

Viking Tech Corporation

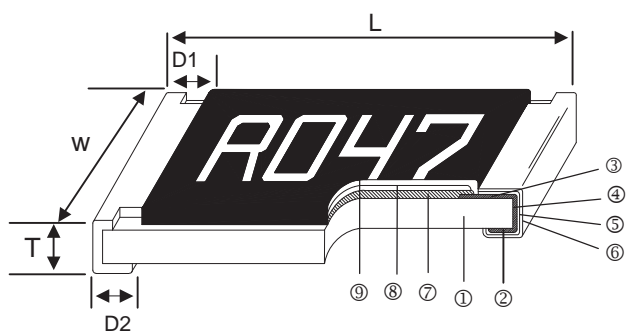
Current Sensing Chip Resistor



■ Features

- 3 Watts power rating in 1 Watt size, 1225 package
- Low TCR of ± 100 PPM/ $^{\circ}$ C
- Resistance values from 1m to 1 ohm
- High purity alumina substrate for high power dissipation
- Long side terminations with higher power rating

■ Construction



■ Applications

- Power Management Applications
- Switching Power Supply
- Over Current Protection in Audio Applications
- Voltage Regulation Module (VRM)
- DC-DC Converter, Battery Pack, Charger, Adaptor
- Automotive Engine Control
- Disk Driver

① Alumina Substrate	④ Edge Electrode (NiCr)	⑦ Resistor Layer (Ag/Pd)
② Bottom Electrode (Ag)	⑤ Barrier Layer (Ni)	⑧ Primary Overcoat (Glass)
③ Top Electrode (Ag-Pd)	⑥ External Electrode (Sn)	⑨ Secondary Overcoat (Epoxy)

■ Dimensions

Type	Size (Inch)	L (mm)	W (mm)	T (mm)	D1 (mm)	D2 (mm)	Weight (g) (1000pcs)
CS01	0201	0.60±0.03	0.30±0.03	0.23±0.05	0.12±0.05	0.15±0.05	0.18
CS02	0402	1.00±0.05	0.50±0.05	0.32±0.10	0.25±0.10	0.20±0.10	0.7
CS03	0603	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20	1.99
CS05	0805	2.00±0.10	1.25±0.10	0.55±0.10	0.30±0.20	0.40±0.25	5.3
CS06	1206	3.10±0.10	1.55±0.10	0.55±0.10	0.50±0.30	0.40±0.25	8.82
CS13	1210	3.10±0.10	2.60±0.15	0.55±0.10	0.50±0.30	0.50±0.25	15.5
CS10	2010	5.00±0.10	2.50±0.15	0.60±0.15	0.60±0.30	0.50±0.25	27.03
CS12	2512	6.35±0.10	3.10±0.15	0.60±0.10	0.60±0.30	0.55±0.25	43.08
CS12 (2W)	2512 (10 - 99mΩ)	6.35±0.20	3.15±0.15	0.74±0.10	0.60±0.30	0.55±0.25	53.08
CS12 (2W)	2512 (100 - 1000mΩ)	6.35±0.20	3.15±0.15	0.74±0.10	0.60±0.30	2.10±0.10	53.08
CS25	1225	3.10±0.15	6.30±0.15	0.90±0.15	0.60±0.30	0.80±0.25	64.88
CS37	3720	2.00±0.20	3.75±0.20	0.60±0.10	0.40±0.20	0.40±0.20	19.96
CS75	7520	2.00±0.20	7.50±0.30	0.60±0.10	0.40±0.20	0.40±0.20	35.71

Thin Film Current Sensing Chip Resistor (TCS Series)



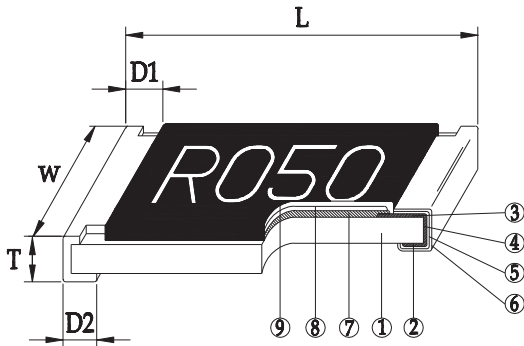
■ Features

- Thin film process
- High power rating up to 3 Watts in 2512 size
- Tight tolerance down to $\pm 0.5\%$
- Extremely low TCR down to ± 50 PPM/ $^{\circ}\text{C}$
- Resistance values from 50m to 1ohm
- High purity alumina substrate for high power dissipation

■ Applications

- Power Management Applications
- Switching Power Supply
- Over Current Protection in Audio Applications
- Voltage Regulation Module (VRM)
- DC-DC Converter, Battery Pack, Charger, Adaptor
- Automotive Engine Control
- Disk Driver
- Portable Devices (PDA, Cell Phone)

■ Construction



① Alumina Substrate	④ Edge Electrode (NiCr)	⑦ Resistor Layer (NiCr)
② Bottom Electrode (Ag)	⑤ Barrier Layer (Ni)	⑧ Overcoat (Epoxy)
③ Top Electrode (Ag-Pd)	⑥ External Electrode (Sn)	⑨ Marking

■ Dimensions

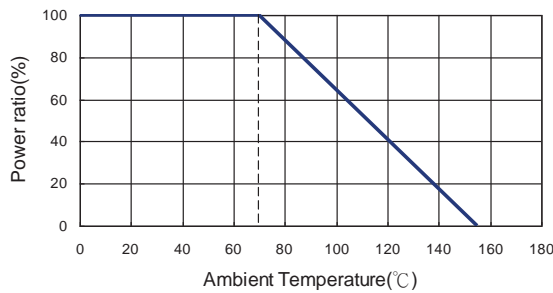
Unit: mm

Type	Size (Inch)	L	W	T	D1	D2	Weight (g) (1000pcs)
TCS02	0402	1.00 \pm 0.05	0.50 \pm 0.05	0.32 \pm 0.10	0.25 \pm 0.10	0.20 \pm 0.10	0.56
TCS03	0603	1.60 \pm 0.10	0.80 \pm 0.10	0.45 \pm 0.10	0.30 \pm 0.20	0.30 \pm 0.20	3.1
TCS05	0805	2.00 \pm 0.15	1.25 \pm 0.15	0.55 \pm 0.10	0.30 \pm 0.20	0.40 \pm 0.25	5.6
TCS06	1206	3.05 \pm 0.15	1.55 \pm 0.15	0.55 \pm 0.10	0.50 \pm 0.30	0.40 \pm 0.25	12.3
TCS10	2010	5.00 \pm 0.20	2.45 \pm 0.15	0.60 \pm 0.15	0.60 \pm 0.30	0.50 \pm 0.25	26.7
TCS12	2512	6.35 \pm 0.20	3.15 \pm 0.15	0.60 \pm 0.10	0.60 \pm 0.30	0.55 \pm 0.25	49.6

Part Numbering

TCS	12	F	T	F		R010	N
Product Type	Dimensions (LxW)	Resistance Tolerance	Packaging Code	TCR (PPM/°C)	Power Rating	Resistance	Marking
	02: 0402 03: 0603 05: 0805 06: 1206 10: 2010 12: 2512	D: ±0.5% F: ±1%	T: Taping Reel B: Bulk	D: ±50 E: ±100 F: ±200	: Standard R: 3W	R010: 0.01Ω R100: 0.1Ω 1R00: 1Ω	: Standard N: No Marking

Derating Curve



Standard Electrical Specifications

Item Type	Power Rating at 70°C	Operating Temp. Range	Resistance Range (mΩ)		TCR (PPM/°C)
			±0.5%	±1%	
TCS02 (0402)	1/16W	-55~+155 C	500 - 1000		±100 ±50
TCS03 (0603)	1/10W		200 - 300 301 - 1000	±100 ±50	
TCS05 (0805)	1/8W		200 - 300 301 - 1000	±100 ±50	
TCS06 (1206)	1/4W	-55~+155 C	—	50 - 100	±200 ±100 ±50
TCS10 (2010)	3/4W		101 - 300 301 - 1000	±200 ±100 ±50	
TCS12 (2512)	1W	-55~+155 C	50 - 100 101 - 300 301 - 1000	±200 ±100 ±50	

High Power Rating Electrical Specifications

Item Type	Power Rating at 70°C	Operating Temp. Range	Resistance Range (mΩ)	TCR (PPM/°C)
			±1%	
TCS12 (2512)	3W	-55~+155 C	100 - 1000	±100

Operating Voltage= $\sqrt{P \cdot R}$

Overload Voltage= $2.5 \cdot \sqrt{P \cdot R}$

■ V king is capable of manufacturing the optional spec based on customer's requirement.

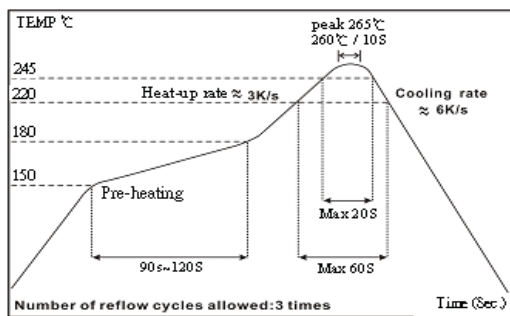
Environmental Characteristics

Item	Requirement	Test Method
Temperature Coefficient of Resistance (T.C.R.)	As Spec.	MIL-STD-202 Method 304 +25/-55/+25/+125/+25 C
Short Time Overload	±1%	JIS-C-5201-1 5.5 RCWV*2.5 or Max. overload voltage whichever is lower for 5seconds
Insulation Resistance	>1000MΩ	MIL-STD-202 Method 302 Apply 100V _{DC} for 1 minute
Endurance	±1%	MIL-STD-202 Method 108A 70±2 C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Damp Heat with Load	±0.5%	MIL-STD-202 Method 103B 40±2 C, 90~95% R.H., RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Bending Strength	As Spec.	JIS-C-5201-1 6.1.4 Bending amplitude 3mm for 10 seconds
Solderability	95% min. coverage	MIL-STD-202 Method 208H 245±5 C for 3 seconds
Resistance to Soldering Heat	±0.5%	MIL-STD-202 Method 210E 260±5 C for 10 seconds
Dielectric Withstand Voltage	By Type	MIL-STD-202 Method 301 Apply Max. Overload Voltage for 1 minute
Thermal Shock	±0.5%	MIL-STD-202 Method 107G -55 C ~ 150 C, 100 cycles
Low Temperature Operation	±0.5%	JIS-C-5201-1 7.1 1 hour, -65 C followed by 45 minutes of RCWV

RCWV(Rated continuous working voltage)= $\sqrt{P \cdot R}$ or Max. Operating voltage whichever is lower

■ **Storage Temperature: 25±3°C; Humidity < 80%RH**

Reflow



Marking

0603 3digit marking

Example :

Resistance	1Ω	0.1Ω	0.15Ω	0.01Ω	0.101Ω	0.035Ω
Codes	1R0	R10	R15	R01	<u>101</u>	<u>035</u>

0805-2512 4digit marking

Example :

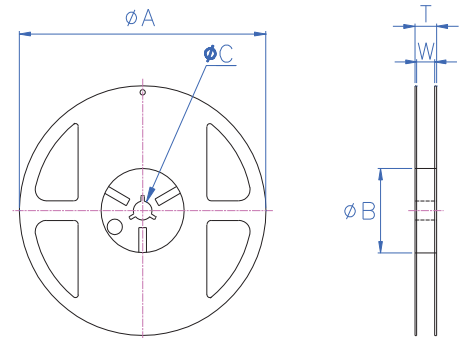
Resistance	1Ω	0.1Ω	0.05Ω	0.015Ω	0.01Ω
Codes	1R00	R100	R050	R015	R010

■ Packaging

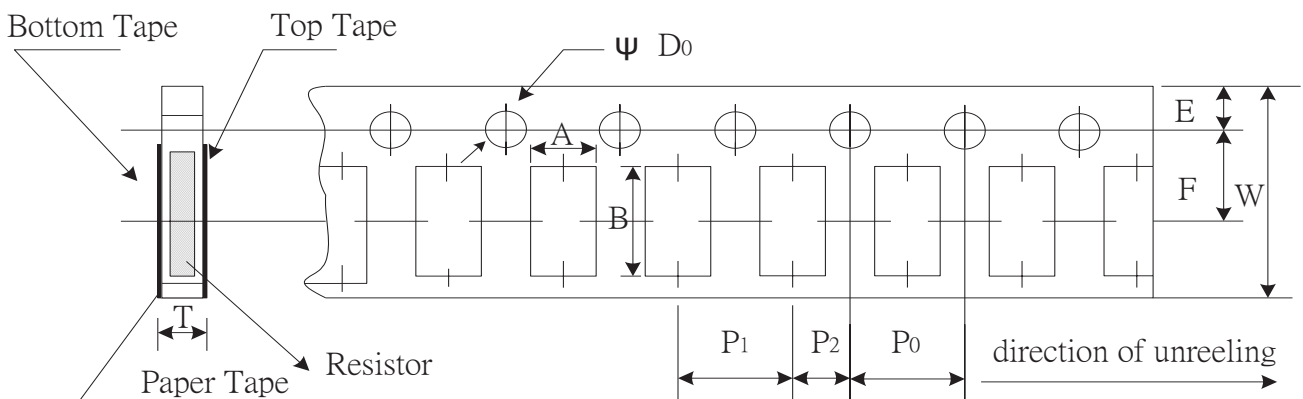
Packaging Quantity & Reel Specifications

Unit :mm

Type	∅A	∅B	∅C	W	T	Paper Tape (EA)	Emboss Plastic Tape (EA)
TCS02	178.0±1.0	60.0+1.0	13.5±0.7	9.5±1.0	11.5±1.0	10,000	
TCS03	178.0±1.0	60.0+1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
TCS05	178.0±1.0	60.0+1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
TCS06	178.0±1.0	60.0+1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
TCS10	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.00	15.5±1.0	-	4,000
TCS12	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.00	15.5±1.0	-	4,000



