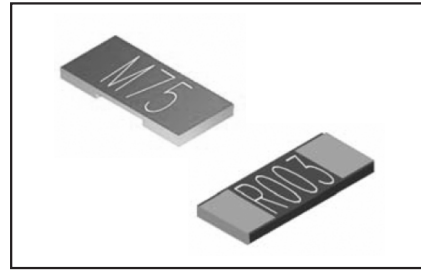


# Ultra Low Ohm(Metal Strip) Chip Resistors

- High Wattage Rating Up to 3W
- Low TCR  $\pm 50, \pm 100$  PPM/ $^{\circ}$ C
- Resistance Values from 0.5 to 22m ohm
- Non-Laser Trimmed Low Inductance
- Customized Resistance Available



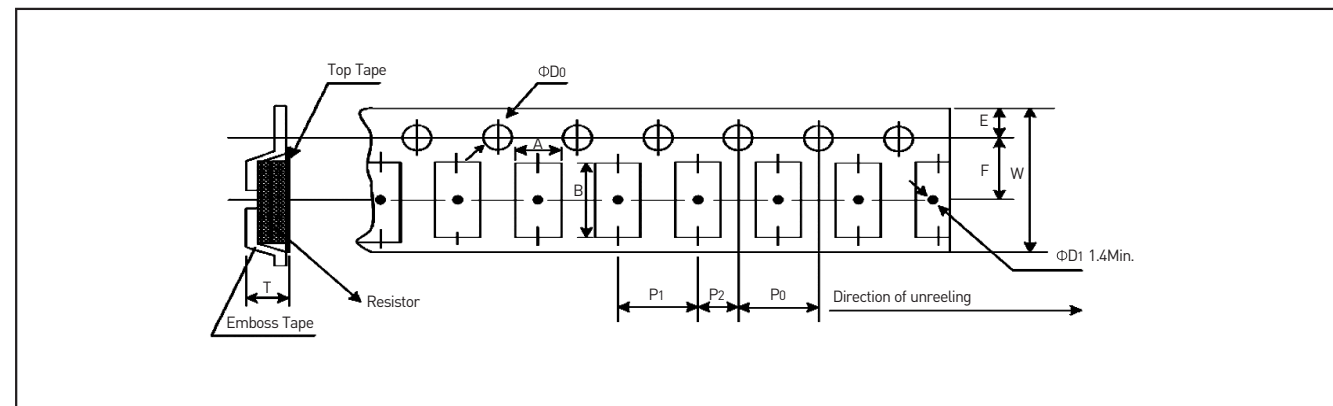
## GENERAL SPECIFICATIONS

Model	Power Rating	Operating Temp. Range	Resistance Tolerance (%)	Resistance [m $\Omega$ ]	TCR[PPM/ $^{\circ}$ C]
LR06	1W	-55 $^{\circ}$ C+170 $^{\circ}$ C	F [ $\pm 1$ ] G [ $\pm 3$ ] J [ $\pm 5$ ]	1.0 ~ 10.0	50
LR10	1.5W			1.0 ~ 10.0	50
LR12	1W			2.5 ~ 3.0	150
				4.0 ~ 5.0	100
				6.0 ~ 7.0	75
				11.0 ~ 20.0	50
LR12 (High Power)	2W 2.5W 3W			1.0 ~ 10.0	50
				0.5 ~ 2.0	50
				7.0 ~ 10.0	50
				4.0 ~ 6.0	50
				0.5 ~ 0.75	100
				3.0	50

## CHARACTERISTICS

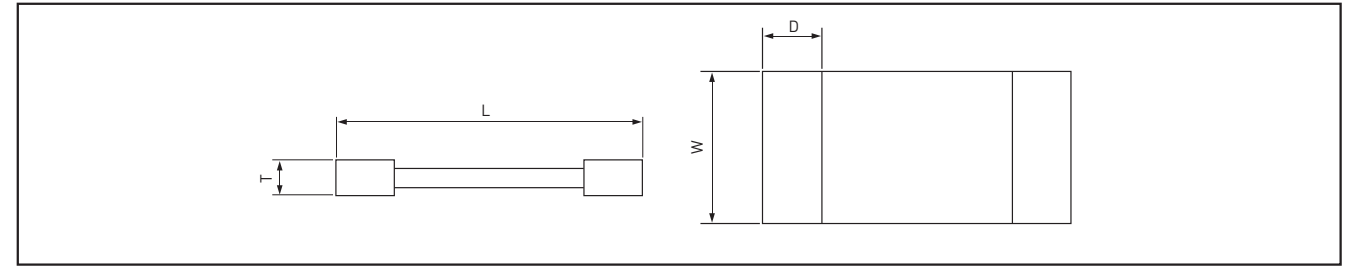
Item.	Specification		
	Black coating	Green coating	
TCR	As Spec.		MIL-STD-202F Method 304 +25/-55/+25/+125/+25 $^{\circ}$ C
Thermal Shock	$\pm 0.5\%$	$\pm 1\%$	MIL-STD-202F Method 107G -55 $^{\circ}$ C~+150 $^{\circ}$ C, 100 Cycles
Short Time Overload	$\pm 0.5\%$	$\pm 1\%$	JIS-C-5202-5.5 5xRated power, 5 sec.
Resistance to Dry Heat	$\pm 1\%$	$\pm 1\%$	JIS-C-5202-7.2 96 hours, @ +170 $^{\circ}$ C without load
Load Life	$\pm 1\%$	$\pm 1\%$	MIL-STD-202F Method 108A RCWW, 70 $^{\circ}$ C, 1.5 hours on, 0.5 hours off for 1000~1048 hours
Resistance to Soldering Heat	$\pm 0.5\%$	$\pm 1\%$	MIL-STD-202F Method 210E 260 $\pm 5^{\circ}$ C, 10 $\pm 1$ sec.
Solderability			MIL-STD-202F Method 208H 245 $\pm 5^{\circ}$ C, 3 $\pm 0.5$ sec.

## EMBOSSED PLASTIC TAPE DIMENSIONS (mm)



Size	Resistance[m $\Omega$ ]	A	B	W	E	F	P0	P1	P2	ΦD0	T
LR10	1 ~ 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 $\pm 0.10$	4.0 $\pm 0.1$	2.0 $\pm 0.05$	1.50 $\pm 0.1$	0.85 $\pm 0.1$
LR12	0.50	3.40 $\pm 0.1$	6.70 $\pm 0.1$	12.0 $\pm 0.1$	1.75 $\pm 0.1$	5.5 $\pm 0.05$	4.0 $\pm 0.05$	4.0 $\pm 0.1$	2.0 $\pm 0.05$	1.50 $\pm 0.1$	1.40 $\pm 0.1$
	0.75	3.50 $\pm 0.1$	6.80 $\pm 0.1$	12.0 $\pm 0.1$	1.75 $\pm 0.1$	5.5 $\pm 0.05$	4.0 $\pm 0.05$	4.0 $\pm 0.1$	2.0 $\pm 0.05$	1.50 $\pm 0.1$	1.35 $\pm 0.1$
	1~22	3.40 $\pm 0.1$	6.70 $\pm 0.1$	12.0 $\pm 0.1$	1.75 $\pm 0.1$	5.5 $\pm 0.05$	4.0 $\pm 0.05$	4.0 $\pm 0.1$	2.0 $\pm 0.05$	1.50 $\pm 0.1$	0.80 $\pm 0.1$

## DIMENSIONS [mm]

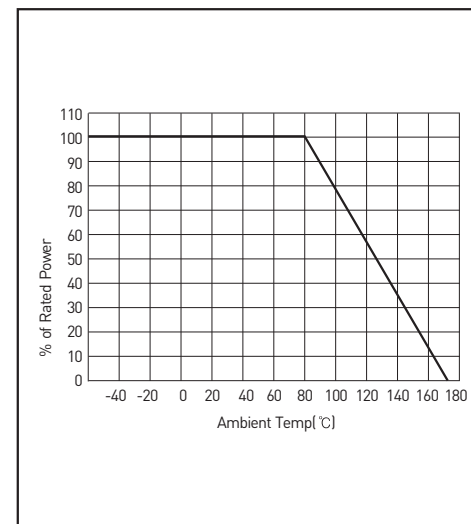


Part NO.	Resistance [m $\Omega$ ]	L	W	T	D
LR06	1.0~10	3.20 $\pm 0.25$	1.60 $\pm 0.10$	0.60 $\pm 0.20$	0.98 $\pm 0.38$
LR10	1.0~10	5.08 $\pm 0.25$	2.54 $\pm 0.15$	0.60 $\pm 0.20$	1.67 $\pm 0.63$
LR12	0.50~0.75	6.35 $\pm 0.25$	3.18 $\pm 0.35$	1.00 $\pm 0.20$	1.93 $\pm 0.75$
LR12	1.0~22	6.35 $\pm 0.25$	3.18 $\pm 0.35$	0.60 $\pm 0.20$	1.93 $\pm 0.75$
LR12	0.50	6.35 $\pm 0.25$	3.18 $\pm 0.25$	1.40 $\pm 0.20$	1.30 $\pm 0.30$
LR12	0.75	6.35 $\pm 0.25$	3.18 $\pm 0.25$	1.00 $\pm 0.20$	1.30 $\pm 0.30$
LR12	1.00	6.35 $\pm 0.25$	3.18 $\pm 0.25$	0.80 $\pm 0.20$	1.30 $\pm 0.30$
LR12	1.50	6.35 $\pm 0.25$	3.18 $\pm 0.25$	0.65 $\pm 0.20$	1.30 $\pm 0.30$
LR12	2.00	6.35 $\pm 0.25$	3.18 $\pm 0.25$	0.50 $\pm 0.20$	1.30 $\pm 0.30$
LR12	2.50	6.35 $\pm 0.25$	3.18 $\pm 0.25$	1.00 $\pm 0.20$	1.30 $\pm 0.30$
LR12	3.00	6.35 $\pm 0.25$	3.18 $\pm 0.25$	0.70 $\pm 0.20$	1.30 $\pm 0.30$
LR12	3.50	6.35 $\pm 0.25$	3.18 $\pm 0.25$	0.41 $\pm 0.20$	1.30 $\pm 0.30$
LR12	4.00	6.35 $\pm 0.25$	3.18 $\pm 0.25$	0.60 $\pm 0.20$	1.30 $\pm 0.30$
LR12	4.50	6.35 $\pm 0.25$	3.18 $\pm 0.25$	0.58 $\pm 0.20$	1.30 $\pm 0.30$
LR12	5.00	6.35 $\pm 0.25$	3.18 $\pm 0.25$	0.50 $\pm 0.20$	1.30 $\pm 0.30$
LR12	5.50	6.35 $\pm 0.25$	3.18 $\pm 0.25$	0.47 $\pm 0.20$	1.30 $\pm 0.30$
LR12	6.00	6.35 $\pm 0.25$	3.18 $\pm 0.25$	0.50 $\pm 0.20$	1.30 $\pm 0.30$
LR12	6.50	6.35 $\pm 0.25$	3.18 $\pm 0.25$	0.47 $\pm 0.20$	1.30 $\pm 0.30$
LR12	7.00	6.35 $\pm 0.25$	3.18 $\pm 0.25$	0.45 $\pm 0.20$	1.30 $\pm 0.30$
LR12	10.0	6.35 $\pm 0.35$	3.20 $\pm 0.25$	0.80 $\pm 0.15$	1.90 $\pm 0.15$

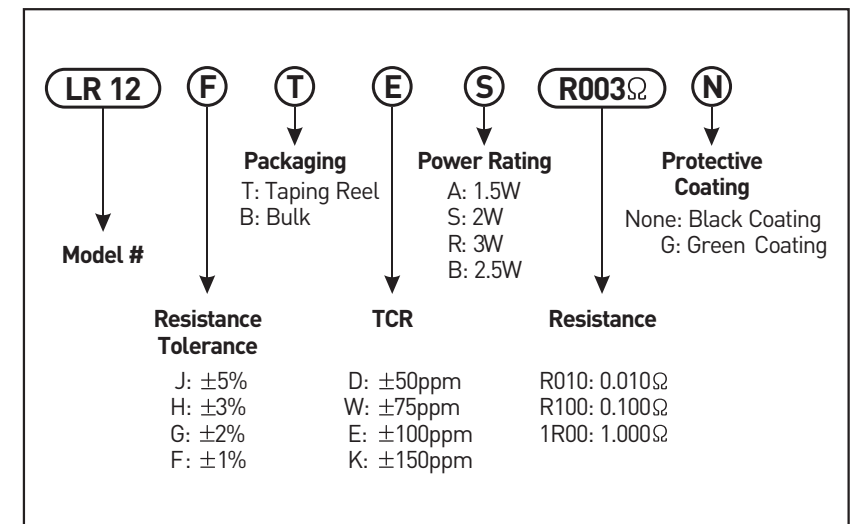
## PACKAGING REEL SPECIFICATIONS

Model	Dimension [mm]					Emboss Plastic Type [pcs]
	ΦA	ΦB	ΦC	W	T	
LR12	180 $^{+0}_{-3}$	60 $^{+1}_{-0}$	13.0 $\pm 1.0$	9.0 $\pm 0.5$	11.4 $\pm 1.0$	2000 2000

## DERATING CURVE

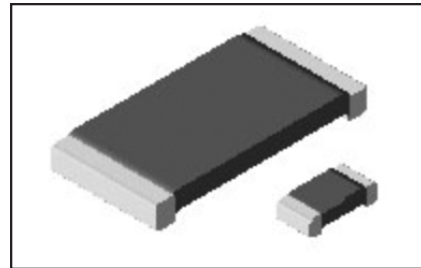


## ORDERING PROCEDURE EXAMPLE



# Power Metal Strip Resistor, Low Value(SMD)

Ideal for all types of current sensing, voltage division and pulse applications including switching and linear power supplies, instruments, power amplifiers. Proprietary processing technique produces extremely low resistance values. All welded construction. Solid metal Nickel-chrome or Manganese-copper alloy resistive element. Solderable terminations. Very low inductance 0.5nH to 5nH. Excellent frequency response. Low thermal EMF.

