

## General Description

The AL5814 is an 8-terminal adjustable linear LED driver-controller offering excellent temperature stability and output current capability. It works with a wide input voltage range from 4.5V to 60V. With an external LED driving power device, its internal power dissipation is minimized compared with traditional linear LED drivers. This makes it ideal for medium to high current LED circuits.

The AL5814 has internal output drive capability up to 15mA, which enables it to drive external bipolar transistors or MOSFETs. It also provides the capability to drive longer LED chains with low drop out voltage and multiple LED channels.

VSET pin is used to directly set output current feedback level. Using a resistor divider between REF pin and VSET pin, the output current can be set. Additionally, the use of an NTC resistor allows the creation of an accurate and configurable thermal foldback behavior.

The AL5814 provides an LED-open detection feature through its VFAULT pin. If VFAULT is brought lower than 2.5V (by any one of the multiple LED channels going open) the AL5814's output will go low turning off the external transistors. The device will recover when the open condition is removed. This ability of VFAULT to turn off the external transistors also allows PWM dimming of the LED current by adding PWM control signal on VFAULT pin.

The AL5814 uses application of power to enable the LED strings. If a separate enable pin is needed the AL5817 should be used. AL5814 is available in the thermally enhanced MSOP-8EP package.

## Applications

- Linear LED Driver
- LED Signs
- Instrumentation Illumination
- Refrigerator Lights

## Key Features

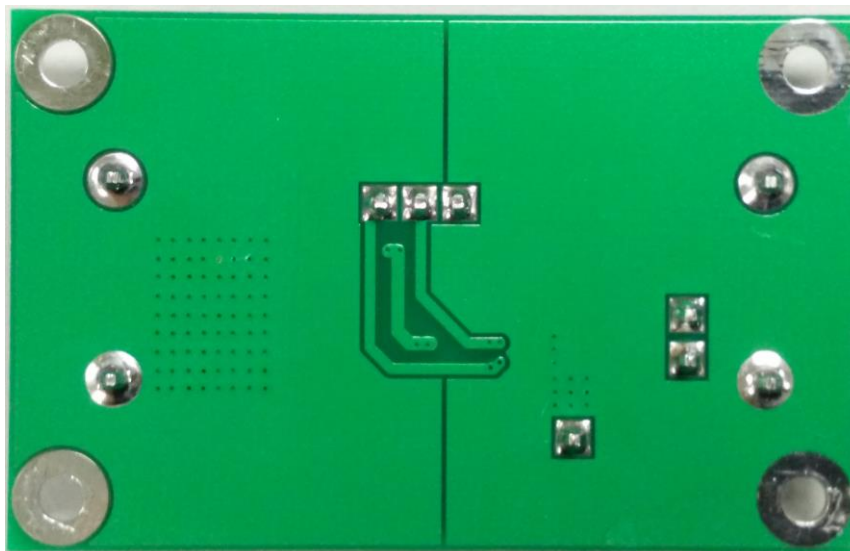
- Wide Input Voltage Range from 4.5V to 60V
- Configurable LED Current Setting
- 3% Reference Voltage Tolerance
- Low Temperature Drift
- 15mA Output Drive Capability for MOSFET or Bipolar Transistor
- LED Open Protection Detected by VFAULT Pin
- LED Thermal Foldback Configured by VSET
- Over Temperature Protection (OTP)
- UVLO Protection
- PWM Dimming Realized through VFAULT pin

## AL5814EV1 Specifications

Parameter	Value
Input Voltage	4.5VDC to 60VDC
LED Current	1A
Number of LEDs	1~17pcs
XY Dimension	63mm x 40mm



