# EMI Suppression Safety Capacitor, Ceramic Disc, Class X1, 760 $V_{AC}$, Class Y1, 500 $V_{AC}$

## FEATURES

- Complying with IEC 60384-14
- Can pass 10 kV pulses (10 per polarity)
- Withstands 1000 h at 85 °C / 85 % RH with rated voltage applied, approved by VDE Annex I grade IIIB
- Reduced size (compact design)
- 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)

## LINKS TO ADDITIONAL RESOURCES

3D Models SPICE Models

| QUICK REFERENCE DATA | | |
|---|---|---|
| DESCRIPTION | VALUE | |
| Ceramic Class | 2 | |
| Ceramic Dielectric | Y5U | Y5U |
| Voltage ($V_{AC}$) | 500 | 760 |
| Min. Capacitance (pF) | 470 | |
| Max. Capacitance (pF) | 4700 | |
| Mounting | Radial | |

## OPERATING TEMPERATURE RANGE

-40 °C to +125 °C

## TEMPERATURE CHARACTERISTICS

Y5U

## SECTIONAL SPECIFICATIONS

Climatic category (according to EN 60058-1)
40/125/21

## COATING

According to UL 94 V-0
Epoxy resin, isolating, flame retardant
Halogen-free
Reinforced insulation

## APPROVALS

IEC 60384-14
UL 60384-14
DIN EN 60384-14
CSA E60384-1:03, CSA E60384-14:09
CQC11-471112-2009

## PACKAGING

Bulk, tape and reel, taped ammopack

## APPLICATIONS

- X1, Y1 according to IEC 60384-14
- Line-to-line filtering (Class X)
- Line-to-ground filtering (Class Y)
- Primary and secondary coupling (SMPS)
- EMI / RFI suppression and filtering

## DESIGN

The capacitor consists of a ceramic disc which is copper plated on both sides. Connection leads are made of tinned 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 10.0 mm, or 12.5 mm. Encapsulation is made of flame retardant epoxy resin in accordance with UL 94 V-0.

## CAPACITANCE RANGE

470 pF to 4700 pF

## RATED VOLTAGE $U_R$

IEC 60384-14:
(X1): 760 $V_{AC}$, 50 Hz
(Y1): 500 $V_{AC}$, 50 Hz
1500 $V_{DC}$

## TEST VOLTAGE

Component test (100 %):
4000 $V_{AC}$, 50 Hz, 2 s
Random sampling test (destructive test):
4000 $V_{AC}$, 50 Hz, 60 s
Voltage proof of coating (destructive test):
4000 $V_{AC}$, 50 Hz, 60 s

## INSULATION RESISTANCE

≥ 10 000 MΩ

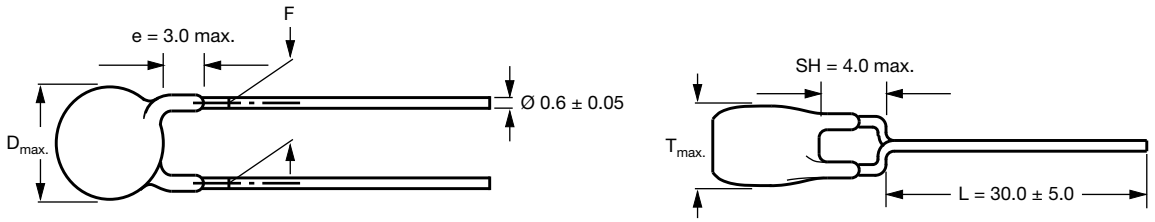
## CAPACITANCE TOLERANCE

± 20 %

## DISSIPATION FACTOR

Max. 2.5 % (1 kHz)

