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Current Sense Resistor Series

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Terminology & Glossary

► Terminology & Glossary

Terminology & Glossary

What is a "Current Sense"?

Current sensing products are the newest and fastest growing resistive products in the industry today. As with most passive products, the majority of new designs are surface mount. These resistors are used to monitor the current in a circuit and translate the amount of current in that circuit into a voltage that can be easily measured and monitored.

Current Detecting Resistors

Due to the increase in sales of notebook PCs, the demand for the DC/DC converter has shown rapid growth because of its high-energy conversion efficiency, and its precise current-limiting capability. However, to ensure the performance of the multiple outputs DC/DC converter, the current limiting voltage must be detected precisely to protect an expensive notebook PC from an overload, which is generally due to shorts within the capacitors used in these devices.

For high-energy conversion efficiency various control ICs have been developed that utilize resistive components. To achieve the perfect cutoff mode of the DC load current at the programmed current-limiting voltage of the control IC, a very stable and accurate sense resistor with the following characteristics is required for precise voltage comparison.

- Very Low Ohmic Value should be below 25mΩ for minimizing power consumption at the current sensing resistor.
- Tight Tolerance must be ±1% or tighter for maximizing the current supply within the limit of acceptable current.
- Low TCR is required for current sensing across the ambient temperature range of 0°C to 60°C.
- Low Thermal EMF for an accurate comparison between the programmed current-limiting voltage of the control IC and the detected voltage.

Furthermore, the self-inductance should be for high frequency applications. Recommended types are general purpose current sensing products or a flame retardant type.

Flip Chip Resistors

An unencapsulated resistor chip on which bead-type leads terminate on one face to permit "flip" (face down) mounting of the resistor chip by contact of the leads with interconnective circuitry.

Hot-Spot Temperature

The maximum temperature measured on the resistor due to both internal heating and the ambient operating temperature.

Low Profile

Components designed with "lower than standard heights", to save space and allow clearance when mounted on PCBs.

Maximum Working Voltage

The maximum specified voltage that may be applied across a resistor.

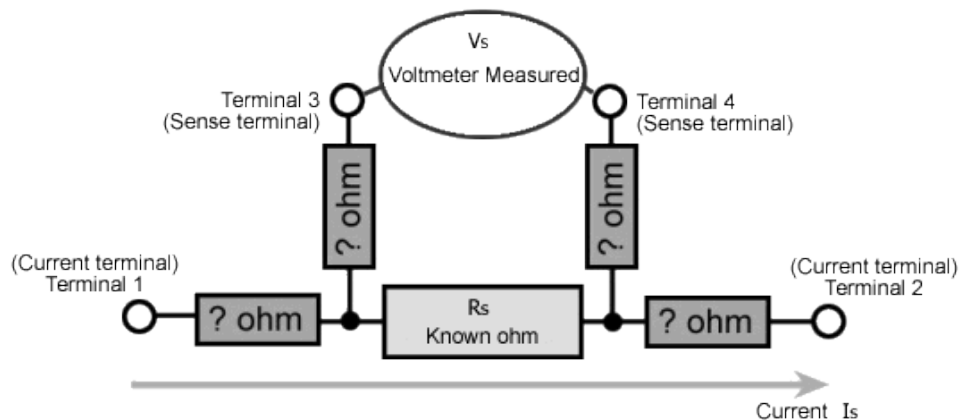


How 4-Terminal Resistor Works

High precision resistors used for current sensing are usually low Ohmic value devices suitable for four terminal connections. To use a four terminal resistor, we force a current from Terminal 1 to Terminal 2. It's current, so the unknown resistances attached to Terminal 1 and Terminal 2 don't affect the amount of the current. The same number of electrons per second flow through from T1 to T2, regardless of the resistance.

A voltmeter measures the resulting voltage drop across the ultra-precise resistor, measuring through the unknown resistors attached to Terminal 3 and Terminal 4. The voltmeter's input impedance is very, very high compared to the unknown resistors, so the unknown resistors have essentially zero effect (typically less than 0.1 parts-per-million).

So the current flows through the 0.100 ohm resistor, unaffected by the unknown resistors, and we measure the voltage across the 0.100 ohm resistor, unaffected by the unknown resistors. And that's how a 4-terminal resistor works!



How 4-Terminal Sense Resistor Works

PPM

Parts per million. The terminology used when describing the temperature coefficient.

Screen

The process of printing a network pattern of thick-film ink or paste onto a substrate by means of a squeegee applied to a photo-etched wire-mesh "silk screen" or metal mask.

Current Shunt Resistors

Current shunt resistors are precision low resistance resistors used to measure AC or DC electrical currents by the voltage drop those currents create across the resistance. Sometimes called an ammeter shunt, it is a type of current sensor.

SMT/SMD

Surface-mount technology/surface-mount device.

Zero Ohm Resistors

Products that look like resistors, but actually have no resistance (very low resistance) and instead perform as jumpers.

How to Design & Select Current Sense Devices

► Design & Selection

How to Design & Select Current Sense Devices

Generally, a resistor manufacturer will offer their most popular devices as standards creating a reference for Engineers to design from. Typically, and especially true in the Current Sensing category, a standard device is available for most common applications. However, for applications requiring parameters that are not currently considered industry standards, Token is uniquely equipped to offer design and development services at comparatively lower costs than our competitors. In this case, the following information is required to effectively design a current sensing resistor:

Point 1 - Power Rating

Calculate the power dissipation under operating conditions

Equation: $P_{avg} = I_{RMS}^2 \times R$; where Power (P), Current (I), Root Mean Square (RMS), Resistance (R).

Allowing for transient or fault conditions and high ambient temperature if applicable, select the required power rating.

For many current sense resistors, only the maximum temperature of the solder joints limits the power rating.

Power rating is thus a function of the PCB layout design as well as of component selection (see point 4.).

Point 2 - Resistance Value

Determine the minimum suitable resistance value. This is the lowest value of peak sense voltage consistent with an acceptable signal to noise ratio, divided by the peak current to be measured.

Point 3 - Temperature Coefficient of Resistance (TCR)

Establish the accuracy needed in terms of a tolerance on the value and of sensitivity to temperature.

The latter factor is quoted as Temperature Coefficient of Resistance (TCR), defined as the value change in parts per million for a 1°C temperature rise. It is generally higher for low value resistors because the metallic leads or terminations, which have a very high TCR, make up a significant part of the total resistance value.

To achieve acceptable accuracy it is normally necessary to make four-terminal (Kelvin) connections to the resistor. This means connecting the current carrying tracks and the voltage sense tracks directly to the component pads. Even when this is done, there is still some pad area and solder in series with the resistor, which may compromise the actual tolerance and TCR of the soldered part. For very high accuracy or very low values, a four-terminal resistor type is the best choice.



Point 4 - PCB Layout

Care must be taken when laying out a PCB if the stated performance of a sense resistor is to be achieved. The current carrying tracks should be as wide as possible, using multiple layers connected by many vias near the component pad. This also improves the heat sinking of the joints.

The best way to make four-terminal connections to a two-terminal through-hole resistor is to use different sides of the PCB for the current and voltage connections. Failing this, current and voltage tracks should connect to opposite sides of the component pad.

In order to avoid interference from stray magnetic fields, the loop area contained by the sense resistor, the voltage sense tracks and the sense circuit input should be minimized. This means keeping the sense circuitry as close as possible to the sense resistor and running the voltage sense tracks close to each other.

Point 5 - High Frequency Applications

Where transient or AC currents involving high frequencies are to be sensed, the self-inductance of the resistor must be minimized. Wire wound or spiraled film parts should be avoided, in favor of bulk metal or low value chips.

Point 6 - High Heat Dissipation

When using a metallic element shunt with high heat dissipation and low sense voltage, consideration may need to be given to thermoelectric voltages. The junction between a metallic resistance element and metal terminations acts as a thermocouple, generating a voltage proportional to the temperature difference across it.

A leaded metallic element sense resistor is therefore like two thermocouples back to back. This means that, if the temperature differences across both junctions are equal, the error voltage is cancelled out. This is achieved by making the design thermally symmetrical, namely, by presenting both terminals with similar heat sinking and by keeping any other heat sources thermally distant.

Chip Current Sense Resistor (CS)

► Product Introduction

Token Chip Current Detecting Chip Resistor (CS) saves space and weight.

Features :

- Low TCR of ± 100 PPM/ $^{\circ}$ C.
- Resistance Values from $1\text{m}\Omega$ to $8000\text{m}\Omega$.
- 3W Power Rating in 1W size, 1225 Package.
- Long size Terminations with Higher Power Rating.
- High Purity Alumina Substrate for High Power Dissipation.
- Products with Pb-free Terminations Meet RoHS Requirements.

Applications :

- Voltage Regulation Module (VRM).
- Portable Devices (PDA, Cell phone).
- Disk Driver, Switching Power Supply.
- Over Current Protection in Audio Application.
- DC-DC Converter, Battery Pack, Charger, Adaptor.
- Automotive Engine Control, Power Management Applications.

Token Electronics has launched the (CS) series, a family of ultra-small and low value surface mount current sensing resistor. These smaller sizes save space on the circuit board, allowing the production of smaller and lighter products.

The new series complements Token's existing (LRC) Series, offering metal resistive film on ceramic construction but providing increased choice for product designers in the form of smaller sizes options of 0201, 0402, 0603, 0805, 1206, 2010, 2512, 1225, 3720, 7520, and 0612.

Designed for current detecting in power electronic systems, the fully RoHS compliant (CS) series is suitable for a range of applications including the monitoring of power usage and battery life; and provision of output protection for power supplies; as well as for a range of consumer and automotive products such as satellite navigation, handheld PDAs and digital set-top boxes.

The series offers ohm values as low as $1\text{m}\Omega$ to minimize power consumption and has an ambient temperature range of -55°C to $+155^{\circ}\text{C}$.

Exhibiting a resistance range up to $8000\text{m}\Omega$ and excellent heat dissipation qualities, the series offers designers enhanced power handling capabilities and protection from the threat of localized heating, resulting in the production of a more energy efficient product.

As demand continues to grow for reduced size, handheld and portable devices operating at low voltages, designers will look to manufacturers to produce smaller and smaller current sense resistors. Token expects that demand for its latest range of small size resistor will be high.

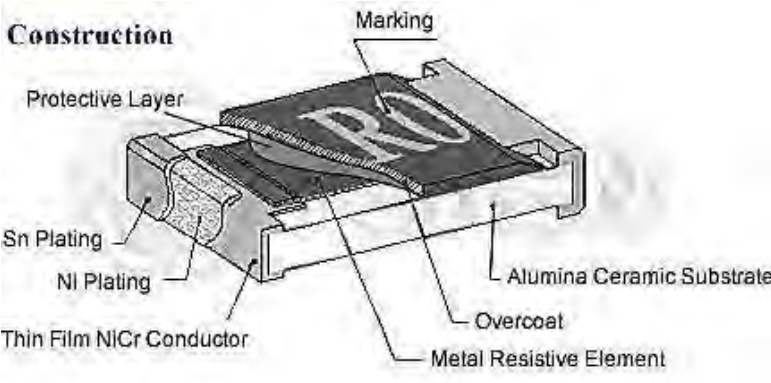
For more chip low ohm thick film resistors, please link to Token official website "[Current Sense Resistors](http://www.token.com.tw)". Contact us with your specific needs.



Construction & Dimensions

Construction & Dimensions (Unit: mm)

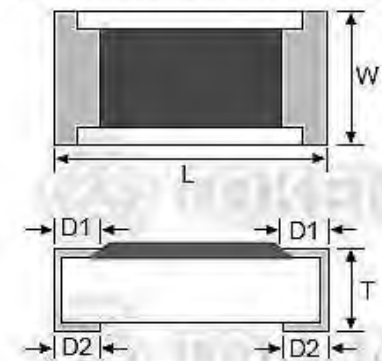
Type	L (mm)	W (mm)	T (mm)	D1 (mm)	D2 (mm)	Weight (g) / 1000pcs
CS01 (0201)	0.60±0.03	0.30±0.03	0.23±0.05	0.12±0.05	0.15±0.05	0.18
CS02 (0402)	1.00±0.05	0.50±0.05	0.32±0.10	0.25±0.10	0.20±0.10	0.7
CS03 (0603)	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20	1.99
CS05 (0805)	2.00±0.10	1.25±0.10	0.55±0.10	0.30±0.20	0.40±0.25	5.3
CS06 (1206)	3.10±0.10	1.55±0.10	0.55±0.10	0.50±0.30	0.40±0.25	8.82
CS13 (1210)	3.10±0.10	2.60±0.15	0.55±0.10	0.50±0.30	0.50±0.25	15.5
CS10 (2010)	5.00±0.10	2.50±0.15	0.60±0.15	0.60±0.30	0.50±0.25	27.03
CS12 (2512)	6.35±0.10	3.10±0.15	0.60±0.10	0.60±0.30	0.55±0.25	43.08
CS12 (2512) 2W (10 ~ 99)mΩ	6.35±0.20	3.15±0.15	0.74±0.10	0.60±0.30	0.55±0.25	53.08
CS12 (2512) 2W (100 ~ 1000)mΩ	6.35±0.20	3.15±0.15	0.74±0.10	0.60±0.30	2.10±0.10	53.08
CS25 (1225)	3.10±0.15	6.30±0.15	0.90±0.15	0.60±0.30	0.80±0.25	64.88
CS37 (3720)	2.00±0.20	3.75±0.20	0.60±0.10	0.40±0.20	0.40±0.20	19.96
CS75 (7520)	2.00±0.20	7.50±0.30	0.60±0.10	0.40±0.20	0.40±0.20	35.71
CS62 (0612)	1.55±0.10	3.10±0.15	0.55±0.10	0.30±0.15	0.45±0.15	10.19




Construction

(CS) Surface Mount Construction

0201/0402/0603/0805/1206/2010/2512



1225/3720/7520



Current Detecting (CS) - Dimensions

Marking for 0603 Current Detecting Resistor (CS)

Marking	Value
1R0	1.000Ω
R10	0.100Ω
R01	0.010Ω
138	0.138Ω
039	0.039Ω

Electrical Specifications

Standard Electrical Specifications (CS)

Type	Power Rating at 70°C	Operating Temp. Range	Resistance Tolerance (%)	Max. Operating Current (A)	Resistance Range (mΩ)	TCR (PPM/°C)
CS01 (0201)	1/20W	(-55 ~ +155)°C	±1% ±2% ±5%	0.70A	100 - 147 150 - 500 510 - 1000	±1000 ±600 ±300
CS02 (0402)	1/16W			1.11A	50 - 100 102 - 500 510 - 1000	±400 ±300 ±200
CS03 (0603)	1/10W			2.23A	20 - 50 51 - 100 102 - 500 510 - 1000	±600 ±400 ±300 ±200
CS05 (0805)	1/8W			2.50A	20 - 50 51 - 100 102 - 196 200 - 1000	±600 ±400 ±300 ±200
CS06 (1206)	1/4W			5.00A	10 - 20 21 - 50 51 - 91 100 - 1000	±600 ±400 ±300 ±200
CS13 (1210)	1/2W			7.07A		
CS10 (2010)	3/4W			8.66A		
CS12 (2512)	1W			10.0A		
CS25 (1225)	3W			31.6A	3 - 5 6 - 20 21 - 30 33 - 8000	±300 ±200 ±150 ±100
CS37 (3720)	1W			10.0A	10 - 18 20 - 500	±300 ±150
CS75 (7520)	2W			±2%,±5%	1 - 4	±300
				±1% ±2% ±5%	44.7A	5 - 10 11 - 350
CS62 (0612)	1W				10.0A	10 - 27 30 - 91 100 - 499 500 - 1000

- Operating Current $I = \sqrt{(P / R)}$, Operating Voltage $V = \sqrt{(P \cdot R)}$, or Max. Operating voltage whichever is lower.
- Optional specifications can be required.



High Power Rating Electrical Specifications Energy Efficient (CS)

Type	Power Rating at 70°C	Operating Temp. Range	Resistance Tolerance (%)	Max. Operating Current (A)	Resistance Range (mΩ)	TCR (PPM/°C)
CS02 (0402)	1/8W	(-55 ~ +155)°C	±1% ±2% ±5%	1.56A	51 - 100 102 - 500 510 - 1000	±400 ±300 ±200
CS03 (0603)	1/8W, 1/5W			1.98A		
CS05 (0805)	1/4W			2.21A		
CS06 (1206)	1/2W			7.07A	10 - 20 21 - 50 51 - 91 100 - 1000	±600 ±400 ±300 ±200
CS13 (1210)	3/4W			8.66A		
CS10 (2010)	1W			10.0A		
CS12 (2512)	1.5W			12.2A		
CS12 (2512)	*2W			14.1A		

● * Ultra High Power

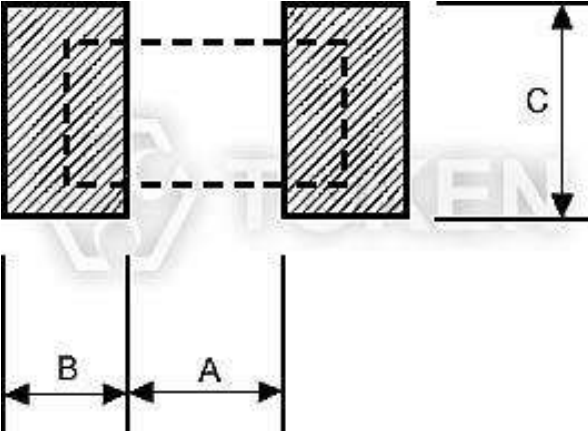
Low TCR Electrical Specifications (CS)

Type	Power Rating at 70°C	Operating Temp. Range	Resistance Tolerance (%)	Max. Operating Current (A)	Resistance Range (mΩ)	TCR (PPM/°C)
CS05 (0805)	1/8W	(-55 ~ +155)°C	±1% ±2% ±5%	1.11A	100 - 1000	±100
CS06 (1206)	1/4W			1.58A	100 - 1000	±100
CS13 (1210)	1/2W			2.58A	75 - 1000	±100
CS10 (2010)	3/4W			2.58A	50 - 1000	±100
CS12 (2512)	1W			7.07A	20 - 1000	±100
CS12 (2512)	*2W			6.32A	50 - 1000	±100
CS37 (3720)	1W			3.16A	100 - 500	±100
CS75 (7520)	2W			6.32A	50 - 350	±100



Land Pattern

Pad Layout (Except For CS12: Ultra High Power Rating Series) (CS)

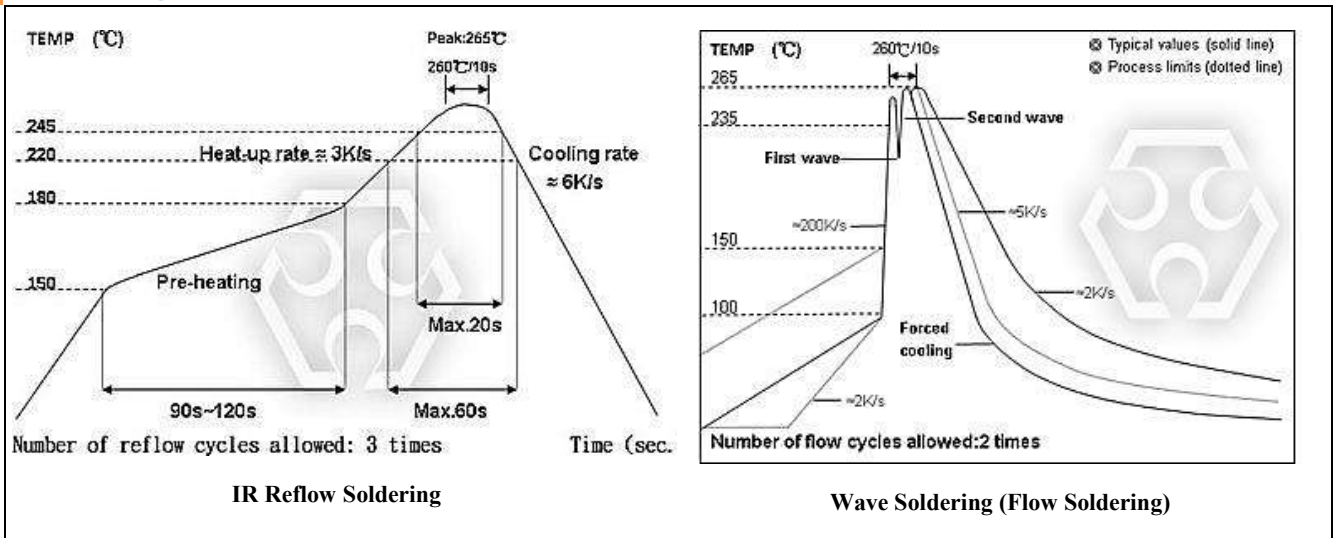
Figure	Codes	A	B	C
 <p>(CS) Recommend Land Pattern</p>	CS01	0.25	0.30	0.40±0.2
	CS02	0.50	0.50	0.60±0.2
	CS03	0.80	1.00	0.90±0.2
	CS05	1.00	1.00	1.35±0.2
	CS06	2.00	1.15	1.70±0.2
	CS13	2.00	1.15	2.50±0.2
	CS10	3.60	1.40	2.50±0.2
	CS12	4.90	1.60	3.20±0.2
	CS25	1.20	2.00	7.00±0.2
	CS37	1.00	1.80	3.90±0.2
	CS75	1.00	1.80	7.60±0.2
	CS62	0.60	1.00	3.20±0.2

Pad Layout (For CS12: Ultra High Power Rating Series) (CS)

Codes	Resistance Range	A	B	C
CS12	(10~99)mΩ	4.90	1.60	3.20±0.2
CS12	(100~1000)mΩ	1.00	3.55	3.20±0.2

