WP25141T5-B

Low Loss Current Limited Power Switch

General Description

The WP25141T5-B 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 WP25141T5-B will be also into protection state due to thermal overload which is caused by limited power dissipation and junction temperature. It can be used to control load that requires 1.4A. 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 WP25141T5-B is available in Pb-free packages and is specified over the -40°C to +85°C ambient temperature range.

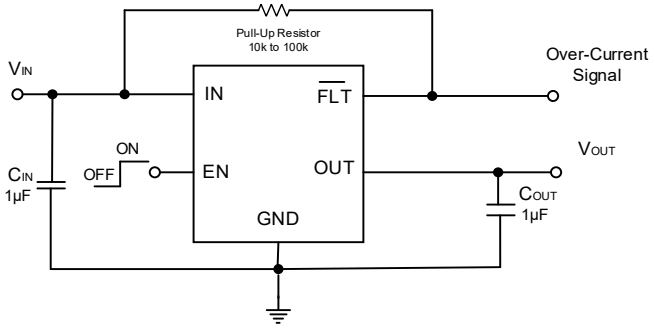
Features

- Input Voltage Range: 2.5V to 5.5V
- 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: SOT23-5
- Ambient Temperature Range：-40°C to +85°C

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

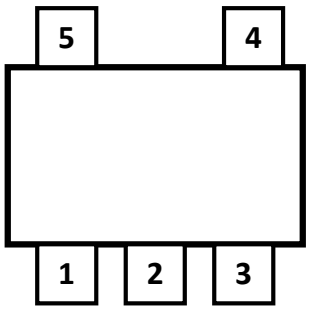
Typical Application



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

Pin Configuration

(Top View)



SOT23-5

Pin Description

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

Absolute Maximum Ratings

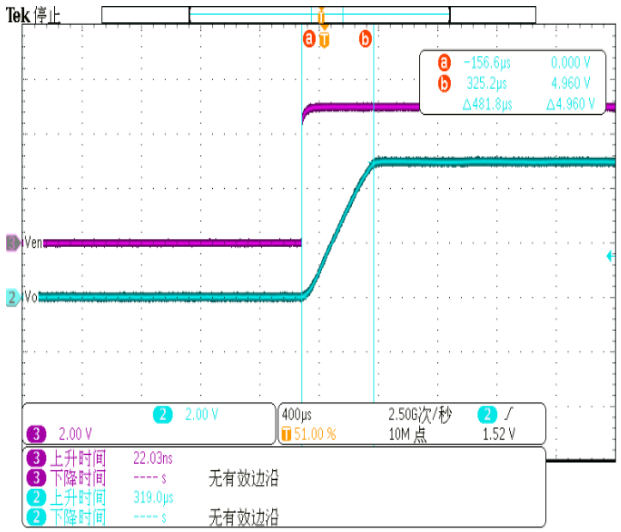
Parameter	Rating	Unit
IN, EN, $\overline{FLT}$ Voltage	-0.3 to 6	V
OUT Voltage	-0.3 to V_{IN} + 0.3	V
OUT Current	Internal Limited	A
Power Dissipation	400	mW
Package Thermal Resistance（θ_{JA}）	250	°C/W
Operating Junction Temperature	-40 to 125	°C
Storage Temperature	-55 to 150	°C
Lead Temperature（Soldering,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

Electrical Characteristics

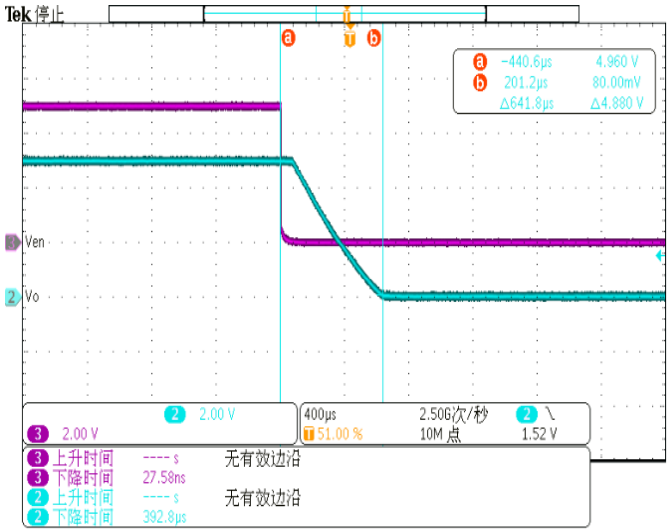
（V_{IN}=+5.0V, T_A=-40ºC to 85ºC, typical values at TA=25ºC, unless otherwise stated）

