

## AC Line Rated Ceramic Disc Capacitors

### Class X1, 440 V<sub>AC</sub>, Class Y2, 300 V<sub>AC</sub>



#### ADDITIONAL RESOURCES



| QUICK REFERENCE DATA       |        |     |               |     |
|----------------------------|--------|-----|---------------|-----|
| DESCRIPTION                | VALUE  |     |               |     |
| Ceramic Class              | 1      |     | 2             |     |
| Ceramic Dielectric         | N750   |     | Y5S, Y5U, Y5V |     |
| Voltage (V <sub>AC</sub> ) | 300    | 440 | 300           | 440 |
| Min. Capacitance (pF)      | 10     |     | 68            |     |
| Max. Capacitance (pF)      | 47     |     | 10 000        |     |
| Mounting                   | Radial |     |               |     |

#### OPERATING TEMPERATURE RANGE

-40 °C to +125 °C

#### TEMPERATURE CHARACTERISTICS

Class 1: N750 (U2J)

Class 2: Y5S, Y5U, Y5V

#### SECTIONAL SPECIFICATIONS

Climatic category (according to EN 60058-1)

Class 1 and class 2: 40/125/21

#### COATING

According to UL 94 V-0

Epoxy resin, isolating, flame retardant

#### APPROVALS

IEC 60384-14.4

UL 60384-14

DIN EN 60384-14

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

CQC11-471112

#### PACKAGING

Bulk, tape and reel, taped 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)

#### APPLICATIONS

- X1, Y2 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 tin plated copper-clad steel having a diameter of 0.6 mm.

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

#### CAPACITANCE RANGE

10 pF to 0.01 µF

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

IEC 60384-14 and UL 60384-14:

(X1): 440 V<sub>AC</sub>, 50 Hz

(Y2): 300 V<sub>AC</sub>, 50 Hz

1000 V<sub>DC</sub>

#### TEST VOLTAGE

Component test (100 %):

2600 V<sub>AC</sub>, 50 Hz, 2 s

(2600 V<sub>AC</sub> for LS 7.5 mm and above)

(2200 V<sub>AC</sub> for LS 5.0 mm)

Random sampling test (destructive test):

2600 V<sub>AC</sub>, 50 Hz, 60 s

Voltage proof of coating (destructive test):

2600 V<sub>AC</sub>, 50 Hz, 60 s

#### INSULATION RESISTANCE

≥ 10 000 MΩ

#### CAPACITANCE TOLERANCE

± 20 % (code M); ± 10 % (code K)

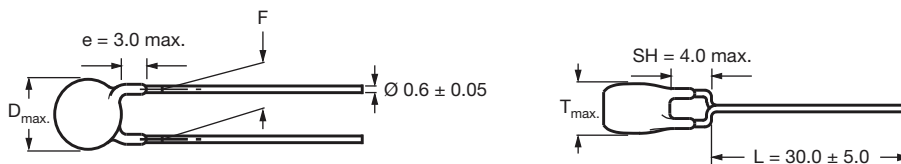
#### DISSIPATION FACTOR

Class 1: max. 0.5 % (1 MHz)

Class 2: max. 2.5 % (1 kHz)



