Getting Started with the LED Platform Power and Communication Arduino Shield

About this document

Scope and purpose

This user guide provides instructions for using the Arduino shield, which is designed to enable the evaluation of the LED Platform reference designs. This user guide provides an overview of the whole system offering for the LED Platform, and extensive technical information on the board.

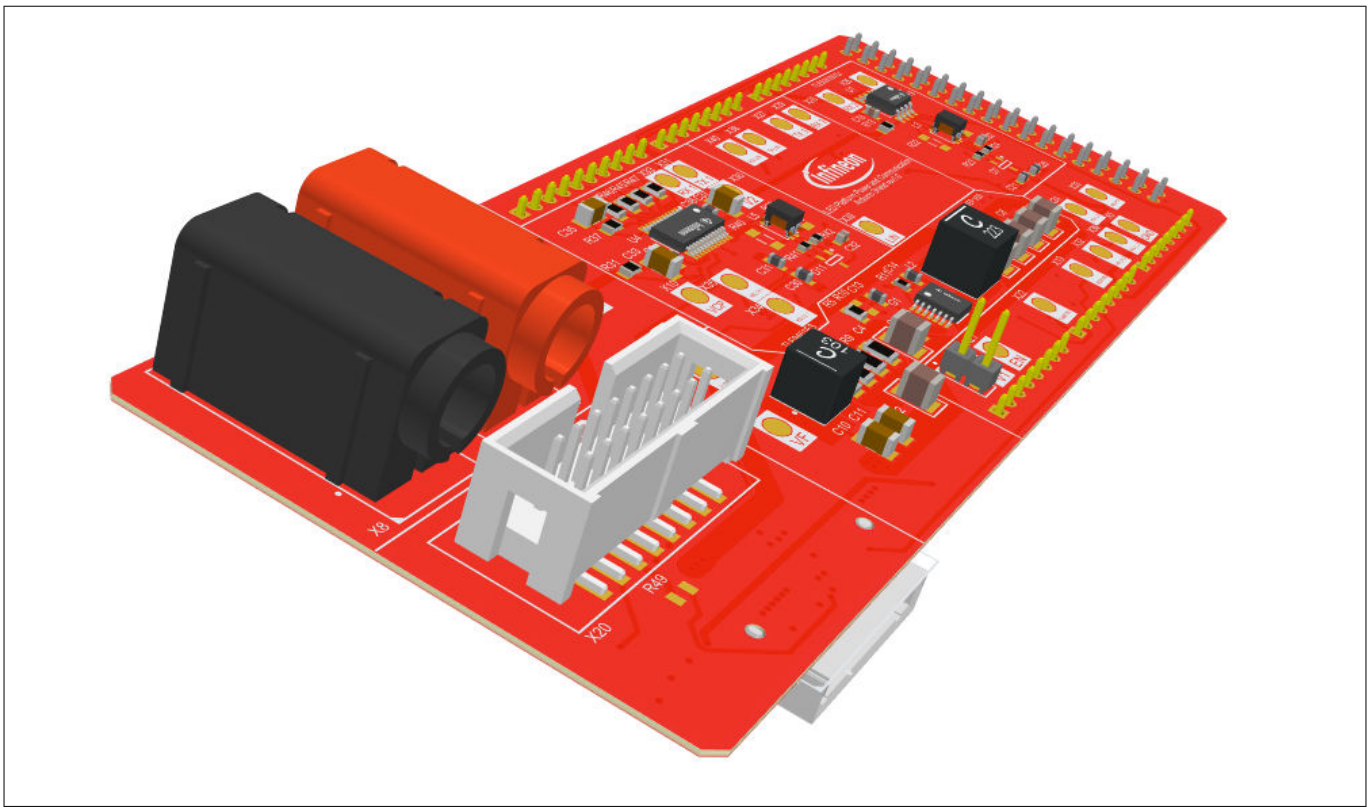

Figure 1 Power and Communication Arduino shield board

Intended audience

This document is intended for anyone using Infineon's LED Platform reference designs.

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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Safety precautions

Table 1	Safety precautions
	**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.*

Table of contents

1 System offering

1.1 Introduction to LED Platform system offering

Infineon's system offering for LED Platform encompasses a range of components that work together to provide a comprehensive solution.

Key Components:

- **Infineon LED Platform Power and Communication Arduino Shield**: a robust hardware foundation to supply the LED Platform boards with the OPTIREG™ DC-DC TLS4125D0EP V50. The shield can be applied on the Traveo™ II Starter Kit, and due to the OPTIREG™ SBC TLE9461ES, it enables the communication with the LED Platform reference designs. For more information, refer to Introduction to the LED Platform Power and Communication Arduino shield
- **Infineon LED Platform Animated Exterior reference design**: a reference for the design of animated exterior lighting applications with the LITIX™ TLD7002-16ES. For more information, refer to Introduction to the LED Platform Animated Exterior reference design
- **Traveo™II Starter Kit** : is the evaluation environment for Traveo™ II Body Entry devices of the Infineon Traveo™ *microcontroller* family. For more information, refer to Introduction to the Traveo™ II Starter Kit
- **Traveo™II LED application software**: there is an application software for each reference design of the LED platform. Each application software is intended to be executed on the Traveo™ II Starter Kit. It enables the charge pump of the OPTIREG™ SBC TLE9461ES, and shows a predefined pattern on the LEDs of the corresponding reference design. For more information, refer to Introduction to the Traveo™ II LED application software
- **uIO-Stick V2**: an interface device for controlling Infineon boards during run time. It provides a built-in *bootstrap loader (BSL)*, for programming the LITIX™ devices over the built-in *controller area network (CAN)* transceiver. For more information, refer to Introduction to the uIO-Stick V2

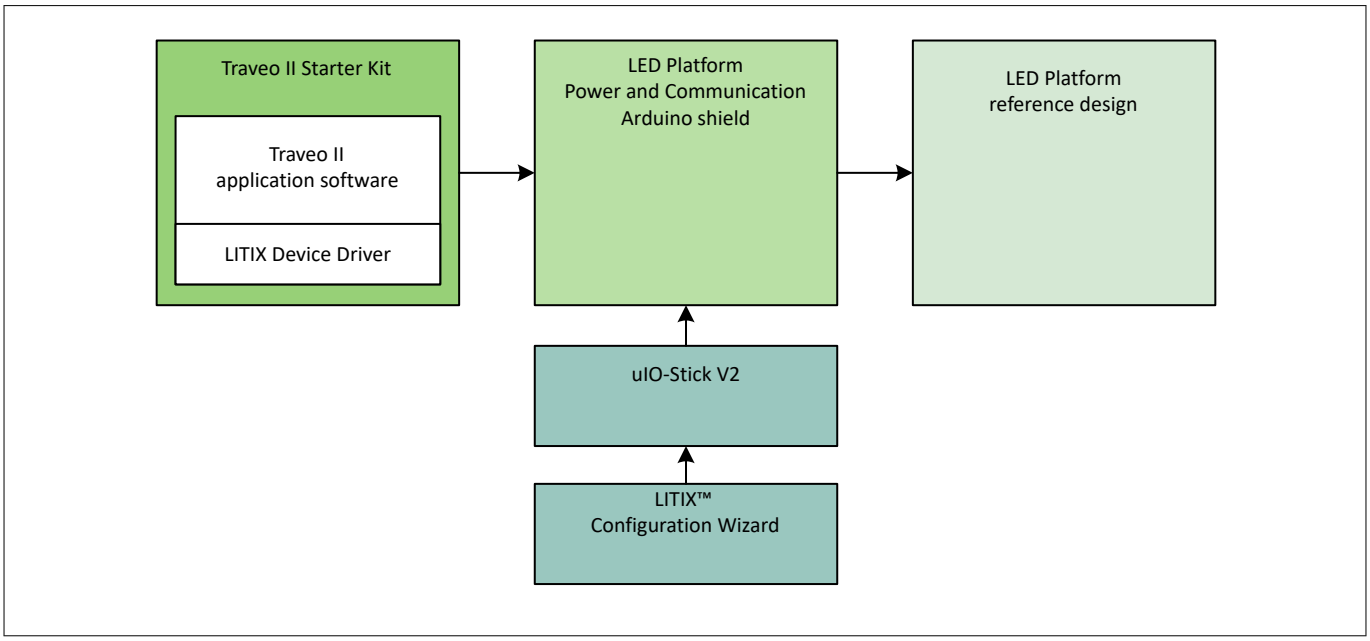


Figure 2 Infineon's LED Platform system offering

1.1.1 Introduction to the LED Platform Power and Communication Arduino shield

The LED Platform Power and Communication Arduino shield enables communication between the TRAVEO™ II Starter kit and the LED Platform reference designs, and supplies power to them.

1 System offering

The LED Platform reference designs can be supplied over the banana jacks on the Power and Communication Arduino shield with 12 V DC. The board is protected against the reverse polarity of the input voltage supply, with the OptiMOS™-7 IAUZN04S7N049 for the power part of the circuit , and with the BAS3010A for the logic part. The NMOS reverse polarity is managed by the charge pump function of the OPTIREG™ SBC TLE9461ES.

The LEDs on the LED Platform reference designs are supplied by the OPTIREG™ switcher TLS4125D0EP V50, which provides a fixed 5 V output voltage.

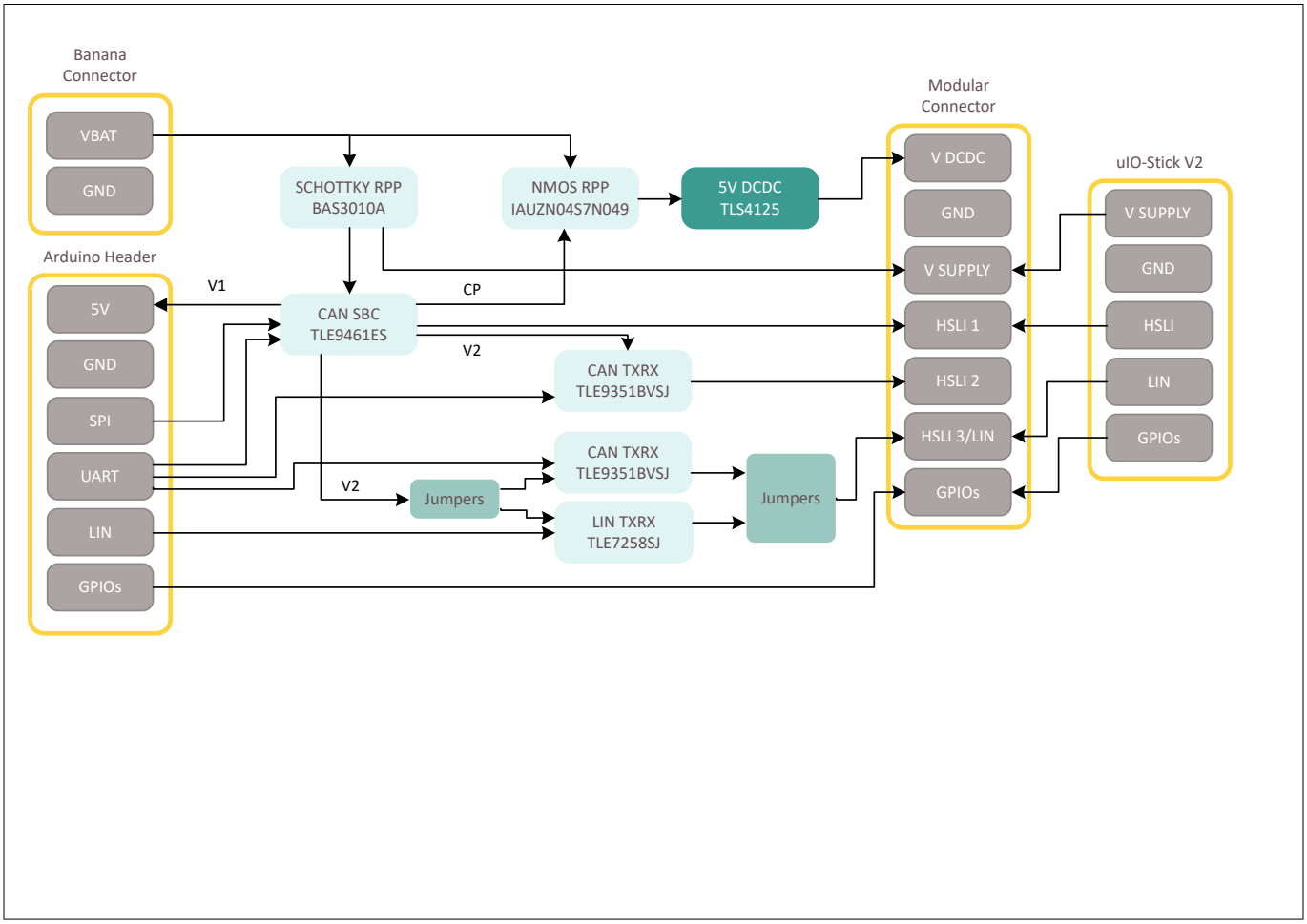


Figure 3 Block diagram

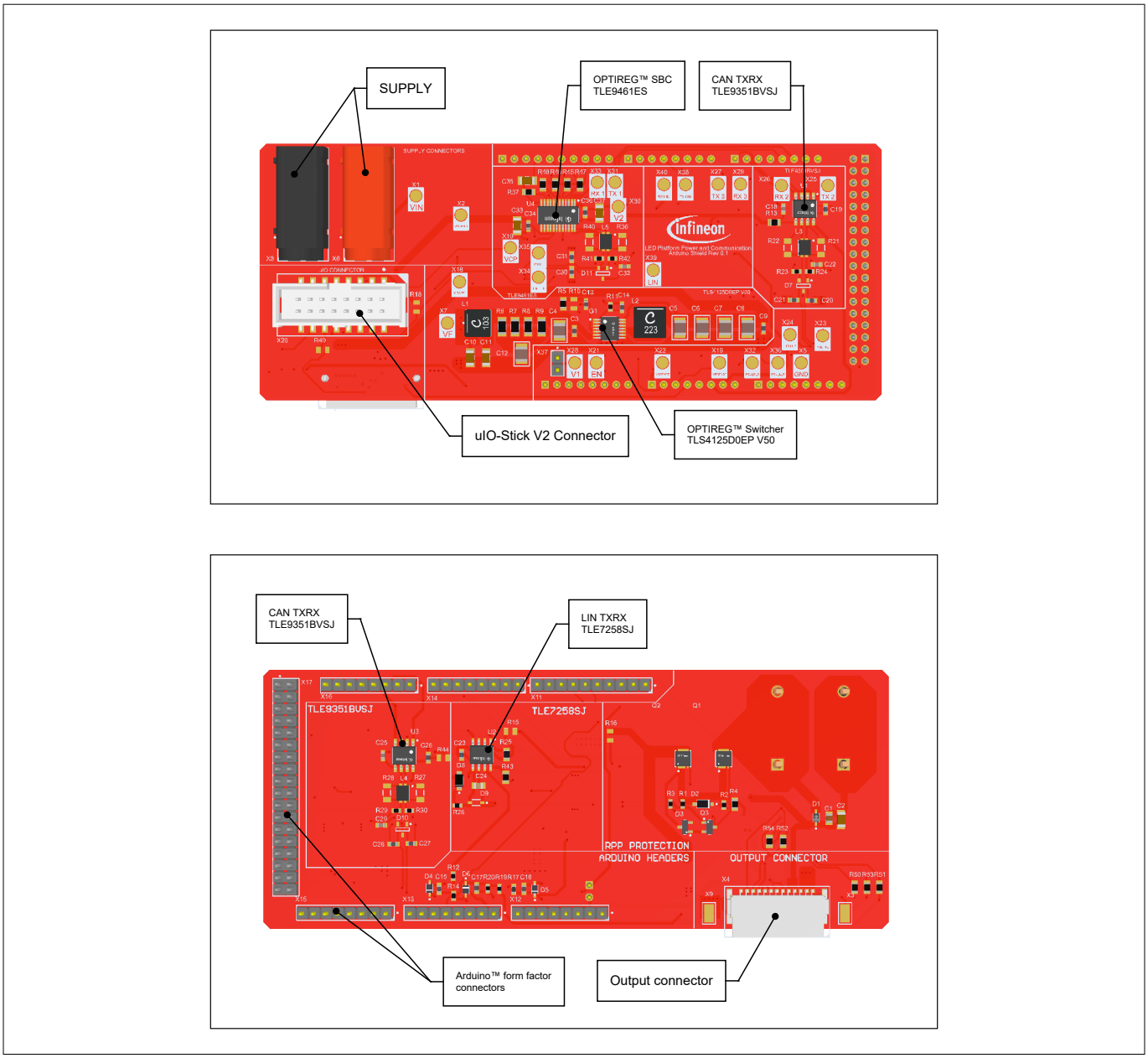


Figure 4 Board description

1.1.2 Introduction to the LED Platform Animated Exterior reference design

The reference design combines the LITIX™ TLD7002-16ES device with Pure Green LEDs. The reference design is supplied and controlled over the modular connectors, which are placed on all the edges of the board, with the LED Platform Power and Communication Arduino shield.

