Notice for TAIYO YUDEN Products

Please read this notice before using the TAIYO YUDEN products.

⚠ REMINDERS

Product Information in this Catalog

Product information in this catalog is as of March 2023. All of the contents specified herein and production status of the products listed in this catalog are subject to change without notice due to technical improvement of our products, etc. Therefore, please check for the latest information carefully before practical application or use of our products.

Please note that TAIYO YUDEN shall not be in any way responsible for any damages and defects in products or equipment incorporating our products, which are caused under the conditions other than those specified in this catalog or individual product specification sheets.

Approval of Product Specifications

Please contact TAIYO YUDEN for further details of product specifications as the individual product specification sheets are available. When using our products, please be sure to approve our product specifications or make a written agreement on the product specification with TAIYO YUDEN in advance.

Pre-Evaluation in the Actual Equipment and Conditions

Please conduct validation and verification of our products in actual conditions of mounting and operating environment before using our products.

Limited Application

1. Equipment Intended for Use

The products listed in this catalog 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 this catalog or the individual product specification sheets, 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 this catalog or the individual product specification sheets 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
	Only for Mobile Devices *4	E	4

*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 4 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.
4. The applications covered by this product series are limited to mobile devices (smartphone, tablet PC, smartwatch, handheld game console, etc.) among general electronic equipment for consumer. The design, specifications and operating environment, etc. differ from those of the product series for "General Electronic Equipment" (Category: S), so please check the individual product specification sheets for details. The product series for "General Electronic Equipment" (Category: S) can also be used for mobile devices.

▶ This catalog contains the typical specification only due to the limitation of space. When you consider the purchase of our products, please check our product specification sheets. For details of each product (characteristics graph, reliability information, precautions for use, and so on), see our website (http://www.ty-top.com/) .

2. Equipment Requiring Inquiry

Please be sure to contact TAIYO YUDEN for further information before using the products listed in this catalog for the following equipment (excluding intended equipment as specified in this catalog or the individual product specification sheets) 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

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.

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 catalog 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.

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.

Intellectual Property Rights

Information contained in this catalog 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.

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 individual product specification sheets, 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 catalog or the individual product specification sheets.

TAIYO YUDEN's Official Sales Channel

The contents of this catalog 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 catalog are not applicable to our products purchased from any seller other than TAIYO YUDEN's official sales channel.

Caution for Export

Some of our products listed in this catalog 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.

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Industrial Application Guide

We have the product series (the 2nd code from the left side of the part number is “B”) intended for use in telecommunications infrastructure and industrial equipment (its typical examples are as shown in the table below). Therefore, when using our products for these equipment, please check it carefully by referring to the part number or the individual product specification sheets and use the corresponding product series. Should you have any questions on this matter, please contact us.

Product Series (The 2nd Code from the Left Side of the Part Number)	Category	Telecommunications Infrastructure and Industrial Equipment (Typical Example)
B	Telecommunications Infrastructure	• Base Station • Optical Transceiver • Router/Switch (Carrier-Grade) • UPS (Uninterruptible Power Supply), etc.
	Factory Automation	• PLC (Programmable Logic Controller) • Servomotor/Servo Driver • Industry Robot, etc.
	Measurement	• Gas Meter • Water Meter • Flow Meter • Pressure Gauge Meter • Magnetometer • Thermometer, etc.
	Electric Power Apparatus	• Power Conditioner (Solar Power System) • Smart Meter • GFCI (Ground Fault Circuit Interrupter) • Electric Vehicle Charging Station, etc.

▶ This catalog contains the typical specification only due to the limitation of space. When you consider the purchase of our products, please check our product specification sheets. For details of each product (characteristics graph, reliability information, precautions for use, and so on), see our website (http://www.ty-top.com/) .

Wire-wound Metal Power Inductors MCOIL™ LBEN series for Telecommunications Infrastructure and Industrial Equipment

Code in front of Series have been extracted from Part number, which describes the segment of products, such as kinds and characteristics.

REFLOW

■PART NUMBER

＊ Operating Temp.: −40〜+125℃ (Including self-generated heat)

L B E N	A	2 5 2 0	M K	T	1 R 0	M	
①	②	③	④	⑤	⑥	⑦	⑧

①Series

Code (1)(2)(3)(4)	
LBEN	Wire-wound Metal Power Inductor for Telecommunications Infrastructure and Industrial Equipment

(1) Product Group

Code	
L	Inductors

(2) Category

Code	Recommended equipment	Quality Grade
B	Telecommunications Infrastructure and Industrial Equipment	2

(3) Type

Code	
E	Metal Wire-wound (High filling type)

(4) Features, Characteristics

Code	
N	Standard Power choke

②Features

Code	Feature
A	5-surface electrode (Ag-resin × Sn-plate)

③Dimensions (L × W)

Code	Dimensions (L × W) [mm]
2016	2.0 × 1.6
2520	2.5 × 2.0

④Dimensions (T)

Code	Dimensions (T) [mm]
MK	1.2

⑤Packaging

Code	Packaging
T	Taping

⑥Nominal inductance

Code (example)	Nominal inductance [μH]
R47	0.47
1R0	1.0
4R7	4.7

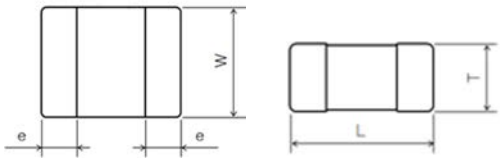
※R=Decimal point

⑦Inductance tolerance

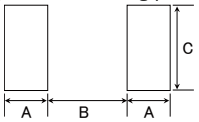
Code	Inductance tolerance
M	±20%

⑧Internal code

■STANDARD EXTERNAL DIMENSIONS / STANDARD QUANTITY



Recommended Land Patterns
Surface Mounting
・Mounting and soldering conditions should be checked beforehand.
・Applicable soldering process to these products is reflow soldering only.



Type	A	B	C
2016	0.8	0.8	1.8
2520	0.85	1.2	2.2

Unit: mm

Type	L	W	T	e	Standard quantity [pcs] Taping
2016MK	2.0±0.2 (0.079±0.008)	1.6±0.2 (0.063±0.008)	1.2 max (0.047 max)	0.5±0.2 (0.020±0.008)	3000
2520MK	2.5±0.2 (0.098±0.008)	2.0±0.2 (0.079±0.008)	1.2 max (0.047 max)	0.6±0.3 (0.020±0.012)	3000

Unit: mm (inch)

■PART NUMBER

・All the Wire-wound Metal Power Inductors of the catalog lineup are RoHS compliant.

Notes)
・The exchange of individual specifications is necessary depending on your application and/or circuit condition. Please contact TAIYO YUDEN's official sales channel.
・The products are for Telecommunications infrastructure and Industrial equipment.
Please consult with TAIYO YUDEN's official sales channel for the details of the product specifications, etc.,
and please review and approve the product specifications before ordering.

●2016MK type 【Thickness:1.2mm max.】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.)			Measuring frequency [MHz]
						Saturation current Idc1	Temperature rise current① Idc2	Temperature rise current② Idc2	
LBENA2016MKTR24M0NK	MEMK2016TR24MGNK8	0.24	±20%	–	0.018	6,800	3,500	5,500	1
LBENA2016MKTR33M0NK	MEMK2016TR33MGNK8	0.33	±20%	–	0.022	5,400	3,000	4,900	1
LBENA2016MKTR47M0NK	MEMK2016TR47MGNK8	0.47	±20%	–	0.025	4,800	2,900	4,700	1
LBENA2016MKT1R0M0NK	MEMK2016T1R0MGNK8	1.0	±20%	–	0.045	3,100	2,000	3,200	1
LBENA2016MKT2R2M0NK	MEMK2016T2R2MGNK8	2.2	±20%	–	0.120	2,200	1,100	1,800	1

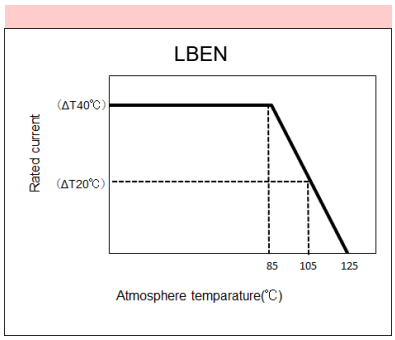
●2520MK type 【Thickness:1.2mm max.】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.)			Measuring frequency [MHz]
						Saturation current Idc1	Temperature rise current① Idc2	Temperature rise current② Idc2	
LBENA2520MKTR15M0NK	MEMK2520TR15MGNK8	0.15	±20%	–	0.009	10,200	4,900	6,700	1
LBENA2520MKTR33M0NK	MEMK2520TR33MGNK8	0.33	±20%	–	0.015	7,000	4,000	5,600	1
LBENA2520MKTR47M0NK	MEMK2520TR47MGNK8	0.47	±20%	–	0.020	5,900	3,700	5,000	1
LBENA2520MKT1R0M0NK	MEMK2520T1R0MGNK8	1.0	±20%	–	0.042	4,400	2,400	3,200	1
LBENA2520MKT1R5M0NK	MEMK2520T1R5MGNK8	1.5	±20%	–	0.057	3,300	2,100	2,800	1
LBENA2520MKT2R2M0NK	MEMK2520T2R2MGNK8	2.2	±20%	–	0.077	3,000	1,700	2,400	1
LBENA2520MKT3R3M0NK	MEMK2520T3R3MGNK8	3.3	±20%	–	0.131	2,300	1,300	1,800	1
LBENA2520MKT4R7M0NK	MEMK2520T4R7MGNK8	4.7	±20%	–	0.185	2,100	1,100	1,500	1

※) The saturation current value (Idc1) is the DC current value having inductance decrease down to 30%. (at 20℃)
※) The temperature rise current value (Idc2)① is the DC current value having temperature increase up to 20℃. (at 20℃)
※) The temperature rise current value (Idc2)② is the DC current value having temperature increase up to 40℃. (at 20℃)
※) The rated current is the DC current value that satisfies both of current value saturation current value and temperature rise current value.
※) Idc2 Measurement board data Material:FR4
Board dimensions: 100×50×1.6t mm
Pattern dimensions: 43×59.2 mm
Pattern thickness: 50μm

■Derating of Rated Current

●LBEN series
Derating of current is necessary for LBEN series depending on ambient temperature.
Please refer to the chart shown below for appropriate derating of current.



