

Notice for TAIYO YUDEN products

Please read this notice before using the TAIYO YUDEN products.

⚠️ REMINDERS

■ Product Information in this Catalog

Product information in this catalog is as of January 2021. All of the contents specified herein and production status of the products listed in this catalog are subject to change without notice due to technical improvement of our products, etc. Therefore, please check for the latest information carefully before practical application or use of our products.

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

■ Approval of Product Specifications

Please contact TAIYO YUDEN for further details of product specifications as the individual product specification sheets are available. When using our products, please be sure to approve our product specifications or make a written agreement on the product specification with TAIYO YUDEN in advance.

■ Pre-Evaluation in the Actual Equipment and Conditions

Please conduct validation and verification of our products in actual conditions of mounting and operating environment before using our products.

■ Limited Application

1. Equipment Intended for Use

The products listed in this catalog are intended for general-purpose and standard use in general electronic equipment (e.g., AV equipment, OA equipment, home electric appliances, office equipment, information and communication equipment including, without limitation, mobile phone, and PC) and other equipment specified in this catalog or the individual product specification sheets.

TAIYO YUDEN has the line-up of the products intended for use in automotive electronic equipment, telecommunications infrastructure and industrial equipment, or medical devices classified as GHTF Classes A to C (Japan Classes I to III). Therefore, when using our products for these equipment, please check available applications specified in this catalog or the individual product specification sheets and use the corresponding products.

2. Equipment Requiring Inquiry

Please be sure to contact TAIYO YUDEN for further information before using the products listed in this catalog for the following equipment (excluding intended equipment as specified in this catalog or the individual product specification sheets) which may cause loss of human life, bodily injury, serious property damage and/or serious public impact due to a failure or defect of the products and/or malfunction attributed thereto.

- (1) Transportation equipment (automotive powertrain control system, train control system, and ship control system, etc.)
- (2) Traffic signal equipment
- (3) Disaster prevention equipment, crime prevention equipment
- (4) Medical devices classified as GHTF Class C (Japan Class III)
- (5) Highly public information network equipment, data-processing equipment (telephone exchange, and base station, etc.)
- (6) Any other equipment requiring high levels of quality and/or reliability equal to the equipment listed above

3. Equipment Prohibited for Use

Please do not incorporate our products into the following equipment requiring extremely high levels of safety and/or reliability.

- (1) Aerospace equipment (artificial satellite, rocket, etc.)
- (2) Aviation equipment *¹
- (3) Medical devices classified as GHTF Class D (Japan Class IV), implantable medical devices *²

- (4) Power generation control equipment (nuclear power, hydroelectric power, thermal power plant control system, etc.)
- (5) Undersea equipment (submarine repeating equipment, underwater work equipment, etc.)
- (6) Military equipment
- (7) Any other equipment requiring extremely high levels of safety and/or reliability equal to the equipment listed above

*Notes:

1. There is a possibility that our products can be used only for aviation equipment that does not directly affect the safe operation of aircraft (e.g., in-flight entertainment, cabin light, electric seat, cooking equipment) if such use meets requirements specified separately by TAIYO YUDEN. Please be sure to contact TAIYO YUDEN for further information before using our products for such aviation equipment.
2. Implantable medical devices contain not only internal unit which is implanted in a body, but also external unit which is connected to the internal unit.

4. Limitation of Liability

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

■ Safety Design

When using our products for high safety and/or reliability-required equipment or circuits, please fully perform safety and/or reliability evaluation. In addition, please install (i) systems equipped with a protection circuit and a protection device and/or (ii) systems equipped with a redundant circuit or other system to prevent an unsafe status in the event of a single fault for a failsafe design to ensure safety.

■ Intellectual Property Rights

Information contained in this catalog is intended to convey examples of typical performances and/or applications of our products and is not intended to make any warranty with respect to the intellectual property rights or any other related rights of TAIYO YUDEN or any third parties nor grant any license under such rights.

■ Limited Warranty

Please note that the scope of warranty for our products is limited to the delivered our products themselves and TAIYO YUDEN shall not be in any way responsible for any damages resulting from a failure or defect in our products. Notwithstanding the foregoing, if there is a written agreement (e.g., supply and purchase agreement, quality assurance agreement) signed by TAIYO YUDEN and your company, TAIYO YUDEN will warrant our products in accordance with such agreement.

