

Lower Voltage Ceramic Singlelayer DC Disc Capacitors 2 kV_{DC} to 7.5 kV_{DC}


RoHS
COMPLIANT

FEATURES

- Low losses
- High capacitance in small sizes
- High stability
- Radial leads
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Lighting ballasts
- SMPS
- DC and pulse high voltage

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 0.025" (0.64 mm) or 0.032" (0.81 mm).

The capacitors may be supplied with radial kinked or straight leads having lead spacing of 0.250" (6.35 mm) or 0.375" (9.5 mm) or 0.500" (12.7 mm).

The standard tolerances are $\pm 10\%$ or $\pm 20\%$.

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

CAPACITANCE RANGE

 10 pF to 0.10 μ F

RATED VOLTAGE

 2 kV_{DC}
 3 kV_{DC}
 6 kV_{DC}
 7.5 kV_{DC}
DIELECTRIC STRENGTH BETWEEN LEADS

Component test, 100 % test at product line:

 2 kV_{DC} 3600 V_{DC}, 2 s
 3 kV_{DC} 5000 V_{DC}, 2 s
 6 kV_{DC} 10 500 V_{DC}, 2 s
 7.5 kV_{DC} 11 250 V_{DC}, 2 s

CERAMIC DIELECTRIC

 C0G, U2J, R3L (Class 1)
 X7R, X5F, X5S, Y5S, Y5U, Y5V, Z5U (Class 2)

| QUICK REFERENCE DATA | | | | | | |
|----------------------------|----------|---------------|-------------------------|-----------------------------------|--------------------|---------------|
| DESCRIPTION | VALUE | | | | | |
| Ceramic class | 1 | | 2 | | | |
| Ceramic dielectric | U2J, R3L | C0G, U2J, R3L | X7R, Y5S, Y5U, Z5U, Y5V | X5F, X5R, X5S, X7R, Y5S, Y5U, Z5U | X5F, X5S, Y5U, Z5U | X5F, Y5U, Z5U |
| Voltage (V _{DC}) | 3000 | 6000 | 2000 | 3000 | 6000 | 7500 |
| Min. capacitance (pF) | 10 | 10 | 100 | 47 | 100 | 100 |
| Max. capacitance (pF) | 33 | 47 | 100 000 | 33 000 | 10 000 | 2500 |
| Mounting | Radial | | | | | |

INSULATION RESISTANCE

 2 kV_{DC} min. 10 000 M Ω
 3 kV_{DC} min. 50 000 M Ω ⁽¹⁾
 6 kV_{DC} min. 75 000 M Ω
 7.5 kV_{DC} min. 200 000 M Ω
Note
⁽¹⁾ Exemption: 565R30GASS33 min. 25 000 M Ω
TOLERANCE ON CAPACITANCE
 $\pm 10\%$, $\pm 20\%$, -20% to $+80\%$
DISSIPATION FACTOR

 Class 1: 0.2 % max. at 1 MHz; 1 V
 Class 2: 2.0 % max. at 1 kHz; 1 V

CATEGORY TEMPERATURE RANGE

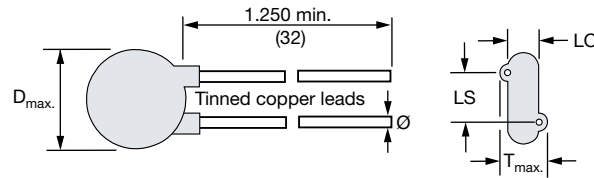
-25 °C to +85 °C

CLIMATIC CATEGORY ACC. TO EN 60068-1

25/085/21

OPERATING TEMPERATURE RANGE

 -25 °C to +105 °C ⁽¹⁾
Note
⁽¹⁾ For explanation about the difference of operating temperature range and temperature characteristic of capacitance, please see www.vishay.com/doc?48299

DIMENSIONS in inches (millimeters)

