KOA Europe GmbH

Improving EV-Chargers by choosing Special Resistor Solutions

25-01-2022

EV-Chargers

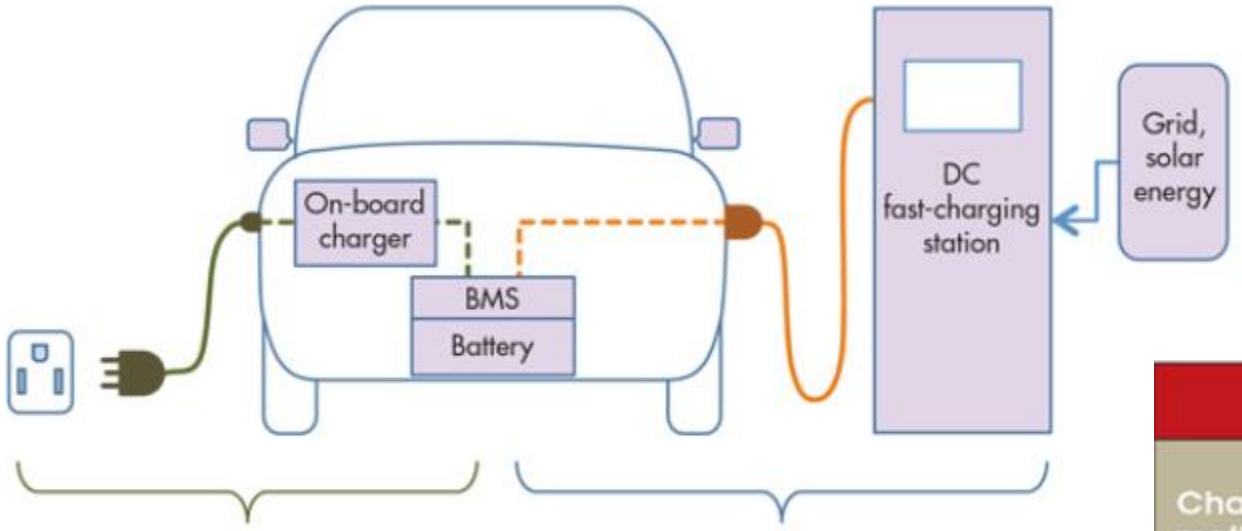
Introduction

Pulse Proof Resistors

High Precision Resistors

Current Measurement Resistors

AC or DC



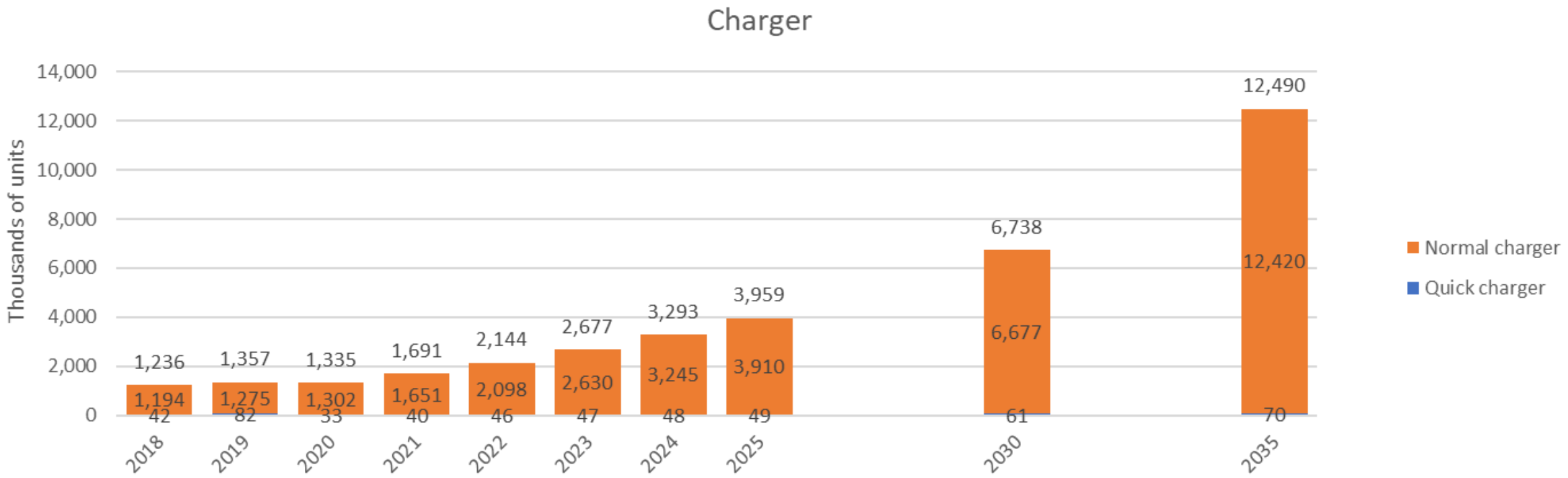
AC charging
- Every vehicle has an on-board charger.
- Limited power, slow charging.

