

WS3218

Over-Voltage Protection Device for USB 2.0 Compliant VBUS and Data Switches

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

Descriptions

The WS3218 features a low RON internal High Voltage Switch for VBUS with input range of absolute maximum 30V. The internal VBUS OVP shuts off the internal Switch if input voltage exceeds the threshold. A 1.1V OVLO threshold could set different OVP by external resistors. Additionally, connect OVLO to GND, OVP threshold would be fixed at 6.2V.

Due to proximity of pins in USB port, there is heightened concern that debris and moisture will cause high VBUS voltage stress on input D+/D- pins which only operates at 3.3V or lower. WS3218 places high voltage switches on the data lines with OVP. When a voltage above 4.25V is detected, the high voltage data switches shut off, isolating the rest of the system from high voltage condition present on the port. Integrated Over-Temperature Protection (OTP) also turn off the switches to protect the device.

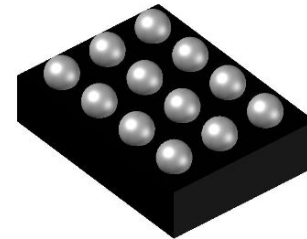
The WS3218 is available in 1.17mm x 1.57mm CSP-12L package. Standard product is Pb-free and Halogen-free.

Features

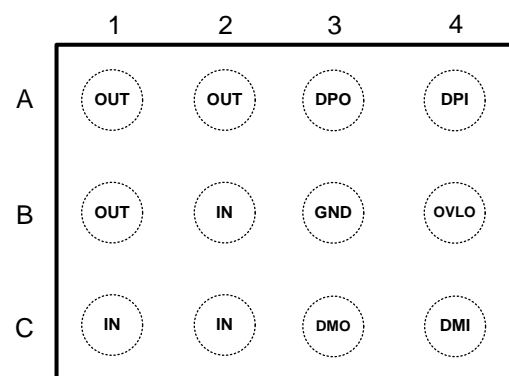
- Absolute Maximum Input Voltage : 30V
- Low R_{ON} Switch (@V_{IN}=5V/9V/12V) : 25mΩ
- Adjustable OVLO Threshold : 1.1V
- Fast OVP Response : 65ns
- Robust ESD Protection
 - Human Body Model (HBM) : 2000V
 - Machine Model (MM) : 200V

Applications

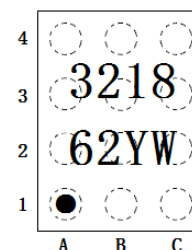
- Mobile Handsets and Tablets
- Portable Media Players
- Peripherals



CSP-12L (Bottom View)



Pin Configuration (Top View)

