

Data Sheet

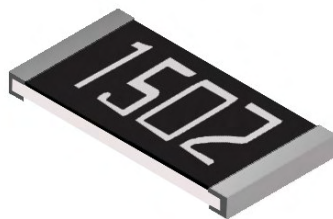
Customer :

Product Type: Thick Film Chip Resistors

Part No.: CR Series

Issued Date: 24-Mar-09

Document No.: CR Series REV.A2



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Thick Film Chip Resistors

(CR Series)

1. Scope

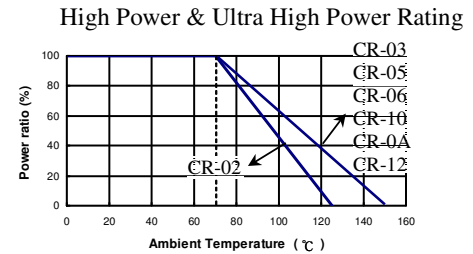
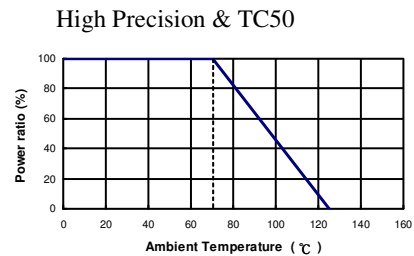
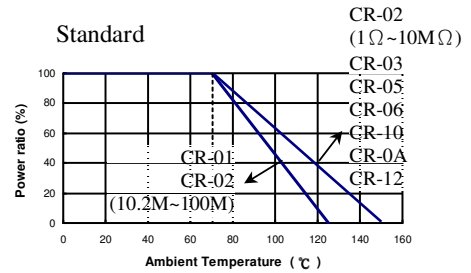
This specification applies to all sizes of rectangular-type fixed chip resistors with Ruthenium-base as material.

2. Features

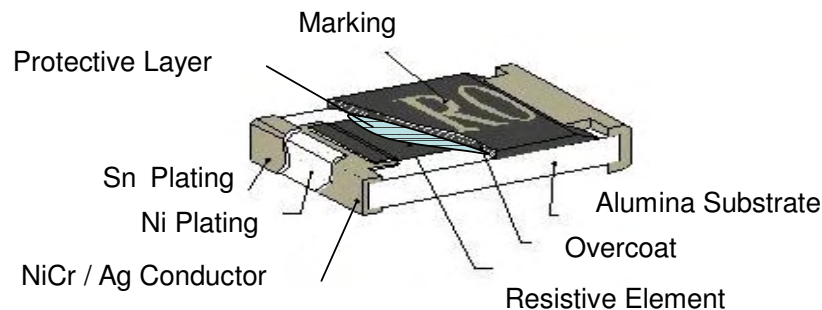
- Small size and light weight
- Highly reliable multilayer electrode construction
- Compatible with all soldering process

3. Applications

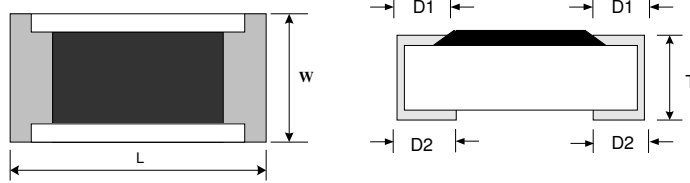
- Telecommunication Equipments
- Radio and Tape Recorders, TV Tuners
- Video Cameras, Watches, Pocket Calculators
- Automotive Industry
- Computers, Instruments
- Medical and Military Equipments



4. Construction



5. Dimensions



Unit: mm

| Size | Codes | L | W | T | D1 | D2 |
|------|-------|-----------|-----------|-----------|-----------|-----------|
| 0201 | CR-01 | 0.60±0.03 | 0.30±0.03 | 0.23±0.03 | 0.15±0.05 | 0.15±0.05 |
| 0402 | CR-02 | 1.00±0.05 | 0.50±0.05 | 0.35±0.05 | 0.20±0.10 | 0.20±0.10 |
| 0603 | CR-03 | 1.60±0.10 | 0.80±0.10 | 0.45±0.10 | 0.30±0.20 | 0.30±0.20 |
| 0805 | CR-05 | 2.00±0.10 | 1.25±0.10 | 0.50±0.10 | 0.35±0.20 | 0.40±0.20 |
| 1206 | CR-06 | 3.10±0.10 | 1.55±0.10 | 0.55±0.10 | 0.50±0.25 | 0.50±0.20 |
| 1210 | CR-10 | 3.20±0.20 | 2.60±0.15 | 0.55±0.10 | 0.50±0.25 | 0.50±0.20 |
| 2010 | CR-0A | 5.00±0.20 | 2.50±0.15 | 0.55±0.10 | 0.60±0.25 | 0.50±0.20 |
| 2512 | CR-12 | 6.35±0.20 | 3.20±0.15 | 0.55±0.10 | 0.60±0.25 | 0.50±0.20 |

