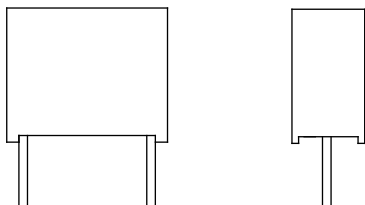


## AC and Pulse Film/Foil Capacitors Radial Potted Type



### FEATURES

- Material categorization:  
for definitions of compliance please see  
[www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

### APPLICATIONS

- High voltage, very high current and high pulse operations, deflection circuits in TV sets (fly-back tuning)
- Electronic ballasts, protection circuits in SMPS's
- Snubber and SCR commutating circuits

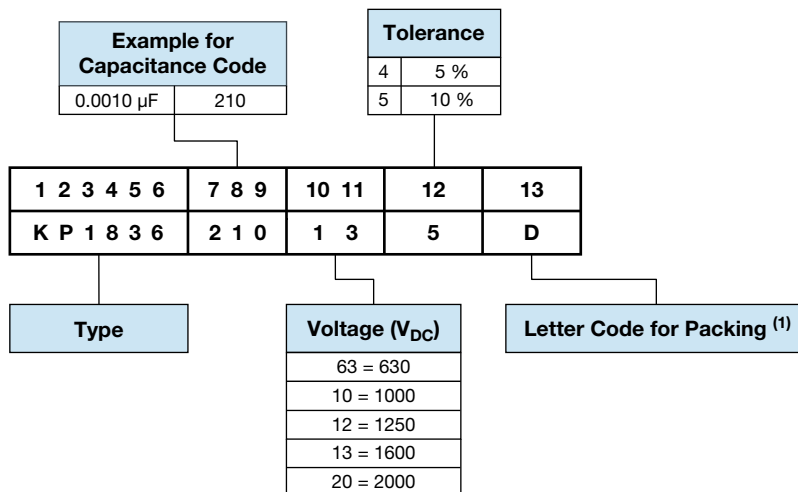


**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
**GREEN**  
(5-2008)

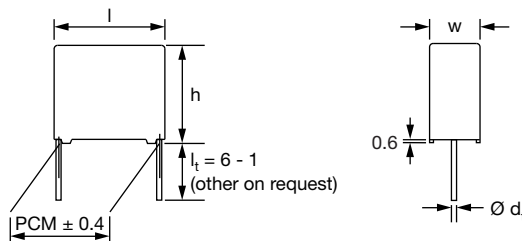
| QUICK REFERENCE DATA                                   |                                                                                                                      |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Capacitance range                                      | 100 pF to 0.22 $\mu$ F                                                                                               |
| Capacitance tolerances                                 | $\pm 10 \%$ , $\pm 5 \%$                                                                                             |
| Climatic testing class according to IEC 60068          | 55/100/56                                                                                                            |
| Dielectric                                             | Polypropylene film                                                                                                   |
| Electrodes                                             | Aluminum foil                                                                                                        |
| Construction                                           | Extended aluminum foil, internal series connection, double-sided metallized, polyester carrier film                  |
| Leads                                                  | Tinned wire                                                                                                          |
| Marking                                                | Manufacturer's logo, type, C-value, rated voltage, tolerance, data of manufacture                                    |
| Coating                                                | Flame retardant plastic case (UL-class 94 V-0), epoxy resin sealed                                                   |
| Insulation resistance                                  | Measured at 500 V <sub>DC</sub> after one minute<br>100 000 M $\Omega$ minimum value (1000 G $\Omega$ typical value) |
| Operating temperature range                            | -55 °C to +100 °C                                                                                                    |
| Rated DC voltages                                      | 630 V <sub>DC</sub> , 1000 V <sub>DC</sub> , 1250 V <sub>DC</sub> , 1600 V <sub>DC</sub> , 2000 V <sub>DC</sub>      |
| Permissible AC voltages (RMS) up to 60 Hz              | 300 V <sub>AC</sub> , 350 V <sub>AC</sub> , 400 V <sub>AC</sub> , 500 V <sub>AC</sub> , 600 V <sub>AC</sub>          |
| Test voltages (electrode/electrode)                    | 2 x U <sub>R</sub> for 2 s                                                                                           |
| Temperature coefficient                                | -250 x 10 <sup>-6</sup> /°C (typical value)                                                                          |
| Capacitance drift                                      | Up to +40 °C, $\pm 0.5 \%$ for a period of two years                                                                 |
| Derating for DC and AC category voltage U <sub>C</sub> | At +85 °C: U <sub>C</sub> = 1.0 U <sub>R</sub><br>At +100 °C: U <sub>C</sub> = 0.7 U <sub>R</sub>                    |
| Self inductance                                        | ~ 6 nH measured with 2 mm long leads                                                                                 |
| Pull test on leads                                     | $\geq 30$ N in direction of leads according to IEC 60068-2-21                                                        |
| Reliability                                            | Operational life > 300 000 h<br>Failure rate < 1 FIT (0.5 x U <sub>R</sub> and 40 °C)                                |

### Note

- For further details, please refer to the general information available at [www.vishay.com/doc?26033](http://www.vishay.com/doc?26033)

**COMPOSITION OF CATALOG NUMBER**

**Note**

<sup>(1)</sup> Letter code for packing please see table "Recommended Packaging"

**DIMENSIONS** in millimeters


| W    | Ø d |
|------|-----|
| ≥ 16 | 1.0 |
| < 16 | 0.8 |

**MAXIMUM PULSE RISE TIME**

| PCM (mm) | MAXIMUM PULSE RISE TIME dV/dt [V/μs] |               |               |               |               |
|----------|--------------------------------------|---------------|---------------|---------------|---------------|
|          | 630 $V_{DC}$                         | 1000 $V_{DC}$ | 1250 $V_{DC}$ | 1600 $V_{DC}$ | 2000 $V_{DC}$ |
| 15       | 6500                                 | 8200          | 11 100        | 13 900        | 13 900        |
| 22.5     | 2600                                 | 3200          | 4600          | 6000          | 9800          |
| 27.5     | 1800                                 | 2300          | 3100          | 4000          | 6000          |
| 37.5     | 1200                                 | 1500          | 1900          | 2400          | 3500          |

