

# IS31LT3135

## MAIN/SUB DUAL-CHANNEL LED DRIVER

November 2011

### GENERAL DESCRIPTION

IS31LT3135 is a main/sub dual-channel LED driver. When the main channel works, it is a constant current source driving the main LED and the current is set by an external resistor connected to the  $I_{SET}$  pin. It needs only 0.1V dropout voltage for 200mA output current. When the sub-channel works, the chip will pull down the sub LED's cathode to ground.

Normally there is only one channel on, the main channel and the sub channel can switch between each other. Sweeping power supply from high voltage to low voltage, main channel switches to sub-channel while UV pin is below the undervoltage threshold 1.17V (IS31LT3135-V1 typical) or 1.23V (IS31LT3135-V2 typical). Sweeping power supply from low voltage to high voltage, the sub-channel switches to the main channel while UV pin is 80mV (typical) higher than the undervoltage threshold. Additionally, the main channel has short protection function, when the main LED is shorted, the chip will switch to sub-channel automatically.

### FEATURES

- Power supply undervoltage detect
- Main channel short protection
- Over-temperature protection
- Input voltage range: 2.7V~5.5V
- Main and sub-channel current set by external resistor
- Main channel  $V_{dp}=0.1V$
- Low quiescent current
- Assembled in SOP-8 package

### APPLICATIONS

- Miner lamp
- Other LED lighting

### TYPICAL APPLICATION CIRCUIT

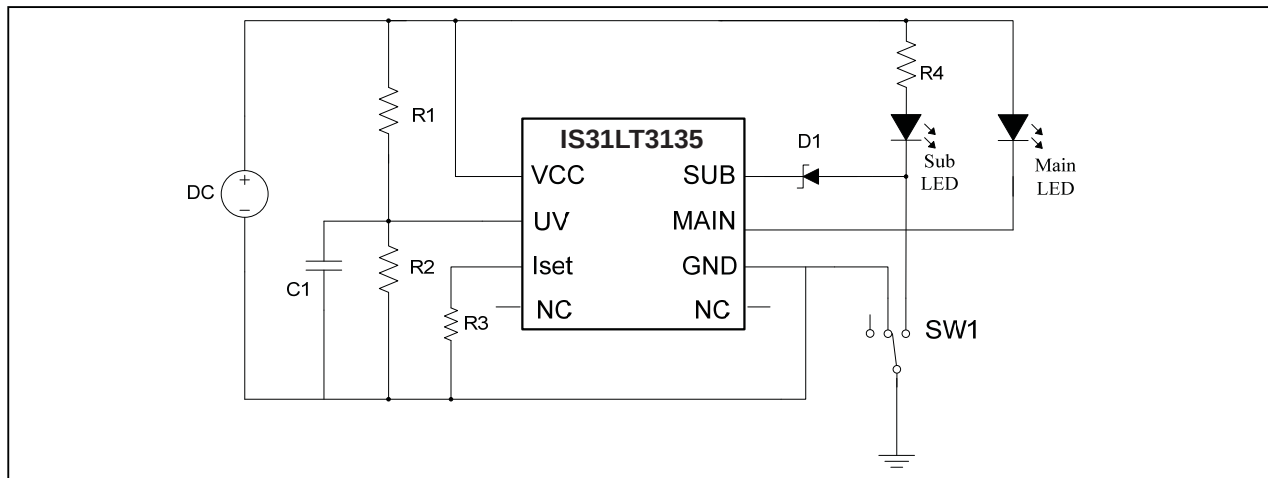


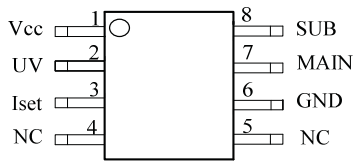
Figure 1

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- a.) the risk of injury or damage has been minimized;
- b.) the user assume all such risks; and
- c.) potential liability of Integrated Silicon Solution, Inc is adequately protected under the circumstances

# IS31LT3135

## PIN CONFIGURATIONS

| Package | Pin Configurations (Top View)                                                                                                                                                                      |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SOP-8   |  <p> V<sub>CC</sub> 1<br/> UV 2<br/> I<sub>set</sub> 3<br/> NC 4<br/> 8 SUB<br/> 7 MAIN<br/> 6 GND<br/> 5 NC </p> |

## PIN DESCRIPTION

| Name             | No.  | Description                                                                            |
|------------------|------|----------------------------------------------------------------------------------------|
| V <sub>CC</sub>  | 1    | Power supply input                                                                     |
| UV               | 2    | The pin detects under-voltage. Decouple to ground with 0.1uF capacitor close to device |
| I <sub>SET</sub> | 3    | The pin sets the main LED current with external resistor                               |
| GND              | 6    | The pin connects to ground.                                                            |
| MAIN             | 7    | Connect to the cathode of main LED                                                     |
| SUB              | 8    | Connect to the cathode of sub LED                                                      |
| NC               | 4, 5 | Not connected                                                                          |

