

Notice for TAIYO YUDEN Products

[For High Quality and/or Reliability Equipment
(Automotive Electronic Equipment / Industrial Equipment)]

Please read this notice before using the TAIYO YUDEN products.

REMINDERS

- Product information in this catalog is as of October 2018. 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 use of our products.

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

- Please contact TAIYO YUDEN for further details of product specifications as the individual product specification sheets are available.
- Please conduct validation and verification of our products in actual condition of mounting and operating environment before using our products.
- The products listed in this catalog are intended for use in general electronic equipment (e.g., AV equipment, OA equipment, home electric appliances, office equipment, information and communication equipment), medical equipment classified as Class I or II by IMDRF, industrial equipment, and automotive interior applications, etc. Please be sure to contact TAIYO YUDEN for further information before using the products for any equipment which may directly cause loss of human life or bodily injury (e.g., transportation equipment including, without limitation, automotive powertrain control system, train control system, and ship control system, traffic signal equipment, medical equipment classified as Class III by IMDRF).

Please do not incorporate our products into any equipment requiring high levels of safety and/or reliability (e.g., aerospace equipment, aviation equipment*, medical equipment classified as Class IV by IMDRF, nuclear control equipment, undersea equipment, military equipment).

*Note: There is a possibility that our products can be used only for aviation equipment that does not directly affect the safe operation of aircraft (e.g., in-flight entertainment, cabin light, electric seat, cooking equipment) if such use meets requirements specified separately by TAIYO YUDEN. Please be sure to contact TAIYO YUDEN for further information before using our products for such aviation equipment.

When our products are used even for high safety and/or reliability-required devices or circuits of general electronic equipment, it is strongly recommended to perform a thorough safety evaluation prior to use of our products and to install a protection circuit as necessary.

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

- Information contained in this catalog is intended to convey examples of typical performances and/or applications of our products and is not intended to make any warranty with respect to the intellectual property rights or any other related rights of TAIYO YUDEN or any third parties nor grant any license under such rights.
- Please note that the scope of warranty for our products is limited to the delivered our products themselves and TAIYO YUDEN shall not be in any way responsible for any damages resulting from a fault or defect in our products. Notwithstanding the foregoing, if there is a written agreement (e.g., supply and purchase agreement, quality assurance agreement) signed by TAIYO YUDEN and your company, TAIYO YUDEN will warrant our products in accordance with such agreement.
- The contents of this catalog are applicable to our products which are purchased from our sales offices or authorized distributors (hereinafter "TAIYO YUDEN's official sales channel"). Please note that the contents of this catalog are not applicable to our products purchased from any seller other than TAIYO YUDEN's official sales channel.

■ Caution for Export

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

Automotive Application Guide

We classify automotive electronic equipment into the following four application categories and set usable application categories for each of our products. When using our products for automotive electronic equipment, please be sure to check such application categories and use our products accordingly. Should you have any questions on this matter, please contact us.

Category	Automotive Electronic Equipment (Typical Example)
POWERTRAIN	<ul style="list-style-type: none"> • Engine ECU (Electronically Controlled Fuel Injector) • Cruise Control Unit • 4WS (4 Wheel Steering) • Automatic Transmission • Power Steering • HEV/PHV/EV Core Control (Battery, Inverter, DC-DC) • Automotive Locator (Car location information providing device), etc.
SAFETY	<ul style="list-style-type: none"> • ABS (Anti-Lock Brake System) • ESC (Electronic Stability Control) • Airbag • ADAS (Equipment that directly controls running, turning and stopping), etc.
BODY & CHASSIS	<ul style="list-style-type: none"> • Wiper • Automatic Door • Power Window • Keyless Entry System • Electric Door Mirror • Interior Lighting • LED Headlight • TPMS (Tire Pressure Monitoring System) • Anti-Theft Device (Immobilizer), etc.
INFOTAINMENT	<ul style="list-style-type: none"> • Car Infotainment System • ITS/Telematics System • Instrument Cluster • ADAS (Sensor, Equipment that is not interlocked with safety equipment or powertrain), etc.

