ELNA®

Tantalum Chip Capacitors

List of Contents

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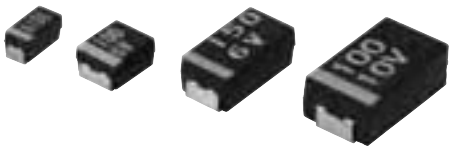
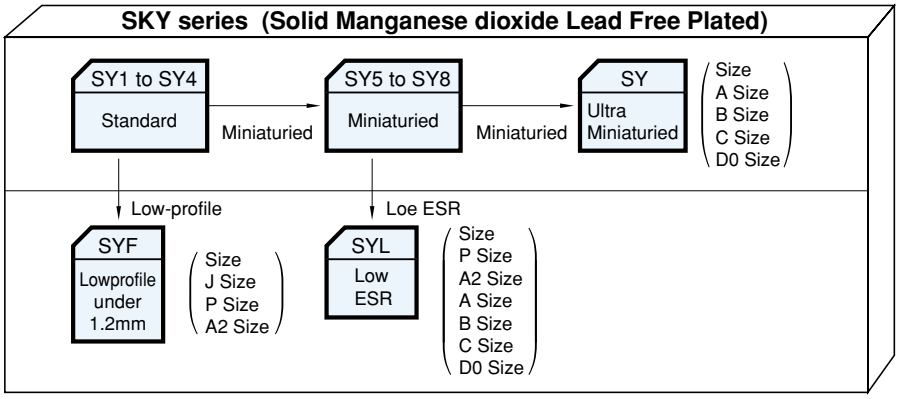
CAT.No.2007/2008E(2007.10.1)

■Type list for tantalum Electrolytic capacitors

Series name	SKY (Solid Manganese dioxide Lead-Free Plated)		
Processed style	Resin molded chip type		
Type designation	SYF	SY1 to SY9	SYL
Photograph			
Features	Lowprofile Hight:1.2mm	Standard , Miniaturied & Ultra Miniaturied	Low ESR
Applicable standard	JISC5101-3:1998(IEC60384-3:1989)		
Category temperature range(˚C)	−55 to +125˚C (Above 85˚C use category voltage)		
Rated voltage(VDC)	2.5 to 25	2.5 to 35	4 to16
Rated capacitance(μF)	0.1 to 47	0.1 to 470	1 to 330
Rated capacitance tolerance(%)	±10%, ±20% (However SY9, SYF-J only ±20%)		
Leakage current(μA)	0.01CV(5 min) or less (SK9: 0.1CV(5 min) or less)		

■Systematized classification



■ Caution for using tantalum chip capacitor. (Refer also to the TECHNICAL NOTE)

Please read product specifications before using ELNA products

■ Circuit design

1. Confirm rated performances.

Confirm the working and installation environments of the set, and use the set within the range of specified rated performances.

Since a failure rate has been provided, set your circuit according to the failure rate. The failure rate can be reduced by decreasing the working voltage, working temperature, or limiting rush current by inserting a resistance, and the like.

2. Use the set within rated voltage.

Rated voltage is defined as a maximum peak voltage (the sum of DCV and peak ACV) that can be applied to a capacitor at a maximum working temperature.

Use the set at voltages within the rated voltage. At temperatures more than 85˚C, use the set at voltages not more than the derated voltage.

It is recommended to derate working temperature as far as reliability allows.

When the set is used in a low impedance circuit, voltage should not be more than or one third of the recommended rated voltage.

3. Use the set at temperatures within the category temperature range.

At temperatures more than 85˚C, apply a voltage not more than the derated voltage. Low temperature usage is advantageous for reliability. If capacitors make self-heat generation by application of ripples or other reasons, take such a temperature rise into consideration.

4. Pay attention to an excessive momentary current.

Since the set's usage in a low-impedance circuit, such as a power circuit, is likely to raise the failure rate. Please be careful about the following matters:

(1) If the power supply side impedance looking from the capacitor side is low when voltage is applied, a momentary current will likely cause a short circuit or an increased leakage current.
Therefore, insert a resistance of 3Ω/V or higher.

(2) The use of a fully derated voltage (one third of the rated voltage or lower) is recommended to control rush current and to lower the failure rate.

5. Pay attention to ripple current.

The ripple capability of the tantalum chip capacitor is determined by heat loss of the capacitor element and the heat radiation coefficient of its package case.

When the allowable value is exceeded, the self-heat-generation of the capacitor increases to cause trouble. This must be given much attention.

The sum of the peak DCV value and ripple voltage must not exceed the rated value. Set the DCV so that the peak value does not become a reverse voltage.

6. Do not apply a reverse voltage.

Since the tantalum chip capacitor has polarity, do not apply a reverse voltage to the part. Applying voltage with reversed polarity could cause an abnormal current to damage the capacitor.

When ripple voltage is applied, control it not to exceed the allowable value.

7. Pay attention to frequency characteristics.

Capacitance and tangent of loss angle of tantalum chip capacitors are usually measured at 120Hz.

Increased frequency decreases capacitance and raises tangent of loss angle, which must be given attention in designing.

Tantalum chip capacitors are different from film and ceramic capacitors in characteristics.

Be careful when a tantalum capacitor is used as an alternative.

■ Mounting

1. In mounting, confirm the rated voltage, capacitance, and polarity before usage.
2. Don't cut off the materials of the capacitor due to the mounting space and other reasons.
3. Don't apply an excessive force to the capacitor.
4. Do not use the capacitor that has fallen once on the floor.
5. Do not remove and reuse the capacitor that has been mounted once.
6. Connect the capacitors to a tester or multimeter carefully. Avoid applying overvoltage or reverse voltage to the capacitors.

■ Caution for using tantalum chip capacitor. (Refer also to the TECHNICAL NOTE)

Please read product specifications before using ELNA products

■ Soldering

1. Be sure to observe the soldering conditions stipulated in our catalogs and specifications.

It is very important in terms of reliability that soldering is completed in the shortest possible time and under conditions where the joints will be soldered perfectly.

2. Wash products immediately after the soldering process so that the dregs of flux and the remaining acid and alkali will not be left.

3. Avoid the use of ultrasonic cleaning whenever possible.

If the use of ultrasonic cleaning is unavoidable, make a trial of the system in conditions severer than those in actual cleaning to check for any abnormality.

4. Melting point of terminal plating(Sn 100%) is 232˚C.

If the soldering of lead free at 232˚C or less, confirm the presence of abnormality enough.
(For the reflow method, soldering from the peak temperature 235˚C to 250˚C is recommended.)

■ In a emergency

1. Do not touch a capacitor directly when the set is being used, it could cause an electric shock.

Never place conductive solutions, such as acid and alkali, on the capacitor. Those solutions could cause a short circuit between circuits or in the capacitor.

2. If a strange smell or smoke is generated from a set in use, turn off the main power supply for the set immediately.

3. If a capacitor burns, combustion and decomposition gases are generated from the wold resin and the like. Therefore, do not get close to the capacitor.

■ Storage

1. Keep the products clean at room temperatures (not more than 40˚C) and relative humidities (not more than 70˚C).

Leaving them at high temperatures and humidities reduces their solderability significantly. Storage in packaged condition is recommended.

2. Keep the product out of direct sun exposure.

3. Store products in a manner that does not apply unnecessary external force.

4. Avoid storage in an area where vibration exists.

5. Fumigation treatment with toxic gas covering the whole wooden container frames as moth proofing during shipment may leave residual toxic gas.

6. Storage for a long period of time deteriorates packaging materials.

Pay attention to taping materials in particular, since they deteriorate easily.
It is recommended to use the capacitor within one year.

■ Transportation

Do not drop the products on the floor or on a table.

Since these products use solidified tantalum powder, handle the capacitors carefully because excessive vibration or shock will likely cause reliability reduction.

■ Disposal

If any capacitors need to be disposed, treat as industrial waste.

■ Other notes

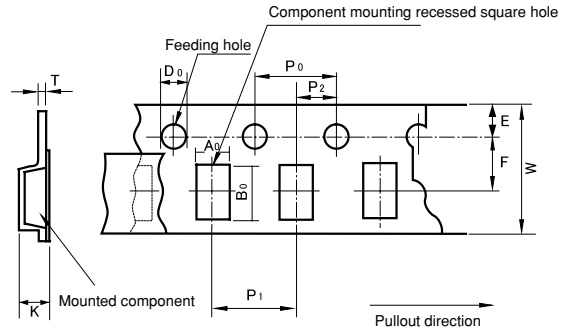
1. In addition to the above-mentioned matters, be sure to confirm the contents of the following document;

Technical report of Japan Electronics and Information Technology Industries Association, EIAJ RCR-2368B, the “Guideline of notabilia for fixed tantalum electrolytic capacitors with solid electrolyte for use in electronic equipment”

2. Please understand beforehand that the contents of our catalogs are subject to alteration for improvement without prior notice.

Data mentioned in our catalog are representative values that do not assure performances.

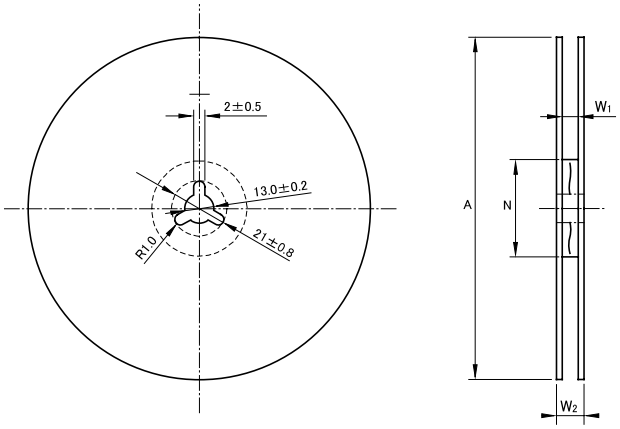
■Emboss carrier tape dimension



Unit: mm

Size code	A0±0.2	B0±0.2	K±0.2	W±0.3 Tape width	F±0.1	P1±0.1 Pitch of component	E±0.1	P2±0.1	P1±0.1 Feed hole pitch	D0 +0.1 −0 Feed hole diameter	T
J	1.0	1.8	1.1	8.0	3.5	4	1.75	2.0	4.0	1.5	0.2 ⌇ 0.3
P	1.4	2.2	1.2								
A2	1.9	3.5	1.25								
A	1.9	3.5	1.9								
B	3.1	3.8	2.1								
C	3.7	6.4	2.9	12.0	5.5	8					
D0	4.8	7.7	3.2		5.7						

■Taping reel dimension



Unit: mm

Size code	Tape width	A±2.0	N (Min.)	W2±1.0	W1±0.3
J, P, A2, A, B	8	180	60	11.4	9
C, D0	12	180	60	15.4	13

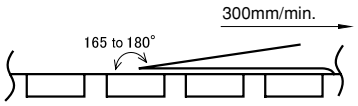
*Recycling Reels might be used for the resource conservation.

■Packaging quantity

Size code	Quantity / Reel
J	4,000 pcs.
P, A2	3,000 pcs.
A, B	2,000 pcs.
C, D0	500 pcs.

■Sealing tape reel strength

Peel angle: 165 to 180˚ referred to the surface on which the tape is glued.
Peel speed: 300mm per minute.
The peel strength must be 0.1 to 0.7N under these conditions.

