3A Load Switch with True Reverse Current Blocking

General Description

The ET3148A 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 (23mΩ Typ) 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 ET3148A has True Reverse Current Blocking (TRCB) function blocking unwanted reverse current from V_{OUT} to V_{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. The input voltage range operates from 1.5V to 6.0V DC to fulfill a wide range of applications in consumer, optical, medical, storage, portable, and industrial device power management. 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.

The device is packaged in advanced full-Green compliant WLCSP6 1.56mm×1.06mm .

Features

- 1.5V to 6.0V Input Voltage Operating Range
- Typical $R_{DS(ON)}$:
  -- 21mΩ at V_{IN}=5.5V
  -- 23mΩ at V_{IN}=4.5V
  -- 30mΩ at V_{IN}=2.5V
- Slew Rate/Inrush Control with t_R: 2.7ms (Typ)
- 3A Maximum Continuous Current Capability
- Low<1uA Off Switch Current
- True Reverse Current Blocking (TRCB)
- ESD Protected: Above 8kV HBM, 1.5kV CDM
- Part No. and package

Part No.	Package	MSL
ET3148A	WLCSP6 1.56mm×1.06mm,0.5mm pitch	Level 1

Application

- Smartphones, Tablet PC
- HDD, Storage, and Solid State Memory Devices
- Portable Media Devices, Laptop & MID
- Industrial Handheld and Enterprise Equipment

Pin Configuration

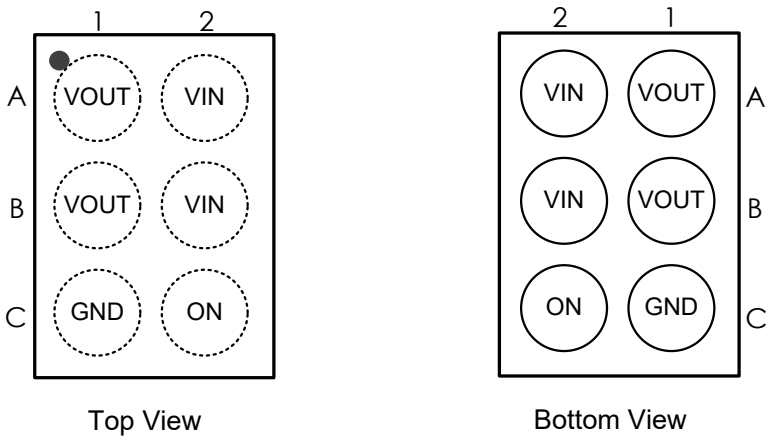


Figure 1.Pin configuration

Pin Function

Pin Number	Name	Function
A1, B1	VOUT	Switch Output Pin
A2, B2	VIN	Switch Input Pin: Input Power to the Switch
C1	GND	Ground Pin
C2	ON	Switch ON/OFF Control, High Set Switch On , Low Set Switch Off .

