有关敝公司产品的注意事项

请务必在使用敝公司产品之前阅读。

⚠ 注 意

产品目录中的记载内容

本产品目录中所记载的内容为2023年3月的内容。因产品改良等原因，可能会不经预告而变更其记载内容，或是停止供应本产品目录中所记载的产品。所以，请务必在使用前先确认最新的产品信息。

未按照本产品目录中所记载的内容或交货规格说明书使用敝公司产品的，即便其致使用设备发生损害、不良情况等时，敝公司也不承担任何责任，敬请知悉。

签署交货规格说明书

就本产品目录中所记载产品的产品规格等相关内容，敝公司备有交货规格说明书，详情请向敝公司咨询。在使用敝公司产品前请务必就交货规格说明书之内容确认并批准之。

实装前的事前评估

使用敝公司产品时，请务必事先安装到使用设备之后，在实际使用的环境下进行评估和确认。

用途的限定

1. 可以使用的设备

本产品目录中所记载的产品预设为使用于一般民用电子设备［音像设备、办公自动化设备、家电产品、办公设备、信息通讯设备（手机、电脑等）］以及面向本产品目录或是交货规格说明书中另行注明的设备或是敝公司另行承诺的设备的通用性，标准性用途。另外，面向下述设备的应用，敝公司也备有预设的产品系列，请参考本产品目录或是交货规格说明书的内容，使用相对应的产品。

用途	产品系列		品质等级(注释3)
	对象设备(注释1)	规格号（型号标记(注释2)）	
车载	汽车用电子设备（控制系 / 安全系）	A	1
	汽车用电子设备（车身系 / 情报系）	C	2
工业	通信基础设备·工业设备	B	2
医疗	医疗设备（国际（GHTF）第三类）	M	2
	医疗设备（国际（GHTF）第一类、第二类）	L	3
民用	一般电子设备	S	3
	移动设备专用(注释4)	E	4

注释1：基于敝公司所认知的该类设备对于电子元器件所需的一般要求规格，对于该产品系列进行的应用推荐。在讨论将各个产品系列使用在对象设备以外的设备上时，请务必事先向敝公司咨询。

注释2：在产品型号中左起第2位标注有上表中所记载的“规格号”。对于相关的详细内容，请参照有关各产品型号标示法的说明资料。

注释3：在各产品系列中，都设定了从上至下1至4的“品质等级”。另外，在未得到敝公司的事前书面承诺之前，请勿将敝公司的产品使用于相对于该产品的品质等级被设定为上位品质等级的设备。

注释4：本产品系列仅可应用于一般民用电子设备中的移动设备（智能手机、平板电脑、智能手表、掌上游戏机等）。由于其设计、规格和使用环境与面向“一般电子设备”的产品系列（规格号：S）不同，有关本产品系列的详细信息请参照交货规格说明书。另外，面向“一般电子设备”的产品系列（规格号：S）也可以应用于移动设备。

▶由于篇幅有限，本产品目录中只记载了有代表性的产品规格，若考虑使用敝公司产品时，请确认交货规格说明书中的详细规格。另外，有关各产品的详细信息(特性图、可靠性信息、使用时的注意事项等)，请参阅敝公司网站(http://www.ty-top.com/)。

2. 需要另行确认的设备

若考虑将本产品目录中所记载的产品使用于当产品发生故障、品质不良，或是由此引起的运转失常而可能会危及生命、身体或是财产，以及有可能给社会造成深刻影响的以下设备（不包括本产品目录或是交货规格说明书中另行注明可以使用设备）等时，请务必事先向敝公司咨询。

(1) 运输用设备（汽车驱动控制设备、火车控制设备、船舶控制设备等）
(2) 交通信号设备
(3) 防灾 / 保安设备
(4) 医疗设备（国际（GHTF）第三类）
(5) 高公共性信息通讯设备 / 信息处理设备（电话交换机、电话 / 无线 / 广播电视基站等）
(6) 其他与上述设备有同等品质与可靠性要求的设备

3. 禁止使用的设备

请勿将敝公司产品使用于对安全性和可靠性有着极高要求的以下设备。

(1) 航天设备（人工卫星、火箭等）
(2) 航空设备(注释1)
(3) 医疗设备（国际（GHTF）第四类）、植体（体内植入型）医疗设备(注释2)
(4) 发电控制设备（面向核能 / 水力 / 火力发电厂等的设备）
(5) 海底设备（海底中继设备、海中的作业设备等）
(6) 军事设备
(7) 其他与上述设备有同等品质与可靠性要求的设备

注释1：仅限于对航空设备的安全运行不产生直接干扰的设备［机内娱乐设备、机内照明设备、电动座椅、餐饮设备等］，在满足敝公司另行指定的相关条件时，亦可将敝公司产品用于以上用途。在贵公司考虑将敝公司的产品用于以上用途时，请务必事先向敝公司咨询相关的信息。

注释2：包括注入人体内的部分和与此相连接的体外部分。

4. 责任的限制

未经敝公司的事先书面同意，把本产品目录中所记载的产品使用于非敝公司预设用途的设备、前述需要向敝公司咨询的设备或敝公司禁止使用的设备，从而给客户或第三方造成损害的，敝公司不承担任何责任，敬请知悉。

安全设计

需将敝公司的产品使用于对安全性和可靠性要求较高的设备、电路上时，请进行充分的安全性评估和可靠性评估。另外，请通过设置保护电路、保护装置的系统，设置冗余电路不会被单一故障影响安全性的系统等失效导向安全（fail-safe）设计，确保充分的安全性。

有关知识产权

本产品目录中所记载的信息是用于说明相关产品的典型操作以及相关应用。此类信息的使用不代表对于敝公司以及第三方的知识产权以及其他权利的使用许可或是不侵权保证。

保证范围

敝公司产品的保证范围仅限于符合交货规格说明书中所记载的产品规格且已经交付的敝公司产品本身，由敝公司产品的故障或不良情况所诱发的损害，敝公司不承担任何责任，敬请知悉。但是，仅限于敝公司的产品作为通用性，标准性用途使用于本产品目录或是交货规格说明书中另行注明的设备，且以书面形式另行签署了交易基本合同书，品质保证协定书等时，敝公司将根据该合同等的条件提供保证。

正规销售渠道

本产品目录中所记载的内容适用于从敝公司营业所、销售子公司、销售代理店（即“正规销售渠道”）购买的敝公司产品，并不适用于从其他渠道购买的敝公司产品，敬请知悉。

出口时的注意事项

本产品目录中所记载的部分产品在出口时须事先确认《外汇和对外贸易法》以及美国在出口管理方面的相关法规，并办理相关手续。如有不明之处，请向敝公司咨询。

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另外，有关各产品的详细信息(特性图、可靠性信息、使用时的注意事项等)，请参阅敝公司网站(http://www.ty-top.com/)。

医疗设备用途使用指引

敝公司对于医疗设备国际（GHTF）第一类、第二类、第三类，都准备了相应的产品系列（左起第二位的产品型号的记号为“M”或是“L”）。因此，有意在医疗设备中采用敝公司产品时，请务必事先确认医疗设备的国际分类，并使用相应的产品系列。
另外，敝公司并没有准备意图使用于被分类为医疗设备国际（GHTF）第四类的所有设备，以及被分类为医疗设备国际（GHTF）第三类的植体（体内植入型）医疗设备（骨导式助听器、人工网膜系统、或是连接人体之体外装置等），因此请不要将敝公司的产品使用于上述任何设备中。如有不明之处，请与敝公司取得联系。

对于人体的风险		低 → 高			
日本	依照医药品医疗机器等法之分类(GHTF)	**第一类** 一般医疗设备 (GHTF Class A)	**第二类** 管制医疗设备 (GHTF Class B)	**第三类** 高度管制医疗设备 (GHTF Class C)	**第四类** 高度管制医疗设备 (GHTF Class D)
		认于发生不良情况时，对于人体产生风险的程度极低者。	认于发生不良情况时，对于人体产生风险的程度较低者。	认于发生不良情况时，对于人体产生风险的程度较高者。	对患者的侵入性高，于发生不良情况时，可能直接危及生命危险者。
		【代表实例】 ・体外诊断用仪器 ・喷雾器 ・血液气体分析器 ・脉波计 ・呼吸传感器 ・电动手术台 ・手术用照明装置 ・胆固醇分析仪 ・血型分析仪　　等	【代表实例】 ・电子体温计 ・电子血压计 ・电子内视镜 ・补聴器 ・心电仪 ・核磁共振成像(MRI) ・超音波诊断装置 ・成像诊断装置 ・X射线诊断装置 ・中央监护仪 ・血氧仪　　等	【代表实例】 ・透析机器 ・放射线治疗机器 ・输液泵 ・人工呼吸器 ・血糖监测系统 ・自动体外心脏除颤器(AED) ・皮肤激光扫描仪 ・手术电刀 ・胰岛素泵　　等	【代表实例】 ・植入式心脏起搏器 ・摄像软式血管镜 ・植入式输液泵 ・心脏用手术电刀 ・附心导管之检查装置 ・除颤器　　等
美国	FDA分类	**Class Ⅰ** General Controls	**Class Ⅱ** General Controls and Special Controls	**Class Ⅲ** General Controls and Premarket Approval	
		以医疗设备发生缺陷或故障之情况下，对病患或使用者也不会产生重大伤害或危害为前提之医疗机器。	可预设当医疗设备发生缺陷或故障时，对病患或使用者可能会造成伤害或产生危害之医疗机器。	可预设当医疗设备发生缺陷或故障时，对病患或使用者可能会产生严重伤害，致残或是致死之医疗机器。	
中国	医疗器械监督管理条例中的分类	**第一类**	**第二类**	**第三类**	
		风险程度低，实行常规管理可以保证其安全、有效的医疗器械。	具有中度风险，需要严格控制管理以保证其安全、有效的医疗器械。	具有较高风险，需要采取特别措施严格控制管理以保证其安全、有效的医疗器械。	
产品系列的对应状况		**面向医疗设备（国际（GHTF）第一类、第二类）的产品系列** （左起第二位的产品型号的记号：“L”）		**面向医疗设备（国际（GHTF）第三类）的产品系列** （左起第二位的产品型号的记号：“M”） ※注释	未对应