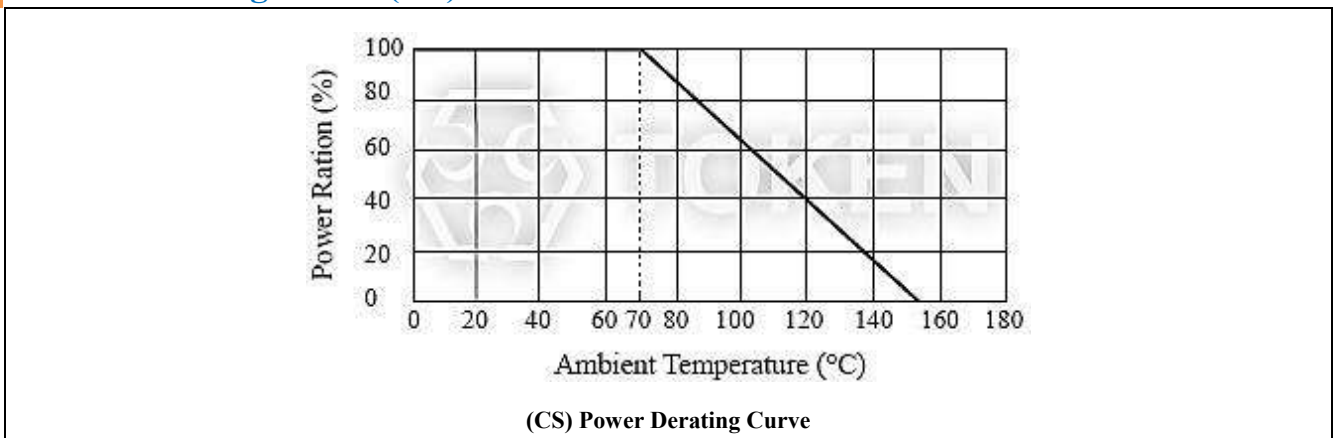
Soldering & Derating

Soldering Condition (CS)



- (1) Time of IR reflow soldering at maximum temperature point 260°C : 10s
- (2) Time of wave soldering at maximum temperature point 260°C : 10s
- (3) Time of soldering iron at maximum temperature point 410°C : 5s

Power Derating Curve (CS)



Environmental Characteristics

Environmental Characteristics (CS)

Item	Specification	Test Method
Temperature Coefficient of Resistance (T.C.R)	As Spec	JIS-C-5201-1 4.8 IEC-60115-1 4.8 -55°C~+125°C, 25°C is the reference temperature
Short Time Overload	±(0.5%+0.05Ω)	JIS C 5201-1 4.13 IEC 60115-1 4.13
	±(1.0%+0.05Ω For High power rating)	RCWV*2.5 or Max. Overload Voltage whichever is less for 5 seconds.
Insulation Resistance	≥10GΩ	JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. Overload Voltage for 1 minute
Endurance	±(1.0%+0.05Ω)	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 70±2°C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Damp Heat with Load	±(0.5%+0.05Ω)	JIS-C-5201-1 4.24 IEC-60115-1 4.24 40±2°C, 90~95% R.H., RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Dry Heat	±(0.5%+0.05Ω)	JIS-C-5201-1 4.23 IEC-60115-1 4.23.2 at +155°C for 1000 hrs
Bending Strength	±(1.0%+0.05Ω)	JIS-C-5201-1 4.33 IEC-60115-1 4.33 Bending once for 5 seconds with 3mm 2010, 2512 sizes: 2mm
Solderability	95% min coverage	JIS-C-5201-1 4.17 IEC-60115-1 4.17 245±5°C for 3 seconds
Resistance to Soldering Heat	±(0.5%+0.05Ω)	JIS-C-5201-1 4.18 IEC-60115-1 4.18 260±5°C for 10 seconds
Voltage Proof	No breakdown or flashover	JIS-C-5201-1 4.7 IEC-60115-1 4.7 1.42 times Max. Operating Voltage for 1 minute
Leaching	Individual leaching area ≤5% Total leaching area ≤10%	JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 260±5°C for 30 seconds
Rapid Change of Temperature	±(0.5%+0.05Ω)	JIS-C-5201-1 4.19 IEC-60115-1 4.19 -55°C to +155°C, 5 cycles

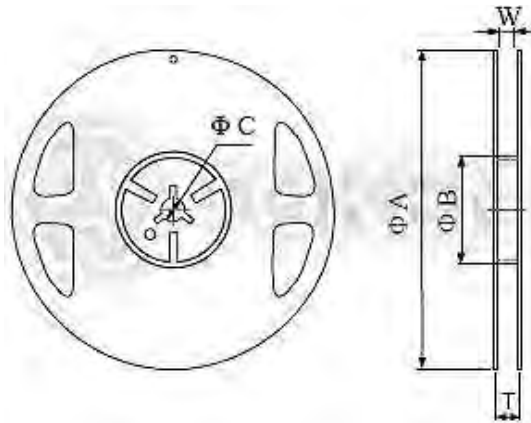
- Rated continuous Working Voltage (RCWV) = $\sqrt{\text{Power Rating} \times \text{Resistance Value}(\Omega)}$ or Max. Operating voltage whichever is lower.
- Storage Temperature: 15 ~ 28°C; Humidity < 80%RH;



▶ Reel & Tape

Packing Quantity & Reel Specifications (CS)

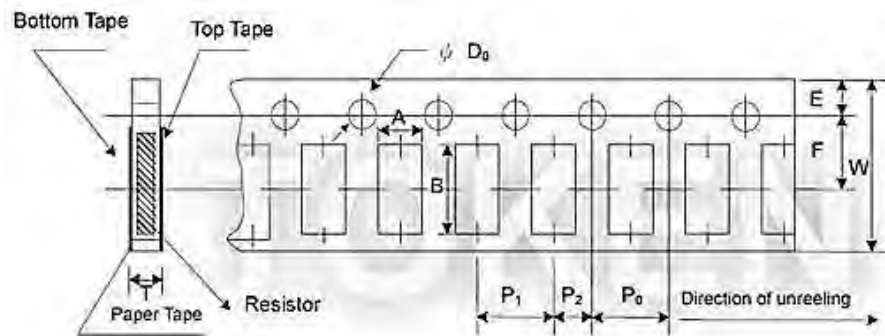
Type	ΦA (mm)	ΦB (mm)	ΦC (mm)	W (mm)	T (mm)	Paper Tape(EA)	Embossed Tape (EA)
CS01	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	10,000	-
CS02	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	10,000	-
CS03	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	5,000	-
CS05	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	5,000	-
CS06	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	5,000	-
CS13	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	5,000	-
CS10	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000
CS12	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000
CS12 (2W)	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	2,000
CS25	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	2,000
CS37	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	2,000
CS75	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	2,000
CS62	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	5,000	-



Reel Dimensions

Paper Tape Specifications (CS)

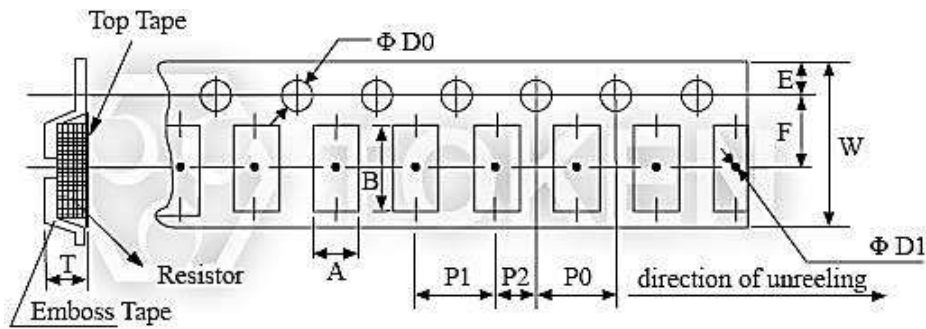
Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ΦD ₀ (mm)	T
CS01	0.38±0.05	0.68±0.05	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.50+0.1,-0	0.42±0.20
CS02	0.65±0.10	1.15±0.10	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.50+0.1,-0	0.45±0.10
CS03	1.10±0.10	1.90±0.10	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.70±0.10
CS05	1.60±0.10	2.40±0.20	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.10
CS06	1.90±0.10	3.50±0.20	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.10
CS13	2.90±0.10	3.50±0.20	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.10
CS62	1.90±0.10	3.50±0.20	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.10



Paper Tape Specifications

Emboss Plastic Tape Specifications (CS)

Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ΦD ₀ (mm)	ΦD ₁ (mm)	T
CS10	2.80±0.10	5.50±0.10	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.4 Min.	1.00±0.20
CS12	3.50±0.10	6.70±0.10	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.4 Min.	1.00±0.20
CS12 (2W)	3.38±0.10	6.68±0.10	12.0±0.30	1.75±0.10	5.5±0.10	4.00±0.10	4.00±0.10	2.00±0.05	1.55+0.05	1.4 Min.	1.45±0.20
CS25	3.38±0.10	6.68±0.10	12.0±0.30	1.75±0.10	5.5±0.10	4.00±0.10	4.00±0.10	2.00±0.05	1.55+0.05	1.4 Min.	1.45±0.20
CS37	2.50±0.20	4.45±0.20	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.4 Min.	1.20±0.20
CS75	2.50±0.20	8.30±0.20	16.0±0.30	1.75±0.10	7.8±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.4 Min.	1.20±0.20



Emboss Plastic Tape Specifications

Order Codes

Order Codes (CS)

CS	12	J	TR	G	A	R100	N					
Product Type	Dimensions (L×W)(mm)		Package		TCR (PPM/°C)		Power Rating(W)		Resistance (Ω)		Marking	
	01	0201	P	Bulk	E	±100	R	3	R010	0.01	N	No Marking
	02	0402		TR	Taping Reel	K		±150	S	2	R100	0.1
	03	0603	J	±5	F	±200	A	1.5	1R00	1		
	05	0805	G	±2	G	±300	T	1				
	06	1206	F	±1	H	±400	Q	3/4				
	13	1210			J	±600	U	1/2				
	10	2010			R	±1000	V	1/4				
	12	2512					W	1/8				
	25	1225					X	1/10				
	37	3720					Y	1/16				
	75	7520										
	62	0612										

► General Information

Your Current Options - Token Current Sense

As the world becomes more and more technology-driven, the uses for current sensing components will continue to increase. The need for even lower resistance value ranges is already becoming evident, as is the need for these resistors to handle more power. The industry-wide trend is the emergence of smaller and smaller products.

Token Electronics offers a wide variety of current sensing products from the industry to military standards, such as current sense in Thin-Film / Thick-Film Technology, Bare Element Resistors, and Open Air Shunts. This enables Token to present an astounding number of possible solutions for any circuit design needs.

Applications of Current Detecting Components

Token's TCS and CS Series unique form factor provides automotive designers with several advantages. Both TCS and CS Series are ideal for applications involving window lift motors, fuel pump systems, seat belt pretensions, and pulse width modulator feedback.

The wider resistive element and lower resistance enables higher current to pass through the device. Token's LRC ultra low Ohmic metal strip chip series provides the inherent ability to flex slightly and offers stress relief during extreme temperature cycling on typical or metal substrates. This LRC series is suitable for switch power supply applications (DC-DC Converter, Charger, and Adaptor) and power management of monitor.

The open air design of bare element resistor LRA and LRB Series provide a far cooler operation by allowing more air flow under the resistive element to keep excess heat from being transmitted to the PC board. They are suitable for high power AC/DC detection of power supply circuit.

Token axial moulded BWL series provides power rating up to 10 watts and lower resistance 0.005Ω , is ideal for all types of current sensing applications including switching and linear power supplies, instruments and power amplifiers.

Token standard current sensing components can be replacement for Vishay, IRC, Ohmite, KOA, Yageo devices with fast delivery and more competitive price. Contact us with your specific needs.



Chip Current Sensing Precision Resistor (TCS)

► Product Introduction

**Token's TCS (thin film current sensing chip resistor)
makes sense of current.**

Features :

- Thin Film Process.
- Resistance Values from 50mΩ to 1Ω.
- Very Tight Tolerance from ±1% to ±0.5%.
- Extremely Low TCR from ±200 PPM/°C to ±50PPM/°C.
- High Purity Alumina Substrate for High Power Dissipation.
- RoHS Requirements with Pb-free Terminations.

Applications :

- Voltage Regulation Module (VRM),
- Portable Devices (PDA, Cell phone),
- Disk Driver, Switching Power Supply,
- Over Current Protection in Audio Application,
- DC-DC Converter, Battery Pack, Charger, Adaptor,
- Automotive Engine Control, Power Management Applications,

The trend towards smaller handheld and portable electronics equipment has also increased the need for ultra-small current sensing resistor. Devices from the Token Electronics' TCS series use a thin film construction that enables them to achieve precision resistance tolerances, low noise and long-term stability.

The Token TCS Series precision resistors are nichrome thin film chip resistors with a temperature coefficient of resistance of just ±50PPM/°C and tolerances of ±0.5%.

They offer excellent stability at high frequencies and are suitable for operating high voltages with more options in the smaller form sizes of 0402, 0603, 0402, 0805, 1206, 2010, and 2512.

The full range of values is from 50mΩ to 1Ω. This low ohm devices are particularly suited to car engine management units to act as current shunt resistors.

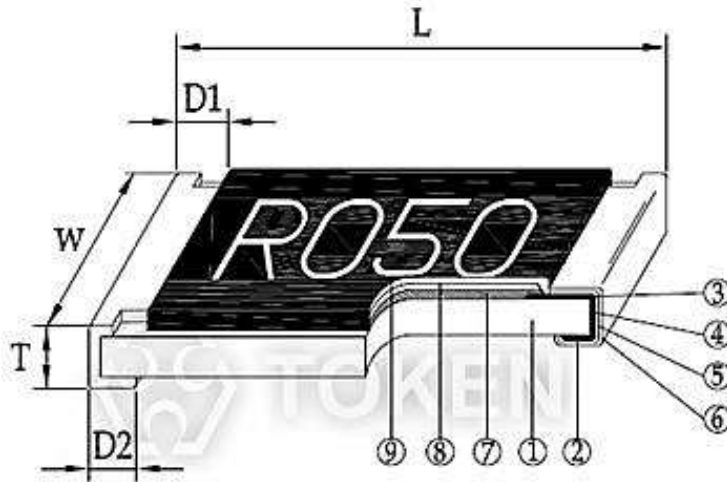
The TCS current sense series is fully RoHS compliant and is supplied in tape and reel packaging ready for use with automated assembly processes.

For more chip low ohm resistors, please link to Token official website "[Current Sense Resistors](http://www.token.com.tw)". Contact us with your specific needs.



Construction & Dimensions

Construction & Dimensions (Unit: mm)



Thin Film Chip Construction

①	Alumina Substrate
②	Bottom Electrode
③	Top Electrode
④	Edge Electrode
⑤	Barrier Layer
⑥	External Electrode
⑦	Resistor Layer
⑧	Overcoat
⑨	Marking

Type	L (Unit: mm)	W (Unit: mm)	T (Unit: mm)	D1 (Unit: mm)	D2 (Unit: mm)	Weight(g)/1000pcs
TCS02 (0402)	1.00±0.05	0.50±0.05	0.32±0.10	0.25±0.10	0.20±0.10	0.56
TCS03 (0603)	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20	3.1
TCS05 (0805)	2.00±0.15	1.25±0.15	0.55±0.10	0.30±0.20	0.40±0.25	5.6
TCS06 (1206)	3.05±0.15	1.55±0.15	0.55±0.10	0.50±0.30	0.40±0.25	12.3
TCS10 (2010)	5.00±0.20	2.45±0.15	0.60±0.15	0.60±0.30	0.50±0.25	26.7
TCS12 (2512)	6.35±0.20	3.15±0.15	0.60±0.10	0.60±0.30	0.55±0.25	49.6

► Electrical Specifications

Standard Electrical Specifications Thin Film (TCS)

Type	Power Rating at 70°C	Resistance Tolerance	Resistance Range	TCR	Operating Temp. Range
TCS02 (0402)	1/16W	±0.5%, ±1.0%	500mΩ~1000mΩ	±100PPM/°C ±50PPM/°C	-55 ~ +155°C
TCS03 (0603)	1/10W	±0.5%, ±1.0%	200mΩ~300mΩ	±100PPM/°C ±50PPM/°C	
TCS05 (0805)	1/8W		301mΩ~1000mΩ		
TCS06 (1206)	1/4W	±1.0%	50mΩ~100mΩ	±200PPM/°C	
		±0.5%, ±1.0%	101mΩ~300mΩ 301mΩ~1000mΩ	±100PPM/°C ±50PPM/°C	
TCS10 (2010)	3/4W	±0.5%, ±1.0%	50mΩ~100mΩ	±200PPM/°C	
TCS12 (2512)	1W		101mΩ~300mΩ 301mΩ~1000mΩ	±100PPM/°C ±50PPM/°C	

High Power Rating Electrical Specifications Thin Film (TCS)

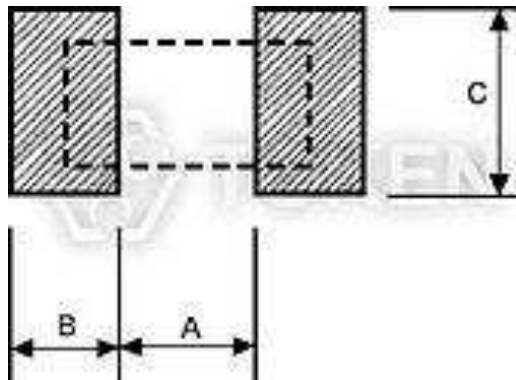
Type	Power Rating at 70°C	Resistance Tolerance	Resistance Range	TCR	Operating Temp. Range
TCS12 (2512)	3W	±0.5%, ±1.0%	100mΩ~1000mΩ	±100PPM/°C	-55 ~ +155°C

- Token has the ability to manufacture following options based on customer's requirement.



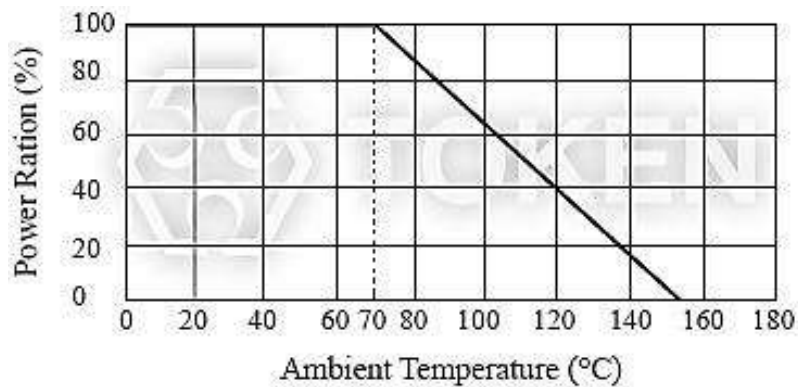
Recommend Land Pattern (TCS)

Type	A (mm)	B (mm)	C (mm)
TCS02	0.50	0.50	0.60±0.2
TCS03	0.80	1.00	0.90±0.2
TCS05	1.00	1.00	1.35±0.2
TCS06	2.00	1.15	1.70±0.2
TCS10	3.60	1.40	2.50±0.2
TCS12	4.90	1.60	3.10±0.2



Recommend Land Pattern

Power Derating Curve (TCS)



Power Derating Curve (TCS) Series

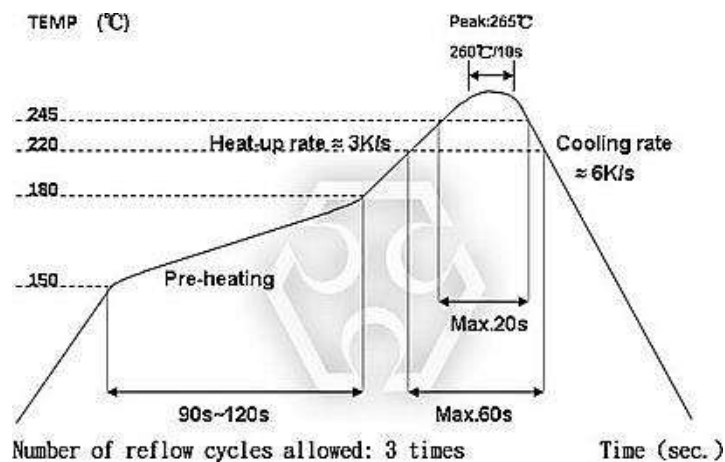
► Environmental Characteristics

Environmental Characteristics (TCS)

Item	Specification	Test Method
Temperature Coefficient of Resistance	As Spec	MIL-STD-202F Method 304 +25/-55/+25/+125/+25°C
Short Time Overload	±1%	JIS-C-5202-5.5 RCWV*2.5 or Max. overload voltage whichever is lower for 5 seconds
Dielectric Withstand Voltage	by Type	MIL-STD-202F Method 301 Apply Max Overload Voltage for 1 minute
Insulation Resistance	>1000MΩ	MIL-STD-202F Method 302 Apply 100VDC for 1 minute
Thermal Shock	±0.5%	MIL-STD-202F Method 107G -55°C~150°C, 100cycles
Load Life (Endurance)	±1%	MIL-STD-202F Method 108A 70±2°C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Humidity (Damp Heat with Load)	±0.5%	MIL-STD-202F Method 103B 40°C, 90~95%RH, RCWV 1.5 hours ON, 0.5 hours OFF, total 1000 hours
Low Temperature Operation	±0.5%	JIS-C-5202-7.1 1hour, -65°C followed by 45minutes of RCWV
Bending Strength	As Spec	JIS-C-5202-6.1.4 Bending Amplitude 3mm for 10seconds
Solderability	95%min coverage	MIL-STD-202F Method 208H 245°C±5°C, 3 seconds
Resistance to Soldering Heat	±0.5%	MIL-STD-202F Method 210E 260±5°C, 10±1 seconds