6. Product Identification

CR- 03 F L 7 ---10K
(1) (2) (3) (4) (5) (6)

(1) Product Type: CR=Thick Film Chip Resistor

(2) Dimensions: 01=0201, 02=0402, 03=0603, 05=0805, 06=1206, 10=1210, 0A=2010, 12=2512

(3) Tolerance: B=±0.1%, C=±0.25%, D=±0.5%, F=±1%, J=±5%

(4) Function: L=Standard & High Precision, E=TC50, P=High Power, H=Ultra High Power

(5) Packaging: 0=7" Reel 15K (0201)

6=7" Reel 10K, B=10" Reel 20K, C=13" Reel 40K (0201, 0402)

7=7" Reel 5K, A=10" Reel 10K, D=13" Reel 20K (0603, 0805, 1206, 1210)

4=7" Reel 4K, 9=10" Reel 8K (2010, 2512)

F=Bulk

(6) Resistance: ---1R2=1.2Ω, ---3K3=3.3KΩ, ---10K=10KΩ, --100K=100KΩ, --33K2=33.2KΩ, ---1M2=1.2MΩ

--" to fill up 6 spaces

7. Electrical Characteristics

● Standard Electrical Specifications

| Item Type | Power Rating at 70°C | Operating Temp. Range | Max. Operating Voltage | Max. Overloading Voltage | Resistance Tolerance (±%) | | Resistance Range | TCR (±PPM/°C) |
|--------------|----------------------------|--------------------------|------------------------------|--------------------------------|------------------------------|--------|------------------|------------------|
| | | | | | E96 E24 | | | |
| CR-01 (0201) | 1/20W | -55 ~ +125°C | 25V | 50V | E96 | 1 | 1Ω~10MΩ | 200 |
| Jumper | 1A | | | | E24 | 5 | | |
| CR-02 (0402) | 1/16W | -55 ~ +155°C | 50V | 100V | E96 E24 | 1 5 | 1Ω~9.76Ω | 200 |
| | | -55 ~ +125°C | | | | | 10Ω~1MΩ | 100 |
| Jumper | 1A | -55 ~ +155°C | | | - | | 1.02MΩ~10MΩ | 200 |
| CR-03 (0603) | 1/10W | -55 ~ +155°C | 50V | 100V | E96 E24 | 1 5 | 10.2MΩ~20MΩ | 200 |
| | | | | | | | 20.5MΩ~39MΩ | 400 |
| Jumper | 1A | -55 ~ +155°C | | | - | | 39.2MΩ~100MΩ | 400 |
| Jumper | 1A | | | | - | | 0Ω (<50mΩ) | - |
| CR-05 (0805) | 1/8W | -55 ~ +155°C | 150V | 300V | E96 E24 | 1 5 | 1Ω~9.76Ω | 200 |
| | | | 200V | 400V | | | 10Ω~1MΩ | 100 |
| CR-06 (1206) | 1/4W | | | | | | 1.02MΩ~10MΩ | 200 |
| Jumper | 2A | | | | - | | 10.2MΩ~20MΩ | 200 |
| Jumper | 2A | | | | - | | 20.5MΩ~39MΩ | 400 |
| Jumper | 2A | | | | - | | 39.2MΩ~100MΩ | 400 |
| Jumper | 2A | | | | - | | 0Ω (<50mΩ) | - |
| CR-10 (1210) | 1/3W | -55 ~ +155°C | 200V | 400V | E96 E24 | 1 5 | 1Ω~9.76Ω | 200 |
| | | | | | | | 10Ω~1MΩ | 100 |
| Jumper | 2.5A | | | | - | | 1.02MΩ~10MΩ | 200 |
| Jumper | 2.5A | | | | - | | 10.2MΩ~20MΩ | 200 |
| Jumper | 2.5A | | | | - | | 20.5MΩ~39MΩ | 400 |
| Jumper | 2.5A | | | | - | | 0Ω (<50mΩ) | - |
| CR-0A (2010) | 3/4W | -55 ~ +155°C | 200V | 400V | E96 E24 | 1 5 | 1Ω~9.76Ω | 200 |
| | | | | | | | 10Ω~1MΩ | 100 |
| Jumper | 3.5A | | | | - | | 1.02MΩ~10MΩ | 200 |
| Jumper | 3.5A | | | | - | | 10.2MΩ~20MΩ | 200 |
| Jumper | 3.5A | | | | - | | 20.5MΩ~39MΩ | 400 |
| Jumper | 3.5A | | | | - | | 0Ω (<50mΩ) | - |
| CR-12 (2512) | 1W | -55 ~ +155°C | 250V | 500V | E96 E24 | 1 5 | 1Ω~9.76Ω | 200 |
| | | | | | | | 10Ω~1MΩ | 100 |
| Jumper | 4A | | | | - | | 1.02MΩ~10MΩ | 200 |
| Jumper | 4A | | | | - | | 10.2MΩ~20MΩ | 200 |
| Jumper | 4A | | | | - | | 20.5MΩ~39MΩ | 400 |
| Jumper | 4A | | | | - | | 0Ω (<50mΩ) | - |

