XPA1134

5.5V, 4A, 8mΩ ON-Resistance Load Switch with Controlled Turn-on

1. Description

The XPA1134 is a small size, 8mΩ ON-resistance load switch with controlled turn-on.

XPA1134 contains a MOSFET that can deliver up to 4A current from 1.0V to 5.5V source. An Enable Logic input turns on or off the device. Internally controlled slew rate limits the inrush current on capacitive loads. It has an integrated 230Ω output discharge resistor to eliminate residual voltage on the output rail.

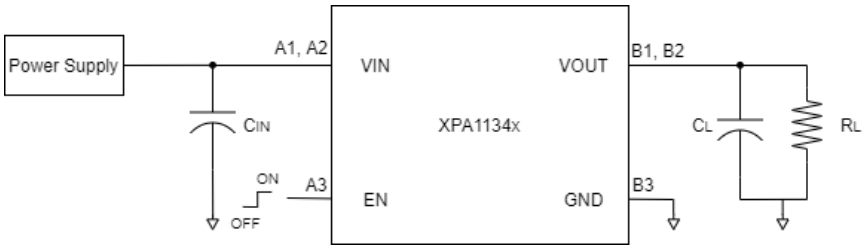
The XPA1134 comes in a compact 6 pin WLCSP package with 1.48mm x 0.98mm size, 0.5mm pitch.

2. Applications

- Optical modules
- Cellular Phones
- Tablets
- Wireless Data Cards
- Embedded Power supply
- Wearables and IoT
- Security and Surveillance

3. Features

- Integrated Single-Channel Load Switch
- Input Voltage: 1V to 5.5V
- 4A Continuous Output Current
- Ultra-Low 8mΩ On-Resistance
- 36uA Quiescent Current @3.6Vin
- 40nA Shutdown Current @5.5Vin
- Logic Enable Input
- 230Ω Output Discharge Resistor
- Controlled Slew Rate to Avoid Inrush Currents
- Ultra-Low Junction-to-Ambient Thermal Resistance
- Small WLCSP-6 Package 1.48mm x 0.98mm, 0.5mm pitch
- RoHS compliance, Pb/Halogen free



Typical Application Circuit

4. Revision History

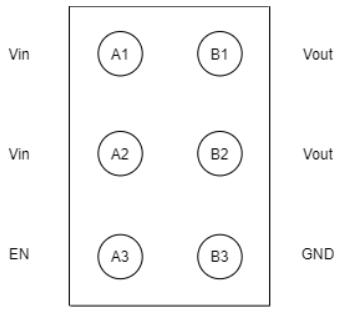
Release	Rev	Changes	Date
Initial release	0.2	Initial release	4/5/22
Update	0.9	Fine tune spec limit	12/12/22
Update	0.92	Add continuous operating current	6/1/2023

5. Ordering Information

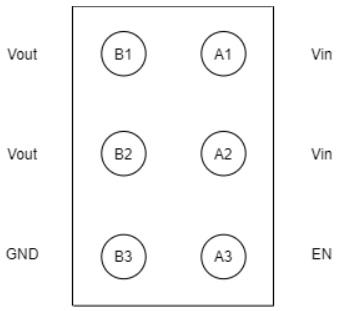
Family	Part Number	Current rating (A)	Top Marking	MPQ
XPA1134CB	XPA1134CB	4	A1134	3,000

MPQ means Minimum Packing Quantity.
For production orders greater than MPQ, the order must be a multiple of MPQ per package size above.

6. PIN Configuration and Description



Laser Mark View



Bump View

Pin	Name	Description
A1, A2	VIN	Power supply input. Place a decoupling capacitor from VIN to GND.
B1, B2	VOUT	Output pin. Connect to Load.
A3	EN	Enable control. Part is active when EN > 1.2V. Part is disabled with internal discharge resistor when EN < 0.4V.
B3	GND	Ground.

