

Type 279 is a complete lead-free tantalum chip capacitor with open mechanism of built-in fuse type, which function is to melt under large current and inhibit burning and smoking from capacitor.

## FEATURES

1. Built-in fuse function to melt under large current and inhibit burning and smoking from capacitor.
2. This type is the most applicable for PC, measurement instrument, semiconductor equipment, ATM, base station for and cell phone.
3. This type is suitable for filtering of power supply with low impedance circuit and by-passing of random noise of source line in ultra high speed logical circuit.
3. Soldering : 260°C for 10 seconds by reflow or flow soldering.
4. Various Case size lineup from 3528 to 7343H and 7257
5. Complete Lead-free with built-in fuse.

## RATING

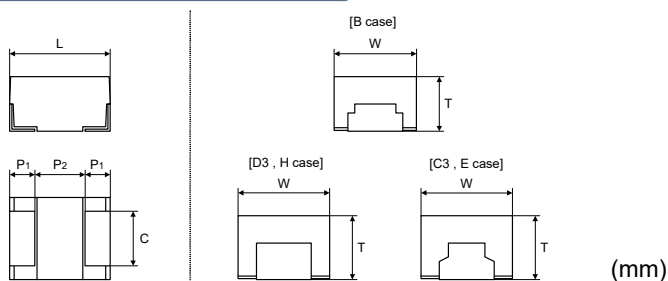
| Item                                                                   | Rating                                                 |
|------------------------------------------------------------------------|--------------------------------------------------------|
| Category temperature range (Operating temperature )                    | -55 ~ +125°C                                           |
| Rated Temperature (Maximum operating temperature for DC rated Voltage) | +85°C <sup>(1)</sup>                                   |
| DC rated voltage range [U <sub>R</sub> ]                               | See CATALOG NUMBERS AND<br>RATING OF STANDARD PRODUCTS |
| Rated capacitance (Normal capacitance range [C <sub>R</sub> ])         |                                                        |
| Rated capacitance tolerance                                            |                                                        |
| Failure rate level                                                     | 1%/1000 h                                              |

Note<sup>(1)</sup>: For operation 125°C, derate voltage linearly to 67% of 85°C voltage rating.

## ORDERING INFORMATION

| 279<br>TYPE |               | M<br>SERIES |              | 1602<br>RATED<br>VOLTAGE |             | 156<br>CAPACITANCE |             | M<br>CAPACITANCE<br>TOLERANCE | R<br>STYLE OF REELED<br>PACKAGE | B<br>CASE CODE                 |
|-------------|---------------|-------------|--------------|--------------------------|-------------|--------------------|-------------|-------------------------------|---------------------------------|--------------------------------|
| Marking     | Rated voltage | Marking     | Capacitance  | Marking                  | Capacitance | Marking            | Capacitance | Marking                       | Capacitance Tolerance           | (Taping specification)         |
| 6301        | 6.3VDC        | 154         | 0.15 $\mu$ F | 225                      | 2.2 $\mu$ F | 336                | 33 $\mu$ F  | K                             | $\pm 10\%$                      | L $\phi$ 180 Reel Feed hole: + |
| 1002        | 10VDC         | 224         | 0.22 $\mu$ F | 335                      | 3.3 $\mu$ F | 476                | 47 $\mu$ F  | M                             | $\pm 20\%$                      | R $\phi$ 180 Reel Feed hole: - |
| 1602        | 16VDC         | 334         | 0.33 $\mu$ F | 475                      | 4.7 $\mu$ F | 686                | 68 $\mu$ F  |                               |                                 | N $\phi$ 330 Reel Feed hole: + |
| 2002        | 20VDC         | 474         | 0.47 $\mu$ F | 685                      | 6.8 $\mu$ F | 107                | 100 $\mu$ F |                               |                                 | P $\phi$ 330 Reel Feed hole: - |
| 2502        | 25VDC         | 684         | 0.68 $\mu$ F | 106                      | 10 $\mu$ F  | 157                | 150 $\mu$ F |                               |                                 |                                |
| 3502        | 35VDC         | 105         | 1.0 $\mu$ F  | 156                      | 15 $\mu$ F  | 227                | 220 $\mu$ F |                               |                                 |                                |
| 5002        | 50VDC         | 155         | 1.5 $\mu$ F  | 226                      | 22 $\mu$ F  | 337                | 330 $\mu$ F |                               |                                 |                                |

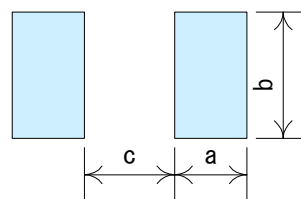
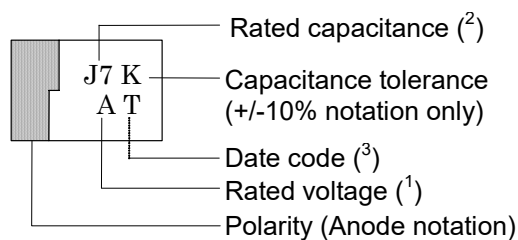
## DIMENSIONS



| Case code | EIA Code | L $\pm 0.2$ | W $\pm 0.2$ | T $\pm 0.2$ | P <sub>1</sub> $\pm 0.2$ | P <sub>2</sub> min. | C $\pm 0.1$ |
|-----------|----------|-------------|-------------|-------------|--------------------------|---------------------|-------------|
| 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         |
| D3        | 7343     | 7.3         | 4.4         | 2.8         | 1.3                      | 4.0                 | 2.4         |
| H         | 7343H    | 7.3         | 4.4         | 4.1         | 1.3                      | 4.0                 | 2.4         |
| E         | 7257     | 7.3         | 5.8         | 3.5         | 1.3                      | 4.0                 | 3.5         |

## MARKING

[B, C3, D3, H, E case]



Note<sup>(1)</sup> Rated voltage

| 定格電圧記号   | j   | A  | C  | D  | E  | V  | H  |
|----------|-----|----|----|----|----|----|----|
| 定格電圧 VDC | 6.3 | 10 | 16 | 20 | 25 | 35 | 50 |

Note<sup>(2)</sup> Rated Capacitance

| 記号                    | -   | E5   | J5   | N5   | S5   | W5   |
|-----------------------|-----|------|------|------|------|------|
| 公称静電容量値 $\mu\text{F}$ | -   | 0.15 | 0.22 | 0.33 | 0.47 | 0.68 |
| 記号                    | A6  | E6   | J6   | N6   | S6   | W6   |
| 公称静電容量値 $\mu\text{F}$ | 1.0 | 1.5  | 2.2  | 3.3  | 4.7  | 6.8  |
| 記号                    | A7  | E7   | J7   | N7   | S7   | W7   |
| 公称静電容量値 $\mu\text{F}$ | 10  | 15   | 22   | 33   | 47   | 68   |
| 記号                    | A8  | E8   | J8   | N8   |      |      |
| 公称静電容量値 $\mu\text{F}$ | 100 | 150  | 220  | 330  |      |      |

| Case Code | EIA Code | a (mm) |        | b (mm) | c (mm) |
|-----------|----------|--------|--------|--------|--------|
|           |          | Flow   | Reflow |        |        |
| B         | 3528     | 3.2    | 2.0    | 2.4    | 1.8    |
| C3        | 6032     | 4.2    | 2.4    | 2.5    | 3.3    |
| D3        | 7343     | 5.2    | 2.4    | 2.7    | 4.6    |
| H         | 7343H    | 5.2    | 2.4    | 2.7    | 4.6    |
| E         | 7257     | 5.6    | 2.4    | 3.8    | 4.6    |

In order to expect the self alignment effect, it is recommended that 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.

Note<sup>(3)</sup> Date codes are based on the Annex 1 Table 13 of JIS C 5101-1.

