

FEATURES

- Low Resistance, Low TCR
- Precision current sensing
- Precision voltage division
- AEC - Q200

APPLICATION

- Battery Management systems
- Power supply
- Precision Measuring equipment
- Replaces RFE LR series

PART NUMBER EXAMPLE

LRMA	2512	20	F	R001	M	Z
Product Type	Size Code	Rated Power	Tolerance	Resistance	Material	Optional
	0805 1206 2512 2725 2728 4527	05=0.50W 07=0.75W 10=1.00W 20=2.00W 30=3.00W 40=4.00W 50=5.00W	D = $\pm 0.5\%$ F = $\pm 1\%$ G = $\pm 2\%$ J = $\pm 5\%$ 0 = Zero Ω	0m20 = 0.2m Ω 2m50 = 2.5m Ω R005 = 5.0m Ω R100 = 100m Ω R500 = 500m Ω	S : MnCuSn M : MnCu F : FeCrAl C : Cu	A : For Automotive Grade Z : Default

ELECTRICAL CHARACTERISTICS & DIMENSIONS

Size Code	Rating Power at 70℃	T.C.R. (ppm/℃)	Max. Rating Current (A)	Max. Overload Current (A)	Resistance Range (mΩ)		Material	Operation Temperature Range (℃)
					0.5% (D)	1.0% (F) 2.0% (G) 5.0% (J)		
0805	0.5W	≤ ±100	31.62	70.71	—	0.5~1	0m50~R002 : MnCuSn 2m50~R008 : MnCu R009~R013 : FeCrAl	-55 ~ +170
		≤ ±75	18.26	40.82	—	1.5~2		
		≤ ±50	14.14	31.62	7~13	2.5~13		
	1W	≤ ±100	44.72	89.44	—	0.5~1		
		≤ ±75	25.81	51.63	—	1.5~2		
		≤ ±50	20.00	40.00	7~13	2.5~13		
1206	0.5W	≤ ±50	22.60	50.00	5~75	1~75	R001 : MnCuSn R002~R007 : MnCu R008~R075 : FeCrAl	
	0.75W		27.38	61.23			R001 : MnCuSn R002~R007 : MnCu R008~R050 : FeCrAl	
	1W		31.62	70.71	5~50	1~50		
	1.5W		38.72	86.60	5~10	1~10	R001 : MnCuSn R002~R007 : MnCu R008~R010 : FeCrAl	

■ ELECTRICAL CHARACTERISTICS & DIMENSIONS (cont.)

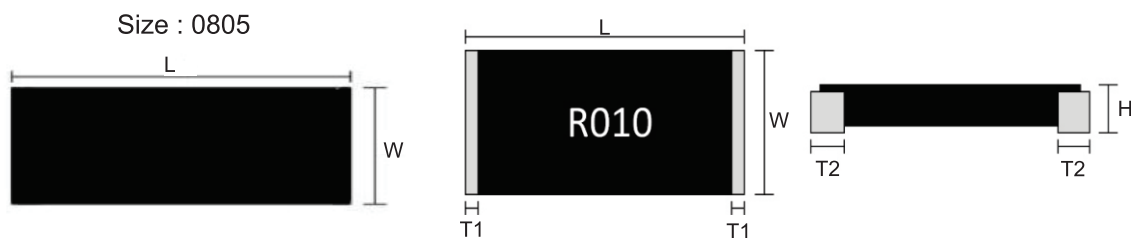
Size Code	Rating Power at 70°C	T.C.R. (ppm/°C)	Max. Rating Current (A)	Max. Overload Current (A)	Resistance Range (mΩ)		Material	Operation Temperature Range (°C)
					0.5% (D)	1.0% (F) 2.0% (G) 5.0% (J)		
2512	1W	≤ ±75	77.72	100.00	—	0.5~0.8	0m50~0m8 : MnCuSn	-55 ~ +170
		≤ ±50	31.62	70.71	5~450	1~500	R001~R006 : MnCu R007~R500 : FeCrAl	
	2W	≤ ±75	63.24	141.42	—	0.5~0.8	0m50~0m8 : MnCuSn	
		≤ ±50	44.72	100.00	5~450	1~450	R001~R006 : MnCu R007~R450 : FeCrAl	
	3W	≤ ±75	77.45	173.20	—	0.5~0.8	0m50~0m8 : MnCuSn	
		≤ ±50	54.77	122.47	5~100	1~100	R001~R006 : MnCu R007~R100 : FeCrAl	
2725	4W	≤ ±100	141.42	282.84	—	0.2	0m20~0m40 : MnCuSn	
		≤ ±50	126.49	252.98		0.25~3	0m50~2m50 : MnCu R003 : FeCrAl	
2728	4W	≤ ±50	31.62	63.24	7~450	4~450	R004~R450 : FeCrAl	
4527	2W	≤ ±75	63.24	141.42	—	0.5	R0005 : MnCuSn	
		≤ ±50	44.72	100.00	5~100	1~100	R001~R040 : MnCu R041~R100 : FeCrAl	
	3W	≤ ±75	77.45	173.20	—	0.5	R0005 : MnCuSn	
		≤ ±50	54.77	122.47	5~60	1~60	R001~R040 : MnCu R041~R60 : FeCrAl	
	5W	≤ ±75	100.00	173.20	—	0.5	R0005 : MnCuSn	
		≤ ±50	70.71	122.47	5~500	1~500	R001~R040 : MnCu R041~R500 : FeCrAl	