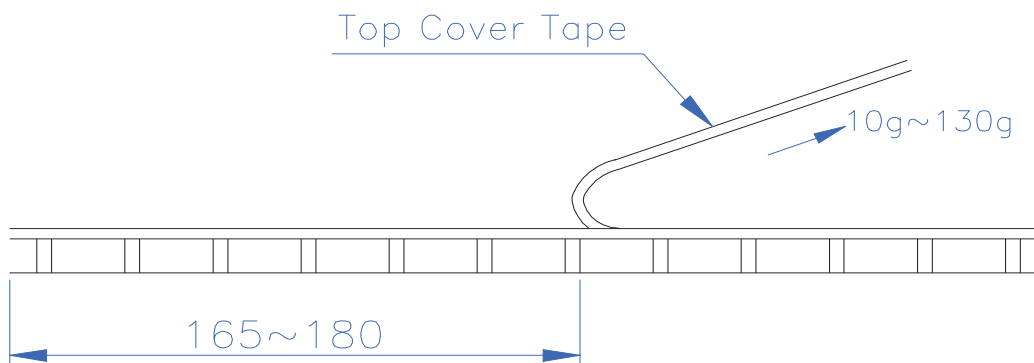
Paper Tape Specifications



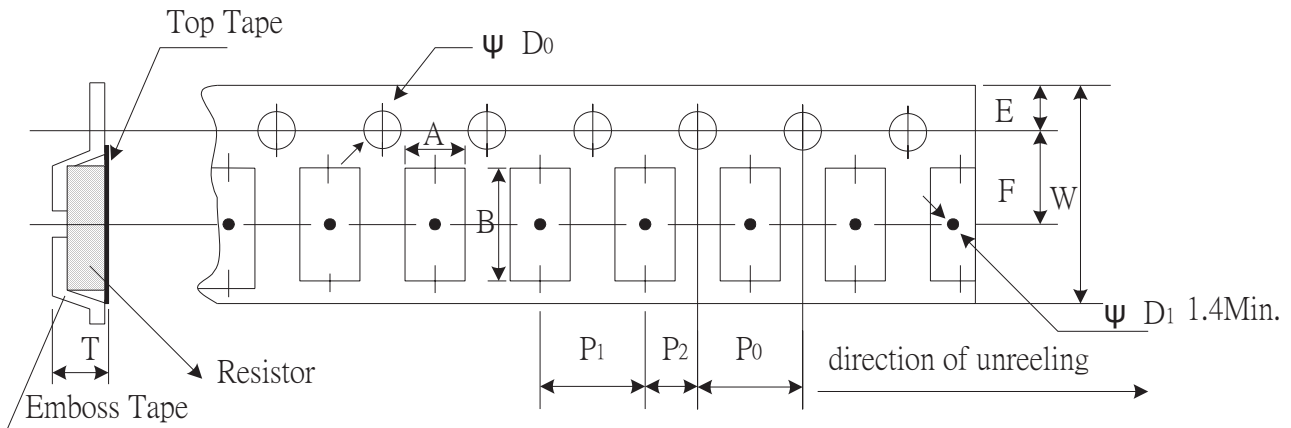
Unit: mm

Type	A	B	W	E	F	P0	P1	P2	∅D0	T
TCS02	0.70±0.05	1.16±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.55±0.05	0.40±0.03
TCS03	1.10±0.05	1.90±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.60±0.03
TCS05	1.60±0.05	2.37±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05
TCS06	2.00±0.05	3.55±0.05	8.00±0.10	1.75±0.05	3.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05

- Peel force of top cover tape
- The peel speed shall be about 300mm/min±5%
- The peel force of top cover tape shall be between 10 to 100g



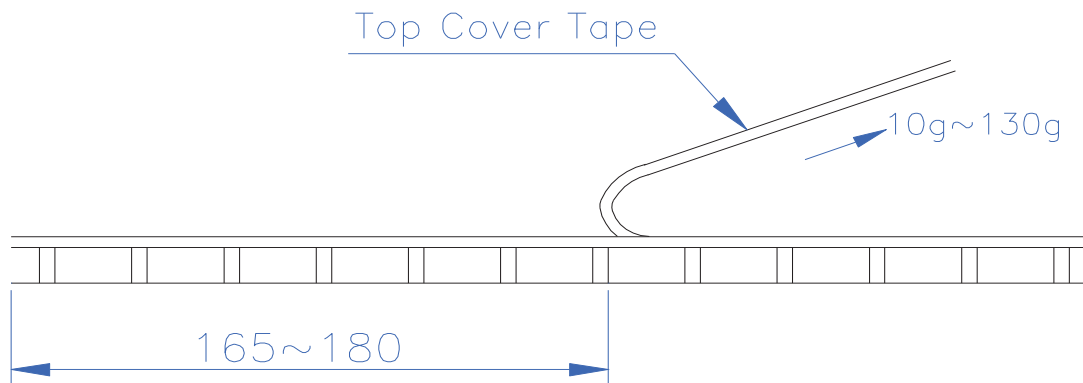
Emboss Plastic Tape Specifications



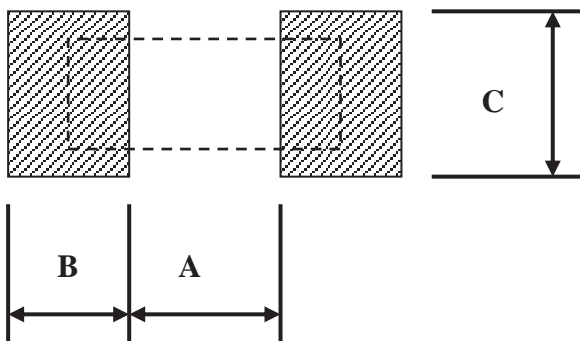
Unit: mm

Type	A	B	W	E	F	P ₀	P ₁	P ₂	ψD ₀	T
TCS10	2.85±0.10	5.45±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.00±0.20
TCS12	3.40±0.10	6.65±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.00±0.20

- Peel force of top cover tape
- The peel speed shall be about 300mm/min±5%
- The peel force of top cover tape shall be between 10 to 130g



■ Recommend Land Pattern



Unit : mm

Type	A	B	C
TCS02	0.50	0.50	0.60±0.2
TCS03	0.80	1.00	0.90±0.2
TCS05	1.00	1.00	1.35±0.2
TCS06	2.00	1.15	1.70±0.2
TCS10	3.60	1.40	2.50±0.2
TCS12	4.90	1.60	3.10±0.2

Current Sensing Thick Film Chip Resistor



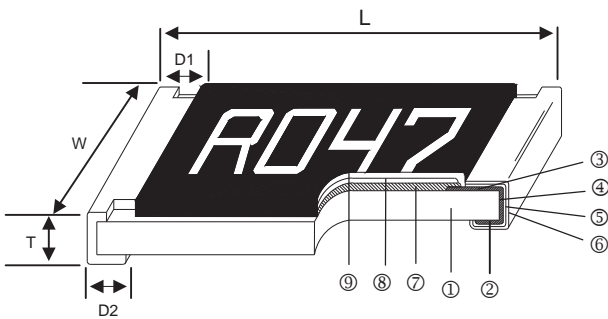
Scope

- This specification applies to all sizes of rectangular-type fixed chip resistors with Ruthenium-base as material.

Features

- Low inductance
- Highly reliable multilayer electrode construction
- Higher component and equipment reliability
- Reduced size of final equipment reliability

Construction



Applications

- Power Management Applications
- Switching Power Supply
- Over Current Protection in Audio Application
- Voltage Regulation Module (VRM)
- DC-DC Converter, Battery Pack, Charger, Adaptor
- Automotive Engine Control
- Disk Driver

①	Alumina Substrate	④	Edge Electrode (NiCr)	⑦	Resistor Layer (RuO ₂ /Ag)
②	Bottom Electrode (Ag)	⑤	Barrier Layer (Ni)	⑧	Primary Overcoat (Glass)
③	Top Electrode (Ag-Pd)	⑥	External Electrode (Sn)	⑨	Secondary Overcoat (Epoxy)

Dimensions

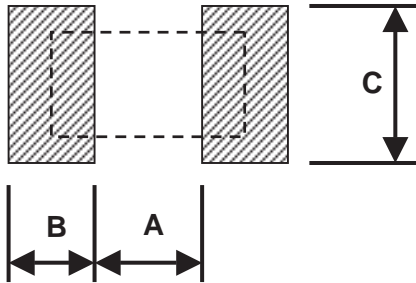
Type	Size (Inch)	L (mm)	W (mm)	T (mm)	D1 (mm)	D2 (mm)	Weight (g) (1000pcs)
RS-02	0402	1.00±0.05	0.50±0.05	0.35±0.05	0.20±0.10	0.20±0.10	0.620
RS-03	0603	1.60±0.10	0.80±0.10	0.45±0.10	0.30±0.20	0.30±0.20	2.042
RS-05	0805	2.00±0.10	1.25±0.10	0.50±0.10	0.35±0.20	0.40±0.20	4.368
RS-06	1206	3.10±0.10	1.55±0.10	0.55±0.10	0.50±0.25	0.50±0.20	8.947
RS-10	1210	3.10±0.10	2.60±0.15	0.55±0.10	0.50±0.25	0.50±0.20	15.959
RS-0A	2010	5.00±0.10	2.50±0.15	0.55±0.10	0.60±0.25	0.50±0.20	24.241
RS-12	2512	6.35±0.10	3.10±0.15	0.55±0.10	0.60±0.25	0.50±0.20	39.448

Part Numbering

Part Number : RS-03FL7-0R047

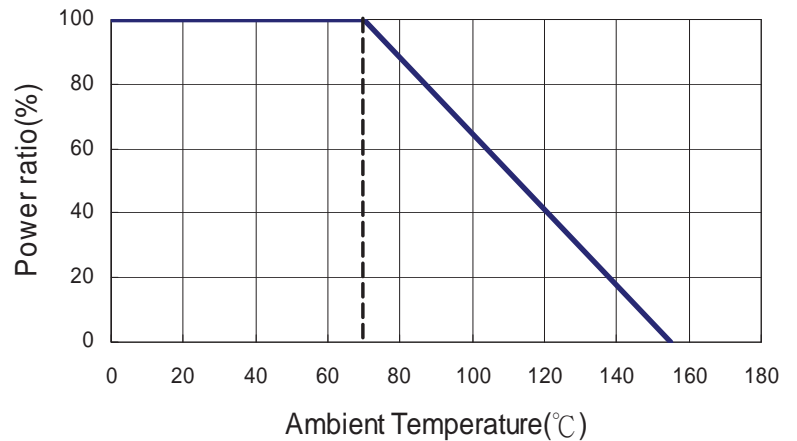
RS-	03	F	L	7	- 0 R 0 4 7
Product Type	Dimensions	Resistance Tolerance	Function Code	Packaging Code	Resistance
RS	02: 0402 03: 0603 05: 0805 06: 1206 10: 1210 0A: 2010 12: 2512	F: $\pm 1\%$ J: $\pm 5\%$	L: Standard P: High Power	4: 7" Reel 4Kpcs 6: 7" Reel 10Kpcs 7: 7" Reel 5Kpcs 9: 10" Reel 8Kpcs A: 10" Reel 10Kpcs B: 10" Reel 20Kpcs C: 13" Reel 40Kpcs D: 13" Reel 20Kpcs F: Bulk	- 0R047: 0.047Ω - - - 0R1: 0.1Ω "-" to fill up 6 spaces

Recommend Land Pattern

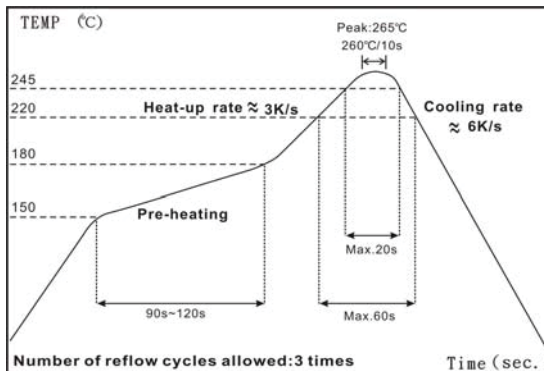


Type	A (mm)	B (mm)	C (mm)
RS-02	0.50	0.45	0.60
RS-03	0.90	0.60	0.90
RS-05	1.20	0.70	1.30
RS-06	2.00	0.90	1.60
RS-10	2.00	0.90	2.80
RS-0A	3.80	0.90	2.80
RS-12	3.80	1.60	3.50

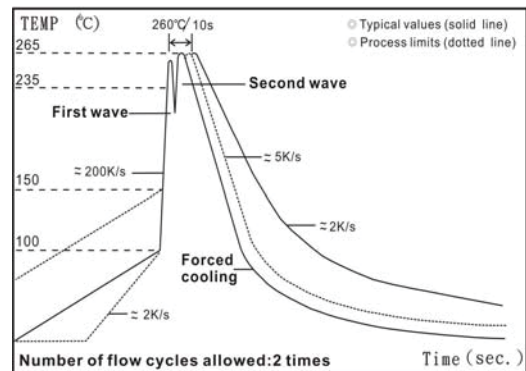
Derating Curve



Soldering Condition



IR Reflow Soldering



Wave Soldering (Flow Soldering)

- (1) Time of IR reflow soldering at maximum temperature point $260^\circ C$: 10s
- (2) Time of wave soldering at maximum temperature point $260^\circ C$: 10s
- (3) Time of soldering iron at maximum temperature point $410^\circ C$: 5s

Standard Electrical Specifications

Item Type	Power Rating at 70°C	Operating Temp. Range	Max. Operating Current	Resistance Range (mΩ)		TCR (PPM/°C)
				±1%	±5%	
RS-02 (0402)	1/16W	-55 ~ +155°C	1.11A	50 - 91 100 - 976		±800 ±500
RS-03 (0603)	1/10W	-55 ~ +155°C	2.23A	20 - 47 50 - 91 100 - 976		±1200 ±800 ±500
RS-05 (0805)	1/8W	-55 ~ +155°C	3.53A	10 - 18 20 - 47 50 - 91 100 - 976		±1500 ±1200 ±800 ±500
RS-06 (1206)	1/4W	-55 ~ +155°C	5.00A			
RS-10 (1210)	1/3W	-55 ~ +155°C	5.77A			
RS-0A (2010)	3/4W	-55 ~ +155°C	8.66A	10 - 18 20 - 91 100 - 976		±1500 ±800 ±500
RS-12 (2512)	1W	-55 ~ +155°C	10.0A			

Operating Voltage= $\sqrt{P \cdot R}$; Overload Voltage= $2.5 \cdot \sqrt{P \cdot R}$

High Power Electrical Specifications

Item Type	Power Rating at 70°C	Operating Temp. Range	Max. Operating Current	Resistance Range (mΩ)		TCR (PPM/°C)
				±1%	±5%	
RS-02 (0402)	1/10W	-55 ~ +155°C	1.40A	50 - 91 100 - 976		±800 ±500
RS-03 (0603)	1/8W	-55 ~ +155°C	2.50A	20 - 47 50 - 91 100 - 976		±1200 ±800 ±500
RS-05 (0805)	1/4W	-55 ~ +155°C	5.00A	10 - 18 20 - 47 50 - 91 100 - 976		±1500 ±1200 ±800 ±500
RS-06 (1206)	1/3W	-55 ~ +155°C	5.77A			
RS-10 (1210)	1/2W	-55 ~ +155°C	7.07A			
RS-0A (2010)	1W	-55 ~ +155°C	10.0A	10 - 18 20 - 91 100 - 976		±1500 ±800 ±500
RS-12 (2512)	2W	-55 ~ +155°C	14.1A			

Operating Voltage= $\sqrt{P \cdot R}$

Overload Voltage= $2.5 \cdot \sqrt{P \cdot R}$

Operating Current= $\sqrt{P/R}$

■ Viking is capable of manufacturing the optional spec based on customer's requirement.

