WS3235

Over Voltage Protection IC with Precision Adjustable Current Limit

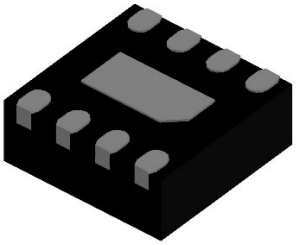
Http://www.omnivision-group.com

Descriptions

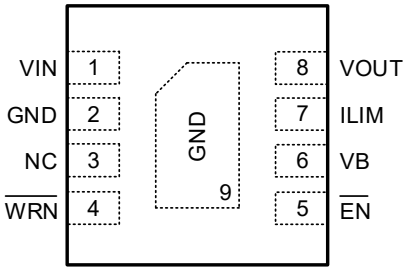
The WS3235 features Input and Battery Over Voltage Protection as well as precision adjustable output Current Limit.

When input voltage exceeds input OVP threshold, the WS3235 will turn off internal MOSFET to disconnect IN to OUT. Current limit threshold can be programmed by external resistor. When OCP occurs and lasts for more than 180μs blanking time, the MOSFET will turn off. Once OCP reaches 16 times, the MOSFET will be permanently off unless the input power is recycled or $\overline{EN}$ pin re-enabled. Battery OVP threshold is fixed 4.35V, and built-in 180μs blanking time could prevent false triggering. When the battery OVP occurs for 16 times, the MOSFET will turn off permanently unless the input power is recycled or $\overline{EN}$ pin re-enabled.

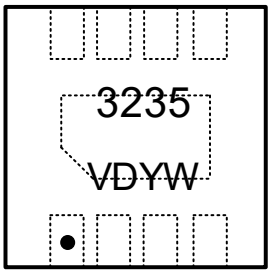
The WS3235 is available in DFN2x2-8L package. Standard product is Pb-Free and Halogen-Free.



DFN2x2-8L（Bottom View）



Pin Configuration (Top view)



3235 = Device code
VD = Special code
Y = Year code
W = Week code

Marking

Features

- Programmable OCP
- Fixed OVP Threshold
  - WS3235D : 6.8V
  - WS3235D58 : 5.85V
  - WS3235D62 : 6.25V
- Battery OVP : 4.35V
- Maximum Input Voltage: 30V
- Input Over Voltage Turn Off Time: 0.1μs
- Over Temperature Protection
- High Immunity of False Triggering Under Transients
- High Accuracy Protection Thresholds
- Warning Indication Output

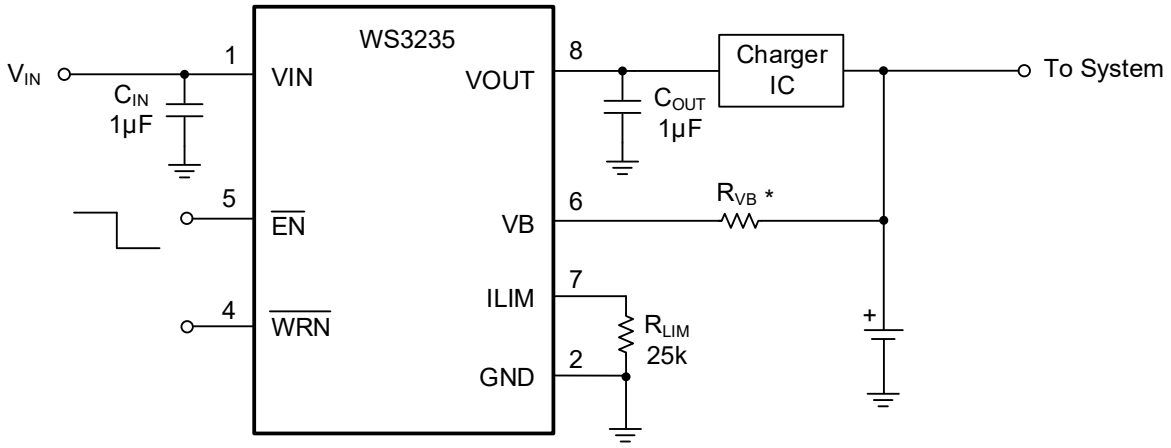
Applications

- Cellular Phones and Digital Cameras
- PDAs and Smart Phones
- Portable Instruments

Order Information

Device	Package	Shipping
WS3235D-8/TR	DFN2x2-8L	3000/Reel & Tape
WS3235D58-8/TR	DFN2x2-8L	3000/Reel & Tape
WS3235D62-8/TR	DFN2x2-8L	3000/Reel & Tape

