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Low-Ohmic Chip Resistors

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Low-Ohmic Chip Resistors

INTRODUCTION

Yageo's low-ohmic chip resistor ranges are the ideal replacement for traditional wirewound and leaded products in modern power control circuits. Based on the company's thick film technology, these products exhibit far lower parasitic inductance than their wirewound and leaded counterparts. They 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.

FEATURES

- Excellent T.C.R. performance
- Standardized sizes which makes them easily interchangeable
- Compatibility with surface-mount assembly processes
- Ultra-low resistance and narrow tolerance, suitable for current detection
- High component and equipment reliability
- RoHS/REACH compliant & Halogen free

Low-ohmic chip resistors in circuit

Low-ohmic resistors are used in power sensing applications, for example, to sense output current in power supplies and automotive engine management systems. As shown in figure 1, a typical function for a low-ohmic chip resistor is as a current sensor (R_{sense}). This generates the sensing voltage V_s for a feedback control network through which an output current I_o passes. The sensing voltage triggers (MOSFET) switches, switching them ON and OFF to regulate the duty factor of the current passing through a choke L.

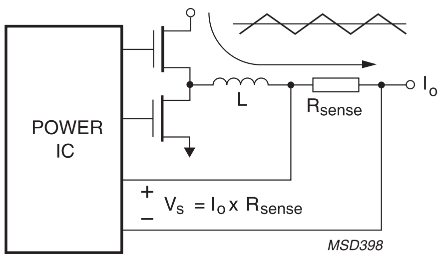


Figure 1 Low-ohmic chip resistor in current sensing application

The sensing voltage V_s is given by the simple relation:

$V_s = I_o \times R_{sense}$

This sensing voltage is generally set at around 100 mV both to save power and maintain satisfactory noise immunity. To sense a 5 A average output current, R_{sense} must be 100 mV/5 A = 20 mΩ. The power dissipation will then be:

$P = I_o^2 R_{sense} = 5\,A \times 5\,A \times 20\,m\Omega = 0.5\,W$

A low-ohmic chip resistor with a power rating 1.0 W would then be recommended for this application to provide an adequate safety margin.

Effect of component characteristics on current sensing applications

Average output current versus peak output current

In the feedback circuit of figure 1, the output current I_o through the choke L is not a pure DC but exhibits some ripple. The magnitude of the output ripple depends on the inductance of the choke - the higher the inductance, the lower the ripple. A high inductance choke, however, reduces the ability of the circuit to respond to high frequency transients. Such a choke will also be physically large, limiting the possibilities for miniaturization so essential to modern mobile equipment.

A trade-off is therefore necessary between choke volume and output current ripple. Experience indicates that a ripple of 0.3 provides a good compromise in this area. With this ripple value, the peak output current I_{peak} is 15% greater than the average current I_{avg}, i.e. $I_{peak} = 1.15 \times I_{avg}$ (Figure 2).

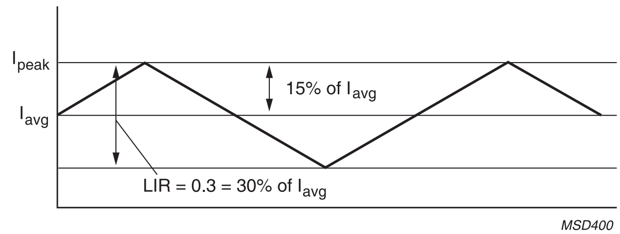


Figure 2 *Relationship between average output current and peak current with a ripple of 0.3*

Safety margin for setting the feedback voltage

The voltage generated across the sensing resistor is used in a feedback network to trigger the power switching IC. To allow for variations in the characteristics of the power switching IC, a safety margin for the sensing voltage is necessary. A -20% margin on sensing voltage is usually taken for general applications.

Tolerances on sensing resistance

As mentioned earlier, the relation between low-ohmic resistance, feedback sensing voltage and output current is given by $R_{sense} = V_s/I_o$. With an output ripple of 0.3, i.e. a 30% (± 15%) deviation on output current and a safety margin on the sensing voltage of -20%, the allowable deviation on R_{sense} is:

$$\frac{0.8 \times V_s}{1.15 \times I_o} \leq R_{sense} \leq \frac{V_s}{0.85 \times I_o}$$

With say, V_s= 100 mV and I_o= 5 A, the allowable low ohmic sensing resistance must lie in the range 14mΩ to 24mΩ.

