OUTLINE (Type TCB)

Type TCB is a tantalum solid electrolytic capacitor with face-down terminal which uses conductive polymer as cathode layer.
Their equivalent series resistance (ESR) is extremely lowered with characteristics of the polymer having high electric conductivity.
This ensures higher permissible ripple current and excellent noise absorption performance on high-frequency circuits.

APPLICATION

Mobile phones, digital cameras, high-performance portable equipments, personal computers, digital TV sets, DC/DC converters, regulators and peripherals

FEATURES

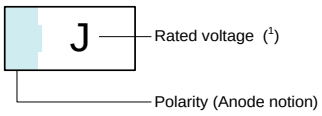
1. Low ESR and Low impedance
   Using a conductive polymer as cathode layer makes low ESR and impedance possible.
   Type TCB makes high permissible ripple current and is suitable for noise bypass application.
2. Stable ESR over temperature.
   ESR is extremely stable from low temperature through high temperature.
3. Ultra Compact and Large capacitance
   The face-down terminal structure makes it possible to design land almost in same size as terminals. As result, components can be downsized, and mounting area can be reduced to 1/2 to 1/3 compared to the conventional structures.
4. Flame Retardancy
   Type TCB offers very safe characteristics which makes ignition and smoking harder by taking advantages of characteristics of conductive polymer if the capacitor be short-circuited.
5. Perfect Lead Free and RoHS Compliant.

RATING

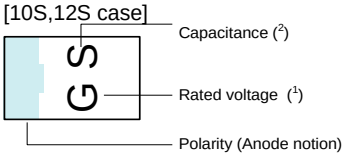
Item	Rating
Failure Rate Level	1% / 1000 h
Category Temperature Range	-55 to +105°C (to be used at derated voltage when temperature exceeds 85°C)
Rated Voltage	2.5－4－6.3－10 VDC
Derated Voltage	2.0－3.2－5.0－8.0 VDC (105°C)
Capacitance	4.7～68 μF
Capacitance Tolerances	±20% (M)

MARKING

[09M case]



[10S,12S case]



Note(1) Rated voltage is described by alphabet, as shown below.

Rated voltage codes

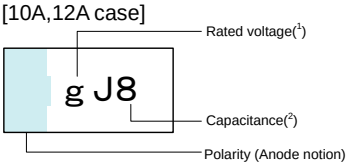
Code	e	G	J	A
Rated Voltage VDC	2.5	4	6.3	10

(2)Capacitance is described by alphabet or alphabet attached upper-bar, as shown below.

Capacitance codes

Code	A	E	J	N	S	W
Capacitance μF	1	1.5	2.2	3.3	4.7	6.8
Code	$\overline{A}$	$\overline{E}$	$\overline{J}$	$\overline{N}$	$\overline{S}$	$\overline{W}$
Capacitance μF	10	15	22	33	47	68

[10A,12A case]



Note(1) Rated voltage is described by alphabet, as shown below.

Rated voltage codes

Code	e	g	j	A
Rated Voltage VDC	2.5	4	6.3	10

(2)Capacitance is described by alphabet and numeral, as shown below.

Capacitance codes

Code	A7	E7	J7	N7	S7	W7
Capacitance μF	10	15	22	33	47	68
Code	A8	E8	J8			
Capacitance μF	100	150	220			

ORDERING INFORMATION

TCB	1002	226	M	R	10A	0150
TYPE	RATED VOLTAGE	CAPACITANCE	CAPACITANCE TOLERANCE	STYLE OF REELED PACKAGE	CASE CODE	ESR（mΩ）

Rated voltage	Marking
2.5V	2501
4V	4001
6.3V	6301
10V	1002

Capacitance	Marking
4.7 μF	475
6.8 μF	685
10μF	106
15μF	156
22μF	226
33μF	336
47μF	476
68μF	686

Capacitance Tolerance	Marking
±20%	M

Anode Notation	Reel Size	Code
Feed hole: -	φ180 Reel	R

Case Code	Height of component max. (mm)	EIA Code
09M	0.9	1608
10S	1.0	2012
12S	1.2	2012
10A	1.0	3216L
12A	1.2	3216L

Note : For a capacitor with special requirements from customers, a 2-digit specific numbers will be added between the case code and the ESR for our product management.

STANDARD RATING

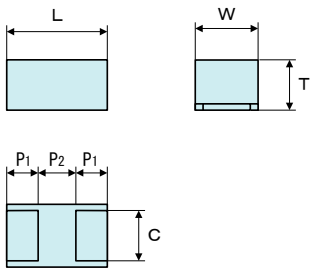
November,2010

R.V.(VDC) / Cap.(μF)	2.5	4	6.3	10
4.7	09M(200,500)	09M(200,500)	09M(200,500)	09M(200,500)
6.8	09M(200,500)	09M(200,500)	09M(200,500)	09M(200,500)
10	09M(200,500)	09M(200,500)	09M(200,500)	
15	09M(200,500)	09M(200,500)		
22	09M(200,500)			12S(150)
47				12A(150,250)
68			12A(150)	

LOW PROFILE RATING

R.V.(VDC) / Cap.(μF)	2.5	4	6.3	10
10				
15				
22			10S(150)	10A(150)
33				
47				

DIMENSIONS



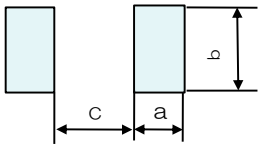
[Standard Rating] (mm)

