

# WS3220

## Over-Voltage Protection Load Switch

<http://www.sh-willsemi.com>

### Descriptions

The WS3220 features a low  $R_{ON}$  internal High Voltage Switch and an input range of absolute maximum 35V DC. An internal Over-Voltage Protection (OVP) that shuts off the internal Switch if input voltage exceeds the fixed OVP threshold 6.2V / 6.8V / 10.5V / 14.0V. The off-state Switch can disconnect the input pin to output pin and protect output from the input high voltage stress. Integrated Over-Temperature Protection (OTP) also shuts off the Switch to protect the device.

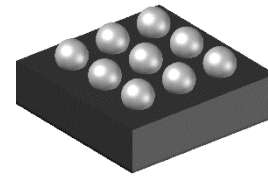
The WS3220 is available in 1.17mm x 1.17mm CSP-9L package. Standard product is Pb-free and Halogen-free.

### Features

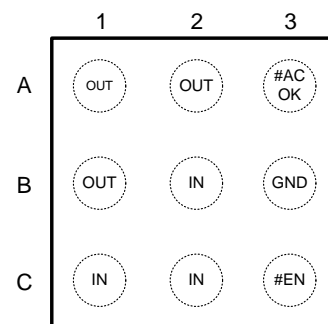
- Absolute Maximum Input Voltage : 35V
- Low  $R_{ON}$  Switch (@ $V_{IN}=5V/9V/12V$ ) : 30m $\Omega$
- Fixed OVP Threshold
  - WS3220C5 : 6.2V
  - WS3220C6 : 6.8V
  - WS3220C9 : 10.5V
  - WS3220C12 : 14.0V
- Fast OVP Response : 65 ns
- Thermal Shutdown Protection
- Robust ESD Protection
  - Human Body Model (HBM) : 4000V
  - Machine Model (MM) : 400V

### Applications

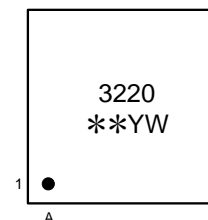
- Mobile Handsets and Tablets
- Portable Media Players
- Peripherals



**CSP-9L (Bottom View)**



**Pin Configuration (Top View)**



**Marking**

**3220** = Device code  
**\*\*** = Special code  
**Y** = Year code  
**W** = Week Code

### Order information

Device	Package	Mark **	Shipping
WS3220C5-9/TR	CSP-9L	05	3K/R&T
WS3220C6-9/TR	CSP-9L	06	3K/R&T
WS3220C9-9/TR	CSP-9L	09	3K/R&T
WS3220C12-9/TR	CSP-9L	12	3K/R&T

