

ALTERNATION HISTORY RECORDS 变更记录

| Date<br>日期 | Version<br>版本 | Mark<br>标记 | Page<br>页码 | Description<br>描述 | Drafter<br>制定者 | Approver<br>审批者 |
|------------|---------------|------------|------------|-------------------|----------------|-----------------|
| 2020-5-10  | A             | /          | 8          | In release        | Doris          | /               |
|            |               |            |            |                   |                |                 |
|            |               |            |            |                   |                |                 |

## 1. Part Numbering System):

| <b>LR</b>                                                                 | <b>1632</b>                                                                                     | <b>J</b>                                         | <b>B</b>                                                              | <b>R015</b>                                                 |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------|
| <u>Series Name</u><br>Chip Resistor:<br>LR:<br>wide Terminal General type | <u>Type</u> Inch (mm)<br>1220(0508)<br>1632 (0612)<br>2550 (1020)<br>3216 (1206)<br>3264 (1225) | <u>Tolerance</u><br>F= $\pm 1\%$<br>J= $\pm 5\%$ | <u>Package</u><br>A=4Kpcs/7"Reel<br>B=5Kpcs/7"Reel<br>C=10Kpcs/7"Reel | <u>Resistance</u><br>R015=15m $\Omega$<br>R15=150m $\Omega$ |

## 2. FEATURE

- Downsizing and High rated dissipation by wide termination structure
- Downsizing and space reduction
- High solderability strength and reliability by wide termination structure.

## 3. APPLICATION

- Vehicle-related equipment
- All kinds of power supply equipment AC-DC inverter AC-DC inverter
- Engines, transformers, QA equipment

## 4. Specification

### 4.1 Short side electrode

| Size   |        | Power Rating | Resistance Value Range                      | Resistance Tolerance               | Temperature Coefficient of Resistance |
|--------|--------|--------------|---------------------------------------------|------------------------------------|---------------------------------------|
| Metric | (Inch) |              |                                             |                                    |                                       |
| 0816   | (0306) | 0.3W         | 10m $\Omega$<br>12~500m $\Omega$ (E-12) *1  | $\pm 1.0\%$ (F)                    | $\pm 50\text{ppm}/^\circ\text{C}$     |
| 1220   | (0508) | 0.5W         | 5~9m $\Omega$ (1m $\Omega$ step)            | $\pm 1.0\%$ (F)<br>$\pm 2.0\%$ (G) | $\pm 100\text{ppm}/^\circ\text{C}$    |
|        |        |              | 10m $\Omega$<br>12~500m $\Omega$ (E-12) *1  | $\pm 1.0\%$ (F)                    | $\pm 50\text{ppm}/^\circ\text{C}$     |
| 1632   | (0612) | 0.75W        | 5~9m $\Omega$ (1m $\Omega$ step)            | $\pm 1.0\%$ (F)<br>$\pm 2.0\%$ (G) | $\pm 100\text{ppm}/^\circ\text{C}$    |
|        |        |              | 10m $\Omega$<br>12~500m $\Omega$ (E-12) *1  | $\pm 1.0\%$ (F)                    | $\pm 50\text{ppm}/^\circ\text{C}$     |
| 2550   | (1020) | 1.5W         | 5~9m $\Omega$ (1m $\Omega$ step)            | $\pm 1.0\%$ (F)<br>$\pm 2.0\%$ (G) | $\pm 100\text{ppm}/^\circ\text{C}$    |
|        |        |              | 10m $\Omega$<br>12~500m $\Omega$ (E-12) *1  | $\pm 1.0\%$ (F)                    | $\pm 50\text{ppm}/^\circ\text{C}$     |
| 3264   | (1225) | 3W           | 5~9m $\Omega$ (1m $\Omega$ step)            | $\pm 1.0\%$ (F)<br>$\pm 2.0\%$ (G) | $\pm 100\text{ppm}/^\circ\text{C}$    |
|        |        |              | 10m $\Omega$<br>12~1000m $\Omega$ (E-12) *1 | $\pm 1.0\%$ (F)                    | $\pm 50\text{ppm}/^\circ\text{C}$     |
| 50110  | (2043) | 5W           | 5~9m $\Omega$ (1m $\Omega$ step)            | $\pm 1.0\%$ (F)<br>$\pm 2.0\%$ (G) | $\pm 100\text{ppm}/^\circ\text{C}$    |
|        |        |              | 10m $\Omega$<br>12~1000m $\Omega$ (E-12) *1 | $\pm 1.0\%$ (F)                    | $\pm 50\text{ppm}/^\circ\text{C}$     |

\*1 Outside the E-12 series 20m $\Omega$ , 25m $\Omega$ , 50m $\Omega$ , 200m $\Omega$ , 500m $\Omega$  can also be delivered.