Consideration of T.C.R. in current sensing applications

The above discussion does not, of course, take into account the effects of the temperature coefficient of resistance (T.C.R.) on current sensing applications. With a maximum deviation of 30% on output current and a safety margin of 20% on sensing voltage, the maximum allowable deviation on sensing resistance is 50%. The limit on T.C.R. is then given by:

$$R_{sense}\,(1+T.C.R. \times \Delta T) \leq 1.5\,R_{sense}$$

so

$$T.C.R. \leq \frac{0.5}{\Delta T}\ \text{ppm/K}$$

Figure 3 plots the allowable T.C.R. values required to maintain tolerance on sensing resistance within the specified limit. T.C.R. values of Yageo's low-ohmic chip resistors fall well within these allowed limits over the temperature range 25°C to 125°C.

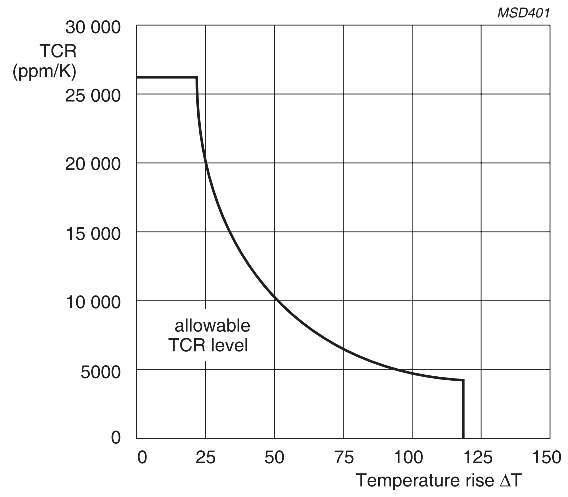


Figure 3 *Allowable T.C.R. values with 50% total deviation on output current and feedback voltage*

For some precision applications, the deviation in output current and the safety margin on sensing voltage may need to be reduced to say 10% on each, giving a total maximum deviation on sensing voltage of 20%. The limit on T.C.R. is then:

$$\text{T.C.R.} \leq \frac{0.2}{\Delta T} \text{ ppm/K}$$

which is plotted in Figure 4. Even with these tighter margins, the T.C.R. values of Yageo's low-ohmic resistor chips (shown in the shaded region in Figure 4) fall well within the allowable T.C.R. level. This shows that for most applications, T.C.R. is not an issue in sensing applications.

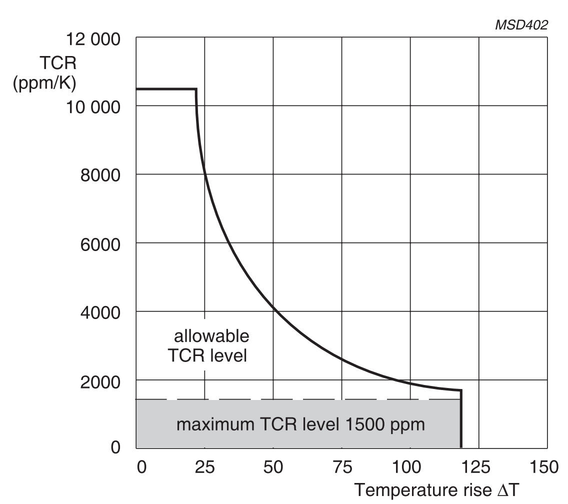


Figure 4 *Allowable T.C.R. values with 20% total deviation on output current and feedback voltage*

Detecting over current

As a means to detect the current passing through the transistor, see figure 5, a resistor in series is added between an emitter and a ground. This resistor should neither emit smoke nor catch fire even when the switching transistor breaks down to be subjected to a larger current. In addition, reduced parasitic inductance is required, particularly for the high frequency switching control. Recommended resistors with low resistance are metal plate type, like PF series.