● High Precision Electrical Specifications

| Item Type | Power Rating at 70°C | Operating Temp. Range | Max. Operating Voltage | Max. Overloading Voltage | Resistance Tolerance (±%) | | Resistance Range | TCR (±PPM/°C) |
|--------------|----------------------------|--------------------------|------------------------------|--------------------------------|---------------------------|--------------------|------------------|------------------|
| | | | | | E96 E24 | | | |
| CR-02 (0402) | 1/16W | -55 ~ +125°C | 50V | 100V | E96 | 0.5 | 10Ω~1MΩ | 100 |
| | | | | | E24 | 0.25 0.5 | 1.02M~10MΩ | 200 |
| CR-03 (0603) | 1/10W | | 50V | 100V | E96 E24 | 0.1 0.25 0.5 | 10Ω~1MΩ | 100 |
| CR-05 (0805) | 1/8W | | 150V | 300V | | | | |
| CR-06 (1206) | 1/4W | | 200V | 400V | | | | |
| CR-10 (1210) | 1/3W | | 200V | 400V | | | | |
| CR-0A (2010) | 3/4W | | 200V | 400V | | | | |
| CR-12 (2512) | 1W | | 250V | 500V | | | | |
| | | | | | | 0.25 0.5 | 1.02M~10MΩ | 200 |

● TC50 Electrical Specifications

| Type | Item | Power Rating at 70°C | Operating Temp. Range | Max. Operating Voltage | Max. Overloading Voltage | Resistance Tolerance (±%) | | Resistance Range | TCR (±PPM/°C) |
|--------------|------|----------------------|-----------------------|------------------------|--------------------------|---------------------------|-------------------------|------------------|---------------|
| | | | | | | E96 | E24 | | |
| CR-03 (0603) | | 1/10W | -55 ~ +125°C | 50V | 100V | E96 | 0.1 0.25 0.5 1 | 10Ω~1MΩ | 50 |
| CR-05 (0805) | | 1/8W | | 150V | 300V | | | | |
| CR-06 (1206) | | 1/4W | | 200V | 400V | | | | |
| CR-10 (1210) | | 1/3W | | 200V | 400V | | | | |
| CR-0A (2010) | | 3/4W | | 200V | 400V | | | | |
| CR-12 (2512) | | 1W | | 250V | 500V | | | | |

