Getting started with the Animated Exterior Reference Design

Preview document

About this document

Scope and purpose

This user guide provides instructions for using the reference design. The reference design is designed to evaluate the associated system solutions for animated exterior lighting. This user guide provides an overview of the whole system offering for animated exterior lighting, and extensive technical information on the board.
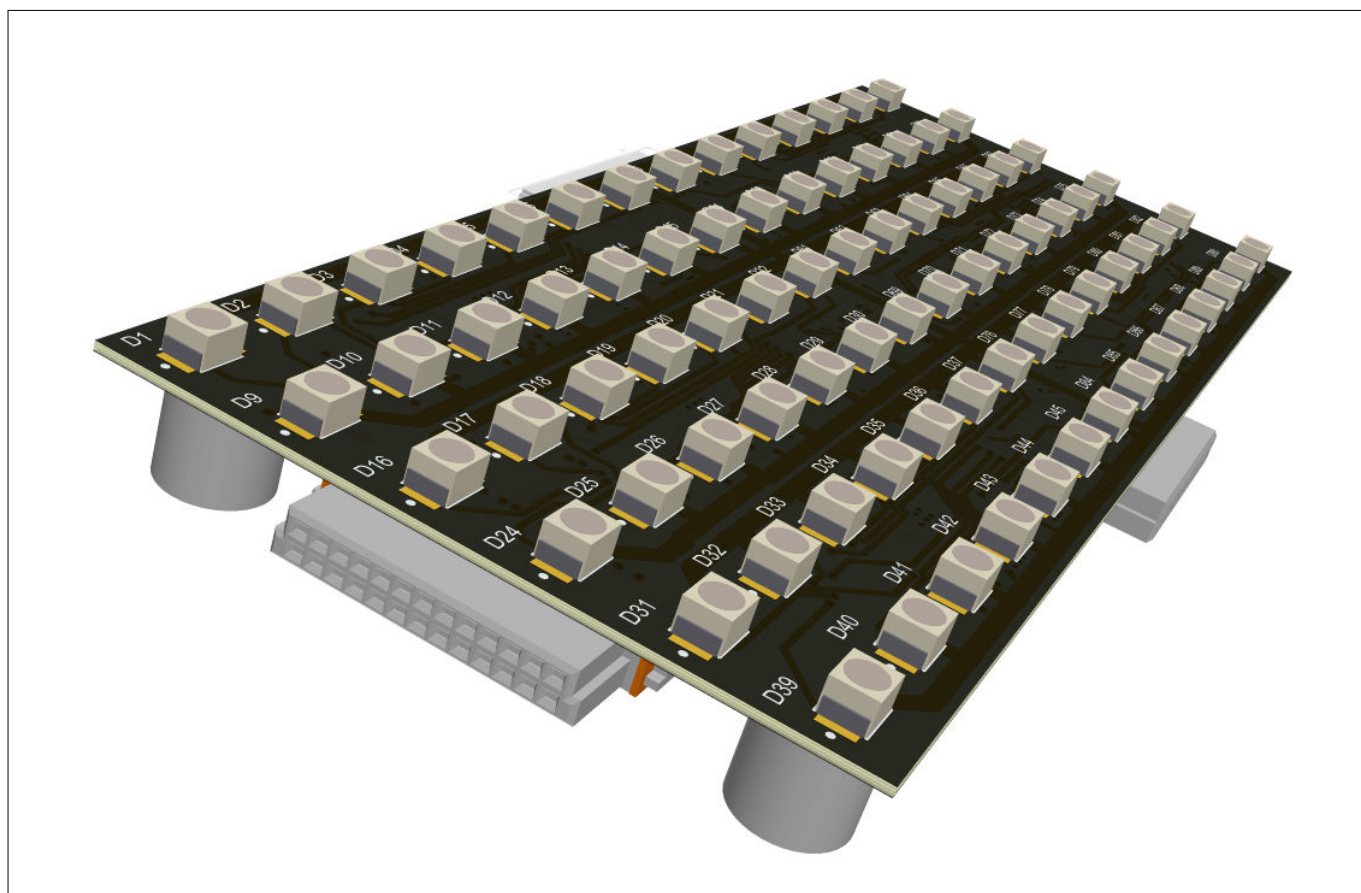

Figure 1   **Animated exterior reference design board**

Intended audience

This document is intended for anyone using Infineon's Animated Exterior reference design.

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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.*

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1 System offering

1.1 Introduction to LED Platform animated exterior lighting system offering

Infineon's system offering for animated exterior lighting encompasses a range of components that work together to provide a comprehensive solution.

Key Components:

- **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

- **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 Animated Exterior reference design. For more information, refer to Introduction to the LED Platform Power and Communication Arduino shield

- **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

- **LITIX™ TLD7002-16ES device driver**: independent embedded software for configuring and controlling the LITIX™ TLD7002-16ES. For more information, refer to Introduction to the LITIX™ TLD7002-16ES device driver

- **Traveo™ II Animated Exterior LED application software**: this application software is intended to be executed on the Traveo™ II Starter Kit. Enabling the charge pump of the OPTIREG™ SBC TLE9461ES, and showing a predefined pattern on the reference design. For more information, refer to Introduction to the Traveo™ II Animated Exterior LED application software

- **uIO-Stick V2**: an interface device for controlling Infineon boards during run time. It provides a built-in *controller area network (CAN)* transceiver, for programming and controlling the LITIX™ devices. For more information, refer to Introduction to the uIO-Stick V2

- **LITIX™ Pixel Rear Configuration Wizard**: a PC tool consisting of a *graphical user interface (GUI)* for programming and controlling the LITIX™ TLD7002-16ES devices on the LED Platform Animated Exterior reference design, over the *high-speed lighting interface (HSLI)*. For more information, refer to Introduction to LITIX™ Pixel Rear Configuration Wizard

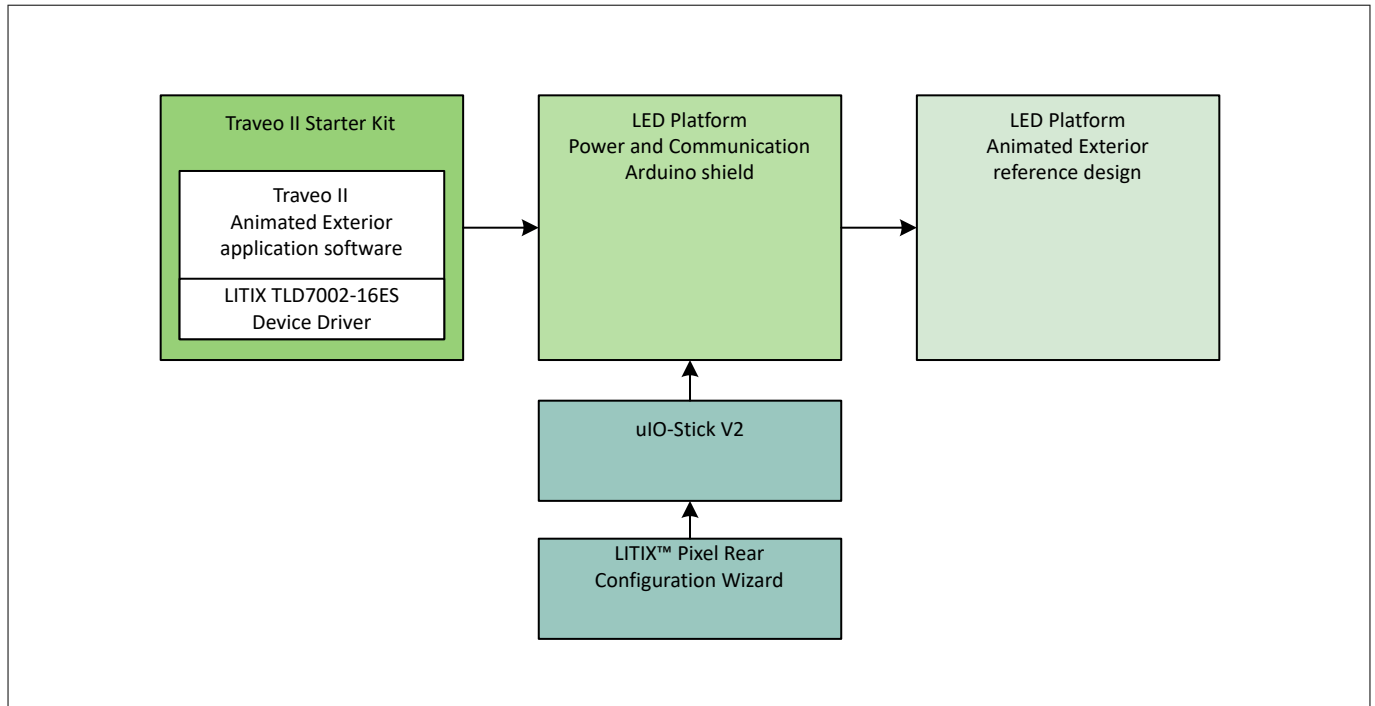**Figure 2**   **Infineon's animated exterior lighting system offering**

