

# Automotive Grade EMI Suppression Safety Capacitor, Ceramic Disc, Class X1, 440 V<sub>AC</sub>, Class Y2, 300 V<sub>AC</sub>



## FEATURES

- AEC-Q200 qualified
- Withstands 85 / 85 / 1000 h test
- Can pass 3000 temperature cycles (from -55 °C to +125 °C)
- Complying with IEC 60384-14
- High reliability
- Vertical (inline) kinked or straight leads
- Singlelayer AC disc safety capacitors
- PPAP (AIAG version) is available
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



## LINKS TO ADDITIONAL RESOURCES



| QUICK REFERENCE DATA       |        |     |               |               |
|----------------------------|--------|-----|---------------|---------------|
| DESCRIPTION                | VALUE  |     |               |               |
| Ceramic Class              | 1      |     | 2             |               |
| Ceramic Dielectric         | U2J    | U2J | Y5S, Y5U, Y5V | Y5S, Y5U, Y5V |
| Voltage (V <sub>AC</sub> ) | 300    | 440 | 300           | 440           |
| Min. Capacitance (pF)      | 10     |     | 68            |               |
| Max. Capacitance (pF)      | 47     |     | 10 000        |               |
| Mounting                   | Radial |     |               |               |

## OPERATING TEMPERATURE RANGE

-55 °C to +125 °C

## TEMPERATURE CHARACTERISTICS

Class 1: N750 (U2J)

Class 2: Y5S, Y5U, Y5V

## SECTIONAL SPECIFICATIONS

Climatic category (according to EN 60058-1)

Class 1 and class 2: 40/125/21

## COATING

According to UL 94 V-0

Epoxy resin, isolating, flame retardant

## APPROVALS

IEC 60384-14

UL 60384-14

DIN EN 60384-14

CSA E60384-1:03, CSA E60384-14:09

CQC (IEC 60384-14)

## PACKAGING

Bulk, tape and reel, taped ammpack

## APPLICATIONS

- X1, Y2 according to IEC 60384-14
- Application as Y capacitors for EMI suppression and primary-secondary coupling on battery chargers for PHEV/EV
- Application as filter capacitors on DC/DC converters for PHEV/EV and HEV
- EMI / RFI suppression and filtering

## DESIGN

The capacitor consists of a ceramic disc which is silver plated on both sides. Connection leads are made of tin plated copper-clad steel having a diameter of 0.6 mm.

The capacitors may be supplied with straight or kinked leads having a lead spacing of 5 mm, 7.5 mm, or 10.0 mm. Encapsulation is made of flame retardant epoxy resin in accordance with UL 94 V-0.

## CAPACITANCE RANGE

10 pF to 10 000 pF

## RATED VOLTAGE U<sub>R</sub>

IEC 60384-14.4:

(X1): 440 V<sub>AC</sub>, 50 Hz

(Y2): 300 V<sub>AC</sub>, 50 Hz

1000 V<sub>DC</sub>

## TEST VOLTAGE

Component test (100 %):

2600 V<sub>AC</sub>, 50 Hz, 2 s

Random sampling test (destructive test):

2600 V<sub>AC</sub>, 50 Hz, 60 s

Voltage proof of coating (destructive test):

2600 V<sub>AC</sub>, 50 Hz, 60 s

## INSULATION RESISTANCE

≥ 10 000 MΩ

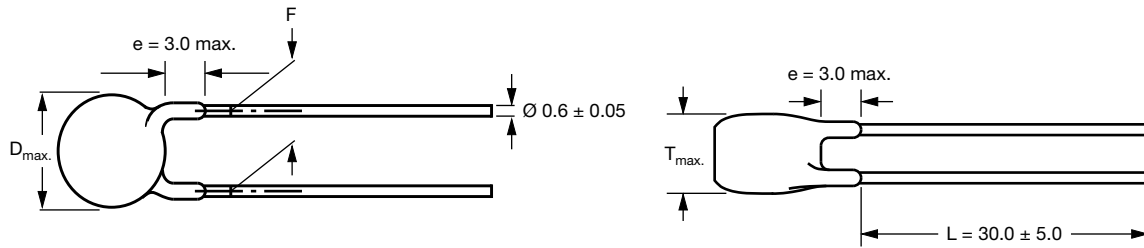
## CAPACITANCE TOLERANCE

± 20 % (code M); ± 10 % (code K)

## DISSIPATION FACTOR

Class 1: max. 0.3 % (1 MHz)

Class 2: max. 2.5 % (1 kHz)

**DIMENSIONS** in millimeters


Capacitors with 5.0 mm, 7.5 mm, or 10.0 mm lead spacing

**TECHNICAL DATA**

| CAPACITANCE<br>C (pF) | CAPACITANCE<br>TOLERANCE<br>(%) | BODY<br>DIAMETER<br>$D_{max.}$ (mm) | BODY<br>THICKNESS<br>$T_{max.}$ (mm) | LEAD SPACING<br>F (mm) $\pm 1$ mm | PART NUMBER                               |
|-----------------------|---------------------------------|-------------------------------------|--------------------------------------|-----------------------------------|---|
|                       |                                 |                                     |                                      |                                   | MISSING DIGITS SEE<br>ORDERING CODE BELOW |
| <b>U2J (N750)</b>     |                                 |                                     |                                      |                                   |   |
| 10                    | $\pm 10$                        | 7.5                                 | 5.0                                  | 5.0, 7.5, or 10.0                 | AY2100K29U2JS6###                         |
| 15                    |                                 |                                     |                                      |                                   | AY2150K29U2JS6###                         |
| 22                    |                                 |                                     |                                      |                                   | AY2220K29U2JS6###                         |
| 33                    |                                 |                                     |                                      |                                   | AY2330K29U2JS6###                         |
| 47                    |                                 |                                     |                                      |                                   | AY2470K29U2JS6###                         |
| <b>Y5S (2C3)</b>      |                                 |                                     |                                      |                                   |   |
| 68                    | $\pm 10$                        | 7.5                                 | 5.0                                  | 5.0, 7.5, or 10.0                 | AY2680K29Y5SS6###                         |
| 100                   |                                 |                                     |                                      |                                   | AY2101K29Y5SS6###                         |
| 150                   |                                 |                                     |                                      |                                   | AY2151K29Y5SS6###                         |
| 220                   |                                 |                                     |                                      |                                   | AY2221K29Y5SS6###                         |
| 330                   |                                 |                                     |                                      |                                   | AY2331K29Y5SS6###                         |
| 470                   |                                 |                                     |                                      |                                   | AY2471K29Y5SS6###                         |
| <b>Y5U (2E3)</b>      |                                 |                                     |                                      |                                   |   |
| 680                   | $\pm 20$                        | 7.5                                 | 5.0                                  | 5.0, 7.5, or 10.0                 | AY2681#29Y5US6###                         |
| 1000                  |                                 | AY2102#29Y5US6###                   |                                      |                                   |   |
| 1500                  |                                 | 8.5                                 |                                      |                                   | AY2152#31Y5US6###                         |
| 2200                  |                                 | 9.5                                 |                                      |                                   | AY2222#35Y5US6###                         |
| 3300                  |                                 | 11.0                                |                                      |                                   | AY2332#41Y5US6###                         |
| 3900                  |                                 | 11.5                                |                                      |                                   | AY2392#43Y5US6###                         |
| 4700                  |                                 | 13.0                                |                                      |                                   | AY2472#49Y5US6###                         |
| <b>Y5V (2F4)</b>      |                                 |                                     |                                      |                                   |   |
| 6800                  | $\pm 20$                        | 13.0                                | 6.0                                  | 7.5 or 10.0                       | AY2682M51Y5VS6#L#                         |
| 10 000                |                                 | 15.5                                |                                      |                                   | AY2103M61Y5VS6#L#                         |

