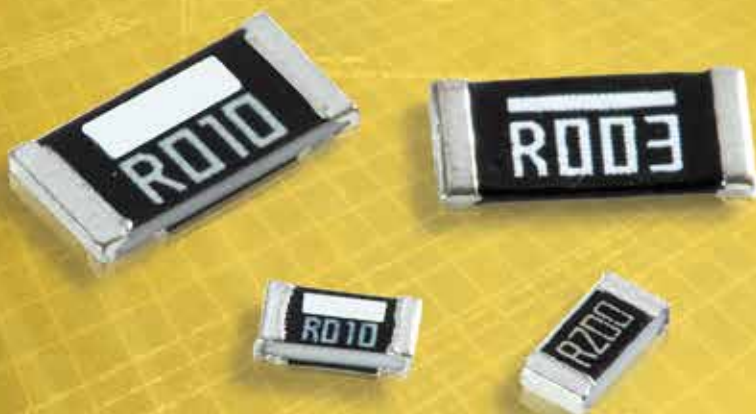# Current Sensing Chip Resistors

YAGEO

*Ph*i*comp*

About Yageo

Founded in 1977, the Yageo Corporation has become a world-class provider of passive component services with capabilities on a global scale, including production and sales facilities in Asia, Europe and the Americas. The corporation provides one-stop-shopping, offering its complete product portfolio of resistors, capacitors and wireless components in both commodity and specialty versions to meet the diverse requirements of customers.

Yageo currently ranks as the world No.1 in chip-resistors, No. 3 in MLCCs and No. 4 in ferrite products, with a strong global presence: 21 sales offices in 15 countries, 9 production sites, 8 JIT logistic hubs, and 2 R&D centers worldwide.

We support our customers with extensive literature including datasheets, brochures and application notes, which are also available electronically on our website at: www.yageo.com

Introduction

Low Resistance, High Power for Current Sensing Applications

Reliable current measurement is critical for the protection, control, and monitoring to keep circuits safe during operation in power and instrumentation systems. Engineers in power supply and battery circuit designs need to consider a give-and-take strategy between low resistance values to minimize power losses and sufficient voltage supplies to avoid noises generated from the environments or particularly in switch mode power supplies.

Yageo's current-sensing chip resistors are also fully compatible with today's high volume pick-and-place assembly systems. As such, they offer attractive, cost-effective solutions to designers of low voltage power supplies and battery management systems. Featuring a comprehensive resistance range of 0.5 milli-ohms to 1 ohm (low-ohmic), and available from 0.05 to 10 watts, they are not only applicable to battery packs, power supplies and converters, but also suitable for use in diverse power control circuits of tablets, notebook computers and hard disks.

Yageo now offers three types of surface-mount (SMT) current-sensing chip resistors based on thick film, metal foil, and metal plate technologies, with scalable product portfolios to meet the various demands of customers and their applications.

Key Features of Yageo's Current Sensing Chip Resistors

- Low resistance value from $0.2m\Omega$ to $20\ m\Omega$ for minimizing power losses
- High power rating from 0.05 to 10 watts
- Tight tolerance within 2% to exhibit actual current via voltage reading
- Low TCR to avoid measurement distortions. TCR ranges from 50 to 100ppm/°C for metal and 100 to 1500ppm/°C for thick film current sensors
- Scalable off-the-shelf products in standard case sizes
- Wide termination and 4-termination are also available
- Compatibility with surface-mount assembly process
- RoHS/REACH-compliant & Halogen-free

The low temperature coefficient of resistance (TCR) of Yageo's current sensing chip resistors minimizes the resistance change caused by self-heating and high temperature environments.

Thermal electromotive force (EMF) is also an important consideration. Thermal EMF is an important parameter of the metal foil series of battery management circuits, and of current sensing resistors. Thermal electromotive force (EMF) of an Mn-Cu alloy is especially optimal with low EMF below μ0.03 uV/°C.

Product Portfolio

Thick Film Current Sensing Chip Resistors (RL & PT Series)

Based on thick film technology, these products exhibit far low parasitic inductance than wirewound and leaded counter parts. Yageo's thick film RL/PT low-ohmic current sensing chip resistors is low cost, capable of providing low TCR down to ±75ppm/°C, resistance value down to 50mΩ with power up to 2 watts of power dissipation.