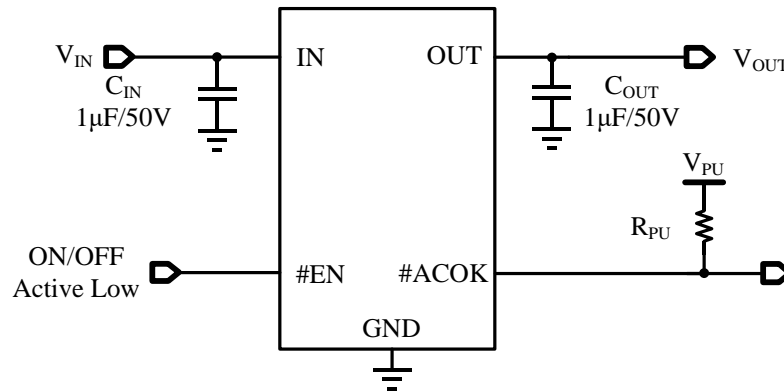
**Typical Applications**


Fig. 1. Typical Application with #EN and #ACOK Used

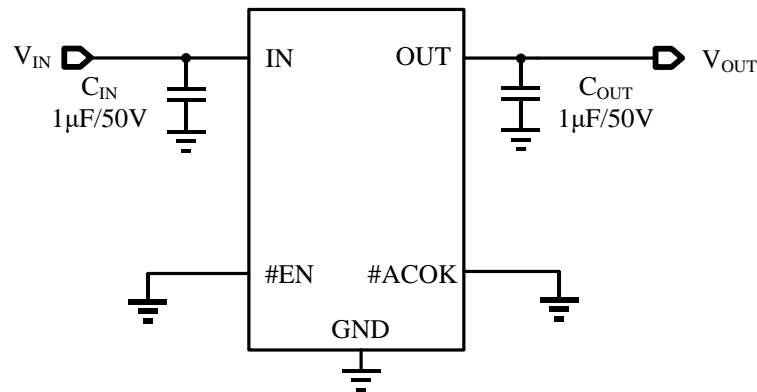
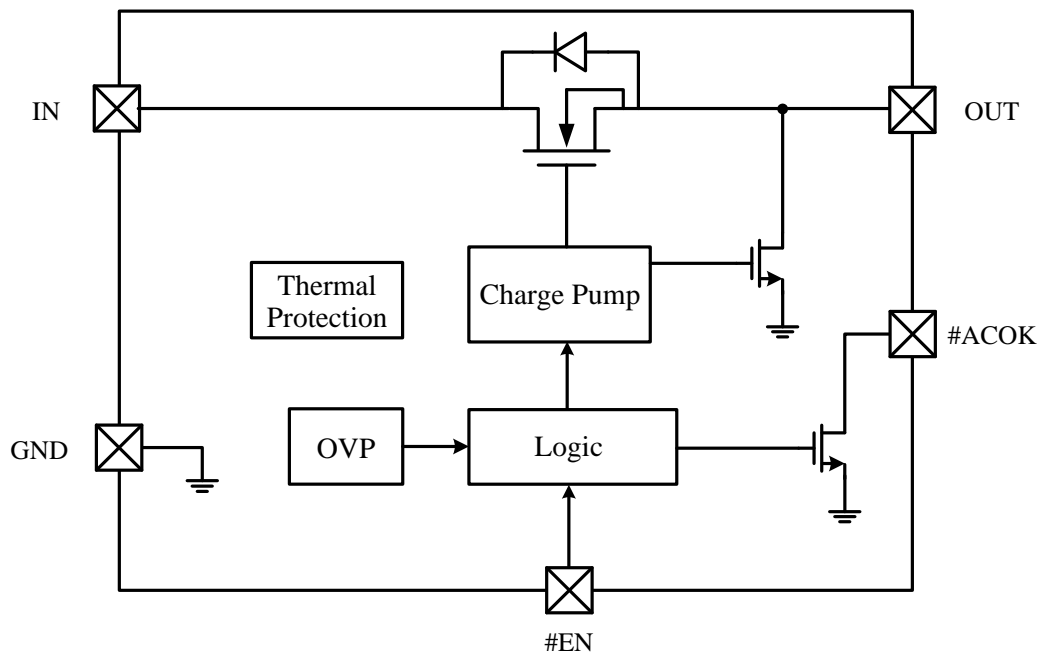


Fig. 2. Typical Application with #EN and #ACOK Connected to GND

**Pin Descriptions**

Pin Number	Symbol	Descriptions		
1C, 2B, 2C	IN	Switch Input Pin and Device Power Supply.		
1A, 1B, 2A	OUT	Switch Output Pin to Load.		
3A	#ACOK	Power Good.	0	Input Stable
		Connect to GND if not used	1	Disabled, UVLO, OVLO, or OTP
3C	#EN	Device Enable. Active Low. Connect to GND if not used.		
3B	GND	Device Ground Pin.		

