KOA Europe GmbH

Improving EV-Chargers with most precise current and voltage measurement

26-04-2022

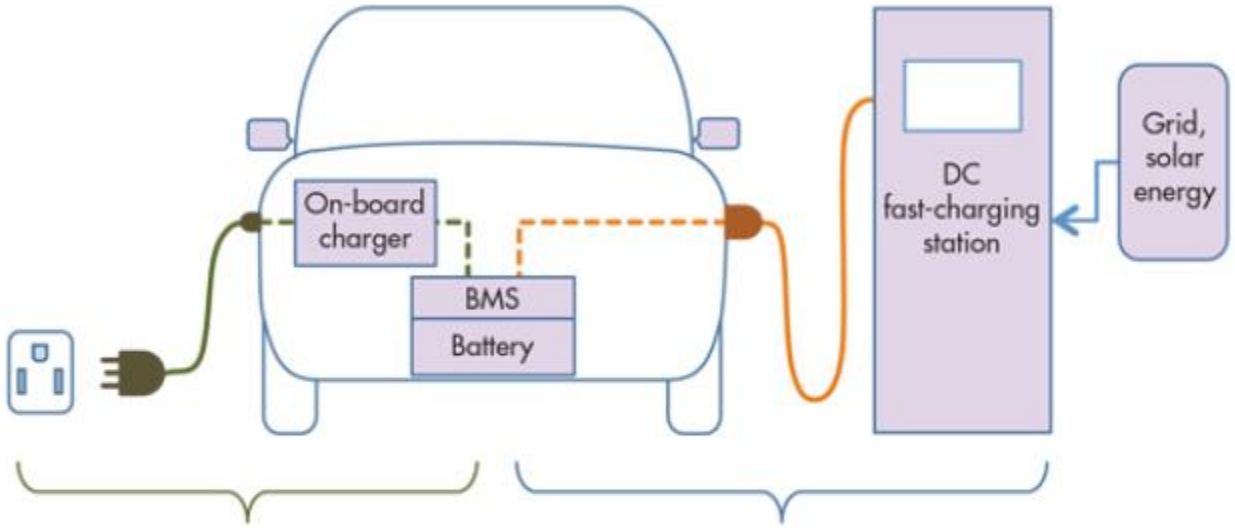
EV-Chargers

Introduction

Current Measurement Resistors

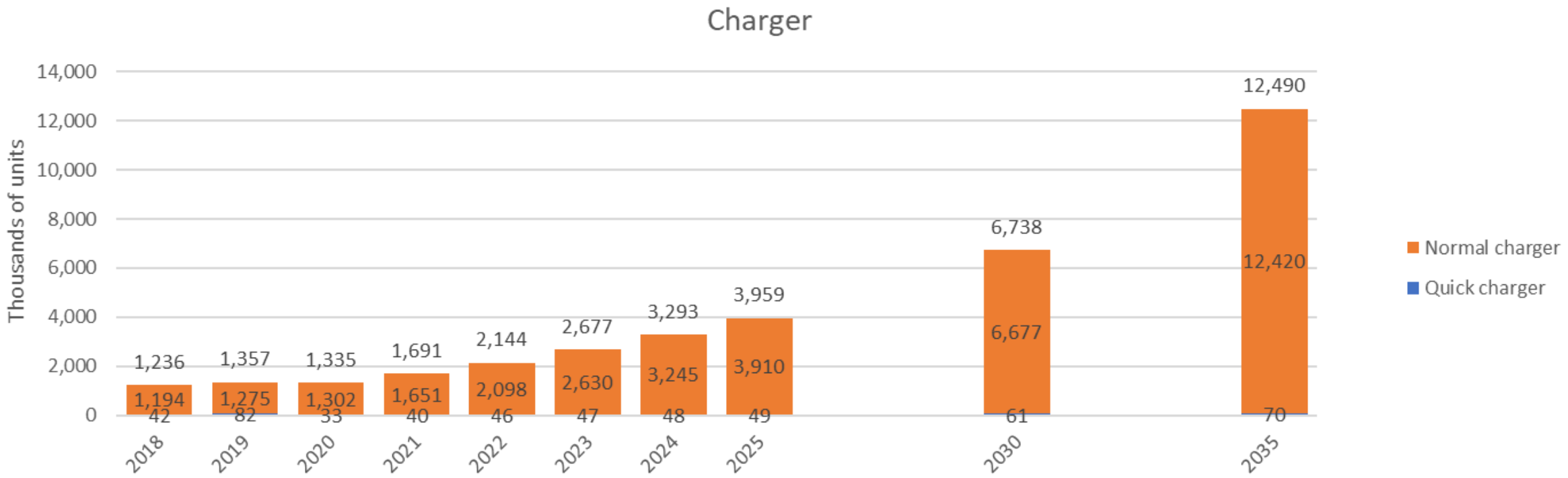
High Precision Resistors

AC or DC



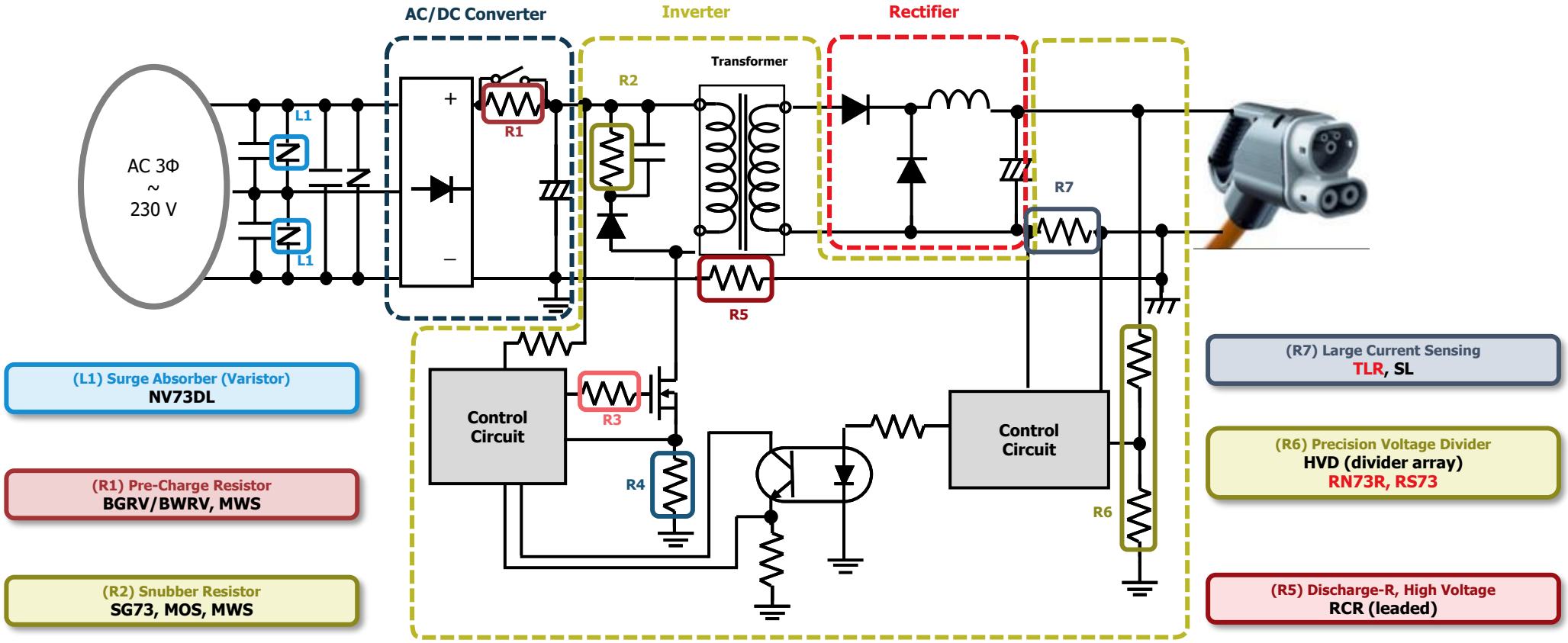
Charge Method	AC up to	DC up to
Level 1	**1.9 kW** (120 V @ 16 A)	**36 kW** (200-450 V @ 80 A)
Level 2	**19.2 kW** (240 V @ 80 A)	**90 kW** (200-450 V @ 200 A)
Level 3	**>20 kW** (TBD)	**240 kW** (200-600 V @ 400 A) not finalised

Charger Development



Source : FUJI KEIZAI CO., LTD.