Typical Application Circuit

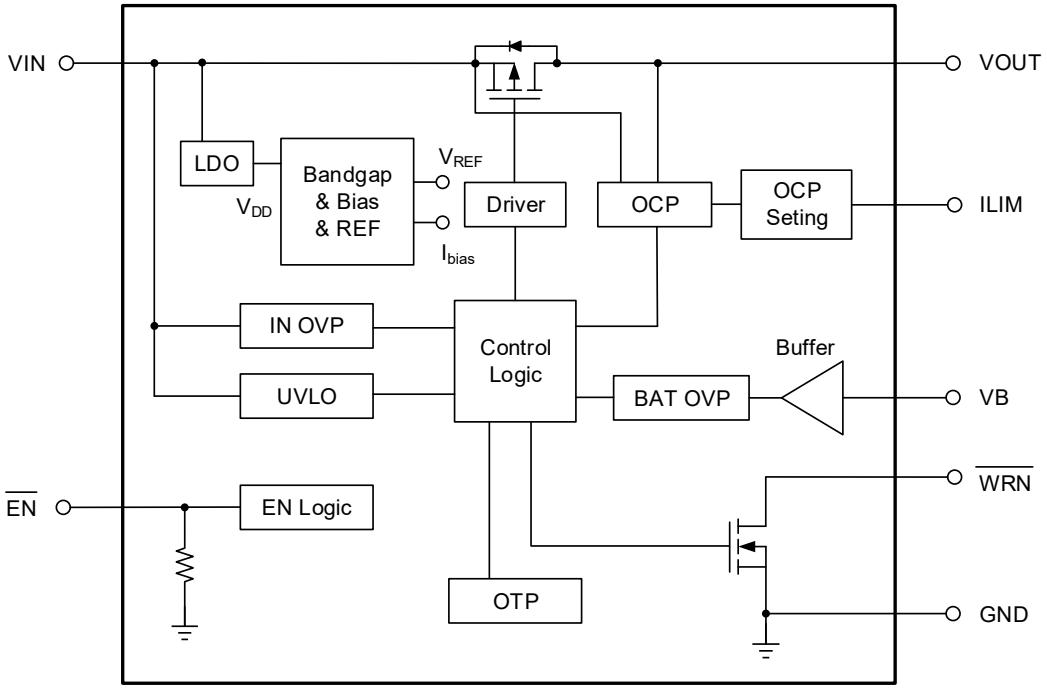


* The recommended value of R_{VB} is 10kΩ~200kΩ.

Pin Descriptions

Pin No.	Symbol	Descriptions
1	VIN	The input power source. The VIN can withstand up to 30V input.
2	GND	Analog Ground.
3	NC	No Internal Connection.
4	$\overline{WRN}$	This is an open-drain logic output that turns LOW when any protection event occurs.
5	$\overline{EN}$	Chip Enable (Active Low). Pull this pin to low or leave it floating to enable the IC and force it to high to disable the IC.
6	VB	Battery voltage monitoring input. This pin is connected to the battery pack positive terminal via an isolation resistor.
7	ILIM	Over current protection threshold setting pin. Connect a resistor between this pin and GND to set the OCP threshold.
8	VOUT	Output through the power MOSFET.
9 (Exposed Pad)	GND	The exposed pad must be soldered to a large PCB and connected to GND for maximum thermal dissipation.

Function Block Diagram



Absolute Maximum Ratings

Parameter		Symbol	Value	Unit
VIN pin voltage range		V_{IN}	-0.3 ~ 30	V
VOUT pin voltage range		V_{OUT}	-0.3 ~ 15	V
VB pin voltage range		V_B	-0.3 ~ 15	V
Other pins voltage range		—	-0.3 ~ 6	V
Package Thermal Resistance-DFN2x2-8L（Note 1）	Junction to Ambient Thermal Resistance	$R_{\theta JA}$	90	°C/W
	Junction to Case Thermal Resistance	$R_{\theta JC}$	15	
Junction temperature		T_J	150	°C
Lead temperature (Soldering, 10sec.)		T_L	260	°C
Operation temperature		Topr	-40 ~ 85	°C
Storage temperature		Tstg	-65 ~ 150	°C
ESD ratings		HBM	4000	V
		CDM	2000	V
		MM	200	V

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.

Note 1: Thermal Resistance is measured with the component mounted on 1.5inch x 1.5inch, 2layers, FR4 test board with 1.0inch x 1.0inch copper area of 2oz in top layer, and in still air condition.