Environmental Characteristics

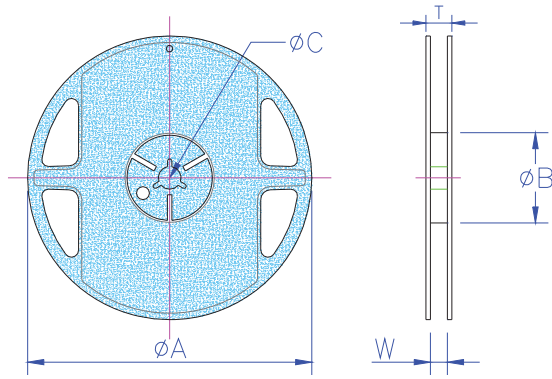
Item	Requirement		Test Method
	±1%	±5%	
Temperature Coefficient of Resistance (T.C.R.)	As Spec.		JIS-C-5201-1 4.8 IEC-60115-1 4.8 -55°C~+125°C, 25°C is the reference temperature
Short Time Overload	±(1.0%+0.05Ω)	±(2.0%+0.05Ω)	JIS-C-5201-1 4.13 IEC-60115-1 4.13 RCWV*2.5 or Max. Overload Voltage whichever is lower for 5 seconds, 2 seconds for High Power Series
Insulation Resistance	≥10G		JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. Overload voltage for 1 minute
Endurance	±(1.0%+0.10Ω)	±(2.0%+0.10Ω)	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 70±2°C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Damp Heat with Load	±(1.0%+0.10Ω)	±(2.0%+0.10Ω)	JIS-C-5201-1 4.24 40±2°C, 90~95% R.H., RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Dry Heat	±(1.0%+0.05Ω)	±(1.5%+0.10Ω)	JIS-C-5201-1 4.23 IEC-60115-1 2.23.2 at +155°C for 1000 hrs
Bending Strength	±(1.0%+0.05Ω)	±(1.0%+0.05Ω)	JIS-C-5201-1 4.33 IEC-60115-1 4.33 Bending once for 5 seconds 2010, 2512 sizes: 2mm Other sizes: 3mm
Solderability	95% min. coverage		JIS-C-5201-1 4.17 IEC-60115-1 4.17 245±5°C for 3 seconds
Resistance to Soldering Heat	±(0.5%+0.05Ω)	±(1.0%+0.05Ω)	JIS-C-5201-1 4.18 IEC-60115-1 4.18 260±5°C for 10 seconds
Voltage Proof	No breakdown or flashover		JIS-C-5201-1 4.7 IEC-60115-1 4.7 1.42 times Max. Operating Voltage for 1 minute
Leaching	Individual leaching area ≤ 5% Total leaching area ≤ 10%		JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 260±5°C for 30 seconds
Rapid Change of Temperature	±(0.5%+0.05Ω)	±(1.0%+0.05Ω)	JIS-C-5201-1 4.18 IEC-60115-1 4.18 -55°C to +155°C, 5 cycles

RCWV(Rated continuous working voltage)= $\sqrt{P \cdot R}$ or Max. Operating voltage whichever is lower.

■ Storage Temperature: 25±3°C; Humidity < 80%RH

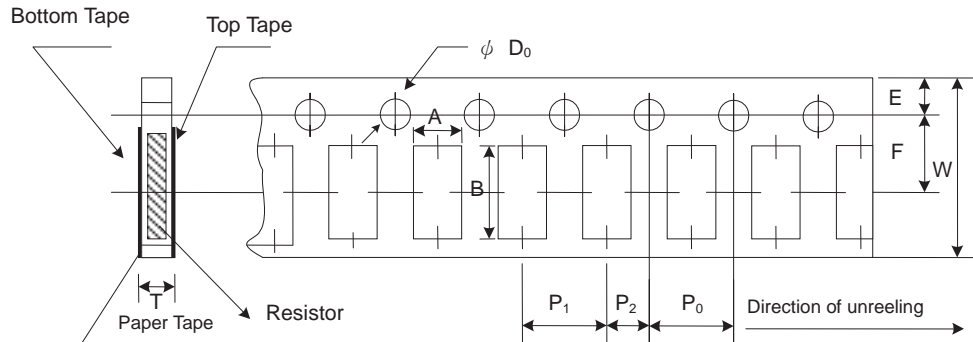
■ Packaging

Reel Specifications & Packaging Quantity



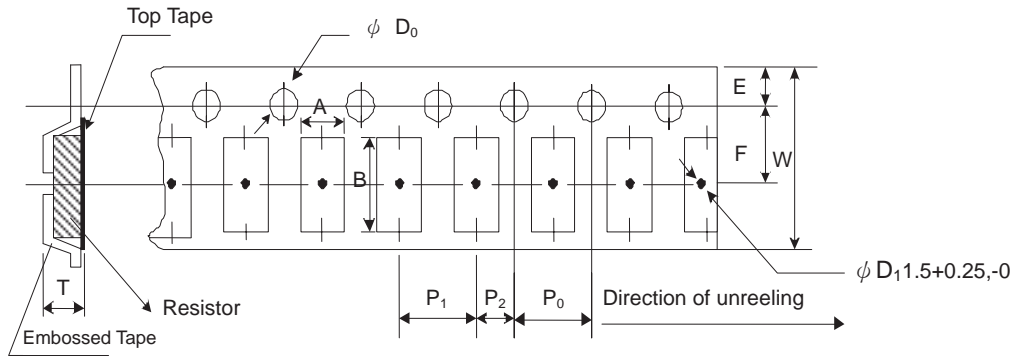
Type	Packaging Quantity	Tape Width	Reel Diameter	ϕA (mm)	ϕB (mm)	ϕC (mm)	W (mm)	T (mm)	
RS-02	Paper	10K	8mm	7 inch	178.5±1.5	60 ^{+1/-0}	13.0±0.2	9.0±0.5	12.5±0.5
		20K	8mm	10 inch	254±1.0	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5
		40K	8mm	13 inch	330±1.0	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5
RS-03 RS-05 RS-06 RS-10	Paper	5K	8mm	7 inch	178.5±1.5	60 ^{+1/-0}	13.0±0.2	9.0±0.5	12.5±0.5
10K		8mm	10 inch	254±1.0	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5	
20K		8mm	13 inch	330±1.0	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5	
RS-0A RS-12	Embossed	4K	12mm	7 inch	178.5±1.5	60 ^{+1/-0}	13.0±0.5	13.0±0.5	15.5±0.5
8K		12mm	10 inch	250±1.0	62±0.5	13.0±0.5	12.5±0.5	16.5±0.5	

Paper Tape Specifications



Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ϕD_0 (mm)	T (mm)
RS-02	0.65±0.10	1.15±0.10	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.50+0.1,-0	0.45±0.10
RS-03	1.10±0.10	1.90±0.10	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.70±0.10
RS-05	1.60±0.10	2.40±0.20	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.10
RS-06	1.90±0.10	3.50±0.20	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.10
RS-10	2.90±0.10	3.50±0.20	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.10

Embossed Plastic Tape Specifications



Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ΦD ₀ (mm)	T (mm)
RS-0A	2.8±0.10	5.5±0.10	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.1, -0	1.2 ⁺⁰
RS-12	3.5±0.10	6.7±0.10	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.1, -0	1.2 ⁺⁰

■ Marking

No Marking for 0402

1%, 5% for 0805/1206/1210/2010/2512: 4 digits marking

Example:

Resistance	47mΩ	75mΩ	15mΩ	750mΩ	820mΩ
Marking	R047	R075	R015	R750	R820

5% for 0603: 3 digits marking in E24

1% for 0603: 3 digits marking with under-line in E96 (non-including E24 series)

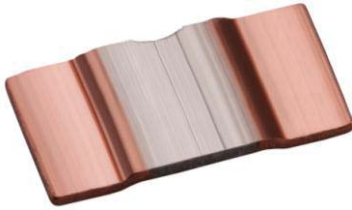


3 digits marking for E24 or R value suffix is zero in E96: R10=100mΩ; R28=280mΩ



3 digits marking for E96: 243=243mΩ; 511=511mΩ

Chip Shunt Resistor



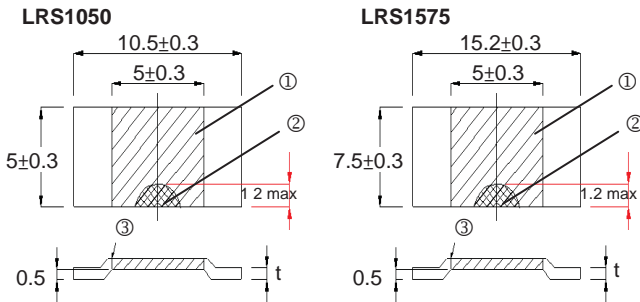
Features

- LRS1050 5W up to 100A at 0.5mΩ
- LRS1575 7W up to 180A at 0.2mΩ
- Maximum soldering temperatures of up to 350 C / 30 sec. or 250 C / 10 min
- Heavy copper connectors
- Excellent long-term stability and low inductance
- Mounting using re-flow soldering or welding on copper

Applications

- Current sensors for hybrid power sources
- Frequency converters
- High current automotive

Construction



①	Resistance Material	②	Trimming Area	③	Electron Beam Welding
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Dimensions

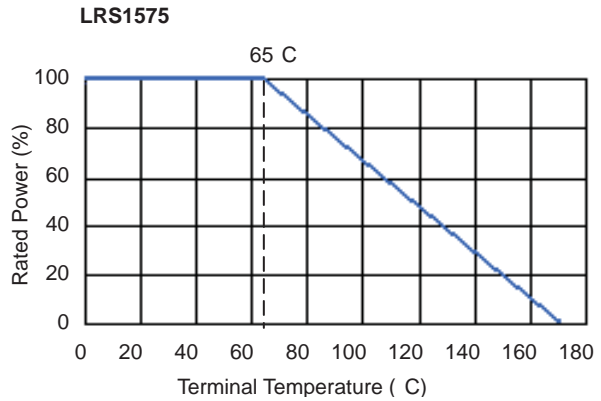
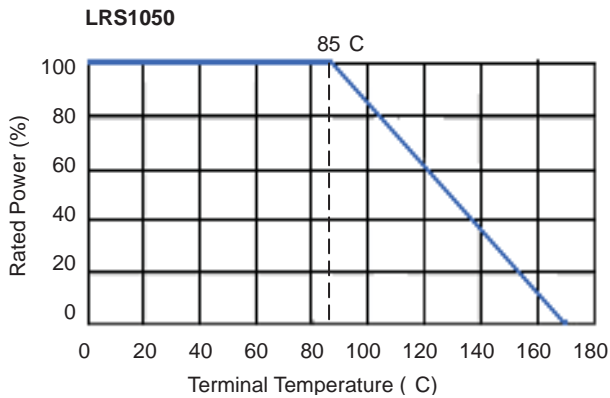
Unit: mm

Type	Size (Inch)	Value	Material	Thickness (t)	Weight (g) (1000pcs)
LRS1050	1050	0.5mΩ	Manganin	0.88 mm±0.05	420
LRS1050	1050	1mΩ	Manganin	0.43 mm±0.05	220
LRS1050	1050	2mΩ	NiCr alloy	0.64 mm±0.05	310
LRS1050	1050	3mΩ	NiCr alloy	0.43 mm±0.05	210
LRS1050	1050	4mΩ	NiCr alloy	0.32 mm±0.05	160
LRS1575	1575	0.2mΩ	Manganin	1.50 mm±0.05	590
LRS1575	1575	0.5mΩ	Manganin	0.56 mm±0.05	590
LRS1575	1575	1mΩ	NiCr alloy	0.90 mm±0.05	940
LRS1575	1575	2mΩ	NiCr alloy	0.45 mm±0.05	470
LRS1575	1575	3mΩ	NiCr alloy	0.30 mm±0.05	320

Part Numbering

LRS	1050	F	T	D	D	0M50	M
Product Type	Dimensions	Resistance Tolerance	Packaging Code	TCR (PPM/°C)	Power Rating	Resistance	Marking Code
	1050: 10.5x5.0 1575: 15.2x7.5	F: ±1% G: ±2% J: ±5%	T: Taping Reel B: Bulk	D: ±50 1: ±60 W: ±75 E: ±100 2: ±120	B: 2.5W R: 3W C: 3.5W D: 5W I: 6W E: 7W	0M50: 0.5mΩ R001: 1mΩ R002: 2mΩ R003: 3mΩ R004: 4mΩ	M: Manganin N: NiCr alloy

Derating Curve



Standard Electrical Specifications

Type	Power Rating	Operating Temp. Range	Resistance Range			TCR (PPM/°C) (+20°C ~ +150°C)
			±1%	±2%	±5%	
LRS1050	5W	-55 C ~ +170 C		0.5mΩ		±75
LRS1050	4W			1mΩ		±60
LRS1050	4W			2mΩ		±100
LRS1050	3W			3mΩ		±100
LRS1050	2.5W			4mΩ		±100
LRS1575	7W			0.2mΩ		±50
LRS1575	6W			0.5mΩ		±100
LRS1575	6W			1mΩ		±120
LRS1575	4W			2mΩ		±120
LRS1575	3.5W			3mΩ		±120

