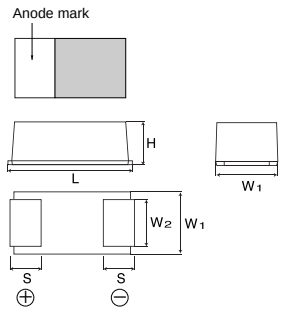
Chip tantalum capacitors

TCT Series AL Case

●**Features (AL)**

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

●**Dimensions** (Unit : mm)



(Unit : mm)

Dimensions	AL case
L	3.2±0.2
W1	1.6±0.2
W2	1.2±0.2
H	1.1±0.1
S	0.8±0.2

●**Part No. Explanation**

T	C	T	A	L	1	A	4	7	6	M	8	R
①			②		③		④			⑤	⑥	

① Series name
TCT

② Case style
AL

③ Rated voltage

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

④ Nominal capacitance
Nominal capacitance in pF in 3 digits:
2 significant figures followed by the figure representing the number of 0's.

⑤ Capacitance tolerance
M : ±20%

⑥ Taping
8 : Tape width
R : Positive electrode on the side opposite to sprocket hole

● **Rated table**

(μF)	Rated voltage (V)							
	2.5 0E	4 0G	6.3 0J	10 1A	16 1C	20 1D	25 1E	35 1V
1.0 (105)								*AL
2.2 (225)								AL
3.3 (335)								AL
4.7 (475)							AL	
6.8 (685)							AL	
10 (106)						AL		
15 (156)					AL			
22 (226)					AL			
33 (336)				AL				
47 (476)				AL				
68 (686)			AL					
100 (107)		AL	AL					
150 (157)		AL	*AL					
220 (227)	AL	AL						
330 (337)	*AL							

Remark) Case size codes (AL) in the above show products line-up.
* Under development

● **Marking**

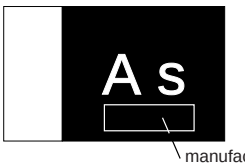
The indications listed below should be given on the surface of a capacitor.

(1) Polarity : The polarity should be shown by ☐ bar. (on the anode side)
(2) Rated DC voltage : Due to the small size of AL case, a voltage code is used as shown below.
(3) Visual typical example (1) voltage code (2) capacitance code

Voltage Code	Rated DC Voltage (V)
e	2.5
g	4
j	6.3
A	10
C	16
D	20
E	25
V	35

Capacitance Code	Nominal Capacitance (μF)
A	1.0
J	2.2
N	3.3
S	4.7
W	6.8
a	10
e	15
j	22
n	33
s	47
w	68
$\bar{a}$	100
$\bar{e}$	150
$\bar{j}$	220
$\bar{n}$	330

[AL case] note 1) $\frac{A}{(1)}\ \frac{s}{(2)}$



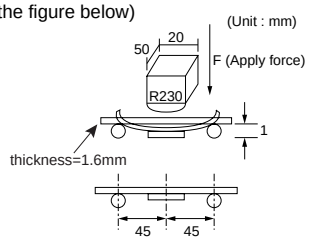
manufacture code

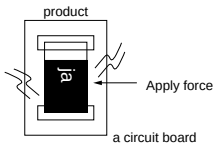
note 2) voltage code and capacitance code are variable with parts number

● Characteristics

Item		Performance	Test conditions (based on JIS C 5101–1 and JIS C 5101–3)
Operating Temperature		–55°C to +125°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 | 16 | 20 | 25 | 35	at 85°C
Category voltage (VDC)		1.6 | 2.5 | 4 | 6.3 | 10 | 13 | 16 | 22	at 125°C
Surge voltage (VDC)		3.2 | 5.0 | 8 | 13 | 20 | 26 | 32 | 44	at 85°C
DC Leakage current		Shall be satisfied the voltage on " Standard list "	As per 4.9 JIS C 5101-1 As per 4.5.1 JIS C 5101-3 Voltage : Rated voltage for 5min
Capacitance tolerance		Shall be satisfied allowance range. ±20%	As per 4.7 JIS C 5101-1 As per 4.5.2 JIS C 5101-3 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 "	As per 4.8 JIS C 5101-1 As per 4.5.3 JIS C 5101-3 Measuring frequency : 120±12Hz Measuring voltage : 0.5Vrms +1.5 to 2V.DC Measuring circuit : DC Equivalent series circuit
Impedance		Shall be satisfied the voltage on " Standard list "	As per 4.10 JIS C 5101-1 As per 4.5.4 JIS C 5101-3 Measuring frequency : 100±10kHz Measuring voltage : 0.5Vrms or less Measuring circuit : DC Equivalent series circuit
Resistance to Soldering heat	Appearance	There should be no significant abnormality. The indications should be clear.	As per 4.14 JIS C 5101-1 As per 4.6 JIS C 5101-3 Dip in the solder bath Solder temp : 260±5°C Duration : 5±0.5s Repetition : 1 After the specimens, leave it at room temperature for over 24h and then measure the sample.
	L.C.	Less than 200% of initial limit	
	ΔC / C	Within ±20% of initial value	
	Df (tan δ)	Less than 200% of initial limit	
Temperature cycle	Appearance	There should be no significant abnormality. The indications should be clear.	As per 4.16 JIS C 5101-1 As per 4.10 JIS C 5101-3 Repetition : 5 cycles (1 cycle : steps 1 to 4) without discontinuation. After the specimens, leave it at room temperature for over 24h and then measure the sample.
	L.C.	Less than 200% of initial limit	
	ΔC / C	Within ±20% of initial value	
	Df (tan δ)	Less than 200% of initial limit	
Moisture resistance	Appearance	There should be no significant abnormality. The indications should be clear.	As per 4.22 JIS C 5101-1 As per 4.12 JIS C 5101-3 After leaving the sample under such atmospheric condition that the temperature and humidity are 60±2°C and 90 to 95% RH, respectiveiy, for 500±12h leave it at room temperature for over 24h and then measure the sample.
	L.C.	Less than 200% of initial limit	
	ΔC / C	Within ±20% of initial value	
	Df (tan δ)	Less than 200% of initial limit	

