# SP619

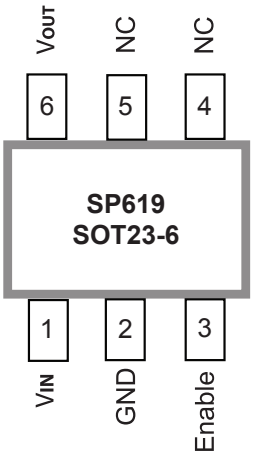
## High Current Power Switch

### FEATURES

- Max $R_{DS(ON)}$ .377 Ohms
- Overcurrent deactivation 800mA
- Max leakage current less than 2µA while deactivated
- Small 6 pin SOT-23 package
- Built-in Over-temperature Protection
- Wide Input voltage range 2.5V to 7V

### APPLICATIONS

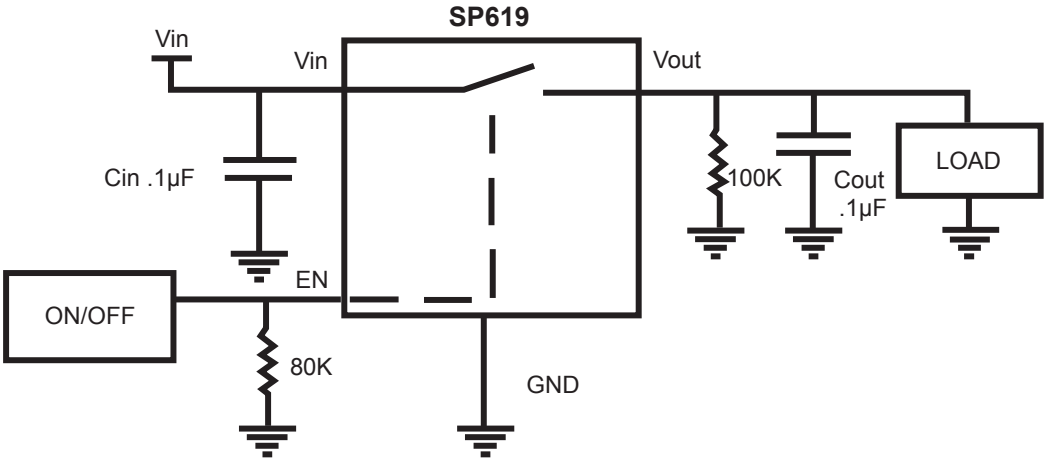
- Ultra low cost handsets
- PDA, DSC, MP3 players
- Cell phones
- Power Distribution Switch
- Battery-Charger Circuit




### DESCRIPTION

The SP619 is a low $R_{DS(ON)}$ high current switch designed with precision current limiting to protect connected devices from damage due to a short circuit condition or against current surges that may cause the supply voltages to fall out of regulation. This switch operates from an input voltage range of 2.5V to 7V, making it ideal for 3V and 5V applications. The SP619 is also protected from thermal overload which limits power dissipation. In shutdown mode, the supply current drops to 2µA.

### TYPICAL APPLICATION CIRCUIT





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## ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

$V_{IN}$……-0.3V to 7V
Storage Temperature..…..…… -65°C to 150°C
Junction Temperature..... ……150°C
Lead Temperature (Soldering, 10 sec).....…….300°C
ESD RATING
Human Body Model…….…….2000V
Machine Model……...200V
OPERATING RATINGS
Thermal resistance SOT23-6
Junction to Ambient…….……191°C
Junction to lead ……..……50°C

## RECOMMENDED OPERATING CONDITIONS

Unless otherwise specified: $V_{IN}$ = 2.5V - 7V, $C_{IN}$ = 0.1µF, $T_A$ = -40°C to + 85°C