**Block Diagram**


**Absolute maximum ratings**

Parameter		Symbol	Value	Unit	
V_IN voltage range		V <sub>IN</sub>	-0.3~35	V	
V_OUT voltage range		V <sub>OUT</sub>	-0.3~V <sub>OVP</sub>	V	
#EN, #ACOK voltage range		V <sub>#EN</sub> , V <sub>#ACOK</sub>	-0.3~6.5	V	
Switch I/O Continuous Current		I <sub>IN</sub>	WS3220C5	4.0	A
			WS3220C6	4.0	
			WS3220C9	3.5	
			WS3220C12	3.0	
Body Diode Forward Peak Pulse Current *1	Pulse Width = 10ms	I <sub>PP</sub>	20	A	
	Pulse Width = 20μs		50	A	
Junction temperature		T <sub>J</sub>	125	°C	
Lead temperature(Soldering, 10s)		T <sub>L</sub>	260	°C	
Storage temperature		T <sub>stg</sub>	-55~150	°C	
ESD Ratings		HBM	4000	V	
		MM	200	V	

**\*1 Single Pulse**

These are stress ratings only. Stresses exceeding the range specified under “Absolute Maximum Ratings” may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

**Recommend Operating Conditions**

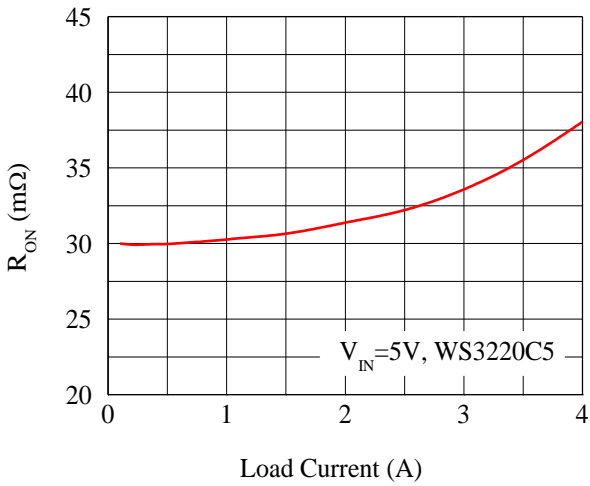
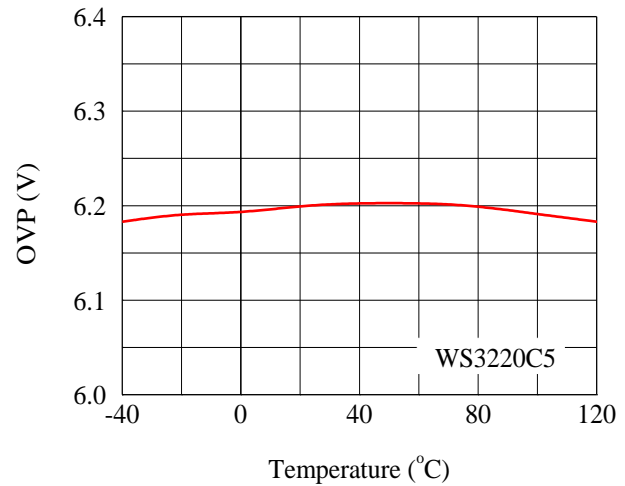
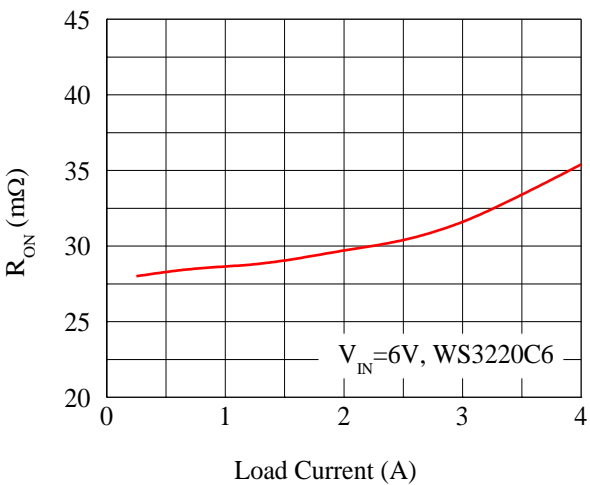
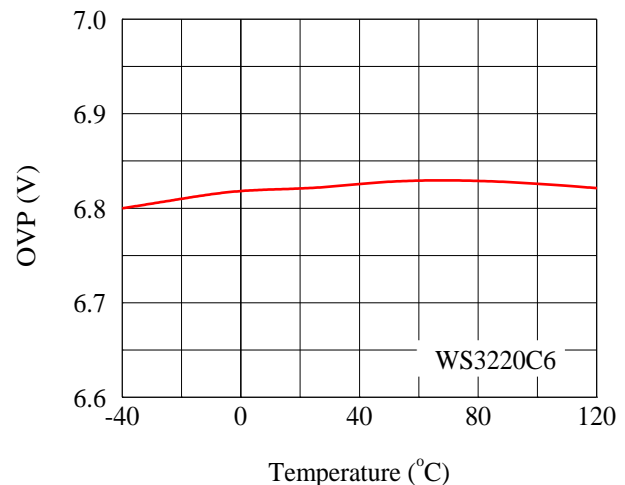
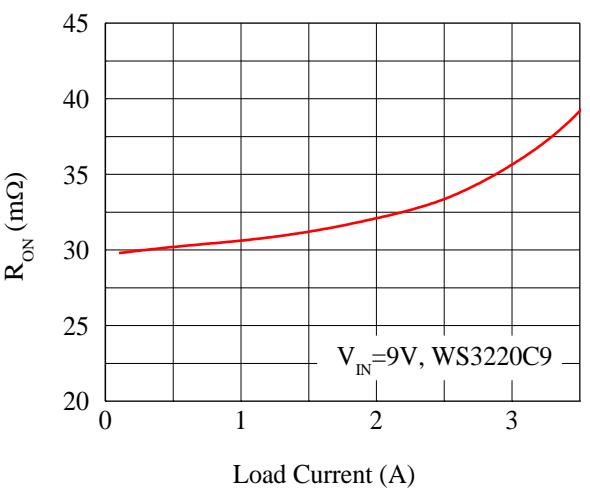
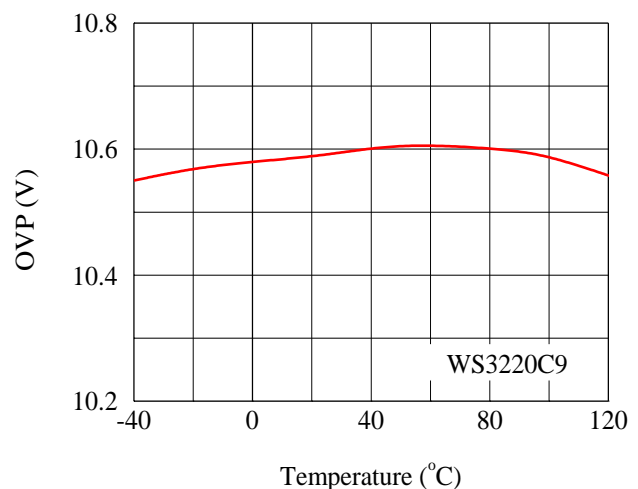
Parameter	Symbol	Value	Unit
V <sub>IN</sub> supply input voltage range	V <sub>CC</sub>	3.2~30	V
Operating ambient temperature	T <sub>A</sub>	-40~85	°C
Thermal Resistance	R <sub>θJA</sub>	95	°C/W

