

## Interference Suppression Film Capacitor - Class X1 Radial MKP 330 V<sub>AC</sub> - Standard Across the Line



### FEATURES

- 7.5 mm to 27.5 mm lead pitch
- Small dimensions
- High voltage capability
- Material categorization:  
for definitions of compliance please see  
[www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



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

### APPLICATIONS

For standard across the line X1 applications

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

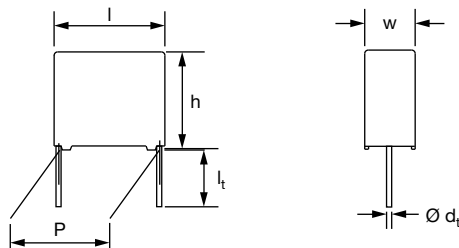
### QUICK REFERENCE DATA

|                                                 |                                                                                                                                                                                            |
|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Capacitance range (E12 series)                  | 0.001 $\mu$ F to 2.2 $\mu$ F (preferred values according to E6)                                                                                                                            |
| Capacitance tolerance                           | $\pm 20\%$ ; $\pm 10\%$ ; ( $\pm 5\%$ on request)                                                                                                                                          |
| Climatic testing class according to IEC 60068-1 | 55/110/56/B                                                                                                                                                                                |
| Rated AC voltage                                | 330 V <sub>AC</sub> ; 50 Hz to 60 Hz                                                                                                                                                       |
| Permissible DC voltage                          | 800 V <sub>DC</sub> at 85 °C                                                                                                                                                               |
| Maximum application temperature                 | 110 °C                                                                                                                                                                                     |
| Reference standards                             | IEC 60384-14 and EN 60384-14<br>IEC 60065 requires pass. flamm. class B<br>CSA-E384-14; UL 60384-14<br>CQC                                                                                 |
| Dielectric                                      | Polypropylene film                                                                                                                                                                         |
| Electrodes                                      | Metallized                                                                                                                                                                                 |
| Construction                                    | Mono construction                                                                                                                                                                          |
| Encapsulation                                   | Plastic case, epoxy resin sealed, flame retardant<br>UL-class 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 |

#### Note

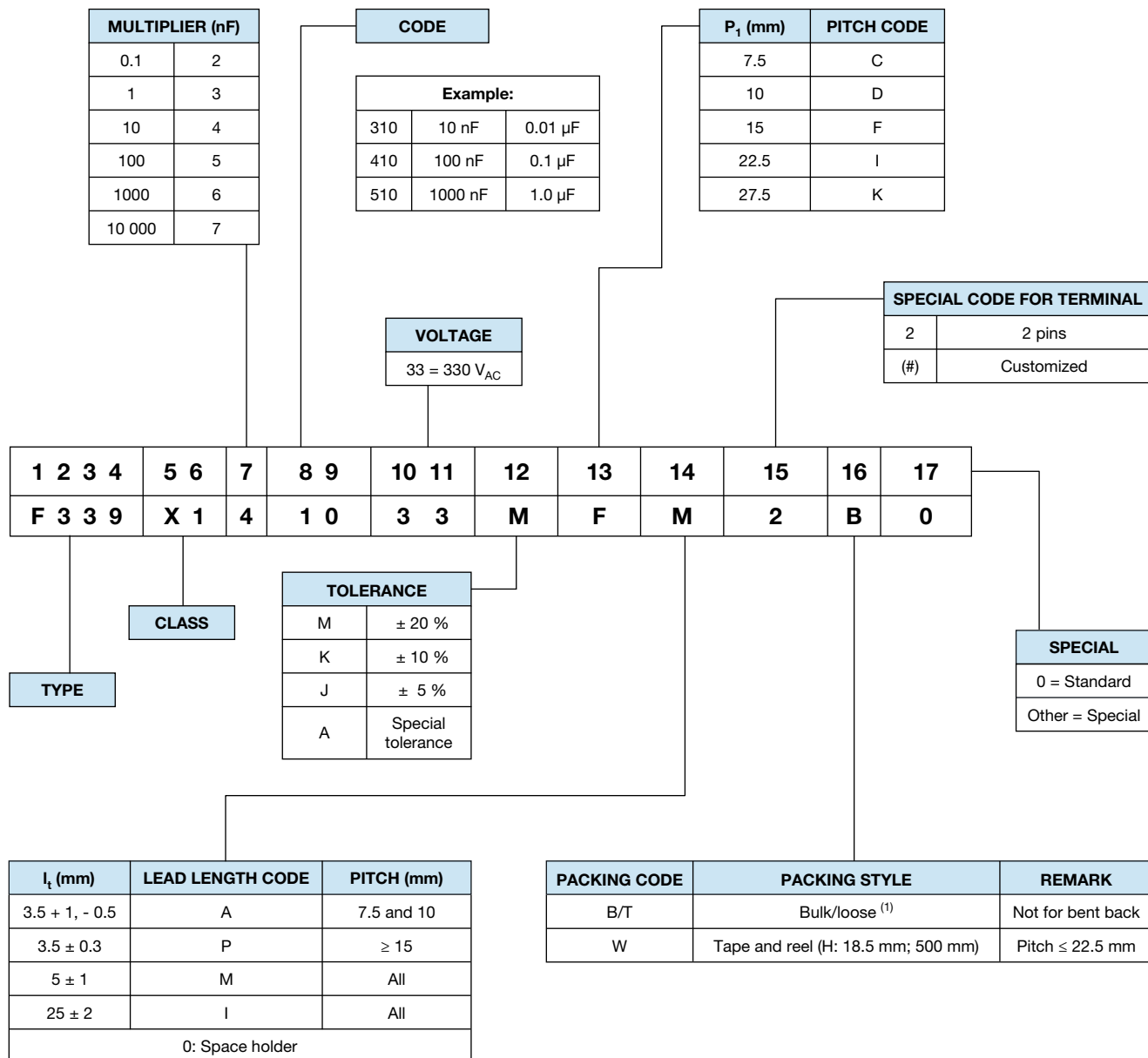
- For more detailed data and test requirements, contact [rfi@vishay.com](mailto:rfi@vishay.com)

### DIMENSIONS in millimeters



#### Note

- $\varnothing d_t \pm 10\%$  of standard diameter specified

**COMPOSITION OF CATALOG NUMBER****Notes**

- For detailed tape specifications refer to packaging information [www.vishay.com/doc?28139](http://www.vishay.com/doc?28139)
- <sup>(1)</sup> Packaging will be bulk for all capacitors with pitch  $\leq 15$  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 <sub>RAC</sub> )                                                     | 330 V                   |                         |
| Permissible DC voltage (U <sub>RDC</sub> )                                               | 800 V                   |                         |
| Tangent of loss angle                                                                    | At 1 kHz                | At 10 kHz               |
| C < 100 nF                                                                               | ≤ 10 x 10 <sup>-4</sup> | ≤ 20 x 10 <sup>-4</sup> |
| 470 nF ≤ C ≤ 2.2 μF                                                                      | ≤ 20 x 10 <sup>-4</sup> | ≤ 70 x 10 <sup>-4</sup> |
| Rated voltage pulse slope (dU/dt) <sub>R</sub> at 465 V <sub>DC</sub>                    | 100 V/μs                |                         |
| R between leads, for C ≤ 0.33 μF at 100 V; 1 min                                         | > 15 000 MΩ             |                         |
| RC between leads, for C > 0.33 μF at 100 V; 1 min                                        | > 5000 s                |                         |
| R between leads and case; 100 V; 1 min                                                   | > 30 000 MΩ             |                         |
| Withstanding (DC) voltage (cut off current 10 mA) <sup>(1)</sup> ; rise time ≤ 1000 V/s: |                         |                         |
| C ≤ 2.2 μF                                                                               | 3400 V; 1 min           |                         |
| C > 2.2 μF                                                                               | 2200 V; 1 min           |                         |
| Withstanding (AC) voltage between leads and case                                         | 2160 V; 1 min           |                         |
| Maximum application temperature                                                          | 110 °C                  |                         |

