TLD7002-16SYS_EVAL board

User guide

LITIX™ Pixel Rear
Multi-channel LED driver
Z8F80459854

About this document

Scope and purpose

The scope of this user manual is to provide instructions on the use of the TLD7002-16SYS_EVAL board.
The TLD7002-16SYS_EVAL is an evaluation platform for the TLD7002-16ES LED driver, which features:

- 16 independent channels set from 5 mA to 76.5 mA
- Power stages can be paralleled for higher currents
- 16 independent 14 bits PWM engines
- UART over CAN interface (HSLI High speed lighting interface)
- OTP (one time programmable) configuration memory

Intended audience

Hardware and Firmware engineers

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

	Caution: The device surface 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.

Table of contents

1 The board at a glance

TLD7002-16SYS_EVAL consists of one PCB, with 3 snappable sections:

- 1 x CAN transceiver section
- 2 x LED driver, TLD7002-16ES section
- 2 x LED load section

The 5 sections of the PCB can be snapped in order to mimic different system implementation. It is possible to connect the snapped sections by means of wires or 2.54 mm pin headers.

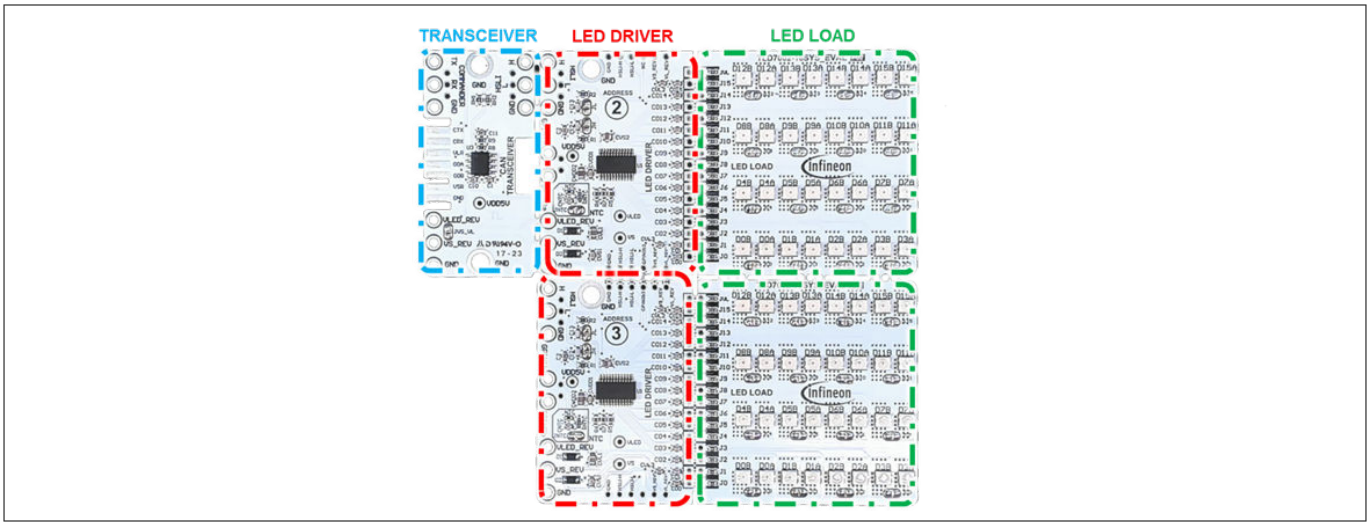

Figure 1 TLD7002-16SYS_EVAL

The two TLD7002-16ES devices in the TLD7002-16SYS_EVAL have a pre-programmed OTP, with addresses 2 and 3 as shown in the PCB silk screen circled numbers. Output current is set to 20 mA. The output current may be increased by emulating a new OTP configuration (see OTP programming application note [3]). The OTP configuration array which was used to program the TLD7002-16SYS_EVAL can be downloaded from the TLD7002-16SYS_EVAL website [4].

1.1 Block diagram

Below, find the block diagram of the TLD7002-16SYS_EVAL.