ORDERING INFORMATION, CERAMIC 2 kV_{DC}

| C (pF) | TOL. (%) | D _{max.} DIAMETER INCH (mm) | T _{max.} THICKNESS INCH (mm) | LS LEAD SPACE INCH (mm) ± 1 mm | LO LEAD OFFSET INCH (mm) ± 0.5 mm | WIRE SIZE | | ORDERING CODE |
|------------|-------------|--|---|---|--|-----------|--------------|------------------|
| | | | | | | AWG | INCH (mm) | |
| X7R | | | | | | | | |
| 100 | ± 10 | 0.330 (8.4) | 0.190 (4.8) | 0.250 (6.4) | 0.075 (1.9) | 20 | 0.032 (0.81) | 564R20TST10 |
| 220 | | | 0.180 (4.6) | | 0.071 (1.8) | | | 564R20TST22 |
| 330 | | | 0.170 (4.3) | | 0.075 (1.9) | | | 564R20TST33 |
| 470 | | | 0.185 (4.7) | | 0.063 (1.6) | | | 564R20TST47 |
| 560 | | | 0.175 (4.4) | | 0.087 (2.2) | | | 564R20TST56 |
| 680 | | | 0.175 (4.4) | | 0.075 (1.9) | | | 564R20TST68 |
| 1000 | | 0.400 (10.2) | 0.175 (4.4) | | 0.083 (2.1) | | | 564R20TSD10 |
| 1500 | | 0.460 (11.7) | 0.160 (4.1) | | 0.063 (1.6) | | | 564R20TSD15 |
| 1800 | | | 0.170 (4.3) | | 0.055 (1.4) | | | 564R20TSD18 |
| 2200 | | | | | 0.067 (1.7) | | | 564R20TSD22 |
| 3300 | | | | | 0.063 (1.6) | | | 564R20TSD33 |
| 3900 | | | | | 0.075 (1.9) | | | 564R20TSD39 |
| 4700 | | | 0.680 (17.3) | | 0.375 (9.5) | | | 0.071 (1.8) |
| Y5S | | | | | | | | |
| 1000 | ± 20 | 0.330 (8.4) | 0.175 (4.4) | 0.250 (6.4) | 0.067 (1.7) | 20 | 0.032 (0.81) | 564R20TSSD10 |
| 2200 | | 0.460 (11.7) | 0.170 (4.3) | | 0.071 (1.8) | | | 564R20TSSD22 |
| 5600 | | 0.790 (20.0) | 0.190 (4.8) | | 0.091 (2.3) | | | 564R20TSSD56 |
| Y5U | | | | | | | | |
| 1000 | ± 20 | 0.330 (8.4) | 0.170 (4.3) | 0.250 (6.4) | 0.067 (1.7) | 20 | 0.032 (0.81) | 564R20GAD10 |
| 1500 | | 0.330 (8.4) | 0.170 (4.3) | | 0.071 (1.8) | | | 564R20GAD15 |
| Z5U | | | | | | | | |
| 1800 | ± 20 | 0.360 (9.1) | 0.170 (4.3) | 0.250 (6.4) | 0.071 (1.8) | 20 | 0.032 (0.81) | 564R20GAD18 |
| 2200 | | 0.400 (10.2) | 0.175 (4.4) | | 0.075 (1.9) | | | 564R20GAD22 |
| 3300 | | 0.430 (10.9) | | | 0.071 (1.8) | | | 564R20GAD33 |
| 4700 | | 0.530 (13.5) | | | 0.075 (1.9) | | | 564R20GAD47 |
| 6800 | | 0.560 (14.2) | 0.170 (4.3) | | 0.375 (9.5) | | | 0.067 (1.7) |
| Y5V | | | | | | | | |
| 0.01 μF | ± 20 | 0.620 (15.7) | 0.170 (4.3) | 0.375 (9.5) | 0.067 (1.7) | 20 | 0.032 (0.81) | 564R20GASS10 |
| 0.05 μF | | 0.950 (24.1) | 0.174 (4.4) | | 0.067 (1.7) | | | 20 |
| 0.10 μF | | 0.950 (24.1) | 0.240 (6.1) | | 0.067 (1.7) | 22 | 0.025 (0.64) | 565R20GAP10 |



