Constant Current for LED Driver Application

ELECTRICAL SPECIFICATION:

Parameters	Value	Note
Input UVLO Falling	7V	
Input UVLO Rising	7.4V	
Output OVP / UVP / LED series number	17.6V / 6.8V / 3 ~ 4 LEDs	JR25 Jumper short
Output OVP / UVP / LED series number	33.8V / 13V / 5 ~ 8 LEDs	JR25 Jumper open
Switching Frequency	350kHz	
LED current	1.5A	

PROGRAMMING OUTPUT VOLTAGE:

Input UVLO Setting

Input under voltage shutdown levels can both be defined through an external resistor divider. EN/INUVLO pin voltages are internally compared to their respective thresholds shown as the following equations. It is recommended that choose R2=10kohm, and R1 can be calculated by following equation. Input under voltage falling threshold $V_{EN/INUVLOTH}$ typical is 1.75V for calculating the VIN UVLO falling. Input under voltage threshold hysteresis $V_{EN/INUVLO_HYS}$ typical is 90mV for calculating the VIN UVLO rising. Following is some examples for R1, R2 selection.

$$UVth = \left(1 + \frac{R1}{R2}\right) \cdot V_{EN/INUVLOTH}$$

Table 1: Parameter Value Setting

VIN UVLO Falling	7V
VIN UVLO Rising	7.4V
R1 (Ω)	30k
R2 (Ω)	10k

Output OVP Setting

The output OVP can be set by the external dividing resistor. VFB typical value is 1.46V. Following are some output voltage examples.

$$R22 = R23 \times \left(\frac{VOUT_OVP}{VFB} - 1\right)$$

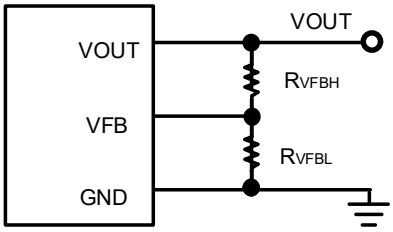


Figure 1: VFB Protection Pin

Table 2: Parameter Value Setting

OVP	33.8V	17.6V
Short Protection	13V	6.8V
Jumper JR25	open	short
R_{VFBH} (Ω)	=R22 =32.2k	=R22//R25 =16.6k
R_{VFBL} (Ω)	=R23=1.5k	=R23=1.5k

Frequency Setting

The switching frequency can be set from 200 kHz to 400 kHz by an external resistor. Select the switching frequency with an external resistor according to the following approximate formulas.

$$R_{FREQ}[k\Omega] = 46023 \cdot (F_{SW}[kHz])^{-1.25}$$

Table 3: Parameter Value Setting

Vout	250kHz	350kHz	400kHz
R12 (Ω)	46.4k	30k	25.5k

LED Constant Current Setting

$V_{FBH-FBL}$ typical value is 150mV. Set the LED current with an external resistor according to the following approximate formulas.

$$I_{LED} = \frac{V_{FBH-FBL}}{R26}$$

Table 4: Parameter Value Setting

ILED	1A	1.5A	2A
R26 (Ω)	150m	100m	75m

EVALUATION BOARD SCHEMATIC:

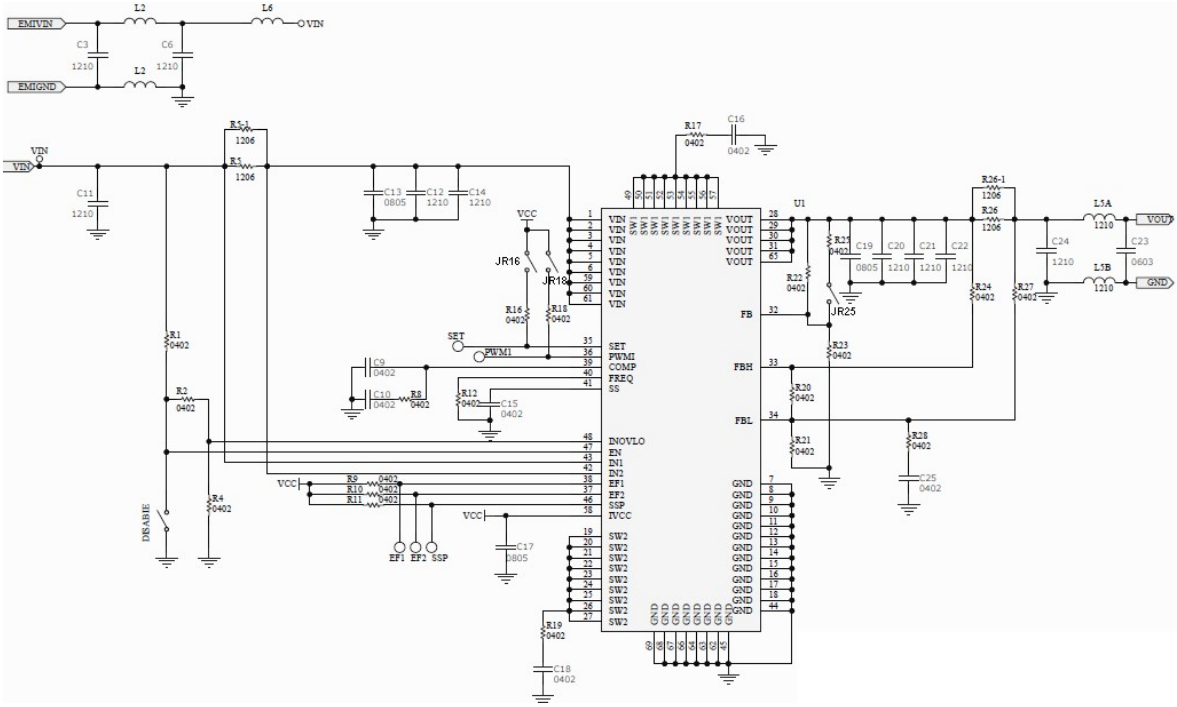


Figure 2: Schematic

BOM LIST:

Table 5: The BOM without EMI solution

Count	Part Reference	Description
1	U1	VPN12AD02-FU
4	C12, C14, C20, C22	MLCC, 10uF, 50V, X7R, 1210
1	C17	MLCC, 10uF, 25V, X7S, 0805
2	C9, C15	MLCC, 22nF, 25V, X7R, 0402
2	R2, R16, R18	RES, 10Kohm, 0402 1%
2	R9, R10	RES, 100Kohm, 0402 1%
1	R22, R25	RES, 33.2Kohm, 0402 1%
2	R23	RES, 1.5Kohm, 0402 1%
1	R1, R12	RES, 30Kohm, 0402 1%
6	R4, R24, R27	RES, 0ohm, 0402
1	R5, R5-1	Short
1	R26	RES, 100mohm, 1206 1%
22	L2, L6, C3, C6, C10, C11, C13, C16, C18, C19 ,C21,C23, C24, C25, R26-1, R17, R19, R11, R8, R28, R20, R21	NC

QUICK START GUIDE:

Power on/off

1. Connect 3~4 LEDs from VOUT to GND if jumper JR25 is short, Connect 5~8 LEDs from VOUT to GND if jumper is open.
2. Short the jumper JR16 and JR18
3. Give Power from VIN to GND (without EMI solution), from EMIIN to EMIG (with EMI solution)
4. Open the Disable jumper to enable VPN12AD02-FU
5. Short the Disable jumper to disable VPN12AD02-FU

Digital and analog dimming

1. For digital dimming, open JR18 and give the PWM signal to PWMI pin.
2. For analog dimming, open JR16 and give the analog signal to SET pin.

