Devices thru Material Innovation

NEC/TOKIN

Vol. 14

Capacitors

· NeoCapacitor (conductive polymer type)
· Tantalum Capacitors (manganese dioxide type)

⚠
- All specifications in this catalog and production status of products are subject to change without notice. Prior to the purchase, please contact NEC TOKIN for updated product data.
- Please request for a specification sheet for detailed product data prior to the purchase.
- Before using the product in this catalog, please read "Precautions" and other safety precautions listed in the printed version catalog.

9653TCAVOL14E1109E0

Correct Use of Tantalum Chip Capacitors

Be sure to read these following Notes before using NEC TOKIN Tantalum Capacitors.

[Notes]

- ●Be sure to read "Notes on Using The Solid Tantalum Capacitor" (p45 - p53) and "Cautions" (p55) before commencing circuit design or using the capacitor.
- ●Confirm the usage conditions and rated performance of the capacitor before use.
- ●Ninety percent of the failure that occurs in this capacitor is caused by an increase in leakage current or short-circuiting. Therefore it's important to make sufficient allowances for redundant wiring in the circuit design.

[Quality Grades]

NEC TOKIN devices are classified into the following quality grades in accordance with their application (for details of the applications, see p51). The quality grade of all devices in this document is "standard"; the devices in this document cannot be used for "special" or "specific" quality grade applications. Customers who intend to use a product or products in this document for applications other than those specified under the "standard" quality grade must contact NEC TOKIN sales representative in advance (see the reverse side of the cover for contact details).

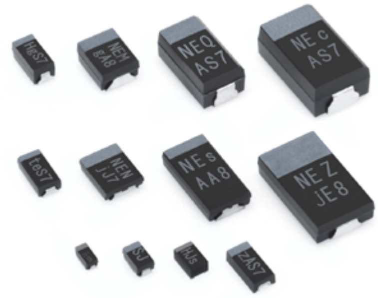
- ●Standard: This quality grade is intended for applications in which failure or malfunction of the device is highly unlikely to cause harm to persons or damage to property, or be the source of any negative effects or problems in the wider community.
- ●Special: This quality grade is intended for special applications that have common requirements, such specific industrial fields. Devices with a "special" quality grade are designed, manufactured, and tested using a more stringent quality assurance program than that used for "standard" grade devices. There is a high possibility that failure or malfunction of the device when being used for applications in this category will cause harm to persons or damage to property, or create negative effects or problems in the wider community.
- ●Specific: Devices with a "specific" quality grade are designed, manufactured, and tested using a quality assurance program that is designated by the customer or that is created in accordance with the customer's specifications. There is an extremely high possibility that failure or malfunction of the device when being used for applications in this category will cause harm to persons or damage to property, or create serious problems in the wider community. Customers who use NEC TOKIN's products for these "specific" applications must conclude an individual quality agreement and/or development agreement with NEC TOKIN. A quality assurance program designated by the customer must also be determined in advance.

NEC TOKIN offers the latest technology

<Tantalum Capacitors>

NEC has been manufacturing solid electrolyte tantalum capacitors for more than 30 years. As a result of NEC's active research and development programs, NEC capacitors offer the designer the latest technology plus outstanding performance. NEC capacitors are used extensively in industrial, commercial, entertainment, and medical electronic equipment.
NEC has obtained ISO 14001 and ISO 9001 certificates of registration for capacitors.
NEC, in response to the wave of the worldwide environment protection consciousness, developed E/SV series by eliminating lead from the terminals.

<Conductive Polymer Tantalum Capacitors>
"NeoCapacitors"



The low-ESR conductive polymer tantalum capacitors are expected to meet an important market need; they are suited for DC/DC converters, video cameras, personal handy phones, etc.
The business of manufacturing and sale of capacitors was divided and transfered to Tokin, as of April 1, 2002. Then Tokin changed its corporate name to "NEC TOKIN Corporation," which has charge of electronic components business within the NEC Group.

TABLE OF CONTENTS

9653TCAVOL14E1109E0

TANTALUM CAPACITORS

Description

NEC TOKIN's tantulum capacitors offer the designer advanced technological design and excellent performance characteristics for filtering, bypassing, coupling, decoupling, blocking, and R C timing circuits. They are used extensively in industrial, commercial, entertainment, and medical electronic equipment.

The tantalum capacitor is inherently very reliable and there is significant evidence that this reliability improves with age–perhaps indefinitely. Capacitance loss with age and other problems often associated with liquid electrolytes are nonexistent in solid electrolyte tantalums.

A process used to further improve the reliability of tantalums is to burn them in at elevated voltages at 85°C for extended periods of time, thus eliminating high leakage and other undesirable characteristics. This process is done because solid electrolyte tantalum capacitors do not conform to the exponential distribution of time ordered failures, but instead exhibit a constantly decreasing failure rate.

If you specify NEC TOKIN tantalums, you can feel confident that you are getting the best available quality, reliability, and price.

TANTALUM CHIP CAPACITORS

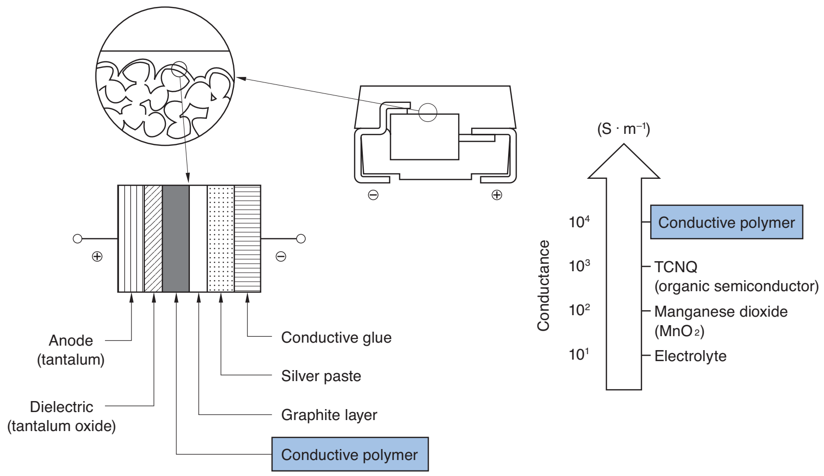
NeoCapacitor (Conductive Polymer Type)							**Lead-free/Conform to RoHS**
Series	**Operating Temperature Range (˚C)**	**DC Rated Voltage Range (V)**	**Capacitance Range (μF)**	**Capacitance Tolerance (%)**	**DC Leakage Current (μA)**	**Dissipation Factor (%)**	**Features**
PS/G	–55 to +105	2.5 and 4	220 to 680	±20	0.1 CV[1] or 3, whichever is greater	8 to 10	Ultra-low ESR (Single digit ESR)
PS/L	–55 to +105	2.5 to 25	2.2 to 1000	±20	0.1 CV[1] or 3, (J case:10) whichever is greater	4 to 10[2]	Ultra-low ESR
F/PS	–55 to +105	4 to 10	22 to 100	±20	0.1 CV[1] or 3, whichever is greater	6 to 8	Face down terminal Ultra miniaturized Large Capacitance
G/PS	–55 to +105	6.3 and 10	22 and 47	±20	0.1 CV[1] or 3, whichever is greater	6	Substrate terminal Ultra miniaturized Much Larger Capacitance
Conventional Type (Manganese Dioxide Type)							**Lead-free/Conform to RoHS**
F/SV	–55 to +125	2.5 to 25	6.8 to 220	±20	0.01 CV[1] or 0.5 whichever is greater	8 to 35	Face down terminal Ultra miniaturized Large Capacitance
E/SV	–55 to +125	2.5 to 35	0.47 to 680	±20 or ±10 (P, J case;±20)	0.01 CV[1] or 0.5 whichever is greater	2.5 Vdc to 10 Vdc[3] : 8 to 35 16 Vdc to 35 Vdc : 4 to 20	Standard Miniaturized Ultra miniaturized
SV/Z	–55 to +125	4 to 35	6.8 to 330	±20 or ±10	0.01 CV[1] or 0.5 whichever is greater	6 to 14[4]	Low ESR

Notes 1. Product of capacitance in μF and voltage in V.
2. Refer to Standard Ratings on page 14.
3. Refer to Standard Ratings on page 34.
4. Refer to Standard Ratings on page 42.

9653TCAVOL14E1109E0

Lead-free / RoHS Compliant

NeoCapacitor has the same structure as a conventional chip tantalum capacitor.
It has a low-resistance cathode of conductive polymer as a substitute for manganese dioxide of a conventional capacitor.
It features high permissible ripple current and effective noise reduction in a high frequency application with its ultra low ESR (equivalent series resistance).
NeoCapacitor is manufactured in the factories certified by the International standards, the ISO9001 and the ISO 14001. RoHs Compliant Lead-free plating.In addition, Halogen free, Antimony free and Red Phosphorous free resin is applied to the exterior mold resin.



NeoCapacitor's Structure

Features

Rich product line-up
Small size (the same as conventional chip)
Ultra Low ESR/low impedance
Suitability for surface mounting
High permissible ripple current
Lead-free Type/RoHs Compliant
Self healing phenomenon when failed

(Conductive polymer used for electrolyte is superior in insulating the damaged portion in comparison with the manganese oxide (used in conventional tantalum capacitor))

Applications

DC / DC converter
Regulator
DVC, DSC
Portable Audio, DVD player, BD player
Mobile phone, Smart phone
Game machine
Note PC

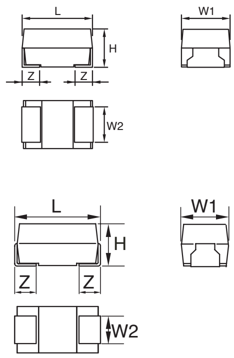
■ FEATURE

- ●Lead-free type. RoHS Compliant.
- ●Extreme low ESR (6mhom) and excellent noise absorption performance.
- ●High capacitance and ultra low ESR based upon on our original Conductive Polymer technology.
- ●Same outer dimension an conventional PS/L series.
- ●Halogen free, Antimony free and Red Phosphorous free resin is applied to the exterior mold resin.

■ DIMENSIONS

[B2 Case]

[V, D Case]



(Unit: mm)

Case Code	L	W1	W2	H	Z
B2	3.5 ± 0.2	2.8 ± 0.2	2.2 ± 0.1	1.9 ± 0.1	0.8 ± 0.2
V	7.3 ± 0.2	4.3 ± 0.2	2.4 ± 0.2	1.9 ± 0.1	1.3 ± 0.2
D	7.3 ± 0.2	4.3 ± 0.2	2.4 ± 0.2	2.8 ± 0.2	1.3 ± 0.2

■ STANDARD C-V VALUE REFERENCE BY CASE CODE

UR :Rated Voltage

µF \ UR		2.5			4
		0E			0G
220	227		V 9, 7		V 9
330	337	B2 9	V 9, 6	D 9, 7	
470	477		V 9, 6	D 9, 7, 6	
680	687			D 9, 7, 6	

*Numeral: ESR(mΩ)

■ PART NUMBER SYSTEM

[Bulk]

PSG D 0E 477 M 7

- 7 — Special Numbering for ESR (ex.7 means 7 mΩ.)
- M — Capacitance Tolerance (M: ±20%)
- 477 — Capacitance (in pF) (First two digits represent significant figures. Third digit specifies number of zero to follow.)
- 0E — DC Rated Voltage in volts
- D — Case code
- PSG — PS/G Series

[Tape and Reel]

TE PSGD0E477M7 -12 R

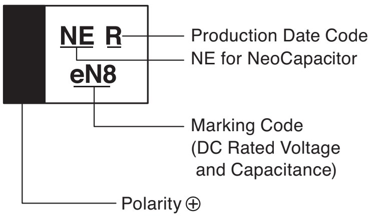
- R — Packing Orientation (R:Cathode on the side of Sproket Hole)
- -12 — Tape width (-12: 12 mm)
- PSGD0E477M7 — Part number of Bulk
- TE — Tape and Reel (TE:180mm ϕ reel)

TL PSGD0E477M7 -12 R E

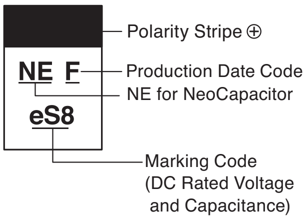
- E — Indicate 330mm ϕ reel
- TL — Tape and Reel (TL:330mm ϕ reel)

■ MARKINGS

[B2 case]



[V, D case]



[Rated voltage and capacitance]

UR :Rated Voltage

μF \ UR		2.5	4
		e	g
220	J8	eJ8	gJ8
330	N8	eN8	
470	S8	eS8	
680	W8	eW8	

[Production date code]

Y \ M	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2011	a	b	c	d	e	f	g	h	j	k	l	m
2012	n	p	q	r	s	t	u	v	w	x	y	z
2013	A	B	C	D	E	F	G	H	J	K	L	M
2014	N	P	Q	R	S	T	U	V	W	X	Y	Z

NOTE: Production date code will resume beginning in 2015.

■ PERFORMANCE CHARACTERISTICS

Test Conditions : Conform to IEC 60384-1

ITEM		PERFORMANCE			TEST CONDITION
Operating temperature		-55°C to +105°C			Derated voltage at 85°C at more
Rated voltage (V.dc)		2.5V		4V	at 85°C
Derated voltage (V.dc)		2V		3.3V	at 105°C
Surge voltage (V.dc)		3.3V		5.2V	at 85°C
Capacitance		220 μF to 680 μF			at 120 Hz
Capacitance tolerance		±20%			
DC Leakage Current (L.C)		0.1C • V(μA) or 3μA, whichever is greater			Voltage: Rated voltage for 5min.
Dissipation Factor		Refer to Standard Ratings			at 120 Hz
Equivalent Series Resistance		Refer to Standard Ratings			at 100 kHz or 300 kHz refer to STANDARD RATINGS
		Capacitance change	DF(%)	L.C	
Surge voltage test		Refer to Standard Ratings	Lower than initial specification	Lower than initial specification	Temperature : 85±2°C Applied voltage : Surge voltage Series resistance : 33 ohm Duration of surge : 30±5 sec Time between surge : 5.5min. Number of cycle : 1000
Characteristic at high and low temperature	-55°C	from 0 to -20%	Lower than initial specification	——	Step 1: 25±2°C Step 2: -55^{0}_{-3}°C Step 3: 25±2°C Step 4: 105^{0}_{-3}°C
	+105°C	from 0 to +50%	Lower than 1.5 times initial specification	Lower than 10 times initial specification	
Rapid change of temperature		Refer to Standard Ratings	Lower than initial specification	Lower than initial specification	Parts shall be temperature cycled over a temperature range of -55 to +105°C, five times continuously as follow. Step 1: -55^{0}_{-3}°C, 30±3min. Step 2: room temp. , 10 to 15min. Step 3: 105^{0}_{-3}°C, 30±3min. Step 4: room temp, 10 to 15min.
Resistance to Soldering heat		Refer to Standard Ratings	Lower than 1.3 times initial specification	Lower than initial specification	Reflow soldering mehod 240°C, 10 sec.Max. *1
Damp heat		from +30% to -20%	Lower than 1.5 times initial specification	Lower than initial specification	at 40°C at 90 to 95% RH 500 hour
Endurance I		Refer to Standard Ratings	Lower than 1.5 times initial specification	Lower than initial specification	at 85°C at rated voltage 1000 hour
Endurance II		Refer to Standard Ratings	Lower than 3 times initial specification	Lower than initial specification	at 105°C at Derated voltage 1000 hour
Failure Rate		λ_0 = 1% / 1000 hour			at 85°C: rated voltage at 105°C: derated voltage 1000 hour
Terminal Strength		Visual: There shall be no evidence of mechanical damage			Strength : 4.9N Time : 10±0.5sec. (two directions)
Permissible ripple current		Refer to Ratings Table			at 100 kHz or 300 kHz refer to STANDARD RATINGS
Others		Conform to IEC60384-1			Conform to IEC60384-1

*1: Refer to the page 52 “NOTES ON USING NeoCapacitor/2. Mounting/(1) Reflow soldering/(b) Temperature and time”

Reference : Derated voltage (85 to 105°C)

$$[U_T] = [U_R] - \frac{[U_R] - [U_C]}{20}(T-85)$$

[U_T] : Derated voltage at operating temperature
[U_R] : Rated voltage
[U_C] : Derated voltage at 105°C
T : Operating temperature

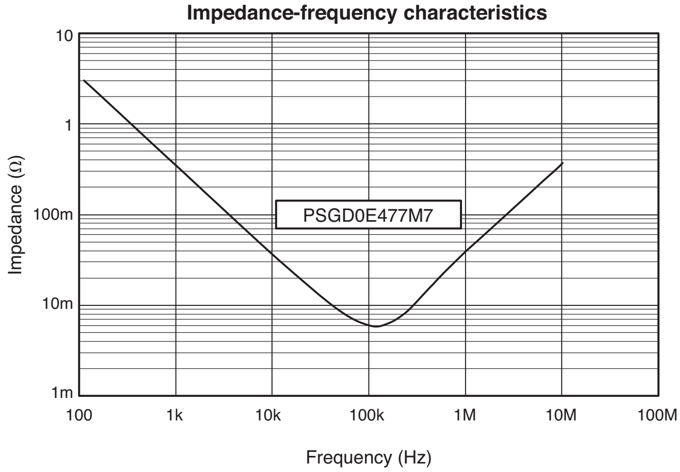
■ STANDARD RATINGS

Rated Voltage (V)	Capacitance (μF)	Case Code	Part Number (Bulk)	Leakage Current (μA) Max	DF (%) Max	ESR (mΩ) Max *1	Permissible Ripple Current (mA rms.) Max *1	DF (%) Max		Capacitance Change	
								-55°C	+105°C	at Surge Voltage at Resistance to Soldering Heat	at Endurance
2.5	330	B2	PSGB20E337M9	82.5	8	9 ●	3073 ●	8	12	±20%	±20%
	220	V	PSGV0E227M9	55	10	9 ●	3726 ●	10	15	±20%	±20%
	220	V	PSGV0E227M7	55	10	7 ●	4226 ●	10	15	±20%	±20%
	330	V	PSGV0E337M9	82.5	10	9 ●	3726 ●	10	15	±20%	±20%
	330	V	PSGV0E337M6	82.5	10	6 ●	4564 ●	10	15	±20%	±20%
	330	D	PSGD0E337M9	82.5	10	9	4082	10	15	±20%	±20%
	330	D	PSGD0E337M7	82.5	10	7	4629	10	15	±20%	±20%
	470	V	PSGV0E477M9	117.5	10	9 ●	3726 ●	10	15	±20%	±20%
	470	V	PSGV0E477M6	117.5	10	6 ●	4564 ●	10	15	±20%	±20%
	470	D	PSGD0E477M9	117.5	10	9	4082	10	15	±20%	±20%
	470	D	PSGD0E477M7	117.5	10	7	4629	10	15	±20%	±20%
	470	D	PSGD0E477M6	117.5	10	6	5000	10	15	±20%	±20%
	680	D	PSGD0E687M9	170	10	9	4082	10	15	±20%	±20%
	680	D	PSGD0E687M7	170	10	7	4629	10	15	±20%	±20%
	680	D	PSGD0E687M6	170	10	6	5000	10	15	±20%	±20%
4	220	V	PSGV0G227M9	88	10	9 ●	3726 ●	10	15	±20%	±20%

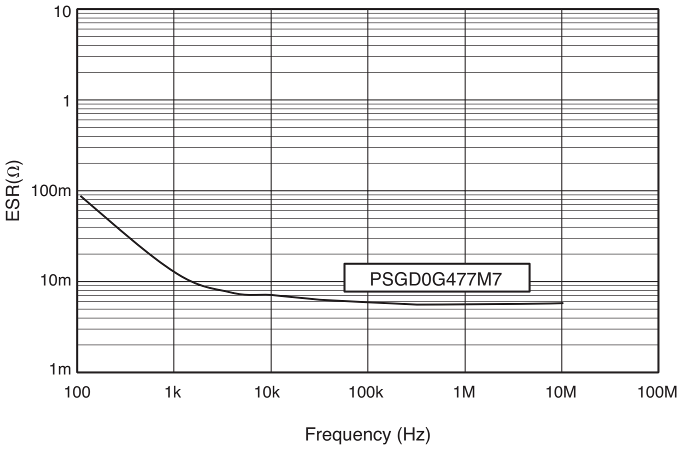
*1: Measure frequency
●: 300kHz, none: 100 kHz

■ FREQUENCY CHARACTERISTICS (reference)

Impedance-frequency characteristics



ESR-frequency characteristics



■ FEATURES

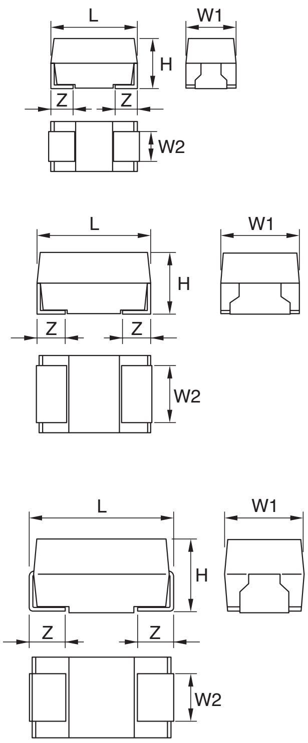
- ●Lead-free Type. RoHS Compliant.
- ●Ultra-Low ESR.
- ●Same Dimension as E/SV series.
- ●Halogen free, Antimony free and Red Phosphorous free resin is applied to the exterior mold resin.