Case Code	EIA Code	Height (max.)	L ± 0.1	W ± 0.1	T ± 0.1	P_1 ± 0.1	P_2 ± 0.1	C ± 0.1
09M	1608	0.9	1.6	0.85	0.8	0.5	0.65	0.7
12S	2012	1.2	2.0	1.25	1.1	0.5	1.05	0.9
12A	3216L	1.2	3.2	1.6	1.1	0.8	1.65	1.2

[Low Profile Rating]

Case Code	EIA Code	Height (max.)	L ± 0.1	W ± 0.1	T ± 0.1	P_1 ± 0.1	P_2 ± 0.1	C ± 0.1
10S	2012	1.0	2.0	1.25	0.9	0.5	1.05	0.9
10A	3216L	1.0	3.2	1.6	0.9	0.8	1.65	1.2

RECOMMENDED PAD DIMENSIONS



Case Code	a	b	c
09M	0.50 or more	0.65	0.65
10S,12S	0.50 or more	0.8	1.05
10A,12A	0.80 or more	1.1	1.65

In order to expect the self alignment effect, it is recommended that the land width is almost the same size as terminal of capacitor, and space between lands(c) nearly equal to the space between terminals for appropriate soldering.
Adjust the mask opening so that the mask thickness is equivalent to 100 μm.

CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS

November,2010

Catalog number (1)	Rated Voltage (VDC)	Capacitance (μF)	Tolerances (±%)	Case Code	Lct. (μA)			Max. Dissipation Factor			ESR (mΩ) 100 kHz	Max. permissible Ripple Current (2) (mArms) 100 kHz
					20℃	85℃	105℃	-55℃	20℃	105℃		
TCB 2501 475 M _1 09M 0500	2.5	4.7	20	09M	1.18	11.8	11.8	0.10	0.10	0.15	500	316
TCB 2501 475 M _1 09M 0200	↓	4.7	↓	09M	1.18	11.8	11.8	0.10	0.10	0.15	200	500
TCB 2501 685 M _1 09M 0500	↓	6.8	↓	09M	1.70	17.0	17.0	0.10	0.10	0.15	500	316
TCB 2501 685 M _1 09M 0200	↓	6.8	↓	09M	1.70	17.0	17.0	0.10	0.10	0.15	200	500
TCB 2501 106 M _1 09M 0500	↓	10	↓	09M	2.50	25.0	25.0	0.10	0.10	0.15	500	316
TCB 2501 106 M _1 09M 0200	↓	10	↓	09M	2.50	25.0	25.0	0.10	0.10	0.15	200	500
TCB 2501 156 M _1 09M 0500	↓	15	↓	09M	3.75	37.5	37.5	0.10	0.10	0.15	500	316
TCB 2501 156 M _1 09M 0200	↓	15	↓	09M	3.75	37.5	37.5	0.10	0.10	0.15	200	500
TCB 2501 226 M _1 09M 0500	↓	22	↓	09M	5.50	55.0	55.0	0.10	0.10	0.15	500	316
TCB 2501 226 M _1 09M 0200	↓	22	↓	09M	5.50	55.0	55.0	0.10	0.10	0.15	200	500
TCB 4001 475 M _1 09M 0500	4	4.7	20	09M	1.88	18.8	18.8	0.10	0.10	0.15	500	316
TCB 4001 475 M _1 09M 0200	↓	4.7	↓	09M	1.88	18.8	18.8	0.10	0.10	0.15	200	500
TCB 4001 685 M _1 09M 0500	↓	6.8	↓	09M	2.72	27.2	27.2	0.10	0.10	0.15	500	316
TCB 4001 685 M _1 09M 0200	↓	6.8	↓	09M	2.72	27.2	27.2	0.10	0.10	0.15	200	500
TCB 4001 106 M _1 09M 0500	↓	10	↓	09M	4.00	40.0	40.0	0.10	0.10	0.15	500	316
TCB 4001 106 M _1 09M 0200	↓	10	↓	09M	4.00	40.0	40.0	0.10	0.10	0.15	200	500
TCB 4001 156 M _1 09M 0500	↓	15	↓	09M	6.00	60.0	60.0	0.10	0.10	0.15	500	316
TCB 4001 156 M _1 09M 0200	↓	15	↓	09M	6.00	60.0	60.0	0.10	0.10	0.15	200	500
TCB 6301 475 M _1 09M 0500	6.3	4.7	20	09M	2.96	29.6	29.6	0.10	0.10	0.15	500	316
TCB 6301 475 M _1 09M 0200	↓	4.7	↓	09M	2.96	29.6	29.6	0.10	0.10	0.15	200	500
TCB 6301 685 M _1 09M 0500	↓	6.8	↓	09M	4.28	42.8	42.8	0.10	0.10	0.15	500	316
TCB 6301 685 M _1 09M 0200	↓	6.8	↓	09M	4.28	42.8	42.8	0.10	0.10	0.15	200	500
TCB 6301 106 M _1 09M 0500	↓	10	↓	09M	6.30	63.0	63.0	0.10	0.10	0.15	500	316
TCB 6301 106 M _1 09M 0200	↓	10	↓	09M	6.30	63.0	63.0	0.10	0.10	0.15	200	500
TCB 6301 686 M _1 12A 0150	↓	68	↓	12A	42.8	428	428	0.08	0.08	0.12	150	721
TCB 1002 475 M _1 09M 0500	10	4.7	20	09M	4.70	47.0	47.0	0.10	0.10	0.15	500	316
TCB 1002 475 M _1 09M 0200	↓	4.7	↓	09M	4.70	47.0	47.0	0.10	0.10	0.15	200	500
TCB 1002 685 M _1 09M 0500	↓	6.8	↓	09M	6.80	68.0	68.0	0.10	0.10	0.15	500	316
TCB 1002 685 M _1 09M 0200	↓	6.8	↓	09M	6.80	68.0	68.0	0.10	0.10	0.15	200	500
TCB 1002 226 M _1 12S 0150	↓	22	↓	12S	22.0	220	220	0.06	0.06	0.09	150	658
TCB 1002 476 M _1 12A 0150	↓	47	↓	12A	47.0	470	470	0.08	0.08	0.12	150	721
TCB 1002 476 M _1 12A 0250	↓	47	↓	12A	47.0	470	470	0.08	0.08	0.12	250	558