- Rated continuous Working Voltage (RCWV) = $\sqrt{\text{Power Rating} \times \text{Resistance Value } (\Omega)}$ or Max. Operating voltage whichever is lower.
- Storage Temperature: 15~28°C, Humidity < 80%RH

Reflow Soldering (TCS)

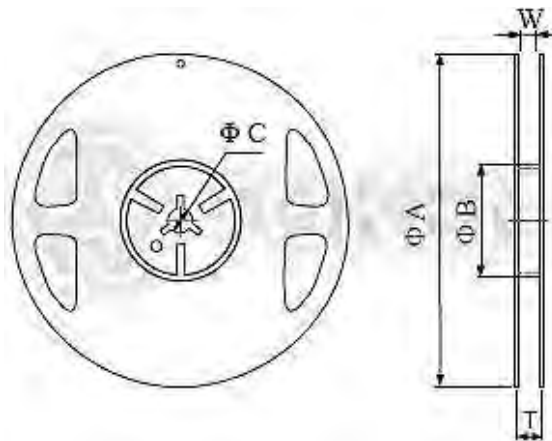


Power Derating Curve (TCS) Series

▶ Reel Tape Specifications

Packaging Quantity & Reel Specifications (TCS)

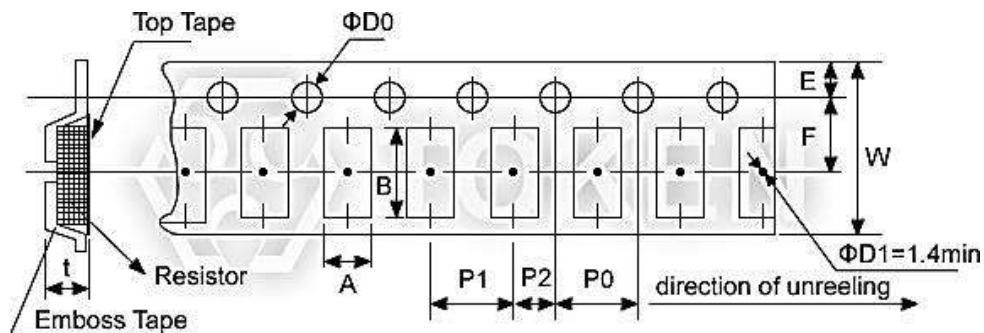
Type	ΦA	ΦB	ΦC	W	T	Paper Tape (EA)	Emboss Plastic Tape (EA)
TCS02	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	10,000	-
TCS03	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
TCS05	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
TCS06	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
TCS10	178.0±1.0	60.0±1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000
TCS12	178.0±1.0	60.0±1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000



Packaging Reel Specifications

Emboss Plastic Tape Specifications (TCS)

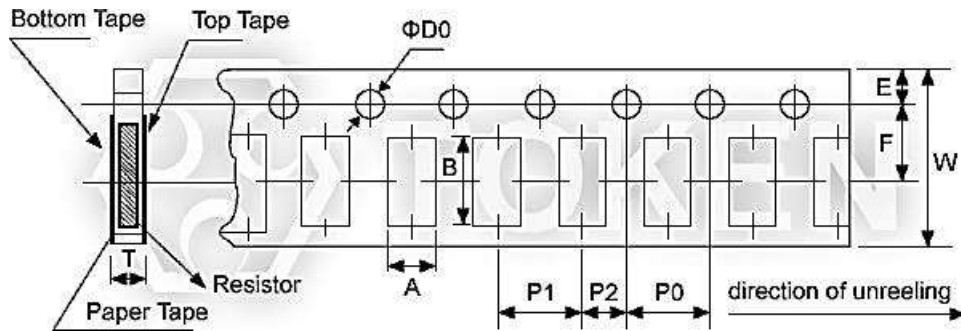
Type	A	B	W	E	F	P0	P1	P2	$\Phi D0$	T
TCS10	2.85±0.10	5.45±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.20
TCS12	3.40±0.10	6.65±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.20



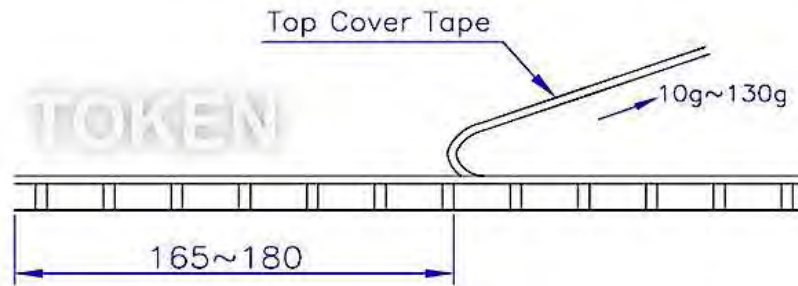
Emboss Plastic Tape Specifications (TCS)

Paper Tape Specifications (TCS)

Type	A	B	W	E	F	P0	P1	P2	ΦD0	T
TCS02	0.70±0.05	1.16±0.05	8.00±0.10	1.75±0.05	3.50±0.05	4.00±0.10	2.00±0.10	2.00±0.05	1.55±0.05	0.40±0.03
TCS03	1.10±0.05	1.90±0.05	8.00±0.10	1.75±0.05	3.50±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.60±0.03
TCS05	1.60±0.05	2.37±0.05	8.00±0.10	1.75±0.05	3.50±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05
TCS06	2.00±0.05	3.55±0.05	8.00±0.10	1.75±0.05	3.50±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05



Paper Tape Specifications



Peel - off force

- Peel force of top cover tape
- The peel speed shall be about 300mm/min \pm 5%
- The peel force of top cover tape shall be between 10 to 100g

Order Codes

Order Codes (TCS)

TCS	02	D	TR	E		1R00	N								
Part Type	Dimensions (L×W) (mm)		Package		TCR (ppm/°C)		Power Rating (W)		Resistance (Ω)		Marking				
			F	±1	P	Bulk	D	±50		Standard	Standard Marking				
	02	0402	D	±0.5	TR	Taping Reel	E	±100	R	3W	R010	0.01	N	No Marking	
	03	0603					F	±200			R100	0.100			
	05	0805									1R00	1.000			
		06	1206												
		10	2010												
		12	2512												

3 Digit Marking (0603) (TCS)

Resistance	1Ω	0.1Ω	0.15Ω	0.01Ω	0.101Ω	0.035Ω
Codes	1R0	R10	R15	R01	101	035

4 Digit Marking (0805~2512) (TCS)

Resistance	1Ω	0.1Ω	0.05Ω	0.015Ω	0.01Ω	0.39Ω
Codes	1R00	R100	R050	R015	R010	R390

► General Information

Your Current Options - Token Current Sense

As the world becomes more and more technology-driven, the uses for current sensing components will continue to increase. The need for even lower resistance value ranges is already becoming evident, as is the need for these resistors to handle more power. The industry-wide trend is the emergence of smaller and smaller products.

Token Electronics offers a wide variety of current sensing products from the industry to military standards, such as current sense in Thin-Film / Thick-Film Technology, Bare Element Resistors, and Open Air Shunts. This enables Token to present an astounding number of possible solutions for any circuit design needs.

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Token's TCS and CS Series unique form factor provides automotive designers with several advantages. Both TCS and CS Series are ideal for applications involving window lift motors, fuel pump systems, seat belt pretensioners, and pulse width modulator feedback.

The wider resistive element and lower resistance enables higher current to pass through the device. Token's LRC ultra low Ohmic metal strip chip series provides the inherent ability to flex slightly and offers stress relief during extreme temperature cycling on typical or metal substrates. This LRC series is suitable for switch power supply applications (DC-DC Converter, Charger, and Adaptor) and power management of monitor.

The open air design of bare element resistor LRA and LRB Series provide a far cooler operation by allowing more air flow under the resistive element to keep excess heat from being transmitted to the PC board. They are suitable for high power AC/DC detection of power supply circuit.

Token axial moulded BWL series provides power rating up to 10 watts and lower resistance 0.005Ω , is ideal for all types of current sensing applications including switching and linear power supplies, instruments and power amplifiers.

Token standard current sensing components can be replacement for Vishay, IRC, Ohmite, KOA, Yageo devices with fast delivery and more competitive price. Contact us with your specific needs.



Metal Strip Chip Current Sense Resistor (LRC)

► Product Introduction

Token (LRC) metal strip current sense chip resistor save space, time, and cost.

Features :

- Low TCR $\pm 50\text{PPM}/^\circ\text{C}$, $\pm 100\text{PPM}/^\circ\text{C}$.
- High Wattage Rating Up to 3W.
- Customized Resistance Available.
- Resistance Values from $0.5\text{m}\Omega$ to $15\text{m}\Omega$.
- Without Laser Trimmed with Very Low Inductance.

Applications :

- For NB power management.
- For MB power management.
- For Monitor power management.
- SWPS: DC-DC converter, Charger, Adaptor.

Providing design engineers with an economical low Ohmic value, metal strip current sense surface mount resistor with high quality performance, Token Electronics LRC Series is suitable for applications in the automotive sector for applications that require high power handling (Up to 3W) and low resistance $0.5\text{m}\Omega$.

From a certified supplier offering the automotive quality, Token's LRC Series gives all round superior performance for current sensing in lamp detection, mirrors, window lift, steering and seat controls.

As a first instance, the LRC Series displays enhanced power handling capabilities, against other technologies.

Thermal conductivity is important for chip resistors - little heat is dissipated directly into the air, and instead, is conducted out through the solder pads.

The heat generated from the specially constructed LRC resistor is more readily dispersed, therefore preventing localized heating, which contributes to TCR and thermal EMF errors, premature aging and possible scorching of the PC board.

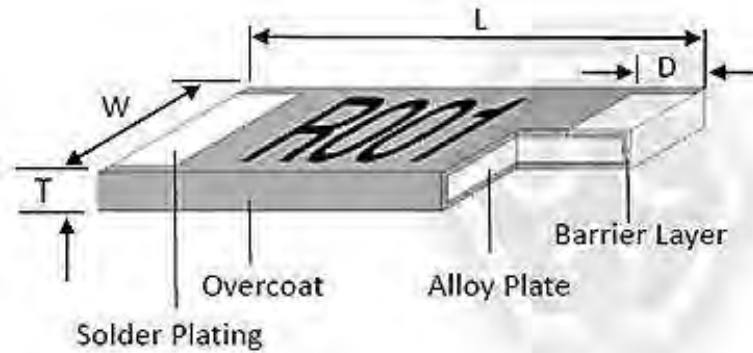
The current sensing resistors (LRC) are rated for ambient operation from -55°C to $+170^\circ\text{C}$. The LRC Series is RoHS compliant and lead free.

Need more detail information about (LRC), please link to Token official website "[Current Sense Resistors](http://www.token.com.tw)". Contact us with your specific needs.

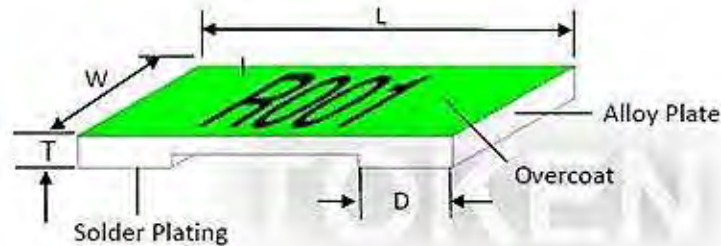


Construction & Dimensions

2512 Construction & Dimension (LRC) (Unit: mm)



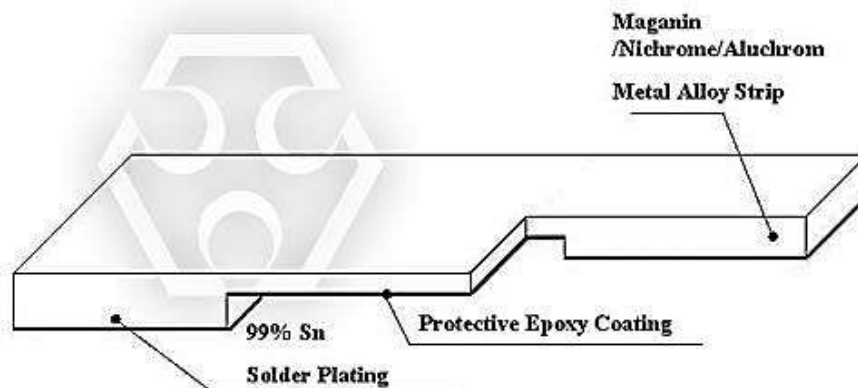
Black 2512 - Wave or IR reflow soldering



Green 2512 - IR reflow soldering only

1206 & 2010 Construction (LRC)

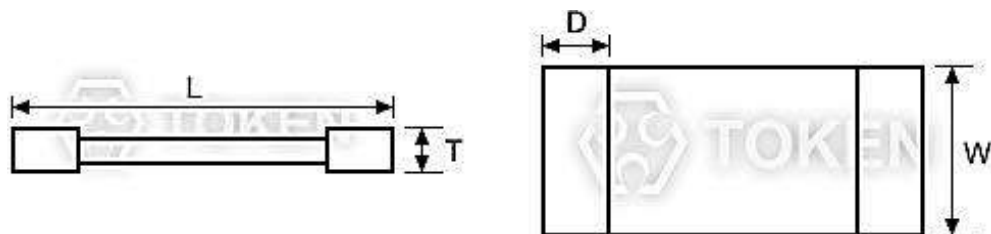
Type	Material
0M50 ~ R003	Manganese, Copper
3M5 ~ R010	Aluminum, Iron, Chromium



1206 & 2010 Construction

Chip 2512, 2010, 1206 Dimensions (LRC)

Type	Resistance (mΩ)	L(mm)	W(mm)	T(mm)	D(mm)	Weight(g) / 1000pcs
LRC06*TF0M50	0.50	3.20±0.25	1.60±0.10	0.60±0.20	1.35±0.25	22.6
LRC06*TD0M75	0.75	3.20±0.25	1.60±0.10	0.60±0.20	1.23±0.25	22.6
LRC06*T*****	1.0, 3.5, 4.0, 5.0, 6.0	3.20±0.25	1.60±0.10	0.60±0.20	1.10±0.25	22.6
LRC06*T*****	2.0, 3.0, 10	3.20±0.25	1.60±0.10	0.60±0.20	0.60±0.25	22.6
LRC06*T*****	1.2, 1.5, 7.0, 8.0, 9.0	3.20±0.25	1.60±0.10	0.60±0.20	0.90±0.25	22.6
LRC10*TEA0M50	0.5	5.08±0.25	2.54±0.15	0.60±0.20	2.17±0.25	42.3
LRC10*TDA0M75	0.75	5.08±0.25	2.54±0.15	0.60±0.20	2.04±0.25	42.3
LRC10*TDAR001	1.0	5.08±0.25	2.54±0.15	0.60±0.20	1.84±0.25	42.3
LRC10*TDA****	2.0, 6.0, 7.0, 8.0	5.08±0.25	2.54±0.15	0.60±0.20	1.54±0.25	42.3
LRC10*TDAR003	3.0	5.08±0.25	2.54±0.15	0.60±0.20	1.04±0.25	42.3
LRC10*TDA****	4.0, 5.0	5.08±0.25	2.54±0.15	0.60±0.20	1.84±0.25	42.3
LRC10*TDA****	9.0, 10	5.08±0.25	2.54±0.15	0.60±0.20	1.29±0.25	42.3
LRC12*T**0M50G	0.50	6.35±0.25	3.00±0.20	0.60±0.20	2.68±0.25	59.13
LRC12*T**0M75G	0.75	6.35±0.25	3.00±0.20	0.60±0.20	2.48±0.25	59.13
LRC12*T*****G	1.0, 6.0	6.35±0.25	3.00±0.20	0.60±0.20	1.93±0.25	59.13
LRC12*T*****G	1.5, 6.5, 7.0	6.35±0.25	3.00±0.20	0.60±0.20	1.43±0.25	59.13
LRC12*T*****G	2.0, 2.5, 3.0, 3.5	6.35±0.25	3.00±0.20	0.60±0.20	1.18±0.25	59.13
LRC12*T*****G	4.0, 4.5	6.35±0.25	3.00±0.20	0.60±0.20	2.18±0.25	59.13
LRC12*T*****G	5.0, 6.0	6.35±0.25	3.00±0.20	0.60±0.20	1.93±0.25	59.13
LRC12*T*****G	8.0 - 10	6.35±0.25	3.00±0.20	0.60±0.20	1.18±0.25	59.13
LRC12*T*****G	11 - 15	6.35±0.25	3.00±0.20	0.60±0.20	1.18±0.25	59.13
LRC12*T*0M50	0.50	6.35±0.254	3.18±0.254	1.25±0.20	1.30±0.38	184.11
LRC12*T*0M75	0.75	6.35±0.254	3.18±0.254	0.75±0.20	1.30±0.38	131.11
LRC12*T*R001	1.00	6.35±0.254	3.18±0.254	0.65±0.20	1.30±0.38	110.85
LRC12*T*1M50	1.50	6.35±0.254	3.18±0.254	0.45±0.20	1.30±0.38	67.16
LRC12*T*R002	2.00	6.35±0.254	3.18±0.254	0.35±0.20	1.30±0.38	49.30
LRC12*T*2M50	2.50	6.35±0.254	3.18±0.254	0.65±0.20	1.30±0.38	97.95
LRC12*T*R003	3.00	6.35±0.254	3.18±0.254	0.55±0.20	1.30±0.38	83.49
LRC12*T*R004	4.00	6.35±0.254	3.18±0.254	0.45±0.20	1.30±0.38	62.59
LRC12*T*R005	5.00	6.35±0.254	3.18±0.254	0.35±0.20	1.30±0.38	49.84
LRC12*T*R006	6.00	6.35±0.254	3.18±0.254	0.32±0.20	1.30±0.38	41.76
LRC12*T*6M50	6.50	6.35±0.254	3.18±0.254	0.30±0.20	1.30±0.38	35.85
LRC12*T*R007	7.00	6.35±0.254	3.18±0.254	0.27±0.20	1.30±0.38	34.01
LRC12*T*R010	10.00	6.35±0.254	3.18±0.254	0.25±0.20	1.30±0.38	25.97



Chip 2512, 2010, 1206 Dimensions (LRC)

● Notice: TOKEN is capable of manufacturing the optional spec based on customer's requirement.



Electrical Specifications

Standard Electrical Specifications (LRC)

Type	Power Rating at 70°C	Operating Temp. Range	Resistance Tolerance (±%)	Resistance (mΩ)	TCR (±PPM/°C)
LRC06*TF0M50	1W	-55°C ~ +170°C	±1, ±3, ±5	0.5	±200
LRC06*TD****	1W			0.75 - 10	±50
LRC12*TD****	1W			0.5, 0.75, 1, 1.5, 2	±50
LRC12*TW****	1W			6, 6.5, 7	±75
LRC12*TE****	1W			4, 5, 10	±100
LRC12*TK****	1W			2.5, 3	±150
LRC12*TD****G	1W			11, 12, 13, 14, 15	±50

High Power Rating Electrical Specifications (LRC)

Type	Power Rating at 70°C	Operating Temp. Range	Resistance Tolerance (±%)	Resistance (mΩ)	TCR (±PPM/°C)
LRC10*TEA0M50	1.5W	-55°C ~ +170°C	±1, ±3, ±5	0.5	±100
LRC10*TDA****	1.5W			0.75 - 10	±50
LRC12*TDS****	2W			0.5, 0.75, 1, 1.5, 2	±50
LRC12*TWS****	2W			6, 6.5, 7	±75
LRC12*TES****	2W			4, 5, 10	±100
LRC12*TKS****	2W			2.5, 3	±150
LR1C2*TDS****G	2W			6.5, 7, 8, 9, 10	±50
LRC12*TDB****G	2.5W			4, 4.5, 5, 6	±50
LRC12*TDR****G	3W			1, 1.5, 2, 2.5, 3, 3.5	±50
LRC12*TER****G	3W			0.5, 0.75	±100

● Remark : Operating Current $I = \sqrt{(P / R)}$, Operating Voltage $V = \sqrt{(P * R)}$

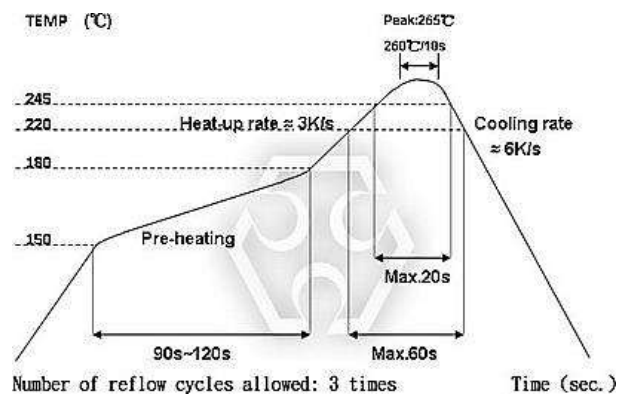
► Environmental Characteristics

Environmental Characteristics (LRC)

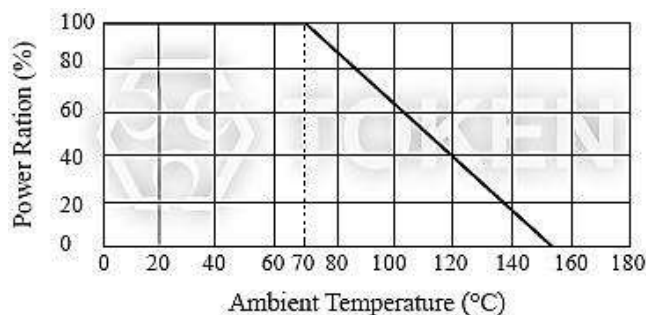
Item	Specification		Test Method
	Black coating	Green coating	
Thermal Shock	±0.5%	±1%	-55°C~150°C, 100 cycles. MIL-STD-202 Method 107G
Short Time Overload	±0.5%	±1%	5*Rated Power for 5 seconds. JIS-C-5202-5.5
Endurance	±1%	±1%	70±2°C, Max. working voltage for 1000 hrs with 1.5 hrs and 0.5 hrs
Dry Heat	±1%	±1%	at +170°C for 1000 hrs
Resistance to Soldering Heat	±0.5%	±1%	260±5°C, for 10 seconds. MIL-STD-202F Method 210E
Solderability	95% min coverage		245±5°C for 3 seconds. MIL-STD-202F Method 210E
Temperature Coefficient of Resistance	As Spec.		+25/-55/+25/+125/+25°C. MIL-STD-202 Method 304