## STANDARD RATING

March, 2017

| R.V.(VDC)<br>Cap.( $\mu\text{F}$ ) | 6.3      | 10        | 16        | 20     | 25        | 35     | 50     |
|------------------------------------|----------|-----------|-----------|--------|-----------|--------|--------|
| 0.15                               |          |           |           |        |           |        | B      |
| 0.22                               |          |           |           |        |           |        | B      |
| 0.33                               |          |           |           |        |           |        | B      |
| 0.47                               |          |           |           |        |           | B      | B, C3  |
| 0.68                               |          |           |           |        | B         | B      | C3     |
| 1.0                                |          |           |           |        | B         | B, C3  | C3     |
| 1.5                                |          |           |           | B      | B         | C3     | C3, D3 |
| 2.2                                |          |           | B         | B      | C3        | C3     | D3     |
| 3.3                                |          | B         | B         | B      | C3        | C3, D3 | D3     |
| 4.7                                | B        | B         | B         | C3     | C3        | D3     | H      |
| 6.8                                | B        | B         | C3        | C3     | C3, D3    | D3, E  |        |
| 10                                 | B        | B, C3     | B, C3     | C3, D3 | C3, D3    | H, E   |        |
| 15                                 | C3       | B, C3, D3 | B, C3, D3 | C3, D3 | C3, D3, E | H, E   |        |
| 22                                 | B, C3    | C3, D3    | C3, D3    | D3, E  | D3, H, E  |        |        |
| 33                                 | C3       | C3, D3    | D3, E     | H, E   |           |        |        |
| 47                                 | C3, D3   | C3, D3, E | D3, H, E  | H      |           |        |        |
| 68                                 | C3, D3   | D3, H, E  | E         |        |           |        |        |
| 100                                | D3, H, E | D3, E     | H         |        |           |        |        |
| 150                                | D3       | D3, H     |           |        |           |        |        |
| 220                                | D3, H    | H         |           |        |           |        |        |
| 330                                | H        |           |           |        |           |        |        |

# CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS

| Catalog number <sup>(1)</sup> ( <sup>2</sup> ) | U <sub>R</sub><br>VDC | U <sub>S</sub><br>VDC |       | C <sub>R</sub><br>μF | Case<br>Code | Leakage current μA |      |       | Dissipation factor |      |      |       | ESR<br>Ω<br>10kHz |
|------------------------------------------------|-----------------------|-----------------------|-------|----------------------|--------------|--------------------|------|-------|--------------------|------|------|-------|-------------------|
|                                                |                       | 85°C                  | 125°C |                      |              | 20°C               | 85°C | 125°C | -55°C              | 20°C | 85°C | 125°C |                   |
| 279M 6301 475 <sup>1 2</sup> B                 | 6.3                   | 8                     | 5     | 4.7                  | B            | 0.5                | 5    | 6.3   | 0.08               | 0.06 | 0.06 | 0.06  | 3.0               |
| 279M 6301 685 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 6.8                  | B            | 0.5                | 5    | 6.3   | ↓                  | ↓    | ↓    | 0.08  | ↓                 |
| 279M 6301 106 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 10                   | B            | 0.6                | 6    | 7.9   | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 6301 156 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 15                   | C3           | 0.9                | 9    | 12    | ↓                  | ↓    | ↓    | 0.06  | 1.2               |
| 279M 6301 226 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 22                   | B            | 1.4                | 14   | 17    | 0.10               | ↓    | ↓    | 0.08  | 3.0               |
| 279M 6301 226 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 22                   | C3           | 1.4                | 14   | 17    | 0.08               | ↓    | ↓    | 0.06  | 1.2               |
| 279M 6301 336 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 33                   | C3           | 2.1                | 21   | 26    | ↓                  | ↓    | ↓    | 0.08  | ↓                 |
| 279M 6301 476 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 47                   | C3           | 3.0                | 30   | 37    | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 6301 476 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 47                   | D3           | 3.0                | 30   | 37    | ↓                  | ↓    | ↓    | ↓     | 1.0               |
| 279M 6301 686 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 68                   | C3           | 4.3                | 43   | 54    | ↓                  | ↓    | ↓    | ↓     | 1.2               |
| 279M 6301 686 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 68                   | D3           | 4.3                | 43   | 54    | ↓                  | ↓    | ↓    | ↓     | 1.0               |
| 279M 6301 107 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 100                  | D3           | 6.3                | 63   | 79    | 0.15               | 0.08 | 0.08 | 0.10  | ↓                 |
| 279M 6301 107 <sup>1 2</sup> H                 | ↓                     | ↓                     | ↓     | 100                  | H            | 6.3                | 63   | 79    | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 6301 107 <sup>1 2</sup> E                 | ↓                     | ↓                     | ↓     | 100                  | E            | 6.3                | 63   | 79    | ↓                  | ↓    | ↓    | ↓     | 0.7               |
| 279M 6301 157 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 150                  | D3           | 9.5                | 95   | 118   | ↓                  | ↓    | ↓    | ↓     | 1.0               |
| 279M 6301 227 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 220                  | D3           | 14                 | 139  | 173   | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 6301 227 <sup>1 2</sup> H                 | ↓                     | ↓                     | ↓     | 220                  | H            | 14                 | 139  | 173   | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 6301 337 <sup>1 2</sup> H                 | ↓                     | ↓                     | ↓     | 330                  | H            | 21                 | 208  | 260   | 0.16               | 0.14 | 0.14 | 0.16  | ↓                 |
| 279M 1002 335 <sup>1 2</sup> B                 | 10                    | 13                    | 8     | 3.3                  | B            | 0.5                | 5    | 6.3   | 0.08               | 0.06 | 0.06 | 0.06  | 3.0               |
| 279M 1002 475 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 4.7                  | B            | 0.5                | 5    | 6.3   | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 1002 685 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 6.8                  | B            | 0.7                | 7    | 8.5   | ↓                  | ↓    | ↓    | 0.08  | ↓                 |
| 279M 1002 106 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 10                   | B            | 1.0                | 10   | 13    | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 1002 106 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 10                   | C3           | 1.0                | 10   | 13    | ↓                  | ↓    | ↓    | 0.06  | 1.2               |
| 279M 1002 156 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 15                   | B            | 1.5                | 15   | 19    | 0.10               | ↓    | ↓    | 0.08  | 3.0               |
| 279M 1002 156 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 15                   | C3           | 1.5                | 15   | 19    | 0.08               | ↓    | ↓    | 0.06  | 1.2               |
| 279M 1002 156 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 15                   | D3           | 1.5                | 15   | 19    | ↓                  | ↓    | ↓    | ↓     | 1.0               |
| 279M 1002 226 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 22                   | C3           | 2.2                | 22   | 28    | ↓                  | ↓    | ↓    | 0.08  | 1.2               |
| 279M 1002 226 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 22                   | D3           | 2.2                | 22   | 28    | ↓                  | ↓    | ↓    | 0.06  | 1.0               |
| 279M 1002 336 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 33                   | C3           | 3.3                | 33   | 41    | ↓                  | ↓    | ↓    | 0.08  | 1.2               |
| 279M 1002 336 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 33                   | D3           | 3.3                | 33   | 41    | ↓                  | ↓    | ↓    | 0.06  | 1.0               |
| 279M 1002 476 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 47                   | C3           | 4.7                | 47   | 59    | ↓                  | ↓    | ↓    | 0.08  | 1.2               |
| 279M 1002 476 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 47                   | D3           | 4.7                | 47   | 59    | ↓                  | ↓    | ↓    | ↓     | 1.0               |
| 279M 1002 476 <sup>1 2</sup> E                 | ↓                     | ↓                     | ↓     | 47                   | E            | 4.7                | 47   | 59    | ↓                  | ↓    | ↓    | ↓     | 0.7               |
| 279M 1002 686 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 68                   | D3           | 6.8                | 68   | 85    | ↓                  | ↓    | ↓    | ↓     | 1.0               |
| 279M 1002 686 <sup>1 2</sup> H                 | ↓                     | ↓                     | ↓     | 68                   | H            | 6.8                | 68   | 85    | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 1002 686 <sup>1 2</sup> E                 | ↓                     | ↓                     | ↓     | 68                   | E            | 6.8                | 68   | 85    | ↓                  | ↓    | ↓    | 0.06  | 0.7               |
| 279M 1002 107 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 100                  | D3           | 10                 | 100  | 130   | 0.15               | 0.08 | 0.08 | 0.10  | 1.0               |
| 279M 1002 107 <sup>1 2</sup> E                 | ↓                     | ↓                     | ↓     | 100                  | E            | 10                 | 100  | 130   | 0.10               | ↓    | ↓    | 0.08  | 0.7               |
| 279M 1002 157 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 150                  | D3           | 15                 | 150  | 188   | 0.15               | ↓    | ↓    | 0.10  | 1.0               |
| 279M 1002 157 <sup>1 2</sup> H                 | ↓                     | ↓                     | ↓     | 150                  | H            | 15                 | 150  | 188   | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 1002 227 <sup>1 2</sup> H                 | ↓                     | ↓                     | ↓     | 220                  | H            | 22                 | 220  | 275   | ↓                  | 0.10 | 0.10 | 0.12  | ↓                 |
| 279M 1602 225 <sup>1 2</sup> B                 | 16                    | 20                    | 13    | 2.2                  | B            | 0.5                | 5    | 6.3   | 0.08               | 0.06 | 0.06 | 0.06  | 3.0               |
| 279M 1602 335 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 3.3                  | B            | 0.5                | 5    | 6.6   | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 1602 475 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 4.7                  | B            | 0.8                | 8    | 9.4   | ↓                  | ↓    | ↓    | 0.08  | ↓                 |
| 279M 1602 685 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 6.8                  | C3           | 1.1                | 11   | 14    | ↓                  | ↓    | ↓    | 0.06  | 1.2               |
| 279M 1602 106 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 10                   | B            | 1.6                | 16   | 20    | ↓                  | ↓    | ↓    | 0.08  | 3.0               |
| 279M 1602 106 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 10                   | C3           | 1.6                | 16   | 20    | ↓                  | ↓    | ↓    | 0.06  | 1.2               |
| 279M 1602 156 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 15                   | B            | 2.4                | 24   | 30    | 0.12               | 0.08 | 0.08 | 0.10  | 3.0               |
| 279M 1602 156 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 15                   | C3           | 2.4                | 24   | 30    | 0.08               | 0.06 | 0.06 | 0.08  | 1.2               |
| 279M 1602 156 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 15                   | D3           | 2.4                | 24   | 30    | ↓                  | ↓    | ↓    | 0.06  | 1.0               |
| 279M 1602 226 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 22                   | C3           | 3.5                | 35   | 44    | ↓                  | ↓    | ↓    | 0.08  | 1.2               |
| 279M 1602 226 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 22                   | D3           | 3.5                | 35   | 44    | ↓                  | ↓    | ↓    | 0.06  | 1.0               |
| 279M 1602 336 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 33                   | D3           | 5.3                | 53   | 66    | ↓                  | ↓    | ↓    | 0.08  | ↓                 |
| 279M 1602 336 <sup>1 2</sup> E                 | ↓                     | ↓                     | ↓     | 33                   | E            | 5.3                | 53   | 66    | ↓                  | ↓    | ↓    | 0.06  | 0.7               |
| 279M 1602 476 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 47                   | D3           | 7.5                | 75   | 94    | ↓                  | ↓    | ↓    | 0.08  | 1.0               |
| 279M 1602 476 <sup>1 2</sup> H                 | ↓                     | ↓                     | ↓     | 47                   | H            | 7.5                | 75   | 94    | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 1602 476 <sup>1 2</sup> E                 | ↓                     | ↓                     | ↓     | 47                   | E            | 7.5                | 75   | 94    | 0.08               | ↓    | ↓    | 0.06  | 0.7               |
| 279M 1602 686 <sup>1 2</sup> E                 | ↓                     | ↓                     | ↓     | 68                   | E            | 11                 | 109  | 136   | 0.10               | 0.08 | 0.08 | 0.08  | ↓                 |
| 279M 1602 107 <sup>1 2</sup> H                 | ↓                     | ↓                     | ↓     | 100                  | H            | 16                 | 160  | 200   | 0.12               | 0.10 | 0.10 | 0.12  | 1.0               |
| 279M 2002 155 <sup>1 2</sup> B                 | 20                    | 26                    | 16    | 1.5                  | B            | 0.5                | 5    | 6.3   | 0.08               | 0.06 | 0.06 | 0.06  | 3.0               |
| 279M 2002 225 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 2.2                  | B            | 0.5                | 5    | 6.3   | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 2002 335 <sup>1 2</sup> B                 | ↓                     | ↓                     | ↓     | 3.3                  | B            | 0.7                | 7    | 8.3   | ↓                  | ↓    | ↓    | 0.08  | ↓                 |
| 279M 2002 475 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 4.7                  | C3           | 0.9                | 9    | 12    | ↓                  | ↓    | ↓    | 0.06  | 1.2               |
| 279M 2002 685 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 6.8                  | C3           | 1.4                | 14   | 17    | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 2002 106 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 10                   | C3           | 2.0                | 20   | 25    | ↓                  | ↓    | ↓    | 0.08  | ↓                 |
| 279M 2002 106 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 10                   | D3           | 2.0                | 20   | 25    | ↓                  | ↓    | ↓    | 0.06  | 1.0               |
| 279M 2002 156 <sup>1 2</sup> C3                | ↓                     | ↓                     | ↓     | 15                   | C3           | 3.0                | 30   | 38    | ↓                  | ↓    | ↓    | 0.08  | 1.2               |
| 279M 2002 156 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 15                   | D3           | 3.0                | 30   | 38    | ↓                  | ↓    | ↓    | ↓     | 1.5               |
| 279M 2002 226 <sup>1 2</sup> D3                | ↓                     | ↓                     | ↓     | 22                   | D3           | 4.4                | 44   | 55    | ↓                  | ↓    | ↓    | ↓     | 1.0               |
| 279M 2002 226 <sup>1 2</sup> E                 | ↓                     | ↓                     | ↓     | 22                   | E            | 4.4                | 44   | 55    | ↓                  | ↓    | ↓    | 0.06  | 0.7               |
| 279M 2002 336 <sup>1 2</sup> H                 | ↓                     | ↓                     | ↓     | 33                   | H            | 6.6                | 66   | 83    | ↓                  | ↓    | ↓    | ↓     | 1.0               |
| 279M 2002 336 <sup>1 2</sup> E                 | ↓                     | ↓                     | ↓     | 33                   | E            | 6.6                | 66   | 83    | ↓                  | ↓    | ↓    | ↓     | ↓                 |
| 279M 2002 476 <sup>1 2</sup> H                 | ↓                     | ↓                     | ↓     | 47                   | H            | 9.4                | 94   | 117   | ↓                  | ↓    | ↓    | ↓     | ↓                 |

