# TLD5542-1IVREG-EVAL evaluation board

## User Manual

## About this document

### Product description

TLD5542-1: H-Bridge buck-boost DC-DC controller designed for high power, high efficiency automotive applications

• Constant current (LED) and constant voltage regulation

• SPI for diagnostics and control

• Limp home function (Fail-safe mode)

• EMC optimized device: Spread spectrum

### Scope and purpose

Scope of this user manual is to provide to the audience instructions on usage of the TLD5542-1 device evaluation board TLD5542-1IVREG-EVAL schematic version S01 PCB version P01

The TLD5542-1IVREG-EVAL is an evaluation platform for the TLD5542-1, which can work as buck-boost LED driver, or as a voltage regulator.
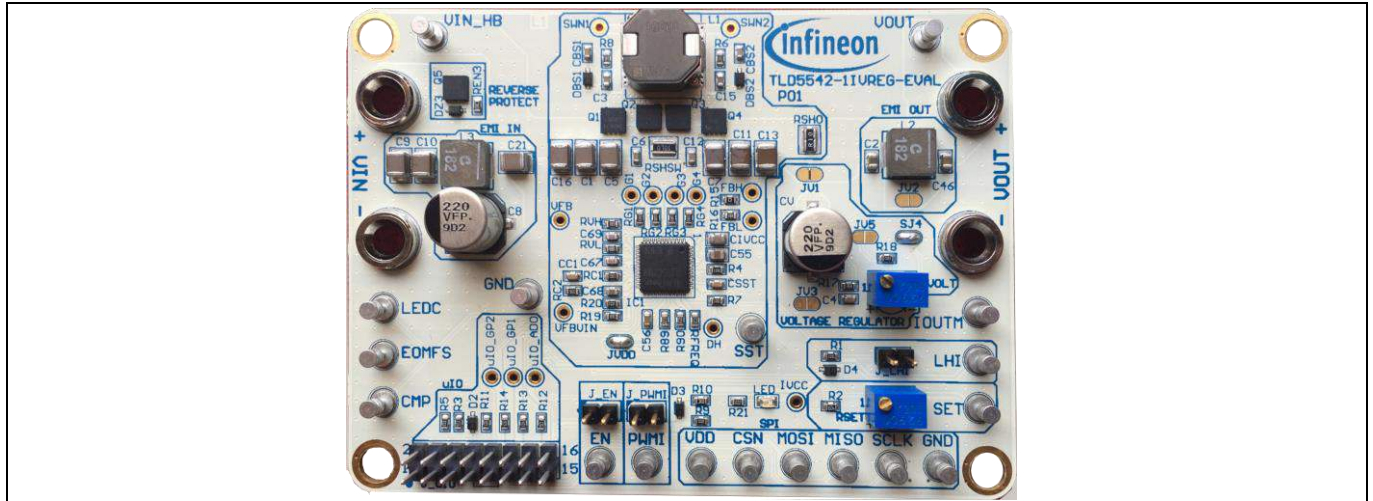


**Figure 1      TLD5542-1IVREG-EVAL device evaluation board**

### Intended audience

Hardware engineers, software engineers, system architects

# 1 Table of contents

# 2 Description

The H-Bridge architecture is among the most efficient buck-boost topologies for high current applications. The TLD5542-1 provides complete control and diagnostics through the SPI interface.

The device can be used in microcontroller-less applications, because of the limp home mode.

The TLD5542-1IVREG-EVAL is an evaluation platform for the TLD5542-1 as LED driver or voltage regulator.

The default configuration is constant current LED driver with 1.5 A maximum output current. The output current can be increased up to 6A by changing RSHO. If higher currents are needed, the output filter has to be bypassed.
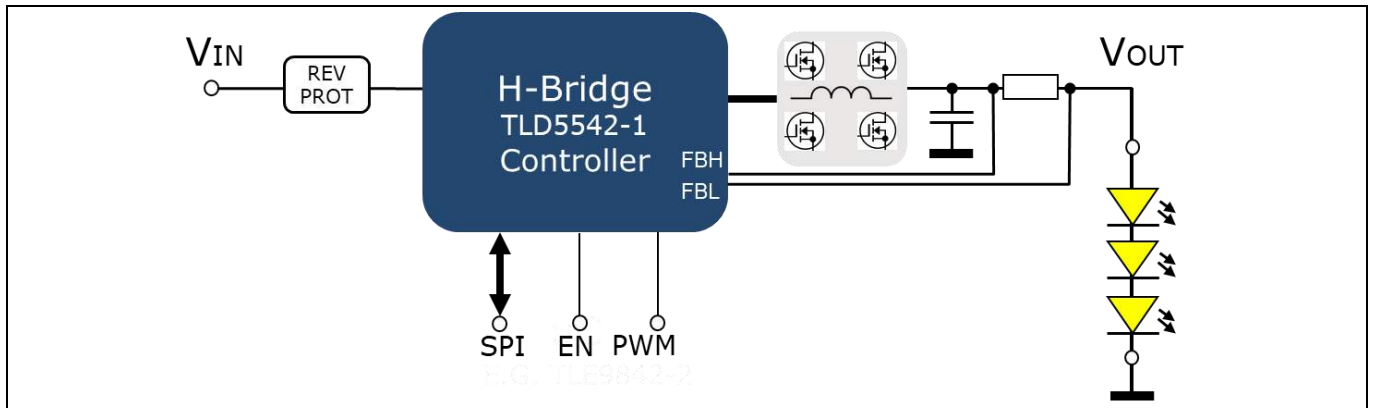
**Figure 2    TLD5542-1 as LED driver**

