TLD6098-1_2B_EVAL

User guide

LITIX™ Power
Multitopology single-channel DC-DC controller

About this document

Product description

The TLD6098-1EP is an AEC qualified DC-DC boost controller, especially 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 the electromagnetic emissions outside the allowed bands.

Scope and purpose

The scope of this user guide is to provide instructions on the use of TLD6098-1_2B_EVAL.

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.

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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.*

Table of contents

1 The board at a glance

TLD6098-1_2B_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.

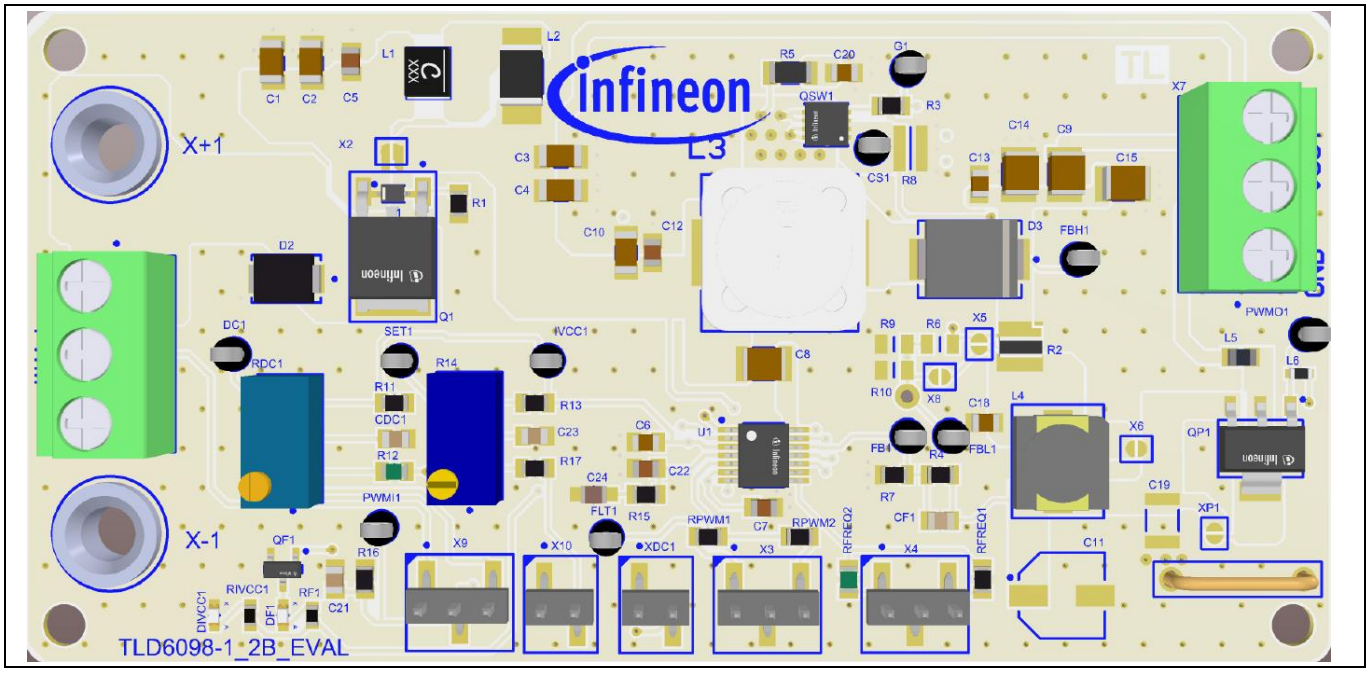

Figure 1 Representation of the TLD6098-1_2B_EVAL

1.1 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.

