

## AC Line Rated Ceramic Disc Capacitors

### Class X1, 760 V<sub>AC</sub>, Class Y1, 500 V<sub>AC</sub>



#### 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> ) | 500    | 760 | 500           | 760           |
| Min. Capacitance (pF)      | 10     |     | 33            |               |
| Max. Capacitance (pF)      | 22     |     | 4700          |               |
| 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

Halogen-free available

Reinforced insulation

#### APPROVALS

IEC 60384-14.4

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

#### FEATURES

- Complying with IEC 60384-14 4<sup>th</sup> 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](http://www.vishay.com/doc?99912)

#### APPLICATIONS

- X1, Y1 according to IEC 60384-14.4
- Across-the-line
- Line by-pass
- Antenna coupling

#### DESIGN

The capacitor consists of a ceramic disc which is silver 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

10 pF to 4700 pF

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

IEC 60384-14.4:

(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

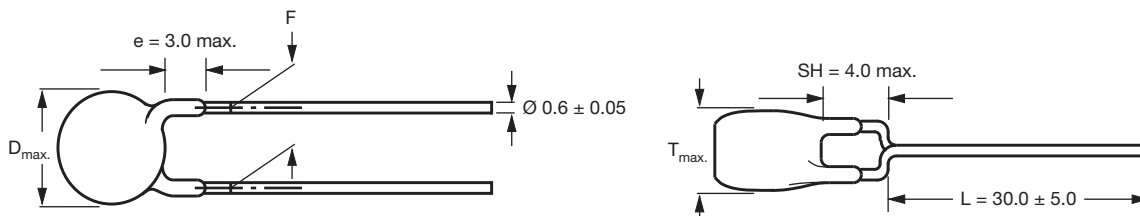
± 20 % (code M); ± 10 % (code K)

#### DISSIPATION FACTOR

Class 1: max. 0.5 % (1 MHz)

Class 2: 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 |
| U2J (N750)                 |                                 |                                            |                                             |                               |                                           |
| 10                         | ± 10                            | 8.0                                        | 5.0                                         | 10.0 or 12.5                  | VY1100K31U2JQ6###                         |
| 15                         |                                 |                                            |                                             |                               | VY1150K31U2JQ6###                         |
| 22                         |                                 |                                            |                                             |                               | VY1220K31U2JQ6###                         |
| Y5S (2C3)                  |                                 |                                            |                                             |                               |                                           |
| 33                         | ± 10                            | 8.0                                        | 5.0                                         | 10.0 or 12.5                  | VY1330K31Y5SQ6###                         |
| 47                         |                                 |                                            |                                             |                               | VY1470K31Y5SQ6###                         |
| 68                         |                                 |                                            |                                             |                               | VY1680K31Y5SQ6###                         |
| 100                        |                                 |                                            |                                             |                               | VY1101K31Y5SQ6###                         |
| 150                        |                                 |                                            |                                             |                               | VY1151K31Y5SQ6###                         |
| 220                        |                                 |                                            |                                             |                               | VY1221K31Y5SQ6###                         |
| 330                        |                                 |                                            |                                             |                               | VY1331K31Y5SQ6###                         |
| Y5U (2E3)                  |                                 |                                            |                                             |                               |                                           |
| 470                        | ± 20 <sup>(1)</sup>             | 8.0                                        | 5.0                                         | 10.0 or 12.5                  | VY1471#31Y5UQ6###                         |
| 680                        |                                 |                                            |                                             |                               | VY1681#31Y5UQ6###                         |
| 1000                       |                                 | 9.0                                        |                                             |                               | VY1102#35Y5UQ6###                         |
| 1500                       |                                 | 10.5                                       |                                             |                               | VY1152#41Y5UQ6###                         |
| 2200                       |                                 | 12.0                                       |                                             |                               | VY1222#47Y5UQ6###                         |
| 3300                       |                                 | 15.0                                       |                                             |                               | VY1332#59Y5UQ6###                         |
| 3900                       |                                 | 15.5                                       |                                             |                               | VY1392#61Y5UQ6###                         |
| 4700                       |                                 | 16.0                                       |                                             |                               | VY1472#63Y5UQ6###                         |
| Y5V (2F3) MINI SIZE SERIES |                                 |                                            |                                             |                               |                                           |
| 1000                       | ± 20                            | 7.5                                        | 5.5                                         | 10.0 or 12.5                  | VY1102M29Y5VQ6###                         |
| 1500                       |                                 | 8.5                                        |                                             |                               | VY1152M33Y5VQ6###                         |
| 2200                       |                                 | 9.5                                        |                                             |                               | VY1222M37Y5VQ6###                         |
| 3300                       |                                 | 11.0                                       |                                             |                               | VY1332M43Y5VQ6###                         |
| 3900                       |                                 | 12.0                                       |                                             |                               | VY1392M47Y5VQ6###                         |
| 4700                       |                                 | 13.0                                       |                                             |                               | VY1472M51Y5VQ6###                         |

