

Multilayer Metal Power Inductors MCOIL™ LSCN series for General

LSCND1412HKTR24ME

[Notes]

- This document is for reference use only and does not guarantee the specifications of the products.
- The contents of this document are based on the existing August 1, 2022.
- This document is subject to change for improvements or others without notice.
- Please request and agree to the specification document of the products before purchasing and using them regardless of types of applications.
- Please check and comply with the usage conditions and precautions described in this specification. Before use, please be sure to verify and validate the products under intended operating environmental conditions with the products being installed in actual devices.

1. Scope

This specification covers multilayer metal power inductors for use in general electronic equipment.
 For the details of such equipment, please refer to "Section 6-1 Limited Application" in this specification.

2. Part Numbering System

Part number is indicated as follows:

$\frac{L}{①}$ $\frac{S}{②}$ $\frac{C}{③}$ $\frac{N}{④}$ $\frac{D}{⑤}$ $\frac{1412}{⑥}$ $\frac{HK}{⑦}$ $\frac{T}{⑧}$ $\frac{R24}{⑨}$ $\frac{M}{⑩}$ $\frac{E}{⑪}$

①Group

| Code | Group |
|------|----------|
| L | Inductor |

②Category

| Code | Category |
|------|------------------------------|
| S | General Electronic Equipment |

③Type

| Code | Type |
|------|------------------|
| C | Metal Multilayer |

④Features

| Code | Features |
|------|----------------------|
| N | Standard Power choke |

⑤Terminal electrode, Marking

| Code | Terminal electrode, Marking |
|------|--|
| D | Bottom electrode with polarity marking |

⑥Dimensions(L×W)

| Code | Dimensions(L×W)[mm] |
|------|---------------------|
| 1608 | 1.6×0.8 |
| 1412 | 1.4×1.2 |
| 2012 | 2.0×1.2 |

⑦Thickness

| Code | Thickness[mm] |
|------|---------------|
| FE | 0.65max |
| HK | 0.8max |

⑧Packaging

| Code | Packaging |
|------|-----------|
| T | Taping |

⑨Nominal inductance

| Code(ex.) | Nominal inductance[μH] |
|-----------|------------------------|
| R24 | 0.24 |
| R47 | 0.47 |
| 1R0 | 1.0 |

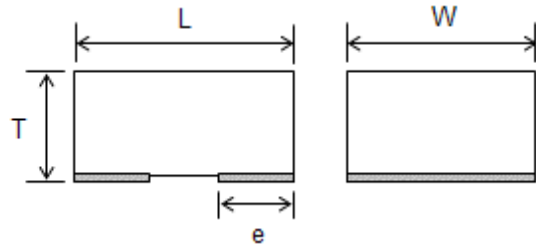
⑩Inductance tolerance

| Code | Inductance tolerance |
|------|----------------------|
| M | ±20% |

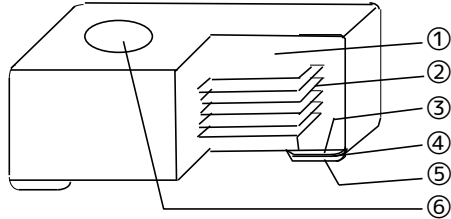
⑪Internal code

※R=Decimal point

3. Shape, Structure, and Dimension



| Type | Dimension [mm] | | | |
|---------|----------------|---------------|---------|---------------|
| | L | W | T | e |
| 1412 HK | 1.4 ± 0.2 | 1.2 ± 0.2 | Max 0.8 | 0.5 ± 0.2 |



| | Name | Material |
|---|-------------------------------|--------------------------|
| ① | Chip body | Metal magnetics |
| ② | Internal Conductors | Ag |
| ③ | Terminal Electrodes (Base) | Ag |
| ④ | Terminal Electrodes (Plating) | Ni |
| ⑤ | Terminal Electrodes (Surface) | Sn |
| ⑥ | Marking | Dielectric glass ceramic |

4. Rated Value

Operating Temperature Range: -40°C to +125°C (Including self-generated heat)

| Part number | Nominal Inductance | Inductance Tolerance | DC Resistance | | Rated Current *) | | | | Measuring frequency |
|-------------------|--------------------|----------------------|----------------|----------------|-------------------------|---------|--------------------------------|---------|---------------------|
| | | | | | Saturation Current Idc1 | | Temperature Rise Current Idc 2 | | |
| | | | (max) | (typ) | (max) | (typ) | (max) | (typ) | |
| LSCND1412HKTR24ME | 0.24 μ H | ± 20 % | 0.022 Ω | 0.018 Ω | 6500 mA | 6900 mA | 4400 mA | 4800 mA | 1 MHz |

*) The saturation current value (Idc1) is the maximum DC current value having inductance decrease down to 30%. (at 20°C)

*) The temperature rise current value (Idc2) is the maximum DC current value having temperature increase up to 40°C. (at 20°C)

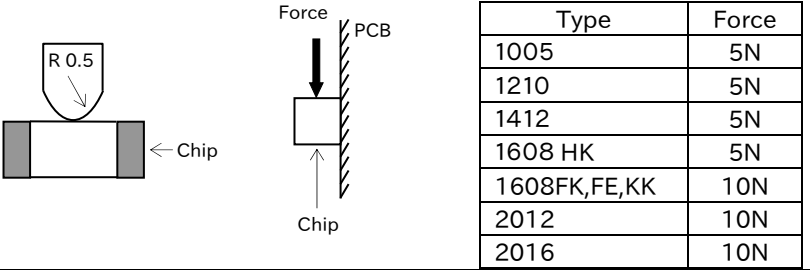
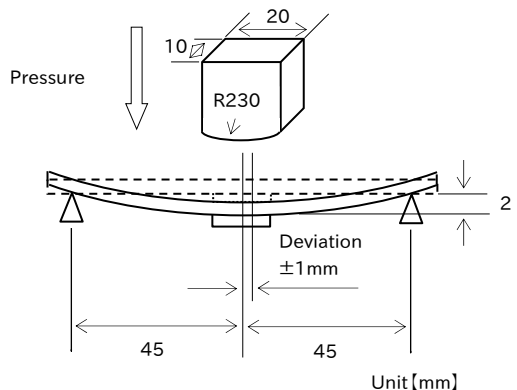
*) The rated current value is following either Idc1(max) or Idc2(max), which is the lower one.

