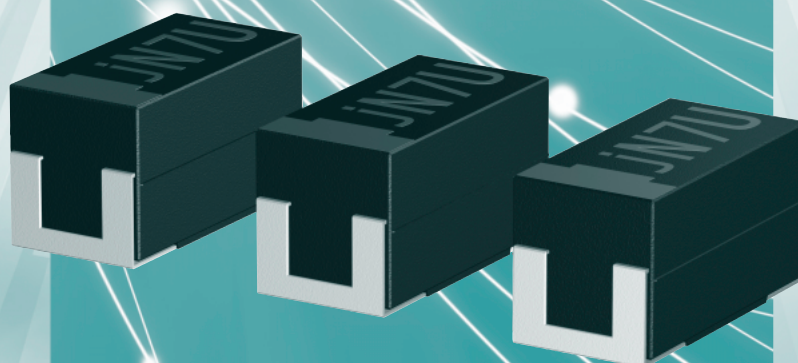


# PRODUCTS DATA SHEET

## Tantalum Solid Electrolytic Capacitors with Conductive Polymer

RoHS COMPLIANT  
LEAD FREE

**Type TCA**



**MATSUO ELECTRIC CO., LTD.**

## OUTLINE

Type TCA is a tantalum solid electrolytic capacitor which uses conductive polymer as cathode layer. Their equivalent series resistance (ESR) is extremely lowered with the 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

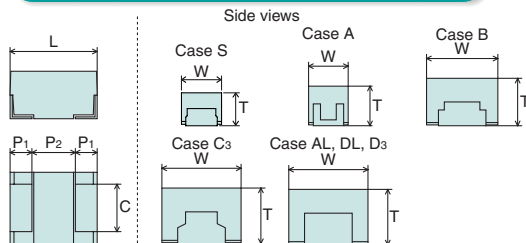
## FEATURES

1. Low ESR and Low impedance  
Using a conductive polymer as cathode layer makes possible of low ESR and impedance.  
Type TCA 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. Compact and Large capacitance  
The capacitor is smaller and has larger capacitance than ceramic capacitor and aluminum electrolytic capacitor.
4. Benign Failure Mode  
Type TCA 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. Lead Free and RoHS Compliant.

## RATINGS

| Item                       | Ratings                                                                     |
|----------------------------|-----------------------------------------------------------------------------|
| 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                | 10~470 µF                                                                   |
| Capacitance Tolerances     | ± 20% (M)                                                                   |

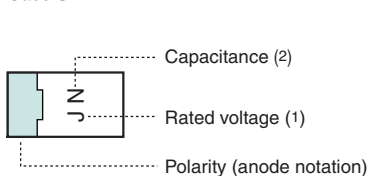
## DIMENSIONS



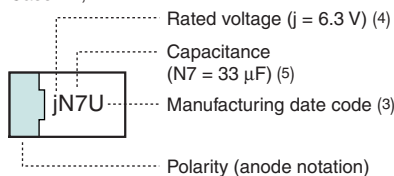
| Case Size | EIA Code | L ± 0.2 | W ± 0.2 | T ± 0.2 | P1 ± 0.2 | P2 min. | C ± 0.1 |
|-----------|----------|---------|---------|---------|----------|---------|---------|
| S         | 2012     | 2.0     | 1.25    | 1.2max. | 0.5      | 0.8     | 0.9     |
| AL        | 3216L    | 3.2     | 1.6     | 1.2max. | 0.8      | 1.4     | 1.2     |
| A         | 3216     | 3.2     | 1.6     | 1.6     | 0.75     | 1.4     | 1.2     |
| B         | 3528     | 3.5     | 2.8     | 1.9     | 0.8      | 1.5     | 2.2     |
| C3        | 6032     | 6.0     | 3.2     | 2.5     | 1.3      | 3.0     | 2.2     |
| DL        | 7343L    | 7.3     | 4.4     | 2.0max. | 1.3      | 4.0     | 2.4     |
| D3        | 7343     | 7.3     | 4.4     | 2.8     | 1.3      | 4.0     | 2.4     |

## MARKING

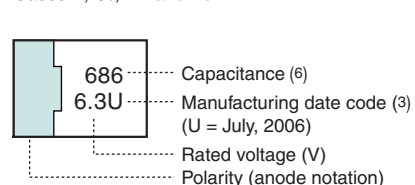
Case S



Case AL, A



Cases B, C3, DL and D3



Note (1) The rated voltage is indicated with one alphabetic letter as shown on the following Table.

| Code        | e   | G | J   | A  |
|-------------|-----|---|-----|----|
| Voltage (V) | 2.5 | 4 | 6.3 | 10 |

(2) The capacitance is indicated with one alphabetic letter or with a line above the letter or below the letter as shown on the following Table.

| Code             | A   | E    | J    | N    | S    | W    |
|------------------|-----|------|------|------|------|------|
| Capacitance (µF) | 0.1 | 0.15 | 0.22 | 0.33 | 0.47 | 0.68 |
| Code             | A   | E    | J    | N    | S    | W    |
| Capacitance (µF) | 1   | 1.5  | 2.2  | 3.3  | 4.7  | 6.8  |
| Code             | A   | E    | J    |      |      |      |
| Capacitance (µF) | 10  | 15   | 22   |      |      |      |

(3) The manufacturing date code is determined according to Table 12 of JIS C 5101. (The codes are used cyclically for four years.)

However, small letter of h is indicated h and k is indicated h respectively.

| Year         | Month | Code | Year         | Month | Code | Year         | Month | Code | Year         | Month | Code |
|--------------|-------|------|--------------|-------|------|--------------|-------|------|--------------|-------|------|
| 2005<br>2009 | 1     | A    | 2006<br>2010 | 1     | N    | 2007<br>2011 | 1     | a    | 2008<br>2012 | 1     | n    |
|              | 2     | B    |              | 2     | P    |              | 2     | b    |              | 2     | p    |
|              | 3     | C    |              | 3     | Q    |              | 3     | c    |              | 3     | q    |
|              | 4     | D    |              | 4     | R    |              | 4     | d    |              | 4     | r    |
|              | 5     | E    |              | 5     | S    |              | 5     | e    |              | 5     | s    |
|              | 6     | F    |              | 6     | T    |              | 6     | f    |              | 6     | t    |

| Year         | Month | Code | Year         | Month | Code | Year         | Month | Code | Year         | Month | Code |
|--------------|-------|------|--------------|-------|------|--------------|-------|------|--------------|-------|------|
| 2005<br>2009 | 7     | G    | 2006<br>2010 | 7     | U    | 2007<br>2011 | 7     | g    | 2008<br>2012 | 7     | u    |
|              | 8     | H    |              | 8     | V    |              | 8     | h    |              | 8     | v    |
|              | 9     | J    |              | 9     | W    |              | 9     | j    |              | 9     | w    |
|              | 10    | K    |              | 10    | X    |              | 10    | k    |              | 10    | x    |
|              | 11    | L    |              | 11    | Y    |              | 11    | l    |              | 11    | y    |
|              | 12    | M    |              | 12    | Z    |              | 12    | m    |              | 12    | z    |

