Adjustable Current-Limit Load Switch with OVP

General Description

ET2095A load switch features True Reverse-Current Blocking (TRCB) capability to isolate the output from the system., the internal switch features low 100mΩ (typ) on-resistance and operate from a +2.5V to +5.5V input voltage range. The slew-rate controlled switch is also ideal for a large load capacitor as well as high-current load switching applications. ET2095A has over-voltage protection and over-temperature protection.

The ET2095A is packaged in small WLCSP9 1.24mm×1.16mm, is suitable for space-limited portable device applications.

The device operates over the -40°C to +85°C extended temperature range.

Features

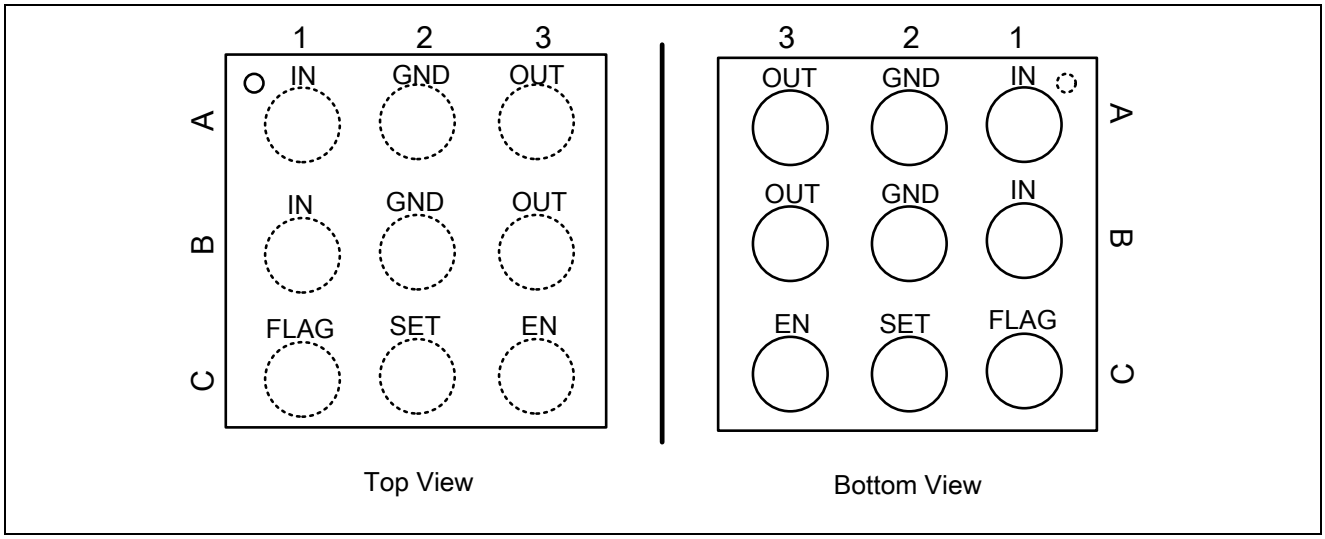
- Wide Input Voltage Range from 2.5V to 5.5V
- Max Current Capability:2.5A
- Absolute maximum voltage of V_{OUT} up to 28V
- Adjustable Current Limit Set Range : 0.1A~2.5A
  - 0.1A~2.0A with 10% Accuracy
  - >2.0A with 12% Accuracy
- Integrated Typical 100mΩ N-Channel MOSFET Switch
- Over-voltage Lockout at V_{OUT} = 5.8V Typical
- Fault Flag Open Drain Output
- Thermal Shutdown Protection (OTP)
- Under-Voltage Lockout (UVLO)
- True Reverse-Current Blocking (TRCB)
- ESD Protected:HBM>2.0kV; Charged Device Model>1.0kV
- Part No. and Package

Part No.	Package	MSL
ET2095A	WLCSP9 (1.24mm × 1.16mm , 0.4mm ball pitch)	1

Application

- Smart Phones, Tablet PCs
- HDD, Storage, and Solid State Memory Devices
- Portable Media Devices, Laptop & MID
- SLR Digital Cameras

