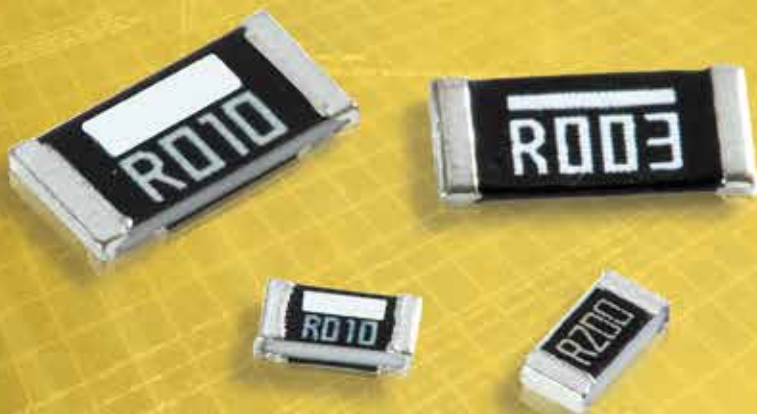


Current Sensing Chip Resistors



www.yageo.com

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 Ω to 20 m Ω 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/ $^{\circ}$ C for metal and 100 to 1500ppm/ $^{\circ}$ 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

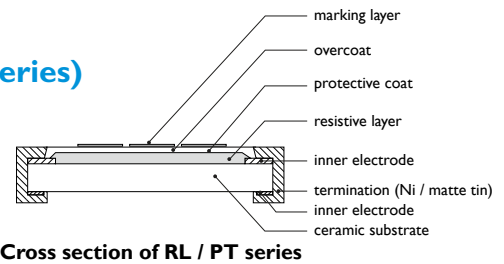
The low temperature coefficient of resistance (TCR) of Yageo's current sensing chip resistors minimizes the resistance change caused by self-heating and high temperature environments.

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 μ 0.03 uV/ $^{\circ}$ C.

Product Portfolio

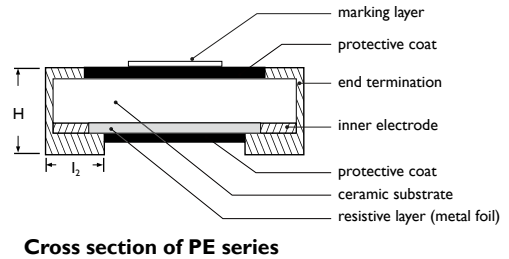
Thick Film Current Sensing Chip Resistors (RL & PT Series)

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 $\pm 75\text{ppm}/^\circ\text{C}$, resistance value down to $50\text{m}\Omega$ with power up to 2 watts of power dissipation.



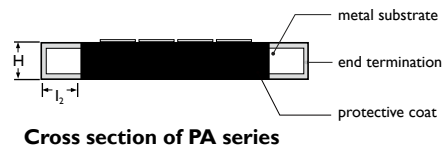
Metal Foil Current Sensing Chip Resistors (PE Series)

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 $300\text{m}\Omega$. In the metal foil type, TCR ranges from 50 to $100\text{ppm}/^\circ\text{C}$, power rates up to 2W, and resistance value is available as low as $5\text{m}\Omega$.



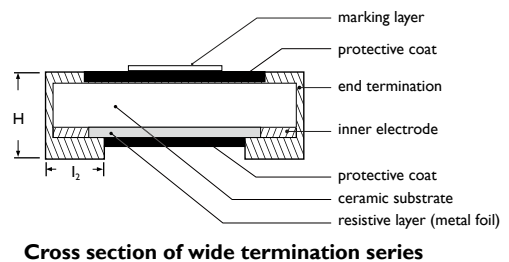
Metal Plate Current Sensing Chip Resistors (PA Series)

A relatively simple construction without multiple cuts, metal plate current sensing resistors provide low TCR down to $\pm 100\text{ppm}/^\circ\text{C}$, high power rating up to 3W, high frequency performance and low resistance down to $1\text{m}\Omega$.



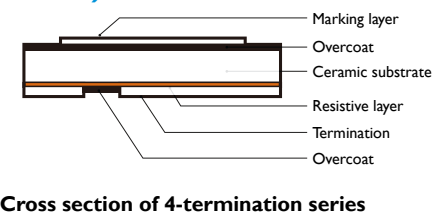
Wide Termination Current Sensing Chip Resistors (PE wide Series)

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.



