

## AC Line Rated Ceramic Disc Capacitors Class X1, 760 V<sub>AC</sub>, Class Y1, 500 V<sub>AC</sub>



### DESIGN SUPPORT TOOLS

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| 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 ammpack

### 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)



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

### 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

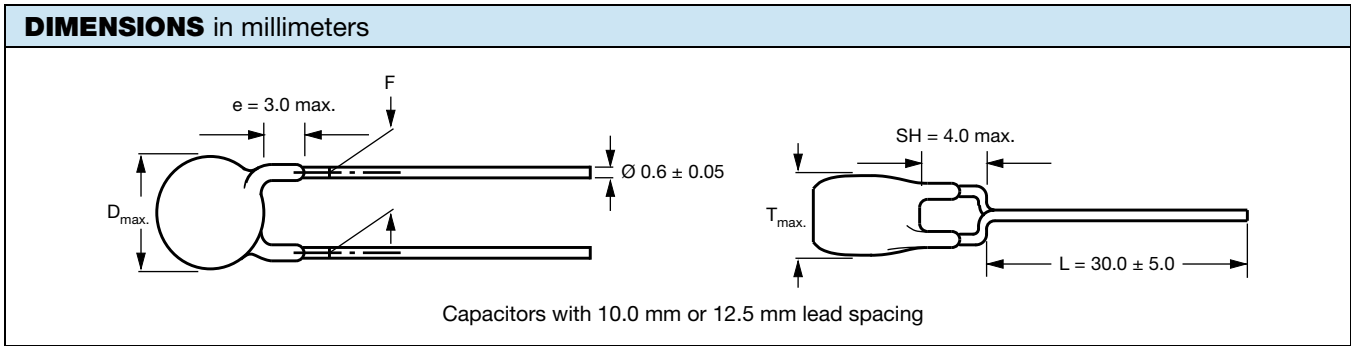
### CAPACITANCE TOLERANCE

± 20 % (code M); ± 10 % (code K)

### DISSIPATION FACTOR

Class 1: max. 0.5 % (1 MHz)

Class 2: max. 2.5 % (1 kHz)



| 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 |
| <b>U2J (N750)</b>                 |                                 |  |   |                               |   |
| 10                                | ± 10                            | 8.0  | 5.0   | 10.0 or 12.5                  | VY1100K31U2JQ6###                         |
| 15                                |                                 |  |   |                               | VY1150K31U2JQ6###                         |
| 22                                |                                 |  |   |                               | VY1220K31U2JQ6###                         |
| <b>Y5S (2C3)</b>                  |                                 |  |   |                               |   |
| 33                                | ± 10                            | 8.0  | 5.0   | 10.0 or 12.5                  | VY1330K31Y5SQ6###                         |
| 47                                |                                 |  |   |                               | VY1470K31Y5SQ6###                         |
| 68                                |                                 |  |   |                               | VY1680K31Y5SQ6###                         |
| 100                               |                                 |  |   |                               | VY1101K31Y5SQ6###                         |
| 150                               |                                 |  |   |                               | VY1151K31Y5SQ6###                         |
| 220                               |                                 |  |   |                               | VY1221K31Y5SQ6###                         |
| 330                               |                                 |  |   |                               | VY1331K31Y5SQ6###                         |
| <b>Y5U (2E3)</b>                  |                                 |  |   |                               |   |
| 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###                         |
| <b>Y5V (2F3) MINI SIZE SERIES</b> |                                 |  |   |                               |   |
| 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**