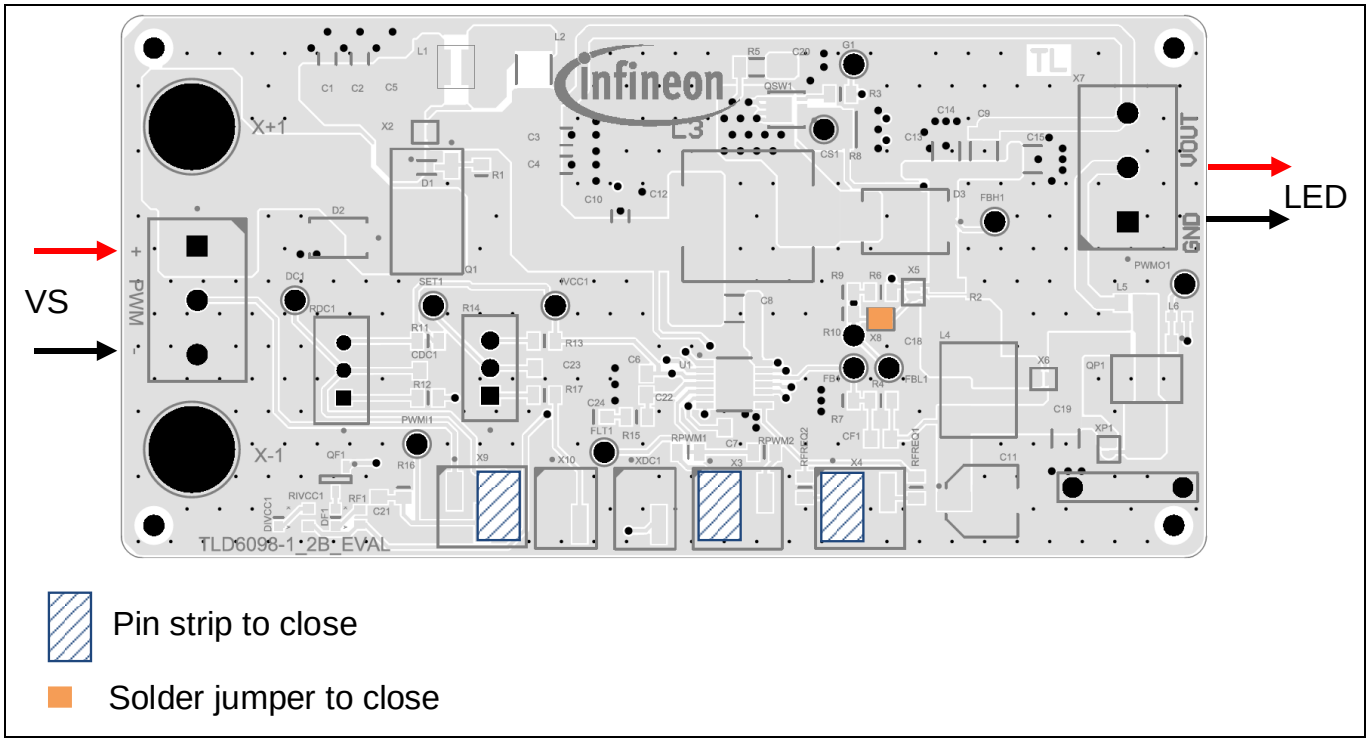

Figure 2 Default configuration of the board

2 System and functional description

2.1 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

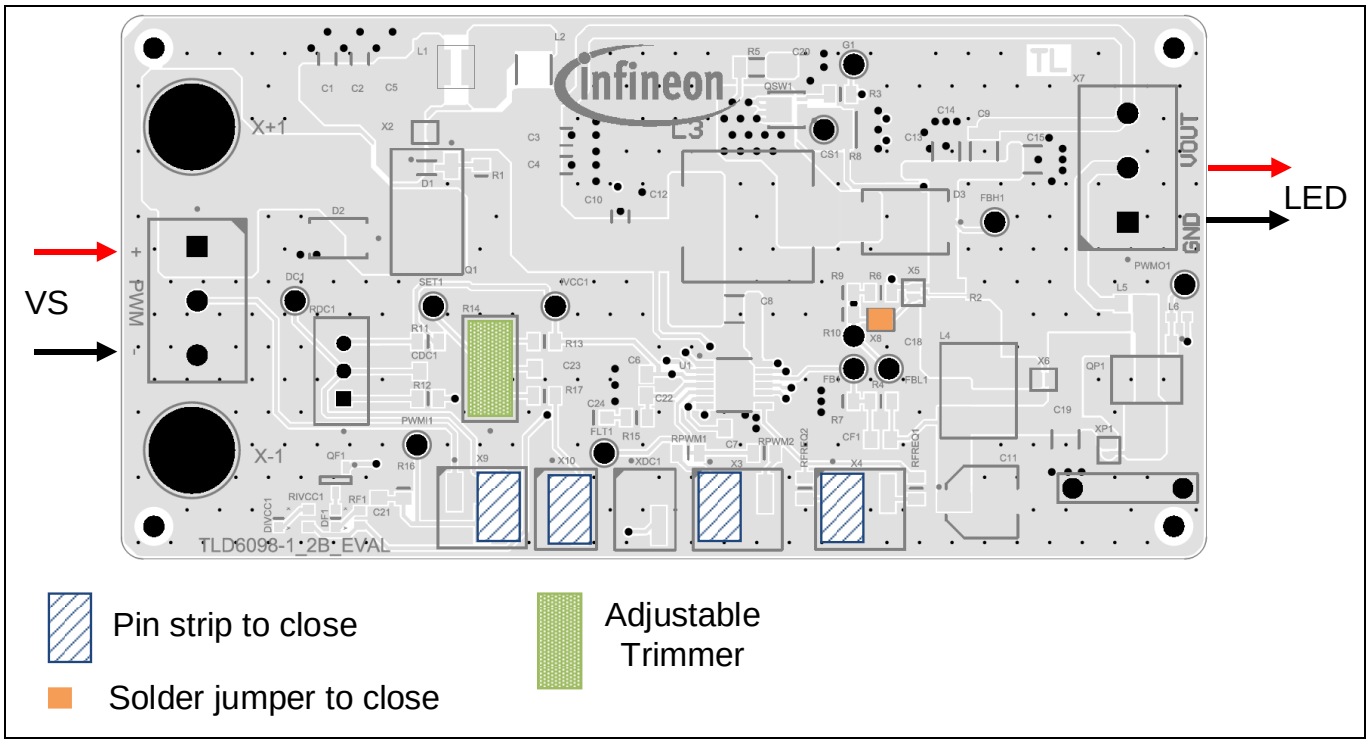

Figure 3 Current adjustment

2.2 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

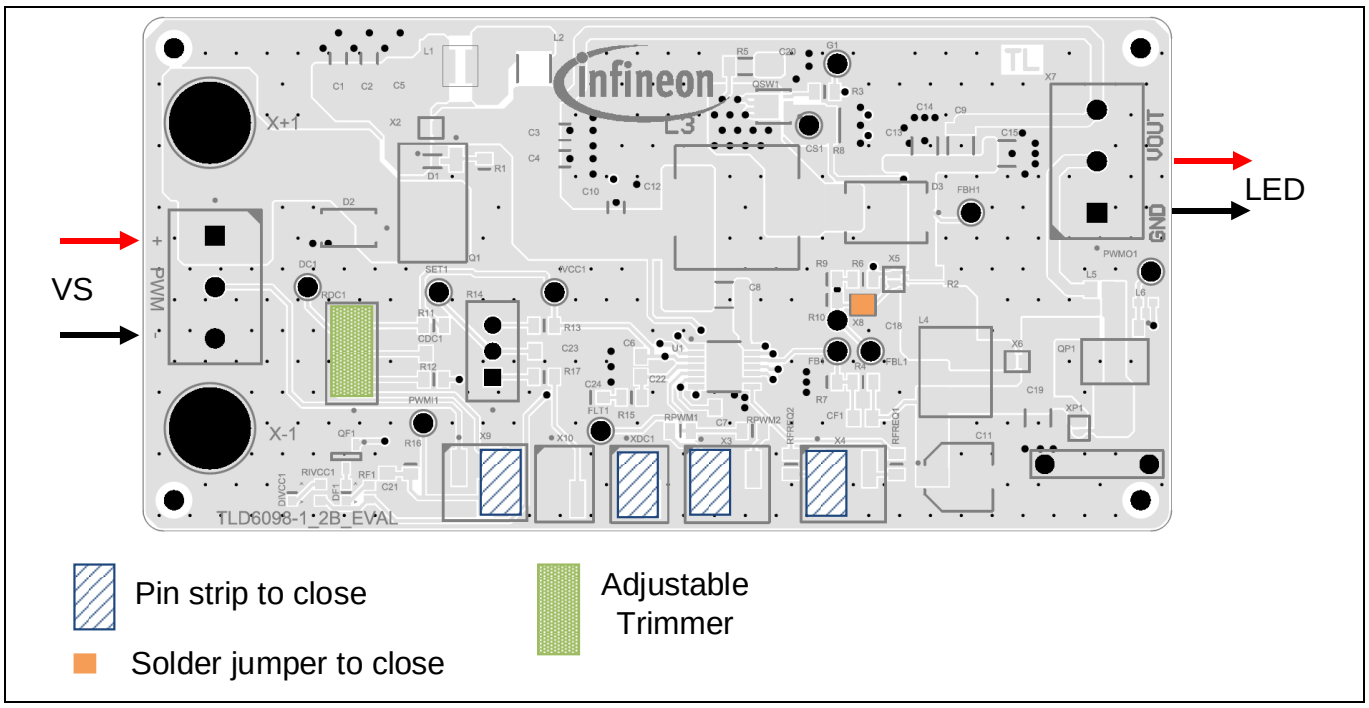

Figure 4 Embedded PWM engine

2.3 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