**Notes**

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

<sup>(1)</sup>  $\pm 10$  % available on request

**ORDERING CODE**

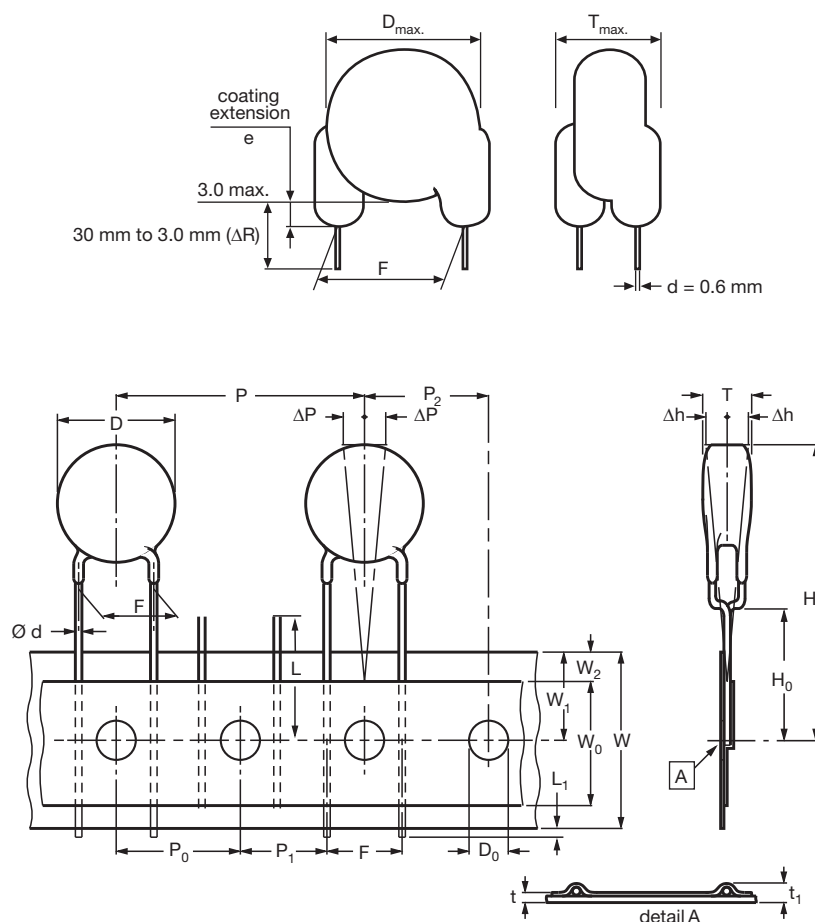
| #              | 7 <sup>th</sup> digit                      | Capacitance tolerance | $\pm 10\% = K, \pm 20\% = M$       |           |                         |                         |                    |                                              |                                      |                      |
|----------------|--------------------------------------------|-----------------------|------------------------------------|-----------|-------------------------|-------------------------|--------------------|----------------------------------------------|--------------------------------------|----------------------|
| ###            | 15 <sup>th</sup> to 17 <sup>th</sup> digit | Lead configuration    | Available configurations see below |           |                         |                         |                    |                                              |                                      |                      |
| <b>Example</b> | <b>VY1</b>                                 | <b>101</b>            | <b>K</b>                           | <b>31</b> | <b>Y5S</b>              | <b>Q</b>                | <b>6</b>           | <b>T</b>                                     | <b>V</b>                             | <b>0</b>             |
|                | Series                                     | Capacitance value     | Tolerance code                     | Size code | Temperature coefficient | Rated voltage           | Lead wire diameter | Packaging / lead length                      | Lead style                           | Lead spacing         |
|                |                                            |                       |                                    |           |                         | Q = X1/Y1<br>500 V (AC) |                    | 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**

| SIZE CODE | BODY DIAMETER<br>$D_{max.}$ (mm) | PACKAGING QUANTITIES |      |      |
|-----------|----------------------------------|----------------------|------|------|
|           |                                  | BULK                 | REEL | AMMO |
| 31 to 47  | 12.0                             | 1000                 | 500  | 750  |
| 51 to 63  | 16.0                             | 500                  | 500  | 750  |