● High Power & Ultra High Power Rating Electrical Specifications

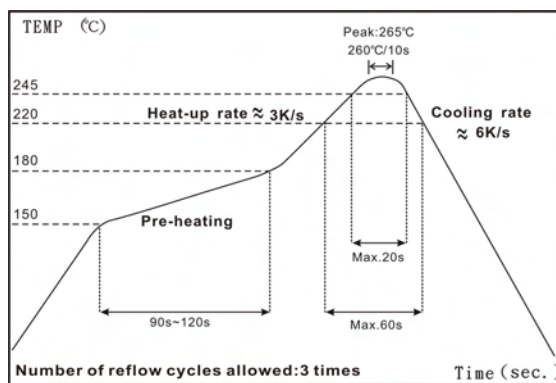
| Type | Item | Power Rating at 70°C | Operating Temp. Range | Max. Operating Voltage | Max. Overloading Voltage | Resistance Tolerance (±%) | | Resistance Range | TCR (±PPM/°C) |
|--------------|------|----------------------|-----------------------|------------------------|--------------------------|---------------------------|--------|------------------------------------|-------------------|
| | | | | | | E96 | E24 | | |
| CR-02 (0402) | | 1/10W | -55 ~ +125°C | 50V | 100V | E96 | 1 5 | 1Ω~9.76Ω 10Ω~1MΩ 1.02MΩ~10MΩ | 200 100 200 |
| CR-03 (0603) | | 1/8W | -55 ~ +155°C | 50V | 100V | | | | |
| CR-05 (0805) | | 1/4W | -55 ~ +155°C | 150V | 300V | | | | |
| CR-06 (1206) | | 1/3 *1/2W | -55 ~ +155°C | 200V | 400V | | | | |
| CR-10 (1210) | | 1/2 *3/4W | -55 ~ +155°C | 200V | 400V | | | | |
| CR-0A (2010) | | 1W | -55 ~ +155°C | 200V | 400V | | | | |
| CR-12 (2512) | | 2W | -55 ~ +155°C | 250V | 500V | | | | |

*: Ultra High Power

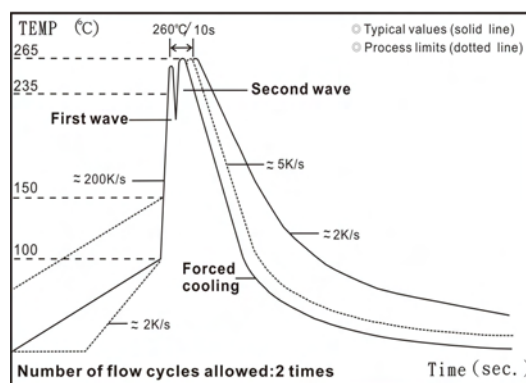
Operating Voltage $V = \sqrt{P \cdot R}$ or Maximum Operating Voltage listed above, whichever is smaller.

Overload Voltage $V = 2.5 \cdot \sqrt{P \cdot R}$ or Maximum Overloading Voltage listed above, whichever is smaller.

● Soldering condition



IR Reflow Soldering



Wave Soldering (Flow Soldering)

- (1) Time of IR reflow soldering at maximum temperature point 260°C : 10s
- (2) Time of wave soldering at maximum temperature point 260°C : 10s
- (3) Time of soldering iron at maximum temperature point 410°C : 5s