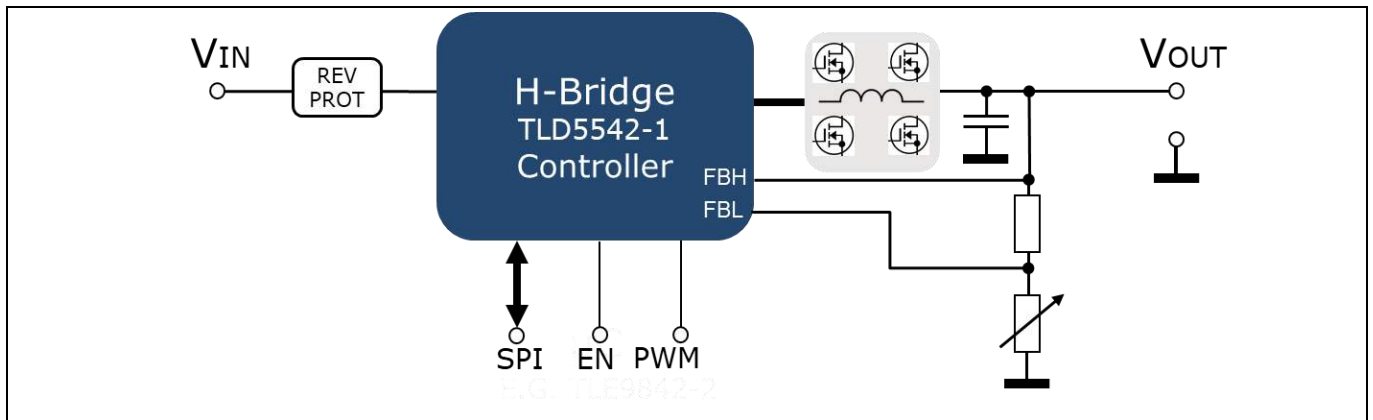By reconfiguring a few solder jumps, the board becomes a powerful voltage regulator.

**Figure 3    TLD5542-1 as voltage regulator**

On the board, in addition the following are present:

- 16-pin 2.54 mm pitch connector for µIO interface or external microcontroller interface
- Limp home jumper for microcontroller-less operation
- Trimmer to adjust output voltage when set as voltage regulator
- Trimmer to adjust output current when set as LED driver and limp home

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Quick start procedure

# 3 Quick start procedure

Below, step by step procedures are laid out for setup and running the TLD5542-1IVREG-EVAL in all available configurations.
Installation procedure for PC GUI (graphical user interface) and µIO stick interface is described from Chapter 4.

## 3.1 Setup as LED driver limp home mode (microcontroller-less)

The following is the simplest configuration, in order to start evaluating the TLD5542-1 without a microcontroller connection, and without µIO stick. In limp home all the registers are set to their default value, and the analog dimming is provided by the voltage on the SET pin (adjustable with RSET trimmer).

1. Configure solder jumper for LED driver configuration: Figure 4
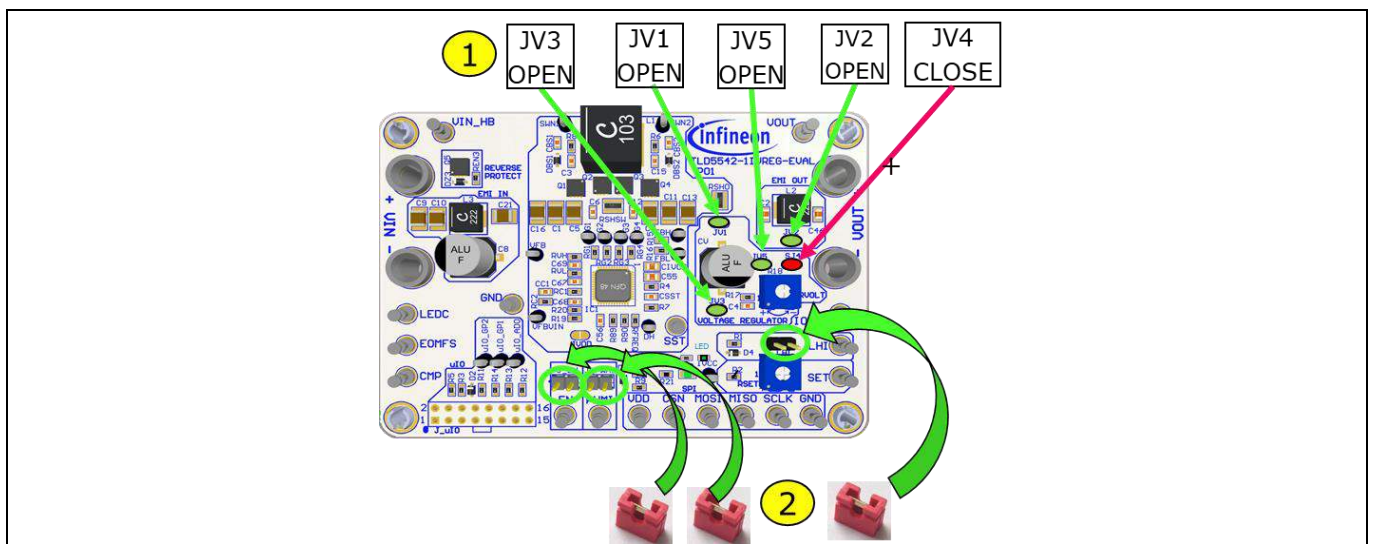2. Connect LHI (limp home), J_EN (Enable) and J_PWMI jumpers



