Power-Distribution Switch

GENERAL DESCRIPTION

The PW1502A is a cost-effective, low voltage, single P-MOSFET load switch, optimized for self-powered and bus-powered Universal Serial Bus (USB) applications. This switch operates with inputs ranging from 2.4V to 5.5V, making it ideal for both 3V and 5V systems. The switch's low RDS(ON), 80mΩ ,meets USB voltage drop requirements.

The PW1502A is also protected from thermal overload which limits power dissipation and junction temperatures. Current limit threshold is programmed with a resistor from IADJ to ground. The quiescent supply current is typically 15μA at switch on state. At switch off state the supply current decreases to less than 1μA.The PW1502A is available in SOT23-5 package

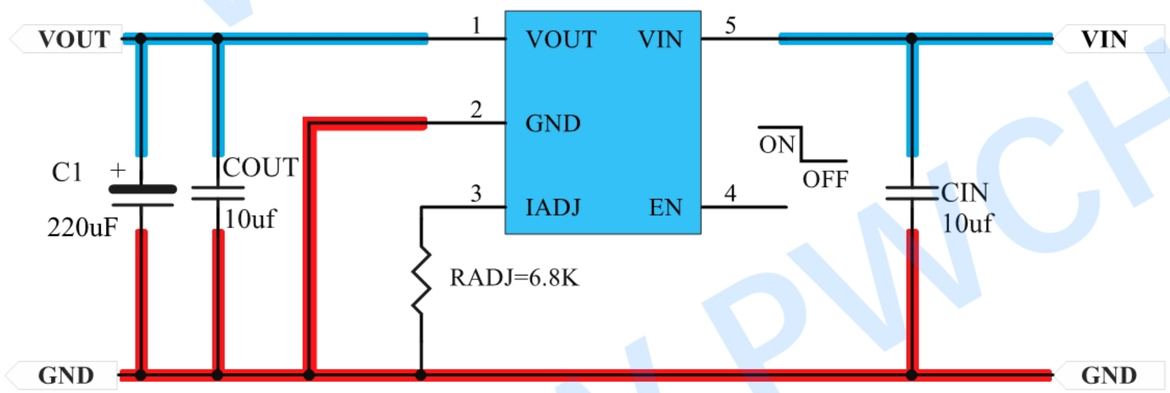
FEATURES

- Compliant to USB Specifications
- Integrated 80mΩ Power MOSFET
- Low Supply Current
  15μA Typical at Switch On State
  1μA Typical at Switch Off State
- Wide Input Voltage Range:2.4V to 5.5V
- Fast Transient Response:<2μs
- Reverse Current Flow Blocking
- Thermal Shutdown Protection
- Hot Plug-In Application (Soft-Start)
- Available in a 5 Pin SOT23-5 Package
- PW1555A (3.3V5A, 5V5A, 12V5A) ;
  PW1558 (3V ~ 20V 5.8A); PW1605 (4V ~ 48V 5A);
  PW1503 (2.5V~6V 3A); PW1515 (3.5V~6V 2A)

APPLICATIONS

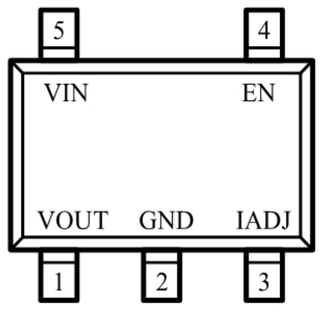
- USB Bus/Self Powered Hubs
- USB Peripherals
- Notebook Computers
- Battery-Charger Circuits
- Personal Communication Devices

TYPICAL APPLICATION CIRCUIT



ILMI(mA)	RADJ(kΩ)
600	11.3
800	8.45
1000	6.8
1500	4.53
2000	3.4

PIN ASSIGNMENT/DESCRIPTION



Pin Name	Pin Number	Description
VOUT	1	Power-switch output
GND	2	Ground connection; connect externally to Power PAD
IADJ	3	External resistor used to IADJ current-limit threshold
EN	4	Enable input, logic high turns on power switch
VIN	5	Input voltage; connect a 10Uf or greater ceramic capacitor from VIN to GND as close to the IC as possible