Absolute maximum voltage: 10V

5. Functions and Test Methods

•Test Conditions:

Standard test conditions shall be temperature of 5°C to 35°C, relative humidity of 25% to 85%. Tests shall be conducted at temperature of 20°C±2°C, relative humidity of 60% to 70% and air pressure of 86kPa to 106kPa if test results are suspicious. Unless otherwise specified, all tests shall be conducted under the standard test conditions.

| No. | Item | Specified Value | Testing Method | | | | | | | | | | | | | | | | |
|--------------|--------------------------------|----------------------|---|------|-------|------|----|------|----|------|----|---------|----|--------------|-----|------|-----|------|-----|
| 5.1 | Inductance | Per Section 4 | Inductance shall be measured at 1MHz. Measuring equipment: E4991B (or equivalent equipment) Measuring OSC level: 0.5V Measuring jig: 16197A (or equivalent equipment) | | | | | | | | | | | | | | | | |
| 5.2 | DC Resistance | Per Section 4 | Measuring equipment: HIOKI RM3545(or equivalent equipment) | | | | | | | | | | | | | | | | |
| 5.3 | Definition of Rated Current | Per Section 4 | Inductance decrease within 30% and temperature rise in an element within 40°C by the application of direct current | | | | | | | | | | | | | | | | |
| 5.4 | Adhesion of Terminal Electrode | No exfoliation | <p>Test samples shall be soldered to test boards. A force shall be applied in vertically downward direction with a R 0.5 fixture for 10 seconds.</p>  <table border="1" data-bbox="1518 678 1848 949"> <thead> <tr> <th>Type</th> <th>Force</th> </tr> </thead> <tbody> <tr> <td>1005</td> <td>5N</td> </tr> <tr> <td>1210</td> <td>5N</td> </tr> <tr> <td>1412</td> <td>5N</td> </tr> <tr> <td>1608 HK</td> <td>5N</td> </tr> <tr> <td>1608FK,FE,KK</td> <td>10N</td> </tr> <tr> <td>2012</td> <td>10N</td> </tr> <tr> <td>2016</td> <td>10N</td> </tr> </tbody> </table> | Type | Force | 1005 | 5N | 1210 | 5N | 1412 | 5N | 1608 HK | 5N | 1608FK,FE,KK | 10N | 2012 | 10N | 2016 | 10N |
| Type | Force | | | | | | | | | | | | | | | | | | |
| 1005 | 5N | | | | | | | | | | | | | | | | | | |
| 1210 | 5N | | | | | | | | | | | | | | | | | | |
| 1412 | 5N | | | | | | | | | | | | | | | | | | |
| 1608 HK | 5N | | | | | | | | | | | | | | | | | | |
| 1608FK,FE,KK | 10N | | | | | | | | | | | | | | | | | | |
| 2012 | 10N | | | | | | | | | | | | | | | | | | |
| 2016 | 10N | | | | | | | | | | | | | | | | | | |
| 5.5 | Bending Strength | No mechanical damage | <p>Test samples shall be soldered to test boards. A force shall be applied in a downward direction until amount of deflection reaches 2mm. Test board dimension: 100×40×0.8mm Test board material: Glass epoxy</p>  <p style="text-align: right;">Unit [mm]</p> | | | | | | | | | | | | | | | | |

| No. | Item | Specified Value | Testing Method | | | | | | | | | | |
|------------------------|------------------------------|---|---|----------------------|------------------------|--------------------|---|----------------|--------------|--------------------|-----------------|----------------|--------------|
| 5.6 | Vibration | <table border="1"> <tr> <td>Appearance</td> <td>No remarkable defect</td> </tr> <tr> <td>Inductance change rate</td> <td>Within $\pm 10\%$</td> </tr> </table> | Appearance | No remarkable defect | Inductance change rate | Within $\pm 10\%$ | Test samples shall be vibrated under the following conditions: - Frequency range: 10Hz to 55Hz - Overall amplitude: 1.5mm - Sweeping method: 10Hz - 55Hz - 10Hz for 1 minute - 2 hours each in X, Y, Z directions: 6 hours in total | | | | | | |
| Appearance | No remarkable defect | | | | | | | | | | | | |
| Inductance change rate | Within $\pm 10\%$ | | | | | | | | | | | | |
| 5.7 | Solderability | More than 90% of terminal electrode shall be covered with fresh solder. | <Preconditioning> Test samples shall be immersed into flux. <Test> Test samples shall be immersed into molten solder under the conditions shown in the tables below, then taken out and checked visually. The speed of immersion and taking out shall be 25mm/s. <table border="1"> <tr> <td>Solder</td> <td>Sn/3.0Ag/0.5Cu</td> </tr> <tr> <td>Solder temperature</td> <td>245°C\pm5°C</td> </tr> <tr> <td>Immersion time</td> <td>4s\pm1s</td> </tr> </table> | Solder | Sn/3.0Ag/0.5Cu | Solder temperature | 245°C \pm 5°C | Immersion time | 4s \pm 1s | | | | |
| Solder | Sn/3.0Ag/0.5Cu | | | | | | | | | | | | |
| Solder temperature | 245°C \pm 5°C | | | | | | | | | | | | |
| Immersion time | 4s \pm 1s | | | | | | | | | | | | |
| 5.8 | Resistance to Soldering Heat | <table border="1"> <tr> <td>Appearance</td> <td>No remarkable defect</td> </tr> <tr> <td>Inductance change rate</td> <td>Within $\pm 10\%$</td> </tr> </table> | Appearance | No remarkable defect | Inductance change rate | Within $\pm 10\%$ | <Preconditioning> Test samples shall be immersed into flux. Preheating as shown in the table below shall be conducted. <Test> Test samples shall be immersed into molten solder under the conditions shown in the table below and taken out. The speed of immersion and taking out shall be 25mm/s. Test samples shall be kept at ambient temperature for 2 or 3 hours (Note 1) before measurement. <table border="1"> <tr> <td>Preheating</td> <td>150°C, 3min.</td> </tr> <tr> <td>Solder Temperature</td> <td>260°C\pm5°C</td> </tr> <tr> <td>Immersion time</td> <td>10s\pm1s</td> </tr> </table> | Preheating | 150°C, 3min. | Solder Temperature | 260°C \pm 5°C | Immersion time | 10s \pm 1s |
| Appearance | No remarkable defect | | | | | | | | | | | | |
| Inductance change rate | Within $\pm 10\%$ | | | | | | | | | | | | |
| Preheating | 150°C, 3min. | | | | | | | | | | | | |
| Solder Temperature | 260°C \pm 5°C | | | | | | | | | | | | |
| Immersion time | 10s \pm 1s | | | | | | | | | | | | |

(Note 1) If any doubt arises in the result of measurement, another measurement shall be conducted after leaving test samples to stand for 48 \pm 2 hours.

