

# Metal Element Current Sense Resistors



Electronics

## ULR Series



### Features:

- Robust metal strip able to withstand high temperature and high current
- Power ratings up to 5W
- Low TCR and inductance
- Resistance range from 0.1 to 10mΩ
- Inverse version
- Higher wattage devices feature PCB clearance gap
- AEC-Q200 qualified



All parts are Pb-free and comply with EU Directive 2011/65/EU amended by (EU) 2015/863 (RoHS3)

### Electrical Data

Green Types ≤2W	ULR1S (ULRG1 <sup>1</sup> )	ULR15S (ULRG15 <sup>1</sup> )	ULR2N	ULR2 (ULRG2 <sup>1</sup> )
Size	1206	2010	1020	2512
Coating	Green underside			
Power rating @80°C W	1	1.5	2	
Resistance range mΩ	0.2 to 10		1 to 3	6.5 to 10 <sup>2</sup>
Standard values mΩ	0.2, 0.25, 0.3, 0.4, 0.5, 0.6, 0.75, 1, 1.2, 2, 2.5, 3, 3.5, 4, 5, 5.5, 6, 7, 8, 9, 10	0.2, 0.25, 0.3, 0.4, 0.5, 0.75, 1, 1.5, 2, 2.5, 3, 4, 5, 5.5, 6, 7, 8, 9, 10	1, 1.5, 2, 2.5, 3	6.5, 7, 7.5, 8, 9, 10
Resistance tolerance %	1, 5			
TCR ppm/°C	≥0.75: 50, <0.75: 200	≥0.75: 50, <0.75: 150	≥1.5: 170, <1.5: 300	50
Ambient temperature °C	-55 to 170			

Note 1: Legacy type Note 2: For lower values of ULR2, see Black Types table.

Green Types >2W	ULR25 (ULRG25 <sup>1</sup> )	ULR3 (ULRG3 <sup>1</sup> )	ULR3N	ULR5
Size	2512		1225	2512
Coating	Green underside			
Power rating @80°C W	2.5	3	5 <sup>2</sup>	
Resistance range mΩ	3.5 to 6	0.15 to 3	0.1 to 3	0.5 to 3
Standard values mΩ	3.5, 4, 4.5, 5, 5.5, 6	0.15, 0.25, 0.3, 0.4, 0.5, 0.75, 1, 1.5, 2, 2.5, 3	0.1, 0.2, 0.25, 0.3, 0.4, 0.5, 0.7, 0.75, 0.8, 0.9, 1, 1.5, 2, 2.5, 3	0.5, 0.75, 1, 1.5, 2, 2.5, 3
Resistance tolerance %	1, 5			
TCR ppm/°C	50	≥1: 50, <1: 150	≥1.5: 100, 0.7-1: 250, 0.5: 300, 0.2-0.4: 350, <0.2: 500	≥1: 50, <1: 150
Ambient temperature °C	-55 to 170			

Note 1: Legacy type Note 2: Terminal temperature must not exceed 110°C.

Black Types	ULR1 (ULRB1 <sup>1</sup> )	ULR2 (ULRB2 <sup>1</sup> )
Size	2512	
Coating	Black	
Power rating @70°C W	1	2
Resistance range mΩ	0.5 to 10	0.5 to 3 <sup>2</sup>
Standard values mΩ	0.5, 0.75, 1, 1.5, 2, 2.5, 3, 3.5, 5, 6, 6.5, 7, 10	0.5, 0.75, 1, 1.5, 2, 2.5, 3
Resistance tolerance %	1, 5	
TCR ppm/°C	10: 100, 6 to 7: 75, 5: 100, 2.5 to 3.5: 150, <2.5: 50	≥2.5: 150, <2.5: 50
Dielectric withstand V	200	
Ambient temperature °C	-55 to 170	

Note 1: Legacy type Note 2: For higher values of ULR2, see Green Types ≤2W table.

