

600mA Line Switch with Low On-Resistance

DESCRIPTION

The EUP3507 is a low dropout line switch IC with ON/OFF control and output current protection which integrates a P-channel MOSFET.

By connecting the EUP3507 to the output pin of a step-down DC/DC converter, the EN pin controls ON/OFF for each distribution switch to deliver power per requirements and maximize total power efficiency. As a result, the EUP3507 helps to extend battery life and product operation time.

The EUP3507 contains a current limit and protection circuit so these are not required externally unlike discrete circuit solutions where MOSFETs and resistors are used.

When a low signal is input to the EN pin, the IC enters shutdown mode. Even where a load capacitor is connected to the output pin during shutdown, the electric charge stored at the load capacitor is discharged through the internal switch. As a result, the VOUT pin voltage falls quickly to the GND level. The EUP3507 contains over current protection.

FEATURES

- 2.5V to 5.5V Input Voltage Range
- $0.4\Omega \sim 0.6\Omega$ On Resistance
- Low $120\mu\text{A}$ Quiescent Current
- Low Shutdown Current : $<1\mu\text{A}$
- High Active ON/OFF Control Function
- High Speed Auto Discharge Function
- Operating Temperature Range: $-40^{\circ}\text{C} \sim +85^{\circ}\text{C}$
- Output Current Limit
- Thermal Shutdown
- RoHS Compliant and 100% Lead (Pb)-Free Halogen-Free

APPLICATIONS

- Cellular Phones, Smart phones
- Portable equipment
- Digital still cameras and video cameras
- Laptop, Palmtops, Notebook Computers

Typical Application Circuit

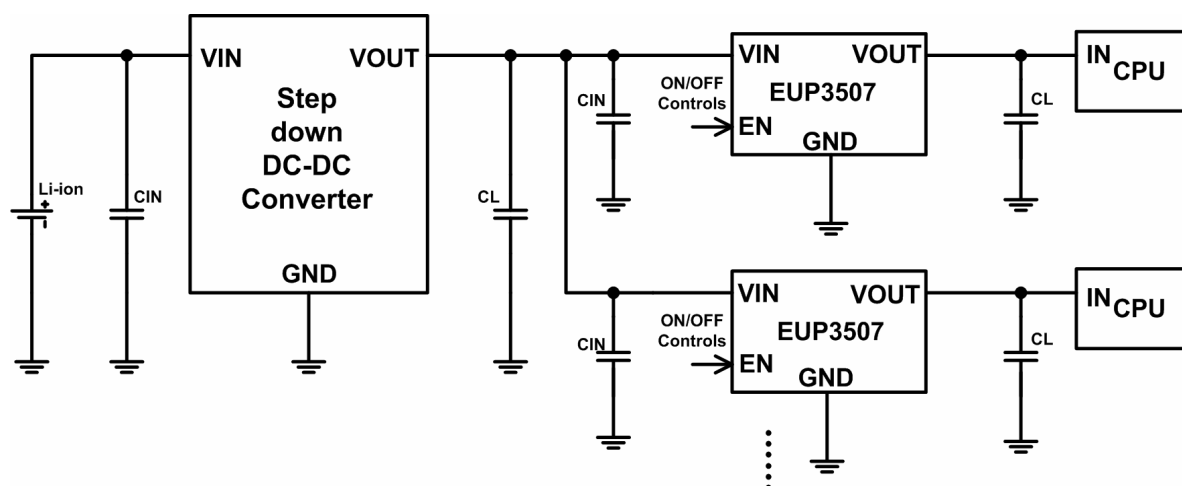


Figure 1.