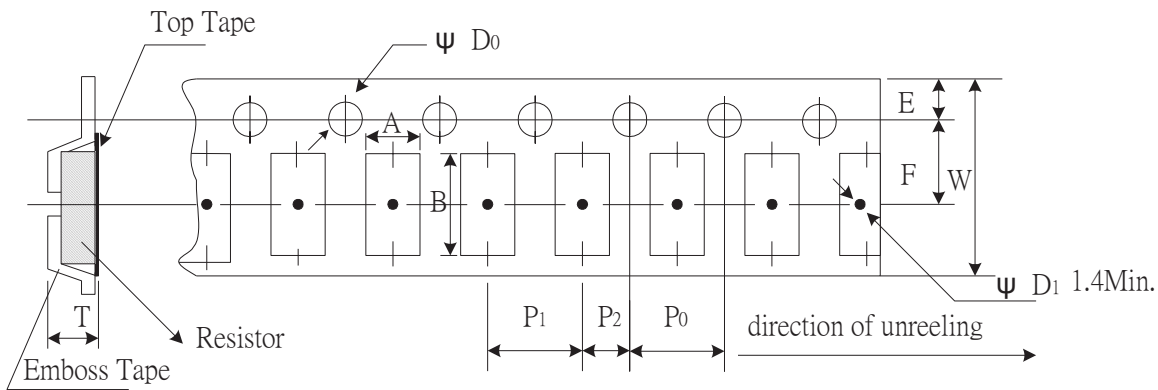
Environmental Characteristics

Item	Requirement	Test Method
Short time overload	±0.2%	Rated Power × 5 for 5 seconds
Load Life	±1.0%	90 min. "ON", 30 min. "OFF" for 2000 hours
Resistance to Soldering Heat	±0.2%	350°C for 30 seconds or 250°C for 10 min.
Thermal Shock	±0.1%	-65 C, 25 C, 125 C, 25 C, 25 cycles
Moisture Resistance	±0.2%	90 ~ 98%RH, +25°C, +65°C, -10°C, 10 cycles
High Temperature Exposure	±0.2%	140°C for 250 hours
V bration, High Frequency	±0.2%	15g 10~2000Hz, 36 cycles
Inductance	<3nH	—

■ Storage Temperature: 25±3°C; Humidity < 80%RH

Packaging

Emboss Plastic Tape Specifications



Unit: mm

Type	A	B	W	E	F	P ₀	P ₁	P ₂	∅D ₀	T	Quantity (EA)
LRS1050	5.7	11.2	16	1.75	7.5	4	12	6	1.50	1.2	3000
LRS1575	8.2	16.1	24	1.75	11.5	4	12	6	1.50	1.9	2000

Low Ohm (Metal Strip) Chip Resistor- LRM Series



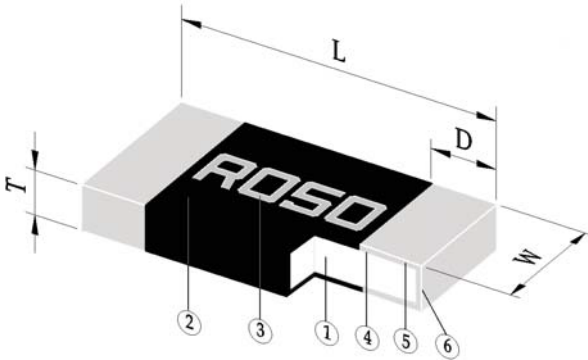
■ Features

- High power rating up to 3 Watts
- Low TCR down to ± 100 PPM/ $^{\circ}\text{C}$
- Resistance values from 10m to 50m ohm
- Customized resistance available

■ Applications

- NB (for Power Management)
- MB (for Power Management)
- SWPS (DC-DC Converter, Charger, Adaptor)
- Monitor (for Power Management)

■ Construction



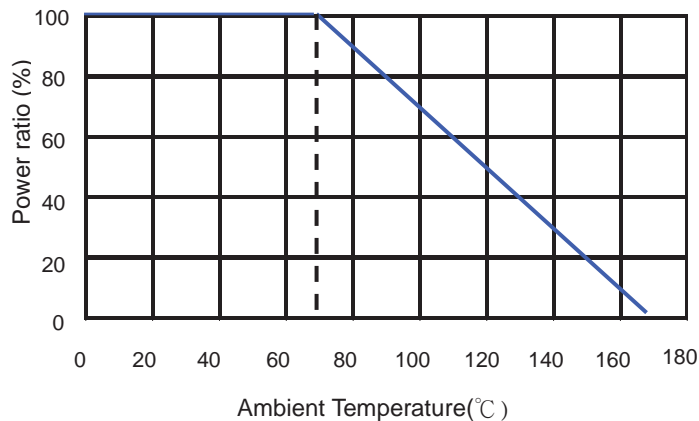
① Alloy Plate	④ Internal Electrode (Cu)
② Overcoat (molding)	⑤ Barrier Layer (Ni)
③ Marking	⑥ Solder Plating (Sn)

Black – Wave or IR reflow soldering

■ Dimensions

Type	Size (Inch)	L (mm)	W (mm)	T (mm)	D (mm)	Weight (g) (1000pcs)
LRM06	1206	3.20 \pm 0.20	1.60 \pm 0.20	0.60 \pm 0.20	0.50 \pm 0.30	18.80
LRM10	2010	5.00 \pm 0.20	2.50 \pm 0.20	0.60 \pm 0.20	0.60 \pm 0.30	40.50
LRM12	2512	6.20 \pm 0.20	3.20 \pm 0.20	0.60 \pm 0.20	1.10 \pm 0.30	90.90

■ Derating Curve



Part Numbering

LRM	12	J	T	E	S	R010	
Product Type	Dimensions (LxW)	Resistance Tolerance	Packaging Code	TCR (PPM/°C)	Power Rating	Resistance	Marking
	06: 1206 10: 2010 12: 2512	F: ±1% G: ±2% J: ±5%	T: Taping Reel	E: ±100 W: ±75	R: 3W S: 2W A: 1.5W T: 1W Q: 3/4W U: 1/2W O: 1/3W V: 1/4W W: 1/8W	R010: 0.01Ω R050: 0.05Ω R100: 0.1Ω	: Black Coating N: No Marking

Standard Electrical Specifications

Item Type	Power Rating at 70°C	Operating Temp. Range	Resistance Range (mΩ)			TCR (PPM/°C)
			±1%	±2%	±5%	
LRM06 (1206)	1/4W 1/2W 1W	-55 ~ +170°C	5-10			±100
			11-30			±75
LRM10 (2010)	3/4W 1W	-55 ~ +170°C	5-10			±100
			11-30			±75
LRM12 (2512)	1W 2W	-55 ~ +170°C	10-100			±75

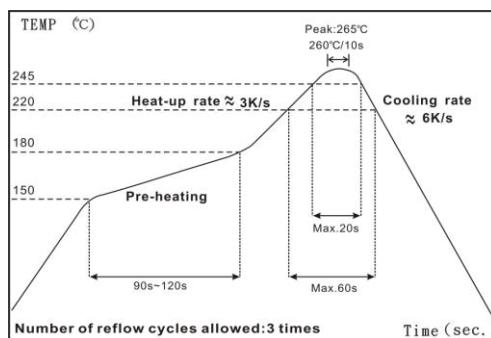
High Power Rating Electrical Specifications

Item Type	Power Rating at 70°C	Operating Temp. Range	Resistance Range (mΩ)			TCR (PPM/°C)
			±1%	±2%	±5%	
LRM10 (2010)	1.5W	-55 ~ +170°C	10-30			±75
LRM12 (2512)	3W	-55 ~ +170°C	10-100			±75

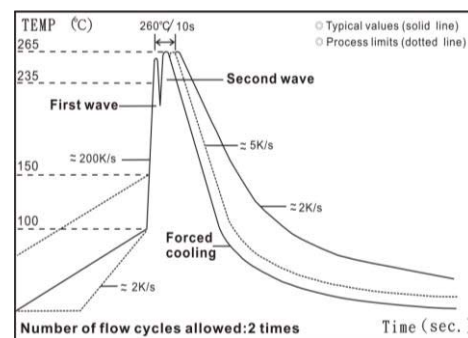
Operating Current = $\sqrt{P/R}$, Operating Voltage = $\sqrt{P \cdot R}$

■ Viking is capable of manufacturing the optional spec based on customer's requirement.

Soldering Condition



IR Reflow Soldering



Wave Soldering (Flow Soldering)

- (1) Time of IR reflow soldering at maximum temperature point 260°C : 10s
- (2) Time of wave soldering at maximum temperature point 260°C : 10s
- (3) Time of soldering iron at maximum temperature point 410°C : 5s

■ Environmental Characteristics

Item	Requirement	Test Method
Temperature Coefficient of Resistance (T.C.R.)	As Spec.	MIL-STD-202 Method 304 +25/-55/+25/+125/+25°C
Short Time Overload	±0.5%	JIS-C-5201-1 5.5 5*rated power for 5 seconds
Insulation Resistance	≥1G	JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. Overload Voltage for 1 minute
Endurance	±1.0%	MIL-STD-202 Method 108A 70±2°C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Dry Heat	±1.0%	JIS-C-5201-1 7.2 at +170°C for 1000 hrs
Bending Strength	±1.0%	JIS-C-5201-1 4.33 IEC-60115-1 4.33 Bending width 2mm once for 5 seconds
Solderability	95% min. coverage	MIL-STD-202 Method 208H 245±5°C for 3 seconds
Resistance to Soldering Heat	±0.5%	MIL-STD-202 Method 210E 260±5°C for 10 seconds
Thermal Shock	±0.5%	MIL-STD-202 Method 107G -55°C ~ 150°C, 100 cycles

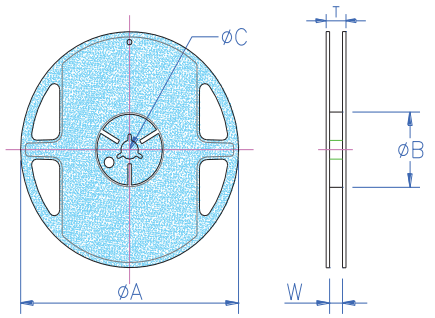
RCWV(Rated continuous working voltage)= $\sqrt{P \cdot R}$ or Max. Operating voltage whichever is lower

■ **Storage Temperature: 25±3°C; Humidity < 80%RH**

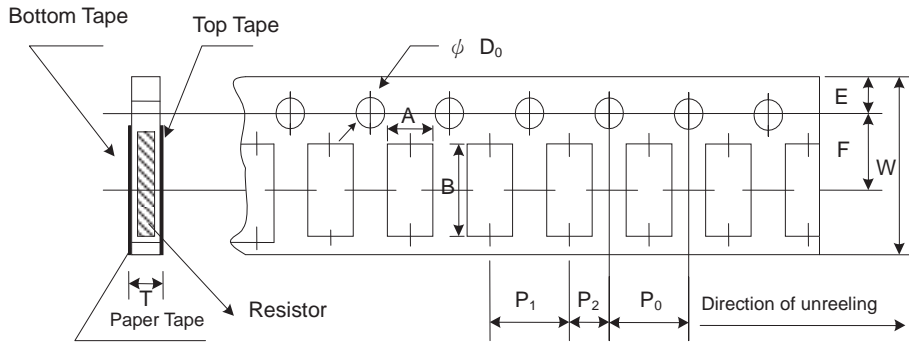
Packaging

Reel Specifications & Packaging Quantity

Type	Packaging Quantity	Tape Width	Reel Diameter	ΦA (mm)	ΦB (mm)	ΦC (mm)	W (mm)	T (mm)	
LRM06	Paper	5K	8mm	7 inch	178.5±1.5	60 ^{+1/-0}	13.0±0.5	9.0±0.5	11.5±0.5
LRM10	Embossed	4K	12mm	7 inch	178.5±1.5	60 ^{+1/-0}	13.0±0.5	13.0±0.5	15.5±0.5
LRM12	Embossed	4K	12mm	7 inch	178.5±1.5	60 ^{+1/-0}	13.0±0.5	13.0±0.5	15.5±0.5

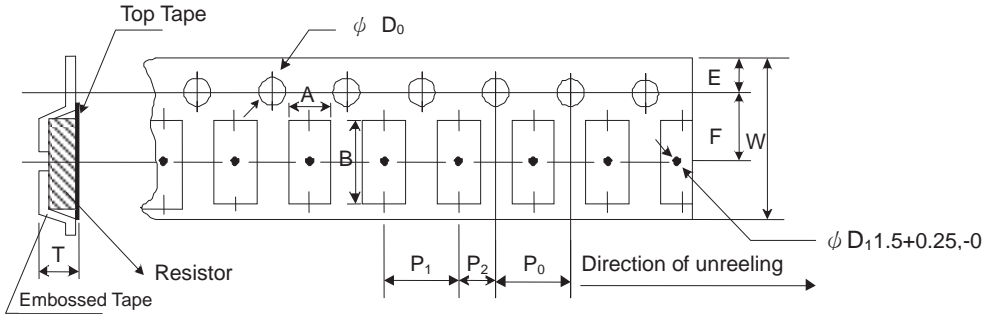


Paper Tape Specifications



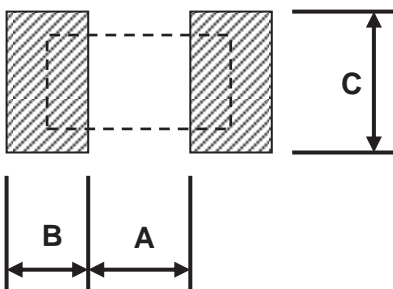
Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ΦD ₀ (mm)	T (mm)
LRM06	2.00±0.15	3.60±0.20	8.00±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.1/-0	0.85±0.10

Embossed Plastic Tape Specifications



Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ΦD ₀ (mm)	T (mm)
LRM10	2.80±0.20	5.30±0.20	12.0±0.20	1.75±0.10	5.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.1, -0	1.2 ⁺⁰
LRM12	3.50±0.10	6.70±0.10	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.1, -0	1.2 ⁺⁰

Recommend Land Pattern



Type	A (mm)	B (mm)	C (mm)
LRM06	1.40	1.90	1.80
LRM10	3.50	1.50	2.80
LRM12 (10-50mΩ)	3.80	1.60	3.50
LRM12 (51-100mΩ)	4.10	2.10	4.00
LRM12 (High Power)	4.10	2.10	4.00

Ultra Low Ohm (Metal Strip) Chip Resistor



■ Features

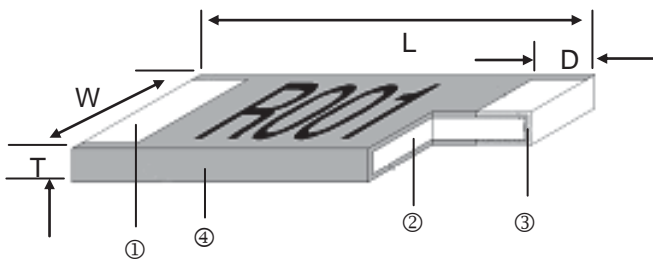
- High power rating up to 3 Watts
- Low TCR down to ± 50 PPM/ $^{\circ}\text{C}$
- Resistance values from 0.5m to 15m ohm
- Customized resistance available
- Wide range package sizes 1206 / 2010 / 2512