| No. | Item | Specified Value | Testing Method | | | | | | | | | | | | | | | | | | | |
|------------------------|---|---|----------------|----------------------|------------------------|-------------------|--|------|-------------|------|---|---|--------------------|---|--------------|----------------|---|---|--------------------|---|--------------|----------------|
| 5.9 | Thermal Shock | <table border="1"> <tr> <td>Appearance</td> <td>No remarkable defect</td> </tr> <tr> <td>Inductance change rate</td> <td>Within $\pm 10\%$</td> </tr> </table> | Appearance | No remarkable defect | Inductance change rate | Within $\pm 10\%$ | <p>Test samples shall be exposed to steps 1 to 4 shown in the table below as one cycle. The test should be repeated for 100 times.</p> <p>Test samples shall be kept at normal temperature and normal humidity for 2 to 3 hours before measurement. (Note 1)</p> <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature</th> <th>Time</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-40°C $^{+0}_{-3}$ $^{\circ}\text{C}$</td> <td>30min.\pm3min.</td> </tr> <tr> <td>2</td> <td>Normal temp.</td> <td>2min. to 3min.</td> </tr> <tr> <td>3</td> <td>$+85^{\circ}\text{C}$ $^{+3}_{-0}$ $^{\circ}\text{C}$</td> <td>30min.\pm3min.</td> </tr> <tr> <td>4</td> <td>Normal temp.</td> <td>2min. to 3min.</td> </tr> </tbody> </table> | Step | Temperature | Time | 1 | -40°C $^{+0}_{-3}$ $^{\circ}\text{C}$ | 30min. \pm 3min. | 2 | Normal temp. | 2min. to 3min. | 3 | $+85^{\circ}\text{C}$ $^{+3}_{-0}$ $^{\circ}\text{C}$ | 30min. \pm 3min. | 4 | Normal temp. | 2min. to 3min. |
| Appearance | No remarkable defect | | | | | | | | | | | | | | | | | | | | | |
| Inductance change rate | Within $\pm 10\%$ | | | | | | | | | | | | | | | | | | | | | |
| Step | Temperature | Time | | | | | | | | | | | | | | | | | | | | |
| 1 | -40°C $^{+0}_{-3}$ $^{\circ}\text{C}$ | 30min. \pm 3min. | | | | | | | | | | | | | | | | | | | | |
| 2 | Normal temp. | 2min. to 3min. | | | | | | | | | | | | | | | | | | | | |
| 3 | $+85^{\circ}\text{C}$ $^{+3}_{-0}$ $^{\circ}\text{C}$ | 30min. \pm 3min. | | | | | | | | | | | | | | | | | | | | |
| 4 | Normal temp. | 2min. to 3min. | | | | | | | | | | | | | | | | | | | | |
| 5.10 | Resistance to Humidity | <table border="1"> <tr> <td>Appearance</td> <td>No remarkable defect</td> </tr> <tr> <td>Inductance change rate</td> <td>Within $\pm 10\%$</td> </tr> </table> | Appearance | No remarkable defect | Inductance change rate | Within $\pm 10\%$ | <p>Test samples shall be kept in an atmosphere at temperature and humidity of $60^{\circ}\text{C}\pm 2^{\circ}\text{C}$ and 90 to 95%RH for 500 $\pm 24/-0$ hours.</p> <p>Test samples shall be kept at normal temperature and normal humidity for 2 to 3 hours before measurement. (Note 1)</p> | | | | | | | | | | | | | | | |
| Appearance | No remarkable defect | | | | | | | | | | | | | | | | | | | | | |
| Inductance change rate | Within $\pm 10\%$ | | | | | | | | | | | | | | | | | | | | | |
| 5.11 | High Temperature Load Life Test | <table border="1"> <tr> <td>Appearance</td> <td>No remarkable defect</td> </tr> <tr> <td>Inductance change rate</td> <td>Within $\pm 10\%$</td> </tr> </table> | Appearance | No remarkable defect | Inductance change rate | Within $\pm 10\%$ | <p>Test samples shall be kept in an atmosphere at temperature of $85^{\circ}\text{C}\pm 2^{\circ}\text{C}$ for 500 $\pm 24/-0$ hours while the rated current ($I_{dc 2 \text{ max}}$) is continuously applied.</p> <p>Test samples shall be kept at normal temperature and normal humidity for 2 to 3 hours before measurement. (Note 1)</p> | | | | | | | | | | | | | | | |
| Appearance | No remarkable defect | | | | | | | | | | | | | | | | | | | | | |
| Inductance change rate | Within $\pm 10\%$ | | | | | | | | | | | | | | | | | | | | | |
| 5.12 | Humidity Resistance Load Life Test | <table border="1"> <tr> <td>Appearance</td> <td>No remarkable defect</td> </tr> <tr> <td>Inductance change rate</td> <td>Within $\pm 10\%$</td> </tr> </table> | Appearance | No remarkable defect | Inductance change rate | Within $\pm 10\%$ | <p>Test samples shall be kept in an atmosphere at temperature and humidity of $60^{\circ}\text{C}\pm 2^{\circ}\text{C}$ and 90 to 95%RH for 500 $\pm 24/-0$ hours while the rated current ($I_{dc 2 \text{ max}}$) is continuously applied.</p> <p>Test samples shall be kept at normal temperature and normal humidity for 2 to 3 hours before measurement. (Note 1)</p> | | | | | | | | | | | | | | | |
| Appearance | No remarkable defect | | | | | | | | | | | | | | | | | | | | | |
| Inductance change rate | Within $\pm 10\%$ | | | | | | | | | | | | | | | | | | | | | |

(Note 1) If any doubt arises in the result of measurement, another measurement shall be conducted after leaving test samples to stand for 48 ± 2 hours.

6. Basic Information and Others

6-1. Limited Application

6-1-1. Equipment Intended for Use

The products listed in this specification are intended for general-purpose and standard use in general electronic equipment for consumer (e.g., AV equipment, OA equipment, home electric appliances, office equipment, information and communication equipment including, without limitation, mobile phone, and PC) and other equipment specified in the catalog or the product specification, or the equipment approved separately by TAIYO YUDEN.

TAIYO YUDEN has the product series intended for use in the following equipment. Therefore, when using our products for these equipment, please check available applications specified in the catalog or the product specification and use the corresponding products.

| Application | Product Series | | Quality Grade ※3 |
|-------------|---|--------------------------------|------------------|
| | Equipment ※1 | Category (Part Number Code ※2) | |
| Automotive | Automotive Electronic Equipment (POWERTRAIN, SAFETY) | A | 1 |
| | Automotive Electronic Equipment (BODY & CHASSIS, INFOTAINMENT) | C | 2 |
| Industrial | Telecommunications Infrastructure and Industrial Equipment | B | 2 |
| Medical | Medical Devices classified as GHTF Class C (Japan Class III) | M | 2 |
| | Medical Devices classified as GHTF Classes A or B (Japan Classes I or II) | L | 3 |
| Consumer | General Electronic Equipment | S | 3 |

*Notes:

1. Based on the general specifications required for electronic components for such equipment, which are recognized by TAIYO YUDEN, the use of each product series for the equipment is recommended. Please be sure to contact TAIYO YUDEN before using our products for equipment other than those covered by the product series.
2. On each of our part number, the 2nd code from the left is a code indicating the “Category” as shown in the above table. For details, please check the explanatory materials regarding the part numbering system of each of our products.
3. Each product series is assigned a “Quality Grade” from 1 to 3 in order of higher quality. Please do not incorporate a product into any equipment with a higher Quality Grade than the Quality Grade of such product without the prior written consent of TAIYO YUDEN.