Block Diagram

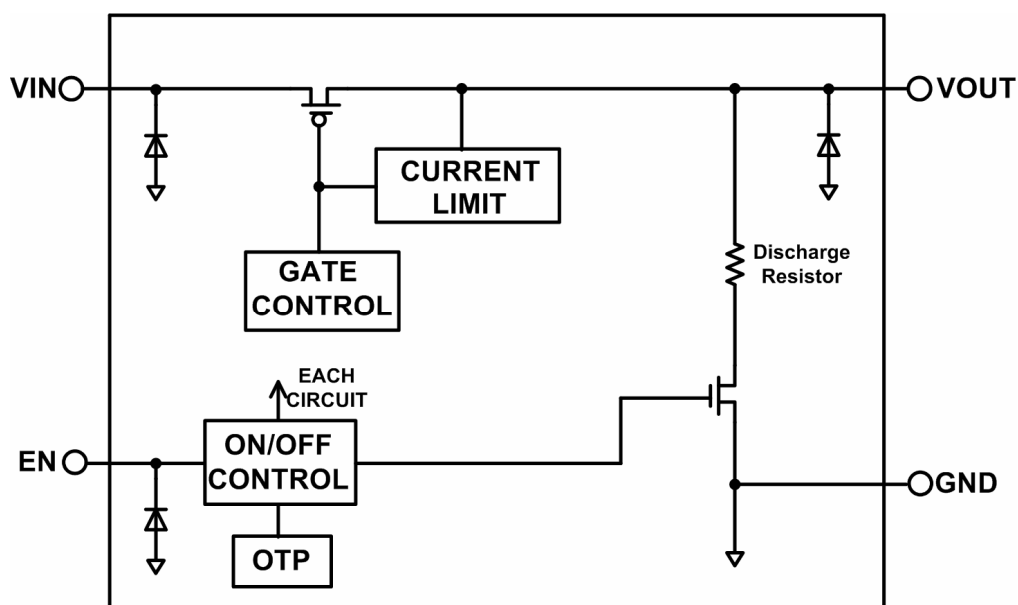


Figure 2.

Pin Configurations

Package Type	Pin Configurations
SOT23-5	EN GND VIN 3 2 1 4 5 NC VOUT

Pin Description

PIN	SOT23-5	DESCRIPTION
VIN	1	Input voltage of the line switch
GND	2	Ground
EN	3	ON/OFF Control
NC	4	No connect or connect to ground
VOUT	5	Output voltage of the line switch

Ordering Information

Order Number	Package Type	Marking	Operating Temperature Range
EUP3507VIR1	SOT23-5	xxxxx Af00	-40°C to +85°C

EUP3507 ☐ ☐ ☐ ☐

- Lead Free Code
1: Lead Free, Halogen Free 0: Lead
- Packing
R: Tape & Reel
- Operating temperature range
I: Industry Standard
- Package Type
V: SOT-23

Absolute Maximum Ratings

■	V_{IN}, V_{EN} -----	-0.3 to 6V
■	V_{OUT} -----	-0.3 to ($V_{IN}+0.3$)
■	I_{OUT} -----	900mA
■	Junction Temperature -----	150°C
■	Storage Temperature Range -----	-65°C to +150°C
■	Lead Temperature -----	260°C
■	Thermal Resistance θ_{JA} (SOT23-5) -----	205°C /W
■	ESD Rating	
	Human Body Model -----	2kV

Recommend Operating Conditions

■	V_{IN} -----	2.5 to 5.5V
■	V_{EN} -----	0 to 5.5V
■	Operating Temperature Range -----	-40°C to +85°C

