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.

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.

Medical Application Guide

According to the medical devices classified as GHTF Classes A to C (Japan Classes Ⅰ to Ⅲ), we have the corresponding product series (the 2nd code from the left side of the part number is “M” or “L”) intended for use in the medical devices. Therefore, when using our products for the medical devices, please be sure to check the classification based on the GHTF Rules and use the corresponding product series.
On the other hand, we don’t have the product series intended for use in (i) all medical devices classified as GHTF Class D (Japan Class Ⅳ) and (ii) implantable medical devices (bone-anchored hearing aid, artificial retina system, and external unit which is connected to internal unit which is implanted in a body, etc.). Therefore, please do not incorporate our products into these medical devices. Should you have any questions on this matter, please contact us.

<table>
<tr><th colspan="2">Risk Level</th><th colspan="4">Low → High</th></tr>
<tr><td rowspan="3">Japan</td><td rowspan="3">Classification according to the PMD Act of Japan (based on the GHTF Rules)</td><td>Class Ⅰ
General
Medical Devices
(GHTF Class A)</td><td>Class Ⅱ
Controlled
Medical Devices
(GHTF Class B)</td><td>Class Ⅲ
Specially-controlled
Medical Devices
(GHTF Class C)</td><td>Class Ⅳ
Specially-controlled
Medical Devices
(GHTF Class D)</td></tr>
<tr><td>Medical devices with extremely low risk to the human body in case of problems</td><td>Medical devices with relatively low risk to the human body in case of problems</td><td>Medical devices with relatively high risk to the human body in case of problems</td><td>Medical devices highly invasive to patients and with life-threatening risk in case of problems</td></tr>
<tr><td>[Ex.]
・In Vitro Diagnostic Devices
・Nebulizer
・Blood Gas Analyzer
・Plethysmographs
・Breathing Sensor
・AC-powered Operating Table
・Surgical Light
・Cholesterol Analysis Device
・Blood Type Analysis Device, etc.</td><td>[Ex.]
・Electronic Thermometer
・Electronic Blood Pressure Gauge
・Electronic Endoscope
・Hearing Aid
・Electrocardiograph
・MRI
・Ultrasonic Diagnostic System
・Diagnostic Imaging Equipment
・X-ray Diagnostic Equipment
・Central Monitor
・Pulse Oximeter, etc.</td><td>[Ex.]
・Dialysis Machine
・Radiation Therapy Equipment
・Infusion Pump
・Respirator
・Glucose Monitoring System
・AED (Automated External Defibrillator)
・Skin Laser Scanner
・Electric Surgical Unit
・Insulin Pump, etc.</td><td>[Ex.]
・Cardiac Pacemaker
・Video Flexible Angioscope
・Implantable Infusion Pump
・Cardiac Electrosurgical Unit
・Inspection Device with Cardiac Catheter
・Defibrillator, etc.</td></tr>
</table>

<table>
<tr><td rowspan="2">U.S.A.</td><td rowspan="2">FDA Classification</td><td>Class Ⅰ
General Controls</td><td>Class Ⅱ
General Controls and
Special Controls</td><td>Class Ⅲ
General Controls and
Premarket Approval</td></tr>
<tr><td>Medical devices without the possibility of causing serious injury or harm to the patient or user even if there is a defect or malfunction in such medical devices</td><td>Medical devices with the possibility of causing injury or harm to the patient or user if there is a defect or malfunction in such medical devices</td><td>Medical devices with the possibility of causing serious injury, disability or death to the patient or user if a defect or malfunction occurs in such medical devices</td></tr>
</table>

<table>
<tr><td>Corresponding TAIYO YUDEN Product Series</td><td>Product Series for Medical Devices classified as GHTF Classes A or B (Japan Classes Ⅰ or Ⅱ)
(The 2nd Code from the Left Side of the Part Number: “L”)</td><td>Product Series for Medical Devices classified as GHTF Class C (Japan Class Ⅲ)
(The 2nd Code from the Left Side of the Part Number: “M”)
(See the Note below.)</td><td>N / A</td></tr>
</table>

* Note : It is prohibited that our products are used in some medical devices such as implantable medical devices even if such medical devices are classified as GHTF Class C (Japan Class Ⅲ).

Wire-wound Metal Power Inductors MCOIL™ LLEN series
for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

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

①Series

Code (1)(2)(3)(4)	
LLEN	Wire-wound Metal Power Inductor for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

(1) Product Group

Code	
L	Inductors

(3) Type

Code	
E	Metal Wire-wound (High filling type)

(2) Category

Code	Recommended equipment	Quality Grade
L	Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)	3

(4) Features, Characteristics

Code	
N	Standard Power choke

②Features

Code	Feature
C	Bottom electrode (Ag-resin×Sn-plate)

⑤Packaging

Code	Packaging
T	Taping

③Dimensions(L×W)

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

⑥Nominal inductance

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

※R=Decimal point

④Dimensions(T)

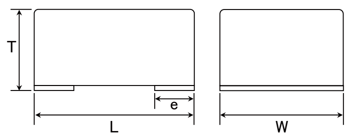
Code	Dimensions(T)[mm]
KK	1.0

⑦Inductance tolerance

Code	Inductance tolerance
M	±20%

⑧Internal code

■STANDARD EXTERNAL DIMENSIONS / STANDARD QUANTITY

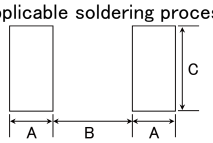


Recommended Land Patterns

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	0.7	0.8	1.8
2520	0.9	1.0	2.2

Unit:mm

Type	L	W	T	e	Standard quantity[pcs] Taping
2016KK	2.0±0.2 (0.079±0.008)	1.6±0.2 (0.063±0.008)	1.0 max (0.039 max)	0.5±0.3 (0.020±0.012)	3000
2520KK	2.5±0.2 (0.098±0.008)	2.0±0.2 (0.079±0.008)	1.0 max (0.039 max)	0.65±0.3 (0.026±0.012)	3000

Unit:mm(inch)

■PART NUMBER

●2016KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	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 current Idc2	
LLENC2016KKTR47M	MEKK2016TR47M	RoHS	0.47	±20%	−	0.030	4,500	4,300	1
LLENC2016KKTR68M	MEKK2016TR68M	RoHS	0.68	±20%	−	0.052	3,800	3,300	1
LLENC2016KKT1R0M	MEKK2016T1R0M	RoHS	1.0	±20%	−	0.060	3,600	3,100	1
LLENC2016KKT2R2M	MEKK2016T2R2M	RoHS	2.2	±20%	−	0.150	2,400	1,900	1

●2520KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	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 current Idc2	
LLENC2520KKTR33M	MEKK2520TR33M	RoHS	0.33	±20%	−	0.022	6,400	5,100	1
LLENC2520KKTR47M	MEKK2520TR47M	RoHS	0.47	±20%	−	0.025	5,900	4,800	1
LLENC2520KKT1R0M	MEKK2520T1R0M	RoHS	1.0	±20%	−	0.053	4,300	3,300	1
LLENC2520KKT1R5M	MEKK2520T1R5M	RoHS	1.5	±20%	−	0.069	3,200	2,800	1
LLENC2520KKT2R2M	MEKK2520T2R2M	RoHS	2.2	±20%	−	0.097	3,100	2,400	1
LLENC2520KKT4R7M	MEKK2520T4R7M	RoHS	4.7	±20%	−	0.240	1,600	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) 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 ㎜
Pattern dimensions：45×45 ㎜ (Double side board)
Pattern thickness：70μm

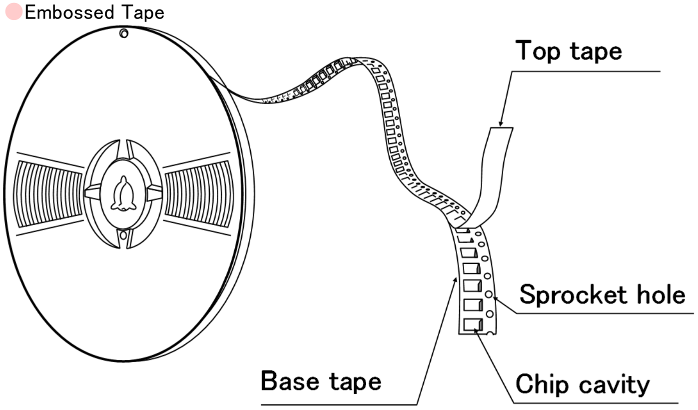
PACKAGING

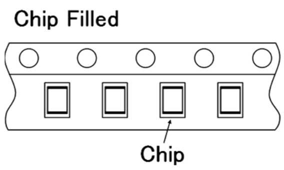
①Minimum Quantity

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

②Tape Material

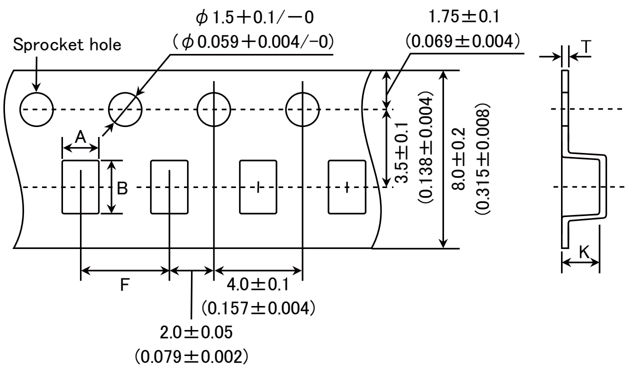
Embossed Tape





③Taping dimensions

Embossed tape 8mm wide (0.315 inches wide)

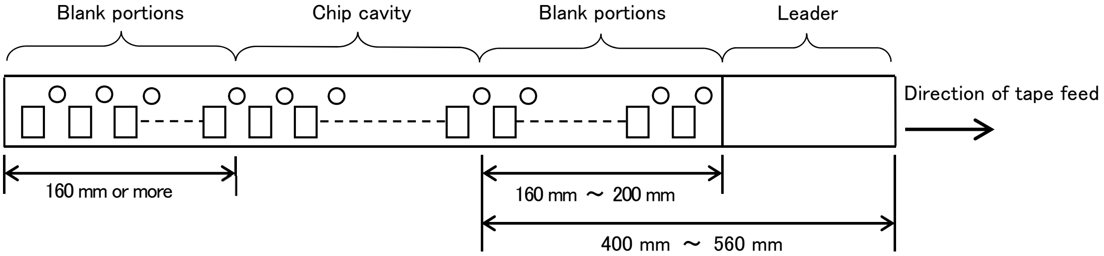


Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
2012HK	1.45±0.1 (0.057±0.004)	2.25±0.1 (0.089±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	0.9+0.15/−0.1 (0.035+0.006/−0.004)
2012KK	1.45±0.1 (0.057±0.004)	2.25±0.1 (0.089±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.1±0.1 (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)

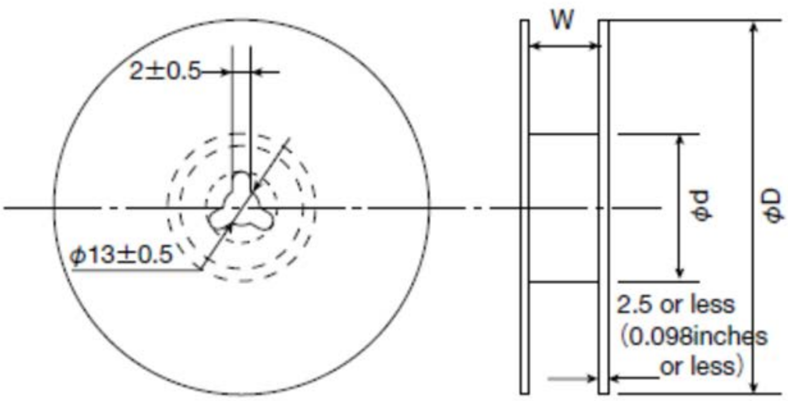
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
2520KK	2.4±0.1 (0.094±0.004)	2.9±0.1 (0.114±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.1±0.1 (0.043±0.004)
2520MK	2.4±0.1 (0.094±0.004)	2.9±0.1 (0.114±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002	1.4±0.1 (0.055±0.004)
3225HK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

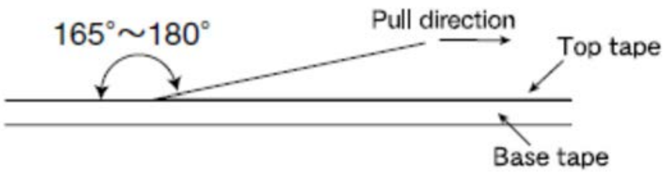


Type	Reel size (Reference values)		
	φD	φd	W
2012HK	180+0/−3 (7.087+0/−0.118)	60+1/−0 (2.36+0.039/0)	10.0±1.5 (0.394±0.059)
2012KK			
2016MK			
2016HK			
2016KK			
2520KK			
2520MK			
3225HK			

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.



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

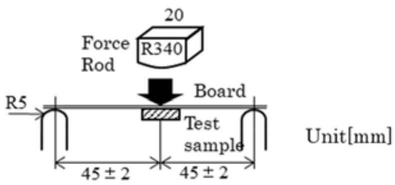
4. Inductance	
Specified Value	Within the specified tolerance
Test Methods and Remarks	Measuring equipment : LCR Meter（HP 4294A or equivalent） Measuring frequency : 1MHz、0.5V

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

6. Self resonance frequency	
Specified Value	－

7. 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.

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 : 100×40×1.0 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 over-coating	
Specified Value	－

11. Withstanding voltage : between wire and over-coating	
Specified Value	－

12. 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 : 10N to X and Y directions. Duration : 5s. Solder cream thickness : 0.10mm

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 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.

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±0.5 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℃ 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.

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 100 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

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

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: 500＋24/－0 hour Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

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: 500＋24/－0 hour Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

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: 500＋24/－0 hour Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

20. 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: 500＋24/－0 hour Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

21. Loading at high temperature life test

Specified Value	－

22. Standard condition

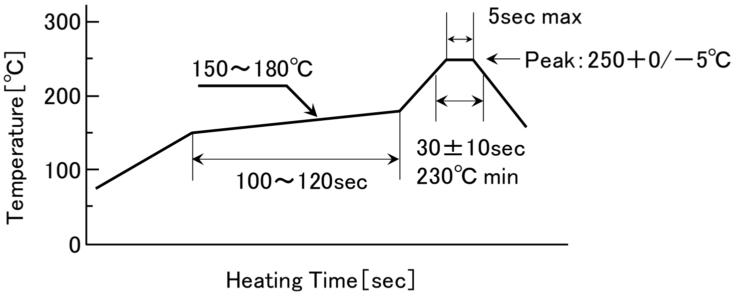
Specified Value	Standard test condition : Unless otherwise specified, temperature is 20±15℃ and 65±20%of relative humidity. When there is any question concerning measurement result: In order to provide correlation data, the test shall be condition of 20±2℃ of temperature, 65±5% relative humidity. Inductance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

Wire-wound Metal Power Inductors MCOIL™ LLEP series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

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 L E P	C	2 0 1 6	K K	T	1 R 0	M	
①	②	③	④	⑤	⑥	⑦	⑧

①Series

Code (1)(2)(3)(4)	
LLEP	Wire-wound Metal Power Inductor for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

(1) Product Group

Code	
L	Inductors

(2) Category

Code	Recommended equipment	Quality Grade
L	Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)	3

(3) Type

Code	
E	Metal Wire-wound (High filling type)

(4) Features, Characteristics

Code	
P	High current power choke

②Features

Code	Feature
C	Bottom electrode (Ag-resin×Sn-plate)

③Dimensions(L×W)

Code	Dimensions(L×W)[mm]
2012	2.0×1.2
2016	2.0×1.6
2520	2.5×2.0

④Dimensions(T)

Code	Dimensions(T)[mm]
HK	0.8
KK	1.0

⑤Packaging

Code	Packaging
T	Taping

⑥Nominal inductance

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

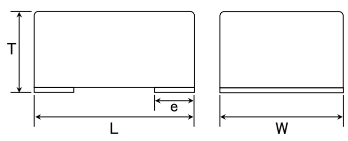
※R=Decimal point

⑦Inductance tolerance

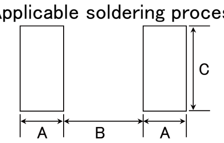
Code	Inductance tolerance
M	±20%

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
2012	0.7	0.8	1.4
2016	0.7	0.8	1.8
2520	0.9	1.0	2.2

Unit:mm

Type	L	W	T	e	Standard quantity[pcs] Taping
2012HK	2.0±0.2 (0.079±0.008)	1.2±0.2 (0.047±0.008)	0.8 max (0.031 max)	0.5±0.3 (0.020±0.012)	3000
2012KK	2.0±0.2 (0.079±0.008)	1.2±0.2 (0.047±0.008)	1.0 max (0.039 max)	0.5±0.3 (0.020±0.012)	3000
2016KK	2.0±0.2 (0.079±0.008)	1.6±0.2 (0.063±0.008)	1.0 max (0.039 max)	0.5±0.3 (0.020±0.012)	3000
2520KK	2.5±0.2 (0.098±0.008)	2.0±0.2 (0.079±0.008)	1.0 max (0.039 max)	0.65±0.3 (0.026±0.012)	3000

Unit:mm(inch)

■PART NUMBER

●2012HK type 【Thickness：0.8mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.) Saturation current Idc1	Rated current ※) [mA] (max.) Temperature rise current Idc2	Measuring frequency [MHz]
LLEPC2012HKTR47M	MEHK2012HR47M	RoHS	0.47	±20%	–	0.035	4,100	3,700	1

●2012KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.) Saturation current Idc1	Rated current ※) [mA] (max.) Temperature rise current Idc2	Measuring frequency [MHz]
LLEPC2012KKTR47M	MEKK2012HR47M	RoHS	0.47	±20%	–	0.030	4,500	4,200	1

●2016KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.) Saturation current Idc1	Rated current ※) [mA] (max.) Temperature rise current Idc2	Measuring frequency [MHz]
LLEPC2016KKTR47M	MEKK2016HR47M	RoHS	0.47	±20%	–	0.026	5,300	4,700	1
LLEPC2016KKT1R0M	MEKK2016H1R0M	RoHS	1.0	±20%	–	0.048	4,000	3,500	1
LLEPC2016KKT2R2M	MEKK2016H2R2M	RoHS	2.2	±20%	–	0.100	2,300	2,300	1

●2520KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.) Saturation current Idc1	Rated current ※) [mA] (max.) Temperature rise current Idc2	Measuring frequency [MHz]
LLEPC2520KKT1R0M	MEKK2520H1R0M	RoHS	1	±20%	–	0.039	4,400	3,800	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) 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 ㎜
Pattern dimensions：45×45 ㎜ (Double side board)
Pattern thickness：70μm