**Figure 4    Connect loads and set jumpers for limp home**

3. Connect the LED load
4. Connect a 12 V power supply to the $V_{IN}$ connector → the LED should turn on indicating $I_{VCC}$ present
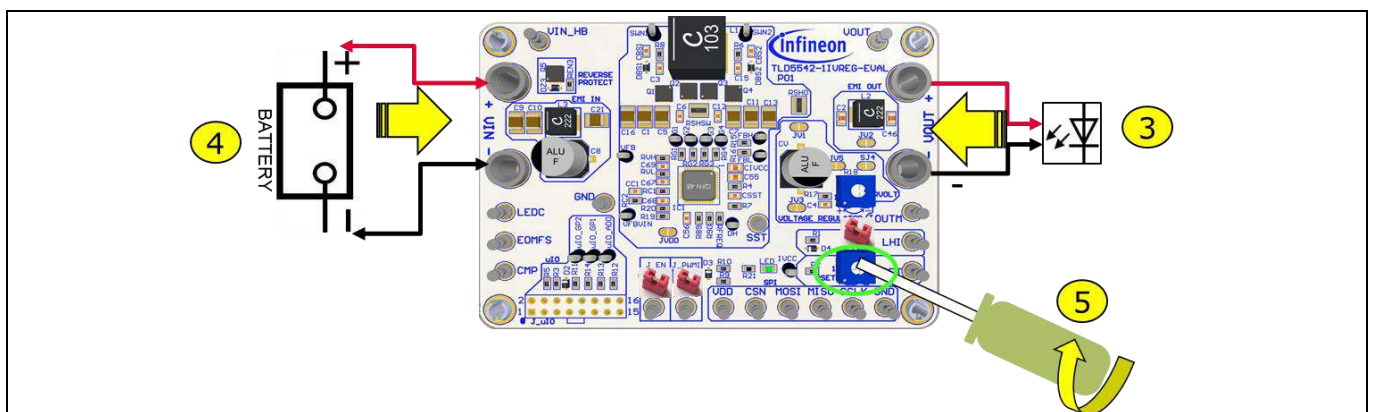5. Adjust $I_{OUT}$ with RSET (>150 mA suggested for better accuracy and transient response)



**Figure 5    Connect power supply and adjust LED current**

## 3.2 Set up as voltage regulator - Limp home mode (µC-less – no PC GUI)

1. Configure solder jumper for VREG (Figure 6), if $I_{OUT}$ > 3 A bypass RSHO with a solder joint on the resistor top
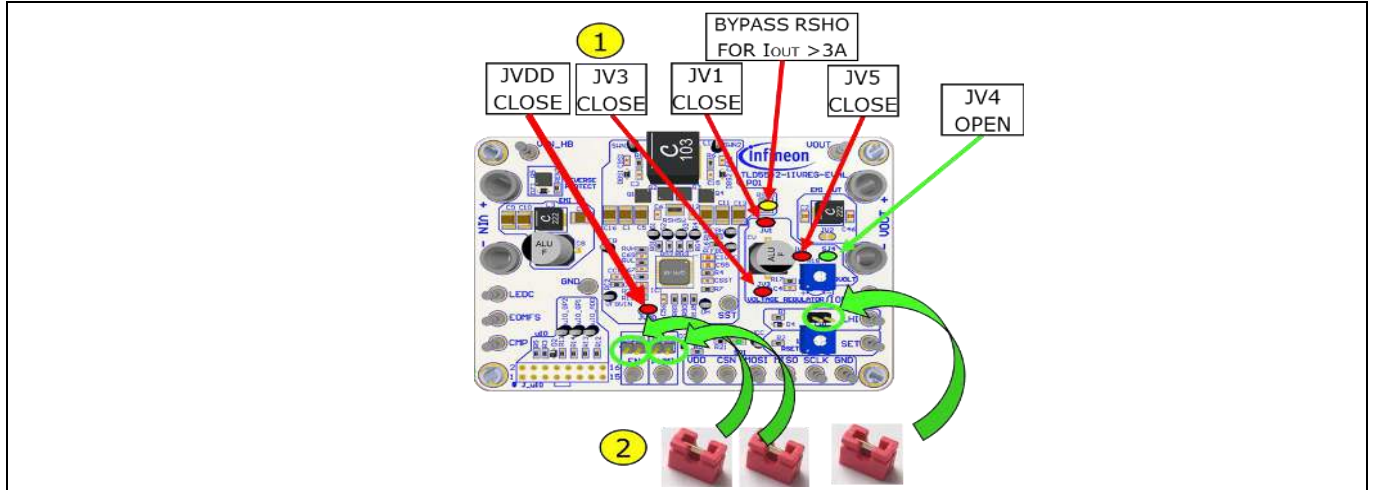2. Connect J_EN, LHI and PWMI jumpers



**Figure 6     Voltage regulator , set LHI and EN  jumpers, populate solder jumps**

3. Connect a 12 V power supply to the $V_{IN}$ connector
4. Rotate RSET trimmer fully clockwise (100% analog dimming, improves transient response and accuracy)
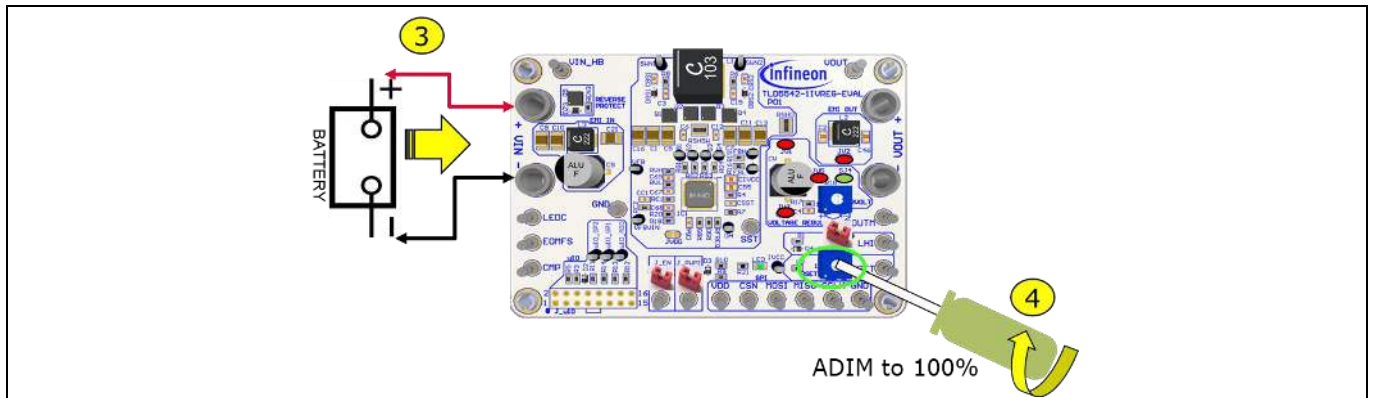