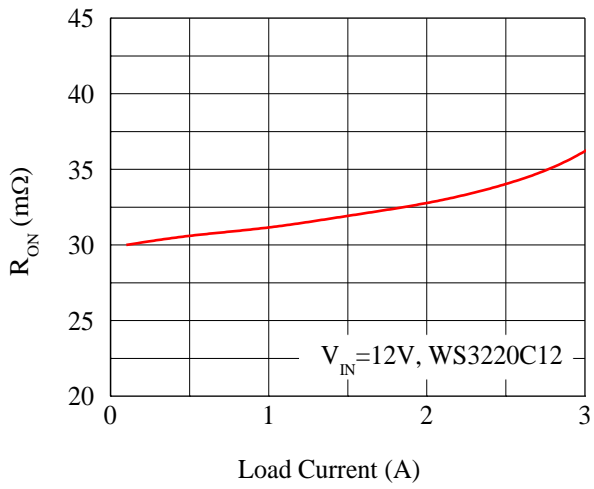
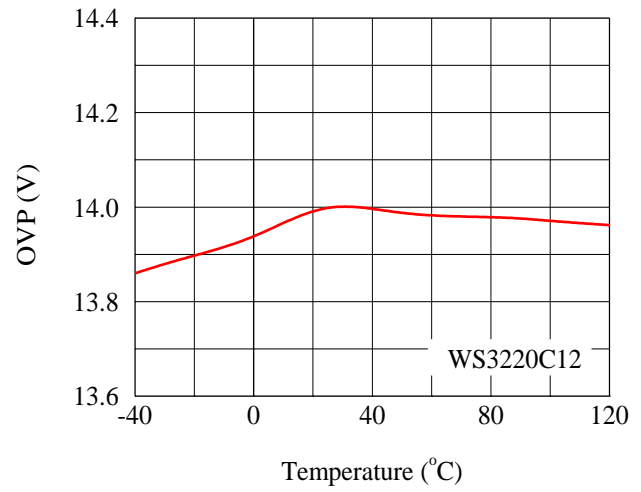
**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$ ,  $C_{IN} = 1\mu\text{F}/50\text{V}$ ,  $C_{OUT} = 1\mu\text{F}/50\text{V}$ , unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
<b>Basic Operation</b>						
Quiescent Supply Current	$I_Q$	$V_{IN} = 5\text{V}$ , $V_{\#EN}=0$ , No Load, WS3220C5		65		$\mu\text{A}$
		$V_{IN} = 6\text{V}$ , $V_{\#EN}=0$ , No Load, WS3220C6		70		
		$V_{IN} = 9\text{V}$ , $V_{\#EN}=0$ , No Load, WS3220C9		80		
		$V_{IN} = 12\text{V}$ , $V_{\#EN}=0$ , No Load, WS3220C12		85		
UVLO Threshold Voltage	$V_{UVLO}$	$V_{IN}$ rising		2.4	3.2	V
Start-up Delay Time	$T_{START\_DLY}$	$V_{IN} = 0 \rightarrow 5\text{V}$ to $V_{OUT} = 0.1 \times V_{IN}$ , $V_{\#EN} = 0$		15		ms
Soft-Start Time	$T_{SS}$	$V_{IN} = 0 \rightarrow 5\text{V}$ to #ACOK goes low, $V_{\#EN} = 0$		30		ms
Main Switch ON-Resistance	$R_{ON}$	$V_{IN} = 5\text{V}$ , $I_{OUT} = 0.5\text{A}$ , WS3220C5		30	39	$\text{m}\Omega$
		$V_{IN} = 6\text{V}$ , $I_{OUT} = 0.5\text{A}$ , WS3220C6		28	39	
		$V_{IN} = 9\text{V}$ , $I_{OUT} = 0.5\text{A}$ , WS3220C9		30	39	
		$V_{IN} = 12\text{V}$ , $I_{OUT} = 0.5\text{A}$ , WS3220C12		32	40	
Enable High Voltage	$V_{IH\_EN}$		1.4			V
Enable Low Voltage	$V_{IL\_EN}$				0.4	V
#EN Input Leakage Current	$I_{\#EN}$	$V_{\#EN}=5\text{V}$		10		$\mu\text{A}$
		$V_{\#EN}=0\text{V}$			0.1	
#ACOK Output Low Voltage	$V_{OL}$	$I_{SINK} = 1\text{mA}$			0.4	V
#ACOK Leakage Current	$I_{\#ACOK}$	$V_{\#ACOK} = 3\text{V}$ , #ACOK De-asserted			1.0	$\mu\text{A}$
<b>Surge and Over-Voltage Protection</b>						
VIN OVP Threshold	$V_{OVP}$	$V_{IN}$ rising, WS3220C5	6.00	6.20	6.40	V
		$V_{IN}$ rising, WS3220C6	6.58	6.80	7.02	
		$V_{IN}$ rising, WS3220C9	10.0	10.5	11.0	V
		$V_{IN}$ rising, WS3220C12	13.5	14.0	14.5	V
OVP Response Time	$t_{OVP}$	$V_{IN}$ rising at $1\text{V} / 0.1\mu\text{s}^{*1}$		65		ns
OVP Hysteresis Voltage	$V_{HYS\_OVP}$	$V_{IN}$ falling		0.1		V
OVP Recovery Time	$t_{R\_OVP}$	$V_{IN}$ recovery from OVP to output on		15		ms
Output discharge resistance	$R_{DCHG}$	OVP, $V_{OUT} = 5\text{V}$ , WS3220C5		90		$\Omega$
		OVP, $V_{OUT} = 6\text{V}$ , WS3220C6		90		