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range		2.5		5.5	V
I_{SHDN}	Input Shutdown Quiescent Current	Disabled, OUT floating or shorted to ground		0.1	1	μA
I_Q	Input Quiescent Current	Enabled, I_{OUT}=0A		25	60	μA
$R_{DS(ON)}$	Switch on-resistance	V_{IN}=5V, I_{OUT}=1A		80	120	mΩ
I_{LMT}	Current Limit	V_{IN}=5V, V_{OUT}=4.5V	1.6	2	2.4	A
V_{IL}	EN Input Logic Low Voltage				0.5	V
V_{IH}	EN Input Logic High Voltage		1.5			V
I_{SINK}	EN Input leakage	V_{EN} =5V		0.01	1	μA
V_{UVLO}	Input UVLO		1.4	1.8	2.2	V
$V_{UVLOHys}$	UVLO Hysteresis			0.1		V
I_{REV}	Reverse leakage current	V_{OUT}= 5V , V_{IN}=0V ,V_{EN}=0V I_{REV} at V_{IN}		0.1	1	μA
T_{SHDN}	Thermal shutdown threshold	V_{IN} = 5V		150		ºC
T_{HYS}	Thermal shutdown hysteresis	V_{IN} = 5V		20		ºC
$R_{\overline{FLT}}$	$\overline{FLT}$ Low Resistance			80		Ω
$T_{\overline{FLT}\_Delay}$	$\overline{FLT}$ Delay Time			15		ms
$R_{discharge}$	Output discharge FET $R_{DS(ON)}$	Disabled, V_{IN} = 5V, V_{OUT}=1V	50	120	300	Ω
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	350	500	μs
ESD HBM	Human Body Model ESD Protection			2000		V

