70mΩ, 5V USB High Side Current Limited Load Switch

Description

BL2556 is a USB output protection chip with adjustable current limit threshold for 5V applications. The device integrates over current protection, short protection, over temperature protection, under voltage lock-out protection functions, etc. It can limit output current when short event happens or heavy capacitive load is applied to the USB output, so as to protect the supply voltage source from collapsing.

Features

- Low on resistance: 70mΩ
- Current-limit threshold adjustable by external resistor
- Current limit accuracy over full operating conditions：±15%
- Output short fast response and protection
- No parasitic substrate diode, and reverse current blocking when switch is off.

Typical Application

- USB hub
- USB periphery
- Notebook and tablet
- Charger and adapter

Package

- 5-pin SOT23-5

Typical Application Circuit

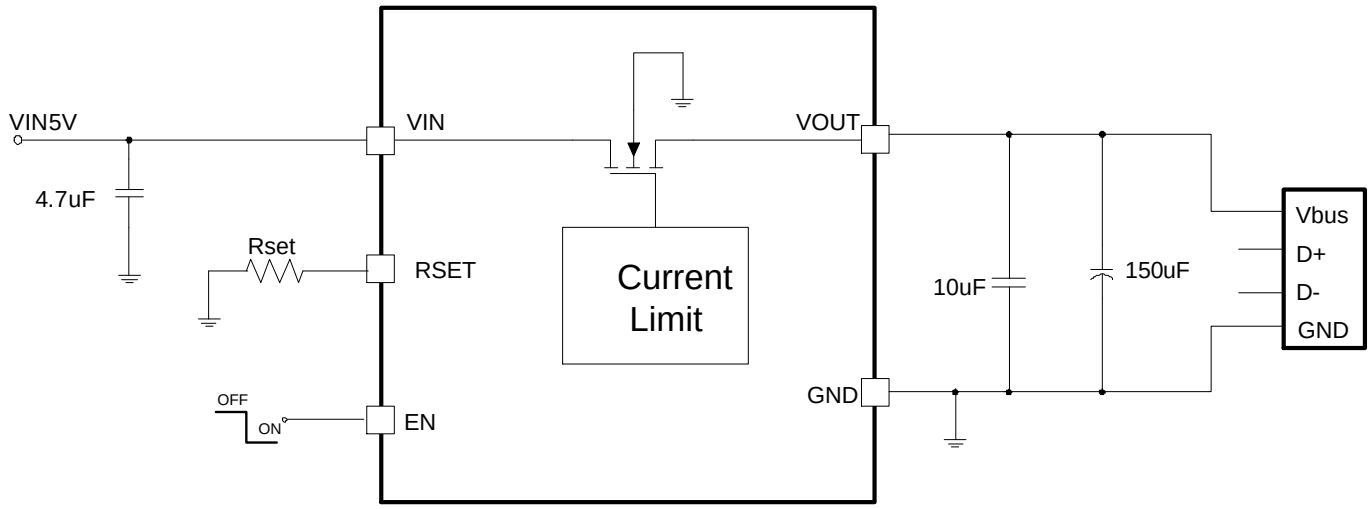
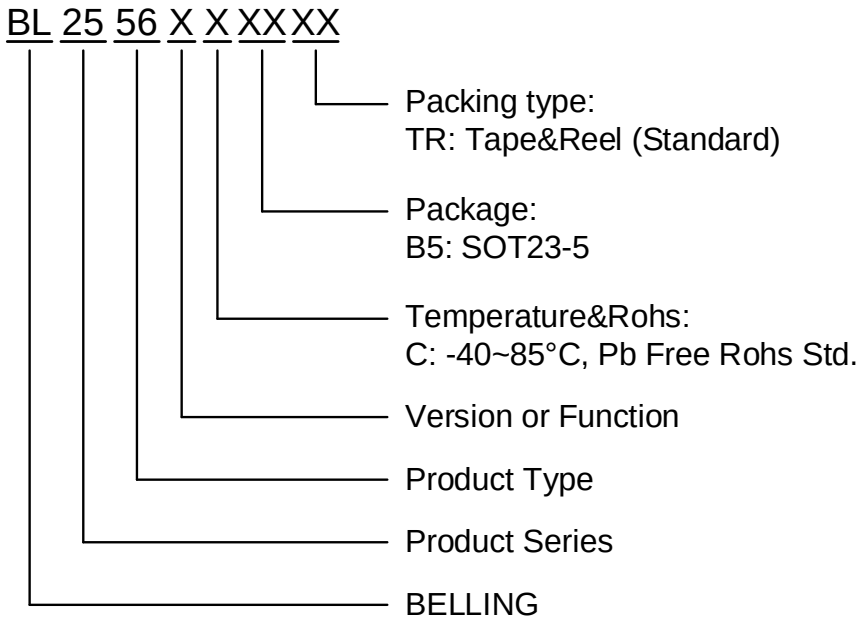


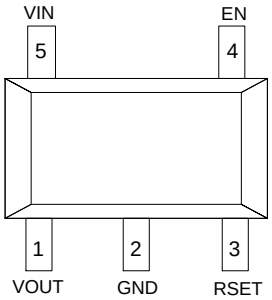
Figure 1. Typical application

Selection Guide



Part Number	Description
BL2556ACB5TR	Current limit threshold is adjustable, EN high enable; Package: SOT23-5
BL2556CCB5TR	Current limit threshold is adjustable, EN low enable; Package: SOT23-5

Pin Configuration



SOT23-5

Mark Explanation

$\overline{\text{SJ}}$: Product Code

3rd: Means Assembly Year

A	…	T	…	W	…	Z
2001	…	2020	…	2023	…	2026

4th: Means Assembly Month

A	B	C	D	E	F
Jan	Feb	Mar	Apr	May	Jun
G	H	I	J	K	L
Jul	Aug	Sep	Oct	Nov	Dec

Pin Assignment

Pin# (SOT23-5)	Symbol	Pin Description
1	VOUT	Output, connected to USB port VBUS.
2	GND	Chip ground.
3	RSET	Current limit threshold setting pin, external resistance to ground to set the current limit threshold. Ioc=60K/Rset
4	EN	Chip enable pin. Logic low effective.
5	VIN	Power supply pin.