| Catalog number <sup>(1)(2)</sup> | U <sub>R</sub><br>VDC | U <sub>S</sub><br>VDC |      | C <sub>R</sub><br>μF | Case<br>Code | Leakage current μA |     |      | Dissipation factor |      |      |      | ESR<br>Ω<br>10kHz |
|----------------------------------|-----------------------|-----------------------|------|----------------------|--------------|--------------------|-----|------|--------------------|------|------|------|-------------------|
|                                  |                       | 85℃                   | 125℃ |                      |              | 20℃                | 85℃ | 125℃ | -55℃               | 20℃  | 85℃  | 125℃ |                   |
| 279M 2502 684 <sup>1 2</sup> B   | 25                    | 32                    | 20   | 0.68                 | B            | 0.5                | 5   | 6.3  | 0.05               | 0.04 | 0.04 | 0.05 | 3.0               |
| 279M 2502 105 <sup>1 2</sup> B   | ↓                     | ↓                     | ↓    | 1.0                  | B            | 0.5                | 5   | 6.3  | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 2502 155 <sup>1 2</sup> B   | ↓                     | ↓                     | ↓    | 1.5                  | B            | 0.5                | 5   | 6.3  | 0.08               | 0.06 | 0.06 | 0.06 | ↓                 |
| 279M 2502 225 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 2.2                  | C3           | 0.6                | 6   | 6.9  | ↓                  | ↓    | ↓    | ↓    | 1.2               |
| 279M 2502 335 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 3.3                  | C3           | 0.8                | 8   | 10   | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 2502 475 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 4.7                  | C3           | 1.2                | 12  | 15   | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 2502 685 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 6.8                  | C3           | 1.7                | 17  | 21   | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 2502 685 <sup>1 2</sup> D3  | ↓                     | ↓                     | ↓    | 6.8                  | D3           | 1.7                | 17  | 21   | ↓                  | ↓    | ↓    | ↓    | 1.0               |
| 279M 2502 106 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 10                   | C3           | 2.5                | 25  | 31   | ↓                  | ↓    | ↓    | 0.08 | 1.2               |
| 279M 2502 106 <sup>1 2</sup> D3  | ↓                     | ↓                     | ↓    | 10                   | D3           | 2.5                | 25  | 31   | ↓                  | ↓    | ↓    | ↓    | 1.5               |
| 279M 2502 156 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 15                   | C3           | 3.8                | 38  | 47   | 0.10               | 0.08 | 0.08 | 0.10 | 1.4               |
| 279M 2502 156 <sup>1 2</sup> D3  | ↓                     | ↓                     | ↓    | 15                   | D3           | 3.8                | 38  | 47   | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 2502 156 <sup>1 2</sup> E   | ↓                     | ↓                     | ↓    | 15                   | E            | 3.8                | 38  | 47   | 0.08               | 0.06 | 0.06 | 0.06 | 0.7               |
| 279M 2502 226 <sup>1 2</sup> D3  | ↓                     | ↓                     | ↓    | 22                   | D3           | 5.5                | 55  | 69   | ↓                  | ↓    | ↓    | ↓    | 1.0               |
| 279M 2502 226 <sup>1 2</sup> H   | ↓                     | ↓                     | ↓    | 22                   | H            | 5.5                | 55  | 69   | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 2502 226 <sup>1 2</sup> E   | ↓                     | ↓                     | ↓    | 22                   | E            | 5.5                | 55  | 69   | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 3502 474 <sup>1 2</sup> B   | 35                    | 44                    | 28   | 0.47                 | B            | 0.5                | 5   | 6.3  | 0.06               | 0.04 | 0.04 | 0.06 | 3.0               |
| 279M 3502 684 <sup>1 2</sup> B   | ↓                     | ↓                     | ↓    | 0.68                 | B            | 0.5                | 5   | 6.3  | 0.05               | 0.04 | 0.04 | 0.05 | ↓                 |
| 279M 3502 105 <sup>1 2</sup> B   | ↓                     | ↓                     | ↓    | 1.0                  | B            | 0.5                | 5   | 6.3  | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 3502 105 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 1.0                  | C3           | 0.5                | 5   | 6.3  | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 3502 155 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 1.5                  | C3           | 0.5                | 5   | 6.6  | 0.08               | 0.06 | 0.06 | 0.06 | 1.2               |
| 279M 3502 225 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 2.2                  | C3           | 0.8                | 8   | 9.6  | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 3502 335 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 3.3                  | C3           | 1.2                | 12  | 14   | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 3502 335 <sup>1 2</sup> D3  | ↓                     | ↓                     | ↓    | 3.3                  | D3           | 1.2                | 12  | 14   | ↓                  | ↓    | ↓    | ↓    | 1.0               |
| 279M 3502 475 <sup>1 2</sup> D3  | ↓                     | ↓                     | ↓    | 4.7                  | D3           | 1.6                | 16  | 21   | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 3502 685 <sup>1 2</sup> D3  | ↓                     | ↓                     | ↓    | 6.8                  | D3           | 2.4                | 24  | 30   | ↓                  | ↓    | ↓    | 0.08 | 1.5               |
| 279M 3502 685 <sup>1 2</sup> E   | ↓                     | ↓                     | ↓    | 6.8                  | E            | 2.4                | 24  | 30   | ↓                  | ↓    | ↓    | 0.06 | 0.7               |
| 279M 3502 106 <sup>1 2</sup> H   | ↓                     | ↓                     | ↓    | 10                   | H            | 3.5                | 35  | 44   | ↓                  | ↓    | ↓    | ↓    | 1.0               |
| 279M 3502 106 <sup>1 2</sup> E   | ↓                     | ↓                     | ↓    | 10                   | E            | 3.5                | 35  | 44   | ↓                  | ↓    | ↓    | ↓    | 0.7               |
| 279M 3502 156 <sup>1 2</sup> H   | ↓                     | ↓                     | ↓    | 15                   | H            | 5.3                | 55  | 66   | ↓                  | ↓    | ↓    | ↓    | 1.0               |
| 279M 3502 156 <sup>1 2</sup> E   | ↓                     | ↓                     | ↓    | 15                   | E            | 5.3                | 55  | 66   | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 5002 154 <sup>1 2</sup> B   | 50                    | 63                    | 40   | 0.15                 | B            | 0.5                | 5   | 6.3  | 0.05               | 0.04 | 0.04 | 0.05 | 5.0               |
| 279M 5002 224 <sup>1 2</sup> B   | ↓                     | ↓                     | ↓    | 0.22                 | B            | 0.5                | 5   | 6.3  | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 5002 334 <sup>1 2</sup> B   | ↓                     | ↓                     | ↓    | 0.33                 | B            | 0.5                | 5   | 6.3  | ↓                  | ↓    | ↓    | ↓    | 3.0               |
| 279M 5002 474 <sup>1 2</sup> B   | ↓                     | ↓                     | ↓    | 0.47                 | B            | 0.5                | 5   | 6.3  | 0.06               | 0.04 | 0.04 | 0.06 | ↓                 |
| 279M 5002 474 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 0.47                 | C3           | 0.5                | 5   | 6.3  | 0.05               | ↓    | ↓    | 0.05 | ↓                 |
| 279M 5002 684 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 0.68                 | C3           | 0.5                | 5   | 6.3  | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 5002 105 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 1.0                  | C3           | 0.5                | 5   | 6.3  | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 5002 155 <sup>1 2</sup> C3  | ↓                     | ↓                     | ↓    | 1.5                  | C3           | 0.8                | 8   | 9.4  | 0.08               | 0.06 | 0.06 | 0.08 | 1.2               |
| 279M 5002 155 <sup>1 2</sup> D3  | ↓                     | ↓                     | ↓    | 1.5                  | D3           | 0.8                | 8   | 9.4  | ↓                  | ↓    | ↓    | 0.06 | 1.5               |
| 279M 5002 225 <sup>1 2</sup> D3  | ↓                     | ↓                     | ↓    | 2.2                  | D3           | 1.1                | 11  | 14   | ↓                  | ↓    | ↓    | ↓    | ↓                 |
| 279M 5002 335 <sup>1 2</sup> D3  | ↓                     | ↓                     | ↓    | 3.3                  | D3           | 1.7                | 17  | 21   | ↓                  | ↓    | ↓    | 0.08 | 1.0               |
| 279M 5002 475 <sup>1 2</sup> H   | ↓                     | ↓                     | ↓    | 4.7                  | H            | 2.4                | 24  | 29   | ↓                  | ↓    | ↓    | ↓    | ↓                 |