***Note**: Microcontroller and power supply are not included*

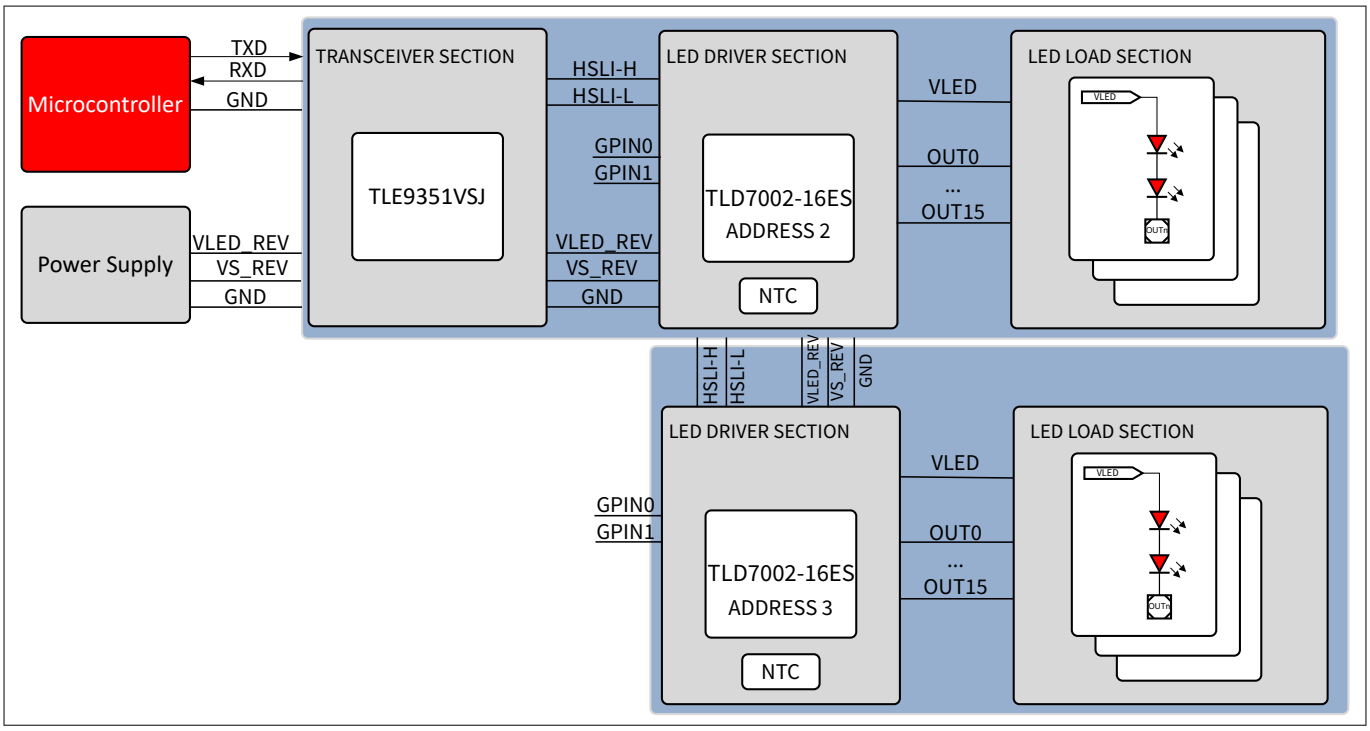

Figure 2 TLD7002-16SYS_EVAL block diagram

1.2 Board parameters

Table 2 Board parameters

Parameter	Symbol	Values			Unit	Note or test condition
		Min.	Typ.	Max.		
Input voltage TLD7002-16ES	V_{S_REV}	6	7	28	V	Reverse protection diode is present and will decrease the effective V_S voltage approximately 200 mV below V_{S_REV}
Input voltage LED	V_{LED_REV}	6	7	20 35	V	V_{LED} ADC reading voltage has 20 V full scale, higher voltage will lead to erroneous LED forward voltage reading. The TLD7002-16ES is a linear regulator. Thermal derating may occur for high V_{LED} and high duty cycle applied
Control voltage GPINx	V_{GPINx}	-0.3	–	20	V	Able to use up to 20 V at the GPINx test points because of the limiting resistor present in the PCB
Output current	I_{OUTn}	5.6	20	76.5	mA	Output current OTP setting is 20 mA for the TLD7002-16SYS_EVAL

2 Quick start

2.1 Operational modes summary

The TLD7002-16SYS_EVAL can operate in three different manners.

- Fail safe operation
- GPINx direct drive control
- HSLI bus control

2.2 Fail safe operation

The TLD7002-16ES devices on the TLD7002-16SYS_EVAL are programmed watchdog timeout set to 2 s. If within 2 seconds from the board power up, no HSLI communication is received by the TLD7002-16ES, then the fail safe configuration will turn on as shown in figure below.

To check the device in Fail safe operation:

1. Close JVS_VL in order to use a single power supply (or use 2 power supplies for VS and VLED_REV)
2. Connect the GND at the - terminal of a 6 V to 20 V 500 mA power supply
3. Connect VS_REV to the + terminal of the power supply
4. The OTP programmed fail safe configuration will turn on after 2 s as shown in figure below