※注释：即使被分类为国际分类（GHTF）第三类，植体等部分的医疗设备也仍未对应。

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另外，有关各产品的详细信息(特性图、可靠性信息、使用时的注意事项等)，请参阅敝公司网站(http://www.ty-top.com/)。

医疗设备（国际（GHTF）第三类）用途 绕线型金属系功率电感器 MCOIL™ LMEN 系列

系列前的记号来自型号，用来区分产品的种类和特性等。

回流焊

■型号标示法

*使用温度范围：-40～+125℃（包含产品本身发热）

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

①系列

代码 ⑴⑵⑶⑷	
LMEN	医疗设备（国际（GHTF）第三类）用途 绕线型金属系功率电感器

(1) 产品群

代码	
L	电感器

(3) 类型

代码	
E	绕线型金属系 高充填型

(2) 范畴

代码	推荐设备	品质等级
M	医疗设备（国际（GHTF）第三类）	2

(4) 特效 / 特性

代码	
N	一般功率扼流

②特征

代码	特征
A	5 面电极（树脂银×镀锡）

⑤包装

代码	包装
T	卷盘带装

③尺寸（L×W）

代码	尺寸（L×W）[mm]
2016	2.0×1.6
2520	2.5×2.0

⑥标称电感值

代码（例）	标称电感值 [μH]
R47	0.47
1R0	1.0
4R7	4.7

※R＝小数点

④尺寸（T）

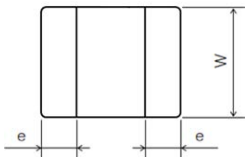
代码	尺寸（T）[mm]
MK	1.2

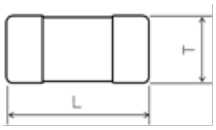
⑦电感量公差

代码	电感量公差
M	±20%

⑧管理记号

■标准外型尺寸 / 标准数量



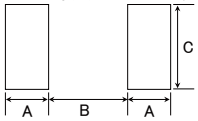


推荐焊盘图案

实装上的注意

・请确认实装状态后使用。

・本产品焊法限定为回流焊法。



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

单位：mm

Type	L	W	T	e	标准数量 [pcs] 卷盘带装
2016MK	2.0±0.2 (0.079±0.008)	1.6±0.2 (0.063±0.008)	1.2 max (0.047 max)	0.5±0.2 (0.020±0.008)	3000
2520MK	2.5±0.2 (0.098±0.008)	2.0±0.2 (0.079±0.008)	1.2 max (0.047 max)	0.6±0.3 (0.024±0.012)	3000

单位：mm（inch）

■PART NUMBER

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

Notes)
・The exchange of individual specifications is necessary depending on your application and/or circuit condition. Please contact TAIYO YUDEN's official sales channel.
・The products are for Medical Devices classified as GHTF Class C (Japan Class Ⅲ).
Please consult with TAIYO YUDEN's official sales channel for the details of the product specifications, etc.,
and please review and approve the product specifications before ordering.

●2016MK type 【Thickness : 1.2mm max.】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.)			Measuring frequency [MHz]
						Saturation current Idc1	Temperature rise current① Idc2	Temperature rise current② Idc2	
LMENA2016MKTR24M0NK	MEMK2016TR24MGNK8	0.24	±20%	–	0.018	6,800	3,500	5,500	1
LMENA2016MKTR33M0NK	MEMK2016TR33MGNK8	0.33	±20%	–	0.022	5,400	3,000	4,900	1
LMENA2016MKTR47M0NK	MEMK2016TR47MGNK8	0.47	±20%	–	0.025	4,800	2,900	4,700	1
LMENA2016MKT1R0M0NK	MEMK2016T1R0MGNK8	1.0	±20%	–	0.045	3,100	2,000	3,200	1
LMENA2016MKT2R2M0NK	MEMK2016T2R2MGNK8	2.2	±20%	–	0.120	2,200	1,100	1,800	1

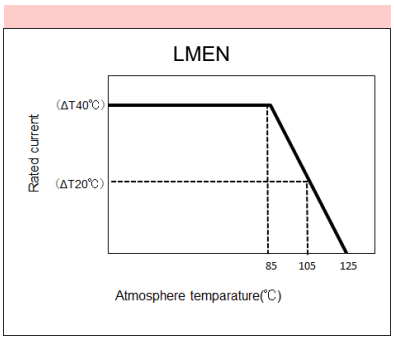
●2520MK type 【Thickness : 1.2mm max.】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA] (max.)			Measuring frequency [MHz]
						Saturation current Idc1	Temperature rise current① Idc2	Temperature rise current② Idc2	
LMENA2520MKTR15M0NK	MEMK2520TR15MGNK8	0.15	±20%	–	0.009	10,200	4,900	6,700	1
LMENA2520MKTR33M0NK	MEMK2520TR33MGNK8	0.33	±20%	–	0.015	7,000	4,000	5,600	1
LMENA2520MKTR47M0NK	MEMK2520TR47MGNK8	0.47	±20%	–	0.020	5,900	3,700	5,000	1
LMENA2520MKT1R0M0NK	MEMK2520T1R0MGNK8	1.0	±20%	–	0.042	4,400	2,400	3,200	1
LMENA2520MKT1R5M0NK	MEMK2520T1R5MGNK8	1.5	±20%	–	0.057	3,300	2,100	2,800	1
LMENA2520MKT2R2M0NK	MEMK2520T2R2MGNK8	2.2	±20%	–	0.077	3,000	1,700	2,400	1
LMENA2520MKT3R3M0NK	MEMK2520T3R3MGNK8	3.3	±20%	–	0.131	2,300	1,300	1,800	1
LMENA2520MKT4R7M0NK	MEMK2520T4R7MGNK8	4.7	±20%	–	0.185	2,100	1,100	1,500	1

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

■Derating of Rated Current

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



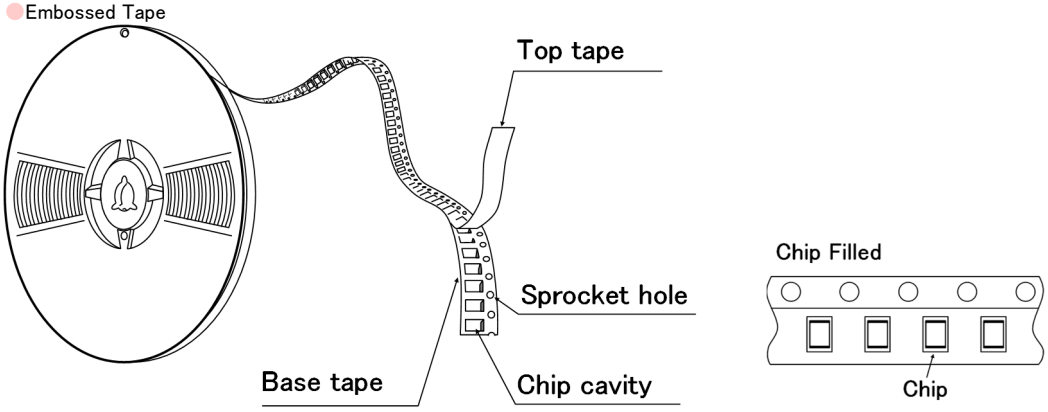
■PACKAGING

①Minimum Quantity

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

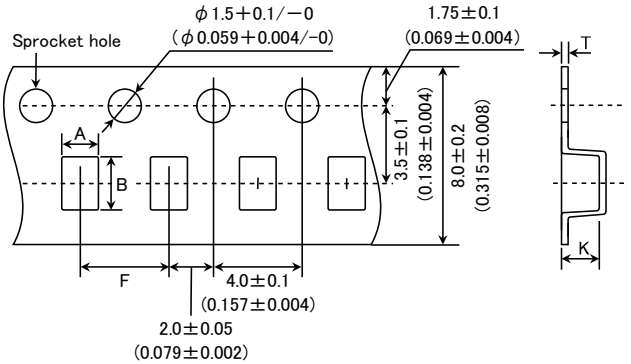
②Tape Material

●Embossed Tape



③Taping dimensions

●Embossed tape 8mm wide (0.315 inches wide)