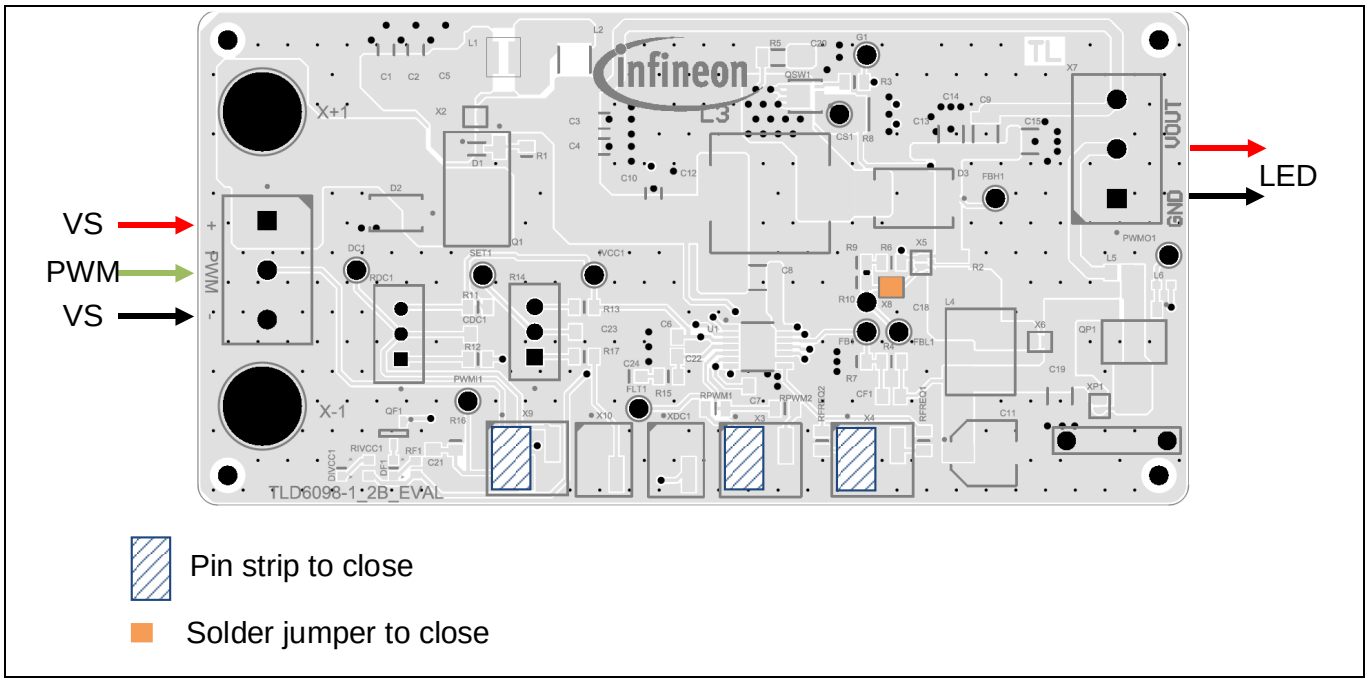

Figure 5 External dimming and output adjustment

2.4 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.

2.5 Boost to battery

TLD6098-1_2B_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 protection presented for boost to ground configuration are also available in boost to battery.
Short to ground protection is implemented only on positive output (anode connection). Short to ground on negative output could damage the board.