DC charging
- Infrastructure investment is shared among hundreds of users.
- Large power rating, fast charging.
- Capable of integration with renewable resources.

AC/DC CHARGING ELECTRICAL RATINGS[14]

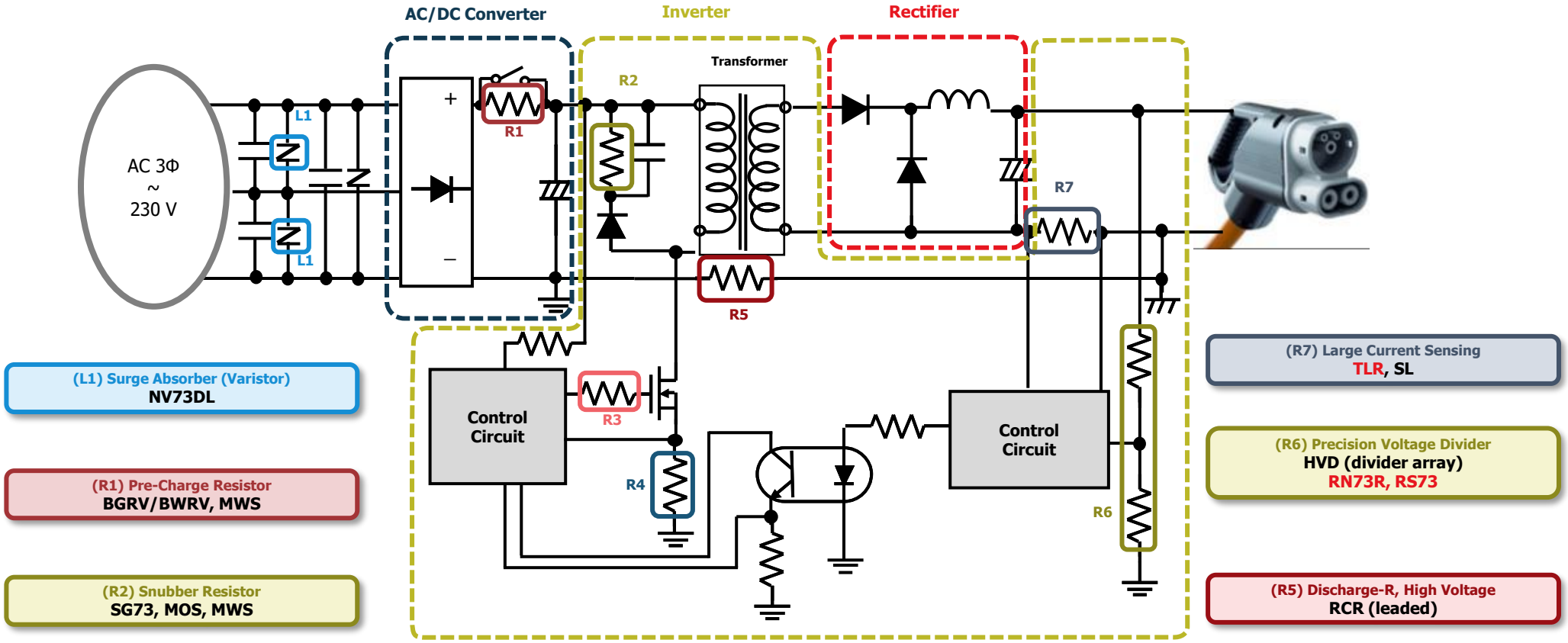
Charge method	Nominal supply voltage	Maximum continuous current (A)	Output power (kW)	Estimated charge time[1]
AC Level 1	120-V ac, 1-phase	12	1.4	17 hr. (OBC, SOC[2]—20% to full)
		16	1.9	
AC Level 2	208- to 240-V ac, 1-phase	80	Up to 19.2	SOC—20% to full: 7 hr. (3.3-kW off-board charger) 3.5 hr. (7-kW off-board charger) 1.2 hr. (20-kW off-board charger)
DC Level 1	200- to 500-V dc (EVSE output)	80	Up to 40	1.2 hr. (SOC—20% to 100%, 20-kW off-board charger)
DC Level 2	200- to 500-V dc (EVSE output)	200	Up to 100	20 min. (SOC—20% to 80%, 45-kW off-board charger)

Charger Development



Source : FUJI KEIZAI CO., LTD.

Charging Station Circuit



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Current Measurement Resistors

SG73P – Series

Features

- Precision endured pulse power resistor: ±0.5%, ±1%, ±2%, ±5%
- Excellent pulse proof – almost the same as SG73 series
- Efficient for rectangular wave form (pulse-width modulation, MOSFET gate resistor) which has longer dwell times
- Higher power ratings compared to general F/C resistors
- AEC-Q200 tested

Applications

ECU for automotive, motor control, power supply, industrial equipment, etc.