**Note**

 (1)  $\pm 10$  % available on request

**ORDERING CODE**

| #              | 7 <sup>th</sup> digit                      | Capacitance tolerance |                |           | $\pm 10$ % = K, $\pm 20$ % = M     |               |                    |  |                                      |                                |
|----------------|--|-----------------------|----------------|-----------|------------------------------------|---------------|--------------------|--|--------------------------------------|--------------------------------|
| ###            | 15 <sup>th</sup> to 17 <sup>th</sup> digit | Lead configuration    |                |           | Available configurations see below |               |                    |  |                                      |                                |
| <b>Example</b> | <b>AY2</b>                                 | <b>221</b>            | <b>K</b>       | <b>29</b> | <b>Y5S</b>                         | <b>S</b>      | <b>6</b>           | <b>U</b>                                     | <b>V</b>                             | <b>7</b>                       |
|                | Series                                     | Capacitance value     | Tolerance code | Size code | Temperature coefficient            | Rated voltage | Lead wire diameter | Packaging / lead length                      | Lead style                           | Lead spacing                   |
|                |  |                       |                |           |                                    |               |                    | 3 = bulk<br>T = tape and reel<br>U = ammpack | L = straight<br>V = inline<br>kinked | 5 = 5.0<br>7 = 7.5<br>0 = 10.0 |

| PACKAGING        |                      |                               |                      |      |      |             |
|------------------|----------------------|-------------------------------|----------------------|------|------|-------------|
| LEADSPACING (mm) | CAPACITANCE VALUE    | BODY DIAMETER $D_{max.}$ (mm) | PACKAGING QUANTITIES |      |      | TAPING FIG. |
|                  |                      |                               | BULK                 | REEL | AMMO |             |
| 5.0              | 10 pF to 3900 pF     | 11.0                          | 1000                 | 1000 | 1000 | Fig. 1      |
| 7.5              | 10 pF to 4700 pF     | 13.0                          | 1000                 | 1000 | 1000 | Fig. 1      |
|                  | 6800 pF to 10 000 pF | 15.5                          | 500                  | 500  | 500  | Fig. 2      |
| 10.0             | 10 pF to 4700 pF     | 15.5                          | 1000                 | 500  | 750  | Fig. 2      |
|                  | 6800 pF to 10 000 pF | 15.5                          | 500                  | 500  | 500  | Fig. 2      |

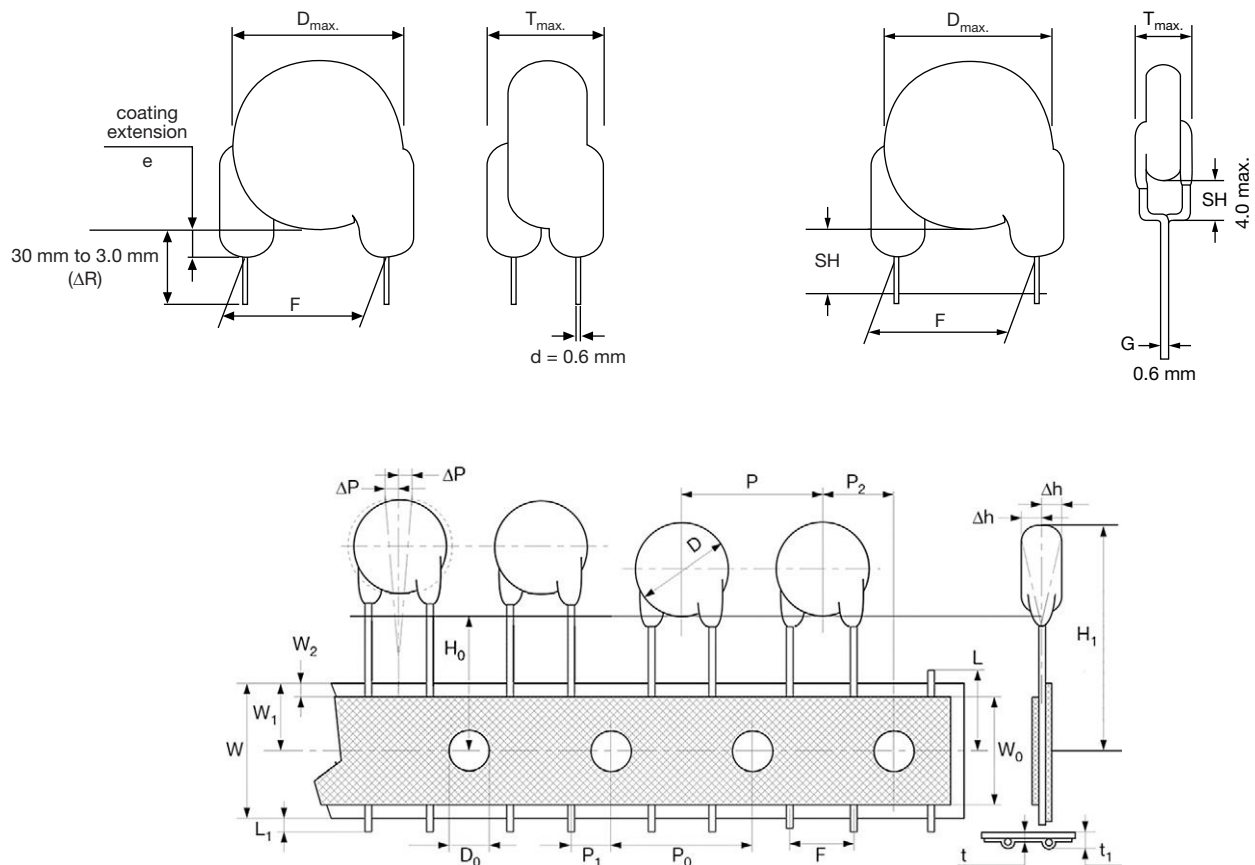
**STRAIGHT LEADS**
**INLINE KINKED LEADS**