6-1-2. Equipment Requiring Inquiry

Please be sure to contact TAIYO YUDEN for further information before using the products listed in this specification for the following equipment (excluding intended equipment as specified in the catalog or the product specification) which may cause loss of human life, bodily injury, serious property damage and/or serious public impact due to a failure or defect of the products and/or malfunction attributed thereto.

- (1) Transportation equipment (automotive powertrain control system, train control system, and ship control system, etc.)

- (2) Traffic signal equipment
- (3) Disaster prevention equipment, crime prevention equipment
- (4) Medical devices classified as GHTF Class C (Japan Class III)
- (5) Highly public information network equipment, data-processing equipment (telephone exchange, and base station, etc.)
- (6) Any other equipment requiring high levels of quality and/or reliability equal to the equipment listed above

6-1-3. Equipment Prohibited for Use

Please do not incorporate our products into the following equipment requiring extremely high levels of safety and/or reliability.

- (1) Aerospace equipment (artificial satellite, rocket, etc.)
- (2) Aviation equipment *1
- (3) Medical devices classified as GHTF Class D (Japan Class IV), implantable medical devices *2
- (4) Power generation control equipment (nuclear power, hydroelectric power, thermal power plant control system, etc.)
- (5) Undersea equipment (submarine repeating equipment, etc.)
- (6) Military equipment
- (7) Any other equipment requiring extremely high levels of safety and/or reliability equal to the equipment listed above

*Notes:

1. There is a possibility that our products can be used only for aviation equipment that does not directly affect the safe operation of aircraft (e.g., in-flight entertainment, cabin light, electric seat, cooking equipment) if such use meets requirements specified separately by TAIYO YUDEN. Please be sure to contact TAIYO YUDEN for further information before using our products for such aviation equipment.
2. Implantable medical devices contain not only internal unit which is implanted in a body, but also external unit which is connected to the internal unit.

6-1-4. Limitation of Liability

Please note that unless you obtain prior written consent of TAIYO YUDEN, TAIYO YUDEN shall not be in any way responsible for any damages incurred by you or third parties arising from use of the products listed in this specification for any equipment that is not intended for use by TAIYO YUDEN, or any equipment requiring inquiry to TAIYO YUDEN or prohibited for use by TAIYO YUDEN as described above.

6-2 RoHS Compliance

- The products conform to RoHS.
- “RoHS compliance” means that the products do not contain lead, cadmium, mercury, hexavalent chromium, PBB, PBDE, DEHP, BBP, DBP, or DIBP referring to EU Directive 2011/65/EU, except other non-restricted substances or impurities which cannot be technically removed at refining process.
- The products are halogen-free.

6-3. Other

6-3-1. Safety Design

When using our products for high safety and/or reliability-required equipment or circuits, please fully perform safety and/or reliability evaluation. In addition, please install (i)

systems equipped with a protection circuit and a protection device and/or (ii) systems equipped with a redundant circuit or other system to prevent an unsafe status in the event of a single fault for a failsafe design to ensure safety.

6-3-2. Intellectual Property Rights

Information contained in this specification is intended to convey examples of typical performances and/or applications of our products and is not intended to make any warranty with respect to the intellectual property rights or any other related rights of TAIYO YUDEN or any third parties nor grant any license under such rights.

6-3-3. Limited Warranty

Please note that the scope of warranty for our products is limited to the delivered our products themselves conforming to the product specifications specified in the product specification, and TAIYO YUDEN shall not be in any way responsible for any damages resulting from a failure or defect in our products. Notwithstanding the foregoing, if there is a written agreement (e.g., supply and purchase agreement, quality assurance agreement) signed by TAIYO YUDEN and your company, TAIYO YUDEN will warrant our products in accordance with such agreement, provided, however, that our products shall be used for general-purpose and standard use in the equipment specified in this specification.

6-3-4. TAIYO YUDEN's Official Sales Channel

The contents of this specification are applicable to our products which are purchased from our sales offices or authorized distributors (hereinafter "TAIYO YUDEN's official sales channel"). Please note that the contents of this specification are not applicable to our products purchased from any seller other than TAIYO YUDEN's official sales channel.

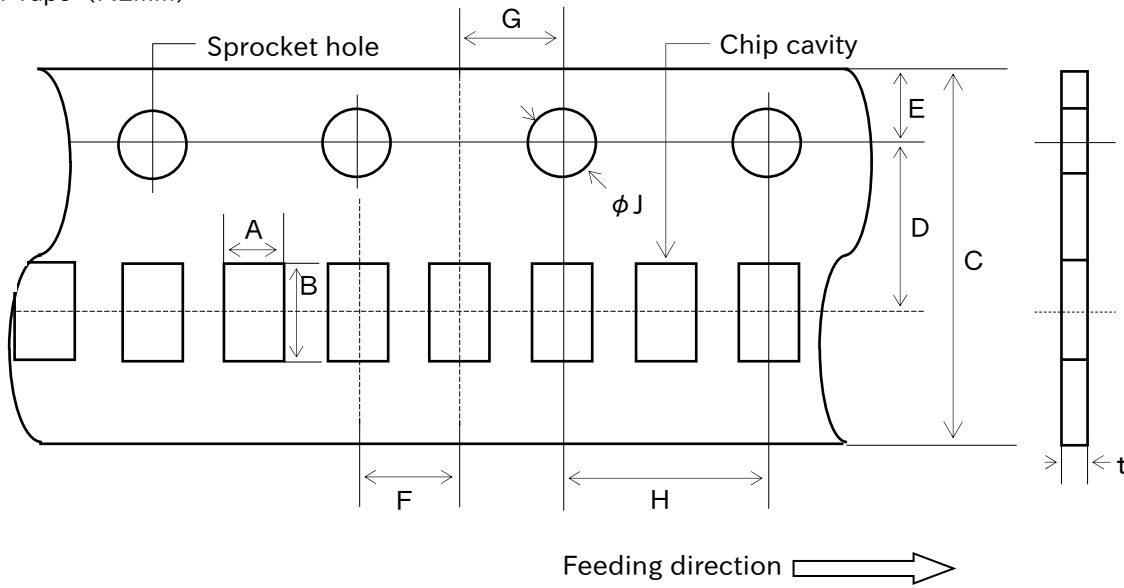
6-3-5. Caution for Export

Some of our products listed in this specification may require specific procedures for export according to "U.S. Export Administration Regulations", "Foreign Exchange and Foreign Trade Control Law" of Japan, and other applicable regulations. Should you have any questions on this matter, please contact our sales staff.

