

Automotive Grade EMI Suppression Safety Capacitor, Ceramic Disc, Class X1, 440 V_{AC}, Class Y2, 300 V_{AC}



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



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 _{AC}) | 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: 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_R

IEC 60384-14.4:

(X1): 440 V_{AC}, 50 Hz

(Y2): 300 V_{AC}, 50 Hz

1000 V_{DC}

TEST VOLTAGE

Component test (100 %):

2600 V_{AC}, 50 Hz, 2 s

Random sampling test (destructive test):

2600 V_{AC}, 50 Hz, 60 s

Voltage proof of coating (destructive test):

2600 V_{AC}, 50 Hz, 60 s

INSULATION RESISTANCE

≥ 10 000 MΩ

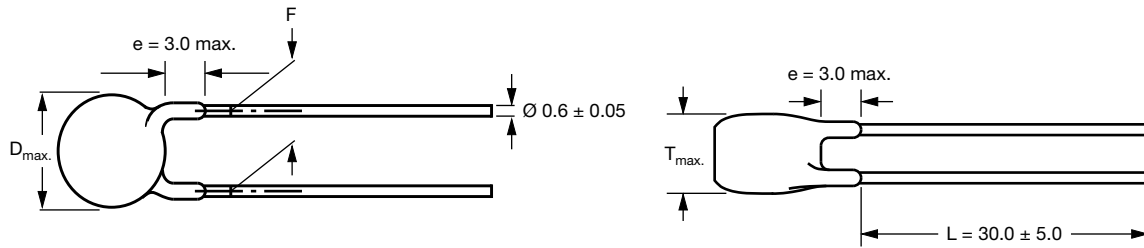
CAPACITANCE TOLERANCE

± 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 C (pF) | CAPACITANCE TOLERANCE (%) | BODY DIAMETER $D_{max.}$ (mm) | BODY THICKNESS $T_{max.}$ (mm) | LEAD SPACING F (mm) ± 1 mm | PART NUMBER |
|-----------------------|---------------------------------|-------------------------------------|--------------------------------------|-----------------------------------|---|
| | | | | | MISSING DIGITS SEE ORDERING CODE BELOW |
| U2J | | | | | |
| 10 | ± 10 | 7.5 | 5.0 | 5.0, 7.5, or 10.0 | AY2100K29U2JS6### |
| 15 | | | | | AY2150K29U2JS6### |
| 22 | | | | | AY2220K29U2JS6### |
| 33 | | | | | AY2330K29U2JS6### |
| 47 | | | | | AY2470K29U2JS6### |
| Y5S | | | | | |
| 68 | ± 10 | 7.5 | 5.0 | 5.0, 7.5, or 10.0 | AY2680K29Y5SS6### |
| 100 | | | | | AY2101K29Y5SS6### |
| 150 | | | | | AY2151K29Y5SS6### |
| 220 | | | | | AY2221K29Y5SS6### |
| 330 | | | | | AY2331K29Y5SS6### |
| 470 | | | | | AY2471K29Y5SS6### |
| Y5U | | | | | |
| 680 | ± 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### |
| Y5V | | | | | |
| 6800 | ± 20 | 13.0 | 6.0 | 7.5 or 10.0 | AY2682M51Y5VS6#L# |
| 10 000 | | 15.5 | | | AY2103M61Y5VS6#L# |