■ Applications

- NB (for Power Management)
- MB (for Power Management)
- SWPS (DC-DC Converter, Charger, Adaptor)
- Monitor (for Power Management)

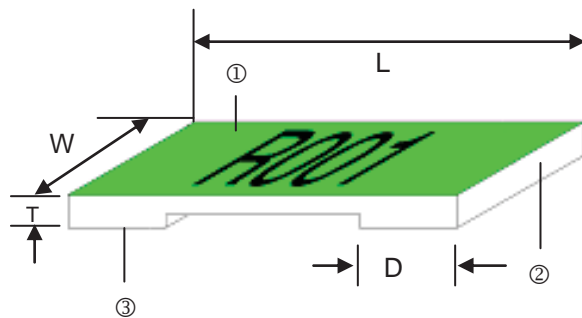
■ Construction & Dimension

2512



Black – Wave or IR reflow soldering

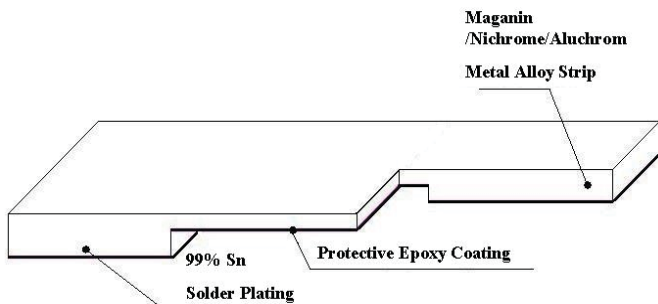
① Solder Plating (Sn)	③ Barrier Layer (Ni)
② Alloy Plate	④ Overcoat



Green – IR reflow soldering only

① Overcoat	③ Solder Plating
② Alloy Plate	

1206 & 2010



Type	Material
0M50~ R003	Manganese, Copper
R004 ~ R010	Aluminum, Iron, Chromium

■ Dimensions

Unit: mm

Part No.	Resistance (mΩ)	L	W	T	D	Weight (g) (1000pcs)
LR06□TF0M50	0.5	3.20±0.25	1.60±0.10	0.60±0.20	1.35±0.25	22.6
LR06□TD0M75	0.75	3.20±0.25	1.60±0.10	0.60±0.20	1.23±0.25	22.6
LR06□T□□□□□	1.0, 4.0, 5.0, 6.0	3.20±0.25	1.60±0.10	0.60±0.20	1.10±0.25	22.6
LR06□T□□□□□	2.0, 3.0, 10	3.20±0.25	1.60±0.10	0.60±0.20	0.60±0.25	22.6
LR06□T□□□□□	7.0, 8.0, 9.0	3.20±0.25	1.60±0.10	0.60±0.20	0.90±0.25	22.6
LR10□TEA0M50	0.5	5.08±0.25	2.54±0.15	0.60±0.20	2.17±0.25	42.3
LR10□TDA0M75	0.75	5.08±0.25	2.54±0.15	0.60±0.20	2.04±0.25	42.3
LR10□TDAR001	1.0	5.08±0.25	2.54±0.15	0.60±0.20	1.84±0.25	42.3
LR10□TDA□□□□	2.0, 6.0, 7.0, 8.0	5.08±0.25	2.54±0.15	0.60±0.20	1.54±0.25	42.3
LR10□TDAR003	3.0	5.08±0.25	2.54±0.15	0.60±0.20	1.04±0.25	42.3
LR10□TDA□□□□	4.0, 5.0	5.08±0.25	2.54±0.15	0.60±0.20	1.84±0.25	42.3
LR10□TDA□□□□	9.0, 10	5.08±0.25	2.54±0.15	0.60±0.20	1.29±0.25	42.3
LR12□T□0M50G	0.50	6.35±0.25	3.00±0.20	0.60±0.20	2.68±0.25	59.13
LR12□T□0M75G	0.75	6.35±0.25	3.00±0.20	0.60±0.20	2.48±0.25	59.13
LR12□T□□□□□G	1.0, 6.0	6.35±0.25	3.00±0.20	0.60±0.20	1.93±0.25	59.13
LR12□T□□□□□G	1.5, 6.5, 7.0	6.35±0.25	3.00±0.20	0.60±0.20	1.43±0.25	59.13
LR12□T□□□□□G	2.0, 3.0	6.35±0.25	3.00±0.20	0.60±0.20	1.18±0.25	59.13
LR12□T□□□□□G	4.0, 4.5	6.35±0.25	3.00±0.20	0.60±0.20	2.18±0.25	59.13
LR12□T□□□□□G	5.0, 6.0	6.35±0.25	3.00±0.20	0.60±0.20	1.93±0.25	59.13
LR12□T□□□□□G	8.0 - 15	6.35±0.25	3.00±0.20	0.60±0.20	1.18±0.25	59.13
LR12□T□0M50	0.50	6.35±0.254	3.18±0.254	1.25±0.20	1.30±0.38	181.10
LR12□T□0M75	0.75	6.35±0.254	3.18±0.254	0.75±0.20	1.30±0.38	127.06
LR12□T□R001	1.00	6.35±0.254	3.18±0.254	0.65±0.20	1.30±0.38	108.81
LR12□T□1M50	1.50	6.35±0.254	3.18±0.254	0.45±0.20	1.30±0.38	63.92
LR12□T□R002	2.00	6.35±0.254	3.18±0.254	0.35±0.20	1.30±0.38	46.92
LR12□T□2M50	2.50	6.35±0.254	3.18±0.254	0.65±0.20	1.30±0.38	97.95
LR12□T□R003	3.00	6.35±0.254	3.18±0.254	0.55±0.20	1.30±0.38	83.49
LR12□T□R004	4.00	6.35±0.254	3.18±0.254	0.45±0.20	1.30±0.38	62.59
LR12□T□R005	5.00	6.35±0.254	3.18±0.254	0.35±0.20	1.30±0.38	49.84
LR12□T□R006	6.00	6.35±0.254	3.18±0.254	0.32±0.20	1.30±0.38	41.76
LR12□T□6M50	6.50	6.35±0.254	3.18±0.254	0.30±0.20	1.30±0.38	35.85
LR12□T□R007	7.00	6.35±0.254	3.18±0.254	0.27±0.20	1.30±0.38	34.01
LR12□T□R010	10.00	6.35±0.254	3.18±0.254	0.25±0.20	1.30±0.38	25.97

■ Part Numbering

LR	12	J	T	E	S	R002	G
Product Type	Dimensions (LxW) 06: 1206 10: 2010 12: 2512	Resistance Tolerance F: ±1% H: ±3% J: ±5%	Packaging Code T: Taping Reel	TCR (PPM/°C) D: ±50 E: ±100 W: ±75 F: ±200	Power Rating : Standard A: 1.5W B: 2.5W R: 3W S: 2W	Resistance R002: 0.002Ω R010: 0.01Ω 0M50: 0.0005Ω 1M50: 0.0015Ω	Marking : Black Coating G: Green Coating **2010/1206 No coating / marking

Standard Electrical Specifications

Part No.	Item	Power Rating at 70°C	Operating Temp. Range	Resistance Range (mΩ)			TCR (PPM/°C)
				±1%	±3%	±5%	
LR06□TF0M50		1W	-55°C ~ +170°C	0.5			±200
LR06□TD□□□□		1W		0.75 - 10			±50
LR12□TD□□□□		1W		0.5, 0.75, 1, 1.5, 2			±50
LR12□TW□□□□		1W		6, 6.5, 7			±75
LR12□TE□□□□		1W		4, 5, 10			±100
LR12□TK□□□□		1W		2.5, 3			±150
LR12□TD□□□□G		1W		11, 12, 13, 14, 15			±50

High Power Rating Electrical Specifications

Part No.	Item	Power Rating at 70°C	Operating Temp. Range	Resistance Range (mΩ)			TCR (PPM/°C)
				±1%	±3%	±5%	
LR10□TEA0M50		1.5W	-55°C ~ +170°C	0.5			±100
LR10□TDA□□□□		1.5W		0.75 - 10			±50
LR12□TDS□□□□		2W		0.5, 0.75, 1, 1.5, 2			±50
LR12□TWS□□□□		2W		6, 6.5, 7			±75
LR12□TES□□□□		2W		4, 5, 10			±100
LR12□TKS□□□□		2W		2.5, 3			±150
LR12□TDS□□□□G		2W		6.5, 7, 8, 9, 10			±50
LR12□TDB□□□□G		2.5W		4, 4.5, 5, 6			±50
LR12□TDR□□□□G		3W		1, 1.5, 2, 3			±50
LR12□TER□□□□G		3W		0.5, 0.75			±100

Operating Current = $\sqrt{P/R}$, Operating Voltage = $\sqrt{P \cdot R}$

■ Viking has the ability of manufacture following options based on customer's requirement.

Resistance codes example

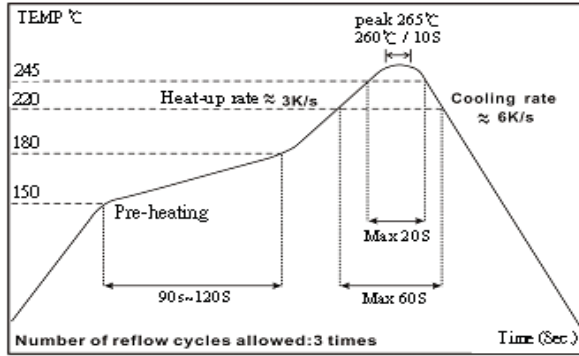
Resistance (3Marking)

Resistance	0.5mΩ	0.75mΩ
Codes	M50	M75

Resistance (4Marking)

Resistance	1mΩ	1.5mΩ	2mΩ	7mΩ	10mΩ
Codes	R001	1M50	R002	R007	R010

Reflow



- Green coating "Reflow Air Convection" is available
- Green coating can't be working with wave soldering bath

Environmental Characteristics

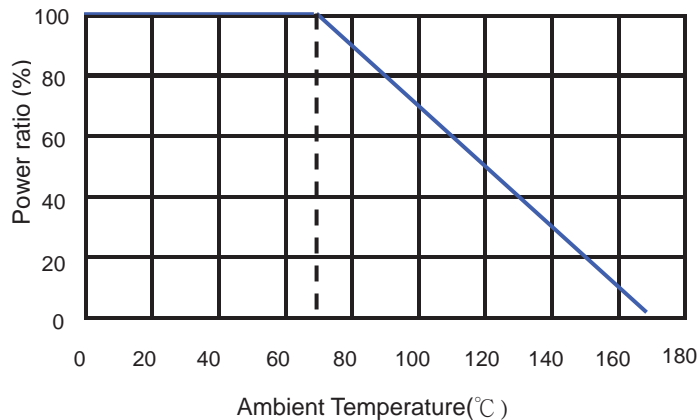
Item	Requirement		Test Method
	Black coating	Green coating	
Temperature Coefficient of Resistance (T.C.R.)	As Spec.		MIL-STD-202 Method 304 +25/-55/+25/+125/+25°C
Short Time Overload	±0.5%	±1%	JIS-C-5201-1 5.5 5*rated power for 5 seconds
Endurance	±1%	±1%	MIL-STD-202 Method 108A 70±2°C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Dry Heat	±1%	±1%	JIS-C-5201-1 7.2 at +170°C for 1000 hrs
Solderability	95% min. coverage		MIL-STD-202 Method 208H 245±5°C for 3 seconds
Resistance to Soldering Heat	±0.5%	±1%	MIL-STD-202 Method 210E 260±5°C for 10 seconds
Thermal Shock	±0.5%	±1%	MIL-STD-202 Method 107G -55°C ~ 150°C, 100 cycles

**Green coating can't be work with wave soldering bath.

RCWV(Rated continuous working voltage)= $\sqrt{P \cdot R}$ or Max. Operating voltage whichever is lower

■ Storage Temperature: 25±3°C; Humidity < 80%RH

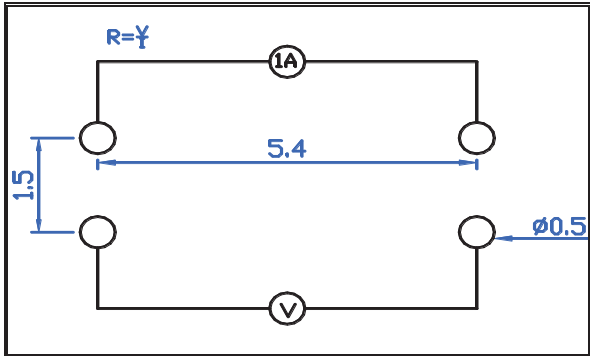
Derating Curve



■ Measurements

1. LR12 4-wire precision measurement (Black Coating)

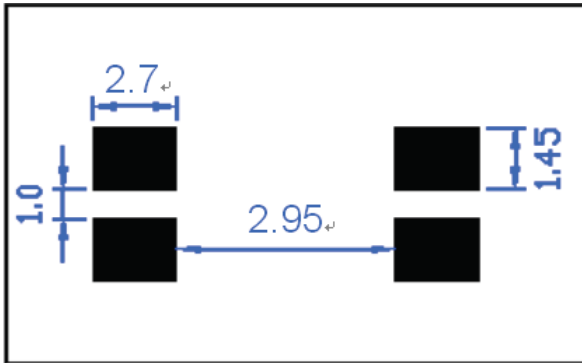
- Equipment: ADEX AX-1152D DC Low Ohm Meter
- Excitation Current: 3A (0.5mΩ~1.5 mΩ)
1A (2mΩ~10mΩ)



Unit: mm

2. LR12 4-wire pad layout (recommended for precision current sensing)

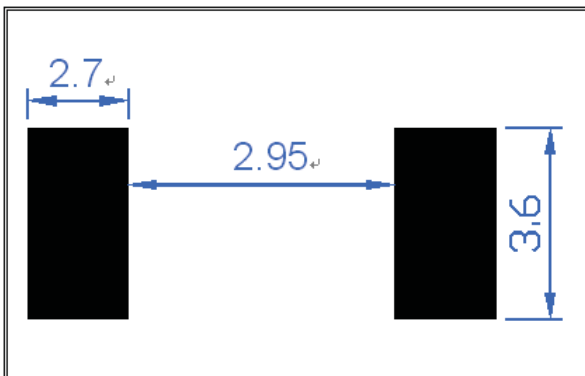
- Note: No circuits between pads to avoid short circuit



