

KOA Europe GmbH

THIN FILM

RN73 - RN73R - RN73H

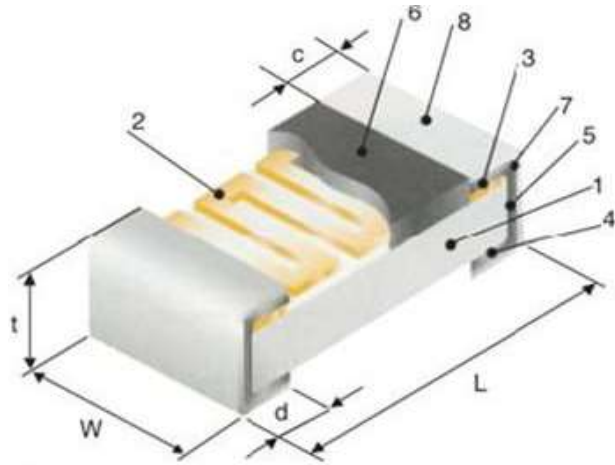


2021-02-17



Thin Film Series Comparison

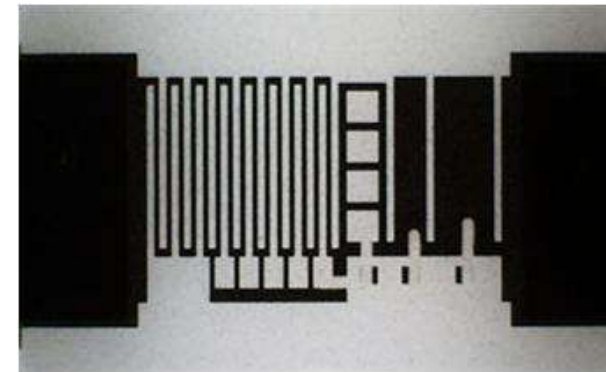
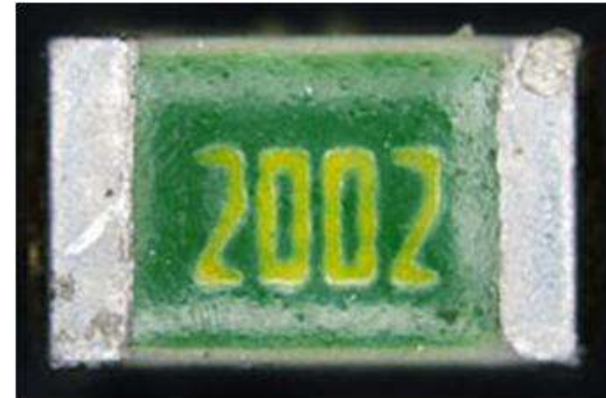
Thin Film Flat Chip Construction



Structure

- 1 Ceramic substrate
- 2 NiCr Metal fil
- 3 Top termination (CrNiCu)
- 4 Bottom termination (CrNiCu)
- 5 End termination (NiCr)
- 6 Protective coat
- 7 Ni Barrier
- 8 Sn plating

~ 0,2 μm



Laser Trimming

What are the Main Advantages of Thin Film?

Advantages of Thin Film Technology

- High precision initial tolerances down to ± 0.05 %
- Extremely low T.C.R. down to ± 5 ppm/K
- Higher stability over lifetime than thick film resistors
- Low drift of resistance value
- Low current noise, excellent linearity
- More stable in higher frequencies
- Better short time overload
- Better resistance to soldering heat
- No sulfuration of terminations
- Operating temperature performance up to $+155$ °C

Thin Film Series Comparison

KOA

Automotive

RN73R & RN73H Features

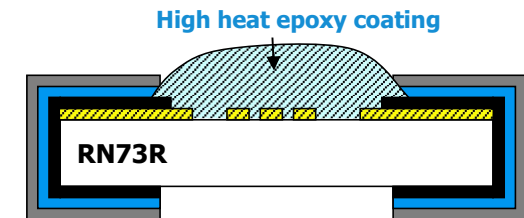
RN73R



Features

- Improved resistance to electric corrosion and stability compared to RN73
- Excellent heat resistance
 - ✓ Operating temperature range: -55 °C ~ +155 °C
 - ✓ High power rating at rated ambient temperature +85 °C
- Improved moisture resistance of 0.25 % (+85 °C ambient, 85 %, 1000 hrs)
- AEC-Q200 qualified, Sulfur resistance verified according to ASTM B 809-95

=> **Recommendation is RN73R instead of RN73 for new designs (planned EOL for RN73 is 2022)**