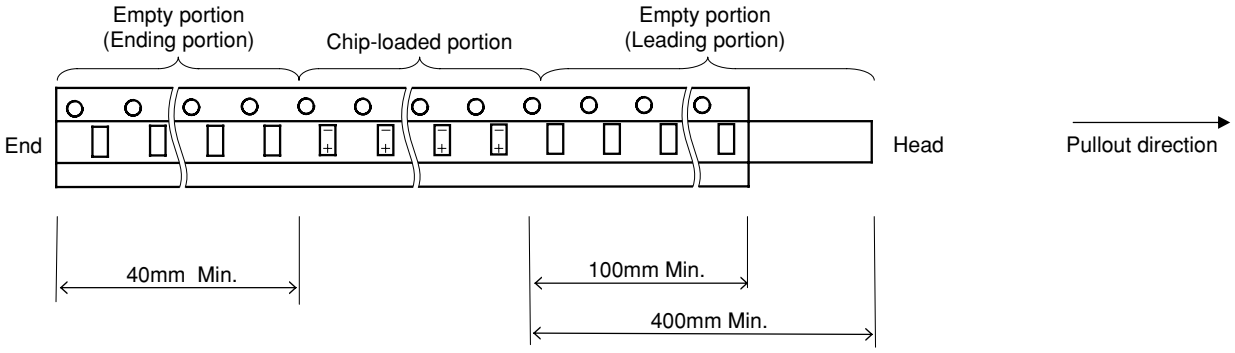


■Component insersion on reel

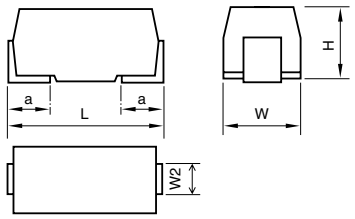
It is required that the number of empty places in the tape par reel shall not exceed 0.1% without consecutive empty places.

■Packing method

- **Polarity: Anode on the opposite side of the feed hole. (for the polarity code R only.) The bottom of lead is toward the emboss pocket. upper marking side is faced to the top cover tape.**
- **The leader length of the tape shall not be less than 400mm including 10mm or more embossed sections in which no parts are contained.**
- **The winding core is provided with an over 40mm long empty section.**



Outside dimensions



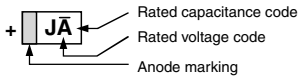
EIA code	Size code	L±0.1	W±0.1	H±0.1	W2±0.1	a±0.15
1608	J	1.6	0.8	0.8	0.6	0.3

EIA code	Size code	L±0.2	W±0.2	H±0.2	W2±0.2	a±0.3
2012	P	2.0	1.25	1.2 (max.)	0.9	0.5
3216L	A2	3.2	1.6	1.2 (max.)	1.2	0.8
3216	A	3.2	1.6	1.6	1.2	0.8
3528	B	3.4	2.8	1.9	2.2	0.8
6032	C	6.0	3.2	2.5	2.2	1.3
7343	D0	7.3	4.3	2.8	2.4	1.3

Printed markings

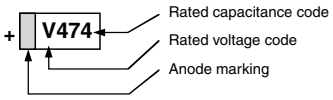
SYF. SKY. SYLSeries

J. P size



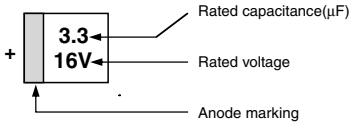
Ex.6.3V 10µF

A. A2 size



Ex.35V 0.47µF

B.C.D0 size



Ex.16V 3.3µF

Rated voltage 2.5V is marked "2V".
Rated voltage 6.3V is marked "6V".

Rated voltage code

Rated voltage(V)	2.5	4	6.3	10	16	20	25	35
Rated voltage code	e	G	J	A	C	D	E	V

●List of capacitance marking
(J, P, A2, A size)

Series name	Rated capacitance code		
	SYF		SYF/SKY
Rated capacitance (µF)	J Size	P Size	A2, A Size
0.1	A	A	104
0.15	E	E	154
0.22	J	J	224
0.33	N	N	334
0.47	S	S	474
0.68	W	W	684
1	A	A	105
1.5	E	E	155
2.2	J	J	225
3.3	N	N	335
4.7	S	S	475
6.8	W	W	685

Series name	Rated capacitance code		
	SYF		SYF/SKY
Rated capacitance (µF)	J Size	P Size	A2, A Size
10	A	$\overline{A}$	106
15	E	$\overline{E}$	156
22	J	$\overline{J}$	226
33	–	–	336
47	–	–	476
68	–	–	686
100	–	–	107

Part No. system

Example: Type SY6: 16V. 10µF: A size

S Y 6 – 1 C | 1 0 6 M □ □ – R A □

Type code

Rated voltage code

Rated voltage (V)	0E	0G	0J	1A	1C	1D	1E	1V
Rated voltage code	2.5	4	6.3	10	16	20	25	35

Rated capacitance code

The 1st and 2nd numeric characters denote significant figures, and the 3rd numeric character the number of zero's placed after the significant figures denoting capacitance in pF. (Exponential of ten)

Example

Rated capacitance	Rated capacitance code
47x10⁴pF=0.47µF	474
10x10⁵pF=1.0µF	105
22x10⁵pF=2.2µF	225

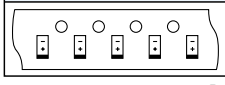
Capacitance tolerance

Rated capacitance tolerance code	Rated capacitance tolerance
K	±10%
M	±20%

Additional code

Not entered for a standard type

Taping polarity code (R only)

Polarity	Taping polarity code
	R

Pullout direction

Size code

J,P,A2,A,B,C,D0

Lowprofile Hight type capacitors — Lowprofile Hight:1.2mm Max.

GREEN CAP SMD

Specifications

Item		Performance
Category temperature range (˚C)		−55 to +125 (Above 85˚C use category voltage)
Leakage current (μA)		Refer to standard ratings table
Tolerance at rated capacitance (%)		±10% (Except J size), ±20% (120Hz)
Tangent of loss angle		Refer to standard ratings table (120Hz)
ESR		Refer to standard ratings table (100kHz)
Resistance to soldering heat		Test conditions: Soaking at 260˚C for 5 seconds Leakage current: J Size: The initial specified value or less; P,A2 Size: The initial specified value or less Percentage of capacitance change: J Size: Within ±20% of initial value; P,A2 Size: Within ±10% of initial value Tangent of loss angle: J Size: 150% or less of the initial specified value; P,A2 Size: 150% or less of the initial specified value
Characteristics at high and low temperature	−55˚C	Percentage of capacitance change: J Size: Within −20 to 0% of the initial value; P,A2 Size: Within −10 to 0% of the initial value Tangent of loss angle: J Size: Refer to standard rating table; P,A2 Size: Refer to standard rating table
	+85˚C	Leakage current: J Size: 1000% or less of the initial specified value; P,A2 Size: 1000% or less of the initial specified value Percentage of capacitance change: J Size: Within 0 to 15% of the initial value; P,A2 Size: Within 0 to 10% of the initial value Tangent of loss angle: J Size: Refer to standard rating table; P,A2 Size: Refer to standard rating table
	+125˚C	Leakage current data have been measured at derated voltage* Leakage current: J Size: 1250% or less of the initial specified value; P,A2 Size: 1250% or less of the initial specified value Percentage of capacitance change: J Size: Within 0 to 20% of the initial value; P,A2 Size: Within 0 to 12% of the initial value Tangent of loss angle: J Size: Refer to standard rating table; P,A2 Size: Refer to standard rating table
Damp heat, steady state (Humidity)		Test conditions: Left at 40˚C under 90 to 95% RH for 500 hours Leakage current: J Size: The initial specified value or less; P,A2 Size: The initial specified value or less Percentage of capacitance change: J Size: Within ±20% of initial value; P,A2 Size: Within ±10% of initial value Tangent of loss angle: J Size: 200% or less of the initial specified value; P,A2 Size: 150% or less of the initial specified value
Endurance (Load life)		Test conditions: Rated voltage applied at 85˚C for 2000 hours; Leakage current: J Size: The initial specified value or less; P,A2 Size: The initial specified value or less Percentage of capacitance change: J Size: Within ±20% of the initial value; P,A2 Size: Within ±10% of the initial value Tangent of loss angle: J Size: 200% or less of the initial specified value; P,A2 Size: 150% or less of the initial specified value
Failure rate		Less than 1% / 1000 hour (Refer to TECHNICAL NOTE)
Others		Conforms to IEC 60384-3 : 1989 (JIS C5101-3 : 1998)

* Relation between the rated and the 125˚C category voltage.

Rated voltage(V)	2.5	4	6.3	10	16	20	25
105˚C category voltage(V)	1.6	2.5	4	6.3	10	13	16

Dimension table

Rated capacitance (μF)	Rated capacitance code	2.5V e	4V G	6.3V J	10V A	16V C	20V D	25V E
0.1	104						A2	
0.15	154						A2	
0.22	224						A2	
0.33	334					P	A2	
0.47	474					P	A2	A2
0.68	684				P	P	A2	A2
1	105				P A2	J P	A2	A2
1.5	155			P A2	J P A2	P	A2	
2.2	225		A2	J P A2	J P A2	P A2	A2	
3.3	335		P A2	J P A2	J P A2	A2		
4.7	475	J A2	J P A2	J P A2	J P A2	A2		
6.8	685	J A2	J P A2	J P A2	P A2			
10	106	J A2	J P A2	J P A2	P A2			
15	156	A2	P A2	P A2	A2			
22	226	A2	P A2	A2				
33	336	P A2	A2	A2				
47	476	A2	A2					
68	686							

NOTE
Design, Specifications are subject to change without notice.
Ask factory for technical specifications before purchase and/or use.

Lowprofile Hight type capacitors — Lowprofile Hight:1.2mm Max.