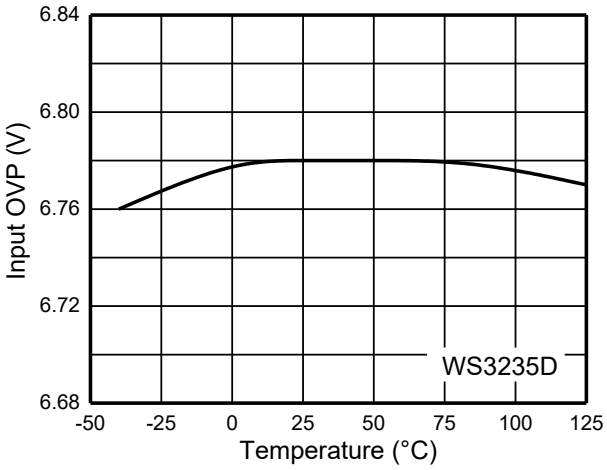
Electronics Characteristics

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

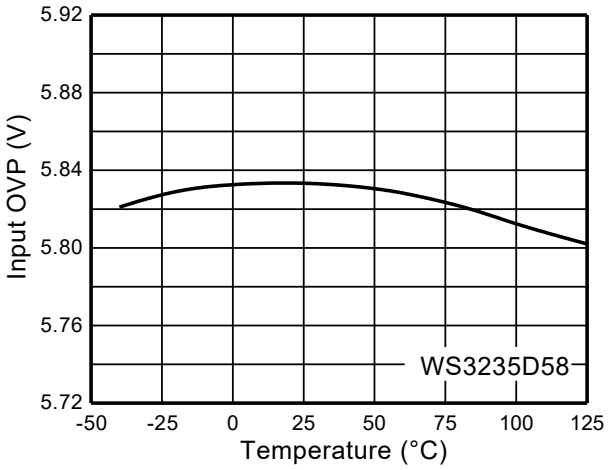
Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Power On Reset						
Operation Voltage Range	V_{IN}	WS3235D	3		6.55	V
		WS3235D58	3		5.5	V
		WS3235D62	3		5.9	V
Supply Voltage POR Threshold	V_{POR}	V_{POR} Rising	2.5	2.7	2.9	V
Deglitch Time of POR				8		ms
Under Voltage Lockout Threshold	V_{UVLO}	V_{UVLO} Falling	2.45		2.75	V
Input Quiescent Current	I_Q	$\overline{EN}$ = 0V		330	400	μA
Input Shutdown Current	I_{SHDN}	$\overline{EN}$ = 5V		55	70	
Protections						
Input OVP Threshold Voltage	V_{IN_OVP}	WS3235D	6.65	6.80	6.95	V
		WS3235D58	5.72	5.85	5.98	V
		WS3235D62	6.11	6.25	6.39	V
Input OVP Hysteresis				100	120	mV
Input OVP Propagation Delay		VIN rising at 10V/μs			0.1	μs
Input OVP Recovery Delay				8		ms
Over Current Protection	I_{OCP}	As R_{ILIM} = 25k	0.91	1	1.09	A
Over Current Protection Blanking Time	T_{OC}			180		μs
Over Current Recover Delay				64		ms
Battery Over Voltage Protection	V_{BOVP}	Rising	4.3	4.35	4.4	V
		Hysteresis		30		mV
Battery OVP Falling Threshold			4.25			V
Battery OVP Blanking Time	T_{VBOV}			180		μs
Battery OVP Recover Delay				8		ms
VB Pin Leakage Current		V_{VB} = 4.4V			85	nA
OTP Threshold	T_{SD}	Rising		155		°C
		Hysteresis		30		°C
OTP Recover Delay				8		ms

Soft-Start Time					8		ms
Logic							
$\overline{EN}$ Threshold Voltage	Logic-High	V_{IH}		1.5			V
	Logic-Low	V_{IL}				0.4	V
$\overline{EN}$ Internal Pull Down Resistor				170	220	270	kΩ
$\overline{WRN}$ Output Logic Low			Sink 1mA		0.19	0.3	V
$\overline{WRN}$ Output Logic High Leakage Current						0.1	μA
Power MOSFET							
On Resistance		R_{ON}	I_{OUT} = 500mA, 4.3V < V_{IN} < 6.5V		200	300	mΩ

