

# IS32LT3126 150MA DUAL CHANNEL LED DRIVER WITH FAULT DETECTION

## DESCRIPTION

The IS32LT3126 is a dual linear programmable current regulator consisting of 2 independently controlled output channels; each channel is capable of sourcing 150mA. Both channels can be combined to provide a total of 300mA. It supports PWM dimming of both channels via power supply modulation (PSM). It also features ENx pins to individually PWM dim and independently adjusts the average output current for each channel. The max current for each channel is set with its corresponding external resistor.

The UVx pins set the VCC under voltage lockout of each channel to match the LED stack for high side PWM dimming operation. In addition, the IC integrates fault protection for LED open/short, ISETx pin open/short and over temperature condition for robust operation. Detection of these failures is reported by FAULTB pin. When a fault is detected the device will disable itself and output an open drain low signal. Multiple devices can have their FAULTB pins connected to create a “one-fail-all-fail” condition. For multiple LED string applications, the device can detect a single LED short. The single LED short detection is set by a resistor divider on the STx pins. A single LED short failure is reported by the separate FAULTB\_S pin.

The IS32LT3126 is targeted at the automotive market with end applications to include interior and exterior lighting. For 12V automotive applications the low dropout driver can support one to several LEDs on the output channels.

## QUICK START

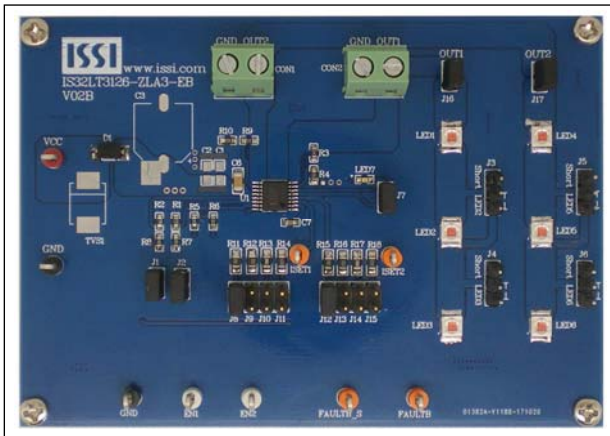


Figure 1: Photo of IS32LT3126 Evaluation Board

## FEATURES

- Four output channels can source up to 150mA each
- Dual channel: each channel can source up to 150mA and the two channels combined to source up to 300mA
- External resistors individually set source current
- 4% channel to channel current matching
- Individually programmable VCC under voltage lockout to match the LED stack for PSM operation
- Individual PWM dimming
- Shared fault flag for multiple devices operation
- Fault protection with flag reporting:
  - Single LED short (optional to turn off all LEDs)
  - LED string open/short
  - OUTx pins short to VCC/GND
  - ISETx pins open/short
  - Over temperature current rollback (no reporting)
  - Thermal shutdown
- External CSTR capacitor keeps fault status during start/stop operation
- eTSSOP-16 package
- Operating temperature range from -40°C ~ +125°C
- AEC-Q100 Qualified

## RECOMMENDED EQUIPMENT

- 12V,1A DC power supply

## ABSOLUTE MAXIMUM RATINGS

- ≤ 40V power supply

**Caution: Do not exceed the conditions listed above, otherwise the board will be damaged.**

## PROCEDURE

The IS32LT3126 evaluation board is fully assembled and tested. Follow the steps listed below to verify board operation.

**Caution: Do not turn on the power supply until all connections are completed.**

- 1) Connect negative terminal of the power supply to the GND and the positive terminal to the VCC.
- 2) Each output current is individually set by four different value resistors ( $R_{ISETX}$ ). Close jumper of J8~J15 to select different output current for each channel.