■ JUMPER SPECIFICATION

Size Code	Rating Power at 70°C	Max. Rating Current (A)	Resistance Range (mΩ)	Material	Operation Temperature Range (°C)
0805	0.5W	50A	≤ 0.20	Jumper : Cu	-55 ~ +170
	1W	70.7A	≤ 0.20		
1206	1W	70.7A	≤ 0.20	Jumper : Cu	
2512	2W	100A	≤ 0.20		

■ DIMENSIONS (unit : mm)

Size : 1206 ~4527



Size Code	Rating Power	Resistance Range (mΩ)	L	W	H	T1	T2						
0805	0.5W 1W	0.5	2.05 ± 0.25	1.30 ± 0.30	0.60 ± 0.20	-----	0.75 ± 0.20						
		1			0.55 ± 0.20		0.40 ± 0.20						
		1.5			0.45 ± 0.20								
		2			0.35 ± 0.20								
		2.5			0.45 ± 0.20								
		3 ~ 8			0.35 ± 0.20								
		9 ~ 13			0.37 ± 0.20								
1206	0.5W 0.75W	1	3.20 ± 0.254	1.65 ± 0.254	0.82 ± 0.254	0.508 ± 0.254	0.508 ± 0.254						
		2			0.70 ± 0.254								
		3			0.60 ± 0.254								
		4 ~ 20			0.55 ± 0.254								
		21 ~ 50			0.47 ± 0.254								
		51 ~ 75			0.40 ± 0.254								
	1W	1			0.82 ± 0.254								
		2			0.70 ± 0.254								
		3			0.60 ± 0.254								
		4 ~ 20			0.55 ± 0.254								
		21 ~ 50			0.47 ± 0.254								
		1.5W			1			0.82 ± 0.254					
	2				0.70 ± 0.254								
	3				0.60 ± 0.254								
	4 ~ 10				0.55 ± 0.254								
	2512				1W 2W			0.5	6.35 ± 0.254	3.05 ± 0.254	0.82 ± 0.254	1.98 ± 0.254	2.00 ± 0.254
								0.75			0.70 ± 0.254	1.15 ± 0.254	1.98 ± 0.254
		1						0.72 ± 0.254			2.20 ± 0.254		
1.5		1.40 ± 0.254											
2 ~ 5		0.55 ± 0.254	1.05 ± 0.254	1.10 ± 0.254									
6		0.60 ± 0.254											
7 ~ 10		0.55 ± 0.254	0.75 ± 0.254										
11 ~ 75		0.47 ± 0.254											
76 ~ 100		0.40 ± 0.254											
101 ~ 135													
136 ~ 200			0.85 ± 0.254										
201 ~ 450													
3W		0.5	6.35 ± 0.254	3.05 ± 0.254	0.82 ± 0.254	1.98 ± 0.254	2.00 ± 0.254						
		0.75			0.70 ± 0.254	1.15 ± 0.254	1.98 ± 0.254						
		1			0.72 ± 0.254		2.20 ± 0.254						
		1.5					1.40 ± 0.254						
		2 ~ 5			0.55 ± 0.254		0.75 ± 0.254	1.10 ± 0.254					
		6			0.60 ± 0.254	1.15 ± 0.254							
		7 ~ 10				0.75 ± 0.254							
		11 ~ 75											
		76 ~ 100											