| PARAMETER | CONDITIONS | MIN | TYP (Note 1) | MAX | UNITS |
|---|---|---|---|---|---|
| Operating Input Voltage Range | | 2.5 | | 7 | V |
| Overcurrent Deactivation Range | EN=1.5V | 725 | 800 | 1010 | mA |
| Overcurrent Duration Before Deactivation | EN=1.5V | 1 | | 5.25 | ms |
| Shutdown Supply Current | $V_{IN}$=4.2V | | | 2 | µA |
| Quiescent Supply Current | EN=1.5V $V_{IN}$=4.2V $I_{OUT}$=0mA | | | 350 | µA |
| Quiescent Supply Current | EN=1.5V $V_{IN}$=4.2V $I_{OUT}$=725mA | | | 5.25 | mA |
| $R_{DS(ON)}$ | $V_{IN}$=2.5V $I_{OUT}$=100mA EN=1.5V | | | .377 | Ω |
| Post Fault Output Load for Recovery | Enable=1.5V | 10 | 15 | 23 | KΩ |
| Post Fault Activation Turn On Time | Enable=1.5V | 1 | | 55 | ms |
| Thermal Shutdown Die Temperature | SP619 will self recover when temperature drops below the trip point . | 120 | 150 | 180 | °C |
| Thermal Restart Die Temperature | | 90 | 120 | 135 | °C |
| ENABLE Logic LOW | Driver is disabled | | | .5 | V |
| ENABLE Pin Logic HIGH | Driver is active | .655 | | 1.4 | V |
| Turn On Delay | $R_L$=100kΩ, $C_L$= 0.01µF (Note 2,3) | | | 600 | µs |
| Turn Off Delay | $R_L$=100kΩ, $C_L$= 0.01µF (Note 2,4) | | | 200 | µs |
| Rise Time | $R_L$=100kΩ, $C_L$= 0.01µF (Note 2) | | | 100 | µs |
| Fall Time | $R_L$=100kΩ, $C_L$= 0.01µF (Note 2) | | | 2500 | µs |

Note 1: Typicals are $T_J$=25°C
Note 2: Characterized, not 100% tested
Note 3: Turn on delay is measured from the time the enable pin is turned on to the time it takes the output to rise to 10% of its final value.
Note 4: Turn off delay is measured from the time the enable pin is turned to the time it takes for the output to fall to 90% of its current value.


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## FAULT AND RECOVERY TRUTH TABLE*

| Enable | Load | Temperature (TJ) | Previous State | Switch | Current State/Fault (Note*) |
|---|---|---|---|---|---|
| Low | X | X | X | Open | Off |
| High | < 800 mA | < 163ºC | Off | Closed | Normal |
| High | < 800 mA | > 163ºC | Off | Open | Thermal Cutoff |
| High | > 800 mA | < 163ºC | Off | Open | Overcurrent |
| High | > 800 mA | > 163ºC | Off | Open | Thermal Cutoff, Overcurrent |
| High | < 15kΩ | < 163ºC | Overcurrent | Open | Load Condition |
| High | < 15kΩ | > 163ºC | Overcurrent | Open | Thermal Cutoff, Overcurrent, Load Condition |
| High | > 15kΩ | < 163ºC | Overcurrent | Closed | Normal |
| High | > 15kΩ | > 163ºC | Overcurrent | Open | Thermal Cutoff |
| High | < 15kΩ | < 120ºC | Thermal Cutoff | Open | Load Condition |
| High | < 15kΩ | > 120ºC | Thermal Cutoff | Open | Load Condition, Thermal Cutoff |
| High | > 15kΩ | < 120ºC | Thermal Cutoff | Closed | Normal |
| High | > 15kΩ | > 120ºC | Thermal Cutoff | Open | Thermal Cutoff |

*Note: This table is for fault conditions, not for continuous operation, else damage to the device may occur. In order to recover to the normal state after a Thermal Cutoff fault, the part's junction temperature must decrease below 120ºC and the load on its output must be greater than 15kΩ.

## PIN ASSIGNMENTS

| PIN NUMBER | PIN NAME | FUNCTION |
|---|---|---|
| 1 | $V_{IN}$ | Input power supply pin (2.5V to 7.0V) |
| 2 | GND | Ground connection |
| 3 | Enable | A logic high turns on the switch |
| 4 | NC | No connect |
| 5 | NC | No connect |
| 6 | $V_{OUT}$ | Switch output |


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The SP619 is a switch capable of handling up to 800mA of current. 7V capability allows the user to have a wide input voltage range that covers the typical Lithium battery range as well as higher 5V input voltage rails commonly found in USB power. The SP619 also can be used as a 3V or 5V power distribution switch. It is intended for power distribution applications where short circuits are likely to be encountered.

**Short circuit operation**

When the SP619 enters a short circuit condition, the switch is disabled. The output of the SP619 will not restart until the output impedance is greater than 15KΩ. The enable pin can be used to re-enable the SP619 into any load condition that is not a fault condition. Refer to the truth table on page 4 for more information on the different SP619 switch states. The typical deactivation time is about 2ms.