7. Absolute Maximum Ratings(1)

Parameter	Min	Max	Units
DC Supply Voltage, VIN	-0.3	+6.5	V
Voltage on other pins, VOUT, EN	-0.3	V_{IN} + 0.3	V
Storage Temperature Range	-40	+150	°C
Junction Temperature	-40	+150	°C
Electrostatic Discharge (HBM)	-5000	+5000	V
Electrostatic Discharge (CDM)	-1000	+1000	V

Note: (1) Operation of the device outside of these parameters may cause permanent damage.

8. Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units
Input Voltage	V_{IN}	1.0		5.5	V
Output Voltage	V_{OUT}	0		V_{IN}	V
High-level Input Voltage	V_{IH}	1.2		5.5	V
Low-level Input Voltage	V_{IL}	0		0.4	V
Input Capacitor	C_{IN}		1		µF
Ambient Temperature	T_A	-40		+85	°C
Junction Temperature	T_J	-40		+125	°C

9. Thermal Information

Junction to ambient thermal resistance is a function of board layout and ambient air flow condition. This data is based on four layers PCB (30mm x 30mm; 70µm Cu top signal layer) in still air box in accordance with JEDEC standard JESD51 on natural convection.

Parameter	Symbol	Typ	Units
Junction-to-Ambient Thermal Resistance	θ_{JA}	37	°C/W
Junction-to-Case Thermal Resistance	θ_{JC}	24	°C/W

10. Electrical Specifications

(Typical values are at T_A = +25°C, V_{IN} = 1V to 5.5V. Unless otherwise noted.)

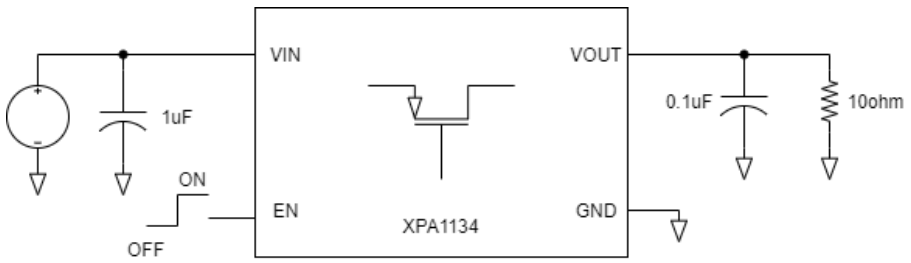
Parameter	Symbol	Test Condition	T_A	Min	Typ	Max	Units
Quiescent Current	I_Q	V_{IN} = 5.5V	Full		56	250	uA
		V_{IN} = 3.6V			36	91	
		V_{IN} = 1.0V			20	32	
Shutdown Current	I_{SHDN}	EN = GND, V_{OUT} = 5.5V, V_{OUT} = 0V	Full		0.04	4.6	uA
		EN = GND, V_{OUT} = 3.6V, V_{OUT} = 0V			0.008	1.5	
On Resistance	R_{ON}	V_{IN} = 5.5V, I_{OUT} = -200mA	25°C		7.7	9.4	mΩ
			Full			13.5	
		V_{IN} = 3.6V, I_{OUT} = -200mA	25°C		7.8	9.4	
			Full			13.5	
		V_{IN} = 1.0V, I_{OUT} = -200mA	25°C		26.5	69.5	
			Full			93	
Continuous Operating Current	I_{OUT}	V_{IN} = 1V to 5.5V	Full	4			A
Output pulldown resistance	R_{PD}	EN=GND, V_{IN} = 3.6V	Full		220	240	Ω