Charging Station Circuit



EV-Chargers

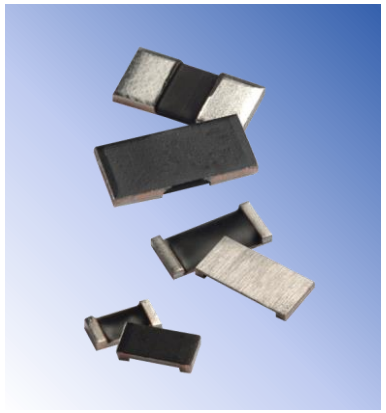
Introduction

Current Measurement Resistors

High Precision Resistors

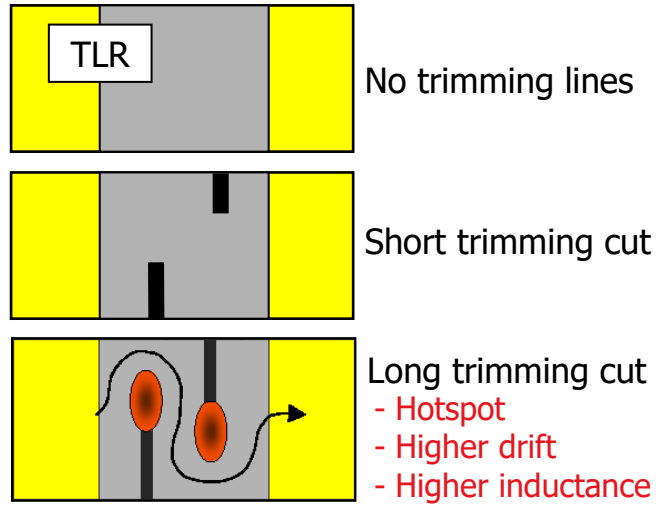
Automotive

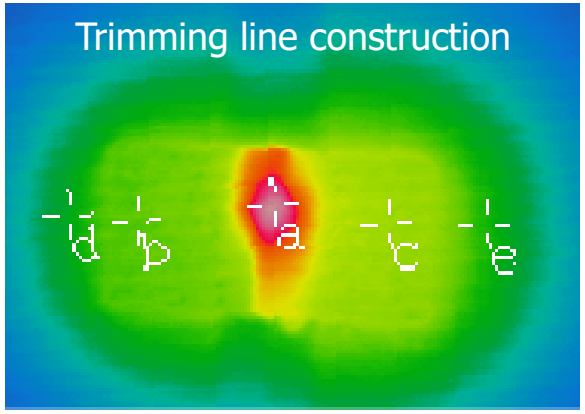
TLR – Series
Advantages of Special Trimming



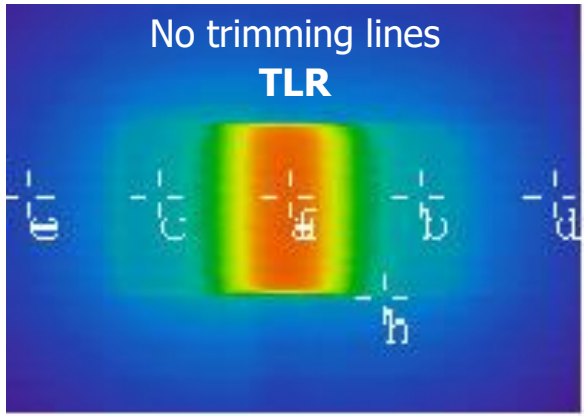
Special trimming of shunts

- 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

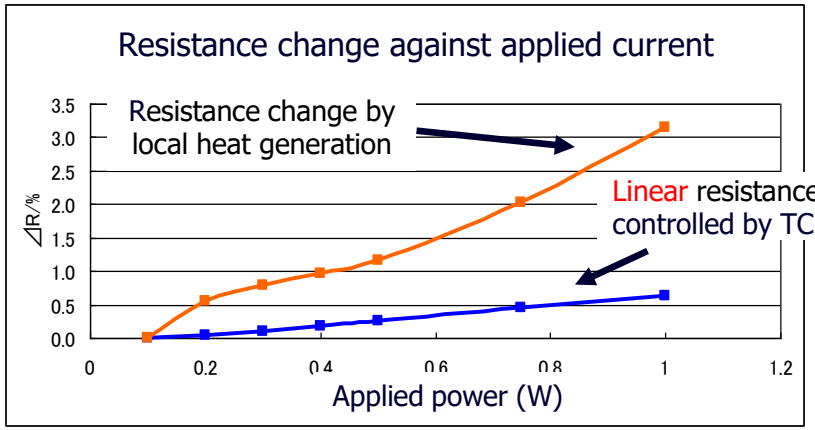




Hot spot is created in the middle, close to the trimming cut.



