

## Interference Suppression Film Capacitor - Class X2 Radial MKP 310 V<sub>AC</sub> - Standard Across the Line



**FEATURES**

- Compliant with IEC 60384-14: AMD1 THB grade IA
- Self-healing properties
- For temperature up to 110 °C
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS  
COMPLIANT**
**APPLICATIONS**

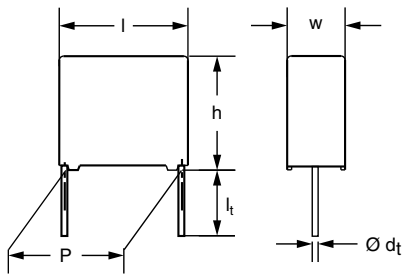
For standard across the line X2 applications.

 See also application note: [www.vishay.com/doc?28153](http://www.vishay.com/doc?28153)

| QUICK REFERENCE DATA                            |   |
|---|---|
| Capacitance range (E12 series)                  | 0.001 µF to 4.7 µF<br>(preferred values acc. to E6)   |
| Capacitance tolerance                           | ± 20 %; ± 10 %; (± 5 % on request)  |
| Rated AC voltage                                | 310 V <sub>AC</sub> ; 50 Hz to 60 Hz  |
| Permissible DC voltage                          | 800 V <sub>DC</sub> at 85 °C<br>630 V <sub>DC</sub> at 110 °C   |
| Climatic testing class according to IEC 60068-1 | 55 / 110 / 56 / B for volumes > 1750 mm <sup>3</sup><br>55 / 110 / 56 / C for volumes ≤ 1750 mm <sup>3</sup>  |
| Maximum application temperature                 | C ≤ 470 nF: 110 °C (125 °C for less than 1000 h)<br>C > 470 nF: 110 °C  |
| Reference standards                             | IEC 60384-14:2013<br>IEC 60384-14:2013 / AMD1:2016<br>EN 60384-14:2013 + AMD1:2016<br>IEC 60065, pass. flamm. class B for volumes > 1750 mm <sup>3</sup><br>CSA-E384-14; CQC<br>UL 60384-14 |
| Dielectric                                      | Polypropylene film  |
| Electrodes                                      | Metallized film   |
| Construction                                    | Mono construction<br>   |
| Encapsulation                                   | Plastic case, epoxy resin sealed, flame retardant class UL 94 V-0   |
| Leads   | Tinned wire   |
| Marking   | C-value; tolerance; rated voltage; sub-class; manufacturer's type;<br>code for dielectric material; manufacturer location, year and week;<br>manufacturer's logo or name; safety approvals  |

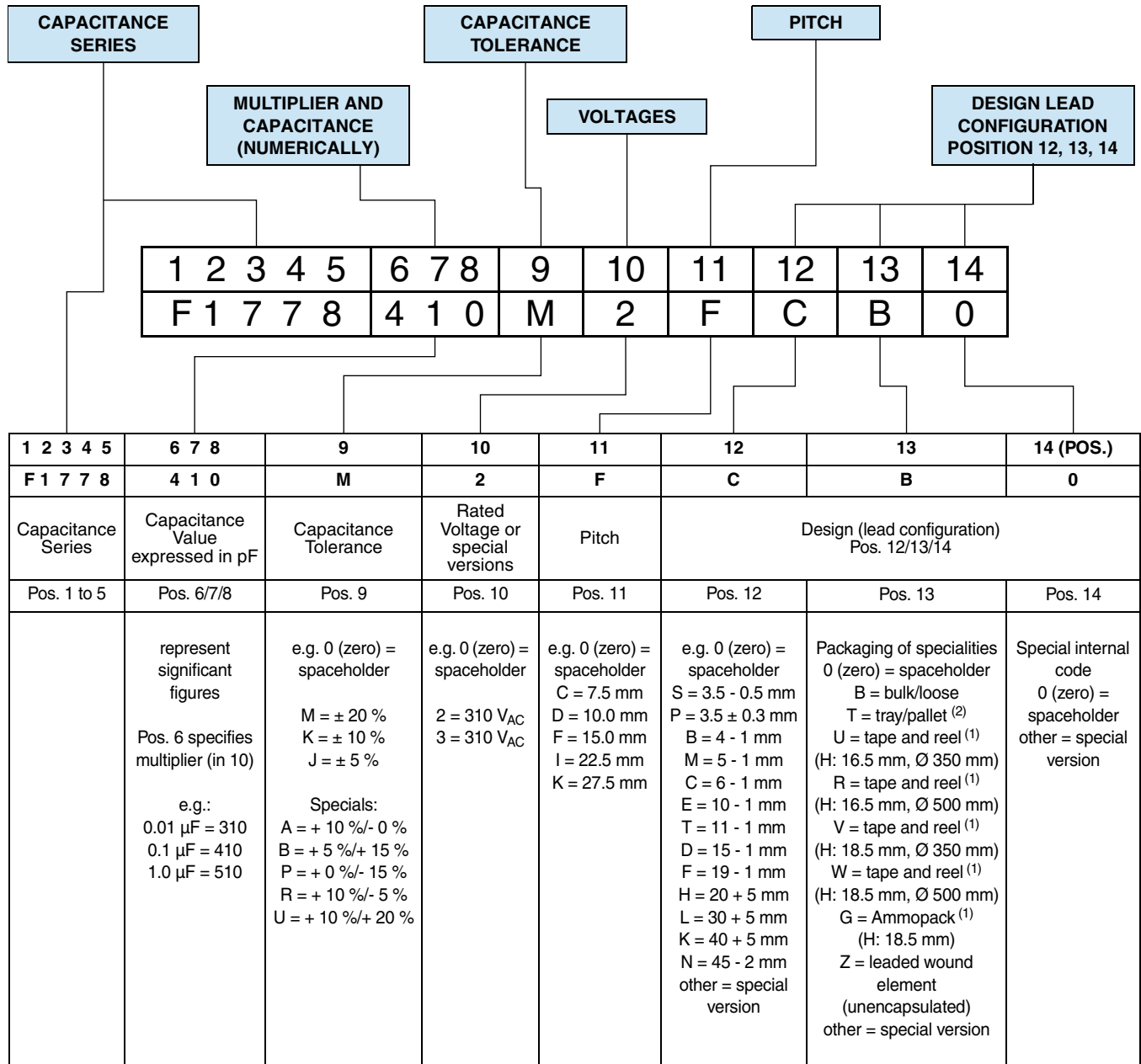
**Notes**

- For more detailed data and test requirements, contact [rfi@vishay.com](mailto:rfi@vishay.com)

| DIMENSIONS in millimeters  |
|--|
|  |

**COMPOSITION OF CATALOG NUMBER**

The new RFI Film Capacitor Code is made up 14 digit code (example)


