

Notice for TAIYO YUDEN products

Please read this notice before using the TAIYO YUDEN products.

REMINDERS

- Product information in this catalog is as of October 2012. All of the contents specified herein are subject to change without notice due to technical improvements, etc. Therefore, please check for the latest information carefully before practical application or usage of the Products.

Please note that Taiyo Yuden Co., Ltd. shall not be responsible for any defects in products or equipment incorporating such products, which are caused under the conditions other than those specified in this catalog or individual specification.

- Please contact Taiyo Yuden Co., Ltd. for further details of product specifications as the individual specification is available.
- Please conduct validation and verification of products in actual condition of mounting and operating environment before commercial shipment of the equipment.
- All electronic components or functional modules listed in this catalog are developed, designed and intended for use in general electronics equipment.(for AV, office automation, household, office supply, information service, telecommunications, (such as mobile phone or PC) etc.). Before incorporating the components or devices into any equipment in the field such as transportation,(automotive control, train control, ship control), transportation signal, disaster prevention, medical, public information network (telephone exchange, base station) etc. which may have direct influence to harm or injure a human body, please contact Taiyo Yuden Co., Ltd. for more detail in advance. Do not incorporate the products into any equipment in fields such as aerospace, aviation, nuclear control, submarine system, military, etc. where higher safety and reliability are especially required.

In addition, even electronic components or functional modules that are used for the general electronic equipment, if the equipment or the electric circuit require high safety or reliability function or performances, a sufficient reliability evaluation check for safety shall be performed before commercial shipment and moreover, due consideration to install a protective circuit is strongly recommended at customer's design stage.

- The contents of this catalog are applicable to the products which are purchased from our sales offices or distributors (so called "TAIYO YUDEN' s official sales channel").
It is only applicable to the products purchased from any of TAIYO YUDEN' s official sales channel.
- Please note that Taiyo Yuden Co., Ltd. shall have no responsibility for any controversies or disputes that may occur in connection with a third party's intellectual property rights and other related rights arising from your usage of products in this catalog. Taiyo Yuden Co., Ltd. grants no license for such rights.

- Caution for export
Certain items in this catalog may require specific procedures for export according to "Foreign Exchange and Foreign Trade Control Law" of Japan, "U.S. Export Administration Regulations", and other applicable regulations. Should you have any question or inquiry on this matter, please contact our sales staff.

METAL CORE SMD POWER INDUCTORS(MCOIL™ MD SERIES)



REFLOW

PARTS NUMBER

M	D	K	K	1	6	1	6	T	1	R	0	M	M	△
①	②	③	④	⑤	⑥	⑦	⑧							

△=Blank space

①Series name

Code	Series name
MD	Metal base coil specification

②Dimensions (H)

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

③Dimensions (L × W)

Code	Dimensions (L × W) [mm]
1616	1.6 × 1.6
2020	2.0 × 2.0
4040	4.0 × 4.0

④Packaging

Code	包装
T	Taping

⑤Nominal inductance

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

※R=Decimal point

⑥Inductance tolerance

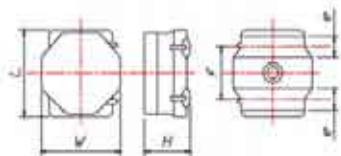
Code	Inductance tolerance
M	±20%

⑦Special code

Code	Special code
F	Ferrite coating
M	Metal coating

⑧Internal code

STANDARD EXTERNAL DIMENSIONS



Type	L	W	H	e	f	Standard quantity [pcs]
MDKK1616	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
MDMK2020	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
MDMK4040	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

Unit: mm(inch)