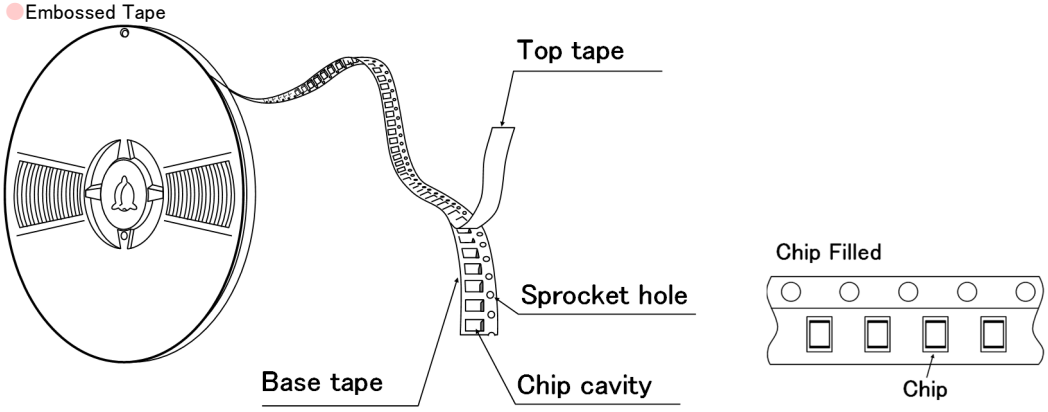
■PACKAGING

①Minimum Quantity

Type	Standard Quantity [pcs]
	Tape & Reel
2012HK	3000
2012KK	3000
2016MK	3000
2016HK	3000
2016KK	3000
2520KK	3000
2520MK	3000
3225HK	3000

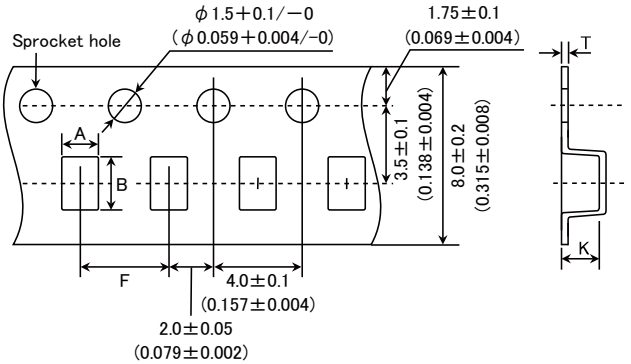
②Tape Material

●Embossed Tape



③Taping dimensions

●Embossed tape 8mm wide (0.315 inches wide)

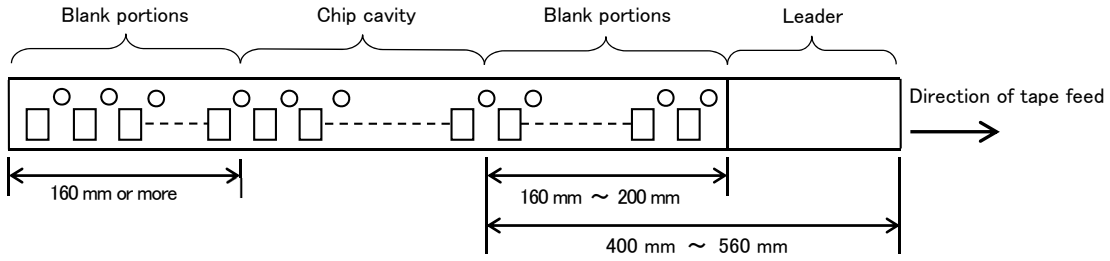


Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
2012HK	1.45±0.1 (0.057±0.004)	2.25±0.1 (0.089±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	0.9+0.15/−0.1 (0.035+0.006/−0.004)
2012KK	1.45±0.1 (0.057±0.004)	2.25±0.1 (0.089±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.1±0.1 (0.043±0.004)
2016MK	1.9±0.1 (0.075±0.004)	2.45±0.1 (0.097±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.4±0.1 (0.055±0.004)
2016HK	1.9±0.1 (0.075±0.004)	2.45±0.1 (0.097±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.2±0.1 (0.047±0.004)
2016KK	1.9±0.1 (0.075±0.004)	2.45±0.1 (0.097±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.2±0.1 (0.047±0.004)

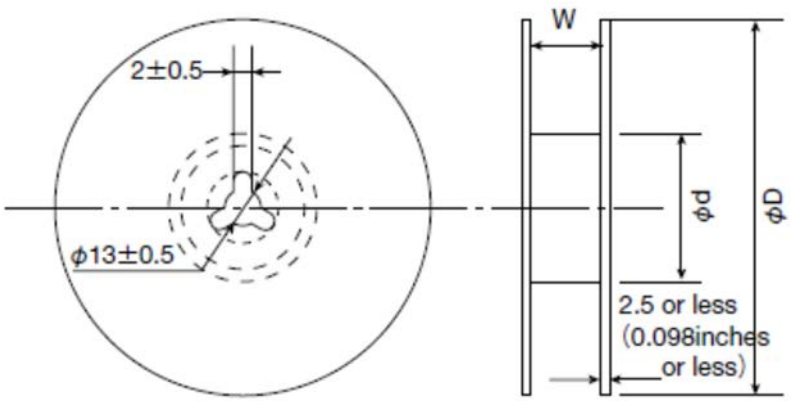
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
2520KK	2.4±0.1 (0.094±0.004)	2.9±0.1 (0.114±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.1±0.1 (0.043±0.004)
2520MK	2.4±0.1 (0.094±0.004)	2.9±0.1 (0.114±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002	1.4±0.1 (0.055±0.004)
3225HK	2.8±0.1 (0.110±0.004)	3.5±0.1 (0.138±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002	1.1±0.1 (0.043±0.004)

Unit : mm (inch)

④Leader and Blank portion



⑤Reel size

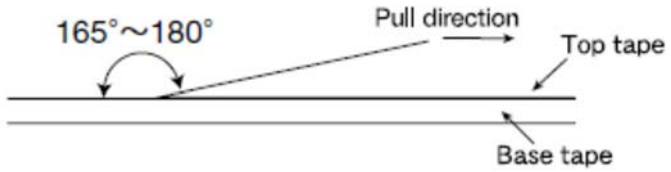


Type	Reel size (Reference values)		
	ϕD	ϕd	W
2012HK	180+0/−3 (7.087+0/−0.118)	60+1/−0 (2.36+0.039/0)	10.0±1.5 (0.394±0.059)
2012KK			
2016MK			
2016HK			
2016KK			
2520KK			
2520MK			
3225HK			

Unit : mm (inch)

⑥Top Tape Strength

The top The top tape requires a peel-off force of 0.1 to 1.0N in the direction of the arrow as illustrated below.



Wire-wound Metal Power Inductors MCOIL™ LBEN series
for Telecommunications Infrastructure and Industrial Equipment
Wire-wound Metal Power Inductors MCOIL™ LMEN series
for Medical Devices classified as GHTF Class C (Japan Class III)

■RELIABILITY DATA

1. Operating Temperature Range	
Specified Value	−40～＋125℃
Test Methods and Remarks	Including self-generated heat

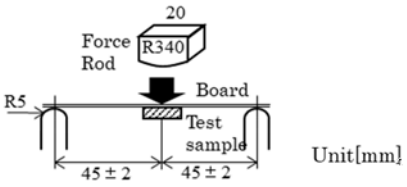
2. Storage Temperature Range	
Specified Value	−40～＋85℃
Test Methods and Remarks	0 to 40℃ for the product with taping.

3. Rated current	
Specified Value	Within the specified tolerance

4. Inductance	
Specified Value	Within the specified tolerance
Test Methods and Remarks	Measuring equipment : LCR Meter (HP 4294A or equivalent) Measuring frequency : 1MHz、0.5V

5. DC Resistance	
Specified Value	Within the specified tolerance
Test Methods and Remarks	Measuring equipment : DC ohmmeter (HIOKI 3227 or equivalent)

6. Temperature characteristic	
Specified Value	Inductance change : Within ±15%
Test Methods and Remarks	Measurement of inductance shall be taken at temperature range within −40℃～＋125℃. With reference to inductance value at ＋20℃., change rate shall be calculated.

7. Resistance to flexure of substrate	
Specified Value	No damage
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. As illustrated below, apply force in the direction of the arrow indicating until deflection of the test board reaches to 2 mm. Test board size : 100×40×1.6 mm Test board material : Glass epoxy-resin Solder cream thickness : 0.1 mm 

8. Adhesion of terminal electrode	
Specified Value	No abnormality.
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. Applied force : 17.7N Duration : 60s. Solder cream thickness : 0.10mm.

9. Resistance to vibration

Specified Value

Inductance change : Within ±10%
No significant abnormality in appearance.

Test Methods and Remarks

The test samples shall be soldered to the test board by the reflow.
Then it shall be submitted to below test conditions.

Frequency Range	10～55Hz	
Total Amplitude	1.5mm (May not exceed acceleration 196m/s^2)	
Sweeping Method	10Hz to 55Hz to 10Hz for 1min.	
Time	X	For 2 hours on ach X, Y, and Z axis.
	Y	
	Z	

Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

10. Solderability

Specified Value

At least 90% of surface of terminal electrode is covered by new solder.

Test Methods and Remarks

The test samples shall be dipped in flux, and then immersed in molten solder as shown in below table.
Flux : Ethanol solution containing rosin 25%.

Solder Temperature	245±5℃
Time	5±0.5 sec.

※Immersion depth : All sides of mounting terminal shall be immersed.

11. Resistance to soldering heat

Specified Value

Inductance change : Within ±10%
No significant abnormality in appearance.

Test Methods and Remarks

The test sample shall be exposed to reflow oven at 230℃ for 40 seconds, with peak temperature at 260+0/−5℃ for 5 seconds, 2 times.
Test board material : Glass epoxy-resin
Test board thickness : 1.6mm
Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

12. Thermal shock

Specified Value

Inductance change : Within ±10%
No significant abnormality in appearance.

Test Methods and Remarks

The test samples shall be soldered to the test board by the reflow. The test samples shall be placed at specified temperature for specified time by step 1 to step 2 as shown in below table in sequence. The temperature cycle shall be repeated 1000 cycles.

Conditions of 1 cycle		
Step	Temperature (℃)	Duration (min)
1	−40±5	30±3
2	+125±5	30±3

Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

13. Damp heat

Specified Value

Inductance change : Within ±10%
No significant abnormality in appearance.

Test Methods and Remarks

The test samples shall be soldered to the test board by the reflow.
The test samples shall be placed in thermostatic oven set at specified temperature and humidity as shown in below table.

Temperature	85±2℃
Humidity	85±5%RH
Time	1000 hour

Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

14. High temperature life test

Specified Value

Inductance change : Within ±10%
No significant abnormality in appearance.

Test Methods and Remarks

The test samples shall be soldered to the test board by the reflow. After that, the test samples shall be placed at test conditions as shown in below table.

Temperature	125±2℃
Time	1000 hour

Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

15. Loading at high temperature life test	
Specified Value	Inductance change : Within ±10% No significant abnormality in appearance.
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. After that, the test samples shall be placed at test conditions as shown in below table. Temperature: 1). 85±2℃ 2). 105±3℃ Applied current: 1). Rated current(+40℃) 2). Rated current(+20℃) Time: 1000hour Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

16. Standard condition	
Specified Value	Standard test condition : Unless otherwise specified, temperature is 20±15℃ and 65±20%of relative humidity. When there is any question concerning measurement result: In order to provide correlation data, the test shall be condition of 20±2℃ of temperature, 65±5% relative humidity. Inductance is in accordance with our measured value.

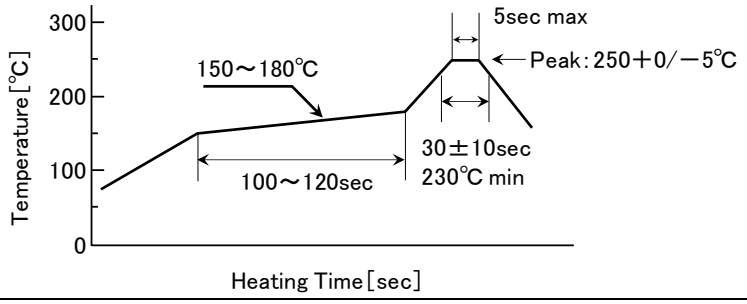
Wire-wound Metal Power Inductors MCOIL™ LSEN/LLEN/LCEN/LBEN/LMEN series
Wire-wound Metal Power Inductors MCOIL™ LSEP/LLEP series
Wire-wound Metal Power Inductors MCOIL™ LSEU/LLEU series

■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	◆Land pattern design 1. Please refer to a recommended land pattern.
Technical considerations	◆Land pattern design Surface Mounting ・ Mounting and soldering conditions should be checked beforehand. ・ Applicable soldering process to this products is reflow soldering only.