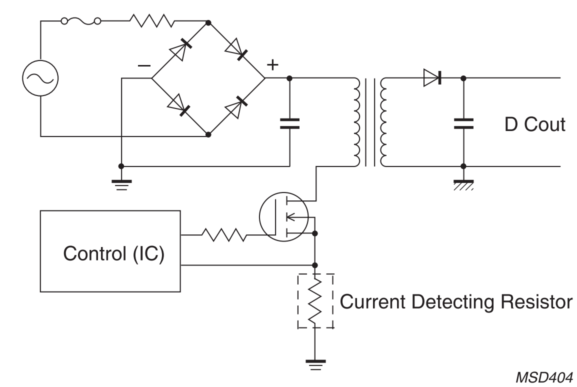


Figure 5 *Over current protection circuit*

DC/DC converter

The figure 6 below shows the current detecting circuit of a DC/DC converter. The voltage across the current detecting resistor is fed back to control the output power. The resistance should be low to reduce power dissipation, and the resistor should stand against repeated rush current. Furthermore the self-inductance should be low for high frequency applications. Recommended types are PT series chip resistors. As for high frequency DC/DC converters, metal plate chip resistors PF series best fit in.

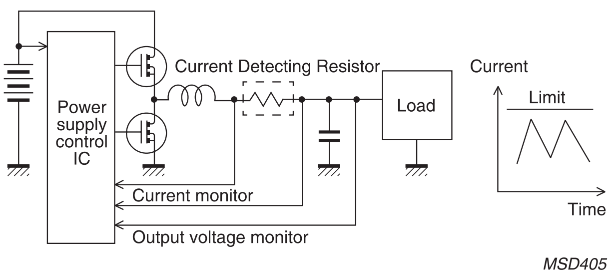


Figure 6 *DC/DC converter circuit*

Applications

Yageo's low-ohmic chip resistors are optimized for current sensing control. The low-ohmic current sensors, available from 0.0625 to 3 watts, are applicable to battery pack, power supply and converter, and are suitable for use in diverse power control circuit of notebook computer or the hard disk 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.

CONSUMER GOODS

- Home appliances
- Lighting
- LCD TV
- Digital camera
- Game console

COMPUTER

- Notebook/tablet
- Power supplies
- Battery management
- DC/DC converters
- Disk drives

TELECOM

- Mobile phones
- Base stations
- Modems
- Set-top-Box

INDUSTRIAL

- Power supplies
- Current detection
- Stepper motor

AUTOMOTIVE

- Engine management
- Current sensing
- Voltage division

ALTERNATIVE ENERGY

- Pulse loading
- Power inverter
- Signal conditioning

General information

Global part number	Series	Size	Power rating	Max. voltage	Operating Temp. range	Resistance range	Tol.	T. C. R.
RL0402xR-07xxxxL	RL	0402	1/16W	(PxR)^1/2	-55°C to 125°C	100mΩ ≤ R < 1Ω	±1% ±2% ±5%	Pls refer to below table "T. C. R. - RL series"
RL0603xR-07xxxxL		0603	1/10W	(PxR)^1/2		10mΩ ≤ R < 1Ω		
RL0805xR-07xxxxL		0805	1/8W	(PxR)^1/2				
RL0805xR-7WxxxxL			1/4W	(PxR)^1/2				
RL1206xR-07xxxxL		1206	1/4W	(PxR)^1/2				
RL1206xR-7WxxxxL			1/2W	(PxR)^1/2				
RL1210xR-07xxxxL		1210	1/2W	(PxR)^1/2				
RL1218xK-07xxxxL		1218	1W	(PxR)^1/2				
RL2010xK-07xxxxL		2010	3/4W	(PxR)^1/2				
RL2512xK-07xxxxL		2512	1W	(PxR)^1/2				

