

Chip tantalum capacitors

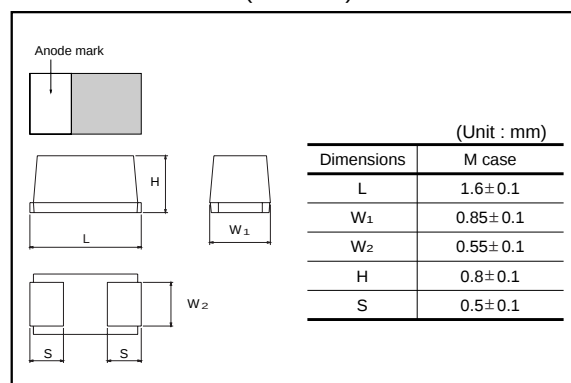
TC Series

●Features (M)

Newly designed ROHM original CSP structure (face-down terminal) provides,

- 1) Excellent adhesion.
- 2) Easy visual recognition of fillets.
- 3) Expanded capacitance range with Low ESR.

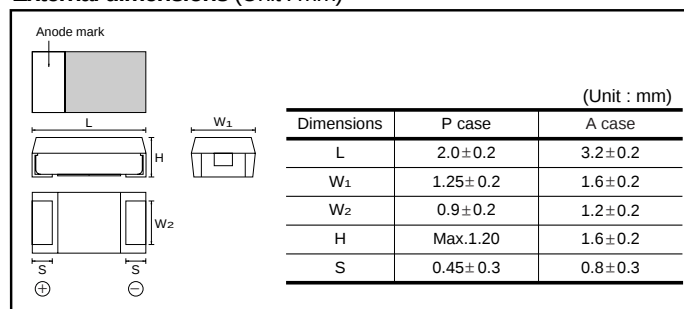
●External dimensions (Unit : mm)



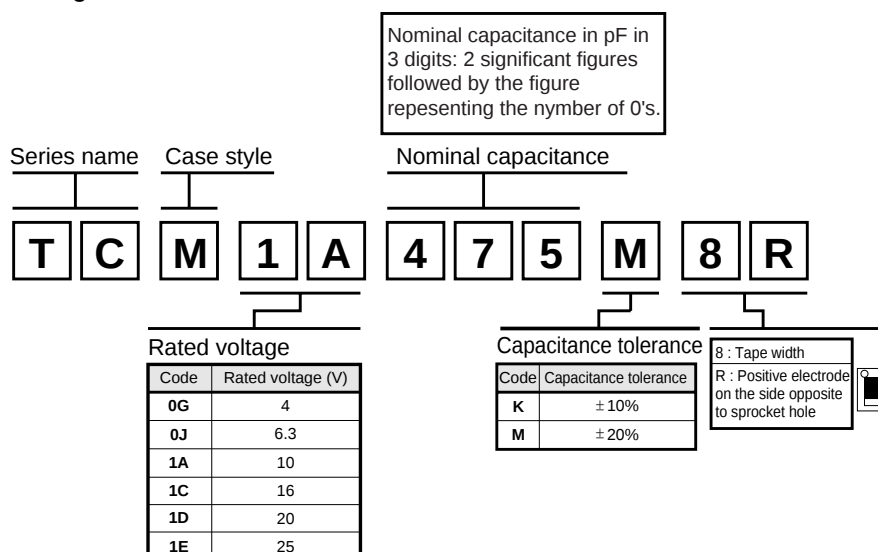
●Features (P , A)

- 1) Vital for all hybrid integrated circuits board application.
- 2) Wide capacitance range.
- 3) Screening by thermal shock.