**Figure 1: Top View**



**Figure 2: Bottom View**

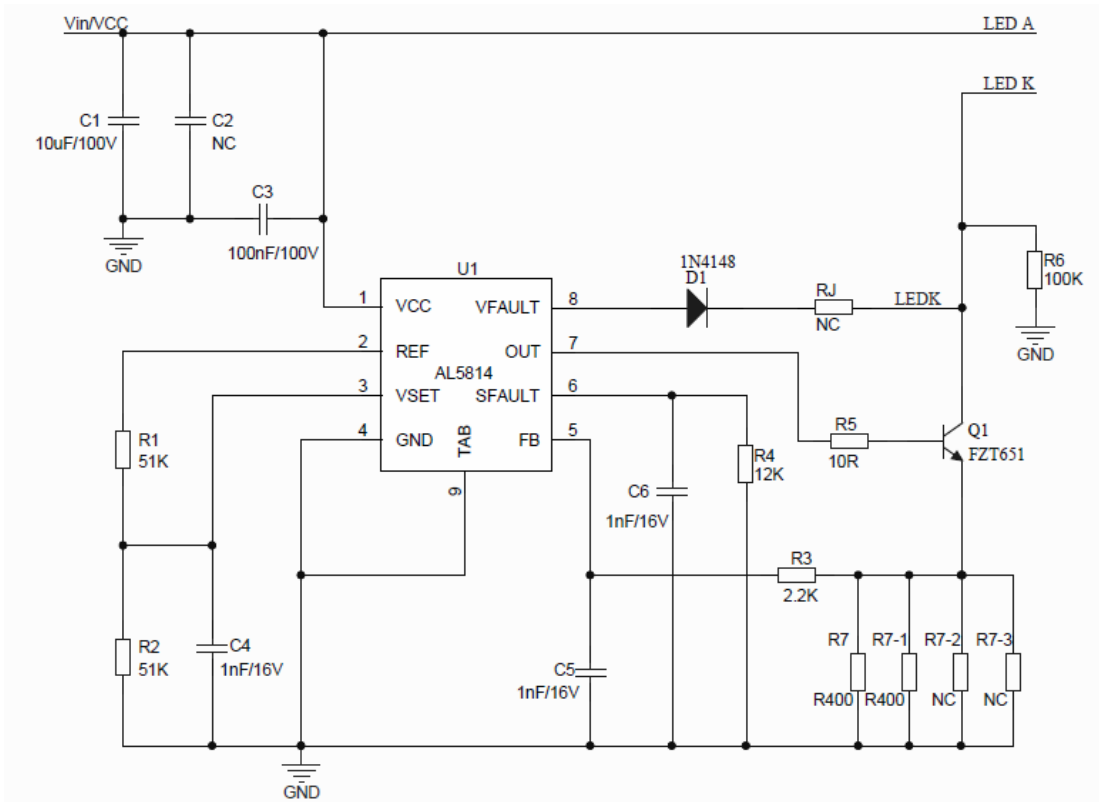
### Connection Instructions

Power Supply Input: 4.5~60V<sub>DC</sub> (VIN, GND)

For LED-open detection operation: add a 0805 0 ohm resistor on location RJ and change R6 to 10k ohm.

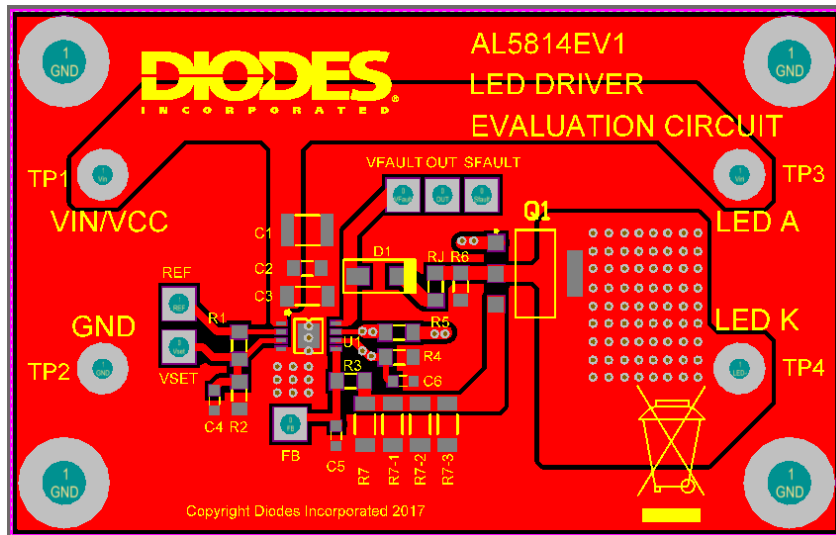
For PWM dimming operation: add open collector/drain signal to the VFAULT pin.

