

## EMI Suppression Capacitor, Ceramic Disc, Class X1, 440 V<sub>AC</sub>, Class Y2, 300 V<sub>AC</sub>



### LINKS TO ADDITIONAL RESOURCES



| QUICK REFERENCE DATA       |        |     |
|----------------------------|--------|-----|
| DESCRIPTION                | VALUE  |     |
| Ceramic Class              | 2      |     |
| Ceramic Dielectric         | Y5U    |     |
| Voltage (V <sub>AC</sub> ) | 440    | 300 |
| Min. Capacitance (pF)      | 1000   |     |
| Max. Capacitance (pF)      | 4700   |     |
| Mounting                   | Radial |     |

### OPERATING TEMPERATURE RANGE

-40 °C to +125 °C <sup>(1)</sup>

#### Note

<sup>(1)</sup> For explanation about the difference of operating temperature range and temperature characteristic of capacitance please see [www.vishay.com/doc?48299](http://www.vishay.com/doc?48299)

### TEMPERATURE CHARACTERISTICS

Class 2: Y5U

### SECTIONAL SPECIFICATIONS

Climatic category (according to EN 60058-1)

Class 2: 40 / 125 / 21

### APPROVALS

IEC 60384-14

UL 60384-14

CSA E60384-14

### FEATURES

- Complying with IEC 60384-14
- High reliability
- Wide range of different leadstyles
- Small dimensions
- 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

### APPLICATIONS

- X1, Y2 according to IEC 60384-14
- Line-to-line filtering (Class X)
- Line-to-ground filtering (Class Y)
- EMI / RFI suppression and filtering
- Primary and secondary coupling (SMPS)

### DESIGN

The capacitors consist of ceramic disc both sides of which are silver plated. Connection leads are made of tinned copper having diameters of 0.6 mm.

The capacitors may be supplied with straight or kinked leads having a lead spacing of 7.5 mm.

Coating is made of blue colored flame retardant epoxy resin in accordance with UL 94 V-0.

### CAPACITANCE RANGE

1.0 nF to 4.7 nF

### TOLERANCE ON CAPACITANCE

± 10 %, ± 20 %

### RATED VOLTAGE

- X1: 440 V<sub>AC</sub>, 50 Hz (IEC 60384-14)  
440 V<sub>AC</sub>, 50 Hz / 60 Hz (US/UL/CSA 60384-14)
- Y2: 300 V<sub>AC</sub>, 50 Hz (IEC 60384-14)  
300 V<sub>AC</sub>, 50 Hz / 60 Hz (US/UL/CSA 60384-14)

### TEST VOLTAGE

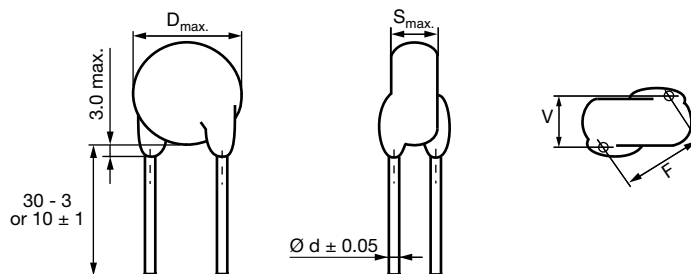
- 2600 V<sub>AC</sub>, 50 Hz, 2 s Component test (100 %)
- 2600 V<sub>AC</sub>, 50 Hz, 60 s Random sampling test (destructive)
- 2600 V<sub>AC</sub>, 50 Hz, 60 s Voltage proof of coating (destructive)

### INSULATION RESISTANCE AT 500 V<sub>DC</sub>

≥ 6000 MΩ (60 s)

### DISSIPATION FACTOR

Class 2: max. 2.5 % (1 kHz)

**DIMENSIONS** in millimeters

**TECHNICAL DATA**

| CAPACITANCE<br>C (pF) <sup>(2)</sup> | CAPACITANCE<br>TOLERANCE | BODY<br>DIAMETER<br>D <sub>MAX.</sub> (mm) | BODY<br>THICKNESS<br>S <sub>MAX.</sub> (mm) | LEAD<br>SPACING <sup>(1)</sup><br>F (mm)<br>± 1 mm | LEAD<br>DIAMETER <sup>(1)</sup><br>d (mm)<br>± 0.05 mm | WIDTH <sup>(1)</sup><br>V (mm)<br>± 0.5 mm | PART NUMBER                                  |
|--------------------------------------|--------------------------|--------------------------------------------|---------------------------------------------|----------------------------------------------------|--------------------------------------------------------|--------------------------------------------|----------------------------------------------|
|                                      |                          |                                            |                                             |                                                    |                                                        |                                            | MISSING DIGITS<br>SEE ORDERING<br>CODE BELOW |
| Y5U                                  |                          |                                            |                                             |                                                    |                                                        |                                            |                                              |
| 1000                                 | ± 10 %,<br>± 20 %        | 7.0                                        | 4.5                                         | 7.5                                                | 0.6                                                    | 1.6                                        | VKO102#CQ####KR                              |
| 1500                                 |                          | 8.0                                        | 6.0                                         |                                                    |                                                        |                                            | VKO152#CQ####KR                              |
| 2200                                 |                          | 10.0                                       |                                             |                                                    |                                                        |                                            | VKO222#CQ####KR                              |
| 3300                                 |                          | 12.0                                       |                                             |                                                    |                                                        |                                            | VKO332#CQ####KR                              |
| 3900                                 |                          | 13.5                                       | 4.5                                         |                                                    |                                                        |                                            | VKO392#CQ####KR                              |
| 4700                                 |                          | 13.5                                       |                                             |                                                    |                                                        |                                            | VKO472#CQ####KR                              |