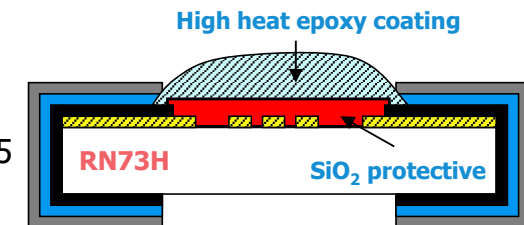
RN73H



Features

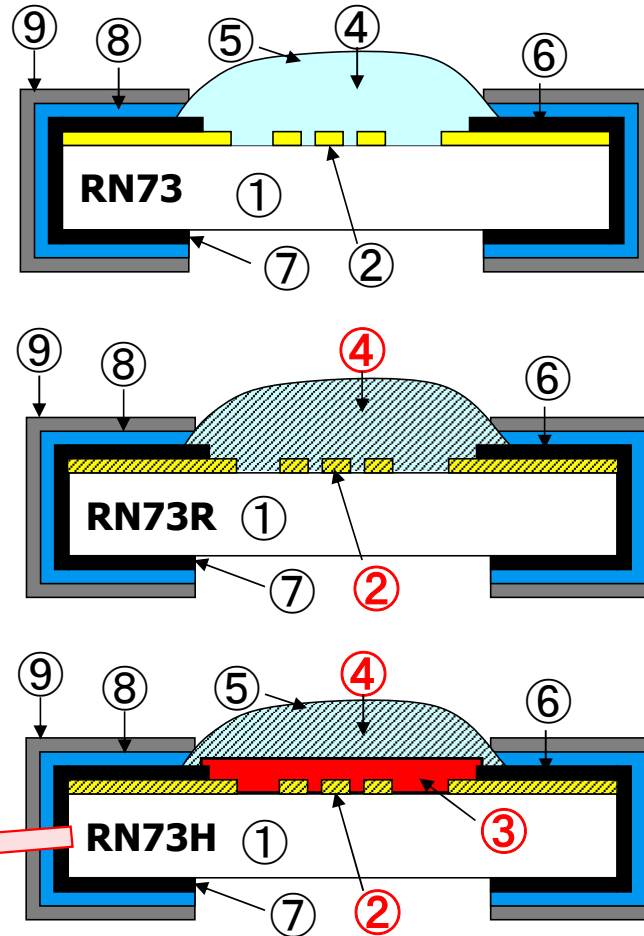
- Recommended for automotive applications
- Excellent moisture resistance and high heat resistance by special resistive film and protective coating
- Additional inorganic passivation
- Improved moisture resistance of 0.1 % (+85 °C ambient, 85 %, 1000 hrs)
- Load life also specified and tested at +85 °C ambient, 3000 hrs
- AEC-Q200 qualified, Sulfur resistance verified according to ASTM B 809-95

=> **Recommendation is RN73H for highest reliability**



Thin Film Series Comparison

Structural Differences



RN73H

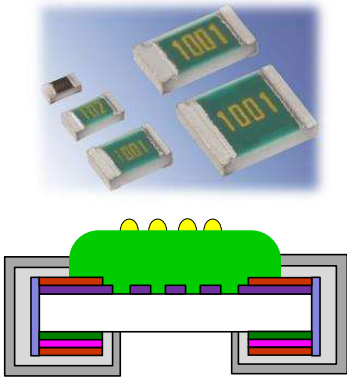
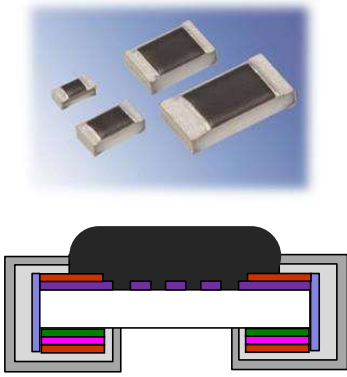
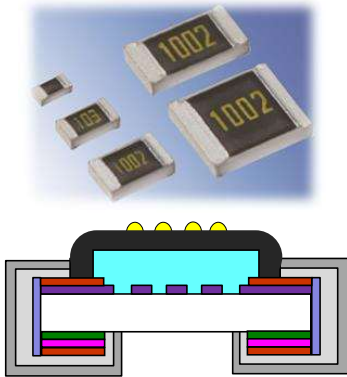
Excellent moisture resistance and high heat resistance by special resistive film and special protection

No.	Name	Material
①	Substrate	Alumina ceramic Al_2O_3
②	Resistive film	NiCr metal film
②	RN73R / RN73H	High heat resistant metal film
③	Inner Protective coating RN73H	SiO_2
④	Over coating	
④	RN73	High purity epoxy resin
④	RN73R / RN73H	High heat resistant
⑤	Marking	No marking
⑤	RN73 / RN73H	High purity epoxy resin
⑥	Inner electrode film (Top/Bottom)	CrNiCu Metal film
⑦	Inner electrode edge film	NiCr metal film
⑧	Middle layer Electrode	Ni plating
⑨	Outer layer Electrode	Sn plating