Note

 (1) ± 10 % available on request

ORDERING CODE

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

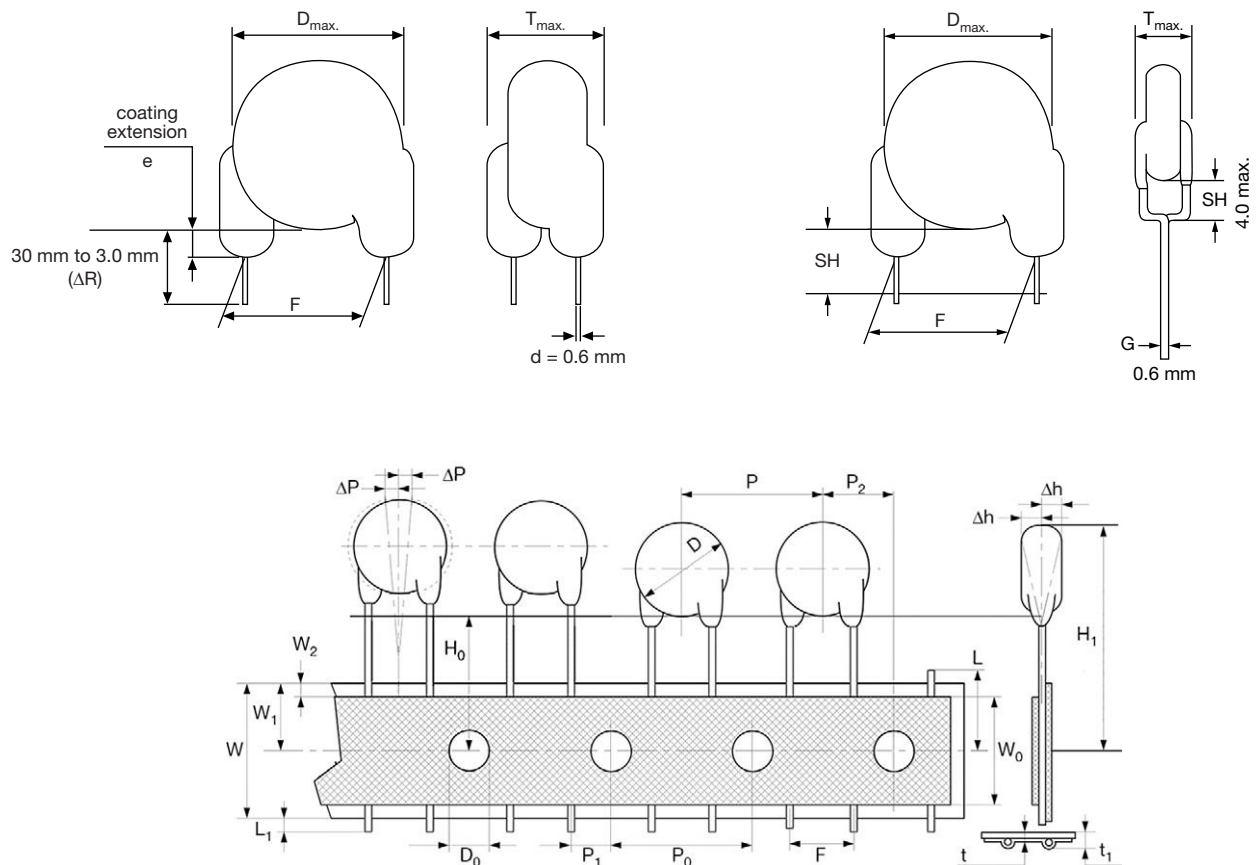
STRAIGHT LEADS
INLINE KINKED LEADS


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")

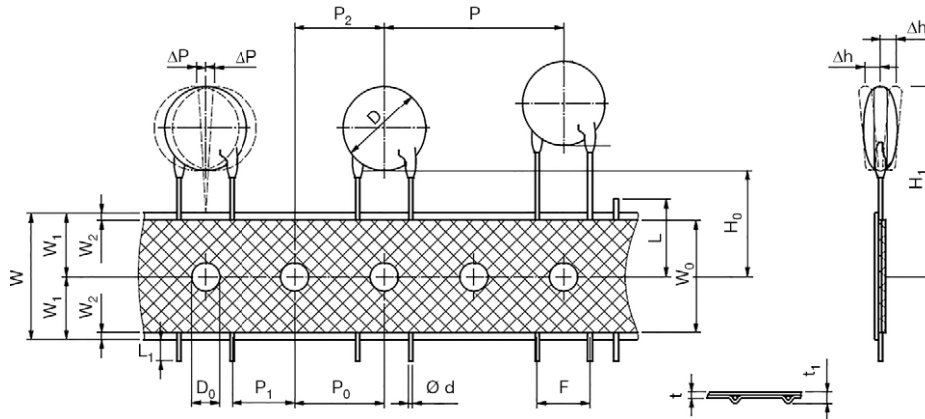
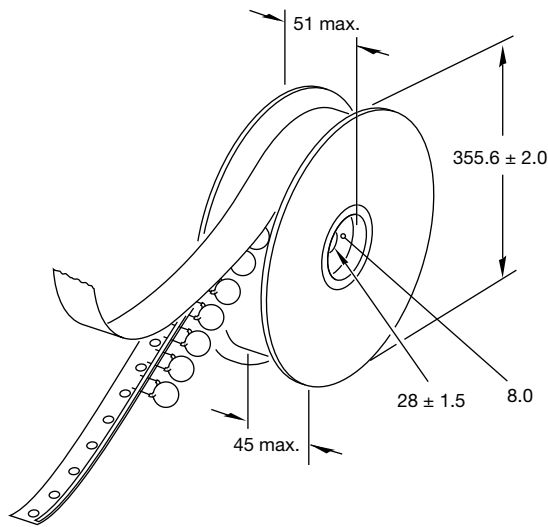