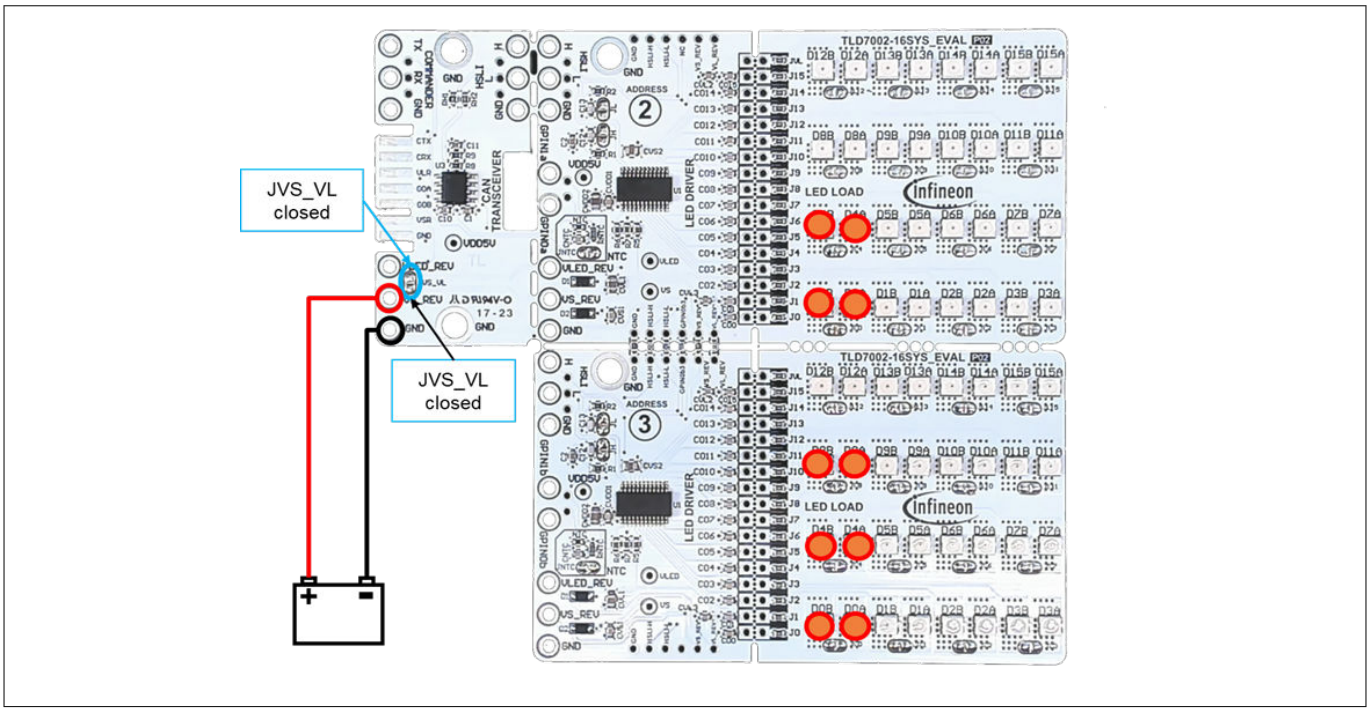

Figure 3 TLD7002-16SYS_EVAL fail safe operation with 1 supply only

2.3 GPINx direct drive control

1. Close JVS_VL to use a single power supply (or use 2 power supplies for VS and VLED_REV)
2. Connect the GND at the - terminal of a 6 V to 20 V 500 m A power supply
3. Connect VS_REV to the + terminal of the power supply
4. Connect GPIN0 or GPIN1 test points to VDD5V test point directly to VBAT or to the VDD test point
5. The respective GPIN0 or GPIN1 OTP configuration, pre-written in the OTP, will light up

Note that in addition, the fail safe configuration remains active, unless correct HSLI messages are received from the TLD7002-16 kicking the watchdog.

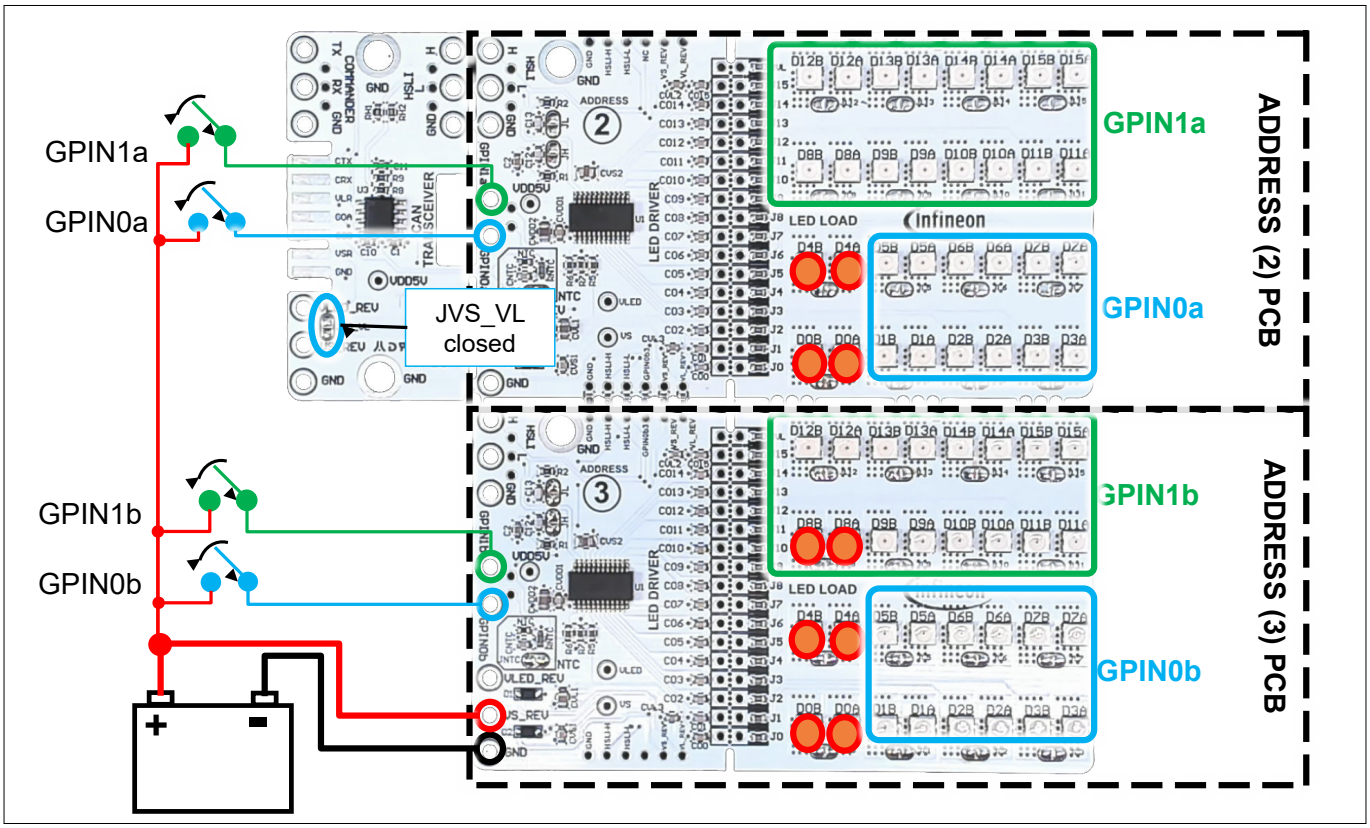

Figure 4 TLD7002-16SYS_EVAL GPIN0 direct control with 1 supply only

GPIN are not intended for PWM transfer to the LED, but only as activators of the output, and the output will produce a pre-defined duty cycle, which is stored on the OTP configuration.

Which LED are turned on when a GPIN is “logic high” are stored in the GPIN0_MAP and GPIN1_MAP OTP registers, Which duty cycle is produced at the outputs (mapped to that GPIN) when the GPINx “HIGH” is applied, is the one stored in DC0_OUTi and DC1_OUTi registers.