## 4.2 Long side electrode

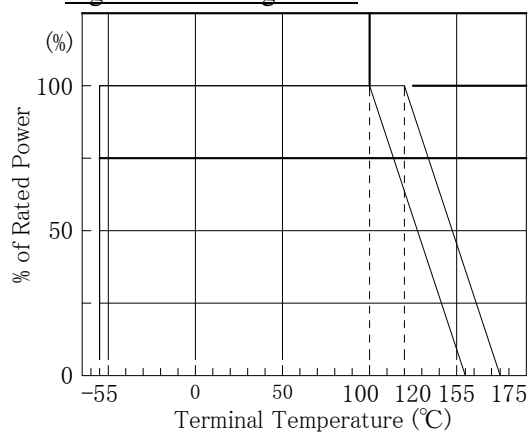
| Size   |        | Power Rating | Resistance Value Range      | Resistance Tolerance | Temperature Coefficient of Resistance |
|--------|--------|--------------|-----------------------------|----------------------|---------------------------------------|
| Metric | (Inch) |              |                             |                      |                                       |
| 2012   | (0805) | 1W           | 1mΩ                         | ±5.0% (J)            | ±150ppm/°C                            |
|        |        |              | 2mΩ                         | ±2.0% (G)            | ±100ppm/°C                            |
|        |        |              | 3~10mΩ (1mΩ step)           | ±1.0% (F)            | ±50ppm/°C                             |
|        |        |              | 15~500mΩ (E-6) <sup>2</sup> |                      |                                       |
| 3216   | (1206) | 1.5W         | 1mΩ                         | ±5.0% (J)            | ±150ppm/°C                            |
|        |        |              | 2mΩ                         | ±2.0% (G)            | ±100ppm/°C                            |
|        |        |              | 3~10mΩ (1mΩ step)           | ±1.0% (F)            | ±50ppm/°C                             |
|        |        |              | 15~500mΩ (E-6) <sup>2</sup> |                      |                                       |
| 5025   | (2010) | 2W           | 1mΩ                         | ±5.0% (J)            | ±150ppm/°C                            |
|        |        |              | 2mΩ                         | ±2.0% (G)            | ±100ppm/°C                            |
|        |        |              | 3~10mΩ (1mΩ step)           | ±1.0% (F)            | ±50ppm/°C                             |
|        |        |              | 15~500mΩ (E-6) <sup>2</sup> |                      |                                       |
| 6432   | (2512) | 3W           | 1mΩ                         | ±5.0% (J)            | ±150ppm/°C                            |
|        |        |              | 2mΩ                         | ±2.0% (G)            | ±100ppm/°C                            |
|        |        |              | 3~10mΩ (1mΩ step)           | ±1.0% (F)            | ±50ppm/°C                             |
|        |        |              | 15~500mΩ (E-6) <sup>2</sup> |                      |                                       |
| 7638   | (3015) | 4W           | 1mΩ                         | ±5.0% (J)            | ±150ppm/°C                            |
|        |        |              | 2mΩ                         | ±2.0% (G)            | ±100ppm/°C                            |
|        |        |              | 3~10mΩ (1mΩ step)           | ±1.0% (F)            | ±50ppm/°C                             |
|        |        |              | 15~500mΩ (E-6) <sup>2</sup> |                      |                                       |
| 9045   | (3518) | 5W           | 1mΩ                         | ±5.0% (J)            | ±150ppm/°C                            |
|        |        |              | 2mΩ                         | ±2.0% (G)            | ±100ppm/°C                            |
|        |        |              | 3~10mΩ (1mΩ step)           | ±1.0% (F)            | ±50ppm/°C                             |
|        |        |              | 15~500mΩ (E-6) <sup>2</sup> |                      |                                       |
| 11050  | (4420) | 6W           | 1mΩ                         | ±5.0% (J)            | ±150ppm/°C                            |
|        |        |              | 2mΩ                         | ±2.0% (G)            | ±100ppm/°C                            |
|        |        |              | 3~9mΩ (1mΩ step)            | ±1.0% (F)            | ±50ppm/°C                             |
|        |        |              | 10~500mΩ (E-6) <sup>2</sup> |                      |                                       |
| 15075  | (6030) | 10W          | 1mΩ                         | ±5.0% (J)            | ±100ppm/°C                            |
|        |        |              | 2mΩ                         | ±2.0% (G)            |                                       |
|        |        |              | 3~9mΩ (1mΩ step)            | ±1.0% (F)            | ±50ppm/°C                             |
|        |        |              | 10~500mΩ (E-6) <sup>2</sup> |                      |                                       |

<sup>2</sup> Outside the E-6 series 20mΩ, 25mΩ, 50mΩ, 200mΩ, 500mΩ can also be delivered.