Block Diagram

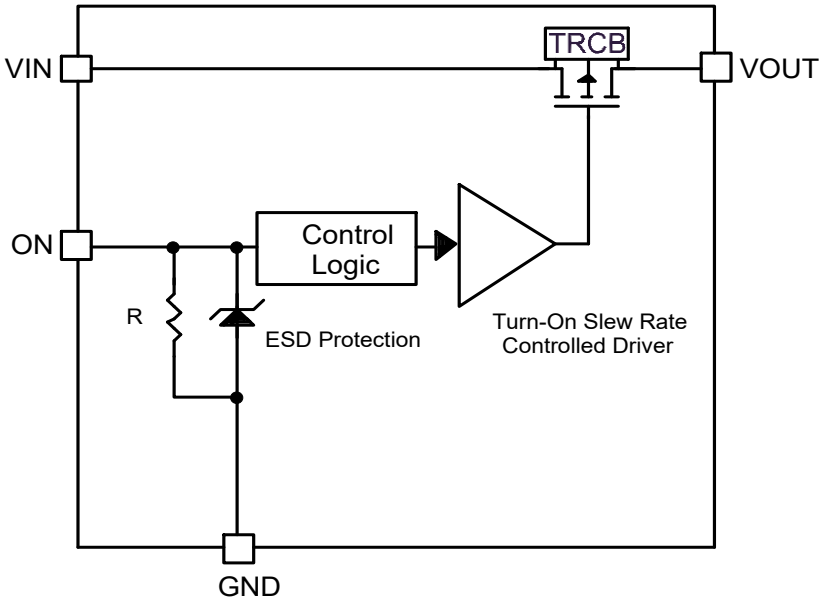


Figure 2. Functional Block Diagram

Functional Description

The ET3148A is low-R_{ON} load switches with controlled turn-on and TRCB (True Reverse Current Blocking). The device is a 23mΩ P-channel MOSFET and controller capable of functioning over a wide input operating range of 1.5 to 6.0V. The ON pin, an active HIGH GIOP/CMOS input, controls the state of the switch. TRCB functionality blocks unwanted reverse current during ON and OFF when higher V_{OUT} than V_{IN} 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 V_{IN} and GND pins. A 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

A 0.1μF capacitor, C_{OUT}, should be placed between the V_{OUT} and GND pins. This capacitor prevents parasitic board inductance from forcing V_{OUT} below GND when the switch is on. C_{IN} greater than C_{OUT} is highly recommended. C_{OUT} greater than C_{IN} can cause V_{OUT} to exceed V_{IN} when the system supply is removed. This could result in current flow through the body diode from V_{OUT} to V_{IN}.

Board Layout

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

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Min	Max	Unit
V_{IN} (1)	V_{IN} to GND, $\|V_{IN} - V_{OUT}\| < 7V$	-2	7	V
V_{ON}	V_{ON} to GND, Input resistance is greater than 1kΩ	-2	7	V
V_{OUT}	V_{OUT} to GND, $\|V_{IN} - V_{OUT}\| < 7V$	-2	7	V
I_{SW1}	Maximum Continuous Switch Current		3.5	A
I_{SW2}	Maximum Repetitive Pulsed Current (1ms,20% Duty Cycle)		6	A
I_{SW3}	Maximum Repetitive Pulsed Current (100μs,20% Duty Cycle)		15	A
P_D	Power Dissipation at T_A=25°C		1.2	W
T_{STG}	Storage Junction Temperature	-65	+150	°C
T_J	Operating Junction Temperature	-40	+150	°C
θ_{JA}	Thermal Resistance, Junction-to-Ambient		85	°C/W
ESD	Human Body Model, JESD22-A114	8		kV
	Charged Device Model, JESD22-C101	1.5		

Note1: ET3148A can pass the 10V test (Instant Contact): can support up to 100mS 10V pulse.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{IN}	Input Voltage	1.5	6	V
T_A	Ambient Operating Temperature	-40	+85	°C

Electrical Characteristics

Unless otherwise noted, V_{IN}=1.5 to 6.0V, T_A=-40 to +85°C; typical values are at V_{IN}=4.5V and T_A=25°C.