1 System offering

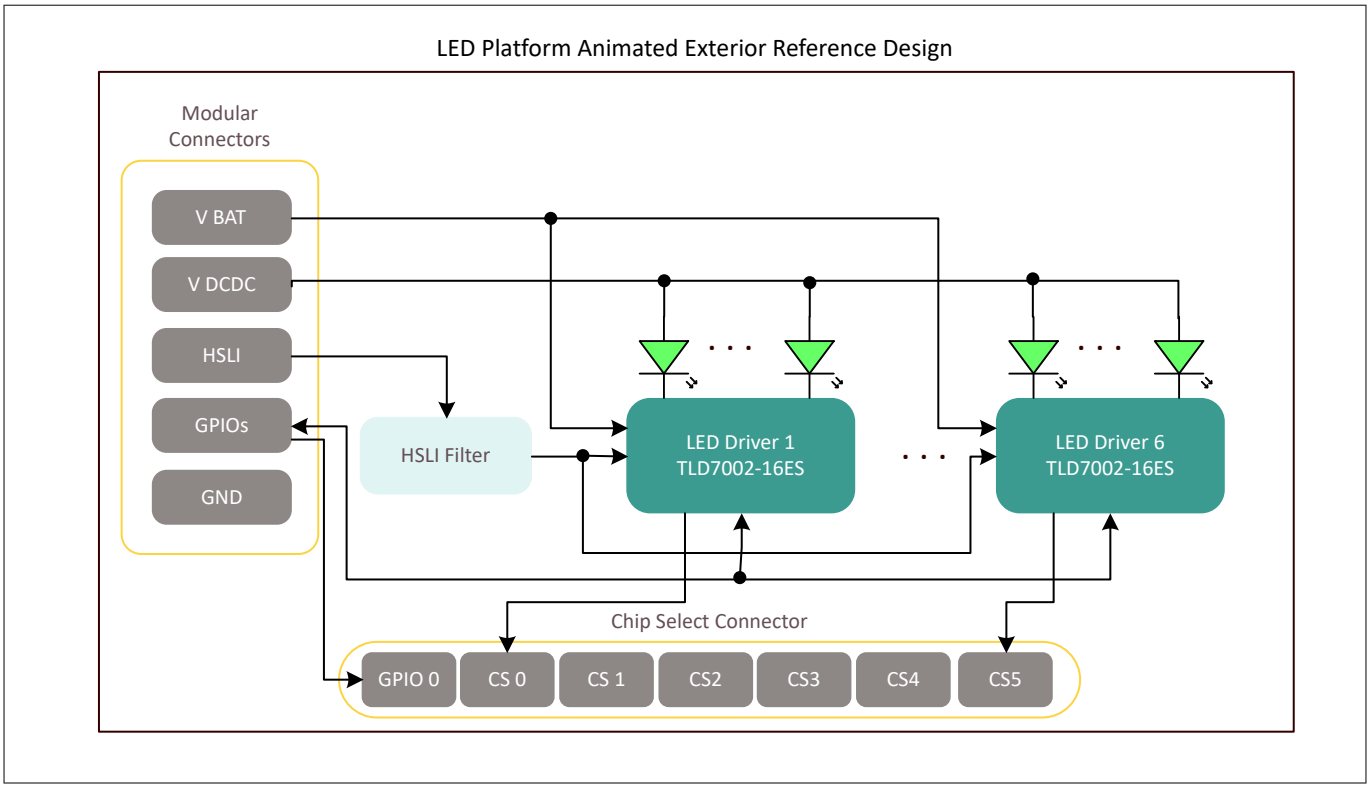


Figure 5 Block diagram

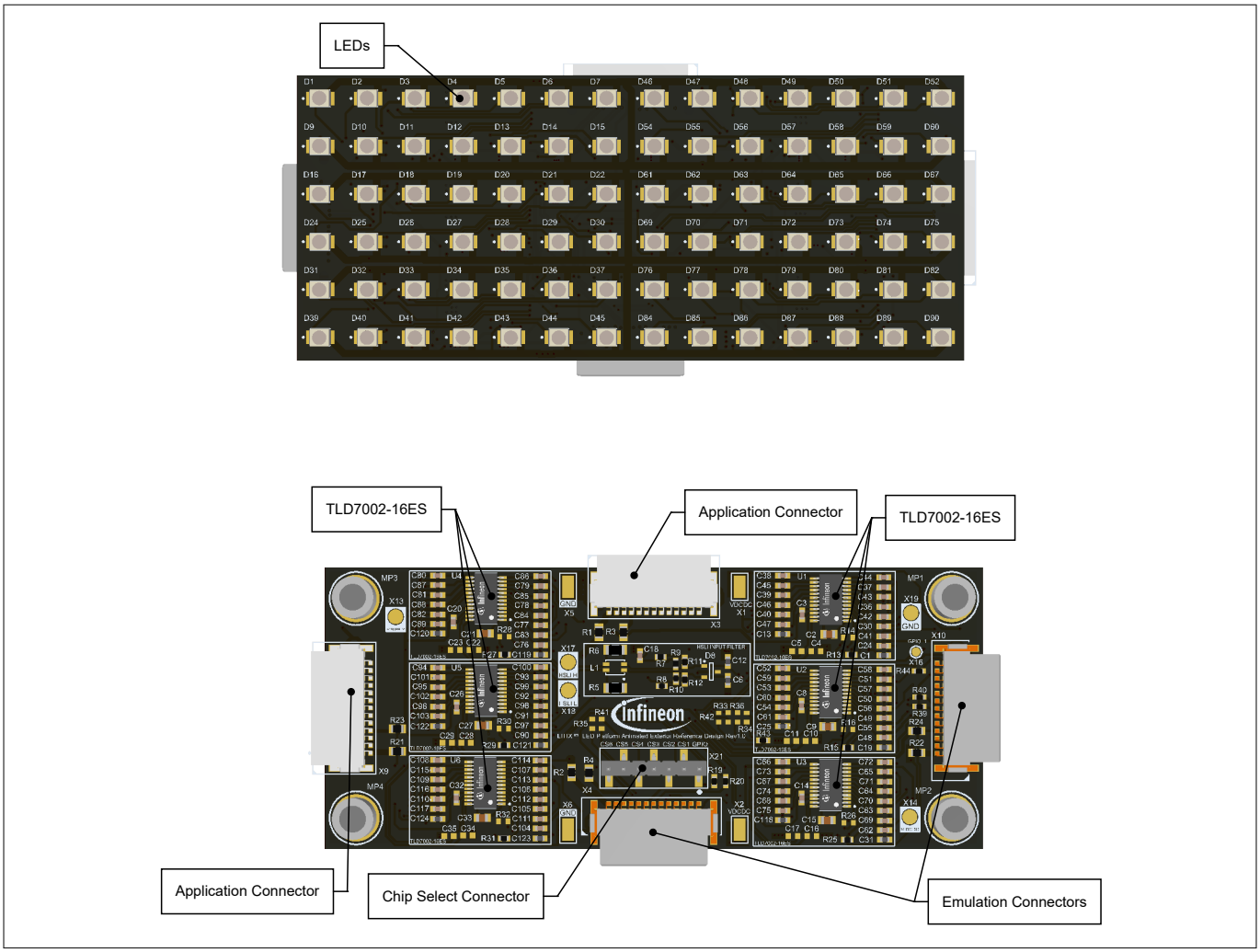


Figure 6 Board description

1.1.3 Introduction to the Traveo™ II Starter Kit

The Traveo™ II Starter Kit (also referred to as CYTVII-B-E-1M-SK) is an easy-to-use evaluation board based on the Traveo™ II body entry family of devices. The CYTVII-B-E-1M-SK board features a CYT2B7 *microcontroller unit (MCU)*, which consists of the following:

- A robust 32-bit MCU core led by the 160 MHz Arm® Cortex®-M4 single
- A memory spectrum of 1 MB flash
- A 96 KB work flash
- A 128 KB SRAM

The application software for the Traveo™ II Starter Kit can be flashed with an on-board PSoC™ 5 based Kitprog3.

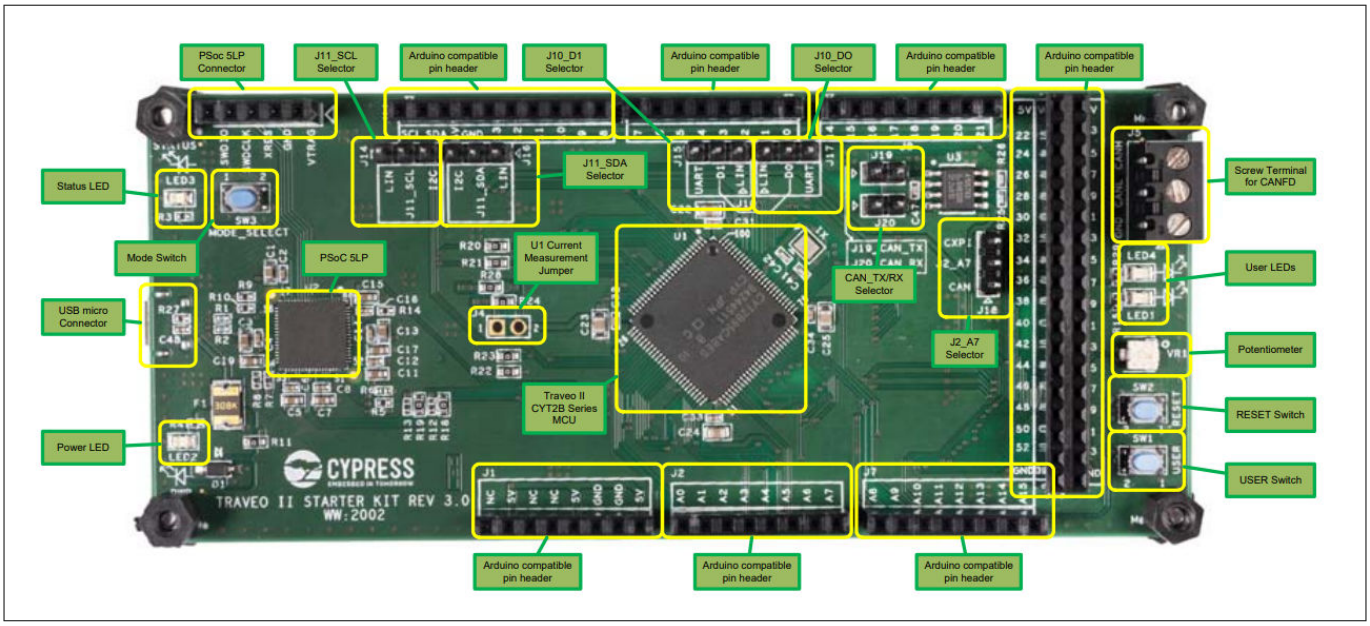


Figure 7 Board description

1.1.4 Introduction to the Traveo™ II LED application software

There is an application software for each reference design of the LED platform. Each Traveo™ II Starter kit application software provides an introductory overview of the device's capabilities supported by the corresponding reference design of the LED Platform, which serves as a guide for integrating the corresponding device driver into software projects. Each software example is specifically tailored for each LED Platform reference design, utilizing the LED Platform Power and Communication Arduino Shield.

Each application software, executed by the Traveo™ II , performs the following primary tasks:

- Initializes the OPTIREG™ SBC TLE9461ES enabling the watchdog, charge pump for reverse polarity protection, and additional supply line for *CAN* transceivers
- Configures the *universal asynchronous receiver transmitter (UART)* peripheral to establish communication with the LED drivers on the reference design
- When the initalization phase is complete and communication has been established, the *MCU* transmits frames of the selected animation, which is controlled by the user buttons on the CYTVII-B-E-1M-SK board
- Periodically reads the status of the LED drivers, indicating errors through the *light-emitting diode (LED)* on the Traveo™ II Starter kit

The application software leverages the APIs provided in the embedded software libraries, including the Traveo™ II Peripheral Driver Library, the LITIX™ device driver, and the OPTIREG™ SBC TLE9461ES example software generated by the Configuration Wizard for SBC tool. All these embedded software libraries are integrated in the application software. This approach enables developers to easily integrate the devices into their evaluation projects.

1.1.5 Introduction to the uIO-Stick V2

The uIO-Stick V2 is a versatile interface device that enables real-time control of the LED Platform reference designs from a PC, offering a comprehensive solution for development and testing. The uIO-Stick V2 controls LITIX™ devices through the *high-speed lighting interface (HSLI)* and *general purpose input output (GPIO)*s. Additionally, the uIO-Stick V2 can supply 3.3 V or 5 V digital levels, and with the aid of a built-in boost converter, it can also generate a 12 V supply to the target device and the integrated *local interconnect network (LIN)* transceiver.