Standard ratings

Rated voltage (V)	Rated capacitance (μF) (120Hz)	Marking	EIA size code	ELNA size code	Leakage current (μA, or less)	Tangent of the loss angle (less)(120Hz) −55°C	20°C	85°C	125°C	E.S.R. (Ω) (100kHz)	ELNA Part No.	Taping minimum packing pcs. (pcs/reel)	Note
2.5	4.7	eS	1608	J	0.50	0.30	0.20	0.25	0.30	10.0	SYF-0E475M-RJ	4,000	
	4.7	e475	3216L	A2	0.50	0.12	0.08	0.10	0.12	8.0	SYF-0E475M-RA2	3,000	*
	6.8	eW	1608	J	0.50	0.30	0.20	0.25	0.30	10.0	SYF-0E685M-RJ	4,000	
	6.8	e685	3216L	A2	0.50	0.12	0.08	0.10	0.12	8.0	SYF-0E685M-RA2	3,000	*
	10	eA	1608	J	0.50	0.30	0.20	0.25	0.30	10.0	SYF-0E106M-RJ	4,000	
	10	e106	3216L	A2	0.50	0.12	0.08	0.10	0.12	4.0	SYF-0E106M-RA2	3,000	*
	15	e156	3216L	A2	0.50	0.18	0.12	0.16	0.18	4.0	SYF-0E156M-RA2	3,000	*
	22	e226	3216L	A2	0.55	0.18	0.12	0.16	0.18	4.0	SYF-0E226M-RA2	3,000	*
	33	eN	2012	P	0.82	0.12	0.08	0.10	0.12	4.0	SYF-0E336M-RP	3,000	
	33	e336	3216L	A2	0.82	0.18	0.12	0.16	0.18	4.0	SYF-0E336M-RA2	3,000	
	47	e476	3216L	A2	1.17	0.18	0.12	0.16	0.18	4.0	SYF-0E476M-RA2	3,000	
4	2.2	G225	3216L	A2	0.50	0.12	0.08	0.10	0.12	8.0	SYF-0G225M-RA2	3,000	*
	3.3	GN	2012	P	0.50	0.12	0.08	0.10	0.12	10.0	SYF-0G335M-RP	3,000	*
	3.3	G335	3216L	A2	0.50	0.12	0.08	0.10	0.12	8.0	SYF-0G335M-RA2	3,000	*
	4.7	GS	1608	J	0.50	0.30	0.20	0.25	0.30	10.0	SYF00G475M-RJ	4,000	
	4.7	GS	2012	P	0.50	0.12	0.08	0.10	0.12	5.5	SYF-0G475M-RP	3,000	*
	4.7	G475	3216L	A2	0.50	0.12	0.08	0.10	0.12	5.0	SYF-0G475M-RA2	3,000	*
	6.8	GW	1608	J	0.50	0.30	0.20	0.25	0.30	10.0	SYF-0G685M-RJ	4,000	
	6.8	GW	2012	P	0.50	0.12	0.08	0.10	0.12	5.5	SYF-0G685M-RP	3,000	*
	6.8	G685	3216L	A2	0.50	0.12	0.08	0.10	0.12	4.0	SYF-0G685M-RA2	3,000	*
	10	GA	1608	J	0.50	0.30	0.20	0.25	0.30	10.0	SYF-0G106M-RJ	4,000	
	10	GA	2012	P	0.50	0.15	0.10	0.12	0.15	5.5	SYF-0G106M-RP	3,000	
	10	G106	3216L	A2	0.50	0.15	0.10	0.13	0.15	4.0	SYF-0G106M-RA2	3,000	
	15	GE	2012	P	0.60	0.15	0.10	0.12	0.15	4.5	SYF-0G156M-RP	3,000	
	15	G156	3216L	A2	0.60	0.15	0.10	0.13	0.15	4.0	SYF-0G156M-RA2	3,000	
	22	GJ	2012	P	0.88	0.15	0.10	0.12	0.15	4.5	SYF-0G226M-RP	3,000	
	22	G226	3216L	A2	0.88	0.18	0.12	0.16	0.18	2.8	SYF-0G226M-RA2	3,000	
	33	G336	3216L	A2	1.32	0.18	0.12	0.16	0.18	2.8	SYF-0G336M-RA2	3,000	
	47	G476	3216L	A2	1.88	0.24	0.16	0.19	0.24	2.8	SYF-0G476M-RA2	3,000	
6.3	1.5	JE	2012	P	0.50	0.12	0.08	0.10	0.12	10.0	SYF-0J155M-RP	3,000	
	1.5	J155	3216L	A2	0.50	0.12	0.08	0.10	0.12	8.0	SYF-0J155M-RA2	3,000	
	2.2	JJ	1608	J	0.50	0.30	0.20	0.25	0.30	10.0	SYF-0J225M-RJ	4,000	
	2.2	JJ	2012	P	0.50	0.12	0.08	0.10	0.12	10.0	SYF-0J225M-RP	3,000	
	2.2	J225	3216L	A2	0.50	0.12	0.08	0.10	0.12	8.0	SYF-0J225M-RA2	3,000	
	3.3	JN	1608	J	0.50	0.30	0.20	0.25	0.30	10.0	SYF-0J335M-RJ	4,000	
	3.3	JN	2012	P	0.50	0.12	0.08	0.10	0.12	10.0	SYF-0J335M-RP	3,000	
	3.3	J335	3216L	A2	0.50	0.12	0.08	0.10	0.12	8.0	SYF-0J335M-RA2	3,000	
	4.7	JS	1608	J	0.50	0.30	0.20	0.25	0.30	8.5	SYF-0J475M-RJ	4,000	
	4.7	JS	2012	P	0.50	0.12	0.08	0.10	0.12	6.0	SYF-0J475M-RP	3,000	
	4.7	J475	3216L	A2	0.50	0.12	0.08	0.10	0.12	4.0	SYF-0J475M-RA2	3,000	
	6.8	JW	1608	J	0.50	0.30	0.20	0.25	0.30	8.0	SYF-0J685M-RJ	4,000	
	6.8	JW	2012	P	0.50	0.12	0.08	0.10	0.12	6.0	SYF-0J685M-RP	3,000	
	6.8	J685	3216L	A2	0.50	0.15	0.10	0.13	0.15	4.0	SYF-0J685M-RA2	3,000	
	10	JA	1608	J	6.30	0.30	0.20	0.25	0.30	8.0	SYF-0J106M-RJ	4,000	
	10	JA	2012	P	0.63	0.15	0.10	0.12	0.15	6.0	SYF-0J106M-RP	3,000	
	10	J106	3216L	A2	0.63	0.12	0.08	0.10	0.12	4.0	SYF-0J106M-RA2	3,000	
	15	JE	2012	P	0.94	0.24	0.16	0.19	0.24	5.0	SYF-0J156M-RP	3,000	
	15	J156	3216L	A2	0.94	0.18	0.12	0.16	0.18	4.0	SYF-0J156M-RA2	3,000	
	22	J226	3216L	A2	1.38	0.21	0.14	0.18	0.21	2.8	SYF-0J226M-RP	3,000	
	33	J336	3216L	A2	2.07	0.24	0.16	0.19	0.24	2.8	SYF-0J336M-RA2	3,000	

The asterisk in the Note row indicates the reduced frequency of manufacture due to miniaturization, etc.
For new design, it is recommended to choose a smaller product with a higher voltage and same capacity.

Lowprofile Hight type capacitors

Lowprofile Hight:1.2mm Max.

Standard ratings

Rated voltage (V)	Rated capacitance (μF) (120Hz)	Marking	EIA size code	ELNA size code	Leakage current (μA, or less)	Tangent of the loss angle (less)(120Hz) –55°C	20°C	85°C	125°C	E.S.R. (Ω) (100kHz)	ELNA Part No.	Taping minimum packing pcs. (pcs/reel)	Note
10	0.68	AW	2012	P	0.50	0.12	0.08	0.10	0.12	28.0	SYF-1A684M-RP	3,000	
	1	AA	2012	P	0.50	0.12	0.08	0.10	0.12	10.0	SYF-1A105M-RP	3,000	
	1	A105	3216L	A2	0.50	0.09	0.06	0.08	0.09	8.0	SYF-1A105M-RA2	3,000	
	1.5	AE	1608	J	0.50	0.30	0.20	0.25	0.30	10.0	SYF-1A155M-RJ	4,000	
	1.5	AE	2012	P	0.50	0.12	0.08	0.10	0.12	10.0	SYF-1A155M-RP	3,000	
	1.5	A155	3216L	A2	0.50	0.12	0.08	0.10	0.12	8.0	SYF-1A155M-RA2	3,000	
	2.2	AJ	1608	J	0.50	0.30	0.20	0.25	0.30	13.0	SYF-1A225M-RJ	4,000	
	2.2	AJ	2012	P	0.50	0.12	0.08	0.10	0.12	10.0	SYF-1A225M-RP	3,000	
	2.2	A225	3216L	A2	0.50	0.12	0.08	0.10	0.12	8.0	SYF-1A225M-RA2	3,000	
	3.3	AN	1608	J	0.50	0.30	0.20	0.25	0.30	10.0	SYF-1A335M-RJ	4,000	
	3.3	AN	2012	P	0.50	0.12	0.08	0.10	0.12	10.0	SYF-1A335M-RP	3,000	
	3.3	A335	3216L	A2	0.50	0.12	0.08	0.10	0.12	8.0	SYF-1A335M-RA2	3,000	
	4.7	AS	1608	J	4.70	0.30	0.20	0.25	0.30	10.0	SYF-1A475M-RJ	4,000	
	4.7	AS	2012	P	0.50	0.12	0.08	0.10	0.12	6.0	SYF-1A475M-RP	3,000	
	4.7	A475	3216L	A2	0.50	0.12	0.08	0.10	0.12	4.0	SYF-1A475M-RA2	3,000	
	6.8	AW	2012	P	0.68	0.15	0.10	0.13	0.15	6.0	SYF-1A685M-RP	3,000	
	6.8	A685	3216L	A2	0.68	0.12	0.08	0.10	0.12	4.0	SYF-1A685M-RA2	3,000	
	10	AA	2012	P	1.00	0.21	0.14	0.18	0.21	6.0	SYF-1A106M-RP	3,000	
	10	A106	3216L	A2	1.00	0.12	0.08	0.10	0.12	4.0	SYF-1A106M-RA2	3,000	
	15	A156	3216L	A2	1.50	0.24	0.12	0.15	0.25	4.0	SYF-1A156M-RA2	3,000	
16	0.33	CN	2012	P	0.50	0.09	0.06	0.07	0.09	28.0	SYF-1C334M-RP	3,000	
	0.47	CS	2012	P	0.50	0.09	0.06	0.07	0.09	28.0	SYF-1C474M-RP	3,000	
	0.68	CW	2012	P	0.50	0.09	0.06	0.07	0.09	28.0	SYF-1C684M-RP	3,000	
	1	CA	1608	J	0.50	0.30	0.20	0.25	0.30	10.0	SYF-1C105M-RJ	4,000	
	1	CA	2012	P	0.50	0.09	0.06	0.07	0.09	25.0	SYF-1C105M-RP	3,000	
	1.5	CE	2012	P	0.50	0.12	0.08	0.10	0.12	20.0	SYF-1C155M-RP	3,000	
	2.2	CJ	2012	P	0.50	0.12	0.08	0.10	0.12	20.0	SYF-1C225M-RP	3,000	
	2.2	C225	3216L	A2	0.50	0.09	0.06	0.08	0.09	8.0	SYF-1C225M-RA2	3,000	
	3.3	C335	3216L	A2	0.50	0.09	0.06	0.08	0.09	6.0	SYF-1C335M-RA2	3,000	
	4.7	C475	3216L	A2	0.75	0.09	0.06	0.08	0.09	6.0	SYF-1C475M-RA2	3,000	
20	0.1	D104	3216L	A2	0.50	0.09	0.06	0.08	0.09	28.0	SYF-1D104M-RA2	3,000	
	0.15	D154	3216L	A2	0.50	0.09	0.06	0.08	0.09	25.0	SYF-1D154M-RA2	3,000	
	0.22	D224	3216L	A2	0.50	0.09	0.06	0.08	0.09	23.0	SYF-1D224M-RA2	3,000	
	0.33	D334	3216L	A2	0.50	0.09	0.06	0.08	0.09	20.0	SYF-1D334M-RA2	3,000	
	0.47	D474	3216L	A2	0.50	0.09	0.06	0.08	0.09	15.0	SYF-1D474M-RA2	3,000	
	0.68	D684	3216L	A2	0.50	0.09	0.06	0.08	0.09	14.0	SYF-1D684M-RA2	3,000	
	1	D105	3216L	A2	0.50	0.09	0.06	0.08	0.09	10.0	SYF-1D105M-RA2	3,000	
	1.5	D155	3216L	A2	0.50	0.09	0.06	0.08	0.09	9.0	SYF-1D155M-RA2	3,000	
	2.2	D225	3216L	A2	0.50	0.09	0.06	0.08	0.09	7.0	SYF-1D225M-RA2	3,000	
25	0.47	E474	3216L	A2	0.50	0.09	0.06	0.08	0.09	15.0	SYF-1E474M-RA2	3,000	
	0.68	E684	3216L	A2	0.50	0.09	0.06	0.08	0.09	14.0	SYF-1E684M-RA2	3,000	
	1	E105	3216L	A2	0.50	0.09	0.06	0.08	0.09	13.0	SYF-1E105M-RA2	3,000	

Resin mold chip type capacitors Standard Type

GREEN CAP SMD

Specifications

Item		Performance		
Category temperature range (˚C)		−55 to +125 (Above 85˚C use category voltage)		
Leakage current (μA)		Refer to standard ratings table		
Tolerance at rated capacitance (%)		±10%(Except SY9) , ±20%		(120Hz)
Tangent of loss angle		Refer to standard ratings table		(120Hz)
ESR		Refer to standard ratings table		(100kHz)
Resistance to soldering heat		Test conditions: Soaking at 260˚C for 5 seconds		
			SY5,SY6,SY7,SY8,SY9,SYL	SY1,SY2,SY3,SY4
		Leakage current	The initial specified value or less	The initial specified value or less
		Percentage of capacitance change	Within ±10% of initial value	Within ±5% of initial value
		Tangent of loss angle	150% or less of the initial specified value	The initial specified value or less
Characteristics at high and low temperature	−55˚C			
		Percentage of capacitance change	Within −10 to 0% of the initial value	Within −10 to 0% of the initial value
		Tangent of loss angle	Refer to standard rating table	Refer to standard rating table
	+85˚C			
		Leakage current	1000% or less of the initial specified value	1000% or less of the initial specified value
		Percentage of capacitance change	Within 0 to 10% of the initial value	Within 0 to 10% of the initial value
		Tangent of loss angle	Refer to standard rating table	Refer to standard rating table
	+125˚C	Leakage current data have been measured at derated voltage*		
		Leakage current	1250% or less of the initial specified value	1250% or less of the initial specified value
		Percentage of capacitance change	Within 0 to 12% of the initial value	Within 0 to 12% of the initial value
		Tangent of loss angle	Refer to standard rating table	Refer to standard rating table
Damp heat, steady state (Humidity)		Test conditions: Left at 40˚C under 90 to 95% RH for 500 hours		
		Leakage current	The initial specified value or less	The initial specified value or less
		Percentage of capacitance change	Within ±10% of initial value	Within ±5% of initial value
		Tangent of loss angle	150% or less of the initial specified value	The initial specified value or less
Endurance (Load life)		Test conditions: Rated voltage applied at 85˚C for 2000 hours;		
		Leakage current	The initial specified value or less	The initial specified value or less
		Percentage of capacitance change	Within ±10% of initial value	Within ±10% of initial value
		Tangent of loss angle	150% or less of the initial specified value	The initial specified value or less
Failure rate		Less than 1% / 1000 hour (Refer to TECHNICAL NOTE)		
Others		Conforms to IEC 60384-3 : 1989 (JIS C5101-3 : 1998)		

* Relation between the rated and the 125˚C category voltage.