Enable pin leakage current	I_{LPIN}	V_{ON} = 1.0V to 5.5V	Full	760	nA

11. Switching Characteristics

Parameter	Symbol	Test Condition	Typ	Units
TA = +25°C, VIN=5.0V, unless otherwise noted				
Turn-on Time	t_{ON}	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	700	us
Turn-off Time	t_{OFF}	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	2.2	
Vout rise time	t_r	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	1060	
Vout fall time	t_f	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	2.5	
Delay time	t_D	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	230	
TA = +25°C, VIN=4.5V, unless otherwise noted				
Turn-on Time	t_{ON}	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	725	us
Turn-off Time	t_{OFF}	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	2.2	
Vout rise time	t_r	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	1084	
Vout fall time	t_f	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	2.4	
Delay time	t_D	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	260	
TA = +25°C, VIN=3.3V, unless otherwise noted				
Turn-on Time	t_{ON}	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	850	us
Turn-off Time	t_{OFF}	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	2.0	
Vout rise time	t_r	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	1170	
Vout fall time	t_f	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	2.4	
Delay time	t_D	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	340	
TA = +25°C, VIN=1.2V, unless otherwise noted				
Turn-on Time	t_{ON}	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	640	us
Turn-off Time	t_{OFF}	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	3.2	
Vout rise time	t_r	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	800	
Vout fall time	t_f	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	2.2	
Delay time	t_D	R_L=10 Ω, C_{IN}=1uF, C_L=0.1uF	300	

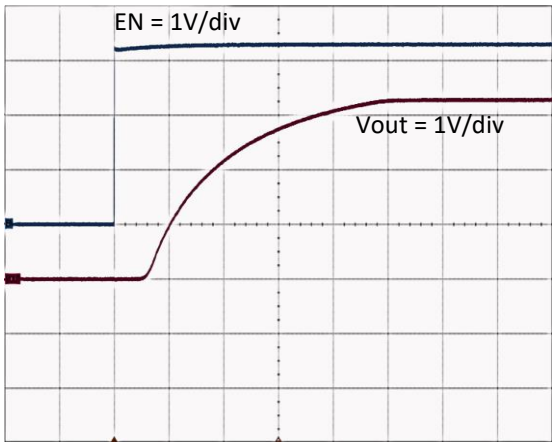
12. Parameter Measurement Information



Test circuit

Timing waveforms

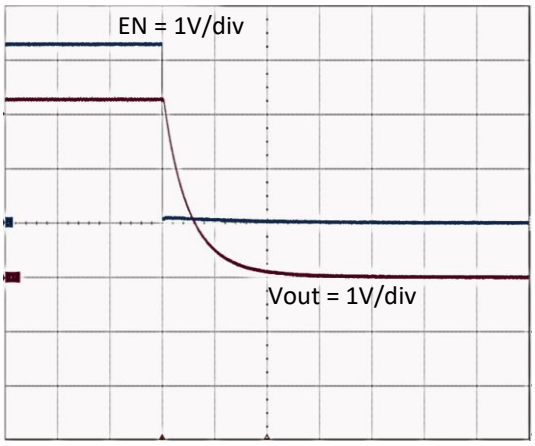
13. Typical Performance and Operating Characteristics



Time = 100us/div

Turn-On Response

V_{IN}=3.3V, C_{IN}=1uF, C_{OUT}=0.1uF, R_L=10Ω



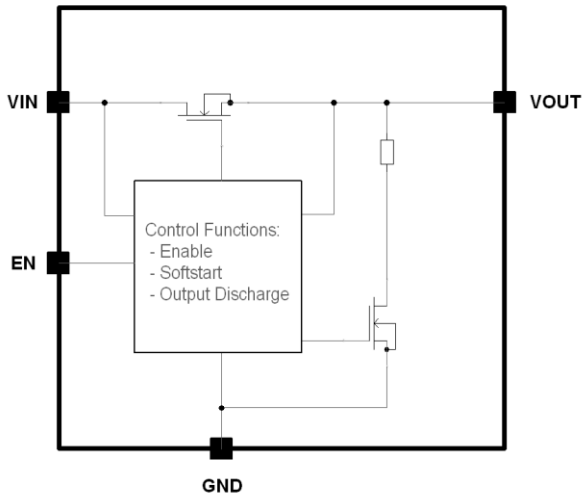
Time = 50us/div

Turn-Off Response, Output Discharge

V_{IN}=3.3V, C_{IN}=1uF, C_{OUT}=0.1uF, R_L=10Ω

14. Functional Description

The XPA1134 is a low on-resistance switch with logic enable/disable function. XPA1134 has a soft-start functionality to limit inrush current of capacitive loads during turn-on. It operates at input voltage between 1.0V and 5.5V and can deliver up to 4A of load current.