●External dimensions (Unit : mm)



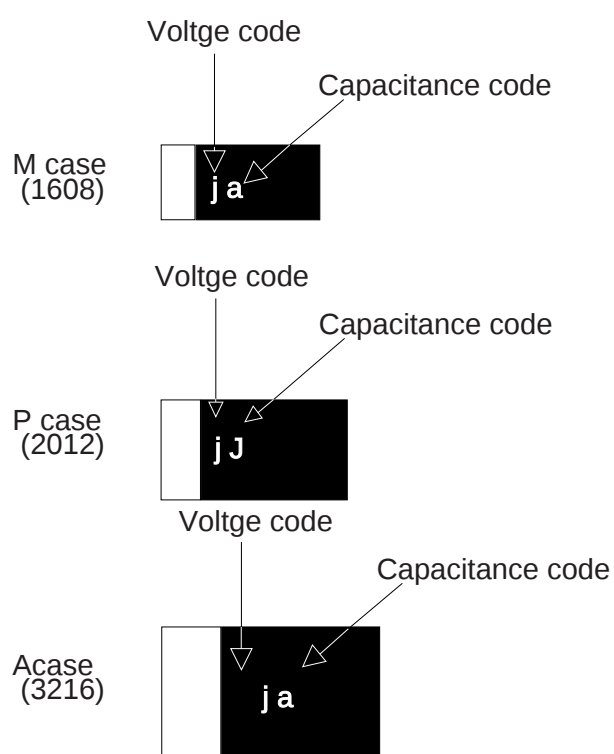
●Model name configuration



Tantalum capacitors

●Rated Table. Marking

μF		Rated voltage (V.DC)					
		4 0G	6.3 0J	10 1A	16 1C	20 1D	25 1E
A	1.0			M,P	M,P,A	P,A	P,A
E	1.5		P	P,A	A	A	A
J	2.2	P	P	M,P,A	A	A	A
N	3.3	P	P,A	P,A	A	A	A
S	4.7	M,P,A	M,P,A	M,P,A	A	A	
W	6.8	P,A	W,P,A	P,A	A		
a	10	M,P,A	M,P,A	P,A	A		
e	15	P,A	P,A	A			
j	22	M,P,A	A	A			
n	33	A	A				
s	47	A	A				
w	68	A					



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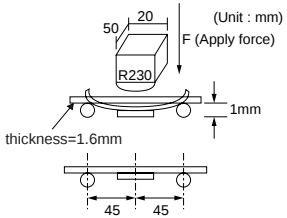
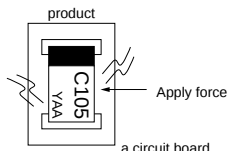
●Characteristics