**Notes**

- (1) For detailed tape specification refer to packaging information: [www.vishay.com/doc?28139](http://www.vishay.com/doc?28139)
- (2) Packaging will be bulk for all capacitors with pitch ≤ 15 mm and such with long leads (> 5 mm). Capacitors with short leads up to 5 mm and pitch > 15 mm will be in tray and asking code will be "T".



| SPECIFIC REFERENCE DATA  |                                  |                          |
|--|----------------------------------|--------------------------|
| DESCRIPTION  | VALUE                            |                          |
| Rated AC voltage ( $U_{RAC}$ )   | 310 V                            |                          |
| Permissible DC voltage ( $U_{RDC}$ )   | 630 V                            |                          |
| Tangent of loss angle:   | at 1 kHz                         | at 10 kHz                |
| $C < 470 \text{ nF}$   | $\leq 10 \times 10^{-4}$         | $\leq 20 \times 10^{-4}$ |
| $470 \text{ nF} \leq C \leq 1 \mu\text{F}$   | $\leq 20 \times 10^{-4}$         | $\leq 70 \times 10^{-4}$ |
| $C > 1 \mu\text{F}$  | $\leq 30 \times 10^{-4}$         | -                        |
| Rated voltage pulse slope ( $dU/dt$ ) <sub>R</sub> at 435 V <sub>DC</sub>                      | 600 V/ $\mu\text{s}$             |                          |
| Pitch = 7.5 mm   | 600 V/ $\mu\text{s}$             |                          |
| Pitch = 10 mm  | 400 V/ $\mu\text{s}$             |                          |
| Pitch = 15 mm  | 150 V/ $\mu\text{s}$             |                          |
| Pitch = 22.5 mm  | 100 V/ $\mu\text{s}$             |                          |
| Pitch = 27.5 mm  | > 15 000 M $\Omega$              |                          |
| R between leads, for $C \leq 0.33 \mu\text{F}$ at 100 V; 1 min                                 | > 5000 s                         |                          |
| RC between leads, for $C > 0.33 \mu\text{F}$ at 100 V; 1 min                                   | > 30 000 M $\Omega$              |                          |
| R between leads and case; 100 V; 1 min   | 2200 V; 1 min                    |                          |
| Withstanding (DC) voltage (cut off current 10 mA) <sup>(1)</sup> ; rise time $1000 \leq V/s$ : | 1800 V; 1 min                    |                          |
| $C \leq 1 \mu\text{F}$   | 2120 V; 1 min                    |                          |
| $C > 1 \mu\text{F}$  | 2120 V; 1 min                    |                          |
| Withstanding (AC) voltage between leads and case   | 110 °C (125 °C less than 1000 h) |                          |
| Max. application temperature for $0.001 \mu\text{F} \leq C \leq 0.47 \mu\text{F}$              | 110 °C                           |                          |
| Max. application temperature for $C > 0.47 \mu\text{F}$  | 110 °C                           |                          |

Note

<sup>(1)</sup> See "Voltage Proof Test for Metallized Film Capacitors": [www.vishay.com/doc?28169](http://www.vishay.com/doc?28169)

| ELECTRICAL DATA AND ORDERING CODE |  |  |   |                            |  |                              |         |      |         |       |                          |
|-----------------------------------|--|--|---|----------------------------|--|------------------------------|---------|------|---------|-------|--------------------------|
| $U_{RAC}$<br>(V)                  | CAP.<br>$\mu\text{F}$<br>POS. 6 TO 8                                   | TOLERANCE<br>CODE<br>POS. 9<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$ | DIMENSIONS<br>MAX.<br>w x h x l<br>(mm) | MASS<br>(g) <sup>(3)</sup> | SPQ <sup>(4)</sup><br>SHORT<br>LEADS<br>(PIECES) | ORDERING CODE <sup>(2)</sup> |         |      |         |       |                          |
|                                   |  |  |   |                            |  | TYPE                         | C-VALUE | TOL. | VOLTAGE | PITCH | LEAD<br>LENGTH<br>DESIGN |
|                                   |  |  |   |                            |  | 1 TO 5                       | 6 TO 8  | 9    | 10      | 11    | 12 TO 14 <sup>(1)</sup>  |
| 310                               | PITCH 7.5 mm $\pm$ 0.4 mm; $d_t = 0.50 \text{ mm} \pm 0.05 \text{ mm}$ |  |   |                            |  |                              |         |      |         |       |                          |
|                                   | 0.0010   | K / M  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 210     | .    | .       | C     | ..0                      |
|                                   | 0.0012   | K  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 212     | K    | .       | C     | ..0                      |
|                                   | 0.0015   | K / M  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 215     | .    | .       | C     | ..0                      |
|                                   | 0.0018   | K  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 218     | K    | .       | C     | ..0                      |
|                                   | 0.0022   | K / M  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 222     | .    | .       | C     | ..0                      |
|                                   | 0.0027   | K  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 227     | K    | .       | C     | ..0                      |
|                                   | 0.0033   | K / M  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 233     | .    | .       | C     | ..0                      |
|                                   | 0.0039   | K  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 239     | K    | .       | C     | ..0                      |
|                                   | 0.0047   | K / M  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 247     | .    | .       | C     | ..0                      |
|                                   | 0.0056   | K  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 256     | K    | .       | C     | ..0                      |
|                                   | 0.0068   | K / M  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 268     | .    | .       | C     | ..0                      |
|                                   | 0.0082   | K  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 282     | K    | .       | C     | ..0                      |
|                                   | 0.010  | K / M  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 310     | .    | .       | C     | ..0                      |
|                                   | 0.012  | K  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 312     | K    | .       | C     | ..0                      |
|                                   | 0.015  | K / M  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 315     | .    | .       | C     | ..0                      |
|                                   | 0.018  | K  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 318     | K    | .       | C     | ..0                      |
|                                   | 0.022  | K / M  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 322     | .    | .       | C     | ..0                      |
|                                   | 0.027  | K  | 4.0 x 9.0 x 10.0                        | 0.45                       | 1500   | F1778                        | 327     | K    | .       | C     | ..0                      |
|                                   | 0.033  | K  | 5.0 x 10.5 x 10.0                       | 0.6                        | 1000   | F1778                        | 333     | K    | .       | C     | ..0                      |
| 0.033                             | M  | 4.0 x 9.0 x 10.0   | 0.45                                    | 1500                       | F1778  | 333                          | M       | .    | C       | ..0   |                          |
| 0.039                             | K  | 5.0 x 10.5 x 10.0  | 0.6                                     | 1000                       | F1778  | 339                          | K       | .    | C       | ..0   |                          |
| 0.047                             | K  | 5.0 x 10.5 x 10.0  | 0.6                                     | 1000                       | F1778  | 347                          | K       | .    | C       | ..0   |                          |
| 0.047                             | M  | 5.0 x 10.5 x 10.0  | 0.4                                     | 1000                       | F1778  | 347                          | M       | .    | C       | ..0   |                          |
| 0.056                             | K  | 6.0 x 11.5 x 10.0  | 0.8                                     | 750                        | F1778  | 356                          | K       | .    | C       | ..0   |                          |
| 0.068                             | M  | 6.0 x 11.5 x 10.0  | 0.8                                     | 750                        | F1778  | 368                          | M       | .    | C       | ..0   |                          |






