

# High Voltage Ceramic DC Disc Capacitors

## 10 kV<sub>DC</sub> and 15 kV<sub>DC</sub>



### LINKS TO ADDITIONAL RESOURCES



| QUICK REFERENCE DATA       |             |        |                    |        |
|----------------------------|-------------|--------|--------------------|--------|
| DESCRIPTION                | VALUE       |        |                    |        |
| Ceramic Class              | 1           |        | 2                  |        |
| Ceramic Dielectric         | T3M (N4700) |        | X5F, Y5R, Y5U, Z5U |        |
| Voltage (V <sub>DC</sub> ) | 10 000      | 15 000 | 10 000             | 15 000 |
| Min. Capacitance (pF)      | 250         | 100    | 100                | 100    |
| Max. Capacitance (pF)      | 1000        | 750    | 3300               | 2500   |
| Mounting                   | Radial      |        |                    |        |

### INSULATION RESISTANCE

Min. 1000 ΩF or 200 000 MΩ

### TOLERANCE ON CAPACITANCE

± 20 % or + 80 % / - 20 %

### DISSIPATION FACTOR

0.2 % max. at 1 kHz; 1 V (Class 1)

2.0 % max. at 1 kHz; 1 V (Class 2)

### CATEGORY TEMPERATURE RANGE

-25 °C to +85 °C

### CLIMATIC CATEGORY ACC. TO EN 60068-1

25 / 85 / 21

### OPERATING TEMPERATURE RANGE

-25 °C to +105 °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)

### FEATURES

- 20 kV rated voltage available on request
- Low losses
- High capacitance in small sizes
- High stability
- Radial leads
- Ceramic singlelayer capacitor
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT

### APPLICATIONS

- High voltage power supplies
- DC and pulse high voltage
- X-ray equipment, baggage scanner, air purifier, ionizer

### DESIGN

The capacitors consist of a ceramic disc of which both sides are silver-plated. Connection leads are made of tinned copper having diameters of 0.032" (0.81 mm).

The capacitors may be supplied with straight leads having lead spacing of 0.375" (9.5 mm), 0.500" (12.7 mm) or 0.750" (19.2 mm).

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

### CAPACITANCE RANGE

100 pF to 3300 pF

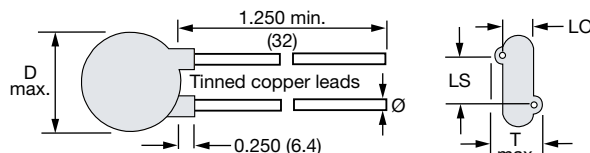
### DIELECTRIC STRENGTH BETWEEN LEADS

10 kV<sub>DC</sub>      15 000 V<sub>DC</sub>, 2 s  
15 kV<sub>DC</sub>      24 000 V<sub>DC</sub>, 2 s  
(in dielectric fluid)

### CERAMIC DIELECTRIC

T3M (Class 1)

X5F, Y5R, Y5U, Z5U (Class 2)