Ratings

Operating Temperature Range: -55 ºC ~ +155 ºC

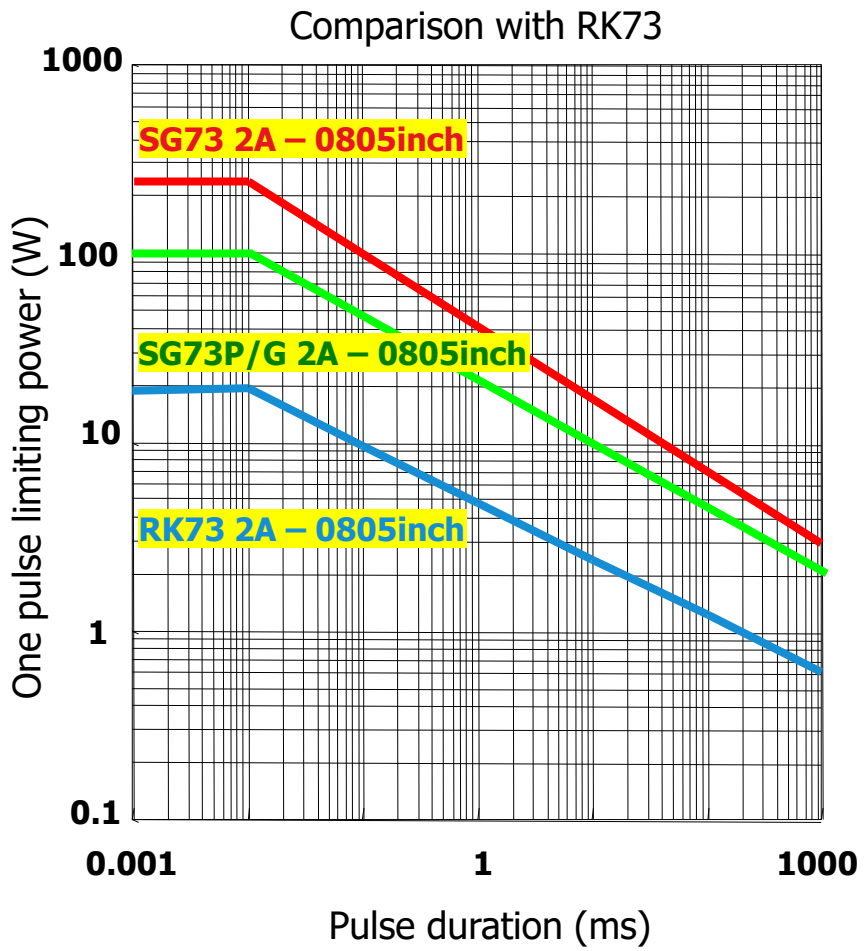
Type	Size (inch)	Power Rating *1	Rated Terminal Part Temperature	T.C.R. (ppm/K)	Max. Working Voltage	Resistance Range	Resistance Tolerance
SG73P 1E	0402	0.2 W	+105 ºC	±200	75 V	1 Ω … 10 MΩ	D: ±0.5 % F: ±1 % G: ±2 % J: ±5 %
SG73P 1EW NEW		**0.25 W**	+125 ºC	**±100** / ±200*3			
SG73P 1J	0603	0.33 W	+125 ºC	±100*2	150 V		
SG73P 2A	0805	0.5 W	+100 ºC	±200 (±100)*3	400 V		
SG73P 2B	1206	0.75 W	+105 ºC		200 V		
SG73P 2E	1210	0.75 W	+110 ºC	±200			
SG73P 2E1	1210	1 W	+95 ºC				

*1 Rated power is guaranteed by keeping the max. termination temperature

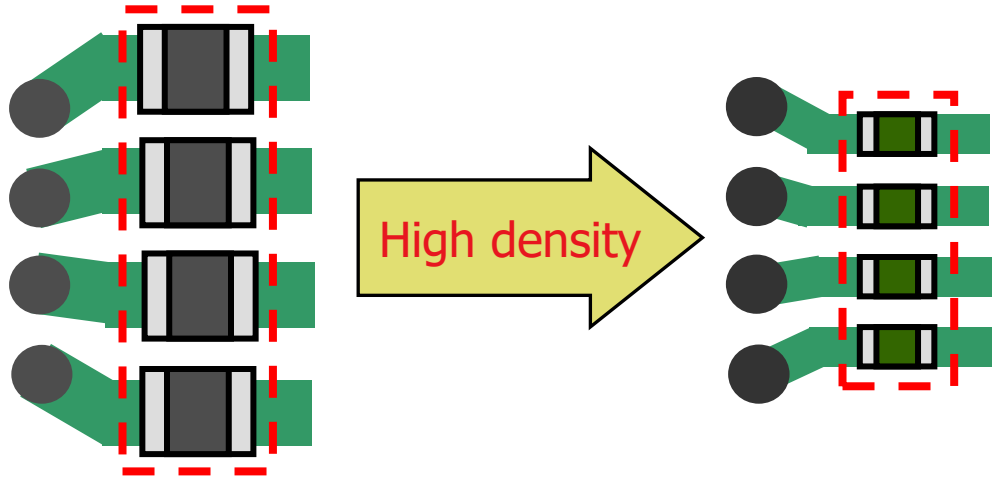
*2 Cold T.C.R. (-55 ~ +25 ºC) of SG73P1J is ±150 ppm/K

*3 T.C.R. ±100ppm/K is specified for a limited resistance range. Please contact KOA.

