

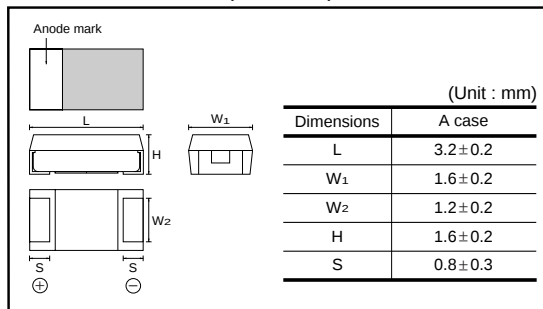
Chip tantalum capacitors

TCO Series

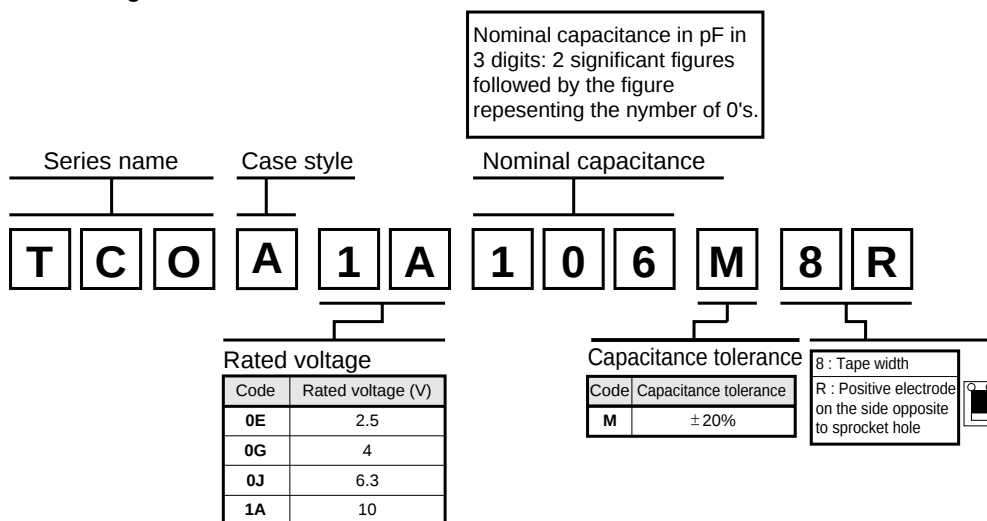
●Features (A)

- 1) Conductive polymer used for the cathode material.
- 2) Ultra-low ESR.
(1/10 compared with the conventional type)
- 3) Screening by thermal shock.

●External dimensions (Unit : mm)



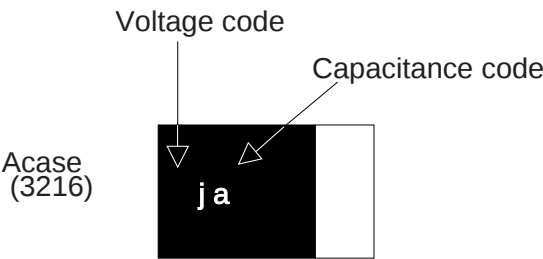
●Model name configuration



Tantalum capacitors

●Rated Table. Marking
TCO Series

μF		Rated voltage (V.DC)			
		2.5 0E	4 0G	6.3 0J	10 1A
A	1.0				
E	1.5				
J	2.2				
N	3.3				A
S	4.7				A
W	6.8			A	A
a	10		A	A	A
e	15	A	A	A	
j	22	A	A	A	
n	33	A	A		
s	47				
w	68				



Tantalum capacitors

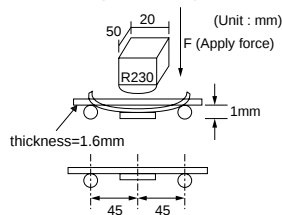
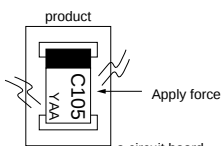
●Characteristics