Symbol	Parameters	Test Conditions	Min	Typ	Max	Unit
Basic Operation						
V_{IN}	Input Voltage		1.5		6	V
$I_{Q(OFF)}$	Off Supply Current	V_{ON}=GND, V_{OUT}=Open			1	μA
I_{SD}	Shutdown Current	V_{ON}=GND, V_{OUT}=GND		0.2	1.2	μA
I_Q	Quiescent Current	I_{OUT}=0mA			11	μA
R_{ON}	On-Resistance[2]	V_{IN}=5.5V, I_{OUT}=3A		22		mΩ
		V_{IN}=5.5V, I_{OUT}=2A		21.5		
		V_{IN}=5.5V, I_{OUT}=1A, T_A=25°C		21	28	
		V_{IN}=4.5V, I_{OUT}=3A		24		
		V_{IN}=4.5V, I_{OUT}=2A		23.5		
		V_{IN}=4.5V, I_{OUT}=1A, T_A=25°C		23	35	
		V_{IN}=3.3V, I_{OUT}=500mA		26		
		V_{IN}=2.5V, I_{OUT}=500mA		30		
V_{IH}	ON Input Logic High Voltage	V_{IN}=1.5V to 5.5V	1.15			V
V_{IL}	ON Input Logic Low Voltage	V_{IN}=1.8V to 6.0V			0.65	V
		V_{IN}=1.5V to 1.8V			0.60	V
I_{ON}	ON Input Leakage	V_{ON}= V_{IN} or GND			1	μA
R_{ON_PD}	Pull-Down Resistance at ON pin	V_{IN}=1.5V to 6.0V, T_A= -40 to+ 85°C	6.38	7.65	8.86	MΩ
True Reverse Current Blocking						
V_{T_RCB}	RCB Protection Trip Point	V_{OUT} - V_{IN}		45		mV
V_{R_RCB}	RCB Protection Release Trip Point	V_{IN} - V_{OUT}		25		mV
	RCB Hysteresis			70		mV
I_{SD_OUT}	V_{OUT} Shutdown Current	V_{ON}=0V, V_{OUT}=6.0V, V_{IN} =Short to GND			2	μA
T_{RCB_ON}	RCB Response Time when Device ON	V_{OUT} - V_{IN} =100mV V_{ON}=High		4		μs
T_{RCB_OFF}	RCB Response Time Device OFF	V_{OUT} - V_{IN} =100mV V_{ON}=Low		2.5		μs

Electrical Characteristics(Continued)

Symbol	Parameters	Test Conditions	Min	Typ	Max	Unit
Dynamic Characteristics: See Definitions Below						
t_{DON}	Turn-On Delay[2,3]	V_{IN} =4.5V, R_L=5Ω, C_L=100μF, T_A=25°C		1.7		ms
t_R	V_{OUT} Rise Time[2,3]			2.7		ms
t_{ON}	Turn-On Time[2,4]			4.4		ms
t_{DON}	Turn-On Delay[2,3]	V_{IN} =4.5V, R_L=150Ω, C_L=100μF, T_A=25°C		1.7		ms
t_R	V_{OUT} Rise Time[2,3]			1.5		ms
t_{ON}	Turn-On Time[2,4]			3.2		ms
t_{DOFF}	Turn-Off Delay[2,4]	V_{IN} =4.5V, R_L=150Ω, C_L=100μF, T_A=25°C		1.8		ms
t_F	V_{OUT} Fall Time[2,3]			34		ms
t_{OFF}	Turn-Off Time[2,5]			35		ms

Notes:

2. This parameter is guaranteed by design and characterization; not production tested.
3. t_{DON} / t_{DOFF} / t_R / t_F are defined in Figure 3.
4. t_{ON} = t_R + t_{DON}
5. t_{OFF} = t_F + t_{DOFF}