(4) The rated voltage is indicated with one alphabetic letter based on Table 9 of Annex 1 to JIS C 5101-1.

| Code        | e   | g | j   | A  |
|-------------|-----|---|-----|----|
| Voltage (V) | 2.5 | 4 | 6.3 | 10 |

(5) The capacitance is indicated with one alphabetic letter and one numeral based on Tables 9 and 10 of Annex 1 to JIS C 5101-1.

| Code             | A6  | E6  | J6  | N6  | S6  | W6  |
|------------------|-----|-----|-----|-----|-----|-----|
| Capacitance (µF) | 1   | 1.5 | 2.2 | 3.3 | 4.7 | 6.8 |
| Code             | A7  | E7  | J7  | N7  | S7  | W7  |
| Capacitance (µF) | 10  | 15  | 22  | 33  | 47  | 68  |
| Code             | A8  | E8  | J8  | N8  | S8  | W8  |
| Capacitance (µF) | 100 | 150 | 220 | 330 | 470 | 680 |

(6) The capacitance of cases B, C3, DL and D3 are indicated as picofarad codes (in pF, the first two numerals are significant digits, and the last numeral indicates the number of zeros following the digits).

## ORDERING INFORMATION

| TCA<br>TYPE   |         | 6301<br>RATED<br>VOLTAGE |         | 336<br>CAPACITANCE |         | M<br>CAPACITANCE<br>TOLERANCE |         | R<br>STYLE OF REELED<br>PACKAGE |         | A<br>CASE CODE |           |                   | 0180<br>ESR(mΩ) |           |
|---------------|---------|--------------------------|---------|--------------------|---------|-------------------------------|---------|---------------------------------|---------|----------------|-----------|-------------------|-----------------|-----------|
| Rated voltage | Marking | Capacitance              | Marking | Capacitance        | Marking | Capacitance                   | Marking | Capacitance<br>Tolerance        | Marking | Code           | Reel Size | Anode<br>Notation | EIA Code        | Case Code |
| 2.5 V         | 2501    | 10 μF                    | 106     | 47 μF              | 476     | 220 μF                        | 227     | ± 20%                           | M       | R              | φ180 Reel | Feed hole: -      | 2012            | S         |
| 4 V           | 4001    | 15 μF                    | 156     | 68 μF              | 686     | 330 μF                        | 337     |                                 |         | N              | φ330 Reel | Feed hole: -      | 3216L           | AL        |
| 6.3 V         | 6301    | 22 μF                    | 226     | 100 μF             | 107     | 470 μF                        | 477     |                                 |         |                |           |                   | 3216            | A         |
| 10 V          | 1002    | 33 μF                    | 336     | 150 μF             | 157     |                               |         |                                 |         |                |           |                   | 3528            | B         |
|               |         |                          |         |                    |         |                               |         |                                 |         |                |           |                   | 6032            | C3        |
|               |         |                          |         |                    |         |                               |         |                                 |         |                |           |                   | 7343L           | DL        |
|               |         |                          |         |                    |         |                               |         |                                 |         |                |           |                   | 7343            | D3        |

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.