Block Diagram

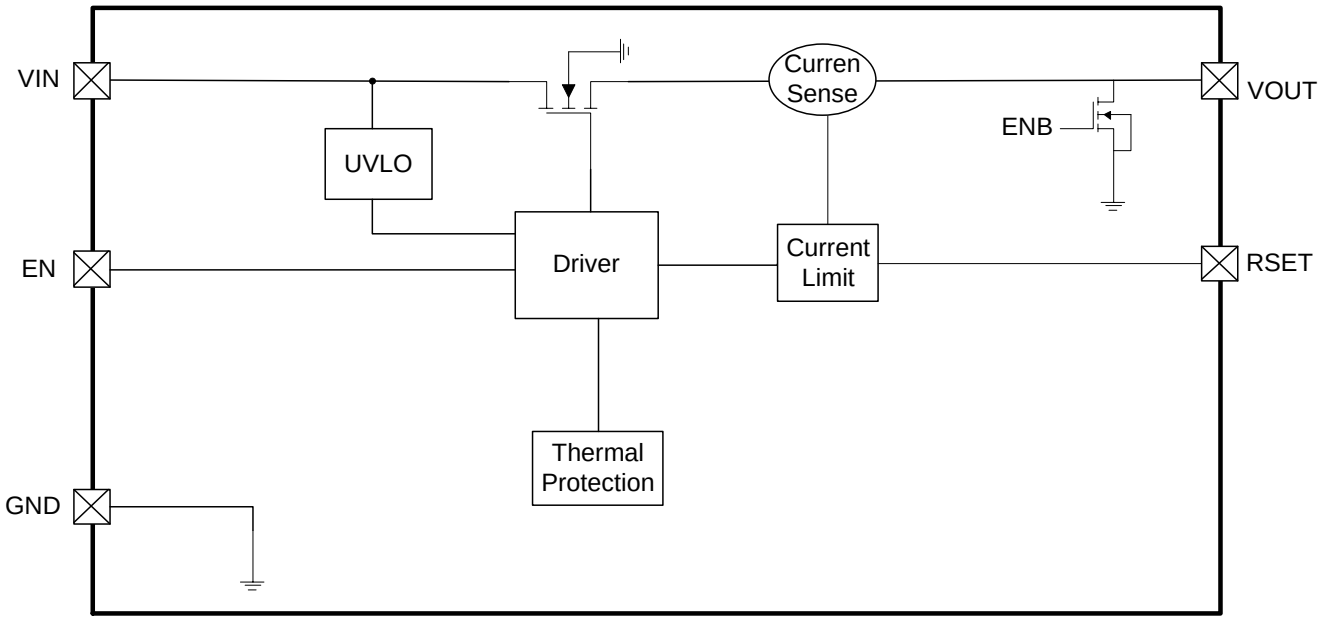


Figure 2. Internal block diagram

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Power supply	VIN	6	V
Output voltage	VOUT	-0.3 to VIN	V
Dissipation power SOT23-5	P_D	600	mW
Thermal resistance(Junction to air) SOT23-5	θ_{JA}	210	°C /W
Junction temperature	T_J	-40 to +150	°C
Storage temperature	T_{STG}	-55 to +150	°C
Soldering temperature (5 seconds)	T_{LEAD}	260	°C

Caution: Exceeding these ratings may damage the device.

Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply	VIN	2.7	5.0	5.5	V
Operating ambient temperature	Ta	-40	25	85	°C

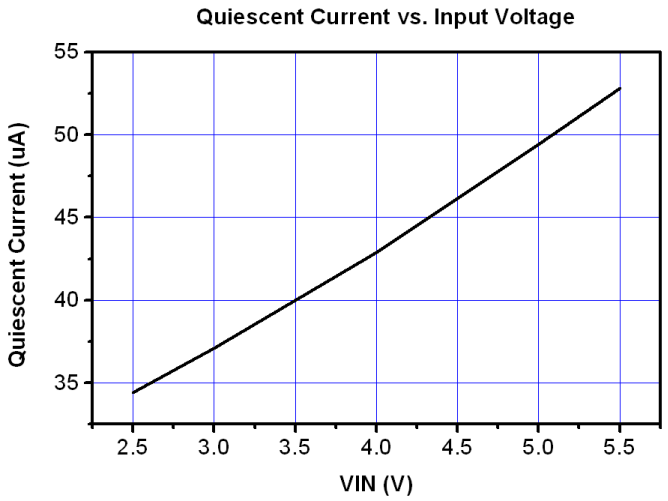
Electrical Characteristics

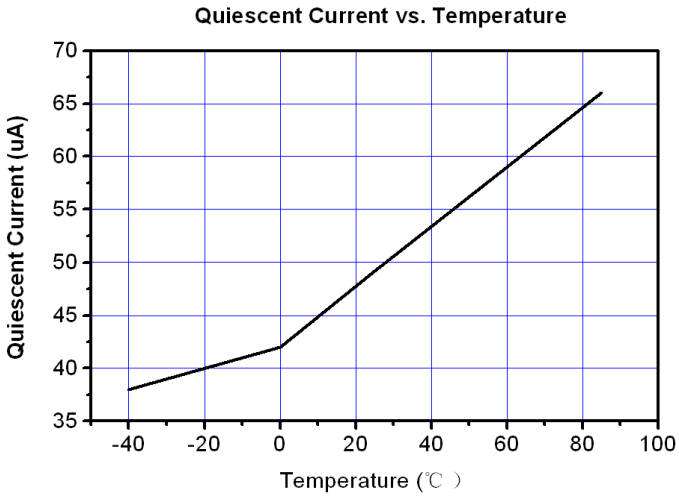
Unless otherwise noticed, Ta=25°C, VIN=5V, Rset=30K.