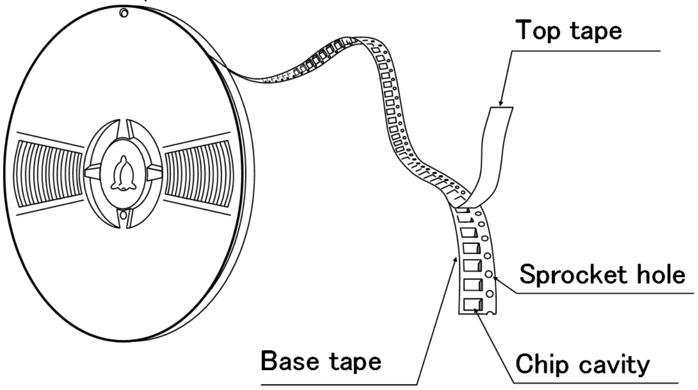
■PACKAGING

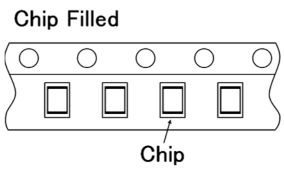
①Minimum Quantity

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

②Tape Material

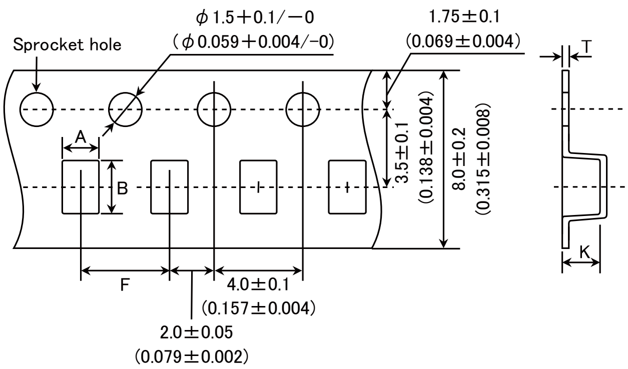
●Embossed Tape





③Taping dimensions

●Embossed tape 8mm wide (0.315 inches wide)

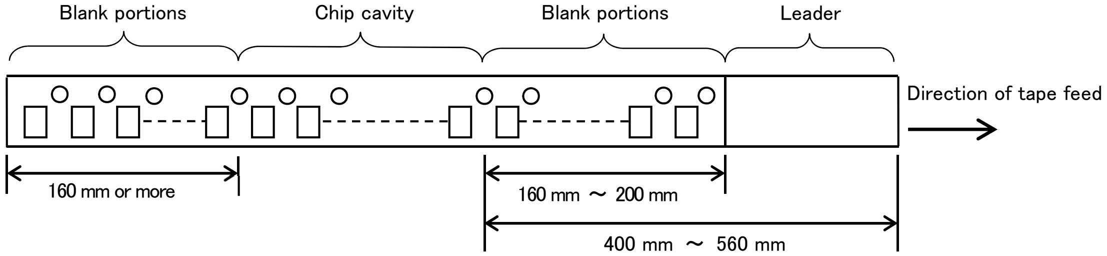


Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
2012HK	1.45±0.1 (0.057±0.004)	2.25±0.1 (0.089±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	0.9+0.15/−0.1 (0.035+0.006/−0.004)
2012KK	1.45±0.1 (0.057±0.004)	2.25±0.1 (0.089±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.1±0.1 (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)

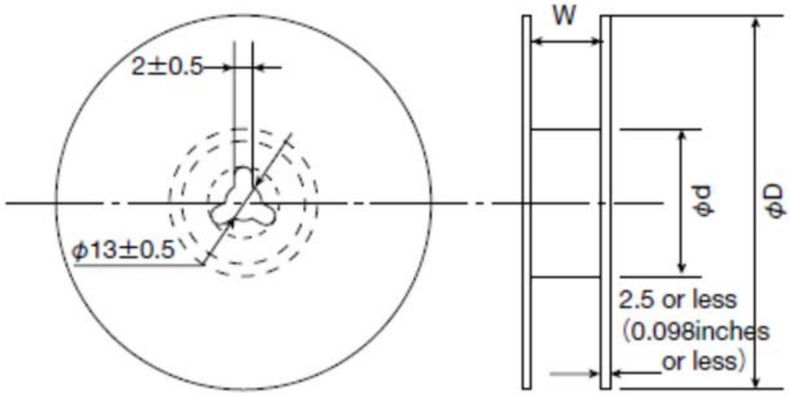
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
2520KK	2.4±0.1 (0.094±0.004)	2.9±0.1 (0.114±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.1±0.1 (0.043±0.004)
2520MK	2.4±0.1 (0.094±0.004)	2.9±0.1 (0.114±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002	1.4±0.1 (0.055±0.004)
3225HK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

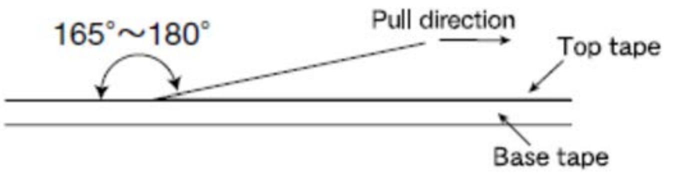


Type	Reel size (Reference values)		
	ϕD	ϕd	W
2012HK	180+0/−3 (7.087+0/−0.118)	60+1/−0 (2.36+0.039/0)	10.0±1.5 (0.394±0.059)
2012KK			
2016MK			
2016HK			
2016KK			
2520KK			
2520MK			
3225HK			

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™ LSEN series for General Electronic Equipment for Consumer
Wire-wound Metal Power Inductors MCOIL™ LSEP series for General Electronic Equipment for Consumer
Wire-wound Metal Power Inductors MCOIL™ LLEN series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)
Wire-wound Metal Power Inductors MCOIL™ LLEP series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

■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.

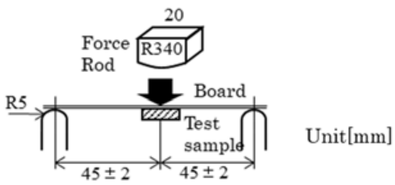
3. Rated current	
Specified Value	Within the specified tolerance

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. Self resonance frequency	
Specified Value	－

7. 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.

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 : 100×40×1.0 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 over-coating	
Specified Value	—

11. Withstanding voltage : between wire and over-coating	
Specified Value	—

12. 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 : 10N to X and Y directions. Duration : 5s. Solder cream thickness : 0.10mm

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 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.

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±0.5 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℃ 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.

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 100 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

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

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: 500＋24/－0 hour Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

Condition	Value
Temperature	60±2℃
Humidity	90～95%RH
Time	500＋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. Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

Condition	Value
Temperature	60±2℃
Humidity	90～95%RH
Applied current	Rated current
Time	500＋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. Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

Condition	Value
Temperature	－40±2℃
Time	500＋24/－0 hour

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

Condition	Value
Temperature	125±2℃
Time	500＋24/－0 hour

21. Loading at high temperature life test	
Specified Value	－

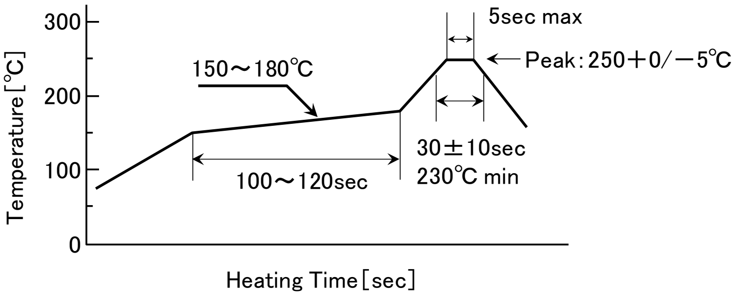
22. Standard condition	
Specified Value	Standard test condition : Unless otherwise specified, temperature is 20±15℃ and 65±20%of relative humidity. When there is any question concerning measurement result: In order to provide correlation data, the test shall be condition of 20±2℃ of temperature, 65±5%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

Wire-wound Metal Power Inductors MCOIL™ LLEU series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

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 L E U	C	2 0 1 6	K K	T	1 R 0	M	
①	②	③	④	⑤	⑥	⑦	⑧

①Series

Code (1)(2)(3)(4)	
LLEU	Wire-wound Metal Power Inductor for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

(1) Product Group

Code	
L	Inductors

(2) Category

Code	Recommended equipment	Quality Grade
L	Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)	3

(3) Type

Code	
E	Metal Wire-wound (High filling type)

(4) Features, Characteristics

Code	
U	High strength power choke

②Features

Code	Feature
C	Bottom electrode (Ag-resin×Sn-plate)

③Dimensions(L×W)

Code	Dimensions(L×W)[mm]
2012	2.0×1.25
2016	2.0×1.6
2520	2.5×2.0
3225	3.2×2.5

④Dimensions(T)

Code	Dimensions(T)[mm]
HK	0.8
KK	1.0

⑤Packaging

Code	Packaging
T	Taping

⑥Nominal inductance

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

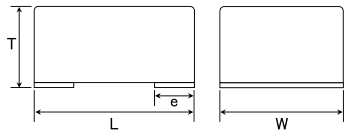
※R=Decimal point

⑦Inductance tolerance

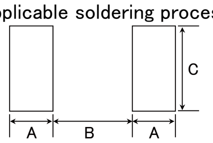
Code	Inductance tolerance
M	±20%

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
2012	0.8	0.6	1.4
2016	0.8	0.6	1.8
2520	1.0	0.8	2.2
3225	1.1	1.3	2.7

Unit：mm

Type	L	W	T	e	Standard quantity[pcs] Taping
2012HK	2.0±0.2 (0.079±0.008)	1.2±0.2 (0.047±0.008)	0.8 max (0.031 max)	0.6±0.3 (0.024±0.012)	3000
2012KK	2.0±0.2 (0.079±0.008)	1.2±0.2 (0.047±0.008)	1.0 max (0.039 max)	0.6±0.3 (0.024±0.012)	3000
2016HK	2.0±0.2 (0.079±0.008)	1.6±0.2 (0.063±0.008)	0.8 max (0.031 max)	0.6±0.3 (0.024±0.012)	3000
2016KK	2.0±0.2 (0.079±0.008)	1.6±0.2 (0.063±0.008)	1.0 max (0.039 max)	0.6±0.3 (0.024±0.012)	3000
2520KK	2.5±0.2 (0.098±0.008)	2.0±0.2 (0.079±0.008)	1.0 max (0.039 max)	0.8±0.3 (0.031±0.012)	3000
3225HK	3.2±0.2 (0.126±0.008)	2.5±0.2 (0.098±0.008)	0.8 max (0.031 max)	1.0±0.3 (0.039±0.012)	3000

Unit：mm(inch)

■PART NUMBER

●2012HK type 【Thickness：0.8mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.) Saturation current Idc1	Rated current ※) [mA] (max.) Temperature rise current Idc2	Measuring frequency [MHz]
LLEUC2012HKTR47M	MEHK2012UR47M	RoHS	0.47	±20%	−	0.033	4,500	3,800	1

●2012KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.) Saturation current Idc1	Rated current ※) [mA] (max.) Temperature rise current Idc2	Measuring frequency [MHz]
LLEUC2012KKTR33M	MEKK2012UR33M	RoHS	0.33	±20%	−	0.024	5,800	4,600	1
LLEUC2012KKTR47M	MEKK2012UR47M	RoHS	0.47	±20%	−	0.027	5,000	4,300	1

●2016HK type 【Thickness：0.8mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.) Saturation current Idc1	Rated current ※) [mA] (max.) Temperature rise current Idc2	Measuring frequency [MHz]
LLEUC2016HKTR47M	MEHK2016UR47M	RoHS	0.47	±20%	−	0.028	4,900	4,200	1
LLEUC2016HKT1R0M	MEHK2016U1R0M	RoHS	1.0	±20%	−	0.050	3,200	3,000	1

●2016KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.) Saturation current Idc1	Rated current ※) [mA] (max.) Temperature rise current Idc2	Measuring frequency [MHz]
LLEUC2016KKTR47M	MEKK2016UR47M	RoHS	0.47	±20%	−	0.026	6,300	4,700	1
LLEUC2016KKT1R0M	MEKK2016U1R0M	RoHS	1.0	±20%	−	0.048	4,100	3,500	1

●2520KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.) Saturation current Idc1	Rated current ※) [mA] (max.) Temperature rise current Idc2	Measuring frequency [MHz]
LLEUC2520KKT1R0M	MEKK2520U1R0M	RoHS	1.0	±20%	−	0.037	4,400	3,600	1
LLEUC2520KKT2R2M	MEKK2520U2R2M	RoHS	2.2	±20%	−	0.076	3,000	2,500	1
LLEUC2520KKT4R7M	MEKK2520U4R7M	RoHS	4.7	±20%	−	0.160	2,200	1,800	1
LLEUC2520KKT6R8M	MEKK2520U6R8M	RoHS	6.8	±20%	−	0.265	1,200	1,300	1
LLEUC2520KKT100M	MEKK2520U100M	RoHS	10	±20%	−	0.432	1,000	1,000	1

●3225HK type 【Thickness：0.8mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.) Saturation current Idc1	Rated current ※) [mA] (max.) Temperature rise current Idc2	Measuring frequency [MHz]
LLEUC3225HKT1R0M	MEHK3225U1R0M	RoHS	1.0	±20%	−	0.043	5,200	4,200	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) 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 ㎜
Pattern dimensions：45×45 ㎜ (Double side board)
Pattern thickness：70μm

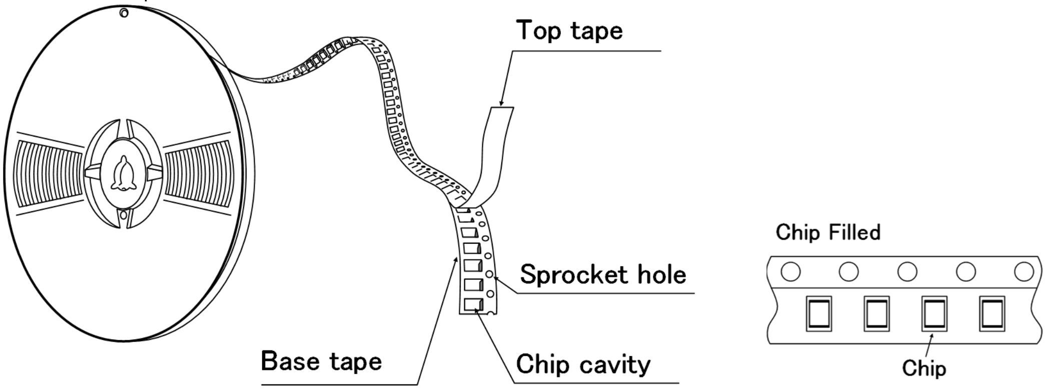
■PACKAGING

①Minimum Quantity

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

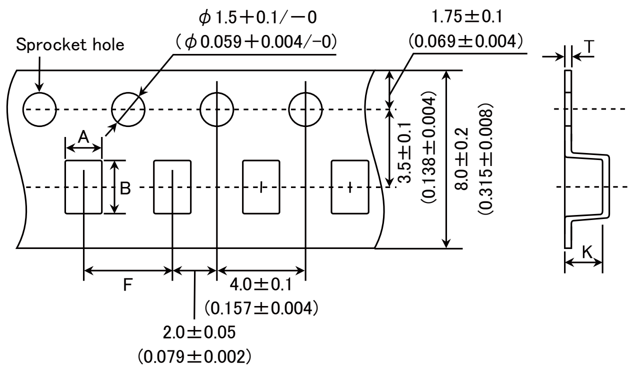
②Tape Material

●Embossed Tape



③Taping dimensions

●Embossed tape 8mm wide (0.315 inches wide)

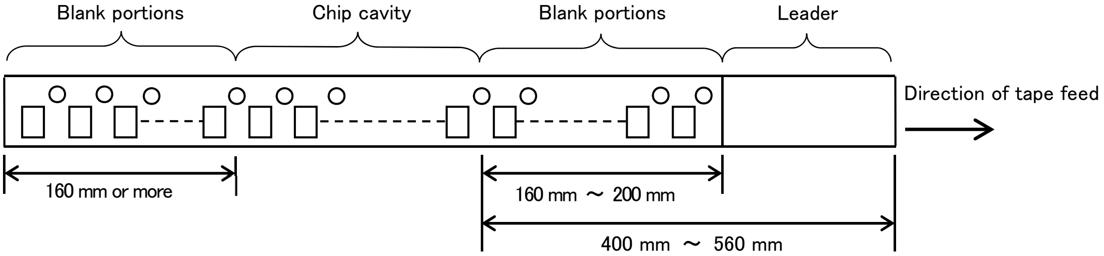


Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
2012HK	1.45±0.1 (0.057±0.004)	2.25±0.1 (0.089±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	0.9+0.15/−0.1 (0.035+0.006/−0.004)
2012KK	1.45±0.1 (0.057±0.004)	2.25±0.1 (0.089±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.1±0.1 (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)

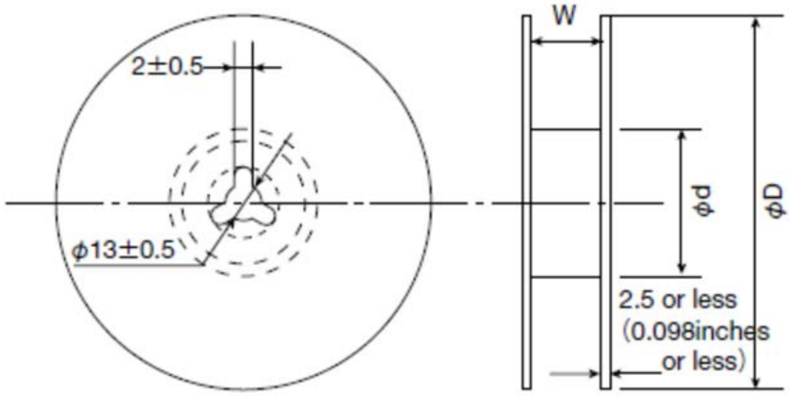
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
2520KK	2.4±0.1 (0.094±0.004)	2.9±0.1 (0.114±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.1±0.1 (0.043±0.004)
2520MK	2.4±0.1 (0.094±0.004)	2.9±0.1 (0.114±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002	1.4±0.1 (0.055±0.004)
3225HK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

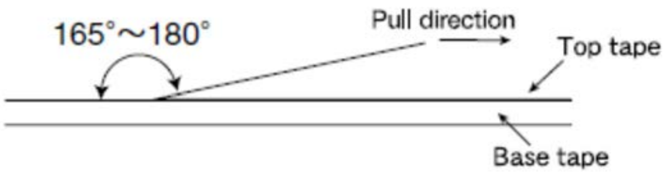


Type	Reel size (Reference values)		
	φD	φd	W
2012HK	180+0/−3 (7.087+0/−0.118)	60+1/−0 (2.36+0.039/0)	10.0±1.5 (0.394±0.059)
2012KK			
2016MK			
2016HK			
2016KK			
2520KK			
2520MK			
3225HK			

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™ LSEU series for General Electronic Equipment for Consumer
Wire-wound Metal Power Inductors MCOIL™ LLEU series
for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

■RELIABILITY DATA

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

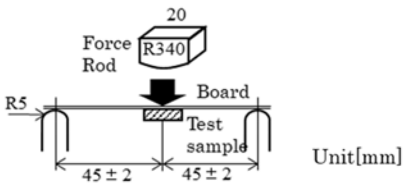
2. Storage Temperature Range	
Specified Value	−40～+85℃
Test Methods and Remarks	0 to 40℃ for the product with taping.