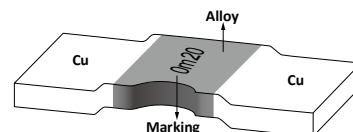
Four-Termination, Current Sensing Chip Resistors (PS Series)

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.



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 $0.2\text{m}\Omega$. Its open air structure has better heat dissipation for high power resistor rating up to 10W.



Shunt structure

Product Selection Tables

Electrical characteristics												
Global part number	Series	Size	Power rating	Max. voltage	Operating Temp. range	Resistance range (mΩ)	Tol.	T. C. R.				
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 125°C	10 ≤ R < 1Ω		
RL0805xR-07xxxxL		0805	1/8W									
RL0805xR-7WxxxxL			1/4W									
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 < 100mΩ ± 300 ppm/°C 100mΩ ≤ R < 1Ω ± 200 ppm/°C
PT0402xRx7WxxxxL	1/8W			50mΩ < R < 68mΩ 0/+400 ppm/°C 50mΩ < R < 68mΩ 0/+350 ppm/°C 68mΩ ≤ R < 100mΩ 0/+300 ppm/°C 100mΩ ≤ R < 1Ω ± 200 ppm/°C								
PT0603xRx07xxxxL	0603		1/10W									
PT0603xRx7WxxxxL			1/5W	50mΩ 0/+400 ppm/°C 50mΩ < R < 68mΩ 0/+350 ppm/°C 68mΩ 0/+300 ppm/°C								
PT0603xRx7TxxxxL			1/3W	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								
PT0805xR-7WxxxxL			1/4W		50mΩ 0/+350 ppm/°C 50mΩ < R < 100mΩ 0/+300 ppm/°C 68mΩ ≤ R < 100mΩ 0/+250 ppm/°C 100mΩ ≤ R < 1Ω ± 100 ppm/°C							
PT1206xR-07xxxxL	1206		1/4W	100 ≤ R < 1Ω	50mΩ ≤ R < 75mΩ ± 350 ppm/°C 75mΩ ≤ R ≤ 100mΩ ± 100 ppm/°C 100mΩ < R < 1Ω ± 75 ppm/°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									
PE0201xRx07xxxxL	PE		0201	1/20W	(PxR) ^{1/2}		-55°C to 170°C	50 ≤ R ≤ 200		±0.5% (>50mΩ) ±1% ±5%		50mΩ ≤ R ≤ 70mΩ ± 350 ppm/°C 70mΩ < R ≤ 200mΩ ± 100 ppm/°C
PE0201xRx7WxxxxL				1/10W								
PE0402xRx07xxxxL			0402	1/16W				10 ≤ R ≤ 910				±100 ppm/°C
PE0402xRx7WxxxxL				1/8W								
PE0402xRx7TxxxxL				1/6W								
PE0402xRx47xxxxL		1/4W										
PE0603xRx07xxxxL		0603	1/10W	5, 10, 20 ≤ R ≤ 910		±75 ppm/°C ±100 ppm/°C						
PE0603xRx7WxxxxL			1/5W									
PE0603xRx7TxxxxL			1/3W									
PE0603xRx47xxxxL			2/5W									
PE0603xRx57xxxxL			1/2W									
PE0805xRx07xxxxL		0805	1/8W	5, 10, 20 ≤ R ≤ 910		±75 ppm/°C ±100 ppm/°C						
PE0805xRx7WxxxxL			1/4W									
PE0805xRx7TxxxxL			1/3W									
PE0805xRx47xxxxL			1/2W									
PE1206xRx07xxxxL		1206	1/4W	5 ≤ R ≤ 910		±50 ppm/°C ±75 ppm/°C ±100 ppm/°C						
PE1206xRx7WxxxxL			1/2W									
PE1206xRx47xxxxL			1W									
PE2010xKx07xxxxL		2010	1/2W	5 ≤ R ≤ 100		±50 ppm/°C ±75 ppm/°C ±100 ppm/°C						
PE2010xKx7WxxxxL			1W									
PE2512xKx07xxxxL		2512	1W	6 ≤ R ≤ 100		±50 ppm/°C ±75 ppm/°C ±100 ppm/°C						
PE2512xKx7WxxxxL			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	
PS0306xRx7WxxxxxL			1/4W		0.5mΩ ≤ R ≤ 10mΩ -55°C to 150°C 12mΩ ≤ R ≤ 100mΩ -55°C to 125°C			0.5, 0.75, 1 ≤ R ≤ 100	3mΩ ≤ R < 5mΩ ±150 ppm/°C
PS0306xRx7TxxxxxL			1/2W						0.5mΩ ≤ R ≤ 1mΩ ±150ppm/°C 10mΩ ≤ R ≤ 13mΩ ±200ppm/°C 2mΩ ≤ R ≤ 9mΩ ±100ppm/°C 14mΩ ≤ R ≤ 100mΩ ±100ppm/°C
PS0612xKx07xxxxxL		0612	1W						
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	
			5W		-65°C to 275°C	0.5/1/ 2/3/4		0.5mR ±175ppm/°C 1mR~4mR ±75ppm/°C	
			9W		-65°C to 170°C	2/3/4		0.2mR ±325ppm/°C 0.3mR/ 0.5mR ±175ppm/°C 1mR~4mR ±75ppm/°C	
					-65°C to 170°C	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	
			7W		-65°C to 275°C	0.3/0.5/1/2/3/4		0.3mR/ 0.5mR ±175ppm/°C 1mR~4mR ±75ppm/°C	
			10W		-65°C to 170°C	1/2/3/4		0.2mR ±225ppm/°C 0.3mR/ 0.5mR ±175ppm/°C 1mR~4mR ±75ppm/°C	
					-65°C to 170°C	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