**Figure 7     Connect power supply**

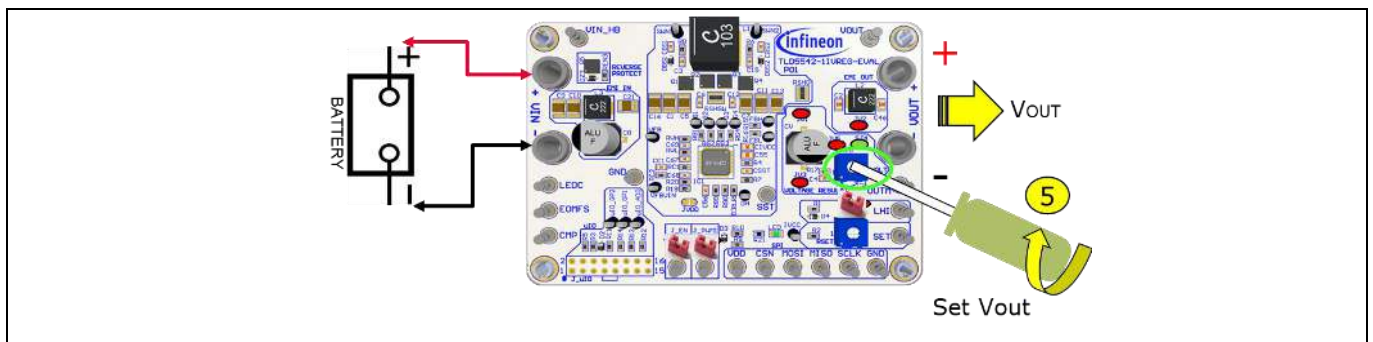5. Rotate RVOLT trimmer to  obtain the desired $V_{OUT}$



**Figure 8     Adjust $V_{OUT}$ using RVOLT**

6. Connect the load

## 3.3 Connecting the board to the µIO stick

1. Configure solder jumpers for voltage regulator/LED driver as described in previous chapters
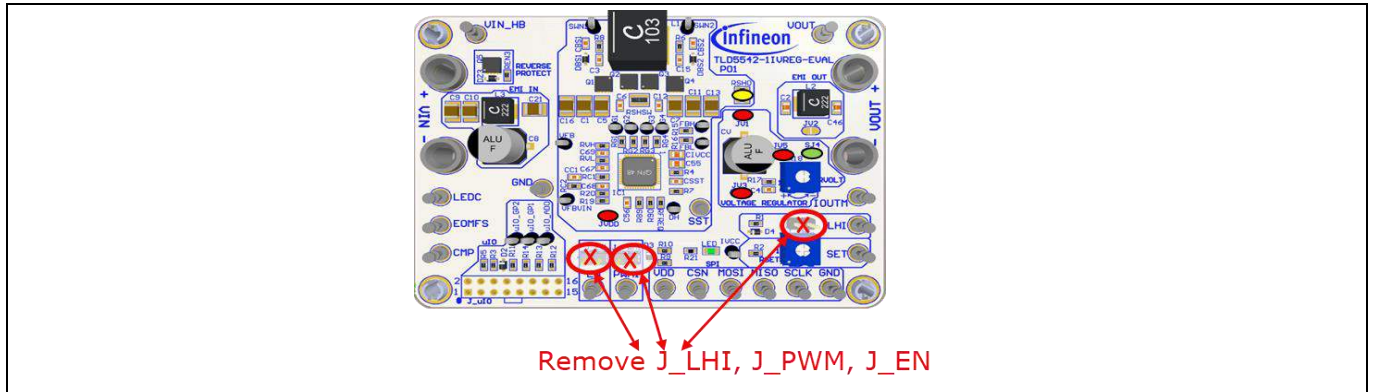2. Remove jumpers plug j_LHI, J_PWMI, J_EN



Remove J_LHI, J_PWM, J_EN

**Figure 9    Control with µIO stick:  remove jumpers**

3. Connect the µIO flat cable to j_uIO connector, paying attention to the polarity (pin 1 is marked on the PCB)
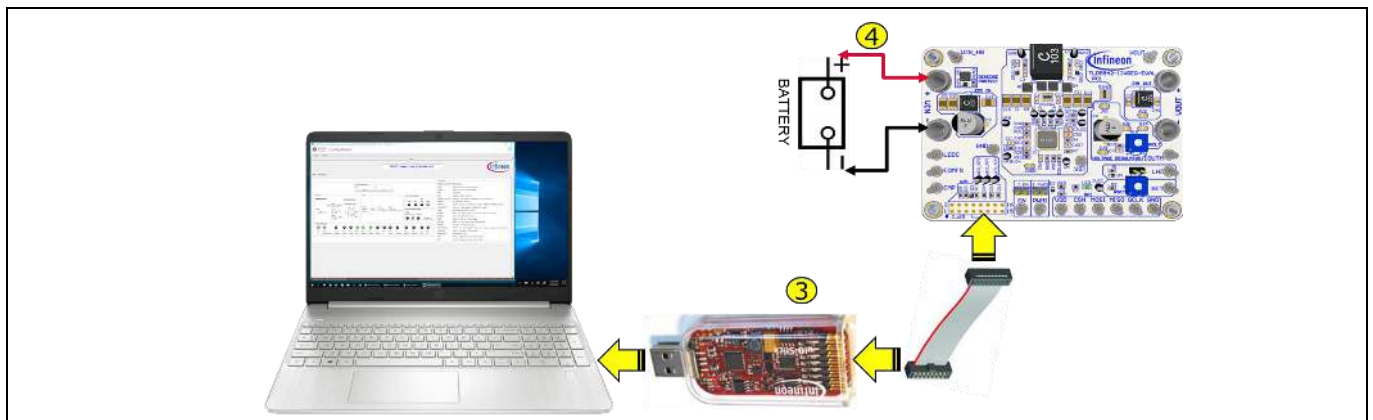4. Connect a 12 V power supply to the $V_{IN}$ connector