■ DIMENSIONS (cont.)

Size Code	Rating Power	Resistance Range (mΩ)	L	W	H	T1	T2	
2725	4W	0.2	6.90 ± 0.254	6.35 ± 0.254	1.10 ± 0.254	1.20 ± 0.254	2.150 ± 0.254	
		0.25			0.95 ± 0.254		2.287 ± 0.254	
		0.3					1.975 ± 0.254	
		0.35					1.710 ± 0.254	
		0.4					1.440 ± 0.254	
		0.5			0.85 ± 0.254		2.080 ± 0.254	
		0.6					1.780 ± 0.254	
		0.8					1.300 ± 0.254	
		1	0.65 ± 0.254			1.80 ± 0.254		
		1.5 ~ 1.6			1.15 ± 0.254	1.50 ± 0.254		
		2 ~ 3					0.55 ± 0.254	
		2728			4W	4 ~ 450	6.60 ± 0.254	6.70 ± 0.254
4527	2W	0.5	11.30 ± 0.50	6.60 ± 0.50	0.77 ± 0.254	0.90 ± 0.254	3.00 ± 0.254	
		1			0.65 ± 0.254		2.00 ± 0.254	
		1.5 ~ 20			0.55 ± 0.254		3.00 ± 0.254	
		21 ~ 100			0.77 ± 0.254		2.00 ± 0.254	
	3W	0.5			0.65 ± 0.254		0.65 ± 0.254	3.00 ± 0.254
		1			0.55 ± 0.254			2.00 ± 0.254
		1.5 ~ 20			0.80 ± 0.254			3.00 ± 0.254
		21 ~ 60			0.68 ± 0.254			2.00 ± 0.254
	5W	0.5			0.58 ± 0.254	0.65 ± 0.254		3.00 ± 0.254
		1			0.58 ± 0.254			2.00 ± 0.254
		1.5 ~ 20						
		21 ~ 500						

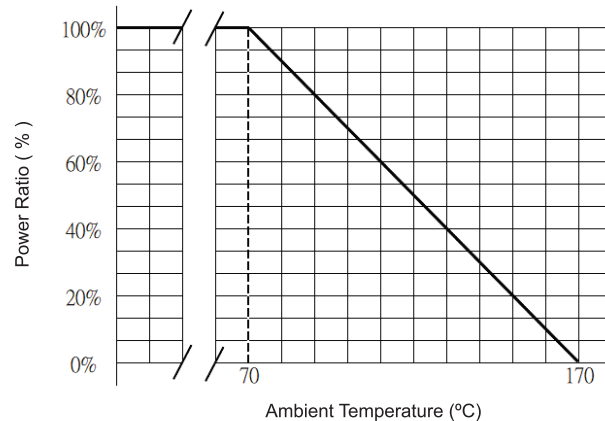
■ JUMPER DIMENSIONS (unit : mm)

Size Code	Rating Power	Resistance Range (mΩ)	L	W	H	T1	T2
0805	0.5W 1W	≤ 0.20	2.05 ± 0.25	1.30 ± 0.30	0.45 ± 0.20	---	0.40 ± 0.20
1206	1W	≤ 0.20	3.20 ± 0.254	1.65 ± 0.254	0.65 ± 0.254	0.508 ± 0.254	0.508 ± 0.254
2512	2W 3W	≤ 0.20	6.35 ± 0.254	3.05 ± 0.254	0.65 ± 0.254	1.15 ± 0.254	1.10 ± 0.254

■ POWER DERATING CURVE

The Operating Temperature Range : -55°C ~ +170°C

For resistors operated in ambient temperature above 70°C, power rating must be derating in accordance with the curve below.