## Note

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

## ELECTRICAL DATA AND ORDERING INFORMATION

| U <sub>RAC</sub><br>(V) | CAP.<br>(μF)                                                                  | DIMENSIONS<br>w x h x l<br>(mm) | MASS<br>(g) <sup>(3)</sup>                                                   | CATALOG NUMBER F339X1... AND PACKAGING                                                                                                      |                                           |      |                                            |      |                                                                                              |      |  |
|-------------------------|-------------------------------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------|--------------------------------------------|------|----------------------------------------------------------------------------------------------|------|--|
|                         |                                                                               |                                 |                                                                              | LOOSE IN BOX                                                                                                                                |                                           |      |                                            |      | TAPED REEL                                                                                   |      |  |
|                         |                                                                               |                                 |                                                                              | SHORT LEADS                                                                                                                                 |                                           |      | LONG LEADS                                 |      |                                                                                              |      |  |
|                         |                                                                               |                                 |                                                                              | $l_t = 3.5 \text{ mm} + 1 \text{ mm/- } 0.5 \text{ mm} (\leq 10 \text{ mm})$<br>or $3.5 \text{ mm} \pm 0.3 \text{ mm} (\geq 15 \text{ mm})$ | $l_t = 5.0 \text{ mm} \pm 1.0 \text{ mm}$ | SPQ  | $l_t = 25.0 \text{ mm} \pm 2.0 \text{ mm}$ | SPQ  | $\varnothing = 500 \text{ mm}^{(1)(2)}$<br>$H = 18.5 \text{ mm};$<br>$P_0 = 12.7 \text{ mm}$ | SPQ  |  |
|                         |                                                                               |                                 | PITCH = 7.5 mm ± 0.4 mm; d <sub>t</sub> = 0.50 mm ± 0.05 mm; C-TOL. = ± 20 % |                                                                                                                                             |                                           |      |                                            |      |                                                                                              |      |  |
| 330                     | 0.0010                                                                        | 4.0 x 9.0 x 10.0                | 0.4                                                                          | 21033MCA2B0                                                                                                                                 | 21033MCM2B0                               | 1500 | 21033MCI2B0                                | 1000 | 21033MC02W0                                                                                  | 2500 |  |
|                         | 0.0015                                                                        |                                 |                                                                              | 21533MCA2B0                                                                                                                                 | 21533MCM2B0                               |      | 21533MCI2B0                                |      | 21533MC02W0                                                                                  |      |  |
|                         | 0.0022                                                                        |                                 |                                                                              | 22233MCA2B0                                                                                                                                 | 22233MCM2B0                               |      | 22233MCI2B0                                |      | 22233MC02W0                                                                                  |      |  |
|                         | 0.0033                                                                        | 5.0 x 10.5 x 10.0               | 0.4                                                                          | 23333MCA2B0                                                                                                                                 | 23333MCM2B0                               | 1000 | 23333MCI2B0                                | 1250 | 23333MC02W0                                                                                  | 2000 |  |
|                         | 0.0047                                                                        | 6.0 x 11.5 x 10.0               | 0.8                                                                          | 24733MCA2B0                                                                                                                                 | 24733MCM2B0                               | 750  | 24733MCI2B0                                | 1000 | 24733MC02W0                                                                                  | 1900 |  |
|                         | PITCH = 10.0 mm ± 0.4 mm; d <sub>t</sub> = 0.60 mm ± 0.06 mm; C-TOL. = ± 20 % |                                 |                                                                              |                                                                                                                                             |                                           |      |                                            |      |                                                                                              |      |  |
|                         | 0.0010                                                                        | 4.0 x 10.0 x 12.5               | 0.6                                                                          | 21033MDA2B0                                                                                                                                 | 21033MDM2B0                               | 1000 | 21033MDI2B0                                | 1250 | 21033MD02W0                                                                                  | 1400 |  |
|                         | 0.0015                                                                        |                                 |                                                                              | 21533MDA2B0                                                                                                                                 | 21533MDM2B0                               |      | 21533MDI2B0                                |      | 21533MD02W0                                                                                  |      |  |
|                         | 0.0022                                                                        |                                 |                                                                              | 22233MDA2B0                                                                                                                                 | 22233MDM2B0                               |      | 22233MDI2B0                                |      | 22233MD02W0                                                                                  |      |  |
|                         | 0.0033                                                                        |                                 |                                                                              | 23333MDA2B0                                                                                                                                 | 23333MDM2B0                               |      | 23333MDI2B0                                |      | 23333MD02W0                                                                                  |      |  |
|                         | 0.0047                                                                        |                                 |                                                                              | 24733MDA2B0                                                                                                                                 | 24733MDM2B0                               |      | 24733MDI2B0                                |      | 24733MD02W0                                                                                  |      |  |
|                         | 0.0068                                                                        |                                 |                                                                              | 26833MDA2B0                                                                                                                                 | 26833MDM2B0                               |      | 26833MDI2B0                                |      | 26833MD02W0                                                                                  |      |  |
|                         | 0.010                                                                         |                                 |                                                                              | 31033MDA2B0                                                                                                                                 | 31033MDM2B0                               |      | 31033MDI2B0                                |      | 31033MD02W0                                                                                  |      |  |
|                         | 0.015                                                                         |                                 |                                                                              | 31533MDA2B0                                                                                                                                 | 31533MDM2B0                               |      | 31533MDI2B0                                |      | 31533MD02W0                                                                                  |      |  |
|                         | 0.022                                                                         | 5.0 x 11.0 x 12.5               | 0.82                                                                         | 32233MDA2B0                                                                                                                                 | 32233MDM2B0                               | 1000 | 32233MDI2B0                                | 1000 | 32233MD02W0                                                                                  | 1100 |  |
|                         | 0.033                                                                         | 6.0 x 12.0 x 12.5               | 1.1                                                                          | 33333MDA2B0                                                                                                                                 | 33333MDM2B0                               | 750  | 33333MDI2B0                                | 750  | 33333MD02W0                                                                                  | 900  |  |
|                         | PITCH = 15.0 mm ± 0.4 mm; d <sub>t</sub> = 0.60 mm ± 0.06 mm; C-TOL. = ± 20 % |                                 |                                                                              |                                                                                                                                             |                                           |      |                                            |      |                                                                                              |      |  |
|                         | 0.010                                                                         | 5.0 x 11.0 x 17.5               | 1.0                                                                          | 31033MFP2B0                                                                                                                                 | 31033MFM2B0                               | 1250 | 31033MFI2B0                                | 1000 | 31033MF02W0                                                                                  | 1100 |  |
|                         | 0.015                                                                         |                                 |                                                                              | 31533MFP2B0                                                                                                                                 | 31533MFM2B0                               |      | 31533MFI2B0                                |      | 31533MF02W0                                                                                  |      |  |
|                         | 0.022                                                                         |                                 |                                                                              | 32233MFP2B0                                                                                                                                 | 32233MFM2B0                               |      | 32233MFI2B0                                |      | 32233MF02W0                                                                                  |      |  |
|                         | 0.033                                                                         |                                 |                                                                              | 33333MFP2B0                                                                                                                                 | 33333MFM2B0                               |      | 33333MFI2B0                                |      | 33333MF02W0                                                                                  |      |  |
|                         | 0.047                                                                         |                                 |                                                                              | 34733MFP2B0                                                                                                                                 | 34733MFM2B0                               |      | 34733MFI2B0                                |      | 34733MF02W0                                                                                  |      |  |
|                         | 0.068                                                                         | 6.0 x 12.0 x 17.5               | 1.4                                                                          | 36833MFP2B0                                                                                                                                 | 36833MFM2B0                               | 1000 | 36833MFI2B0                                | 1000 | 36833MF02W0                                                                                  | 900  |  |
|                         | PITCH = 15.0 mm ± 0.4 mm; d <sub>t</sub> = 0.80 mm ± 0.08 mm; C-TOL. = ± 20 % |                                 |                                                                              |                                                                                                                                             |                                           |      |                                            |      |                                                                                              |      |  |
|                         | 0.10                                                                          | 7.0 x 13.5 x 17.5               | 1.8                                                                          | 41033MFP2B0                                                                                                                                 | 41033MFM2B0                               | 750  | 41033MFI2B0                                | 500  | 41033MF02W0                                                                                  | 800  |  |
|                         | 0.15                                                                          | 8.5 x 15.0 x 17.5               | 2.4                                                                          | 41533MFP2B0                                                                                                                                 | 41533MFM2B0                               | 750  | 41533MFI2B0                                | 500  | 41533MF02W0                                                                                  | 650  |  |
|                         | 0.22                                                                          | 10.0 x 16.5 x 17.5              | 3.0                                                                          | 42233MFP2B0                                                                                                                                 | 42233MFM2B0                               | 500  | 42233MFI2B0                                | 450  | 42233MF02W0                                                                                  | 600  |  |



