3A TRCB Load Switch with Auto-discharge

General Description

The ET3159 advanced load management switches target applications requiring a highly integrated solution. It disconnects loads powered from DC Power Rail (<6V) with stringent off-state current targets and high load capacitances (up to 200uF). Each switch consists of slew-rate controlled low-impedance MOSFET Switch and other integrated analog features. The slew-rate controlled turn-on characteristic prevents inrush-current and the resulting excessive voltage droop on power rails.

The ET3159 has True Reverse Current Blocking (TRCB) function blocking unwanted reverse current from OUT to IN during ON/OFF state. These devices have exceptionally low off-state current drain (<1uA max) which facilitate compliance in very low stand-by power applications. Switch control is managed by a logic input (Active HIGH) capable of interfacing directly with low voltage control signal/GPIO with no external pull-down resistor required, In ET3159, 90Ω on-chip load resistor is added for output quick discharge when switch is turned off (EN=0V).

ET3159 is offered DFN4(1.2×1.6) package, which is ideal for small form factor portable equipment.

Features

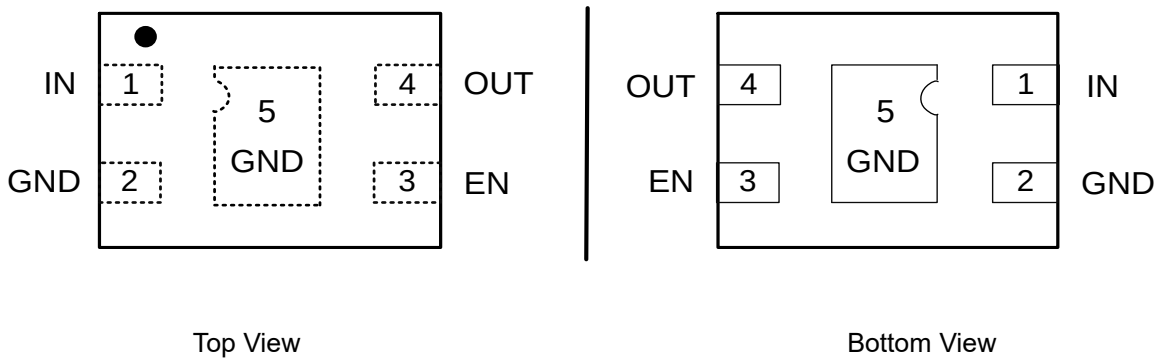
- 1.5V to 6 V Operation voltage range
- Low quiescent current is 8uA typical
- Slew rate/inrush control with t_R is 0.6ms typical
- Typical $R_{DS(ON)}$ is 75mΩ at V_{IN}=3.6V
- True reverse current blocking (TRCB)
- With auto discharge function when switch turned off
- ESD protected: Above 8kV (contact) IEC,4kV HBM, 1.5kV CDM
- Part No. and package

Part No.	Package	Packing Option	MSL
ET3159	DFN4 (1.2mm ×1.6mm)	Tape and Reel ,3K/Reel	Level 1

Application

- PDAs / smart phones
- Notebook / computers
- Portable media players
- Digital camera
- GPS navigation devices
- Data storage devices
- Optical, industrial, medical, and health-care devices