Comparison: SG73 vs SG73P vs RK73



Size (inch)	One-pulse limiting electric power [W] Pulse duration: 10 µs		
	General RK73	For Pulse SG73P/G	For Pulse SG73
0805	20	103	220
1206	40	268	500
1210	52	531	1300



General-purpose chip resistors
RK73 1210

Anti-surge chip resistors
SG73P 0603

EV-Chargers

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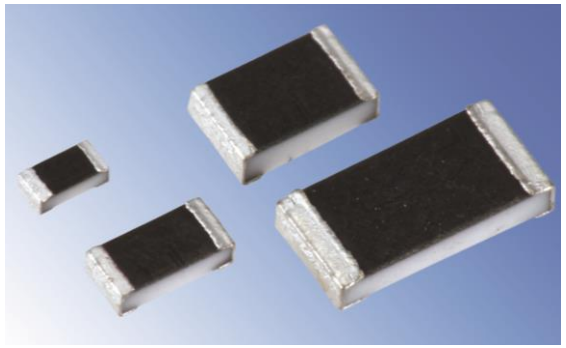
Current Measurement Resistors

Automotive

RS73 – Ultra Precision & High Reliability Resistors



Features

- Ultra precise initial resistance tolerances
- Low T.C.R.: ±25 ppm/K
- Precise long-term stability (±0.2 %~)
- ESD stability of thick film resistors
- Ideal for applications where thin film is not suitable
- Can replace MINI-MELF resistors in several applications
- AEC-Q200 tested

Applications

- High precision circuits for automotive and industrial
- A/D signal conversion
- High precision sensing
- Voltage detector

Anti-Sulfuration types are also available:
RS73F_RT
RS73G_RT

Ratings

Operating Temperature Range: -55 ~ +155 ºC

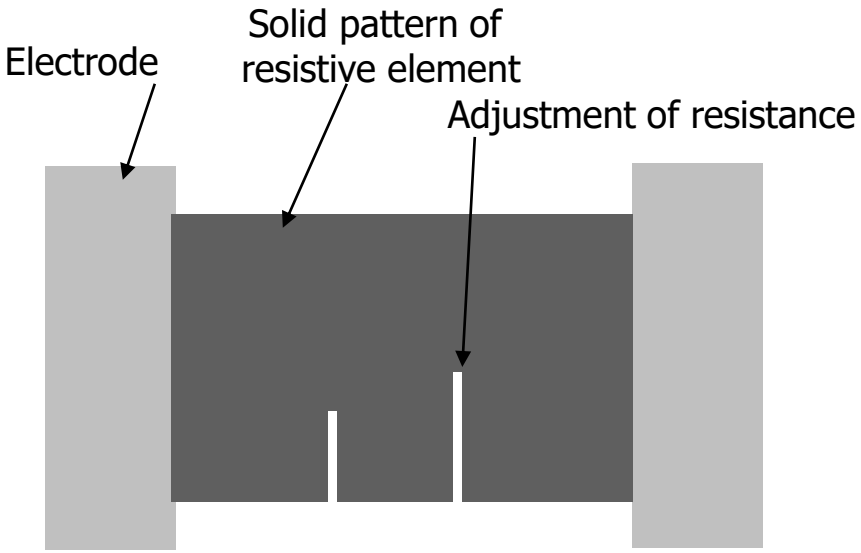
Type	Size (inch)	Power Rating	Rated Ambient Temperature	Rated Terminal Part Temperature	T.C.R. (ppm/K)	Resistance Range E24 • E96*			Long-Term Stability ΔR
						B: ±0.1%	C: ±0.25%	D: ±0.5% F: ±1%	
RS73 (F/G) 1E NEW	0402	0.125 W	+85 ºC	+125 ºC	F: ±25 G: ±50	300 Ω ~ 100 kΩ	300 Ω ~ 1 MΩ		±0.2 % ~ ±0.4 %
RS73 (F/G) 1J	0603	0.2 W				10 Ω ~ 1 MΩ			
RS73 (F/G) 2A	0805	0.25 W				10 Ω ~ 3 MΩ	10 Ω ~ 6.8 MΩ	10 Ω ~ 10 MΩ	
RS73 (F/G) 2B	1206	0.33 W				10 Ω ~ 1 MΩ			

* Values from E192 series on request

What is the Structural Difference?

