IS32LT3128/3128A TRIPLE CHANNELS LINEAR CURRENT LED DRIVER

DESCRIPTION

The IS32LT3128/3128A is a programmable triple channel linear current regulator; two channels of up to 150mA each for LED lighting and a single channel of up to 30mA for illuminating switches. The device operates as a fully configurable theatrical dimming LED driver; no microcontroller is required. External resistors will program the current levels as well as the LED fade ON/OFF ramp rate. Additional configuration such as PWM source (internal or external), polarity (positive or negative) and switch type (momentary contact or latched) are selectable via the MODE1/2 pins.

An integrated debounce and latch circuit on the channel enable pin (EN1/2) is enabled when the device is configured for a momentary contact switch interface. The other option is to configure the EN pins to accept a static level signal for operation with latched switches. A VCC level PWM dimming signal can be connected to the PWM input pin to directly drive both LED channels. If configured for Internal PWM Dimming mode, the integrated PWM source will be triggered by a PWM pin voltage level. This enables LED dimming without the need for an external PWM input. The IS32LT3128A PWM input has a higher priority and will override the EN switch inputs. The IS32LT3128 PWM input has a lower priority than the EN inputs; the switches have higher priority.

The device integrates a 63 steps fade ON/OFF algorithm (Gamma correction) which causes the output LED brightness to gradually ramp up to the full source value after the EN1/2 or PWM pins are triggered (when configured for Internal PWM Dimming mode). The same controller causes the LED brightness to gradually ramp down to zero if the EN1/2 or PWM pins are triggered while the output channel is ON (when configured for Internal-PWM-Dimming mode). The fade ramp can be interrupted mid-cycle before completion of the ramp cycle.

The IS32LT3128/3128A is targeted at the automotive market with end applications to include map and dome lighting as well as exterior accent lighting. For 12V automotive applications the low dropout driver can support 1 to 3 LEDs per channel. It is offered in a small thermally enhanced eTSSOP-20 package.

FEATURES

- Operating voltage range, 5V to 42V
- Dual channel current sources
  - Individual programmable current via a single external resistor
  - Configurable from 20mA to 150mA

- Single channel 30mA (Max.) current source for switch illumination
- EN input supports either momentary contact or latched switch
  - Input is debounced and latched
  - PWM input lower priority than EN input (IS32LT3128)
  - EN input lower priority than PWM input (IS32LT3128A)
  - Gamma corrected Fade ON/OFF algorithm
  - Pull down resistors set independent fade ON and OFF ramp time
- Selectable external or internal PWM source
  - External PWM directly drives the current source
  - Internal 220Hz PWM source with Gamma corrected algorithm for automatic dimming the current source
  - Support both positive and negative polarity PWM
- Fault Protection:
  - Fault Reporting
    ✓ LED strings short
    ✓ Over temperature thermal shutdown
  - ISET pin shorted to GND
  - Over temperature current roll off
- AEC-Q100 Qualified
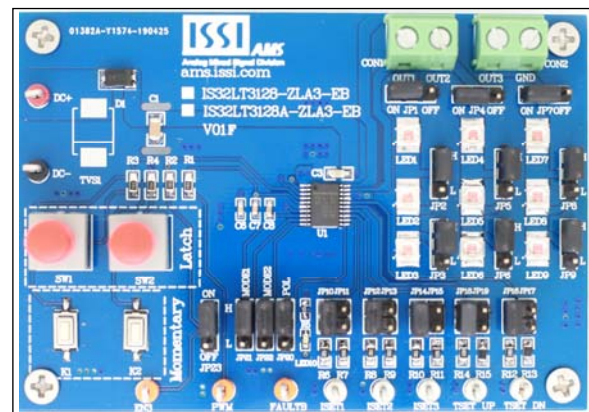- Operating temperature range from -40°C ~ +125°C

QUICK START

Figure 1: IS32LT3128/3128A Demo Board Photo

RECOMMENDED EQUIPMENT

- 12V,1A DC power supply

ABSOLUTE MAXIMUM RATINGS

- ≤ 42V power supply

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

ORDERING INFORMATION

Part No.	Temperature Range	Package
IS32LT3128-ZLA3-EB	-40°C ~ +125°C (Automotive)	eTSSOP-20, Lead-free
IS32LT3128A-ZLA3-EB		

Table 1: Ordering Information

For pricing, delivery, and ordering information, please contact Lumissil's analog marketing team at analog@Lumissil.com or (408) 969-6600.