Notes : (1) _1:No code for single item. 'R' for taping specification.
(2) Reference value.

CATALOG NUMBERS AND RATING OF LOW PROFILE

Nobember,2010

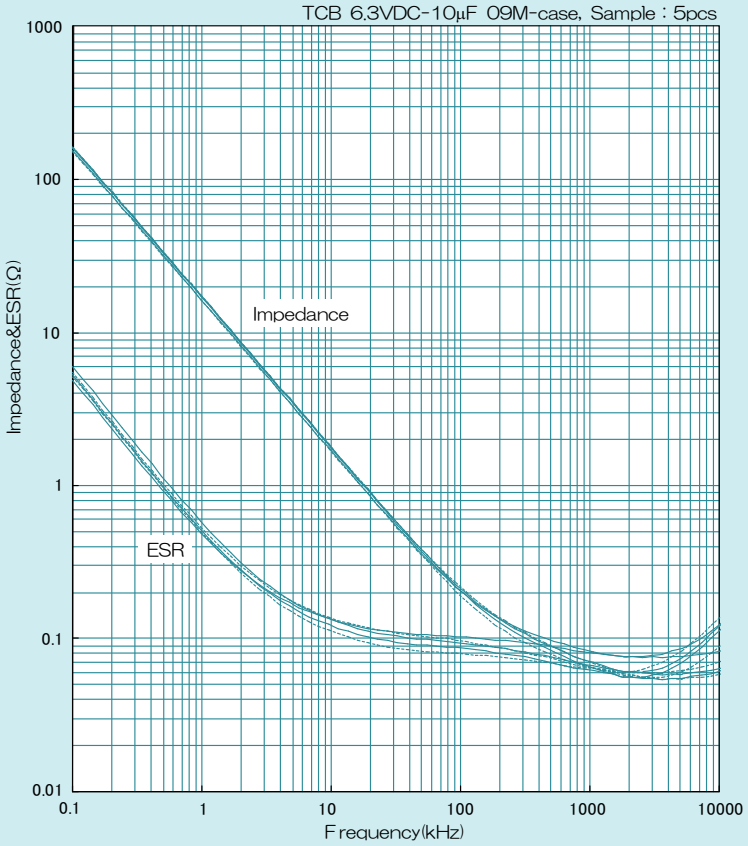
Catalog number (1)	Rated Voltage (VDC)	Capacitance (μF)	Tolerances (±%)	Case Code	Lct. (μA)			Max. Dissipation Factor			ESR (mΩ) 100 kHz	Max. permissible Ripple Current (2) (mArms) 100 kHz
					20℃	85℃	105℃	-55℃	20℃	105℃		
TCB 6301 226 M _1 10S 0150	6.3	22	20	10S	13.8	138	138	0.06	0.06	0.09	150	658
TCB 1002 226 M _1 10A 0150	10	22	↓	10A	22.00	220.0	220.0	0.06	0.06	0.09	150	721