## DIMENSIONS in millimeters




Capacitors with 10.0 mm or 12.5 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 |
|---|---|---|---|---|---|
| 470 | ± 20 | 7.5 | 5.0 | 10.0 or 12.5 | VY1471M29Y5UC6### |
| 680 | | | | | VY1681M29Y5UC6### |
| 1000 | | 8.0 | | | VY1102M31Y5UC6### |
| 1500 | | 9.0 | | | VY1152M35Y5UC6### |
| 2200 | | 11.0 | | | VY1222M43Y5UC6### |
| 2700 | | 12.0 | | | VY1272M47Y5UC6### |
| 3300 | | 13.0 | | | VY1332M51Y5UC6### |
| 3900 | | 15.0 | | | VY1392M59Y5UC6### |
| 4700 | | 15.5 | | | VY1472M61Y5UC6### |

**Notes**

- Straight leads available on request
- Coating extension DR valid for straight leads only

## ORDERING CODE

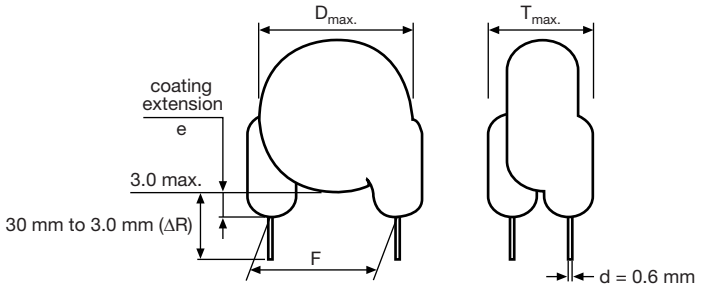
| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| # | 7th digit | | Capacitance tolerance | | ± 20 % = M | | | | | |
| ### | 15th to 17th digit | | Lead configuration | | Available configurations see below | | | | | |
| **Example** | **VY1** | **471** | **M** | **29** | **Y5U** | **C** | **6** | **T** | **V** | **0** |
| | Series | Capacitance value | Tolerance code | Size code | Temperature coefficient | Rated voltage<br>Compact size | Lead wire diameter | Packaging / lead length<br>3 = bulk<br>T = tape and reel<br>U = ammopack | Lead style<br>L = straight<br>V = inline kinked | Lead spacing<br>0 = 10.0<br>X = 12.5 |

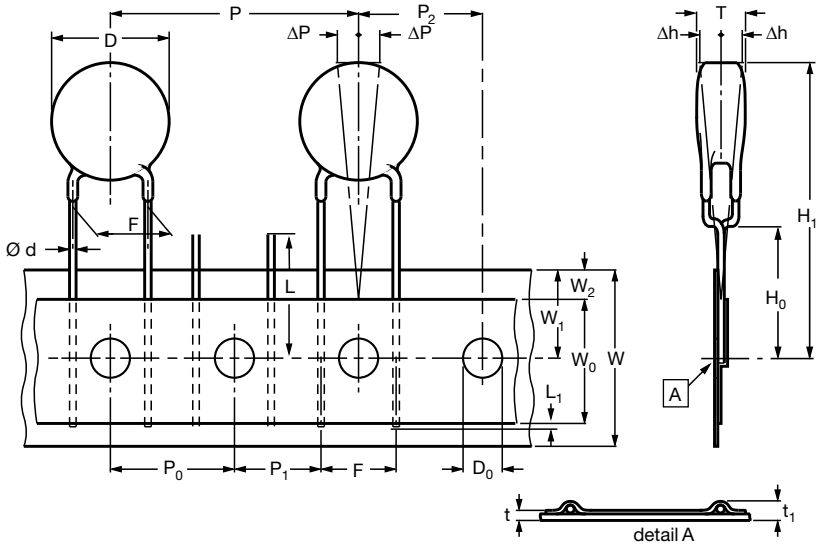
| PACKAGING | | | | | |
|---|---|---|---|---|---|
| CAPACITANCE VALUE | SIZE CODE | BODY DIAMETER $D_{max.}$ (mm) | PACKAGING QUANTITIES | | |
| | | | BULK | REEL | AMMO |
| 470 pF to 2700 pF | 29 to 47 | 12.0 | 1000 | 500 | 750 |
| 3300 pF to 4700 pF | 51 to 61 | 15.5 | 500 | 500 | 750 |