PARTS NUMBER

MDKK1616 type

Parts number	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency [MHz]
						Saturation current Idc1	Temperature rise current Idc2	
MDKK1616TR47MM	RoHS	0.47	±20%	-	0.095	3,300	1,500	1
MDKK1616T1R0MM	RoHS	1.0	±20%	-	0.140	2,200	1,200	1
MDKK1616T1R5MM	RoHS	1.5	±20%	-	0.185	1,750	1,100	1
MDKK1616T2R2MM	RoHS	2.2	±20%	-	0.250	1,500	950	1
MDKK1616T3R3MM	RoHS	3.3	±20%	-	0.515	1,150	650	1
MDKK1616T4R7MM	RoHS	4.7	±20%	-	0.640	950	550	1

MDMK2020 type

Parts number	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency [MHz]
						Saturation current Idc1	Temperature rise current Idc2	
MDMK2020TR47MM	RoHS	0.47	±20%	-	0.046	4,200	2,300	1
MDMK2020T1R0MM	RoHS	1.0	±20%	-	0.064	2,550	1,900	1
MDMK2020T1R5MM	RoHS	1.5	±20%	-	0.086	2,000	1,650	1
MDMK2020T2R2MM	RoHS	2.2	±20%	-	0.109	1,750	1,450	1
MDMK2020T3R3MM	RoHS	3.3	±20%	-	0.178	1,350	1,150	1
MDMK2020T4R7MM	RoHS	4.7	±20%	-	0.242	1,150	950	1

MDMK4040 type

Parts number	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz] (min.)	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency [kHz]
						Saturation current Idc1	Temperature rise current Idc2	
MDMK4040TR47MF	RoHS	0.47	±20%	-	0.029	7,500	4,600	100
MDMK4040T1R0MF	RoHS	1.0	±20%	-	0.047	5,200	3,500	100
MDMK4040T1R2MF	RoHS	1.2	±20%	-	0.047	4,200	3,500	100
MDMK4040T1R5MF	RoHS	1.5	±20%	-	0.065	3,700	3,300	100
MDMK4040T2R2MF	RoHS	2.2	±20%	-	0.092	3,200	2,500	100

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

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

※) The rated current is the DC current value that satisfies both of current value saturation current value and temperature rise current value.

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METAL CORE SMD POWER INDUCTORS (MCOIL™ MD SERIES)

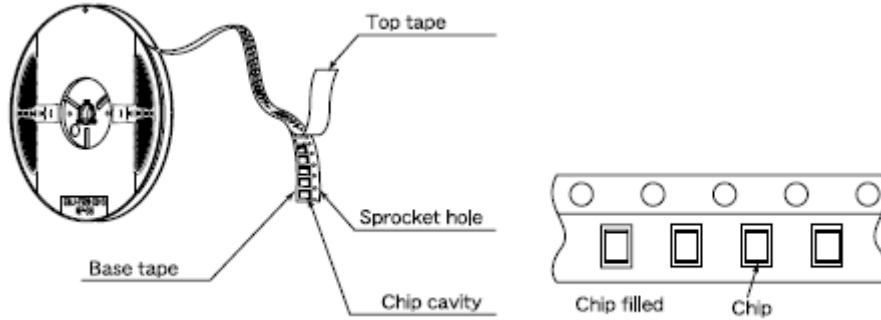
PACKAGING

① Minimum Quantity

Type	Standard Quantity [pcs]
	Tape & Reel
MDKK 1616	2500
MDMK 2020	2500
MDMK 4040	1000