## CATALOG NUMBERS AND RATING

October, 2008

| Catalog number (1)       | Rated Voltage<br>(VDC) | Capacitance<br>(μF) | Tolerances<br>(±%) | Case Code | Lct. (μA) |      |       | Max. Dissipation Factor |      |       | ESR<br>(mΩ)<br>100 kHz | Max. Permissible<br>Ripple Current (2)<br>(mA Arms)<br>100 kHz |
|--------------------------|------------------------|---------------------|--------------------|-----------|-----------|------|-------|-------------------------|------|-------|------------------------|----------------------------------------------------------------|
|                          |                        |                     |                    |           | 20°C      | 85°C | 105°C | -55°C                   | 20°C | 105°C |                        |                                                                |
| TCA 2501 226 M 1 S 0500  | 2.5                    | 22                  | 20                 | S         | 5.50      | 55.0 | 55.0  | 0.06                    | 0.06 | 0.09  | 500                    | 293                                                            |
| TCA 2501 226 M 1 S 0200  | ↓                      | 22                  | ↓                  | S         | 5.50      | 55.0 | 55.0  | 0.06                    | 0.06 | 0.09  | 200                    | 463                                                            |
| TCA 2501 226 M 1 A 0200  | ↓                      | 22                  | ↓                  | A         | 5.50      | 55.0 | 55.0  | 0.06                    | 0.06 | 0.09  | 200                    | 474                                                            |
| TCA 2501 226 M 1 A 0180  | ↓                      | 22                  | ↓                  | A         | 5.50      | 55.0 | 55.0  | 0.06                    | 0.06 | 0.09  | 180                    | 500                                                            |
| TCA 2501 336 M 1 A 0200  | ↓                      | 33                  | ↓                  | A         | 8.25      | 82.5 | 82.5  | 0.06                    | 0.06 | 0.09  | 200                    | 474                                                            |
| TCA 2501 336 M 1 A 0180  | ↓                      | 33                  | ↓                  | A         | 8.25      | 82.5 | 82.5  | 0.06                    | 0.06 | 0.09  | 180                    | 500                                                            |
| TCA 2501 476 M 1 A 0200  | ↓                      | 47                  | ↓                  | A         | 11.7      | 117  | 117   | 0.06                    | 0.06 | 0.09  | 200                    | 474                                                            |
| TCA 2501 476 M 1 A 0180  | ↓                      | 47                  | ↓                  | A         | 11.7      | 117  | 117   | 0.06                    | 0.06 | 0.09  | 180                    | 500                                                            |
| TCA 2501 686 M 1 A 0200  | ↓                      | 68                  | ↓                  | A         | 17.0      | 170  | 170   | 0.06                    | 0.06 | 0.09  | 200                    | 474                                                            |
| TCA 2501 686 M 1 B 0070  | ↓                      | 68                  | ↓                  | B         | 17.0      | 170  | 170   | 0.08                    | 0.08 | 0.12  | 70                     | 845                                                            |
| TCA 2501 107 M 1 B 0070  | ↓                      | 100                 | ↓                  | B         | 25.0      | 250  | 250   | 0.08                    | 0.08 | 0.12  | 70                     | 845                                                            |
| TCA 2501 157 M 1 B 0070  | ↓                      | 150                 | ↓                  | B         | 37.5      | 375  | 375   | 0.08                    | 0.08 | 0.12  | 70                     | 845                                                            |
| TCA 4001 156 M 1 S 0500  | 4                      | 15                  | 20                 | S         | 4.00      | 40.0 | 40.0  | 0.06                    | 0.06 | 0.09  | 500                    | 293                                                            |
| TCA 4001 156 M 1 S 0200  | ↓                      | 15                  | ↓                  | S         | 4.00      | 40.0 | 40.0  | 0.06                    | 0.06 | 0.09  | 200                    | 474                                                            |
| TCA 4001 226 M 1 A 0200  | ↓                      | 22                  | ↓                  | A         | 8.80      | 88.0 | 88.0  | 0.06                    | 0.06 | 0.09  | 200                    | 474                                                            |
| TCA 4001 226 M 1 A 0180  | ↓                      | 22                  | ↓                  | A         | 8.80      | 88.0 | 88.0  | 0.06                    | 0.06 | 0.09  | 180                    | 500                                                            |
| TCA 4001 336 M 1 A 0200  | ↓                      | 33                  | ↓                  | A         | 13.2      | 132  | 132   | 0.06                    | 0.06 | 0.09  | 200                    | 474                                                            |
| TCA 4001 336 M 1 A 0180  | ↓                      | 33                  | ↓                  | A         | 13.2      | 132  | 132   | 0.06                    | 0.06 | 0.09  | 180                    | 500                                                            |
| TCA 4001 476 M 1 A 0200  | ↓                      | 47                  | ↓                  | A         | 18.8      | 188  | 188   | 0.06                    | 0.06 | 0.09  | 200                    | 474                                                            |
| TCA 4001 476 M 1 A 0180  | ↓                      | 47                  | ↓                  | A         | 18.8      | 188  | 188   | 0.06                    | 0.06 | 0.09  | 180                    | 500                                                            |
| TCA 4001 686 M 1 B 0070  | ↓                      | 68                  | ↓                  | B         | 27.2      | 272  | 272   | 0.08                    | 0.08 | 0.12  | 70                     | 845                                                            |
| TCA 4001 107 M 1 B 0070  | ↓                      | 100                 | ↓                  | B         | 40.0      | 400  | 400   | 0.08                    | 0.08 | 0.12  | 70                     | 845                                                            |
| TCA 4001 157 M 1 B 0070  | ↓                      | 150                 | ↓                  | B         | 60.0      | 600  | 600   | 0.08                    | 0.08 | 0.12  | 70                     | 845                                                            |
| TCA 4001 227 M 1 C3 0060 | ↓                      | 220                 | ↓                  | C3        | 88.0      | 880  | 880   | 0.08                    | 0.08 | 0.12  | 60                     | 1040                                                           |
| TCA 4001 227 M 1 C3 0040 | ↓                      | 220                 | ↓                  | C3        | 88.0      | 880  | 880   | 0.08                    | 0.08 | 0.12  | 40                     | 1275                                                           |
| TCA 4001 227 MR DL 0055  | ↓                      | 220                 | ↓                  | DL        | 88.0      | 880  | 880   | 0.10                    | 0.10 | 0.15  | 55                     | 1168                                                           |
| TCA 4001 227 MR DL 0035  | ↓                      | 220                 | ↓                  | DL        | 88.0      | 880  | 880   | 0.10                    | 0.10 | 0.15  | 35                     | 1464                                                           |
| TCA 4001 477 M 1 D3 0055 | ↓                      | 470                 | ↓                  | D3        | 188       | 1880 | 1880  | 0.10                    | 0.10 | 0.15  | 55                     | 1243                                                           |
| TCA 4001 477 M 1 D3 0040 | ↓                      | 470                 | ↓                  | D3        | 188       | 1880 | 1880  | 0.10                    | 0.10 | 0.15  | 40                     | 1458                                                           |
| TCA 6301 106 M 1 S 0500  | 6.3                    | 10                  | 20                 | S         | 6.30      | 63.0 | 63.0  | 0.06                    | 0.06 | 0.09  | 500                    | 293                                                            |
| TCA 6301 106 M 1 S 0200  | ↓                      | 10                  | ↓                  | S         | 6.30      | 63.0 | 63.0  | 0.06                    | 0.06 | 0.09  | 200                    | 474                                                            |
| TCA 6301 156 M 1 AL 0200 | ↓                      | 15                  | ↓                  | AL        | 9.45      | 94.5 | 94.5  | 0.06                    | 0.06 | 0.09  | 200                    | 469                                                            |
| TCA 6301 226 M 1 A 0200  | ↓                      | 22                  | ↓                  | A         | 13.8      | 138  | 138   | 0.06                    | 0.06 | 0.09  | 200                    | 474                                                            |
| TCA 6301 226 M 1 A 0180  | ↓                      | 22                  | ↓                  | A         | 13.8      | 138  | 138   | 0.06                    | 0.06 | 0.09  | 180                    | 500                                                            |
| TCA 6301 336 M 1 A 0200  | ↓                      | 33                  | ↓                  | A         | 20.8      | 208  | 208   | 0.06                    | 0.06 | 0.09  | 200                    | 474                                                            |
| TCA 6301 336 M 1 A 0180  | ↓                      | 33                  | ↓                  | A         | 20.8      | 208  | 208   | 0.06                    | 0.06 | 0.09  | 180                    | 500                                                            |
| TCA 6301 336 M 1 B 0080  | ↓                      | 33                  | ↓                  | B         | 20.8      | 208  | 208   | 0.08                    | 0.08 | 0.12  | 80                     | 791                                                            |
| TCA 6301 476 M 1 B 0070  | ↓                      | 47                  | ↓                  | B         | 29.6      | 296  | 296   | 0.08                    | 0.08 | 0.12  | 70                     | 845                                                            |
| TCA 6301 686 M 1 B 0070  | ↓                      | 68                  | ↓                  | B         | 42.8      | 428  | 428   | 0.08                    | 0.08 | 0.12  | 70                     | 845                                                            |
| TCA 6301 157 M 1 C3 0060 | ↓                      | 150                 | ↓                  | C3        | 94.5      | 945  | 945   | 0.08                    | 0.08 | 0.12  | 60                     | 1040                                                           |
| TCA 6301 157 M 1 C3 0040 | ↓                      | 150                 | ↓                  | C3        | 94.5      | 945  | 945   | 0.08                    | 0.08 | 0.12  | 40                     | 1275                                                           |
| TCA 6301 157 MR DL 0055  | ↓                      | 150                 | ↓                  | DL        | 94.5      | 945  | 945   | 0.10                    | 0.10 | 0.15  | 55                     | 1168                                                           |
| TCA 6301 157 MR DL 0035  | ↓                      | 150                 | ↓                  | DL        | 94.5      | 945  | 945   | 0.10                    | 0.10 | 0.15  | 35                     | 1464                                                           |
| TCA 6301 227 M 1 D3 0040 | ↓                      | 220                 | ↓                  | D3        | 138       | 1380 | 1380  | 0.10                    | 0.10 | 0.15  | 40                     | 1458                                                           |
| TCA 6301 337 M 1 D3 0055 | ↓                      | 330                 | ↓                  | D3        | 208       | 2080 | 2080  | 0.10                    | 0.10 | 0.15  | 55                     | 1243                                                           |
| TCA 6301 337 M 1 D3 0040 | ↓                      | 330                 | ↓                  | D3        | 208       | 2080 | 2080  | 0.10                    | 0.10 | 0.15  | 40                     | 1458                                                           |
| TCA 1002 106 M 1 AL 0200 | 10                     | 10                  | 20                 | AL        | 10.0      | 100  | 100   | 0.06                    | 0.06 | 0.09  | 200                    | 469                                                            |
| TCA 1002 226 M 1 A 0200  | ↓                      | 22                  | ↓                  | A         | 22.0      | 220  | 220   | 0.06                    | 0.06 | 0.09  | 200                    | 474                                                            |
| TCA 1002 226 M 1 A 0180  | ↓                      | 22                  | ↓                  | A         | 22.0      | 220  | 220   | 0.06                    | 0.06 | 0.09  | 180                    | 500                                                            |
| TCA 1002 336 M 1 B 0080  | ↓                      | 33                  | ↓                  | B         | 33.0      | 330  | 330   | 0.08                    | 0.08 | 0.12  | 80                     | 791                                                            |
| TCA 1002 476 M 1 B 0070  | ↓                      | 47                  | ↓                  | B         | 47.0      | 470  | 470   | 0.08                    | 0.08 | 0.12  | 70                     | 845                                                            |
| TCA 1002 686 M 1 C3 0060 | ↓                      | 68                  | ↓                  | C3        | 68.0      | 680  | 680   | 0.08                    | 0.08 | 0.12  | 60                     | 1040                                                           |
| TCA 1002 686 M 1 C3 0045 | ↓                      | 68                  | ↓                  | C3        | 68.0      | 680  | 680   | 0.08                    | 0.08 | 0.12  | 45                     | 1202                                                           |
| TCA 1002 107 MR DL 0055  | ↓                      | 100                 | ↓                  | DL        | 100       | 1000 | 1000  | 0.10                    | 0.10 | 0.15  | 55                     | 1168                                                           |
| TCA 1002 107 MR DL 0045  | ↓                      | 100                 | ↓                  | DL        | 100       | 1000 | 1000  | 0.10                    | 0.10 | 0.15  | 45                     | 1291                                                           |
| TCA 1002 157 M 1 D3 0055 | ↓                      | 150                 | ↓                  | D3        | 150       | 1500 | 1500  | 0.10                    | 0.10 | 0.15  | 55                     | 1243                                                           |
| TCA 1002 157 M 1 D3 0040 | ↓                      | 150                 | ↓                  | D3        | 150       | 1500 | 1500  | 0.10                    | 0.10 | 0.15  | 40                     | 1458                                                           |