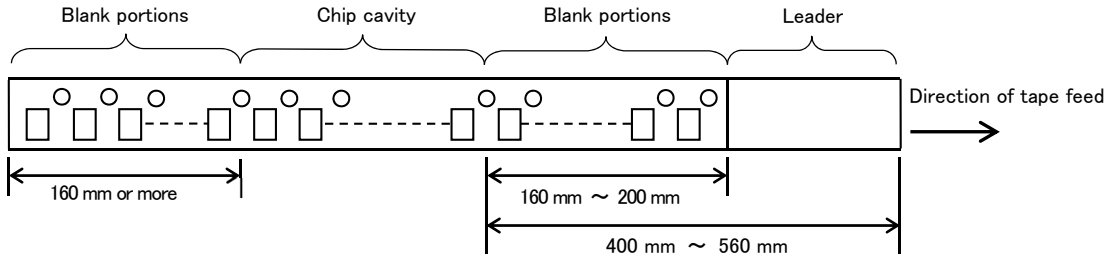


Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
2012HK	1.45±0.1 (0.057±0.004)	2.25±0.1 (0.089±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	0.9+0.15/−0.1 (0.035+0.006/−0.004)
2012KK	1.45±0.1 (0.057±0.004)	2.25±0.1 (0.089±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.1±0.1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

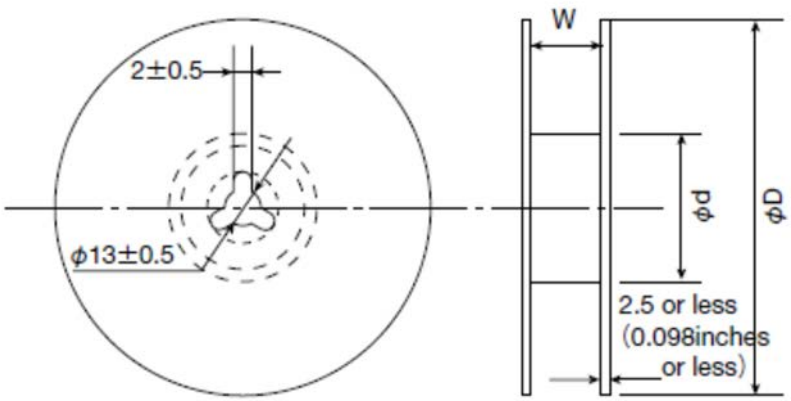
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
2520KK	2.4±0.1 (0.094±0.004)	2.9±0.1 (0.114±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.1±0.1 (0.043±0.004)
2520MK	2.4±0.1 (0.094±0.004)	2.9±0.1 (0.114±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002	1.4±0.1 (0.055±0.004)
3225HK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

Unit : mm (inch)

④Leader and Blank portion



⑤Reel size

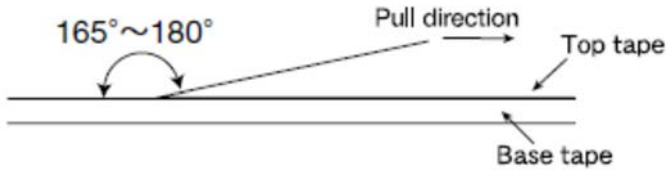


Type	Reel size (Reference values)		
	ϕD	ϕd	W
2012HK	180+0/−3 (7.087+0/−0.118)	60+1/−0 (2.36+0.039/0)	10.0±1.5 (0.394±0.059)
2012KK			
2016MK			
2016HK			
2016KK			
2520KK			
2520MK			
3225HK			

Unit : mm (inch)

⑥Top Tape Strength

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



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

■RELIABILITY DATA

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

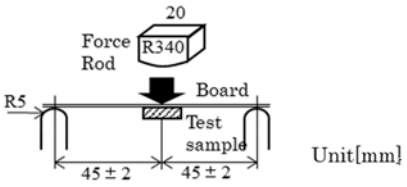
2. Storage Temperature Range	
Specified Value	−40～＋85℃
Test Methods and Remarks	0 to 40℃ for the product with taping.

3. Rated current	
Specified Value	Within the specified tolerance

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

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

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

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

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

9. Resistance to vibration

Specified Value

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

Test Methods and Remarks

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

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

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

10. Solderability

Specified Value

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

Test Methods and Remarks

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

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

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

11. Resistance to soldering heat

Specified Value

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

Test Methods and Remarks

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

12. Thermal shock

Specified Value

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

Test Methods and Remarks

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

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

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

13. Damp heat

Specified Value

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

Test Methods and Remarks

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

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

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

14. High temperature life test

Specified Value

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

Test Methods and Remarks

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

Temperature	125±2℃
Time	1000 hour

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

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

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

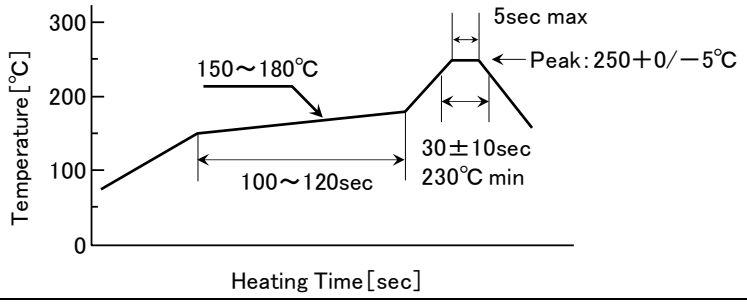
Wire-wound Metal Power Inductors MCOIL™ LSEN/LLEN/LCEN/LBEN/LMEN series
Wire-wound Metal Power Inductors MCOIL™ LSEP/LLEP series
Wire-wound Metal Power Inductors MCOIL™ LSEU/LLEU series

■PRECAUTIONS

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

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

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

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

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

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

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

医疗设备（国际（GHTF）第三类）用途 多层金属系功率电感器 MCOIL™ LMCN 系列

系列前的记号来自型号，用来区分产品的种类和特性等。

回流焊

*使用温度范围：-40～+125℃（包含产品本身发热）
*使用温度范围：-55～+150℃（包含产品本身发热）

■型号标示法

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

①系列

代码 ⑴⑵⑶⑷	
LMCN	医疗设备（国际（GHTF）第三类）用途 多层金属系功率电感器

(1) 产品群

代码	
L	电感器

(2) 范畴

代码	推荐设备	品质等级
M	医疗设备（国际（GHTF）第三类）	2

②特征

代码	特征
F	5 面电极、极性表示产品

③尺寸（L×W）

代码	外型（inch）	尺寸（L×W）[mm]
1608	1608（0603）	1.6×0.8
2012	2012（0805）	2.0×1.25

④产品厚度

代码	产品厚度 [mm]
KK	1.0 max

(3) 类型

代码	
C	多层金属系

(4) 特效 / 特性

代码	
N	一般功率扼流

⑤包装

代码	包装
T	卷盘带装

⑥标称电感值

代码（例）	标称电感值 [μH]
R24	0.24
R47	0.47
1R0	1.0

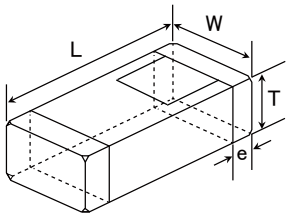
※R＝小数点

⑦电感量公差

代码	电感量公差
M	±20%

⑧管理记号

■标准外型尺寸 / 标准数量



Type	L	W	T	e	标准数量 [pcs]	
					纸带	压模带
1608KK (0603)	1.6±0.2 (0.063±0.008)	0.8±0.2 (0.031±0.008)	1.0 max (0.039 max)	0.3±0.2 (0.012±0.008)	-	3000
2012KK (0805)	2.0±0.2 (0.079±0.008)	1.25±0.2 (0.049±0.008)	1.0 max (0.039 max)	0.5±0.3 (0.02±0.012)	—	3000

单位：mm（inch）

■PART NUMBER

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

Notes)
・The exchange of individual specifications is necessary depending on your application and/or circuit condition. Please contact TAIYO YUDEN's official sales channel.
・The products are for Medical Devices classified as GHTF Class C (Japan Class Ⅲ).
Please consult with TAIYO YUDEN's official sales channel for the details of the product specifications, etc.,
and please review and approve the product specifications before ordering.