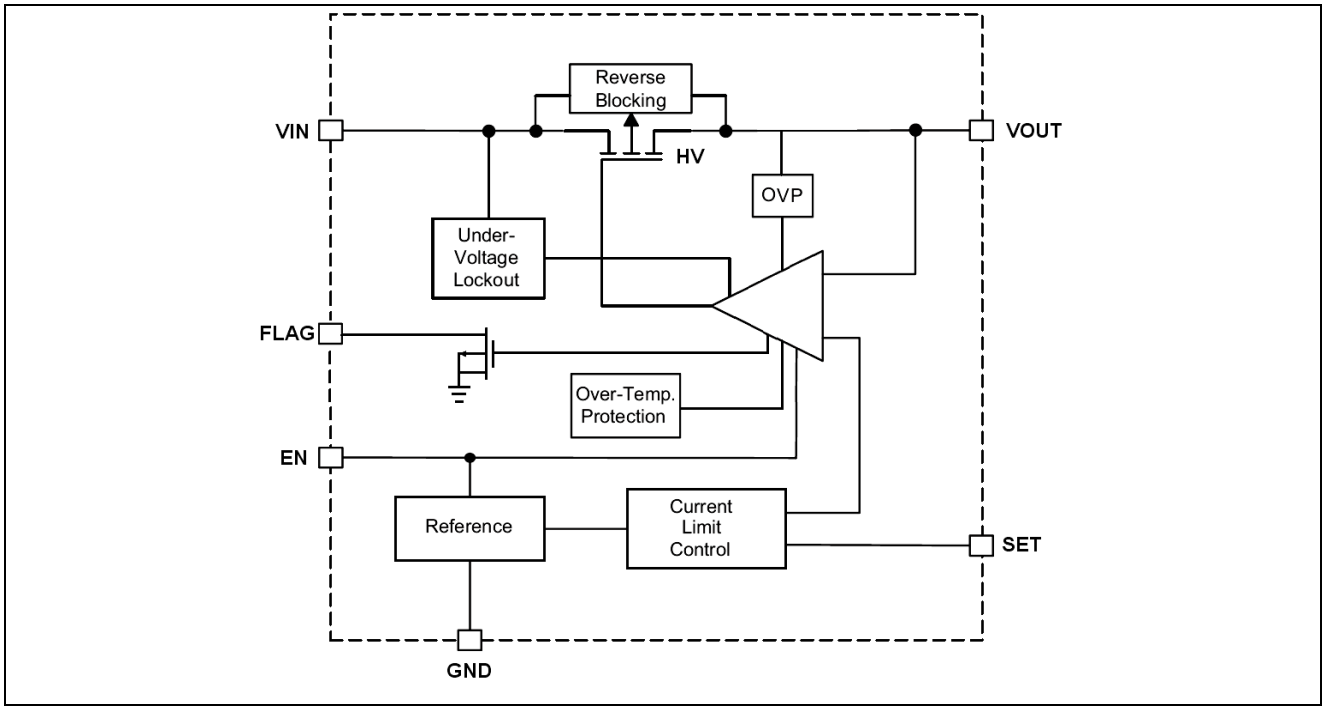
Pin Configuration



Pin Function

Pin	Name	Description
A3、B3	VOUT	Output of the load switch.
A1、B1	VIN	Input of the load switch.
A2、B2	GND	Ground.
C3	EN	Active HIGH - GPIO compatible Enable input. EN high to turn on the load switch.
C1	FLAG	Current limit fault flag pin. Open-drain output, active low signal. Pull up with a resistor.
C2	SET	Current limit set pin. Connect a resistor between this pin and ground to program the desired current limit point.

Block Diagram



Input Capacitor

The input capacitor C_{IN} protects the power supply from current transients generated by the load attached to the ET2095A. C_{IN} should be located as close to the device V_{IN} pin as practically possible. A high-value capacitor on C_{IN} can be used to reduce the voltage drop in high-current applications.

Output Capacitor

An output capacitor should be placed between the V_{OUT} and GND pins. This capacitor prevents parasitic board inductance from dorcing V_{OUT} below GND when the switch is on. This capacitor also prevents reverse inrush current from creating a voltage spike that could damage the device in the case of a V_{OUT} short.

Fault Reporting

The FLAG pin is provided to alert the system if an ET2095A load is not receiving sufficient current to operate properly. Upon the detection of an over-current, FLAG signal the fault by activating LOW.

Current Limiting

The current limit ensures that the current through the switch does not exceed the maximum set value, while not limiting the minimum value. The current at which the part's limit is adjustable through the selection of the external resistor connected to the SET pin. Information for selecting the resistor is found in the section below. The device acts as a constant-current source when the load draws more than the maximum value set by the device until thermal shutdown occurs. The device recovers if the die temperature drops below the threshold temperature. If current limit is not used, the SET pin could be connected with GND, but the maximum current must be less than the maximum current capability of 2.8A.