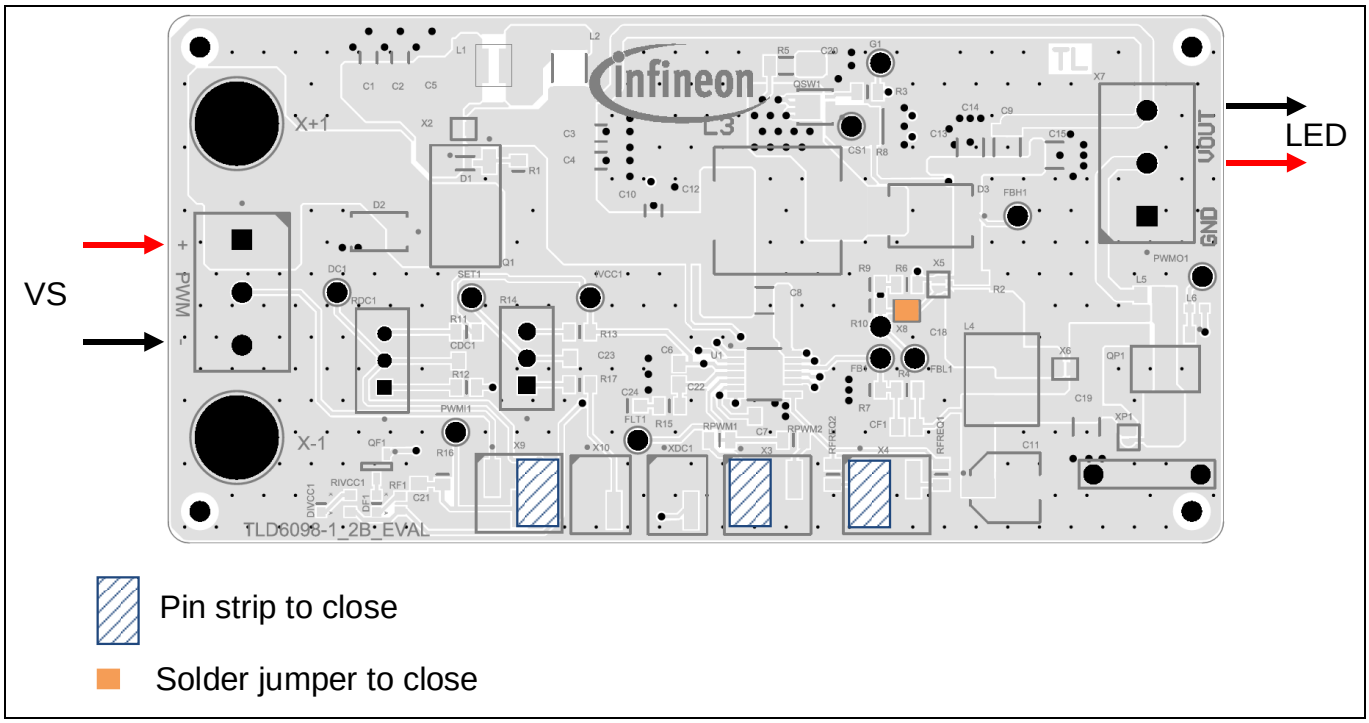

Figure 6 Boost to battery connection

3 System design

3.1 Schematics

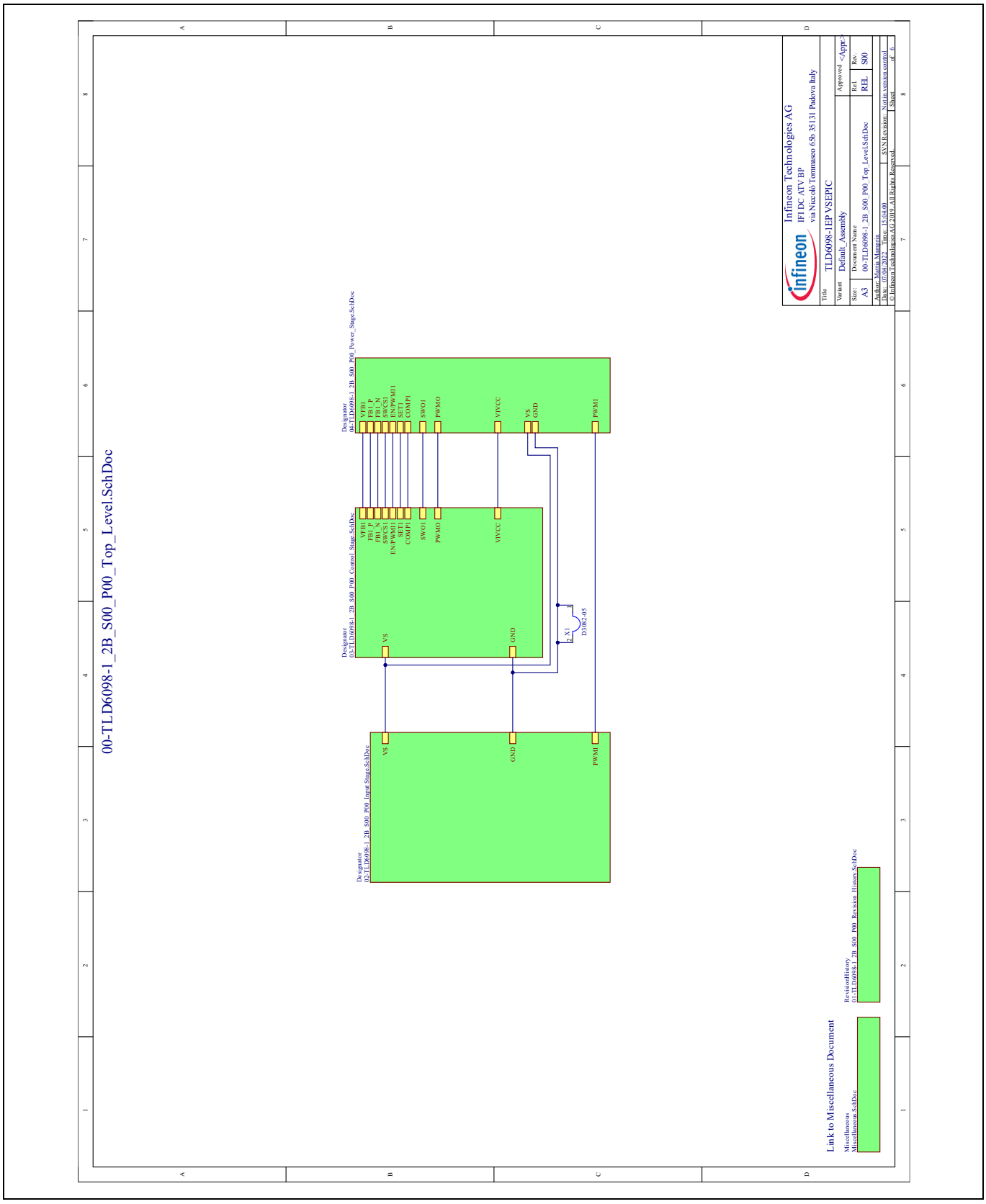

Figure 7 Schematic Top level

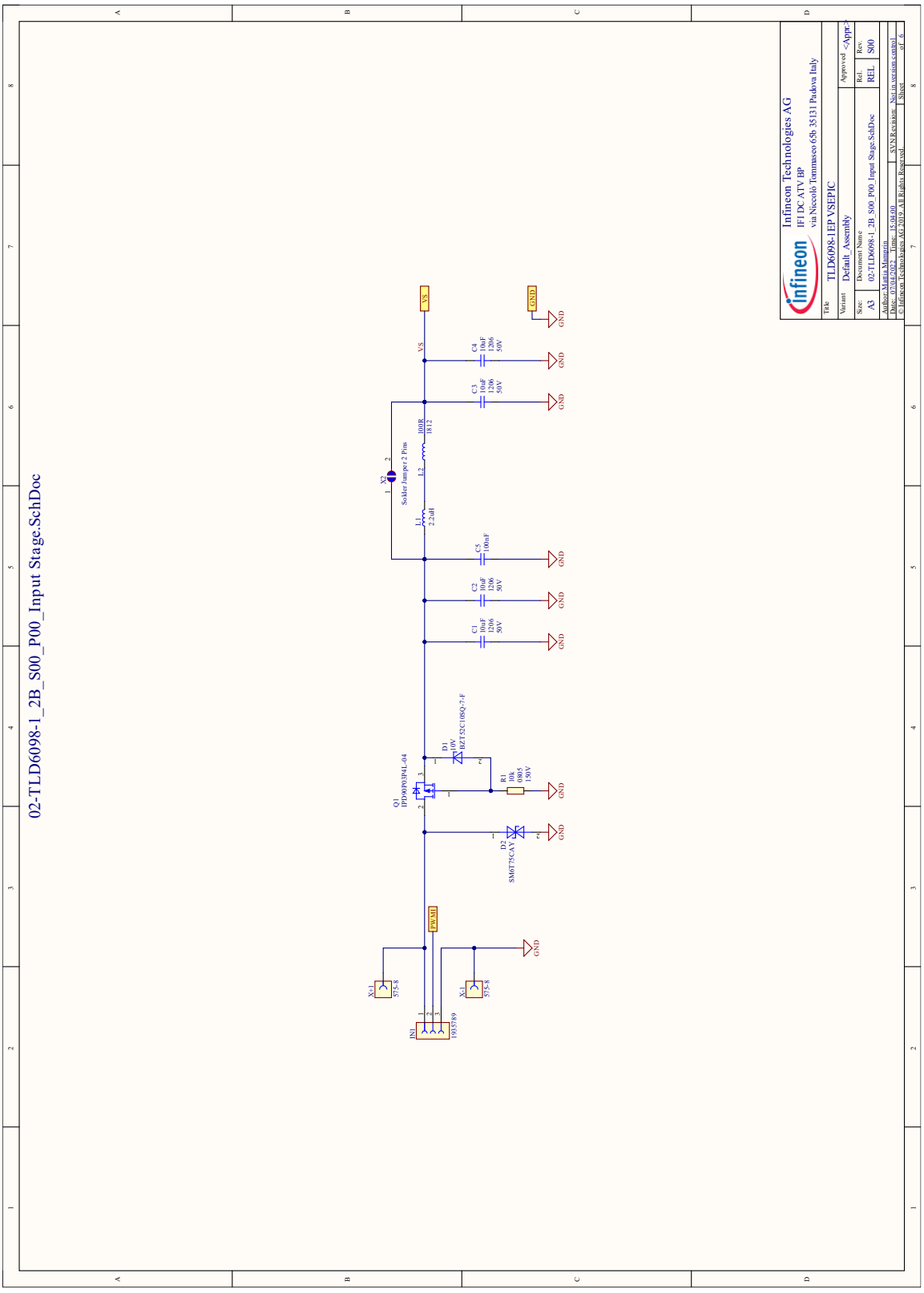

Figure 8 Schematic Input stage

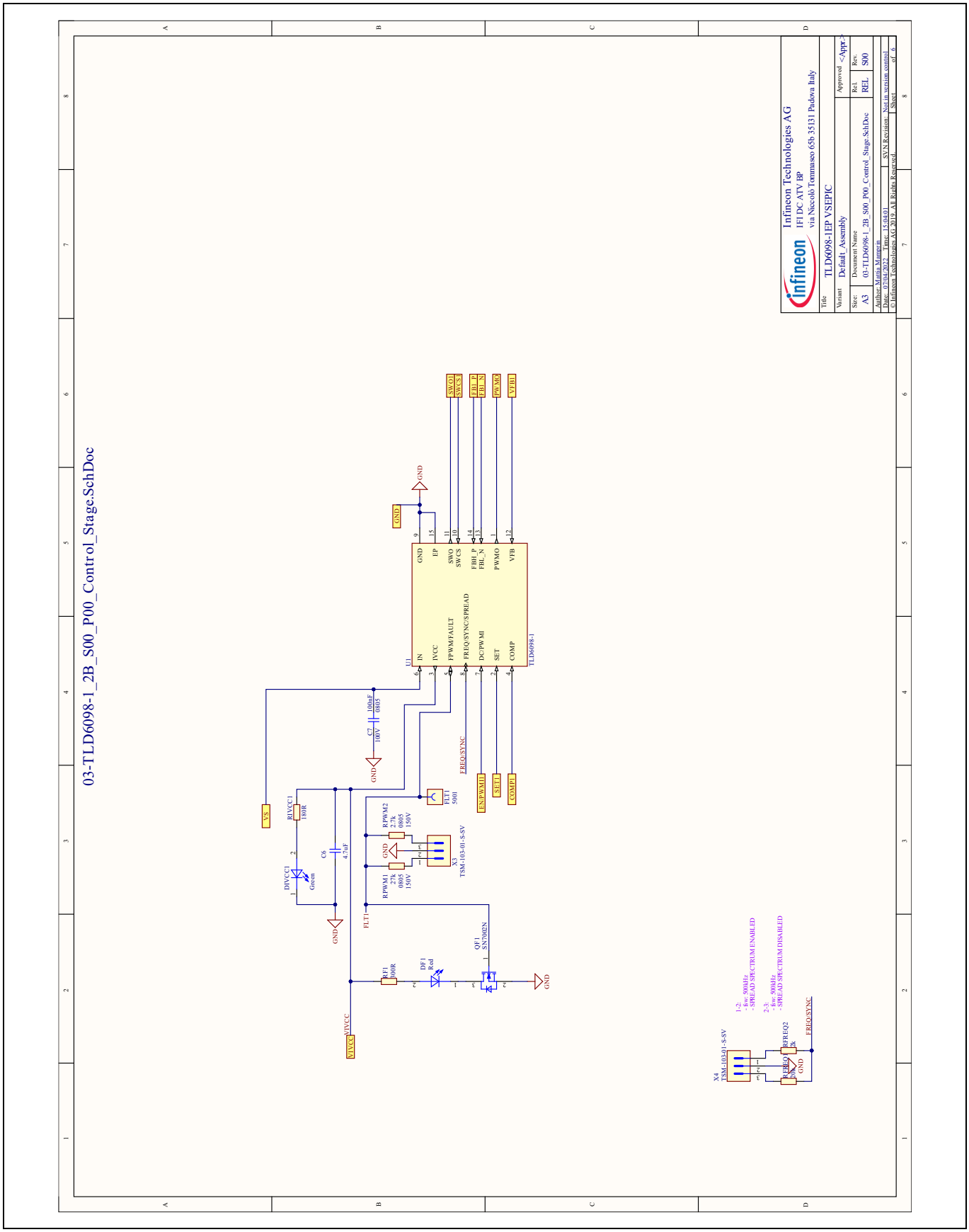

Figure 9 Schematic Control stage

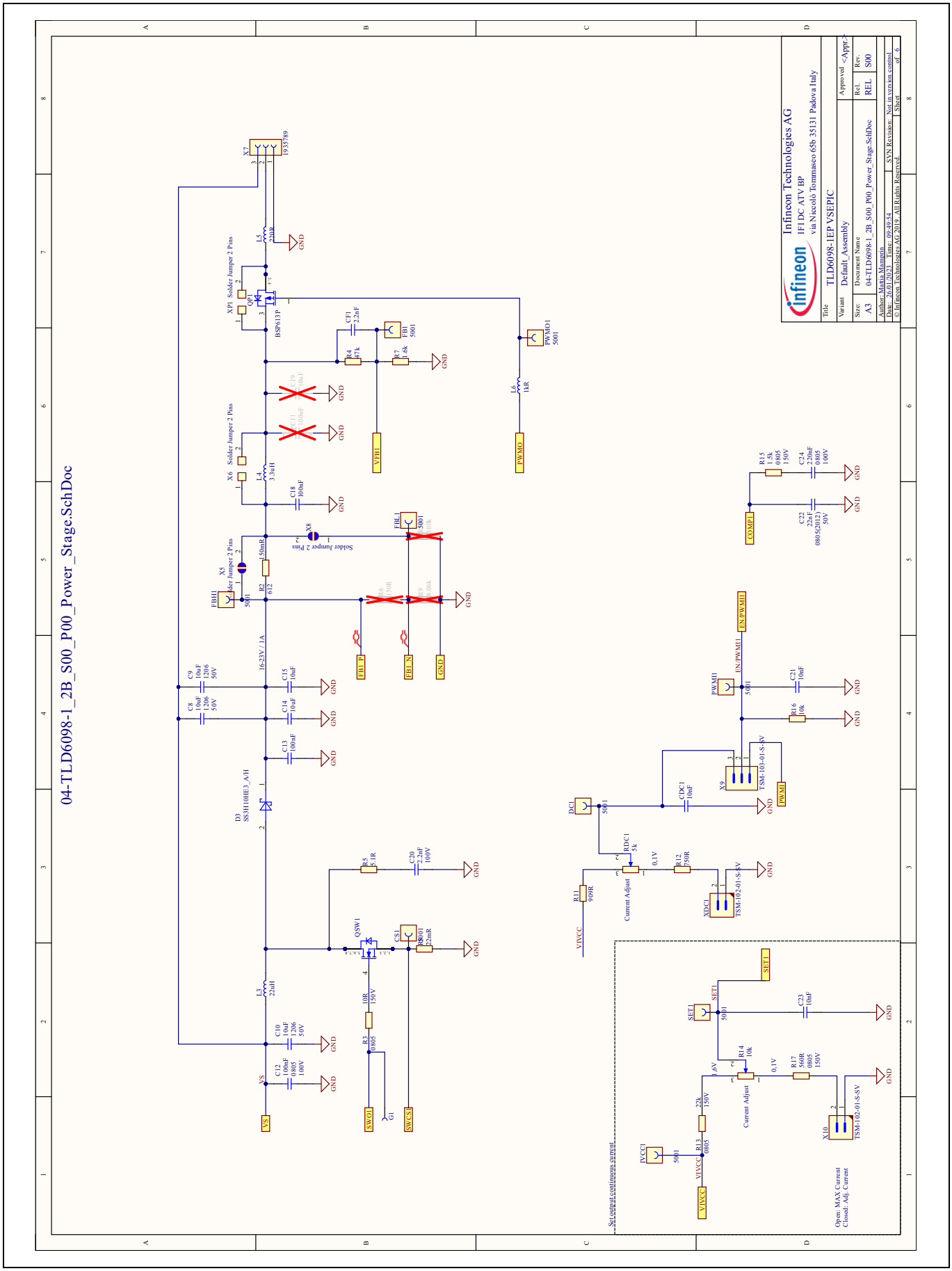

Figure 10 Schematic Power stage

3.2 PCB Layout

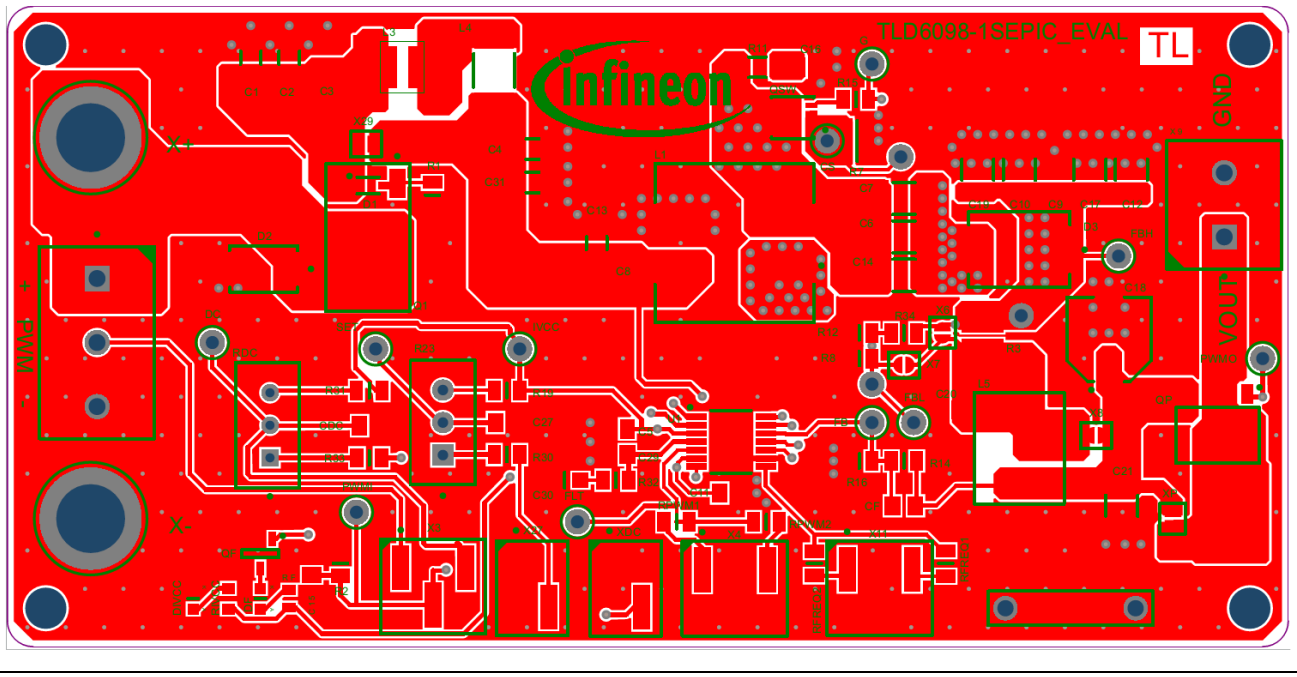

Figure 11 PCB layout top view

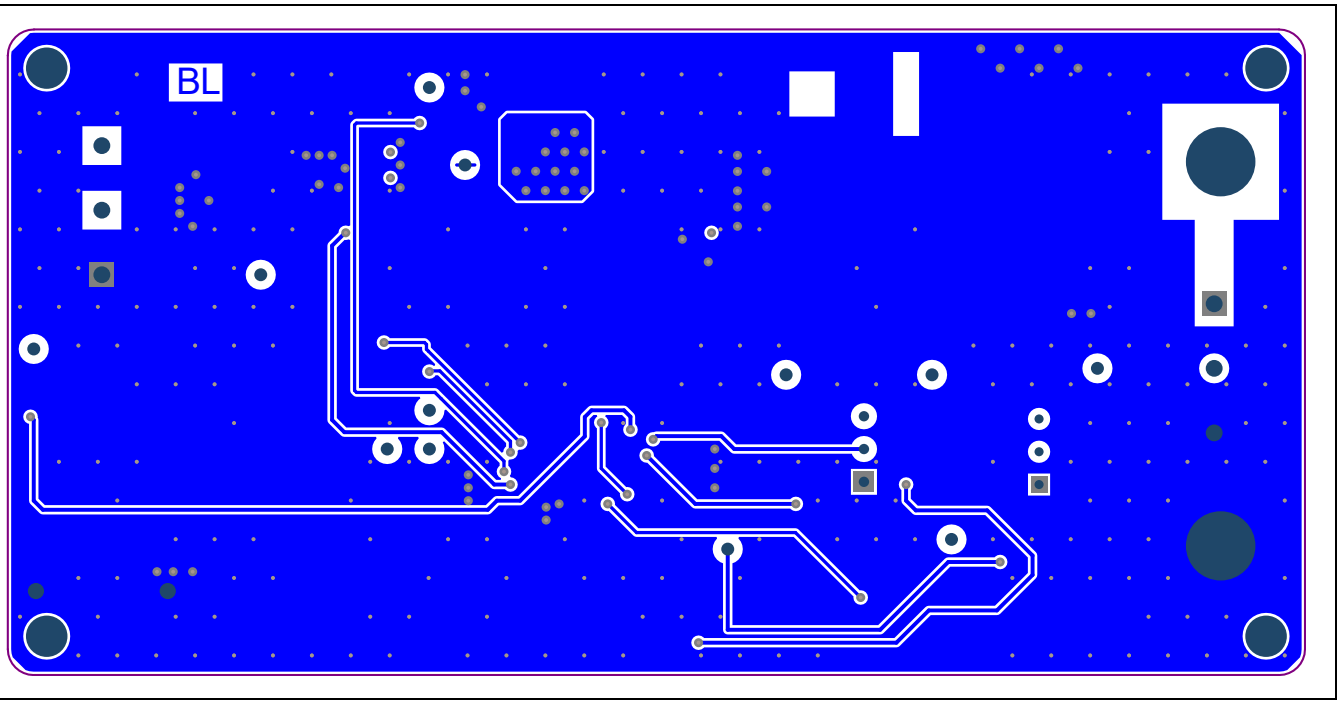

Figure 12 PCB layout bottom view

3.3 Bill of material

Table 8 Bill of material