Block Diagram

Functional Table

EN	V_{IN} TO V_{OUT}	Output Discharge(1)
L	Off	Active
H	On	Disabled

Note (1): This feature discharges the output of the switch to ground through a 230ohm resistor, preventing the output from floating.

Enable

Setting the EN voltage to logic level High enables the device. Alternatively, the device is disabled when the EN voltage is set to logic level Low. In this state the IC draws less than 1.5µA of current and the output is pulled to ground through a resistive load. This pin has an internal discharge resistor.

Soft-Start

When the device is enabled, internal soft-start circuitry ramps V_{OUT} up at 1.2ms @ 3.3Vin to limit inrush current. This feature protects a high impedance source from being pulled to a lower voltage as the device turns on.

Active Output Discharge

When the device is disabled through the EN pin, a discharge path for the output capacitor is created between V_{OUT} and ground through a 230Ω resistor.

15. Application Information

Input and Output Capacitors

It is recommended to place 1uF capacitor between VIN and GND and 0.1uF capacitor between VOUT and GND, in close proximity to improve stability.

Higher output capacitance can be used but inrush current during startup should be considered and managed. Inrush current can be calculated by below formula.

$$\text{I\_Inrush} = Cout \times \frac{dv}{dt}$$

Where:

- C_{OUT} is Output capacitance
- d_v = Output voltage
- d_t = Rise time

Power Dissipation

The MOSFET power dissipation is the main contributor to device junction temperature.
Assuming this, the power dissipation and the junction temperature in stable status can be calculated with the following equations.

$$P_D = R_{ON} \times {I_{OUT}}^2$$

Where:

- P_D = Power dissipation (W)
- R_{ON} = Power MOSFET on-resistance (Ω)
- I_{OUT} = Output current (A)

$$T^J = P_D \times \theta_{JA} + T_A$$

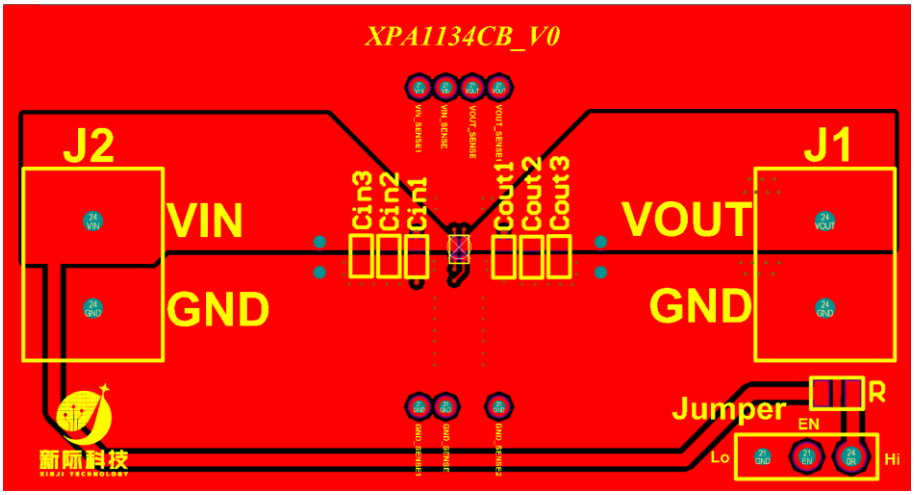
Where:

- T_J = Junction temperature (°C)
- θ_{JA} = Junction-to-Ambient Thermal Resistance (°C/W)
- T_A = Ambient temperature (°C)