■ DIMENSIONS [mm]

[J, P, A2, A cases]

[B3, B15, B2 cases]

[C2, C, V, D cases]



(Unit: mm)

Case code	EIA code	L	W1	W2	H	Z
J	–	1.6 ± 0.1	0.8 ± 0.1	0.6 ± 0.1	0.8 ± 0.1	0.3 ± 0.15
P	2012	2.0 ± 0.2	1.25 ± 0.2	0.9 ± 0.1	1.1 ± 0.1	0.5 ± 0.1
A2(U)	3216L	3.2 ± 0.2	1.6 ± 0.2	1.2 ± 0.1	1.1 ± 0.1	0.8 ± 0.2
A	3216	3.2 ± 0.2	1.6 ± 0.2	1.2 ± 0.1	1.6 ± 0.2	0.8 ± 0.2
B3(W)	3528L	3.5 ± 0.2	2.8 ± 0.2	2.2 ± 0.1	1.1 ± 0.1	0.8 ± 0.2
B15	–	3.5 ± 0.2	2.8 ± 0.2	2.2 ± 0.1	1.4 ± 0.1	0.8 ± 0.2
B2(S)	3528	3.5 ± 0.2	2.8 ± 0.2	2.2 ± 0.1	1.9 ± 0.1	0.8 ± 0.2
C2	–	6.0 ± 0.2	3.2 ± 0.2	2.2 ± 0.1	1.4 ± 0.1	1.3 ± 0.2
C	6032	6.0 ± 0.2	3.2 ± 0.2	2.2 ± 0.1	2.5 ± 0.2	1.3 ± 0.2
V	7343L	7.3 ± 0.2	4.3 ± 0.2	2.4 ± 0.1	1.9 ± 0.1	1.3 ± 0.2
D	7343	7.3 ± 0.2	4.3 ± 0.2	2.4 ± 0.1	2.8 ± 0.2	1.3 ± 0.2

Conductive Polymer type

■ STANDARD C-V VALUE REFERENCE BY CASE CODE

UR :Rated Voltage

µF \ UR		2.5 V	4V	6.3V	10V	16V	20V	25V
		0E	0G	0J	1A	1C	1D	1E
1.0	105							
2.2	225			J	J			
3.3	335			J, P	J, A	A		
4.7	475			J, P	J, A2, A	B2		
6.8	685			J, P, A	A2, A, B2	B2		B2
10	106		J, P, A	P, A2, A	P, A2, A, B2	B2		
15	156			A2, A, B2	A, B2, C			V
22	226	P	P, A2, B2	A2, A, B3, B2	A, B3, B2, C		V	V
33	336	A2	A2, A	A, B3, B2	A, B3, B2, C2, C	V	V	D
47	476	A2	A, B3	A, B3, B2, C2, C	B3, B2, C2, C, V, D	V, D	V, D	
68	686		A, C2, C	B3, B2, C2, C	C2, C, V, D	V, D		
100	107	A, B3	A, B3, B2, C2	A, B2, C2, C, V	B2, C2, C, V, D			
150	157		B2, C	B15, B2, C2, C, V, D	C, V, D			
220	227	A, B2	B2, C, V, D	B2, V, D	D			
330	337	B2, C, V	C, V, D	V, D				
470	477	V	D					
680	687	D	D					
1000	108	D						

■ PART NUMBER SYSTEM

[Bulk]

PSL D 0J 337 M (25)

- (25) — Special numbering for ESR (ex. (25) shows 25 mΩ)
- M — Capacitance Tolerance (M: ±20%)
- 337 — Capacitance (pF) (First two digits represent significant figures. Third digit specifies number of zeros to follow.)
- 0J — DC rated voltage in volts (0E: 2.5 V, 0G: 4 V, 0J: 6.3 V, 1A: 10 V, 1C: 16 V, 1D: 20 V, 1E: 25 V)
- D — Case code
- PSL — PS/L Series

[Tape and Reel]

TE PSLD0J337M 12 R

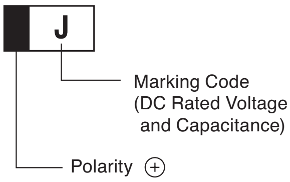
- R — Packing Orientation (R: Cathode on the Side of Sproket Hole)
- 12 — Tape width (8: 8 mm (J, P, A2, A, B3, B15, B2 case) 12: 12 mm (C2, C, V, D cases))
- PSLD0J337M — Part number of Bulk
- TE — Tape and Reel (TE: 180mmϕ reel)

TL PSLD0J337M 12 R E

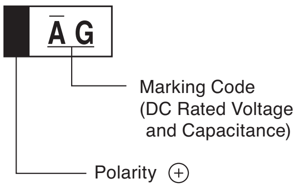
- TL — Tape and Reel (TL: 330mmϕ reel)
- E — Indicates 330mmϕ reel

9653TCAVOL14E1109E0

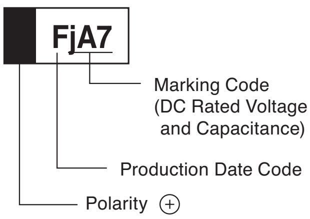
[J case] (ex. 4.7 μF / 6.3 V)



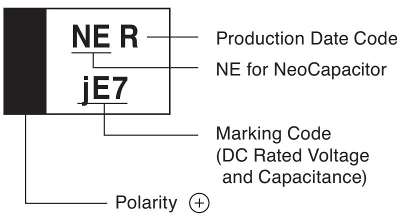
[P case] (ex. 10 μF / 4 V)



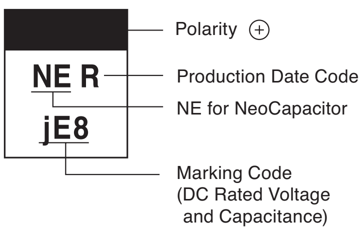
[A2, A cases] (ex. 10 μF / 6.3 V)



[B3, B15, B2 cases] (ex. 15 μF / 6.3 V)



[C2, C, V, D cases] (ex. 150 μF / 6.3 V)



[J case Marking Code]

UR :Rated Voltage

μF \ UR	4V	6.3V	10V
2.2		ſ	ᐊ
3.3		ᒍ	A
4.7		J	ᐅ
6.8		ᒐ	
10	ᘓ		

[P case Marking Code]

μF \ UR	2.5V	4V	6.3V	10V	16V
1.0					
2.2					
3.3			NJ		
4.7			SJ		
6.8			WJ		
10		$\overline{\text{A}}$G	$\overline{\text{A}}$J	$\overline{\text{A}}$A	
15					
22	$\overline{\text{J}}$e	$\overline{\text{J}}$G			

[A2, A, B3, B15, B2, C2, C, V, D cases Marking Code]

μF \ UR		2.5V	4V	6.3V	10V	16V	20V	25V
		e	g	j	A	C	D	E
3.3	N6				AN6	CN6		
4.7	S6				AS6	CS6		
6.8	W6			jW6	AW6	CW6		EW6
10	A7		gA7	jA7	AA7	CA7		
15	E7			jE7	AE7			EE7
22	J7		gJ7	jJ7	AJ7		DJ7	EJ7
33	N7	eN7	gN7	jN7	AN7	CN7	DN7	EN7
47	S7	eS7	gS7	jS7	AS7	CS7	DS7	
68	W7		gW7	jW7	AW7	CW7		
100	A8	eA8	gA8	jA8	AA8			
150	E8		gE8	jE8	AE8			
220	J8	eJ8	gJ8	jJ8	AJ8			
330	N8	eN8	gN8	jN8				
470	S8	eS8	gS8					
680	W8	eW8	gW8					
1000	A9	eA9						

[A2, A, B3, B15, B2, C2, C, V, D cases production date code]

Y \ M	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2011	a	b	c	d	e	f	g	h	j	k	l	m
2012	n	p	q	r	s	t	u	v	w	x	y	z
2013	A	B	C	D	E	F	G	H	J	K	L	M
2014	N	P	Q	R	S	T	U	V	W	X	Y	Z

NOTE: Production date code will resume beginning in 2015.

■ PERFORMANCE CHARACTERISTICS

Test Conditions : Conform to IEC 60384-1

ITEM	PERFORMANCE							TEST CONDITION
Operating temperature	–55°C to +105°C							Derated voltage at 85°C at more
Rated voltage (V.dc)	2.5V	4V	6.3V	10V	16V	20V	25V	at 85°C
Derated voltage (V.dc)	2V	3.3V	5V	8V	12.8V	16V	20V	at 105°C
Surge voltage (V.dc)	3.3V	5.2V	8V	13V	20V	23V	29V	Rated voltage 2.5 to 16V: at 85°C Rated voltage over 20V: at 15 to 35°C
Capacitance	2.2 μF to 1000 μF							at 120 Hz
Capacitance tolerance	±20%							
DC Leakage Current (L.C)	0.1C • V(μA) or 3μA (J case:10μA) , whichever is greater							Voltage: Rated voltage for 5min.
Dissipation Factor	Refer to Standard Ratings							at 120 Hz
Equivalent Series Resistance	Refer to Standard Ratings							at 100 kHz or 300 kHz refer to STANDARD RATINGS

ITEM		Capacitance change	DF(%)	L.C	TEST CONDITION
Surge voltage test		Refer to Standard Ratings	Lower than initial specification	Lower than initial specification	Temperature : 85±2°C Applied voltage : Surge voltage Series resistance : 33 ohm Duration of surge : 30±5 sec Time between surge : 5.5min. Number of cycle : 1000
Characteristic at high and low temperature	–55°C	from 0 to –20%	Lower than initial specification	––––	Step 1: 25±2°C Step 2: -55^{0}_{-3}°C Step 3: 25±2°C Step 4: 105^{0}_{-3}°C
	+105°C	from 0 to +50%	Lower than 1.5 times initial specification	Lower than 10 times initial specification	
Rapid change of temperature		Refer to Standard Ratings	Lower than initial specification	Lower than initial specification	Parts shall be temperature cycled over a temperature range of –55 to +105°C, five times continuously as follow. Step 1: -55^{0}_{-3}°C, 30±3min. Step 2: room temp. , 10 to 15min. Step 3: 105^{0}_{-3}°C, 30±3min. Step 4: room temp, 10 to 15min.
Resistance to Soldering heat		Refer to Standard Ratings	Lower than 1.3 times initial specification	Lower than initial specification	Reflow soldering method 240°C, 10 sec.Max. *1
Damp heat		from +30% to –20%	Lower than 1.5 times initial specification	Lower than initial specification	at 40°C at 90 to 95% RH 500 hour
Endurance I		Refer to Standard Ratings	Lower than 1.5 times initial specification	Lower than initial specification	at 85°C at rated voltage 1000 hour
Endurance II		Refer to Standard Ratings	Lower than 3 times initial specification	Lower than initial specification	at 105°C at Derated voltage 1000 hour
Failure Rate		λ_0 = 1% / 1000 hour			at 85°C: rated voltage at 105°C: derated voltage 1000 hour
Terminal Strength		Visual: There shall be no evidence of mechanical damage			Strength : 4.9N Time : 10±0.5sec. (two directions)
Permissible ripple current		Refer to Ratings Table			at 100 kHz or 300 kHz refer to STANDARD RATINGS
Others		Conform to IEC60384–1			Conform to IEC60384–1

*1: Refer to the page 52 "NOTES ON USING NeoCapacitor/2. Mounting/(1) Reflow soldering/(b) Temperature and time"

Reference : Derated voltage (85 to 105°C)

$$[U_T] = [U_R] - \frac{[U_R] - [U_C]}{20}(T-85)$$

$[U_T]$: Derated voltage at operating temperature
$[U_R]$: Rated voltage
$[U_C]$: Derated voltage at 105°C
T : Operating temperature

■ STANDARD RATINGS

Rated Voltage (V)	Capacitance (μF)	Case Code	Part Number (Bulk)	Leakage Current (μA) Max	DF (%) Max	ESR (mΩ) Max *1	Permissible Ripple Current (mA rms.) Max *1	DF (%) Max		Capacitance Change	
								-55°C	+105°C	at Surge Voltage at Resistance to Soldering Heat	at Endurance
2.5	22	P	PSLP0E226M	5.5	6	200	354	6	9	±20%	±20%
	33	A2	PSLA20E336M	8.3	6	150	632	6	9	±20%	±20%
	47	A2	PSLA20E476M	11.7	6	150	632	6	9	±20%	±20%
	100	A	PSLA0E107M	25	8	100	866	8	12	±20%	±20%
	100	A	PSLA0E107M(45)	25	8	45	1291	8	12	±20%	±20%
	100	A	PSLA0E107M(35)	25	8	35	1464	8	12	±20%	±20%
	100	B3	PSLB30E107M	25	8	70	1035	8	12	±20%	±20%
	220	A	PSLA0E227M(45)	55	8	45 ●	1291 ●	8	12	±20%	±20%
	220	A	PSLA0E227M(35)	55	8	35 ●	1464 ●	8	12	±20%	±20%
	220	A	PSLA0E227M(25)	55	8	25	1732	8	12	±20%	±20%
	220	B2	PSLB20E227M	55	8	45	1374	8	12	±20%	±20%
	220	B2	PSLB20E227M(35)	55	8	35	1558	8	12	±20%	±20%
	220	B2	PSLB20E227M(25)	55	8	25	1844	8	12	±20%	±20%
	220	B2	PSLB20E227M(21)	55	8	21	2012	8	12	±20%	±20%
	220	B2	PSLB20E227M(15)	55	8	15 ●	2380 ●	8	12	±20%	±20%
	330	B2	PSLB20E337M	82.5	8	45	1374	8	12	±20%	±20%
	330	B2	PSLB20E337M(35)	82.5	8	35	1558	8	12	±20%	±20%
	330	B2	PSLB20E337M(21)	82.5	8	21	2012	8	12	±20%	±20%
	330	B2	PSLB20E337M(15)	82.5	8	15 ●	2380 ●	8	12	±20%	±20%
	330	C	PSLC0E337M	82.5	10	55	1414	10	15	±20%	±20%
	330	C	PSLC0E337M(45)	82.5	10	45	1563	10	15	±20%	±20%
	330	C	PSLC0E337M(25)	82.5	10	25	2098	10	15	±20%	±20%
	330	C	PSLC0E337M(18)	82.5	10	18	2472	10	15	±20%	±20%
	330	V	PSLV0E337M	82.5	10	25	2236	10	15	±20%	±20%
	330	V	PSLV0E337M(15)	82.5	10	15	2887	10	15	±20%	±20%
	330	V	PSLV0E337M(12)	82.5	10	12	3227	10	15	±20%	±20%
	470	V	PSLV0E477M(15)	117.5	10	15	2887	10	15	±20%	±20%
	470	V	PSLV0E477M(12)	117.5	10	12	3227	10	15	±20%	±20%
	680	D	PSLD0E687M	170	10	25	2449	10	15	±20%	±20%
	680	D	PSLD0E687M(15)	170	10	15	3162	10	15	±20%	±20%
	680	D	PSLD0E687M(12)	170	10	12	3536	10	15	±20%	±20%
	1000	D	PSLD0E108M	250	10	25	2449	10	15	±20%	±20%
	1000	D	PSLD0E108M(15)	250	10	15	3162	10	15	±20%	±20%
4	10	J	PSLJ0G106M	10	4	300	183	4	6	±20%	±20%
	10	P	PSLP0G106M	4	6	200	354	6	9	±20%	±20%
	10	A	PSLA0G106M	4	6	200	612	6	9	±20%	±20%
	22	P	PSLP0G226M	8.8	6	200	354	6	9	±20%	±20%
	22	A2	PSLA20G226M	8.8	6	200	548	6	9	±20%	±20%
	22	B2	PSLB20G226M	8.8	8	150	753	8	12	±20%	±20%
	33	A2	PSLA20G336M	13.2	6	150	632	6	9	±20%	±20%
	33	A	PSLA0G336M	13.2	6	180	645	6	9	±20%	±20%
	47	A	PSLA0G476M	18.8	6	180	645	6	9	±20%	±20%
	47	B3	PSLB30G476M	18.8	8	70	1035	8	12	±20%	±20%
	68	A	PSLA0G686M	27.2	6	180	645	6	9	±20%	±20%
	68	C2	PSLC20G686M	27.2	8	55	1279	8	12	±20%	±20%
	68	C	PSLC0G686M	27.2	9	100	1049	9	14	±20%	±20%
	100	A	PSLA0G107M	40	8	100	866	8	12	±20%	±20%
	100	A	PSLA0G107M(45)	40	8	45	1291	8	12	±20%	±20%
	100	A	PSLA0G107M(35)	40	8	35	1464	8	12	±20%	±20%
	100	A	PSLA0G107M(25)	40	8	25	1732	8	12	±20%	±20%
	100	B3	PSLB30G107M	40	8	70	1035	8	12	±20%	±20%
	100	B2	PSLB20G107M	40	8	70	1102	8	12	±20%	±20%
	100	B2	PSLB20G107M(45)	40	8	45	1374	8	12	±20%	±20%
	100	B2	PSLB20G107M(35)	40	8	35	1558	8	12	±20%	±20%
	100	C2	PSLC20G107M	40	9	55	1279	9	14	±20%	±20%
	150	B2	PSLB20G157M	60	8	45	1374	8	12	±20%	±20%
	150	B2	PSLB20G157M(35)	60	8	35	1558	8	12	±20%	±20%
	150	B2	PSLB20G157M(25)	60	8	25	1844	8	12	±20%	±20%
	150	C	PSLC0G157M	60	9	100	1049	9	14	±20%	±20%
	220	B2	PSLB20G227M	88	8	45	1374	8	12	±20%	±20%
	220	B2	PSLB20G227M(35)	88	8	35	1558	8	12	±20%	±20%
	220	B2	PSLB20G227M(25)	88	8	25	1844	8	12	±20%	±20%
	220	B2	PSLB20G227M(15)	88	8	15	2380	8	12	±20%	±20%