METAL CORE SMD POWER INDUCTORS(MCOIL™ MD SERIES)



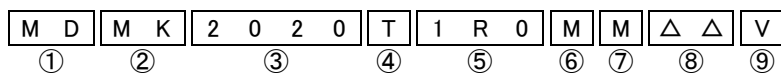
REFLOW
AEC-Q200

AEC-Q200 Grade 3 (we conduct the evaluation at the test condition of Grade 3.)

*Operating environment Temp:-40~85°C

PART NUMBER

*Operating Temp. : -40~125°C(Including self-generated heat)



Δ=Blank space

①Series name

Code	Series name
MD	Metal base coil specification

②Dimensions(H)

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

③Dimensions(L×W)

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

④Packaging

Code	Packaging
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%
N	±30%

⑦Special code 1

Code	Special code
F	Ferrite coating
M	Metal coating

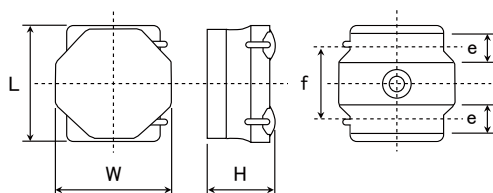
⑧Special code 2

Code	Special code
ΔΔ	Standard

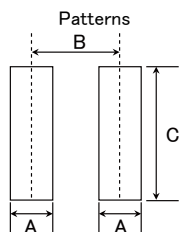
⑨Internal code

Code	Internal code
V	Inductor for Industrial and Automotive

STANDARD EXTERNAL DIMENSIONS



Recommended Land Patterns



Type	A	B	C
MDKK2020	0.65	1.35	2.0
MDMK2020			
MDKK3030	0.8	2.2	2.7
MDMK3030			
MDMK4040/ MDWK4040	1.2	2.8	3.7

Unit:mm

Type	L	W	H	e	f	Standard quantity [pcs] Taping
MDKK2020	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
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
MDKK3030	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
MDMK3030	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
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
MDWK4040	4.0±0.2 (0.157±0.008)	4.0±0.2 (0.157±0.008)	2.0 max (0.079 max)	1.1±0.2 (0.043±0.008)	2.5±0.2 (0.098±0.008)	700

Unit:mm (inch)

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PART NUMBER

• All the Metal Core SMD Power Inductors of the catalog lineup are RoHS compliant.

Note)

• The exchange of individual specifications is necessary depending on the application and circuit condition. Please contact Taiyo Yuden sales channels.

• *1: Automotive (AEC-Q200 Qualified) products for BODY & CHASSIS, and INFOTAINMENT. Please check "Automotive Application Guide" for further details before using the products.

< AEC-Q200 : AEC-Q200 qualified >

All the Metal Core SMD Power Inductors of *1 marks are tested based on the test conditions and methods defined in AEC-Q200 by family item.

Please consult with TAIYO YUDEN's official sales channel for the details of the product specification and AEC-Q200 test results, etc.,

and please review and approve TAIYO YUDEN's product specification before ordering.

• *2: Industrial products and Medical products

● MDKK2020 type [Thickness: 1.0mm max]

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

Absolute maximum voltage: DC20V

(Typ): Reference

● MDMK2020 type [Thickness: 1.2mm max]

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

Absolute maximum voltage: DC20V

(Typ): Reference

● MDKK3030 type [Thickness: 1.0mm max]

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

Absolute maximum voltage: DC20V

(Typ): Reference

● MDMK3030 type [Thickness: 1.2mm max]

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

Absolute maximum voltage: DC20V

(Typ): Reference

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

※1-1) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40°C, 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°C)

※1-2) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40°C, 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°C)

※1-3) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40°C, 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°C)

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

※1-1) MDKK2020, MDMK2020 type

※1-2) MDKK3030, MDMK3030 type

※1-3) MDMK4040, MDWK4040 type

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PART NUMBER

MDMK4040F type [Thickness: 1.2mm max]

Part number	Nominal inductance [μ H]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency [kHz]	Note
				Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)		
MDMK4040TR47MF V	0.47	$\pm 20\%$	0.029	7,500 (10,000)	4,600 (5,400)	100	*1, *2
MDMK4040T1R0MF V	1.0	$\pm 20\%$	0.047	5,200 (7,500)	3,500 (4,200)	100	*1, *2
MDMK4040T1R2MF V	1.2	$\pm 20\%$	0.047	4,200 (6,200)	3,500 (4,200)	100	*1, *2
MDMK4040T1R5MF V	1.5	$\pm 20\%$	0.065	3,700 (5,400)	3,300 (3,600)	100	*1, *2
MDMK4040T2R2MF V	2.2	$\pm 20\%$	0.092	3,200 (4,500)	2,500 (2,900)	100	*1, *2