## ELECTRICAL DATA AND ORDERING INFORMATION

| U <sub>RAC</sub><br>(V) | CAP.<br>(μF)                                                                  | DIMENSIONS<br>w x h x l<br>(mm) | MASS<br>(g) <sup>(3)</sup> | CATALOG NUMBER F339X1... AND PACKAGING                                                     |                                     |      |                                      |      |                                                                          |      |  |
|-------------------------|-------------------------------------------------------------------------------|---------------------------------|----------------------------|--------------------------------------------------------------------------------------------|-------------------------------------|------|--------------------------------------|------|--------------------------------------------------------------------------|------|--|
|                         |                                                                               |                                 |                            | LOOSE IN BOX                                                                               |                                     |      |                                      |      | TAPED REEL                                                               |      |  |
|                         |                                                                               |                                 |                            | SHORT LEADS                                                                                |                                     |      | LONG LEADS                           |      |                                                                          |      |  |
|                         |                                                                               |                                 |                            | l <sub>t</sub> = 3.5 mm<br>+ 1 mm/- 0.5 mm<br>(≤ 10 mm)<br>or 3.5 mm ± 0.3 mm<br>(≥ 15 mm) | l <sub>t</sub> = 5.0 mm<br>± 1.0 mm | SPQ  | l <sub>t</sub> = 25.0 mm<br>± 2.0 mm | SPQ  | Ø = 500 mm <sup>(1)(2)</sup><br>H = 18.5 mm;<br>P <sub>0</sub> = 12.7 mm | SPQ  |  |
| 330                     | PITCH = 22.5 mm ± 0.4 mm; d <sub>t</sub> = 0.80 mm ± 0.08 mm; C-TOL. = ± 20 % |                                 |                            |                                                                                            |                                     |      |                                      |      |                                                                          |      |  |
|                         | 0.10                                                                          | 6.0 x 15.5 x 26.0               | 2.4                        | 41033MIP2T0                                                                                | 41033MIM2T0                         | 300  | 41033MII2B0                          | 250  | 41033MI02W0                                                              | 600  |  |
|                         | 0.15                                                                          |                                 |                            | 41533MIP2T0                                                                                | 41533MIM2T0                         |      | 41533MII2B0                          |      | 41533MI02W0                                                              |      |  |
|                         | 0.22                                                                          | 7.0 x 16.5 x 26.0               | 2.9                        | 42233MIP2T0                                                                                | 42233MIM2T0                         | 200  | 42233MII2B0                          | 250  | 42233MI02W0                                                              | 500  |  |
|                         | 0.33                                                                          | 8.5 x 18.0 x 26.0               | 3.8                        | 43333MIP2T0                                                                                | 43333MIM2T0                         | 200  | 43333MII2B0                          | 250  | 43333MI02W0                                                              | 450  |  |
|                         | 0.47                                                                          | 10.0 x 19.5 x 26.0              | 6.8                        | 44733MIP2T0                                                                                | 44733MIM2T0                         | 200  | 44733MII2B0                          | 200  | 44733MI02W0                                                              | 350  |  |
|                         | 0.68                                                                          | 12.0 x 22.0 x 26.0              | 7.8                        | 46833MIP2T0                                                                                | 46833MIM2T0                         | 150  | 46833MII2B0                          | 200  | 46833MI02W0                                                              | 300  |  |
|                         | 0.82                                                                          | 12.5 x 22.5 x 26.5              | 7.8                        | 48233MIP2T0                                                                                | 48233MIM2T0                         | 140  | 48233MII2B0                          | 400  | 48233MI02W0                                                              | 300  |  |
|                         | PITCH = 27.5 mm ± 0.4 mm; d <sub>t</sub> = 0.80 mm ± 0.08 mm; C-TOL. = ± 20 % |                                 |                            |                                                                                            |                                     |      |                                      |      |                                                                          |      |  |
|                         | 0.22                                                                          | 9.0 x 19.0 x 31.5               | 5.5                        | 42233MKP2T0                                                                                | 42233MKM2T0                         | 100  | 42233MKI2B0                          | 150  | -                                                                        | -    |  |
|                         | 0.33                                                                          |                                 |                            | 43333MKP2T0                                                                                | 43333MKM2T0                         |      | 43333MKI2B0                          |      |                                                                          |      |  |
|                         | 0.47                                                                          |                                 |                            | 44733MKP2T0                                                                                | 44733MKM2T0                         |      | 44733MKI2B0                          |      |                                                                          |      |  |
|                         | 0.68                                                                          | 11.0 x 21.0 x 31.0              | 7.4                        | 46833MKP2T0                                                                                | 46833MKM2T0                         | 100  | 46833MKI2B0                          | 125  |                                                                          |      |  |
|                         | 1.0                                                                           | 13.0 x 23.0 x 31.0              | 9.2                        | 51033MKP2T0                                                                                | 51033MKM2T0                         | 100  | 51033MKI2B0                          | 125  |                                                                          |      |  |
|                         | 1.5                                                                           | 18.0 x 28.0 x 31.5              | 16.1                       | 51533MKP2T0                                                                                | 51533MKM2T0                         | 100  | 51533MKI2B0                          | 100  |                                                                          |      |  |
|                         | 2.2                                                                           | 21.0 x 31.0 x 31.0              | 20.3                       | 52233MKP2T0                                                                                | 52233MKM2T0                         | 50   | 52233MKI2B0                          | 75   |                                                                          |      |  |
|                         | PITCH = 7.5 mm ± 0.4 mm; d <sub>t</sub> = 0.50 mm ± 0.05 mm; C-TOL. = ± 10 %  |                                 |                            |                                                                                            |                                     |      |                                      |      |                                                                          |      |  |
|                         | 0.0010                                                                        | 4.0 x 9.0 x 10.0                | 0.4                        | 21033KCA2B0                                                                                | 21033KCM2B0                         | 1500 | 21033KCI2B0                          | 1000 | 21033KC02W0                                                              | 2500 |  |
|                         | 0.0012                                                                        |                                 |                            | 21233KCA2B0                                                                                | 21233KCM2B0                         |      | 21233KCI2B0                          |      | 21233KC02W0                                                              |      |  |
|                         | 0.0015                                                                        |                                 |                            | 21533KCA2B0                                                                                | 21533KCM2B0                         |      | 21533KCI2B0                          |      | 21533KC02W0                                                              |      |  |
|                         | 0.0018                                                                        |                                 |                            | 21833KCA2B0                                                                                | 21833KCM2B0                         |      | 21833KCI2B0                          |      | 21833KC02W0                                                              |      |  |
|                         | 0.0022                                                                        |                                 |                            | 22233KCA2B0                                                                                | 22233KCM2B0                         |      | 22233KCI2B0                          |      | 22233KC02W0                                                              |      |  |
|                         | 0.0027                                                                        |                                 |                            | 22733KCA2B0                                                                                | 22733KCM2B0                         |      | 22733KCI2B0                          |      | 22733KC02W0                                                              |      |  |
|                         | 0.0033                                                                        | 5.0 x 10.5 x 10.0               | 0.4                        | 23333KCA2B0                                                                                | 23333KCM2B0                         | 1000 | 23333KCI2B0                          | 1250 | 23333KC02W0                                                              | 2000 |  |
|                         | 0.0039                                                                        |                                 |                            | 23933KCA2B0                                                                                | 23933KCM2B0                         |      | 23933KCI2B0                          |      | 23933KC02W0                                                              |      |  |
|                         | 0.0047                                                                        | 6.0 x 11.5 x 10.0               | 0.8                        | 24733KCA2B0                                                                                | 24733KCM2B0                         | 750  | 24733KCI2B0                          | 1000 | 24733KC02W0                                                              | 1900 |  |
|                         | 0.0056                                                                        |                                 |                            | 25633KCA2B0                                                                                | 25633KCM2B0                         |      | 25633KCI2B0                          |      | 25633KC02W0                                                              |      |  |
|                         | PITCH = 10.0 mm ± 0.4 mm; d <sub>t</sub> = 0.60 mm ± 0.06 mm; C-TOL. = ± 10 % |                                 |                            |                                                                                            |                                     |      |                                      |      |                                                                          |      |  |
|                         | 0.0010                                                                        | 4.0 x 10.0 x 12.5               | 0.6                        | 21033KDA2B0                                                                                | 21033KDM2B0                         | 1000 | 21033KDI2B0                          | 1250 | 21033KD02W0                                                              | 1400 |  |
|                         | 0.0012                                                                        |                                 |                            | 21233KDA2B0                                                                                | 21233KDM2B0                         |      | 21233KDI2B0                          |      | 21233KD02W0                                                              |      |  |
|                         | 0.0015                                                                        |                                 |                            | 21533KDA2B0                                                                                | 21533KDM2B0                         |      | 21533KDI2B0                          |      | 21533KD02W0                                                              |      |  |
|                         | 0.0018                                                                        |                                 |                            | 21833KDA2B0                                                                                | 21833KDM2B0                         |      | 21833KDI2B0                          |      | 21833KD02W0                                                              |      |  |
|                         | 0.0022                                                                        |                                 |                            | 22233KDA2B0                                                                                | 22233KDM2B0                         |      | 22233KDI2B0                          |      | 22233KD02W0                                                              |      |  |
|                         | 0.0027                                                                        |                                 |                            | 22733KDA2B0                                                                                | 22733KDM2B0                         |      | 22733KDI2B0                          |      | 22733KD02W0                                                              |      |  |
|                         | 0.0033                                                                        |                                 |                            | 23333KDA2B0                                                                                | 23333KDM2B0                         |      | 23333KDI2B0                          |      | 23333KD02W0                                                              |      |  |
|                         | 0.0039                                                                        |                                 |                            | 23933KDA2B0                                                                                | 23933KDM2B0                         |      | 23933KDI2B0                          |      | 23933KD02W0                                                              |      |  |
|                         | 0.0047                                                                        |                                 |                            | 24733KDA2B0                                                                                | 24733KDM2B0                         |      | 24733KDI2B0                          |      | 24733KD02W0                                                              |      |  |
|                         | 0.0056                                                                        |                                 |                            | 25633KDA2B0                                                                                | 25633KDM2B0                         |      | 25633KDI2B0                          |      | 25633KD02W0                                                              |      |  |
|                         | 0.0068                                                                        |                                 |                            | 26833KDA2B0                                                                                | 26833KDM2B0                         |      | 26833KDI2B0                          |      | 26833KD02W0                                                              |      |  |
|                         | 0.0082                                                                        |                                 |                            | 28233KDA2B0                                                                                | 28233KDM2B0                         |      | 28233KDI2B0                          |      | 28233KD02W0                                                              |      |  |
|                         | 0.010                                                                         |                                 |                            | 31033KDA2B0                                                                                | 31033KDM2B0                         |      | 31033KDI2B0                          |      | 31033KD02W0                                                              |      |  |
|                         | 0.012                                                                         |                                 |                            | 31233KDA2B0                                                                                | 31233KDM2B0                         |      | 31233KDI2B0                          |      | 31233KD02W0                                                              |      |  |
|                         | 0.015                                                                         |                                 |                            | 31533KDA2B0                                                                                | 31533KDM2B0                         |      | 31533KDI2B0                          |      | 31533KD02W0                                                              |      |  |
|                         | 0.018                                                                         | 5.0 x 11.0 x 12.5               | 0.82                       | 31833KDA2B0                                                                                | 31833KDM2B0                         | 1000 | 31833KDI2B0                          | 1000 | 31833KD02W0                                                              | 1100 |  |
|                         | 0.022                                                                         |                                 |                            | 32233KDA2B0                                                                                | 32233KDM2B0                         |      | 32233KDI2B0                          |      | 32233KD02W0                                                              |      |  |
|                         | 0.027                                                                         | 6.0 x 12.0 x 12.5               | 1.1                        | 32733KDA2B0                                                                                | 32733KDM2B0                         | 750  | 32733KDI2B0                          | 750  | 32733KD02W0                                                              | 900  |  |
| 0.033                   | 33333KDA2B0                                                                   |                                 |                            | 33333KDM2B0                                                                                | 33333KDI2B0                         |      | 33333KD02W0                          |      |                                                                          |      |  |



