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 2015. 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.

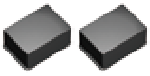
  In addition, even electronic components or functional modules that are used for the general electronic equipment, if the equipment or the electric circuit require high safety or reliability function or performances, a sufficient reliability evaluation check for safety shall be performed before commercial 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 WIRE-WOUND CHIP POWER INDUCTORS(MCOIL^{TM} MA-H SERIES)



REFLOW

■PARTS NUMBER

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

M A	K K	2 0 1 6	H	1 R 0	M	△	△
①	②	③	④	⑤	⑥	⑦	⑧

△=Blank space

①Series name

Code	Series name
MA	Metal Core Wire-wound Chip Power Inductor

②Dimensions(T)

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

③Dimensions(L×W)

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

④Packaging

Code	Packaging or Special specification
H	Taping(High characteristics)

⑤Nominal inductance

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

※R=Decimal point

⑥Inductance tolerance

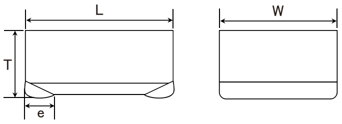
Code	Inductance tolerance
M	±20%

⑦Special code

Code	Special code
△	Standard

⑧Internal code

■STANDARD EXTERNAL DIMENSIONS / STANDARD QUANTITY



Type	L	W	T	e	Standard quantity [pcs] Taping
MAKK2016H	2.0±0.1 (0.079±0.004)	1.6±0.1 (0.063±0.004)	1.0 max (0.039 max)	0.5±0.3 (0.020±0.012)	3000
MAKK2520H	2.5±0.2 (0.098±0.008)	2.0±0.2 (0.079±0.008)	1.0 max (0.039 max)	0.5±0.3 (0.020±0.012)	3000
MAMK2520H	2.5±0.2 (0.098±0.008)	2.0±0.2 (0.079±0.008)	1.2 max (0.047 max)	0.5±0.3 (0.020±0.012)	3000

Unit:mm(inch)

■PARTS NUMBER

●MAKK2016H type

Parts number	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz](min.)	DC Resistance [Ω](max.)	Rated current ※) [mA](max.) Saturation current Idc1	Rated current ※) [mA](max.) Temperature rise current Idc2	Measuring frequency[MHz]
MAKK2016HR24M	RoHS	0.24	±20%	−	0.026	5,800	4,000	2
MAKK2016HR33M	RoHS	0.33	±20%	−	0.030	4,700	3,500	2
MAKK2016HR47M	RoHS	0.47	±20%	−	0.036	4,300	3,300	2
MAKK2016HR68M	RoHS	0.68	±20%	−	0.050	3,200	2,700	2
MAKK2016H1R0M	RoHS	1.0	±20%	−	0.070	2,700	2,300	2

●MAKK2520H type

Parts number	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz](min.)	DC Resistance [Ω](max.)	Rated current ※) [mA](max.) Saturation current Idc1	Rated current ※) [mA](max.) Temperature rise current Idc2	Measuring frequency[MHz]
MAKK2520HR33M	RoHS	0.33	±20%	−	0.026	6200	4300	2
MAKK2520HR47M	RoHS	0.47	±20%	−	0.029	5700	4000	2
MAKK2520HR68M	RoHS	0.68	±20%	−	0.043	4300	3400	2
MAKK2520H1R0M	RoHS	1.0	±20%	−	0.053	3800	3000	2
MAKK2520H2R2M	RoHS	2.2	±20%	−	0.120	2500	1800	2

●MAMK2520H type

Parts number	EHS	Nominal inductance [μH]	Inductance tolerance	Self-resonant frequency [MHz](min.)	DC Resistance [Ω](max.)	Rated current ※) [mA](max.) Saturation current Idc1	Rated current ※) [mA](max.) Temperature rise current Idc2	Measuring frequency[MHz]
MAMK2520HR47M	RoHS	0.47	±20%	−	0.026	5800	4100	2
MAMK2520HR68M	RoHS	0.68	±20%	−	0.036	5100	3500	2
MAMK2520H1R0M	RoHS	1.0	±20%	−	0.045	4300	3100	2
MAMK2520H1R5M	RoHS	1.5	±20%	−	0.065	3300	2600	2
MAMK2520H2R2M	RoHS	2.2	±20%	−	0.090	2800	2200	2

