



# Carbon Film Fixed Resistors (RoHS Compliant)

# CF-RC Series

## FEATURES

- Temperature Range -55°C ~ +155°C
- ±5% tolerance
- High quality performance at economical prices
- Compatible with automatic insertion equipment
- Flame retardant type available
- Tin coated annealed copper wire
- Value Range below 1Ω or above 10MΩ are available by special request, please ask for details



RoHS Compliant



## DERATING CURVE



## CURRENT NOISE



## TEMPERATURE COEFFICIENT



## PART NUMBERING SYSTEM



## SERIES, SIZE, WATTAGE, VOLTAGE, DIMENSIONS, AND AVAILABLE PACKAGING



| Code: | Package:      |
|-------|---------------|
|       | Bulk          |
| /REEL | Tape and Reel |
| /AP   | Ammo Pack     |

| Series | Size     | Watts | Voltage (V) (max.) |       | Dimensions (mm) |        |    |      | Standard Quantities Available |               |           |
|--------|----------|-------|--------------------|-------|-----------------|--------|----|------|-------------------------------|---------------|-----------|
|        |          |       | W.V.               | O.V.  | L max.          | D max. | H  | d    | Bulk                          | Tape and Reel | Ammo Pack |
| 291    | Standard | 1/4   | 250                | 500   | 6.8             | 2.5    | 28 | 0.54 | 1,000                         | 5,000         | 1,000     |
| 293    | Standard | 1/2   | 350                | 700   | 10              | 3.5    | 28 | 0.54 | 1,000                         | 3,000         | 1,000     |
| 294    | Small    | 1     | 500                | 1,000 | 12              | 5.0    | 28 | 0.7  | 1,000                         | 3,000         | 1,000     |
| 299    | Standard | 1/8   | 200                | 400   | 3.5             | 1.85   | 28 | 0.45 | 1,000                         | 5,000         | 2,000     |

## STANDARD VALUES (Ω)

|     |     |     |     |    |    |     |     |     |      |      |      |      |     |     |      |      |      |      |      |      |      |
|-----|-----|-----|-----|----|----|-----|-----|-----|------|------|------|------|-----|-----|------|------|------|------|------|------|------|
| 0.5 | 2.0 | 4.3 | 9.1 | 20 | 43 | 91  | 200 | 430 | 910  | 2K   | 3.9K | 8.2K | 18K | 39K | 82K  | 180K | 390K | 820K | 1.8M | 3.9M | 8.2M |
| 1.0 | 2.2 | 4.7 | 10  | 22 | 47 | 100 | 220 | 470 | 1K   | 2.2K | 4.3K | 9.1K | 20K | 43K | 91K  | 200K | 430K | 910K | 2M   | 4.3M | 9.1M |
| 1.1 | 2.4 | 5.1 | 11  | 24 | 51 | 110 | 240 | 510 | 1.1K | 2.4K | 4.7K | 10K  | 22K | 47K | 100K | 220K | 470K | 1M   | 2.2M | 4.7M | 10M  |
| 1.2 | 2.7 | 5.6 | 12  | 27 | 56 | 120 | 270 | 560 | 1.2K | 2.7K | 5.1K | 11K  | 24K | 51K | 110K | 240K | 510K | 1.1M | 2.4M | 5.1M | 15M  |
| 1.3 | 3.0 | 6.2 | 13  | 30 | 62 | 130 | 300 | 620 | 1.3K | 3K   | 5.6K | 12K  | 27K | 56K | 120K | 270K | 560K | 1.2M | 2.7M | 5.6M | 22M  |
| 1.5 | 3.3 | 6.8 | 15  | 33 | 68 | 150 | 330 | 680 | 1.5K | 3.2K | 6.2K | 13K  | 30K | 62K | 130K | 300K | 620K | 1.3M | 3M   | 6.2M |      |
| 1.6 | 3.6 | 7.5 | 16  | 36 | 75 | 160 | 360 | 750 | 1.6K | 3.3K | 6.8K | 15K  | 33K | 68K | 150K | 330K | 680K | 1.5M | 3.3M | 6.8M |      |
| 1.8 | 3.9 | 8.2 | 18  | 39 | 82 | 180 | 390 | 820 | 1.8K | 3.6K | 7.5K | 16K  | 36K | 75K | 160K | 360K | 750K | 1.6M | 3.6M | 7.5M |      |