Fig. 2 - The hole pitch 12.7 mm for lead spacing 10.0 mm (0.4")

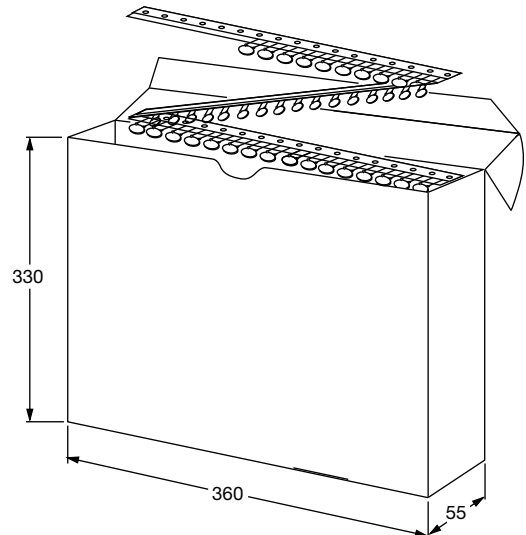
| DIMENSION OF TAPE | | | | |
|-------------------------------|--|-------------------|-------------------|--------------------|
| SYMBOL | PARAMETER | DIMENSIONS (mm) | | |
| | | FIG. 1 (5 mm) | FIG. 1 (7.5 mm) | FIG. 2 (10 mm) |
| D ⁽¹⁾ | Body diameter | 11.0 max. | 14.0 max. | 16.0 max. |
| d | Lead 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 ₀ ⁽²⁾ | Pitch of sprocket hole | 12.7 ± 0.3 | 15.0 ± 0.3 | 12.7 ± 0.3 |
| P ₁ ⁽³⁾ | Distance, hole center to lead | 3.85 ± 0.7 | 3.75 ± 0.7 | 7.7 ± 1.0 |
| P ₂ ⁽³⁾ | 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 ₀ | Hold-down tape width | 5.0 min. | 5.0 min. | 5.0 min. |
| W ₁ | Position of sprocket hole | 9.0 + 0.75/- 0.5 | 9.0 + 0.75/- 0.5 | 9.0 + 0.75/- 0.5 |
| W ₂ | Distance of hold-down tape | 3.0 max. | 3.0 max. | 3.0 max. |
| H ₁ | Maximum component height | 32 | 40 | 40 |
| H ₀ | Height to seating plane (for kinked leads) | 16.0 ± 0.5 | 16.0 ± 0.5 | 16.0 ± 0.5 |
| H ₀ | 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 ₁ | Length of lead protrusion | 1.0 max. | 1.0 max. | 1.0 max. |
| D ₀ | 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 ₁ | 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

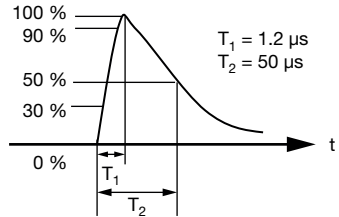
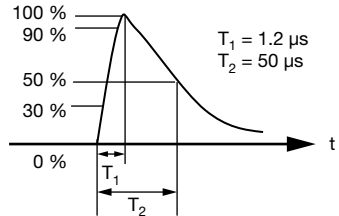


Ammpack with capacitors on tape

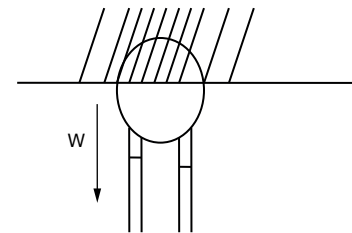
| APPROVALS | | | | |
|--|----------------|----------------|---------------------|--|
| IEC 60384-14 - Safety tests This approval together with CB test certificate substitutes all national approvals. | | | | |
| CB Certificate | | | | |
| Y2-capacitor: CB test certificate: | US-26163-UL | 10 pF to 10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