*1: Measure frequency
●: 300kHz, none: 100 kHz

Rated Voltage (V)	Capacitance (μF)	Case Code	Part Number (Bulk)	Leakage Current (μA) Max	DF (%) Max	ESR (mΩ) Max *1	Permissible Ripple Current (mA rms.)	DF (%) Max -55°C	DF (%) Max +105°C	Capacitance Change at Surge Voltage at Resistance to Soldering Heat	Capacitance Change at Endurance
4	220	C	PSLC0G227M	88	9	55	1414	9	14	±20%	±20%
	220	C	PSLC0G227M(45)	88	9	45	1563	9	14	±20%	±20%
	220	C	PSLC0G227M(25)	88	9	25	2098	9	14	±20%	±20%
	220	C	PSLC0G227M(18)	88	9	18	2472	9	14	±20%	±20%
	220	V	PSLV0G227M	88	10	45	1667	10	15	±20%	±20%
	220	V	PSLV0G227M(25)	88	10	25	2236	10	15	±20%	±20%
	220	V	PSLV0G227M(18)	88	10	18	2635	10	15	±20%	±20%
	220	V	PSLV0G227M(15)	88	10	15	2887	10	15	±20%	±20%
	220	V	PSLV0G227M(12)	88	10	12	3227	10	15	±20%	±20%
	220	D	PSLD0G227M	88	10	55	1651	10	15	±20%	±20%
	220	D	PSLD0G227M(40)	88	10	40	1936	10	15	±20%	±20%
	220	D	PSLD0G227M(25)	88	10	25	2449	10	15	±20%	±20%
	220	D	PSLD0G227M(15)	88	10	15	3162	10	15	±20%	±20%
	220	D	PSLD0G227M(12)	88	10	12	3536	10	15	±20%	±20%
	330	C	PSLC0G337M	132	10	55	1414	10	15	±20%	±20%
	330	C	PSLC0G337M(25)	132	10	25	2098	10	15	±20%	±20%
	330	V	PSLV0G337M	132	10	45	1667	10	15	±20%	±20%
	330	V	PSLV0G337M(25)	132	10	25	2236	10	15	±20%	±20%
	330	V	PSLV0G337M(15)	132	10	15	2887	10	15	±20%	±20%
	330	V	PSLV0G337M(12)	132	10	12	3227	10	15	±20%	±20%
	330	D	PSLD0G337M	132	10	40	1936	10	15	±20%	±20%
	330	D	PSLD0G337M(25)	132	10	25	2449	10	15	±20%	±20%
	330	D	PSLD0G337M(15)	132	10	15	3162	10	15	±20%	±20%
	470	D	PSLD0G477M	188	10	25	2449	10	15	±20%	±20%
	470	D	PSLD0G477M(18)	188	10	18	2887	10	15	±20%	±20%
	470	D	PSLD0G477M(15)	188	10	15	3162	10	15	±20%	±20%
	470	D	PSLD0G477M(12)	188	10	12	3536	10	15	±20%	±20%
	470	D	PSLD0G477M(10)	188	10	10	3873	10	15	±20%	±20%
	680	D	PSLD0G687M	272	10	25	2449	10	15	±20%	±20%
	680	D	PSLD0G687M(15)	272	10	15	3162	10	15	±20%	±20%
	680	D	PSLD0G687M(12)	272	10	12	3536	10	15	±20%	±20%
6.3	2.2	J	PSLJ0J225M	10	4	500	141	4	6	±20%	±20%
	3.3	J	PSLJ0J335M	10	4	500	141	4	6	±20%	±20%
	3.3	P	PSLP0J335M	3	6	300	289	6	9	±20%	±20%
	4.7	J	PSLJ0J475M	10	4	500	141	4	6	±20%	±20%
	4.7	P	PSLP0J475M	3	6	300	289	6	9	±20%	±20%
	6.8	J	PSLJ0J685M	10	6	500	141	6	6	±20%	±20%
	6.8	P	PSLP0J685M	4.2	6	300	289	6	9	±20%	±20%
	6.8	A	PSLA0J685M	4.2	6	300	500	6	9	±20%	±20%
	10	P	PSLP0J106M	6.3	6	200	354	6	9	±20%	±20%
	10	A2	PSLA20J106M	6.3	6	200	548	6	9	±20%	±20%
	10	A	PSLA0J106M	6.3	6	200	612	6	9	±20%	±20%
	15	A2	PSLA20J156M	9.4	6	200	548	6	9	±20%	±20%
	15	A	PSLA0J156M	9.4	6	200	612	6	9	±20%	±20%
	15	B2	PSLB20J156M	9.4	8	150	753	8	12	±20%	±20%
	22	A2	PSLA20J226M	13.8	6	200	548	6	9	±20%	±20%
	22	A	PSLA0J226M	13.8	6	180	645	6	9	±20%	±20%
	22	B3	PSLB30J226M	13.8	8	70	1035	8	12	±20%	±20%
	22	B2	PSLB20J226M	13.8	8	150	753	8	12	±20%	±20%
	33	A	PSLA0J336M	20.7	6	180	645	6	9	±20%	±20%
	33	B3	PSLB30J336M	20.7	8	70	1035	8	12	±20%	±20%
	33	B2	PSLB20J336M	20.7	8	150	753	8	12	±20%	±20%
	47	A	PSLA0J476M	29.6	6	180	645	6	9	±20%	±20%
	47	A	PSLA0J476M(70)	29.6	6	70	1035	6	9	±20%	±20%
	47	B3	PSLB30J476M	29.6	8	70	1035	8	12	±20%	±20%
	47	B3	PSLB30J476M(55)	29.6	8	55	1168	8	12	±20%	±20%
	47	B2	PSLB20J476M	29.6	8	150	753	8	12	±20%	±20%
	47	B2	PSLB20J476M(70)	29.6	8	70	1102	8	12	±20%	±20%
	47	C2	PSLC20J476M	29.6	9	70	1134	9	14	±20%	±20%
	47	C	PSLC0J476M	29.6	9	100	1049	9	14	±20%	±20%
	68	B3	PSLB30J686M	42.8	8	70	1035	8	12	±20%	±20%
	68	B2	PSLB20J686M	42.8	8	70	1102	8	12	±20%	±20%
	68	B2	PSLB20J686M(55)	42.8	8	55	1243	8	12	±20%	±20%

*1: Measure frequency
●: 300kHz, none: 100 kHz

Rated Voltage (V)	Capacitance (μF)	Case Code	Part Number (Bulk)	Leakage Current (μA) Max	DF (%) Max	ESR (mΩ) Max *1	Permissible Ripple Current (mA rms.)	DF (%) Max		Capacitance Change	
								-55°C	+105°C	at Surge Voltage at Resistance to Soldering Heat	at Endurance
6.3	68	C2	PSLC20J686M	42.8	9	55	1279	9	14	±20%	±20%
	68	C	PSLC0J686M	42.8	9	100	1049	9	14	±20%	±20%
	100	A	PSLA0J107M(70)	63	8	70	1035	8	12	±20%	±20%
	100	A	PSLA0J107M(45)	63	8	45	1300	8	12	±20%	±20%
	100	A	PSLA0J107M(35)	63	8	35	1500	8	12	±20%	±20%
	100	B2	PSLB20J107M	63	8	70	1102	8	12	±20%	±20%
	100	B2	PSLB20J107M(45)	63	8	45	1374	8	12	±20%	±20%
	100	B2	PSLB20J107M(35)	63	8	35	1558	8	12	±20%	±20%
	100	B2	PSLB20J107M(25)	63	8	25	1844	8	12	±20%	±20%
	100	C2	PSLC20J107M	63	9	70	1134	9	14	±20%	±20%
	100	C2	PSLC20J107M(55)	63	9	55	1279	9	14	±20%	±20%
	100	C	PSLC0J107M	63	9	100	1049	9	14	±20%	±20%
	100	C	PSLC0J107M(55)	63	9	55	1414	9	14	±20%	±20%
	100	V	PSLV0J107M(18)	63	10	18	2635	10	15	±20%	±20%
	100	V	PSLV0J107M(15)	63	10	15	2887	10	15	±20%	±20%
	150	B15	PSLB150J157M(70)	94.5	10	70	1069	10	15	±20%	±20%
	150	B15	PSLB150J157M(35)	94.5	10	35	1512	10	15	±20%	±20%
	150	B2	PSLB20J157M	94.5	8	45	1374	8	12	±20%	±20%
	150	B2	PSLB20J157M(35)	94.5	8	35	1558	8	12	±20%	±20%
	150	B2	PSLB20J157M(25)	94.5	8	25	1844	8	12	±20%	±20%
	150	C2	PSLC20J157M	94.5	9	55	1279	9	14	±20%	±20%
	150	C	PSLC0J157M	94.5	9	100	1049	9	14	±20%	±20%
	150	C	PSLC0J157M(55)	94.5	9	55	1414	9	14	±20%	±20%
	150	C	PSLC0J157M(45)	94.5	9	45	1563	9	14	±20%	±20%
	150	C	PSLC0J157M(25)	94.5	9	25	2098	9	14	±20%	±20%
	150	V	PSLV0J157M	94.5	10	45	1667	10	15	±20%	±20%
	150	V	PSLV0J157M(25)	94.5	10	25	2236	10	15	±20%	±20%
	150	V	PSLV0J157M(18)	94.5	10	18	2635	10	15	±20%	±20%
	150	V	PSLV0J157M(15)	94.5	10	15	2887	10	15	±20%	±20%
	150	V	PSLV0J157M(12)	94.5	10	12	3227	10	15	±20%	±20%
	150	D	PSLD0J157M	94.5	10	55	1651	10	15	±20%	±20%
	150	D	PSLD0J157M(40)	94.5	10	40	1936	10	15	±20%	±20%
	150	D	PSLD0J157M(25)	94.5	10	25	2449	10	15	±20%	±20%
	220	B2	PSLB20J227M(45)	138.6	8	45	1374	8	12	±20%	±20%
	220	B2	PSLB20J227M(35)	138.6	8	35	1558	8	12	±20%	±20%
	220	B2	PSLB20J227M(25)	138.6	8	25	1844	8	12	±20%	±20%
	220	V	PSLV0J227M	138.6	10	45	1667	10	15	±20%	±20%
	220	V	PSLV0J227M(25)	138.6	10	25	2236	10	15	±20%	±20%
	220	V	PSLV0J227M(15)	138.6	10	15	2887	10	15	±20%	±20%
	220	V	PSLV0J227M(12)	138.6	10	12	3227	10	15	±20%	±20%
	220	D	PSLD0J227M	138.6	10	55	1651	10	15	±20%	±20%
	220	D	PSLD0J227M(40)	138.6	10	40	1936	10	15	±20%	±20%
	220	D	PSLD0J227M(25)	138.6	10	25	2449	10	15	±20%	±20%
	330	V	PSLV0J337M	207.9	10	45	1667	10	15	±20%	±20%
	330	V	PSLV0J337M(25)	207.9	10	25	2236	10	15	±20%	±20%
	330	D	PSLD0J337M	207.9	10	40	1936	10	15	±20%	±20%
	330	D	PSLD0J337M(25)	207.9	10	25	2449	10	15	±20%	±20%
	330	D	PSLD0J337M(18)	207.9	10	18	2887	10	15	±20%	±20%
10	2.2	J	PSLJ1A225M	10	4	500	141	4	6	±20%	±20%
	3.3	J	PSLJ1A335M	10	6	500	141	6	6	±20%	±20%
	3.3	A	PSLA1A335M	3.3	6	300	500	6	9	±20%	±20%
	4.7	J	PSLJ1A475M	10	6	500	141	6	6	±20%	±20%
	4.7	A2	PSLA21A475M	4.7	6	300	447	6	9	±20%	±20%
	4.7	A	PSLA1A475M	4.7	6	300	500	6	9	±20%	±20%
	6.8	A2	PSLA21A685M	6.8	6	300	447	6	9	±20%	±20%
	6.8	A	PSLA1A685M	6.8	6	300	500	6	9	±20%	±20%
	6.8	B2	PSLB21A685M	6.8	8	200	652	8	12	±20%	±20%
	10	P	PSLP1A106M	10	6	200	354	6	9	±20%	±20%
	10	A2	PSLA21A106M	10	6	200	548	6	9	±20%	±20%
	10	A	PSLA1A106M	10	6	200	612	6	9	±20%	±20%
	10	B2	PSLB21A106M	10	8	200	652	8	12	±20%	±20%
	15	A	PSLA1A156M	15	6	180	645	6	9	±20%	±20%
	15	B2	PSLB21A156M	15	8	150	753	8	12	±20%	±20%

*1: Measure frequency
●: 300kHz, none: 100 kHz

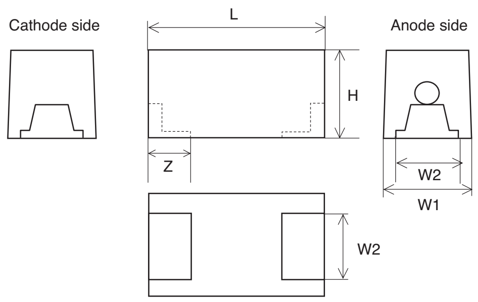
Rated Voltage (V)	Capacitance (μF)	Case Code	Part Number (Bulk)	Leakage Current (μA) Max	DF (%) Max	ESR (mΩ) Max *1	Permissible Ripple Current (mA rms.)	DF (%) Max -55°C	DF (%) Max +105°C	Capacitance Change at Surge Voltage at Resistance to Soldering Heat	Capacitance Change at Endurance
10	15	C	PSLC1A156M	15	9	200	742	9	14	±20%	±20%
	22	A	PSLA1A226M	22	6	180	645	6	9	±20%	±20%
	22	B3	PSLB31A226M	22	8	70	1035	8	12	±20%	±20%
	22	B2	PSLB21A226M	22	8	150	753	8	12	±20%	±20%
	22	C	PSLC1A226M	22	9	150	856	9	14	±20%	±20%
	33	A	PSLA1A336M	33	8	200	612	8	12	±20%	±20%
	33	B3	PSLB31A336M	33	8	70	1035	8	12	±20%	±20%
	33	B2	PSLB21A336M	33	8	150	753	8	12	±20%	±20%
	33	C2	PSLC21A336M	33	9	70	1134	9	14	±20%	±20%
	33	C	PSLC1A336M	33	9	100	1049	9	14	±20%	±20%
	47	B3	PSLB31A476M	47	8	70	1035	8	12	±20%	±20%
	47	B2	PSLB21A476M	47	8	70	1102	8	12	±20%	±20%
	47	B2	PSLB21A476M(35)	47	8	35	1558	8	12	±20%	±20%
	47	C2	PSLC21A476M	47	9	70	1134	9	14	±20%	±20%
	47	C	PSLC1A476M	47	9	100	1049	9	14	±20%	±20%
	47	C	PSLC1A476M(55)	47	9	55	1414	9	14	±20%	±20%
	47	V	PSLV1A476M	47	10	60	1443	10	15	±20%	±20%
	47	D	PSLD1A476M	47	10	100	1225	10	15	±20%	±20%
	68	C2	PSLC21A686M	68	9	55	1279	9	14	±20%	±20%
	68	C	PSLC1A686M	68	9	100	1049	9	14	±20%	±20%
	68	C	PSLC1A686M(55)	68	9	55	1414	9	14	±20%	±20%
	68	V	PSLV1A686M	68	10	60	1443	10	15	±20%	±20%
	68	D	PSLD1A686M	68	10	100	1225	10	15	±20%	±20%
	100	B2	PSLB21A107M(45)	100	10	45	1374	10	15	±20%	±20%
	100	C2	PSLC21A107M	100	9	70	1134	9	14	±20%	±20%
	100	C2	PSLC21A107M(55)	100	9	55	1279	9	14	±20%	±20%
	100	C	PSLC1A107M	100	9	100	1049	9	14	±20%	±20%
	100	C	PSLC1A107M(55)	100	9	55	1414	9	14	±20%	±20%
	100	V	PSLV1A107M	100	10	45	1667	10	15	±20%	±20%
	100	V	PSLV1A107M(25)	100	10	25	2236	10	15	±20%	±20%
	100	D	PSLD1A107M	100	10	55	1651	10	15	±20%	±20%
	150	C	PSLC1A157M	150	9	55	1414	9	14	±20%	±20%
	150	V	PSLV1A157M	150	10	45	1667	10	15	±20%	±20%
	150	V	PSLV1A157M(40)	150	10	40	1768	10	15	±20%	±20%
	150	D	PSLD1A157M	150	10	55	1651	10	15	±20%	±20%
	150	D	PSLD1A157M(40)	150	10	40	1936	10	15	±20%	±20%
	220	D	PSLD1A227M	220	10	55	1651	10	15	±20%	±20%
	220	D	PSLD1A227M(40)	220	10	40	1936	10	15	±20%	±20%
	220	D	PSLD1A227M(25)	220	10	25	2449	10	15	±20%	±20%
16	3.3	A	PSLA1C335M	5.2	6	800	306	6	9	±20%	±20%
	4.7	B2	PSLB21C475M	7.5	8	200	652	8	12	±20%	±20%
	6.8	B2	PSLB21C685M	10.8	8	200	652	8	12	±20%	±20%
	10	B2	PSLB21C106M	16	8	100	922	8	12	±20%	±20%
	33	V	PSLV1C336M	52.8	10	70	1336	10	15	±20%	±20%
	47	V	PSLV1C476M	75.2	10	70	1336	10	15	±20%	±20%
	47	D	PSLD1C476M	75.2	10	70	1464	10	15	±20%	±20%
	68	V	PSLV1C686M	108.8	10	50	1581	10	15	±20%	±20%
	68	D	PSLD1C686M	108.8	10	55	1651	10	15	±20%	±20%
20	22	V	PSLV1D226M	44	10	90	1179	10	15	±20%	±20%
	33	V	PSLV1D336M	66	10	70	1336	10	15	±20%	±20%
	47	V	PSLV1D476M	94	10	70	1336	10	15	±20%	±20%
	47	D	PSLD1D476M	94	10	70	1464	10	15	±20%	±20%
25	6.8	B2	PSLB21E685M	17	8	100	922	8	12	±20%	±20%
	15	V	PSLV1E156M	37.5	10	90	1179	10	15	±20%	±20%
	22	V	PSLV1E226M	55	10	90	1179	10	15	±20%	±20%
	33	D	PSLD1E336M	82.5	10	60	1581	10	15	±20%	±20%

*1: Measure frequency
●: 300kHz, none: 100 kHz

■ FEATURE

- ●Lead-free type. RoHS Compliant.
- ●Face down terminal.
- ●The low-profile of height 1.0 mm Max, large capacitance and ultra-low ESR.
- ●Enable fillet bonding.
- ●Halogen free, Antimony free and Red Phosphorous free resin is applied to the exterior mold resin.

■ DIMENSIONS



(Unit: mm)

Case Code	L	W_1	W_2	H	Z
A3	3.2 ±0.2	1.6 ±0.2	1.2 ±0.1	0.9 ±0.1	0.8 ±0.2

■ STANDARD C-V VALUE REFERENCE BY CASE CODE

U_R :Rated Voltage

µF \ U_R		4.0 0G	6.3 0J	10 1A
10	106			
15	156			
22	226			A3 200
33	336			A3 200
47	476		A3 200	A3 200
68	686			
100	107	A3 200		

*Numeral: ESR(mΩ)

9653TCAVOL14E1109E0

■ PART NUMBER SYSTEM

[Bulk]

FPS A3 1A 336 M

- M: Capacitance Tolerance (M: ±20%)
- 336: Capacitance (in pF) (First two digits represent significant figures. Third digit specifies number of zeros to follow.)
- 1A: Rated voltage (0G : 4 V, 0J : 6.3 V, 1A : 10 V)
- A3: Case code
- FPS: F/PS Series

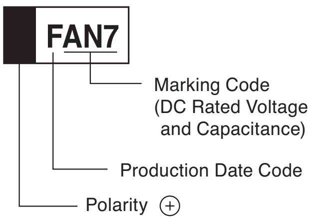
[Tape and Reel]

TE FPSA31A336M 8 R

- R: Packing Orientation (R: Cathode on the Side of Sproket Hole)
- 8: Tape width (8: 8 mm)
- FPSA31A336M: Part number of Bulk
- TE: Tape and Reel packing

■ MARKINGS

[A3, cases] (ex. 33 µF / 10 V)



[A3 case Marking Code]

UR :Rated Voltage

µF \ UR		4V	6.3V	10V
		g	j	A
22	J7			AJ7
33	N7			AN7
47	S7		jS7	AS7
68	W7			
100	A8	gA8		

[A3 cases production date code]

Y \ M	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2011	a	b	c	d	e	f	g	h	j	k	l	m
2012	n	p	q	r	s	t	u	v	w	x	y	z
2013	A	B	C	D	E	F	G	H	J	K	L	M
2014	N	P	Q	R	S	T	U	V	W	X	Y	Z

NOTE: Production date code will resume beginning in 2015.