**Note**

- If the maximum pulse voltage is less than the rated voltage higher dV/dt values can be permitted

**DISSIPATION FACTOR  $\tan \delta$** 

| MEASURED AT    | $C \leq 0.1 \mu F$   | $C > 1.0 \mu F$      |
|----------------|----------------------|----------------------|
| 1 kHz          | $0.3 \times 10^{-3}$ | $0.3 \times 10^{-3}$ |
| 10 kHz         | $0.4 \times 10^{-3}$ | $0.4 \times 10^{-3}$ |
| 100 kHz        | $1 \times 10^{-3}$   | -                    |
| Maximum values |                      |                      |

**ELECTRICAL DATA**

| $U_{RDC}$<br>(V) | CAP.<br>( $\mu$ F) | CAPACITANCE<br>CODE | VOLTAGE<br>CODE | $V_{AC}$ | DIMENSIONS <sup>(1)</sup><br>(w x h x l)<br>(mm) | PCM  |
|------------------|--------------------|---------------------|-----------------|----------|--------------------------------------------------|------|
| 630              | 0.0027             | -227                | 63              | 300      | 5.5 x 10.5 x 18.0                                | 15   |
|                  | 0.0033             | -233                |                 |          | 5.5 x 10.5 x 18.0                                | 15   |
|                  | 0.0039             | -239                |                 |          | 6.5 x 12.5 x 18.0                                | 15   |
|                  | 0.0047             | -247                |                 |          | 6.5 x 12.5 x 18.0                                | 15   |
|                  | 0.0056             | -256                |                 |          | 7.5 x 13.5 x 18.0                                | 15   |
|                  | 0.0068             | -268                |                 |          | 7.5 x 13.5 x 18.0                                | 15   |
|                  | 0.0082             | -282                |                 |          | 8.5 x 14.5 x 18.0                                | 15   |
|                  | 0.010              | -310                |                 |          | 8.5 x 14.5 x 18.0                                | 15   |
|                  | 0.012              | -312                |                 |          | 8.5 x 17.5 x 18.0                                | 15   |
|                  | 0.015              | -315                |                 |          | 10.5 x 17.5 x 18.0                               | 15   |
|                  | 0.018              | -318                |                 |          | 7.5 x 15.5 x 26.5                                | 22.5 |
|                  | 0.022              | -322                |                 |          | 7.5 x 15.5 x 26.5                                | 22.5 |
|                  | 0.027              | -327                |                 |          | 8.5 x 16.5 x 26.5                                | 22.5 |
|                  | 0.033              | -333                |                 |          | 10.5 x 18.5 x 26.5                               | 22.5 |
|                  | 0.039              | -339                |                 |          | 10.5 x 18.5 x 26.5                               | 22.5 |
|                  | 0.047              | -347                |                 |          | 10.5 x 18.5 x 26.5                               | 22.5 |
|                  | 0.056              | -356                |                 |          | 11.5 x 20.5 x 31.5                               | 27.5 |
|                  | 0.068              | -368                |                 |          | 11.5 x 20.5 x 31.5                               | 27.5 |
|                  | 0.082              | -382                |                 |          | 11.5 x 20.5 x 31.5                               | 27.5 |
|                  | 0.10               | -410                |                 |          | 13.5 x 23.5 x 31.5                               | 27.5 |
|                  | 0.12               | -412                |                 |          | 12.5 x 22.5 x 41.5                               | 37.5 |
|                  | 0.15               | -415                |                 |          | 12.5 x 22.5 x 41.5                               | 37.5 |
|                  | 0.18               | -418                |                 |          | 14.5 x 24.5 x 41.5                               | 37.5 |
|                  | 0.22               | -422                |                 |          | 14.5 x 24.5 x 41.5                               | 37.5 |
| 1000             | 0.0018             | -218                | 10              | 350      | 5.5 x 10.5 x 18.0                                | 15   |
|                  | 0.0022             | -222                |                 |          | 5.5 x 10.5 x 18.0                                | 15   |
|                  | 0.0027             | -227                |                 |          | 6.5 x 12.5 x 18.0                                | 15   |
|                  | 0.0033             | -233                |                 |          | 6.5 x 12.5 x 18.0                                | 15   |
|                  | 0.0039             | -239                |                 |          | 7.5 x 13.5 x 18.0                                | 15   |
|                  | 0.0047             | -247                |                 |          | 7.5 x 13.5 x 18.0                                | 15   |
|                  | 0.0056             | -256                |                 |          | 8.5 x 14.5 x 18.0                                | 15   |
|                  | 0.0068             | -268                |                 |          | 8.5 x 14.5 x 18.0                                | 15   |
|                  | 0.0082             | -282                |                 |          | 6.5 x 14.5 x 26.5                                | 22.5 |
|                  | 0.010              | -310                |                 |          | 6.5 x 14.5 x 26.5                                | 22.5 |
|                  | 0.012              | -312                |                 |          | 7.5 x 15.5 x 26.5                                | 22.5 |
|                  | 0.015              | -315                |                 |          | 7.5 x 15.5 x 26.5                                | 22.5 |
|                  | 0.018              | -318                |                 |          | 8.5 x 16.5 x 26.5                                | 22.5 |
|                  | 0.022              | -322                |                 |          | 8.5 x 16.5 x 26.5                                | 22.5 |
|                  | 0.027              | -327                |                 |          | 10.5 x 18.5 x 26.5                               | 22.5 |
|                  | 0.033              | -333                |                 |          | 11.5 x 20.5 x 31.5                               | 27.5 |
|                  | 0.039              | -339                |                 |          | 11.5 x 20.5 x 31.5                               | 27.5 |
|                  | 0.047              | -347                |                 |          | 11.5 x 20.5 x 31.5                               | 27.5 |
|                  | 0.056              | -356                |                 |          | 12.5 x 22.5 x 41.5                               | 37.5 |
|                  | 0.068              | -368                |                 |          | 12.5 x 22.5 x 41.5                               | 37.5 |
|                  | 0.082              | -382                |                 |          | 12.5 x 22.5 x 41.5                               | 37.5 |
|                  | 0.10               | -410                |                 |          | 14.5 x 24.5 x 41.5                               | 37.5 |
|                  | 0.12               | -412                |                 |          | 14.5 x 24.5 x 41.5                               | 37.5 |
|                  | 0.15               | -415                |                 |          | 16.0 x 28.5 x 41.5                               | 37.5 |
|                  | 0.18               | -418                |                 |          | 16.0 x 28.5 x 41.5                               | 37.5 |
|                  | 0.22               | -422                |                 |          | 18.0 x 32.5 x 41.5                               | 37.5 |

