

## Current Sensing Chip Resistors

### Type SL/TSL Resistor

ISO 9001:2000  
TS-16949

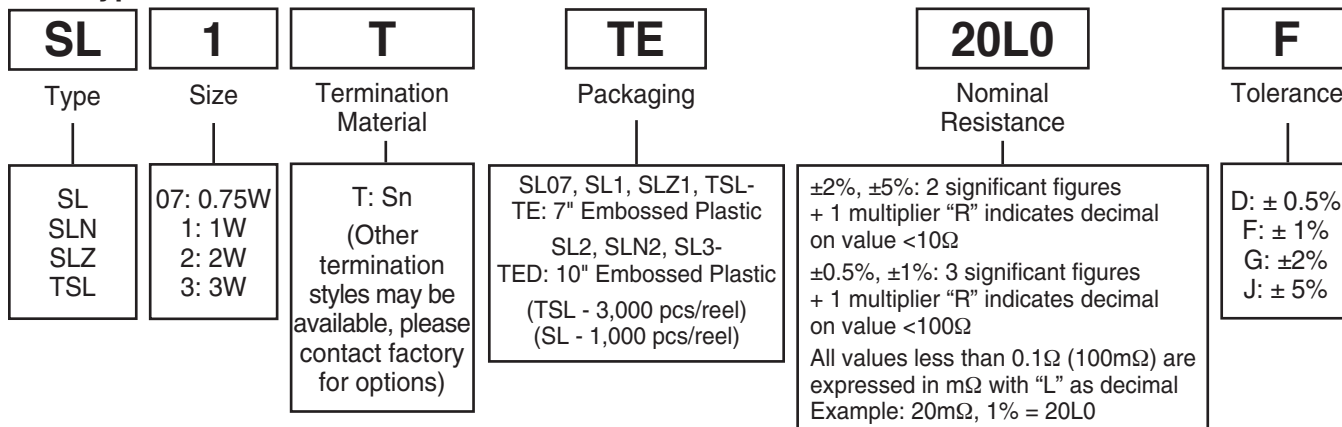
#### 1. Scope

This specification applies to current sensing chip resistors (SL/TSL) produced by KOA Corporation. Products with lead-free terminations meet EU-RoHS requirements. Pb located in glass material, electrode and resistor element is exempt per Annex 1, exemption 5 of EU directive 2005/95/EC

#### 2. Type Designation

The type designation shall be in the following form:

##### New Type



#### 3. Standard Applications

| Part Designation | Power Rating | T.C.R.<br>(ppm/°C)<br>Max.      | Resistance Range | Resistance Tolerance<br>E-24*      | Absolute Maximum Working Voltage | Absolute Maximum Overload Voltage | Operating Temperature Range |
|------------------|--------------|---------------------------------|------------------|------------------------------------|----------------------------------|-----------------------------------|-----------------------------|
| SL07             | 0.75W        | 0~200: R<10mΩ<br>0~150: R=>11mΩ | 5mΩ - 100mΩ      | (F: ±1%)<br>(J: ±5%)               | —                                | —                                 | -55°C to +180°C             |
| SL1              | 1W           | ±180: R<13mΩ<br>±100: R=>15mΩ   | 10mΩ - 1MΩ       | (D: ±0.5%)                         | 200V                             | 400V                              |                             |
|                  |              |                                 | 5mΩ - 1MΩ        | (F: ±1%)                           |                                  |                                   |                             |
|                  |              |                                 | 3mΩ, 4mΩ         | (G: ±2%)                           |                                  |                                   |                             |
|                  |              |                                 | 3mΩ ~ 22MΩ       | (J: ±5%)                           |                                  |                                   |                             |
| SL2              | 2W           | ±180: R<10mΩ<br>±100: R=>11mΩ   | 10mΩ - 1MΩ       | (D: ±0.5%)                         | 500V                             | 1000V                             |                             |
|                  |              |                                 | 5mΩ ~ 1MΩ        | (F: ±1%)                           |                                  |                                   |                             |
|                  |              |                                 | 3mΩ, 4mΩ         | (G: ±2%)                           |                                  |                                   |                             |
|                  |              |                                 | 3mΩ - 22MΩ       | (J: ±5%)                           |                                  |                                   |                             |
| SLN2             | 2W           | ±110: R<10mΩ<br>±75: R=>10mΩ    | 5mΩ - 200mΩ      | (D: ±0.5%)<br>(F: ±1%)<br>(J: ±5%) | —                                | —                                 |                             |