Explanation of ordering code

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 = $\pm 0.5\%$
 F = $\pm 1\%$
 G = $\pm 2\%$
 J = $\pm 5\%$
 “-” for Jumper ordering

Packing style (code 8)

R = Paper tape reel
 K = Embossed plastic tape reel

T.C.R (code 9)

E = ± 50 ppm/ $^{\circ}$ C	G = ± 200 ppm/ $^{\circ}$ C
M = ± 75 ppm/ $^{\circ}$ C	H = ± 225 ppm/ $^{\circ}$ C
F = ± 100 ppm/ $^{\circ}$ C	O = ± 325 ppm/ $^{\circ}$ C
L = ± 150 ppm/ $^{\circ}$ C	J = ± 350 ppm/ $^{\circ}$ C
N = ± 175 ppm/ $^{\circ}$ 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 = 0.1 Ω
 0R01 = 0.01 Ω
 0R001 = 0.001 Ω
 0U5 = 0.0005 Ω

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 converters 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				

YAGEO - A GLOBAL COMPANY

HQ

Taipei, Taiwan
Tel. +886 2 6629 9999
Fax. +886 2 6628 8886

China and ASIA

Suzhou, China
Tel. +86 512 6825 5568
Fax. +86 512 6825 5386

Shanghai, China
Tel. +86 21 64858697

Dongguan, China
Tel. +86 769 8772 0275
Fax. +86 769 8791 0053

Tokyo, Japan
Tel. +81 3 6809 3972
Fax. +81 3 6809 3982

Seongnam, Korea
Tel. +82 31 712 4797
Fax. +82 31 712 5866

Singapore
Tel. +65 6244 7800
Fax. +65 6244 4943

Kuala Lumpur, Malaysia
Tel. +60 3 8063 8864
Fax. +60 3 8063 7376

Penang, Malaysia
Tel. +60 4 3973049
Fax. +60 4 3973050

EUROPE

Munich, Germany
Tel. +49 8990 7784 380
Fax. +49 8990 7784 379

Milan, Italy
Tel. +39 02 6129 1017
Fax. +39 02 6601 7490

Roermond, Benelux
Tel. +31 475 385 555
Fax. +31 475 385 589

Szombathely, Hungary
Tel. +36 94 517 702
Fax. +36 94 517 701

Moscow, Russian Federation
Tel. +7 965 408 18 11
Fax. +7 498 610 07 07

NORTH AMERICA

San Jose, U.S.A.
Tel. +1 408 240 6200
Fax. +1 408 240 6201

Mexico
Tel. +52 33 31330631
Fax. +1 408 240 6201

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