**Note**

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

**STRAIGHT LEADS**


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

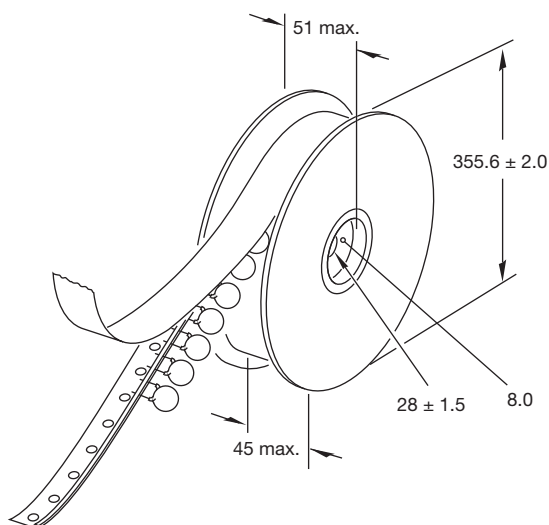
| DIMENSIONS OF TAPE            |                                              |                          |
|-------------------------------|----------------------------------------------|--------------------------|
| SYMBOL                        | PARAMETER                                    | DIMENSIONS (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**

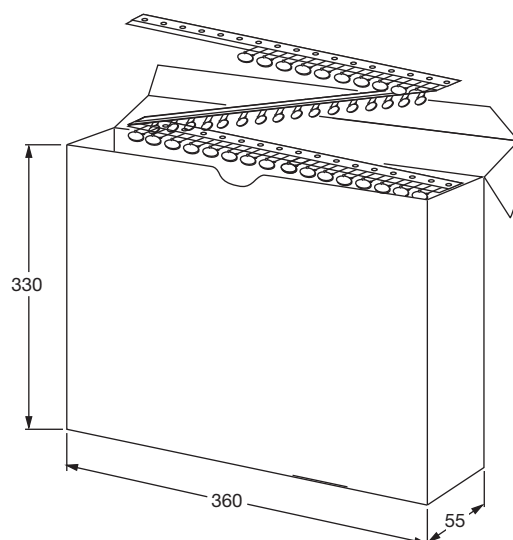
(1) See "Technical Data" table

(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 60384-14.4 - Safety tests

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

**CB Certificate**

|                                    |             |                 |                     |
|------------------------------------|-------------|-----------------|---------------------|
| Y1-capacitor: CB test certificate: | US-26561-UL | 10 pF to 4.7 nF | 500 V <sub>AC</sub> |
| X1-capacitor: CB test certificate: | US-26561-UL | 10 pF to 4.7 nF | 760 V <sub>AC</sub> |


**VDE**

|                                   |          |                 |                     |
|-----------------------------------|----------|-----------------|---------------------|
| Y1-capacitor: VDE marks approval: | 40012673 | 10 pF to 4.7 nF | 500 V <sub>AC</sub> |
| X1-capacitor: VDE marks approval: | 40012673 | 10 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 | 10 pF to 4.7 nF | 500 V <sub>AC</sub> |
| X1-capacitor: CSA test certificate: | E183844 | 10 pF to 4.7 nF | 760 V <sub>AC</sub> |



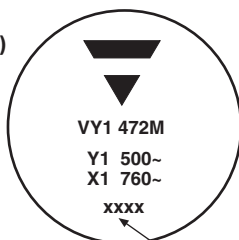
UL 60384-14, CSA E60384-1:03, CSA E60384-14:09

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

**CQC**

|                                     |                |                 |                     |
|-------------------------------------|----------------|-----------------|---------------------|
| Y1-capacitor: CQC test certificate: | CQC05001015032 | 10 pF to 4.7 nF | 500 V <sub>AC</sub> |
| X1-capacitor: CQC test certificate: | CQC05001015032 | 10 pF to 4.7 nF | 760 V <sub>AC</sub> |