| ELECTRICAL DATA AND ORDERING CODE |  |  |   |                            |  |                              |         |      |         |       |                          |  |
|-----------------------------------|--|--|---|----------------------------|--|------------------------------|---------|------|---------|-------|--------------------------|--|
| U <sub>RAC</sub><br>(V)           | CAP.<br>μF<br>POS. 6 TO 8                                | TOLERANCE<br>CODE<br>POS. 9<br>J = ± 5 %<br>K = ± 10 %<br>M = ± 20 % | DIMENSIONS<br>MAX.<br>w x h x l<br>(mm) | MASS<br>(g) <sup>(3)</sup> | SPQ <sup>(4)</sup><br>SHORT<br>LEADS<br>(PIECES) | ORDERING CODE <sup>(2)</sup> |         |      |         |       |                          |  |
|                                   |  |  |   |                            |  | TYPE                         | C-VALUE | TOL. | VOLTAGE | PITCH | LEAD<br>LENGTH<br>DESIGN |  |
|                                   |  |  |   |                            |  | 1 TO 5                       | 6 TO 8  | 9    | 10      | 11    | 12 TO 14 <sup>(1)</sup>  |  |
| 310                               | PITCH 10 mm ± 0.4 mm; d <sub>t</sub> = 0.60 mm ± 0.06 mm |  |   |                            |  |                              |         |      |         |       |                          |  |
|                                   | 0.0010   | K / M  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 210     | .    | .       | D     | ..0                      |  |
|                                   | 0.0012   | K  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 212     | K    | .       | D     | ..0                      |  |
|                                   | 0.0015   | K / M  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 215     | .    | .       | D     | ..0                      |  |
|                                   | 0.0018   | K  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 218     | K    | .       | D     | ..0                      |  |
|                                   | 0.0022   | K / M  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 222     | .    | .       | D     | ..0                      |  |
|                                   | 0.0027   | K  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 227     | K    | .       | D     | ..0                      |  |
|                                   | 0.0033   | K / M  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 233     | .    | .       | D     | ..0                      |  |
|                                   | 0.0039   | K  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 239     | K    | .       | D     | ..0                      |  |
|                                   | 0.0047   | K / M  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 247     | .    | .       | D     | ..0                      |  |
|                                   | 0.0056   | K  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 256     | K    | .       | D     | ..0                      |  |
|                                   | 0.0068   | K / M  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 268     | .    | .       | D     | ..0                      |  |
|                                   | 0.0082   | K  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 282     | K    | .       | D     | ..0                      |  |
|                                   | 0.010  | K / M  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 310     | .    | .       | D     | ..0                      |  |
|                                   | 0.012  | K  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 312     | K    | .       | D     | ..0                      |  |
|                                   | 0.015  | K / M  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1500   | F1778                        | 315     | .    | .       | D     | ..0                      |  |
|                                   | 0.018  | K  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1250   | F1778                        | 318     | K    | .       | D     | ..0                      |  |
|                                   | 0.022  | K / M  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1250   | F1778                        | 322     | .    | .       | D     | ..0                      |  |
|                                   | 0.027  | K  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1250   | F1778                        | 327     | K    | .       | D     | ..0                      |  |
|                                   | 0.033  | K / M  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1000   | F1778                        | 333     | .    | .       | D     | ..0                      |  |
|                                   | 0.039  | K  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1000   | F1778                        | 339     | K    | .       | D     | ..0                      |  |
|                                   | 0.047  | K  | 4.0 x 10.0 x 12.5                       | 0.6                        | 750  | F1778                        | 347     | K    | .       | D     | ..0                      |  |
|                                   | 0.047  | M  | 4.0 x 10.0 x 12.5                       | 0.6                        | 1000   | F1778                        | 347     | M    | .       | D     | ..0                      |  |
|                                   | 0.056  | K  | 5.0 x 11.0 x 12.5                       | 0.82                       | 1000   | F1778                        | 356     | K    | .       | D     | ..0                      |  |
|                                   | 0.068  | K / M  | 5.0 x 11.0 x 12.5                       | 0.82                       | 750  | F1778                        | 368     | .    | .       | D     | ..0                      |  |
|                                   | 0.082  | K  | 6.0 x 12.0 x 12.5                       | 1.10                       | 750  | F1778                        | 382     | K    | .       | D     | ..0                      |  |
|                                   | 0.100  | K / M  | 6.0 x 12.0 x 12.5                       | 1.10                       | 750  | F1778                        | 410     | .    | .       | D     | ..0                      |  |
|                                   | PITCH 15 mm ± 0.4 mm; d <sub>t</sub> = 0.60 mm ± 0.06 mm |  |   |                            |  |                              |         |      |         |       |                          |  |
|                                   | 0.010  | K / M  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 310     | .    | .       | F     | ..0                      |  |
|                                   | 0.012  | K  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 312     | K    | .       | F     | ..0                      |  |
|                                   | 0.015  | K / M  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 315     | .    | .       | F     | ..0                      |  |
|                                   | 0.018  | K  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 318     | K    | .       | F     | ..0                      |  |
|                                   | 0.022  | K / M  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 322     | .    | .       | F     | ..0                      |  |
|                                   | 0.027  | K  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 327     | K    | .       | F     | ..0                      |  |
|                                   | 0.033  | K / M  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 333     | .    | .       | F     | ..0                      |  |
|                                   | 0.039  | K  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 339     | K    | .       | F     | ..0                      |  |
|                                   | 0.047  | K / M  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 347     | .    | .       | F     | ..0                      |  |
|                                   | 0.056  | K  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 356     | K    | .       | F     | ..0                      |  |
|                                   | 0.068  | K / M  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 368     | .    | .       | F     | ..0                      |  |
|                                   | 0.082  | K  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 382     | K    | .       | F     | ..0                      |  |
|                                   | 0.10   | K  | 5.0 x 11.0 x 17.5                       | 1.0                        | 600  | F1778                        | 410     | K    | .       | F     | ..0                      |  |
|                                   | 0.10   | M  | 5.0 x 11.0 x 17.5                       | 1.0                        | 750  | F1778                        | 410     | M    | .       | F     | ..0                      |  |
|                                   | 0.12   | K  | 6.0 x 12.0 x 17.5                       | 1.4                        | 600  | F1778                        | 412     | K    | .       | F     | ..0                      |  |
|                                   | 0.15   | K  | 6.0 x 12.0 x 17.5                       | 1.4                        | 450  | F1778                        | 415     | K    | .       | F     | ..0                      |  |
|                                   | 0.15   | M  | 6.0 x 12.0 x 17.5                       | 1.4                        | 600  | F1778                        | 415     | M    | .       | F     | ..0                      |  |
|                                   | PITCH 15 mm ± 0.4 mm; d <sub>t</sub> = 0.80 mm ± 0.08 mm |  |   |                            |  |                              |         |      |         |       |                          |  |
|                                   | 0.18   | K  | 7.0 x 13.5 x 17.5                       | 1.8                        | 450  | F1778                        | 418     | K    | .       | F     | ..0                      |  |
|                                   | 0.22   | K / M  | 7.0 x 13.5 x 17.5                       | 1.8                        | 300  | F1778                        | 422     | .    | .       | F     | ..0                      |  |
| 0.27                              | K  | 8.5 x 15.0 x 17.5  | 2.4                                     | 240                        | F1778  | 427                          | K       | .    | F       | ..0   |                          |  |
| 0.33                              | K / M  | 8.5 x 15.0 x 17.5  | 2.4                                     | 240                        | F1778  | 433                          | .       | .    | F       | ..0   |                          |  |
| 0.39                              | K  | 10.0 x 16.5 x 17.5   | 3                                       | 225                        | F1778  | 439                          | K       | .    | F       | ..0   |                          |  |
| 0.47                              | K / M  | 10.0 x 16.5 x 17.5   | 3                                       | 225                        | F1778  | 447                          | .       | .    | F       | ..0   |                          |  |
| 0.56                              | K / M  | 10.0 x 18.5 x 18.0   | 4.3                                     | 225                        | F1778  | 456                          | .       | .    | F       | ..0   |                          |  |
| 0.68                              | M  | 11.0 x 18.5 x 18.0   | 5.5                                     | 225                        | F1778  | 468                          | M       | .    | F       | ..0   |                          |  |