**Notes**

- (1) Standard lead configuration, other lead spacing and diameter available on request  
(2) When capacitance values less than 1 nF are required, the usage of VKO series is recommended

**ORDERING CODE**

| #              | 7 <sup>th</sup> digit                      | Capacitance tolerance | ± 10 % = K, ± 20 % = M                                                                           |
|----------------|--------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------|
| ###            | 10 <sup>th</sup> to 12 <sup>th</sup> digit | Lead configuration    | See "General Information" <a href="http://www.vishay.com/doc?22001">www.vishay.com/doc?22001</a> |
| <b>Example</b> | <b>VKO</b>                                 | <b>102</b>            | <b>K</b>                                                                                         |
|                | Series                                     | Capacitance value     | Tolerance code                                                                                   |
|                |                                            |                       | <b>CQ</b>                                                                                        |
|                |                                            |                       | Voltage code                                                                                     |
|                |                                            |                       | <b>TC0</b>                                                                                       |
|                |                                            |                       | Lead configuration                                                                               |
|                |                                            |                       | <b>K</b>                                                                                         |
|                |                                            |                       | Internal code                                                                                    |
|                |                                            |                       | <b>R</b>                                                                                         |
|                |                                            |                       | RoHS compliant                                                                                   |

**MARKING**

|                                                                        |                                                                                                 |                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>VKO<br/>440~X1<br/>300~Y2<br/>1n5 M</p> <p>VKO 1.0 nF to 1.5 nF</p> | <p>VKO 2n2 M<br/>IEC 384-14<br/>440   300   250~<br/>X1   Y2   </p> <p>VKO 2.2 nF to 4.7 nF</p> | <p>Type: VKO472KCQCD0KR<br/> Cap.: 4700pF ±10%<br/> Ur.: 300/440VAC<br/> Qty.: 1000<br/> IEC 60 384-14/2: Y2(300~), X1(440~)<br/> EN132400:125°C c<u>u</u>s<br/> LOT1: 033142 OC1: 1134<br/> LOT2: OC2:<br/> BATCH NO.: 201134CZ<br/> REGION: 7032 S.L.: 0010<br/> RoHS</p> <p>PN: VKO472KCQCD0KR PO: 0031254565/0001 SN: 28033142B012</p> |
|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## APPROVALS

IEC 60384-14 - Safety tests  
This approval together with CB test certificate substitutes all national approvals.

### CB Certificate ([www.vishay.com/doc?22220](http://www.vishay.com/doc?22220))

|                                         |             |                |                     |
|-----------------------------------------|-------------|----------------|---------------------|
| Y2-capacitor: CB test certificate:      | US-26162-UL | 1 nF to 4.7 nF | 300 V <sub>AC</sub> |
| X1-capacitor: CB test certificate:      | US-26162-UL | 1 nF to 4.7 nF | 440 V <sub>AC</sub> |
| Minimum thickness of insulation: 0.4 mm |             |                |                     |



### VDE ([www.vishay.com/doc?22222](http://www.vishay.com/doc?22222))

|                                         |        |                |                     |
|-----------------------------------------|--------|----------------|---------------------|
| Y2-capacitor: VDE marks approval:       | 137866 | 1 nF to 4.7 nF | 300 V <sub>AC</sub> |
| X1-capacitor: VDE marks approval:       | 137866 | 1 nF to 4.7 nF | 440 V <sub>AC</sub> |
| DIN EN 60384-14 (VDE 0565-1-1)          |        |                |                     |
| Minimum thickness of insulation: 0.4 mm |        |                |                     |

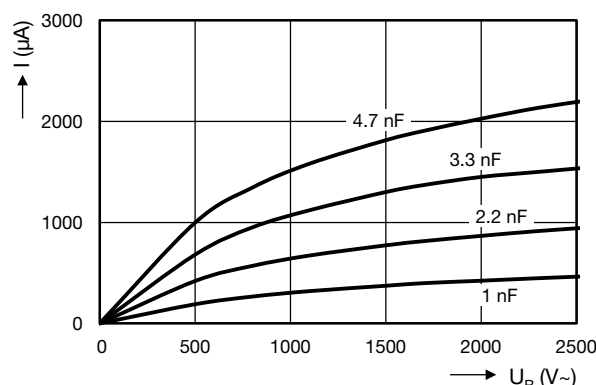


### Underwriters Laboratories Inc. / Canadian Standards Association ([www.vishay.com/doc?22221](http://www.vishay.com/doc?22221))