<table>
<tr><th colspan="13">T. C. R. - RL series</th></tr>
<tr><td></td><td colspan="6">100mΩ≤R<500mΩ</td><td colspan="6">500mΩ≤R<1Ω</td></tr>
<tr><td>RL0402</td><td colspan="6">±800 ppm/°C</td><td colspan="6">±300 ppm/°C</td></tr>
<tr><td></td><td colspan="3">10mΩ≤R≤36mΩ</td><td colspan="3">36mΩ<R≤91mΩ</td><td colspan="3">91mΩ<R≤500mΩ</td><td colspan="3">500mΩ<R<1Ω</td></tr>
<tr><td>RL0603</td><td colspan="3">±1 500 ppm/°C</td><td colspan="3">±1 200 ppm/°C</td><td colspan="3">±800 ppm/°C</td><td colspan="3">±300 ppm/°C</td></tr>
<tr><td></td><td colspan="2">10mΩ≤R≤18mΩ</td><td colspan="2">18mΩ<R≤47mΩ</td><td colspan="2">47mΩ<R≤91mΩ</td><td colspan="2">91mΩ<R≤360mΩ</td><td colspan="2">360mΩ<R≤500mΩ</td><td colspan="2">500mΩ<R<1Ω</td></tr>
<tr><td>RL0805 / RL1206 / RL2010</td><td colspan="2">±1 500 ppm/°C</td><td colspan="2">±1 200 ppm/°C</td><td colspan="2">±1 000 ppm/°C</td><td colspan="2">±600 ppm/°C</td><td colspan="2">±300 ppm/°C</td><td colspan="2">±200 ppm/°C</td></tr>
<tr><td>RL1210 / RL2512</td><td colspan="2">±1 500 ppm/°C</td><td colspan="2">±1 000 ppm/°C</td><td colspan="2">±800 ppm/°C</td><td colspan="2">±600 ppm/°C</td><td colspan="2">±300 ppm/°C</td><td colspan="2">±200 ppm/°C</td></tr>
<tr><td></td><td colspan="3">10mΩ≤R≤30mΩ</td><td colspan="3">30mΩ<R≤56mΩ</td><td colspan="3">56mΩ<R≤180mΩ</td><td colspan="3">180mΩ<R<1Ω</td></tr>
<tr><td>RL1218</td><td colspan="3">±2 000 ppm/°C</td><td colspan="3">±1 000 ppm/°C</td><td colspan="3">±700 ppm/°C</td><td colspan="3">±250 ppm/°C</td></tr>
</table>

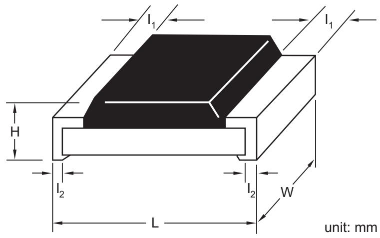
Global part number	Series	Size	Power rating	Max. voltage	Operating Temp. range	Resistance range	Tol.	T. C. R.	
PT0402xRx07xxxxL	PT	0402	1/16W	(PxR)^1/2	-55°C to 155°C	68mΩ ≤ R < 1Ω	±1% ±2% ±5%	68mΩ ≤ R < 100mΩ	±300 ppm/°C
PT0402xRx7WxxxxL			1/8W					100mΩ ≤ R < 1Ω	±200 ppm/°C
!PT0402xRx7TxxxxL			1/6W			68mΩ		±300 ppm/°C	
PT0603xRx07xxxxL		0603	1/10W			100mΩ ≤ R < 1Ω		±200 ppm/°C	
PT0603xRx7WxxxxL			1/5W						
PT0805xRx07xxxxL		0805	1/8W					±100 ppm/°C	
PT0805xRx7WxxxxL			1/4W						
PT1206xRx07xxxxL		1206	1/4W					100mΩ 100mΩ < R < 1Ω	±100 ppm/°C ±75 ppm/°C
PT1206xRx7WxxxxL			1/2W						
PT2010xKx07xxxxL		2010	3/4W						
PT2010xKx7WxxxxL			1W						
PT2512xKx07xxxxL		2512	1W						
PT2512xKx7WxxxxL			2W						
PT0815xK-07xxxxL	PT (Wide)	0815	1/2W	(PxR)^1/2	-55°C to 155°C	25mΩ ≤ R ≤ 50mΩ	±1% ±2% ±5%	±100 ppm/°C	
PT0815xK-7WxxxxL			1W						