3. Considerations for automatic placement	
Precautions	◆Adjustment of mounting machine 1. Excessive impact load should not be imposed on the products when mounting onto the PC boards. 2. Mounting and soldering conditions should be checked beforehand.
Technical considerations	◆Adjustment of mounting machine 1. When installing products, care should be taken not to apply distortion stress as it may deform the products.

4. Soldering	
Precautions	◆Reflow soldering 1. Please contact any of our offices for a reflow soldering, and refer to the recommended condition specified. 2. The product shall be used reflow soldering only. 3. Please do not add any stress to a product until it returns in normal temperature after reflow soldering. ◆Lead free soldering 1. When using products with lead free soldering, we request to use them after confirming adhesion, temperature of resistance to soldering heat, soldering etc sufficiently.
Technical considerations	◆Reflow soldering 1. 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. Recommended reflow condition (Pb free solder) 

5. Cleaning	
Precautions	◆Cleaning conditions 1. Washing by supersonic waves shall be avoided.
Technical considerations	◆Cleaning conditions 1. If washed by supersonic waves, the products might be broken.

6. Handling	
Precautions	◆Handling 1. Keep the product away from all magnets and magnetic objects. ◆Breakaway PC boards (splitting along perforations) 1. When splitting the PC board after mounting product, care should be taken 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. ◆Mechanical considerations 1. Please do not give the product any excessive mechanical shocks. 2. Please do not add any shock and power to a product in transportation. ◆Pick-up pressure 1. Please do not push to add any pressure to a winding part. Please do not give any shock and push into a ferrite core exposure part. ◆Packing 1. Please avoid accumulation of a packing box as much as possible.
Technical considerations	◆Handling 1. There is a case that a characteristic varies with magnetic influence. ◆Breakaway PC boards (splitting along perforations) 1. The position of the product on PCBs shall be carefully considered to minimize the stress caused from splitting of the PCBs. ◆Mechanical considerations 1. There is a case to be damaged by a mechanical shock. 2. There is a case to be broken by the handling in transportation. ◆Pick-up pressure 1. Damage and a characteristic can vary with an excessive shock or stress. ◆Packing 1. If packing boxes are accumulated, that could cause a deformation on packing tapes or a damage on the products.

7. Storage conditions	
Precautions	◆Storage 1. To maintain the solderability of terminal electrodes and to keep the packing material in good condition, temperature and humidity in the storage area should be controlled. ・ Storage conditions Ambient temperature : 0～40℃ Humidity : Below 70% RH ・ The recommended ambient temperature is below 30℃. Even under ideal storage conditions, solderability of products electrodes may decrease as time passes. For this reason, product should be used within 6 months from the time of delivery. In case of storage over 6 months, solderability shall be checked before actual usage.
Technical considerations	◆Storage 1. Under 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.

Multilayer Metal Power Inductors MCOIL™ LBCN series for Telecommunications Infrastructure and Industrial Equipment

Code in front of Series have been extracted from Part number, which describes the segment of products, such as kinds and characteristics.

REFLOW

＊Operating Temp.: −40〜+125℃(Including self-generated heat)
＊Operating Temp.: −55〜+150℃(Including self-generated heat)

■PART NUMBER

L	B	C	N	F	2	0	1	2	K	K	T	1	R	0	M	A
①				②	③				④		⑤	⑥			⑦	⑧

①Series

Code (1)(2)(3)(4)	
LBCN	Multilayer metal power inductor for Telecommunications Infrastructure and Industrial Equipment

(1) Product Group

Code	
L	Inductors

(3) Type

Code	
C	Metal Multilayer

(2) Category

Code	Recommended equipment	Quality Grade
B	Telecommunications Infrastructure and Industrial Equipment	2

(4) Features, Characteristics

Code	
N	Standard Power choke

②Features

Code	Feature
F	5-surface electrode with polarity marking

⑤Packaging

Code	Packaging
T	Taping

③Dimensions (L×W)

Code	Type (inch)	Dimensions (L×W) [mm]
1608	1608 (0603)	1.6×0.8
2012	2012 (0805)	2.0×1.25

⑥Nominal inductance

Code (example)	Nominal inductance [μH]
R24	0.24
R47	0.47
1R0	1.0

※R=Decimal point

④Thickness

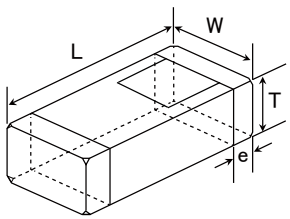
Code	Thickness [mm]
KK	1.0 max

⑦Inductance tolerance

Code	Inductance tolerance
M	±20%

⑧Internal code

■STANDARD EXTERNAL DIMENSIONS / STANDARD QUANTITY



Type	L	W	T	e	Standard quantity [pcs]	
					Paper tape	Embossed tape
1608KK (0603)	1.6±0.2 (0.063±0.008)	0.8±0.2 (0.031±0.008)	1.0 max (0.039 max)	0.3±0.2 (0.012±0.008)	–	3000
2012KK (0805)	2.0±0.2 (0.079±0.008)	1.25±0.2 (0.049±0.008)	1.0 max (0.039 max)	0.5±0.3 (0.02±0.012)	—	3000

Unit: mm (inch)

■PART NUMBER

・All the Multilayer Metal Power Inductors of the catalog lineup are RoHS compliant.

Notes)
・The exchange of individual specifications is necessary depending on your application and/or circuit condition. Please contact TAIYO YUDEN's official sales channel.
・The products are for Telecommunications infrastructure and Industrial equipment.
Please consult with TAIYO YUDEN's official sales channel for the details of the product specifications, etc.,
and please review and approve the product specifications before ordering.

●1608 type

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [mΩ]		Rated current(Idc1) [A] (max.)	Rated current(Idc2) [A] (max.)	Measuring frequency [MHz]	Thickness [mm] (max.)
					(max.)	(typ.)				
LBCNF1608KKTR24MA	MCKK1608TR24M8C	RoHS	0.24	±20%	35	29	3.2	3.8	1	1.00
LBCNF1608KKTR33MA	MCKK1608TR33M8C	RoHS	0.33	±20%	46	38	2.8	3.3	1	1.00
LBCNF1608KKTR47MA	MCKK1608TR47M8C	RoHS	0.47	±20%	65	54	2.6	3.0	1	1.00

●1608 type ＊Operating Temp.:−55〜+150℃(Including self-generated heat)

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [mΩ]		Rated current(Idc1) [A] (max.)	Rated current(Idc2) [A] (max.)	Measuring frequency [MHz]	Thickness [mm] (max.)
					(max.)	(typ.)				
LBCNF1608KKTR24MAD	MCKK1608TR24M8C D	RoHS	0.24	±20%	35	29	3.2	3.8	1	1.00
LBCNF1608KKTR33MAD	MCKK1608TR33M8C D	RoHS	0.33	±20%	46	38	2.8	3.3	1	1.00
LBCNF1608KKTR47MAD	MCKK1608TR47M8C D	RoHS	0.47	±20%	65	54	2.6	3.0	1	1.00

●2012 type

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [mΩ]		Rated current(Idc1) [A] (max.)	Rated current(Idc2) [A] (max.)	Measuring frequency [MHz]	Thickness [mm] (max.)
					(max.)	(typ.)				
LBCNF2012KKTR24MA	MCKK2012TR24M8C	RoHS	0.24	±20%	20	17	4.8	5.4	1	1.00
LBCNF2012KKTR33MA	MCKK2012TR33M8C	RoHS	0.33	±20%	30	25	4.4	4.5	1	1.00
LBCNF2012KKTR47MA	MCKK2012TR47M8C	RoHS	0.47	±20%	41	34	3.8	3.8	1	1.00
LBCNF2012KKT1R0MA	MCKK2012T1R0M8C	RoHS	1.0	±20%	85	71	2.7	2.7	1	1.00

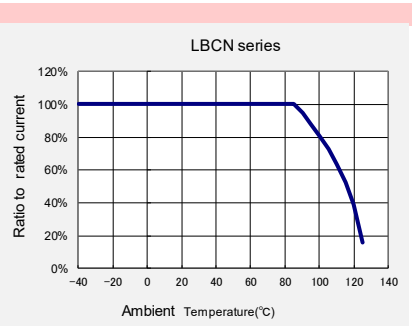
●2012 type ＊Operating Temp.:−55〜+150℃(Including self-generated heat)

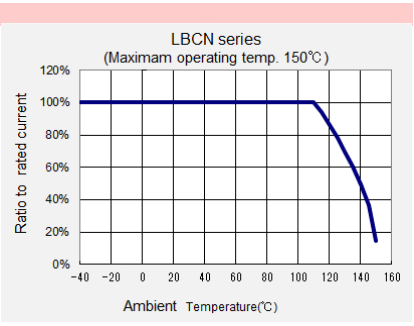
New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [mΩ]		Rated current(Idc1) [A] (max.)	Rated current(Idc2) [A] (max.)	Measuring frequency [MHz]	Thickness [mm] (max.)
					(max.)	(typ.)				
LBCNF2012KKTR24MAD	MCKK2012TR24M8C D	RoHS	0.24	±20%	20	17	4.8	5.4	1	1.00
LBCNF2012KKTR33MAD	MCKK2012TR33M8C D	RoHS	0.33	±20%	30	25	4.4	4.5	1	1.00
LBCNF2012KKTR47MAD	MCKK2012TR47M8C D	RoHS	0.47	±20%	41	34	3.8	3.8	1	1.00
LBCNF2012KKT1R0MAD	MCKK2012T1R0M8C D	RoHS	1.0	±20%	85	71	2.7	2.7	1	1.00

※Idc1 is the DC value at which the initial L value is decreased within 30% by the application of DC bias. (at 20℃)
※Idc2 is the DC value at which the temperature of element is increased within 40℃ by the application of DC bias. (at 20℃)

■Derating of Rated Current

●LBCN series
Derating of current is necessary for LBCN series depending on ambient temperature.
Please refer to the chart shown below for appropriate derating of current.





