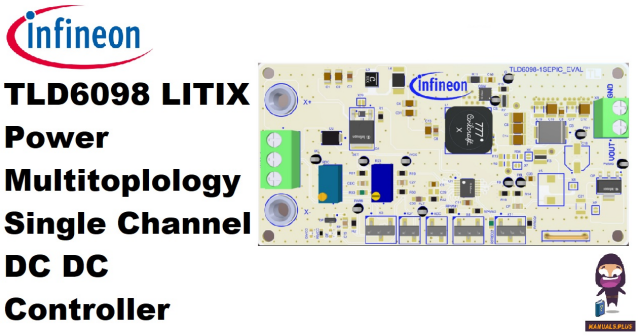
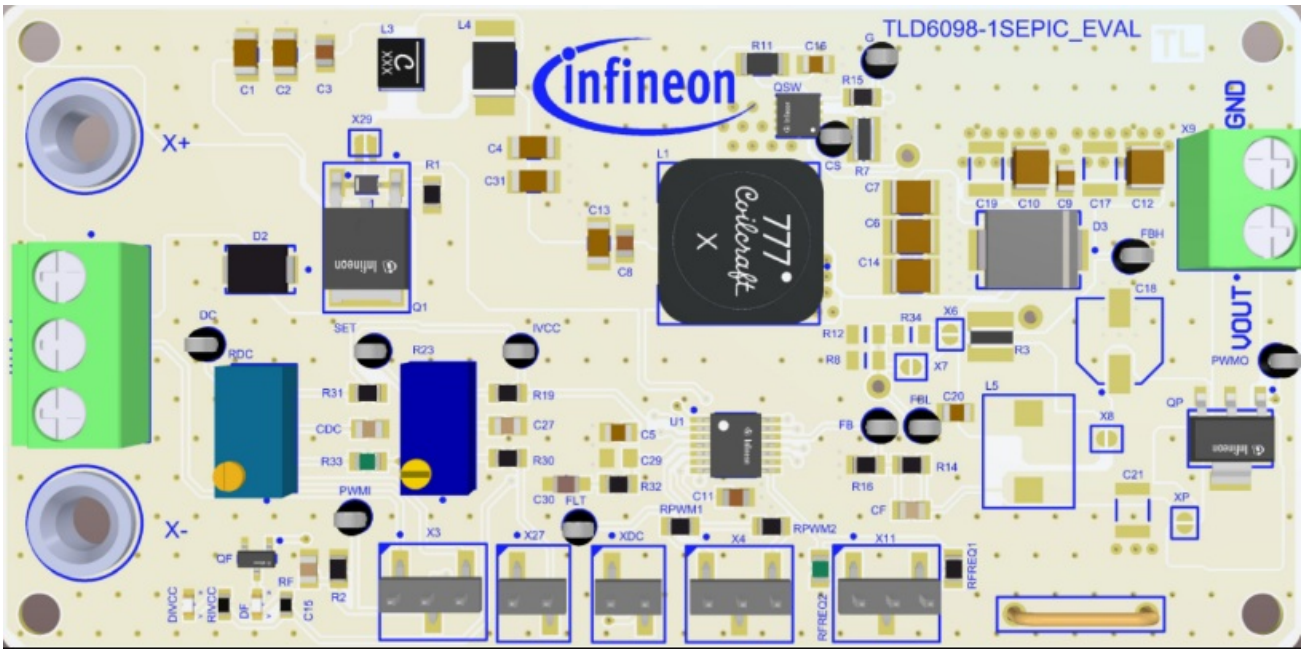


infineon TLD6098 LITIX Power Multitoplology Single Channel DC DC Controller User Guide

Contents

infineon TLD6098 LITIX Power Multitoplology Single Channel DC DC Controller



About this document

Product Description
The TLD6098-1EP is an AEC-qualified DC-DC boost controller, specially designed to drive LEDs. It embeds:

- Built-in diagnosis and protection features
- Pulse width modulator to implement a dimming function with reduced color shifting
- Coded faults to easily detect the root cause of load failures
- Voltage loop availability to implement constant output voltage power supply

The device also incorporates a spread spectrum modulator to reduce electromagnetic emissions outside the allowed bands.

Scope and purpose
Scope of this user guide is to provide instructions on use of the TLD6098-12B_EVAL board.

Intended audience
Hardware engineers, software engineers, system architects

Evaluation Board
This board is to be used during the design-in process for evaluating and measuring characteristic curves, and for checking datasheet specifications.

Note: PCB and auxiliary circuits are NOT optimized for final customer design.

Important notice

“Evaluation Boards and Reference Boards” shall mean products embedded on a printed circuit board (PCB) for demonstration and/or evaluation purposes, which include, without limitation, demonstration, reference and evaluation boards, kits and design (collectively referred to as “Reference Board”).

- Environmental conditions have been considered in the design of the Evaluation Boards and Reference Boards provided by Infineon Technologies. The design of the Evaluation Boards and Reference Boards has been

tested by Infineon Technologies only as described in this document. The design is not qualified in terms of safety requirements, manufacturing and operation over the entire operating temperature range or lifetime.

- The Evaluation Boards and Reference Boards provided by Infineon Technologies are subject to functional testing only under typical load conditions. Evaluation Boards and Reference Boards are not subject to the same procedures as regular products regarding returned material analysis (RMA), process change notification (PCN) and product discontinuation (PD).
- Evaluation Boards and Reference Boards are not commercialized products, and are solely intended for evaluation and testing purposes. In particular, they shall not be used for reliability testing or production. The Evaluation Boards and Reference Boards may therefore not comply with CE or similar standards (including but not limited to the EMC Directive 2004/EC/108 and the EMC Act) and may not fulfill other requirements of the country in which they are operated by the customer. The customer shall ensure that all Evaluation Boards and Reference Boards will be handled in a way which is compliant with the relevant requirements and standards of the country in which they are operated.
- The Evaluation Boards and Reference Boards as well as the information provided in this document are addressed only to qualified and skilled technical staff, for laboratory usage, and shall be used and managed according to the terms and conditions set forth in this document and in other related documentation supplied with the respective Evaluation Board or Reference Board.
- It is the responsibility of the customer’s technical departments to evaluate the suitability of the Evaluation Boards and Reference Boards for the intended application, and to evaluate the completeness and correctness of the information provided in this document with respect to such application.
- The customer is obliged to ensure that the use of the Evaluation Boards and Reference Boards does not cause any harm to persons or third party property. The Evaluation Boards and Reference Boards and any information in this document is provided “as is” and Infineon Technologies disclaims any warranties, express or implied, including but not limited to warranties of non-infringement of third party rights and implied warranties of fitness for any purpose, or for merchantability.
- Infineon Technologies shall not be responsible for any damages resulting from the use of the Evaluation Boards and Reference Boards and/or from any information provided in this document. The customer is obliged to defend, indemnify and hold Infineon Technologies harmless from and against any claims or damages arising out of or resulting from any use thereof.
- Infineon Technologies reserves the right to modify this document and/or any information provided herein at any time without further notice.