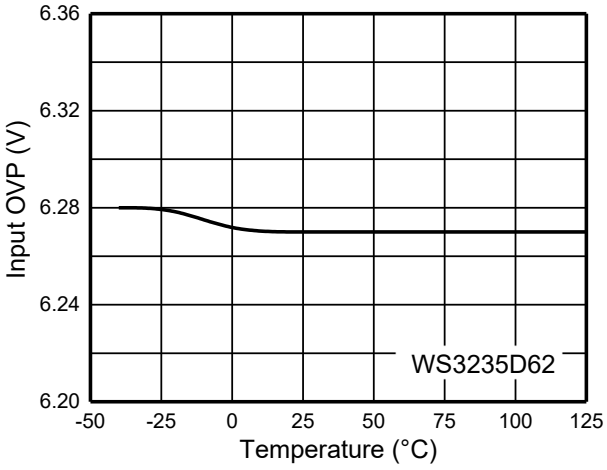
Typical Characteristics (C_{IN}=1μF, C_{OUT}=1μF, T_A=25°C, WS3235D, unless otherwise noted)



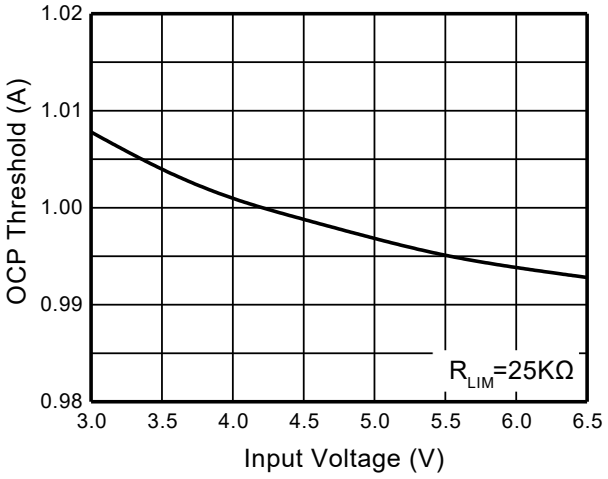
Input OVP vs. Temperature



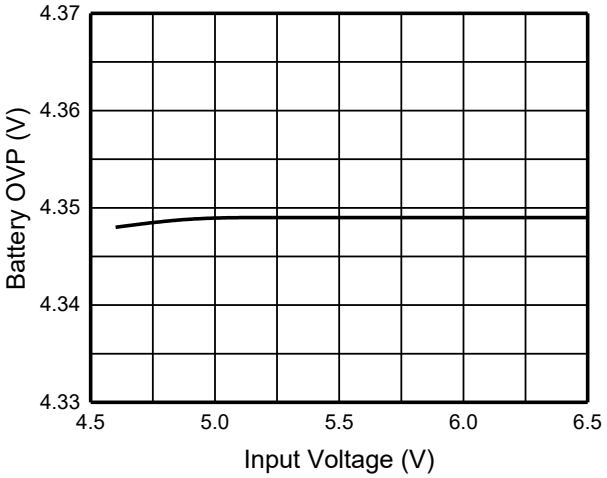
Input OVP vs. Temperature



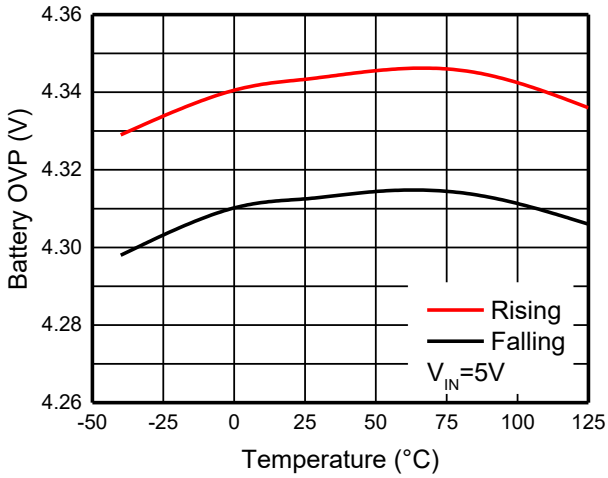
Input OVP vs. Temperature



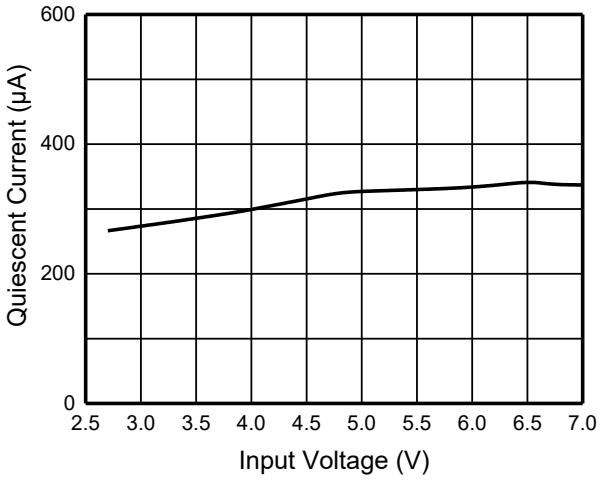
OCP Threshold vs. Input Voltage



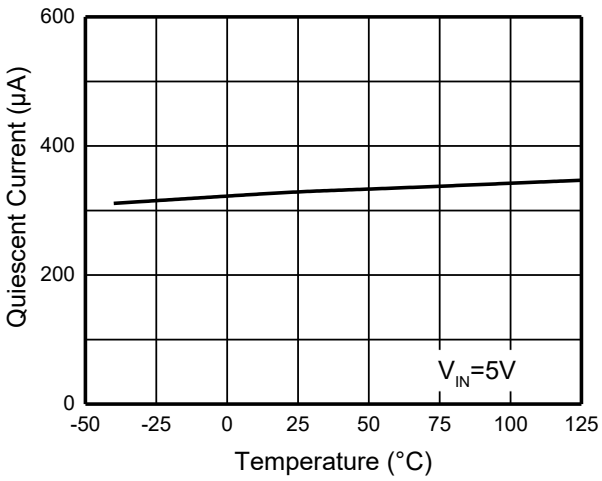
Battery OVP vs. Input Voltage



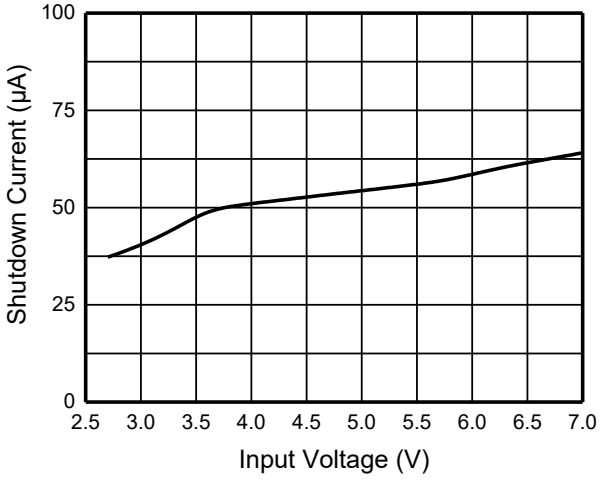
