1. General Description

The WP25P21XX-B is a 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 WP25P21XX-B includes thermal shutdown protection that prevents damage to the device when a continuous over-current condition causes excessive heating by turning off the switch. The load of the switch can be up to 1.4A. Current limit threshold is programmed with a resistor from SET to ground. The quiescent current is only 28μA in active mode while it is less than 1μA in shutdown mode. Fault flag ($\overline{FLT}$) can indicate over current and fault conditions.

The WP25P21XX-B is available in Pb-free packages and is characterized for operation over the free-air temperature range of - 40℃ to 85°℃.

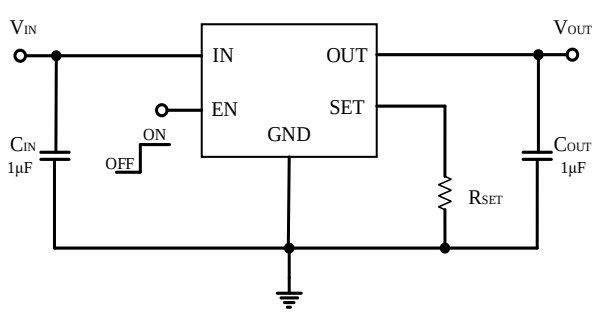
2. Features

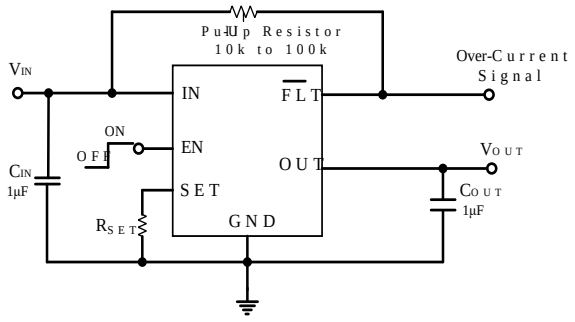
- Input Voltage Range: 2.5V to 5.5V
- Programmable Current Limit (0.4A to 2A)
- Reverse Current Blocking
- Short-Circuit Response: 2μs
- Very Low Quiescent Current: 28μA (Typ.)
- 1μA Max Shutdown Supply Current
- Fault Flag ($\overline{FLT}$) output for over current and fault conditions (WP25P21T6-B, WP25P21F6-B)
- Built-in Pull-up Resistor for EN Pin
- Automatic Output Discharge at Shutdown
- Under-Voltage Lockout
- Thermal Shutdown
- 8kV ESD Rating
- Package: SOT23-5, SOT23-6, DFN-6

3. Applications

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

4. Typical Application

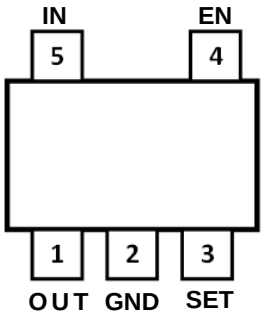




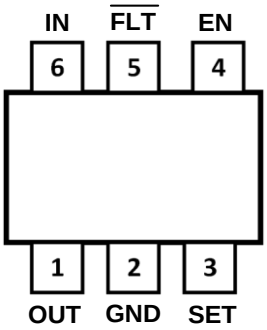
Note: Tantalum or Aluminum Electrolytic capacitors (C_{IN} and C_{OUT}) may be required for USB applications

5. Pin Configuration

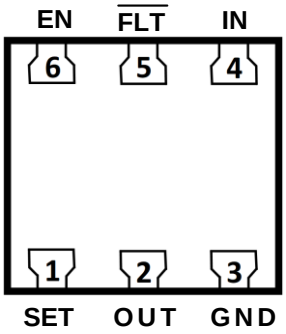
(Top View)



SOT23-5



SOT23-6



DFN-6

6.Pin Description

PIN NUMBER			PIN NAME	I/O	PIN FUNCTION
SOT23-5	SOT23-6	DFN-6			
1	1	2	OUT	O	Switch output.
2	2	3	GND		Common ground.
3	3	1	SET	O	Current limit programming pin. with a resistor R_{SET} from this pin to ground to program the current limit.
4	4	6	EN	I	Enable input. Active High.
5	6	4	IN	I	Switch input.
	5	5	$\overline{FLT}$	O	Fault FLAG output. Open drain output that indicates an over current, supply under voltage or over temperature state.

7. Absolute Maximum Ratings [1]

Over operating free-air temperature range (unless otherwise noted)

PARAMETER		RATING	UNIT
IN, EN, SET, $\overline{FLT}$ Voltage		-0.3 to 6	V
OUT Voltage		-0.3 to V_{IN} + 0.3	V
OUT Current		ADJ	A
Power Dissipation	SOT23-5	400	mW
	SOT23-6	400	
	DFN-6	606	
Package Thermal Resistance(θ_{JA})	SOT23-5	250	℃/W
	SOT23-6	250	
	DFN-6	165	
Junction Temperature		150	℃
Storage Temperature		-65 to 150	℃
Lead Temperature (Soldering, 10 sec)		260	℃
ESD(HBM)		8000	V

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

8. Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{IN}	Input Voltage	2.5	5.5	V
V_{EN}	EN Input Voltage		V_{IN}	V
T_A	Operating Ambient Temperature	-40	85	℃
T_J	Operating Junction Temperature	-40	125	℃

