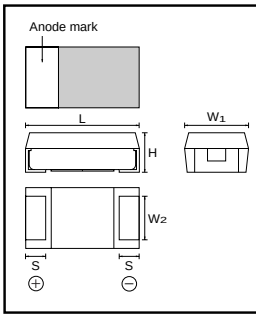
Chip tantalum capacitors

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)



(Unit : mm)

Dimensions	A case
L	3.2±0.2
W_1	1.6±0.2
W_2	1.2±0.2
H	1.6±0.2
S	0.8±0.3

●**Model name configuration**

Nominal capacitance in pF in 3 digits: 2 significant figures followed by the figure repesenting the nymber of 0's.

Series name | Case style | Nominal capacitance

T	C	O	A	1	A	1	0	6	M	8	R

Rated voltage

Code	Rated voltage (V)
0E	2.5
0G	4
0J	6.3
1A	10

Capacitance tolerance

Code	Capacitance tolerance
M	±20%

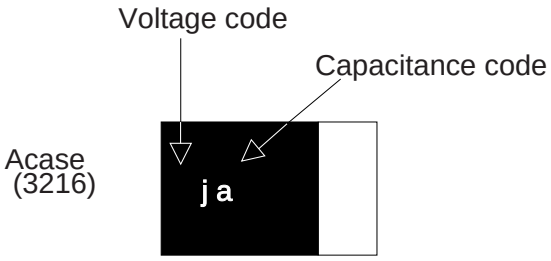
8 : Tape width
R : Positive electrode on the side opposite to sprocket hole



●Rated Table. Marking

TCO Series

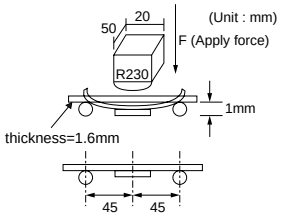
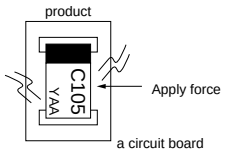
μF		Raited voltage (V.DC)			
		2.5 0E	4 0G	6.3 0J	10 1A
A	1.0				
E	1.5				
J	2.2				
N	3.3				A
S	4.7				A
W	6.8			A	A
a	10		A	A	A
e	15	A	A	A	
j	22	A	A	A	
n	33	A	A		
s	47				
w	68				



●Characteristics

Item		Performance	Test conditions (based on JIS C 5101−1 and JIS C 5101−3)
Operating Temperature		−55℃ to +105℃	Voltage reduction when temperature exceeds+85℃
Maximum operating temperature with no voltage derating		+85℃	
Rated voltage (VDC)		2.5 4 6.3 10	at 85℃
Category voltage (VDC)		2 3.2 5 8	at 105℃
Surge voltage (VDC)		3.2 5.2 8 13	at 85℃
DC Leakage current		3μF or 0.1CV whichever is greater Shown in " Standard list "	Ratedvoltage for 5min
Capacitance tolerance		±20% Shall be satisfied allowance range.	Measuring frequency : 120±12Hz Measuring voltage : 0.5Vrms +1.5 to 2V.DC Measuring circut : 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 circut : 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 nosignificant abnormality. The indications should be clear.	Dip in the solder bath Solder temp : 240±5℃ 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	

<table>
<tr><th colspan="2">Item</th><th>Performance</th><th>Test conditions
(based on JIS C 5101–1 and JIS C 5101–3)</th></tr>
<tr><td rowspan="4">Temperature cycle</td><td>Appearance</td><td>There should be no significant abnormality.</td><td rowspan="4">Repetition : 5 cycles
(1 cycle : steps 1 to 4) without discontinuation.
<table><tr><th></th><th>Temp.</th><th>Time</th></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></td></tr>
<tr><td>L.C</td><td>Less than 500% of initial limit</td></tr>
<tr><td>ΔC / C</td><td>Within±20% of intial value</td></tr>
<tr><td>Df
(tan δ)</td><td>Less than 150% of initial limit</td></tr>
<tr><td rowspan="4">Moisture resistance</td><td>Appearance</td><td>There should be no significant abnormality.
The indications should be</td><td rowspan="4">After leaving the sample under such atmospheric condition that the temperature and humidity are 60 2℃ and 90 to 95% RH,respectiveiy,for 500 12h leave it at room
temperature for 1 to 2h and then measure the sample.</td></tr>
<tr><td>L.C</td><td>Less than 150% of initial limit</td></tr>
<tr><td>ΔC / C</td><td>+30% / –20%</td></tr>
<tr><td>Df
(tan δ)</td><td>Less than 150% of initial limit</td></tr>
<tr><td rowspan="9">Temperature Stebility</td><td>Temp.</td><td>–55℃</td><td rowspan="9"></td></tr>
<tr><td>ΔC / C</td><td>Within 0/–20% of initial value</td></tr>
<tr><td>Df
(tan δ)</td><td>Shall be satisfied the voltage on " Standard list "</td></tr>
<tr><td>L.C</td><td>–</td></tr>
<tr><td>Temp.</td><td>+105℃</td></tr>
<tr><td>ΔC / C</td><td>Within +50/0% of initial value</td></tr>
<tr><td>Df
(tan δ)</td><td>Shall be satisfied the voltage on " Standard list "</td></tr>
<tr><td>L.C</td><td>Less than 1CV</td></tr>
<tr><td rowspan="4">Surge voltage</td><td>Appearance</td><td>There should be no significant avnormality.</td><td rowspan="4">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.</td></tr>
<tr><td>L.C</td><td>Less than initial limit</td></tr>
<tr><td>ΔC / C</td><td>Within± 20% of initial value</td></tr>
<tr><td>Df
(tan δ)</td><td>Less than initial limit</td></tr>
</table>