Table 1 Current Setting

| Jumper J8,J12    | Jumper J9,J13    | Jumper J10,J14  | Jumper J11,J15  |
|------------------|------------------|-----------------|-----------------|
| $I_{OUT1}=150mA$ | $I_{OUT1}=100mA$ | $I_{OUT1}=50mA$ | $I_{OUT1}=25mA$ |
| $I_{OUT2}=150mA$ | $I_{OUT2}=100mA$ | $I_{OUT2}=50mA$ | $I_{OUT2}=25mA$ |



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- 3) J16, J17 are used to connect the IS32LT3126's outputs to the onboard LED strings (LED1~LED6). Use the green terminal blocks to connect the external LED strings. Remove the corresponding jumper J16 and J17 to disable the onboard LED string.

**Note: Connecting an external LED string without removing the onboard string jumper header will drive both onboard and external LED strings in parallel resulting in lower current drive to the LED string.**

- 4) Close jumper J1, J2 to pull EN1/EN2 pins via 100kΩ resistor to VCC. If apply a PWM signal to EN1/2 pins, please remove corresponding jumper J1 and J2, otherwise the PWM source may be damaged.
- 5) Close jumper J7, FAULTB and FAULTB\_S are tied

together. In the case of single LED short is detected, the FAULTB\_S pin pulls down the FAULTB pin together that turns off the no fault condition channel.

- 6) The on board LED string can be adjusted from 1 to 3 LEDs by using header J3, J4, J5, J6. Close the jumper to pins1-2 of J3,J4,J5,J6 disables the corresponding LED2,LED3,LED5,LED6.To enable all the LEDs close the jumper to pins 2-3 of J3,J4,J5,J6 or remove jumper.
- 7) R19, R20, C8, ZD1 and LED7 are used as fault reporting indicator.

**Note: This circuit is not necessary for real application.**

### ORDERING INFORMATION

| Part No.           | Temperature Range           | Package              |
|--------------------|-----------------------------|----------------------|
| IS32LT3126-ZLA3-EB | -40°C ~ +125°C (Automotive) | eTSSOP-16, Lead-free |

Table 1: Ordering Information

For pricing, delivery, and ordering information, please contact ISSI's analog marketing team at [analog@issi.com](mailto:analog@issi.com) or (408) 969-6600.

Table 2 Jumper Setting

| Jumper   | Options  | Settings  |
|----------|--|---|
| J1,J2    | EN setting. If use PWM dimming, please remove jumper J1, J2. | Close jumper: EN1, EN2 pin pulled up to VCC via a 100kΩ resistor and enable the corresponding output.<br>Open jumper: PWM dimming |
| J3~J6    | Number of LED control  | Close pin1-2 : disable the corresponding LED<br>Close pin2-3 : enable the corresponding LED                                       |
| J7       | FAULTB and FAULTB_S setting                                  | Close jumper: FAULTB and FAULTB_S are tied together<br>Open jumper: FAULTB and FAULTB_S are separated                             |
| J8~J15   | Output current setting.                                      | Close jumper to select corresponding resistor. Refer to table 1 for details   |
| J16, J17 | Onboard LED strings select.                                  | Close jumper: enable the corresponding onboard LED string<br>Open jumper: disable the corresponding onboard LED string            |

### EVALUATION BOARD OPERATION

#### OUTPUT CURRENT SETTING

A single resistor ( $R_{ISETx}$ ) controls the maximum output current for each channel. The resistor value for a specific current level is calculated using the following Equation (1):

$$R_{ISET} = \frac{2000}{I_{SET}} \quad (1)$$

$$(13.33k\Omega \leq R_{ISET} \leq 80k\Omega)$$

$R_{ISET}$  need to be chosen 1% accuracy resistor with good temperature characteristic to ensure stable output current.

The device is protected from an output overcurrent condition caused by a too low value  $R_{ISETx}$ , by internally limiting the maximum current to  $I_{OUT\_L}$ .

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If only one channel is used, the EN pin of the unused channel should be tied to GND to prevent unwanted fault reporting.