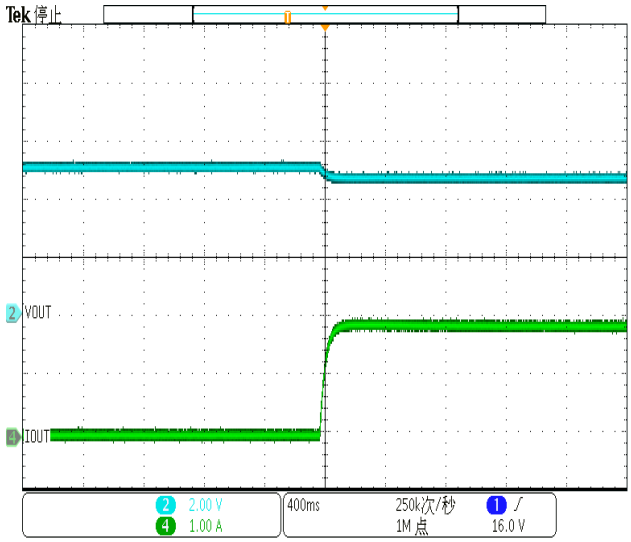
Typical Performance Characteristics



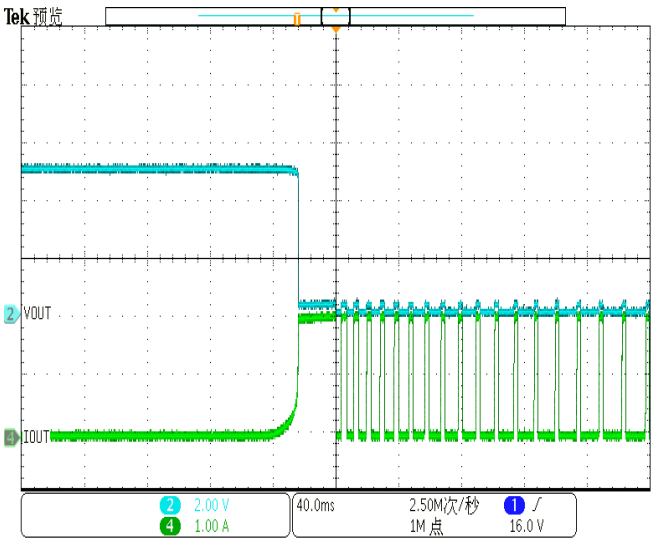
Turn On Response



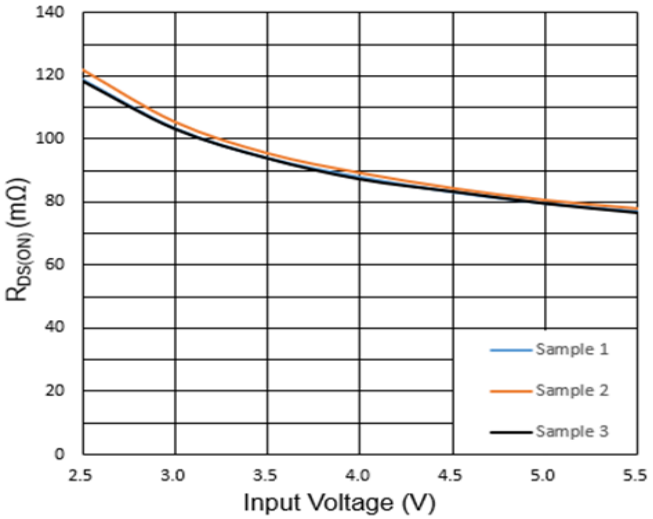
Turn Off Response



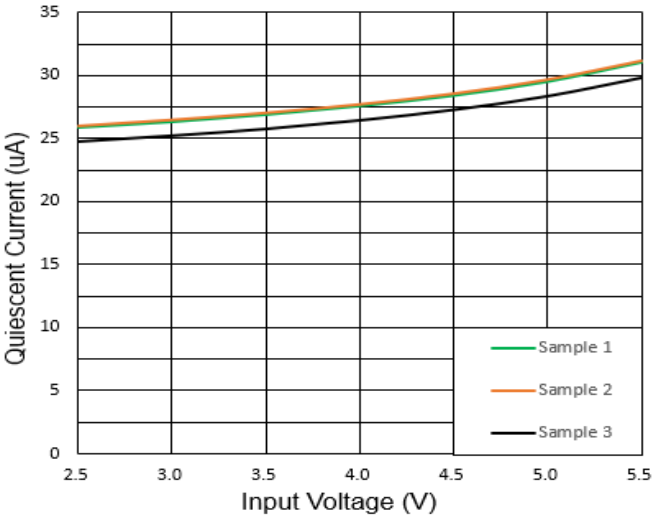
Overload Current-Limit



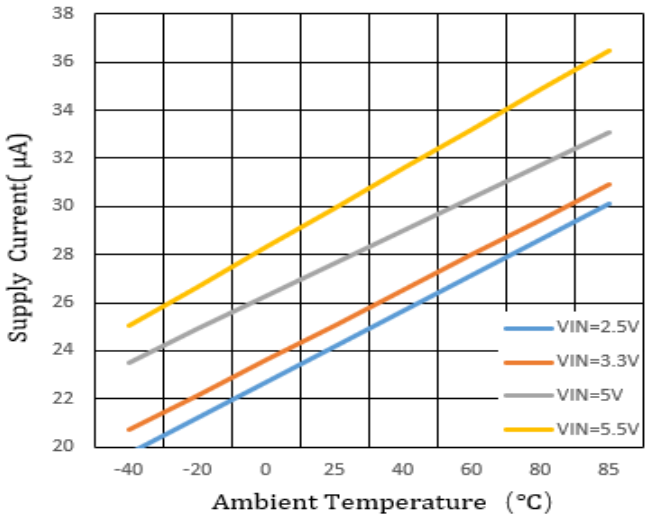
Short Current Response & Thermal Shutdown