Figure 8 uIO-Stick V2

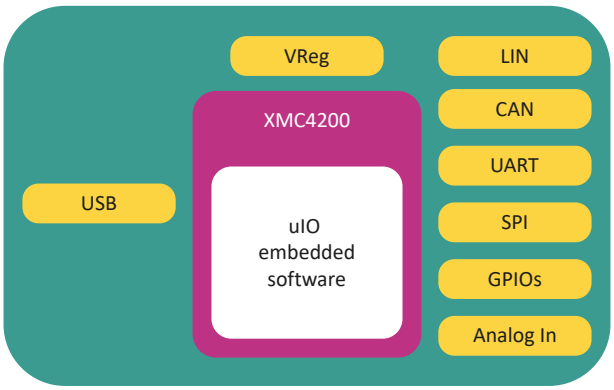


Figure 9 Block diagram

1.2 How to get the system offering

1.2.1 How to get the LED Platform boards and the uIO-Stick V2

To order an LED Platform board or the uIO-Stick V2:

1. Go to https://www.infineon.com
2. In the search bar, enter your required product, for example, `LED Platform Power and Communication Arduino shield`
3. Once you have found the product page, navigate to the **Order** section
4. To place an order for the product directly from Infineon or from a distribution partner, click **Order online**

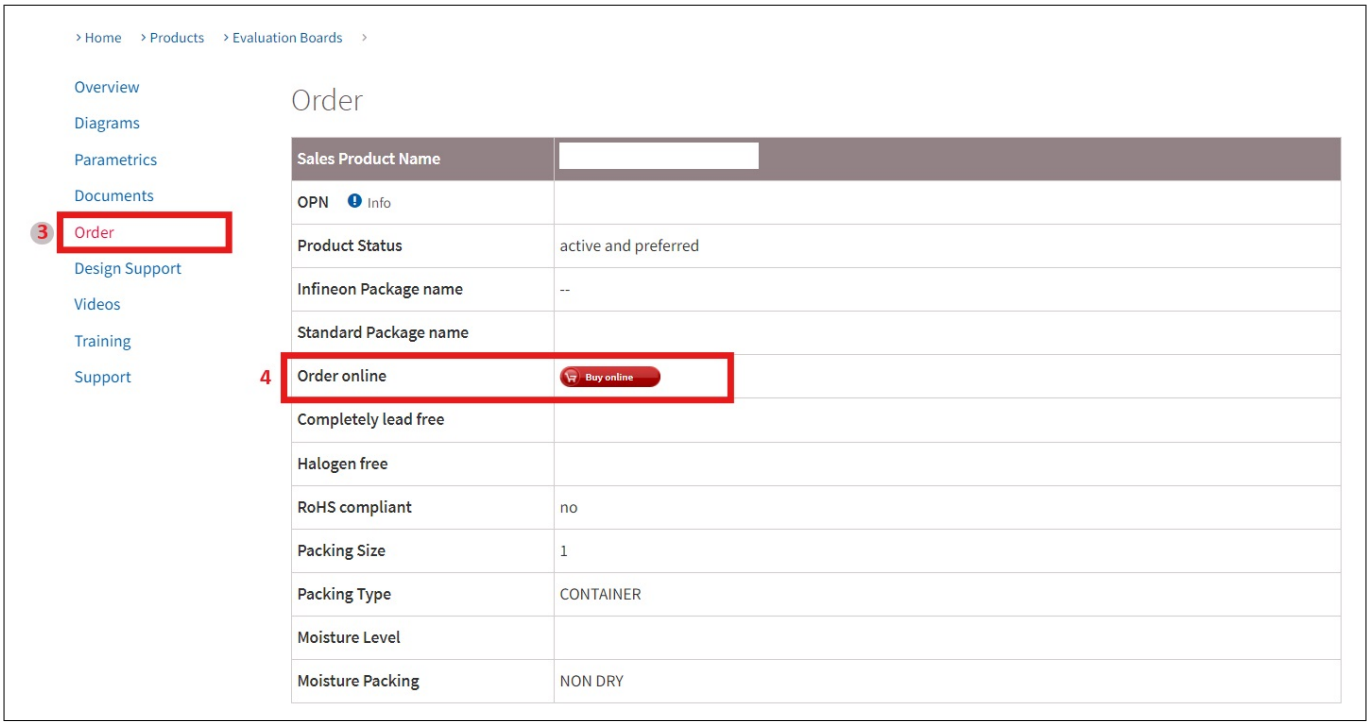


Figure 10 Navigation on the web page to order the board

1.2.2 How to get the LED Platform application software and the device driver

To download the embedded software packages:

1. Go to https://softwaretools.infineon.com/software
2. In the search field, enter the name of the embedded software package
3. Click **Request**, as shown in Figure 11
4. Click the cart
5. Click **Request**
6. Fill in the questionnaire, accept the license terms, and click **Submit request**, as shown in Figure 12
7. After a few minutes, the software package is available for download in the **My Space** tab under **My Software**. Click **Details**, and then **Download**

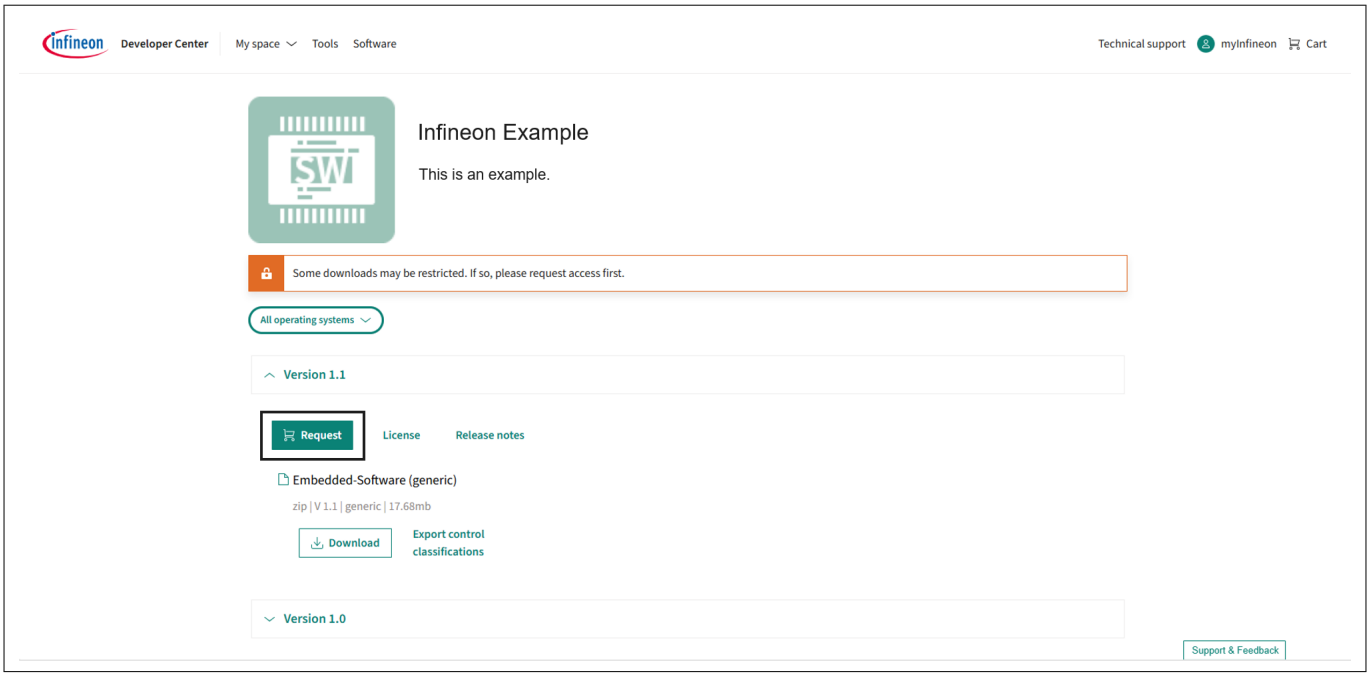


Figure 11 Software package within the Infineon Developer Center

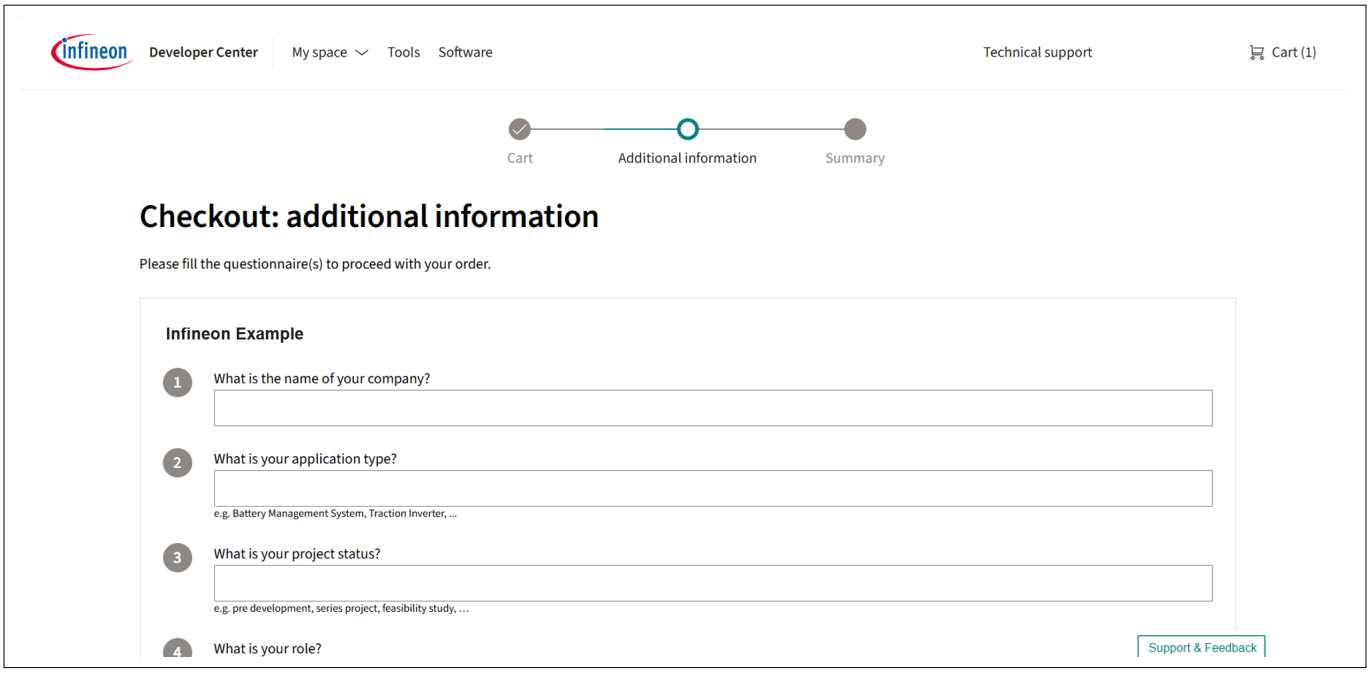


Figure 12 Requesting download of software package

2 Setting up the LED Platform Power and Communication Arduino shield

Box delivery content

The Dynamic Interior reference design is delivered together with a QR code on the box. This QR code provides access to the board's exclusive content, such as *printed circuit board (PCB)* design files.

Exclusive content

To access exclusive content, click here.

2.1 Application setup

The Application setup is needed for the main use-case of the reference design, where the application software is executed by the Traveo™ II and the *LED*s on the reference design to show an animation. The Application setup represents a comprehensive setup that consists of:

- The Traveo™ II Starter Kit
- The LED Platform Power and Communication Arduino Shield
- The LED Platform reference design
- The LITIX™ device driver
- The Traveo™ II application software

By combining these components, users are able to create a fully functional setup that closely resembles a real-world application, enabling a seamless transition to the final product.

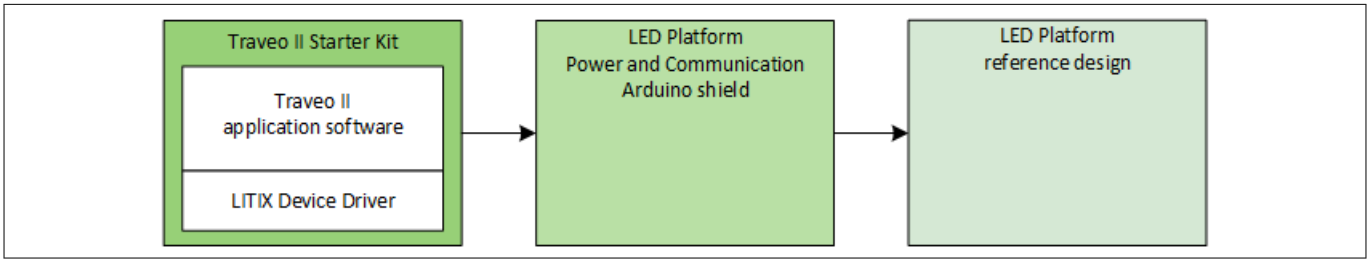


Figure 13 Application setup system offering

The Traveo™ II Starter Kit requires re-flashing by the user to run the Application setup using the Traveo™ II application software. For the LED Platform, the recommended programming interface is the onboard KitProg3 programmer, used with the IAR Embedded Workbench for ARM® .

To program and debug the kit using the IAR Embedded Workbench for Arm tool and the onboard KitProg3 programmer/debugger, use the following steps:

1. Before connecting any power or cables, ensure that the solder jumpers on the LED Platform reference design and on the LED Platform Power and Communication Arduino Shield are set at the default position. Refer to the figures below where the default solder jumpers are highlighted in red

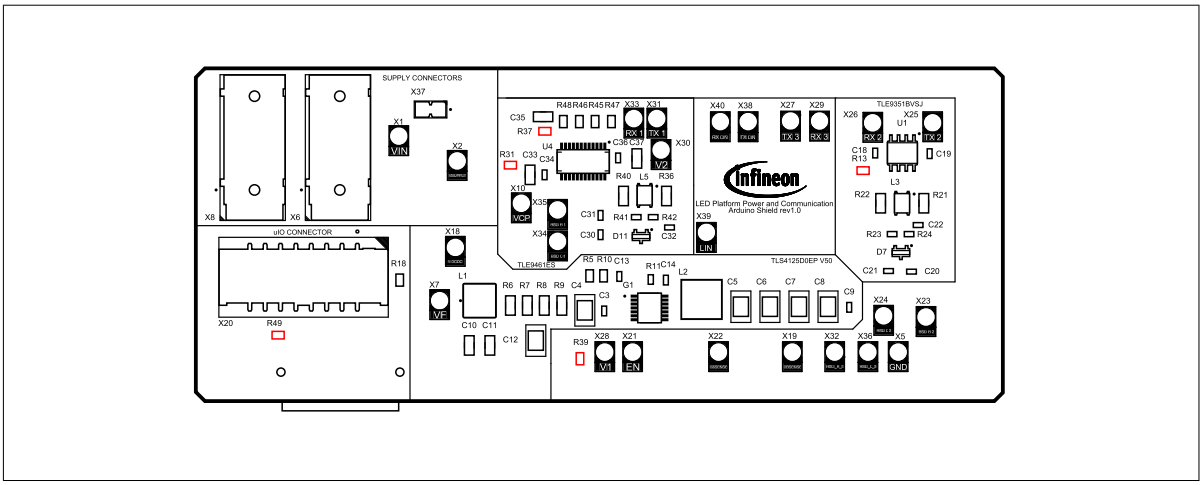


Figure 14 Default solder jumpers LED Platform Power and Communication Arduino Shield

2. Mount the LED Platform Power and Communication Arduino Shield onto the Traveo™ board's Arduino form factor connectors
3. Connect the USB micro-B cable between the KitProg3 on the Traveo™ II Starter kit and the PC's USB port
4. Download the application software as explained here, How to get the LED Platform application software and the device driver, then unzip the folder and open the IAR Embedded Workbench workspace within the unzipped folder
5. Build the project by going to the menu option **Project** and select **Rebuild All**. Once the build process is finished, download it to the board by clicking **Project** > **Download** > **Download active application**
6. Connect the LED Platform reference design to the LED Platform Power and Communication Arduino Shield by inserting the X4 or the X10 connector into the X4 connector on the shield
7. Connect the LED Platform Power and Communication Arduino Shield to a 12 V power supply using the banana connectors (X6, X8) on the board