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

## STANDARD RATING

October, 2008

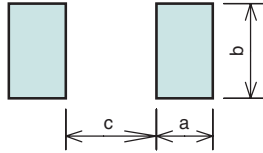
| R.V. (VDC)<br>Cap. (μF) | 2.5                          | 4            | 6.3          | 10           |
|-------------------------|------------------------------|--------------|--------------|--------------|
| 3.3                     |                              |              |              |              |
| 4.7                     |                              |              |              |              |
| 6.8                     |                              |              |              |              |
| 10                      |                              |              | S (200, 500) | AL (200)     |
| 15                      |                              | S (200, 500) | AL (200)     |              |
| 22                      | S (200, 500)<br>A (180, 200) | A (180, 200) | A (180, 200) | A (180, 200) |

| R.V. (VDC)<br>Cap. (μF) | 2.5             | 4            | 6.3                        | 10          |
|-------------------------|-----------------|--------------|----------------------------|-------------|
| 33                      | A (180, 200)    | A (180, 200) | A (180, 200)<br>B (80)     | B (80)      |
| 47                      | A (180, 200)    | A (180, 200) | B (70)                     | B (70)      |
| 68                      | A (200), B (70) | B (70)       | B (70)                     | C3 (45, 60) |
| 100                     | B (70)          | B (70)       |                            | DL (45, 55) |
| 150                     | B (70)          | B (70)       | C3 (40, 60)<br>DL (35, 55) | D3 (40, 55) |

| R.V. (VDC)<br>Cap. (μF) | 2.5 | 4                          | 6.3         | 10 |
|-------------------------|-----|----------------------------|-------------|----|
| 220                     |     | C3 (40, 60)<br>DL (35, 55) | D3 (40)     |    |
| 330                     |     |                            | D3 (40, 55) |    |
| 470                     |     |                            |             |    |
| 680                     |     |                            |             |    |
| 1000                    |     |                            |             |    |

The parenthesized values show ESR.  
(maximum values in mΩ at 100 kHz)