Rated voltage(V)	2.5	4	6.3	10	16	20	25	35
105˚C category voltage(V)	1.6	2.5	4	6.3	10	13	16	22

SKY Type Dimension table

Rated capacitance (μF)	Rated capacitance code	2.5V e	4V G	6.3V J	10V A	16V C	20V D	25V E	35V V
0.1	104								A
0.15	154								A
0.22	224								A
0.33	334								A
0.47	474							A	A B
0.68	684						A	A	A B
1	105					A	A	A	A B
1.5	155				A	A	A	A B	A B C
2.2	225			A	A	A	A B	A B	B C
3.3	335		A	A	A	A B	A B	B	B C
4.7	475		A	A	A B	A B	A B	B C	C D0
6.8	685		A	A B	A B	A B	A B C	B C	C D0
10	106		A B	A B	A B	A B C	B C	C D0	C D0
15	156	A	A B	A B	A B C	B C	C D0	C D0	D0
22	226	A	A B	A B C	A B C	B C D0	C D0	D0	D0
33	336	A	A B C	A B C	B C D0	C D0	D0	D0	
47	476	A	A B C	A B C D0	B C D0	C D0	D0		
68	686	A B	A B C D0	B C D0	C D0	D0			
100	107	A B	B C D0	B C D0	C D0	D0			
150	157	B	B C D0	C D0	D0				
220	227	B	B C D0	D0	D0				
330	337		D0	D0					
470	477		D0						
680	687								

NOTE
Design, Specifications are subject to change without notice.
Ask factory for technical specifications before purchase and/or use.

Resin mold chip type capacitors Standard Type

Standard ratings

Rated voltage (V)	Rated capacitance (μF) (120Hz)	Marking	EIA size code	ELNA size code	Leakage current (μA, or less)	Tangent of the loss angle (less)(120Hz)				E.S.R. (Ω) (100kHz)	ELNA Part No.	Taping minimum packing pcs. (pcs/reel)	Note
						–55°C	20°C	85°C	125°C				
2.5	15	e156	3216	A	0.50	0.09	0.06	0.08	0.09	4.0	SY3-0E156M-RA	2,000	*
	22	e226	3216	A	0.55	0.12	0.08	0.10	0.12	2.8	SY4-0E226M-RA	2,000	*
	33	e336	3216	A	0.82	0.18	0.08	0.10	0.12	2.5	SY5-0E336M-RA	2,000	
	47	e476	3216	A	1.17	0.18	0.12	0.16	0.18	2.5	SY6-0E476M-RA	2,000	
	68	e686	3216	A	1.70	0.27	0.18	0.23	0.27	2.0	SY7-0E686M-RA	2,000	
	68	---	3528	B	1.70	0.12	0.08	0.10	0.12	1.5	SY5-0E686M-RB	2,000	*
	100	e107	3216	A	2.50	0.27	0.18	0.23	0.27	2.0	SY8-0E107M-RA	2,000	
	100	---	3528	B	2.50	0.12	0.08	0.10	0.12	1.0	SY6-0E107M-RB	2,000	
	150	---	3528	B	3.75	0.18	0.12	0.16	0.18	1.0	SY7-0E157M-RB	2,000	
	220	---	3528	B	5.50	0.27	0.18	0.23	0.27	1.0	SY8-0E157M-RB	2,000	
4	3.3	G335	3216	A	0.50	0.09	0.06	0.07	0.09	8.0	SY1-0G335M-RA	2,000	*
	4.7	G475	3216	A	0.50	0.12	0.08	0.10	0.12	4.0	SY2-0G475M-RA	2,000	
	6.8	G685	3216	A	0.50	0.12	0.08	0.10	0.12	4.0	SY2-0G685M-RA	2,000	
	10	G106	3216	A	0.50	0.12	0.08	0.10	0.12	4.0	SY3-0G106M-RA	2,000	
	10	---	3528	B	0.50	0.09	0.06	0.07	0.09	2.5	SY1-0G106M-RB	2,000	*
	15	G156	3216	A	0.60	0.12	0.08	0.10	0.12	3.0	SY4-0G156M-RA	2,000	
	15	---	3528	B	0.60	0.12	0.08	0.10	0.12	3.5	SY2-0G156M-RB	2,000	*
	22	G226	3216	A	0.88	0.12	0.08	0.10	0.12	2.5	SY5-0G226M-RA	2,000	
	22	---	3528	B	0.88	0.09	0.06	0.08	0.09	1.5	SY3-0G226M-RB	2,000	
	33	G336	3216	A	1.32	0.15	0.10	0.12	0.15	2.5	SY6-0G336M-RA	2,000	
	33	---	3528	B	1.32	0.12	0.08	0.10	0.12	1.5	SY4-0G336M-RB	2,000	
	33	---	6032	C	1.32	0.09	0.06	0.07	0.09	2.2	SY1-0G336M-RC	500	*
	47	G476	3216	A	1.88	0.15	0.10	0.13	0.15	2.5	SY7-0G476M-RA	2,000	
	47	---	3528	B	1.88	0.12	0.08	0.10	0.12	1.5	SY5-0G476M-RB	2,000	
	47	---	6032	C	1.88	0.12	0.06	0.08	0.12	1.0	SY2-0G476M-RC	500	
	68	G686	3216	A	2.72	0.24	0.16	0.19	0.24	2.5	SY8-0G686M-RA	2,000	
	68	---	3528	B	2.72	0.12	0.08	0.10	0.12	1.5	SY6-0G686M-RB	2,000	
	68	---	6032	C	2.72	0.09	0.06	0.08	0.09	1.0	SY3-0G686M-RC	500	
	68	---	7343	D0	2.72	0.09	0.06	0.07	0.09	0.7	SY1-0G686M-RD0	500	
	100	---	3528	B	4.00	0.15	0.10	0.13	0.15	1.0	SY7-0G107M-RB	2,000	
	100	---	6032	C	4.00	0.12	0.08	0.10	0.12	0.8	SY4-0G107M-RC	500	
	100	---	7343	D0	4.00	0.12	0.08	0.10	0.12	0.8	SY2-0G107M-RD0	500	*
	150	---	3528	B	6.00	0.24	0.16	0.19	0.24	1.0	SY8-0G157M-RB	2,000	
	150	---	6032	C	6.00	0.15	0.10	0.13	0.15	0.8	SY5-0G157M-RC	500	
	150	---	7343	D0	6.00	0.12	0.08	0.10	0.12	0.8	SY3-0G157M-RD0	500	
	220	---	3528	B	88.00	0.27	0.18	0.23	0.27	1.0	SY9-0G227M-RB	2,000	
	220	---	6032	C	8.80	0.18	0.12	0.15	0.18	0.7	SY6-0G227M-RC	500	
	220	---	7343	D0	8.80	0.12	0.08	0.10	0.12	1.0	SY4-0G227M-RD0	500	
	330	---	7343	D0	13.20	0.21	0.14	0.18	0.21	0.7	SY5-0G337M-RD0	500	
	470	---	7343	D0	18.80	0.24	0.16	0.21	0.24	0.3	SY6-0G477M-RD0	500	

The asterisk in the Note row indicates the reduced frequency of manufacture due to miniaturization, etc.
For new design, it is recommended to choose a smaller product with a higher voltage and same capacity.