Global part number	Series	Size	Power rating	Max. voltage	Operating Temp. range	Resistance range	Tol.	T. C. R.
!PR1206xKx07xxxxxx	PR	1206	1/4W	(PxR)^1/2	-55°C to 155°C	1mΩ ≤ R ≤ 6mΩ	±1% ±2% ±5%	±50 ppm/°C
!PR1206xKx7Wxxxxxx			1/2W					
!PR1206xKx47xxxxxx			1W					
PR2010xKx07xxxxxx		2010	1/2W			1mΩ ≤ R < 100mΩ		
PR2010xKx7Wxxxxxx			1W					
PR2512xKx07xxxxxx		2512	1W			0.5mΩ ≤ R < 5mΩ		0.5mΩ ≤ R ≤ 2mΩ: ±200 ppm/°C
PR2512xKx7Wxxxxxx			2W					3mΩ ≤ R < 5mΩ: ±100 ppm/°C
!PR2512xKx7Txxxxxx			3W			0.5mΩ ≤ R ≤ 10mΩ		±50 ppm/°C
!PR2512DKx07xxxxxx			1W			7mΩ ≤ R ≤ 75mΩ	±0.5%	
!PR2512DKx7Wxxxxxx			2W					
!PF0603xRx57xxxxxx	PF	0603	1/2W	(PxR)^1/2	-55°C to 155°C	5mΩ ≤ R ≤ 100mΩ	±1% ±2% ±5%	±75 ppm/°C
PF0805xRx07xxxxxx		0805	1/8W			4mΩ ≤ R ≤ 100mΩ		
PF0805xRx7Wxxxxxx			1/4W					
PF0805xRx7Txxxxxx			1/3W					
!PF0805xRx47xxxxxx			1/2W					
PF1206xxx07xxxxxx		1206	1/4W			3mΩ ≤ R < 100mΩ		
PF1206xxx7Wxxxxxx			1/2W					
!PF2010xKx7Wxxxxxx		2010	1W			5mΩ ≤ R < 100mΩ		
PF2512xKx07xxxxxx		2512	1W			1mΩ ≤ R < 100mΩ		
PF2512xKx7Wxxxxxx			2W					
!PF2512xKx7Txxxxxx			3W			1mΩ ≤ R ≤ 50mΩ		
PF0612xK-07xxxxxx	PF (Wide)	0612	1W	(PxR)^1/2	-55°C to 155°C	1mΩ ≤ R ≤ 50mΩ	±1% ±2% ±5%	±75 ppm/°C
PF0815xK-7Wxxxxx		0815	1W			1mΩ ≤ R ≤ 20mΩ		
!PF0830xK-07xxxxx		0830	2W			1mΩ ≤ R < 100Ω		
!PH0805xRx07xxxxxx	PH	0805	4/5W	(PxR)^1/2	-55°C to 155°C	4mΩ ≤ R ≤ 50mΩ	±1% ±2% ±5%	±75 ppm/°C
PH1206xRx07xxxxx		1206	1W					
!PE0603xRx57xxxxxx	PE	0603	1/2W	(PxR)^1/2	-55°C to 155°C	5mΩ ≤ R < 100mΩ	±1% ±2% ±5%	±75 ppm/°C
!PE0805xRx47xxxxxx		0805	1/2W			4mΩ ≤ R < 100mΩ		
!PE1206xRx47xxxxxx		1206	1W			3mΩ ≤ R < 100mΩ		
PE2512xKx7Wxxxxxx		2512	2W			1mΩ ≤ R < 100mΩ		

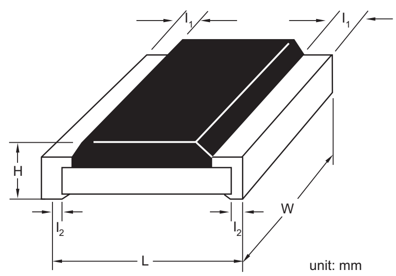
Global part number	Series	Size	Power rating	Operating Temp. range	Max. Resistance	Rated Current
!PT0603-R-xx0RL	PT (Jumper)	0603	1/4W	-55°C to 155°C	8mΩ	5A
!PT1206-R-xx0RL		1206	1/2W		5mΩ	10A