## ORDERING INFORMATION

Industrial Range: -40°C to +85°C

| Order Part No.        | Package          | QTY/Reel | V <sub>UV</sub> |
|-----------------------|------------------|----------|-----------------|
| IS31LT3135-V1GRSL2-TR | SOP-8, Lead-free | 2500     | 1.13V~1.21V     |
| IS31LT3135-V1GRSL2-TR | SOP-8, Lead-free | 2500     | 1.19V~1.26V     |

# IS31LT3135

## ABSOLUTE MAXIMUM RATINGS

|                                      |                |
|--------------------------------------|----------------|
| Supply voltage, $V_{CC}$             | -0.3V ~ +6.5V  |
| UV, Iset, Sub, Main                  | -0.3V to 6.5V  |
| Junction temperature, $T_{JMAX}$     | +150°C         |
| Storage temperature range, $T_{stg}$ | -65°C ~ +150°C |
| ESD(human body mode)                 | 4kV            |
| $I_{MAIN}$                           | 500mA          |
| $I_{SUB}$                            | 300mA          |
| $T_A$ ( Ambient temperature)         | -40°C ~ +85°C  |

### Note:

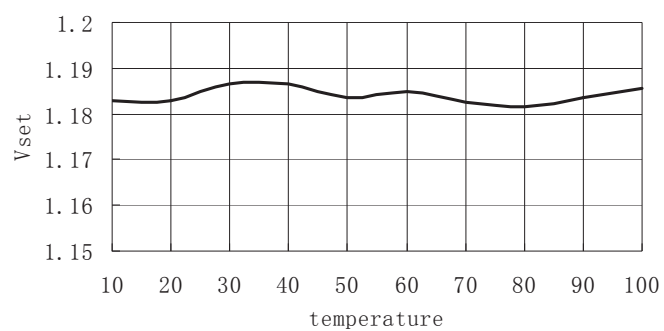
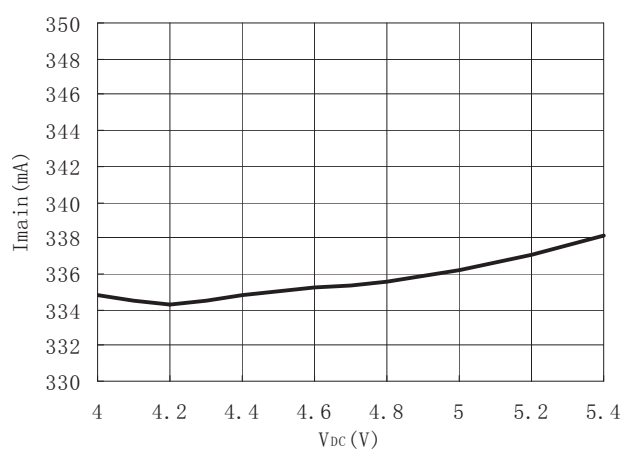
- Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

(Test conditions:  $V_{CC}=3.6V$ ,  $T_{amb}=25^{\circ}C$  unless otherwise stated)

| Symbol                | Parameter                                                                 | Condition                                                                                                                                                                                                   |               | Min  | Typical | Max  | Unit |
|-----------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|---------|------|------|
| V <sub>CC</sub>       | Input voltage                                                             |                                                                                                                                                                                                             |               | 2.7  |         | 5.5  | V    |
| I <sub>CC</sub>       | Quiescent current                                                         | V <sub>CC</sub> =2.7V~5.5V,no load,<br>5.5V>V <sub>uv</sub> >1.4V                                                                                                                                           |               |      | 250     | 320  | μA   |
| I <sub>ratio</sub>    | Ratio of I <sub>MAIN</sub> to I <sub>SET</sub>                            | V <sub>CC</sub> =4.2V, R <sub>set</sub> =30K                                                                                                                                                                |               |      | 8000    |      |      |
| V <sub>ISET</sub>     | Voltage of I <sub>SET</sub> pin                                           |                                                                                                                                                                                                             |               |      | 1.2     |      | V    |
| I <sub>accuracy</sub> | Current accuracy of main LED                                              | V <sub>CC</sub> = 2.7V ~ 5.5V, V <sub>main</sub> =0.5V                                                                                                                                                      |               |      | ±5      |      | %    |
| V <sub>dp</sub>       | Main channel current source dropout voltage                               | R <sub>set</sub> =47K,I <sub>out</sub> =204mA                                                                                                                                                               |               |      |         | 0.2  | V    |
| R <sub>sub</sub>      | Sub-channel “ON” resistance                                               | V <sub>CC</sub> =2.7V~5.5V                                                                                                                                                                                  |               |      |         | 2.0  | ohm  |
| V <sub>UV</sub>       | Undervoltage threshold of UV pin                                          | Switch from main-LED to sub-LED when VUV sweeps from high voltage to low voltage                                                                                                                            | IS31LT3135-V1 | 1.13 | 1.17    | 121  | V    |
|                       |                                                                           |                                                                                                                                                                                                             | IS31LT3135-V2 | 1.19 | 1.23    | 1.26 |      |
| V <sub>UVHYS</sub>    | Comparator hysteresis of UV pin(Upper threshold - Undervoltage threshold) | Switch from sub-LED to main-LED when VUV sweeps from low voltage to high voltage(Upper threshold); Switch from main-LED to sub-LED when VUV sweeps from high voltage to low voltage(Undervoltage threshold) |               |      | 80      |      | mV   |
| T <sub>SD</sub>       | Thermal protection Threshold                                              |                                                                                                                                                                                                             |               |      | 160     |      | ℃    |
| R <sub>θJA</sub>      | Junction to ambient                                                       | SOP-8                                                                                                                                                                                                       |               |      | 80      |      | ℃/W  |