Thin Film Series Comparison



Structural Differences

	RN73	RN73R	RN73H
Structure			
Substrate	□: Al ₂ O ₃	□: Al ₂ O ₃	□: Al ₂ O ₃
Metal Film Resistor	■: Metal-A	■: Metal-B	■: Metal-B
Inner protective coat	—	—	■: SiX
Environmental Seal	■: Epoxy Resin	■: Epoxy Resin	■: Epoxy Resin
Marking	■: Epoxy Resin	—	■: Epoxy Resin
Under layer Electrode (Top/Bottom)	■: Cr ■: Ni ■: Cu	■: Cr ■: Ni ■: Cu	■: Cr ■: Ni ■: Cu
Under layer Electrode (Edge)	■: NiCr Alloy	■: NiCr Alloy	■: NiCr Alloy
Middle/Top Electrode	■: Ni Plating ■: Sn Plating	■: Ni Plating ■: Sn Plating	■: Ni Plating ■: Sn Plating

Thin Film Series Comparison



Comparison of Ratings

		RN73		RN73R	RN73H
		General	High Power		
Power Rating	1E (0402)	0.063 W	-	0.063 W	
	1J (0603)	0.063 W	0.1 W	0.1 W	
	2A (0805)	0.1 W	0.125 W	0.125 W	
	2B (1206)	0.125 W	0.25 W	0.25 W	
	2E (1210)	0.25 W	-	0.25 W	
Max. Working Voltage	1E (0402)	50 V			
	1J (0603)	75 V			
	2A (0805)	150 V			
	2B (1206)	200 V			
	2E (1210)	200 V			
Max. Overload Voltage	1E (0402)	100 V			
	1J (0603)	150 V			
	2A (0805)	300 V			
	2B (1206)	400 V			
	2E (1210)	400 V			
Rated Ambient Temperature		+70 °C		+85 °C	
Operating Temperature Range		+55 °C ~ +155 °C			
T.C.R. Condition		+25 °C / -55 °C and +25 °C / +125 °C			

Thin Film Series Comparison



Comparison of Performance

(specification values)		RN73	RN73R	RN73H
Rated ambient temperature		+70 °C	+85 °C	+ 85°C
Short time overload	Rated voltage x 2.5 or Max. overload vol., whichever is less, for 5s	±0.1 %: General ±0.5 %: High Power	±0.05 %	±0.05 %
Resistance to soldering heat	260°C±5°C, 10s±1s	±0.1%	±0.05 %*1	±0.05 %*1
Temp Cycling / Rapid change of temperature	-55°C(30min.) / +125°C(30min.) 300 cycles	±0.25%	-	-
	1E, 1J, 2A: -55°C(30min.) / +155°C(30min.) 1000 cycles 2B: -55°C(30min.) / +155°C(30min.) 500 cycles	-	±0.1 %*1	±0.1 %*1
Moisture Resistance	+40°C±2°C, 90%~95%RH, 1000h, 1.5h ON / 0.5h OFF cycle	±0.5 %: General ±0.5 %: High Power	-	-
	+85°C±2°C , 85%±5%RH, 1000h, 1.5h ON / 0.5h OFF cycle	-	±0.25 %	±0.1 %*1
Load Life / Endurance at +70 °C, +85°C	+70°C±2°C, 1000h 1.5h ON / 0.5h OFF cycle	±0.25 %: General ±0.5 %: High Power	-	-
	+85°C±2°C , 1000h 1.5h ON / 0.5h OFF cycle	-	±0.1 % (1000 h)	±0.1 % (3000 h)
High temperature Exposure	+155°C, 1000h	±0.5 %	±0.25 %	±0.1 %*1

*1 Depends on resistance value.

=> The RN73H-series is especially recommended for automotive applications.