Electrical Characteristics

$T_A=+25^\circ\text{C}$, unless otherwise specified⁽¹⁾

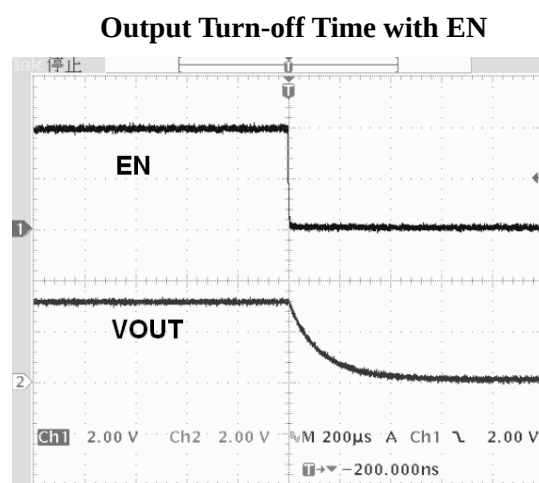
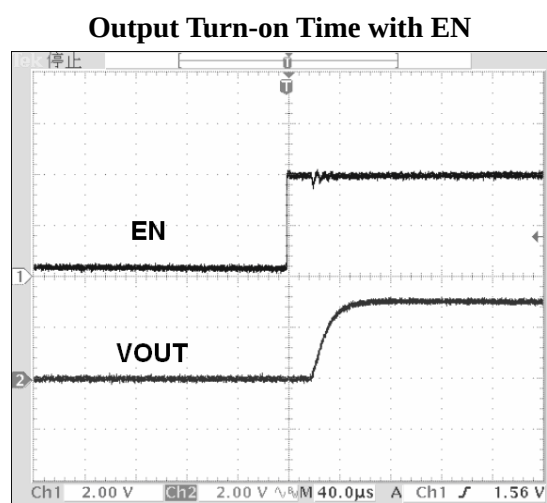
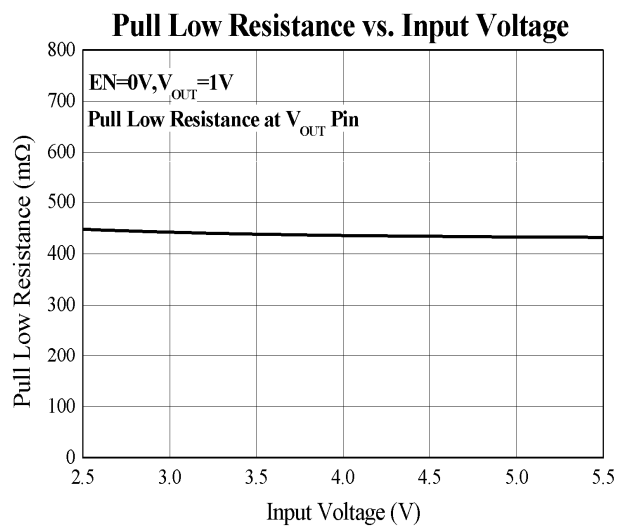
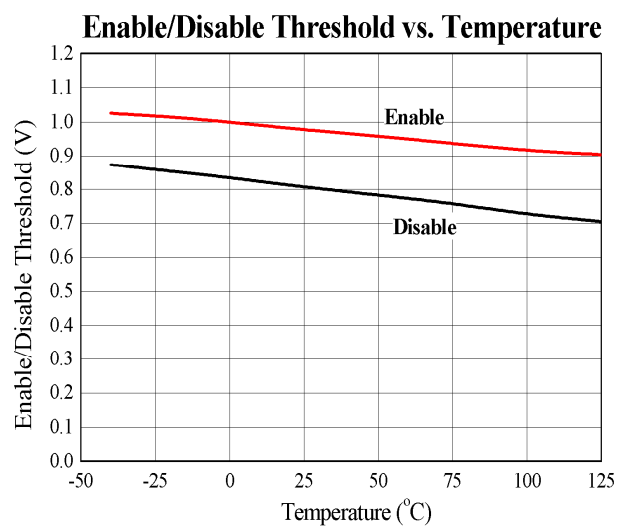
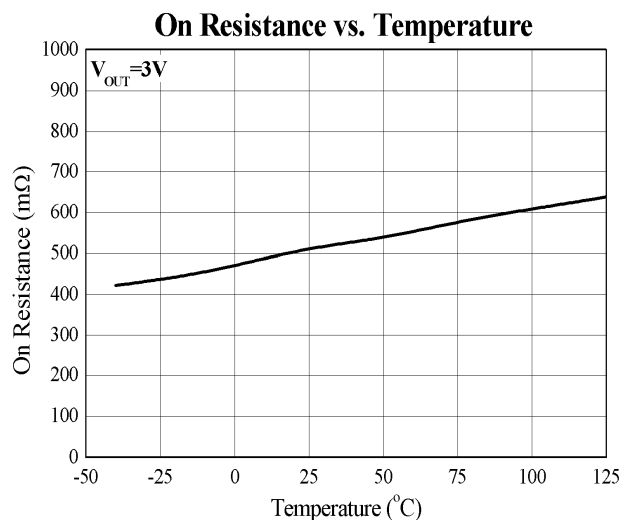
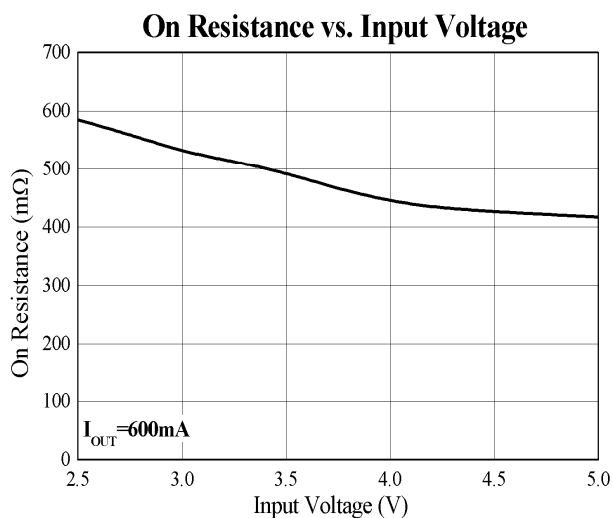
Symbol	Parameter	Conditions	EUP3507			Unit
			Min.	Typ.	Max.	
Input Voltage						
V _{IN}	Input Voltage		2.5		5.5	V
I _Q	Quiescent Current	V _{IN} =V _{EN} , I _{OUT} =0mA		120	180	μA
I _{SHDN}	Shutdown Current	V _{IN} =5V, V _{EN} =GND, V _{OUT} =OPEN	--	0.1	1	
I _{LEAK}	Switch Leakage Current	V _{IN} =5V, V _{EN} =GND, V _{OUT} =0V		0.1	1	
R _{ON}	On Resistance	V _{IN} =5V, V _{EN} =V _{IN}		0.4		Ω