■ RATING CURRENT

The following equation may be used to determine the DC (Direct Current) or AC (Alternating Current) (RMS, root mean square value) of normal rated power. However, if the result value exceeds the highest current of regulated standards (paragraph 5), the highest normal rated power is to be used.

$$I = \sqrt{P/R}$$

I = Rating Current (A)

P = Rating Power (W)

R = Resistance (Ω)

■ MARKING FORMAT

- All the other products marking are 4 digits
- “R” designates the decimal location in ohms
e.g. 1m Ω =R001, 25m Ω =R025, 100m Ω =R100
- “m” designates the decimal location in milli-ohms
e.g. 0.25m Ω =0m25, 0.5m Ω =0m50, 25.5m Ω =25m5
- 0 Ω marking as 0R

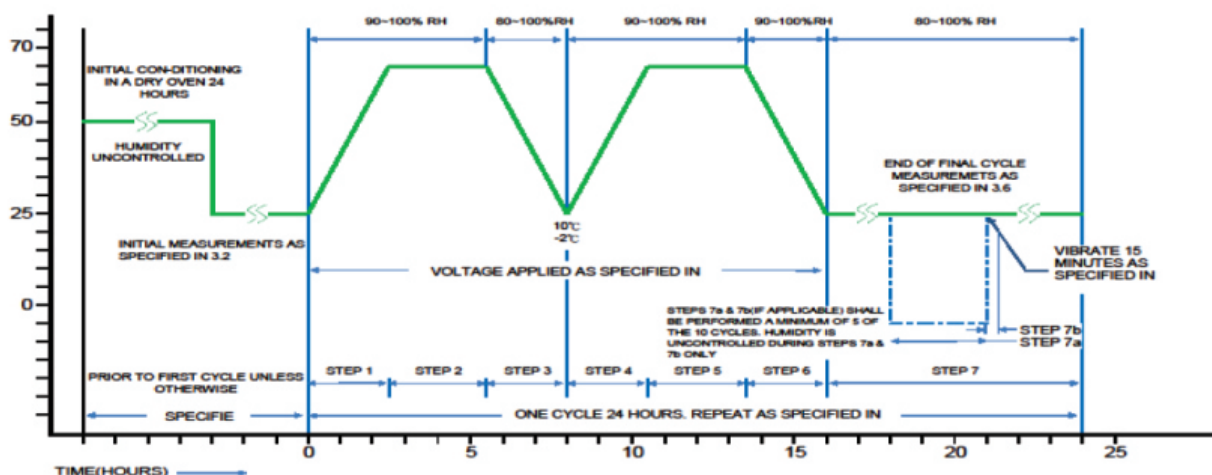
■ TEST PROCEDURES except Jumper

Test Item	Test Method	Procedure	Requirement
Temperature Coefficient of Resistance (T.C.R)	JIS-C-5201-1 4.8 IEC-60115-1 4.8	At 25°C / +150°C, 25°C is the reference temperature	As Spec.
Short Time Overload	JIS-C-5201-1 4.13 IEC-60115-1 4.13	The number of rated power as follows: (for 5 seconds) • 0805 - 0.5W : 5 times • 0805 - 1W : 4 times • 1206 - 0.5W to 1.5W : 5 times • 2512 - 1W to 3W : 5 times • 2725 - 4W : 4 times • 2728 - 4W : 4 times • 4527 - 2W & 3W : 5 times • 4527 - 5W : 3 times	• Size 0805 : $\Delta R/R1 \leq \pm 1.0\%$ • Size 4527 : $\Delta R/R1 \leq \pm 2.0\%$ • The others : $\Delta R/R1 \leq \pm 0.5\%$
High Temperature Exposure (Storage)	ML-STD-202 Method 108	Size 0805 : 1000 hours @ 170°C, Unpowered, measured at 24±4 hours after test conclusion	• Size 0805 : $\Delta R/R1 \leq \pm 1.0\%$
	JIS-C-5201-1 4.25 IEC-60068-2-2	Other sizes : 1000 hours @ 170°C	• Size 4527 : $\Delta R/R1 \leq \pm 2.0\%$ • The others : $\Delta R/R1 \leq \pm 1.0\%$