Fig. 1 - The hole pitch 12.7 mm for lead spacing 5.0 mm (0.2"), and hole pitch 15.0 mm for lead spacing 7.5 mm (0.3")

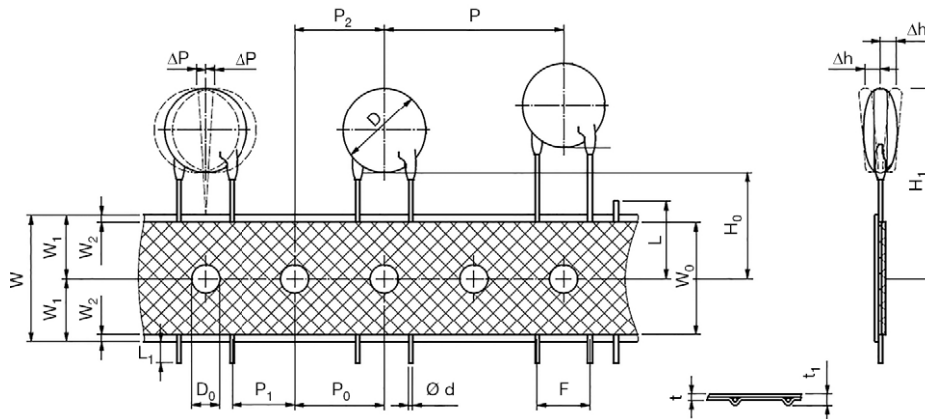


Fig. 2 - The hole pitch 12.7 mm for lead spacing 10.0 mm (0.4")

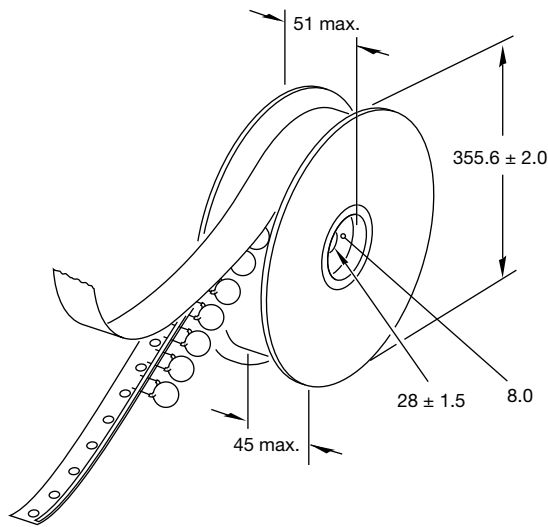
| DIMENSION OF TAPE             |  |                   |                   |                    |
|-------------------------------|--|-------------------|-------------------|--------------------|
| SYMBOL                        | PARAMETER                                    | DIMENSIONS (mm)   |                   |                    |
|                               |  | FIG. 1 (5 mm)     | FIG. 1 (7.5 mm)   | FIG. 2 (10 mm)     |
| D <sup>(1)</sup>              | Body diameter                                | 11.0 max.         | 14.0 max.         | 16.0 max.          |
| d                             | Lead diameter                                | 0.6 ± 0.05        | 0.6 ± 0.05        | 0.6 ± 0.05         |
| P                             | Pitch of component                           | 12.7 ± 1          | 15.0 ± 1          | 25.4 ± 1           |
| P <sub>0</sub> <sup>(2)</sup> | Pitch of sprocket hole                       | 12.7 ± 0.3        | 15.0 ± 0.3        | 12.7 ± 0.3         |
| P <sub>1</sub> <sup>(3)</sup> | Distance, hole center to lead                | 3.85 ± 0.7        | 3.75 ± 0.7        | 7.7 ± 1.0          |
| P <sub>2</sub> <sup>(3)</sup> | Distance, hole to center of component        | 6.35 ± 1.3        | 7.5 ± 1.5         | 12.7 ± 1.5         |
| F                             | Lead spacing                                 | 5.0 (+ 0.6/- 0.4) | 7.5 (+ 0.6/- 0.4) | 10.0 (+ 0.6/- 0.4) |
| Δh                            | Average deviation across tape                | ± 1.0 max.        | ± 1.0 max.        | ± 1.0 max.         |
| ΔP                            | Average deviation in direction of reeling    | ± 1.0 max.        | ± 1.0 max.        | ± 1.0 max.         |
| W                             | Carrier tape width                           | 18.0 + 1/- 0.5    | 18.0 + 1/- 0.5    | 18.0 + 1/- 0.5     |
| W <sub>0</sub>                | Hold-down tape width                         | 5.0 min.          | 5.0 min.          | 5.0 min.           |
| W <sub>1</sub>                | Position of sprocket hole                    | 9.0 + 0.75/- 0.5  | 9.0 + 0.75/- 0.5  | 9.0 + 0.75/- 0.5   |
| W <sub>2</sub>                | Distance of hold-down tape                   | 3.0 max.          | 3.0 max.          | 3.0 max.           |
| H <sub>1</sub>                | Maximum component height                     | 32                | 40                | 40                 |
| H <sub>0</sub>                | Height to seating plane (for kinked leads)   | 16.0 ± 0.5        | 16.0 ± 0.5        | 16.0 ± 0.5         |
| H <sub>0</sub>                | Height to seating plane (for straight leads) | 20.0 ± 0.5        | 20.0 ± 0.5        | 20.0 ± 0.5         |
| L                             | Length of cut leads                          | 11.0 max.         | 11.0 max.         | 11.0 max.          |
| L <sub>1</sub>                | Length of lead protrusion                    | 1.0 max.          | 1.0 max.          | 1.0 max.           |
| D <sub>0</sub>                | Diameter of sprocket hole                    | 4.0 ± 0.2         | 4.0 ± 0.2         | 4.0 ± 0.2          |
| t                             | Total tape thickness                         | 0.9 max.          | 0.9 max.          | 0.9 max.           |
| t <sub>1</sub>                | Maximum thickness of tape and wires          | 1.5 max.          | 1.5 max.          | 1.5 max.           |