■PACKAGING

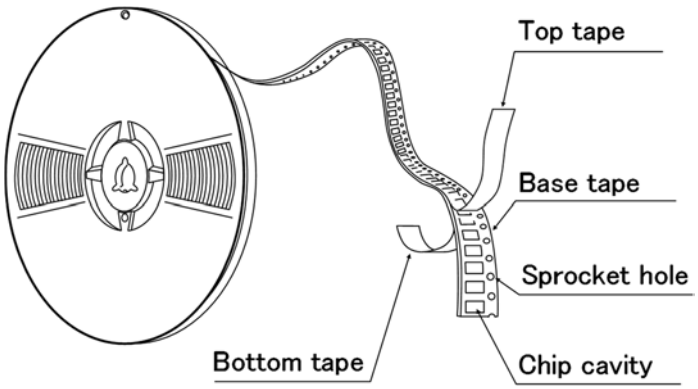
①Minimum Quantity

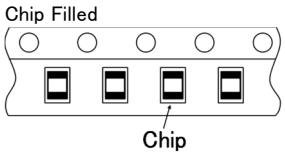
●Tape & Reel Packaging

Type	Thickness		Standard Quantity [pcs]	
	Code	mm (inch)	Paper Tape	Embossed Tape
1005 (0402)	EE	0.55 max (0.022 max)	10000	—
1210 (0504)	EK	0.5 max (0.020 max)	5000	—
1412 (0505)	FE	0.65 max (0.026 max)	4000	—
1608 (0603)	FK	0.6 max (0.024 max)	4000	—
1608 (0603)	FE	0.65 max (0.026 max)	4000	—
1608 (0603)	HK	0.8 max (0.031 max)	4000	—
1608 (0603)	KK	1.0 max (0.039 max)	–	3000
2012 (0806)	HK	0.8 max (0.031 max)	4000	—
2012 (0805)	KK	1.0 max (0.039 max)	–	3000
2016 (0806)	FE	0.65 max (0.026 max)	4000	—

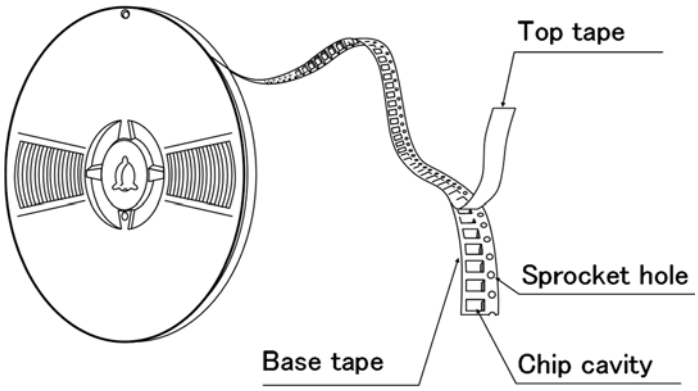
②Taping material

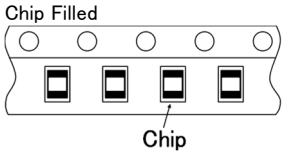
●Card board carrier tape 1005/1210/1412/1608/2012/2016 type





●Embossed Tape 1608/2012 type

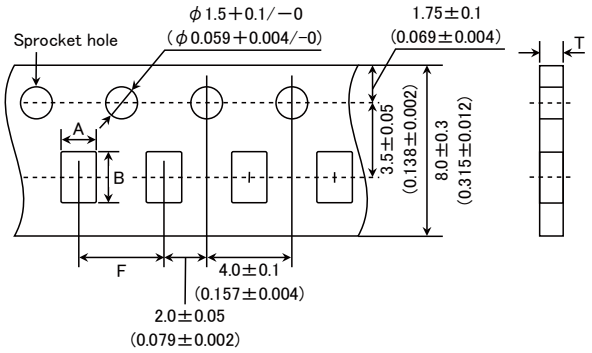




③Taping Dimensions

Paper tape (8mm wide)

Unit : mm (inch)

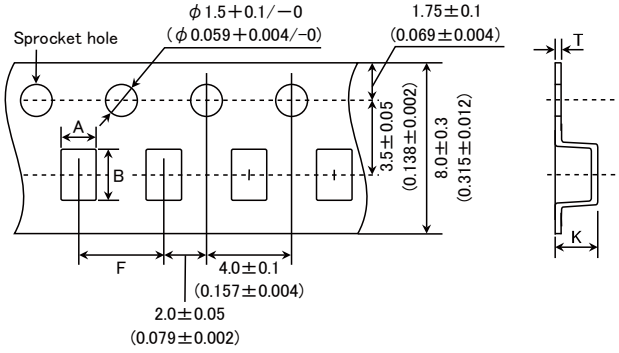


Type	Thickness		Chip cavity		Insertion Pitch	Tape Thickness
	Code	mm (inch)	A	B	F	T
1005 (0402)	EE	0.55 max (0.021 max)	0.8 (0.031)	1.3 (0.051)	2.0±0.05 (0.079±0.002)	0.64max (0.025max)
1210 (0504)	EK	0.5 max (0.020 max)	1.3 (0.051)	1.55 (0.061)	4.0±0.1 (0.157±0.004)	0.64max (0.025max)
1412 (0505)	FE	0.65 max (0.026 max)	1.6 (0.063)	1.8 (0.071)	4.0±0.1 (0.157±0.004)	0.72max (0.028max)
1608 (0603)	FK	0.6 max (0.024 max)	1.1 (0.043)	1.9 (0.075)	4.0±0.1 (0.157±0.004)	0.72max (0.028max)
1608 (0603)	FE	0.65 max (0.026 max)	1.1 (0.043)	1.9 (0.075)	4.0±0.1 (0.157±0.004)	0.72max (0.028max)
1608 (0603)	HK	0.8 max (0.031 max)	1.2 (0.047)	2.0 (0.079)	4.0±0.1 (0.157±0.004)	0.9max (0.035max)
2012 (0805)	HK	0.8 max (0.031 max)	1.65 (0.065)	2.4 (0.094)	4.0±0.1 (0.157±0.004)	0.9max (0.035max)
2016 (0806)	FE	0.65 max (0.026 max)	1.95 (0.077)	2.3 (0.091)	4.0±0.1 (0.157±0.004)	0.72max (0.028max)

Unit : mm (inch)

Embossed Tape (8mm wide)

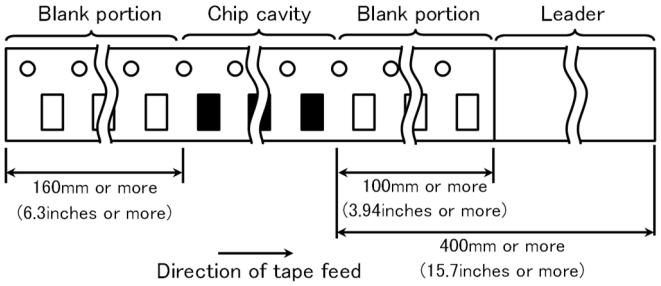
Unit : mm (inch)



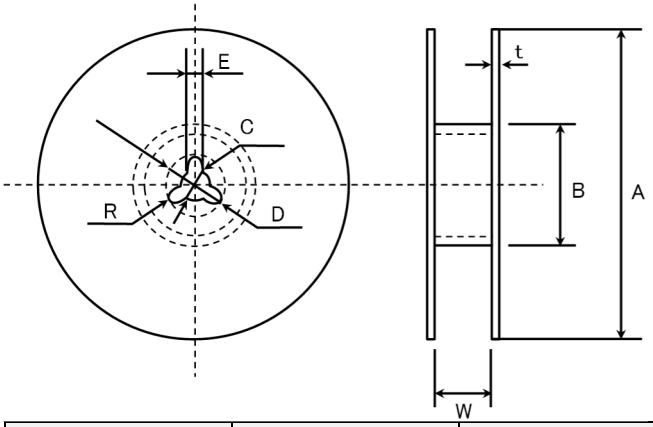
Type	Thickness		Chip cavity		Insertion Pitch	Tape Thickness	
	Code	mm (inch)	A	B	F	K	T
1608 (0603)	KK	1.0 max (0.039 max)	1.15 (0.045)	1.95 (0.077)	4.0±0.1 (0.157±0.004)	1.5 max (0.059 max)	0.3 max (0.012 max)
2012 (0805)	KK	1.0 max (0.039 max)	1.55 (0.061)	2.35 (0.093)	4.0±0.1 (0.157±0.004)	1.5 max (0.059 max)	0.3 max (0.012 max)

Unit : mm (inch)

④LEADER AND BLANK PORTION



⑤Reel Size



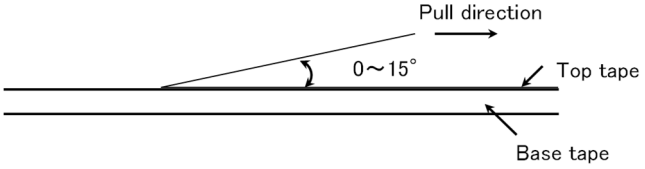
A	B	C	D	E	R
ϕ178±2.0	ϕ50 or more	ϕ13.0±0.2	ϕ21.0±0.8	2.0±0.5	1.0

	t	W
4mm width tape	1.5max.	5±1.0
8mm width tape	2.5max.	10±1.5

(Unit : mm)

⑥Top tape strength

The top tape requires a peel-off force of 0.1 to 1.0N in the direction of the arrow as illustrated below.



Multilayer Metal Power Inductors MCOIL™ LBCN series
for Telecommunications Infrastructure and Industrial Equipment
Multilayer Metal Power Inductors MCOIL™ LMCN series
for Medical Devices classified as GHTF Class C (Japan Class III)

■RELIABILITY DATA

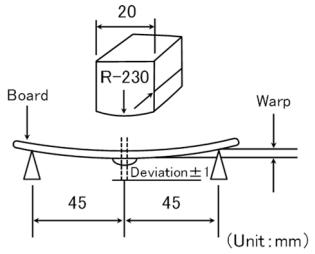
1. Operating Temperature Range	
Specified Value	−40～＋125℃(Including self-generated heat)　,　End of part number "D"⇒−55～＋150℃(Including self-generated heat)

2. Storage Temperature Range	
Specified Value	−40～＋85℃　,　End of part number "D"⇒−55～＋110℃

3. Rated Current	
Specified Value	Idc1: The decreasing-rate of inductance value is within 30 % Idc2: The temperature of the element is increased within 40℃

4. Inductance	
Specified Value	Refer to each specification.
Test Methods and Remarks	Measuring frequency　: 1MHz Measuring equipment　: E4991(or its equivalent)

5. DC Resistance	
Specified Value	Refer to each specification.
Test Methods and Remarks	Measuring equipment: HIOKI RM3545 (or its equivalent)

6. Resistance to Flexure of Substrate	
Specified Value	No mechanical damage.
Test Methods and Remarks	Warp　: 2mm Testing board　: glass epoxy-resin substrate Thickness　: 0.8mm 

7. Solderability	
Specified Value	At least 90% of terminal electrode is covered by new solder.
Test Methods and Remarks	Solder temperature　:245±3℃ (Sn/3.0Ag/0.5Cu) Duration　:4±1 sec.

8. Resistance to Soldering	
Specified Value	Appearance:No significant abnormality Inductance change: Within ±10%
Test Methods and Remarks	Solder temperature　:260±5℃ Duration　:10±0.5 sec. Preheating temperature　:150 to 180℃ Preheating time　:3 min. Flux　:Immersion into ethanol solution with colophony for 3 to 5 sec. Recovery　:2 to 3 hrs of recovery under the standard condition after the test.(See Note 1)

9. Thermal Shock	
Specified Value	Appearance : No significant abnormality Inductance change : Within ±10%
Test Methods and Remarks	Conditions for 1 cycle Step 1: (Minimum Operating Temperature) +0/−3, 30±3 Step 2: Room temperature, 2〜3 Step 3: (Maximum Operating Temperature) +3/−0, 30±3 Step 4: Room temperature, 2〜3 Number of cycles : 1000 Recovery : 2 to 3 hrs of recovery under the standard condition after the test. (See Note 1)

10. Damp Heat (Steady state)	
Specified Value	Appearance : No significant abnormality Inductance change : Within ±10%
Test Methods and Remarks	Temperature : 60±2℃ Humidity : 90 to 95%RH Duration : 1000+24/−0 hrs Recovery : 2 to 3 hrs of recovery under the standard condition after the removal from test chamber. (See Note 1)

11. Loading under Damp Heat	
Specified Value	Appearance : No significant abnormality Inductance change : Within ±10%
Test Methods and Remarks	Temperature : 60±2℃ Humidity : 90 to 95%RH Applied current : Idc2max Duration : 1000+24/−0 hrs Recovery : 2 to 3 hrs of recovery under the standard condition after the removal from test chamber. (See Note 1)

12. Loading at High Temperature	
Specified Value	Appearance : No significant abnormality Inductance change : Within ±10%
Test Methods and Remarks	Temperature : 85±2℃ (End of part number "D"⇒ 110±2℃) Applied current : Idc2max Duration : 1000 +24/−0 hrs. Recovery : 2 to 3 hrs of recovery under the standard condition after the removal from test chamber. (See Note 1)

(Note 1) Measurement shall be made after 48±2 hrs of recovery under the standard condition.
Note on standard condition: "standard condition" referred to herein is defined as follows:
5 to 35℃ of temperature, 25 to 85% relative humidity.
When there are questions concerning measurement results:
In order to provide correlation data, the test shall be conducted under condition of 20±2℃ of temperature, 60 to 70% relative humidity, and 86 to 106kPa of air pressure. Unless otherwise specified, all the tests are conducted under the "standard condition."

