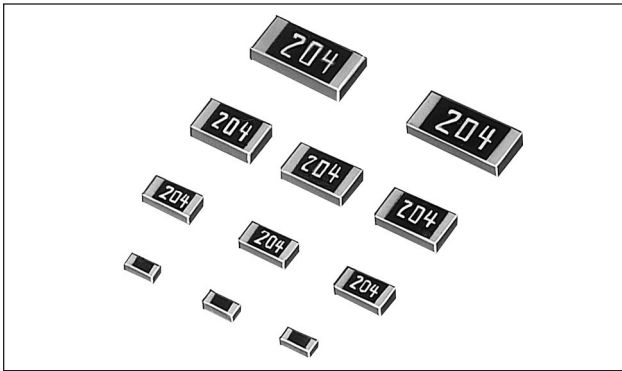


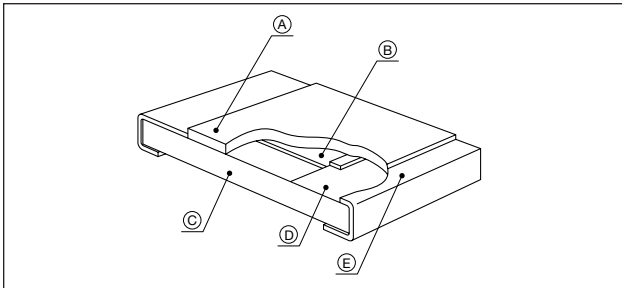
# Thick Film Chip Resistors



## CR, CJ Series



### STRUCTURE AND MATERIAL



| Code | Structure   | Material  |
|------|-------------|---|
| A    | Coating     | Glass or Epoxy  |
| B    | Resistor    | RuO <sub>2</sub> Resistor<br>(The same material of Termination for chip jumper) |
| C    | Substrate   | 96% Alumina   |
| D    | Termination | Silver  |
| E    | Plating     | (Ni, Sn-Pb) Plating   |

### FEATURES

- Low Noise
- Nickel Barrier Terminations

### APPLICATION

- General Purpose

### HOW TO ORDER

**CR 05 - 472 J - H**

#### Packaging

- T = 7" Reel/Punched Paper Tape (5,000 pcs/reel) except CR05
- H = 7" Reel/Punched Paper Tape (10,000 pcs/reel, 2mm pitch taping) CR05 and CR10
- D = 10" Reel/Punched Paper Tape (10,000 pcs/reel) CR32, CR21, CR10
- K = 13" Reel/Punched Paper Tape (20,000 pcs/reel) except CR05 (optional)

#### Resistance Tolerance

- D = ±0.5%      J = ±5%
- F = ±1%      Blank = Jumper Chips

#### Resistance Value (3 digits or 4 digits)

Example: 562 =  $56 \times 10^2 = 5600\Omega$   
 4021 =  $402 \times 10^1 = 4020\Omega$   
 Chip Jumper = 000

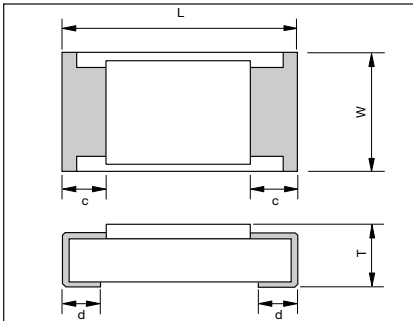
#### Size (EIA)

- 05 = 0402      21 = 0805
- 10 = 0603      32 = 1206

#### Series

CR = Resistor CJ = Jumper

### DIMENSIONS



millimeters (inches)

|   | CR05, CJ05 (0402)          | CR10, CJ10 (0603)   | CR21, CJ21 (0805)   | CR32, CJ32 (1206)   |
|---|----------------------------|---|---|---|
| W | 0.50±0.05<br>(0.020±0.002) | 0.80 <sup>+0.18</sup> <sub>-0.004</sub><br>(0.031 <sup>+0.009</sup> <sub>-0.004</sub> ) | 1.25 <sup>+0.18</sup> <sub>-0.009</sub><br>(0.050 <sup>+0.009</sup> <sub>-0.009</sub> ) | 1.55 <sup>+0.18</sup> <sub>-0.009</sub><br>(0.061 <sup>+0.009</sup> <sub>-0.009</sub> ) |
| L | 1.00±0.05<br>(0.039±0.002) | 1.60±0.10<br>(0.063±0.004)  | 2.00±0.10<br>(0.080±0.004)  | 3.10±0.10<br>(0.122±0.004)  |
| C | 0.20±0.15<br>(0.008±0.006) | 0.25±0.20<br>(0.010±0.008)  | 0.35±0.20<br>(0.014±0.008)  | 0.45±0.20<br>(0.018±0.008)  |
| d | 0.20±0.10<br>(0.008±0.004) | 0.20 <sup>+0.20</sup> <sub>-0.008</sub><br>(0.008 <sup>+0.008</sup> <sub>-0.008</sub> ) | 0.40±0.20<br>(0.016±0.008)  | 0.45±0.20<br>(0.018±0.008)  |
| T | 0.35±0.05<br>(0.014±0.002) | 0.50±0.10<br>(0.020±0.004)  | 0.55±0.10<br>(0.022±0.004)  | 0.55 <sup>+0.10</sup> <sub>-0.004</sub><br>(0.022 <sup>+0.010</sup> <sub>-0.004</sub> ) |

