# AC Line Rated Ceramic Disc Capacitors Class X1, 440 $V_{AC}$, Class Y2, 300 $V_{AC}$

## FEATURES

- Complying with IEC 60384-14 4th edition
- High reliability
- Vertical (inline) kinked or straight leads
- Singlelayer AC disc safety capacitors
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb e3 RoHS COMPLIANT HALOGEN FREE GREEN (5-2008)

## APPLICATIONS

- X1, Y2 according to IEC 60384-14.4
- Across-the-line
- Line by-pass
- Antenna coupling

## ADDITIONAL RESOURCES

3D Models SPICE Models

| QUICK REFERENCE DATA | | | | |
|---|---|---|---|---|
| DESCRIPTION | VALUE | | | |
| Ceramic Class | 1 | | 2 | |
| Ceramic Dielectric | N750 | | 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

-40 °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 60384-14.4
UL 60384-14
DIN EN 60384-14
CSA E60384-1:03, CSA E60384-14:09
CQC11-471112

## PACKAGING

Bulk, tape and reel, taped ammopack

## 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 vertical (inline) kinked leads having a lead spacing of 5.0 mm, 7.5 mm, 10.0 mm, or 12.5 mm. Encapsulation is made of flame retardant epoxy resin in accordance with UL 94 V-0.

## CAPACITANCE RANGE

10 pF to 0.01 µF

## RATED VOLTAGE $U_R$

IEC 60384-14 and UL 60384-14:
(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
(2600 $V_{AC}$ for LS 7.5 mm and above)
(2200 $V_{AC}$ for LS 5.0 mm)
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. 0.5 % (1 MHz)
Class 2: max. 2.5 % (1 kHz)



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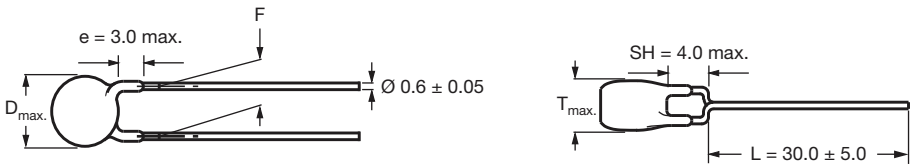
## DIMENSIONS in millimeters




Capacitors with 5.0 mm, 7.5 mm, 10 mm, or 12.5 mm lead spacing.
Coating extension e valid for straight leads only.

## TECHNICAL DATA

| CAPACITANCE C (pF) | CAPACITANCE TOLERANCE (%) | BODY DIAMETER $D_{max.}$ (mm) | BODY THICKNESS $T_{max.}$ (mm) | LEAD SPACING [1] F (mm) ± 1 mm | PART NUMBER MISSING DIGITS SEE ORDERING CODE BELOW |
|---|---|---|---|---|---|
| **U2J (N750)** | | | | | |
| 10 | ± 10 | 7.5 | 5.0 | 5.0, 7.5, 10.0, or 12.5 | VY2100K29U2JS6### |
| 15 | | | | | VY2150K29U2JS6### |
| 22 | | | | | VY2220K29U2JS6### |
| 33 | | | | | VY2330K29U2JS6### |
| 47 | | | | | VY2470K29U2JS6### |
| **Y5S (2C3)** | | | | | |
| 68 | ± 10 | 7.5 | 5.0 | 5.0, 7.5, 10.0, or 12.5 | VY2680K29Y5SS6### |
| 100 | | | | | VY2101K29Y5SS6### |
| 150 | | | | | VY2151K29Y5SS6### |
| 220 | | | | | VY2221K29Y5SS6### |
| 330 | | | | | VY2331K29Y5SS6### |
| 470 | | | | | VY2471K29Y5SS6### |
| **Y5U (2E3)** | | | | | |
| 680 | ± 20 | 7.5 | 5.0 | 5.0, 7.5, 10.0, or 12.5 | VY2681M29Y5US6### |
| 1000 | | | | | VY2102M29Y5US6### |
| 1500 | | 8.0 | | | VY2152M31Y5US6### |
| 2200 | | 9.0 | | | VY2222M35Y5US6### |
| 3300 | | 10.5 | | | VY2332M41Y5US6### |
| 3900 | | 11.0 | | | VY2392M43Y5US6### |
| 4700 | | 12.5 | | 7.5, 10.0, or 12.5 | VY2472M49Y5US6### |
| 6800 | | 14.5 | | | VY2682M59Y5US63## |
| 10 000 | | 16.0 | | | VY2103M63Y5US63## |
| **Y5V (2F3) MINI SIZE SERIES** | | | | | |
| 1000 | ± 20 | 7.5 | 5.0 | 5.0, 7.5, 10.0, or 12.5 | VY2102M29Y5VS6### |
| 1500 | | 7.5 | | | VY2152M29Y5VS6### |
| 2200 | | 8.0 | | | VY2222M31Y5VS6### |
| 3300 | | 9.0 | | | VY2332M35Y5VS6### |
| 3900 | | 10.0 | | | VY2392M39Y5VS6### |
| 4700 | | 10.5 | | | VY2472M41Y5VS6### |
| 6800 | | 12.0 | | | VY2682M47Y5VS6### |
| 10 000 | | 15.0 | | | VY2103M59Y5VS6### |