■ TAIYO YUDEN's Official Sales Channel

The contents of this catalog are applicable to our products which are purchased from our sales offices or authorized distributors (hereinafter "TAIYO YUDEN's official sales channel"). Please note that the contents of this catalog are not applicable to our products purchased from any seller other than TAIYO YUDEN's official sales channel.

■ Caution for Export

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

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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) • 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 • Automobile Digital Mirror • Interior Lighting • Automobile Air Conditioning System • 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) • Dashcam (genuine products for automotive manufacturer), etc.

SMD POWER INDUCTORS (NR SERIES M TYPE)

REFLOW

AEC-Q200

AEC-Q200 Grade 2 (we conduct the evaluation at the test condition of Grade 2.)

*Operating environment Temp:-40~105°C

■ PART NUMBER

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

N	R	M	6	0	4	5	T	△	1	0	0	M	M	R	S	V
①			②				③		④			⑤	⑥			⑦

△=Blank space

①Series name

Code	Series name
NRM	Coating resin specification

②Dimensions (L × W × H)

Code	Dimensions (L × W × H) [mm]
5030	5.0 × 5.0 × 3.1
6045	6.0 × 6.0 × 4.5

③Packaging

Code	Packaging
T△	Taping

④Nominal inductance

Code (example)	Nominal inductance [μH]
2R2	2.2
100	10
102	1000

※R=Decimal point

⑤Inductance tolerance

Code	Inductance tolerance
M	±20%
N	±30%

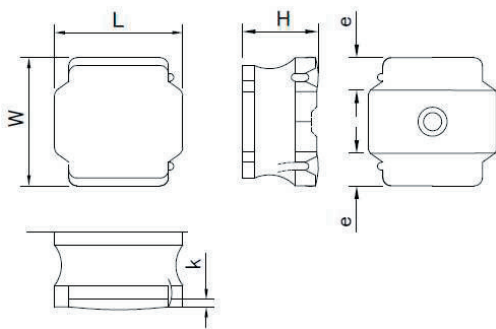
⑥Special code

Code	Special code
△R△	Standard

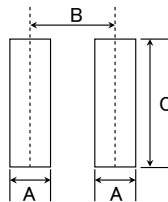
⑦Internal code

Code	Internal code
V	Inductor for Automotive
8	Inductor for Telecommunications infrastructure and Industrial equipment / Medical devices

■ STANDARD EXTERNAL DIMENSIONS / STANDARD QUANTITY



Recommended Land Patterns

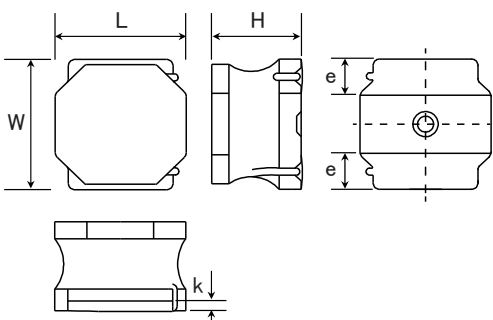


Type	A	B	C
NRM5030	1.9	4.2	3.8

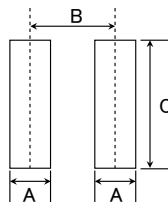
Unit: mm

Type	L	W	H	e	k(ref)	Standard quantity [pcs] Taping
NRM5030	5.0±0.2 (0.197±0.008)	5.0±0.2 (0.197±0.008)	3.1 max (0.122 max)	1.3±0.3 (0.051±0.012)	0.2 min (0.012 min)	500

Unit: mm(inch)



Recommended Land Patterns



Type	A	B	C
NRM6045	2.4	5.0	4.8

Unit: mm

Type	L	W	H	e	k(ref)	Standard quantity [pcs] Taping
NRM6045	6.0±0.2 (0.236±0.008)	6.0±0.2 (0.236±0.008)	4.5 max (0.177 max)	1.65±0.3 (0.053±0.012)	0.3 min (0.012 min)	1500

Unit: mm(inch)

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■ PART NUMBER

• All the SMD 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.
- For 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 SMD Power Inductors for Automotive products 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 specifications and AEC-Q200 test results, etc.,
 and please review and approve the product specifications before ordering.