**ELECTRICAL DATA**

| $U_{RDC}$<br>(V) | CAP.<br>( $\mu$ F) | CAPACITANCE<br>CODE | VOLTAGE<br>CODE | $V_{AC}$ | DIMENSIONS <sup>(1)</sup><br>(w x h x l)<br>(mm) | PCM  |
|------------------|--------------------|---------------------|-----------------|----------|--------------------------------------------------|------|
| 1250             | 0.0012             | -212                | 12              | 400      | 5.5 x 10.5 x 18.0                                | 15   |
|                  | 0.0015             | -215                |                 |          | 5.5 x 10.5 x 18.0                                | 15   |
|                  | 0.0018             | -218                |                 |          | 6.5 x 12.5 x 18.0                                | 15   |
|                  | 0.0022             | -222                |                 |          | 6.5 x 12.5 x 18.0                                | 15   |
|                  | 0.0027             | -227                |                 |          | 7.5 x 13.5 x 18.0                                | 15   |
|                  | 0.0033             | -233                |                 |          | 7.5 x 13.5 x 18.0                                | 15   |
|                  | 0.0039             | -239                |                 |          | 6.5 x 14.5 x 26.5                                | 22.5 |
|                  | 0.0047             | -247                |                 |          | 6.5 x 14.5 x 26.5                                | 22.5 |
|                  | 0.0056             | -256                |                 |          | 6.5 x 14.5 x 26.5                                | 22.5 |
|                  | 0.0068             | -268                |                 |          | 6.5 x 14.5 x 26.5                                | 22.5 |
|                  | 0.0082             | -282                |                 |          | 57.5 x 15.5 x 26.5                               | 22.5 |
|                  | 0.010              | -310                |                 |          | 7.5 x 15.5 x 26.5                                | 22.5 |
|                  | 0.012              | -312                |                 |          | 10.5 x 18.5 x 26.5                               | 22.5 |
|                  | 0.015              | -315                |                 |          | 10.5 x 18.5 x 26.5                               | 22.5 |
|                  | 0.018              | -318                |                 |          | 11.0 x 21.0 x 26.5                               | 22.5 |
|                  | 0.022              | -322                |                 |          | 11.0 x 21.0 x 26.5                               | 22.5 |
|                  | 0.027              | -327                |                 |          | 11.0 x 21.0 x 31.0                               | 27.5 |
|                  | 0.033              | -333                |                 |          | 11.0 x 21.0 x 31.0                               | 27.5 |
|                  | 0.039              | -339                |                 |          | 13.5 x 23.5 x 31.5                               | 27.5 |
|                  | 0.047              | -347                |                 |          | 13.5 x 23.5 x 31.5                               | 27.5 |
|                  | 0.056              | -356                |                 |          | 12.5 x 23.5 x 41.5                               | 37.5 |
|                  | 0.068              | -368                |                 |          | 12.5 x 22.5 x 41.5                               | 37.5 |
|                  | 0.082              | -382                |                 |          | 14.5 x 24.5 x 41.5                               | 37.5 |
|                  | 0.10               | -410                |                 |          | 14.5 x 24.5 x 41.5                               | 37.5 |
|                  | 0.12               | -412                |                 |          | 16.0 x 28.5 x 41.5                               | 37.5 |
|                  | 0.15               | -415                |                 |          | 16.0 x 28.5 x 41.5                               | 37.5 |
|                  | 0.18               | -418                |                 |          | 20.0 x 40.0 x 42.5                               | 37.5 |
|                  | 0.22               | -422                |                 |          | 20.0 x 40.0 x 42.5                               | 37.5 |
| 1600             | 0.00068            | -168                | 13              | 500      | 5.5 x 10.5 x 18.0                                | 15   |
|                  | 0.0010             | -210                |                 |          | 5.5 x 10.5 x 18.0                                | 15   |
|                  | 0.0012             | -212                |                 |          | 6.5 x 12.5 x 18.0                                | 15   |
|                  | 0.0015             | -215                |                 |          | 6.5 x 12.5 x 18.0                                | 15   |
|                  | 0.0018             | -218                |                 |          | 6.5 x 14.5 x 26.5                                | 22.5 |
|                  | 0.0022             | -222                |                 |          | 6.5 x 14.5 x 26.5                                | 22.5 |
|                  | 0.0027             | -227                |                 |          | 6.5 x 14.5 x 26.5                                | 22.5 |
|                  | 0.0033             | -233                |                 |          | 6.5 x 14.5 x 26.5                                | 22.5 |
|                  | 0.0039             | -239                |                 |          | 7.5 x 15.5 x 26.5                                | 22.5 |
|                  | 0.0047             | -247                |                 |          | 7.5 x 15.5 x 26.5                                | 22.5 |
|                  | 0.0056             | -256                |                 |          | 8.5 x 16.5 x 26.5                                | 22.5 |
|                  | 0.0068             | -268                |                 |          | 8.5 x 16.5 x 26.5                                | 22.5 |
|                  | 0.0082             | -282                |                 |          | 10.5 x 18.5 x 26.5                               | 22.5 |
|                  | 0.010              | -310                |                 |          | 10.5 x 18.5 x 26.5                               | 22.5 |
|                  | 0.012              | -312                |                 |          | 11.5 x 20.5 x 31.5                               | 27.5 |
|                  | 0.015              | -315                |                 |          | 11.5 x 20.5 x 31.5                               | 27.5 |
|                  | 0.018              | -318                |                 |          | 11.5 x 20.5 x 31.5                               | 27.5 |
|                  | 0.022              | -322                |                 |          | 11.5 x 20.5 x 31.5                               | 27.5 |
|                  | 0.027              | -327                |                 |          | 13.5 x 23.5 x 31.5                               | 27.5 |
|                  | 0.033              | -333                |                 |          | 13.5 x 23.5 x 31.5                               | 27.5 |
|                  | 0.039              | -339                |                 |          | 12.5 x 22.5 x 41.5                               | 37.5 |
|                  | 0.047              | -347                |                 |          | 12.5 x 22.5 x 41.5                               | 37.5 |
|                  | 0.056              | -356                |                 |          | 14.5 x 24.5 x 41.5                               | 37.5 |
|                  | 0.068              | -368                |                 |          | 14.5 x 24.5 x 41.5                               | 37.5 |
|                  | 0.082              | -382                |                 |          | 16.0 x 28.5 x 41.5                               | 37.5 |
|                  | 0.10               | -410                |                 |          | 16.0 x 28.5 x 41.5                               | 37.5 |