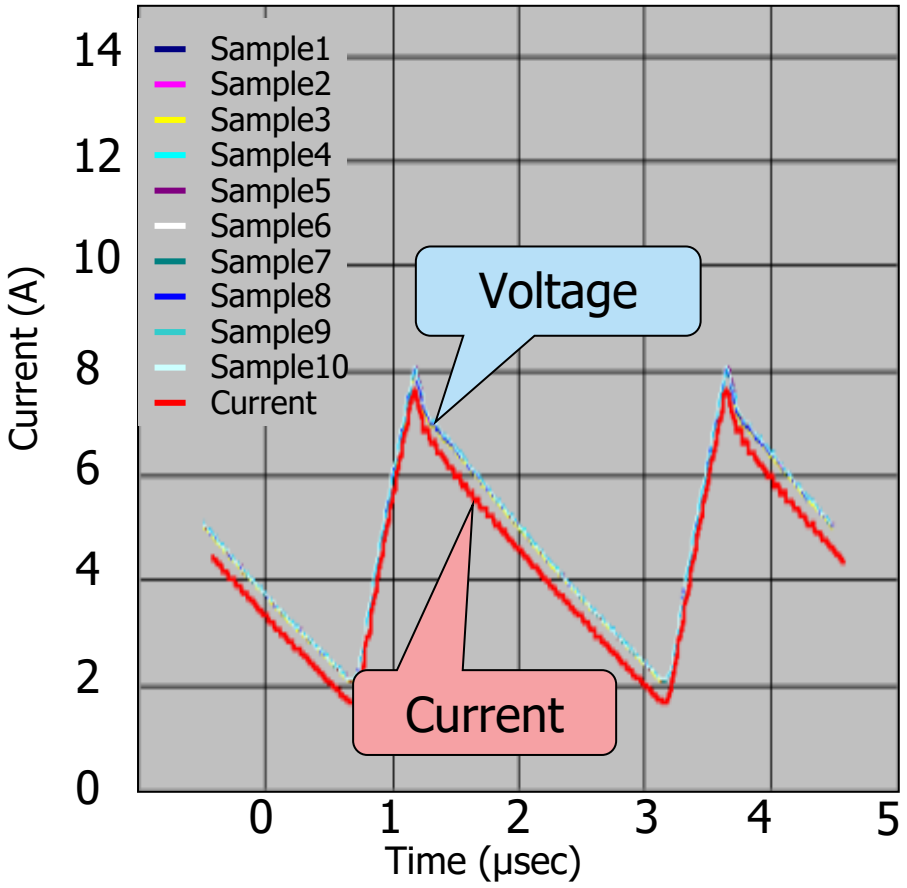
Hot spot is created symmetrically to the central axis.
=> Better heat distribution for resistance stability.