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 : 100×40×1.0 mm Test board material : Glass epoxy-resin Solder cream thickness : 0.10 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 : 10N Duration : 5s. 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. <table><tr><td>Frequency Range</td><td colspan="2">10～55Hz</td></tr><tr><td>Total Amplitude</td><td colspan="2">1.5mm (May not exceed acceleration 196m/s²)</td></tr><tr><td>Sweeping Method</td><td colspan="2">10Hz to 55Hz to 10Hz for 1min.</td></tr><tr><td rowspan="3">Time</td><td>X</td><td rowspan="3">For 2 hours on ach X, Y, and Z axis.</td></tr><tr><td>Y</td></tr><tr><td>Z</td></tr></table>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%. <table><tr><td>Solder Temperature</td><td>245±5℃</td></tr><tr><td>Time</td><td>5±0.5 sec.</td></tr></table>※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 100 cycles. <table><tr><td colspan="3">Conditions of 1 cycle</td></tr><tr><td>Step</td><td>Temperature (℃)</td><td>Duration (min)</td></tr><tr><td>1</td><td>－40±5</td><td>30±3</td></tr><tr><td>2</td><td>＋85±5</td><td>30±3</td></tr></table>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. <table><tr><td>Temperature</td><td>85±2℃</td></tr><tr><td>Humidity</td><td>85±5%RH</td></tr><tr><td>Time</td><td>500 hour</td></tr></table>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. <table><tr><td>Temperature</td><td>125±2℃</td></tr><tr><td>Time</td><td>500 hour</td></tr></table>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: 85±2℃ Applied current: Rated current Time: 500hour Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

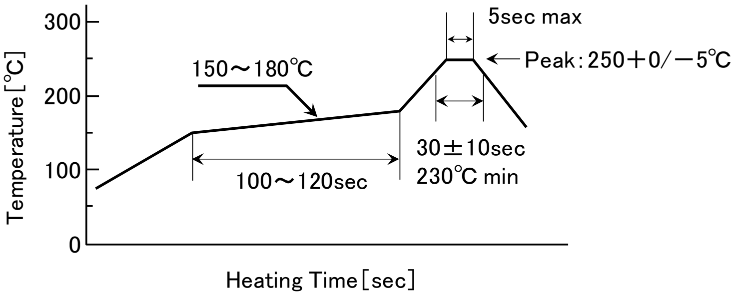
16. Standard condition	
Specified Value	Standard test condition : Unless otherwise specified, temperature is 20±15℃ and 65±20%of relative humidity. When there is any question concerning measurement result: In order to provide correlation data, the test shall be condition of 20±2℃ of temperature, 65±5%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

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™ LLCN series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

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

①Series

Code (1)(2)(3)(4)	
LLCN	Multilayer metal power inductor for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

(1) Product Group

Code	
L	Inductors

(2) Category

Code	Recommended equipment	Quality Grade
L	Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)	3

(3) Type

Code	
C	Metal Multilayer

(4) Features, Characteristics

Code	
N	Standard Power choke

②Features

Code	Feature
A	L-shape electrode
B	L-shape electrode with polarity marking
D	Bottom electrode with polarity marking
E	5-surface electrode

③Dimensions (L×W)

Code	Type (inch)	Dimensions (L×W) [mm]
1005	1005(0402)	1.0×0.5
1210	1210(0504)	1.25×1.05
1412	1412(0505)	1.4×1.2
1608	1608(0603)	1.6×0.8
2012	2012(0805)	2.0×1.25
2016	2016(0806)	2.0×1.6

④Thickness

Code	Thickness [mm]
EK	0.50 max
EE	0.55 max
FK	0.60 max
FE	0.65 max
HK	0.80 max
KK	1.0 max

⑤Packaging

Code	Packaging
T	Taping

⑥Nominal inductance

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

※R=Decimal point

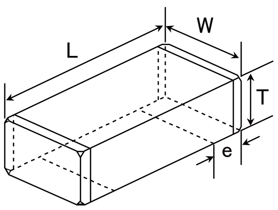
⑦Inductance tolerance

Code	Inductance tolerance
M	±20%

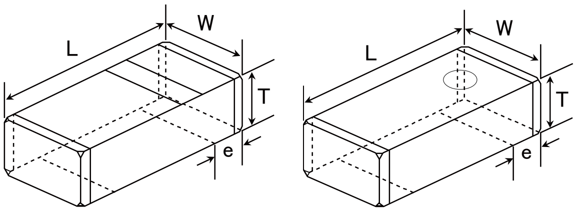
⑧Internal code

STANDARD EXTERNAL DIMENSIONS / STANDARD QUANTITY

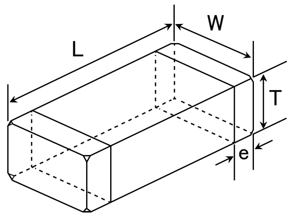
L-shape electrode



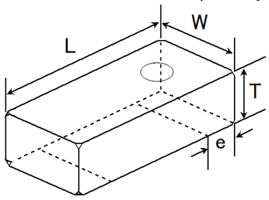
L-shape electrode with polarity marking



5-surface electrode



Bottom electrode with polarity marking



Type	L	W	T	e	Standard quantity[pcs]	
					Paper tape	Embossed tape
1005EE (0402)	1.0±0.2 (0.039±0.008)	0.5±0.2 (0.020±0.008)	0.55 max (0.022 max)	0.25±0.15 (0.010±0.006)	10000	—
1210EK (0504)	1.25±0.1 (0.049±0.004)	1.05±0.1 (0.041±0.004)	0.50 max (0.020 max)	0.30±0.2 (0.012±0.008)	5000	—
1412FE (0505)	1.4±0.2 (0.055±0.008)	1.2±0.2 (0.047±0.008)	0.65 max (0.026 max)	0.50±0.2 (0.02±0.008)	4000	—
1608FK (0603)	1.6±0.2 (0.063±0.008)	0.8±0.2 (0.031±0.008)	0.60 max (0.024 max)	0.3±0.2 (0.012±0.008)	4000	—
1608FE (0603)	1.6±0.2 (0.063±0.008)	0.8±0.2 (0.031±0.008)	0.65 max (0.026 max)	0.3±0.2 (0.012±0.008)	4000	—
1608HK (0603)	1.6±0.2 (0.063±0.008)	0.8±0.2 (0.031±0.008)	0.80 max (0.031 max)	0.4±0.2 (0.016±0.008)	4000	—
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
2012HK (0805)	2.0±0.2 (0.079±0.008)	1.25±0.2 (0.049±0.008)	0.80 max (0.031 max)	0.5±0.3 (0.02±0.012)	4000	—
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
2016FE (0806)	2.0±0.2 (0.079±0.008)	1.6±0.2 (0.063±0.008)	0.65 max (0.026 max)	0.5±0.3 (0.02±0.012)	4000	—

Unit:mm(inch)

■PART NUMBER

●1005 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.)				
LLCNB1005EETR10MB	MCEE1005TR10MHN	RoHS	0.10	±20%	50	41	2.0	2.0	1	0.55
LLCNB1005EETR22MB	MCEE1005TR22MHN	RoHS	0.22	±20%	80	65	1.6	1.6	1	0.55
LLCNB1005EETR47MB	MCEE1005TR47MHN	RoHS	0.47	±20%	140	114	1.2	1.2	1	0.55
LLCNB1005EET1R0MB	MCEE1005T1R0MHN	RoHS	1.0	±20%	300	244	1.0	0.8	1	0.55

●1210 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.)				
LLCNB1210EKTR47MB	MCEK1210TR47MHN	RoHS	0.47	±20%	82	70	2.3	1.6	1	0.50
LLCNB1210EKT1R0MB	MCEK1210T1R0MHN	RoHS	1.0	±20%	179	157	1.5	1.1	1	0.50
LLCNB1210EKT1R5MB	MCEK1210T1R5MHN	RoHS	1.5	±20%	240	200	1.2	0.9	1	0.50

●1412 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.)				
LLCND1412FETR33MC	MCFE1412TR33MJB	RoHS	0.33	±20%	32	29	5.0	3.7	1	0.65
LLCND1412FETR47MC	MCFE1412TR47MJB	RoHS	0.47	±20%	42	39	3.0	3.1	1	0.65

●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.)				
LLCNA1608FKTR24MA	MCFK1608TR24M	RoHS	0.24	±20%	50	40	2.3	2.1	1	0.60
LLCNA1608FKTR47MA	MCFK1608TR47M	RoHS	0.47	±20%	85	69	1.9	1.6	1	0.60
LLCNA1608FKT1R0MA	MCFK1608T1R0M	RoHS	1.0	±20%	224	182	1.5	0.9	1	0.60
LLCNE1608FETR24MA	MCFE1608TR24MG	RoHS	0.24	±20%	100	75	2.6	1.5	1	0.65
LLCNE1608FETR47MA	MCFE1608TR47MG	RoHS	0.47	±20%	150	114	2.0	1.2	1	0.65
LLCNE1608FET1R0MA	MCFE1608T1R0MG	RoHS	1.0	±20%	340	270	1.4	0.8	1	0.65
LLCNB1608HKTR24MD	MCHK1608TR24MKN	RoHS	0.24	±20%	24	20	4.3	3.7	1	0.80
LLCNB1608HKTR47MD	MCHK1608TR47MKN	RoHS	0.47	±20%	43	38	3.3	2.7	1	0.80
LLCNB1608HKTR56MD	MCHK1608TR56MKN	RoHS	0.56	±20%	55	45	2.7	2.6	1	0.80
LLCNB1608HKT1R0MD	MCHK1608T1R0MKN	RoHS	1.0	±20%	110	89	2.2	1.6	1	0.80
LLCNB1608HKT1R5MD	MCHK1608T1R5MKN	RoHS	1.5	±20%	200	160	1.7	1.3	1	0.80
LLCNB1608HKT2R2MD	MCHK1608T2R2MKN	RoHS	2.2	±20%	292	237	1.5	1.2	1	0.80
LLCNB1608KKTR24MA	MCKK1608TR24M N	RoHS	0.24	±20%	38	35	2.8	2.6	1	1.00
LLCNB1608KKTR47MA	MCKK1608TR47M N	RoHS	0.47	±20%	55	44	2.4	2.0	1	1.00
LLCNB1608KKT1R0MA	MCKK1608T1R0M N	RoHS	1.0	±20%	123	100	2.0	1.3	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.)				
LLCNA2012HKTR24MA	MCHK2012TR24M	RoHS	0.24	±20%	24	19	4.32	3.60	1	0.80
LLCNA2012HKTR47MA	MCHK2012TR47M	RoHS	0.47	±20%	36	30	3.21	3.15	1	0.80
LLCNA2012HKT1R0MA	MCHK2012T1R0M	RoHS	1.0	±20%	111	90	2.26	1.47	1	0.80
LLCNA2012KKTR24MA	MCKK2012TR24M	RoHS	0.24	±20%	25	20	6.2	4.0	1	1.00
LLCNA2012KKTR47MA	MCKK2012TR47M	RoHS	0.47	±20%	39	32	4.5	3.1	1	1.00
LLCNA2012KKT1R0MA	MCKK2012T1R0M	RoHS	1.0	±20%	90	73	3.6	2.1	1	1.00
LLCNE2012HKTR11MD	MCHK2012TR11MKG	RoHS	0.11	±20%	12	9.1	6.9	5.8	1	0.80
LLCNE2012HKTR24MD	MCHK2012TR24MKG	RoHS	0.24	±20%	17	14	6.0	4.8	1	0.80
LLCNE2012HKTR47MD	MCHK2012TR47MKG	RoHS	0.47	±20%	32	26	4.8	4.0	1	0.80
LLCND2012HKTR47MD	MCHK2012TR47MKB	RoHS	0.47	±20%	26	21	4.8	4.0	1	0.80

●2016 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.)				
LLCNE2016FETR47MCB	MCFE2016TR47MJG B	RoHS	0.47	±20%	45	40	4.0	3.2	1	0.65
LLCNE2016FETR68MCB	MCFE2016TR68MJG B	RoHS	0.68	±20%	60	50	3.0	2.5	1	0.65
LLCNE2016FET1R0MCB	MCFE2016T1R0MJG B	RoHS	1.0	±20%	70	60	2.8	2.3	1	0.65

※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℃)

■PACKAGING

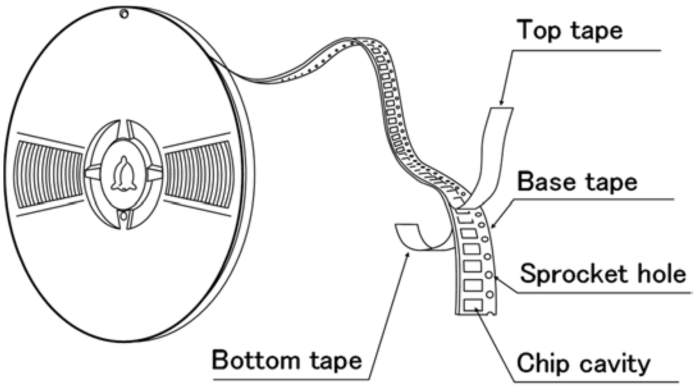
①Minimum Quantity

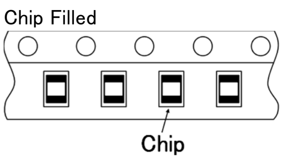
●Tape & Reel Packaging

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	—

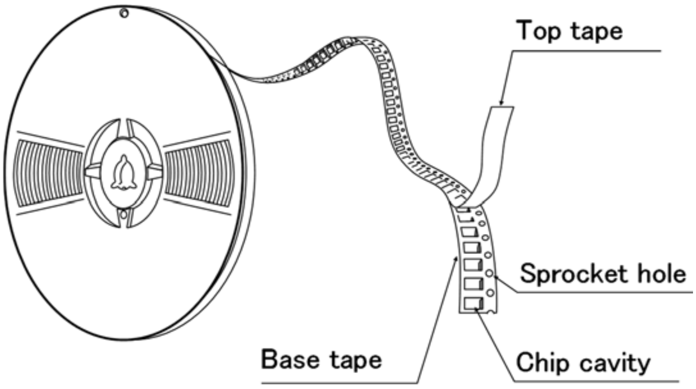
②Taping material

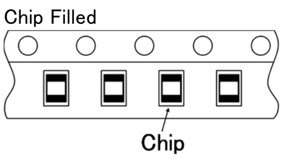
●Card board carrier tape 1005/1210/1412/1608/2012/2016 type





●Embossed Tape 1608/2012 type

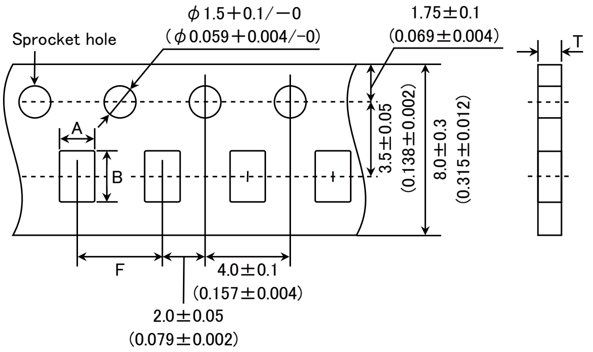




③Taping Dimensions

Paper tape (8mm wide)

Unit : mm (inch)

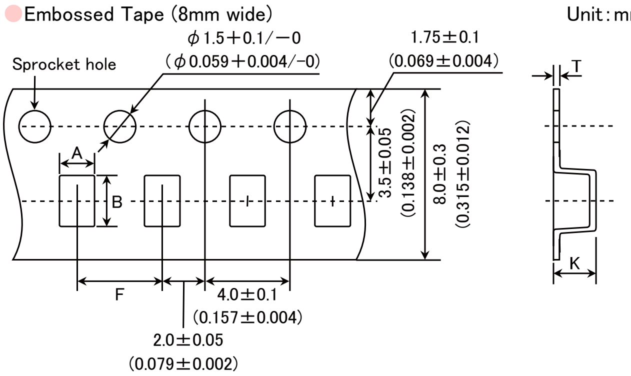


Type	Thickness		Chip cavity		Insertion Pitch	Tape Thickness
	Code	mm (inch)	A	B	F	T
1005 (0402)	EE	0.55 max (0.021 max)	0.8 (0.031)	1.3 (0.051)	2.0±0.05 (0.079±0.002)	0.64max (0.025max)
1210 (0504)	EK	0.5 max (0.020 max)	1.3 (0.051)	1.55 (0.061)	4.0±0.1 (0.157±0.004)	0.64max (0.025max)
1412 (0505)	FE	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)

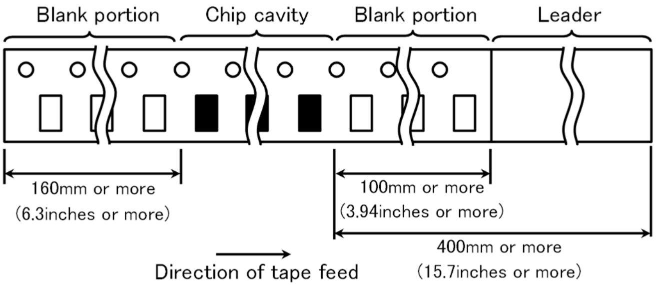
Unit : mm (inch)



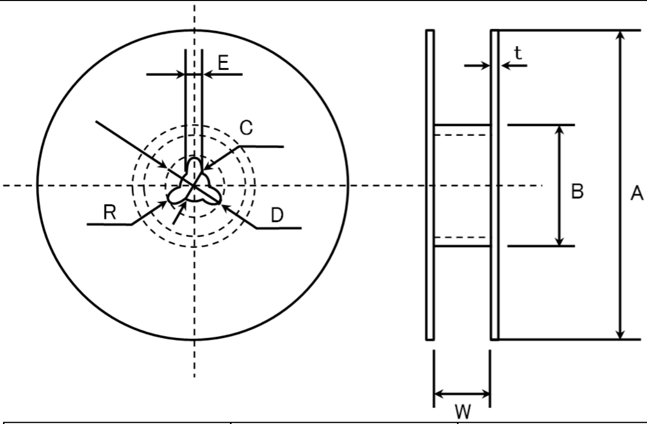
Type	Thickness		Chip cavity		Insertion Pitch	Tape Thickness	
	Code	mm (inch)	A	B	F	K	T
1608 (0603)	KK	1.0 max (0.039 max)	1.15 (0.045)	1.95 (0.077)	4.0±0.1 (0.157±0.004)	1.5 max (0.059 max)	0.3 max (0.012 max)
2012 (0805)	KK	1.0 max (0.039 max)	1.55 (0.061)	2.35 (0.093)	4.0±0.1 (0.157±0.004)	1.5 max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

Unit : mm (inch)

④LEADER AND BLANK PORTION



⑤Reel Size



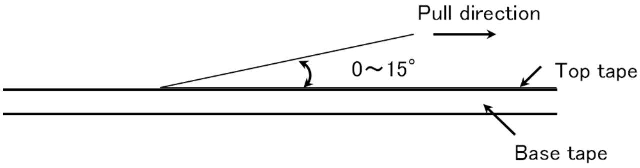
A	B	C	D	E	R
ϕ178±2.0	ϕ50 or more	ϕ13.0±0.2	ϕ21.0±0.8	2.0±0.5	1.0

	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™ LSCN series
for General Electronic Equipment for Consumer
Multilayer Metal Power Inductors MCOIL™ LLCN series
for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

■RELIABILITY DATA

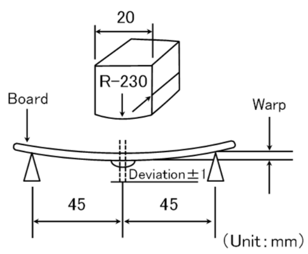
1. Operating Temperature Range	
Specified Value	−40～＋125℃(Including self-generated heat)

2. Storage Temperature Range	
Specified Value	−40～＋85℃

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: −40 +0/−3 °C, 30±3 min. Step 2: Room temperature, 2～3 min. Step 3: +85 +3/−0 °C, 30±3 min. Step 4: Room temperature, 2～3 min. Number of cycles: 100 Recovery: 2 to 3 hrs of recovery under the standard condition after the test.(See Note 1)

Conditions for 1 cycle

Step	temperature(℃)	time(min.)
1	−40 +0/−3	30±3
2	Room temperature	2～3
3	+85 +3/−0	30±3
4	Room temperature	2～3

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 : 500 +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 : 500 +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℃ Applied current : Idc2max Duration : 500 +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.
"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."