**Notes**

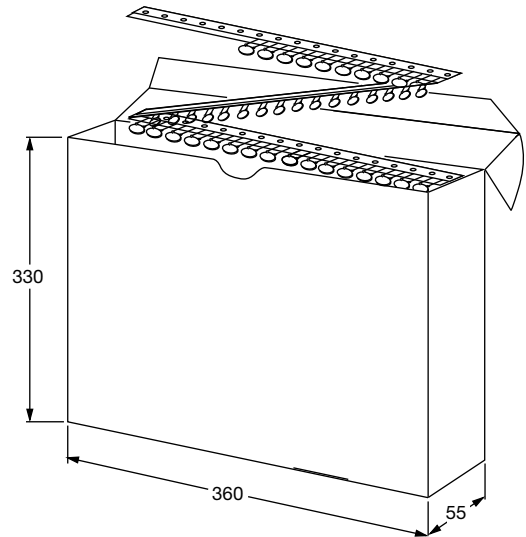
- (1) See "Technical Data" table  
 (2) Cumulative pitch error: ± 1 mm/20 pitches  
 (3) Obliquity maximum 3°



REEL AND TAPE DATA in millimeters



Reel with capacitors on tape

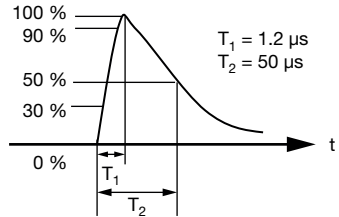
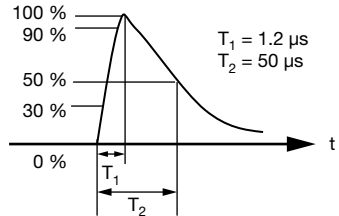


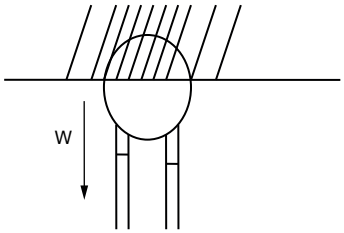
Ammopack with capacitors on tape

| APPROVALS  |                |                |                     |  |
|--|----------------|----------------|---------------------|--|
| IEC 60384-14 - Safety tests<br>This approval together with CB test certificate substitutes all national approvals.   |                |                |                     |  |
| <b>CB Certificate</b>  |                |                |                     |  |
| Y2-capacitor: CB test certificate:   | US-26163-UL    | 10 pF to 10 nF | 300 V <sub>AC</sub> |  |
| X1-capacitor: CB test certificate:   | US-26163-UL    | 10 pF to 10 nF | 440 V <sub>AC</sub> |  |
| <b>VDE</b>   |                |                |                     |  |
| Y2-capacitor: VDE marks approval:  | 40009669       | 10 pF to 10 nF | 300 V <sub>AC</sub> |  |
| X1-capacitor: VDE marks approval:  | 40009669       | 10 pF to 10 nF | 440 V <sub>AC</sub> |  |
| DIN EN 60384-14 VDE 0565-1-1:2006-04 - Safety tests  |                |                |                     |  |
| <b>Underwriters Laboratories Inc./Canadian Standards Association</b>   |                |                |                     |  |
| Y2-capacitor: UL-test certificate:   | E183844        | 10 pF to 10 nF | 300 V <sub>AC</sub> |  |
| X1-capacitor: UL-test certificate:   | E183844        | 10 pF to 10 nF | 440 V <sub>AC</sub> |  |
| UL 60384-14, CSA E60384-1:03 2 <sup>nd</sup> edition, CSA E60384-14:09 2 <sup>nd</sup> edition<br>Across-the-line, antenna-coupling and line-by-pass component |                |                |                     |  |
| <b>CQC</b>   |                |                |                     |  |
| Y2-capacitor: CQC test certificate:  | CQC05001012316 | 10 pF to 10 nF | 300 V <sub>AC</sub> |  |
| X1-capacitor: CQC test certificate:  | CQC05001012316 | 10 pF to 10 nF | 440 V <sub>AC</sub> |  |

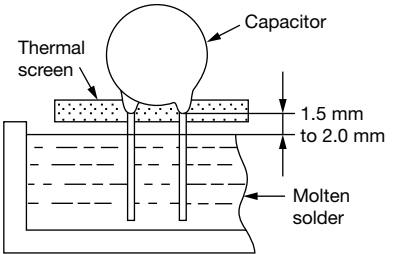
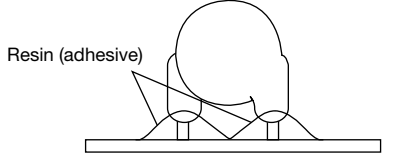
| MARKING   |   |
|---|---|
| <p>Sample<br/>(2 sides)</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <br/>                     Front                 </div> <div style="text-align: center;"> <br/>                     Back                 </div> </div> <p style="margin-left: 150px;">XX - Year<br/>ΔΔ - Week</p> | <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div>                     PN: AY2472M49Y5US63LD<br/>                     QTY: 225<br/>                     PO:<br/>                     SO:                 </div> <div>                     Lot1: 14Z551S12<br/>                     Lot2:<br/>                     Batch: 200601CN<br/>                     Region: 9520<br/>                     Ser.No: 0601H69340                 </div> <div>                     DC1: 0601<br/>                     DC2:<br/>                     SL: 0010                 </div> </div> <div style="text-align: center; margin-top: 10px;"> </div> <p style="text-align: right;">1/1</p> |