## RECOMMENDED PAD DIMENSIONS



(mm)

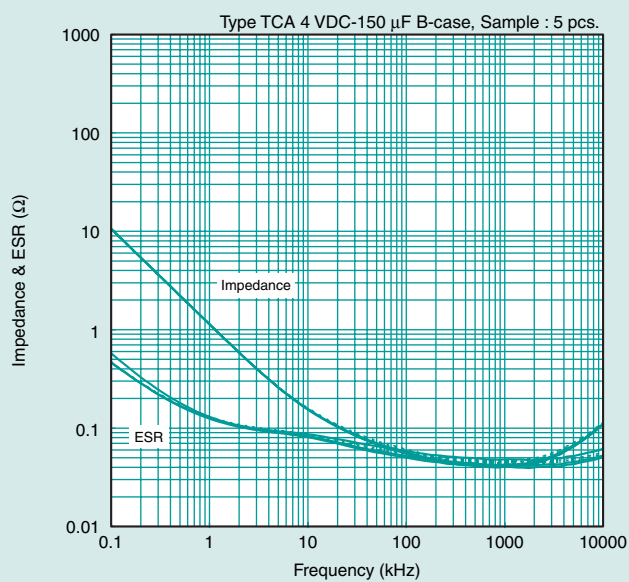
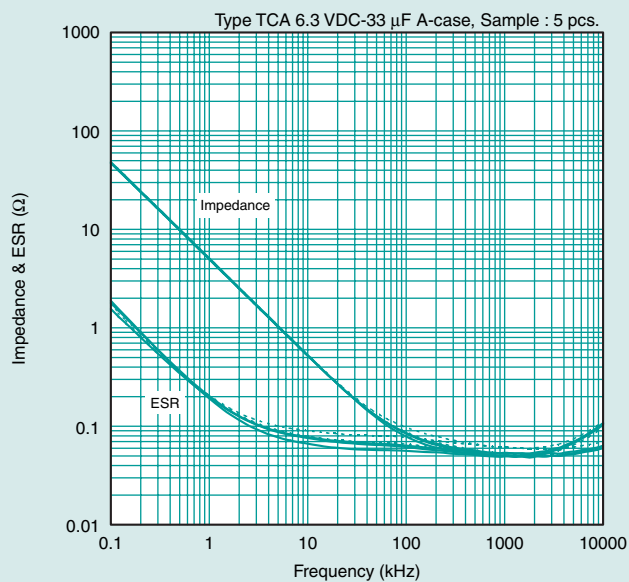
| Case Size | a   | b   | c   |
|-----------|-----|-----|-----|
| S         | 1.4 | 1.2 | 0.9 |
| AL, A     | 2.0 | 1.5 | 1.5 |
| B         | 2.0 | 2.4 | 1.8 |
| C3        | 2.4 | 2.5 | 3.3 |
| DL, D3    | 2.4 | 2.7 | 4.6 |

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.