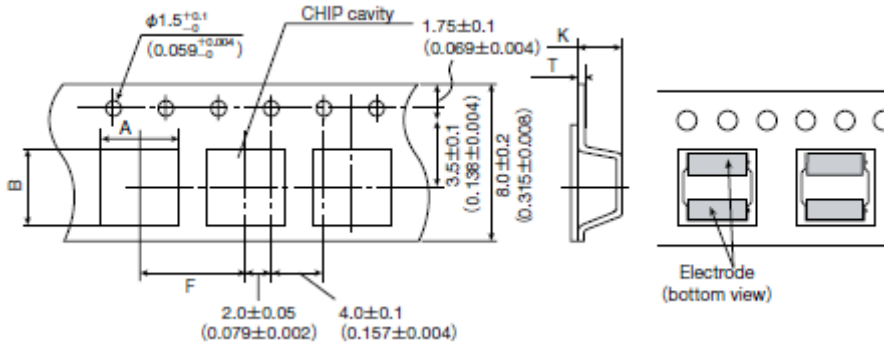
② Tape Material

● Embossed Tape



③ Taping dimensions

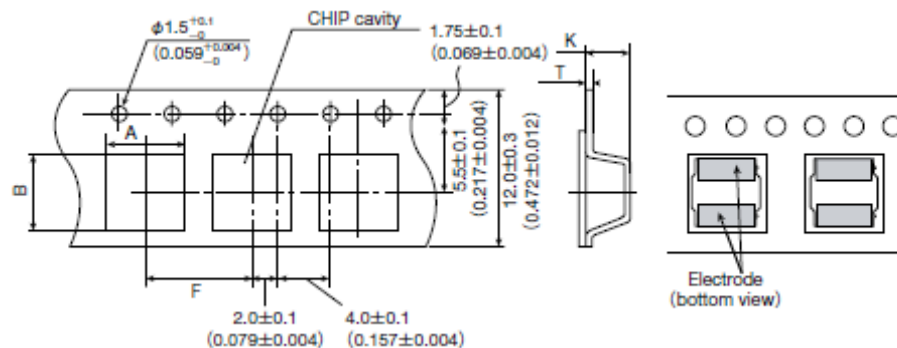
● Embossed tape 8mm wide (0.315 inches wide)



Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B		T	K
MDKK 1616	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)
MDMK 2020	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)

Unit: mm (inch)

● Embossed tape 12mm wide (0.47 inches wide)

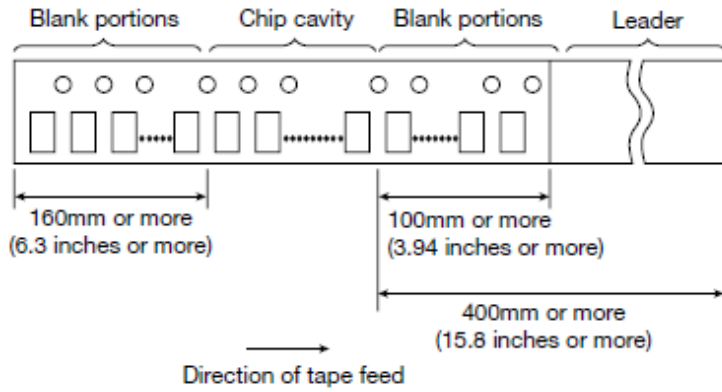


Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B		T	K
MDMK 4040	4.3 ± 0.1 (0.169 ± 0.004)	4.3 ± 0.1 (0.169 ± 0.004)	8.0 ± 0.1 (0.315 ± 0.004)	0.3 ± 0.1 (0.012 ± 0.004)	1.6 ± 0.1 (0.063 ± 0.004)

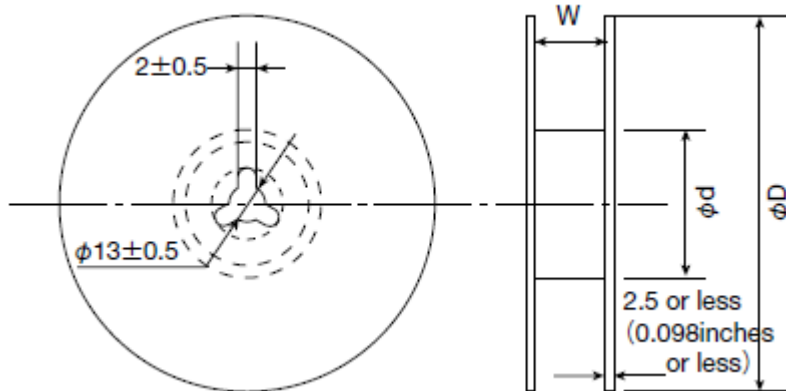
Unit: mm (inch)

