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DIRECT

Electronics Tech.

(TCS) Chip Current Sensing Precision Resistor

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Product Introduction**Direct's TCS (thin film current sensing chip resistor) makes sense of current.****Features :**

- Thin Film Process.
- Resistance Values from 50mΩ to 1Ω.
- Very Tight Tolerance from ±1% to ±0.5%.
- Extremely Low TCR from ±200 PPM/°C to ±50PPM/°C.
- High Purity Alumina Substrate for High Power Dissipation.
- RoHS Requirements with Pb-free Terminations.

Applications :

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

The trend towards smaller handheld and portable electronics equipment has also increased the need for ultra-small current sensing resistor. Devices from the Direct Electronics' TCS series use a thin film construction that enables them to achieve precision resistance tolerances, low noise and long-term stability.

The Direct TCS Series precision resistors are nichrome thin film chip resistors with a temperature coefficient of resistance of just ±50PPM/°C and tolerances of ±0.5%.

They offer excellent stability at high frequencies and are suitable for operating high voltages with more options in the smaller form sizes of 0402, 0603, 0402, 0805, 1206, 2010, and 2512.

The full range of values is from 50mΩ to 1Ω. This low ohm devices are particularly suited to car engine management units to act as current shunt resistors.

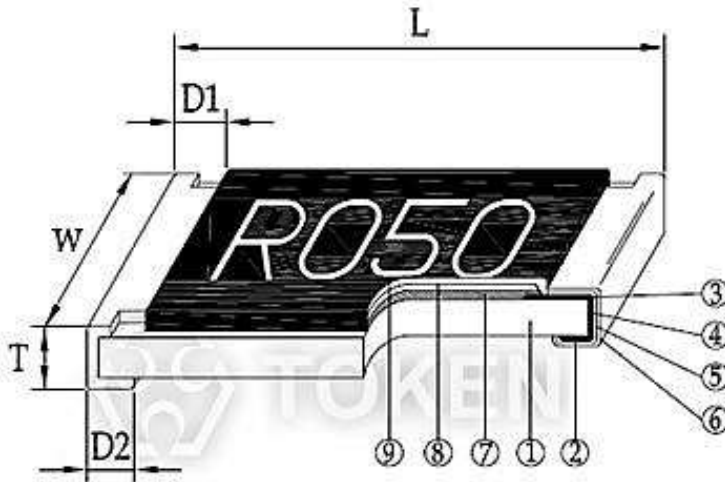
The TCS current sense series is fully RoHS compliant and is supplied in tape and reel packaging ready for use with automated assembly processes.

For more chip low ohm resistors, please link to Direct official website "[Current Sense Resistors](#)". Contact us with your specific needs.



► **Construction & Dimensions**

Construction & Dimensions (Unit: mm)



①	Alumina Substrate
②	Bottom Electrode
③	Top Electrode
④	Edge Electrode
⑤	Barrier Layer
⑥	External Electrode
⑦	Resistor Layer
⑧	Overcoat
⑨	Marking

Thin Film Chip Construction

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

► Electrical Specifications

Standard Electrical Specifications Thin Film (TCS)

Type	Power Rating at 70°C	Resistance Tolerance	Resistance Range	TCR	Operating Temp. Range
TCS02 (0402)	1/16W	±0.5%, ±1.0%	500mΩ~1000mΩ	±100PPM/°C ±50PPM/°C	-55 ~ +155°C
TCS03 (0603)	1/10W	±0.5%, ±1.0%	200mΩ~300mΩ	±100PPM/°C	
TCS05 (0805)	1/8W		301mΩ~1000mΩ	±50PPM/°C	
TCS06 (1206)	1/4W	±1.0%	50mΩ~100mΩ	±200PPM/°C	
		±0.5%, ±1.0%	101mΩ~300mΩ 301mΩ~1000mΩ	±100PPM/°C ±50PPM/°C	
TCS10 (2010)	3/4W	±0.5%, ±1.0%	50mΩ~100mΩ	±200PPM/°C	
TCS12 (2512)	1W		101mΩ~300mΩ 301mΩ~1000mΩ	±100PPM/°C ±50PPM/°C	

High Power Rating Electrical Specifications Thin Film (TCS)

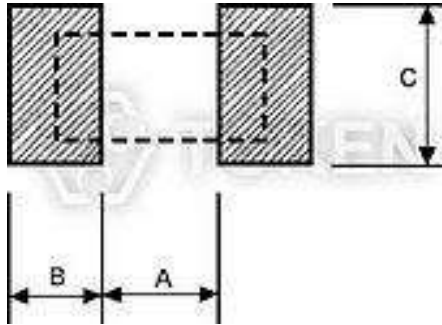
Type	Power Rating at 70°C	Resistance Tolerance	Resistance Range	TCR	Operating Temp. Range
TCS12 (2512)	3W	±0.5%, ±1.0%	100mΩ~1000mΩ	±100PPM/°C	-55 ~ +155°C

- Direct has the ability to manufacture following options based on customer's requirement.