Battery OVP vs. Temperature



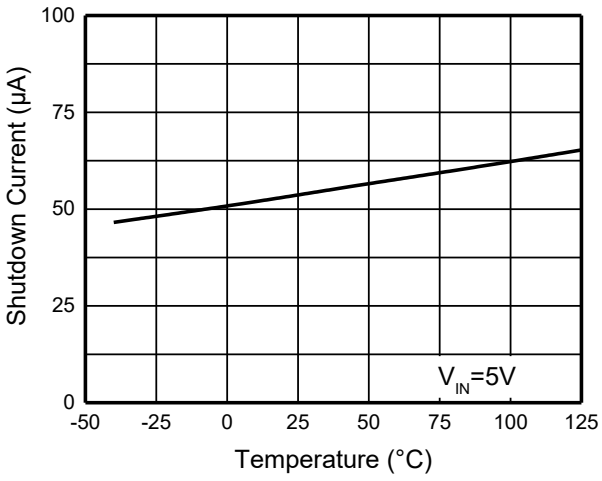
Quiescent Current vs. Input Voltage



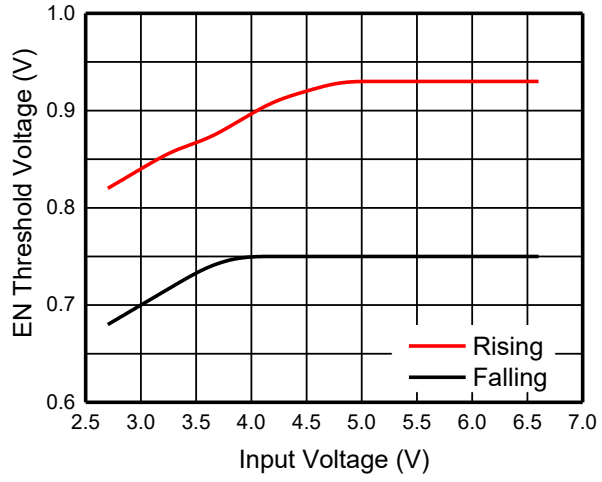
Quiescent Current vs. Temperature



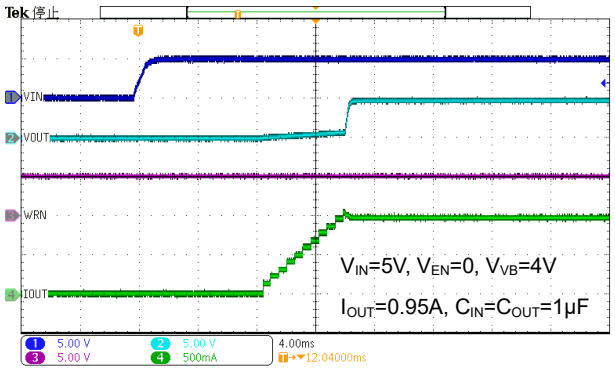
Shutdown Current vs. Input Voltage



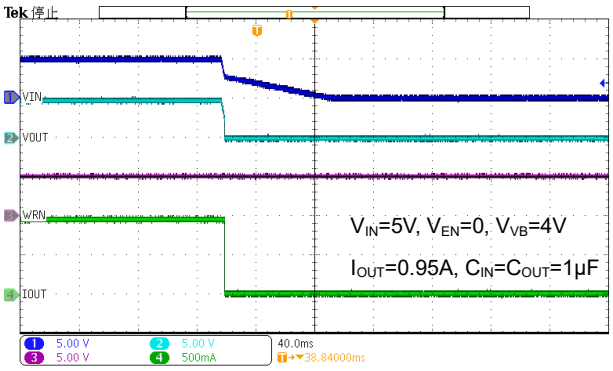
Shutdown Current vs. Temperature



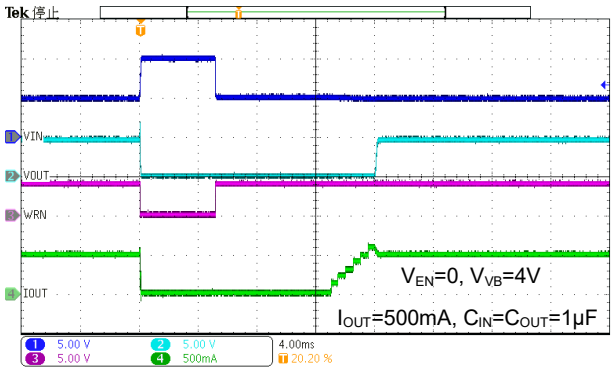
EN Threshold Voltage vs. Input Voltage



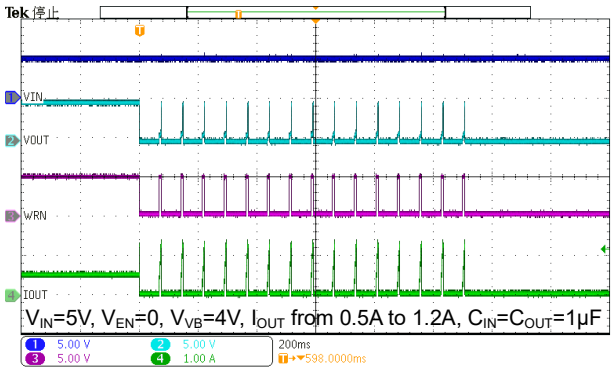
Power On



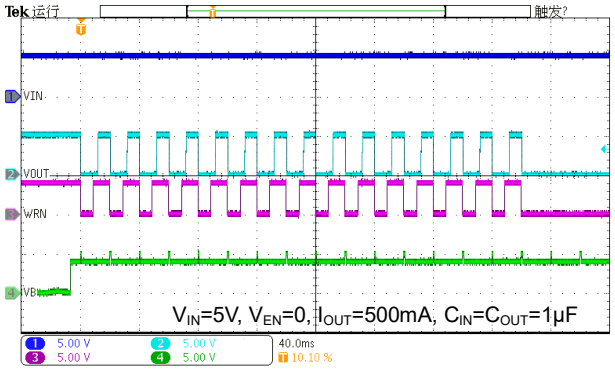
Power Off



Input OVP



OCP



Battery OVP

Operation Information

Power Up

The WS3235 has a threshold of 2.7V power on reset (POR). The hysteresis of the POR threshold is 100mV. The IC is off before the input voltage reaches the POR threshold. When the input voltage is over the POR threshold, the WS3235 soft-start which can reduce the inrush current will be activated after 8ms delay. Any transients at the input during a hot insertion of the power supply will be settled down before the IC starts to operate.