**Figure 10    Voltage regulator with µIO stick: connect µIO and power supply**

5. Launch Infineon toolbox, see chapter 5 to learn how to control the eval board with the PC GUI
6. In case of voltage regulator: rotate RVOLT trimmer to obtain the maximum desired $V_{OUT}$: analog dimming can then be used on the Config Wizard GUI to reduce $V_{OUT}$, but full scale has to be set by RVOLT
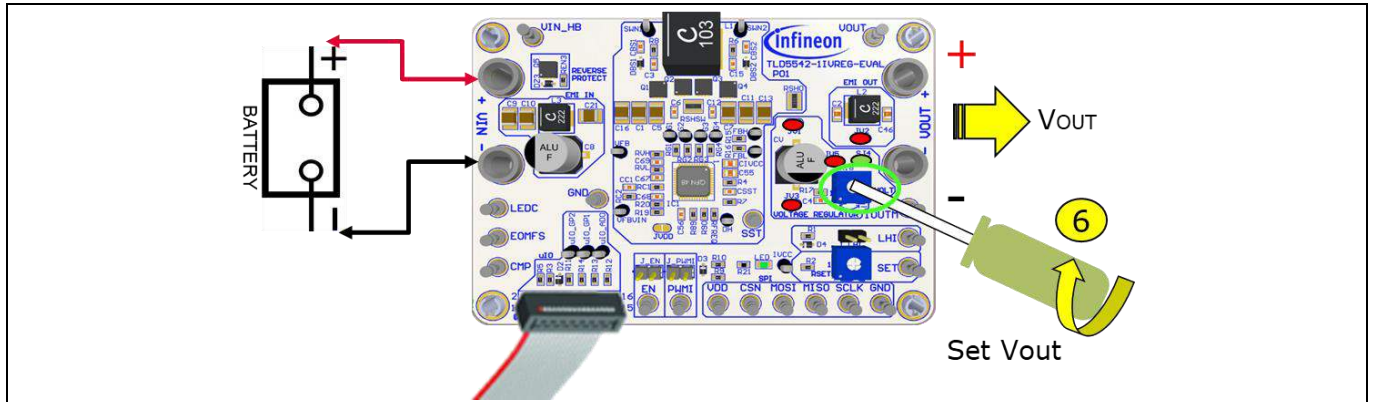
**Figure 11    Voltage regulator with µIO stick: Adjust full scale (100% ADIM) $V_{OUT}$**

7. Connect the load

**NOTE:**

It is possible to adjust output voltage from 0 to full scale (previously set by RVOLT) with the GUI Analog dimming knob, but the best transient response is when analog dimming is set to 100%.

# 4   Infineon µIO stick and Infineon Toolbox

The Infineon µIO stick is an interface device for controlling Infineon boards/kits during run time through PC.

- Enables the connection between the evaluation board and USB for SPI programming and monitoring by using the **Config Wizard** software, which can be downloaded via the **Infineon Toolbox**.
- Plugs into the evaluation board via a standard 16-pin connector and allows easy interface to the microcontroller via USB for SPI, CAN, LIN communication etc.



**Figure 12    µIO stick to the PC and the µIO flat cable to the evalboard**

The Infineon Toolbox it is a single platform interface which allows for:

- Quick installation of tools by name or QR code
- Help with documentation
- Viewing and starting installed tools from built-in launcher
- Receiving update notifications



**Figure 13    Infineon Toolbox**

For details about Infineon toolbox and µIO stick check the Infineon website: **Infineon Toolbox**.

## 4.1 Install and launch Config Wizard

1. Open the "Manage tools" tab
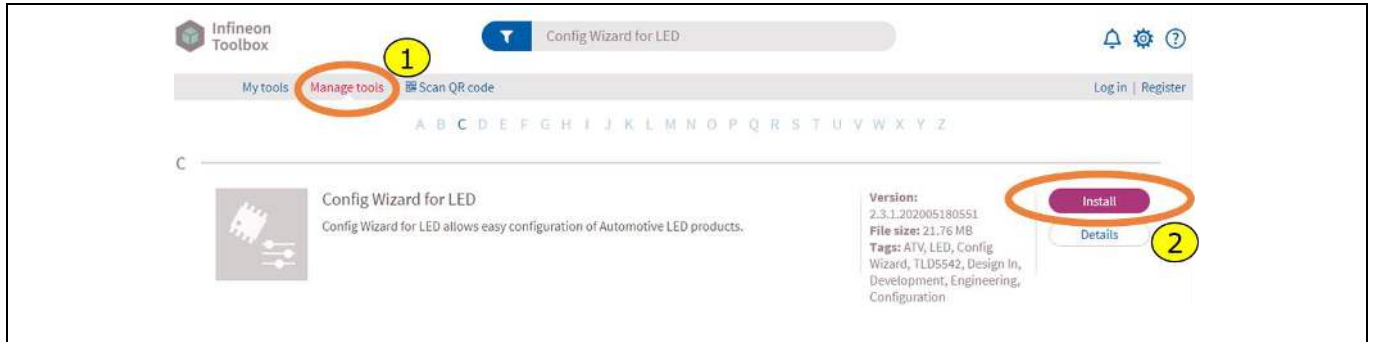2. Search for "Config Wizard for LED" and click on "Install" button



**Figure 14    Install Config Wizard for LED**

3. Select "My Tools" tab on Infineon Toolbox
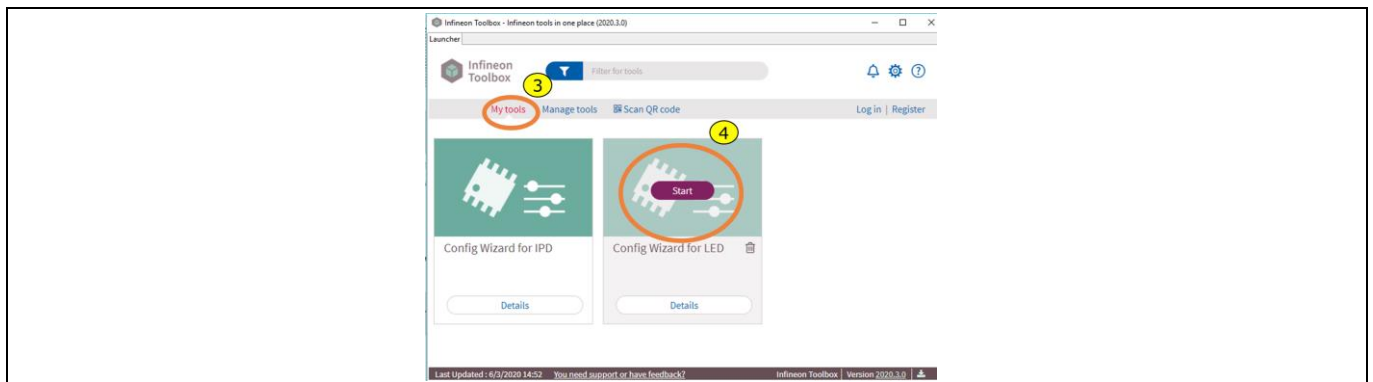4. Press "Start" on the config wizard for LED to start