Pin Configuration

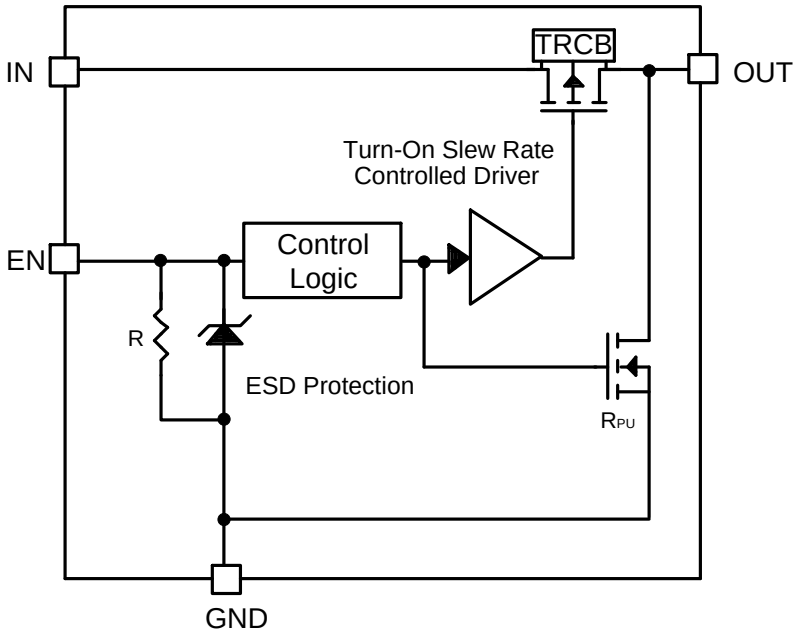


Top View Bottom View

Pin Function

Pin Number	Name	Function
1	IN	This is the input pin of the switch
2,5	GND	Ground connection
3	EN	Enable input
4	OUT	This is the output pin of the switch

Block Diagram



Functional Description

The ET3159 is low-R_{ON} P-channel load switches with controlled turn on and TRCB (True Reverse Current Blocking). The core of each device is a P-channel MOSFET and controller capable of functioning over a wide input operating range of 1.5 to 6.0V. The EN pin, an active HIGH GIOP input, controls the state of the switch. TRCB functionality blocks unwanted reverse current during ON and OFF when OUT higher than IN is applied.

Input Capacitor

To limit the voltage drop on the input supply caused by transient inrush current when the switch turns on into a discharged load capacitor or short-circuit, a capacitor must be placed between the IN and GND pins. At least 1μF ceramic capacitor, C_{IN}, placed close to the pins is usually sufficient. Higher-value C_{IN} can be used to reduce the voltage drop in higher-current applications.

Output Capacitor

At least 0.1μF capacitor, C_{OUT}, should be placed between the OUT and GND pins. This capacitor prevents parasitic board inductance from forcing OUT below GND when the switch is on.

Board Layout

For best performance, all traces should be as short as possible. To be most effective, the input and output capacitors should be placed close to the device to minimize the effect that parasitic trace inductance may have on normal and short-circuit operation.

Using wide traces or large copper planes for all pins (IN, OUT, EN, and GND) helps minimize the parasitic electrical effects along with minimizing the case ambient thermal impedance.

Pulse Current Capability

The device is mounted on the evaluation board shown in the PCB layout section. It is loaded with pulses of 6 A and 1 ms for periods of 4.6 ms.

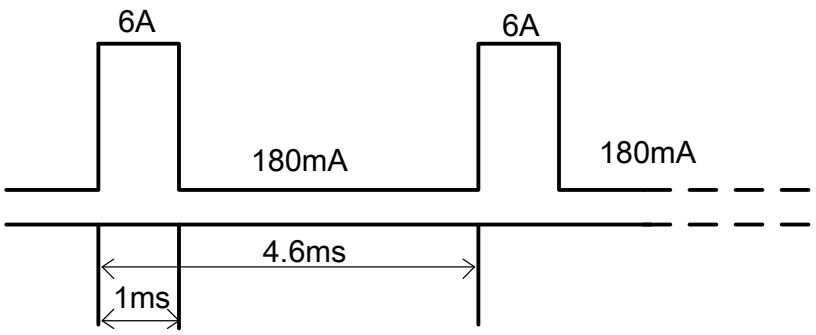


Figure 1.

The ET3159 can safely support 6A pulse current repetitively at 25 °C.

Switch Non-Repetitive Pulsed Current

The ET3159 can withstand inrush current of up to 15A for 100μs at 25 °C when heavy capacitive loads are connected and the part is already enabled.

Absolute Maximum Ratings

Parameter		Value	Unit
Supply Input Voltage (IN)[1]		- 2 to 7	V
Enable Input Voltage (EN) , Input resistance is greater than 1kΩ		- 2 to 7	
Maximum Continuous Switch Current (I_{MAX}) [3]		3	A
Maximum Repetitive Pulsed Current (1 ms, 10 % Duty Cycle) [3]		6	
Maximum Non-Repetitive Pulsed Current (100μs, EN = Active) [3]		15	
ESD/Electrostatic Discharge Capability	Human Body Model, JESD22-A114	4.0	KV
	Charged Device Model,JESD22-C101	1.5	
	ESD Withstand Voltage IEC61000-4-2	8.0(Contact)	
Junction Temperature (T_J)		- 40 to 150	°C
Thermal Resistance (θ_{JA}) [2]		170	°C/W
Max Power Dissipation (P_D)		735	mW