Safety precautions

Note: Please note the following warnings regarding the hazards associated with development systems

Table 1 Safety precautions

	**Warning:** *Remove or disconnect power from the drive before you disconnect or reconnect wires, or perform maintenance work. Wait five minutes after removing power to discharge the bus capacitors. Do not attempt to service the drive until the bus capacitors have discharged to zero. Failure to do so may result in personal injury or death.*
	**Caution:** *The heat sink and device surfaces of the evaluation or reference board may become hot during testing. Hence, necessary precautions are required while handling the board. Failure to comply may cause injury.*
	**Caution:** *Only personnel familiar with the drive, power electronics and associated machinery should plan, install, commission and subsequently service the system. Failure to comply may result in personal injury and/or equipment damage.*
	**Caution:** *The evaluation or reference board contains parts and assemblies sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.*
	**Caution:** *A drive that is incorrectly applied or installed can lead to component damage or reduction in product lifetime. Wiring or application errors such as undersizing the motor, supplying an incorrect or inadequate AC supply, or excessive ambient temperatures may result in system malfunction.*
	**Caution:** *The evaluation or reference board is shipped with packing materials that need to be removed prior to installation. Failure to remove all packing materials that are unnecessary for system installation may result in overheating or abnormal operating conditions.*

The board at a glance

TLD6098-12B EVAL is a PCB board designed to supply high power LED with TLD6098-1EP in boost topologies. It serves boost to ground and boost to battery configurations, depending on the load connection at the terminal X7. In both configurations, the board can deliver up to 25 W. Auxiliary circuits are present and enabled to protect the DC-DC and the load during the short to ground failure.

Table 2 Performance summary

Parameter	Conditions	Value
Input supply voltage	Parameter degradation below 8 V	8 V to 27 V
Output current	–	1 A
Overvoltage protection threshold	–	48.6 V
Short to ground protection threshold	–	3 V
Switching frequency	Spread spectrum “ON”	400 kHz

The output current is fixed by R2. Change this resistor if different output current is needed.
The overvoltage protection and the short to ground protection thresholds are defined by R4 and R7.

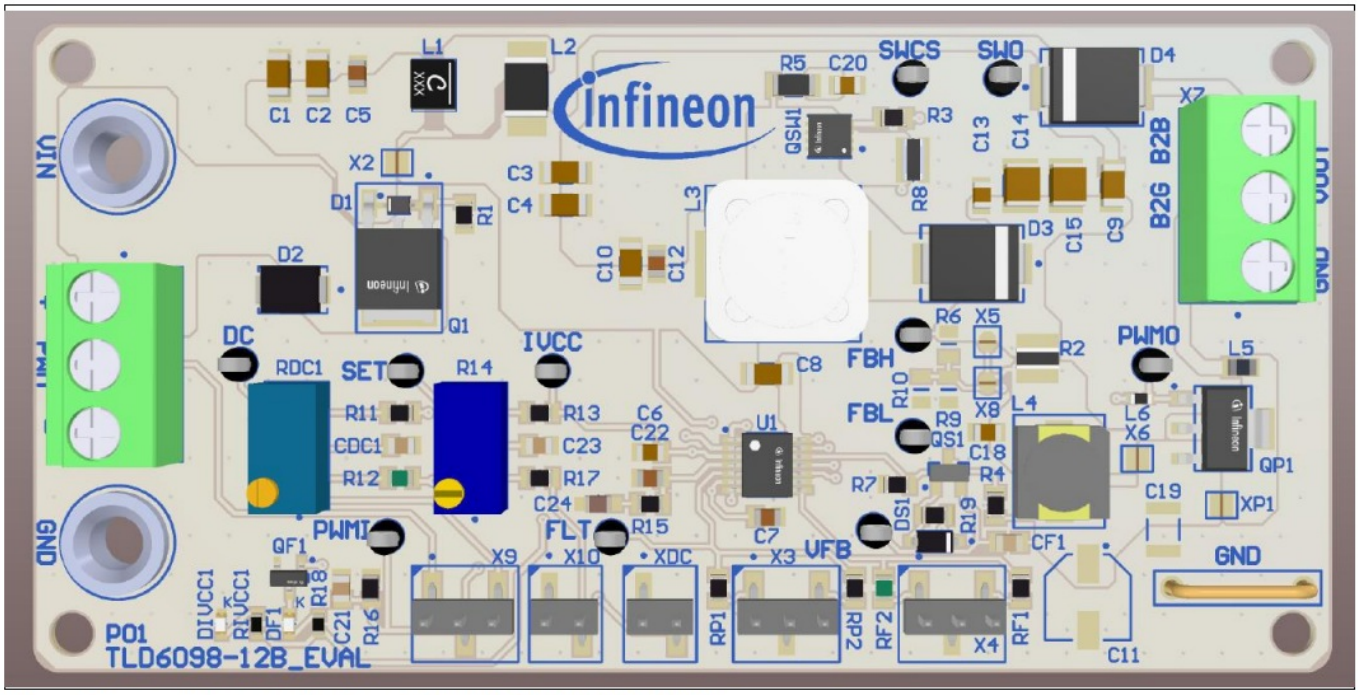


Figure 1 **Representation of the TLD6098-12B_EVAL**

Scope of supply

The jumpers are positioned as follows:

Table 3 Jumper position

Jumper Number	Condition	Meaning
XDC1	Open	PWM adjustment disabled
X9	Close 2-3	Internal biased to provide DC = 100% External dimming disabled
X10	Open	Output current analog adjustment disabled

The default configuration is depicted below.

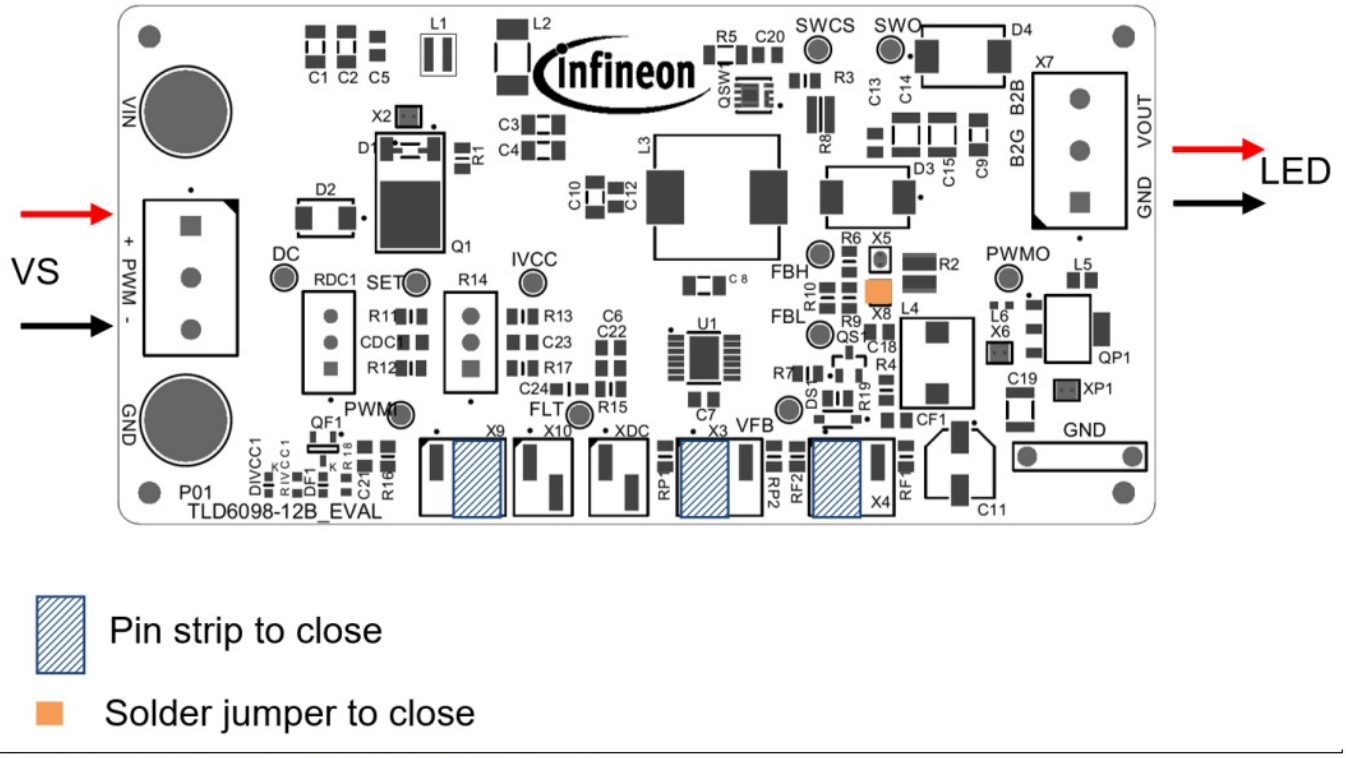


Figure 2 **Default configuration of the board**

System and functional description

Current adjustment

- The output current adjustment is performed by adjusting the value of trimmer R14. The feature is enabled when the jumper X10 is closed.
- The output current can vary from 0% to 100% of the maximum output current. Jumpers are positioned as follows:

Table 4 Jumper position

Jumper Number	Condition	Meaning
XDC1	Open	PWM adjustment disabled
X9	Close 2-3	Internal biased to provide DC = 100% External dimming disabled
X10	Close	Output current analog adjustment enabled

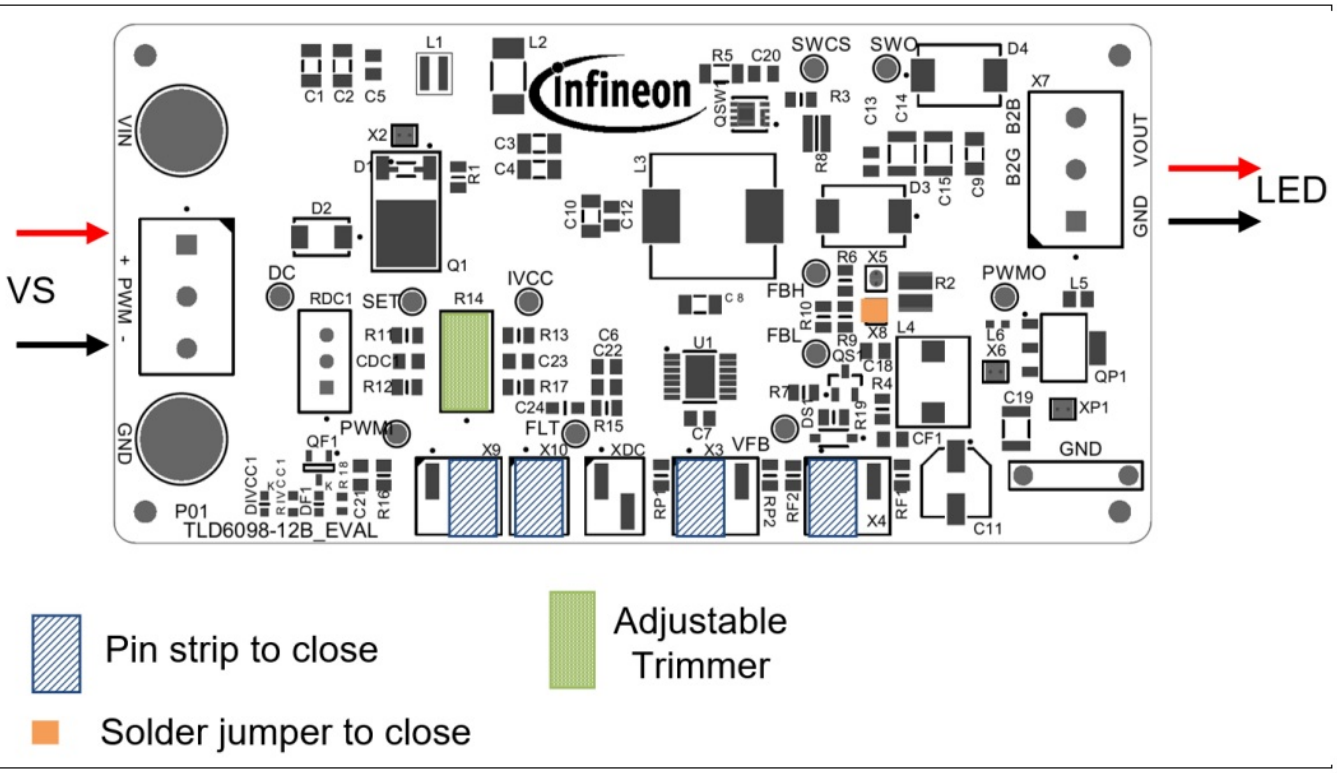


Figure 3 Current adjustment

Embedded PWM engine

The embedded PWM engine provides an internal PWM signal without any external dimming signal required. To enable the feature the jumper XDC is closed. RDC1 trimmer adjusts the dimming duty cycle by changing the voltage on the respective DC/PWMI pin. The PWM dimming frequency is set to 410 Hz. If another PWM frequency is needed, the respective RPWM1 and/or RPWM2 must be changed to a proper value (please refer to the TLD6098-1EP datasheet [1] for more information).
Jumpers are positioned as follows:

Table 5 Jumper position

Jumper Number	Condition	Meaning
XDC1	Close	PWM adjustment enabled
X9	Close2-3	Internal biased to provide DC = 100% External dimming disabled
X10	Open	Output current analog adjustment disabled

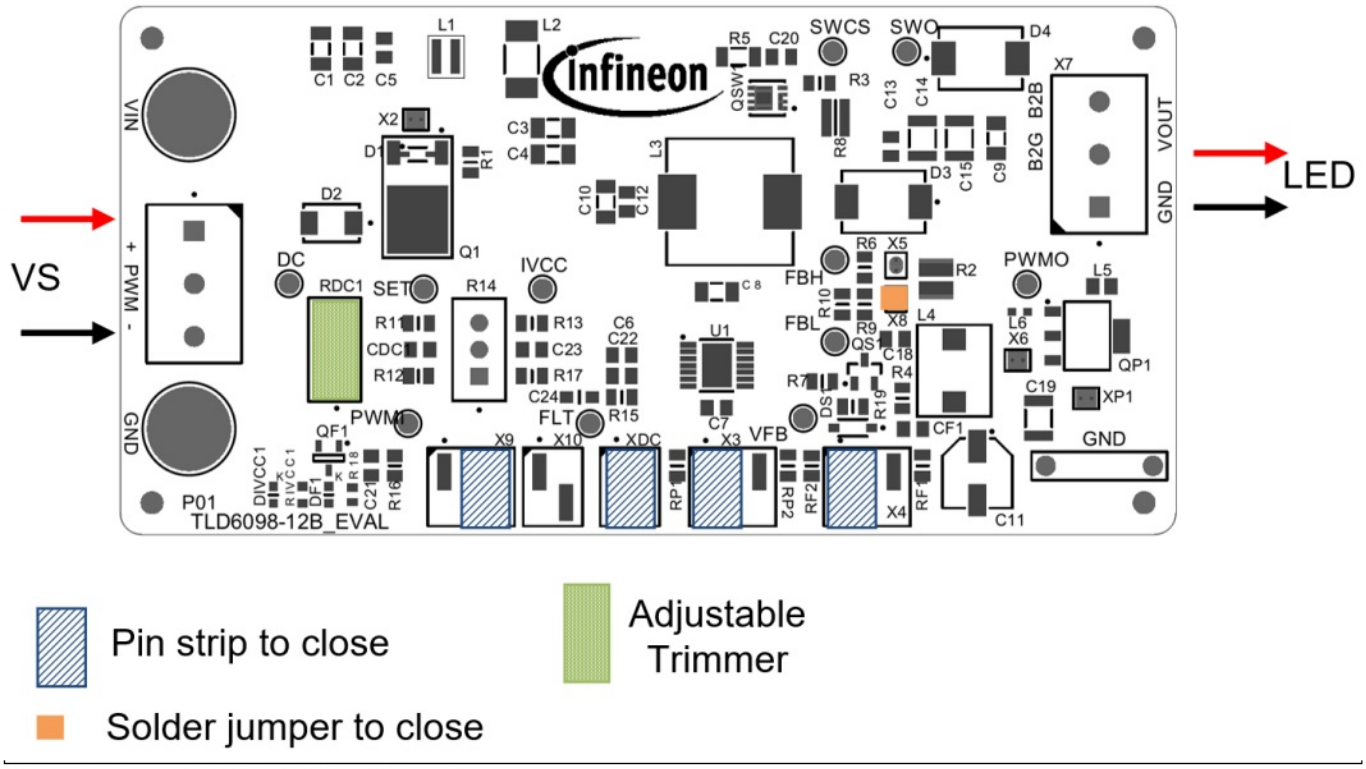


Figure 4 Embedded PWM engine

External dimming and output adjustment

The analog output adjustment and the dimming signals can be provided by external sources. To enable the control from external sources the jumpers are positioned as follows:

Table 6 Jumper position

Jumper Number	Condition	Meaning
XDC1	Close 1-2	External signal enabled
X9	Close 1-2	External signal enabled
X10	Open	Output current analog adjustment disabled

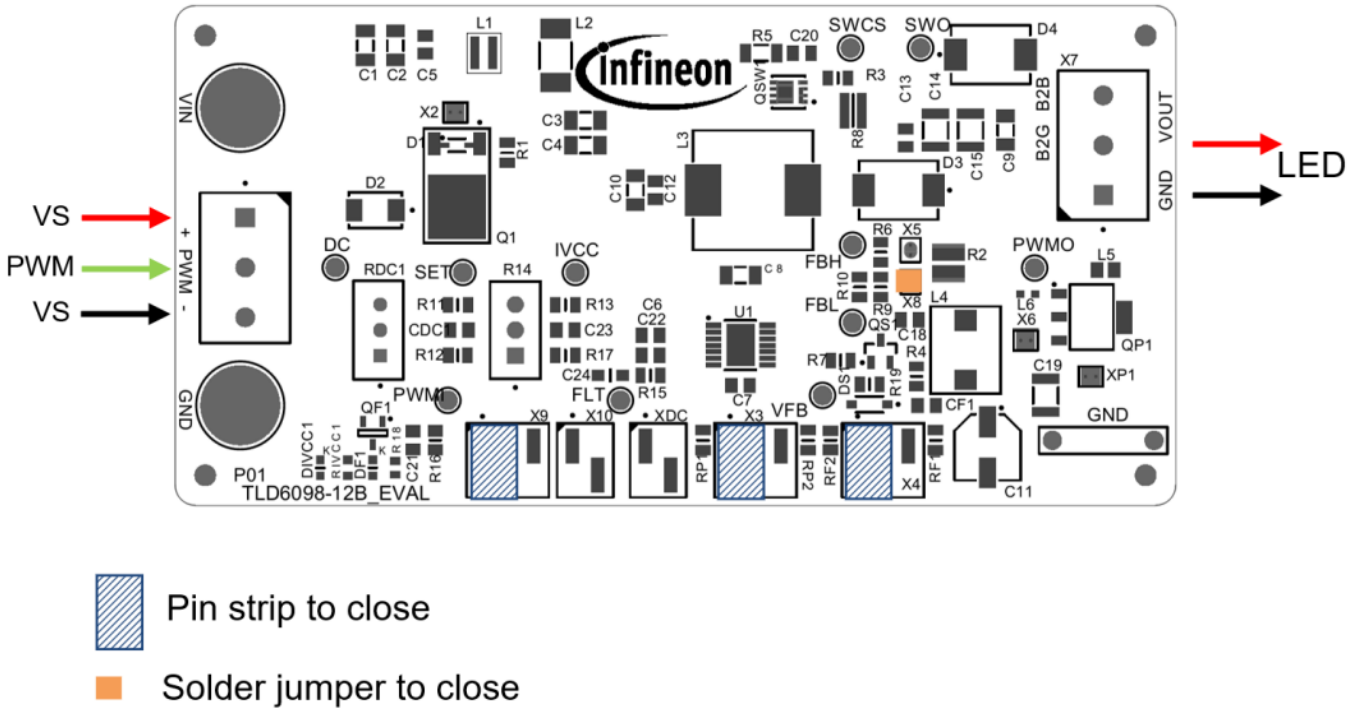


Figure 5 External dimming and output adjustment

Faults

The system has been designed to use hard threshold for overvoltage detection. With this option, once the threshold is reached, the gate driver is disabled until the output voltage goes below the reset threshold. This behavior is selected with a resistor on FPWM/FAULT pin in range 18 kΩ to 90 kΩ (X3 closed in position 1-2). In this case each fault type is reported by the FPWM/FAULT pin with a dedicated PWM waveform. Typical values for these waveforms are

Table 7 Coded PWM pulses on FPWM/FAULT pin

	PWM period	DC (ON time)
Overtemperature	10 ms	100% (10 ms)
Short to ground	10 ms	80% (8 ms)
Overvoltage on FBH pin	10 ms	60 % (6 ms)
Overvoltage on VFB pin	10 ms	40% (4 ms)
Output overcurrent (> 200%)	10 ms	20% (2 ms)

This feature is disabled if X3 is closed in position 2-3.

Boost to battery

TLD6098-12B_EVAL has been designed to work in boost to ground or boost to battery. The choice of the configuration depends on the load connection at the connector X7. Overvoltage and short to ground protections presented for boost to ground configuration are also available in boost to battery.