9. Electrical Characteristics

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

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, OUT floating		28	60	μA
$R_{DS(ON)}$	Switch on-resistance	V_{IN}=5V, I_{OUT}=0.6A, Open R_{SET}		80	120	mΩ
I_{LIM}	Current Limit	V_{IN}=5V, R_{SET}=10kΩ	1.6	2	2.4	A
		V_{IN}=5V, R_{SET}=12.7kΩ	1.2	1.5	1.8	
		V_{IN}=5V, R_{SET}=19.6kΩ	0.8	1	1.2	
		V_{IN}=5V, R_{SET}=47kΩ	0.32	0.4	0.48	
		V_{IN}=5V, Open R_{SET}	0.8	1	1.2	
V_{IL}	EN Input Logic-Low Voltage [2]				0.5	V
V_{IH}	EN Input Logic-High Voltage [2]		1.5			V
$R_{\overline{FLT}}$	$\overline{FLT}$ Low Resistance [3]			80		Ω
$t_{\overline{FLT}_DELAY}$	$\overline{FLT}$ Delay Time [3]			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	Enabled, V_{IN} rising	1.4	1.8	2.2	V
V_{UVLO_HYS}	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	R_{LOAD}=100Ω	0.2	0.5	1	ms
t_R	Output Turn-on Rise Time	R_{LOAD}=100Ω	0.2	0.4	0.8	ms

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
t_{OFF}	Output Turn-off Delay Time	R_{LOAD}=100Ω	0.2	0.5	0.8	ms
t_F	Output Turn-off Fall Time	R_{LOAD}=100Ω	100	350	500	μs
R_{DIS}	Output Discharge Resistance	Disabled, V_{IN} = 5V, V_{OUT}=1V,	50	120	300	Ω
T_{SHDN}	Thermal Shutdown Threshold [3]			150		℃
T_{HYS}	Thermal shutdown hysteresis [3]			20		℃

Note 2: EN includes a pull-up resistor, nominally 20MΩ. When EN pin is floating, the chip is enabled.

Note 3: Guaranteed by design.

Note 4: Limits over full temperature are guaranteed by design, but not tested in production.

10. Typical Performance Characteristics

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

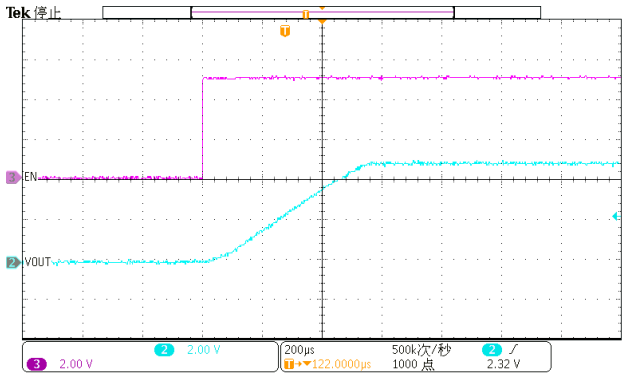


Figure 1. Turn On Response

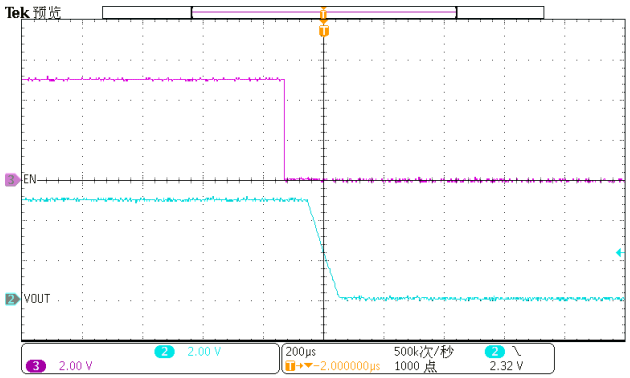


Figure 2. Turn Off Response

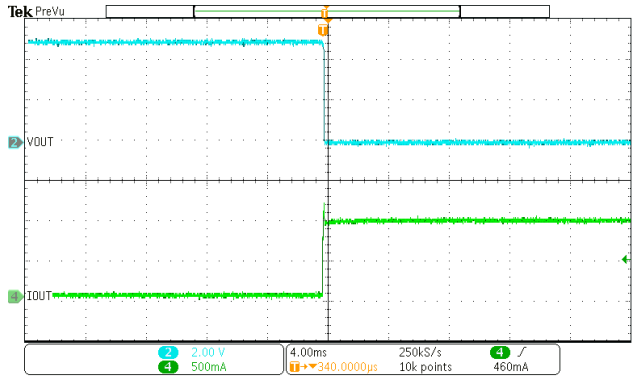


Figure 3. Current-Limit (Open R_{SET})

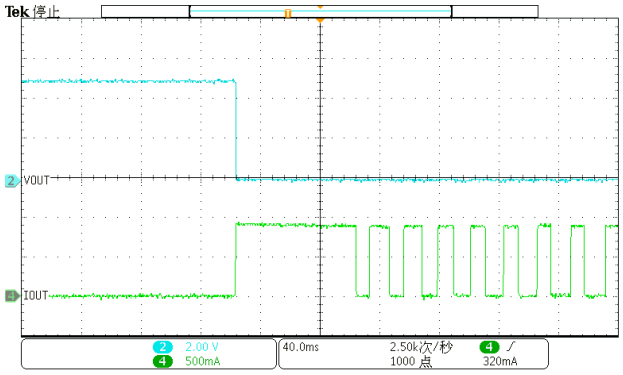


Figure 4. Short Current Response & Thermal Shutdown(Open R_{SET})