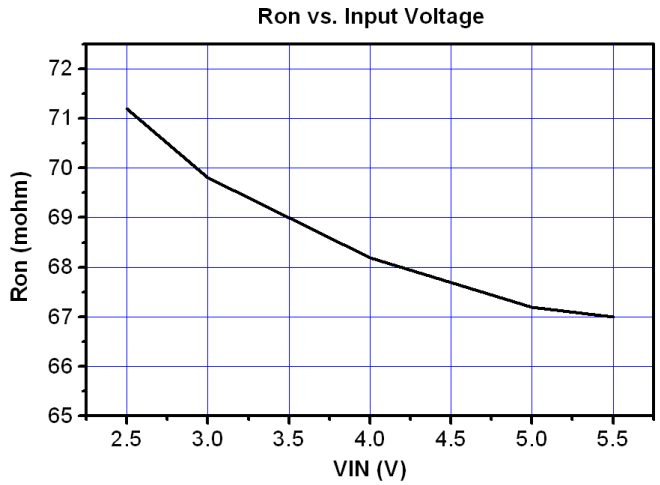
Parameter	Conditions	Min.	Typ.	Max.	Unit
Supply voltage range		2.7		5.5	V
Quiescent current	EN=0	30	50	80	uA
Shutdown current	EN=5V	0	0.01	1.0	uA
On resistance	Iout=500mA		70		mΩ
Current limit threshold	Current ramping (<0.1A/ms) VIN: 2.7~5V Ta: -40°C~85°C Rset=30K	1.7	2.0	2.3	A
Short current	Rset=30K, VOUT short to GND		1.2		A
UVLO	VIN increasing	1.8	2.2	2.6	V
UVLO hysteresis	VIN decreasing		0.2		V
EN high level		1.6			V
EN low level				0.4	V
Over temperature protection threshold			155		°C
Over temperature protection hysteresis			20		°C
Tr	Full load at VIN=3V CL=1μF, RL=100	11	15.8	20.6	ms
Turn On		298	427	556	us
Turn Off		281	403	524	us
Tr	Full load at VIN=5V CL=1μF, RL=100	4.9	7	9.2	ms
Turn On		298	427	556	us
Turn Off		281	403	524	us

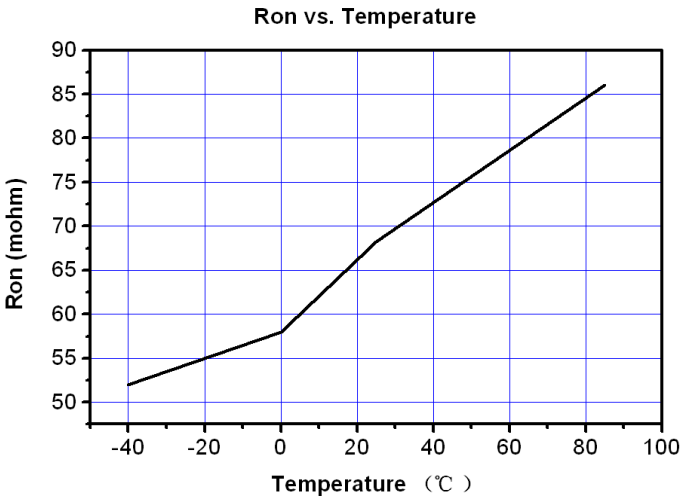
Typical Operating Characteristics

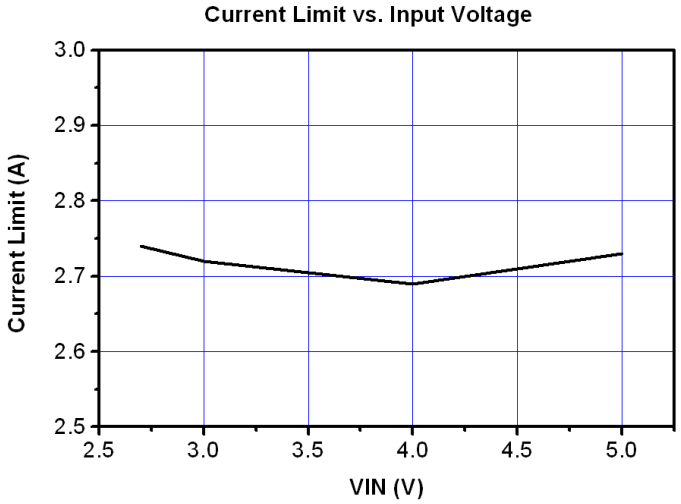
(Unless otherwise noticed: Ta=25°C, VIN=5V, Rset=22K.)