| ORDERING INFORMATION, CERAMIC 3 kV _{DC} | | | | | | | | | | | | |
|--|-------------|--|---|---|--|-----------|--------------|------------------|--------------|--------------|-------------|-------------|
| C (pF) | TOL. (%) | D _{max.} DIAMETER INCH (mm) | T _{max.} THICKNESS INCH (mm) | LS LEAD SPACE INCH (mm) ± 1 mm | LO LEAD OFFSET INCH (mm) ± 0.5 mm | WIRE SIZE | | ORDERING CODE | | | | |
| | | | | | | AWG | INCH (mm) | | | | | |
| U2J (N750) | | | | | | | | | | | | |
| 10 | ± 20 | 0.330 (8.4) | 0.210 (5.3) | 0.250 (6.4) | 0.110 (2.8) | 20 | 0.032 (0.81) | 564R30GAQ10 | | | | |
| R3L (N2200) | | | | | | | | | | | | |
| 22 | ± 20 | 0.330 (8.4) | 0.200 (5.1) | 0.250 (6.4) | 0.102 (2.6) | 20 | 0.032 (0.81) | 564R30GAQ22 | | | | |
| 27 | | | 0.190 (4.8) | | 0.091 (2.3) | | | 564R30GAQ27 | | | | |
| 33 | | | 0.170 (4.3) | | 0.071 (1.8) | | | 564R30GAQ33 | | | | |
| X5F | | | | | | | | | | | | |
| 56 | ± 20 | 0.330 (8.4) | 0.190 (4.8) | 0.250 (6.4) | 0.091 (2.3) | 20 | 0.032 (0.81) | 564R30GAQ56 | | | | |
| 68 | | | 0.200 (5.1) | | 0.102 (2.6) | | | 564R30GAQ68 | | | | |
| 270 | | | 0.180 (4.6) | | 0.083 (2.1) | | | 564R30GAT27 | | | | |
| X5R | | | | | | | | | | | | |
| 330 | ± 20 | 0.330 (8.4) | 0.175 (4.4) | 0.250 (6.4) | 0.075 (1.9) | 20 | 0.032 (0.81) | 564R30GAT33 | | | | |
| X5S | | | | | | | | | | | | |
| 470 | ± 20 | 0.330 (8.4) | 0.175 (4.4) | 0.250 (6.4) | 0.075 (1.9) | 20 | 0.032 (0.81) | 564R30GAT47 | | | | |
| X7R | | | | | | | | | | | | |
| 47 | ± 20 | 0.330 (8.4) | 0.230 (5.8) | 0.250 (6.4) | 0.130 (3.3) | 20 | 0.032 (0.81) | 564R30GAQ47 | | | | |
| 100 | | | 0.180 (4.6) | | 0.083 (2.1) | | | 564R30GAT10 | | | | |
| 150 | | | 0.190 (4.8) | | 0.091 (2.3) | | | 564R30GAT15 | | | | |
| 220 | | | 0.175 (4.4) | | 0.075 (1.9) | | | 564R30GAT22 | | | | |
| 390 | | | 0.180 (4.6) | | 0.083 (2.1) | | | 564R30GAT39 | | | | |
| 680 | ± 10 | 0.330 (8.4) | 0.180 (4.6) | 0.250 (6.4) | 0.079 (2.0) | 20 | 0.032 (0.81) | 564R30TST68 | | | | |
| 1000 | | | 0.400 (10.2) | | 0.190 (4.8) | | | 0.091 (2.3) | 564R30TSD10 | | | |
| 1500 | | | 0.490 (12.5) | | 0.185 (4.7) | | | 0.087 (2.2) | 564R30TSD15 | | | |
| 1800 | | | 0.530 (13.5) | | 0.180 (4.6) | | | 0.079 (2.0) | 564R30TSD18 | | | |
| 2200 | | | | | | | | 0.079 (2.0) | 564R30TSD22 | | | |
| 2700 | | | 0.620 (15.7) | | 0.185 (4.7) | | | 0.185 (4.7) | 0.083 (2.1) | 564R30TSD27 | | |