**Evaluation Board Schematic**



**Figure 3: Evaluation Board Schematic**

**Evaluation Board Layout**



**Figure 4: PCB Board Layout Top View**

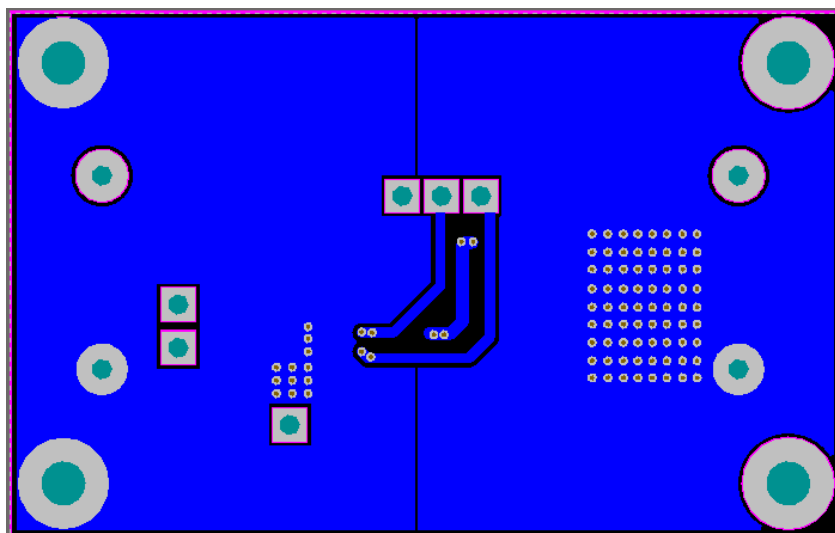


Figure 5: PCB Board Layout Bottom View

### Quick Start Guide

1. By default, the LED current of evaluation board is preset at 1A.
2. Ensure that the DC source is switched OFF or disconnected before soldering or connecting.
3. Supply voltage at which LED-open detection function become operational is preset to 6.6V.
4. Connect the anode wire of external LED string to LED A of the evaluation board.
5. Connect the cathode wire of external LED string to LED K of the evaluation board.
6. Connect two DC line wires to the VIN and GND terminals on the evaluation board.
7. Ensure that the area around the board is clear and safe, and preferably that the board and LEDs are enclosed in a transparent safety cover.
8. Turn on the main switch. LED string should light up with LED.

### Bill of Material

#	Item	Description	Package
1	C1	Ceramic Cap,10uF/100V, X7R	1210
2	C2	NC	NC
3	C3	Ceramic Cap,0.1uF/100V, X7R	1206
4	C4	Ceramic Cap,1nF/16V, X7R	0603
5	C5	Ceramic Cap,1nF/16V, X7R	0603
6	C6	Ceramic Cap,1nF/16V, X7R	0603
7	D1	Switching diode, 1N4148,Diodes Inc	SOD123
8	Q1	FZT651TA, 60V/3A, NPN Transistor, Diodes Inc	SOT223
9	R1	SMD Resistor, 51K, 5%, 1/8W	0805
10	R2	SMD Resistor, 51K, 5%, 1/8W	0805
11	R3	SMD Resistor, 2.2K, 5%, 1/8W	0805
12	R4	SMD Resistor, 12K, 5%, 1/8W	0805

13	R5	SMD Resistor, 10R, 5%, 1/8W	0805
14	R6	SMD Resistor, 100K, 5%, 1/8W	0805
15	RJ	NC	NC
16	R7	SMD Resistor, R400, 1%, 1/4W	1206
17	R7-1	SMD Resistor, R400, 1%, 1/4W	1206
18	R7-2	NC	NC
19	R7-3	NC	NC
20	U1	AL5814, Diodes Inc	MSOP8-EP