GPINx have 2 options for control:

- PWM decoding enabled: can use an Input PWM Signal to either Enable or Disable LED output
  - Interprets an input PWM Duty Cycle < 25% as OFF, Disabling GPINx mapped outputs
  - Interprets an input PWM Duty Cycle > 75% as ON, Enabling GPINx mapped outputs
- PWM decoding disabled: can use static Input HIGH or LOW Signal to Enable or Disable LED outputs
  - HIGH → Disabling GPINx mapped outputs
  - LOW → Enabling GPINx mapped outputs

If PWM decoding is disabled on the OTP configuration; which is the case for the TLD7002-16SYS_EVAL, and the user applies a duty cycle at the GPIN0, this may result in a flicker. The flicker is as a result of the device sampling the GPIN0 in random points of the PWM input signal, and therefore it is possible that the output turns ON (with duty specified on DC0_OUTi) or outputs turn OFF.

2.4 HSLI bus control

The TLD 7002-16ES can be connected to an external microcontroller UART. The TLD7002-16ES device drivers are available on the TLD7002-16ES webpage [2].

1. Close JVS_VL to use a single power supply
2. Connect the GND at the - terminal of a 6 V to 20 V 1 A power supply
3. Connect VS_REV to the + terminal of the power supply
4. Connect GND, RX, TX COMMANDER test points to a commander µC GND, RX(UART), TX(UART)
5. Write and Execute on the µC a software which controls two TLD7002-16 at addresses 2 and 3
6. If the sequence of commands is correct, the TLD7002-16SYS_EVAL will exit the fail safe and follow commands received from the HSLI bus

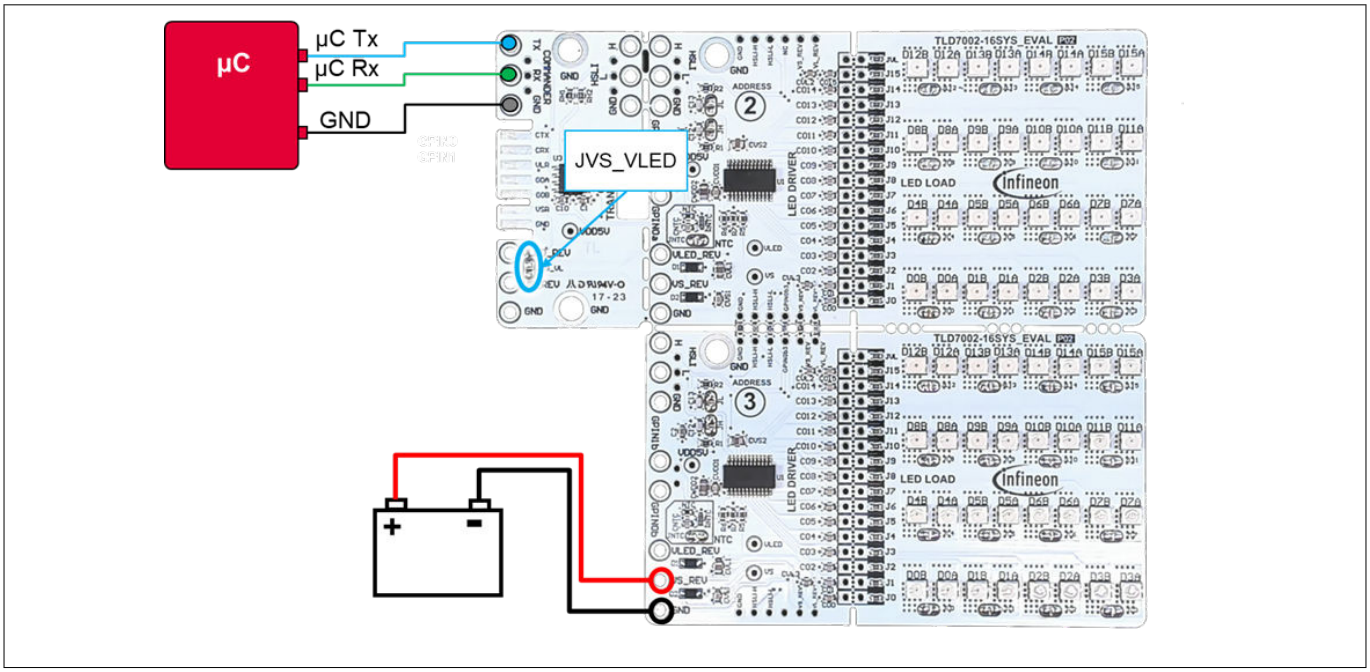

Figure 5 TLD7002-16SYS_EVAL µC control

2.5 Control with Arduino UNO and demo software sketch

The software sketch for Arduino and the TLD7002-16SYS_EVAL can be used as starting point for the software development with the TLD7002-16ES. This sketch runs an animation to the two TLD7002-16 devices.

1. Download the TLD7002-16SYS_EVAL sketch from the TLD7002-16SYS_EVAL website [4]
2. Download and open the Arduino IDE [1]
3. Connect the Arduino Uno board to the PC with a USB cable
4. Upload the TLD7002-16SYS_EVAL sketch in the Arduino Uno (D0 pin must be disconnected)
5. Close JVS_VL in order to use a single power supply
6. Connect the TLD7002-16SYS_EVAL to the Arduino Uno with jumper wires as shown in the figure below
   a. GPIN0a and GPIN0b connections are optional, use them if OTP emulation is needed
7. Connect the GND at the (-) terminal of a 6 V to 20 V 1 A power supply
8. Connect VS_REV to the + terminal of the power supply
9. The TLD7002-16SYS_EVAL (address 2 only part) will show a wiping indicator
10. Optional: open Tools > Serial Monitor and set the speed to 230400 bps to see diagnostic prints

***Note**: It is not possible to upload a sketch to the Arduino Uno if the RX commander Jumper wire is connected to the Arduino. Therefore, when a new sketch is uploaded, the RX commander wire must be momentarily disconnected from the Arduino D0 pin.*