| ELECTRICAL DATA AND ORDERING INFORMATION |                                                                               |                                 |                            |                                                                                                                                     |                                         |      |                                          |      |                                                                                           |      |  |  |
|------------------------------------------|-------------------------------------------------------------------------------|---------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------|------------------------------------------|------|-------------------------------------------------------------------------------------------|------|--|--|
| U <sub>RAC</sub><br>(V)                  | CAP.<br>(μF)                                                                  | DIMENSIONS<br>w x h x l<br>(mm) | MASS<br>(g) <sup>(3)</sup> | CATALOG NUMBER F339X1... AND PACKAGING                                                                                              |                                         |      |                                          |      |                                                                                           |      |  |  |
|                                          |                                                                               |                                 |                            | LOOSE IN BOX                                                                                                                        |                                         |      |                                          |      | TAPED REEL                                                                                |      |  |  |
|                                          |                                                                               |                                 |                            | SHORT LEADS                                                                                                                         |                                         |      | LONG LEADS                               |      |                                                                                           |      |  |  |
|                                          |                                                                               |                                 |                            | $l_t = 3.5\text{ mm} + 1\text{ mm/- }0.5\text{ mm} (\leq 10\text{ mm})$<br>or $3.5\text{ mm} \pm 0.3\text{ mm} (\geq 15\text{ mm})$ | $l_t = 5.0\text{ mm} \pm 1.0\text{ mm}$ | SPQ  | $l_t = 25.0\text{ mm} \pm 2.0\text{ mm}$ | SPQ  | $\varnothing = 500\text{ mm}^{(1)(2)}$<br>$H = 18.5\text{ mm};$<br>$P_0 = 12.7\text{ mm}$ | SPQ  |  |  |
| 330                                      | PITCH = 15.0 mm ± 0.4 mm; d <sub>t</sub> = 0.60 mm ± 0.06 mm; C-TOL. = ± 10 % |                                 |                            |                                                                                                                                     |                                         |      |                                          |      |                                                                                           |      |  |  |
|                                          | 0.010                                                                         | 5.0 x 11.0 x 17.5               | 1.0                        | 31033KFP2B0                                                                                                                         | 31033KFM2B0                             | 1000 | 31033KFI2B0                              | 1000 | 31033KF02W0                                                                               | 1100 |  |  |
|                                          | 0.012                                                                         |                                 |                            | 31233KFP2B0                                                                                                                         | 31233KFM2B0                             |      | 31233KFI2B0                              |      | 31233KF02W0                                                                               |      |  |  |
|                                          | 0.015                                                                         |                                 |                            | 31533KFP2B0                                                                                                                         | 31533KFM2B0                             |      | 31533KFI2B0                              |      | 31533KF02W0                                                                               |      |  |  |
|                                          | 0.018                                                                         |                                 |                            | 31833KFP2B0                                                                                                                         | 31833KFM2B0                             |      | 31833KFI2B0                              |      | 31833KF02W0                                                                               |      |  |  |
|                                          | 0.022                                                                         |                                 |                            | 32233KFP2B0                                                                                                                         | 32233KFM2B0                             |      | 32233KFI2B0                              |      | 32233KF02W0                                                                               |      |  |  |
|                                          | 0.027                                                                         |                                 |                            | 32733KFP2B0                                                                                                                         | 32733KFM2B0                             |      | 32733KFI2B0                              |      | 32733KF02W0                                                                               |      |  |  |
|                                          | 0.033                                                                         |                                 |                            | 33333KFP2B0                                                                                                                         | 33333KFM2B0                             |      | 33333KFI2B0                              |      | 33333KF02W0                                                                               |      |  |  |
|                                          | 0.039                                                                         |                                 |                            | 33933KFP2B0                                                                                                                         | 33933KFM2B0                             |      | 33933KFI2B0                              |      | 33933KF02W0                                                                               |      |  |  |
|                                          | 0.047                                                                         |                                 |                            | 34733KFP2B0                                                                                                                         | 34733KFM2B0                             |      | 34733KFI2B0                              |      | 34733KF02W0                                                                               |      |  |  |
|                                          | 0.056                                                                         | 6.0 x 12.0 x 17.5               | 1.4                        | 35633KFP2B0                                                                                                                         | 35633KFM2B0                             | 1000 | 35633KFI2B0                              | 1000 | 35633KF02W0                                                                               | 900  |  |  |
|                                          | 0.068                                                                         |                                 |                            | 36833KFP2B0                                                                                                                         | 36833KFM2B0                             |      | 36833KFI2B0                              |      | 36833KF02W0                                                                               |      |  |  |
|                                          | PITCH = 15.0 mm ± 0.4 mm; d <sub>t</sub> = 0.80 mm ± 0.08 mm; C-TOL. = ± 10 % |                                 |                            |                                                                                                                                     |                                         |      |                                          |      |                                                                                           |      |  |  |
|                                          | 0.082                                                                         | 7.0 x 13.5 x 17.5               | 1.8                        | 38233KFP2B0                                                                                                                         | 38233KFM2B0                             | 1000 | 38233KFI2B0                              | 500  | 38233KF02W0                                                                               | 800  |  |  |
|                                          | 0.100                                                                         |                                 |                            | 41033KFP2B0                                                                                                                         | 41033KFM2B0                             |      | 41033KFI2B0                              |      | 41033KF02W0                                                                               |      |  |  |
|                                          | 0.120                                                                         | 8.5 x 15.0 x 17.5               | 2.4                        | 41233KFP2B0                                                                                                                         | 41233KFM2B0                             | 1000 | 41233KFI2B0                              | 500  | 41233KF02W0                                                                               | 650  |  |  |
|                                          | 0.150                                                                         |                                 |                            | 41533KFP2B0                                                                                                                         | 41533KFM2B0                             |      | 41533KFI2B0                              |      | 41533KF02W0                                                                               |      |  |  |
|                                          | 0.180                                                                         | 10.0 x 16.5 x 17.5              | 3.0                        | 41833KFP2B0                                                                                                                         | 41833KFM2B0                             | 500  | 41833KFI2B0                              | 500  | 41833KF02W0                                                                               | 600  |  |  |
|                                          | PITCH = 22.5 mm ± 0.4 mm; d <sub>t</sub> = 0.80 mm ± 0.08 mm; C-TOL. = ± 10 % |                                 |                            |                                                                                                                                     |                                         |      |                                          |      |                                                                                           |      |  |  |