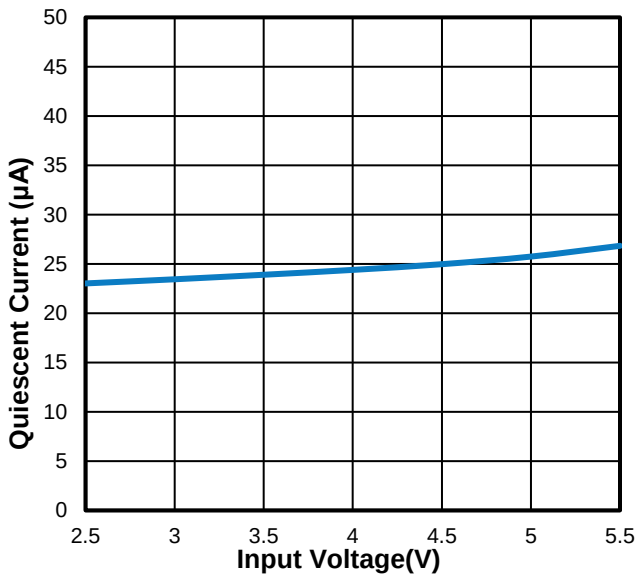


Figure 5. Quiescent Current vs. Input Voltage

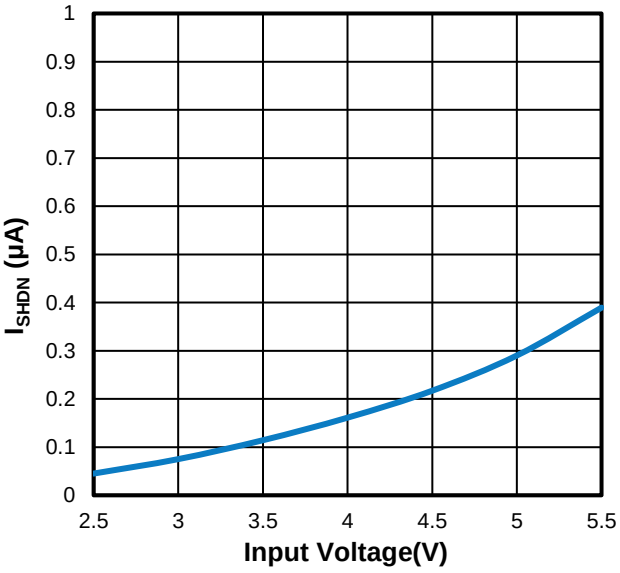


Figure 6. Shutdown Quiescent Current vs. Input Voltage

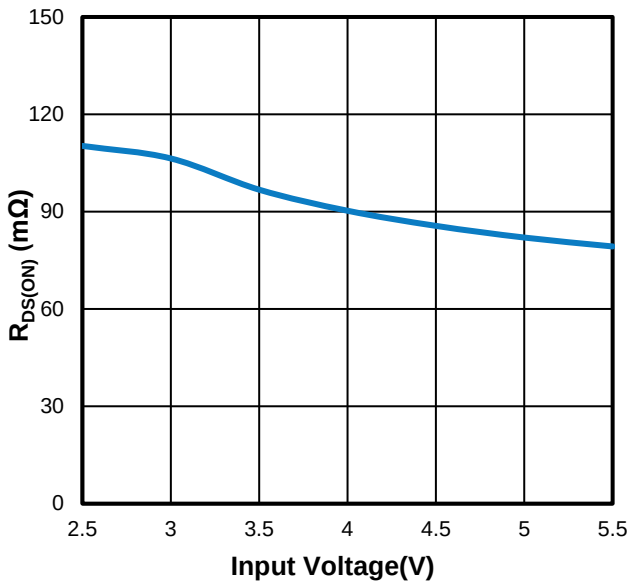


Figure 7. Switch On-Resistance vs. Input Voltage

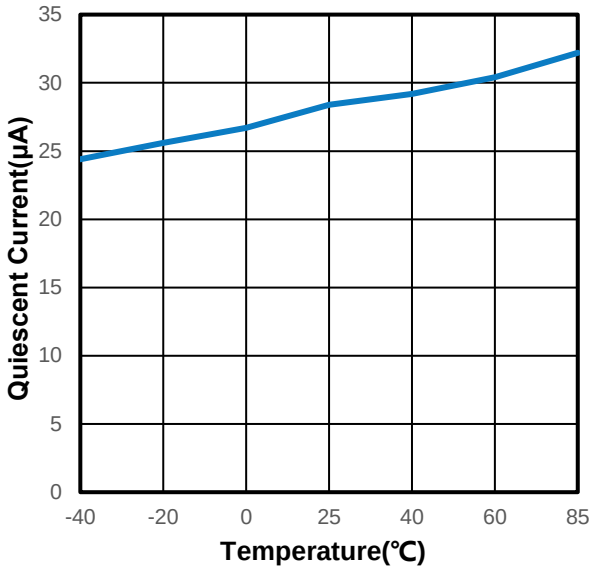


Figure 8. Quiescent Current vs. Ambient Temperature

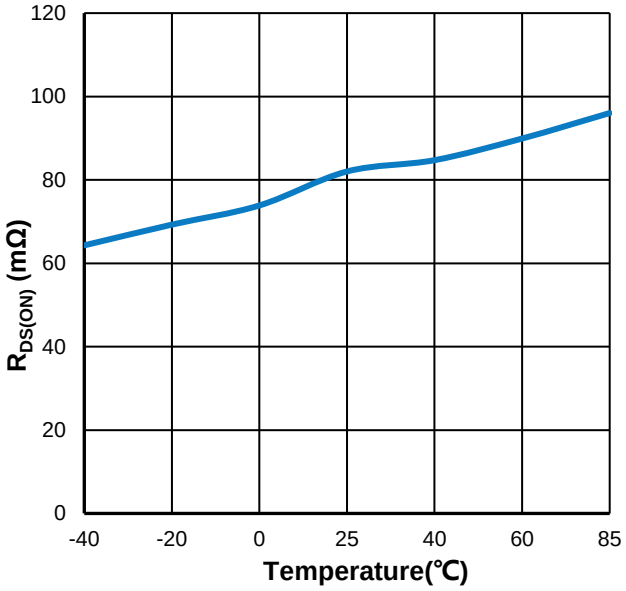


Figure 9. Switch On-Resistance vs. Ambient Temperature

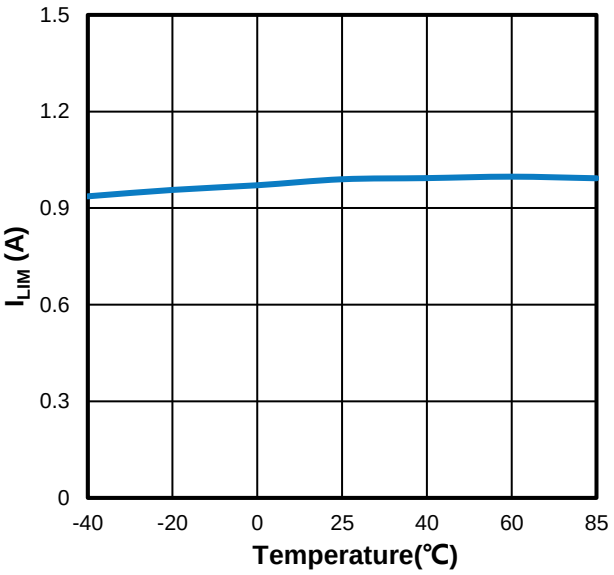


Figure 10. Current Limit vs. Ambient Temperature (Open R_{SET})

