Low Loss Current Limited Load Switch

General Description

The WP2106 is current limited P-channel MOSFET power switch designed for high-side load switching applications. This switch operates with inputs ranging from 2.5V to 5.5V, making it ideal for both 3.3V and 5V systems. An integrated current-limiting circuit protects the input supply against large currents which may cause the supply to fall out of regulation. The WP2106 is also protected from thermal overload which limits power dissipation and junction temperatures. It can be used to control load that requires1A. The quiescent supply current in active mode is only 28μA. In shutdown mode, the supply current decreases to less than 1μA. Fault flag ($\overline{FLT}$) can indicate over current and fault conditions.

The WP2106 is available in Pb-free packages and is specified over the -40°C to +85°C ambient temperature range.

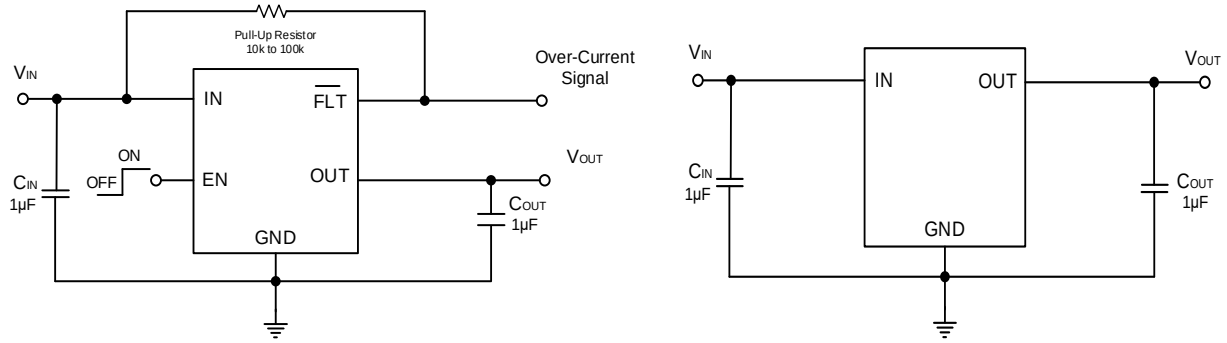
Features

- Input Voltage Range: 2.5V to 5.5V
- 1A,1.5A,2A Accurate Current Limit
- Reverse Current Blocking
- Short-Circuit Response: 2μs
- Very Low Quiescent Current: 28μA (Typ)
- 1μA Max Shutdown Supply Current
- Fault Flag ($\overline{FLT}$) output for over current and fault conditions.
- Built-in Pull-up Resistor for EN Pin
- Automatic Output Discharge at Shutdown
- Under-Voltage Lockout
- Thermal Shutdown
- 2kV ESD Rating
- Package: SOT23-3, SOT23-5

Applications

- Laptop/Desktop Computers and Netbooks
- 3G Wireless Cards
- Smart Phones and PDAs
- LCD TVs and Monitors
- Set-Top-Boxes
- MP3/MP4
- Printers
- Portable Game Players
- Portable Media Players and MIDs
- USB Keyboards
- USB Hard Disk Drives
- USB Memory Drives
- USB Hubs

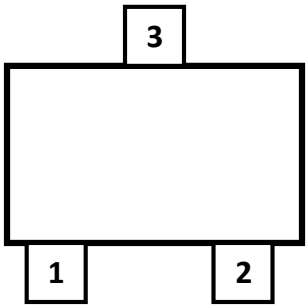
Typical Application



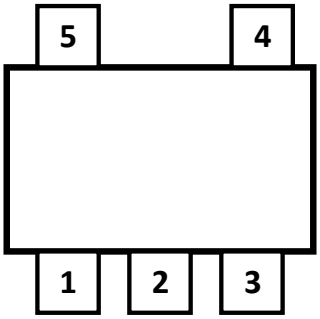
Note: Tantalum or Aluminum Electrolytic capacitors (C_{IN} and C_{OUT}) may be required for USB applications

Pin Configuration

(Top View)



SOT23-3



SOT23-5

Pin Description

Pin Number		Pin Name	Pin Function
SOT23-3	SOT23-5		
2	1	OUT	Power output.
1	2	GND	Ground pin.
-	3	$\overline{FLT}$	Open drain fault flag
-	4	EN	Enable input, High enable.
3	5	IN	Power supply input.