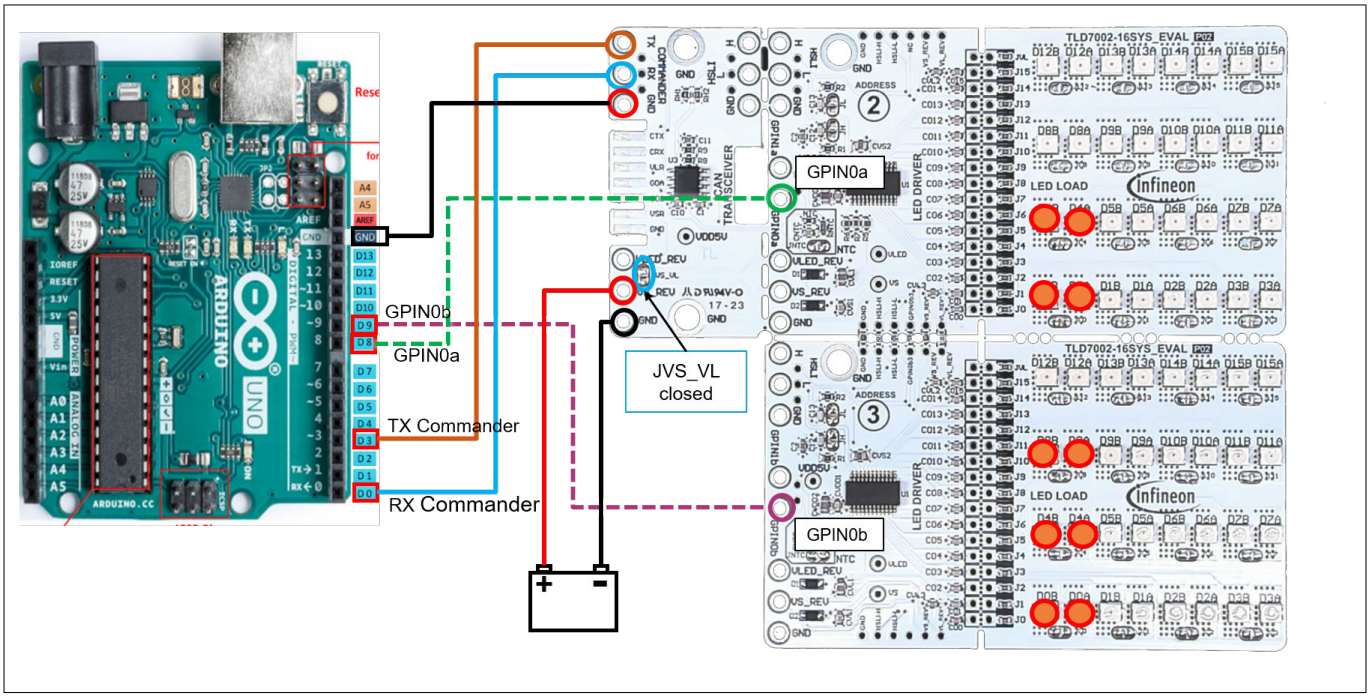

Figure 6 TLD7002-16SYS_EVAL board connected to an Arduino Uno

2.6 OTP configuration

The TLD7002-16SYS_EVAL comes with pre-written OTP memory on the two TLD7002-16ES devices. In case a different OTP configuration is required, (e.g. GPINx set as analog inputs, increased LED current), it is possible to emulate a new OTP configuration in the TLD7002-16ES directly from the Arduino code by using the OTPemuComplete() function.

The OTP configuration files, pre-written in the TLD7002-16SYS_EVAL LED drivers, are provided on the TLD7002-16_ES website [4]. The OTP wizard can be used to read the OTP configuration files. The OTP wizard tool (see Figure 7) can used to read and interpret the .ocfg configuration files. The tool can be installed from the Infineon developer center [5].

2 Quick start

The TLD7002-16SYS_EVAL sketch program can be used to emulate the OTP, because the OTP emulation function is implemented in the code - OTPemuComplete function present in file TLD7002FuncLayer.c.
See TLD7002-16 OTP programming application note [3] for further details on OTP emulation and programming.