Item		Performance								Test conditions (based on JIS C 5101-1 and JIS C 5101-3)	
Operating Temperature		-55℃~+125℃								Voltage reduction when temperature exceeds+85℃	
Maximum operating temperature with no voltage derating		+85℃									
Rated voltage (VDC)		M case	4	6.3	10	16			at 85℃		
		P, Acase	4	6.3	10	16	20				
Category voltage (VDC)		M case	2.5	4	6.3	10			at 125℃		
		P, Acase	2.5	4	6.3	10	13				
Surge voltage (VDC)		M case	5.2	8	13	20			at 85℃		
		P, Acase	5.2	8	13	20	26				
DC Leakage current		0.5 μF or 0.01CV whichever is greater Shown in " Standard list "								Mcase	Ratedvoltage for 5min
										P,Acase	Rated voltage for 1min
Capacitance tolerance		M case	±20% Shall be satisfied allowance range.						Measuring frequency : 120±12Hz Measuring voltage : 0.5Vrms +1.5~2V.DC Measuring circuit : DC Equivalent series circuit		
		P,Acase	±10%, ±20% Shall be satisfied allowance range.								
Tangent of loss angle (Df, tan δ)		Shall be satisfied the voltage on " Standard list "								Measuring frequency : 120±12Hz Measuring voltage : 0.5Vrms +1.5~2V.DC Measuring circuit : DC Equivalent series circuit	
Impedance		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 : 260±5℃ Duration : 5±0.5s Repetition : 1	
	L.C.	M case	Less than 200% of initial limit								
		P,Acase	Shall be satisfied the value in Item No.6								
	ΔC / C	M case	Within ±20% of initial value								
		P case	±10% of initial value								
		A case	± 5% of initial value								
	Df (tan δ)	M case	Less than 200% of initial limit								
		P case	Less than 150% of initial limit								
A case		Less than 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 1~4) 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>125±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	125±2℃	30±3min	4	Room temp.	3min.or less
		Temp.	Time																
	1	-55±3℃	30±3min																
	2	Room temp.	3min.or less																
	3	125±2℃	30±3min																
	4	Room temp.	3min.or less																
	L.C	M case	Less than 200% of initial limit																
		P , A case	Less than initial limit																
ΔC / C	M cas	Within ±20% of initial limit																	
	P case	1~10μF: within ±10% of initial value 15~22μF: within ±20% of initial value																	
	A case	TCA1A226□ , TCA0J476 □ : Within±15% of intial value Others: Within±10% of initial value																	
Df (tan δ)	M case	Less than 200% of initial limit																	
	P case	Less than 150% of initial limit																	
	A case	Less than 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 C and 90 to 95% RH,respectively,for 500 12h leave it at room temperature for 1 to 2h and then measure the sample.															
	L.C	M case	Less than 200% of initial limit																
		P , A case	Shall be satisfied the value in Item No.6																
	ΔC / C	M , P case	Within± 20% of initial limit																
		A case	Within± 10% of initial limit																
	Df (tan δ)	M case	Less than 200% of initial limit																
		P case	Less than 150% of initial limit																
		A casr	Less than initial limit																
Temperature Stebility	Temp.	-55℃																	
	ΔC / C	M , P case	Within 0/-15% of initial value																
		A case	Within 0/-12% of initial value																
	Df (tan δ)	Shall be satisfied the voltage on " Standard list "																	
	L.C	-																	
	Temp.	+85℃																	
	ΔC / C	M , P case	Within +15/0 of initial value																
		A case	Within +12/0% of initial value																
	Df (tan δ)	Shall be satisfied the voltage on " Standard list "																	
	L.C	5 μA or 0.1CV whitchever is greater																	
	Temp.	+125℃																	
	ΔC / C	M , P case	Within +20/0 of initial value																
		A case	Within +15/0% of initial value																
	Df (tan δ)	Shall be satisfied the voltage on " Standard list "																	
	L.C	6.3 μA or 0.125CV whitchever is greater																	
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	M case	Less than 200% of initial limit																
		P , A case	Less than initial limit																
	ΔC / C	M case	Within± 20% of initial value																
		P case	Within± 10% of initial value																
	Df (tan δ)	M case	Less than 200% of initial limit																
		P case	Less than 150% of initial limit																
		A case	Less than initial limit																

Tantalum capacitors

Item		Performance		Test conditions (based on JIS C 5101-1 and JIS C 5101-3)
Loading at High temperature	Appearance	M , A case	There should be nosignificant abnormality.	M , P case : 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. A case : After applying the rated voltage for 2000 ⁺⁷² 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.
		P case	There should be nosignificant abnormality. The indications should be clear.	
	L.C	M case	Less than 200% of initial limit	
		P , A case	Less than initial limit	
	ΔC / C	M case	Within± 20% of initial value	
		P case	Within± 10% of initial value	
		A case	TCA1A226 □ , TCA0J476 □ within ±15% of initial value Others within ±10% of initial value	
	Df (tan δ)	M case	Less than 200% of initial limit	
		P case	150% of initial limit less than	
A case		Less than initial limit		
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.		