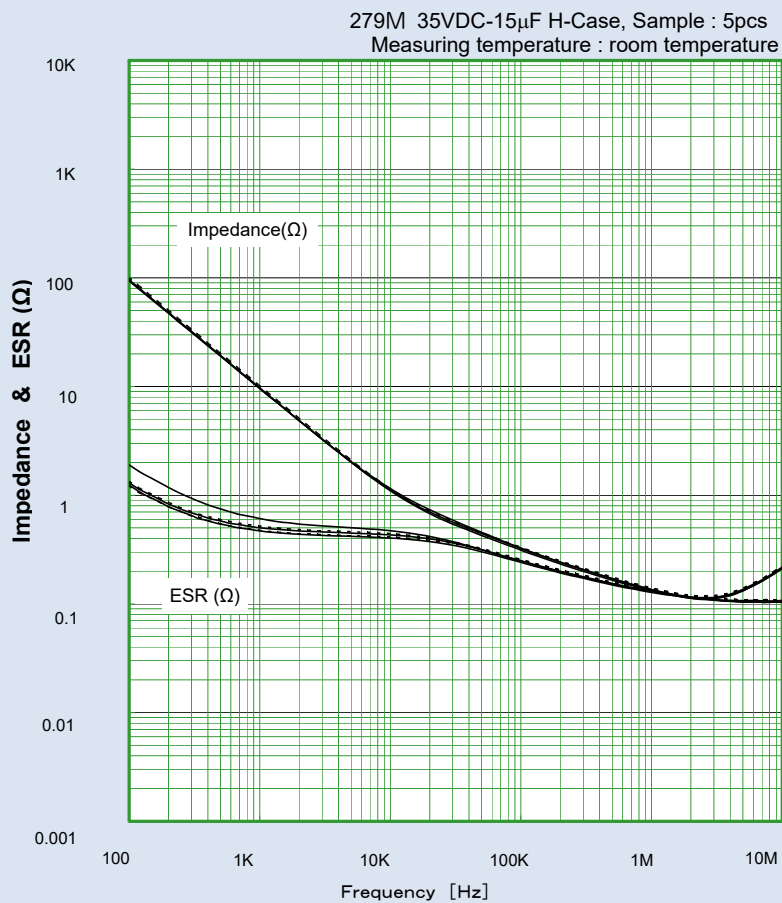
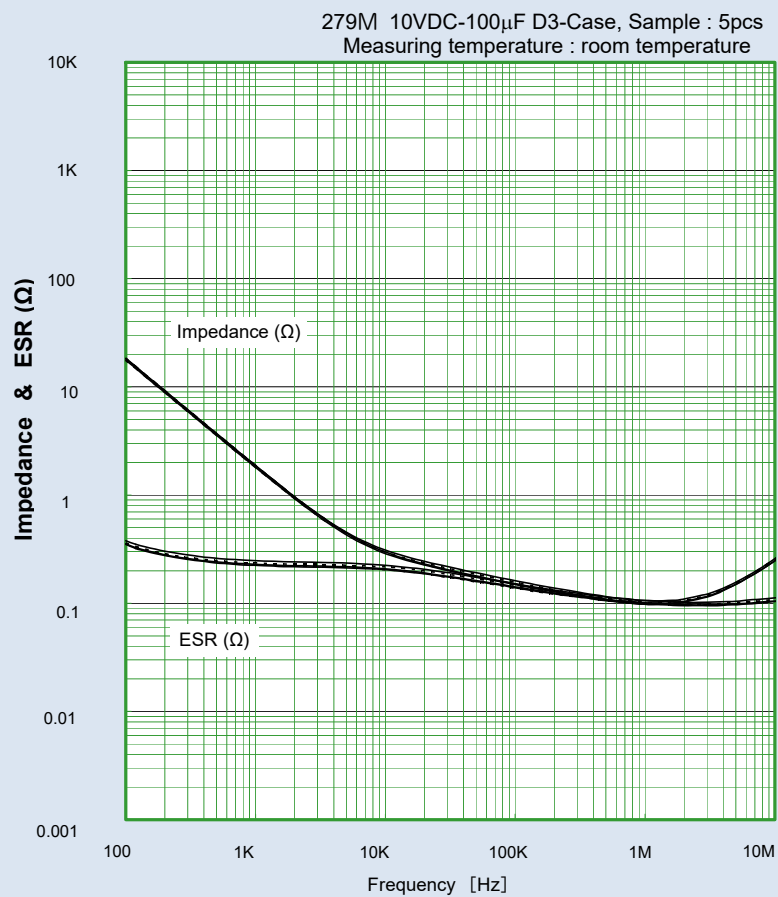
※ U<sub>R</sub> = Rated Voltage    U<sub>S</sub> = Surge Voltage    C<sub>R</sub> = Capacitance  
Note 1 : For Capacitance Tolerance, insert "K" or "M" into <sup>1</sup>\_.  
Note 2 : For Reeled Package, insert "R", "L", "N" or "P" into <sup>2</sup>\_.