1.1.1   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 by the modular connectors, which are placed on all the edges of the board, with the LED Platform Power and Communication Arduino shield.
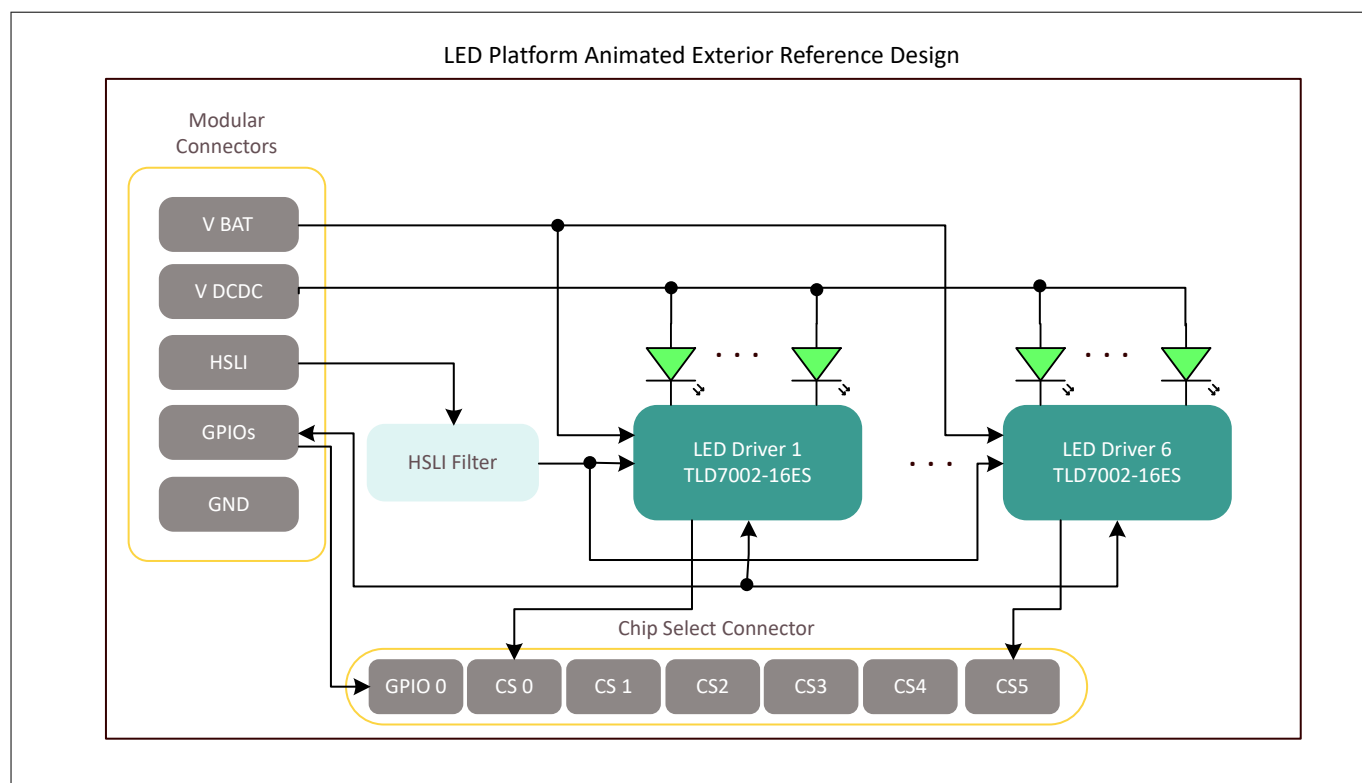
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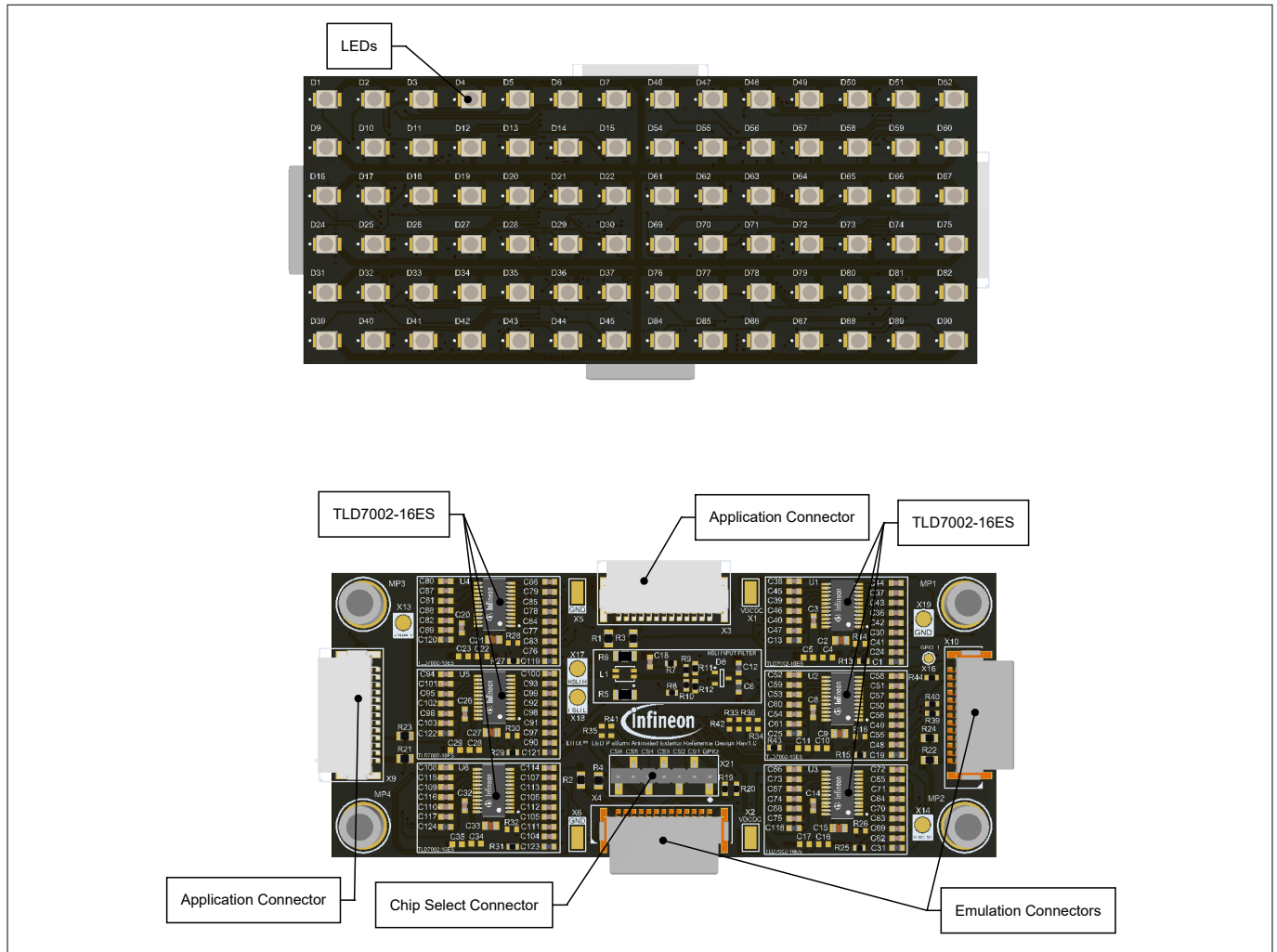

Figure 3   Block diagram

Figure 4   Board description

1.1.2   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 them.

The LED Platform reference designs can be supplied through 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 *light-emitting diode (LED)*s on the LED Platform reference designs are powered by the OPTIREG™ switcher TLS4125D0EP V50, which provides a fixed 5 V output voltage.
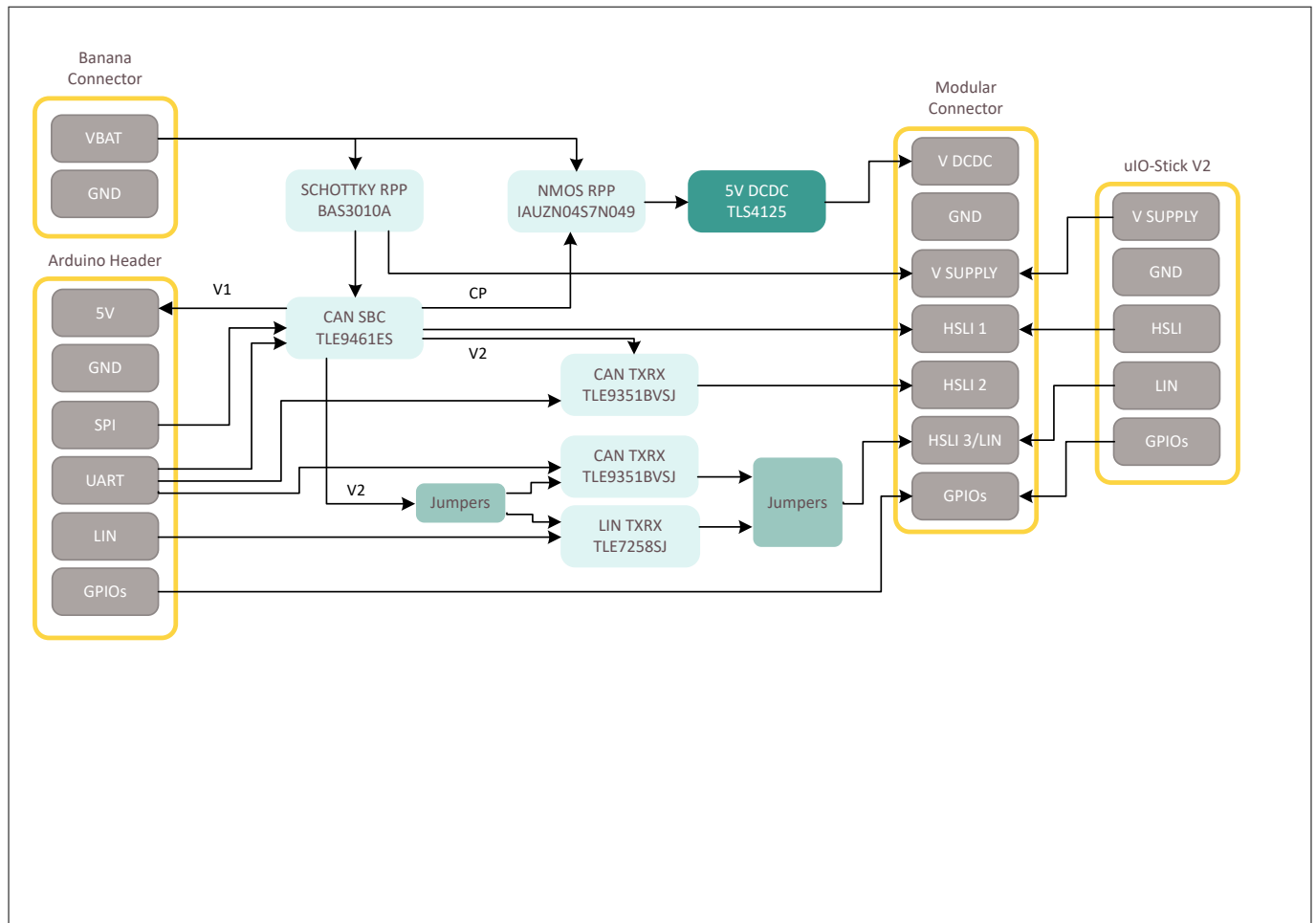
1 System offering