### SPECIFICATIONS

| Series                 | CR05 (0402)                        | CR10 (0603)  | CR21 (0805)  | CR32 (1206)  |
|------------------------|------------------------------------|--|--|--|
| Rated Power            | 0.0625 (1/16) W                    | 0.10 (1/10) W  | 0.125 (1/8) W  | 0.25 (1/4) W   |
| Max. Working Voltage   | 50V                                | 50V  | 100V   | 200V   |
| Resistance Tolerance   | F = ±1%<br>J = ±5%                 | D = ±0.5%<br>F = ±1%<br>J = ±5%                      | D = ±0.5%<br>F = ±1%<br>J = ±5%                      | D = ±0.5%<br>F = ±1%<br>J = ±5%                      |
| Resistance Value Range | 10Ω to 1MΩ : F<br>1.0Ω to 10MΩ : J | 10Ω to 1MΩ : D<br>10Ω to 1MΩ : F<br>1.0Ω to 10MΩ : J | 10Ω to 1MΩ : D<br>10Ω to 1MΩ : F<br>1.0Ω to 10MΩ : J | 10Ω to 1MΩ : D<br>10Ω to 1MΩ : F<br>1.0Ω to 10MΩ : J |
| Working Temperature    | -55 to +125°C                      | -55 to +125°C  | -55 to +125°C  | -55 to +125°C  |

# Thick Film Chip Resistors



## CR, CJ Series

### SPECIFICATIONS

#### CJ Series

| Part Number         | CJ05, CJ10, CJ21<br>(0402, 0603, 0805 Type) | CJ32<br>(1206 Type) |
|---------------------|---|---------------------|
| Rated Current       | 1A (70°C)                                   | 2A (70°C)           |
| Resistivity         | 50mΩ max.                                   | 50mΩ max.           |
| Working Temperature | -55 to +125°C                               | -55 to +125°C       |

### HOW TO CALCULATE RATED VOLTAGE

$$E = \sqrt{P \cdot R}$$

E = Rated Voltage (V)

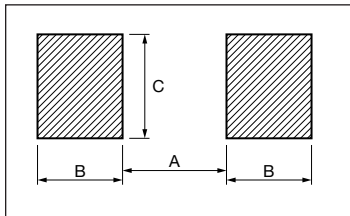
P = Rated Power (W)

R = Standard Resistance Value (Ω)

Rated voltage should be lower than max. working voltage.

### RECOMMENDED LAND PATTERN

millimeters (inches)



| EIA Size | 0402            | 0603            | 0805            | 1206            |
|----------|-----------------|-----------------|-----------------|-----------------|
| A        | 0.50<br>(0.020) | 0.80<br>(0.031) | 1.00<br>(0.039) | 2.00<br>(0.079) |
| B        | 0.40<br>(0.016) | 0.70<br>(0.028) | 0.80<br>(0.031) | 0.80<br>(0.031) |
| C        | 0.50<br>(0.020) | 0.80<br>(0.031) | 1.20<br>(0.047) | 1.50<br>(0.059) |

### MARKING

Marking available as follows:

Series: CR32, CJ32, CR21, CJ21, CR10, CJ10

3 digit indication

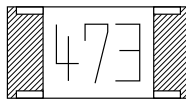
Example: 473=47x10<sup>3</sup> = 47000 Ω = 47 kΩ

0 = 0 Ω (Jumper)

100 = 10 Ω

102 = 1 kΩ

105 = 1 MΩ



Series: CR05 and CJ05 - No marking

Note: On CR32 4 digit marking is standard for ±1% and ±0.5% tolerances.