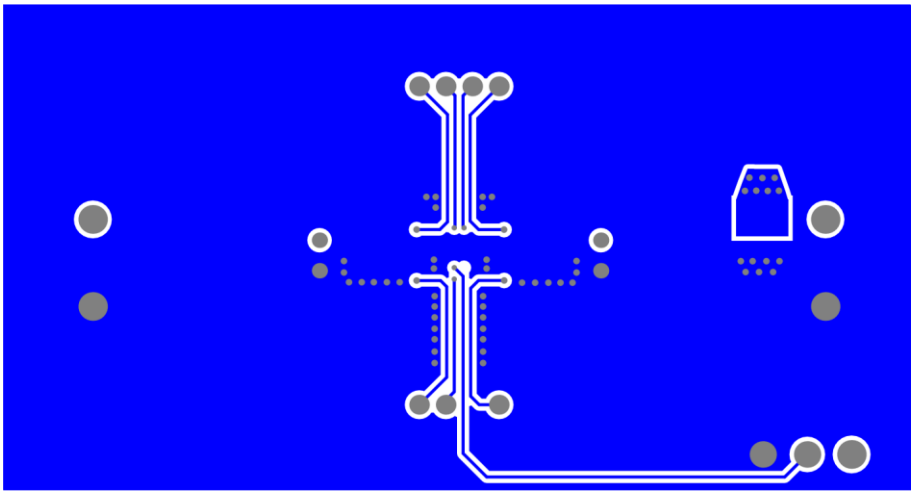
PCB Layout

Place the input and output capacitors as close to the device as possible.

All traces should be as short as possible to minimize parasitic inductance effects. Wide traces for VIN, VOUT, and GND can help reduce signal degradation and parasitic effects during dynamic operation as well as improve the thermal performance at high load currents.