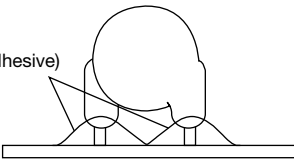
| PERFORMANCE                              |  |   |   |  |      |             |   |              |   |               |   |              |   |               |   |              |
|--|--|---|---|--|------|-------------|---|--------------|---|---------------|---|--------------|---|---------------|---|--------------|
| NO.                                      | ITEMS                                    | SPECIFICATION   | TEST METHOD   |  |      |             |   |              |   |               |   |              |   |               |   |              |
| 1  | Visual and mechanical examination        | No visible damage.<br>The marking shall be legible.<br>Dimensions are within specification. | Capacitors shall be visually inspected for visible evidence of defect.<br>Dimensions shall be measured with calipers or micrometers.                                |  |      |             |   |              |   |               |   |              |   |               |   |              |
| 2  | Capacitance                              | Within the specified tolerance.   | The capacitance shall be measured at 25 °C ± 3 °C, 75 % RH maximum with 1.0 V <sub>RMS</sub> ± 0.2 V <sub>RMS</sub> , 1 kHz for Y5U, Y5S, and 1 MHz for U2J.        |  |      |             |   |              |   |               |   |              |   |               |   |              |
| 3  | Dissipation factor (D.F.)                | U2J: 0.3 % max.<br>Y5U, Y5S: 2.5 % max.   | The dissipation factor shall be measured at 25 °C ± 3 °C, 75 % RH maximum with 1.0 V <sub>RMS</sub> ± 0.2 V <sub>RMS</sub> , 1 kHz for Y5U, Y5S, and 1 MHz for U2J. |  |      |             |   |              |   |               |   |              |   |               |   |              |
| 4  | Insulation resistance (I.R.)             | 10 GΩ min.  | Insulation resistance shall be measured within 60 s ± 5 s of charging at 500 V <sub>DC</sub> .  |  |      |             |   |              |   |               |   |              |   |               |   |              |
| 5  | Dielectric strength (between lead wires) | No damage.  | 2600 V <sub>AC</sub> are applied for 60 s.<br>50 mA max. (destructive test)   |  |      |             |   |              |   |               |   |              |   |               |   |              |
| 6  | Temperature characteristic               | External appearance   | The capacitance shall be measured at each step specified in table below.<br>The capacitance change from the value of step 3 shall not exceed the limit specified.   |  |      |             |   |              |   |               |   |              |   |               |   |              |
|  |  | Capacitance change  |   | n/a  |      |             |   |              |   |               |   |              |   |               |   |              |
|  |  | Dissipation factor  |   | U2J: 0.5 % max. at 1 V, 1 MHz<br>Y5U, Y5S: 5 % max. at 1 V, 1 kHz  |      |             |   |              |   |               |   |              |   |               |   |              |
|  |  | Insulation resistance   | 10 GΩ min. at 500 V <sub>DC</sub><br>60 s at 25 °C and -40 °C<br>500 MΩ min. at 500 V <sub>DC</sub><br>60 s at 125 °C   | <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>Step</th> <th>Temperature</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>25 °C ± 3 °C</td> </tr> <tr> <td>2</td> <td>-40 °C ± 3 °C</td> </tr> <tr> <td>3</td> <td>25 °C ± 3 °C</td> </tr> <tr> <td>4</td> <td>125 °C ± 3 °C</td> </tr> <tr> <td>5</td> <td>25 °C ± 3 °C</td> </tr> </tbody> </table> | Step | Temperature | 1 | 25 °C ± 3 °C | 2 | -40 °C ± 3 °C | 3 | 25 °C ± 3 °C | 4 | 125 °C ± 3 °C | 5 | 25 °C ± 3 °C |
|  |  | Step  | Temperature   |  |      |             |   |              |   |               |   |              |   |               |   |              |
|  | 1  | 25 °C ± 3 °C  |   |  |      |             |   |              |   |               |   |              |   |               |   |              |
| 2  | -40 °C ± 3 °C                            |   |   |  |      |             |   |              |   |               |   |              |   |               |   |              |
| 3  | 25 °C ± 3 °C                             |   |   |  |      |             |   |              |   |               |   |              |   |               |   |              |
| 4  | 125 °C ± 3 °C                            |   |   |  |      |             |   |              |   |               |   |              |   |               |   |              |
| 5  | 25 °C ± 3 °C                             |   |   |  |      |             |   |              |   |               |   |              |   |               |   |              |
| Dielectric strength (between lead wires) | 5 s 250 % rated voltage                  |   |   |  |      |             |   |              |   |               |   |              |   |               |   |              |
|  |  |   |   |  |      |             |   |              |   |               |   |              |   |               |   |              |

| PERFORMANCE |                                 |  |   |   |
|-------------|---------------------------------|--|---|---|
| NO.         | ITEMS                           |  | SPECIFICATION   | TEST METHOD   |
| 7           | High temperature operation life | External appearance                      | No visible damage.<br>The marking shall be legible.               | <p>Test voltage: 1.5 kV<sub>AC</sub>, 60 s<br/>Impulse voltage: each individual capacitor shall be subjected to a 5 kV impulse for three times. Before the capacitors are applied to life test.</p>  <p>The specimen capacitors shall be submitted to an endurance test of 1000 h + 48 h / - 0 h in a chamber at 125 °C ± 3 °C with a voltage of 550 V<sub>AC</sub>.</p> <p>Pre-treatment: capacitor shall be backed at 125 °C ± 3 °C for 1 h before initial measurements.</p> <p>Post-treatment: capacitors shall be placed at room condition for 24 h ± 2 h before measurements.</p>   |
|             |                                 | Capacitance change                       | ± 15 % max.   |   |
|             |                                 | Dissipation factor                       | U2J: 0.5 % max. at 1 V, 1 MHz<br>Y5U, Y5S: 5 % max. at 1 V, 1 kHz |   |
|             |                                 | Insulation resistance                    | 3 GΩ min. at 500 V <sub>DC</sub> , 60 s                           |   |
|             |                                 | Dielectric strength (between lead wires) | No failure at 1.5 kV <sub>AC</sub> , 60 s                         |   |
| 8           | Life Test                       | External appearance                      | No visible damage.<br>The marking shall be legible.               | <p>Test voltage: 1.5 kV<sub>AC</sub>, 60 s<br/>Impulse voltage: each individual capacitor shall be subjected to a 5 kV impulse for three times. Before the capacitors are applied to life test.</p>  <p>The specimen capacitors shall be submitted to an endurance test of 1000 h + 48 h / - 0 h in a chamber at 125 °C ± 3 °C with a voltage of 550 V<sub>AC</sub>, except that once every hour the voltage shall be increase to 1000 V<sub>AC</sub> for 0.1 s.</p> <p>Pre-treatment: capacitor shall be backed at 125 °C ± 3 °C for 1 h before initial measurements.</p> <p>Post-treatment: capacitors shall be placed at room condition for 24 h ± 2 h before measurements.</p> |
|             |                                 | Capacitance change                       | ± 15 % max.   |   |
|             |                                 | Dissipation factor                       | U2J: 0.5 % max. at 1 V, 1 MHz<br>Y5U, Y5S: 5 % max. at 1 V, 1 kHz |   |
|             |                                 | Insulation resistance                    | 3 GΩ min. at 500 V <sub>DC</sub> , 60 s                           |   |
|             |                                 | Dielectric strength (between lead wires) | No failure at 1.5 kV <sub>AC</sub> , 60 s                         |   |