PROCEDURE

The IS32LT3128/3128A 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. Output Current Setting
   OUT1/2/3 current can be adjusted by R6/R7, R8/R9, R10/R11 resistors using Table 2 jumper settings.

Output	Jumper Setting	Current
OUT1	JP10 connected	100mA
	JP11 connected	50mA
	JP10/11 connected	150mA
OUT2	JP12 connected	100mA
	JP13 connected	50mA
	JP12/13 connected	150mA
OUT3	JP14 connected	20mA
	JP15 connected	10mA
	JP14/15 connected	30mA

Table 2: Output Current Setting

2. Fade ON/OFF Time Setting
   Fade ON/OFF time can be adjusted by R14/R15, R12/R13 resistors using Table 3 jumper settings.

Function	Jumper Setting	Time
Fade ON	JP18 connected	250ms
	JP19 connected	1550ms
Fade OFF	JP16 connected	250ms
	JP17 connected	1550ms

Table 3: Fade ON/OFF Time Setting

3. OUT1/2 Control
   IS32LT3128/3128A's OUT1/2 can be controlled by either Momentary Contact Switch or Latched Switch.
   To support Latched Switch control, connect JP22 to L side (MODE2 pin is connected to GND). Toggling SW1/SW2 will enable/disable the corresponding output LED string.
   To support Momentary Contact Switch control, connect JP22 to H side (MODE2 pin is connected to VIO) and make sure both latch switches (SW1/SW2) are released. Pushing K1/K2 will enable/disable the corresponding output LED string.

Note: if SW1/SW2 is not released, the K1/K2 momentary contact switches control will be abnormal.

Switch Type	Setting
Latched Switch	JP22 connected to L pin (GND)
Momentary Contact Switch	JP22 connected to H pin (VIO)
	SW1/SW2 in release state.

Table 4: Switch Type Setting

4. PWM Polarity Selection
   IS32LT3128/3128A supports either positive or negative PWM polarity control.
   To support positive polarity control (PWM pin active high), connect JP20 to H side (POL pin is connected to VIO).
   To support negative polarity control (PWM pin active low), connect JP20 to L side (POL pin is connected to GND).

PWM Polarity	Jumper Setting
Positive	JP20 connected to H side (VIO)
Negative	JP20 connected to L side (GND)

*Table 5: PWM Polarity Setting*

5. PWM Dimming Mode Setting
   IS32LT3128/3128A supports either External or Internal PWM Dimming.
   To support External PWM Dimming, connect JP21 to H side (MODE1 pin is connected to VIO). Apply an external PWM signal on PWM terminal to simultaneously dim both OUT1/2.
   To support Internal PWM Dimming, connect JP21 to L side (MODE1 pin is connected to GND). Depending on the selected PWM polarity, apply a voltage or ground level signal to the PWM terminal to trigger the internal PWM source so both OUT1/2 will simultaneously fade ON or OFF.

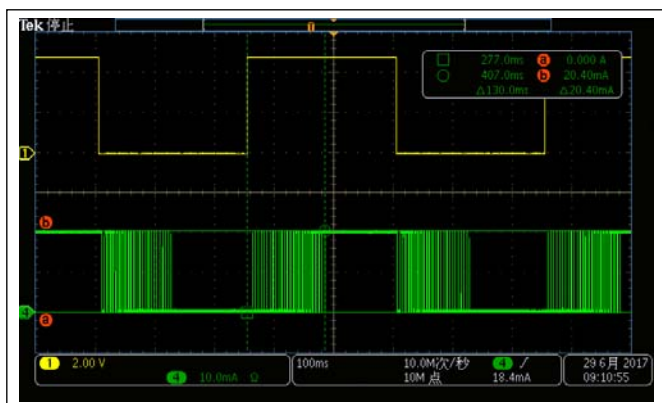| PWM Dimming Mode	Jumper Setting
External PWM Dimming	JP21 connected to H side (VIO)
Internal PWM Dimming	JP21 connected to L side (GND)