Notes:

1. ET3159 can pass the 10V test (Instant Contact): can support up to 100mS 10V pulse.

2. Device mounted with all leads and power pad soldered or welded to PC board.

3. T_A = 25 °C.

Recommended Operating Range

Parameter	Value	Unit
Input Voltage Range (V_{IN})	1.5 to 6.0	V
Operating Junction Temperature Range (T_A)	-40 to 85	°C

Electrical Characteristics

(V_{IN} = 5V, T_A = -40°C to 85°C ,Typical values are at T_A = 25°C)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}[a]	Operating Voltage		1.5		6	V
I_Q	Quiescent Current	V_{IN} = 3.6 V, EN = active		8		uA
		V_{IN} = 4.3 V, EN = active		10		
		V_{IN} = 5 V, EN = active		11	14	
I_{Q_OFF}	Off Supply Current	EN = inactive, OUT = Open			1	
I_{DS_OFF}	Off Switch Current	EN = inactive, OUT = GND			1.2	
$R_{DS(ON)}$	On-Resistance	V_{IN} = 3.6 V, I_L = 100 mA, T_A = 25 °C		75	95	mΩ
		V_{IN} = 4.3 V, I_L = 100 mA, T_A = 25 °C		70	90	
		V_{IN} = 5 V, I_L = 100 mA, T_A = 25 °C		65	85	

Electrical Characteristics(Continued)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
R_{PD}	Output Pull Down Resistance	V_{IN} = 5V, EN = 0V, V_{OUT}=1V, T_A = 25°C		90	150	Ω
V_{IL}	EN Input Low Voltage	V_{IN} = 1.5 V to 6V			0.4	V
V_{IH}	EN Input High Voltage	V_{IN} = 1.5 V to 6V	1.5			
I_{SINK}	EN Input Leakage	V_{EN} = 5 V,V_{IN}=0 V			10	uA
		V_{EN}=0 V, V_{IN}=5 V	-1			
R_{ON_PD}	Pull-Down Resistance at EN pin		0.6	1	1.4	MΩ
V_{T_RCB}	RCB Protection Trip Point[(b)]	V_{OUT} - V_{IN}		45		mV
V_{R_RCB}	RCB Protection Release Trip Point[(b)]	V_{IN} - V_{OUT}		25		mV
	RCB Hysteresis[(b)]			70		mV
I_{SD_OUT}	V_{OUT} Shutdown Current	V_{EN}=0V, V_{OUT}=5V, V_{IN} =Short to GND			2	μA
T_{RCB_ON}	RCB Response Time when Device EN[(b)]	V_{OUT} - V_{IN} =100mV V_{EN}=High		4.0		μs
T_{RCB_OFF}	RCB Response Time Device OFF[(b)]	V_{OUT} - V_{IN} =100mV V_{EN}=Low		2.5		μs
t_{DON}	Turn-On Delay[(c)]	V_{IN} =5V, R_L=150Ω, C_L=100μF,T_A=25°C		0.4		ms
t_R	V_{OUT} Rise Time[(c)]			0.6		ms
t_{ON}	Turn-On Time[(d)]			1.0		ms
t_{DOFF}	Turn-Off Delay[(c)]	V_{IN} =5V, R_L=150Ω, C_L=100μF,T_A=25°C		0.2		ms
t_F	V_{OUT} Fall Time[(e)]			9.4		ms
t_{OFF}	Turn-Off Time[(e)]			9.6		ms

Notes:

a. If IN is float state, OUT is forbidden to connect power.

b. This parameter is guaranteed by design and characterization; not production tested.

c. t_{DON} / t_{DOFF} / t_R / t_F are defined in Figure 2.

d. t_{ON} = t_R + t_{DON}

e. t_{OFF} = t_F + t_{DOFF}

Timing Diagram

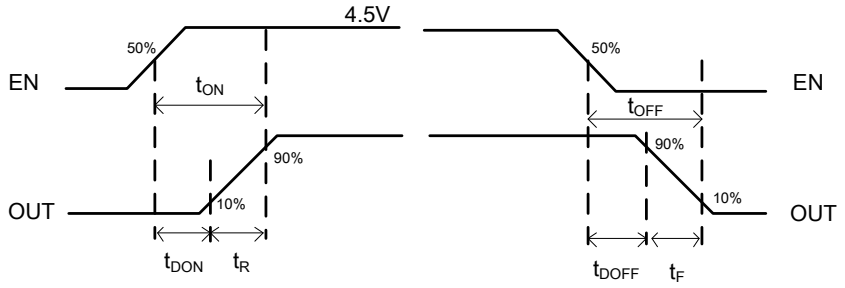


Figure 2.