|                                          | 0.10                                                                          | 6.0 x 15.5 x 26.0               | 2.4                        | 41033KIP2T0                                                                                                                         | 41033KIM2T0                             | 300  | 41033KII2B0                              | 250  | 41033KI02W0                                                                               | 600  |  |  |
|                                          | 0.12                                                                          |                                 |                            | 41233KIP2T0                                                                                                                         | 41233KIM2T0                             |      | 41233KII2B0                              |      | 41233KI02W0                                                                               |      |  |  |
|                                          | 0.15                                                                          |                                 |                            | 41533KIP2T0                                                                                                                         | 41533KIM2T0                             |      | 41533KII2B0                              |      | 41533KI02W0                                                                               |      |  |  |
|                                          | 0.18                                                                          | 7.0 x 16.5 x 26.0               | 2.9                        | 41833KIP2T0                                                                                                                         | 41833KIM2T0                             | 200  | 41833KII2B0                              | 250  | 41833KI02W0                                                                               | 500  |  |  |
|                                          | 0.22                                                                          |                                 |                            | 42233KIP2T0                                                                                                                         | 42233KIM2T0                             |      | 42233KII2B0                              |      | 42233KI02W0                                                                               |      |  |  |
|                                          | 0.27                                                                          | 8.5 x 18.0 x 26.0               | 3.8                        | 42733KIP2T0                                                                                                                         | 42733KIM2T0                             | 200  | 42733KII2B0                              | 250  | 42733KI02W0                                                                               | 450  |  |  |
|                                          | 0.33                                                                          |                                 |                            | 43333KIP2T0                                                                                                                         | 43333KIM2T0                             |      | 43333KII2B0                              |      | 43333KI02W0                                                                               |      |  |  |
|                                          | 0.39                                                                          | 10.0 x 19.5 x 26.0              | 6.8                        | 43933KIP2T0                                                                                                                         | 43933KIM2T0                             | 200  | 43933KII2B0                              | 200  | 43933KI02W0                                                                               | 350  |  |  |
|                                          | 0.47                                                                          | 12.0 x 22.0 x 26.0              | 7.8                        | 44733KIP2T0                                                                                                                         | 44733KIM2T0                             | 150  | 44733KII2B0                              | 200  | 44733KI02W0                                                                               | 300  |  |  |
|                                          | 0.56                                                                          |                                 |                            | 45633KIP2T0                                                                                                                         | 45633KIM2T0                             |      | 45633KII2B0                              |      | 45633KI02W0                                                                               |      |  |  |
|                                          | 0.68                                                                          | 12.5 x 22.5 x 26.5              | 8.0                        | 46833KIP2T0                                                                                                                         | 46833KIM2T0                             | 150  | 46833KII2B0                              | 200  | 46833KI02W0                                                                               | 300  |  |  |
|                                          | PITCH = 27.5 mm ± 0.4 mm; d <sub>t</sub> = 0.80 mm ± 0.08 mm; C-TOL. = ± 10 % |                                 |                            |                                                                                                                                     |                                         |      |                                          |      |                                                                                           |      |  |  |
|                                          | 0.22                                                                          | 9.0 x 19.0 x 31.5               | 5.5                        | 42233KKP2T0                                                                                                                         | 42233KKM2T0                             | 100  | 42233KKI2B0                              | 150  | -                                                                                         | -    |  |  |
|                                          | 0.27                                                                          |                                 |                            | 42733KKP2T0                                                                                                                         | 42733KKM2T0                             |      | 42733KKI2B0                              |      |                                                                                           |      |  |  |
|                                          | 0.33                                                                          |                                 |                            | 43333KKP2T0                                                                                                                         | 43333KKM2T0                             |      | 43333KKI2B0                              |      |                                                                                           |      |  |  |
|                                          | 0.39                                                                          |                                 |                            | 43933KKP2T0                                                                                                                         | 43933KKM2T0                             |      | 43933KKI2B0                              |      |                                                                                           |      |  |  |
|                                          | 0.47                                                                          | 11.0 x 21.0 x 31.0              | 7.4                        | 44733KKP2T0                                                                                                                         | 44733KKM2T0                             | 100  | 44733KKI2B0                              | 125  |                                                                                           |      |  |  |
|                                          | 0.56                                                                          |                                 |                            | 45633KKP2T0                                                                                                                         | 45633KKM2T0                             |      | 45633KKI2B0                              |      |                                                                                           |      |  |  |
|                                          | 0.68                                                                          | 13.0 x 23.0 x 31.0              | 9.2                        | 46833KKP2T0                                                                                                                         | 46833KKM2T0                             | 100  | 46833KKI2B0                              | 125  |                                                                                           |      |  |  |
|                                          | 0.82                                                                          |                                 |                            | 48233KKP2T0                                                                                                                         | 48233KKM2T0                             |      | 48233KKI2B0                              |      |                                                                                           |      |  |  |
|                                          | 1.0                                                                           | 15.0 x 25.0 x 31.5              | 12.3                       | 51033KKP2T0                                                                                                                         | 51033KKM2T0                             | 100  | 51033KKI2B0                              | 125  |                                                                                           |      |  |  |
|                                          | 1.2                                                                           |                                 |                            | 51233KKP2T0                                                                                                                         | 51233KKM2T0                             |      | 51233KKI2B0                              |      |                                                                                           |      |  |  |
|                                          | 1.5                                                                           | 18.0 x 28.0 x 31.5              | 16.1                       | 51533KKP2T0                                                                                                                         | 51533KKM2T0                             | 100  | 51533KKI2B0                              | 100  |                                                                                           |      |  |  |
|                                          | 1.8                                                                           | 21.0 x 31.0 x 31.0              | 20.3                       | 51833KKP2T0                                                                                                                         | 51833KKM2T0                             | 50   | 51833KKI2B0                              | 75   |                                                                                           |      |  |  |
|                                          | 2.2                                                                           |                                 |                            | 52233KKP2T0                                                                                                                         | 52233KKM2T0                             |      | 52233KKI2B0                              |      |                                                                                           |      |  |  |