■ PERFORMANCE CHARACTERISTICS

Test Conditions : Conform to IEC 60384-1

ITEM	PERFORMANCE			TEST CONDITION
Operating temperature	–55°C to +105°C			Derated voltage at 85°C at more
Rated voltage (V.dc)	4V	6.3V	10V	at 85°C
Derated voltage (V.dc)	3.3V	5V	8V	at 105°C
Surge voltage (V.dc)	5.2V	8V	13V	at 85°C
Capacitance	22 μF to 100μF			at 120 Hz
Capacitance tolerance	±20%			
DC Leakage Current (L.C)	0.1C • V(μA) or 3μA, whichever is greater			Voltage: Rated voltage for 5min.
Dissipation Factor	Refer to Standard Ratings			at 120 Hz
Equivalent Series Resistance	Refer to Standard Ratings			at 100 kHz
	Capacitance change	DF(%)	L.C	
Surge voltage test	Refer to Standard Ratings	Lower than initial specification	Lower than initial specification	Temperature : 85±2°C Applied voltage : Surge voltage Series resistance : 33 ohm Duration of surge : 30±5 sec Time between surge : 5.5min. Number of cycle : 1000
Characteristic at high and low temperature –55°C	from 0 to –20%	Lower than initial specification	––––	Step 1: 25±2°C Step 2: $-55^{\,0}_{-3}$°C Step 3: 25±2°C Step 4: $105^{\,0}_{-3}$°C
Characteristic at high and low temperature +105°C	from 0 to +50%	Lower than 1.5 times initial specification	Lower than 10 times initial specification	
Rapid change of temperature	Refer to Standard Ratings	Lower than initial specification	Lower than initial specification	Parts shall be temperature cycled over a temperature range of –55 to +105°C, five times continuously as follow. Step 1: $-55^{\,0}_{-3}$ °C, 30±3min. Step 2: room temp. , 10 to 15min. Step 3: $105^{\,0}_{-3}$ °C, 30±3min. Step 4: room temp, 10 to 15min.
Resistance to Soldering heat	Refer to Standard Ratings	Lower than 1.3 times initial specification	Lower than initial specification	Reflow soldering method 240°C, 10 sec.Max. *1
Damp heat	from +30% to –20%	Lower than 1.5 times initial specification	Lower than initial specification	at 40°C at 90 to 95% RH 500 hour
Endurance I	Refer to Standard Ratings	Lower than 1.5 times initial specification	Lower than initial specification	at 85°C at rated voltage 1000 hour
Endurance II	Refer to Standard Ratings	Lower than 3 times initial specification	Lower than initial specification	at 105°C at Derated voltage 1000 hour
Failure Rate	λ_0 = 1% / 1000 hour			at 85°C: rated voltage at 105°C: derated voltage 1000 hour
Terminal Strength	Visual: There shall be no evidence of mechanical damage			Strength : 4.9N Time : 10±0.5sec. (two directions)
Permissible ripple current	Refer to Ratings Table			at 100 kHz
Others	Conform to IEC60384–1			Conform to IEC60384–1

*1: Refer to the page 52 "NOTES ON USING NeoCapacitor/2. Mounting/(1) Reflow soldering/(b) Temperature and time"

Reference : Derated voltage (85 to 105°C)

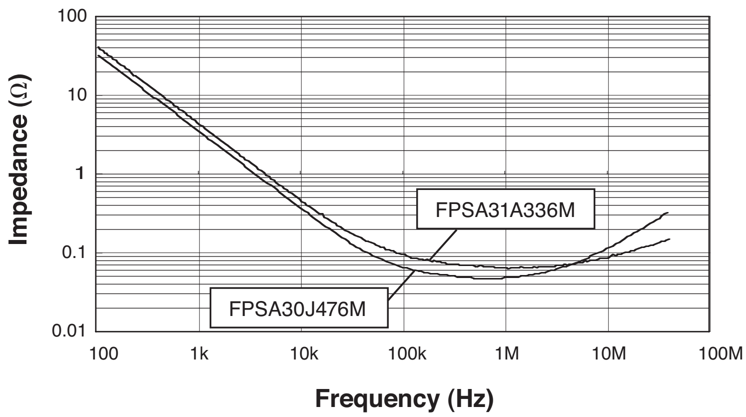
$$[U_T] = [U_R] - \frac{[U_R] - [U_C]}{20}(T-85)$$

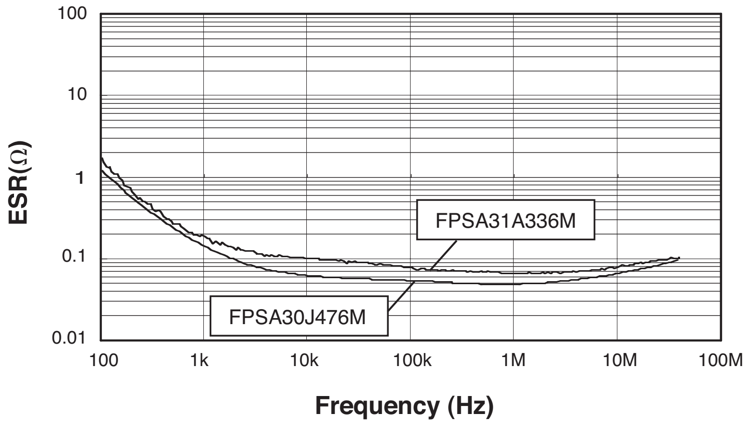
$[U_T]$: Derated voltage at operating temperature
$[U_R]$: Rated voltage
$[U_C]$: Derated voltage at 105°C
T : Operating temperature

■ STANDARD RATINGS

Rated Voltage (V)	Capacitance (μF)	Case Code	Part Number (Bulk)	Leakage Current (μA) Max	DF (%) Max	ESR (mΩ) Max	Permissible Ripple Current (mA rms.) Max	DF (%) Max -5°C	DF (%) Max +105°C	Capacitance Change at Surge Voltage at Resistance to Soldering Heat	Capacitance Change at Endurance
4	100	A3	FPSA30G107M	40	8	200	548	8	12	±20%	±20%
6.3	47	A3	FPSA30J476M	29.6	6	200	548	6	9	±20%	±20%
10	22	A3	FPSA31A226M	22	8	200	548	8	12	±20%	±20%
	33	A3	FPSA31A336M	33	6	200	548	6	9	±20%	±20%
	47	A3	FPSA31A476M	47	6	200	548	6	9	±20%	±20%

■ FREQUENCY CHARACTERISTICS (reference)

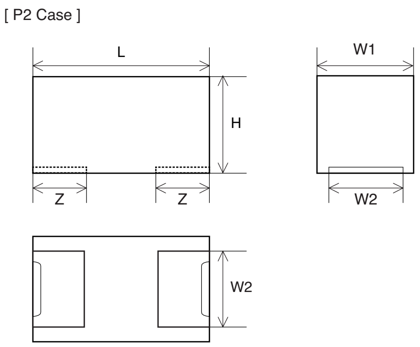




■ FEATURE

- ●The low-profile of height 1.0 mm Max, much large capacitance and ultra-low ESR and Low ESL.
- ●Substrate terminal.
- ●Enable fillet bonding.
- ●Lead-free type. RoHS Compliant.
- ●Halogen free, Antimony free and Red Phosphorous free resin is applied to the exterior mold resin.

■ DIMENSIONS



(Unit: mm)

Case Code	L	W_1	W_2	H	Z
P2	2.0 ± 0.1	1.25 ± 0.1	0.9 ± 0.1	0.9 ± 0.1	0.55 ± 0.1

■ STANDARD C-V VALUE REFERENCE BY CASE CODE

U_R :Rated Voltage

μF	U_R	2.5	4	6.3	10
		0E	0G	0J	1A
15	156				
22	226				P2 200
33	336				
47	476			P2 200	
68	686				
100	107				
150	157				

*Numeral: ESR(mΩ)

9653TCAVOL14E1109E0

■ PART NUMBER SYSTEM

[Bulk]

GPS P2 0J 476 M

- M — Capacitance Tolerance (M: ±20%)
- 476 — Capacitance (in pF) (First two digits represent significant figures. Third digit specifies number of zeros to follow.)
- 0J — Rated voltage (0J: 6.3V, 1A: 10V)
- P2 — Case code
- GPS — G/PS series

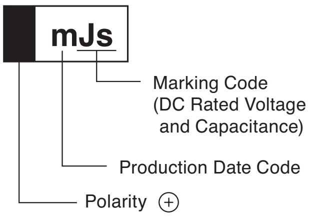
[Tape and Reel]

TE GPSP20J476M 8 R

- R — Packing Orientation (R: Cathode on the Side of Sproket Hole)
- 8 — Tape width (8 : 8 mm)
- GPSP20J476M — Part number of Bulk
- TE — Tape and Reel packing

■ MARKINGS

[P2 case] (ex. 47 μF / 6.3 V)



[P2 case Marking Code]

U_R :Rated Voltage

μF \ U_R	2.5	4	6.3	10
15				
22				Aj
33				
47			Js	
68				
100				
150				

《 **Production Date Code** 》

Y \ M	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2011	a	b	c	d	e	f	g	h	j	k	l	m
2012	n	p	q	r	s	t	u	v	w	x	y	z
2013	A	B	C	D	E	F	G	H	J	K	L	M
2014	N	P	Q	R	S	T	U	V	W	X	Y	Z

NOTE: Production date code will resume beginning in 2015.

■ PERFORMANCE CHARACTERISTICS

Test Conditions : Conform to IEC 60384-1

ITEM		PERFORMANCE			TEST CONDITION
Operating temperature		–55°C to +105°C			Derated voltage at 85°C at more
Rated voltage (V.dc)		6.3V	10V		at 85°C
Derated voltage (V.dc)		5.0V	8.0V		at 105°C
Surge voltage (V.dc)		8.0V	13V		at 85°C
Capacitance		22 μF to 47 μF			at 120 Hz
Capacitance tolerance		±20%			at 120 Hz
DC Leakage Current (L.C)		0.1C • V(μA) or 3μA , whichever is greater			Voltage: Rated voltage for 5min.
Dissipation Factor		Refer to Standard Ratings			at 120 Hz
Equivalent Series Resistance		Refer to Standard Ratings			at 100 kHz
		Capacitance change	DF(%)	L.C	
Surge voltage test		Refer to Standard Ratings	Lower than initial specification	Lower than initial specification	Temperature : 85±2°C Applied voltage : Surge voltage Series resistance : 33 ohm Duration of surge : 30±5 sec Time between surge : 5.5min. Number of cycle : 1000
Characteristic at high and low temperature	–55°C	from 0 to –20%	Lower than initial specification	——	Step 1: 25±2 °C Step 2: –55°C Step 3: 25±2 °C Step 4: 105°C
	+105°C	from 0 to +50%	Lower than 1.5 times initial specification	Lower than 10 times initial specification	
Rapid change of temperature		Refer to Standard Ratings	Lower than initial specification	Lower than 3 times initial specification	Parts shall be temperature cycled over a temperature range of –55 to +105°C, five times continuously as follow. Step 1: –55°C, 30±3min. Step 2: room temp. , 10 to 15min. Step 3: 105°C, 30±3min. Step 4: room temp, 10 to 15min.
Resistance to Soldering heat		Refer to Standard Ratings	Lower than 1.3 times initial specification	Lower than 3 times initial specification	Reflow soldering method 240°C, 10 sec.Max. *1
Damp heat		from +30% to –20%	Lower than 1.5 times initial specification	Lower than 3 times initial specification	at 40°C at 90 to 95% RH 500 hour
Endurance I		Refer to Standard Ratings	Lower than 1.5 times initial specification	Lower than 3 times initial specification	at 85°C at rated voltage 1000 hour
Endurance II		Refer to Standard Ratings	Lower than 3 times initial specification	Lower than 3 times initial specification	at 105°C at Derated voltage 1000 hour
Failure Rate		λ_0 = 1% / 1000 hrs			at 85°C: rated voltage at 105°C: derated voltage 1000 hour
Terminal Strength		Visual: There shall be no evidence of mechanical damage			Strength : 4.9N Time : 10±0.5sec. (two directions)
Permissible ripple current		Refer to Standard Ratings			at 100 kHz
Others		Conform to IEC60384–1			Conform to IEC60384–1

*1: Refer to the page 52 "NOTES ON USING NeoCapacitor/2. Mounting/(1) Reflow soldering/(b) Temperature and time"

Reference : Derated voltage (85 to 105°C)

$$[U_T] = [U_R] - \frac{[U_R] - [U_C]}{20}(T-85)$$

$[U_T]$: Derated voltage at operating temperature
$[U_R]$: Rated voltage
$[U_C]$: Derated voltage at 105°C
T : Operating temperature

■ STANDARD RATINGS

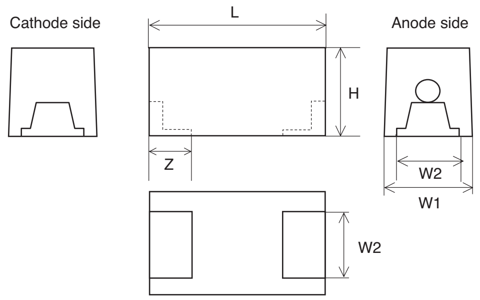
Rated Voltage (V)	Capacitance (μF)	Case Code	Part Number (Bulk)	Leakage Current (μA) Max	DF (%) Max	ESR (mΩ) Max	Permissible Ripple Current (mA rms.) Max	DF (%) Max		Capacitance Change	
								-55°C	+105°C	at Surge Voltage at Resistance to Soldering heat	at Endurance
6.3	47	P2	GPSP20J476M	29.6	6	200	354	6	9	±20%	±20%
10	47	P2	GPSP21A226M	22	6	200	354	6	9	±20%	±20%

F/SV Series

■ FEATURE

- ●Lead-free type. RoHS Compliant.
- ●Face down terminal.
- ●The low-profile of height 0.9mm Max and large capacitance of 47μF available in 1608 size.
- ●Enable fillet bonding.
- ●Halogen free, Antimony free and Red Phosphorous free resin is applied to the exterior mold resin.

■ DIMENSIONS



(Unit: mm)

Case Code	L	W1	W2	H	Z
J	1.6 ± 0.1	0.85 ± 0.1	0.65 ± 0.1	0.8 ± 0.1	0.5 ± 0.1
P2	2.0 ± 0.1	1.25 ± 0.1	0.9 ± 0.1	0.9 ± 0.1	0.55 ± 0.1
A3	3.2 ± 0.2	1.6 ± 0.2	1.2 ± 0.1	0.9 ± 0.1	0.8 ± 0.2

■ STANDARD C-V VALUE REFERENCE BY CASE CODE

UR :Rated Voltage

μF	UR	2.5V 0E	4V 0G	6.3V 0J	10V 1A	16V 1C	20V 1D	25V 1E
2.2	225							
3.3	335							
4.7	475							
6.8	685							A3
10	106					A3		
15	156							
22	226			J				
33	336		J		A3			
47	476	J						
68	686		P2	A3				
100	107	P2						
220	227	A3						

■ PART NUMBER SYSTEM

[Bulk]

FSV P2 0E 107 M

- M: Capacitance Tolerance (M: ±20%)
- 107: Capacitance (in pF) (First two digits represent significant figures. Third digit specifies number of zeros to follow.)
- 0E: Rated voltage
- P2: Case code
- FSV: F/SV Series

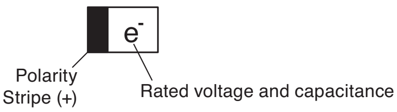
[Tape and Reel]

TE FSVP20E107M 8 R

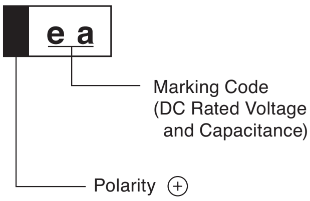
- R: Packing Orientation (R: Cathode on the Side of Sproket Hole)
- 8: Tape width (8: 8 mm)
- FSVP20E107M: Part number of Bulk
- TE: Tape and Reel packing

■ MARKINGS

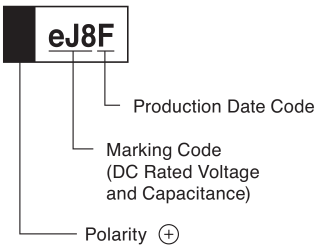
[J case] (ex. 47 μF / 2.5 V)



[P2 case] (ex. 100 μF / 2.5 V)



[A3 case] (ex. 220 μF / 2.5 V)



【J case Marking code】

U_R :Rated Voltage

μF \ U_R	2.5	4	6.3	10	16	20
4.7						
6.8						
10						
15						
22			J-			
33		G-				
47	e-					

【P2 case Making code】

μF \ U_R	2.5	4	6.3	10	16	20	25
10							
15							
22							
33							
47							
68		G$\overline{\text{W}}$					
100	ea						

【A3 case Making code】

μF \ U_R		2.5V	4V	6.3V	10V	16V	20V	25V
		e	g	j	A	C	D	E
6.8	W6							EW6
10	A7					CA7		
15	E7							
22	J7							
33	N7				AN7			
47	S7							
68	W7			jW7				
100	A8							
150	E8							
220	J8	eJ8						

[A3 case production date code]

Y \ M	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2011	a	b	c	d	e	f	g	h	j	k	l	m
2012	n	p	q	r	s	t	u	v	w	x	y	z
2013	A	B	C	D	E	F	G	H	J	K	L	M
2014	N	P	Q	R	S	T	U	V	W	X	Y	Z

NOTE: Production date code will resume beginning in 2015.

Manganese dioxide type

■ PERFORMANCE CHARACTERISTICS

Test Conditions : Conform to IEC 60384-1

<table>
<tr><th colspan="2">ITEM</th><th colspan="6">PERFORMANCE</th><th>TEST CONDITION</th></tr>
<tr><td colspan="2">Operating temperature</td><td colspan="6">-55°C to +125°C</td><td>Derated voltage at 85°C at more</td></tr>
<tr><td colspan="2">Rated voltage (V.dc)</td><td>2.5V</td><td>4V</td><td>6.3V</td><td>10V</td><td>16V</td><td>25V</td><td>at 85°C</td></tr>
<tr><td colspan="2">Derated voltage (V.dc)</td><td>1.6V</td><td>2.5V</td><td>4V</td><td>6.3V</td><td>10V</td><td>16V</td><td>at 125°C</td></tr>
<tr><td colspan="2">Surge voltage (V.dc)</td><td>3.3V</td><td>5.2V</td><td>8V</td><td>13V</td><td>20V</td><td>33V</td><td>at 85°C</td></tr>
<tr><td colspan="2">Capacitance</td><td colspan="6">6.8 μF to 220 μF</td><td rowspan="2">at 120 Hz</td></tr>
<tr><td colspan="2">Capacitance tolerance</td><td colspan="6">±20%</td></tr>
<tr><td colspan="2">DC Leakage Current (L.C)</td><td colspan="6">0.01C • V(μA) or 0.5μA , whichever is greater</td><td>Voltage:
Rated voltage for 5min.</td></tr>
<tr><td colspan="2">Dissipation Factor</td><td colspan="6">Refer to Standard Ratings</td><td>at 120 Hz</td></tr>
<tr><td colspan="2">Equivalent Series Resistance</td><td colspan="6">Refer to Standard Ratings</td><td>at 100 kHz</td></tr>
<tr><td colspan="2"></td><td colspan="2">Capacitance change</td><td colspan="2">DF(%)</td><td colspan="2">L.C</td><td></td></tr>
<tr><td colspan="2">Surge voltage test</td><td colspan="2">Refer to Standard Ratings</td><td colspan="2">Lower than initial specification</td><td colspan="2">Lower than initial specification</td><td>Temperature : 85±2°C
Applied voltage : Surge voltage
Series resistance : 33 ohm
Duration of surge : 30±5 sec
Time between surge : 5.5min.
Number of cycle : 1000</td></tr>
<tr><td rowspan="3">Characteristic at high and low temperature</td><td>-55°C</td><td colspan="2">Not to exceed -20%</td><td colspan="2">Refer to Standard Ratings</td><td colspan="2">———</td><td rowspan="3">Step 1: 25±2°C
Step 2: -55 $^{0}_{-3}$°C
Step 3: 25±2°C
Step 4: 125 $^{0}_{-3}$°C</td></tr>
<tr><td>+85°C</td><td colspan="2">Not to exceed +20%</td><td colspan="2">Lower than initial specification</td><td colspan="2">0.1C•V(μA) or 5 μA, which ever is greater</td></tr>
<tr><td>+125°C</td><td colspan="2">Not to exceed +20%</td><td colspan="2">Refer to Standard Ratings</td><td colspan="2">0.125C•V(μA) or 6.25 μA, which ever is greater</td></tr>
<tr><td colspan="2">Rapid change of temperature</td><td colspan="2">Refer to Standard Ratings</td><td colspan="2">Lower than initial specification</td><td colspan="2">Lower than initial specification</td><td>Parts shall be temperature cycled over a temperature range of -55 to +125°C, five times continuously as follow.
Step 1: -55 $^{0}_{-3}$°C, 30±3min.
Step 2: room temp. , 10 to 15min.
Step 3: 125 $^{0}_{-3}$°C, 30±3min.
Step 4: room temp, 10 to 15min.</td></tr>
<tr><td colspan="2">Resistance to Soldering heat</td><td colspan="2">Refer to Standard Ratings</td><td colspan="2">Lower than initial specification</td><td colspan="2">Lower than initial specification</td><td>solder dip : 260°C, 5sec
solder reflow : 260°C, 10sec</td></tr>
<tr><td colspan="2">Damp heat</td><td colspan="2">Refer to Standard Ratings</td><td colspan="2">Lower than 1.5 times initial specification</td><td colspan="2">Lower than initial specification</td><td>at 40°C
at 90 to 95% RH
500 hour</td></tr>
<tr><td colspan="2">Endurance</td><td colspan="2">Refer to Standard Ratings</td><td colspan="2">Lower than initial specification</td><td colspan="2">Lower than 2 times initial specification</td><td>at 85°C : Rated voltage
at 125°C : Derated voltage
2000 hour</td></tr>
<tr><td colspan="2">Failure Rate</td><td colspan="6">λ_0=1% / 1000 hour</td><td>at 85°C: Rated voltage
at 125°C: Derated voltage
2000 hour</td></tr>
<tr><td colspan="2">Terminal Strength</td><td colspan="6">Visual:
There shall be no evidence of mechanical damage</td><td>Strength : 4.9N
Time : 10±0.5sec.
(two directions)</td></tr>
<tr><td colspan="2">Others</td><td colspan="6">Conform to IEC60384–1</td><td>Conform to IEC60384–1</td></tr>
</table>

$$[U_T] = [U_R] - \frac{[U_R] - [U_C]}{40}(T-85)$$

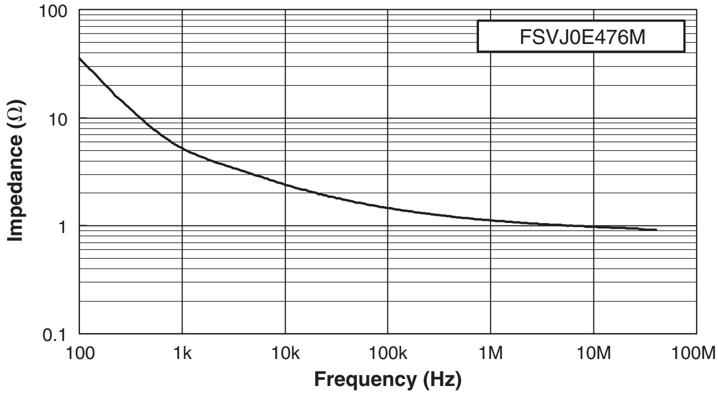
$[U_T]$: Derated voltage at operating temperature
$[U_R]$: Rated voltage
$[U_C]$: Derated voltage at 125°C
T : Operating temperature