Under-Voltage Lockout (UVLO)

The under-voltage lockout turns the switch off if the input voltage drops below the lockout threshold. With the EN pin active, the input voltage rising above the UVLO threshold releases the lockout and enables the switch.

True Reverse-Current Blocking

The true reverse-current blocking feature protects the input source against current flow from output to input when the load switch is off.

Thermal Shutdown

The thermal shutdown protects the die from internally or externally generated excessive temperature. During an over-temperature condition, the switch is turned off. The switch automatically turns on again if the temperature of the die drops below the threshold temperature.

Setting Current Limit

The current limit is set with an external resistor connected between the SET and GND pins. The resistor is selected using Table 1. Resistor tolerance of 10% or less is recommended.

R_{SET} (Ω)	Current Limit (mA)		
	Min	Typ	Max
422	2200	2500	2800
528	1800	2000	2200
604	1570	1750	1920
680	1350	1500	1650
866	1125	1250	1375
1070	900	1000	1100
1200	810	900	990
1330	720	800	880
1500	630	700	770
1740	540	600	660
2100	450	500	550
2320	405	450	495
2550	360	400	440
2940	315	350	385
3400	270	300	330
4020	225	250	275
4990	180	200	220
6490	135	150	165
9530	90	100	110

Note: Table values based on 1% tolerance resistor.

Board Layout

For best performance, all traces should be as short as possible. To be most effctive, 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 for V_{IN},V_{OUT},GND helps minimize parasitic electrical effects along with minimizing the case-to-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	Parameters		Min	Max	Unit
V_{PIN}	V_{OUT} to GND, V_{OUT} to V_{IN}		-0.3	28	V
	EN,V_{IN},FLAG,SET to GND		-0.3	7.0	V
I_{SW}	Maximum Continuous Switch Current			2.8	A
T_J	Operating Junction Temperature		-40	+150	°C
T_{STG}	Storage Junction Temperature		-65	+150	°C
θ_{JA}	Thermal Resistance, Junction-to-Ambient (1-inch Square Pad of 2 oz.copper)			95	°C/w
P_D	Total Power Dissipation at T_A=25°C			1.0	W
V_{ESD}	Electrostatic Discharge Capability	Human Body Model, JESD22-A114	2.0		kV
		Charged Device Model, JESD22-C101	1.5		
	IEC61000-4-2 System Level	Air Discharge (V_{IN},V_{EN},V_{OUT} to GND)	15.0		
		Contact Discharge(V_{IN},V_{EN},V_{OUT} to GND)	8.0		

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. ET2095 does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameters	Min	Max	Unit
V_{IN}	Supply Voltage	2.5	5.5	V
T_A	Ambient Operating Temperature	-40	85	°C

Electrical Characteristics

(V_{IN}=2.5 to 5.5 V, T_A= -40 to +85°C, typical values are at V_{IN}=5V and T_A=25°C, unless otherwise stated)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
Basic Operation						
V_{IN}	Input Voltage		2.5		5.5	V
$I_{Q(OFF)}$	Off Supply Current	V_{EN}=GND,V_{OUT}=Open		1	2	uA
$I_{SD(OFF)}$	Shutdown Current	V_{IN}=5.5V,V_{OUT}=0V,V_{EN}=GND		0.1	4.0	uA
I_Q	Quiescent Current	I_{OUT}=0mA		65	100	uA
R_{ON}	On Resistance	V_{IN}=5.0V, I_{OUT}=1A		100	120	mΩ
V_{IH}	EN Input Logic HIGH Voltage	V_{IN}=2.5V to 5.5V	1.15			V
V_{IL}	EN Input Logic LOW Voltage	V_{IN}=2.5V to 5.5V			0.65	V
V_{IL_FLAG}	FLAG Output Logic LOW Voltage	V_{IN}=5.0V, I_{SINK}=10mA		0.1	0.2	V
		V_{IN}=2.5V, I_{SINK}=10mA		0.15	0.30	
I_{FLAG_LK}	FLAG Output HIGH Leakage Current	V_{IN}=5.0V,Switch On			1	uA
I_{EN}	EN Input Leakage	V_{EN}=0V to V_{IN}			1	uA
R_{EN_PD}	Pull-Down Resistance at EN Pin	V_{IN}=2.5~5.5V, V_{EN}=HIGH, T_A=-40 to 85°C		14		MΩ
Over-Voltage Protection						
V_{OV_TRIP}	Output OVP Lockout	V_{OUT} Rising Threshold	5.5	5.8	6.0	V
		V_{OUT} Falling Threshold		5.5		
OUT_{HYS}	Output OVP Hysteresis		0.1	0.3	0.5	V
t_{OVP}	Response Time	I_{OUT}=0.5A,C_L=1uF,T_A=25°C, V_{OUT} from 5.5V to 6.0V	1		4	us
Over-Current Protection						
I_{LIM}	Current Limit[(1)]	V_{IN}=5.0V,R_{SET}=2100Ω, V_{OUT}=1.68V to 5.0V with 10% Accuracy	450	500	550	mA
		V_{IN}=5.0V,R_{SET}=1070Ω, V_{OUT}=1.68V to 5.0V with 10% Accuracy	900	1000	1100	
V_{UVLO}	Under-Voltage Lockout	V_{IN} Incresaing	1.9	2.3	2.5	V
		V_{IN} Decreasing	1.8	2.1	2.4	
V_{UVLO_HYS}	UVLO Hysteresis			200		mV
I_{RCB}	RCB Current	V_{EN}=0V,V_{OUT}=5.5V			3	uA
t_{HOCP}	Hard Over-Current Response Time	Moderate Over-Current Condition, I_{OUT}≥I_{LIM} V_{OUT}=0V		6		us
t_{OCP}	Over-Current Response Time	Moderate Over-Current Condition, I_{OUT}≥I_{LIM} V_{OUT}≤V_{IN}		7		us