| PERFORMANCE |                                    |  |   |   |  |  |
|-------------|------------------------------------|--|---|---|--|--|
| NO.         | ITEMS                              |  | SPECIFICATION   | TEST METHOD   |  |  |
| 9           | Humidity test (under steady state) | External appearance                      | No visible damage.  | Ambient temperature: 40 °C ± 2 °C<br>Relative humidity: 90 % to 95 % RH<br>Duration: 500 h + 48 h / - 0 h<br>Without loading<br><br>Pre-treatment: capacitor shall be stored at 40 °C ± 2 °C for 24 h ± 5 h before initial measurements.<br><br>Post-treatment: capacitor shall be stored for 2 h at room conditions before final measurements.   |  |  |
|             |                                    | Capacitance change                       | U2J: ± 10 %<br>Y5U, Y5S: ± 20 %                                   |   |  |  |
|             |                                    | Dissipation factor                       | U2J: 0.5 % max. at 1 V, 1 MHz<br>Y5U, Y5S: 5 % max. at 1 V, 1 kHz |   |  |  |
|             |                                    | Insulation resistance                    | 3 GΩ min. at 500 V <sub>DC</sub> , 60 s                           |   |  |  |
|             |                                    | Dielectric strength (between lead wires) | No failure at 1.5 kV <sub>AC</sub> , 60 s                         |   |  |  |
| 10          | Humidity test (under load state)   | External appearance                      | No visible damage.<br>The marking shall be legible.               | Ambient temperature: 40 °C ± 2 °C<br>Relative humidity: 90 % to 95 % RH<br>Duration: 500 h + 48 h / - 0 h<br>Loading voltage: 440 V <sub>AC</sub><br><br>Pre-treatment: capacitor shall be stored at 40 °C ± 5 °C for 24 h ± 2 h before initial measurements.<br><br>Post-treatment: capacitor shall be stored for 2 h at room conditions before final measurements.  |  |  |
|             |                                    | Capacitance change                       | U2J: ± 10 %<br>Y5U, Y5S: ± 15 %                                   |   |  |  |
|             |                                    | Dissipation factor                       | U2J: 0.5 % max. at 1 V, 1 MHz<br>Y5U, Y5S: 5 % max. at 1 V, 1 kHz |   |  |  |
|             |                                    | Insulation resistance                    | 3 GΩ min. at 500 V <sub>DC</sub> , 60 s                           |   |  |  |
|             |                                    | Dielectric strength (between lead wires) | No failure at 1.5 kV <sub>AC</sub> , 60 s                         |   |  |  |
| 11          | Biased humidity                    | External appearance                      | No visible damage.<br>The marking shall be legible.               | Loading voltage: 440 V <sub>AC</sub><br>Ambient temperature: 85 °C ± 3 °C<br>Relative humidity: 85 % RH<br>Duration: 1000 h + 48 h / - 0 h<br><br>Pre-treatment: capacitor shall be stored at 40 °C ± 5 °C for 24 h ± 2 h, then place at room condition for 24 h ± 2 h before initial measurements.<br><br>Post-treatment: capacitor shall be stored for 24 h at room conditions before final measurements. |  |  |
|             |                                    | Capacitance change                       | U2J: ± 10 %<br>Y5U, Y5S: ± 15 %                                   |   |  |  |
|             |                                    | Dissipation factor                       | U2J: 0.5 % max. at 1 V, 1 MHz<br>Y5U, Y5S: 5 % max. at 1 V, 1 kHz |   |  |  |
|             |                                    | Insulation resistance                    | 3 GΩ min. at 500 V <sub>DC</sub> , 60 s                           |   |  |  |
|             |                                    | Dielectric strength (between lead wires) | No failure at 1.5 kV <sub>AC</sub> , 60 s                         |   |  |  |
| 12          | Termination strength               | Pull test                                | External appearance   | As a figure, fix the body of capacitor, apply a tensile weight gradually to each lead wire in the radial direction of capacitor up to 20 N, and keep it for 10 s ± 1 s.<br><br>  |  |  |
|             |                                    |  | Capacitance change  |   | Within specification   |  |
|             |                                    |  | Dissipation factor  |   | Within specification   |  |
|             |                                    |  | Insulation resistance   |   | Within specification   |  |
|             |                                    | Bending test                             | External appearance   |   | Lead wire should not be cut off, capacitor should not be broken.<br><br>Bending each lead wire to 90° from the lead egress with 2.5 N force, then back to original position and bent again from the same direction.<br>Totally 3 bends, 3 s each time.<br>1 bend: bending to 90° the return to normal position is one bend.<br>Start from 1.6 mm to 3.2 mm from the part body. |  |
|             |                                    |  | External appearance   |   |  | Lead wire should not be cut off, capacitor should not be broken. |
|             |                                    |  | External appearance   |   |  | Lead wire should not be cut off, capacitor should not be broken. |