## PERFORMANCE

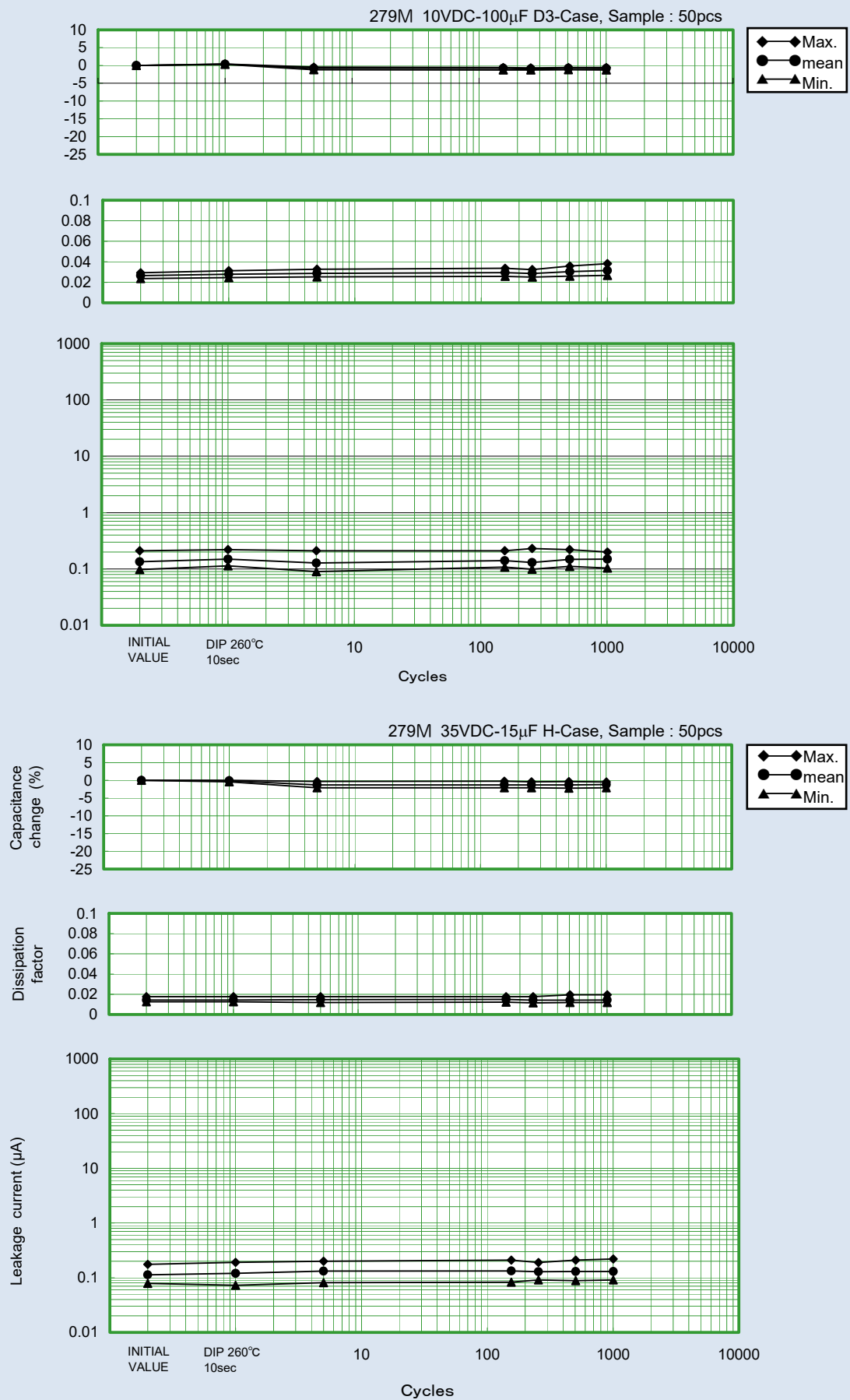
| No. | Item                                        |                                                                           | Performance                                                                                                                                                                                          | Test method                                                                                                                                                                                                                                                                                      |
|-----|---------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Leakage Current (μA)                        |                                                                           | Shall not exceed 0.01 CV or 0.5 whichever is greater.                                                                                                                                                | JIS C 5101-1, 4.9<br>Applied Voltage : Rated Voltage for 5 min.<br>Temperature : 20°C                                                                                                                                                                                                            |
| 2   | Capacitance (μF)                            |                                                                           | Shall be within tolerance of the nominal value specified.                                                                                                                                            | JIS C 5101-1, 4.7<br>Frequency : 120 Hz± 20%<br>Voltage : 0.5Vrms+1.5 ~2VDC<br>Temperature : 20°C                                                                                                                                                                                                |
| 3   | Dissipation Factor                          |                                                                           | Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS.                                                                                                                | JIS C 5101-1, 4.8<br>Frequency : 120 Hz± 20%<br>Voltage : 0.5Vrms+1.5 ~2VDC<br>Temperature : 20°C                                                                                                                                                                                                |
| 4   | ESR(Equivalent series resistance)           |                                                                           | Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS.                                                                                                                | Frequency : 10 kHz<br>Temperature : 20°C                                                                                                                                                                                                                                                         |
| 5   | Characteristics at High and Low Temperature |                                                                           |                                                                                                                                                                                                      | JIS C 5101-1, 4.29                                                                                                                                                                                                                                                                               |
|     | Step 1                                      | Leakage Current<br>Capacitance Change<br>Dissipation Factor               | Shall not exceed the value in No.1.<br>Shall be within the specified tolerance.<br>Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS.                             | Measuring temperature : 20 ± 2°C                                                                                                                                                                                                                                                                 |
|     | Step 2                                      | Capacitance Change<br>Dissipation Factor                                  | Shall be within $0_{-10}$ % of the value at Step 1.<br>Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS.                                                         | Measuring temperature : -55 ± 3°C                                                                                                                                                                                                                                                                |
|     | Step 3                                      | Leakage Current<br>Capacitance Change<br>Dissipation Factor               | Shall not exceed the value in No.1.<br>Shall be within ± 2% of the value at Step 1.<br>Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS.                         | Measuring temperature : 20 ± 2°C                                                                                                                                                                                                                                                                 |
|     | Step 4                                      | Leakage Current<br>Capacitance Change<br>Dissipation Factor               | Shall not exceed 0.1 CV or 5 whichever is greater.<br>Shall be within $+10_0$ % of the value at Step 1.<br>Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS.     | Measuring temperature : 85 ± 2°C                                                                                                                                                                                                                                                                 |
|     | Step 5                                      | Leakage Current<br>Capacitance Change<br>Dissipation Factor               | Shall not exceed 0.125 CV or 6.3 whichever is greater.<br>Shall be within $+15_0$ % of the value at Step 1.<br>Shall not exceed the values shown in CATALOG NUMBERS AND RATING OF STANDARD PRODUCTS. | Measuring temperature : 125 ± 2°C<br>Measuring voltage : Derated voltage at 125°C                                                                                                                                                                                                                |
| 6   | Surge                                       | Leakage Current<br>Capacitance Change<br>Dissipation Factor<br>Appearance | Shall not exceed the value in No.1.<br>Shall be within ± 10% of initial value.<br>Shall not exceed the value in No.3.<br>There shall be no evidence of mechanical damage.                            | JIS C 5101-1, 4.26<br>Test temperature and applied voltage : To each half of specimens<br>· 85 ± 2°C,<br>· 125 ± 2°C<br>Applied Voltage :DC surge voltage<br>Series protective resistance : 1000 Ω<br>Discharge resistance : 1000 Ω                                                              |
|     |                                             |                                                                           |                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                  |
| 7   | Shear Test                                  |                                                                           | No exfoliation between lead terminal and board.                                                                                                                                                      | JIS C 5101-1, 4.34<br>Capacitors mounted under conditions JIS C 5101-1, 4.33 are used as specimens.<br>Pressure : 5N<br>Duration : 5 ± 1 s                                                                                                                                                       |
| 8   | Substrate Bending Test                      | Capacitance Appearance                                                    | Initial value to remain steady during measurement.<br>There shall be no evidence of mechanical damage.                                                                                               | JIS C 5101-1, 4.35<br>Bending : 3 mm<br>Duration:5s                                                                                                                                                                                                                                              |
| 9   | Vibration                                   | Capacitance Appearance                                                    | Initial value to remain steady during measurement.<br>There shall be no evidence of mechanical damage.                                                                                               | JIS C 5101-1, 4.17<br>Frequency range :<br>10 ~ 55 Hz Swing width : 1.5 mm<br>Vibration direction :<br>3 directions with mutually right-angled<br>Duration :<br>2 hours in each of these mutually perpendicular directions (total 6 hours)<br>Mounting :<br>Solder terminal to the printed board |