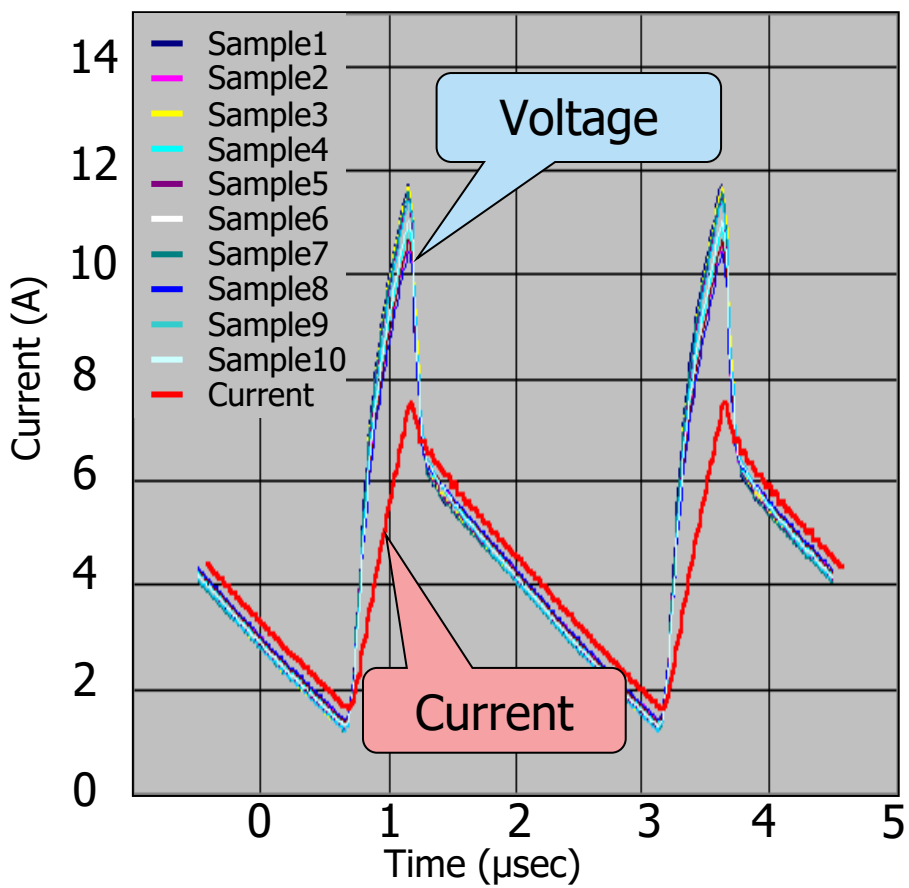
Advantage of Non-Trimming Structure

Parasitic inductance has an influence on the current detection accuracy

Shunt with no trimming cut (2 mΩ)



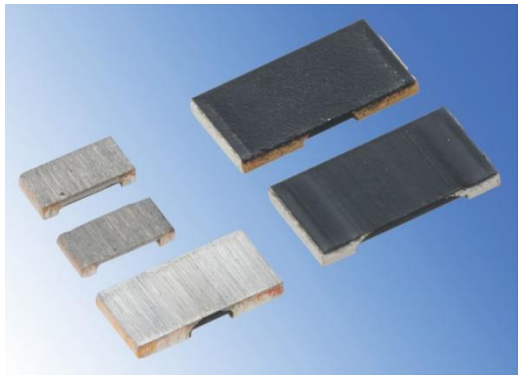
Shunt with trimming cut (2 mΩ)



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

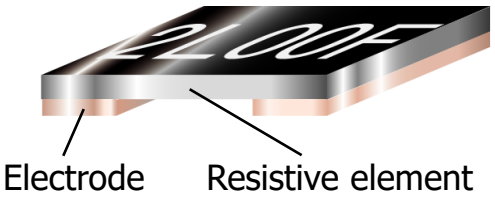
Automotive

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
TLR3AP	2512	3 ~ **5 W**	+90 ºC / +110 ºC		0.5 mΩ ~ 10 mΩ

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, 3A)

EV-Chargers

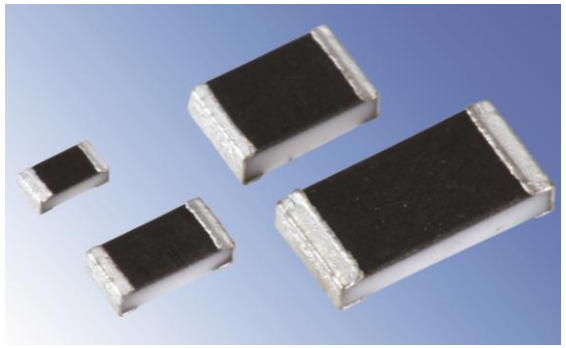
Introduction

Current Measurement Resistors

High Precision 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

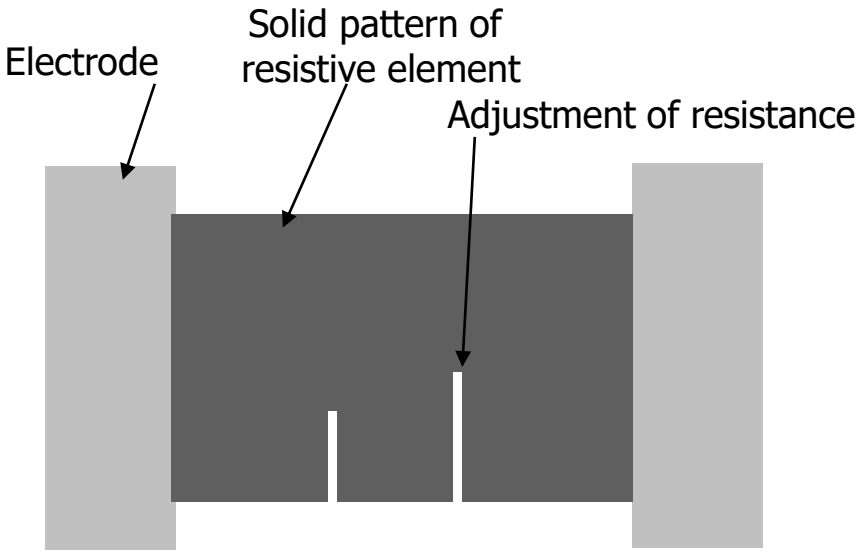
Type	Size (inch)	Power Rating	Rated Ambient Temperature	Rated Terminal Part Temperature	T.C.R. (ppm/K)	Resistance Range E24 • E96*			Long-Term Stability ΔR
						B: ±0.1%	C: ±0.25%	D: ±0.5% F: ±1%	
RS73 (F/G) 1E NEW	0402	0.125 W	+85 ºC	+125 ºC	F: ±25 G: ±50	300 Ω ~ 100 kΩ	300 Ω ~ 1 MΩ		±0.2 % ~ ±0.4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