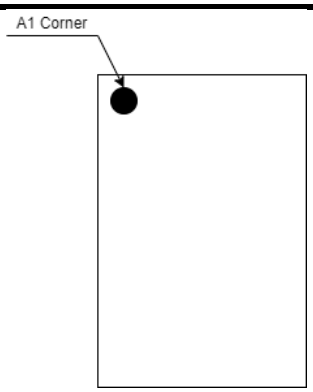
Demo board PCB Top Layer



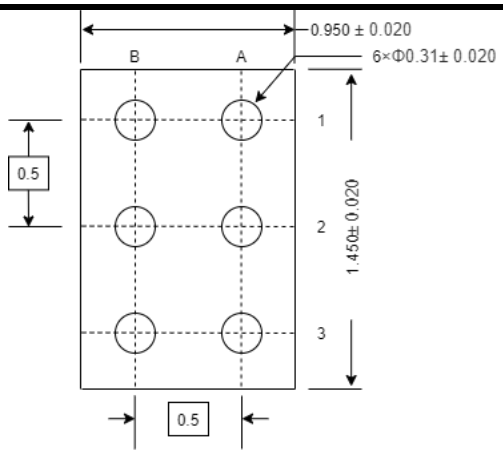
Demo board PCB Bottom Layer

Physical Dimensions

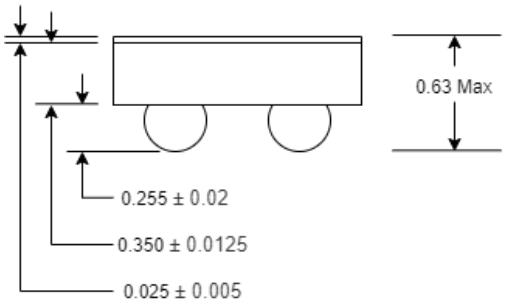
WLCSP-1.48mm x 0.98-6B



Top View

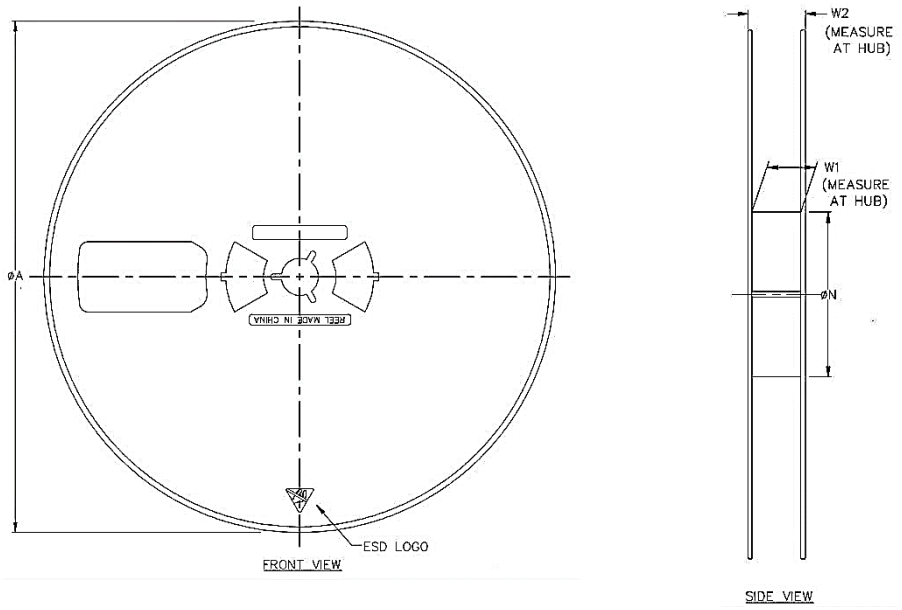


Bottom View



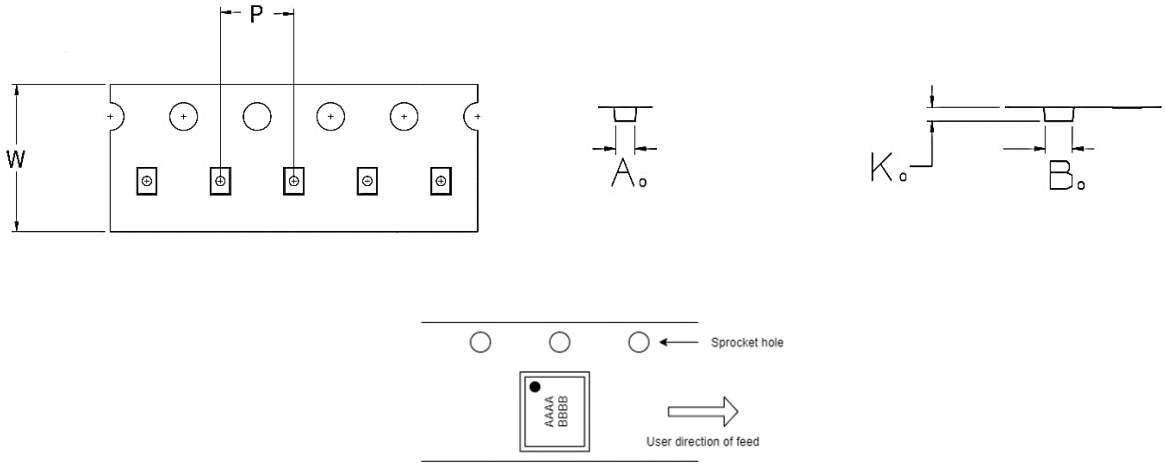
Side View

Tape and Reel Information



Reel Dimensions

Tape Width	ØA	ØN	W1	W2
8.0 mm	178.0 mm	54.0 mm	9.5 mm	15 mm (max)



Carrier Tape Dimensions

Symbol	Description	Value (mm)
W	Carrier tape overall width	8.00
P	Pitch between successive cavity centers	4.00
A0	Cavity dimension designed to accommodate the component width	1.10
B0	Cavity dimension designed to accommodate the component length	1.60
K0	Cavity dimension designed to accommodate the component thickness	0.72