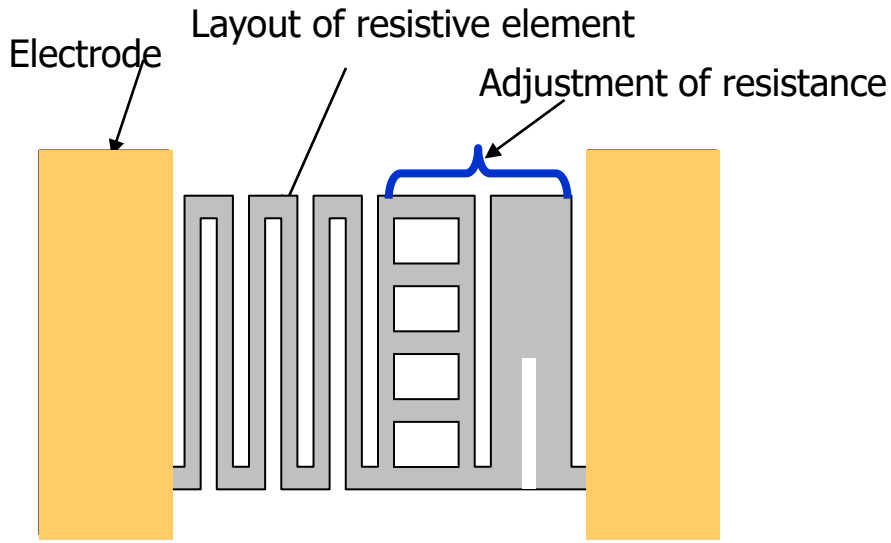
- The resistive element of a metal glaze resistor is formed by screen printing and the resistance value is finally adjusted by trimming.
- The resistive element of the metal film resistors is deposited by sputtering, the pattern is formed by photolithography technology and resistance value is finally adjusted by trimming.

Thick film(metal glaze) chip resistor (RK73)



Film thickness: ~10-14 µm

Thin Film(metal film) chip resistor (RN73R)

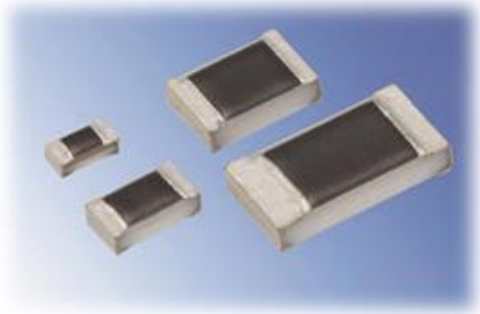


Film thickness: ~0.2-0.4 µm

Automotive

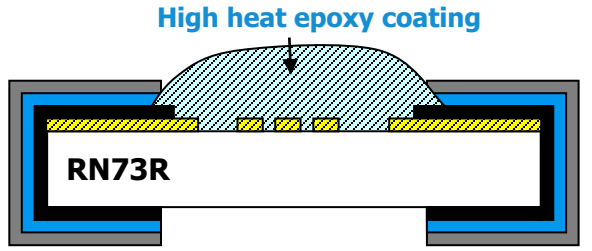
RN73R & RN73H: Precision Metal Thin Film

RN73R



Features

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

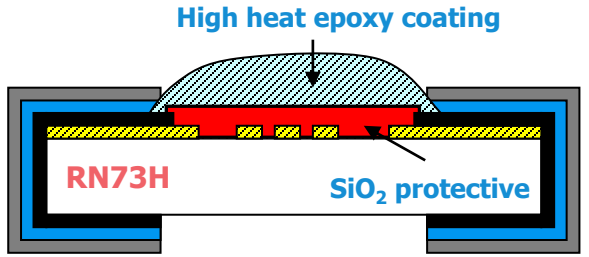


RN73H

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 ºC ambient, 85 %, 1000 hrs)
- Load live also specified and tested at +85 ºC ambient, 3000 hrs
- AEC-Q200 tested, Sulfur resistance verified according to ASTM B 809-95

=> Recommendation is RN73H for highest reliability



Precision Portfolio and Total Tolerance (worst case)