Frequency Spread Spectrum

1. Add R11=10kohm to enable Frequency Spread Spectrum.
2. Remove R11 to disable Frequency Spread Spectrum.

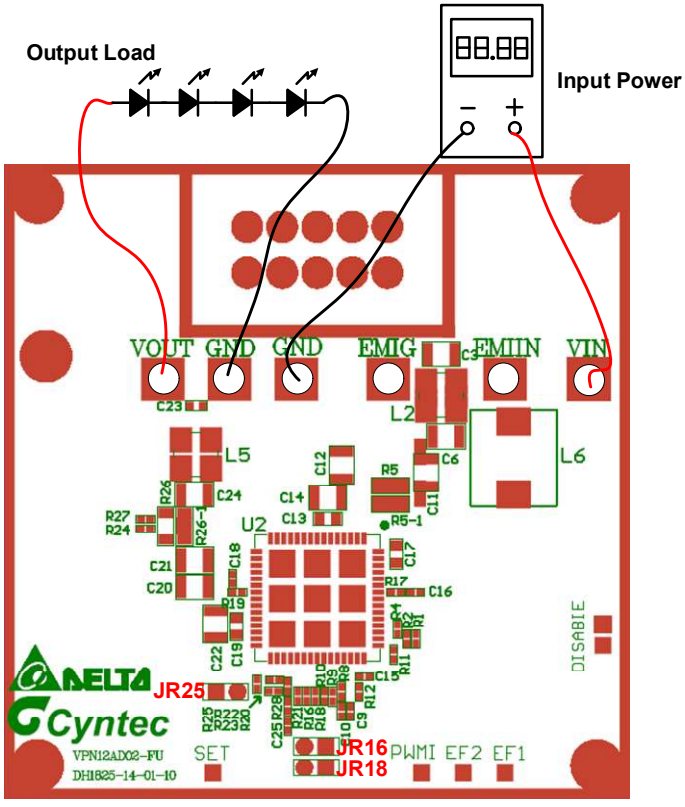


Figure 3: Quick Start Guide for Constant Current Application

Constant Voltage Application

ELECTRICAL SPECIFICATION:

Parameters	Value	Note
Output Voltage	12V	
Input UVLO Falling	7V	
Input UVLO Rising	7.4V	
Output OVP	15V	
Output Short	6V	

PROGRAMMING OUTPUT VOLTAGE:

Input UVLO Setting

Input under voltage shutdown levels can both be defined through an external resistor divider. EN/INUVLO pin voltages are internally compared to their respective thresholds shown as the following equations. It is recommended that choose R2=10kohm, and R1 can be calculated by following equation. Input under voltage falling threshold $V_{EN/INUVLOTH}$ typical is 1.75V for calculating the VIN UVLO falling. Input under voltage threshold hysteresis $V_{EN/INUVLO_HYS}$ typical is 90mV for calculating the VIN UVLO rising. Following is some examples for R1, R2 selection.

$$UVth = \left(1 + \frac{R1}{R2}\right) \cdot V_{EN/INUVLOTH}$$

Table 6: Parameter Value Setting

VIN UVLO Falling	7V
VIN UVLO Rising	7.4V
R1 (Ω)	30k
R2 (Ω)	10k

Output OVP Setting

The output OVP can be set by the external dividing resistor. VFB typical value is 1.46V. Following are some output voltage examples.

$$R22 = R23 \times \left(\frac{VOUT_OVP}{VFB} - 1\right)$$

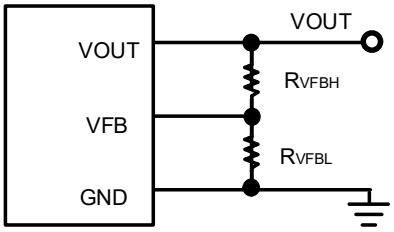


Figure 4: VFB Protection Pin

Table 7: Parameter Value Setting

VOUT OVP	15.1V
Short Protection	5.8V
R_{VFBH} (Ω)	=R22 =14k
R_{VFBL} (Ω)	=R23 =1.5k

Frequency Setting

The switching frequency can be set from 200 kHz to 400 kHz by an external resistor. Select the switching frequency with an external resistor according to the following approximate formulas.

$$R_{FREQ}[k\Omega] = 46023 \cdot (F_{SW}[kHz])^{-1.25}$$

Table 8: Parameter Value Setting

Vout	350kHz
R12 (Ω)	30k

Output Voltage Setting

For a voltage regulator, the output voltage can be set by selecting the values R20, R21 according to the following equation. IFBL typical value is 30uA. $V_{FBH-FBL}$ typical value is 150mV.

$$V_{OUT} = \left(\frac{V_{FBH-FBL}}{R20} - I_{FBL}\right) R21 + V_{FBH-FBL}$$

Table 9: Parameter Value Setting

Vout	12.1V
R20 (Ω)	150
R21 (Ω)	12.4k

EVALUATION BOARD SCHEMATIC:

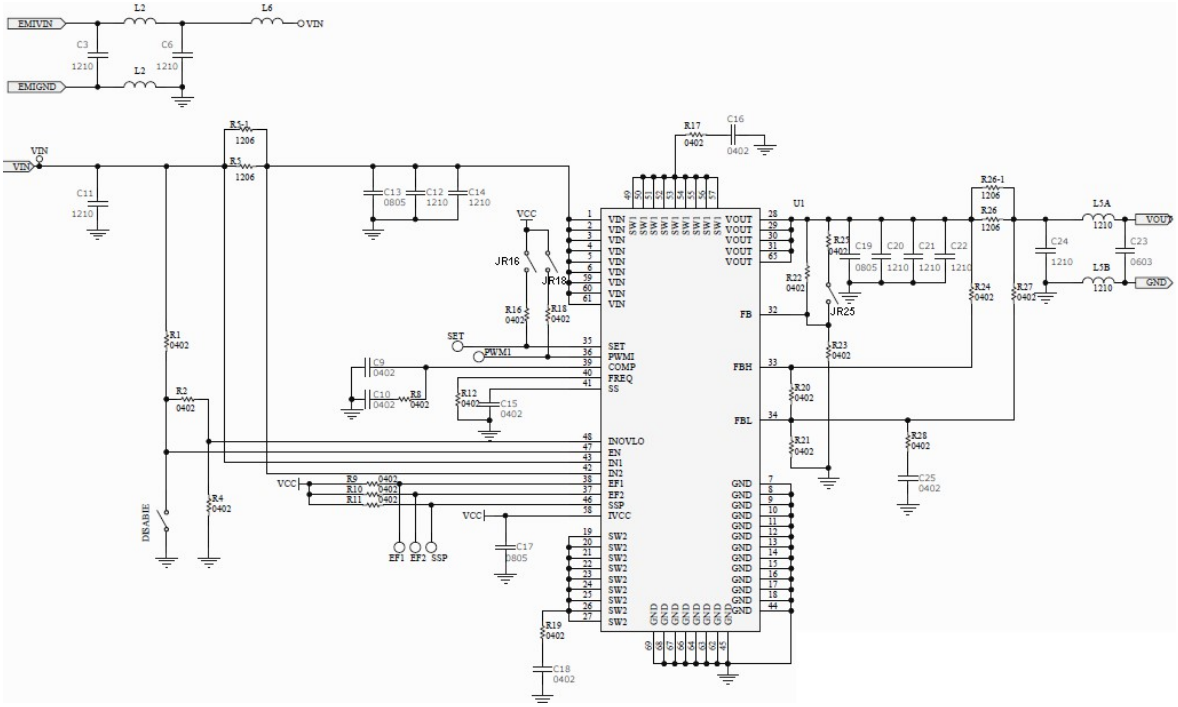


Figure 5: Schematic

BOM LIST:

Table 10: The BOM without EMI solution

COUNT	REF DES	DESCRIPTION
1	U1	VPN12AD02-FUV
2	C12, C14,	MLCC, 10uF, 50V, X7R, 1210
2	C20, C22	MLCC, 22uF, 25V, X7R, 1206
1	C11	E-cap, 82uF, 50V
1	C24	E-cap, 270uF, 16V
1	C17	MLCC, 10uF, 10V, X7R, 0805
1	C10	MLCC, 2.2nF, 25V, X7R, 0402
1	C25	MLCC, 4.7nF, 16V, X7R, 0402
1	C15	MLCC, 22nF, 16V, X7R, 0402
1	R28	RES, 5.6Kohm, 0402 1%
2	R2, R16, R18	RES, 10Kohm, 0402 1%
2	R9, R10	RES, 100Kohm, 0402 1%
1	R8	RES, 1Kohm, 0402 1%
1	R22	RES, 14Kohm, 0402 1%
2	R23	RES, 1.5Kohm, 0402 1%
1	R1, R12	RES, 30Kohm, 0402 1%
1	R4, R24	RES, 0ohm, 0402
1	R20	RES, 150ohm, 0402 1%
1	R21	RES, 12.4Kohm, 0402 1%
6	R5, R5-1, R26, R26-1, JR16, JR18	Short
16	L2, L6, C3, C9, C13, C16, C18, C19, C21, C23, R11, R17, R19, R25, R27, JR25	NC

QUICK START GUIDE:

Power on/off

1. Give Power from VIN to GND as following figure.
2. Open the Disable Jumper to enable VPN12AD02-FUV
3. Short the Disable Jumper to disable VPN12AD02-FUV