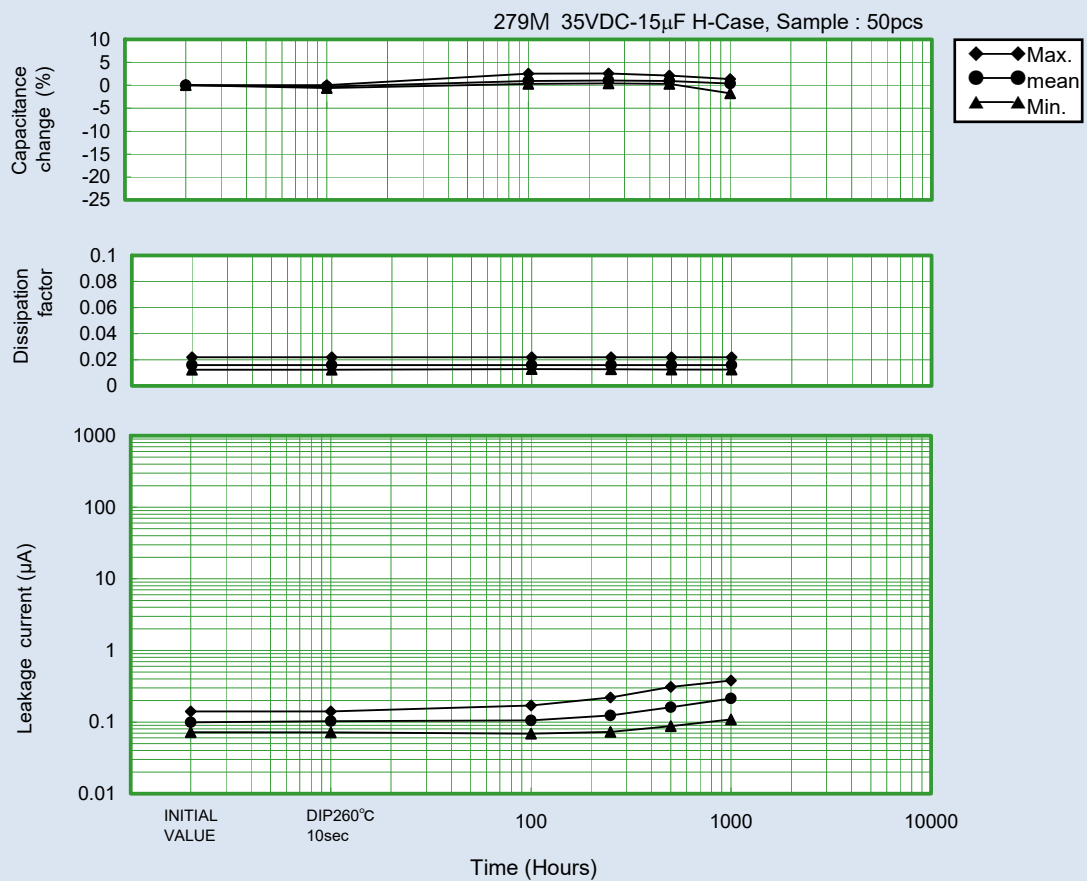
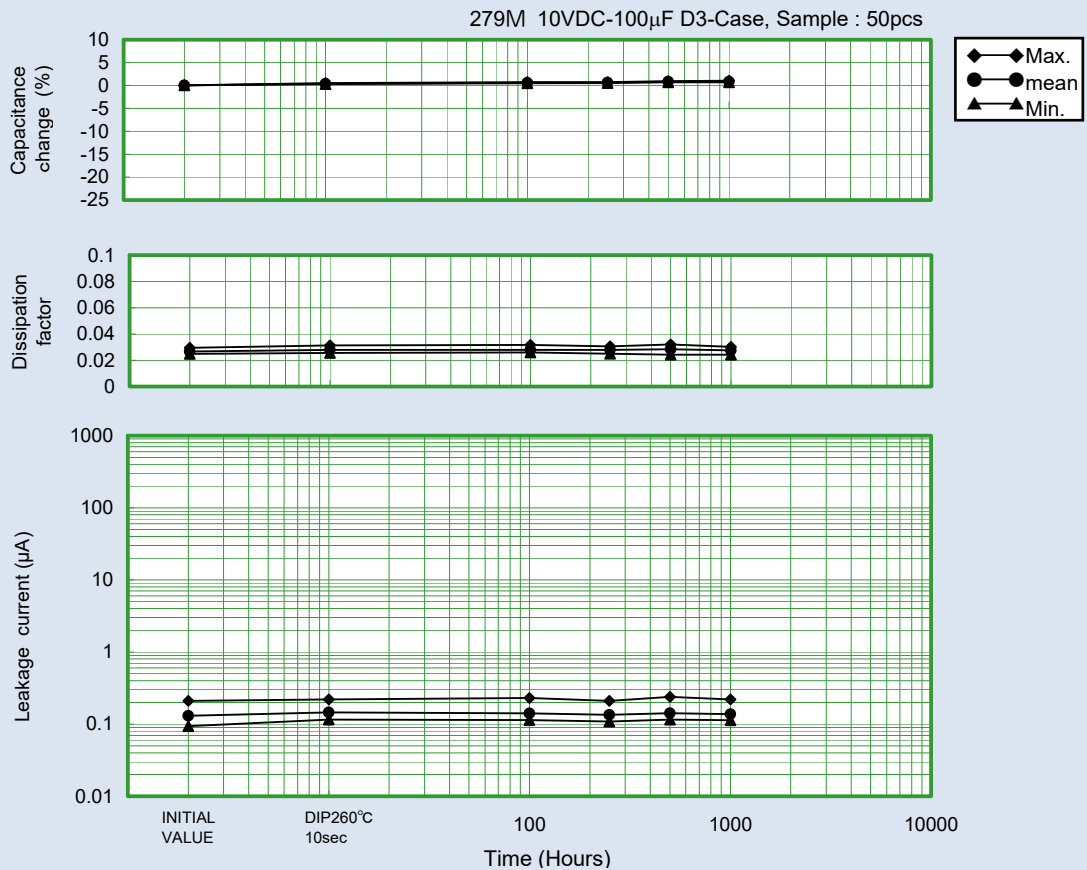
| No. | Item                          |                                                                                    | Performance                                                                                                                                                                                   | Test method                                                                                                                                                                                                                                                                                |
|-----|-------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 : 245 ± 5°C<br>Dipping time : 3 to 5 sec<br>Dipping depth :<br>Terminal shall be dipped into melted solder.                                                                                                                                       |
| 12  | Resistance to Soldering Heat  | Leakage<br>Current<br>Capacitance<br>Change<br>Dissipation<br>Factor<br>Appearance | Shall not exceed the value in No.1.<br><br>Shall be within ± 5% of initial value.<br><br>Shall not exceed the value in No.3.<br><br>There shall be no evidence of mechanical damage.          | JIS C 5101-1, 4.14<br>One of the following methods<br>(a) Complete dipping method<br>Solder temperature: 260 ± 5°C<br>Dipping time: 10 ± 1 s<br>(b) Terminal dipping method<br>Solder temperature: 260 ± 5°C<br>Dipping time: 10 ± 1 s                                                     |
| 13  | Component solvent resistance  | Leakage<br>Current<br>Capacitance<br>Change<br>Dissipation<br>Factor               | Shall not exceed the value in No.1.<br><br>Shall be within ± 5% of initial value.<br><br>Shall not exceed the value in No.3.                                                                  | JIS C 5101-1, 4.31<br>Temperature : 23 ± 5°C<br>Dipping time : 5 ± 0.5 min.<br>Conditioning : JIS C 0052 method 2<br>Solvent : 2-propanol (Isopropyl alcohol)                                                                                                                              |
| 14  | Solvent resistance of marking | Visual examination                                                                 | After the test the marking shall be legible.                                                                                                                                                  | JIS C 5101-1, 4.32<br>Temperature : 23 ± 5°C<br>Dipping time : 5 ± 0.5 min.<br>Conditioning : JIS C 0052 method 1<br>Solvent : 2-propanol (Isopropyl alcohol)<br>Rubbing material : cotton wool                                                                                            |
| 15  | Rapid Change of Temperature   | Leakage<br>Current<br>Capacitance<br>Change<br>Dissipation<br>Factor<br>Appearance | Shall not exceed the value in No.1.<br><br>Shall be within ± 10% of initial value.<br><br>Shall not exceed the value in No.3.<br><br>There shall be no evidence of mechanical damage.         | JIS C 5101-1, 4.16<br>Step 1 : -55 <sup>+0</sup> <sub>-3</sub> °C, 30 ± 3 min.<br>Step 2 : 25 <sup>+10</sup> <sub>-5</sub> °C, 3 min. max.<br>Step 3 : 125 <sup>+3</sup> <sub>-0</sub> °C, 30 ± 3 min.<br>Step 4 : 25 <sup>+10</sup> <sub>-5</sub> °C, 3 min. max.<br>Number of cycles : 5 |
| 16  | Damp heat, Steady state       | Leakage<br>Current<br>Capacitance<br>Change<br>Dissipation<br>Factor<br>Appearance | Shall not exceed the value in No.1.<br><br>Shall be within ± 10% of initial value.<br><br>Shall not exceed the value in No.3.<br><br>There shall be no evidence of mechanical damage.         | JIS C 5101-1, 4.22<br>Temperature : 40 ± 2°C<br>Moisture : 90 ~ 95%RH<br>Duration : 500 <sup>24</sup> <sub>0</sub> h                                                                                                                                                                       |
| 17  | Endurance                     | Leakage<br>Current<br>Capacitance<br>Change<br>Dissipation<br>Factor<br>Appearance | Shall not exceed 125% of the value in No.1.<br><br>Shall be within ± 10% of initial value.<br><br>Shall not exceed the value in No.3.<br><br>There shall be no evidence of mechanical damage. | JIS C 5101-1, 4.23<br>Test temperature and applied voltage :<br>85 ± 2°C and rated voltage or<br>125 ± 3°C and 2/3 × rated voltage<br>Duration : 2000 <sup>+72</sup> <sub>0</sub> h<br>Power supply impedance : 3 Ω or less                                                                |
| 18  | Fusing characteristics        |                                                                                    | Please refer to FUSING CHARACTERISTICS (Reference).                                                                                                                                           |                                                                                                                                                                                                                                                                                            |
| 19  | Rushed current test           |                                                                                    | The fuse shall not blow out.                                                                                                                                                                  | Applied voltage: Rated voltage<br>Power supply capacity:<br>Apply more than 20 A current                                                                                                                                                                                                   |