<Common to all Part Number>

| Parameter                  | Specification                                                         |
|----------------------------|-----------------------------------------------------------------------|
| Rated Terminal Temperature | Type C: +120°C    Type M: +100°C<br>Refer to Derating curve, Figure-1 |
| Operating Temperature      | Type C: -55 ~ +175°C<br>Type M: -55 ~ +155°C                          |
| Rated Voltage              | $\sqrt{\text{Power(W)} \times \text{Resistance Value}(\Omega)}$ (V)   |

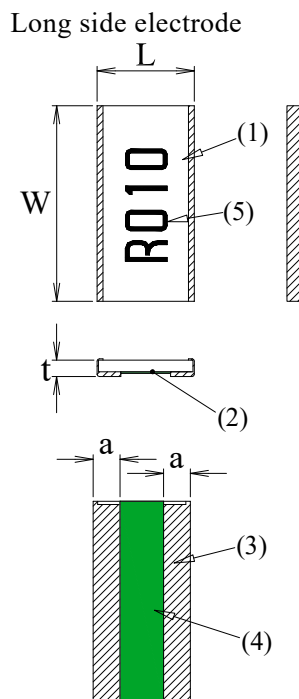
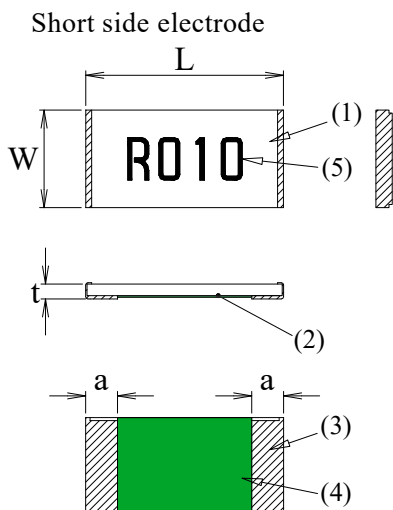
Figure-1 Derating curve:



## 5. Structure

Metal alloy (Ni-Cu) foil resistive element is adhered to the ceramic substrate. The terminals are formed by tin-plating on the foil.

## 6. Dimensions



| No  | Components      | Material / process                             |
|-----|-----------------|------------------------------------------------|
| (1) | Substrate       | Alumina 96%                                    |
| (2) | Resistor        | Ni-Cu alloy                                    |
| (3) | Terminals       | Plated Sn + Ni (on Cu)                         |
| (4) | Protection coat | Epoxy resin (Green)                            |
| (5) | Marking         | Epoxy resin (Black)<br>*No Marking in KRL0816E |