**Note**

[1] Straight leads are available on request



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| ORDERING CODE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ### | 15th to 17th digit | | Lead configuration | | | Available configurations see below | | | | |
| **Example** | **VY2** | **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 |
| | | | | | | S = X1/Y2 300 V (AC) | | 3 = bulk T = tape and reel U = ammopack | L = straight V = inline kinked | 5 = 5.0 7 = 7.5 0 = 10.0 X = 12.5 |

## LEADSPACING 5.0 mm AND 7.5 mm

| PACKAGING | | | | |
|---|---|---|---|---|
| SIZE CODE | BODY DIAMETER $D_{max.}$ (mm) | PACKAGING QUANTITIES | | |
| | | BULK | REEL | AMMO |
| 29 to 49 | 12.5 | 1000 | 1000 | 1000 |
| 59 to 63 | 16.0 | 500 | - | - |

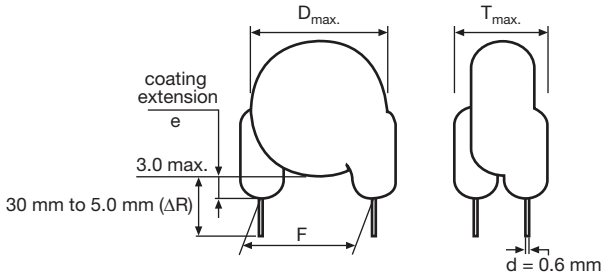
## LEADSPACING 10.0 mm AND 12.5 mm

| PACKAGING | | | | | |
|---|---|---|---|---|---|
| CAPACITANCE VALUE | SIZE CODE | BODY DIAMETER $D_{max.}$ (mm) | PACKAGING QUANTITIES | | |
| | | | BULK | REEL | AMMO |
| 10 pF to 4700 pF | 29 to 49 | 12.5 | 1000 | 500 | 750 |
| 6800 pF to 0.01 µF | 59 to 63 | 16.0 | 500 | 500 | 750 |

**Note**

- The capacitors are supplied in bulk packaging (cardboard boxes), in tape on reel in ammopack