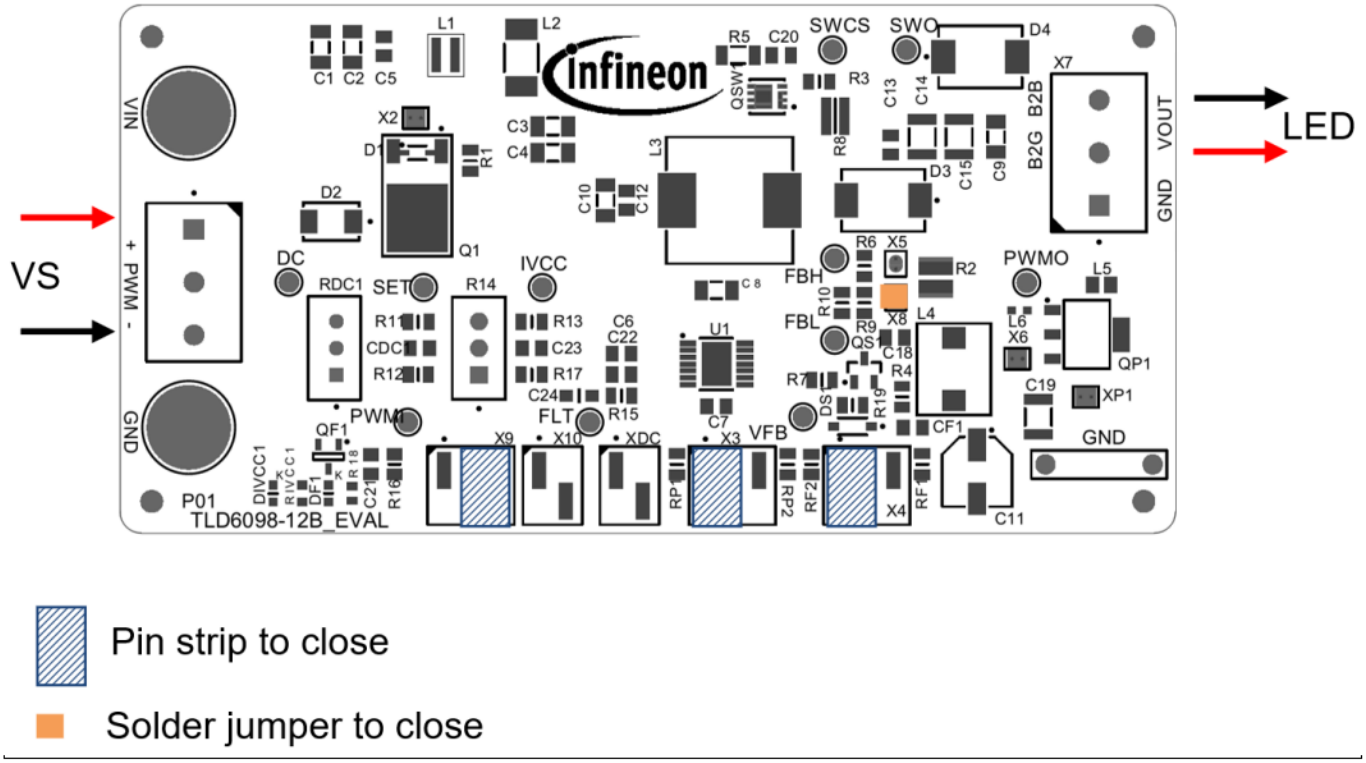
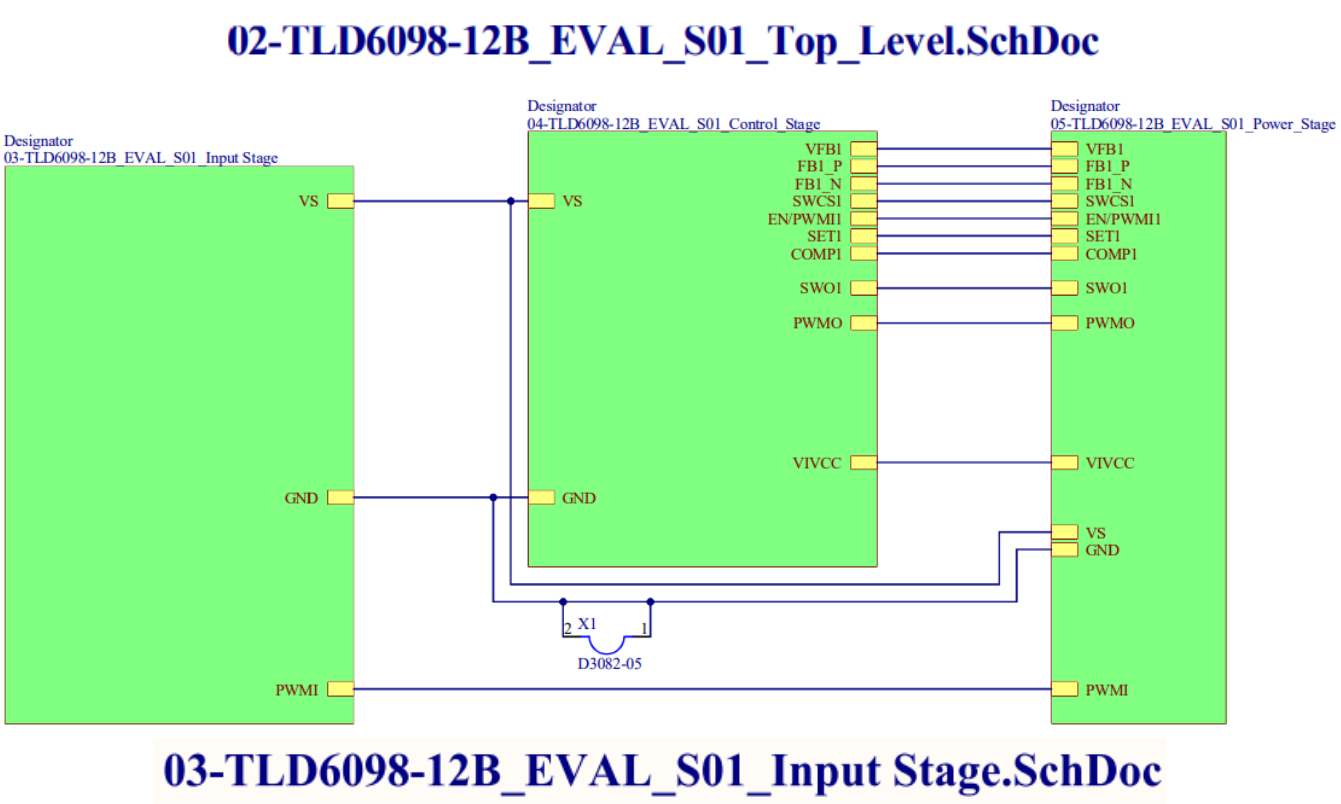