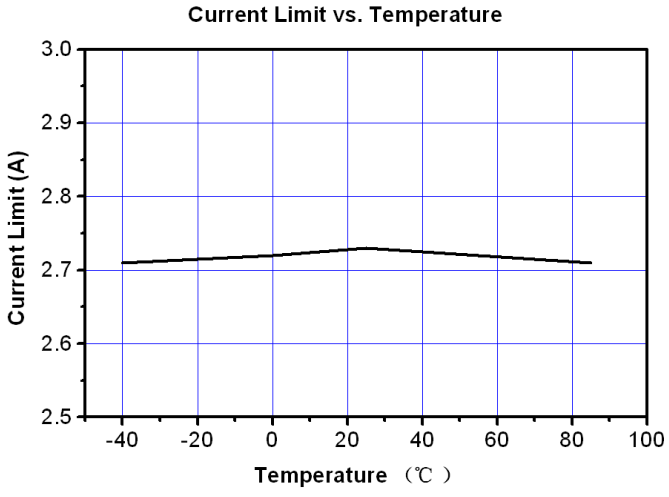








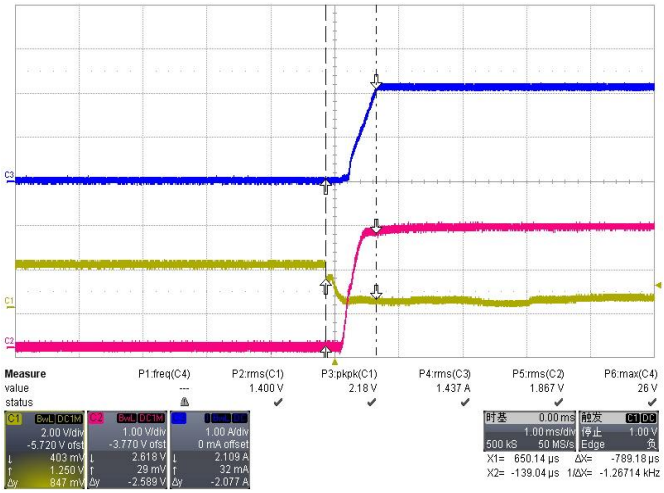




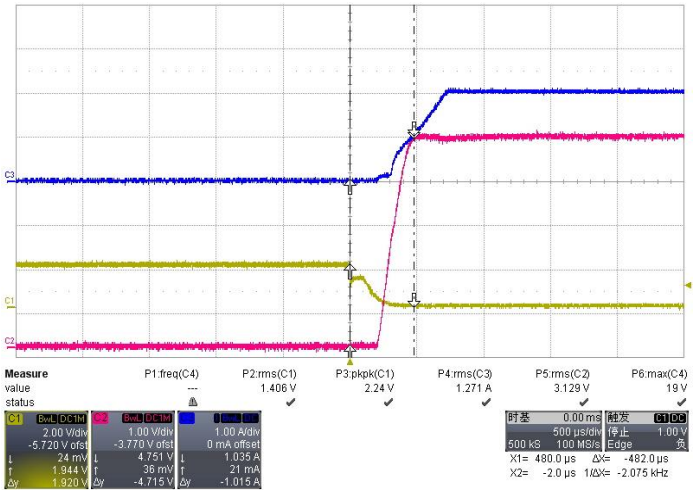
Power supply working waveform diagram (EN: yellow VOUT: red IL: blue)