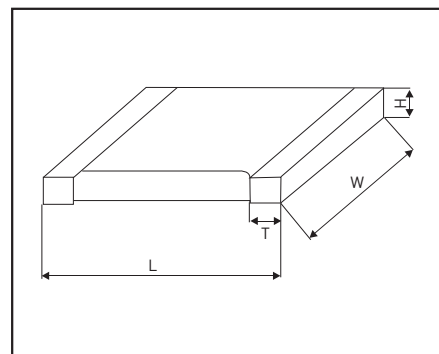


## GENERAL SPECIFICATIONS

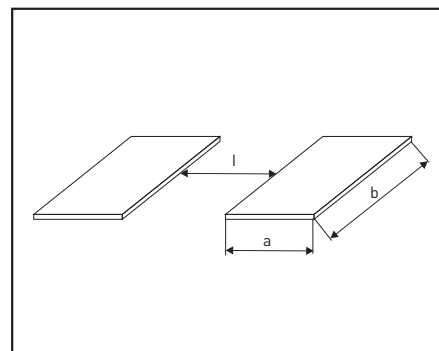
Model	Power Rating at 70°C [W]	Working Voltage Max. [V]	Resistance Range[Ω]		Temperature coefficient [ppm/°C]
			±0.5%	±1.0%	
WSL0805	0.125	$\sqrt{P \times R}$	0.01 ~ 0.2	0.01 ~ 0.2	±275 for 1mΩ to 2.9mΩ ±150 for 3mΩ to 4.9mΩ ±110 for 5mΩ to 6.9mΩ ±75 for 7mΩ to 0.5Ω
WSL0805-18	0.25				
WSL1206	0.25				
WSL1206-18	0.5				
WSL2010	0.5				
WSL2010-18	1.0				
WSL2512	1.0 <sup>(1)</sup>				
WSL2512-18	2.0				
WSL2816	2.0				

(1) For Values above 0.1Ω derate linearly to 80% rated power at 0.5 Ω

## DIMENSIONS [mm] AND SOLDER PAD DIMENSIONS



Model	Dimensions [mm]				
	Resistance Range[Ω]	L	W	H	T
WSL0805	0.01-0.2	2.03±0.254	1.27±0.254	0.330±0.127	0.381±0.254
WSL1206	0.002-0.2	3.2±0.254	1.6±0.254	0.635±0.254	0.508±0.254
WSL2010	0.001-0.0069	5.08±0.254	2.54±0.254	0.635±0.254	1.47±0.254
	0.007-0.5	5.08±0.254	2.54±0.254	0.635±0.254	0.508±0.254
WSL2512	0.001-0.0049	6.35±0.254	3.18±0.254	0.635±0.254	2.21±0.254
	0.005-0.0069	6.35±0.254	3.18±0.254	0.635±0.254	1.19±0.254
	0.007-0.5	6.35±0.254	3.18±0.254	0.635±0.254	0.762±0.254
WSL2816	0.01-0.1	7.1±0.254	4.2±0.254	0.635±0.254	1.57±0.254

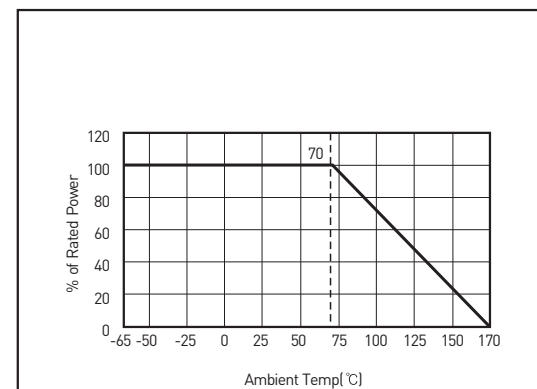


Model	Solder PAD Dimensions[mm]			
	Resistance Range[Ω]	a	b	l
WSL0805	0.01-0.2	1.02	1.27	0.50
WSL1206	0.002-0.2	1.27	1.78	1.40
WSL2010	0.001-0.0069	2.36	3.05	1.40
	0.007-0.5	1.40	3.05	3.30
WSL2512	0.001-0.0049	3.05	3.68	1.27
	0.005-0.0069	2.11	3.68	3.18
	0.007-0.5	1.65	3.68	4.06
WSL2816	0.01-0.1	3.3	4.8	1.00

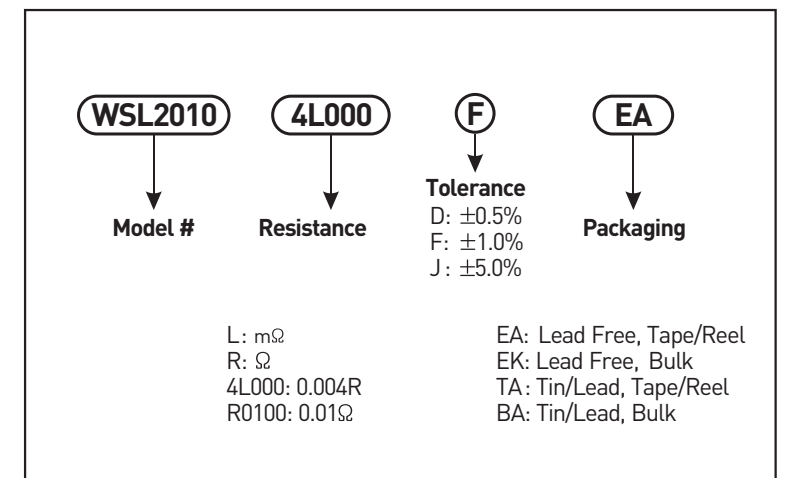
## CHARACTERISTICS

Operating Temperature range	-65°C~ +170°C	
Weight/1000 pieces(g)	WSL 0805: 4.8g, 1206: 16.2g, 2010: 38.9g, 2512: 63.6g, 2816: 118g	
Thermal Shock	±(0.5%+0.0005Ω)ΔR	-55°C ~ +150°C 1000cycles 15 minutes at each extreme
Short Time Overload	±(0.5%+0.0005Ω)ΔR	5 × rated power for 5 sec.
Low Temperature Operation	±(0.5%+0.0005Ω)ΔR	-65°C for 24 hours
High Temperature Exposure	±(1.0%+0.0005Ω)ΔR	1000 hours at +170°C
Bias Humidity	±(0.5%+0.0005Ω)ΔR	+85°C, 85%RH, 10% Bias, 1000 hours
Mechanical Shock	±(0.5%+0.0005Ω)ΔR	100g's for 6 ms, 5 pulses
Vibration	±(0.5%+0.0005Ω)ΔR	Frequency varied 10 ~ 2000 Hz in 1minutes, 3 directions, 12 hours
Load Life	±(1.0%+0.0005Ω)ΔR	1000 hours at rated power, +70°C, 1.5hours on, 0.5 hours off
Resistance to Solder Heat	±(0.5%+0.0005Ω)ΔR	+260°C Solder, 10-12 sec. dwell, 25mm/sec. emergence
Moisture Resistance	±(0.5%+0.0005Ω)ΔR	MIL-STD-202, Method 106, 0% power, 7a and 7b not required

## DERATING



## ORDERING PROCEDURE EXAMPLE



\* Part Marking: Model, Value, Tolerance; due to resistor size limitations some resistors will be marked with only the resistance value

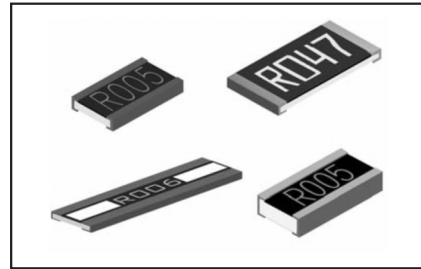
## PACKGING

Model	REEL			
	Tape Width	Diameter	Pieces/Reel	Code
WSL0805	8mm / Punched Paper	178mm / 7"	5000	EA
WSL1206	8mm / Embossed Plastic	178mm / 7"	4000	EA
WSL2010	12mm / Embossed Plastic	178mm / 7"	4000	EA
WSL2512	12mm / Embossed Plastic	178mm / 7"	2000	EA
WSL2816	16mm / Embossed Plastic	330mm / 13"	5000	EA

\* Embossed carrier tape per EIA-481-1A

# Current Sensing Chip Resistor

- 3W Rating in 1W size, 1225 Package
- Low TCR from  $\pm 100 \sim \pm 600$  PPM/ $^{\circ}\text{C}$
- Resistance Values from 1m to 1000m ohm
- High Purity Alumina Substrate for High Power Dissipation



## GENERAL SPECIFICATIONS

Model	Power Rating	Operating Temp. Range	Resistance Tolerance (%)	Resistance Range[ $\Omega$ ]	TCR[ppm/ $^{\circ}\text{C}$ ]
CS02(0402)	1/16W	-55 ~ +155 $^{\circ}\text{C}$	F [ $\pm 1$ ] G [ $\pm 2$ ] J [ $\pm 5$ ]	50m ~ 100m	$\pm 400$
CS03(0603)	1/10W			101m ~ 500m	$\pm 300$
				501m ~ 1000m	$\pm 200$
				20m ~ 50m	$\pm 600$
CS05(0805)	1/8W			51m ~ 100m	$\pm 400$
				101m ~ 500m	$\pm 300$
				501m ~ 1000m	$\pm 200$
CS06(1206)	1/4W			10m ~ 20m	$\pm 600$
				21m ~ 50m	$\pm 400$
				51m ~ 500m	$\pm 300$
CS12(2512)	1W			501m ~ 1000m	$\pm 200$
				3m ~ 5m	$\pm 300$
		6m ~ 20m	$\pm 200$		
CS25(1225)	3W	21m ~ 30m	$\pm 150$		
		31m ~ 300m	$\pm 100$		
		10m ~ 19m	$\pm 300$		
CS37(3720)	1W	20m ~ 500m	$\pm 150$		
		G [ $\pm 2$ ], J [ $\pm 5$ ]	1m ~ 4m	$\pm 300$	
CS75(7520)	2W	F [ $\pm 1$ ], G [ $\pm 2$ ], J [ $\pm 5$ ]	5m ~ 10m	$\pm 200$	
			11m ~ 350m	$\pm 150$	

## CHARACTERISTICS

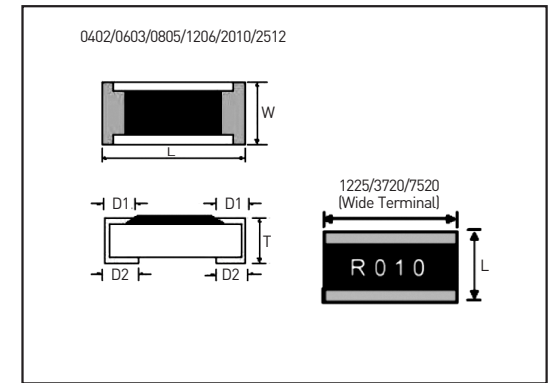
Values in [ ] mean change in  $\Omega$  after test

Temp. Coefficient of Resistance	As Spec	MIL-STD-202F Method 304	+25/-55/+25/+125/+25 $^{\circ}\text{C}$
Short Time Overload	$\pm[0.5\%+0.05\Omega]$	JIS-C-5202-5.5	RCWV*2.5 or maximum Overloading Voltage, 5sec.
Dielectric Withstanding Voltage	By Type	MIL-STD-202F Method 301	Apply maximum Overload Voltage for 1minute
Insulation Resistance	$> 1000M\Omega$	MIL-STD-202F-Method 302	Apply 100VDC for 1minute
Thermal Shock	$\pm[0.5\%+0.05\Omega]$	MIL-STD-202F Method 107G	-55 $^{\circ}\text{C}$ ~150 $^{\circ}\text{C}$ , 100cycles
Load Life	$\pm[1.0\%+0.05\Omega]$	MIL-STD-202F Method 108A	RCWV, 70 $^{\circ}\text{C}$ 1.5hours on, 0.5hours off for 100-1048hours
Humidity(Steady State)	$\pm[0.5\%+0.05\Omega]$	MIL-STD-202F Method 103B	40 $^{\circ}\text{C}$ , 90-95%RH, RCWV 1.5hours on, 0.5hours off for 1000-1048hours
Resistance to Dry Heat	$\pm[0.5\%+0.05\Omega]$	JIS-C-5202-7.2	96hours at +155 $^{\circ}\text{C}$ without load
Low Temperature Operation	$\pm[0.5\%+0.05\Omega]$	JIS-C-5202-7.1	1hours, -65 $^{\circ}\text{C}$ followed by 45minute of RCWV
Bending Strength	As Spec.	JIS-C-5202-6.1.4	Bending Amplitude 3mm for 10sec.
Solerability	95% minimum. coverage	MIL-STD-202F Method 208H	245 $\pm 5^{\circ}\text{C}$ , 2 $\pm 0.5$ sec.
Resistance to Soldering Heat	$\pm[0.5\%+0.05\Omega]$	MIL-STD-202F Method 210E	260 $\pm 5^{\circ}\text{C}$ , 10 $\pm 1$ sec.

\* Storage Temperature: 25 $\pm 3^{\circ}\text{C}$ ; Humidity < 0% RH

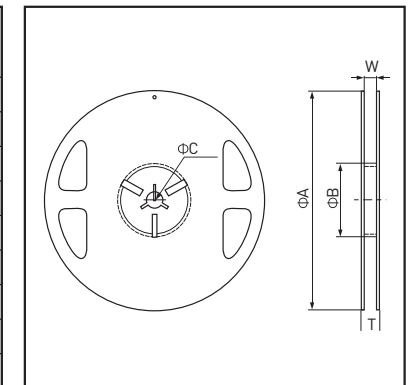
## DIMENSIONS [mm]

Model	Dimensions [mm]				
	L	W	T	D1	D2
CS02	1.00 $\pm 0.05$	0.50 $\pm 0.05$	0.32 $\pm 0.10$	0.20 $\pm 0.10$	0.20 $\pm 0.10$
CS03	1.60 $\pm 0.10$	0.80 $\pm 0.10$	0.45 $\pm 0.10$	0.30 $\pm 0.20$	0.30 $\pm 0.20$
CS05	2.00 $\pm 1.15$	1.25 $\pm 0.15$	0.55 $\pm 0.10$	0.30 $\pm 0.20$	0.40 $\pm 0.25$
CS06	3.05 $\pm 0.15$	1.55 $\pm 0.15$	0.55 $\pm 0.10$	0.50 $\pm 0.30$	0.40 $\pm 0.25$
CS10	5.00 $\pm 0.20$	2.45 $\pm 0.15$	0.60 $\pm 0.15$	0.60 $\pm 0.30$	0.50 $\pm 0.25$
CS12	6.35 $\pm 0.20$	3.15 $\pm 0.15$	0.60 $\pm 0.10$	0.60 $\pm 0.30$	0.55 $\pm 0.25$
CS25	3.10 $\pm 0.15$	6.30 $\pm 0.15$	0.90 $\pm 0.15$	0.60 $\pm 0.30$	0.55 $\pm 0.25$
CS37	2.00 $\pm 0.20$	3.72 $\pm 0.20$	0.60 $\pm 0.10$	0.40 $\pm 0.20$	0.40 $\pm 0.20$
CS75	2.00 $\pm 0.20$	7.50 $\pm 0.30$	0.60 $\pm 0.10$	0.40 $\pm 0.20$	0.40 $\pm 0.20$