### 3. Standard Applications (continued)

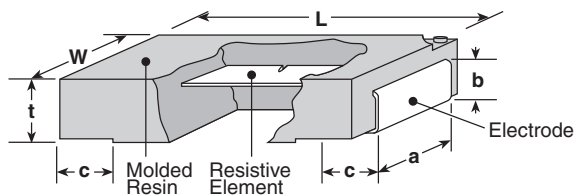
| Part Designation | Power Rating | T.C.R. (ppm/°C) Max.           | Resistance Range            | Resistance Tolerance E-24*         | Absolute Maximum Working Voltage | Absolute Maximum Overload Voltage | Operating Temperature Range |
|------------------|--------------|--------------------------------|-----------------------------|------------------------------------|----------------------------------|-----------------------------------|-----------------------------|
| SL3              | 3W           | ±180: R=<10mΩ<br>±100: R=>11mΩ | 10mΩ - 100mΩ<br>5mΩ - 100mΩ | (D: ±0.5%)<br>(F: ±1%)<br>(J: ±5%) | —                                | —                                 | -55°C to +180°C             |
| SLZ1**           | —            | 4000 Max.                      | 0.5mΩ Max.                  | —                                  | —                                | —                                 |                             |
| TSL1             | 1W           | ±180: R=<13mΩ<br>±100: R=>15mΩ | 10mΩ - 100mΩ<br>5mΩ - 100mΩ | (D: ±0.5%)<br>(F: ±1%)<br>(J: ±5%) | —                                | —                                 |                             |

\* 3m, 4m, 5m, 6m, 7m, 8m, 9m resistance values also available

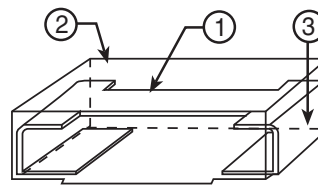
\*\* SLZ1: Current rating: 44A

### 4. Dimensions and Structure

#### 4-1 Dimensions



#### 4-2 Structure

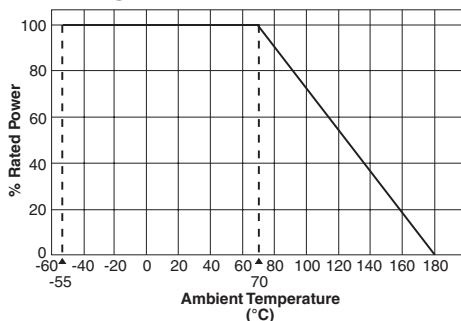


- Resistive Element  
Metal Plate: SL1 ≤ 100 mΩ, SL2 ≤ 360 mΩ, SL3  
Thick Film: SL1 > 100 mΩ, SL2 > 360 mΩ
- Flameproof Molded Epoxy Case with UL94V-0 Flammability Rating
- End Termination with Tin/Lead Solder Plating