### System Performance

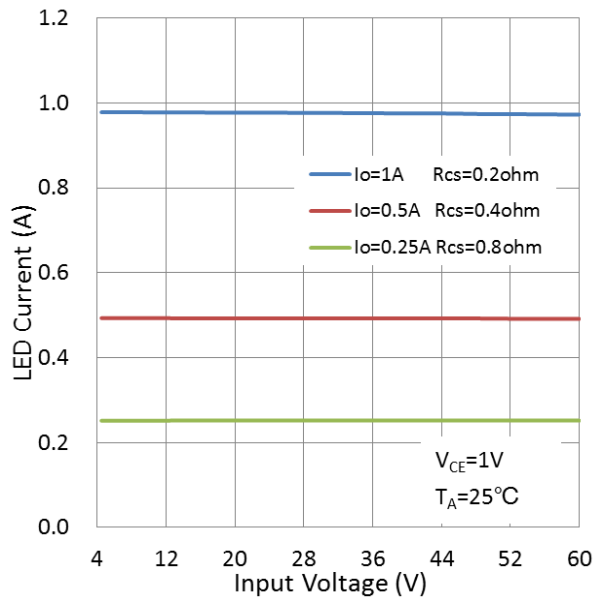


Figure 6: LED current VS input voltage

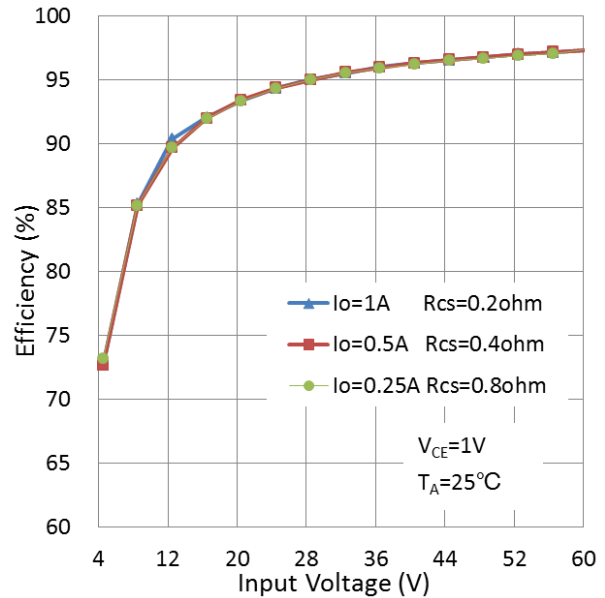


Figure 7: Efficiency VS input voltage

### LED current setup

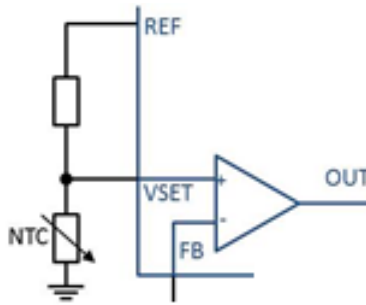
The LED current is set by the reference voltage at the emitter/drain voltage of the LED driving transistor. This reference voltage is determined by the resistor R1 and R2. On the demo board, the VSET voltage is preset to 0.2V.

Then the output current for LED strings can be calculated by:

$$I_{OUT} = V_{VSET} / R_{SENSE}$$

On the board, the  $R_{SENSE}$  consists of R7, R7-1, R7-2, R7-3; the effective resistance is 0.2 ohm, so the output current is 1A.

The LED driver's LED current behavior under different ambient or LED temperatures can be configured by using NTC for R2 shown in Figure 8.



**Figure 1: Thermal Fold Back Circuit Basing on NTC**

### LED-open detection function

This demo board is preset with no LED-open detection function. If this function is needed, change the demo board with the following action:

- 1) A 0 ohm SMD resistor should be added on location RJ;
- 2) R5 change from 100k ohm to 10k ohm;
- 3) SFAULT configuration should be checked;
- 4) Differential voltage between input and output should be higher than 2.6V to ensure VFAULT pin function working normally.