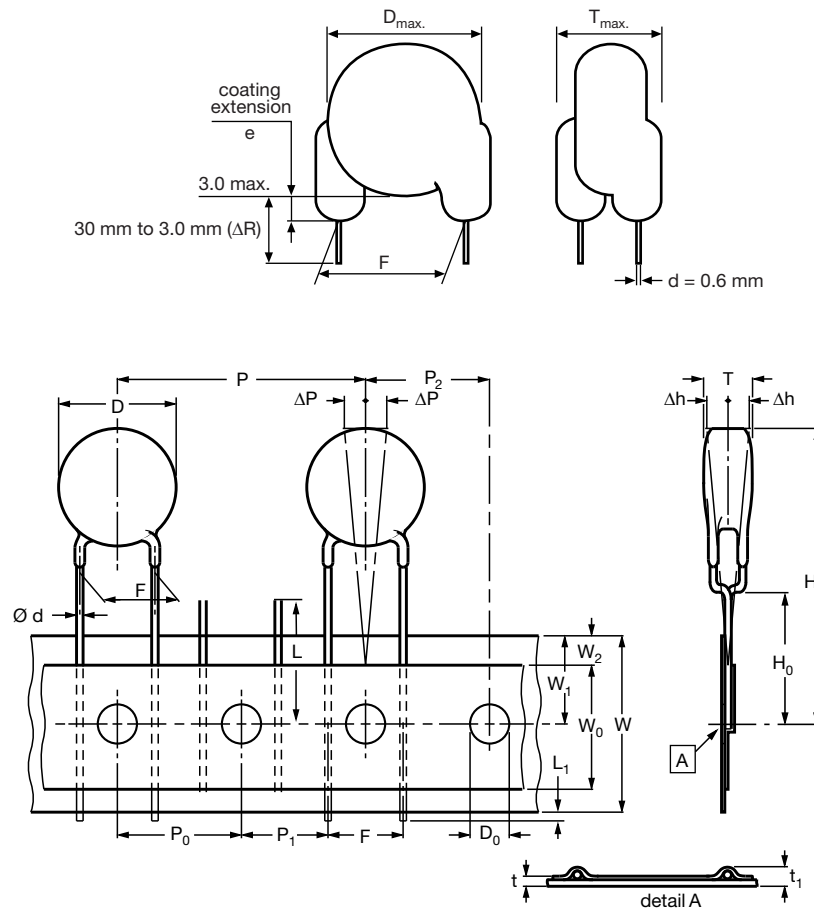
- Straight leads available on request
  - Coating extension DR valid for straight leads only
- <sup>(1)</sup> ± 10 % available on request

| ORDERING CODE  |  |                   |                       |           |                         |                                    |                    |  |                                      |                      |
|----------------|--|-------------------|-----------------------|-----------|-------------------------|------------------------------------|--------------------|--|--------------------------------------|----------------------|
| #              | 7 <sup>th</sup> digit                      |                   | Capacitance tolerance |           |                         | ± 10 % = K, ± 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

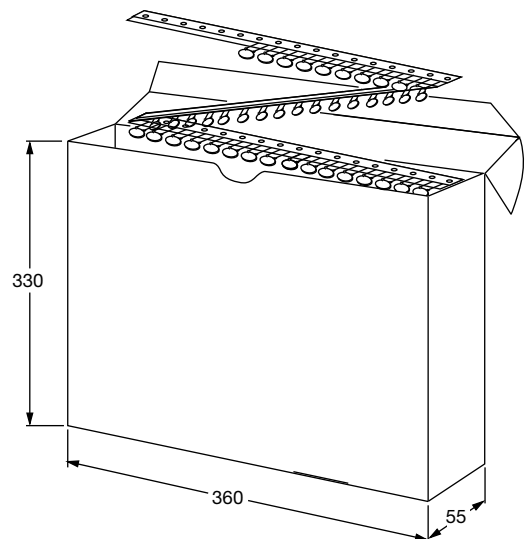
| DIMENSIONS OF TAPE            |  |                          |
|-------------------------------|--|--------------------------|
| SYMBOL                        | PARAMETER                                    | DIMENSIONS (mm)          |
| D <sup>(1)</sup>              | Body diameter                                | 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**