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④ Leader and Blank portion



⑤ Reel size

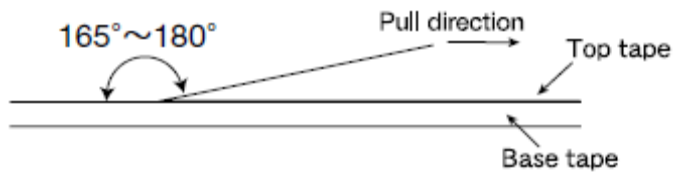


Type	Reel size (Reference values)		
	ϕD	ϕd	W
MDKK 1616	180 ± 0.5	60 ± 1.0	10.0 ± 1.5
MDMK 2020	(7.087 ± 0.019)	(2.36 ± 0.04)	(0.394 ± 0.059)
MDMK 4040	180 ± 3.0	60 ± 2.0	14.0 ± 1.5
	(7.087 ± 0.118)	(2.36 ± 0.08)	(0.551 ± 0.059)

Unit: mm (inch)

⑥ Top Tape Strength

The top tape requires a peel-off force of 0.1 to 1.3N in the direction of the arrow as illustrated below.



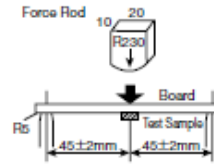
METAL CORE SMD POWER INDUCTORS (MCOIL™ MD SERIES)

RELIABILITY DATA

1. Operating Temperature Range		
Specified Value	MDKK 1616	-40~+125°C
	MDMK 2020	
	MDMK 4040	
Test Methods and Remarks	Including self-generated heat	
2. Storage Temperature Range		
Specified Value	MDKK 1616	-40~+85°C
	MDMK 2020	
	MDMK 4040	
Test Methods and Remarks	-5 to 40°C for the product with taping.	
3. Rated current		
Specified Value	MDKK 1616	Within the specified tolerance
	MDMK 2020	
	MDMK 4040	
4. Inductance		
Specified Value	MDKK 1616	Within the specified tolerance
	MDMK 2020	
	MDMK 4040	
Test Methods and Remarks	Measuring equipment : LCR Meter (HP 4285A or equivalent) Measuring frequency : MDKK1616, MDMK2020: 1MHz 1V MDMK4040: 100kHz 1V	
5. DC Resistance		
Specified Value	MDKK 1616	Within the specified tolerance
	MDMK 2020	
	MDMK 4040	
Test Methods and Remarks	Measuring equipment : DC ohmmeter (HIOKI 3227 or equivalent)	
6. Self resonance frequency		
Specified Value	MDKK 1616	-
	MDMK 2020	
	MDMK 4040	
7. Temperature characteristic		
Specified Value	MDKK 1616	Inductance change : Within ±10%
	MDMK 2020	
	MDMK 4040	
Test Methods and Remarks	Measurement of inductance shall be taken at temperature range within -40°C~+125°C. With reference to inductance value at +20°C., change rate shall be calculated.	

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8. Resistance to flexure of substrate		
Specified Value	MDKK 1616	No damage
	MDMK 2020	
	MDMK 4040	
Test Methods and Remarks	<p>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.</p> <p>Test board size : 100 × 40 × 1.0 mm Test board material : glass epoxy-resin Solder cream thickness : 0.10 mm</p>	



9. Insulation resistance : between wires		
Specified Value	MDKK 1616	—
	MDMK 2020	
	MDMK 4040	

10. Insulation resistance : between wire and core		
Specified Value	MDKK 1616	—
	MDMK 2020	
	MDMK 4040	

11. Withstanding voltage : between wire and core		
Specified Value	MDKK 1616	—
	MDMK 2020	
	MDMK 4040	

12. Adhesion of terminal electrode		
Specified Value	MDKK 1616	Shall not come off PC board
	MDMK 2020	
	MDMK 4040	
Test Methods and Remarks	<p>The test samples shall be soldered to the test board by the reflow.</p> <p>Applied force : 10N to X and Y directions. Duration : 5s. Solder cream thickness : 0.15mm.</p>	