●1608 type

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [mΩ]		Rated current(Idc1) [A] (max.)	Rated current(Idc2) [A] (max.)	Measuring frequency [MHz]	Thickness [mm] (max.)
					(max.)	(typ.)				
LMCNF1608KKTR24MA	MCKK1608TR24M8C	RoHS	0.24	±20%	35	29	3.2	3.8	1	1.00
LMCNF1608KKTR33MA	MCKK1608TR33M8C	RoHS	0.33	±20%	46	38	2.8	3.3	1	1.00
LMCNF1608KKTR47MA	MCKK1608TR47M8C	RoHS	0.47	±20%	65	54	2.6	3.0	1	1.00

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

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [mΩ]		Rated current(Idc1) [A] (max.)	Rated current(Idc2) [A] (max.)	Measuring frequency [MHz]	Thickness [mm] (max.)
					(max.)	(typ.)				
LMCNF1608KKTR24MAD	MCKK1608TR24M8C D	RoHS	0.24	±20%	35	29	3.2	3.8	1	1.00
LMCNF1608KKTR33MAD	MCKK1608TR33M8C D	RoHS	0.33	±20%	46	38	2.8	3.3	1	1.00
LMCNF1608KKTR47MAD	MCKK1608TR47M8C D	RoHS	0.47	±20%	65	54	2.6	3.0	1	1.00

●2012 type

New part number	Old part number (for reference)	EHS	Nominal inductance [μH]	Inductance tolerance	DC Resistance [mΩ]		Rated current(Idc1) [A] (max.)	Rated current(Idc2) [A] (max.)	Measuring frequency [MHz]	Thickness [mm] (max.)
					(max.)	(typ.)				
LMCNF2012KKTR24MA	MCKK2012TR24M8C	RoHS	0.24	±20%	20	17	4.8	5.4	1	1.00
LMCNF2012KKTR33MA	MCKK2012TR33M8C	RoHS	0.33	±20%	30	25	4.4	4.5	1	1.00
LMCNF2012KKTR47MA	MCKK2012TR47M8C	RoHS	0.47	±20%	41	34	3.8	3.8	1	1.00
LMCNF2012KKT1R0MA	MCKK2012T1R0M8C	RoHS	1.0	±20%	85	71	2.7	2.7	1	1.00

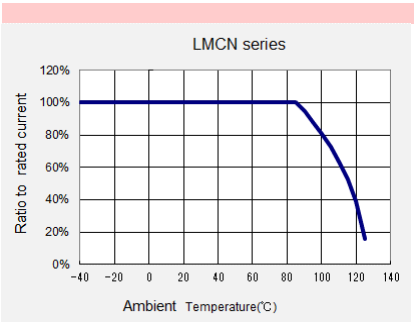
●2012 type ＊Operating Temp.:−55〜+150℃(Including self-generated heat)

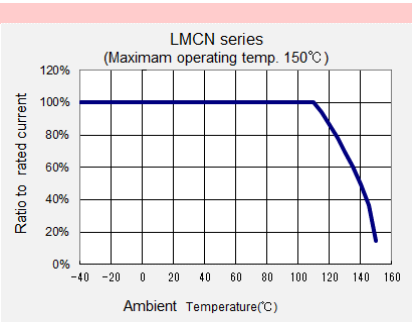
New part number	Old part number (for reference)	EHS	公称インダクタンス [μH]	インダクタンス許容差	直流抵抗 [mΩ]		定格電流(Idc1) [A] (max.)	定格電流(Idc2) [A] (max.)	測定周波数 [MHz]	厚み [mm] (max.)
					(max.)	(typ.)				
LMCNF2012KKTR24MAD	MCKK2012TR24M8C D	RoHS	0.24	±20%	20	17	4.8	5.4	1	1.00
LMCNF2012KKTR33MAD	MCKK2012TR33M8C D	RoHS	0.33	±20%	30	25	4.4	4.5	1	1.00
LMCNF2012KKTR47MAD	MCKK2012TR47M8C D	RoHS	0.47	±20%	41	34	3.8	3.8	1	1.00
LMCNF2012KKT1R0MAD	MCKK2012T1R0M8C D	RoHS	1.0	±20%	85	71	2.7	2.7	1	1.00

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

■Derating of Rated Current

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





■PACKAGING

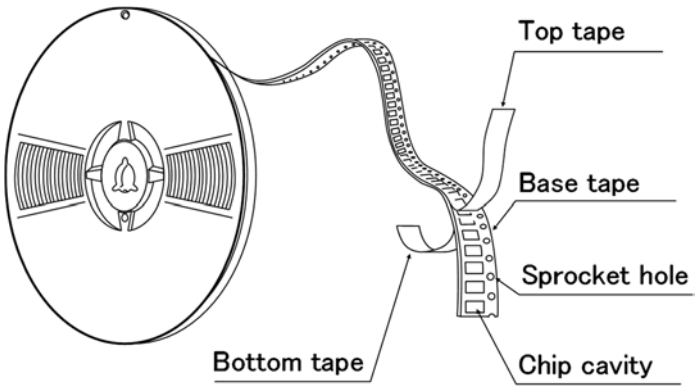
①Minimum Quantity

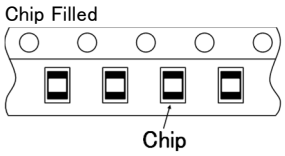
●Tape & Reel Packaging

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

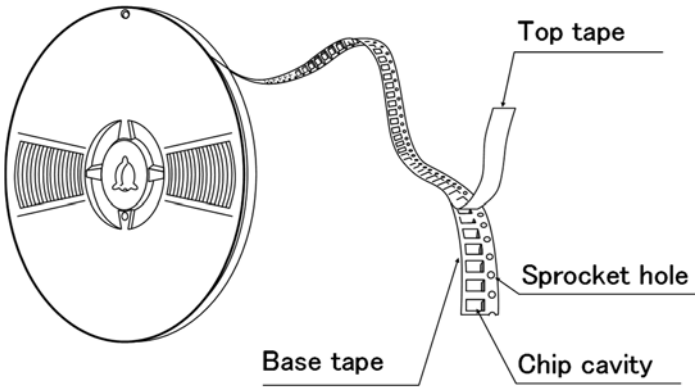
②Taping material

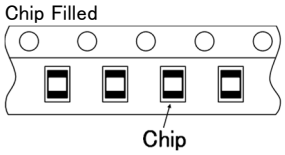
●Card board carrier tape 1005/1210/1412/1608/2012/2016 type





●Embossed Tape 1608/2012 type

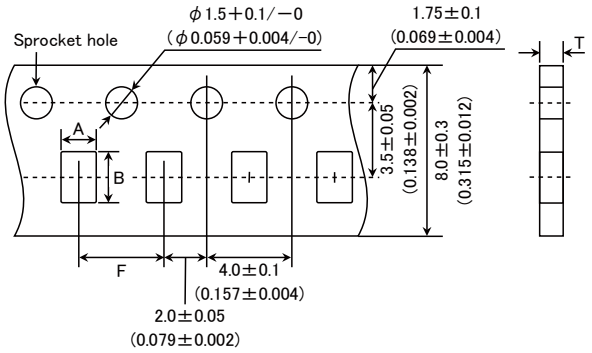




③Taping Dimensions

Paper tape (8mm wide)

Unit : mm (inch)

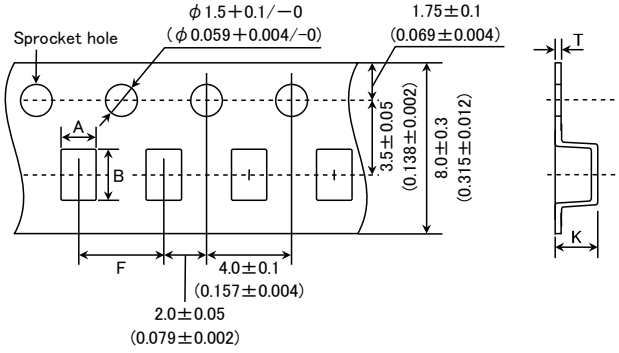


Type	Thickness		Chip cavity		Insertion Pitch	Tape Thickness
	Code	mm (inch)	A	B	F	T
1005 (0402)	EE	0.55 max (0.021 max)	0.8 (0.031)	1.3 (0.051)	2.0±0.05 (0.079±0.002)	0.64max (0.025max)
1210 (0504)	EK	0.5 max (0.020 max)	1.3 (0.051)	1.55 (0.061)	4.0±0.1 (0.157±0.004)	0.64max (0.025max)
1412 (0505)	FE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

Unit : mm (inch)

Embossed Tape (8mm wide)

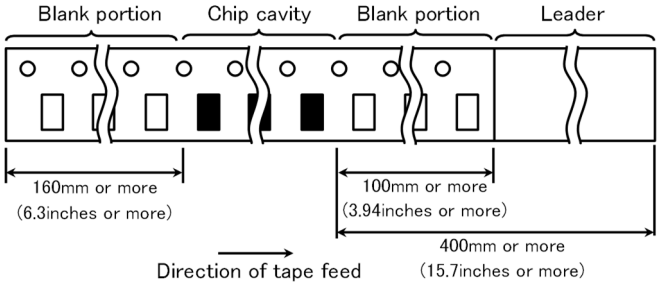
Unit : mm (inch)



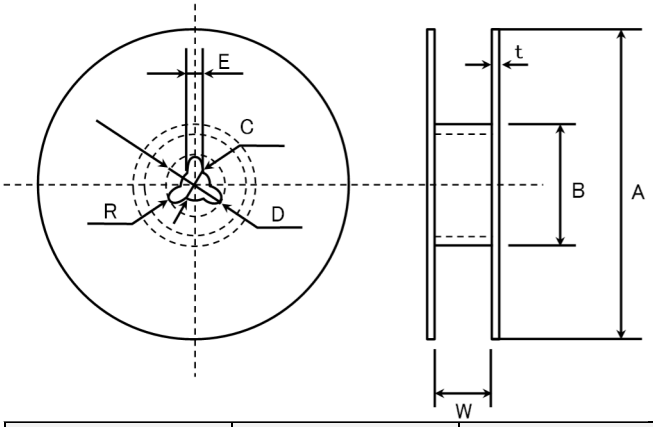
Type	Thickness		Chip cavity		Insertion Pitch	Tape Thickness	
	Code	mm (inch)	A	B	F	K	T
1608 (0603)	KK	1.0 max (0.039 max)	1.15 (0.045)	1.95 (0.077)	4.0±0.1 (0.157±0.004)	1.5 max (0.059 max)	0.3 max (0.012 max)
2012 (0805)	KK	1.0 max (0.039 max)	1.55 (0.061)	2.35 (0.093)	4.0±0.1 (0.157±0.004)	1.5 max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