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■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

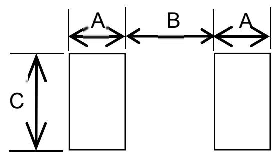
◆Pattern configurations(Design of Land-patterns)

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

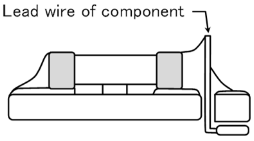
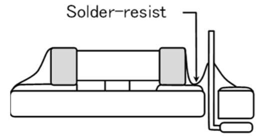
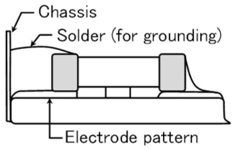
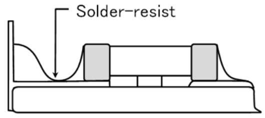
(Unit:mm)

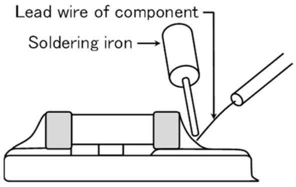
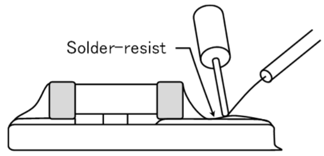
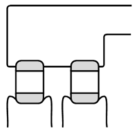
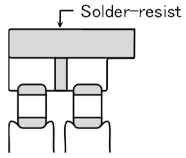
Type	1005	1210	1412	1608	2012	2016
A	0.4	0.45	0.55	0.45	0.5	0.7
B	0.5	0.6	0.4	1.0	1.2	0.8
C	0.7	1.15	1.3	1.0	1.45	1.8



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

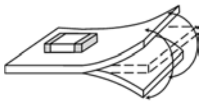
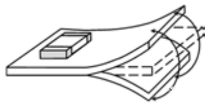
(2)Examples of good and bad solder application

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

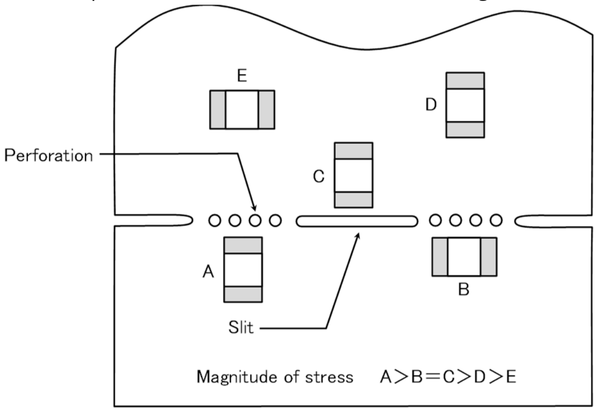
Hand-soldering of leaded components near mounted components		
Horizontal component placement		

◆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.

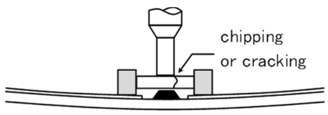
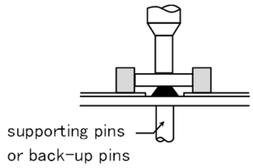
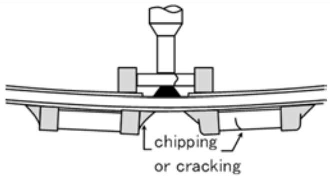
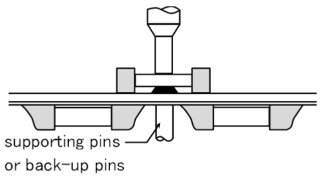
3. Considerations for automatic placement

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.

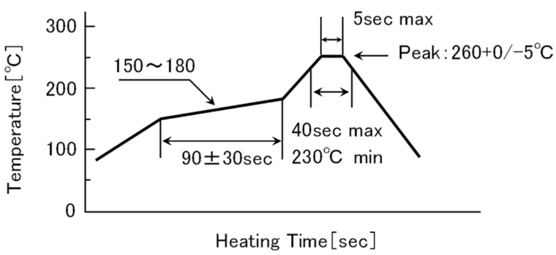
◆Lead free soldering
・ When using products with lead free soldering, we request to use them after confirming adhesion, temperature of resistance to soldering heat, soldering etc sufficiently.

◆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™ LLDN series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

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

①Series

Code (1)(2)(3)(4)	
LLDN	Wire-wound Metal Power Inductor for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

(1) Product Group

Code	
L	Inductors

(2) Category

Code	Recommended equipment	Quality Grade
L	Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)	3

(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]
1616	1.6×1.6
2020	2.0×2.0
3030	3.0×3.0
4040	4.0×4.0
5050	4.9×4.9

④Dimensions(H)

Code	Dimensions(H)[mm]
JE	0.95
KK	1.0
MK	1.2
PK	1.4
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

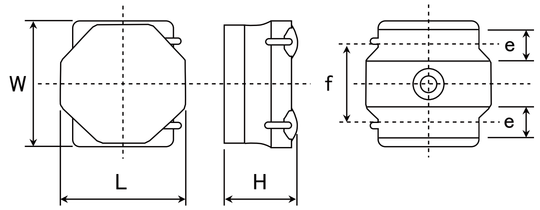
Code	Inductance tolerance
M	±20%
N	±30%

⑧Special code

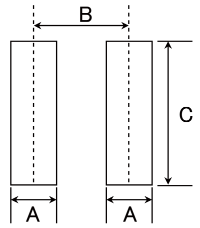
Code	Special code
F	Ferrite coating
M	Metal coating

⑨Internal code

STANDARD EXTERNAL DIMENSIONS / STANDARD QUANTITY



Recommended Land Patterns



Type	A	B	C
1616	0.5	1.10	1.65
2020	0.65	1.35	2.0
3030	0.8	2.2	2.7
4040	1.2	2.8	3.7
5050	1.5	3.6	4.2

Unit:mm

Type	L	W	H	e	f	Standard quantity [pcs]Taping
1616KK	1.64±0.1 (0.065±0.004)	1.64±0.1 (0.065±0.004)	1.0 max (0.039 max)	0.40 +0.2/−0.1 (0.016 +0.008/−0.004)	1.0±0.2 (0.039±0.008)	2500
2020JE	2.0±0.15 (0.079±0.006)	2.0±0.15 (0.079±0.006)	0.95 max (0.037 max)	0.50±0.2 (0.02±0.008)	1.25±0.2 (0.049±0.008)	2500
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
4040JE	4.0±0.2 (0.157±0.008)	4.0±0.2 (0.157±0.008)	0.95 max (0.037 max)	1.1±0.2 (0.043±0.008)	2.5±0.2 (0.098±0.008)	1000
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
5050PK	4.9±0.2 (0.193±0.008)	4.9±0.2 (0.193±0.008)	1.4 max (0.055 max)	1.20±0.2 (0.047±0.008)	3.3±0.2 (0.130±0.008)	1000

Unit:mm(inch)

PART NUMBER

1616KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω]		Rated current ※) [mA] Saturation current: Idc1		Rated current ※) [mA] Temperature rise current: Idc2		Measuring frequency [MHz]
					Max.	Typ.	Max.	Typ.	Max.	Typ.	
LLDND1616KKTR47MM	MDKK1616TR47MM	RoHS	0.47	±20%	0.095	0.080	3,300	4,100	1,500	1,780	1
LLDND1616KKT1R0MM	MDKK1616T1R0MM	RoHS	1.0	±20%	0.140	0.120	2,200	2,750	1,200	1,490	1
LLDND1616KKT1R5MM	MDKK1616T1R5MM	RoHS	1.5	±20%	0.185	0.160	1,750	2,200	1,100	1,330	1
LLDND1616KKT2R2MM	MDKK1616T2R2MM	RoHS	2.2	±20%	0.250	0.215	1,500	1,800	950	1,110	1
LLDND1616KKT3R3MM	MDKK1616T3R3MM	RoHS	3.3	±20%	0.515	0.450	1,150	1,450	650	730	1
LLDND1616KKT4R7MM	MDKK1616T4R7MM	RoHS	4.7	±20%	0.640	0.550	950	1,200	550	630	1
LLDND1616KKT6R8MM	MDKK1616T6R8MM	RoHS	6.8	±20%	0.820	0.710	630	880	520	600	1
LLDND1616KKT100MM	MDKK1616T100MM	RoHS	10	±20%	1.120	0.970	550	800	450	500	1
LLDND1616KKT150MM	MDKK1616T150MM	RoHS	15	±20%	1.800	1.600	460	640	400	440	1

2020JE type 【Thickness：0.95mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω]		Rated current ※) [mA] Saturation current: Idc1		Rated current ※) [mA] Temperature rise current: Idc2		Measuring frequency [MHz]
					Max.	Typ.	Max.	Typ.	Max.	Typ.	
LLDND2020JET1R0MM	MDJE2020T1R0MM	RoHS	1.0	±20%	0.121	0.106	3,100	3,800	1,550	1,800	1
LLDND2020JET2R2MM	MDJE2020T2R2MM	RoHS	2.2	±20%	0.266	0.230	1,550	1,900	1,050	1,200	1
LLDND2020JET3R3MM	MDJE2020T3R3MM	RoHS	3.3	±20%	0.340	0.290	1,350	1,600	950	1,100	1
LLDND2020JET4R7MM	MDJE2020T4R7MM	RoHS	4.7	±20%	0.475	0.410	1,200	1,550	850	950	1
LLDND2020JET6R8MM	MDJE2020T6R8MM	RoHS	6.8	±20%	0.630	0.550	800	1,100	750	850	1
LLDND2020JET100MM	MDJE2020T100MM	RoHS	10	±20%	1.040	0.910	700	900	550	600	1

2020KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω]		Rated current ※) [mA] Saturation current: Idc1		Rated current ※) [mA] Temperature rise current: Idc2		Measuring frequency [MHz]
					Max.	Typ.	Max.	Typ.	Max.	Typ.	
LLDND2020KKTR47MM	MDKK2020TR47MM	RoHS	0.47	±20%	0.046	0.040	3,500	4,150	2,200	2,500	1
LLDND2020KKTR68MM	MDKK2020TR68MM	RoHS	0.68	±20%	0.060	0.052	3,200	3,650	2,000	2,100	1
LLDND2020KKT1R0MM	MDKK2020T1R0MM	RoHS	1.0	±20%	0.085	0.074	2,900	3,400	1,700	1,900	1
LLDND2020KKT1R5MM	MDKK2020T1R5MM	RoHS	1.5	±20%	0.133	0.115	1,900	2,250	1,350	1,500	1
LLDND2020KKT2R2MM	MDKK2020T2R2MM	RoHS	2.2	±20%	0.165	0.139	1,650	1,950	1,200	1,350	1
LLDND2020KKT3R3MM	MDKK2020T3R3MM	RoHS	3.3	±20%	0.275	0.240	1,300	1,550	940	1,050	1
LLDND2020KKT4R7MM	MDKK2020T4R7MM	RoHS	4.7	±20%	0.435	0.375	1,050	1,250	750	850	1
LLDND2020KKT100MM	MDKK2020T100MM	RoHS	10	±20%	0.690	0.600	750	900	630	680	1
LLDND2020KKT150MM	MDKK2020T150MM	RoHS	15	±20%	1.180	1.020	550	750	480	550	1

2020MK type 【Thickness：1.2mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω]		Rated current ※) [mA] Saturation current: Idc1		Rated current ※) [mA] Temperature rise current: Idc2		Measuring frequency [MHz]
					Max.	Typ.	Max.	Typ.	Max.	Typ.	
LLDND2020MKTR47MM	MDMK2020TR47MM	RoHS	0.47	±20%	0.046	0.040	4,200	4,800	2,300	2,450	1
LLDND2020MKTR68MM	MDMK2020TR68MM	RoHS	0.68	±20%	0.058	0.050	3,500	4,100	2,000	2,200	1
LLDND2020MKT1R0MM	MDMK2020T1R0MM	RoHS	1.0	±20%	0.064	0.056	2,550	2,900	1,900	2,050	1
LLDND2020MKT1R5MM	MDMK2020T1R5MM	RoHS	1.5	±20%	0.086	0.075	2,000	2,300	1,650	1,750	1
LLDND2020MKT2R2MM	MDMK2020T2R2MM	RoHS	2.2	±20%	0.109	0.095	1,750	2,000	1,450	1,550	1
LLDND2020MKT3R3MM	MDMK2020T3R3MM	RoHS	3.3	±20%	0.178	0.155	1,350	1,550	1,150	1,200	1
LLDND2020MKT4R7MM	MDMK2020T4R7MM	RoHS	4.7	±20%	0.242	0.210	1,150	1,300	950	1,050	1

3030KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω]		Rated current ※) [mA] Saturation current: Idc1		Rated current ※) [mA] Temperature rise current: Idc2		Measuring frequency [MHz]
					Max.	Typ.	Max.	Typ.	Max.	Typ.	
LLDND3030KKTR47MM	MDKK3030TR47MM	RoHS	0.47	±20%	0.039	0.033	5,400	6,500	3,900	4,500	1
LLDND3030KKT1R0MM	MDKK3030T1R0MM	RoHS	1.0	±20%	0.086	0.074	4,400	5,200	2,400	2,800	1
LLDND3030KKT1R5MM	MDKK3030T1R5MM	RoHS	1.5	±20%	0.100	0.087	3,000	3,500	2,100	2,400	1
LLDND3030KKT2R2MM	MDKK3030T2R2MM	RoHS	2.2	±20%	0.144	0.125	2,500	3,000	1,900	2,200	1
LLDND3030KKT3R3MM	MDKK3030T3R3MM	RoHS	3.3	±20%	0.248	0.215	2,000	2,400	1,350	1,500	1
LLDND3030KKT4R7MM	MDKK3030T4R7MM	RoHS	4.7	±20%	0.345	0.300	1,700	2,000	1,150	1,300	1
LLDND3030KKT6R8MM	MDKK3030T6R8MM	RoHS	6.8	±20%	0.437	0.380	1,400	1,700	1,000	1,150	1
LLDND3030KKT100MM	MDKK3030T100MM	RoHS	10	±20%	0.575	0.500	1,100	1,300	850	1,000	1

3030MK type 【Thickness：1.2mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω]		Rated current ※) [mA] Saturation current: Idc1		Rated current ※) [mA] Temperature rise current: Idc2		Measuring frequency [MHz]
					Max.	Typ.	Max.	Typ.	Max.	Typ.	
LLDND3030MKTR30MM	MDMK3030TR30MM	RoHS	0.30	±20%	0.020	0.017	7,600	9,200	5,500	6,400	1
LLDND3030MKTR33MM	MDMK3030TR33MM	RoHS	0.33	±20%	0.020	0.017	6,400	8,700	5,500	6,400	1
LLDND3030MKTR47MM	MDMK3030TR47MM	RoHS	0.47	±20%	0.027	0.023	6,300	7,500	4,700	5,500	1
LLDND3030MKT1R0MM	MDMK3030T1R0MM	RoHS	1.0	±20%	0.050	0.043	4,300	5,100	3,300	3,900	1
LLDND3030MKT1R5MM	MDMK3030T1R5MM	RoHS	1.5	±20%	0.074	0.064	3,400	4,100	2,500	3,000	1
LLDND3030MKT2R2MM	MDMK3030T2R2MM	RoHS	2.2	±20%	0.112	0.097	2,800	3,600	2,100	2,400	1
LLDND3030MKT3R3MM	MDMK3030T3R3MM	RoHS	3.3	±20%	0.167	0.145	2,100	2,700	1,650	1,900	1
LLDND3030MKT4R7MM	MDMK3030T4R7MM	RoHS	4.7	±20%	0.263	0.228	1,800	2,300	1,350	1,550	1

■PART NUMBER

●4040JE type 【Thickness：0.95mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance[Ω]		Rated current ※) [mA] Saturation current: Idc1		Rated current ※) [mA] Temperature rise current: Idc2		Measuring frequency[MHz]
					Max.	Typ.	Max.	Typ.	Max.	Typ.	
LLDND4040JETR47MM	MDJE4040TR47MM	RoHS	0.47	±20%	0.040	0.035	6,000	7,900	4,000	4,500	1
LLDND4040JET1R0MM	MDJE4040T1R0MM	RoHS	1.0	±20%	0.069	0.060	4,700	5,700	3,000	3,500	1
LLDND4040JET1R5MM	MDJE4040T1R5MM	RoHS	1.5	±20%	0.084	0.073	3,000	4,000	2,700	3,100	1
LLDND4040JET2R2MM	MDJE4040T2R2MM	RoHS	2.2	±20%	0.115	0.100	2,400	3,100	2,400	2,700	1
LLDND4040JET3R3MM	MDJE4040T3R3MM	RoHS	3.3	±20%	0.200	0.175	2,000	2,600	1,800	2,000	1
LLDND4040JET4R7MM	MDJE4040T4R7MM	RoHS	4.7	±20%	0.250	0.220	1,900	2,300	1,600	1,900	1
LLDND4040JET6R8MM	MDJE4040T6R8MM	RoHS	6.8	±20%	0.370	0.320	1,500	1,800	1,300	1,500	1
LLDND4040JET100MM	MDJE4040T100MM	RoHS	10	±20%	0.510	0.440	1,400	1,700	1,100	1,300	1