| 3300 | | | | | | | | | 0.170 (4.3) | 0.075 (1.9) | 564R30TSD33 | |
| 3900 | | | | | | | | | 0.720 (18.3) | 0.185 (4.7) | 0.087 (2.2) | 564R30TSD39 |
| 4700 | | | | | | | | | | | 0.175 (4.4) | 0.075 (1.9) |
| 6800 | | | 0.900 (22.9) | | 0.185 (4.7) | | | 0.087 (2.2) | 564R30TSD68 | | | |
| Y5S | | | | | | | | | | | | |
| 1000 | ± 20 | 0.400 (10.2) | 0.190 (4.8) | 0.250 (6.4) | 0.098 (2.5) | 20 | 0.032 (0.81) | 564R30TSSD10 | | | | |
| 1500 | | 0.460 (11.7) | | | 0.091 (2.3) | | | 564R30TSSD15 | | | | |
| 1800 | | 0.490 (12.4) | | | 0.087 (2.2) | | | 564R30TSSD18 | | | | |
| 2200 | | 0.530 (13.5) | | | 0.185 (4.7) | | | 0.083 (2.1) | 564R30TSSD22 | | | |
| 2700 | | 0.560 (14.2) | | | | | | | 0.087 (2.2) | 564R30TSSD27 | | |
| 3300 | | 0.620 (15.7) | 0.185 (4.7) | 0.375 (9.5) | 0.083 (2.1) | | | 564R30TSSD33 | | | | |
| 3900 | | | | | 0.087 (2.2) | | | 564R30TSSD39 | | | | |
| 4700 | | 0.680 (17.3) | 0.190 (4.8) | 0.375 (9.5) | 0.091 (2.3) | | | 564R30TSSD47 | | | | |
| 5600 | | | | | 0.091 (2.3) | | | 564R30TSSD56 | | | | |
| 6800 | | | | | 0.900 (22.9) | | | 0.205 (5.2) | 0.102 (2.6) | 564R30TSSD68 | | |
| Y5U | | | | | | | | | | | | |
| 680 | ± 20 | 0.330 (8.4) | 0.175 (4.4) | 0.250 (6.4) | 0.075 (1.9) | 20 | 0.032 (0.81) | 564R30GAT68 | | | | |
| 0.010 µF | | 0.720 (18.3) | 0.185 (4.7) | 0.375 (9.5) | 0.091 (2.3) | | | 564R30GAS10 | | | | |
| Z5U | | | | | | | | | | | | |
| 1000 | ± 20 | 0.330 (8.4) | 0.190 (4.8) | 0.250 (6.4) | 0.098 (2.5) | 20 | 0.032 (0.81) | 564R30GAD10 | | | | |
| 1500 | | 0.360 (9.1) | | | 0.091 (2.3) | | | 564R30GAD15 | | | | |
| 1800 | | 0.400 (10.2) | | | 0.098 (2.5) | | | 564R30GAD18 | | | | |
| 2200 | | 0.430 (10.9) | | | 0.091 (2.3) | | | 564R30GAD22 | | | | |
| 2700 | | 0.460 (11.7) | | | 0.200 (5.1) | | | 0.098 (2.5) | 564R30GAD27 | | | |
| 3300 | | 0.530 (13.5) | 0.185 (4.7) | 0.087 (2.2) | 564R30GAD33 | | | | | | | |
| 3900 | | | | | 564R30GAD39 | | | | | | | |
| 4700 | | 0.620 (15.7) | 0.195 (5.0) | 0.375 (9.5) | 0.091 (2.3) | | | 564R30GAD47 | | | | |
| 6800 | | | | | 0.102 (2.6) | | | 564R30GAD68 | | | | |
| 8200 | | | | | 0.102 (2.6) | | | 564R30GAD82 | | | | |
| 0.020 µF | ± 20 | 0.720 (18.3) | 0.265 (6.7) | 0.375 (9.5) | 0.087 (2.2) | 22 | 0.025 (0.64) | 565R30GASS20 | | | | |
| 0.033 µF | | 0.900 (22.9) | 0.240 (6.1) | 0.375 (9.5) | 0.087 (2.2) | 22 | 0.025 (0.64) | 565R30GASS33 | | | | |