Table 6: PWM Dimming Setting
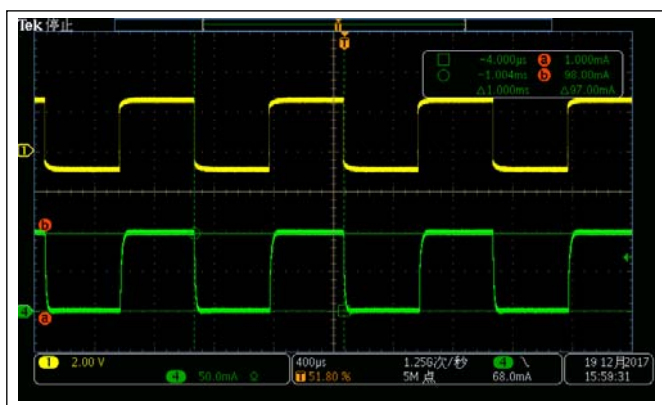
CH1: PWM Pin Voltage CH4:OUT1/2 Current
Figure 2: External PWM Dimming (Positive Polarity)
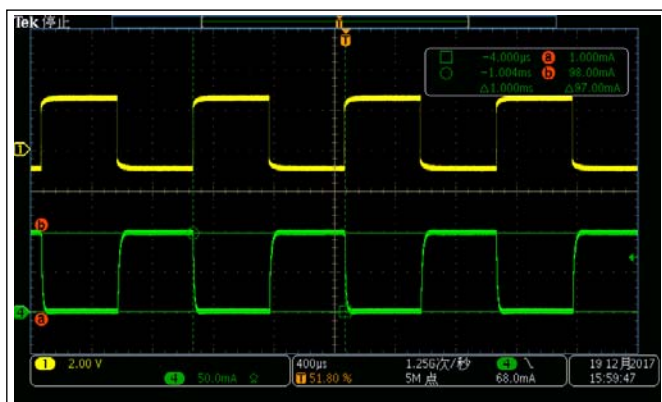
CH1: PWM Pin Voltage CH4:OUT1/2 Current
Figure 3: External PWM Dimming (Negative Polarity)

CH1: PWM Pin Voltage CH4:OUT1/2 Current
Figure 4: Internal PWM Dimming

6. OUT3 Control
   IS32LT3128/3128A's OUT3 is designed for switch backlight illumination. OUT3 is an independent channel, which is only controlled by EN3 pin and without fade ON and fade OFF function. Connect JP23 to ON side to enable and OFF side to disable OUT3 LED string. If an external PWM control is required, open JP23 and apply an external PWM signal on EN3 terminal for PWM dimming.
   Note: JP23 is connected to VCC. If JP23 is not opened, the external PWM source may be damaged by high voltage.

7. Fault Reporting
   If IS32LT3128/3128A's OUT1, OUT2 or OUT3 voltage drops below 1.2V (min.), or the device junction temperature rises above 175°C (typ.), the FAULTB pin will be pulled down to report the fault condition and LED10 will light up. Once the fault condition is removed, the FAULTB pin goes back to high impedance and LED10 will be turned off.
   Note: R5 and LED10 is not necessary for actual application.

8. On Board LED Strings Setting
   There are 3 on board LED strings, one for each OUTx channel. Each string can be adjusted from 1 to 3 LEDs by jumpers, JP2/JP3 for OUT1, JP5/JP6 for OUT2 and JP8/JP9 for OUT3. Connect to H side to enable and L side to disable the corresponding LEDs.