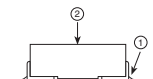
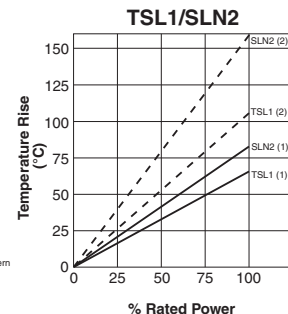
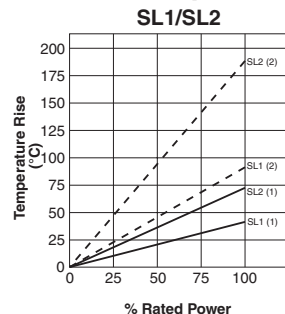
| Size Code | Dimensions inches (mm)  |                        |                        |                        |                        |                         |
|-----------|-------------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|
|           | L                       | W                      | t                      | a                      | b                      | c                       |
| SL07      | .197±.012<br>(5.0±0.3)  | .098±.008<br>(2.5±0.2) | .067±.008<br>(1.7±0.2) | .079±.008<br>(2.0±0.2) | .047±.008<br>(0.9±0.2) | .035±.012<br>(1.2±0.3)  |
| SL1/SLZ1  | .248±.012<br>(6.3±0.3)  | .122±.008<br>(3.1±0.2) | .075±.008<br>(1.9±0.2) | .094±.008<br>(2.4±0.2) | .047±.008<br>(1.2±0.2) | .047±.012<br>(1.2±0.3)  |
| SL2       | .453±.012<br>(11.5±0.3) | .276±.008<br>(7.0±0.2) | .098±.008<br>(2.5±0.2) | .197±.008<br>(5.0±0.2) | .067±.008<br>(1.7±0.2) | .102±.02<br>(2.6±0.5)   |
| SLN2      | .453±.012<br>(11.5±0.3) | .276±.008<br>(7.0±0.2) | .094±.008<br>(2.4±0.2) | .217±.008<br>(5.5±0.2) | .063±.008<br>(1.6±0.2) | .100±.016<br>(2.55±0.4) |
| SL3       | .453±.012<br>(11.5±0.3) | .276±.008<br>(7.0±0.2) | .098±.008<br>(2.5±0.2) | .197±.008<br>(5.0±0.2) | .067±.008<br>(1.7±0.2) | .102±.02<br>(2.6±0.5)   |
| TSL1      | .248±.012<br>(6.3±0.3)  | .122±.008<br>(3.1±0.2) | .039±.008<br>(1.0±0.2) | .094±.008<br>(2.4±0.2) | .028±.008<br>(0.7±0.2) | .047±.012<br>(1.2±0.3)  |

### 5. Rating

#### Derating Curve



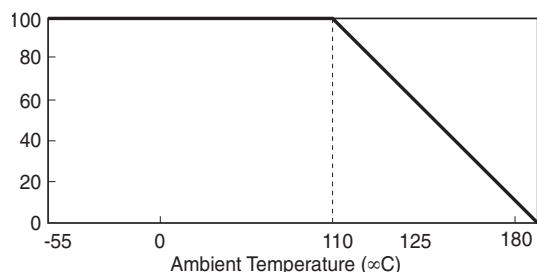
#### Surface Temperature Rise



\* TSL1: 20mΩ  
SLN2: 110mΩ  
10mm pattern

## 5-1 Rating SL3

For temperature in excess of 110°C, the load shall be derated in accordance with the following figure.



## 5-2 Voltage Rating

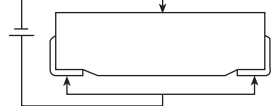
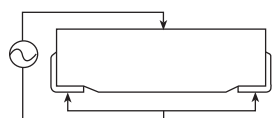
Resistors shall have a rated direct-current (DC) continuous working voltage or approximate sine-wave root-mean-square (RMS) alternating-current (AC) continuous working voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula:

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

Where:  
 E = Rated voltage (V)  
 P = Rated power (W)  
 R = Nominal resistance (Ω)

## 6. Characteristics

### 6-1 Electrical Characteristics

| No. | Item                                  |     | Requirement                                   | Test Method (JIS C 5202)                                                                                                             |
|-----|---------------------------------------|-----|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Resistance                            |     | Within specified tolerance                    | JIS C 5202 5.1 Measured at 25°C                                                                                                      |
| 2   | Temperature coefficient of resistance | 1 W | ±180: R=<14.7 mΩ<br>±100: R=>15 mΩ            | JIS C 5202 5.2<br>+ 25°C / +125°C                                                                                                    |
|     |                                       | 2 W | ±180: R=<10.7 mΩ<br>±100: R=>11 mΩ            |                                                                                                                                      |
|     |                                       | 3 W | ±180: R=<10.7 mΩ<br>±100: R=>11 mΩ            |                                                                                                                                      |
| 3   | Short time overload                   |     | ± 1.0% maximum                                | 5* times rated power for 5 seconds<br>10 Watts (SL3 only)                                                                            |
| 4   | Intermittent overload                 |     | ± 5.0% maximum                                | Rated voltage x 3.0*<br>1 sec. ON/25 seconds OFF 1,000 cycles<br>18 Watts 1 second ON/125 seconds OFF<br>1,000 cycles (SL3 only)     |
| 5   | Insulation Resistance                 |     | 10,000 MΩ minimum                             | Surface center to terminations<br>D. C 500V<br> |
| 6   | Dielectric Withstanding Voltage       |     | ± 0.5% maximum<br>No short, burning or arcing | A. C 500V<br>60 sec.<br>                        |