Item		Performance	Test conditions (based on JIS C 5101-1 and JIS C 5101-3)
Operating Temperature		-55°C to +105°C	Voltage reduction when temperature exceeds +85°C
Maximum operating temperature with no voltage derating		+85°C	
Rated voltage (VDC)		2.5 4 6.3 10	at 85°C
Category voltage (VDC)		2 3.2 5 8	at 105°C
Surge voltage (VDC)		3.2 5.2 8 13	at 85°C
DC Leakage current		3μF or 0.1CV whichever is greater Shown in " Standard list "	Rated voltage for 5min
Capacitance tolerance		±20% Shall be satisfied allowance range.	Measuring frequency : 120±12Hz Measuring voltage : 0.5Vrms +1.5 to 2V.DC Measuring circuit : DC Equivalent series circuit
Tangent of loss angle (Df, tan δ)		Shall be satisfied the voltage on " Standard list "	Measuring frequency : 120±12Hz Measuring voltage : 0.5Vrms +1.5 to 2V.DC Measuring circuit : DC Equivalent series circuit
ESR		Shall be satisfied the voltage on " Standard list "	Measuring frequency : 100±10kHz Measuring voltage : 0.5Vrms or less
Resistance to Soldering heat	Appearance	There should be no significant abnormality. The indications should be clear.	Dip in the solder bath Solder temp : 240±5°C Duration : 5±0.5s Repetition : 1
	L.C.	Less than 150% of initial limit	
	ΔC / C	Within ±20% of initial value	
	tan δ	Less than 150% of initial limit	

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Item		Performance	Test conditions (based on JIS C 5101-1 and JIS C 5101-3)															
Temperature cycle	Appearance	There should be no significant abnormality.	Repetition : 5 cycles (1 cycle : steps 1 to 4) without discontinuation. <table><tr><td></td><td>Temp.</td><td>Time</td></tr><tr><td>1</td><td>-55±3℃</td><td>30±3min</td></tr><tr><td>2</td><td>Room temp.</td><td>3min.or less</td></tr><tr><td>3</td><td>105±2℃</td><td>30±3min</td></tr><tr><td>4</td><td>Room temp.</td><td>3min.or less</td></tr></table>		Temp.	Time	1	-55±3℃	30±3min	2	Room temp.	3min.or less	3	105±2℃	30±3min	4	Room temp.	3min.or less
		Temp.		Time														
	1	-55±3℃		30±3min														
	2	Room temp.		3min.or less														
	3	105±2℃		30±3min														
4	Room temp.	3min.or less																
L.C	Less than 500% of initial limit																	
ΔC / C	Within±20% of intial value																	
Df (tan δ)	Less than 150% of initial limit																	
Moisture resistance	Appearance	There should be no significant abnormality. The indications should be	After leaving the sample under such atmospheric condition that the temperature and humidity are 60 2℃ and 90 to 95% RH,respectievely,for 500 12h leave it at room temperature for 1 to 2h and then measure the sample.															
	L.C	Less than 150% of initial limit																
	ΔC / C	+30% / -20%																
	Df (tan δ)	Less than 150% of initial limit																
	Temperature Stebility	Temp.		-55℃														
ΔC / C		Within 0/-20% of initial value																
Df (tan δ)		Shall be satisfied the voltage on " Standard list "																
L.C		-																
Temp.		+105℃																
ΔC / C		Within +50/0% of initial value																
Df (tan δ)		Shall be satisfied the voltage on " Standard list "																
L.C		Less than 1CV																
Surge voltage	Appearance	There should be no significant avnormality.	Apply the spesified sergevoltage every 5±0.5 min. for 30±5 s. each time in the atmospheric condition of 85±2℃. Repeat this rocedure 1,000 times.															
	L.C	Less than initial limit																
	ΔC / C	Within± 20% of initial value																
	Df (tan δ)	Less than initial limit																

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Item		Performance	Test conditions (based on JIS C 5101-1 and JIS C 5101-3)
Loading at High temperature	Appearance	There should be no significant abnormality.	After applying the rated voltage for 1000 ⁺³⁶ h without discontinuation via the serial resistance of 3Ω or less at a temperature of 85 ±2 °C, leave the sample at room temperature / humidity for 1 to 2h and measure the value.
	L.C	Less than 200% of initial limit	
	ΔC / C	Within ±20% of initial value	
	Df (tan δ)	150% of initial limit less than	
Terminal strength	Capacitance	The measured value should be stable.	A force is applied to the terminal until it bends to 1mm and by a prescribed tool maintain the condition for 5s. (See the figure below)  (Unit : mm) F (Apply force) 1mm thickness=1.6mm 45 45
	Appearance	There should be no significant abnormality.	
Adhesiveness		The terminal should not come off.	Apply force of 5N in the two directions shown in the figure below for 10± 1s after mounting the terminal on a circuit board.  product C105 a circuit board Apply force
Dimensions		Refer to "External dimensions"	Measure using a caliper of JISB 7507 Class 2 or higher grade.
Resistance to solvents		The indication should be clear	Dip in the isopropyl alcohol for 30 ± 5s, at room temperature.
Solderability		3/4 or more surface area of the solder coated terminal dipped in the soldering bath should be covered with the new solder.	Dip speed=25± 2.5mm / s Pre-treatment(accelerated aging): Leave the sample on the boiling distilled water for 1 h. Solder temp.: 235± 5 °C Duration : 2± 0.5s Solder : H63A Flux : Rosin25% IPA75%
Vibration	Capacitance	Measure value should not fluctuate during the measurement.	Frequency : 10 to 55 to 10Hz/min. Amplitude : 1.5mm Time : 2h each in X and Y directions Mounting : The terminal is soldered on a print circuit board.
	Appearance	There should be no significant abnormality.	