Typical Characteristics

Internally regulated, T_A = 25 °C, unless otherwise noted

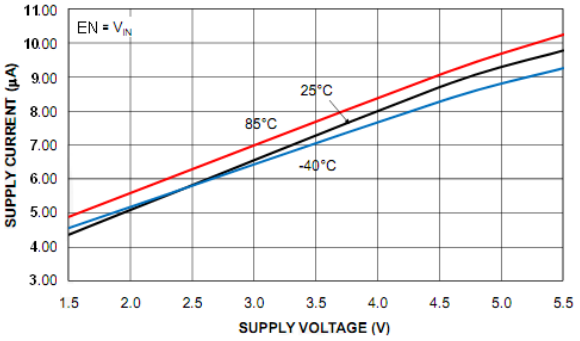


Figure 3. Supply Current vs Supply Voltage

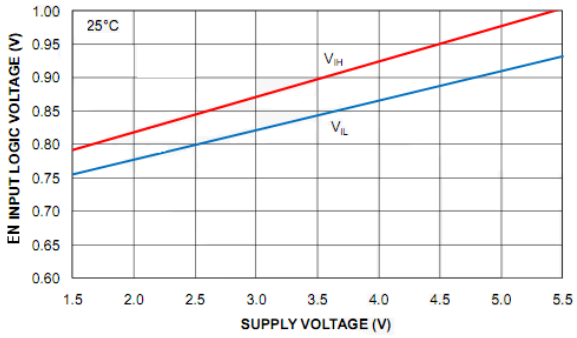


Figure 4. EN Pin Threshold vs Supply Voltage

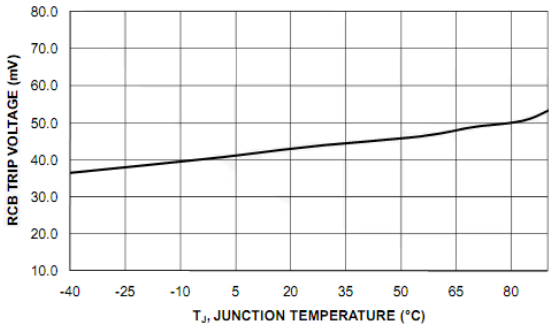


Figure 5. RCB Trip vs Temperature

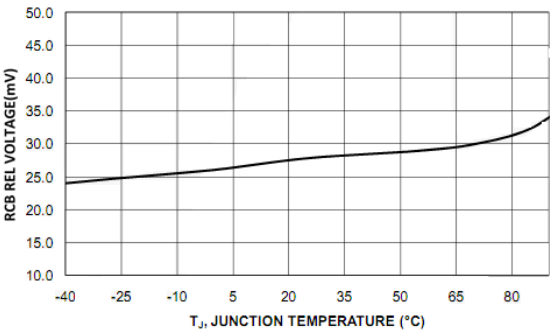
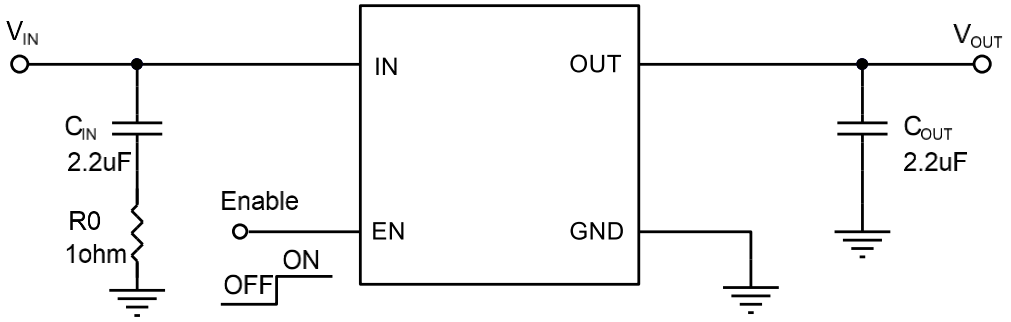