Item		Performance	Test conditions (based on JIS C 5101−1 and JIS C 5101−3)
Loading at High temperature	Appearance	There should be nosignificant 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℃, 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 perscribed tool maintain the condition for5s.(See the figure below) 
	Appearance	There should nosignificant 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. 
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 shoule not fluctuate during the measurement.	Frequency : 10 to 55 to 10Hz/min. Amplitude : 1.5mm Time : 2h each in X and Ydirections Mounting : The terminal is soldered on a print circuit board.
	Appearance	There should no significant abnormality.	

●Standard list, TCO series

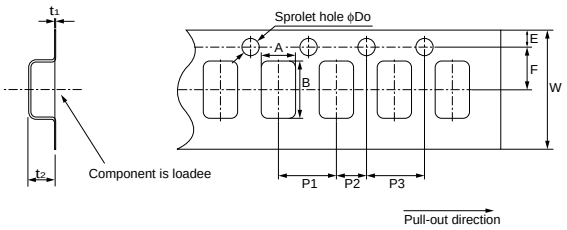
< A case : 3216 size >

Part No.	Rated Voltage 85°C (V)	Category Voltage 105°C (V)	Surge Voltage 85°C (V)	Cap. 120Hz (μF)	Tolerance (%)	Leakage Current 25°C 1WV 5min (μA)	Df 120Hz (%) –55°C	Df 120Hz (%) 25°C 85°C	Df 120Hz (%) 105°C	ESR 100kHz (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 ☐				33		13.2				
TCO A 0J 475 ☐	6.3	5	8	4.7	±20	3.0	6	6	9	800
TCO A 0J 685 ☐				6.8		4.3				
TCO A 0J 106 ☐				10		6.3				500
TCO A 0J 156 ☐				15		9.5				
TCO A 0J 226 ☐				22		13.9				
TCO A 1A 335 ☐	10	8	13	3.3	±20	3.3	6	6	9	800
TCO A 1A 475 ☐				4.7		4.7				
TCO A 1A 685 ☐				6.8		6.8				
TCO A 1A 106 ☐				10		10.0				500

☐=Tolerance(M : ±20%)

●Packaging specifications

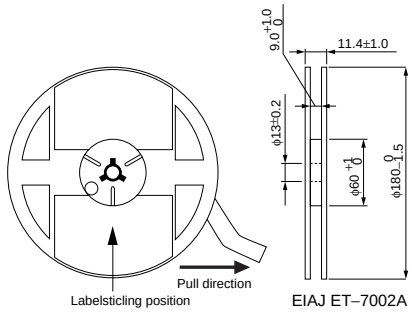
Tape [A case]



Unit : [mm]

Case	A±0.1	B±0.1	W±0.1	E±0.1	F±0.1	P1±0.1	P2±0.05	P0±0.1
A	1.9	3.5	8.0	1.75	3.5	4.0	2.0	4.0

Reek [A case]