13. Resistance to vibration		
Specified Value	MDKK 1616	Inductance change : Within $\pm 10\%$ No significant abnormality in appearance.
	MDMK 2020	
	MDMK 4040	

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	<table border="1"> <tr> <td>X</td> <td rowspan="3">For 2 hours on each X, Y, and Z axis.</td> </tr> <tr> <td>Y</td> </tr> <tr> <td>Z</td> </tr> </table>	X	For 2 hours on each X, Y, and Z axis.	Y
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	MDKK 1616	At least 90% of surface of terminal electrode is covered by new solder.
	MDMK 2020	
	MDMK 4040	
Test Methods and Remarks	The test samples shall be dipped in flux, and then immersed in molten solder as shown in below table. Flux : Methanol solution containing rosin 25%.	
	Solder Temperature	245±5°C
	Time	5±1.0 sec.
※Immersion depth : All sides of mounting terminal shall be immersed.		

15. Resistance to soldering heat		
Specified Value	MDKK 1616	Inductance change : Within ±10% No significant abnormality in appearance.
	MDMK 2020	
	MDMK 4040	
Test Methods and Remarks	The test sample shall be exposed to reflow oven at 230±5°C for 40 seconds, with peak temperature at 260±5°C for 5 seconds, 2 times.	
	Test board material	: glass epoxy-resin
	Test board thickness	: 1.0mm

16. Thermal shock			
Specified Value	MDKK 1616	Inductance change : Within ±10% No significant abnormality in appearance.	
	MDMK 2020		
	MDMK 4040		
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 (°C)	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	MDKK 1616	Inductance change : Within ±10% No significant abnormality in appearance.
	MDMK 2020	
	MDMK 4040	
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°C
	Humidity	90~95%RH
	Time	500+24/-0 hour

18. Loading under damp heat		
Specified Value	MDKK 1616	Inductance change : Within ±10% No significant abnormality in appearance.
	MDMK 2020	
	MDMK 4040	
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°C
	Humidity	90~95%RH
	Applied current	Rated current
	Time	500+24/-0 hour

19. Low temperature life test		
Specified Value	MDKK 1616	Inductance change : Within $\pm 10\%$ No significant abnormality in appearance.
	MDMK 2020	
	MDMK 4040	
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	$-40 \pm 2^{\circ}\text{C}$
	Time	500+24/-0 hour

20. High temperature life test		
Specified Value	MDKK 1616	Inductance change : Within $\pm 10\%$ No significant abnormality in appearance.
	MDMK 2020	
	MDMK 4040	
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	$105 \pm 3^{\circ}\text{C}$
	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	MDKK 1616	Inductance change : Within $\pm 10\%$ No significant abnormality in appearance.
	MDMK 2020	
	MDMK 4040	
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	$85 \pm 2^{\circ}\text{C}$
	Applied current	Rated current
	Time	500+24/-0 hour

22. Standard condition		
Specified Value	MDKK 1616	Standard test condition : Unless otherwise specified, temperature is $20 \pm 15^{\circ}\text{C}$ and $65 \pm 20\%$ of relative humidity. When there is any question concerning measurement result: In order to provide correlation data, the test shall be condition of $20 \pm 2^{\circ}\text{C}$ of temperature, $65 \pm 5\%$ relative humidity. Inductance is in accordance with our measured value.
	MDMK 2020	
	MDMK 4040	

METAL CORE SMD POWER INDUCTORS (MCOIL™ MD SERIES)