Electrical Characteristics (Continued)

(V_{IN}=2.5 to 5.5 V, T_A= -40 to +85°C, typical values are at V_{IN}=5V and T_A=25°C, unless otherwise stated)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
t_{OCF}	Over-Current Flag Response Time	When Over-Current Occurs to Flag Pulling LOW		8		ms
TSD	Thermal Shutdown(2)	Shutdown Threshold		155		°C
		Return from Shutdown		135		
		Hysteresis		20		
Dynamic Characteristics						
t_{DON}	Turn-On Delay(2,3)	V_{IN}=5V, R_L=100Ω, C_L=1μF, T_A=25°C, R_{SET}=2.04kΩ		0.67		ms
t_R	V_{OUT} Rise Time(2,3)			0.69		
t_{ON}	Turn-On Time(2,4)			1.36		
t_{DOFF}	Turn-Off Delay(2,3)			0.01		
t_F	V_{OUT} Fall Time(2,3)			0.22		
t_{OFF}	Turn-Off Time(2,5)			0.23		

Notes:

1. Characterization based on 1% tolerance resistor.

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

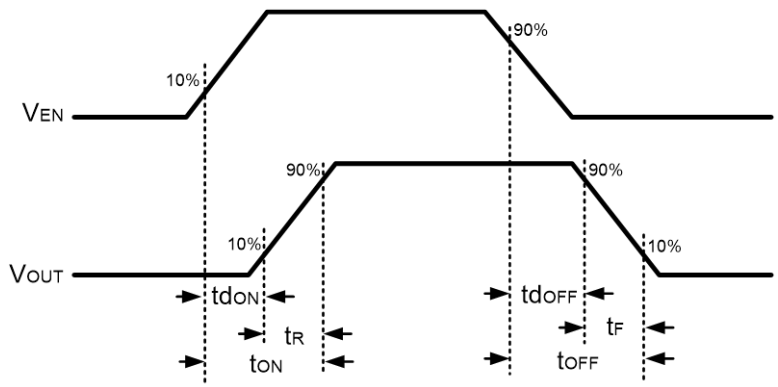
3. t_{DON}/t_{DOFF}/t_R/t_F are defined in Timing Diagrm below.