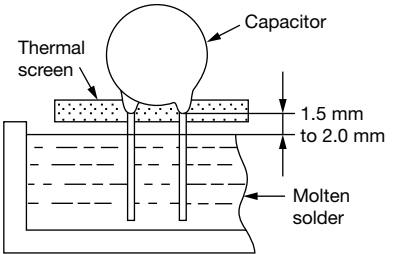
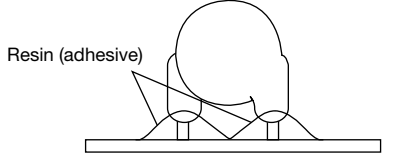
| MARKING | |
|--|---|
| <p>Sample (2 sides)</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>Front</p> </div> <div style="text-align: center;"> <p>Back</p> </div> </div> | <div style="display: flex; justify-content: space-between;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

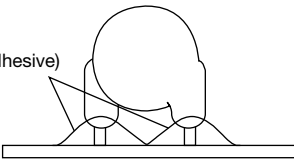
| PERFORMANCE | | | | | | | | | | | | | | | | |
|--|--|---|---|--|------|-------------|---|--------------|---|---------------|---|--------------|---|---------------|---|--------------|
| NO. | ITEMS | SPECIFICATION | TEST METHOD | | | | | | | | | | | | | |
| 1 | Visual and mechanical examination | No visible damage. The marking shall be legible. Dimensions are within specification. | Capacitors shall be visually inspected for visible evidence of defect. 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 _{RMS} ± 0.2 V _{RMS} , 1 kHz for Y5U, Y5S, and 1 MHz for U2J. | | | | | | | | | | | | | |
| 3 | Dissipation factor (D.F.) | U2J: 0.3 % max. Y5U, Y5S: 2.5 % max. | The dissipation factor shall be measured at 25 °C ± 3 °C, 75 % RH maximum with 1.0 V _{RMS} ± 0.2 V _{RMS} , 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 _{DC} . | | | | | | | | | | | | | |
| 5 | Dielectric strength (between lead wires) | No damage. | 2600 V _{AC} are applied for 60 s. 50 mA max. (destructive test) | | | | | | | | | | | | | |
| 6 | Temperature characteristic | External appearance | The capacitance shall be measured at each step specified in table below. 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 Y5U, Y5S: 5 % max. at 1 V, 1 kHz | | | | | | | | | | | | |
| | | Insulation resistance | 10 GΩ min. at 500 V _{DC} 60 s at 25 °C and -40 °C 500 MΩ min. at 500 V _{DC} 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. The marking shall be legible. | <p>Test voltage: 1.5 kV_{AC}, 60 s 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_{AC}.</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 Y5U, Y5S: 5 % max. at 1 V, 1 kHz | |
| | | Insulation resistance | 3 GΩ min. at 500 V _{DC} , 60 s | |
| | | Dielectric strength (between lead wires) | No failure at 1.5 kV _{AC} , 60 s | |
| 8 | Life Test | External appearance | No visible damage. The marking shall be legible. | <p>Test voltage: 1.5 kV_{AC}, 60 s 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_{AC}, except that once every hour the voltage shall be increase to 1000 V_{AC} 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 Y5U, Y5S: 5 % max. at 1 V, 1 kHz | |
| | | Insulation resistance | 3 GΩ min. at 500 V _{DC} , 60 s | |
| | | Dielectric strength (between lead wires) | No failure at 1.5 kV _{AC} , 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 Relative humidity: 90 % to 95 % RH Duration: 500 h + 48 h / - 0 h Without loading Pre-treatment: capacitor shall be stored at 40 °C ± 2 °C for 24 h ± 5 h before initial measurements. Post-treatment: capacitor shall be stored for 2 h at room conditions before final measurements. | |
| | | Capacitance change | U2J: ± 10 % Y5U, Y5S: ± 20 % | | |
| | | Dissipation factor | U2J: 0.5 % max. at 1 V, 1 MHz Y5U, Y5S: 5 % max. at 1 V, 1 kHz | | |
| | | Insulation resistance | 3 GΩ min. at 500 V _{DC} , 60 s | | |
| | | Dielectric strength (between lead wires) | No failure at 1.5 kV _{AC} , 60 s | | |
| 10 | Humidity test (under load state) | External appearance | No visible damage. The marking shall be legible. | Ambient temperature: 40 °C ± 2 °C Relative humidity: 90 % to 95 % RH Duration: 500 h + 48 h / - 0 h Loading voltage: 440 V _{AC} Pre-treatment: capacitor shall be stored at 40 °C ± 5 °C for 24 h ± 2 h before initial measurements. Post-treatment: capacitor shall be stored for 2 h at room conditions before final measurements. | |
| | | Capacitance change | U2J: ± 10 % Y5U, Y5S: ± 15 % | | |
| | | Dissipation factor | U2J: 0.5 % max. at 1 V, 1 MHz Y5U, Y5S: 5 % max. at 1 V, 1 kHz | | |
| | | Insulation resistance | 3 GΩ min. at 500 V _{DC} , 60 s | | |
| | | Dielectric strength (between lead wires) | No failure at 1.5 kV _{AC} , 60 s | | |
| 11 | Biased humidity | External appearance | No visible damage. The marking shall be legible. | Loading voltage: 440 V _{AC} Ambient temperature: 85 °C ± 3 °C Relative humidity: 85 % RH Duration: 1000 h + 48 h / - 0 h 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. Post-treatment: capacitor shall be stored for 24 h at room conditions before final measurements. | |
| | | Capacitance change | U2J: ± 10 % Y5U, Y5S: ± 15 % | | |
| | | Dissipation factor | U2J: 0.5 % max. at 1 V, 1 MHz Y5U, Y5S: 5 % max. at 1 V, 1 kHz | | |
| | | Insulation resistance | 3 GΩ min. at 500 V _{DC} , 60 s | | |
| | | Dielectric strength (between lead wires) | No failure at 1.5 kV _{AC} , 60 s | | |
| 12 | Termination strength | Pull test | External appearance | Lead wire should not be cut off, capacitor should not be broken. 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. | |
| | | | 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. 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. Totally 3 bends, 3 s each time. 1 bend: bending to 90° the return to normal position is one bend. 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 | | |