Tantalum capacitors

●Standard list, TCO series

< A case : 3216 size >

Part No.	Rated Voltage 85°C	Category Voltage 105°C	Surge Voltage 85°C	Cap. 120Hz	Tolerance	Leakage Current 25°C 1WV 5min	Df 120Hz (%)			ESR 100kHz
	(V)	(V)	(V)	(μF)	(%)	(μA)	-55°C	25°C 85°C	105°C	(mΩ)
TCO A 0E 106 □	2.5	2.0	3.2	10	±20	3.0	6	6	9	500
TCO A 0E 156 □				15		3.8				
TCO A 0E 226 □				22		5.5				
TCO A 0E 336 □				33		8.3				
TCO A 0G 685 □	4	3.2	5.2	6.8	±20	3.0	6	6	9	800
TCO A 0G 106 □				10		4.0				500
TCO A 0G 156 □				15		6.0				
TCO A 0G 226 □				22		8.8				
TCO A 0G 336 □	6.3	5	8	33	±20	13.2	6	6	9	500
TCO A 0J 475 □				4.7		3.0				
TCO A 0J 685 □				6.8		4.3				
TCO A 0J 106 □				10		6.3				
TCO A 0J 156 □	10	8	13	15	±20	9.5	6	6	9	800
TCO A 0J 226 □				22		13.9				
TCO A 1A 335 □				3.3		3.3				
TCO A 1A 475 □				4.7		4.7				
TCO A 1A 685 □	10	8	13	6.8	±20	6.8	6	6	9	500
TCO A 1A 106 □				10		10.0				

□=Tolerance(M : ±20%)

●Packaging specifications

Tape [A case]

Diagram of a tape reel showing dimensions A, B, E, F, W, P1, P2, P3, and sprocket hole ϕD_o . A note indicates "Component is loadable".

Pull-out direction

Unit : [mm]

Case	A ± 0.1	B ± 0.1	W ± 0.1	E ± 0.1	F ± 0.1	P ₁ ± 0.1	P ₂ ± 0.05	P ₃ ± 0.1
A	1.9	3.5	8.0	1.75	3.5	4.0	2.0	4.0

Reel [A case]

Diagram of a reel showing dimensions 9.0 ± 1.0 , 11.4 ± 1.0 , $\phi 13 \pm 0.2$, $\phi 60 \pm 1$, $\phi 180 \pm 0.5$, and a label indicating "Labelsticking position" and "Pull direction".

EIAJ ET-7002A

●Packaging style

Case code	package	Packaging style		Symbol	Basic ordering units
A	Taping	plastic taping	φ180mmReel	R	2,000pcs

Tantalum capacitors

● Electrical characteristics and operation notes

(1) Soldering conditions (soldering temperature and soldering time)

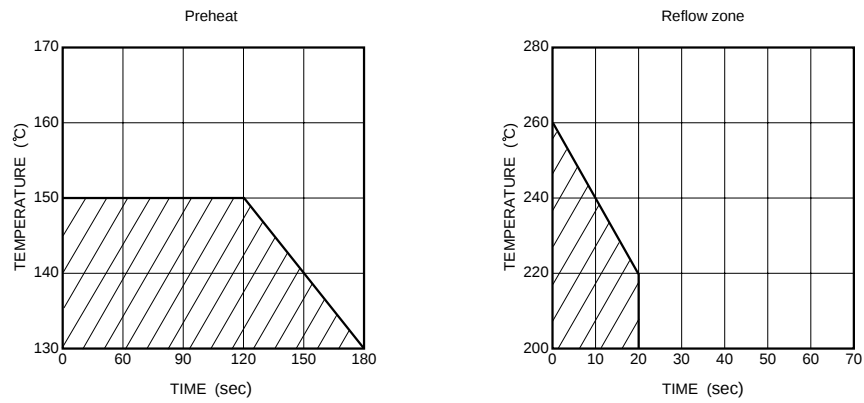


Fig.1 reflow soldering

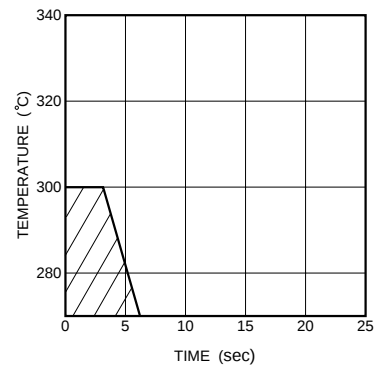


Fig.2 Hand soldering (Wattage : 30W MAX.)