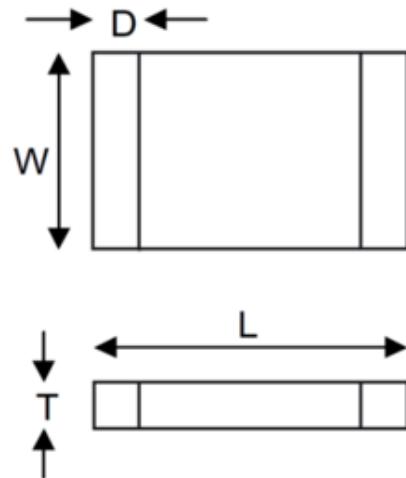
#### General Note

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### Physical Data

Dimensions in mm and weight in mg			Tolerances $\pm 0.25$ mm unless stated				
Coating	Size	Value (m $\Omega$ )	L	W	T $\pm 0.2$	D	Wt. nom.
Green underside	1206	0.2, 0.25	3.2	1.6 $\pm 0.3$	1	1.5	25
		0.3, 0.4				1.4	
		0.5, 0.6		1.6 $\pm 0.1$	0.6	1.35	20
		0.75				1.23	
		1, 1.2, 3.5, 4, 5, 5.5, 6				1.1	
		2, 2.5, 3, 10				0.6	
		7, 8, 9				0.9	
	2010	0.2	5.08	2.54 $\pm 0.3$	1	2.34	50
		0.25				2.24	
		0.3				2.04	
		0.4				1.84	
		0.5		2.54 $\pm 0.15$	0.6	2.17	40
		0.75				2.04	
		1, 1.5, 4, 5, 5.5				1.84	
		2, 2.5, 6, 7, 8				1.54	
		3				1.04	
		9, 10				1.29	
	1020	1, 1.5, 2, 2.5, 3	2.54	5.08		0.57	45
Black	2512	0.15	6.35	3 $\pm 0.3$	1	2.98	59
		0.2				2.88	
		0.25, 0.3				2.68	
		0.4				2.18	
		0.5		3 $\pm 0.2$	0.6	2.68	65
		0.75				2.48	
		1, 1.5, 5.5, 6				1.93	
		2, 2.5, 3, 3.5, 8, 9, 10				1.18	
		4, 4.5				2.18	
		1.5, 6.5, 7, 7.5				1.43	
	1225	0.1, 0.2	3	6.35	1	1	184
		0.25, 0.3, 0.4				0.5	
		0.5, 0.7, 0.75, 0.8, 0.9, 1				1	
		1.5		6.35	0.6	0.8	
		2				0.5	
		2.5, 3					
	2512	0.5	3.18	1.25	$1.85 \pm 0.38$	184	131
		0.75				131	
		1				111	
		1.5				69	
		2				49	
		2.5		0.65	$1.55 \pm 0.38$	98	
		3				83	
		4				63	
		5				50	
		6		0.35	$1.4 \pm 0.38$	42	
		6.5				36	
		7				34	
		10				26	



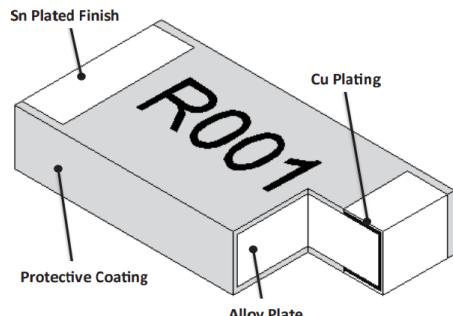
### Construction

#### Black Coat

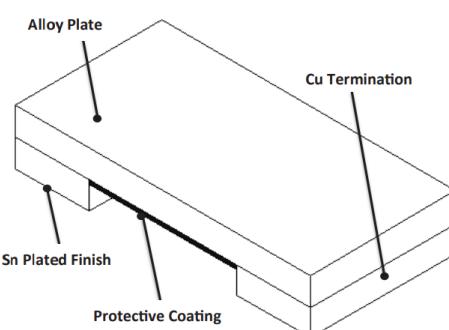
A low TCR resistance alloy plate, with tin plated connection bands is protectively coated on the upper and lower faces and numerically marked with the resistance value. This part is suitable for wave or reflow soldering.

#### Green Underside Coat

A low TCR resistance alloy plate is grooved to set the final resistance and the lower face only is protected with an epoxy coating. The lower faces are tin plated for connections. This part is ONLY suitable for reflow soldering.



Black Coat



Green Underside Coat

### Marking

Only black coated parts are marked. For values which are integer numbers of milliohms the marking is a 4-character IEC62 code; e.g. "R002" for  $2\text{m}\Omega$ , "R010" for  $10\text{m}\Omega$ . For values including a fraction of a milliohm the marking is a 3 or 4-character code using "M" to indicate the decimal point; e.g. "M75" for  $0.75\text{m}\Omega$ , "1M50" for  $1.5\text{m}\Omega$ .

### Terminations

ULR resistors have a matt tin plated finish over copper.