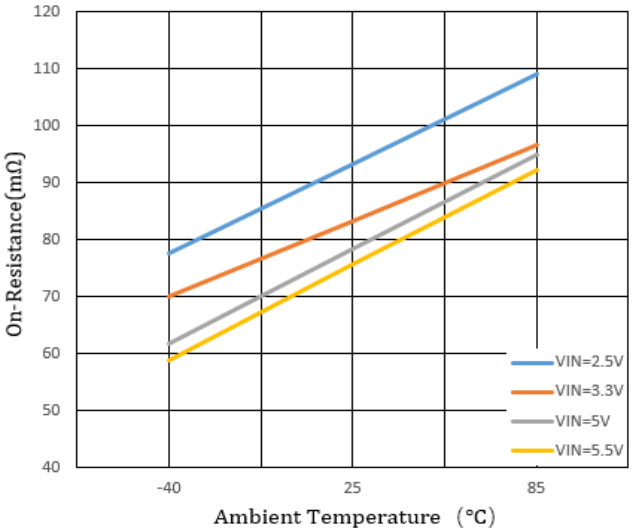
$R_{DS(ON)\ (m\Omega)}$ vs. Supply Voltage



Quiescent Current vs. Supply Voltage

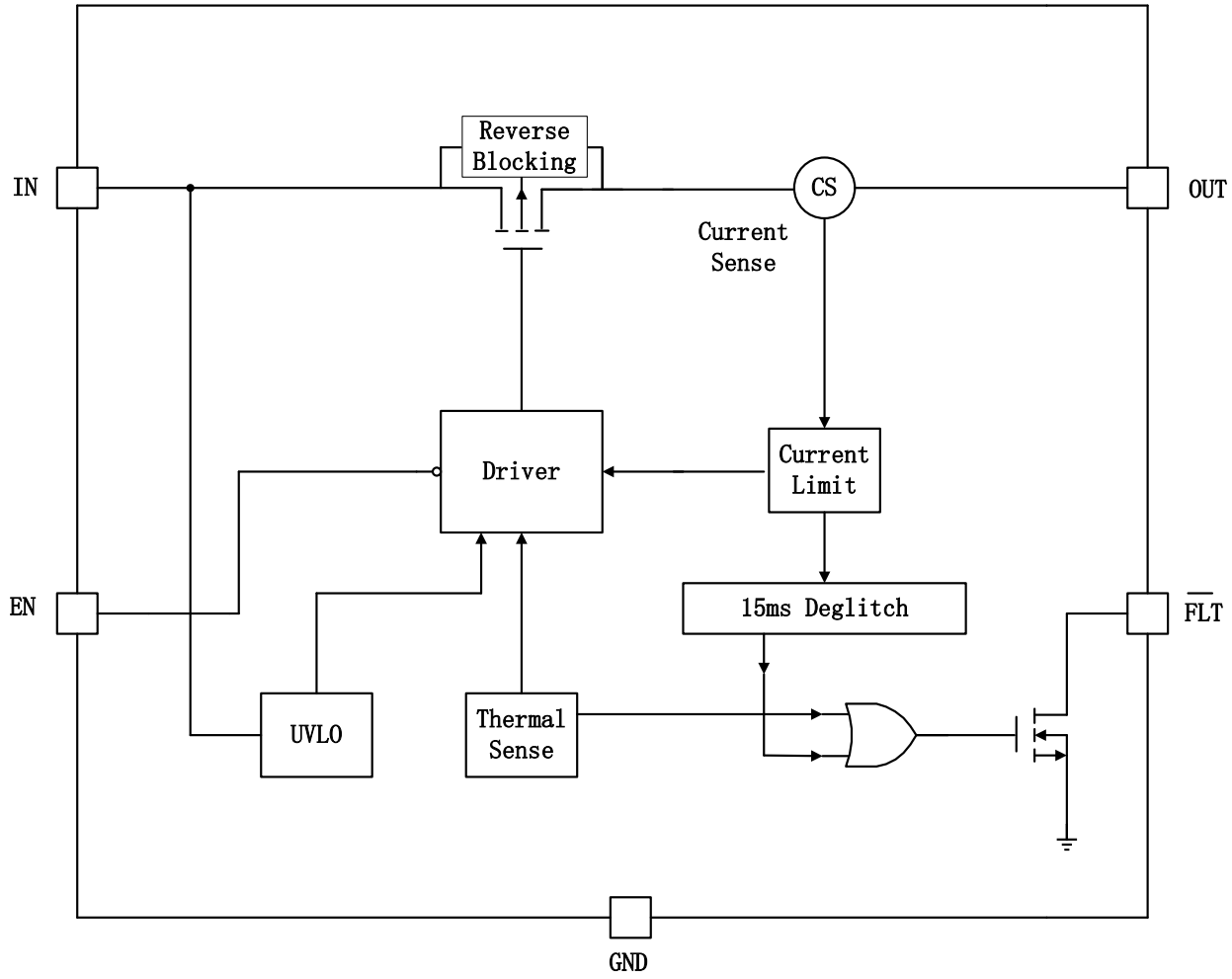


Quiescent Supply Current vs. Ambient Temperature



Switch On-Resistance vs. Ambient Temperature

Block Diagram



Operation

WP25141T5-B is an integrated power switch with a low $R_{DS(ON)}$ P-channel MOSFET, internal gate drive circuit. When the WP25141T5-B turns on, it can deliver up to 1.4A 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 0.01μF to 0.1μF 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 0.01μF to 0.1μF 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. WP25141T5-B 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 WP25141T5-B 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 over current trip threshold, the device switches into constant-current mode.