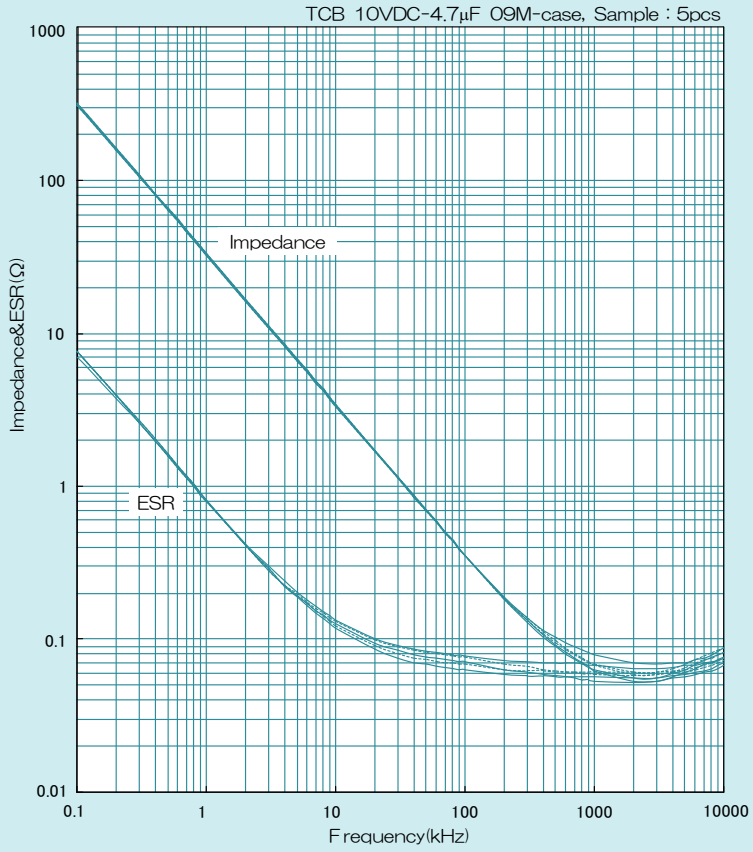
Notes : (1) _1:No code for single item. 'R' and 'N' for taping specification.
(2) Reference value.