<Standard dimension>

| Type                 | Size   |        | Resistance Value Range | Dimensions (mm) |          |           |          |
|----------------------|--------|--------|------------------------|-----------------|----------|-----------|----------|
|                      | Metric | (Inch) |                        | L               | W        | a         | t        |
| Short side electrode | 0816   | (0306) | 10~18mΩ                | 1.6±0.2         | 0.8±0.2  | 0.70±0.15 | 0.5±0.2  |
|                      |        |        | 20~39mΩ                |                 |          | 0.55±0.15 |          |
|                      |        |        | 47mΩ~                  |                 |          | 0.30±0.15 |          |
|                      | 1220   | (0508) | 5mΩ~                   | 2.0±0.2         | 1.25±0.2 | 0.4±0.2   | 0.5±0.2  |
|                      | 1632   | (0612) | 5~8mΩ                  | 3.2±0.2         | 1.6±0.2  | 1.1±0.2   | 0.5±0.2  |
|                      |        |        | 9mΩ~                   |                 |          | 0.5±0.2   |          |
|                      | 2550   | (1020) | 5~8mΩ                  | 5.0±0.2         | 2.5±0.2  | 1.4±0.2   | 0.5±0.2  |
|                      |        |        | 9mΩ~                   |                 |          | 0.6±0.2   |          |
|                      | 3264   | (1225) | 5~8mΩ                  | 6.3±0.2         | 3.1±0.2  | 1.9±0.2   | 0.5±0.2  |
|                      |        |        | 9mΩ~                   |                 |          | 1.0±0.2   |          |
| Long side electrode  | 2012   | (0805) | 1mΩ                    | 1.25±0.2        | 2.0±0.2  | 0.55±0.2  | 0.5±0.2  |
|                      |        |        | 2mΩ~                   |                 |          | 0.3±0.2   |          |
|                      | 3216   | (1206) | 1mΩ                    | 1.6±0.2         | 3.2±0.2  | 0.55±0.2  | 0.5±0.2  |
|                      |        |        | 2mΩ~                   |                 |          | 0.3±0.2   |          |
|                      | 5025   | (2010) | 1mΩ                    | 2.5±0.2         | 5.0±0.2  | 0.9±0.2   | 0.5±0.2  |
|                      |        |        | 2mΩ~                   |                 |          | 0.55±0.2  |          |
|                      | 6432   | (2512) | 1mΩ                    | 3.1±0.2         | 6.3±0.2  | 1.2±0.2   | 0.5±0.2  |
|                      |        |        | 2mΩ~                   |                 |          | 0.5±0.2   |          |
|                      | 7638   | (3015) | 1mΩ                    | 3.8±0.2         | 7.6±0.2  | 1.35±0.2  | 0.5±0.2  |
|                      |        |        | 2mΩ~                   |                 |          | 0.6±0.2   |          |
|                      | 9045   | (3518) | 1mΩ                    | 4.5±0.2         | 9.0±0.2  | 1.6±0.2   | 0.5±0.2  |
|                      |        |        | 2mΩ~                   |                 |          | 0.7±0.2   |          |
|                      | 11050  | (4420) | 1mΩ                    | 5.0±0.2         | 11.0±0.2 | 1.6±0.2   | 0.5±0.2  |
|                      |        |        | 2mΩ~                   |                 |          | 0.8±0.2   |          |
|                      | 15075  | (6030) | 1mΩ                    | 7.5±0.2         | 15.0±0.2 | 2.75±0.2  | 0.65±0.2 |
|                      |        |        | 2mΩ~                   |                 |          | 1.1±0.2   |          |

## 7. Marking

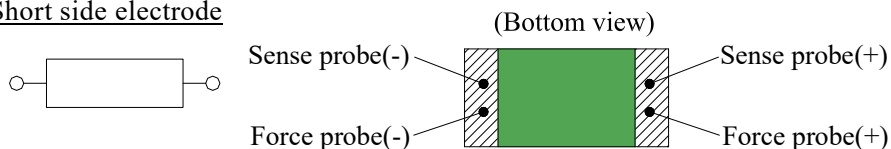
Resistance value code is marked on the top surface.

Note: No marking in KRL0816E.

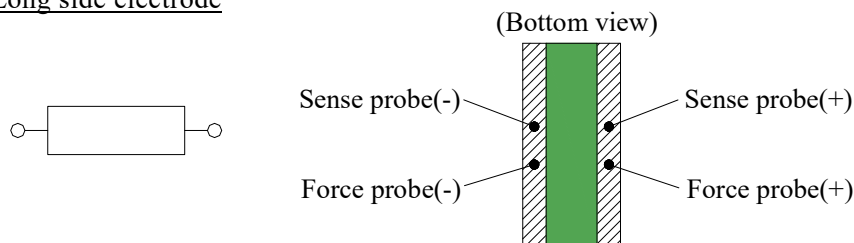
Ex.) 5mΩ : R005  
10mΩ : R010  
100mΩ : R100

## 8. Schematic Diagram, Measurement (probing) area

### Short side electrode



### Long side electrode



## 9. Reliability Characteristics

| Test Item                    | Test Conditions                                                                          | Specification                                  |
|------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------|
| Short Time Over Load         | Power of 1.5 times the rated power shall be applied for 5s.                              | ±1.0%                                          |
| Load Life                    | Rated power on for 90 min, off for 30 min at 70±3°C for 1000h.                           | ±1.0%                                          |
| Moisture Load Life           | Rated power for 90 min, off for 30 min at 60±2°C, relative humidity of 90~95% for 1000h. | ±2.0%                                          |
| Temperature Cycle            | [-55°C 30 min → R.T. 3 min → +155°C 30 min → R.T. 3 min]                                 | 100 continuous cycles                          |
|                              |                                                                                          | 1,000 continuous cycles                        |
| Resistance to soldering Heat | 260±5°C solder, 10±1sec dip                                                              | ±0.5%                                          |
| Board Bending                | Test board length: 90mm      Bend depth: 2mm<br>Test board: Glass-Epoxy t=1.6mm          | ±1.0%                                          |
| Solderability                | 245±5°C solder, 3+1/-0 sec dip.                                                          | 90% terminal surface coverage by fresh solder. |