9. External LED String Connection
   CON1 and CON2 are used to connect with external LED strings. If external LED strings are used, please make sure JP1, JP4 and JP7 jumpers are connected to the OFF side. Connect the external LED string anodes to CON1/2 and the cathodes to CON2 GND.
   Note: Connecting an external LED string without removing the onboard string jumper header JP1/JP4/JP7 will drive both onboard and the external LED strings in parallel resulting in lower current drive to the LED string.

10. For this evaluation board, it is best to use a 12V DC power source. Connect the DC+ terminal to VCC of the power supply and DC- terminal to GND of the power supply. Turn on the power supply and verify the OUT3 LED string lights up. If the OUT1/2 strings fail to light up, check the power connections and status of the fault LED10.

11. Test points for EN3, PWM (input), FAULTB (output), ISET1/2/3, TSET_UP and TSET_DN are available for external monitoring and control.

EVALUATION BOARD OPERATION

OUTPUT CURRENT SETTING

An individual programming resistor (R_{ISETx}) is connected to the ISETx pin to set the maximum output current for each output channel.

The programming resistor of OUT1/2 can be computed using the following Equation (1):

$$R_{ISET1/2} = \frac{1500}{I_{OUT1/2}} \qquad (1)$$

(10kΩ≤R$_{ISET1/2}$≤75kΩ)

Where I$_{OUT1/2}$ is the desired output current value in Amps.

The programming resistor of OUT3 can be computed using the following Equation (2):

$$R_{ISET3} = \frac{300}{I_{OUT3}} \qquad (2)$$

(10kΩ≤R$_{ISET3}$≤75kΩ)

Where I$_{OUT3}$ is the desired output current value in Amps.

It is highly recommended to use 1% accuracy R$_{ISETx}$ resistors with good temperature characteristics to ensure accurate and stable output currents.

The device is protected from an output overcurrent condition caused by an accidental short circuit of the ISETx pin, by internally limiting the maximum current in the event of an ISETx short circuit to 205mA (Typ.) for OUT1/2 and 40mA (Typ.) for OUT3.

SETTING THE FADE TIME

The fade time is set by two external programming resistors; R$_{TSET\_UP}$ and R$_{TSET\_DN}$. The R$_{TSET\_UP}$ connected to the TSET_UP pin configures the fade ramp ON time while the R$_{TSET\_DN}$ connected to the TSET_DN pin configures the fade ramp OUT time. The fade time (ON or OFF) is programmable by Equation (3):

$$t \approx R_{TSET} \times 2.5\mu s \qquad (3)$$

For example, R$_{TSET}$=100kΩ, Fade ON/OFF time is about 0.25s.

Note: In order to get the optimized effect, the recommended fading time is between 1.5s (R$_{TSET}$= 600kΩ) and 0.25s (R$_{TSET}$= 100kΩ).

If either the TSET_UP or TSET_DN pin is tied directly to GND, the corresponding fade function is canceled and the ramp time is about 70μs, or "instant on". However, the debounce feature of the EN pin is not disabled.