### ENx PINS OPERATION

The voltage at the ENx pins must be higher than  $V_{EN}$  to enable the channel and below  $(V_{EN} - V_{ENHY})$  to disable the channel. The ENx pins of the IS32LT3126 can accept a PWM signal to implement LED dimming. LED average current may be computed using the following Equation (2).

$$I_{LED} = I_{MAX} \times D_{PWM} \quad (2)$$

$I_{MAX}$  is computed using Equation (1) and  $D_{PWM}$  is the duty cycle. To guarantee a reasonably good dimming effect, recommend PWM frequency in the range of 100Hz ~ 1kHz. Driving the ENx pins with a PWM signal can effectively adjust the LED intensity. The PWM signal voltage levels must meet the ENx pins input voltage levels,  $V_{EN}$ . Tie them to VCC pin via a 10KΩ resistor when ENx pins are unused; do not leave them floating.

### UVx PINS OPERATION

The IC has an internal VCC UVLO set at  $V_{UVLO}$ . However, it may be desirable to externally set an UVLO to track the number of LED's used in the string. For PSM dimming application, the higher UVLO will track the PSM off time to a pre-determined VCC level. In addition, it is necessary to prevent false LED open detection due to the LED string losing its headroom voltage, such as when VCC rises up from zero during power up or PSM dimming. The UVx pin can be used to independently set a VCC under voltage lockout threshold via a resistor divider for each channel.

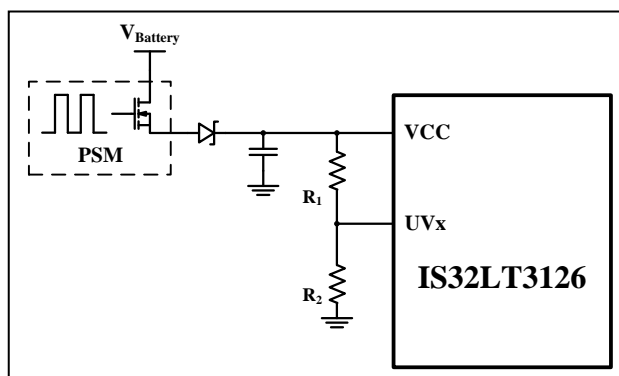


Figure 2 UVx Pins Operation

This external UVLO threshold voltage can be computed using the following Equation (3):

$$V_{CC\_UVLO} = V_{UV} \times \frac{R_1 + R_2}{R_2} \quad (3)$$

Any unused UVLO pin must be tied to VCC pin via a 10kΩ resistor; do not leave it floating.

To prevent false open detection, the external UVLO

threshold voltage should be set at Equation (4):

$$V_{CC\_UVLO} > V_{LED\_MAX} + V_{OCD} \quad (4)$$

Where  $V_{LED\_MAX}$  is the maximum LED string forward voltage on the output channel.

### STx PINS OPERATION

IS32LT3126 device features single LED short detection using a resistor divider on the STx pins. In the case of any single LED short will result in that the STx pin voltage to drop below the threshold voltage  $V_{ST}$  and remains for  $t_{FD}$ , the FAULTB\_S pin pulls low to report the failure to host and all channels continue sourcing current. If FAULTB\_S pin is tied to FAULTB pin, the FAULTB\_S pin pulls down the FAULTB pin together that turns off the no fault condition channel but keep 4mA sourcing on fault channel for recovery detection. In multiple LEDs per string application, set the detection threshold voltage  $V_{DT}$  into below voltage range:

$$(N - 1) \times V_{F\_max} < V_{DT} < N \times V_{F\_min} \quad (5)$$

Where, N is the number of LEDs in the string.  $V_{F\_max}$  and  $V_{F\_min}$  are the maximum and minimum forward voltage of a single LED.