●4040MK F type 【Thickness：1.2mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance[Ω]		Rated current ※) [mA] Saturation current: Idc1		Rated current ※) [mA] Temperature rise current: Idc2		Measuring frequency[kHz]
					Max.	Typ.	Max.	Typ.	Max.	Typ.	
LLDND4040MKTR47MF	MDMK4040TR47MF	RoHS	0.47	±20%	0.029	0.025	7,500	10,000	4,600	5,400	100
LLDND4040MKT1R0MF	MDMK4040T1R0MF	RoHS	1.0	±20%	0.047	0.041	5,200	7,500	3,500	4,200	100
LLDND4040MKT1R2MF	MDMK4040T1R2MF	RoHS	1.2	±20%	0.047	0.041	4,200	6,200	3,500	4,200	100
LLDND4040MKT1R5MF	MDMK4040T1R5MF	RoHS	1.5	±20%	0.065	0.056	3,700	5,400	3,300	3,600	100
LLDND4040MKT2R2MF	MDMK4040T2R2MF	RoHS	2.2	±20%	0.092	0.080	3,200	4,500	2,500	2,900	100

●4040MK type 【Thickness：1.2mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance[Ω]		Rated current ※) [mA] Saturation current: Idc1		Rated current ※) [mA] Temperature rise current: Idc2		Measuring frequency[MHz]
					Max.	Typ.	Max.	Typ.	Max.	Typ.	
LLDND4040MKTR68MM	MDMK4040TR68MM	RoHS	0.68	±20%	0.029	0.025	6,700	7,800	5,000	5,700	1
LLDND4040MKT1R0MM	MDMK4040T1R0MM	RoHS	1.0	±20%	0.036	0.031	5,000	6,200	4,500	5,100	1
LLDND4040MKT1R5MM	MDMK4040T1R5MM	RoHS	1.5	±20%	0.065	0.056	4,500	5,600	3,200	3,600	1
LLDND4040MKT2R2MM	MDMK4040T2R2MM	RoHS	2.2	±20%	0.079	0.069	3,800	4,500	2,800	3,200	1
LLDND4040MKT3R3MM	MDMK4040T3R3MM	RoHS	3.3	±20%	0.130	0.113	3,200	4,000	2,200	2,500	1
LLDND4040MKT4R7MM	MDMK4040T4R7MM	RoHS	4.7	±20%	0.160	0.140	2,500	3,000	1,900	2,200	1
LLDND4040MKT6R8MM	MDMK4040T6R8MM	RoHS	6.8	±20%	0.230	0.200	1,900	2,200	1,600	1,800	1
LLDND4040MKT100MM	MDMK4040T100MM	RoHS	10	±20%	0.330	0.280	1,700	2,000	1,400	1,600	1

●4040WK type 【Thickness：2.0mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance[Ω]		Rated current ※) [mA] Saturation current: Idc1		Rated current ※) [mA] Temperature rise current: Idc2		Measuring frequency[MHz]
					Max.	Typ.	Max.	Typ.	Max.	Typ.	
LLDND4040WKTR33NM	MDWK4040TR33NM	RoHS	0.33	±30%	0.013	0.011	16,000	21,000	7,800	8,800	1
LLDND4040WKTR47NM	MDWK4040TR47NM	RoHS	0.47	±30%	0.013	0.011	10,000	15,000	7,800	8,800	1
LLDND4040WKTR56NM	MDWK4040TR56NM	RoHS	0.56	±30%	0.016	0.014	9,000	13,000	6,500	7,500	1
LLDND4040WKTR68MM	MDWK4040TR68MM	RoHS	0.68	±20%	0.016	0.014	8,000	12,000	7,300	8,300	1
LLDND4040WKT1R0MM	MDWK4040T1R0MM	RoHS	1.0	±20%	0.027	0.023	7,000	9,400	5,100	5,800	1
LLDND4040WKT1R5MM	MDWK4040T1R5MM	RoHS	1.5	±20%	0.041	0.035	7,000	9,400	4,100	4,700	1
LLDND4040WKT2R2MM	MDWK4040T2R2MM	RoHS	2.2	±20%	0.054	0.047	5,400	7,500	3,500	4,000	1
LLDND4040WKT3R3MM	MDWK4040T3R3MM	RoHS	3.3	±20%	0.075	0.066	3,700	5,200	3,000	3,300	1
LLDND4040WKT4R7MM	MDWK4040T4R7MM	RoHS	4.7	±20%	0.107	0.093	3,500	5,000	2,500	2,800	1
LLDND4040WKT6R8MM	MDWK4040T6R8MM	RoHS	6.8	±20%	0.158	0.138	2,900	4,000	2,000	2,300	1
LLDND4040WKT100MM	MDWK4040T100MM	RoHS	10	±20%	0.194	0.169	2,200	3,100	1,600	1,900	1
LLDND4040WKT220MM	MDWK4040T220MM	RoHS	22	±20%	0.460	0.400	1,500	2,100	1,200	1,400	1
LLDND4040WKT330MM	MDWK4040T330MM	RoHS	33	±20%	0.720	0.625	1,200	1,700	800	1,000	1

●5050PK type 【Thickness：1.4mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance[Ω]		Rated current ※) [mA] Saturation current: Idc1		Rated current ※) [mA] Temperature rise current: Idc2		Measuring frequency[MHz]
					Max.	Typ.	Max.	Typ.	Max.	Typ.	
LLDND5050PKT1R0MM	MDPK5050T1R0MM	RoHS	1.0	±20%	0.040	0.034	8,500	10,000	4,300	4,700	1
LLDND5050PKT2R2MM	MDPK5050T2R2MM	RoHS	2.2	±20%	0.055	0.047	4,100	5,000	3,600	4,200	1
LLDND5050PKT3R3MM	MDPK5050T3R3MM	RoHS	3.3	±20%	0.086	0.073	3,800	4,500	2,900	3,400	1
LLDND5050PKT4R7MM	MDPK5050T4R7MM	RoHS	4.7	±20%	0.102	0.088	3,500	4,200	2,500	3,000	1
LLDND5050PKT6R8MM	MDPK5050T6R8MM	RoHS	6.8	±20%	0.138	0.12	2,700	3,200	2,200	2,500	1
LLDND5050PKT100MM	MDPK5050T100MM	RoHS	10	±20%	0.225	0.19	2,200	2,600	1,700	2,000	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) 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.

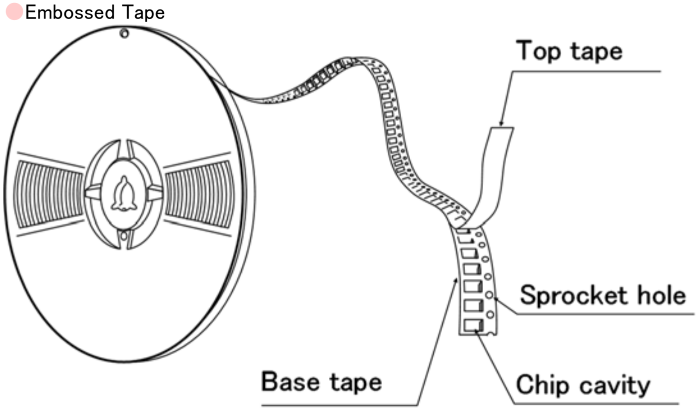
■PACKAGING

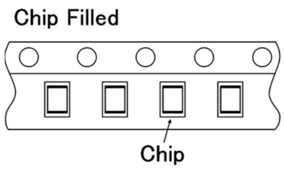
①Minimum Quantity

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

②Tape Material

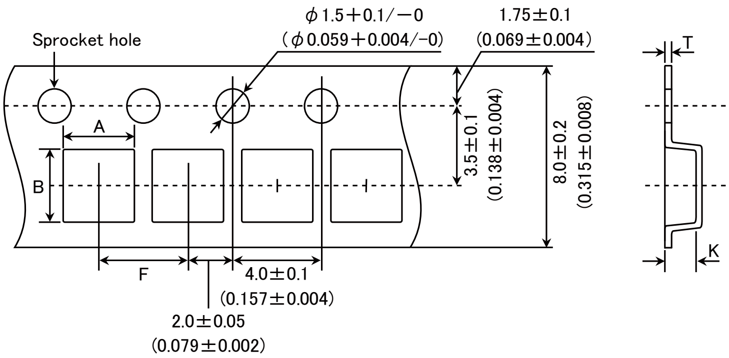
Embossed Tape

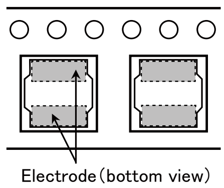




③Taping dimensions

Embossed tape 8mm wide (0.315 inches wide)

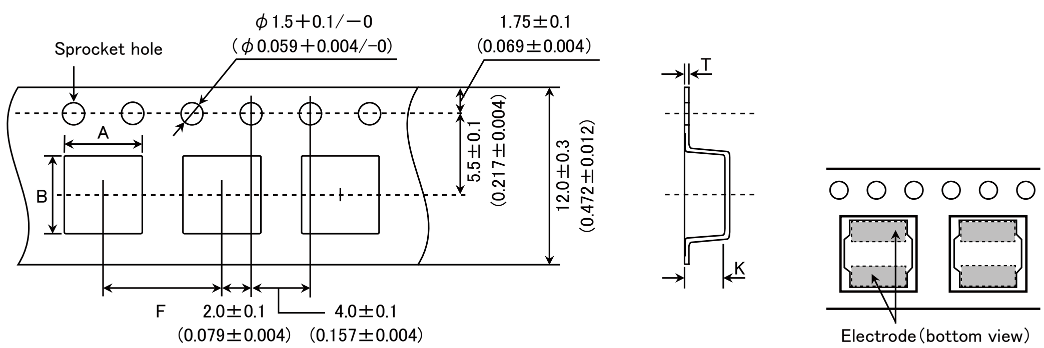




Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
1616KK	1.79±0.1 (0.071±0.004)	1.79±0.1 (0.071±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.010±0.002)	1.1±0.1 (0.043±0.004)
2020JE 2020KK 2020MK	2.2±0.1 (0.102±0.004)	2.2±0.1 (0.102±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.3±0.1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

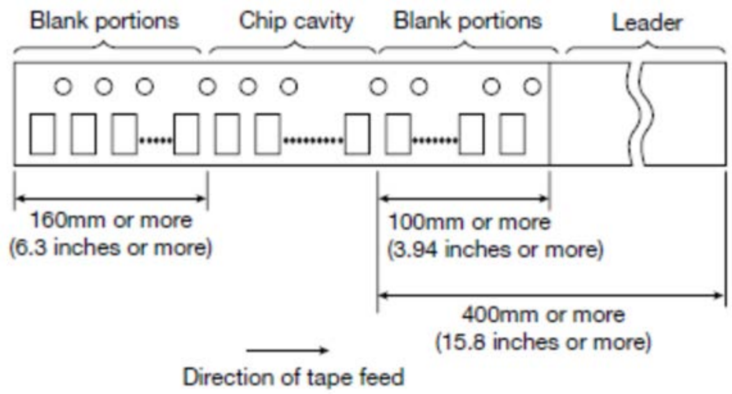
●Embossed tape 12mm wide (0.47 inches wide)



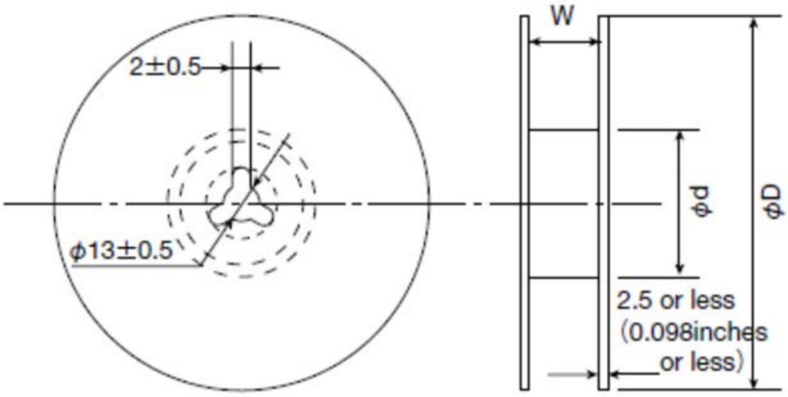
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
4040JE 4040MK	4.3±0.1 (0.169±0.004)	4.3±0.1 (0.169±0.004)	8.0±0.1 (0.315±0.004)	0.3±0.05 (0.012±0.002)	1.6±0.1 (0.063±0.004)
4040WK	4.3±0.1 (0.169±0.004)	4.3±0.1 (0.169±0.004)	8.0±0.1 (0.315±0.004)	0.3±0.05 (0.012±0.002)	2.3±0.1 (0.091±0.004)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



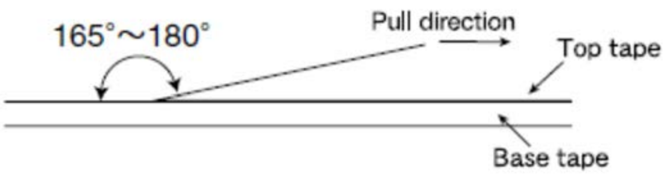
Type	Reel size (Reference values)		
	ϕD	ϕd	W
1616KK 2020JE 2020KK 2020MK 3030KK 3030MK	180±0.5 (7.087±0.019)	60±1.0 (2.36±0.04)	10.0±1.5 (0.394±0.059)
4040JE 4040MK 4040WK 5050PK	180±3.0 (7.087±0.118)	60±2.0 (2.36±0.08)	14.0±1.5 (0.551±0.059)

Unit：mm(inch)

⑥Top Tape Strength

Top tape strength

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



Wire-wound Metal Power Inductors MCOIL™ LSDN series
for General Electronic Equipment for Consumer
Wire-wound Metal Power Inductors MCOIL™ LLDN series
for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

■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	−5 to 40℃ for the product with taping.

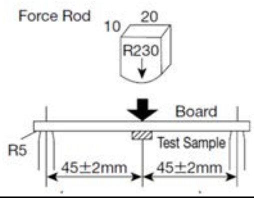
3. Rated current	
Specified Value	Within the specified tolerance

4. Inductance	
Specified Value	Within the specified tolerance
Test Methods and Remarks	Measuring equipment : LCR Meter (HP 4285A or equivalent) Measuring condition : Please see item list.

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 : 100×40×1.0 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 : 0.10mm.

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

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	

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 100 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: 500+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: 500＋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: 500＋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: 500＋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

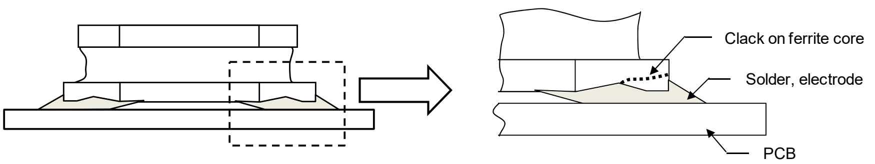
1. Please refer to a recommended land pattern.
2. There is stress, which has been caused by distortion of a PCB, to the inductor.
3. Please consider the arrangement of parts on a PCB.

Technical considerations

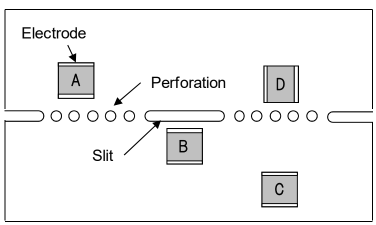
◆Land pattern design

Surface Mounting

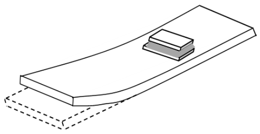
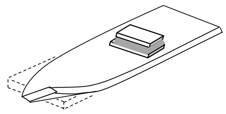
1. Mounting and soldering conditions should be checked beforehand.
2. Applicable soldering process to this products is reflow soldering only.
3. Please use the recommended land pattern shown as below. Electrical characteristics and the mounting ability of the product are being considered in the recommended 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.

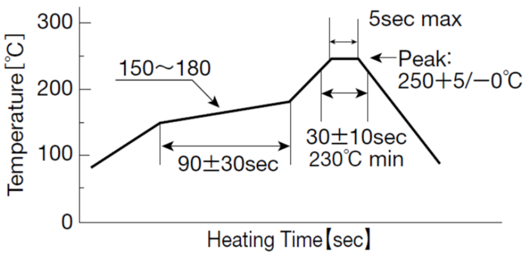


5. SMD inductors should be located to minimize any possible mechanical stresses from board warp or deflection. When splitting the PC board after mounting inductors and other components, care is required so as not to give any stresses of deflection or twisting to the board.



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. <Wrap>  <Twist> 

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.