Absolute maximum voltage: DC25V

(Typ): Reference

MDMK4040 type [Thickness: 1.2mm max]

Part number	Nominal inductance [μ H]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency [MHz]	Note
				Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)		
MDMK4040TR68MM V	0.68	$\pm 20\%$	0.029	6,700 (7,800)	5,000 (5,700)	1	*1, *2
MDMK4040T1R0MM V	1.0	$\pm 20\%$	0.036	5,000 (6,200)	4,500 (5,100)	1	*1, *2
MDMK4040T1R5MM V	1.5	$\pm 20\%$	0.065	4,500 (5,600)	3,200 (3,600)	1	*1, *2
MDMK4040T2R2MM V	2.2	$\pm 20\%$	0.079	3,800 (4,500)	2,800 (3,200)	1	*1, *2
MDMK4040T3R3MM V	3.3	$\pm 20\%$	0.130	3,200 (4,000)	2,200 (2,500)	1	*1, *2
MDMK4040T4R7MM V	4.7	$\pm 20\%$	0.160	2,500 (3,000)	1,900 (2,200)	1	*1, *2
MDMK4040T6R8MM V	6.8	$\pm 20\%$	0.230	1,900 (2,200)	1,600 (1,800)	1	*1, *2
MDMK4040T100MM V	10	$\pm 20\%$	0.330	1,700 (2,000)	1,400 (1,600)	1	*1, *2

Absolute maximum voltage: DC25V

(Typ): Reference

MDWK4040 type [Thickness: 2.0mm max]

Part number	Nominal inductance [μ H]	Inductance tolerance	DC Resistance [Ω] (max.)	Rated current ※) [mA]		Measuring frequency [MHz]	Note
				Saturation current Idc1 Max (Typ)	Temperature rise current Idc2 Max (Typ)		
MDWK4040TR56NM V	0.56	$\pm 20\%$	0.016	9,000 (13,000)	6,500 (7,500)	1	*1, *2
MDWK4040TR68MM V	0.68	$\pm 20\%$	0.016	8,000 (12,000)	7,300 (8,300)	1	*1, *2
MDWK4040T1R0MM V	1.0	$\pm 20\%$	0.027	7,000 (9,400)	5,100 (5,800)	1	*1, *2
MDWK4040T1R5MM V	1.5	$\pm 20\%$	0.041	7,000 (9,400)	4,100 (4,700)	1	*1, *2
MDWK4040T2R2MM V	2.2	$\pm 20\%$	0.054	5,400 (7,500)	3,500 (4,000)	1	*1, *2
MDWK4040T3R3MM V	3.3	$\pm 20\%$	0.075	3,700 (5,200)	3,000 (3,300)	1	*1, *2
MDWK4040T4R7MM V	4.7	$\pm 20\%$	0.107	3,500 (5,000)	2,500 (2,800)	1	*1, *2
MDWK4040T6R8MM V	6.8	$\pm 20\%$	0.158	2,900 (4,000)	2,000 (2,300)	1	*1, *2
MDWK4040T100MM V	10	$\pm 20\%$	0.194	2,200 (3,100)	1,600 (1,900)	1	*1, *2

Absolute maximum voltage: DC25V

(Typ): Reference

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

※1-1) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40°C, 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°C)

※1-2) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40°C, 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°C)

※1-3) The temperature rise current value (Idc2) is the DC current value having temperature increase by 40°C, 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°C)