### Performance Data

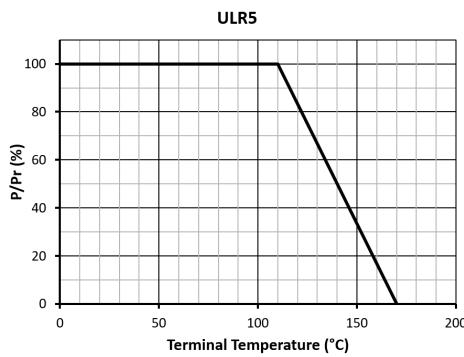
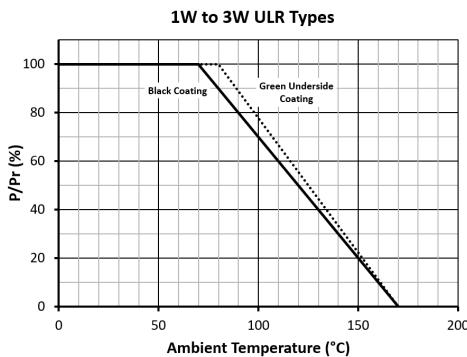
AEC-Q200 Table 7		Methods	Max (+R0005)		
			Black	Green underside	
Test				1206 & 2010	1020, 2512, 1225
3	High temp. exposure <sup>1</sup>	MIL-STD-202 method 108	$\pm\Delta R\%$	1	
4	Temperature cycling	JESD22 method JA-104	$\pm\Delta R\%$	0.5	1
6	Moisture resistance	MIL-STD-202 method 106	$\pm\Delta R\%$	1	
7	Biased humidity	MIL-STD-202 method 103	$\pm\Delta R\%$	1	
8	Operational life (load) <sup>1</sup>	MIL-STD-202 method 108	$\pm\Delta R\%$	1	
14	Vibration	MIL-STD-202 method 204	$\pm\Delta R\%$	0.5	1
15	Resistance to soldering heat <sup>1</sup>	MIL-STD-202 method 210	$\pm\Delta R\%$	0.5	1
16	Thermal shock <sup>1</sup>	MIL-STD-202 method 107	$\pm\Delta R\%$	0.5	1
18	Solderability	J-STD-002		>95% coverage	
21	Board flex	AEC-Q200-005	$\pm\Delta R\%$	0.5	1
22	Terminal strength	AEC-Q200-006	$\pm\Delta R\%$	0.25	1
Short term overload <sup>1</sup>		5 x Pr for 5s	$\pm\Delta R\%$	0.5	1
Resistance to sulphur-bearing gas <sup>2</sup>		EIA-977	$\pm\Delta R\%$	N/A	1

Note 1: Full AEC-Q200 qualification applies to 2512 size. The 1206 and 2010 sizes have received the indicated tests.

Note 2: Resistance to sulphur-bearing gas has been tested for green underside construction only.

## ULR Series

### Thermal Performance, Mounting & Measurement

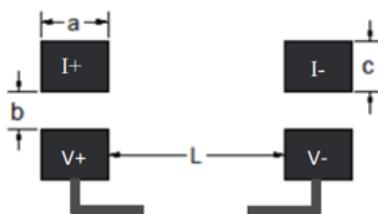


**Note:** The power derating curve is guidance based on a conservative design model. The ULR is a solid metal alloy construction that can withstand significantly greater operating temperatures than the conservative model permits. The protective coating will operate up to 260°C and the alloy can withstand in excess of 350°C. Therefore, the system thermal design will be a more significant factor due to the heat limitations of the solder joint.

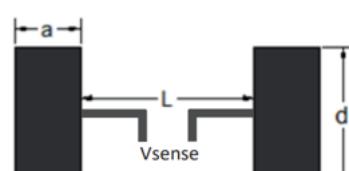
**Note:** Full power dissipation is achievable with the part mounted on 120 x 51mm high-Tg FR4 board with 70µm inner and outer planes. Alternative mounting arrangements may be used, provided the heatsinking effect permits a combination of power dissipation and terminal temperature within the derating curve shown.

Coating	Size	Value (mΩ)	a	b	c	L	d	e	f
Green underside	1206	0.5, 0.6, 1, 4 - 6	1.55	0.5	0.7	0.55	1.9	2.6	1.25
		2 - 3, 10	1.05			1.55			
		7 - 9	1.35			0.95			
	2010	0.5	2.61	0.8	1.05	0.3	2.9	4.32	1.2
		1, 4 - 5	2.29			0.95			
		2, 6 - 8	1.99			1.55			
		3	1.49			2.55			
		9 - 10	1.74			2.05			
	1020	All	0.93	1	1.2	1.04	5.53	2	1.77
	2512	0.5	3.13			0.54			
		0.75	2.93			0.94			
		1	2.38			2.04			
		1.5	1.88			3.04			
		2 - 3	1.63			3.54			
		4, 4.5	2.63			1.54			
		5 - 6	2.38			2.04			
		6.5, 7	1.88			3.04			
		8 - 10	1.63			3.54			
	1225	0.1 - 0.25	1.4		3	0.6	3.45	5.4	1.5
		0.3 - 1	0.9			1.6			
		1.5	1.4			0.6			
		2	1.2			1			
		2.5, 3	0.9			1.6			
Black	2512	All	2.7	1	1.45	2.95	3.6	5.4	1.5