Absolute Maximum Ratings

Parameter	Rating	Unit
IN, EN, $\overline{FLT}$ Voltage	-0.3 to 6	V
OUT Voltage	-0.3 to V_{IN} + 0.3	V
OUT Current	Internal Limited	A
Power Dissipation	400	mW
Junction-to-ambient Thermal Resistance($R_{\theta JA}$)	250	°C/W
Junction-to-case (top)Thermal Resistance ($R_{\theta JC}$)	110	°C/W
Operating Junction Temperature	-40 to 125	°C
Storage Temperature	-55 to 150	°C
Lead Temperature (Soldering, 10 sec)	300	°C

Recommended Operating Conditions

Parameter		Min	Max	Unit
Input Voltage Range		2.5	5.5	V
Output Current	A	0	0.6	A
	B	0	1.0	A
	C	0	1.4	A
Operating Ambient Temperature		-40	85	°C

Electrical Characteristics

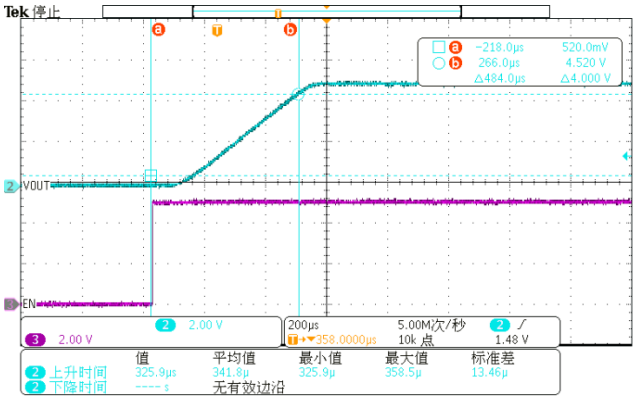
(V_{IN}=+5.0V, T_A=25°C, unless otherwise specified.)

Symbol	Parameter	Test Conditions		Min	Typ.	Max	Unit
I_{SHDN}	Shutdown Quiescent Current	Disabled, OUT floating or shorted to ground			0.3	1	μA
I_Q	Quiescent Current	Enabled, I_{OUT}= 0			28	60	μA
$R_{DS(ON)}$	Switch on-resistance	V_{IN}=5V, I_{OUT}=0.6A			70	120	mΩ
I_{LMT}	Current Limit	V_{IN}=5V	A	0.8	1	1.2	A
			B	1.2	1.5	1.8	
			C	1.6	2	2.4	
V_{IL}	EN Input Logic Low Voltage	Note 1				0.5	V
V_{IH}	EN Input Logic High Voltage	Note 1		1.5			V
$R_{\overline{FLT}}$	$\overline{FLT}$ Low Resistance	Note 2			80		Ω
$T_{\overline{FLT}\_Delay}$	$\overline{FLT}$ Delay Time	Note 2			15		ms
I_{SINK}	EN Input leakage	V_{EN} =5V			0.01	1	μA
		V_{EN} =0V		-2	-0.25		μA
V_{UVLO}	Input UVLO Threshold			1.4	1.8	2.2	V
$V_{UVLOHys}$	Input UVLO Hysteresis				0.1		V
I_{REV}	Reverse Leakage Current	V_{IN} = 0V, V_{OUT} = 5V,I_{REV} at V_{IN}			0.1	1	μA
T_{ON}	Output Turn-on Delay Time	V_{IN} =5V, C_L=1μF, R_{LOAD}=100Ω		0.2	0.5	1	ms
T_R	Output Turn-on Rise Time	V_{IN} =5V, C_L=1μF, R_{LOAD}=100Ω		0.2	0.4	0.8	ms
T_{OFF}	Output Turn-off Delay Time	V_{IN} =5V, C_L=1μF, R_{LOAD}=100Ω		0.2	0.5	0.8	ms
T_F	Output Turn-off Fall Time	V_{IN} =5V, C_L=1μF, R_{LOAD}=100Ω		100	300	450	μs
$R_{dischrg}$	Output discharge FET $R_{DS(ON)}$	Disabled, V_{IN} = 5V, V_{OUT}=1V		50	200	350	Ω
T_{SHDN}	Thermal shutdown threshold	V_{IN} = 5V			150		°C
T_{HYS}	Thermal shutdown hysteresis	V_{IN} = 5V			20		°C
ESD HBM	Human Body Model ESD Protection				2000		V