PERFORMANCE

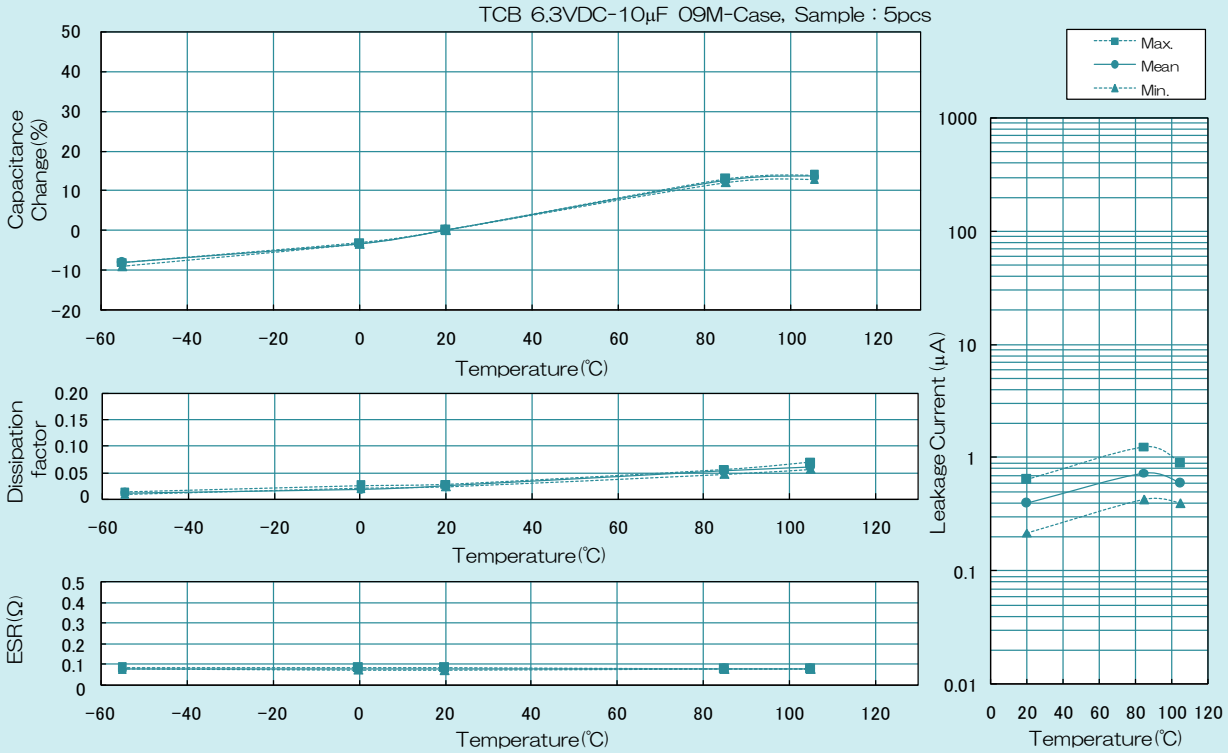
No	Item	Performance			Test Method
1	Leakage Current (μA)	Shall not exceed 0.1 CV Max. or the values shown in CATALOG NUMBERS AND RATING.			JIS C 5101-1, 4.9 Applied voltage : Rated voltage Duration : 5 min Measuring temperature : 20±2°C
2	Capacitance (μF)	Shall be within specified tolerances.			JIS C 5101-1, 4.7 Measuring frequency : 120 Hz±20% Measuring temperature : 20±2°C
3	Dissipation Factor	Shall not exceed the values shown in CATALOG NUMBERS AND RATING.			JIS C 5101-1, 4.8 Test conditions shown in No.2
4	Equivalent Series Resistance	Shall not exceed the values shown in CATALOG NUMBERS AND RATING.			EIAJ RC-2378, 4.5.4 Measuring frequency : 100 kHz ±10% Measuring temperature : 20±2°C
5	Characteristics at High and Low Temperature	Leakage Current	Capacitance	Dissipation Factor	JIS C 5101-1, 4.29
	Step 1	Shall not exceed the value in No.1.	Within specified tolerances	Shall not exceed the value in No.3.	20±2°C
	Step 2	–	Within $^{0}_{-20}$ % of value at Step 1	Shall not exceed the value in No.3.	-55±3°C
	Step 3	Shall not exceed the value in No.1.	Within ±5% of value at Step 1	Shall not exceed the value in No.3.	20±2°C
	Step 4	Shall not exceed 10-times of the value in No.1.	–	–	85±2°C
	Step 5	Shall not exceed 10-times of the value in No.1.	Within $^{+50}_{0}$ % of value at Step 1	Shall not exceed 1.5-times of the value in No.3.	105±2°C Derated voltage at 105°C
	Step 6	Shall not exceed the value in No.1.	Within ±5% of value at Step 1	Shall not exceed the value in No.3.	20±2°C
6	Surge	Leakage current : Shall not exceed 3-times of the value in No.1. Capacitance change : Within ±20% of the value before test Dissipation Factor : Shall not exceed the value in No.3. Visual Examination : There shall be no evidence of mechanical damage.			JIS C 5101-1, 4.26 Test temperature : 85°C and 105°C Applied voltage : According to the following table Rated voltage (VDC) / Surge voltage (VDC): 2.5, 4, 6.3, 10; 85°C: 3.3, 5.2, 8.2, 13; 105°C: 2.6, 4.2, 6.5, 10.4 Series protective resistance : 1000 Ω Discharge resistance : 1000 Ω Number of cycles : 1000 cycles
7	Shear Test	There shall be no evidence of mechanical damage.			JIS C 5101-1, 4.34 Force : 5 N Holding time : 10±1 sec
8	Substrate Bending Test	Capacitance : Initial value to remain steady during measurement. Visual Examination : There shall be no evidence of mechanical damage.			JIS C 5101-1, 4.35 Bending : 1 mm
9	Vibration	Capacitance : Initial value to remain steady during measurement. Visual Examination : There shall be no evidence of mechanical damage.			JIS C 5101-1 4.17 Frequency range : 10-55 Hz Swing width : 1.5 mm Vibration direction : 3 directions with mutually right-angled Duration : 2 hours in each of these mutually perpendicular directions (total 6 hours) Mounting : Solder terminal to the printed board
10	Shock	There shall be no intermittent contact of 0.5 ms or greater, short, or open. Nor shall there be any spark discharge, insulation breakdown, or evidence of mechanical damage.			JIS C 5101-1 4.19 Peak acceleration : 490 m/s² Duration : 11 ms Wave form : Half-sine
11	Solderability	Solder shall be in close contact with terminal (pinholes, non-solderability and solder repelling are not allowed). (1) Note (1) : If any question arises relating to the judgment, make sure that the part dipped in solder, more than 3/4 of the terminal surface, is covered with new solder.			JIS C 5101-1 4.15 Solder temperature : 235±5°C Dipping time : 2±0.5 sec Dipping depth : Terminal shall be dipped into melted solder
12	Resistance to Soldering Heat	Leakage Current : Shall not exceed 2-times of the value in No.1. Capacitance change : Within ±20% of the value before test. Dissipation Factor : Shall not exceed 1.3-times of the value in No.3. Visual Examination : There shall be no evidence of mechanical damage.			EIAJ RC-2378, 4.6 IR reflow Preheating : 140 to 160°C, 110 to 130 sec Reflow : 200°C, 25 to 30 sec Peak : 240°C max. Number of cycles : 2
13	Component solvent resistance	Leakage Current : Shall not exceed the value in No.1. Capacitance change : Within ±20% of the value before test. Dissipation Factor : Shall not exceed the value in No.3.			JIS C 5101-1 4.31 Temperature : 23±5°C Dipping time : 5±0.5 min. Conditioning : JIS C 0052 method 2 Solvent : 2-proparol (Isopropyl alcohol)
14	Solvent resistance of marking	Visual examination : After the test the marking shall be legible.			JIS C 5101-1 4.32 Temperature : 23±5°C Dipping time : 5±0.5 min. Conditioning : JIS C 0052 method 2 Solvent : 2-proparol (Isopropyl alcohol)
15	Rapid Change of Temperature	Leakage Current : Shall not exceed 2-times of the value in No.1. Capacitance change : Within ±20% of the value before test. Dissipation Factor : Shall not exceed 1.5-times of the value in No.3. Visual Examination : There shall be no evidence of mechanical damage.			JIS C 5101-1, 4.16 Step 1 : -55±3°C , 30±3 min Step 2 : 25 $^{+10}_{-5}$ °C, 3 min or less Step 3 : 105±2°C, 30±3 min Step 4 : 25 $^{+10}_{-5}$ °C, 3 min or less Number of cycles : 5
16	Damp Heat, Steady State	Leakage Current : Shall not exceed 2-times of the value in No.1. Capacitance change : Within -20% to +40% of the value before test. Dissipation Factor : Shall not exceed 1.5-times of the value in No.3. Visual Examination : There shall be no evidence of mechanical damage.			JIS C 5101-1, 4.21 Temperature : 40±2°C Moisture : 90 to 95% RH Duration : 500 $^{+24}_{0}$ hrs
17	Endurance I	Leakage Current : Shall not exceed 2-times of the value in No.1. Capacitance change : Within ±20% of the value before test. Dissipation Factor : Shall not exceed 1.5-times of the value in No.3. Visual Examination : There shall be no evidence of mechanical damage.			JIS C 5101-1, 4.23 Test temperature : 85±2°C Applied voltage : Rated voltage Duration : 1000 $^{+48}_{0}$ hrs
18	Endurance II	Leakage Current : Shall not exceed 2-times of the value in No.1. Capacitance change : Within ±20% of the value before test. Dissipation Factor : Shall not exceed 3-times of the value in No.3. Visual Examination : There shall be no evidence of mechanical damage.			JIS C 5101-1, 4.23 Test temperature : 105±2°C Applied voltage : Derated voltage Duration : 1000 $^{+48}_{0}$ hrs