■ RATINGS

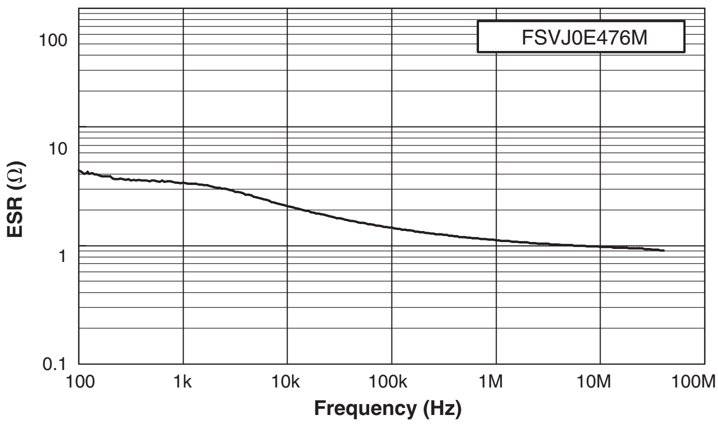
Rated Voltage (V)	Capacitance (μF)	Case Code	Part Number (Bulk)	Leakage Current (μA) Max	DF (%) Max	ESR (Ω) Max	DF (%) Max		Capacitance Change	
							-55°C	+125°C	at Surge Voltage at Damp Heat at Resistance to Soldering Heat	at Endurance
2.5	47	J	FSVJ0E476M	1.1	30	4	60	40	±20%	±20%
	100	P2	FSVP20E107M	2.5	35	3	60	40	±20%	±20%
	220	A3	FSVA30E227M	5.5	20	1	40	30	±20%	±20%
4	33	J	FSVJ0G336M	1.3	30	4	60	30	±20%	±20%
	68	P2	FSVP20G686M	2.7	18	2.5	34	20	±20%	±20%
6.3	22	J	FSVJ0J226M	1.3	20	4	38	22	±20%	±20%
	68	A3	FSVA30J686M	4.2	20	2	38	22	±20%	±20%
10	33	A3	FSVA31A336M	3.3	12	1	22	14	±20%	±20%
16	10	A3	FSVA31C106M	1.6	8	3	12	10	±20%	±20%
25	6.8	A3	FSVA31E685M	1.7	15	3	30	20	±20%	±20%

■ CHARACTERISTICS (reference)

Impedance-frequency characteristics



ESR-frequency characteristics



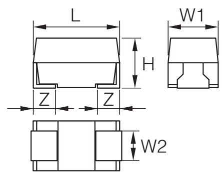
Manganese dioxide type

■ FEATURES

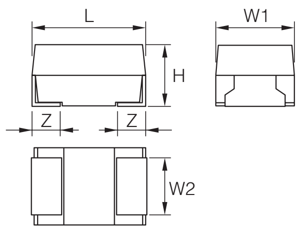
- Lead-free Type. RoHS Compliant.
- Offer a range of small, high-capacity models.
- Succeed to the latest technology plus outstanding peformance.
- Halogen free, Antimony free and Red Phosphorous free resin is applied to the exterior mold resin.

■ DIMENSIONS [mm]

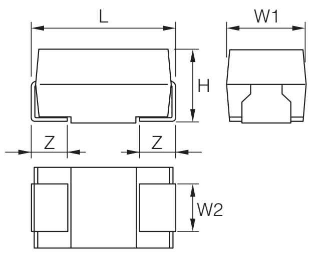
[J, P, A2, A cases]



[B3, B2 cases]



[C2, C, V, D cases]



(Unit: mm)

Case Code	EIA code	L	W1	W2	H	Z
J	–	1.6 ± 0.1	0.8 ± 0.1	0.6 ± 0.1	0.8 ± 0.1	0.3 ± 0.15
P	2012	2.0 ± 0.2	1.25 ± 0.2	0.9 ± 0.1	1.1 ± 0.1	0.5 ± 0.1
A2 (U)	3216L	3.2 ± 0.2	1.6 ± 0.2	1.2 ± 0.1	1.1 ± 0.1	0.8 ± 0.2
A	3216	3.2 ± 0.2	1.6 ± 0.2	1.2 ± 0.1	1.6 ± 0.2	0.8 ± 0.2
B3 (W)	3528L	3.5 ± 0.2	2.8 ± 0.2	2.2 ± 0.1	1.1 ± 0.1	0.8 ± 0.2
B2 (S)	3528	3.5 ± 0.2	2.8 ± 0.2	2.2 ± 0.1	1.9 ± 0.2	0.8 ± 0.2
C2	–	6.0 ± 0.2	3.2 ± 0.2	2.2 ± 0.1	1.4 ± 0.1	1.3 ± 0.2
C	6032	6.0 ± 0.2	3.2 ± 0.2	2.2 ± 0.1	2.5 ± 0.2	1.3 ± 0.2
V	–	7.3 ± 0.2	4.3 ± 0.2	2.4 ± 0.1	1.9 ± 0.1	1.3 ± 0.2
D	7343	7.3 ± 0.2	4.3 ± 0.2	2.4 ± 0.1	2.8 ± 0.2	1.3 ± 0.2

■ STANDARD C-V VALUE REFERENCE BY CASE CODE

UR :Rated Voltage

μF \ UR		2.5V	4V	6.3V	10V	16V	20V	25V	35V
		0E	0G	0J	1A	1C	1D	1E	1V
0.47	474					P	A2	A	A
0.68	684					P	A2	A	A
1.0	105				P	J, P	A2	P, A2, A	A2, A
1.5	155			P	J, P	J, A	A2		A
2.2	225			J	J, P	J, P, A2, A	P, A2, A	A	A, B2
3.3	335		P	J	J, P, A2	P, A2, A	A2, A, B3	A	B3, B2
4.7	475			J, P, A	J, P, A2, A	A2, A	A2, A, B3, B2	B3, B2	C
6.8	685		J	J, P, A2	A2, A	A, B3	B3, B2	B2	C
10	106	J	J, P	J, P, A2, A	P, A2, A, B2	A, B3, B2	B2	C2, C	C, D
15	156	J	P	P, A2, A	A2, B3	A, B2	C	C	D
22	226	P, A2	P, A2, A	P, A2, A, B3, B2	A, B3, B2	B3, B2, C	B2, C2, C, D	D	
33	336	P, A2	P, A2, A	A2, A, B3	B3, B2	B2, C2, C	D	D	
47	476	P, A2, A	P, A2, A, B3	A, B3, B2, C	A, B2, C2, C	C, D	C, D		
68	686	A	A, B3	A, B3, B2, C2	B2, C2, C	C, D			
100	107	A, B3, B2	A2, A, B3, B2, C2	A, B3, B2, C2, C	B2, C2, C, V, D	D			
150	157	A, B3, C2	B2, C2	B2, C	V, D				
220	227	B3, B2, C2	B2, C	B2, C, V, D	D				
330	337	B3, B2, C	C, V	V, D					
470	477	B2, C, D	D	D					
680	687		D						

■ PART NUMBER SYSTEM

[Bulk]

ESV D 0G 687 M

- M — Capacitance tolerance (M: ±20%, K: ±10%)
- 687 — Capacitance (pF) (First two digits represent significant figures. Third digit specifies number of zeros to follow.)
- 0G — DC rated voltage in volts (0E: 2.5 V, 0G: 4 V, 0J: 6.3 V, 1A: 10 V, 1C: 16 V, 1D: 20 V, 1E: 25 V, 1V: 35 V)
- D — Case code
- ESV — E/SV Series

[Tape and Reel]

TE ESVD0G687M 12 R

- R — Packing Orientation (R: Cathode on the Side of Sproket Hole)
- 12 — Tape width (8 : 8 mm (J, P, A2, A, B3, B2 case), 12 : 12 mm (C2, C, V, D case))
- ESVD0G687M — Part number of Bulk
- TE — Tape and Reel (TE : 180 mmϕ reel)

TL ESVD0G687M 12 R E

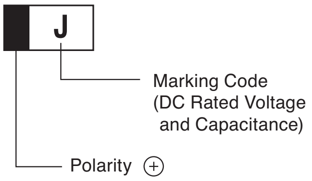
- TL — Tape and Reel (TL : 330 mmϕ reel)
- E — Indicates 330mmϕ reel

Manganese dioxide type

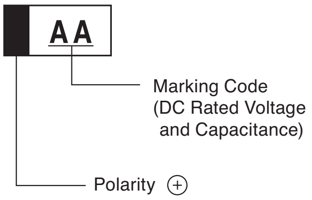
■ MARKINGS

The standard marking shows capacitance, DC rated voltage, and polarity.

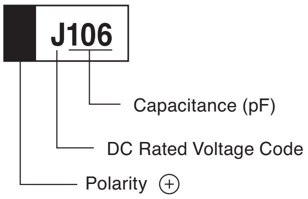
[J case] (ex. 4.7 μF / 6.3 V)



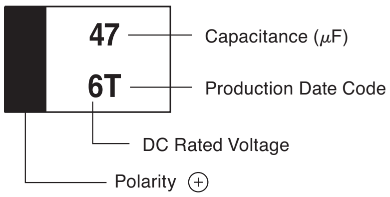
[P case] (ex. 1 μF / 10 V)



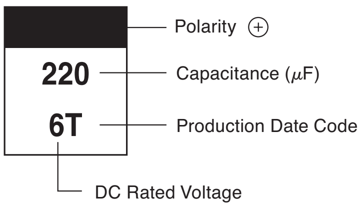
[A2, A cases] (ex. 10 μF / 6.3 V)



[B3, B2 cases] (ex. 47 μF / 6.3 V)



[C2, C, V, D cases] (ex. 220 μF / 6.3 V)



[J case Marking Code]

UR :Rated Voltage

UR / μF	2.5 V	4 V	6.3 V	10 V	16 V
1.0					Ɔ
1.5				∀	ᑎ
2.2			ſ	ᐊ	C
3.3			ᓗ	A	
4.7			J	ᐅ	
6.8		G	ᓚ		
10	e	⅁	ſ̅		
15	ә				

[P case Marking Code]

UR / μF	2.5 V	4 V	6.3 V	10 V	16 V	20V	25V
0.47					CS		
0.68					CW		
1				AA	CA		EA
1.5			JE	AE			
2.2				AJ	CJ	DJ	
3.3		GN		AN	CN̅		
4.7			JS	AS			
6.8			JW				
10		GA̅	JA̅	AA̅			
15		GE̅	JE̅				
22	eJ̅	GJ̅	JJ̅				
33	eN̅	GN̅					
47	eS̅	GS̅					

[P, A2, A, cases DC Rated Voltage code]

Code	e	G	J	A	C	D	E	V
Rated Voltage	2.5 V	4 V	6.3 V	10 V	16 V	20 V	25 V	35V

[B3, B2, C2, C, V, D cases Production date code]

Y / M	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2011	a	b	c	d	e	f	g	h	j	k	l	m
2012	n	p	q	r	s	t	u	v	w	x	y	z
2013	A	B	C	D	E	F	G	H	J	K	L	M
2014	N	P	Q	R	S	T	U	V	W	X	Y	Z

NOTE: Production date code will resume beginning in 2015.

■ PERFORMANCE CHARACTERISTICS

Test Conditions : Conform to IEC 60384-1

<table>
<tr><th colspan="2">ITEM</th><th colspan="8">PERFORMANCE</th><th>TEST CONDITION</th></tr>
<tr><td colspan="2">Operating temperature</td><td colspan="8">–55°C to +125°C</td><td>Derated voltage at 85°C at more</td></tr>
<tr><td colspan="2">Rated voltage (V.dc)</td><td>2.5V</td><td>4V</td><td>6.3V</td><td>10V</td><td>16V</td><td>20V</td><td>25V</td><td>35V</td><td>at 85°C</td></tr>
<tr><td colspan="2">Derated voltage (V.dc)</td><td>1.6V</td><td>2.5V</td><td>4V</td><td>6.3V</td><td>10V</td><td>13V</td><td>16V</td><td>22V</td><td>at 125°C</td></tr>
<tr><td colspan="2">Surge voltage (V.dc)</td><td>3.3V</td><td>5.2V</td><td>8V</td><td>13V</td><td>20V</td><td>26V</td><td>33V</td><td>46V</td><td>at 85°C</td></tr>
<tr><td colspan="2">Capacitance</td><td colspan="8">0.47 μF to 680 μF</td><td rowspan="2">at 120 Hz</td></tr>
<tr><td colspan="2">Capacitance tolerance</td><td colspan="8">±20% or ±10% (P,J case: ±20%)</td></tr>
<tr><td colspan="2">DC Leakage Current (L.C)</td><td colspan="8">0.01C • V(μA) or 0.5 μA , whichever is greater</td><td>Voltage:
Rated voltage for 5min.</td></tr>
<tr><td colspan="2">Dissipation Factor</td><td colspan="8">Refer to Standard Ratings</td><td>at 120 Hz</td></tr>
<tr><td colspan="2">Equivalent Series Resistance</td><td colspan="8">Refer to Standard Ratings</td><td>at 100 kHz</td></tr>
<tr><td colspan="2"></td><td colspan="3">Capacitance change</td><td colspan="3">DF(%)</td><td colspan="2">L.C</td><td></td></tr>
<tr><td colspan="2">Surge voltage test</td><td colspan="3">Refer to Standard Ratings</td><td colspan="3">Lower than initial specification</td><td colspan="2">Lower than initial specification</td><td>Temperature : 85±2°C
Applied voltage : Surge voltage
Series resistance : 33 ohm
Duration of surge : 30±5 sec
Time between surge : 5.5min.
Number of cycle : 1000</td></tr>
<tr><td rowspan="3">Characteristic at high and low temperature</td><td>–55°C</td><td colspan="3">Not to exceed –20% (P, J case) or –12%</td><td colspan="3">Refer to Standard Ratings</td><td colspan="2">– – – –</td><td rowspan="3">Step 1: 25±2°C
Step 2: -55^{0}_{-3}°C
Step 3: 25±2°C
Step 4: 125^{0}_{-3}°C</td></tr>
<tr><td>+85°C</td><td colspan="3">Not to exceed +20% (P, J case) or +12%</td><td colspan="3">Lower than initial specification</td><td colspan="2">0.1C • V(μA) or 5μA, which ever is greater</td></tr>
<tr><td>+125°C</td><td colspan="3">Not to exceed +20% (P, J case) or +15%</td><td colspan="3">Refer to Standard Ratings</td><td colspan="2">0.125C • V(μA) or 6.25μA, which ever is greater</td></tr>
<tr><td colspan="2">Rapid change of temperature</td><td colspan="3">Refer to Standard Ratings</td><td colspan="3">Lower than initial specification</td><td colspan="2">Lower than initial specification</td><td>Parts shall be temperature cycled over a temperature range of –55 to +125°C, five times continuously as follow.
Step 1: -55^{0}_{-3}°C, 30±3min.
Step 2: room temp. 10 to 15min.
Step 3: 125^{0}_{-3}°C, 30±3min.
Step 4: room temp, 10 to 15min.</td></tr>
<tr><td colspan="2">Resistance to Soldering heat</td><td colspan="3">Refer to Standard Ratings</td><td colspan="3">Lower than initial specification</td><td colspan="2">Lower than initial specification</td><td>solder dip : 260°C, 5sec
solder reflow : 260°C,10sec</td></tr>
<tr><td colspan="2">Damp heat</td><td colspan="3">Refer to Standard Ratings</td><td colspan="3">Lower than 1.5 times initial specification</td><td colspan="2">Lower than initial specification</td><td>at 40°C
at 90 to 95% RH
500 hour</td></tr>
<tr><td colspan="2">Endurance</td><td colspan="3">Refer to Standard Ratings</td><td colspan="3">Lower than initial specification</td><td colspan="2">Lower than 2 times initial specification (P, J case) or 1.25 times initial specification</td><td>at 85°C: Rated voltage
at 125°C: Derated voltage
2000 hour</td></tr>
<tr><td colspan="2">Failure Rate</td><td colspan="8">λ_0=1% / 1000 hour</td><td>at 85°C: Rated voltage
at 125°C: Derated voltage
2000 hour</td></tr>
<tr><td colspan="2">Terminal Strength</td><td colspan="8">Visual:
There shall be no evidence of mechanical damage</td><td>Strength : 4.9N
Time : 10±0.5sec.
(two directions)</td></tr>
<tr><td colspan="2">Others</td><td colspan="8">Conform to IEC60384–1</td><td>Conform to IEC60384–1</td></tr>
</table>

Manganese dioxide type

Reference : Derated voltage (85 to 125°C)

$$[U_T] = [U_R] - \frac{[U_R] - [U_C]}{40}(T-85)$$

$[U_T]$: Derated voltage at operating temperature
$[U_R]$: Rated voltage
$[U_C]$: Derated voltage at 125°C
T : Operating temperature