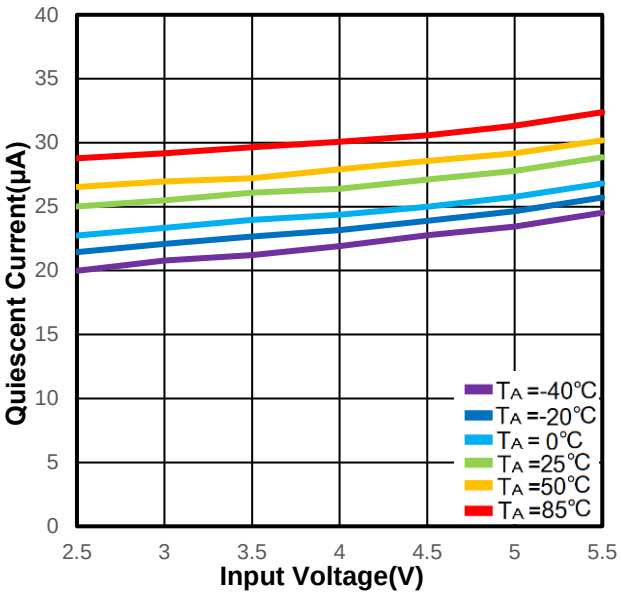


Figure 11. Quiescent Current vs. Input Voltage vs. Ambient Temperature

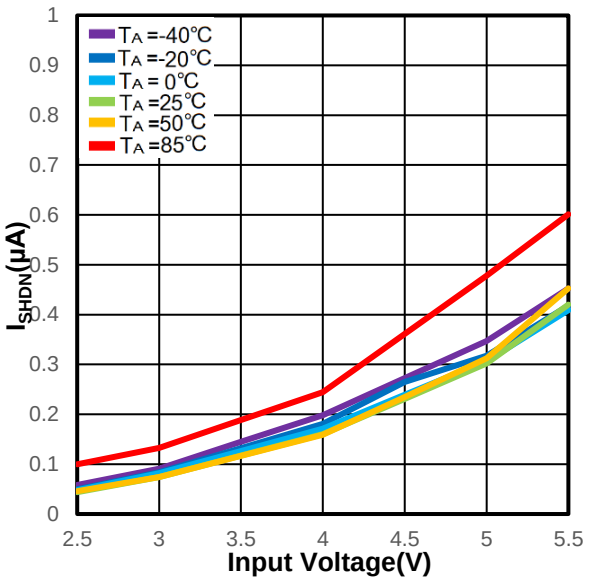


Figure 12. Shutdown Quiescent Current vs. Input Voltage vs. Ambient Temperature

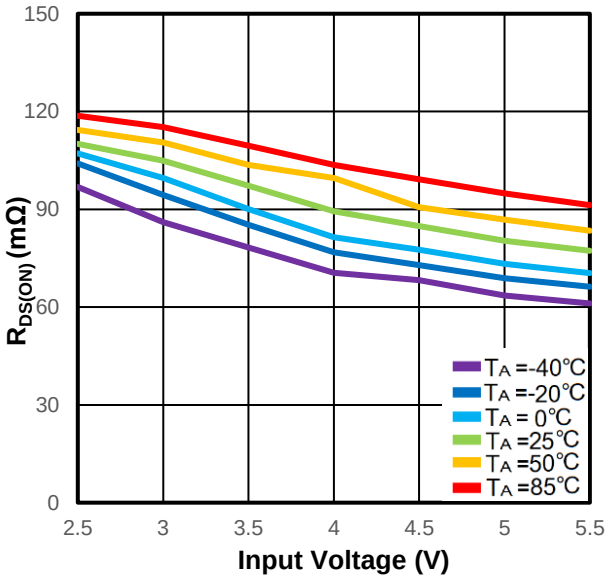


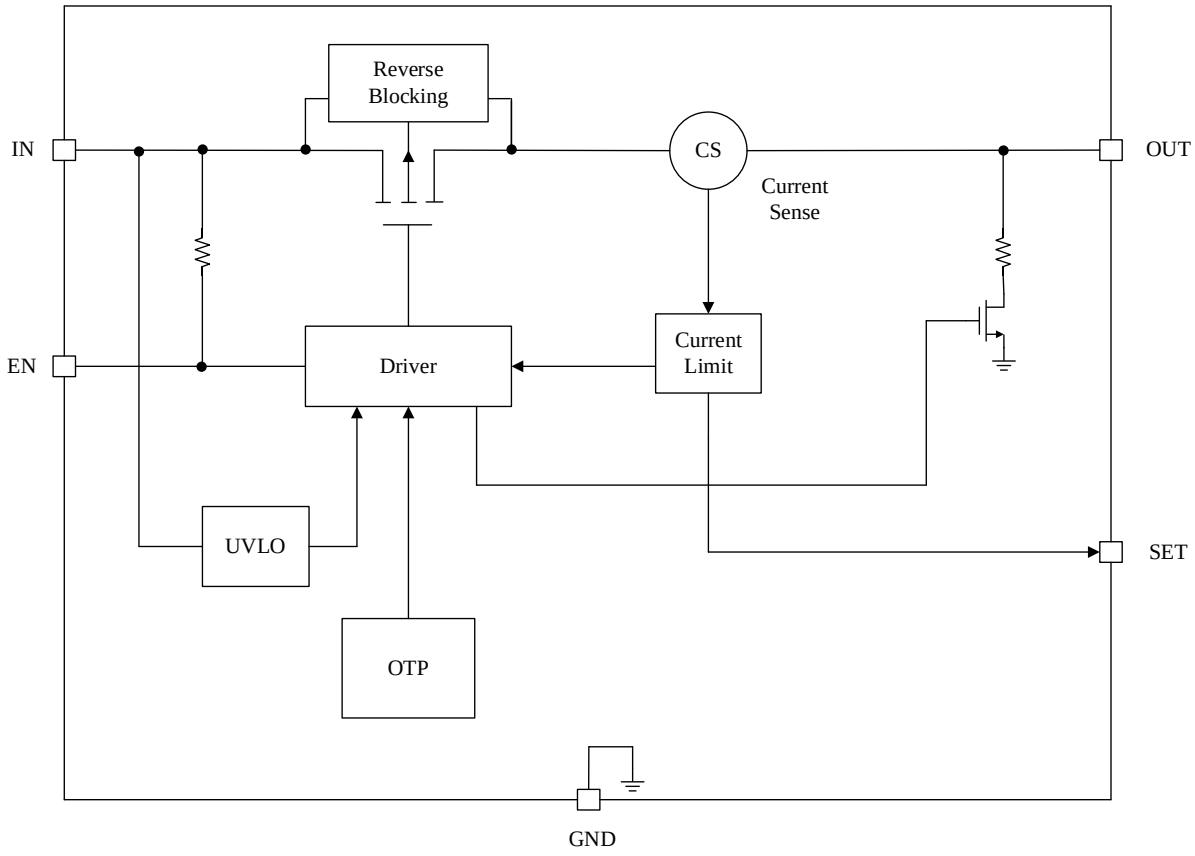
Figure 13. Switch On-Resistance vs. Input Voltage vs. Ambient Temperature

11. Function Description

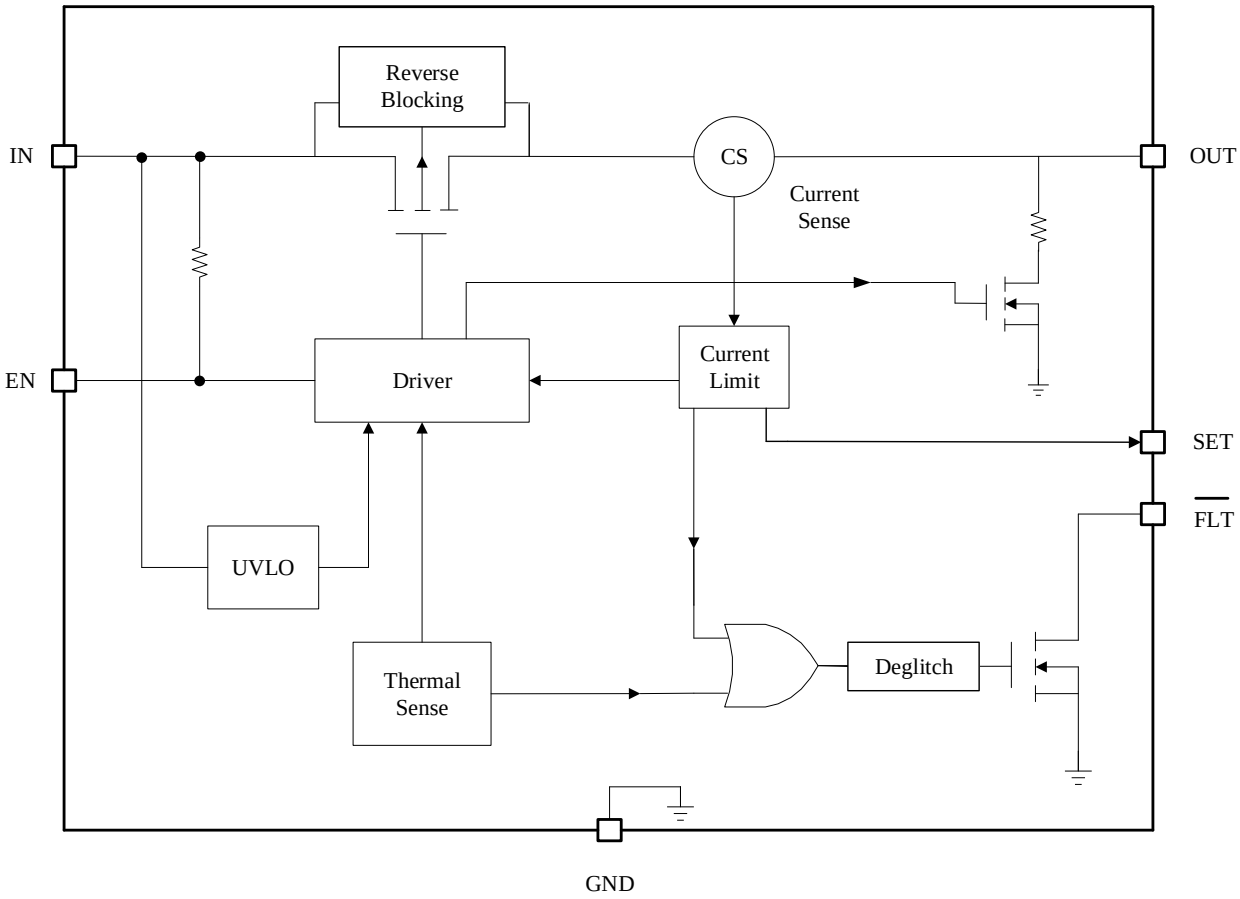
11.1 Overview

The WP25P21XX-B load switches are 5.5V, current limited load switches in SOT23-5/SOT23-6/DFN-6 package. The devices contain a 80 mΩ current-limited P-channel MOSFET that can operate over an input voltage range of 2.5 V to 5.5V. When the switch current reaches the maximum limit, the WP25P21XX-B operates in a constant-current mode to prohibit excessive currents from causing damage. WP25P21XX-B has a programmable current limit (0.4A to 2A).