Tantalum capacitors

●Standard list, TC series

< M case : 1608 size >

Part No.	Rated Voltage 85°C (V)	Category Voltage 125°C (V)	Surge Voltage 85°C (V)	Cap. 120Hz (μF)	Tolerance (%)	Leakage Current 25°C 1WV 5min (μA)	Df 120Hz (%)			Impedance 100kHz (Ω)
							-55°C	25°C 85°C	125°C	
TC M 0G 475 □	4	2.5	5.2	4.7	±20	0.5	30	20	30	9.0
TC M 0G 106 □				10						
TC M 0G 226 □				22		1.8				
TC M 0J 475 □	6.3	4	8	4.7	±20	0.5	30	20	30	9.0
TC M 0J 685 □				6.8						
TC M 0J 106 □				10		0.6				
TC M 1A 105 □	10	6.3	13	1.0	±20	0.5	15	10	15	15.0
TC M 1A 225 □				2.2			30	20	30	13.5
TC M 1A 475 □				4.7						9.0
TC M 1C 105 □	16	10	20	1.0	±20	0.5	15	10	15	15.0

□=Tolerance (M : ±20%)

Tantalum capacitors

< P case : 2012 size >

Part No.	Rated Voltage 85℃	Cstegory Voltage 125℃	Surge Voltage 85℃	Cap. 120Hz	Tolerance	Leakage Current 25℃ 1WV.60s (mA)	Df 120Hz (%)			Impedance 100kHz
	(V)	(V)	(V)	(mF)	(%)		−55℃	25℃ 85℃	125℃	(Ω)
TC P 0G 225□	4	2.5	5.2	2.2	±20,10	0.5	15	10	15	27.5
TC P 0G 335□										
TC P 0G 475□										
TC P 0G 685□										
TC P 0G 106□				30		20	30			
TC P 0G 156□										
TC P 0G 226□										
TC P 0J 155□	6.3	4	8	1.5	±20,10	0.5	15	10	15	27.5
TC P 0J 225□										
TC P 0J 335□										
TC P 0J 475□										
TC P 0J 685□				30		20	30			
TC P 0J 106□										
TC P 0J 156□										
TC P 1A 105 □	10	6.3	13	1.0	+20,10	0.5	15	10	15	27.5
TC P 1A 155 □										
TC P 1A 225 □										
TC P 1A 335 □										
TC P 1A 475 □				30			20	30		
TC P 1A 685 □										
TC P 1A 106 □										
TC P 1C 105□	16	10	20	1.0	±20,10	0.5	15	10	15	27.5

□=Tolerance (M : ±20%, K : ±10%)

Tantalum capacitors

< A case : 3216 size >

Part No.	Rated Voltage 85℃	Category Voltage 125℃	Surge Voltage 85℃	Cap. 120Hz	Tolerance	Leakage Current 25℃ 1WV 5min (μA)	Df 120Hz (%)			Impedance 100kHz
	(V)	(V)	(V)	(μF)	(%)		-55℃	25℃ 85℃	125℃	(Ω)
TC A 0G 475□	4	2.5	5.2	4.7	±20,10	0.5	10	6	8	20.0
TC A 0G 685□										
TC A 0G 106□										
TC A 0G 156□						12	8	10		
TC A 0G 226□										
TC A 0G 336□										
TC A 0G 476□										
TC A 0G 686□										
TC A 0J 335□	6.3	4	8	3.3	±20,10	0.5	10	6	8	20.0
TC A 0J 475□										
TC A 0J 685□										
TC A 0J 106□						12	8	10		
TC A 0J 156□										
TC A 0J 226□										
TC A 0J 336□										
TC A 0A 476 □										
TC A 1A 155 □	10	6.3	13	1.5	±20,10	0.5	10	6	8	20.0
TC A 1A 225 □										
TC A 1A 335 □										
TC A 1A 475 □										
TC A 1A 685 □						12	8	10		
TC A 1A 106 □										
TC A 1A 156 □										
TC A 1A 226 □										
TC A 1C 105□	16	10	20	1.0	±20,10	0.5	10	6	8	20.0
TC A 1C 155□										
TC A 1C 225□										
TC A 1C 335□										
TC A 1C 475□						0.8				
TC A 1C 685□						1.1				
TC A 1C 106□						0.6				
TC A 1D 105□	20	13	26	1.0	±20,10	0.5	10	6	8	20.0