**DIMENSIONS** in inches (millimeters)

**ORDERING INFORMATION, CERAMIC 10 kV<sub>DC</sub>**

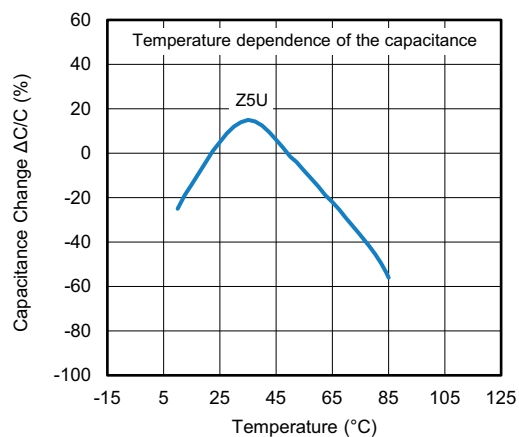
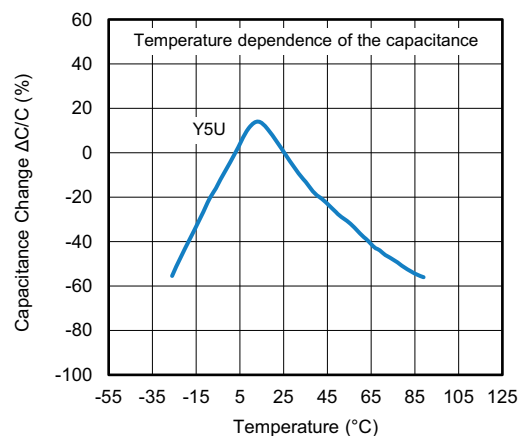
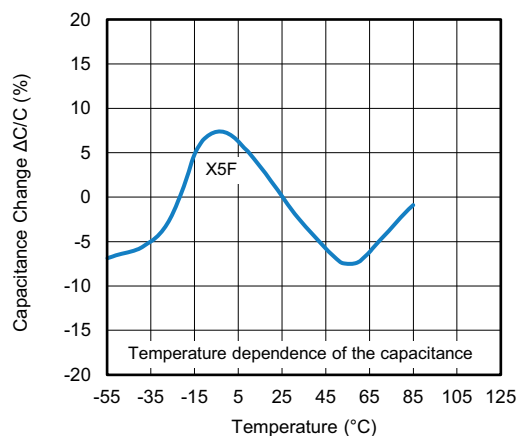
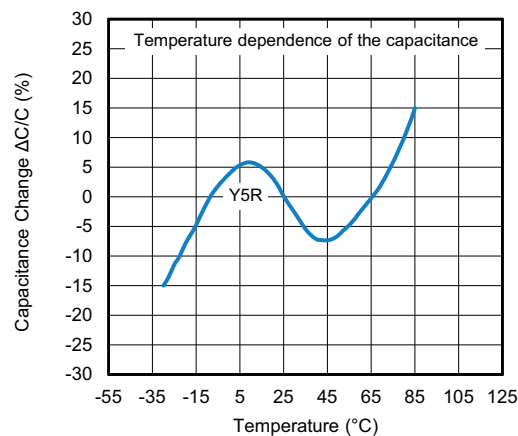
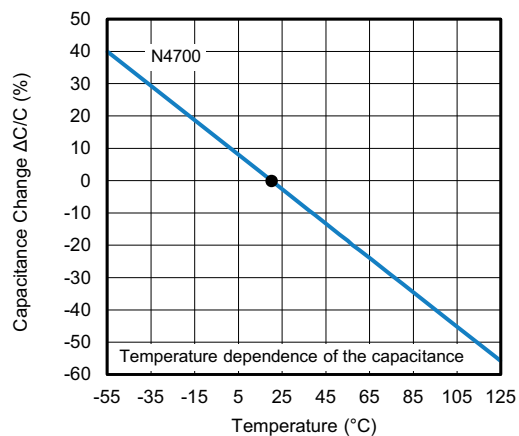
| C<br>(pF)   | TOL.<br>(%) | D <sub>max.</sub><br>DIAMETER<br>INCH (mm) | T <sub>max.</sub><br>THICKNESS<br>INCH (mm) | LS<br>LEAD SPACE<br>INCH (mm)<br>± 0.040" (± 1 mm) | LO<br>LEAD OFFSET<br>INCH (mm)<br>± 0.020" (± 0.5 mm) | WIRE SIZE |              | ORDERING<br>CODE |
|-------------|-------------|--------------------------------------------|---------------------------------------------|----------------------------------------------------|-------------------------------------------------------|-----------|--------------|------------------|
| T3M (N4700) |             |                                            |                                             |                                                    |                                                       |           |              |                  |
| 250         | ± 20        | 0.490 (12.4)                               | 0.290 (7.4)                                 | 0.375 (9.5)                                        | 0.193 (4.9)                                           | 20        | 0.032 (0.81) | 615R100GATT25    |
| 500         |             | 0.680 (17.3)                               | 0.272 (6.9)                                 | 0.500 (12.7)                                       | 0.173 (4.4)                                           |           |              | 615R100GATT50    |
| 680         |             | 0.750 (19.1)                               | 0.300 (7.6)                                 |                                                    | 0.181 (4.6)                                           |           |              | 615R100GATT68    |
| 820         |             | 0.810 (20.6)                               |                                             |                                                    | 0.181 (4.6)                                           |           |              | 615R100GATT82    |
| 1000        |             | 0.980 (24.9)                               |                                             |                                                    | 0.320 (8.1)                                           |           |              | 0.189 (4.8)      |
| X5F         |             |                                            |                                             |                                                    |                                                       |           |              |                  |
| 100         | ± 20        | 0.680 (17.3)                               | 0.382 (9.7)                                 | 0.500 (12.7)                                       | 0.283 (7.2)                                           | 20        | 0.032 (0.81) | 615R100GAT10     |
| 250         |             |                                            | 0.300 (7.6)                                 |                                                    | 0.201 (5.1)                                           |           |              | 615R100GAT25     |
| 500         |             |                                            | 0.345 (8.8)                                 |                                                    | 0.248 (6.3)                                           |           |              | 615R100GAT50     |
| Y5R         |             |                                            |                                             |                                                    |                                                       |           |              |                  |
| 100         | ± 20        | 0.490 (12.4)                               | 0.320 (8.1)                                 | 0.375 (9.5)                                        | 0.220 (5.6)                                           | 20        | 0.032 (0.81) | 615R100GAST10    |
| 250         |             |                                            | 0.331 (8.4)                                 |                                                    | 0.232 (5.9)                                           |           |              | 615R100GAST25    |
| 500         |             |                                            | 0.310 (7.9)                                 |                                                    | 0.213 (5.4)                                           |           |              | 615R100GAST50    |
| 1000        |             |                                            | 0.750 (19.1)                                | 0.320 (8.1)                                        | 0.500 (12.7)                                          |           |              | 0.220 (5.6)      |
| Y5U         |             |                                            |                                             |                                                    |                                                       |           |              |                  |
| 1000        | + 80 / - 20 | 0.680 (17.3)                               | 0.330 (8.4)                                 | 0.500 (12.7)                                       | 0.232 (5.9)                                           | 20        | 0.032 (0.81) | 615R100GASD10    |
| 2500        | ± 20        | 0.980 (24.9)                               |                                             |                                                    |                                                       |           |              | 615R100GATD25    |
| Z5U         |             |                                            |                                             |                                                    |                                                       |           |              |                  |
| 2500        | + 80 / - 20 | 0.750 (19.1)                               | 0.350 (8.9)                                 | 0.500 (12.7)                                       | 0.256 (6.5)                                           | 20        | 0.032 (0.81) | 615R100GAD25     |
| 3300        |             | 0.980 (24.9)                               | 0.390 (9.9)                                 |                                                    | 0.303 (7.7)                                           |           |              | 615R100GAD33     |