Figure 6. RCB Release vs Temperature

Application Circuits

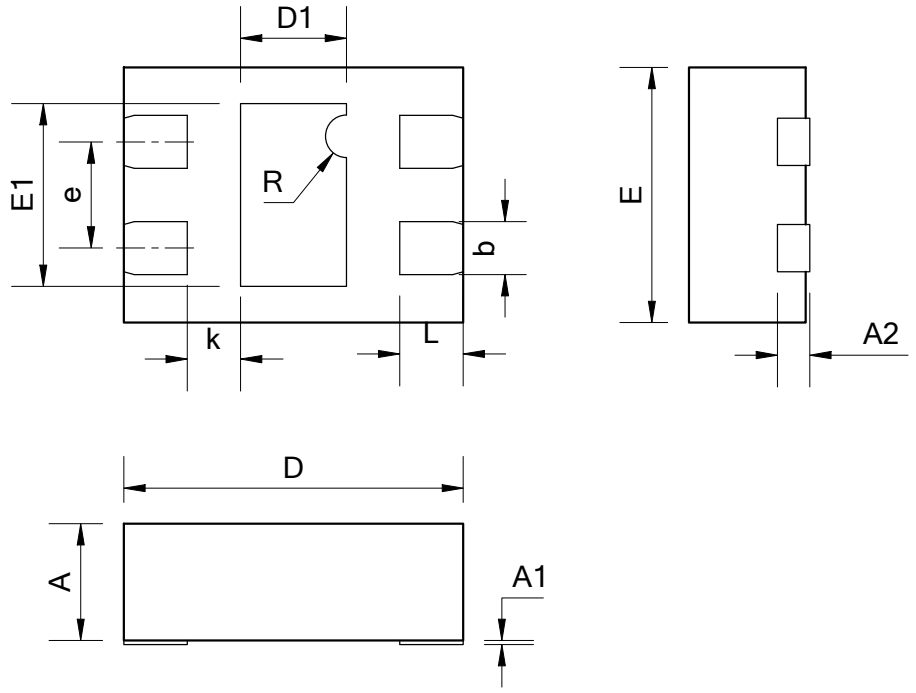


Notes:

- This circuit only supplies for reference,
- Recommended Capacitor C_{IN} value is 2.2uF or 1uF ,
- Recommended Capacitor C_{OUT} value is 4.7uF or 2.2uF or 1uF,
- Recommended R0 resister value is 2.2Ω or 1Ω.

Package Dimension

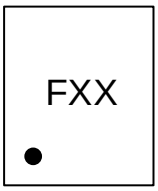
DFN4



Unit:mm

Symbol	Min	Typ	Max	Symbol	Min	Typ	Max
A	0.5	0.55	0.6	D1	0.45	0.5	0.55
A1	0	0.02	0.05	E1	0.81	0.86	0.91
A2	0.152REF			L	0.25	0.3	0.35
D	1.5	1.6	1.7	b	0.2	0.25	0.3
E	1.10	1.20	1.30	e	0.500BSC		
R	0.05	0.1	0.15	k	0.15	0.25	0.35

Marking Information



F = Part Number

XX = Tracking Number (01～99)

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2016-08-08	Original Version	Wu Xiang Jun	Wu Xiang Jun	Wu Xiang Jun
1.1	2016-09-18	Update t_{DON}, t_R, t_{ON} Value	Wu Xiang Jun	Wu Xiang Jun	Wu Xiang Jun
1.2	2016-09-28	Add Ambient Temperature	Wu Xiang Jun	Wu Xiang Jun	Wu Xiang Jun
1.3	2018-03-30	Update t_{DON}, t_R, t_{ON} Value	Liuxm	Liuxm	Liuxm
1.4	2021-06-8	Update TRCB	Liuxm	Liuxm	Liuxm
1.5	2021-09-08	Document formalize	Liuxm	Liuxm	Liuxm
1.6	2021-10-12	Add Trend Curve on page 7	Liuxm	Liuxm	Liuxm
1.7	2023-3-29	Update Typeset	Shi Bo	Liuxm	Zhu Jun Li
1.8	2025-5-26	Add Marking	Shi Bo	Liuxm	