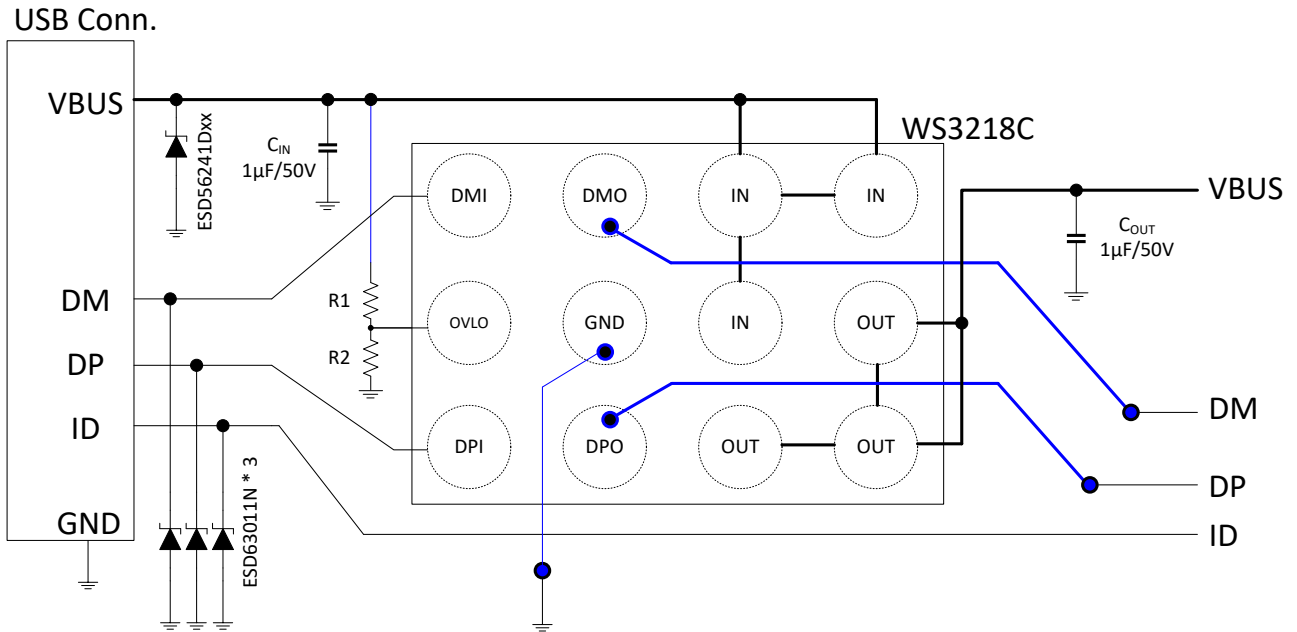


Marking

3218 = Device code
 Y = Year code
 W = Week Code

Order information

Device	Package	Shipping
WS3218C-12/TR	CSP-12L	3000/Reel&Tape

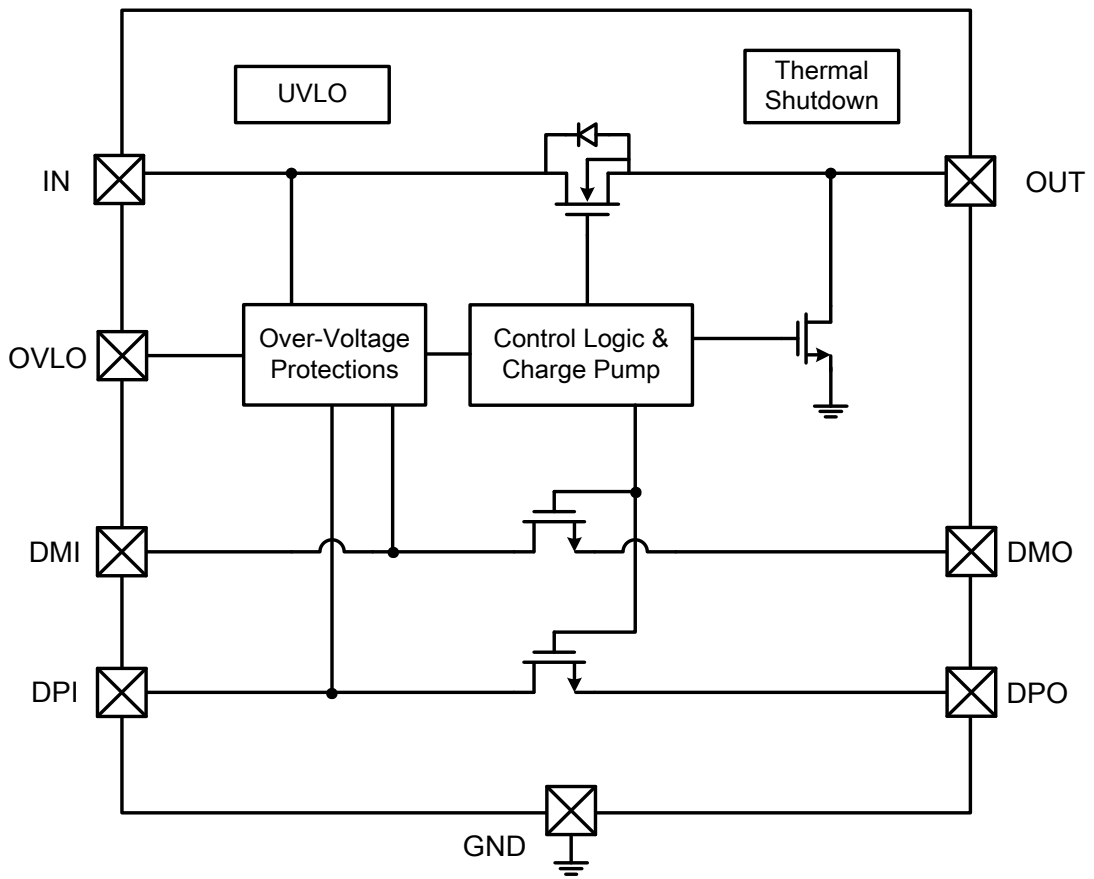
Typical Applications


Note1: R₁ and R₂ are only required for External OVP, otherwise connect OVLO to GND.

Note2: $V_{OVP} = V_{OVLO_TH} \times (R_1 + R_2) / R_2$. Recommended selection: $10K \leq R_2 \leq 50K$.

Pin Descriptions

Pin Number	Symbol	Descriptions
1C, 2B, 2C	IN	VBUS Input Pin and Power Supply.
1A, 1B, 2A	OUT	Output Pin of VBUS to Load.
3A	DPO	USB Data Bus Output.
3C	DMO	USB Data Bus Output.
4A	DPI	USB Data Bus Input.
4C	DMI	USB Data Bus Input.
3B	GND	Device Ground Pin.
4B	OVLO	External OVP Threshold Set Pin. Connect OVLO to GND when using internal fixed threshold. Connect a resistor divider to OVLO to set a different OVP threshold.

Block Diagram


Absolute Maximum Ratings