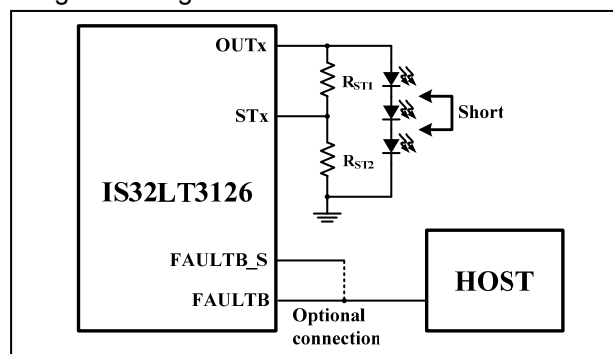


Figure 3 STx Pins Operation

The detection threshold voltage  $V_{DT}$  is calculated by the following Equation (6):

$$V_{DT} = V_{ST} \times \frac{R_{ST1} + R_{ST2}}{R_{ST2}} \quad (6)$$

If single LED short detection is unused, the unused STx pin should be tied to its corresponding OUTx pin.

### OUTPUT STATE DETECTION AND FAULT DIAGNOSTIC

IS32LT3126 offers a fault diagnostic function. Output short to GND/VCC, LED string open/short, ISET pins short/open and over temperature shutdown will trigger this function.

An output short to GND or VCC is detected as a fault if the OUTx pin voltage drops below the short detect voltage threshold  $V_{SCD}$  or VCC to OUTx drop voltage is lower than  $V_{OCD}$  and remains below the threshold for

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$t_{FD}$ . Then the fault channel will change to source a 4mA current for recovery detection and the other channel will turn off. The FAULTB pin will be pulled low to indicate the fault condition. This state will recover after the fault condition is removed.

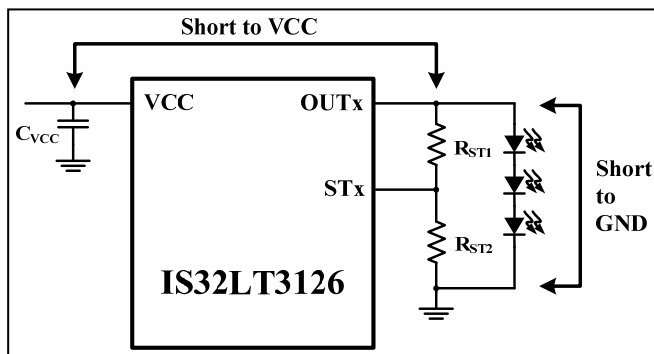


Figure 4 OUTx Pins Short Operation

In the event the LED channel is open circuited, the OUTx pin voltage will go up close to  $V_{CC}$ . If  $V_{CC}$  to OUTx drop voltage remains below the threshold  $V_{OCD}$  for  $t_{FD}$ , the fault channel will change to source a 4mA current for recovery detection and the other channel will turn off. The FAULTB pin will be pulled low to indicate the fault condition. The state will recover after the open condition is removed.

If the ISETx pin is either short or open, the FAULTB pin will pull low to assert the fault and the both channels will turn off. The state will recover after the fault condition is removed.

Table 3 Fault Actions

| Fault Type                           | Fault Condition  | Fault Channel                                     | Another Channel | FAULTB                 | FAULTB_S | Recovery  |
|--------------------------------------|--|---|-----------------|------------------------|----------|---|
| ISETx open                           | ISETx pin current close to zero                                  | Off   | Off             | Low                    | High     | ISETx pin current goes back normal              |
| ISETx short                          | ISETx pin voltage close to zero                                  | Off   | Off             | Low                    | High     | ISETx pin voltage goes back normal              |
| LED string open (OUTx short to VCC)  | $(V_{CC}-V_{OUTx}) < V_{OCD}$                                    | 4mA for recovery detection                        | Off             | Low                    | High     | $(V_{CC}-V_{OUTx}) > (V_{OCD}+V_{OCD\_HY})$     |
| LED string short (OUTx short to GND) | $V_{OUTx} < V_{SCD}$   | 4mA for recovery detection                        | Off             | Low                    | High     | $V_{OUTx} > (V_{SCD}+V_{SCD\_HY})$              |
| One LED short                        | STx pin voltage drops below $V_{ST}$                             | Keep normal sourcing                              |                 | High                   | Low      | STx pin voltage rises above $(V_{ST}+V_{STHY})$ |
|                                      | FAULTB_S tied to FAULTB and STx pin voltage drops below $V_{ST}$ | 4mA for recovery detection                        | Off             | Pulled low by FAULTB_S | Low      | STx pin voltage rises above $(V_{ST}+V_{STHY})$ |
| Thermal rollback                     | $T_J > T_{RO}$   | Output current linearly decreases following $T_J$ |                 | High                   | High     | $T_J < T_{RO}$                                  |
| Thermal shutdown                     | $T_J > T_{SD}$   | Off   |                 | Low                    | High     | $T_J < (T_{SD}-T_{HY})$                         |