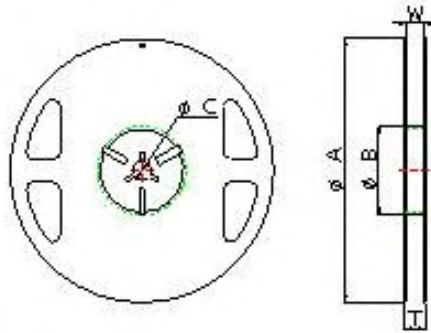
8. Environmental Characteristics

| Item | Specification | | | Test Method |
|--|--|---------------|--------|---|
| | 1% and Below | 5% | Jumper | |
| Temperature Coefficient of Resistance (T.C.R.) | Within the specification | | | JIS C 5201 4.8 IEC 60115-1 4.8 -55°C~+125/+155°C, 20°C is the reference temperature |
| Short Time Overload | ±(1.0%+0.05Ω) | ±(2.0%+0.05Ω) | <50mΩ | JIS C 5201 4.13 IEC 60115-1 4.13 2.5 times RCWV / Max. overload voltage for 5 seconds, 2 seconds for high power series |
| Insulation Resistance | ≥ 10G | | | JIS C 5201 4.6 IEC 60115-1 4.6 Max. overload voltage for 1 minute |
| Voltage Proof | No breakdown or flashover | | | JIS C 5201 4.7 IEC 60115-1 4.7 1.42 times RCWV (RMS) for 1 minute |
| Substrate Bending Test | ±(1.0%+0.05Ω) | ±(1.0%+0.05Ω) | <50mΩ | JIS C 5201 4.33 IEC 60115-1 4.33 Bending once for 5 seconds with 3mm 2010, 2512 size: 2 mm |
| Resistance to Soldering Heat | ±(0.5%+0.05Ω) | ±(1.0%+0.05Ω) | <50mΩ | JIS C 5201 4.18 IEC 60115-1 4.18 260±5°C for 10 seconds |
| Leaching | Individual leaching area ≤ 5% Total leaching area ≤ 10% | | | JIS C 5201 4.18 IEC 60068-2-58 8.2.1 260±5°C for 30 seconds |
| Solderability | >95% coverage | | | JIS C 5201 4.17 IEC 60115-1 4.17 245±5°C for 3 seconds |
| Endurance at Upper Category Temperature | ±(1.0%+0.05Ω) | ±(1.5%+0.10Ω) | <50mΩ | JIS C 5201 4.23 IEC 60115-1 2.23.2 at +125/+155°C for 1000 hrs |
| Rapid Change of Temperature | ±(0.5%+0.05Ω) | ±(1.0%+0.05Ω) | <50mΩ | JIS C 5201 4.19 IEC 60115-1 4.19 -55°C to +125/+155°C, 5 cycles |
| Damp Heat with Load | ±(2.0%+0.10Ω) | ±(3.0%+0.10Ω) | <100mΩ | JIS 5201 4.24 40±2°C, 90~95% R.H., Max. working voltage for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF" |
| Endurance | ±(2.0%+0.10Ω) | ±(3.0%+0.10Ω) | <100mΩ | JIS C 5201 4.25 IEC 60115-1 4.25.1 70±2°C, Max. working voltage for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF" |

* Storage Temperature: 25±3°C; Humidity < 80% RH

9. Packaging

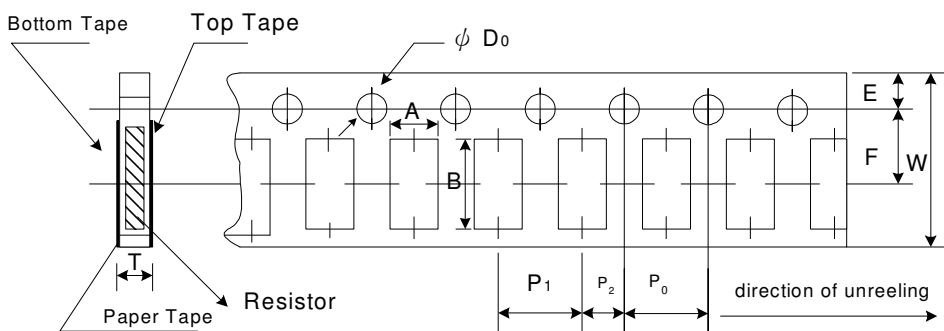
9-1 Reel Specifications & Packaging Quantity



Unit: mm

| Series | Tape Width | Reel Diameter | ΦA | ΦB | ΦC | W | T | Packaging Method | Packaging | |
|--------|------------|---------------|-----------|---------------------|----------|----------|----------|------------------|----------------|---------|
| | | | | | | | | | Series | Quality |
| CR-01 | 8mm | 7 inch | 178.5±1.5 | 60 ^{+1/-0} | 13.0±0.2 | 9.0±0.5 | 12.5±0.5 | Paper | CR-01 | 15K |
| CR-01 | 8mm | 7 inch | 178.5±1.5 | 60 ^{+1/-0} | 13.0±0.2 | 9.0±0.5 | 12.5±0.5 | Paper | CR-01/02 | 10K |
| CR-02 | | 10 inch | 254±1 | 100±0.5 | 13.0±0.2 | 9.5±0.5 | 13.5±0.5 | | CR-03/05/06/10 | 5K |
| CR-03 | | | | | | | | | CR-01/02 | 20K |
| CR-05 | | | | | | | | | CR-03/05/06/10 | 10K |
| CR-06 | | | | | | | | | CR-01/02 | 40K |
| CR-10 | | | | | | | | | CR-03/05/06/10 | 20K |
| CR-0A | 12mm | 7 inch | 178.5±1.5 | 60 ^{+1/-0} | 13.0±0.5 | 13.0±0.5 | 15.5±0.5 | Embossed | CR-0A/12 | 4K |
| CR-12 | | 10 inch | 250±1 | 62±0.5 | 13.0±0.5 | 12.5±0.5 | 16.5±0.5 | | CR-0A/12 | 8K |