**Enable**

The enable pin allows easy control of the SP619. The enable pin should not be enabled high prior to a voltage being present on the input of the device. The enable pin should not exceed the input voltage by more than 0.1V due to an internal ESD diode. Doing so will affect the operation of the SP619 and could damage the device. In a typical application an 80KΩ resistor to GND should be used on the enable pin. This resistor will pull the enable low when an enable signal is not present. This prevents the SP619 from falsely turning on. The enable pin can also be used to restart the part into a load condition that is high in current. Please refer to the truth table on page 4 for more details.

**Inrush Current**

The SP619 is a simple resistive switch. When the switch is turned on into a highly capacitive load there could be a significant inrush current that can be encountered. At 6 volts in, the inrush current was about 250mA into a 100µF capacitor.

**Output Voltage Rise Time**

The output voltage of the SP619 has an output capacitance dependency on the slope of $V_{OUT}$. A simple RC circuit is created when the switch is turned on.

Equation 1

$$V(t)=V_O+V_{IN}\left(1-e^{\frac{-t}{R_{DS(ON)} \cdot C_{OUT}}}\right)$$

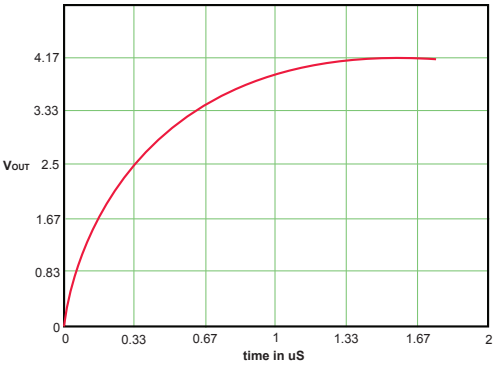
Where $V_O$ is initial Voltage condition typically 0V

$V_{IN}$ is the input voltage

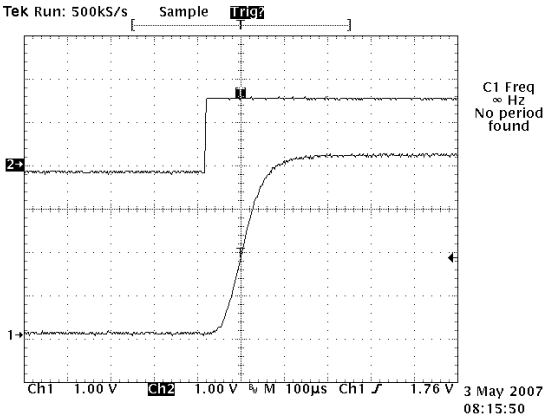
$R_{DS(ON)}$ is the switch resistance

$C_{OUT}$ is the output capacitance

For 4.2V $V_{IN}$ and 100µF output capacitance we get about 150ns delay in figure 2.




This is comparable to actual measured value in figure 3.



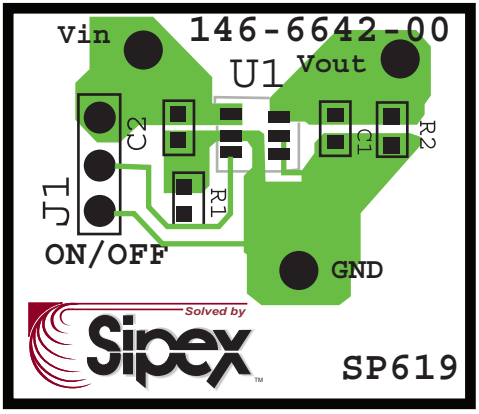

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### Overtemperature Protection

The SP619 has built-in overtemperature protection to protect the part against damage if the die temperature gets too hot. The typical thermal cutoff is about 150ºC. The part will self recover if the temperature drops below the thermal restart threshold of about 120ºC.

### Layout Considerations

The input and output decoupling capacitors should be placed as close as possible to the input and output pins. The GND pin should be stitched to the GND plain to help with thermal performance. The input and output traces should be as large as possible. The 100KΩ is also recommended in the design and should be placed close to the output decoupling cap.