Multilayer Metal Power Inductors MCOIL™ LCCN series
for Automotive Body & Chassis and Infotainment
Multilayer Metal Power Inductors MCOIL™ LBCN series
for Telecommunications Infrastructure and Industrial Equipment
Multilayer Metal Power Inductors MCOIL™ LMCN series
for Medical Devices classified as GHTF Class C (Japan Class III)

■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.

Technical considerations

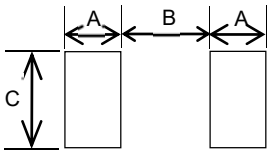
◆Pattern configurations (Design of Land-patterns)

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

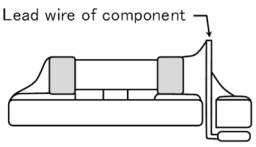
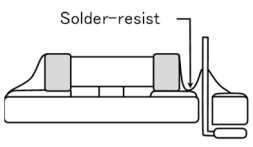
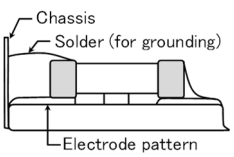
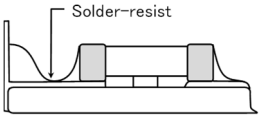
(1) Recommended land dimensions for a typical chip inductor land patterns for PCBs

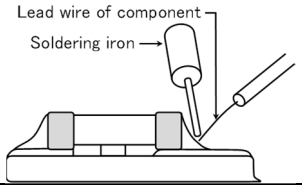
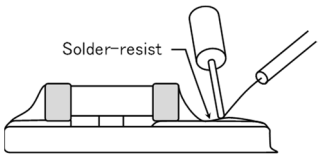
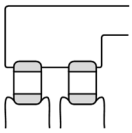
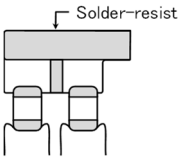
(Unit : mm)

Type	1608	2012
A	0.7	0.95
B	0.9	0.8
C	1.0	1.4



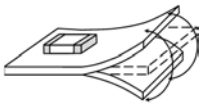
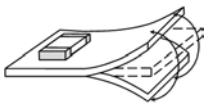
(2) Examples of good and bad solder application

Item	Not recommended	Recommended
Mixed mounting of SMD and leaded components		
Component placement close to the chassis		

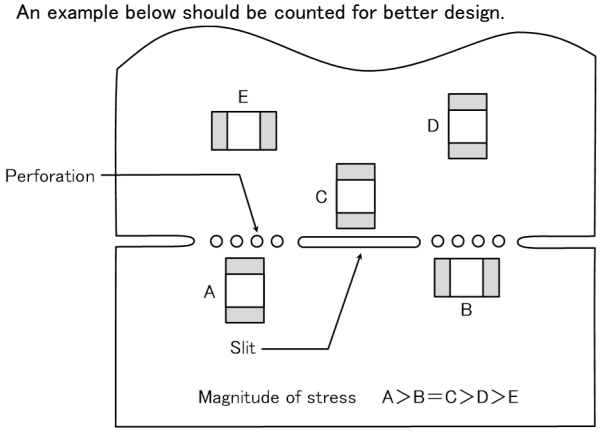
Hand-soldering of leaded components near mounted components		
Horizontal component placement		

◆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

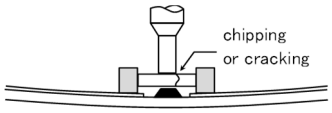
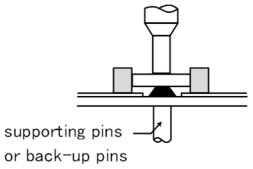
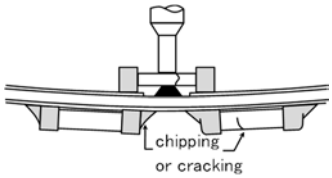
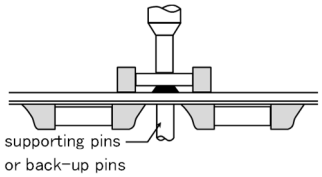
◆Adjustment of mounting machine

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

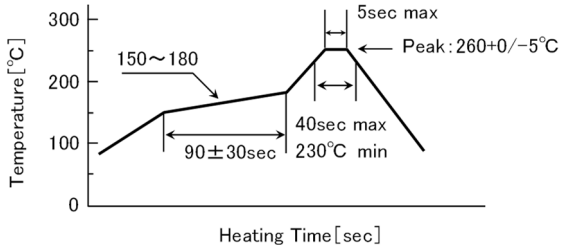
・Put the soldering iron on the land-pattern and don't touch it to the inductor directly.
Soldering iron's temperature below 350 ℃ , Duration 3 seconds or less

Technical considerations

◆Reflow soldering

- 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.

Recommended reflow condition (Pb free solder)



The allowable number of reflow soldering is 3 times.

5. Cleaning

Precautions

◆Cleaning conditions

- Washing by supersonic waves shall be avoided.

Technical considerations

◆Cleaning conditions

- If washed by supersonic waves, the products might be broken.

6. Resin coating and mold	
Precautions	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	
Precautions	◆Breakaway PC boards (splitting along perforations) 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. ◆General handling precautions ・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. ◆Mechanical considerations Be careful not to subject the inductors to excessive mechanical shocks. (1) If inductors are dropped on the floor or a hard surface they should not be used. (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.

8. Storage conditions	
Precautions	◆Storage 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. ・Recommended conditions Ambient temperature: 30℃ or below Humidity: 30% to 70% The ambient temperature must be kept −5℃ to +40℃. 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. ・Inductor should be kept where no chlorine or sulfur exists in the air.
Technical considerations	◆Storage 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.

Wire-wound Metal Power Inductors MCOIL™ LBDN series for Telecommunications Infrastructure and Industrial Equipment

Code in front of Series have been extracted from Part number, which describes the segment of products, such as kinds and characteristics.

REFLOW

■PART NUMBER

*Operating Temp. : −40～125℃(Including self-generated heat)

L	B	D	N	D	2	0	2	0	K	K	T	1	R	0	M	M	
①				②	③				④		⑤	⑥			⑦	⑧	⑨

①Series

Code (1)(2)(3)(4)	
LBDN	Wire-wound Metal Power Inductor for Telecommunications Infrastructure and Industrial Equipment

(1) Product Group

Code	
L	Inductors

(2) Category

Code	Recommended equipment	Quality Grade
B	Telecommunications Infrastructure and Industrial Equipment	2

(3) Type

Code	
D	Metal Wire-wound (Drum type)

(4) Features, Characteristics

Code	
N	Standard Power choke

②Features

Code	Feature
D	Bottom electrode (Ag × solder)

③Dimensions (L × W)

Code	Dimensions (L × W) [mm]
2020	2.0 × 2.0
3030	3.0 × 3.0
4040	4.0 × 4.0

④Dimensions (H)

Code	Dimensions (H) [mm]
KK	1.0
MK	1.2
WK	2.0

⑤Packaging

Code	Packaging
T	Taping

⑥Nominal inductance

Code (example)	Nominal inductance [μH]
R47	0.47
1R0	1.0
4R7	4.7

※R=Decimal point

⑦Inductance tolerance

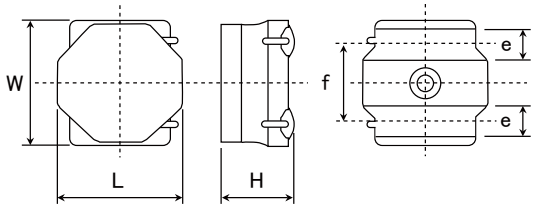
Code	Inductance tolerance
M	±20%
N	±30%

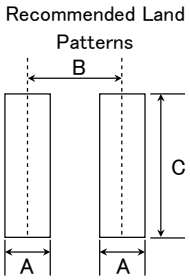
⑧Special code

Code	Special code
F	Ferrite coating
M	Metal coating

⑨Internal code

■STANDARD EXTERNAL DIMENSIONS





Type	A	B	C
2020	0.65	1.35	2.0
3030	0.8	2.2	2.7
4040	1.2	2.8	3.7

Unit : mm

Type	L	W	H	e	f	Standard quantity [pcs] Taping
2020KK	2.0±0.15 (0.079±0.006)	2.0±0.15 (0.079±0.006)	1.0 max (0.039 max)	0.50±0.2 (0.02±0.008)	1.25±0.2 (0.049±0.008)	2500
2020MK	2.0±0.15 (0.079±0.006)	2.0±0.15 (0.079±0.006)	1.2 max (0.047 max)	0.50±0.2 (0.02±0.008)	1.25±0.2 (0.049±0.008)	2500
3030KK	3.0±0.1 (0.118±0.004)	3.0±0.1 (0.118±0.004)	1.0 max (0.039 max)	0.90±0.2 (0.035±0.008)	1.9±0.2 (0.075±0.008)	2000
3030MK	3.0±0.1 (0.118±0.004)	3.0±0.1 (0.118±0.004)	1.2 max (0.047 max)	0.90±0.2 (0.035±0.008)	1.9±0.2 (0.075±0.008)	2000
4040MK	4.0±0.2 (0.157±0.008)	4.0±0.2 (0.157±0.008)	1.2 max (0.047 max)	1.1±0.2 (0.043±0.008)	2.5±0.2 (0.098±0.008)	1000
4040WK	4.0±0.2 (0.157±0.008)	4.0±0.2 (0.157±0.008)	2.0 max (0.079 max)	1.1±0.2 (0.043±0.008)	2.5±0.2 (0.098±0.008)	700

Unit : mm (inch)

■PART NUMBER

・All the Wire-wound Metal Power Inductors of the catalog lineup are RoHS compliant.

Notes)
・The exchange of individual specifications is necessary depending on your application and/or circuit condition. Please contact TAIYO YUDEN's official sales channel.
・The products are for Telecommunications infrastructure and Industrial equipment.
Please consult with TAIYO YUDEN's official sales channel for the details of the product specifications, etc.,
and please review and approve the product specifications before ordering.