BILL OF MATERIALS

Name	Symbol	Description	Qty	Supplier	Part No.
LED Driver	U1	Constant current LED driver	1	Lumissil	IS32LT3128/3128A
	TVS1,C2	Not installed			
Capacitor	C6,C7	CAP,3.3nF,50V,±10%,SMD	2	Yageo	AC0603KRX7R9BB332
Capacitor	C8	CAP,1µF,10V,±10%,SMD	1	Yageo	AC0603KRX7R6BB105
Capacitor	C3	CAP,100nF,50V,±10%,SMD	1	Yageo	AC0805KRX7R9BB104
Capacitor	C1	CAP,4.7µF,50V,±10%,SMD	1	TDK	CGA5L3X7R1H475K160AE
Resistor	R5	RES,4.7k,0603,±1%,SMD	1	Panasonic	ERJ-3EKF4701V
Resistor	R1,R2,R3,R4	RES,10k,0805,±1%,SMD	4	Panasonic	ERJ-6ENF1002V
Resistor	R6,R8,R10	RES,15k,0805,±1%,SMD	3	Panasonic	ERJ-6ENF1502V
Resistor	R7,R9,R11	RES,30k,0805,±1%,SMD	3	Panasonic	ERJ-6ENF3002V
Resistor	R12,R14	RES,100k,0805,±1%,SMD	2	Panasonic	ERJ-6ENF1003V
Resistor	R13,R15	RES,620k,0805,±1%,SMD	2	Panasonic	ERJ-6ENF6203V
Diode	D1	SS16,1A,60V,SMA	1	Vishay	SS16HE3_B/I
Button	SW1,SW2	Latch switch	2		
Button	K1,K2	Momentary contact switch	2		
LED	LED1~LED9	White LED,0.5W,V_F=3.2V	9		
LED	LED10	Red LED,0402,V_F=2.8V	1		
Header	JP1~JP9, JP20~JP23	3 pin headers	13		
Header	JP10~JP19	2 pin headers	10		
Connector	CON1,CON2	2 pin connectors	2		
Test point	DC+,DC-,EN3, PWM,FAULTB, ISET1~ISET3, TSET_UP, TSET_DN	1 pin test point	10		
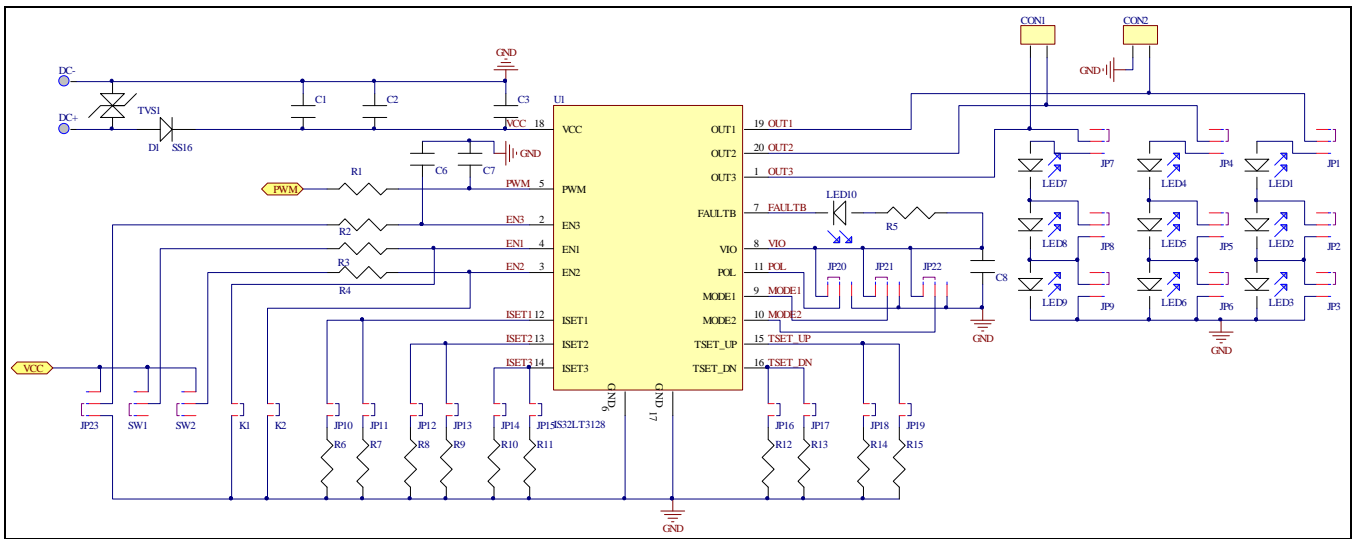
SCHEMATIC