**Figure 15    Start Config Wizard tool**

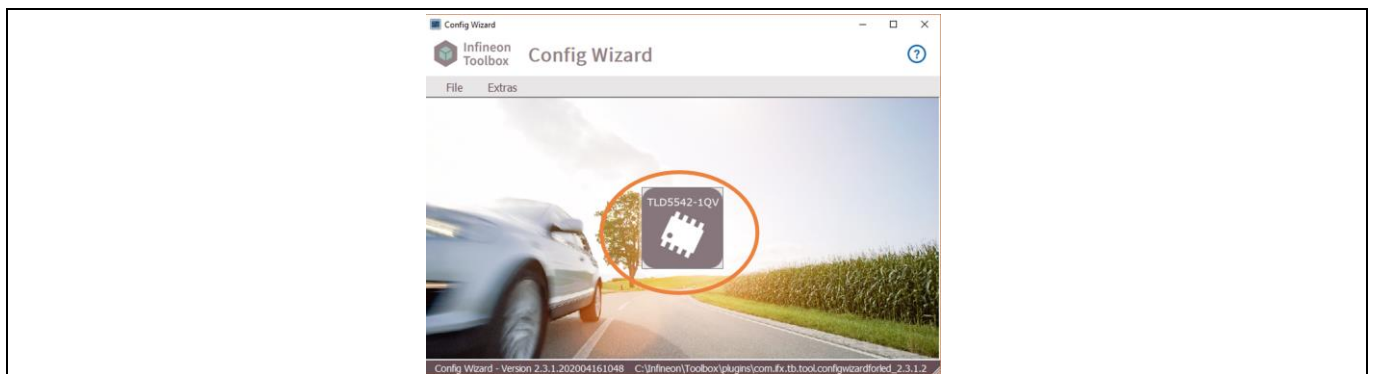5. Click on TLD5542-1 icon to start the LED GUI interface



**Figure 16    Launch TLD5542-1 GUI**

# 5  Board control with PC GUI

The TLD5542-1 PC GUI consists of 2 interfaces:

- Basic user interface

- Engineering user interface

The GUI works only if the TLD5542-1 EVALBOARD is correctly connected to the µIO stick and power supply is applied to the $V_{IN}$ connector.

**NOTE:** The text "ON/OFF" displayed on the PC GUI buttons, shows the action that will be performed, and not the status, of the item that is being utilized. For example, enable button showing "ON" → device is actually off and if the button is pressed device will turn on.

## 5.1         Basic user interface

Basic user interface allows simplified access to the main registers on TLD5542-1 (e.g. analog dimming with a knob) and provides direct feedback on TLD5542-1 status, showing indicators for each standard diagnosis register bit.

It is possible to provide EN signal and PWMI without the need for a function generator.

In order to turn on the device press the EN button, the "Power State Feedback" tab, the "Active" indicator shall turn on.
Only once the device is on, the desired analog dimming value can be set by the "Analog Dimming" knob on the "Dimming" tab.

**NOTE:** Analog dimming value is reset to 100% on the TLD5542-1 device once the EN is turned off.
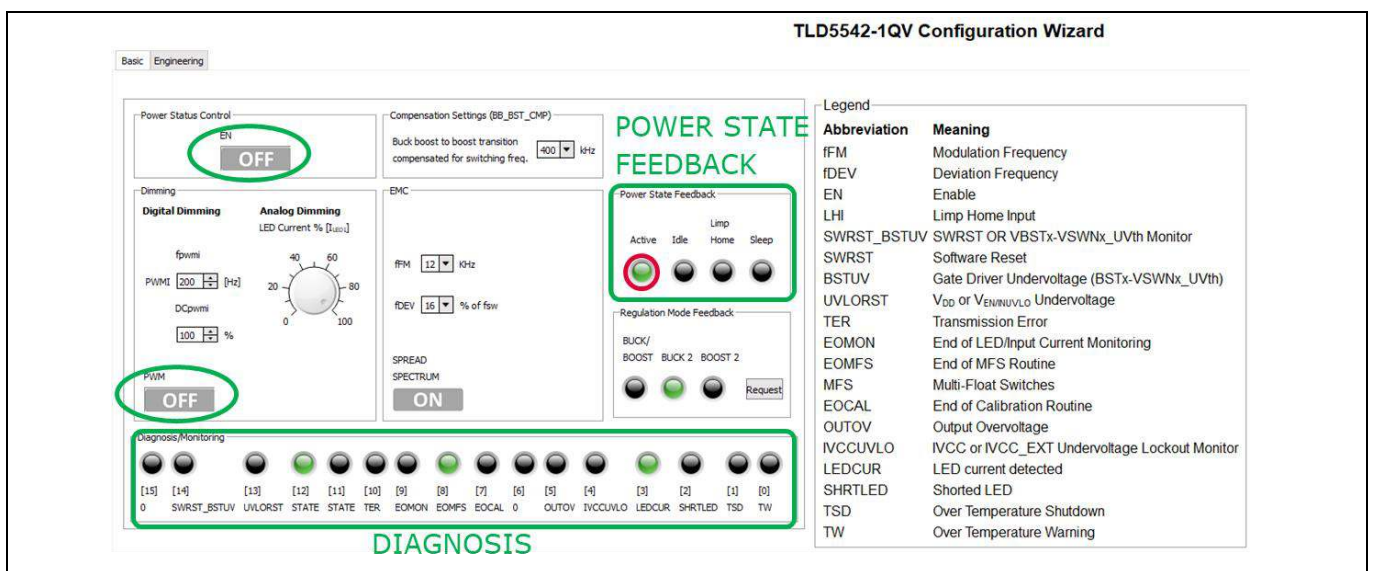


**Figure 17     TLD5542-1 GUI – Basic user interface**

On the "Diagnosis/Monitoring" tab, (see Figure 17 ) the standard diagnosis register is provided, showing information on the working status of the device.