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

METAL CORE WIRE-WOUND CHIP POWER INDUCTORS (MCOIL™ MA SERIES / MCOIL™ MA-H SERIES)

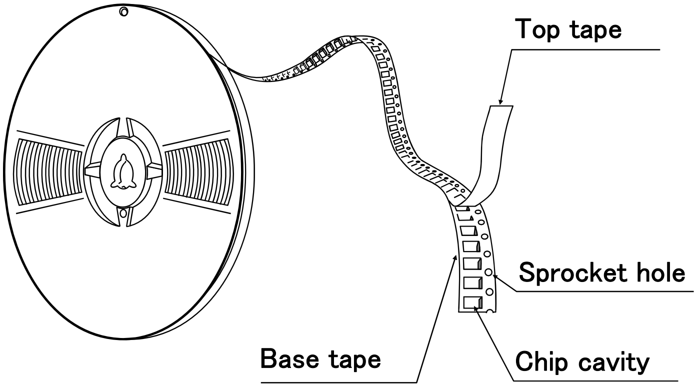
■PACKAGING

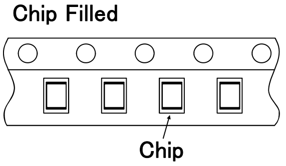
①Minimum Quantity

Type	Standard Quantity [pcs]
	Tape & Reel
MAKK2016	3000
MAKK2520	3000
MAMK2520	3000

②Tape Material

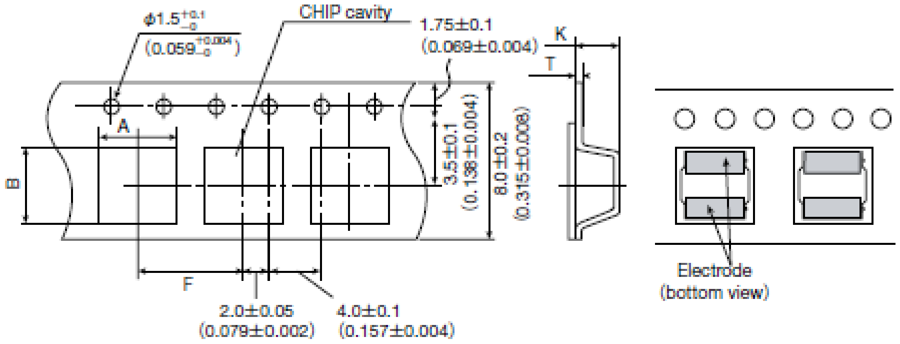
● Embossed Tape





③Taping dimensions

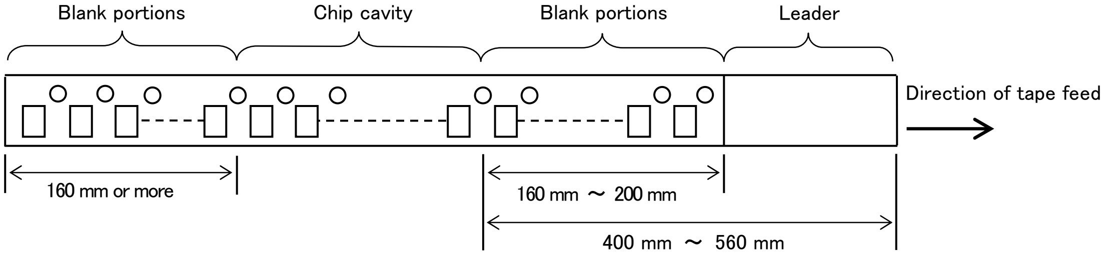
● Embossed tape 8mm wide (0.315 inches wide)