Figure 5: IS32LT3128/3128A DEMO Board Schematic
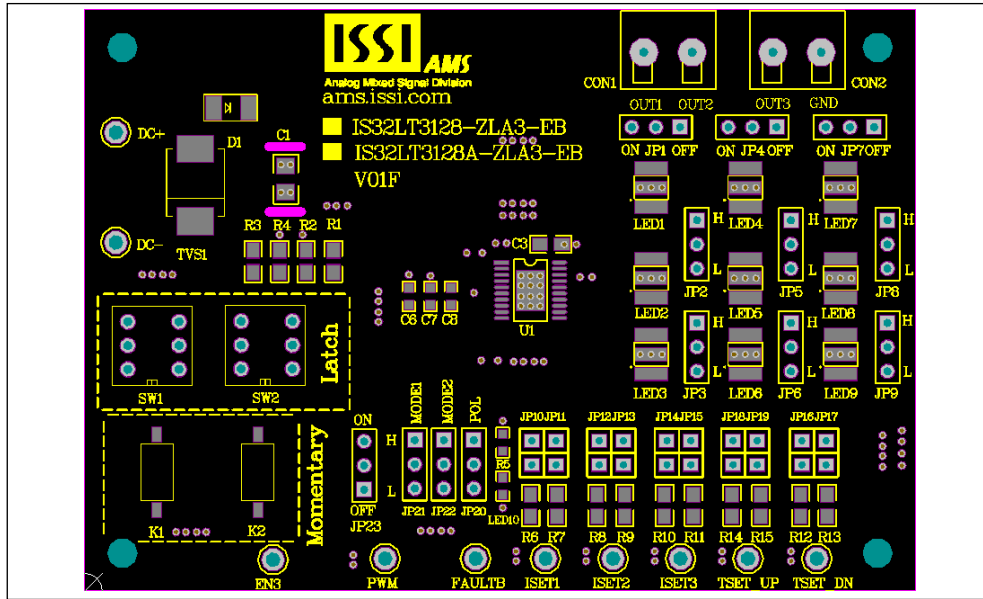
PCB LAYOUT