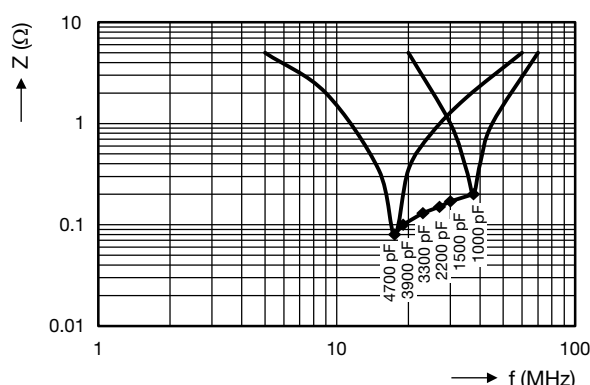
|                                         |         |                |                     |
|-----------------------------------------|---------|----------------|---------------------|
| Y2-capacitor: UL-test certificate:      | E183844 | 1 nF to 4.7 nF | 300 V <sub>AC</sub> |
| X1-capacitor: UL-test certificate:      | E183844 | 1 nF to 4.7 nF | 440 V <sub>AC</sub> |
| UL 60384-14, CSA E60384-14              |         |                |                     |
| Minimum thickness of insulation: 0.4 mm |         |                |                     |



## AC CURRENT VS. VOLTAGE (typical)



## IMPEDANCE VS. FREQUENCY (typical)



## STORAGE

The capacitors must not be stored in a corrosive atmosphere, where sulphide or chloride gas, acid, alkali or salt are present. Exposure of the components to moisture, should be avoided. The solderability of the leads is not affected by storage of up to 24 months (temperature +10 °C to +35 °C, relative humidity up to 60 %). Class 2 ceramic dielectric capacitors are also subject to aging, see [www.vishay.com/doc?22001](http://www.vishay.com/doc?22001).

## SOLDERING

### SOLDERING SPECIFICATIONS

Soldering test for capacitors with wire leads: (according to IEC 60068-2-20, solder bath method)

|                              | SOLDERABILITY | RESISTANCE TO SOLDERING HEAT |
|------------------------------|---------------|------------------------------|
| Soldering temperature        | 235 °C ± 5 °C | 260 °C ± 5 °C                |
| Soldering duration           | 2 s ± 0.5 s   | 10 s ± 1 s                   |
| Distance from component body | ≥ 2 mm        | ≥ 5 mm                       |



## SOLDERING RECOMMENDATIONS

Soldering of the component should be achieved using a Sn60/40 type or a silver-bearing Sn62/36/2Ag type solder. Ceramic capacitors are very sensitive to rapid changes in temperature (thermal shock) therefore the solder heat resistance specification (see Soldering Specifications table) should not be exceeded. Subjecting the capacitor to excessive heating may result in thermal shocks that can crack the ceramic body. Similarly, excessive heating can cause the internal solder junction to melt.

## CLEANING

The components should be cleaned immediately following the soldering operation with vapor degreasers.

## SOLVENT RESISTANCE

The coating and marking of the capacitors are resistant to the following test method: IEC 60068-2-45 (method XA).

## MOUNTING

If a defined product stop is required for mounting on a PCB, a mechanically formed product stop (kinked or inline wire) or a mounting tool should be used.

We do not recommend modifying the lead terminals, e.g. bending or cropping. This action could break the coating or crack the ceramic insert. If however, the lead must be modified in any way, we recommend support of the lead with a clamping fixture next to the coating.

## OPERATING VOLTAGE

In case the voltage is applied to the circuit, starting as well as stopping, may generate irregular voltage for a transit period because of resonance or switching. Be sure to use a capacitor with a rated voltage range that includes these irregular voltages.

## OPERATING TEMPERATURE AND SELF-GENERATED HEAT

Keep the surface temperature of a capacitor below the upper limit of its rated operating temperature range. Be sure to take into account the heat generated by the capacitor itself. When the capacitor is used in a high frequency, pulse, or similar application, it may have self-generated heat due to dielectric dissipation.

Temperature increase due to self-generated heating should not exceed 20 °C while operating at an atmosphere temperature of 25 °C.

When measuring, the surface temperature, make sure that the capacitor is not affected by radiant, conductive and convective heat by its surroundings. Excessive heat may lead to thermo-mechanical deterioration of the capacitor's characteristics and reliability.

| RELATED DOCUMENTS   |                                                                        |
|---------------------|------------------------------------------------------------------------|
| General Information | <a href="http://www.vishay.com/doc?22001">www.vishay.com/doc?22001</a> |
| CB Test Certificate | <a href="http://www.vishay.com/doc?22220">www.vishay.com/doc?22220</a> |
| VDE Marks Approval  | <a href="http://www.vishay.com/doc?22222">www.vishay.com/doc?22222</a> |
| UL Test Certificate | <a href="http://www.vishay.com/doc?22221">www.vishay.com/doc?22221</a> |



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