| ELECTRICAL DATA         |              |                     |                 |                 |                                                  |      |
|-------------------------|--------------|---------------------|-----------------|-----------------|--------------------------------------------------|------|
| U <sub>RDC</sub><br>(V) | CAP.<br>(μF) | CAPACITANCE<br>CODE | VOLTAGE<br>CODE | V <sub>AC</sub> | DIMENSIONS <sup>(1)</sup><br>(w x h x l)<br>(mm) | PCM  |
| 2000                    | 0.00010      | -110                | 20              | 600             | 5.5 x 10.5 x 18.0                                | 15   |
|                         | 0.00015      | -115                |                 |                 | 5.5 x 10.5 x 18.0                                | 15   |
|                         | 0.00022      | -122                |                 |                 | 5.5 x 10.5 x 18.0                                | 15   |
|                         | 0.00033      | -133                |                 |                 | 5.5 x 10.5 x 18.0                                | 15   |
|                         | 0.00047      | -147                |                 |                 | 5.5 x 10.5 x 18.0                                | 15   |
|                         | 0.00068      | -168                |                 |                 | 5.5 x 10.5 x 18.0                                | 15   |
|                         | 0.0010       | -210                |                 |                 | 6.5 x 14.5 x 26.5                                | 22.5 |
|                         | 0.0012       | -212                |                 |                 | 6.5 x 14.5 x 26.5                                | 22.5 |
|                         | 0.0015       | -215                |                 |                 | 6.5 x 14.5 x 26.5                                | 22.5 |
|                         | 0.0018       | -218                |                 |                 | 6.5 x 14.5 x 26.5                                | 22.5 |
|                         | 0.0022       | -222                |                 |                 | 6.5 x 14.5 x 26.5                                | 22.5 |
|                         | 0.0027       | -227                |                 |                 | 7.5 x 15.5 x 26.5                                | 22.5 |
|                         | 0.0033       | -233                |                 |                 | 7.5 x 15.5 x 26.5                                | 22.5 |
|                         | 0.0039       | -239                |                 |                 | 10.5 x 18.5 x 26.5                               | 22.5 |
|                         | 0.0047       | -247                |                 |                 | 10.5 x 18.5 x 26.5                               | 22.5 |
|                         | 0.0056       | -256                |                 |                 | 10.5 x 18.5 x 26.5                               | 22.5 |
|                         | 0.0068       | -268                |                 |                 | 11.5 x 20.5 x 31.5                               | 27.5 |
|                         | 0.0082       | -282                |                 |                 | 11.5 x 20.5 x 31.5                               | 27.5 |
|                         | 0.010        | -310                |                 |                 | 11.5 x 20.5 x 31.5                               | 27.5 |
|                         | 0.012        | -312                |                 |                 | 13.5 x 23.5 x 31.5                               | 27.5 |
|                         | 0.015        | -315                |                 |                 | 13.5 x 23.5 x 31.5                               | 27.5 |
|                         | 0.018        | -318                |                 |                 | 15.0 x 24.5 x 31.5                               | 27.5 |
|                         | 0.022        | -322                |                 |                 | 15.0 x 24.5 x 31.5                               | 27.5 |
|                         | 0.027        | -327                |                 |                 | 14.5 x 24.5 x 41.5                               | 37.5 |
|                         | 0.033        | -333                |                 |                 | 14.5 x 24.5 x 41.5                               | 37.5 |
|                         | 0.039        | -339                |                 |                 | 16.0 x 28.5 x 41.5                               | 37.5 |
|                         | 0.047        | -347                |                 |                 | 16.0 x 28.5 x 41.5                               | 37.5 |

**Notes**

- Further C-values upon request
- (1) For tolerances see chapter "Space Requirements for Printed-Circuit Board Applications and Dimension Tolerances"

| RECOMMENDED PACKAGING |                      |                    |                       |                           |           |                     |             |
|-----------------------|----------------------|--------------------|-----------------------|---------------------------|-----------|---------------------|-------------|
| LETTER<br>CODE        | TYPE OF<br>PACKAGING | HEIGHT (H)<br>(mm) | REEL DIAMETER<br>(mm) | ORDERING CODE<br>EXAMPLES | PCM<br>15 | PCM<br>22.5 TO 27.5 | PCM<br>37.5 |
| D                     | Ammo                 | 16.5               | S <sup>(1)</sup>      | KP1836-168/205-D          | x         | -                   | -           |
| G                     | Ammo                 | 18.5               | S <sup>(1)</sup>      | KP1836-168/205-G          | x         | -                   | -           |
| F                     | Reel                 | 16.5               | 350                   | KP1836-168/205-F          | x         | -                   | -           |
| W                     | Reel                 | 18.5               | 350                   | KP1836-168/205-W          | x         | -                   | -           |
| V                     | Reel                 | 18.5               | 500                   | KP1836-310/134-V          | x         | x                   | -           |
| G                     | Ammo                 | 18.5               | L <sup>(2)</sup>      | KP1836-310/134-G          | -         | x                   | -           |
| -                     | Bulk                 | -                  | -                     | KP1836-310/134            | x         | x                   | x           |

**Notes**

- (1) S = Box size 55 mm x 210 mm x 340 mm (W x H x L)
- (2) L = Box size 60 mm x 360 mm x 510 mm (W x H x L)

## MOUNTING

### Normal Use

The capacitors are designed for mounting on printed-circuit boards. The capacitors packed in bandoleers are designed for mounting on printed-circuit boards by means of automatic insertion machines.