| ELECTRICAL DATA AND ORDERING CODE                                |  |  |   |                            |  |                              |         |      |         |       |                          |     |
|--|--|--|---|----------------------------|--|------------------------------|---------|------|---------|-------|--------------------------|-----|
| U <sub>RAC</sub><br>(V)  | CAP.<br>μF<br>POS. 6 TO 8  | TOLERANCE<br>CODE<br>POS. 9<br>J = ± 5 %<br>K = ± 10 %<br>M = ± 20 % | DIMENSIONS<br>MAX.<br>w x h x l<br>(mm) | MASS<br>(g) <sup>(3)</sup> | SPQ <sup>(4)</sup><br>SHORT<br>LEADS<br>(PIECES) | ORDERING CODE <sup>(2)</sup> |         |      |         |       |                          |     |
|  |  |  |   |                            |  | TYPE                         | C-VALUE | TOL. | VOLTAGE | PITCH | LEAD<br>LENGTH<br>DESIGN |     |
|  |  |  |   |                            |  | 1 TO 5                       | 6 TO 8  | 9    | 10      | 11    | 12 TO 14 <sup>(1)</sup>  |     |
| <b>PITCH 22.5 mm ± 0.4 mm; d<sub>t</sub> = 0.80 mm ± 0.08 mm</b> |  |  |   |                            |  |                              |         |      |         |       |                          |     |
| 310  | 0.12   | K  | 6.0 x 15.5 x 26.0                       | 2.4                        | 260  | F1778                        | 412     | K    | .       | I     | ..0                      |     |
|  | 0.15   | K / M  | 6.0 x 15.5 x 26.0                       | 2.4                        | 260  | F1778                        | 415     | .    | .       | I     | ..0                      |     |
|  | 0.18   | K  | 6.0 x 15.5 x 26.0                       | 2.4                        | 260  | F1778                        | 418     | K    | .       | I     | ..0                      |     |
|  | 0.22   | K / M  | 6.0 x 15.5 x 26.0                       | 2.4                        | 260  | F1778                        | 422     | .    | .       | I     | ..0                      |     |
|  | 0.27   | K  | 6.0 x 15.5 x 26.0                       | 2.4                        | 200  | F1778                        | 427     | K    | .       | I     | ..0                      |     |
|  | 0.33   | K  | 6.0 x 15.5 x 26.0                       | 2.4                        | 190  | F1778                        | 433     | K    | .       | I     | ..0                      |     |
|  | 0.33   | M  | 6.0 x 15.5 x 26.0                       | 2.4                        | 235  | F1778                        | 433     | M    | .       | I     | ..0                      |     |
|  | 0.39   | K  | 7.0 x 16.5 x 26.0                       | 2.9                        | 200  | F1778                        | 439     | K    | .       | I     | ..0                      |     |
|  | 0.47   | K  | 7.0 x 16.5 x 26.0                       | 2.9                        | 190  | F1778                        | 447     | K    | .       | I     | ..0                      |     |
|  | 0.47   | M  | 7.0 x 16.5 x 26.0                       | 2.9                        | 200  | F1778                        | 447     | M    | .       | I     | ..0                      |     |
|  | 0.56   | K  | 8.5 x 18.0 x 26.0                       | 3.8                        | 150  | F1778                        | 456     | K    | .       | I     | ..0                      |     |
|  | 0.68   | K  | 10.0 x 19.5 x 26.0                      | 6.8                        | 150  | F1778                        | 468     | K    | .       | I     | ..0                      |     |
|  | 0.68   | M  | 8.5 x 18.0 x 26.0                       | 3.8                        | 170  | F1778                        | 468     | M    | .       | I     | ..0                      |     |
|  | 0.82   | K  | 10.0 x 19.5 x 26.0                      | 6.8                        | 200  | F1778                        | 482     | K    | .       | I     | ..0                      |     |
|  | 1.0  | K  | 12.0 x 22.0 x 26.0                      | 7.8                        | 150  | F1778                        | 510     | K    | .       | I     | ..0                      |     |
|  | 1.0  | M  | 10.0 x 19.5 x 26.0                      | 6.8                        | 135  | F1778                        | 510     | M    | .       | I     | ..0                      |     |
|  | 1.5  | M  | 12.5 x 22.5 x 26.5                      | 10                         | 140  | F1778                        | 515     | M    | .       | I     | ..0                      |     |
|  | <b>PITCH 27.5 mm ± 0.4 mm; d<sub>t</sub> = 0.80 mm ± 0.08 mm</b> |  |   |                            |  |                              |         |      |         |       |                          |     |
|  |  | 0.47   | K / M                                   | 9.0 x 19.0 x 31.5          | 5.5  | 160                          | F1778   | 447  | .       | .     | K                        | ..0 |
|  |  | 0.56   | K                                       | 9.0 x 19.0 x 31.5          | 5.5  | 160                          | F1778   | 456  | K       | .     | K                        | ..0 |
|  | 0.68   | K / M  | 9.0 x 19.0 x 31.5                       | 5.5                        | 160  | F1778                        | 468     | .    | .       | K     | ..0                      |     |
|  | 0.82   | K  | 11.0 x 21.0 x 31.0                      | 7.4                        | 125  | F1778                        | 482     | K    | .       | K     | ..0                      |     |
|  | 1.0  | K / M  | 11.0 x 21.0 x 31.0                      | 7.4                        | 125  | F1778                        | 510     | .    | .       | K     | ..0                      |     |
|  | 1.2  | K  | 11.0 x 21.0 x 31.0                      | 7.4                        | 110  | F1778                        | 512     | K    | .       | K     | ..0                      |     |
|  | 1.5  | K / M  | 13.0 x 23.0 x 31.0                      | 9.2                        | 110  | F1778                        | 515     | .    | .       | K     | ..0                      |     |
|  | 1.8  | K  | 15.0 x 25.0 x 31.5                      | 12.3                       | 85   | F1778                        | 518     | K    | .       | K     | ..0                      |     |
|  | 2.2  | K / M  | 15.0 x 25.0 x 31.5                      | 12.3                       | 85   | F1778                        | 522     | .    | .       | K     | ..0                      |     |
|  | 2.7  | K  | 18.0 x 28.0 x 31.5                      | 16.1                       | 100  | F1778                        | 527     | K    | .       | K     | ..0                      |     |
|  | 3.3  | K  | 21.0 x 31.0 x 31.0                      | 20.3                       | 70   | F1778                        | 533     | K    | .       | K     | ..0                      |     |
|  | 3.3  | M  | 18.0 x 28.0 x 31.5                      | 16.1                       | 80   | F1778                        | 533     | M    | .       | K     | ..0                      |     |
|  | 3.9  | K  | 21.0 x 31.0 x 31.0                      | 20.3                       | 50   | F1778                        | 539     | K    | .       | K     | ..0                      |     |
|  | 4.7  | M  | 21.0 x 31.0 x 31.0                      | 20.3                       | 50   | F1778                        | 547     | M    | .       | K     | ..0                      |     |