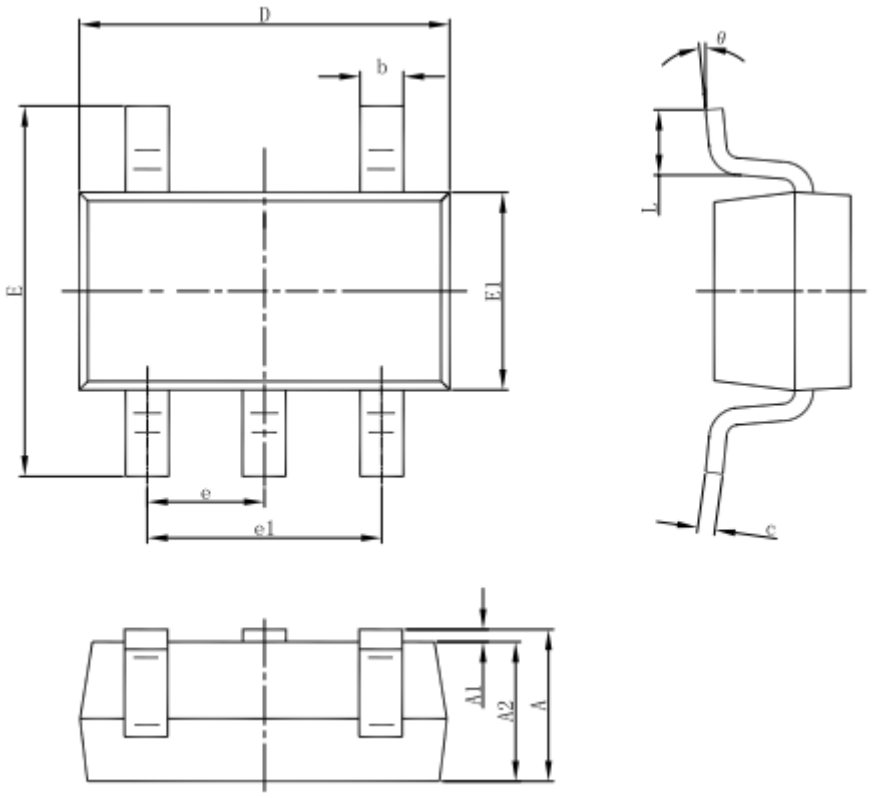
In the third condition, the load has been gradually increased beyond the recommended operating current. The current is permitted to rise until the current-limit threshold is reached or until the thermal limit of the device is exceeded. The WP25141T5-B is capable of delivering current up to the current-limit threshold without damaging the device. Once the threshold has been reached, the device switches into its constant-current mode.

Thermal Protection

Thermal protection prevents damage to the IC when heavy-overload or short-circuit faults are present for extended periods of time. The WP25141T5-B 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.

Package Information



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*
WP25141T5-B	2A	SOT23-5	3k/Reel	WP25141B XXXX

*XXXX is variable.

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