NEC

SOLID TANTALUM CAPACITOR
SV/F SERIES

Surface mount resin molded chip with Built-in fuse, Low blow-out current (2A)

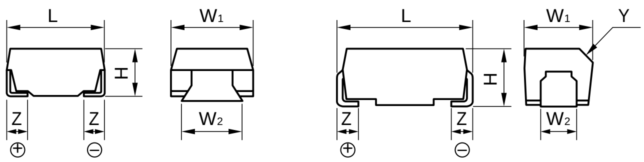
The SV/F series features a built-in fuse to minimize circuit damage from over current by protection with less than a half blow-out current of the former type.

This fuse-protected capacitor is suitable for noise absorption applications such as those required for computers, terminals and measuring instruments.

FEATURES

- ○ Built-in fuse protection (2A)
- ○ High-temperature durability for either wave soldering or reflow soldering applications
- ○ The same excellent performance as NEC's R series
- ○ Wide operating temperature range (–55˚C to +125˚C)
- ○ High reliability (Failure rate = 1%/1 000H at 85˚C, DC rated voltage applied)

DIMENSIONS

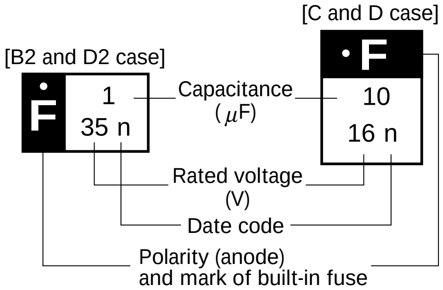


[B2 and D2 case] **[C and D case]**

(Unit : mm)

Case Code	L	W1	W2	H	Z	Y
B2	3.5±0.2	2.8±0.2	2.3±0.1	1.9±0.2	0.8±0.3	–
C	6.0±0.3	3.2±0.3	1.8±0.1	2.5±0.3	1.3±0.3	0.4C
D2	5.8±0.3	4.6±0.3	2.4±0.1	3.2±0.3	1.3±0.3	–
D	7.3±0.3	4.3±0.3	2.4±0.1	2.8±0.3	1.3±0.3	0.5C

MARKING



The information in this document is subject to change without notice.

Document No. EC0003EJ3V1DS00 (3rd edition)
Date Published June 1996 M CP(K)
Printed in Japan

PRODUCTION DATE CODE

Year \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995	a	b	c	d	e	f	g	h	j	k	l	m
1996	n	p	q	r	s	t	u	v	w	x	y	z
1997	A	B	C	D	E	F	G	H	J	K	L	M
1998	N	P	Q	R	S	T	U	V	W	X	Y	Z

Date code will resume beginning in 1999.

PRODUCT LINE-UP AND MARKING CODE

Capacitance (μF) \ U_R (Vdc)	10	16	20	25	35	50
1.0					B2	C
1.5				B2		
2.2			B2		C	
3.3		B2		C		D2
4.7	B2	C	C		D2, D	
6.8		C		D2, D	D	
10		C	D2, D	D		
15	C, D2	D2	D			
22		D2, D	D			
33	D2, D	D				
47	D					

U_R : Rated voltage

PART NUMBER SYSTEM

BULK (Packed in poly bag)

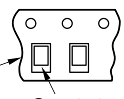
SVF B2 1V 105 M

- M — Capacitance tolerance: M for ±20%
- 105 — Capacitance code in pF: First two digits represent significant figures. Third digit specifies number of zeros to follow.
- 1V — Rated voltage: 1H : 50 V, 1V : 35 V, 1E : 25 V, 1D : 20 V, 1C : 16 V, 1A : 10 V
- B2 — Case code
- SVF — SVF series

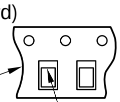
TAPE AND REEL

TE SVFB21V105M 8 R

- R — Packing orientation
  - R : (Standard) Orientation



  - L : (Non-Standard) Orientation



- 8 — Tape width: 8 mm for B2 case; 12 mm for C, D and D2 case
- SVFB21V105M — Part number of bulk (see left)
- TE — Tape and reel

SPECIFICATIONS

<table>
<tr><th>No.</th><th colspan="2">Items</th><th colspan="7">Specifications</th><th>Test Conditions</th></tr>
<tr><td>1</td><td colspan="2">Operating Temp. Range</td><td colspan="7">–55 to +125˚C</td><td>Over 85˚C, applied voltage shall be derated on the basis of the Derated Voltage at 125˚C specified in this table item no.4</td></tr>
<tr><td>2</td><td colspan="2">Rated Voltage</td><td>10</td><td>16</td><td>20</td><td>25</td><td>35</td><td>50</td><td>Vdc</td><td>up to 85˚C</td></tr>
<tr><td>3</td><td colspan="2">Surge Voltage</td><td>13</td><td>20</td><td>26</td><td>33</td><td>46</td><td>65</td><td>Vdc</td><td>up to 85˚C</td></tr>
<tr><td>4</td><td colspan="2">Derated Voltage</td><td>6.3</td><td>10</td><td>13</td><td>16</td><td>22</td><td>32</td><td>Vdc</td><td>at 125˚C</td></tr>
<tr><td>5</td><td colspan="2">Capacitance Range</td><td colspan="7">1.0 to 4.7 μF</td><td>at 120 Hz</td></tr>
<tr><td>6</td><td colspan="2">Capacitance Tolerance</td><td colspan="7">±20%</td><td>at 120 Hz</td></tr>
<tr><td>7</td><td colspan="2">Leakage Current</td><td colspan="7">0.01 CV (μA) or 0.5 μA whichever is greater</td><td>5 min. after rated voltage applied</td></tr>
<tr><td>8</td><td colspan="2">Tangent of loss angle</td><td colspan="7">1.0 to 4.7 μF : 0.04 max.
6.8 to 47 μF : 0.06 max.</td><td>at 25˚C, 120 Hz</td></tr>
<tr><td>9</td><td colspan="2">Surge Voltage Resistance</td><td colspan="7">ΔC/C : ±5%
Tangent of loss angle : Initial requirement
Leakage Current : Initial requirement</td><td>at 85˚C
Surge voltage for 30 sec. (Rs = 1 kΩ)
Discharge for 4 min. 30 sec.
1 000 cycles</td></tr>
<tr><td rowspan="4">10</td><td rowspan="4">Characteristics at high and low temperature</td><td>Temp.</td><td colspan="2">–55˚C</td><td colspan="2">+85˚C</td><td colspan="3">+125˚C</td><td rowspan="4">Step1 : +25˚C
Step2 : –55˚C
Step3 : +25˚C
Step4 : +85˚C
Step5 : +125˚C
Step6 : +25˚C</td></tr>
<tr><td>ΔC/C</td><td colspan="2">$^{0}_{-12}$ %</td><td colspan="2">$^{+12}_{0}$ %</td><td colspan="3">$^{+15}_{0}$ %</td></tr>
<tr><td>Tangent of loss angle</td><td colspan="2">1.0 to 4.7 μF : 0.08
6.8 to 47 μF : 0.10</td><td colspan="2">Initial requirement</td><td colspan="3">1.0 to 4.7 μF : 0.06
6.8 to 47 μF : 0.08</td></tr>
<tr><td>Leakage Current</td><td colspan="2">—</td><td colspan="2">0.1 CV or 5 μA whichever is greater</td><td colspan="3">0.125 CV or 6.25 μA whichever is greater</td></tr>
<tr><td>11</td><td colspan="2">Repid change of temperature</td><td colspan="7">ΔC/C : ±5%
Tangent of loss angle : Initial requirement
Leakage Current : Initial requirement</td><td>IEC68-2-14 Test N and IEC68-2-33 Guidance
–55 to +125˚C
5 cycles</td></tr>
<tr><td>12</td><td colspan="2">Resistance to soldering</td><td colspan="7">ΔC/C : ±5%
Tangent of loss angle : Initial requirement
Leakage Current : Initial requirement</td><td>IEC68-2-58 Test Td
Fully immersion to solder at 260˚C for 5 sec.</td></tr>
<tr><td>13</td><td colspan="2">Damp Heat (Steady state)</td><td colspan="7">ΔC/C : ±5%
Tangent of loss angle : 150% of Intial requirement
Leakage Current : Initial requirement</td><td>IEC68-2-3 Test Ca
at 40˚C, 90 to 95% RH, for 500H</td></tr>
<tr><td>14</td><td colspan="2">Endurance</td><td colspan="7">ΔC/C : ±10%
Tangent of loss angle : Initial requirement
Leakage Current : 125% of Initial requirement</td><td>at 85˚C
Rated Voltage applied for 2 000 H</td></tr>
<tr><td>15</td><td colspan="2">Fuse Blow-out Characteristics</td><td colspan="7">B2 : 2A – 5 sec. max.
C : 2A – 10 sec. max.
D2, D : 2A – 20 sec. max.</td><td>at 25˚C</td></tr>
</table>