● NRM5030

Parts number	Nominal inductance [μH]	Inductance tolerance	DC Resistance [mΩ] Max (Typ)	Rated current ※) [A]			Measuring frequency [MHz]	Note
				Saturation current Idc1 Max (Typ)	Temperature rise current① Idc2 Max (Typ)	Temperature rise current② Idc2 Max (Typ)		
NRM5030T R47NMRPV	0.47	±30%	13 (10)	11.00 (12.00)	4.10 (5.50)	6.80 (7.70)	0.1	
NRM5030T 1R5NMRPV	1.5	±30%	21.6 (18)	6.30 (6.80)	2.80 (3.70)	4.50 (5.10)	0.1	
NRM5030T 3R3NMRPV	3.3	±30%	37 (32)	4.30 (4.80)	2.10 (2.90)	3.50 (3.90)	0.1	
NRM5030T 220MMRPV	22	±20%	228 (190)	1.70 (1.90)	0.80 (1.10)	1.30 (1.50)	0.1	
NRM5030T 471MMRQV	470	±20%	3672 (3060)	0.25 (0.28)	0.17 (0.24)	0.30 (0.35)	0.1	

● NRM6045

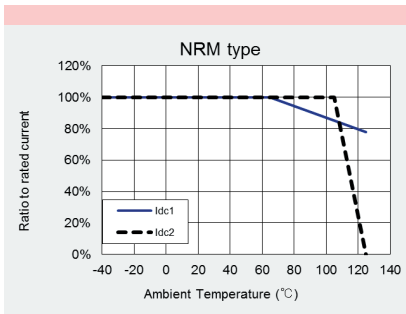
Parts number	Nominal inductance [μH]	Inductance tolerance	DC Resistance [mΩ] Max (Typ)	Rated current ※) [A]			Measuring frequency [MHz]	Note
				Saturation current Idc1 Max (Typ)	Temperature rise current① Idc2 Max (Typ)	Temperature rise current② Idc2 Max (Typ)		
NRM6045T 1R0NMRRV	1	±30%	13 (10)	13.50 (14.50)	4.00 (6.00)	6.20 (7.00)	0.1	
NRM6045T 2R2NMRRV	2.2	±30%	23 (18)	8.50 (9.50)	3.00 (4.00)	4.40 (5.10)	0.1	
NRM6045T 4R7MMRRV	4.7	±20%	36 (30)	6.00 (6.50)	2.20 (3.00)	3.60 (3.90)	0.1	
NRM6045T 6R8MMRRV	6.8	±20%	52 (43)	5.10 (5.60)	1.90 (2.60)	3.10 (3.50)	0.1	
NRM6045T 100MMRSV	10	±20%	60 (50)	4.00 (4.40)	1.80 (2.40)	2.60 (3.20)	0.1	
NRM6045T 220MMRRV	22	±20%	132 (110)	2.50 (3.00)	1.20 (1.60)	1.80 (2.00)	0.1	
NRM6045T 470MMRRV	47	±20%	272 (227)	1.55 (1.70)	0.70 (0.90)	1.20 (1.30)	0.1	
NRM6045T 101MMRRV	100	±20%	600 (475)	1.05 (1.15)	0.55 (0.70)	0.85 (0.95)	0.1	
NRM6045T 151MMRRV	150	±20%	816 (680)	0.83 (0.90)	0.48 (0.65)	0.76 (0.85)	0.1	
NRM6045T 221MMRRV	220	±20%	1320 (1100)	0.70 (0.75)	0.35 (0.50)	0.57 (0.65)	0.1	
NRM6045T 471MMRRV	470	±20%	2760 (2300)	0.45 (0.50)	0.22 (0.30)	0.38 (0.45)	0.1	

- ※) 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)① is the DC current value having temperature increase up to 20°C. (at 20°C)
- ※) The temperature rise current value (Idc2)② is the DC current value having temperature increase up to 40°C. (at 20°C)
- ※) The temperature rise current value (Idc2)② is a reference value.
- ※) The rated current is the DC current value that satisfies both of current value saturation current value and temperature rise current value.