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

※1-1) MDK2020, MDMK2020 type

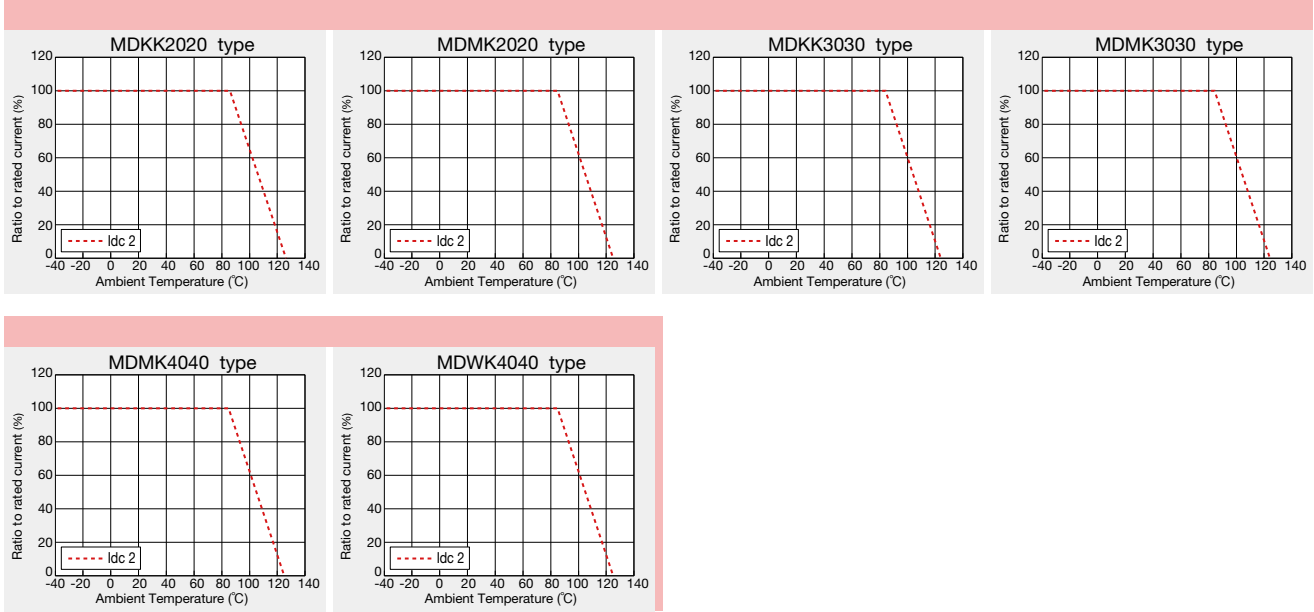
※1-2) MDK3030, MDMK3030 type

※1-3) MDMK4040, MDWK4040 type

Derating of Rated Current

MD series

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



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METAL CORE SMD POWER INDUCTORS (MCOIL™ MD SERIES)

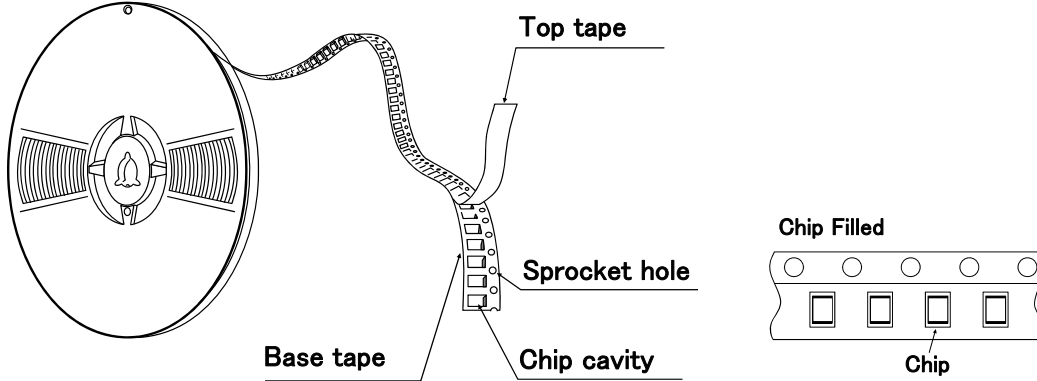
PACKAGING

① Minimum Quantity

Type	Standard Quantity [pcs]
	Tape & Reel
MDKK1616	2500
MDJE2020	2500
MDKK2020	
MDMK2020	
MDKK3030	2000
MDMK3030	
MDJE4040	1000
MDMK4040	
MDWK4040	700
MDPK5050	1000