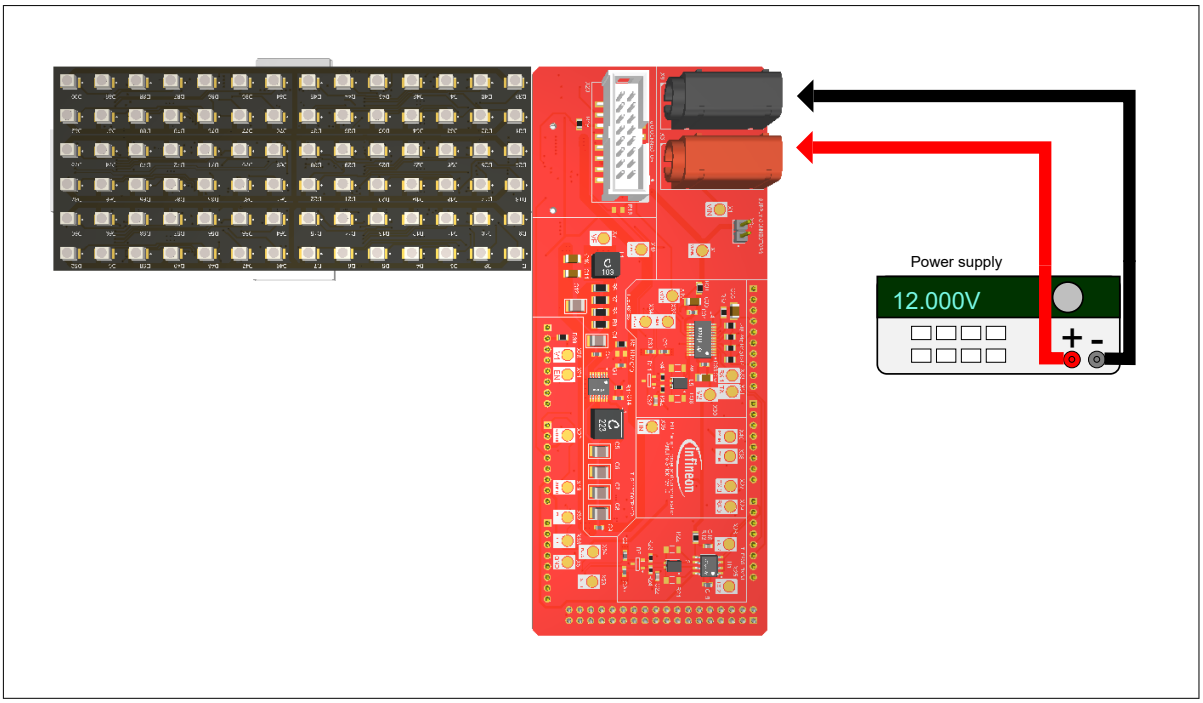


Figure 15 Application setup power supply

8. Finally, press the reset button on the Traveo™ II Starter Kit to complete the download process
9. The reference design should now illuminate and display the predefined animation, indicating a successful programming and debugging process

2.2 Emulation setup

The Emulation setup enables expert users to interact with the devices featured in the LED Platform reference designs. The emulation setup consists of:

- The LED Platform Power and Communication Arduino Shield
- The LED Platform reference designs
- The uIO-Stick V2
- The LITIX™ Configuration Wizard

By integrating these components, users can quickly and easily interact with the devices, providing a streamlined solution for testing and development.

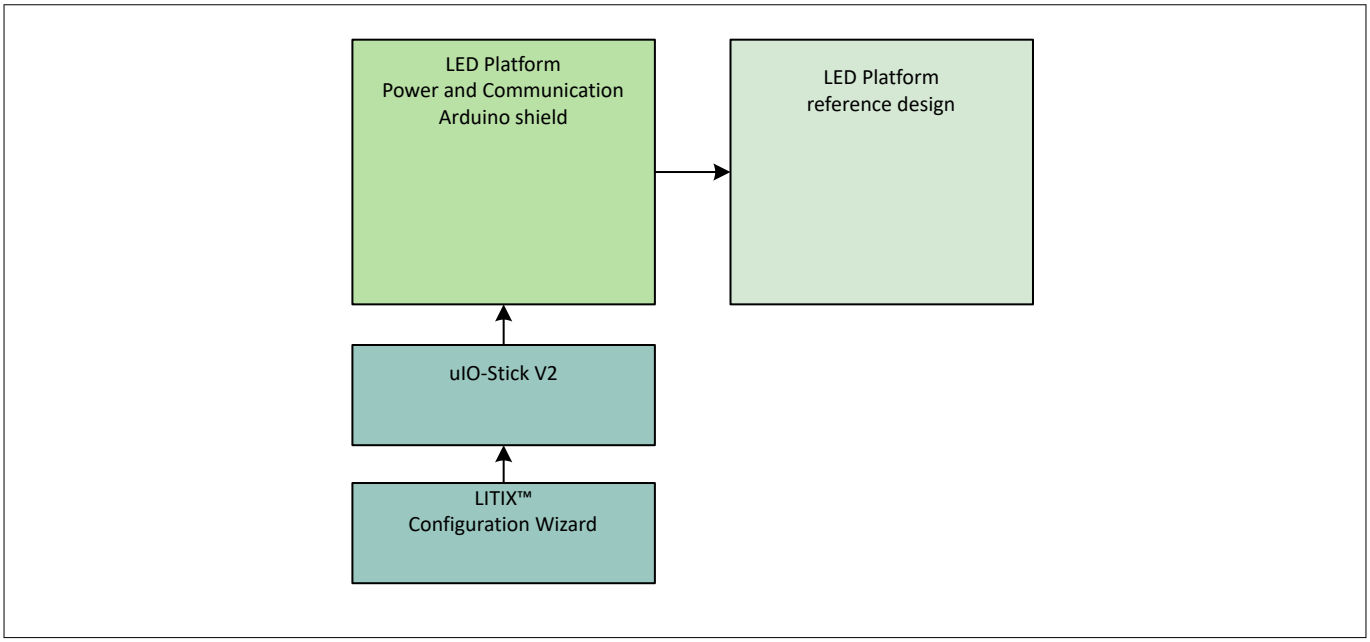


Figure 16 Emulation setup system offering

To enable the emulation mode on the reference designs, refer to the user guide of the corresponding LED Platform reference design for the detailed steps.

3 In detail: LED Platform Power and Communication Arduino Shield

3.1 Technical data

The supply's technical data is outlined in the table below. Note that the current capability varies based on the different LED Platform boards connected to the shield.

Table 2 Technical data

System Parameter	Symbol	Value
Input voltage	V_{IN}	Typ. 12 V (max. 28 V)
Input current	I_{IN}	Typ. 200 mA
Board size		133.4 mm x 55 mm

3.2 Functional description

3.2.1 Functional blocks

The LED Platform Power and Communication Arduino shield is composed of several functional blocks:

- **Reverse Polarity Protection**: this functional block comprises of the OptiMOS™-7 technology automotive power MOSFET IAUZN04S7N049 and the Schottky diode BAS3010A-03W, protecting the circuit from reverse polarity on the input connectors

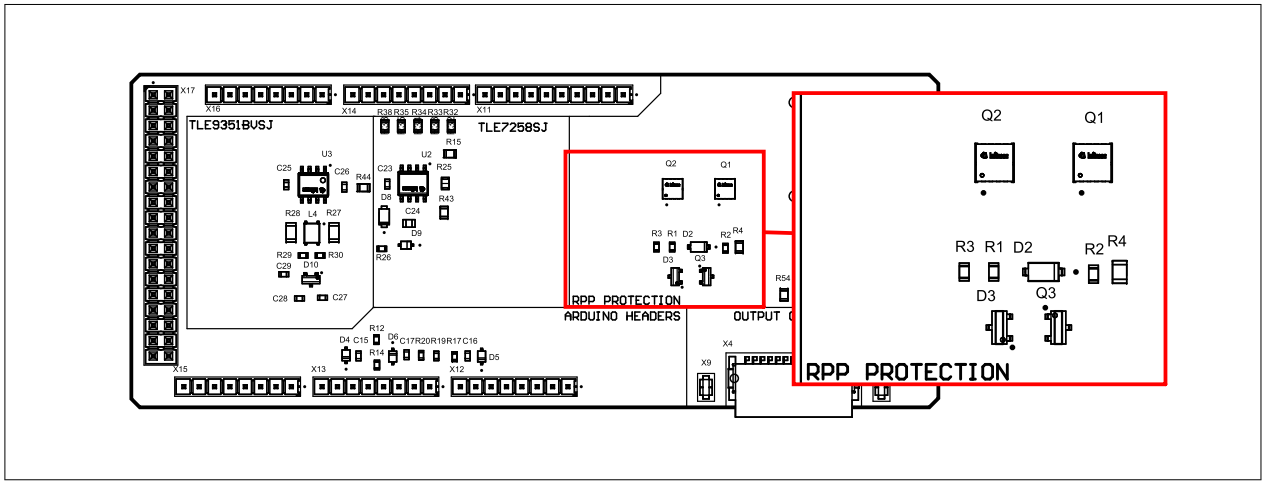


Figure 17 Reverse Polarity Protection functional block

- **SBC**: this functional block comprises of the OPTIREG™ Lite SBC TLE9461ES, enabling the communication between the Traveo™ II Starter kit and the LED Platform reference design, and managing the charge pump for the NMOS reverse polarity protection

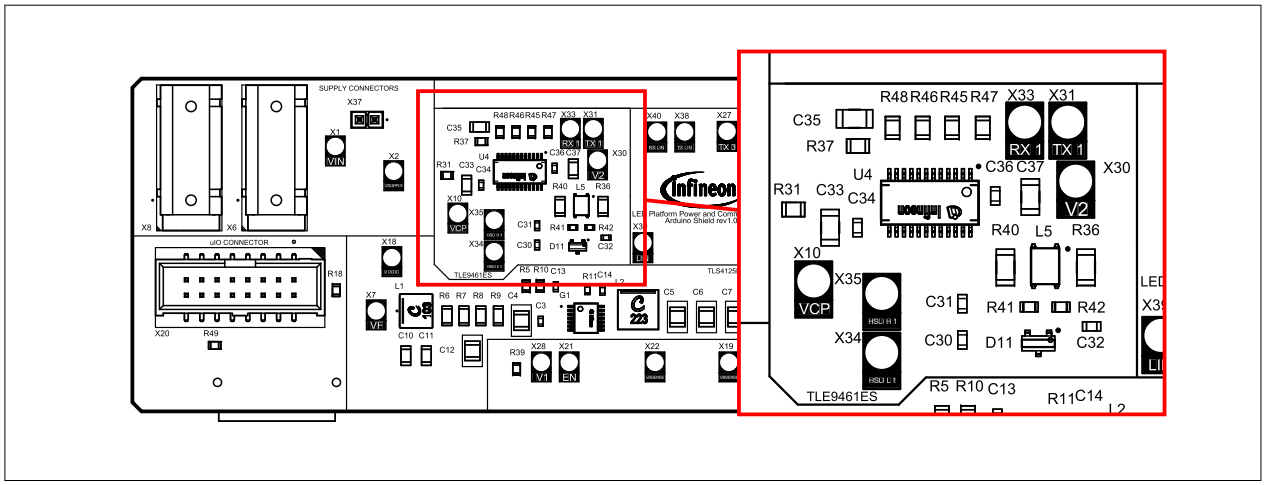


Figure 18 SBC functional block

- **DC-DC**: this functional block comprises of the OPTIREG™ Switcher TLS4125D0EP V50, supplying a fixed output voltage to the LEDs featured in the reference designs

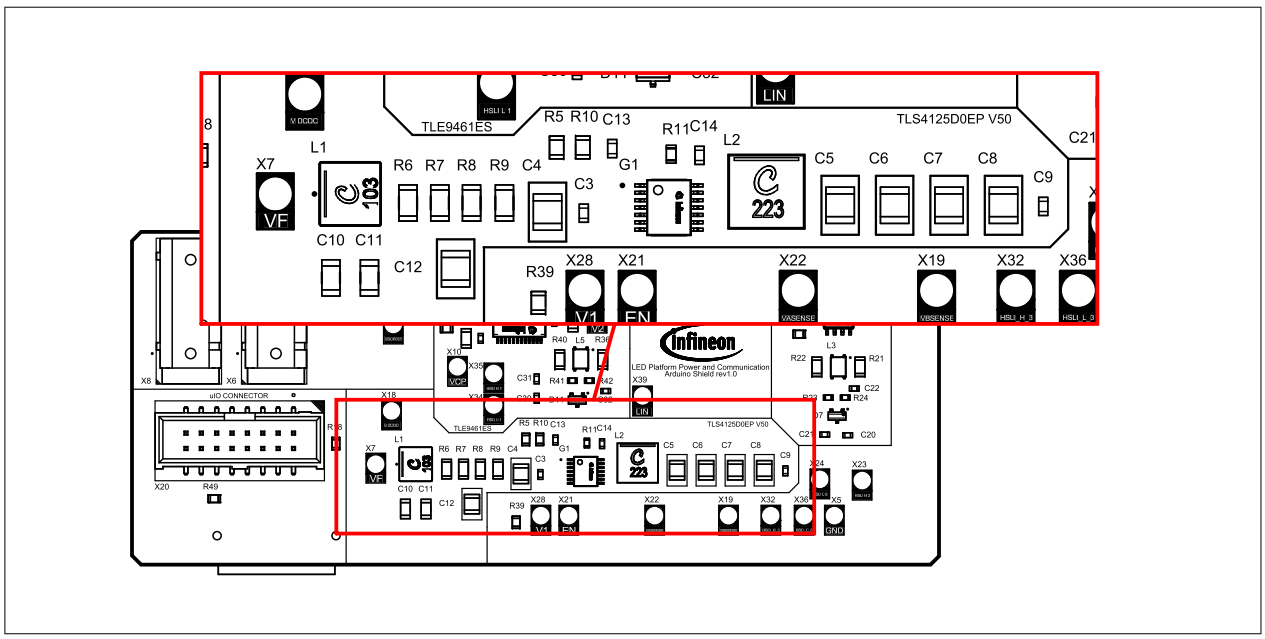


Figure 19 DC-DC functional block

- **CAN Transceiver**: this functional block comprises of the CAN transceiver TLE9351BVSJ, enabling the communication between the Traveo™ II Starter kit and the LED Platform reference design

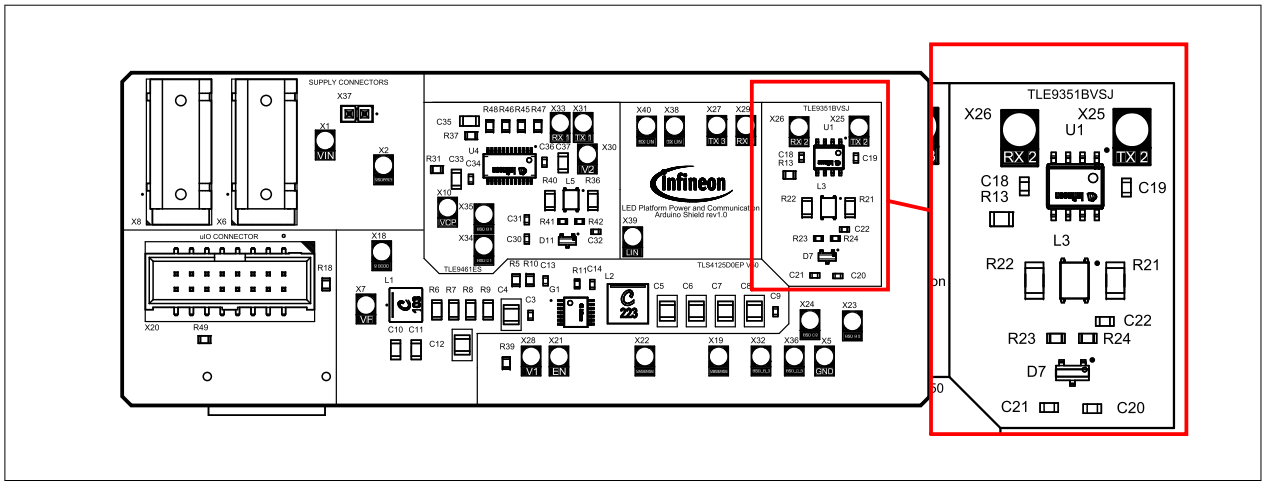


Figure 20 CAN Transceiver functional block

- **LIN Transceiver**: this functional block comprises of the LIN transceiver TLE7258SJ, enabling communication between the Traveo™ II Starter kit and the LED Platform reference design