(2) Leakage current-to-voltage ratio

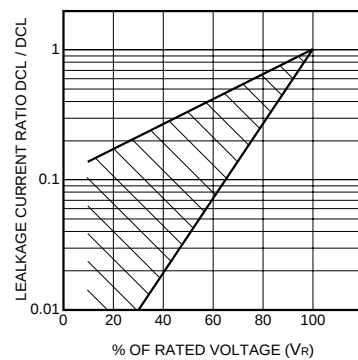


Fig.3

Tantalum capacitors

(3) Derating voltage as function of temperature

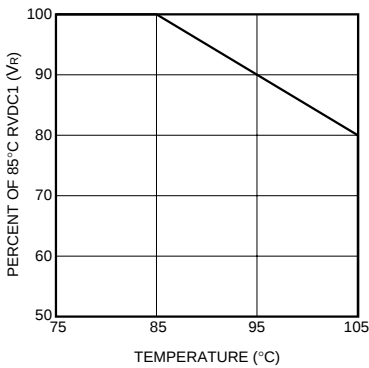


Fig.4

85°C		105°C
Rated Voltage (V.DC)	Surge Voltage (V.DC)	Category Voltage (V.DC)
2.5	3.2	2
4	5.2	3.2
6.3	8	5
10	13	8

(4) Reliability

The malfunction rate of tantalum solid state electrolytic capacitors varies considerably depending on the conditions of usage (ambient temperature, applied voltage, circuit resistance).

Formula for calculating malfunction rate

$$\lambda_p = \lambda_b \times (\pi_E \times \pi_{SR} \times \pi_Q \times \pi_{CV})$$

- λ_p : Malfunction rate stemming from operation
- λ_b : Basic malfunction rate
- π_E : Environmental factors
- π_{SR} : Series resistance
- π_Q : Level of malfunction rate
- π_{CV} : Capacitance

For details on how to calculate the malfunction rate stemming from operation, see the tantalum solid state electrolytic capacitors column in MIL-HDBK-217.

(5) Impedance frequency characteristics

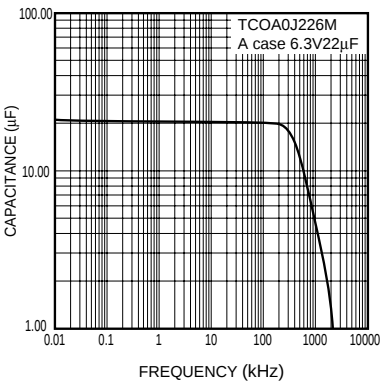


Fig.5

(6) ESR frequency characteristics

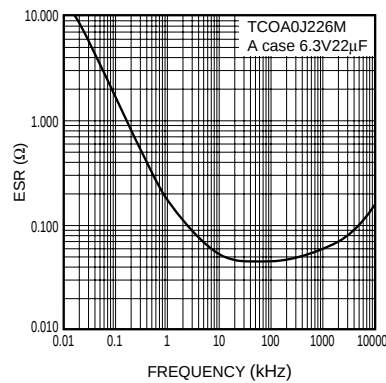


Fig.6

Tantalum capacitors

(7) Capacitance temperature characteristics 120Hz

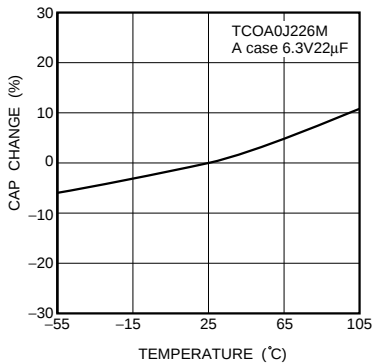


Fig.7

(8) ESR temperature characteristics 100kHz

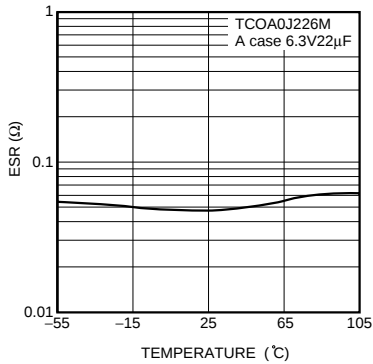


Fig.8

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