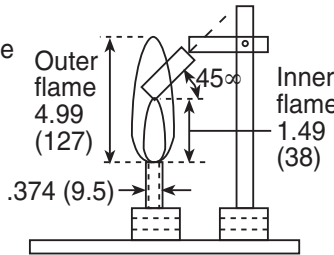
\* Since temperature rise of this product are affected by the circuit board size, materials, peripheral heat-producing components, etc. check that the solder fillet part temperature after mounting is less than the solder melting point (180°C) in operating condition and that the package surface is 200°C or less. Also, please install radiating patterns and carefully design the pattern width with respect to the load current so that the above temperatures can be maintained.

## 6-2 Mechanical Characteristics

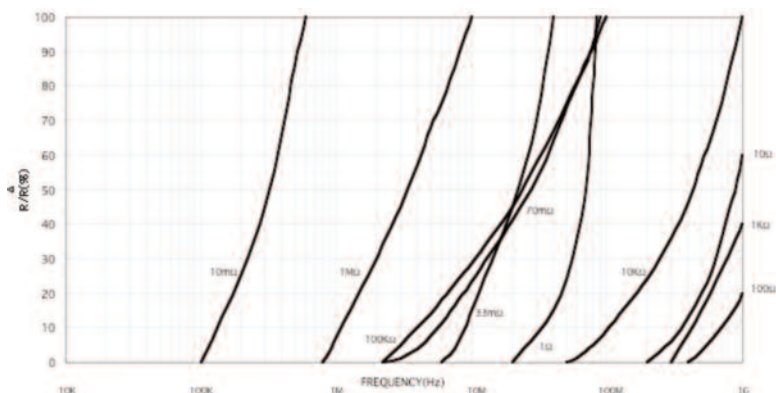
| No. | Item                         | Requirement                                           | Test Method (JIS C 5202)                                |
|-----|------------------------------|-------------------------------------------------------|---------------------------------------------------------|
| 1   | Resistance to Soldering Heat | ± 1.0% maximum                                        | MIL-R55342 π 4.7.7,<br>260°C for 10 seconds             |
| 2   | Solderability                | 95% of the terminal should be covered with new solder | Immerse in solder at 230°C ± 5°C<br>for 3 ± 0.5 seconds |
| 3   | Vibration                    | ± 0.5% maximum                                        | 6.3      Condition A      Each direction/2 hours        |
| 4   | Resistance to Solvents       | No visual and mechanical damage                       | 6.9                                                     |

### 6-3 Environmental Characteristics

Dimensions in inches (mm)

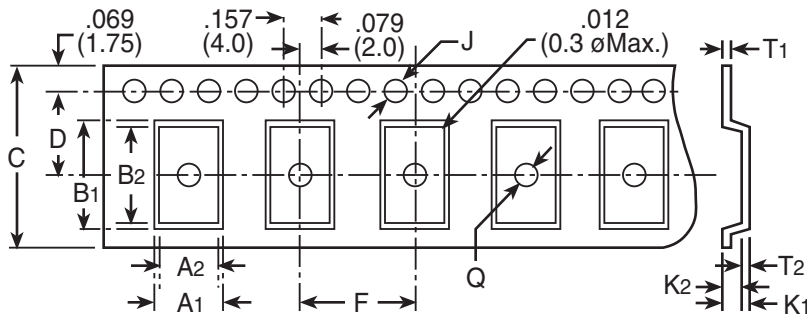
| No. | Item                      | Requirement                             | Test Method (JIS C 5202)                                                                                                                            |
|-----|---------------------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Damp Heat                 | ± 2.0% maximum<br>No visual damage      | 7.9<br>40°C ± 2°C; 90 ~ 95% RH; 1,000 hours                                                                                                         |
| 2   | Moisture Resistance       | ± 2.0% maximum<br>No evidence of damage | MIL-STD-202, Method 103, 40°C, 90-95% RH, 1000 hours                                                                                                |
| 3   | Load Life<br>(Rated load) | ± 2.0% maximum<br>No visual damage      | MIL-STD-202, Method 108, 70°C, 1000 hours<br>@ RCWV, 1.5 hr ON, 0.5 hr OFF                                                                          |
| 4   | Temperature<br>Cycling    | ± 1.0% maximum<br>No mechanical damage  | 30 minutes @ -55°C, 15 minutes @ +25°C,<br>30 minutes @ +125°C, 15 minutes @ +25°C,<br>5 cycles                                                     |
| 5   | Flammability              | Incombustible                           | 7.12 3.1<br>in flame/out flame<br>15 sec./15 sec.<br>5 cycles  |