## 10. Country of origin and Production location

Country of origin : Japan

Production location : Susumu Co., Ltd., Niigata Plant

Address : 3005-2 Suzawa, Itoigawa City, Niigata-Pref., 949-0301, Japan

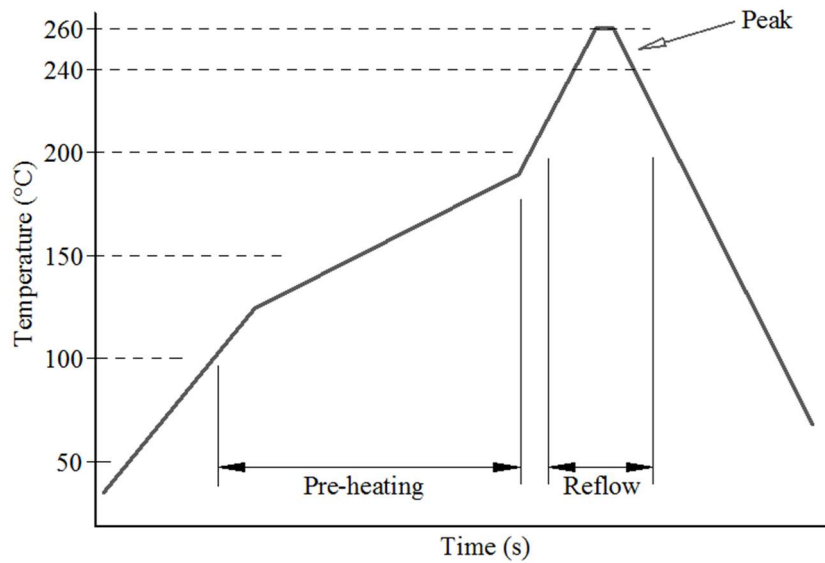
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## 11.Recommended implementation temperature profile

### 11.1 Reflow temperature profile (Lead-free solder)

Twice reflows are allowed by the following temperature profile

- Surface temperature of resistor and time



|             |               |             |
|-------------|---------------|-------------|
| Pre-heating | : 130 ~ 180°C | 60 ~ 90 sec |
| Reflow      | : >220°C      | 30 ~ 90 sec |
| Peak        | : 240~ 260°C  | 10 sec Max  |

### 11.2 Flow temperature profile

Less than 260°C 10sec Max

### 11.3 Hand solder attachment conditions

Working at temperatures of 350 ° C for 5 seconds or less is possible.

When soldering using a soldering iron, heating should be done on the land, so that the tip does not touch the product body

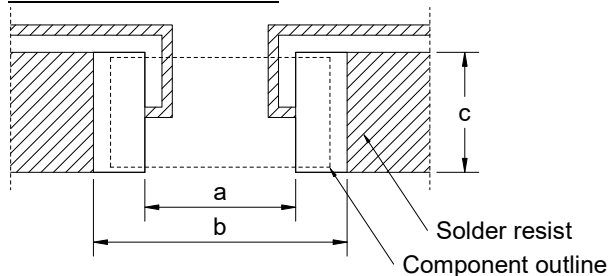
## 12.Recommended land pattern (for current sensing)

\* Please be careful not to exceed the terminal temperature of 120 °C for the high heat resistant product (C) and 100 °C for the low thermal electromotive force product (M) when applying the rated power.

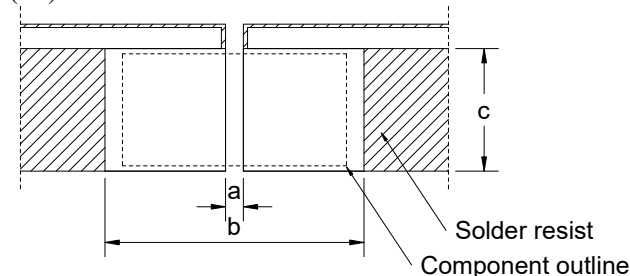
\* Cover the voltage sensing terminals with solder resist, please be sure to provide an insulating layer on the wiring pattern under the mounting surface or the through hole terminal.