Frequency spread spectrum

1. Give R11=10kΩ to enable frequency spread spectrum
2. Remove R11 to disable frequency spread spectrum

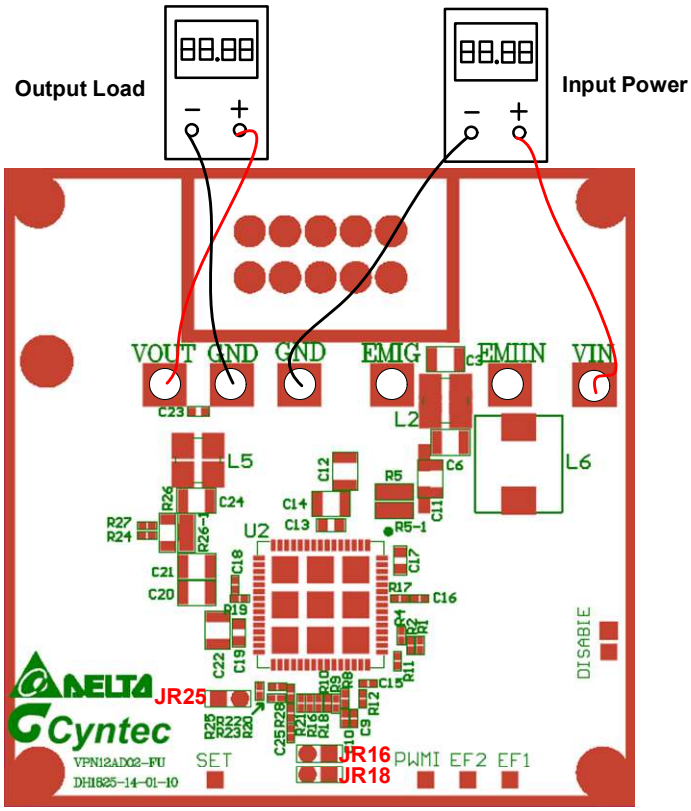


Figure 6: Quick Start Guide for Constant Voltage Application

PRIENTED CIRCUIT BOARD LAYOUT:

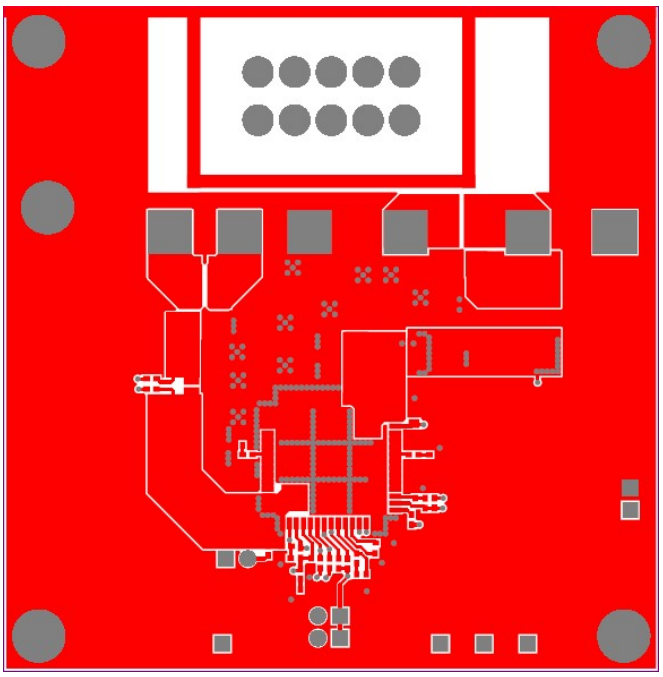


Figure 7: First layer (Top layer)