Resin mold chip type capacitors Standard Type

Standard ratings

Rated voltage (V)	Rated capacitance (μF) (120Hz)	Marking	EIA size code	ELNA size code	Leakage current (μA, or less)	Tangent of the loss angle (less)(120Hz) −55°C	20°C	85°C	125°C	E.S.R. (Ω) (100kHz)	ELNA Part No.	Taping minimum packing pcs. (pcs/reel)	Note
6.3	2.2	J225	3216	A	0.50	0.09	0.06	0.07	0.09	8.0	SY1-0J225M-RA	2,000	*
	3.3	J335	3216	A	0.50	0.09	0.06	0.08	0.09	7.0	SY2-0J335M-RA	2,000	
	4.7	J475	3216	A	0.50	0.09	0.06	0.10	0.09	4.0	SY2-0J475M-RA	2,000	
	6.8	J685	3216	A	0.50	0.09	0.06	0.08	0.09	3.5	SY3-0J685M-RA	2,000	
	6.8	---	3528	B	0.50	0.09	0.06	0.07	0.09	3.0	SY1-0J685M-RB	2,000	*
	10	J106	3216	A	0.63	0.12	0.08	0.10	0.12	3.0	SY4-0J106M-RA	2,000	
	10	---	3528	B	0.63	0.09	0.06	0.08	0.09	3.0	SY2-0J106M-RB	2,000	
	15	J156	3216	A	0.94	0.12	0.08	0.10	0.12	3.0	SY5-0J156M-RA	2,000	
	15	---	3528	B	0.94	0.09	0.06	0.08	0.09	2.0	SY3-0J156M-RB	2,000	
	22	J226	3216	A	1.38	0.15	0.10	0.13	0.15	2.5	SY6-0J226M-RA	2,000	
	22	---	3528	B	1.38	0.12	0.08	0.10	0.12	1.5	SY4-0J226M-RB	2,000	
	22	---	6032	C	1.38	0.09	0.06	0.07	0.09	1.0	SY1-0J226M-RC	500	*
	33	J336	3216	A	2.07	0.15	0.10	0.13	0.15	2.5	SY7-0J336M-RA	2,000	
	33	---	3528	B	2.07	0.12	0.08	0.10	0.12	1.5	SY5-0J336M-RB	2,000	
	33	---	6032	C	2.07	0.09	0.06	0.08	0.09	1.0	SY2-0J336M-RC	500	
	47	J476	3216	A	2.96	0.24	0.16	0.19	0.24	2.5	SY8-0J476M-RA	2,000	
	47	---	3528	B	2.96	0.15	0.10	0.13	0.15	1.0	SY6-0J476M-RB	2,000	
	47	---	6032	C	2.96	0.09	0.06	0.08	0.09	1.0	SY3-0J476M-RC	500	
	47	---	7343	D0	2.96	0.09	0.06	0.07	0.09	0.7	SY1-0J476M-RD0	500	*
	68	---	3528	B	4.28	0.15	0.10	0.13	0.15	1.0	SY7-0J686M-RB	2,000	
	68	---	6032	C	4.28	0.12	0.08	0.10	0.12	0.8	SY4-0J686M-RC	500	
	68	---	7343	D0	4.28	0.09	0.06	0.08	0.09	0.8	SY2-0J686M-RD0	500	*
	100	---	3528	B	6.30	0.18	0.12	0.15	0.18	1.0	SY8-0J107M-RB	2,000	
	100	---	6032	C	6.30	0.15	0.10	0.13	0.15	0.7	SY5-0J107M-RC	500	
	100	---	7343	D0	6.30	0.12	0.08	0.10	0.12	0.8	SY3-0J107M-RD0	500	
	150	---	6032	C	9.45	0.18	0.12	0.15	0.18	0.7	SY6-0J157M-RC	500	
	150	---	7343	D0	9.45	0.12	0.08	0.10	0.12	1.0	SY4-0J157M-RD0	500	
	220	---	7343	D0	13.86	0.18	0.12	0.16	0.18	0.5	SY5-0J227M-RD0	500	
	330	---	7343	D0	20.79	0.24	0.16	0.20	0.24	0.5	SY6-0J337M-RD0	500	
10	1.5	A155	3216	A	0.50	0.09	0.06	0.07	0.09	8.0	SY1-1A155M-RA	2,000	*
	2.2	A225	3216	A	0.50	0.09	0.06	0.08	0.09	7.0	SY2-1A225M-RA	2,000	
	3.3	A335	3216	A	0.50	0.09	0.06	0.08	0.09	5.0	SY2-1A335M-RA	2,000	
	4.7	A475	3216	A	0.50	0.09	0.06	0.08	0.09	4.5	SY3-1A475M-RA	2,000	
	4.7	---	3528	B	0.50	0.09	0.06	0.07	0.09	3.0	SY1-1A475M-RB	2,000	*
	6.8	A685	3216	A	0.68	0.09	0.06	0.08	0.09	3.0	SY4-1A685M-RA	2,000	
	6.8	---	3528	B	0.68	0.09	0.06	0.08	0.09	3.0	SY2-1A685M-RB	2,000	*
	10	A106	3216	A	1.00	0.12	0.08	0.10	0.12	3.0	SY5-1A106M-RA	2,000	
	10	---	3528	B	1.00	0.09	0.06	0.08	0.09	2.0	SY3-1A106M-RB	2,000	
	15	A156	3216	A	1.50	0.15	0.10	0.13	0.15	3.0	SY6-1A156M-RA	2,000	
	15	---	3528	B	1.50	0.09	0.06	0.08	0.09	2.0	SY4-1A156M-RB	2,000	
	15	---	6032	C	1.50	0.09	0.06	0.07	0.09	1.0	SY1-1A156M-RC	500	*
	22	A226	3216	A	2.20	0.18	0.12	0.16	0.18	2.5	SY7-1A226M-RA	2,000	
	22	---	3528	B	2.20	0.12	0.08	0.10	0.12	2.0	SY5-1A226M-RB	2,000	
	22	---	6032	C	2.20	0.09	0.06	0.08	0.09	1.0	SY2-1A226M-RC	500	
	33	---	3528	B	3.30	0.12	0.08	0.10	0.12	1.5	SY6-1A336M-RB	2,000	
	33	---	6032	C	3.30	0.09	0.06	0.08	0.09	1.0	SY3-1A336M-RC	500	
	33	---	7343	D0	3.30	0.09	0.06	0.07	0.09	0.7	SY1-1A336M-RD0	500	*
	47	---	3528	B	4.70	0.15	0.10	0.13	0.15	1.0	SY7-1A476M-RB	2,000	
	47	---	6032	C	4.70	0.09	0.06	0.08	0.09	0.9	SY4-1A476M-RC	500	
	47	---	7343	D0	4.70	0.09	0.06	0.08	0.09	0.8	SY2-1A476M-RD0	500	
	68	---	6032	C	6.80	0.12	0.08	0.10	0.12	0.8	SY5-1A686M-RC	500	
	68	---	7343	D0	6.80	0.09	0.06	0.08	0.09	0.6	SY3-1A686M-RD0	500	
	100	---	6032	C	10.00	0.15	0.10	0.13	0.15	0.7	SY6-1A107M-RC	500	
	100	---	7343	D0	10.00	0.12	0.08	0.10	0.12	0.6	SY4-1A107M-RD0	500	
	150	---	7343	D0	15.00	0.15	0.10	0.13	0.15	0.7	SY5-1A157M-RD0	500	

The asterisk in the Note row indicates the reduced frequency of manufacture due to miniaturization, etc.
For new design, it is recommended to choose a smaller product with a higher voltage and same capacity.

Resin mold chip type capacitors Standard Type

Standard ratings

Rated voltage (V)	Rated capacitance (μF) (120Hz)	Marking	EIA size code	ELNA size code	Leakage current (μA, or less)	Tangent of the loss angle (less)(120Hz)				E.S.R. (Ω) (100kHz)	ELNA Part No.	Taping minimum packing pcs. (pcs/reel)	Note
						–55°C	20°C	85°C	125°C				
	1	C105	3216	A	0.50	0.09	0.05	0.07	0.09	7.0	SY1-1C105M-RA	2,000	
	1.5	C155	3216	A	0.50	0.09	0.06	0.08	0.09	7.0	SY2-1C155M-RA	2,000	
	2.2	C225	3216	A	0.50	0.09	0.06	0.08	0.09	5.0	SY2-1C225M-RA	2,000	
	3.3	C335	3216	A	0.50	0.09	0.06	0.08	0.09	4.5	SY3-1C335M-RA	2,000	
	3.3	---	3528	B	0.50	0.09	0.06	0.07	0.09	3.0	SY1-1C335M-RB	2,000	*
	4.7	C475	3216	A	0.75	0.09	0.06	0.08	0.09	4.0	SY4-1C475M-RA	2,000	
	4.7	---	3528	B	0.75	0.09	0.06	0.08	0.09	3.0	SY2-1C475M-RB	2,000	*
	6.8	C685	3216	A	1.08	0.12	0.08	0.10	0.12	3.5	SY5-1C685M-RA	2,000	
	6.8	---	3528	B	1.08	0.09	0.06	0.08	0.09	2.5	SY3-1C685M-RB	2,000	
	10	C106	3216	A	1.60	0.12	0.08	0.10	0.12	4.0	SY6-1C106M-RA	2,000	
	10	---	3528	B	1.60	0.09	0.06	0.08	0.09	2.0	SY4-1C106M-RB	2,000	
16	10	---	6032	C	1.60	0.09	0.06	0.07	0.09	2.2	SY1-1C106M-RC	500	*
	15	---	3528	B	2.40	0.09	0.06	0.08	0.09	2.0	SY5-1C156M-RB	2,000	
	15	---	6032	C	2.40	0.09	0.06	0.08	0.09	2.0	SY2-1C156M-RC	500	*
	22	---	3528	B	3.52	0.12	0.06	0.10	0.12	2.0	SY6-1C226M-RB	2,000	
	22	---	6032	C	3.52	0.09	0.06	0.08	0.09	1.0	SY3-1C226M-RC	500	
	22	---	7343	D0	3.52	0.09	0.06	0.07	0.09	0.7	SY1-1C226M-RD0	500	*
	33	---	6032	C	5.28	0.09	0.06	0.08	0.09	1.1	SY4-1C336M-RC	500	
	33	---	7343	D0	5.28	0.09	0.06	0.08	0.09	1.0	SY2-1C336M-RD0	500	*
	47	---	6032	C	7.52	0.12	0.08	0.10	0.12	0.8	SY5-1C476M-RC	500	
	47	---	7343	D0	7.52	0.09	0.06	0.08	0.09	0.7	SY3-1C476M-RD0	500	
	68	---	7343	D0	10.80	0.09	0.06	0.08	0.09	0.6	SY4-1C686M-RD0	500	
	100	---	7343	D0	16.00	0.15	0.10	0.13	0.15	0.6	SY5-1C107M-RD0	500	
	0.68	D684	3216	A	0.50	0.09	0.05	0.06	0.09	10.0	SY1-1D684M-RA	2,000	*
	1	D105	3216	A	0.50	0.09	0.05	0.06	0.09	7.5	SY2-1D105M-RA	2,000	
	1.5	D155	3216	A	0.50	0.09	0.06	0.08	0.09	6.0	SY2-1D155M-RA	2,000	
	2.2	D225	3216	A	0.50	0.09	0.06	0.08	0.09	5.0	SY3-1D225M-RA	2,000	
	2.2	---	3528	B	0.50	0.09	0.06	0.07	0.09	5.0	SY1-1D225M-RB	2,000	*
	3.3	D335	3216	A	0.66	0.09	0.06	0.08	0.09	4.0	SY4-1D335M-RA	2,000	
	3.3	---	3528	B	0.66	0.09	0.06	0.08	0.09	3.8	SY2-1D335M-RB	2,000	
	4.7	D475	3216	A	0.94	0.09	0.06	0.08	0.09	4.0	SY5-1D475M-RA	2,000	
	4.7	---	3528	B	0.94	0.09	0.06	0.08	0.09	3.0	SY3-1D475M-RB	2,000	
	6.8	D685	3216	A	1.36	0.12	0.08	0.10	0.12	4.0	SY6-1D685M-RA	2,000	
20	6.8	---	3528	B	1.36	0.09	0.06	0.08	0.09	3.0	SY4-1D685M-RB	2,000	
	6.8	---	6032	C	1.36	0.09	0.06	0.07	0.09	2.5	SY1-1D685M-RC	500	*
	10	---	3528	B	2.00	0.09	0.06	0.08	0.09	2.0	SY5-1D106M-RB	2,000	
	10	---	6032	C	2.00	0.09	0.06	0.08	0.09	2.5	SY2-1D106M-RC	500	
	15	---	6032	C	3.00	0.09	0.06	0.08	0.09	1.7	SY3-1D156M-RC	500	
	15	---	7343	D0	3.00	0.09	0.06	0.07	0.09	2.0	SY1-1D156M-RD0	500	*
	22	---	6032	C	4.40	0.09	0.06	0.08	0.09	1.5	SY4-1D226M-RC	500	
	22	---	7343	D0	4.40	0.09	0.06	0.08	0.09	0.8	SY2-1D226M-RD0	500	
	33	---	7343	D0	6.60	0.09	0.06	0.08	0.09	0.7	SY3-1D336M-RD0	500	
	47	---	7343	D0	9.40	0.09	0.06	0.08	0.09	0.7	SY4-1D476M-RD0	500	

The asterisk in the Note row indicates the reduced frequency of manufacture due to miniaturization, etc.
For new design, it is recommended to choose a smaller product with a higher voltage and same capacity.