- Rated continuous Working Voltage (RCWV) = $\sqrt{\text{Power Rating} \times \text{Resistance Value } (\Omega)}$ or Max. Operating voltage whichever is lower.
- Green coating can't be work with wave soldering bath.
- Humidity < 80%RH; Storage Temperature: 25±3°C

Soldering Condition (LRC)



Green coating "Reflow Air Convection" is available
 Green coating can't be working with wave soldering bath

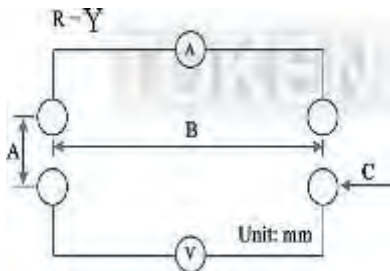


Power Derating Curve



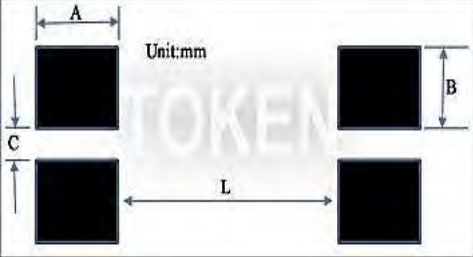
► Pad Layout

4-Wire Precision Measurement (LRC)

Figure	Type	A	B	C	Excitation Current (A)	Resistance (Ω)
 <p>4-Wire Precision Measurement</p>	LRC12 Black Coating	1.5	5.4	$\Phi 0.5$	3A	0.5m ~ 1.5m
	LRC12 Black Coating	1.5	5.4	$\Phi 0.5$	1A	2m ~ 10m
	LRC12 Green Coating	1.5	5.4	$\Phi 0.5$	3A	0.5m ~ 1.5m
	LRC12 Green Coating	1.5	5.4	$\Phi 0.5$	1A	2m ~ 15m
	LRC06	1.25	2.6	$\Phi 0.5$	3A	0.5m ~ 1.5m
	LRC06	1.25	2.6	$\Phi 0.5$	1A	2m ~ 10m
	LRC10	1.2	4.32	$\Phi 0.5$	3A	0.5m ~ 1.5m
	LRC10	1.2	4.32	$\Phi 0.5$	1A	2m ~ 10m

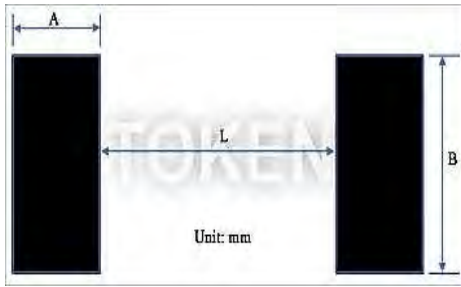
● Note: Equipment: ADEX AX-1152D DC Low Ohm Meter

4-Wire Pad Layout (LRC)

Figure	Type	Resistance (Ω)	A	B	C	L
 <p>Unit:mm</p> <p>4-Wire Pad Layout (recommended for precision current sensing)</p>	LRC12 Black Coating	-	1.0	2.7	2.95	1.45
	LRC12 Green Coating	0M50	3.13	1.2	1.0	0.52
		0M75	2.93	1.2	1.0	0.94
		R001	2.38	1.2	1.0	2.04
		1M5	1.88	1.2	1.0	3.04
		R002~3M5	1.63	1.2	1.0	3.54
		R004~4M5	2.63	1.2	1.0	1.54
		R005~R006	2.38	1.2	1.0	2.04
		6M5~R007	1.88	1.2	1.0	3.04
	R008~R015	1.63	1.2	1.0	3.54	
	LRC10	0M50	2.61	1.045	0.8	0.60
		0M75	2.49	1.045	0.8	0.80
		R001	2.29	1.045	0.8	0.95
		R002	1.99	1.045	0.8	1.55
		R003	1.49	1.045	0.8	2.55
		R004~R005	2.29	1.045	0.8	0.95
		R006~R008	1.99	1.045	0.8	1.55
		R009~R010	1.74	1.045	0.8	2.05
	LRC06	0M50	1.80	0.7	0.5	0.55
		0M75	1.68	0.7	0.5	0.55
		R001	1.55	0.7	0.5	0.55
		1M2	1.35	0.7	0.5	0.95
		1M5	1.35	0.7	0.5	1.55
		R002~R003	1.05	0.7	0.5	1.55
		3M5~R006	1.55	0.7	0.5	0.55
		R007~R009	1.35	0.7	0.5	0.95
	R010	1.05	0.7	0.5	1.55	

● **Note:** No circuits between pads to avoid short circuit

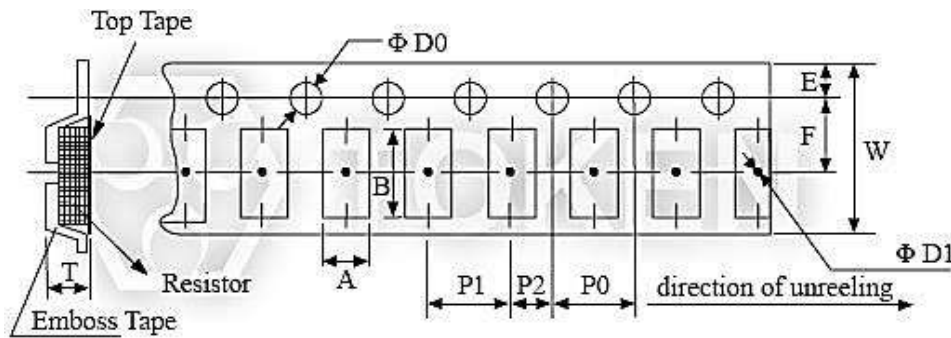
2-Wire Pad Layout (LRC)

Figure	Type	Resistance (Ω)	A	B	L
 <p>2-Wire Pad Layout</p>	LRC12 Black Coating	-	2.7	3.6	2.95
	LRC12 Green Coating	0M50	3.13	3.4	0.52
		0M75	2.93	3.4	0.94
		R001	2.38	3.4	2.04
		1M5	1.88	3.4	3.04
		R002~3M5	1.63	3.4	3.54
		R004~4M5	2.63	3.4	1.54
		R005~R006	2.38	3.4	2.04
		6M5~R007	1.88	3.4	3.04
		R008~R015	1.63	3.4	3.54
	LRC10	0M50	2.61	2.89	0.60
		0M75	2.49	2.89	0.80
		R001	2.29	2.89	0.95
		R002	1.99	2.89	1.55
		R003	1.49	2.89	2.55
		R004~R005	2.29	2.89	0.95
		R006~R008	1.99	2.89	1.55
		R009~R010	1.74	2.89	2.05
		LRC06	0M50	1.80	1.90
	0M75		1.68	1.90	0.55
	R001		1.55	1.90	0.55
	1M2		1.35	1.90	0.95
	1M5		1.35	1.90	1.55
	R002~R003		1.05	1.90	1.55
	3M5~R006		1.55	1.90	0.55
	R007~R009		1.35	1.90	0.95
	R010		1.05	1.90	1.55

● Note: No circuits between pads to avoid short circuit

▶ Reel & Tape

Emboss Plastic Tape Specifications (LRC)



Emboss Plastic Tape Specifications

Type	Resistance (mΩ)	P0 (mm)	P1 (mm)	P2 (mm)	ΦD0 (mm)	ΦD1 (mm)	T (mm)
LRC06	0.5 - 10	4.0±0.1	4.0±0.1	2.0±0.05	1.55±0.05	1.0min	0.87±0.1
LRC10	0.5 - 10	4.0±0.1	4.0±0.1	2.0±0.05	1.55±0.05	1.4min	0.85±0.1
LRC12	0.50 - 0.75	4.0±0.1	4.0±0.1	2.0±0.05	1.55±0.05	1.4min.	1.45±0.2
	1 - 10	4.0±0.1	4.0±0.1	2.0±0.05	1.55±0.05	1.4min.	0.81±0.1
LR12 (G)	0.50 - 15	4.0±0.1	4.0±0.1	2.0±0.05	1.55±0.05	1.4min	0.85±0.1

- The cumulative tolerance of 10 sprocket whole pitch is ±0.2mm.
- Carrier camber shall be not more than 1mm per 100mm through a length of 250mm.
- A & B measured 0.3mm from the bottom of the packet.
- t measured at a point on the inside bottom of the packet to the top surface of the carrier.
- Pocket position relative to sprocket hole is measured as the true position of the pocket and not the pocket hole.

Order Codes

Order Codes (LRC)

LRC	12		H		TR		D		R011		G		
Part Type	Dimensions (L×W)(mm)		Resistance Tolerance (%)		Package		TCR (PPM/°C)		Power Rating (W)		Resistance (Ω)		
	12	6.3×3.1	EIA2512	J	±5	TR	Taping Reel	D	±50		Standard	0m50	0.00050
	10	5.1×2.5	EIA2010	H	±3			W	±75	A	1.5	0m75	0.00075
	06	3.2×1.6	EIA1206	F	±1			E	±100	S	2	1m50	0.00150
								F	±200	R	3	R011	0.01100
								K	±150	B	2.5	R002	0.00200
												R020	0.02000
												**2010/1206	No coating / marking

Resistance codes example (3 Marking)

Resistance	0.39mΩ	0.5mΩ	0.75mΩ	330mΩ	5.1Ω
Codes	M39	M50	M75	R33	5R1

Resistance codes example (4 Marking)

Resistance	1mΩ	1.5mΩ	2mΩ	7mΩ	10mΩ
Codes	R001	1M50	R002	R007	R010

► General Information

Your Current Options - Token Current Sense

As the world becomes more and more technology-driven, the uses for current sensing components will continue to increase. The need for even lower resistance value ranges is already becoming evident, as is the need for these resistors to handle more power. The industry-wide trend is the emergence of smaller and smaller products.

Token Electronics offers a wide variety of current sensing products from the industry to military standards, such as current sense in Thin-Film / Thick-Film Technology, Bare Element Resistors, and Open Air Shunts. This enables Token to present an astounding number of possible solutions for any circuit design needs.

Applications of Current Detecting Components

Token's TCS and CS Series unique form factor provides automotive designers with several advantages. Both TCS and CS Series are ideal for applications involving window lift motors, fuel pump systems, seat belt pretensioners, and pulse width modulator feedback.

The wider resistive element and lower resistance enables higher current to pass through the device. Token's LRC ultra low Ohmic metal strip chip series provides the inherent ability to flex slightly and offers stress relief during extreme temperature cycling on typical or metal substrates. This LRC series is suitable for switch power supply applications (DC-DC Converter, Charger, and Adaptor) and power management of monitor.

The open air design of bare element resistor LRA and LRB Series provide a far cooler operation by allowing more air flow under the resistive element to keep excess heat from being transmitted to the PC board. They are suitable for high power AC/DC detection of power supply circuit.

Token axial moulded BWL series provides power rating up to 10 watts and lower resistance 0.005Ω , is ideal for all types of current sensing applications including switching and linear power supplies, instruments and power amplifiers.

Token standard current sensing components can be replacement for Vishay, IRC, Ohmite, KOA, Yageo devices with fast delivery and more competitive price. Contact us with your specific needs.



Four-terminal Kelvin Connected Resistors (LRD)

► Product Introduction

Token's open air 4-terminal kelvin connected resistors (LRD) tackle current sensing applications.

Features :

- Low inductance.
- 4 leads for Kelvin connection.
- Decimal marked, silicone coated.
- Tinned copper terminal for easy soldering.
- Radial, self-supporting, design is ideal for PC board mounting.

Applications :

- Surge/Pulse Applications.
- Current Sensing Application.
- Feed Back & Motor Control.
- High Precision Measurement Instrumentation.

Always preferred in current sense applications, Token's LRD Series range is available in the 1W, 3W, 5W, 7W and 10W packages, resistance values down to 0.001 ohm, with tolerances as tight as 0.50% and TCRs of 50ppm standard.

The 4 Lead Kelvin configurations enables current to be applied through two opposite terminals and a sensing voltage to be measured across the other two terminals, eliminating the resistance and temperature coefficient of the terminals for a more accurate current measurement.

With up to 10W power rating and TCRs as low as 50ppm/°C, the LRD 4-Lead Kelvin resistors deliver excellent performance, making them ideal for a variety of applications. The resistor is constructed using a low-resistance, low-inductance, high-impulse proprietary metal element that gives the device its extended power and temperature ratings.

Continually upgrading its current sense resistors to take advantage of modern technologies and manufacturing methods, Token is now able to offer complete ranges of products which meet the RoHS requirements and in addition to detailing these, the component selector also provides designers with a comprehensive selection of application notes.

The Open Air (LRD) Kelvin 4-terminal Resistor can be manufactured to custom length/width for use as a current shunt. Token will also produce outside these specifications to meet customer requirements. Contact us with your specific needs, or link to Token official website "[Current Sensing Resistors](http://www.token.com.tw)" for more information.

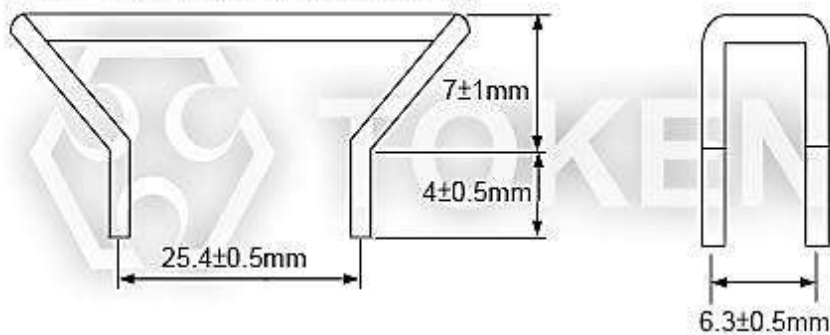


► LRD Spec. & Dim

Specification & Dimensions (Unit: mm) (LRD)

Type	Rating Current	Resistance Range (mΩ)	Tolerance (%)	TCR (ppm/°C)
LRD-1	1A	1 ~ 10 mΩ	D(±0.5%) F(±1%) G(±2%) J(±5%)	±10 ppm/°C
LRD-3	3A	1 ~ 10 mΩ		±20 ppm/°C
LRD-5	5A	0.5 ~ 5 mΩ		±25 ppm/°C
LRD-7	7A	0.3 ~ 3 mΩ		±50 ppm/°C
LRD-10	10A	0.1 ~ 1 mΩ		±100 ppm/°C

LRD Dimensions (Unit: mm)

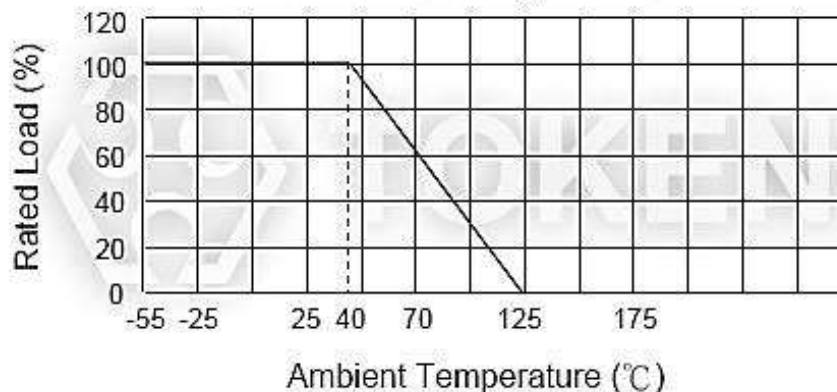


4-Terminal Current Sensing Open Air (LRD) Dimensions

► Derating Curve

Power Derating Curve (LRD)

Power Derating Curve



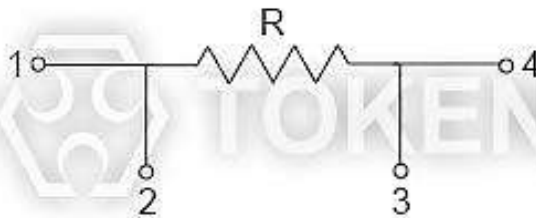
(LRD) Power Derating Curve

Characteristics

Characteristic Specification & 4-Lead Kelvin Connections (LRD)

Test Items	Test Method	Specification
Operating Temperature Range		-55°C ~ 125°C
Maximum Working Voltage		(P40°C x R)/2
Terminal Tensile Strength	50N, 10s	$\Delta R \leq \pm 1.0\%R$
Withstand Voltage	1000V, 1 Min.	No damage on the appearance.
Short Time Overload	5 times rated power, 5s	$\Delta R \leq \pm 4.0\%R$
Thermal Shock	-55°C ~ +125°C, 5 cycles, 30 min.	$\Delta R \leq \pm 5.0\%R$
Load Life	70°C, 1000h 1.5 hours on, 0.5 hours off.	$\Delta R \leq \pm 5.0\%R$

KELVIN ELECTRICAL CONNECTION:



Terminals 2 & 3 Current Traces.
Terminals 1 & 4 Sense Traces.

4 Lead Kelvin Connections (LRD)

Order Codes

Order Codes (LRD)

LRD	-	5	R005	F	P
Part Number		Rated Current	Resistance Value (Ω)	Tolerance %	Package-Code
LRD		1 1 A	R005 0.005Ω	D ±0.5%	P Bulk
		3 3 A	R05 0.05Ω	F ±1%	
		5 5 A	R1 0.1Ω	G ±2%	
		7 7 A		J ±5%	
		10 10 A			

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Token standard current sensing components can be replacement for Vishay, IRC, Ohmite, KOA, Yageo devices with fast delivery and more competitive price. Contact us with your specific needs.



4-Terminal Current Sensing Resistor (LSQ)

► Product Introduction

Token's Kelvin style (LSQ) family current sensing 4-terminal resistors handle high-wattage applications.

Features :

- Welded & fireproof construction.
- Superior anti-surge capability & Low TCR.
- Special inorganic potting construction provides high moisture resistance and thermal conductivity.
- 4 leads for Kelvin connection with extremely low resistance values.

Applications :

- Automatic Test Equipment.
- Current Sensing Application.
- High Precision Instrumentation.
- Industrial, Medical and Military.
- Measurement Instrumentation.

Providing ultralow resistance values (to 0.01 ohm) for relatively high current requirements, new four-terminal cement filling resistor from Token combine the advantages of a Kelvin configuration with PC board mounting capability.

The Kelvin (or 4-terminal) configuration enables current to be applied through two opposite terminals and a sensing voltage to be measured across the other two terminals, eliminating the resistance and temperature coefficient of the terminals for a more accurate current measurement.

The 4 lead resistors are a new version of Token's (LSQ) Precision Current Sensing Family Resistors which was specially designed for use in a Kelvin method where a current is applied through two opposing leads and sensing voltage is measured across the other two leads. Token LSQ series is specifically designed for low resistance applications requiring the highest accuracy and temperature stability.

The advantages of Kelvin connection enable the resistance and temperature coefficient of the leads to be effectively eliminated. The need to connect to the leads at precise test points is eliminated, allowing for tighter tolerance on the end application. Also results in a lower temperature coefficient of resistance and lower self-heating drift which may be experienced on two-terminal resistor.

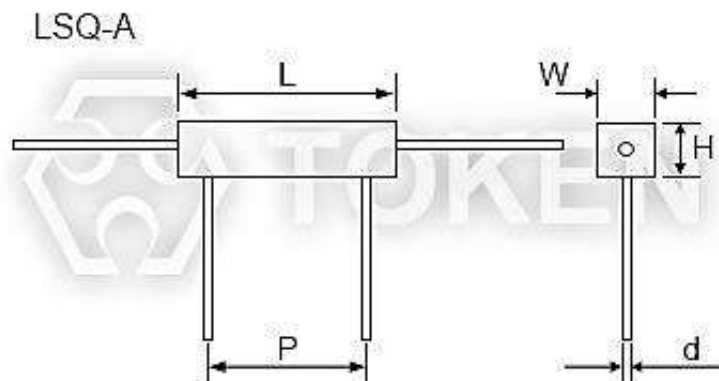
Token will also produce low ohmic resistor LSQ series outside these specifications to meet customer requirements. Contact us with your specific needs, or link to Token official website "[Current Sensing Resistors](http://www.token.com.tw)" for more information.