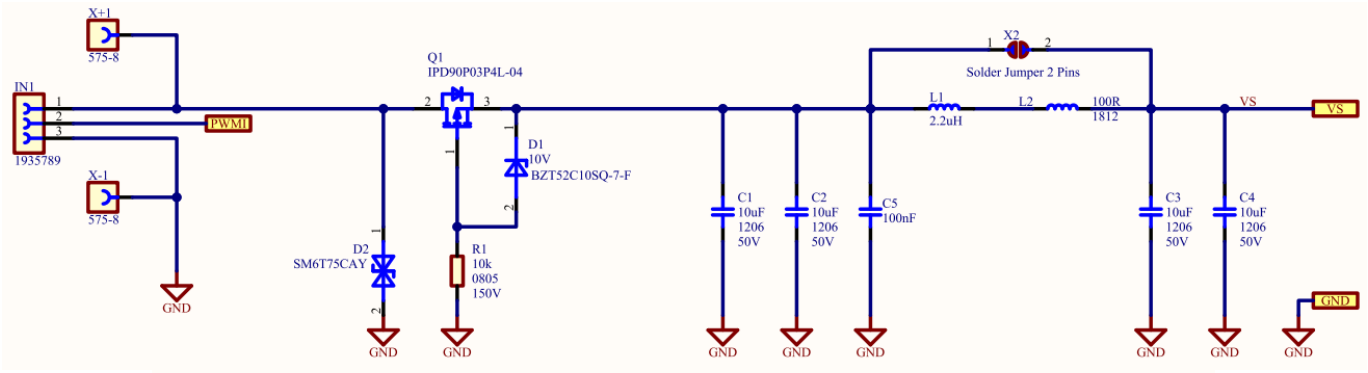
Figure 6 Boost to battery connection

System design

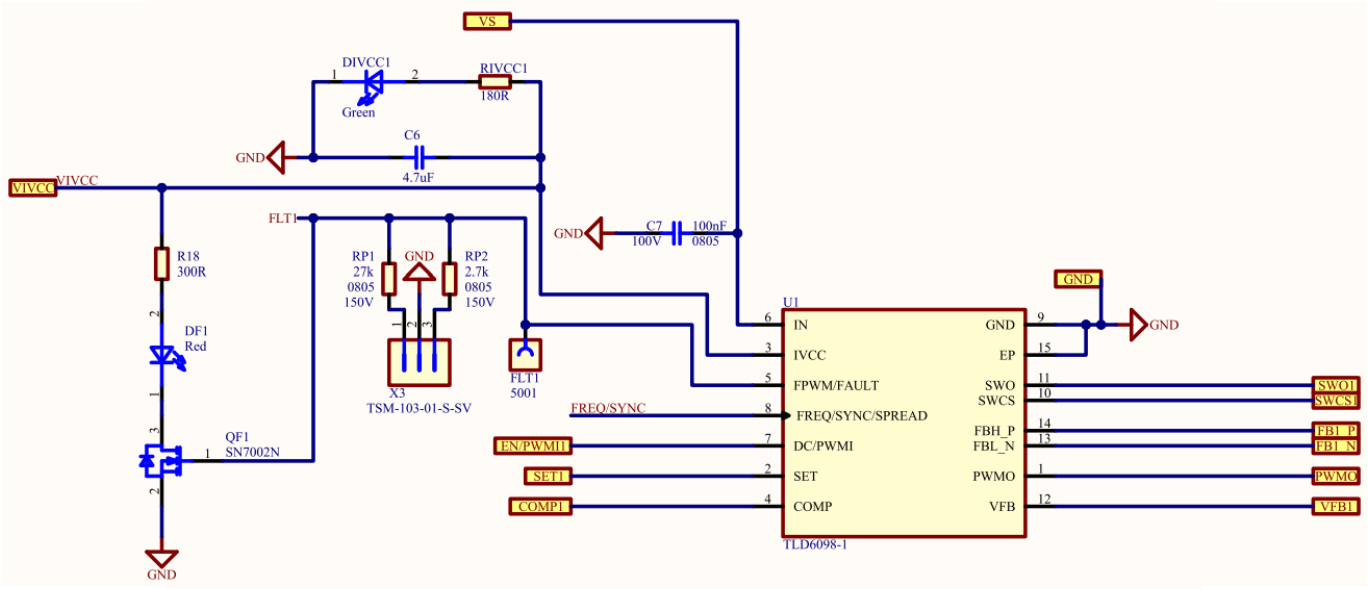
Schematics



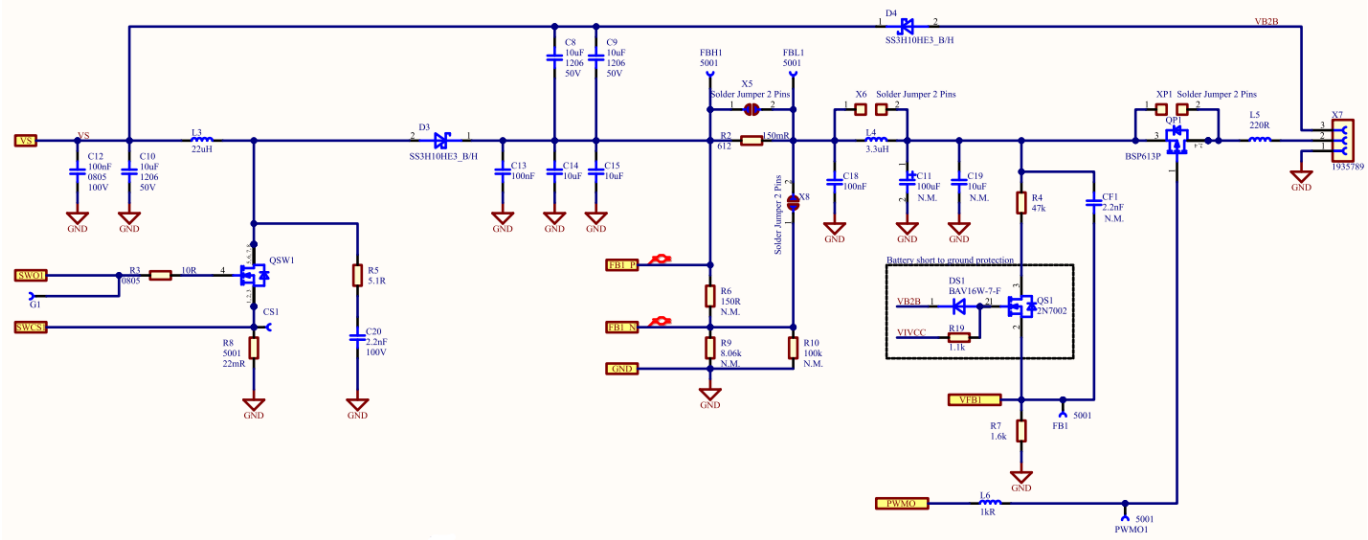
03-TLD6098-12B_EVAL_S01_Input Stage.SchDoc

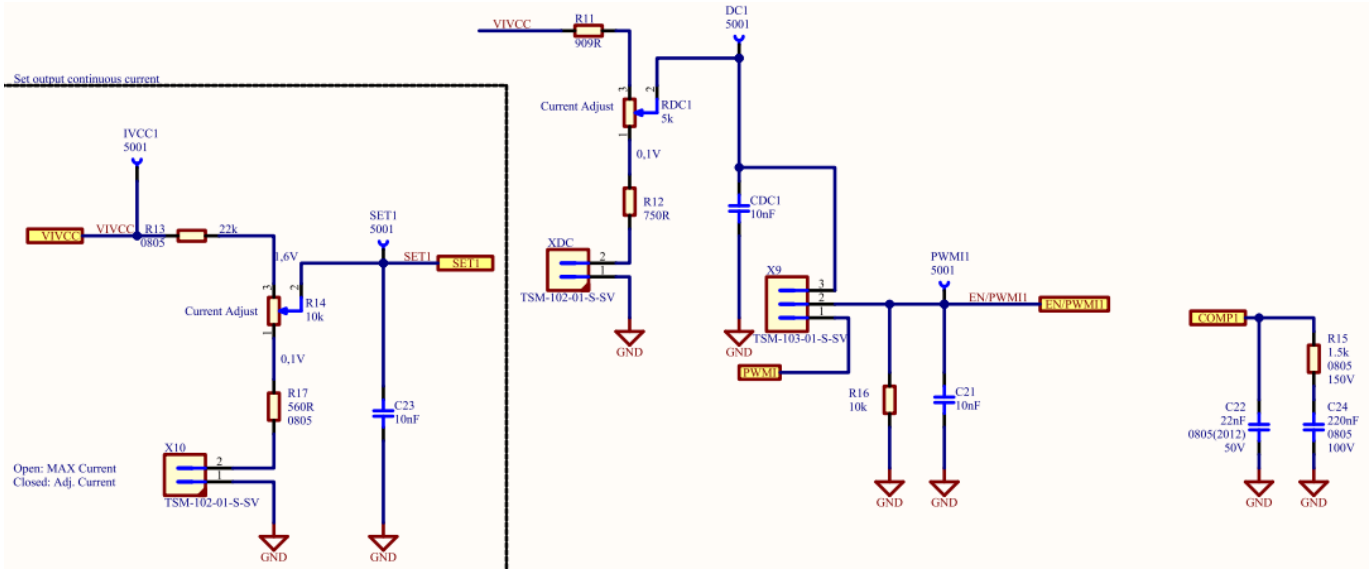


04-TLD6098-12B_EVAL_S01_Control_Stage.SchDoc



05-TLD6098-12B_EVAL_S01_Power_Stage.SchDoc




Set output continuous current
IVCC1
5001
VIVCC
VIVCC
R13
0805
22k
1,6V
SET1
5001
SET1
SET1
Current Adjust
R14
10k
0,1V
R17
560R
0805
C23
10nF
X10
Open: MAX Current
Closed: Adj. Current
TSM-102-01-S-SV
GND
GND
VIVCC
R11
909R
DC1
5001
Current Adjust
RDC1
5k
0,1V
R12
750R
XDC
TSM-102-01-S-SV
GND
CDC1
10nF
X9
TSM-103-01-S-SV
GND
PWMI
PWMI1
5001
EN/PWMI1
EN/PWMI1
R16
10k
C21
10nF
GND
GND
COMP1
R15
1.5k
0805
150V
C22
22nF
0805(2012)
50V
C24
220nF
0805
100V
GND
GND