**Note**

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

## STRAIGHT LEADS




The sprocket hole pitch ($P_0$) is 12.7 mm for lead spacing 10.0 mm and 12.5 mm

| DIMENSIONS OF TAPE | | |
|---|---|---|
| **SYMBOL** | **PARAMETER** | **DIMENSIONS (mm)** |
| D (1) | Body diameter | 16.0 max. |
| d | Lead diameter | 0.6 ± 0.05 |
| P | Pitch of component | 25.4 ± 1 |
| $P_0$ (2) | Pitch of sprocket hole | 12.7 ± 0.3 |
| $P_1$ (3) | Distance, hole center to lead | 7.7 or 6.4 ± 1.0 |
| $P_2$ (3) | Distance, hole to center of component | 12.7 ± 1.5 |
| F | Lead spacing | 10.0 or 12.5 + 0.6/- 0.4 |
| Δh | Average deviation across tape | ± 1.0 max. |
| ΔP | Average deviation in direction of reeling | ± 1.0 max. |
| W | Carrier tape width | 18.0 + 1/- 0.5 |
| $W_0$ | Hold-down tape width | 5.0 min. |
| $W_1$ | Position of sprocket hole | 9.0 + 0.75/- 0.5 |
| $W_2$ | Distance of hold-down tape | 3.0 max. |
| $H_1$ | Maximum component height | 40.0 |
| $H_0$ | Height to seating plane (for kinked leads) | 16.0 ± 0.5 |
| $H_0$ | Height to seating plane (for straight leads) | 20.0 ± 0.5 |
| L | Length of cut leads | 11.0 max. |
| $L_1$ | Length of lead protrusion | 1.0 max. |
| $D_0$ | Diameter of sprocket hole | 4.0 ± 0.2 |
| t | Total tape thickness | 0.9 max. |
| $t_1$ | Total tape thickness with lead wire | t + d |

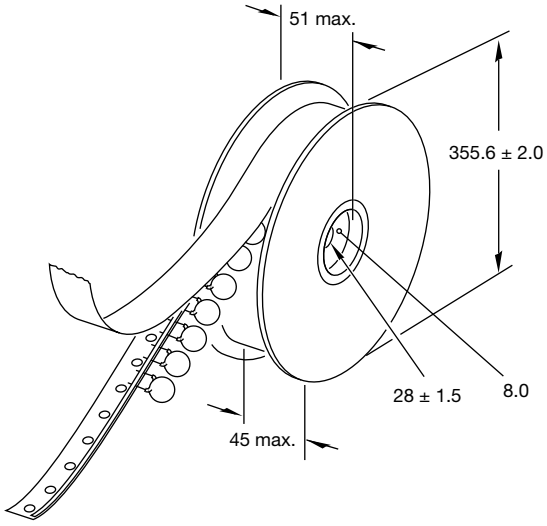
**Notes**

(1) See “Technical Data” table

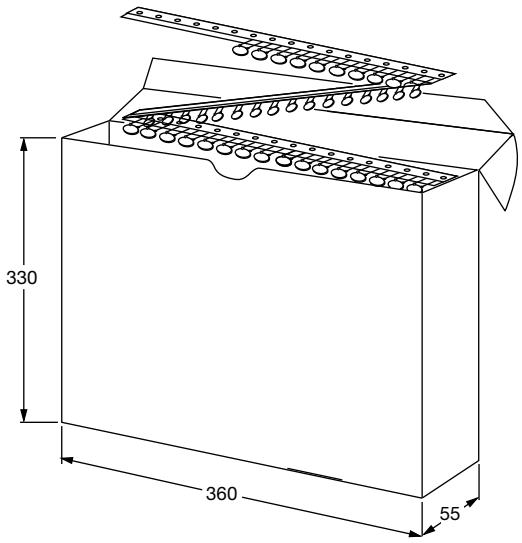
(2) Cumulative pitch error: ± 1 mm/20 pitches

(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
This approval together with CB test certificate substitutes all national approvals.