**ORDERING INFORMATION, CERAMIC 15 kV<sub>DC</sub>**

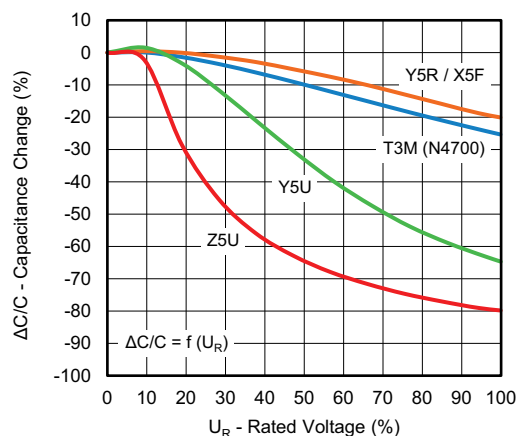
| C<br>(pF)   | TOL.<br>(%) | D <sub>max.</sub><br>DIAMETER<br>INCH (mm) | T <sub>max.</sub><br>THICKNESS<br>INCH (mm) | LS<br>LEAD SPACE<br>INCH (mm)<br>± 0.040" (± 1 mm) | LO<br>LEAD OFFSET<br>INCH (mm)<br>± 0.020" (± 0.5 mm) | WIRE SIZE |              | ORDERING<br>CODE |
|-------------|-------------|--------------------------------------------|---------------------------------------------|----------------------------------------------------|-------------------------------------------------------|-----------|--------------|------------------|
| T3M (N4700) |             |                                            |                                             |                                                    |                                                       |           |              |                  |
| 100         | ± 20        | 0.490 (12.4)                               | 0.470 (11.9)                                | 0.500 (12.7)                                       | 0.370 (9.4)                                           | 20        | 0.032 (0.81) | 615R150GATT10    |
| 250         |             | 0.670 (17.0)                               | 0.460 (11.7)                                | 0.750 (19.1)                                       | 0.362 (9.2)                                           |           |              | 615R150GATT25    |
| 390         |             | 0.750 (19.1)                               | 0.425 (10.8)                                |                                                    | 0.283 (7.2)                                           |           |              | 615R150GATT39    |
| 500         |             | 0.810 (20.6)                               | 0.382 (9.7)                                 |                                                    | 0.283 (7.2)                                           |           |              | 615R150GATT50    |
| 750         |             | 1.063 (27.0)                               | 0.430 (10.9)                                |                                                    | 0.331 (8.4)                                           |           |              | 615R150GATT75    |
| X5F         |             |                                            |                                             |                                                    |                                                       |           |              |                  |
| 100         | ± 20        | 0.670 (17.0)                               | 0.430 (10.9)                                | 0.750 (19.1)                                       | 0.331 (8.4)                                           | 20        | 0.032 (0.81) | 615R150GAT10     |
| 250         |             |                                            | 0.455 (11.6)                                |                                                    | 0.358 (9.1)                                           |           |              | 615R150GAT25     |
| Y5R         |             |                                            |                                             |                                                    |                                                       |           |              |                  |
| 100         | ± 20        | 0.490 (12.4)                               | 0.449 (11.4)                                | 0.500 (12.7)                                       | 0.350 (8.9)                                           | 20        | 0.032 (0.81) | 615R150GAST10    |
| 250         |             |                                            | 0.480 (12.2)                                | 0.750 (19.1)                                       | 0.382 (9.7)                                           |           |              | 615R150GAST25    |
| 500         |             | 0.670 (17.0)                               | 0.450 (11.4)                                |                                                    | 0.331 (8.4)                                           |           |              | 615R150GAT50     |
| 1000        |             | 0.980 (24.9)                               | 0.460 (11.7)                                |                                                    | 0.362 (9.2)                                           |           |              | 615R150GATD10    |
| Y5U         |             |                                            |                                             |                                                    |                                                       |           |              |                  |
| 500         | + 80 / - 20 | 0.490 (12.4)                               | 0.375 (9.5)                                 | 0.500 (12.7)                                       | 0.276 (7.0)                                           | 20        | 0.032 (0.81) | 615R150GAST50    |
| 1000        |             | 0.670 (17.0)                               | 0.420 (10.7)                                | 0.750 (19.1)                                       | 0.323 (8.2)                                           |           |              | 615R150GAD10     |
| Z5U         |             |                                            |                                             |                                                    |                                                       |           |              |                  |
| 2200        | + 80 / - 20 | 0.980 (24.9)                               | 0.510 (13.0)                                | 0.750 (19.1)                                       | 0.413 (10.5)                                          | 20        | 0.032 (0.81) | 615R150GAD22     |
| 2500        |             |                                            | 0.450 (11.4)                                |                                                    | 0.350 (8.9)                                           |           |              | 615R150GAD25     |