Designator	Value	Manufacturer	Manufacturer order number
C1, C2, C3, C4, C8, C9, C10	10 µF	MuRata	GRT31CR61H106KE01L
C5, C7, C12	100 nF	TDK Corporation	CGA4J2X7R2A104M125AE
C6	4.7 µF	MuRata	GCM21BR71C475KA73
C11	100 µF	Nichicon	UCL1E101MCL1GS
C13, C18	100 nF	MuRata	GCM21BR72A104JA37
C14, C15, C19	10 µF	MuRata	GCM32EC71H106MA03
C20	2.2 nF	MuRata	GCM2165C2A222FA16
C21, C23, CDC1	10 nF	Kemet	C0805C103K5RACAUTO
C22	22 nF	TDK Corporation	CGJ4J2C0G1H223J125AA
C24	220 nF	TDK Corporation	CGA4F3X7S2A224K085AE
CF1	2.2 nF	MuRata	GRM21AR72D222KW01
CS1, DC1, FB1, FBH1, FBL1, FLT1, G1, IVCC1, PWMI1, PWMO1, SET1	5001	Keystone Electronics Corp., Keystone	5001
D1	10 V	DIODES	BZT52C10SQ-7-F
D2	SM6T75CAY	STMicroelectronics	SM6T75CAY
D3	SS3H10HE3_A/H	Vishay	SS3H10HE3_A/H
DF1	Red	Wurth Elektronik	150060RS75000
DIVCC1	Green	Wurth Elektronik	150060GS75000
IN1, X7	1935789	Phoenix Contact	1935789
L1	2.2 µH	Coilcraft	XGL3520-222MED
L2	100 Ω	Wurth Elektronik	74279226101
L3	22 µH	Wurth Elektronik	7447709220
L4	3.3 µH	TDK Corporation	RLF7030T-3R3M4R1-T
L5	220 Ω	TDK Corporation	MPZ2012S221ATD25
L6	1 k Ω	Wurth Elektronik	742792663
Not Used1	0 Ω	Vishay	
Q1	IPD90P03P4L-04	Infineon Technologies	IPD90P03P4L-04
QF1	SN7002N	Infineon Technologies	SN7002N

Designator	Value	Manufacturer	Manufacturer order number