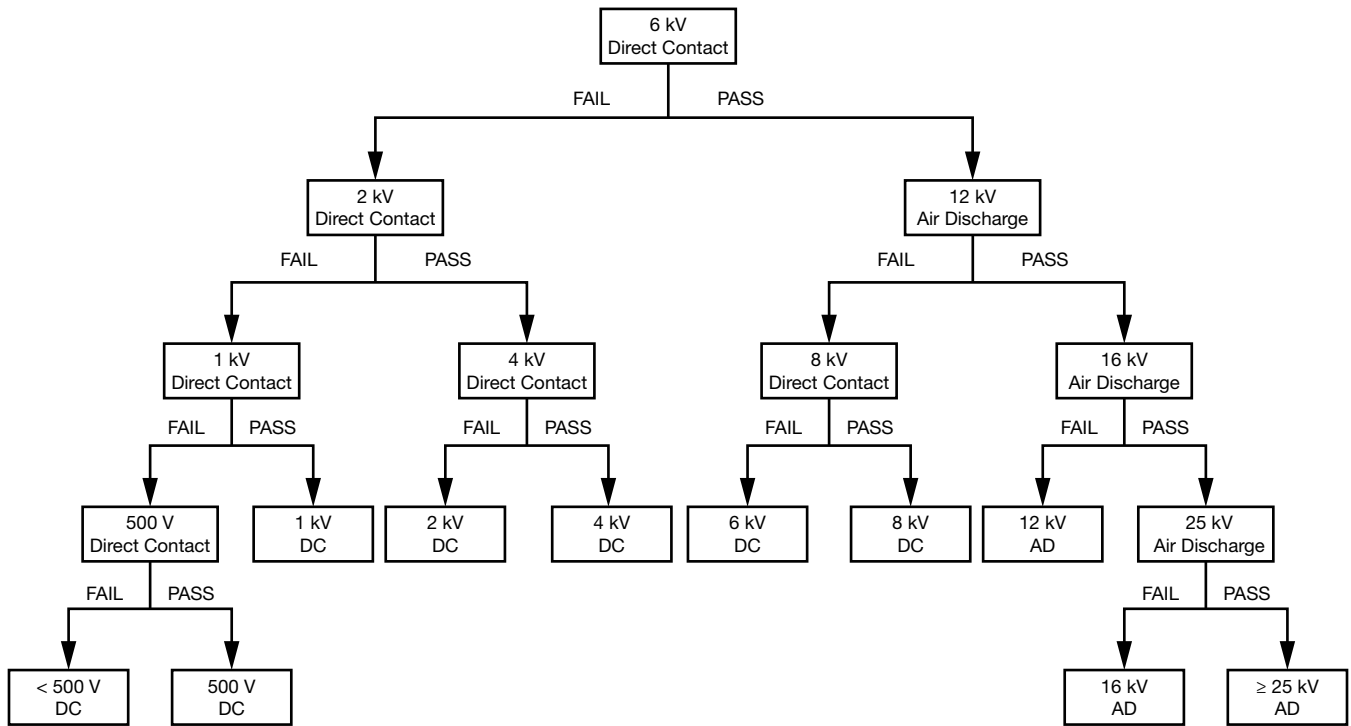
| PERFORMANCE |                           |  |   |   |
|-------------|---------------------------|--|---|---|
| NO.         | ITEMS                     |  | SPECIFICATION   | TEST METHOD   |
| 13          | Resistance to solder heat | Visual                                   | No visible damage.<br>The marking shall be legible.                       | <p>The lead wire shall be immersed into the melted solder of <math>260\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}</math> up to about 1.5 mm to 2 mm from the main body for <math>10\text{ s} \pm 2\text{ s}</math>.<br/>Inspect under 10 x magnification</p>  <p>Pre-treatment:<br/>Capacitor shall be stored at <math>125\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}</math> for 1 h, then placed at room condition for <math>24\text{ h} \pm 2\text{ h}</math> before initial measurements.</p> <p>Post-treatment:<br/>Capacitor shall be stored for <math>24\text{ h} \pm 2\text{ h}</math> at room condition.</p> |
|             |                           | Capacitance change                       | Within $\pm 10\%$   |   |
|             |                           | Dissipation factor                       | U2J: 0.5 % max. at 1 V, 1 MHz<br>Y5U, Y5S: 5 % max. at 1 V, 1 kHz         |   |
|             |                           | Insulation resistance                    | 1 G $\Omega$ min. at 500 V <sub>DC</sub> , 60 s                           |   |
|             |                           | Dielectric strength (between lead wires) | No failure at 1.5 kV <sub>AC</sub> , 60 s                                 |   |
| 14          | Solderability             | External appearance                      | 95 % of terminations evenly covered with solder under 10 x magnification. | <p>Method A at category 3, steam aging for <math>8\text{ h} \pm 15\text{ min}</math>.<br/>Solder and temperature:</p> <p>a) Lead (Pb)-free solder (Sn-3Ag-0.5Cu) <math>245\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}</math></p> <p>b) H63 eutectic solder <math>235\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}</math><br/>dip lead wire into an ethanol solution of <math>25\% \pm 0.5\%</math> rosin and then into molten solder for <math>5\text{ s} + 0\text{ s} / - 0.5\text{ s}</math>.</p> <p>Depth of immersion within 1.25 mm, immerse and withdraw at <math>25\text{ mm/s} \pm 6\text{ mm/s}</math></p>   |
| 15          | Vibration test            | Visual                                   | No visible damage.<br>The marking shall be legible.                       |  <p>Solder the capacitor and gum up the body to the test jig by resin (adhesive).<br/>The capacitor should be firmly soldered to the supporting lead wire.<br/>Vibration change from 10 Hz to 2000 Hz, then back to 10 Hz.<br/>Total amplitude: 1.5 mm with 5 g max., 12 cycles, 20 min for each mutually perpendicular directions, 3 directions.</p>  |
|             |                           | Capacitance change                       | Within $\pm 10\%$   |   |
|             |                           | Dissipation factor                       | U2J: 0.5 % max. at 1 V, 1 MHz<br>Y5U, Y5S: 5 % max. at 1 V, 1 kHz         |   |
|             |                           | Insulation resistance                    | 10 G $\Omega$ min. at 500 V <sub>DC</sub> , 60 s                          |   |