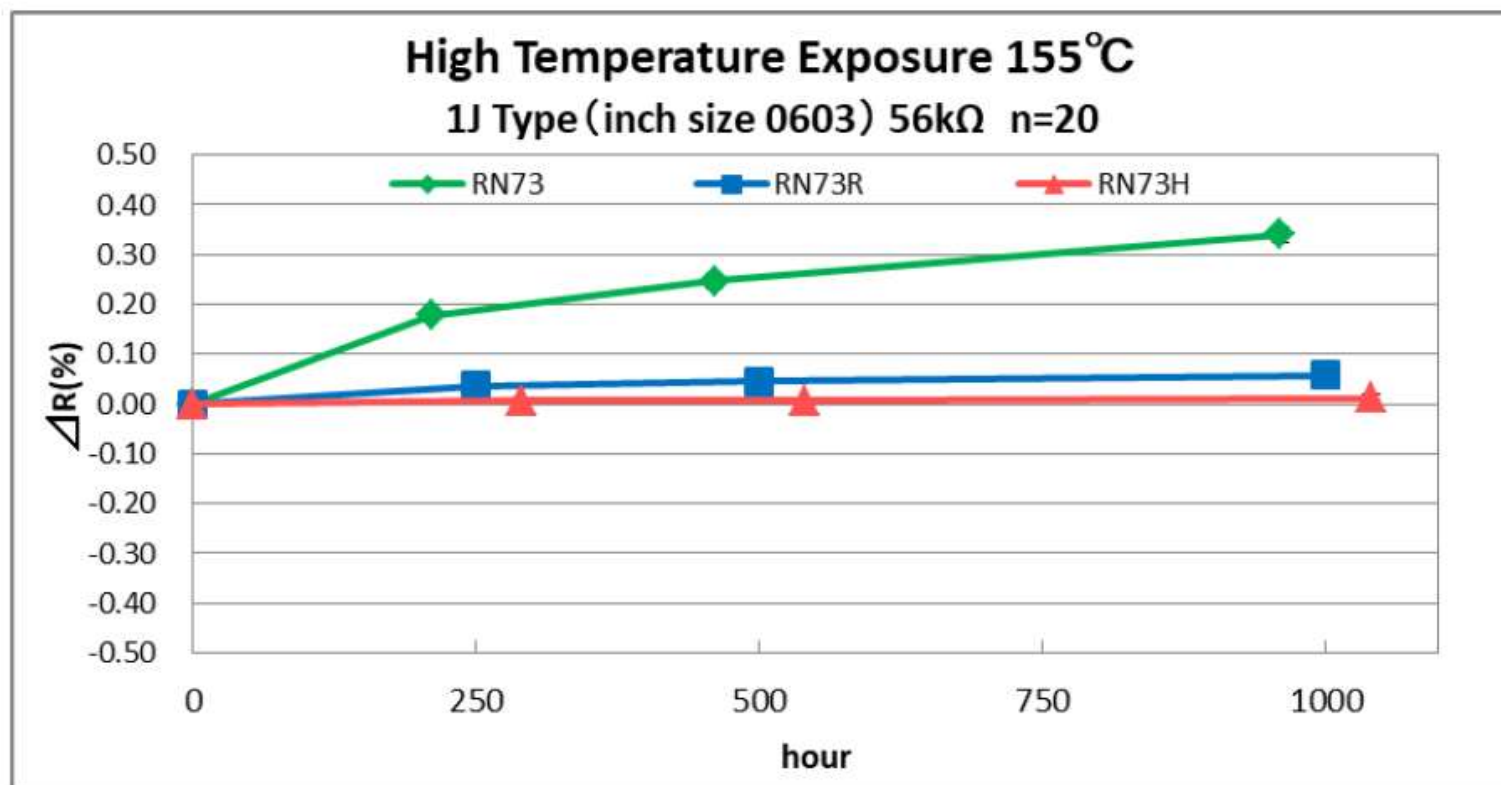
Thin Film Series Comparison



Comparison of Performance

High temperature exposure

155°C (loaded 0% of rated power)