11.2 Block Diagram



WP25P21T5-B



WP25P21T6-B, WP25P21F6-B

11.3 Feature Description

11.3.1 Current Limiting

When the switch current reaches the maximum limit, the WP25P21XX-B operates in a constant-current mode to prohibit excessive currents from causing damage.

11.3.2 Fault Reporting

When an overcurrent, input undervoltage, or overtemperature condition is detected, $\overline{FLT}$ is set active low to indicate the fault mode. $\overline{FLT}$ is an open-drain MOSFET and requires a pull up resistor.

11.3.3 Thermal Shutdown

Thermal shutdown protects the device from internally or externally generated excessive temperatures. During an overtemperature condition the switch is turned off. The switch automatically turns on again if the temperature of the die drops below the threshold temperature.

11.3.4 Quick Output Discharge

The WP25P21XX-B include the Quick Output Discharge (QOD) feature. When the Quick Output Discharge (QOD) feature is on, a discharge resistance with a typical value of 120Ω is connected between the OUT and GND. This resistance pulls down the output and prevent it from floating when the device is disabled.

The Quick Output Discharge (QOD) feature turns on in the following states:

IN	EN	OUT	QOD
$V_{IN} \leq V_{UVLO}$	High	-	ON
$V_{IN} > V_{UVLO}$	Low	-	ON
$V_{IN} > V_{UVLO}$	High	$V_{OUT} = V_{IN}+0.5V$ [5]	ON
$V_{IN}=0V$	Low	$V_{OUT} > 0.6V$	ON

Note 5: Guaranteed by design.

11.3.5 Reverse Current Blocking

When EN is disable, the reverse current blocking will prevent the current from flowing from the OUT pin to the IN pin. Reverse current blocking is disabled while the switch is on.

11.4 Device Functional Modes

When the EN pin is actively pulled high and no fault conditions are present, the switch will be turned on, connecting V_{IN} to V_{OUT}. When the EN pin is actively pulled low regardless of the fault condition, the switch will be turned off. In the event that the current limit is exceeded, the device will operate in a constant-current mode until the fault condition is removed. During thermal shutdown conditions, the switch will automatically turn off and will turn back on again if the temperature of the die drops below the threshold temperature.

11.5 Current Limiting Setting

Current limit is programmable. Connect the 1% tolerance resistor R_{SET} from SET pin to GND to program the current limit:

$$I_{LIM}\ (A) = 19400 / R_{SET}\ (\Omega)$$

The minimum current limit is 0.4A. Current limit beyond 2A is not recommended.

When $R_{SET} = \infty$ (SET Pin is floating), the current limit is 0.8A～1.2A.

12. Application and Implementation

12.1 Application Information

12.1.1 EN Control

The EN pin controls the state of the switch. Activating EN continuously holds the switch in the on state as long as there is no fault. An undervoltage lockout or thermal shutdown event will override the EN pin control and turn off the switch. EN is active high and has a low threshold, making it capable of interfacing with low-voltage signals.

12.1.2 Input Capacitor

To limit the voltage drop on the input supply caused by transient inrush current, a capacitor 1μF or larger must be placed between the IN and GND pins.

12.1.3 Output Capacitor

A 1μF or larger capacitor should be placed between the OUT and GND pins. This capacitor will prevent parasitic board inductances from forcing OUT below GND when the switch turns off.

12.1.4 Undervoltage Lockout

The undervoltage lockout turns off the switch if the input voltage drops below the undervoltage lockout threshold. Under-voltage detection functions only when the switch is enabled.

12.1.5 Power Dissipation and Junction Temperature

The junction temperature of the switch depend on several factors such as the load, PCB layout, ambient temperature and package type. Power dissipation can be calculated based on the output current and the $R_{DS(ON)}$ of the switch as below.

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

The junction temperature can be estimated by the following thermal equation:

$$T_J = P_D \times \theta_{JA} + T_A$$

Where:

T_A = Ambient temperature

θ_{JA} = Thermal resistance

P_D = Total power dissipation

With all possible conditions, the junction temperature must be within the range specified under operating conditions. The maximum output current must be derated at higher ambient temperature to ensure the junction temperature does not exceed the maximum junction temperature which is 125℃.

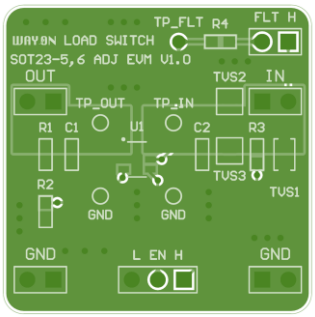
13. Power Supply Recommendations

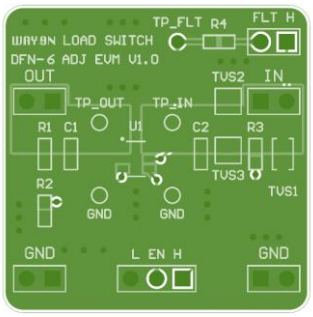
The device is designed to operate from a V_{IN} range of 2.5 V to 5.5 V. This supply must be well regulated and placed as close to the device terminal as possible with the recommended 1µF bypass capacitor. If the supply is located more than a few inches from the device terminals, additional bulk capacitance may be required in addition to the ceramic bypass capacitors. If additional bulk capacitance is required, an electrolytic, tantalum, or ceramic capacitor of 10 µF may be sufficient

14. Layout

For best performance, all traces should be as short as possible, the input and output capacitors should be placed close to the device to minimize the effects that parasitic trace inductances may have on normal and short-circuit operation. The V_{IN} terminal should be bypassed to ground with low ESR ceramic bypass capacitors. The typical recommended bypass capacitance is 1µF ceramic with X5R or X7R dielectric. This capacitor should be placed as close to the device terminals as possible. Using wide traces for V_{IN}, V_{OUT}, and GND will help minimize parasitic electrical effects along with minimizing the case to ambient thermal impedance.