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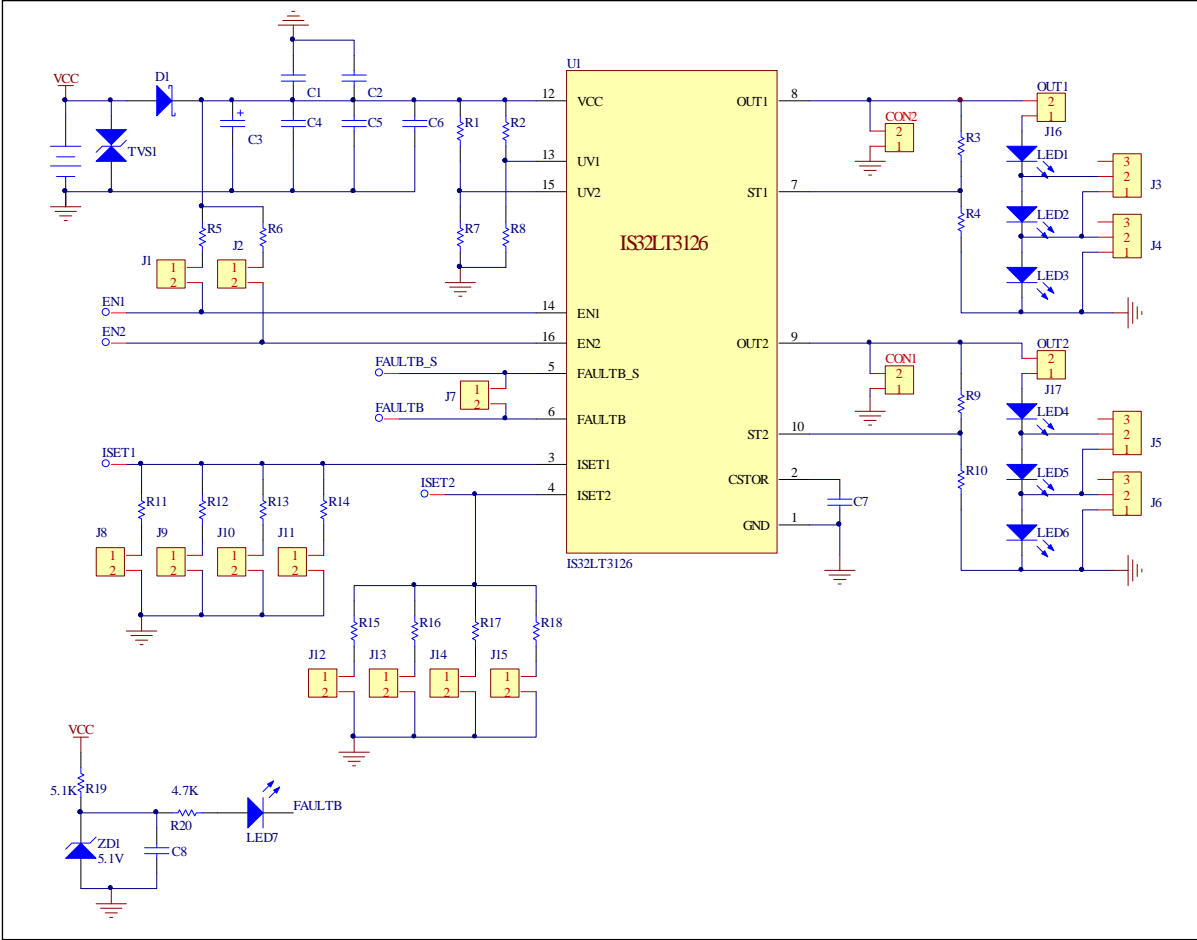