**Notes**

- SPQ = Standard Packing Quantity
- For detailed tape specifications refer to packaging information: [www.vishay.com/doc?28139](http://www.vishay.com/doc?28139)
- (1) For further packaging see table "Composition of Catalog Number"
- (2) Further information about packaging quantities with different lead length and / or taped versions, see document "Packing Quantities" [www.vishay.com/doc?27608](http://www.vishay.com/doc?27608)
- (3) Weight for short lead product only

| APPROVALS   |                     |                |                       |  |
|---|---------------------|----------------|-----------------------|--|
| SAFETY APPROVALS X2   | VOLTAGE             | VALUE          | FILE NUMBERS          | LINKS  |
| EN 60384-14 (ENEC)<br>(= IEC 60384-14 ed-4 (2013))  | 310 V <sub>AC</sub> | 1 nF to 4.7 μF | ENEC16/FI/21/01054/A2 | <a href="http://www.vishay.com/doc?28179">www.vishay.com/doc?28179</a> |
| UL 60384-14   | 310 V <sub>AC</sub> | 1 nF to 4.7 μF | E354331               | <a href="http://www.vishay.com/doc?28184">www.vishay.com/doc?28184</a> |
| CSA-E384-14   | 310 V <sub>AC</sub> | 1 nF to 4.7 μF | E354331               |  |
| CQC   | 310 V <sub>AC</sub> | 1 nF to 4.7 μF | CQC08001026060 (F)    | <a href="http://www.vishay.com/doc?27624">www.vishay.com/doc?27624</a> |
|   |                     |                | CQC08001026061 (L)    | <a href="http://www.vishay.com/doc?27625">www.vishay.com/doc?27625</a> |
| CB test certificate   | 310 V <sub>AC</sub> | 1 nF to 4.7 μF | FI-39827/A1           | <a href="http://www.vishay.com/doc?28175">www.vishay.com/doc?28175</a> |
| The ENEC-approval together with the CB-certificate replace all national marks of the following countries (they have already signed the ENEC-agreement): Austria; Belgium; Czech Republic; Denmark; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Luxembourg; Netherlands; Norway; Portugal; Slovenia; Spain; Sweden; Switzerland and United Kingdom. |                     |                |                       |  |
|      |                     |                |                       |  |

## MOUNTING

### Normal Use

The capacitors are designed for mounting on printed-circuit boards. The capacitors packed in bandoleers are designed for mounting in 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 capacitors shall be mechanically fixed by the leads
- For larger pitches the capacitors shall be mounted in the same way and the body clamped in addition

### Space Requirements on Printed Circuit-Board

The maximum space for length ( $l_{max.}$ ), width ( $w_{max.}$ ), and height ( $h_{max.}$ ) of film capacitors to take in account on the printed circuit board is shown in the drawings:

- For products with pitch  $\leq 15$  mm,  $\Delta w \times \Delta l = 0.3$  mm and  $\Delta h = 0.1$  mm
- For products with  $15$  mm  $<$  pitch  $\leq 27.5$  mm,  $\Delta w \times \Delta l = 0.5$  mm and  $\Delta h = 0.1$  mm
- For products with pitch = 37.5 mm,  $\Delta w \times \Delta l = 0.7$  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.