14.1 Layout Example





15. Evaluation Modules

Evaluation Modules (EVMs) are available to help evaluate the device performance. We have evaluation modules for different packages, you can contact us by phone or address at the end to get the evaluation module or schematic.

The module names are listed in the table below.

NAME	PACKAGE	EVALUATION MODULE
WP25P21T5-B	SOT23-5	WAYON LOAD SWITCH SOT23-5,6 ADJ EVM V1.0
WP25P21T6-B	SOT23-6	WAYON LOAD SWITCH SOT23-5,6 ADJ EVM V1.0
WP25P21F6-B	DFN-6	WAYON LOAD SWITCH DFN-6 ADJ EVM V1.0

16. Naming Conventions

WP AB CCC D EE - F

WP: WAYON Protection IC;

A: Product Category –2: Load Switch;

B: Maximum Output Voltage – 5: ＜6V;

CCC: Maximum Current Limit– P2: 2A Max；

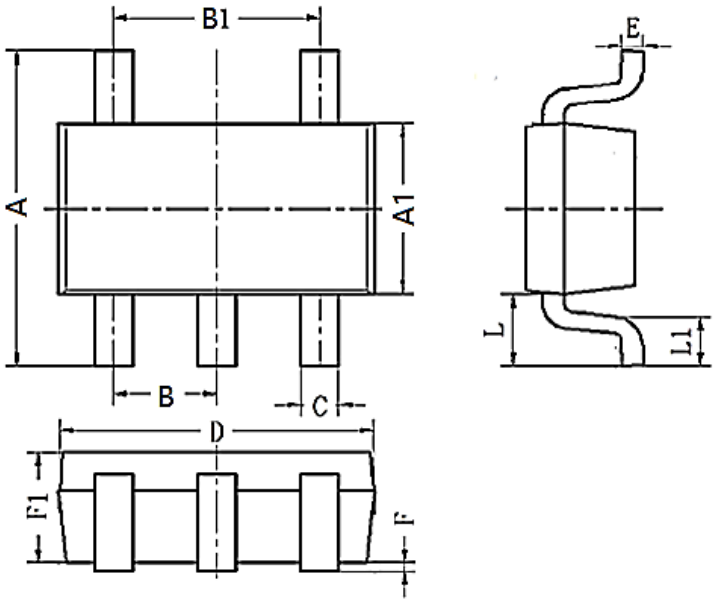
D: Serial number;

EE: Package – T5: SOT23-5/ T6: SOT23-6/ F6: DFN-6;

F: Current Limit Accuracy – B: 20%

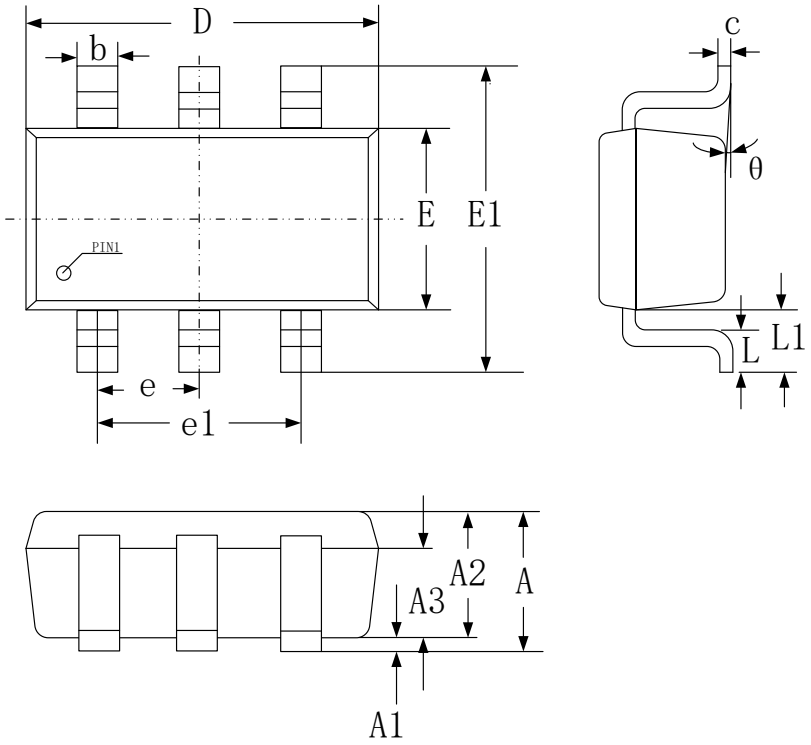
17. Package Information

SOT 23-5



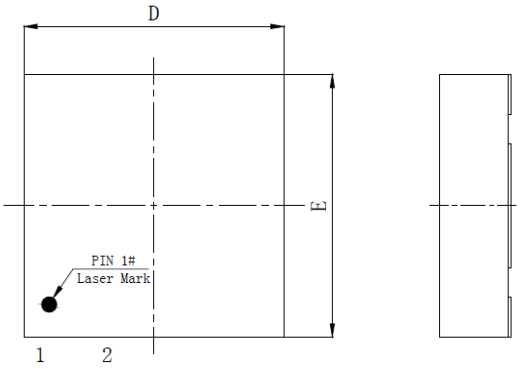
SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	2.60	2.80	3.00
A1	1.50	1.60	1.70
B	0.85	0.95	1.05
B1	1.80	1.90	2.00
C	0.25	0.37	0.50
D	2.79	2.90	3.02
E	0.10	0.15	0.20
F	0.00	0.10	0.20
L	0.60REF		
L1	0.30	0.45	0.60
F1	0.85	1.10	1.30