●2020KK type 【Thickness:1.0mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency [MHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LBDND2020KKTR47MM	MDKK2020TR47MM 8	0.47	±20%	0.046	3,500 (4,150)	2,200 (2,500)	1
LBDND2020KKTR68MM	MDKK2020TR68MM 8	0.68	±20%	0.060	3,200 (3,650)	2,000 (2,100)	1
LBDND2020KKT1R0MM	MDKK2020T1R0MM 8	1.0	±20%	0.085	2,900 (3,400)	1,700 (1,900)	1
LBDND2020KKT1R5MM	MDKK2020T1R5MM 8	1.5	±20%	0.133	1,900 (2,250)	1,350 (1,500)	1
LBDND2020KKT2R2MM	MDKK2020T2R2MM 8	2.2	±20%	0.165	1,650 (1,950)	1,200 (1,350)	1
LBDND2020KKT3R3MM	MDKK2020T3R3MM 8	3.3	±20%	0.275	1,300 (1,550)	940 (1,050)	1
LBDND2020KKT4R7MM	MDKK2020T4R7MM 8	4.7	±20%	0.435	1,050 (1,250)	750 (850)	1
LBDND2020KKT100MM	MDKK2020T100MM 8	10	±20%	0.690	750 (900)	630 (680)	1

Absolute maximum voltage:DC20V

●2020MK type 【Thickness:1.2mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency [MHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LBDND2020MKTR47MM	MDMK2020TR47MM 8	0.47	±20%	0.046	4,200 (4,800)	2,300 (2,450)	1
LBDND2020MKTR68MM	MDMK2020TR68MM 8	0.68	±20%	0.058	3,500 (4,100)	2,000 (2,200)	1
LBDND2020MKT1R0MM	MDMK2020T1R0MM 8	1.0	±20%	0.064	2,550 (2,900)	1,900 (2,050)	1
LBDND2020MKT1R5MM	MDMK2020T1R5MM 8	1.5	±20%	0.086	2,000 (2,300)	1,650 (1,750)	1
LBDND2020MKT2R2MM	MDMK2020T2R2MM 8	2.2	±20%	0.109	1,750 (2,000)	1,450 (1,550)	1
LBDND2020MKT3R3MM	MDMK2020T3R3MM 8	3.3	±20%	0.178	1,350 (1,550)	1,150 (1,200)	1
LBDND2020MKT4R7MM	MDMK2020T4R7MM 8	4.7	±20%	0.242	1,150 (1,300)	950 (1,050)	1

Absolute maximum voltage:DC20V

●3030KK type 【Thickness:1.0mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency [MHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LBDND3030KKTR47MM	MDKK3030TR47MM 8	0.47	±20%	0.039	5,400 (6,500)	3,900 (4,500)	1
LBDND3030KKT1R0MM	MDKK3030T1R0MM 8	1.0	±20%	0.086	4,400 (5,200)	2,400 (2,800)	1
LBDND3030KKT1R5MM	MDKK3030T1R5MM 8	1.5	±20%	0.100	3,000 (3,500)	2,100 (2,400)	1
LBDND3030KKT2R2MM	MDKK3030T2R2MM 8	2.2	±20%	0.144	2,500 (3,000)	1,900 (2,200)	1
LBDND3030KKT3R3MM	MDKK3030T3R3MM 8	3.3	±20%	0.248	2,000 (2,400)	1,350 (1,500)	1
LBDND3030KKT4R7MM	MDKK3030T4R7MM 8	4.7	±20%	0.345	1,700 (2,000)	1,150 (1,300)	1
LBDND3030KKT6R8MM	MDKK3030T6R8MM 8	6.8	±20%	0.437	1,400 (1,700)	1,000 (1,150)	1
LBDND3030KKT100MM	MDKK3030T100MM 8	10	±20%	0.575	1,100 (1,300)	850 (1,000)	1

Absolute maximum voltage:DC20V

●3030MK type 【Thickness:1.2mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency [MHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LBDND3030MKTR30MM	MDMK3030TR30MM 8	0.30	±20%	0.020	7,600 (9,200)	5,500 (6,400)	1
LBDND3030MKTR33MM	MDMK3030TR33MM 8	0.33	±20%	0.020	6,400 (8,700)	5,500 (6,400)	1
LBDND3030MKTR47MM	MDMK3030TR47MM 8	0.47	±20%	0.027	6,300 (7,500)	4,700 (5,500)	1
LBDND3030MKT1R0MM	MDMK3030T1R0MM 8	1.0	±20%	0.050	4,300 (5,100)	3,300 (3,900)	1
LBDND3030MKT1R5MM	MDMK3030T1R5MM 8	1.5	±20%	0.074	3,400 (4,100)	2,500 (3,000)	1
LBDND3030MKT2R2MM	MDMK3030T2R2MM 8	2.2	±20%	0.112	2,800 (3,600)	2,100 (2,400)	1
LBDND3030MKT3R3MM	MDMK3030T3R3MM 8	3.3	±20%	0.173	2,100 (2,700)	1,650 (1,900)	1
LBDND3030MKT4R7MM	MDMK3030T4R7MM 8	4.7	±20%	0.263	1,800 (2,300)	1,350 (1,550)	1

Absolute maximum voltage:DC20V

※) The saturation current value (Idc1) is the DC current value having inductance decrease down to 30%. (at 20℃)
※1-1) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40℃, when mounted in FR4 High heat dissipation board (board thickness:1.0mm copper thickness:0.035mm, board size:110×30×1.0mm, land size:12.6×19.6mm). (at 20℃)
※1-2) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40℃, when mounted in FR4 High heat dissipation board (board thickness:1.6mm copper thickness:0.050mm, board size:100×100×1.6mm, land size:14.6×43mm). (at 20℃)
※1-3) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40℃, when mounted in FR4 High heat dissipation board (board thickness:1.6mm copper thickness:0.050mm, board size:100×100×1.6mm, land size:44.5×90mm). (at 20℃)
※) The rated current is the DC current value that satisfies both of current value saturation current value and temperature rise current value.

※1-1) 2020KK, 2020MK type
※1-2) 3030KK, 3030MK type
※1-3) 4040MK, 4040WK type

■PART NUMBER

●4040MK F type 【Thickness:1.2mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency[kHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LBDND4040MKTR47MF	MDMK4040TR47MF 8	0.47	±20%	0.029	7,500 (10,000)	4,600 (5,400)	100
LBDND4040MKT1R0MF	MDMK4040T1R0MF 8	1.0	±20%	0.047	5,200 (7,500)	3,500 (4,200)	100
LBDND4040MKT1R2MF	MDMK4040T1R2MF 8	1.2	±20%	0.047	4,200 (6,200)	3,500 (4,200)	100
LBDND4040MKT1R5MF	MDMK4040T1R5MF 8	1.5	±20%	0.065	3,700 (5,400)	3,300 (3,600)	100
LBDND4040MKT2R2MF	MDMK4040T2R2MF 8	2.2	±20%	0.092	3,200 (4,500)	2,500 (2,900)	100

Absolute maximum voltage:DC25V

●4040MK type 【Thickness:1.2mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency[MHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LBDND4040MKTR68MM	MDMK4040TR68MM 8	0.68	±20%	0.029	6,700 (7,800)	5,000 (5,700)	1
LBDND4040MKT1R0MM	MDMK4040T1R0MM 8	1.0	±20%	0.036	5,000 (6,200)	4,500 (5,100)	1
LBDND4040MKT1R5MM	MDMK4040T1R5MM 8	1.5	±20%	0.065	4,500 (5,600)	3,200 (3,600)	1
LBDND4040MKT2R2MM	MDMK4040T2R2MM 8	2.2	±20%	0.079	3,800 (4,500)	2,800 (3,200)	1
LBDND4040MKT3R3MM	MDMK4040T3R3MM 8	3.3	±20%	0.130	3,200 (4,000)	2,200 (2,500)	1
LBDND4040MKT4R7MM	MDMK4040T4R7MM 8	4.7	±20%	0.160	2,500 (3,000)	1,900 (2,200)	1
LBDND4040MKT6R8MM	MDMK4040T6R8MM 8	6.8	±20%	0.230	1,900 (2,200)	1,600 (1,800)	1
LBDND4040MKT100MM	MDMK4040T100MM 8	10	±20%	0.330	1700 (2,000)	1,400 (1,600)	1

Absolute maximum voltage:DC25V

●4040WK type 【Thickness:2.0mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency[MHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LBDND4040WKTR56NM	MDWK4040TR56NM 8	0.56	±20%	0.016	9,000 (13,000)	6,500 (7,500)	1
LBDND4040WKTR68MM	MDWK4040TR68MM 8	0.68	±20%	0.016	8,000 (12,000)	7,300 (8,300)	1
LBDND4040WKT1R0MM	MDWK4040T1R0MM 8	1.0	±20%	0.027	7,000 (9,400)	5,100 (5,800)	1
LBDND4040WKT1R5MM	MDWK4040T1R5MM 8	1.5	±20%	0.041	7,000 (9,400)	4,100 (4,700)	1
LBDND4040WKT2R2MM	MDWK4040T2R2MM 8	2.2	±20%	0.054	5,400 (7,500)	3,500 (4,000)	1
LBDND4040WKT3R3MM	MDWK4040T3R3MM 8	3.3	±20%	0.075	3,700 (5,200)	3,000 (3,300)	1
LBDND4040WKT4R7MM	MDWK4040T4R7MM 8	4.7	±20%	0.107	3,500 (5,000)	2,500 (2,800)	1
LBDND4040WKT6R8MM	MDWK4040T6R8MM 8	6.8	±20%	0.158	2,900 (4,000)	2,000 (2,300)	1
LBDND4040WKT100MM	MDWK4040T100MM 8	10	±20%	0.194	2,200 (3,100)	1,600 (1,900)	1

Absolute maximum voltage:DC25V

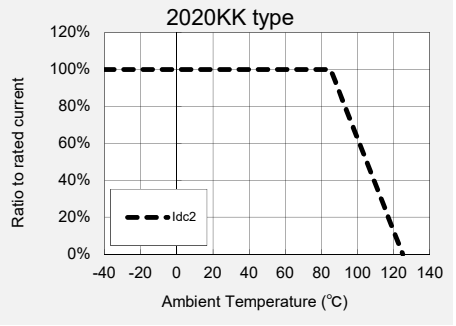
※) The saturation current value (Idc1) is the DC current value having inductance decrease down to 30%. (at 20℃)
※1-1) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40℃, when mounted in FR4 High heat dissipation board (board thickness:1.0mm copper thickness:0.035mm, board size:110×30×1.0mm, land size:12.6×19.6mm). (at 20℃)
※1-2) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40℃, when mounted in FR4 High heat dissipation board (board thickness:1.6mm copper thickness:0.050mm, board size:100×100×1.6mm, land size:14.6×43mm). (at 20℃)
※1-3) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40℃, when mounted in FR4 High heat dissipation board (board thickness:1.6mm copper thickness:0.050mm, board size:100×100×1.6mm, land size:44.5×90mm). (at 20℃)
※) The rated current is the DC current value that satisfies both of current value saturation current value and temperature rise current value.