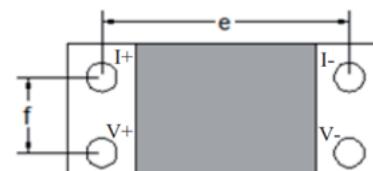
4-Pad Layout



2-Pad Layout



4-Wire Measurement Probe Positions



**Note:** These resistors are designed to have the correct ohmic value when mounted on a PCB. Probed measurements may read higher values and mounting offsets may need to be established to account for this, especially with sub-milliohm values.

#### General Note

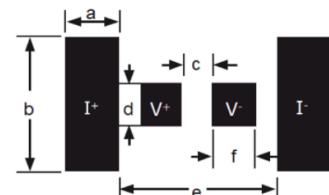
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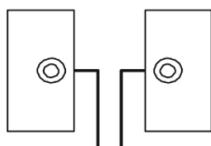
## ULR Series

### Mounting Values < 0.5mΩ & Alternative Kelvin Connections

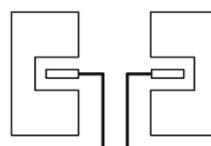
Coating	Size	Value (mΩ)	a	b	c	d	e	f	
Green underside	1206	0.2 – 0.4	0.75	1.9	0.4	0.6	2.15	0.6	
	2010	0.2 – 0.4	1.35	2.89	1.4		3.08		
	2512	0.15 – 0.3	2	3.4	1	2.8	2.8		
		0.4	1.5		2		3.8		



Vias with copper traces on internal layers



Sense traces on solder pads beneath the chip



### Packaging

												Tolerances ±0.1 unless stated					
Coating	Size	Value (mΩ)	A <sup>3</sup>	B <sup>3</sup>	W	E	F ±0.05	P <sub>0</sub> <sup>1</sup>	P <sub>1</sub>	P <sub>2</sub> <sup>5</sup> ±0.05	ΦD <sub>0</sub> ±0.05	ΦD <sub>1</sub> min	T <sup>4</sup>	Tape	Reel Qty		
Green underside	1206	<0.5	1.9	3.6	8 ±0.2	3.5						1	1.25	Plastic	2000 on 7" reel		
		≥0.5											0.87				
	2010	<0.5	2.85	5.55		1.75	5.5	4	2	1.55	1.5	1.35					
		≥0.5										0.85					
	1020	All										1.4					
		<0.5										0.8					
	2512	≥0.5										1.2					
		<0.5	3.4	6.75	12 ±0.3	1.75	5.5	4	2	1.55	1.5	0.8					
Black	2512	≥0.5										1.45±0.2	Plastic	2000 on 7" reel			
		≤0.75										0.81					

Note 1: The cumulative tolerance of 10 sprocket hole pitches is ±0.2mm.

Note 2: Carrier camber shall not be more than 1mm per 100mm through a length of 250mm.

Note 3: A & B measured 0.3mm from the bottom of the pocket.

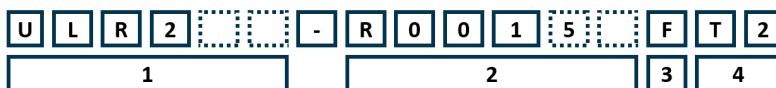
Note 4: T measured at a point on the inside bottom of the pocket to the top surface of the carrier.

Note 5: Pocket position relative to sprocket hole is measured as the true position of the pocket and not the pocket hole.



### Ordering Procedure

Global Part Number Example: ULR2-R0015FT2 (2512, 1.5mΩ ±1%, Pb-free)



1 Type	2 Value	3 Tolerance	4 Packing		
ULR1	3 to 6 characters	F = ±1%	T2	Plastic tape	2000/reel
ULR15S		J = ±5%			
ULR1S	R = ohms				
ULR2					
ULR25					
ULR2N					
ULR3					
ULR3N					
ULR5					

### Legacy Part Numbers

This product has a legacy part number format. This is still available for ordering, but for new designs use of the Global Part Number is recommended.

Legacy Part Number Example: ULRB22512R0015FLFSLT (2512, 1.5mΩ ±1%, Pb-free)



1 Type	2 Size	3 Value	4 Tolerance	5 Termination	6 Packing		
ULRB1	1206	3 to 6 characters	F = ±1%	LF = Pb-free	SLT	Plastic tape	2000/reel
ULRB2	2010		J = ±5%				
ULRG1	2512	R = ohms					
ULRG15							
ULRG2							
ULRG25							
ULRG3							