■ Derating of Rated Current

● NR series M type

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



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SMD POWER INDUCTORS (NR SERIES/NR SERIES H TYPE/M TYPE/S TYPE/V TYPE)

PACKAGING

① Minimum Quantity

Type	Standard Quantity [pcs]
	Tape & Reel
NRV2010	2500
NRS2012	2500
NRV2012	2500
NRH2410	2500
NRH2412	2500
NR 3010	2000
NRH3010	2000
NR 3012	2000
NRH3012	2000
NRV3012	2000
NR 3015	2000
NRS3015	2000
NR 4010	5000
NRS4010	5000
NR 4012	4500
NRS4012	4500
NR 4018	3500
NRS4018	3500

Type	Standard Quantity [pcs]
	Tape & Reel
NRS5010	1000
NRS5012	1000
NRS5014	1000
NRS5020	800
NRS5024	2500
NRS5030	500
NR 5040	1500
NRS5040	1500
NRS6010	1000
NR 6012	1000
NRS6012	1000
NRS6014	1000
NR 6020	2500
NRS6020	2500
NR 6028	2000
NRS6028	2000
NR 6045	1500
NRM6045	1500
NRS6045	1500
NRS8030	1000
NR 8040	1000
NRS8040	1000

② Tape Material

● Embossed Tape



③ Taping dimensions

● Embossed tape 8mm wide (0.315 inches wide)



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Type	Chip cavity		Insertion pitch	Tape thickness	
	A	B		T	K
NRV2010	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)
NRS2012 NRV2012					
NRH2410	2.6±0.1 (0.087±0.004)	2.6±0.1 (0.102±0.004)		0.25±0.05 (0.009±0.002)	1.3±0.1 (0.051±0.004)
NRH2412					
NR 3010 NRH3010	3.2±0.1 (0.126±0.004)	3.2±0.1 (0.126±0.004)		0.3±0.05 (0.012±0.002)	1.4±0.1 (0.055±0.004)
NR 3012 NRH3012 NRV3012					1.6±0.1 (0.063±0.004)
NR 3015 NRS3015			1.9±0.1 (0.075±0.004)		

Unit : mm (inch)

● Embossed tape 12mm wide (0.47 inches wide)



Type	Chip cavity		Insertion pitch	Tape thickness		
	A	B		T	K	
NR 4010 NRS4010	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)	1.4±0.1 (0.055±0.004)	
NR 4012 NRS4012					1.6±0.1 (0.063±0.004)	
NR 4018 NRS4018	2.1±0.1 (0.083±0.004)					
NRS5010	5.25±0.1 (0.207±0.004)	5.25±0.1 (0.207±0.004)			1.4±0.1 (0.055±0.004)	
NRS5012						1.4±0.1 (0.055±0.004)
NRS5014						1.6±0.1 (0.063±0.004)
NRS5020				2.3±0.1 (0.091±0.004)		
NRS5024	5.15±0.1 (0.203±0.004)	5.15±0.1 (0.203±0.004)		2.7±0.1 (0.106±0.004)		
NRS5030					3.2±0.1 (0.126±0.004)	
NR 5040 NRS5040					4.2±0.1 (0.165±0.004)	
NRS6010					6.3±0.1 (0.248±0.004)	6.3±0.1 (0.248±0.004)
NR 6012 NRS6012	1.6±0.1 (0.063±0.004)					
NRS6014	1.6±0.1 (0.063±0.004)					
NR 6020 NRS6020	2.3±0.1 (0.090±0.004)					
NR 6028 NRS6028	3.1±0.1 (0.122±0.004)					
NR 6045 NRM6045 NRS6045	4.7±0.1 (0.185±0.004)					

Unit : mm (inch)

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● Embossed tape 16mm wide (0.63 inches wide)



Type	Chip cavity		Insertion pitch F	Tape thickness	
	A	B		T	K
NRS8030	8.3 ± 0.1 (0.327 ± 0.004)	8.3 ± 0.1 (0.327 ± 0.004)	12.0 ± 0.1 (0.472 ± 0.004)	0.5 ± 0.1 (0.020 ± 0.004)	3.4 ± 0.1 (0.134 ± 0.004)
NR 8040 NRS8040					4.5 ± 0.1 (0.177 ± 0.004)

Unit: mm (inch)