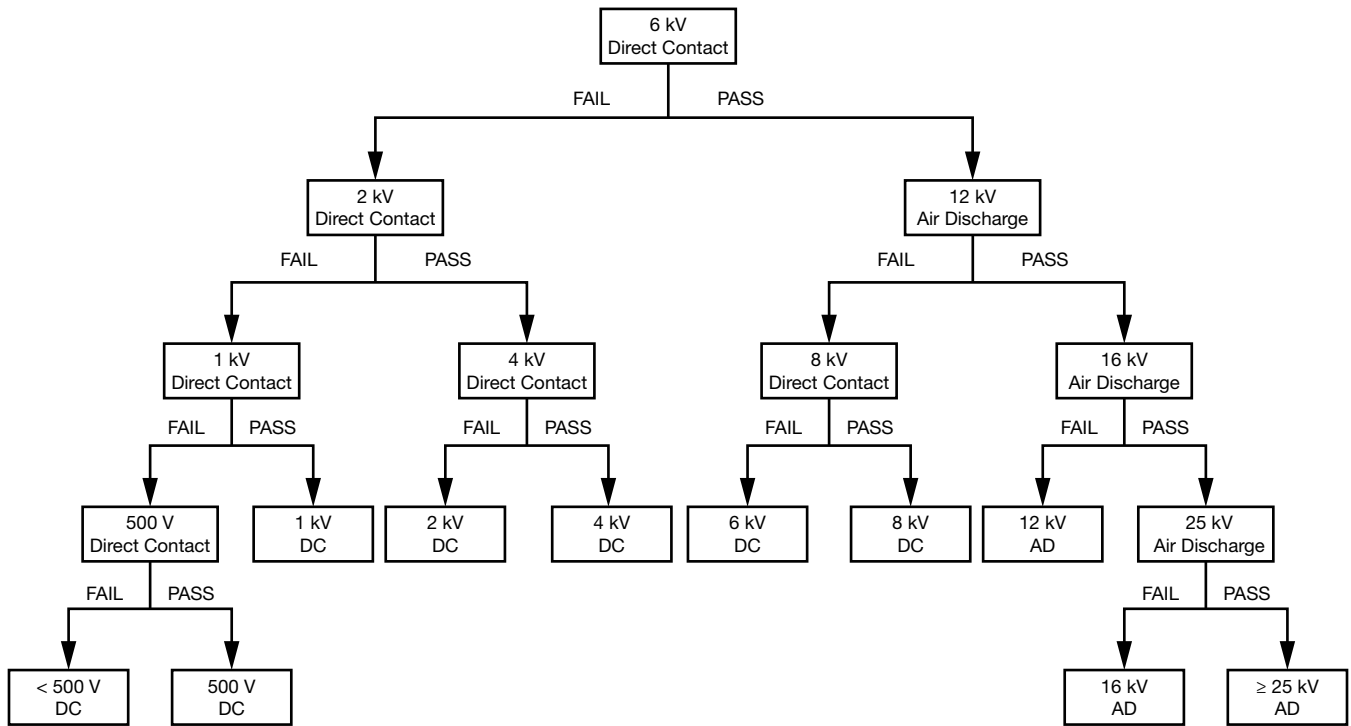
| PERFORMANCE | | | | |
|-------------|---------------------------|--|---|---|
| NO. | ITEMS | | SPECIFICATION | TEST METHOD |
| 13 | Resistance to solder heat | Visual | No visible damage. The marking shall be legible. | <p>The lead wire shall be immersed into the melted solder of $260\text{ }^{\circ}\text{C}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