FREQUENCY CHARACTERISTICS

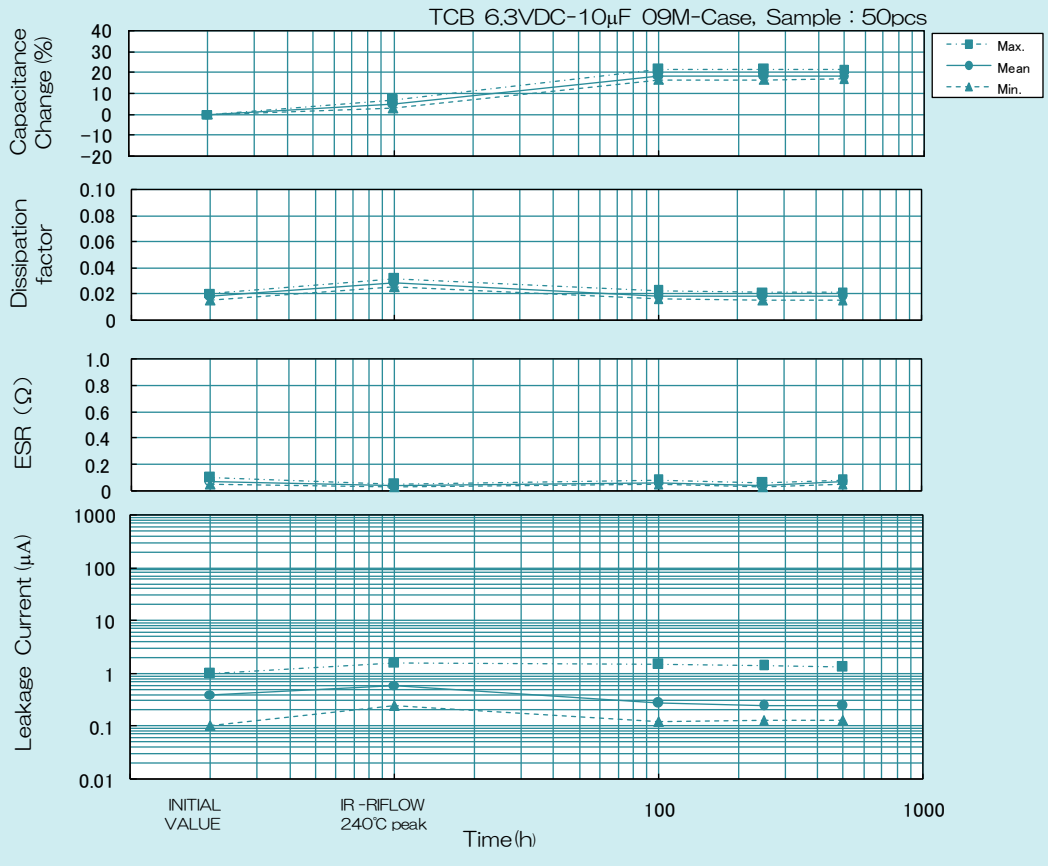




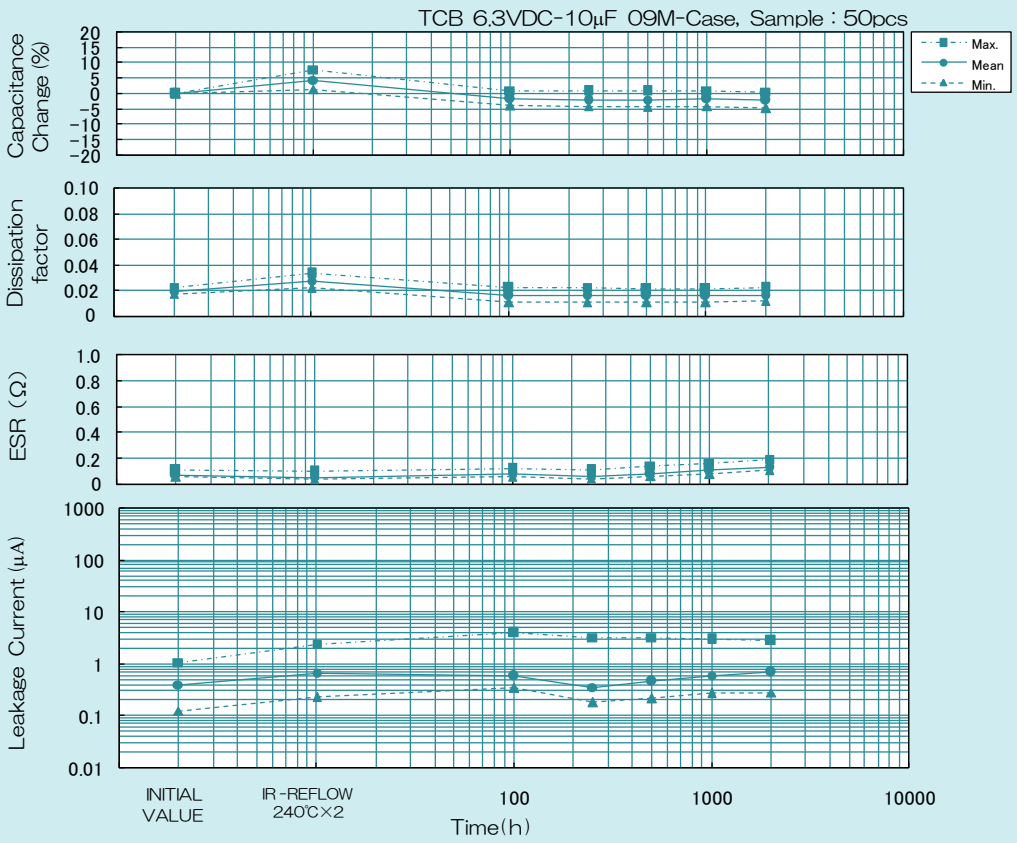
CHARACTERISTICS AT HIGH AND LOW TEMPERATURE