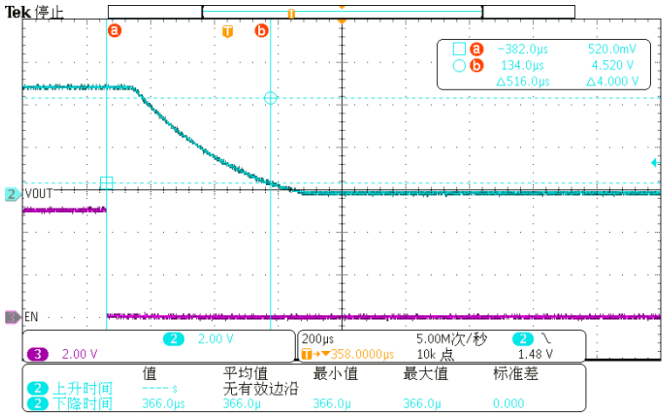
Note 1: When EN pin is floating, the chip is enabled.

Note 2: Guaranteed by design

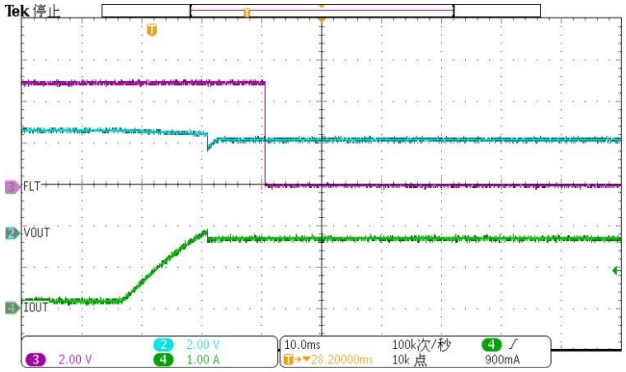
Typical Performance Characteristics



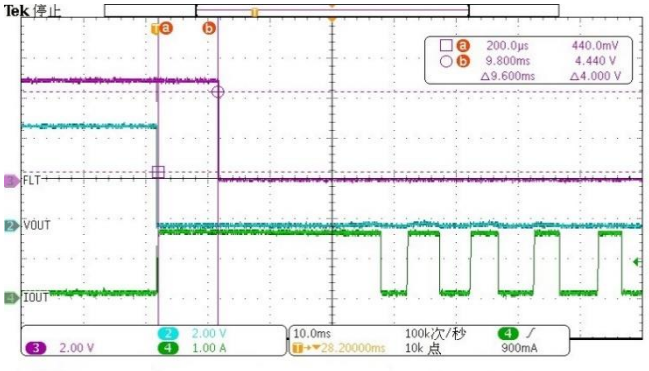
Turn On Response