Enable Control

The WS3235 offers a chip enable ($\overline{EN}$) input. There is an internal pull-down resistor in the $\overline{EN}$ pin. Pull this pin to low (<0.4V) or leave it floating to enable the IC and force it to high (>1.5V) to disable the IC.

Over Temperature Protection (OTP)

As soon as the junction temperature reaches 155°C, the WS3235 will turn off the MOSFET. And the IC will not turn on the MOSFET unless the junction temperature is cooled down 30°C.

Input Over Voltage Protection

The WS3235 input OVP threshold is set by the internal resistors. When the input voltage exceeds the threshold, the MOSFET is turned off in 0.1μs, removing power from the system. The hysteresis of the input OVP threshold is 100mV. When the input voltage returns to normal operation voltage range, the WS3235 will turn on the MOSFET.

Battery Over Voltage Protection

The battery OVP threshold voltage is set at 4.35V with 30mV hysteresis typically. To prevent transient voltage from triggering the battery OVP, the WS3235 has a built-in 180μs blanking time. If the battery OVP situation still exists after 180μs, the MOSFET will be turned off and the $\overline{WRN}$ pin indicates a LOW signal. The MOSFET will be turned off permanently if the battery OVP event occurs 16 times which is recorded by the counter. Reset input power or $\overline{EN}$ pin can turn on the MOSFET.

Over Current Protection (OCP)

The WS3235 OCP threshold can be set by an external resistor:

$$I_{OCP} = \frac{25000}{R_{ILIM}}$$

The WS3235 has a built-in 180μs delay time to prevent any transient noise from triggering the OCP. If the OCP situation lasts for 180μs, the MOSFET will be turned off and the $\overline{WRN}$ pin indicates a LOW signal. After 64ms recover delay, the MOSFET will be turned on again. When the OCP occurs 16 times, the MOSFET will be turned off permanently unless the input power or the $\overline{EN}$ pin is reset.

Warning Indication Output

The $\overline{WRN}$ pin is an open-drain output that indicates a LOW signal when protection event occurs (Input OVP, Output OCP and Battery OVP). When the protection events are released and then the $\overline{WRN}$ pin indicates a HIGH signal.

Application Information

Capacitors Selection

Input over shoot voltage will be reduced by increasing the input capacitance, but in the meantime, it will increase the inrush current of input. The input over shoot voltage range which can be influenced by AC adapter hot-plugging is 1.5 to 2 times of the input voltage. The recommended capacitance on input and output is 1μF, and the rated voltage should be higher than at 1.5 to 2 times of the operation voltage.

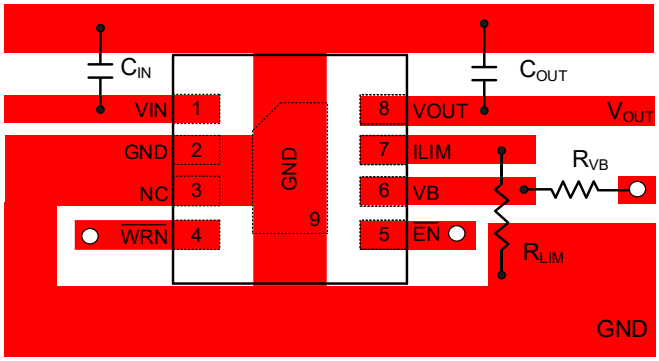
R_{VB} Selection

Battery OVP threshold error is determined by R_{VB}. Decrease the R_{VB} will reduce the battery OVP threshold error, but this will also increase the discharge current when the battery is reversed, which will easily cause reliability problems. To balance the negative factors, the resistance of 10kΩ to 200kΩ is allowed for R_{VB}.

PCB Layout Consideration

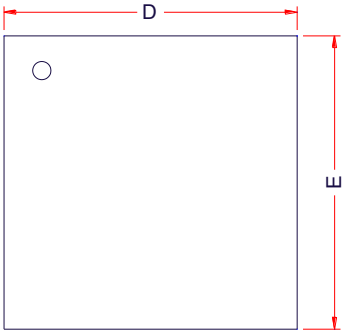
Following guidelines:

1. To reduce noise coupling, locate C_{IN} and C_{OUT} as close to the IC as possible and get them connect to ground plane.
2. R_{LIMIT} should be placed closed to ILIM pin as near as possible and connect to ground plane.
3. Keep main current traces as short and as wide as possible.
4. The exposed pad should be connected to a strong ground plane for heat sink.