Timing Diagram

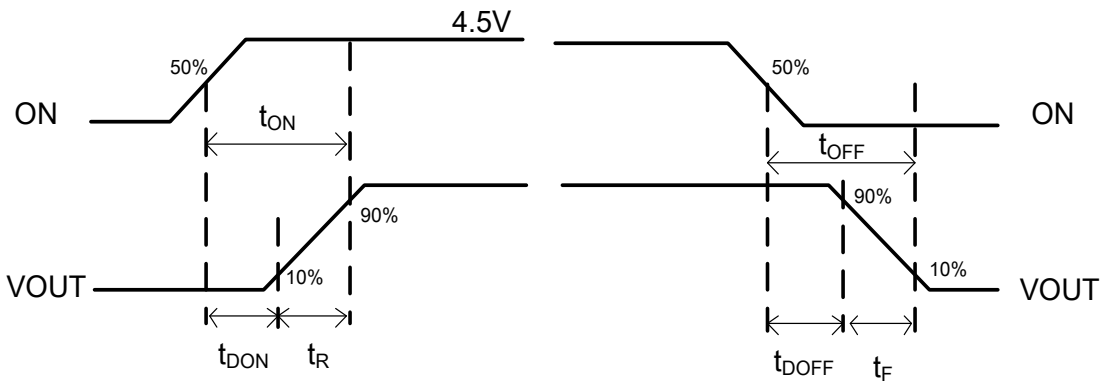


Figure 3.Timing Diagram

Application Circuits

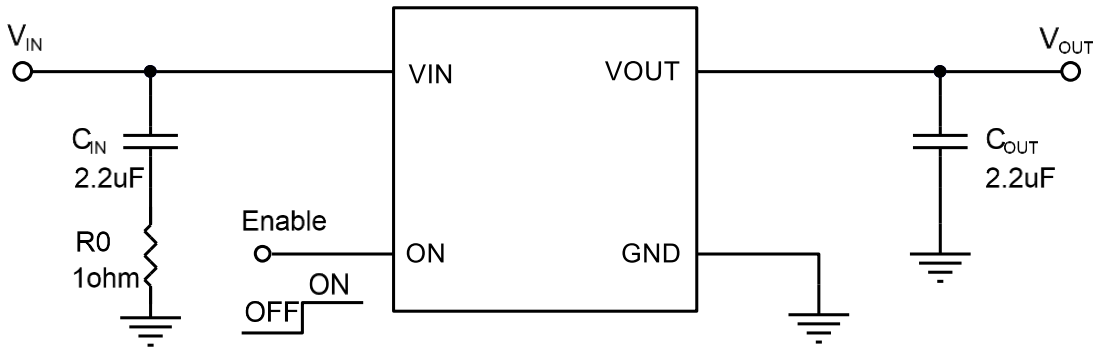


Figure 4. Typical Application

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.

Typical Characteristics

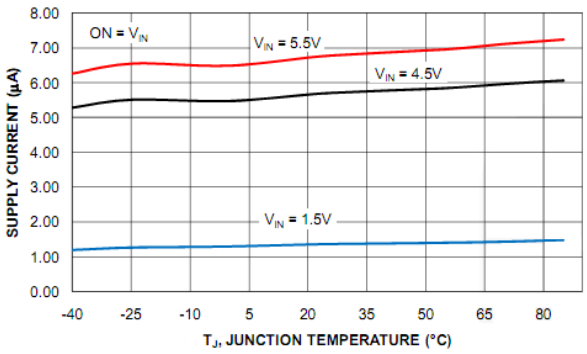


Figure 5. Supply Current vs Temperature

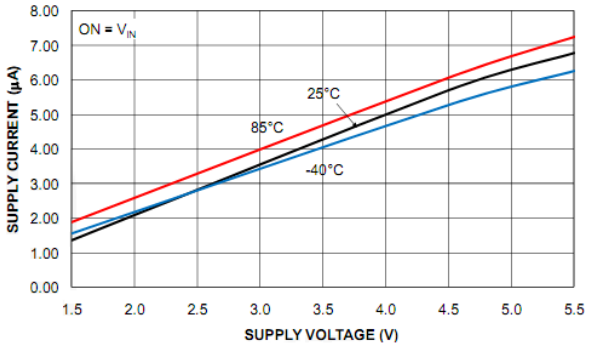


Figure 6. Supply Current vs Supply Voltage

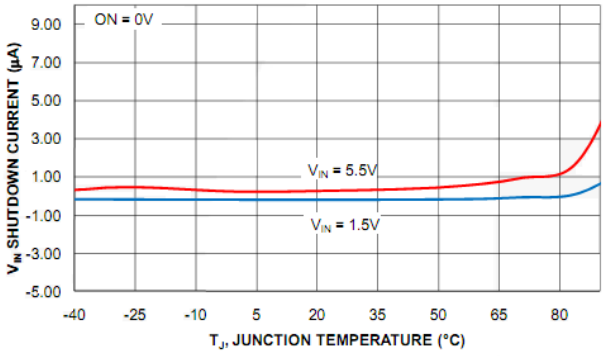


Figure 7. Shutdown Current vs Temperature

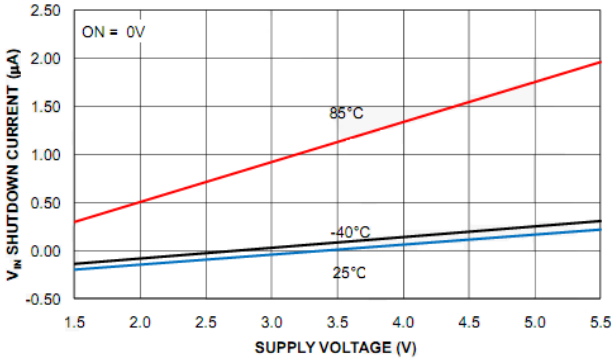


Figure 8. Shutdown Current vs Supply Voltage

Typical Characteristics(Continued)