■ STANDARD RATINGS

Rated Voltage (V)	Capacitance (µF)	Case Code	Part Number (Bulk)	Leakage Current (µA) Max	DF (%) Max	ESR (Ω) Max	DF (%) Max		Capacitance Change	
							-55°C	+125°C	at Surge Voltage at Damp Heat at Resistance to Soldering Heat	at Endurance
2.5	10	J	ESVJ0E106M	0.5	20	6.5	30	30	±20%	±20%
	15	J	ESVJ0E156M	0.5	20	8	30	30	±20%	±20%
	22	P	ESVP0E226M	0.5	20	4	30	30	±20%	±20%
	22	A2	ESVA20E226M	0.5	12	3	20	14	±12%	±12%
	33	A2	ESVA20E336M	0.8	12	4	22	14	±12%	±12%
	33	P	ESVP0E336M	0.8	20	4	30	30	±20%	±20%
	47	P	ESVP0E476M	1.1	30	6	60	40	±20%	±20%
	47	A2	ESVA20E476M	1.1	12	4.5	22	14	±12%	±12%
	47	A	ESVA0E476M	1.1	12	4.5	22	16	±12%	±12%
	68	A	ESVA0E686M	1.7	18	4.5	34	20	±12%	±12%
	100	A	ESVA0E107M	2.5	30	2	60	40	±20%	±20%
	100	B3	ESVB30E107M	2.5	18	1.3	34	20	±15%	±15%
	100	B2	ESVB20E107M	2.5	8	1	14	10	±12%	±12%
	150	A	ESVA0E157M	3.7	30	2	60	40	±20%	±20%
	150	B3	ESVB30E157M	3.7	20	1	40	30	±15%	±15%
	150	C2	ESVC20E157M	3.7	12	0.8	26	18	±12%	±12%
	220	B3	ESVB30E227M	5.5	30	1	60	40	±15%	±15%
	220	B2	ESVB20E227M	5.5	18	0.6	34	20	±12%	±12%
	220	C2	ESVC20E227M	5.5	12	0.8	26	18	±12%	±12%
	330	B3	ESVB30E337M	8.2	30	1	60	40	±15%	±15%
	330	B2	ESVB20E337M	8.2	25	0.6	50	30	±12%	±20%
	330	C	ESVC0E337M	8.2	16	0.3	34	18	±12%	±12%
	470	B2	ESVB20E477M	11.7	35	0.6	70	50	±20%	±20%
	470	C	ESVC0E477M	11.7	18	1.5	34	20	±12%	±12%
	470	D	ESVD0E477M	11.7	14	0.5	18	16	±12%	±12%
4	3.3	P	ESVP0G335M	0.5	20	20	30	30	±20%	±20%
	6.8	J	ESVJ0G685M	0.5	20	7.5	30	30	±20%	±20%
	10	J	ESVJ0G106M	0.5	20	6.5	30	30	±20%	±20%
	10	P	ESVP0G106M	0.5	20	6	30	30	±20%	±20%
	15	P	ESVP0G156M	0.6	20	5	30	30	±20%	±20%
	22	P	ESVP0G226M	0.8	20	4	30	30	±20%	±20%
	22	A2	ESVA20G226M	0.8	12	2.8	22	16	±12%	±12%
	22	A	ESVA0G226M	0.8	8	2.5	12	10	±12%	±12%
	33	P	ESVP0G336M	1.3	20	4	30	30	±20%	±20%
	33	A2	ESVA20G336M	1.3	8	4.5	14	10	±12%	±12%
	33	A	ESVA0G336M	1.3	10	3	14	12	±12%	±12%
	47	P	ESVP0G476M	1.8	30	3	60	40	±20%	±20%
	47	A2	ESVA20G476M	1.8	15	4.5	30	20	±12%	±12%
	47	A	ESVA0G476M	1.8	12	2.5	22	14	±12%	±12%
	47	B3	ESVB30G476M	1.8	12	1.7	18	15	±15%	±15%
	68	A	ESVA0G686M	2.7	12	2.5	22	14	±12%	±12%
	68	B3	ESVB30G686M	2.7	15	1.5	28	17	±15%	±15%
	100	A2	ESVA20G107M	4	30	2	60	40	±20%	±20%
	100	A	ESVA0G107M	4	30	2	60	40	±20%	±20%
	100	B3	ESVB30G107M	4	20	1.3	38	22	±15%	±15%
	100	B2	ESVB20G107M	4	12	0.8	22	14	±12%	±12%
	100	C2	ESVC20G107M	4	10	0.8	18	12	±12%	±12%
	150	B2	ESVB20G157M	6	18	0.7	34	20	±12%	±12%
	150	C2	ESVC20G157M	6	10	0.8	18	12	±12%	±12%
	220	B2	ESVB20G227M	8.8	18	0.5	34	20	±12%	±12%
	220	C	ESVC0G227M	8.8	12	0.6	22	14	±12%	±12%
	330	C	ESVC0G337M	13.2	14	0.2	26	16	±12%	±12%
	330	V	ESVV0G337M	13.2	12	0.5	18	14	±12%	±12%
	470	D	ESVD0G477M	18.8	16	0.3	30	18	±12%	±12%
	680	D	ESVD0G687M	27.2	24	0.3	46	26	±12%	±12%
6.3	1.5	P	ESVP0J155M	0.5	10	25	15	15	±20%	±20%
	2.2	J	ESVJ0J225M	0.5	20	17.5	30	30	±20%	±20%
	3.3	J	ESVJ0J335M	0.5	20	13.5	30	30	±20%	±20%
	4.7	J	ESVJ0J475M	0.5	20	8.5	30	30	±20%	±20%
	4.7	P	ESVP0J475M	0.5	20	10	30	30	±20%	±20%
	4.7	A	ESVA0J475M	0.5	8	5.5	12	10	± 5%	±10%
	6.8	J	ESVJ0J685M	0.5	20	7	30	30	±20%	±20%
	6.8	P	ESVP0J685M	0.5	20	7	30	30	±20%	±20%

Rated Voltage (V)	Capacitance (μF)	Case Code	Part Number (Bulk)	Leakage Current (μA) Max	DF (%) Max	ESR (Ω) Max	DF (%) Max		Capacitance Change	
							-55°C	+125°C	at Surge Voltage at Damp Heat at Resistance to Soldering Heat	at Endurance
6.3	6.8	A2	ESVA20J685M	0.5	8	6.5	12	10	±12%	±12%
	10	J	ESVJ0J106M	0.6	20	8	38	22	±20%	±20%
	10	P	ESVP0J106M	0.6	20	6	30	30	±20%	±20%
	10	A2	ESVA20J106M	0.6	8	4.5	12	10	±12%	±12%
	10	A	ESVA0J106M	0.6	8	3.2	12	10	±12%	±12%
	15	P	ESVP0J156M	0.9	20	5	30	30	±20%	±20%
	15	A2	ESVA20J156M	0.9	12	4	22	14	±12%	±12%
	15	A	ESVA0J156M	0.9	8	3	12	10	±12%	±12%
	22	P	ESVP0J226M	1.3	20	4	38	22	±20%	±20%
	22	A2	ESVA20J226M	1.3	12	2.8	22	14	±12%	±12%
	22	A	ESVA0J226M	1.3	10	3	14	12	±12%	±12%
	22	B3	ESVB30J226M	1.3	8	2	12	10	±15%	±15%
	22	B2	ESVB20J226M	1.3	8	1.6	12	10	± 5%	±10%
	33	A2	ESVA20J336M	2	18	3	34	20	±20%	±20%
	33	A	ESVA0J336M	2	12	2.5	22	14	±12%	±12%
	33	B3	ESVB30J336M	2	12	1.7	18	15	±15%	±15%
	47	A	ESVA0J476M	2.9	12	2	22	14	±12%	±12%
	47	B3	ESVB30J476M	2.9	12	1.7	18	15	±15%	±15%
	47	B2	ESVB20J476M	2.9	8	1.3	12	10	± 5%	±10%
	47	C	ESVC0J476M	2.9	8	0.9	12	10	± 5%	±10%
	68	A	ESVA0J686M	4.2	30	2	60	40	±12%	±12%
	68	B3	ESVB30J686M	4.2	20	2	38	22	±15%	±15%
	68	B2	ESVB20J686M	4.2	10	1	18	12	±12%	±12%
	68	C2	ESVC20J686M	4.2	10	0.8	14	12	±12%	±12%
	100	A	ESVA0J107M	6.3	25	2	60	40	±20%	±20%
	100	B3	ESVB30J107M	6.3	20	1.3	38	22	±15%	±15%
	100	B2	ESVB20J107M	6.3	12	0.9	22	14	±12%	±12%
	100	C2	ESVC20J107M	6.3	10	0.8	18	12	±12%	±12%
	100	C	ESVC0J107M	6.3	10	0.6	14	12	±12%	±12%
	150	B2	ESVB20J157M	9.4	12	1	22	14	±12%	±12%
	150	C	ESVC0J157M	9.4	10	0.6	18	12	±12%	±12%
	220	B2	ESVB20J227M	13.8	18	1	34	20	±12%	±12%
	220	C	ESVC0J227M	13.8	14	1.2	26	16	±12%	±12%
	220	V	ESVV0J227M	13.8	12	0.5	18	14	±12%	±12%
	220	D	ESVD0J227M	13.8	12	0.5	18	14	±12%	±12%
	330	V	ESVV0J337M	20.7	14	0.5	26	16	±5%	±10%
	330	D	ESVD0J337M	20.7	14	0.5	26	16	±12%	±12%
	470	D	ESVD0J477M	29.6	20	0.3	38	22	±20%	±20%
10	1	P	ESVP1A105M	0.5	10	25	15	15	±20%	±20%
	1.5	J	ESVJ1A155M	0.5	20	25.5	30	30	±20%	±20%
	1.5	P	ESVP1A155M	0.5	20	25	30	30	±20%	±20%
	2.2	J	ESVJ1A225M	0.5	20	17.5	30	30	±20%	±20%
	2.2	P	ESVP1A225M	0.5	20	19	30	30	±20%	±20%
	3.3	J	ESVJ1A335M	0.5	20	25	30	30	±20%	±20%
	3.3	P	ESVP1A335M	0.5	20	13	30	30	±20%	±20%
	3.3	A2	ESVA21A335M	0.5	8	8	12	10	±12%	±12%
	4.7	J	ESVJ1A475M	0.5	20	10	30	30	±20%	±20%
	4.7	P	ESVP1A475M	0.5	20	6	30	30	±20%	±20%
	4.7	A2	ESVA21A475M	0.5	8	8	12	10	±12%	±12%
	4.7	A	ESVA1A475M	0.5	8	4.5	12	10	±12%	±12%
	6.8	A2	ESVA21A685M	0.6	8	8	12	10	±12%	±12%
	6.8	A	ESVA1A685M	0.6	8	4.5	12	10	±12%	±12%
	10	P	ESVP1A106M	1	20	6	30	30	±20%	±20%
	10	A2	ESVA21A106M	1	8	8	12	10	±12%	±12%
	10	A	ESVA1A106M	1	8	3.2	12	10	±12%	±12%
	10	B2	ESVB21A106M	1	8	2.4	12	10	± 5%	±10%
	15	A2	ESVA21A156M	1.5	12	3	22	14	±12%	±12%
	15	B3	ESVB31A156M	1.5	8	2.7	12	10	±15%	±15%
	22	A	ESVA1A226M	2.2	12	2.5	22	14	±12%	±12%
	22	B3	ESVB31A226M	2.2	8	1.9	12	10	±15%	±15%
	22	B2	ESVB21A226M	2.2	8	1.4	12	10	± 5%	±10%
	33	B3	ESVB31A336M	3.3	12	1.7	18	15	±15%	±15%
	33	B2	ESVB21A336M	3.3	8	1.4	12	10	± 5%	±10%

Rated Voltage (V)	Capacitance (μF)	Case Code	Part Number (Bulk)	Leakage Current (μA) Max	DF (%) Max	ESR (Ω) Max	DF (%) Max		Capacitance Change	
							-55°C	+125°C	at Surge Voltage at Damp Heat at Resistance to Soldering Heat	at Endurance
	47	A	ESVA1A476M	4.7	20	5	36	24	±20%	±20%
	47	B2	ESVB21A476M	4.7	8	1	12	10	±12%	±12%
	47	C2	ESVC21A476M	4.7	8	1	14	10	±12%	±12%
	47	C	ESVC1A476M	4.7	8	0.9	12	10	± 5%	±10%
	68	B2	ESVB21A686M	6.8	12	0.9	14	14	±12%	±12%
	68	C2	ESVC21A686M	6.8	10	1	18	14	±12%	±12%
	68	C	ESVC1A686M	6.8	8	0.7	12	10	±12%	±12%
10	100	B2	ESVB21A107M	10	16	1.4	20	20	±20%	±30%
	100	C2	ESVC21A107M	10	10	0.8	18	14	±12%	±12%
	100	C	ESVC1A107M	10	10	0.5	18	12	±12%	±12%
	100	V	ESVV1A107M	10	8	0.5	18	10	±12%	±12%
	100	D	ESVD1A107M	10	8	0.6	18	10	± 5%	±10%
	150	V	ESVV1A157M	15	8	0.5	18	10	±12%	±12%
	150	D	ESVD1A157M	15	10	0.6	18	12	±12%	±12%
	220	D	ESVD1A227M	22	12	0.6	22	14	±12%	±12%
	0.47	P	ESVP1C474M	0.5	10	35	15	15	±20%	±20%
	0.68	P	ESVP1C684M	0.5	10	25	15	15	±20%	±20%
	1	J	ESVJ1C105M	0.5	10	25.5	30	15	±20%	±20%
	1	P	ESVP1C105M	0.5	10	20	15	15	±20%	±20%
	1.5	J	ESVJ1C155M	0.5	10	25	20	15	±20%	±20%
	1.5	A	ESVA1C155M	0.5	4	6	8	6	± 5%	±10%
	2.2	J	ESVJ1C225M	6.8	20	20	30	30	±20%	±20%
	2.2	P	ESVP1C225M	0.5	10	19	15	15	±20%	±20%
	2.2	A2	ESVA21C225M	0.5	6	10	10	8	±12%	±12%
	2.2	A	ESVA1C225M	0.5	6	6	10	8	± 5%	±10%
	3.3	P	ESVP1C335M	0.5	10	8	15	15	±20%	±20%
	3.3	A2	ESVA21C335M	0.5	8	7	14	10	±12%	±12%
	3.3	A	ESVA1C335M	0.5	6	4.5	10	8	±12%	±12%
	4.7	A2	ESVA21C475M	0.7	8	4.5	14	10	±12%	±12%
	4.7	A	ESVA1C475M	0.7	6	4	10	8	±12%	±12%
	6.8	A	ESVA1C685M	1	6	4	10	8	±12%	±12%
16	6.8	B3	ESVB31C685M	1	6	4.1	10	8	±15%	±15%
	10	A	ESVA1C106M	1.6	8	3.2	12	10	±12%	±12%
	10	B3	ESVB31C106M	1.6	8	3.5	14	10	±15%	±15%
	10	B2	ESVB21C106M	1.6	6	2	10	8	± 5%	±10%
	15	A	ESVA1C156M	2.4	12	5	22	14	±12%	±12%
	15	B2	ESVB21C156M	2.4	6	2	10	8	± 5%	±10%
	22	B3	ESVB31C226M	3.5	10	2.2	18	12	±15%	±15%
	22	B2	ESVB21C226M	3.5	6	2.2	10	8	± 5%	±10%
	22	C	ESVC1C226M	3.5	6	1.5	10	8	± 5%	±10%
	33	B2	ESVB21C336M	5.2	8	1.4	14	10	±5%	±10%
	33	C2	ESVC21C336M	5.2	6	1.4	10	8	±12%	±12%
	33	C	ESVC1C336M	5.2	6	1.1	10	8	± 5%	±10%
	47	C	ESVC1C476M	7.5	6	0.8	10	8	±12%	±12%
	47	D	ESVD1C476M	7.5	6	0.7	10	8	± 5%	±10%
	68	C	ESVC1C686M	10.8	6	0.7	16	10	±12%	±12%
	68	D	ESVD1C686M	10.8	6	0.7	10	8	± 5%	±10%
	100	D	ESVD1C107M	16	8	0.5	18	10	±12%	±12%
	0.47	A2	ESVA21D474M	0.5	6	25	10	8	± 5%	±10%
	0.68	A2	ESVA21D684M	0.5	6	15	10	8	± 5%	±10%
	1	A2	ESVA21D105M	0.5	6	12	10	8	±12%	±12%
	1.5	A2	ESVA21D155M	0.5	6	7.4	10	8	±12%	±12%
	2.2	P	ESVP1D225M	0.5	10	8	15	15	±20%	±20%
	2.2	A2	ESVA21D225M	0.5	6	7	10	8	±12%	±12%
	2.2	A	ESVA1D225M	0.5	6	6	10	8	±12%	±12%
20	3.3	A2	ESVA21D335M	0.6	8	5	14	10	±12%	±12%
	3.3	A	ESVA1D335M	0.6	6	5	10	8	±12%	±12%
	3.3	B3	ESVB31D335M	0.6	6	3.9	10	8	±15%	±15%
	4.7	A2	ESVA21D475M	0.9	15	5	30	20	±12%	±12%
	4.7	A	ESVA1D475M	0.9	6	5	10	8	±12%	±12%
	4.7	B3	ESVB31D475M	0.9	6	3	10	8	±15%	±15%
	4.7	B2	ESVB21D475M	0.9	6	3	10	8	± 5%	±10%
	6.8	B3	ESVB31D685M	1.3	6	3	10	8	±15%	±15%

Rated Voltage (V)	Capacitance (μF)	Case Code	Part Number (Bulk)	Leakage Current (μA) Max	DF (%) Max	ESR (Ω) Max	DF (%) Max -55°C	DF (%) Max +125°C	Capacitance Change at Surge Voltage at Damp Heat at Resistance to Soldering Heat	Capacitance Change at Endurance
20	6.8	B2	ESVB21D685M	1.3	6	2.8	10	8	± 5%	±10%
	10	B2	ESVB21D106M	2	6	2.5	10	8	± 5%	±10%
	15	C	ESVC1D156M	3	6	1.7	10	8	± 5%	±10%
	22	B2	ESVB21D226M	4.4	6	3	10	8	±20%	±20%
	22	C2	ESVC21D226M	4.4	6	1.4	10	8	±12%	±12%
	22	C	ESVC1D226M	4.4	6	1.4	10	8	±12%	±12%
	22	D	ESVD1D226M	4.4	6	0.8	10	8	± 5%	±10%
	33	D	ESVD1D336M	6.6	6	0.8	10	8	± 5%	±10%
	47	C	ESVC1D476M	9.4	6	1	10	8	±12%	±12%
	47	D	ESVD1D476M	9.4	6	0.7	10	8	± 5%	±10%
25	0.47	A	ESVA1E474M	0.5	4	13	8	6	± 5%	±10%
	0.68	A	ESVA1E684M	0.5	6	9	10	8	± 5%	±10%
	1	P	ESVP1E105M	0.5	6	8	10	8	±20%	±20%
	1	A2	ESVA21E105M	0.5	6	13	10	8	±12%	±12%
	1	A	ESVA1E105M	0.5	6	8	10	8	± 5%	±10%
	2.2	A	ESVA1E225M	0.5	6	7	10	8	±12%	±12%
	3.3	A	ESVA1E335M	0.8	6	7	10	8	±12%	±12%
	4.7	B3	ESVB31E475M	1.1	6	3	10	8	±15%	±15%
	4.7	B2	ESVB21E475M	1.1	6	3	10	8	± 5%	±10%
	6.8	B2	ESVB21E685M	1.7	6	2.5	10	8	± 5%	±10%
	10	C2	ESVC21E106M	2.5	6	2	10	8	±12%	±12%
	10	C	ESVC1E106M	2.5	6	1.5	10	8	± 5%	±10%
	15	C	ESVC1E156M	3.7	6	1.5	10	8	±12%	±12%
	22	D	ESVD1E226M	5.5	6	0.8	10	8	± 5%	±10%
	33	D	ESVD1E336M	8.2	6	0.7	10	8	± 5%	±10%
35	0.47	A	ESVA1V474M	0.5	6	12	10	8	± 5%	±10%
	0.68	A	ESVA1V684M	0.5	6	8	10	8	± 5%	±10%
	1	A2	ESVA21V105M	0.5	6	13	10	8	±12%	±12%
	1	A	ESVA1V105M	0.5	6	7	10	8	±12%	±12%
	1.5	A	ESVA1V155M	0.5	6	7	10	8	±12%	±12%
	2.2	A	ESVA1V225M	0.7	6	5	10	8	±12%	±12%
	2.2	B2	ESVB21V225M	0.7	6	4	10	8	± 5%	±10%
	3.3	B3	ESVB31V335M	1.1	6	3	10	8	±15%	±15%
	3.3	B2	ESVB21V335M	1.1	6	3.5	10	8	± 5%	±10%
	4.7	C	ESVC1V475M	1.6	6	2.2	10	8	± 5%	±10%
	6.8	C	ESVC1V685M	2.3	6	1.9	10	8	± 5%	±10%
	10	C	ESVC1V106M	3.5	6	1.5	10	8	± 5%	±10%
	10	D	ESVD1V106M	3.5	6	1	10	8	± 5%	±10%
	15	D	ESVD1V156M	5.2	6	0.9	10	8	± 5%	±10%

SV/Z Series

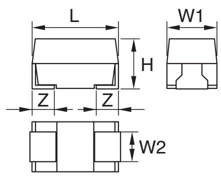
Low ESR / RoHS Compliant

■ FEATURES

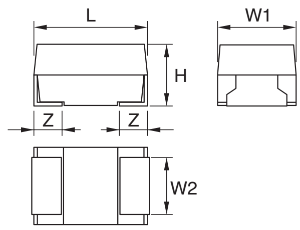
- ●Lead-free Type. RoHS Compliant.
- ●Low-ESR Type.
- ●Same Dimension as E/SV series.
- ●Halogen free, Antimony free and Red Phosphorous free resin is applied to the exterior mold resin.