Figure 5: IS32LT3126 DEMO Schematic



# IS32LT3126 150MA DUAL CHANNEL LED DRIVER WITH FAULT DETECTION

## BILL OF MATERIALS

| Name            | Symbol            | Description                            | Qty | Supplier | Part No.          |
|-----------------|-------------------|--|-----|----------|-------------------|
| LED Driver      | U1                | LED Driver                             | 1   | ISSI     | IS32LT3126        |
| Resistor        | R1,R2             | RES,36K,1/10W,±1%,SMD                  | 2   | YAGEO    | AC0603FR-0736KL   |
| Resistor        | R3,R9             | RES,10K,1/10W,±1%,SMD                  | 2   | YAGEO    | AC0603FR-0710KL   |
| Resistor        | R4,R10            | RES,3K,1/10W,±1%,SMD                   | 2   | YAGEO    | AC0603FR-073KL    |
| Resistor        | R5,R6             | RES,100K,1/10W,±1%,SMD                 | 2   | YAGEO    | AC0603FR-07100KL  |
| Resistor        | R7,R8             | RES,6.8K,1/10W,±1%,SMD                 | 2   | YAGEO    | AC0603FR-076K8L   |
| Resistor        | R11,R15           | RES,13K,1/8W,±1%,SMD                   | 2   | YAGEO    | AC0805FR-0713KL   |
| Resistor        | R12,R16           | RES,20K,1/8W,±1%,SMD                   | 2   | YAGEO    | AC0805FR-0720KL   |
| Resistor        | R13,R17           | RES,39K,1/8W,±1%,SMD                   | 2   | YAGEO    | AC0805FR-0739KL   |
| Resistor        | R14,R18           | RES,82K,1/8W,±1%,SMD                   | 2   | YAGEO    | AC0805FR-0782KL   |
| Resistor        | R19               | RES,5.1K,1/8W,±5%,SMD                  | 1   | YAGEO    | AC0805JR-075K1L   |
| Resistor        | R20               | RES,4.7K,1/8W,±5%,SMD                  | 1   | YAGEO    | AC0603JR-074K7L   |
| Capacitor       | C6                | CAP,0.1µF,50V,±10%,SMD                 | 1   | YAGEO    | AC1206KRX7R9BB104 |
| Capacitor       | C7                | CAP,1µF,10V,±10%,SMD                   | 1   | YAGEO    | AC0603KRX7R6BB105 |
| Schottky        | D1                | 60V/1A,Diode Schottky                  | 1   | ON Semi  | SS16FA            |
| LEDs            | LED1~LED6         | Yellow LED,1W,V <sub>F</sub> =2.0~2.2V | 6   |          |                   |
| Zener           | ZD1               | ZMM5.1V,0.5W, LL-34                    | 1   |          |                   |
| LED             | LED7              | Red LED,20mA,V <sub>F</sub> =1.8V      | 1   |          |                   |
|                 | C1~C5,C8,<br>TVS1 | Not installed                          | 7   |          |                   |
| Header          | J1,J2             | 2 pin header                           | 13  |          |                   |
|                 | J7~J17            |  |     |          |                   |
| Header          | J3,J4,J5,J6       | 3 pin header                           | 4   |          |                   |
| Terminal blocks | CON1              | Ext terminal blocks                    | 2   |          |                   |
|                 | CON2              |  |     |          |                   |

Bill of Materials, refers to Figure 5 above.