PRECAUTIONS

1. Circuit Design	
Precautions	<ul style="list-style-type: none"> ◆ Operating environment <ol style="list-style-type: none"> 1. The products described in this specification are intended for use in general electronic equipment, (office supply equipment, telecommunications systems, measuring equipment, and household equipment). They are not intended for use in mission-critical equipment or systems requiring special quality and high reliability (traffic systems, safety equipment, aerospace systems, nuclear control systems and medical equipment including life-support systems,) where product failure might result in loss of life, injury or damage. For such uses, contact TAIYO YUDEN Sales Department in advance.
2. PCB Design	
Precautions	<ul style="list-style-type: none"> ◆ Land pattern design <ol style="list-style-type: none"> 1. Please refer to a recommended land pattern.
Technical considerations	<ul style="list-style-type: none"> ◆ Land pattern design <ul style="list-style-type: none"> Surface Mounting <ul style="list-style-type: none"> • Mounting and soldering conditions should be checked beforehand. • Applicable soldering process to this products is reflow soldering only.
3. Considerations for automatic placement	
Precautions	<ul style="list-style-type: none"> ◆ Adjustment of mounting machine <ol style="list-style-type: none"> 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	<ul style="list-style-type: none"> ◆ Adjustment of mounting machine <ol style="list-style-type: none"> 1. When installing products, care should be taken not to apply distortion stress as it may deform the products.
4. Soldering	
Precautions	<ul style="list-style-type: none"> ◆ Reflow soldering <ol style="list-style-type: none"> 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 <ol style="list-style-type: none"> 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. ◆ Recommended conditions for using a soldering iron (NR10050 Type) <ul style="list-style-type: none"> • Put the soldering iron on the land-pattern. • Soldering iron's temperature - Below 350°C • Duration - 3 seconds or less • The soldering iron should not directly touch the inductor.
Technical considerations	<ul style="list-style-type: none"> ◆ Reflow soldering <ol style="list-style-type: none"> 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. <ul style="list-style-type: none"> • NR30/40/50/60/80, NRV20/30, NRH24/30, NRS20/40/50/60/80 Type, NR10050 Type, NS101/125 Type <p style="margin-left: 20px;">Recommended reflow condition (Pb free solder)</p> <p style="margin-left: 20px;">Temperature [°C]</p> <p style="margin-left: 20px;">Heating Time [sec]</p>
5. Cleaning	
Precautions	<ul style="list-style-type: none"> ◆ Cleaning conditions <ol style="list-style-type: none"> 1. Washing by supersonic waves shall be avoided.
Technical considerations	<ul style="list-style-type: none"> ◆ Cleaning conditions <ol style="list-style-type: none"> 1. If washed by supersonic waves, the products might be broken.

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6. Handling	
Precautions	<ul style="list-style-type: none"> ◆ Handling <ol style="list-style-type: none"> 1. Keep the product away from all magnets and magnetic objects. ◆ Breakaway PC boards (splitting along perforations) <ol style="list-style-type: none"> 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 <ol style="list-style-type: none"> 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 <ol style="list-style-type: none"> 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 <ol style="list-style-type: none"> 1. Please avoid accumulation of a packing box as much as possible. ◆ Board mounting <ol style="list-style-type: none"> 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	<ul style="list-style-type: none"> ◆ Handling <ol style="list-style-type: none"> 1. There is a case that a characteristic varies with magnetic influence. ◆ Breakaway PC boards (splitting along perforations) <ol style="list-style-type: none"> 1. The position of the product on PCBs shall be carefully considered to minimize the stress caused from splitting of the PCBs. ◆ Mechanical considerations <ol style="list-style-type: none"> 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 <ol style="list-style-type: none"> 1. Damage and a characteristic can vary with an excessive shock or stress. ◆ Packing <ol style="list-style-type: none"> 1. If packing boxes are accumulated, that could cause a deformation on packing tapes or a damage on the products. ◆ Board mounting <ol style="list-style-type: none"> 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	<ul style="list-style-type: none"> ◆ Storage <ol style="list-style-type: none"> 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. <ul style="list-style-type: none"> • Recommended conditions <ul style="list-style-type: none"> Ambient temperature : $-5\sim 40^{\circ}\text{C}$ Humidity : Below 70% RH • The ambient temperature must be kept below 30°C. 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	<ul style="list-style-type: none"> ◆ Storage <ol style="list-style-type: none"> 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.