Unit: mm

3. LR12 2-wire pad layout

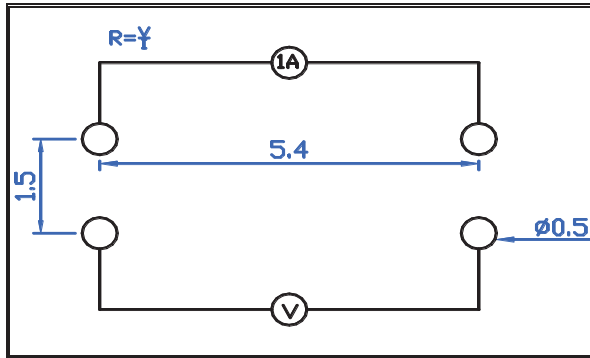
- Note: No circuits between pads to avoid short circuit



Unit: mm

4. LR12 4-wire precision measurement (Green Coating)

- Equipment: ADEX AX-1152D DC Low Ohm Meter
- Excitation Current: 3A (0.5mΩ~1.5 mΩ)
1A (2mΩ~15mΩ)

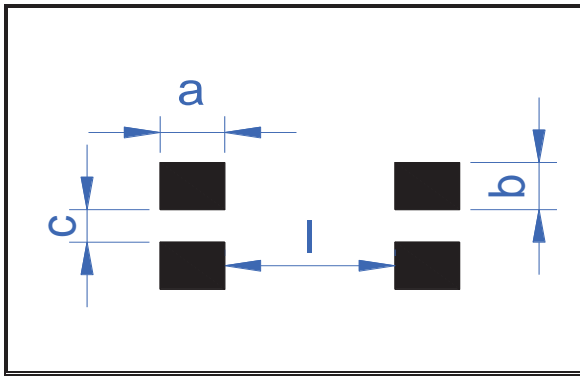


Unit: mm

5. LR12 4-wire pad layout (recommended for precision current sensing)

- Note: No circuits between pads to avoid short circuit

Unit: mm

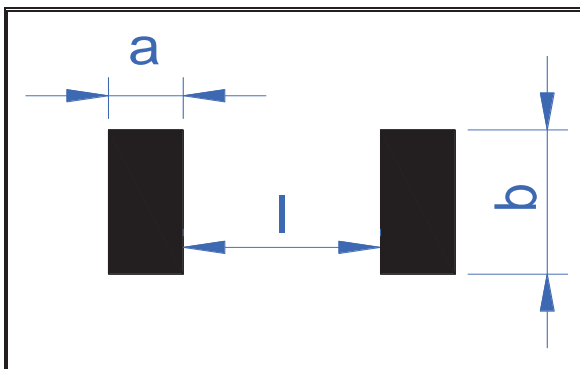


Item Type	a m/m	b m/m	C m/m	l m/m
0M50	3.13	1.2	1.0	0.52
0M75	2.93	1.2	1.0	0.94
R001	2.38	1.2	1.0	2.04
1M5	1.88	1.2	1.0	3.04
R002~R003	1.63	1.2	1.0	3.54
R004~4M5	2.63	1.2	1.0	1.54
R005~R006	2.38	1.2	1.0	2.04
6M5~R007	1.88	1.2	1.0	3.04
R008~R015	1.63	1.2	1.0	3.54

6. LR12 2-wire pad layout

- Note: No circuits between pads to avoid short circuit

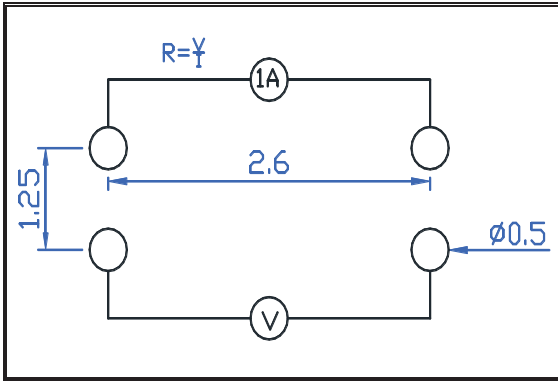
Unit: mm



Item Type	a m/m	b m/m	l m/m
0M50	3.13	3.4	0.52
0M75	2.93	3.4	0.94
R001	2.38	3.4	2.04
1M5	1.88	3.4	3.04
R002~R003	1.63	3.4	3.54
R004~4M5	2.63	3.4	1.54
R005~R006	2.38	3.4	2.04
6M5~R007	1.88	3.4	3.04
R008~R015	1.63	3.4	3.54

7. LR06 4-wire precision measurement

- Equipment: ADEX AX-1152D DC Low Ohm Meter
- Excitation Current: 3A (0.5mΩ~1.5mΩ)
1A (2mΩ~10mΩ)

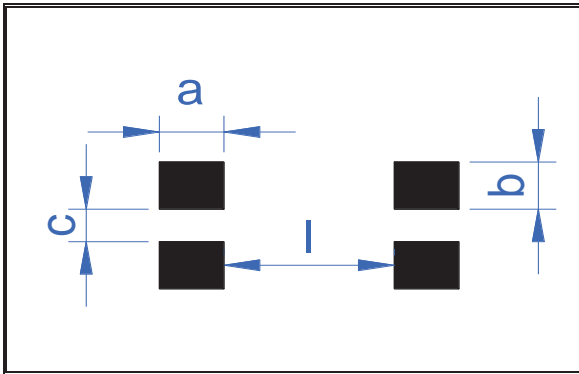


Unit: mm

8. LR06 4-wire pad layout (recommended for precision current sensing)

- Note: No circuits between pads to avoid short circuit

Unit: mm

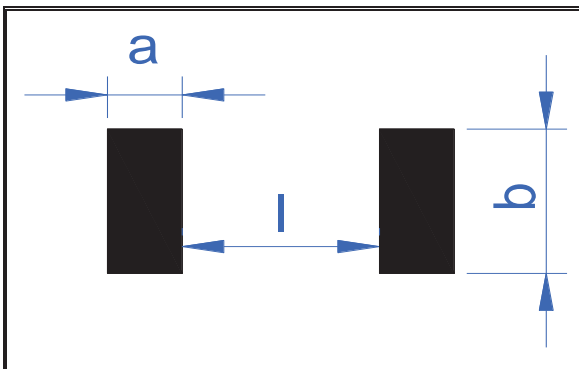


Item Type	a m/m	b m/m	C m/m	l m/m
0M50	1.80	0.7	0.5	0.55
0M75	1.68	0.7	0.5	0.55
R001	1.55	0.7	0.5	0.55
R002~R003	1.05	0.7	0.5	1.55
R004~R006	1.55	0.7	0.5	0.55
R007~R009	1.35	0.7	0.5	0.95
R010	1.05	0.7	0.5	1.55

9. LR06 2-wire pad layout

- Note: No circuits between pads to avoid short circuit

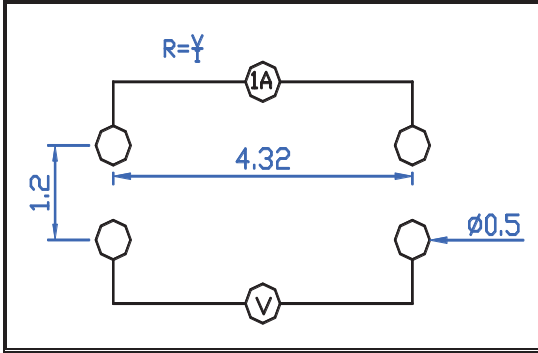
Unit: mm



Item Type	a m/m	b m/m	l m/m
0M50	1.80	1.90	0.55
0M75	1.68	1.90	0.55
R001	1.55	1.89	0.55
R002~R003	1.05	1.89	1.55
R004~R006	1.55	1.89	0.55
R007~R009	1.35	1.89	0.95
R010	1.05	1.89	1.55

10. LR10 4-wire precision measurement

- Equipment: ADEX AX-1152D DC Low Ohm Meter
- Excitation Current: 3A (0.5mΩ~1.5mΩ)
1A (2mΩ~10mΩ)

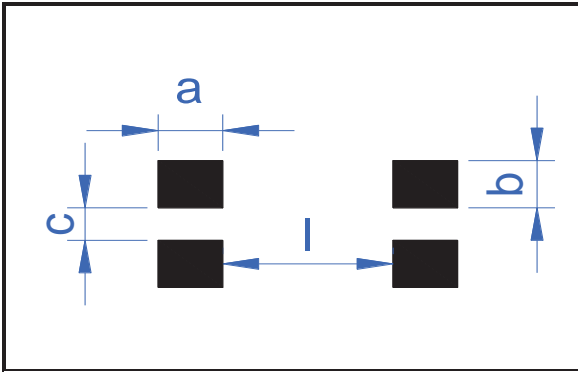


Unit: mm

11. LR10 4-wire pad layout (recommended for precision current sensing)

- Note: No circuits between pads to avoid short circuit

Unit: mm

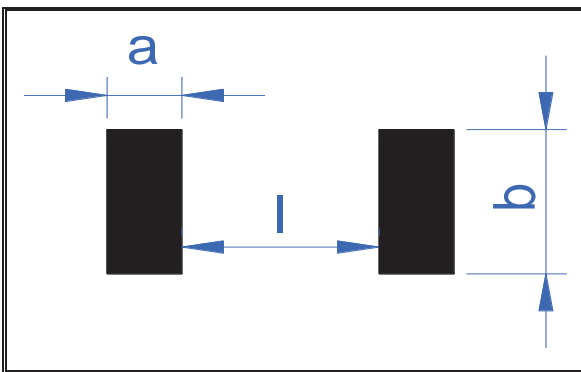


Item Type	a m/m	b m/m	C m/m	l m/m
0M50	2.61	1.045	0.8	0.60
0M75	2.49	1.045	0.8	0.80
R001	2.29	1.045	0.8	0.95
R002	1.99	1.045	0.8	1.55
R003	1.49	1.045	0.8	2.55
R004~R005	2.29	1.045	0.8	0.95
R006~R008	1.99	1.045	0.8	1.55
R009~R010	1.74	1.045	0.8	2.05

12. LR10 2-wire pad layout

- Note: No circuits between pads to avoid short circuit

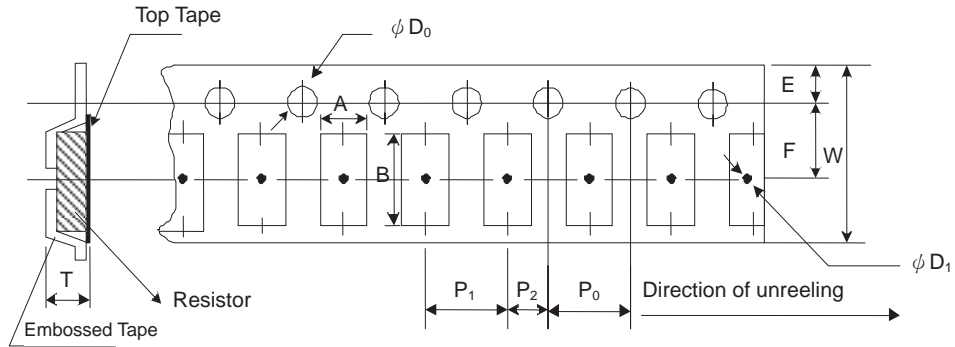
Unit: mm



Item Type	a m/m	b m/m	l m/m
0M50	2.61	2.89	0.60
0M75	2.49	2.89	0.80
R001	2.29	2.89	0.95
R002	1.99	2.89	1.55
R003	1.49	2.89	2.55
R004~R005	2.29	2.89	0.95
R006~R008	1.99	2.89	1.55
R009~R010	1.74	2.89	2.05

■ Packaging

Embossed Plastic Tape Specifications



Unit: mm

Type	Resistance (m Ω)	A	B	W	E	F	P ₀	P ₁	P ₂	ΦD_0	ΦD_1	T	Quantity (EA)
LR06	0.5 - 10	1.90 \pm 0.1	3.60 \pm 0.1	8.0 \pm 0.2	1.75 \pm 0.1	3.5 \pm 0.05	4.0 \pm 0.1	4.0 \pm 0.1	2.0 \pm 0.05	1.55 \pm 0.05	1.0min.	0.87 \pm 0.1	2,000
LR10	0.5 - 10	2.85 \pm 0.1	5.55 \pm 0.1	12.0 \pm 0.2	1.75 \pm 0.1	5.5 \pm 0.05	4.0 \pm 0.1	4.0 \pm 0.1	2.0 \pm 0.05	1.55 \pm 0.05	1.4min.	0.85 \pm 0.1	2,000
LR12	0.50 - 0.75	3.40 \pm 0.1	6.75 \pm 0.1	12.0 \pm 0.1	1.75 \pm 0.1	5.5 \pm 0.05	4.0 \pm 0.1	4.0 \pm 0.1	2.0 \pm 0.05	1.55 \pm 0.05	1.4min.	1.45 \pm 0.2	2,000
	1 - 10											0.81 \pm 0.1	
LR12 (G)	0.50 - 15	3.40 \pm 0.1	6.75 \pm 0.1	12.0 \pm 0.1	1.75 \pm 0.1	5.5 \pm 0.05	4.0 \pm 0.1	4.0 \pm 0.1	2.0 \pm 0.05	1.55 \pm 0.05	1.4min.	0.81 \pm 0.1	2,000

1. The cumulative tolerance of 10 sprockets hole pitch is ± 0.2 mm.
2. Carrier camber shall be not more than 1mm per 100mm through a length of 250mm.
3. A & B measured 0.3mm from the bottom of the packet
4. T measured at a point on the inside bottom of the packet to the top surface of the carrier.
5. Pocket position relative to sprocket hole is measured as the true position of the pocket and not the pocket hole.