- **Chip on condition when the EN pin is controlled (Normal temperature test)**

Full load at VIN=3V vs. Switch EN pin from 2V to 0V

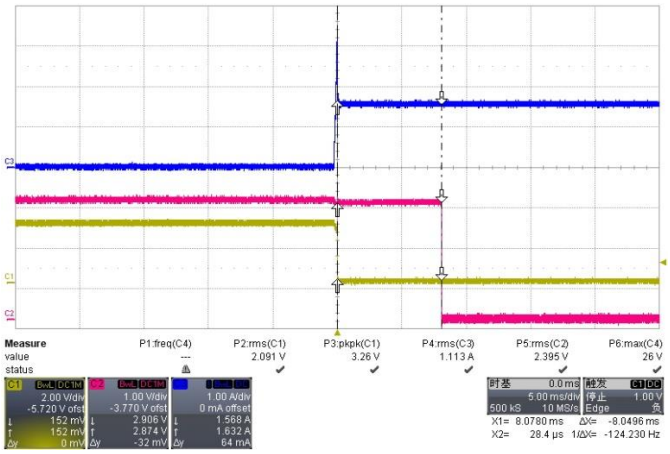


Full load at VIN=5V vs. Switch EN pin from 2V to 0V

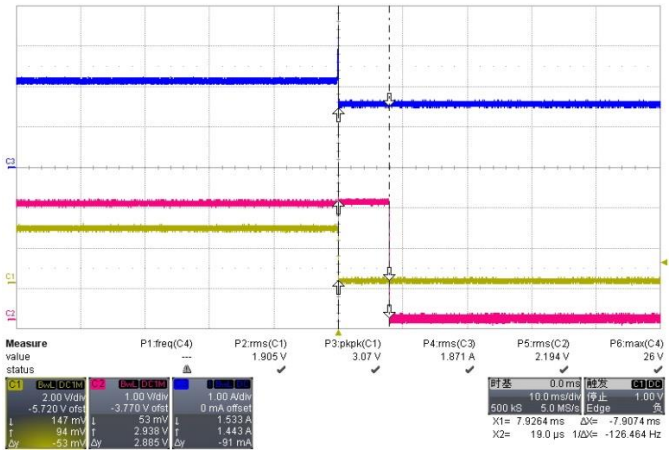


- **FLG waveform**

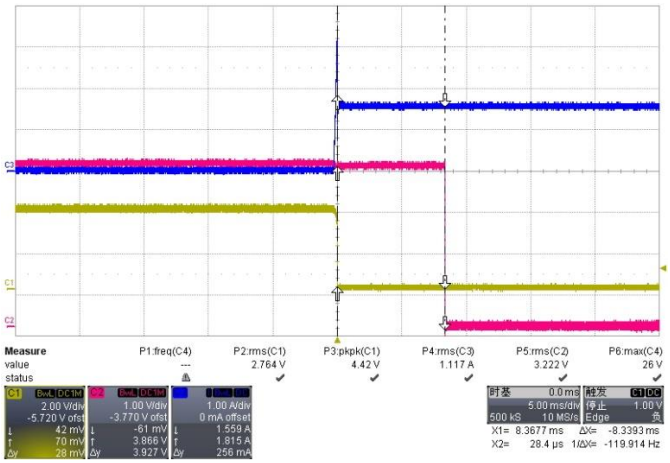
No load at VIN=3V



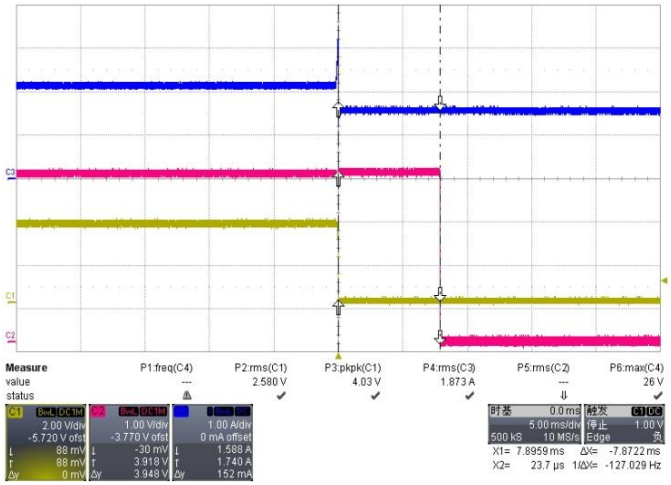
Full load at VIN=3V



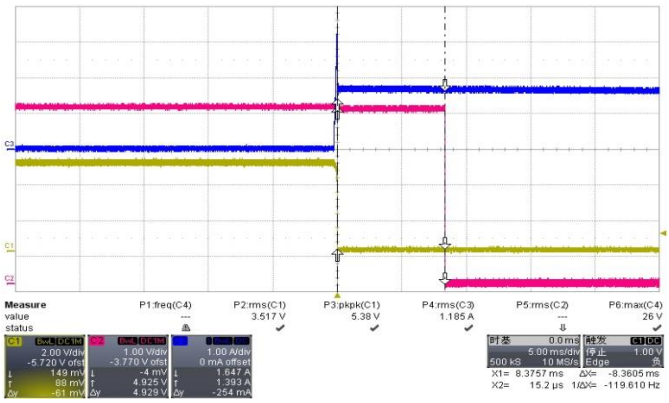
No load at VIN=4V



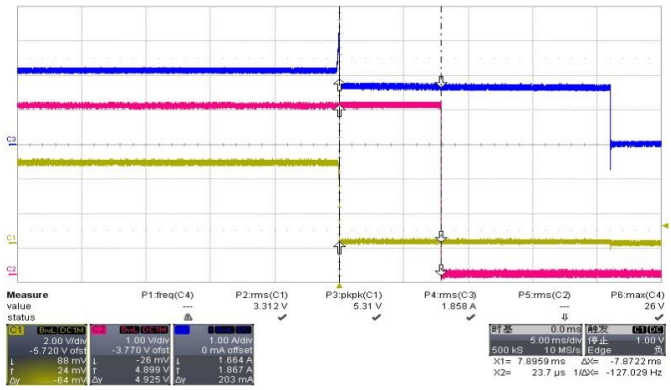
Full load at VIN=4V



No load at VIN=5V

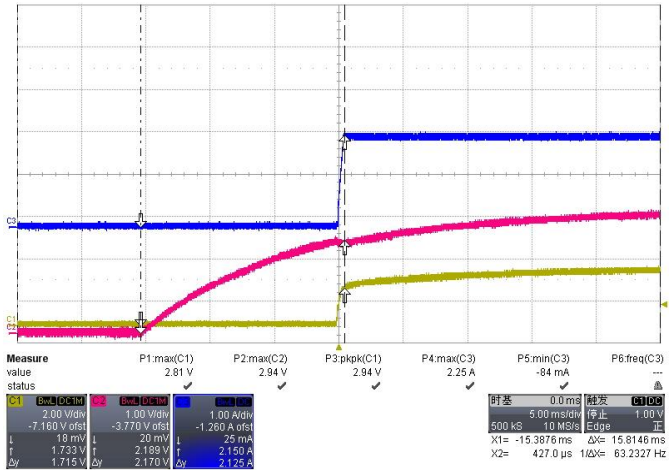


Full load at VIN=5V

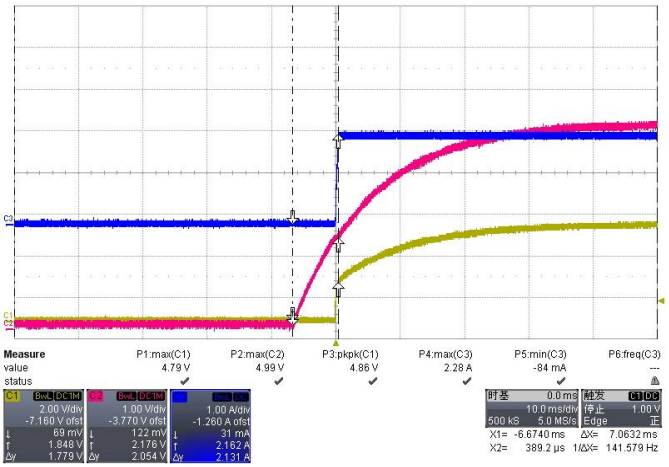


Start waveform (EN: yellow VOUT: red IL: blue)