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

**DIMENSIONS** in millimeters

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

**TECHNICAL DATA**

| CAPACITANCE<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 <sup>(1)</sup><br>F (mm) ± 1 mm | PART NUMBER                               |
|----------------------------|---------------------------------|--------------------------------------------|---------------------------------------------|----------------------------------------------|-------------------------------------------|
|                            |                                 |                                            |                                             |                                              | MISSING DIGITS SEE<br>ORDERING CODE BELOW |
| U2J (N750)                 |                                 |                                            |                                             |                                              |                                           |
| 10                         | ± 10                            | 7.5                                        | 5.0                                         | 5.0, 7.5, 10.0, or 12.5                      | VY2100K29U2JS6###                         |
| 15                         |                                 |                                            |                                             |                                              | VY2150K29U2JS6###                         |
| 22                         |                                 |                                            |                                             |                                              | VY2220K29U2JS6###                         |
| 33                         |                                 |                                            |                                             |                                              | VY2330K29U2JS6###                         |
| 47                         |                                 |                                            |                                             |                                              | VY2470K29U2JS6###                         |
| Y5S (2C3)                  |                                 |                                            |                                             |                                              |                                           |
| 68                         | ± 10                            | 7.5                                        | 5.0                                         | 5.0, 7.5, 10.0, or 12.5                      | VY2680K29Y5SS6###                         |
| 100                        |                                 |                                            |                                             |                                              | VY2101K29Y5SS6###                         |
| 150                        |                                 |                                            |                                             |                                              | VY2151K29Y5SS6###                         |
| 220                        |                                 |                                            |                                             |                                              | VY2221K29Y5SS6###                         |
| 330                        |                                 |                                            |                                             |                                              | VY2331K29Y5SS6###                         |
| 470                        |                                 |                                            |                                             |                                              | VY2471K29Y5SS6###                         |
| Y5U (2E3)                  |                                 |                                            |                                             |                                              |                                           |
| 680                        | ± 20                            | 7.5                                        | 5.0                                         | 5.0, 7.5, 10.0, or 12.5                      | VY2681M29Y5US6###                         |
| 1000                       |                                 |                                            |                                             |                                              | VY2102M29Y5US6###                         |
| 1500                       |                                 | 8.0                                        |                                             |                                              | VY2152M31Y5US6###                         |
| 2200                       |                                 | 9.0                                        |                                             |                                              | VY2222M35Y5US6###                         |
| 3300                       |                                 | 10.5                                       |                                             |                                              | VY2332M41Y5US6###                         |
| 3900                       |                                 | 11.0                                       |                                             |                                              | VY2392M43Y5US6###                         |
| 4700                       |                                 | 12.5                                       |                                             | 7.5, 10.0, or 12.5                           | VY2472M49Y5US6###                         |
| 6800                       |                                 | 14.5                                       |                                             |                                              | VY2682M59Y5US63##                         |
| 10 000                     |                                 | 16.0                                       |                                             |                                              | VY2103M63Y5US63##                         |
| Y5V (2F3) MINI SIZE SERIES |                                 |                                            |                                             |                                              |                                           |
| 1000                       | ± 20                            | 7.5                                        | 5.0                                         | 5.0, 7.5, 10.0,<br>or 12.5                   | VY2102M29Y5VS6###                         |
| 1500                       |                                 | 7.5                                        |                                             |                                              | VY2152M29Y5VS6###                         |
| 2200                       |                                 | 8.0                                        |                                             |                                              | VY2222M31Y5VS6###                         |
| 3300                       |                                 | 9.0                                        |                                             |                                              | VY2332M35Y5VS6###                         |
| 3900                       |                                 | 10.0                                       |                                             |                                              | VY2392M39Y5VS6###                         |
| 4700                       |                                 | 10.5                                       |                                             |                                              | VY2472M41Y5VS6###                         |
| 6800                       |                                 | 12.0                                       |                                             |                                              | VY2682M47Y5VS6###                         |
| 10 000                     |                                 | 15.0                                       |                                             |                                              | VY2103M59Y5VS6###                         |

**Note**

<sup>(1)</sup> Straight leads are available on request

| ORDERING CODE |                                            |                   |                    |           |                         |                                    |                    |                                                     |                                         |                                            |
|---------------|--------------------------------------------|-------------------|--------------------|-----------|-------------------------|------------------------------------|--------------------|-----------------------------------------------------|-----------------------------------------|--------------------------------------------|
| ###           | 15 <sup>th</sup> to 17 <sup>th</sup> digit |                   | Lead configuration |           |                         | Available configurations see below |                    |                                                     |                                         |                                            |
| Example       | VY2                                        | 221               | K                  | 29        | Y5S                     | S                                  | 6                  | U                                                   | V                                       | 7                                          |
|               | Series                                     | Capacitance value | Tolerance code     | Size code | Temperature coefficient | Rated voltage                      | Lead wire diameter | Packaging / lead length                             | Lead style                              | Lead spacing                               |
|               |                                            |                   |                    |           |                         | S =<br>X1/Y2<br>300 V (AC)         |                    | 3 = bulk<br>T = tape<br>and reel<br>U =<br>ammopack | L =<br>straight<br>V = inline<br>kinked | 5 = 5.0<br>7 = 7.5<br>0 = 10.0<br>X = 12.5 |