Resin mold chip type capacitors — Standard Type

Standard ratings

Rated voltage (V)	Rated capacitance (μF) (120Hz)	Marking	EIA size code	ELNA size code	Leakage current (μA, or less)	Tangent of the loss angle (less)(120Hz) −55°C	20°C	85°C	125°C	E.S.R. (Ω) (100kHz)	ELNA Part No.	Taping minimum packing pcs. (pcs/reel)	Note
25	0.47	E474	3216	A	0.50	0.09	0.05	0.06	0.09	10.0	SY1-1E474M-RA	2,000	
	0.68	E684	3216	A	0.50	0.09	0.05	0.06	0.09	9.0	SY2-1E684M-RA	2,000	
	1	E105	3216	A	0.50	0.09	0.06	0.08	0.09	7.0	SY2-1E105M-RA	2,000	
	1.5	E155	3216	A	0.50	0.09	0.06	0.08	0.09	6.5	SY3-1E155M-RA	2,000	
	1.5	---	3528	B	0.50	0.09	0.06	0.07	0.09	5.0	SY1-1E155M-RB	2,000	*
	2.2	E225	3216	A	0.55	0.09	0.06	0.08	0.09	6.0	SY4-1E225M-RA	2,000	
	2.2	---	3528	B	0.55	0.09	0.06	0.08	0.09	5.0	SY2-1E225M-RB	2,000	
	3.3	---	3528	B	0.82	0.09	0.06	0.08	0.09	4.0	SY3-1E335M-RB	2,000	
	4.7	---	3528	B	1.17	0.09	0.06	0.08	0.09	3.5	SY4-1E475M-RB	2,000	
	4.7	---	6032	C	1.17	0.09	0.06	0.07	0.09	2.5	SY1-1E475M-RC	500	
	6.8	---	3528	B	1.70	0.12	0.08	0.10	0.12	2.0	SY5-1E685M-RB	2,000	
	6.8	---	6032	C	1.70	0.09	0.06	0.08	0.09	2.0	SY2-1E685M-RC	500	
	10	---	6032	C	2.50	0.09	0.06	0.08	0.09	1.5	SY3-1E106M-RC	500	
	10	---	7343	D0	2.50	0.09	0.06	0.07	0.09	1.2	SY1-1E106M-RD0	500	
	15	---	6032	C	3.75	0.09	0.06	0.06	0.09	1.0	SY4-1E156M-RC	500	
	15	---	7343	D0	3.75	0.09	0.06	0.08	0.09	1.0	SY2-1E156M-RD0	500	
	22	---	7343	D0	5.50	0.09	0.06	0.08	0.09	0.8	SY3-1E226M-RD0	500	
	33	---	7343	D0	8.25	0.09	0.06	0.08	0.09	0.7	SY3-1E226M-RD0	500	
35	0.1	V104	3216	A	0.50	0.09	0.05	0.08	0.09	28.0	SY1-1V104M-RA	2,000	
	0.15	V154	3216	A	0.50	0.09	0.05	0.08	0.09	24.0	SY1-1V154M-RA	2,000	
	0.22	V224	3216	A	0.50	0.09	0.05	0.08	0.09	20.0	SY1-1V224M-RA	2,000	
	0.33	V334	3216	A	0.50	0.09	0.05	0.08	0.09	15.0	SY1-1V334M-RA	2,000	
	0.47	V474	3216	A	0.50	0.09	0.05	0.08	0.09	11.0	SY2-1V474M-RA	2,000	
	0.47	---	3528	B	0.50	0.09	0.04	0.06	0.09	11.0	SY1-1V474M-RB	2,000	
	0.68	V684	3216	A	0.50	0.09	0.04	0.06	0.09	8.0	SY2-1V684M-RA	2,000	
	0.68	---	3528	B	0.50	0.09	0.04	0.06	0.09	8.0	SY1-1V684M-RB	2,000	
	1	V105	3216	A	0.50	0.09	0.06	0.08	0.09	7.0	SY3-1V105M-RA	2,000	
	1	---	3528	B	0.50	0.09	0.04	0.06	0.09	6.0	SY1-1V105M-RB	2,000	
	1.5	V155	3216	A	0.52	0.09	0.06	0.08	0.09	4.0	SY4-1V155M-RA	2,000	
	1.5	---	3528	B	0.52	0.09	0.06	0.08	0.09	5.0	SY2-1V155M-RB	2,000	
	1.5	---	6032	C	0.52	0.09	0.06	0.07	0.09	4.5	SY1-1V155M-RC	500	
	2.2	---	3528	B	0.77	0.09	0.06	0.08	0.09	4.0	SY3-1V225M-RB	2,000	
	2.2	---	6032	C	0.77	0.09	0.06	0.07	0.09	3.5	SY1-1V225M-RC	500	
	3.3	---	3528	B	1.15	0.09	0.06	0.08	0.09	4.0	SY4-1V335M-RB	2,000	
	3.3	---	6032	C	1.15	0.09	0.06	0.07	0.09	3.0	SY1-1V335M-RC	500	
	4.7	---	6032	C	1.64	0.09	0.06	0.08	0.09	2.0	SY2-1V475M-RC	500	
	4.7	---	7343	D0	1.64	0.09	0.06	0.07	0.09	1.5	SY1-1V475M-RD0	500	
	6.8	---	6032	C	2.38	0.09	0.06	0.08	0.09	1.8	SY3-1V685M-RC	500	
	6.8	---	7343	D0	2.38	0.09	0.06	0.07	0.09	1.3	SY1-1V685M-RD0	500	
	10	---	6032	C	3.50	0.09	0.06	0.07	0.09	1.5	SY4-1V106M-RC	500	
	10	---	7343	D0	3.50	0.09	0.06	0.08	0.09	1.0	SY2-1V106M-RD0	500	
	15	---	7343	D0	5.25	0.09	0.06	0.08	0.09	0.8	SY3-1V156M-RD0	500	
	22	---	7343	D0	7.70	0.12	0.08	0.10	0.12	0.7	SY4-1V226M-RD0	500	

The asterisk in the Note row indicates the reduced frequency of manufacture due to miniaturization, etc.
For new design, it is recommended to choose a smaller product with a higher voltage and same capacity.

Resin mold chip type capacitors

GREEN CAP | SMD | Low ESR

Standard ratings Type SYL (LOW ESR)

Rated voltage (V)	Rated capacitance (μF) (120Hz)	Marking (P, A2, A)	EIA size code	ELNA size symbol	Leakage current (μA, or less)	Tangent of the loss angle (less)(120Hz) –55°C	20°C	85°C	125°C	E.S.R. (Ω) (100kHz)	Allouable Ripple Current (Arms) (100kHz)	ELNA Part No.	Taping minimum packing pcs. (pcs/reel)	Note
4	10	GĀ	2012	P	0.50	0.15	0.1	0.12	0.15	1.2	0.13	SYL-0G106M-RP	3,000	
	22	G226	3216L	A2	0.88	0.18	0.12	0.16	0.18	1.0	0.16	SYL-0G226M-RA2	3,000	
	33	G336	3216L	A2	1.32	0.21	0.14	0.18	0.21	1.0	0.16	SYL-0G336M-RA2	3,000	
	33	G336	3216	A	1.32	0.15	0.1	0.12	0.15	0.8	0.19	SYL-0G336M-RA	2,000	
	47	G476	3216	A	1.88	0.15	0.1	0.13	0.15	0.8	0.19	SYL-0G476M-RA	2,000	
	47	—	3528	B	1.88	0.12	0.08	0.1	0.12	0.8	0.19	SYL-0G476M-RB	2,000	
	100	—	3528	B	4.00	0.15	0.1	0.13	0.15	0.7	0.21	SYL-0G107M-RB	2,000	
	100	—	6032	C	4.00	0.12	0.08	0.1	0.12	0.3	0.41	SYL-0G107M-RC	500	
	220	—	7343	D0	8.80	0.12	0.08	0.1	0.12	0.1	0.87	SYL-0G227M-RD0	500	
	330	—	7343	D0	13.20	0.21	0.14	0.18	0.21	0.1	0.87	SYL-0G337M-RD0	500	
6.3	3.3	JN	2012	P	0.50	0.12	0.08	0.096	0.12	3.0	0.09	SYL-0J335M-RP	3,000	
	4.7	JS	2012	P	0.50	0.12	0.08	0.096	0.12	2.0	0.10	SYL-0J475M-RP	3,000	
	4.7	J475	3216L	A2	0.50	0.12	0.08	0.1	0.12	2.0	0.11	SYL-0J475M-RA2	3,000	
	10	J Ā	2012	P	0.63	0.15	0.1	0.12	0.15	1.2	0.13	SYL-0J106M-RP	3,000	
	10	J106	3216L	A2	0.63	0.12	0.08	0.1	0.12	1.2	0.14	SYL-0J106M-RA2	3,000	
	10	J106	3216	A	0.63	0.12	0.08	0.1	0.12	1.2	0.16	SYL-0J106M-RA	2,000	
	22	J226	3216	A	1.38	0.15	0.1	0.13	0.15	0.8	0.19	SYL-0J226M-RA	2,000	
	33	J336	3216	A	2.07	0.15	0.1	0.13	0.15	0.8	0.19	SYL-0J336M-RA	2,000	
	33	—	3528	B	2.07	0.12	0.08	0.1	0.12	0.8	0.19	SYL-0J336M-RB	2,000	
	47	—	3528	B	2.96	0.15	0.1	0.13	0.15	1.0	0.17	SYL-0J476M-RB	2,000	
	47	—	6032	C	2.96	0.09	0.06	0.08	0.09	0.4	0.35	SYL-0J476M-RC	500	
	100	—	3528	B	6.30	0.18	0.12	0.15	0.18	0.7	0.21	SYL-0J107M-RB	2,000	
	100	—	6032	C	6.30	0.15	0.1	0.13	0.15	0.25	0.45	SYL-0J107M-RC	500	
	100	—	7343	D0	6.30	0.12	0.08	0.1	0.12	0.15	0.46	SYL-0J107M-RD0	500	
	220	—	7343	D0	13.90	0.18	0.12	0.16	0.18	0.1	0.79	SYL-0J227M-RD0	500	
10	2.2	A J	2012	P	0.50	0.12	0.08	0.1	0.12	5.0	0.07	SYL-1A225M-RP	3,000	
	3.3	A335	3216L	A2	0.50	0.12	0.08	0.1	0.12	3.0	0.09	SYL-1A335M-RA2	3,000	
	4.7	A475	3216L	A2	0.50	0.15	0.1	0.13	0.15	2.0	0.11	SYL-1A475M-RA2	3,000	
	4.7	A475	3216	A	0.50	0.09	0.06	0.08	0.09	2.0	0.12	SYL-1A475M-RA	2,000	
	10	A106	3216L	A2	1.00	0.24	0.16	0.21	0.24	1.5	0.13	SYL-1A106M-RA2	3,000	
	10	A106	3216	A	1.00	0.12	0.08	0.1	0.12	1.0	0.15	SYL-1A106M-RA	2,000	
	22	—	3528	B	2.20	0.12	0.08	0.1	0.12	1.0	0.17	SYL-1A226M-RB	2,000	
	33	—	3528	B	3.30	0.12	0.08	0.1	0.12	0.8	0.19	SYL-1A336M-RB	2,000	
	33	—	6032	C	3.30	0.09	0.06	0.08	0.09	0.375	0.37	SYL-1A336M-RC	500	
	47	—	3528	B	4.70	0.15	0.1	0.13	0.15	0.7	0.21	SYL-1A476M-RB	2,000	
	47	—	6032	C	4.70	0.09	0.06	0.08	0.09	0.4	0.35	SYL-1A476M-RC	500	
	47	—	7343	D0	4.70	0.09	0.06	0.08	0.09	0.3	0.50	SYL-1A476M-RD0	500	
	100	—	7343	D0	10.00	0.12	0.08	0.1	0.12	0.12	0.79	SYL-1A107M-RD0	500	
	150	—	7343	D0	15.00	0.15	0.1	0.13	0.15	0.12	0.79	SYL-1A157M-RD0	500	
16	1	CA	2012	P	0.50	0.09	0.06	0.072	0.09	5.0	0.06	SYL-1C105M-RP	3,000	
	2.2	C J	2012	P	0.50	0.12	0.08	0.096	0.12	5.0	0.06	SYL-1C225M-RP	3,000	
	2.2	C225	3216L	A2	0.50	0.09	0.06	0.08	0.09	4.0	0.08	SYL-1C225M-RA2	3,000	
	3.3	C335	3216L	A2	0.50	0.09	0.06	0.08	0.09	3.0	0.09	SYL-1C335M-RA2	3,000	
	3.3	C335	3216	A	0.50	0.09	0.06	0.08	0.09	1.8	0.13	SYL-1C335M-RA	2,000	
	4.7	C475	3216	A	0.75	0.09	0.06	0.08	0.09	1.8	0.13	SYL-1C475M-RA	2,000	
	4.7	—	3528	B	0.75	0.09	0.06	0.08	0.09	1.8	0.13	SYL-1C475M-RB	2,000	
	10	—	3528	B	1.60	0.09	0.06	0.08	0.09	1.0	0.17	SYL-1C106M-RB	2,000	
	10	—	6032	C	1.60	0.09	0.06	0.08	0.09	0.9	0.24	SYL-1C106M-RC	500	
	22	—	6032	C	3.52	0.09	0.06	0.08	0.09	0.4	0.35	SYL-1C226M-RC	500	
	33	—	6032	C	5.28	0.09	0.06	0.08	0.09	0.4	0.35	SYL-1C336M-RC	500	
	33	—	7343	D0	5.28	0.09	0.06	0.08	0.09	0.25	0.55	SYL-1C336M-RD0	500	
	47	—	7343	D0	7.52	0.09	0.06	0.08	0.09	0.2	0.61	SYL-1C476M-RD0	500	

Case size & ESR(Ω)

Rated capacitance (μF)	4V	6.3V	10V	16V
1				P(5.0)
2.2			P(5.0)	P(5.0), A2(4.0)
3.3		P(3.0)	A2(3.0)	A2(3.0), A(1.8)
4.7		P(2.0), A2(2.0)	A2(2.0), A(2.0)	A(1.8), B(1.8)
10	P(1.2)	P(1.2), A2(1.2), A(1.2)	A2(1.5), A(1.0)	B(1.0), C(0.9)
22	A2(1.0)	A(0.8)	B(1.0)	C(0.4)
33	A2(1.0), A(0.8)	A(0.8), B(0.8)	B(0.8), C(0.375)	C(0.4), D0(0.25)
47	A(0.8), B(0.8)	B(1.0), C(0.4)	B(0.7), C(0.4), D0(0.3)	D0(0.2)
100	B(0.7), C(0.3)	B(0.7), C(0.25), D0(0.15)	D0(0.12)	
150			D0(0.12)	
220	D0(0.1)	D0(0.1)		
330	D0(0.1)			

NOTE
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Ask factory for technical specifications before purchase and/or use.