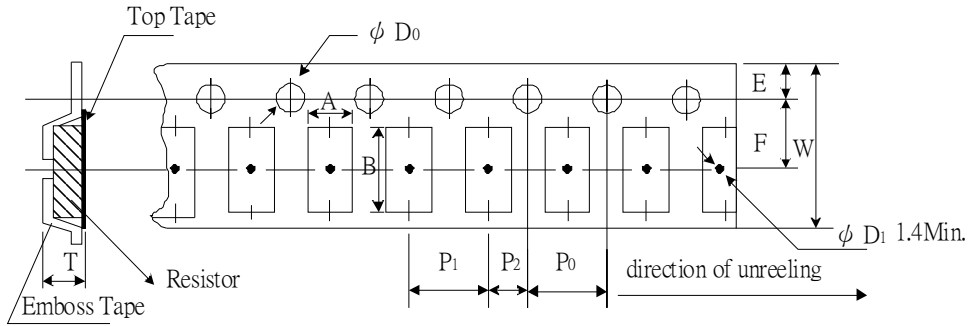
9-1-2 Paper Tape Specifications



Unit: mm

| Series | A | B | W | F | E | P1 | P2 | P0 | φ D0 | T |
|--------|-----------|-----------|---------|-----------|----------|-----------|-----------|-----------|-------------|----------|
| CR-01 | 0.38±0.05 | 0.68±0.05 | 8.0±0.2 | 3.50±0.05 | 1.75±0.1 | 2.00±0.05 | 2.00±0.05 | 4.00±0.10 | 1.50+0.1,-0 | 0.42±0.2 |
| CR-02 | 0.65±0.10 | 1.15±0.1 | 8.0±0.2 | 3.50±0.05 | 1.75±0.1 | 2.00±0.05 | 2.00±0.05 | 4.00±0.10 | 1.50+0.1,-0 | 0.45±0.1 |
| CR-03 | 1.10±0.10 | 1.90±0.1 | 8.0±0.2 | 3.50±0.05 | 1.75±0.1 | 4.00±0.05 | 2.00±0.05 | 4.00±0.10 | 1.50+0.1,-0 | 0.70±0.1 |
| CR-05 | 1.60±0.10 | 2.40±0.2 | 8.0±0.2 | 3.50±0.05 | 1.75±0.1 | 4.00±0.05 | 2.00±0.05 | 4.00±0.10 | 1.50+0.1,-0 | 0.85±0.1 |
| CR-06 | 1.90±0.10 | 3.50±0.2 | 8.0±0.2 | 3.50±0.05 | 1.75±0.1 | 4.00±0.05 | 2.00±0.05 | 4.00±0.10 | 1.50+0.1,-0 | 0.85±0.1 |
| CR-10 | 2.80±0.10 | 3.50±0.2 | 8.0±0.2 | 3.50±0.05 | 1.75±0.1 | 4.00±0.05 | 2.00±0.05 | 4.00±0.10 | 1.50+0.1,-0 | 0.85±0.1 |

9-1-3 Emboss Plastic Tape Specifications



Unit: mm

| Series | A | B | W | F | E | P ₁ | P ₂ | P ₀ | φ D ₀ | T |
|--------|----------|----------|----------|----------|----------|----------------|----------------|----------------|------------------|-------------------|
| CR-0A | 2.8±0.20 | 5.5±0.20 | 12.0±0.3 | 5.5±0.05 | 1.75±0.1 | 4.00±0.1 | 2.00±0.05 | 4.00±0.10 | 1.50+0.25, -0 | 1.2 ⁺⁰ |
| CR-12 | 3.5±0.20 | 6.7±0.20 | 12.0±0.3 | 5.5±0.05 | 1.75±0.1 | 4.00±0.1 | 2.00±0.05 | 4.00±0.10 | 1.50+0.25, -0 | 1.2 ⁺⁰ |

10. Marking

10-1 No Marking for 0201 and 0402

10-2 Jumper for all: Letter “0”

10-3 1% for 0805/1206/1210/2010/2512: 4 digits marking

Example:

| | | | | | |
|------------|------|-------|------|--------|-------|
| Resistance | 100Ω | 2.2KΩ | 10KΩ | 49.9KΩ | 100KΩ |
| Marking | 1000 | 2201 | 1002 | 4992 | 1003 |