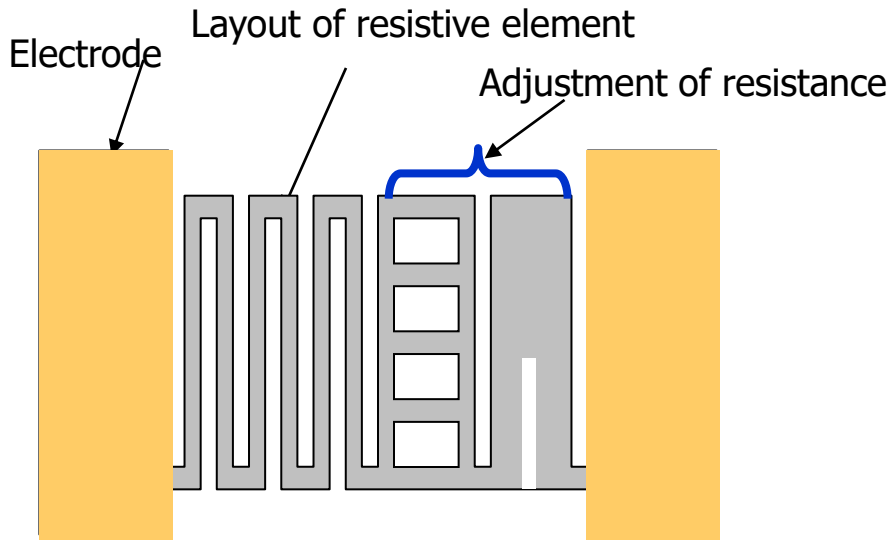
- The resistive element of a metal glaze resistor is formed by screen printing and the resistance value is finally adjusted by trimming.
- The resistive element of the metal film resistors is deposited by sputtering, the pattern is formed by photolithography technology and resistance value is finally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

Thick film(metal glaze) chip resistor (RK73)



Film thickness: ~10-14 µm

Thin Film(metal film) chip resistor (RN73R)

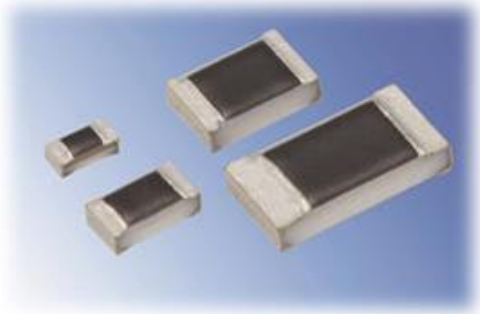


Film thickness: ~0.2-0.4 µm

Automotive

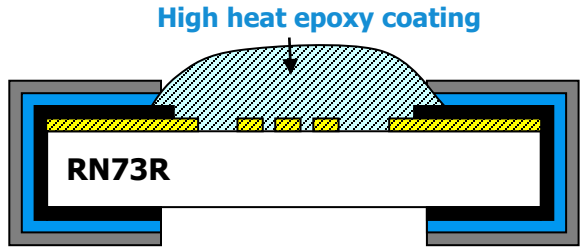
RN73R & RN73H: Precision Metal Thin Film