Unit : mm (inch)

④LEADER AND BLANK PORTION



⑤Reel Size



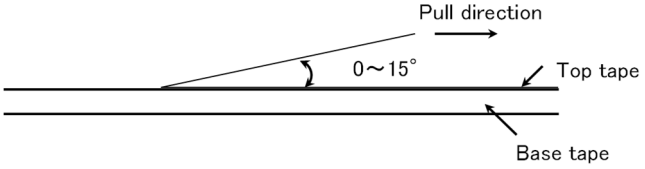
A	B	C	D	E	R
ϕ178±2.0	ϕ50 or more	ϕ13.0±0.2	ϕ21.0±0.8	2.0±0.5	1.0

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

(Unit : mm)

⑥Top tape strength

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



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

■RELIABILITY DATA

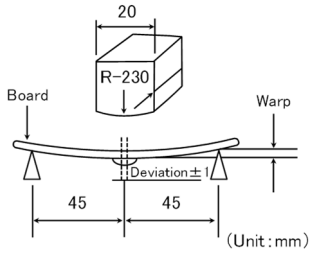
1. Operating Temperature Range	
Specified Value	−40～＋125℃(Including self-generated heat)　,　End of part number "D"⇒−55～＋150℃(Including self-generated heat)

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

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

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

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

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

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

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

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

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

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

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

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

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

■PRECAUTIONS

1. Circuit Design

Precautions

◆Verification of operating environment, electrical rating and performance

1. A malfunction in medical equipment, spacecraft, nuclear reactors, etc. may cause serious harm to human life or have severe social ramifications. As such, any inductors to be used in such equipment may require higher safety and/or reliability considerations and should be clearly differentiated from components used in general purpose applications.
2. When inductors are used in places where dew condensation develops and/or where corrosive gas such as hydrogen sulfide, sulfurous acid, or chlorine exists in the air, characteristic deterioration may occur. Please do not use inductors under such environmental conditions.

◆Operating Current (Verification of Rated current)

1. The operating current including inrush current for inductors must always be lower than their rated values.
2. Do not apply current in excess of the rated value because the inductance may be reduced due to the magnetic saturation effect.

◆Temperature rise

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

2. PCB Design

Precautions

◆Pattern configurations (Design of Land-patterns)

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

(1) The amount of solder applied can affect the ability of chips to withstand mechanical stresses which may lead to breaking or cracking. Therefore, when designing land-patterns it is necessary to consider the appropriate size and configuration of the solder pads which in turn determines the amount of solder necessary to form the fillets.

(2) When more than one part is jointly soldered onto the same land or pad, the pad must be designed so that each component's soldering point is separated by solder-resist.

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

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

Technical considerations

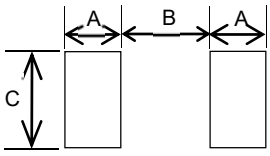
◆Pattern configurations (Design of Land-patterns)

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

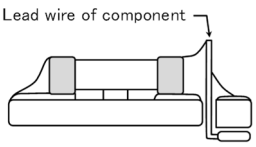
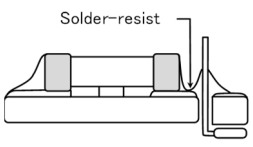
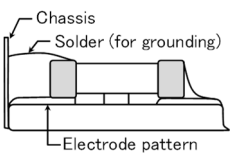
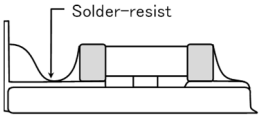
(1) Recommended land dimensions for a typical chip inductor land patterns for PCBs

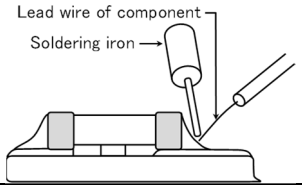
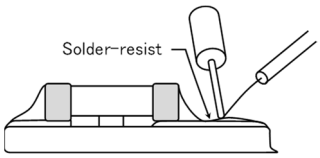
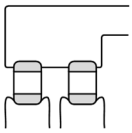
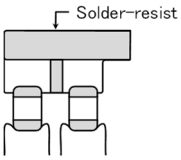
(Unit : mm)

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



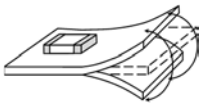
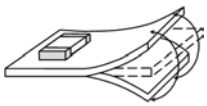
(2) Examples of good and bad solder application

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

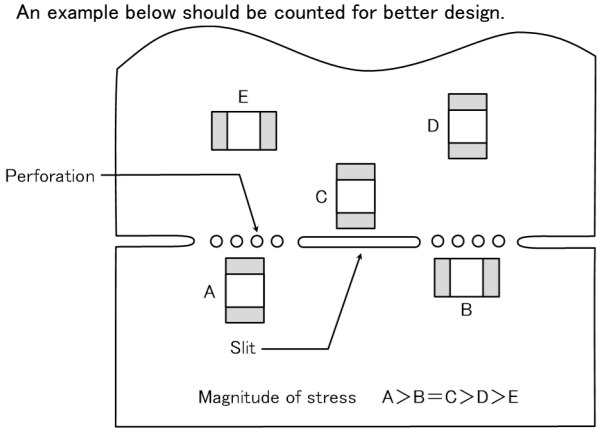
Hand-soldering of leaded components near mounted components		
Horizontal component placement		

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

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

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

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



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

3. Considerations for automatic placement

Precautions

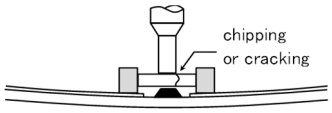
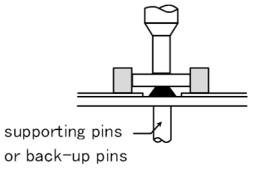
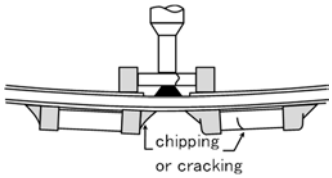
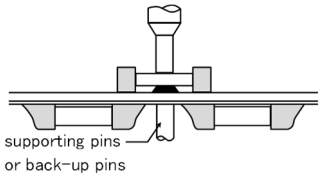
◆Adjustment of mounting machine

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

Technical considerations

◆Adjustment of mounting machine

1. If the lower limit of the pick-up nozzle is low, too much force may be imposed on the inductors, causing damage. To avoid this, the following points should be considered before lowering the pick-up nozzle:
   (1) The lower limit of the pick-up nozzle should be adjusted to the surface level of the PC board after correcting for deflection of the board.
   (2) The pick-up pressure should be adjusted between 1 and 3N static loads.
   (3) To reduce the amount of deflection of the board caused by impact of the pick-up nozzle, supporting pins or back-up pins should be used under the PC board. The following diagrams show some typical examples of good pick-up nozzle placement:

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

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

4. Soldering

Precautions

◆Reflow soldering

- Please contact any of our offices for a reflow soldering, and refer to the recommended condition specified.
- The product shall be used reflow soldering only.
- Please do not add any stress to a product until it returns in normal temperature after reflow soldering.

◆Lead free soldering

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

◆The conditions for Reworking with soldering irons

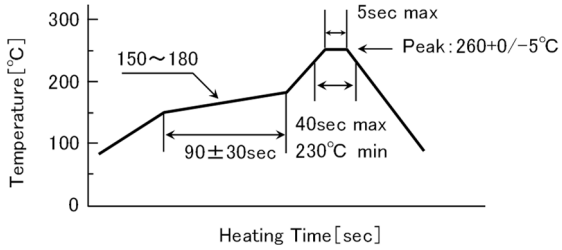
・Put the soldering iron on the land-pattern and don't touch it to the inductor directly.
Soldering iron's temperature below 350 ℃ , Duration 3 seconds or less

Technical considerations

◆Reflow soldering

- If products are used beyond the range of the recommended conditions, heat stresses may deform the products, and consequently degrade the reliability of the products.

Recommended reflow condition (Pb free solder)



The allowable number of reflow soldering is 3 times.

5. Cleaning

Precautions

◆Cleaning conditions

- Washing by supersonic waves shall be avoided.

Technical considerations

◆Cleaning conditions

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

6. Resin coating and mold	
Precautions	1. With some type of resins a decomposition gas or chemical reaction vapor may remain inside the resin during the hardening period or while left under normal storage conditions resulting in the deterioration of the inductor's performance. 2. Thermal expansion and thermal shrinkage characteristics of resins may lead to the deterioration of inductors' performance. 3. When a resin hardening temperature is higher than inductor operating temperature, the stresses generated by the excessive heat may lead to damage in inductors. 4. In prior to use, please make the reliability evaluation with the product mounted in your application set.