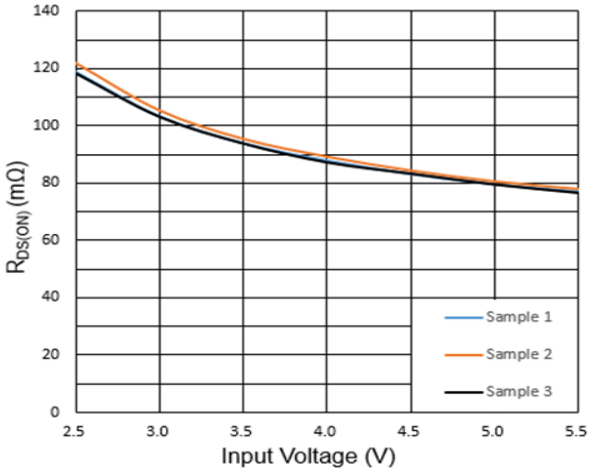
Turn Off Response



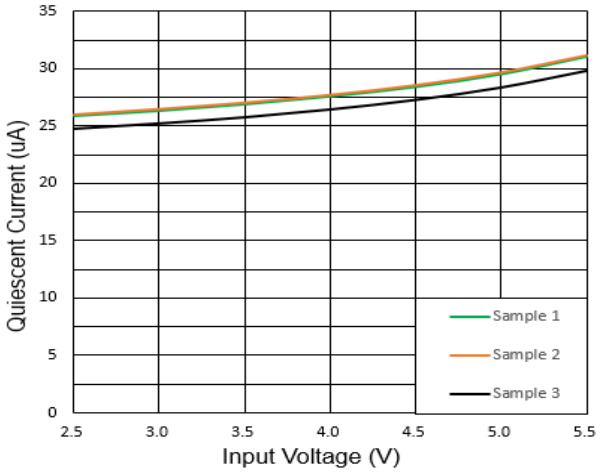
Over Current-Limit（WP2106-B）



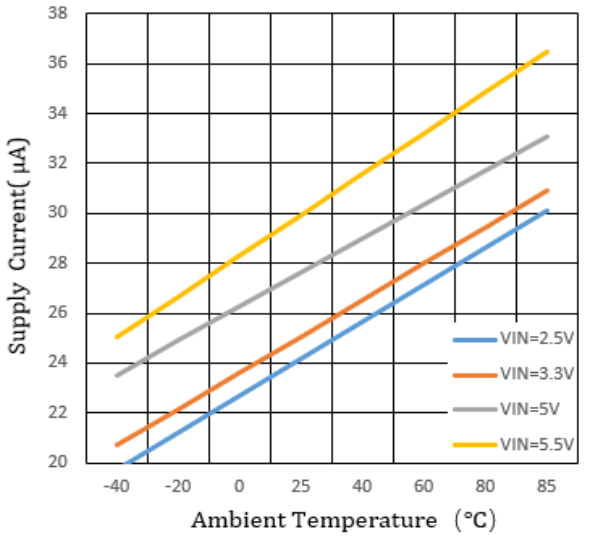
Over Current Conditions Indicated by $\overline{\text{FLT}}$（WP2106-B）