LEGEND

CV : Product of capacitance in μF and voltage in V

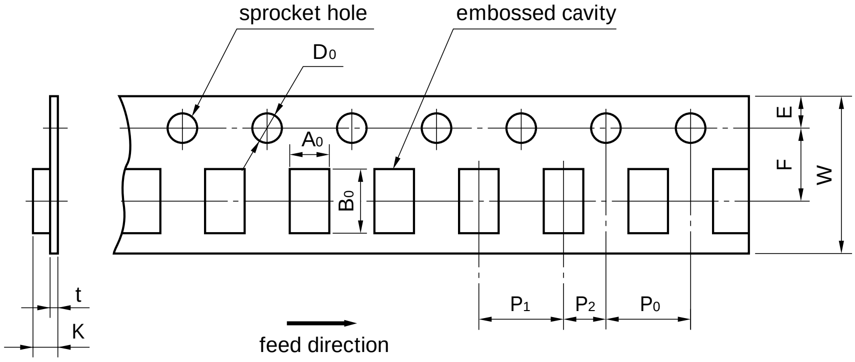
ΔC/C : Capacitance change ratio

PART NUMBER WITH FUNDAMENTAL PERFORMANCE

Rated Voltage (Vdc)	Capacitance (μF)	Tangent of loss angle max.	Leakage Current (μA) max.	Case Code	Part Number
10	4.7	0.04	0.5	B2	SVFB21A475M
	15	0.06	1.5	C	SVFC1A156M
	15	0.06	1.5	D2	SVFD21A156M
	33	0.06	3.3	D2	SVFD21A336M
	33	0.06	3.3	D	SVFD1A336M
	47	0.06	4.7	D	SVFD1A476M
16	3.3	0.04	0.5	B2	SVFB21C335M
	4.7	0.04	0.7	C	SVFC1C475M
	6.8	0.06	1.0	C	SVFC1C685M
	10	0.06	1.6	C	SVFC1C106M
	15	0.06	2.4	D2	SVFD21C156M
	22	0.06	3.5	D2	SVFD21C226M
	22	0.06	3.5	D	SVFD1C226M
	33	0.06	5.2	D	SVFD1C336M
20	2.2	0.04	0.5	B2	SVFB21D225M
	4.7	0.04	0.9	C	SVFC1D475M
	10	0.06	2.0	D2	SVFD21D106M
	10	0.06	2.0	D	SVFD1D106M
	15	0.06	3.0	D	SVFD1D156M
	22	0.06	4.4	D	SVFD1D226M
25	1.5	0.04	0.5	B2	SVFB21E155M
	3.3	0.04	0.8	C	SVFC1E335M
	6.8	0.06	1.7	D2	SVFD21E685M
	6.8	0.06	1.7	D	SVFD1E685M
	10	0.06	2.5	D	SVFD1E106M
35	1.0	0.04	0.5	B2	SVFB21V105M
	2.2	0.04	0.7	C	SVFC1V225M
	4.7	0.04	1.6	D2	SVFD21V475M
	4.7	0.04	1.6	D	SVFD1V475M
	6.8	0.06	2.3	D	SVFD1V685M
50	1.0	0.04	0.5	C	SVFC1H105M
	3.3	0.04	1.7	D2	SVFD21H335M

TAPE AND REEL SPECIFICATION

[Carrier Tape Specification and Packaging Quantity]

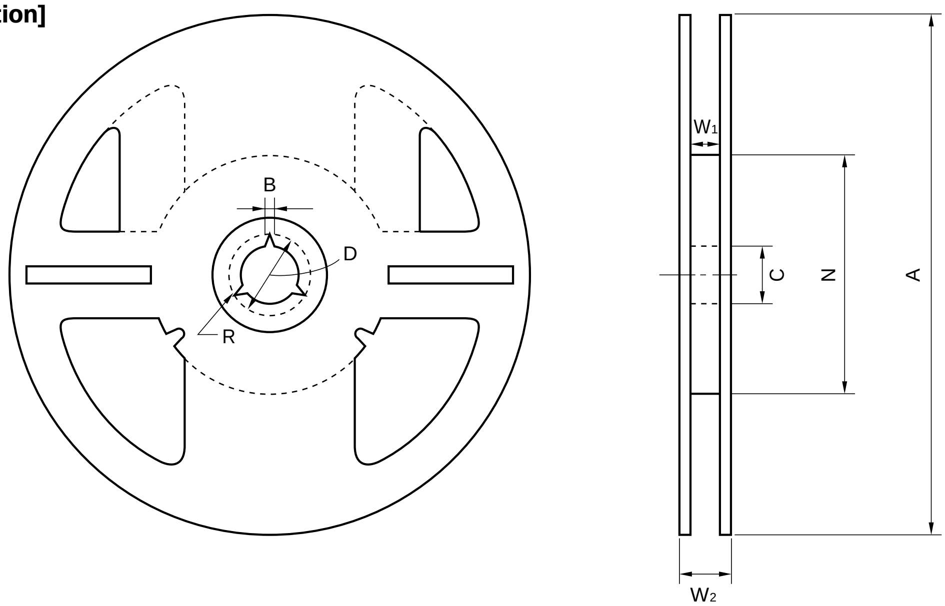


(Unit : mm)