## PERFORMANCE

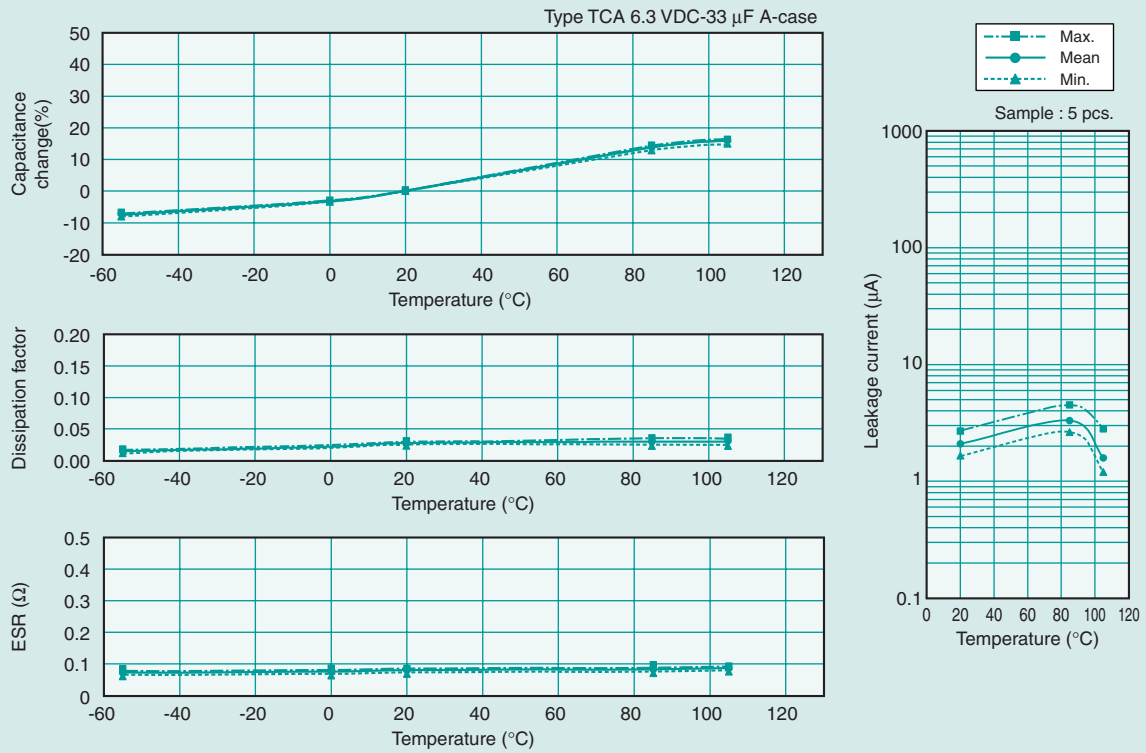
| No                  | Item                                        | Performance                                                                                                                                                                                                                                                                              |                                     |                                                  | 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<br>Applied voltage : Rated voltage<br>Duration : 5 min<br>Measuring temperature : 20 ± 2°C                                                                                                                                                                                                                                                                                                                                                            |                     |     |   |     |    |                     |               |            |            |            |            |
| 2                   | Capacitance (μF)                            | Shall be within specified tolerances.                                                                                                                                                                                                                                                    |                                     |                                                  | JIS C 5101-1, 4.7<br>Measuring frequency : 120 Hz ± 20%<br>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<br>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<br>Measuring frequency : 100 kHz ± 10%<br>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 $\pm 5\%$ 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 $\pm 5\%$ of value at Step 1 | Shall not exceed 1.5-times of the value in No.3. | 105 ± 2°C<br>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.<br>Capacitance change : Within ± 20% of the value before test<br>Dissipation Factor : Shall not exceed the value in No.3.<br>Visual Examination : There shall be no evidence of mechanical damage.                      |                                     |                                                  | JIS C 5101-1, 4.26<br>Test temperature : 85°C and 105°C<br>Applied voltage : According to the following table <table><tr><td>Rated voltage (VDC)</td><td>2.5</td><td>4</td><td>6.3</td><td>10</td></tr><tr><td>Surge voltage (VDC)</td><td>85°C<br/>105°C</td><td>3.3<br/>2.6</td><td>5.2<br/>4.2</td><td>8.2<br/>6.5</td><td>13<br/>10.4</td></tr></table><br>Series protective resistance : 1000 Ω<br>Discharge resistance : 1000 Ω<br>Number of cycles : 1000 cycles | Rated voltage (VDC) | 2.5 | 4 | 6.3 | 10 | Surge voltage (VDC) | 85°C<br>105°C | 3.3<br>2.6 | 5.2<br>4.2 | 8.2<br>6.5 | 13<br>10.4 |
| Rated voltage (VDC) | 2.5                                         | 4                                                                                                                                                                                                                                                                                        | 6.3                                 | 10                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |     |   |     |    |                     |               |            |            |            |            |
| Surge voltage (VDC) | 85°C<br>105°C                               | 3.3<br>2.6                                                                                                                                                                                                                                                                               | 5.2<br>4.2                          | 8.2<br>6.5                                       | 13<br>10.4                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |     |   |     |    |                     |               |            |            |            |            |
| 7                   | Shear Test                                  | No separation of terminal from solder.                                                                                                                                                                                                                                                   |                                     |                                                  | JIS C 5101-1, 4.34<br>Force : 5 N<br>Holding time : 5 ± 1 sec                                                                                                                                                                                                                                                                                                                                                                                                           |                     |     |   |     |    |                     |               |            |            |            |            |
| 8                   | Substrate Bending Test                      | Capacitance : Initial value to remain steady during measurement.<br>Visual Examination : There shall be no evidence of mechanical damage.                                                                                                                                                |                                     |                                                  | JIS C 5101-1, 4.35<br>Bending : 3 mm                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |     |   |     |    |                     |               |            |            |            |            |
| 9                   | Vibration                                   | Capacitance : Initial value to remain steady during measurement.<br>Visual Examination : There shall be no evidence of mechanical damage.                                                                                                                                                |                                     |                                                  | JIS C 5101-1 4.17<br>Frequency range : 10-55 Hz    Swing width : 1.5 mm<br>Vibration direction : 3 directions with mutually right-angled<br>Duration : 2 hours in each of these mutually perpendicular directions (total 6 hours)<br>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<br>Peak acceleration : 490 m/s <sup>2</sup><br>Duration : 11 ms<br>Wave form : Half-sine                                                                                                                                                                                                                                                                                                                                                              |                     |     |   |     |    |                     |               |            |            |            |            |
| 11                  | Solderability                               | Shall be covered to over 3/4 of terminal surface by new soldering.                                                                                                                                                                                                                       |                                     |                                                  | JIS C 5101-1 4.15<br>Solder temperature : 230 ± 5°C<br>Dipping time : 3 to 5 seconds<br>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.<br>Capacitance change : Within ± 20% of the value before test.<br>Dissipation Factor : Shall not exceed 1.3-times of the value in No.3.<br>Visual Examination : There shall be no evidence of mechanical damage.        |                                     |                                                  | EIAJ RC-2378, 4.6<br>IR reflow Preheating : 140 to 160°C, 110 to 130 sec<br>Reflow : 200°C, 25 to 30 sec<br>Peak : 240°C max.<br>Number of cycles : 2                                                                                                                                                                                                                                                                                                                   |                     |     |   |     |    |                     |               |            |            |            |            |
| 13                  | Rapid Change of Temperature                 | Leakage Current : Shall not exceed 2-times of the value in No.1.<br>Capacitance change : Within ± 20% of the value before test.<br>Dissipation Factor : Shall not exceed 1.5-times of the value in No.3.<br>Visual Examination : There shall be no evidence of mechanical damage.        |                                     |                                                  | JIS C 5101-1, 4.16<br>Step 1 : -55 ± 3°C, 30 ± 3 min<br>Step 2 : 25 $\pm 5^{\circ}\text{C}$ , 3 min or less<br>Step 3 : 105 ± 2°C, 30 ± 3 min<br>Step 4 : 25 $\pm 5^{\circ}\text{C}$ , 3 min or less<br>Number of cycles : 5                                                                                                                                                                                                                                            |                     |     |   |     |    |                     |               |            |            |            |            |
| 14                  | Damp Heat, Steady State                     | Leakage Current : Shall not exceed 2-times of the value in No.1.<br>Capacitance change : Within -20% to +40% of the value before test.<br>Dissipation Factor : Shall not exceed 1.5-times of the value in No.3.<br>Visual Examination : There shall be no evidence of mechanical damage. |                                     |                                                  | JIS C 5101-1, 4.21<br>Temperature : 40 ± 2°C<br>Moisture : 90 to 95% RH<br>Duration : 500 $\pm 24$ hrs                                                                                                                                                                                                                                                                                                                                                                  |                     |     |   |     |    |                     |               |            |            |            |            |
| 15                  | Endurance I                                 | Leakage Current : Shall not exceed 2-times of the value in No.1.<br>Capacitance change : Within ± 20% of the value before test.<br>Dissipation Factor : Shall not exceed 1.5-times of the value in No.3.<br>Visual Examination : There shall be no evidence of mechanical damage.        |                                     |                                                  | JIS C 5101-1, 4.23<br>Test temperature : 85 ± 2°C<br>Applied voltage : Rated voltage<br>Duration : 1000 $\pm 48$ hrs                                                                                                                                                                                                                                                                                                                                                    |                     |     |   |     |    |                     |               |            |            |            |            |
| 16                  | Endurance II                                | Leakage Current : Shall not exceed 2-times of the value in No.1.<br>Capacitance change : Within ± 20% of the value before test.<br>Dissipation Factor : Shall not exceed 3-times of the value in No.3.<br>Visual Examination : There shall be no evidence of mechanical damage.          |                                     |                                                  | JIS C 5101-1, 4.23<br>Test temperature : 105 ± 2°C<br>Applied voltage : Derated voltage<br>Duration : 1000 $\pm 48$ hrs                                                                                                                                                                                                                                                                                                                                                 |                     |     |   |     |    |                     |               |            |            |            |            |