| PERFORMANCE | | | | |
|-------------|-------------------------------------|-----------------------|---|---|
| NO. | ITEMS | | SPECIFICATION | TEST METHOD |
| 16 | Mechanical shock | External appearance | No visible damage. 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. Shock from: half-sine Duration: 6 ms Acceleration: 100 g</p> |
| | | Capacitance change | Within the specified tolerance. | |
| | | Dissipation factor | U2J: 0.5 % max. at 1 V, 1 MHz Y5U, Y5S: 5 % max. at 1 V, 1 kHz | |
| | | Insulation resistance | 10 GΩ min. at 500 V _{DC} , 60 s. | |
| 17 | Resistance to solvents | External appearance | No visible damage. The marking shall be legible. | <p>Leave parts in solvent for 3 to 8 min at 25 °C ± 5 °C, 1 min air-drying Rub parts against wet bristle 10 times (3 x for marking, 10 x for part damage)</p> <p>Solvent 1: 1 part (by volume) of isopropyl alcohol, 3 parts (by volume) of mineral spirits</p> <p>Solvent 2: Terpene defluxer</p> <p>Solvent 3: 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 Within ± 20 % for Y5U and Y5S | <p>The capacitor should be run 3000 temperature cycles. Step as below: Step 1 -55 °C + 0 °C / - 3 °C, dwell time ≤ 30 min Step 2 Transition time ≤ 1 min Step 3 +125 °C + 3 °C / - 0 °C, dwell time ≤ 30 min Step 4 Transition time ≤ 1 min</p> <p>Pre-treatment: 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: capacitor shall be stored for 24 h ± 2 h at room condition.</p> <p>Note</p> <ul style="list-style-type: none"> • 6800 pF and 10 000 pF only 1000 cycles |
| | | Dissipation factor | U2J: 0.5 % max. at 1 V, 1 MHz Y5U, Y5S: 5 % max. at 1 V, 1 kHz | |
| | | Insulation resistance | 3 GΩ min at 500 V _{DC} , 60 s | |
| | | Dielectric strength | No failure at 1.5 kV _{AC} , 60 s | |
| | | External appearance | No visible damage. The marking shall be legible. | |
| 19 | High temperature exposure (storage) | External appearance | No visible damage. 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: 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: capacitor shall be stored for 24 h ± 2 h at room condition.</p> |
| | | Capacitance change | Within ± 10 % for U2J Within ± 20 % for Y5U and Y5S | |
| | | Dissipation factor | U2J: 0.5 % max. at 1 V, 1 MHz Y5U, Y5S: 5 % max. at 1 V, 1 kHz | |
| | | Insulation resistance | 1 GΩ min. at 500 V _{DC} , 60 s | |