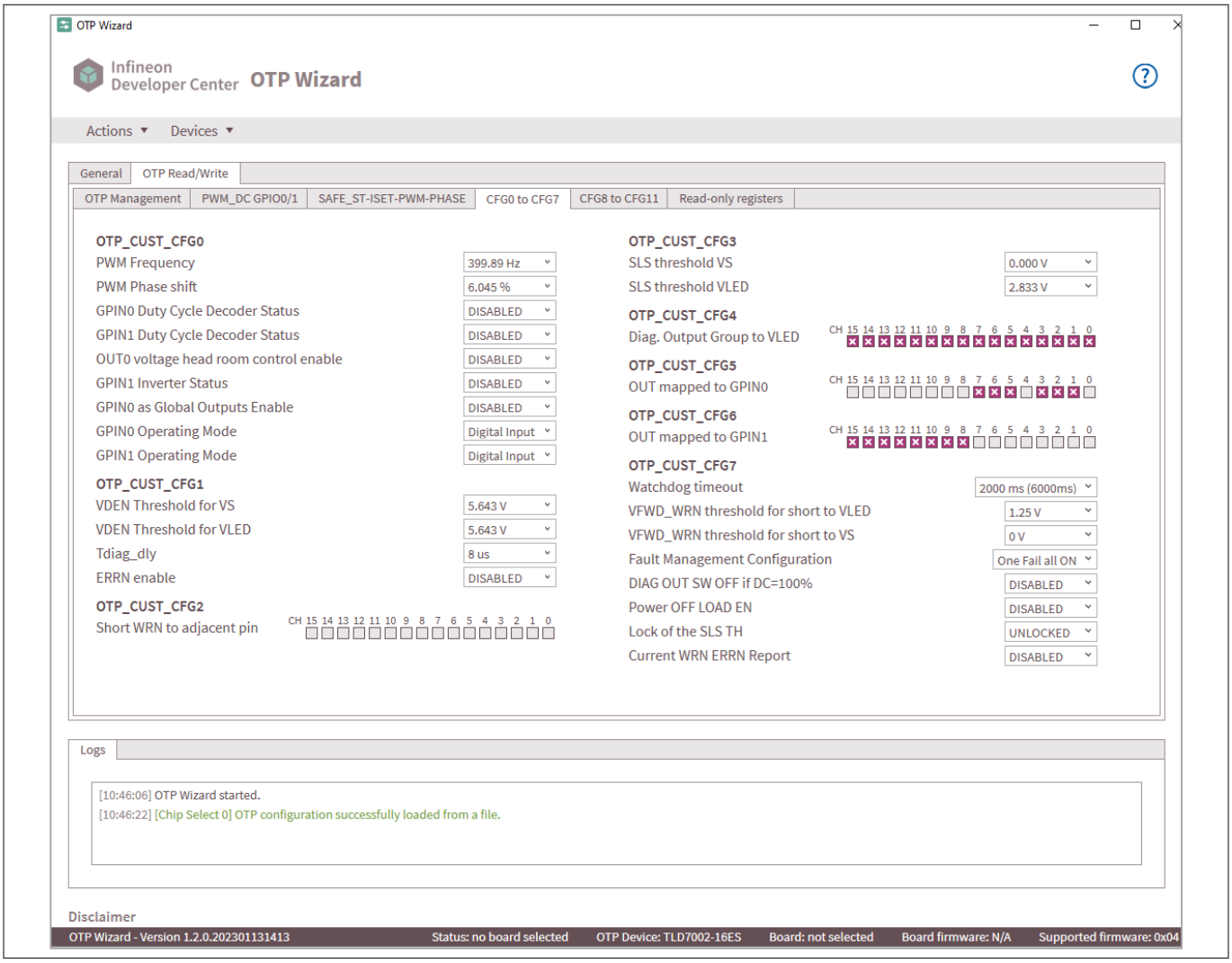

Figure 7 OTP Wizard

3 System design

3.1 Schematics

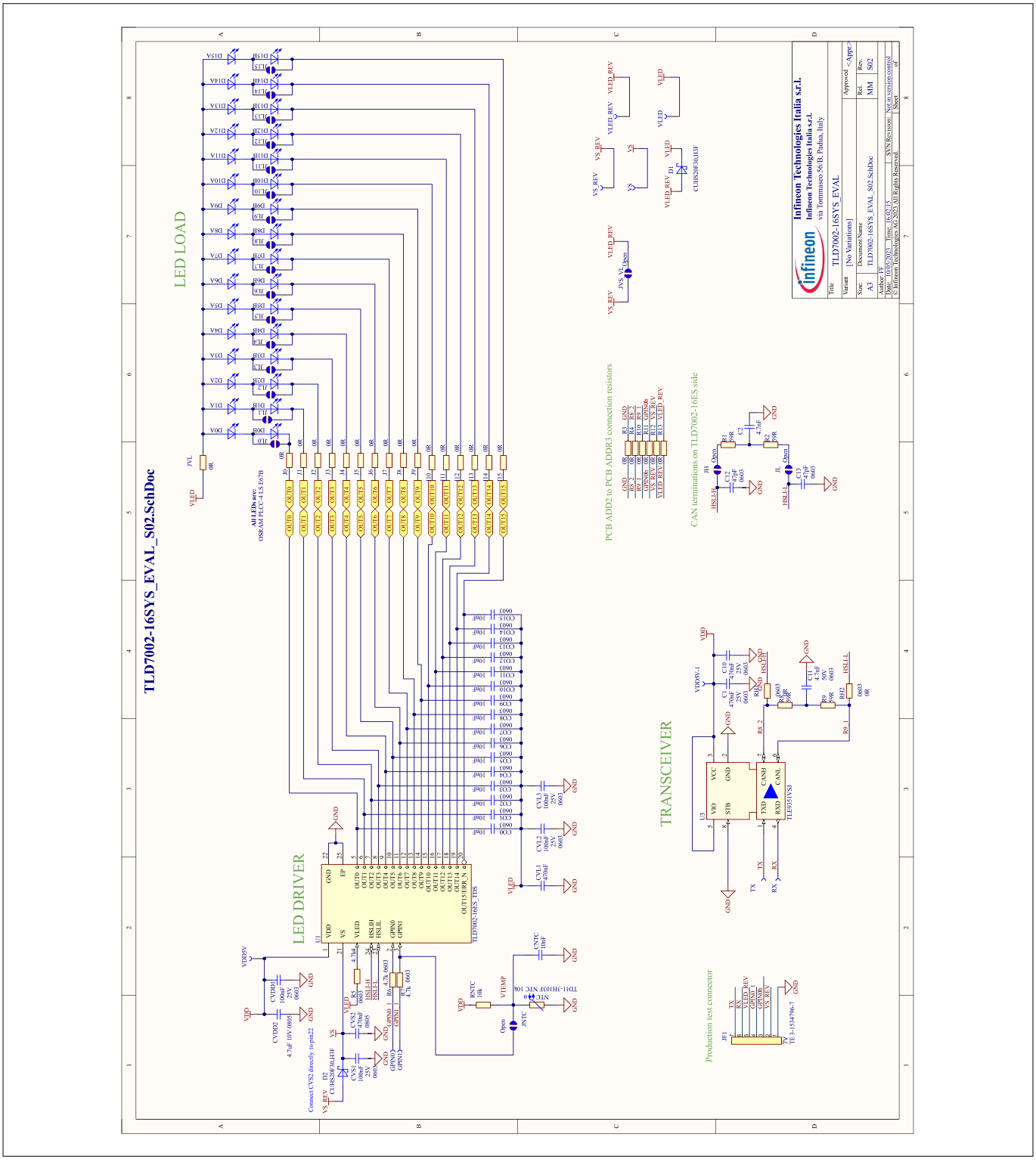

Figure 8 Schematic

3.2 Layout

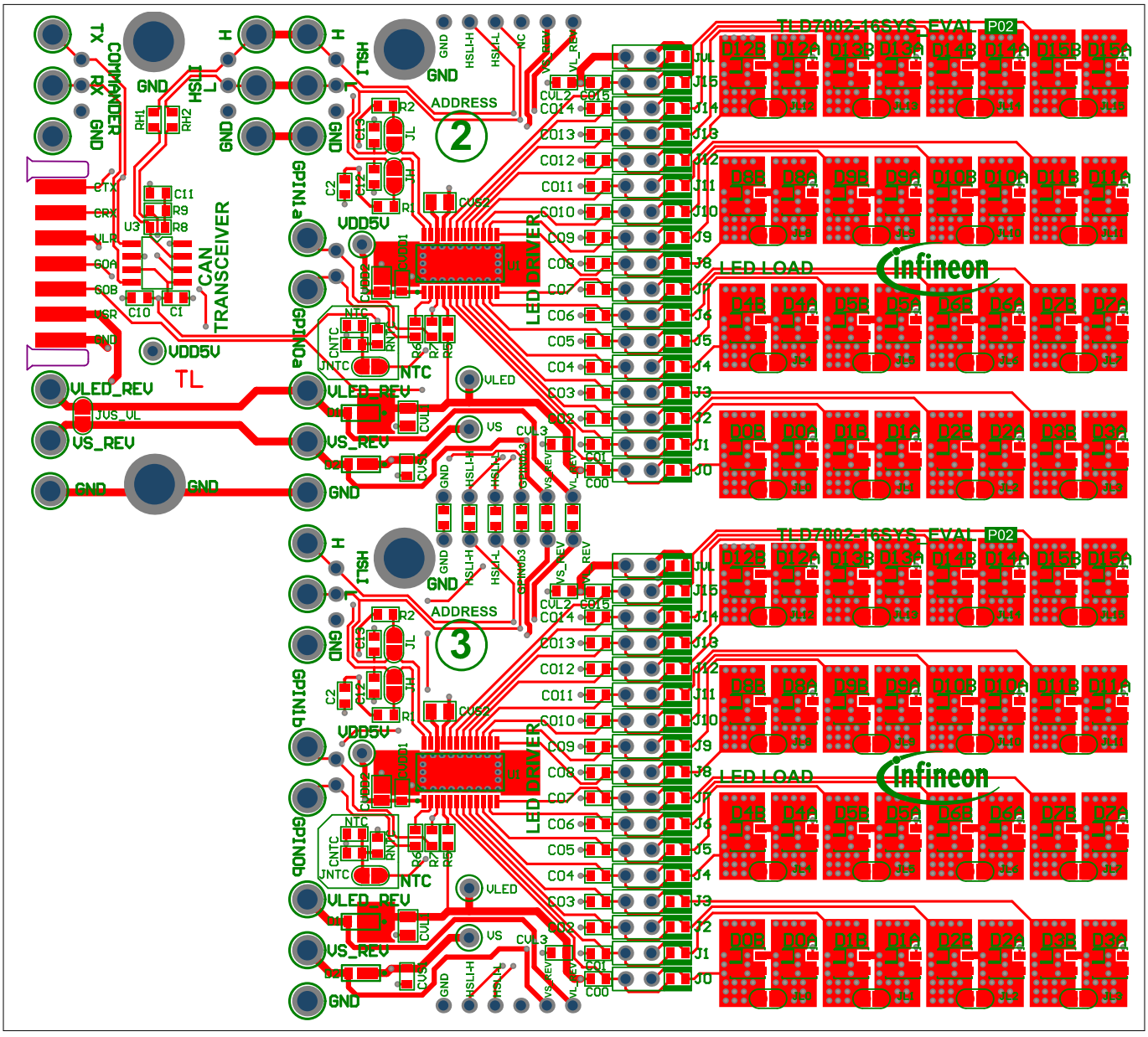

Figure 9 Top layer

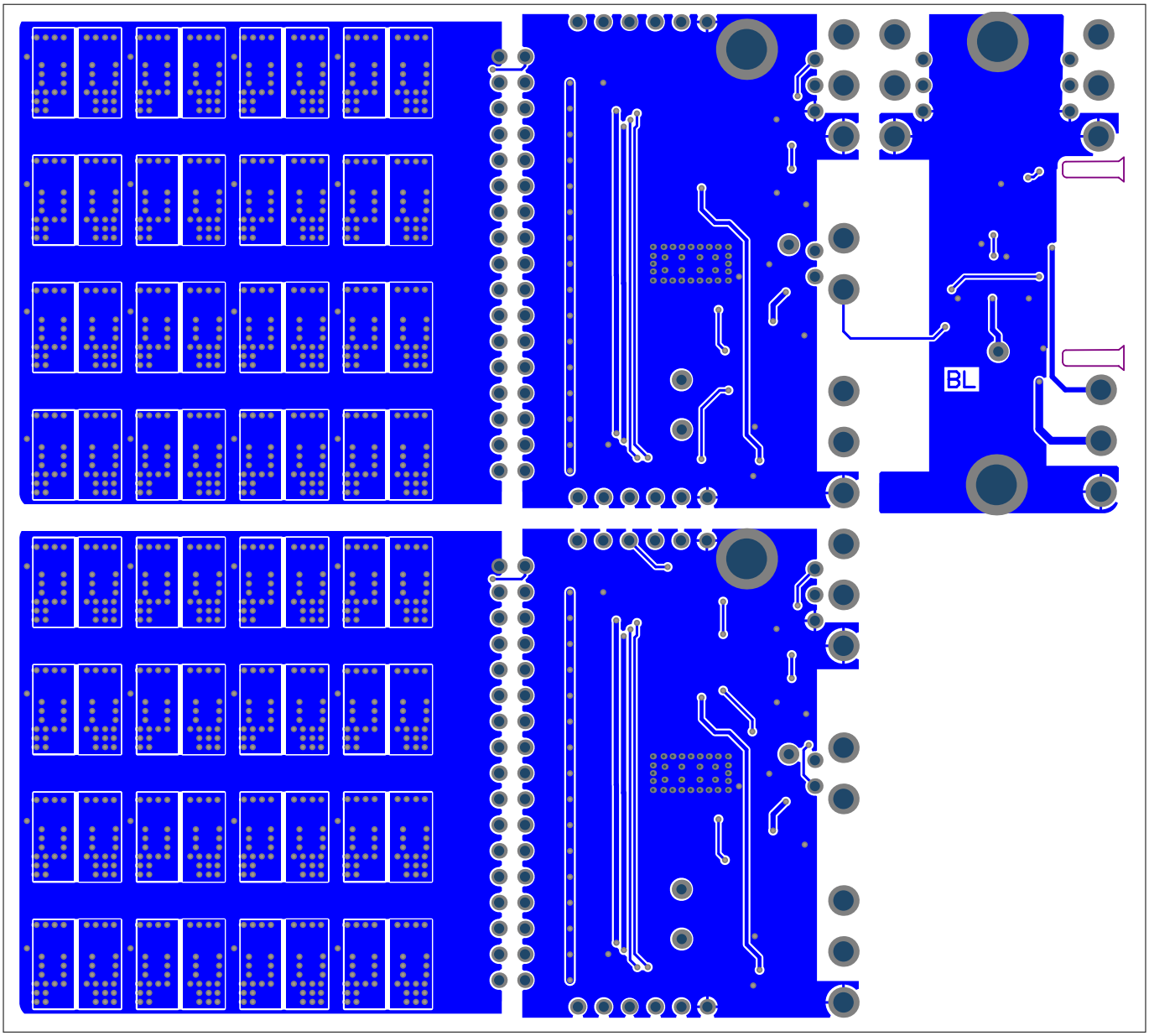

Figure 10 **Bottom layer**

3.3 Bill of material

Table 3 **Bill of material**

Designator	Value	Quantity	Footprint	Voltage [V]	Note
C1, C10	470nF	2	C0603	25	X7R 5%
C12, C13	47pF	4	C0603	50	X7R 5%
C2, C11	4.7nF	3	C0603	50	X7R 5%
CNTC, CO0, CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8, CO9, CO10, CO11, CO12, CO13, CO14, CO15	10nF	34	C0603	25	X7R 5%

(table continues...)

Table 3 (continued) Bill of material

Designator	Value	Quantity	Footprint	Voltage [V]	Note
CVDD1, CVL2, CVL3, CVS1	100nF	8	c0603	25	X7R 5%
CVDD2	4.7uF	2	c0805	10	X7R 5%
CVL1, CVS2	470nF	4	C0805	50	X7R 5%