■ DIMENSIONS [mm]

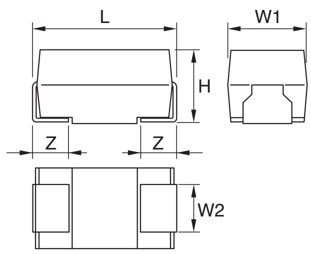
[A case]



[B2 case]



[C, V, D cases]



(Unit: mm)

Case code	EIA code	L	W1	W2	H	Z
A	3216	3.2 ± 0.2	1.6 ± 0.2	1.2 ± 0.1	1.6 ± 0.2	0.8 ± 0.2
B2	3528	3.5 ± 0.2	2.8 ± 0.2	2.2 ± 0.1	1.9 ± 0.2	0.8 ± 0.2
C2	–	6.0 ± 0.2	3.2 ± 0.2	2.2 ± 0.1	1.4 ± 0.1	1.3 ± 0.2
C	6032	6.0 ± 0.2	3.2 ± 0.2	2.2 ± 0.1	2.5 ± 0.2	1.3 ± 0.2
V	7343L	7.3 ± 0.2	4.3 ± 0.2	2.4 ± 0.1	1.9 ± 0.1	1.3 ± 0.2
D	7343	7.3 ± 0.2	4.3 ± 0.2	2.4 ± 0.1	2.8 ± 0.2	1.3 ± 0.2

⚠

- ●All specifications in this catalog and production status of products are subject to change without notice. Prior to the purchase, please contact NEC TOKIN for updated product data.
- ●Please request for a specification sheet for detailed product data prior to the purchase.
- ●Before using the product in this catalog, please read "Precautions" and other safety precautions listed in the printed version catalog.

■ STANDARD C-V VALUE REFERENCE BY CASE CODE

UR :Rated Voltage

µF \ UR		4V 0G	6.3V 0J	10V 1A	16V 1C	20V 1D	25V 1E	35V 1V
6.8	685						C 600	C 600
10	106		A 800	B2 600				D 300
15	156						D 250	D 300
22	226		B2 800				D 200	
33	336					D 200		
47	476			C , D 300 , 140	D 150	D 150		
68	686		B2 250	B2 250	C, D 200, 150			
100	107		C , D 150 , 150	C2, C, V, D 150,125,150,100	D 100			
150	157		C , D 125 , 100	V , D 150 , 100				
220	227	D 100	V , D 150 , 100	D 100				
330	337	V , D 150 , 100	V , D 100 , 100					

*Number : ESR (mΩ)

■ PART NUMBER SYSTEM

[Bulk]

SVZ D 1C 107 M

- M: Capacitance Tolerance (M: ±20%)
- 107: Capacitance (pF) (First two digits represent significant figures. Third digit specifies number of zeros to follow.)
- 1C: DC rated voltage in volts (0G: 4 V, 0J: 6.3 V, 1A: 10 V, 1C: 16 V, 1D: 20 V, 1E: 25 V, 1V: 35 V)
- D: Case code
- SVZ: SV/Z Series

[Tape and Reel]

TE SVZD1C107M 12 R

- R: Packing Orientation (R: Cathode on the Side of Sproket Hole)
- 12: Tape width (8: 8 mm (A, B2 case), 12: 12 mm (C, V, D cases))
- SVZD1C107M: Part number of Bulk
- TE: Tape and Reel (TE: 180mmϕ reel)

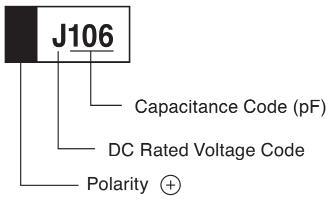
TL SVZD1C107M 12 R E

- TL: Tape and Reel (TL: 330mmϕ reel)
- E: Indicates 330mmϕ reel

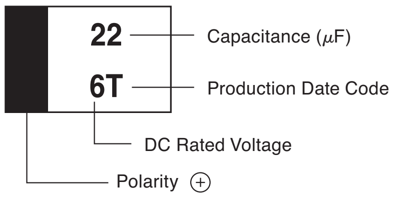
■ MARKINGS

The standard marking shows capacitance, DC rated voltage, and polarity.

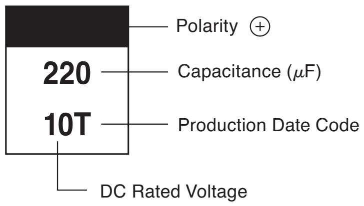
[A case] (ex. 10 μF / 6.3 V)



[B2 case] (ex. 22 μF / 6.3 V)



[C2, C, V, D case] (ex. 220 μF / 10 V)



[DC Rated Voltage code]

Code	G	J	A	C	D	E	V
Rated Voltage	4 V	6.3 V	10 V	16 V	20 V	25 V	35V

[B2, C2, C, V, D cases production date code]

Y \ M	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2011	a	b	c	d	e	f	g	h	j	k	l	m
2012	n	p	q	r	s	t	u	v	w	x	y	z
2013	A	B	C	D	E	F	G	H	J	K	L	M
2014	N	P	Q	R	S	T	U	V	W	X	Y	Z

NOTE: Production date code will resume beginning in 2015.

■ PERFORMANCE CHARACTERISTICS

Test Conditions : Conform to IEC 60384-1

ITEM	PERFORMANCE							TEST CONDITION
Operating temperature	–55°C to +125°C							Derated voltage at 85°C at more
Rated voltage (V.dc)	4V	6.3V	10V	16V	20V	25V	35V	at 85°C
Derated voltage (V.dc)	2.5V	4V	6.3V	10V	13V	16V	22V	at 125°C
Surge voltage (V.dc)	5.2V	8V	13V	20V	26V	33V	46V	at 85°C
Capacitance	6.8 μF to 330 μF							at 120 Hz
Capacitance tolerance	±20% or ±10%							
DC Leakage Current (L.C)	0.01C • V(μA) or 0.5μA , whichever is greater							Voltage: Rated voltage for 5min.
Dissipation Factor	Refer to Standard Ratings							at 120 Hz
Equivalent Series Resistance	Refer to Standard Ratings							at 100 kHz
	Capacitance change	DF(%)	L.C					
Surge voltage test	Refer to Standard Ratings	Lower than initial specification	Lower than initial specification					Temperature : 85±2°C Applied voltage : Surge voltage Series resistance : 33 ohm Duration of surge : 30±5 sec Time between surge : 5.5min. Number of cycle : 1000
Characteristic at high and low temperature –55°C	Not to exceed –12%	Refer to Standard Ratings	————					Step 1: 25±2°C Step 2: -55^{0}_{-3}°C Step 3: 25±2°C Step 4: 125^{0}_{-3}°C
+85°C	Not to exceed +12%	Lower than initial specification	0.1C • V(μA) or 5μA, which ever is greater					
+125°C	Not to exceed +15%	Refer to Standard Ratings	0.125C • V(μA) or 6.25μA, which ever is greater					
Rapid change of temperature	Refer to Standard Ratings	Lower than initial specification	Lower than initial specification					Parts shall be temperature cycled over a temperature range of –55 to +125°C, five times continuously as follow. Step 1: -55^{0}_{-3}°C, 30±3min. Step 2: room temp. , 10 to 15min. Step 3: 125^{0}_{-3}°C, 30±3min. Step 4: room temp, 10 to 15min.
Resistance to Soldering heat	Refer to Standard Ratings	Lower than initial specification	Lower than initial specification					solder dip : 260°C, 5sec solder reflow : 260°C, 10sec
Damp heat	Refer to Standard Ratings	Lower than 1.25 times initial specification	Lower than initial specification					at 40°C at 90 to 95% RH 500 hour
Endurance	Refer to Standard Ratings	Lower than initial specification	Lower than 1.25 times initial specification					at 85°C : Rated voltage at 125°C : Derated voltage 2000 hour
Failure Rate	λ_0 = 1% / 1000 hour							at 85°C : Rated voltage at 125°C : Derated voltage 2000 hour
Terminal Strength	Visual: There shall be no evidence of mechanical damage							Strength : 4.9N Time : 10±0.5sec. (two directions)
Others	Conform to IEC60384–1							Conform to IEC60384–1

Manganese dioxide type

Reference : Derated voltage (85 to 125°C)

$$[U_T] = [U_R] - \frac{[U_R] - [U_C]}{40}(T-85)$$

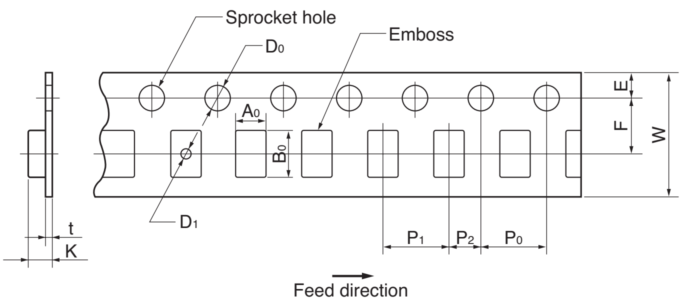
$[U_T]$: Derated voltage at operating temperature
$[U_R]$: Rated voltage
$[U_C]$: Derated voltage at 125°C
T : Operating temperature

■ STANDARD RATINGS

Rated Voltage (V)	Capacitance (μF)	Case Code	Part Number (Bulk)	Leakage Current (μA) Max	DF (%) Max	ESR (Ω) Max	DF (%) Max		Capacitance Change	
							-55°C	+125°C	at Surge Voltage at Damp Heat at Resistance to Soldering Heat	at Endurance
4	220	D	SVZD0G227M	8.8	8	0.1	18	10	± 5%	±10%
	330	V	SVZV0G337M	13.2	12	0.15	18	14	±12%	±12%
	330	D	SVZD0G337M	13.2	14	0.1	18	16	±12%	±12%
6.3	10	A	SVZA0J106M	0.6	8	0.8	12	10	±12%	±12%
	22	B2	SVZB20J226M	1.3	8	0.8	12	10	± 5%	±10%
	68	B2	SVZB20J686M	4.2	10	0.25	18	12	±12%	±12%
	100	C	SVZC0J107M	6.3	10	0.15	14	12	±12%	±12%
	100	D	SVZD0J107M	6.3	8	0.15	12	10	± 5%	±10%
	150	C	SVZC0J157M	9.4	10	0.125	18	12	±12%	±12%
	150	D	SVZD0J157M	9.4	8	0.1	18	10	± 5%	±10%
	220	V	SVZV0J227M	13.8	12	0.15	18	14	±12%	±12%
	220	D	SVZD0J227M	13.8	12	0.1	18	14	±12%	±12%
	330	V	SVZV0J337M	20.7	14	0.1	26	16	±20%	±20%
	330	D	SVZD0J337M	20.7	14	0.1	26	16	±12%	±12%
10	10	B2	SVZB21A106M	1	8	0.6	12	10	± 5%	±10%
	47	C	SVZC1A476M	4.7	8	0.3	12	10	± 5%	±10%
	47	D	SVZD1A476M	4.7	8	0.14	12	10	± 5%	±10%
	68	B2	SVZB21A686M	6.8	12	0.25	14	14	±12%	±12%
	100	C2	SVZC21A107M	10	10	0.15	18	14	±12%	±12%
	100	C	SVZC1A107M	10	10	0.125	18	12	±12%	±12%
	100	V	SVZV1A107M	10	8	0.15	18	10	±12%	±12%
	100	D	SVZD1A107M	10	8	0.1	18	10	± 5%	±10%
	150	V	SVZV1A157M	15	8	0.15	14	10	±12%	±12%
	150	D	SVZD1A157M	15	10	0.1	18	12	±12%	±12%
	220	D	SVZD1A227M	22	12	0.1	22	14	±12%	±12%
16	47	D	SVZD1C476M	7.5	6	0.15	10	8	± 5%	±10%
	68	C	SVZC1C686M	10.8	6	0.2	16	10	±12%	±12%
	68	D	SVZD1C686M	10.8	6	0.15	10	8	± 5%	±10%
	100	D	SVZD1C107M	16	8	0.1	18	10	±12%	±12%
20	33	D	SVZD1D336M	6.6	6	0.2	10	8	± 5%	±10%
	47	D	SVZD1D476M	9.4	6	0.15	10	8	± 5%	±10%
25	6.8	C	SVZC1E685M	1.7	6	0.6	10	8	± 5%	±10%
	15	D	SVZD1E156M	3.7	6	0.25	10	8	± 5%	±10%
	22	D	SVZD1E226M	5.5	6	0.2	10	8	± 5%	±10%
35	6.8	C	SVZC1V685M	2.3	6	0.6	10	8	± 5%	±10%
	10	D	SVZD1V106M	3.5	6	0.3	10	8	± 5%	±10%
	15	D	SVZD1V156M	5.2	6	0.3	10	8	± 5%	±10%

TAPE AND REEL SPECIFICATIONS

■ Plastic Tape Carrier



Unit: mm

Case Code	A0 ± 0.2	B0 ± 0.2	K ± 0.2
J	1.0	1.8	1.1
P, P2	1.4	2.2	1.4
P2 *1	1.55	2.3	1.3
A3	1.9	3.5	1.1
A2 (U)	1.9	3.5	1.4
A	1.9	3.5	1.9
B3	3.2	3.8	1.4
B15	3.25	3.8	1.7
B2 (S)	3.3	3.8	2.1
C2	3.7	6.4	1.7
C	3.7	6.4	3.0
V	4.6	7.7	2.4
D	4.8	7.7	3.3

*1: G/PS series

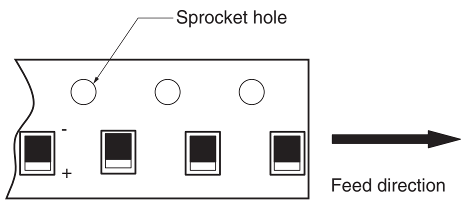
Unit: mm

<table>
<tr><th>Case Code</th><th>W ± 0.3</th><th>F ± 0.05</th><th>E ± 0.1</th><th>P^1 ± 0.1</th><th>P^2 ± 0.05</th><th>P^0 ± 0.1</th><th>$D^0 +^{0.1}_{0}$</th><th>D^1 min.</th><th>t</th></tr>
<tr><td>J</td><td rowspan="9">8</td><td rowspan="9">3.5</td><td rowspan="13">1.75</td><td rowspan="9">4</td><td rowspan="13">2</td><td rowspan="13">4</td><td rowspan="13">ϕ1.5</td><td>–</td><td rowspan="2">0.2</td></tr>
<tr><td>P, P2</td><td>–</td></tr>
<tr><td>P2 *1</td><td>–</td><td rowspan="2">0.25</td></tr>
<tr><td>A3</td><td>–</td></tr>
<tr><td>A2(U)</td><td rowspan="5">ϕ1.0</td><td rowspan="3">0.2</td></tr>
<tr><td>A</td></tr>
<tr><td>B3(W)</td></tr>
<tr><td>B15</td><td>0.25</td></tr>
<tr><td>B2(S)</td><td>0.2</td></tr>
<tr><td>C2</td><td rowspan="4">12</td><td rowspan="4">5.5</td><td rowspan="4">8</td><td rowspan="4">ϕ1.5</td><td rowspan="2">0.3</td></tr>
<tr><td>C</td></tr>
<tr><td>V</td><td>0.4</td></tr>
<tr><td>D</td><td>0.3</td></tr>
</table>

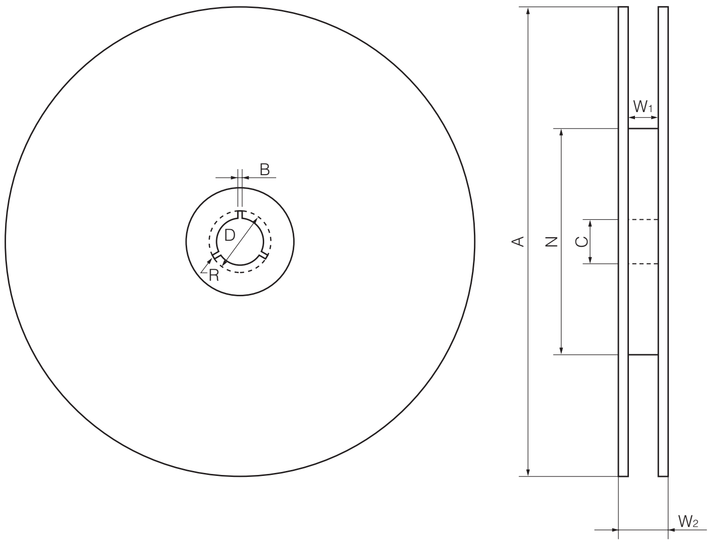
*1: G/PS series

■ Packing Orientation

ex. R:Cathode on the side of Sprocket hole



REEL



Unit: mm

Tape Width	A	N Min.	C ± 0.5	D	B ± 0.5	W1	W2 Max.	R
8 mm	$\phi\,180^{+0}_{-3}$	ϕ 50	ϕ 13	ϕ 21 ± 0.5	2	9.0 ± 1.0	11.4 ± 1.0	1
12 mm						13.0 ± 1.0	15.4 ± 1.0	
12 mm	ϕ 330±2	ϕ 80	ϕ 13	ϕ 21 ± 1.0	2	14.0 Max.	18.5 Max.	1

Case Code	ϕ 180 Reel	ϕ 330 Reel
J	4000	–
P,P2	3000	–
A3	3000	–
A2(U)	3000	–
A	2000	–
B3(W)	3000	–
B15	2500	–
B2(S)	2000	–
C2	1000	4000
V	1000	3000
C,D	500	2500

[Quantity Per Reel]

NOTES ON USING THE SOLID TANTALUM CAPACITORS

About 90% of the failure mode of the solid tantalum capacitor is short-circuit.
Please take surplus for the operating condition.

1.Circuit Design

(1) Reliability

The reliability of the solid tantalum capacitor is heavily influenced by environmental conditions such as temperature, humidity, shock, vibration, mechanical stresses, and electric stresses, including applied voltage, current, ripple current, transient current and voltage, and frequency. When using solid tantalum capacitors, therefore, provide enough margin so that the reliability of the capacitors is maintained.

Voltage and temperature are important parameters when estimating the reliability (field failure rate). The field failure rate of a solid tantalum capacitor can be calculated by the following expression if emphasis is placed only on the voltage and temperature:

$$\boxed{\lambda = \lambda_0 (V/V_0)^3 \times 2^{(T-T_0)/10}}$$

Where

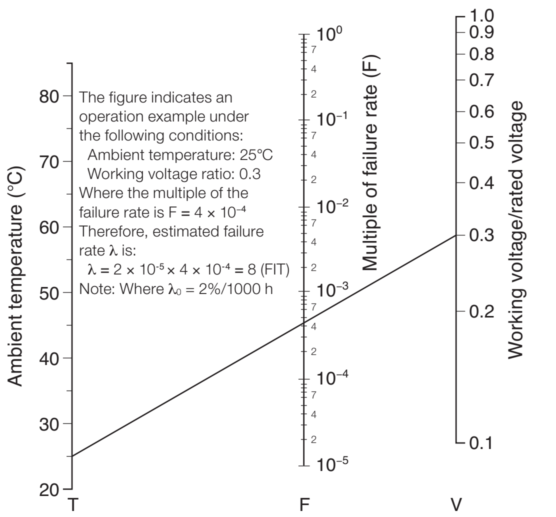
λ: estimated failure rate in actual working condition
temperature: T; voltage: V

λ_0: failure rate under rated load (See table below.)
temperature: T_0; voltage: V_0

Failure rate level λ_0 of each series

Series	Failure rate level
PS/L	1% / 1000 h
E/SV	1% / 1000 h
F/SV	1% / 1000 h
PS/G	1% / 1000 h
SV/Z	1% / 1000 h
F/PS	1% / 1000 h
G/PS	1% / 1000 h

<Test conditions>
Temperature: 85°C
Voltage: rated voltage
RS: 3Ω



This figure graphically indicates $(V/V0)^3 \times 2^{(T-T0)/10}$ in the expression $\lambda = \lambda_0 (V/V0)^3 \times 2^{(T-T0)/10}$. By using this figure, the estimated failure rate can be easily calculated.