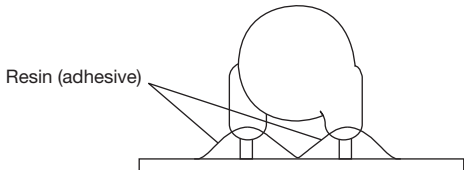

**MARKING**

Sample  
(2 sides)

4 digit date code  
(year/week; add suffix "V" for mini size series)


PN: VY1471M31Y5UQ6XT0 Lot1: 14Z551S12 DC1: 0601  
QTY: 225 Lot2: DC2:  
PO: Batch: 200601CN  
SO: Region: 9520 SL: 0010  
Ser.No: 0601H69340

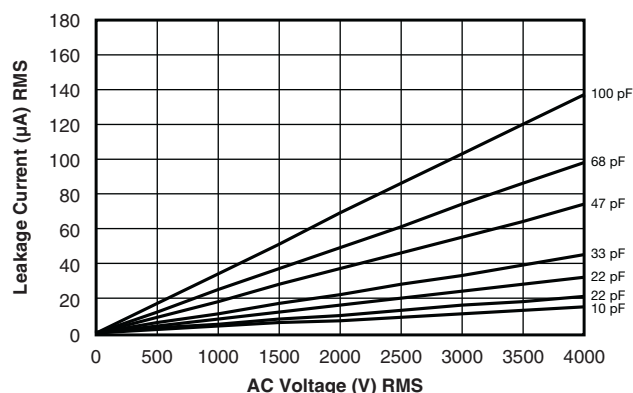
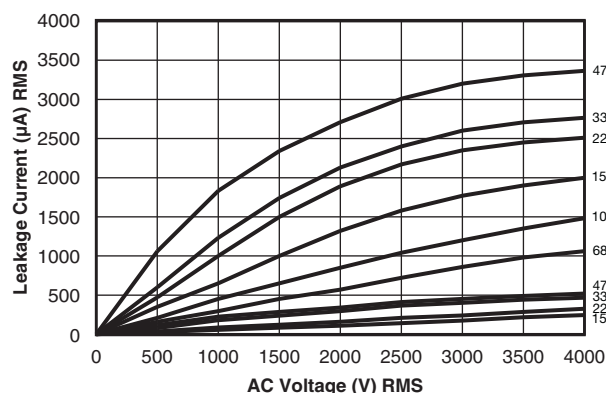


1/1

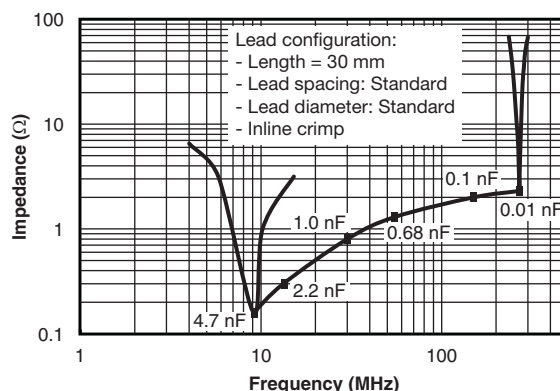
| PERFORMANCE                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                 |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 for Y5U and Y5S, and 1 MHz for U2J                                                                                                                                                                                                                                                                                                                                  | Capacitance within specified tolerance                                                                                                                                                          |
| Dissipation factor (DF)          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | DF ≤ 0.3 % for U2J and<br>DF ≤ 2.5 % for Y5S and Y5U                                                                                                                                            |
| 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 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 8 kV                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 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 ≤ 0.5 % for U2J and ≤ 5 % for Y5S and Y5U<br>IR ≥ 3000 MΩ<br>Dielectric strength: 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 ≤ ± 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;<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 ≤ ± 5 % for U2J and ≤ ± 10 % for Y5S and Y5U<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 ≤ 0.3 % for U2J and ≤ 2.5 % for Y5S and Y5U<br>IR ≥ 10 000 GΩ                                            |



### LEAKAGE 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 KITS

|                                    |                                                                        |
|------------------------------------|------------------------------------------------------------------------|
| Part Number (VY1 Sample Kit)       | VY11-KIT-HF                                                            |
| Link (VY1 Sample Kit)              | <a href="http://www.vishay.com/doc?28552">www.vishay.com/doc?28552</a> |
| Part Number (VY1...Y5V Sample Kit) | VY1-KIT-MS                                                             |
| Link (VY1...Y5V Sample Kit)        | <a href="http://www.vishay.com/doc?28561">www.vishay.com/doc?28561</a> |



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