④ Leader and Blank portion

● NR, NRH, NRS, NRV



⑤ Reel size

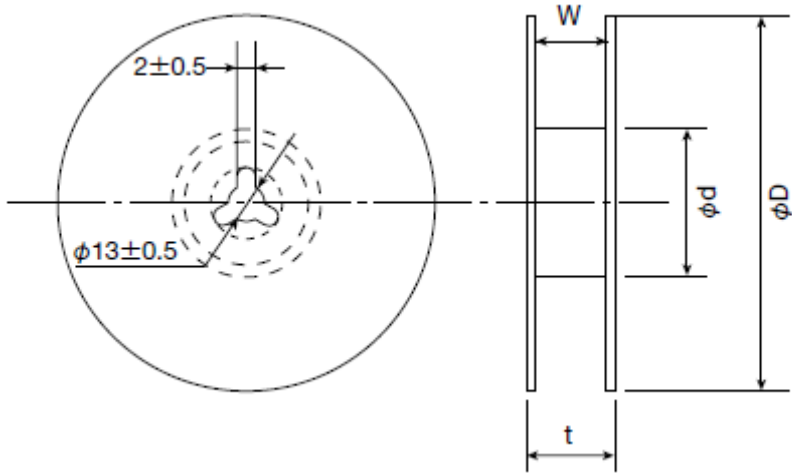


Type	Reel size (Reference values)		
	ϕD	ϕd	W
NRV2010	180 ± 0.5 (7.087 ± 0.019)	60 ± 1.0 (2.36 ± 0.04)	10.0 ± 1.5 (0.394 ± 0.059)
NRS2012			
NRV2012			
NRH2410			
NRH2412			
NR 3010			
NRH3010			
NR 3012			
NRH3012			
NRV3012			
NR 3015	180 ± 0.5 (7.087 ± 0.019)	60 ± 1.0 (2.36 ± 0.04)	10.0 ± 1.5 (0.394 ± 0.059)
NRS3015			

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NRS5010	180±3.0 (7.087±0.118)	60±2.0 (2.36±0.08)	14.0±1.5 (0.551±0.059)
NRS5012			
NRS5014			
NRS5020			
NRS5030			
NRS6010			
NR 6012			
NRS6012			
NRS6014			

Unit : mm (inch)

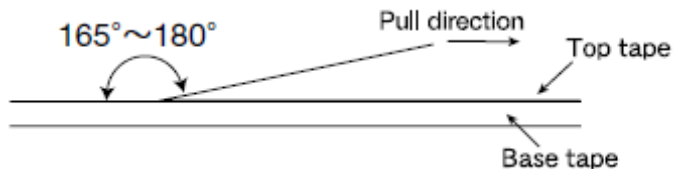


Type	Reel size (Reference values)			
	ϕD	ϕd	t (max.)	W
NR 4010	330±3.0 (12.99±0.118)	80±2.0 (3.15±0.078)	18.5 (0.72)	13.5±1.0 (0.531±0.04)
NRS4010				
NR 4012				
NRS4012				
NR 4018				
NRS4018				
NRS5024				
NR 5040				
NRS5040				
NR 6020				
NRS6020				
NR 6028				
NRS6028				
NR 6045				
NRM6045				
NRS6045				
NRS8030	22.5 (0.89)	17.5±1.0 (0.689±0.04)		
NR 8040				
NRS8040				

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.



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SMD POWER INDUCTORS (NR SERIES)

RELIABILITY DATA

1. Operating Temperature Range		
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type, NRM50/60Type	-40~+125°C (Including self-generated heat)
Test Methods and Remarks	Including self-generated heat	
2. Storage Temperature Range		
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type, NRM50/60Type	-40~+85°C
Test Methods and Remarks	-5 to 40°C for the product with taping.	
3. Rated current		
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type, NRM50/60Type	Within the specified tolerance
4. Inductance		
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type, NRM50/60Type	Within the specified tolerance
Test Methods and Remarks	Measuring equipment : LCR Meter (HP 4285A or equivalent) Measuring frequency : 100kHz, 1V	
5. DC Resistance		
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type, NRM50/60Type	Within the specified tolerance
Test Methods and Remarks	Measuring equipment : DC ohmmeter (HIOKI 3227 or equivalent)	
6. Self resonance frequency		
Specified Value	NRV30Type, NRH24/30Type NRS30/40/50/60/80Type, NRM50/60Type	Within the specified tolerance
	NRV20, NRS20	—
Test Methods and Remarks	NRV30, NRH24/30, NRS30/40/50/60/80Type, NRM50/60Type Measuring equipment : Impedance analyzer/material analyzer (HP4291A or equivalent HP4191A, 4192A or equivalent)	
7. Temperature characteristic		
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type, NRM50/60Type	Inductance change : Within $\pm 20\%$
Test Methods and Remarks	NRV20/30, NRH24/30, NRS20/30/40/50/60/80 Type, NRM50/60Type : Measurement of inductance shall be taken at temperature range within -40°C~+85°C. With reference to inductance value at +20°C., change rate shall be calculated.	
	Change of maximum inductance deviation in step 1 to 5	
	Step	Temperature (°C)
	1	20
	2	Minimum operating temperature
	3	20 (Standard temperature)
4	Maximum operating temperature	
5	20	