■ Structure of a tantalum chip capacitor

To manufacture a tantalum chip capacitor, metallic tantalum(Ta) powder is pressed and formed with a tantalum lead wire, and then sintered in a vacuum; by the electrochemical anodic oxidation, tantalum oxide film (Ta_2O_5) is formed on the fired sur-face; this oxide is used as the dielectric.

On top of the dielectric, a solid manganese dioxide layer(MnO_2) is formed as the electrolyte through the thermal decomposition of manganese nitrate.

To make an electrical connection on the manganese dioxide layer, a graphite layer and a conductive adhesive are used to fix a cathode lead.

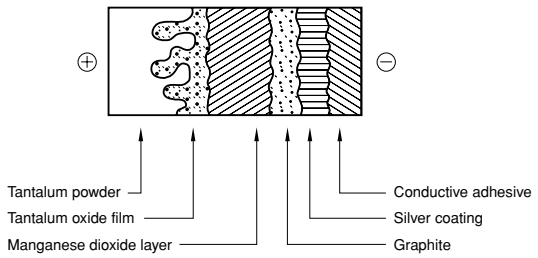

Fig.1 Diagrammatic sketch of a tantalum electrolytic capacitor

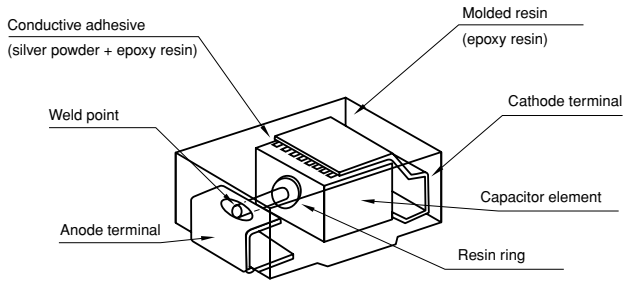

Fig.2 Structure of a tantalum chip capacitor

■ Working conditions and reliability (failure rate) of tantalum chip capacitors

Tantalum chip capacitors basically have high temperature resistance and stable electrical characteristics, and is expected to have a long life, because tantalum and tantalum oxidized films are extremely stable, and manganese dioxide serving as a solid electrolyte is also a stable inorganic solid.

On the other side, they tend to have a sudden failure because the tantalum oxidized films serving as an electrolyte are very thin and solid elements.

Consequently, the failure rate curve shows a gradual downturn from the beginning, different from a Bath-tub shaped curve specific to the aluminum electrolytic capacitors.

More than 90% of tantalum chip capacitor failures are caused by increased leakage current or short circuits. Reliability is affected by various conditions for solid tantalum chip capacitors and environmental conditions. These capacitors are particularly affected by ambient temperatures, applied voltage(working voltage), and circuit resistance.

■Ambient temperature, applied voltage(working voltage), and reliability

Reliability (failure rate) of solid tantalum electrolytic capacitors is generally proportional to the powers of temperature and powers of voltage in natural logarithm. An estimated failure rate is expressed by the following formula.

$$\lambda = \lambda_0 \left(\frac{V}{V_0}\right) \cdot 2^{\left(\frac{T-T_0}{F}\right)}$$

λ : Basic failure rate.
n : Factor for capacitor type.
F : Factor for capacitor type.
T : Working temperature.
T_0 : Upper category temperature.
V : Working voltage.
V_0 : Rated voltage.

For solid tantalum electrolytic capacitors, it has been confirmed that n and F are 3 and 15 respectively on an experimental basis. This easy formula is illustrated in Fig.3.

In the figure;

Vertical lines : Actual failure rate to failure rate λ_0, which is the failure rate at T_0=85˚C and V0=Rated voltage

Horizontal lines: Actual working temperature

The parameter of each line [working voltage / rated voltage] shows the voltage reduction factor.

■Series circuit resistance and reliability

A resistance connected with a capacitor reduces the electrical load to the dielectric film of the capacitor. This occurs because it controls the charging and discharging current of the capacitor.

Namely, the greater the series resistance, the greater the electrical load reduction to the dielectric film. Thus, resulting in higher reliability.

The relationship between a series resistance and reliability (failure rate) is shown in Fig.4.

In the figure;

Vertical lines : Ratio when the failure for 3Ω/V is assumed to be 1.

Horizontal lines: Resistance value per volt of applied voltage.

■ Estimation of the failure rate under actual working conditions

Reliability of electronic parts is generally shown by the failure rate;

$$\text{Failure Rate} = \frac{\text{Number of failure parts}}{\text{Working hours x Number of components in operation}} \times 100 \quad (\%/1000 \text{ hours})$$

Note: The unit of working hours to be 1000 hours.

Failure rate setting: For our products, failure rates are set under the following conditions.

Standard conditions for setting the failure rates	
Applied voltage	Rated Voltage
Working temperature	85˚C
Circuit resistance	3Ω /V

(A) Failure the setting
1%/1000 hours(60% reliability level)

Failure rate of actual working time : A prediction of reliability in actual working time can be calculated from coefficients in Fig.3 and Fig.4 and the calculation formula.

Estimated failure rate in actual working time(%/1000 hours)=AxBxC

A= Set failure rate

B= Working voltage; Reduction index of temperature (refer to Fig.3)

C= Circuit resistance coefficient(refer to Fig.4)

Example of calculation: A Type SK 16V10μF capacitor with a capacitance tolerance of ±20% is used under the following conditions:

Working conditions: Applied voltage: 9.6V;
Working temperature: 50˚C; 0.043 from Fig.3;
Circuit resistance: 2Ω / V; 1.7 from Fig.4;

Estimated failure rate: 1x 0.043 x1.7=0.073(% / 1000 hours).

Mean time of failure: If the reliability function (Rt) abides by the exponential distribution, the failure rate will be constant in any section and the MTTF (Mean Time to Failures) will be the inverse number of the failure rate,

$$\text{MTTF} = \frac{1}{\text{Mean Failure Rate}}$$

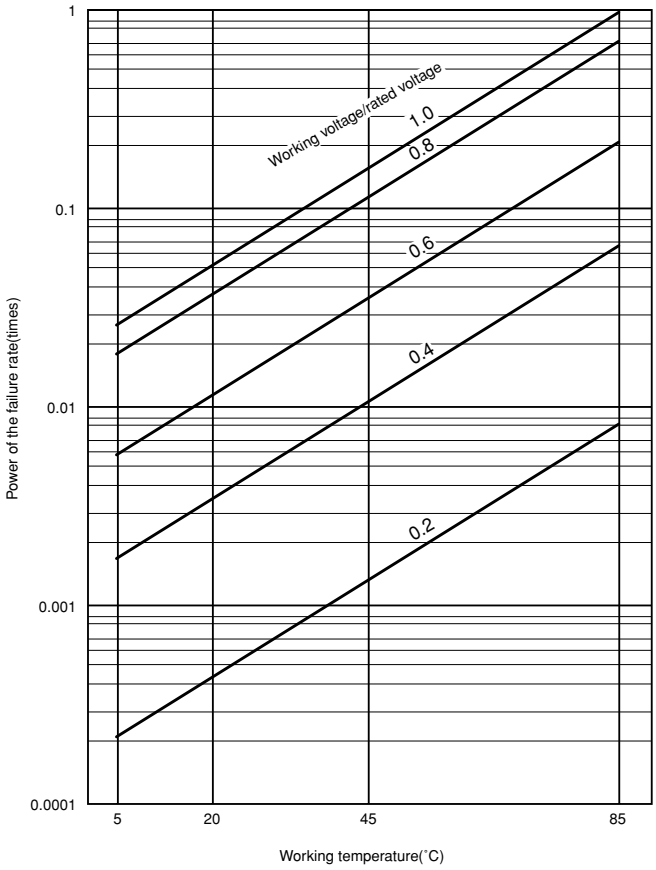

Fig.3 Relationship between the working temperature, applied voltage, and the failure rate.

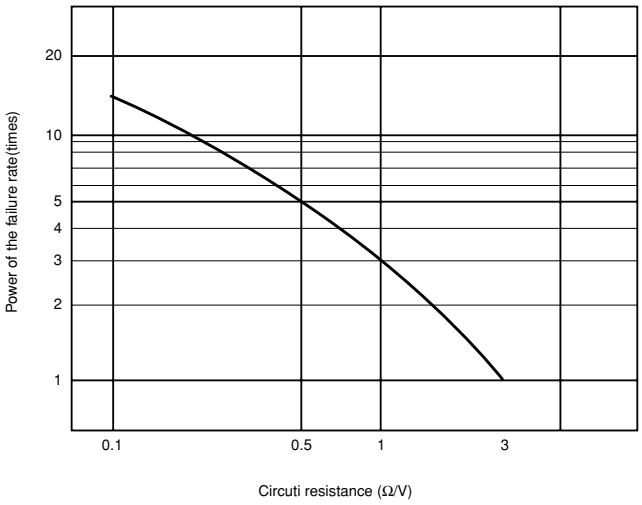

Fig.4 Relationship between the series circuit resistance and failure rate.

■ Ripple capability

The ripple current capability of tantalum solid electrolytic capacitor takes into consideration the equivalent series resistance (ESR) and the effect of heat generation due to ripple.

Ripple current generates heat due to the internal energy loss of the capacitor.

The allowable ripple current is decided by the heat generated due the internal resistance of the capacitor and the balance of thermal discharge of the mold resin, lead frame, and the like. The allowable ripple current is also presumed to be affected by capacitance, frequency, ambient temperature, case size, and the like.

Heat value, P, generated by ripple current due to the internal loss of the capacitor is expressed as follows.

$$P=I^2R=\frac{V^2}{Z^2}R \quad \cdots\cdots\cdots\cdots\cdots\cdots ①$$

Where P: Generated heat value (V)
I : Ripple current (Arms)
R: ESR (Ω)
V: Ripple voltage (Vrms)
Z: Impedance (Ω)

Temperature rise due to heat generation is expressed as follows;

$$\Delta T=\frac{P}{A\cdot H} \quad \cdots\cdots\cdots\cdots\cdots\cdots ②$$

ΔT: Temperature rise due to heat generation (deg)
A: Surface area (cm^2)
H: Radiation coefficient ($W/cm^2\cdot deg$)

Set an allowable ripple current and allowable voltage so that ΔT should be 5deg or under.

In general, since the tantalum solid electrolytic capacitor does not often carry large low-frequency current for smoothing power supply or the like, allowable ripple voltage and current are set. This takes into consideration the effect of voltage in the low-frequency domain and that of current in the high-frequency domain.

■ Allowable ripple voltage and allowable ripple current in low-frequency domain

From Formula ①

$$Vmax=Z\sqrt{\frac{Pmax}{R}} \quad \cdots\cdots ③$$

Pmax: Maximum generated heat value
Vmax: Maximum allowable ripple voltage

Where (1) The sum of the DC bias voltage and the max. AC applied ripple voltage (V max) can not exceed the rated voltage
(2) The sum of the DC bias voltage and the min. AC applied ripple voltage can not be a negative voltage (reverse voltage).