| ORDERING INFORMATION, CERAMIC 6 kV _{DC} | | | | | | | | |
|--|-------------|--|---|---|--|-----------|--------------|------------------|
| C (pF) | TOL. (%) | D _{max.} DIAMETER INCH (mm) | T _{max.} THICKNESS INCH (mm) | LS LEAD SPACE INCH (mm) ± 1 mm | LO LEAD OFFSET INCH (mm) ± 0.5 mm | WIRE SIZE | | ORDERING CODE |
| | | | | | | AWG | INCH (mm) | |
| C0G (NP0) | | | | | | | | |
| 10 | ± 20 | 0.400 (10.2) | 0.220 (5.6) | 0.375 (9.5) | 0.122 (3.1) | 20 | 0.032 (0.81) | 564R60GAQ10 |
| U2J (N750) | | | | | | | | |
| 22 | ± 20 | 0.460 (11.7) | 0.240 (6.1) | 0.375 (9.5) | 0.142 (3.6) | 20 | 0.032 (0.81) | 564R60GAQ22 |
| R3L (N2200) | | | | | | | | |
| 33 | ± 20 | 0.400 (10.2) | 0.230 (5.8) | 0.375 (9.5) | 0.130 (3.3) | 20 | 0.032 (0.81) | 564R60GAQ33 |
| 47 | | 0.460 (11.7) | | | 0.126 (3.2) | | | 564R60GAQ47 |
| X5F | | | | | | | | |
| 100 | ± 20 | 0.400 (10.2) | 0.240 (6.1) | 0.375 (9.5) | 0.142 (3.6) | 20 | 0.032 (0.81) | 564R60GAT10 |
| 220 | | | 0.265 (6.7) | | 0.165 (4.2) | | | 564R60GAT22 |
| X5S | | | | | | | | |
| 330 | ± 20 | 0.400 (10.2) | 0.260 (6.6) | 0.375 (9.5) | 0.161 (4.1) | 20 | 0.032 (0.81) | 564R60GAT33 |
| Y5U | | | | | | | | |
| 470 | ± 20 | 0.400 (10.2) | 0.290 (7.4) | 0.375 (9.5) | 0.193 (4.9) | 20 | 0.032 (0.81) | 564R60GAT47 |
| 560 | | | 0.240 (6.1) | | 0.142 (3.6) | | | 564R60GAT56 |
| Z5U | | | | | | | | |
| 1000 | ± 20 | 0.400 (10.2) | 0.270 (6.9) | 0.375 (9.5) | 0.173 (4.4) | 20 | 0.032 (0.81) | 564R60GAD10 |
| 1500 | | 0.460 (11.7) | 0.280 (7.1) | | 0.157 (4.0) | | | 564R60GAD15 |
| 2200 | | 0.530 (13.5) | 0.240 (6.1) | | 0.142 (3.6) | | | 564R60GAD22 |
| 3300 | | 0.620 (15.7) | 0.260 (6.6) | | 0.169 (4.3) | | | 564R60GAD33 |
| 4700 | | 0.790 (20.0) | | | 0.161 (4.1) | | | 564R60GAD47 |
| 0.010 μF | | 0.950 (24.1) | 0.250 (6.4) | | 0.150 (3.8) | | | 564R60GAS10 |