Case Code	A_0±0.2	B_0±0.2	W±0.3	F±0.05	E±0.1	P_1±0.1	P_2±0.05
B2	3.3	3.8	8.0	3.5	1.75	4.0	2.0
C	3.7	6.4	12.0	5.5	1.75	8.0	2.0
D2	5.1	6.2	12.0	5.5	1.75	8.0	2.0
D	4.8	7.7	12.0	5.5	1.75	8.0	2.0

Case Code	P_0±0.1	$D_0{}^{+0.1}_{0}$	K±0.2	t	Q'ty/Reel
B2	4.0	ϕ1.5	2.1	0.2	2 000
C	4.0	ϕ1.5	3.0	0.3	500
D2	4.0	ϕ1.5	3.6	0.4	500
D	4.0	ϕ1.5	3.3	0.3	500

[Reel Specification]

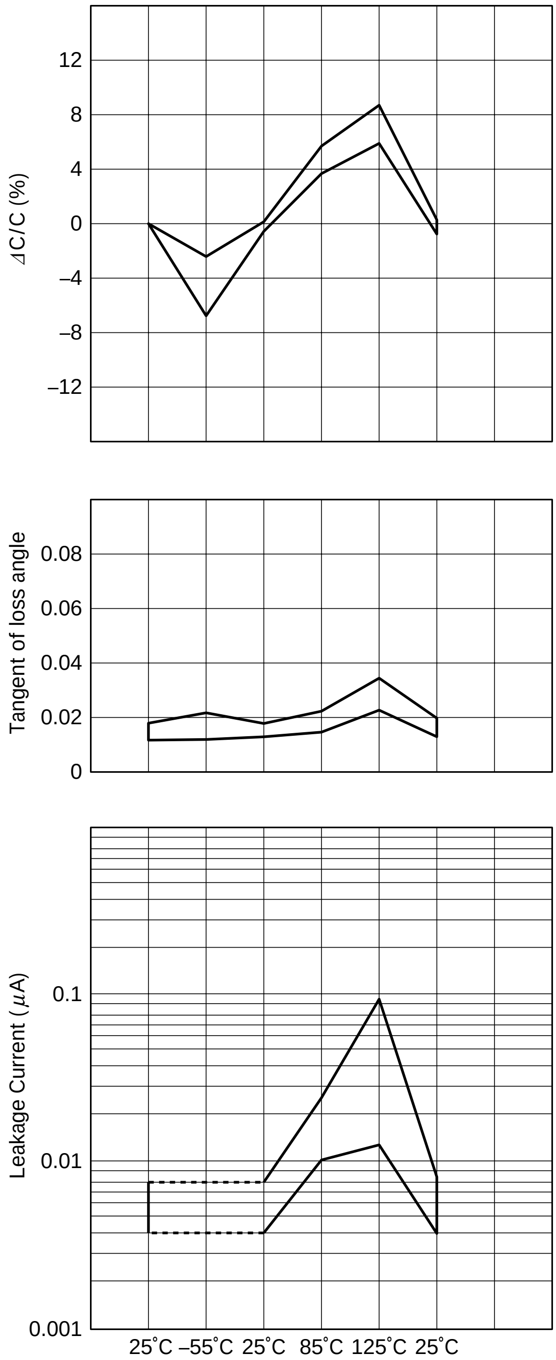


(Unit : mm)

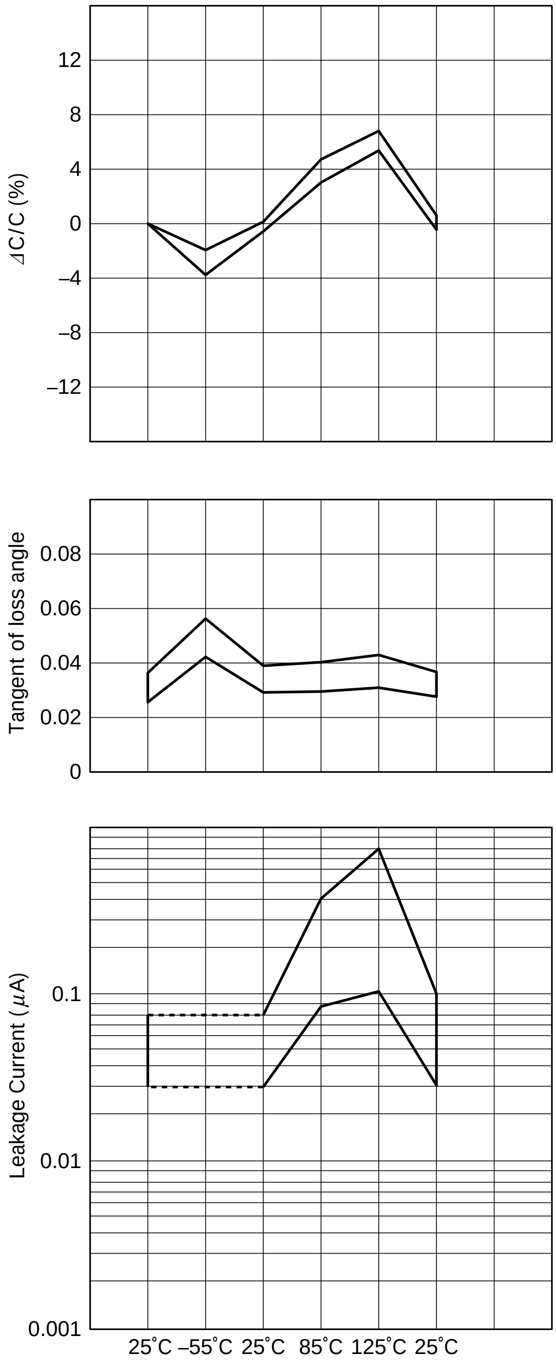
Tape width	A	N	C	D	B	W_1	W_2	R
8	ϕ178±2.0	ϕ50 min.	ϕ13±0.5	ϕ21±0.5	20±0.5	10.0±1.0	14.5 max.	1
12	ϕ178±2.0	ϕ50 min.	ϕ13±0.5	ϕ21±0.5	20±0.5	14.5±1.0	18.5 max.	1

