TLD40X0STD_KIT

User guide

LITIX™ Interior
RGB LED driver
Z8F80859300

About this document

Scope and purpose

The TLD40X0STD_KIT evaluation platform is designed to facilitate the development and testing of the LITIX™ Interior *local interconnect network (LIN) light-emitting diode (LED)* drivers. This LED driver family features integrated, independent, and protected low-side current sinks output-channels, and an embedded 32-bit Arm® Cortex®-M23 core.

It is possible to debug a custom application software running on the LITIX™ device. This is done by connecting a micro-*universal serial bus (USB)* cable between the PC and the TLD40X0STD_EVAL board, or by using an external debugger probe such as a SEGGER J-link BASE.

The TLD40X0STD_KIT is an evolution of the TLD4020-3STD_KIT, and the scope of this user guide is to provide instructions on its usage.

***Note**: PCBs and schematics are NOT optimized for final customer design.*

Supported products

The TLD40X0STD_KIT allows the evaluation of the following devices from the Infineon LITIX™ Interior LED driver family:

- TLD4020-3ET
- TLD4020-4ET
- TLD4030-12ES

Intended audience

Hardware engineers and software engineers.

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”).

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1 Safety precautions

Safety precautions

***Note**: Note the following warnings regarding the hazards associated with development systems.*

Table 1 Safety precautions

	**Warning:** *The evaluation or reference board contains DC bus capacitors which take time to discharge after removal of the main supply. Before working on the drive system, wait 5 minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.*
	**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:** *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.*

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2 Evaluation kit composition

The TLD40X0STD_KIT is composed of a main board TLD40X0STD_EVAL, a set of load boards (mounting different types of *LED* loads), and a set of *integrated circuit (IC)* daughterboards (mounting the LITIX™ Interior LED drivers).

LED load boards and IC daughterboards can be combined in various ways based on the specific application use case under testing, as outlined in the Boards selection guide, which provides an overview of the possible combinations.

Attention**:* ***It is important to note that the factory assembly of TLD40X0STD_EVAL does not include the LITIX™ device and the LED load. Therefore, the main board must always be used in combination with load boards and daughterboards.

The boards' functionalities are fully described in the chapters that follow.

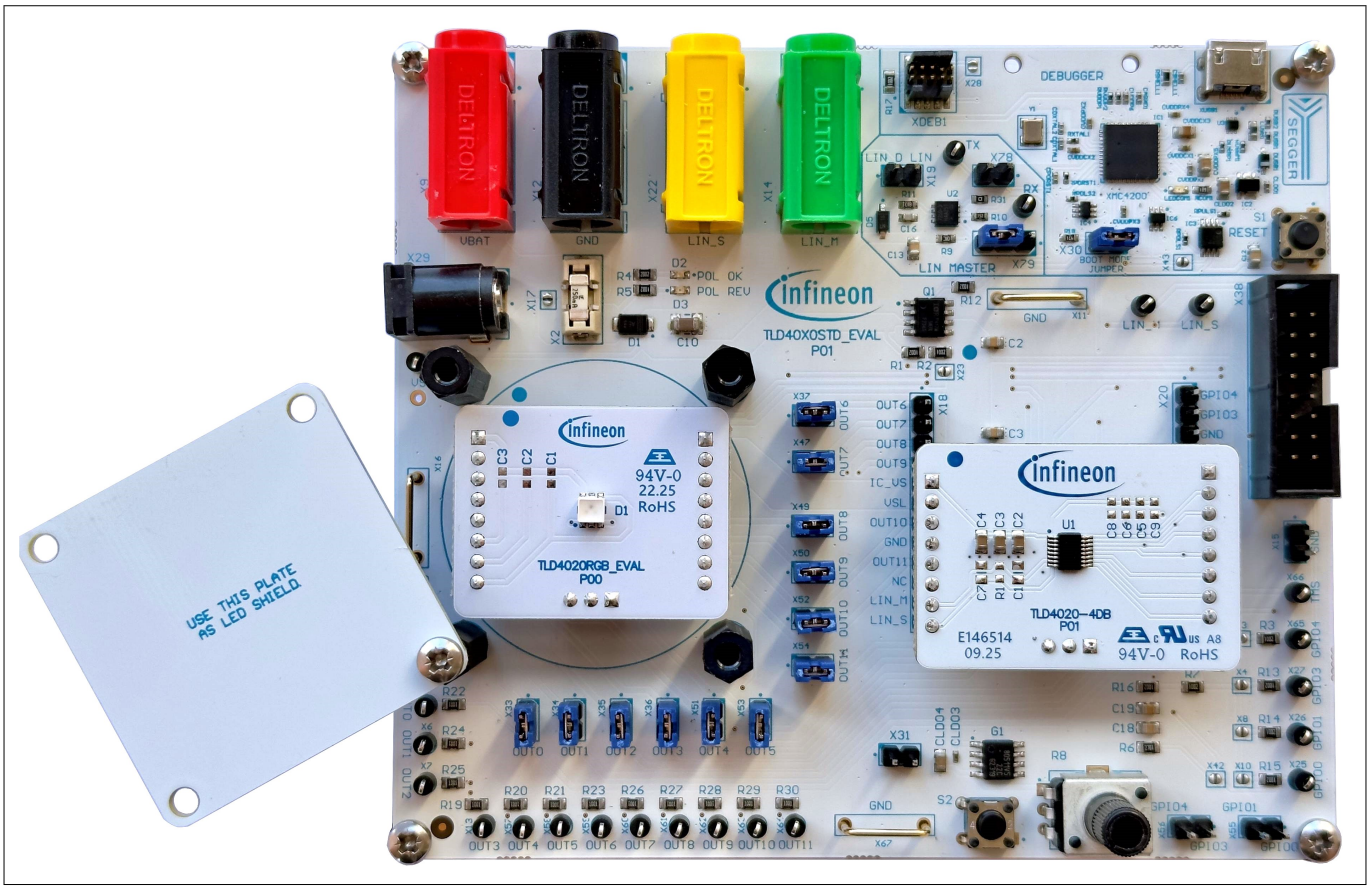


Figure 1 TLD40X0STD_KIT - Top side view

3 Boards selection guide

Typically one LITIX™ *IC daughterboard (DB)* is coupled to a specific load board (**"Preferred load"** in the table below). However, the TLD40X0STD_KIT offers the possibility to evaluate the drivers using other load boards.

The following table gives an overview on the possible matches between load boards and daughterboards.

Table 2 Boards selection guide

	Daughterboard		
Load board	**TLD4020-3DB**	**TLD4020-4DB**	**TLD4030-12DB**
TLD4020RGB_EVAL	✔ **Preferred load**	Out channels partially connected	✔ Out channels partially connected
TLD4020RGBW_EVAL	✔ Preferred load - White LED not in use	✔ **Preferred load**	✔ Out channels partially connected
TLD4030RGB_EVAL	✖ Load board not supplied - Do not use	✖ Load board not supplied - Do not use	✔ Preferred load - Independent out channels
TLD4030HCRGB_EVAL	✖ Load board not supplied - Do not use	✖ Load board not supplied - Do not use	✔ **Preferred load** Paralleled out channels (x4)

4 TLD40X0STD_EVAL – main board

4.1 The board at a glance

The TLD40X0STD_EVAL provides a complete set of functionalities to enable the user to evaluate the LITIX™ Interior *LED* drivers.

The board can be supplied from the banana type red/black connectors (X9/X12) or by using the jack connector (X29). The recommended supply voltage range is 7 V to 29 V (see Board parameters).

An integrated reverse polarity protection is present on the board to avoid any component damage in case of incorrect supply connections. In addition, an input supply fuse is present for overcurrent protection.

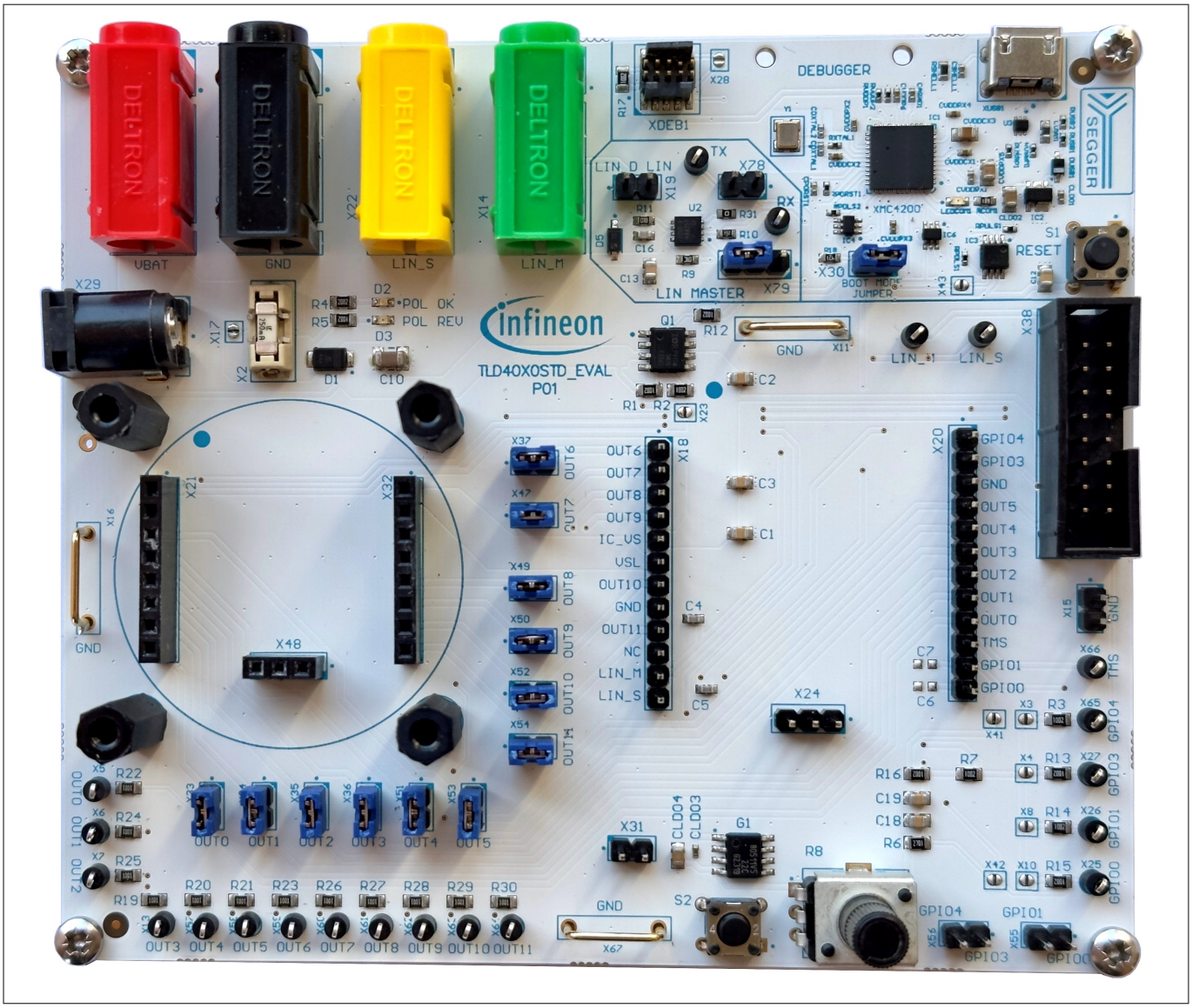


Figure 2 TLD40X0STD_EVAL - Top side view

The board features a built-in XMC™ Link debugger, and can be connected to a PC through a micro-*USB* cable[1)].

The additional banana type yellow/green connectors (X22/X14) make it possible to concatenate multiple boards in "bus mode". This is useful, for example, in case the user wants to evaluate the behavior of multiple devices connected within the same *LIN* bus, or to test animations effects and light patterns scenarios.

A system block diagram for the "bus mode" operation is shown in the figure below.

1 At first power up of the TLD40X0STD_EVAL, it is recommended to update the firmware of the SEGGER J-Link on-board debugger

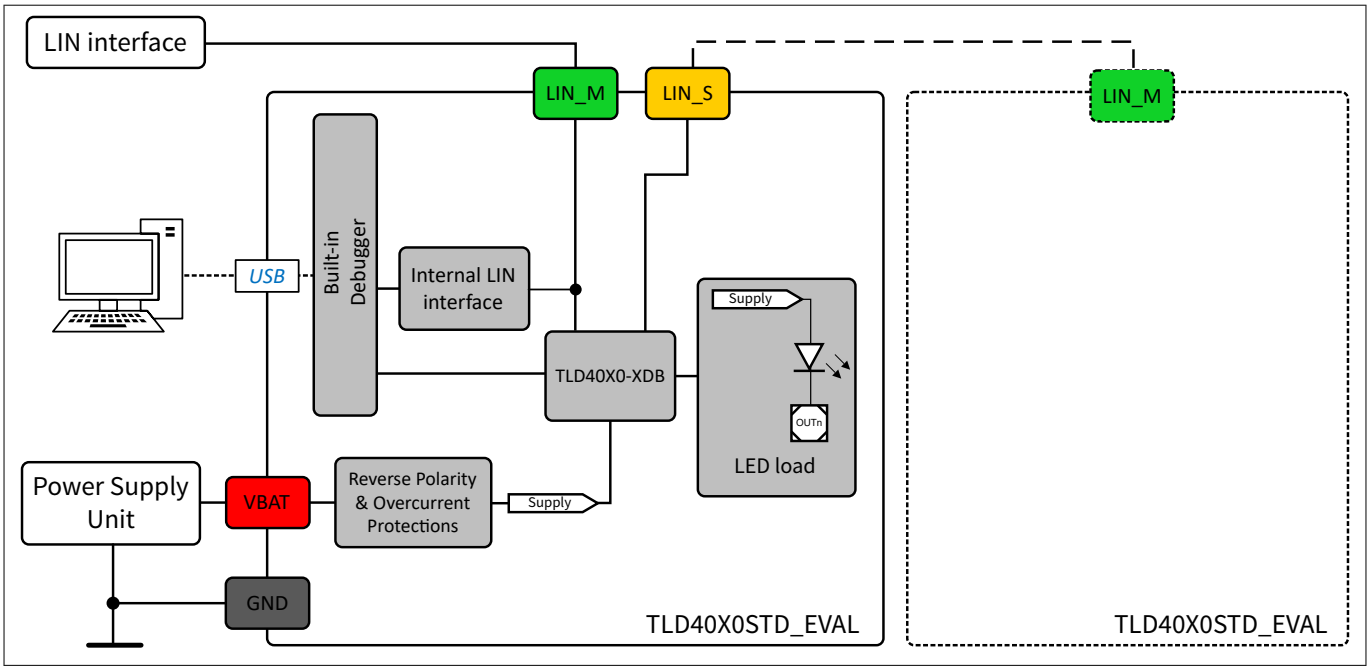


Figure 3 TLD40X0STD_EVAL - Bus mode operation

4.2 Main features

- Built-in XMC™ Link debugger [2)]
- On-board *LIN* transceiver connected to VCOM port
- Socket strips for *LED* load board connection
- Header strips for *IC DB* connection
- On-board LIN *bootstrap loader (BSL)* connector for *uIO-Stick* v2
- *general purpose input output (GPIO)* interfaces
- GPIO connection to VCOM port
- Reverse polarity and overcurrent protected input
- Test points for main signals probing
- Shielding board for eye protection

4.3 Board parameters

Table 3 TLD40X0STD_EVAL – board parameters

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Input voltage	V_{IN}	7	12	29	V	Maintain V_{IN} as low as possible to limit the power dissipation on the LED driver
Input current	I_{IN}	0.005	–	2	A	V_{IN} = 13.5 V
LIN baud rate	LIN_{BRATE}	2.4	–	115.2	kbit/s	Standard LIN is limited to 20 kbit/s, higher speed for *BSL*
Ambient Temperature	T_{AMB}	-20	25	85	°C	–

2 Based on the SEGGER J-Link debugger [8]

4.4 Output stage configuration

The output stage is equipped with integrated low-side current sink channels, with output-currents ratings depending on the LITIX™ *IC* part number.

Pin headers are present on the board and connected in series with each output channel, giving the possibility to test diagnostic feedback (open load detection), or to simply disconnect channels that are not in use.

Each output channel also has a dedicated test point for signal probing.

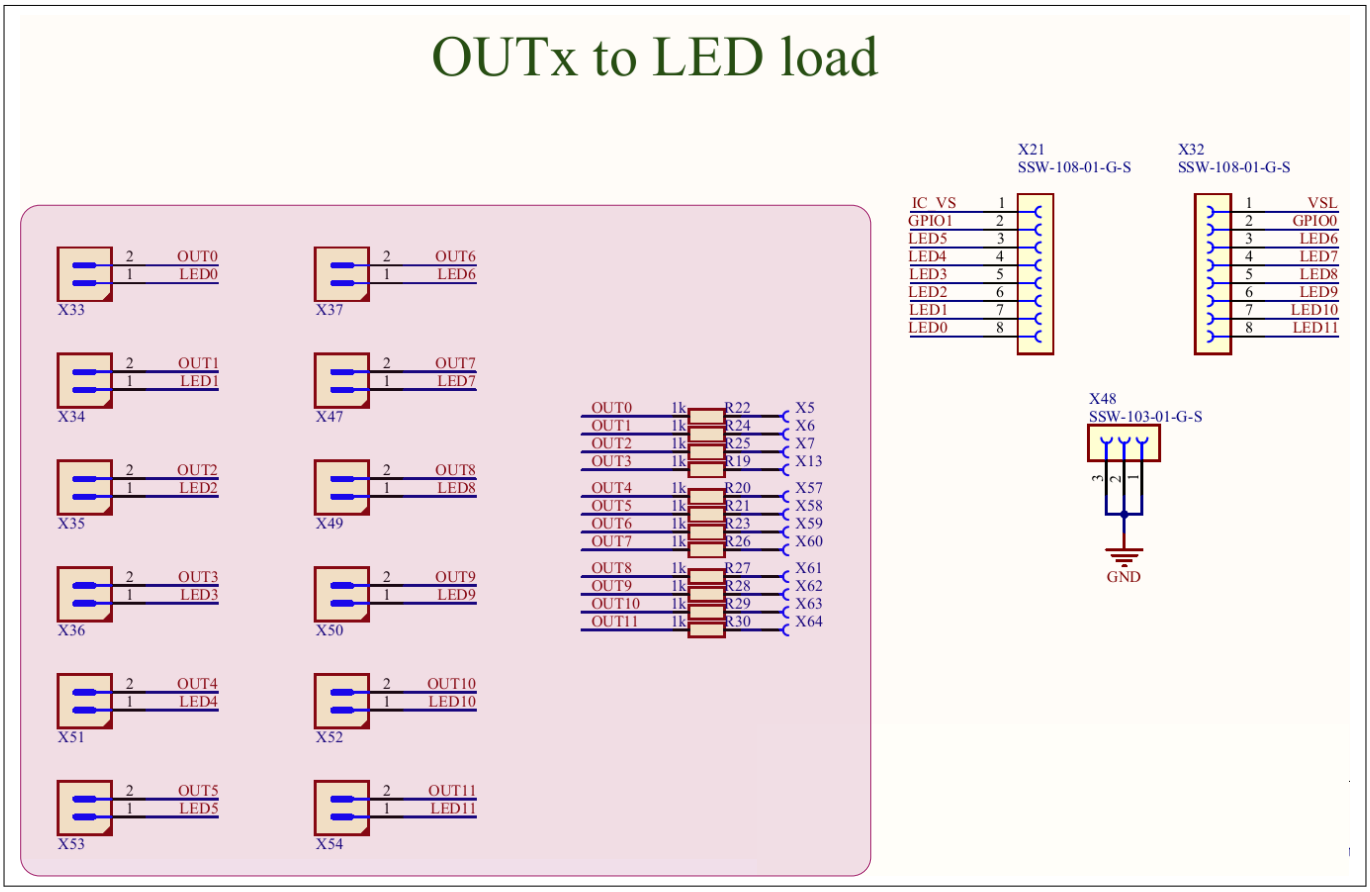


Figure 4 Output stage configuration - schematic

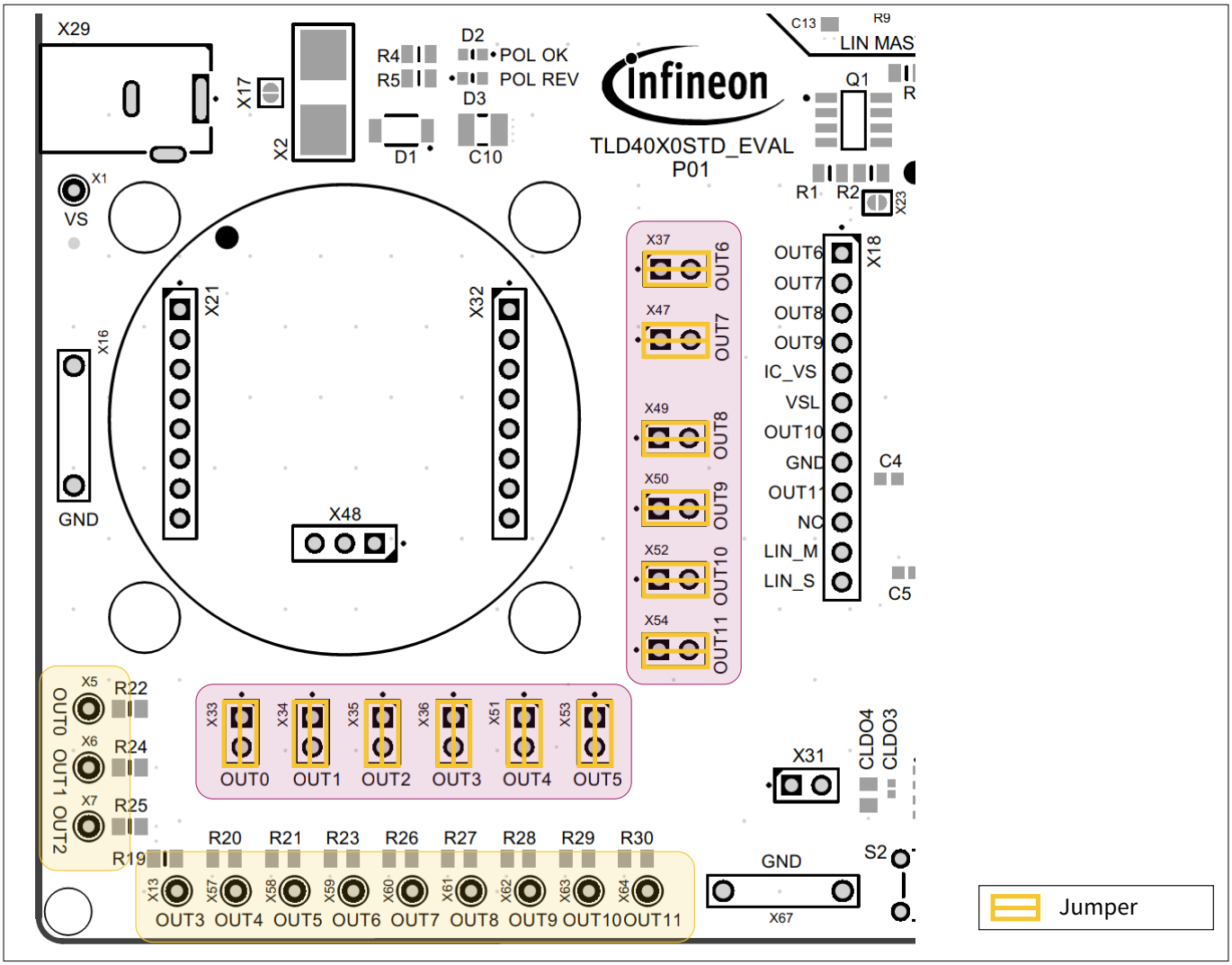


Figure 5 Output stage configuration - layout

4.5 Operation modes

The LITIX™ devices mounted on the *DB*s features two different operation modes:

- Debug mode
- User mode

Debug mode

In this operation mode, the debug is enabled and the device can be accessed by the *serial wire debug (SWD)*. The SWD functions (SWDIO and SWDCLK) are assigned to the following pins:

Table 4 Debug Pins

Pin	Functions
TMS	SWDIO
GPIO1	SWDCLK

The entry and exit of the debug mode is controlled by the *boot code in ROM (bootROM)* firmware, which is reading the TMS and SWDCLK pins during the boot-up, after a cold or warm reset. Therefore, to switch between the user and the debug mode, a device reset in while controlling the pins is needed.