D0A, D0B, D1A, D1B, D2A, D2B, D3A, D3B, D4A, D4B, D5A, D5B, D6A, D6B, D7A, D7B, D8A, D8B, D9A, D9B, D10A, D10B, D11A, D11B, D12A, D12B, D13A, D13B, D14A, D14B, D15A, D15B	Red LED	64	LED SMD Lite On PLCC-4 LS E67B	–	–
D1, D2	CUHS20F30,H3F	4	DIO-SMD-US2H	–	–
GPIN0, GPIN1, VLED_REV, VS_REV	5001	6	PAD D3 H2	–	–
J0, J1, J2, J3, J4, J5, J6, J7, J8, J9, J10, J11, J12, J13, J14, J15, JVL,'R3, R4, R10, R11, R12, R13, RH1, RH2	0R	42	R0603	–	–
JF1	TE 3-1534796-7	Not Populated		–	–
JVS_VL	Close	1	Solder Jumper	–	–
JH, JL, JL0, JL1, JL2, JL3, JL4, JL5, JL6, JL7, JL8, JL9, JL10, JL11, JL12, JL13, JL14, JL15, JNTC	Open	38	Solder Jumper	–	–
NTC	Mitsubishi TD11-3H103F NTC 10k	2	r0603	–	Use this NTC or similar 10k
R1, R2, R8, R9	59R	6	R0603	–	–
R5, R6, R7	4.7k	6	R0603	–	–
RNTC	10k	2	R0603	–	–
U1	TLD7002-16ES_TDS	2	PG-TSDSO-24	–	–
U3	TLE9351VSJ	1	PG-DSO-8	–	–

References

[1] Arduino *IDE downloads*:; https://www.arduino.cc/en/software

[2] Infineon *TLD7002-16ES* https://www.infineon.com/cms/en/product/power/lighting-ics/litix-automotive-led-driver-ic/litix-pixel-rear/tld7002-16es/

[3] Infineon *TLD7002-16ES OTP programming procedure* https://www.infineon.com/dgdl/Infineon-Infineon-TLD7002-16ES_OTP_programming_procedure-AN-v01_20-EN-ApplicationNotes-v01_20-EN.pdf?fileId=8ac78c8c80f4d32901816672cf833ad1

[4] Infineon *TLD7002-16SYS_EVAL* https://www.infineon.com/cms/en/product/power/lighting-ics/litix-automotive-led-driver-ic/litix-pixel-rear/tld7002-16es/?tab=~%27boards_designs#!designsupport

[5] Infineon *Developer Center Launcher* https://www.infineon.com/cms/en/design-support/tools/utilities/infineon-developer-center-idc-launcher/

Revision history

Document version	Date of release	Description of changes
Rev. 1.10	2024-06-15	• Figure update in Control with Arduino UNO and demo software sketch
Rev. 1.00	2023-05-29	• Initial release

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