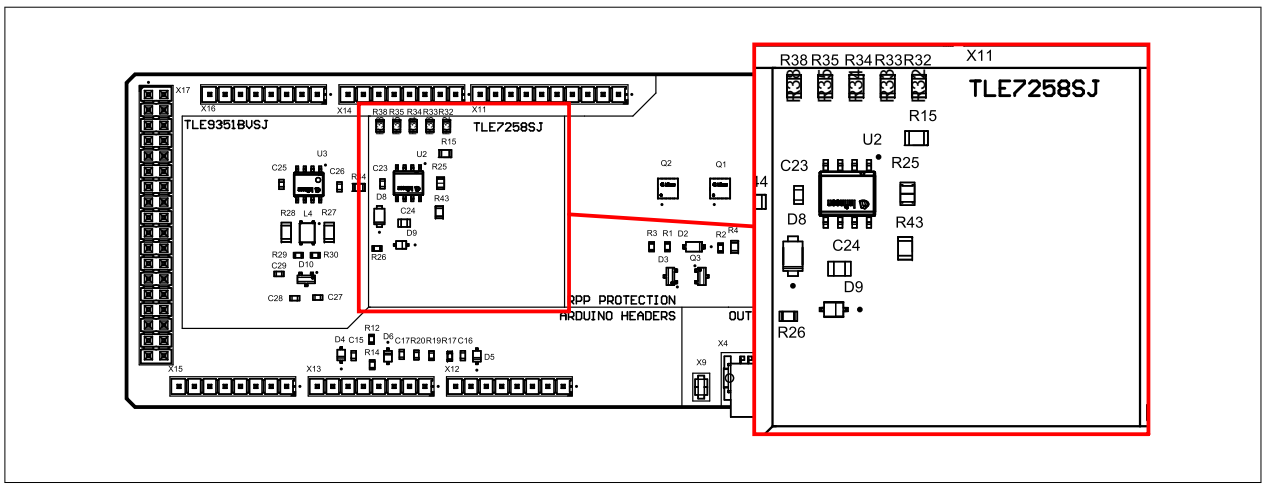


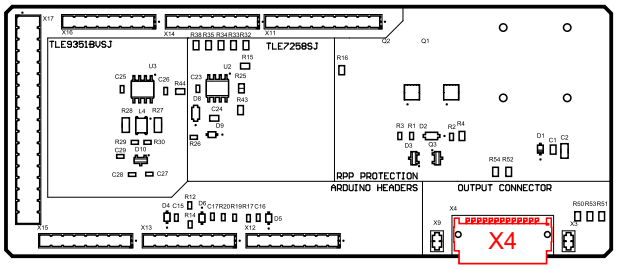
Figure 21 LIN Transceiver functional block

3.2.2 Functional connectors

The LED Platform Power and Communication Arduino shield features various types of connectors, which facilitate control of the LED Platform reference designs, with the Traveo™ II Starter kit and the uIO-Stick V2.

Output connector

The output connector (X4) serves as an interface between the Power and Communication Arduino shield and the reference designs.



X4

A1. GND	B1. V_DCDC
A2. GND	B2. V_DCDC
A3. GND	B3. V_DCDC
A4. GND	B4. V_SUPPLY
A5. GND	B5. V_SUPPLY
A6. GND	B6. HSLI_H 1
A7. HSLI_H 2	B7. HSLI_L 1
A8. HSLI_L 2	B8. HSLI_H 3
A9. GND	B9. HSLI_L 3
A10. GPIO 3	B10. LIN
A11. GPIO 2	B11. GPIO 5
A12. GPIO 1	B12. GPIO 4
A13. GPIO 0	B13. NC

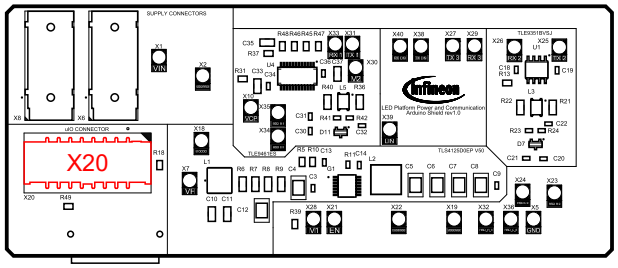
Figure 22 Output connector

Table 3 Connector pinout description

Pin	Symbol	Function
B6, A7, B8	HSLI_H	High-speed lighting interface high level I/O
B7, A8, B9	HSLI_L	High-speed lighting interface low level I/O
B10	LIN	LIN interface I/O
A13, A12, A11, A10, B12, B11	GPIOs	GPIOs with different functions for different reference designs
B1, B2, B3	V_DCDC	Power supply voltage pin for the LEDs
A1, A2, A3, A4, A5, A6, A9	GND	Ground potential for digital, analog and power

uIO-Stick V2 Connector

The Power and Communication Arduino shield serves as a convenient interface between the uIO-Stick V2 and the reference designs, with the connection established through the X20 connector.



X20

1. HSLI_H	2. GND
3. HSLI_L	4. NC
5. LIN	6. V_SUPPLY
7. NC	8. GPIO 3
9. NC	10. GPIO 2
11. GPIO 5	12. GPIO 1
13. GPIO 4	14. GPIO 0

Figure 23 uIO-Stick V2 connector

Arduino header

The Power and Communication Arduino shield features Arduino Mega form factor connectors, enabling seamless interfacing with the Traveo™ II Starter Kit, and other boards compatible with the Arduino Mega standard.

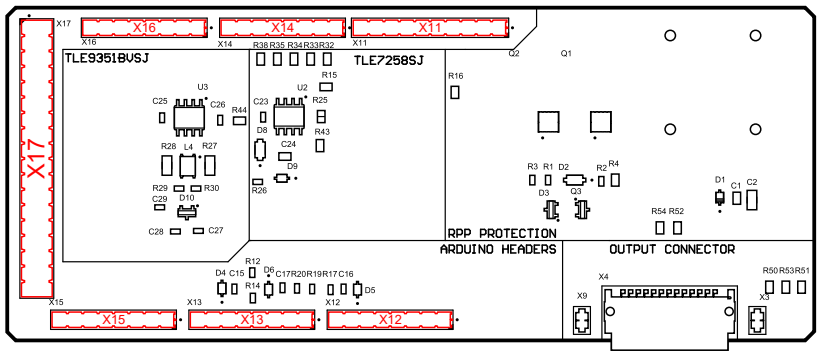


Figure 24 Arduino form factor connectors

Table 4 Connectors pinout description

Connector reference	Pin number	Symbol	Function
X12	2, 5, 8	V1_T	Supply line for the controller
X12	6,7	GND	Ground connection with the controller
X13	1,3	VS_SENSE, VD_SENSE	Connection to V_SUPPLY and V_DCDC
X13	2	EN_DCDC	Enable/disable pin for the DCDC
X13	4	GPIO_3	GPIO connected to the reference designs

(table continues...)

Table 4 (continued) Connectors pinout description

Connector reference	Pin number	Symbol	Function
X13	5,6,7	RST_SBC, STB_1, STB_2	GPIOs to control the HSLI transceivers
X17	35,36	GND	Ground connection with the controller
X17	25, 26	RX_LIN, TX_LIN	Connection to the LIN transceiver
X16	1,2	TX_2, RX_2	Connection to the CAN transceiver
X16	3,4	TX_3, RX_3	Connection to the CAN transceiver
X16	5,6	TX_1, RX_1	Connection to the CAN transceiver
X14	2,3,4,5,6	GPIO_5, GPIO_0, GPIO_2, GPIO_4, GPIO_1	GPIOs connected to the reference designs
X11	4	GND	Ground connection with the controller
X11	5,6,7,8	SPI_CLK, SPI_MISO, SPI_MOSI, SPI_CS	Connection to the SPI peripheral of the SBC

4 Hardware design guide

4.1 Components selection

Reverse Polarity Protection

The Power and Communication Arduino shield is designed with built-in protection against reverse polarity, ensuring safe and reliable operation. To achieve this protection, the shield's supply is divided into two separate paths: one for the logic part and one for the power part. This division allows for the implementation of different protection mechanisms, each tailored to the specific requirements of its respective path.

The logic part of the shield is protected by the Infineon Schottky diode BAS3010A-03W, which provides low voltage and fast clamping protection. This diode is specifically chosen for its ability to quickly respond to voltage spikes and surges, ensuring that the logic part of the shield remains safe and functional.

In contrast, the power part of the shield requires a different type of protection. To address this, the Infineon OptiMOS™-7 NMOS IAUZN04S7N049 has been used for the reverse polarity protection circuit, which is activated by the charge pump of the OPTIREG™ SBC TLE9461ES. This protection circuit is designed to provide low voltage drop and high current capability, making it ideal for protecting the power delivered to the reference designs.

DC-DC Converter

The Power and Communication Arduino shield is designed to provide a stable and efficient power supply to the reference designs. They are designed to operate with a single *LED* per string, which requires a fixed output voltage of 5 V. To achieve this, the shield utilizes the OPTIREG™ TLS4125D0EP V50 DC-DC converter, which is specifically chosen for its ability to provide a fixed output voltage of 5 V, with a high current capability of 2.5 A. This high current capability ensures that the shield can provide the necessary power to the reference designs, even when multiple designs are connected.

The Power and Communication Arduino shield's design incorporates the OPTIREG™ TLS4125D0EP V50 DC-DC converter, which is optimized for high power conversion efficiency and stability. To achieve this, the surrounding components are carefully selected and simulated with the Infineon Designer, the online SPICE simulator. The design aims to achieve a power conversion efficiency above 85%, at the typical working voltage, reducing the heat generation. The design also focuses on achieving a stable output with a phase margin above 60° degrees. This ensures that the output voltage remains stable and regulated, even in the presence of input voltage variations or load changes. A high phase margin also improves the transient response performance of the converter.