PCB Layout

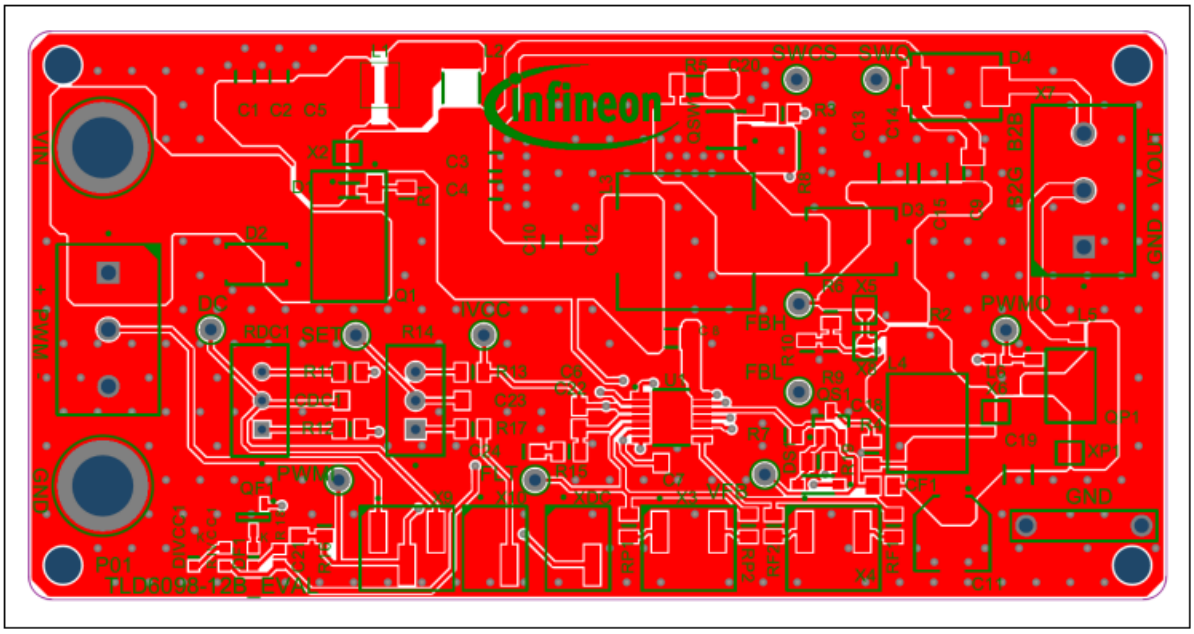


Figure 11 **PCB layout top view**

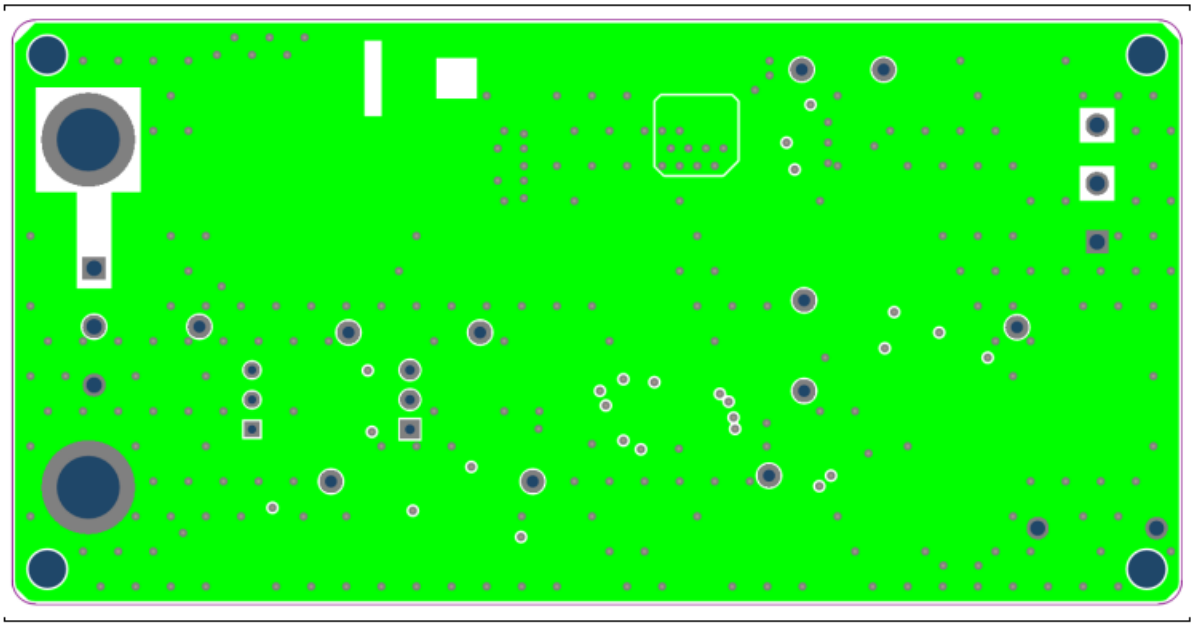


Figure 12 **PCB layout internal 1**

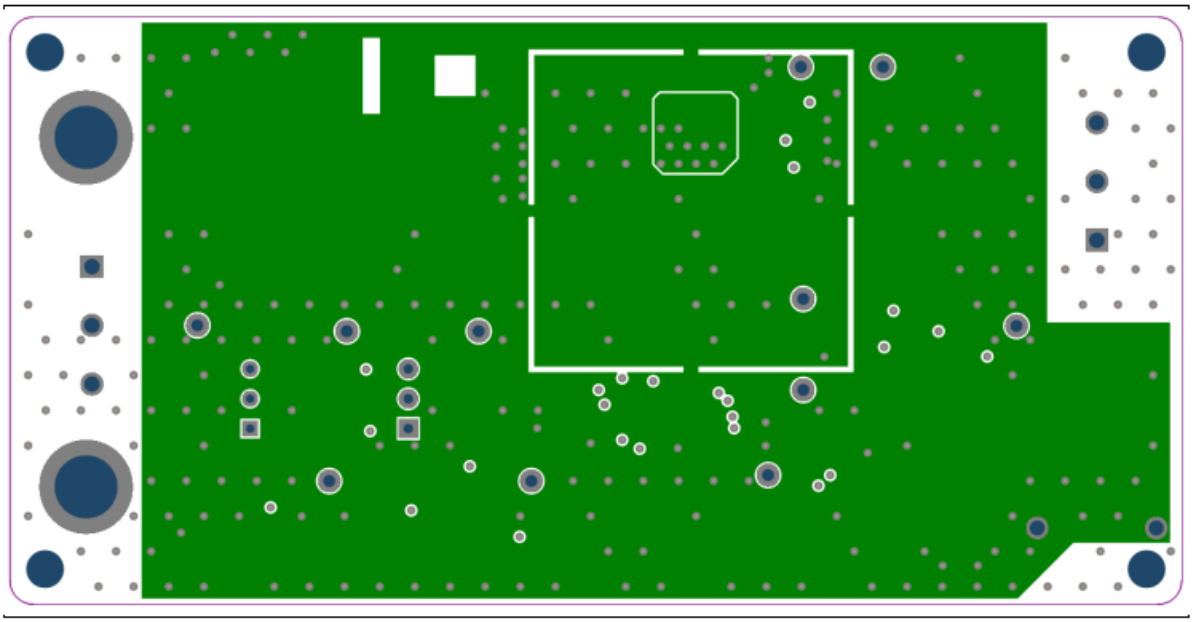


Figure 13 **PCB layout internal 2**

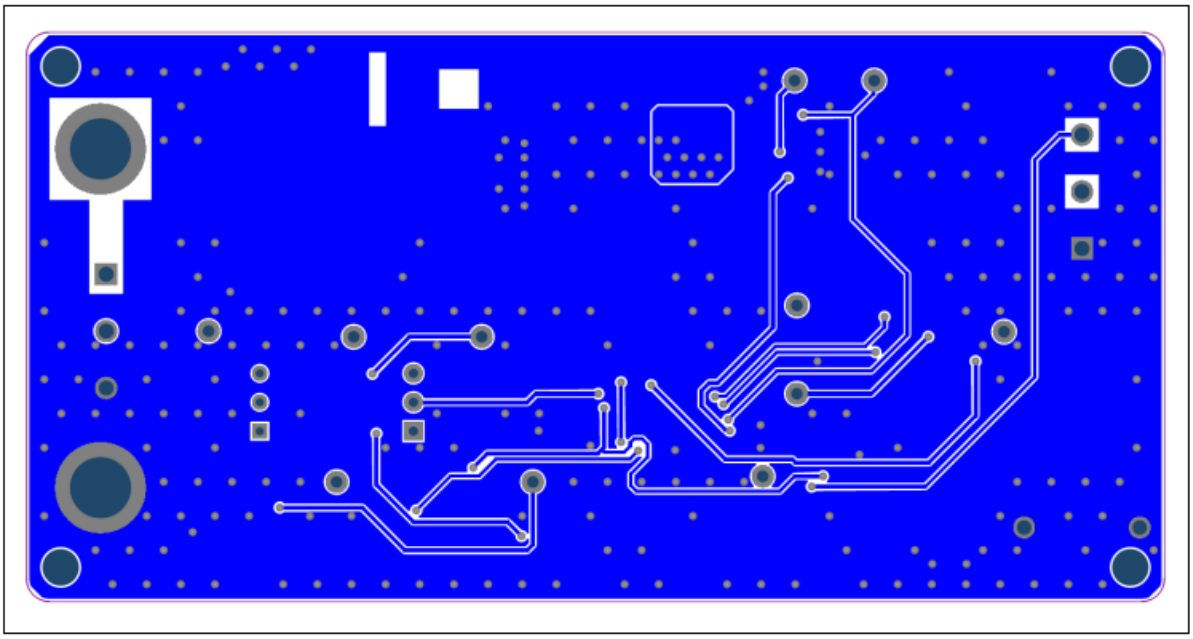


Figure 14 **PCB layout bottom view**

Bill of material

Table 8 Bill of Material

Designator	Value	Manufacturer	Manufacturer order number
C1, C2, C3, C4, C8, C9, C10	10uF	MuRata	GRT31CR61H106KE01L
C5, C7, C12	100nF	TDK Corporation	CGA4J2X7R2A104M125AE
C6	4.7uF	MuRata	GCM21BR71C475KA73
C11	100uF	Nichicon	UCL1E101MCL1GS
C13, C18	100nF	MuRata	GCM21BR72A104JA37
C14, C15	10uF	MuRata	GCM32EC71H106MA03
C19	10uF	MuRata	GCM32EC71H106MA03
C20	2.2nF	MuRata	GCM2165C2A222FA16
C21, C23, CDC1	10nF	Kemet	C0805C103K5RACAUTO
C22	22nF	TDK Corporation	CGJ4J2C0G1H223J125AA
C24	220nF	TDK Corporation	CGA4F3X7S2A224K085AE
CF1	2.2nF	MuRata	GRM21AR72D222KW01
CS1, DC1, FB1, FBH1, FBL1, FLT1, G1, IVCC1, PWMI1, PWMO1, SET1	5001	Keystone Electronics Corp., Keystone	5001
D1	10V	DIODES	BZT52C10SQ-7-F
D2	SM6T75CAY	STMicroelectronics	SM6T75CAY
D3, D4	100V	Vishay	SS3H10HE3_B/H
DF1	Red	Wurth Elektronik	150060RS75000
DIVCC1	Green	Wurth Elektronik	150060GS75000
DS1	BAV16W-7-F	Diodes Incorporated	BAV16W-7-F
IN1, X7	1935789	Phoenix Contact	1935789
L1	2.2uH	Coilcraft	XGL3520-222MED
L2	100R	Wurth Elektronik	74279226101
L3	22uH	Wurth Elektronik	7447709220
L4	3.3uH	TDK Corporation	RLF7030T-3R3M4R1-T
L5	220R	TDK Corporation	MPZ2012S221ATD25
L6	1kR	Wurth Elektronik	742792663
Q1	IPD90P03P4L-04	Infineon Technologies	IPD90P03P4L-04
QF1	SN7002N	Infineon Technologies	SN7002N
QP1	BSP613P	Infineon Technologies	BSP613P
QS1	2N7002	ON Semiconductor	2N7002
QSW1	IAUZ30N06S5L140	Infineon Technologies	IAUZ30N06S5L140
R1	10k	Vishay	CRCW080510K0FK
R2	150mR	ROHM Semiconductors	LTR18EZPFLR150
R3	10R	Vishay	CRCW080510R0FK
R4	47k	Vishay	CRCW080547K0FK

Designator	Value	Manufacturer	Manufacturer order number
R5	5.1R	KOA Speer Electronics Inc.	SG732BTTD5R1K
R6	150R	Vishay	CRCW0805150RFK