The maximum allowable ripple current is obtained by dividing the maximum allowable voltage by the Impedance.

$$Irms=\frac{Vrms}{Z} \quad \cdots\cdots\cdots\cdots ④$$

Now

$$Z=\sqrt{X^2+R^2} \quad \cdots\cdots\cdots\cdots ⑤$$

$$X=\frac{1}{\omega C}+\omega L \quad \cdots\cdots\cdots ⑥$$

$$\omega=2\pi f,\ R=\frac{\tan\delta}{\omega C} \quad \cdots\cdots\cdots ⑦$$

Now, since the inductance component can be neglected within the range of frequency we are facing.

$$Z=\sqrt{\left(\frac{1}{\omega C}\right)^2+\left(\frac{\tan\delta}{\omega C}\right)^2}$$

$$=\left(\frac{1}{2\pi fC}\right)\sqrt{1+(\tan\delta)^2} \quad \cdots\cdots\cdots ⑧$$

Since tanδ is as small as 0.02 to 0.04 within the low-frequency range of 500Hz or under, it is insignificant when compares to 1 , therefore can be ignored.

From formula 8

$$Z=\frac{1}{2\pi fC} \quad \cdots\cdots\cdots\cdots ⑨$$

Substituting formula ⑨ for formula ④

$$Irms=2\pi fC\ Vrms \quad \cdots\cdots\cdots\cdots\cdots ⑩$$

Expressing the capacity in μF.

$$Irms=2\pi fC\ Vrms\times 10^{-6} \quad \cdots\cdots\cdots ⑪$$

■ Allowable ripple current in high-frequency domain

In a domain of 500Hz to several hundred kHz, since considerably large current flows through dielectric film due to low impedance, heat generated by ripple current must be taken into consideration.

From Formula①

$$Irms=\sqrt{\frac{Pmax}{R}} \quad \cdots\cdots\cdots ⑫$$

The allowable maximum heat values generated at 20˚C have been decided by case size as follows.

Table 1. Allowable maximum heat values by case size

Case Size	Allowable maximum heat values Pmax(W)	
	SPY	SYF,SKY,SYL
J	–	0.020
P	0.025	0.022
A2	–	0.026
A	–	0.030
B	0.085	0.030
C	–	0.050
D0	–	0.075

Where, R is ESR at a required frequency. Use ($\bar{\chi}+3\sigma$) of actual average value for safety. Make a calculation using ESR values shown in the standard model table.

Furthermore, multiply the value by a temperature compensation coefficient taking heat radiation acoording to ambient temperature into consideration.

Table 2. Temperature compensation coefficient

Ambient temperature	Coefficient	
	SPY	SYF,SKY,SYL
20˚C	1.0	1.0
50˚C	–	0.7
85˚C	0.9	0.5
105˚C	0.4	–

NOTE
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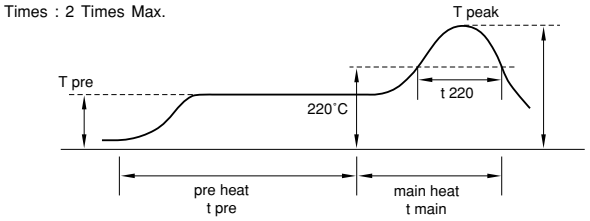
■ Soldering

1. It is recommended that chip type parts be soldered within the following conditions. Soldering should be carried out in a short time and at low temperature as much as possible.

(1) Solder dipping method
Solder temperature : Not more than 260˚C
Dipping time : Not more than 5 s
(2) Reflow method
According to the reflow profile conditions shown in the following.



		SPY	SYF,SKY,SYL
T pre	Preheating temperature	160~180˚C	160~180˚C
T peak	Peak temperature	240˚C (Max.)	250˚C (Max.)
t pre	Preheating time	100 s (Max.)	100 s (Max.)
t main	Main heating time	50 s (Max.)	50 s (Max.)
t 220	Time for which solder temperature exceeds 220˚C	20 s (Max.)	40 s (Max.)
t peak	Time at peak temperature	5 s (Max.)	3 s (Max.)

The peak temperature of soldering recommends from 235 to 250˚C.

Though upward heating, such as that by a hot plate, does not cause any problem, downward heating by an atmospheric furnace by means of infrared rays could raise the temperature of capacitors to temperatures higher than that of the substrate surface. Therefore, care must be taken.

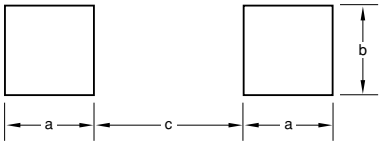
2. Use preliminary heating as far as possible, and relieve the temperature gradient for soldering.

3. Use resin flux.

4. For the reflow method, if the land area is too big in comparison with the capacitor terminal area, the capacitor is likely to slip or turn over. Therefore, caution must be taken.

5. For the solder bathing method, since high density packaging sometimes adversely affects solderability, take measures, such as removing air, into consideration.

6. Recommended pad pattern and size

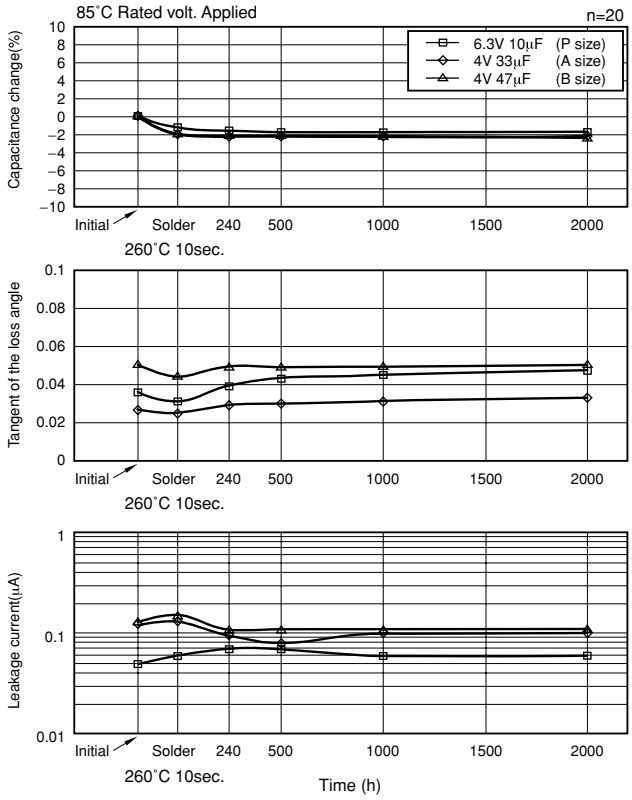


Unit : mm

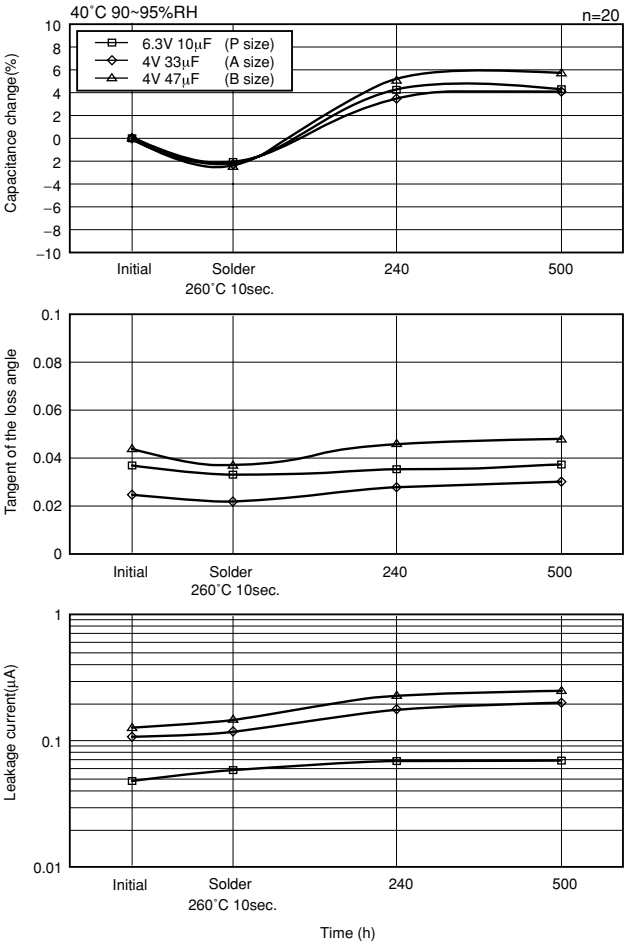
Case Size	a		b	c
	Solder Dipping	Reflow		
J	–	0.90	1.0	0.7
P	2.2	1.05	1.2	0.5
A2, A	2.9	1.35	1.5	1.1
B	3.0	1.35	2.7	1.4
C	4.1	2.0	2.7	2.9
D0	5.2	2.05	2.9	4.1

Reference data

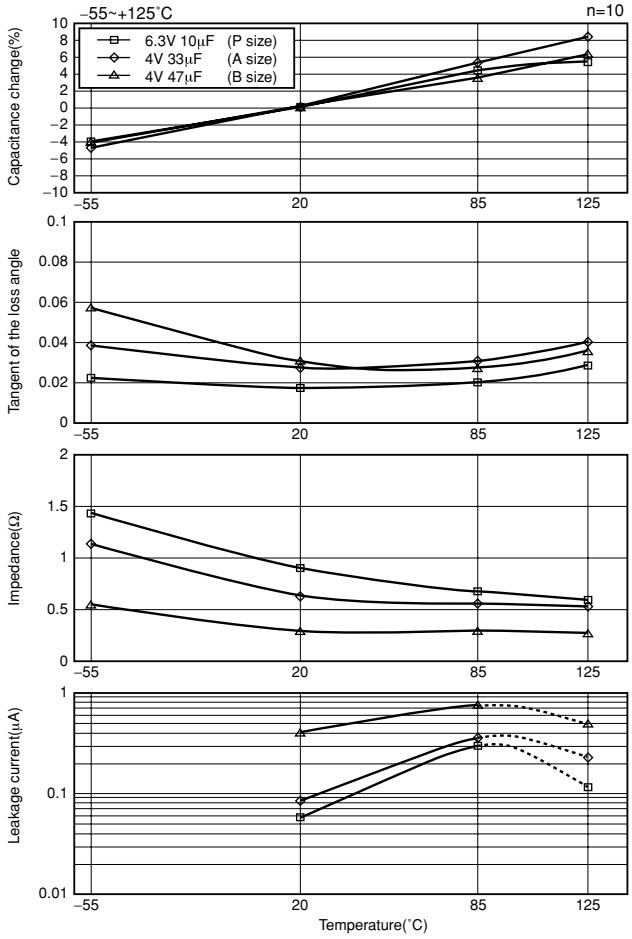
■ Endurance (Load life)



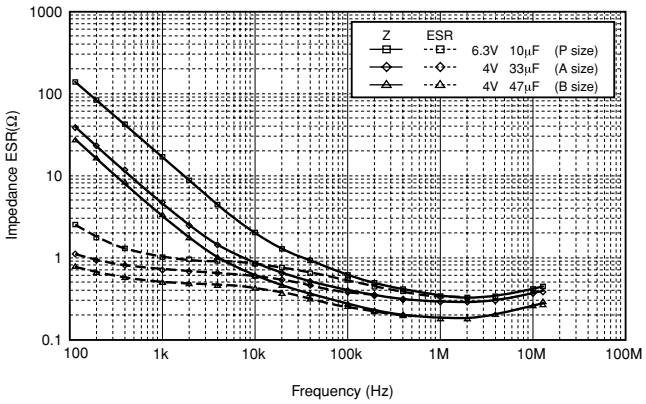
■ Damp hear, stady state (Humidity)



■ Temperature characteristics



■ Frequency characteristics



Notice: The measurement values are not guaranteed values, but measurements.

Data of leakage current at 125˚C have been measured at category voltage.