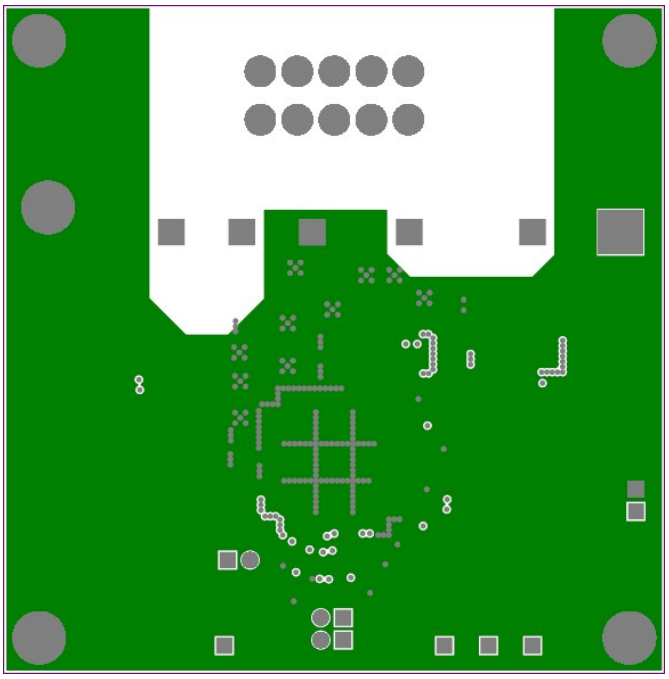


Figure 8: Second layer

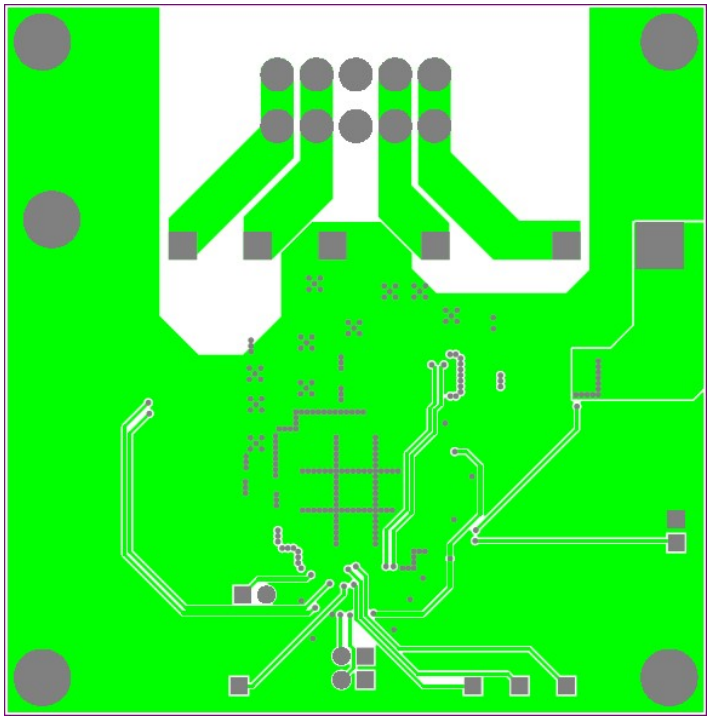


Figure 9: Third layer

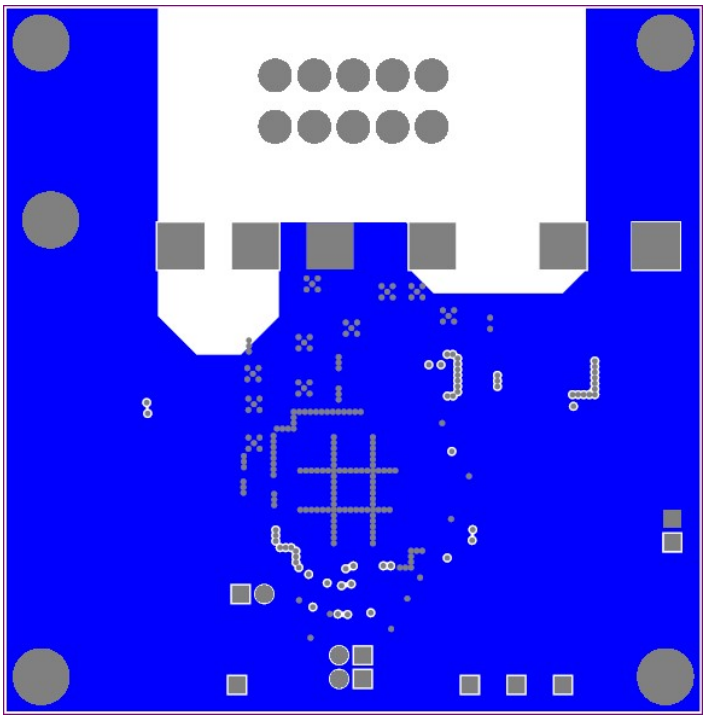


Figure 10: Fourth layer (bottom layer)

REVISION HISTORY:

Date	Revision	Changes
2019.06.03	P00	Release the preliminary EVB guide.
2019.06.05	P01	Modify the BOM component
2019.08.15	P02	Modify the layout and BOM component
2019.10.01	P03	Modify the layout and BOM component
2019.10.01	P04	Modify the layout and BOM component
2019.12.02	P05	Add the constant voltage mode application