Connect the desired temperature and voltage ratio with a straight line (from the left most vertical axis in the figure to the right most axis) in the figure. The multiple of the failure rate can be obtained at the intersection of the line drawn and the middle vertical axis in the figure.

Therefore,

$\lambda = \lambda_0 \times F$

Where

F: multiple of failure rate at given temperature and ratio of working voltage to rated voltage.

2. Ripple Current and Ripple Voltage

If ripple current is applied, heat is generated within capacitor by Joule's heat (power dissipation) and it may affect to the reliability of the capacitor.

(1) Power Dissipation
The actual power dissipated in the capacitor is calculated using the formula1.

$P = I^2 \times ESR$......Formula1

P : Power Dissipation (Watts)
I : Ripple Current (Arms)
ESR : Equivalent Series Resistance (Ω)

Dissipation Ratings

TABLE 1-1 E/SV,SV/Z,PS/L, PS/G series

Case Code	Maximum Power Dissipation Watts, 100kHz, at 25°C
J	0.010
P	0.025
A2	0.060
A	0.075
B3	0.075
B15	0.080
B2	0.085
C2	0.090
C	0.110
V	0.125
D	0.150

TABLE 1-2 F/SV,F/PS,G/PS series

Case Code	Maximum Power Dissipation Watts, 100kHz, at 25°C
J	0.010
P2	0.025
A3	0.060

(2) Ripple Current
Using P Max from TABLE1, maximum ripple current I (Arms) may be determined as follow :

$I = \sqrt{P_{Max}/ESR} \times K \times F$......Formula2

K : Temperature Derating Factor TABLE2
E/SV, F/SV, SV/Z....TABLE2-1,
P/SL, PS/G, F/PS, G/PS....TABLE2-2
F : Frequency Derating Factor......TABLE3
ESR : refer to Ratings

TABLE 2-1 E/SV, F/SV, SV/Z Series

Temp.	Temperature Derating Factor K
25°C	1
45°C	1
85°C	0.9
125°C	0.4

TABLE 2-2 P/SL, PS/G, F/PS, G/PS Series

Temp.	Temperature Derating Factor K
25°C	1
45°C	1
85°C	0.9
105°C	0.4

Ripple voltage E is calculated using the Formula3.

$E = Z \times I$......Formula3

E : Ripple voltage
Z : Impedance at specified frequency

TABLE 3 Frequency Derating Factor F

Series	10kHz	100kHz	300kHz	500kHz	1MHz
I	0.80	1.00	1.00	1.15	1.20
II	0.75	1.00	1.00	1.10	1.30

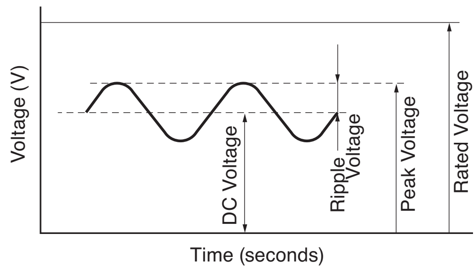
I : E/SV, F/SV, SV/Z
II : PS/L, PS/G, F/PS, G/PS

(3) Ripple Voltage
The ripple voltage which may be applied is limited by three criteria :

(a) The power dissipated in the ESR of the capacitor must not exceed the appropriate value specified in TABLE1.

(b) The sum of the DC voltage and peak value of the ripple voltage must not exceed the rated voltage.

(c) The negative peak value of the ripple voltage must not exceed the permissible reverse voltage value specified in the following section, Reverse Voltage.



3. Reverse Voltage

Tantalum capacitor has polarity. Reverse voltage applying will cause increase of leak current and reliability degradation. Please do not apply reverse voltage.

4. Unsuited circuit and application

When it is used in the circuit like as below, there are possibility to cause failure.
a. the circuit which has high sensitivity with leak current.
b. the series connection of capacitors to exceed rated voltage.
Conductive polymer tantalum capacitor (NeoCapacitor) are not suite to below circuits either.
c. High impedance circuit
d. Coupling circuit
e. Time constant circuit

5. Applied Voltage

(1) For general applications, apply 70% or less of the rated voltage to the capacitor.

(2) When the capacitor is used in a power line or a low-impedance circuit, keep the applied voltage within 30% (50% max.) of the rated voltage to avoid the adverse influence of inrush current.

(3) For conductive polymer type,NeoCapacitor,apply 80% or less of the rated voltage to the capacitor.

Recommended Ratio of Operating Voltage to Rated Voltage

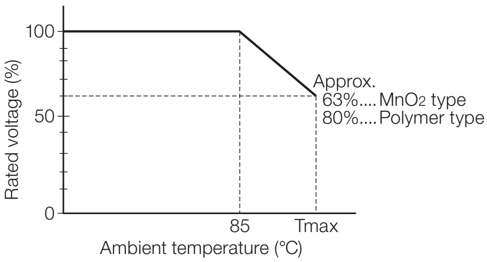
Circuit	Manganese dioxide type E/SV, F/SV, SV/Z series	Conductive polymer type (NeoCapacitor) PS/L, PS/G, F/PS, G/PS series Rated Voltage	
		2.5V, 4V, 6.3V	10V, 16V, 20V, 25V
high-impedance	70% or less	90% or less	80% or less
low-impedance	within 30% (50% max)	90% or less	80% or less

(4) Derated voltage at 85°C or more.
When using a Chip-type capacitor at a temperature of 85°C or higher, calculate reduced voltage UT from the following expression. Note, however, that the ambient temperature must not exceed the maximum operating temperature.

The rated voltage ratio is as shown in the figure on the right.

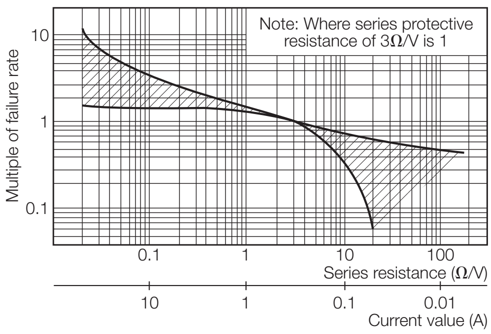
$$UT = UR - \frac{UR - UC}{Tmax - 85}(T - 85)$$

Where
UR: rated voltage (V)
UC: derated voltage at Tmax
T: operating temperature (°C)
Tmax: Maximum Operating temperature
MnO2 type E/SV, F/SV, SV/Z ....125°C
Conductive Polymer type PS/L,PS/G,F/PS,G/PS ....105°C



6. Current (Series Resistance)

As shown in the figure on the right, reliability is increased by inserting a series resistance of at least 3Ω/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.



7. In the Case of Short-Circuit

(1) Manganese oxide tantalum capacitor (conventional tantalum capacitor) is heated and may generate fire and may burn depending upon its excess current, time and other factors.

(2) Conductive polymer tantalum capacitor (NeoCapacitor) is heated and may generate smoke emission depending upon its excess current, time and other factors.

(Conductive polymer used for electrolyte of NeoCapacitor is superior in insulanting the damaged portion compare to manganese oxide (used in conventional tantalum capacitor).)

When designing the circuit, provide as much margin as possible to maintain capacitor reliability.

When above failure happen by any possibility, please shut off the power immediately. Please do not touch the failed capacitor and move your face to it carelessly to protect burn injury. When smoke get in your eyes and you shuck smoke, please wash out your eyes and gargle.

NOTES ON USING THE CHIP TANTALUM CAPACITORS, EXCLUDING NeoCapacitors

1. Mounting

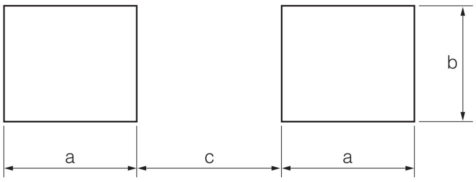
(1) Direct Soldering

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

(a) Temporarily fixing resin

Because chip tantalum capacitors are larger and subject to more force than 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



(mm)

Case	a	b	c
P	2.2	1.4	0.7
A2 (U), A	2.9	1.7	1.2
B3 (W), B2 (S)	3.0	2.8	1.6
C2, C	4.1	2.7	2.4
V, 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 within the following values:

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

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

(d) Component layout

If many types of chip components are mounted on a printed circuit board that 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).

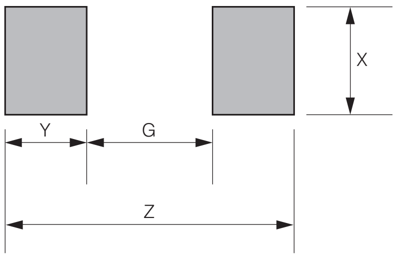
(e) Flux

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

(2) Reflow Soldering

Keep the following points in mind when soldering the capacitor in a soldering oven or with a hot plate.
The heat stress given by soldering depends on mounted position on PWB mount density, pad design and so on.
Please check resistance to soldering prior to actual using.

(a) Pattern design (in accordance with JEITA RC-2371A)



(mm)

Case	G Max.	Z Min.	X Min.	Y (reference)
J*	0.65	1.65	0.65	0.5
P2*	1.05	2.05	0.80	0.5
A3*	1.65	3.25	1.1	0.8
J	0.7	2.5	1.0	0.9
P	0.5	2.6	1.2	1.05
A2 (U), A	1.1	3.8	1.5	1.05
B3 (W), B2 (S)	1.4	4.1	2.7	1.35
C2, C	2.9	6.9	2.7	2.0
V, D	4.1	8.2	2.9	2.05

* F/SV Series only (Conform to JEITA RC-2371A)

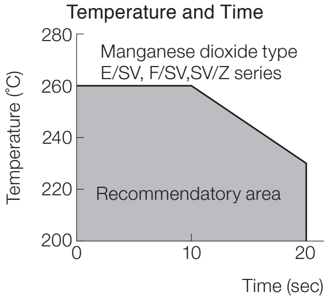
The above dimensions are recommended. Note that if the pattern is too big, the component may not be mounted in place.

(b) Temperature and time

Keep the peak temperature and time within the following values:

Solder temperature .... 260°C max.
Time .... 10 seconds max.
Number of times .... 2 times

Whenever possible, perform preheating (at 150°C max.) for a smooth temperature profile. To maintain reliability, mount the capacitor at low temperature and in a short time. 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 a 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 ....350°C max.
Time...3 seconds max.
Iron power..30 W max.

2. 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; 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 the 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 R 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.

Note. <u>Ultrasonic cleaning</u>

This cleaning method is extremely effective for eliminating dust generated by mechanical processes, but may pose problems depending on the condition. An experiment conducted by NEC TOKIN 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 metal fatigue of the capacitor terminals 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 effective. However, it is difficult to specify the 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 abnormalities occur as a result of the cleaning. For further information, consult NEC TOKIN.

3. Others

(1) Do not subject the capacitor to excessive vibration and shock.
(2) The solderability of the capacitor may be degraded by humidity. Store the capacitor at room temperature (–5 to +40°C) and humidity (40 to 60% RH).
(3) Take care that no external force is applied to tape-packaged products (if the packaging material is deformed, the capacitor may not be automatically mounted by a chip mounter).
(4) Laser beam mounting is not acceptable.
(5) Confirm polarity, nominal capacitance, rated voltage before mounting.
(6) Care impact strength of sorbing and populating with mounter.
(7) Do not use a fallen product.
(8) Do not re-use a dismounted product from board.
(9) Capacitor is composed with several organic and metal materials. Scrap the capacitor as industrial waste.

9653TCAVOL14E1109E0

NOTES ON USING NeoCapacitor

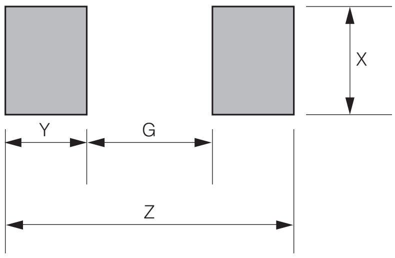
1. Mounting

This capacitor is designed to be surface mounted by means of reflow soldering.
(The conditions under which the capacitor should be soldered with a soldering iron are explained in (2) Using a Soldering Iron. Because the capacitor is not designed to be soldered by means of laser beam soldering, VPS, or flow soldering, the conditions for these soldering methods are not explained in this document.

(1) Reflow Soldering

Keep the following points in mind when soldering the capacitor in a soldering oven with a hot plate:
The heat stress given by soldering depends on mounted position on PWB mount density, pad design and so on.
Please check resistance to soldering prior to actual using.

(a) Pattern design (in accordance with JEITA RC-2371A)



(mm)

Case	G Max.	Z Min.	X Min.	Y (reference)
J	0.7	2.5	1.0	0.9
P	0.5	2.6	1.2	1.05
P2*	1.05	2.05	0.8	0.5
A3*	1.65	3.25	1.1	0.8
A2 (U), A	1.1	3.8	1.5	1.35
B3 (W), B15, B2 (S)	1.4	4.1	2.7	1.35
C2, C	2.9	6.9	2.7	2.0
V, D	4.1	8.2	2.9	2.05

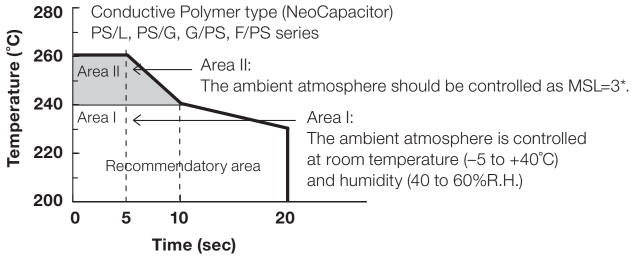
* F/PS, and G/PS Series only (Conform to JEITA RC-2371A)

The above dimensions are recommended. 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 within the following recommended conditions.

Solder temperature … 240°C max.
Time …………………… 10 seconds max.
Number of times …… 2 times



(*):Moisture Control Condition equivalent to MSL=3.

After opening the bag, store the capacitor at 30°C-60%R.H.max, and mount within 168 Hr.

When it is over 168Hr from opening bag, carry out baking before mounting under below condition.
Temperature……………50°C
Time……………………96Hr
Do not subject the Reel to excessive external stress so as not to cause strain.

In the case of moisture control condition equivalent to MSL=3.
(Refer to JEDEC J-STD-020D.01 Table 5-1 Moisture Sensitivity Levels)

Solder temperature … 260°C max.
Time …………………… 5 seconds max.
Number of times …… 2 times

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

REMARKS
Reflow condition of NeoCapacitor (PS/G, PS/L, F/PS, G/PS) is affected by moisture controlling. The peak temperature is 240 degree C under none moisture controlling, and it is 260 degree C under moisture controlling as MSL=3.

(2) Using a 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 350°C max.
Time …………… 3 seconds max.
Iron power ……… 30 W max.

2. 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, with may be used alone or 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 the 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 NeoCapacitor be cleaned under the following conditions:

[Recommended conditions of flux cleaning]

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

Note: Ultrasonic cleaning

This cleaning method is extremely effective for eliminating dust generated by mechanical processes, but may pose problems, depending on the condition. An experiment conducted by NEC TOKIN 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 metal fatigue of the capacitor terminals due to ultrasonic cleaning. To prevent the terminal from being cut, decreasing the output power of the ultrasonic cleaning machine or decreasing the cleaning time may be effective. However, it is difficult to specify 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 abnormalities occur as a result of the cleaning. For further information, contact NEC TOKIN.

3. Long term using under high temperature atmosphere

Even If NeoCapacitor is used within a rated condition, ESR and dissipation factor increase and capacitance decreases little by little due to chemical and structural change of conductive polymer used for cathode.
These characteristics change may occur within upper category temperature, rated voltage and specified mechanical strength.
In order to draw out best performance of NeoCapacitor, please pay sufficient attention to your circuit design.

4. Others

(1) Storage

a. The solderability of the capacitor may be degraded by humidity. Store the capacitor at room temperature (-5 to +40°C) and humidity (40 to 60% RH).
b. Take care that no external force is applied to tape-packaged products (if the packaging material is deformed, the capacitor may not be automatically mounted by a chip mounter).
c. In the case of long-term storage, there are possibility that increasing of leakage current is occurred. In this case we recommend to leave the capacitor applying DC rated voltage through series resistance 1 k ohm at 1 hour- 85 to 105 degree C.

(2) Using surroundings

Do not use under surroundings like as below.
a. under direct sunlight
b. attach water, salted water and oil directly
c. be subjected high humidity to cause dew condensation on the surface of product
d. be permeated with acid gas (hydrogen sulfide, sulfurous, chlorine) and alkali gas (ammonium etc.)

Do not subject the capacitor to excessive vibration and shock.

(3) Scrap

Capacitor is composed with several organic and metal materials. Scrap the capacitor as industrial waste.

— Environmental Philosophy —

In all domains of company activities, NEC TOKIN promotes activities for global environmental protection by pursuing technologies and production in consideration of environment.

— Environmental conformance of Product —

The products described in this catalog have below environmental conformance.

➢Conform to Lead free and EU RoHS directive (2002/95/EC)

Restricted substances
Cadmium and cadmium compound
Lead and lead compound
Mercury and mercury compound
Hexavalent chromium
Polybrominated biphenyl (PBBs)
Polybrominated diphenyl ether (PBDEs)

➢Halogen free, Antimony free, Red phosphorous free resin is applied to exterior moldresin.

Halogen free specification*1
Chlorine (Cl) content: less than 0.9 wt% (900 ppm)
Bromine (Br) content: less than 0.9 wt% (900 ppm)
Total content of Cl and Br: less than 1.5wt% (1500 ppm)

Antimony free specification
Antimony (Sb) content: less than 0.9wt% (900 ppm)
Antimony trioxide (Sb_2O_3): less than 0.1wt% (1000 ppm)

Red phosphorous free specification
Red phosphorous content: less than 0.1wt% (1000 ppm)

*1: except Fluorine (F), Iodine (I), Astatine (At)
*2: Please ask to our sales department for more detail information for above and the other environmental substances.

CAUTIONS

The information in this document is based on documents issued in September. 2011 at the latest.

The information is subject to change without notice. For actual design in, request shipment specification, for the latest specifications of capacitor.

The contents of this catalog is for guarantee of property and quality of product it self. Customer must check the results of evaluation after mounting in customer set and line before using capacitor.

No part of this document may be copied or reproduced in any form or by any means without the prior written consent of NEC TOKIN Corporation. NEC TOKIN Corporation assumes no responsibility for any errors which may appear in this document.

NEC TOKIN Corporation does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from use of a device described herein or any other liability arising from use of such device. No license, either express, implied, or otherwise, is granted under any patents, copyrights, or other intellectual property rights of NEC TOKIN Corporation or others.

While NEC TOKIN Corporation has been making a continuous effort to enhance the reliability of its electronic components, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC TOKIN electronic component, customers must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features. NEC TOKIN devices are classified into the following three quality grades: "Standard," "Special," and "Specific." The Specific quality grade applies only to devices developed based on a customer-designated quality assurance program for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.

Standard : Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment, and industrial robots

Special : Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment, and medical equip ment (not specifically designed for life support)

Specific : Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems, or medical equipment for life support, etc.

The quality grade of NEC TOKIN devices is "Standard" unless otherwise specified in NEC TOKIN's data sheets or data books. If customers intend to use NEC TOKIN devices for applications other than those specified for Standard quality grade, they should contact an NEC TOKIN sales representative in advance.

When the products are exported out of Japan, the export procedure thereof shall comply with Foreign Exchange and Foreign Trade Act and all applicable laws, regulations and rules of Japan.

(Note)

(1) "NEC TOKIN" as used in this statement means NEC TOKIN Corporation and also includes its majority-owned subsidiaries.

(2) "NEC TOKIN electronic component products" means any electronic component product developed or manufactured by or for NEC TOKIN (as defined above).

⚠

●All specifications in this catalog and production status of products are subject to change without notice. Prior to the purchase, please contact NEC TOKIN for updated product data.
●Please request for a specification sheet for detailed product data prior to the purchase.
●Before using the product in this catalog, please read "Precautions" and other safety precautions listed in the printed version catalog.

9653TCAVOL14E1109E0