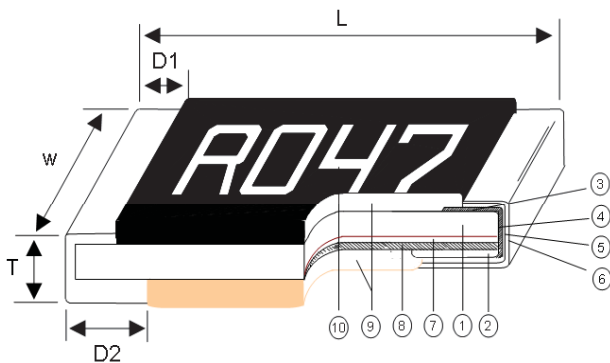
Current Sensing Metal Chip Resistor



■ Features

- SMD Type designed for automatic insertion
- High power rating in small size
- Low resistance resistor for current detection
- Metal foil construction ensures high reliability and performance with very low and stable TCR
- Designed for current sense circuits in power electronic systems
- Pb-Free to meet RoHS requirements

■ Construction



■ Applications

- Power Management Applications
- Switching Power Supply
- Over Current Protection in Audio Applications
- Voltage Regulation Module (VRM)
- DC-DC Converter, Battery Pack, Charger, Adaptor

① Alumina Substrate	⑤ Barrier Layer (Ni)	⑨ Primary Overcoat (Epoxy)
② Bottom Electrode (Cu)	⑥ External Electrode (Sn)	⑩ Marking (Epoxy)
③ Top Electrode (NiCr)	⑦ Adhesive (Acrylic)	
④ Edge Electrode (NiCr)	⑧ Resistor Layer (Alloy)	

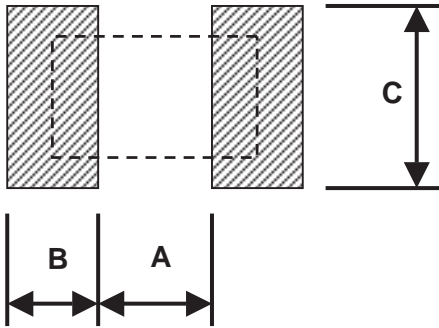
■ Dimensions

Type	Size (Inch)	Resistance Range (mΩ)	L (mm)	W (mm)	T (mm)	D1 (mm)	D2 (mm)
CSM03	0603	10 - 29	1.55±0.10	0.85±0.10	0.40±0.10	0.30±0.15	0.45±0.15
		30 - 100	1.55±0.10	0.85±0.10	0.40±0.10	0.30±0.15	0.35±0.15
CSM05	0805	10 - 29	2.00±0.15	1.25±0.15	0.55±0.10	0.30±0.20	0.50±0.20
		30 - 100	2.00±0.15	1.25±0.15	0.52±0.10	0.30±0.20	0.35±0.20
CSM06	1206	10 - 29	3.05±0.15	1.55±0.15	0.58±0.15	0.50±0.25	0.90±0.25
		30 - 100	3.05±0.15	1.55±0.15	0.55±0.15	0.50±0.25	0.60±0.25
CSM10	2010	10 - 29	5.00±0.20	2.50±0.20	0.58±0.15	0.60±0.30	1.50±0.30
		30 - 100	5.00±0.20	2.50±0.20	0.55±0.15	0.60±0.30	0.90±0.30
CSM12	2512	10 - 29	6.30±0.20	3.15±0.20	0.58±0.15	0.60±0.30	1.80±0.30
		30 - 100	6.30±0.20	3.15±0.20	0.55±0.15	0.60±0.30	1.20±0.30

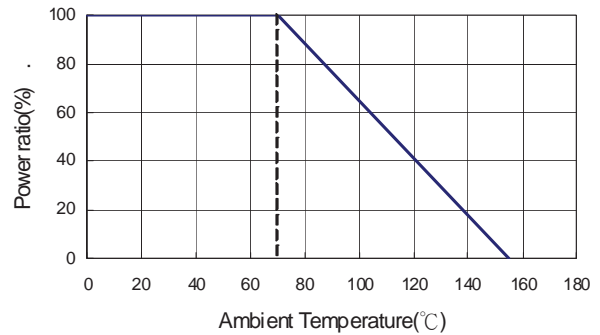
Part Numbering

CSM	06	F	T	E	U	R100	
Product Type	Dimensions (LxW)	Resistance Tolerance	Packaging Code	TCR (PPM/°C)	Power Rating	Resistance	Marking
	03: 0603 05: 0805 06: 1206 10: 2010 12: 2512	F: ±1% G: ±2% J: ±5%	T: Taping Reel B: Bulk	D: ±50 E: ±100	T: 1W Q: 3/4W U: 1/2W V: 1/4W W: 1/8W	R010: 0.01Ω R100: 0.1Ω	: Standard N: No Marking

Recommend Land Pattern



Derating Curve

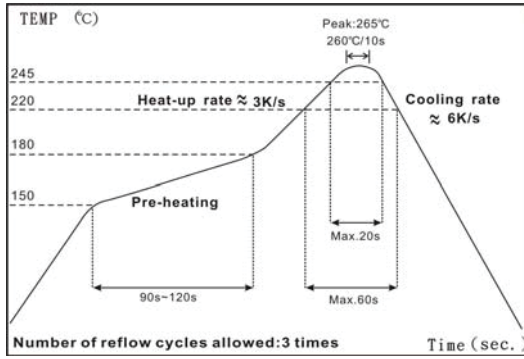


Type	Resistance Range	A (mm)	B (mm)	C (mm)
CSM03	10-29mΩ	0.40	1.20	0.9
	30-100mΩ	0.70	1.05	0.9
CSM05	10-29mΩ	0.80	1.10	1.35
	30-100mΩ	1.00	1.00	1.35
CSM06	10-29mΩ	0.9	1.70	1.70
	30-100mΩ	1.50	1.40	1.70
CSM10	10-29mΩ	1.70	2.35	2.50
	30-100mΩ	2.80	1.80	2.50
CSM12	10-29mΩ	2.30	2.90	3.10
	30-100mΩ	3.60	2.25	3.10

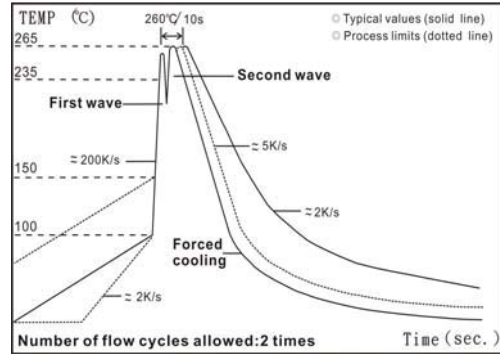
Marking for 0603

Type	Code
R10	0.100Ω
R01	0.010Ω
<u>101</u>	0.101Ω
<u>035</u>	0.035Ω

Soldering Condition



IR Reflow Soldering



Wave Soldering (Flow Soldering)

- (1) Time of IR reflow soldering at maximum temperature point 260°C : 10s
- (2) Time of wave soldering at maximum temperature point 260°C : 10s
- (3) Time of soldering iron at maximum temperature point 410°C : 5s

Standard Electrical Specifications

Type \ Item	Power Rating at 70°C	Operating Temp. Range	Resistance Range (mΩ)			TCR (PPM/°C)
			±1%	±2%	±5%	
CSM03 (0603)	1/8W	-55 ~ +155°C	10 - 19			±100
			20 - 100			±50 ±100
CSM05 (0805)	1/4W		10 - 19			±100
			20 - 100			±50 ±100
CSM06 (1206)	1/2W		10 - 19			±100
			20 - 100			±50 ±100
CSM10 (2010)	3/4W		10 - 19			±100
			20 - 100			±50 ±100
CSM12 (2512)	1W	10 - 19			±100	
		20 - 100			±50 ±100	

Operating Voltage= $\sqrt{P \cdot R}$; Overload Voltage= $2.5 \cdot \sqrt{P \cdot R}$; Operating Current= $\sqrt{P/R}$

Viking is capable of manufacturing the optional spec based on customer's requirement

■ Environmental Characteristics

Item	Requirement	Test Method
Temperature Coefficient of Resistance (T.C.R.)	As Spec.	JIS-C-5201-1 4.8 IEC-60115-1 4.8 -55°C~+125°C, 25°C is the reference temperature
Short Time Overload	$\pm(0.5\%+0.05\Omega)$	JIS-C-5201-1 4.13 IEC-60115-1 4.13 5 X Rated Power for 5 seconds
Insulation Resistance	$\geq 10G$	JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. Overload voltage for 1 minute
Endurance	$\pm(1.0\%+0.05\Omega)$	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 70 \pm 2°C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Damp Heat with Load	$\pm(1.0\%+0.05\Omega)$	JIS-C-5201-1 4.24 40 \pm 2°C, 90~95% R.H., RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Dry Heat	$\pm(0.5\%+0.05\Omega)$	JIS-C-5201-1 4.23 IEC-60115-1 2.23.2 at +155°C for 1000 hrs
Bending Strength	$\pm(1.0\%+0.05\Omega)$	JIS-C-5201-1 4.33 IEC-60115-1 4.33 Bending once for 5 seconds with 3mm 2010, 2512 sizes: 2mm
Solderability	95% min. coverage	JIS-C-5201-1 4.17 IEC-60115-1 4.17 245 \pm 5°C for 3 seconds
Resistance to Soldering Heat	$\pm(0.5\%+0.05\Omega)$	JIS-C-5201-1 4.18 IEC-60115-1 4.18 260 \pm 5°C for 10 seconds
Voltage Proof	No breakdown or flashover	JIS-C-5201-1 4.7 IEC-60115-1 4.7 1.42 times Max. Operating Voltage for 1 minute
Leaching	Individual leaching area $\leq 5\%$ Total leaching area $\leq 10\%$	JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 260 \pm 5°C for 30 seconds
Rapid Change of Temperature	$\pm(0.5\%+0.05\Omega)$	JIS-C-5201-1 4.18 IEC-60115-1 4.18 -55°C to +155°C, 5 cycles

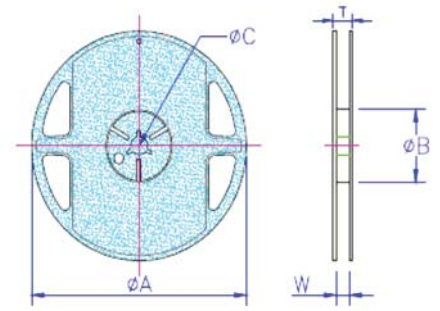
RCWV(Rated continuous working voltage)= $\sqrt{P \cdot R}$ or Max. Operating voltage whichever is lower.

■ **Storage Temperature: 25 \pm 3°C; Humidity < 80%RH**

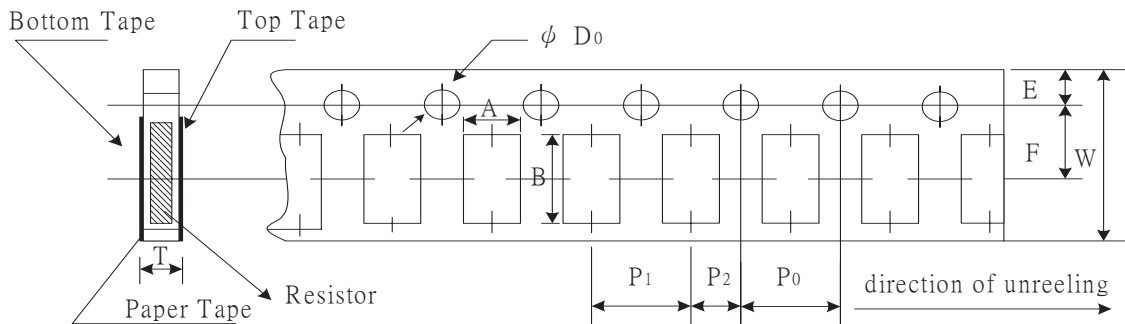
Packaging

Packaging Quantity & Reel Specifications

Type	ΦA (mm)	ΦB (mm)	ΦC (mm)	W (mm)	T (mm)	Paper Tape (EA)	Emboss Plastic Tape (EA)
CSM03	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	5,000	-
CSM05	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	5,000	-
CSM06	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	5,000	-
CSM10	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000
CSM12	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000

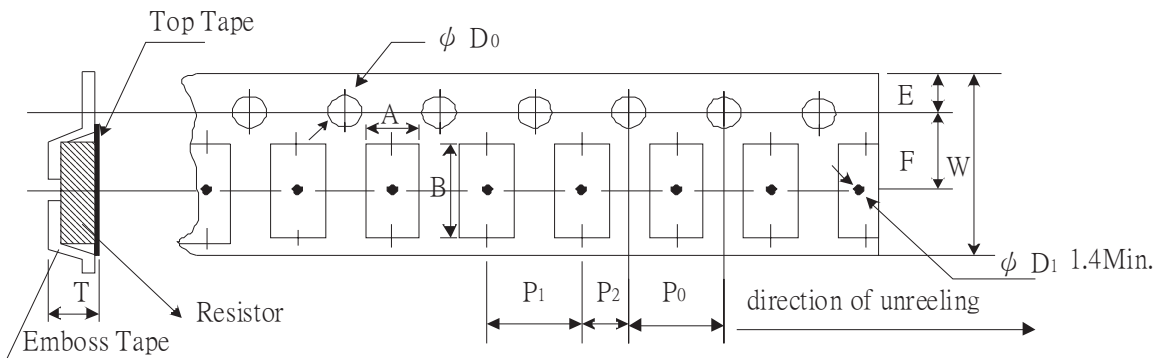


Paper Tape Specifications



Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P0 (mm)	P1 (mm)	P2 (mm)	ΦD_0 (mm)	T (mm)
CSM03	1.10±0.10	1.90±0.10	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.70±0.10
CSM05	1.60±0.10	2.40±0.20	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.10
CSM06	1.90±0.10	3.50±0.20	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.10

Emboss Plastic Tape Specifications

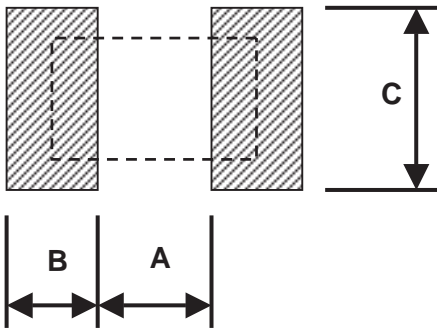


Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P0 (mm)	P1 (mm)	P2 (mm)	ΦD_0 (mm)	T (mm)
CSM10	2.80±0.10	5.50±0.10	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.00±0.20
CSM12	3.50±0.10	6.70±0.10	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.00±0.20