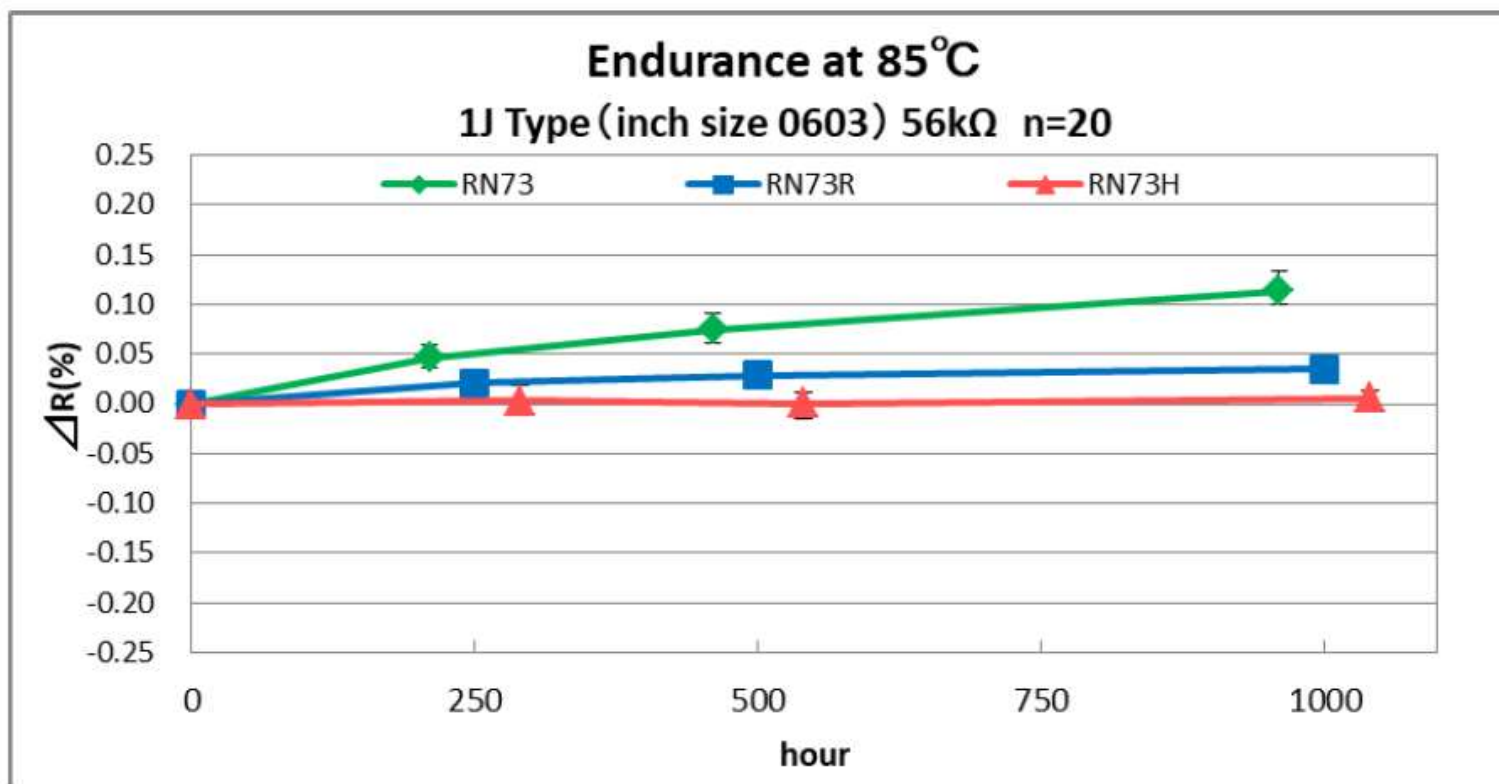


Thin Film Series Comparison



Comparison of Performance

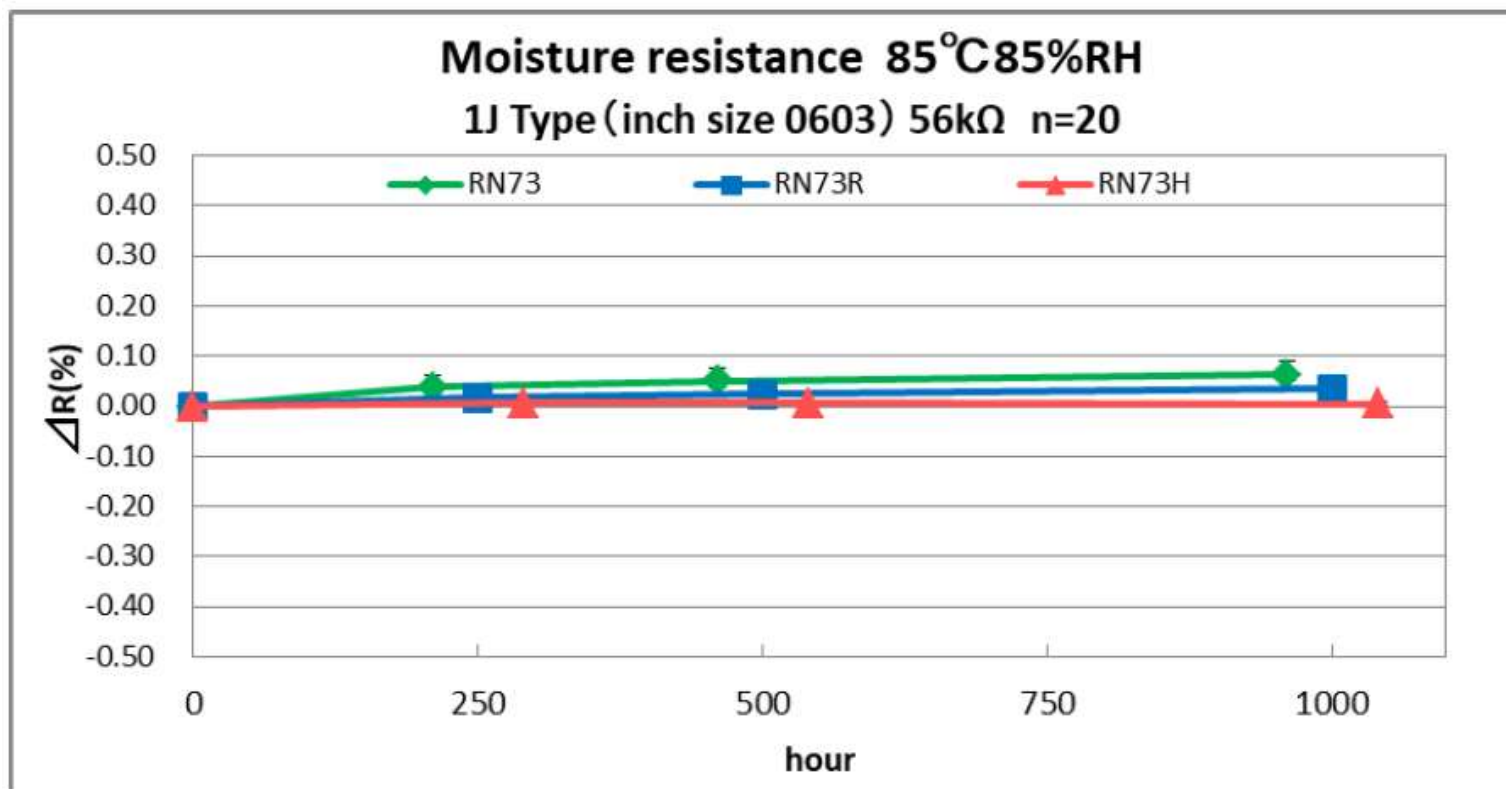
Endurance at 85°C
85°C applied voltage



Comparison of Performance

Moisture resistance

85°C 85%RH applied voltage