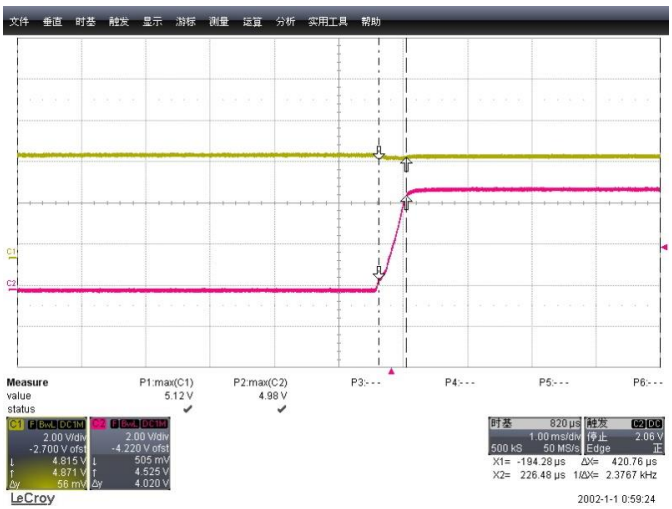
Full load at VIN=3V



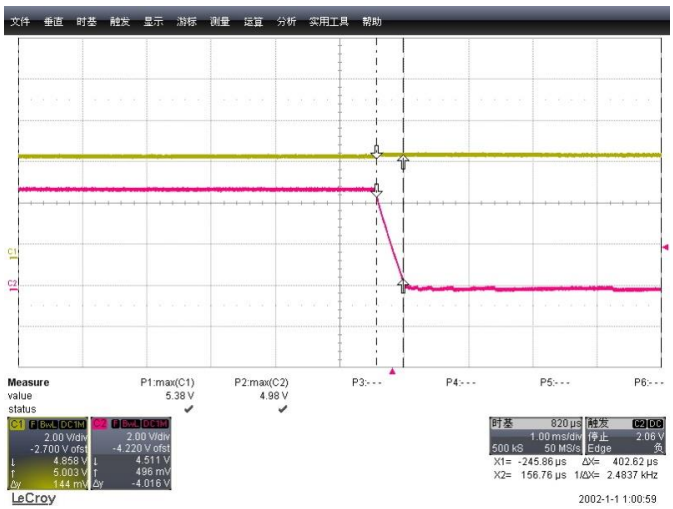
Full load at VIN=5V



EN pin Control on

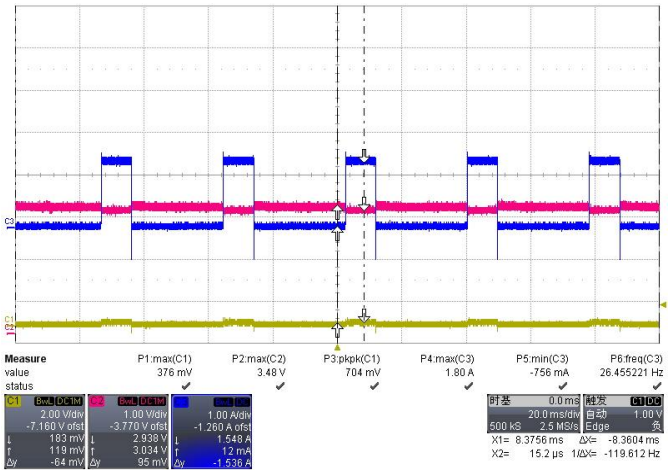


EN pin Control off

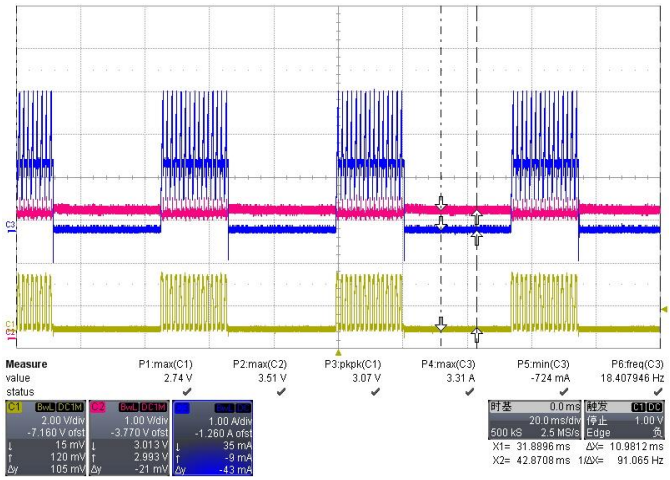


Short circuit protection and OCP protection waveform (EN: yellow VOUT: red IL: blue)