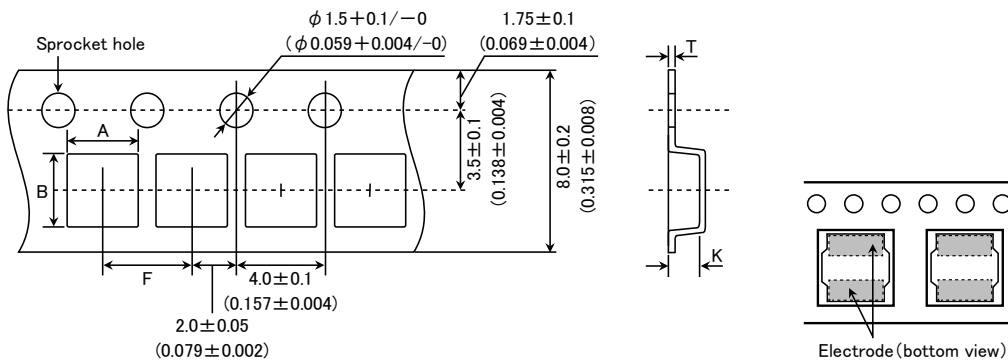
② Tape Material

● Embossed Tape



③ Taping dimensions

● Embossed tape 8mm wide (0.315 inches wide)

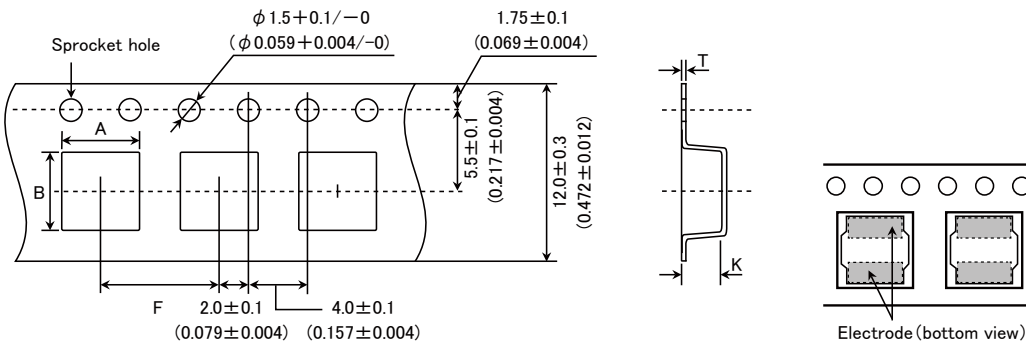


Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B		T	K
MDKK1616	1.79 ± 0.1 (0.071 ± 0.004)	1.79 ± 0.1 (0.071 ± 0.004)	4.0 ± 0.1 (0.157 ± 0.004)	0.25 ± 0.05 (0.010 ± 0.002)	1.1 ± 0.1 (0.043 ± 0.004)
MDJE2020	2.2 ± 0.1 (0.102 ± 0.004)	2.2 ± 0.1 (0.102 ± 0.004)	4.0 ± 0.1 (0.157 ± 0.004)	0.25 ± 0.05 (0.009 ± 0.002)	1.3 ± 0.1 (0.051 ± 0.004)
MDKK2020					
MDMK2020					
MDKK3030	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)
MDMK3030					

Unit: mm (inch)

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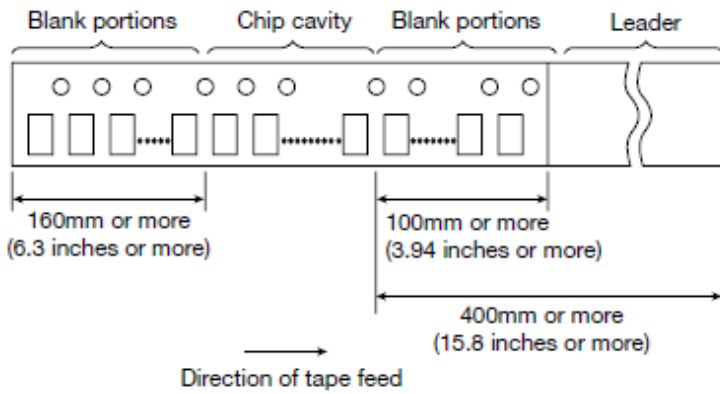
● Embossed tape 12mm wide (0.47 inches wide)