To enter the debug mode, TMS and SWDCLK both need to be driven "high" externally after device reset. If this condition occurs, the bootROM firmware proceeds with the device start-up in debug mode instead of user mode.

A "high" level on the TMS pin is recognized by the device when the jumper X30 is left open during start-up. By doing this, the pin will be pulled "high" via a high-ohmic pull-up resistor (R17).

Logic level changes of the SWDCLK pin and device resets are handled by the debugger when entering debug mode.

For a detailed description of the *Debug system*, refer to the respective device *User manual* [2].

User mode

While operating in user mode, connection to the debugger is not possible. This mode is the standard operation mode and occurs when the TMS pin is kept "low" during device start-up. In order to do this, it is sufficient to set the jumper X30. A current limiting resistor (R18) is present on the board for short circuit protection.

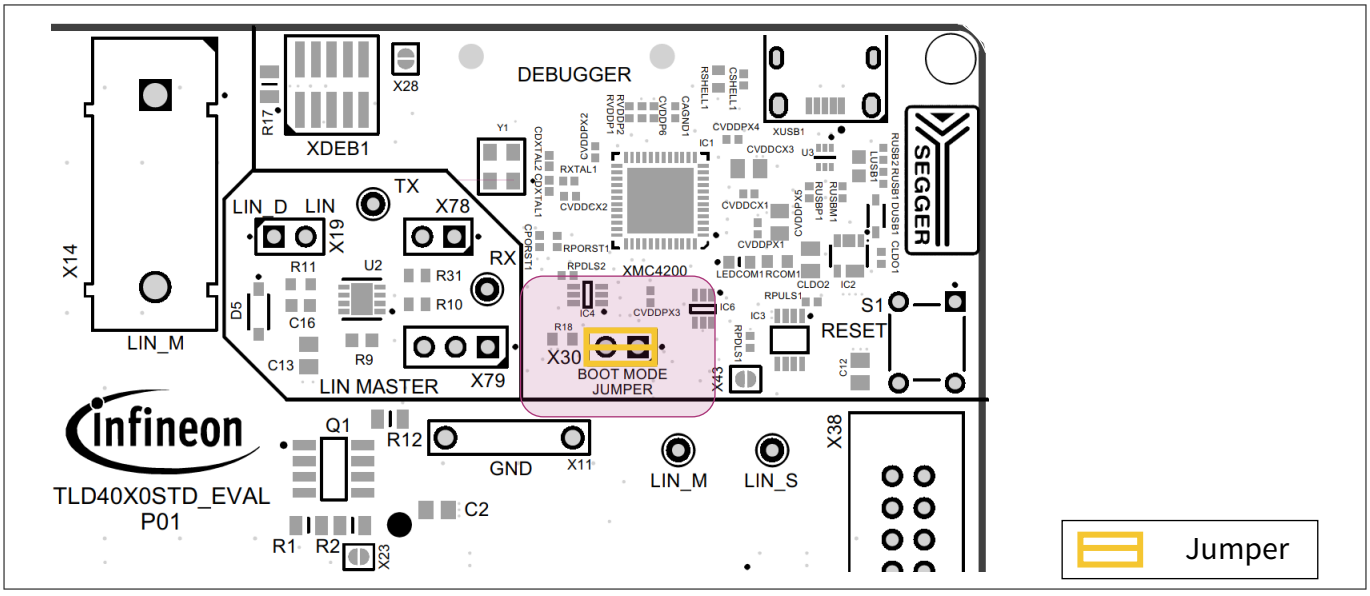


Figure 6 Operation mode setting

The bootup flow of the device is summarized in the following table:

Table 5 Bootup flow

Mode	TMS	GPIO1	Note
User	Low	x	X30 in place
Debug	High	High	X30 open

4.5.1 Debugger connection

The on-board debugger circuitry of the TLD40X0STD_EVAL is shown in the figure below.

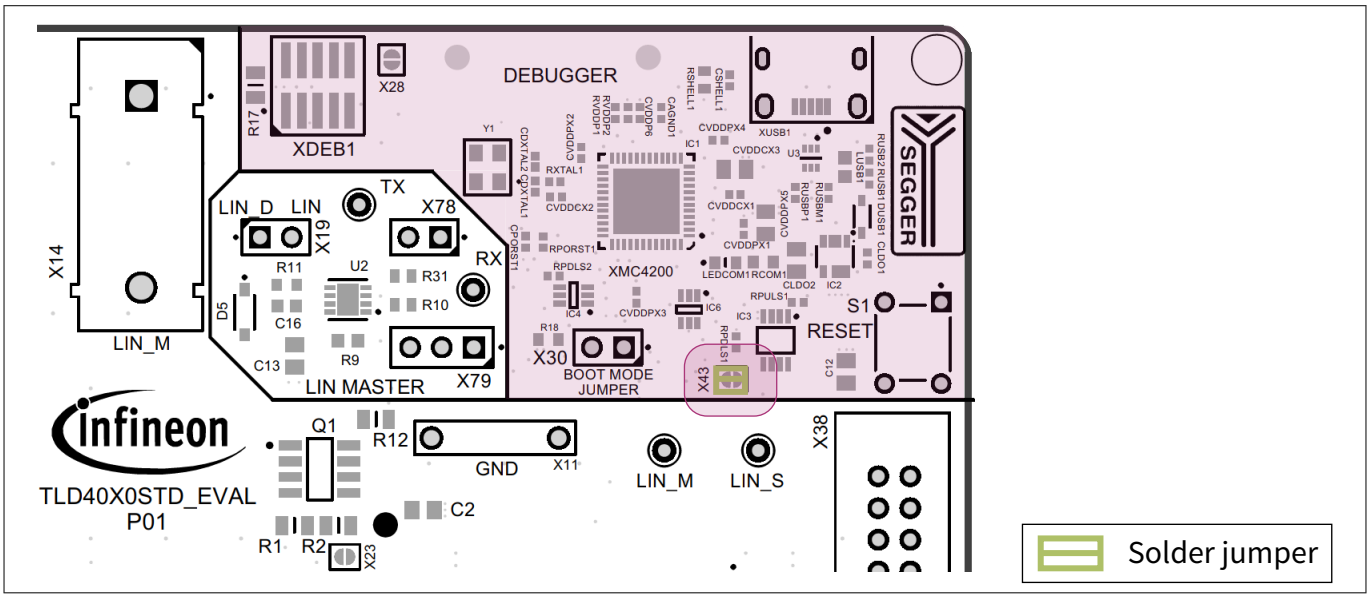


Figure 7 TLD40X0STD_EVAL - Debugger section

The debugger is an indispensable tool not only for programming the *LED* drivers, but also for debugging and verifying the application's functionality in real time. To utilize the debugger while developing application firmware, download the PC installation of the Keil µVision[3] or the IAR Embedded Workbench[4], as well as the dedicated software driver for the debugger[5].

***Note**: A complete development toolchain installation guideline, for the Keil µVision or the IAR Embedded Workbench, is provided within the application note "TLD40xx toolchain and evaluation board getting started", available on the product's webpage.*

Connecting the board to a PC via a micro-*USB* cable allows the user to leverage the built-in debugger circuitry. Alternatively, it is possible to connect a SEGGER J-Link BASE debugger (or other compatible debuggers) directly to the 10-pin connector XDEB1, located in the debugger section (see Figure 7). When using this method, it is crucial to ensure the correct polarity of the mounted connector, as indicated by the dot marking pin 1[6].

Additionally, the S1 button provides a convenient reset function. By pressing S1, the power supply to the LED driver *IC* is temporarily removed, allowing for a device reset.

Attention**: **Ensure that the solder jumper X43 is closed, for a proper connection with the on-board debugger.

***Note**: In case there are connection issues with the debugger, trimmer R8 shall be rotated all the way in a clockwise direction, in addition to the jumper X30 being left open.*

3 Keil µVision download [10]
4 IAR Embedded Workbench download [11]
5 SEGGER J-Link drivers download [8]; J-Link version 9.10 or newer is required
6 A suitable connector for the Segger J-Link debuggers is the 9-Pin Cortex-M Adapter [9]

4.6 Interfaces and features

4.6.1 GPIOs interfaces

The LITIX™ Interior *LIN LED* drivers feature *GPIO* pins, which can be configured and tested to evaluate various application use cases.

To facilitate this, a trimmer (R8) and a push button (S2) are conveniently located on the board, with the trimmer connected to GPIO0, and the push button connected to GPIO1. These components can be easily accessed and utilized by connecting the X42 and X41 solder jumpers, respectively.

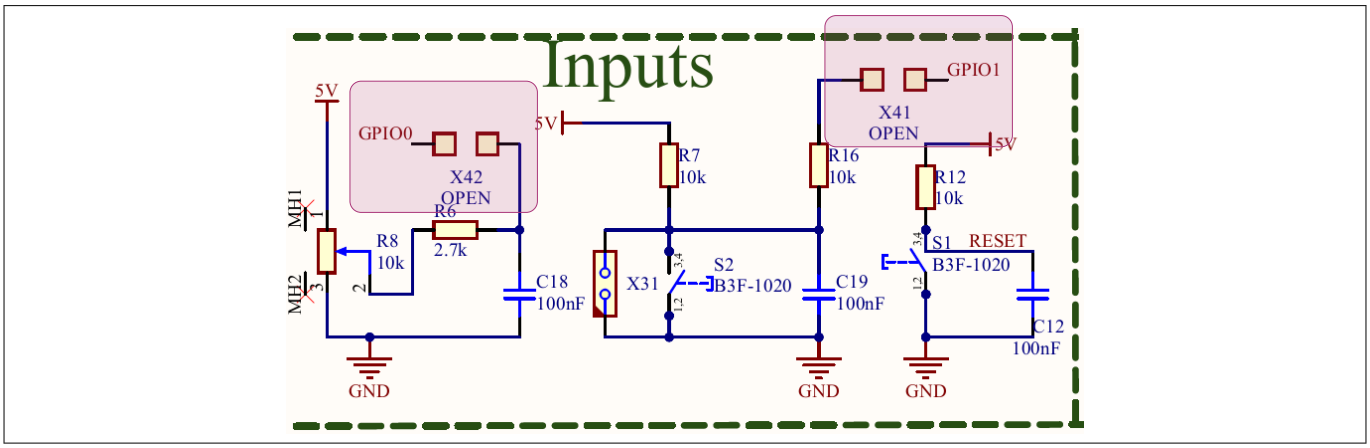


Figure 8 TLD40X0STD_EVAL - GPIOs interfaces - schematic

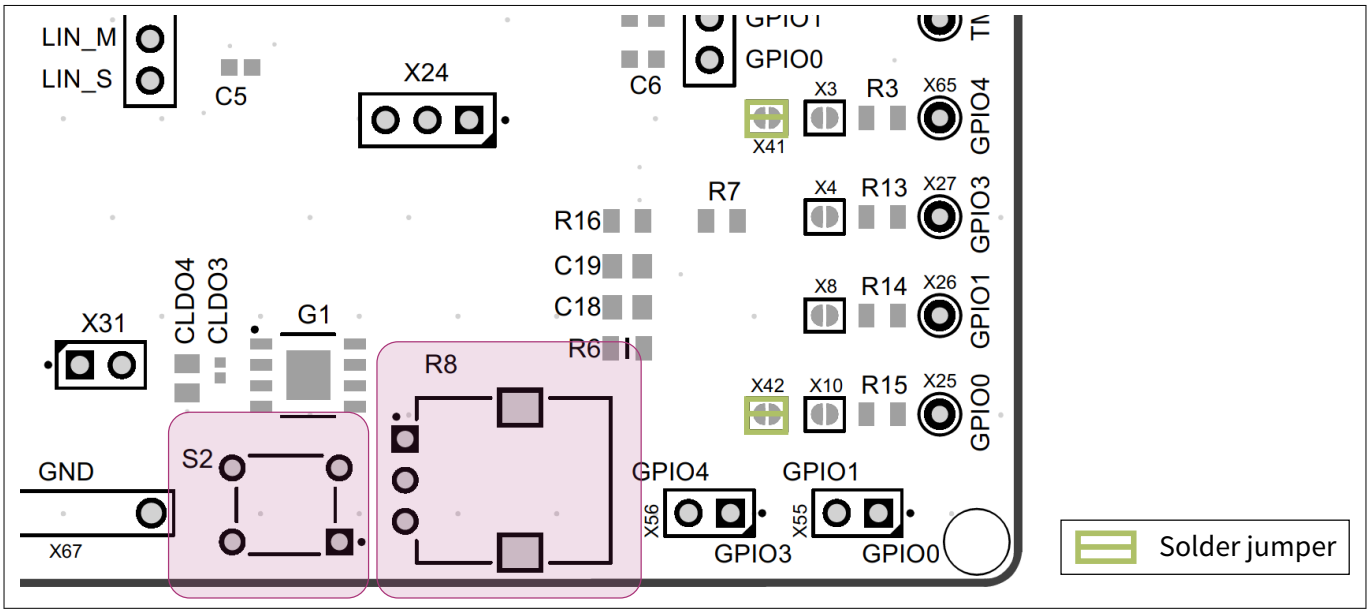


Figure 9 TLD40X0STD_EVAL - GPIOs interfaces - layout

4.6.2 LIN master transceiver interface

The TLD40X0STD_EVAL is equipped with an integrated *LIN* master transceiver TLE7259-3LE [6], providing a convenient interface to the LIN bus. To connect the LIN master to the device's LIN bus, use the X19 jumper. The RX signal needs to be routed to the transceiver through a proper setting of the X79 jumper (see Figure 11).

When the micro-*USB* cable is connected to a PC, a virtual serial port is established, enabling the user to transmit and receive data over the LIN bus. Furthermore, the LIN master and debugger functions can be utilized simultaneously via the USB connection, allowing for seamless testing and debugging of the device.

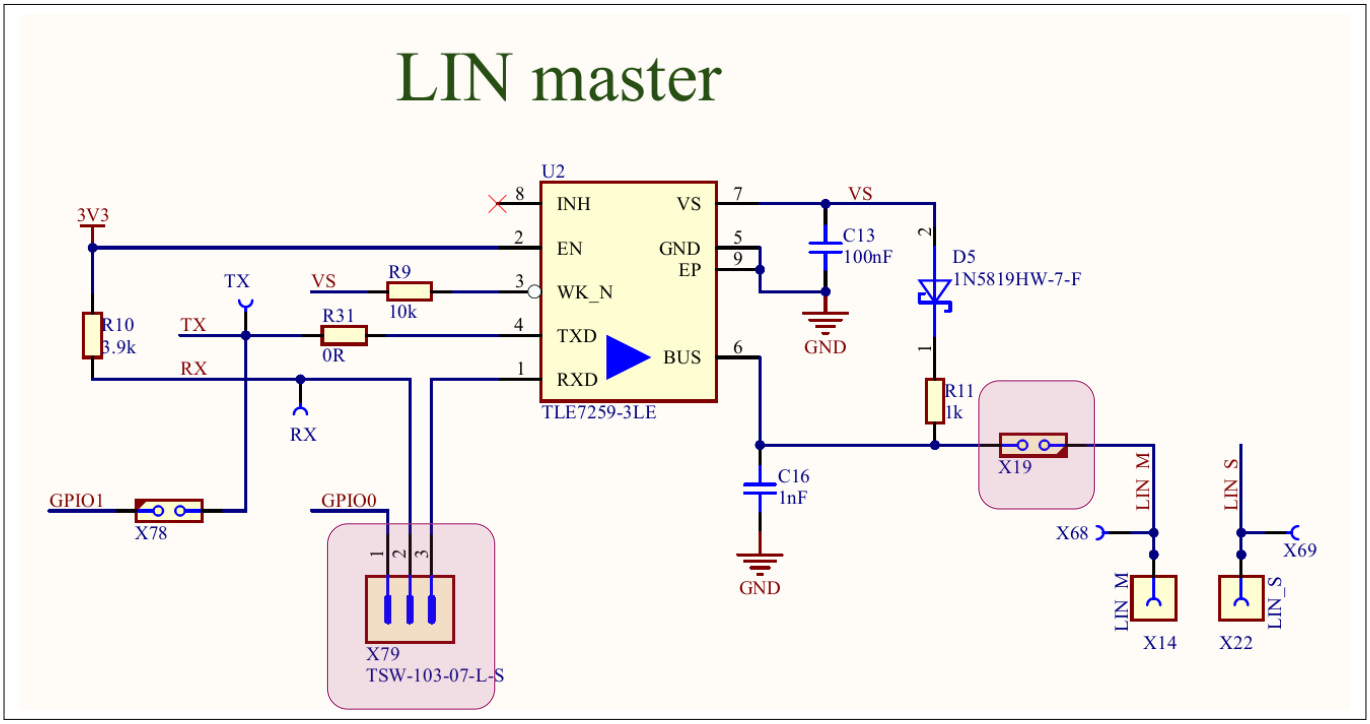


Figure 10 TLD40X0STD_EVAL - LIN master section - schematic

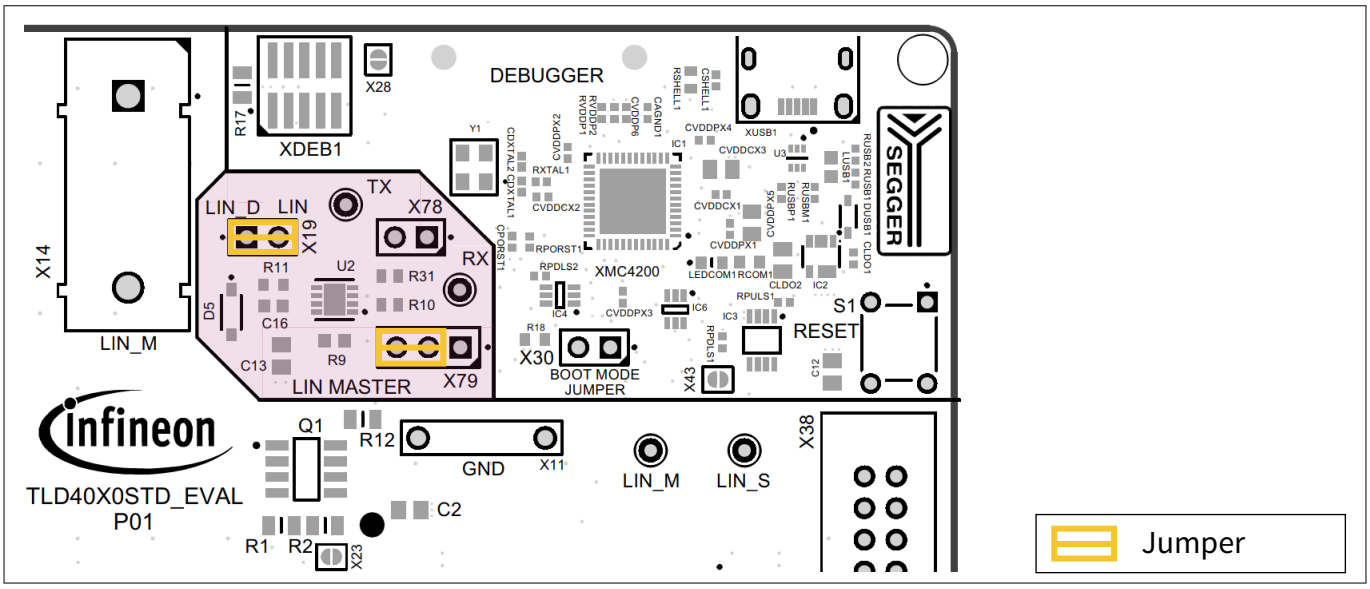


Figure 11 TLD40X0STD_EVAL - LIN master section - layout

4.6.3 Bootstrap loader interface

The TLD40X0STD_EVAL makes it possible to control the firmware of the LED driver *IC* through the user interface *Infineon BSL programming tool for MCUs*[7].

The dedicated connector X38 is present to allow the connection to an external *Infineon uIO-Stick v2*[8], which acts as hardware support to establish a *universal asynchronous receiver transmitter (UART)*-over-*LIN* communication to the device, and to enable the *BSL* features.

Attention**:* ***The external power supply unit must be disconnected when using the bootstrap loader interface. Supply voltages are provided by the Infineon uIO-Stick v2 device.

For a complete description of the BSL protocol functionality, refer to the device *User manual* [2] and *Firmware user manual* [3].

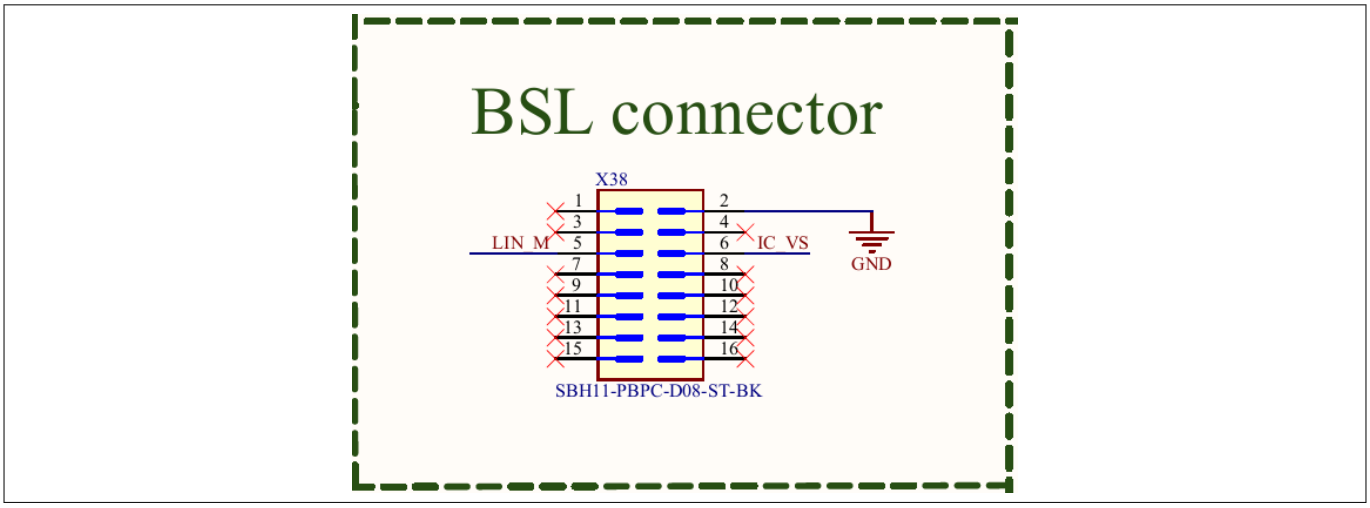


Figure 12 TLD40X0STD_EVAL - BSL connector - schematic

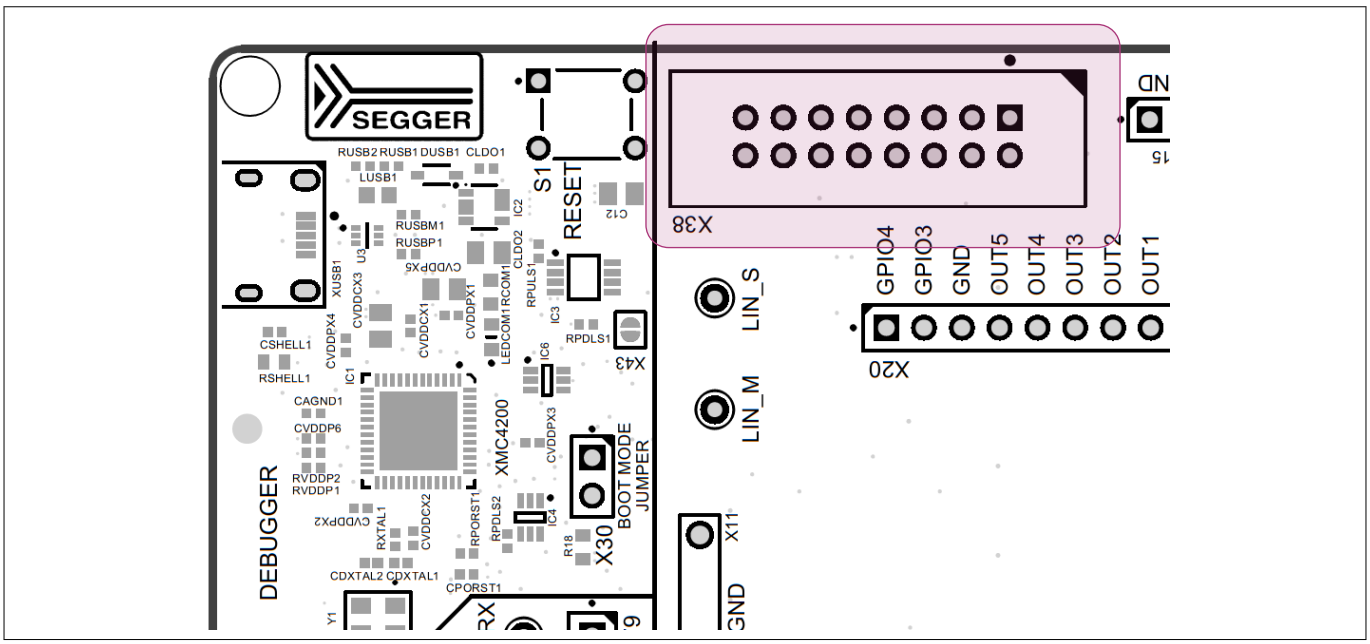


Figure 13 TLD40X0STD_EVAL - BSL connector - layout

7 *Infineon BSL programming tool for MCUs* can be downloaded from the Infineon Developer Center IDC [7]
8 For information on the Infineon uIO-Stick v2 refer to [4]

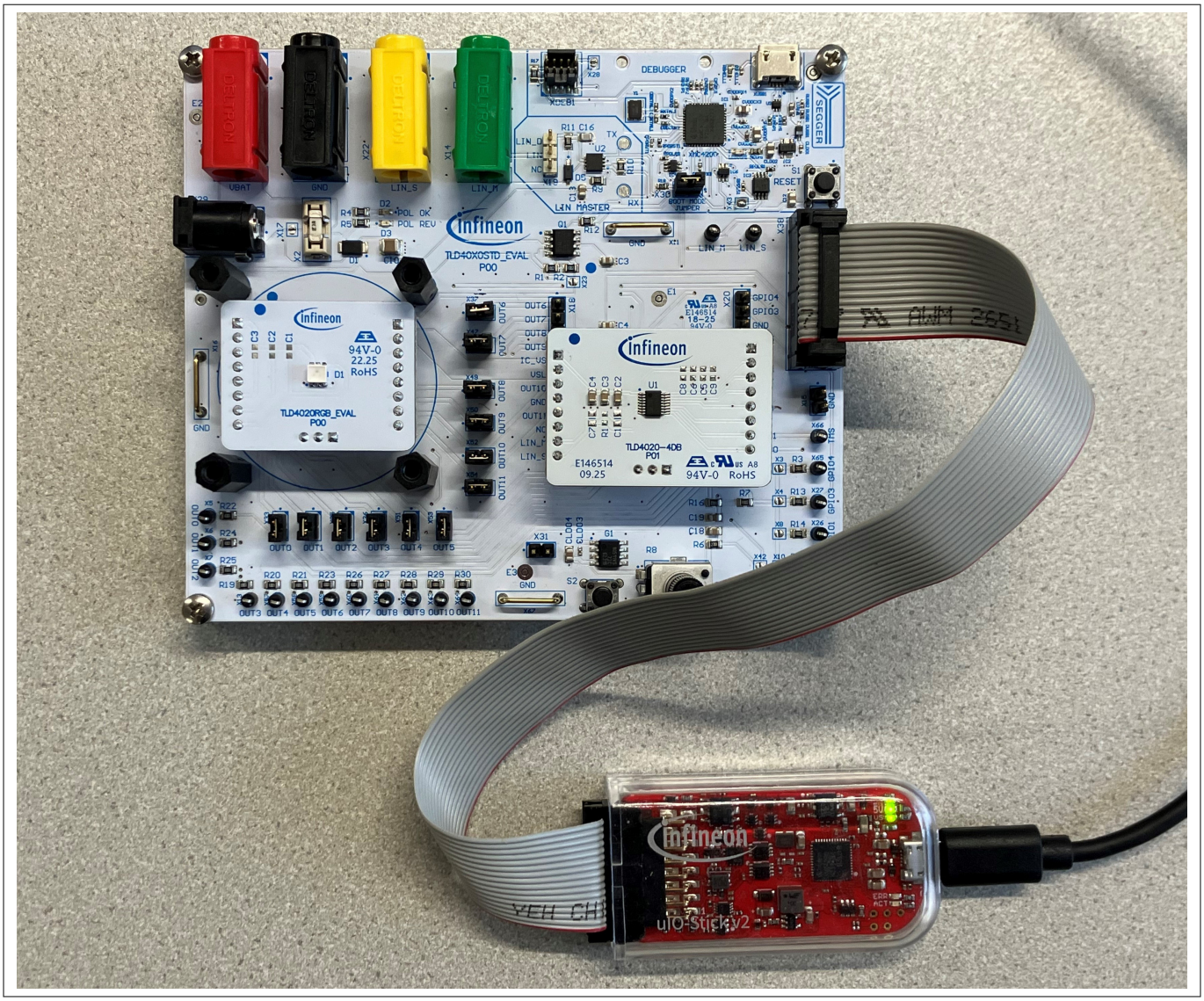


Figure 14 TLD40X0STD_KIT - Bootstrap loader interface

4.6.4 UART bridge interface

TLD40X0STD_EVAL is equipped with two pin header X55 and X56 connected to the LED driver's *GPIO*s, giving the possibility to access and expose the *UART* interface. This feature can be used in the application to connect the LITIX™ devices together, typically located on the same *printed circuit board (PCB)*, extending the *LIN* bus communication to a local sub-network.

A system block diagram for the "UART bridge" operation is shown in the figure below.

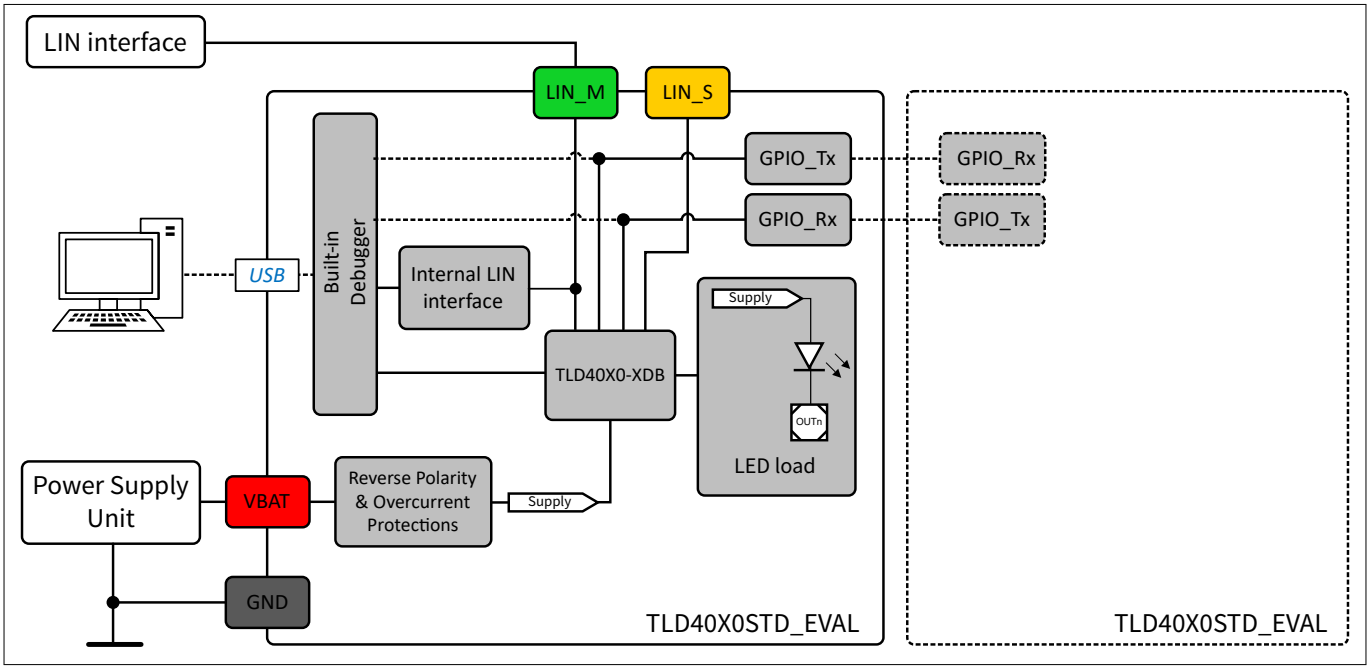


Figure 15 TLD40X0STD_EVAL - UART bridge interface

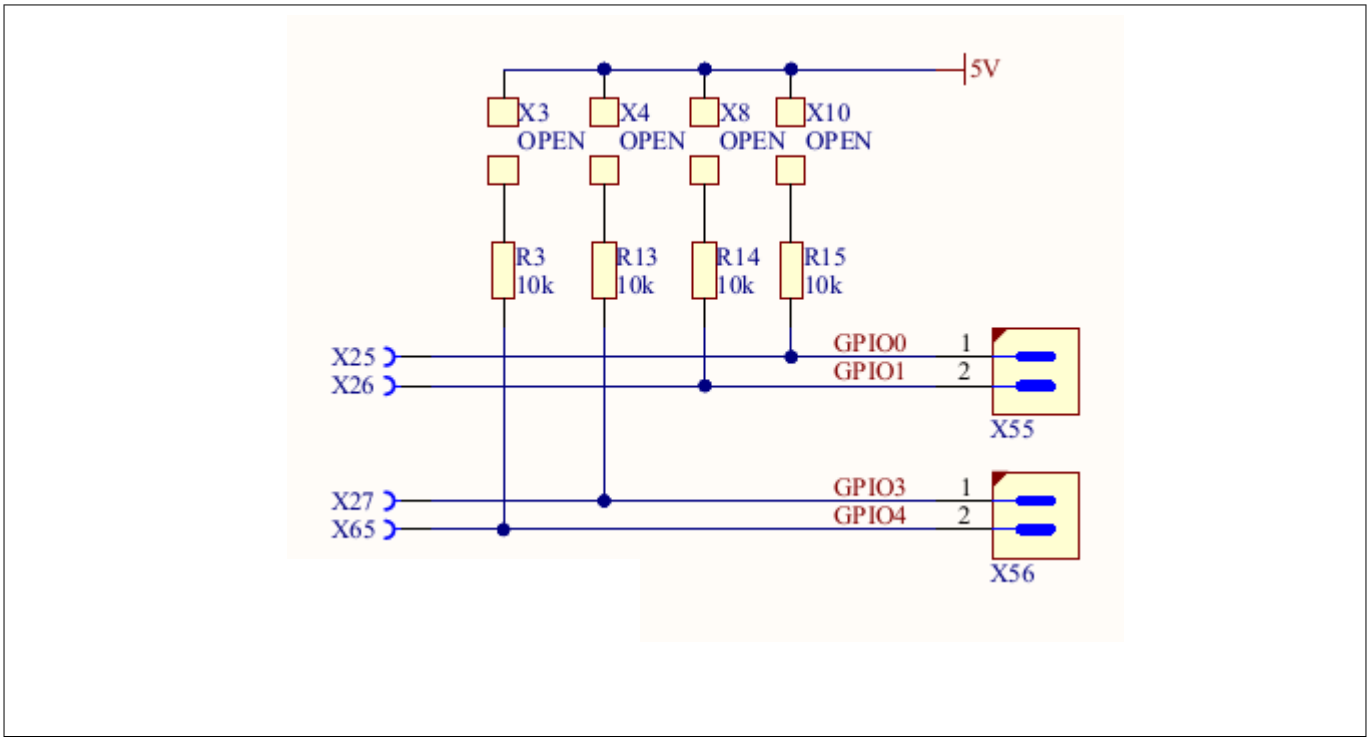


Figure 16 TLD40X0STD_EVAL - UART bridge interface - schematic

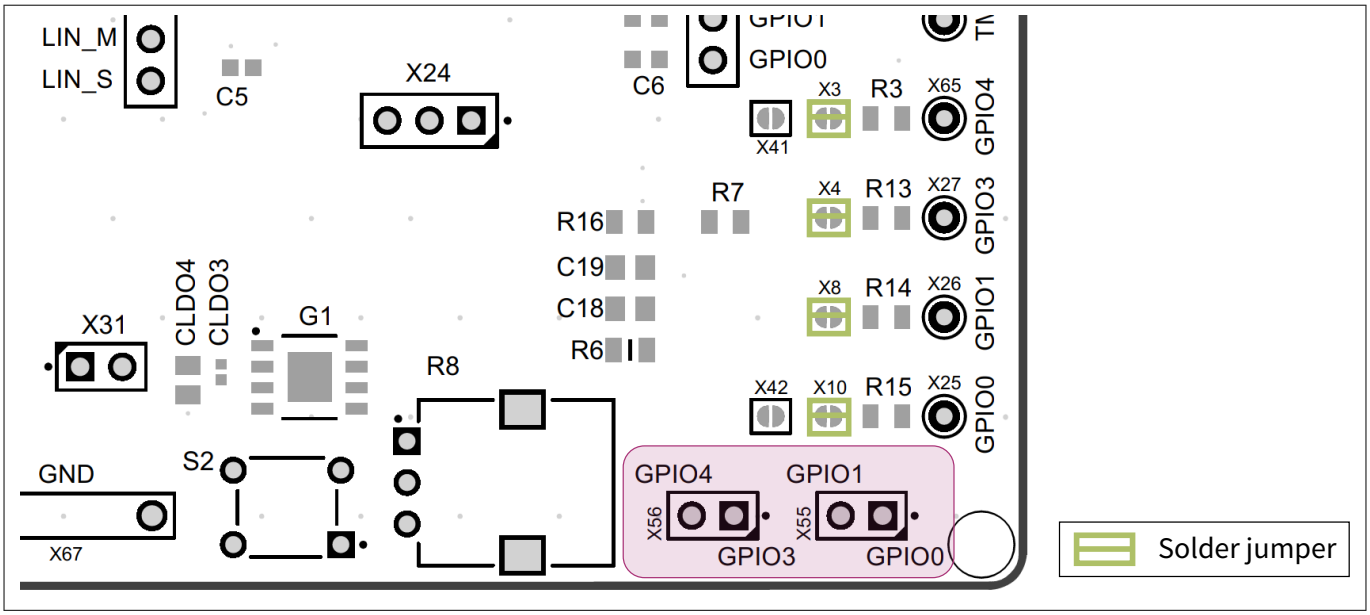


Figure 17 TLD40X0STD_EVAL - UART bridge interface - layout

The following picture refers to an evaluation example, where a LITIX™ TLD4030-12ES device is connected to a LITIX™ TLD4020-4ET device through the UART interface.

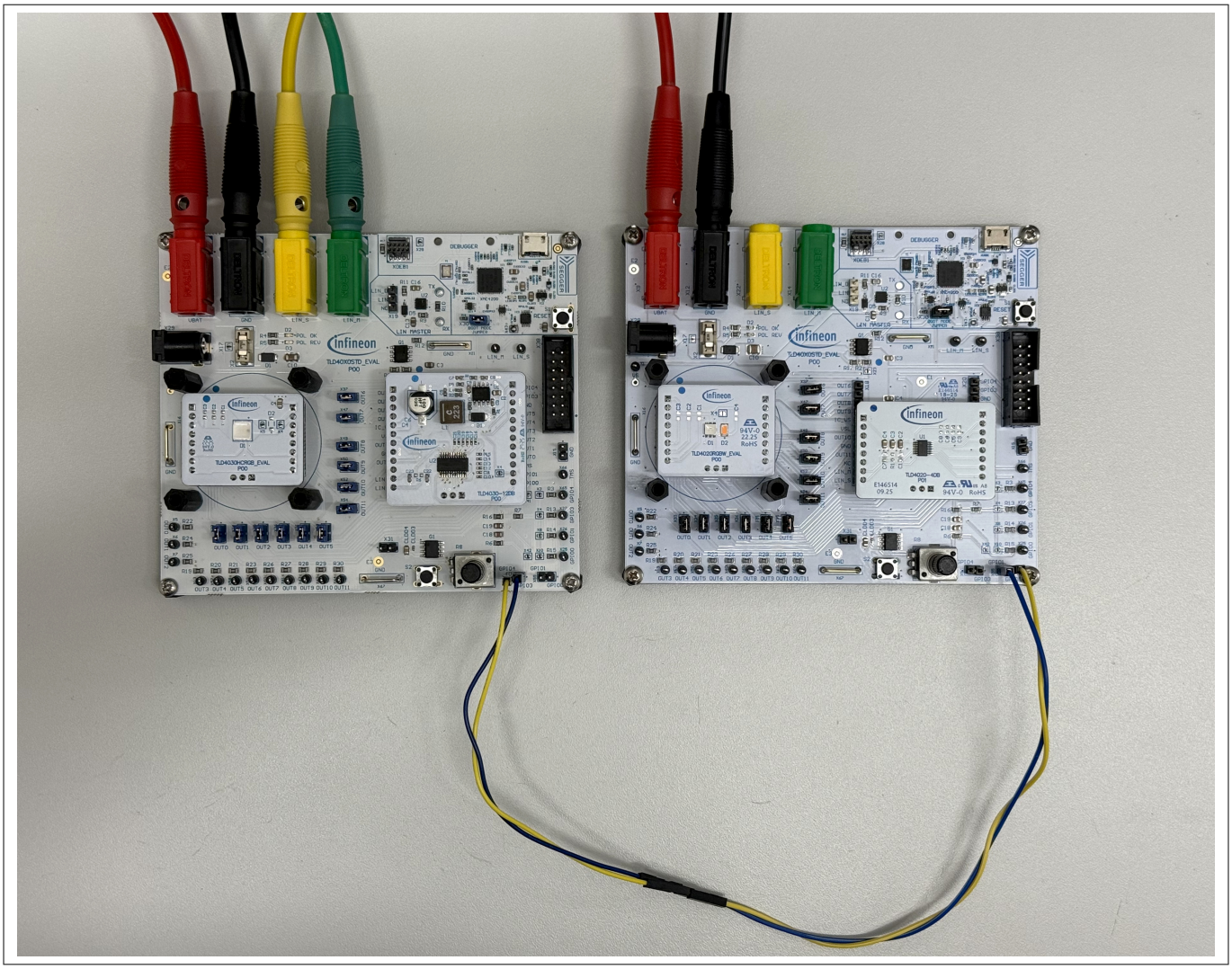


Figure 18 TLD40X0STD_KIT - UART bridge interface

The LED driver's GPIOs can also be accessed via UART from the virtual serial port of the PC[9], bypassing the LIN transceiver. This is possible through a proper setting of the X78 and X79 jumpers to interface the GPIOs with the on-board debugger (see Figure 19).

9 Feature available from board revision P01 onwards

4 TLD40X0STD_EVAL – main board

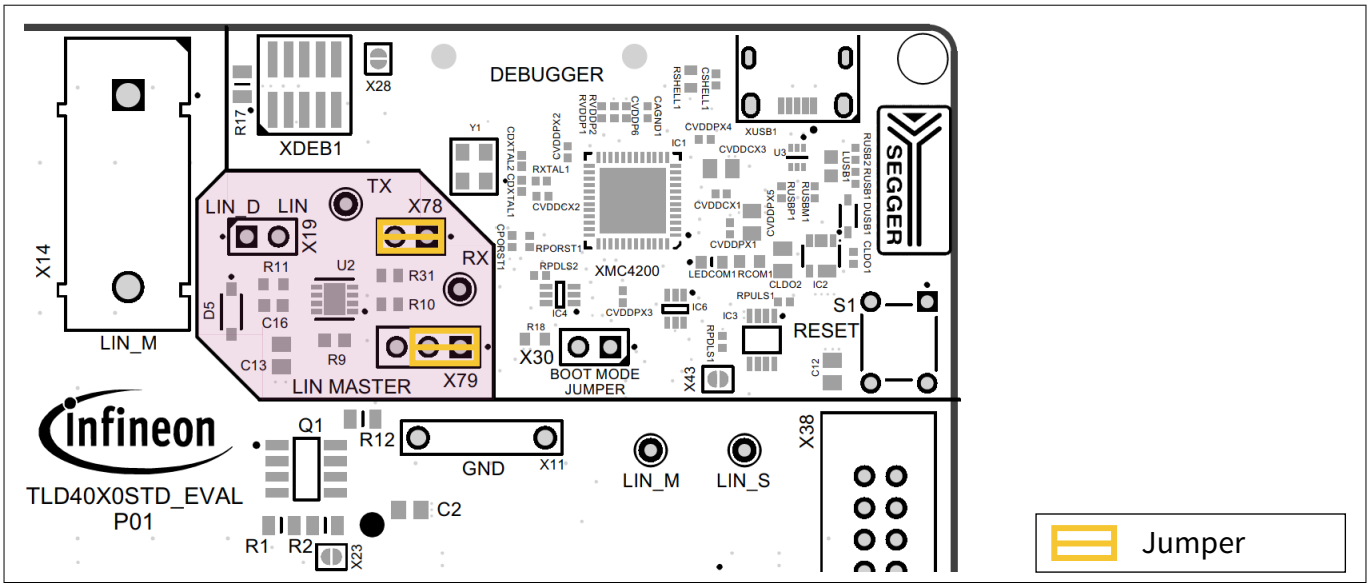


Figure 19 TLD40X0STD_EVAL - GPIOs connection to VCOM port

5 Daughterboards

To facilitate the programming of multiple devices or to quickly replace a device, a *DB* can be connected to the main board through the pin strips X4, X10, and X24.

It is essential to ensure proper alignment and polarity between the two boards to prevent malfunctions. To achieve this, the dots present on both boards (indicated by the red arrows in the figures below) must be positioned with the same orientation. This important step ensures a secure and functional connection between the main board and the daughterboard.

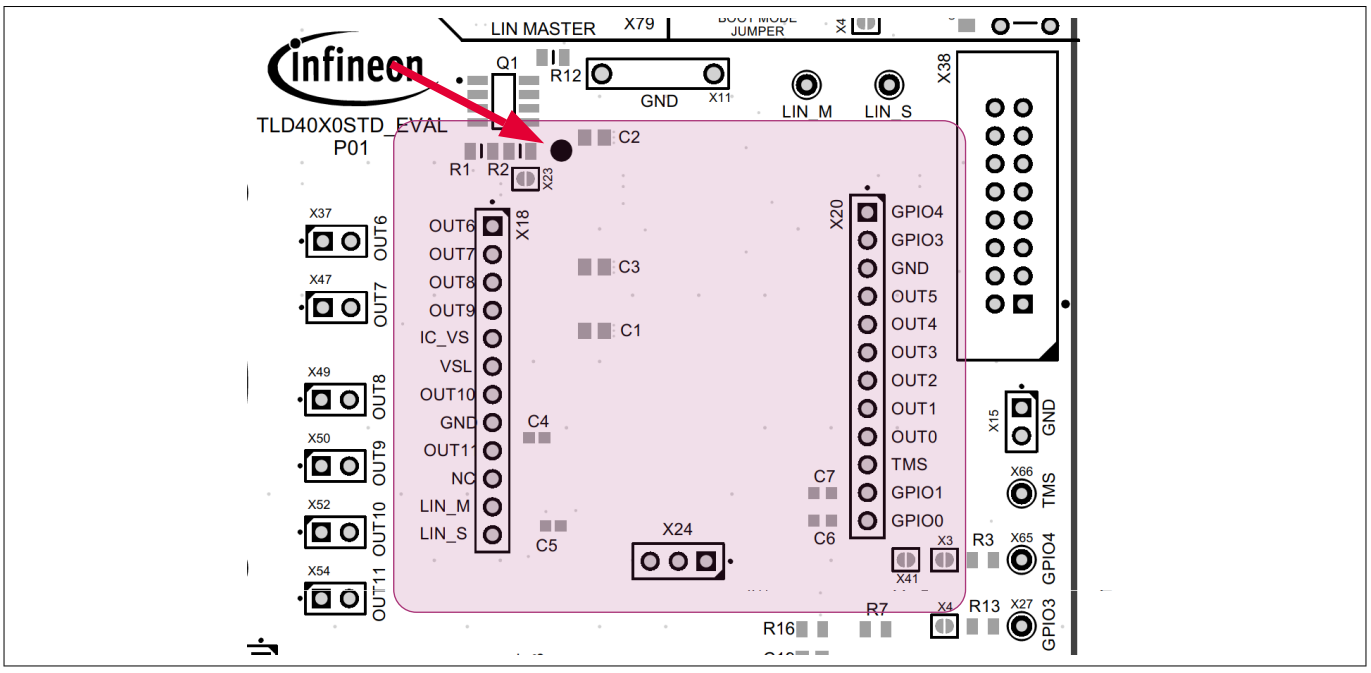


Figure 20 TLD40X0STD_EVAL - Orientation dot

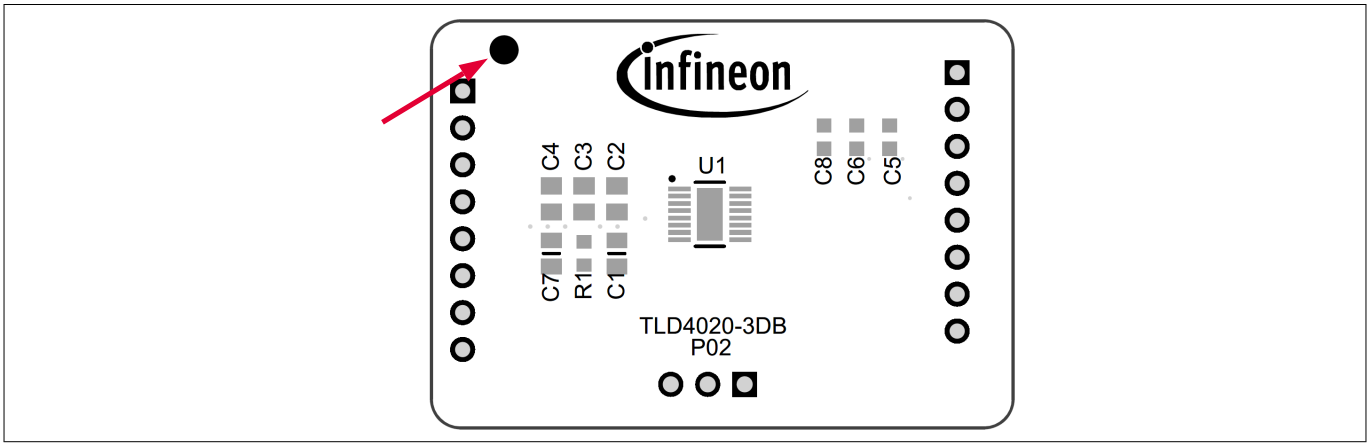


Figure 21 Daughterboard - Orientation dot

5.1 TLD4020-3DB

5.1.1 The board at a glance

The LITIX™ TLD4020-3ET is mounted on the TLD4020-3DB *DB*.

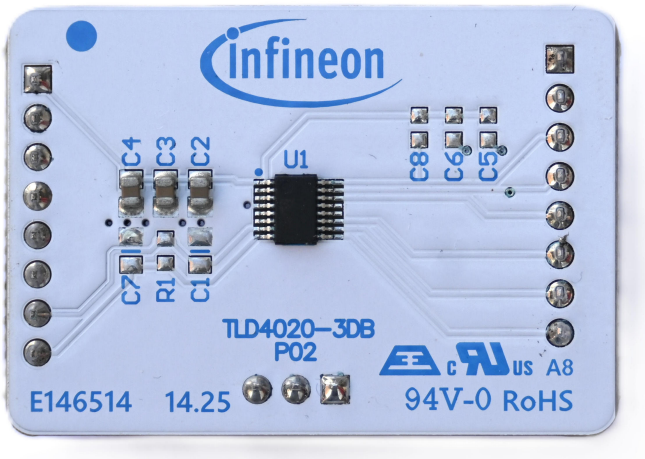


Figure 22 TLD4020-3DB - Top side view

5.1.2 Main features

- Pre-assembled LITIX™ TLD4020-3ET device

5.2 TLD4020-4DB

5.2.1 The board at a glance

The LITIX™ TLD4020-4ET is mounted on the TLD4020-4DB *DB*.

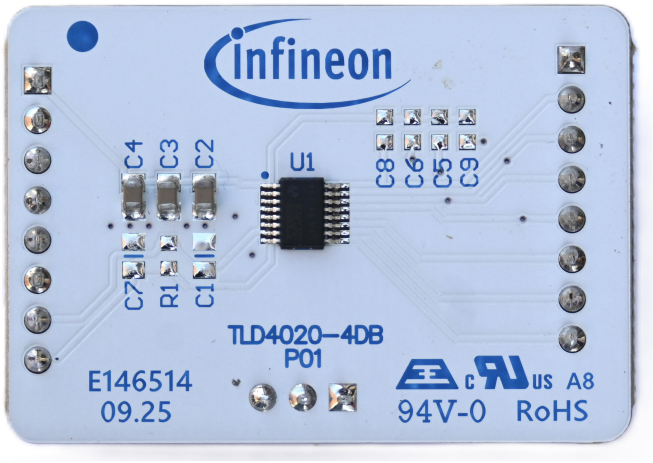


Figure 23 TLD4020-4DB - Top side view

5.2.2 Main features

- Pre-assembled LITIX™ TLD4020-4ET device

5.3 TLD4030-12DB

5.3.1 The board at a glance

The LITIX™ TLD4030-12ES is mounted on the TLD4030-12DB *DB*.

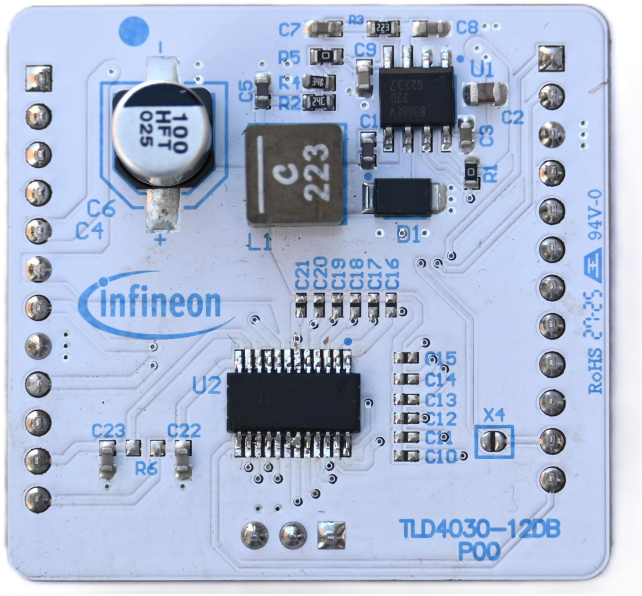


Figure 24 TLD4030-12DB - Top side view

A step-down converter is present on the board to supply the *LED* load and the VSL pin with a stable and controlled voltage reference. The *direct current to direct current (DC-DC)* output voltage is set at 5.3 V.

5.3.2 Main features

- Pre-assembled LITIX™ TLD4030-12ES device
- On-board step-down *DC-DC* converter, based on OPTIREG™ Switcher TLE8366EV [5]
- DC-DC converter enable controllable from TLD4030-12ES device

5.3.3 DC-DC converter enable

It is possible to control the enable signal of the step-down converter from the GPIO1 of the TLD4030-12ES device.

In order to do so, the X4 solder jumper needs to be closed, while the R1 resistor (soldered by default assembly) must be removed.

Attention*: *Removal of R1 resistor is strictly needed in order to avoid failures of the LED driver when X4 jumper is closed.

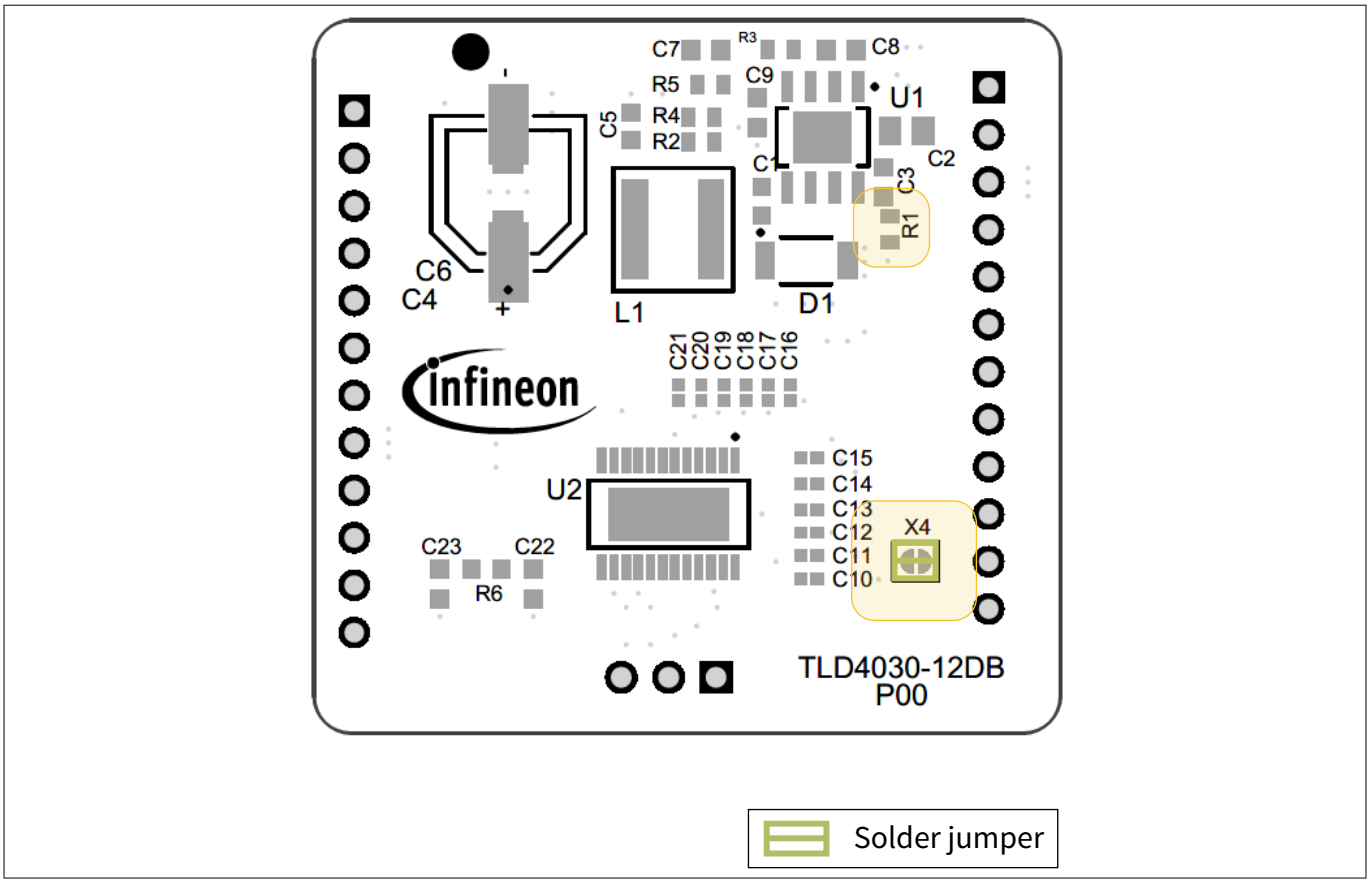


Figure 25 TLD4030-12DB - DC-DC converter enable setting

6 Load boards

In order to ensure a secure and functional connection between the main board and the load board, an orientation dot is present on both of them, similarly to what has been presented in the Daughterboards section.

6.1 TLD4020RGB_EVAL

This load board is equipped with a single RGB *LED*.



Figure 26 TLD4020RGB_EVAL - Top side view

6.2 TLD4020RGBW_EVAL

This load board is equipped with a single RGB *LED* and one Warm White LED. This last one can be disconnected by opening the solder jumper X4.

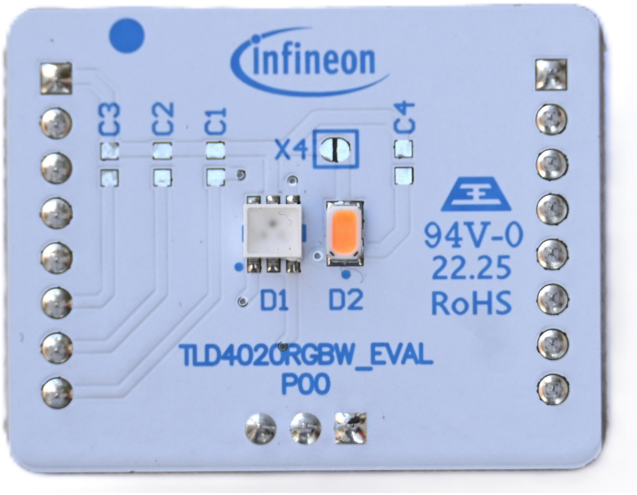


Figure 27 TLD4020RGBW_EVAL - Top side view

6.3 TLD4030RGB_EVAL

This load board is equipped with four RGB *LED*s.



Figure 28 TLD4030RGB_EVAL - Top side view

6.4 TLD4030HCRGB_EVAL

This load board is equipped with a single high current RGB *LED*.
D2, X4 and X5 are dedicated parts to enable/disable the power off-load feature of TLD4030-12ES.

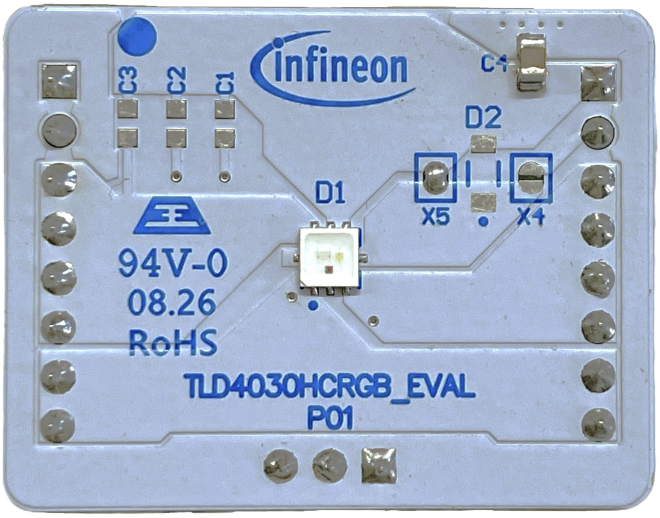


Figure 29 TLD4030HCRGB_EVAL - Top side view

Power off load feature

The Power off load feature allows for efficient management of power dissipation by shifting a portion of it to an external component, such as a diode or resistor, ensuring optimal thermal performance and enhancing the reliability of the LED driver in various applications, especially where PCB space is a constrain.
The feature is enabled through a proper setting of the X4 and X5 solder jumpers, and by adding an appropriate diode D2 (SOD123 package):

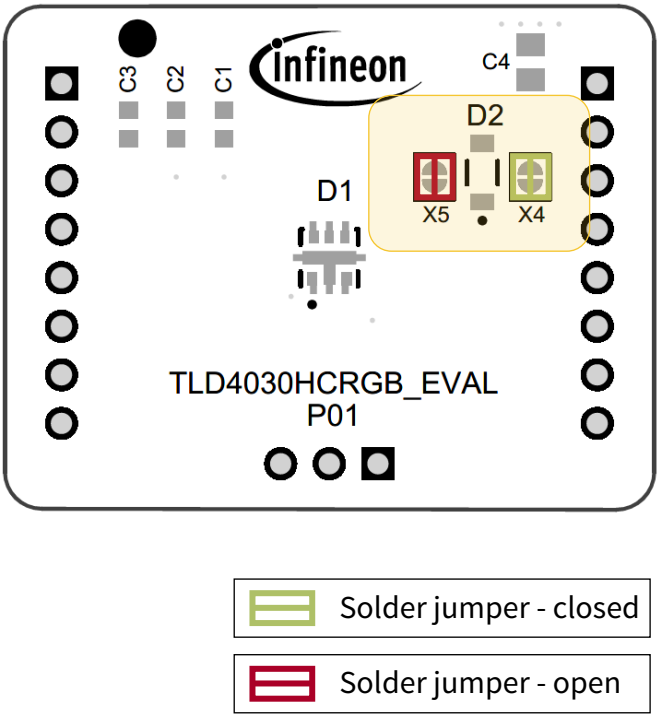


Figure 30 TLD4030HCRGB_EVAL - Power off load setting

For a detailed description of the *Power off load* feature, refer to the device *User manual* [2].

7 System design

7.1 TLD40X0STD_EVAL

7.1.1 Bill of material

Ref designator	Value	Manufacturer	Manufacturer P/N	Not fitted item
C1, C2, C3, C12, C13, C18, C19	100nF	AVX	08051C104JAT2A	
C4, C5	100pF	TDK Corporation	CGA3E2NP01H101J080AA	
C6, C7	–	–	–	Not Fitted
C10	10uF	Samsung	CL32B106KBJNNWE	
C16	1nF	TDK Corporation	CGA4F2X7R2A102M085AE	
CAGND1, CLDO1, CLDO3, CSHELL1, CVDDCX1, CVDDCX2, CVDDP6, CVDDPX1, CVDDPX2, CVDDPX3, CVDDPX4	100nF	TDK Corporation	CGA2B3X7R1H104K050BB	
CDXTAL1, CDXTAL2	12pF	MuRata	GCM1555C1H120JA16	
CLDO2, CLDO4, CVDDPX5	10uF	MuRata	GCM21BR71A106KE22	
CPORST1	10nF	TDK Corporation	CGA2B3X7R1H103K050BB	
CVDDCX3	4.7uF	MuRata	GCM21BR71C475KA73	
D1	PMEG4030EP	Nexperia	PMEG4030EP	
D2	Green LED	Vishay	TLMP1100-GS08	
D3, LEDCOM1	Red LED	Vishay	TLMS1100-GS08, TLMS1000-GS08	
D5	1N5819HW-7-F	Diodes Incorporated	1N5819HW-7-F	
DUSB1	BAT60A	Infineon Technologies	BAT60A	
G1	TLF80511EJ V50	Infineon Technologies	TLF80511EJ V50	

Ref designator	Value	Manufacturer	Manufacturer P/N	Not fitted item
IC1	XMC4200Q48K256ABXUMA1	Infineon Technologies	XMC4200Q48K256ABXUMA1	
IC2	TLS202B1MBV33	Infineon Technologies	TLS202B1MBV33	
IC3	SN74LVC2T45DCTT	Texas Instruments	SN74LVC2T45DCTT	
IC4, IC6	SN74LVC1T45DCKR	Texas Instruments	SN74LVC1T45DCKR	
LUSB1	60R	MuRata	BLM18PG600SN1D	
MP1, MP2, MP5, MP6	Spacer bolt M3/M3 20mm	Buerklin	18H376	
MP3, MP4, MP7, MP8	Spacer bolt M3/M3 10mm	Buerklin	18H372	
MP9, MP10, MP11, MP12, MP13, MP14, MP15, MP16, MP17, MP18, MP19, MP20	Screw M3 6mm	Multicomp	MP006555	
Q1	IRF7343TRPBF	Infineon Technologies	IRF7343TRPBF	
R1, R2, R3, R5, R7, R9, R12, R13, R14, R15, R16, R17	10k	Vishay	CRCW080510K0FK	
R4	20k	Vishay	CRCW080520K0FK	
R6	2.7k	Vishay	CRCW08052K70FK	
R8	10k	Bourns	PTV09A-4020U-B103	
R10	3.9k	Vishay	CRCW08053K90FK	
R11, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28, R29, R30	1k	Panasonic	ERJ-P06J102V	
R18	470R	TE Connectivity	CRGCQ0603F470R	
R31	0R	Vishay	CRCW06030000ZSTA	
RCOM1	680R	Yageo	AC0603FR-07680RL	
RPDLS1, RPDLS2, RPORST1, RUSB2	10k	Vishay	CRCW040210K0FK	

Ref designator	Value	Manufacturer	Manufacturer P/N	Not fitted item
RPULS1, RUSB1, RVDDP1, RVDDP2	4.7k	Vishay	CRCW04024K70FK	
RSHELL1	1.1M	Vishay	CRCW06031M10FK	
RUSBM1, RUSBP1	22R	Vishay	CRCW040222R0FK	
RXTAL1	150R	Vishay	CRCW0402150RFK	
S1, S2	Tactile Switch, 24V, 50mA	Omron	B3F-1020	
U2	TLE7259-3LE	Infineon Technologies	TLE7259-3LE	
U3	TPD2E1B06DRLR	Texas Instruments	TPD2E1B06DRLR	
RX, TX, X1, X5, X6, X7, X13, X25, X26, X27, X57, X58, X59, X60, X61, X62, X63, X64, X65, X66, X68, X69	Test Point	Keystone Electronics Corp.	5001	
X2	Fuse 3A	Littelfuse	0154003.DR	
X3, X4, X8, X10, X17, X23, X28, X41, X42, X43	Solder Jumper 2 Pins	–	–	
X9	Banana socket Red	Deltron	571-0500	
X11, X16, X67	GND plug	Harwin	D3082-05	
X12	Banana socket Black	Deltron	571-0100	
X14	Banana socket Green	Deltron	571-0400	
X15, X19, X30, X31, X33, X34, X35, X36, X37, X47, X49, X50, X51, X52, X53, X54, X55, X56, X78	Header 2 pins	Samtec	TSW-102-08-G-S	
X18, X20	Header 12 pins	Samtec	TSW-112-07-L-S	
X21, X32	Socket 8 pins	Samtec	SSW-108-01-G-S	
X22	Banana socket Yellow	Deltron	571-0700	
X24, X79	TSW-103-07-L-S	Samtec	TSW-103-07-L-S	
X29	DC jack connector 5.5x2.1 mm	Tensility International Corp.	54-00129	
X38	Header 16 pins	Sullins	SBH11-PBPC-D08-ST-BK	

Ref designator	Value	Manufacturer	Manufacturer P/N	Not fitted item
X39, X40, X44, X45, X46, X70, X71, X72, X73, X74, X75, X76, X77, X80	Top Jumper Socket, 1A Rated Current	Harwin	M7583-05	
X48	Socket 3 pins	Samtec	SSW-103-01-G-S	
XDEB1	Micro Header 10 pin	Samtec	FTSH-105-01-L-DV-K	
XUSB1	Micro USB 2.0 Type B - Horizontal	Wurth Elektronik	629105150521	
Y1	Crystal 12 MHz	Kyocera	CX3225CA12000D0HSSCC	

7.1.2 PCB layout

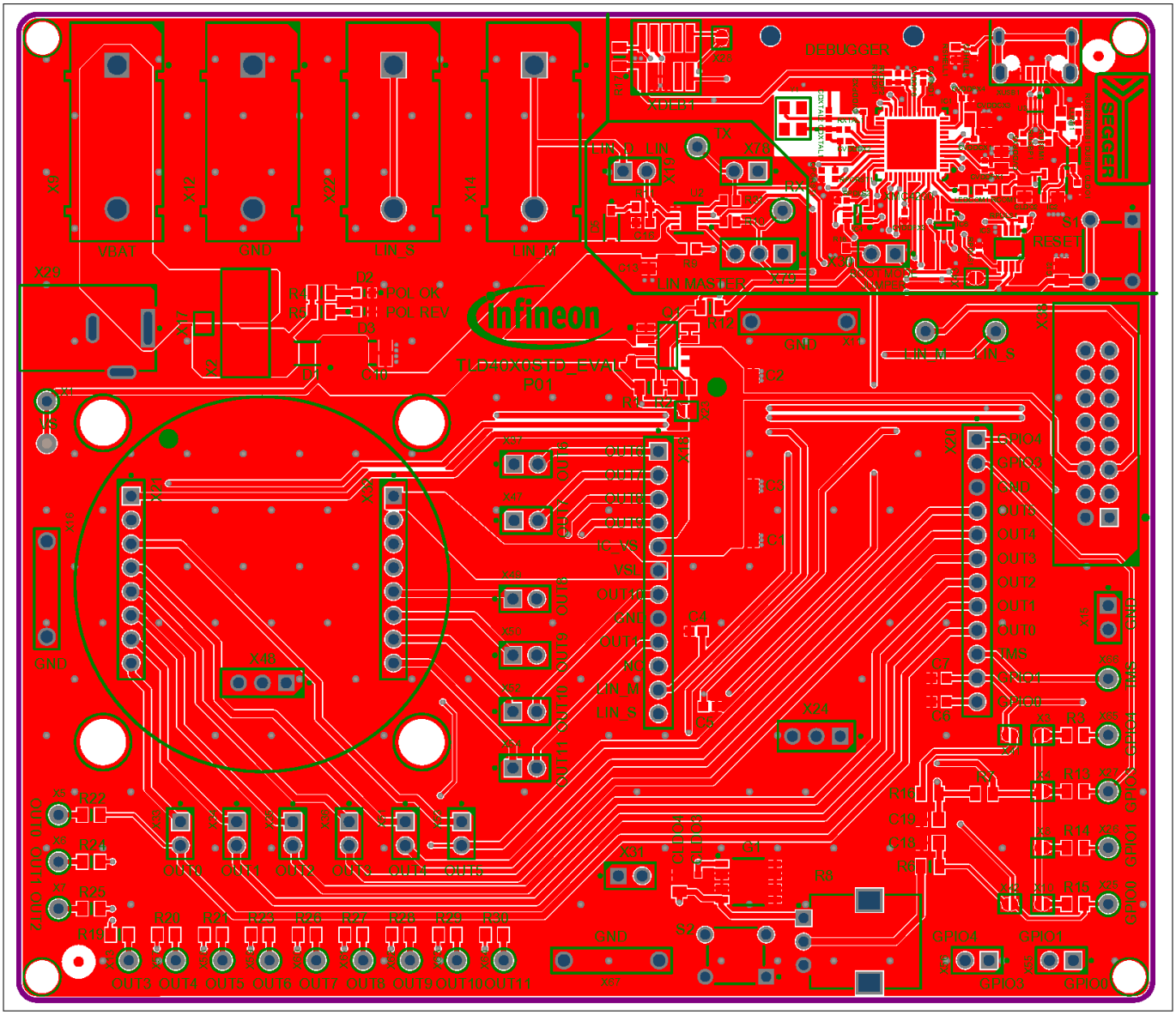


Figure 31 Top overlay

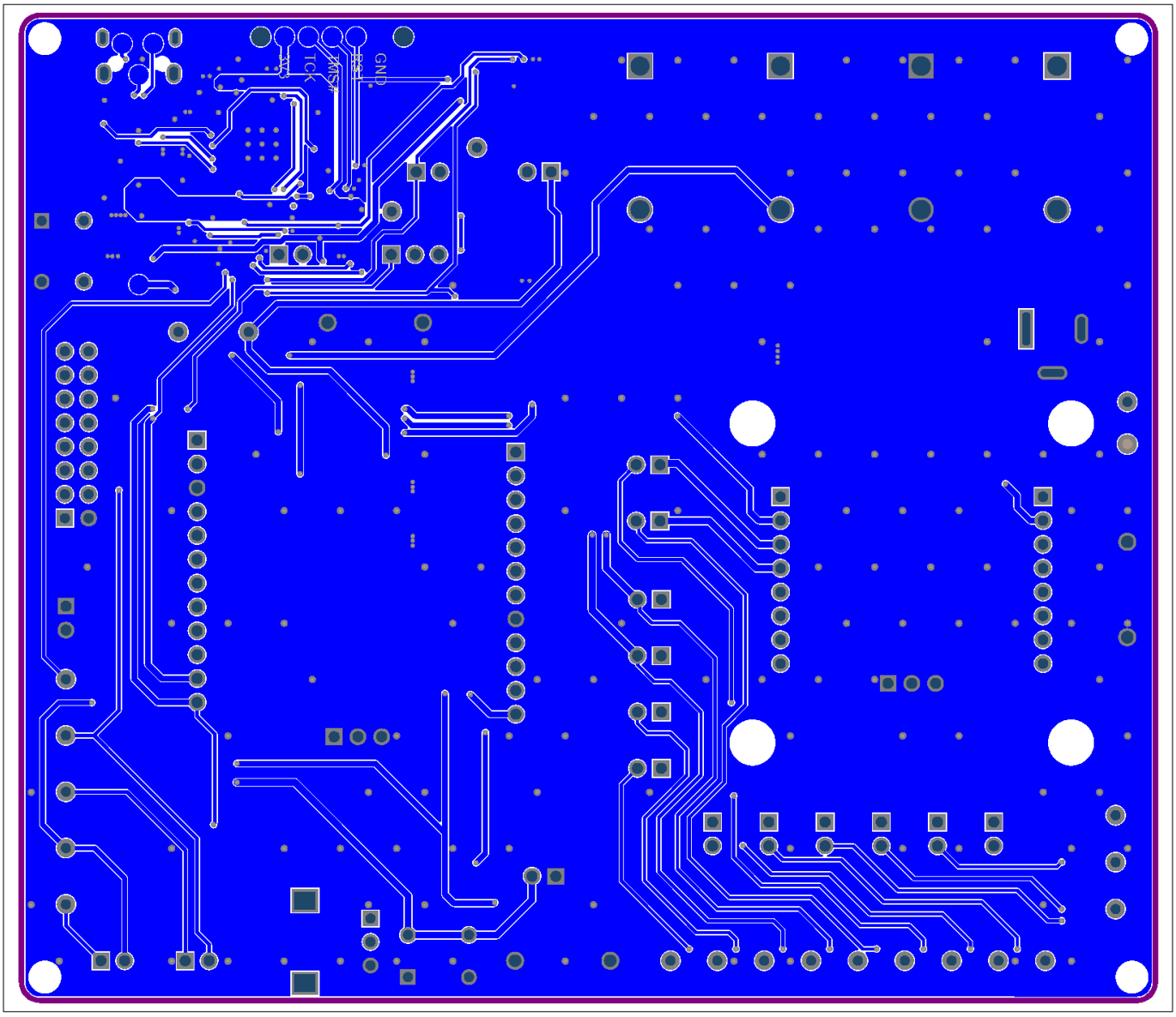


Figure 32 Bottom overlay

7.1.3 Schematics

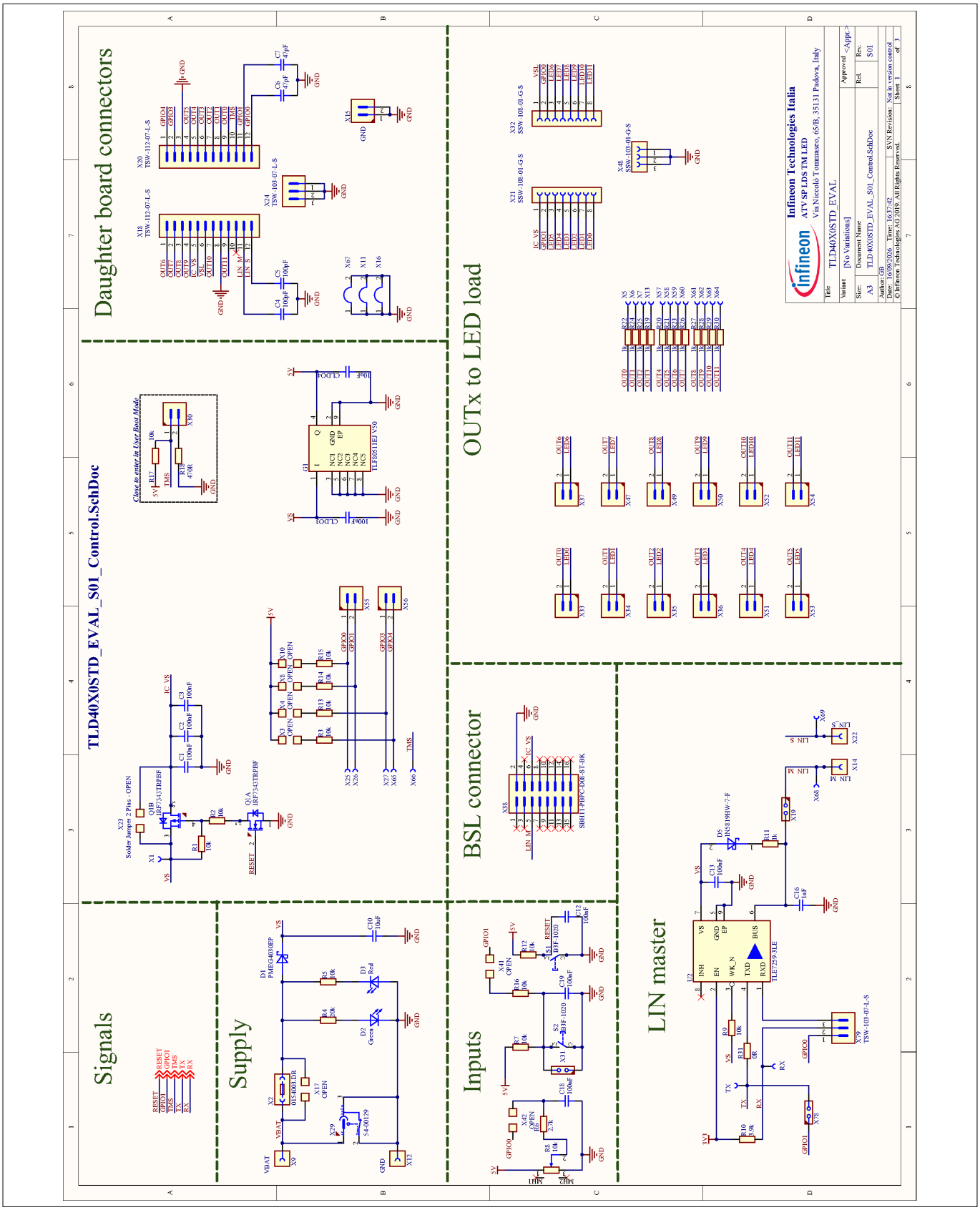


Figure 33 Control schematic

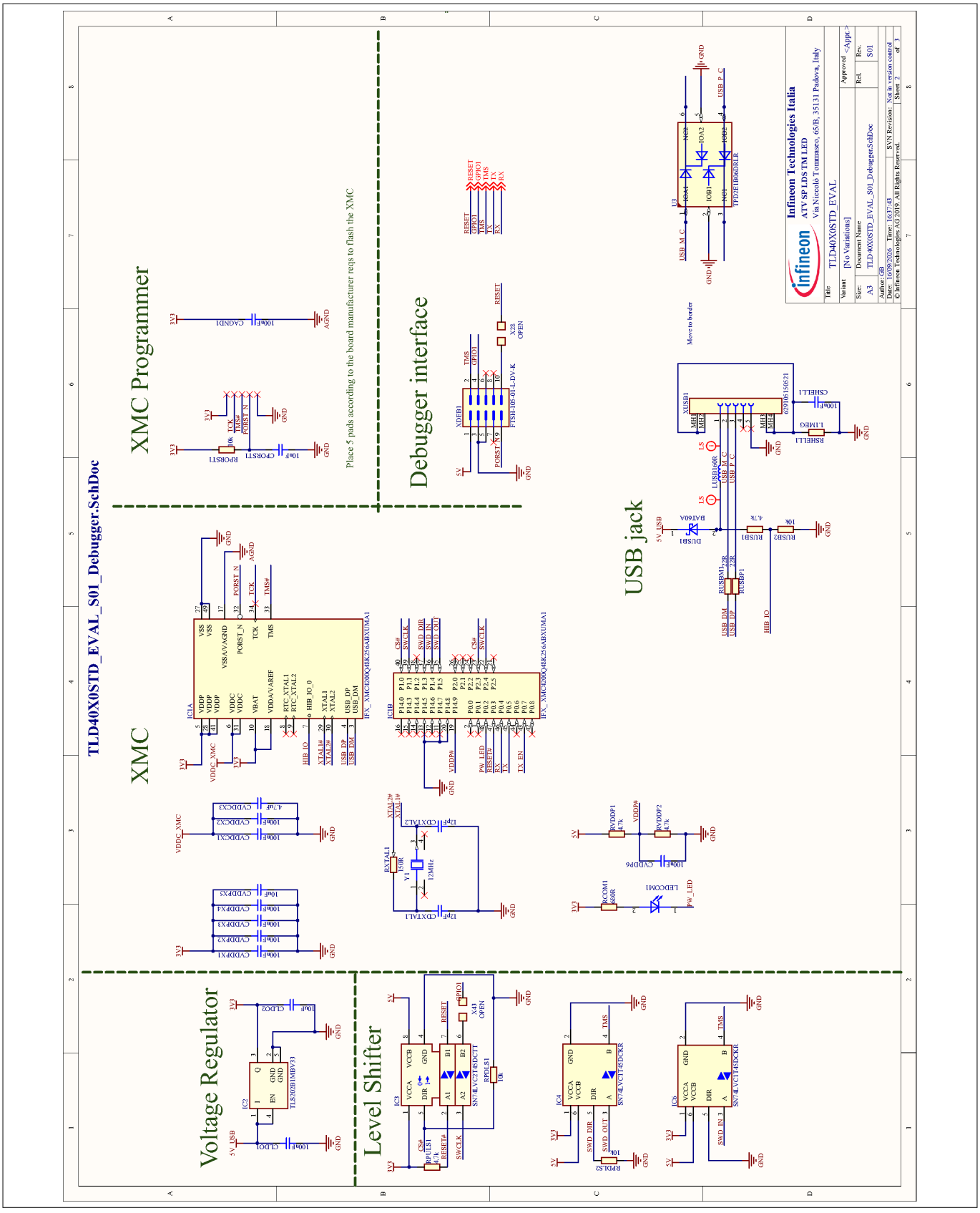


Figure 34 Debugger schematic

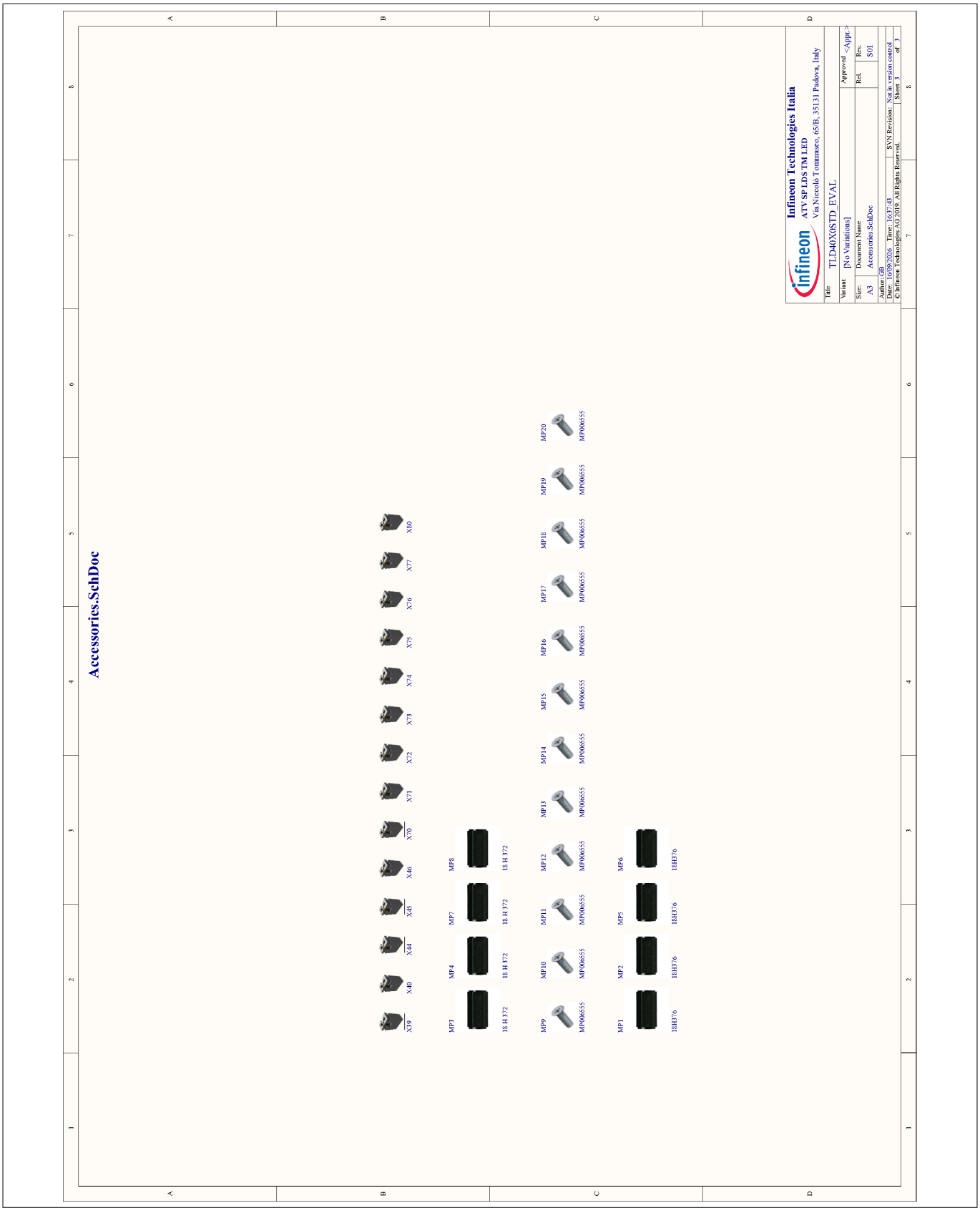


Figure 35 Accessories

7.2 Daughterboards

7.2.1 TLD4020-3DB

7.2.1.1 Bill of material

Ref designator	Value	Manufacturer	Manufacturer P/N	Not fitted item
C1, C7	100 pF	–	–	Not Fitted
C2, C3, C4	100 nF	AVX	08051C104JAT2A	
C5, C6, C8	10 nF	–	–	Not Fitted
R1	–	–	–	Not Fitted
U1	**TLD4020-3ET**	**Infineon Technologies**	**TLD4020-3ET**	
X1, X2	SSW-108-01-G-S	Samtec	SSW-108-01-G-S	
X3	SSW-103-01-G-S	Samtec	SSW-103-01-G-S	

7.2.1.2 PCB layout

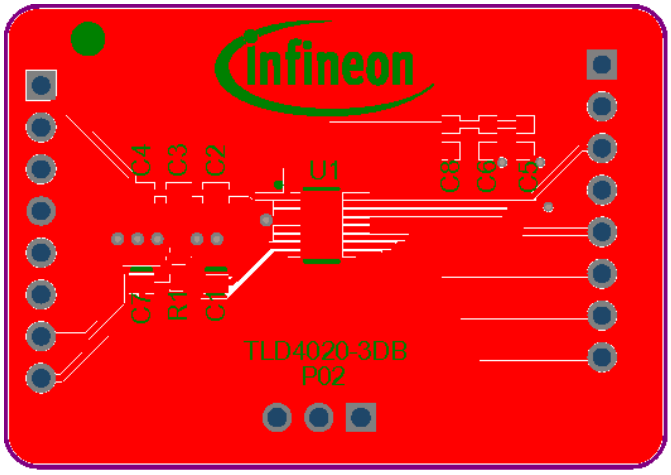


Figure 36 Top overlay

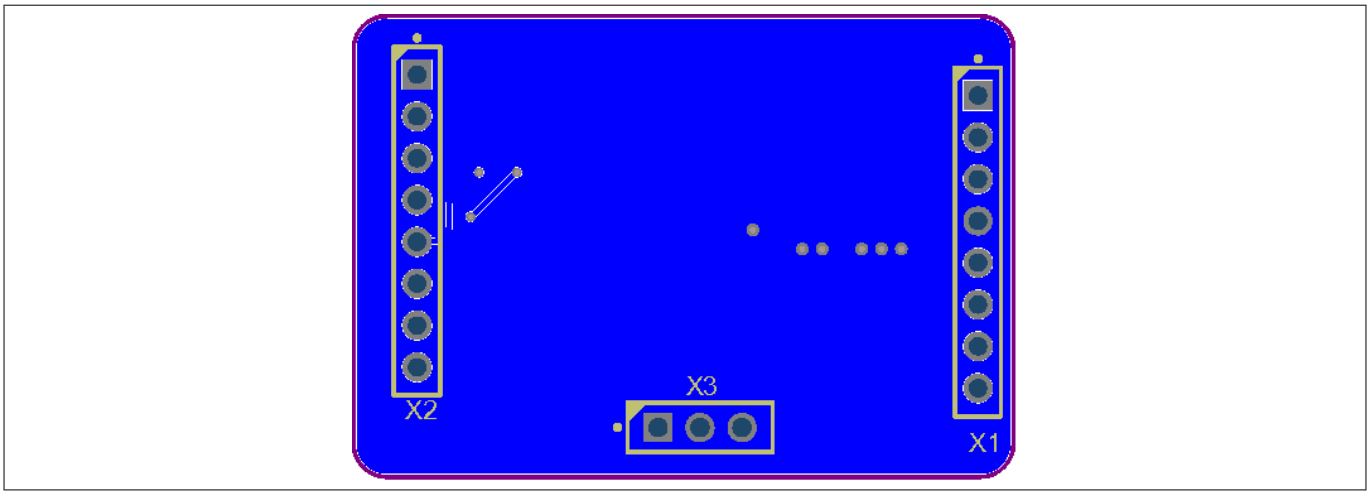


Figure 37 Bottom overlay

7.2.1.3 Schematics

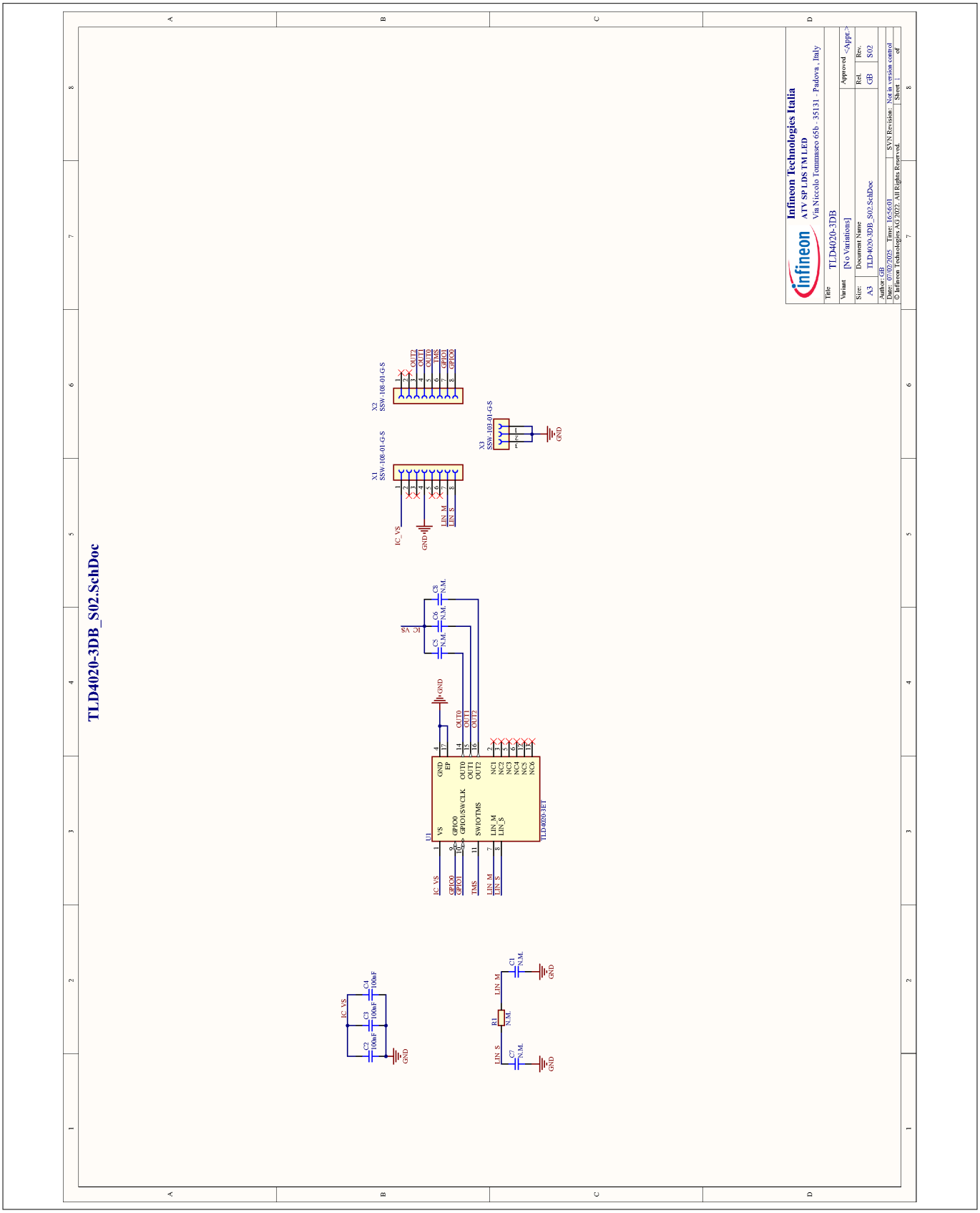


Figure 38 Schematic

7.2.2 TLD4020-4DB

7.2.2.1 Bill of material

Ref designator	Value	Manufacturer	Manufacturer P/N	Not fitted item
C1, C7	100 pF	–	–	Not Fitted
C2, C3, C4	100 nF	AVX	08051C104JAT2A	
C5, C6, C8, C9	10 nF	–	–	Not Fitted
R1	–	–	–	Not Fitted
U1	**TLD4020-4ET**	**Infineon Technologies**	**TLD4020-4ET**	
X1, X2	SSW-108-01-G-S	Samtec	SSW-108-01-G-S	
X3	SSW-103-01-G-S	Samtec	SSW-103-01-G-S	

7.2.2.2 PCB layout

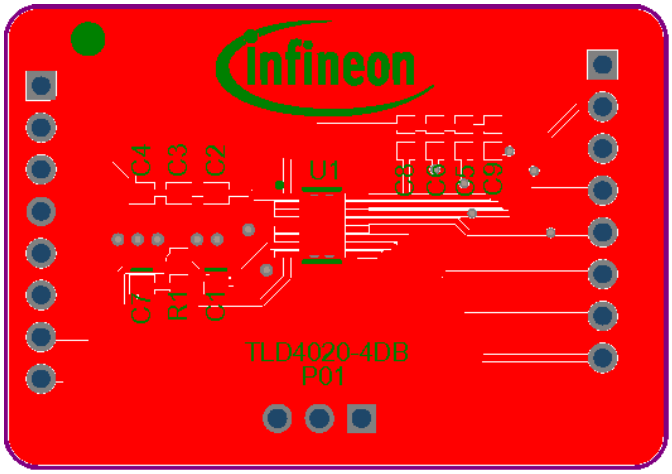


Figure 39 Top overlay

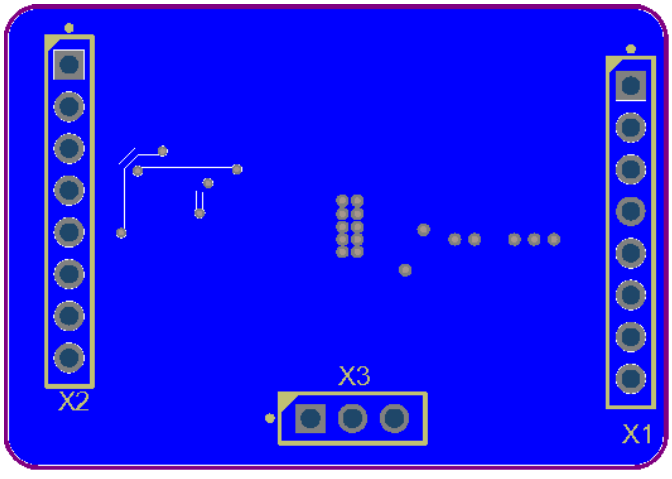


Figure 40 Bottom overlay

7.2.2.3 Schematics

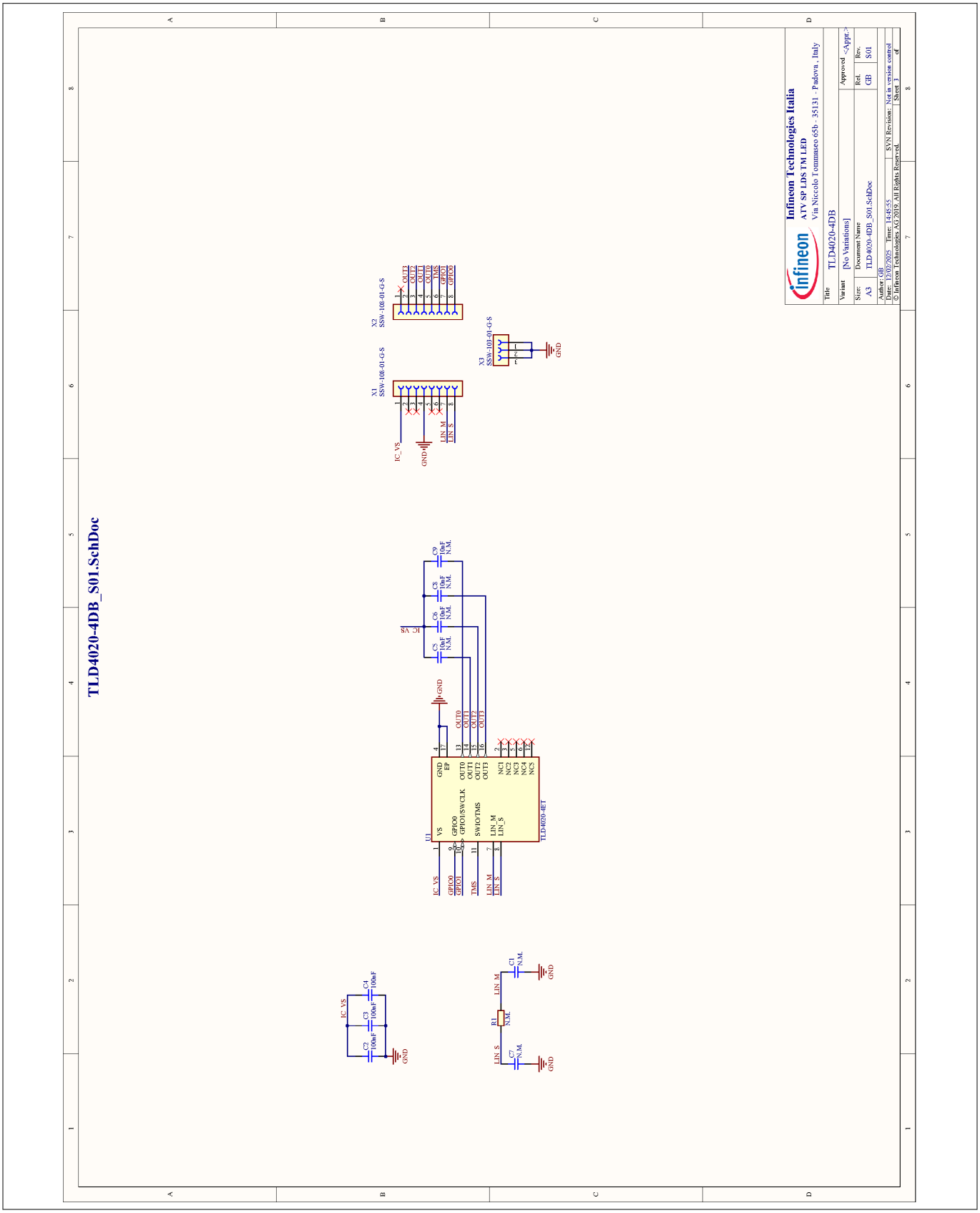


Figure 41 Schematic

7.2.3 TLD4030-12DB

7.2.3.1 Bill of material

Ref designator	Value	Manufacturer	Manufacturer P/N	Not fitted item
C1, C5	220 nF	Murata	GCM188R71H224KA64D	
C2	2.2 uF	TDK	CGA4J3X7R1H225K125AB	
C3	100 nF	Murata	GCM188L81H104KA57	
C4	100 uF	–	–	Not Fitted
C6	100 uF	Panasonic	EEE-FTH101XAP	
C7	22 nF	Kyocera AVX	06035C223K4T4A	
C8	100 pF	Murata	GCM1885C1H101FA16	
C9	1 nF	Murata	GCM1885C1H102FA16	
C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21	–	–	–	Not Fitted
C22, C23	100 pF	–	–	Not Fitted
D1	Schottky Barrier Rectifier 3 A/40 V	Nexperia	PMEG4030EP	
L1	22 uH / 3.6 A	Coilcraft	XAL6060-223ME	
R1, R5	0R	Vishay	CRCW06030000Z0EB	
R2	17.4 k	Vishay	CRCW060317K4FK	
R3	22 k	Vishay	CRCW060322K0FK	
R4	2.21 k	Vishay	CRCW06032K21FK	
R6	–	–	–	Not Fitted
U1	**TLE8366EV**	**Infineon Technologies**	**TLE8366EV**	
U2	**TLD4030-12ES**	**Infineon Technologies**	**TLD4030-12ES**	
X1, X2	SSW-112-01-G-S	Samtec	SSW-112-01-G-S	
X3	SSW-103-01-G-S	Samtec	SSW-103-01-G-S	
X4	Solder Jumper 2 Pins	–	–	

7.2.3.2 PCB layout

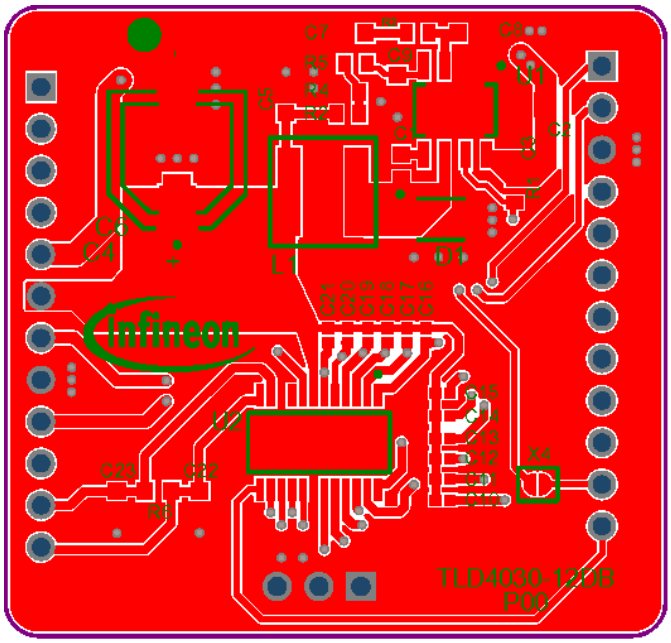


Figure 42 Top overlay

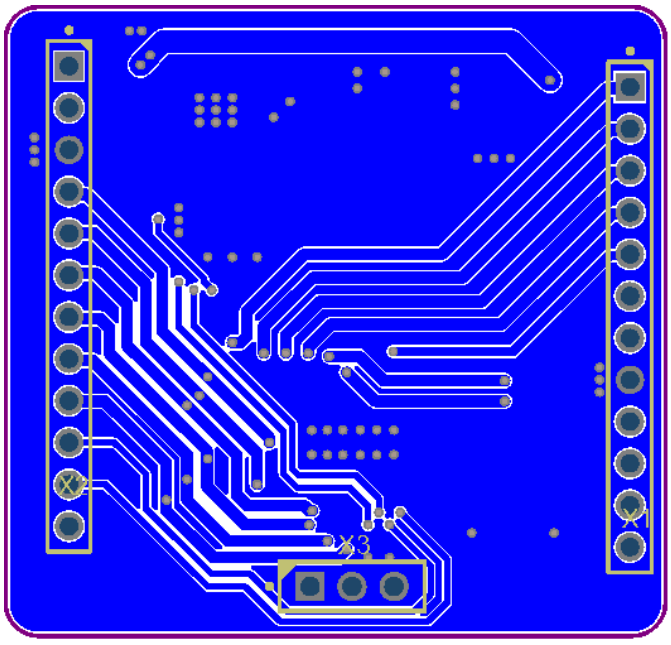


Figure 43 Bottom overlay

7.2.3.3 Schematics

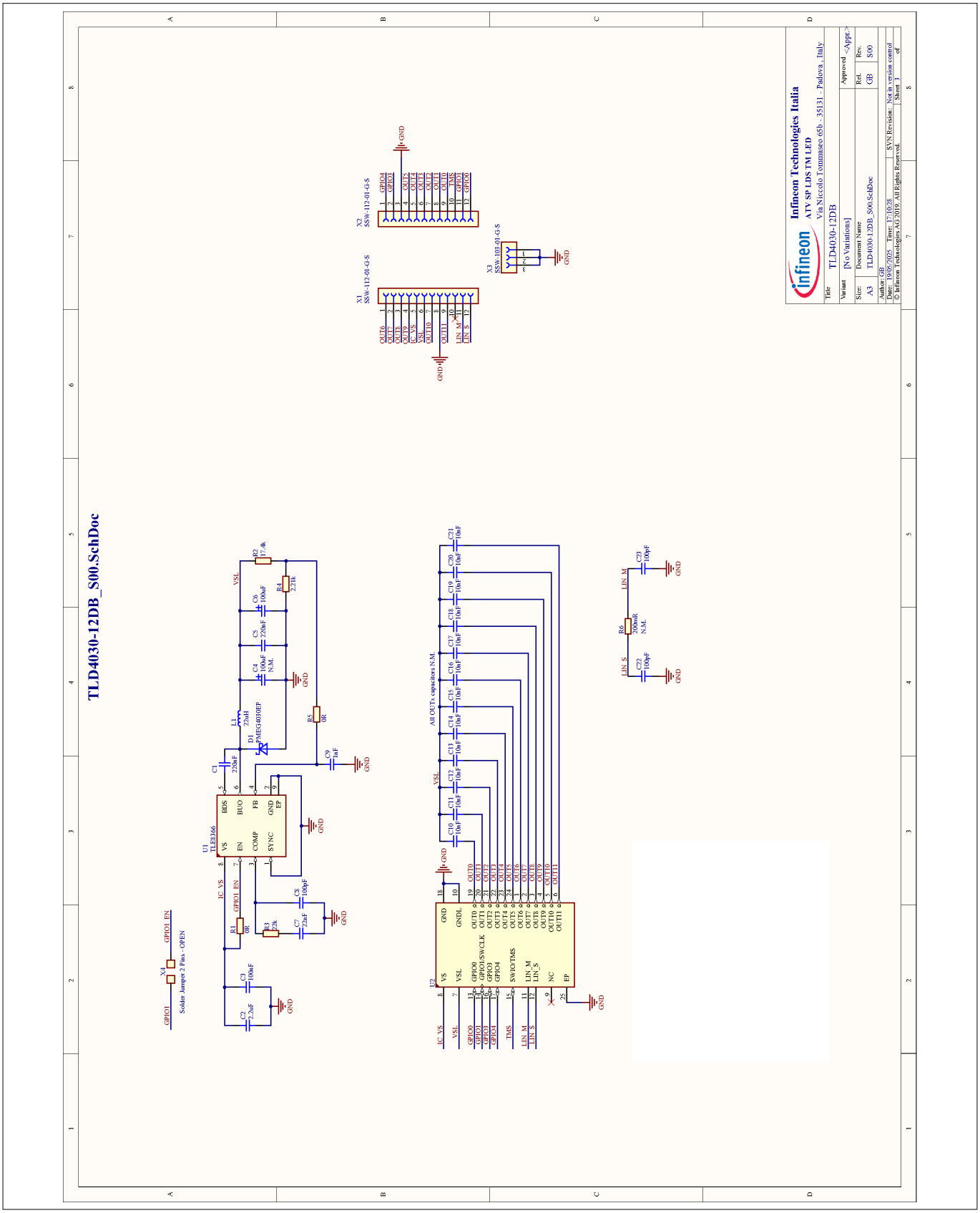


Figure 44 Schematic

7.3 Load boards

7.3.1 TLD4020RGB_EVAL

7.3.1.1 Bill of material

Ref designator	Value	Manufacturer	Manufacturer P/N	Not fitted item
C1, C2, C3	10 nF	–	–	Not Fitted
D1	RGB LED	NICHIA CORPORATION	NSSM313AT	
X1, X2	TSW-108-07-L-S	Samtec	TSW-108-07-L-S	
X3	TSW-103-07-L-S	Samtec	TSW-103-07-L-S	

7.3.1.2 PCB layout

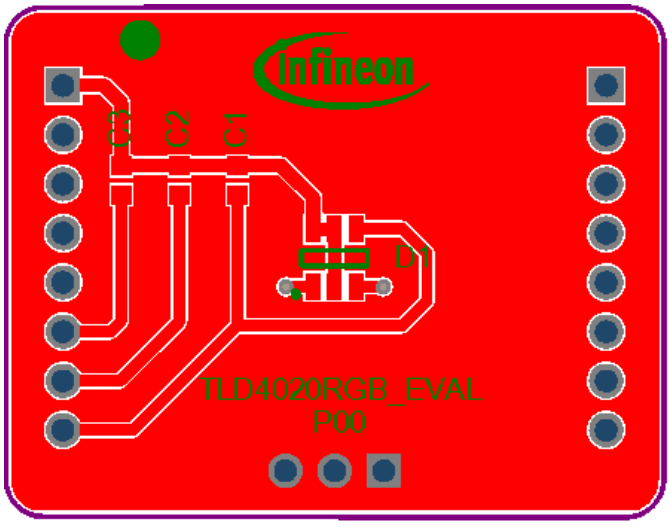


Figure 45 Top overlay

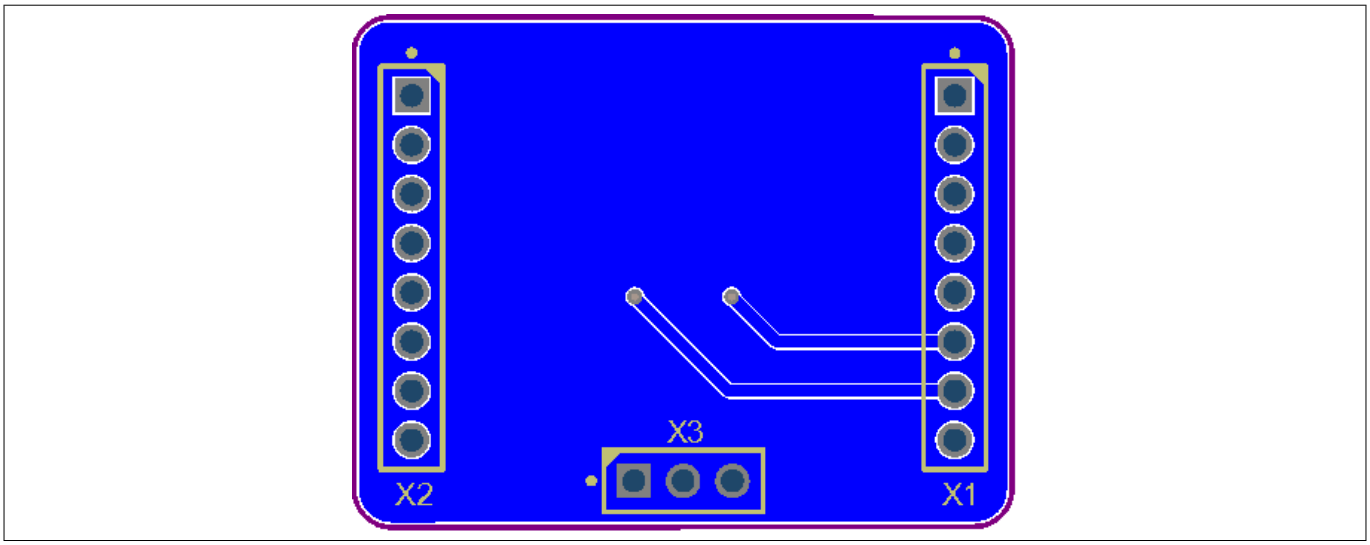


Figure 46 Bottom overlay

7.3.1.3 Schematics

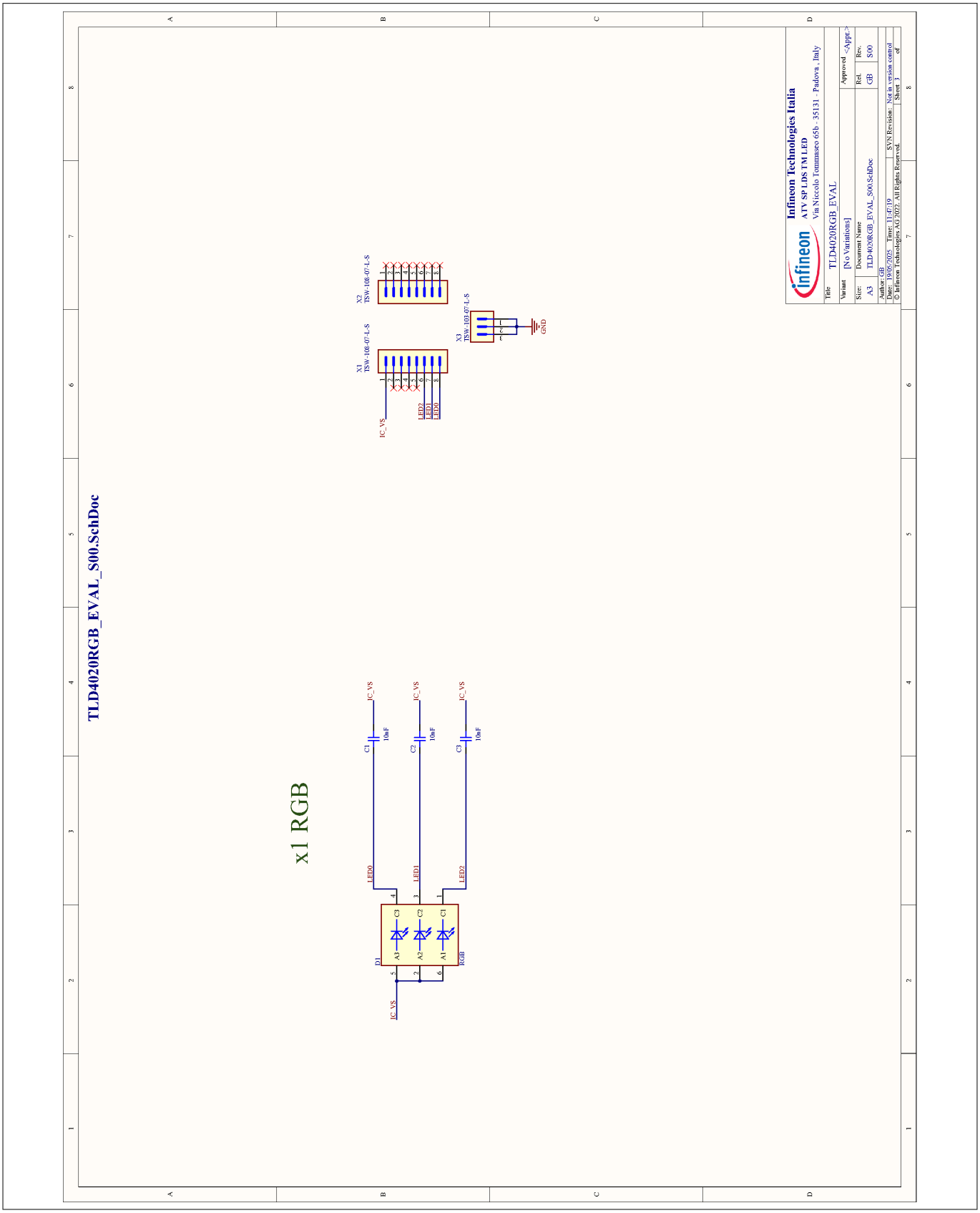


Figure 47 Schematic

7.3.2 TLD4020RGBW_EVAL

7.3.2.1 Bill of material

Ref designator	Value	Manufacturer	Manufacturer P/N	Not fitted item
C1, C2, C3, C4	10 nF	–	–	Not Fitted
D1	RGB LED	NICHIA CORPORATION	NSSM313AT	
D2	Warm White LED	NICHIA CORPORATION	NFSW123FT	
X1, X2	TSW-108-07-L-S	Samtec	TSW-108-07-L-S	
X3	TSW-103-07-L-S	Samtec	TSW-103-07-L-S	
X4	Solder Jumper 2 Pins	–	–	

7.3.2.2 PCB layout

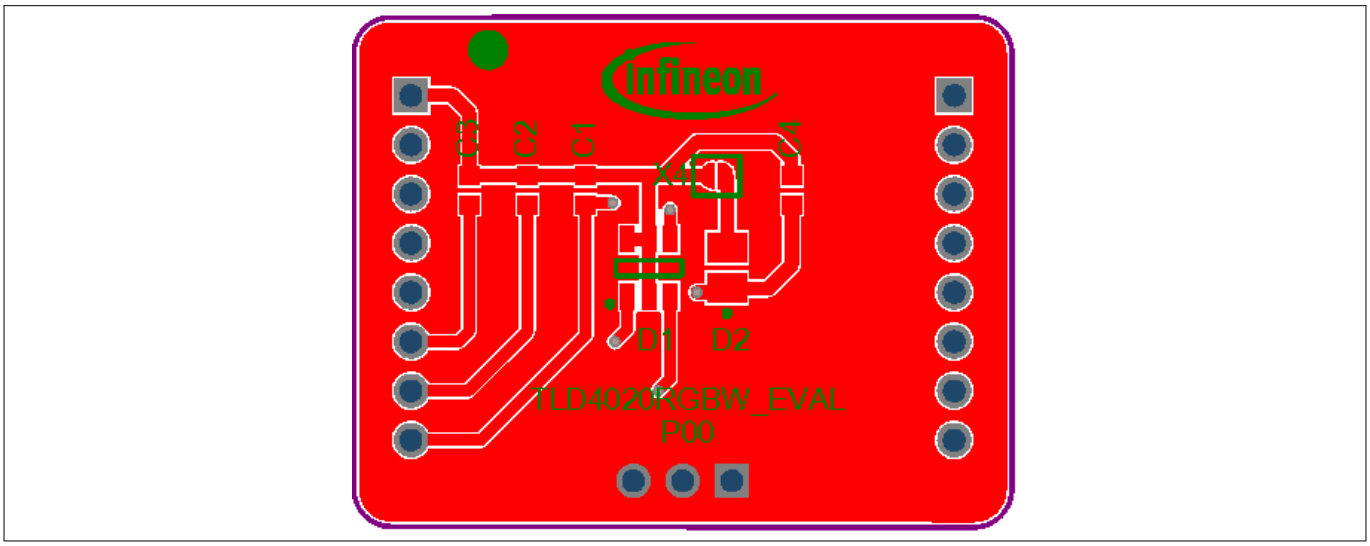


Figure 48 Top overlay

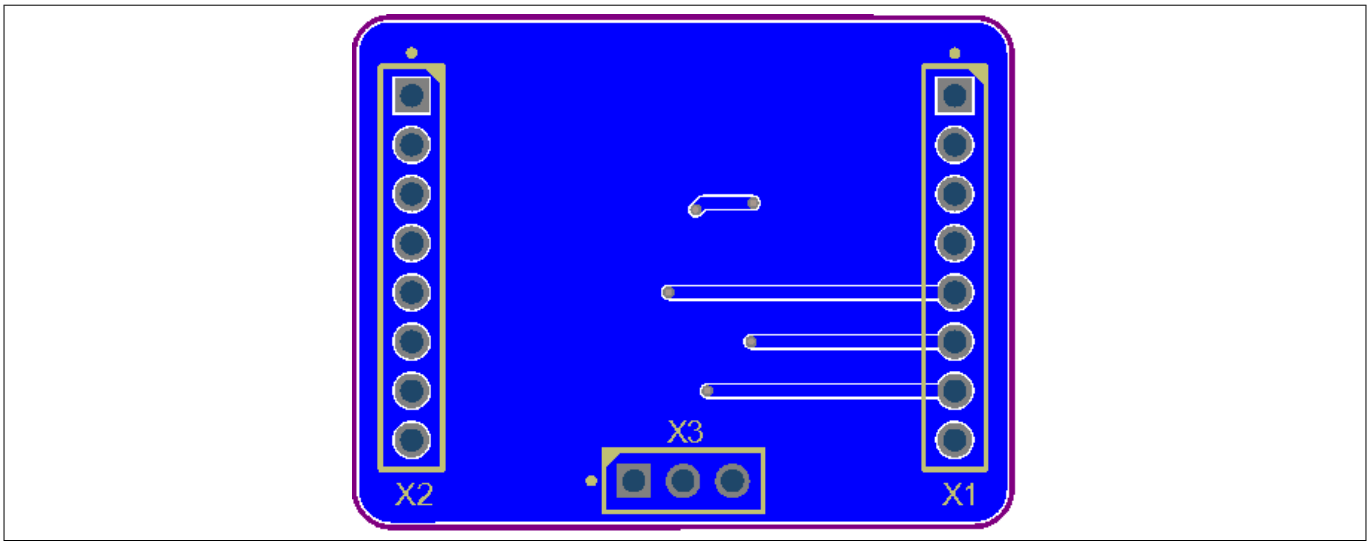


Figure 49 Bottom overlay

7.3.2.3 Schematics

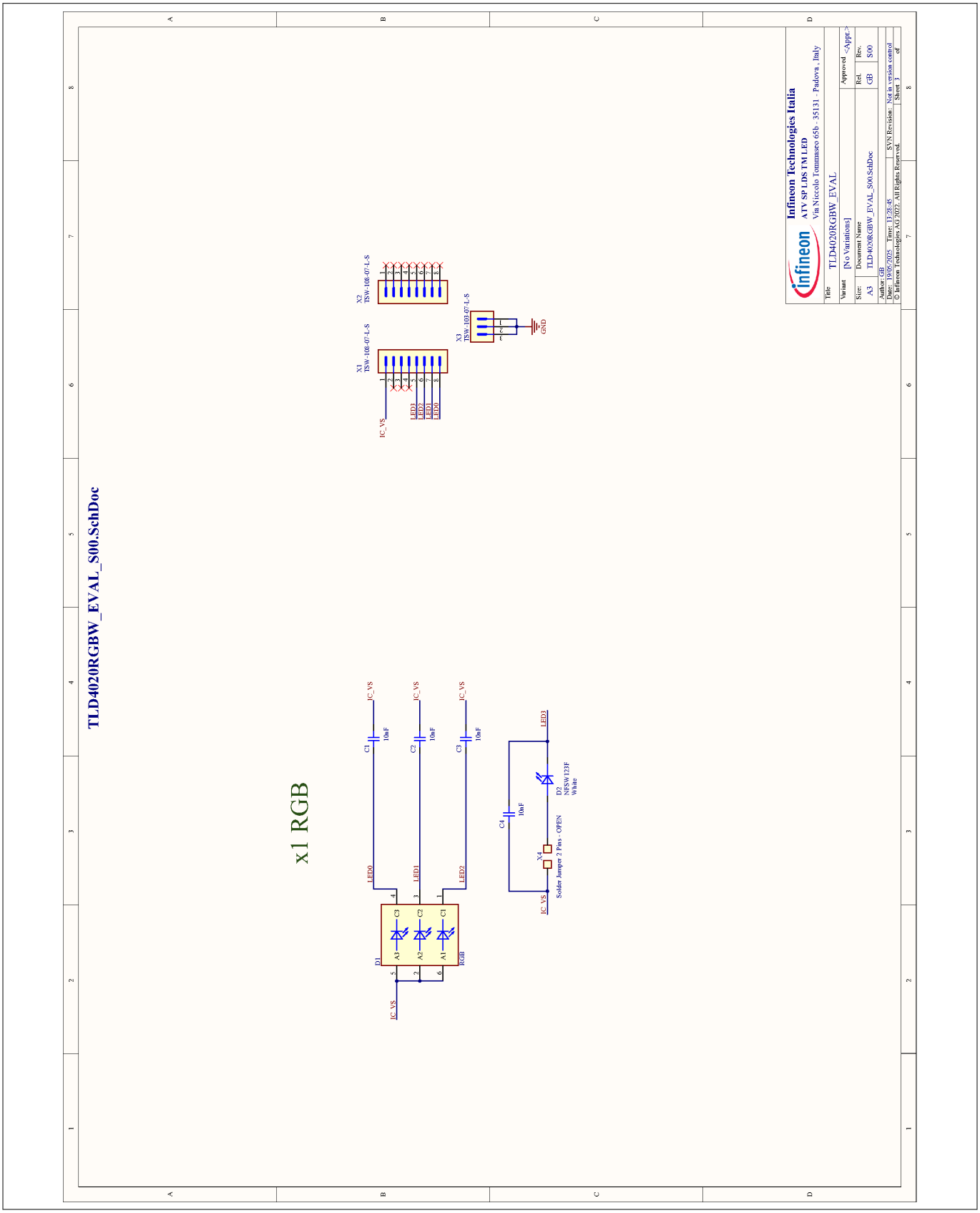


Figure 50 Schematic

7.3.3 TLD4030RGB_EVAL

7.3.3.1 Bill of material

Ref designator	Value	Manufacturer	Manufacturer P/N	Not fitted item
C1	2.2 uF	TDK Corporation	CGA4J3X7R1H225K125AB	
D1, D2, D3, D4	RGB LED	NICHIA CORPORATION	NSSM313AT	
X1, X2	TSW-108-07-L-S	Samtec	TSW-108-07-L-S	
X3	TSW-103-07-L-S	Samtec	TSW-103-07-L-S	

7.3.3.2 PCB layout

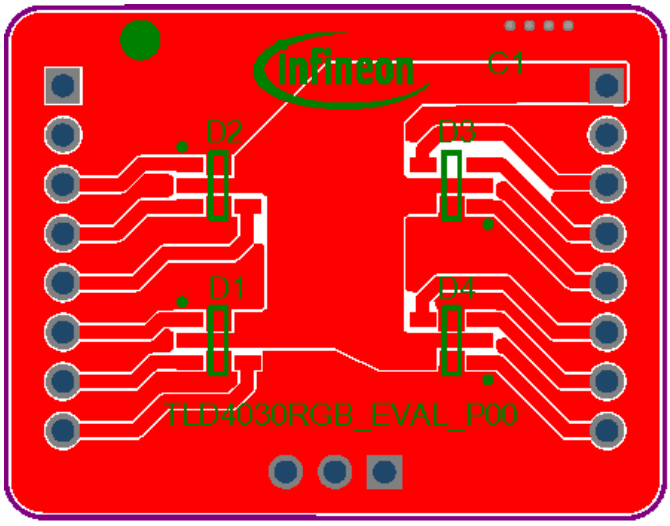


Figure 51 Top overlay

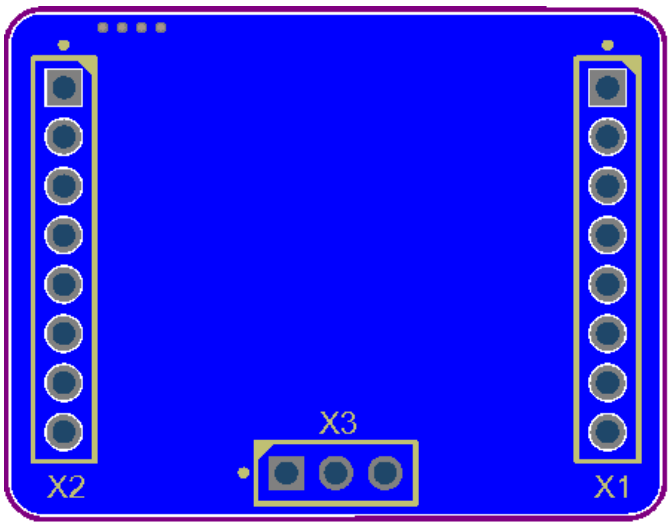


Figure 52 Bottom overlay

7.3.3.3 Schematics

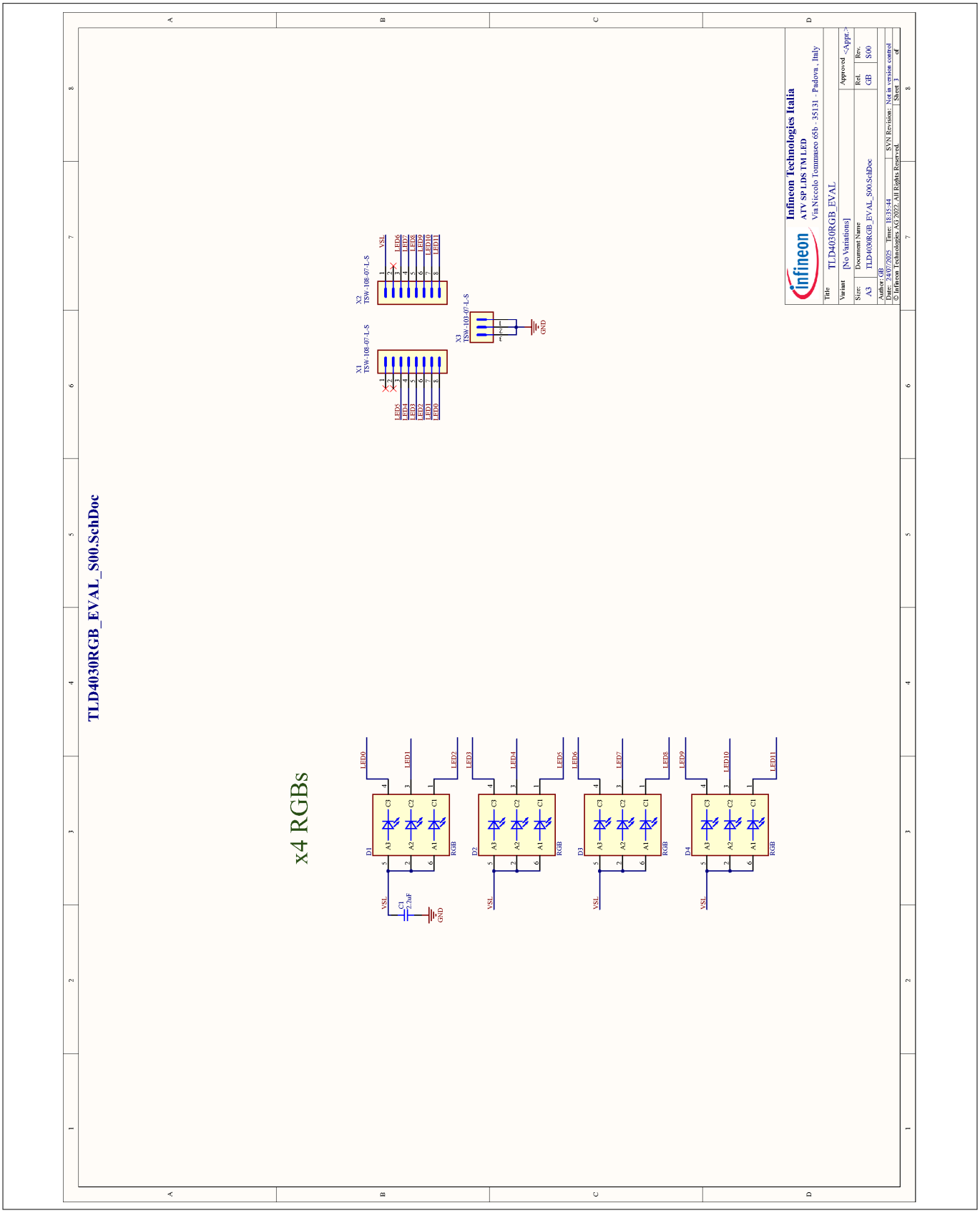


Figure 53 Schematic

7.3.4 TLD4030HCRGB_EVAL

7.3.4.1 Bill of material

Ref designator	Value	Manufacturer	Manufacturer P/N	Not fitted item
C1, C2, C3	10 nF	–	–	Not Fitted
C4	2.2 uF	TDK Corporation	CGA4J3X7R1H225K125AB	
D1	RGB LED	Ams Osram	KRTB DSLP31.33	
D2	Diode SOD-123	–	–	Not Fitted
X1, X2	TSW-108-07-L-S	Samtec	TSW-108-07-L-S	
X3	TSW-103-07-L-S	Samtec	TSW-103-07-L-S	
X4, X5	Solder Jumper 2 Pins	–	–	

7.3.4.2 PCB layout

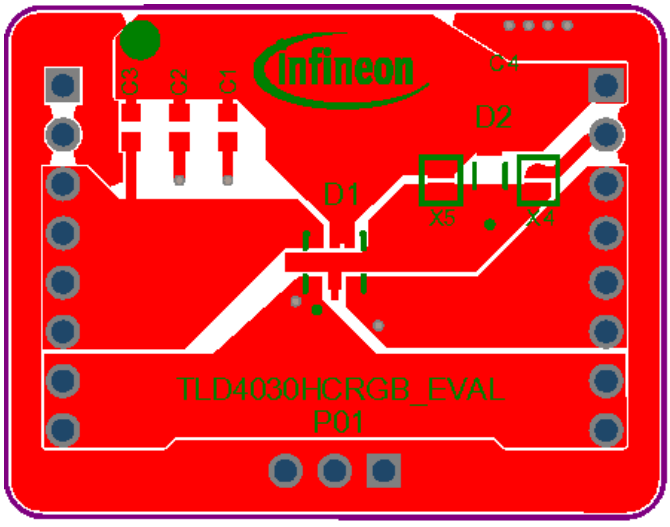


Figure 54 Top overlay

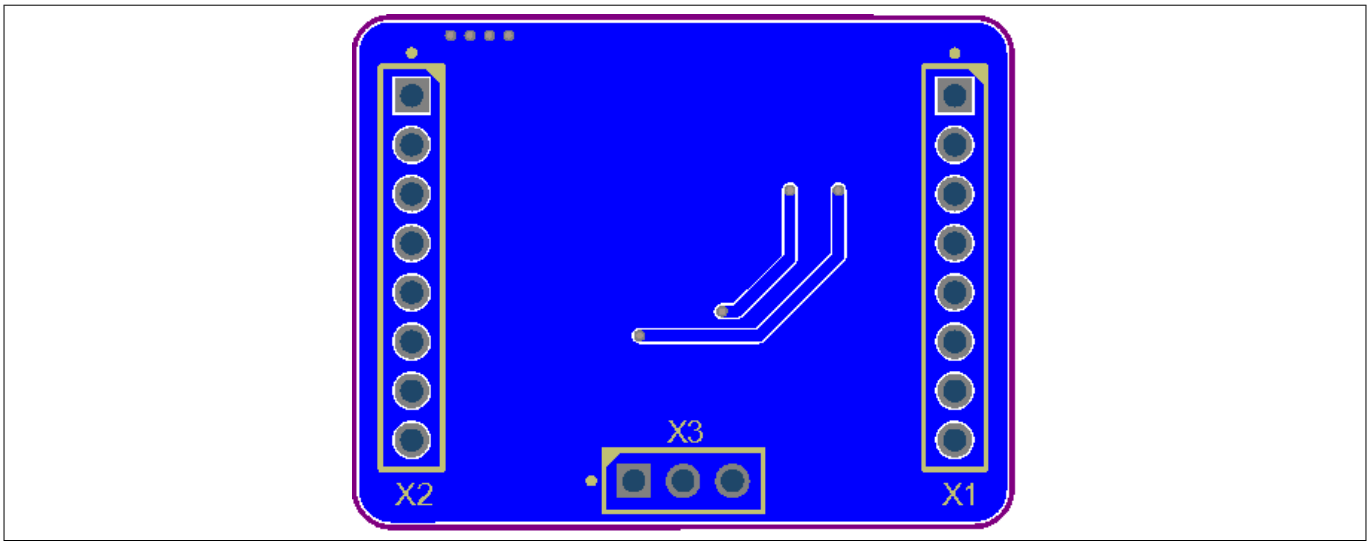


Figure 55 Bottom overlay

7.3.4.3 Schematics

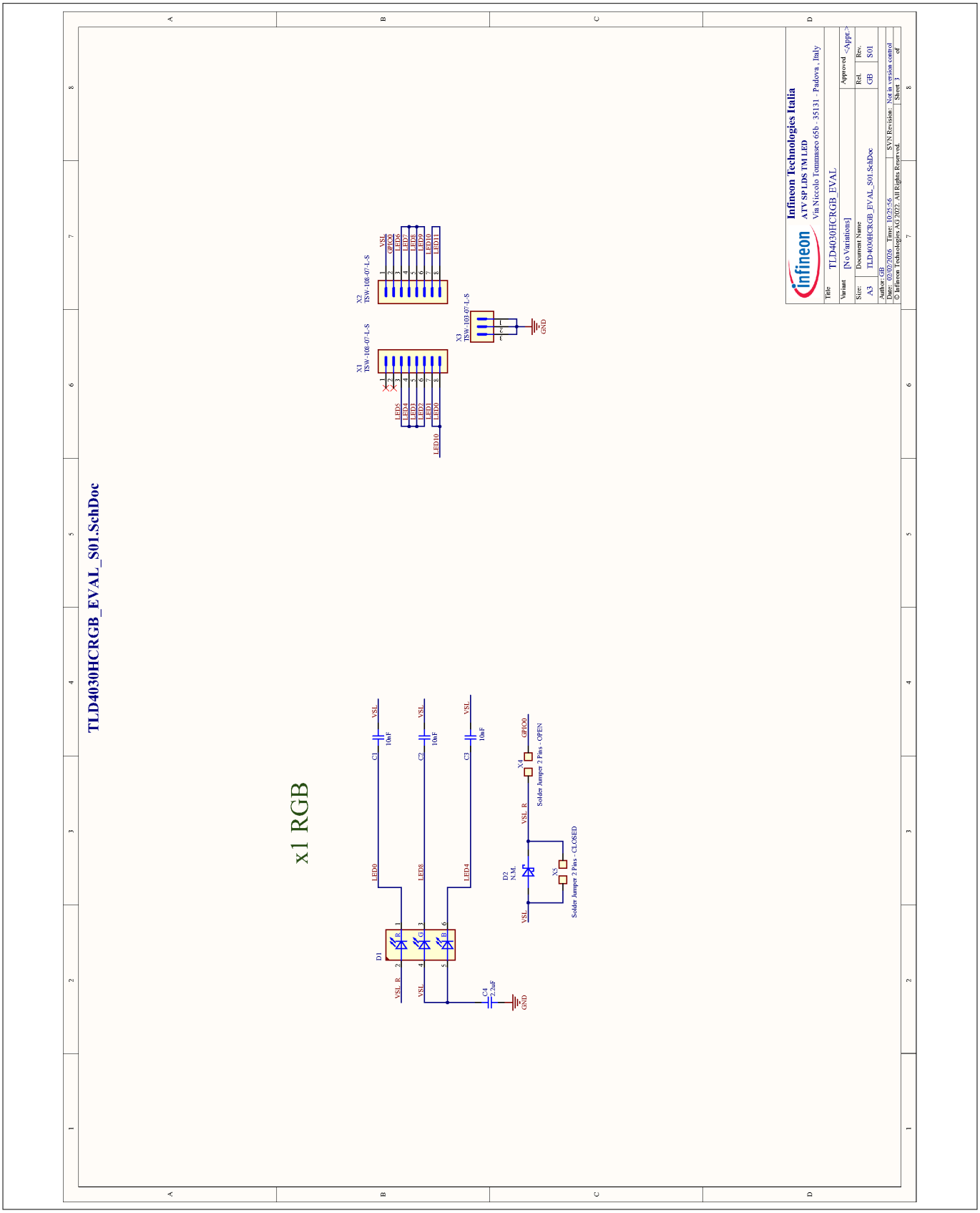


Figure 56 Schematic

8 Accessories

A list of accessories is provided with the TLD40X0STD_EVAL:

- x4 spacer bolts M3/M3 10 mm, which are dedicated to the mechanical support of the TLD40X0STD_EVAL board
- x4 spacer bolts M3/M3 20 mm, which are dedicated mounting spacers for the *LED* load shield (see below)
- x14 top jumper sockets, 1 A rated current
- x12 screws M3 6 mm

Accessories are also depicted in the TLD40X0STD_EVAL Schematics, in the chapter Figure 35.

In addition to the mechanical parts, a square FR4 *PCB* shield TLD40X0LLS_EVAL is provided to be placed over the LED load boards, serving as an eye protector.

The following figure displays the correct installation of the shield.

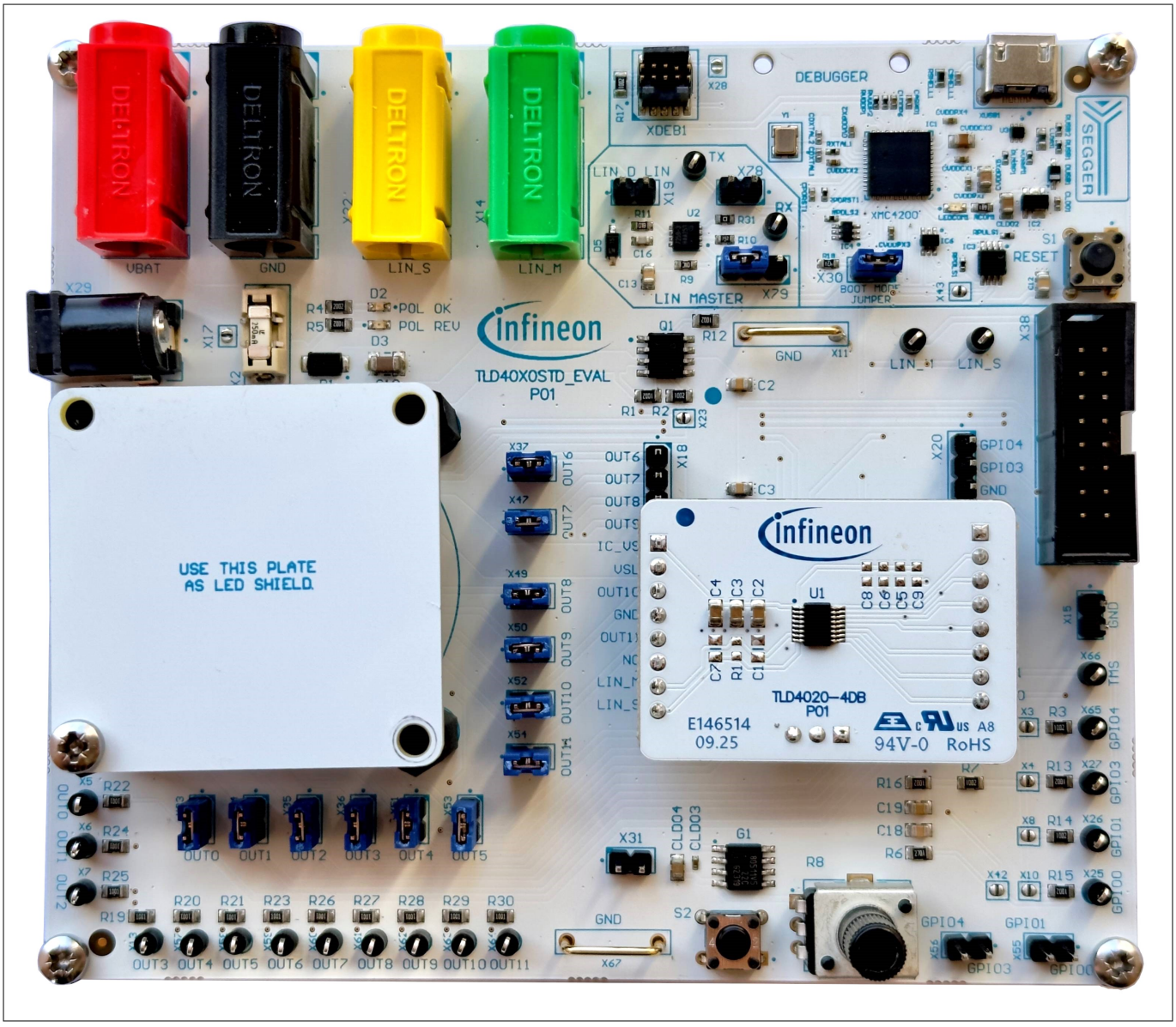


Figure 57 TLD40X0STD_EVAL - TLD40X0LLS_EVAL Shield installation

References

[1] Infineon: *TLD4020-3ET/TLD4020-4ET/TLD4030-12ES Datasheet*. Downloadable from the product's webpage. See https://www.infineon.com/products/power/led-driver-ics/litix-automotive/litix-interior or get in contact with your IFX representative if not available

[2] Infineon: *TLD4020-3ET/TLD4020-4ET/TLD4030-12ES User manual*. Downloadable from the product's webpage (see point 1)

[3] Infineon: *TLD4020-3ET/TLD4020-4ET/TLD4030-12ES Firmware user manual*. Downloadable from the product's webpage (see point 1)

[4] Infineon: *Infineon uIO Stick v2*; https://www.infineon.com/cms/en/product/evaluation-boards/uio-stick-v2/

[5] Infineon: *TLE8366EV*; https://www.infineon.com/part/TLE8366EV

[6] Infineon: *TLE7259-3LE*; https://www.infineon.com/part/TLE7259-3LE

[7] Infineon: *Infineon Developer Center*; https://softwaretools.infineon.com/home

[8] SEGGER Microcontroller GmbH *SEGGER J-Link*; https://www.segger.com/downloads/jlink/

[9] SEGGER Microcontroller GmbH *9-Pin Cortex-M Adapter*; https://www.segger.com/products/debug-probes/j-link/accessories/adapters/9-pin-cortex-m-adapter/

[10] Arm KEIL *Keil µVision*; https://www.keil.com/download/product/

[11] IAR Systems *IAR Embedded Workbench*; https://www.iar.com/products/architectures/arm/iar-embedded-workbench-for-arm/

Glossary

bootROM

boot code in ROM (bootROM)

The location of boot code.

BSL

bootstrap loader (BSL)

A small program or routine that is responsible for initializing the system and loading the main operating system or application into the memory of the target device during the system boot-up process.

DB

daughterboard (DB)

An expansion circuit card connected to a motherboard.

DC-DC

direct current to direct current (DC-DC)

GPIO

general purpose input output (GPIO)

IC

integrated circuit (IC)

A miniature electronic circuit built on the surface of a thin substrate of a semiconductor material.

LED

light-emitting diode (LED)

A semiconductor circuit that emits light when activated.

LIN

local interconnect network (LIN)

PCB

printed circuit board (PCB)

A board that mechanically supports and electrically connects electronic components using conductive tracks, pads, and other features etched from copper sheets laminated onto a non-conductive substrate.

SWD

serial wire debug (SWD)

A communication interface and protocol used for debugging and programming embedded systems, particularly microcontrollers and other integrated circuits.

UART

universal asynchronous receiver transmitter (UART)

A peripheral device or module for asynchronous serial communication in which the data format and transmission speeds are configurable.

uIO-Stick

uIO-Stick

An interface device for controlling Infineon boards or kits during runtime.

USB

universal serial bus (USB)

An industry standard that defines cables, connectors, and communication protocols used in a bus for connection, communication, and power supply between computers and electronic devices.

Revision history

Document version	Date of release	Description of changes
Rev. 1.00	2026-09-25	• Content update for board rev. P01 support
Rev. 0.02	2026-05-15	• Updated bill of material for TLD4030-12DB • Updated TLD4030HCRGB_EVAL. Added Power off load feature description
Rev. 0.01	2025-10-22	• Initial user guide release

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Customer shall not touch the Evaluation Board during operation and keep a safe distance.
Customer shall not touch the Evaluation Board after disconnecting the power supply, several components may still store electrical voltage and can discharge through physical contact. Several parts, like heat sinks and transformers, may still be very hot. Allow the components to cool before touching or servicing.
The electrical installation must be completed in accordance with the appropriate safety requirements.