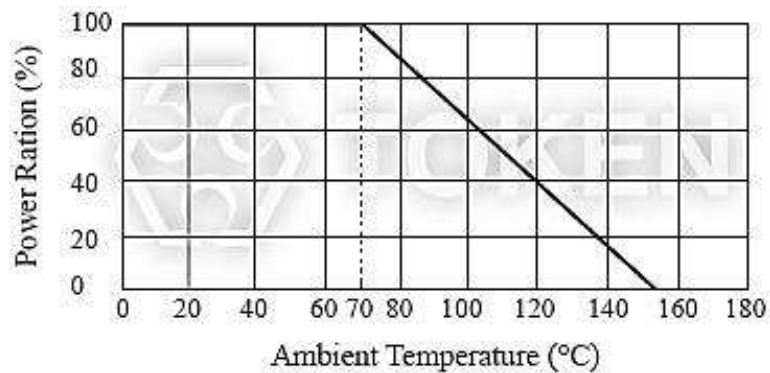
Recommend Land Pattern (TCS)

Type	A (mm)	B (mm)	C (mm)
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



Recommend Land Pattern

Power Derating Curve (TCS)



Power Derating Curve (TCS) Series



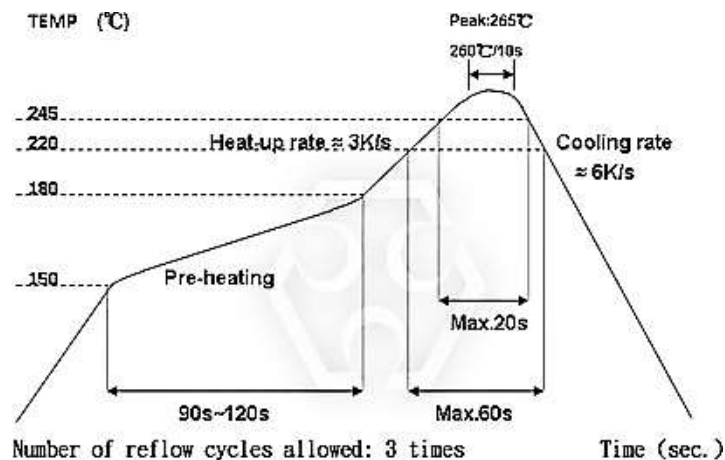
► Environmental Characteristics

Environmental Characteristics (TCS)

Item	Specification	Test Method
Temperature Coefficient of Resistance	As Spec	MIL-STD-202F Method 304 +25/-55/+25/+125/+25°C
Short Time Overload	±1%	JIS-C-5202-5.5 RCWV*2.5 or Max. overload voltage whichever is lower for 5 seconds
Dielectric Withstand Voltage	by Type	MIL-STD-202F Method 301 Apply Max Overload Voltage for 1 minute
Insulation Resistance	>1000MΩ	MIL-STD-202F Method 302 Apply 100VDC for 1 minute
Thermal Shock	±0.5%	MIL-STD-202F Method 107G -55°C~150°C, 100cycles
Load Life (Endurance)	±1%	MIL-STD-202F Method 108A 70±2°C, RCWV for 1000 hrs with 1.5 hrs “ON” and 0.5 hrs “OFF”
Humidity (Damp Heat with Load)	±0.5%	MIL-STD-202F Method 103B 40°C, 90~95%RH, RCWV 1.5 hours ON, 0.5 hours OFF, total 1000 hours
Low Temperature Operation	±0.5%	JIS-C-5202-7.1 1hour, -65°C followed by 45minutes of RCWV
Bending Strength	As Spec	JIS-C-5202-6.1.4 Bending Amplitude 3mm for 10seconds
Solderability	95% min coverage	MIL-STD-202F Method 208H 245°C±5°C, 3 seconds
Resistance to Soldering Heat	±0.5%	MIL-STD-202F Method 210E 260±5°C, 10±1 seconds

- Rated continuous Working Voltage (RCWV) = $\sqrt{\text{Power Rating} \times \text{Resistance Value } (\Omega)}$ or Max. Operating voltage whichever is lower.
- Storage Temperature: 15~28°C, Humidity < 80%RH