●Packaging style

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

● **Electrical characteristics and operation notes**

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

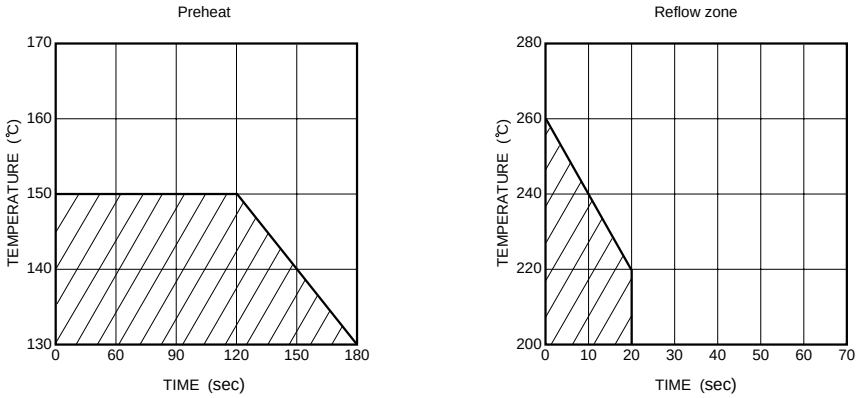


Fig.1 reflow soldering

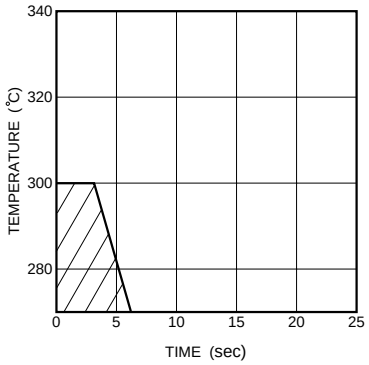


Fig.2 Hand soldering (Wattage : 30W MAX.)

(2) Leakage current-to-voltage ratio

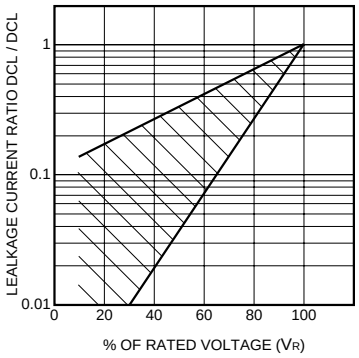


Fig.3

(3) Derating voltage as function of temperature

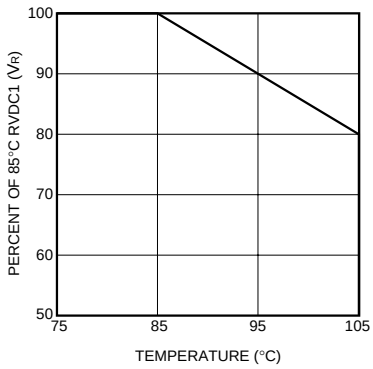


Fig.4

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

$\lambda p = \lambda b \times (\pi E \times \pi SR \times \pi Q \times \pi CV)$

- λp : Malfunction rate stemming from operation
- λb : Basic malfunction rate
- πE : Environmental factors
- πSR : Series resistance
- πQ : Level of malfunction rate
- πCV : 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

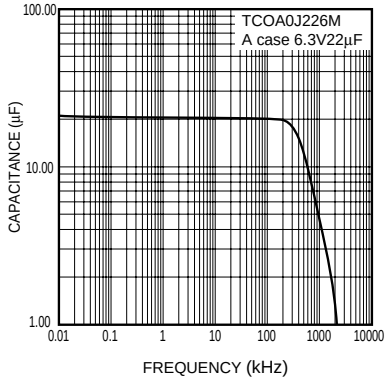


Fig.5

(6) ESR frequency characteristics

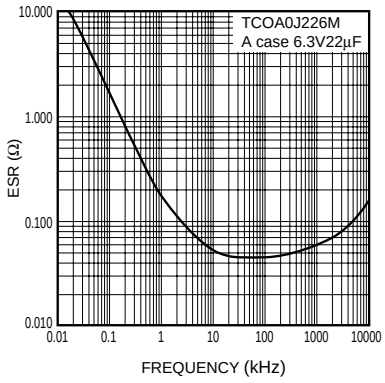


Fig.6

(7) Capacitance temperature characteristics 120Hz

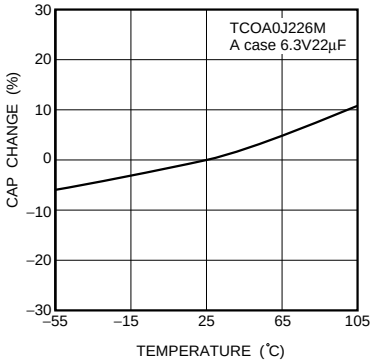


Fig.7

(8) ESR temperature characteristics 100kHz

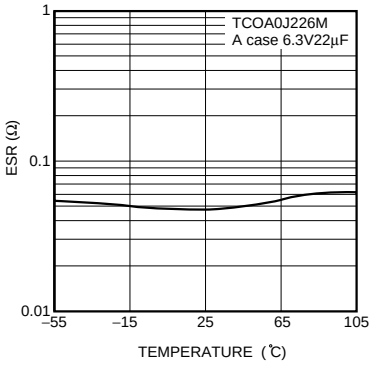


Fig.8

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