Cross section of RL / PT series
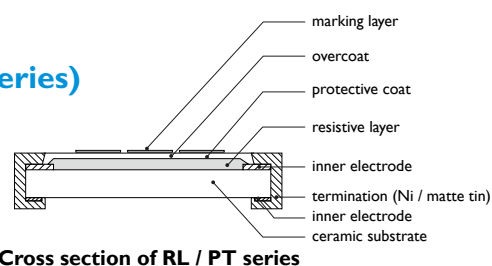
Metal Foil Current Sensing Chip Resistors (PE Series)

Metal foil current-sensing resistors made of Mn-Cu alloy are developed with substrates to provide a better thermal dissipation and with a wider resistance range up to 300mΩ. In the metal foil type, TCR ranges from 50 to 100ppm/°C, power rates up to 2W, and resistance value is available as low as 5mΩ.

Cross section of PE series
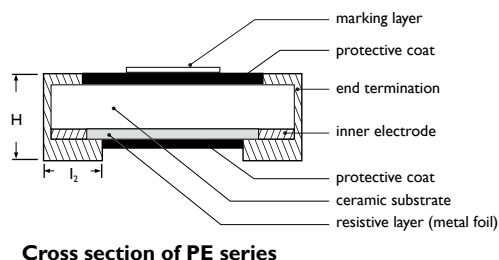
Metal Plate Current Sensing Chip Resistors (PA Series)

A relatively simple construction without multiple cuts, metal plate current sensing resistors provide low TCR down to ±100ppm/°C, high power rating up to 3W, high frequency performance and low resistance down to 1mΩ.

Cross section of PA series
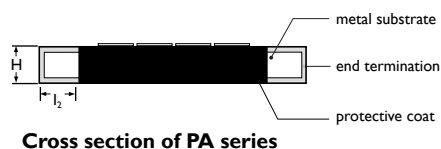
Wide Termination Current Sensing Chip Resistors (PE wide Series)

Using the wider side as connection in the mounting plate, wide termination current sensing chip resistors strengthen solder joints, holding reliably to achieve higher power rating needs. With an ideal structure to suppress heat generation, wide termination type current sensors save space, and reduce resistor numbers in high-density circuit board designs.

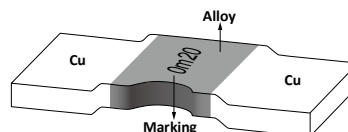**Cross section of wide termination series**
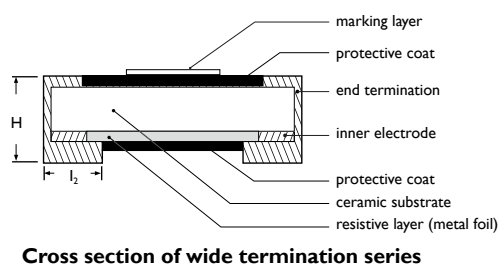
Four-Termination, Current Sensing Chip Resistors (PS Series)

Design of accurate measurement circuitry, lower power consumption, higher accuracy, and smaller space requirements are important features for electronic control units. Four termination, current sensing resistors separating current-carry from voltage-sensing termination are able to improve voltage and current measurement accuracy from the ideal Kelvin configuration. They also improve interference and thermoelectric effects at higher applied power.

Cross section of 4-termination series
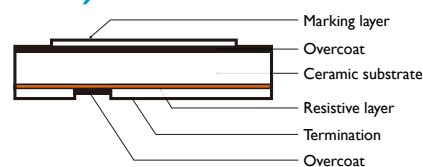
Shunt, Current Sensing Chip Resistors (PU Series)

This series are used for current sensing under the high current circuit, and provide ultra low resistance value down to 0.2mΩ. Its open air structure has better heat dissipation for high power resistor rating up to 10W.

