

# EMI Suppression Safety Capacitor, Ceramic Disc, Class X1, 760 V<sub>AC</sub>, Class Y1, 500 V<sub>AC</sub>



## 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](http://www.vishay.com/doc?99912)



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

## LINKS TO ADDITIONAL RESOURCES



| QUICK REFERENCE DATA       |         |
|----------------------------|---------|
| DESCRIPTION                | VALUE   |
| Ceramic Class              | 2       |
| Ceramic Dielectric         | Y5U Y5U |
| Voltage (V <sub>AC</sub> ) | 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 ammpack

## 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<sub>R</sub>

IEC 60384-14:  
(X1): 760 V<sub>AC</sub>, 50 Hz  
(Y1): 500 V<sub>AC</sub>, 50 Hz  
1500 V<sub>DC</sub>

## TEST VOLTAGE

Component test (100 %):  
4000 V<sub>AC</sub>, 50 Hz, 2 s  
Random sampling test (destructive test):  
4000 V<sub>AC</sub>, 50 Hz, 60 s  
Voltage proof of coating (destructive test):  
4000 V<sub>AC</sub>, 50 Hz, 60 s

## INSULATION RESISTANCE

≥ 10 000 MΩ

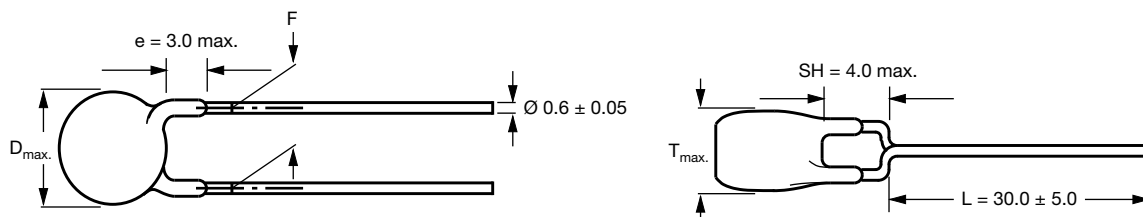
## CAPACITANCE TOLERANCE

± 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<br>C (pF) | CAPACITANCE<br>TOLERANCE<br>(%) | BODY<br>DIAMETER<br>D <sub>max.</sub> (mm) | BODY<br>THICKNESS<br>T <sub>max.</sub> (mm) | LEAD SPACING<br>F (mm) ± 1 mm | PART NUMBER                               |
|-----------------------|---------------------------------|--------------------------------------------|---------------------------------------------|-------------------------------|-------------------------------------------|
|                       |                                 |                                            |                                             |                               | MISSING DIGITS SEE<br>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