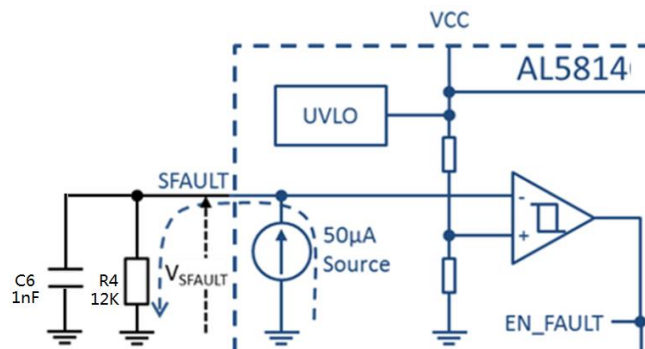
#### ● SFAULT Setup:

The AL5814 can be configured to detect the presence of the LEDs on the external output transistor going open circuit. This function is activated by the SFAULT pin. A 50μA current source from SFAULT creates a voltage (VSFAULT) across an external resistor (R7) which is compared to potential divided down VCC voltage see **Error! Reference source not found.** (blue components are internal to the AL5814).

Once VCC has risen to above the set voltage on the VSFAULT pin the EN\_FAULT becomes high and LED-open detection becomes functional. This avoids false triggering of open load protection during start up and power down procedure.

Supply voltage at which LED-open detection become operational is set by the following equation:

$$V_{CC} = 11 \times 50 \times 10^{-6} \times R4$$



**Figure 9: SFAULT configuration**

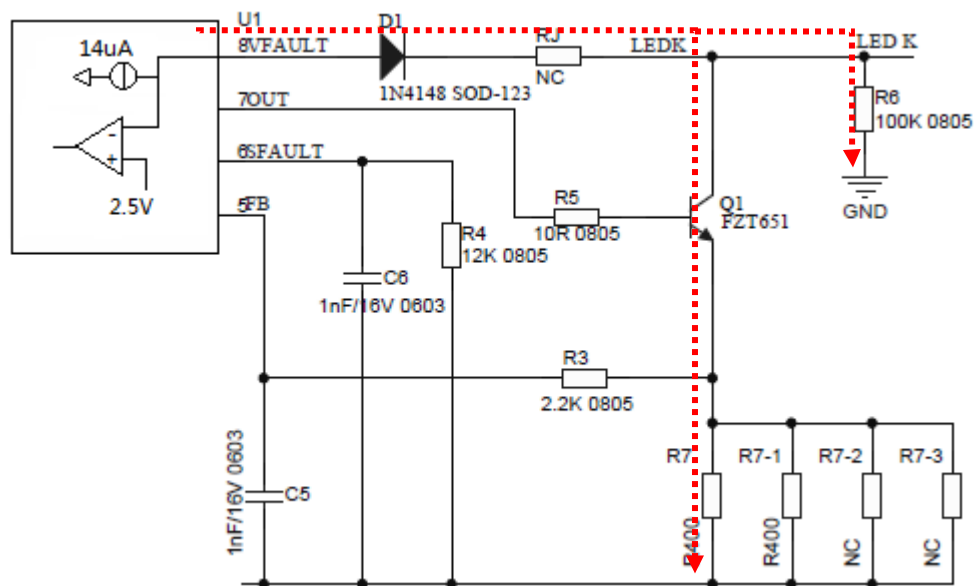
The table below shows some approximate supply voltages that the LED-open detection becomes active by different resistor values.

V <sub>CC</sub> (V)	R4 (kΩ)
5.01	9.1
5.50	10
6.60	12
8.25	15
9.90	18
11.55	21

If SFAULT is shorted to GND then by default LED-open fault detection is automatically entered. If SFAULT is left open then LED-open detection is inhibited.

● **VFAULT**

The AL5814 detects open conditions on the collector/drain of the external transistor driving the LEDs using the VFAULT pin, see Figure 10.