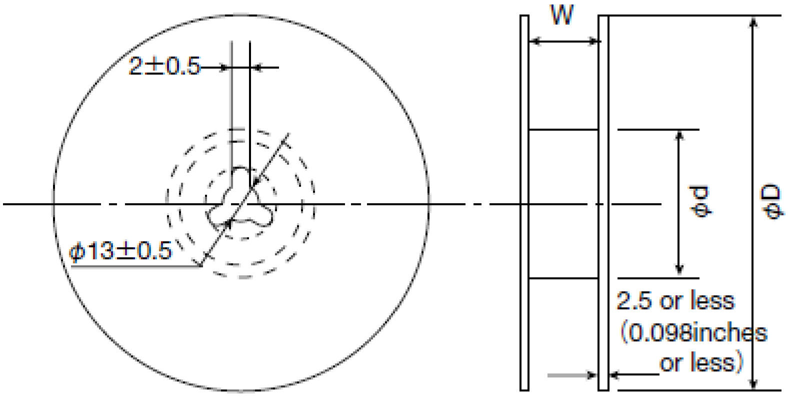
Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B	F	T	K
MAKK2016	1.9±0.1 (0.075±0.004)	2.3±0.1 (0.091±0.004)	4.0±0.1 (0.157±0.004)	0.25±0.05 (0.009±0.002)	1.1 max (0.043 max)
MAKK2520	2.3±0.1 (0.091±0.004)	2.8±0.1 (0.110±0.004)	4.0±0.1 (0.157±0.004)	0.3±0.05 (0.012±0.002)	1.1 max (0.043 max)
MAMK2520	2.3±0.1 (0.091±0.004)	2.8±0.1 (0.110±0.004)	4.0±0.1 (0.157±0.004)	0.3±0.05 (0.012±0.002)	1.45 max (0.057 max)

Unit : mm (inch)

④Leader and Blank portion



⑤Reel size

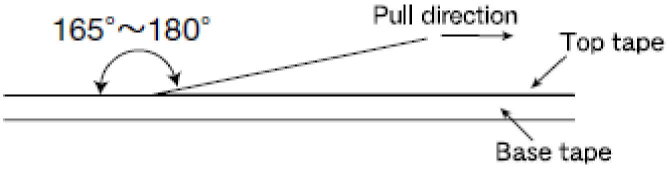


Type	Reel size (Reference values)		
	ϕD	ϕd	W
MAKK2016	180+0/−3 (7.087+0/−0.118)	60+1/−0 (2.36+0.039/0)	10.0±1.5 (0.394±0.059)
MAKK2520			
MAMK2520			

Unit：mm(inch)

⑥Top Tape Strength

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



METAL CORE WIRE-WOUND CHIP POWER INDUCTORS
(MCOIL™ MA SERIES / MCOIL™ MA-H SERIES)

■RELIABILITY DATA

1. Operating Temperature Range		
Specified Value	MA series	－40～＋105℃
	MA-H series	－40～＋125℃
Test Methods and Remarks	Including self-generated heat	

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

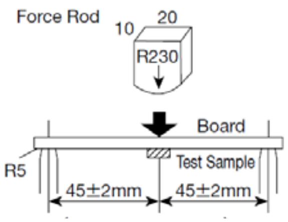
3. Rated current		
Specified Value	MA series	Within the specified tolerance
	MA-H series	

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

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

6. Self resonance frequency		
Specified Value	MA series	－
	MA-H series	

7. Temperature characteristic		
Specified Value	MA series	Inductance change : Within ±15%
	MA-H series	
Test Methods and Remarks	Measurement of inductance shall be taken at temperature range within －40℃～＋85℃. With reference to inductance value at ＋20℃., change rate shall be calculated.	

8. Resistance to flexure of substrate		
Specified Value	MA series	No damage
	MA-H series	
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. As illustrated below, apply force in the direction of the arrow indicating until deflection of the test board reaches to 2 mm. Test board size : 100×40×1.0 mm Test board material : Glass epoxy-resin Solder cream thickness : 0.12 mm 	

9. Insulation resistance : between wires

Specified Value	MA series	—
	MA-H series	

10. Insulation resistance : between wire and core

Specified Value	MA series	MAKK2016、MAMK2520 タイプ:DC25V 100kΩ min MAKK2520 タイプ :DC20V 100kΩ min
	MA-H series	

11. Withstanding voltage : between wire and core

Specified Value	MA series	—
	MA-H series	

12. Adhesion of terminal electrode

Specified Value	MA series	No abnormality.
	MA-H series	
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. Applied force : 10N to X and Y directions. Duration : 5s. Solder cream thickness : 0.12mm.	