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14. Solderability																			
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type、NRM50/60Type	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"> <tr> <td>Solder Temperature</td> <td>245±5°C</td> </tr> <tr> <td>Time</td> <td>5±1.0 sec.</td> </tr> </table>	Solder Temperature	245±5°C	Time	5±1.0 sec.	※Immersion depth : All sides of mounting terminal shall be immersed.													
Solder Temperature	245±5°C																		
Time	5±1.0 sec.																		
15. Resistance to soldering heat																			
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type、NRM50/60Type	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°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	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type、NRM50/60Type	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.																		
	<table border="1"> <thead> <tr> <th colspan="3">Conditions of 1 cycle</th> </tr> <tr> <th>Step</th> <th>Temperature (°C)</th> <th>Duration (min)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-40±3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temperature</td> <td>Within 3</td> </tr> <tr> <td>3</td> <td>+85±2</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temperature</td> <td>Within 3</td> </tr> </tbody> </table>	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
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	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type、NRM50/60Type	Inductance change : Within ±10% No significant abnormality in appearance.																	
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. The test samples shall be placed in thermostatic oven set at specified temperature and humidity as shown in below table.																		
	<table border="1"> <tr> <td>Temperature</td> <td>60±2°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±2°C	Humidity	90~95%RH	Time	1000+24/-0 hour												
Temperature	60±2°C																		
Humidity	90~95%RH																		
Time	1000+24/-0 hour																		
18. Loading under damp heat																			
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type、NRM50/60Type	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.																		
	<table border="1"> <tr> <td>Temperature</td> <td>60±2°C</td> </tr> <tr> <td>Humidity</td> <td>90~95%RH</td> </tr> <tr> <td>Applied current</td> <td>Rated current</td> </tr> <tr> <td>Time</td> <td>1000+24/-0 hour</td> </tr> </table>	Temperature	60±2°C	Humidity	90~95%RH	Applied current	Rated current	Time	1000+24/-0 hour										
Temperature	60±2°C																		
Humidity	90~95%RH																		
Applied current	Rated current																		
Time	1000+24/-0 hour																		
19. Low temperature life test																			
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type、NRM50/60Type	Inductance change : Within ±10% No significant abnormality in appearance.																	
Test Methods and Remarks	The test samples shall be soldered to the test board by the reflow. After that, the test samples shall be placed at test conditions as shown in below table.																		
	<table border="1"> <tr> <td>Temperature</td> <td>-40±2°C</td> </tr> <tr> <td>Time</td> <td>1000+24/-0 hour</td> </tr> </table>	Temperature	-40±2°C	Time	1000+24/-0 hour														
Temperature	-40±2°C																		
Time	1000+24/-0 hour																		
20. High temperature life test																			
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type、NRM50/60Type	-																	

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21. Loading at high temperature life test		
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type, NRM50/60Type	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 soldering.	
	Temperature	$85 \pm 2^\circ\text{C}$
	Applied current	Rated current
	Time	$1000 + 24 / - 0$ hour

22. Standard condition		
Specified Value	NRV20/30Type, NRH24/30Type NRS20/30/40/50/60/80Type NRM50/60Type	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.