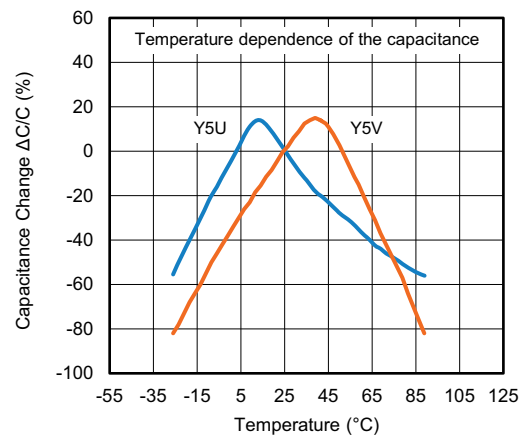
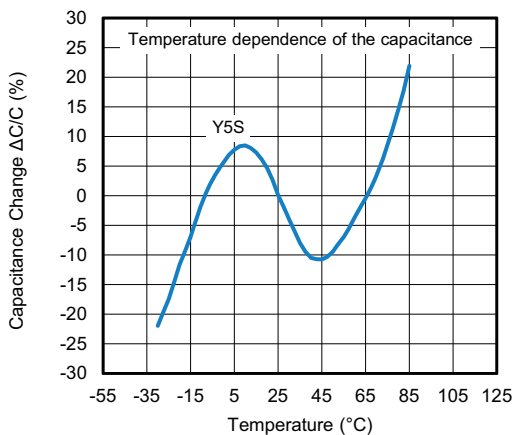
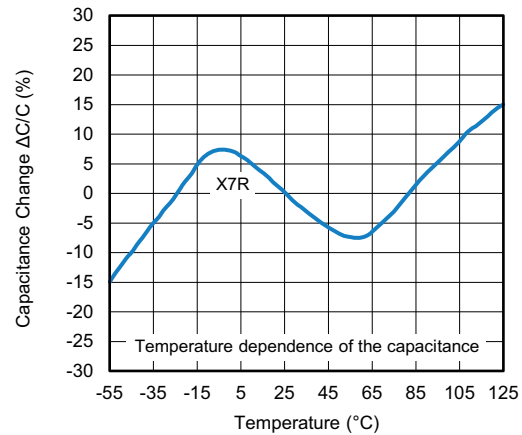
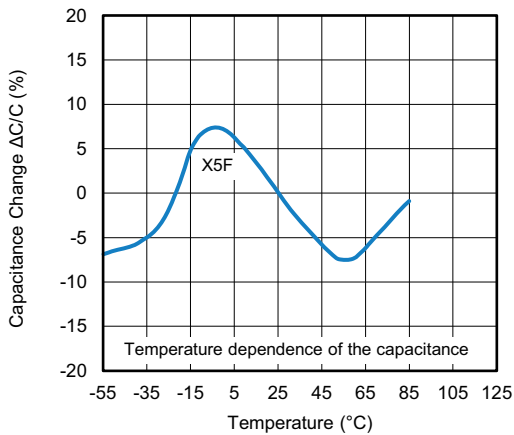
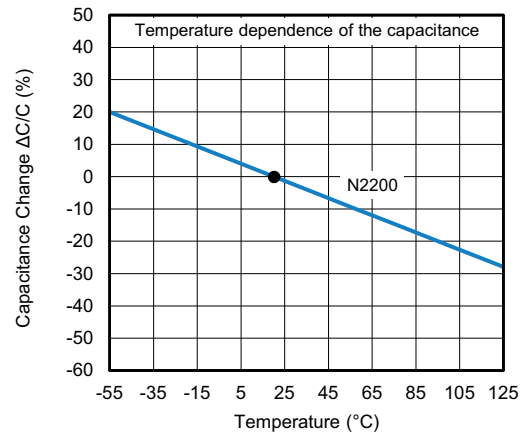
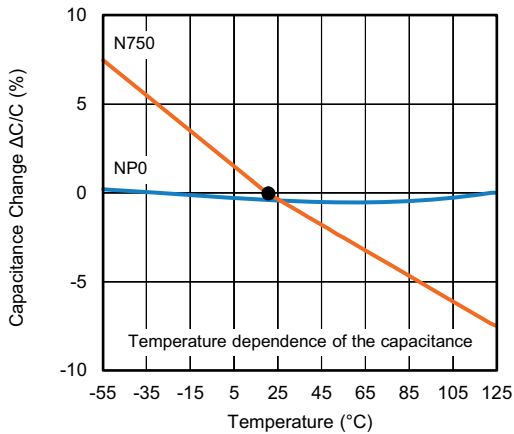
| ORDERING INFORMATION, CERAMIC 7.5 kV _{DC} | | | | | | | | |
|--|-------------|--|---|---|--|-----------|--------------|------------------|
| C (pF) | TOL. (%) | D _{max.} DIAMETER INCH (mm) | T _{max.} THICKNESS INCH (mm) | LS LEAD SPACE INCH (mm) ± 1 mm | LO LEAD OFFSET INCH (mm) ± 0.5 mm | WIRE SIZE | | ORDERING CODE |
| | | | | | | AWG | INCH (mm) | |
| X5F | | | | | | | | |
| 100 | ± 20 | 0.530 (13.5) | 0.310 (7.9) | 0.500 (12.7) | 0.181 (4.6) | 20 | 0.032 (0.81) | 564R75GAT10 |
| 470 | | 0.620 (15.7) | 0.270 (6.9) | | 0.161 (4.1) | | | 564R75GAT47 |
| Y5U | | | | | | | | |
| 1000 | + 80 / - 20 | 0.620 (15.7) | 0.320 (8.1) | 0.500 (12.7) | 0.181 (4.6) | 20 | 0.032 (0.81) | 564R75GAD10 |
| Z5U | | | | | | | | |
| 2500 | + 80 / - 20 | 0.620 (15.7) | 0.280 (7.1) | 0.500 (12.7) | 0.181 (4.6) | 20 | 0.032 (0.81) | 564R75GAD25 |