**SOLDERING CONDITIONS**

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

**Storage Temperature**

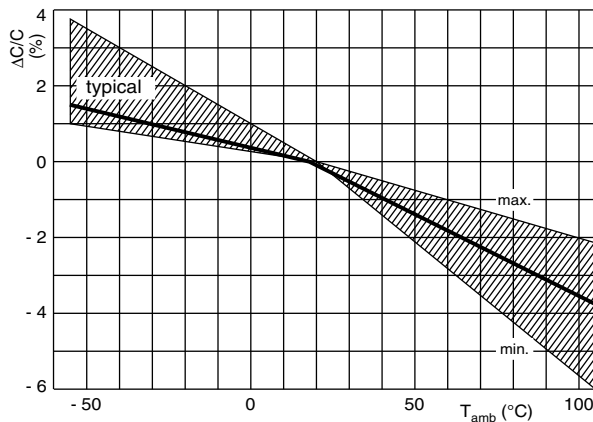
T<sub>stg</sub> = -25 °C to +35 °C with RH maximum 75 % without condensation

**Ratings and Characteristics Reference Conditions**

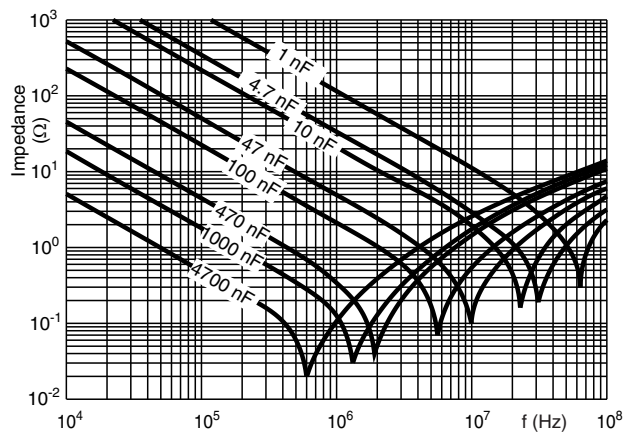
Unless otherwise specified, all electrical values apply to an ambient free air temperature of 23 °C ± 1 °C, an atmospheric pressure of 86 kPa to 106 kPa and a relative humidity of 50 % ± 2 %.

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

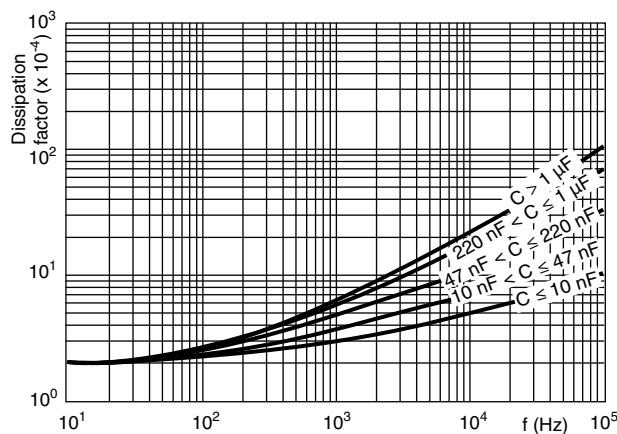
**CHARACTERISTICS**



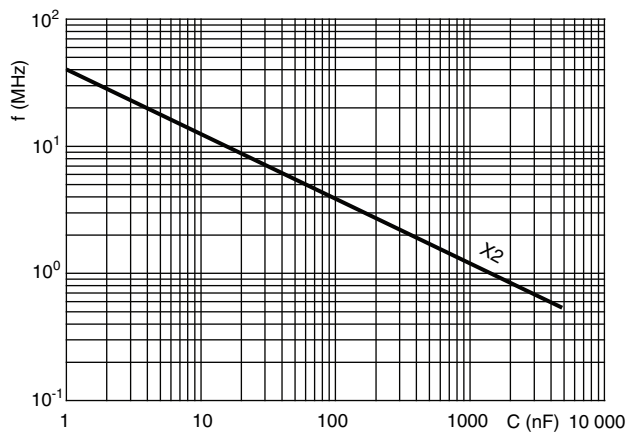
Capacitance as a function of ambient temperature (typical curve)



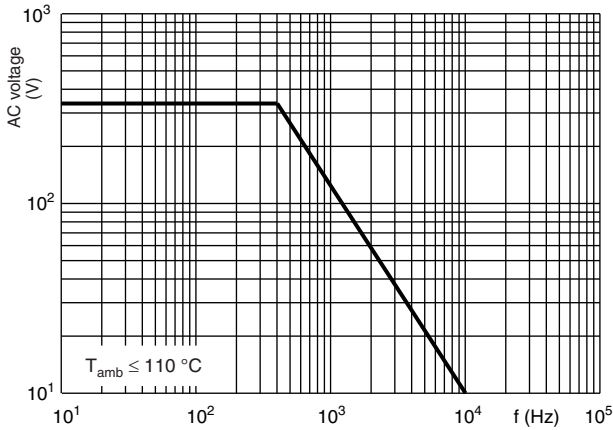
Impedance as a function of frequency (typical curve)



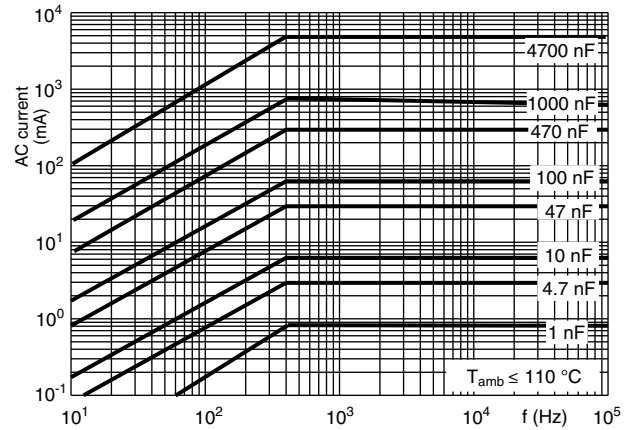
Tangent of loss angle as a function of frequency (typical curve)