13. Resistance to vibration

<table>
<tr><td>Specified Value</td><td>MA series</td><td>Inductance change : Within ±10%
No significant abnormality in appearance.</td></tr>
<tr><td></td><td>MA-H series</td><td></td></tr>
<tr><td>Test Methods and Remarks</td><td colspan="2">The test samples shall be soldered to the test board by the reflow.
Then it shall be submitted to below test conditions.
<table>
<tr><td>Frequency Range</td><td colspan="2">10～55Hz</td></tr>
<tr><td>Total Amplitude</td><td colspan="2">1.5mm (May not exceed acceleration 196m/s^2)</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.</td></tr>
</table>

14. Solderability

<table>
<tr><td>Specified Value</td><td>MA series</td><td>At least 90% of surface of terminal electrode is covered by new solder.</td></tr>
<tr><td></td><td>MA-H series</td><td></td></tr>
<tr><td>Test Methods and Remarks</td><td colspan="2">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>
<tr><td>Solder Temperature</td><td>245±5℃</td></tr>
<tr><td>Time</td><td>5±0.5 sec.</td></tr>
</table>
※Immersion depth : All sides of mounting terminal shall be immersed.</td></tr>
</table>

15. Resistance to soldering heat

Specified Value	MA series	Inductance change : Within ±10% No significant abnormality in appearance.
	MA-H series	
Test Methods and Remarks	The test sample shall be exposed to reflow oven at 230℃ for 40 seconds, with peak temperature at 260＋0/－5℃ for 5 seconds, 3 times. Test board material : Glass epoxy-resin Test board thickness : 1.0mm Recovery : At least 2hrs of recovery under the standard condition after the test, followed by the measurement within 48hrs.	

16. Thermal shock

Specified Value	MA series MA-H series	Inductance change : Within ±10% No significant abnormality in appearance.

Test Methods and Remarks

The test samples shall be soldered to the test board by the reflow. The test samples shall be placed at specified temperature for specified time by step 1 to step 4 as shown in below table in sequence. The temperature cycle shall be repeated 100 cycles.

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

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

17. Damp heat

Specified Value	MA series MA-H series	Inductance change : Within ±10% No significant abnormality in appearance.

Test Methods and Remarks

The test samples shall be soldered to the test board by the reflow.

The test samples shall be placed in thermostatic oven set at specified temperature and humidity as shown in below table.

Temperature	60±2℃
Humidity	90～95%RH
Time	500＋24/－0 hour

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

18. Loading under damp heat

Specified Value	MA series MA-H series	Inductance change : Within ±10% No significant abnormality in appearance.

Test Methods and Remarks

The test samples shall be soldered to the test board by the reflow.

The test samples shall be placed in thermostatic oven set at specified temperature and humidity and applied the rated current continuously as shown in below table.

Temperature	60±2℃
Humidity	90～95%RH
Applied current	Rated current
Time	500＋24/－0 hour

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

19. Low temperature life test

Specified Value	MA series MA-H series	Inductance change : Within ±10% No significant abnormality in appearance.

Test Methods and Remarks

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

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

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

20. High temperature life test

Specified Value	MA series MA-H series	Inductance change : Within ±10% No significant abnormality in appearance.

Test Methods and Remarks

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

Temperature	85±2℃
Time	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	MA series MA-H series	—

22. Standard condition

Specified Value	MA series	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.
	MA-H series	

■PRECAUTIONS

1. Circuit Design

Precautions	◆Operating environment 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.

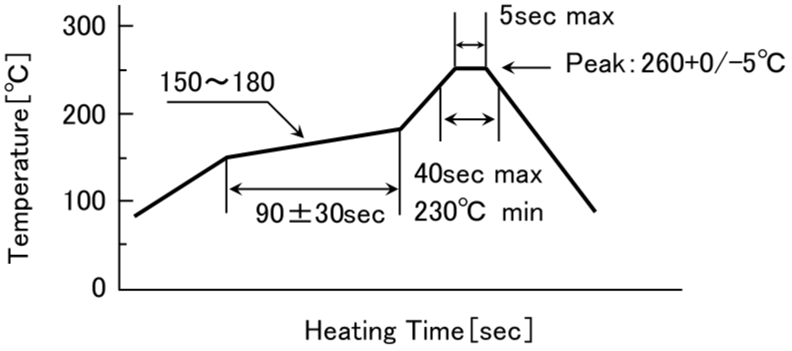
2. PCB Design

Precautions	◆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. ・ Recommended conditions Ambient temperature : 0～40℃ Humidity : Below 70% RH ・ The ambient temperature must be kept 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.