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## ■ CHARACTERISTICS

| Characteristics                 | Limits                                                                               |                                               | Test Methods ( JIS C 5201-1 )                                                                                                                                                                                                                                                                                                                                                                            |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
|---------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------|------|---|------------|---------|---|------------|------------|---|-------------|---------|---|------------|------------|
| DC. Resistance                  | Must be within the specified tolerance.                                              |                                               | 5.1 The limit of error of measuring apparatus shall not exceed allowable range or 5% of resistance tolerance                                                                                                                                                                                                                                                                                             |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
| Temperature coefficient         | Resist. Range                                                                        | T.C.R. (PPM / °C)                             | 5.2 Natural resistance change per temp. degree centigrade.<br>R2-R1<br>———— x106 (PPM/°C)<br>R1(t2-t1)<br>R1: Resistance value at room temperature (t1)<br>R2: Resistance value at room temp.plus 100°C (t2)                                                                                                                                                                                             |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
|                                 | < 10 Ω<br>11Ω ~ 99K<br>100K ~ 1M<br>1.1M ~ 10M                                       | 0 ~ ±350<br>0 ~ -450<br>0 ~ -700<br>0 ~ -1500 |                                                                                                                                                                                                                                                                                                                                                                                                          |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
| Short time overload             | Resistance change rate is ± (1 % + 0.05Ω) Max. with no evidence of mechanical damage |                                               | 5.5 Permanent resistance change after the application of a potential of 2.5 times RCWV for 5 seconds.                                                                                                                                                                                                                                                                                                    |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
| Insulation Resistance           | Insulation resistance is 10,000 MΩ Min                                               |                                               | 5.6 Resistors shall be clamped in the trough of a 90° metallic V-block and shall be tested at DC potential respectively specified in the above list for 60 +10/ -0 seconds.                                                                                                                                                                                                                              |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
| Dielectric withstanding voltage | No evidence of flashover mechanical damage, arcing or insulation break down.         |                                               | 5.7 Resistors shall be clamped in the trough of a 90° metallic V-block and shall be tested at AC potential respectively specified in the table 1 for 60 + 10/-0 seconds.                                                                                                                                                                                                                                 |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
| Terminal strength               | No evidence of mechanical damage.                                                    |                                               | <b>6.1 Direct load</b><br>Resistance to a 2.5 kgs direct load for 10 secs. in the direction of the longitudinal axis of the terminal leads.<br><b>Twist test :</b><br>Terminal leads shall be bent through 90° at a point of about 6mm from the body of the resistor and shall be rotated through 360° about the original axis of the bent terminal in alternating direction for a total of 3 rotations. |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
| Resistance to soldering heat    | Resistance change rate is ± (1% + 0.05Ω) Max. with no evidence of mechanical damage. |                                               | 6.4 Permanent resistance change when leads immersed to 3.2 to 4.8 mm from the body in 350 °C ± 10°C solder for 3 ± 0.5 seconds                                                                                                                                                                                                                                                                           |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
| Solderability                   | 95 % coverage Min.                                                                   |                                               | 6.5 The area covered with a new , smooth clean , shiny and continuous surface free from concentrated pinholes.<br>Test temp. of solder : 245°C ± 3°C<br>Dwell time in solder : 2 ~ 3 seconds                                                                                                                                                                                                             |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
| Temperature cycling             | Resistance change rate is ± (1% + 0.05Ω) Max. with no evidence of mechanical damage. |                                               | 7.4 Resistance change after continuous 5 cycles for duty shown below:                                                                                                                                                                                                                                                                                                                                    |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
|                                 |                                                                                      |                                               | <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature</th> <th>Time</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-55°C ±3°C</td> <td>30 mins</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>10~15 mins</td> </tr> <tr> <td>3</td> <td>+155°C ±2°C</td> <td>30 mins</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>10~15 mins</td> </tr> </tbody> </table>                             | Step           | Temperature | Time | 1 | -55°C ±3°C | 30 mins | 2 | Room temp. | 10~15 mins | 3 | +155°C ±2°C | 30 mins | 4 | Room temp. | 10~15 mins |
|                                 |                                                                                      |                                               | Step                                                                                                                                                                                                                                                                                                                                                                                                     | Temperature    | Time        |      |   |            |         |   |            |            |   |             |         |   |            |            |
|                                 |                                                                                      |                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                        | -55°C ±3°C     | 30 mins     |      |   |            |         |   |            |            |   |             |         |   |            |            |
|                                 |                                                                                      |                                               | 2                                                                                                                                                                                                                                                                                                                                                                                                        | Room temp.     | 10~15 mins  |      |   |            |         |   |            |            |   |             |         |   |            |            |
| 3                               | +155°C ±2°C                                                                          | 30 mins                                       |                                                                                                                                                                                                                                                                                                                                                                                                          |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
| 4                               | Room temp.                                                                           | 10~15 mins                                    |                                                                                                                                                                                                                                                                                                                                                                                                          |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
|                                 |                                                                                      |                                               |                                                                                                                                                                                                                                                                                                                                                                                                          |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
|                                 |                                                                                      |                                               |                                                                                                                                                                                                                                                                                                                                                                                                          |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
|                                 |                                                                                      |                                               |                                                                                                                                                                                                                                                                                                                                                                                                          |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
| Load life in humidity           | Resistance value                                                                     |                                               | 7.9 Resistance change after 1,000 hours operating at RCWV with duty cycle of (1.5 hours "on", 0.5 hour "off") in a humidity test chamber controlled at 40°C ± 2°C and 90 to 95 % relative humidity                                                                                                                                                                                                       |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
|                                 | Normal Type                                                                          | < than 100KΩ<br>>100KΩ                        |                                                                                                                                                                                                                                                                                                                                                                                                          | ± 3 %<br>± 5 % |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
| Load life                       | Resistance value                                                                     |                                               | 7.10 Permanent resistance change after 1,000 hours operating at RCWV with duty cycle of ( 1.5 hours "on", 0.5 hour "off" ) at 70°C ± 2°C ambient                                                                                                                                                                                                                                                         |                |             |      |   |            |         |   |            |            |   |             |         |   |            |            |
|                                 | Normal Type                                                                          | < than 56KΩ<br>> 56KΩ                         |                                                                                                                                                                                                                                                                                                                                                                                                          | ± 2 %<br>± 3 % |             |      |   |            |         |   |            |            |   |             |         |   |            |            |