CHARACTERISTICS DATA

Characteristics at high and low temperature



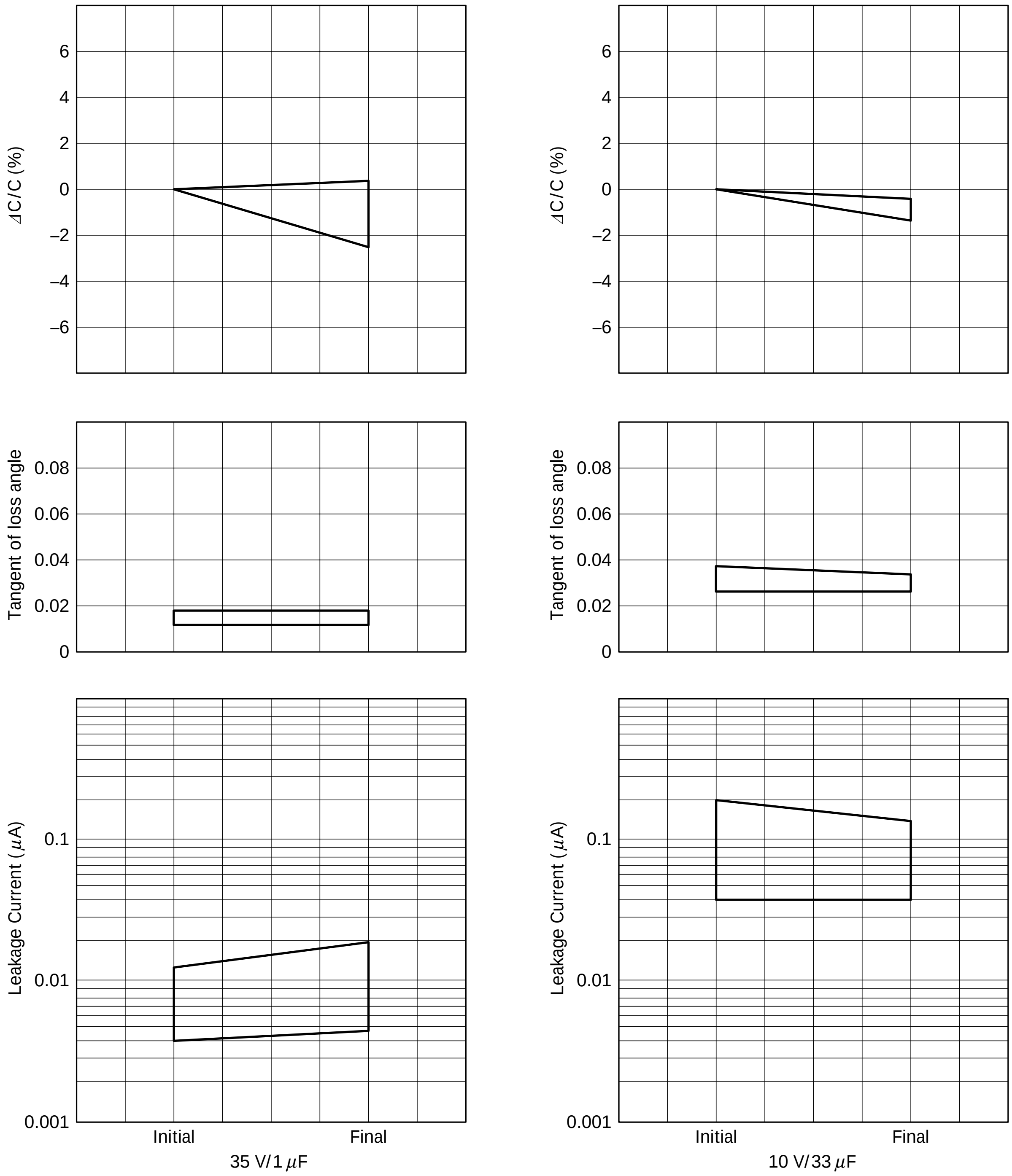
35 V/1 μF



10 V/33 μF

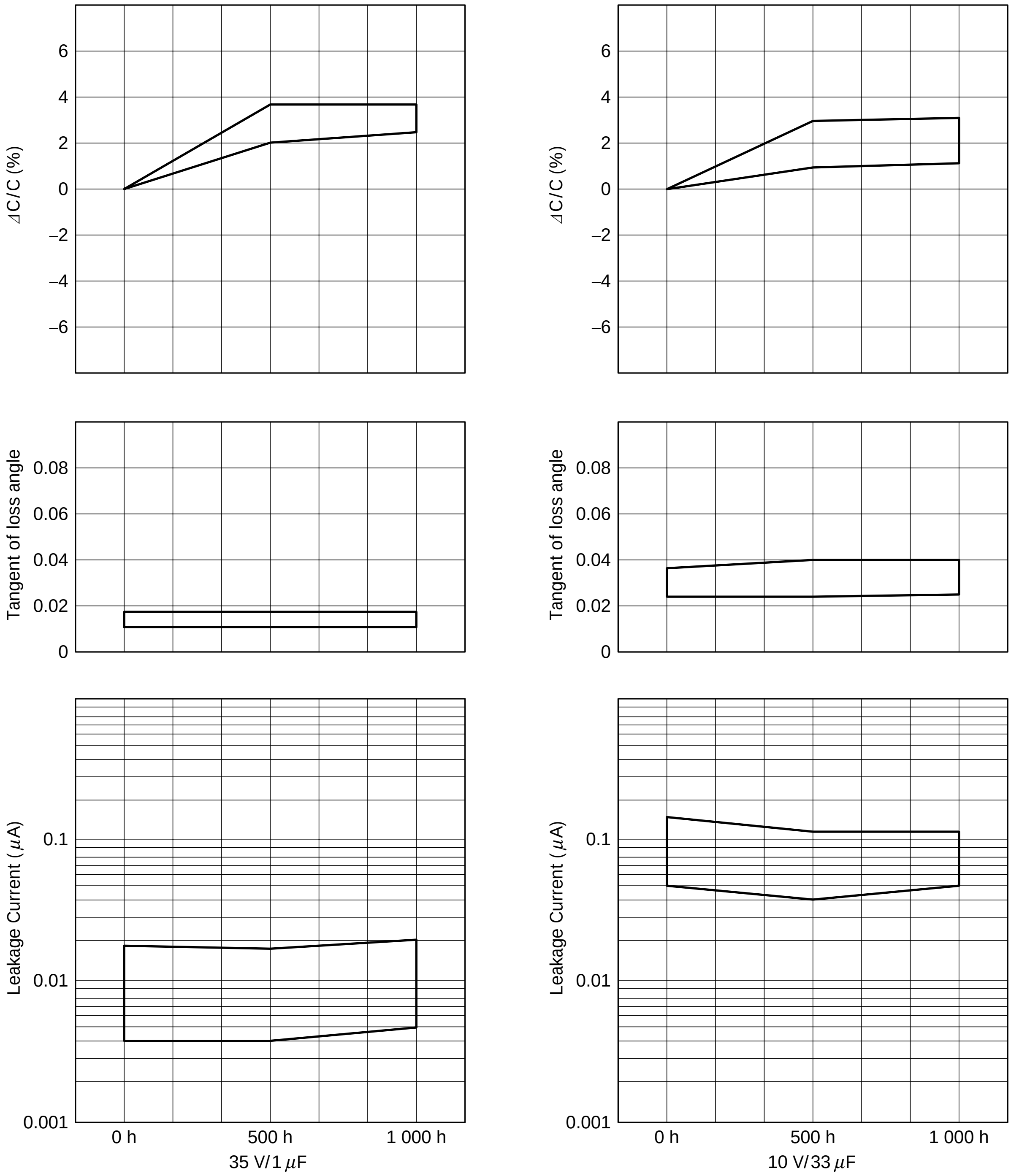
Resistance to soldering (immersing at 260˚C for 10 sec.)