Note: " ! " is the symbol for new product

Dimensions



Wide termination



Type	Resistance range	L	W	H	l_1	l_2
RL0402	100mΩ ≤ R < 1Ω	1.00 ±0.10	0.50 ±0.05	0.35 ±0.05	0.20 ±0.10	0.25 ±0.10
RL0603	10mΩ ≤ R < 1Ω	1.60 ±0.10	0.80 ±0.10	0.45 ±0.10	0.25 ±0.15	0.25 ±0.15
RL0805		2.00 ±0.10	1.25 ±0.10	0.50 ±0.10	0.35 ±0.20	0.35 ±0.20
RL1206		3.10 ±0.10	1.60 ±0.10	0.55 ±0.10	0.45 ±0.20	0.45±0.20
RL1210		3.10 ±0.10	2.60 ±0.15	0.55 ±0.10	0.50 ±0.20	0.50 ±0.20
RL1218		3.05 ±0.15	4.60 ±0.20	0.55 ±0.10	0.45 ±0.25	0.50 ±0.25
RL2010		5.00 ±0.10	2.50 ±0.15	0.55 ±0.10	0.60 ±0.20	0.50 ±0.20
RL2512		6.35 ±0.10	3.20 ±0.15	0.55 ±0.10	0.60 ±0.20	0.50 ±0.20
PT0402	68mΩ ≤R < 1Ω	1.00 ±0.10	0.50 ±0.05	0.35 ±0.05	0.20 ±0.10	0.25 ±0.10
PT0603	100mΩ ≤R < 1Ω	1.60 ±0.10	0.80 ±0.10	0.45 ±0.10	0.25 ±0.15	0.25 ±0.15
PT0805		2.00 ±0.10	1.25 ±0.10	0.55 ±0.10	0.35 ±0.20	0.35 ±0.20
PT1206		3.10 ±0.10	1.60 ±0.10	0.55 ±0.10	0.45 ±0.20	0.45 ±0.20
PT2010		5.00 ±0.10	2.50 ±0.15	0.55 ±0.10	0.60 ±0.20	0.50 ±0.20
PT2512		6.35 ±0.10	3.20 ±0.15	0.55 ±0.10	0.60 ±0.20	0.50 ±0.20
PR1206 (2)	1mΩ ≤ R ≤ 6mΩ	3.20 ±0.25	1.60 ±0.25	0.64 ±0.25	0.50 ±0.25	0.50 ±0.25
PR2010 (2)	1mΩ ≤ R ≤ 3mΩ	5.10 ±0.25	2.54 ±0.25	0.80 ±0.25	1.30 ±0.25	1.30 ±0.25
	4mΩ ≤ R ≤ 100mΩ	5.10 ±0.25	2.54 ±0.25	0.64 ±0.25	0.80 ±0.25	0.80 ±0.25
PR2512 (1)	1mΩ ≤ R ≤ 2mΩ	6.40±0.20	3.20±0.20	0.75±0.15	1.20±0.20	1.20±0.20
	3mΩ ≤ R ≤ 5mΩ	6.40±0.20	3.20±0.20	0.55±0.10	0.60±0.20	0.60±0.20
PR2512 (2)	0.5mΩ ≤ R ≤ 4mΩ	6.25±0.25	3.30±0.25	0.78±0.25	1.88±0.25	1.88±0.25
	5mΩ ≤ R ≤ 75mΩ	6.25±0.25	3.30±0.25	0.64±0.25	1.11±0.25	1.11±0.25
PF/PE0603 (2)	5mΩ ≤ R < 100m	1.60 ±0.20	0.80 ±0.20	0.60 ±0.15	---	0.30 ±0.15
PF/PH0805 (1)	10mΩ ≤ R ≤ 50mΩ	2.03 ±0.25	1.27 ±0.25	0.33 ±0.12	0.38 ±0.25	0.38 ±0.25

Note: 1. Apply to ordering codes ending in “L”
2. Apply to ordering codes ending in “Z”
Please contact sales offices, distributors and representatives in your region before ordering