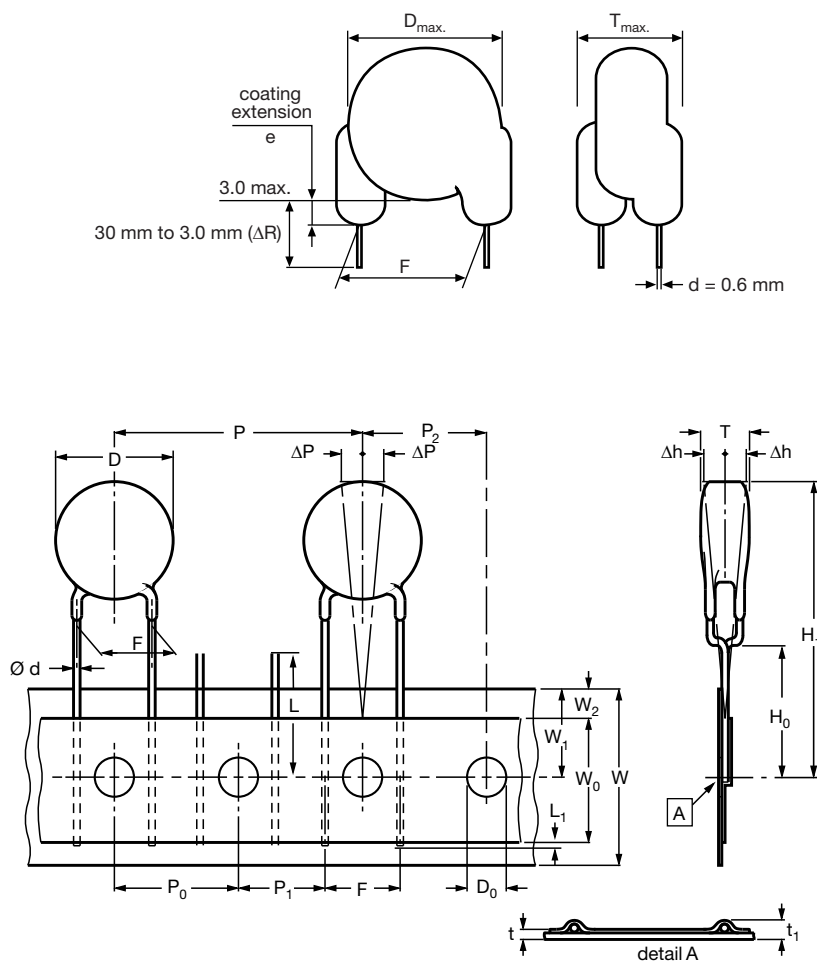
| #       | 7 <sup>th</sup> digit                      |                   | Capacitance tolerance |           | ± 20 % = M                         |               |                    |                                              |                                      |                      |
|---------|--------------------------------------------|-------------------|-----------------------|-----------|------------------------------------|---------------|--------------------|----------------------------------------------|--------------------------------------|----------------------|
| ###     | 15 <sup>th</sup> to 17 <sup>th</sup> 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 | Lead wire diameter | Packaging / lead length                      | Lead style                           | Lead spacing         |
|         |                                            |                   |                       |           |                                    | Compact size  |                    | 3 = bulk<br>T = tape and reel<br>U = ammpack | L = straight<br>V = inline<br>kinked | 0 = 10.0<br>X = 12.5 |

| PACKAGING          |           |                                     |                      |      |      |
|--------------------|-----------|-------------------------------------|----------------------|------|------|
| CAPACITANCE VALUE  | SIZE CODE | BODY DIAMETER<br>$D_{max.}$<br>(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



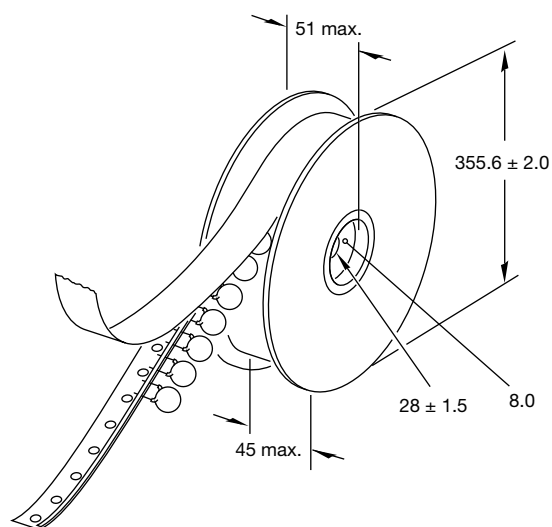
The sprocket hole pitch ( $P_0$ ) is 12.7 mm for lead spacing 10.0 mm and 12.5 mm