## STRAIGHT LEADS





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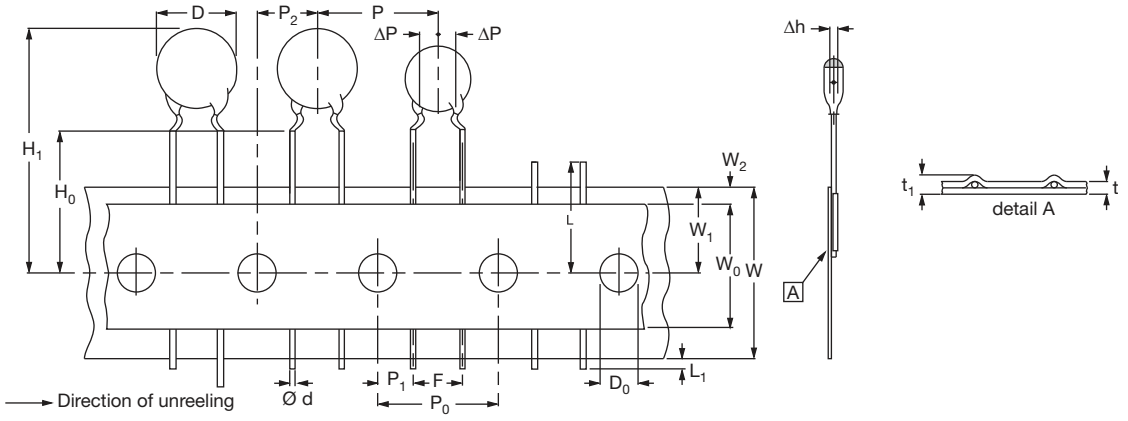


Fig. 1 - Kinked capacitors on tape, lead spacing 5.0 mm (0.2") and 7.5 mm (0.3")

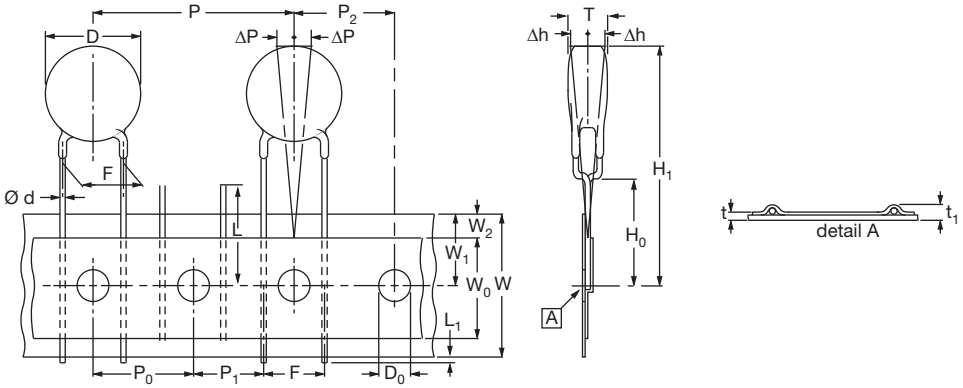


Fig. 2 - Inline kink (V) leaded capacitors on tape, lead spacing 10 mm (0.40")

| 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°


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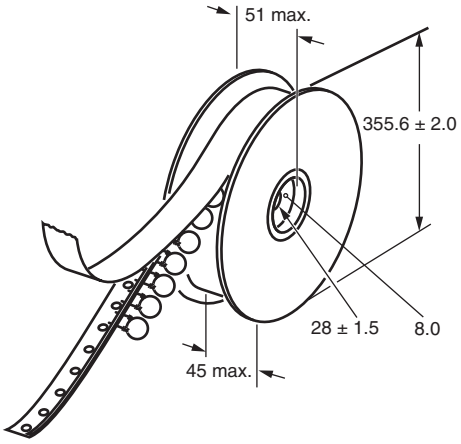
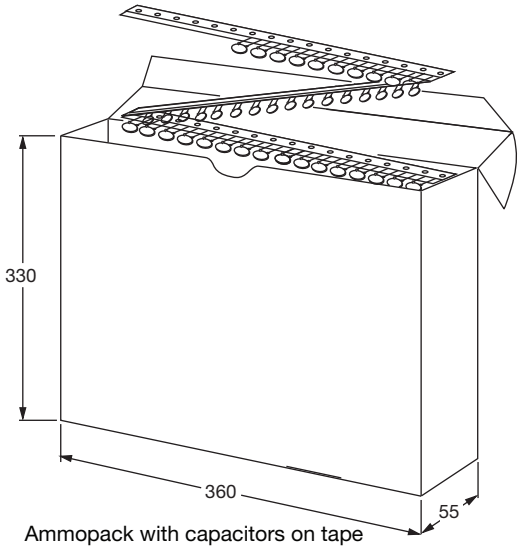
**REEL AND TAPE DATA** in millimeters