Type	Resistance range	L	W	H	I_1	I_2
PF/PH/PE 0805 (2)	4mΩ	2.00±0.20	1.25±0.20	0.60±0.15	---	0.70±0.15
	5mΩ	2.00±0.20	1.25±0.20	0.60±0.15	---	0.63±0.15
	6mΩ ≤ R ≤7mΩ	2.00±0.20	1.25±0.20	0.60±0.15	---	0.55±0.15
	8mΩ ≤ R < 100mΩ	2.00±0.20	1.25±0.20	0.60±0.15	---	0.40±0.15
PF/PH1206 (1)	10mΩ≤ R ≤ 50mΩ	3.20 ±0.25	1.60 ±0.25	0.60 ±0.25	0.50 ±0.25	0.65 ±0.25
PF/PH/PE 1206 (2)	3mΩ	3.20±0.20	1.60±0.20	0.60±0.15	---	1.30±0.20
	4mΩ	3.20±0.20	1.60±0.20	0.60±0.15	---	1.20±0.20
	5mΩ ≤ R ≤8mΩ	3.20±0.20	1.60±0.20	0.60±0.15	---	1.15±0.20
	9mΩ ≤ R < 100mΩ	3.20±0.20	1.60±0.20	0.60±0.15	---	0.58±0.20
PF2010 (2)	5mΩ ≤ R ≤9mΩ	5.00±0.20	2.50±0.20	0.60±0.15	---	1.50±0.20
	10mΩ ≤ R < 100mΩ	5.00±0.20	2.50±0.20	0.60±0.15	---	0.60±0.20
PF2512 (1)	6mΩ	6.45 ±0.25	3.25 ±0.25	0.70 ±0.25	0.75 ±0.25	1.85 ±0.25
	7mΩ ≤ R ≤ 15mΩ	6.45 ±0.25	3.25 ±0.25	0.70 ±0.25	0.75 ±0.25	1.55 ±0.25
	20mΩ ≤ R ≤ 50mΩ (1W)	6.45 ±0.25	3.25 ±0.25	0.70 ±0.25	1.30 ±0.25	0.75 ±0.25
	20mΩ ≤ R ≤ 50mΩ (2W)	6.45 ±0.25	3.25 ±0.25	0.70 ±0.25	0.75 ±0.25	1.30 ±0.25
PF/PE2512 (2)	1mΩ	6.30±0.20	3.10±0.20	0.60±0.15	---	2.93±0.20
	2mΩ	6.30±0.20	3.10±0.20	0.60±0.15	---	2.70±0.20
	3mΩ	6.30±0.20	3.10±0.20	0.60±0.15	---	2.50±0.20
	4mΩ	6.30±0.20	3.10±0.20	0.60±0.15	---	2.15±0.20
	5mΩ	6.30±0.20	3.10±0.20	0.60±0.15	---	1.95±0.20
	6mΩ ≤ R ≤8mΩ	6.30±0.20	3.10±0.20	0.60±0.15	---	1.90±0.20
	9mΩ ≤ R < 100mΩ	6.30±0.20	3.10±0.20	0.60±0.15	---	0.95±0.20
PF4527 (2)	6mΩ ≤ R <1Ω	11.50±0.20	7.00±0.20	0.60±0.15	---	2.60±0.20
Wide termination						
PT0815	25mΩ ≤ R ≤ 50mΩ	2.00 ±0.10	3.70 ±0.10	0.50 ±0.10	0.35 ±0.20	0.40 ±0.20
PF0612 (2)	1mΩ ≤ R ≤ 50mΩ	1.60 ±0.20	3.20 ±0.20	0.60 ±0.15	---	0.60 ±0.20
PF0815 (2)	1mΩ ≤ R ≤ 20mΩ	2.15 ±0.20	3.75 ±0.20	0.60 ±0.125	---	0.60 ±0.20
PF0815 (1)	10/15/20mΩ	2.15 ±0.20	3.75 ±0.25	0.65 ±0.25	0.65 ±0.25	0.70 ±0.25
PF0830 (2)	1mΩ ≤ R ≤ 9mΩ	2.5±0.20	7.50±0.30	0.60±0.15	---	0.60 ±0.15
	10mΩ ≤ R ≤ 100mΩ	2.5±0.20	7.50±0.30	0.60±0.15	---	0.58 ±0.15