**CB Certificate**

| | | | | |
|---|---|---|---|---|
| Y1-capacitor: CB test certificate: | US-26561-UL | 470 pF to 4.7 nF | 500 $V_{AC}$ | |
| X1-capacitor: CB test certificate: | US-26561-UL | 470 pF to 4.7 nF | 760 $V_{AC}$ | |

**VDE**

| | | | | |
|---|---|---|---|---|
| Y1-capacitor: VDE marks approval: | 40012673 | 470 pF to 4.7 nF | 500 $V_{AC}$ | |
| X1-capacitor: VDE marks approval: | 40012673 | 470 pF to 4.7 nF | 760 $V_{AC}$ | |

DIN EN 60384-14 VDE 0565-1-1:2006-04 - Safety tests

**Underwriters Laboratories Inc./Canadian Standards Association**

| | | | | |
|---|---|---|---|---|
| Y1-capacitor: CSA test certificate: | E183844 | 470 pF to 4.7 nF | 500 $V_{AC}$ | |
| X1-capacitor: CSA test certificate: | E183844 | 470 pF to 4.7 nF | 760 $V_{AC}$ | |

UL 60384-14, CSA E60384-1:03, CSA E60384-14:09

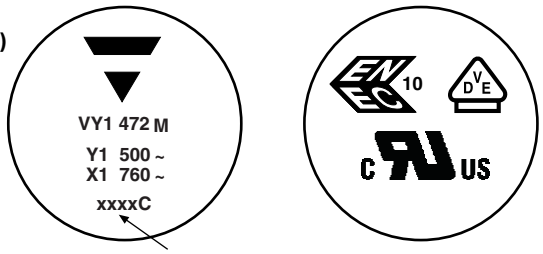
Fixed capacitors for electromagnetic interference suppression and connection to the supply mains.

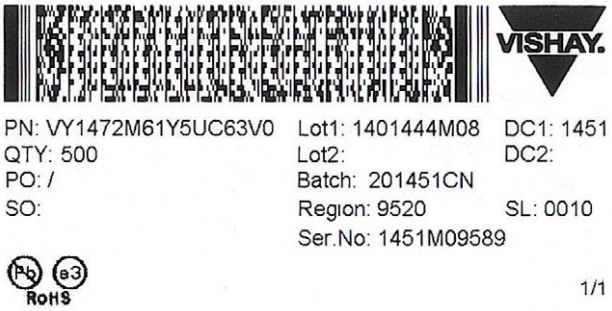
**CQC**

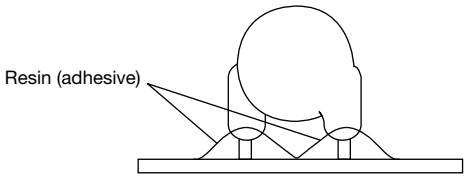
| | | | | |
|---|---|---|---|---|
| Y1-capacitor: CQC test certificate: | CQC05001015032 | 470 pF to 4.7 nF | 500 $V_{AC}$ | |
| X1-capacitor: CQC test certificate: | CQC05001015032 | 470 pF to 4.7 nF | 760 $V_{AC}$ | |