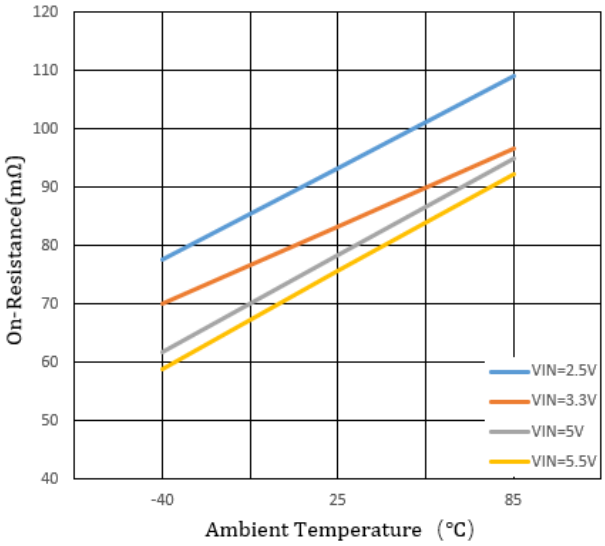
$R_{DS(ON)}$ vs. Input Voltage



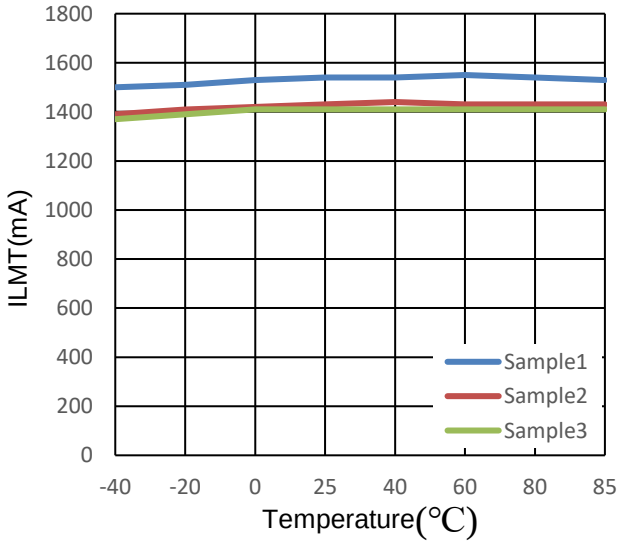
Quiescent Current vs. Input Voltage



Quiescent Supply Current vs. Ambient Temperature

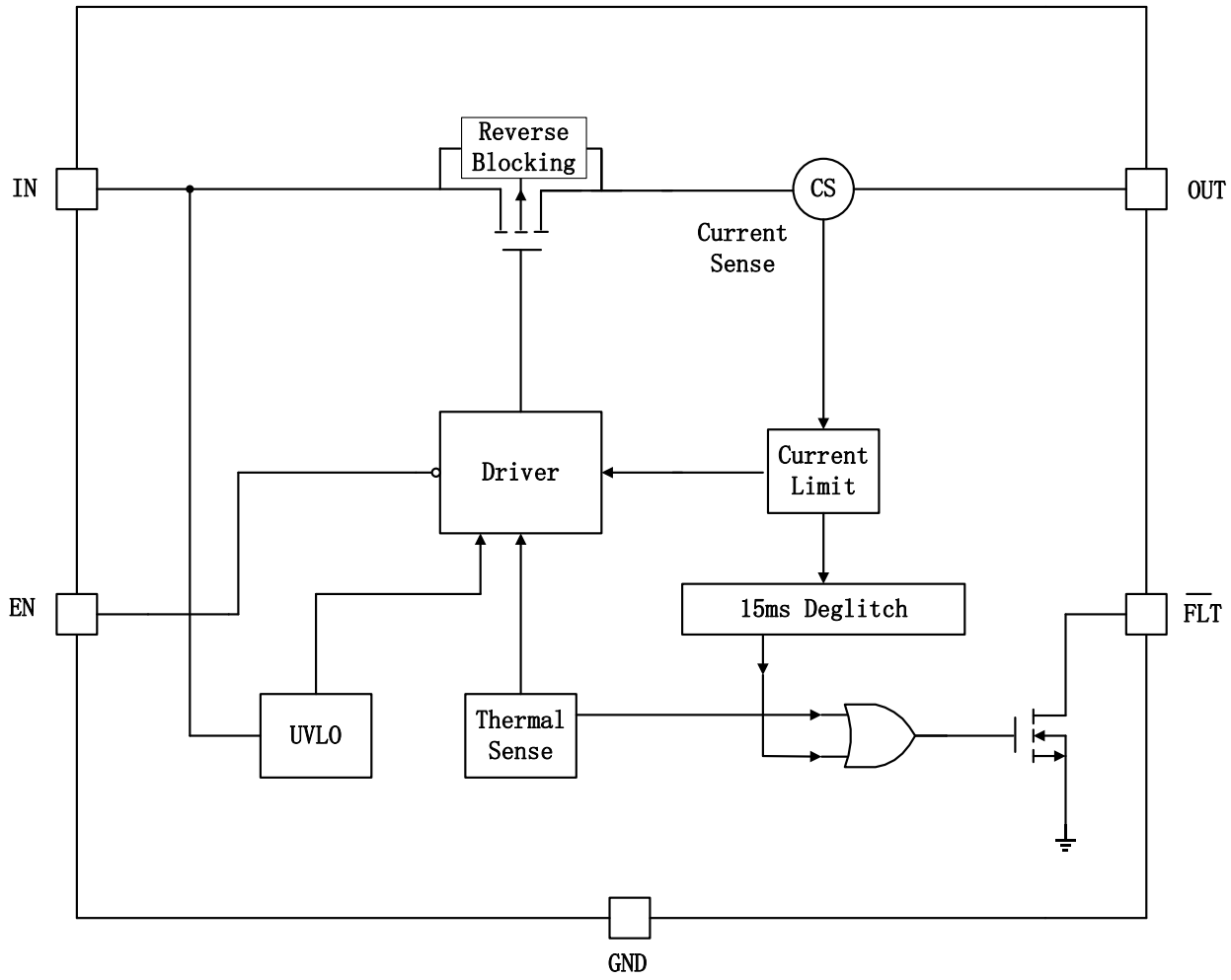


Switch On-Resistance vs. Ambient Temperature



Current Limit vs. Ambient Temperature

Block Diagram



Operation

WP2106 is an integrated power switch with a low $R_{DS(ON)}$ P-channel MOSFET, internal gate drive circuit. When the WP2106 turns on, it can deliver up to 1A continuous current to load. When the device is active, if there is no load, the device only consumes 28μA supply current, which makes the device suitable for battery powered applications.

Power Supply Considerations

A 0.1μF to 1μF ceramic bypass capacitor between IN and GND, close to the device, is recommended. Placing a high-value electrolytic capacitor on the output pin is recommended when the output load is heavy. This precaution reduces power-supply transients that may cause ringing on the input and minimize the input voltage droops. Additionally, bypassing the output with a 0.1μF to 1μF ceramic capacitor improves the immunity of the device to short-circuit transients.

Power Dissipation and Junction Temperature

The low on-resistance on the P-channel MOSFET allows the small surface-mount packages to pass large currents. It is good design practice to check power dissipation and junction temperature for each application. Begin by determining the $R_{DS(ON)}$ of the P-channel MOSFET relative to the input voltage and operating temperature. Using the highest operating ambient temperature of interest and $R_{DS(ON)}$, the power dissipation per switch can be calculated by:

$$P_D = R_{DS(ON)} \times I^2$$

Finally, calculate the junction temperature:

$$T_J = P_D \times R_{\theta JA} + T_A$$

Where:

T_A= Ambient temperature

$R_{\theta JA}$ = Thermal resistance

P_D = Total power dissipation

Compare the calculated junction temperature with the maximum junction temperature which is 125°C. If they are within degrees, either the maximum load current needs to be reduced or another package option will be required.

Over Current

A sense FET is employed to check for over current conditions. When an over current condition is detected, the device maintains a constant output current and reduces the output voltage accordingly. WP2106 will limit the current until the overload condition is removed or the device begins to thermal cycle.

Three possible overload conditions can occur. In the first condition, the output has been shorted before the device is enabled or before V_{IN} has been applied. The WP2106 senses the short and immediately switches into a constant-current output.

In the second condition, a short or an overload occurs while the device is enabled. At the instant the overload occurs, high currents may flow for a short period of time before the current-limit circuit can react. After the current-limit circuit reached the overcurrent trip threshold, the device switches into constant-current mode.

In the third condition, the load has been gradually increased beyond the recommended operating current. The current is permitted to rise until the current-limit threshold is reached or until the thermal limit of the device is exceeded. The WP2106 is capable of delivering current up to the current-limit threshold without damaging the device. Once the threshold has been reached, the device switches into its constant-current mode.

Reverse Current Blocking

The P-channel MOSFET has a Reverse Block. When V_{IN} = 0V and V_{OUT}= 5V, the current is prevented by the Reverse Block from flowing from OUT to IN. I_{REV} is less than 1μA.