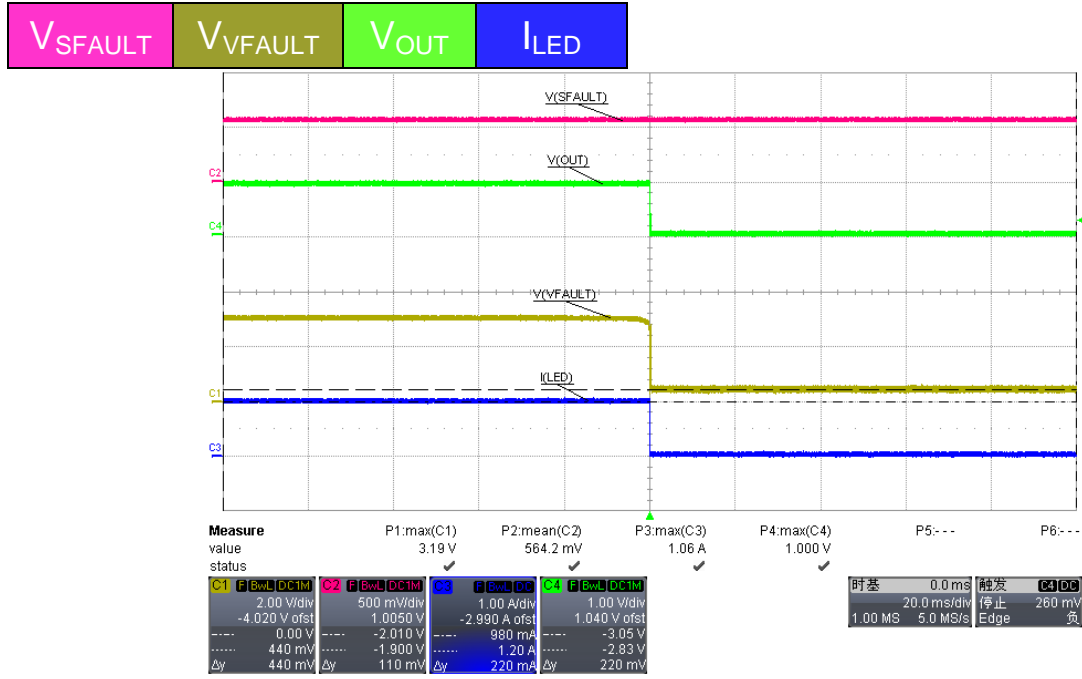
**Figure 10: VFAULT configuration**

If the LED string becomes open, VFAULT pin will be pulled down by the power bipolar or MOSFET below its internal 2.5V threshold. This condition triggers an output disable condition causing OUT to go low, turning off the external MOSFET/BJT. A resistor (R6, 10K) is needed to keep the VFAULT signal low during a fault condition. A 10k will keep this node low. When the fault condition is fixed and VFAULT pin rises above 2.63V the device will operate normally.

**Waveforms:**

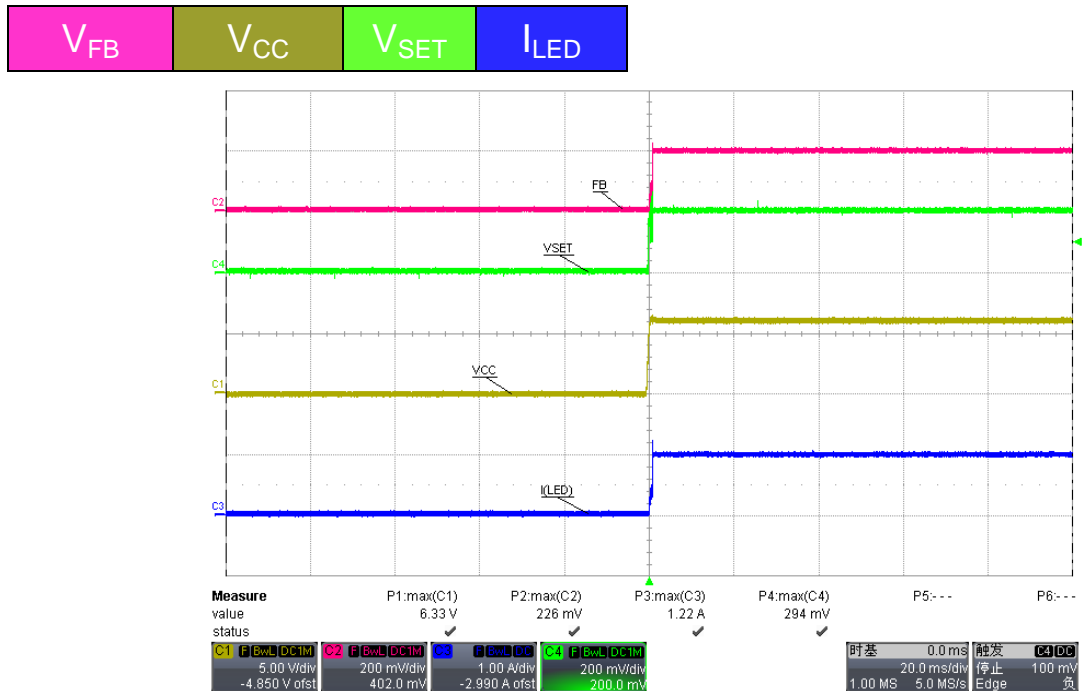
Test condition: input 6Vdc, output 1 LED/1A.