Wire-wound Metal Power Inductors MCOIL™ LLAN series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

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～+105℃(Including self-generated heat)

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

①Series

Code (1)(2)(3)(4)	
LLAN	Wire-wound Metal Power Inductor for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

(1) Product Group

Code	
L	Inductors

(2) Category

Code	Recommended equipment	Quality Grade
L	Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)	3

(3) Type

Code	
A	Metal Wire-wound

(4) Features, Characteristics

Code	
N	Standard Power choke

②Features

Code	Feature
B	L-shape electrode (Ag-resin×Sn-plate)

③Dimensions(L×W)

Code	Type(inch)	Dimensions (L×W)[mm]
2016	2016(0806)	2.0×1.6
2520	2520(1008)	2.5×2.0

④Dimensions(T)

Code	Dimensions(T)[mm]
KK	1.0
MK	1.2

⑤Packaging

Code	Packaging
T	Taping

⑥Nominal inductance

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

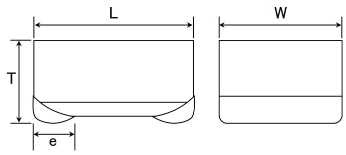
※R=Decimal point

⑦Inductance tolerance

Code	Inductance tolerance
M	±20%

⑧Internal code

■STANDARD EXTERNAL DIMENSIONS / STANDARD QUANTITY

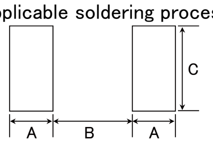


Recommended Land Patterns

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	0.7	0.8	1.8
2520	0.8	1.2	2.0

Unit:mm

Type	L	W	T	e	Standard quantity[pcs] Taping
2016KK	2.0±0.1 (0.079±0.004)	1.6±0.1 (0.063±0.004)	1.0 max (0.039 max)	0.5±0.3 (0.020±0.012)	3000
2520KK	2.5±0.2 (0.098±0.008)	2.0±0.2 (0.079±0.008)	1.0 max (0.039 max)	0.5±0.3 (0.020±0.012)	3000
2520MK	2.5±0.2 (0.098±0.008)	2.0±0.2 (0.079±0.008)	1.2 max (0.047 max)	0.5±0.3 (0.020±0.012)	3000

Unit:mm(inch)

■PART NUMBER

●2016KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	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 current Idc2	
LLANB2016KKTR24M	MAKK2016TR24M	RoHS	0.24	±20%	－	0.037	4,200	3,000	2
LLANB2016KKTR33M	MAKK2016TR33M	RoHS	0.33	±20%	－	0.040	3,600	3,200	2
LLANB2016KKTR47M	MAKK2016TR47M	RoHS	0.47	±20%	－	0.460	3,200	2,800	2
LLANB2016KKTR68M	MAKK2016TR68M	RoHS	0.68	±20%	－	0.065	2,500	2,500	2
LLANB2016KKT1R0M	MAKK2016T1R0M	RoHS	1.0	±20%	－	0.075	2,200	2,200	2
LLANB2016KKT1R5M	MAKK2016T1R5M	RoHS	1.5	±20%	－	0.130	1,600	1,650	2
LLANB2016KKT2R2M	MAKK2016T2R2M	RoHS	2.2	±20%	－	0.160	1,500	1,500	2
LLANB2016KKT3R3M	MAKK2016T3R3M	RoHS	3.3	±20%	－	0.255	1,150	1,200	2
LLANB2016KKT4R7M	MAKK2016T4R7M	RoHS	4.7	±20%	－	0.380	1,000	950	2

●2520KK type 【Thickness：1.0mm max.】

New part number	Old part number (for reference)	EHS	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 current Idc2	
LLANB2520KKTR33M	MAKK2520TR33M	RoHS	0.33	±20%	－	0.038	4,700	3,500	2
LLANB2520KKTR47M	MAKK2520TR47M	RoHS	0.47	±20%	－	0.046	3,900	3,200	2
LLANB2520KKTR68M	MAKK2520TR68M	RoHS	0.68	±20%	－	0.059	3,700	2,900	2
LLANB2520KKT1R0M	MAKK2520T1R0M	RoHS	1.0	±20%	－	0.072	2,700	2,500	2
LLANB2520KKT1R5M	MAKK2520T1R5M	RoHS	1.5	±20%	－	0.125	2,300	1,800	2
LLANB2520KKT2R2M	MAKK2520T2R2M	RoHS	2.2	±20%	－	0.156	1,900	1,500	2
LLANB2520KKT3R3M	MAKK2520T3R3M	RoHS	3.3	±20%	－	0.200	1,550	1,300	2
LLANB2520KKT4R7M	MAKK2520T4R7M	RoHS	4.7	±20%	－	0.300	1,300	1,100	2

●2520MK type 【Thickness：1.2mm max.】

New part number	Old part number (for reference)	EHS	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 current Idc2	
LLANB2520MKTR47M	MAMK2520TR47M	RoHS	0.47	±20%	－	0.039	4,200	3,400	2
LLANB2520MKTR68M	MAMK2520TR68M	RoHS	0.68	±20%	－	0.048	3,200	3,200	2
LLANB2520MKT1R0M	MAMK2520T1R0M	RoHS	1.0	±20%	－	0.059	3,100	2,700	2
LLANB2520MKT2R2M	MAMK2520T2R2M	RoHS	2.2	±20%	－	0.110	2,000	1,900	2
LLANB2520MKT3R3M	MAMK2520T3R3M	RoHS	3.3	±20%	－	0.156	1,800	1,700	2
LLANB2520MKT4R7M	MAMK2520T4R7M	RoHS	4.7	±20%	－	0.260	1,500	1,300	2

※) The saturation current value (Idc1) is the DC current value having inductance decrease down to 30%. (at 20℃)
※) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40℃. (at 20℃)
※) The rated current value is following either Idc1 or Idc2, which is the lower one.

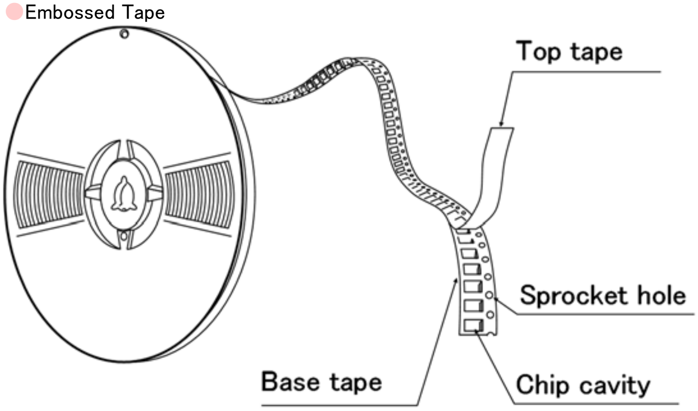
■PACKAGING

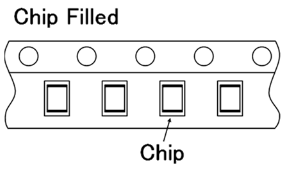
①Minimum Quantity

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

②Tape Material

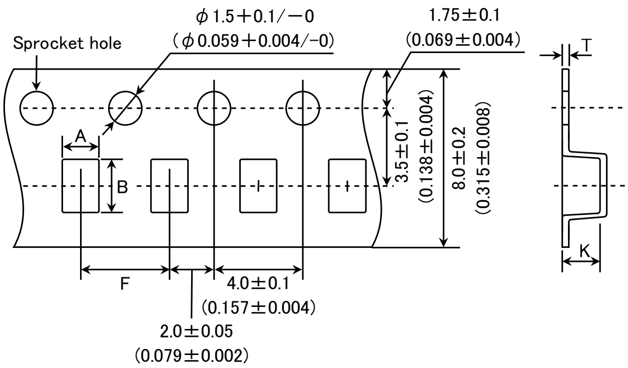
●Embossed Tape

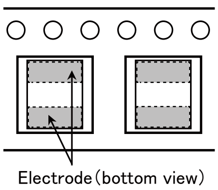




③Taping dimensions

●Embossed tape 8mm wide (0.315 inches wide)

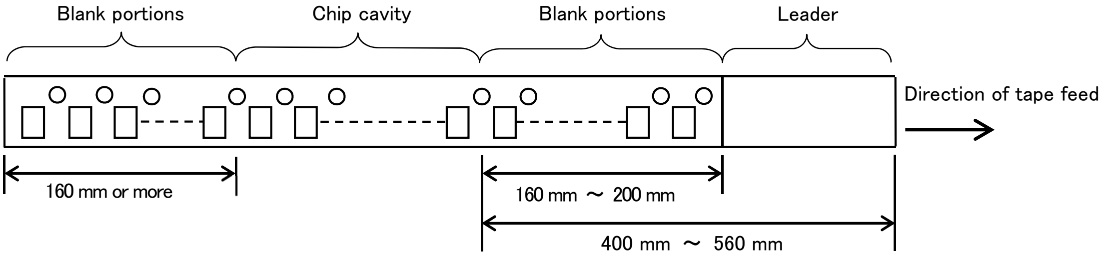




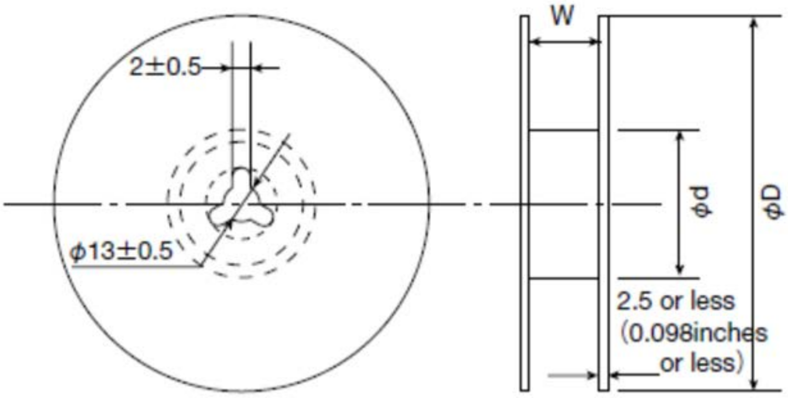
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
2016KK	1.9±0.1 (0.075±0.004)	2.3±0.1 (0.091±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.2 max (0.047 max)
2520KK	2.3±0.1 (0.091±0.004)	2.8±0.1 (0.110±0.004)	4.0±0.1 (0.157±0.004)	0.3±0.05 (0.012±0.002)	1.25 max (0.049 max)
2520MK	2.3±0.1 (0.091±0.004)	2.8±0.1 (0.110±0.004)	4.0±0.1 (0.157±0.004)	0.3±0.05 (0.012±0.002)	1.4 max (0.055 max)

Unit : mm (inch)

④Leader and Blank portion



⑤Reel size

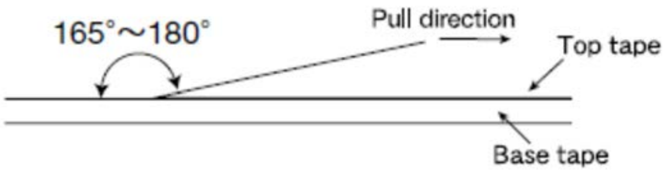


Type	Reel size (Reference values)		
	φD	φd	W
2016KK	180+0/−3 (7.087+0/−0.118)	60+1/−0 (2.36+0.039/0)	10.0±1.5 (0.394±0.059)
2520KK			
2520MK			

Unit : mm (inch)

⑥Top Tape Strength

The top The top tape requires a peel-off force of 0.1 to 1.2N in the direction of the arrow as illustrated below.



Wire-wound Metal Power Inductors MCOIL™ LSAN series for General Electronic Equipment for Consumer
Wire-wound Metal Power Inductors MCOIL™ LSAP series for General Electronic Equipment for Consumer
Wire-wound Metal Power Inductors MCOIL™ LLAN series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)
Wire-wound Metal Power Inductors MCOIL™ LLAP series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

■RELIABILITY DATA

1. Operating Temperature Range	
Specified Value	－40～＋105℃：LSAN/LLAN －40～＋125℃：LSAP/LLAP
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.

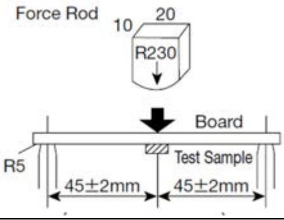
3. Rated current	
Specified Value	Within the specified tolerance

4. Inductance	
Specified Value	Within the specified tolerance
Test Methods and Remarks	Measuring equipment : LCR Meter（HP 4285A or equivalent） Measuring frequency : 2MHz、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 ±15%
Test Methods and Remarks	Measurement of inductance shall be taken at temperature range within －40℃～＋85℃. 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 : 100×40×1.0 mm Test board material : Glass epoxy-resin Solder cream thickness : 0.12 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	No abnormality.
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 : 0.12mm.

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±0.5 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℃ for 40 seconds, with peak temperature at 260+0/−5℃ for 5 seconds, 3 times. Test board material : Glass epoxy-resin Test board thickness : 1.0mm Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

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 100 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

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

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: 500＋24/－0 hour Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

Temperature	60±2℃
Humidity	90～95%RH
Time	500＋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. Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

Temperature	60±2℃
Humidity	90～95%RH
Applied current	Rated current
Time	500＋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. Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

Temperature	－40±2℃
Time	500＋24/－0 hour

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

Temperature	85±2℃
Time	500＋24/－0 hour

21. Loading at high temperature life test	
Specified Value	－

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.

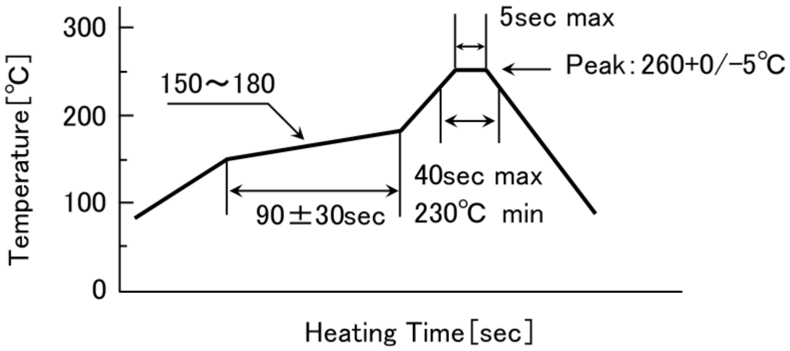
Wire-wound Metal Power Inductors MCOIL™ LSAN/LLAN series
Wire-wound Metal Power Inductors MCOIL™ LSAP/LLAP series

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.

Wire-wound Metal Power Inductors MCOIL™ LLAP series
for Medical Devices classified as GHTF Classes A or B (Japan Classes Ⅰ or Ⅱ)

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.:－40～+105℃(Including self-generated heat)※1Parts Number reference

■PART NUMBER

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

①Series

Code (1)(2)(3)(4)	
LLAP	Wire-wound Metal Power Inductor for Medical Devices classified as GHTF Classes A or B (Japan Classes Ⅰ or Ⅱ)

(1) Product Group

Code	
L	Inductors

(2) Category

Code	Recommended equipment	Quality Grade
L	Medical Devices classified as GHTF Classes A or B (Japan Classes Ⅰ or Ⅱ)	3

(3) Type

Code	
A	Metal Wire-wound

(4) Features, Characteristics

Code	
P	High current power choke

②Features

Code	Feature
B	L-shape electrode (Ag-resin×Sn-plate)

③Dimensions(L×W)

Code	Type(inch)	Dimensions (L×W)[mm]
2016	2016(0806)	2.0×1.6
2520	2520(1008)	2.5×2.0

④Dimensions(T)

Code	Dimensions(T)[mm]
KK	1.0
MK	1.2

⑤Packaging

Code	Packaging
T	Taping

⑥Nominal inductance

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

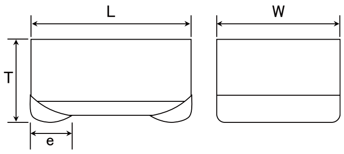
※R=Decimal point

⑦Inductance tolerance

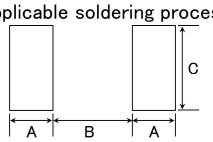
Code	Inductance tolerance
M	±20%

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	0.7	0.8	1.8
2520	0.8	1.2	2.0

Unit:mm

Type	L	W	T	e	Standard quantity[pcs] Taping
2016KK	2.0±0.1 (0.079±0.004)	1.6±0.1 (0.063±0.004)	1.0 max (0.039 max)	0.5±0.3 (0.020±0.012)	3000
2520KK	2.5±0.2 (0.098±0.008)	2.0±0.2 (0.079±0.008)	1.0 max (0.039 max)	0.5±0.3 (0.020±0.012)	3000
2520MK	2.5±0.2 (0.098±0.008)	2.0±0.2 (0.079±0.008)	1.2 max (0.047 max)	0.5±0.3 (0.020±0.012)	3000

Unit:mm(inch)

■PART NUMBER

●2016KK type 【Thickness:1.0mm max.】

New part number	Old part number (for reference)	EHS	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 current Idc2	
LLAPB2016KKTR22M	MAKK2016HR22M	RoHS	0.22	±20%	－	0.026	5,800	4,000	2
LLAPB2016KKTR24M	MAKK2016HR24M	RoHS	0.24	±20%	－	0.026	5,800	4,000	2
LLAPB2016KKTR33M	MAKK2016HR33M	RoHS	0.33	±20%	－	0.030	4,700	3,500	2
LLAPB2016KKTR47M	MAKK2016HR47M	RoHS	0.47	±20%	－	0.036	4,300	3,300	2
LLAPB2016KKTR68M	MAKK2016HR68M	RoHS	0.68	±20%	－	0.050	3,200	2,700	2
LLAPB2016KKT1R0M	MAKK2016H1R0M	RoHS	1.0	±20%	－	0.070	2,700	2,300	2
LLAPB2016KKT1R5M	MAKK2016H1R5M	RoHS	1.5	±20%	－	0.105	2,100	1,800	2

●2520KK type 【Thickness:1.0mm max.】

New part number	Old part number (for reference)	EHS	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 current Idc2	
LLAPB2520KKTR22M	MAKK2520HR22M	RoHS	0.22	±20%	－	0.021	7500	4900	2
LLAPB2520KKTR33M	MAKK2520HR33M	RoHS	0.33	±20%	－	0.026	6200	4300	2
LLAPB2520KKTR47M	MAKK2520HR47M	RoHS	0.47	±20%	－	0.029	5700	4000	2
LLAPB2520KKTR68M	MAKK2520HR68M	RoHS	0.68	±20%	－	0.043	4300	3400	2
LLAPB2520KKT1R0M	MAKK2520H1R0M	RoHS	1.0	±20%	－	0.053	3800	3000	2
LLAPB2520KKT1R5M	MAKK2520H1R5M	RoHS	1.5	±20%	－	0.078	3000	2400	2
LLAPB2520KKT2R2M	MAKK2520H2R2M	RoHS	2.2	±20%	－	0.120	2500	1800	2
LLAPB2520KKT100M	MAKK2520H100M ※1	RoHS	10	±20%	－	0.650	1100	750	2

●2520MK type 【Thickness:1.2mm max.】

New part number	Old part number (for reference)	EHS	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 current Idc2	
LLAPB2520MKTR22M	MAMK2520HR22M	RoHS	0.22	±20%	－	0.021	7500	5000	2
LLAPB2520MKTR33M	MAMK2520HR33M	RoHS	0.33	±20%	－	0.023	6600	4400	2
LLAPB2520MKTR47M	MAMK2520HR47M	RoHS	0.47	±20%	－	0.026	5800	4100	2
LLAPB2520MKTR68M	MAMK2520HR68M	RoHS	0.68	±20%	－	0.036	5100	3500	2
LLAPB2520MKT1R0M	MAMK2520H1R0M	RoHS	1.0	±20%	－	0.045	4300	3100	2
LLAPB2520MKT1R5M	MAMK2520H1R5M	RoHS	1.5	±20%	－	0.065	3300	2600	2
LLAPB2520MKT2R2M	MAMK2520H2R2M	RoHS	2.2	±20%	－	0.090	2800	2200	2

※) The saturation current value (Idc1) is the DC current value having inductance decrease down to 30%. (at 20℃)
※) The temperature rise current value(Idc2) is the DC current value having temperature increase by 40℃. (at 20℃)
※) The rated current value is following either Idc1 or Idc2, which is the lower one.