Parameter	Symbol	Value	Unit	
V_IN voltage range	V _{IN}	-0.3~30	V	
V_OUT voltage range	V _{OUT}	-0.3~30	V	
DMO, DPO voltage range	V _{DPO} , V _{DMO}	-0.3~6.5	V	
DMI, DPI voltage range	V _{DPI} , V _{DMI}	-0.3~12	V	
VBUS Switch FET Continuous Current	I _{IN}	4.5	A	
VBUS Switch FET Body Diode Continuous Current	I _{DIODE}	4	A	
Body Diode Forward Peak Pulse Current *1	I _{PP}	Pulse Width = 10ms	20	A
		Pulse Width = 20μs	50	A
Junction temperature	T _J	150	°C	
Lead temperature (Soldering, 10s)	T _L	260	°C	
Storage temperature	T _{stg}	-55~150	°C	
ESD Ratings	HBM	2000	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
VIN supply input voltage range	V _{CC}	3.6~28	V
Operating ambient temperature	T _A	-40~85	°C
Thermal Resistance	R _{θJA}	95	°C/W

VBUS and Data Input OVP Control Logic

IN	DPI / DMI	VBUS Switch	Data Switch
OV (over voltage)	Not OV	Off	On
Not OV	OV	On	Off
OV	OV	Off	Off
Not OV	Not OV	On	On