### LEADSPACING 5.0 mm AND 7.5 mm

| PACKAGING |                                         |                      |      |      |
|-----------|-----------------------------------------|----------------------|------|------|
| SIZE CODE | BODY DIAMETER<br>D <sub>max.</sub> (mm) | PACKAGING QUANTITIES |      |      |
|           |                                         | BULK                 | REEL | AMMO |
| 29 to 49  | 12.5                                    | 1000                 | 1000 | 1000 |
| 59 to 63  | 16.0                                    | 500                  | -    | -    |

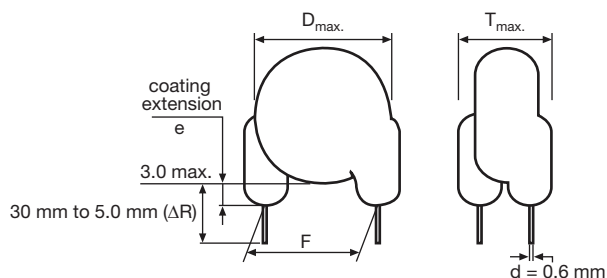
### LEADSPACING 10.0 mm AND 12.5 mm

| PACKAGING          |           |                                         |                      |      |      |
|--------------------|-----------|-----------------------------------------|----------------------|------|------|
| CAPACITANCE VALUE  | SIZE CODE | BODY DIAMETER<br>D <sub>max.</sub> (mm) | PACKAGING QUANTITIES |      |      |
|                    |           |                                         | BULK                 | REEL | AMMO |
| 10 pF to 4700 pF   | 29 to 49  | 12.5                                    | 1000                 | 500  | 750  |
| 6800 pF to 0.01 µF | 59 to 63  | 16.0                                    | 500                  | 500  | 750  |

#### Note

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

### STRAIGHT LEADS



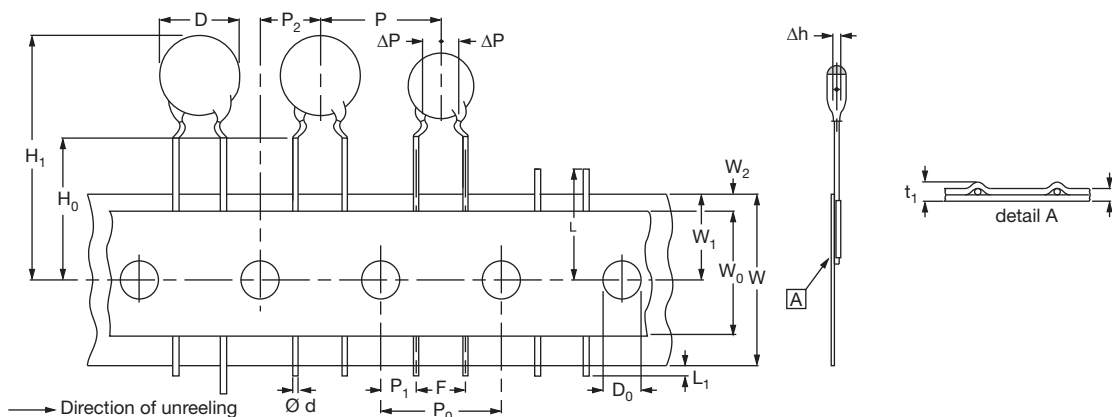


Fig. 1 - Kinked capacitors on tape, lead spacing 5.0 mm (0.2") and 7.5 mm (0.3")