Banana
Connector

| VBAT |
| GND |

Arduino Header

| 5V |
| GND |
| SPI |
| UART |
| LIN |
| GPIOs |

SCHOTTKY RPP
BAS3010A

NMOS RPP
IAUZN04S7N049

5V DCDC
TLS4125

CAN SBC
TLE9461ES

CP

V1

V2

V2

CAN TXRX
TLE9351BVSJ

CAN TXRX
TLE9351BVSJ

LIN TXRX
TLE7258SJ

Jumpers

Jumpers

Modular
Connector

| V DCDC |
| GND |
| V SUPPLY |
| HSLI 1 |
| HSLI 2 |
| HSLI 3/LIN |
| GPIOs |

uIO-Stick V2

| V SUPPLY |
| GND |
| HSLI |
| LIN |
| GPIOs |

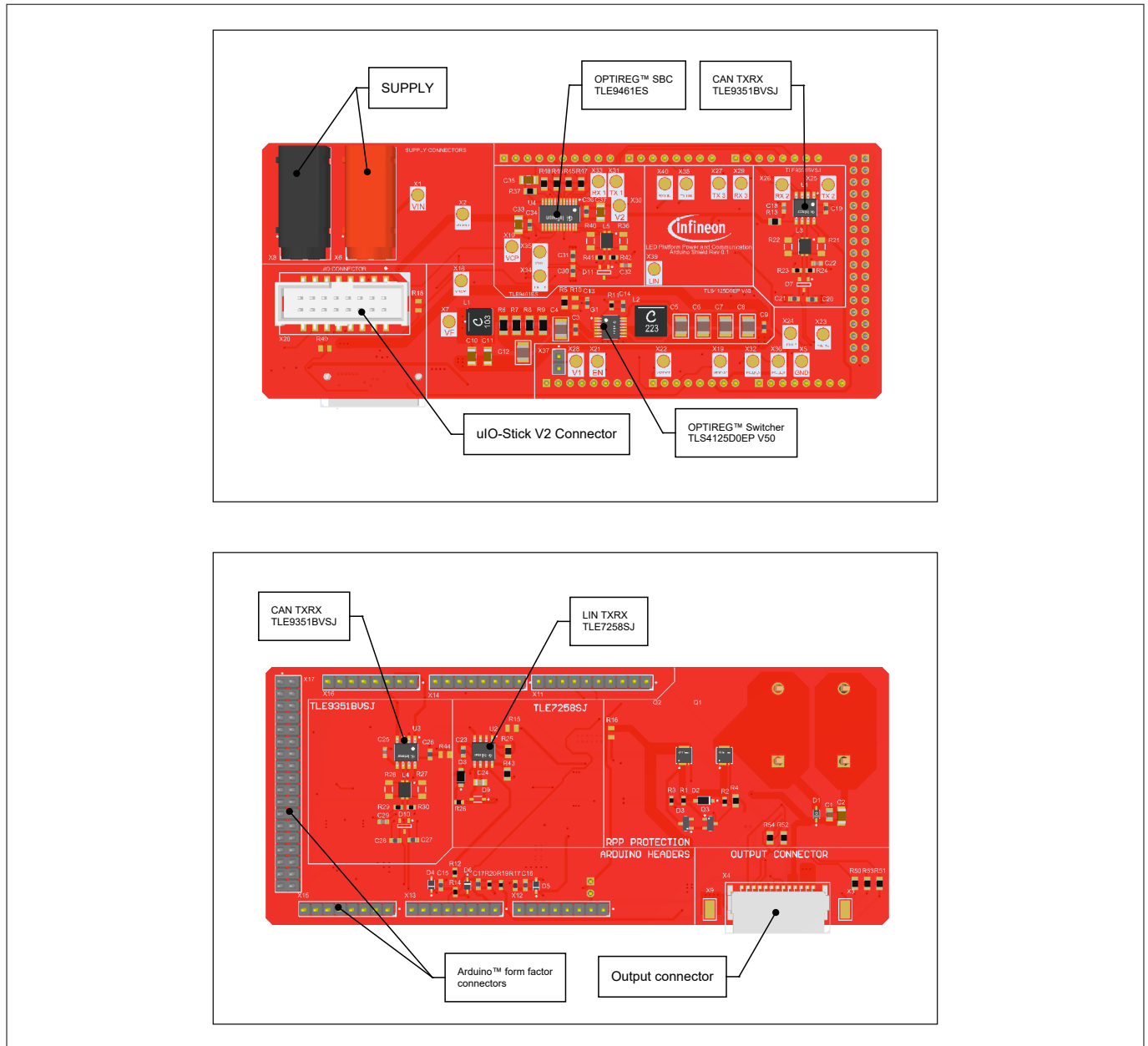**Figure 5   Block diagram**

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 using the on-board PSoC™ 5 based Kitprog3.
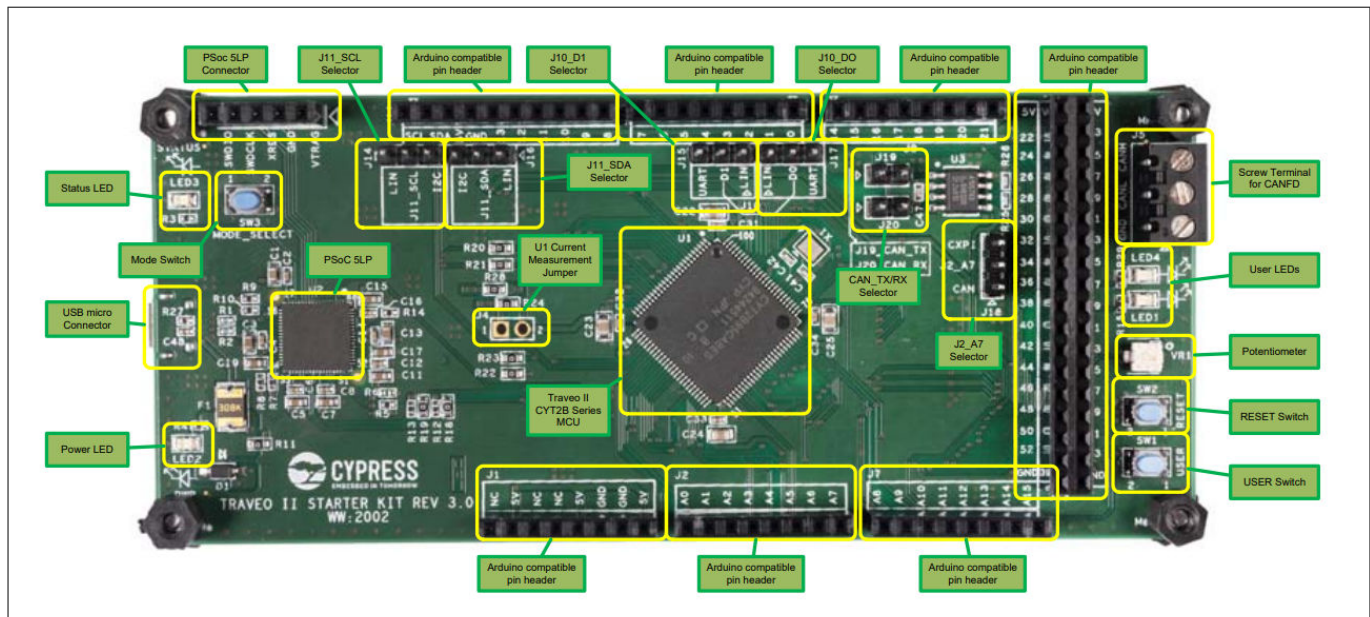
Figure 7   **Board description**

1.1.4   Introduction to the LITIX™ TLD7002-16ES device driver

The LITIX™ TLD7002-16ES device driver is a microcontroller-independent embedded software library that provides an easy-to-use *application programming interface (API)* to communicate with the TLD7002-16ES LED driver. The device driver is designed to be independent, offers a range of functions to control the *LED*s' current and *pulse-width modulation (PWM)* settings, and reads the status registers.

1.1.5   Introduction to the Traveo™ II Animated Exterior LED application software

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

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

- Initializes the OPTIREG™ SBC TLE9461ES, enabling the watchdog, the charge pump for reverse polarity protection, and an additional supply line for the *CAN* transceivers
- Configures the *universal asynchronous receiver transmitter (UART)* peripheral to establish communication with the TLD7002-16ES LED drivers
- When the initialization 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 TLD7002-16ES LED driver, indicating errors through the *LED* on the Traveo™ II Starter kit

The application software leverages the *API*s provided in the embedded software libraries, including the Traveo™ II Peripheral Driver Library, the LITIX™ TLD7002-16ES 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.

1.1.6   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, providing a comprehensive solution for development and testing. The uIO-Stick V2 controls LITIX™ devices through the *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.