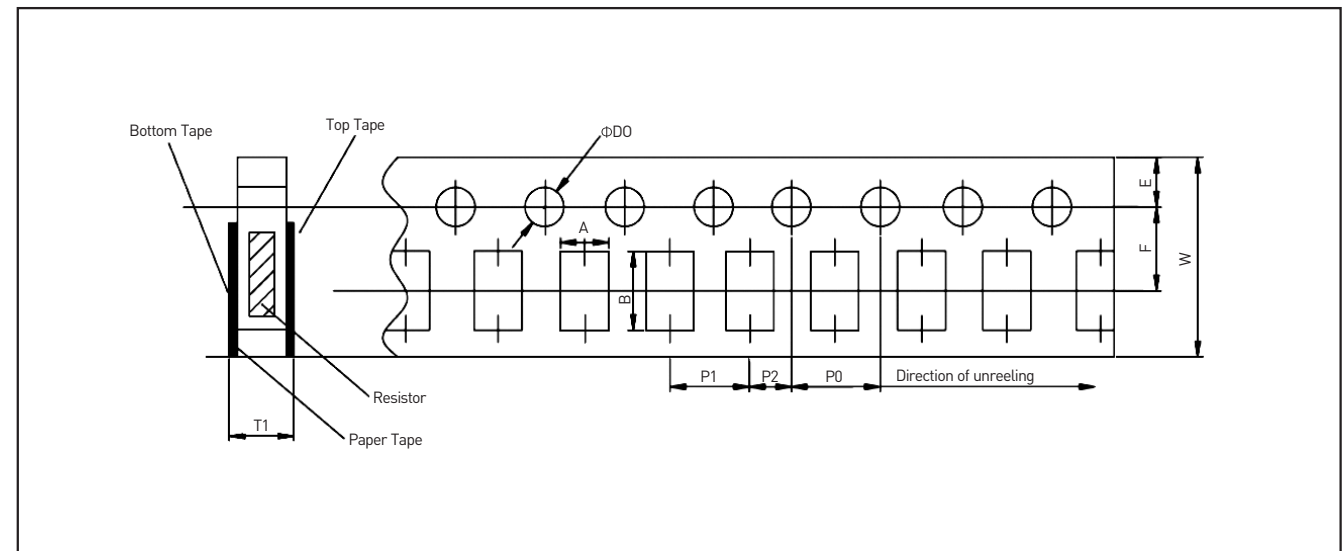


## REEL SPECIFICATIONS

Model	Dimensions [mm]					Paper Tape [pcs]	Emboss Plastic Tape[pcs]
	$\Phi A$	$\Phi B$	$\Phi C$	W	T		
CS02	178 $\pm 1$	60.0 $\pm 1.0$	13.0 $\pm 0.20$	9.00 $\pm 0.50$	12.0 $\pm 0.15$	10,000	-
CS03	178 $\pm 1$	60.0 $\pm 1.0$	13.0 $\pm 0.20$	9.00 $\pm 0.50$	12.0 $\pm 0.15$	5,000	-
CS05	178 $\pm 1$	60.0 $\pm 1.0$	13.0 $\pm 0.20$	9.00 $\pm 0.50$	12.0 $\pm 0.15$	5,000	-
CS06	178 $\pm 1$	60.0 $\pm 1.0$	13.0 $\pm 0.20$	9.00 $\pm 0.50$	12.0 $\pm 0.15$	5,000	-
CS10	178 $\pm 1$	60.2 $\pm 1.0$	13.0 $\pm 0.50$	13.2 $\pm 1.50$	16.0 $\pm 0.20$	-	4,000
CS12	178 $\pm 1$	60.2 $\pm 1.0$	13.0 $\pm 0.50$	13.2 $\pm 1.50$	16.0 $\pm 0.20$	-	4,000
CS25	178 $\pm 1$	60.2 $\pm 1.0$	13.0 $\pm 0.50$	13.2 $\pm 1.50$	16.0 $\pm 0.20$	-	2,000
CS37	178 $\pm 1$	60.2 $\pm 1.0$	13.0 $\pm 0.50$	13.2 $\pm 1.50$	16.0 $\pm 0.20$	-	2,000
CS75	178 $\pm 1$	60.2 $\pm 1.0$	13.0 $\pm 0.50$	17.0 $\pm 1.50$	19.0 $\pm 1.00$	-	2,000

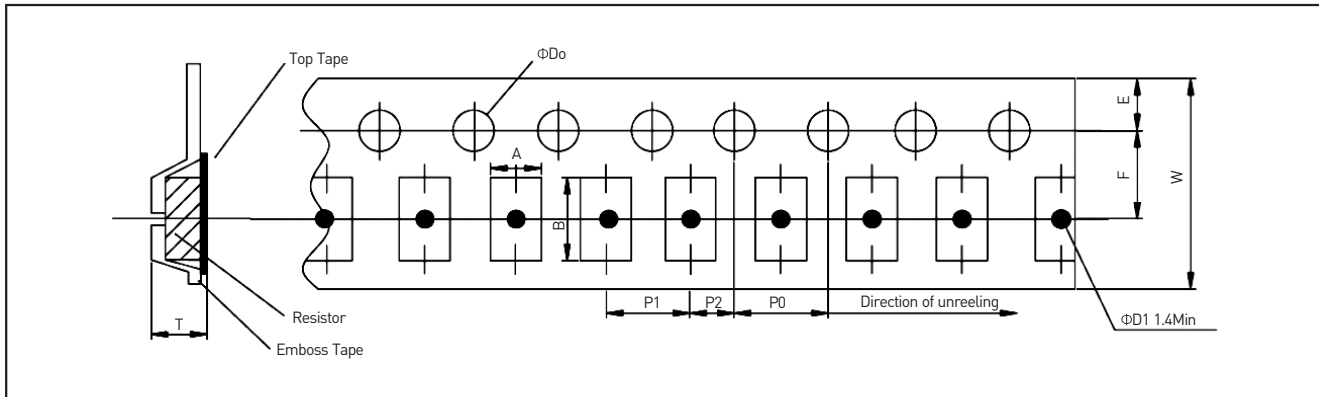


## PAPER TAPE SPECIFICATIONS



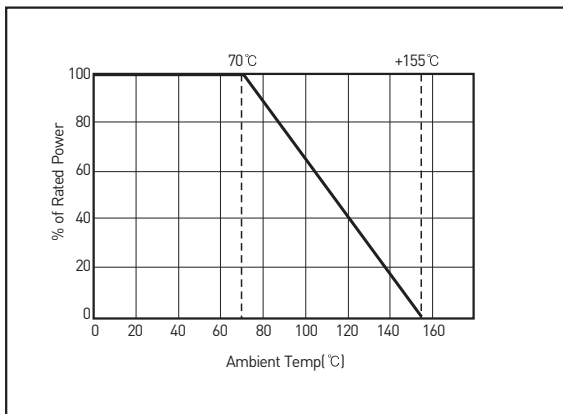
Model	Dimensions [mm]									
	A	B	W	E	F	P0	P1	P2	$\Phi D0$	T
CS02	0.70 $\pm 0.05$	1.16 $\pm 0.05$	8.00 $\pm 0.10$	1.75 $\pm 0.05$	3.5 $\pm 0.05$	4.00 $\pm 0.10$	2.00 $\pm 0.05$	2.00 $\pm 0.05$	1.55 $\pm 0.05$	0.40 $\pm 0.03$
CS03	1.10 $\pm 0.05$	1.90 $\pm 0.05$					0.60 $\pm 0.03$			
CS05	1.60 $\pm 0.05$	2.37 $\pm 0.05$					0.75 $\pm 0.05$			
CS06	2.00 $\pm 0.05$	3.55 $\pm 0.05$								

EMBOSS PALSTIC TAPE SPECIFICATION

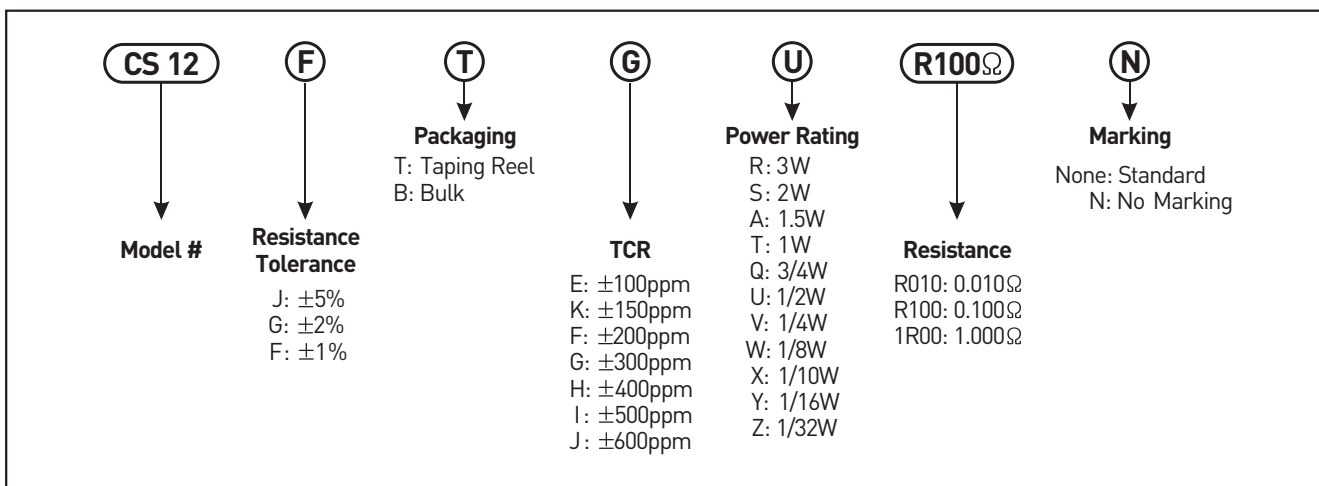


Model	Dimensions [mm]									
	A	B	W	E	F	P0	P1	P2	ΦD0	T
CS10	2.85±0.10	5.45±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.20
CS12	3.40±0.10	6.65±0.10	12.0±0.10		5.5±0.05	4.00±0.05			1.50±0.10	1.00±0.20
CS25	3.38±0.10	6.68±0.10	12.0±0.30	1.75±0.01	5.5±0.10	4.00±0.10	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		5.5±0.05	4.00±0.05			1.50±0.10	1.50±0.10
CS75	2.50±0.20	8.30±0.20	16.0±0.30		7.8±0.05	4.00±0.05			1.50±0.10	1.50±0.10

DERATING CURVE

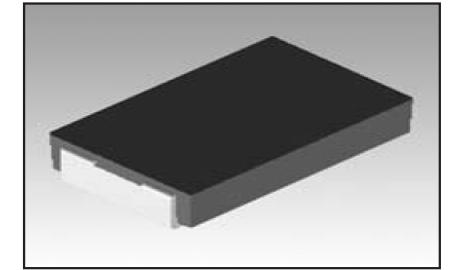


ORDERING PROCEDURE EXAMPLE



Power Metal Strip Resistors, Low Value (SMD)

Molded high temperature encapsulation. Ideal for all types of current sensing, voltage division and pulse applications including switching and linear power supplies, instruments, power amplifiers. Proprietary processing technique produces extremely low resistance values. All welded construction. Solid metal Nickel-chrome or Manganese-copper alloy resistive element. 60/40 tin/lead copper terminations. Very low inductance 0.5nH to 5nH. Excellent frequency response to 50MHz. Low thermal EMF. Lead(Pb)-free version is RoHS compliant.



GENERAL SPECIFICATIONS

Model	Power Rating at 70°C[W]	Working Voltage Max.[V]	Resistance Range[Ω]		Temperature coefficient [ppm/°C]
			±0.5%	±1.0%	
WSR2	2.0	$\sqrt{P \times R}$	0.01 ~ 1.0	0.001 ~ 1.0	0.005Ω-0.0099Ω : ±110
WSR3	*3.0		0.01 ~ 0.2	0.001 ~ 0.2	0.010Ω-1.0Ω : ±75
WSR5	*5.0		0.01 ~ 0.3	0.0075 ~ 0.3	0.0075Ω-0.0099Ω : ±110 0.01Ω-0.3Ω : ±75

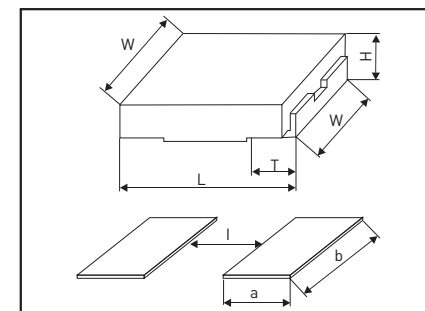
\*1) The WSR3 requires a minimum of 1050 sq. mil. circuit traces connecting to the recommended solder pad  
\*2) The WSR5 is rated at 5 watts with terminal temperature maintained ≤120°C

CHARACTERISTICS

Values in [ ] mean change in Ω after test

Operating Temperature Range				-65°C~+275°C
Insulation Resistance				minimum 10GΩ
Dielectric Withstanding Voltage				> 500 VAC
Short Time Overload	±[0.5%+0.0005Ω]ΔR	±[2.0%+0.0005Ω]ΔR	WSR2:5×rated power WSR3:4×rated power WSR5:3×rated power	for 5 sec.
Moisture Resistance	±[0.5%+0.0005Ω]ΔR	±[0.5%+0.0005Ω]ΔR	MIL-STD-202, Method 106, 0% Power 7a and 7b not required	
Thermal Shock	WSR2 ±[0.5%+0.0005Ω]ΔR	WSR3, WSR5 ±[0.5%+0.0005Ω]ΔR	-55°C ~ +150°C 1000cycles 15 minutes at each extreme	
Mechanical Shock	±[0.5%+0.0005Ω]ΔR		100g's for 6 milliseconds, 5 pulses	
Vibration	±[0.5%+0.0005Ω]ΔR		Frequency varied 10-2000 Hz in 1minutes, 3directions,12hours	
Low Temperature Storage	±[0.5%+0.0005Ω]ΔR		-65°C For 24hours	
High Temperature Exposure	±[1.0%+0.0005Ω]ΔR		1000 hours at +275°C	
Resistance to Solder Heat	±[0.5%+0.0005Ω]ΔR		+260°C Solder, 10-12 sec. dwell, 25mm/sec. emergence	
Bias Moisture Resistance	±[0.5%+0.0005Ω]ΔR		+85°C, 85%RH, 10% Bias, 1000hours	
Load Life	±[1.0%+0.0005Ω]ΔR		1000 hours at rated power, +70°C, 1.5hours on, 0.5hours off	

DIMENSIONS [mm]



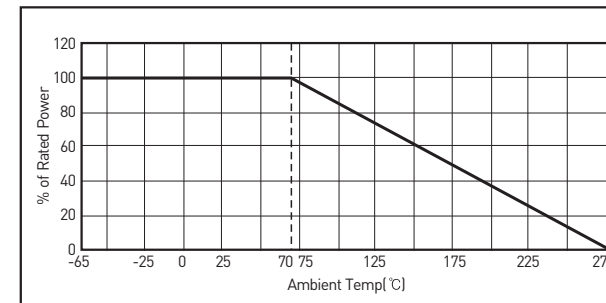
SOLDER PAD DIMENSIONS

Model	Dimensions [mm]				
	L	H	T	W	W1
WSR2	11.56±0.813	2.41±0.127	2.54±0.254	6.98±0.127	5.46±0.127
WSR3					
WSR5					

Model	Solder Pad Dimensions [mm]		
	a	b	c
WSR2	3.94	5.84	5.21
WSR3			
WSR5			

DERATING CURVE

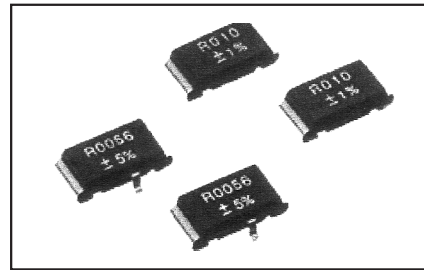


ORDERING INFORMATION



## Precision Shunt Chip Resistors

- Precision and power resistor
- Duroplast package
- Four-terminal connection technology on the substrate
- Solid Cu contact suitable for high current load
- Reflow and wave-soldering



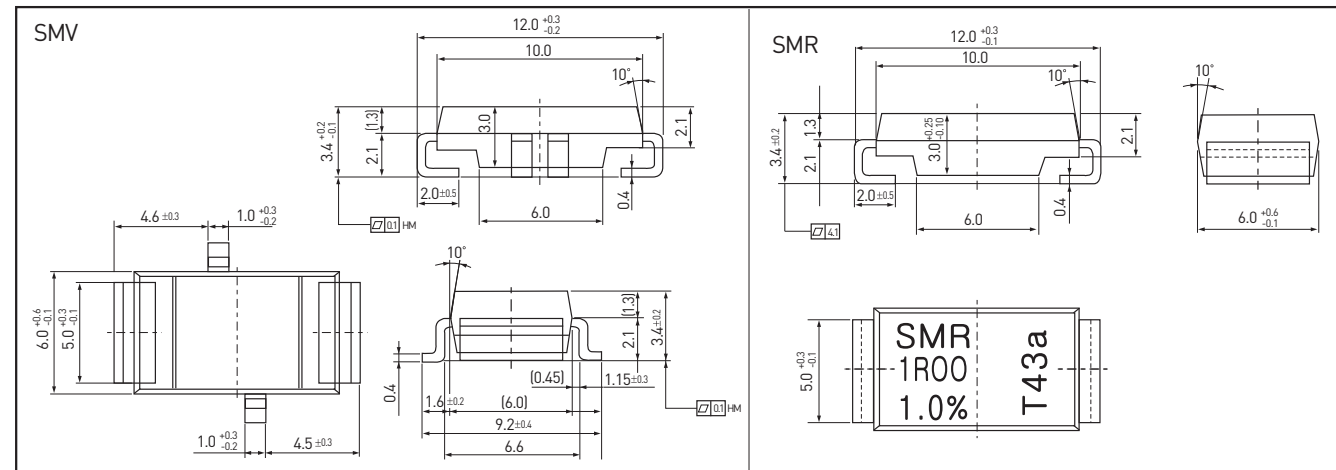
### GENERAL SPECIFICATIONS

Type	Load Capacity [W]	Resistance Range[Ω]	Tolerance[%]	Terminal	TCR [20°C-60°C]	Dielectric with standing voltage	Operating Temp	Solder Reflow	Weight[g]
SMV	3	0.001 ~ 1	±0.5, ±1, ±5	4	±30ppm/°C	AC 1000V	-55/°C~+140°C	Max.255°C (t < 40sec)	0.65
SMR	3	0.01 ~ 4.7	0.5(≥0.05Ω), ±1, ±5	2	±50ppm/°C				0.63