7. Handling	
Precautions	◆Breakaway PC boards (splitting along perforations) 1. When splitting the PC board after mounting inductors and other components, care is required so as not to give any stresses of deflection or twisting to the board. 2. Board separation should not be done manually, but by using the appropriate devices. ◆General handling precautions ・Always wear static control bands to protect against ESD. ・ Keep the inductors away from all magnets and magnetic objects. ・ Use non-magnetic tweezers when handling inductors. ・ Any devices used with the inductors (soldering irons, measuring instruments) should be properly grounded. ・ Keep bare hands and metal products (i.e., metal desk) away from inductor electrodes or conductive areas that lead to chip electrodes. ・ Keep inductors away from items that generate magnetic fields such as speakers or coils. ◆Mechanical considerations Be careful not to subject the inductors to excessive mechanical shocks. (1) If inductors are dropped on the floor or a hard surface they should not be used. (2) When handling the mounted boards, be careful that the mounted components do not come in contact with or bump against other boards or components.

8. Storage conditions	
Precautions	◆Storage To maintain the solderability of terminal electrodes and to keep the packaging material in good condition, care must be taken to control temperature and humidity in the storage area. Humidity should especially be kept as low as possible. ・Recommended conditions Ambient temperature: 30℃ or below Humidity: 30% to 70% The ambient temperature must be kept −5℃ to +40℃. Even under ideal storage conditions, solderability of inductor is deteriorated as time passes, so inductors should be used within 6 months from the time of delivery. ・Inductor should be kept where no chlorine or sulfur exists in the air.
Technical considerations	◆Storage If the parts are stocked in a high temperature and humidity environment, problems such as reduced solderability caused by oxidation of terminal electrodes and deterioration of taping/packaging materials may take place. For this reason, components should be used within 6 months from the time of delivery. If exceeding the above period, please check solderability before using the inductors.

医疗设备（国际（GHTF）第三类）用途 绕线型金属系功率电感器 MCOIL™ LMDN 系列

系列前的记号来自型号，用来区分产品的种类和特性等。

回流焊

■型号标示法

*使用温度范围 ： -40～125℃（包含产品本身发热）

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

①系列

代码 ⑴⑵⑶⑷	
LMDN	医疗设备（国际（GHTF）第三类）用途 绕线型金属系功率电感器

(1) 产品群

代码	
L	电感器

(2) 范畴

代码	推荐设备	品质等级
M	医疗设备（国际（GHTF）第三类）	2

(3) 类型

代码	
D	绕线型金属系 鼓型

(4) 特效 / 特性

代码	
N	一般功率扼流

②特征

代码	特征
D	底面电极（银×焊料）

③尺寸（L×W）

代码	尺寸（L×W）[mm]
2020	2.0×2.0
3030	3.0×3.0
4040	4.0×4.0

④尺寸（H）

代码	尺寸（H）[mm]
KK	1.0
MK	1.2
WK	2.0

⑤包装

代码	包装
T	卷盘带装

⑥标称电感值

代码（例）	标称电感值 [μH]
R47	0.47
1R0	1.0
4R7	4.7

※R＝小数点

⑦电感量公差

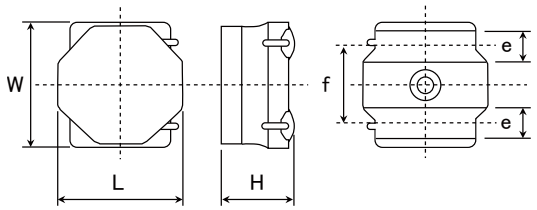
代码	电感量公差
M	±20%
N	±30%

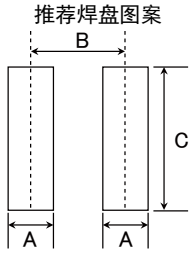
⑧个别规格

代码	个别规格
F	铁氧体外涂品
M	金属外涂品

⑨管理记号

■标准外型尺寸





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

单位：mm

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

单位：mm（inch）

■PART NUMBER

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

Notes)
・The exchange of individual specifications is necessary depending on your application and/or circuit condition. Please contact TAIYO YUDEN's official sales channel.
・The products are for Medical Devices classified as GHTF Class C (Japan Class Ⅲ).
Please consult with TAIYO YUDEN's official sales channel for the details of the product specifications, etc.,
and please review and approve the product specifications before ordering.

●2020KK type 【Thickness:1.0mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency[MHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LMDND2020KKTR47MM	MDKK2020TR47MM 8	0.47	±20%	0.046	3,500 (4,150)	2,200 (2,500)	1
LMDND2020KKTR68MM	MDKK2020TR68MM 8	0.68	±20%	0.060	3,200 (3,650)	2,000 (2,100)	1
LMDND2020KKT1R0MM	MDKK2020T1R0MM 8	1.0	±20%	0.085	2,900 (3,400)	1,700 (1,900)	1
LMDND2020KKT1R5MM	MDKK2020T1R5MM 8	1.5	±20%	0.133	1,900 (2,250)	1,350 (1,500)	1
LMDND2020KKT2R2MM	MDKK2020T2R2MM 8	2.2	±20%	0.165	1,650 (1,950)	1,200 (1,350)	1
LMDND2020KKT3R3MM	MDKK2020T3R3MM 8	3.3	±20%	0.275	1,300 (1,550)	940 (1,050)	1
LMDND2020KKT4R7MM	MDKK2020T4R7MM 8	4.7	±20%	0.435	1,050 (1,250)	750 (850)	1
LMDND2020KKT100MM	MDKK2020T100MM 8	10	±20%	0.690	750 (900)	630 (680)	1

Absolute maximum voltage:DC20V

●2020MK type 【Thickness:1.2mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency[MHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LMDND2020MKTR47MM	MDMK2020TR47MM 8	0.47	±20%	0.046	4,200 (4,800)	2,300 (2,450)	1
LMDND2020MKTR68MM	MDMK2020TR68MM 8	0.68	±20%	0.058	3,500 (4,100)	2,000 (2,200)	1
LMDND2020MKT1R0MM	MDMK2020T1R0MM 8	1.0	±20%	0.064	2,550 (2,900)	1,900 (2,050)	1
LMDND2020MKT1R5MM	MDMK2020T1R5MM 8	1.5	±20%	0.086	2,000 (2,300)	1,650 (1,750)	1
LMDND2020MKT2R2MM	MDMK2020T2R2MM 8	2.2	±20%	0.109	1,750 (2,000)	1,450 (1,550)	1
LMDND2020MKT3R3MM	MDMK2020T3R3MM 8	3.3	±20%	0.178	1,350 (1,550)	1,150 (1,200)	1
LMDND2020MKT4R7MM	MDMK2020T4R7MM 8	4.7	±20%	0.242	1,150 (1,300)	950 (1,050)	1

Absolute maximum voltage:DC20V

●3030KK type 【Thickness:1.0mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency[MHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LMDND3030KKTR47MM	MDKK3030TR47MM 8	0.47	±20%	0.039	5,400 (6,500)	3,900 (4,500)	1
LMDND3030KKT1R0MM	MDKK3030T1R0MM 8	1.0	±20%	0.086	4,400 (5,200)	2,400 (2,800)	1
LMDND3030KKT1R5MM	MDKK3030T1R5MM 8	1.5	±20%	0.100	3,000 (3,500)	2,100 (2,400)	1
LMDND3030KKT2R2MM	MDKK3030T2R2MM 8	2.2	±20%	0.144	2,500 (3,000)	1,900 (2,200)	1
LMDND3030KKT3R3MM	MDKK3030T3R3MM 8	3.3	±20%	0.248	2,000 (2,400)	1,350 (1,500)	1
LMDND3030KKT4R7MM	MDKK3030T4R7MM 8	4.7	±20%	0.345	1,700 (2,000)	1,150 (1,300)	1
LMDND3030KKT6R8MM	MDKK3030T6R8MM 8	6.8	±20%	0.437	1,400 (1,700)	1,000 (1,150)	1
LMDND3030KKT100MM	MDKK3030T100MM 8	10	±20%	0.575	1,100 (1,300)	850 (1,000)	1

Absolute maximum voltage:DC20V

●3030MK type 【Thickness:1.2mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency[MHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LMDND3030MKTR30MM	MDMK3030TR30MM 8	0.30	±20%	0.020	7,600 (9,200)	5,500 (6,400)	1
LMDND3030MKTR33MM	MDMK3030TR33MM 8	0.33	±20%	0.020	6,400 (8,700)	5,500 (6,400)	1
LMDND3030MKTR47MM	MDMK3030TR47MM 8	0.47	±20%	0.027	6,300 (7,500)	4,700 (5,500)	1
LMDND3030MKT1R0MM	MDMK3030T1R0MM 8	1.0	±20%	0.050	4,300 (5,100)	3,300 (3,900)	1
LMDND3030MKT1R5MM	MDMK3030T1R5MM 8	1.5	±20%	0.074	3,400 (4,100)	2,500 (3,000)	1
LMDND3030MKT2R2MM	MDMK3030T2R2MM 8	2.2	±20%	0.112	2,800 (3,600)	2,100 (2,400)	1
LMDND3030MKT3R3MM	MDMK3030T3R3MM 8	3.3	±20%	0.173	2,100 (2,700)	1,650 (1,900)	1
LMDND3030MKT4R7MM	MDMK3030T4R7MM 8	4.7	±20%	0.263	1,800 (2,300)	1,350 (1,550)	1