QP1	BSP613P	Infineon Technologies	BSP613P
QSW1	IAUZ30N06S5L140	Infineon Technologies	IAUZ30N06S5L140
R1	10 kΩ	Vishay	CRCW080510K0FK
R2	150 mΩ	ROHM Semiconductors	LTR18EZPFLR150
R3	10 Ω	Vishay	CRCW080510R0FK
R4	47 kΩ	Vishay	CRCW080547K0FK
R5	5.1 Ω	KOA Speer Electronics Inc.	SG732BTTD5R1K
R6	150 Ω	Vishay	CRCW0805150RFK
R7	1.6 kΩ	Vishay	CRCW08051K60FK
R8	22 mΩ	Vishay	RCWE061222L0JMEA
R9	8.06 kΩ	Vishay	CRCW08058K06FK
R10	100 kΩ	Vishay	CRCW0805100KFK
R11	909 Ω	Vishay	CRCW0805909RFK
R12	750 Ω	Vishay	TNPW0805750RBY
R13	22 kΩ	Vishay	CRCW080522K0FK
R14	10 kΩ	Vishay	T93YA103KT20
R15	1.5 kΩ	Vishay	CRCW08051K50FK
R16	10 kΩ	Panasonic	ERJP06J103V
R17	560 Ω	Vishay	CRCW0805560RFK
RDC1	5 kΩ	Vishay	T93YA502KT20
RF1	300 Ω	Vishay	CRCW0603300RFK
RFREQ1	20 Ωk	Vishay	CRCW080520K0FK
RFREQ2	2 kΩ	Vishay	TNPW08052K00BEEA
RIVCC1	180 Ω	Yageo	RC0603FR-07180RL
RPWM1	27 kΩ	Vishay	CRCW080527K0FK
RPWM2	2.7 kΩ	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, XDC1	TSM-102-01-S-SV	Samtec	TSM-102-01-S-SV
X-1, X+1	575-8	Keystone Electronics Corp.	575-8

References

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

Revision history

Document revision	Date	Description of changes
Revision 1.00	2023-01-28	Initial release for evaluation board TLD6098-1_2B S02_P00

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