<Recommended land pattern>

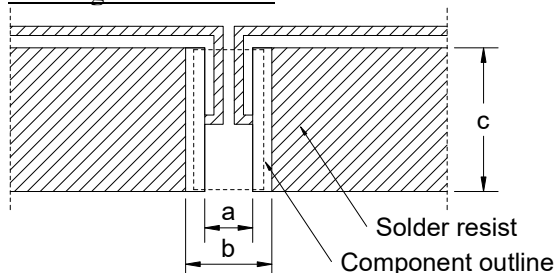
**A: Short side electrode**



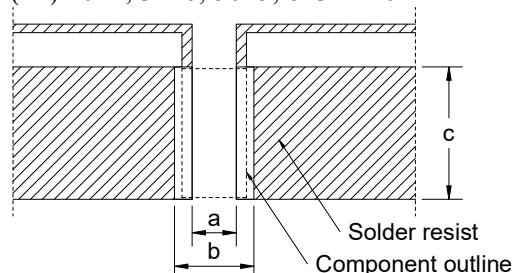
(\*1) 0816: 10~39mΩ



**B: Long side electrode**



(\*2) 2012, 3216, 5025, 6432: 1.0mΩ



| Type                 | Size  | Resistance Value Range | Thickness of copper foil (μm) | Dimensions (mm) |      |      |
|----------------------|-------|------------------------|-------------------------------|-----------------|------|------|
|                      |       |                        |                               | a               | b    | c    |
| Short side electrode | 0816  | 10~18mΩ (*1)           | 35                            | 0.1             | 2.2  | 1.0  |
|                      |       | 20~39mΩ (*1)           |                               | 0.5             |      |      |
|                      |       | 47mΩ~                  |                               | 0.9             |      |      |
|                      | 1220  | 5mΩ~                   | 100                           | 1.2             | 2.7  | 1.5  |
|                      | 1632  | 5~8mΩ                  |                               | 1.0             | 4.0  | 1.9  |
|                      |       | 9mΩ~                   |                               | 2.0             |      |      |
|                      | 2550  | 5~8mΩ                  |                               | 2.2             | 6.0  | 2.8  |
|                      |       | 9mΩ~                   |                               | 3.8             |      |      |
|                      | 3264  | 5~8mΩ                  |                               | 2.5             | 7.4  | 3.5  |
|                      |       | 9mΩ~                   |                               | 4.4             |      |      |
|                      | 50110 | 5~7mΩ                  |                               | 2.8             | 14.0 | 5.75 |
|                      |       | 8mΩ~                   |                               | 5.0             |      |      |
| Long side electrode  | 2012  | 1mΩ (*2)               | 100                           | 0.25            | 2.0  | 2.2  |
|                      |       | 2mΩ~                   | 35                            | 0.6             |      |      |
|                      | 3216  | 1mΩ (*2)               | 100                           | 0.4             | 2.4  | 3.4  |
|                      |       | 2mΩ~                   | 35                            | 0.6             |      |      |
|                      | 5025  | 1mΩ (*2)               |                               | 0.7             | 4.0  | 5.2  |
|                      |       | 2mΩ~                   | 100                           | 1.2             | 4.2  | 6.6  |
|                      | 6432  | 1mΩ (*2)               |                               | 0.7             |      |      |
|                      |       | 2mΩ~                   |                               | 2.2             | 4.6  | 7.8  |
|                      | 7638  | 1mΩ                    |                               | 1.1             |      |      |
|                      |       | 2mΩ~                   |                               | 2.6             | 5.1  | 9.2  |
|                      | 9045  | 1mΩ                    |                               | 1.3             |      |      |
|                      |       | 2mΩ~                   |                               | 3.1             | 5.6  | 11.2 |
|                      | 11050 | 1mΩ                    |                               | 1.8             |      |      |
|                      |       | 2mΩ~                   |                               | 3.6             | 8.4  | 15.2 |
|                      | 15075 | 1mΩ                    |                               | 2.0             |      |      |
|                      |       | 2mΩ~                   |                               | 5.0             |      |      |

### 13.Precautions on Storage

- (1) Please keep in a room where temperature and humidity are controlled (temperature 5 ~ 35 °C, humidity 45 ~ 85% RH). However, keep the humidity as low as possible.
- (2) Store in a place where there is no substance that deteriorates solderability such as moisture, dust, etc. and toxic gas (hydrogen chloride, sulfurous acid gas, hydrogen sulfide).
- (3) Please keep it from direct sunlight.
- (4) If you deviate from the matters listed above, or when one year or more has passed since the date of your arrival, please confirm the solderability for use.

### 14.Packaging

Packing quantity: 500, 1,000 or 5,000 pieces.