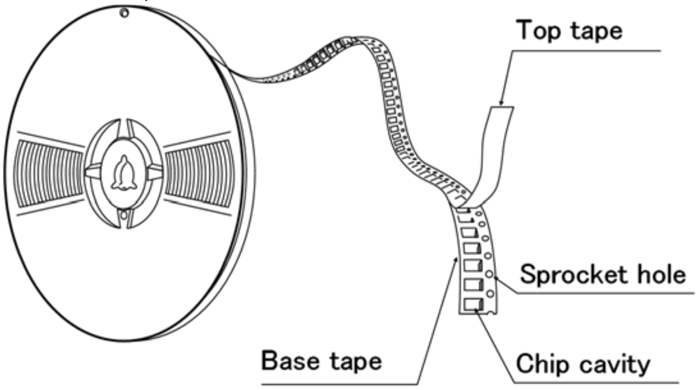
PACKAGING

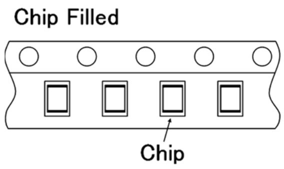
①Minimum Quantity

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

②Tape Material

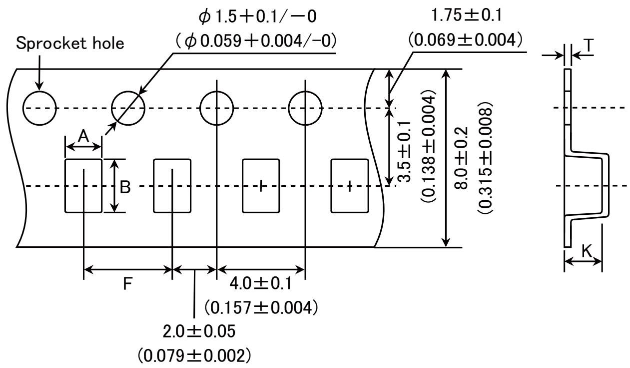
Embossed Tape

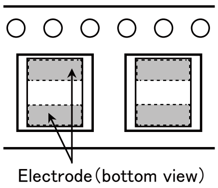




③Taping dimensions

Embossed tape 8mm wide (0.315 inches wide)

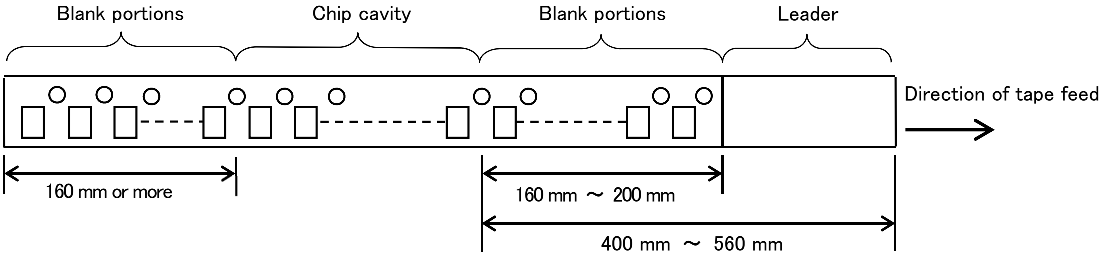




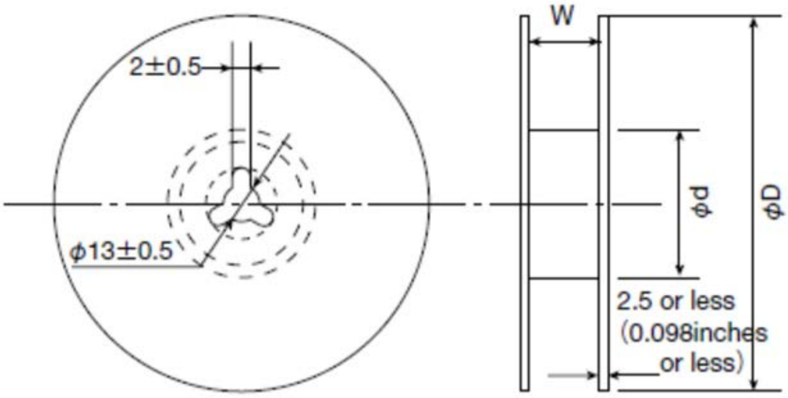
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
2016KK	1.9±0.1 (0.075±0.004)	2.3±0.1 (0.091±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.2 max (0.047 max)
2520KK	2.3±0.1 (0.091±0.004)	2.8±0.1 (0.110±0.004)	4.0±0.1 (0.157±0.004)	0.3±0.05 (0.012±0.002)	1.25 max (0.049 max)
2520MK	2.3±0.1 (0.091±0.004)	2.8±0.1 (0.110±0.004)	4.0±0.1 (0.157±0.004)	0.3±0.05 (0.012±0.002)	1.4 max (0.055 max)

Unit: mm (inch)

④Leader and Blank portion



⑤Reel size

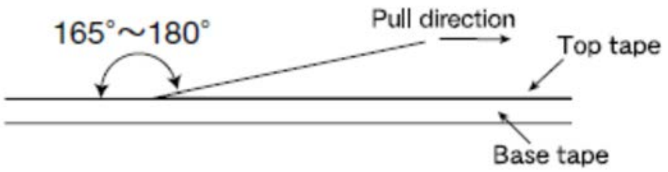


Type	Reel size (Reference values)		
	ϕD	ϕd	W
2016KK	180+0/−3 (7.087+0/−0.118)	60+1/−0 (2.36+0.039/0)	10.0±1.5 (0.394±0.059)
2520KK			
2520MK			

Unit：mm(inch)

⑥Top Tape Strength

The top The top tape requires a peel-off force of 0.1 to 1.2N in the direction of the arrow as illustrated below.



Wire-wound Metal Power Inductors MCOIL™ LSAN series for General Electronic Equipment for Consumer
Wire-wound Metal Power Inductors MCOIL™ LSAP series for General Electronic Equipment for Consumer
Wire-wound Metal Power Inductors MCOIL™ LLAN series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)
Wire-wound Metal Power Inductors MCOIL™ LLAP series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

■RELIABILITY DATA

1. Operating Temperature Range	
Specified Value	−40～+105℃:LSAN/LLAN −40～+125℃:LSAP/LLAP
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

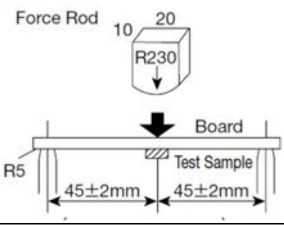
4. Inductance	
Specified Value	Within the specified tolerance
Test Methods and Remarks	Measuring equipment : LCR Meter (HP 4285A or equivalent) Measuring frequency : 2MHz、1V

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 ±15%
Test Methods and Remarks	Measurement of inductance shall be taken at temperature range within −40℃～+85℃. 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 : 100×40×1.0 mm Test board material : Glass epoxy-resin Solder cream thickness : 0.12 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	No abnormality.
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 : 0.12mm.

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±0.5 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℃ for 40 seconds, with peak temperature at 260+0/−5℃ for 5 seconds, 3 times. Test board material : Glass epoxy-resin Test board thickness : 1.0mm Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

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 100 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

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

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: 500＋24/－0 hour Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

Temperature	60±2℃
Humidity	90～95%RH
Time	500＋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. Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

Temperature	60±2℃
Humidity	90～95%RH
Applied current	Rated current
Time	500＋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. Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

Temperature	－40±2℃
Time	500＋24/－0 hour

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

Temperature	85±2℃
Time	500＋24/－0 hour

21. Loading at high temperature life test	
Specified Value	－

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.

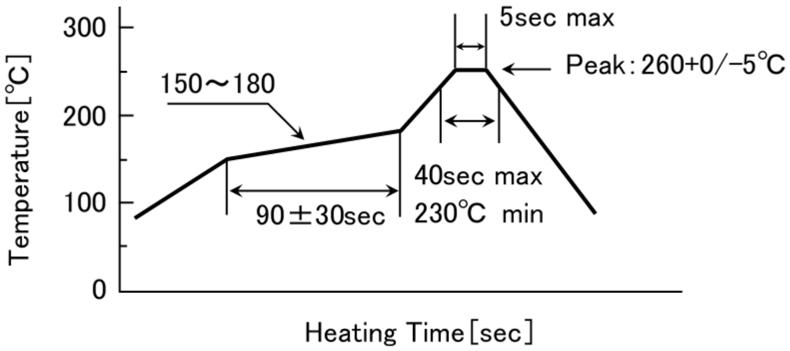
PRECAUTIONS

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.
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.

Wire-wound Metal Power Inductors MCOIL™ LLBH series for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

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～+105℃(Including self-generated heat)

L L B H	B	1 6 0 8	K K	T	1 R 0	M	
①	②	③	④	⑤	⑥	⑦	⑧

①Series

Code (1)(2)(3)(4)	
LLBH	Wire-wound Metal Power Inductor for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

(1) Product Group

Code	
L	Inductors

(2) Category

Code	Recommended equipment	Quality Grade
L	Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)	3

(3) Type

Code	
B	Metal Wire-wound (Horizontal type)

(4) Features, Characteristics

Code	
H	Hybrid power choke

②Features

Code	Feature
B	L-shape electrode (Ag-resin × Sn-plate)

③Dimensions (L×W)

Code	Type (inch)	Dimensions (L×W) [mm]
1608	1608 (0603)	1.6×0.8
2012	2012 (0805)	2.0×1.25
2520	2520 (1008)	2.5×2.0

④Dimensions (T)

Code	Dimensions (T) [mm]
KK	1.0
MK	1.2

⑤Packaging

Code	Packaging
T	Taping

⑥Nominal inductance

Code (example)	Nominal inductance [μH]
R24	0.24
1R0	1.0
4R7	4.7

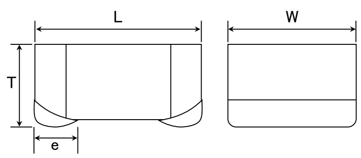
※R=Decimal point

⑦Inductance tolerance

Code	Inductance tolerance
M	±20%
N	±30%

⑧Internal code

■STANDARD EXTERNAL DIMENSIONS / STANDARD QUANTITY

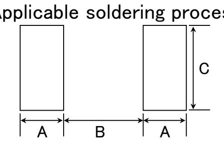


Recommended Land Patterns

Surface Mounting

・Mounting and soldering conditions should be checked beforehand.

・Applicable soldering process to these products is reflow soldering only.



Type	A	B	C
1608	0.55	0.70	1.00
2012	0.60	1.00	1.45
2520	0.60	1.50	2.00

Unit:mm

Type	L	W	T	e	Standard quantity [pcs]	
					Paper tape	Embossed tape
1608KK	1.6±0.2 (0.063±0.008)	0.8±0.2 (0.031±0.008)	1.0 max (0.040 max)	0.45±0.15 (0.016±0.006)	—	3000
2012KK	2.0±0.2 (0.079±0.008)	1.25±0.2 (0.049±0.008)	1.0 max (0.040 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)	0.5±0.2 (0.020±0.008)	—	3000

Unit:mm(inch)

■PART NUMBER

●1608KK type 【Thickness:1.0mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz](min.)	DC Resistance [Ω](max.)	Rated current ※) [mA](max.) Saturation current Idc1	Rated current ※) [mA](max.) Temperature rise current Idc2	Measuring frequency[MHz]
LLBHB1608KKTR24N	MBKK1608TR24N	RoHS	0.24	±30%	−	0.049	1,650	2,300	1.0
LLBHB1608KKTR47N	MBKK1608TR47N	RoHS	0.47	±30%	−	0.104	1,100	1,400	1.0
LLBHB1608KKTR68N	MBKK1608TR68N	RoHS	0.68	±30%	−	0.120	950	1,200	1.0
LLBHB1608KKT1R0M	MBKK1608T1R0M	RoHS	1.0	±20%	−	0.150	800	1,150	1.0
LLBHB1608KKT1R5M	MBKK1608T1R5M	RoHS	1.5	±20%	−	0.200	650	1,000	1.0
LLBHB1608KKT2R2M	MBKK1608T2R2M	RoHS	2.2	±20%	−	0.345	520	750	1.0
LLBHB1608KKT3R3M	MBKK1608T3R3M	RoHS	3.3	±20%	−	0.512	450	600	1.0
LLBHB1608KKT4R7M	MBKK1608T4R7M	RoHS	4.7	±20%	−	0.730	370	500	1.0

●2012KK type 【Thickness:1.0mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz](min.)	DC Resistance [Ω](max.)	Rated current ※) [mA](max.) Saturation current Idc1	Rated current ※) [mA](max.) Temperature rise current Idc2	Measuring frequency[MHz]
LLBHB2012KKTR24N	MBKK2012TR24N	RoHS	0.24	±30%	−	0.041	3,000	2,400	1.0
LLBHB2012KKTR47N	MBKK2012TR47N	RoHS	0.47	±30%	−	0.078	2,000	1,650	1.0
LLBHB2012KKTR68N	MBKK2012TR68N	RoHS	0.68	±30%	−	0.090	1,800	1,500	1.0
LLBHB2012KKT1R0M	MBKK2012T1R0M	RoHS	1.0	±20%	−	0.106	1,500	1,450	1.0
LLBHB2012KKT1R5M	MBKK2012T1R5M	RoHS	1.5	±20%	−	0.173	1,200	1,100	1.0
LLBHB2012KKT2R2M	MBKK2012T2R2M	RoHS	2.2	±20%	−	0.290	900	850	1.0
LLBHB2012KKT3R3M	MBKK2012T3R3M	RoHS	3.3	±20%	−	0.500	700	650	1.0
LLBHB2012KKT4R7M	MBKK2012T4R7M	RoHS	4.7	±20%	−	0.615	600	600	1.0

●2520MK type 【Thickness:1.2mm max.】

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz](min.)	DC Resistance [Ω](max.)	Rated current ※) [mA](max.) Saturation current Idc1	Rated current ※) [mA](max.) Temperature rise current Idc2	Measuring frequency[MHz]
LLBHB2520MKTR24N	MBMK2520TR24N	RoHS	0.24	±30%	−	0.026	4,750	3,500	1.0
LLBHB2520MKTR47N	MBMK2520TR47N	RoHS	0.47	±30%	−	0.042	3,900	2,600	1.0
LLBHB2520MKTR68N	MBMK2520TR68N	RoHS	0.68	±30%	−	0.058	3,150	2,150	1.0
LLBHB2520MKT1R0M	MBMK2520T1R0M	RoHS	1.0	±20%	−	0.072	2,350	1,850	1.0
LLBHB2520MKT1R5M	MBMK2520T1R5M	RoHS	1.5	±20%	−	0.106	2,050	1,500	1.0
LLBHB2520MKT2R2M	MBMK2520T2R2M	RoHS	2.2	±20%	−	0.159	1,800	1,250	1.0
LLBHB2520MKT3R3M	MBMK2520T3R3M	RoHS	3.3	±20%	−	0.260	1,400	970	1.0
LLBHB2520MKT4R7M	MBMK2520T4R7M	RoHS	4.7	±20%	−	0.380	1,150	800	1.0

※)The saturation current value (Idc1) is the DC current value having inductance decrease down to 30%. (at 20℃)
※)The temperature rise current value (Idc2) is the DC current value having temperature increase by 40℃. (at 20℃)
※)The rated current value is following either Idc1 or Idc2, which is the lower one.

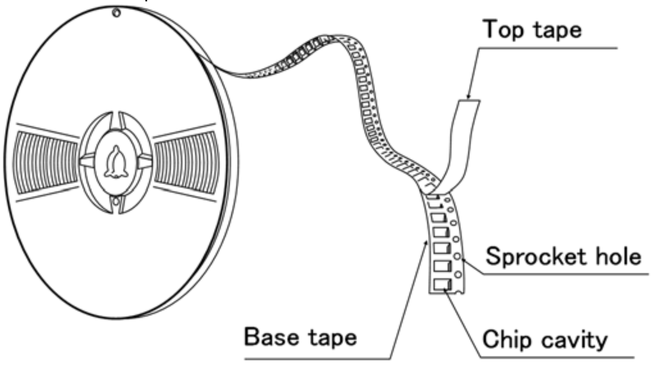
■PACKAGING

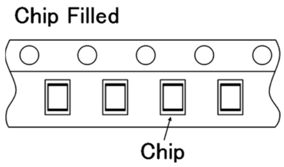
①Minimum Quantity

Type	Standard Quantity [pcs]
	Tape & Reel
1608KK	3000
2012KK	3000
2520MK	3000

②Tape Material

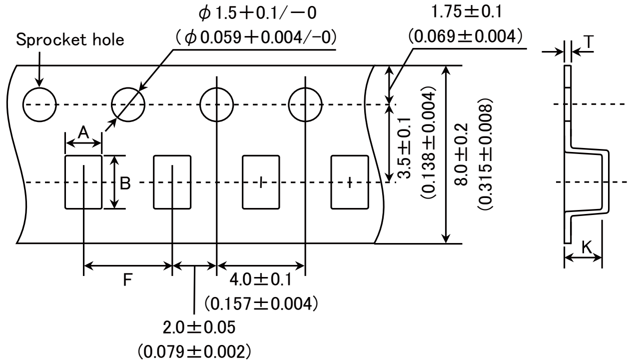
Embossed Tape

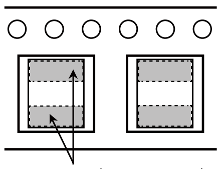




③Taping dimensions

Embossed tape 8mm wide (0.315 inches wide)

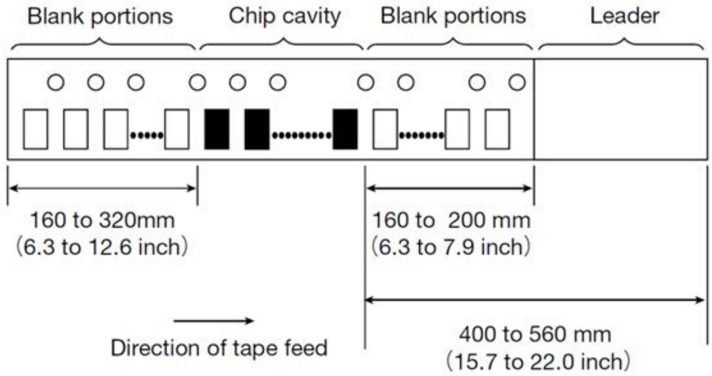




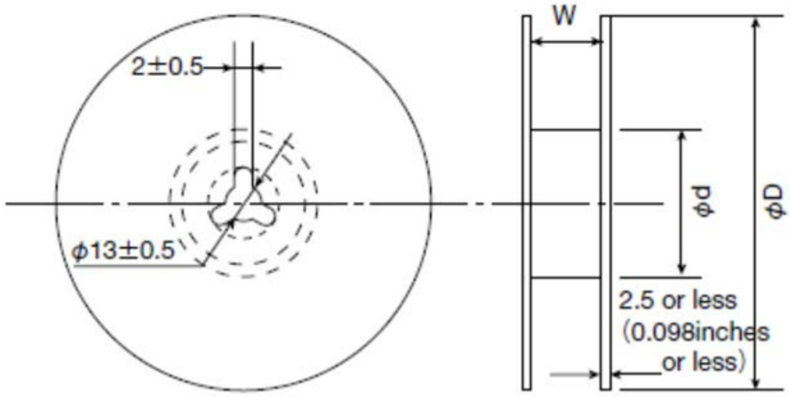
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
1608KK	1.1 (0.043)	1.9 (0.075)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.010±0.002)	1.2 max (0.047 max)
2012KK	1.45 (0.057)	2.2 (0.087)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.010±0.002)	1.2 max (0.047 max)
2520MK	2.3 (0.091)	2.8 (0.110)	4.0±0.1 (0.157±0.004)	0.3±0.05 (0.012±0.002)	1.45 max (0.057 max)

Unit : mm (inch)

④Leader and Blank portion



⑤Reel size

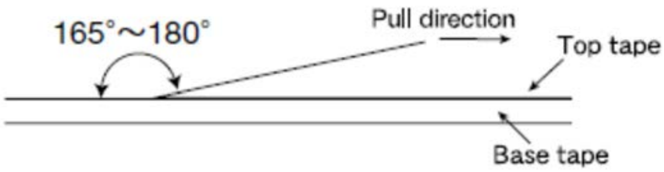


Type	Reel size (Reference values)		
	φD	φd	W
1608KK	180+0/−3 (7.087+0/−0.118)	60+1/−0 (2.36+0.039/0)	10.0±1.5 (0.394±0.059)
2012KK			
2520MK			

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™ LSBH series
for General Electronic Equipment for Consumer
Wire-wound Metal Power Inductors MCOIL™ LSBH series (125℃ guaranteed product)
for General Electronic Equipment for Consumer
Wire-wound Metal Power Inductors MCOIL™ LLBH series
for Medical Devices classified as GHTF Classes A or B (Japan Classes Ⅰ or Ⅱ)
Wire-wound Metal Power Inductors MCOIL™ LLBH series (125℃ guaranteed product)
for Medical Devices classified as GHTF Classes A or B (Japan Classes Ⅰ or Ⅱ)

RELIABILITY DATA

1. Operating Temperature Range	
Specified Value	−40～+105℃：LSBH/LLBH −40～+125℃：LSBH/LLBH (125℃ guaranteed product)
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 4285A or equivalent) Measuring frequency : 1MHz、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 ±15%
Test Methods and Remarks	LSBH/LLBH： Measurement of inductance shall be taken at temperature range within −40℃～+105℃. With reference to inductance value at +20℃., change rate shall be calculated. LSBH/LLBH (125℃ guaranteed product)： Measurement of inductance shall be taken at temperature range within −40℃～+125℃. With reference to inductance value at +20℃., change rate shall be calculated.