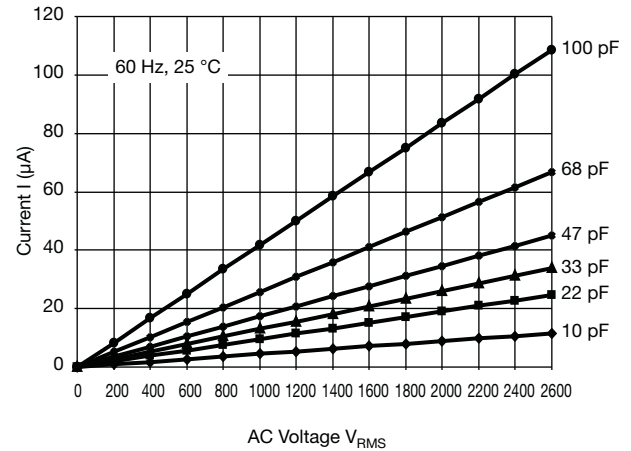
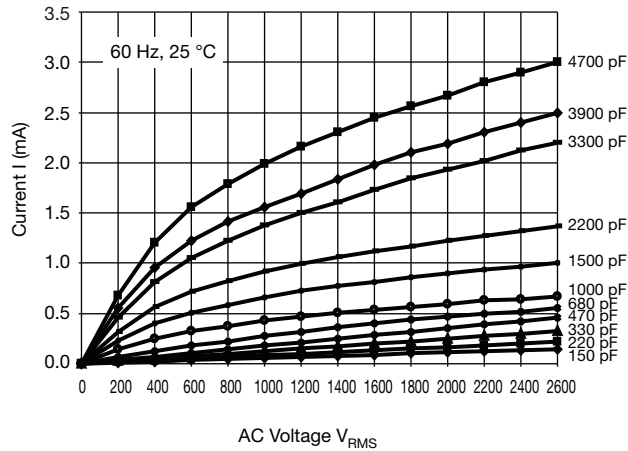
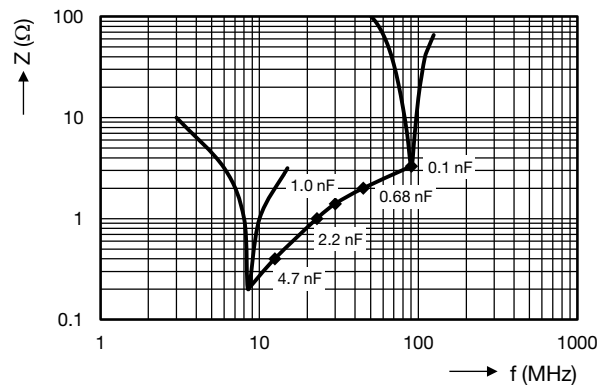
| PERFORMANCE | | | | |
|-------------|-------|-----------------------|---|-----------------------------------|
| NO. | ITEMS | SPECIFICATION | TEST METHOD | |
| 20 | ESD | External appearance | No visible damage. The marking shall be legible. | See chart "ESD Test Method" below |
| | | Capacitance change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

| RELATED DOCUMENTS | |
|----------------------|--|
| General Information | www.vishay.com/doc?28536 |
| CB Test Certificate | www.vishay.com/doc?22254 |
| VDE Marks Approval | www.vishay.com/doc?22256 |
| UL Test Certificate | www.vishay.com/doc?22253 |
| CQC Test Certificate | www.vishay.com/doc?22255 |
| LTspice® Models | www.vishay.com/doc?28568 |

| SAMPLE KIT | |
|-------------|--|
| Part Number | AY21-KIT-HF |
| Link | www.vishay.com/doc?28553 |



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EMI SAFETY CAPACITOR SOLUTIONS

FILM AND CERAMIC

CLASS X

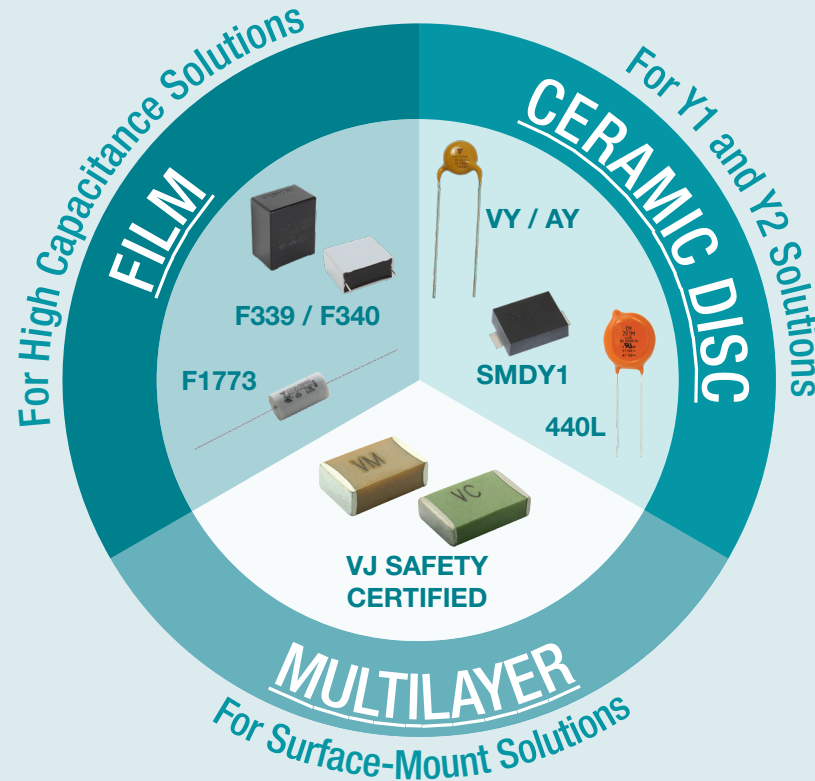
Differential Mode Filtering
Across the Line