For detailed tape specifications refer to packaging information [www.vishay.com/doc?28139](http://www.vishay.com/doc?28139)

### Specific Method of Mounting to Withstand Vibration and Shock

In order to withstand vibration and shock tests, it must be ensured that the stand-off pips are in good contact with the printed-circuit board:

- For pitches  $\leq 15$  mm the capacitors shall be mechanically fixed by the leads
- For larger pitches the capacitors shall be mounted in the same way and the body clamped

### Space Requirements for Printed-Circuit Board Applications and Dimension Tolerances

For the maximum product dimensions and maximum space requirements for length ( $l_{max.}$ ), width ( $w_{max.}$ ), and height ( $h_{max.}$ ) following tolerances must be taken in account in the envelopment of the components as shown in the drawings below:

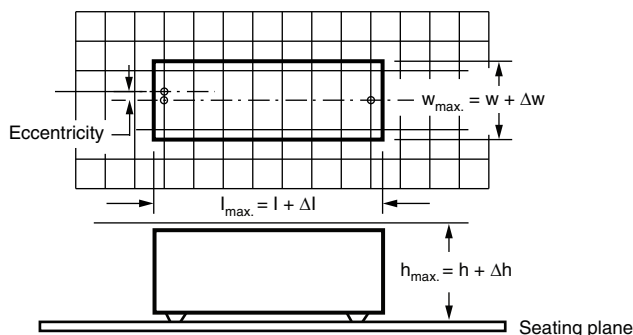
For products with pitch  $\leq 15$  mm,  $\Delta w = \Delta l = 0.3$  mm and  $\Delta h = 0.1$  mm

For products with  $15 \text{ mm} < \text{pitch} \leq 27.5$  mm,  $\Delta w = \Delta l = 0.5$  mm and  $\Delta h = 0.1$  mm

For products with pitch = 37.5 mm,  $\Delta w = \Delta l = 0.7$  mm and  $\Delta h = 0.5$  mm

For products with pitch = 52.5 mm,  $\Delta w = \Delta l = 1.0$  mm and  $\Delta h = 0.5$  mm

Eccentricity defined as in drawing. The maximum eccentricity is smaller than or equal to the lead diameter of the product concerned.



For the minimum product dimensions for length ( $l_{min.}$ ), width ( $w_{min.}$ ), and height ( $h_{min.}$ ) following tolerances of the components are valid:

$l_{min.} = l - \Delta l$ ,  $w_{min.} = w - \Delta w$ , and  $h_{min.} = h - \Delta h$  following

For products with pitch  $\leq 10$  mm,  $\Delta l = 0.3$  mm and  $\Delta w = \Delta h = 0.3$  mm

For products with pitch = 15 mm,  $\Delta l = 0.5$  mm and  $\Delta w = \Delta h = 0.5$  mm

For products with  $15 \text{ mm} < \text{pitch} \leq 27.5$  mm,  $\Delta l = 1.0$  mm and  $\Delta w = \Delta h = 0.5$  mm

For products with pitch = 37.5 mm,  $\Delta l = 1.0$  mm and  $\Delta w = \Delta h = 1.0$  mm

For products with pitch = 52.5 mm,  $\Delta l = 1.5$  mm and  $\Delta w = \Delta h = 1.0$  mm

## SOLDERING CONDITIONS

For general soldering conditions and wave soldering profile, we refer to the application note "Soldering Guidelines for Film Capacitors": [www.vishay.com/doc?28171](http://www.vishay.com/doc?28171)

## STORAGE TEMPERATURE

$T_{stg} = -25$  °C to  $+35$  °C with RH maximum 75 % without condensation.

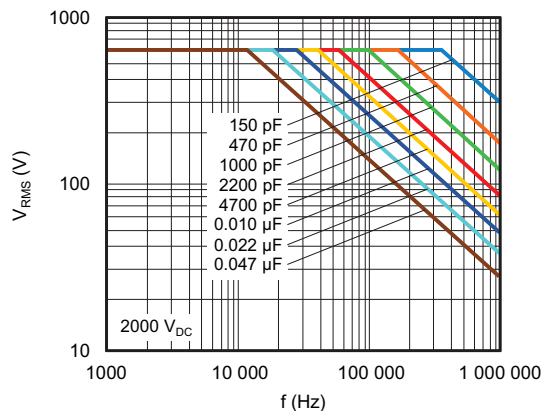
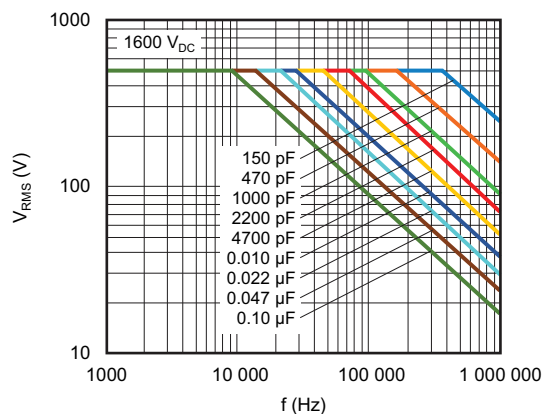
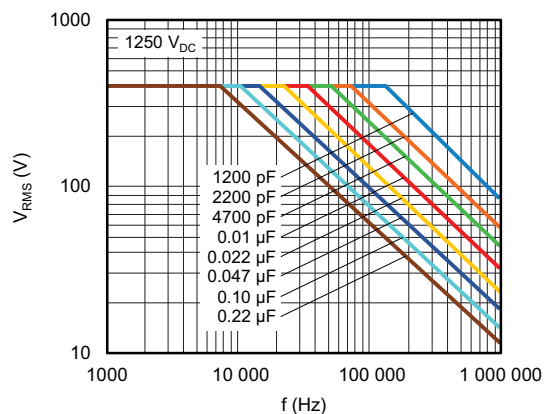
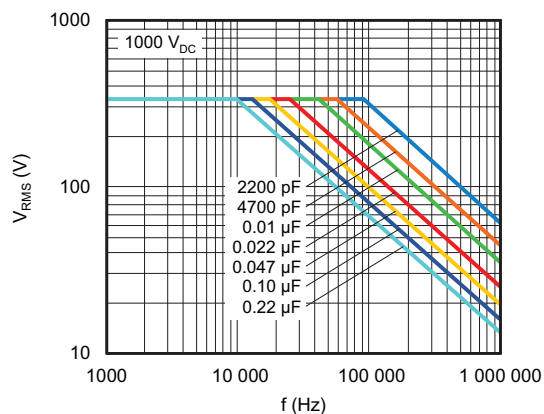
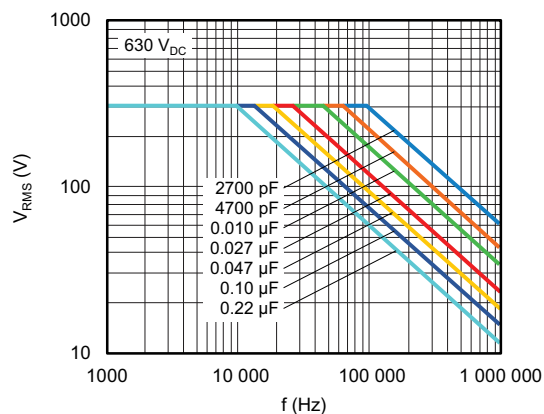
## RATINGS AND CHARACTERISTICS REFERENCE CONDITIONS