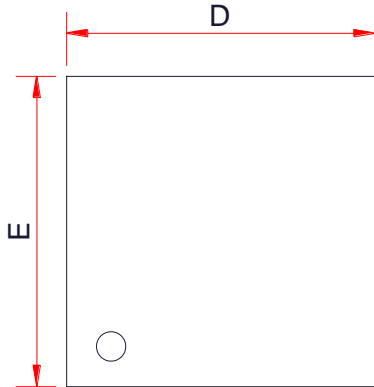
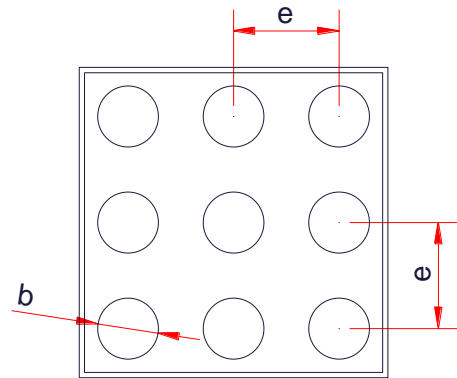
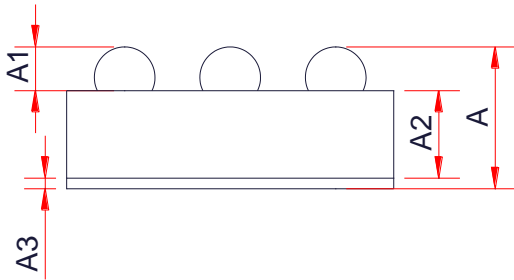
		OVP, V <sub>OUT</sub> = 9V, WS3220C9		95		Ω
		OVP, V <sub>OUT</sub> = 12V, WS3220C12		100		
<b>Thermal Protection</b>						
Over-Temperature Protection Threshold	T <sub>SD</sub>			140		°C
Over-Temperature Protection Hysteresis	T <sub>HYS</sub>			20		°C