7. Packaging

7-1 External Dimension of Tape

(1) Paper Tape (F:2mm)

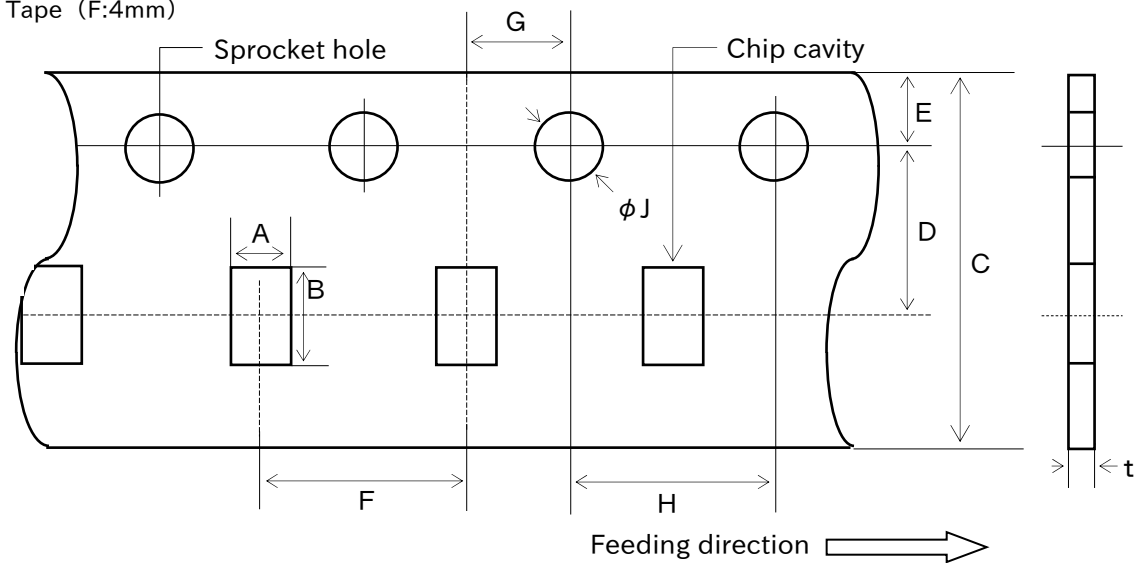


| Type | A※ | B※ | C | D | E | F | G | H | ϕJ | t※ |
|--------|---------|---------|---------|----------|----------|----------|----------|---------|-----------------------------------|----------|
| 1005EE | 0.8±0.1 | 1.3±0.1 | 8.0±0.2 | 3.5±0.05 | 1.75±0.1 | 2.0±0.05 | 2.0±0.05 | 4.0±0.1 | 1.5 ^{+0.1} ₋₀ | 0.64 max |

※A, B, t: Sufficient clearance

Unit[mm]

(2) Paper Tape (F:4mm)

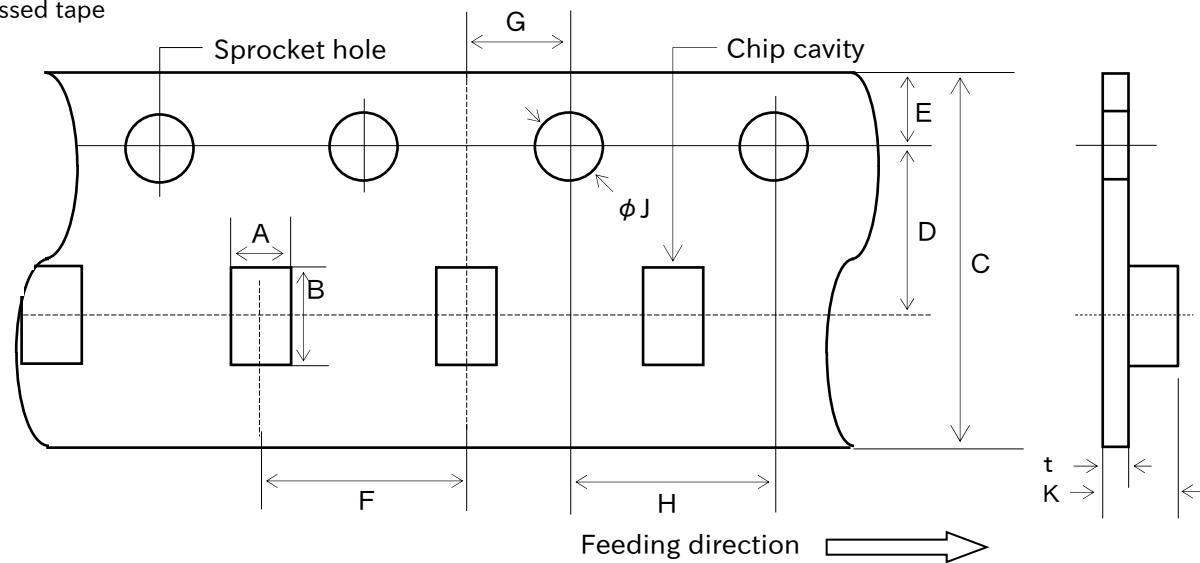


| Type | A※ | B※ | C | D | E | F | G | H | ϕJ | t※ |
|--------|----------|----------|---------|----------|----------|---------|----------|---------|-----------------------------------|-----------|
| 1210EK | 1.3±0.1 | 1.55±0.1 | 8.0±0.2 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.05 | 4.0±0.1 | 1.5 ^{+0.1} ₋₀ | 0.64 max |
| 1412FE | 1.6±0.1 | 1.8±0.1 | 8.0±0.2 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.05 | 4.0±0.1 | 1.5 ^{+0.1} ₋₀ | 0.72 max |
| 1412HK | 1.6±0.1 | 1.8±0.1 | 8.0±0.2 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.05 | 4.0±0.1 | 1.5 ^{+0.1} ₋₀ | 0.9 max |
| 1608FK | 1.1±0.1 | 1.9±0.1 | 8.0±0.2 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.05 | 4.0±0.1 | 1.5 ^{+0.1} ₋₀ | 0.72 max. |
| 1608FE | 1.1±0.1 | 1.9±0.1 | 8.0±0.2 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.05 | 4.0±0.1 | 1.5 ^{+0.1} ₋₀ | 0.72 max. |
| 1608HK | 1.2±0.1 | 2.0±0.1 | 8.0±0.2 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.05 | 4.0±0.1 | 1.5 ^{+0.1} ₋₀ | 0.9 max |
| 2012HK | 1.65±0.1 | 2.4±0.1 | 8.0±0.2 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.05 | 4.0±0.1 | 1.5 ^{+0.1} ₋₀ | 0.9 max |
| 2016FE | 1.95±0.1 | 2.3±0.1 | 8.0±0.2 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.05 | 4.0±0.1 | 1.5 ^{+0.1} ₋₀ | 0.72 max |