Unless otherwise specified, all electrical values apply to an ambient free temperature of  $23$  °C  $\pm 1$  °C, an atmospheric pressure of 86 kPa to 106 kPa, and a relative humidity of  $50$  %  $\pm 2$  %.

For reference testing, a conditioning period shall be applied over  $96$  h  $\pm 4$  h by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.



## PERMISSIBLE AC VOLTAGE VS. FREQUENCY



| <b>HEAT CONDUCTIVITY (G) AS A FUNCTION OF CAPACITOR BODY THICKNESS IN mW/°C</b> |                                  |                      |                      |                      |                      |
|---------------------------------------------------------------------------------|----------------------------------|----------------------|----------------------|----------------------|----------------------|
| <b>W<sub>max.</sub><br/>(mm)</b>                                                | <b>HEAT CONDUCTIVITY (mW/°C)</b> |                      |                      |                      |                      |
|                                                                                 | <b>PITCH 15 mm</b>               | <b>PITCH 22.5 mm</b> | <b>PITCH 27.5 mm</b> | <b>PITCH 37.5 mm</b> | <b>PITCH 52.5 mm</b> |
| 5.5                                                                             | 10.0                             | -                    | -                    | -                    | -                    |
| 6.5                                                                             | 13.0                             | 20.0                 | -                    | -                    | -                    |
| 7.5                                                                             | 15.0                             | 22.0                 | -                    | -                    | -                    |
| 8.5                                                                             | 16.0                             | 24.0                 | -                    | -                    | -                    |
| 9.0                                                                             | -                                | -                    | 32.0                 | -                    | -                    |
| 10.5                                                                            | -                                | 30.0                 | -                    | -                    | -                    |
| 11.0                                                                            | -                                | -                    | 38.0                 | -                    | -                    |
| 11.5                                                                            | -                                | -                    | 38.0                 | -                    | -                    |
| 12.5                                                                            | -                                | 34.0                 | -                    | -                    | -                    |
| 13.0                                                                            | -                                | -                    | 45.0                 | -                    | -                    |
| 13.5                                                                            | -                                | -                    | 45.0                 | -                    | -                    |
| 15.0                                                                            | -                                | -                    | 50.0                 | -                    | -                    |
| 16.5                                                                            | -                                | -                    | 58.0                 | -                    | -                    |
| 18.0                                                                            | -                                | -                    | 60.0                 | -                    | -                    |
| 18.5                                                                            | -                                | -                    | -                    | 90.0                 | -                    |
| 20.0                                                                            | -                                | -                    | 73.0                 | -                    | -                    |
| 21.0                                                                            | -                                | -                    | 70.0                 | -                    | -                    |
| 21.5                                                                            | -                                | -                    | -                    | 102.0                | -                    |
| 24.0                                                                            | -                                | -                    | -                    | 118.0                | -                    |
| 25.0                                                                            | -                                | -                    | -                    | -                    | 155.0                |
| 30.0                                                                            | -                                | -                    | -                    | 135.0                | 170.0                |
| 35.0                                                                            | -                                | -                    | -                    | -                    | 200.0                |

## POWER DISSIPATION AND MAXIMUM COMPONENT TEMPERATURE RISE

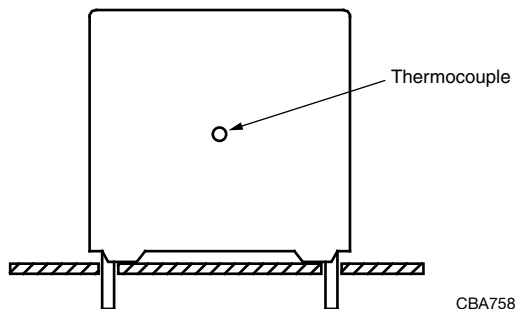
The power dissipation must be limited in order not to exceed the maximum allowed component temperature rise as a function of the free air ambient temperature.

The component temperature rise ( $\Delta T$ ) can be measured or calculated by  $\Delta T = P/G$ :

- $\Delta T$  = component temperature rise (°C) with a maximum of 15 °C
- P = power dissipation of the component (mW)
- G = heat conductivity of the component (mW/°C)

## MEASURING THE COMPONENT TEMPERATURE

A thermocouple must be attached to the capacitor body as in:



The temperature is measured in unloaded ( $T_{amb}$ ) and maximum loaded condition ( $T_C$ ).

The temperature rise is given by  $\Delta T = T_C - T_{amb}$ .

To avoid thermal radiation or convection, the capacitor should be tested in a closed area from air circulation.