▶ LSQ-A Spec. & Dim

Specification & Dimensions (Unit: mm) (LSQ-A) for Kelvin Connection

Type	Power (Watts)	Resistance Range (Ω)	Dimensions (Unit: mm)				
			L	W \pm 1	H \pm 1	P \pm 1	d \pm 0.5
LSQ-A-3	3	R01~R1	22 \pm 1.0	8	8	14	0.8
LSQ-A-5	5	R01~R1	22 \pm 1.5	9.5	9.5	14	0.8
LSQ-A-7	7	R01~R1	35 \pm 2.0	9.5	9.5	25	0.8
LSQ-A-10	10	R01~R1	48 \pm 2.0	9.5	9.5	36	0.8
LSQ-A-15	15	R01~R1	48 \pm 2.0	12.5	12.5	36	0.8

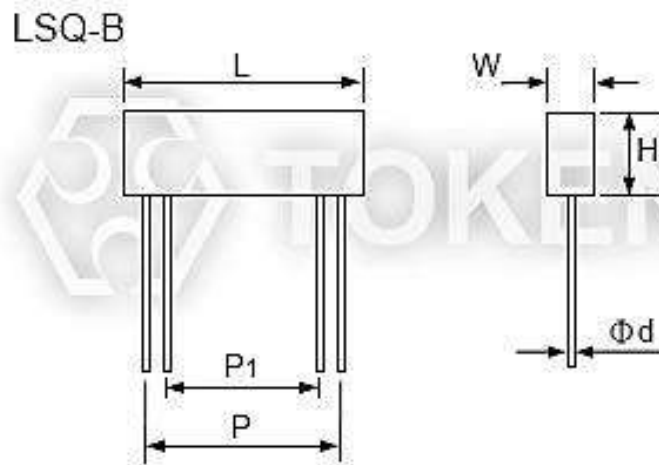


4-T Kelvin Sensing (LSQ-A) Dimensions

▶ LSQ-B Spec. & Dim

Specification & Dimensions (Unit: mm) (LSQ-B) for Kelvin Connection

Type	Power (Watts)	Resistance Range (Ω)	Dimensions (Unit: mm)					
			L \pm 2	W \pm 1	H \pm 1	P \pm 1	P ₁ \pm 1	d \pm 0.5
LSQ-B-5	5	R01~R1	26	5	10	20	12	0.8

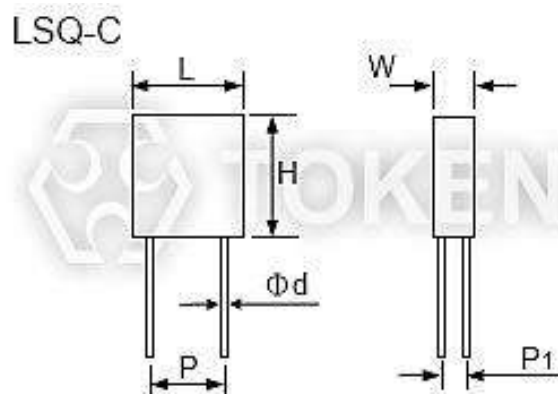


4 Terminal Sensing (LSQ-B) Dimensions

▶ LSQ-C Spec. & Dim

Specification & Dimensions (Unit: mm) (LSQ-C) for Kelvin Connection

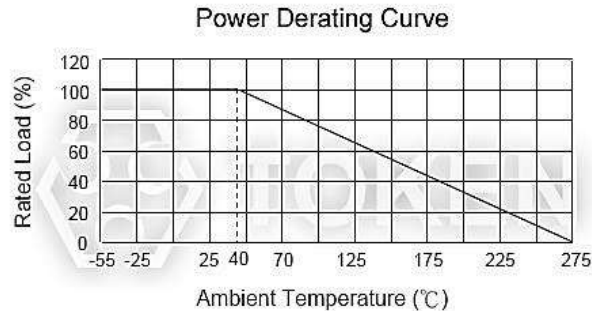
Type	Power (Watts)	Resistance Range (Ω)	Dimensions (Unit: mm)					
			L \pm 2	W \pm 1	H \pm 1	P \pm 1	P ₁ \pm 1	d \pm 0.5
LSQ-C-10	10	R01~R1	18	10.5	20	12	5	1.0



4-wire Sensing (LSQ-C) Dimensions

Derating Curve

Power Derating Curve (LSQ)



Power Derating Curve (LSQ)

Characteristics

Characteristic Specification (LSQ)

Test Items	Test Method	Specification
Resistance Tolerances		D(±0.5%), F(±1%), G(±2%), J(±5%)
Temperature Coefficients		±10 ppm/°C, ±20 ppm/°C, ±25 ppm/°C, ±50 ppm/°C
Operating Temperature Range		-55°C~275°C
Maximum Working Voltage		(P40°C x R)1/2
Terminal Tensile Strength	50N, 10s	ΔR≤±1.0%R
Withstand Voltage	1000V, 1 Min.	No damage on the appearance.
Short Time Overload	5 times rated power, 5s	ΔR≤±4.0%R
Thermal Shock	-55°C~+275°C, 5 cycles, 30 min.	ΔR≤±5.0%R
Load Life	40°C, 1000h 1.5 hours on, 0.5 hours off.	ΔR≤±5.0%R

Order Codes

Order Codes (LSQ)

LSQ-A	-	15	R01	J	P
Part Number		Rated Power	Resistance Value (Ω)	Tolerance	Package-Code
LSQ-A		3 3 Watt	R01 0.01Ω	J ±5%	P Bulk
LSQ-B		5 5 Watt	R05 0.05Ω		
LSQ-C		7 7 Watt	R1 0.1Ω		
		10 10 Watt			
		15 15 Watt			

► General Information

Your Current Options - Token Current Sense

As the world becomes more and more technology-driven, the uses for current sensing components will continue to increase. The need for even lower resistance value ranges is already becoming evident, as is the need for these resistors to handle more power. The industry-wide trend is the emergence of smaller and smaller products.

Token Electronics offers a wide variety of current sensing products from the industry to military standards, such as current sense in Thin-Film / Thick-Film Technology, Bare Element Resistors, and Open Air Shunts. This enables Token to present an astounding number of possible solutions for any circuit design needs.

Applications of Current Detecting Components

Token's TCS and CS Series unique form factor provides automotive designers with several advantages. Both TCS and CS Series are ideal for applications involving window lift motors, fuel pump systems, seat belt pretensioners, and pulse width modulator feedback.

The wider resistive element and lower resistance enables higher current to pass through the device. Token's LRC ultra low Ohmic metal strip chip series provides the inherent ability to flex slightly and offers stress relief during extreme temperature cycling on typical or metal substrates. This LRC series is suitable for switch power supply applications (DC-DC Converter, Charger, and Adaptor) and power management of monitor.

The open air design of bare element resistor LRA and LRB Series provide a far cooler operation by allowing more air flow under the resistive element to keep excess heat from being transmitted to the PC board. They are suitable for high power AC/DC detection of power supply circuit.

Token axial moulded BWL series provides power rating up to 10 watts and lower resistance 0.005Ω , is ideal for all types of current sensing applications including switching and linear power supplies, instruments and power amplifiers.

Token standard current sensing components can be replacement for Vishay, IRC, Ohmite, KOA, Yageo devices with fast delivery and more competitive price. Contact us with your specific needs.



Power Low Resistance Resistor (BWL)

▶ Product Introduction

Token's low resistance current sensing (BWL) resistor minimizes power consumption.

Features :

- Low inductance.
- Excellent load life stability.
- Low temperature coefficient.
- Cooler operation for high power to size ratio.
- Proprietary processing technique produces extremely low resistance values

Applications :

- Switching and linear power supplies.
- Notebook power management.
- Power amplifiers.
- Instruments.

In response to demand for more energy efficient products, Token Electronics has expanded its current sensing series offering with the launch of the BWL series, its lowest resistance value resistor, to minimize power consumption.

The BWL series has been designed for current sensing in power electronic systems and the resistors are available in 0.5W to 10W power ratings, with a wide Ohmic range starting from as low as 0.005Ω.

Products in the economical, low-inductance BWL resistors are axial leads with high temperature mold compound, making them well-suited to the industry trend and are ideal for all types of current sensing applications including switching and linear power supplies, instruments and power amplifiers

In addition, the BWL series utilizes metal strip technology, essential for those involved in constructing devices and circuits for the detection of currents.

Token's BWL standard series is lead-free and RoHS compliant and can be a replacement for Vishay, IRC, KOA, Panasonic current sense resistor with more competitive price and short lead time. Contact us with your specific needs. Or link to our official website "[Current Sensing Resistors](#)" to get more information.

Material:

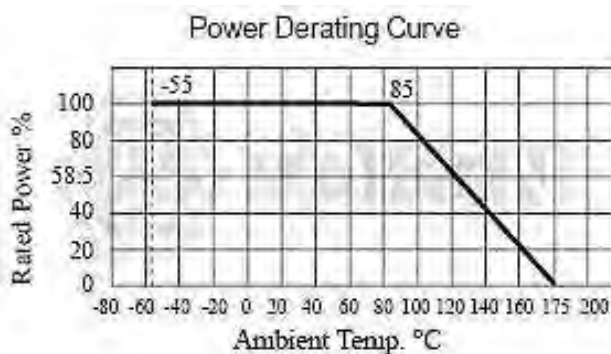
- Encapsulation: High temperature mold compound.
- BWL metal strip technology utilizes manganin.
- Element: Self-supporting nickel-chrome alloy.
- Terminals: Tinned copper.



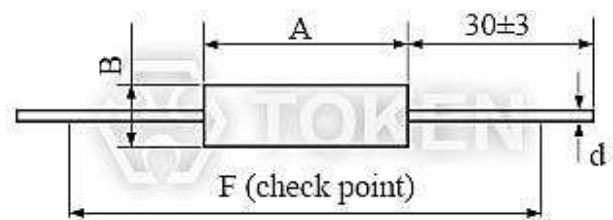
► Technical Specifications & Dimensions

Technical Specifications & Dimensions (BWL)

Type	Rated Watts at 25°C (W)	Resistance Range (Ω)		Tolerance	Dimensions (Unit: mm)			
		Min	Max		A±0.25	ΦB±0.25	Φd	F
BWL-0.5	0.5	0.01	1	±1% ±2% ±5%	7.0	3.0	0.8	27.0
BWL-1	1.0	0.005	2		11.0	3.0	0.8	31.0
BWL-3	3.0	0.005	2		15.0	5.2	0.8	34.0
BWL-4	4.0	0.005	5		18.0	6.5	0.8	38.0
BWL-5	5.0	0.005	1		24.0	8.4	1.0	44.0
BWL-10	10.0	0.01	1		46.5	10.0	1.0	66.0



(BWL) Power Derating Curve



► Electrical Performance

Electrical Performance (BWL)

Test Items	Test Conditions	Specifications
Operating Temp. Range		-55°C ~ 175°C
Insulation Resistance	500V	>1GΩ
Dielectric Withstanding Voltage	500V AC 1 Min.	$\Delta R \leq \pm 0.1\%R$
Load Life	70°C on~off cycle 1000 Hrs.	$\Delta R \leq \pm 1\%R$
Moisture-Proof Load Life	40°C 95% RH on~off cycle 21 Hrs.	$\Delta R \leq \pm 0.2\%R$
Resistance to soldering heat	350°C, 3.5s	$\Delta R \leq \pm 0.1\%R$
Solderability	235±5°C, 5s(solder bath method)	IEC68-2-20(1968)

Order Codes

Order Codes (BWL)

BWL	-	1W	R01	F	P
Part Number		Power Rating (W)	Resistance (Ω)	Resistance Tolerance (%)	Package
		0.5W 0.5	R01 0.01	F ± 1	P Bulk
		1W 1.0	0R1 0.1	G ± 2	
		3W 3.0	1R 1	J ± 5	
		4W 4.0			
		5W 5.0			
		10W 10.0			

General Information

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The open air design of bare element resistor LRA and LRB Series provide a far cooler operation by allowing more air flow under the resistive element to keep excess heat from being transmitted to the PC board. They are suitable for high power AC/DC detection of power supply circuit.

Token axial moulded BWL series provides power rating up to 10 watts and lower resistance 0.005 Ω , is ideal for all types of current sensing applications including switching and linear power supplies, instruments and power amplifiers.

Token standard current sensing components can be replacement for Vishay, IRC, Ohmite, KOA, Yageo devices with fast delivery and more competitive price. Contact us with your specific needs.



Low Ohmic Resistor (LRA)

▶ Product Introduction

Open Air Low Ohmic Resistors (LRA) Feature Longer Thermal Path.

Features :

- Radial leads.
- Non-inductance.
- Solderable Copper Leads.
- Lead (Pb)-free and RoHS compliant.
- $\pm 1\%$, $\pm 2\%$, $\pm 5\%$, $\pm 10\%$ standard tolerance.
- High stability bare metal element open air style.

Applications :

- Automotive, Feedback System.
- Residual Battery Power Detection.
- CPU Drive Control, Power Tool Motor controls.
- Power Supply Shunt, Current Detective, and Current Sensing.
- Inverter and Switching Power Supplies
- High power AC/DC detection.

Token's current sense LRA open air resistors are expected to gain wide acceptance in the worldwide market as a result of increased thermal management capabilities.

The LRA series is designed for applications requiring the transfer of heat away from circuits and solder joints. Available in 0.5W, 1W, and 1.5W rating, the resistor is being specified for current sensing, feedback, current detective, super low inductance, as well as surge and pulse applications.



The hot spot on the LRA open-air resistor is approximately 0.2 degrees higher than on a typical metal strip chip resistor. This results in an increased thermal path for the LRA, reducing heat transfer into the solder joints and circuits.

The flameproof LRA low resistance value resistors are constructed of a wire resistive element with welded copper leads to prevent solder wicking, which can change the device's resistance value in the circuit by as much as 30%. Because of this, the device is ideal for thermally harsh environments, including automotive and aerospace applications, as well as enclosed poorly ventilated circuits in applications such as laptop computers.

The LRA Open Air Series feature a reduced pitch, or spacing between the leads on the circuit board (with a corresponding increase in the board mounted profile), when compared to the standard Token LRB Series devices.

The LRA resistors are rated for 1W or 1.5W at 70°C, with resistance values from 0.1Ω to 0.003Ω and tolerances down to $\pm 1\%$. Operating temperature range is -50°C to 300°C. The LRA Series is available in bulk packaging in 200 increments.

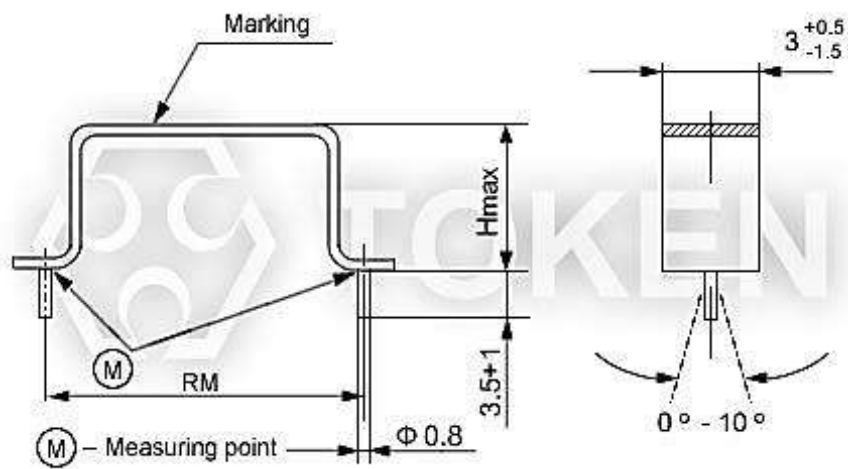
Token will also produce devices outside these specifications to meet customer requirements. A lead-free RoHS-compliant version is available, as is a non-inductive version for high frequency applications. Contact us with your specific needs, or link to Token official website "[Current Sensing Resistors](http://www.token.com.tw)" for more information.



► Dimensions

Dimensions (Unit: mm) (LRA)

Type	H Max. (Unit: mm)	RM (Unit: mm)
LRA350-009	6.5	10
LRA351-009	10.5	
LRA352-009	17.0	
LRA351-010	8.0	15
LRA352-010	14.5	
LRA352-010	16.1±1.0	14.5±1.0
LRA352-010	17.1±1.0	14.5±1.0
LRA352-011	12.0	20



Low Ohmic Open Air (LRA) Dimensions

Construction:

- 1. The resistive elements consist of a flat metal-band.
- 2. Spot welded Cu-terminals ensure high stability of contacts.
- 3. Thus, this construction results in a non-inductive of both high stability and overload capacity.

Characteristics

Characteristic Specification (LRA)

Type	LRA	350-009	351-009 351-010	352-009 352-010 352-011
Power rating P70	W	0.5	1.0	1.5
Resistance range	Ω	R003~R051	R004~R068	R006~R10
E-series		E24≥R010		
Tolerances	%	±1, ±2, ±5, ±10		
Temperature coefficient	PPM	±25~±100		
Max. Cont. working voltage	VRMS	$\sqrt{P70 * R}$ For all styles		
Insulation voltage (1min.)	VRMS	Non insulated		
Insulation resistance	Ω	Non insulated		
Derating, linear	°C	70~300(0W)		
Climatic category		55/200/56		
Temperature range	°C	-50~300		
Thermal resistance	KW-1	200	100	70
Failure rate (Total, V _{0max} , 60% conf. lev.)	10-9 * h-1	Ca.10, Depends on value		
Endurance (P70, 70,1000h)	$[\frac{\Delta R}{R}]%$	±3.0		
Damp heat, steady state(40°C,93% r.h.,56d)	$[\frac{\Delta R}{R}]%$	±0.5		
Climatic sequence	$[\frac{\Delta R}{R}]%$	±0.5		
Terminal strength	$[\frac{\Delta R}{R}]%$	±0.5		
Terminal tensile strength	N	30		
Resistance to soldering heat (260°C,10s)	$[\frac{\Delta R}{R}]%$	±0.2 typ.		
Solder ability	s	2.5 Flow time, solder globule test IEC 60068-2-20-T		
Making		Value imprinted		

► Packing Specification

Packing Specification (LRA)

Type	Package	Pieces	Pack.-Code
LRA350-009	Bulk	200pcs	Bulk
LRA351-009 LRA351-010	Bulk	200pcs	Bulk
LRA352-010 LRA352-011	Bulk	200pcs	Bulk

► Order Codes

Order Codes (LRA)

LRA351-009	R024		J		P	
Part Number	Resistance Value (Ω)		Tolerance (%)		Pack. -Code	
R020	0.020 Ω	F	$\pm 1\%$	P	Bulk	
R022	0.022 Ω	G	$\pm 2\%$			
R024	0.024 Ω	J	$\pm 5\%$			
R100	0.100 Ω	K	$\pm 10\%$			



► General Information

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Metal Strip Chip High Power Low Ohmic Resistor (LRP)

► Product Introduction

Things go better with Token (LRP) high power metal strip resistors.

Features :

- Customized Resistance Available.
- Low TCR $\pm 50\text{PPM}/^\circ\text{C}$, $\pm 75\text{PPM}/^\circ\text{C}$.
- High power rating from 1 Watts to 3 Watts
- Low resistance values from $7\text{m}\Omega$ to $100\text{m}\Omega$.
- Without Laser Trimmed with very low inductance.

Applications :

- For NB power management.
- For MB power management.
- For Monitor power management.
- SWPS: DC-DC converter, Charger, Adaptor.

(LRP) Low ohm metal strip resistors from Token Electronics offer a wide range of high-power current sensing applications including power management of NB, MB and monitor, automotive, shunts and power amplifiers, DC-DC converter and charger, test & measurement instruments, linear power supplies and switching.

(LRP) Design for applications that require high power handling (Up to 3W) and low resistance values from $7\text{m}\Omega$ to $100\text{m}\Omega$ and come with a range of advantages including a wide temperature range and a varied choice of wide range package sizes 2512 with high current capability.

Token (LRP) is aiming for very high power-to-footprint size ratio, excellent frequency response and very low inductance in a solid metal nickel-chrome or manganese-copper alloy resistive element with Low TCR $\pm 50\text{PPM}/^\circ\text{C}$. Also, (LRP) is ideal for all types of voltage division, current sensing and pulse applications.

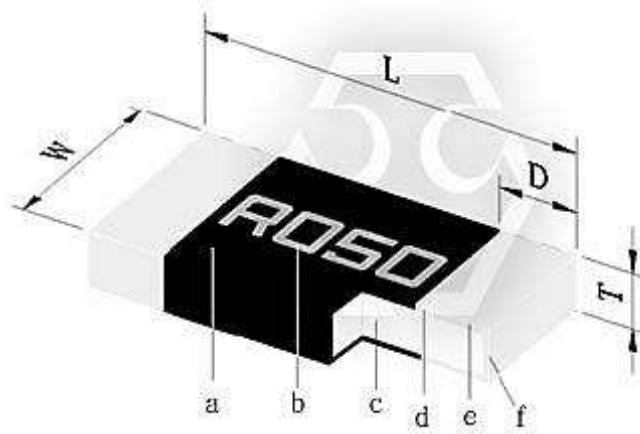
For more power metal strip chip low ohm resistors, please link to Token official website "[Current Sense Resistors](http://www.token.com.tw)". Contact us with your specific needs.



Construction & Dimensions

Dimensions Chip 2512 (LRP)

Type	Size (Inch)	L(mm)	W(mm)	T(mm)	D(mm)
LRP12	2512	6.40±0.25	3.20±0.25	0.70±0.20	0.90±0.30



Chip 2512 Dimensions (LRP)

Construction (LRP)

a	b	c	d	e	f
Overcoat	Marking	Alloy Plate	Internal Electrode	Barrier Layer	Solder Plating

- Notice: TOKEN is capable of manufacturing the optional spec based on customer's requirement.

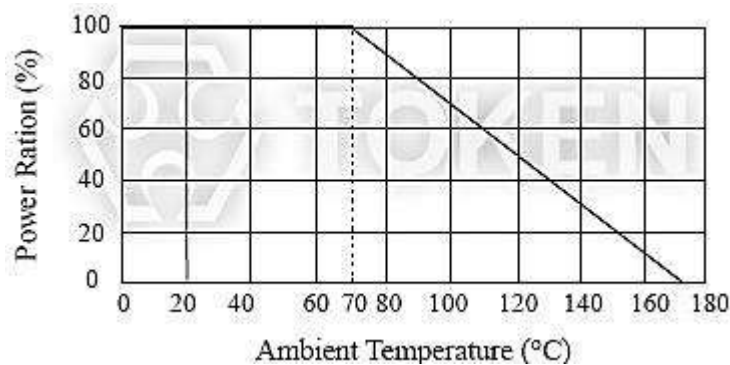
Electrical Specification

Electrical Specifications Chip 2512 (LRP)

Type	Power Rating at 70°C	Operating Temp. Range	Resistance Tolerance (± %)	Resistance (mΩ)	TCR (±PPM/°C)
LRP12 (2512)	1W, 2W, 3W	-55°C ~ +170°C	±0.5%, ±1%, ±5%	15, 18, 20, 22, 25, 30, 33, 35, 39, 40, 47, 50, 60, 68, 70, 75, 80, 82, 90, 91, 100	±50
				7, 8, 9, 10, 12, 15, 18, 20, 22, 25, 30, 33, 35, 39, 40, 47, 50, 60, 68, 70, 75, 80, 82, 90, 91, 100	±75

- Operating Current $I = \sqrt{P/R}$ Operating Voltage $V = \sqrt{P * R}$. or Max. Operating voltage whichever is lower.
- Token is capable of manufacturing the optional spec based on customer's requirement.