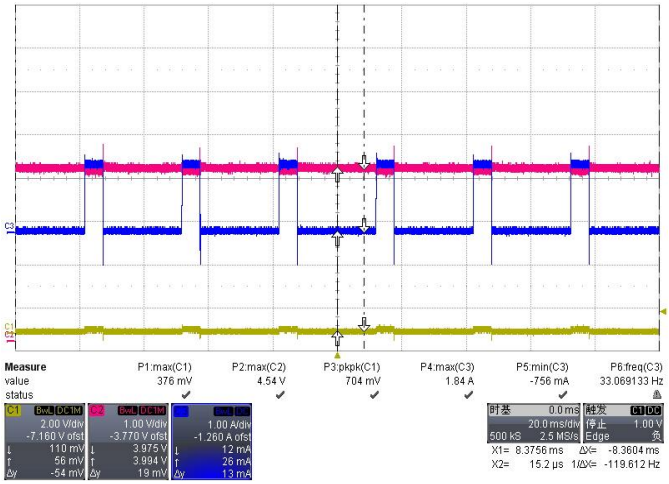
Full load at VIN=3V vs. short circuit



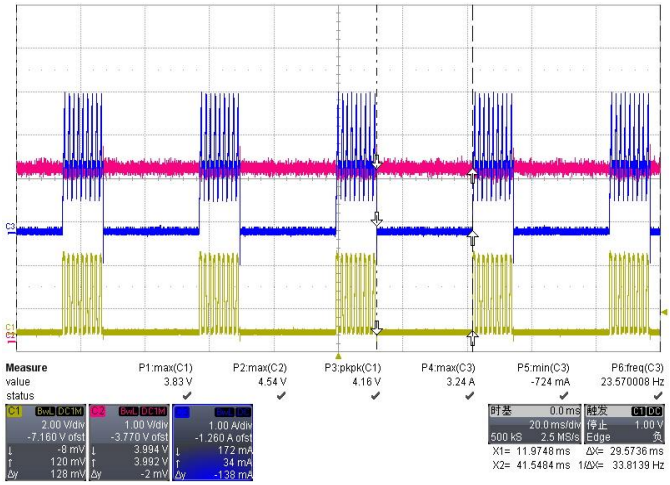
Full load at VIN=3V vs. OCP



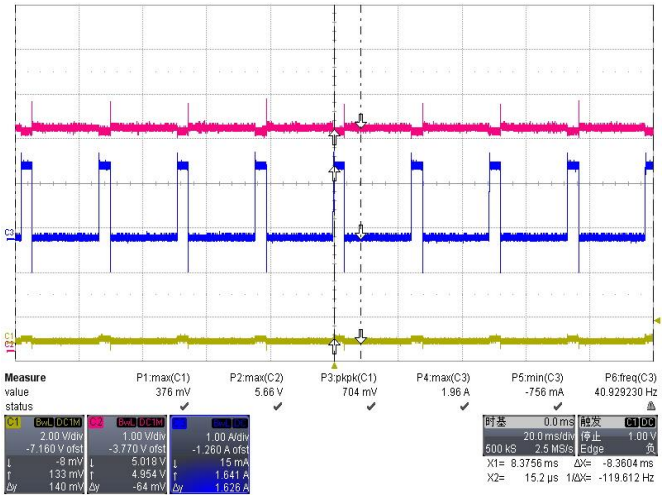
Full load at VIN=4V vs. short circuit



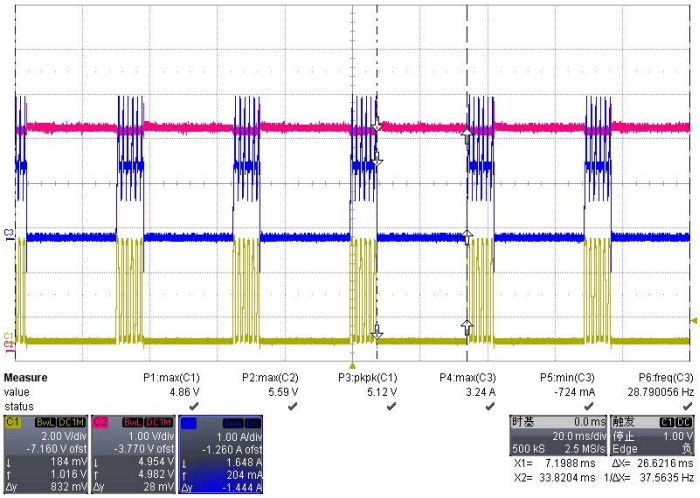
Full load at VIN=4V vs. OCP



Full load at VIN=5V vs. short circuit

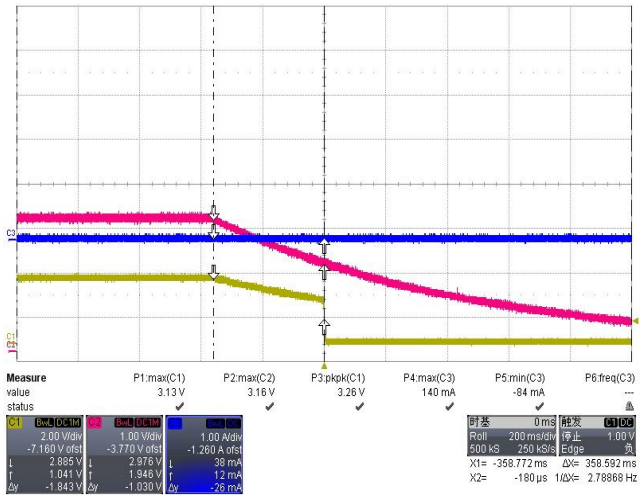


Full load at VIN=5V vs. OCP

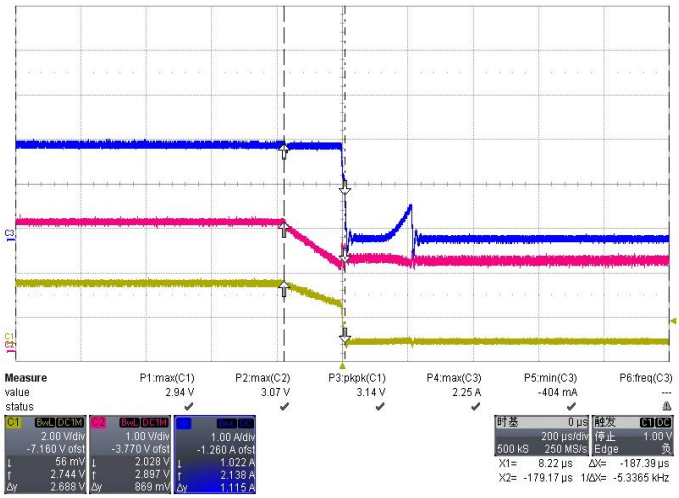


Falling time waveform (EN: yellow VOUT: red IL: blue)

No load at VIN=3V



Full load at VIN=3V



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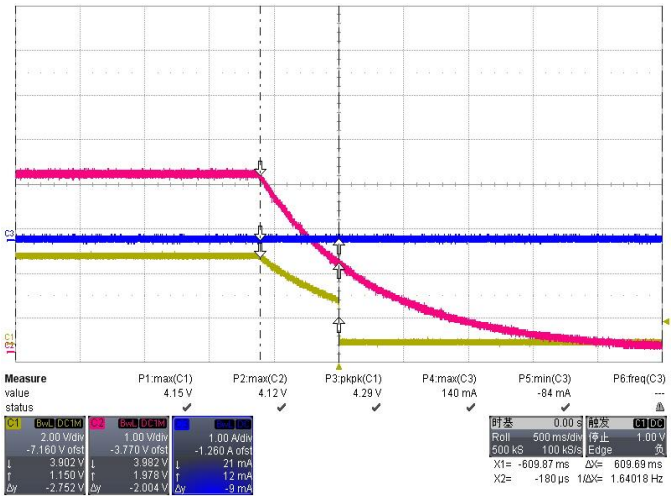
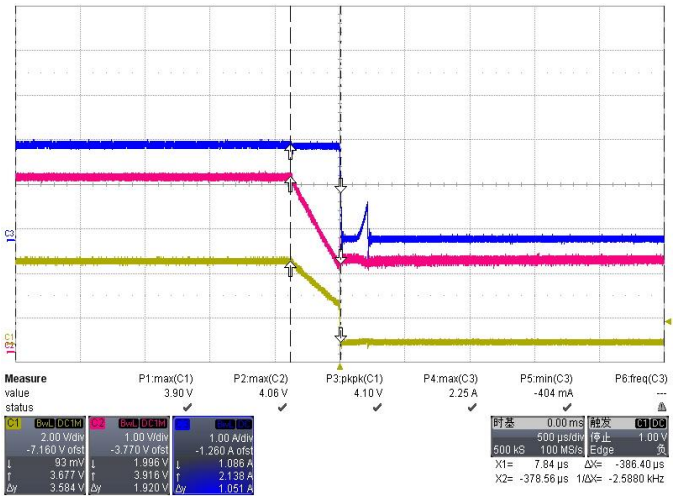
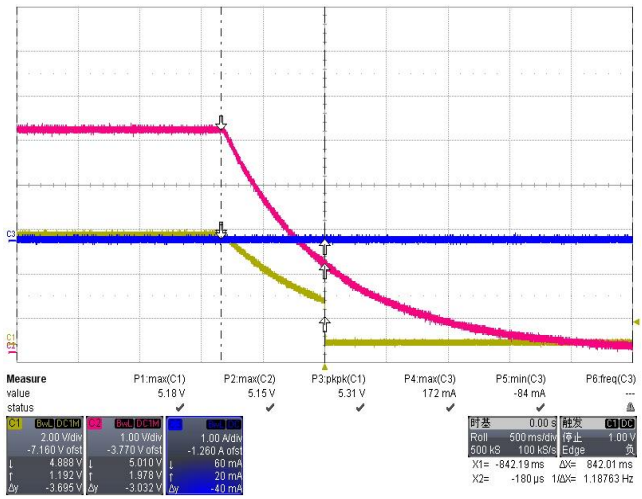


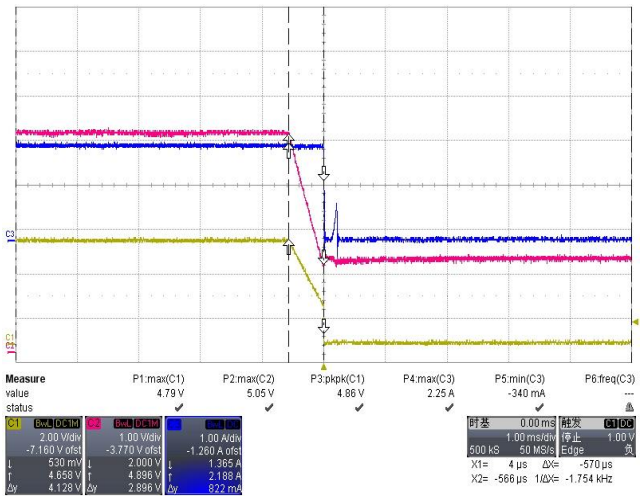
Full load at VIN=4V



No load at VIN=5V



Full load at VIN=5V



Operation Theory

- Startup / Shutdown / On resistance

When the EN pin is connected to the enable level，and VIN voltage is higher than UVLO threshold. When device is enabled, the power NMOS between VIN and VOUT is turned on, and exhibits low resistance. The typical on resistance is 70 mΩ.