Absolute maximum voltage:DC20V

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

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

■PART NUMBER

●4040MK F type 【Thickness:1.2mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency[kHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LMDND4040MKTR47MF	MDMK4040TR47MF 8	0.47	±20%	0.029	7,500 (10,000)	4,600 (5,400)	100
LMDND4040MKT1R0MF	MDMK4040T1R0MF 8	1.0	±20%	0.047	5,200 (7,500)	3,500 (4,200)	100
LMDND4040MKT1R2MF	MDMK4040T1R2MF 8	1.2	±20%	0.047	4,200 (6,200)	3,500 (4,200)	100
LMDND4040MKT1R5MF	MDMK4040T1R5MF 8	1.5	±20%	0.065	3,700 (5,400)	3,300 (3,600)	100
LMDND4040MKT2R2MF	MDMK4040T2R2MF 8	2.2	±20%	0.092	3,200 (4,500)	2,500 (2,900)	100

Absolute maximum voltage:DC25V

●4040MK type 【Thickness:1.2mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency[MHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LMDND4040MKTR68MM	MDMK4040TR68MM 8	0.68	±20%	0.029	6,700 (7,800)	5,000 (5,700)	1
LMDND4040MKT1R0MM	MDMK4040T1R0MM 8	1.0	±20%	0.036	5,000 (6,200)	4,500 (5,100)	1
LMDND4040MKT1R5MM	MDMK4040T1R5MM 8	1.5	±20%	0.065	4,500 (5,600)	3,200 (3,600)	1
LMDND4040MKT2R2MM	MDMK4040T2R2MM 8	2.2	±20%	0.079	3,800 (4,500)	2,800 (3,200)	1
LMDND4040MKT3R3MM	MDMK4040T3R3MM 8	3.3	±20%	0.130	3,200 (4,000)	2,200 (2,500)	1
LMDND4040MKT4R7MM	MDMK4040T4R7MM 8	4.7	±20%	0.160	2,500 (3,000)	1,900 (2,200)	1
LMDND4040MKT6R8MM	MDMK4040T6R8MM 8	6.8	±20%	0.230	1,900 (2,200)	1,600 (1,800)	1
LMDND4040MKT100MM	MDMK4040T100MM 8	10	±20%	0.330	1700 (2,000)	1,400 (1,600)	1

Absolute maximum voltage:DC25V

●4040WK type 【Thickness:2.0mm max】

New part number	Old part number (for reference)	Nominal inductance [μH]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency[MHz]
					Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)	
LMDND4040WKTR56NM	MDWK4040TR56NM 8	0.56	±20%	0.016	9,000 (13,000)	6,500 (7,500)	1
LMDND4040WKTR68MM	MDWK4040TR68MM 8	0.68	±20%	0.016	8,000 (12,000)	7,300 (8,300)	1
LMDND4040WKT1R0MM	MDWK4040T1R0MM 8	1.0	±20%	0.027	7,000 (9,400)	5,100 (5,800)	1
LMDND4040WKT1R5MM	MDWK4040T1R5MM 8	1.5	±20%	0.041	7,000 (9,400)	4,100 (4,700)	1
LMDND4040WKT2R2MM	MDWK4040T2R2MM 8	2.2	±20%	0.054	5,400 (7,500)	3,500 (4,000)	1
LMDND4040WKT3R3MM	MDWK4040T3R3MM 8	3.3	±20%	0.075	3,700 (5,200)	3,000 (3,300)	1
LMDND4040WKT4R7MM	MDWK4040T4R7MM 8	4.7	±20%	0.107	3,500 (5,000)	2,500 (2,800)	1
LMDND4040WKT6R8MM	MDWK4040T6R8MM 8	6.8	±20%	0.158	2,900 (4,000)	2,000 (2,300)	1
LMDND4040WKT100MM	MDWK4040T100MM 8	10	±20%	0.194	2,200 (3,100)	1,600 (1,900)	1

Absolute maximum voltage:DC25V

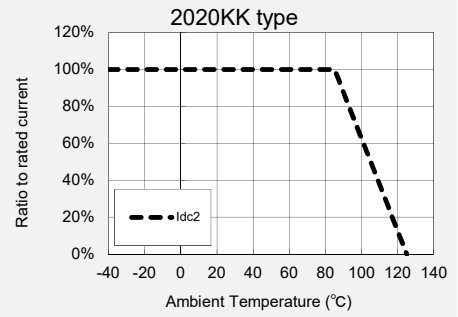
※) The saturation current value (Idc1) is the DC current value having inductance decrease down to 30%. (at 20℃)
※1-1) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40℃, when mounted in FR4 High heat dissipation board (board thickness:1.0mm copper thickness:0.035mm,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

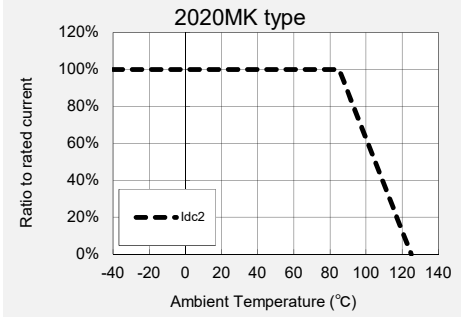
※1-1) 2020KK, 2020MK type
※1-2) 3030KK, 3030MK type
※1-3) 4040MK, 4040WK type

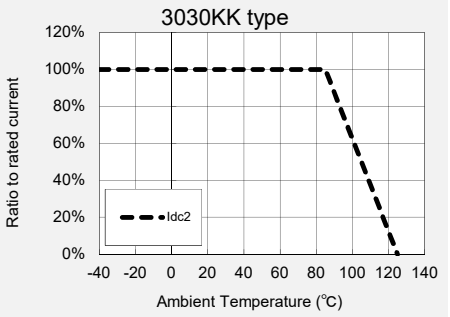
Derating of Rated Current

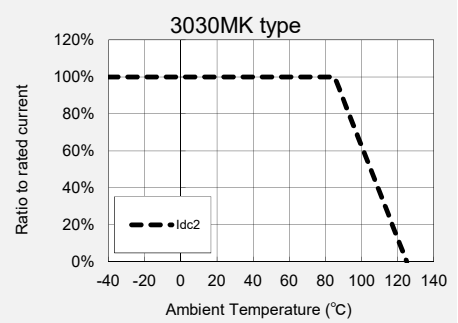
LMDN series

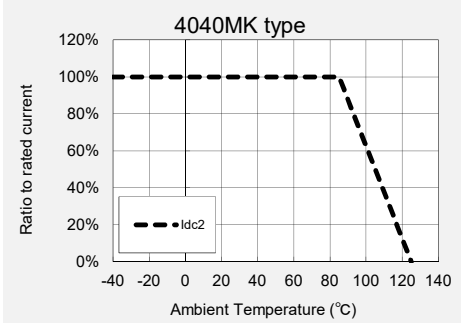
Derating of current is necessary for LMDN series depending on ambient temperature.
Please refer to the chart shown below for appropriate derating of current.