	Temp.	Time
1	–55± 3°C	30±3min.
2	Room temp.	3min. or less
3	125± 2°C	30±3min.
4	Room temp.	3min. or less

Item		Performance	Test conditions (based on JIS C 5101−1 and JIS C 5101− 3)
Temperature Stability	Temp.	−55°C	As per 4.29 JIS C 5101-1 As per 4.13 JIS C 5101-3
	ΔC / C	Within 0/−15% of initial value	
	Df (tan δ)	Shall be satisfied the voltage on " Standard list "	
	L.C.	−	
	Temp.	+85°C	
	ΔC / C	Within +15/0% of initial value	
	Df (tan δ)	Shall be satisfied the voltage on " Standard list "	
	L.C.	5μA or 0.1CV whichever is greater	
	Temp.	+125°C	
	ΔC / C	Within +20/0% of initial value	
	Df (tan δ)	Shall be satisfied the voltage on " Standard list "	
	L.C.	6.3μA or 0.125CV whichever is greater	
Surge voltage	Appearance	There should be no significant abnormality.	As per 4.26JIS C 5101-1 As per 4.14JIS C 5101-3 Apply the specified surge voltage every 5±0.5 min. for 30±5 s. each time in the atmospheric condition of 85±2°C. Repeat this procedure 1,000 times. After the specimens, leave it at room temperature for over 24h and then measure the sample.
	L.C.	Less than 200% of initial value	
	ΔC / C	Within ±20% of initial value	
	Df (tan δ)	Less than 200% of initial limit	
Loading at High temperature	Appearance	There should be no significant abnormality.	As per 4.23 JIS C 5101-1 As per 4.15 JIS C 5101-3 After applying the rated voltage for 2000+72/0 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 over 24h and measure the value.
	L.C.	Less than 200% of initial limit	
	ΔC / C	Within ±20% of initial value	
	Df (tan δ)	Less than 200% of initial limit	
Terminal strength	Capacitance	The measured value should be stable.	As per 4.35 JIS C 5101-1 As per 4.9 JIS C 5101-3 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) 
	Appearance	There should be no significant abnormality.	

Item		Performance	Test conditions (JIS C 5101–1 and JIS C 5101– 3)
Adhesiveness		The terminal should not come off.	As per 4.34 JIS C 5101-1 As per 4.8 JIS C 5101-3 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 JIS B 7507 Class 2 or higher grade.
Resistance to solvents		The indication should be clear	As per 4.32 JIS C 5101-1 As per 4.18 JIS C 5101-3 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.	As per 4.15.2 JIS C 5101-1 As per 4.7 JIS C 5101-3 Dip speed=25±2.5mm / s Pre–treatment(accelerated aging): Leave the sample on the boiling distilled water for 1 h. Solder temp. : 245±5°C Duration : 3±0.5s Solder : M705 Flux : Rosin 25% IPA 75%
Vibration	Capacitance	Measure value should not fluctuate during the measurement.	As per 4.17 JIS C 5101-1 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.	