Reflow Soldering (TCS)



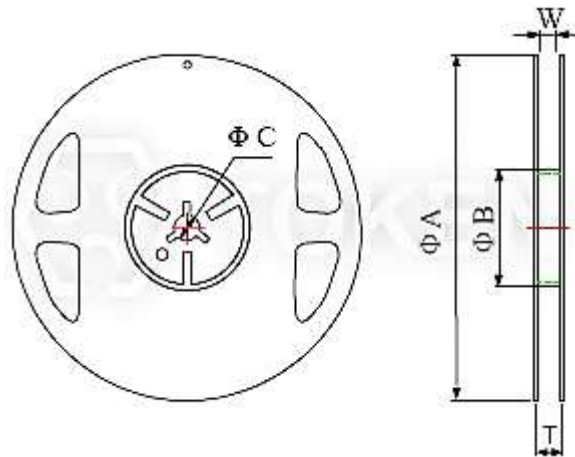
Power Derating Curve (TCS) Series



▶ Reel Tape Specifications

Packaging Quantity & Reel Specifications (TCS)

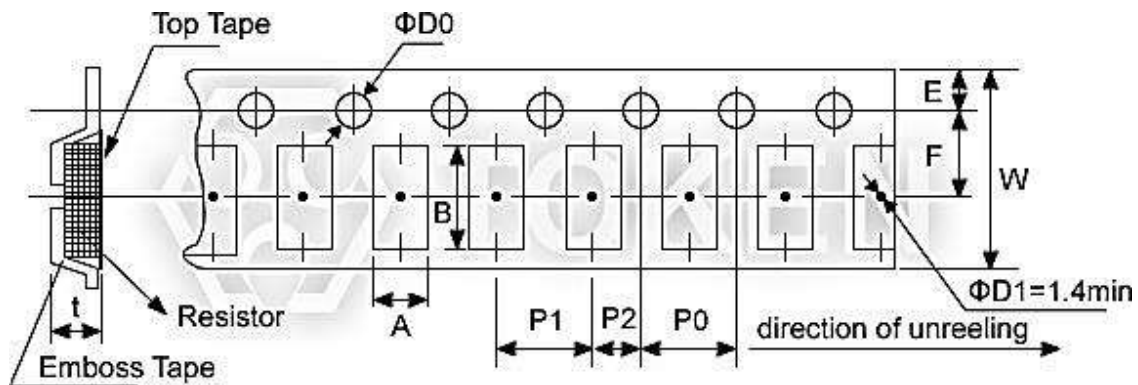
Type	ΦA	ΦB	ΦC	W	T	Paper Tape (EA)	Emboss Plastic Tape (EA)
TCS02	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	10,000	-
TCS03	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
TCS05	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
TCS06	178.0±1.0	60.0±1.0	13.5±0.7	9.5±1.0	11.5±1.0	5,000	-
TCS10	178.0±1.0	60.0±1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000
TCS12	178.0±1.0	60.0±1.0	13.5±0.7	13.5±1.0	15.5±1.0	-	4,000



Packaging Reel Specifications

Emboss Plastic Tape Specifications (TCS)

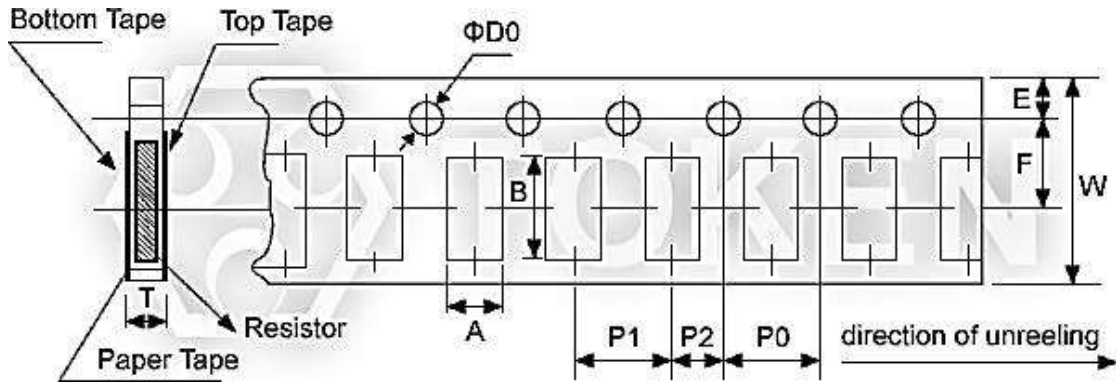
Type	A	B	W	E	F	P0	P1	P2	ΦD0	T
TCS10	2.85±0.10	5.45±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.20
TCS12	3.40±0.10	6.65±0.10	12.0±0.10	1.75±0.10	5.5±0.05	4.00±0.05	4.00±0.10	2.00±0.05	1.50±0.10	1.00±0.20