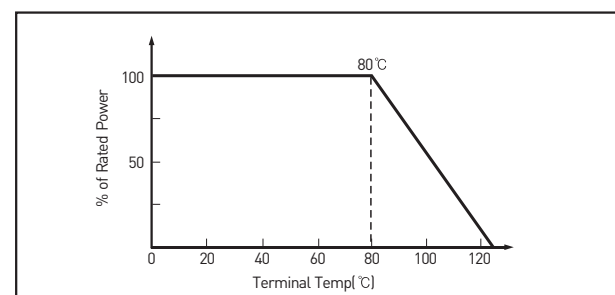
### CHARACTERISTICS

Thermal Shock	±0.2%	-65°C, 25°C, 125°C, 25°C, 25cycles
Short Time Overload	±0.2%	5 × Power rating 5secs.
Resistance to Solvents	No Damage	IPA 3minutes
Low temp. Storage and Operation	±0.1%	MIL-R-26E
Thermal Strength	±0.02%	44N 5~10secs.
Resistance to Soldering Heat	±0.1%	260°C 10secs.
Moisture Resistance	±0.1%	Near 100°C RH, +25°C, +65°C, -10°C 10cycles(10days)
Shock	±0.2%	50g's 11ms
Vibration, High Frequency	±0.2%	MIL-STD-202 Method 204D-B
Load Life	±0.2%	Rated Power(1.5hours on-0.5hours off) 2000hours
Storage Life at Elevated Temp.	±0.3%	MIL-STD-202 method 108A-F
High Temperature Exposure	±0.5%	140°C 2000hours
Current Noise	±0.01%	MIL-STD-202 method 308
Voltage Coefficient	linearity error less than 120dB	MIL-STD-202 method 309
Thermal EMF	-2μV/°C maximum	0 ~ 100°C
Frequency Characteristic	< 20nH (SMR 0.1Ω)	Inductance

### DIMENSIONS [mm]



### DERATING CURVE



### ORDERING PROCEDURE EXAMPLE

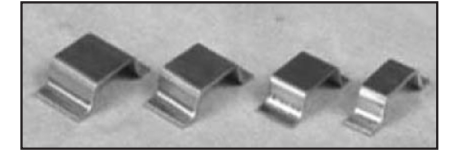
Model	Resistance	Tolerance[%]
SMV	4.7mΩ	±0.5

- Standard Resistance E-06 Series
- Taping Standard Quantity

SMV: 1500pcs  
SMR: 1500pcs

## Preliminary version Metal Strip Shunt Resistor for Detecting Electrical Current

These are durable, surface mounted, low resistance, low profile, low inductance metal plate resistors capable of handling large pulses. Standard characteristics include a 5% tolerance and a TCR of 80ppm/°C. Applications include: Current detection for high speed CPU peripherals, battery charging current protection, DC/DC conversion modules, DC/AC conversion, servo motor control and intelligent power modules.



### GENERAL SPECIFICATIONS

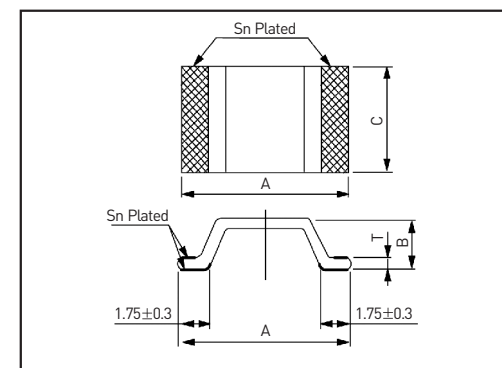
Model	Resistance[Ω]	Power Rating	Current Rating	Max. Current [2.5sec one time]	Series Inductance	TCR[ppm/°C]	Tolerance
CS30	1.0m	3W	54A	81A	3[nH]	±80 [20°C-105°C]	J [±5%] K [±10%]
	1.5m		45A	65A			
	2m		38A	57A			
	3m		31A	46A			

\* Designed to suit your request

### CHARACTERISTICS

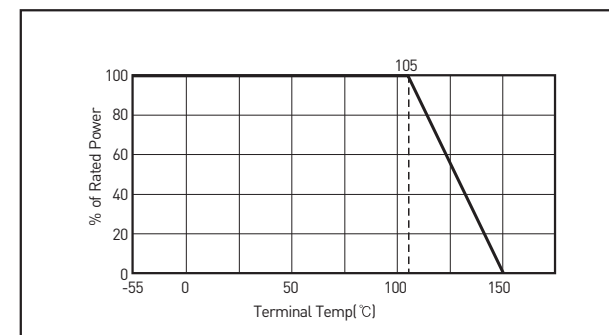
Temperature Range		-55°C ~150°C
Short Time Overload	±[0.5%]	maximum current, 2.5secs.
Moisture Resistance	±[0.5%]	80°C, 85%RH, DC 0.1W, 1000hours
Thermal Shock	±[0.5%]	+55°C~+125°C, 20minutes interval, 5minutes 5Cycles
Vibration	±[0.5%]	10-2000Hz, 1.5mm/20gr, 2hours
Low Temperature Storage	±[0.5%]	-55°C, 24hours.
High Temperature Storage	±[1.0%]	+175°C, 1000hours
Soldering Heat	±[0.25%]	260°C±5°C, 10±1secs.
Solderability		90% terminal surface
Load Life	±[0.5%]	Rated power, 90minutes on, 30minutes off, 1000 hours

### DIMENSIONS [mm]

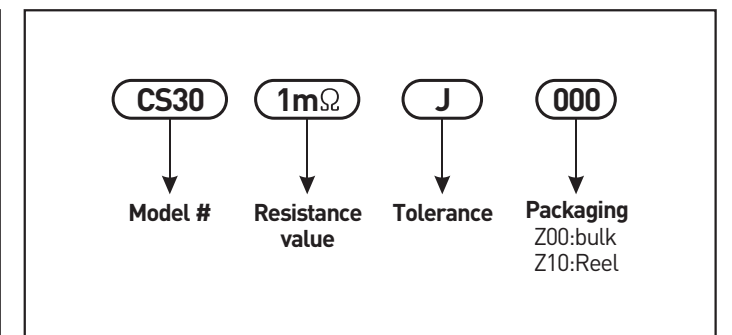


Model	Resistance	Dimensions [mm]			
		A	B	C	T
CS30	1.0mΩ	10.7±0.5	2.9±0.3	5.2±0.5	0.8
	1.5mΩ	10.7±0.5	2.9±0.3	6.5±0.5	0.5
	2.0mΩ	10.7±0.5	2.9±0.3	4.2±0.5	0.5
	3.0mΩ	10.7±0.5	2.9±0.3	3.2±0.5	0.5

### DERATING CURVE

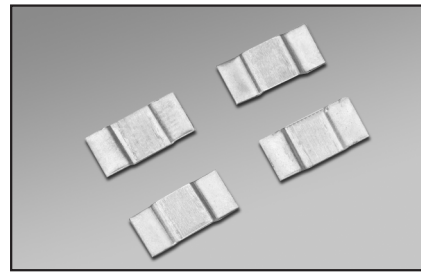


### ORDERING PROCEDURE EXAMPLE



# BWS03, BWS05 Chip Shunt Resistors

BWS03 resistors exhibit a constant power of 3 watts up to 77A at 0.5mΩ. BWS05 resistors exhibit a constant power of 5watts up to 100A at 0.5mΩ. These models have heavy copper connectors, excellent long term stability and low inductance. Maximum soldering temperatures of up to 350 °C/30 sec. Or 250 °C/10 min. Mounting using re-flow soldering or welding on copper. Applications include: Current sensors for hybrid power sources, frequency converters and high current automotive applications.

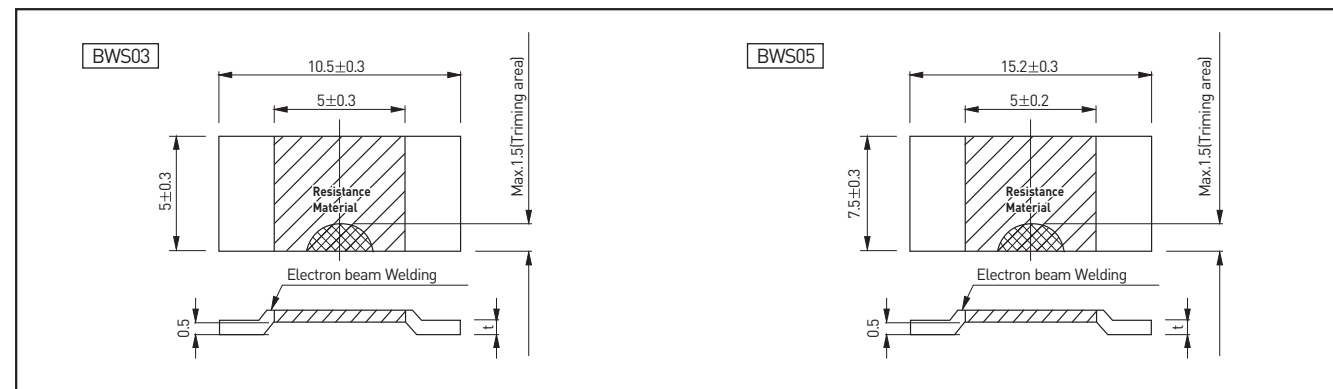


## GENERAL SPECIFICATIONS

Model	Power Rating(W)	Resistance(mΩ)	Tolerance(%)	TCR	Internal Heat Resistance	Operating Ambient Temp.
BWS03	3	0.5, 1, 2, 3, 4	F [±1], G [±2] J [5]	±50ppm(20°C to 60°C)	Rthi < 10k/W	55°C~170°C
BWS05	5	0.5, 1, 2, 3		maximum ±100ppm		

## DIMENSIONS (mm) & Materials

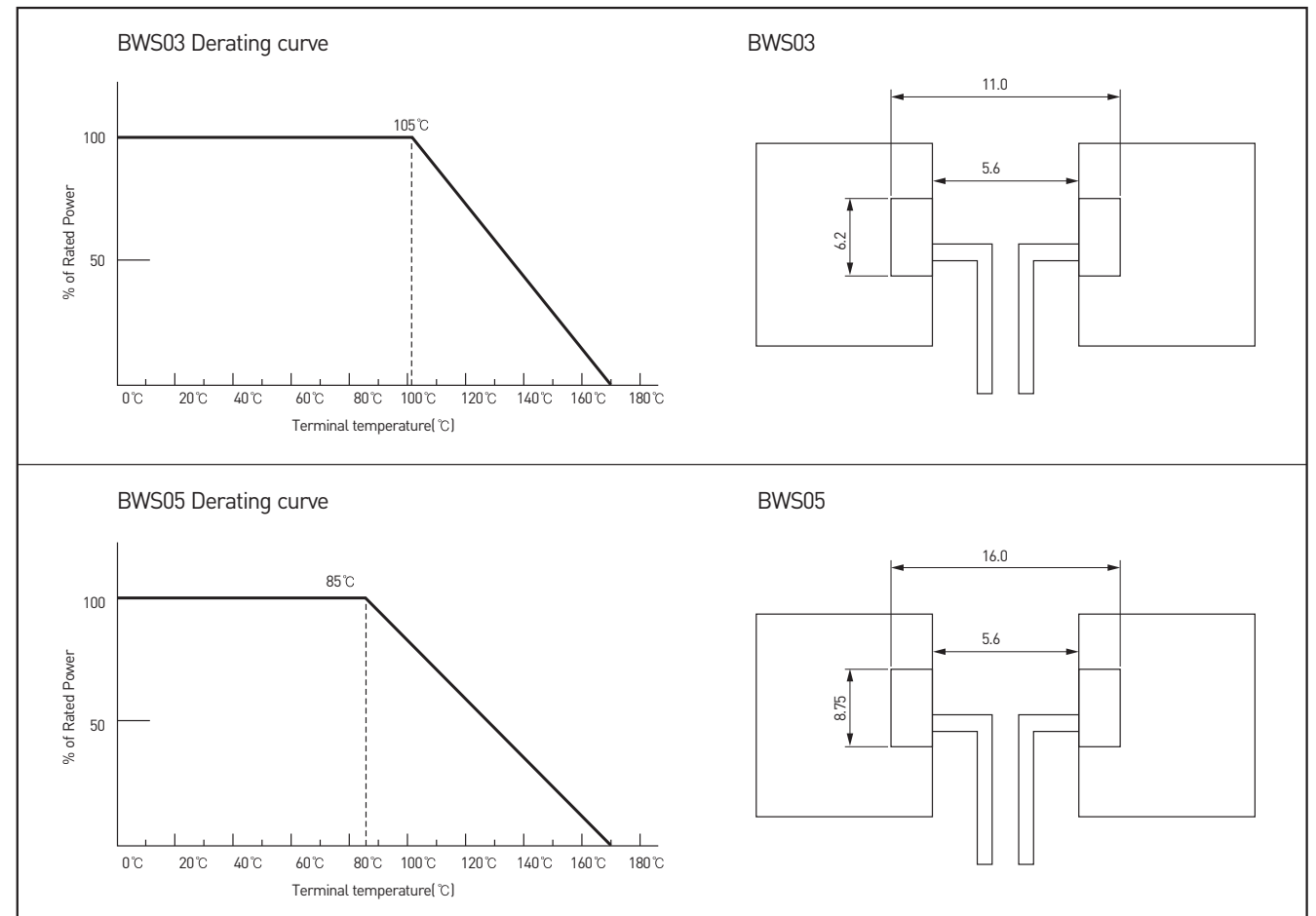
Model	Value	Material	Thickness(t)
BWS03-M	0.5mΩ	Manganin	0.88mm±0.05
BWS03-M	1mΩ	Manganin	0.43mm±0.05
BWS03-N	2mΩ	NiCr alloy	0.64mm±0.05
BWS03-N	3mΩ	NiCr alloy	0.43mm±0.05
BWS03-N	4mΩ	NiCr alloy	0.32mm±0.05
BWS05-M	0.5mΩ	Manganin	0.56mm±0.05
BWS05-N	1mΩ	NiCr alloy	0.9mm±0.05
BWS05-N	2mΩ	NiCr alloy	0.45mm±0.05
BWS05-N	3mΩ	NiCr alloy	0.3mm±0.05