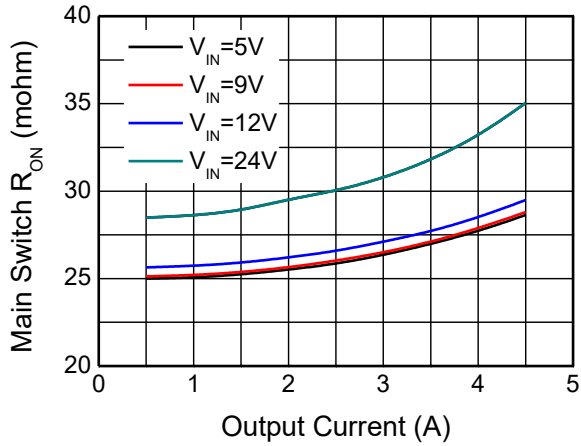
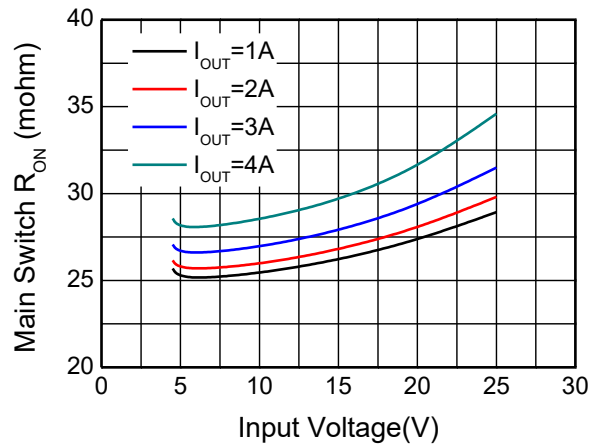
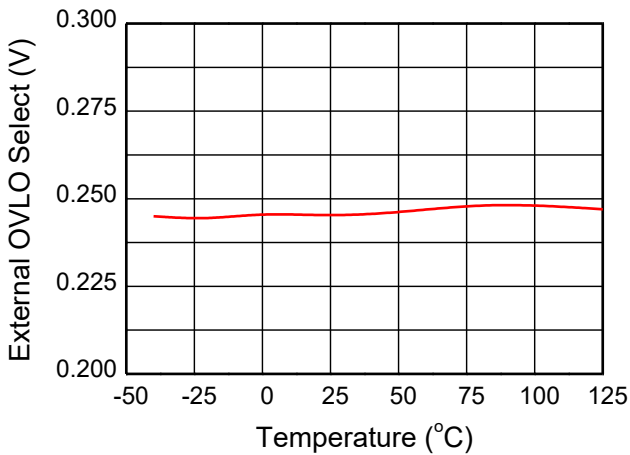
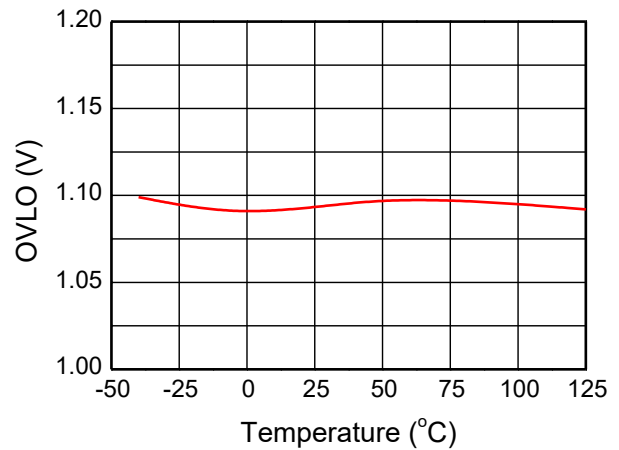
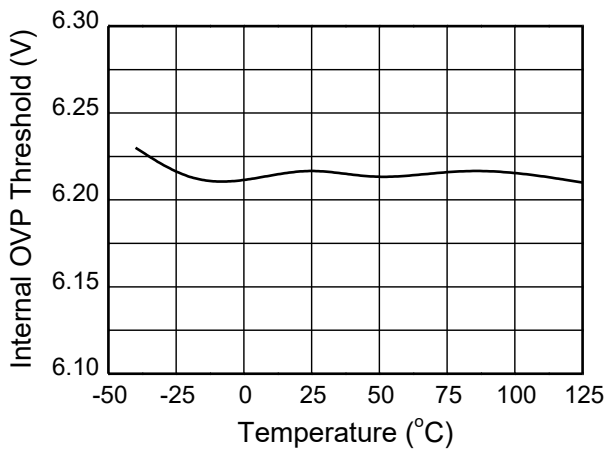
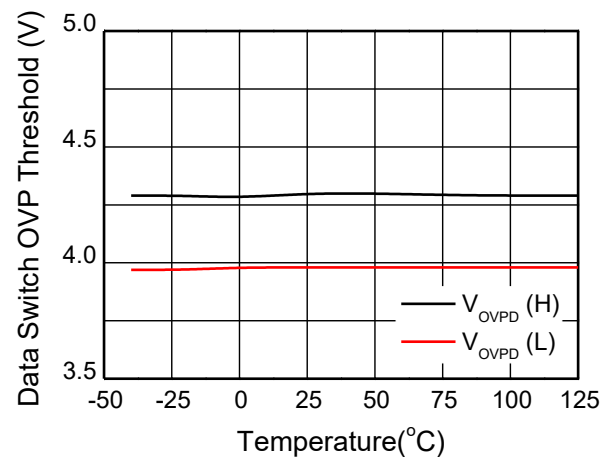
Electrical Characteristics