Each product are used different quantity per reel. Quantity of product are below.

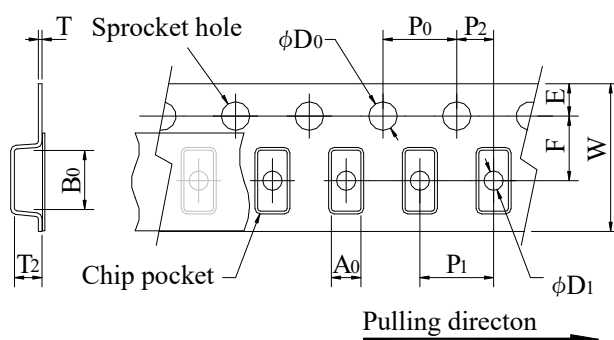
LR15075E : 500 pieces, 1,000 pieces

LR50110E, LR11050E : 1,000 pieces

Other size : 1,000 pieces, 5,000 pieces

|                                 |          |
|---------------------------------|----------|
| Tape diagram/dimension          | Figure-2 |
| Peeling strength of sealed tape | Figure-3 |
| Reel diagram/dimension          | Figure-4 |
| Taping direction                | Figure-5 |

**Figure-2 Tape diagram/dimension:**



Material: Plastic

**Tape dimension (mm): Short / (Long) electrode**

| Symbol         | 0816       | 1220<br>(2012) | 1632<br>(3216) | 2550<br>(5025) | 3264<br>(6432) | (7638)    | (9045)    | 50110<br>(11050) | (15075)      |
|----------------|------------|----------------|----------------|----------------|----------------|-----------|-----------|------------------|--------------|
| A <sub>0</sub> | 0.95±0.05  | 1.45±0.1       | 1.9±0.1        | 2.9±0.2        | 3.43±0.2       | 4.15±0.1  | 4.85±0.1  | 5.4±0.1          | 8.3±0.1      |
| B <sub>0</sub> | 1.85±0.05  | 2.3±0.1        | 3.5±0.1        | 5.3±0.2        | 6.63±0.2       | 7.95±0.1  | 9.35±0.1  | 11.5±0.1         | 15.6±0.1     |
| W              | 8.0±0.1    | 8.0±0.2/-0     | 8.0±0.2        | 12.0±0.3       | 12.0±0.3       | 16.0±0.3  | 16.0±0.3  | 24.0±0.3         | 24.0±0.2     |
| F              | 3.50±0.05  | 3.50±0.05      | 3.50±0.05      | 5.50±0.05      | 5.50±0.05      | 7.5±0.1   | 7.5±0.1   | 11.5±0.1         | 1.75±0.1     |
| E              | 1.75±0.1   | 1.75±0.1       | 1.75±0.1       | 1.75±0.1       | 1.75±0.1       | 1.75±0.1  | 1.75±0.1  | 1.75±0.1         | 11.5±0.1     |
| P <sub>0</sub> | 4.0±0.1    | 4.0±0.1        | 4.0±0.1        | 4.0±0.1        | 4.0±0.1        | 4.0±0.1   | 4.0±0.1   | 4.0±0.1          | 4.0±0.1      |
| P <sub>1</sub> | 4.0±0.1    | 4.0±0.1        | 4.0±0.1        | 4.0±0.1        | 4.0±0.1        | 8.0±0.1   | 8.0±0.1   | 8.0±0.1          | 12.0±0.1     |
| P <sub>2</sub> | 2.00±0.05  | 2.00±0.05      | 2.00±0.05      | 2.00±0.05      | 2.00±0.05      | 2.0±0.1   | 2.0±0.1   | 2.0±0.1          | 2.0±0.1      |
| D <sub>0</sub> | 1.5±0.1/-0 | 1.5±0.1/-0     | 1.5±0.1/-0     | 1.5±0.1/-0     | 1.5±0.1/-0     | 1.5±0.1   | 1.5±0.1   | 1.5±0.1          | 1.50±0.05/-0 |
| D <sub>1</sub> | 0.60±0.05  | -              | 1.0±0.2/-0     | 1.5±0.2/-0     | 1.5±0.2/-0     | 1.5±0.1   | 1.5±0.1   | 1.5±0.1          | 1.50±0.05/-0 |
| T              | 0.20±0.05  | 0.20±0.05      | 0.20±0.05      | 0.3Max         | 0.20±0.05      | 0.30±0.05 | 0.30±0.05 | 0.30±0.05        | 0.30±0.05    |
| T <sub>2</sub> | 0.55±0.05  | 0.65±0.1       | 0.75±0.1       | 1.5Max         | 0.76±0.1       | 1.20±0.15 | 1.20±0.15 | 1.20±0.15        | 2.3±0.1      |