(reference data)

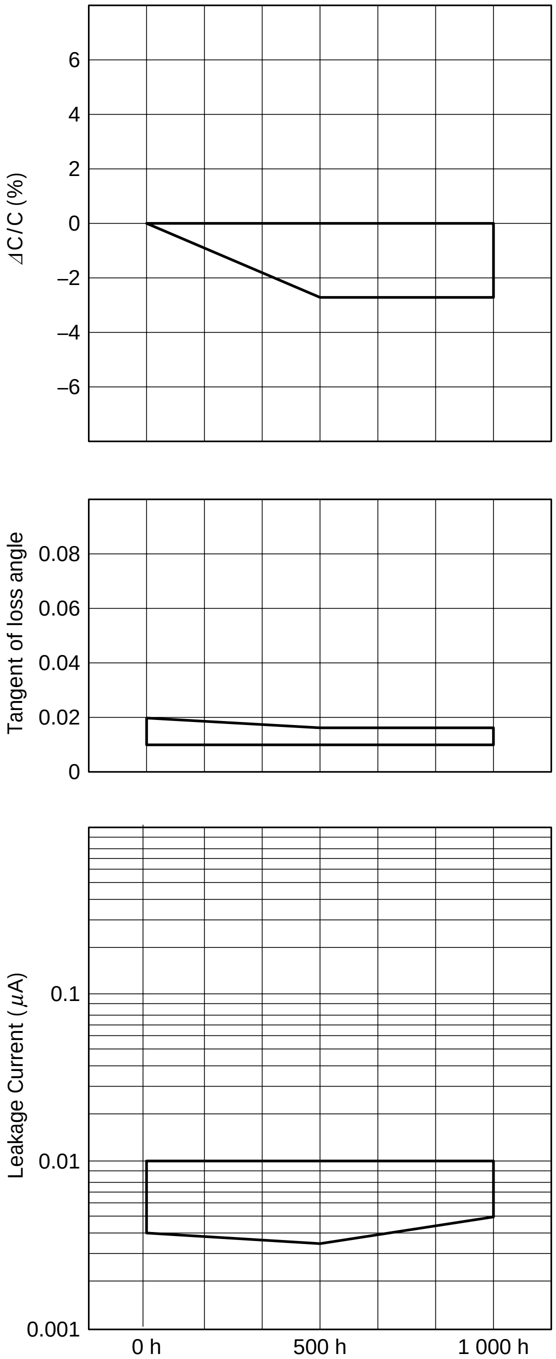


Damp heat (steady state) (65˚C, 90 to 95% RH)

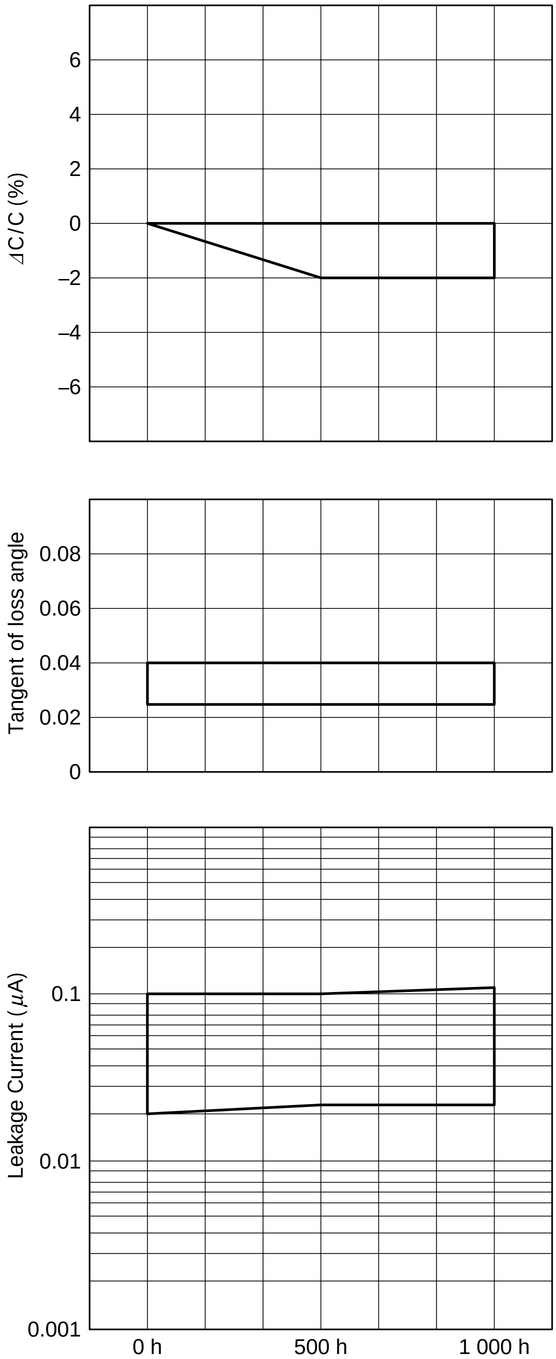
(reference data)