## Notes

- SPQ = Standard Packing Quantity
- (1) Reel diameter = 356 mm is available on request
- (2) H = in-tape height; P<sub>0</sub> = sprocket hole distance; for detailed specifications refer to "Packaging Information"
- (3) Weight for short lead product only

| APPROVALS                                                                                                                                                                                                                                                                                                                                                           |                     |                |                 |                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------|-----------------|------------------------------------------------------------------------|
| SAFETY APPROVALS X1                                                                                                                                                                                                                                                                                                                                                 | VOLTAGE             | VALUE          | FILE NUMBERS    | LINK                                                                   |
| EN 60384-14 (ENEC)<br>(= IEC 60384-14 ed-3)                                                                                                                                                                                                                                                                                                                         | 330 V <sub>AC</sub> | 1 nF to 2.2 µF | 40031978        | <a href="http://www.vishay.com/doc?28229">www.vishay.com/doc?28229</a> |
| UL 60384-14                                                                                                                                                                                                                                                                                                                                                         | 330 V <sub>AC</sub> | 1 nF to 2.2 µF | E354331B        | <a href="http://www.vishay.com/doc?28210">www.vishay.com/doc?28210</a> |
| CSA-E384-14                                                                                                                                                                                                                                                                                                                                                         | 330 V <sub>AC</sub> | 1 nF to 2.2 µF | E354331B        | <a href="http://www.vishay.com/doc?28210">www.vishay.com/doc?28210</a> |
| CQC                                                                                                                                                                                                                                                                                                                                                                 | 330 V <sub>AC</sub> | 1 nF to 2.2 µF | 12001067597 (L) | <a href="http://www.vishay.com/doc?28235">www.vishay.com/doc?28235</a> |
|                                                                                                                                                                                                                                                                                                                                                                     |                     |                | 12001067600 (F) | <a href="http://www.vishay.com/doc?28236">www.vishay.com/doc?28236</a> |
| CB-test certificate                                                                                                                                                                                                                                                                                                                                                 | 330 V <sub>AC</sub> | 1 nF to 2.2 µF | DE1-48009/M1    | <a href="http://www.vishay.com/doc?28218">www.vishay.com/doc?28218</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; Slovenian; Spain; Sweden, Switzerland and United Kingdom. |                     |                |                 |                                                                        |
|                                                                                                                |                     |                |                 |                                                                        |

## MOUNTING

### Normal Use

The capacitors are designed for mounting on printed-circuit boards. The capacitors packed in bandoliers 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/docs?28139](http://www.vishay.com/docs?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:

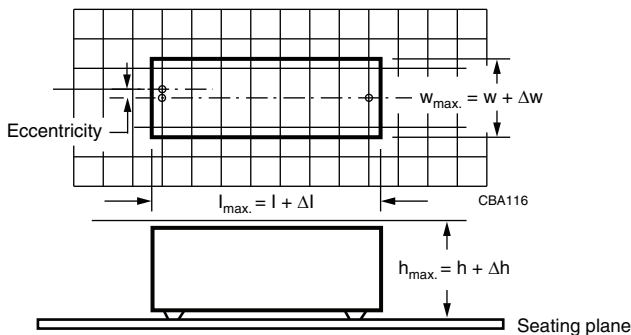
- For original pitch  $\leq 15$  mm the capacitors shall be mechanically fixed by the leads
- For larger pitches the capacitors shall be mounted in the same way and the body clamped

### Space Requirements 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,  $\Delta w = \Delta l = 0.3$  mm and  $\Delta h = 0.1$  mm
- For products with  $15$  mm  $<$  pitch  $\leq 27.5$  mm,  $\Delta w = \Delta l = 0.5$  mm and  $\Delta h = 0.1$  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 document "Soldering Guidelines 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