Resistance to Soldering Heat	JIS-C-5201-1 4.18 IEC-60115-1 4.18	260 ± 5°C for 10 seconds	$\Delta R/R1 \leq \pm 0.5\%$
Temperature Cycling	JESD22 Method JA-104	1000 Cycles (-55°C to 155°C), Measured at 24±4 hours after test conclusion. 30 minutes maximum dwell time at each temperature extreme	$\Delta R/R1 \leq \pm 0.5\%$
Biased Humidity	ML-STD-202 Method 103	1000 hours, 85°C / 85% RH, 10% of operating power. Measurement at 24±4 hours after test conclusion	$\Delta R/R1 \leq \pm 0.5\%$
Load Life (Endurance)	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1	70±2°C, RCWV or Max. working voltage whichever is less for 1000 hours with 1.5hrs "ON" and 0.5hr "OFF"	• Size 0805 : $\Delta R/R1 \leq \pm 1.0\%$ • Size 4527 : $\Delta R/R1 \leq \pm 2.0\%$ • The others : $\Delta R/R1 \leq \pm 1.0\%$
Solderability	J-STD-002	Size 0805 : 1) 4 hours 155°C dry heat 2) 245 ± 5°C 3 seconds	> 95% Coverage
	JIS-C-5201-1 4.17 IEC-60115-1 4.17	245 ± 5°C 3 seconds	
Dielectric Withstanding Voltage	JIS-C-5201-1 4.7	Applied 500VAC for 1 minute, and limit surge current 50mA (max.)	No short or burned on the appearance
Board Flex (Bending Strength)	AEC Q200-005 JIS-C-5201-1 4.33 IEC-60115-1 4.33	Size 0805 : bend once 2mm for 60 seconds Other size : bend once 2mm for 10 seconds	$\Delta R/R1 \leq \pm 0.5\%$ no broken
Terminal Strength (SMD)	AEC Q200-006	Pressurizing force 17.7N for 60 seconds	$\Delta R/R1 \leq \pm 0.5\%$ no broken
Moisture Resistance	ML-STD-202 Method 106	24 hours / Cycle, 10 cycles. Steps 7a & 7b not required. Unpowered. (Figure 1)	• Size 0805 : $\Delta R/R1 \leq \pm 1.0\%$ • The others : $\Delta R/R1 \leq \pm 0.5\%$