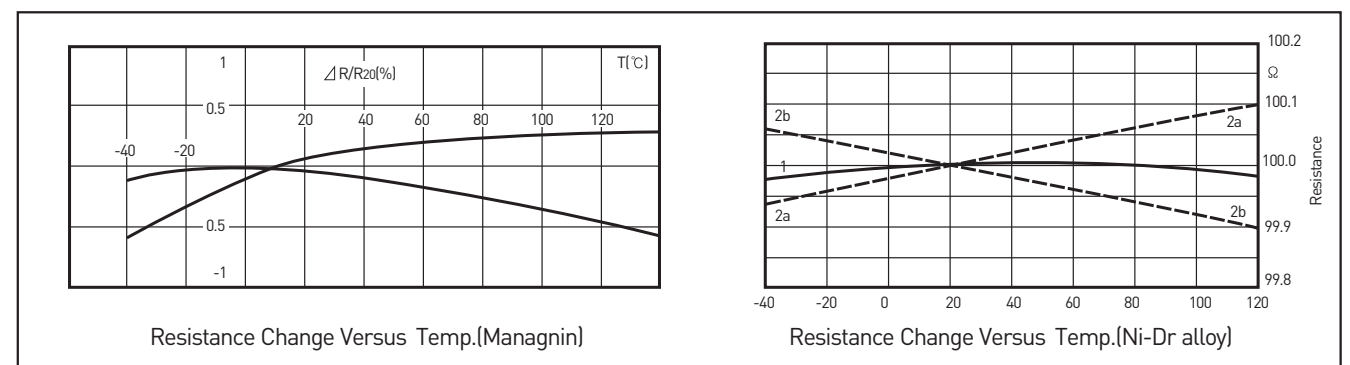
## CHARACTERISTICS

Thermal Shock	[±0.1%]	-65°C, 25°C, 125°C, 25°C 25 cycles
Short time Overload	[±0.2%]	Power Rating × 5 for 5 sec.
Resistance to Soldering Heat	[±0.2%]	260°C 10 sec.
Moisture Resistance	[±0.2%]	90~98%RH, +25°C, +65°C, -10°C 10 Cycle
High Temperature Exposure	[±0.2%]	140°C for 2000 hours
Vibration, High Frequency	[±0.2%]	15g 10~2000Hz 36 Cycles
Inductance	[ < 3nH ]	
Load Life[Terminal temp. maximum 105°C]	[±1.0%]	Power Rating 90 minutes on, 30 minutes off for 2000 hours
Thermal EMF[μV/°C]	[2μV/°C maximum]	0 ~ 100°C
Current Noise	[±0.01%]	MIL-STD-202 Method 308
Voltage Coefficient	Linearity error less than 120dB	MIL-STD-202 Method 309
Shock	[±0.2%]	50g's, 11ms

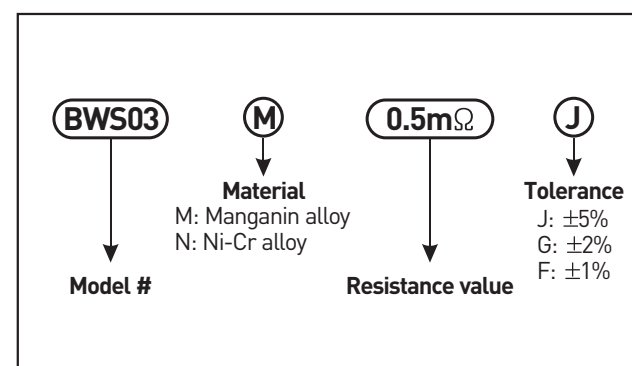
## DERATING CURVE & PROPOSED INSTALLATIONS



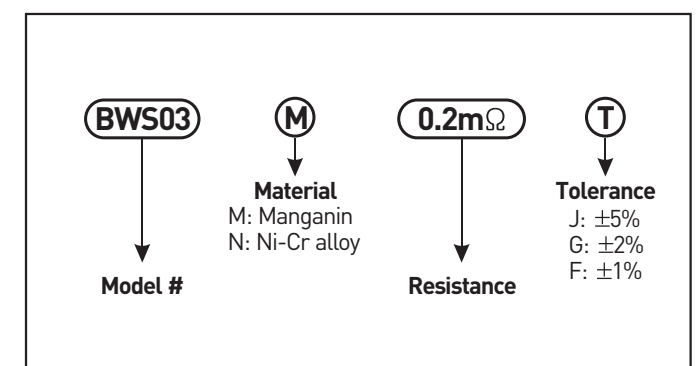
## RESISTANCE CHANGE VS TEMPERATURE



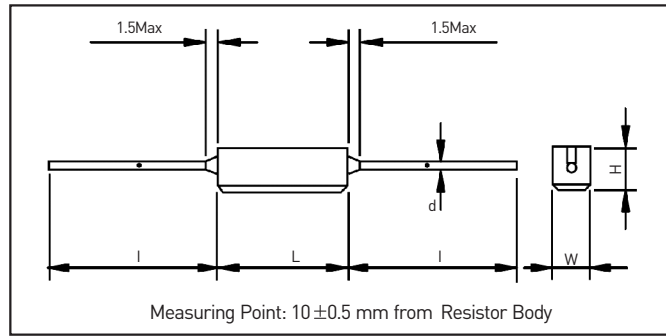
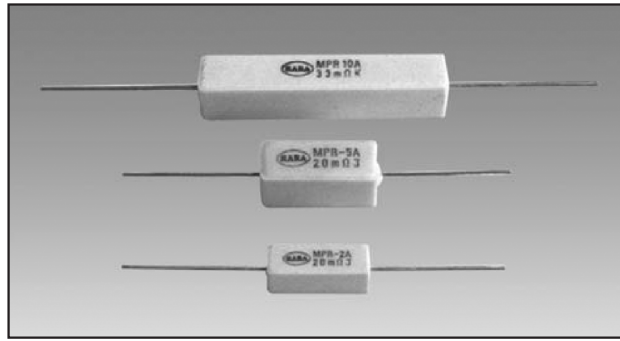
## ORDERING PROCEDURE EXAMPLE



## ORDERING PROCEDURE EXAMPLE



## Metal Plate Shunt Resistors(Axial Type)



### GENERAL SPECIFICATIONS & DIMENSIONS [mm]

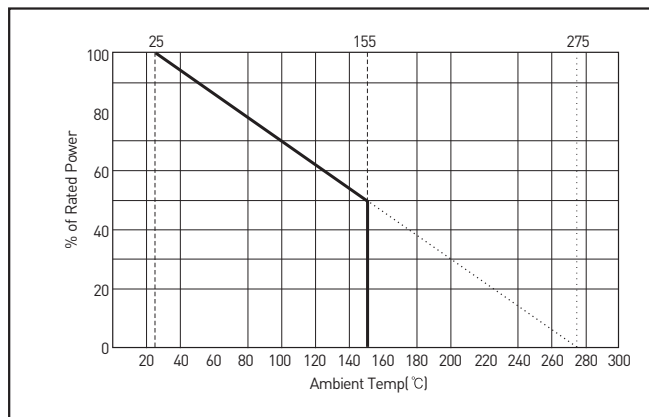
Model	Power Rating	Resistance Range	Maximum Current	Dimensions[mm]				
				L±1	W±1	H±1	l±Min	d±0.02
MPR 1A	1W	0.005 ~ 0.03Ω	5A	13.0	6.5	7.0	35	0.8
MPR 2A	2W	0.005 ~ 0.05Ω	10A	18.0	6.5	7.0	35	0.8
MPR 3A	3W	0.005 ~ 0.10Ω	10A	22.5	8.0	8.5	35	0.8
MPR 5A	5W	0.005 ~ 0.10Ω	10A	21.5	9.5	9.5	35	0.8
MPR 7A	7W	0.01 ~ 0.120Ω	20A	34.5	9.5	9.5	35	0.8
MPR 10A	10W	0.01 ~ 0.300Ω	20A	48.5	9.5	9.5	35	1.0
MPR 15A	15W	0.01 ~ 0.300Ω	20A	48.5	12.5	12.5	35	1.0
MPR 20A	20W	0.01 ~ 0.400Ω	20A	62.5	12.5	12.5	35	1.0

### CHARACTERISTICS

Values in [ ] mean change in Ω after test

Temperature Range	-25°C ~ 155°C	
Insulation Resistance	DC 500V, minimum 20MΩ	
Dielectric Withstanding Strength	AC 1500V; maximum leakage current: 2mA	
Short Time Overload	±[2%+0.05Ω]	1W-3W: 5 x power rating-5 sec., 5W-20W: 10 x Power rating-5 sec.
Load Life	±[5%+0.05Ω]	Power rating 1.5 hours on, 30minutes off, 500 hours
Thermal Shock	±[2%+0.05Ω]	Power rating 30minutes, -40°C, 15minutes
Temperature Coefficient	±260 ppm/°C maximum	
Terminal Strength	4.5kgf	
Solderability	75% coverage min.	230°C, 3 sec.

### DERATING CURVE

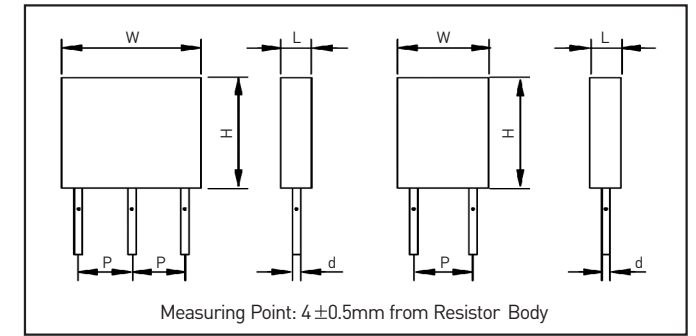
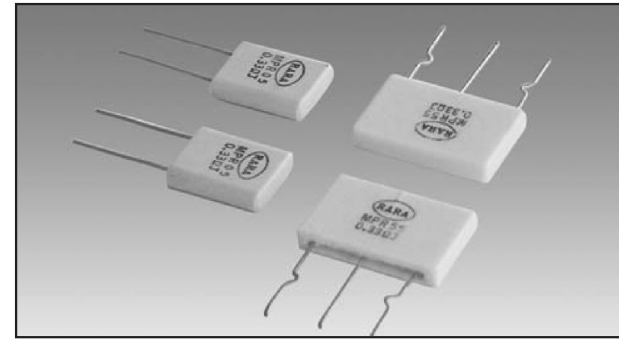


### ORDERING PROCEDURE EXAMPLE

**MPR 1A**   **1W**   **0.03Ω**   **J**  
 ↓   ↓   ↓   ↓  
**Model #**   **Wattage**   **Resistance**   **Tolerance**

If you require more detailed technical information, then please contact the RARA design team using the contact information at the top of every page.

## Metal Plate Shunt Resistors(Radial Type)



### GENERAL SPECIFICATIONS & DIMENSIONS [mm]

Model	Power Rating	Standard Resistance Range	Maximum Current	Dimensions[mm]				
				L±0.5	W±1	H±1	P±0.5	d±0.02
MPR 3R	3W	0.1Ω, 0.12Ω, 0.15Ω,	5.5A	5	14	13.5	10	0.8
MPR 5RS	5W	0.18Ω, 0.2Ω, 0.22Ω	7A	5	14	18	10	0.8
MPR 5RL	5W	0.33Ω, 0.47Ω	7A	5	26	13.5	20	0.8
MPR 33RS	3W+3W	0.1Ω, 0.15Ω, 0.22Ω, 0.27Ω, 0.33Ω, 0.39Ω	7A+7A	5	26	13.5	10	0.8
MPR 33RL	3W+3W		7A+7A	8	26	13.5	10	0.8
MPR 55RS	5W+5W		7.5A+7.5A	5	26	18	10	0.8
MPR 55RL	7W+7W		7.5A+7.5A	8	26	18	10	0.8

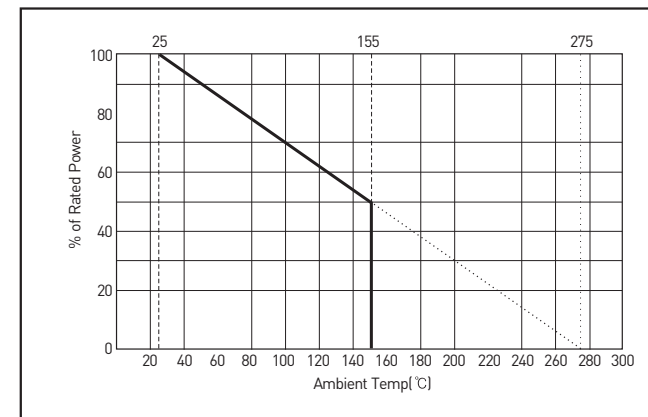
\*0.01Ω-0.08Ω resistance value are available

### CHARACTERISTICS

Values in [ ] mean change in Ω after test

Temperature Range	-25°C ~ 155°C	
Insulation Resistance	DC 500V, minimum 20MΩ	
Dielectric Withstanding Strength	AC 1500V; maximum leakage current: 2mA	
Short Time Overload	±[2%+0.05Ω]	3W: 5 x Power rating-5 sec., 5W-20W: 10 x Power rating -5 sec.
Load Life	±[5%+0.05Ω]	Power rating 1.5hours on, 30minutes off, 500 hours
Thermal Shock	±[2%+0.05Ω]	Power rating 30minutes, -40°C, 15minutes
Temperature Coefficient	±260 ppm/°C maximum	
Terminal Strength	1kgf	
Solderability	75% coverage min.	230°C, 3 sec.

### DERATING CURVE



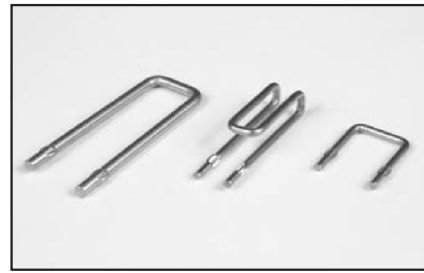
### ORDERING PROCEDURE EXAMPLE

**MPR 3R**   **3W**   **0.1Ω**   **K**  
 ↓   ↓   ↓   ↓  
**Model #**   **Wattage**   **Resistance**   **Tolerance**

If you require more detailed technical information, then please contact the RARA design team using the contact information at the top of every page.

## Current Sensing Resistors

The extremely low resistance(3mΩ) makes these resistors suitable for high power current detection. Various pitches and heights are available. These are all custom-made, non-inductive products exhibiting easy soldering.