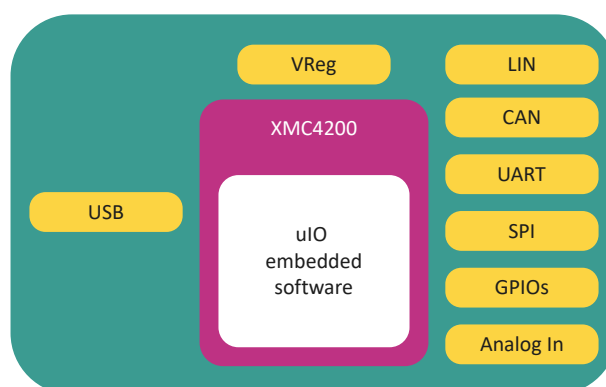

Figure 8   uIO-Stick V2

Figure 9   Block diagram

1.1.7   Introduction to LITIX™ Pixel Rear Configuration Wizard

The Infineon LITIX™ Pixel Rear Configuration Wizard is a user-friendly PC tool that features a *GUI* for programming and controlling TLD7002-16ES devices over the *HSLI*. The GUI is compatible with LED drivers that utilize either the uIO-Stick V2 or TLD7002-16 OTP PRG board as an interface. Specifically, the Animated Exterior

reference design supports the Pixel Rear Configuration Wizard when used with the uIO-Stick V2 and the LED Platform Power and Communication Arduino shield.

The Pixel Rear Configuration Wizard offers a range of functionalities, including the ability to read the existing OTP configuration and status registers of the TLD7002-16ES devices. Additionally, it enables users to emulate new OTP configurations and stream predefined animations.

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 Animated Exterior reference design`
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**

1 System offering

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**
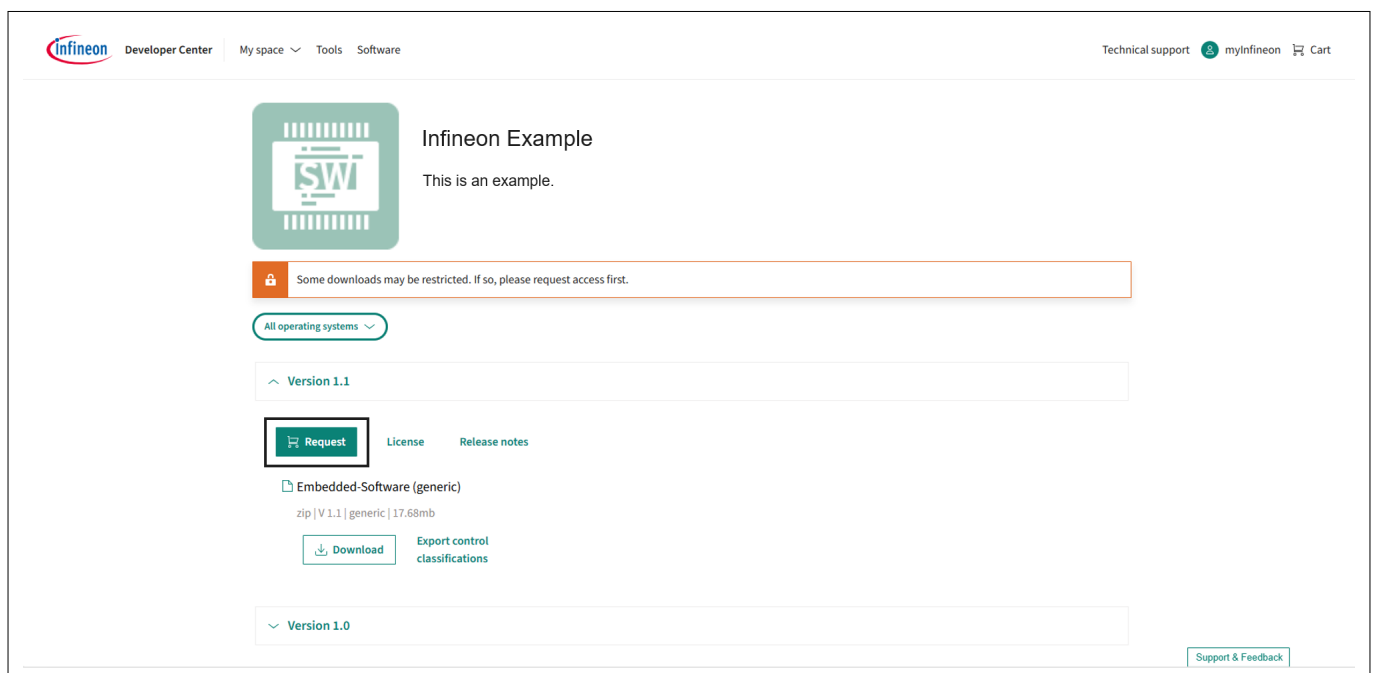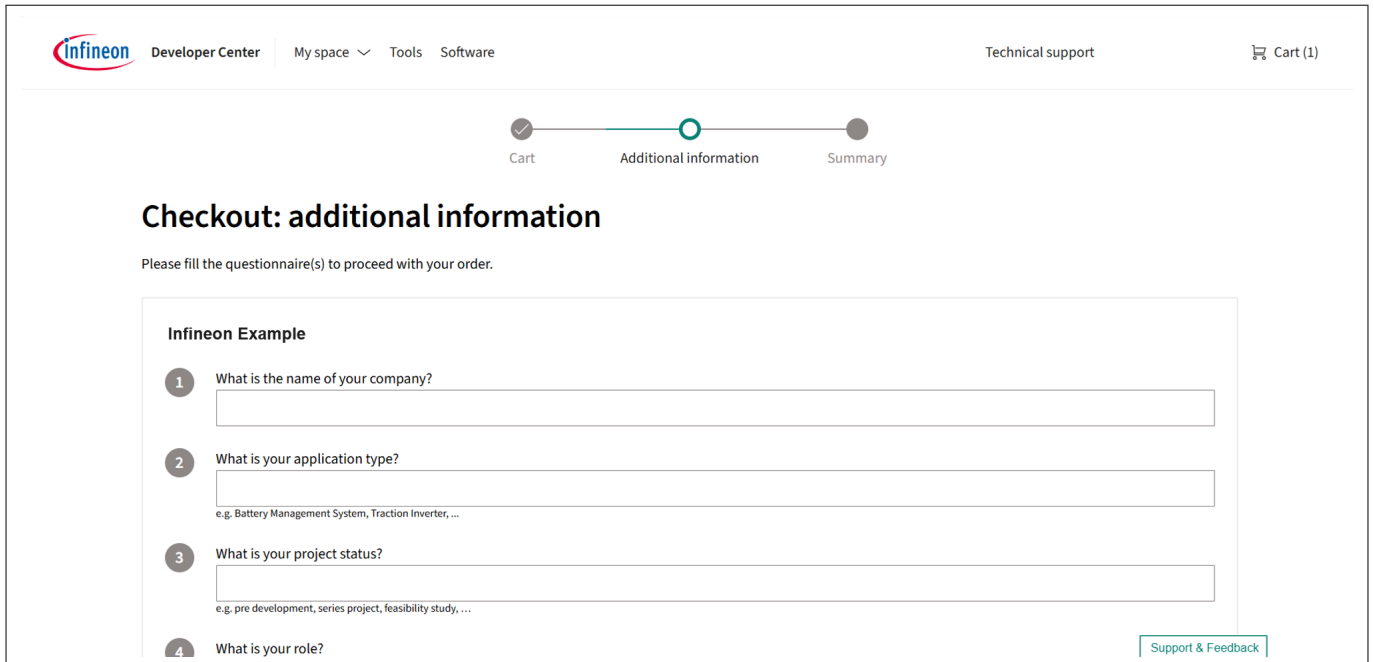

Figure 11   **Software package within the Infineon Developer Center**

Figure 12   **Requesting download of software package**

1.2.3   How to get the LITIX™ Pixel Rear Configuration Wizard

The tool can be installed from the Infineon Developer Center Launcher, which can be downloaded here.
To download the *GUI* from the Infineon Developer Center Launcher:

1.   Open the Infineon Developer Center Launcher and click **Manage Tools**
2.   In the search field, enter LITIX™ Pixel Rear Configuration Wizard
3.   Click **Install**
4.   After a few minutes, the software package is available on the **Launcher** in the **My tools** tab
5.   In the new window that appears, click **TLD7002-16ES** to start the tool
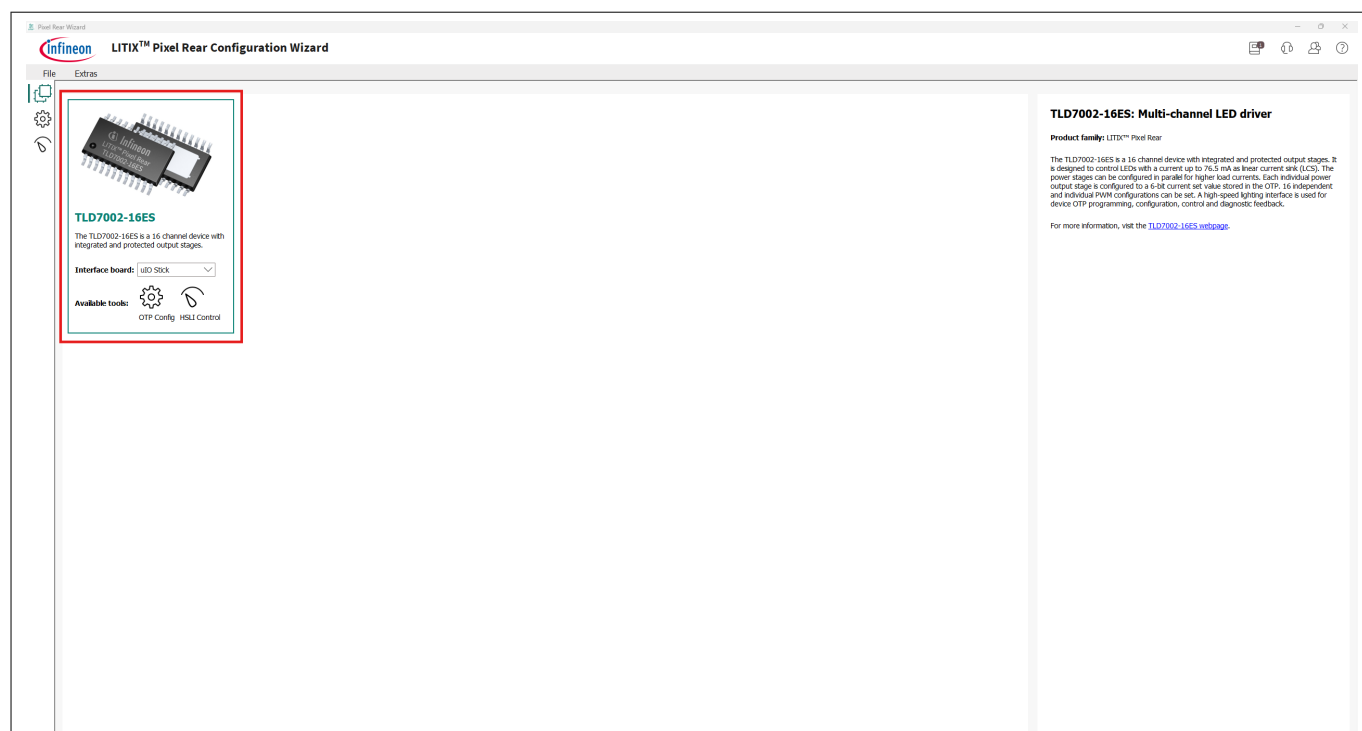
1 System offering