Product line-up list *1		Thick Film		Thin Film	
		RK73G (High Precision)	**RS73F** NEW (Ultra High Prec. & High Reliability)	**RN73R** NEW (Thin Film, High heat resistance)	**RN73H** (Thin Film, High heat resistance)
Product size (inch)		0201 ~ 1206	0402 ~ 1206	0402 ~ 1206	0402 ~ 1210
Resistance range (Ω)		10 ~ 1M	10 ~ 10M	10 ~ 1.5M	10 ~ 1.5M
Resistance tolerance		C (±0.25%) D (±0.5%) F (±1%)	B (±0.1%) C (±0.25%) D (±0.5%) F (±1%)	A (±0.05%) B (±0.1%) C (±0.25%) D (±0.5%) F (±1%)	A (±0.05%) B (±0.1%) C (±0.25%) D (±0.5%) F (±1%)
T.C.R. (ppm/K)		±50	±25*2	±5*3 / ±25	±5*3 / ±25
Power rating (W)		0.05 ~ 0.2	0.125 ~ 0.33	0.063 ~ 0.25	0.063 ~ 0.25
Upper category ambient temperature		+155°C			
Reliability guarantee (%)	Short time overload	±2.0	±0.2	±0.05	±0.05
	Solder dip resistance	±1.0	±0.2	±0.05	±0.05
	Rapid change of temp.	±0.5	±0.2*4	±0.1	±0.1
	Moisture resistance load	±2.0	±0.2*4	±0.25	±0.1
	Rated load	±2.0	±0.2	±0.1	±0.1
(%)	Total tolerance (Initial + TCR + Solder heat + Rated load)	±4.15	±0.83	±0.58	±0.58

*1 Each product specification is extracted from the best guaranteed value of each item. Please refer to the catalog for detailed product specifications.
*2 Hot: (+25ºC/+125ºC): ±25ppm/K ambient, Cold: (-55ºC/+25ºC): -50/~+25ppm/K ambient
*3 Valid for +25ºC/+125ºC ambient
*4 The resistance range of long-term stability ±0.2% is 100 Ω ~ 200 kΩ (upper r-range is ±0.4%)

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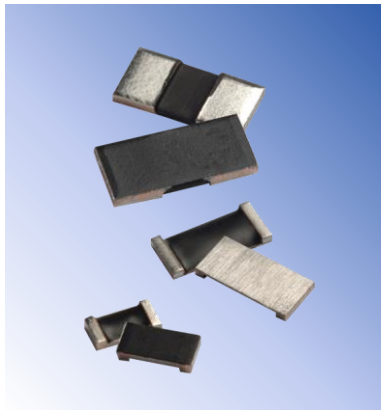
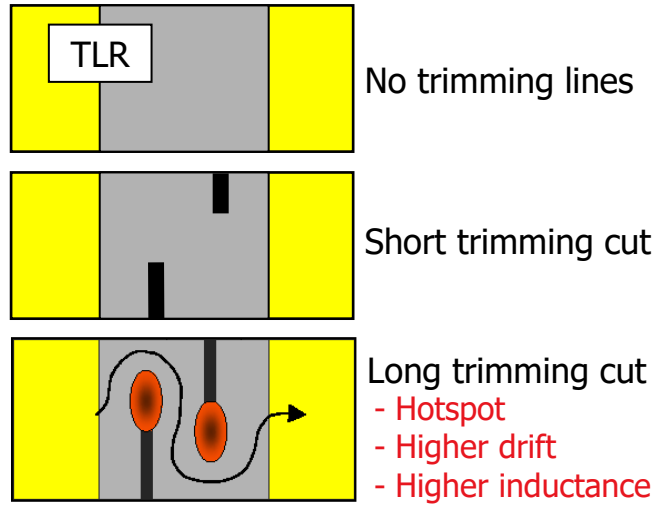
Automotive

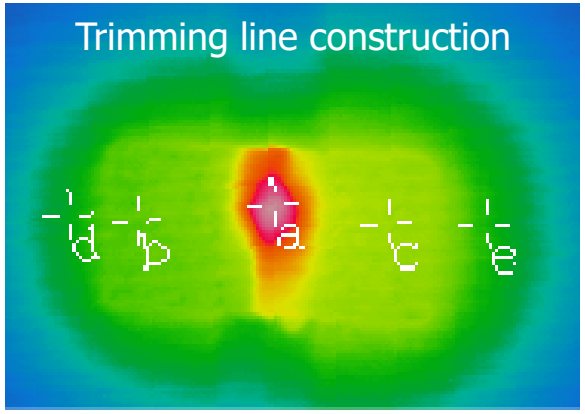
TLR – Series
Advantages of Special Trimming



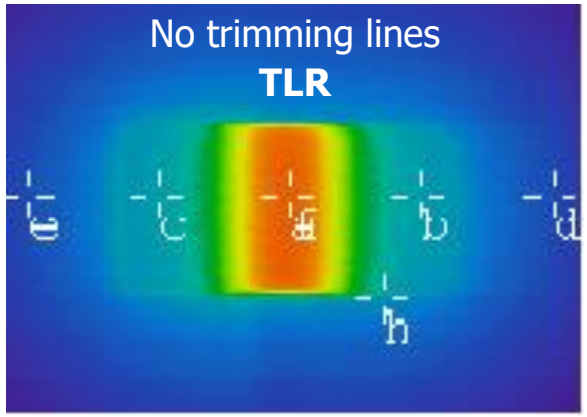
Special trimming of shunts

- Extremely low resistance values 0.2 mΩ ~ 20 mΩ
- Tolerance ±1 % is standard
- Special trimming for uniform temperature distribution and enhanced reliability
- Ultra low inductance - suitable for high frequencies
- Excellent heat radiation due to wide electrode