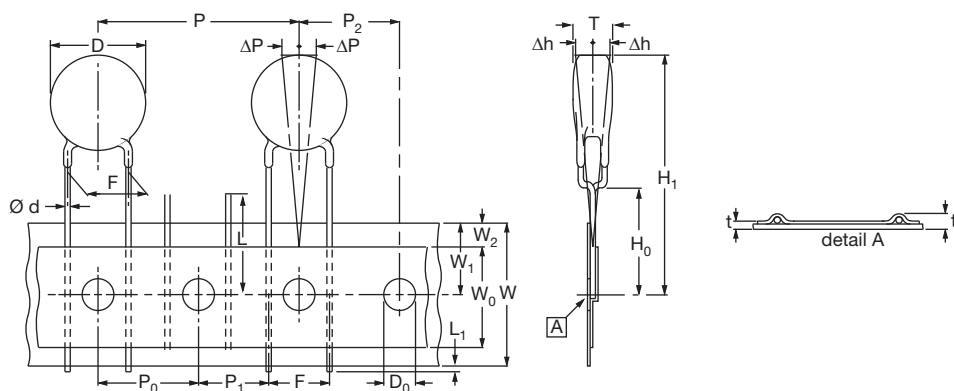


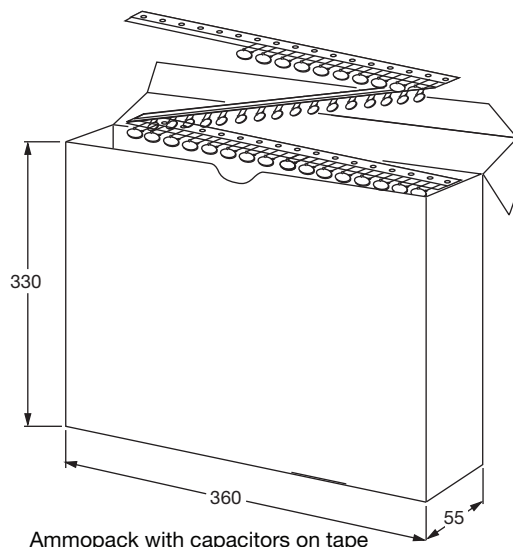
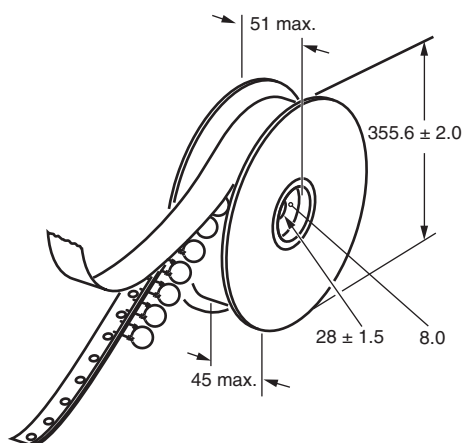
Fig. 2 - Inline kink (V) leaded capacitors on tape, lead spacing 10 mm (0.40")

| DIMENSION OF TAPE             |                                              |                     |                     |                      |
|-------------------------------|----------------------------------------------|---------------------|---------------------|----------------------|
| SYMBOL                        | PARAMETER                                    | DIMENSIONS (mm)     |                     |                      |
|                               |                                              | FIG. 1 (5 mm)       | FIG. 1 (7.5 mm)     | FIG. 2 (10 mm)       |
| D <sup>(1)</sup>              | Body diameter                                | 11.0 max.           | 14.0 max.           | 16.0 max.            |
| d                             | Lead diameter                                | 0.6 ± 0.05          | 0.6 ± 0.05          | 0.6 ± 0.05           |
| P                             | Pitch of component                           | 12.7 ± 1            | 15.0 ± 1            | 25.4 ± 1             |
| P <sub>0</sub> <sup>(2)</sup> | Pitch of sprocket hole                       | 12.7 ± 0.3          | 15.0 ± 0.3          | 12.7 ± 0.3           |
| P <sub>1</sub> <sup>(3)</sup> | Distance, hole center to lead                | 3.85 ± 0.7          | 3.75 ± 0.7          | 7.7 ± 1.0            |
| P <sub>2</sub> <sup>(3)</sup> | Distance, hole to center of component        | 6.35 ± 1.3          | 7.5 ± 1.5           | 12.7 ± 1.5           |
| F                             | Lead spacing                                 | 5.0 (+ 0.6 / - 0.4) | 7.5 (+ 0.6 / - 0.4) | 10.0 (+ 0.6 / - 0.4) |
| $\Delta h$                    | Average deviation across tape                | ± 1.0 max.          | ± 1.0 max.          | ± 1.0 max.           |
| $\Delta P$                    | Average deviation in direction of reeling    | ± 1.0 max.          | ± 1.0 max.          | ± 1.0 max.           |
| W                             | Carrier tape width                           | 18.0 + 1 / - 0.5    | 18.0 + 1 / - 0.5    | 18.0 + 1 / - 0.5     |
| W <sub>0</sub>                | Hold-down tape width                         | 5.0 min.            | 5.0 min.            | 5.0 min.             |
| W <sub>1</sub>                | Position of sprocket hole                    | 9.0 + 0.75 / - 0.5  | 9.0 + 0.75 / - 0.5  | 9.0 + 0.75 / - 0.5   |
| W <sub>2</sub>                | Distance of hold-down tape                   | 3.0 max.            | 3.0 max.            | 3.0 max.             |
| H <sub>1</sub>                | Maximum component height                     | 32                  | 40                  | 40                   |
| H <sub>0</sub>                | Height to seating plane (for kinked leads)   | 16.0 ± 0.5          | 16.0 ± 0.5          | 16.0 ± 0.5           |
| H <sub>0</sub>                | Height to seating plane (for straight leads) | 20.0 ± 0.5          | 20.0 ± 0.5          | 20.0 ± 0.5           |
| L                             | Length of cut leads                          | 11.0 max.           | 11.0 max.           | 11.0 max.            |
| L <sub>1</sub>                | Length of lead protrusion                    | 1.0 max.            | 1.0 max.            | 1.0 max.             |
| D <sub>0</sub>                | Diameter of sprocket hole                    | 4.0 ± 0.2           | 4.0 ± 0.2           | 4.0 ± 0.2            |
| t                             | Total tape thickness                         | 0.9 max.            | 0.9 max.            | 0.9 max.             |
| t <sub>1</sub>                | Maximum thickness of tape and wires          | 1.5 max.            | 1.5 max.            | 1.5 max.             |