Figure 13   **LITIX™ Pixel Rear Configuration Wizard**

2   Setting up the LED Platform Animated Exterior reference design

Box delivery content

The Animated Exterior 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 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 (included in the application software)
- 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.
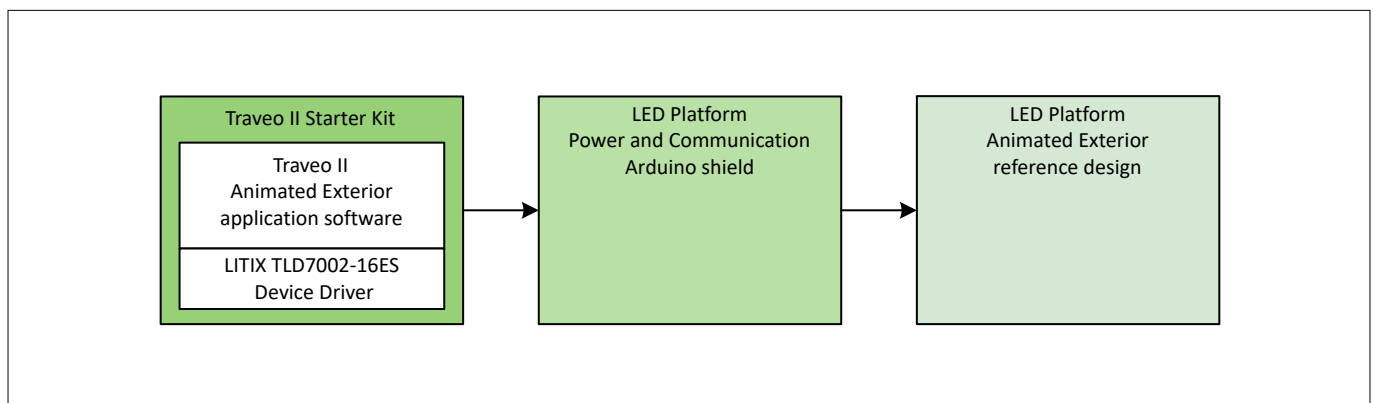

Figure 14   **Application setup system offering**

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

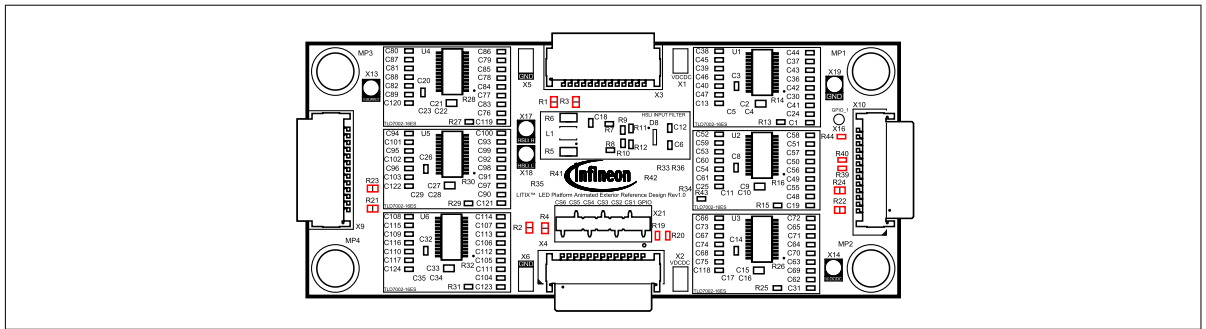## 2 Setting up the LED Platform Animated Exterior reference design

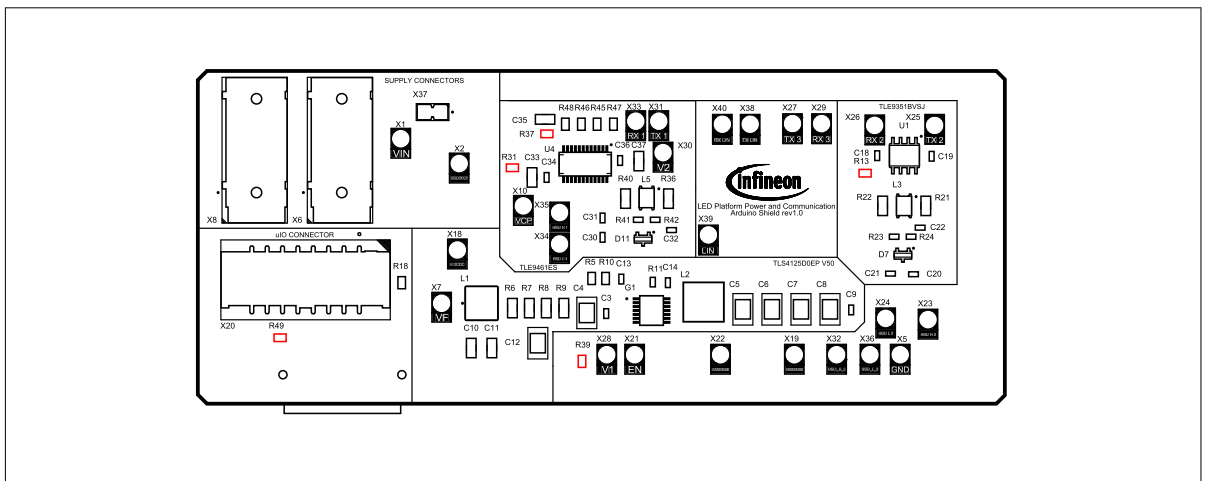**Figure 15   Default solder jumpers LED Platform Animated Exterior reference design**

Figure 16   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
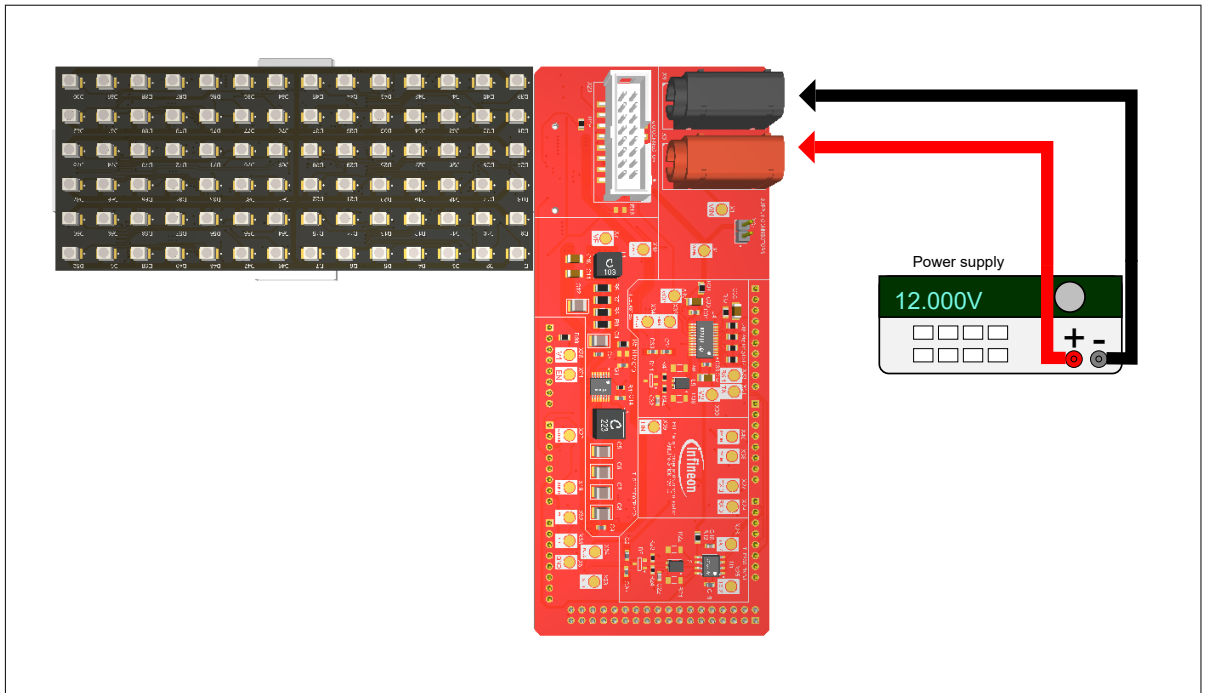
Figure 17   **Application setup power supply**

8. Finally, press the reset button on the Traveo™ II Starter Kit to complete the download process

9. The reference design should illuminate and display the predefined animation, indicating a successful programming process

2.2 Emulation setup

The Emulation setup allows expert users to read or emulate new OTP configurations on the TLD7002-16ES devices featured, and run animations in the reference design. The Emulation setup consists of:

- The LED Platform Power and Communication Arduino Shield
- The LED Platform Animated Exterior reference design
- The uIO-Stick V2
- The LITIX™ Pixel Rear Configuration Wizard

By integrating these components, users can quickly and easily emulate new OTP configurations on the TLD7002-16ES devices featured in the reference design, providing a streamlined solution for testing and development.