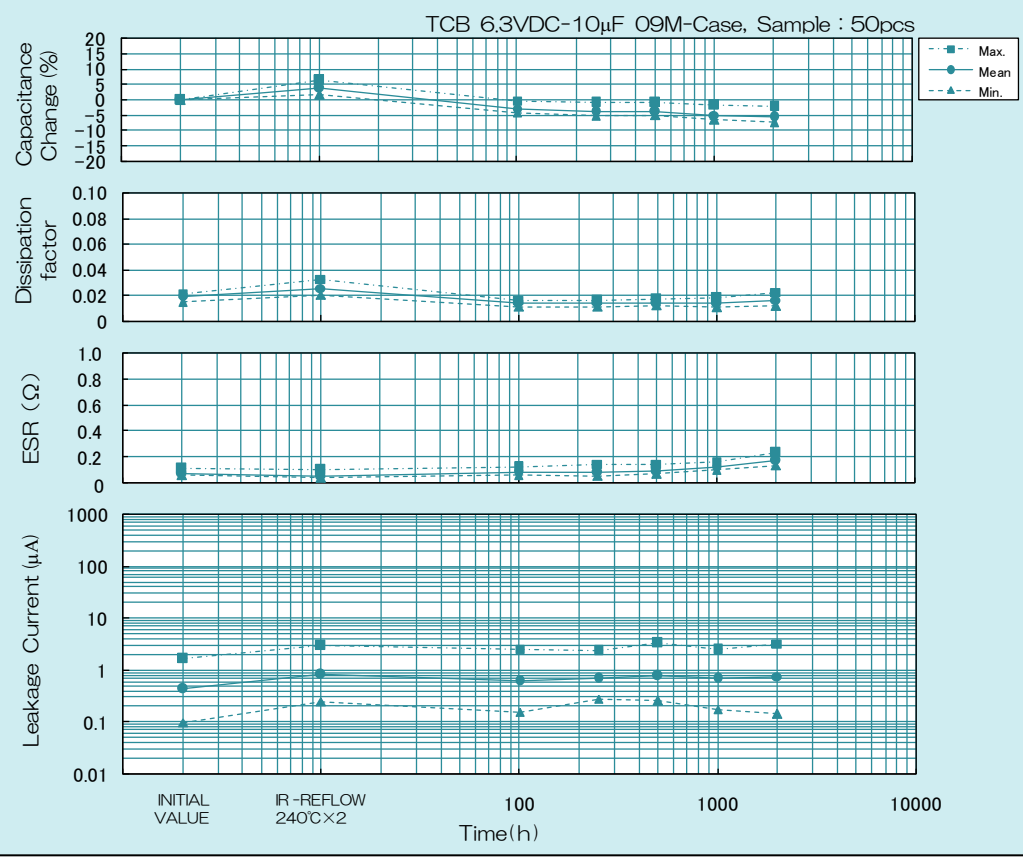
HIGH TEMPERATURE / MOISTURE 40℃ , 95%RH



ENDURANCE Ⅰ 85℃ RATED VOLTAGE



ENDURANCE Ⅱ 105℃ DERATED VOLTAGE



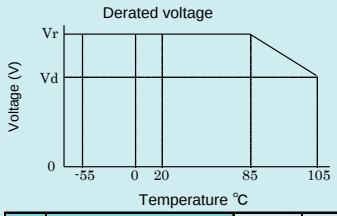
⚠ Application Notes for Tantalum Solid Electrolytic Capacitor with Conductive Polymer

1. Operating voltage

The capacitors shall be operated at the rated voltage or lower. Over rated voltage applied even for a short time may cause short failure.
When designing the circuit, the equipment's required reliability must be considered and appropriate voltage derating must be performed.

- · Recommended operating voltage : 80% or less of the rated voltage
- · When the operating temperature exceeds 85°C, derate the applied voltage.

The voltage derating formula is shown below.