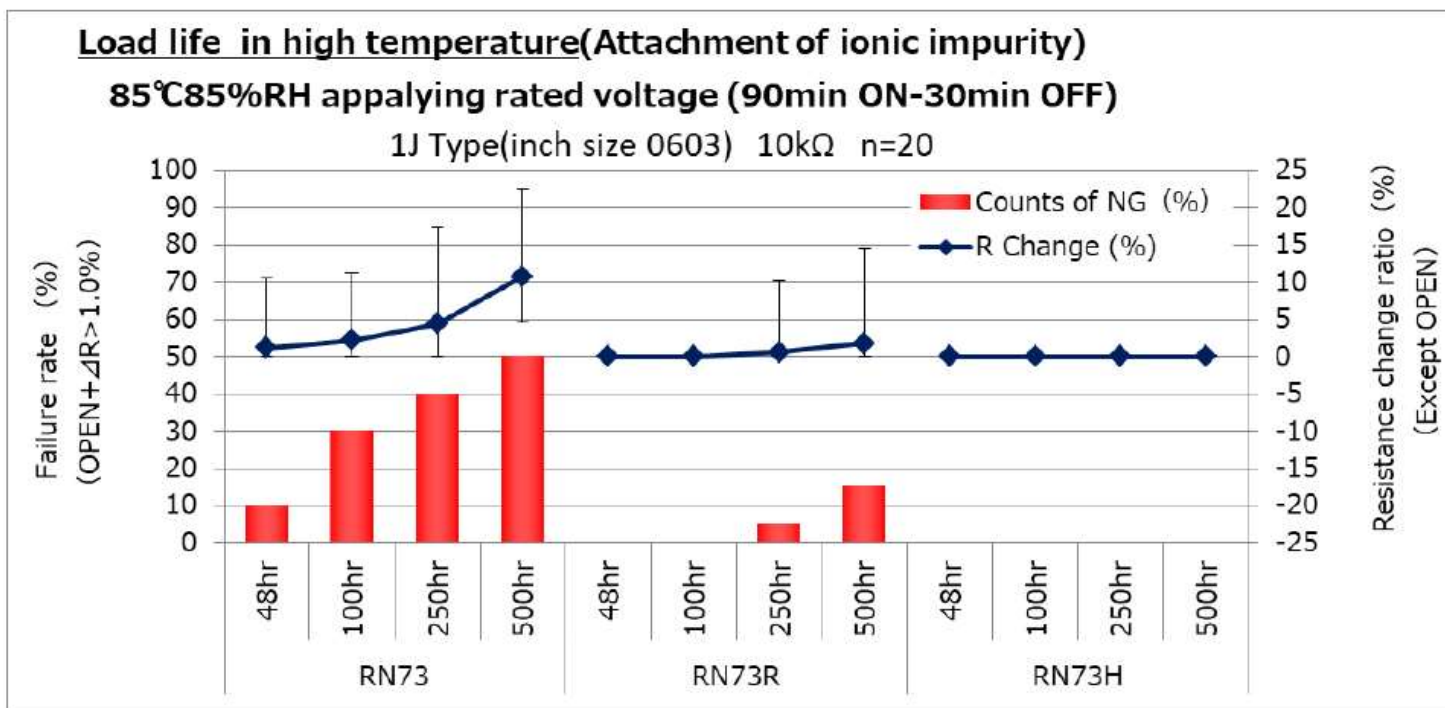


Thin Film Series Comparison

Comparison of Performance

Moisture resistance

85°C 85%RH applied voltage (Attachment of ionic impurity)



RN73 : Using RN73 series under harsh environment can cause breaking by electric corrosion.