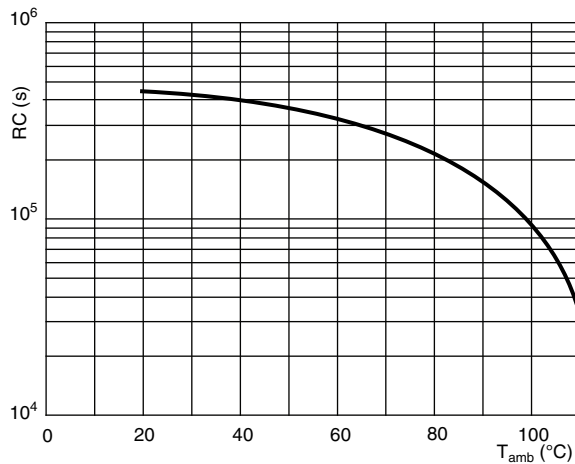
Resonant frequency as a function of capacitance (typical curve)



Max. RMS voltage as a function of frequency  
(typical curve)



Max. RMS current as a function of frequency  
(typical curve)



Insulation resistance as a function of ambient temperature  
(typical curve)

### APPLICATION NOTES

- For X2 electromagnetic interference suppression in **standard across the line applications** (50 Hz / 60 Hz) with a maximum mains voltage of 310 V<sub>AC</sub>.
- For series impedance applications we refer to application note [www.vishay.com/doc?28153](http://www.vishay.com/doc?28153)
- 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: [rfi@vishay.com](mailto:rfi@vishay.com)
- These capacitors are not intended for continuous pulse applications. For these situations, capacitors of the AC and pulse programs must be used.
- The maximum ambient temperature must not exceed 110 °C (125 °C for less than 1000 h) for C ≤ 470 nF and 110 °C for C > 470 nF.
- Rated voltage pulse slope:  
if the pulse voltage is lower than the rated voltage, the values of the specific reference data can be multiplied by 435 V<sub>DC</sub> and divided by the applied voltage.





**INSPECTION REQUIREMENTS**

**General Notes**

Sub-clause numbers of tests and performance requirements refer to the “Sectional Specification, IEC Publication IEC 60384-14 ed-4 (2013) and Specific Reference Data”.

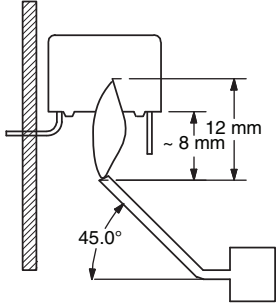
| <b>GROUP C INSPECTION REQUIREMENTS</b>              |  |   |
|---|--|---|
| <b>SUB-CLAUSE NUMBER AND TEST</b>                   | <b>CONDITIONS</b>  | <b>PERFORMANCE REQUIREMENTS</b>   |
| <b>SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1</b> |  |   |
| 4.1 Dimensions (detail)                             |  | As specified in section “General Data” of this specification  |
| Initial measurements                                | Capacitance<br>Tangent of loss angle:<br>for C ≤ 1 μF at 10 kHz<br>for C > 1 μF at 1 kHz   |   |
| 4.3 Robustness of terminations                      | Tensile: load 10 N; 10 s<br>Bending: load 5 N; 4 x 90°   | No visible damage   |
| 4.4 Resistance to soldering heat                    | No pre-drying<br>Method: 1A<br>Solder bath: 280 °C ± 5 °C<br>Duration: 10 s  |   |
| 4.19 Component solvent resistance                   | Isopropylalcohol at room temperature<br>Method: 2<br>Immersion time: 5 min ± 0.5 min<br>Recovery time:<br>min. 1 h, max. 2 h   |   |
| 4.4.2 Final measurements                            | Visual examination   | No visible damage<br>Legible marking  |
|   | Capacitance  | ΔC/C  ≤ 5 % of the value measured initially.  |
|   | Tangent of loss angle  | Increase of tan δ:<br>≤ 0.008 for: C ≤ 1 μF or<br>≤ 0.005 for: C > 1 μF<br>Compared to values measured initially. |
|   | Insulation resistance  | As specified in section “Insulation Resistance” of this specification   |
| <b>SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1</b> |  |   |
| Initial measurements                                | Capacitance<br>Tangent of loss angle:<br>for C ≤ 1 μF at 10 kHz<br>for C > 1 μF at 1 kHz   |   |
| 4.20 Solvent resistance of the marking              | Isopropylalcohol 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                     | θA = -55 °C<br>θB = +110 °C<br>5 cycles<br>Duration t = 30 min   |   |
| 4.6.1 Inspection                                    | Visual examination   | No visible damage   |
| 4.7 Vibration                                       | Mounting: see section “Mounting” of this specification<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 |   |



| <b>GROUP C INSPECTION REQUIREMENTS</b>                                     |   |   |
|--|---|---|
| <b>SUB-CLAUSE NUMBER AND TEST</b>  | <b>CONDITIONS</b>   | <b>PERFORMANCE REQUIREMENTS</b>   |
| <b>SUB-GROUP C1B 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                         |   |
| 4.9.2 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 5\%$ of the value measured initially.<br><br>Increase of $\tan \delta$ :<br>$\leq 0.008$ for: $C \leq 1 \mu\text{F}$ or<br>$\leq 0.005$ for: $C > 1 \mu\text{F}$<br>Compared to values measured initially.<br><br>As specified in section "Insulation Resistance" of this specification   |
| <b>SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B</b> |   |   |
| 4.11 Climatic sequence   |   |   |
| 4.11.1 Initial measurements  | Capacitance measured in 4.4.2 and 4.9.2<br>Tangent of loss angle: measured initially in C1A and C1B   |   |
| 4.11.2 Dry heat  | Temperature: 110 °C   |   |
| 4.11.3 Damp heat cyclic Test Db First cycle                                | Duration: 16 h  |   |
| 4.11.4 Cold  | Temperature: -55 °C   |   |
| 4.11.5 Damp heat cyclic Test Db Remaining cycles                           | Duration: 2 h   |   |
| 4.11.6 Final measurements  | Visual examination<br><br>Capacitance<br><br>Tangent of loss angle<br><br>Voltage proof<br>1350 V <sub>DC</sub> ; 1 min between terminations<br><br>Insulation resistance | No visible damage<br>Legible marking<br><br>$ \Delta C/C  \leq 5\%$ of the value measured in 4.11.1.<br><br>Increase of $\tan \delta$ :<br>$\leq 0.008$ for: $C \leq 1 \mu\text{F}$ or<br>$\leq 0.005$ for: $C > 1 \mu\text{F}$<br>Compared to values measured in 4.11.1.<br><br>No permanent breakdown or flash-over<br><br>$\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |
| <b>SUB-GROUP C2</b>  |   |   |
| 4.12 Damp heat steady state  | 56 days; 40 °C; 90 % to 95 % RH<br>no load  |   |
| 4.12.1 Initial measurements  | Capacitance<br>Tangent of loss angle: at 1 kHz  |   |
| 4.12.3 Final measurements  | Visual examination<br><br>Capacitance   | No visible damage<br>Legible marking<br><br>$ \Delta C/C  \leq 5\%$ of the value measured in 4.12.1.  |