Endurance (85°C, Rated Voltage × 1.3 applied)
(reference data)

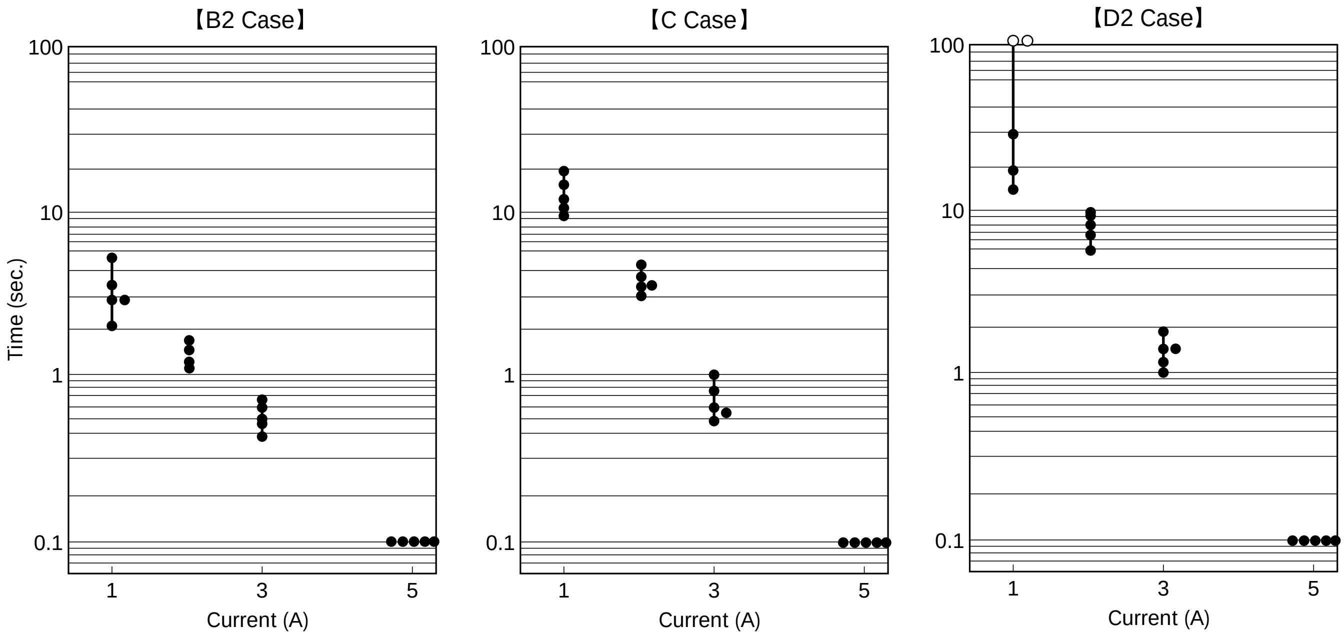


35 V/1 μF



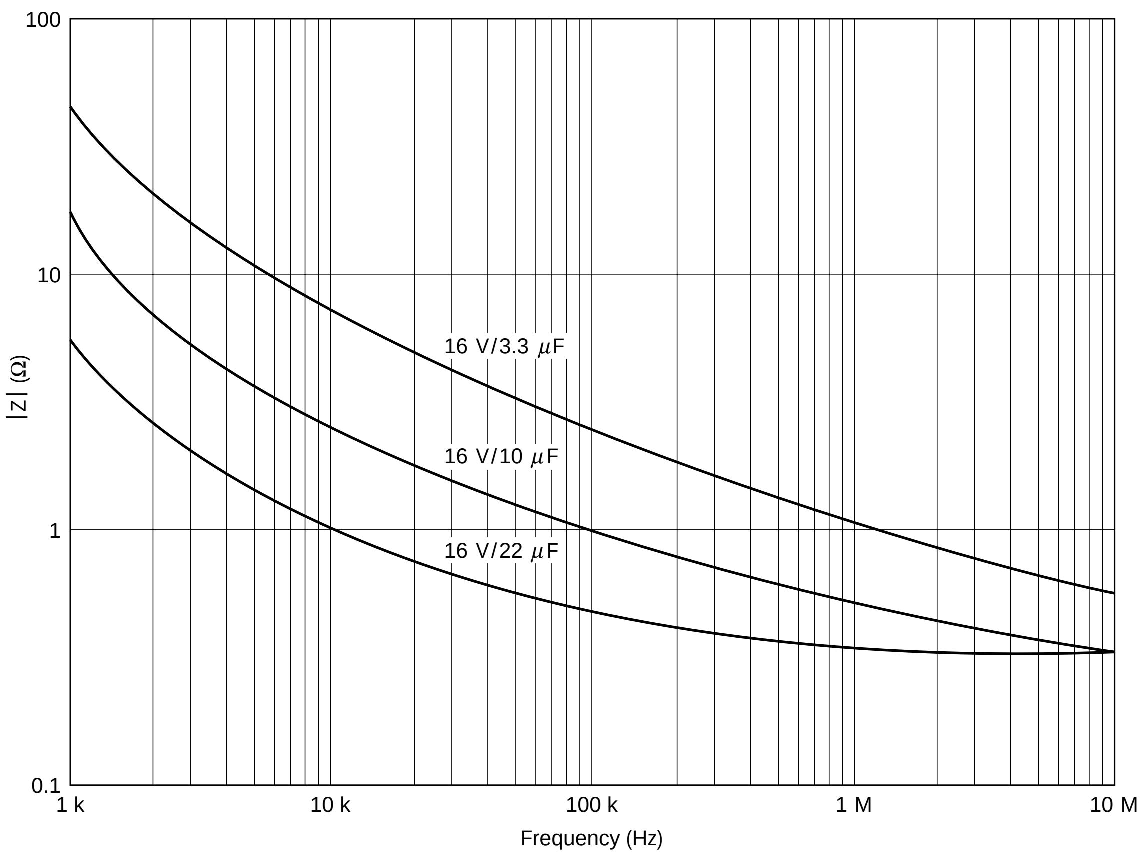
10 V/33 μF

Fuse Blow-out Characteristics



Note : "○" is not for blow-out.

Impedance – Frequency characteristics (reference data)



GUIDE TO APPLICATIONS FOR TANTALUM CHIP CAPACITORS

The failure of the solid tantalum capacitor is mostly classified into a short-circuiting mode and a large leakage current mode.

SV/F series features a built-in-fuse to minimize circuit damage from short circuiting current, but the fuse may not work under some environmental conditions.

Refer to the following in detail for reliable circuit design.