### STANDARD RESISTANCE VALUE

| E24 | 1.0 | 1.1 | 1.2 | 1.3 | 1.5 | 1.6 | 1.8 | 2.0 | 2.2 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|     | 2.4 | 2.7 | 3.0 | 3.3 | 3.6 | 3.9 | 4.3 | 4.7 | 5.1 |
|     | 5.6 | 6.2 | 6.8 | 7.5 | 8.2 | 9.1 |     |     |     |

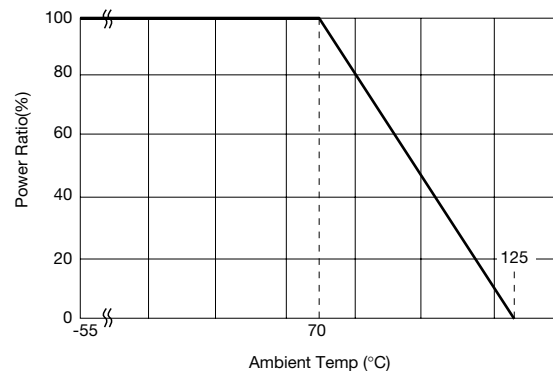
#### For ±1% and ±.5% Tolerance

| E96 | 10.0 | 10.2 | 10.5 | 10.7 | 11.0 | 11.3 | 11.5 | 11.8 | 12.1 | 12.4 |
|-----|------|------|------|------|------|------|------|------|------|------|
|     | 12.7 | 13.0 | 13.3 | 13.7 | 14.0 | 14.3 | 14.7 | 15.0 | 15.4 | 15.8 |
|     | 16.2 | 16.5 | 16.9 | 17.4 | 17.8 | 18.2 | 18.7 | 19.1 | 19.6 | 20.0 |
|     | 20.5 | 21.0 | 21.5 | 22.1 | 22.6 | 23.2 | 23.7 | 24.3 | 24.9 | 25.5 |
|     | 26.1 | 26.7 | 27.4 | 28.0 | 28.7 | 29.4 | 30.1 | 30.9 | 31.6 | 32.4 |
|     | 33.2 | 34.0 | 34.8 | 35.7 | 36.5 | 37.4 | 38.3 | 39.2 | 40.2 | 41.2 |
|     | 42.2 | 43.2 | 44.2 | 45.3 | 46.4 | 47.5 | 48.7 | 49.9 | 51.1 | 52.3 |
|     | 53.6 | 54.9 | 56.2 | 57.6 | 59.0 | 60.4 | 61.9 | 63.4 | 64.9 | 66.5 |
|     | 68.1 | 69.8 | 71.5 | 73.2 | 75.0 | 76.8 | 78.7 | 80.6 | 82.5 | 84.5 |
|     | 86.6 | 88.7 | 90.9 | 93.1 | 95.3 | 97.6 |      |      |      |      |

### DERATING CURVE

Rated power should be reduced as below when temperature become higher.

Under high temperature, power derated as follows:

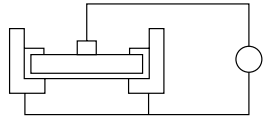


# Chip Resistor Arrays



## CR, CJ, CRA, CRB, CRC Series - Test Conditions

### ELECTRICAL CHARACTERISTICS

| Item                                 | Standard  |                                  | Test Conditions  |   |                     |              |                                      |  |   |   |
|--------------------------------------|---|----------------------------------|--|---|---------------------|--------------|--------------------------------------|--|---|---|
|                                      | Resistor  | Jumper                           | Resistor   | Jumper  |                     |              |                                      |  |   |   |
| <b>DC Resistance</b>                 | Within Initial Tolerance  |                                  | Power Condition A<br>(20°C, 65% RH)  |   |                     |              |                                      |  |   |   |
| <b>Temperature Characteristics</b>   | <table border="1"> <thead> <tr> <th>Resistance (<math>\Omega</math>)</th> <th>TCR (ppm/°C)</th> </tr> </thead> <tbody> <tr> <td>D, F<br/>10 ≤ R ≤ 1M</td> <td>-100 to +100</td> </tr> <tr> <td>J<br/>R &lt; 10<br/>10 ≤ R ≤ 1M<br/>1M &lt; R</td> <td>-100 to +600<br/>-200 to +200<br/>-500 to +300</td> </tr> </tbody> </table> |                                  | Resistance ( $\Omega$ )  | TCR (ppm/°C)  | D, F<br>10 ≤ R ≤ 1M | -100 to +100 | J<br>R < 10<br>10 ≤ R ≤ 1M<br>1M < R | -100 to +600<br>-200 to +200<br>-500 to +300 | / | Test Temperature: 25, 125(°C)<br>$\Delta R/R = R_2 - R_1 / R_1 \times 1 / T_2 - T_1 \times 10^6$<br>$\Delta R/R = \text{Temp. Coefficient (ppm/°C)}$<br>$T_1 = 25(°C)$<br>$T_2 = 125(°C)$<br>$R_1 = T_1 \text{ Resistance at } (\Omega)$<br>$R_2 = T_2 \text{ Resistance at } (\Omega)$ |
|                                      | Resistance ( $\Omega$ )   | TCR (ppm/°C)                     |  |   |                     |              |                                      |  |   |   |
| D, F<br>10 ≤ R ≤ 1M                  | -100 to +100  |                                  |  |   |                     |              |                                      |  |   |   |
| J<br>R < 10<br>10 ≤ R ≤ 1M<br>1M < R | -100 to +600<br>-200 to +200<br>-500 to +300  |                                  |  |   |                     |              |                                      |  |   |   |
| <b>Short-time Overload</b>           | $\Delta R/R$<br>$\pm(2.0\% + 0.10\Omega)$ max. of the initial value<br><br>Visual<br>No evidence of mechanical damage intermittent overload   | 50mΩ max.                        | (1) Apply 2.0 x rated voltage for 5 sec. (2.5 x rated voltage for Arrays)<br>(2) Wait 30 minutes<br>(3) Measure resistance<br>CR05 = 50V max.<br>CR10 = 100V max.<br>CR21 = 200V max.<br>CR32 = 400V max.<br>CRA, CRB, CRC = 100V max.<br><br>(1) 2A for 5 sec.<br>(2) Wait 30 minutes<br>(3) Measure resistance   |   |                     |              |                                      |  |   |   |
| <b>Intermittent Overload</b>         | $\Delta R/R$<br>$\pm(5\% + 0.1\Omega)$ max. of the initial value<br><br>Visual<br>No evidence of mechanical damage  | 50mΩ max.                        | (1) Perform 10,000 voltage cycles as follows:<br>ON (2.0 x rated voltage, 2.5 x for Arrays) 1 sec.<br>OFF 25 sec.<br>(2) Stabilization time 30 min. without loading<br>(3) Measure resistance<br>CR05 = 50V max.<br>CR10 = 150V max.<br>CR21 = 200V max.<br>CR32 = 400V max.<br>CRA, CRB, CRC = 100V max.<br><br>(1) Perform 10,000 current cycles as follows:<br>ON (2A) 1 sec.<br>OFF 25 sec.<br>(2) Wait 30 minutes<br>(3) Measure resistance |   |                     |              |                                      |  |   |   |
|                                      | <b>Dielectric Withstanding Voltage</b>  | No evidence of mechanical damage |  | Apply 500 VAC for 1 min. (CR10 300 VAC)<br>(CR05, CRA, CRB, CRC 300 VAC/1 sec.) |                     |              |                                      |  |   |   |
| <b>Insulation Resistance</b>         | <ul style="list-style-type: none"> <li>• CR05, CJ05 = 10<sup>9</sup>Ω min.</li> <li>• CR10, CJ10 = 10<sup>9</sup>Ω min.</li> <li>• CR21, CJ21 = 10<sup>10</sup>Ω min.</li> <li>• CR32, CJ32 = 10<sup>12</sup>Ω min.</li> <li>• CRA, CRB, CRC = 10<sup>9</sup>Ω min.</li> </ul>  |                                  |  <p>Apply 500V DC<br/>(CR05, CRA, CRB, CRC 100V DC)</p>   |   |                     |              |                                      |  |   |   |