# IS32LT3126 150MA DUAL CHANNEL LED DRIVER WITH FAULT DETECTION

## PCB LAYOUT

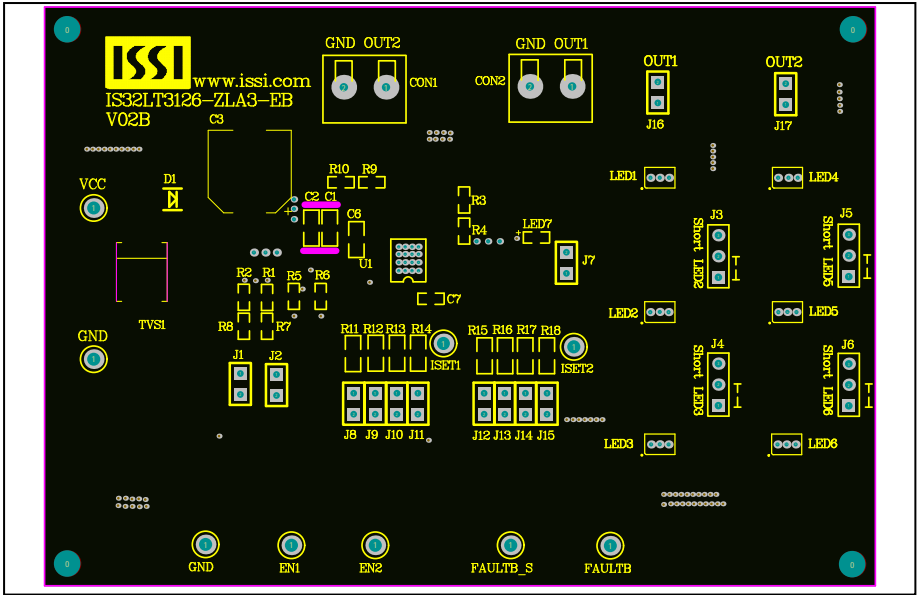


Figure 6 Board Component Placement Guide - Top Layer

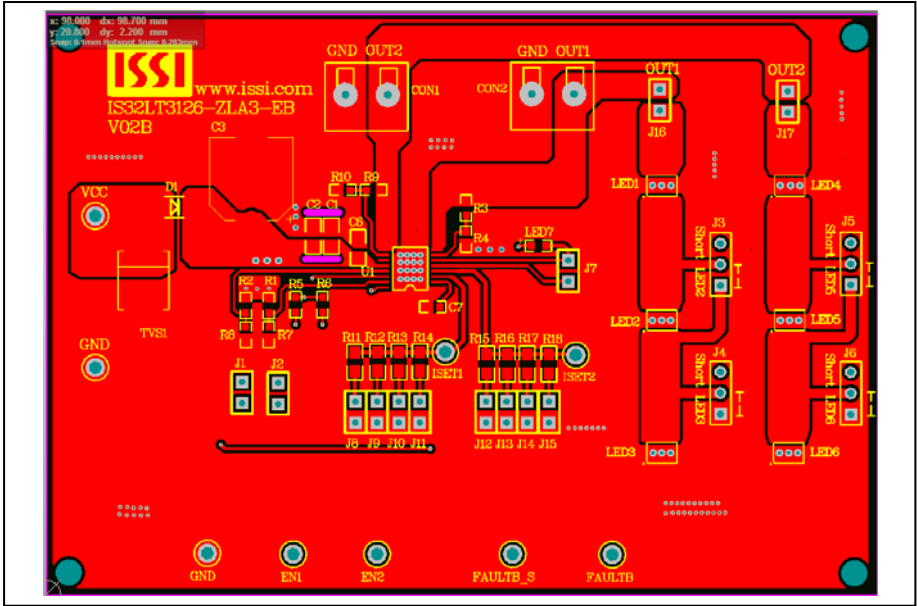


Figure 7 Board PCB Layout- Top Layer



# IS32LT3126 150MA DUAL CHANNEL LED DRIVER WITH FAULT DETECTION

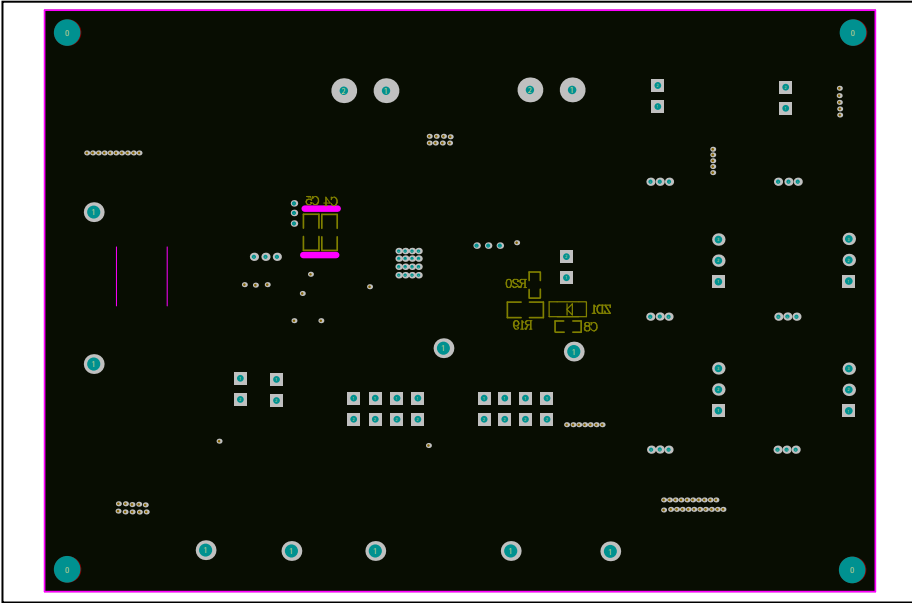


Figure 8 Board Component Placement Guide - Bottom Layer

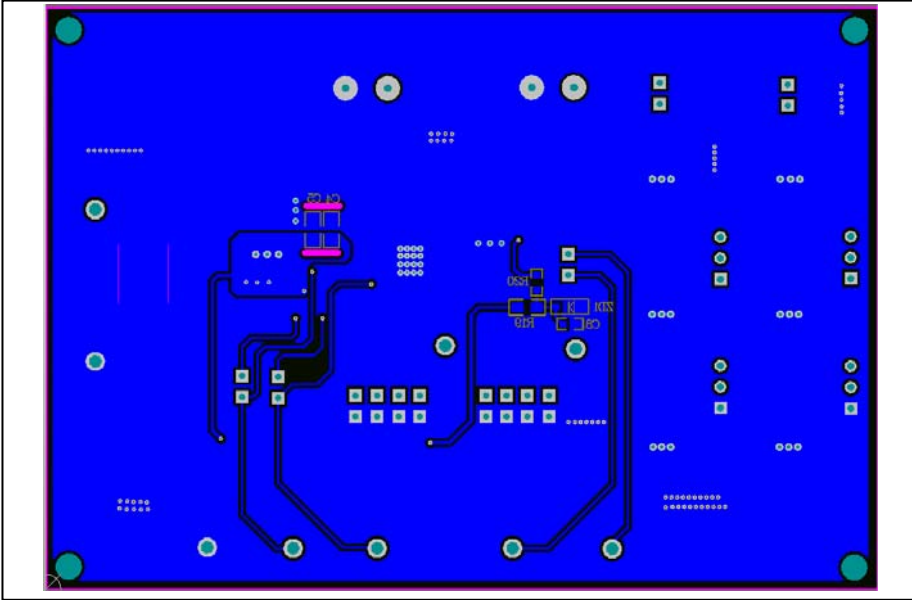


Figure 9 Board PCB Layout - Bottom Layer

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**IS32LT3126 150MA DUAL CHANNEL LED DRIVER  
WITH FAULT DETECTION**

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**REVISION HISTORY**

| Revision | Detail Information | Date       |
|----------|--------------------|------------|
| A        | Initial release    | 2018.11.09 |

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

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