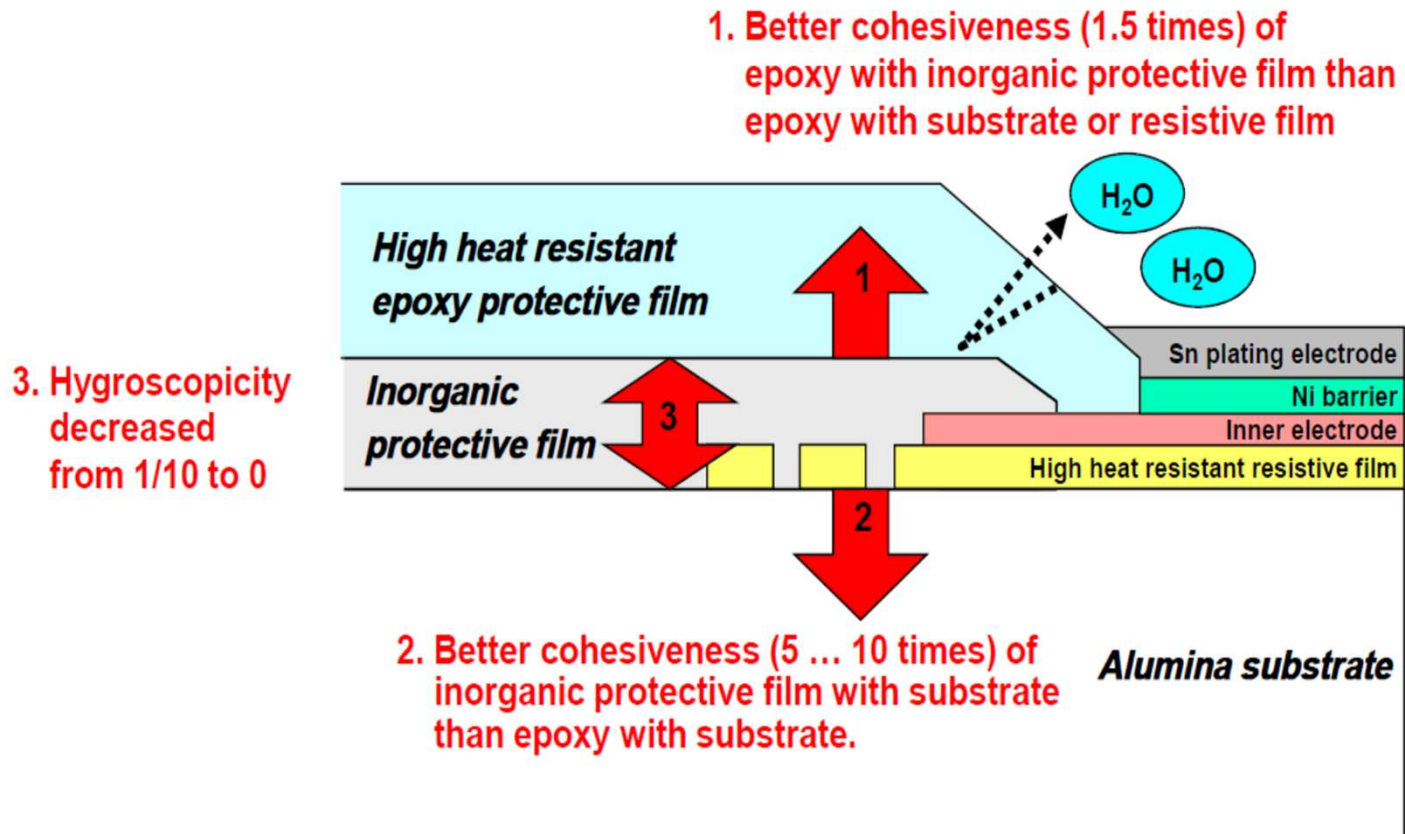
RN73R : Electric corrosion performance is improved compared with RN73 series.

RN73H : RN73H had no electric corrosion. The extra protective coat shut off the moisture

Please note that the possibility of various troubles occurring when the product is excessively contaminated becomes high.

RN73H Internal Structure

Effect of Inorganic Protection



Thank you very much for your attention



Wide Terminal Chip Resistors

AEC-Q200 qualified

Wide Terminal Chip Resistors

WK73/WU73 Series

High reliability and enhanced terminal strength are essential in all power applications. KOA's wide terminal resistors offer several advantages compared to standard footprints. The 0612 chip size allows 6 x power rating and is standard 1206 parts. This saves heat dissipation via the terminals due to the improved heat dissipation possible due to the large terminals also enhance terminal strength and the smaller distance between the terminals reduces expansion stress. Finally, the inner resistive pattern is designed to minimize hotspots. These benefits combined, result in a superior reliability compared to standard flat chip resistors.

KOA offers the **WK73S** & the **WU73**-series which are suitable for **current sensing (10 mΩ to 9.1 Ω)** and the **WK73R**-series for the standard resistance range (10 Ω to 1 MΩ) in 7 different sizes.