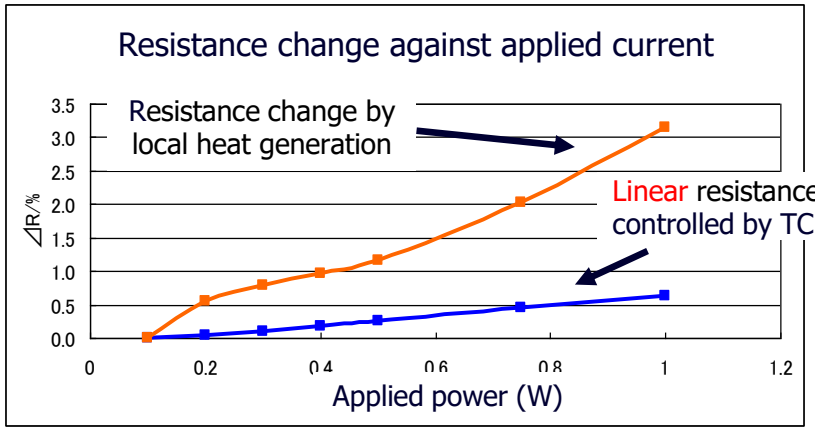




Hot spot is created in the middle, close to the trimming cut.



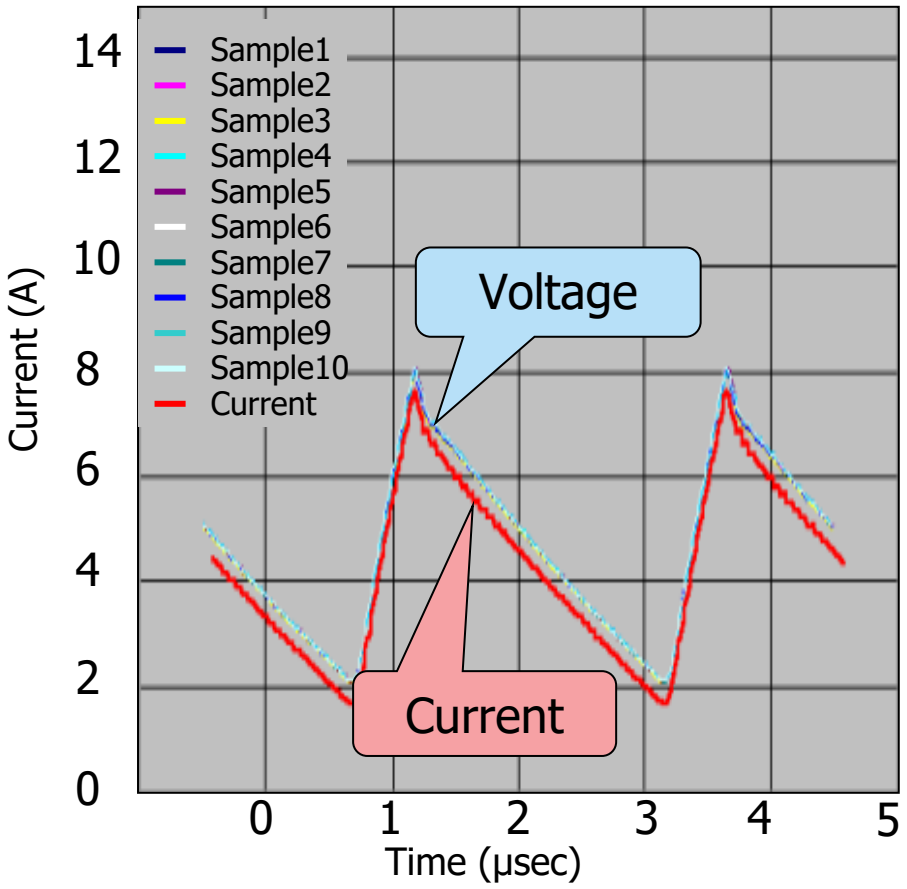
Hot spot is created symmetrically to the central axis.
=> Better heat distribution for resistance stability.