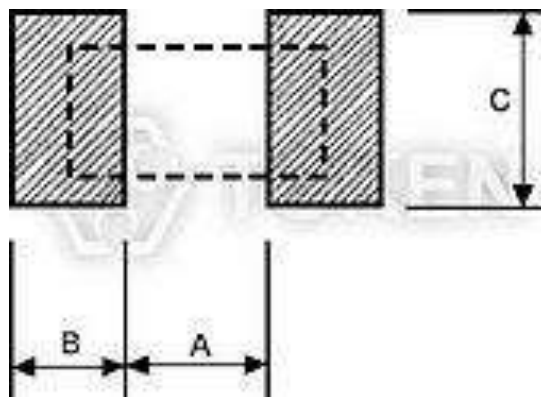
Derating Curve (LRP)



(LRP) Power Derating Curve

Recommend Land Pattern (LRP)

Type	A (mm)	B (mm)	C (mm)
LRP12	4.00	2.00	3.50



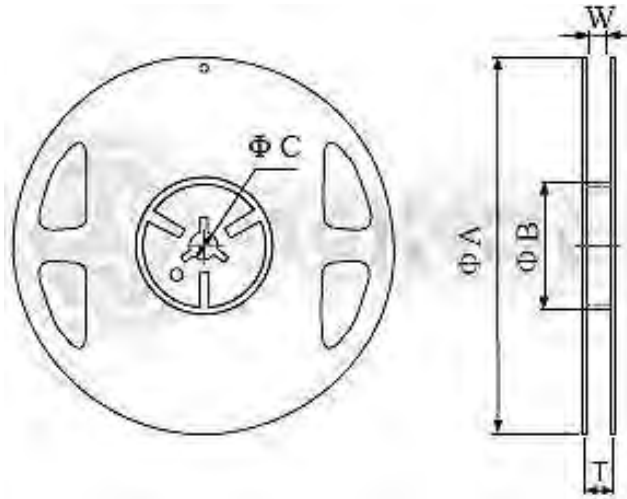
Recommend Land Pattern

- FR4 copper board, 100µm of copper pad thickness.

Reel & Tape

Packing Quantity & Reel Specifications (LRP)

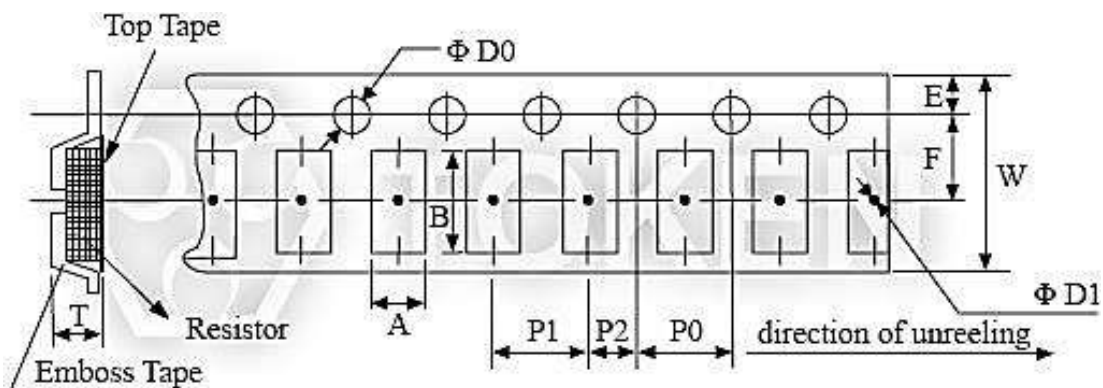
Type	Packaging Quantity	Tape Width	Reel Diameter	ΦA (mm)	ΦB (mm)	ΦC (mm)	W (mm)	T (mm)
LRP12	Embossed 4,000 pcs	12 mm	7 inch	178.0±1.5	60.0±1.0	13.0±0.5	13.0±1.0	15.5±0.5



Reel Specifications Dimensions

Emboss Plastic Tape Specifications (LRP)

Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ΦD ₀ (mm)	ΦD ₁ (mm)	T
LRP12	3.50±0.10	6.70±0.10	12.0±0.30	1.75±0.10	5.5±0.05	4.0±0.10	4.0±0.10	2.0±0.05	1.50±0.10	1.50±0.25	1.2±0.15



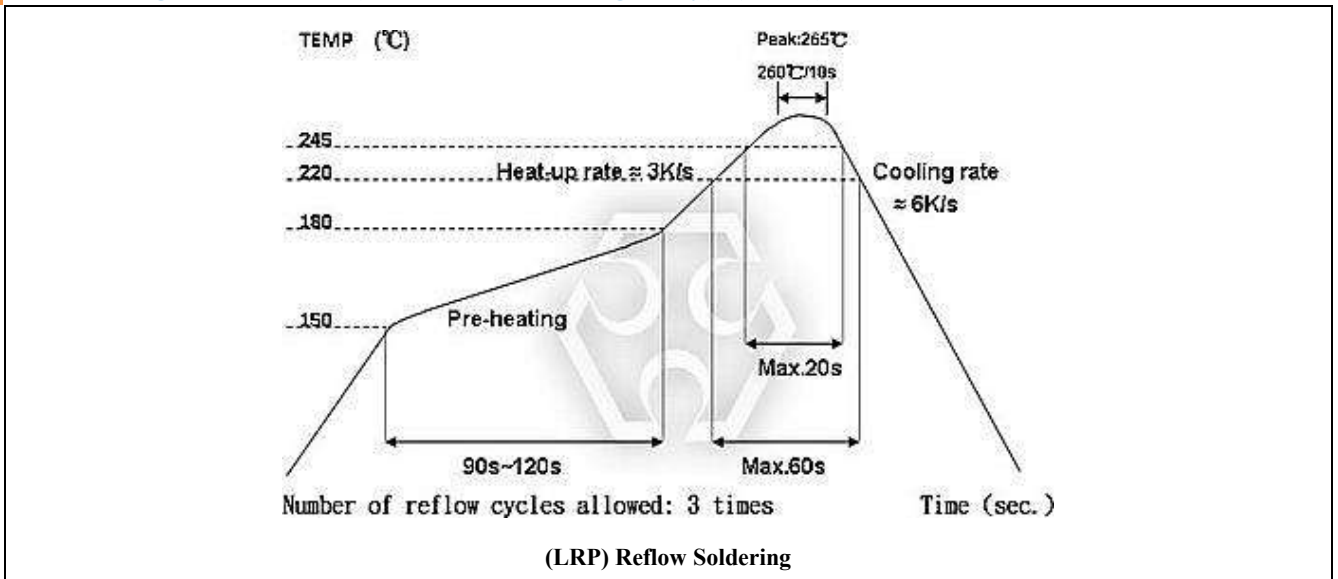
Low Ohm Metal Strip (LRP) Emboss Plastic Tape Specifications

Notice:

1. The cumulative tolerance of 10 sprocket hole pitch is ±0.2mm.
2. Carrier camber shall be not more than 1mm per 100mm through a length of 250mm.
3. A & B measured 0.3mm from the bottom of the packet.
4. t measured at a point on the inside bottom of the packet to the top surface of the carrier.
5. Pocket position relative to sprocket hole is measured as the true position of the pocket and not the pocket hole.

▶ Reflow Soldering

Soldering Condition (Reflow soldering only) (LRP)



- Time of IR reflow soldering at maximum temperature point 260°C : 10s
- Time of soldering iron at maximum temperature point 410°C : 5s

► Environmental Characteristics

Environmental Characteristics (LRP)

Item	Requirement	Test Method
Thermal Shock	±1%	IEC-60115-1 4.19 JIS-C-5201-1 4.19 -55°C ~ 155°C, 5 cycles
Short Time Overload	±1%	IEC60115-1 4.13 JIS-C-5201-1 4.13 5*rated power for 5 seconds
Low Temperature Storage	±1%	IEC-60115-1 4.23.4 JIS-C-5201-1 4.23.4 at-55°C for 1000 hrs
Biased Humidity	±1%	MIL-STD-202 Method 103 1000 hrs 85°C/85% RH 10% of operating power
Bending Strength	±1%	IEC-60115-1 4.33 JIS-C-5201-1 4.33 Bending width 2mm once for 5 seconds
Endurance	±1%	IEC60115-1 4.25 JIS-C-5201-1 4.25.1 70±2°C, RCWV for 1000 hrs with 1.5 hrs “ON” and 0.5 hrs “OFF”
Dry Heat	±1%	IEC60115-1 4.23.2 JIS-C-5201-1 4.23.2 at +170°C for 1000 hrs
Resistance to Soldering Heat	±0.5%	IEC-60115-1 4.18 JIS-C-5201-1 4.18 260±5°C, for 10 seconds
Insulation Resistance	>100MΩ	IEC60115-1 4.6 JIS-C-5201-1 4.13 100V DC for 1 minute
Solderability	95% min coverage	IEC-60115-1 4.17 JIS-C-5201-1 4.17 245±5°C for 3 seconds
Temperature Coefficient of Resistance (T.C.R.)	As Spec.	IEC60115-1 4.8 JIS-C-5201-1 4.8 -55°C ~+125°C. (25°C is the reference temperature)

- Rated continuous Working Voltage (RCWV) = $\sqrt{\text{Power Rating} \times \text{Resistance Value } (\Omega)}$ or Max. Operating voltage whichever is lower.
- Storage Temperature: 25±3°C; Humidity < 80%RH;



Order Codes

Order Codes (LRP)

LRP	12	F	TR	D	S	R050										
Product Type	Dimensions (L×W)(mm)		Package		TCR (PPM/°C)		Power Rating(W)		Resistance (Ω)		Marking					
	12	EIA2512	D	±50	T	1	R015	0.015	No Marking							
		F							±1	W	±75	S	2	R050	0.05	
		J							±5	R	3					

General Information

Your Current Options - Token Current Sense

As the world becomes more and more technology-driven, the uses for current sensing components will continue to increase. The need for even lower resistance value ranges is already becoming evident, as is the need for these resistors to handle more power. The industry-wide trend is the emergence of smaller and smaller products.

Token Electronics offers a wide variety of current sensing products from the industry to military standards, such as current sense in Thin-Film / Thick-Film Technology, Bare Element Resistors, and Open Air Shunts. This enables Token to present an astounding number of possible solutions for any circuit design needs.

Applications of Current Detecting Components

Token's TCS and CS Series unique form factor provides automotive designers with several advantages. Both TCS and CS Series are ideal for applications involving window lift motors, fuel pump systems, seat belt pretensioners, and pulse width modulator feedback.

The wider resistive element and lower resistance enables higher current to pass through the device. Token's LRC ultra low Ohmic metal strip chip series provides the inherent ability to flex slightly and offers stress relief during extreme temperature cycling on typical or metal substrates. This LRC series is suitable for switch power supply applications (DC-DC Converter, Charger, and Adaptor) and power management of monitor.

The open air design of bare element resistor LRA and LRB Series provide a far cooler operation by allowing more air flow under the resistive element to keep excess heat from being transmitted to the PC board. They are suitable for high power AC/DC detection of power supply circuit.

Token axial moulded BWL series provides power rating up to 10 watts and lower resistance 0.005Ω, is ideal for all types of current sensing applications including switching and linear power supplies, instruments and power amplifiers.

Token standard current sensing components can be replacement for Vishay, IRC, Ohmite, KOA, Yageo devices with fast delivery and more competitive price. Contact us with your specific needs.



4 Kelvin Current Sense Resistor (LPS)

► Product Introduction

Token's low value 4 lead kelvin current sensing (LPS) resistors family offers a variety of possibilities for current shunts.

Features :

- Radial leads.
- Non-inductance.
- Solderable Copper Leads.
- Lead (Pb)-free and RoHS compliant.
- $\pm 2\%$, $\pm 5\%$, $\pm 10\%$ standard tolerance.
- High stability bare metal element open air resistor.

Applications :

- Automotive, Feedback System.
- Residual Battery Power Detection.
- CPU Drive Control, Power Tool Motor controls.
- Power Supply Shunt, Current Detective, and Current Sensing.
- Inverter and Switching Power Supplies
- High power AC/DC detection.

The (LPS) family for shunt is expected to gain wide acceptance in the worldwide market as a result of offering a variety of possibilities.

The U-shaped semi-customized LPS family for direct board mounting is specified for precision current sensing, feedback, current detective, supper low inductance, as well as surge and pulse applications. LPS family Available in very low ohm ($0.002\Omega \sim 0.05\Omega$) and high power ($1W \sim 5W$).

The dimension of the semi-customized final unit is designed in accordance with the application requirements of resistance value and required power rating. Token's LPS series can be manufactured with 2 or 4 solder tags (terminals). The LPS type B with 2 solder tags (1 pin on each side) is a standard part of LPS series and type A with 4 terminals (2 pin on each side) is used either for Kelvin connections or for high current applications. Depending from the alloy material's thickness, one terminal contact on each side can carry up to 50A ($A \text{ (Current)} = (W \text{ (Power)} / \Omega \text{ (Resistance)})^{1/2}$), so a 4-terminal part can carry 100A (ask Token factory).

Operating temperature range is -50°C to 300°C with tolerances $\pm 2\%$, $\pm 5\%$, and $\pm 10\%$.

Token will also produce low value current sense resistor LPS series outside these specifications to meet customer requirements. Contact us with your specific needs, or link to Token official website "[Current Sensing Resistors](#)" for more information.

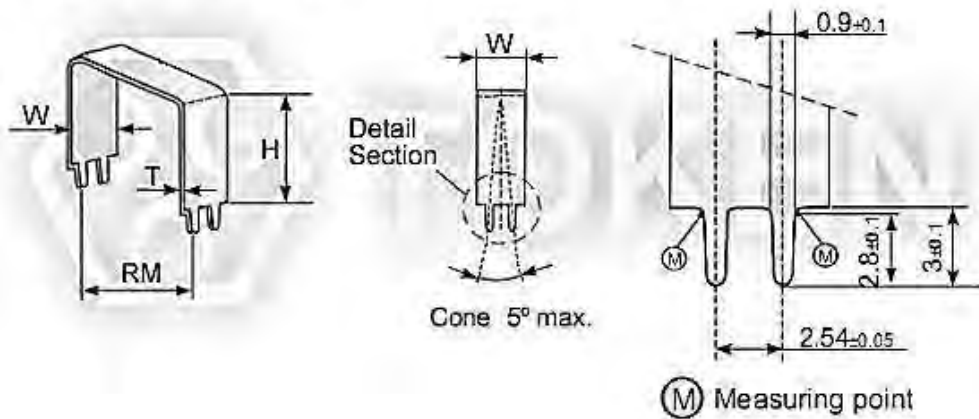


Dimensions

Dimensions (Unit: mm) Open Air 4-T & 2-T (LPS)

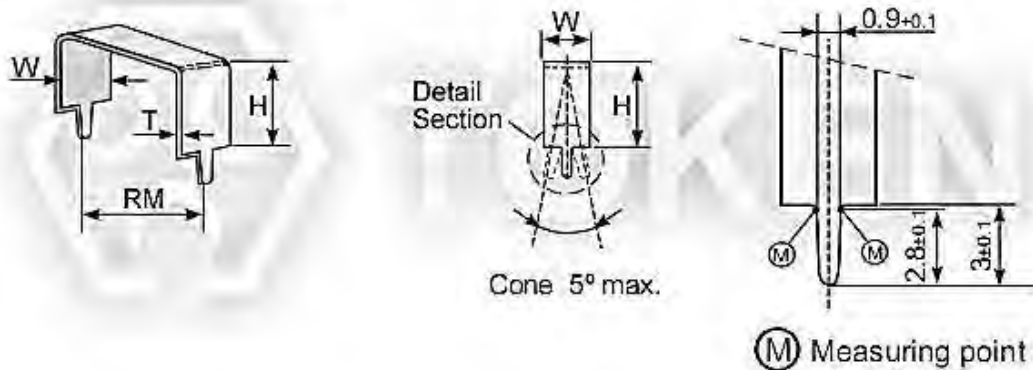
Type	Power (Watts)	Resistance Range (Ω)	RM (mm)	H (mm) Max.
LPS359-008	1	R005~R05	5 ~ 30	20.0
LPS359-009	2	R005~R02		
LPS359-010	3	R003~R01		
LPS359-011	5	R002~R005		

Type A - 4 Terminals



Semi-customized (LPS) Dimensions Type A - Four Terminal for Kelvin Connection

Type B - Two Terminals



Semi-customized (LPS) Dimensions Type B - Open Air Low Value Two Terminal Resistor

Construction:

- 1. W, T and H depend on material, resistance value and required power rating.
- 2. RM: 5~30 mm, preferably in 5 mm-steps. Special varieties on request.
- 3. M: Measuring point.

Characteristics

Characteristic Specification (LPS)

Test Items	Specification
Resistance range	R002~R05
Tolerances	±2%, ±5%, ±10%
Temperature coefficient	Upon request
Insulation voltage	Non insulated
Insulation resistance	Non insulated
Derating, linear	70~300°C (0W)
Climatic category	55/155/21
Temperature range	-50~300°C
Endurance (P70, 70°C, 1000 Hrs.)	$\Delta R \leq \pm 2\%R$
Damp heat, steady state (40°C, 93% r.h., 56d)	$\Delta R \leq \pm 2\%R$
Climatic sequence	$\Delta R \leq \pm 0.5\%R$
Terminal strength	None
Terminal tensile strength	None
Resistance to soldering heat (350°C, 3.5s)	$\Delta R \leq \pm 0.5\%R$ typ.
Solderability (Solder bath method 235±5°C, 2±0.5s)	Good tinning (≥ 90 % covered), no visible damage

Order Codes

Order Codes (LPS)

LPS359-008	B	3	R024	J	P			
Part Number	Terminal Type	Rated Power		Resistance Value (Ω)		Tolerance (%)	Pack. -Code	
LPS359-008	A 4 Terminals	1	1 W	R002	0.002	G	±2	P Bulk
LPS359-009	B 2 Terminals	2	2 W	R010	0.010	J	±5	
LPS359-010		3	3 W	R022	0.022	K	±10	
LPS359-011		5	5 W	R050	0.050			

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Metal Strip Low Ohm Power Chip Resistor (LRM)

► Product Introduction

Build Token (LRM) Power Low Ohmic Metal Strip resistors into your Design

Features :

- Low TCR down to $\pm 75\text{PPM}/^\circ\text{C}$.
- Low resistance values from $1\text{m}\Omega$ to $100\text{m}\Omega$.
- High power rating from 1/8 Watts to 3 Watts
- Wide range package sizes 0805, 1206, 2010, and 2512.

Applications :

- For NB power management.
- For MB power management.
- For Monitor power management.
- SWPS: DC-DC converter, Charger, Adaptor.

(LRM) Low ohm Power Metal Strip resistors from Token Electronics offer a wide range of high-power current sensing applications including power DC-DC converter and charger, management of NB, MB and monitor, test & measurement instruments, linear power supplies and switching, automotive, shunts and power amplifiers.

(LRM) Design for applications that require a wide range power handling from 1/8W up to 3W and low resistance values from $1\text{m}\Omega$ to $100\text{m}\Omega$ and come with a range of advantages including a wide temperature range and a varied choice of wide range package sizes 0805, 1206, 2010, and 2512 with high current capability.

Token (LRM) is aiming for very high power-to-footprint size ratio, excellent frequency response and very low inductance in a solid metal nickel-chrome or manganese-copper allow resistive element with Low TCR $\pm 75\text{PPM}/^\circ\text{C}$. Also, ideal for all types of voltage division, current sensing and pulse applications.

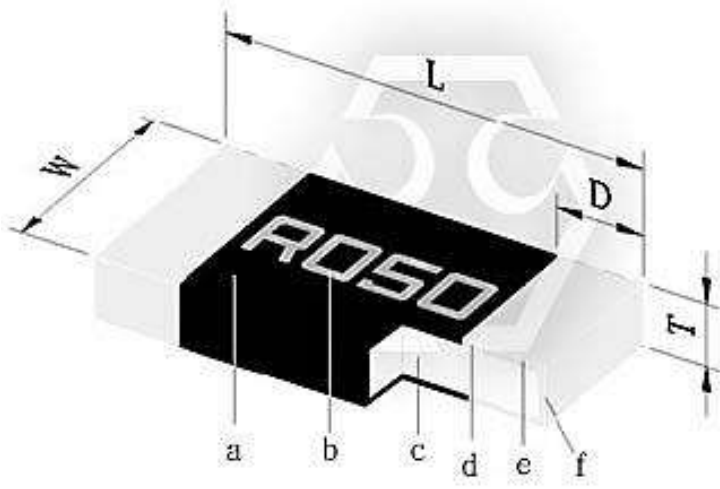
For more power metal strip chip low ohm resistors, please link to Token official website "[Current Sense Resistors](#)". Contact us with your specific needs.