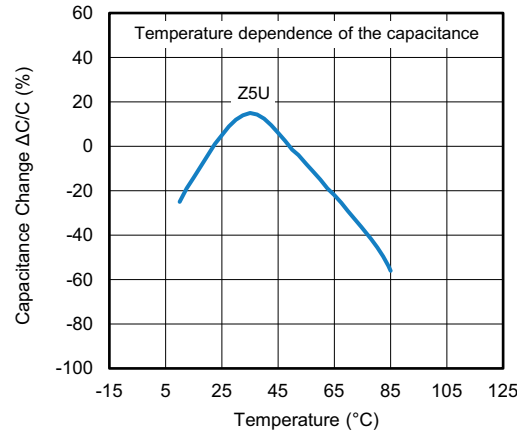
TAPE AND REEL OPTIONS

Part number codes and specifications for tape and reel packaging are found in the general information document www.vishay.com/doc?23140.



CAPACITANCE CHANGE VS. TEMPERATURE (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 +40 °C, relative humidity up to 60 % RH). Class 2 ceramic dielectric capacitors are also subject to aging see general information (www.vishay.com/doc?23140).

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 ± 5) °C | (260 ± 5) °C |
| Soldering duration | (2 ± 0.5) s | (10 ± 1) s |
| Distance from component body | ≥ 2 mm | ≥ 5 mm |

SOLDERING RECOMMENDATIONS

Ceramic capacitors are very sensitive to rapid changes in temperature (thermal shock) therefore the solder heat resistance specification (see table above) should not be exceeded. Exposing 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.

When soldering radial leaded ceramic capacitors with a soldering iron, it should be performed under the following conditions and should not exceed:

- Maximum temperature of iron-tip: 400 °C
- Maximum soldering iron wattage: 50 W
- Maximum soldering time: 3.5 s

Failure to follow the above cautions may result, in worst case, in short circuit or cause fuming or thermo-mechanical damage when the product is used.

Leaded ceramic capacitors are not designed for reflow process or dipping the body into a solder melt.

CLEANING

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

CLEANING (ULTRASONIC CLEANING)

To perform ultrasonic cleaning, observe the following conditions:

- Maximum rinse bath capacity output: 20 W/liter
- Maximum rinsing time: 300 s
- Do not vibrate the PCB/PWB directly
- Excessive ultrasonic cleaning may lead to mechanical damage



SOLVENT RESISTANCE

The coating and marking of the capacitors are resistant to the following test method:

IEC 60068-2-45 (method XA)

MOUNTING

We do not recommend modifying the lead terminals, e.g. bending or cropping. This action could break the coating or crack the ceramic insert. In order to avoid such failures we are offering different lead wire designs (e.g. straight, inline, inside crimp, outside crimp etc.) If however, the lead must be modified in any way, we recommend support of the lead with a clamping fixture next to the coating. If a defined product stop is required for mounting on a PCB, a mechanically formed product stop or a mounting tool should be used.

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 | www.vishay.com/doc?23140 |



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