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

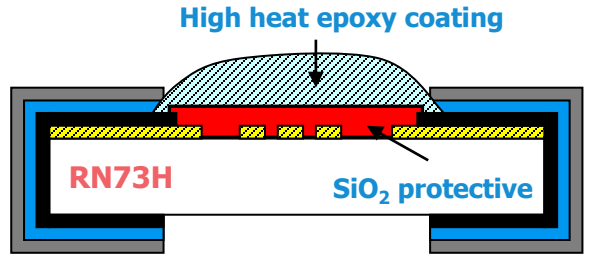


RN73H

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



EV-Chargers: Thick Film vs. Thin Film

Comparison of High Precision Resistors (0603 inch)

Advantage

Disadvantage

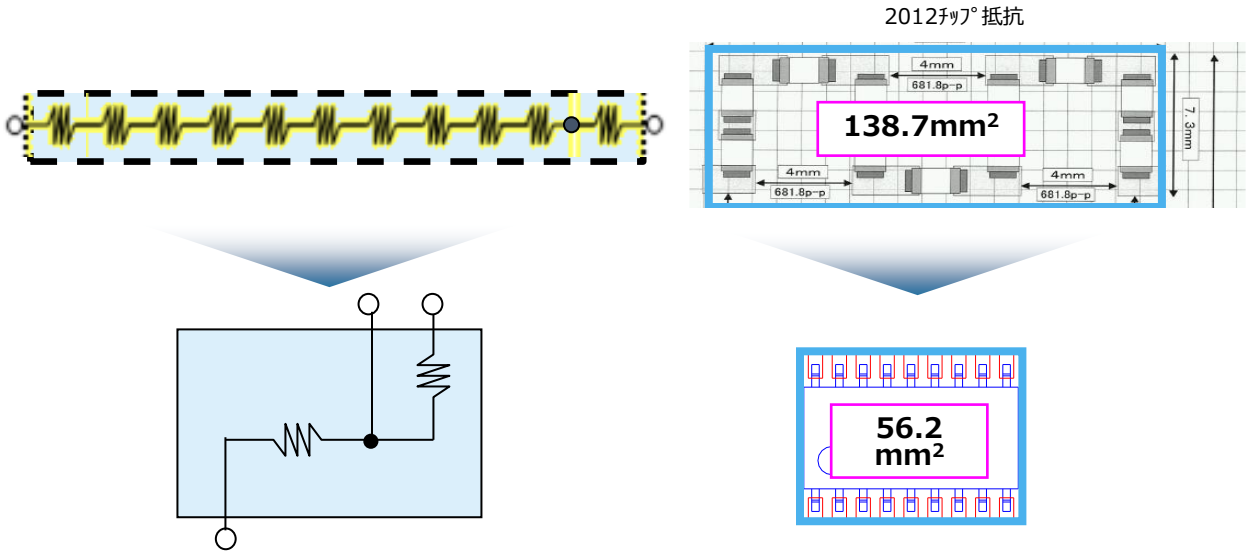
	Thick Film		Thin Film	
	RK73G High precision	**RS73F** Ultra high prec. & High reliability	**RN73R/H** Thin Film, High Heat Resistance	
Resistance tolerance (%)	0.25 ~	0.1 ~	0.05 ~	Thin Film advantage
T.C.R. (ppm/K)	50 ~	25 ~	5 ~	
Long-term stability (%)	2	0.2	0.1	Thin Film advantage
Current noise (μV/V)	3.3	2.1	0.1	
Solder heat resistance (%)	1	0.2	0.05	
ESD resistance	High	High	Low	Thick Film advantage
Power rating (W)	0.1	0.2	0.1	

- Thin film resistors are superior in high accuracy (Tolerance, TCR, long-term stability, noise).
- Thick film resistors are superior in terms of performance of ESD resistance and power rating.

HVD : High Voltage Divider Thin Film Resistor Network

1. Save the mounting area

Example: 11 discrete thin film resistors in series of size 0805



For 0805 size resistor
Mounting area is 138.7mm²

Mounting area less than 1/2

For resistor network
Mounting area is 56.2mm²

2. Guarantee of relative precision

Thin Film Si-chips ensure good relative resistance tolerance and relative T.C.R.

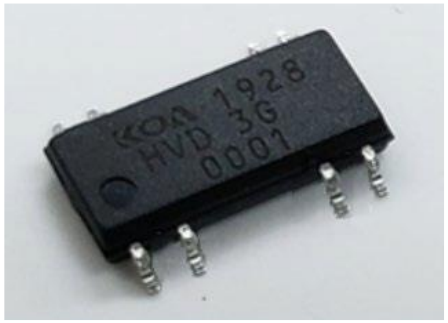
3. The mounting cost can be decreased.