## 6-4 High Frequency Characteristics



## 7. Taping

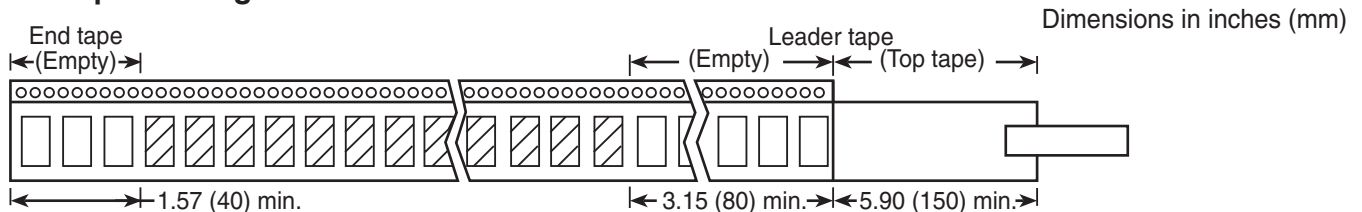
### 7-1 Dimensions of Carrier Tape



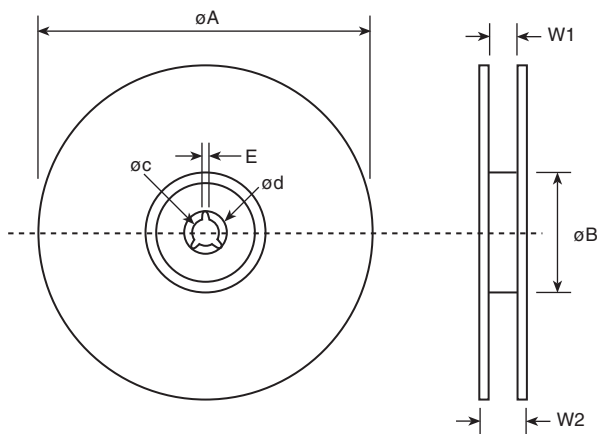
Dimensions in inches (mm)

|       | A1                | A2                | B1                 | B2                 | C                  | D                  | F                  | J                                              | K1                 | K2                  | Q                                              | T1                  | T2                  |
|-------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------------------------------------------|--------------------|---------------------|------------------------------------------------|---------------------|---------------------|
| TSL   | .134<br>(3.4±0.1) | .125<br>(3.2±0.1) | .260<br>(6.6±0.1)  | .244<br>(6.2±0.1)  | .472<br>(12.0±0.2) | .216<br>(5.5±0.1)  | .157<br>(4.0±0.1)  | .059<br>(1.5± <sup>0.1</sup> <sub>0.0</sub> )  | .051<br>(1.3±0.1)  | .043<br>(1.1 ± 0.1) | .059<br>(1.5± <sup>0.1</sup> <sub>0.0</sub> )  | .010<br>(0.25±0.05) | .008<br>(0.20±0.05) |
| SL-1  | .142<br>(3.6±0.1) | .134<br>(3.4±0.1) | .267<br>(6.8±0.1)  | .252<br>(6.4±0.1)  | .472<br>(12.0±0.2) | .216<br>(5.5±0.1)  | .315<br>(8.0±0.1)  | .059<br>(1.5± <sup>0.1</sup> <sub>0.0</sub> )  | .092<br>(2.35±0.1) | .085<br>(2.15±0.1)  | .059<br>(1.5± <sup>0.1</sup> <sub>0.0</sub> )  | .010<br>(0.25±0.05) | .008<br>(0.20±0.05) |
| SL-2  | .303<br>(7.7±0.1) | .291<br>(7.4±0.1) | .480<br>(12.2±0.1) | .469<br>(11.9±0.1) | .945<br>(24.0±0.2) | .452<br>(11.5±0.1) | .472<br>(12.0±0.1) | .059<br>(1.55± <sup>0.5</sup> <sub>0.5</sub> ) | .134<br>(3.4±0.1)  | .126<br>(3.2±0.1)   | .081<br>(2.05± <sup>0.5</sup> <sub>0.5</sub> ) | .010<br>(0.25±0.05) | .008<br>(0.20±0.05) |
| SL-3  | .303<br>(7.7±0.1) | .291<br>(7.4±0.1) | .480<br>(12.2±0.1) | .469<br>(11.9±0.1) | .945<br>(24.0±0.2) | .452<br>(11.5±0.1) | .472<br>(12.0±0.1) | .059<br>(1.5± <sup>0.1</sup> <sub>0.0</sub> )  | .122<br>(3.1±0.1)  | .110<br>(2.8±0.1)   | .059<br>(1.5± <sup>0.1</sup> <sub>0.0</sub> )  | .016<br>(0.40±0.05) | .012<br>(0.30±0.05) |
| SLN-2 | .303<br>(7.7±0.1) | —                 | .480<br>(12.2±0.1) | —                  | .472<br>(12.0±0.1) | —                  | .472<br>(12.0±0.2) | —                                              | .122<br>(3.1±0.1)  | —                   | —                                              | —                   | —                   |