**LED-Open detection:**



**Figure 11: LED-Open Detection**

**Normal Turn ON:**



**Figure 12: Turn ON (1)**



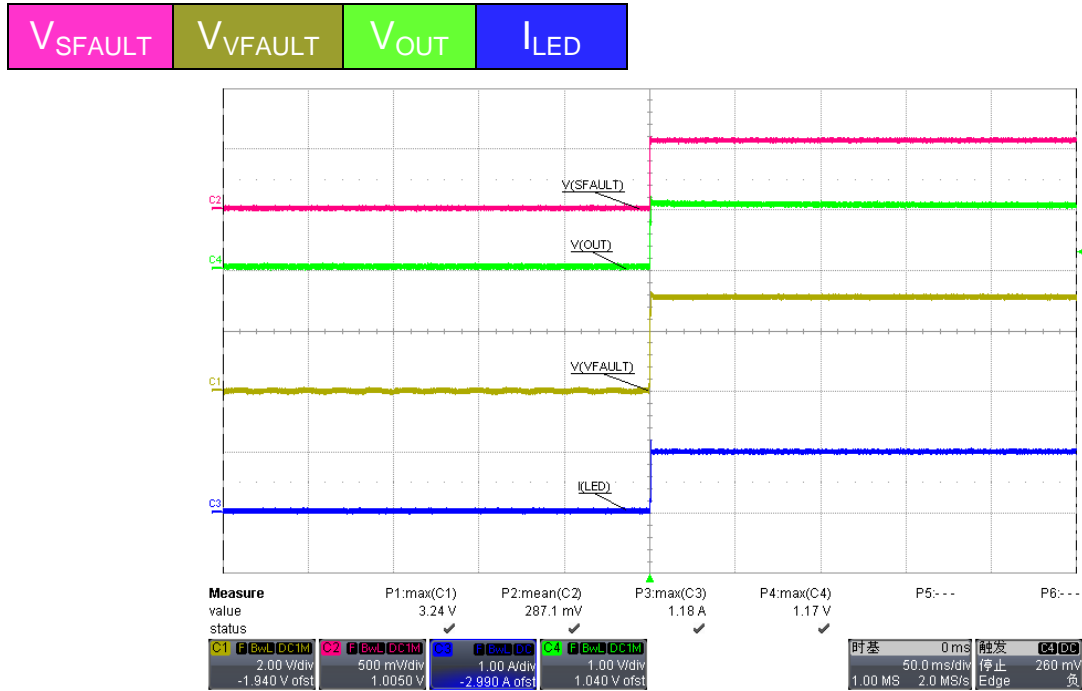


Figure 13: Turn ON (2)

Turn OFF:

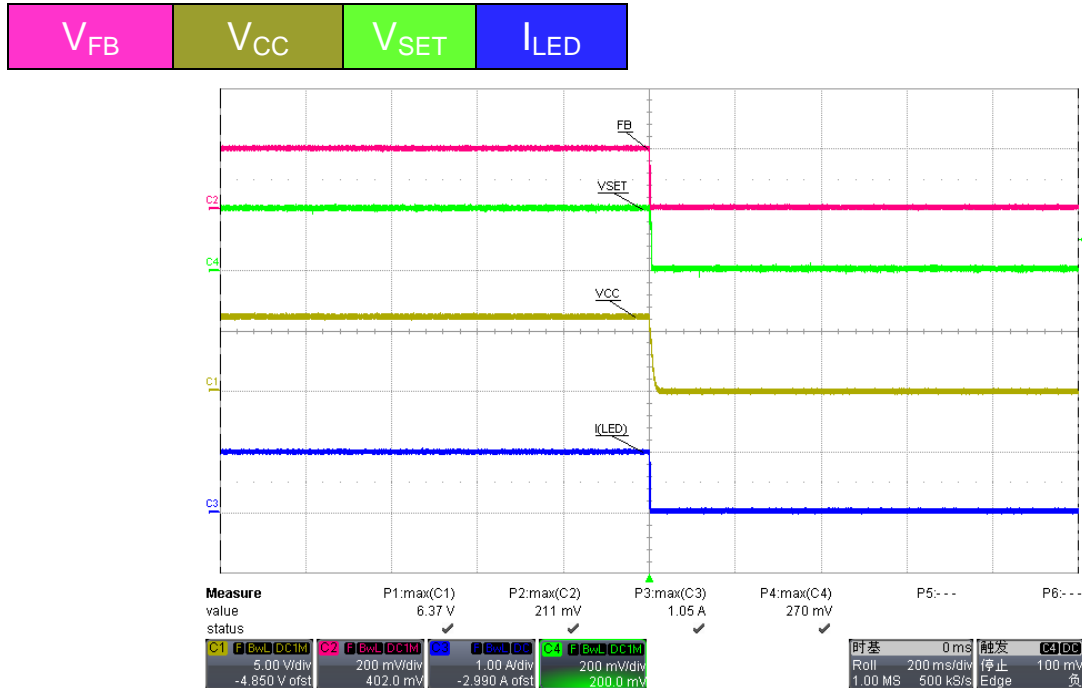
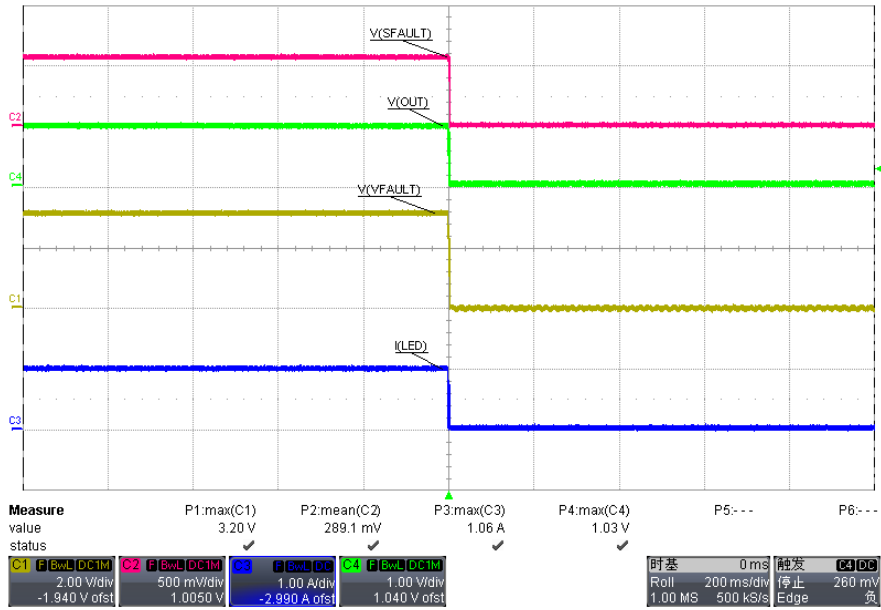


Figure 14: Turn OFF (1)



**Figure 15: Turn OFF (2)**

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