## FREQUENCY CHARACTERISTICS

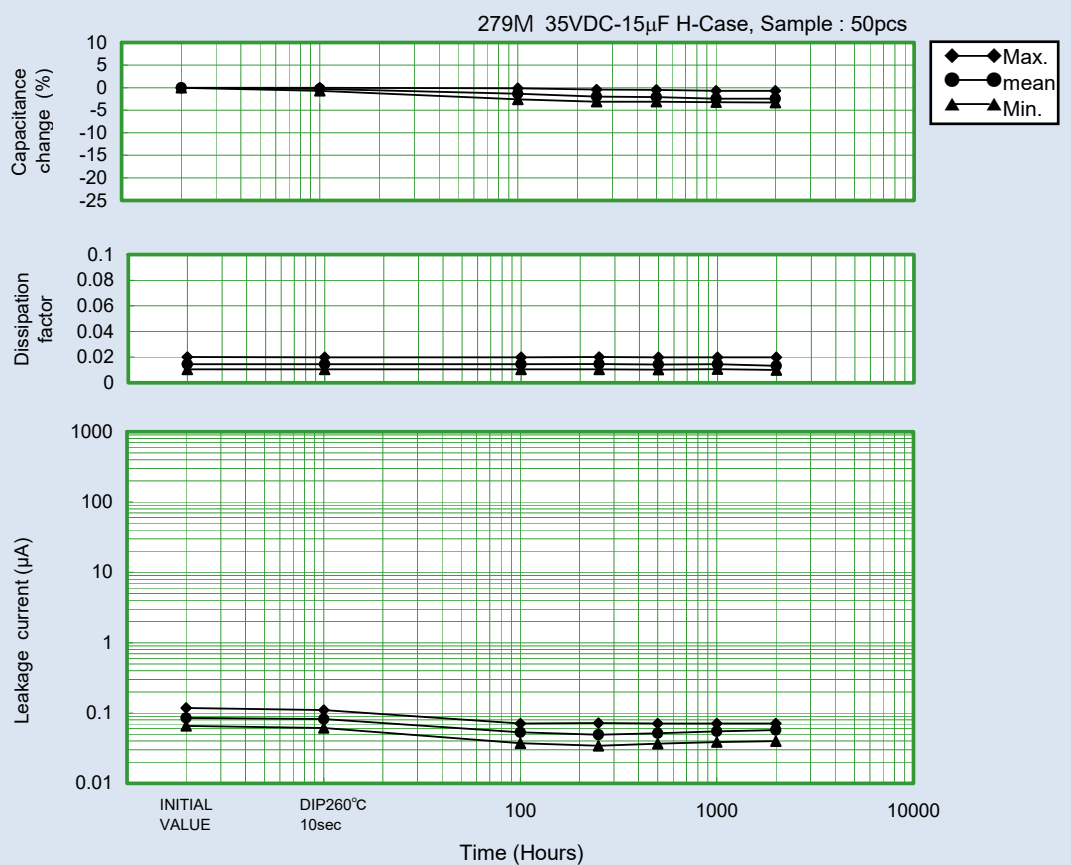
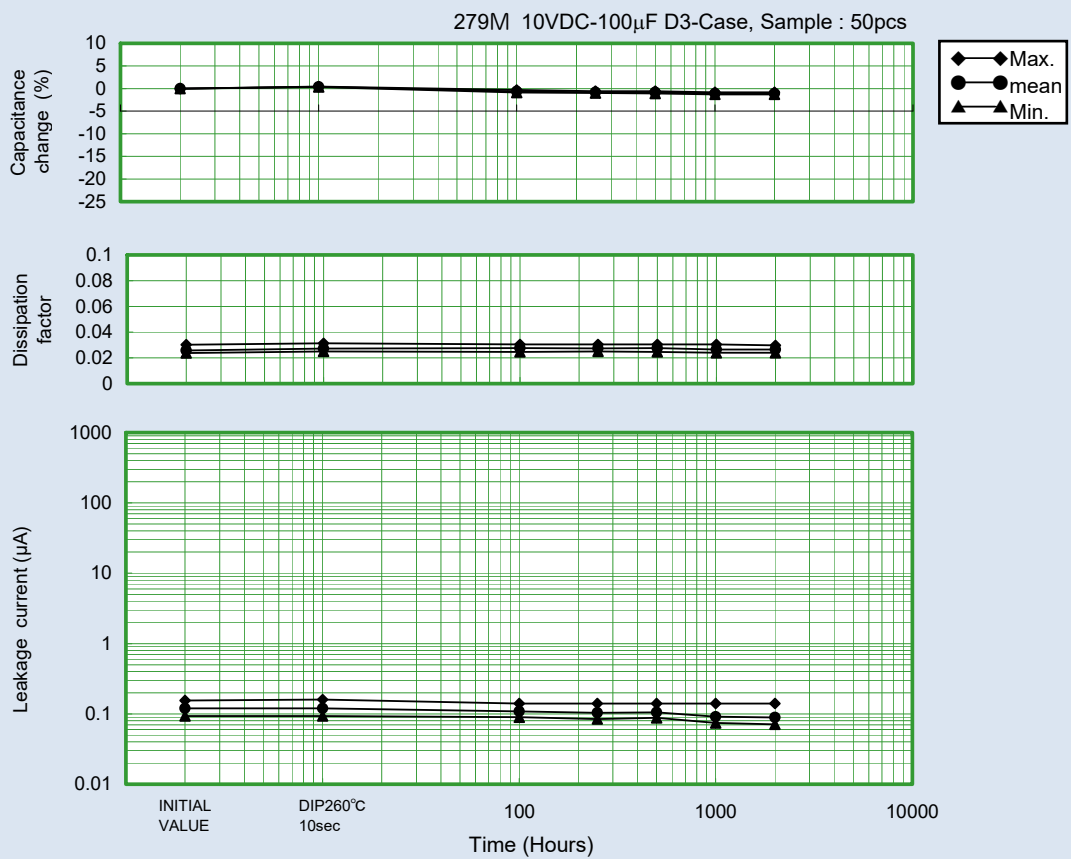