□=Tolerance (M : ±20%,K : ±10%)

Tantalum capacitors

●Packaging specifications

Tape [M case]

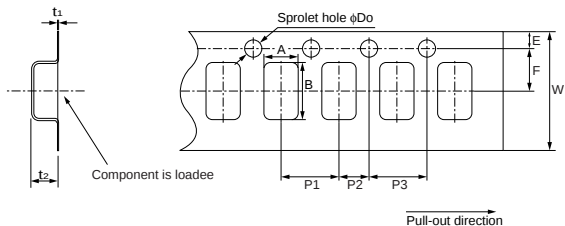
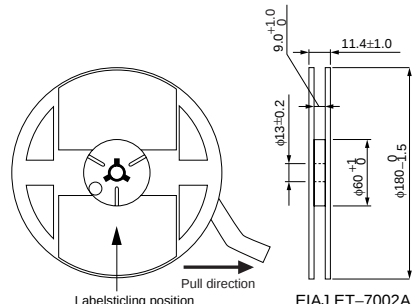
Technical drawing of a tape cross-section showing sprocket holes and dimensions. The drawing includes a sprocket hole with diameter ϕDo . Dimensions are labeled: A (width of sprocket hole), B (height of sprocket hole), E (total width), F (height of sprocket hole), W (total width), P1 (pitch), P2 (pitch), and P0 (pitch).

Unit : [mm]

Case	A ± 0.1	B ± 0.1	W ± 0.2	E ± 0.1	F ± 0.05	P1 ± 0.1	P2 ± 0.05	P0 ± 0.1
M	1.0	1.85	8.0	1.75	3.5	4.0	2.0	4.0

Reel [M case]

Technical drawing of a reel showing label sticking position and dimensions. The drawing includes a label sticking position and a pull direction arrow. Dimensions are labeled: 9.0 ± 1.0 , 11.4 ± 1.0 , $\phi 13 \pm 0.2$, $\phi 60 \pm 1.0$, and $\phi 180 \pm 1.5$. The label is EIAJ ET-7002A.

Tape [P.A case]	Reel [P.A case]																											
 Component is loadee Sprocket hole ϕD_o Pull-out direction Unit : [mm] <table><tr><th>Case</th><th>A± 0.1</th><th>B± 0.1</th><th>W± 0.1</th><th>E± 0.1</th><th>F± 0.1</th><th>P$_1 \pm 0.1$</th><th>P$_2 \pm 0.05$</th><th>P$_0 \pm 0.1$</th></tr><tr><td>P</td><td>1.55</td><td>2.3</td><td>8.0</td><td>1.75</td><td>3.5</td><td>4.0</td><td>2.0</td><td>4.0</td></tr><tr><td>A</td><td>1.9</td><td>3.5</td><td>8.0</td><td>1.75</td><td>3.5</td><td>4.0</td><td>2.0</td><td>4.0</td></tr></table>	Case	A ± 0.1	B ± 0.1	W ± 0.1	E ± 0.1	F ± 0.1	P $_1 \pm 0.1$	P $_2 \pm 0.05$	P $_0 \pm 0.1$	P	1.55	2.3	8.0	1.75	3.5	4.0	2.0	4.0	A	1.9	3.5	8.0	1.75	3.5	4.0	2.0	4.0	 Label sticking position Pull direction EIAJ ET-7002A
Case	A ± 0.1	B ± 0.1	W ± 0.1	E ± 0.1	F ± 0.1	P $_1 \pm 0.1$	P $_2 \pm 0.05$	P $_0 \pm 0.1$																				
P	1.55	2.3	8.0	1.75	3.5	4.0	2.0	4.0																				
A	1.9	3.5	8.0	1.75	3.5	4.0	2.0	4.0																				