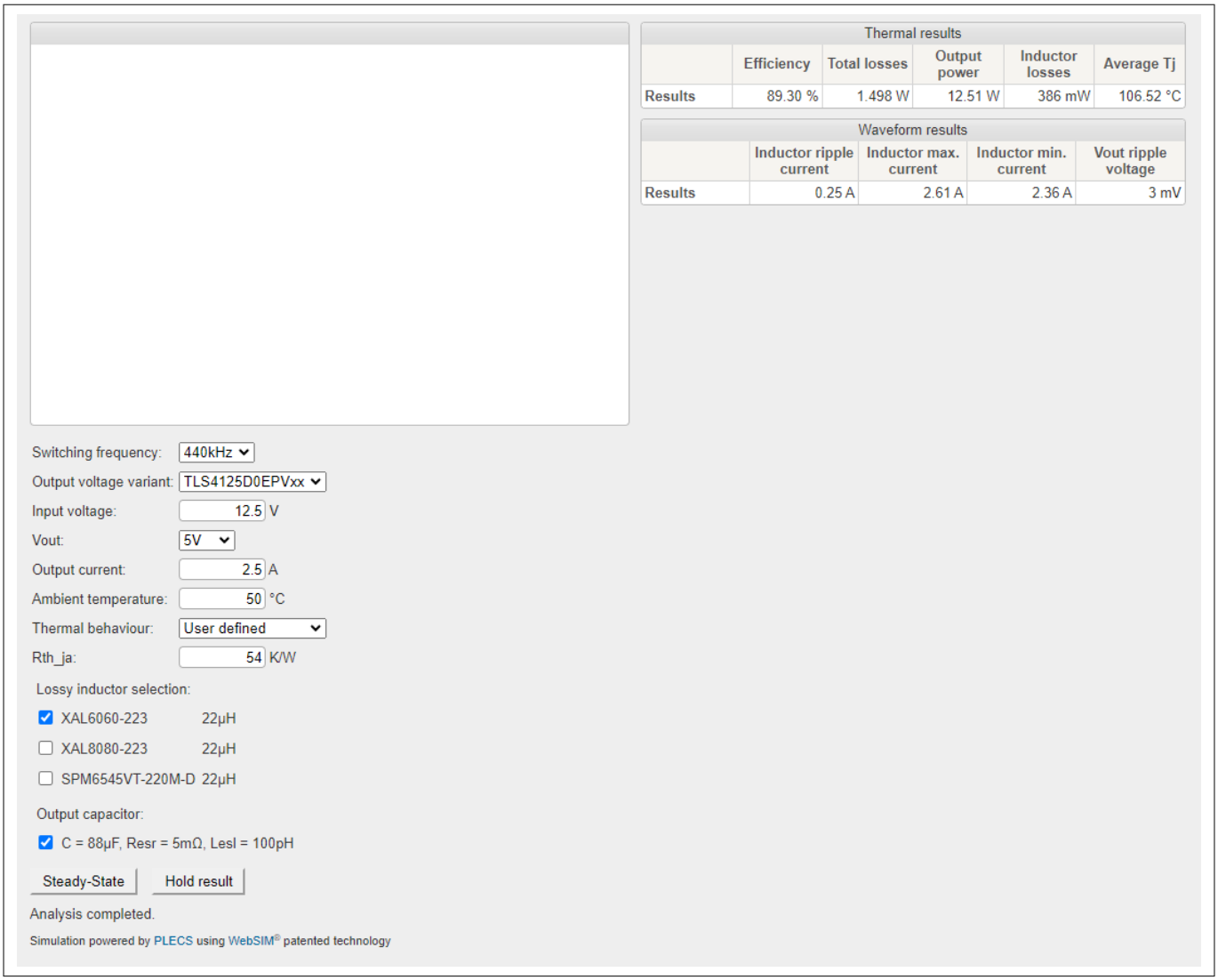


Figure 25 DC-DC simulated efficiency

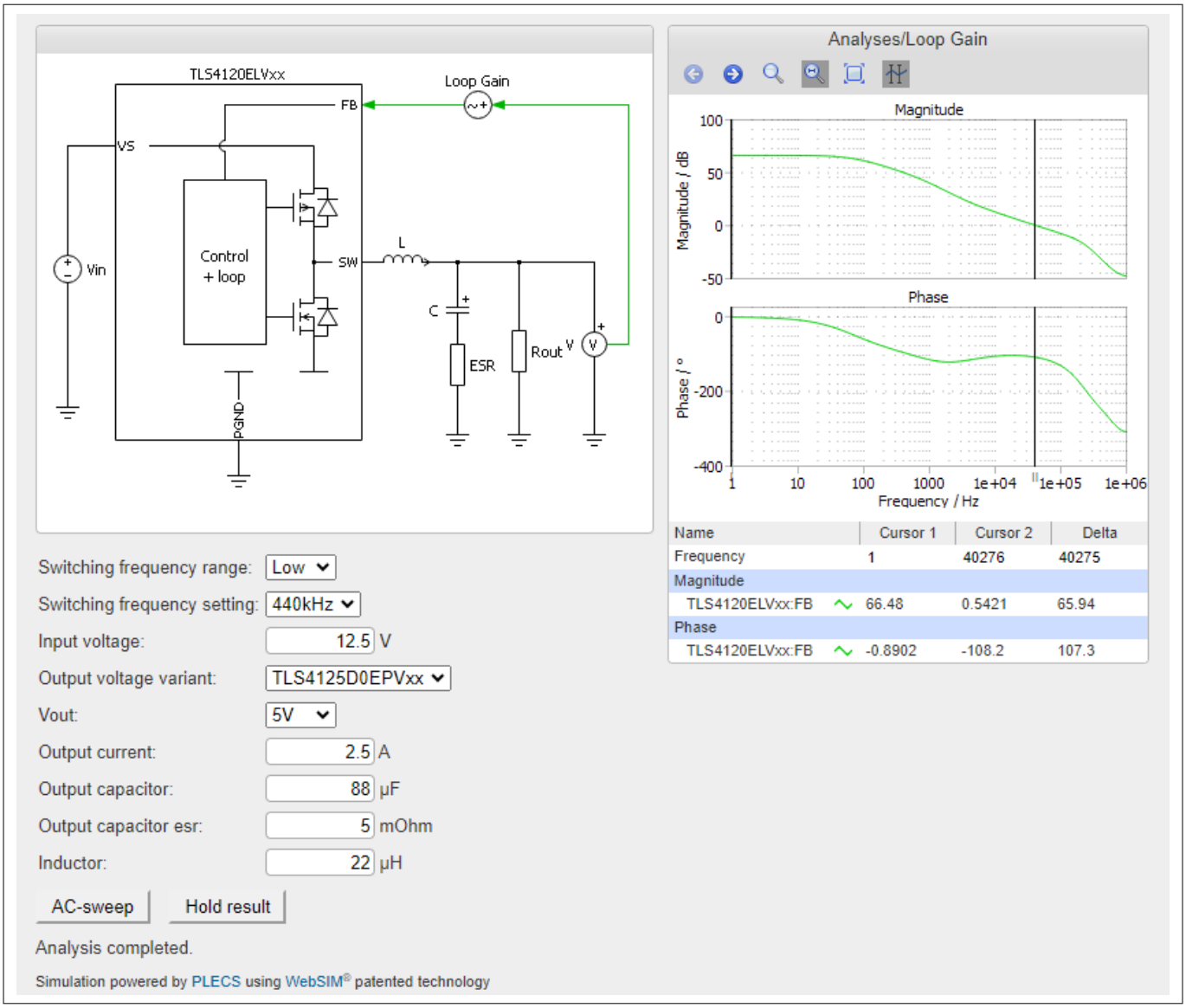


Figure 26 DC-DC simulated stability

EMI input PI filter

To reduce *electromagnetic interference (EMI)* from the DC-DC converter, a π filter is implemented with a low-pass configuration to filter the high-frequency noise. The switching frequency of the DC-DC is set to 440 Hz, the corner frequency of the π filter must be, as a rule of thumb, around 1/10 of the switching frequency of the DC-DC. Since the inductor is the most expensive component of the filter, its value has been selected first, with a standard value of 10 µH. Then, the capacitors value has been computed using the following formula:

$$f_C = \frac{1}{2\pi \cdot \sqrt{LC}} \quad \rightarrow \quad C = \quad 1.5 \quad \mu F$$

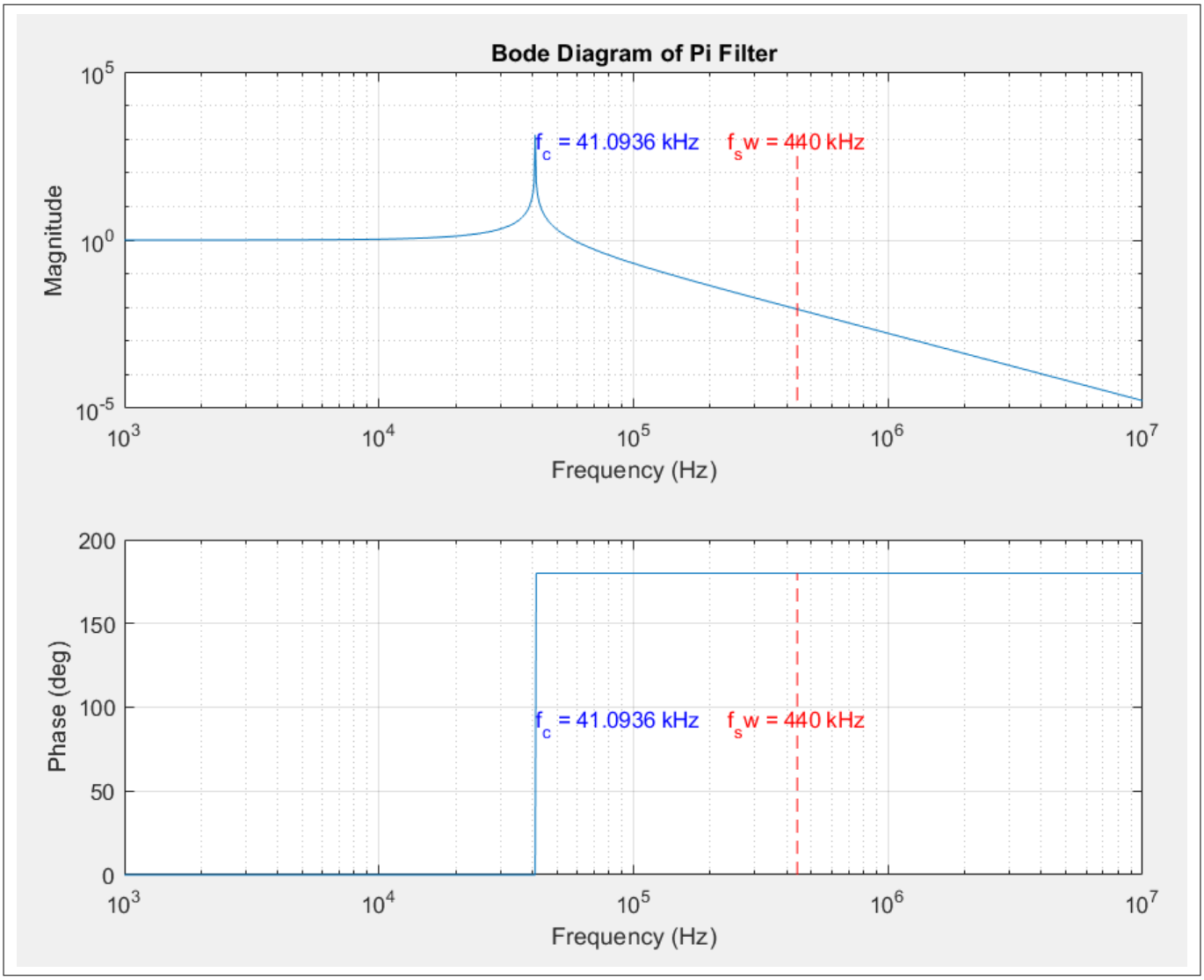


Figure 27 PI filter simulated performance

In addition to the π filter, a damping circuit has been implemented to prevent unwanted oscillations near the resonance frequency of the π filter. The π filter, while effective in reducing noise and ripple, sometimes introduces a resonant peak at the corner frequency. The damping circuit is carefully designed to minimize the impact on the overall system performance, while effectively reducing the resonance.

The resistor of the damping filter has been computed using the following formula:

$$R = \sqrt{\frac{L_{PI}}{C_{PI}}} = 2.5 \quad \Omega \quad \rightarrow R_D = 3 \quad \Omega$$

The capacitor, in series to the resistor, blocks the *direct current (DC)* portion of the input voltage in order to reduce the power dissipation in the damping resistor. To have an optimized damping effect, the ratio of the blocking capacitor and the π filter capacitor should be between 5 and 10, for this reason the value of the blocking capacitor is 10 µF.

SBC Selection

The OPTIREG™ SBC TLE9461ES has been selected for these features:

- One 5 V *low dropout regulator (LDO)* to supply the Traveo™ II Starter kit
- Another 5 V LDO to supply the internal *CAN* transceiver and one additional TLE9351BVSJ

- Configurable charge pump to activate the NMOS reverse polarity protection
- Included in the approval component list of the majority of *original equipment manufacturer (OEM)*s

4.2 Layout design

HSLI differential impedance traces

It is crucial for the Power and Communication Arduino shield to maintain a consistent 120 Ω differential impedance for the *HSLI* lines, as this prevents signal reflections and distortions. To achieve this, careful attention was paid to the selection of resistors for the termination. Furthermore, all tracks involved in HSLI communication was designed to match the 120 Ω differential impedance. This ensures that the signal integrity is preserved, and the risk of errors or data corruption is minimized.

To facilitate this, Altium's impedance control feature was utilized, allowing for the precise management of trace impedance throughout the design. By leveraging this functionality, the differential impedance of the HSLI lines were maintained at 120 Ω, ensuring optimal signal quality and reliability.

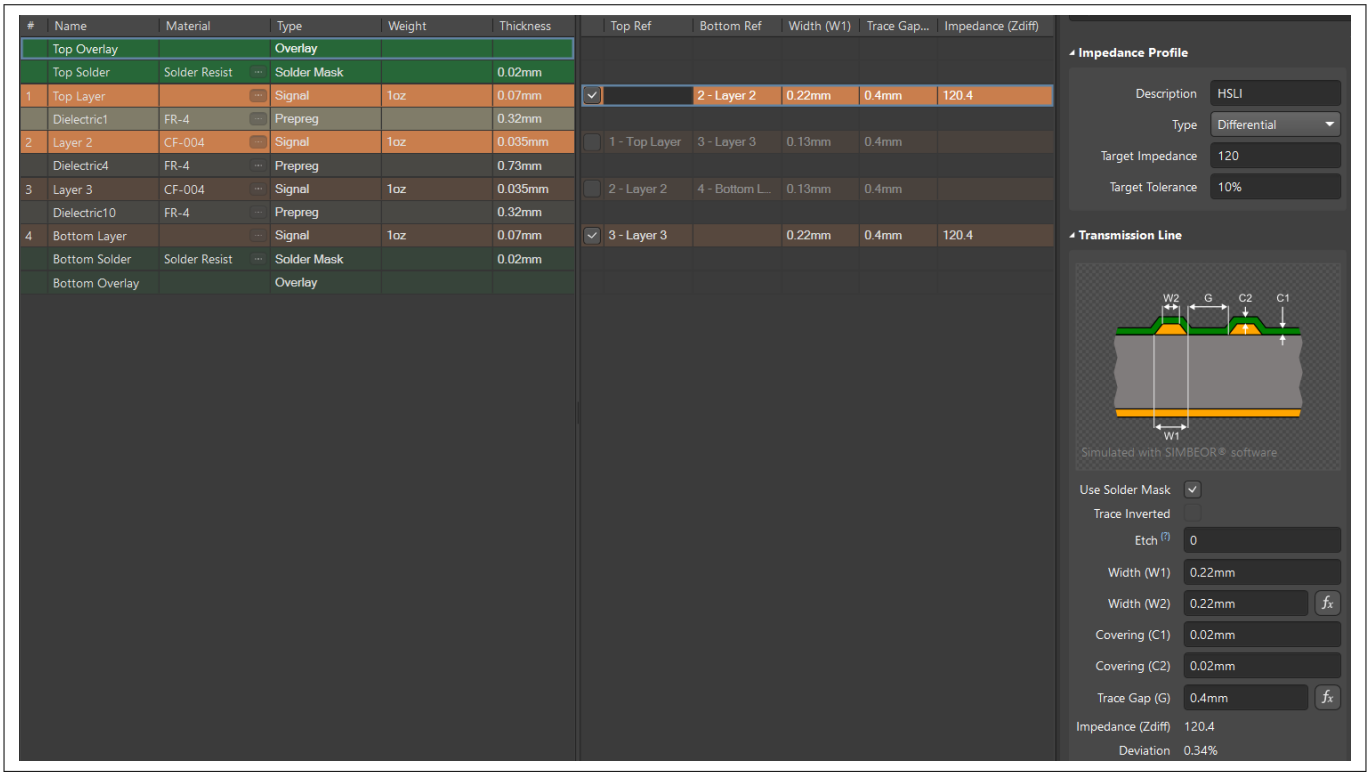


Figure 28 Altium HSLI trace configuration

DC-DC Power path loops

The simplified schematic of a synchronous buck converter has four different power path loops, as shown in the figure below. The TLD4125D0EP V50 has integrated power switches (SW1 and SW2). The *alternating current (AC)* loops 2 and 3 are the most critical in the *PCB* layout and has been given an higher priority. However, the *DC* loops must not be ignored as they do effect efficiency, regulation and stability due to long, high current DC traces are resistant and have inductance.

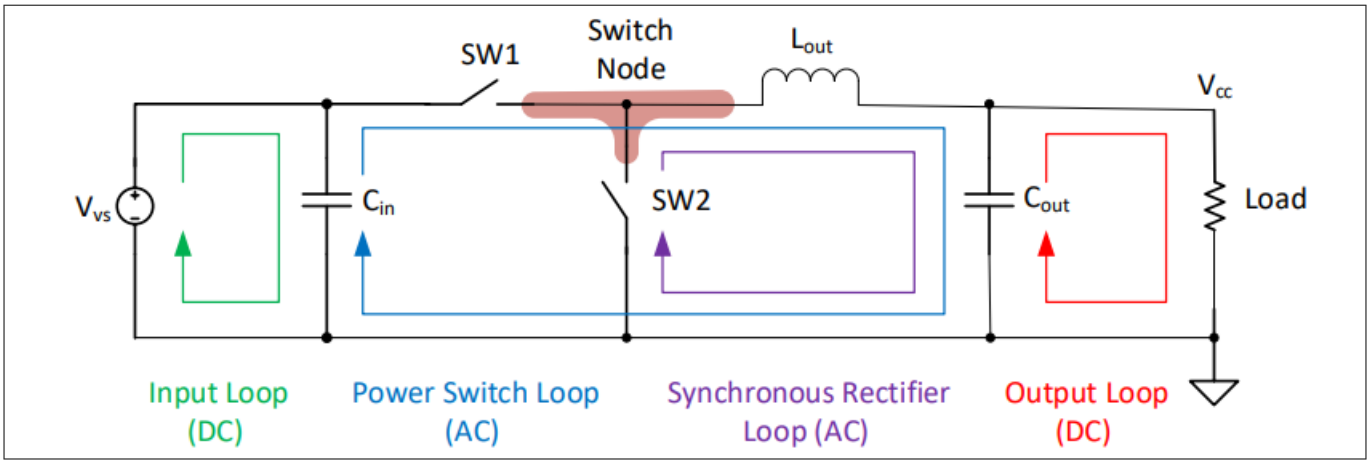


Figure 29 Buck Converter Power Path Loops

The TLD4125D0EP V50 implementation on the Power and Communication Arduino shield prioritizes the placement and the routing of the switch nodes, the AC loops and then the DC loops. More information can be found in the OPTIREG™ switcher TLS412x PCB layout and routing guidelines.

GND Plane

The Power and Communication Arduino shield is assembled on a 4-layer PCB, one of them is completely dedicated to provide a *ground (GND)* connection. The GND plane is useful as it reduces the noise providing a low-impedance path for the return currents.