R7	1.6k	Vishay	CRCW08051K60FK
R8	22mR	Vishay	RCWE061222L0JMEA
R9	8.06k	Vishay	CRCW08058K06FK
R10	100k	Vishay	CRCW0805100KFK
R11	909R	Vishay	CRCW0805909RFK
R12	750R	Vishay	TNPW0805750RBY
R13	22k	Vishay	CRCW080522K0FK
R14	10k	Vishay	T93YA103KT20
R15	1.5k	Vishay	CRCW08051K50FK
R16	10k	Panasonic	ERJP06J103V
R17	560R	Vishay	CRCW0805560RFK
R18	300R	Vishay	CRCW0603300RFK
R19	1.1k	Vishay	CRCW08051K10FK
RDC1	5k	Vishay	T93YA502KT20
RF1	20k	Vishay	CRCW080520K0FK
RF2	2k	Vishay	TNPW08052K00BEEA
RIVCC1	180R	Yageo	RC0603FR-07180RL
RP1	27k	Vishay	CRCW080527K0FK
RP2	2.7k	Vishay	CRCW08052K70FK
U1	TLD6098-1	Infineon Technologies	TLD6098-1
X1	D3082-05	Harwin	D3082-05
X2, X5, X6, X8, XP1	Solder Jumper 2 Pins	Infineon Technologies AG, Infineon Technologies	Solder Jumper 2 Pins
X3, X4, X9	TSM-103-01-S-SV	Samtec	TSM-103-01-S-SV
X10, XDC	TSM-102-01-S-SV	Samtec	TSM-102-01-S-SV
X-1, X+1	575-8	Keystone Electronics Corp.	575-8

References

Infineon: TLD6098-1EP Datasheet; https://www.infineon.com/cms/en/product/power/lighting-ics/litixautomotive-led-driver-ic/litix-power/tld6098-1ep/#!documents

Revision history

Document revision	Date	Description of changes
Revision 2.00	2024-03-06	Release for EVAL board S01_P01
Revision 1.00	2023-01-23	Initial release for EVAL board S00_P00

Trademarks

Edition 2024-03-06

Published by
Infineon Technologies AG
81726 Munich, Germany

Do you have a question about this document?
Email: erratum@infineon.com
Document reference
Z8F80416293

Warnings
Due to technical requirements, products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office. Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

Documents / Resources

	infineon TLD6098 LITIX Power Multitoplology Single Channel DC DC Controller [pdf] User Guide TLD6098-1EP, Z8F80416293, TLD6098 LITIX Power Multitoplology Single Channel DC DC Controller, TLD6098, LITIX Power Multitoplology Single Channel DC DC Controller, Multitoplology Single Channel DC DC Controller, Channel DC DC Controller, Controller

References

- User Manual