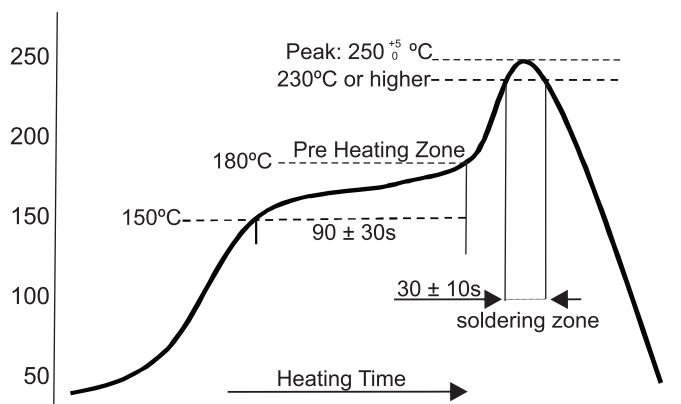
■ TEST PROCEDURES for Jumper

Test Item	Test Method	Procedure	Requirement
Short Time Overload	JIS-C-5201-1 4.13 IEC-60115-1 4.13	4 times of rated power for 5 seconds.	$\leq 0.2\text{m}\Omega$
Temperature Cycling	JESD22 Method JA-104	1000 Cycles (-55°C to 155°C). Measurement at 24±4 hours after test conclusion. 30 minutes maximum dwell time at each temperature extreme	$\leq 0.2\text{m}\Omega$
High Temperature Exposure (Storage)	JIS-C-5201-1 4.25 IEC-60068-2-2	At 170°C for 1,000 hours	$\leq 0.2\text{m}\Omega$
Biased Humidity	ML-STD-202 Method 103	1000 hours, 85°C / 85% RH, 10% of operating power. Measurement at 24±4 hours after test conclusion	$\leq 0.2\text{m}\Omega$
Load Life (Endurance)	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1	70±2°C, RCWV or Max. working voltage whichever is less for 1000 hours with 1.5hrs "ON" and 0.5hr "OFF"	$\leq 0.2\text{m}\Omega$
Solderability	JIS-C-5201-1 4.17 IEC-60115-1 4.17	245 ± 5°C for 3 seconds	> 95% Coverage

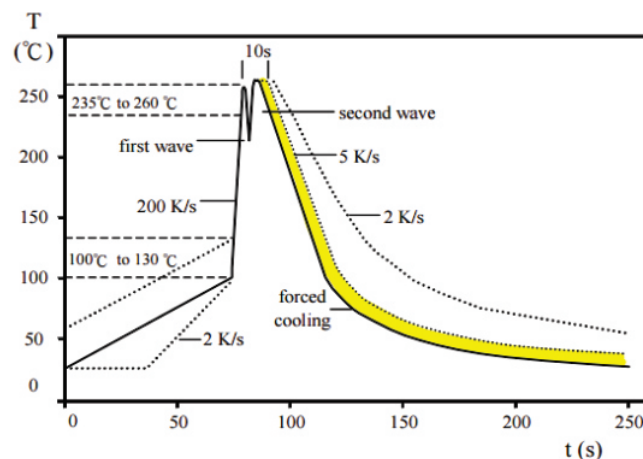
Figure 1



■ SOLDERING PROFILE

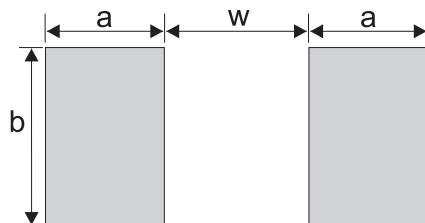


REFLOW Soldering



WAVE soldering.

■ RECOMMENDED LAND PATTERN DESIGN Dimension (unit: mm)



Plating Thickness :

Ni : $\geq 2\mu\text{m}$

Sn(Tin) : $\geq 3\mu\text{m}$

Size Code	Rating Power	Resistance Range (m Ω)	a	b	w
0805	0.5W	0.5	1.35	1.80	0.30
	1W	0 / 1~13	1.00	1.80	1.00
1206	0.75W	Jumper : 0.2m Ω	1.00	2.15	1.40
	1W	1 ~ 100	1.60	2.15	0.66
2512	1W 2W 3W	Jumper : 0.2m Ω	2.11	3.68	3.18
		0.5 ~ 1.5	3.05		1.27
		2 ~ 3.5	2.11		3.18
		3.6 ~ 500	1.90		3.58
2725	4W	0.25 ~ 0.5	3.18	6.85	1.32
		1 ~ 3	2.34		3.00
2728	4W	4 ~ 450	2.75	7.20	3.51
4527	2W	0.5 ~ 3	4.50	8.74	4.50
	3W	3.5 ~ 100	3.40		6.43
	5W	101 ~ 500	2.93		7.63

■ PACKAGE QUANTITY

Size	PCS / REEL
0805	5000
1206	5000
1206 R001	4000
2512	4000
2725	2000
2728	2000
4527	1000