## FREQUENCY CHARACTERISTICS

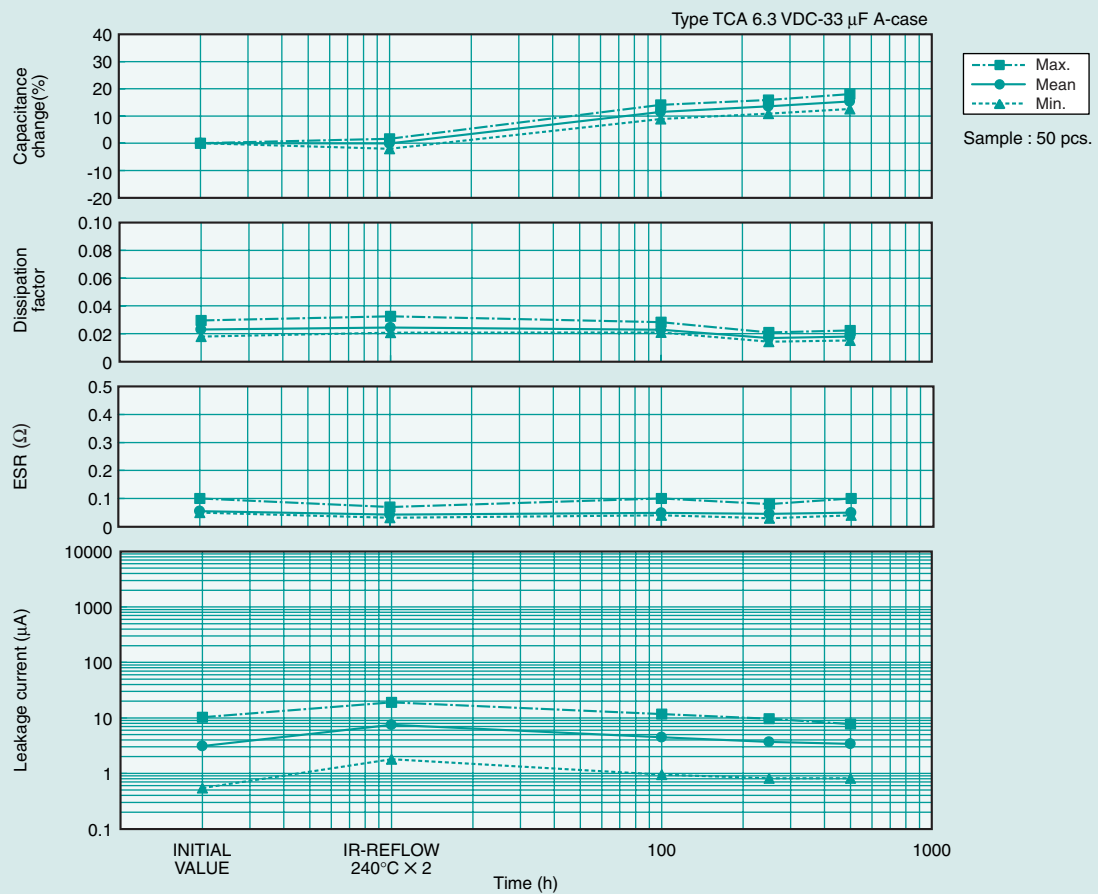




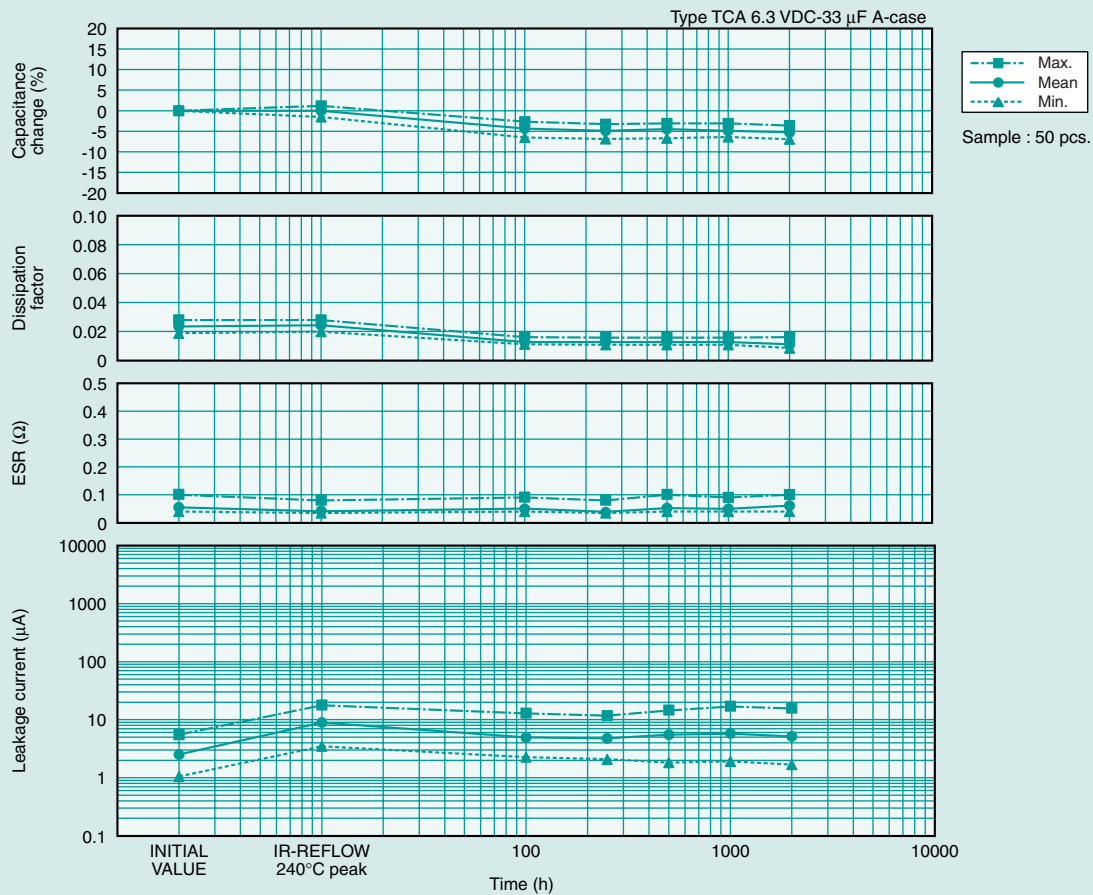
## CHARACTERISTICS AT HIGH AND LOW TEMPERATURE