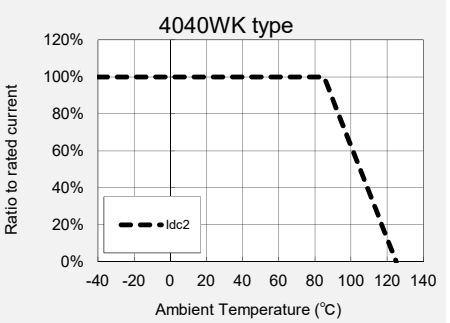












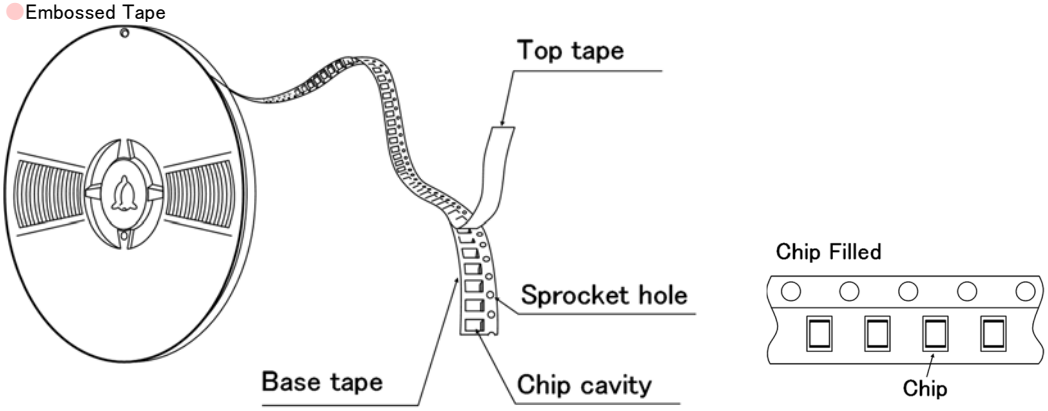
■PACKAGING

①Minimum Quantity

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

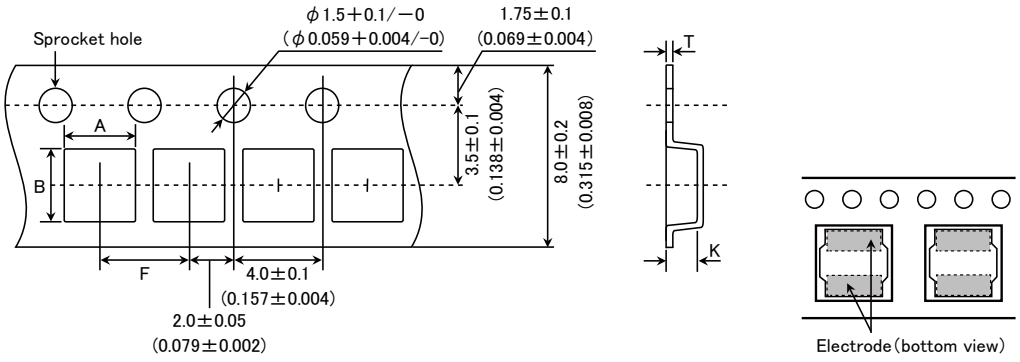
②Tape Material

●Embossed Tape



③Taping dimensions

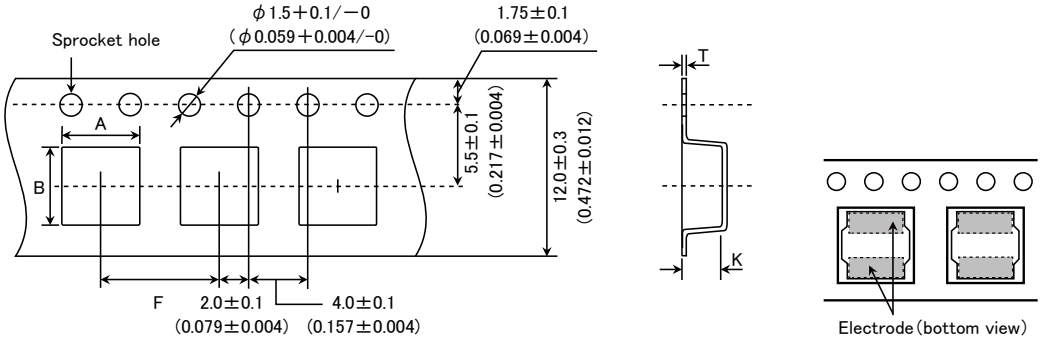
●Embossed tape 8mm wide (0.315 inches wide)



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

Unit : mm (inch)

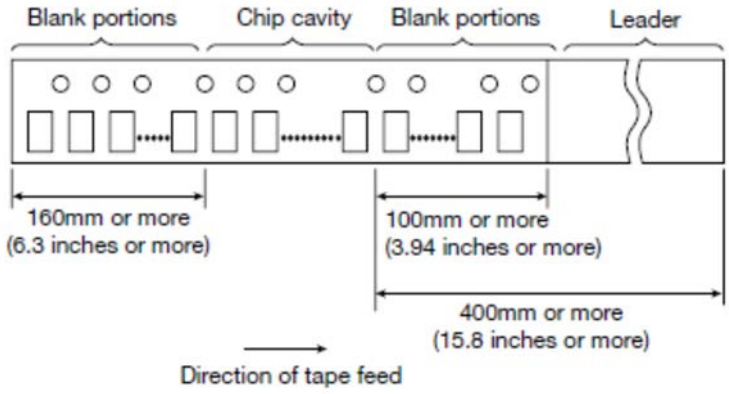
Embossed tape 12mm wide (0.47 inches wide)



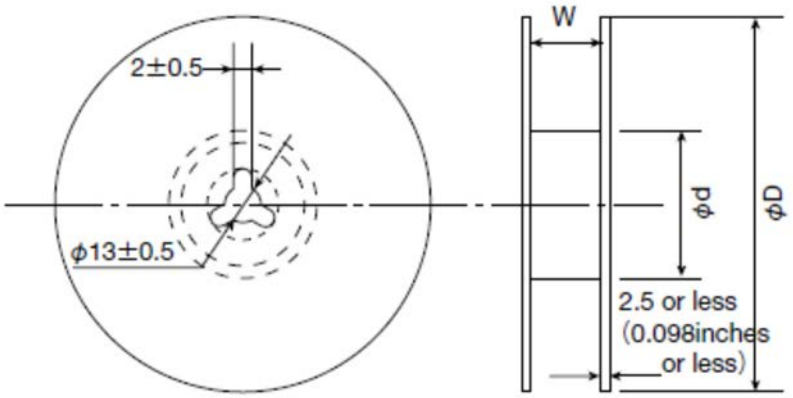
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
4040JE 4040MK	4.3±0.1 (0.169±0.004)	4.3±0.1 (0.169±0.004)	8.0±0.1 (0.315±0.004)	0.3±0.05 (0.012±0.002)	1.6±0.1 (0.063±0.004)
4040WK	4.3±0.1 (0.169±0.004)	4.3±0.1 (0.169±0.004)	8.0±0.1 (0.315±0.004)	0.3±0.05 (0.012±0.002)	2.3±0.1 (0.091±0.004)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

Unit : mm (inch)

④Leader and Blank portion



⑤Reel size



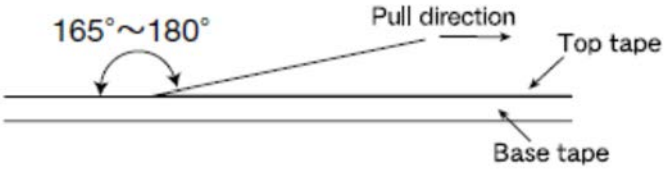
Type	Reel size (Reference values)		
	φD	φd	W
1616KK	180±0.5 (7.087±0.019)	60±1.0 (2.36±0.04)	10.0±1.5 (0.394±0.059)
2020JE 2020KK 2020MK			
3030KK 3030MK			
4040JE 4040MK 4040WK	180±3.0 (7.087±0.118)	60±2.0 (2.36±0.08)	14.0±1.5 (0.551±0.059)
5050PK			

Unit : mm (inch)

⑥Top Tape Strength

Top tape strength

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



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

■RELIABILITY DATA

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

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

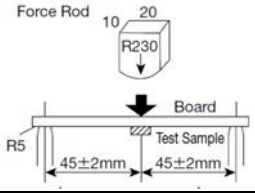
3. Rated current	
Specified Value	Within the specified tolerance

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

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

6. Self resonance frequency	
Specified Value	—

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

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

9. Insulation resistance : between wires	
Specified Value	—

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

20. High temperature life test	
Specified Value	—

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

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

■PRECAUTIONS

1. Circuit Design

Precautions

◆Verification of operating environment, electrical rating and performance

1. A malfunction in medical equipment, spacecraft, nuclear reactors, etc. may cause serious harm to human life or have severe social ramifications. As such, any inductors to be used in such equipment may require higher safety and/or reliability considerations and should be clearly differentiated from components used in general purpose applications.
2. When inductors are used in places where dew condensation develops and/or where corrosive gas such as hydrogen sulfide, sulfurous acid, or chlorine exists in the air, characteristic deterioration may occur. Please do not use inductors under such environmental conditions.

◆Operating Current (Verification of Rated current)

1. The operating current including inrush current for inductors must always be lower than their rated values.
2. Do not apply current in excess of the rated value because the inductance may be reduced due to the magnetic saturation effect.

◆Temperature rise

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

2. PCB Design

Precautions

◆Land pattern design

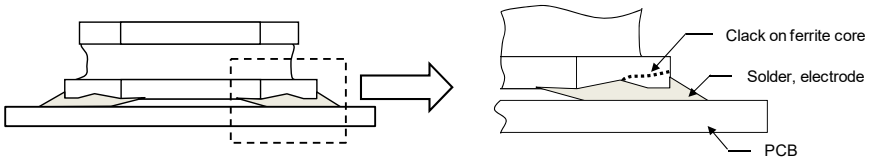
1. Please refer to a recommended land pattern.
2. There is stress, which has been caused by distortion of a PCB, to the inductor.
3. Please consider the arrangement of parts on a PCB.

Technical considerations

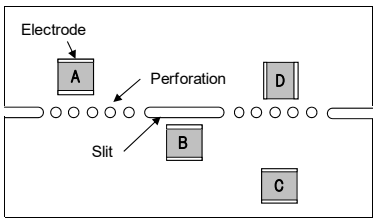
◆Land pattern design

Surface Mounting

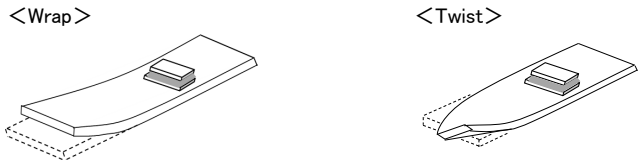
1. Mounting and soldering conditions should be checked beforehand.
2. Applicable soldering process to this products is reflow soldering only.
3. Please use the recommended land pattern shown as below. Electrical characteristics and the mounting ability of the product are being considered in the recommended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

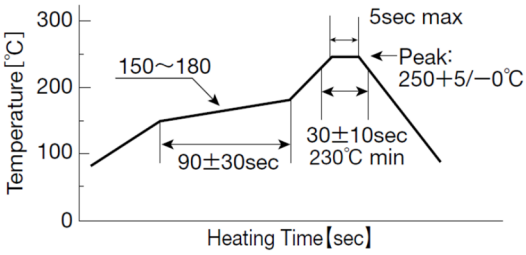


5. SMD inductors should be located to minimize any possible mechanical stresses from board warp or deflection. When splitting the PC board after mounting inductors and other components, care is required so as not to give any stresses of deflection or twisting to the board.



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

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

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

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

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

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