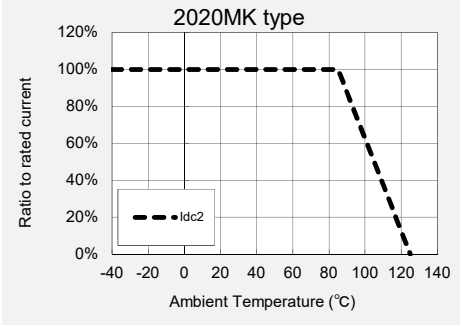
※1-1) 2020KK, 2020MK type
※1-2) 3030KK, 3030MK type
※1-3) 4040MK, 4040WK type

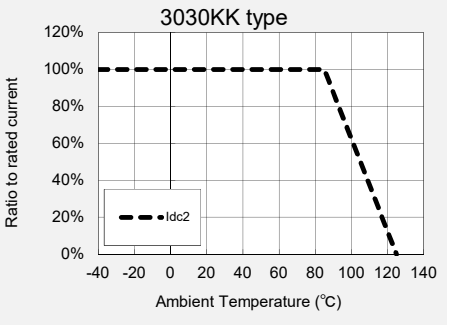
Derating of Rated Current

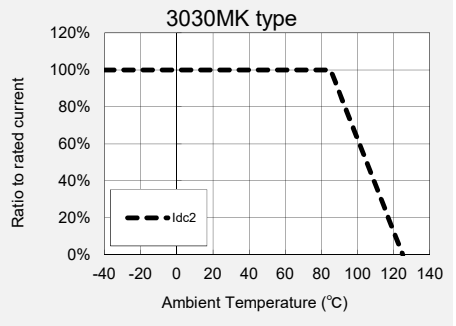
LBDN series

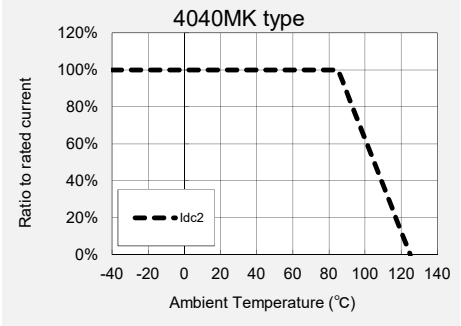
Derating of current is necessary for LBDN series depending on ambient temperature.
Please refer to the chart shown below for appropriate derating of current.

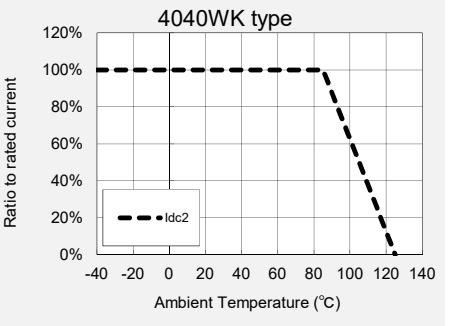












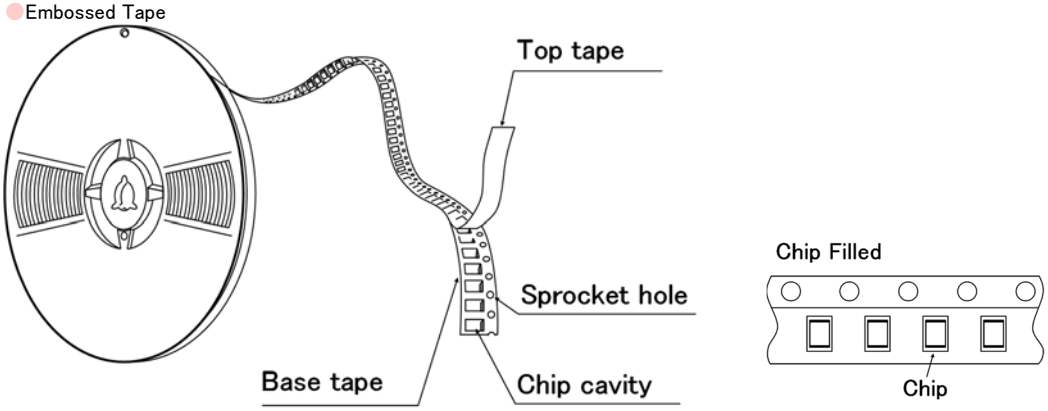
■PACKAGING

①Minimum Quantity

Type	Standard Quantity [pcs]
	Tape & Reel
1616KK	2500
2020JE 2020KK 2020MK	2500
3030KK 3030MK	2000
4040JE 4040MK	1000
4040WK	700
5050PK	1000

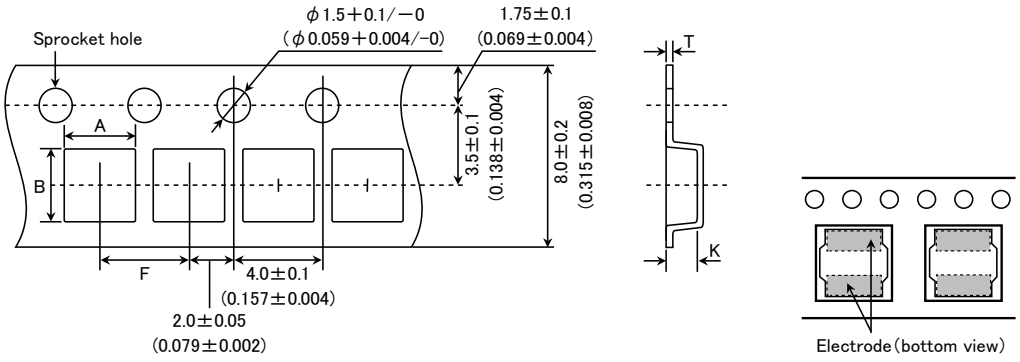
②Tape Material

●Embossed Tape



③Taping dimensions

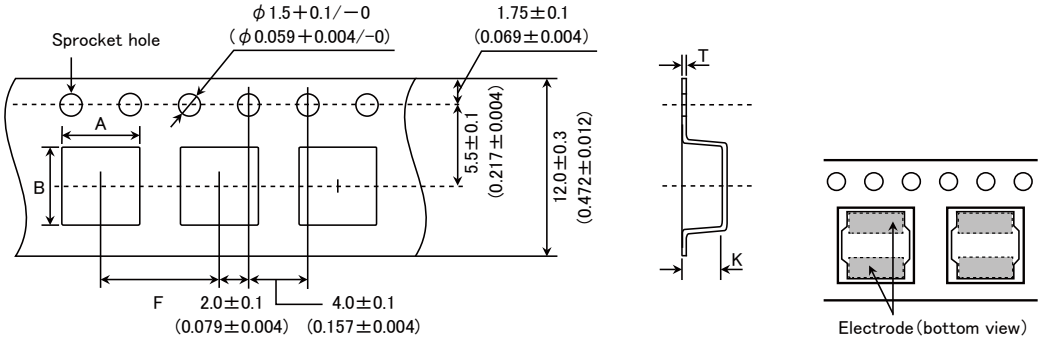
●Embossed tape 8mm wide (0.315 inches wide)



Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
1616KK	1.79±0.1 (0.071±0.004)	1.79±0.1 (0.071±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.010±0.002)	1.1±0.1 (0.043±0.004)
2020JE 2020KK 2020MK	2.2±0.1 (0.102±0.004)	2.2±0.1 (0.102±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.3±0.1 (0.051±0.004)
3030KK 3030MK	3.2±0.1 (0.126±0.004)	3.2±0.1 (0.126±0.004)	4.0±0.1 (0.157±0.004)	0.3±0.05 (0.012±0.002)	1.4±0.1 (0.055±0.004)

Unit : mm (inch)

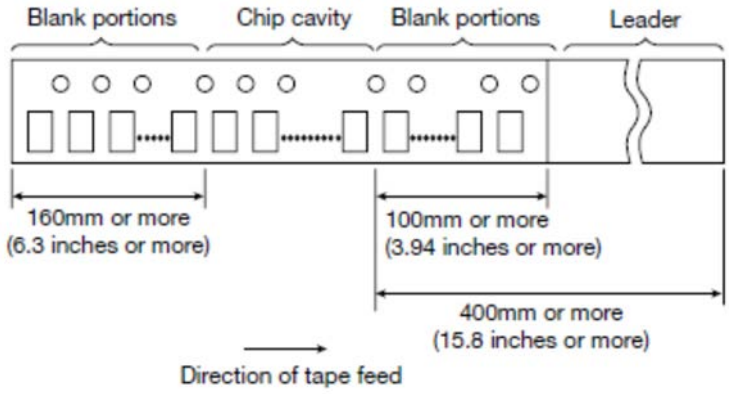
Embossed tape 12mm wide (0.47 inches wide)



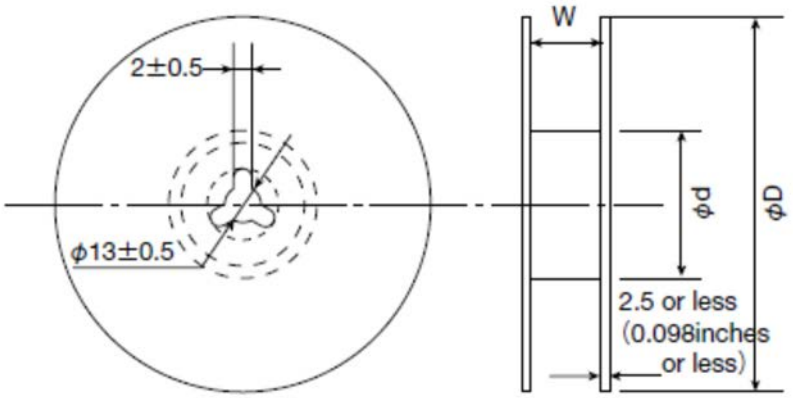
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
4040JE 4040MK	4.3±0.1 (0.169±0.004)	4.3±0.1 (0.169±0.004)	8.0±0.1 (0.315±0.004)	0.3±0.05 (0.012±0.002)	1.6±0.1 (0.063±0.004)
4040WK	4.3±0.1 (0.169±0.004)	4.3±0.1 (0.169±0.004)	8.0±0.1 (0.315±0.004)	0.3±0.05 (0.012±0.002)	2.3±0.1 (0.091±0.004)
5050PK	5.25±0.1 (0.207±0.004)	5.25±0.1 (0.207±0.004)	8.0±0.1 (0.315±0.004)	0.3±0.1 (0.012±0.004)	1.6±0.1 (0.063±0.004)

Unit : mm (inch)

④Leader and Blank portion



⑤Reel size



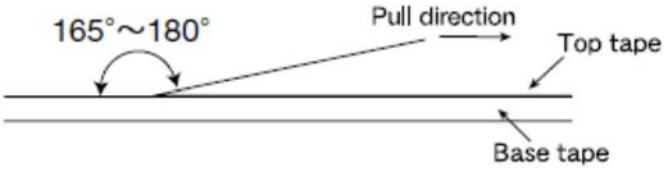
Type	Reel size (Reference values)		
	φD	φd	W
1616KK	180±0.5 (7.087±0.019)	60±1.0 (2.36±0.04)	10.0±1.5 (0.394±0.059)
2020JE 2020KK 2020MK			
3030KK 3030MK			
4040JE 4040MK 4040WK	180±3.0 (7.087±0.118)	60±2.0 (2.36±0.08)	14.0±1.5 (0.551±0.059)
5050PK			

Unit : mm (inch)

⑥Top Tape Strength

Top tape strength

Type	Peel-off strength
MDKK1616	0.1N～1.0N
MDJE2020 MDKK2020 MDMK2020	
MDKK3030 MDMK3030	
MDJE4040 MDMK4040 MDWK4040	0.1N～1.3N
MDPK5050	



Wire-wound Metal Power Inductors MCOIL™ LBDN series
for Telecommunications Infrastructure and Industrial Equipment
Wire-wound Metal Power Inductors MCOIL™ LMDN series
for Medical Devices classified as GHTF Class C (Japan Class III)

■RELIABILITY DATA

1. Operating Temperature Range	
Specified Value	−40～＋125℃(Including self-generated heat)
Test Methods and Remarks	Including self-generated heat

2. Storage Temperature Range	
Specified Value	−40～＋85℃
Test Methods and Remarks	−5 to 40℃ for the product with taping.

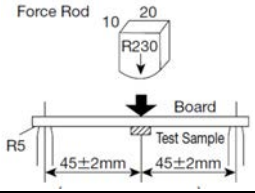
3. Rated current	
Specified Value	Within the specified tolerance

4. Inductance	
Specified Value	Within the specified tolerance
Test Methods and Remarks	Measuring equipment : LCR Meter (HP 4285A or equivalent) Measuring frequency : 1MHz 1V (4040F:100kHz 1V)

5. DC Resistance	
Specified Value	Within the specified tolerance
Test Methods and Remarks	Measuring equipment : DC ohmmeter (HIOKI 3227 or equivalent)

6. Self resonance frequency	
Specified Value	—

7. Temperature characteristic	
Specified Value	Inductance change : Within ±10%
Test Methods and Remarks	Measurement of inductance shall be taken at temperature range within −40℃～＋125℃. With reference to inductance value at ＋20℃., change rate shall be calculated.