# Chip Resistor Arrays



## CR, CJ, CRA, CRB, CRC Series - Test Conditions

### MECHANICAL CHARACTERISTICS

| Item                      |              | Standard  |                   | Test Conditions   |        |
|---------------------------|--------------|---|-------------------|---|--------|
|                           |              | Resistor  | Jumper            | Resistor  | Jumper |
| Terminal Strength         | $\Delta R/R$ | $\pm(1\%+0.05\Omega)$ max. of the initial value   | 50m $\Omega$ max. | Apply the load as shown:<br>Measure resistance during load application  |        |
|                           | Visual       | No evidence of mechanical damage after loading    |                   |   |        |
| Soldering Heat Resistance | $\Delta R/R$ | $\pm(1\%+0.05\Omega)$ max. of the initial value   | 50m $\Omega$ max. | Immerse into molten solder at 260 $\pm$ 5 $^{\circ}$ C for 10 $\pm$ 1 sec. Stabilize component at room temperature for 1 hr. Measure resistance.                        |        |
|                           | Visual       | No evidence of leaching                           |                   |   |        |
| Solderability             |              | Coverage $\geq$ 95% each termination end          |                   | Immerse in Rogin Flux for 2 $\pm$ 0.5 sec. and in SN62 solder at 235 $\pm$ 5 $^{\circ}$ C for 2 $\pm$ 0.5 sec.  |        |
| Anti-Vibration Test       | $\Delta R/R$ | $\pm(1\%+0.1\Omega)$ max. of the initial value    | 50m $\Omega$ max. | 2 hrs. each in X, Y and Z axis. (TTL 6 hrs.) 10 to 55 Hz sweep in 1 min. at 1.5mm amplitude.  |        |
|                           | Visual       | No evidence of mechanical damage                  |                   |   |        |
| Solvent Resistance        | $\Delta R/R$ | $\pm(0.5\%+0.05\Omega)$ max. of the initial value | 50m $\Omega$ max. | Immerse in static state butyl acetate at 20 $^{\circ}$ C to 25 $^{\circ}$ C for 30 $\pm$ 5 sec. Stabilize component at room temperature for 30 min. then measure value. |        |
|                           | Visual       | No evidence of mechanical damage                  |                   |   |        |

### ENVIRONMENTAL CHARACTERISTICS

| Item                     |              | Standard  |                   | Test Conditions   |        |
|--------------------------|--------------|---|-------------------|---|--------|
|                          |              | Resistor  | Jumper            | Resistor  | Jumper |
| Temperature Cycle        | $\Delta R/R$ | $\pm(1\%+0.05\Omega)$ max. of the initial value | 50m $\Omega$ max. | (1) Run 5 cycles as follows: -55 $\pm$ 3 $^{\circ}$ C for 30 min. 125 $\pm$ 3 $^{\circ}$ C for 30 min. Room temp. for 10-15 min.<br>(2) Stabilize component at room temperature for 1 hr. then measure value. |        |
|                          | Visual       | No evidence of mechanical damage                |                   |   |        |
| Low Temperature Storage  | $\Delta R/R$ | $\pm(2\%+0.1\Omega)$ max. of the initial value  | 50m $\Omega$ max. | (1) Dwell in -55 $^{\circ}$ C chamber without loading for 1000 $^{+48}$ hrs.<br>(2) Stabilize component at room temperature for 1 hr. then measure value.   |        |
|                          | Visual       | No evidence of mechanical damage                |                   |   |        |
| High Temperature Storage | $\Delta R/R$ | $\pm(3\%+0.1\Omega)$ max. of the initial value  | 50m $\Omega$ max. | (1) Dwell in 125 $^{\circ}$ C chamber without loading for 1000 $^{+48}$ hrs.<br>(2) Stabilize component at room temperature for 1 hr. then measure value.   |        |
|                          | Visual       | No evidence of mechanical damage                |                   |   |        |
| Moisture Resistance      | $\Delta R/R$ | $\pm(3\%+0.1\Omega)$ max. of the initial value  | 50m $\Omega$ max. | (1) Dwell in temp.: 65 $^{\circ}$ C RH90 to 95% RH chamber without loading for 1000 $^{+48}$ hrs.<br>(2) Stabilize component at room temperature for 1 hr. then measure value.                                |        |
|                          | Visual       | No evidence of mechanical damage                |                   |   |        |
| Life Test                | $\Delta R/R$ | $\pm(3\%+0.1\Omega)$ max. of the initial value  | 50m $\Omega$ max. | (1) Temp.: 70 $\pm$ 3 $^{\circ}$ C Voltage: (rated voltage) on 90 min. off 30 min. Duration: 1000 $^{+48}$ hrs.<br>(2) Stabilize component at room temperature for 1 hr. then measure value.                  |        |
|                          | Visual       | No evidence of mechanical damage                |                   |   |        |
| Loading Life in Moisture | $\Delta R/R$ | $\pm(3\%+0.1\Omega)$ max. of the initial value  | 50m $\Omega$ max. | (1) Temp.: 40 $\pm$ 2 $^{\circ}$ C RH: 90-95% Voltage Cycle: on 90 min. (rated voltage) off 30 min. Duration: 1000 $^{+48}$ hrs.<br>(2) Stabilize component at room temperature for 1 hr. then measure value. |        |
|                          | Visual       | No evidence of mechanical damage                |                   |   |        |