Thermal Protection

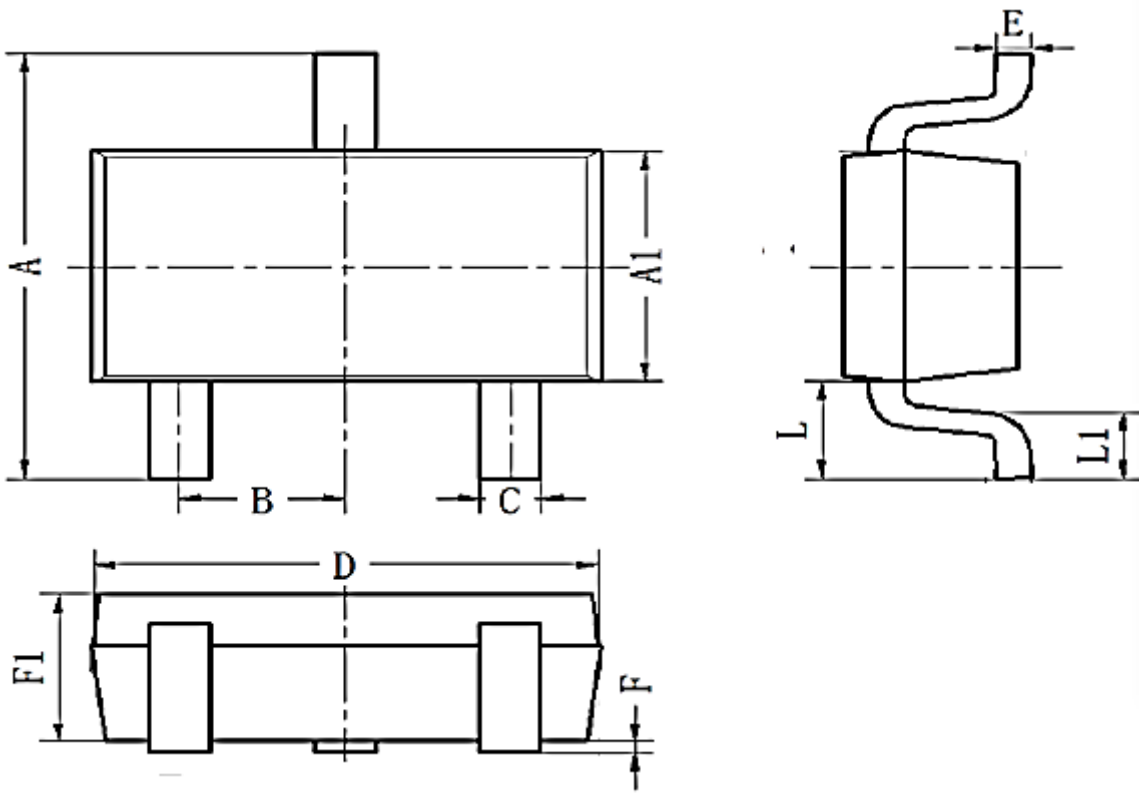
Thermal protection prevents damage to the IC when overload or short-circuit faults are present for extended periods of time. The WP2106 implements a thermal sensing to monitor the operating junction temperature of the power distribution switch. In an over current or short-circuit condition, the junction temperature rises due to excessive power dissipation. Once the die temperature rises to approximately 150°C due to over current conditions, the internal thermal

sense circuitry turns the power switch off, thus preventing the power switch from damage. Hysteresis is built into the thermal sense circuit, and after the device has cooled approximately 20° C, the switch turns back on. The switch continues to cycle in this manner until the load fault or input power is removed.

Fault Flag ($\overline{FLT}$)