### GENERAL SPECIFICATIONS

Model	Φd(Diameter)	Max. Current Rating[A]	Resistance Range [mΩ]	Resistivity [mΩ/10mm]	Resistance Tolerance[%]	Rated Ambient Temp.
CSR 04	0.4	2.0	70 ~ 200	38.98	≥ 20mΩ J [±5] < 20mΩ K [±10]	+70°C
CSR 05	0.5	2.5	50 ~ 150	24.95		
CSR 06	0.6	3.0	50 ~ 100	17.34		
CSR 07	0.7	4.0	30 ~ 70	12.74		
CSR 08	0.8	4.5	20 ~ 50	9.747		
CSR 09	0.9	5.0	20 ~ 40	7.702		
CSR 10	1.0	5.5	15 ~ 30	6.238		
CSR 11	1.1	6.0	15 ~ 20	5.157		
CSR 12	1.2	7.0	10 ~ 20	4.332		
CSR 13	1.3	7.5	10 ~ 20	3.693		
CSR 14	1.4	8.0	10 ~ 20	3.184		
CSR 15	1.5	9.0	10 ~ 20	2.773		
CSR 16	1.6	9.5	10 ~ 15	2.436		
CSR 18	1.8	11.0	5 ~ 10	1.925		
CSR 20	2.0	12.0	5 ~ 10	1.560		

### CHARACTERISTICS

Values in [ ] mean change in Ω after test

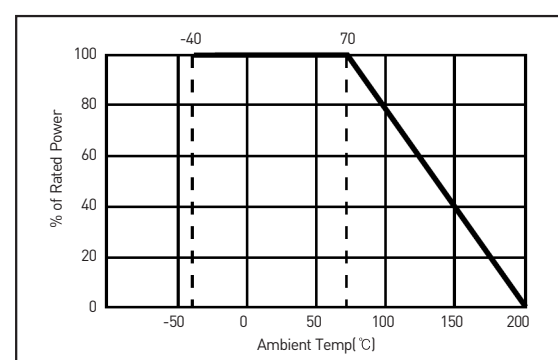
Temperature Range	40°C ~ +155°C
Temp. Coefficient	9.0A ≥±100ppm/°C maximum., 9.5A ≤±260ppm/°C maximum
Short Time Overload	±[2%] Power Rating × 2.5 for 5 sec.
Moisture Resistance	±[2%] 40°C, 95% RH, 240 hours
Heat Resistance	±[2%] 200°C, 2 hours
Solderability	90% Coverage minimum 235°C, 5 sec.
Thermal Shock	±[2%] Power Rating 30 minutes on, -40°C 15 minutes off
Load Life	±[5%] Power Rating, 1.5hours on, 30minutes off, 1000 hours

\* Values in [ ] mean change in Ω after test

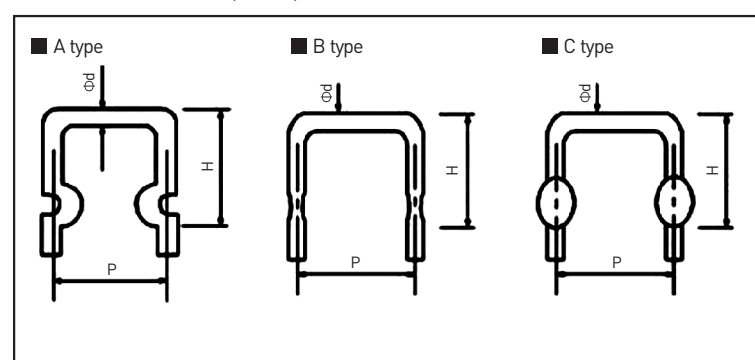
### ORDERING PROCEDURE

Model	Type	Nominal Resistance	Resistance Tolerance	Terminal Pitch
CSR 16	A	10mΩ	K	10

### DERATING CURVE

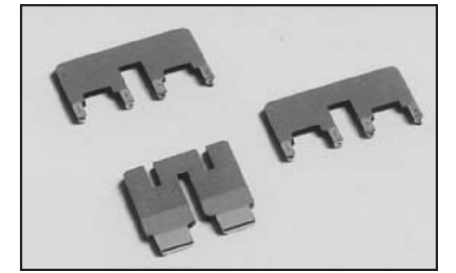


### DIMENSIONS(mm)



## E-Beam Welded Through Hole Precision Shunts

These space saving components feature E-Beam welded construction and full RoHS compliancy. Available in 2-terminal or 4-terminal Kelvin connections. Other features include a 55 ampere continuous operating current and an inductance of less than 10nH.



### GENERAL SPECIFICATIONS

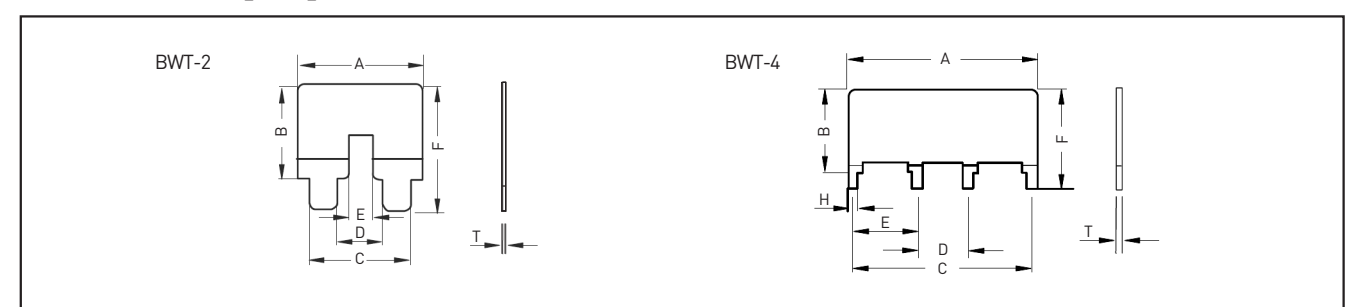
Model	Power Rating[W]	Resistance[Ω]	Tolerance[%]
BWT-2	2	0.001 ~ 0.01	J [±5]
BWT-4	5	0.0005 ~ 0.01	F [±1], J [±5]

### CHARACTERISTICS

Values in [ ] mean change in Ω after test

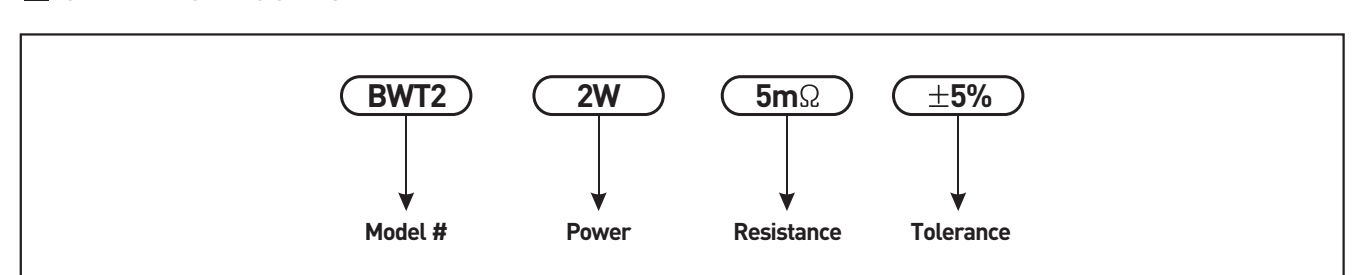
Test	BWT 2	BWT 4
Temperature Coefficient(-55°C ~ +125°C)	[ < 50 ppm/°C ]	
Moisture Resistance	[ < 0.5% ]	[ < 1.0% ]
Thermal Shock	[ < 1.0% ]	[ < 1.5% ]
Temperature Cycle(-55°C ~ 125°C , 1000 hours)	[ < 0.5% ]	[ < 1.0% ]
High Temp. Exposure(125°C , 1000 hours)	[ < 1.0% ]	[ < 1.75% ]
Mechanical Shock	[ < 0.5% ]	[ < 1.0% ]
Vibration	[ < 0.5% ]	[ < 1.0% ]
Solder Heating	[ < 0.5% ]	[ < 1.0% ]
Solderability	[Meets-STD-002]	[Meets-STD-002]
Load Life(1000 hours, 70°C )	[ < 0.5% ]	[ < 1.0% ]

### DIMENSIONS [mm]



Type	A	B	C	D	E	F	H	T±0.05
BWT-2	17.2±0.5	10.0±0.3	15.2±0.2	5.6±0.2	1.2±0.2	13.0±0.3	-	0.32
BWT-4	22.0±0.5	10.8±0.3	20.3±0.2	5.1±0.2	7.6±0.2	14.4±0.3	1.7±0.2	0.35 ~ 1.80

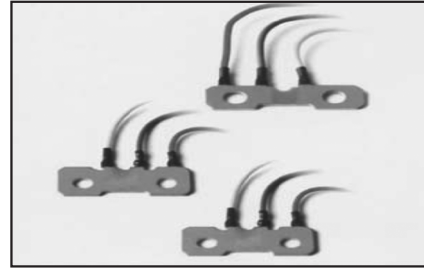
### ORDERING PROCEDURE EXAMPLE





# Power Metering Precision Shunts

These components have E-Beam welded manganese-copper alloy elements giving high strength, stability and reliability. Low thermal EMF and TCR. Small size and minimal power loss. Minimal heat generation and surface temperature due to small total resistance. Proprietary processing technique allows very low resistance values. Ideally suited for kWh meters and sampling sensor shunts. These units are also suitable for custom design.



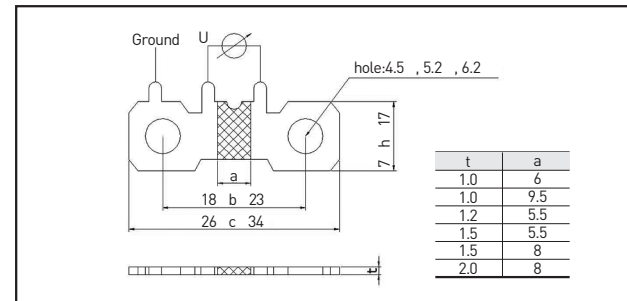
## GENERAL SPECIFICATIONS

Model	Power Rating[W]	Resistance Range[Ω]	Tolerance(%)
PMS	3	100μΩ~1200μΩ	F [±1], J [±5], K [±10]

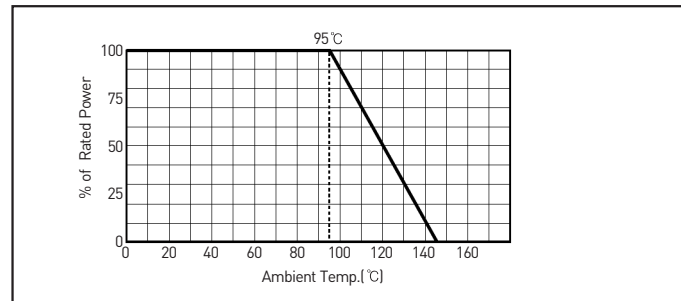
## CHARACTERISTICS

Temperature Range	-55°C~+125°C
Temp. Coefficient	≤±50ppm/°C
Internal Heat Resistance	< 10K/W
Load Life	Deviation < 0.5% after 2000 hours at 70 °C

## DIMENSIONS [mm]

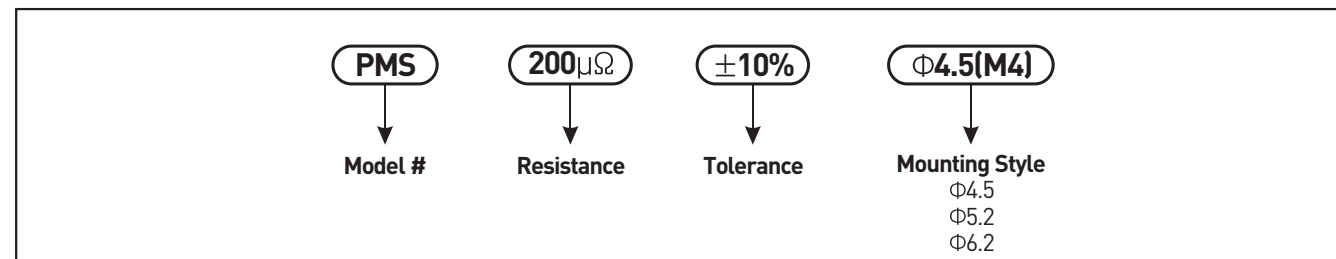


## DERATING CURVE



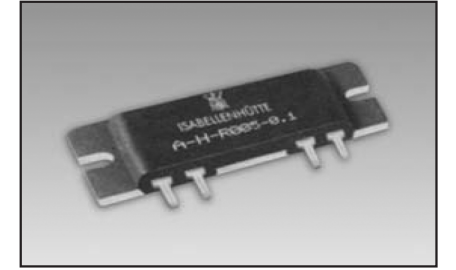
Resistance Value	Thickness	Rated Current
≤100μΩ	2.0mm	100A
120μΩ	1.5mm	80A
150μΩ	1.5mm	60A
200μΩ	1.2mm	60A
250μΩ	1.2mm	40A
300μΩ	1.0mm	40A
350μΩ	1.0mm	30A
500μΩ	1.0mm	25A
1200μΩ	1.0mm	15A

## ORDERING PROCEDURE EXAMPLE



# Four Terminal Precision Resistors

A-H resistors are constructed with four terminal, isolated voltage and current connections (i.e. Kelvin Connection) making them suitable for very precise current measurements, current limitations and current regulation in power units, current sources and electronic loads. Other applications include: Current measurements in Pulse Width Modulated (PWM) control circuits as in servo and stepper motors and solenoid driver circuits.



## GENERAL SPECIFICATIONS

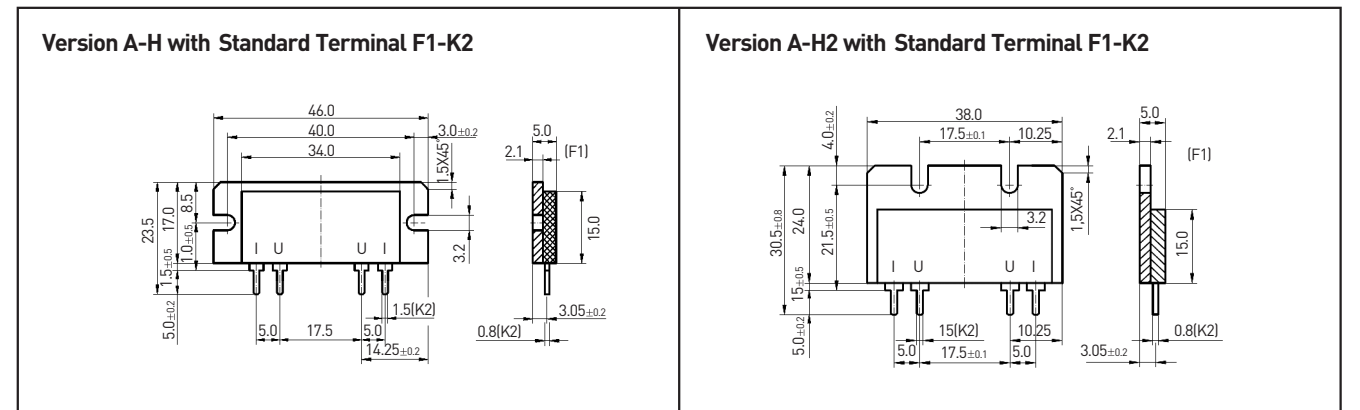
Model	Resistance	Load Capacity	TCR[ppm/°C] (R < 20mΩ)	Tolerance(%)
A-H	(1,2,5,10,22,50,100,200,500)mΩ (1,2,5,10,20,100)Ω	10W (With Heatsink)	< ±10ppm/K (20°C to 60°C)	B [±0.1], D [±0.5], F [±1]

\*Tolerance 0.1% for values from 5mΩ

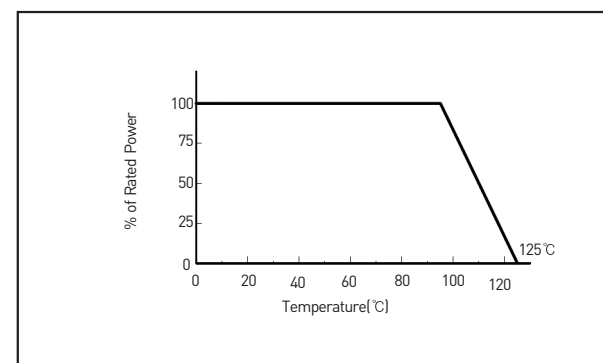
## CHARACTERISTICS

Temperature Range	-55°C to +125°C
Dielectric Withstanding Voltage	500V AC
Load Capacity	10W with heatsink provided
Thermal Resistance to Aluminium Base Plate	Rth < 3°C / W
Thermal Resistance to Ambient Temperature	15°C / W
Inductance(R=10mΩ)	< 10nH
Stability at 125 °C Foil Temperature	Deviation < 0.1% after 2,000hours

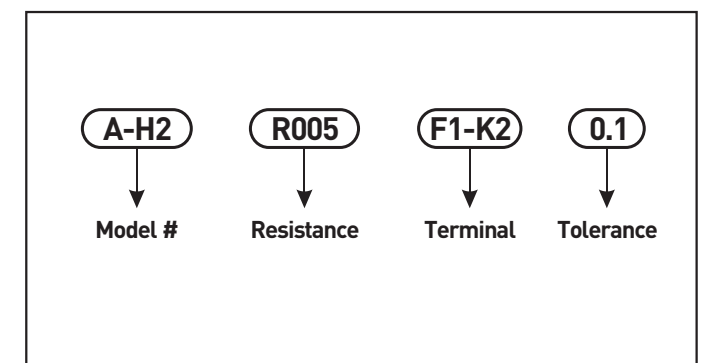
## DIMENSIONS (mm)



## DERATING CURVE

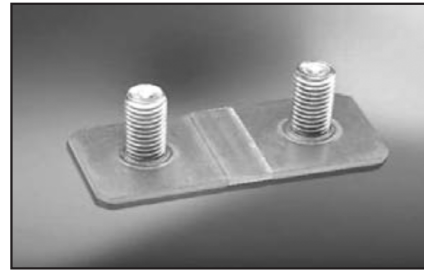


## ORDERING PROCEDURE EXAMPLE



# Precision Resistors for Current Applications

These components have excellent long term stability and can handle continuous current of up to 200 amperes(0.1mΩ). Units have a low inductance, heavy copper terminals and 3W continuous power. Easily mounted using reflow soldering, welding on copper or bolted onto cables or bus bars. Maximum soldering temperatures of 350 °C/30sec. or 250 °C/10min. Applications include: KWh meters, energy metering, battery current sensing, high current automotive circuits and high current measurement in welding machines.