● Standard products list, TCT series

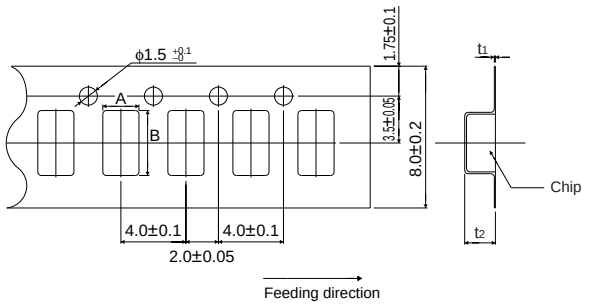
Part No.	Rated voltage 85°C (V)	Category voltage 125°C (V)	Surge voltage 85°C (V)	Cap. 120Hz (μF)	Tolerance (%)	Leakage current 25°C 1WV.5min (μA)	Df 120Hz (%)			Impedance 100kHz
							–55°C	25°C 85°C	125°C	(Ω)
TCT AL 0E 227☐	2.5	1.6	3.3	220	±20	5.5	35	20	25	2.5
∗TCT AL 0E 337☐	2.5	1.6	3.3	330	±20	16.5	80	30	40	2.5
TCT AL 0G 107☐	4	2.5	5.2	100	±20	4.0	35	20	25	3.0
∗TCT AL 0G 157☐	4	2.5	5.2	150	±20	6.0	35	20	25	2.7
TCT AL 0G 227☐	4	2.5	5.2	220	±20	20	35	20	25	2.5
TCT AL 0J 686☐	6.3	4	8.0	68	±20	4.3	35	20	25	4.0
TCT AL 0J 107☐	6.3	4	8.0	100	±20	6.3	34	18	24	3.0
TCT AL 1A 336☐	10	6.3	13	33	±20	3.3	30	15	20	4.0
TCT AL 1A 476☐	10	6.3	13	47	±20	4.7	35	20	25	4.0
TCT AL 1C 156☐	16	10	20	15	±20	2.4	30	15	20	4.0
TCT AL 1C 226☐	16	10	20	22	±20	3.6	35	20	25	4.0
TCT AL 1D 106☐	20	13	26	10	±20	2.0	30	15	20	8.0
TCT AL 1E 475☐	25	16	32	4.7	±20	1.2	30	15	20	8.0
TCT AL 1E 685☐	25	16	32	6.8	±20	1.7	30	15	20	8.0
TCT AL 1V 225☐	35	22	45	2.2	±20	0.8	30	15	20	8.0
TCT AL 1V 335☐	35	22	45	3.3	±20	1.2	30	15	20	8.0

☐=Tolerance (M : ±20%)
∗ : Under development

● **Packaging specifications**

Case code	A±0.1	B±0.1	t_1±0.05	t_2±0.1
AL	1.9	3.5	0.25	1.3

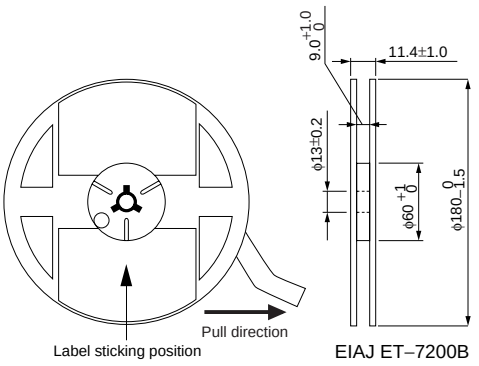
Taping [AL case]



● **Packaging style**

Case code	Packaging	Packaging style		Symbol	Basic ordering units
AL case	Taping	plastic taping	ϕ180mm Reel	R	3,000pcs

Reel [AL case]



● **Electrical characteristics and operation note**

(1) Leakage current-to-voltage ratio

The leakage current increases exponentially to applied voltage. If the leakage current is problem, use it at low voltage, please.

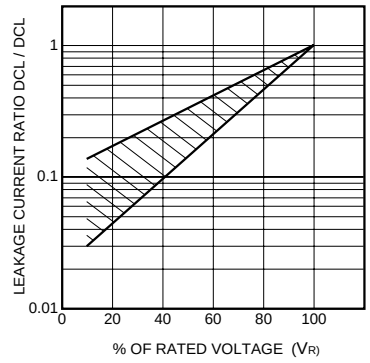


Fig.1

(2) Derating voltage as function of temperature

Please don't forget voltage derating in design.