## APPLICATION NOTE AND LIMITING CONDITIONS

These capacitors are not suitable for mains applications as across-the-line capacitors without additional protection, as described hereunder. These mains applications are strictly regulated in safety standards and therefore electromagnetic interference suppression capacitors conforming the standards must be used.

To select the capacitor for a certain application, the following conditions must be checked:

1. The peak voltage ( $U_p$ ) shall not be greater than the rated DC voltage ( $U_{RDC}$ )
2. The peak-to-peak voltage ( $U_{p-p}$ ) shall not be greater than the maximum ( $U_{p-p}$ ) to avoid the ionization inception level
3. The voltage peak slope ( $dU/dt$ ) shall not exceed the rated voltage pulse slope in an RC-circuit at rated voltage and without ringing. If the pulse voltage is lower than the rated DC voltage, the rated voltage pulse slope may be multiplied by  $U_{RDC}$  and divided by the applied voltage.

For all other pulses following equation must be fulfilled:

$$2 \times \int_0^T \left( \frac{dU}{dt} \right) \times dt < U_{NDC} \times \left( \frac{dU}{dt} \right)_{rated}$$

T is the pulse duration

4. The maximum component surface temperature rise must be lower than the limits (see graph "Max. allowed component temperature rise").
5. Since in circuits used at voltages over 280 V peak-to-peak the risk for an intrinsically active flammability after a capacitor breakdown (short circuit) increases, it is recommended that the power to the component is limited to 100 times the values mentioned in the table: "Heat Conductivity"
6. When using these capacitors as across-the-line capacitor in the input filter for mains applications or as series connected with an impedance to the mains the applicant must guarantee that the following conditions are fulfilled in any case (spikes and surge voltages from the mains included).
7. For capacitors connected in parallel, normally the proof voltage and possibly the rated voltage must be reduced. For information depending of the capacitance value and the number of parallel connections contact [dc-film@vishay.com](mailto:dc-film@vishay.com).

| <b>VOLTAGE CONDITIONS FOR 6 ABOVE</b>       |                                             |                                                              |
|---------------------------------------------|---------------------------------------------|--------------------------------------------------------------|
| <b>ALLOWED VOLTAGES</b>                     | <b><math>T_{amb} \leq 85^\circ C</math></b> | <b><math>85^\circ C &lt; T_{amb} \leq 100^\circ C</math></b> |
| Maximum continuous RMS voltage              | $U_{RAC}$                                   | $U_{RAC}$                                                    |
| Maximum temporary RMS-over voltage (< 24 h) | $1.25 \times U_{RAC}$                       | $0.875 \times U_{RAC}$                                       |
| Maximum peak voltage ( $V_{o-p}$ ) (< 2 s)  | $1.6 \times U_{RDC}$                        | $1.1 \times U_{RDC}$                                         |

## INSPECTION REQUIREMENTS

### General Notes

Sub-clause numbers of tests and performance requirements refer to the “Sectional Specification, Publication IEC 60384-14 and Specific Reference Data”.

| GROUP C INSPECTION REQUIREMENTS                           |                                                                                                                                                                                                                                                  |                                                                                                                                                                                              |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SUB-CLAUSE NUMBER AND TEST                                | CONDITIONS                                                                                                                                                                                                                                       | PERFORMANCE REQUIREMENTS                                                                                                                                                                     |
| <b>SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1</b>       |                                                                                                                                                                                                                                                  |                                                                                                                                                                                              |
| 4.1 Dimensions (detail)                                   |                                                                                                                                                                                                                                                  | As specified in chapters “General Data” of this specification                                                                                                                                |
| 4.3.1 Initial measurements                                | Capacitance<br>Tangent of loss angle at 100 kHz                                                                                                                                                                                                  |                                                                                                                                                                                              |
| 4.3 Robustness of terminations                            | Tensile and bending                                                                                                                                                                                                                              | No visible damage                                                                                                                                                                            |
| 4.4 Resistance to soldering heat                          | Method: 1A<br>Solder bath: 280 °C ± 5 °C<br>Duration: 10 s                                                                                                                                                                                       |                                                                                                                                                                                              |
| 4.14 Component solvent resistance                         | Isopropylalcohol at room temperature<br>Method: 2<br>Immersion time: 5 min ± 0.5 min<br>Recovery time: min. 1 h, max. 2 h                                                                                                                        |                                                                                                                                                                                              |
| 4.4.2 Final measurements                                  | Visual examination<br><br>Capacitance<br><br>Tangent of loss angle                                                                                                                                                                               | No visible damage<br>Legible marking<br><br>$ \Delta C/C  \leq 2\%$ of the value measured initially<br><br>Increase of $\tan \delta$ : $\leq 0.002$<br>Compared to values measured initially |
| <b>SUB-GROUP C1B OTHER PART OF SAMPLE OF SUB-GROUP C1</b> |                                                                                                                                                                                                                                                  |                                                                                                                                                                                              |
| 4.6.1 Initial measurements                                | Capacitance<br>Tangent of loss angle at 100 kHz                                                                                                                                                                                                  |                                                                                                                                                                                              |
| 4.15 Solvent resistance of the marking                    | Isopropyl alcohol at room temperature<br>Method: 1<br>Rubbing material: cotton wool<br>Immersion time: 5 min ± 0.5 min                                                                                                                           | No visible damage<br>Legible marking                                                                                                                                                         |
| 4.6 Rapid change of temperature                           | $\theta A$ = lower category temperature<br>$\theta B$ = upper category temperature<br>5 cycles<br>Duration $t = 30$ min                                                                                                                          |                                                                                                                                                                                              |
| 4.7 Vibration                                             | Visual examination<br>Mounting: see section “Mounting” for more information<br>Procedure B4:<br>frequency range: 10 Hz to 55 Hz<br>Amplitude: 0.75 mm or<br>Acceleration 98 m/s <sup>2</sup><br>(whichever is less severe)<br>Total duration 6 h | No visible damage                                                                                                                                                                            |