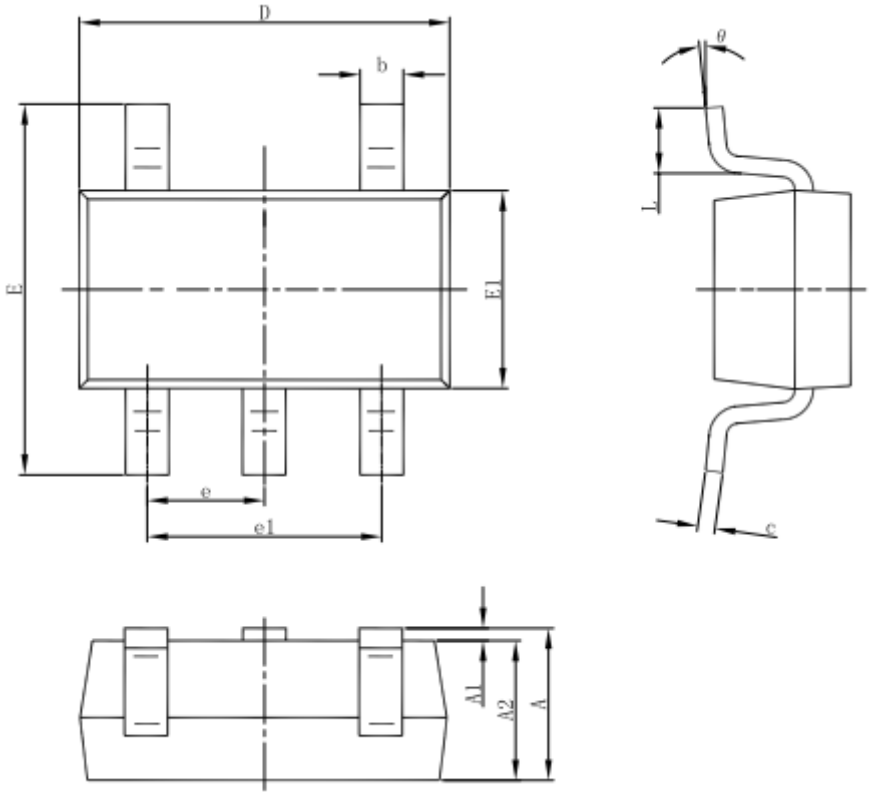
The Fault flag ($\overline{FLT}$) can indicate over current condition. Fault flag is an open drain signal and must be pulled up by a pull-up resister. Fault flag is logic high in normal. In the condition of over current or over temperature, fault flag changes to logic low after about 15ms delay, which is guaranteed by design.

Package Information



SOT 23-3

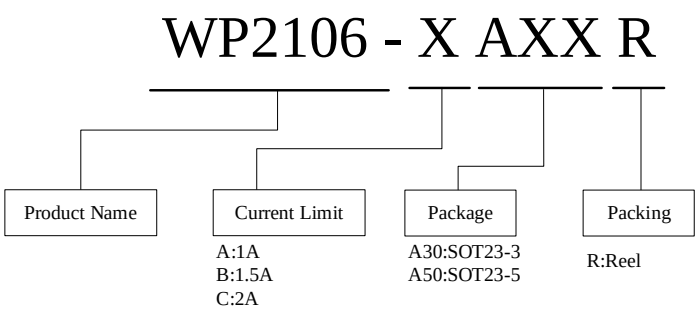
SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	2.60	2.80	3.00
A1	1.50	1.60	1.70
B		0.95BSC	
C	0.25	0.40	0.50
D	2.82	2.92	3.02
E	0.10	0.15	0.20
L		0.59REF	
L1	0.30	0.45	0.60
F1	0.90	1.10	1.30
F	0.00	0.08	0.15



SOT23-5

SYMBOL	DIMENSIONS IN MILLIMETERS	
	MIN	MAX
A	1.000	1.350
A1	0.000	0.150
A2	1.000	1.200
b	0.300	0.500
c	0.100	0.200
D	2.820	3.020
E1	1.500	1.700
E	2.600	3.000
e	0.950(BSC)	
e1	1.800	2.000
L	0.300	0.600
θ	0°	8°

Ordering Information



Part Number	Current Limit	Package	Packing Quantity	Marking*
WP2106-AA30R	1A	SOT23-3	3k/Reel	2106 AXXXX
WP2106-BA30R	1.5A	SOT23-3	3k/Reel	2106 BXXXX
WP2106-CA30R	2A	SOT23-3	3k/Reel	2106 CXXXX
WP2106-AA50R	1A	SOT23-5	3k/Reel	2106 AXXXX
WP2106-BA50R	1.5A	SOT23-5	3k/Reel	2106 BXXXX
WP2106-CA50R	2A	SOT23-5	3k/Reel	2106 CXXXX

*XXXX is variable.

Contact Information

No.1001, Shiwan(7) Road, Pudong District, Shanghai, P.R.China.201202

Tel: 86-21-68960674 Fax: 86-21-50757680 Email: market@way-on.com

WAYON website: **http://www.way-on.com**

For additional information, please contact your local Sales Representative.

Specifications are subject to change without notice.

The device characteristics and parameters in this data sheet can and do vary in different applications and actual device performance may vary over time.

Users should verify actual device performance in their specific applications.