●Packaging style

Case code	package	Packaging style		Symbol	Basic ordering units
M	Taping	plastic taping	φ180mmReel	R	4,000pcs
P					3,000pcs
A					2,000pcs

Tantalum capacitors

● Electrical characteristics and operation notes

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

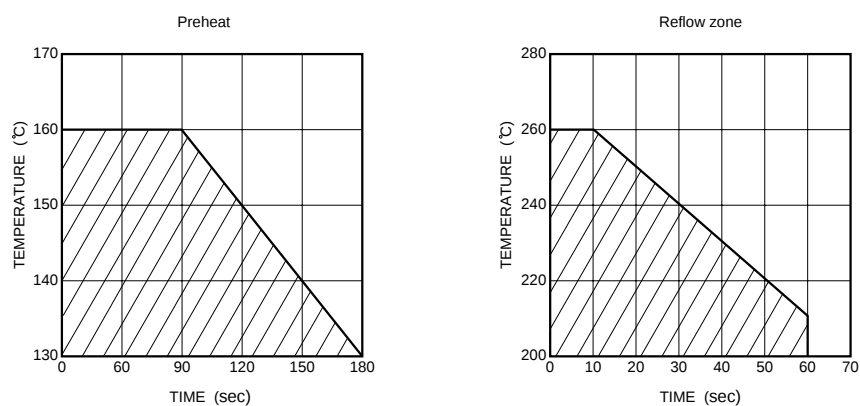


Fig.1 reflow soldering

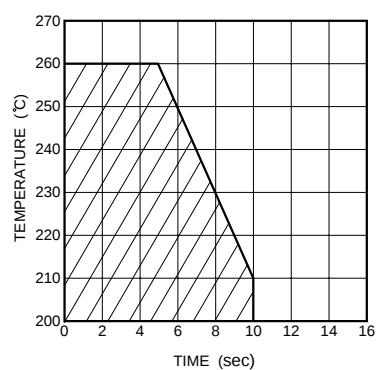


Fig.2 Flow soldering (Dip-wave soldering)

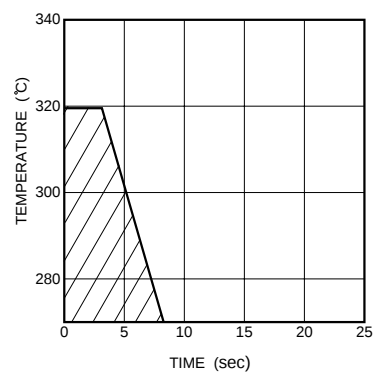


Fig.3 Hand soldering (Wattage : 30W MAX.)

(2) Leakage current-to-voltage ratio

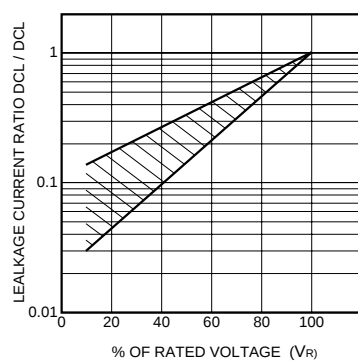


Fig.4

Tantalum capacitors

(3) Derating voltage as function of temperature

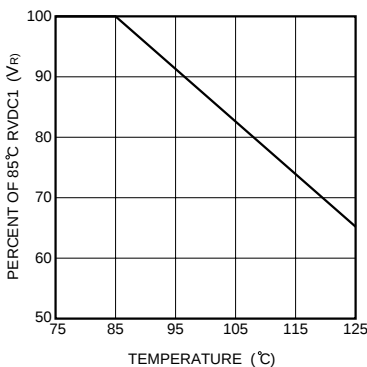


Fig.5

85 °C		125 °C	
Rated Voltage (V.DC)	Surge Voltage (V.DC)	Category Voltage (V.DC)	Surge Voltage (V.DC)
4	5.2	2.5	3.4
6.3	8	4	5
10	13	6.3	9
16	20	10	12
20	26	13	16

(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.