Shunt structure

Product Selection Tables

Global part number	Series	Size	Power rating	Max. voltage	Operating Temp. range	Resistance range (mΩ)	Tol.	T. C. R.
Electrical characteristics								
RL0402xR-07xxxxL	RL	0402	1/16W	$(PxR)^{1/2}$	-55°C to 155°C	50 ≤ R < 1Ω	±1% ±2% ±5%	Please refer to RL datasheet
RL0603xR-07xxxxL		0603	1/10W		-55°C to 155°C	10 ≤ R < 1Ω		
RL0805xR-07xxxxL		0805	1/8W					
RL0805xR-7WxxxxL			1/4W		-55°C to 125°C			
RL1206xR-07xxxxL		1206	1/4W		-55°C to 155°C			
RL1206xR-7WxxxxL			1/2W		-55°C to 125°C			
RL1210xR-07xxxxL		1210	1/2W		-55°C to 155°C			
RL1218xK-07xxxxL		1218	1W					
RL2010xK-07xxxxL		2010	3/4W					
RL2512xK-07xxxxL		2512	1W					
PT0402xRx07xxxxL	PT	0402	1/16W	$(PxR)^{1/2}$	-55°C to 155°C	50 ≤ R < 1Ω	±1% ±2% ±5%	50mΩ ≤ R < 68mΩ ± 600 ppm/°C; 68mΩ ≤ R < 100Ω ± 300 ppm/°C; 100mΩ ≤ R < 1Ω ± 200 ppm/°C
PT0402xRx7WxxxxL			1/8W					
PT0603xRx07xxxxL		0603	1/10W					50mΩ 0/+400 ppm/°C; 50mΩ < R < 68mΩ 0/+350 ppm/°C; 68mΩ ≤ R < 100Ω 0/+300 ppm/°C; 100mΩ ≤ R < 1Ω ±200 ppm/°C
PT0603xRx7WxxxxL			1/5W					
PT0603xRx7TxxxxL			1/3W			50 ≤ R ≤ 68		50mΩ 0/+400 ppm/°C; 50mΩ < R < 68mΩ 0/+350 ppm/°C; 68mΩ 0/+300 ppm/°C
PT0805xR-07xxxxL		0805	1/8W			50 ≤ R < 1Ω		50mΩ 0/+350 ppm/°C; 50mΩ < R < 68mΩ 0/+300 ppm/°C; 68mΩ ≤ R < 100Ω 0/+250 ppm/°C; 100mΩ ≤ R < 1Ω ±100 ppm/°C
PT0805xR-7WxxxxL			1/4W					
PT1206xR-07xxxxL		1206	1/4W					50mΩ ≤ R <75mΩ ±350ppm/°C; 75mΩ ≤ R ≤100mΩ ±100ppm/°C; 100mΩ < R < 1Ω ±75ppm/°C
PT1206xR-7WxxxxL			1/2W					
PT2010xK-07xxxxL		2010	3/4W			100 ≤ R < 1Ω		100mΩ ±100 ppm/°C; 100mΩ < R < 1Ω ±75 ppm/°C
PT2010xK-7WxxxxL			1W					
PT2512xK-07xxxxL		2512	1W			100 ≤ R < 1Ω		100mΩ ±100 ppm/°C; 100mΩ < R < 1Ω ±75 ppm/°C
PT2512xK-7WxxxxL			2W					
PE0201xRx07xxxxxL	PE	0201	1/20W	$(PxR)^{1/2}$	-55°C to 125°C	50 ≤R≤200	±0.5% (>50mΩ) ±1% ±5%	50mΩ ≤ R ≤ 70mΩ ±350 ppm/°C; 70mΩ < R ≤ 200mΩ ±100 ppm/°C
PE0201xRx7WxxxxxL			1/10W					
PE0402xRx07xxxxxL		0402	1/16W			10 ≤ R ≤ 910		±100ppm/°C
PE0402xRx7WxxxxxL			1/8W					
PE0402xRx7TxxxxxL			1/6W					
PE0402xRx47xxxxL			1/4W					
PE0603xRx07xxxxxL		0603	1/10W		-55°C to 170°C	5,10, 20 ≤ R ≤ 910		±75 ppm/°C; ±100 ppm/°C
PE0603xRx7WxxxxxL			1/5W					
PE0603xRx7TxxxxxL			1/3W					
PE0603xRx47xxxxxL			2/5W					
PE0603xRx57xxxxxL			1/2W					
PE0805xRx07xxxxxL		0805	1/8W			5,10, 20 ≤ R ≤910		
PE0805xRx7WxxxxxL			1/4W					
PE0805xRx7TxxxxxL			1/3W					
PE0805xRx47xxxxxL			1/2W					
PE1206xRx07xxxxL		1206	1/4W			5 ≤ R ≤ 910		
PE1206xRx7WxxxxxL			1/2W					
PE1206xRx47xxxxxL			1W					
PE2010xKx07xxxxL		2010	1/2W			5 ≤ R ≤ 100		±50 ppm/°C; ±75 ppm/°C; ±100 ppm/°C
PE2010xKx7WxxxxxL			1W					
PE2512xKx07xxxxL		2512	1W			6 ≤ R ≤ 100		
PE2512xKx7WxxxxxL			2W					