Absolute Maximum Ratings

Item	VALUE	Unit
Input Supply Voltage	-0.3 to 7	V
EN Voltages	-0.3 to (VIN+0.3V)	V
IADJ Voltage	-0.3 to (VIN+0.3V)	V
Power dissipation	0.4	W
Junction Temperature	150	°C
Operating Temperature Range	-40 to 85	°C
Storage Temperature Range	-65 to 150	°C
Lead Temperature (Soldering, 10sec.)	260	°C
ESD Human Body Model (HBM)	2000	V
ESD MM (Machine Mode)	200	V
Thermal Resistance θJA	250	°C/W
Thermal Resistance θJC	130	°C/W

Note : Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

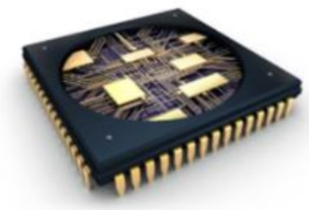
Products

Reel /outer anti-static packaging

NO：1, QR code content: WWW.PWCHIP.COM;
2. Product: PWCHIP product model name;
3. Lot No: wafer batch code/internal system production code (customers can send this code to support@pwchip.com to verify product information and confirm);
4. D/C: packaging cycle;
5. QTY: packaging quantity (box/disc);
6. Data: packaging time.

Product	
PW1502A	
Brand	**Package**
平芯微/PWCHIP	SOT23-5L
Specification	**Qty per reel**
Taping & Reel	3000 PCS
Marking	
D00XXx Device code: D00； Lot number code: XXx .	

Product Center



MOSFET OVP/OCP Protection Li-ion Charger Li-ion Protector Li-ion charge-discharge LDO

Voltage Detector DC-DC Boost DC-DC Buck DC-DC Boost-Buck USB Fast charging LED driver

Product Title	MODE	Vin Range	Vout Range	Iout MAX	FOSC	Iq typ	Package	Link
PW2052B	Synchronous	2.3V~6V	0.6V~5V	2A	1.5MHZ	150uA	SOT23-6L	Detail
PW2335	Synchronous	4.5V~30V	ADJ	3A	500KHZ	600uA	SOP8-EP	Detail
PW2312A	Synchronous	4.5V~55V	ADJ	0.6A	1.2MHZ	250uA	SOT23-6L	Detail
PW2458	Synchronous	3.8V~36V	0.8V~35V	5A	0.1-1.1MHZ	25uA	SOP8-EP	Detail
PW2153	Asynchronous	8V~150V	5V~30V	10A	140KHZ	1mA	SOP8	Detail
PW2902	Asynchronous	8V~90V	5V~30V	2A	140KHZ	1mA	SOP8-EP	Detail
PW2906	Asynchronous	12V~90V	1.3V~20V	0.6A	150KHZ	2.5mA	SOP8-EP	Detail
PW2815	Asynchronous	4.5V~80V	ADJ	1.5A	480KHZ	0.73mA	SOP8-EP	Detail

ELECTRICAL CHARACTERISTICS

(VIN=5V, TA =-40°C to 85°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Input Voltage Range	V_{IN}		2.4		5.5	V
Switch On Resistance	$R_{DS(ON)}$	VIN=5V		80	100	mΩ
		VIN=3V		90	110	mΩ
Operation Quiescent Current	I_Q	VIN=5V,EN=Active,No load		15	25	μA
Off Supply Current	$I_{Q(OFF)}$	VIN=5.5V,EN=Inactive			1	μA
Off Switch Current	$I_{Q(SW\_OFF)}$	VIN=5.5V,EN=Inactive			1	μA
Under-voltage Lockout	V_{UVLO}	VIN Increasing		1.8	2.4	V
Under-voltage Lockout Hysteresis	ΔV_{UVLO}	VIN decreasing		0.1		V
Current Limit Threshold	I_{LIM}	R_{ADJ}=6.8kΩ		1		A
EN Threshold, Logic-Low	V_{IL}	VIN=2.5V to 5.5V			0.8	V
EN Threshold,Logic-High	V_{IH}	VIN=2.5V to 5.5V	2			V
Output Leakage Current	I_{LEAK}	EN=Inactive,RLOAD=0Ω		0.5	10	μA
Current Limit Response Time	T_{RESP}	VIN=5V		1		μs
Thermal Shutdown Protection	T_{SD}			150		°C
Thermal Shutdown Hysteresis	ΔT_{SD}			20		°C

Note： 100% production test at 25°C. Specifications over the temperature range are guaranteed by design and characterization

APPLICATION INFORMATION

The PW1502A is a single channel current limiting load switch that is intended to protect against short circuit and over current events by current limiting to a preset level. This device is optimized for self-powered and bus-powered Universal Serial Bus (USB) applications. The switch's low $R_{DS(ON)}$, 80mΩ , meets USB voltage drop requirements; and a flag output is available to indicate fault conditions to the local USB controller

Input and Output

VIN (input) is the power source connection to the internal circuitry and the source of the MOSFET. VOUT (output) is the drain of the MOSFET. In a typical application, current flows through the switch from VIN to VOUT toward the load. If VOUT is greater than VIN, current will flow from VOUT to VIN since the MOSFET is bidirectional when on. The PW1502A's reverse current blocking feature prevents current to flow from VOUT to VIN when the device is disabled.

Soft Start for Hot Plug-In Applications

In order to eliminate the upstream voltage droop caused by the large inrush current during hot-plug events,the “soft-start” feature effectively isolates the power source from extremely large capacitive loads,satisfying the USB voltage droop requirements.

Input capacitor

The input capacitor CIN protects the power supply from current transients generated by the load attached to the PW1502A. When a short circuit is suddenly applied to the output of the PW1502A, a large current, limited only by the $R_{DS(ON)}$ of the MOSFET, will flow for less than 2μs before the current limit circuitry activates. In this event, a moderately sized C_{IN} will dramatically reduce the voltage transient seen by the power supply and by other circuitry upstream from the PW1502A. The extremely fast short-circuit response time of the PW1502A reduces the size requirement for C_{IN}. C_{IN} should be located as close to the device VIN pin as practically possible. Ceramic, tantalum, or aluminum electrolytic capacitors are appropriate for C_{IN}. There is no specific capacitor ESR requirement for C_{IN}. However, for higher current operation, ceramic capacitors are recommended for C_{IN} due to their inherent capability over tantalum capacitors to withstand input current surges from low impedance sources such as batteries in portable devices.

Output capacitor

A low-ESR 150μF aluminum electrolytic or tantalum between VOUT and GND is strongly recommended to meet the 330mV maximum droop requirement in the hub VBUS (Per USB 2.0, output ports must have a minimum 120μF of low-ESR bulk capacitance per hub). Standard bypass methods should be used to minimize inductance and resistance between the bypass capacitor and the downstream connector to reduce EMI and decouple voltage droop caused when downstream cables are hot-insertion transients. Ferrite beads in series with VBUS, the ground line and the 0.1μF bypass capacitors at the power connector pins are recommended for EMI and ESD protection. The bypass capacitor itself should have a low dissipation factor to allow decoupling at higher frequencies.

Thermal Considerations

Since the PW1502A has internal current limit and over temperature protection, junction temperature is rarely a concern. However, if the application requires large currents in a hot environment, it is possible that temperature, rather than current limit, will be the dominant regulating condition. In these applications, the maximum current available without risk of an over-temperature condition must be calculated. Power dissipation can be calculated based on the output current and the $R_{DS(ON)}$ of switch as below.

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

Although the devices are rated for 2A(max) of output current, but the application may limit the amount of output current based on the total power dissipation and the ambient temperature. The final operating junction temperature for any IADJ of conditions can be estimated by the following thermal equation :

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\theta_{JA}}$$

Where $T_{J(MAX)}$ is the maximum operation junction temperature 150°C,TA is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance. The junction to ambient thermal resistance θ_{JA} is layout dependent. For SOT23-5 and TSOT23-5 packages, the thermal resistance θ_{JA} is 250°C/W. The maximum power dissipation at T_A = 25°C is 0.4W for SOT23-5 and TSOT23-5 Package

Current limit threshold Setting

Current limit threshold is programmed with a resistor from IADJ to ground marked as RADJ. It can be estimated by the following equation:

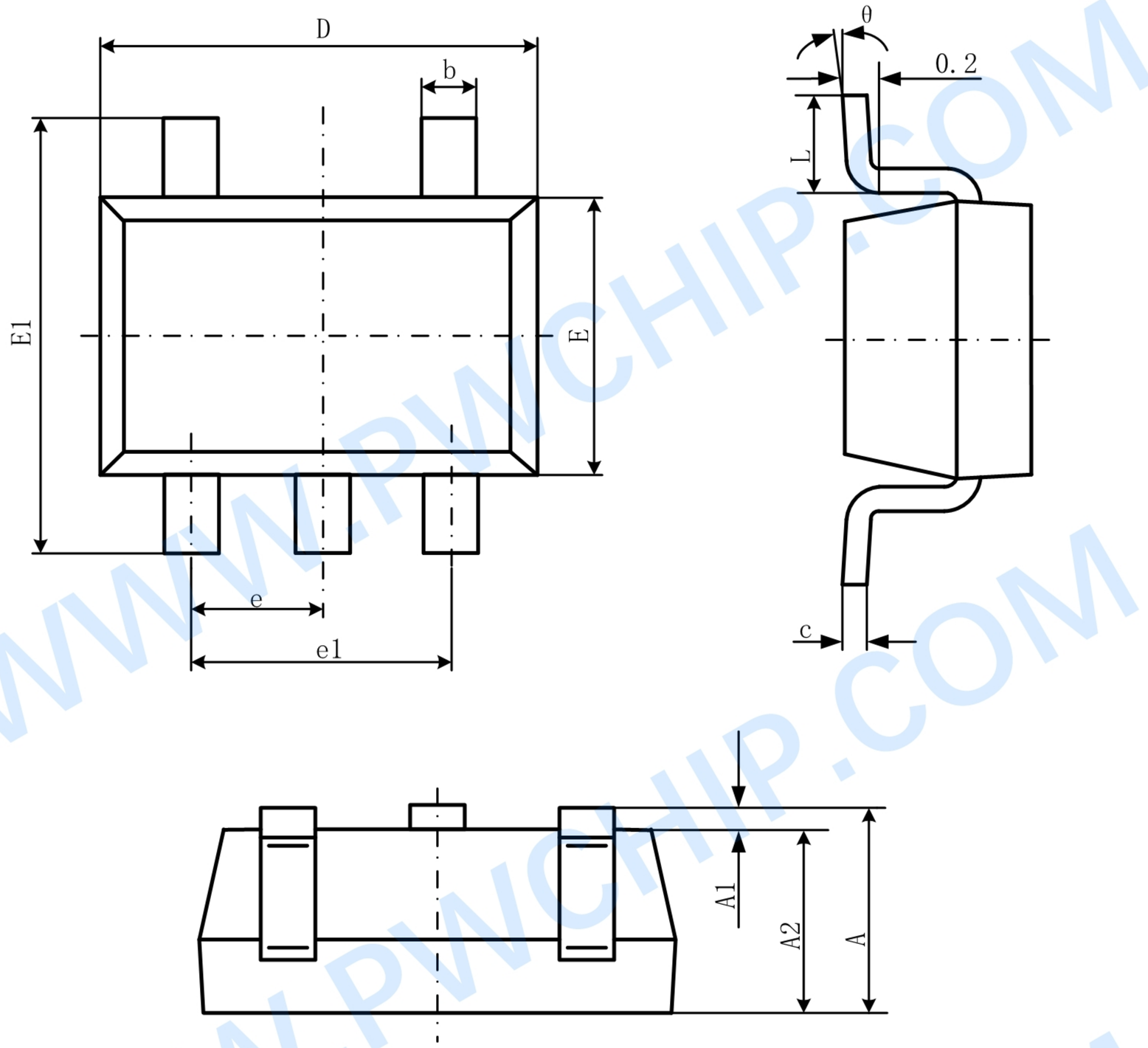
$$I_{LMI}\ (A) = 6.8 / R_{ADJ}\ (K\Omega)$$

Such as the following table.

ILMI(mA)	RADJ(kΩ)
600	11.3
800	8.45
1000	6.8
1500	4.53
2000	3.4

PACKAGE DESCRIPTION

SOT23-5L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

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