# TEMPERATURE CHARACTERISTICS -55/+125°C



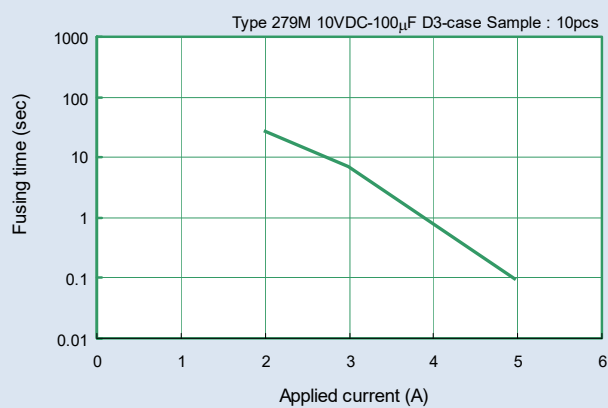
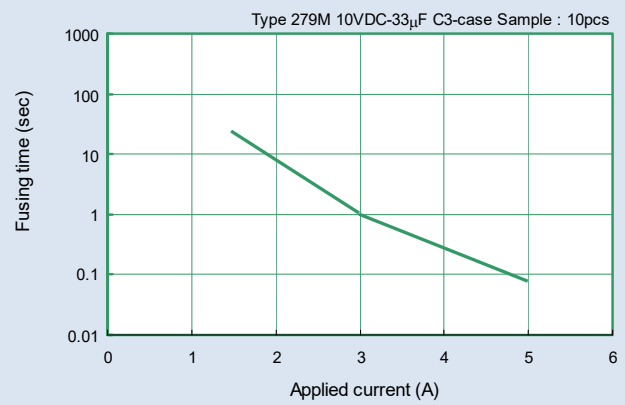
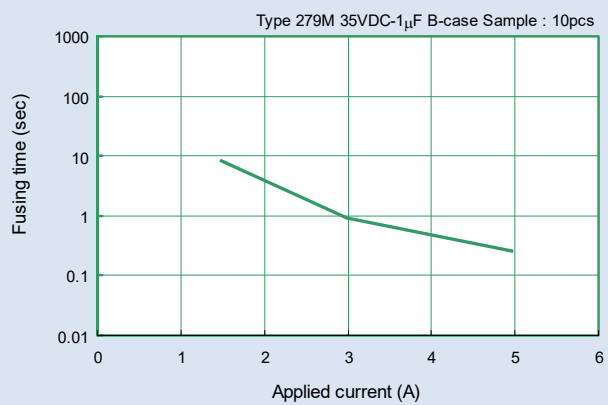


## ENDURANCE 85°C, RATED VOLTAGE



## FUSING CHARACTERISTICS

Reference





## Application Notes for Tantalum Solid Electrolytic Capacitor

### 1. Operating Voltage

Tantalum Solid Electrolytic Capacitor shall be operated at the rated voltage or lower.

**Rated voltage:** The "rated voltage" refers to the maximum DC voltage that is allowed to be continuously applied between the capacitor terminals at the rated temperature.

**Surge voltage:** The "surge voltage" refers to the voltage that is allowed to be instantaneously applied to the capacitor at the rated temperature or the maximum working temperature. The capacitor shall withstand the voltage when a 30-second cycle of application of the voltage through a 1000 Ω series resistance is repeated 1000 times in 6-minute periods.

When designing the circuit, the equipment's required reliability must be considered and appropriate voltage derating must be performed.

### 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 current should not exceed the allowable values.

### 3. Reverse Voltage

Tantalum solid electrolytic capacitor is polarity. Please do not impress reverse voltage. As well, please confirm the potential of the tester beforehand when both ends of the capacitor are checked with the tester etc.

### 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 (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.

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

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

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

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

| Case size | Pmax (W) |
|-----------|----------|
| B         | 0.050    |
| C3        | 0.065    |
| D3        | 0.085    |
| H         | 0.100    |
| E         | 0.105    |

Table 2 Pmax multiplier at each operating temperature

| Operating temperature (°C) | Multiplier |
|----------------------------|------------|
| 25                         | 1.0        |
| 55                         | 0.9        |
| 85                         | 0.8        |
| 125                        | 0.4        |

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.

### 5. Application on low-impedance circuit

The failure rate of low impedance circuit at 0.1Ω/V is about five times greater than that of a 1Ω/V circuit. To curtail this higher failure rate, tantalum capacitors used in low impedance circuits, such as filters for power supplies, particularly switching power supplies, or for noise by-passing, require that operating voltage be derated to less than half of the rated voltage. Actually, less than 1/3 of the rated voltage is recommended.

### 6. Non Polar Application(BACK TO BACK)

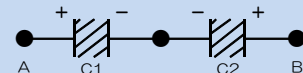
Tantalum capacitors can be used as a non-polar unit if two capacitors are connected "BACK-TO-BACK" when reserve voltage is applied at a more than permissible value, or in a purely AC circuit. The two capacitors should both be of the same rated voltage and capacitance tolerance, and they should both be twice the required capacitance value.

**Ripple Voltage:** Permissible Ripple Voltage shall not exceed the value allowed for either C1 or C2 (This will be the same, as the capacitors should be identical.)

**Capacitance:** (C1 × C2) / (C1 + C2)

**Leakage Current:** If terminal A is (+), the Leakage Current will be equal to C1's Leakage Current.

If terminal B is (+), the Leakage Current will be equal to C2's Leakage Current.



### 7. Soldering

#### 7.1. Preheating

To obtain optimal reliability and solderability conditions, capacitors should be pre-heated at 130 to 200 °C for approximately 60 to 120 seconds.

#### 7.2. Soldering

The body of the capacitor shall not exceed 260 °C during soldering.

##### (1) Reflow Soldering

Reflow soldering is a process in which the capacitors are mounted on a printed board with solder paste. There are two methods of Reflow Soldering: Direct and Atmospheric Heat.

· Direct Heat (Hot plate)

During the Direct Heat method, the capacitor has been positioned on a printed board, which is then placed upon a hot plate. The capacitor maintains a lower temperature than the substrate, which in turn stays at a lower temperature than the hot plate.

· Atmospheric Heat

a) VPS (Vapor Phase Soldering)

During VPS, the substrate is heated by an inert liquid with a high boiling point. The temperature of the capacitor's body and the

temperature of the substrate are about the same as the atmosphere. This temperature should be below 240°C.

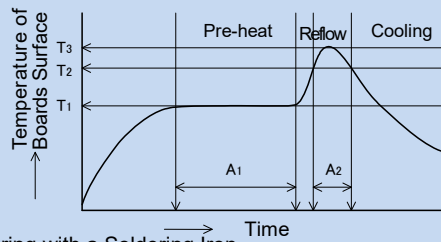
b) Near and Far IR Ray

Due to the heat absorption of the capacitor's body, the internal temperature of the capacitors may be 20 ~ 30°C higher than the setting temperature and may exceed 260°C.

Temperature control is crucial in maintaining a temperature of 260 °C or lower.

c) Convection Oven

An infrared ray is the main source of heat in this process. The temperature of the substrate and the capacitors can be maintained at a similar level by the circulation of heated air, or an inert gas.



| Temperature    | Time                    |
|----------------|-------------------------|
| T1=130°C~200°C | A1= 60~120sec.          |
| T2=220°C~230°C | A2<60sec.               |
| T3=~260°C      | 10 sec. or less than 10 |

Number of times : 2 times max..

(2) Soldering with a 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 5 seconds.

(3) Please consult us for other methods.

### 8. 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.

### 9. Protective Resin Coating

After components are assembled to substrate, a protective resin coating is sometimes applied. As this resin coating cures, it gives mechanical and thermal stress to Tantalum capacitors. This stress can cause damage to the capacitors, which affects their reliability. Before using a resin coating, proper research must be done in regards to the material and process to insure that excessive stress will not be applied to capacitors and other components.

### 10. Vibration

Approximately 300 G shall be applied to a capacitor, when dropped from 1 meter to a concrete floor.

Although capacitors are made to withstand this drop test, stress from shock due to falling or striking does cause damage to the capacitors and increases failure rates. Do not subject capacitors to this type of mechanical stress.

### 11. Ultrasonic cleaning

Matsuo does not recommend Ultrasonic cleaning. This may cause damage to the capacitors, and may even cause broken terminals. 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<sup>2</sup>.
- (3)The cleaning time should be kept to a minimum. Also, samples must be swang in the solvent. Please consult us.

### 12. Additional Notes

- When more than one capacitor is connected in series, a resistor that can distribute the voltage equally to the capacitors shall be connected in parallel.
- The capacitor cases shall not be cut even if the mounting space is insufficient.
- During a customers aging process, voltage should remain under the rated voltage at all times.
- Capacitors should never be touched or manipulated while operating.
- Capacitors are not meant to be dismantled.
- When testing capacitors, please examine the power source before conducting test to insure the tester's polarity and applied voltage.
- In the event of a capacitor burning, smoking, or emitting an offensive smell during operation, please turn the circuit "off" and keep hands and face away from the burning capacitor.
- If a capacitor be electrical shorted, it becomes hot, and the capacitor element may ignite. In this case, the printed board may be burnt out.
- Capacitors should be stored at room temperature under low humidity. Capacitors should never be stored under direct sunlight, and should be stored in an environment containing dust.
- If the capacitors will be operated in a humid environment, they should be sealed with a compound under proper conditions.
- Capacitors should not be stored or operated in environments containing acids, alkalis or active gasses.
- When capacitors are disposed of as "scrap" or waste, they should be treated as Industria Waste since they contain various metals and polymers.
- Capacitors submitted as samples should not be used for production purposes.

These application notes are prepared based on "Guideline of notabilia for fixed tantalum electrolytic capacitors with solid electrolyte for use in electronic equipment" (EIAJ RCR-2368) issued by Japan Electronics and Information Technology Industries Association (JEITA). 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.

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