## CAPACITANCE CHANGE VS. TEMPERATURE (TYPICAL)



## CAPACITANCE CHANGE VS. VOLTAGE (TYPICAL)



## 1. QUALIFICATION

### 1.1 BASICS

All components are tested according to the related testing plan, which you find in series datasheet. We do not guarantee if any limit is exceeded. Internal test procedures are more severe than noted in the table “Performance” because of aging and storage effects of the components.

### 1.2 LIMITS OF APPLICATION

Please take care whilst designing our parts into one of these applications, which require highest reliability and possible errors might harm life, body or property of a third party.

- Transportation (aerospace, aircraft, train, ship, submarine, etc.)
- Medical equipment
- Critical control equipment (power plant, traffic signals, disaster prevention)
- Other application requiring similar reliability characteristics

## 2. STORAGE

### 2.1 ORIGINAL PACKAGING

Storing in the sealed original packages is preferred.

### 2.2 STORING CONDITIONS

Epoxy coating does not protect perfectly from all environmental conditions. Some materials can penetrate the epoxy and harm the performance of the parts. Therefore it is not recommended to use or store the parts in corrosive or humid atmosphere.

Optimal storing conditions should not exceed +10 °C to +35 °C and relative humidity up to 60 %.

## 3. ASSEMBLY

### 3.1 WIRE FORMING

If wire forming is needed, excessive mechanical force to the component body must be avoided as it might cause cracks in the ceramic element.

Do not crack coating extension of the epoxy layer, when applying force onto the wire.

### 3.2 SOLDERING

For best performance it is recommended to dry the components at 125 °C for 2 hours before assembly.

Do not exceed resistance to soldering heat specification of the component. Subjecting this product to excessive heating could melt the internal junction solder and may result in thermal shocks that can crack the ceramic element.

#### Manual Soldering / Rework

Set the soldering iron (50 W max.) to less than 300 °C and solder the wires within 4 seconds onto the PCB. Exceeding that recommendations might reduce the electrical performance of the component.

**Wave Soldering**

Most common way to assemble these kind of components is carried out in 4 steps:

1. Increasing temperature to 120 °C within about 20 s
2. Preheating at 120 °C for about 60 s
3. Soldering at 260 °C in less than 10 s
4. Gradual air cooling in constant air flow

**Reflow Soldering**

It is not recommended to use reflow soldering with these components.

**3.3 MOLDING AND COATING**

Molding and / or applying another coating material might harm the performance of the components. Therefore it is recommended to test the electrical characteristics of the molded / coated part in advance.