5 Design files

5.1 Schematics

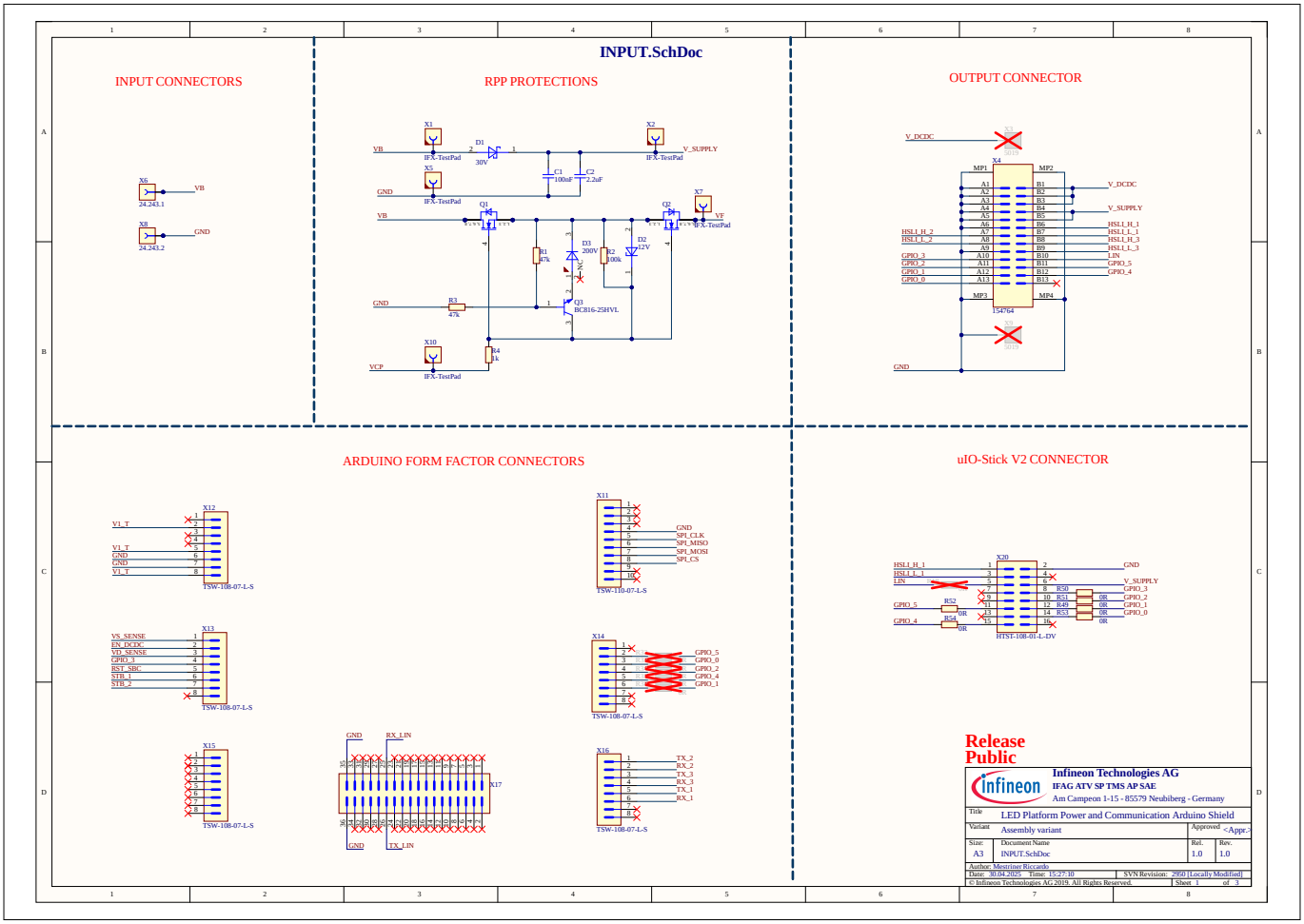


Figure 30 Power and Communication Arduino shield, sheet 1

5 Design files

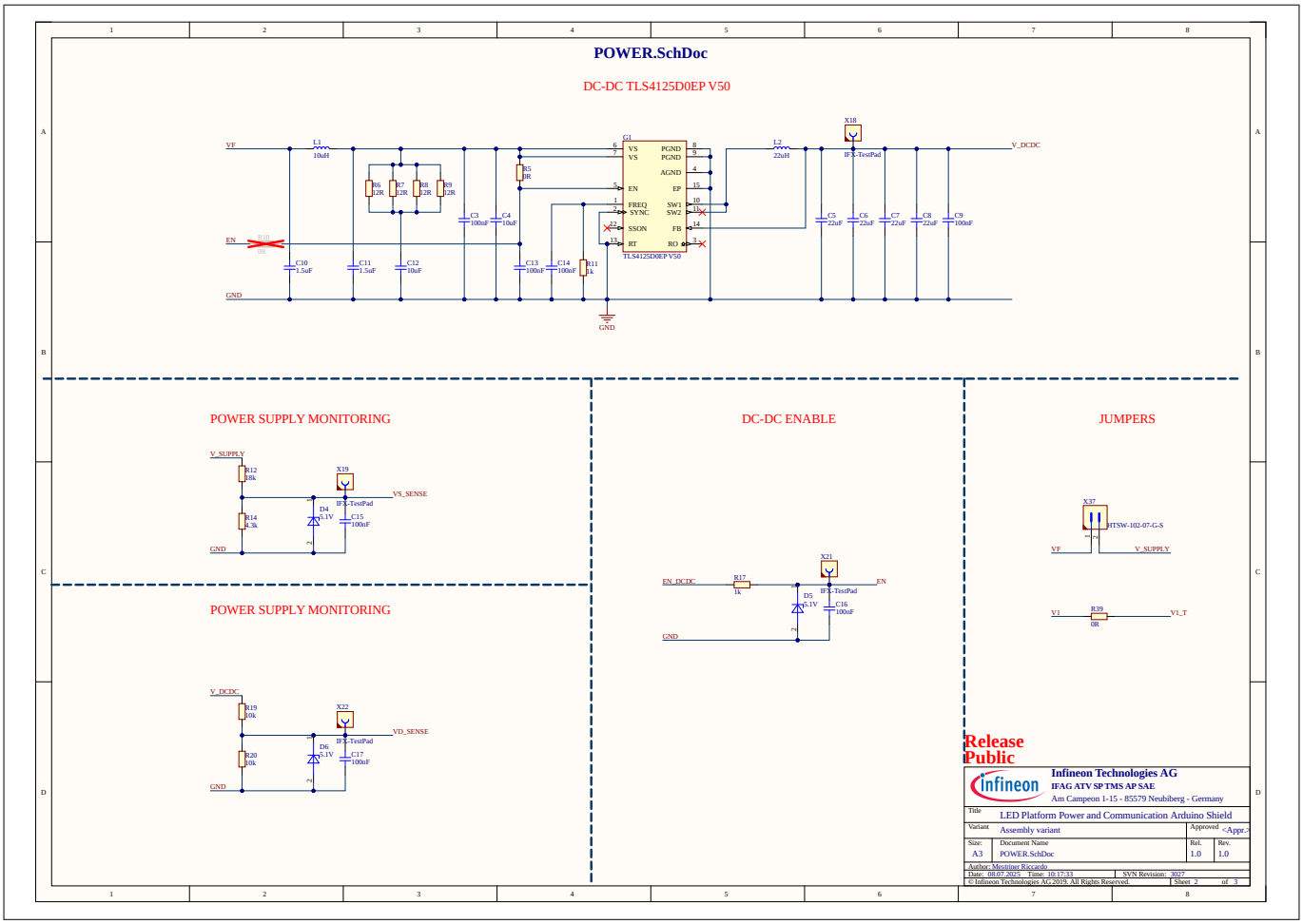


Figure 31 Power and Communication Arduino shield, sheet 2

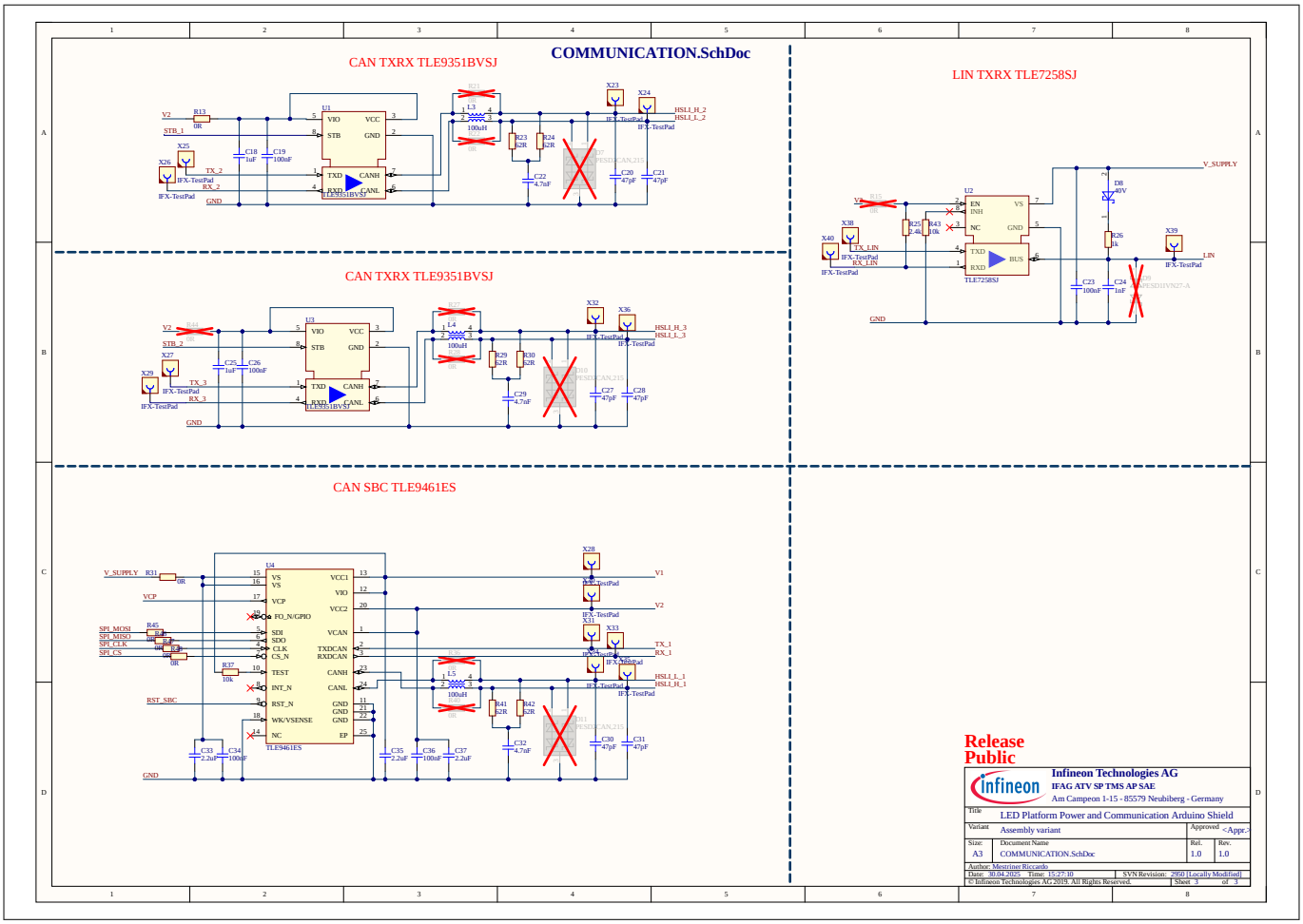


Figure 32 **Power and Communication Arduino shield, sheet 3**

5.2 Layout

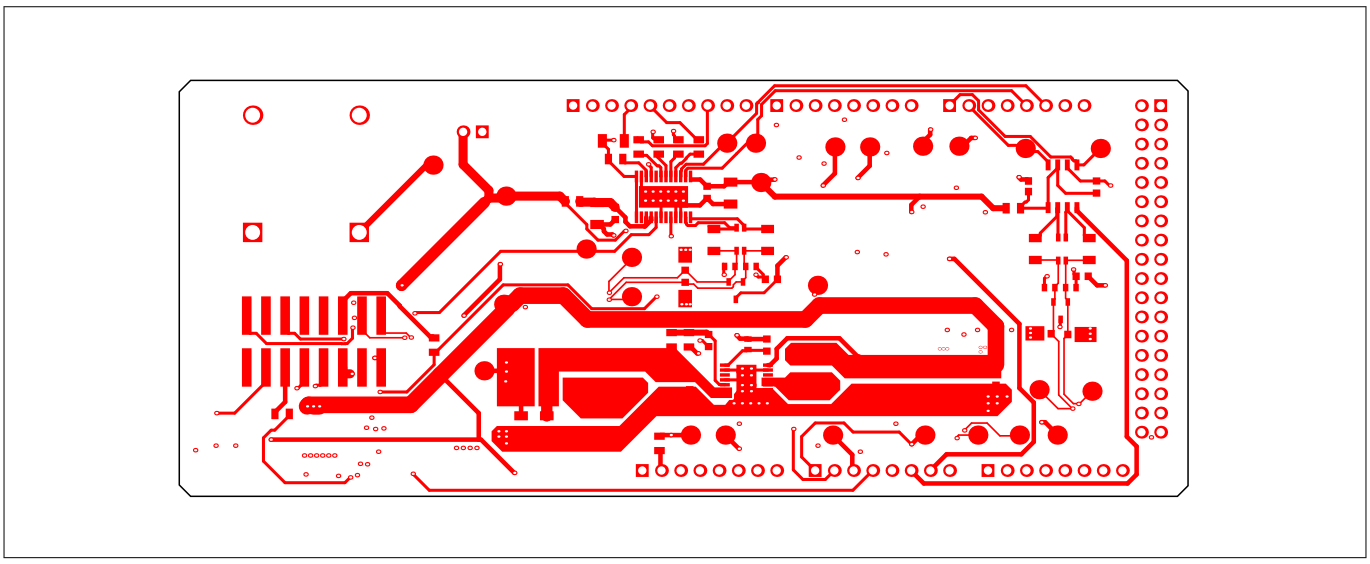


Figure 33 **Power and Communication Arduino shield layer 1 (top layer, signal)**

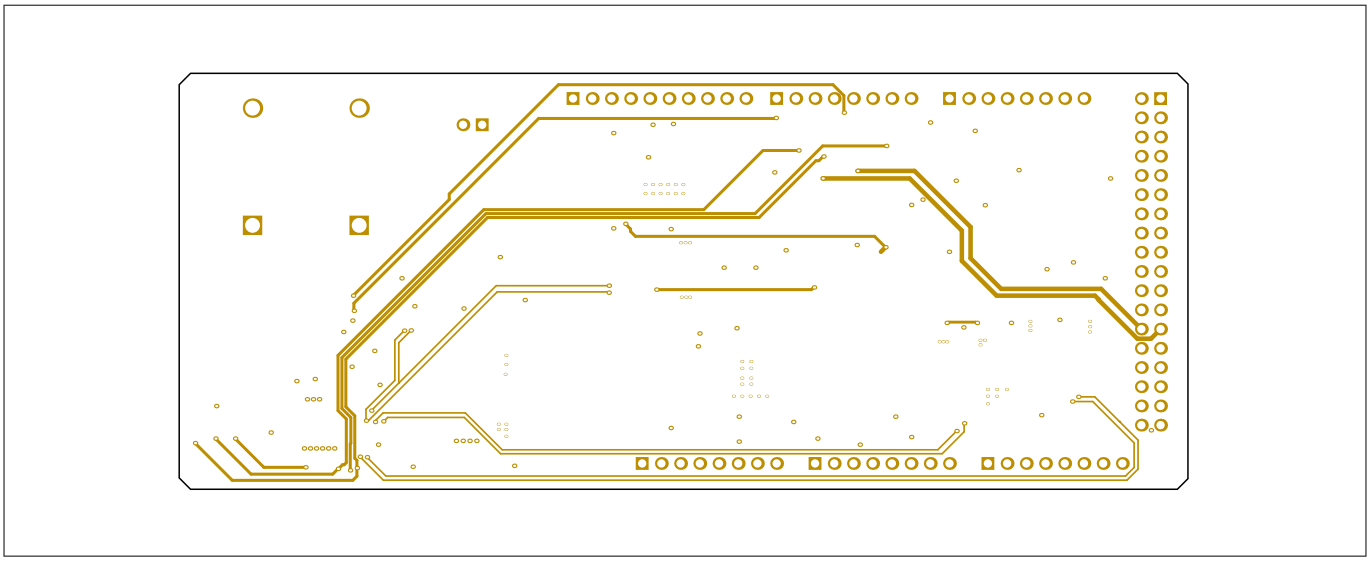


Figure 34 **Power and Communication Arduino shield layer 2 (middle layer, signal)**