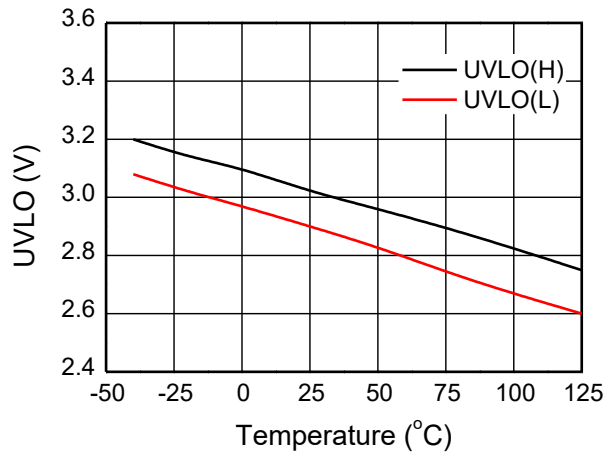
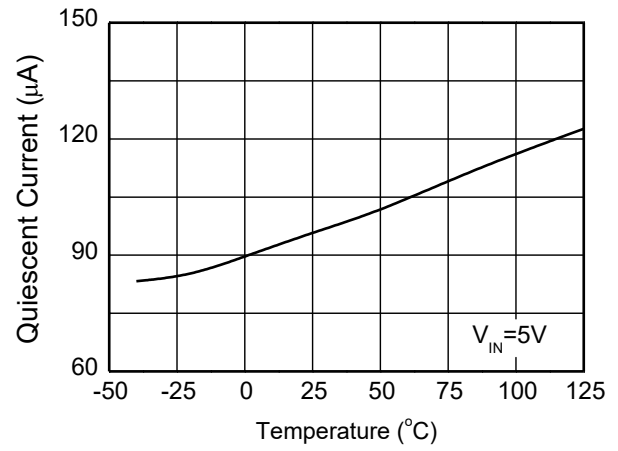
 (T_A = 25°C, V_{IN} = 5V, C_{IN} = 1μF, C_{OUT} = 1μF, for 5V application, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Basic Operation						
Quiescent Supply Current	I _Q	V _{IN} = 5V, No Load		90	150	μA
OVLO Supply Current	I _{IN_Q1}	V _{IN} = 5V, V _{OUT} =0V when VBUS is OV		88	140	μA
Data Input OVLO Supply Current	I _{IN_Q2}	V _{IN} = 5V, V _{OUT} =0V when DPI or DMI is OV		88	140	μA
UVLO Threshold Voltage of V _{IN}	V _{UVLO}	V _{IN} rising		3	3.5	V
UVLO Threshold Hysteresis	V _{UVLO_HYS}	V _{IN} falling		0.1		V
V _{IN} Debounce Delay Time	T _{DEB}	V _{IN} = 0-> 5V to V _{OUT} = 0.1 x V _{IN} , V _{#EN} = 0		15		ms
Main Switch Turn On Time	T _{ON}	R _L =100Ω, C _L =22μF, V _{OUT} from 0.1V _{IN} to 0.9V _{IN}		2		ms
Main Switch ON-Resistance	R _{ON}	V _{IN} = 5V, I _{OUT} = 1A		25	30	mΩ
VBUS Switch Over-Voltage Protection						
Internal IN OVP Threshold	V _{OVP}	V _{IN} rising	6.00	6.20	6.45	V
IN OVP Response Time	t _{OVP}	V _{IN} rising at 1V / 0.1μs ⁻¹		65	100	ns
IN OVP Hysteresis Voltage	V _{HYS_OVP}	V _{IN} falling		0.1		V
External OVLO Select Threshold	V _{OVLO_SEL}	OVLO rising	0.2	0.25	0.3	V
External OVLO Select Hysteresis	V _{OVLO_HYS}	OVLO falling		50		mV
External OVLO Threshold	V _{OVLO_TH}	OVLO preset threshold	1.075	1.1	1.125	V
		Adjustable IN OVP threshold range	4		24	
External OVLO Threshold Hysteresis	V _{OVLO_THYS}			20		mV
OVLO Input Leakage Current	I _{OVLO}		-0.1		0.1	μA
OVP Recovery Time	t _{R_OVP}	V _{IN} recovery from OVP to output on		15		ms
Output discharge resistance	R _{DCHG}	OVP, V _{OUT} = 5V		90		Ω
Data Switch Over-Voltage Protection						
DPI / DMI OVP Threshold	V _{OVDP}	Data input voltage rising	4.0	4.25	4.50	V
DPI / DMI OVP Hysteresis	V _{HYS_D}	Data input voltage falling		0.3		V
Data OVP Response Time	t _{OVDP}	Data input voltage rising at 1V / 0.1μs ⁻¹		0.3	1	μs