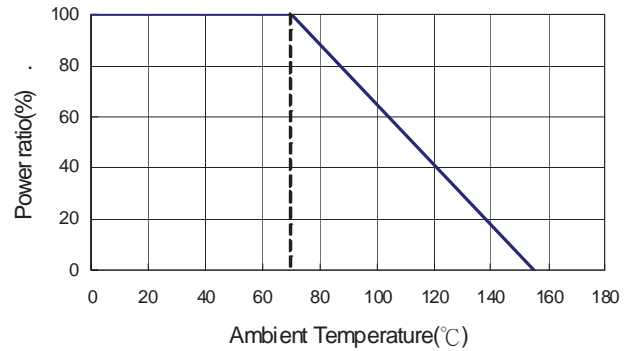
Part Numbering

CS	06	F	T	G	U	R100	
Product Type	Dimensions (LxW)	Resistance Tolerance	Packaging Code	TCR (PPM/°C)	Power Rating	Resistance	Marking
	01: 0201 02: 0402 03: 0603 05: 0805 06: 1206 13: 1210 10: 2010 12: 2512 25: 1225 37: 3720 75: 7520	F: ±1% G: ±2% J: ±5%	T: Taping Reel B: Bulk	E: ±100 F: ±200 G: ±300 H: ±400 J: ±600 K: ±150 R: ±1000	: Standard S: 2W A: 1.5W T: 1W Q: 3/4W U: 1/2W V: 1/4W P: 1/5W W: 1/8W	R010: 0.01Ω R100: 0.1Ω 1R00: 1Ω	: Standard N: No Marking W: Wide

Recommend Land Pattern



Derating Curve



Pad Layout (Except For CS12:High Power Rating Series)

Type	A (mm)	B (mm)	C (mm)
CS01	0.25	0.30	0.40±0.2
CS02	0.50	0.50	0.60±0.2
CS03	0.80	1.00	0.90±0.2
CS05	1.00	1.00	1.35±0.2
CS06	2.00	1.15	1.70±0.2
CS13	2.00	1.15	2.50±0.2
CS10	3.60	1.40	2.50±0.2
CS12	4.90	1.60	3.10±0.2
CS25	2.00	2.00	6.40±0.2
CS37	1.00	1.80	3.90±0.2
CS75	1.00	1.80	7.60±0.2

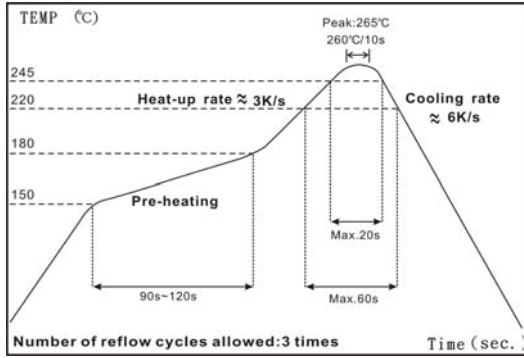
Marking for 0603

Type	Code
1R0	1.000Ω
R10	0.100Ω
R01	0.010Ω
<u>101</u>	0.101Ω
<u>035</u>	0.035Ω

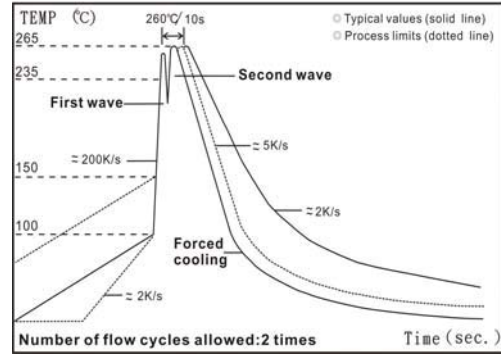
Pad Layout (For CS12:High Power Rating Series)

Type	Resistance Range	A (mm)	B (mm)	C (mm)
CS12	10~99 mΩ	4.9	1.6	3.1±0.2
CS12	100~1000mΩ	1.0	3.55	3.1±0.2

Soldering Condition



IR Reflow Soldering



Wave Soldering (Flow Soldering)

- (1) Time of IR reflow soldering at maximum temperature point 260°C : 10s
- (2) Time of wave soldering at maximum temperature point 260°C : 10s
- (3) Time of soldering iron at maximum temperature point 410°C : 5s

Standard Electrical Specifications

Type	Item	Power Rating at 70°C	Operating Temp. Range	Max. Operating Current	Resistance Range (mΩ)			TCR (PPM/°C)
					±1%	±2%	±5%	
CS01 (0201)		1/20W	-55 ~ +155°C	0.70A	100 - 149 150 - 500 501 - 1000			±1000 ±600 ±300
CS02 (0402)		1/16W		1.11A	50 - 100 101 - 500 501 - 1000			±400 ±300 ±200
CS03 (0603)		1/10W		2.23A	20 - 50 51 - 100 101 - 500 501 - 1000			±600 ±400 ±300 ±200
CS05 (0805)		1/8W		2.50A	20 - 50 51 - 100 101 - 500 501 - 1000			±600 ±400 ±300 ±200
CS06 (1206)		1/4W		5.00A	10 - 20 21 - 50 51 - 99 100 - 1000			±600 ±400 ±300 ±200
CS13 (1210)		1/2W		7.07A				
CS10 (2010)		3/4W		8.66A				
CS12 (2512)		1W		10.0A				
CS25 (1225)		3W		31.6A	3 - 5 6 - 20 21 - 30 31 - 8000			±300 ±200 ±150 ±100
CS37 (3720)		1W		10.0A	10 - 19 20 - 500			±300 ±150
CS75 (7520)		2W		44.7A	—			±300
					1 - 4			
				5 - 10 11 - 350			±200 ±150	

High Power Rating Electrical Specifications

Type \ Item	Power Rating at 70°C	Operating Temp. Range	Max. Operating Current	Resistance Range (mΩ)			TCR (PPM/°C)
				±1%	±2%	±5%	
CS02 (0402)	1/8W	-55 ~ +155°C	1.56A	51 - 100 101 - 500 501 - 1000	±400	±300	
CS03 (0603)	1/8W 1/5W		1.98A				
CS05 (0805)	1/4W		2.21A				
CS06 (1206)	1/2W		7.07A	10 - 20 21 - 50 51 - 99 100 - 1000	±600	±400	
CS13 (1210)	3/4W		8.66A				
CS10 (2010)	1W		10.0A				
CS12 (2512)	1.5W		12.2A				
CS12 (2512)	2W		14.1A				

Low TCR Electrical Specifications

Type \ Item	Power Rating at 70°C	Operating Temp. Range	Max. Operating Current	Resistance Range (mΩ)			TCR (PPM/°C)
				±1%	±2%	±5%	
CS05 (0805)	1/8W	-55 ~ +155°C	1.11A	100 - 1000			±100
CS06 (1206)	1/4W		1.58A	100 - 1000			±100
CS13 (1210)	1/2W		2.58A	75 - 1000			±100
CS10 (2010)	3/4W		3.87A	50 - 1000			±100
CS12 (2512)	1W		7.07A	20 - 1000			±100
CS12 (2512)	2W		6.32A	50 - 1000			±100
CS37 (3720)	1W		3.16A	100 - 500			±100
CS75 (7520)	2W		6.32A	50 - 350			±100

Operating Current= $\sqrt{P/R}$

■ Viking is capable of manufacturing the optional spec based on customer's requirement.

■ Environmental Characteristics

Item	Requirement	Test Method
Temperature Coefficient of Resistance (T.C.R.)	As Spec.	JIS-C-5201-1 4.8 IEC-60115-1 4.8 -55°C~+125°C, 25°C is the reference temperature
Short Time Overload	$\pm(0.5\%+0.05\Omega)$	JIS C 5201-1 4.13 IEC 60115-1 4.13 RCWV*2.5 or Max. Overload voltage whichever is lower for 5 seconds
	$\pm(1.0\%+0.05\Omega)$ For High power rating	
Insulation Resistance	$\geq 10G$	JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. Overload voltage for 1 minute
Endurance	$\pm(1.0\%+0.05\Omega)$	JIS-C-5201-1 4.25 IEC-60115-1 4.25.1 70 \pm 2°C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Damp Heat with Load	$\pm(0.5\%+0.05\Omega)$	JIS-C-5201-1 4.24 40 \pm 2°C, 90~95% R.H., RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hrs "OFF"
Dry Heat	$\pm(0.5\%+0.05\Omega)$	JIS-C-5201-1 4.23 IEC-60115-1 2.23.2 at +155°C for 1000 hrs
Bending Strength	$\pm(1.0\%+0.05\Omega)$	JIS-C-5201-1 4.33 IEC-60115-1 4.33 Bending once for 5 seconds with 3mm 2010, 2512 sizes: 2mm
Solderability	95% min. coverage	JIS-C-5201-1 4.17 IEC-60115-1 4.17 245 \pm 5°C for 3 seconds
Resistance to Soldering Heat	$\pm(0.5\%+0.05\Omega)$	JIS-C-5201-1 4.18 IEC-60115-1 4.18 260 \pm 5°C for 10 seconds
Voltage Proof	No breakdown or flashover	JIS-C-5201-1 4.7 IEC-60115-1 4.7 1.42 times Max. Operating Voltage for 1 minute
Leaching	Individual leaching area $\leq 5\%$ Total leaching area $\leq 10\%$	JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 260 \pm 5°C for 30 seconds
Rapid Change of Temperature	$\pm(0.5\%+0.05\Omega)$	JIS-C-5201-1 4.18 IEC-60115-1 4.18 -55°C to +155°C, 5 cycles

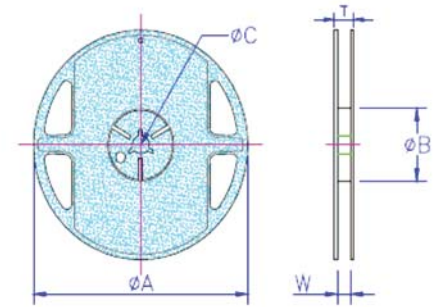
RCWV(Rated continuous working voltage)= $\sqrt{P \cdot R}$ or Max. Operating voltage whichever is lower.

■ **Storage Temperature: 25 \pm 3°C; Humidity < 80%RH**

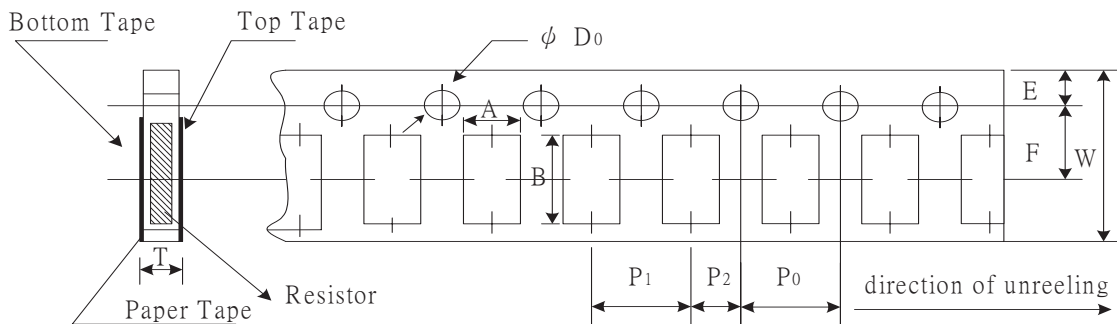
■ Packaging

Packaging Quantity & Reel Specifications

Type	ΦA (mm)	ΦB (mm)	ΦC (mm)	W (mm)	T (mm)	Paper Tape (EA)	Emboss Plastic Tape (EA)
CS01	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	10,000	
CS02	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	10,000	-
CS03	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	5,000	-
CS05	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	5,000	-
CS06	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	5,000	-
CS13	178.0±1.0	60.0+1.0	13.5±0.7	9.5±0.1	11.5±1.0	5,000	
CS10	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000
CS12	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000
CS12 (2W)	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	2,000
CS25	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	2,000
CS37	178.0±1.0	60.0+1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	2,000
CS75	178.0±1.0	60.0+1.0	13.5±0.7	17.5±1.0	19.5±1.0	-	2,000

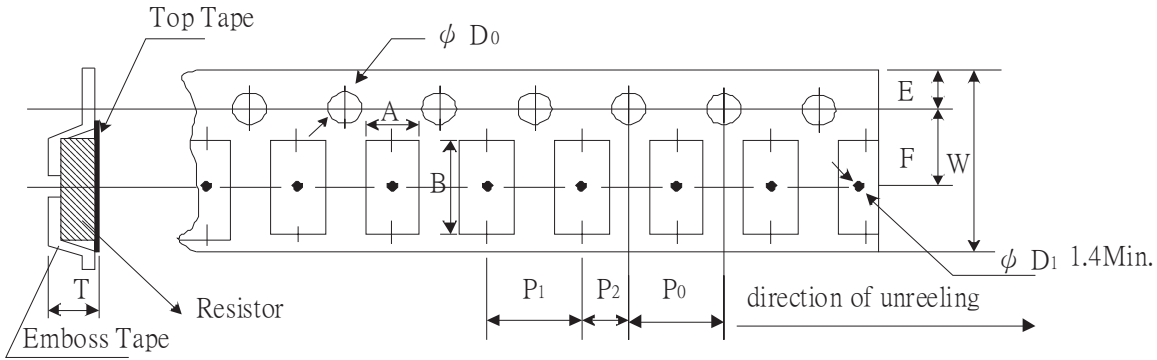


Paper Tape Specifications



Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P0 (mm)	P1 (mm)	P2 (mm)	ΦD ₀ (mm)	T (mm)
CS01	0.38±0.05	0.68±0.05	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.50+0.1,-0	0.42±0.20
CS02	0.65±0.10	1.15±0.10	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	2.00±0.05	2.00±0.05	1.50+0.1,-0	0.45±0.10
CS03	1.10±0.10	1.90±0.10	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.70±0.10
CS05	1.60±0.10	2.40±0.20	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.10
CS06	1.90±0.10	3.50±0.20	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.10
CS13	2.90±0.10	3.50±0.20	8.0±0.20	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.05	2.00±0.05	1.50+0.1,-0	0.85±0.10

Emboss Plastic Tape Specifications



Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ΦD ₀ (mm)	T (mm)
CS10	2.80±0.10	5.50±0.10	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.00±0.20
CS12	3.50±0.10	6.70±0.10	12.0±0.30	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.00±0.20
CS12 (2W)	3.38±0.10	6.68±0.10	12.0±0.30	1.75±0.10	5.5±0.10	4.00±0.10	4.00±0.10	2.00±0.05	1.55+0.05	1.45±0.20
CS25	3.38±0.10	6.68±0.10	12.0±0.30	1.75±0.10	5.5±0.10	4.00±0.10	4.00±0.10	2.00±0.05	1.55+0.05	1.45±0.20
CS37	2.50±0.20	4.45±0.20	12.0±0.30	1.75±0.10	5.5±0.05	4.00 ±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.20 ±0.20
CS75	2.50±0.20	8.30±0.20	16.0±0.30	1.75±0.10	7.8±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50+0.10	1.20 ±0.20