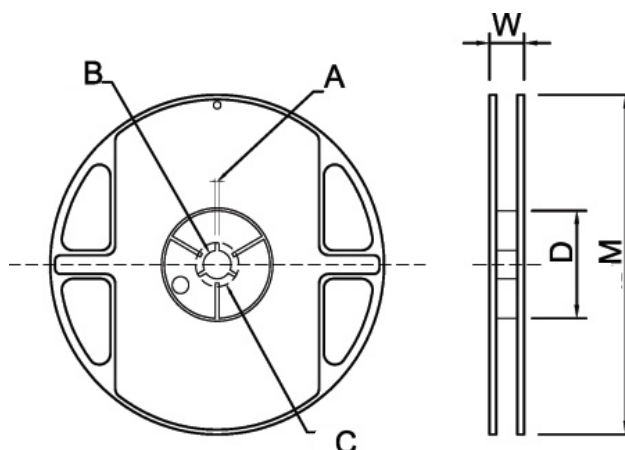
■ STORAGE TEMPERATURE

Temperature: $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$

Humidity: $60 \pm 20\%$

■ PACKAGING DIMENSIONS (mm)

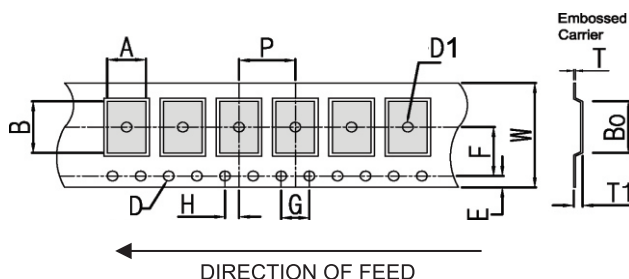
Tape & Reel



■ TAPE & REEL

Reel	A	B	C	D	W	M
7" reel for 8 mm embossed (for 0805 & 1206 only)	2.0 ± 0.5	13.2 ± 0.5	17.7 ± 0.5	60.0 ± 0.5	12.00 ± 0.5	178 ± 1.0
7" reel for 12 mm embossed	2.5 ± 0.5	13.5 ± 0.5	17.7 ± 0.5	60.0 ± 0.5	16.2 ± 0.5	178 ± 1.0
7" reel for 24 mm embossed	2.0 ± 0.5	13.5 ± 0.5	17.7 ± 0.5	60.0 ± 0.5	24.4 ± 2.0	178 ± 1.0

Embossed Tape



■ EMBOSSED TAPE

Size	Resistance Range (mΩ)	Measurement (± 0.10)				D	Measurement (± 0.10)					T1	T
		W	P	E	F		D1	G	H	A	B		
0805	0 ~ 2.5	8.0	4.0	1.75	3.5	$1.50^{+0.1}_{-0.0}$	1.00	4.0	2.0	1.70	2.45	0.90 ± 0.25	0.20 ± 0.05
	3 ~ 13	8.0	4.0	1.75	3.5		1.00	4.0	2.0	1.70	2.45	0.55 ± 0.25	0.20 ± 0.05
1206	1	8.0	4.0	1.75	3.5		1.00	4.0	2.0	2.03	3.55	1.10 ± 0.10	0.20 ± 0.05
	2 ~ 75	8.0	4.0	1.75	3.5		1.00	4.0	2.0	2.03	3.55	0.85 ± 0.10	0.20 ± 0.05
2512	0.5 ~ 2	12.0	4.0	1.75	5.5		1.55	4.0	2.0	3.50	6.75	1.10 ± 0.10	0.20 ± 0.05
	3 ~ 450	12.0	4.0	1.75	5.5		1.55	4.0	2.0	3.50	6.75	0.90 ± 0.10	0.20 ± 0.05
2725	0.2 ~ 0.8	12.0	8.0	1.75	5.5		1.55	4.0	2.0	6.81	7.16	1.30 ± 0.10	0.25 ± 0.05
	1 ~ 3	12.0	8.0	1.75	5.5		1.55	4.0	2.0	6.81	7.16	1.05 ± 0.10	0.25 ± 0.05
2728	4 ~ 450	12.0	8.0	1.75	5.5		1.55	4.0	2.0	7.10	7.06	0.95 ± 0.10	0.20 ± 0.05
4527	0.5 ~ 500	24.0	12.0	1.75	11.5		1.50	4.0	2.0	7.38	12.00	1.05 ± 0.10	0.30 ± 0.10