2 Setting up the LED Platform Animated Exterior reference design
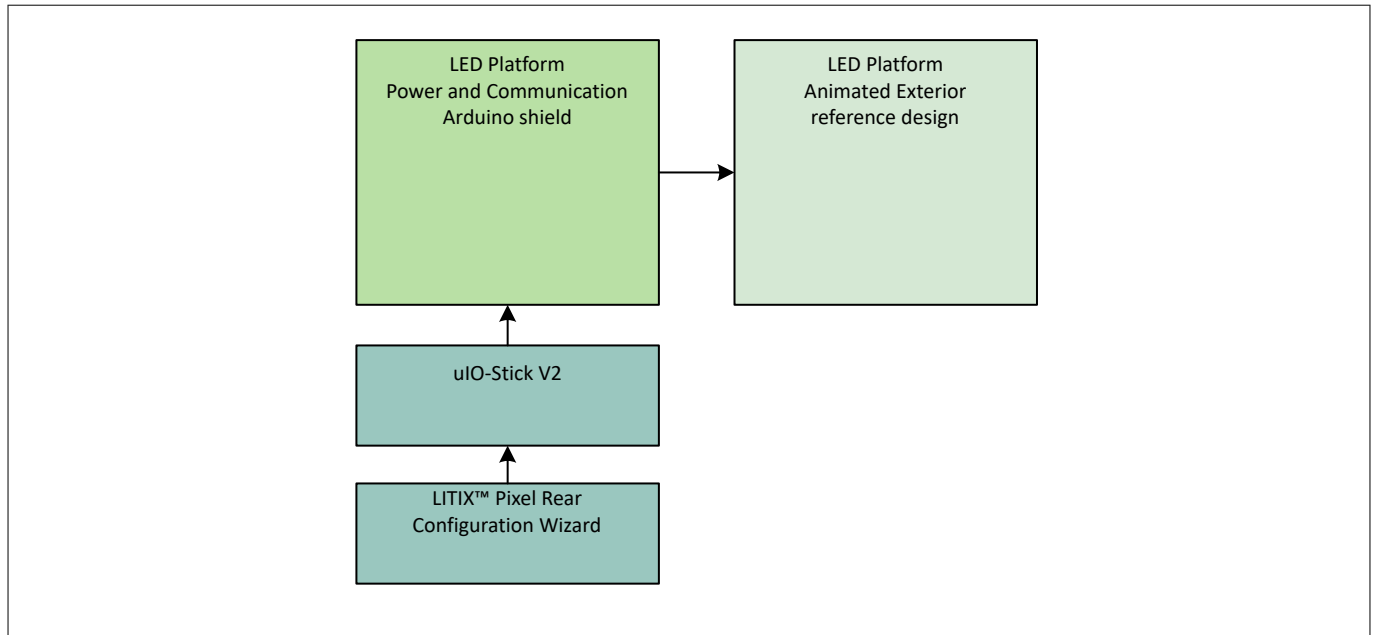
Figure 18 **Emulation setup system offering**

To emulate a new OTP configuration and to control the Animated Exterior reference design with the LITIX™ Pixel Rear configuration wizard, follow these steps:

1. Before connecting any power or cables, ensure that the 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 19 **Default solder jumpers LED Platform Animated Exterior reference design**

2 Setting up the LED Platform Animated Exterior reference design

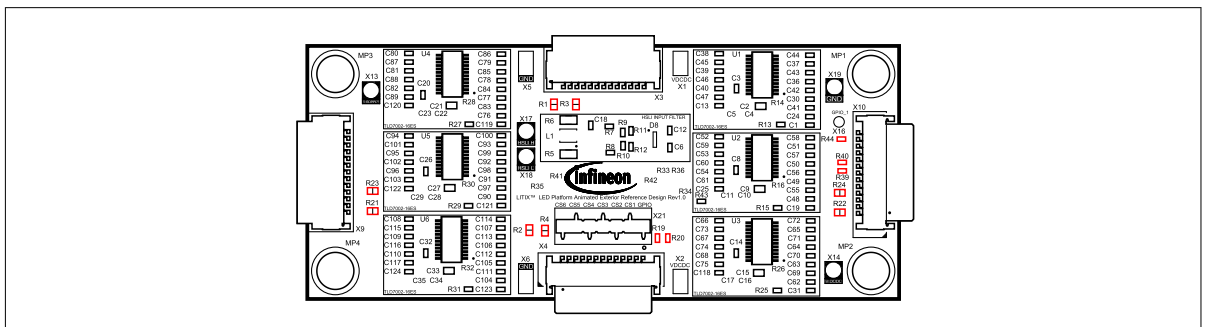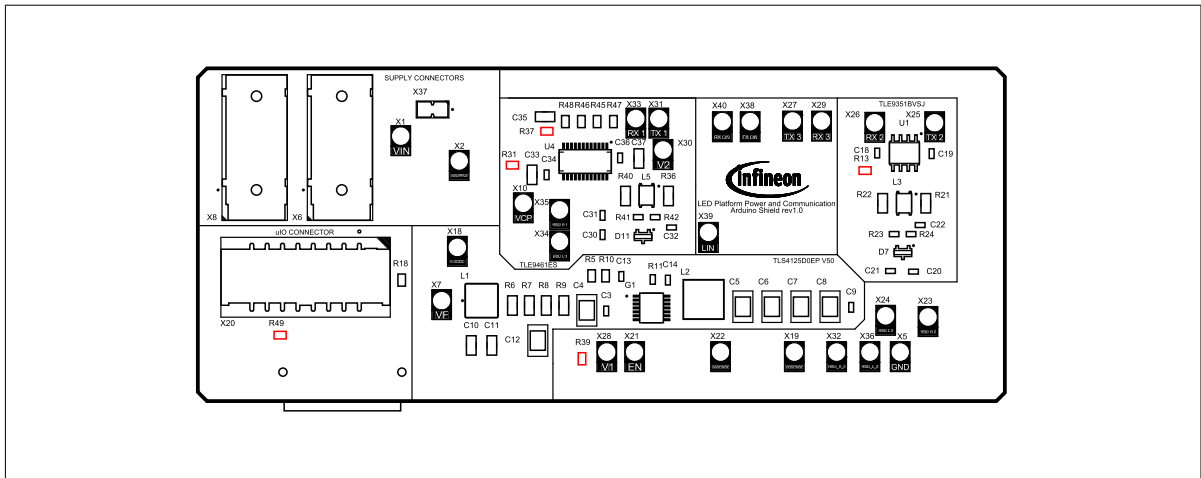**Figure 20**   **Default solder jumpers LED Platform Power and Communication Arduino Shield**

2.   Connect the LED Platform reference design to the LED Platform Power and Communication Arduino Shield by inserting the X4 or X10 connector into the X4 connector on the shield

3.   Close the jumper X37 on the Power and Communication Arduino shield to supply the power part of the Animated Exterior reference design from the Schottky reverse polarity diode and not from the NMOS

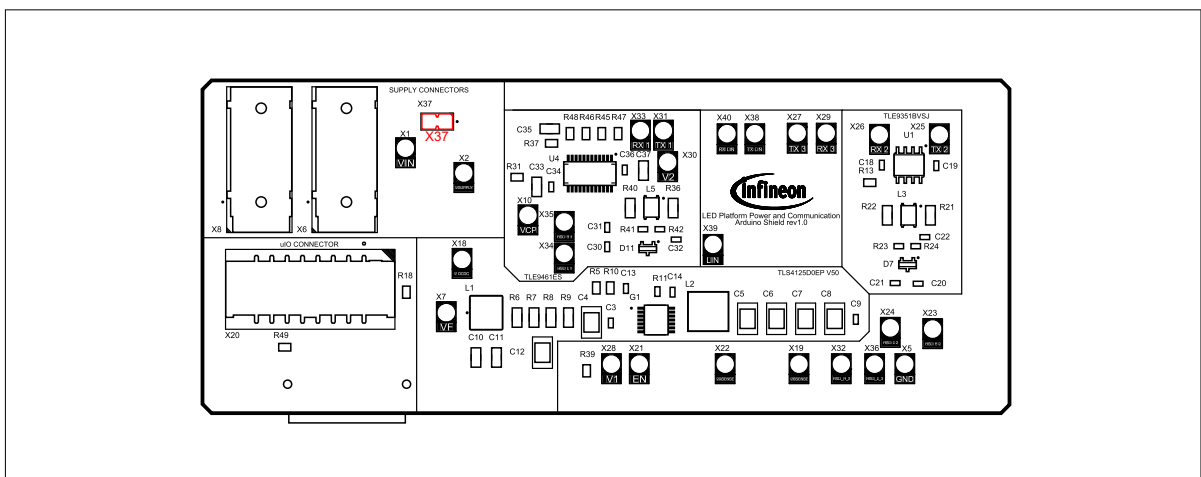**Figure 21**   **Supply jumper for Emulation setup**