| <b>GROUP C INSPECTION REQUIREMENTS</b>                                     |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>SUB-CLAUSE NUMBER AND TEST</b>                                          | <b>CONDITIONS</b>                                                                                                                                                                                  | <b>PERFORMANCE REQUIREMENTS</b>                                                                                                                                                                                                                                                                                                                   |
| <b>SUB-GROUP C1B OTHER PART OF SAMPLE OF SUB-GROUP C1</b>                  |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                   |
| 4.7.2 Final inspection                                                     | Visual examination                                                                                                                                                                                 | No visible damage                                                                                                                                                                                                                                                                                                                                 |
| 4.9 Shock                                                                  | Mounting: see section "Mounting" for more information<br>Pulse shape: half sine<br>Acceleration: 490 m/s <sup>2</sup><br>Duration of pulse: 11 ms                                                  |                                                                                                                                                                                                                                                                                                                                                   |
| 4.9.3 Final measurements                                                   | Visual examination<br><br>Capacitance<br><br>Tangent of loss angle<br><br>Insulation resistance                                                                                                    | No visible damage<br><br>$ \Delta C/C  \leq 2\%$ of the value measured in 4.6.1<br><br>Increase of $\tan \delta$ : $\leq 0.002$<br>Compared to values measured in 4.6.1<br><br>$\geq 50\%$ of values specified in section "Insulation Resistance" of this specification                                                                           |
| <b>SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B</b> |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                   |
| 4.10 Climatic sequence                                                     |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                   |
| 4.10.2 Dry heat                                                            | Temperature: +100 °C<br>Duration: 16 h                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                   |
| 4.10.3 Damp heat cyclic<br>Test Db, first cycle                            |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                   |
| 4.10.4 Cold                                                                | Temperature: -55 °C<br>Duration: 2 h                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                   |
| 4.10.6 Damp heat cyclic<br>Test Db, remaining cycles                       | Voltage proof = $U_{RDC}$ for 1 minute within<br>15 minutes after removal from test chamber                                                                                                        |                                                                                                                                                                                                                                                                                                                                                   |
| 4.10.6.2 Final measurements                                                | Visual examination<br><br>Capacitance<br><br>Tangent of loss angle<br><br>Insulation resistance                                                                                                    | No breakdown or flashover<br><br>No visible damage<br>Legible marking<br>$ \Delta C/C  \leq 3\%$ of the value measured initially.<br><br>Increase of $\tan \delta$ : $\leq 0.003$<br>Compared to values measured in 4.3.1 or 4.6.1<br><br>$\geq 50\%$ of values specified in section "Insulation Resistance" of this specification                |
| <b>SUB-GROUP C2</b>                                                        |                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                   |
| 4.11 Damp heat steady state                                                | 56 days, 40 °C, 90 % to 95 % RH,<br>no load                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                   |
| 4.11.1 Initial measurements                                                | Capacitance<br>Tangent of loss angle at 1 kHz                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                   |
| 4.11.3 Final measurements                                                  | Voltage proof = $U_{RDC}$ for 1 minute within<br>15 minutes after removal from test chamber<br><br>Visual examination<br><br>Capacitance<br><br>Tangent of loss angle<br><br>Insulation resistance | No permanent breakdown or flash-over<br><br>No visible damage<br>Legible marking<br><br>$ \Delta C/C  \leq 3\%$ of the value measured initially.<br><br>Increase of $\tan \delta$ : $\leq 0.001$<br>Compared to values measured in 4.3.1 or 4.6.1<br><br>$\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |



| GROUP C INSPECTION REQUIREMENTS                                                        |                                                                                                                     |                                                                                                                               |
|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| SUB-CLAUSE NUMBER AND TEST                                                             | CONDITIONS                                                                                                          | PERFORMANCE REQUIREMENTS                                                                                                      |
| <b>SUB-GROUP C3A</b>                                                                   |                                                                                                                     |                                                                                                                               |
| 4.12.1 Endurance test at 50 Hz alternating voltage                                     | Duration: 2000 h<br>Voltage: 1.0 x U <sub>RAC</sub> at 100 °C                                                       |                                                                                                                               |
| 4.12.1.1 Initial measurements                                                          | Capacitance<br>Tangent of loss angle: at 10 kHz                                                                     |                                                                                                                               |
| 4.12.1.3 Final measurements                                                            | Visual examination                                                                                                  | No visible damage<br>Legible marking                                                                                          |
|                                                                                        | Capacitance                                                                                                         | $ \Delta C/C  \leq 5\%$ of the value measured in 4.12.1                                                                       |
|                                                                                        | Tangent of loss angle                                                                                               | Increase of $\tan \delta$ : $\leq 0.004$<br>Compared to values measured in 4.12.1                                             |
|                                                                                        | Insulation resistance                                                                                               | $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification                                      |
| <b>SUB-GROUP C4</b>                                                                    |                                                                                                                     |                                                                                                                               |
| 4.2.6 Temperature characteristics<br>Initial measurements<br>Intermediate measurements | Capacitance<br>Capacitance at: -55 °C<br>Capacitance at: 20 °C<br>Capacitance at: 100 °C                            | For -55 °C to +20 °C:<br>$+1\% \leq  \Delta C/C  \leq 3.75\%$ or<br>for 20 °C to 105 °C:<br>$-6\% \leq  \Delta C/C  \leq 0\%$ |
| Final measurements                                                                     | Capacitance                                                                                                         | As specified in section "Capacitance" of this specification                                                                   |
|                                                                                        | Insulation resistance                                                                                               | As specified in section "Insulation Resistance" of this specification                                                         |
| 4.13 Charge and discharge                                                              | 10 000 cycles<br>Charged to U <sub>RDC</sub><br>Discharge resistance:<br>$R = \frac{U_{RDC}}{2.5 \times C (dU/dt)}$ |                                                                                                                               |
| 4.13.1 Initial measurements                                                            | Capacitance<br>Tangent of loss angle at 100 kHz                                                                     |                                                                                                                               |
| 4.13.3 Final measurements                                                              | Capacitance                                                                                                         | $ \Delta C/C  \leq 3\%$ compared to values measured in 4.13.1.                                                                |
|                                                                                        | Tangent of loss angle                                                                                               | Increase of $\tan \delta$ : $\leq 0.005$<br>Compared to values measured in 4.13.1                                             |
|                                                                                        | Insulation resistance                                                                                               | $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification                                      |



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