※A, B, t: Sufficient clearance

Unit[mm]

(3) Embossed tape

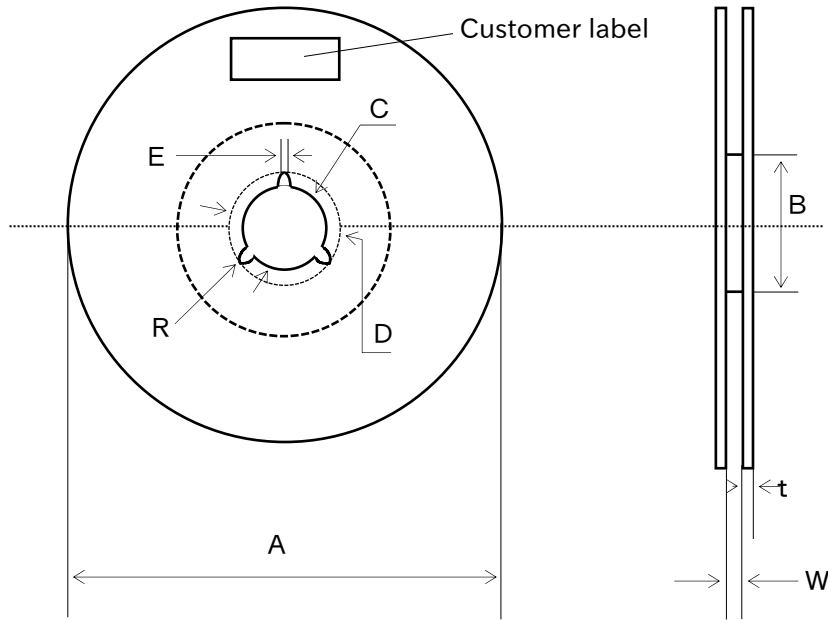


| Type | A※ | B※ | C | D | E | F | G | H | ϕJ | K※ | t |
|--------|----------|----------|---------|----------|----------|---------|----------|---------|-----------------------------------|---------|---------|
| 1608KK | 1.15±0.1 | 1.95±0.1 | 8.0±0.2 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.05 | 4.0±0.1 | 1.5 ^{+0.1} ₋₀ | 1.5 max | 0.3 max |
| 2012KK | 1.55±0.1 | 2.35±0.1 | 8.0±0.2 | 3.5±0.05 | 1.75±0.1 | 4.0±0.1 | 2.0±0.05 | 4.0±0.1 | 1.5 ^{+0.1} ₋₀ | 1.5 max | 0.3 max |

※A, B, K: Sufficient clearance

Unit[mm]

7-2 Labels and Dimensions of Reel



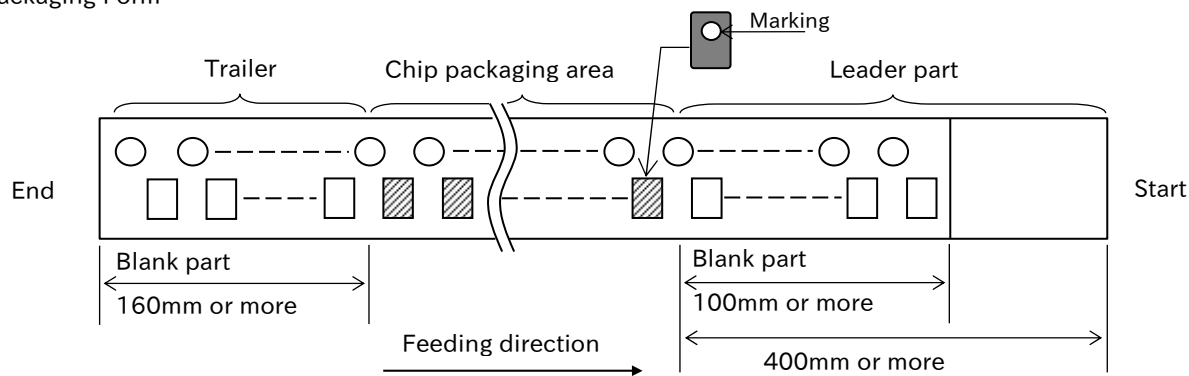
Customer label description

1. Manufacturer name
2. Customer part No.
3. Our part No.
4. Quantity
5. Control No. (Shipping lot No.)
6. Manufacturing site (MADE IN ○○○)
7. RoHS

| Code | ϕA | ϕB | ϕC | ϕD | E | W | t | R |
|-----------|---------------|----------|--------------|--------------|---------------|--------------|--------|-----|
| Dimension | 178 ± 2.0 | 50 min | 13 ± 0.2 | 21 ± 0.8 | 2.0 ± 0.5 | 10 ± 1.5 | 2.5 以下 | 1.0 |

Unit[mm]

7-3 Packaging Form



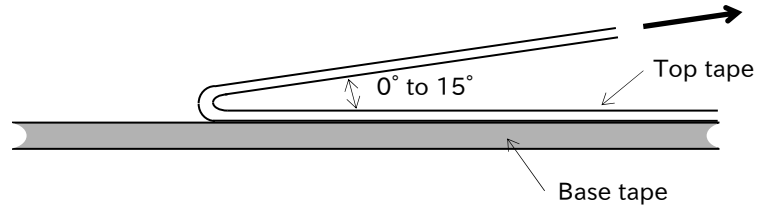
The number of empty compartments in a reel, which shall not appear continuously, must be limited to 2.

7-4 Tensile Strength of Tape

Tensile strength of the tape shall be 5N or over.

7-5 Top Tape Strength

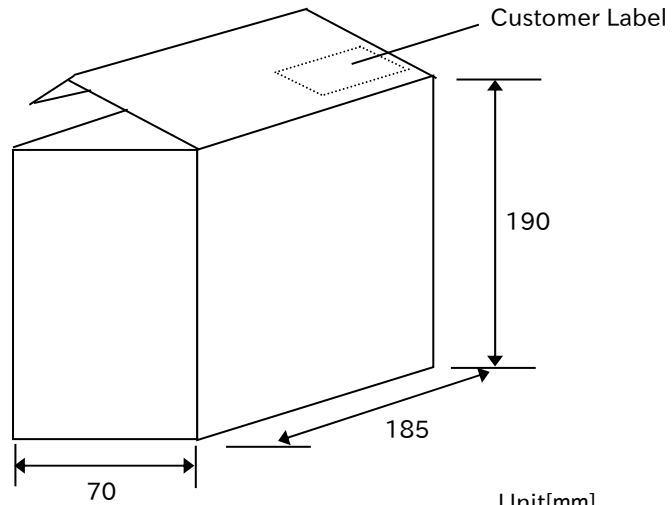
Peeling strength of the top tape shall be 0.1N to 1.0N when the top tape is peeled from carrier tape at an angle as the figure below shows.