1. Expecting Reliability

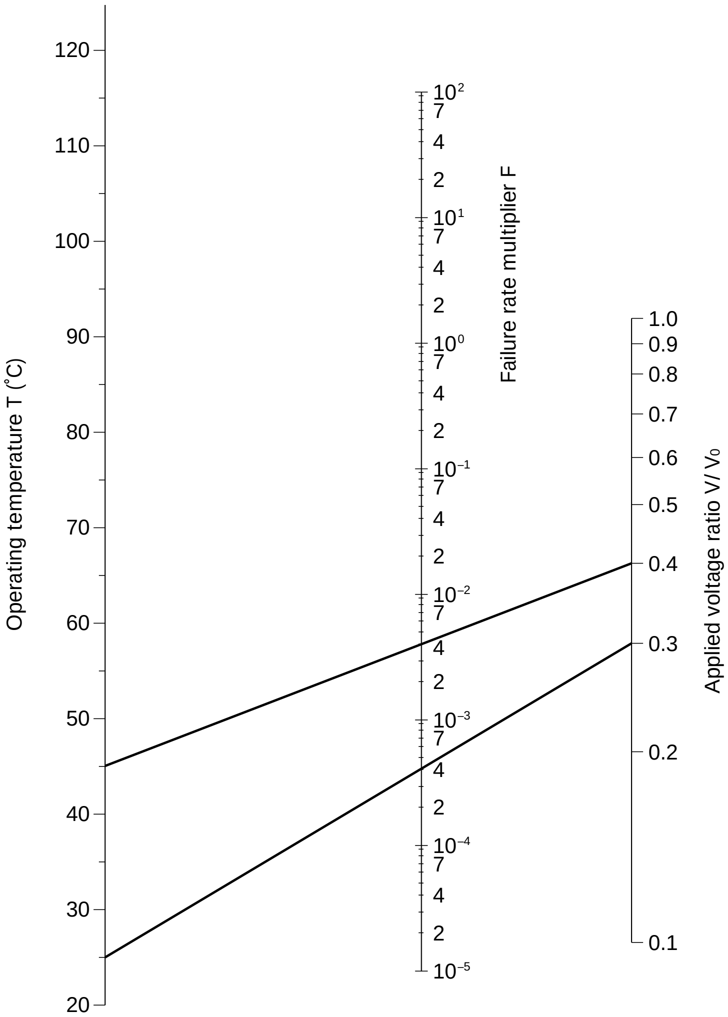
SV/F series tantalum chip capacitors are typically applied to decoupling, blocking, bypassing and filtering.

The SV/F series has a very high reliability (low failure rate) in the field. For example, the maximutn field failure rate of an SV/F series capacitor with a DC rated voltage of 16 V is 0.0004%/1000 hour (4 Fit) at an applied voltage of 5 V, operating temperature of 25˚C and series resistance of 3 Ω.

The maximum failure rate in the field is estimated by the following expression :

$$\lambda = \lambda_0 \left(\frac{V}{V_0}\right)^3 \times 2^{\left(\frac{T-T_0}{10}\right)}$$

λ : Maximum field failure rate
λ_0 : 1% 1000 hour (The failure rate of the SV/F series at the full DC rated voltage at operating temperature of 85˚C and series resistance of 3 Ω.)
V : Applied voltage in actual use
V_0 : DC Rated voltage
T : Operating temperature in actual use
T_0 : 85˚C



The nomograph is provided for quick estimation of maximum fieid failure rates.

Connect operating temperature T and applied voltage ratio V/V_0 of interest with a straight line. The failure rate multiplier F is given at the intersection of this line with the model scale. The failure rate is obtained as $\lambda = \lambda_0 \cdot F$.

Examples :

Given V/V_0 = 0.4 and T = 45˚C, read
$F = 4 \times 10^{-3}$
Hence, λ = 0.004%/1000 hour (40 Fit)
Given V/V_0 = 0.3 and T = 25˚C, read
$F = 4 \times 10^{-4}$
Hence, λ = 0.0004%/1000 hour (4 Fit)

2. Built-in-fuse characteristics

The briefing of the built-in-fuse characteristics is that:

(1) Fuse may not work under some environmental conditions.

(2) When the built fuse blows, slight smoking may occur.

(3) Fuse blowout data is as shown on page 10.

(4) The ESR (equivalent series resistance) is larger than the conventional tantalum capacitor by the built-in-fuse resistance.

Taking notice the above, refer to the following in detail for reliable circuit design.

3. Series resistance

As shown in Figure 1, reliability is increased by inserting a series resistance of at least 3 Ω/V into circuits where current flow is momentary (switching circuits, charge/discharge circuits, etc).

If the capacitor is in a low-impedance circuit, the voltage applied to the capacitor should be less than 1/2 to 1/3 of the DC rated voltage.

Figure 1 Effects of series resistance

4. Ripple voltage

The sum of DC voltage and peak ripple voltage should not exceed the rated DC rated voltage of the capacitor.

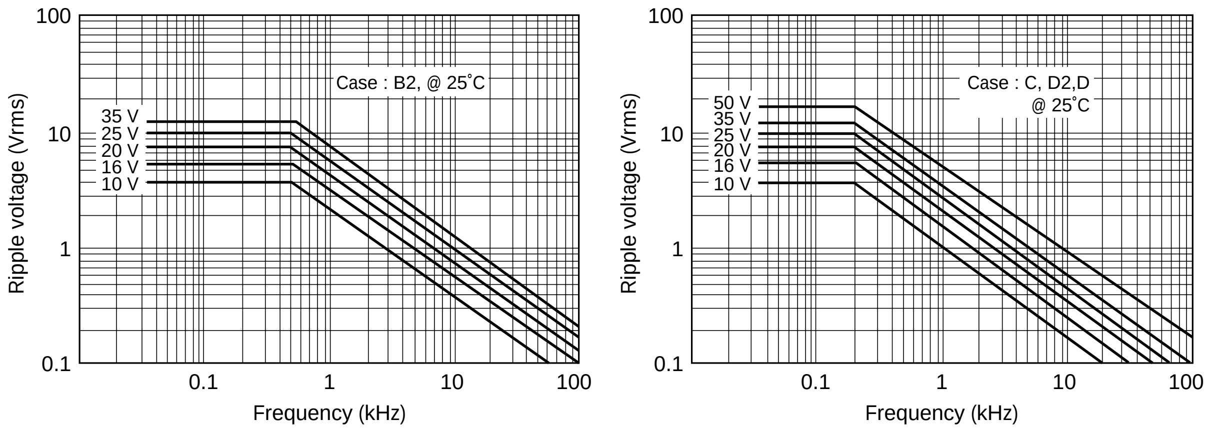


Figure 2 Permissible ripple voltage vs. frequency

Figure 2 is based on an ambient temperature of 25˚C. For higher temperature, permissible ripple voltage shall be derated as follows.