Reduced number of chips are mounted

Confidential

Under Development

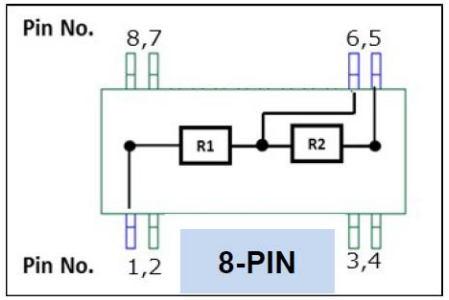
HVD : High Voltage Divider Thin Film Resistor Network



ES	QS	MP
on request	On request	Nov 2022

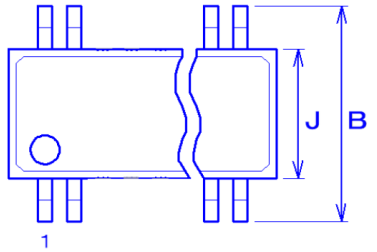
Features

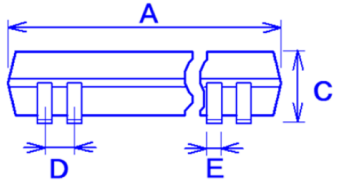
- High precision high voltage divider
- High precision ratio matching (resistance tolerance and T.C.R.)
- Available custom combination of R1 & R2



Dimensions

Dimensions (mm)			
A	8.66 ± 0.2	D	1.50 ± 0.1
B	5.99 ± 0.2	E	0.25 ± 0.1
C	1.60 ± 0.2	F	3.81 ± 0.2





Ratings

	Maximum Working Voltage	Power Rating per Element	Rated Ambient Temperature	Operating Temperature Range	Resistance Range		Absolute Resistance Tolerance	Relative Resistance Tolerance	T.C.R.	Relative T.C.R. Tracking**
High R (R1)	**1000 V**	250 mW	+85 ºC	-55 ºC…+155 ºC	0.5 MΩ ~ 51 MΩ	Voltage ratio 1:10 ~ 1:1000	±0.1 % ±0.25 % ±0.5 % ±1 %	0.1 % 0.25 %	±25 ppm/K ±50 ppm/K	**10 ppm/K** 25 ppm/K
Low R (R2)	15 V	50 mW			1.5 kΩ** ~ 1 MΩ		-			

** Relative T.C.R. tracking in R-range 1.5kΩ ≤ R2 < 4.5kΩ is 25ppm

Specifications given herein may be changed at any time without prior notice.

HVD : High Voltage Divider Thin Film Resistor Network

Comparison: Thick film – Thin film – Thin film network

Simulation of R-value drift (based on specification)

RK73H	(Absolute: ±0.5%, ±100 ppm/K)	Thick film chip resistor
RS73F	(Absolute: ±0.1%, ±25 ppm/K)	Thick film chip resistor
RN73H	(Absolute: ±0.1%, ±25 ppm/K)	Thin film chip resistor)
HVD	**(Relative: 0.1%, 10 ppm/K)**	**Thin film precision network**

	① Chip (RK73H)		② Chip (RS73F)		③ Chip (RN73H)		④HVD
	Absolute	**Relative**	**Absolute**	**Relative**	**Absolute**	**Relative**	**Relative**
R Tolerance	±0.5 %	1.0 %	±0.1 %	0.2 %	±0.1 %	0.2 %	0.1 %
T.C.R（+25℃→+125℃）	±1.0 %	2.0 %	±0.25 %	0.5 %	±0.25 %	0.5 %	0.1 %
Resistance to Solder Heat	±1.0 %	2.0 %	±0.2 %	0.4 %	±0.05 %	0.1 %	0.1 %
Load Life (+85℃, 1000h)※1	±2.0 %	4.0 %	±0.2 %	0.4 %	±0.1 %	0.2 %	0.1 %
Rapid change of Temperature (-55℃/155℃, 1000cyc)	±0.5 %	1.0 %	0.2 %	0.4 %	±0.25 %	0.5 %	0.1 %
Total		**10 %**		**1.9 %**		**1.5 %**	**0.5 %**
Drifting factor after calibration in red		**7 %**		**1.3 %**		**1.2 %**	**0.3 %**

※1－Actual temp. condition of thick film is 70℃.

Specification given herein may be changed at any time without prior notice.

Thank you very much for your attention

Newsletter

Subscribe to our newsletter:

https://koaeurope.de/newsletter/