4.   Download the GUI as explained here, How to get the LITIX™ Pixel Rear Configuration Wizard

5.   Connect the LED Platform Power and Communication Arduino Shield to a 12 V power supply using the banana connectors (X6, X8) on the board. If the LEDs are turning ON, the setup is correct and you can move to the next step
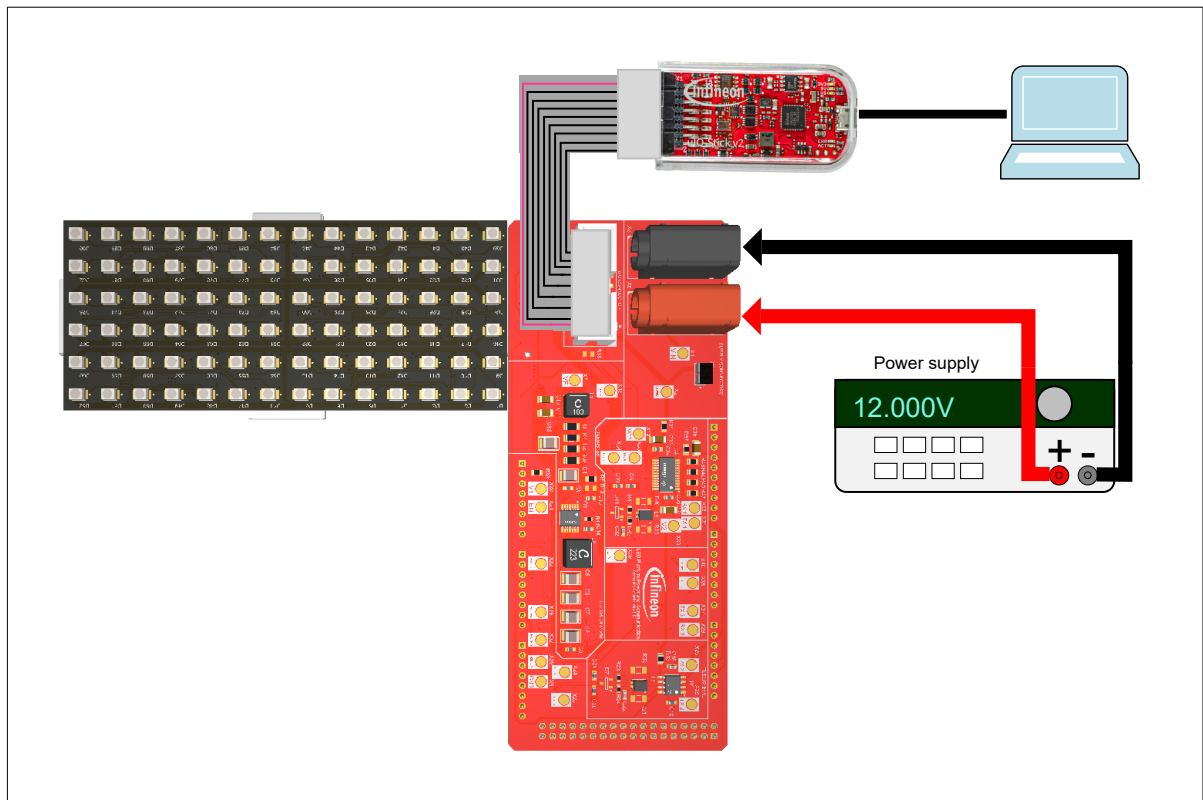
Figure 22   Emulation Setup power supply

6. If you want to run an animation, open the LITIX™ Pixel Rear Configuration Wizard and select the **LITIX™ TLD7002-16ES HSLI Control** icon. Then, navigate to the **Animation** tab and choose the Animated Exterior reference design board from the selection menu. This will enable you to run an animation on the reference design

7. If you want to emulate a new OTP configuration, connect the GPIO 0 pin, which is connected to one of the uIO-Stick V2 GPIOs, to the corresponding Chip Select pin of the selected device for OTP emulation on connector X21. Open the LITIX™ Pixel Rear Configuration Wizard and select the **LITIX™ TLD7002-16ES OTP Config** icon. This will enable you to read and emulate a new OTP configuration on the reference design
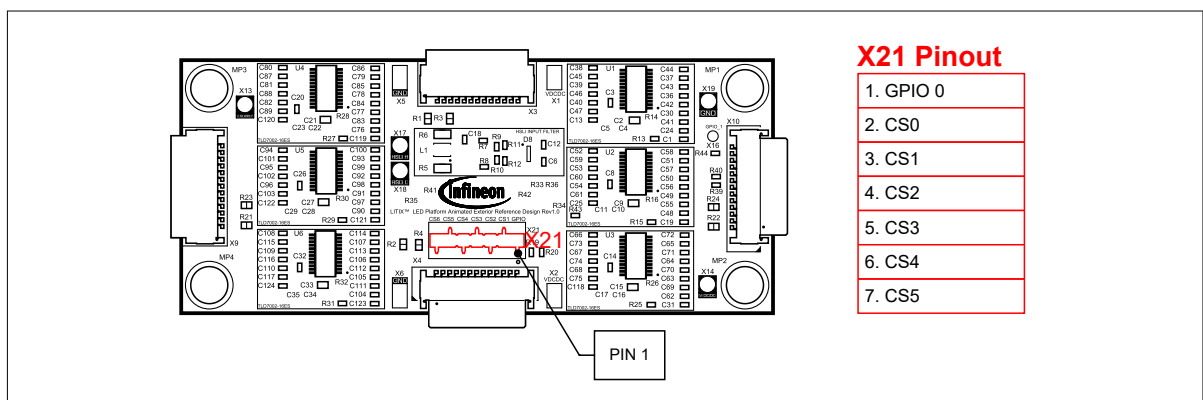

Figure 23   Chip Select connector

3 In detail: LED Platform Animated Exterior reference design

3.1 Technical data

The supply's technical data is outlined in the table below. Note that the current capability is limited by the power dissipation on the board, and higher current levels typically result in increased temperatures on the *PCB*.

Table 2 **Technical data**

System Parameter	Symbol	Value
Digital supply voltage	V_{SUPPLY}	Typ. 12 V (max. 28 V)
Digital supply current	I_{SUPPLY}	Typ. 110 mA
Power supply voltage	V_{DCDC}	5 V
Power supply current	I_{DCDC}	Typ. 400 mA (max. 2.5 A)
Board size		111.8 mm x 47.8 mm

3.2 Functional description

3.2.1 Functional blocks

The LED Platform Animated Exterior reference design is composed of two main functional blocks:

- **LED Driver**: this functional block comprises of the LITIX™ TLD7002-16ES LED Driver to drive the LEDs in the reference design
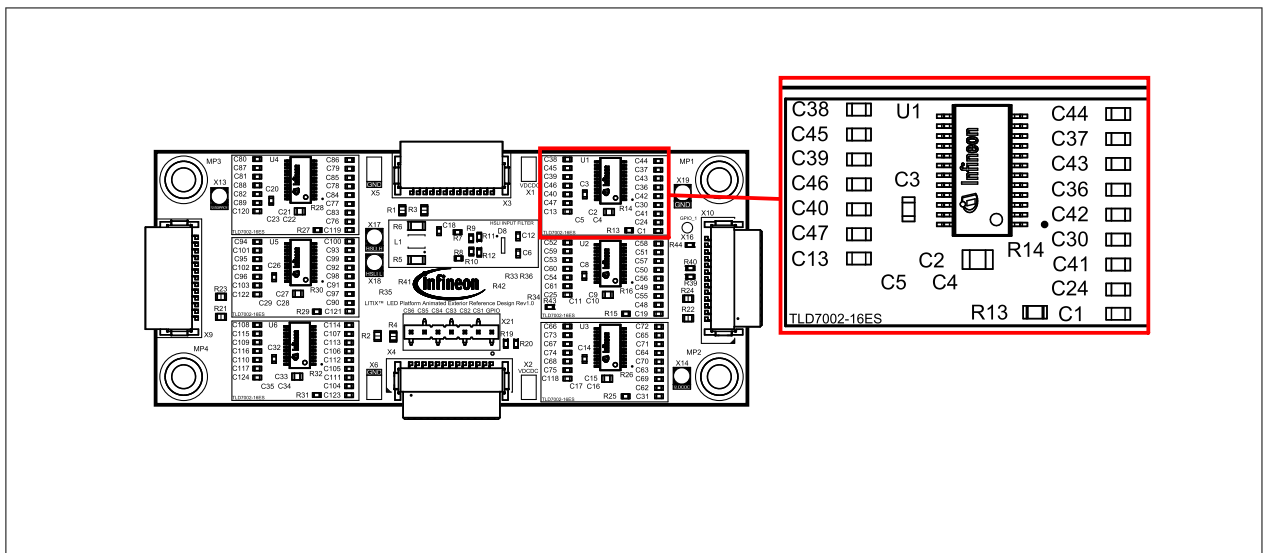

Figure 24 **LED Driver functional block**

- **HSLI Input Filter**: this functional block comprises of some passive components that adapt the impedance of the HSLI communication bus on the reference design

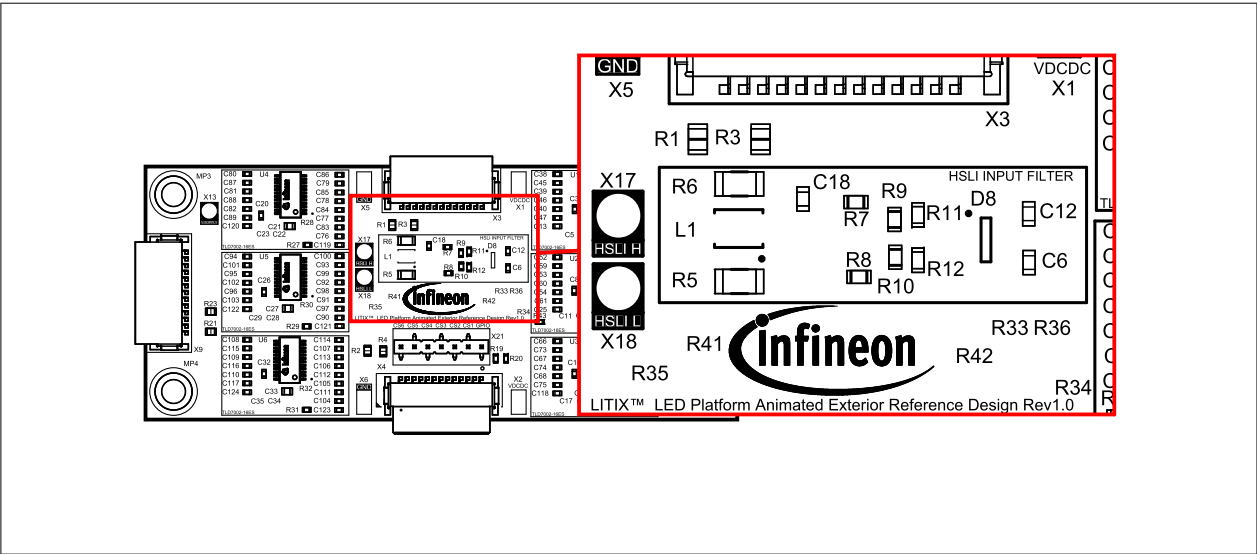**3 In detail: LED Platform Animated Exterior reference design**

Figure 25   **HSLI Input Filter functional block**

3.2.2   Functional connectors

The LED Platform Animated Exterior reference design features two types of connectors to facilitate modular connections between them, namely the Application connectors and the Emulation connectors. These connectors share most of their pins, with some additional pins connected to the Emulation connectors to enable the Emulation setup.