## GENERAL SPECIFICATIONS

Model	Wattage Rating	Resistance Range[Ω]	Tolerance(%)	TCR
BVM-F	5W	0.1m / 0.2m / 0.3m (0.3mΩ under development)	J [±5]	< 20ppm/°C(20°C~60°C)

## CHARACTERISTICS

Operating Temp	-55°C~+140°C
Internal Heat Resistance	< 10K/W
Inductance	< 1nH
Load Life (nominal load)	Deviation < 0.5% after 2000 hours at 80 °C

## DIMENSIONS [mm]

**BVM-F(mm) version A**

R	B
0.1mΩ	5.0±0.3mm
0.2mΩ	10.0±0.3mm

t=1.0 bis 1.5mm  
Z-YF-051c

**BVM-F(mm) version B**

R	B
0.1mΩ	5.0±0.3mm
0.2mΩ	10.0±0.3mm

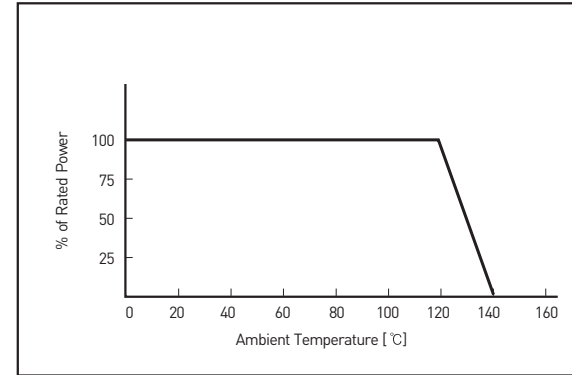
t=1.0 bis 1.5mm  
Z-YF-051c

**BVM-F(mm) version D**

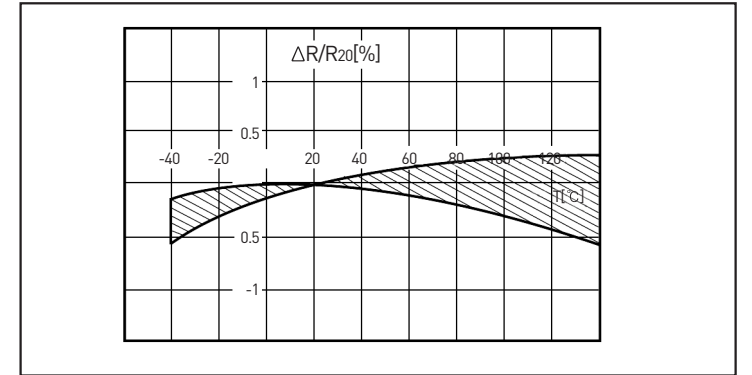
R	B
0.1mΩ	5.0±0.3mm
0.2mΩ	10.0±0.3mm

Z-YF-051c

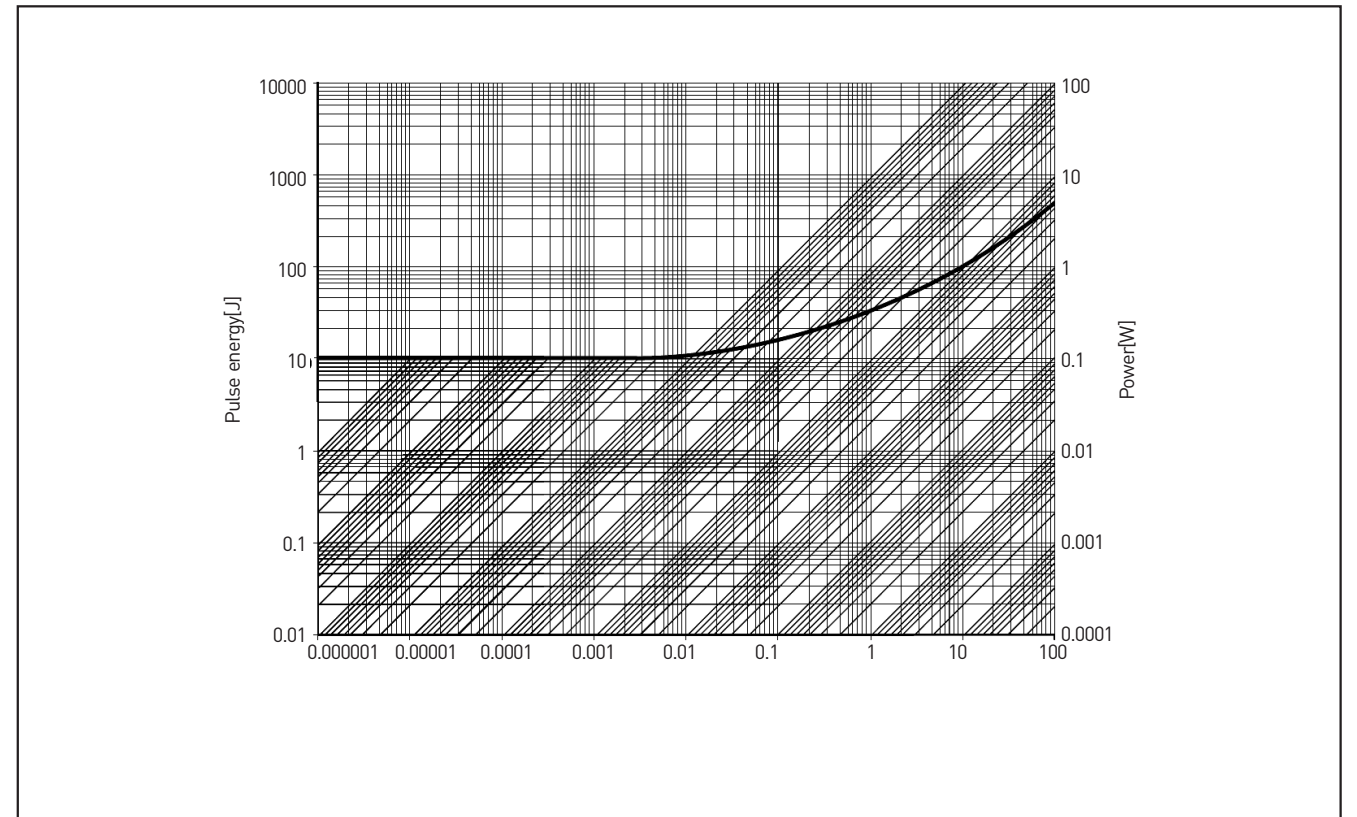
## POWER DERATING



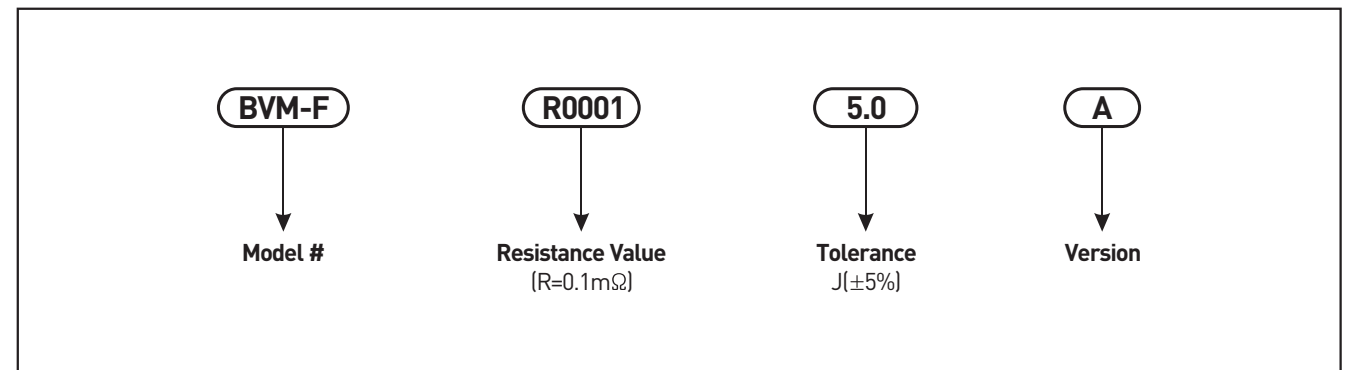
## TEMPERATURE DEPENDENCE



## DIAGRAM OF PULSE ENERGY



## ORDERING PROCEDURE EXAMPLE AND NOTES

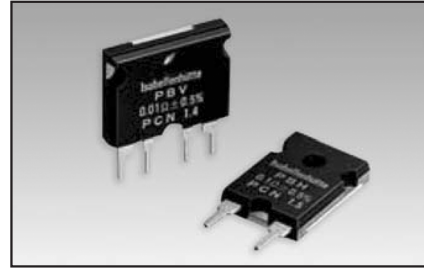


Note:  
Packing: 1000pcs in plastic bags sealed filled with dry Nitrogen  
Remarks for mounting: The resistor is designed for direct reflow solder mounting on a pc-board or screwed direct with the bus bar or cable

# Precision Shunt Resistors

- Max: 10W
- Tolerance: 0.5%
- TCR: 30ppm/°C

High power low resistance values and high precision. Low temperature coefficient. Excellent load life stability. Excellent short time over load. Ideal for current sensing applications.



## GENERAL SPECIFICATIONS

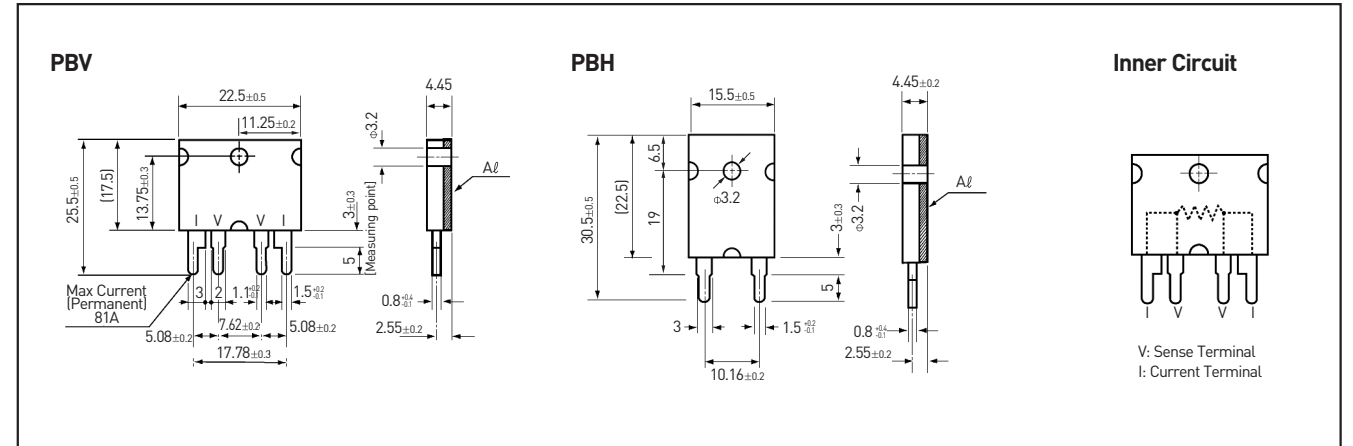
Model	Wattage Rating		Resistance Range[Ω]	Resistance Tolerance[%]	Terminal	Operating Temp.	Temp Coefficient (20°C~60°C)	Terminal Resistance To Base Plate	Weight [g]
	With Heat Sink	In Free Air							
PBV	10W	3W	0.5m~1	D [±0.5] F [±1] J [±5]	4	-55°C~+125°C	±30ppm/°C (R > 10mΩ)	3°C/W (6°C/W for R < 2mΩ)	5
PBH	10W	3W	0.002~10		2				

\*1) Restriction on Temp. of Resistance Element: 125°C Max. **CAUTION**

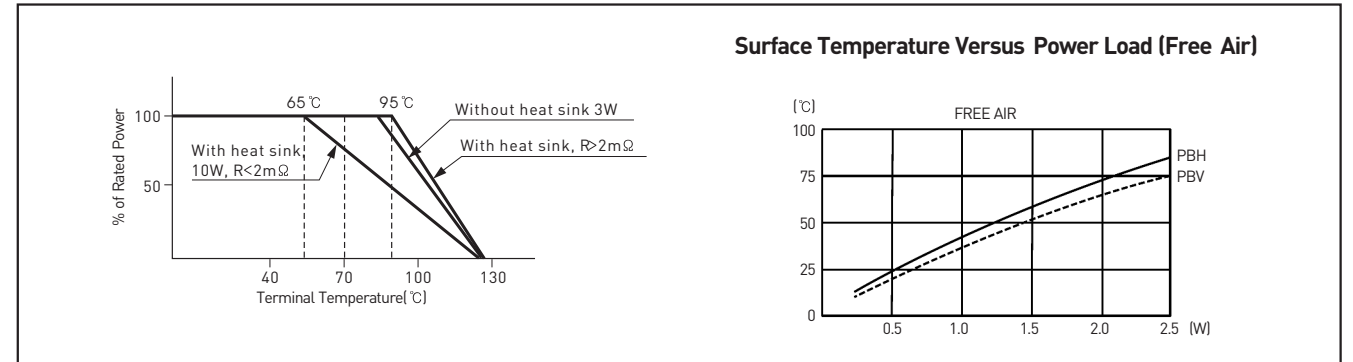
## CHARACTERISTICS

TEST	LIMIT	TYPICAL	CONDITION
Insulation Resistance	100MΩ minimum	10GΩ	DC 100V
Dielectric Withstanding Voltage	±0.02% maximum	0	AC 300V 1minute
Over Load	±0.1% maximum	±0.01%	2.5 x Power rating 5sec.
Moisture Resistance	±0.1%	±0.02%	90~98%RH, +25°C, +65°C, -10°C 10Cycles (10days)
Thermal Shock	±0.1% maximum	±0.02%	-65°C 30minutes +125°C 30minutes 25Cycles
Shock	±0.2%	±0.01%	50g's 11ms
Vibration High Frequency	±0.2%	±0.01%	Peak 15g, 10~2000Hz 12cycles 12hours
Storage Life at Elevated Temp	±0.3%	±0.02%~0.05%	70°C 2000hours
Thermal EMF	-2μV/°C maximum	-0.05μV/°C	0°C~100°C
Frequency Characteristic	< 50 nH	4nH	Inductance(PBV 3.3mΩ)
Resistance to Solvents	No Damage	No Damage	IPA 3minute
Solderability	> 95% Coverage	≥99%	245°C 5sec.
Resistance to Soldering Heat	±0.02% maximum	0	350°C 3sec.
Terminal Strength	±0.02% maximum	0	50N 5~10sec.
Load Life	±0.2%(PBV), ±0.5%(PBH)	±0.02%~0.05%	Power rating 1.5 hours on, 0.5 hours off, 2000 hours