Ammopack with capacitors on tape

## APPROVALS

IEC 60384-14.4 - 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 60384-14.1, CSA E60384-1:03 2nd edition, CSA E60384-14:09 2nd 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 $V_{AC}$ |



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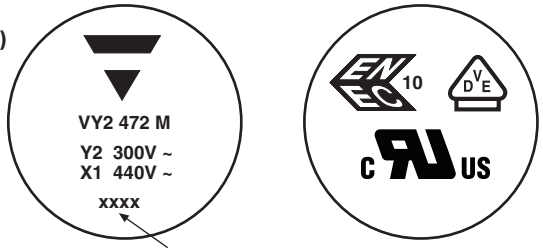
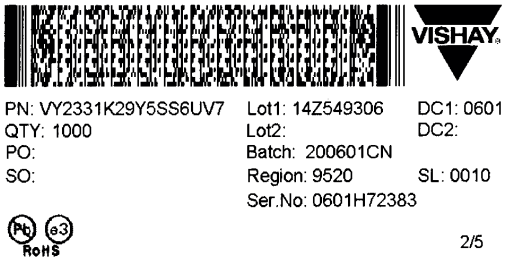
## MARKING

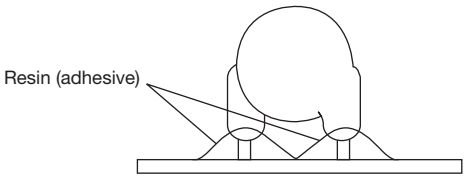
Sample (2 sides)




Front Back




## PERFORMANCE

| TEST | TEST CONDITION | TEST LIMITS |
|---|---|---|
| Visual and mechanical inspection | Optical inspection, dimensions measured with caliper | No visible damage, marking legible |
| Capacitance (C) | 25 °C ± 3 °C, relative humidity (RH) ≤ 75 %, 1.0 $V_{RMS}$ ± 0.2 $V_{RMS}$ at 1 kHz for Y5U and Y5S, and 1 MHz for U2J | Capacitance within specified tolerance |
| Dissipation factor (DF) | | DF ≤ 0.3 % for U2J and DF ≤ 2.5 % for Y5S and Y5U |
| Insulation resistance (IR) | Measured within 60 s ± 5 s after charging at 500 $V_{DC}$ | 10 000 MΩ min. |
| Dielectric strength | 2600 $V_{AC}$ at 50 Hz / 60 Hz for 1 min, 50 mA max. | No failure |
| Temperature characteristic | RH ≤ 75 %, 1.0 $V_{RMS}$ ± 0.2 $V_{RMS}$ at 1 kHz for Y5U and Y5S, and 1 MHz for U2J | U2J: -750 ppm ± 120 ppm<br>Y5S: ± 22 %<br>Y5U: +22 % / -56 % |
| Impulse voltage | 3 pulses of 5 kV | No failure |
| Life test | 1000 h at 125 °C ± 2 °C, 550 $V_{AC}$/50 Hz; once every hour 1000 $V_{AC}$ for 0.1 s | External appearance: no visible damage<br>ΔC/C ≤ ± 15 %<br>DF ≤ 0.5 % for U2J and ≤ 5 % for Y5S and Y5U<br>IR ≥ 3000 MΩ<br>Dielectric strength: no failure |
| Humidity test | 500 h at 440 $V_{AC}$, 50 Hz and 500 h unloaded<br>40 °C, RH = 90 % to 95 % | External appearance: no visible damage<br>ΔC/C ≤ ± 10 % for U2J and ≤ ± 15 % for Y5S and Y5U<br>DF ≤ 0.5 % for U2J and ≤ 5 % for Y5S and Y5U<br>IR ≥ 3000 MΩ<br>Dielectric strength: no failure |
| Robustness of termination | Pull test: 0.5 kg tensile weight in radial direction for 10 s ± 1 s<br>Bending strength: capacitor body rotated by 90° in both directions | No damage to capacitor body and lead wire |
| Soldering effect | Immersion of lead wires into 260 °C ± 5 °C solder for 10 s ± 2 s; min. distance from body: 1.5 mm<br>Hand soldering at 400 °C ± 10 °C for 3 s to 4 s; min. distance from body: 1.5 mm | External appearance: no visible damage<br>ΔC/C ≤ ± 5 % for U2J and ≤ ± 10 % for Y5S and Y5U<br>Dielectric strength: no failure |
| Vibration test |  <br>Solder the capacitor onto test jig (glass epoxy body) and use resin (adhesive) to stick the body to the test jig.<br>The capacitor must be soldered firmly to the supporting lead wire.<br>Vibration change from 10 Hz to 2000 Hz and back to 10 Hz;<br>Total amplitude: 1.5 mm; Acceleration: 100 $m/s^2$;<br>Sweep rate: 1 oct/min, each axis 2 h (6 h in total) | External appearance: no visible damage<br>Capacitance within specified tolerance<br>DF ≤ 0.3 % for U2J and ≤ 2.5 % for Y5S and Y5U<br>IR ≥ 10 000 GΩ |