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On the "Compensation Setting" tab (see Figure 18 ), it is possible to tune the compensation transfer function in order to have the smoothest transition from buck-boost to boost mode, which depends by the switching frequency (385 kHz for the TLD5542-1 IVREG_EVAL board)
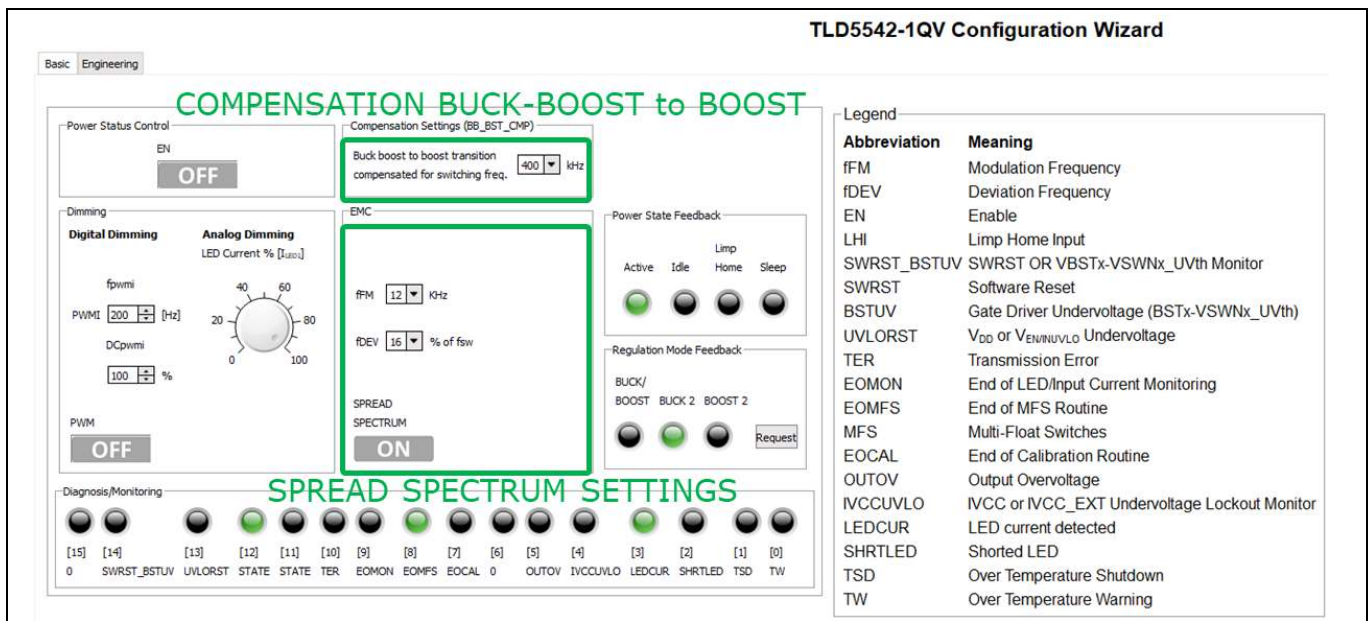


**Figure 18     TLD5542-1 GUI basic user interface – compensation and EMC tabs**

## 5.2        Engineering user interface

The Engineering user interface allows the user to send a sequence of SPI commands to the TLD5542-1. PWMI and EN pin control is also possible in this interface.

The suggested sequence of operations in order to send the SPI commands is:

1.  Write the list of SPI commands that has to be sent
2.  Turn on the device by pressing the EN button
3.  Enable the switching activity by pressing PWMI button
4.  Press the SEND button to send commands on the list, starting from the one highlighted in the list
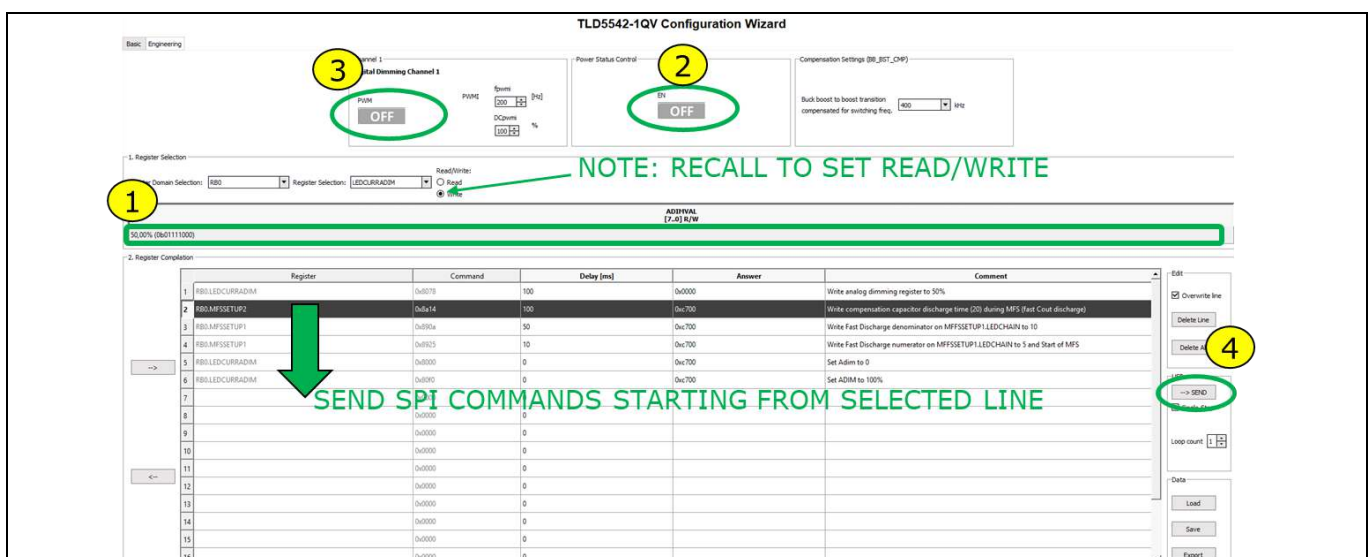


**Figure 19     TLD5542-1 GUI – Engineering user interface**

It is possible to describe each command with a comment and to save the list of commands by clicking on the "Save" button.