SOT 23-6

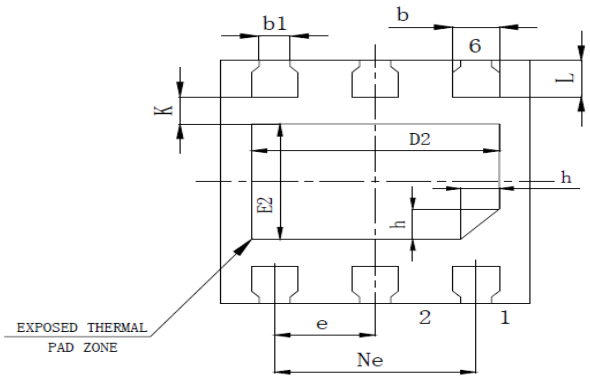


SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	-	-	1.25
A1	0.00	-	0.15
A2	1.00	1.10	1.20
A3	0.575	0.65	0.725
b	0.325	-	0.5
c	0.1	-	0.2
D	2.82	2.92	3.02
E	1.50	1.60	1.70
E1	2.60	2.80	3.00
e	0.925	0.95	0.975
e1	1.90 BSC		
L1	0.59 REF		
L	0.35	0.45	0.60
θ	0°		8°

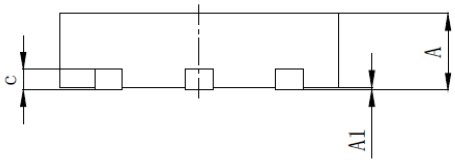
DFN2*2-6



TOP VIEW



BOTTOM VIEW



SIDE VIEW

SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0	0.02	0.05
b	0.25	0.30	0.35
b1	0.15	0.20	0.25
c	0.10	0.15	0.20
D	1.90	2.00	2.10
D2	1.50	1.60	1.70
e	0.650BSC		
Ne	1.30BSC		
E	1.90	2.00	2.10
E2	0.85	0.95	1.05
L	0.25	0.30	0.35
h	0.20	0.25	0.30
K	0.20	0.225	0.28

18. Ordering Information

PART NUMBER	CURRENT LIMIT	PACKAGE	PACKING QUANTITY	MARKING*
WP25P21T5-B	ADJ	SOT23-5	3k/Reel	WP25P21 B CXXXX
WP25P21T6-B	ADJ	SOT23-6	3k/Reel	WP25P21 B CXXXX
WP25P21F6-B	ADJ	DFN-6	3k/Reel	25P21 BXXXX

* XXXX is variable.

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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.

Product Specification Statement

- The product specification aims to provide users with a reference regarding various product parameters, performance, and usage. It presents certain aspects of the product's performance in graphical form and is intended solely for users to select product and make product comparisons, enabling users to better understand and evaluate the characteristics and advantages of the product. It does not constitute any commitment, warranty, or guarantee.
- The product parameters described in the product specification are numerical values, characteristics, and functions obtained through actual testing or theoretical calculations of the product in an independent or ideal state. Due to the complexity of product applications and variations in test conditions and equipment, there may be slight fluctuations in parameter test values. WAYON shall not guarantee that the actual performance of the product when installed in the customer's system or equipment will be entirely consistent with the product specification, especially concerning dynamic parameters. It is recommended that users consult with professionals for product selection and system design. Users should also thoroughly validate and assess whether the actual parameters and performance when installed in their respective systems or equipment meet their requirements or expectations. Additionally, users should exercise caution in verifying product compatibility issues, and WAYON assumes no responsibility for the application of the product.
- WAYON strives to provide accurate and up-to-date information to the best of our ability. However, due to technical, human, or other reasons, WAYON cannot guarantee that the information provided in the product specification is entirely accurate and error-free. WAYON shall not be held responsible for any losses or damages resulting from the use or reliance on any information in these product specifications. WAYON reserves the right to revise or update the product specification and the products at any time without prior notice, and the user's continued use of the product specification is considered an acceptance of these revisions and updates. Prior to purchasing and using the product, users should verify the above information with WAYON to ensure that the product specification is the most current, effective, and complete. If users are particularly concerned about product parameters, please consult WAYON in detail or request relevant product test reports. Any data not explicitly mentioned in the product specification shall be subject to separate agreement.
- Users are advised to pay attention to the parameter limit values specified in the product specification and maintain a certain margin in design or application to ensure that the product does not exceed the parameter limit values defined in the product specification. This precaution should be taken to avoid exceeding one or more of the limit values, which may result in permanent irreversible damage to the product, ultimately affecting the quality and reliability of the system or equipment.
- The design of the product is intended to meet civilian needs and is not guaranteed for use in harsh environments or precision equipment. It is not recommended for use in systems or equipment such as medical devices, aircraft, nuclear power, and similar systems, where failures in these systems or equipment could reasonably be expected to result in personal injury. WAYON shall assume no responsibility for any consequences resulting from such usage.
- Users should also comply with relevant laws, regulations, policies, and standards when using the product specification. Users are responsible for the risks and liabilities arising from the use of the product specification and must ensure that it is not used for illegal purposes. Additionally, users should respect the intellectual property rights related to the product specification and refrain from infringing upon any third-party legal rights. WAYON shall assume no responsibility for any disputes or controversies arising from the above-mentioned issues in any form.