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

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

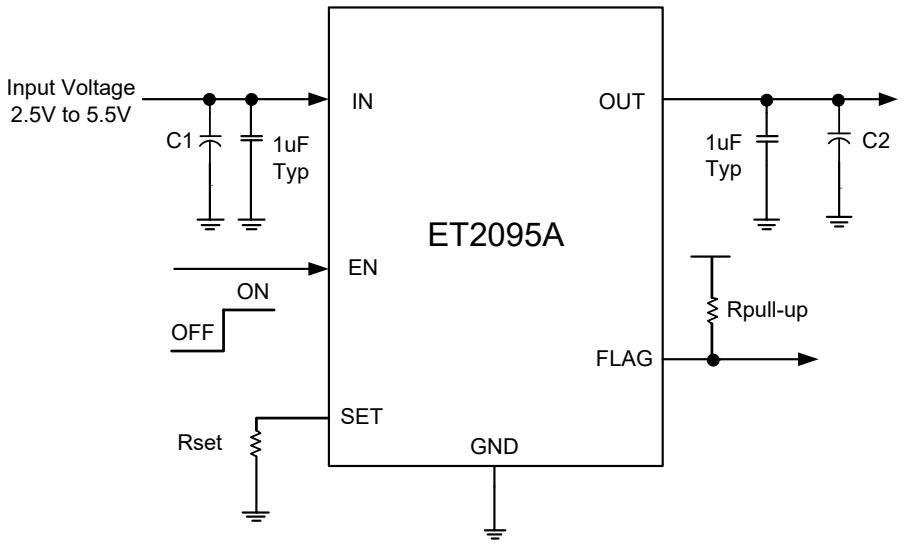
6. The relationship between V_{IH}/V_{IL} and V_{IN} is as shown below. Please follow EC table when using ET2095A.

Timing Diagram



Timing Diagram

Application Circuits



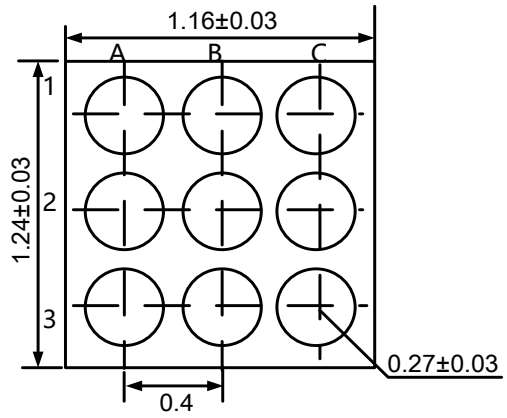
Notes:

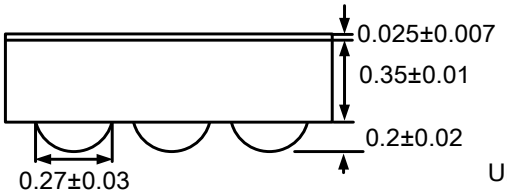
* C_{IN} and C_{OUT} capacitors recommended for improvement of device stability.

** This electric circuit only supplies for reference.

Package Dimension

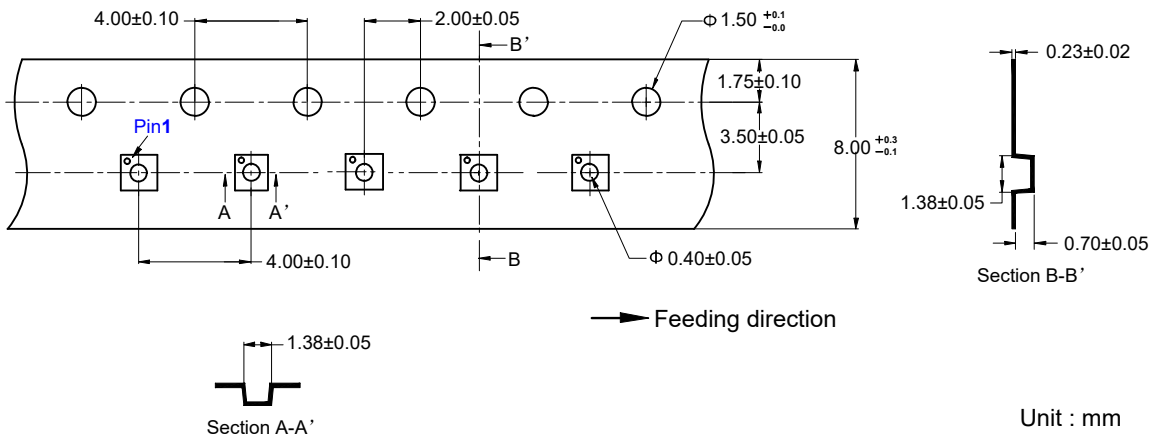
WLCSP9





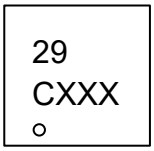
Unit:mm

Tape Information



Unit : mm

Marking



29 - Part Number

CXXX - Tracking Number

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2021-11-10	First version	Wum	Wuxj	Zhujl
1.1	2022-02-24	Correct Typo	Wum	Wuxj	Zhujl
1.2	2022-12-14	Update Format	Zou Chao Min	Shi Bo	Zhujl
1.3	2023-10-23	Update marking	Shibo	Shi Bo	Liu Jia Ying