**Notes**
<sup>(1)</sup> See "Technical Data" table

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

<sup>(3)</sup> Obliquity maximum 3°

**REEL AND TAPE DATA** in millimeters

**APPROVALS**

IEC 60384-14.4 - Safety tests

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

**CB Certificate**

|                                    |             |                |                     |
|------------------------------------|-------------|----------------|---------------------|
| Y2-capacitor: CB test certificate: | US-26163-UL | 10 pF to 10 nF | 300 V <sub>AC</sub> |
| X1-capacitor: CB test certificate: | US-26163-UL | 10 pF to 10 nF | 440 V <sub>AC</sub> |


**VDE**

|                                   |          |                |                     |
|-----------------------------------|----------|----------------|---------------------|
| Y2-capacitor: VDE marks approval: | 40009669 | 10 pF to 10 nF | 300 V <sub>AC</sub> |
| X1-capacitor: VDE marks approval: | 40009669 | 10 pF to 10 nF | 440 V <sub>AC</sub> |



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

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

|                                    |         |                |                     |
|------------------------------------|---------|----------------|---------------------|
| Y2-capacitor: UL-test certificate: | E183844 | 10 pF to 10 nF | 300 V <sub>AC</sub> |
| X1-capacitor: UL-test certificate: | E183844 | 10 pF to 10 nF | 440 V <sub>AC</sub> |


UL 60384-14.1, CSA E60384-1:03 2<sup>nd</sup> edition, CSA E60384-14:09 2<sup>nd</sup> edition

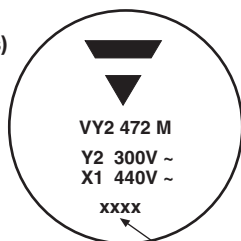
Across-the-line, antenna-coupling, and line-by-pass component

**CQC**

|                                     |                |                |                     |
|-------------------------------------|----------------|----------------|---------------------|
| Y2-capacitor: CQC test certificate: | CQC05001012316 | 10 pF to 10 nF | 300 V <sub>AC</sub> |
| X1-capacitor: CQC test certificate: | CQC05001012316 | 10 pF to 10 nF | 440 V <sub>AC</sub> |



**MARKING**

Sample  
(2 sides)


Front



Back

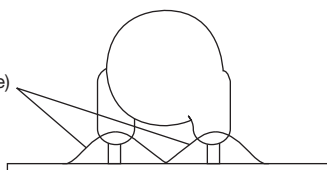
4 digit date code  
(year/week; add suffix "V" for mini size series)

PN: VY2331K29Y5SS6UV7  
QTY: 1000  
PO:  
SO:

Lot1: 14Z549306  
Lot2:  
Batch: 200601CN  
Region: 9520  
Ser.No: 0601H72383  
DC1: 0601  
DC2:

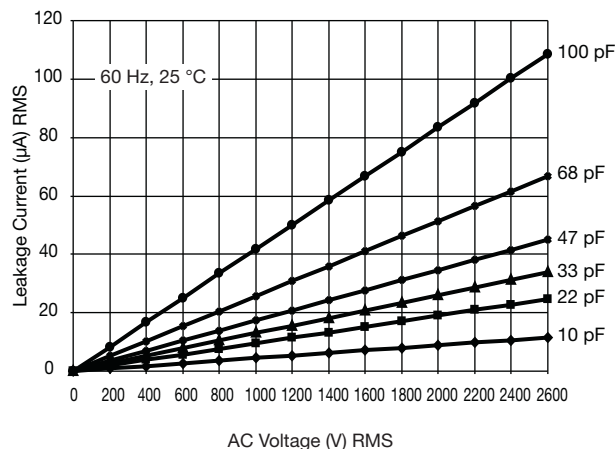
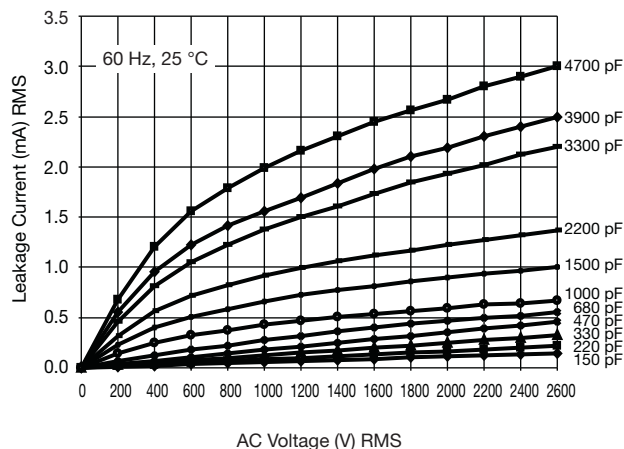

2/5

**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 <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              | 2600 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 5 kV                                                                                                                                                                                                                                                                                                                                                                                                                                                          | No failure                                                                                                                                                                                      |
| Life test                        | 1000 h at 125 °C ± 2 °C, 550 V <sub>AC</sub> /50 Hz; 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 440 V <sub>AC</sub> , 50 Hz and 500 h unloaded 40 °C, RH = 90 % to 95 %                                                                                                                                                                                                                                                                                                                                                                                          | External appearance: no visible damage<br>ΔC/C ≤ ± 10 % for U2J and ≤ ± 15 % for Y5S and Y5U<br>DF ≤ 0.5 % for U2J and ≤ 5 % for Y5S and Y5U<br>IR ≥ 3000 MΩ<br>Dielectric strength: no failure |
| Robustness of termination        | Pull test: 0.5 kg tensile weight in radial direction for 10 s ± 1 s<br>Bending strength: capacitor body rotated by 90° in both directions                                                                                                                                                                                                                                                                                                                                 | No damage to capacitor body and lead wire                                                                                                                                                       |
| Soldering effect                 | Immersion of lead wires into 260 °C ± 5 °C solder for 10 s ± 2 s; min. distance from body: 1.5 mm<br>Hand soldering at 400 °C ± 10 °C for 3 s to 4 s; min. distance from body: 1.5 mm                                                                                                                                                                                                                                                                                     | External appearance: no visible damage<br>ΔC/C ≤ ± 5 % for U2J and ≤ ± 10 % for Y5S and Y5U<br>Dielectric strength: no failure                                                                  |
| Vibration test                   |  <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)



#### 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?22254">www.vishay.com/doc?22254</a> |
| VDE Marks Approval   | <a href="http://www.vishay.com/doc?22256">www.vishay.com/doc?22256</a> |
| UL Test Certificate  | <a href="http://www.vishay.com/doc?22253">www.vishay.com/doc?22253</a> |
| CQC Test Certificate | <a href="http://www.vishay.com/doc?22255">www.vishay.com/doc?22255</a> |
| LTspice® Models      | <a href="http://www.vishay.com/doc?28568">www.vishay.com/doc?28568</a> |

#### SAMPLE KITS

|                                    |                                                                        |
|------------------------------------|------------------------------------------------------------------------|
| Part Number (VY2 Sample Kit)       | VY21-KIT-HF                                                            |
| Link (VY2 Sample Kit)              | <a href="http://www.vishay.com/doc?28554">www.vishay.com/doc?28554</a> |
| Part Number (VY2...Y5V Sample Kit) | VY2-KIT-MS                                                             |
| Link (VY2...Y5V Sample Kit)        | <a href="http://www.vishay.com/doc?28562">www.vishay.com/doc?28562</a> |



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