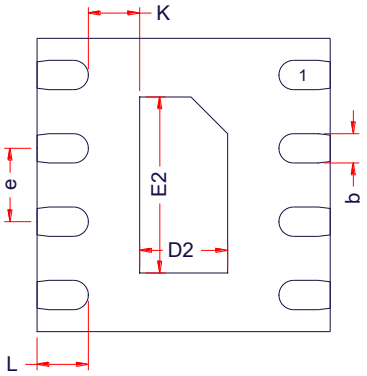


PACKAGE OUTLINE DIMENSIONS

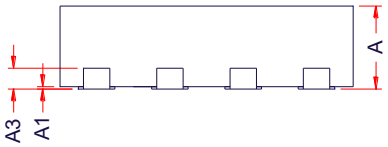
DFN2x2-8L



TOP VIEW



BOTTOM VIEW

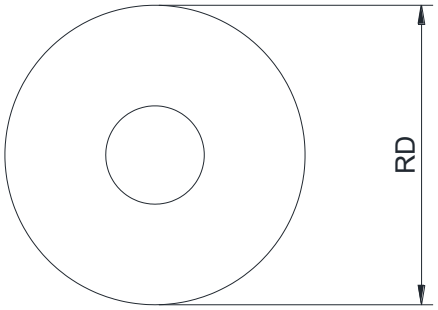


SIDE VIEW

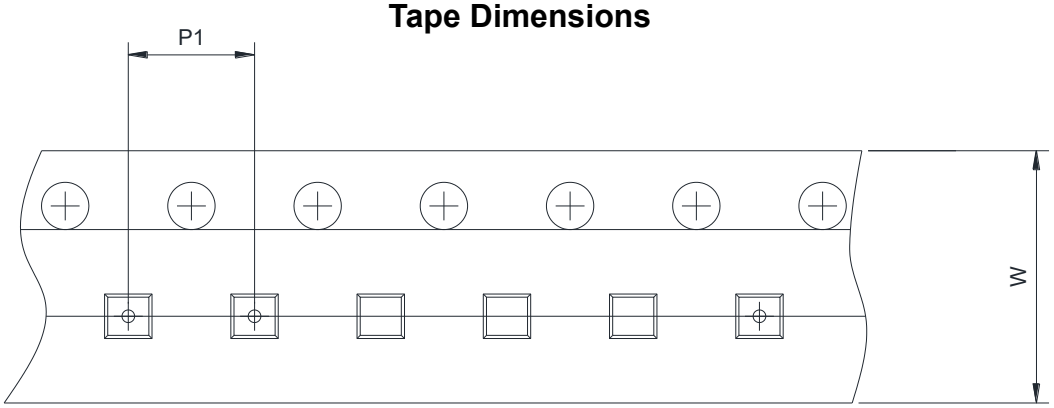
Symbol	Dimensions in Millimeters		
	Min.	Typ.	Max.
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3		0.20 Ref.	
b	0.20	0.25	0.30
D	1.90	2.00	2.10
E	1.90	2.00	2.10
D2	0.50	0.60	0.70
E2	1.10	1.20	1.30
e		0.50 BSC	
L	0.27	0.35	0.43
K		0.35 Ref.	

TAPE AND REEL INFORMATION

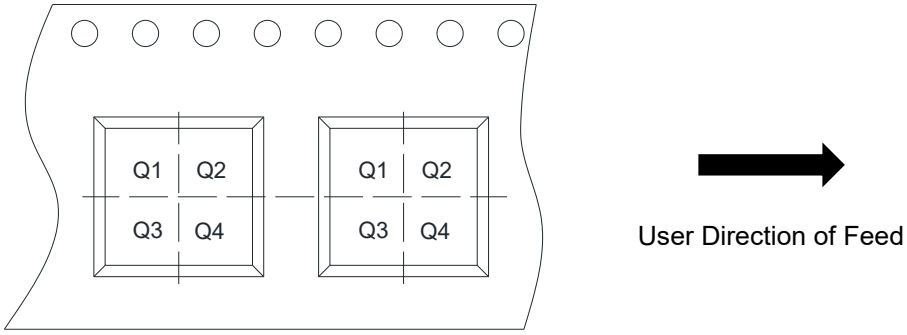
Reel Dimensions



Tape Dimensions



Quadrant Assignments For PIN1 Orientation In Tape



RD	Reel Dimension	☑ 7inch	☐ 13inch		
W	Overall width of the carrier tape	☑ 8mm	☐ 12mm	☐ 16mm	
P1	Pitch between successive cavity centers	☐ 2mm	☑ 4mm	☐ 8mm	
Pin1	Pin1 Quadrant	☑ Q1	☐ Q2	☐ Q3	☐ Q4