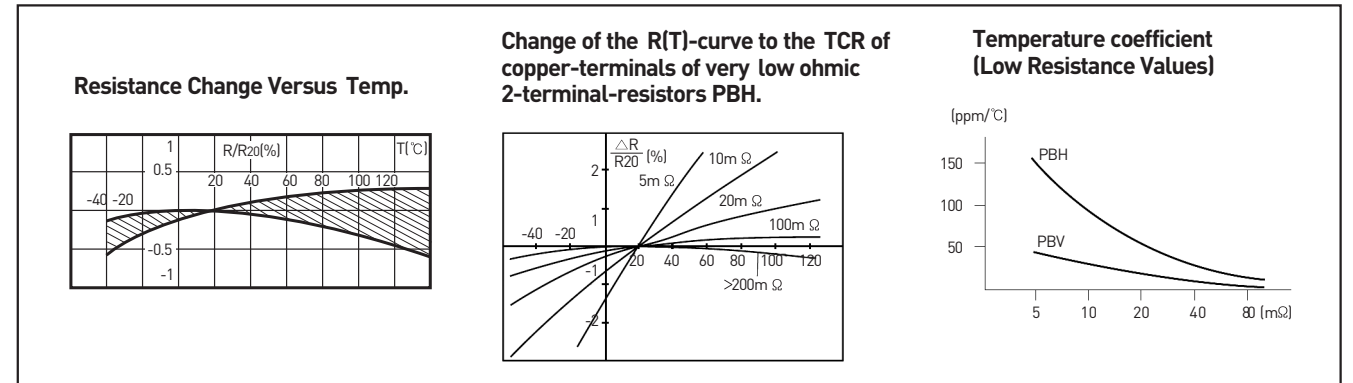
## DIMENSIONS (mm)



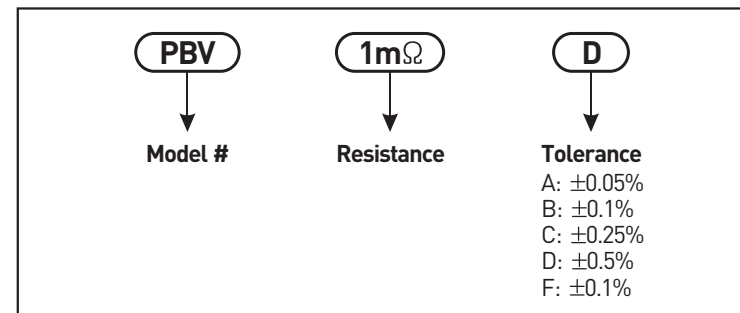
## SURFACE TEMPERATURE INCREASE VS POWER LOAD



## CHARACTERISTIC CURVES



## ORDERING PROCEDURE EXAMPLE



## STANDARD RESISTANCES(STOCK)

- 1, 1.5, 2, 2.2, 3.3, 4.7, 5, 6.8(mΩ): ±0.5%
- 10, 15, 20, 22, 33, 47, 50, 68(mΩ): ±0.5%
- 100, 150, 220, 330, 470, 680(mΩ): ±0.5%

## Current Sensing Resistors

Using advanced welding techniques and nickel alloys these resistors have a long term stability of less than 50ppm/°C. The simple four port Kelvin design ensures easy installation on large current bus bars. Current of 170A(0.1mΩ-3W), 100A(0.1mΩ-2W) and 350A(0.1mΩ-14W) are standard. Applications include: Current detection in precise power sources, constant current sources, industrial power conversion circuits, HEVs, fuel cells and constant electronic loads.



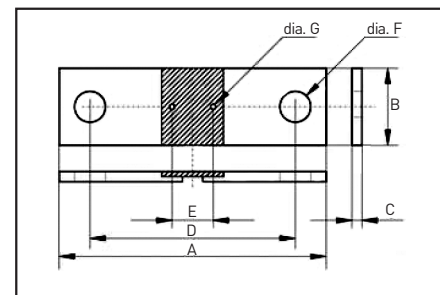
### GENERAL SPECIFICATIONS

Model	Power Rating[W]	Resistance[Ω]	Resistance Tolerance(%)
TCS2	2	0.1m-0.5m	F [±1.0]
TCS3	3		J [±5.0]
TCS14	14	0.1m	J [±5.0]

### CHARACTERISTICS

TEST	TCS2	TCS3	TCS14
Temperature Range			-55°C~+125°C
Temperature Storage			-55°C~+125°C
Temp. Coefficient	0~80ppm/°C		±50ppm/°C
Overload	2KW for 0.1sec.	3KW for 0.1sec.	5 X Power rating 5 sec.
Inductance	15nH	17nH	3nH

### DIMENSIONS [mm]



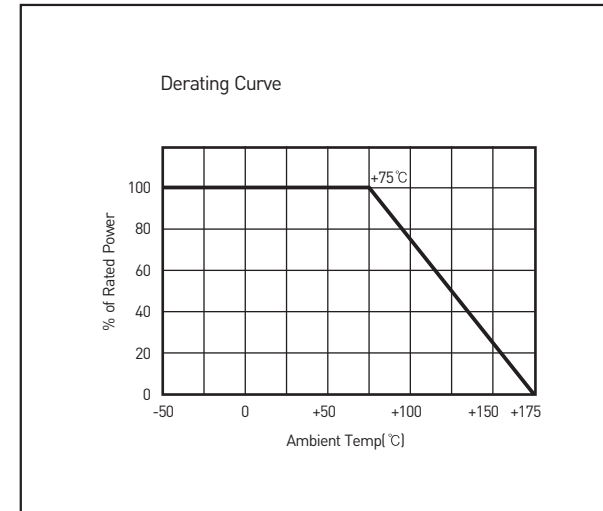
Model	Dimensions [mm]						
	A	B	C	D	E	F	G
TCS2	50.0	12.0	2.0	35.0	See Below	6.2	3.2
TCS3	55.0	15.0	2.0	40.0		6.2	0.8
TCS14	84.0	20.0	3.0	66.0		8.3	0.8

Model	Dimensions of E [mm]				
	0.1mΩ	0.2mΩ	0.3mΩ	0.4mΩ	0.5mΩ
TCS2	5.6	7.7	9.6	11.6	14.0
TCS3	7.0	9.6	12.0	14.5	17.5
TCS14	9.0	N/A	N/A	N/A	N/A

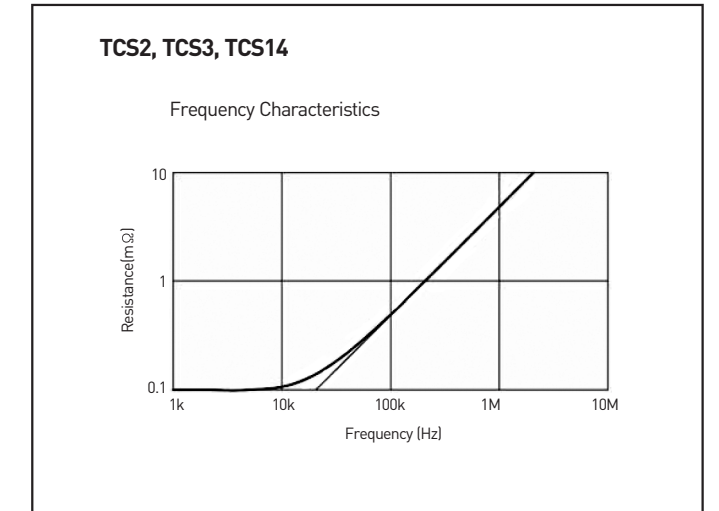
### CURRENT RATING

Resistance	0.1mΩ	0.2mΩ	0.3mΩ	0.4mΩ	0.5mΩ
TCS2	141.4A	100.0A	81.6A	70.7A	63.2A
TCS3	173.2A	122.4A	100.0A	86.6A	77.4A
TCS14	350A	N/A	N/A	N/A	N/A

### DERATING CURVE



### FREQUENCY CHARACTERISTICS

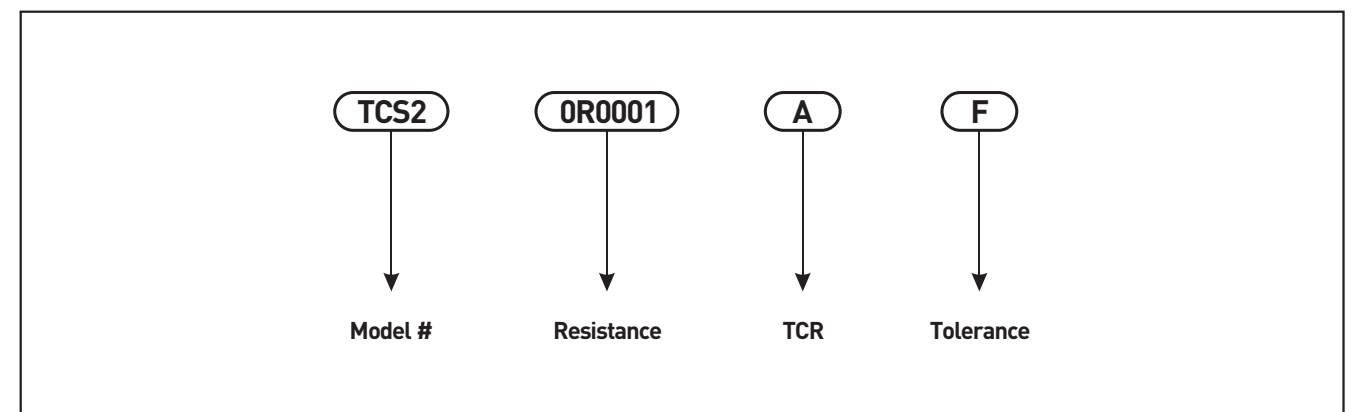


### RECOMMENDATION

Note:

- When TCS2,3 current detector is attached to current bus, mechanical strain shall be rejected from the resistor as shown in above illustration.
- Resistance shall be made by calculating from DC voltage on detecting terminal at application of current through current terminals.
- Voltage output Copper pins shall be contacted to Copper terminals of resistor

### ORDERING PROCEDURE EXAMPLE



## Preliminary Version High Power Shunt Resistors (SOT-227)

The CS227 is a metal foil, SOT227 resistor designed to give a high current capability. The metal foil element is situated on an insulated heatsink composed of plated copper. This assembly is then mounted into a durable plastic housing and sealed with high temperature epoxy. This product features: Four terminals for precise circuits, vibration proof, good insulation, compact size and easy bolt mounting.



### GENERAL SPECIFICATIONS

Model	Resistance Range[Ω]	Power Rating[W]	TCR[ppm/°C] [20°C - 105°C]	Tolerance(%)	Max. Current
CS227M-1	1mΩ, 2mΩ, 3mΩ, 4mΩ, 5mΩ	25W	Max. ±80	F [±1]	158A
CS227A-1		30W		G [±2]	173A
CS227M-2	2mΩ+2mΩ, 3mΩ+3mΩ	10W+10W		J [±5]	70AX2
CS227A-2	2mΩ+2mΩ, 3mΩ+3mΩ	13W+13W			80AX2

### CHARACTERISTICS

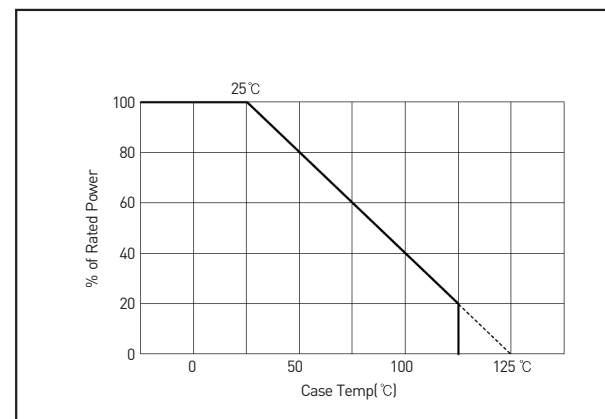
Temperature Range	-55°C ~ +105°C
Dielectric Withstanding Voltage	CS227A-1: 1000VAC, CS227A-2: 2000VAC
Internal Heat Resistance	R < 2.5KW
Inductance	5nH for R < 10mΩ
Load Life	Deviation < 2% after 2000hours

### DIMENSIONS [mm] AND STRUCTURE

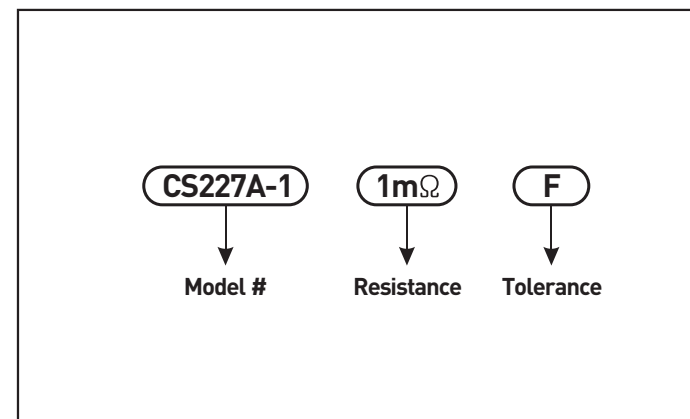
**Schematics**

Symbol	A	B	C	D	E	F	G	H
(mm)	38±0.5	25±0.5	10±0.5	30±0.2	15±0.5	13±0.5	2 - 4.2	4 - M4.0

### DERATING CURVE



### ORDERING PROCEDURE EXAMPLE



## SPR 008 Shunt Resistors

The SPR 008 is a heavy duty shunt resistor. With a 400A rating at 0.3 milli-ohms, this resistor can handle almost any job. The compact style and low TCR is extremely useful in rectifiers to balance to circuits.



### GENERAL SPECIFICATIONS

Model	Rated Current[A]	Rated Voltage[V]	Resistance Range[Ω]	Tolerance(%)
SPR 008	400	120m	0.3m	J [±5] K [±10]

### DIMENSIONS [mm]

Model	Dimensions(mm)			
	A±1	B±1	C±1.5	Weight
SPR 008	9.25	17	18.75	330g

### CHARACTERISTICS

Insulation Resistance	100MΩ minimum
Dielectric Withstanding Strength	AC 1000V 1minute
Temp. Coefficient	±50ppm/°C

## SPR 038 Precision Shunt Resistors

The SPR038 is a high precision and compact shunt resistor. They are extremely easy to install and handle a prodigious current. The most common applications for these models are amp meters and current controllers.



### GENERAL SPECIFICATIONS

Model	Rated Current[A]	Rated Voltage[V]	Resistance Range[Ω]	Tolerance(%)
SPR 038	120	60m	0.5m	D [±0.5], F [±1], J, [±5]
	120	120m	1.0m	

### DIMENSIONS [mm]

Model	Dimensions(mm)		
	A	B	C
SPR 038	28±1	43±0.5	58±1
	47±1	62±0.5	77±1

### CHARACTERISTICS

Temp. Coefficient	±50ppm/°C
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