		V _{IN} =3.3V, V _{EN} =V _{IN}		0.47		
		V _{IN} =2.5V, V _{EN} =V _{IN}		0.58		
ON/OFF Control						
V _{ENH}	EN High Level Voltage		1.2			V
I _{ENH}	EN High Input Current	V _{EN} = V _{IN}	-1		1	μA
V _{ENL}	EN Low Level Voltage				0.4	V
I _{ENL}	EN Low Input Current	V _{EN} = GND	-1		1	μA
T _{DELAY(ON)}	Turn On Time ⁽²⁾	V _{IN} =5V, V _{EN} =0.3V→1.5V		22		μs
T _{DELAY(OFF)}	Turn Off Time ⁽³⁾	V _{IN} =5V, V _{EN} =1.5V→0.3V		15		
R _{DCHG}	Auto Discharge Resistance	V _{IN} =5V, V _{OUT} =5V, V _{EN} =GND	400	500		Ω
Protection						
I _{LIM}	Current Limit		600	900		mA
T _{SD}	Thermal Shutdown Temperature	V _{IN} =V _{EN} =5V, V _{OUT} =OPEN		170		°C
T _{SDHYS}	Thermal Shutdown Hysteresis	V _{IN} =V _{EN} =5V, V _{OUT} =OPEN		30		