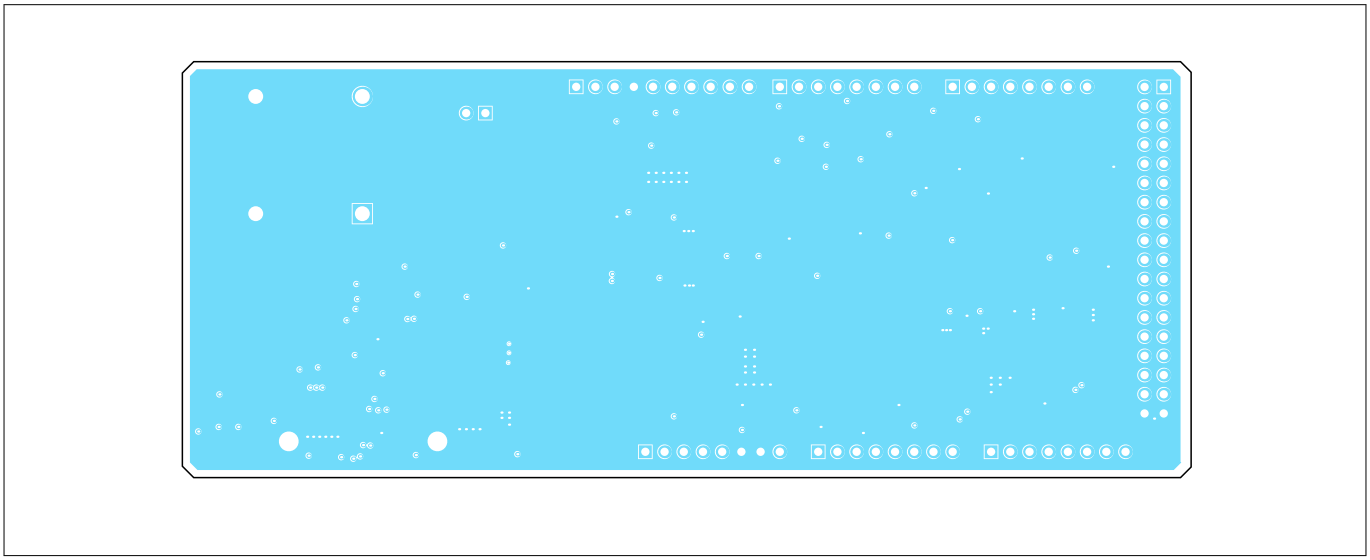


Figure 35 **Power and Communication Arduino shield layer 3 (middle layer, GND plane)**

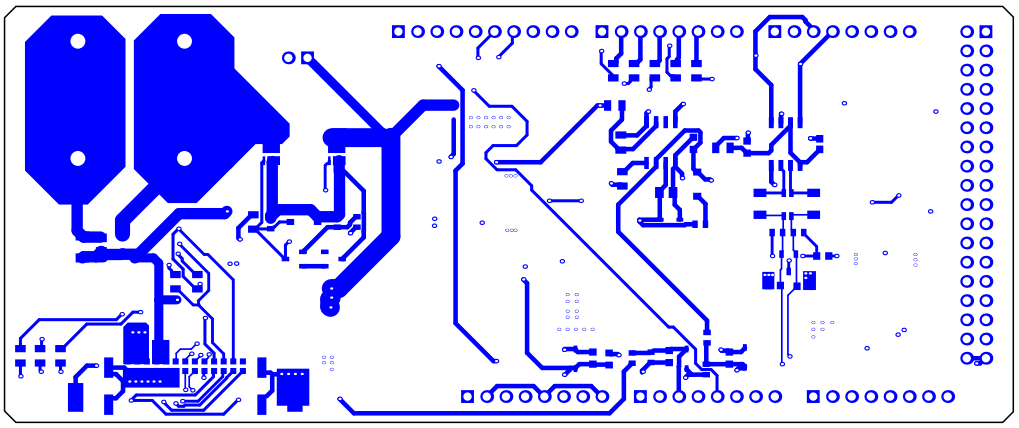


Figure 36 Power and Communication Arduino shield layer 4 (bottom layer, signal)

5.3 Bill of materials

All the components used for the Power and Communication Arduino shield are automotive-qualified. The complete bill of material (BOM) is shown below.

Table 5 BOM Power and Communication Arduino shield

Designator	Description	Quantity	Manufacturer order number	Manufacturer
Q1, Q2	Insulated-Gate Field-Effect Transistor (IGFET), N-Channel, Enhancement, Body Diode, Pin 1 Source, 2 Source, 3 Source, 4 Gate, 5 Drain, 6 Drain, 7 Drain, 8 Drain, 8 Pins	2	IAUZN04S7N049	Infineon Technologies
R5, R13, R31, R39, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54	RES / STD / 0 R / 125 mW / 0 R / 0 ppm/K / -55°C to 155°C / 0805(2012) / SMD / -	14	AC0805JR-070RL	Yageo
R17	RES / STD / 1 k / 100 mW / 1% / 100 ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	1	ERJ-3EKF1001V	Panasonic

(table continues...)

Table 5 (continued) BOM Power and Communication Arduino shield

Designator	Description	Quantity	Manufacturer order number	Manufacturer
R4	RES / STD / 1 k / 125 mW / 1% / 100 ppm/K / -55°C to 155°C / 0805(2012) / SMD / -	1	AC0805FR-071KL	Yageo
R11, R26	RES / STD / 1 k / 100 mW / 1% / 100 ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	2	CRCW06031K00FK	Vishay
C24	CAP / CERA / 1 nF / 50 V / 10% / X7R (EIA) / -55°C to 125°C / 0805(2012) / SMD / -	1	C0805C102K5RACTU	Kemet
C18, C25	CAP / CERA / 1 uF / 25 V / 10% / X7R (EIA) / -55°C to 125°C / 0603(1608) / SMD / -	2	CGA3E1X7R1E105K080AC	TDK Corporation
C10, C11	CAP / CERA / 1.5 uF / 50 V / 5% / X7R (EIA) / -55°C to 125°C / 1206(3216) / SMD / -	2	GCM31CR71H155JA55	MuRata
C2, C33, C35, C37	CAP / CERA / 2.2 uF / 50 V / 10% / X7R (EIA) / -55°C to 125°C / 1206(3216) / SMD / -	4	GCM31CR71H225KA55L	MuRata
R25	RES / STD / 2.4 k / 125 mW / 1% / 100 ppm/K / -55°C to 155°C / 0805(2012) / SMD / -	1	CRCW08052K40FK	Vishay
R14	RES / STD / 4.3 k / 100 mW / 1% / 100 ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	1	CRCW06034K30FK	Vishay

(table continues...)

Table 5 (continued) BOM Power and Communication Arduino shield

Designator	Description	Quantity	Manufacturer order number	Manufacturer
C22, C29, C32	CAP / CERA / 4.7 nF / 50 V / 10% / X8R (EIA) / -55°C to 150°C / 0603(1608) / SMD / -	3	GCM188R91H472KA37	MuRata
D4, D5, D6	Small Signal Zener Diode	3	GDZ5V1B-G3-08	Vishay
R19, R20	RES / STD / 10 k / 100 mW / 1% / 100 ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	2	RMCF0603FT10K0	Stackpole Electronics
R37, R43	RES / STD / 10 k / 125 mW / 1% / 50 ppm/K / -55°C to 155°C / 0805(2012) / SMD / -	2	RT0805FRE0710KL	Yageo
C4, C12	CAP / CERA / 10 uF / 50 V / 20% / X7S (EIA) / -55°C to 125°C / 1210(3225) / SMD / -	2	CGA6P3X7S1H106M250AB	TDK Corporation
L1	IND / STD / 10 uH / 3.6 A / 20% / -40°C to 125°C / 40.9 mR / SMD / 5.28x5.48x5.1 mm / SMD / -	1	XAL5050-103MEC	Coilcraft
R6, R7, R8, R9	RES / STD / 12 R / 250 mW / 1% / 100 ppm/K / -55°C to 155°C / 1206(3216) / SMD / -	4	CRCW120612R0FK	Vishay
D2	Zener Voltage Regulators 500 mW SOD-123 Surface Mount	1	MMSZ4699T1G	ON Semiconductor
R12	RES / STD / 18 k / 100 mW / 1% / 100 ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	1	CRCW060318K0FK	Vishay

(table continues...)

Table 5 (continued) BOM Power and Communication Arduino shield

Designator	Description	Quantity	Manufacturer order number	Manufacturer
C5, C6, C7, C8	CAP / CERA / 22 uF / 16 V / 20% / X7R (EIA) / -55°C to 125°C / 1210(3225) / SMD / -	4	CGA6P1X7R1C226M250AC	TDK Corporation
L2	IND / STD / 22 uH / 3.6 A / 20% / -40°C to 125°C / 61 mR / SMD / DFN;2 pin,6.36 mm L X 6.56 mm W X 6.10 mm H / SMD / -	1	XAL6060-223ME	Coilcraft
D1	Medium Power AF Schottky Diode	1	BAS3010A-03W	Infineon Technologies
D8	Low VF Trench MEGA Schottky Barrier Rectifier	1	PMEG40T10ERX	Nexperia
R1, R3	RES / STD / 47 k / 100 mW / 1% / 100 ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	2	CRCW060347K0FK	Vishay
C20, C21, C27, C28, C30, C31	CAP / CERA / 47 pF / 50 V / 10% / C0G (EIA) / NP0 / -55°C to 125°C / 0603(1608) / SMD / -	6	C0603C470K5GACAUTO	Kemet
R23, R24, R29, R30, R41, R42	RES / STD / 62 R / 100 mW / 1% / 100 ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	6	CRCW060362R0FK	Vishay
R2	RES / STD / 100 k / 100 mW / 1% / 100 ppm/K / -55°C to 155°C / 0603(1608) / SMD / -	1	CRCW0603100KFK	Vishay
C1	CAP / CERA / 100 nF / 50 V / 10% / X8R (EIA) / -55°C to 150°C / 0805(2012) / SMD / -	1	CGA4J2X8R1H104K125AA	TDK Corporation

(table continues...)

Table 5 (continued) BOM Power and Communication Arduino shield

Designator	Description	Quantity	Manufacturer order number	Manufacturer
C3, C9, C13, C14, C15, C16, C17, C19, C23, C26, C34, C36	CAP / CERA / 100 nF / 25 V / 5% / X7R (EIA) / -55°C to 125°C / 0603(1608) / SMD / -	12	C0603C104J3RAC	Kemet
L3, L4, L5	IND / STD / 100 uH / 150 mA / 50% / -55°C to 150°C / 1.5 R / 1210(3225) / Filter SMD, 4-Leads, Molded Body 3.20 mm L X 2.50 mm W X 2.5 mm H / SMD / -	3	ACT1210-101-2P-TL00	TDK Corporation
D3	High-voltage switching diode, Reverse voltage VR = 200 V	1	BAS21,215	Nexperia
X4	Male SMC-B 26 SMD type7-03, 1.27 mm pitch, 26 pin, Double Row	1	154764	ERNI
X6	Banana Test Connector, 4 mm, Socket, PCB Mount, 24 A, 60 VDC, Silver Plated Contacts, Red	1	24.243.1	Multicomp
X8	Banana Test Connector, 4 mm, Socket, PCB Mount, 24 A, 60 VDC, Silver Plated Contacts, Black	1	24.243.2	Multicomp
Q3	NPN general-purpose transistors, Surface-Mounted Device (SMD), Application General-purpose switching and amplification	1	BC816-25HVL	Nexperia

(table continues...)

Table 5 (continued) BOM Power and Communication Arduino shield

Designator	Description	Quantity	Manufacturer order number	Manufacturer
X17	Through hole .025 SQ Post Header, 2.54 mm pitch, 36 pin, vertical, double row	1	TSW-118-23-L-D	Samtec
X20	SMT, .025 Shrouded SQ POST IDC Headers , 2.54 mm pitch, 16-pin Vertical, Double row	1	HTST-108-01-L-DV	Samtec
X37	Through hole .025 SQ Post Header, 2.54 mm pitch, 2 pin, vertical, single row	1	HTSW-102-07-G-S	Samtec
U2	LIN Transceiver-Slave	1	TLE7258SJ	Infineon Technologies
U1, U3	High speed CAN FD Transceiver	2	TLE9351BVSJ	Infineon Technologies
U4	Lite CAN SBC Family	1	TLE9461ES	Infineon Technologies
G1	DC to DC Converter Step-Down Synchronous 2.8 MHz, 5 V, 2.5 A	1	TLS4125D0EP V50	Infineon Technologies
X12, X13, X14, X15, X16	Through hole .025 SQ Post Header, 2.54 mm pitch, 8 pin, vertical, single row	5	TSW-108-07-L-S	Samtec
X11	Through hole .025 SQ Post Header, 2.54 mm pitch, 10 pin, vertical, single row	1	TSW-110-07-L-S	Samtec

References

[1] *Infineon - TLD7002-16ES hardware design guideline*: https://www.infineon.com/dgdl/Infineon-TLD7002-16ES_hardware_design_guideline-ApplicationNotes-v01_10-EN.pdf?fileId=8ac78c8c956a0a470195a9f2ac7878df

[2] *Infineon - OPTIREG™ switcher TLS412x PCB layout and routing guidelines*: https://www.infineon.com/dgdl/Infineon-Z8F65942697_TLS412x_layout-ApplicationNotes-v01_00-EN.pdf?fileId=5546d46272e49d2a01730462233a5deb&da=t

Glossary

AC

alternating current (AC)

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.

CAN

controller area network (CAN)

DC

direct current (DC)

One-directional flow of electric charge. An electrochemical cell is a prime example of DC power. Direct current may flow through a conductor such as a wire, but can also flow through semiconductors, insulators, or even through a vacuum as in electron or ion beams. The electric current flows in a constant direction, distinguishing it from alternating current (AC).

EMI

electromagnetic interference (EMI)

A disturbance generated by an external source that affects an electrical circuit by electromagnetic induction, electrostatic coupling, or conduction.

GND

ground (GND)

GPIO

general purpose input output (GPIO)

HSLI

high-speed lighting interface (HSLI)

An Infineon-specific protocol for exchanging data among leaders and lighting-device followers.

LDO

low dropout regulator (LDO)

A linear voltage regulator that can operate with a small voltage difference between the input and output.

LED

light-emitting diode (LED)

A semiconductor circuit that emits light when activated.

LIN

local interconnect network (LIN)

MCU

microcontroller unit (MCU)

A small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals.

microcontroller
A small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals.

OEM
original equipment manufacturer (OEM)

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.

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.

Revision history

Document version	Date of release	Description of changes
v 1.00	2025-08-07	Initial release

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