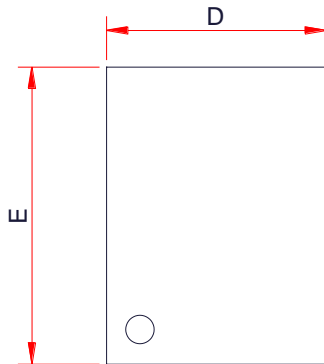
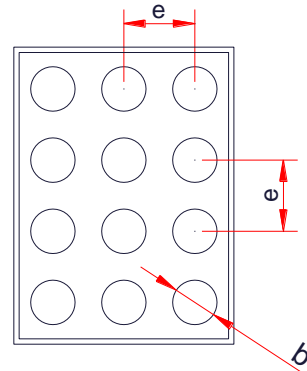
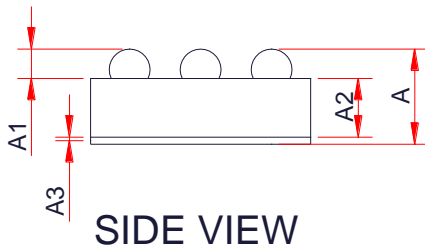
Data OVP Recovery Time	t_{R_OVDP}	Data input voltage recovery from OVP to output on		15		ms
Data Switches Turn On Delay Time	t_{OND}	$V_{IN} = 0 \rightarrow 5V$ to data output voltage reaches 0.9 times data input voltage		15		ms
Basic Data Switch Operation						
Data Switch On-Resistance	R_{OND}	$V_{IN}=5V, V_{DMI/DPI}=0.4V$		7		Ω
R_{OND} Mismatch	ΔR_{OND}	V_{IN} floating, $V_{IN}=5V$		0.2		Ω
R_{OND} Flatness	$R_{FLAT(ON)}$	$V_{IN}=5V, V_{DMI/DPI}=0\sim 0.4V$		1.5		Ω
DPI / DMI On Capacitance	C_{ON}	Data switch on, $V_{DPI/DMI}=0.4V$		6		pF
DPI / DMI Off Capacitance	C_{OFF}	Data switch off, $V_{DPI/DMI}=0.4V$		3.6		pF
-3dB Bandwidth	BW	$R_L=50\Omega, C_L=0pF$		850		MHz
		$R_L=50\Omega, C_L=5pF$		500		
Off Isolation	OIRR	$R_L=50\Omega, f=250MHz$		-30		dB
Cross Talk	Xtalk	$R_L=50\Omega, f=250MHz$		-40		dB
Propagation Delay Time	T_{PLH} / T_{PHL}	$R_L=50\Omega, C_L=5pF$ *1		0.25		ns
Leakage of Off-State DPI / DMI	I_{L_DI}	$V_{DPI / DMI} = 3.6V$, Off-State		1.5	2.5	μA
Leakage of Off-State DPO / DMO	I_{L_DO}	$V_{DPO / DMO} = 3.6V$, Off-State		0.1	1	μA
Thermal Protection						
Over-Temperature Protection Threshold	T_{SD}			140		$^{\circ}C$
Over-Temperature Protection Hysteresis	T_{HYS}			20		$^{\circ}C$