| GROUP C INSPECTION REQUIREMENTS |   |   |
|---------------------------------|---|---|
| SUB-CLAUSE NUMBER AND TEST      | CONDITIONS  | PERFORMANCE REQUIREMENTS  |
| <b>SUB-GROUP C2</b>             |   |   |
| 4.12.3 Final measurements       | Tangent of loss angle<br><br>Voltage proof<br>1350 V <sub>DC</sub> ; 1 min between terminations<br><br>Insulation resistance  | Increase of tan δ:<br>≤ 0.008 for: C ≤ 1 μF or<br>≤ 0.005 for: C > 1 μF<br>Compared to values measured in 4.12.1.<br><br>No permanent breakdown or flash-over<br><br>≥ 50 % of values specified in section<br>"Insulation Resistance" of this specification   |
| <b>SUB-GROUP C3</b>             |   |   |
| 4.13.1 Initial measurements     | Capacitance<br>Tangent of loss angle:<br>for C ≤ 1 μF at 10 kHz<br>for C > 1 μF at 1 kHz  |   |
| 4.13 Impulse voltage            | 3 successive impulses, full wave, peak voltage:<br>X2: 2.5 kV for C ≤ 1 μF<br>X2: 2.5 kV/√C for C > 1 μF<br>Max. 24 pulses  | No self healing, breakdowns or flash-over   |
| 4.14 Endurance                  | Duration: 1000 h<br>1.25 x U <sub>RAC</sub> at 110 °C<br>Once in every hour the voltage is increased to 1000 V <sub>RMS</sub> for 0.1 s via resistor of 47 Ω ± 5 %  |   |
| 4.14.7 Final measurements       | Visual examination<br><br>Capacitance<br><br>Tangent of loss angle<br><br>Voltage proof<br>1350 V <sub>DC</sub> ; 1 min between terminations<br>2120 V <sub>AC</sub> ; 1 min between terminations and case<br><br>Insulation resistance | No visible damage<br>Legible marking<br><br> ΔC/C  ≤ 10 % compared to values measured in 4.13.1.<br><br>Increase of tan δ:<br>≤ 0.008 for: C ≤ 1 μF or<br>≤ 0.005 for: C > 1 μF<br>Compared to values measured in 4.13.1.<br><br>No permanent breakdown or flash-over<br><br>≥ 50 % of values specified in section<br>"Insulation Resistance" of this specification |
| <b>SUB-GROUP C4</b>             |   |   |
| 4.15 Charge and discharge       | 10 000 cycles<br>Charged to 435 V <sub>DC</sub><br>Discharge resistance:<br>$R = \frac{435 V_{DC}}{1.25 \times C (dU/dt)}$  |   |
| 4.15.1 Initial measurements     | Capacitance<br>Tangent of loss angle:<br>for C ≤ 1 μF at 10 kHz<br>for C > 1 μF at 1 kHz  |   |
| 4.15.3 Final measurements       | Capacitance<br><br>Tangent of loss angle<br><br>Insulation resistance   | ΔC/C  ≤ 10 % compared to values measured in 4.15.1.<br><br>Increase of tan δ:<br>≤ 0.008 for: C ≤ 1 μF or<br>≤ 0.005 for: C > 1 μF<br>Compared to values measured in 4.15.1.<br><br>≥ 50 % of values specified in section<br>"Insulation Resistance" of this specification  |

| <b>GROUP C INSPECTION REQUIREMENTS</b>  |  |   |
|---|--|---|
| <b>SUB-CLAUSE NUMBER AND TEST</b>       | <b>CONDITIONS</b>  | <b>PERFORMANCE REQUIREMENTS</b>   |
| <b>SUB-GROUP C5</b>                     |  |   |
| 4.16 Radio frequency characteristic     | Resonance frequency  | $\geq 0.9$ times the value as specified in section "Resonant Frequency" of this specification.  |
| <b>SUB-GROUP C6</b>                     |  |   |
| 4.17 Passive flammability<br>Class B    | Bore of gas jet: $\varnothing 0.5$ mm<br>Fuel: butane<br>Test duration for actual volume $V$ in $\text{mm}^3$ :<br>$V \leq 250$ : 10 s<br>$250 < V \leq 500$ : 20 s<br>$500 < V \leq 1750$ : 30 s<br>$V > 1750$ : 60 s<br>One flame application<br> | After removing test flame from capacitor, the capacitor must not continue to burn for more than 10 s. No burning particle must drop from the sample.  |
| <b>SUB-GROUP C7</b>                     |  |   |
| 4.18 Active flammability                | 20 cycles of 2.5 kV discharges on the test capacitor connected to $U_{RAC}$ .  | The cheese cloth around the capacitors shall not burn with a flame.<br>No electrical measurements are required.   |
| <b>SUB-GROUP ADD1</b>                   |  |   |
| A.1 Damp heat steady state with voltage | RH: 40 %; temp.: 93 °C, voltage: 300 $V_{AC}$<br>Duration: 21 days   |   |
| A.1.1 Initial measurements              | Capacitance<br>Tangent of loss angle: at 10 kHz  |   |
| A.1.2 Final measurements                | Visual examination<br><br>Capacitance<br><br>Tangent of loss angle<br><br>Insulation resistance  | No visible damage<br>Legible marking<br><br>$ \Delta C/C  \leq 10\%$ of the value with initial measurement A.1.1<br><br>Increase of $\tan \delta \leq 0.024$<br>Compared to values with initial measurement A.1.1<br><br>$\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |



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