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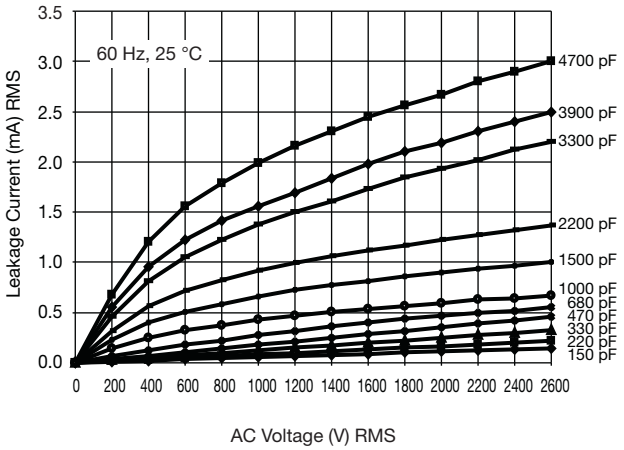
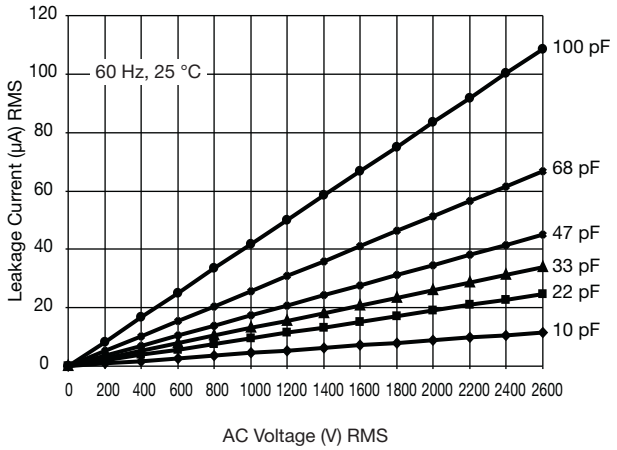
## LEAKAGE CURRENT VS. VOLTAGE (Typical)




**Note**

- The capacitors meet the essential requirements of EIA 198. Unless stated otherwise all electrical values apply at an ambient temperature of 25 °C ± 3 °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 KITS | |
|---|---|
| Part Number (VY2 Sample Kit) | VY21-KIT-HF |
| Link (VY2 Sample Kit) | www.vishay.com/doc?28554 |
| Part Number (VY2...Y5V Sample Kit) | VY2-KIT-MS |
| Link (VY2...Y5V Sample Kit) | www.vishay.com/doc?28562 |



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