SMD POWER INDUCTORS (NR, NS, ES SERIES)

PRECAUTIONS

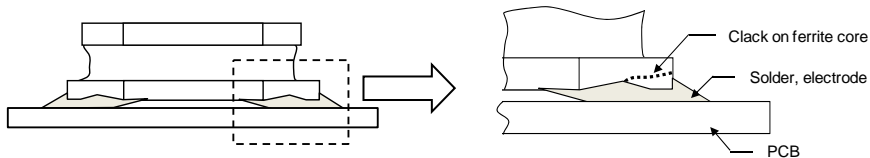
1. Circuit Design

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>
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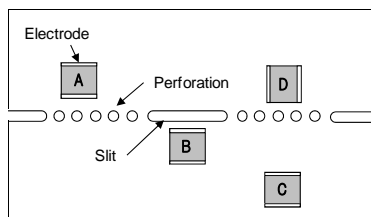
2. PCB Design

Precautions	<p>◆ Land pattern design</p> <ol style="list-style-type: none"> 1. Please refer to a recommended land pattern. 2. There is stress, which has been caused by distortion of a PCB, to the inductor. (NRV20/30, NRH24/30, NRS20/30/40/50/60/80, NRM60 Type) 3. Please consider the arrangement of parts on a PCB. (NRV20/30, NRH24/30, NRS20/30/40/50/60/80, NRM60 Type)
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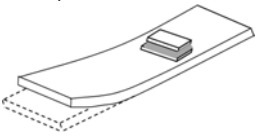
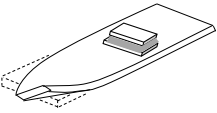
Technical considerations	<p>◆ Land pattern design</p> <p>Surface Mounting</p> <ol style="list-style-type: none"> 1. Mounting and soldering conditions should be checked beforehand. 2. Applicable soldering process to this products is reflow soldering only. 3. Please use the recommended land pattern shown 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. (NR30/40/50/60/80, NRV20/30, NRH24/30, NRS20/30/40/50/60/80, NRM60 Type) 4. As coefficients of thermal expansion between an inductor and a PCB differs, cracks may occur on a ferrite 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. (NRV20/30, NRH24/30, NRS20/30/40/50/60/80, NRM60 Type)
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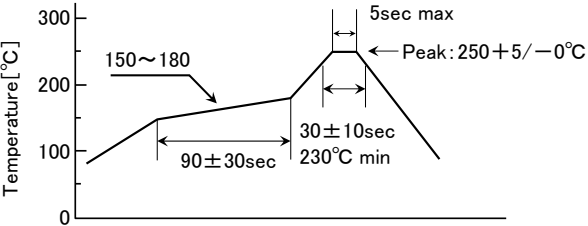
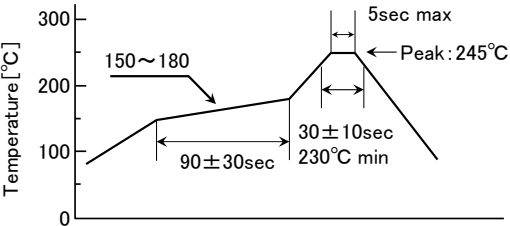


5. SMD inductors should be located to minimize any possible mechanical stresses from board warp or deflection. When splitting the PCB after mounting inductors and other components, care is required so as not to give any stresses of deflection or twisting to the board. (NRV20/30, NRH24/30, NRS20/30/40/50/60/80, NRM60 Type)



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	<p>◆Adjustment of mounting machine</p> <ol style="list-style-type: none"> Excessive impact load should not be imposed on the products when mounting onto the PC boards. Mounting and soldering conditions should be checked beforehand.
Technical considerations	<p>◆Adjustment of mounting machine</p> <ol style="list-style-type: none"> When installing products, care should be taken not to apply distortion stress as it may deform the products. 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. (NRV20/30, NRH24/30, NRS20/30/40/50/60/80, NRM60 Type) <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p><Wrap></p>  </div> <div style="text-align: center;"> <p><Twist></p>  </div> </div>

4. Soldering	
Precautions	<p>◆Reflow soldering</p> <ol style="list-style-type: none"> 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. <p>◆Lead free soldering</p> <ol style="list-style-type: none"> 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>◆Recommended conditions for using a soldering iron</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> <ol style="list-style-type: none"> 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"> NRV20/30, NRH24/30, NRS20/30/40/50/60/80, NRM60 Type, NS101/125 Type, EST0645/1040/1060 Type Recommended reflow condition (Pb free solder) <u>NR, NS Series</u>  <p><u>ES Series</u></p> 

5. Cleaning	
Precautions	<p>◆Cleaning conditions</p> <ol style="list-style-type: none"> Washing by supersonic waves shall be avoided.
Technical considerations	<p>◆Cleaning conditions</p> <ol style="list-style-type: none"> If washed by supersonic waves, the products might be broken.

6. Handling

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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.
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.

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. <ul style="list-style-type: none"> 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.