Malfunction rate as function of operating temperature and rated voltage

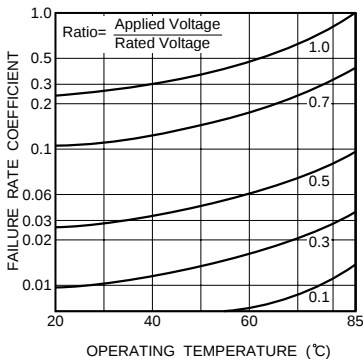


Fig.6

Malfunction rate as function of circuit resistance (Ω/V)

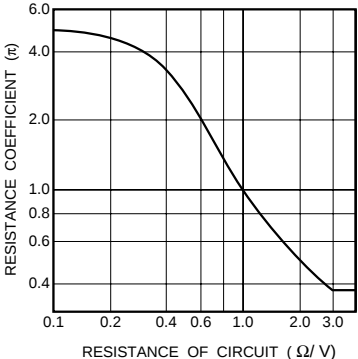


Fig.7

Tantalum capacitors

(5) Maximum power dissipation

Warming of the capacitor due to ripple voltage balances with warming caused by Joule heating and by radiated heat. Maximum allowable warming of the capacitor is to 5°C above ambient temperature. When warming exceeds 5°C, it can damage the dielectric and cause a short circuit.

$$\text{Power dissipation (P)} = I^2 \cdot R$$

Ripple current

P : As shown in table at right

R : Equivalent series resistance

Notes:

1. Please be aware that when case size is changed, maximum allowable power dissipation is reduced.
2. Maximum power dissipation varies depending on the package. Be sure to use a case which will keep warming within the limits shown in the table below.

Allowable power dissipation (W) and maximum temperature rising

Temp.	+25°C	+55°C	+85°C	+125°C
Case				
P case (2012)	0.025	0.022	0.020	0.010
A case (3216)	0.070	0.063	0.056	0.028
Max. Temp Rise [°C]	5	5	5	2