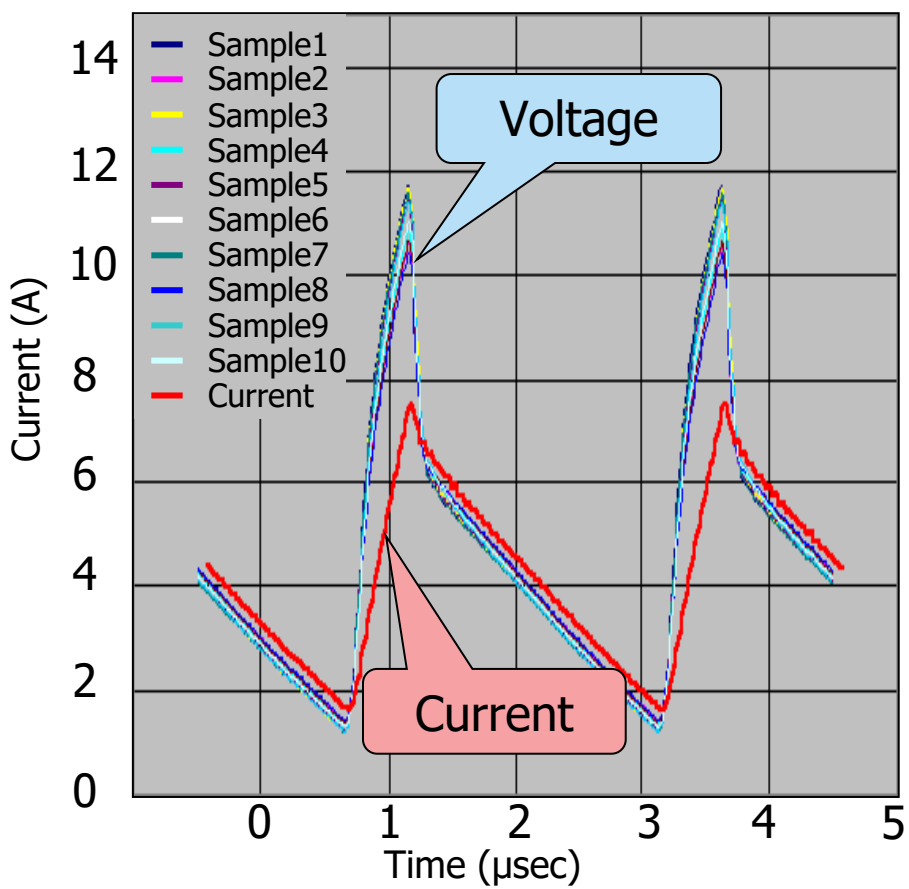
Advantage of Non-Trimming Structure

Parasitic inductance has an influence on the current detection accuracy

Shunt with no trimming cut (2 mΩ)



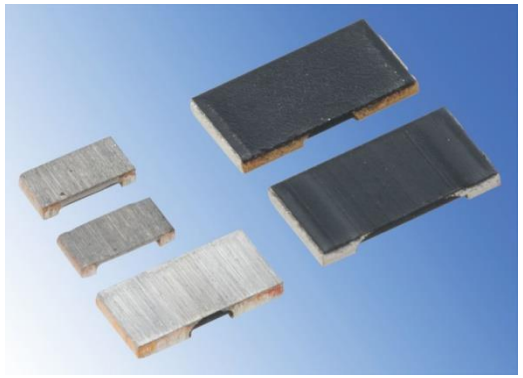
Shunt with trimming cut (2 mΩ)



High frequency and large slope (rising fast) are affected by inductance.

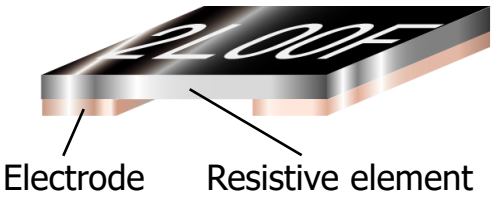
Automotive

TLR – Series
Metal Plate Chip Type Resistor – High Power



Features

- High power in small package
- Low resistances available: 0.5 mΩ ~ 20 mΩ
- Ultra low profile: 0.6 mm ~ 0.7 mm height
- No laser trimming cut - excellent pulse resistance - low inductance
- Metal alloy: superior corrosion and heat resistance
- Soldering area is mainly the bottom electrode
- AEC-Q200 tested



Applications

Automotive electronics, power steering (EPS), motor control units, power supplies,
AC / DC-DC converter, metering, CPU current sensing, mobile devices charge controller, etc.

Ratings

Type	Inch Size	Power Rating	Rated Terminal Part Temperature	T.C.R. (ppm/K)	Resistance Range F: ±1%
TLR2A	0805	1 W	+105 ºC	±100	2 mΩ ~ 10 mΩ
TLR2BP	1206	1.5 ~ **3 W**	+100 ºC / +110 ºC	**±50** /±75	0.5 mΩ ~ 20 mΩ
TLR2HW	2010	2 W	+120 ºC		0.5 mΩ ~ 10 mΩ
TLR3AP	2512	3 ~ **5 W**	+90 ºC / +110 ºC		

TLRH: Higher resistance range of TLR

- 10mΩ … 270mΩ, 0.25W ~ 5W, 0805 and 2512

TLRZ: Metal plate chip jumper

- 10A … 50A, 0402/0603/0805/1206

Operating Temp. Range:
-65 ~ +155 ºC (2A size)
-65 ~ +170 ºC (2B,2H,3A)

Thank you very much for your attention

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