Typical error is a reduced withstand voltage because of an inadequate solvent in the molding material, which penetrates the epoxy coating (please see recommendations for cleaning and drying in section 4.1 to 4.3). A similar result can be caused by an inadequate coating material, which might pull the original epoxy off the ceramic element.

**4. CLEANING AND DRYING****4.1 CLEANING AGENTS**

Cleaning agents might have an influence to the performance of the components after washing and after unsuitable drying. The following agents have been tested and classified:

**Recommended**

- DI water
- Isopropanol
- Ethanol
- Ehtyl alcohol
- ...

**Not Recommended**

- Acetone
- ...

**4.2 ULTRASONIC**

Settings for ultrasonic cleaning

Rinse bath capacity: output of 20 Watts per liter or less

Rinsing time: 300 s max.

Do not vibrate the PCB / PWB directly.

Excessive ultrasonic cleaning may lead to permanent destruction of the component.

**4.3 DRYING**

In case of cleaning the assembled PCB with cleaning agents a proper drying is recommended. It is recommended to properly insulate the assembled PCB (see section 5.2) after drying.

**5. TESTING AND OPERATION****5.1 SHORT CIRCUIT**

Avoid repetitive zero-ohm-short circuits because they might harm the components core construction, such as arcs between lead wires because of inadequate insulation material (e.g air).

**5.2 INSULATION**

During operation, components should be surrounded by adequate insulating material (silicone oil, epoxy, or molding material). Voltage breakdowns or leakage current through this material (between lead wires or to ground) is not acceptable. It is recommended to properly clean and dry the assembled PCB (see section 4.1 to 4.3) before enclosing in insulating material.

**5.3 APPLIED VOLTAGE**

When using DC-rated components in AC applications (also ripple) the peak-to-peak voltage should not exceed the nominal DC-rating of the component.

## 6. CAUTION

### 6.1 OPERATING VOLTAGE AND FREQUENCY CHARACTERISTIC

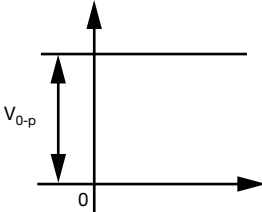
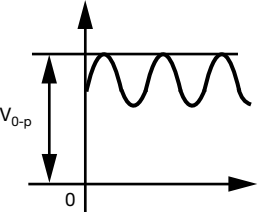
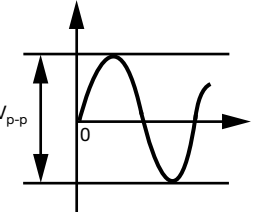
When sinusoidal or ripple voltage applied to DC ceramic disc capacitors, be sure to maintain the peak-to-peak value or the peak value of the sum of both AC + DC within the rated voltage.

When start or stop applying the voltage, resonance may generate irregular voltage.

When rectangular or pulse wave voltage is applied to DC ceramic disc capacitors, the self-heating generated by the capacitor is higher than the sinusoidal application with the same frequency. The allowable voltage rating for the rectangular or pulse wave corresponds approximately with the allowable voltage of a sinusoidal wave with the double fundamental frequency.

The allowable voltage varies, depending on the voltage and the waveform.

Diagrams of the limiting values are available for each capacitor series on request.

| VOLTAGE         | DC                                                                                | DC + AC                                                                            | AC                                                                                  |
|-----------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Waveform figure |  |  |  |

### 6.2 OPERATING TEMPERATURE AND SELF-GENERATED HEAT

The surface temperature of the capacitors must not exceed the upper limit of its rated operating temperature.

During operation in a high frequency circuit or a pulse signal circuit, the capacitor itself generate heat due to dielectric losses.

Applied voltage should be the load such as self-generated heat is within 20 °C on the condition of environmental temperature 25 °C.

Note, that excessive heat may lead to deterioration of the capacitor's characteristics.

## RELATED DOCUMENTS

General Information

[www.vishay.com/doc?23140](http://www.vishay.com/doc?23140)



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Hyperlinks included in this datasheet may direct users to third-party websites. These links are provided as a convenience and for informational purposes only. Inclusion of these hyperlinks does not constitute an endorsement or an approval by Vishay of any of the products, services or opinions of the corporation, organization or individual associated with the third-party website. Vishay disclaims any and all liability and bears no responsibility for the accuracy, legality or content of the third-party website or for that of subsequent links.

Vishay products are not designed for use in life-saving or life-sustaining applications or any application in which the failure of the Vishay product could result in personal injury or death unless specifically qualified in writing by Vishay. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.