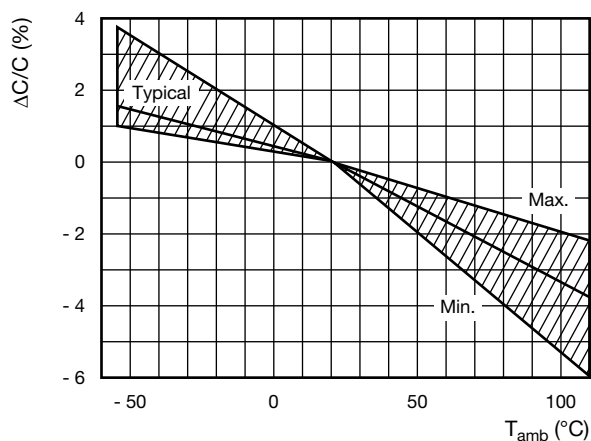
## RATINGS AND CHARACTERISTICS REFERENCE CONDITIONS

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

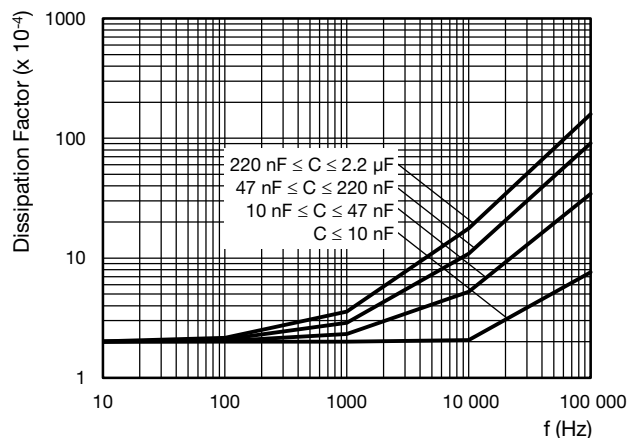
For reference testing, a conditioning period shall be applied over 96 h  $\pm$  4 h by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.



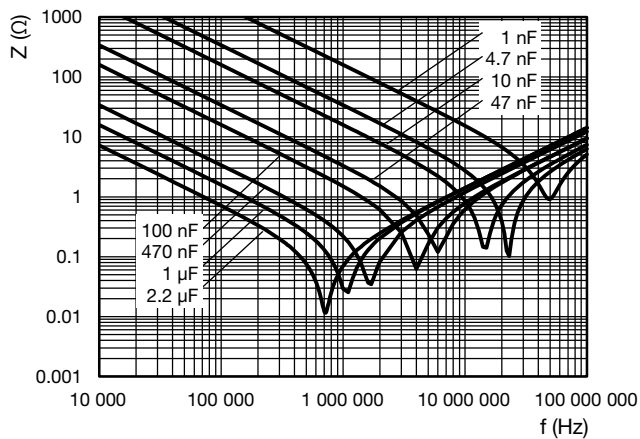
## CHARACTERISTICS



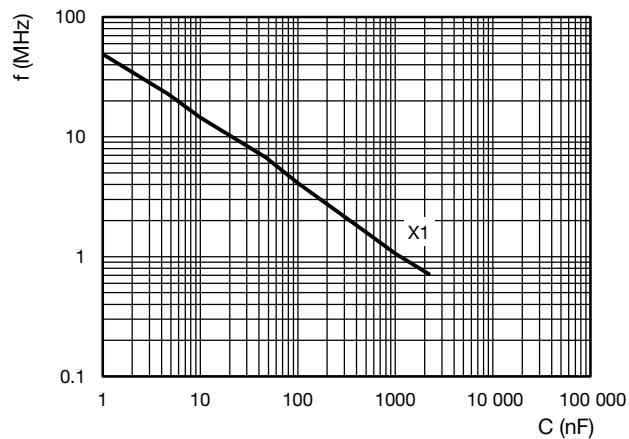
Capacitance as a function of ambient temperature (typical curve)



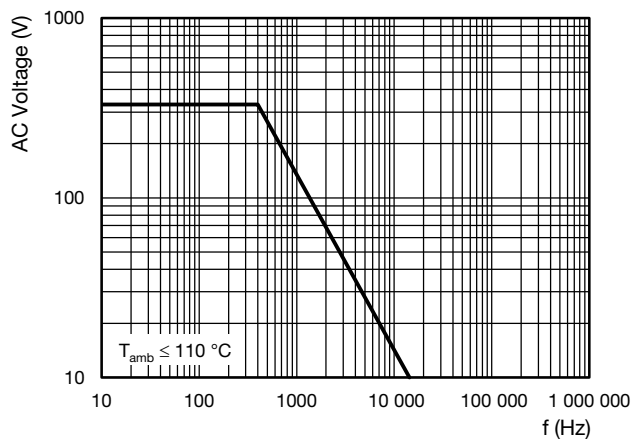
Tangent of loss angle as a function of frequency (typical curve)



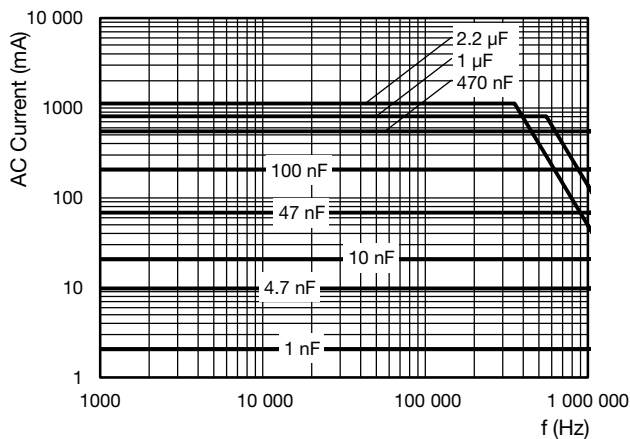
Impedance as a function of frequency (typical curve)



Resonant frequency as a function of capacitance (typical curve)

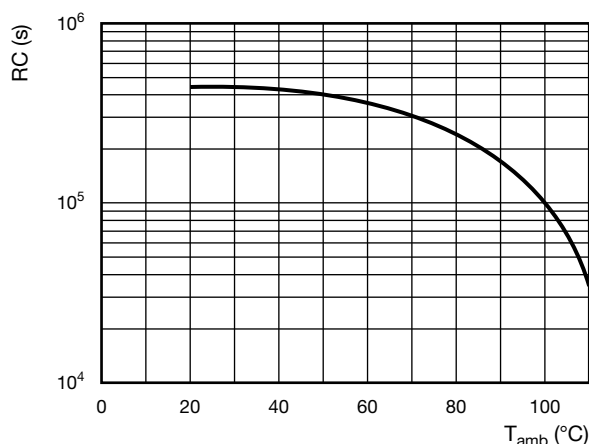


Max. RMS voltage as a function of frequency



Max. RMS current as a function of frequency





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

## APPLICATION NOTES

- For X1 electromagnetic interference suppression in **standard across the line applications** (50 Hz/60 Hz) with a maximum mains voltage of 330 V<sub>AC</sub>
- For series impedance applications we refer to the 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.
- 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 465 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, Publication IEC 60384-14 ed-3 and Specific Reference Data".

| GROUP C INSPECTION REQUIREMENTS              |                                                                                                            |                                                               |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| SUB-CLAUSE NUMBER AND TEST                   | CONDITIONS                                                                                                 | PERFORMANCE REQUIREMENTS                                      |
| SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1 |                                                                                                            |                                                               |
| 4.1 Dimensions (detail)                      |                                                                                                            | As specified in chapters "General Data" of this specification |
| Initial measurements                         | Capacitance<br>Tangent of loss angle at 10 kHz for C ≤ 1 µF<br>Tangent of loss angle at 1 kHz for C > 1 µF |                                                               |
| 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                                |                                                               |