| Sub class | Peak Impulse Voltage | Typical Application |
|-----------|----------------------|---------------------|
| X1 | 4.0 kV | High Pulse |
| X2 | 2.5 kV | General Purpose |

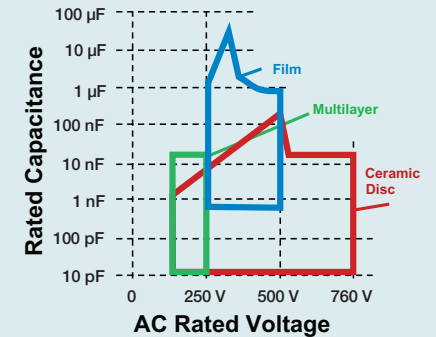
CLASS Y

Common Mode Filtering
Line to Ground

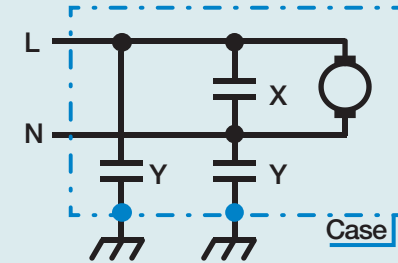
| Sub class | Peak Impulse Voltage | Typical Application |
|-----------|----------------------|---------------------|
| Y1 | 8.0 kV | High Pulse |
| Y2 | 5.0 kV | General Purpose |



Safety Capacitor Map



Typical Circuit



| Technology | Rating | Series | Capacitance | Certificates | Special Features |
|--------------|---------|---|---------------------|-----------------------|---|
| Ceramic Disc | X1 / Y1 | SMDY1 | 470 pF to 4700 pF | IEC, UL, CSA, and CQC | Industry-first 500 V _{AC} SMD type Y1 safety capacitor available |
| | X1 / Y1 | VY1 , VY1C , AY1 , WKP , 440L | 10 pF to 20 nF | IEC, UL, CSA, and CQC | Industry-first 20 nF, 85 °C / 85 % RH 1000 h available. AEC-Q200 available |
| | X1 / Y2 | VY2 , AY2 , WYO | 10 pF to 12 nF | IEC, UL, CSA, and CQC | AEC-Q200 available |
| MLCC | X1 / Y2 | VJ Safety Certified Capacitors | 10 pF to 1000 pF | IEC, cCSA | 1 nF in X1 / Y2 with COG (NP0) Meets IEC 60384-14 min. 4 mm creepage, AEC-Q200 available |
| | X2 | | 10 pF to 470 pF | IEC, cCSA | Meets IEC 60384-14 min. 4 mm creepage, AEC-Q200 available |
| | X1 / Y2 | | 100 pF to 4700 pF | IEC, cCSA | Meets IEC 60384-14 min. 4 mm creepage, AEC-Q200 available |
| | X2 | | 100 pF to 12 nF | IEC, cCSA | Meets IEC 60384-14 min. 4 mm creepage, AEC-Q200 available |
| Film | X1 | F340X1 , F339X1 , and MKP3381 | 0.001 μF to 2.2 μF | IEC, UL, CSA, and CQC | THB Class IIIB available |
| | X2 | F340X2 , F339X2 , and F1773 | 0.001 μF to 40 μF | IEC, UL, CSA, and CQC | THB Class IIB, IIIB, and AEC-Q200 available |
| | Y2 | F340Y2 , MKP3386Y2 | 0.001 μF to 0.47 μF | IEC, UL, and CSA | THB Class IIIB and AEC-Q available |

For a full overview of RFI capacitors, please visit www.vishay.com/doc?48140