7-6 Quantity of Taping Package

| Type | 1 reel | 1 cartom box |
|---------|-------------|----------------|
| 1005EE | 10,000/reel | 50,000/5 reels |
| 1210 EK | 5,000/reel | 25,000/5 reels |
| 1412FE | 4,000/reel | 20,000/5 reels |
| 1412HK | 4,000/reel | 20,000/5 reels |
| 1608FK | 4,000/reel | 20,000/5 reels |
| 1608FE | 4,000/reel | 20,000/5 reels |
| 1608HK | 4,000/reel | 20,000/5 reels |
| 1608KK | 3,000/reel | 15,000/5 reels |
| 2012HK | 4,000/reel | 20,000/5 reels |
| 2012KK | 3,000/reel | 15,000/5 reels |
| 2016FE | 4,000/reel | 20,000/5 reels |

7-7 Labels and Dimensions of Reel Box



Customer label description

1. Manufacturer name
2. Customer part No.
3. Our part No.
4. Quantity
5. Control No. (Shipping lot No.)
6. Manufacturing site (MADE IN ○○○)
7. RoHS

Unit[mm]
(The size is only for reference)

■ PRECAUTIONS

1. Circuit Design

Precautions

- ◆ Verification of operating environment, electrical rating and performance
 1. A malfunction in medical equipment, spacecraft, nuclear reactors, etc. may cause serious harm to human life or have severe social ramifications. As such, any inductors to be used in such equipment may require higher safety and/or reliability considerations and should be clearly differentiated from components used in general purpose applications.
 2. When inductors are used in places where dew condensation develops and/or where corrosive gas such as hydrogen sulfide, sulfurous acid, or chlorine exists in the air, characteristic deterioration may occur. Please do not use inductors under such environmental conditions.
- ◆ Operating Current (Verification of Rated current)
 1. The operating current including inrush current for inductors must always be lower than their rated values.
 2. Do not apply current in excess of the rated value because the inductance may be reduced due to the magnetic saturation effect.
- ◆ Temperature rise

Temperature rise of power choke coil depends on the installation condition in end products.
Make sure that temperature rise of power choke coils in actual end products is within the specified temperature range.

2. PCB Design

Precautions

- ◆ Pattern configurations (Design of Land-patterns)

When inductors are mounted on a PCB, the size of land patterns and the amount of solder used (size of fillet) can directly affect inductor performance. Therefore, the following items must be carefully considered in the design of solder land patterns:

 - (1) The amount of solder applied can affect the ability of chips to withstand mechanical stresses which may lead to breaking or cracking. Therefore, when designing land-patterns it is necessary to consider the appropriate size and configuration of the solder pads which in turn determines the amount of solder necessary to form the fillets.
 - (2) When more than one part is jointly soldered onto the same land or pad, the pad must be designed so that each component's soldering point is separated by solder-resist.
- ◆ Pattern configurations (Inductor layout on panelized [breakaway] PC boards)

After inductors have been mounted on the boards, chips can be subjected to mechanical stresses in subsequent manufacturing processes (PCB cutting, board inspection, mounting of additional parts, assembly into the chassis, wave soldering the reflow soldered boards etc.) For this reason, planning pattern configurations and the position of SMD inductors should be carefully performed to minimize stress.

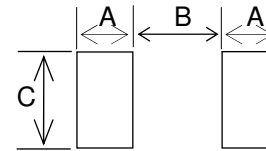
◆Pattern configurations (Design of Land-patterns)

The following diagrams and tables show some examples of recommended patterns to prevent excessive solder amounts. Examples of improper pattern designs are also shown.

(1) Recommended land dimensions for a typical chip inductor land patterns for PCBs

(Unit: mm)

| Type | 1005 | 1210 | 1412 | 1608 | 2012 | 2016 |
|------|------|------|------|------|------|------|
| A | 0.4 | 0.45 | 0.55 | 0.45 | 0.5 | 0.7 |
| B | 0.5 | 0.6 | 0.4 | 1.0 | 1.2 | 0.8 |
| C | 0.7 | 1.15 | 1.3 | 1.0 | 1.45 | 1.8 |



Note: The values in the table above are representative. Recommended land dimensions are different by part numbers.

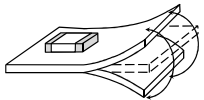
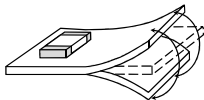
(2) Examples of good and bad solder application

| Items | Not recommended | Recommended |
|---|-----------------|-------------|
| Mixed mounting of SMD and leaded components | | |
| Component placement close to the chassis | | |
| Hand-soldering of leaded components near mounted components | | |
| Horizontal component placement | | |

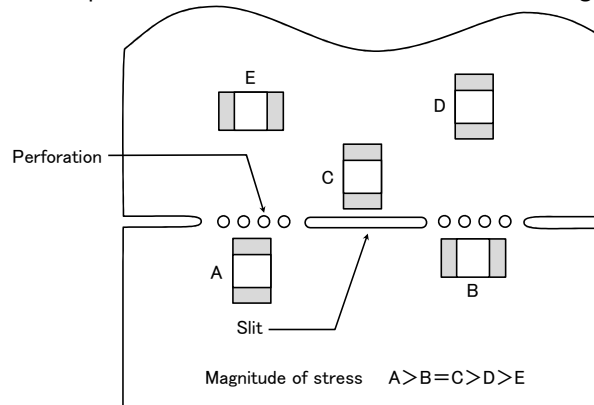
Technical considerations

◆Pattern configurations (Inductor layout on panelized [breakaway] PC boards)

1. The following are examples of good and bad inductor layout; SMD inductors should be located to minimize any possible mechanical stresses from board warp or deflection.

| Item | Not recommended | Recommended |
|-------------------------|---|---|
| Deflection of the board |  |  Position the component at a right angle to the direction of the mechanical stresses that are anticipated. |

2. To layout the inductors for the breakaway PC board, it should be noted that the amount of mechanical stresses given will vary depending on inductor layout. An example below should be counted for better design.



3. When breaking PC boards along their perforations, the amount of mechanical stress on the inductors can vary according to the method used. The following methods are listed in order from least stressful to most stressful: push-back, slit, V-grooving, and perforation. Thus, any ideal SMD inductor layout must also consider the PCB splitting procedure.