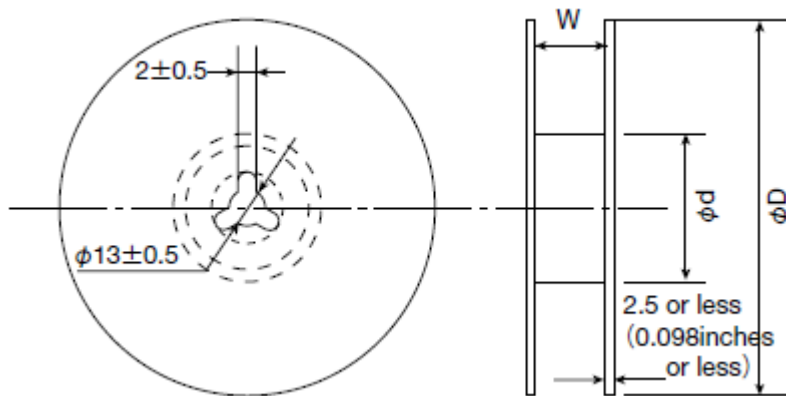
Type	Chip cavity		Insertion pitch F	Tape thickness	
	A	B		T	K
MDJE4040	4.3 ± 0.1 (0.169 ± 0.004)	4.3 ± 0.1 (0.169 ± 0.004)	8.0 ± 0.1 (0.315 ± 0.004)	0.3 ± 0.1 (0.012 ± 0.004)	1.6 ± 0.1 (0.063 ± 0.004)
MDMK4040					
MDWK4040					
MDPK5050	5.25 ± 0.1 (0.207 ± 0.004)	5.25 ± 0.1 (0.207 ± 0.004)	8.0 ± 0.1 (0.315 ± 0.004)	0.3 ± 0.1 (0.012 ± 0.004)	1.6 ± 0.1 (0.063 ± 0.004)

Unit : mm (inch)

④ Leader and Blank portion



⑤ Reel size



Type	Reel size (Reference values)		
	ϕD	ϕd	W
MDKK1616	180 ± 0.5 (7.087 ± 0.019)	60 ± 1.0 (2.36 ± 0.04)	10.0 ± 1.5 (0.394 ± 0.059)
MDJE2020			
MDKK2020			
MDMK2020			
MDKK3030	180 ± 3.0 (7.087 ± 0.118)	60 ± 2.0 (2.36 ± 0.08)	14.0 ± 1.5 (0.551 ± 0.059)
MDMK3030			
MDJE4040			
MDMK4040			
MDWK4040			
MDPK5050			

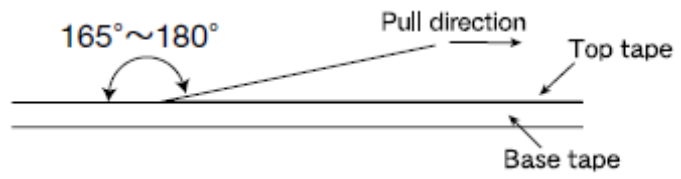
Unit : mm (inch)

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⑥ Top Tape Strength

Top tape strength

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



METAL CORE SMD POWER INDUCTORS (MCOIL™ MD SERIES)

RELIABILITY DATA

1. Operating Temperature Range		
Specified Value	MD series	-40~+125°C (Including self-generated heat)
Test Methods and Remarks	Including self-generated heat	
2. Storage Temperature Range		
Specified Value	MD series	-40~+85°C
Test Methods and Remarks	-5 to 40°C for the product with taping.	
3. Rated current		
Specified Value	MD series	Within the specified tolerance
4. Inductance		
Specified Value	MD series	Within the specified tolerance
Test Methods and Remarks	MDKK2020, MDMK2020, MDKK3030, MDMK3030 Measuring equipment : LCR Meter (HP 4285A or equivalent) Measuring frequency : 1MHz 1V MDMK4040 Measuring equipment : LCR Meter (HP 4285A or equivalent) Measuring frequency : 100kHz 1V	
5. DC Resistance		
Specified Value	MD series	Within the specified tolerance
Test Methods and Remarks	Measuring equipment : DC ohmmeter (HIOKI 3227 or equivalent)	
6. Self resonance frequency		
Specified Value	MD series	—
7. Temperature characteristic		
Specified Value	MD series	Inductance change : Within ±10%
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.	
8. Resistance to flexure of substrate		
Specified Value	MD series	No damage
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. As illustrated below, apply force in the direction of the arrow indicating until deflection of the test board reaches to 2 mm. Test board size : 100 × 40 × 1.0 mm Test board material : glass epoxy-resin Solder cream thickness : 0.10 mm	

9. Insulation resistance : between wires

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

Specified Value	MD series	—
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11. Withstanding voltage : between wire and core																				
Specified Value	MD series	—																		
12. Adhesion of terminal electrode																				
Specified Value	MD series	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	MD series	Inductance change : Within $\pm 10\%$ No significant abnormality in appearance.																		
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. Then it shall be submitted to below test conditions. <table border="1" style="margin-left: 20px;"> <tr> <td>Frequency Range</td> <td colspan="2">10~55Hz</td> </tr> <tr> <td>Total Amplitude</td> <td colspan="2">1.5mm (May not exceed acceleration 196m/s²)</td> </tr> <tr> <td>Sweeping Method</td> <td colspan="2">10Hz to 55Hz to 10Hz for 1min.</td> </tr> <tr> <td rowspan="3">Time</td> <td>X</td> <td rowspan="3">For 2 hours on each X, Y, and Z axis.</td> </tr> <tr> <td>Y</td> </tr> <tr> <td>Z</td> </tr> </table> Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.		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				
Frequency Range	10~55Hz																			
Total Amplitude	1.5mm (May not exceed acceleration 196m/s ²)																			
Sweeping Method	10Hz to 55Hz to 10Hz for 1min.																			
Time	X	For 2 hours on each X, Y, and Z axis.																		
	Y																			
	Z																			
14. Solderability																				
Specified Value	MD series	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 : Methanol solution containing rosin 25%. <table border="1" style="margin-left: 20px;"> <tr> <td>Solder Temperature</td> <td>245\pm5$^{\circ}$C</td> </tr> <tr> <td>Time</td> <td>5\pm1.0 sec.</td> </tr> </table> ※Immersion depth : All sides of mounting terminal shall be immersed.		Solder Temperature	245 \pm 5 $^{\circ}$ C	Time	5 \pm 1.0 sec.														
Solder Temperature	245 \pm 5 $^{\circ}$ C																			
Time	5 \pm 1.0 sec.																			
15. Resistance to soldering heat																				
Specified Value	MD series	Inductance change : Within $\pm 10\%$ No significant abnormality in appearance.																		
Test Methods and Remarks	The test sample shall be exposed to reflow oven at 230 \pm 5 $^{\circ}$ C for 40 seconds, with peak temperature at 260 \pm 5 $^{\circ}$ C for 5 seconds, 2 times. Test board material : glass epoxy-resin Test board thickness : 1.0mm																			
16. Thermal shock																				
Specified Value	MD series	Inductance change : Within $\pm 10\%$ 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. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="3">Conditions of 1 cycle</th> </tr> <tr> <th>Step</th> <th>Temperature ($^{\circ}$C)</th> <th>Duration (min)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-40\pm3</td> <td>30\pm3</td> </tr> <tr> <td>2</td> <td>Room temperature</td> <td>Within 3</td> </tr> <tr> <td>3</td> <td>+85\pm2</td> <td>30\pm3</td> </tr> <tr> <td>4</td> <td>Room temperature</td> <td>Within 3</td> </tr> </tbody> </table>		Conditions of 1 cycle			Step	Temperature ($^{\circ}$ C)	Duration (min)	1	-40 \pm 3	30 \pm 3	2	Room temperature	Within 3	3	+85 \pm 2	30 \pm 3	4	Room temperature	Within 3
Conditions of 1 cycle																				
Step	Temperature ($^{\circ}$ C)	Duration (min)																		
1	-40 \pm 3	30 \pm 3																		
2	Room temperature	Within 3																		
3	+85 \pm 2	30 \pm 3																		
4	Room temperature	Within 3																		
17. Damp heat																				
Specified Value	MD series	Inductance change : Within $\pm 10\%$ No significant abnormality in appearance.																		
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. The test samples shall be placed in thermostatic oven set at specified temperature and humidity as shown in below table. <table border="1" style="margin-left: 20px;"> <tr> <td>Temperature</td> <td>60\pm2$^{\circ}$C</td> </tr> <tr> <td>Humidity</td> <td>90~95%RH</td> </tr> <tr> <td>Time</td> <td>1000+24/-0 hour</td> </tr> </table>		Temperature	60 \pm 2 $^{\circ}$ C	Humidity	90~95%RH	Time	1000+24/-0 hour												
Temperature	60 \pm 2 $^{\circ}$ C																			
Humidity	90~95%RH																			
Time	1000+24/-0 hour																			