*1: guaranteed by design

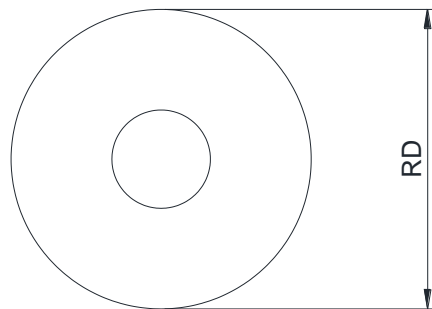
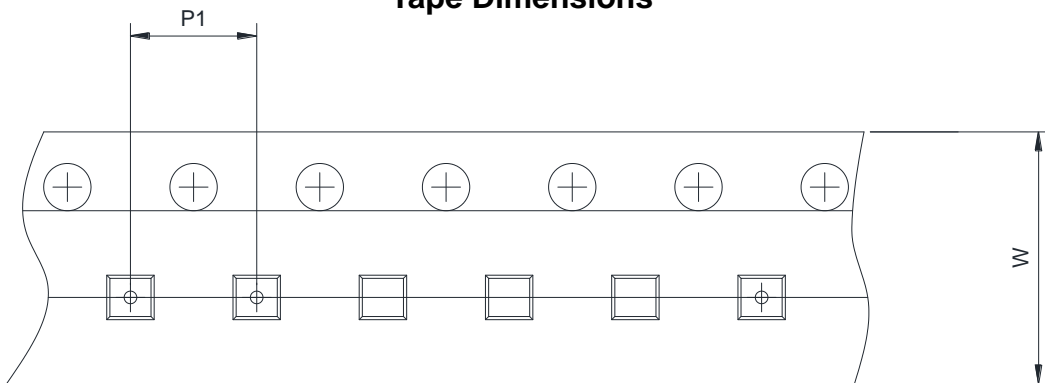
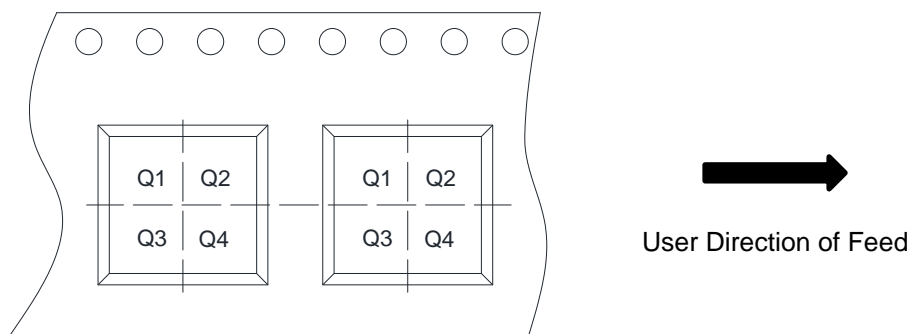
Typical Characteristics ($T_A = 25^\circ\text{C}$, $C_{IN} = 1\mu\text{F}/50\text{V}$, $C_{OUT} = 1\mu\text{F}/50\text{V}$, unless otherwise noted)

Main Switch R_{ON} vs. Load Current

Main Switch R_{ON} vs. Supply Voltage

 V_{OVLO_SEL} vs. Temperature

OVLO Threshold vs. Temperature

Internal OVP vs. Temperature

Data Switch OVP vs. Temperature


UVLO Threshold vs. Temperature

Quiescent Current vs. Temperature

Data Switch Bandwidth

PACKAGE OUTLINE DIMENSIONS
CSP-12L

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	1.54	1.57	1.60
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 type="checkbox"/> Q1	<input type="checkbox"/> Q2 <input checked="" type="checkbox"/> Q3 <input type="checkbox"/> Q4