| DIMENSIONS OF TAPE            |                                              |                          |
|-------------------------------|----------------------------------------------|--------------------------|
| SYMBOL                        | PARAMETER                                    | DIMENSIONS (mm)          |
| D <sup>(1)</sup>              | Body diameter                                | 16.0 max.                |
| d                             | Lead diameter                                | 0.6 ± 0.05               |
| P                             | Pitch of component                           | 25.4 ± 1                 |
| P <sub>0</sub> <sup>(2)</sup> | Pitch of sprocket hole                       | 12.7 ± 0.3               |
| P <sub>1</sub> <sup>(3)</sup> | Distance, hole center to lead                | 7.7 or 6.4 ± 1.0         |
| P <sub>2</sub> <sup>(3)</sup> | 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 <sub>0</sub>                | Hold-down tape width                         | 5.0 min.                 |
| W <sub>1</sub>                | Position of sprocket hole                    | 9.0 + 0.75/- 0.5         |
| W <sub>2</sub>                | Distance of hold-down tape                   | 3.0 max.                 |
| H <sub>1</sub>                | Maximum component height                     | 40.0                     |
| H <sub>0</sub>                | Height to seating plane (for kinked leads)   | 16.0 ± 0.5               |
| H <sub>0</sub>                | Height to seating plane (for straight leads) | 20.0 ± 0.5               |
| L                             | Length of cut leads                          | 11.0 max.                |
| L <sub>1</sub>                | Length of lead protrusion                    | 1.0 max.                 |
| D <sub>0</sub>                | Diameter of sprocket hole                    | 4.0 ± 0.2                |
| t                             | Total tape thickness                         | 0.9 max.                 |
| t <sub>1</sub>                | Total tape thickness with lead wire          | t + d                    |

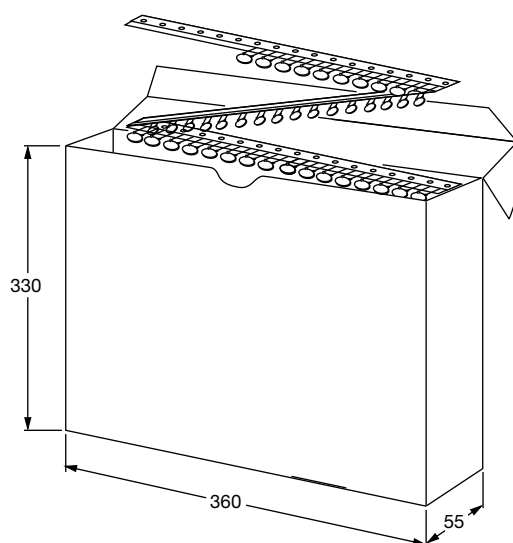
## Notes

- (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<sub>AC</sub>

X1-capacitor: CB test certificate: US-26561-UL 470 pF to 4.7 nF 760 V<sub>AC</sub>

**VDE**

Y1-capacitor: VDE marks approval: 40012673 470 pF to 4.7 nF 500 V<sub>AC</sub>

X1-capacitor: VDE marks approval: 40012673 470 pF to 4.7 nF 760 V<sub>AC</sub>


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<sub>AC</sub>

X1-capacitor: CSA test certificate: E183844 470 pF to 4.7 nF 760 V<sub>AC</sub>


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

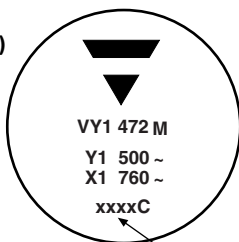
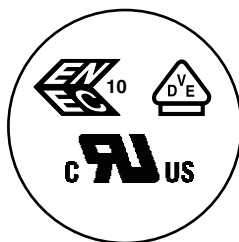
Fixed capacitors for electromagnetic interference suppression and connection to the supply mains.

**CQC**

Y1-capacitor: CQC test certificate: CQC05001015032 470 pF to 4.7 nF 500 V<sub>AC</sub>

X1-capacitor: CQC test certificate: CQC05001015032 470 pF to 4.7 nF 760 V<sub>AC</sub>

**MARKING**

Sample  
(2 sides)

4 digit date code  
(year / week)


PN: VY1472M61Y5UC63V0

QTY: 500

PO: /

SO:

Lot1: 1401444M08

Lot2:

Batch: 201451CN

Region: 9520

Ser.No: 1451M09589

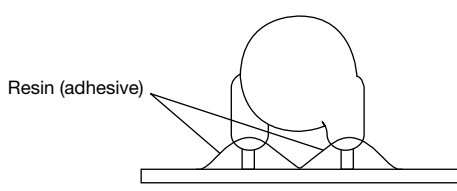
DC1: 1451

DC2:

SL: 0010

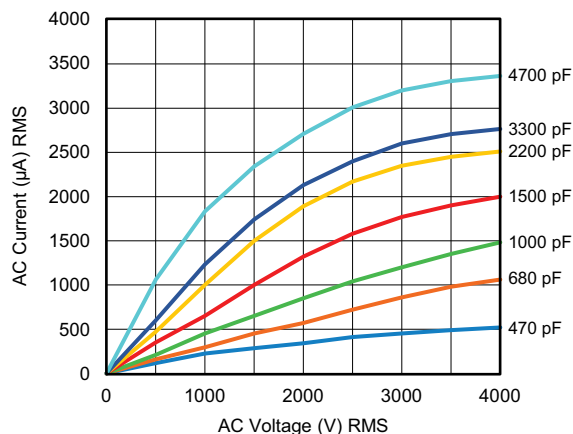


1/1

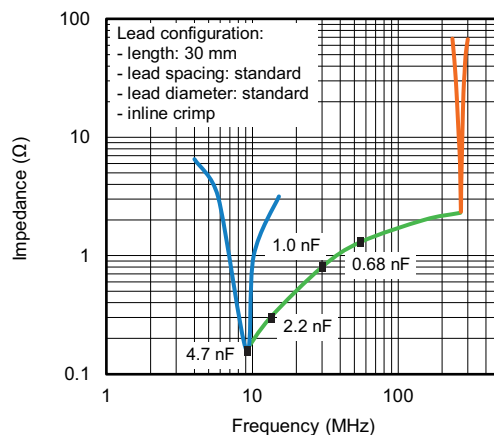
| PERFORMANCE                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                        |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| 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 % ,<br>1.0 V <sub>RMS</sub> ± 0.2 V <sub>RMS</sub> 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 <sub>DC</sub>                                                                                                                                                                                                                                                                                                                                                                                                          | 10 000 MΩ min.                                                                                                         |
| Dielectric strength                  | 4000 V <sub>AC</sub> at 50 Hz/60 Hz for 1 min, 50 mA max.                                                                                                                                                                                                                                                                                                                                                                                                                 | No failure                                                                                                             |
| Temperature characteristic           | RH ≤ 75 % , 1.0 V <sub>RMS</sub> ± 0.2 V <sub>RMS</sub> 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 <sub>AC</sub> / 50 Hz;<br>once every hour 1000 V <sub>AC</sub> 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<br>(85 / 85 / 1000 h) | 1000 h + 48 h / - 0 h at 85 % relative humidity, 85 °C ± 3 °C,<br>loading voltage: 760 V <sub>AC</sub>                                                                                                                                                                                                                                                                                                                                                                    | No failure                                                                                                             |
| Humidity test                        | 500 h at 500 V <sub>AC</sub> , 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                       |  <p>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<sup>2</sup>;<br/>Sweep rate: 1 oct/min, each axis 2 h (6 h in total)</p> | 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  $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$ , at normal atmospheric conditions

## RELATED DOCUMENTS

|                      |                                                                        |
|----------------------|------------------------------------------------------------------------|
| General Information  | <a href="http://www.vishay.com/doc?28536">www.vishay.com/doc?28536</a> |
| CB Test Certificate  | <a href="http://www.vishay.com/doc?22249">www.vishay.com/doc?22249</a> |
| VDE Marks Approval   | <a href="http://www.vishay.com/doc?22251">www.vishay.com/doc?22251</a> |
| UL Test Certificate  | <a href="http://www.vishay.com/doc?22250">www.vishay.com/doc?22250</a> |
| CQC Test Certificate | <a href="http://www.vishay.com/doc?22248">www.vishay.com/doc?22248</a> |
| LTspice® Models      | <a href="http://www.vishay.com/doc?28568">www.vishay.com/doc?28568</a> |

## SAMPLE KIT

|             |                                                                        |
|-------------|------------------------------------------------------------------------|
| Part Number | VY11-KIT-CS                                                            |
| Link        | <a href="http://www.vishay.com/doc?28556">www.vishay.com/doc?28556</a> |



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