Figure 6: Board Component Placement Guide - Top Layer
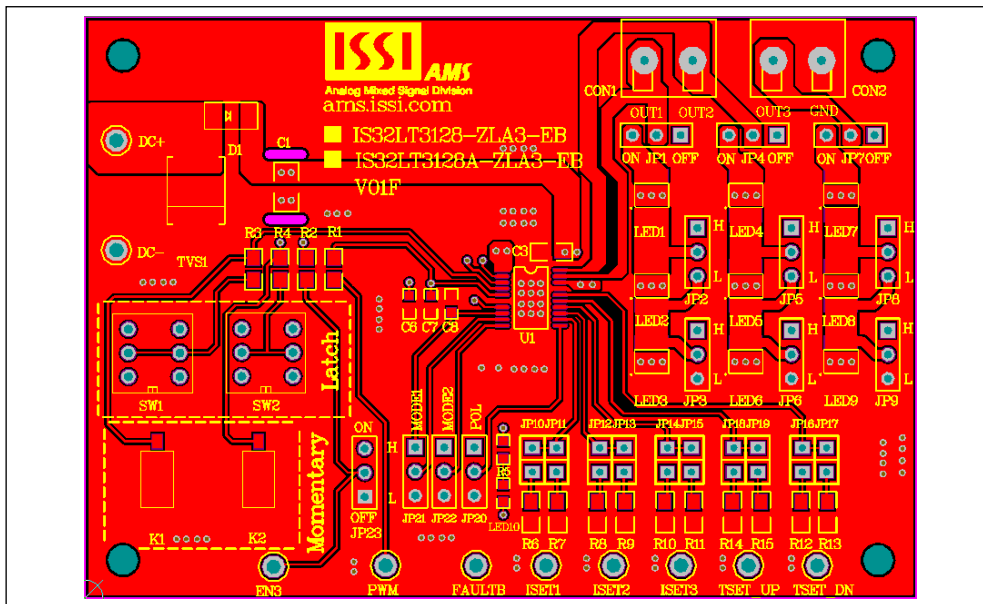
Figure 7: Board PCB Layout - Top Layer
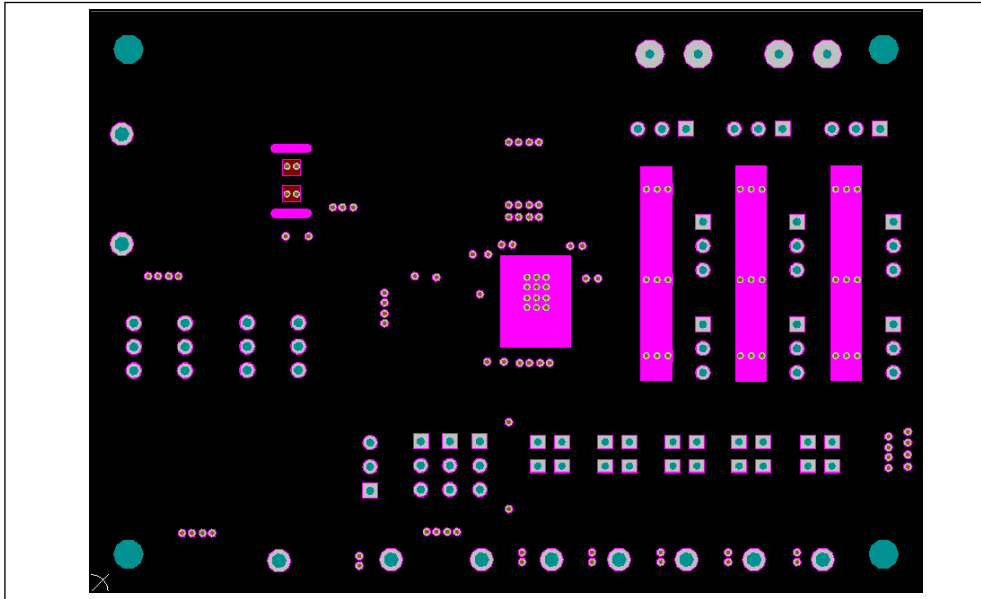
Figure 8: Board Component Placement Guide - Bottom Layer
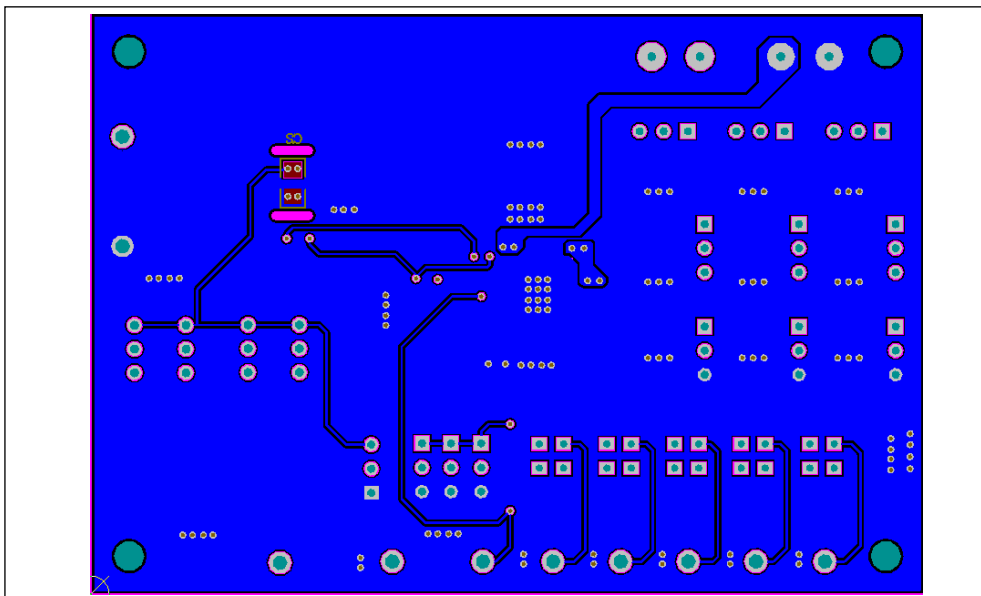
Figure 9: Board PCB Layout - Bottom Layer