Application connectors

The Application connectors are female connectors placed on the top and on the left edge of the reference design. They can be used to scale up the number of devices connected to the same Power and Communication Arduino shield.

X9, X3 Pinout

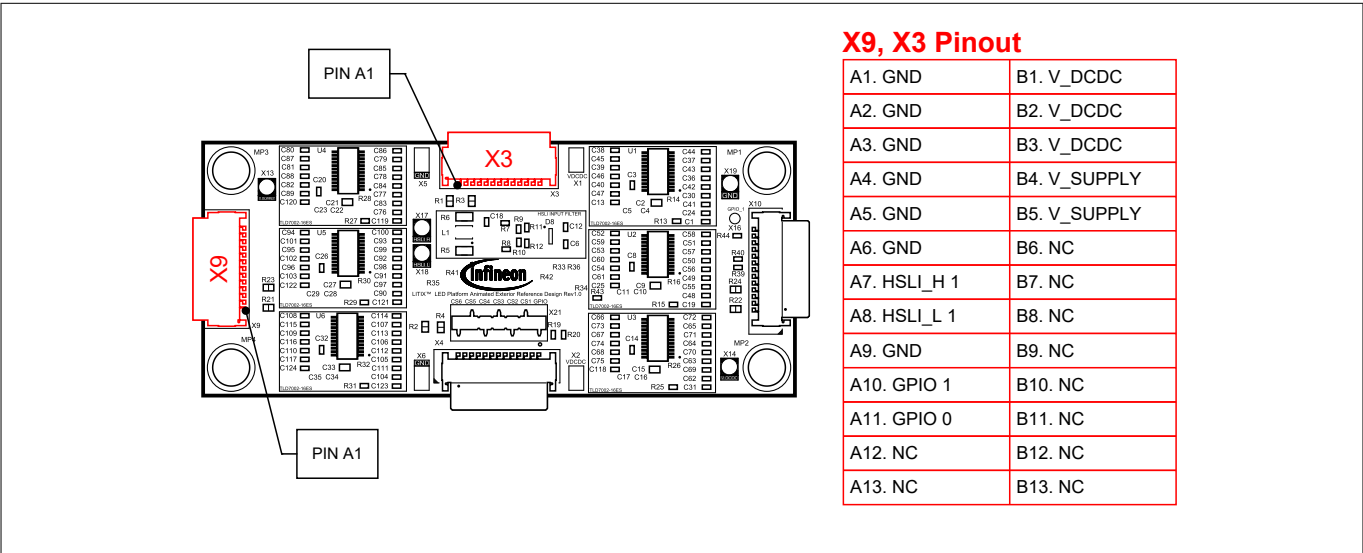|	
A1. GND	B1. V_DCDC
A2. GND	B2. V_DCDC
A3. GND	B3. V_DCDC
A4. GND	B4. V_SUPPLY
A5. GND	B5. V_SUPPLY
A6. GND	B6. NC
A7. HSLI_H 1	B7. NC
A8. HSLI_L 1	B8. NC
A9. GND	B9. NC
A10. GPIO 1	B10. NC
A11. GPIO 0	B11. NC
A12. NC	B12. NC
A13. NC	B13. NC

Figure 26   **Application connectors of the Animated Exterior Reference Design**

3 In detail: LED Platform Animated Exterior reference design

Table 3   Application Connectors pinout description

Pin	Symbol	Function
A7	HSLI_H_1	High-speed lighting interface high level I/O
A8	HSLI_L_1	High-speed lighting interface low level I/O
A10	GPIO 1	Input pin to trigger a fail-safe behavior
A11	GPIO 0	Input pin to trigger a fail-safe behavior
B4, B5	V_SUPPLY	Power supply voltage pin for the LED drivers
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

Emulation connectors

The Emulation connectors are male connectors located on the bottom and on the right edge of the reference design. They are used to connect the reference design to the Power and Communication Arduino shield, enabling the connection of the Chip Select (CP) of the devices with the uIO-Stick V2 GPIOs. They can also be utilized to scale up the number of devices connected to the same Power and Communication Arduino shield.
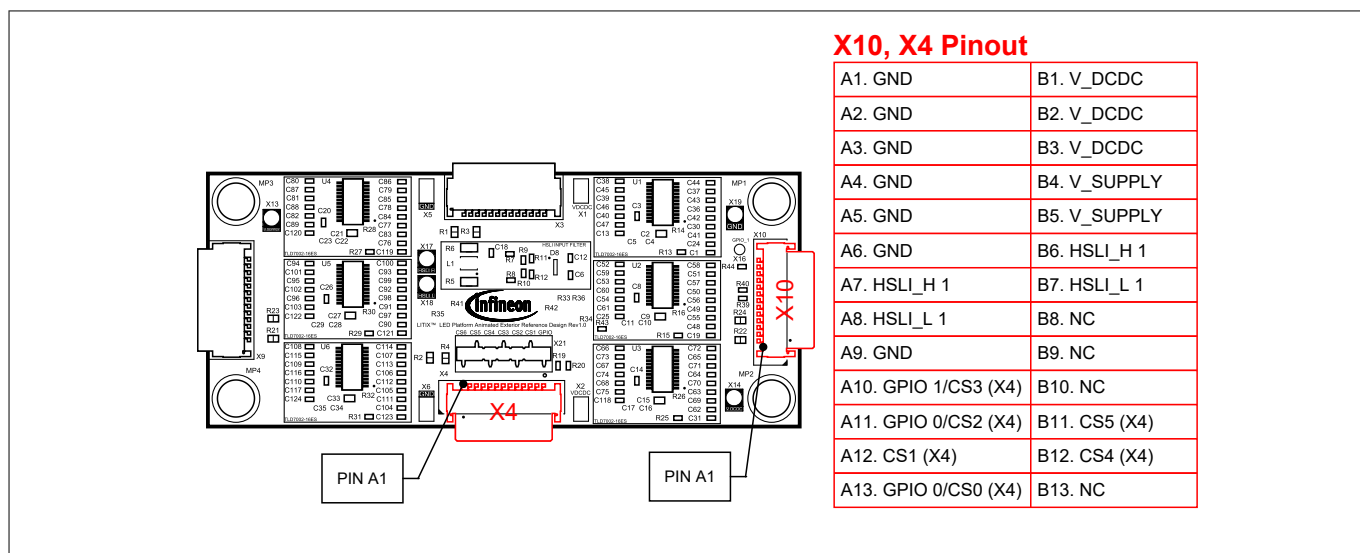

X10, X4 Pinout

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 1	B7. HSLI_L 1
A8. HSLI_L 1	B8. NC
A9. GND	B9. NC
A10. GPIO 1/CS3 (X4)	B10. NC
A11. GPIO 0/CS2 (X4)	B11. CS5 (X4)
A12. CS1 (X4)	B12. CS4 (X4)
A13. GPIO 0/CS0 (X4)	B13. NC

Figure 27   Emulation connectors of the Animated Exterior Reference Design

Table 4   Emulation Connectors pinout description

Pin	Symbol	Function
A7, B6	HSLI_H_1	High-speed lighting interface high level I/O

(table continues…)

Table 4 (continued) Emulation Connectors pinout description

Pin	Symbol	Function
A8, B7	HSLI_L_1	High-speed lighting interface low level I/O
A10	GPIO 1/CS3 (X4)	Input pin to trigger a fail-safe behavior and on X4 it is connected to the CS of the device 3
A11	GPIO 0/CS2 (X4)	Input pin to trigger a fail-safe behavior and on X4 it is connected to the CS of the device 2
A12	CS1 (X4)	On X4 it is connected to the CS of the device 1
A13	GPIO 0/CS2 (X4)	Input pin to trigger a fail-safe behavior and on X4 it is connected to the CS of the device 0
B11	CS5 (X4)	On X4 it is connected to the CS of the device 5
B12	CS4 (X4)	On X4 it is connected to the CS of the device 4
B4, B5	V_SUPPLY	Power supply voltage pin for the LED drivers
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

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 - LITIX™ Power PCB design guidelines*: https://www.infineon.com/row/public/documents/10/42/
         infineon-z8f80033957-tld509x-applicationnotes-en.pdf

Glossary

API
application programming interface (API)
A set of defined rules that enables various software components to communicate with each other.

CAN
controller area network (CAN)

GPIO
general purpose input output (GPIO)

GUI
graphical user interface (GUI)
An interface that enables users to interact with electronic devices through icons and visual indicators.

HSLI
high-speed lighting interface (HSLI)
An Infineon-specific protocol for exchanging data among leaders and lighting-device followers.

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.

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.

PWM
pulse-width modulation (PWM)
A technique to encode an analog value into the duty cycle of a pulsing signal with arbitrary amplitude.

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
Rev 1.00	2025-09-03	Initial document release

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