Figure-3 Peeling strength of sealed tape:

$F$  = peeling strength: 0.1-0.7N (10 - 71gf)

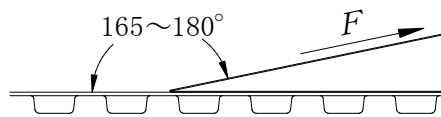
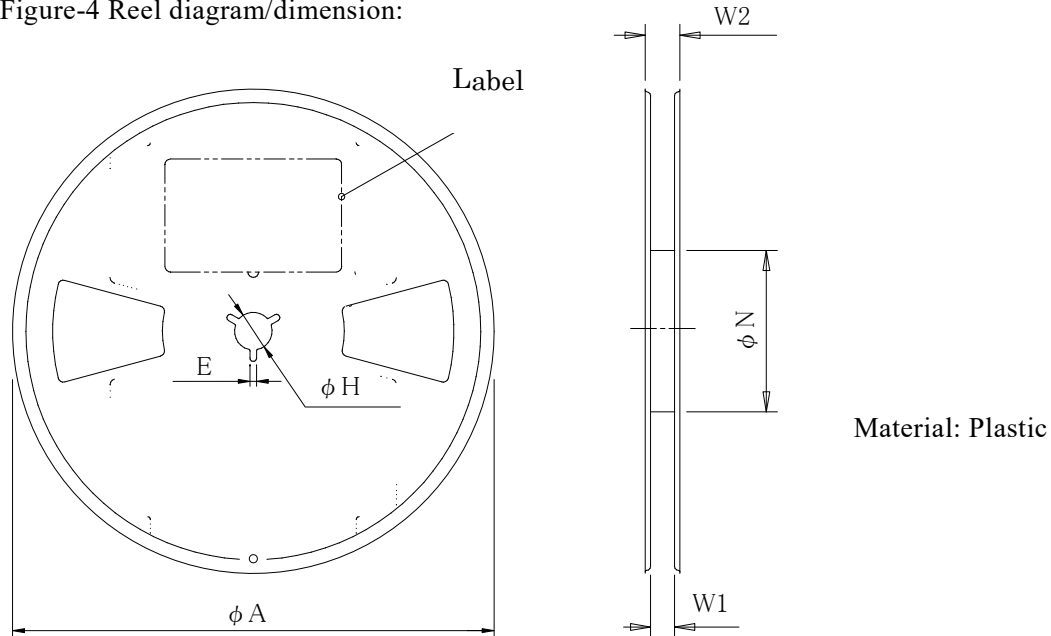


Figure-4 Reel diagram/dimension:



Reel dimension (mm): Short / (Long) electrode

| Size     | 0816,<br>1220, 1632<br>(2012),<br>(3216) | 2550, 3264<br>(5025), (6432) |          | (7638), (9045) |          | 50110<br>(11050) | (15075)  |          |
|----------|------------------------------------------|------------------------------|----------|----------------|----------|------------------|----------|----------|
| Quantity | 1,000 / 5,000                            | 1,000                        | 5,000    | 1,000          | 5,000    | 1,000            | 500      | 1,000    |
| $\phi A$ | 180+0/-3                                 | 180+0/-3                     | 255±1    | 180+0/-3       | 330±2    | 180±2            | 180±2    | 330±2    |
| $\phi H$ | 13.0±0.2                                 | 13.0±0.2                     | 13.0±0.3 | 13.0±0.2       | 13.0±0.2 | 13.0±0.2         | 13.0±0.2 | 13.0±0.2 |
| E        | 2.0±0.5                                  | 2.0±0.5                      | 2.0±0.2  | 2.0±0.5        | 2.0±0.5  | 2.0±0.5          | 2.0±0.5  | 2.0±0.5  |
| $\phi N$ | 60+1/-0                                  | 60+1/-0                      | 80±0.5   | 60+1/-0        | 80±1     | 80±1             | 80±1     | 100±1    |
| W1       | 9.0±0.3                                  | 13.0±0.3                     | 13.5±1   | 17.0±0.3       | 17.4±1   | 25.4±1           | 25.4±1   | 25.4±1   |
| W2       | 13.0±1.4                                 | 17.0±1.4                     | >18.4    | 19.4±1         | 21.4±1   | 29.4±1           | 29.4±1   | 29.4±1   |

Figure-5 Taping direction:

