



2.1A Power Switch with Programmable Current Limit

General Description

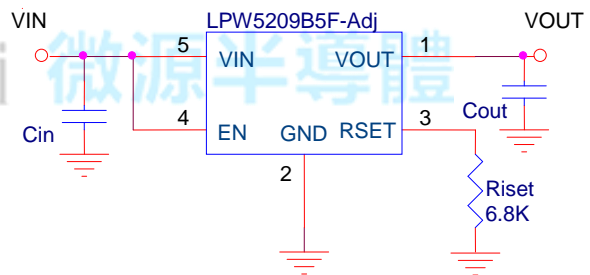
The LPW5209 is an integrated power switch for self-powered and bus-powered Universal Series Bus (USB) applications. A built-in charge pump is used to drive the N-Channel MOSFET that is free of parasitic body diode to eliminate any reversed current flow across the switch when it is powered off. Its low quiescent current (16µA) and small package (SOT23-5) is particularly suitable in battery-powered portable equipment.

Several protection functions include soft start to limit inrush current during plug-in, current limiting at 2.1A to meet USB power requirement, and thermal shutdown to protect damage under over current conditions.

Features

- ◆ 80mΩ Low $R_{DS(ON)}$, High-side N-MOSFET
- ◆ 2100mA Programmable current limit
- ◆ 2.5V to 6V Input Voltage
- ◆ Low Quiescent Current:30µA
- ◆ Soft Start Function
- ◆ Built-In Short-Circuit Protection
- ◆ Built-in Thermal Protection
- ◆ RoHS Compliant and 100% Lead (Pb)-Free

Typical Application Circuit



Order Information

| Ordering Number | Current | Package |
|-----------------|------------|---------|
| LPW5209AB5F | Adjustable | SOT23-5 |
| LPW5209B5F-21 | 2.1A | |
| LPW5209B5F-11 | 1.1A | |
| LPW5209B5F-06 | 600mA | |

Applications

- ✧ Power Switch
- ✧ USB Device
- ✧ Battery Charger Circuits

Marking Information

| Device | Marking | Shipping |
|---------------|--------------|----------|
| LPW5209AB5F | LPS C0YWX | 3K/REEL |
| LPW5209B5F-21 | LPS C1YWX | |
| LPW5209B5F-11 | LPS C2YWX | |
| LPW5209B5F-06 | LPS C3YWX | |

Marking indication:

Y:Production year W:Production week X:Production batch



Functional Pin Description

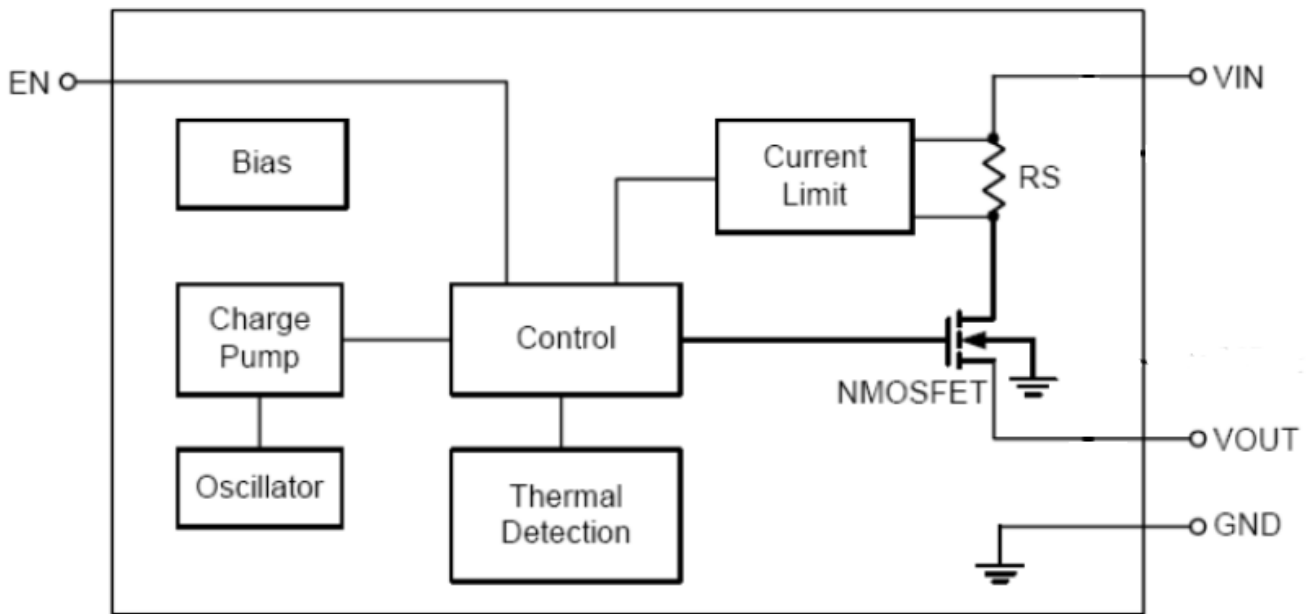
| Package Type | Pin Configurations |
|--------------|---|
| SOT23-5 | <p style="text-align: center;">Top View</p> <p>The diagram shows a top view of the SOT23-5 package with five pins. Pin 1 is labeled VOUT, Pin 2 is GND, Pin 3 is ISET/NC, Pin 4 is EN, and Pin 5 is VIN. The pins are arranged in a U-shape with Pin 1 on the left, Pin 2 in the middle, Pin 3 on the right, Pin 4 on the right, and Pin 5 on the left.</p> |

Pin Description

| Name | Pin | | Description |
|------|----------|------------------|--|
| | LPW5209A | LPW5209-21/11/06 | |
| VOUT | 1 | 1 | Output to system pin. |
| GND | 2 | 2 | Ground. |
| ISET | 3 | 3 | Connect a resistor to GND for setting current limit. |
| NC | | 3 | No connector |
| EN | 4 | 4 | Device Enable (active High). |
| VIN | 5 | 5 | Input pin. |



Function Block Diagram



Absolute Maximum Ratings ^{Note 1}

- ✧ Input Voltage to GND ----- 7V
- ✧ Output Voltage to GND ----- 7V
- ✧ Other pin to GND ----- 6V
- ✧ Maximum Junction Temperature ----- 150°C
- ✧ Operating Ambient Temperature Range (T_A) ----- -40°C to 85°C
- ✧ Maximum Soldering Temperature (at leads, 10 sec) ----- 260°C

Note 1. Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Thermal Information

- ✧ Maximum Power Dissipation (SOT23-5, P_D, T_A=25°C) ----- 0.45W
- ✧ Thermal Resistance (SOT23-5, θ_{JA}) ----- 250°C/W

ESD Susceptibility

- ✧ HBM(Human Body Mode) ----- 2KV
- ✧ MM(Machine Mode) ----- 200V



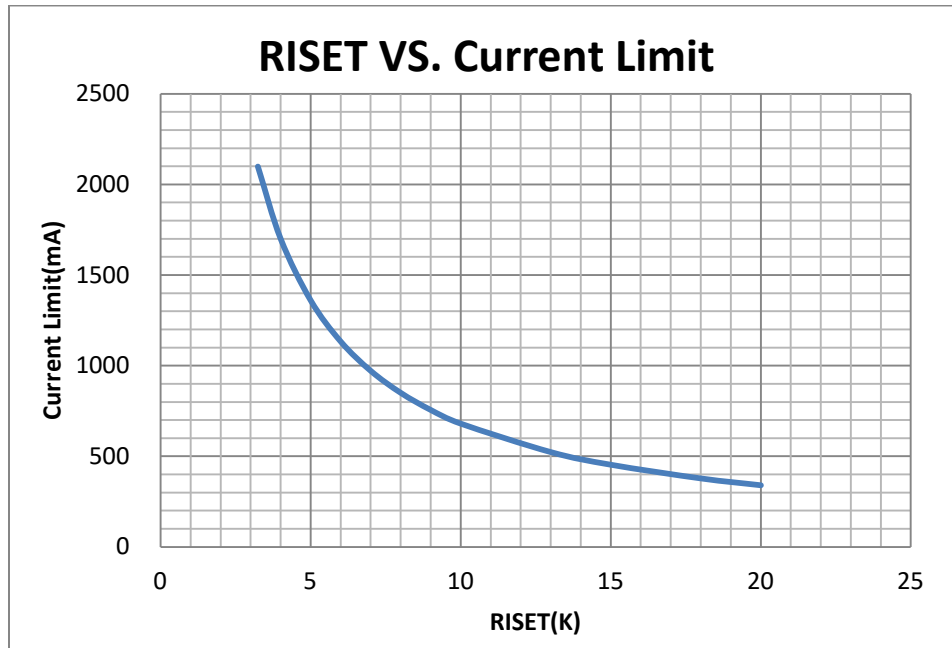
Electrical Characteristics

(Over recommended operating conditions unless specified otherwise, $T_A=25^{\circ}\text{C}$)

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|--------------|------------------------------|---------------------------------------|-----|------|-----|--------------------|
| V_{IN} | Input Voltage | | 2.5 | | 6 | V |
| I_{OUT} | Output Current Limit | LPW5209B5F-Adj, $R_{ISET}=10\text{K}$ | | 680 | | mA |
| | | PW5209B5F-Adj, $R_{ISET}=6.8\text{K}$ | | 1000 | | |
| | | PW5209B5F-Adj, $R_{ISET}=3.4\text{K}$ | | 2000 | | |
| | | LPW5209B5F-21 | | 2100 | | |
| | | PW5209B5F-11 | | 1100 | | |
| | | PW5209B5F-06 | | 600 | | |
| $R_{DS(ON)}$ | Output N-MOSFET $R_{DS(ON)}$ | $I_{out}=1\text{A}$ | | 80 | 100 | m Ω |
| I_Q | Quiescent Current | $V_{IN}=3\text{V}$ | | 30 | 50 | μA |
| I_{SHDN} | Shutdown Current | $V_{EN}=\text{GND}$ | | 0.1 | 1 | μA |
| $V_{EN(L)}$ | Enable Threshold Low | | | | 0.4 | V |
| $V_{EN(H)}$ | Enable Threshold High | | 1.4 | | | V |
| I_{EN} | Input High Current | $V_{IN}=V_{EN}=5.0\text{V}$ | | 5 | | μA |
| OTP | Over temperature protection | | | 150 | | $^{\circ}\text{C}$ |
| OTP-HYS | Over temperature hysteresis | | | 20 | | $^{\circ}\text{C}$ |



Typical Operating Characteristics





Application Information

The LPW5209 are single N-Channel MOSFET high-side power switches with active-high enable input, optimized for self-powered and bus-powered Universal Serial Bus (USB) applications. The LPW5209 equipped with a charge pump circuitry to drive the internal NMOS switch; the switch's low RDS(ON), 80mΩ, meets USB voltage drop requirements.

Input and Output

VIN (input) is the power source connection to the internal circuitry and the drain of the MOSFET. VOUT (output) is the source 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. Unlike a normal MOSFET, there is no a parasitic body diode between drain and source of the MOSFET, the LPW5209 prevents reverse current flow if VOUT being externally forced to a higher voltage than VIN when the output disabled ($V_{EN} < 0.4V$).

Chip Enable Input

The switch will be disabled when the EN pin is in a logic low condition. During this condition, the internal circuit is turned off, reducing the supply current to 0.1μA typical. The maximum guaranteed voltage for a logic low at the EN pin is 0.4V. A minimum guaranteed voltage of 1.4V at the EN pin will turn the LPW5209 back on. Floating the input may cause unpredictable operation. EN should not be allowed to go negative with respect to GND. The EN pin may be directly tied to VIN to keep the part on.

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.

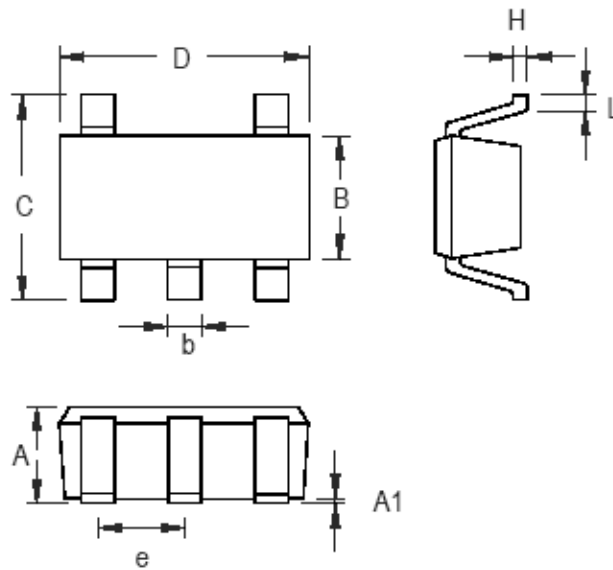
Thermal Shutdown

Thermal shutdown is employed to protect the device from damage if the die temperature exceeds approximately 150°C. If enabled, the switch automatically restarts when the die temperature falls 20°C. The output will continue to cycle on and off until the device is disabled or the fault is removed.



Packaging Information

SOT23-5



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 0.889 | 1.295 | 0.035 | 0.051 |
| A1 | 0.000 | 0.152 | 0.000 | 0.006 |
| B | 1.397 | 1.803 | 0.055 | 0.071 |
| b | 0.356 | 0.559 | 0.014 | 0.022 |
| C | 2.591 | 2.997 | 0.102 | 0.118 |
| D | 2.692 | 3.099 | 0.106 | 0.122 |
| e | 0.838 | 1.041 | 0.033 | 0.041 |
| H | 0.080 | 0.254 | 0.003 | 0.010 |
| L | 0.300 | 0.610 | 0.012 | 0.024 |

SOT-23-5 Surface Mount Package