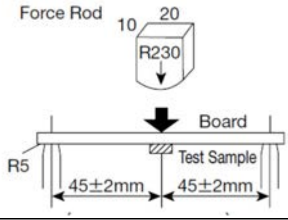
8. Resistance to flexure of substrate

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	: 100×40×1.0 mm (1608 type:0.8mm)
Test board material	: Glass epoxy-resin
Solder cream thickness	: 0.1 mm



9. Insulation resistance : between wires

Specified Value	－

10. Insulation resistance : between wire and core

Specified Value	LSBH/LLBH: DC25V 100kΩ min LSBH/LLBH (125℃ guaranteed product): DC50V 100kΩ min

11. Withstanding voltage : between wire and core

Specified Value	－

12. 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 : 10N (1608 type:5N) 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℃
Immersing speed	25mm/s
Time	5±0.5 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℃ for 40 seconds, with peak temperature at 260+0/−5℃ for 5 seconds, 3 times. Test board material : Glass epoxy-resin Test board thickness : 1.0mm Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

16. Thermal shock

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

Test Methods and Remarks

LSBH/LLBH:
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 100 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

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

LSBH/LLBH (125℃ guaranteed product):
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 100 cycles.

Conditions of 1 cycle		
Step	Temperature (℃)	Duration (min)
1	−40±3	30±3
2	Room temperature	Within 3
3	+125±2	30±3
4	Room temperature	Within 3

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

17. Damp heat

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

Test Methods and Remarks

LSBH/LLBH:
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

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

LSBH/LLBH (125℃ guaranteed product):
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%RH
Time	1000+24/−0 hour

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

18. Loading under damp heat

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

Test Methods and Remarks

LSBH/LLBH:
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

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

LSBH/LLBH (125℃ guaranteed product):
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	85±2℃
Humidity	85%RH
Applied current	Rated current
Time	1000+24/−0 hour

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

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

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

20. 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: 85±2℃ Time: 1000＋24/－0 hour Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

21. Loading at high temperature life test	
Specified Value	－

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.

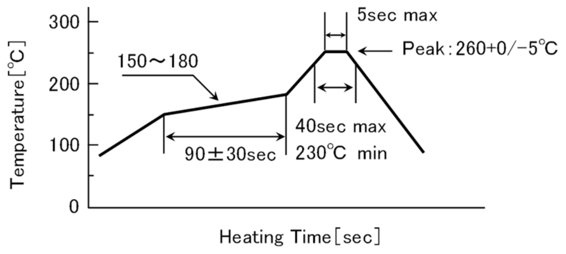
PRECAUTIONS

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.
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.

Wire-wound Metal Power Inductors MCOIL™ LLBH series (125℃ guaranteed product) for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

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

①Series

Code (1)(2)(3)(4)	
LLBH	Wire-wound Metal Power Inductor for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

(1) Product Group

Code	
L	Inductors

(2) Category

Code	Recommended equipment	Quality Grade
L	Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)	3

(3) Type

Code	
B	Metal Wire-wound (Horizontal type)

(4) Features, Characteristics

Code	
H	Hybrid power choke

②Features

Code	Feature
B	L-shape electrode (Ag-resin×Sn-plate)

③Dimensions (L×W)

Code	Type (inch)	Dimensions (L×W) [mm]
1608	1608 (0603)	1.6×0.8
2520	2520 (1008)	2.5×2.0

④Dimensions (T)

Code	Dimensions (T) [mm]
KK	1.0
MK	1.2

⑤Packaging

Code	Packaging
T	Taping

⑥Nominal inductance

Code (example)	Nominal inductance [μH]
R24	0.24
1R0	1.0
4R7	4.7

※R=Decimal point

⑦Inductance tolerance

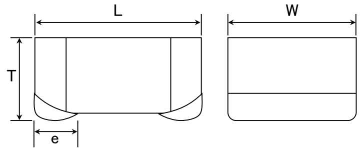
Code	Inductance tolerance
M	±20%
N	±30%

⑧Special code

Code	Special code
G	High characteristic specification

⑨Internal code

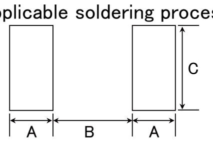
■STANDARD EXTERNAL DIMENSIONS / STANDARD QUANTITY



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
1608	0.55	0.70	1.00
2520	0.60	1.50	2.00

Unit:mm

Type	L	W	T	e	Standard quantity [pcs]	
					Paper tape	Embossed tape
1608KK	1.6±0.2 (0.063±0.008)	0.8±0.2 (0.031±0.008)	1.0 max (0.040 max)	0.45±0.15 (0.016±0.006)	—	3000
2520MK	2.5±0.2 (0.098±0.008)	2.0±0.2 (0.079±0.008)	1.2 max (0.047 max)	0.5±0.2 (0.020±0.008)	—	3000

Unit:mm(inch)

■PART NUMBER

●1608KK type 【Thickness:1.0mm max.】

New part number	Old part number (for reference)	EHS	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 current Idc2	
LLBHB1608KKTR24NG	MBKK1608HR24N	RoHS	0.24	±30%	−	0.049	1,650	2,300	1.0
LLBHB1608KKTR47NG	MBKK1608HR47N	RoHS	0.47	±30%	−	0.104	1,100	1,400	1.0
LLBHB1608KKTR68NG	MBKK1608HR68N	RoHS	0.68	±30%	−	0.120	950	1,200	1.0
LLBHB1608KKT1R0MG	MBKK1608H1R0M	RoHS	1.0	±20%	−	0.150	800	1,150	1.0
LLBHB1608KKT1R5MG	MBKK1608H1R5M	RoHS	1.5	±20%	−	0.200	650	1,000	1.0
LLBHB1608KKT2R2MG	MBKK1608H2R2M	RoHS	2.2	±20%	−	0.345	520	750	1.0
LLBHB1608KKT3R3MG	MBKK1608H3R3M	RoHS	3.3	±20%	−	0.512	450	600	1.0
LLBHB1608KKT4R7MG	MBKK1608H4R7M	RoHS	4.7	±20%	−	0.730	370	500	1.0

●2520MK type 【Thickness:1.2mm max.】

New part number	Old part number (for reference)	EHS	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 current Idc2	
LLBHB2520MKTR24NG	MBMK2520HR24N	RoHS	0.24	±30%	−	0.026	4,750	3,500	1.0
LLBHB2520MKTR47NG	MBMK2520HR47N	RoHS	0.47	±30%	−	0.042	3,900	2,600	1.0
LLBHB2520MKTR68NG	MBMK2520HR68N	RoHS	0.68	±30%	−	0.058	3,150	2,150	1.0
LLBHB2520MKT1R0MG	MBMK2520H1R0M	RoHS	1.0	±20%	−	0.072	2,350	1,850	1.0
LLBHB2520MKT1R5MG	MBMK2520H1R5M	RoHS	1.5	±20%	−	0.106	2,050	1,500	1.0
LLBHB2520MKT2R2MG	MBMK2520H2R2M	RoHS	2.2	±20%	−	0.159	1,800	1,250	1.0
LLBHB2520MKT3R3MG	MBMK2520H3R3M	RoHS	3.3	±20%	−	0.260	1,400	970	1.0
LLBHB2520MKT4R7MG	MBMK2520H4R7M	RoHS	4.7	±20%	−	0.380	1,150	800	1.0

※)The saturation current value (Idc1) is the DC current value having inductance decrease down to 30%. (at 20℃)
※)The temperature rise current value (Idc2) is the DC current value having temperature increase by 40℃. (at 20℃)
※)The rated current value is following either Idc1 or Idc2, which is the lower one.

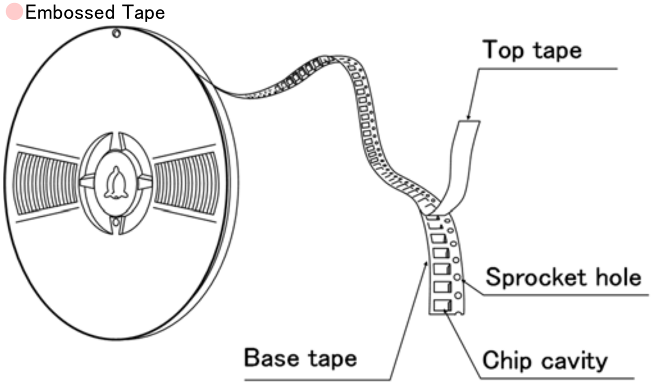
■PACKAGING

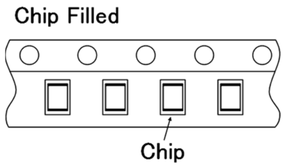
①Minimum Quantity

Type	Standard Quantity [pcs]
	Tape & Reel
1608KK	3000
2012KK	3000
2520MK	3000

②Tape Material

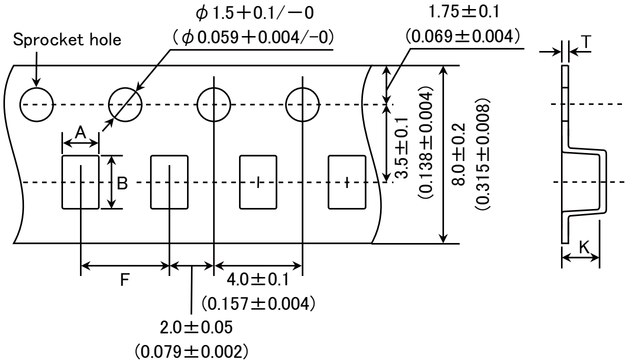
●Embossed Tape

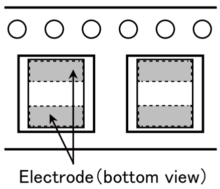




③Taping dimensions

●Embossed tape 8mm wide (0.315 inches wide)

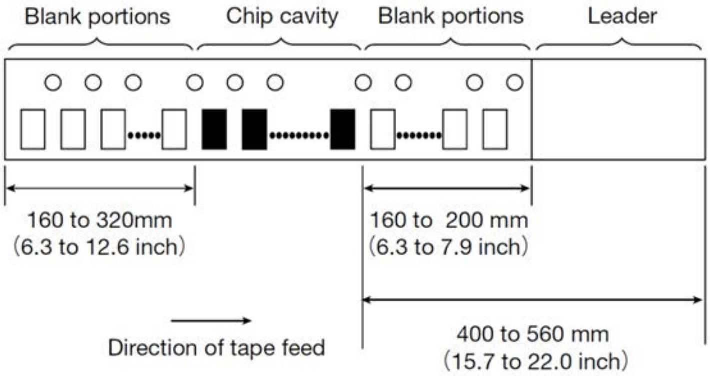




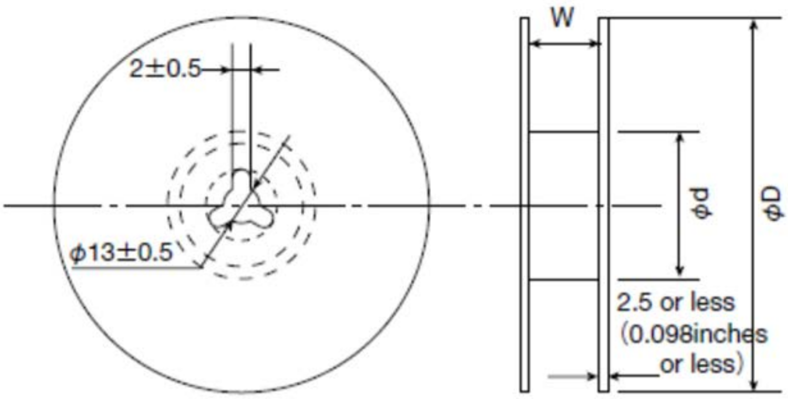
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
1608KK	1.1 (0.043)	1.9 (0.075)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.010±0.002)	1.2 max (0.047 max)
2012KK	1.45 (0.057)	2.2 (0.087)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.010±0.002)	1.2 max (0.047 max)
2520MK	2.3 (0.091)	2.8 (0.110)	4.0±0.1 (0.157±0.004)	0.3±0.05 (0.012±0.002)	1.45 max (0.057 max)

Unit: mm (inch)

④Leader and Blank portion



⑤Reel size

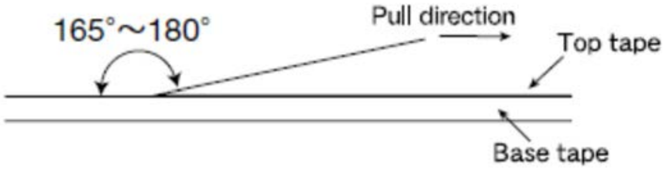


Type	Reel size (Reference values)		
	φD	φd	W
1608KK	180+0/−3 (7.087+0/−0.118)	60+1/−0 (2.36+0.039/0)	10.0±1.5 (0.394±0.059)
2012KK			
2520MK			

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™ LSBH series
for General Electronic Equipment for Consumer
Wire-wound Metal Power Inductors MCOIL™ LSBH series (125℃ guaranteed product)
for General Electronic Equipment for Consumer
Wire-wound Metal Power Inductors MCOIL™ LLBH series
for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)
Wire-wound Metal Power Inductors MCOIL™ LLBH series (125℃ guaranteed product)
for Medical Devices classified as GHTF Classes A or B (Japan Classes I or II)

■RELIABILITY DATA

1. Operating Temperature Range	
Specified Value	－40～＋105℃ : LSBH/LLBH －40～＋125℃ : LSBH/LLBH (125℃ guaranteed product)
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.

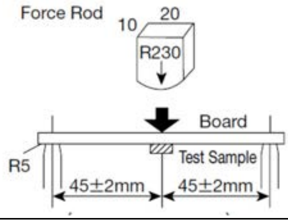
3. Rated current	
Specified Value	Within the specified tolerance

4. Inductance	
Specified Value	Within the specified tolerance
Test Methods and Remarks	Measuring equipment : LCR Meter (HP 4285A or equivalent) Measuring frequency : 1MHz、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 ±15%
Test Methods and Remarks	LSBH/LLBH : Measurement of inductance shall be taken at temperature range within －40℃～＋105℃. With reference to inductance value at ＋20℃., change rate shall be calculated. LSBH/LLBH (125℃ guaranteed product) : 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 × 1.0 mm (1608 type : 0.8mm) Test board material : Glass epoxy-resin Solder cream thickness : 0.1 mm 

9. Insulation resistance : between wires	
Specified Value	—

10. Insulation resistance : between wire and core	
Specified Value	LSBH/LLBH : DC25V 100kΩ min LSBH/LLBH (125℃ guaranteed product) : DC50V 100kΩ min

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

12. 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 : 10N (1608 type : 5N) 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℃
Immersing speed	25mm/s
Time	5±0.5 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℃ for 40 seconds, with peak temperature at 260+0/−5℃ for 5 seconds, 3 times. Test board material : Glass epoxy-resin Test board thickness : 1.0mm Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

16. Thermal shock		
Specified Value	Inductance change : Within ±10% No significant abnormality in appearance.	
Test Methods and Remarks	LSBH/LLBH: 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 100 cycles.	LSBH/LLBH (125℃ guaranteed product): 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 100 cycles.

LSBH/LLBH:

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

LSBH/LLBH (125℃ guaranteed product):

Conditions of 1 cycle		
Step	Temperature (℃)	Duration (min)
1	−40±3	30±3
2	Room temperature	Within 3
3	+125±2	30±3
4	Room temperature	Within 3

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

17. Damp heat		
Specified Value	Inductance change : Within ±10% No significant abnormality in appearance.	
Test Methods and Remarks	LSBH/LLBH: 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.	LSBH/LLBH (125℃ guaranteed product): 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.

LSBH/LLBH:

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

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

LSBH/LLBH (125℃ guaranteed product):

Temperature	85±2℃
Humidity	85%RH
Time	1000+24/−0 hour

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

18. Loading under damp heat		
Specified Value	Inductance change : Within ±10% No significant abnormality in appearance.	
Test Methods and Remarks	LSBH/LLBH: 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.	LSBH/LLBH (125℃ guaranteed product): 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.

LSBH/LLBH:

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

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

LSBH/LLBH (125℃ guaranteed product):

Temperature	85±2℃
Humidity	85%RH
Applied current	Rated current
Time	1000+24/−0 hour

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

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

20. 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: 85±2℃ Time: 1000+24/−0 hour Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.

21. Loading at high temperature life test	
Specified Value	−

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.

Wire-wound Metal Power Inductors MCOIL™ LSBH/LLBH series
Wire-wound Metal Power Inductors MCOIL™ LSBH/LLBH series (125℃ guaranteed product)

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

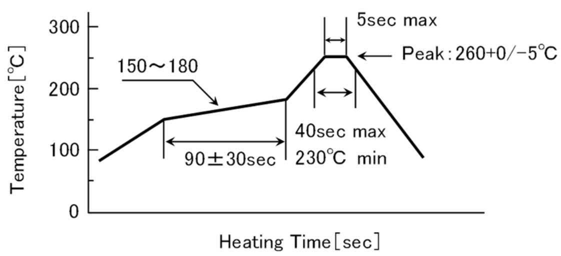
1. When using products with lead free soldering, we request to use them after confirming adhesion, temperature of resistance to soldering heat, soldering etc sufficiently.

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.