Derating voltage Vt at any temperature T between 85℃ and 105℃ shall be calculated by the follwing formula.

$$Vt = Vr - \frac{Vr - Vd}{20} (T-85)$$

Vr : Rated voltage
Vd : Derating voltage at 105℃

Vr	Rated voltage (VDC)	2.5	4	6.3	10
Vd	Derated voltage (VDC)	2.0	3.2	5.0	8.0

2. Application that contain AC Voltage

Special attention to the following 3 items.

(1) The sum of the DC bias voltage and the positive peak value of the AC voltage should not exceed the rated voltage.
(2) Reverse voltage should not exceed the allowable values of the negative peak AC voltage.
(3) Ripple voltage should not exceed the allowable values.

3. Reverse voltage

Special attention to the polar character.
Reverse Voltage should not be applied.

4. Permissible ripple current

The permissible ripple current and voltage at about 100 kHz or higher can be determined by the following formula from the permissible power loss for each case size (Pmax value) shown in Table 1 and the specified ESR value. However, when the expected operating temperature is higher than room temperature, determine the permissible values multiplying the Pmax value by the specified multiplier (Table 2).
For the permissible values at different frequencies, consult our Sales Department.

$$P=I^2 \times ESR \text{ or } P=\frac{E^2 \times ESR}{Z^2}$$

Permissible ripple current $I_{max}=\sqrt{\frac{Pmax}{ESR}}$ (A_{rms})

Permissible ripple voltage $E_{max}=\sqrt{\frac{Pmax}{ESR}} \times Z = I_{max} \times Z$ (V_{rms})

I max: Permissible ripple current at regulated frequency (Arms : RMS value)
E max: Permissible ripple voltage at regulated frequency (Vrms : RMS value)
P max: Permissible power loss (W)
E S R: Specified ESR value at regulated frequency (Ω)
Z : Impedance at regulated frequency (Ω)

Table 1 Permissible power loss for each case size

Case Code	Pmax（W）
09M	0.050
10S,12S	0.065
10A,12A	0.078

Note: Above values are measured at 0.8t glass epoxy board mounting in free air and may be changed depending on the kind of board, packing density, and air convection condition. Please consult us if calculated power loss value is different from above list of P max value.

Table 2 Pmax multiplier at each operating temperature

Operating temperature(℃)	Multiplier
20	1.0
55	0.9
85	0.8
105	0.4

5. Non Polar Connection

The capacitor cannot be used as a non-polar unit.

6. Soldering

6.1 Preheating

To obtain optimal reliability, lowering the heat shock during the soldering process is favorable. Capacitors should be pre-heated at 130-160°C for approximately 60 seconds.

6.2 Soldering

The body of the capacitor should not exceed 240°C during soldering.

(1) Reflow Soldering
Reflow soldering is a process in which the capacitors are mounted on a printed circuit board with solder paste. Two methods of Reflow Soldering: Direct and Atmospheric Heat.
· Direct Heat (Hot plate)
· Atmospheric Heat
a) Near and Far IR Ray
b) Convection Oven
Vapor Phase Soldering and Flow Soldering are not recommended.

(2) Soldering Iron
Soldering with a soldering iron cannot be recommended due to the lack of consistency in maintaining temperatures and process times. If this method should be necessary, the iron should never touch the capacitor's terminals, and the temperature of the soldering iron should never exceed 350°C. The application of the iron should not exceed 3 seconds and 30 watt.

(3) Please consult us for other methods.

7. Solvent cleaning

Cleaning by organic solvent may damage capacitor's appearance and performance. However, our capacitors are not effected even when soaked at 20-30°C 2-propanol for 5 minutes. When introducing new cleaning methods or changing the cleaning term, please consult us.

8. Ultrasonic cleaning

Ultrasonic cleaning under severe condition may break terminals. Also, from an electrical characteristics aspect, it is unfavorable. Therefore, please do not use ultrasonic cleaning if possible. If the Ultrasonic cleaning process will be used, please note the following.

(1) The solvent should not be boiled. (Lower the ultrasonic wave output or use solvent with the high boiling point.)
(2) The recommended wattage is less than 0.5 watts per cm^2.
(3) The cleaning time should be kept to a minimum. Also, samples must be swang in the solvent. Please consult us.

9. Storage

Capacitors should be tightly sealed in moisture prevention bag and stored with supplied reel.

10. Inapplicable circuits

The capacitors may cause nonconformity if they are used on the following circuits.

(1) High-impedance voltage holding circuits
(2) Coupling circuits
(3) Time constant circuits
(4) Circuits significantly affected by leakage current

If a short circuit occurs, the capacitors may generate heat or smoke depending on the short-circuit current.
When designing a circuit, take the instructions stated herein into consideration, and take as much redundant measures as possible.

These application notes are prepared based on the technical report RCR-2368B "Guideline of notabilia for fixed tantalum electrolytic capacitors with solid electrolyte for use in electronic equipment" issued by Japan Electronics and Information Technology Industries Association. For the details of the instructions (explanation, reasons and concrete examples), please refer to this guideline, or consult our Sales Department.

MATSUO ELECTRIC CO., LTD.

Please feel free to ask our Sales Department for more information on Tantalum Solid Electrolytic Capacitor with Conductive Polymer.

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