## TYPICAL OPERATING CONDITION

**Figure 2** Iset pin voltage change with temperature**Figure 3** Main LED current change with power supply

## APPLICATION NOTES

## MAIN LED CURRENT SET

Current of the main LED is set by resistor connected to Iset pin. Voltage of Iset pin is 1.2V. It is constant even if the environment temperature and power supply voltage changes. (Refer to figure2, figure3). The current of main channel is 8000 times to the current of Iset pin. It is obtained by:

$$I_{\text{main}} = 8000 * \frac{V_{\text{set}}}{R_{\text{set}}}$$

Main LED current flows through the MAIN pin to ground. There is only 0.1V voltage dropout when the main channel current is 200mA (Note 1).

## SUB LED CURRENT SET

Sub-LED current flows through SUB to ground. This current can be set by the resistor of SUB pin and is given by:

$$I_{\text{sub}} = \frac{V_{\text{CC}} - V_{\text{F2}} - V_{\text{d2}}}{R_{\text{SUB}}}$$

$V_{\text{CC}}$  is power supply voltage,  $V_{\text{F2}}$  is the sub-LED voltage.  $V_{\text{d2}}$  is the diode voltage (Refer to Figure 1), its value should be as small as possible.

## UNDERVOLTAGE THRESHOLD SET

UV pin has undervoltage detect function and the undervoltage threshold gets a 0.8V hysteresis to avoid error operation caused by power supply ripple. Sweeping power supply from high voltage to low voltage, the main channel switches to sub-channel while UV pin is below undervoltage threshold, 1.17V (IS31LT3135-V1 typical) or 1.23V (IS31LT3135-V2 typical). Sweeping power supply from low voltage to high voltage, the sub-channel switches to the main channel while UV pin is 80mV (typical) higher than the undervoltage threshold.  $U_{\text{uv}}$  is set by the ratio of resistor of R1 and R2 (Refer to Figure1).

When  $\frac{R_2}{R_1 + R_2} V_{\text{CC}} = 1.17\text{V}$  or  $1.23\text{V}$ , chip switches from the main channel to the sub-channel.

Typically, Li battery voltage maintains at 3.7V during discharge. Therefore, it is recommended to set the undervoltage threshold at 3.4V.

Typically, R1 and R2 are set to 10K Ohm magnitude (e.g. 51K Ohm), the current flows through R1 and R2 is large if the value of R1 and R2 are small, which will reduce system efficiency. We can specify the value of R2, and then calculate the value of R1 based on the ratio.

## MAIN LED SHORT PROTECTION

When the main LED is short circuit, chip will switch to sub-channel automatically.

