.
- (2). Do not use capacitor as a handle when moving the circuit board assembly.
- (3). Avoid striking the capacitor after assembly to prevent failure due to excessive shock.

### 2.7 Circuit Board Cleaning

- \* (1) Circuit boards can be immersed or ultrasonically cleaned using suitable cleaning solvents for up to 5 minutes and up to 60°C maximum temperatures. The boards should be thoroughly rinsed and dried.  
The use of ozone depleting cleaning agents is not recommended in the interest of protecting the environment.
- \* (2) Avoid using the following solvent groups unless specifically allowed for in the specification;
  - Halogenated cleaning solvents: except for solvent resistant capacitor types, halogenated solvents can permeate the seal and cause internal capacitor corrosion and failure. For solvent resistant capacitors, carefully follow the temperature and time requirements of the specification. 1-1-1 trichloroethane should never be used on any aluminum electrolytic capacitor.
  - Alkali solvents : could attack and dissolve the aluminum case.
  - Petroleum based solvents: deterioration of the rubber seal could result.
  - Xylene : deterioration of the rubber seal could result.
  - Acetone : removal of the ink markings on the vinyl sleeve could result.
- \* (3) A thorough drying after cleaning is required to remove residual cleaning solvents which may be trapped between the capacitor and the circuit board. Avoid drying temperatures, which exceed the maximum rated temperature of the capacitor.
- \* (4) Monitor the contamination levels of the cleaning solvents during use by electrical conductivity, pH, specific gravity, or water content. Chlorine levels can rise with contamination and adversely affect the performance of the capacitor.  
Please consult us for additional information about acceptable cleaning solvents or cleaning methods.

### 2.8 Mounting Adhesives and Coating Agents

When using mounting adhesives or coating agents to control humidity, avoid using materials containing halogenated solvents. Also, avoid the use of chloroprene based polymers.  
After applying adhesives or coatings, dry thoroughly to prevent residual solvents from being trapped between the capacitor and the circuit board.

## 3. Precautions for using capacitors

### 3.1 Environmental Conditions

Capacitors should not be stored or used in the following environments.

- \* (1) Temperature exposure above the maximum rated or below the minimum rated temperature of the capacitor.
- \* (2) Direct contact with water, salt water, or oil.
- \* (3) High humidity conditions where water could condense on the capacitor.

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- \* (4) Exposure to toxic gases such as hydrogen sulfide, sulfuric acid, nitric acid chlorine, or ammonia.
- \* (5) Exposure to ozone, radiation, or ultraviolet rays.
- \* (6) Vibration and shock conditions exceeding specified requirements.

### 3.2 Electrical Precautions

- (1) Avoid touching the terminals of the capacitor as possible electric shock could result. The exposed aluminum case is not insulated and could also cause electric shock if touched.
- (2) Avoid short circuit the area between the capacitor terminals with conductive materials including liquids such as acids or alkaline solutions.

## 4. Emergency Procedures

- (1) If the pressure relief vent of the capacitor operates, immediately turn off the equipment and disconnect from the power source. This will minimize additional damage caused by the vaporizing electrolyte.
- (2) Avoid contact with the escaping electrolyte gas which can exceed 100°C temperatures.  
If electrolyte or gas enters the eye, immediately flush the eyes with large amounts of water.  
If electrolyte or gas is ingested by mouth, gargle with water.  
If electrolyte contacts the skin, wash with soap and water.

## 5. Long Term Storage

Leakage current of a capacitor increases with long storage times. The aluminum oxide film deteriorates as a function of temperature and time. If used without reconditioning, an abnormally high current will be required to restore the oxide film. This current surge could cause the circuit or the capacitor to fail.

After one year, a capacitor should be reconditioned by applying rated voltage in series with a 1000 Ω ,current limiting resistor for a time period of 30 minutes .

If the expired date of products date code is over eighteen months, the products should be return to confirmation.

### 5.1 Environmental Conditions

The capacitor shall be not use in the following condition:

- (1) Temperature exposure above the maximum rated or below the minimum rated temperature of the capacitor.
- (2) Direct contact with water, salt water, or oil.
- (3) High humidity conditions where water could condense on the capacitor.
- (4) Exposure to toxic gases such as hydrogen sulfide, sulfuric acid, nitric acid, chlorine, or ammonia.
- (5) Exposure to ozone, radiation, or ultraviolet rays.
- (6) Vibration and shock conditions exceeding specified requirements.

## 6. Capacitor Disposal

When disposing of capacitors, use one of the following methods.

- \* Incinerate after crushing the capacitor or puncturing the can wall (to prevent explosion due to internal pressure rise). Capacitors should be incinerated at high temperatures to prevent the release of toxic gases such as chlorine from the polyvinyl chloride sleeve, etc.
- \* Dispose of as solid waste.

NOTE: Local laws may have specific disposal requirements, which must be followed.

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