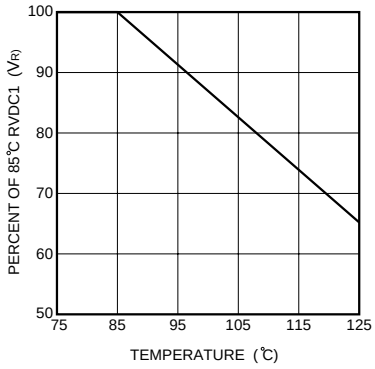


Fig.2

85℃		125℃	
Rated Voltage (V.DC)	Surge Voltage (V.DC)	Category Voltage (V.DC)	Surge Voltage (V.DC)
2.5	3.2	1.6	2.0
4	5	2.5	3.2
6.3	8	4	5
10	13	6.3	8
16	20	10	13
20	26	13	16
25	32	16	20
35	44	22	28

(3) 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

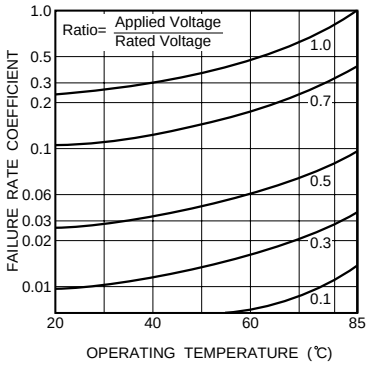


Fig.3

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

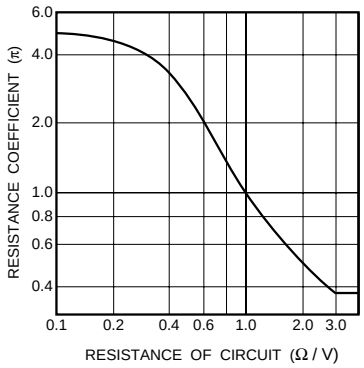


Fig.4

(4) 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.

Power dissipation (P) = $I^2 \bullet R$

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. / Case	+25℃	+55℃	+85℃	+125℃
AL case (3216)	0.053	0.047	0.042	0.021
Max. Temp Rise [˚C]	5	5	5	2

(5) Frequency characteristics

Please consider frequency characteristics in design. Below figure are example of Impedance an ESR.

Impedance frequency characteristics

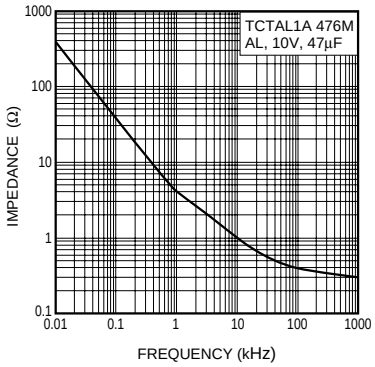


Fig.5

ESR frequency characteristics

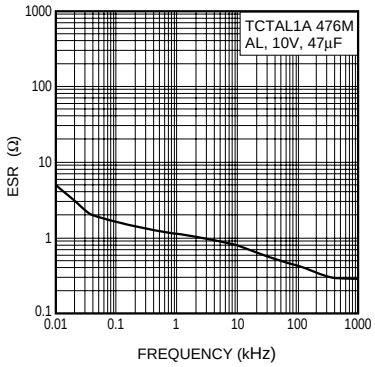


Fig.6

(6) Temperature characteristics

Please consider temperature characteristics in design below figures are example of TCTAL1A476.

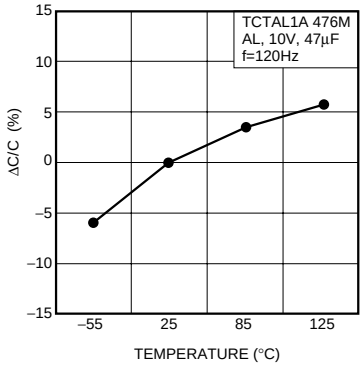


Fig.7

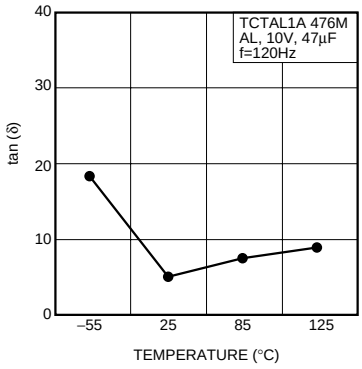


Fig.8

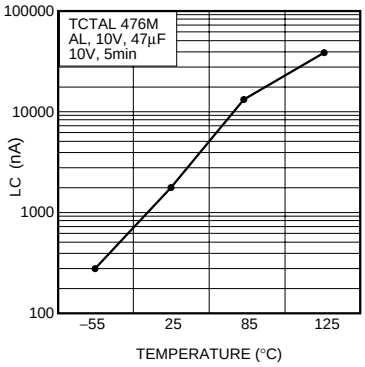


Fig.9

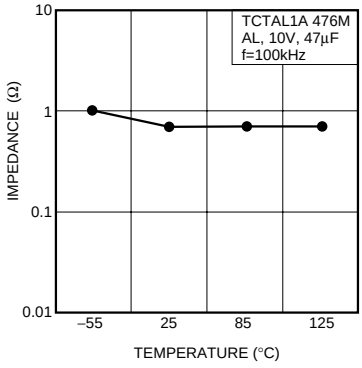


Fig.10

Notes

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