**\*1: Guaranteed by design**

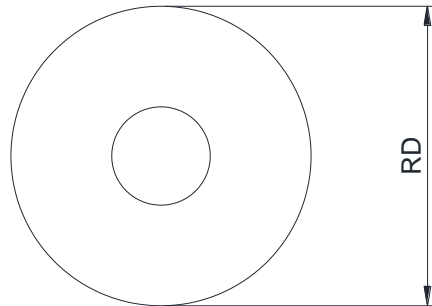
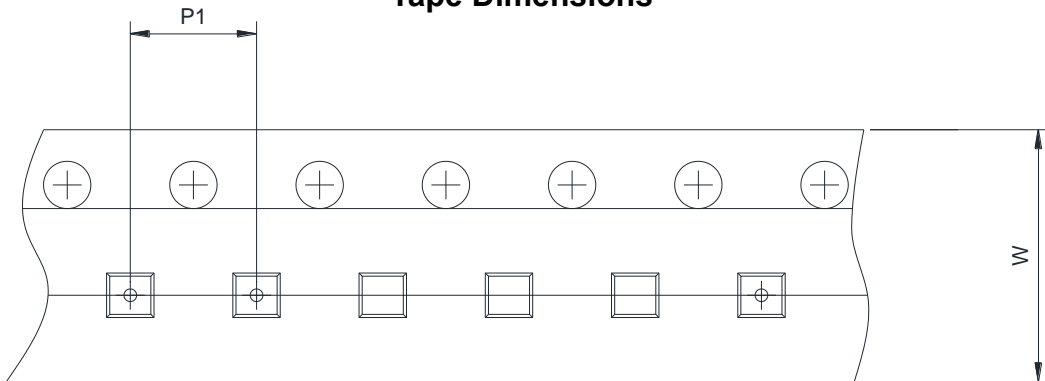
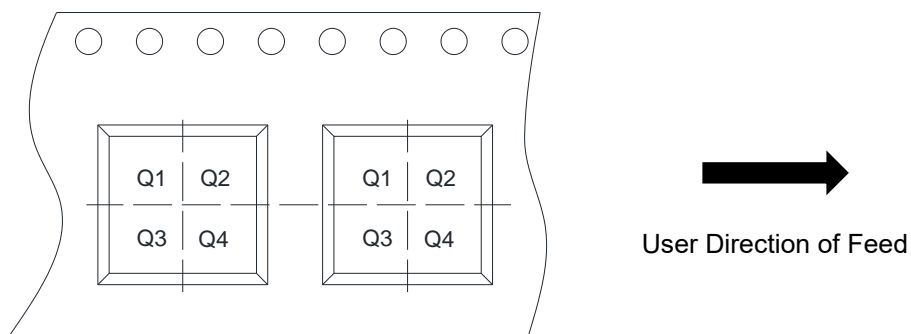
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**ON-Resistance vs. Load Current**

**OVP Threshold vs. Temperature**

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**ON-Resistance vs. Load Current**

**OVP Threshold vs. Temperature**



**Package Outline Dimensions**
**CSP-9L**

**TOP VIEW**

**BOTTOM VIEW**

**SIDE VIEW**

Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	0.54	-	0.61
A1	0.16	-	0.21
A2	0.35	-	0.38
A3	0.03 Ref.		
D	1.14	1.17	1.20
E	1.14	1.17	1.20
b	0.21	0.23	0.25
e	0.40 BSC		

**Tape and Reel Information**
**Reel Dimensions**

**Tape Dimensions**

**Quadrant Assignments For PIN1 Orientation In Tape**


RD	Reel Dimension	<input checked="" type="checkbox"/> 7inch	<input type="checkbox"/> 13inch		
W	Overall width of the carrier tape	<input checked="" type="checkbox"/> 8mm	<input type="checkbox"/> 12mm		
P1	Pitch between successive cavity centers	<input type="checkbox"/> 2mm	<input checked="" type="checkbox"/> 4mm	<input type="checkbox"/> 8mm	
Pin1	Pin1 Quadrant	<input checked="" type="checkbox"/> Q1	<input type="checkbox"/> Q2	<input type="checkbox"/> Q3	<input type="checkbox"/> Q4