When the EN pin is connected to the shutdown level, or VIN voltage decreases to lower than UVLO hysteresis voltage, the device is shut down, and the power NMOS is turned off, which exhibits high resistance. When device is shutdown, the output discharge function accelerates VOUT voltage decreasing.

The current limit circuit takes effect during startup, which will limit the inrush current caused by attaching to a large capacitive load.

- Current limiting

When output current is larger than current limit threshold, the internal power NMOS resistance increases, which makes VOUT to decrease, and the output current is limited. The internal current limit circuit will set the output current value according to VOUT voltage. If VOUT keep decreasing, the output current will decrease as well, and reaches to short current if VOUT is shorted to GND. The current-limit threshold can be set through the RSET pin external resistor to ground. The relationship between the current-limit threshold Ioc and the Rset resistor value is:

$$Ioc = 60K / Rset.$$

- Over temperature protection

In current limiting status, the internal power dissipation of the device increases due to VOUT decreasing, which makes junction temperature increase. When the junction temperature exceeds over temperature threshold, the device is shut down, which will cool down the device. When junction temperature decreases to lower than OT hysteresis threshold, the device is auto restarted.

- Under voltage lock out protection

When power on, the device is turned on when VIN voltage ramps to higher than UVLO threshold. When power off, the device is shut down when VIN voltage decreases to lower than UVLO hysteresis threshold.

Application Information

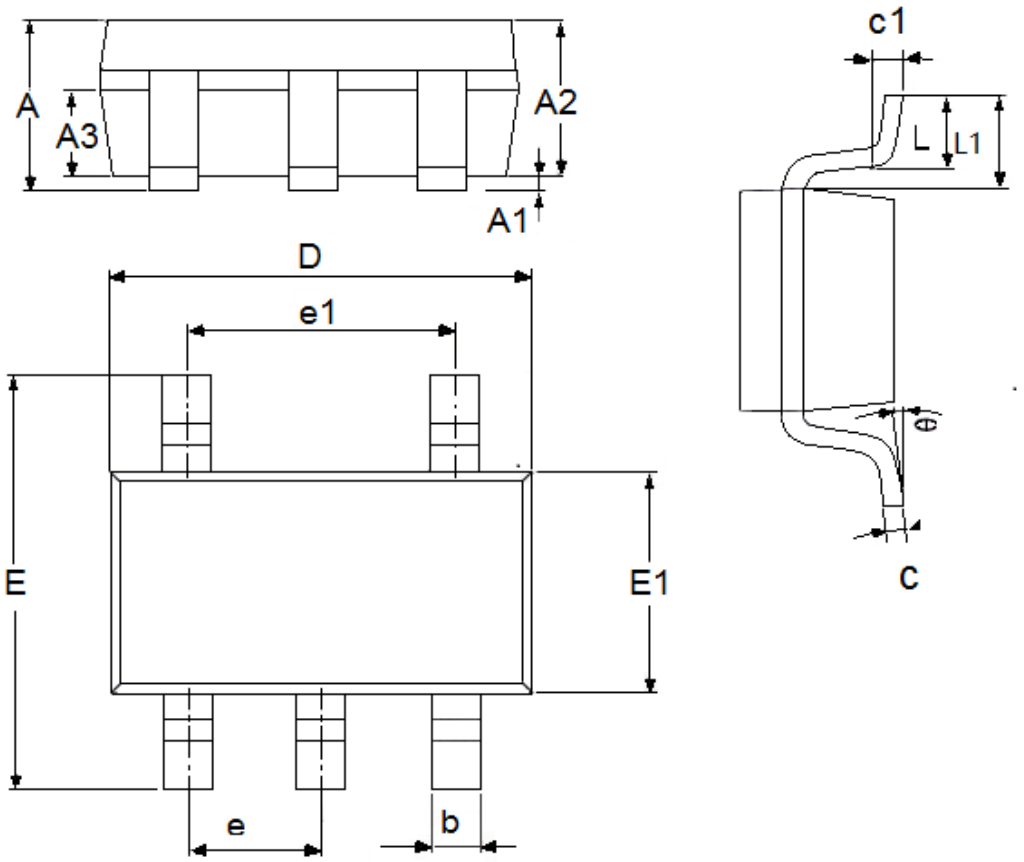
- Cin and Cout capacitor should be placed as near as device pin.
- VIN and VOUT routings should be as wide as possible on PCB.
- The Rset resistor should be placed as close as possible to the RSET pin to reduce parasitic resistance and capacitance.
- Makes copper area as large as possible.

Package Quantity

Package Type	Minimum Packing QTY	Units	Small Box	Large Box
SOT23-5	3000	Tape & Reel	30K	120K

Package Information

- **Packaging Type: SOT23-5**



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.05	1.45	0.0413	0.0571
A1	0	0.15	0.0000	0.0059
A2	0.9	1.3	0.0354	0.0512
A3	0.6	0.7	0.0236	0.0276
b	0.25	0.5	0.0098	0.0197
c	0.1	0.23	0.0039	0.0091
D	2.82	3.05	0.1110	0.1201
e1	1.9(TYP)		0.0748(TYP)	
E	2.6	3.05	0.1024	0.1201
E1	1.5	1.75	0.0512	0.0689
e	0.95(TYP)		0.0374(TYP)	
L	0.25	0.6	0.0098	0.0236
L1	0.59(TYP)		0.0232(TYP)	
θ	0	8°	0.0000	8°
c1	0.2(TYP)		0.0079(TYP)	