3. Considerations for automatic placement

Precautions

◆Adjustment of mounting machine

1. Excessive impact load should not be imposed on the inductors when mounting onto the PC boards.
2. The maintenance and inspection of the mounter should be conducted periodically.

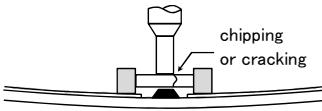
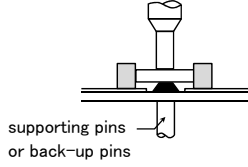
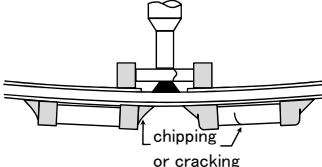
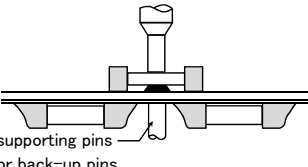
Technical considerations

◆Adjustment of mounting machine

1. If the lower limit of the pick-up nozzle is low, too much force may be imposed on the inductors, causing damage. To avoid this, the following points should be considered before lowering the pick-up nozzle:
 - (1) The lower limit of the pick-up nozzle should be adjusted to the surface level of the PC board after correcting for deflection of the board.

- (2) The pick-up pressure should be adjusted between 1 and 3N static loads.
 (3) To reduce the amount of deflection of the board caused by impact of the pick-up nozzle, supporting pins or back-up pins should be used under the PC board.

The following diagrams show some typical examples of good pick-up nozzle placement:

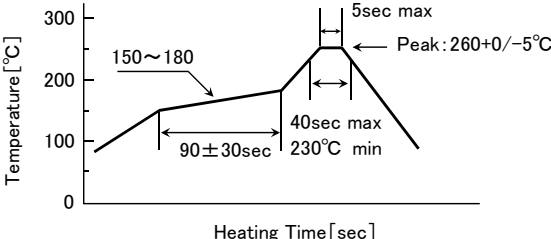
| Item | Improper method | Proper method |
|-----------------------|--|---|
| Single-sided mounting |  |  |
| Double-sided mounting |  |  |

2. As the alignment pin wears out, adjustment of the nozzle height can cause chipping or cracking of the inductors because of mechanical impact on the inductors. To avoid this, the monitoring of the width between the alignment pin in the stopped position, and maintenance, inspection and replacement of the pin should be conducted periodically.

4. Soldering

Precautions

- ◆Reflow soldering
 - Please contact any of our offices for a reflow soldering, and refer to the recommended condition specified.
 - The product shall be used reflow soldering only.
 - Please do not add any stress to a product until it returns in normal temperature after reflow soldering.
- ◆Lead free soldering
 - When using products with lead free soldering, we request to use them after confirming adhesion, temperature of resistance to soldering heat, soldering etc sufficiently.
- ◆The conditions for Reworking with soldering irons
 - Put the soldering iron on the land-pattern and don't touch it to the inductor directly.
 Soldering iron's temperature below 350°C, Duration 3 seconds or less

| | |
|---------------------------------|---|
| <p>Technical considerations</p> | <p>◆Reflow soldering</p> <ul style="list-style-type: none"> · If products are used beyond the range of the recommended conditions, heat stresses may deform the products, and consequently degrade the reliability of the products. <p>Recommended reflow condition (Pb free solder)</p>  <p>The allowable number of reflow soldering is 3 times.</p> |
|---------------------------------|---|

5. Cleaning

| | |
|---------------------------------|--|
| <p>Precautions</p> | <p>◆Cleaning conditions</p> <ul style="list-style-type: none"> · Washing by supersonic waves shall be avoided. |
| <p>Technical considerations</p> | <p>◆Cleaning conditions</p> <ul style="list-style-type: none"> · If washed by supersonic waves, the products might be broken. |

6. Resin coating and mold

| | |
|--------------------|---|
| <p>Precautions</p> | <ol style="list-style-type: none"> 1. With some type of resins a decomposition gas or chemical reaction vapor may remain inside the resin during the hardening period or while left under normal storage conditions resulting in the deterioration of the inductor's performance. 2. Thermal expansion and thermal shrinkage characteristics of resins may lead to the deterioration of inductors' performance. 3. When a resin hardening temperature is higher than inductor operating temperature, the stresses generated by the excessive heat may lead to damage in inductors. 4. In prior to use, please make the reliability evaluation with the product mounted in your application set. |
|--------------------|---|

7. Handling

| | |
|--------------------|---|
| <p>Precautions</p> | <p>◆Breakaway PC boards (splitting along perforations)</p> <ol style="list-style-type: none"> 1. When splitting the PC board after mounting inductors and other components, care is required so as not to give any stresses of deflection or twisting to the board. 2. Board separation should not be done manually, but by using the appropriate devices. <p>◆General handling precautions</p> <ul style="list-style-type: none"> · Always wear static control bands to protect against ESD. · Keep the inductors away from all magnets and magnetic objects. · Use non-magnetic tweezers when handling inductors. · Any devices used with the inductors (soldering irons, measuring instruments) should be properly grounded. · Keep bare hands and metal products (i.e., metal desk) away from inductor electrodes or conductive areas that lead to chip electrodes. · Keep inductors away from items that generate magnetic fields such as speakers or coils. |
|--------------------|---|

| | |
|--|--|
| | <p>◆Mechanical considerations</p> <p>Be careful not to subject the inductors to excessive mechanical shocks.</p> <p>(1) If inductors are dropped on the floor or a hard surface they should not be used.</p> <p>(2) When handling the mounted boards, be careful that the mounted components do not come in contact with or bump against other boards or components.</p> |
|--|--|

8. Storage conditions

| | |
|--------------------------|--|
| Precautions | <p>◆Storage</p> <p>To maintain the solderability of terminal electrodes and to keep the packaging material in good condition, care must be taken to control temperature and humidity in the storage area. Humidity should especially be kept as low as possible.</p> <ul style="list-style-type: none"> · Recommended conditions <ul style="list-style-type: none"> Ambient temperature: 30°C or below Humidity: 30% to 70% RH <p>The ambient temperature must be kept -5°C to +40°C. Even under ideal storage conditions, solderability of inductor is deteriorated as time passes, so inductors should be used within 6 months from the time of delivery.</p> <ul style="list-style-type: none"> · Inductor should be kept where no chlorine or sulfur exists in the air. |
| Technical considerations | <p>◆Storage</p> <p>If the parts are stocked in a high temperature and humidity environment, problems such as reduced solderability caused by oxidation of terminal electrodes and deterioration of taping/packaging materials may take place. For this reason, components should be used within 6 months from the time of delivery. If exceeding the above period, please check solderability before using the inductors.</p> |