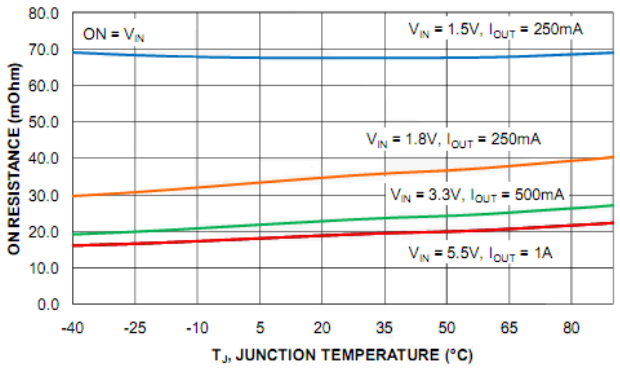


Figure 9. R_{ON} vs Temperature

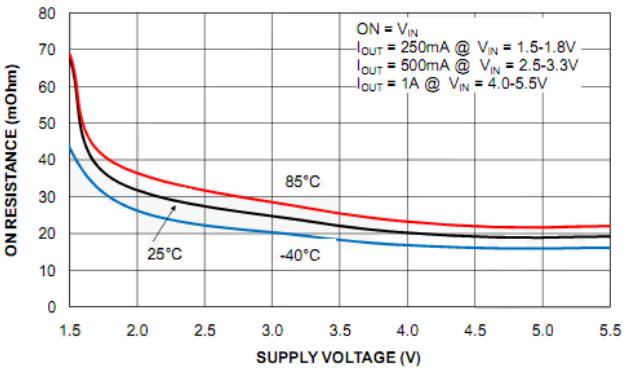


Figure 10. R_{ON} vs Supply Voltage

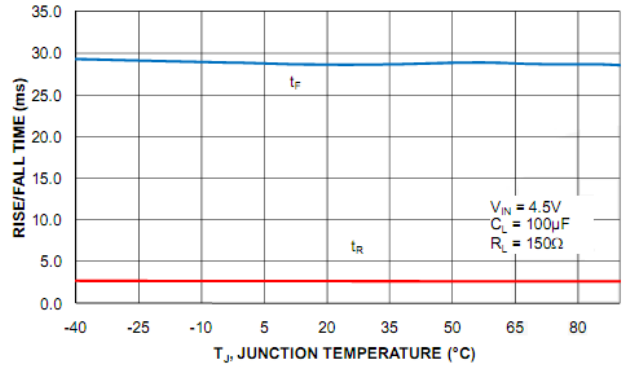


Figure 11. t_R /t_F vs Temperature

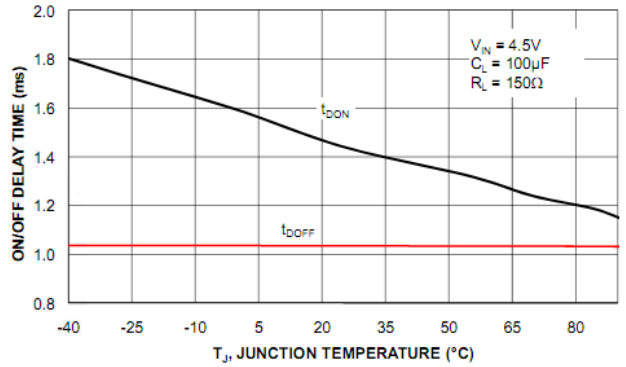


Figure 12. t_{DON} vs Temperature

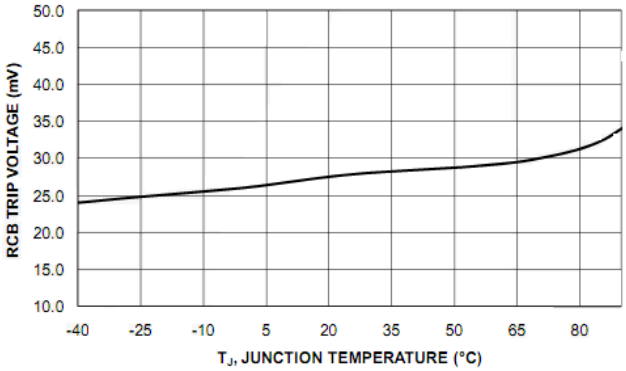


Figure 13. RCB Trip vs Temperature

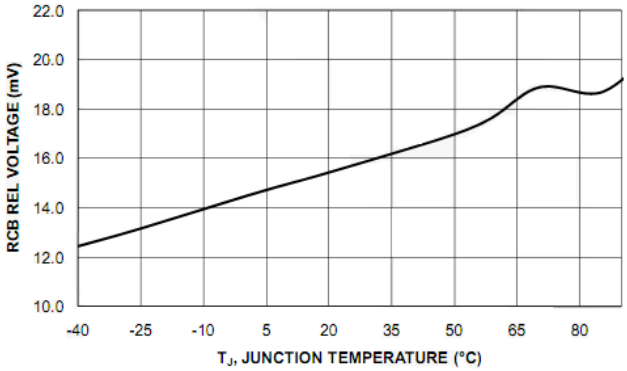
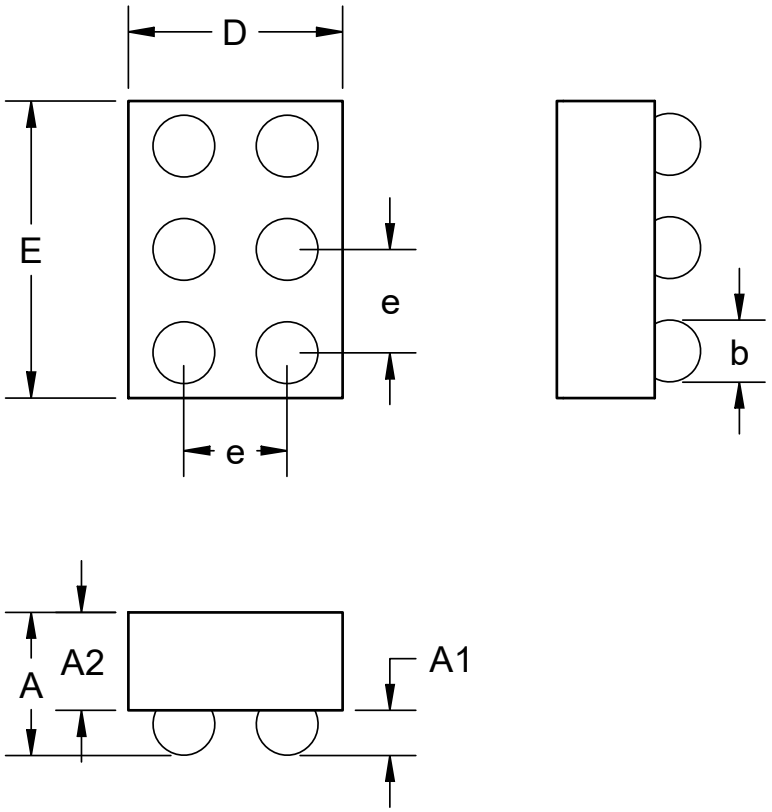


Figure 14. RCB Release vs Temperature

Package Dimension

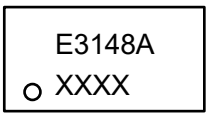
WLCSP6



Dimensions Table (Units: mm)

Symbol	Min	Nom	Max
A	0.490	0.565	0.640
A1	0.185	0.235	0.285
A2	0.305	0.33	0.355
b	0.30	0.32	0.34
D	1.04	1.06	1.08
E	1.54	1.56	1.58
e	0.5BSC		

Marking



E3148A = Part Number

XXXX = Track Number

Pin1 = A1

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.1	2022-10-29	Update Typeset	Shi Bo	Liuxm	Zhu Jun Li