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18. Loading under damp heat		
Specified Value	MD series	Inductance change : Within $\pm 10\%$ 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	$60 \pm 2^\circ\text{C}$
	Humidity	90~95%RH
	Applied current	Rated current
	Time	1000+24/-0 hour
19. Low temperature life test		
Specified Value	MD series	Inductance change : Within $\pm 10\%$ 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	$-40 \pm 2^\circ\text{C}$
	Time	1000+24/-0 hour
20. High temperature life test		
Specified Value	MD series	—
21. Loading at high temperature life test		
Specified Value	MD series	Inductance change : Within $\pm 10\%$ 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	$85 \pm 2^\circ\text{C}$
	Applied current	Rated current
	Time	1000+24/-0 hour
22. Standard condition		
Specified Value	MD series	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.

METAL CORE SMD POWER INDUCTORS (MCOIL™ MD SERIES)

PRECAUTIONS

1. Circuit Design	
Precautions	<p>◆ Operating environment</p> <p>1. The products listed in this catalogue are intended for use in general electronic equipment (e.g., AV equipment, OA equipment, home electric appliances, office equipment, information and communication equipment), general medical equipment, industrial equipment, and automotive interior applications, etc.</p> <p>Please be sure to contact TAIYO YUDEN for further information before using the products for any equipment which may directly cause loss of human life or bodily injury (e.g., specially controlled medical equipment, transportation equipment including, without limitation, automotive powertrain control system, train control system, and ship control system, traffic signal equipment).</p> <p>Please do not incorporate our products into any equipment requiring high levels of safety and/or reliability (e.g., aerospace equipment, aviation equipment, nuclear control equipment, undersea equipment, military equipment, etc.).</p>
2. PCB Design	
Precautions	<p>◆ Land pattern design</p> <p>1. Please refer to a recommended land pattern.</p>
Technical considerations	<p>◆ Land pattern design</p> <p>Surface Mounting</p> <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	<p>◆ Adjustment of mounting machine</p> <p>1. Excessive impact load should not be imposed on the products when mounting onto the PC boards.</p> <p>2. Mounting and soldering conditions should be checked beforehand.</p>
Technical considerations	<p>◆ Adjustment of mounting machine</p> <p>1. When installing products, care should be taken not to apply distortion stress as it may deform the products.</p>
4. Soldering	
Precautions	<p>◆ Reflow soldering</p> <p>1. Please contact any of our offices for a reflow soldering, and refer to the recommended condition specified.</p> <p>2. The product shall be used reflow soldering only.</p> <p>3. Please do not add any stress to a product until it returns in normal temperature after reflow soldering.</p> <p>◆ Lead free soldering</p> <p>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.</p> <p>◆ Recommended conditions for using a soldering iron (NR10050 Type)</p> <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	<p>◆ Reflow soldering</p> <p>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.</p> <p>• NR30/40/50/60/80, NRV20/30, NRH24/30, NRS20/40/50/60/80 Type, NR10050 Type, NS101/125 Type</p> <p>Recommended reflow condition (Pb free solder)</p> <p>Temperature [°C]</p> <p>Heating Time [sec]</p>
5. Cleaning	
Precautions	<p>◆ Cleaning conditions</p> <p>1. Washing by supersonic waves shall be avoided.</p>
Technical considerations	<p>◆ Cleaning conditions</p> <p>1. If washed by supersonic waves, the products might be broken.</p>

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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. <p style="margin-left: 20px;">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.</p>
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.