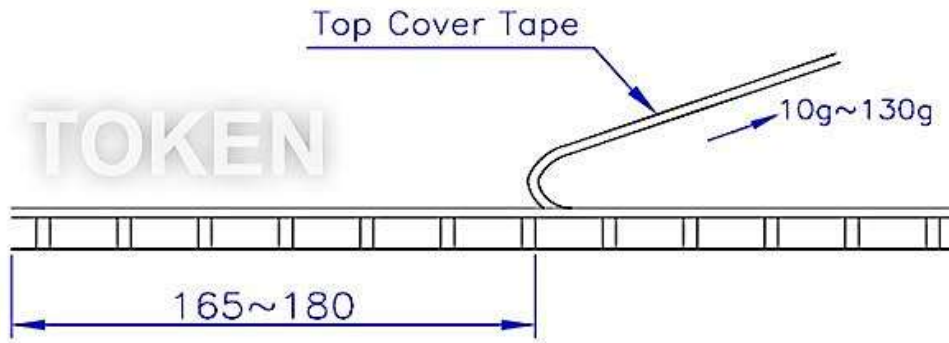
Emboss Plastic Tape Specifications (TCS)

Paper Tape Specifications (TCS)

Type	A	B	W	E	F	P0	P1	P2	ΦD0	T
TCS02	0.70±0.05	1.16±0.05	8.00±0.10	1.75±0.05	3.50±0.05	4.00±0.10	2.00±0.10	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	3.50±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	3.50±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	3.50±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.55±0.05	0.75±0.05



Paper Tape Specifications



Peel - off force

- 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

Order Codes

Order Codes (TCS)

TCS	02	D	TR	E		1R00	N							
Part Type	Dimensions (L×W) (mm)		Package		TCR (ppm/°C)		Power Rating (W)		Resistance (Ω)		Marking			
			F	±1	P	Bulk	D	±50		Standard	Standard Marking			
	02	0402	D	±0.5	TR	Taping Reel	E	±100	R	3W	R010	0.01	N	
	03	0603					F	±200			R100	0.100		
	05	0805									1R00	1.000		
		06	1206											
		10	2010											
		12	2512											

3 Digit Marking (0603) (TCS)

Resistance	1Ω	0.1Ω	0.15Ω	0.01Ω	0.101Ω	0.035Ω
Codes	1R0	R10	R15	R01	101	035

4 Digit Marking (0805~2512) (TCS)

Resistance	1Ω	0.1Ω	0.05Ω	0.015Ω	0.01Ω	0.39Ω
Codes	1R00	R100	R050	R015	R010	R390



► General Information

Your Current Options - Direct Current Sense

As the world becomes more and more technology-driven, the uses for current sensing components will continue to increase. The need for even lower resistance value ranges is already becoming evident, as is the need for these resistors to handle more power. The industry-wide trend is the emergence of smaller and smaller products.

Direct Electronics offers a wide variety of current sensing products from the industry to military standards, such as current sense in Thin-Film / Thick-Film Technology, Bare Element Resistors, and Open Air Shunts. This enables Direct to present an astounding number of possible solutions for any circuit design needs.

Applications of Current Detecting Components

Direct's TCS and CS Series unique form factor provides automotive designers with several advantages. Both TCS and CS Series are ideal for applications involving window lift motors, fuel pump systems, seat belt pretensioners, and pulse width modulator feedback.

The wider resistive element and lower resistance enables higher current to pass through the device. Direct's LRC ultra low Ohmic metal strip chip series provides the inherent ability to flex slightly and offers stress relief during extreme temperature cycling on typical or metal substrates. This LRC series is suitable for switch power supply applications (DC-DC Converter, Charger, and Adaptor) and power management of monitor.

The open air design of bare element resistor LRA and LRB Series provide a far cooler operation by allowing more air flow under the resistive element to keep excess heat from being transmitted to the PC board. They are suitable for high power AC/DC detection of power supply circuit.

Direct axial moulded BWL series provides power rating up to 10 watts and lower resistance 0.005Ω , is ideal for all types of current sensing applications including switching and linear power supplies, instruments and power amplifiers.

Direct standard current sensing components can be replacement for Vishay, IRC, Ohmite, KOA, Yageo devices with fast delivery and more competitive price. Contact us with your specific needs.