(6) Impedance frequency characteristics

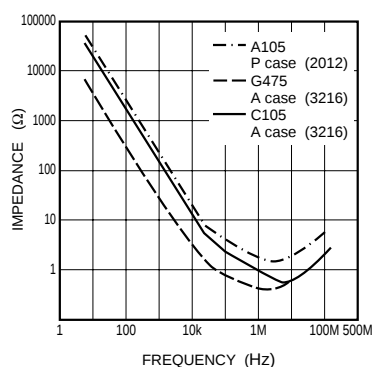


Fig.10

(7) ESR frequency characteristics

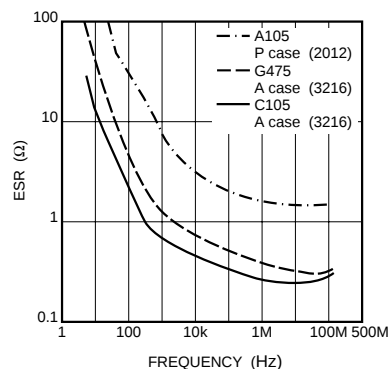


Fig.11

(8) Temperature characteristics

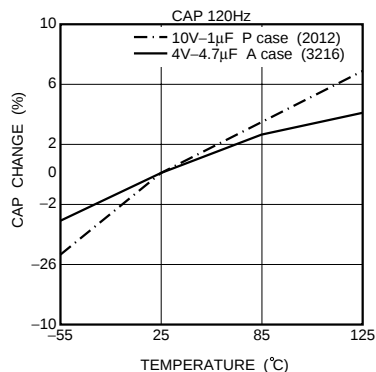


Fig.12

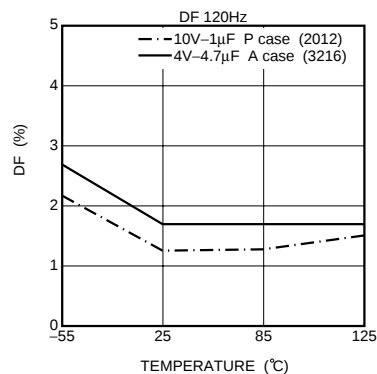


Fig.13

Tantalum capacitors

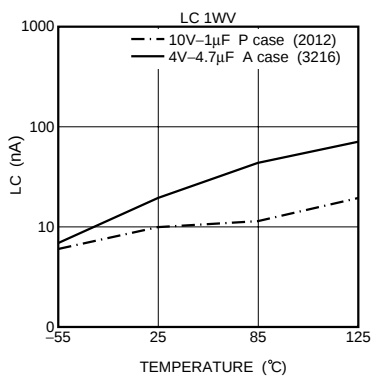


Fig.14

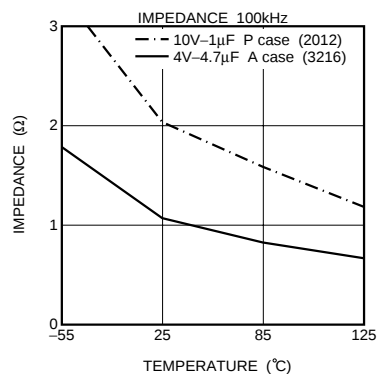


Fig.15

Rush current

The rush current is in inverse proportion to the ESR.
The excessive rush current may cause a damage.

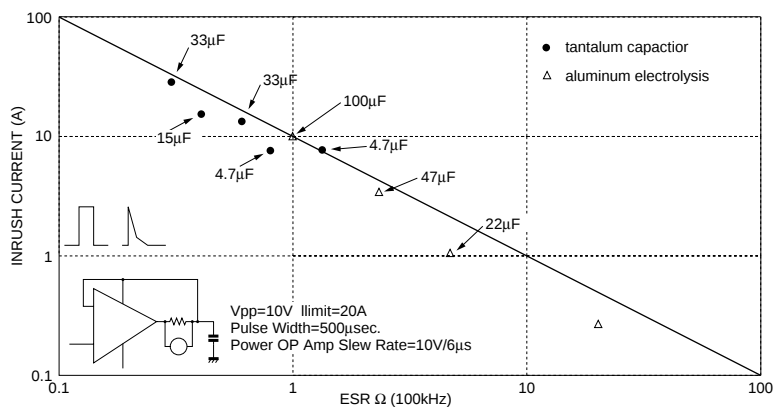


Fig. 16 Max. rush current and ESR

The rush current may be reduced by the protection resistors

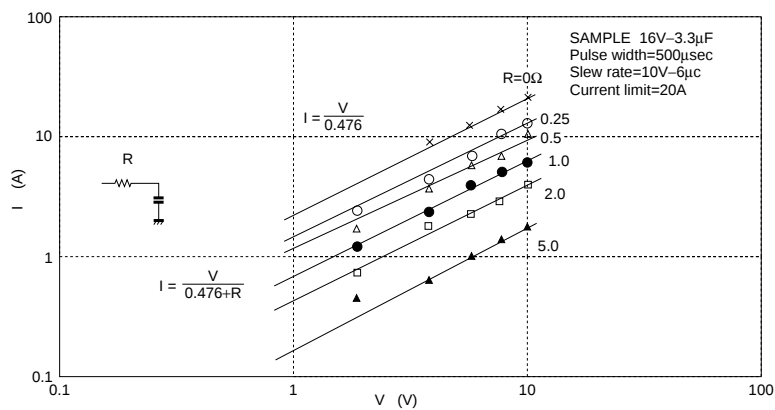


Fig. 17 Change in I max by protection resistors

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