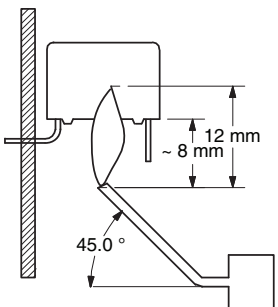
| <b>GROUP C INSPECTION REQUIREMENTS</b>                    |                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <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>       |                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                |
| 4.19 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<br><br>Insulation resistance                                                                                                                            | No visible damage<br>Legible marking<br><br>$ \Delta C/C  \leq 5\%$ of the value measured initially<br><br>Increase of $\tan \delta \leq 0.008$ for $\leq 1 \mu\text{F}$<br>Increase of $\tan \delta \leq 0.005$ 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 C1B OTHER PART OF SAMPLE OF SUB-GROUP C1</b> |                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                |
| Initial measurements                                      | Capacitance<br>Tangent of loss angle at 10 kHz for $C \leq 1 \mu\text{F}$<br>Tangent of loss angle at 1 kHz for $C > 1 \mu\text{F}$                                                                                        |                                                                                                                                                                                                                                                                                                                                                                |
| 4.20 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                           | $\theta A = -55^\circ\text{C}$<br>$\theta B = +110^\circ\text{C}$<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 $98 \text{ m/s}^2$<br>(whichever is less severe)<br>Total duration 6 h |                                                                                                                                                                                                                                                                                                                                                                |
| 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: $490 \text{ m/s}^2$<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 $\tan \delta \leq 0.008$ for $\leq 1 \mu\text{F}$<br>Increase of $\tan \delta \leq 0.005$ for $C > 1 \mu\text{F}$<br>Compared to values measured initially<br><br>As specified in section "Insulation Resistance" of this specification                    |



| <b>GROUP C INSPECTION REQUIREMENTS</b>                                             |                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>SUB-CLAUSE NUMBER AND TEST</b>                                                  | <b>CONDITIONS</b>                                                                                                                                                         | <b>PERFORMANCE REQUIREMENTS</b>                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>SUB-GROUP C1<br/>COMBINED SAMPLE OF SPECIMENS<br/>OF SUB-GROUPS C1A AND C1B</b> |                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 4.11 Climatic sequence                                                             |                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 4.11.1 Initial measurements                                                        | Capacitance<br>Measured in 4.4.2 and 4.9.2<br>Tangent of loss angle:<br>measured initially in C1A and C1B                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 4.11.2 Dry heat                                                                    | Temperature: 110 °C                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 4.11.3 Damp heat cyclic<br>Test Db<br>First cycle                                  | Duration: 16 h                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 4.11.4 Cold                                                                        | Temperature: -55 °C                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 4.11.5 Damp heat cyclic<br>Test Db<br>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>1900 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 $\tan \delta \leq 0.008$ for $\leq 1 \mu\text{F}$<br>Increase of $\tan \delta \leq 0.005$ 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<br>“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<br><br>Tangent of loss angle<br><br>Voltage proof<br>1900 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 4.12.1.<br><br>Increase of $\tan \delta \leq 0.008$<br>Compared to values measured in 4.12.1.<br><br>No permanent breakdown or flash-over<br><br>$\geq 50\%$ 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 C3</b>                    |                                                                                                                                                                                                  |                                                                                                                                                                        |
| 4.13.1 Initial measurements            | Capacitance<br>Tangent of loss angle at 10 kHz for $C \leq 1 \mu\text{F}$<br>Tangent of loss angle at 1 kHz for $C > 1 \mu\text{F}$                                                              |                                                                                                                                                                        |
| 4.13 Impulse voltage                   | 3 successive impulses, full wave, peak voltage:<br>X1: 4.0 kV for $C \leq 1 \mu\text{F}$<br>X1: 4.0 kV/ $\sqrt{C}$ for $C > 1 \mu\text{F}$<br>Max. 24 pulses                                     | No self healing breakdowns or flash-over                                                                                                                               |
| 4.14 Endurance                         | Duration: 1000 h<br>1.25 x $U_{\text{RAC}}$ at 110 °C<br>Once in every hour the voltage is increased to 1000 $V_{\text{RMS}}$ for 0.1 s via resistor of $47 \Omega \pm 5 \%$                     |                                                                                                                                                                        |
| 4.14.7 Final measurements              | Visual examination                                                                                                                                                                               | No visible damage<br>Legible marking                                                                                                                                   |
|                                        | Capacitance                                                                                                                                                                                      | $ \Delta C/C  \leq 10 \%$ compared to values measured in 4.13.1.                                                                                                       |
|                                        | Tangent of loss angle                                                                                                                                                                            | Increase of $\tan \delta \leq 0.008$ for $\leq 1 \mu\text{F}$<br>Increase of $\tan \delta \leq 0.005$ for $C > 1 \mu\text{F}$<br>Compared to values measured in 4.13.1 |
|                                        | Voltage proof<br>1900 $V_{\text{DC}}$ ; 1 min between terminations<br>2160 $V_{\text{AC}}$ ; 1 min between terminations and case                                                                 | No permanent breakdown or flash-over                                                                                                                                   |
|                                        | Insulation resistance                                                                                                                                                                            | $\geq 50 \%$ of values specified in section "Insulation Resistance" of this specification                                                                              |
| <b>SUB-GROUP C4</b>                    |                                                                                                                                                                                                  |                                                                                                                                                                        |
| 4.15 Charge and discharge              | 10 000 cycles<br>charged to 465 $V_{\text{DC}}$<br>Discharge resistance:<br>$R_{\text{min.}} = 2.2 \Omega$ for pitch 37.5 mm and 52.5 mm<br>$R = \frac{465 V_{\text{DC}}}{1.5 \times C (dU/dt)}$ |                                                                                                                                                                        |
| 4.15.1 Initial measurements            | Capacitance<br>Tangent of loss angle at 10 kHz for $C \leq 1 \mu\text{F}$<br>Tangent of loss angle at 1 kHz for $C > 1 \mu\text{F}$                                                              |                                                                                                                                                                        |
| 4.15.3 Final measurements              | Capacitance                                                                                                                                                                                      | $ \Delta C/C  \leq 10 \%$ compared to values measured in 4.15.1.                                                                                                       |
|                                        | Tangent of loss angle                                                                                                                                                                            | Increase of $\tan \delta \leq 0.008$ for $\leq 1 \mu\text{F}$<br>Increase of $\tan \delta \leq 0.005$ for $C > 1 \mu\text{F}$<br>Compared to values measured in 4.15.1 |
|                                        | Insulation resistance                                                                                                                                                                            | $\geq 50 \%$ 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 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 | <p>Bore of gas jet: <math>\varnothing 0.5</math> mm<br/>           Fuel: butane<br/>           Test duration for actual volume <math>V</math> in <math>\text{mm}^3</math>:<br/> <math>V \leq 250</math>: 10 s<br/> <math>250 &lt; V \leq 500</math>: 20 s<br/> <math>500 &lt; V \leq 1750</math>: 30 s<br/> <math>V &gt; 1750</math>: 60 s<br/>           One flame application</p>  | 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 4 kV discharges on the test capacitor connected to $U_{\text{RAC}}$                                                                                                                                                                                                                                                                                                                                                                                      | <p>The cheese cloth around the capacitors shall not burn with a flame.</p> <p>No electrical measurements are required.</p>                           |



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