Global part number	Series	Size	Power rating	Max. voltage	Operating Temp. range	Resistance range (mΩ)	Tol.	T. C. R.
PA2512xKF07xxxxxE	PA	2512	1W	(PxR)^1/2	–55°C to 170°C	1≤ R ≤ 50	±1% ±5%	±100 ppm/°C
PA2512xKF7WxxxxxE			2W					
PA2512xKF7TxxxxxE			3W					
PA1206xRF07xxxxxL		1206	1/4W			1≤ R ≤5		
PA1206xRF7WxxxxxL			1/2W					
PA1206xRF47xxxxxL			1W					
PE0508xRx07xxxxxL	PE (Wide)	0508	1.2W	(PxR)^1/2	-55°C to 155°C	5≤R≤100	±1% ±5%	±50ppm°C ±75ppm/°C ±100ppm/°C
PE0612xKx07xxxxxL		0612	1W			1≤R≤100		
PE0612xKx7WxxxxxL			2W					
PS0306xRx07xxxxxL	PS	0306	1/8W	(PxR)^1/2	-55°C to 125°C	3≤ R ≤ 100	±1% ±5%	5mΩ ≤ R ≤ 100mΩ ±75 ppm/°C ±100 ppm/°C 3mΩ ≤ R < 5mΩ ±150 ppm/°C
PS0306xRx7WxxxxxL			1/4W		0.5mΩ ≤ R ≤10mΩ -55°C to 150°C 12mΩ ≤ R ≤ 100mΩ -55°C to 125°C			
PS0306xRx7TxxxxxL			1/2W					
PS0612xKx07xxxxxL		0612	1W			0.5, 0.75, 1≤ R ≤ 100		0.5mΩ ≤ R ≤ 1mΩ ±150ppm/°C 10mΩ ≤ R ≤ 13mΩ ±200ppm/°C 2mΩ ≤ R ≤ 9mΩ ±100ppm/°C 14mΩ ≤ R ≤ 100mΩ ±100ppm/°C
PU3921xKxxxxxxxL	PU	3921	3W	(PxR)^1/2	-65°C to 170°C	0.2/ 0.3/ 0.5/ 1/ 2/3/4	±1% ±5%	0.2mR/ 0.3mR/ 0.5mR ±175ppm/°C 1mR~4mR ±75ppm/°C
					-65°C to 275°C	0.5/1/ 2/3/4		0.5mR ±175pm/°C 1mR~4mR ±75ppm/°C
			5W		-65°C to 170°C	2/3/4		0.2mR ±325ppm/°C 0.3mR/ 0.5mR ±175ppm/°C 1mR~4mR ±75ppm/°C
			9W			0.2/ 0.3/ 0.5/1		
PU5931xKxxxxxxxL		5931	5W		-65°C to 170°C	0.2/0.3/ 0.5/1/ 2/3/4		0.2mR ±225ppm/°C 0.3mR/ 0.5mR ±175ppm/°C 1mR~4mR ±75ppm/°C
					-65°C to 275°C	0.3/0.5/1/2/3/4		0.3mR/ 0.5mR ±175ppm/°C 1mR~4mR ±75ppm/°C
			7W		-65°C to 170°C	1/2/3/4		0.2mR ±225ppm/°C 0.3mR/ 0.5mR ±175ppm/°C 1mR~4mR ±75ppm/°C
			10W			0.2/0.3/ 0.5		