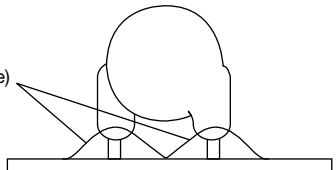

Reel with capacitors on tape



Ammpack with capacitors on tape

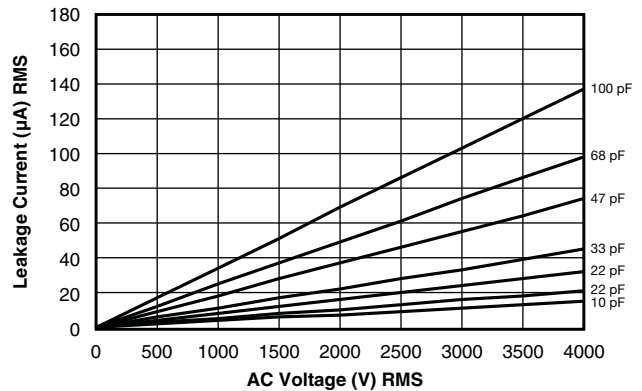
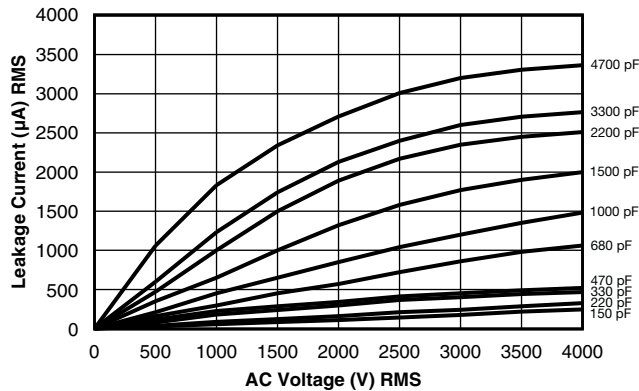
| <b>APPROVALS</b>  |                |                 |                     |  |
|---|----------------|-----------------|---------------------|--|
| IEC 60384-14.4 - Safety tests<br>This approval together with CB test certificate substitutes all national approvals.                                |                |                 |                     |  |
| <b>CB Certificate</b>   |                |                 |                     |  |
| 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> |  |
| <b>VDE</b>  |                |                 |                     |  |
| 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   |                |                 |                     |  |
| <b>Underwriters Laboratories Inc./Canadian Standards Association</b>  |                |                 |                     |  |
| 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<br>Fixed capacitors for electromagnetic interference suppression and connection to the supply mains. |                |                 |                     |  |
| <b>CQC</b>  |                |                 |                     |  |
| 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> |  |

| <b>MARKING</b>   |   |
|--|---|
| <p><b>Sample (2 sides)</b></p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>4 digit date code<br/>(year/week; add suffix "V" for mini size series)</p> </div> <div style="text-align: center;"> </div> </div> | <div style="text-align: center;"> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div>                 PN: VY1471M31Y5UQ6XT0<br/>                 QTY: 225<br/>                 PO:<br/>                 SO:             </div> <div>                 Lot1: 14Z551S12<br/>                 Lot2:<br/>                 Batch: 200601CN<br/>                 Region: 9520<br/>                 Ser.No: 0601H69340             </div> <div>                 DC1: 0601<br/>                 DC2:<br/>                 SL: 0010             </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="text-align: center;"> </div> <div style="text-align: right;">1/1</div> </div> |

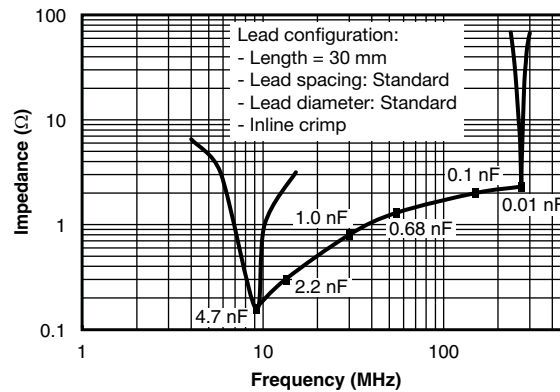
| <b>PERFORMANCE</b>               |   |   |
|----------------------------------|---|---|
| <b>TEST</b>                      | <b>TEST CONDITION</b>   | <b>TEST LIMITS</b>  |
| Visual and mechanical inspection | Optical inspection, dimensions measured with caliper  | No visible damage, marking legible  |
| 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 °C ± 3 °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> |

| 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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