8. Resistance to flexure of substrate	
Specified Value	No damage
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. As illustrated below, apply force in the direction of the arrow indicating until deflection of the test board reaches to 2 mm. Test board size : 100×40×1.6 mm Test board material : glass epoxy-resin Solder cream thickness : 0.10 mm 

9. Insulation resistance : between wires	
Specified Value	—

10. Insulation resistance : between wire and core	
Specified Value	—

11. Withstanding voltage : between wire and core	
Specified Value	—

12. Adhesion of terminal electrode	
Specified Value	Shall not come off PC board
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. Applied force : 10N to X and Y directions. Duration : 5s. Solder cream thickness : 0.1mm.

13. Resistance to vibration	
Specified Value	Inductance change : Within ±10% No significant abnormality in appearance.
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. Then it shall be submitted to below test conditions.

Frequency Range	10～55Hz	
Total Amplitude	1.5mm (May not exceed acceleration 196m/s^2)	
Sweeping Method	10Hz to 55Hz to 10Hz for 1min.	
Time	X	For 2 hours on each X, Y, and Z axis.
	Y	
	Z	

Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

14. Solderability	
Specified Value	At least 90% of surface of terminal electrode is covered by new solder.
Test Methods and Remarks	The test samples shall be dipped in flux, and then immersed in molten solder as shown in below table. Flux : Ethanol solution containing rosin 25%.

Solder Temperature	245±5℃
Time	5±1.0 sec.

※Immersion depth : All sides of mounting terminal shall be immersed.

15. Resistance to soldering heat	
Specified Value	Inductance change : Within ±10% No significant abnormality in appearance.
Test Methods and Remarks	The test sample shall be exposed to reflow oven at 230±5℃ for 40 seconds, with peak temperature at 260±5℃ for 5 seconds, 2 times. Test board material : glass epoxy-resin Test board thickness : 1.0mm

16. Thermal shock	
Specified Value	Inductance change : Within ±10% No significant abnormality in appearance.
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. The test samples shall be placed at specified temperature for specified time by step 1 to step 4 as shown in below table in sequence. The temperature cycle shall be repeated 1000 cycles.

Conditions of 1 cycle		
Step	Temperature (℃)	Duration (min)
1	−40±3	30±3
2	Room temperature	Within 3
3	+85±2	30±3
4	Room temperature	Within 3

17. Damp heat	
Specified Value	Inductance change : Within ±10% No significant abnormality in appearance.
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. The test samples shall be placed in thermostatic oven set at specified temperature and humidity as shown in below table.

Temperature	60±2℃
Humidity	90～95%RH
Time	1000+24/−0 hour

18. Loading under damp heat	
Specified Value	Inductance change : Within ±10% No significant abnormality in appearance.
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. The test samples shall be placed in thermostatic oven set at specified temperature and humidity and applied the rated current continuously as shown in below table. Temperature: 60±2℃ Humidity: 90～95%RH Applied current: Rated current Time: 1000＋24／－0 hour

19. Low temperature life test	
Specified Value	Inductance change : Within ±10% No significant abnormality in appearance.
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. After that, the test samples shall be placed at test conditions as shown in below table. Temperature: －40±2℃ Time: 1000＋24／－0 hour

20. High temperature life test	
Specified Value	—

21. Loading at high temperature life test	
Specified Value	Inductance change : Within ±10% No significant abnormality in appearance.
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. The test samples shall be placed in thermostatic oven set at specified temperature and applied the rated current continuously as shown in below table. Temperature: 85±2℃ Applied current: Rated current Time: 1000＋24／－0 hour

22. Standard condition	
Specified Value	Standard test condition : Unless otherwise specified, temperature is 20±15℃ and 65±20%of relative humidity. When there is any question concerning measurement result: In order to provide correlation data, the test shall be condition of 20±2℃ of temperature, 65±5% relative humidity. Inductance is in accordance with our measured value.

■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

◆Land pattern design

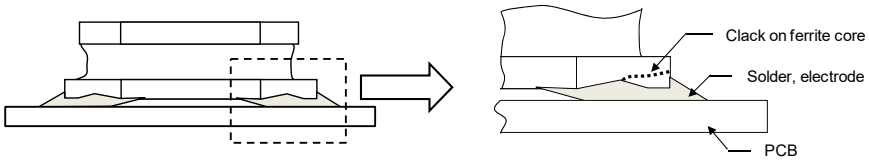
1. Please refer to a recommended land pattern.
2. There is stress, which has been caused by distortion of a PCB, to the inductor.
3. Please consider the arrangement of parts on a PCB.

Technical considerations

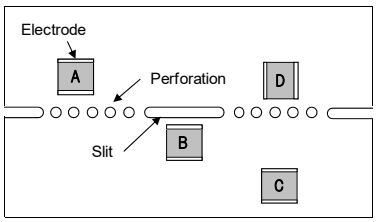
◆Land pattern design

Surface Mounting

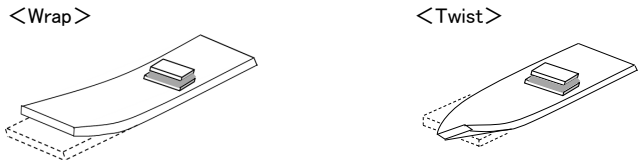
1. Mounting and soldering conditions should be checked beforehand.
2. Applicable soldering process to this products is reflow soldering only.
3. Please use the recommended land pattern shown as below. Electrical characteristics and the mounting ability of the product are being considered in the recommended land pattern. If a PCB is designed with other dimensions, defective soldering and stress to a product may occur due to misalignment. The performance of the product may not be brought out. If an adopted land pattern is different from the recommended land pattern, stress to the product will increase. It may cause cracks or defective electrical characteristics of the product. Please conduct validation completely before studying adoption of this product and please judge the pros and cons of adoption of this product with taking on responsibility.
4. As coefficients of thermal expansion between an inductor and a PCB differs, cracks may occur on a core when thermal stress is applied to them after mounting an inductor. (Please refer to the drawings below.) Please conduct validation completely before studying adoption of this product and please judge the pros and cons of adoption of this product with taking on responsibility.

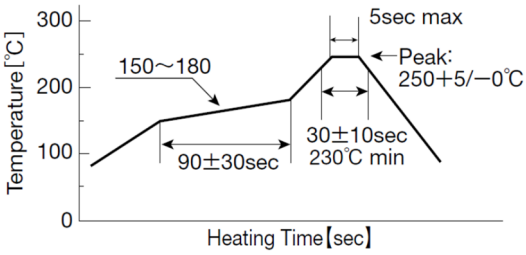


5. SMD inductors should be located to minimize any possible mechanical stresses from board warp or deflection. When splitting the PC board after mounting inductors and other components, care is required so as not to give any stresses of deflection or twisting to the board.



A product tends to undergo stress in order “A>C>B≡D”.
Please consider the layouts of a product to minimize any stresses.

3. Considerations for automatic placement	
Precautions	◆Adjustment of mounting machine 1. Excessive impact load should not be imposed on the products when mounting onto the PC boards. 2. Mounting and soldering conditions should be checked beforehand.
Technical considerations	◆Adjustment of mounting machine 1. When installing products, care should be taken not to apply distortion stress as it may deform the products. 2. Stress may be applied to a product with a warp or a twist in handling of the product. Please conduct validation completely before studying adoption of this product and please judge the pros and cons of adoption of this product with taking on responsibility. 

4. Soldering	
Precautions	◆Reflow soldering 1. Please contact any of our offices for a reflow soldering, and refer to the recommended condition specified. 2. The product shall be used reflow soldering only. 3. Please do not add any stress to a product until it returns in normal temperature after reflow soldering. ◆Lead free soldering 1. When using products with lead free soldering, we request to use them after confirming adhesion, temperature of resistance to soldering heat, soldering etc sufficiently.
Technical considerations	◆Reflow soldering 1. 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. Recommended reflow condition (Pb free solder) 

5. Cleaning	
Precautions	◆Cleaning conditions 1. Washing by supersonic waves shall be avoided.
Technical considerations	◆Cleaning conditions 1. If washed by supersonic waves, the products might be broken.

6. Handling	
Precautions	◆Handling 1. Keep the product away from all magnets and magnetic objects. ◆Breakaway PC boards (splitting along perforations) 1. When splitting the PC board after mounting product, care should be taken 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. ◆Mechanical considerations 1. Please do not give the product any excessive mechanical shocks. 2. Please do not add any shock and power to a product in transportation. ◆Pick-up pressure 1. Please do not push to add any pressure to a winding part. Please do not give any shock and push into a ferrite core exposure part. ◆Packing 1. Please avoid accumulation of a packing box as much as possible. ◆Board mounting 1. There shall be no pattern or via between terminals at the bottom of product. 2. Components which are located in peripheral of product shall not make contact with surface (top, side) of product.
Technical considerations	◆Handling 1. There is a case that a characteristic varies with magnetic influence. ◆Breakaway PC boards (splitting along perforations) 1. The position of the product on PCBs shall be carefully considered to minimize the stress caused from splitting of the PCBs. ◆Mechanical considerations 1. There is a case to be damaged by a mechanical shock. 2. There is a case to be broken by the handling in transportation. ◆Pick-up pressure 1. Damage and a characteristic can vary with an excessive shock or stress. ◆Packing 1. If packing boxes are accumulated, that could cause a deformation on packing tapes or a damage on the products. ◆Board mounting 1. If there is pattern or via between terminals at the bottom of product, it may cause characteristics change. 2. If components which are located in peripheral of product make contact with surface (top, side) of product, it may cause damage or characteristics change.

7. Storage conditions	
Precautions	◆Storage 1. To maintain the solderability of terminal electrodes and to keep the packing material in good condition, temperature and humidity in the storage area should be controlled. ・ Storage conditions Ambient temperature : －5～40℃ Humidity : Below 70% RH ・ The recommended ambient temperature is below 30℃. Even under ideal storage conditions, solderability of products electrodes may decrease as time passes. For this reason, product should be used within 6 months from the time of delivery. In case of storage over 6 months, solderability shall be checked before actual usage.
Technical considerations	◆Storage 1. Under 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.