| PERFORMANCE |                                     |                       |   |   |
|-------------|-------------------------------------|-----------------------|---|---|
| NO.         | ITEMS                               |                       | SPECIFICATION   | TEST METHOD   |
| 16          | Mechanical shock                    | External appearance   | No visible damage.<br>The marking shall be legible.               |  <p>Resin (adhesive)</p> <p>Solder the capacitor and gum up the body to the test jig by resin (adhesive). 3 shocks in 2 directions should be applied, totally 3 mutually perpendicular axes, 18 shocks.<br/>Shock from: half-sine<br/>Duration: 6 ms<br/>Acceleration: 100 g</p>   |
|             |                                     | Capacitance change    | Within the specified tolerance.                                   |   |
|             |                                     | Dissipation factor    | U2J: 0.5 % max. at 1 V, 1 MHz<br>Y5U, Y5S: 5 % max. at 1 V, 1 kHz |   |
|             |                                     | Insulation resistance | 10 GΩ min. at 500 V <sub>DC</sub> , 60 s.                         |   |
| 17          | Resistance to solvents              | External appearance   | No visible damage.<br>The marking shall be legible.               | <p>Leave parts in solvent for 3 to 8 min at 25 °C ± 5 °C, 1 min air-drying<br/>Rub parts against wet bristle 10 times (3 x for marking, 10 x for part damage)</p> <p>Solvent 1:<br/>1 part (by volume) of isopropyl alcohol,<br/>3 parts (by volume) of mineral spirits</p> <p>Solvent 2:<br/>Terpene defluxer</p> <p>Solvent 3:<br/>42 parts (by volume) of water, 1 part (by volume) of propylene glycol, 1 part (by volume) of monoethanolamine</p>  |
| 18          | Temperature cycle                   | Capacitance change    | Within ± 10 % for U2J<br>Within ± 20 % for Y5U and Y5S            | <p>The capacitor should be run 3000 temperature cycles. Step as below:<br/>Step 1 -55 °C + 0 °C / - 3 °C, dwell time ≤ 30 min<br/>Step 2 Transition time ≤ 1 min<br/>Step 3 +125 °C + 3 °C / - 0 °C, dwell time ≤ 30 min<br/>Step 4 Transition time ≤ 1 min</p> <p>Pre-treatment:<br/>capacitor shall be stored at 125 °C ± 3 °C for 1 h, then placed at room condition for 24 h ± 2 h before initial measurement.</p> <p>Post-treatment:<br/>capacitor shall be stored for 24 h ± 2 h at room condition.</p> <p><b>Note</b></p> <ul style="list-style-type: none"> <li>• 6800 pF and 10 000 pF only 1000 cycles</li> </ul> |
|             |                                     | Dissipation factor    | U2J: 0.5 % max. at 1 V, 1 MHz<br>Y5U, Y5S: 5 % max. at 1 V, 1 kHz |   |
|             |                                     | Insulation resistance | 3 GΩ min at 500 V <sub>DC</sub> , 60 s                            |   |
|             |                                     | Dielectric strength   | No failure at 1.5 kV <sub>AC</sub> , 60 s                         |   |
|             |                                     | External appearance   | No visible damage.<br>The marking shall be legible.               |   |
| 19          | High temperature exposure (storage) | External appearance   | No visible damage.<br>The marking shall be legible.               | <p>Storage capacitor at 125 °C ± 3 °C for 1000 h + 48 h / - 0 h without loading.</p> <p>Pre-treatment:<br/>capacitor shall be stored at 125 °C ± 3 °C for 1 h, then placed at room condition for 24 h ± 2 h before initial measurement.</p> <p>Post-treatment:<br/>capacitor shall be stored for 24 h ± 2 h at room condition.</p>  |
|             |                                     | Capacitance change    | Within ± 10 % for U2J<br>Within ± 20 % for Y5U and Y5S            |   |
|             |                                     | Dissipation factor    | U2J: 0.5 % max. at 1 V, 1 MHz<br>Y5U, Y5S: 5 % max. at 1 V, 1 kHz |   |
|             |                                     | Insulation resistance | 1 GΩ min. at 500 V <sub>DC</sub> , 60 s                           |   |



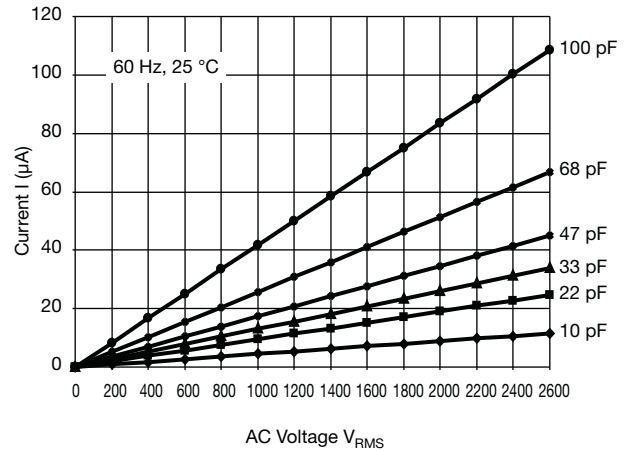
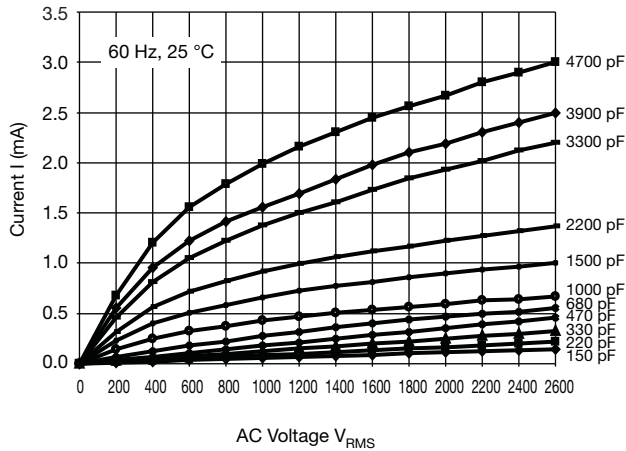
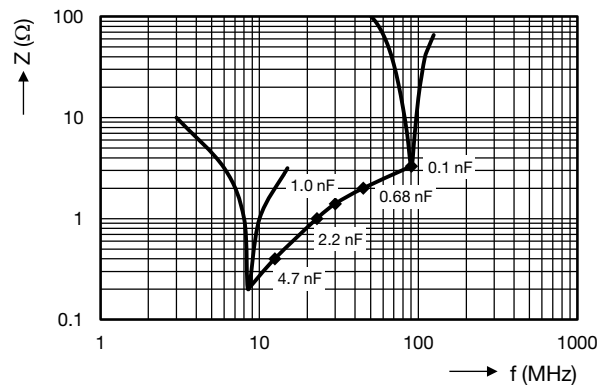
| PERFORMANCE |       |                       |   |                                   |
|-------------|-------|-----------------------|---|-----------------------------------|
| NO.         | ITEMS | SPECIFICATION         | TEST METHOD   |                                   |
| 20          | ESD   | External appearance   | No visible damage.<br>The marking shall be legible.               | See chart "ESD Test Method" below |
|             |       | Capacitance change    | Within $\pm 10\%$   |                                   |
|             |       | Dissipation factor    | U2J: 0.5 % max. at 1 V, 1 MHz<br>Y5U, Y5S: 5 % max. at 1 V, 1 kHz |                                   |
|             |       | Insulation resistance | 1 G $\Omega$ min. at 500 V <sub>DC</sub> , 60 s.                  |                                   |

**ESD TEST METHOD**



**Notes**

- DC means "direct contact discharge"
- AC means "air discharge"
- Classify the components according to the highest ESD voltage level survived during ESD testing

**LEAKAGE CURRENT VS. VOLTAGE (Typical)**

**IMPEDANCE VS. FREQUENCY (Typical)**


Lead configuration: length = 30 mm, lead spacing: standard, lead diameter: standard, inline crimp

**Note**

- The capacitors meet the essential requirements of "EIA 198". Unless stated otherwise all electrical values apply at an ambient temperature of  $25\text{ °C} \pm 3\text{ °C}$ , at normal atmospheric conditions

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|----------------------|--|
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| SAMPLE KIT  |  |
|-------------|--|
| Part Number | AY21-KIT-HF  |
| Link        | <a href="http://www.vishay.com/doc?28553">www.vishay.com/doc?28553</a> |



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