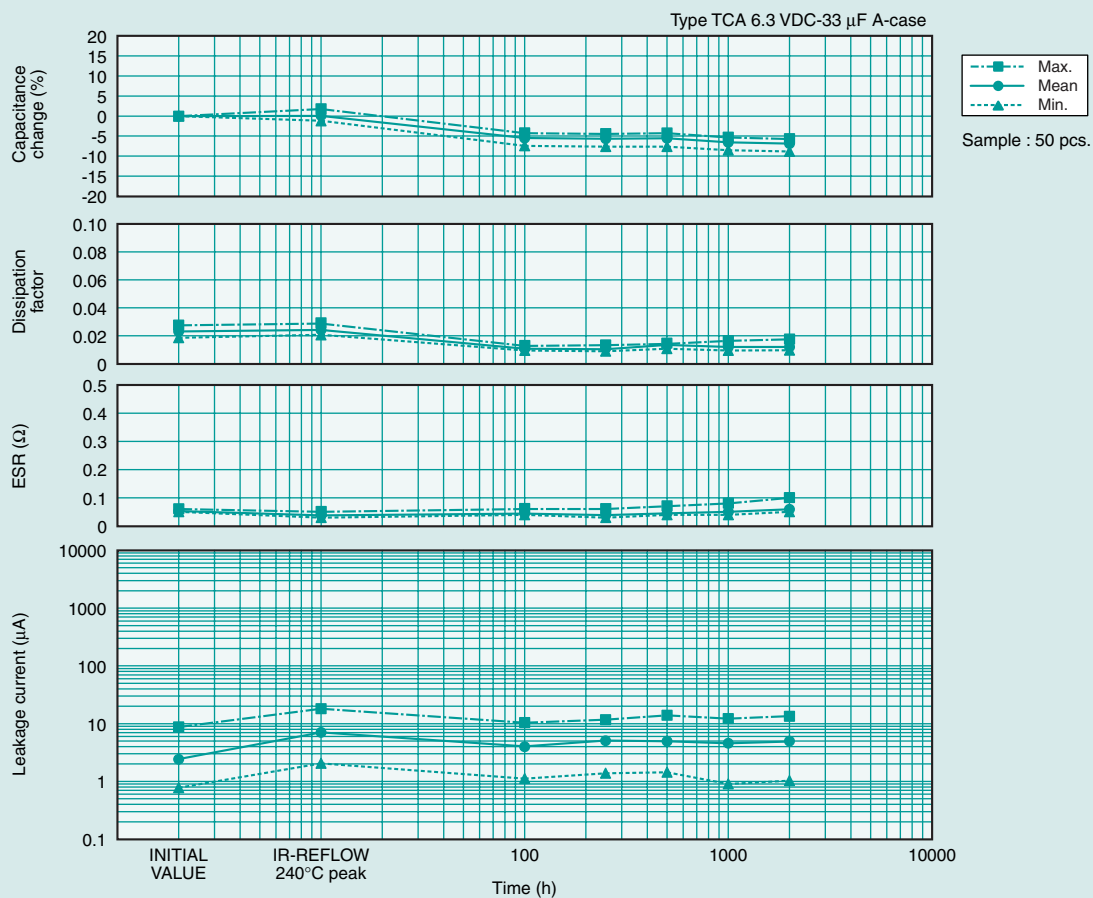
## HIGH TEMPERATURE / MOISTURE 40°C, 95%RH



## ENDURANCE I 85°C RATED VOLTAGE 6.3 V



## ENDURANCE II 105°C DERATED VOLTAGE 5.0 V



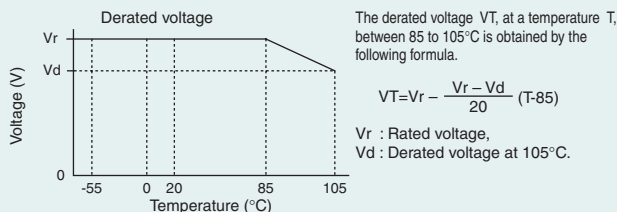
# Application Notes for Tantalum Solid Electrolytic Capacitor with Conductive Polymer

## 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.



|    |                       |     |     |     |     |
|----|-----------------------|-----|-----|-----|-----|
| 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.

- The sum of the DC bias voltage and the positive peak value of the AC voltage should not exceed the rated voltage.
- Reverse voltage should not exceed the allowable values of the negative peak AC voltage.
- 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.

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

$$\text{Permissible ripple current } I_{max} = \sqrt{\frac{P_{max}}{ESR}} \text{ (Arms)}$$

$$\text{Permissible ripple voltage } E_{max} = \sqrt{\frac{P_{max}}{ESR}} \times Z = I_{max} \times Z \text{ (Vrms)}$$

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

Table 1 Permissible power loss for each case size

| Case size      | Pmax (W) |
|----------------|----------|
| S              | 0.043    |
| AL             | 0.044    |
| A              | 0.045    |
| B              | 0.050    |
| C <sub>3</sub> | 0.065    |
| DL             | 0.075    |
| D <sub>3</sub> | 0.085    |

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(°C) | 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
  - Near and Far IR Ray
  - 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.

- The solvent should not be boiled. (Lower the ultrasonic wave output or use solvent with the high boiling point.)
- The recommended wattage is less than 0.5 watts per cm<sup>2</sup>.
- 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.

- High-impedance voltage holding circuits
- Coupling circuits
- Time constant circuits
- 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 the Tantalum Solid Electrolytic Capacitor with Conductive Polymer.

|                     |                                                                                                |                    |                    |
|---------------------|------------------------------------------------------------------------------------------------|--------------------|--------------------|
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| URL                 | http://www.ncc-matsuo.co.jp/                                                                   |                    |                    |

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