Construction & Dimensions

Construction (LRM)

a	b	c	d	e	f
Overcoat (molding)	Marking	Alloy Plate	Internal Electrode (Cu)	Barrier Layer (Ni)	Solder Plating (Sn)



Power Metal Strip Dimensions (LRM)

Dimensions Chip (LRM)

Part No.	Resistance (mΩ)	Material	L (mm)	W (mm)	T (mm)	D (mm)	Weight(g) 1000pcs
LRM05*TE****M	5, 9, 10, 20	MnCu	2.00±0.10	1.25±0.10	0.60±0.20	0.40±0.20	15.00
LRM06*TFR001M	1	MnCu	3.20±0.20	1.60±0.20	0.75±0.20	1.10±0.30	18.00
LRM06*T****M	2 ~ 30	MnCu	3.20±0.20	1.60±0.20	0.60±0.20	0.50±0.30	18.00
LRM10*T****	5, 6, 10, 15, 20	NiCu	5.00±0.20	2.50±0.20	0.60±0.20	0.60±0.30	40.50
LRM12*T****M	0.5, 0.75	MnCu	6.40±0.20	3.20±0.20	0.60±0.20	2.60±0.20	90.90
LRM12*T****M	5, 10, 20, 25, 30, 40, 50	MnCu	6.40±0.20	3.20±0.20	0.60±0.20	0.90±0.20	90.90
LRM12*T****M	4 ~ 50	NiCu	6.40±0.20	3.20±0.20	0.60±0.20	0.90±0.20	90.90
LRM12*T****	1, 1.5, 2, 3	NiCu	6.40±0.20	3.20±0.20	0.60±0.20	2.0±0.20	90.90
LRM12*T****	2, 3, 4	NiCu	6.40±0.20	3.20±0.20	0.70±0.20	2.0±0.20	90.90
LRM12*T****	10 ~ 100	NiCu	6.40±0.20	3.20±0.20	0.70±0.20	0.90±0.20	90.90

● Notice: TOKEN is capable of manufacturing the optional spec based on customer's requirement.

Electrical Specification

MnCu Material - Electrical Specifications (LRM)

Type	Power Rating at 70°C	Operating Temp. Range	Resistance Tolerance (± %)	Resistance (mΩ)	TCR (±PPM/°C)
LRM05 (0805)	1/8W, 1/4W, 1/2W	-55°C ~ +170°C	±1%, ±5%	5, 9, 10, 20	±100
LRM06 (1206)	1/4W, 1/2W, 1W			1	±200
				2, 3, 4, 5, 6, 7, 8, 9, 10	±100
				12, 14, 15, 20, 22, 25, 30	±75
LRM12 (2512)	1W, 2W			0.5, 0.75	±200
	1W			5, 10	±100
		20, 25, 30, 40, 50	±75		

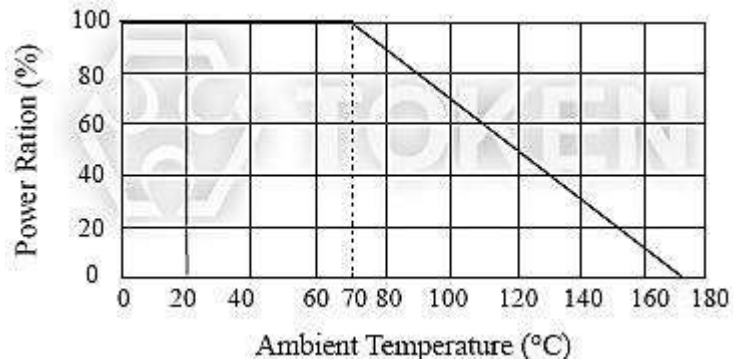
NiCu Material - Electrical Specifications (LRM)

Type	Power Rating at 70°C	Operating Temp. Range	Resistance Tolerance (± %)	Resistance (mΩ)	TCR (±PPM/°C)
LRM10 (2010)	1/2W, 3/4W, 1W, 1.5W	-55°C ~ +170°C	±1%, ±5%	5, 6, 10	±100
LRM12 (2512)	1W, 2W			15, 20	±75
				1, 1.5	±275
				2, 3, 4, 5, 6, 7, 8, 10	±100
				12, 15, 18, 20, 25, 30, 33, 35, 40, 50	±75
				2, 3, 4, 10, 12, 15, 18, 20, 25, 30, 39, 40, 50, 60, 70, 80, 100	±75

- Operating Current $I = \sqrt{(P / R)}$, Operating Voltage $V = \sqrt{(P * R)}$ or Max. Operating voltage whichever is lower.
- Optional specifications can be required.



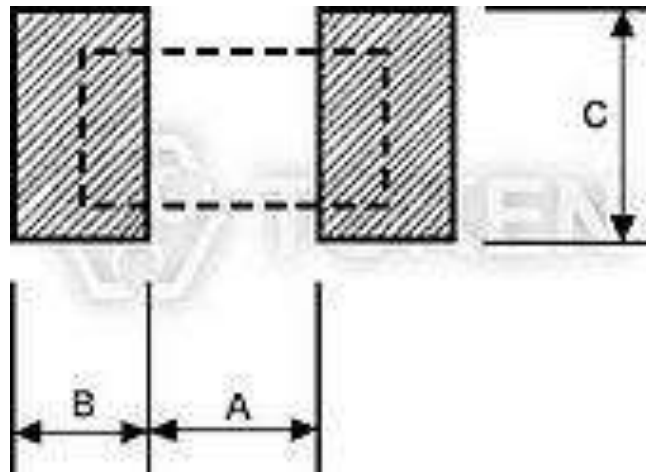
Derating Curve (LRM)



(LRM) Power Derating Curve

Recommend Land Pattern (LRM)

Type	A ±0.2(mm)	B ±0.2(mm)	C ±0.2(mm)
LRM05	1.20	1.15	1.40
LRM06 (1mΩ)	1.00	2.30	1.80
LRM06 (2mΩ ~ 30mΩ)	1.60	1.70	1.80
LRM10	3.50	1.50	3.40
LRM12 (0.5mΩ ~ 3mΩ)	1.30	3.10	4.00
LRM12 (4mΩ ~ 100mΩ)	4.10	2.10	4.00



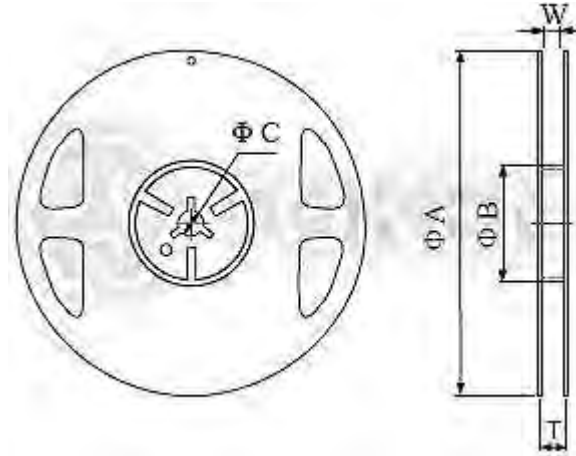
Recommend Land Pattern

- * FR4 copper board, 100μm of copper pad thickness

▶ Reel & Tape

Packing Quantity & Reel Specifications (LRM)

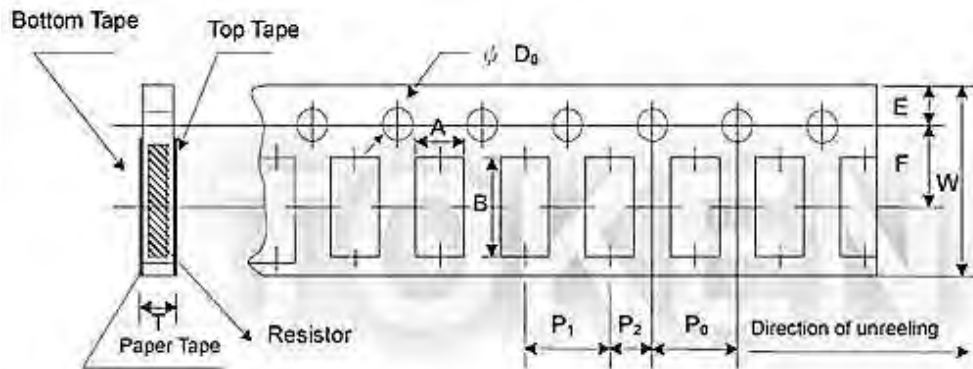
Type	Packaging Quantity	Tape Width	Reel Diameter	ΦA (mm)	ΦB (mm)	ΦC (mm)	W (mm)	T (mm)
LRM05	Paper 5,000 pcs	8 mm	7 inch	178.0±2.0	60.0±1.0	13.0±1.0	9.0±1.0	11.4±1.0
LRM06	Paper 5,000 pcs	8 mm	7 inch	178.0±2.0	60.0±1.0	13.0±1.0	9.0±1.0	11.5±1.0
LRM10	Embossed 4,000 pcs	12 mm	7 inch	178.0±2.0	60.0±1.0	13.0±1.0	13.0±1.0	15.5±1.0
LRM12	Embossed 4,000 pcs	12 mm	7 inch	180.0+0/-3	60.0±1.0	13.0±1.0	13.0±1.0	15.4±2.0



Reel Dimensions

Paper Tape Specifications (LRM)

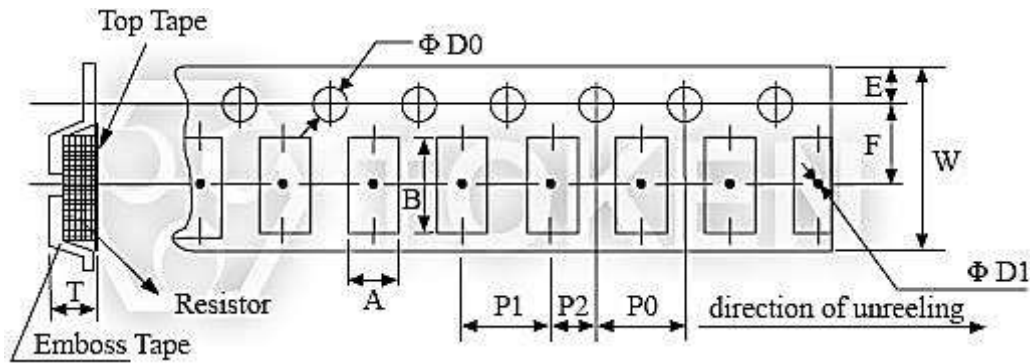
Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ΦD ₀ (mm)	T
LRM05	1.60±0.15	2.40±0.20	8.00±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.1/-0	0.84±0.10
LRM06	2.00±0.15	3.60±0.20	8.00±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.1/-0	0.84±0.10



(LRM) Paper Tape Specifications

Emboss Plastic Tape Specifications (LRM)

Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ΦD ₀ (mm)	ΦD ₁ (mm)	T
LRM10	2.80±0.20	5.30±0.20	12.0±0.20	1.75±0.10	5.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.1, -0	1.50±0.25	0.85±0.15
LRM12	3.60±0.20	6.90±0.20	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.1, -0	1.50±0.25	0.85±0.15
LRM12	3.60±0.20	6.90±0.20	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.1, -0	1.50±0.25	1.20±0.15



(LRM) Emboss Plastic Tape Specifications

- 1. The cumulative tolerance of 10 sprocket whole pitch is $\pm 0.2\text{mm}$.
- 2. Carrier camber shall be not more than 1mm per 100mm through a length of 250mm.
- 3. A & B measured 0.3mm from the bottom of the packet.
- 4. T measured at a point on the inside bottom of the packet to the top surface of the carrier.
- 5. Pocket position relative to sprocket hole is measured as the true position of the pocket and not the pocket hole.

Environmental Characteristics

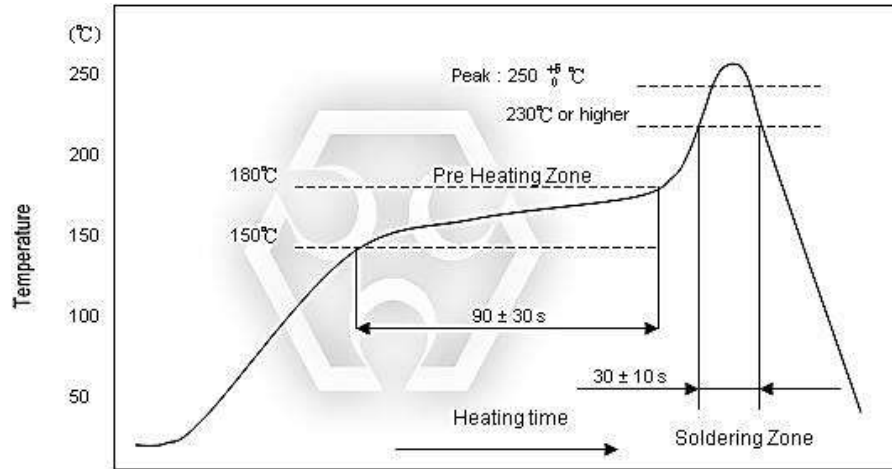
Environmental Characteristics (LRM)

Item	Requirement	Test Method
Thermal Shock	0805, 2010: $\pm 0.5\%$ 1206, 2512: $\pm 1\%$	JIS-C-5201-1 4.19 IEC-60115-1 4.19 -55°C ~ 155°C, 300 cycles, 15min per extreme condition
Short Time Overload	0805, 2010, 2512: $\pm 0.5\%$ 1206: $\pm 1\%$	IEC60115-1 4.13 JIS-C-5201-1 4.13 5*rated power for 5 seconds
Low Temperature Storage	0805, 2010, 2512: $\pm 0.5\%$ 1206: $\pm 1\%$	IEC-60115-1 4.23.4 JIS-C-5201-1 4.23.4 at -55°C for 1000 hrs
Damp Heat no Load	2512 0.5m Ω , 0.75m Ω , 1206: $\pm 0.5\%$ Other sizes: $\pm 1.0\%$	IEC60115-1 4.24.2.1a JIS-C-5201-1 4.24.2.1a 85°C, 85%RH, 1000 hrs
Bending Strength	$\pm 1\%$	IEC-60115-1 4.33 JIS-C-5201-1 4.33 Bending width 2mm once for 5 seconds
Endurance	$\pm 1\%$	IEC60115-1 4.25 JIS-C-5201-1 4.25.1 70 ± 2 °C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Dry Heat	$\pm 1\%$	IEC60115-1 4.23.2 JIS-C-5201-1 4.23.2 at +170°C for 1000 hrs
Resistance to Soldering Heat	$\pm 0.5\%$	IEC-60115-1 4.18 JIS-C-5201-1 4.18 0805, 2010: 260 ± 5 °C for 10 seconds 1206, 2512: 260 ± 5 °C for 20 seconds
Insulation Resistance	>100M Ω	IEC60115-1 4.6 JIS-C-5201-1 4.13 100V DC for 1 minute
Solderability	95% min coverage	IEC-60115-1 4.17 JIS-C-5201-1 4.17 245 ± 5 °C for 3 seconds
Temperature Coefficient of Resistance (T.C.R.)	As Spec.	IEC60115-1 4.8 JIS-C-5201-1 4.8 -55°C ~ +125°C. (25°C is the reference temperature)

- Rated continuous Working Voltage (RCWV) = $\sqrt{\text{Power Rating} \times \text{Resistance Value } (\Omega)}$ or Max. Operating voltage whichever is lower.
- Storage Temperature: 25 ± 3 °C; Humidity < 80%RH;

▶ Reflow soldering

| Soldering Condition (Reflow soldering only) (LRM)



(LRM) Reflow Soldering

▶ Order Codes

| Order Codes (LRM)

LRM	12	F	TR	D	S	R050								
Product Type	Dimensions (L×W)(mm)		Package		TCR (PPM/°C)		Power Rating(W)		Resistance (Ω)		Marking			
	05	EIA0805	F	±1	TR	Taping Reel	W	±75	W	1/8	R015	0.015	N	No Marking
06	EIA1206	G					±2	E	±100	V	1/4	R050	0.05	M
	10	EIA2010	J	±5			F	±200	O	1/3				
	12	EIA2512					3	±275	U	1/2				NiCu Material
									Q	3/4				
									T	1				
									A	1.5				
									S	2				
									R	3				

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Open Air Resistors (OAR)

► Product Introduction

Token's "tight pitch" version of its open air metal element current sense resistor (OAR) need less PCB space.

Features :

- High stability open-air style.
- Precision alloys resistive element.
- Lead (Pb)-free and RoHS compliant.
- Standard tolerance $\pm 1\%$, $\pm 2\%$, $\pm 5\%$.
- Low inductance. Solderable copper leads (60/40).
- Radial leads, low resistance value $0.05\Omega \sim 0.005\Omega$.

Applications :

- CPU Drive Control.
- Power Tool Motor controls.
- Automotive, Feedback System.
- Power Supply Shunt, Current Detective.
- Inverter and Switching Power Supplies.
- Residual Battery Power Detection, and Current Sensing.

In response to requests from power electronics design engineers with the means to squeeze more current-sensing capability into crowded power supply designs, Token Electronics has developed a "tight pitch" version of its open air metal element current sensing resistor with ratings as high as 5W in a reduced PC board footprint and longer thermal path.

Designated the OAR Series, these through-hole devices offer a high current, flameproof alternative to conventional axial devices and flat chips for current-sense circuits where PC board space is at a premium. The open air resistor's footprint is reduced by extending the height of the device above the board, thus keeping the resistor element's "hot spot" safely off the PC board and providing for increased air circulation under it, which in turn provides increased heat dissipation and cooler operation.

The OAR devices with increased height improve cooling efficiency, and because many power supply designs are already tightly-packed at the PC board level, the additional height does not create any profile issues. The OAR series feature a reduced pitch, or spacing between the leads on the circuit board with a corresponding increase in the board mounted profile.

The OAR low resistance value resistors are power rated for 1W, 2W, 3W, or 5W at 85°C , with resistance values from 0.05Ω to 0.005Ω , with tolerances down to $\pm 1\%$. They feature TCRs as low as $\pm 50\text{ppm}/^{\circ}\text{C}$ and inductance values in the single-digit nano henry range (10 nH Max.). Operating temperature range is -40°C to $+125^{\circ}\text{C}$. The flameproof OAR resistors are constructed of a wire resistive element with welded copper leads to prevent solder wicking, which can change the device's resistance value in the circuit by as much as 30%.

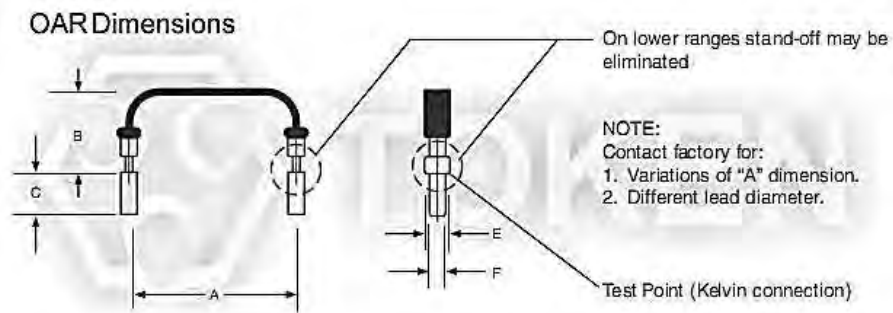
The Low Ohmic Value Current Sense (OAR) Resistor is available in bulk packaging and is RoHS compliant and lead free. For non-standard technical requirements and special applications, please contact us with your specific needs, or link to Token official website "[Current Sensing Resistors](http://www.token.com.tw)" for more information.



OAR Dimensions

Dimensions (Unit: mm) (OAR)

Type	Dimensions (Unit: mm)				
	A±1	B±3	C±0.8	E±0.3	F±0.1
OAR-1	10	10	3.5	1.6	1.0
OAR-2	15	15	3.5	1.6	1.0
OAR-3	20	20	3.5	1.6	1.0
OAR-5	20	20	3.5	1.6	1.0



Open Air Current Sensing (OAR) Resistor Dimensions

Specification

Specification (OAR)

Type	Power Rating @ 85°C (W)	Resistance Range (mΩ)	Tolerance (±%)	Temperature Coefficient TCR (ppm/°C)	Inductance (nH)
OAR-1	1	R005~R05	±1% ±2% ±5%	±50	10 Max.
OAR-2	2	R005~R05			
OAR-3	3	R005~R05			
OAR-5	5	R005~R01			

▶ Characteristics

Characteristic Specification (OAR)

Test Items	Test Method	Specification
Load Life	1000 hours @ 25°C	$\Delta R/R < 1\%$
Moisture Test	no load for 1000 hours	$\Delta R/R < 1\%$
Temperature Cycling	-40°C to +125°C for 1000 cycles	$\Delta R/R < 1\%$
Operating Temperature		-40°C to +125°C

▶ Order Codes

Order Codes (OAR)

OAR	-	1	R01	J	P
Part Number		Rated power (W)	Resistance Value (Ω)	Tolerance (%)	Package-Code
OAR		1 1 W	R005 0.005 Ω	F $\pm 1\%$	P Bulk
		2 2 W	R01 0.01 Ω	G $\pm 2\%$	
		3 3 W	R05 0.05 Ω	J $\pm 5\%$	
		5 5 W			



► General Information

Your Current Options - Token Current Sense

As the world becomes more and more technology-driven, the uses for current sensing components will continue to increase. The need for even lower resistance value ranges is already becoming evident, as is the need for these resistors to handle more power. The industry-wide trend is the emergence of smaller and smaller products.

Token Electronics offers a wide variety of current sensing products from the industry to military standards, such as current sense in Thin-Film / Thick-Film Technology, Bare Element Resistors, and Open Air Shunts. This enables Token to present an astounding number of possible solutions for any circuit design needs.

Applications of Current Detecting Components

Token's TCS and CS Series unique form factor provides automotive designers with several advantages. Both TCS and CS Series are ideal for applications involving window lift motors, fuel pump systems, seat belt pretensioners, and pulse width modulator feedback.

The wider resistive element and lower resistance enables higher current to pass through the device. Token's LRC ultra low Ohmic metal strip chip series provides the inherent ability to flex slightly and offers stress relief during extreme temperature cycling on typical or metal substrates. This LRC series is suitable for switch power supply applications (DC-DC Converter, Charger, and Adaptor) and power management of monitor.