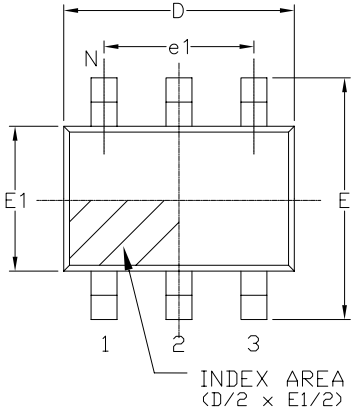


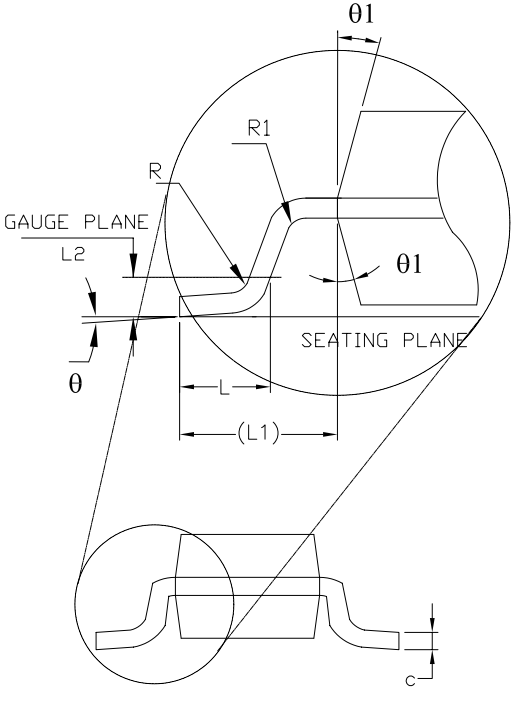

Recommended Layout

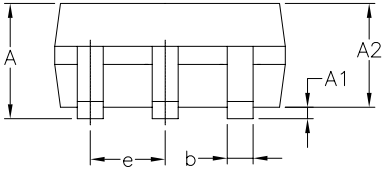
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| REVISION HISTORY | | | |
|---|---|---|---|
| REV. | DISCRIPTION | DATE | APP'D |
| A | DRAWING ORIGINATION | 10/3/05 | JL |
| B | DRAWING FORMAT MODIFICATION | 07/25/06 | JL |

Top View




Side View

Front View

| 6 Pin SOT-23 JEDEC MO-178 Variation AB | | | | | | | |
|---|---|---|---|---|---|---|---|
| SYMBOLS | DIMENSIONS IN MM (Control Unit) | | | DIMENSIONS IN INCH (Reference Unit) | | | |
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| A | — | — | 1.45 | — | — | 0.057 | |
| A1 | 0.00 | — | 0.15 | 0.000 | — | 0.006 | |
| A2 | 0.90 | 1.15 | 1.30 | 0.036 | 0.045 | 0.051 | |
| b | 0.30 | — | 0.50 | 0.012 | — | 0.020 | |
| c | 0.08 | — | 0.22 | 0.003 | — | 0.009 | |
| D | 2.90 BSC | | | 0.115 BSC | | | |
| E | 2.80 BSC | | | 0.111 BSC | | | |
| E1 | 1.60 BSC | | | 0.063 BSC | | | |
| e | 0.95 BSC | | | 0.038 BSC | | | |
| e1 | 1.90 BSC | | | 0.075 BSC | | | |
| L | 0.30 | 0.45 | 0.60 | 0.012 | 0.018 | 0.024 | |
| L1 | 0.60 REF | | | 0.024 REF | | | |
| L2 | 0.25 BSC | | | 0.010 BSC | | | |
| R | 0.10 | — | — | 0.004 | — | — | |
| R1 | 0.10 | — | 0.25 | 0.004 | — | 0.010 | |
| θ | 0° | 4° | 8° | 0° | 4° | 8° | |
| θ1 | 5° | 10° | 15° | 5° | 10° | 15° | |
| N | 6 | | | 6 | | | |

| | | | |
|---|---|---|---|
| Solved by Sipex | | SIPEX CORPORATION | |
| | | 6 PIN SOT-23 PACKAGE OUTLINE | |
| Packaging Approval: | | Drawing No: | 6-PIN SOT-23 |
| By: JL | Date: 07/25/06 | Revision: B | Sheet: 1 OF 1 |

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| Part number | Temperature range | Package Type |
|---|---|---|
| SP619EK-L | From -40 to +85ºC | Lead Free 6 pin SOT23 |
| SP619EK-L/TR | From -40 to +85ºC | Lead Free 6 pin SOT23 |

For availability of “M” temperatures (-40 to +125ºC) or in other packages contact factory.

/TR = Tape and Reel.

For further assistance:

Email: Sipexsupport@sipex.com
WWW Support page: http://www.sipex.com/content.aspx?p=support
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