Note: 1. Apply to ordering codes ending in "L"
2. Apply to ordering codes ending in "Z"
Please contact sales offices, distributors and representatives in your region before ordering

Environmental characteristics

Performance test		Test method	Procedure	Requirements
Life		MIL-STD-202G-method 108A	1 000 hours at 70°C ±5°C applied RCWV 1.5 hours on, 0.5 hours off, still air required	±(1%+ 0.0005Ω) <20mΩ for jumper
High temperature exposure		MIL-STD-202G-method 108A	1 000 hours at maximum operating temperature depending on specification, unpowered	±(1%+ 0.0005Ω) <20mΩ for jumper
Moisture resistance		MIL-STD-202G-method 106F	Each temperature / humidity cycle is defined as 8 hours (method 106F), 3 cycles / 24 hours for 10d with 25°C / 65°C 95% R.H	±(0.5%+ 0.0005Ω) <20mΩ for jumper
Solderability	Wetting	IPC/JEDECJ-STD-002B testB	Electrical test not required. Magnification 50X Lead-free solder bath at 245 ±3°C Dipping time: 3 ±0.5 seconds	Well tinned (≥95% covered) No visible damage
	Resistance to soldering heat	MIL-STD-202G-method 210F	Lead-free solder, 260°C, 10 seconds immersion time	±(0.5%+ 0.0005Ω) <10mΩ for jumper No visible damage
Short time overload		MIL-R-55342D-para 4.7.5	PT/RL standard power: 6.25 times of rated power for 5 seonds at room temperature PR/PE/PF/PH & PT/RL high power: 5 times of rated power for 5 seconds at room temperature PT jumper: 2.5 times of rated current for 5 seconds at room temperature	±(1%+ 0.0005Ω) <10mΩ for jumper No visible damage

Packing quantities

Size code	Tape width	178mm / Ø7" reel		254mm / Ø10" reel	330mm / Ø13" reel
		Paper	Embossed	Paper	Paper
0402	8mm	10 000	---	20 000	50 000
0603	8mm	5 000	---	10 000 (1)	20 000 (1)
0612	8mm	---	5 000	---	---
0805	8mm	4 000 (2) / 5 000	---	10 000 (1)	20 000 (1)
0815	8mm	---	4 000	---	---
0830	12mm	---	4 000	---	---
1206	8mm	4 000 (2) / 5 000 (1)	4 000	10 000 (1)	20 000 (1)
1210	8mm	5 000	---	10 000 (1)	20 000 (1)
1218	12mm	---	4 000	---	---
2010	12mm	---	4 000 / 2 000 (3)	---	---
2512	12mm	---	4 000 / 2 000 (3)	---	---
4527	24mm	---	2 000	---	---

Note: (1) RL/PT series
(2) PF/PH series with ordering code ending in "L"
(3) PR series with ordering code ending in "Z"

Explanation of ordering code

PT	2512	F	K	–	07	0R01	L

Code 1-2 — Series Name

RL = Thick film low ohmic
PT = Thick film low ohmic low T. C. R.
PR/PF/PH/PE = Current sensor - low T. C. R.

Code 3-6 — Size Code (inch / metric)

0402 = 1.0 x 0.5
0603 = 1.6 x 0.8
0612 = 1.6 x 3.2
0805 = 2.0 x 1.25
0815 = 2.15 x 3.75
0830 = 2.0 x 7.5
1206 = 3.2 x 1.6
1218 = 3.2 x 4.5
2010 = 5.0 x 2.5
2512 = 6.35 x 3.2
4527 = 11.0 x 7.0

Code 7 — Tolerance

F = ±1%
G = ±2%
J = ±5%
"–" for Jumper ordering

Code 8 — Packing Style

R = Paper tape reel
K = Embossed plastic tape reel

Code 9 — T. C. R.

E = ±50 ppm/°C
M = ±75 ppm/°C
F = ±100 ppm/°C

"–" Based on spec.
(– for RL/PT only)

Code 10-11 — Taping Reel

07 = 7 inch Dia. reel
10 = 10 inch Dia. reel
13 = 13 inch Dia. reel

Code 12-16 — Resistance

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

Code 17 — Default Code

L / Z = Default code

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www.yageo.com

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