Jumper

Global part number	Series	Size	Operating Temp. range	Max. Resistance	Rated Current
RL0402-R-070RL	RL	0402	-55°C to 125°C	20mΩ	1.5A
RL0603-R-070RL		0603		20mΩ	2A
RL0805-R-070RL		0805		20mΩ	2.5A
RL1206-R-070RL		1206		20mΩ	3.5A
PT0402-R-070RL	PT	0402	-55°C to 155°C	10mΩ	3A
PT0603-R-070RL		0603		8mΩ	5A
PT0805-R-070RL		0805		5mΩ	6A
PT1206-R-070RL		1206		5mΩ	10A

P T 2 5 1 2 F K - 0 7 0 R 1 L

Series name (code 1-2)
RL = Thick film current sensor
PT = Thick film current sensor low T. C. R.
PA/PE = Current sensor - low T. C. R.
PS = 4 termination, Current sensor
PU = Shunt, Current sensor

Size code (inch / metric) (code 3-6)
0306 = 0.8 x 1.6   1210 = 3.2 x 2.5
0402 = 1.0 x 0.5   1218 = 3.2 x 4.5
0508 = 1.25 x 2.0   2010 = 5.0 x 2.5
0603 = 1.6 x 0.8   2512 = 6.35 x 3.2
0612 = 1.6 x 3.2   3921 = 10.0 x 5.2
0805 = 2.0 x 1.25   5931 = 15.0 x 7.75
1206 = 3.2 x 1.6

Tolerance (code 7)
D = ±0.5%
F = ±1%
G = ±2%
J = ±5%
"–" for Jumper ordering

Packing style (code 8)
R = Paper tape reel
K = Embossed plastic tape reel

T.C.R (code 9)
E = ±50 ppm/°C   G = ±200 ppm/°C
M = ±75 ppm/°C   H = ±225 ppm/°C
F = ±100 ppm/°C   O = ±325 ppm/°C
L = ±150 ppm/°C   J = ±350 ppm/°C
N = ±175 ppm/°C
"–" Based on spec. (– for RL/PT only)

Default Code (code 17)
L = Default code
E = PA2512 only

Resistance (code 12-16)
There are 2~5 digits indicated the resistance value. Letter R is decimal point.
Ex:
0R = Jumper
0R1 = 0.1Ω
0R01 = 0.01Ω
0R001= 0.001Ω
0U5= 0.0005Ω

Taping Reel (code 10-11)
07 = 7 inch Dia. reel
13 = 13 inch Dia. reel
7W = 7 inch Dia. reel 2 x standard power type
7T = 7 inch Dia. reel 3 x standard power type
47 = 7 inch Dia. reel 4 x standard power type
57 = 7 inch Dia. reel 5 x standard power type
P5 = 5W , 13 inch Dia. reel
P7 = 7W, 13 inch Dia. reel
P9 = 9W , 13 inch Dia. reel
T3 = 3W , High temperature 13 inch Dia. reel
T5 = 5W , High temperature 13 inch Dia. reel
PA = 10W, 13 inch Dia. reel

Market Applications

Yageo's current sensing chip resistors are optimized for current sensing control. The current sensor, available from 0.05 to 10 watts, are applicable to battery packs, power supplies and converter,s and are suitable for use in diverse power control circuits of notebook computers or the hard disks of other compact portable devices that have current sensing and over current protection requirements. Featuring a comprehensive resistance range of 0.5 milli-ohms to 1 ohm and superior temperature coefficient (T.C.R.) performance is able to meet various customer demands and applications.

Application	Segment				
	Consumer	Automotive	Industrial	Telecom	Medical
Device & Computing					
Home Appliances	v				
Air Conditioners	v	v			
Diagnostic Equipment					v
Infotainment System	v		v		
Smart Meters			v		
Smartphones & Tablets	v			v	
Notebooks	v			v	
Wearable Devices	v		v	v	v
Networking				v	
Batteries					
Battery Chargers	v	v	v	v	v
Battery Life Indicators	v	v	v	v	v
Battery Packs	v	v	v	v	v
Motors					
Motor Controls	v	v	v		
Motor Drives	v	v	v		
Power Supplies					
DC/DC Converters	v		v	v	v
Switch Mode Power Supplies	v	v	v	v	v
LED Lighting					
LED Drivers	v	v	v		v
Ballasts	v	v	v		v
Storage & Cloud Computing					
Disk Drives (HDD & SSD)	v				
Servers	v				

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