Permissible voltage at 50˚C = 0.7 × permissible voltage at 25˚C

Permissible voltage at 85˚C = 0.5 × permissible voltage at 25˚C

Permissible voltage at 125˚C = 0.3 × permissible voltage at 25˚C

5. Reverse voltage

Because the capacitors are polarized, reverse voltage should not be applied.

If reverse voltage cannot be avoided because of circuit design, the voltage application should be for a very short time and should not exceed the following.

10% of DC rated voltage at 25˚C
5% of DC rated voltage at 85˚C
1% of DC rated voltage at 125˚C

6. Mounting

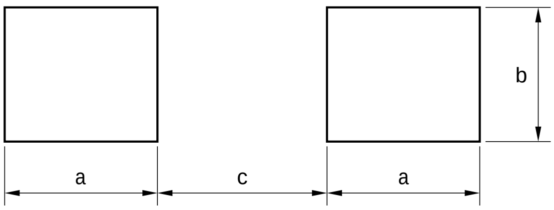
(1) Direct soldering

Keep in mind the following points when soldering the capacitor by means of jet soldering or dip soldering:

(a) Temporarily fixing resin

Because the SV/F series solid tantalum capacitors are larger in size and subject to more force than the chip multilayer ceramic capacitors or chip resistors, more resin is required to temporarily secure the solid tantalum capacitors. However, if too much resin is used, the resin adhering to the patterns on a printed circuit board may adversely affect the solderability.

(b) Pattern design



Case	a	b	c
B2	3.0	2.8	1.6
C	4.1	2.3	2.4
D2	5.4	2.9	2.4
D	5.2	2.9	3.7

The above dimensions are for reference only. If the capacitor is to be mounted by this method, and if the pattern is too small, the solderability may be degraded.

(c) Temperature and time

Keep the peak temperature and time to within the following values:

Solder temperature ... 260˚C max.
Time .... 5 seconds max.

Whenever possible, perform preheating (at 150˚C max.) for smooth temperature profile. To maintain the reliability, mount the capacitor at a low temperature and in a short time whenever possible.

(d) Component layout

If many types of chip components are mounted on a printed circuit board which is to be soldered by means of jet soldering, solderability may not be uniform over the entire board depending on the layout and density of the components on the board (also take into consideration generation of flux gas).

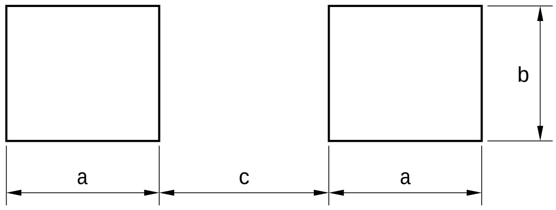
(e) Flux

Use resin-based flux. Do not use flux with strong acidity.

(2) Reflow soldering

Keep in mind the following points when soldering the capacitor in a soldering oven or with a hot plate:

(a) Pattern design



Case	a	b	c
B2	1.6	2.8	1.6
C	2.4	2.3	2.4
D2	2.4	2.9	2.4
D	2.4	2.9	3.7

The above dimensions are for reference only. Note that if the pattern is too big, the component may not be mounted in place.

(b) Temperature and time

Keep the peak temperature and time to within the following values:

Solder temperature ...... 260˚C max.

Time : 10 seconds max.

Whenever possible, perform preheating (at 150˚C max.) for smooth temperature profile. To maintain the reliability, mount the capacitor at a low temperature and in a short time whenever possible. The peak temperature and time shown above are applicable when the capacitor is to be soldered in a soldering oven or with a hot plate. When the capacitor is soldered by means of infrared reflow soldering, the internal temperature of the capacitor may rise beyond the surface temperature.

(3) Using soldering iron

When soldering the capacitor with a soldering iron, controlling the temperature at the tip of the soldering iron is very difficult. However, it is recommended that the following temperature and time be observed to maintain the reliability of the capacitor:

Iron temperature ...... 300˚C max.
Time .... 3 seconds max.
Iron power .... 30 W max.

7. Cleaning

Generally, several organic solvents are used for flux cleaning of an electronic component after soldering. Many cleaning methods, such as immersion cleaning, rinse cleaning, brush cleaning, shower cleaning, vapor cleaning, and ultrasonic cleaning, are available, and one of these cleaning methods may be used alone or two or more may be used in combination. The temperature of the organic solvent may vary from room temperature to several 10˚C, depending on the desired effect. If cleaning is carried out with emphasis placed only on cleaning effect, however, the marking on the electronic component cleaned may be erased, the appearance of the component may be damaged, and in the worst case, the component may be functionally damaged. It is therefore recommended that the SV/F series solid tantalum capacitor be cleaned under the following conditions:

[Recommended conditions of flux cleaning]

(1) Cleaning solvent .... Chlorosen, isopropyl alcohol
(2) Cleaning method ...... Shower cleaning, rinse cleaning, vapor cleaning
(3) Cleaning time .... 5 minutes max.

* **Ultrasonic cleaning**

This cleaning method is extremely effective for eliminating dust that has been generated as a result of mechanical processes, but may pose a problem depending on the condition. As a result of an experiment conducted by NEC, it was confirmed that the external terminals of the capacitor were cut when it was cleaned with some ultrasonic cleaning machines. The cause of this phenomenon is considered metal fatigue of the capacitor terminals that occurred due to ultrasonic cleaning. To prevent the terminal from being cut, decreasing the output power of the ultrasonic cleaning machine or shortening the cleaning time may be a possible solution. However, it is difficult to specify the safe cleaning conditions because there are many factors involved such as the conversion efficiency of the ultrasonic oscillator, transfer efficiency of the cleaning bath, difference in cleaning effect depending on the location in the cleaning bath, the size and quantity of the printed circuit boards to be cleaned, and the securing states of the components on the boards. It is therefore recommended that ultrasonic cleaning be avoided as much as possible.

If ultrasonic cleaning is essential, make sure through experiments that no abnormality occur as a result of the cleaning. For further information, consult NEC.

8. Others

(1) Do not apply excessive vibration and shock to the capacitor.
(2) The solderability of the capacitor may be degraded by humidity. Store the capacitor at (–5 to +40˚C) room temperature and (40 to 60% RH) humidity.
(3) Exercise care that no external force is applied to the tape packaged products (if the packaging material is deformed, the capacitor may not be automatically mounted by a chip mounter).