The open air design of bare element resistor LRA and LRB Series provide a far cooler operation by allowing more air flow under the resistive element to keep excess heat from being transmitted to the PC board. They are suitable for high power AC/DC detection of power supply circuit.

Token axial moulded BWL series provides power rating up to 10 watts and lower resistance 0.005Ω , is ideal for all types of current sensing applications including switching and linear power supplies, instruments and power amplifiers.

Token standard current sensing components can be replacement for Vishay, IRC, Ohmite, KOA, Yageo devices with fast delivery and more competitive price. Contact us with your specific needs.



Low Ohmic Open Air Resistor (LRB)

▶ Product Introduction

Token's open-air, low inductance, low ohmic resistor is alternative current shunts.

Features :

- Low inductance.
- High stability open-air style.
- Precision alloys resistive element.
- Lead (Pb)-free and RoHS compliant.
- Standard tolerance $\pm 3\%$, $\pm 5\%$, $\pm 10\%$.
- Radial leads, low resistance value $2\text{ m}\Omega \sim 50\text{ m}\Omega$.

Applications :

- CPU Drive Control.
- Automotive, Feedback System.
- Residual Battery Power Detection, and Current Sensing.
- Power Supply Shunt, Current Detective.
- Inverter and Switching Power Supplies.
- Power Tool Motor controls.

Developed for current sensing and shunt applications, Token's LRB series of bare element resistors have a precision alloys (Ni-Cu) element welded construction. Built-in stand-offs and standard spacing makes for easy mounting.

The bare metal element design allows for maximum cooling via airflow, forcing less heat into the PCB. The flameproof construction offers values down to $2\text{ m}\Omega$ with low inductance. Customer can specify resistance range designed to satisfy challenging and specific technical requirements.

These factors make the LRB Series an outstanding choice for all types of high current power supplies and power applications requiring a robust part that is impervious to most environmental stresses. The device is ideal for current limited, current balance, and sampling sense in power supplier. It takes on the capability of high overload, and the function easily welding and non-inductance as well.

The Open Air (LRB) Low Ohmic Value Resistor is available in bulk packaging and is RoHS compliant and lead free. For non-standard technical requirements and special applications, please contact us with your specific needs, or link to Token official website "[Current Sensing Resistors](http://www.token.com.tw)" for more information.

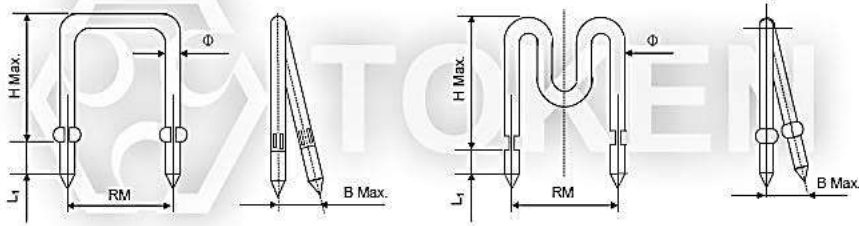


LRB Dimensions

Dimensions (Unit: mm) (LRB)

RM (mm)	H Max. (mm)	B Max. (mm)	Ø (mm)	L1 (mm)
5 ~ 50	20	1	5 ~ 29	3±0.5

LRB Dimensions (Unit: mm)



Current Sensing Open Air Resistors (LRB) Dimensions

Specification

Specification (LRB)

Type	Diameter Ø (mm)	Rated Current (A)	Resistance Range (mΩ)	Tolerance (%)	Temperature Coefficient (ppm/°C)	Temperature Range (°C)
LRB-05	0.5	2.5	20~50	±3%(H) ±5%(J) ±10%(K)	±50 ~ ±100	-55 ~ +85
LRB-06	0.6	3.0	20~50			
LRB-07	0.7	4.0	20~50			
LRB-08	0.8	4.5	20~50			
LRB-09	0.9	5.0	10~50			
LRB-10	1.0	5.5	10~30			
LRB-11	1.1	6.0	5~20			
LRB-12	1.2	7.0	5~20			
LRB-13	1.3	7.5	5~20			
LRB-14	1.4	8.0	5~20			
LRB-15	1.5	9.0	5~20			
LRB-16	1.6	9.5	5~15			
LRB-18	1.8	11	3~10			
LRB-20	2.0	12	2~8			
LRB-23	2.3	14	2~8			
LRB-25	2.5	17	2~5			
LRB-29	2.9	21	2~5			

Order Codes

Order Codes (LRB)

LRB	-	08	05	R005	K	P
Part Number		Diameter Ø	Leads Pitch RM (mm)	Resistance Value (Ω)	Tolerance %	Package-Code
LRB		05 0.5 mm	05 5 mm	R005 0.005Ω	H ±3%	P Bulk
		06 0.6 mm	10 10 mm	R02 0.02Ω	J ±5%	
		07 0.7 mm	15 15 mm	R05 0.05Ω	K ±10%	
		08 0.8 mm	20 20 mm			
		09 0.9 mm	25 25 mm			
		10 1.0 mm	30 30 mm			
		11 1.1 mm	35 35 mm			
		12 1.2 mm	40 40 mm			
		13 1.3 mm	45 45 mm			
		14 1.4 mm	50 50 mm			
		15 1.5 mm				
		16 1.6 mm				
		17 1.7 mm				
		18 1.8 mm				
		20 2.0 mm				
		23 2.3 mm				
		25 2.5 mm				
		29 2.9 mm				



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Current Shunts Resistors (FL)

► Product Introduction

Token's Current Shunt Resistors (FL) for high-current applications aid precision measurement.

Current shunts are low resistance precision resistors used to measure AC or DC electrical currents by the voltage drop those currents create across the resistance. Sometimes called an ammeter shunt, it is a type of current sensor.

A wide range of precision shunts, designed for use with kilowatt-hour meters and other high-current applications where a high level of accuracy is required, is now available from Token Electronics.



The interchangeable shunts (FL) are used to multiply the measuring range of measuring instrument and designed for PCB and bus bar mounting, are manufactured from electron beam welded copper and manganin, and have low temperature coefficients. Featuring low inductance values, shunts FL series can handle permanent currents of up to 10000A at voltage 75 mV.

FLQ-54 type shunt is made of precision alloy board. Its copper terminals spot welded by silver alloy ensure extremely high electric capability. The construction provides a kind of excellent stability and high overloaded ability non-inductive resistor, applied widely as current limited, current balance or sampling sense in communication system, electric equipment and auto-controlling electrical circuit.

The FL Series is available in bulk packaging and is RoHS compliant and lead free. For non-standard technical requirements and special applications, please contact us with your specific needs, or link to Token official website "[Current Sensing Resistors](http://www.token.com.tw)" for more information.

Power Rating: Watts (W) = Current (I^2) × Resistance Value (R)

- Because current shunt is resistor and dissipate heat from the current flowing through them, when they get hot.
- Since that heat can change their resistance and even permanently damage the shunt, so it is often given a power rating or a derating factor.
- In practice current shunt is often rated to be used continuously at only 2/3 of their "rated current".
- The heat produced is power measured in Watts (W).

Calculate Current: Current (I) = Voltage (V) / Resistance Value (R)

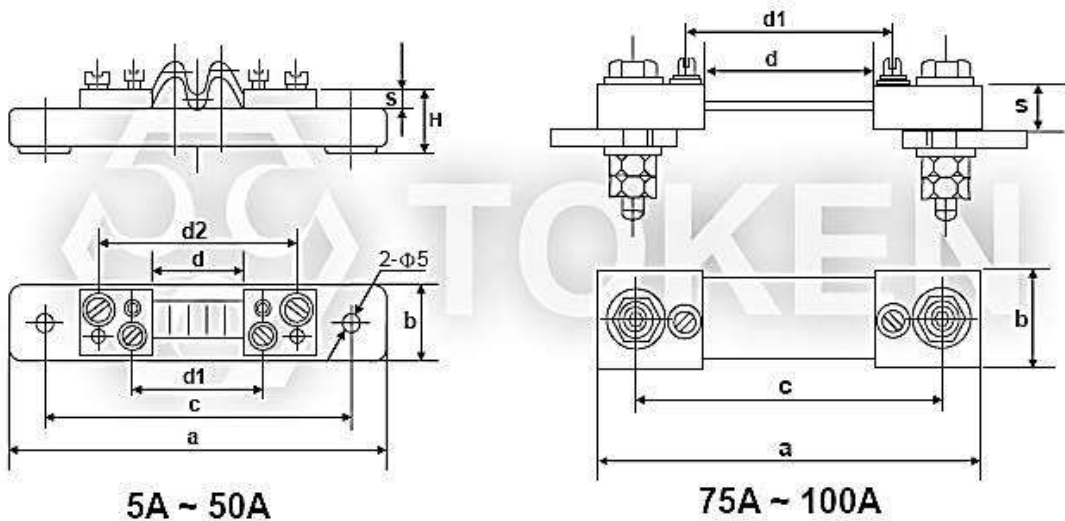
- By inserting a current shunt into a circuit whose current you want to measure your can find the current by measuring the voltage drop across the shunt.
- Then knowing the resistance of the current shunt you can calculate the current using Ohm's law.



► FL-2 (5A-10000A)

Dimensions (5A-100A, Unit: mm) (FL-2)

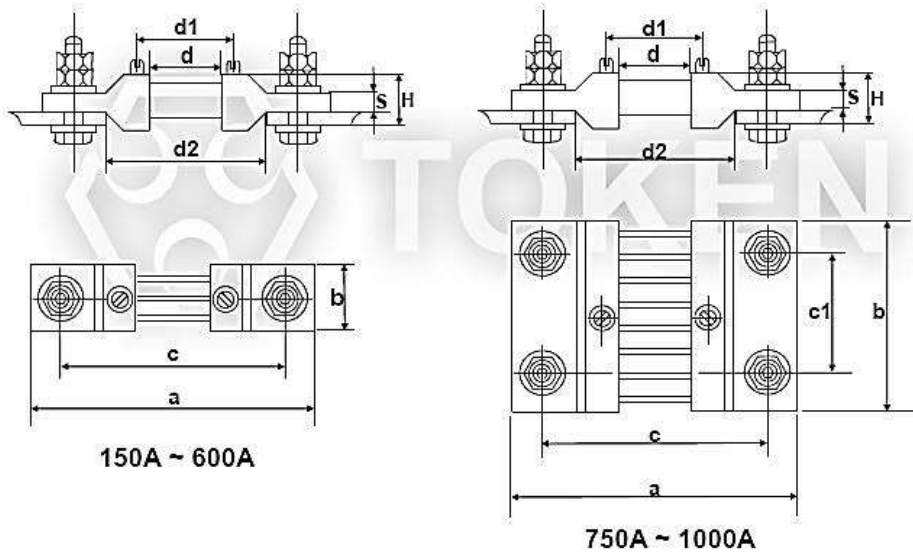
Rating Current (A)	Dimensions (Unit: mm)										High Current Bolt (mm)-PC (Option)	Shunt Voltage Bolt (mm)-PC (Option)
	a	c	b	c1	c2	H	S	d	d1	d2		
5	120	100	20			15	5	30	42	60	M5x6-2	M5x6-2
10	120	100	20			15	5	30	42	60	M5x6-2	
15	120	100	20			15	5	30	42	60	M5x6-2	
20	120	100	20			15	5	30	42	60	M5x6-2	
30	120	100	20			15	5	30	42	60	M5x6-2	
50	120	100	20			15	5	30	42	60	M5x6-2	
75	104	85	22			22	10	40	53		M8x35-2	
100	104	85	22			22	10	40	53		M8x35-2	



FL-2 Type (5A-100A) Shunt

► Dimensions (150A-1000A, Unit: mm) (FL-2)

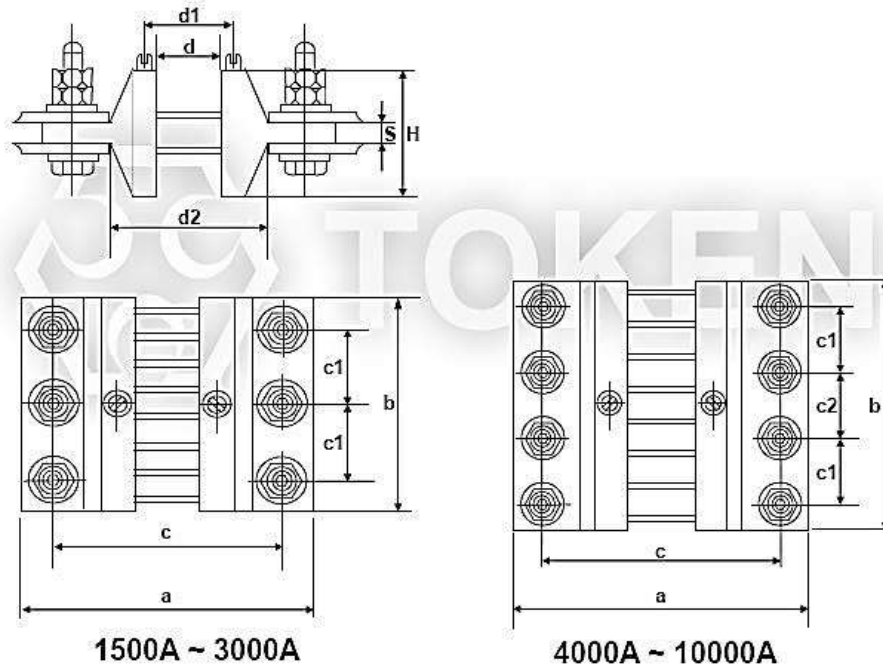
Rating Current (A)	Dimensions (Unit: mm)										High Current Bolt (mm)-PC (Option)	Shunt Voltage Bolt (mm)-PC (Option)
	a	c	b	c1	c2	H	S	d	d1	d2		
150	116	85	22			22	6	30	39	54	M8x35-2	M5x6-2
200	116	85	22			22	6	30	39	54	M8x35-2	
250	126	100	26			22	6	40	49	64	M10x35-2	
300	126	100	26			22	6	40	49	64	M10x35-2	
400	126	100	38			22	6	40	49	64	M10x35-2	
500	126	100	45			22	6	40	49	64	M10x35-2	
600	126	100	62			22	6	40	49	64	M10x35-2	
750	126	100	76	50		22	6	40	49	64	M10x35-4	
1000	126	100	95	50		22	6	40	49	64	M10x35-4	



FL-2 Type (150A-1000A) Shunt

► Dimensions (1500A-10000A, Unit: mm) (FL-2)

Rating Current (A)	Dimensions (Unit: mm)										High Current Bolt (mm)-PC (Option)	Shunt Voltage Bolt (mm)-PC (Option)
	a	c	b	c1	c2	H	S	d	d1	d2		
1500	190	160	95	50		100	6	40	52	64	M12x60-4	M5x6-2
2000	190	160	95	50		100	6	40	52	64	M12x60-4	
2500	190	160	110	50		100	13	40	52	84	M12x60-4	
3000	190	160	145	2-50		100	13	40	52	84	M12x60-6	
4000	190	160	195	2-50	55	100	13	40	52	84	M16x80-8	
5000	284	220	195	2-50	55	150	18	40	52	88	M16x80-8	
6000	284	220	210	2-50	80	150	18	40	52	88	M16x80-8	
7500	290	220	320	3-50	2-60	150	18	40	52	88	M16x80-12	
10000	290	220	400	3-50	2-90	150	18	40	52	88	M16x80-12	

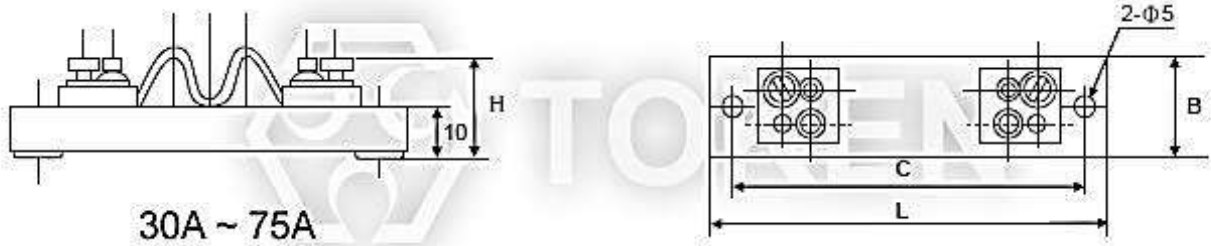


FL-2 Type (1500A-10000A) Shunt

▶ FL-13 (30A-75A)

Dimensions (30A-75A, Unit: mm) (FL-13)

Voltage (mV)	Rating Current (A)	Dimensions (Unit: mm)			Mounting size (mm)	
		L	B	H	C	Bolt
75mV	30A	100	20	21	85	M5
75mV	50A	130	14	30	85	M8
75mV	75A	130	14	30	85	M8

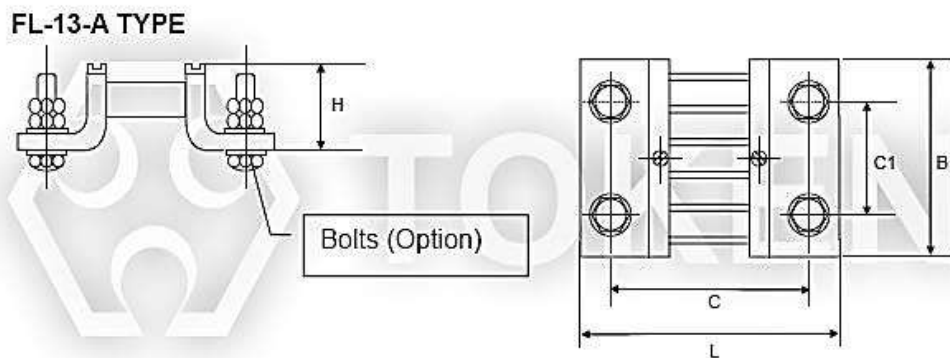


FL-13 Type (30A-75A) Shunt

► FL-13-A (100A-1000A)

Dimensions (100A-1000A, Unit: mm) (FL-13-A)

Voltage (mV)	Rating Current (A)	Dimensions (Unit: mm)			Mounting size (mm)		
		L	B	H	C	C1	Bolt
75mV	100A	130	14	30	85		M8
75mV	200A	130	24	30	85		M10
75mV	300A	130	30	30	100		M10
75mV	400A	130	42	30	100		M10
75mV	500A	130	52	30	100		M10
75mV	600A	130	60	30	100	50	M10
75mV	750A	130	77	30	100	50	M10
75mV	1000A	130	95	30	100		M10

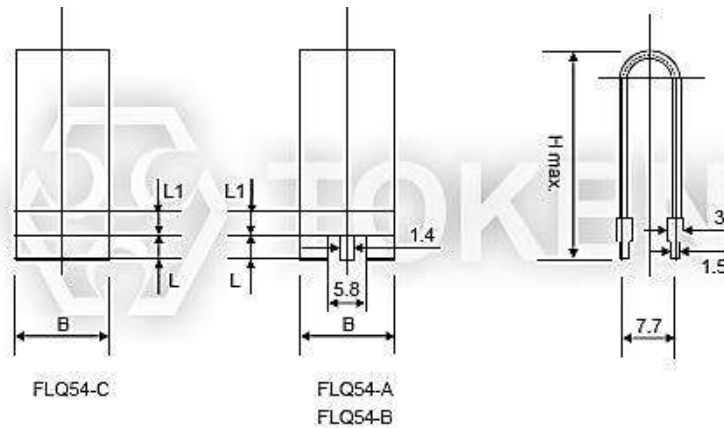


FL-13-A Type (100A-1000A) Shunt

► FLQ54 (30A-100A)

Dimensions (30A-100A, Unit: mm) (FLQ54)

Type	Dimensions (Unit: mm)				Style of terminal
	H max.	B	L	L ₁	
FLQ54-A	37	18	3	3	6
FLQ54-B	60	30	5	5	6
FLQ54-C	32	15	3	3	2



FLQ54 Type (30A-100A) Shunt

Technical Specifications (30A-100A) (FLQ54)

Type	Rated Current (A)	Rated Voltage Drop (mV)	Nominal Resistance (mΩ)	Accuracy Class	Temperature Range (°C)	Temperature Coefficient (ppm/°C)
FLQ54-A	30	50	1.6667	0.5	-55 ~ +85	±25
FLQ54-A	50	50	1.0000			
FLQ54-A	60	50	0.8333			
FLQ54-B	60	50	0.8333			
FLQ54-B	75	50	0.6667			
FLQ54-B	100	50	0.5000			
FLQ54-C	30	45	1.5000			
FLQ54-C	60	45	0.7500			

► Characteristics

Characteristic Specification (FL-2, FL-13, FL-13-A)

Test Items	Specification
Rated Voltage Drop	50mV, 60mV, 75mV, 100mV.
Accuracy Class	0.5% for 5~4000 A; 1% for 5000~6000 A
Over Rating Capacity	120% of rated current for 2 hours.
Ambient Conditions	Temperature: -40~+60°C; relative humidity: ≤95% 35°C
Giving Out Heat When Loaded	Not be more than 80°C at rated current of below 50A.; not be more than 120°C at rated current of 50A and over 50A.
Capacity to Withstand Mechanical Force	It is capable of withstanding the transport bumping at acceleration of 70m/S ² and shock frequency of 80-120 times/min for 5 hours.

► Order Codes

Order Codes (FL)

FL-2	-	5A		50mV		F		p	
Part Number		Rating Current (A)		Voltage Drop (mV)		Accuracy Class (%)		Package-Code	
FL-2		5A	5 A	50mV	50 mV	F	±1%	P	Bulk
FL-13		10A	10 A	60mV	60 mV	D	±0.5%		
FL-13-A		200A	200 A	75mV	75 mV				
FLQ54-A		750A	750 A	100mV	100 mV				
FLQ54-B									
FLQ54-C									



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