### 7-2 Taped Configuration



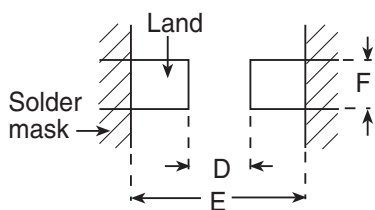
## 7-3 Reel Dimensions



Dimensions in inches (mm)

|                            | øA                  | øB                 | øC                   | øD                   | E                   | W1                   | W2                   | Qty/<br>Reel |
|----------------------------|---------------------|--------------------|----------------------|----------------------|---------------------|----------------------|----------------------|--------------|
| <b>TSL</b>                 | 7.08<br>(180 ± 0.0) | 2.36<br>(60 ± 1.0) | .511<br>(13.0 ± 0.2) | .826<br>(21.0 ± 0.8) | .079<br>(2.0 ± 0.2) | .511<br>(13.0 ± 0.3) | .606<br>(15.4 ± 1.0) | 3,000        |
| <b>SL-1</b>                | 7.08<br>(180 ± 0.0) | 2.36<br>(60 ± 1.0) | .511<br>(13.0 ± 0.2) | .826<br>(21.0 ± 0.8) | .079<br>(2.0 ± 0.2) | .511<br>(13.0 ± 0.3) | .606<br>(15.4 ± 1.0) | 1,000        |
| <b>SL-2</b><br><b>SL-3</b> | 10.0<br>(255 ± 0.0) | 3.15<br>(80 ± 1.0) | .511<br>(13.0 ± 0.2) | .984<br>(25.0 ± 1.0) | .079<br>(2.0 ± 0.5) | 1.00<br>(25.5 ± 2.0) | 1.18<br>(30.0 ± 1.0) | 1,000        |

## 8. Recommended Land Pattern TSL1, SL1 & SL2



Dimensions in inches (mm)

|              | D             | E              | F             |
|--------------|---------------|----------------|---------------|
| <b>TSL1</b>  | .133<br>(3.4) | .315<br>(8.0)  | .118<br>(3.0) |
| <b>SL1</b>   | .133<br>(3.4) | .315<br>(8.0)  | .118<br>(3.0) |
| <b>SL2</b>   | .213<br>(5.4) | .591<br>(15.0) | .157<br>(4.0) |
| <b>SL3</b>   | .213<br>(5.4) | .591<br>(15.0) | .157<br>(4.0) |
| <b>SLN-2</b> | .197<br>(5.0) | .591<br>(15.0) | .197<br>(5.0) |

## 8-1 Body and Marking

|               |                                |
|---------------|--------------------------------|
| Body color    | Black                          |
| Marking color | White                          |
| Marking items | Resistance value and tolerance |