Note 1: Stresses listed as the above “Absolute Maximum Ratings” may cause permanent damage to the device. These are for stress ratings. 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 remain possibility to affect device reliability.

Note 2: Time to reach 90% of V_{OUT} after V_{EN} entering the V_{ENH} threshold

Note 3: Time to fall to 10% of V_{OUT} after V_{EN} entering the V_{ENL} threshold

Typical Operating Characteristics



Detailed Function Description

On/Off Control

The EUP3507 enables an output P-channel MOSFET switch and the IC internal circuitry to turn off by the signal to the EN pin. In the shutdown mode, the V_{OUT} pin will be pulled down to the GND by the auto-discharge function.

The output voltage becomes unstable when the EN pin is opened. If the input voltage to the EN pin is within the specified threshold voltages, the logic is fixed and the EUP3507 will operate normally. However, supply current may increase as a result of the shoot-through current of internal circuitry when the medium level voltage is input to the EN pin.

Input/Output Capacitor

The EUP3507 works well without an input and output capacitors. Also, an output capacitor of the power source can be used as an input capacitor of the EUP3507 and a bypass capacitor of the driving IC can be used as an output capacitor of the EUP3507.

Auto-Discharge Function

The EUP3507 contains an auto-discharge resistor and an N-channel transistor between the V_{OUT} pin and the GND pin. The device quickly discharges the electric charge in the output capacitor when a low signal to the EN pin is input to turn off the whole IC. The auto-discharge resistance R_{DCHG} is set at 500Ω (V_{OUT}=4.0V TYP. @ V_{IN}=4.0). Discharge time of the output capacitor is determined by an auto-discharge resistor value (R_{DCHG}) and an output capacitor value. Time constant τ is defined as (τ = C*R_{DCHG}). Discharge time t can be calculated by the following formula:

$$t = \tau \ln(V_{OUT}/V)$$

V: Output voltage after starting discharge

V_{OUT}: Output voltage

t : Discharge time

τ: Output discharge resistor value R_{DCHG}*Output capacitor value C

Current Limit

The EUP3507 contains a constant current limit circuit to monitor the gate voltage of the pass transistor to limit the output current. When the output current is higher than the over-current limit, the circuit will pull high the gate voltage of the pass transistor to reduce the current flowing to the output.

Over-thermal shutdown

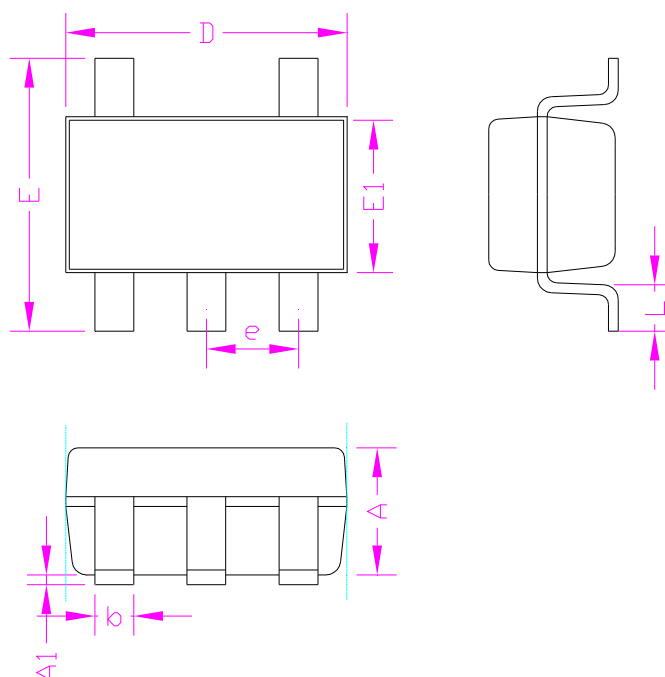
The EUP3507 monitor its temperature automatically. When the operation junction temperature exceeds 170°C, the OTP circuit starts the thermal shutdown function to turn the pass transistor off until it cooled down by 30°C then the pass transistor turned on again. For continue operation, do not exceed absolute maximum operation junction temperature. The circuit is a non-latched protection.

Application Information

Please use this IC within the stated absolute maximum ratings. Operation beyond these limits may cause degrading or permanent damage to the device.

The EUP3507 goes into an undefined operation when the EN pin is left open. The EN pin shall be tied to low or high level.

V_{OUT} pin voltage should not be applied beyond the V_{IN} pin voltage. The IC may get damage due to the reverse current toward the V_{IN} pin. The current limit function is integrated.

Packaging Information**SOT23-5**

SYMBOLS	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	-	1.30	-	0.052
A1	0.00	0.15	0.000	0.006
D	2.90		0.114	
E1	1.60		0.063	
E	2.60	3.00	0.102	0.118
L	0.30	0.60	0.012	0.024
b	0.30	0.50	0.012	0.020
e	0.95		0.037	