## OVER-TEMPERATURE PROTECTION

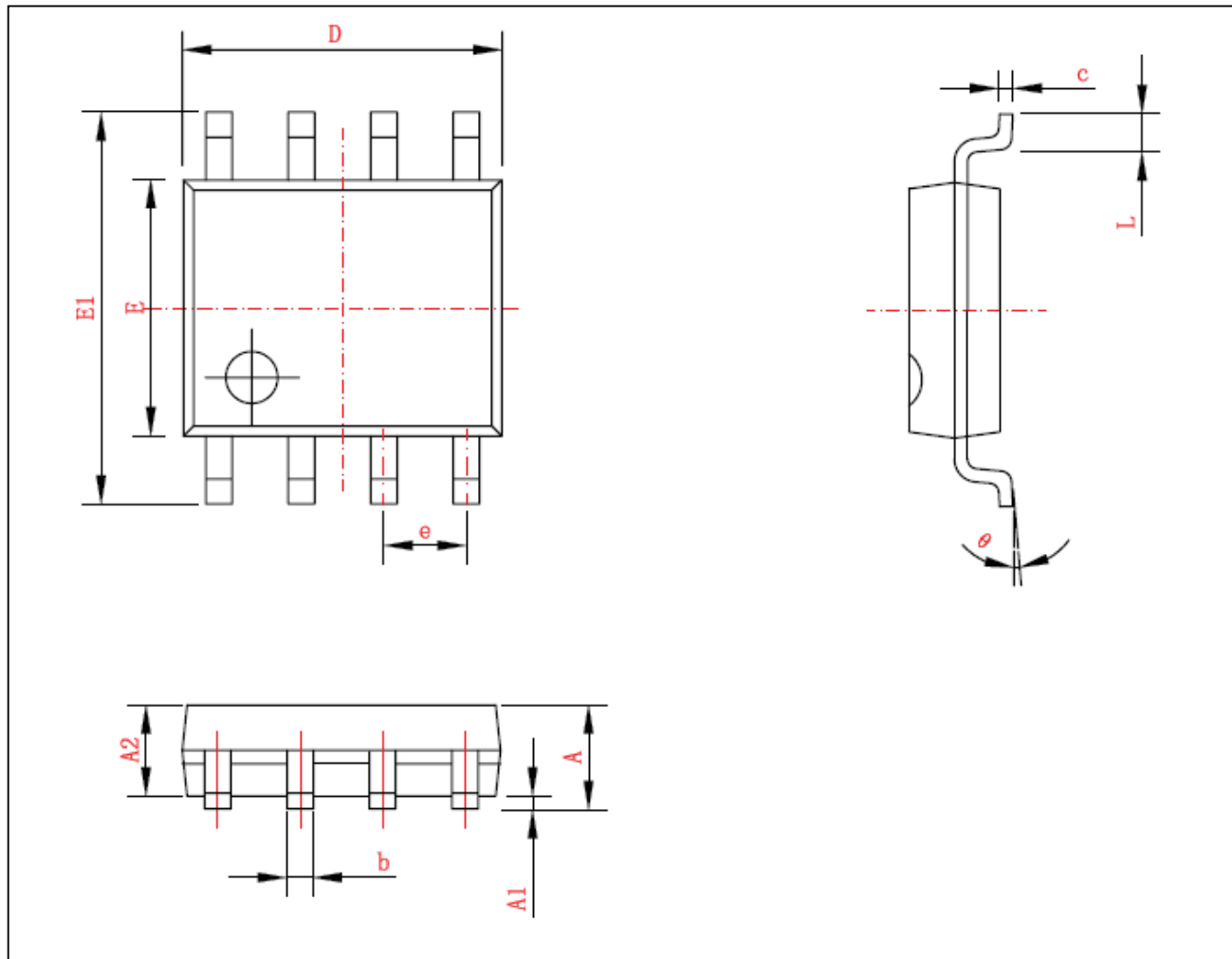
When the chip temperature reaches 160°C, the chip turns off automatically. When temperature drops back to 140°C, the chip turns on again.

## PCB LAYOUT REFERENCE

The switch should be placed at the low voltage point (Refer to Figure 1) to avoid an instant spark while switching. The traces between GND pin and Iset pin to real ground should be as short as possible and as wide as possible to improve the main LED current accuracy and undervoltage threshold accuracy. Adding a 0.1uF capacitor connected to UV pin can reduce the noise pick-up at this pin.

**Note 1:** When power supply voltage is larger than LED voltage, the extra voltage would be added on the Main pin, which will reduce the efficiency of the whole system.

## SOP-8



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 1.350                     | 1.750 | 0.053                | 0.069 |
| A1     | 0.100                     | 0.250 | 0.004                | 0.010 |
| A2     | 1.450TYP                  |       | 0.057TYP             |       |
| b      | 0.350                     | 0.490 | 0.014                | 0.019 |
| c      | 0.178                     | 0.250 | 0.007                | 0.010 |
| D      | 4.800                     | 5.000 | 0.189                | 0.197 |
| E      | 3.800                     | 4.000 | 0.150                | 0.157 |
| E1     | 5.800                     | 6.240 | 0.228                | 0.246 |
| e      | 1.270TYP                  |       | 0.050TYP             |       |
| L      | 0.400                     | 1.270 | 0.016                | 0.050 |
| θ      | 0°                        | 8°    |                      |       |