10-4 5% for 0603/0805/1206/1210/2010/2512: 3 digits marking in E24

Example: 101=100Ω 102=1KΩ (1st and 2nd are E24 code and 3rd code is multiplier)

| E24 code | 10 | 11 | 12 | 13 | 15 | 16 | 18 | 20 | 22 | 24 | 27 | 30 | 33 | 36 | 39 | 43 | 47 | 51 | 56 | 62 | 68 | 75 | 82 | 91 |
|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|

10-5 1% for 0603: 3 digits marking in E96



3 digits marking for Example: 14C=13K7 Ω 13C=13K3 Ω
68B=4K99 Ω 68X=49.9 Ω

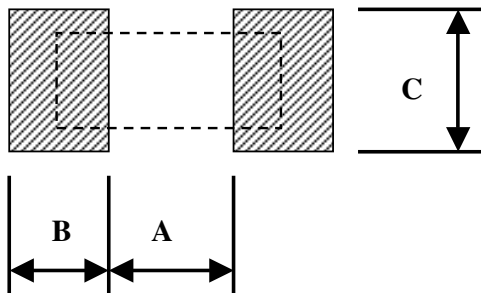
Marking Table

| Code | E96 | Code | E96 | Code | E96 | Code | E96 |
|------|-----|------|-----|------|-----|------|-----|
| 01 | 100 | 25 | 178 | 49 | 316 | 73 | 562 |
| 02 | 102 | 26 | 182 | 50 | 324 | 74 | 576 |
| 03 | 105 | 27 | 187 | 51 | 332 | 75 | 590 |
| 04 | 107 | 28 | 191 | 52 | 340 | 76 | 604 |
| 05 | 110 | 29 | 196 | 53 | 348 | 77 | 619 |
| 06 | 113 | 30 | 200 | 54 | 357 | 78 | 634 |
| 07 | 115 | 31 | 205 | 55 | 365 | 79 | 649 |
| 08 | 118 | 32 | 210 | 56 | 374 | 80 | 665 |
| 09 | 121 | 33 | 215 | 57 | 383 | 81 | 681 |
| 10 | 124 | 34 | 221 | 58 | 392 | 82 | 698 |
| 11 | 127 | 35 | 226 | 59 | 402 | 83 | 715 |
| 12 | 130 | 36 | 232 | 60 | 412 | 84 | 732 |
| 13 | 133 | 37 | 237 | 61 | 422 | 85 | 750 |
| 14 | 137 | 38 | 243 | 62 | 432 | 86 | 768 |
| 15 | 140 | 39 | 249 | 63 | 442 | 87 | 787 |
| 16 | 143 | 40 | 255 | 64 | 453 | 88 | 806 |
| 17 | 147 | 41 | 261 | 65 | 464 | 89 | 825 |
| 18 | 150 | 42 | 267 | 66 | 475 | 90 | 845 |
| 19 | 154 | 43 | 274 | 67 | 487 | 91 | 866 |
| 20 | 158 | 44 | 280 | 68 | 499 | 92 | 887 |
| 21 | 162 | 45 | 287 | 69 | 511 | 93 | 909 |
| 22 | 165 | 46 | 294 | 70 | 523 | 94 | 931 |
| 23 | 169 | 47 | 301 | 71 | 536 | 95 | 953 |
| 24 | 174 | 48 | 309 | 72 | 549 | 96 | 976 |

| Code | A | B | C | D | E | F | G | H | X | Y | Z |
|------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|
| Multiplier | 10 ⁰ | 10 ¹ | 10 ² | 10 ³ | 10 ⁴ | 10 ⁵ | 10 ⁶ | 10 ⁷ | 10 ⁻¹ | 10 ⁻² | 10 ⁻³ |

11. Recommend Land Pattern

Unit: mm



| Codes | A | B | C |
|-------|------|------|------|
| CR-01 | 0.30 | 0.25 | 0.30 |
| CR-02 | 0.50 | 0.45 | 0.60 |
| CR-03 | 0.90 | 0.60 | 0.90 |
| CR-05 | 1.20 | 0.70 | 1.30 |
| CR-06 | 2.00 | 0.90 | 1.60 |
| CR-10 | 2.00 | 0.90 | 2.80 |
| CR-0A | 3.80 | 0.90 | 2.80 |
| CR-12 | 3.80 | 1.60 | 3.50 |