## MARKING

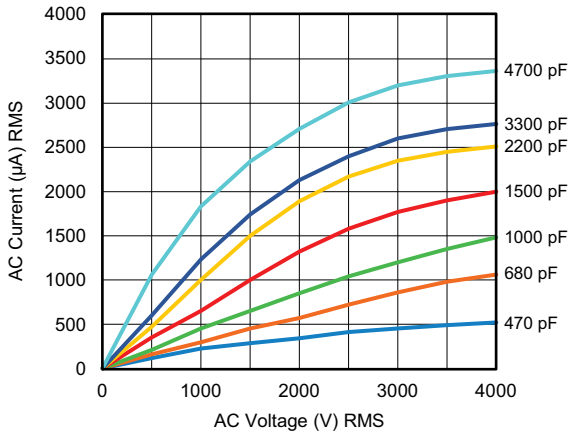
**Sample (2 sides)**



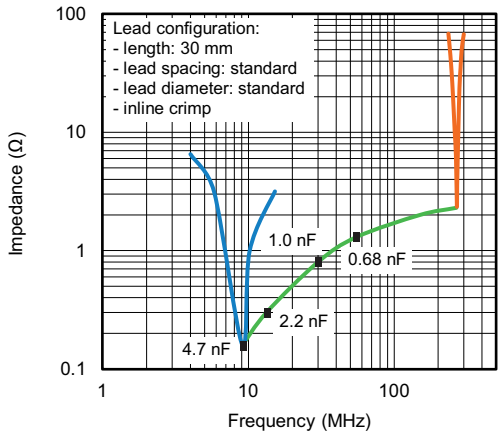



| PERFORMANCE | | |
|---|---|---|
| **TEST** | **TEST CONDITION** | **TEST LIMITS** |
| Visual and mechanical inspection | Optical inspection, dimensions measured with caliper | No visible damage, marking legible |
| Capacitance (C) | 25 °C ± 3 °C , relative humidity (RH) ≤ 75 %, 1.0 $V_{RMS}$ ± 0.2 $V_{RMS}$ at 1 kHz | Capacitance within specified tolerance |
| Dissipation factor (DF) | | DF ≤ 2.5 % |
| Insulation resistance (IR) | Measured within 60 s ± 5 s after charging at 500 $V_{DC}$ | 10 000 MΩ min. |
| Dielectric strength | 4000 $V_{AC}$ 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 | +22 % / -56 % |
| Impulse voltage | Pulse voltage: 10 kV<br>Pulses per polarity: 10<br>Polarity: ± (both)<br>Time between pulses of same polarity: 20 s<br>Time between pulses of different polarity: 30 s | No failure |
| Life test | 1000 h at 125 °C ± 2 °C, 850 $V_{AC}$ / 50 Hz;<br>once every hour 1000 $V_{AC}$ for 0.1 s | External appearance: no visible damage<br>ΔC/C ≤ ± 15 %<br>DF ≤ 5 %<br>IR ≥ 3000 MΩ<br>Dielectric strength: no failure |
| Damp heat test (85 / 85 / 1000 h) | 1000 h + 48 h / - 0 h at 85 % relative humidity, 85 °C ± 3 °C,<br>loading voltage: 760 $V_{AC}$ | No failure |
| Humidity test | 500 h at 500 $V_{AC}$, 50 Hz and 500 h unloaded<br>40 °C, RH = 90 % to 95% | External appearance: no visible damage<br>ΔC/C ≤ ± 15 %<br>DF ≤ 5 %<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;<br>min. distance from body: 1.5 mm<br>Hand soldering at 400 °C ± 10 °C for 3 s to 4 s;<br>min. distance from body: 1.5 mm | External appearance: no visible damage<br>ΔC/C ≤ ± 10 %<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 ≤ 2.5 %<br>IR ≥ 10 000 GΩ |

## AC CURRENT VS. VOLTAGE (Typical)




## IMPEDANCE VS. FREQUENCY (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?22249 |
| VDE Marks Approval | www.vishay.com/doc?22251 |
| UL Test Certificate | www.vishay.com/doc?22250 |
| CQC Test Certificate | www.vishay.com/doc?22248 |
| LTspice® Models | www.vishay.com/doc?28568 |

| SAMPLE KIT | |
|---|---|
| Part Number | VY11-KIT-CS |
| Link | www.vishay.com/doc?28556 |

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