NEW
Smaller sizes: WK73_1E (0204), WK73_1J (0306), WK73_2A (0508)

Rated Power of a resistor strongly depends on the maximum available heat transport capability, which mainly relies on heat conduction through the solder joint to the PCB. The temperature dissipation through air, the solder joint and radiation can be neglected. Knowing this, KOA offers to WK73 resistors with inverse geometry. The long sides of the flat chip resistors are used for better heat dissipation through the solder joints:

- Size 0612**
 - power rating 1.5 W
 - short distance between the terminations
 - small mechanical stress at solder fillet
 - low thermal expansion influence from PCB
- Size 1206**
 - power rating 0.25 W
 - longer distance between the terminations
 - absolute stress at solder fillet is high
 - absolute thermal expansion influence is higher

Application Examples

- Automotive, including under the hood applications
- Power supplies
- Motor control units
- Industrial power control
- Battery packs
- Consumer electronics

Product Features

- Excellent heat dissipation
- Superior temperature and power cycling performance
- Low thermal expansion stress
- Higher rated power - less board space than standard chips
- Standard sizes 0204, 0306, 0508, 0612, 1020, 1218 and 1225
- Resistance range 10 mΩ - 1 MΩ
- EU-RoHS compliant, AEC-Q200 qualified
- Lead-free are available
- Anti-Sulfuration types also available (WK73SR_RT)

For more information, please contact:
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Current Sensing Resistors

Metal Plate Technology

SL Series

High Temperature - Molded

High reliability of the terminal connection in case of heat cycle stress is essential in several circuit designs and applications. With the SL-series, KOA offers excellent terminal strength and solderability due to its molded design with metal electrodes which easily absorb thermal expansion and shrinkage stress.

NEW SLNS: 4527, 7 W, 3 mΩ to 200 mΩ
SLZ1: 2512, Jumper, 44 A

Heat Stress & Mechanical Stress

Molded resin, Inner Metal Plate, Sn surface plated electrode (heat cycle), The stress of solder junction is reduced

Standard Flat Chip Style vs KOA SL-types

Mechanical stress can cause cracks due to the different thermal expansion coefficient of the ceramic substrate and the PCB. The special electrode construction of the SL-series gives the ability to absorb this stress.

Features

- Low risk of solder cracks - electrodes absorb heat & mechanical stress
- High component and equipment reliability
- Flame retardant resin molding (UL94 V-0)
- Low resistance 3 mΩ - and high precision ±0.5 %
- T.C.R. ±50 ppm/K is possible
- Available in sizes 2010, 2512 and 4528 inch
- Operating temperatures up to +180 °C
- EU-RoHS compliant, AEC-Q200 qualified
- Lab Kits are available

Application Examples

- Current detection in automotive (e.g. ECU)
- Power supplies, battery packs
- DC-DC converter
- AC adapters
- Inverter circuits
- Current sensing for CPU
- Power conditioner/inverter
- Industrial equipment
- Notebook PC's

Ratings

Type	Power Rating	Resistance Range (Ω) ¹⁾		T.C.R. (ppm/K)	Rated Terminal Foot Temp.	Operating Temp. Range
		D: ±0.5% E24-E96	F: ±1% E24-E96			
2010	1W	—	5m-100m ²⁾	0-200/Rg 10mΩ 0-150/Rg 11mΩ	120°C	-55°C ~ +180°C
2512	1.5W	10m-100m	5m-100m	±100/Rg 10mΩ ±75.20m/Rg 100mΩ ±50.34m/Rg 100mΩ	120°C	-55°C ~ +180°C
4527	3W	—	5m-110m	±110/Rg 10mΩ ±75/Rg 10mΩ	100°C	-55°C ~ +180°C
SLNS	7W	—	3m-200m ²⁾	—	70°C	-55°C ~ +180°C

¹⁾ 5m, 6m, 7m, 8m, 9m are also available in each resistance range ²⁾ 3mΩ - 4.7mΩ only in E24 series ³⁾ 5W in case of rated terminal temperature below 100°C

For more information, please contact:
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Datasheet

Low Temperature Co-fired Multilayer Ceramic Substrates

VIA ELECTRONIC

Multilayer ceramics and cavity packages enable complex module creation

- Highly controlled dimensions, flatness
- Low thermal expansion enhances bare IC's use
- Ceramics with low dielectric constant & loss
- Low ohm silver conductor

Optimal for bare chip module

- High frequency performance
- Environmental & reliability

Miniaturization & Integration

- High heat/moisture resistance (zero water absorption)
- Outgases/dust free, impermeability

Application Examples

- Interposer
- Semiconductor package
- Multi-chip module
- Multi-cavity
- Customized shape
- High frequency module

Labels in diagram: Cavity, Surface printed resistor, Buried printed resistor, Transmission line, Inner conductor, Integrated capacitor, Integrated inductor, Thermal via, Via

For more information, please contact:
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18 Nov. 2020

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