It is possible to set the delay applied before executing the next command in the "Delay" column, the accuracy of the timer is approximately 10 ms.
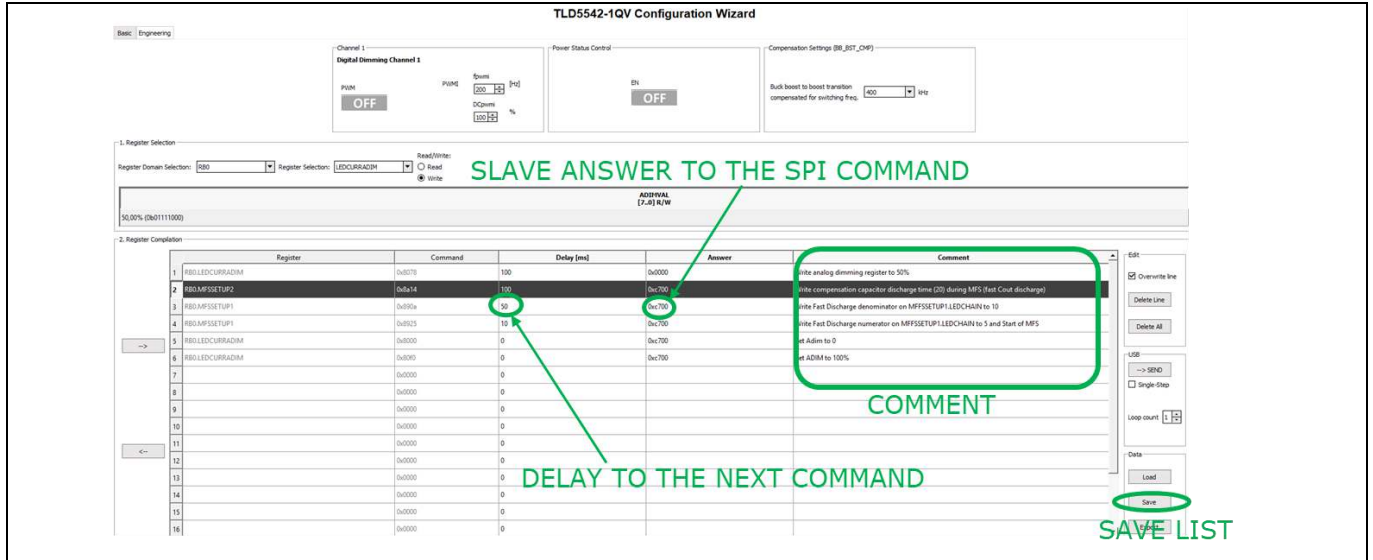


**Figure 20    TLD5542-1 GUI – writing comment - saving command list - delay between commands**

# 6    Operating range and power derating

The TLD5542-1IVREG-EVAL has very high efficiency, so it can deliver up to 60 W at the output without a heat sink at $T_A$ = 25°C, $V_{IN}$ = 12 V ( see Figure 22 for power-derating curve).

Please note that the module does not implement thermal protection, so ensure proper cooling when output power exceeds the power-derating curve. The heat sink has to be positioned below the switching MOSFETs as shown in Figure 21.
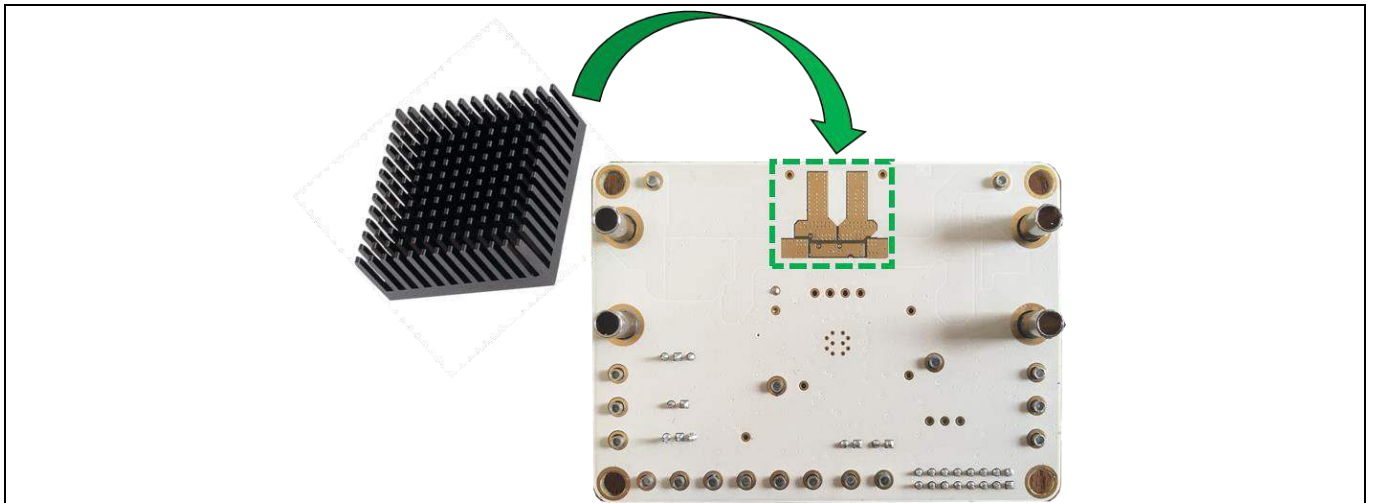


**Figure 21    TLD5542-1 Heat sink placement**

The heat sink shall be electrically insulated from the PCB, by means of a thermal pad.
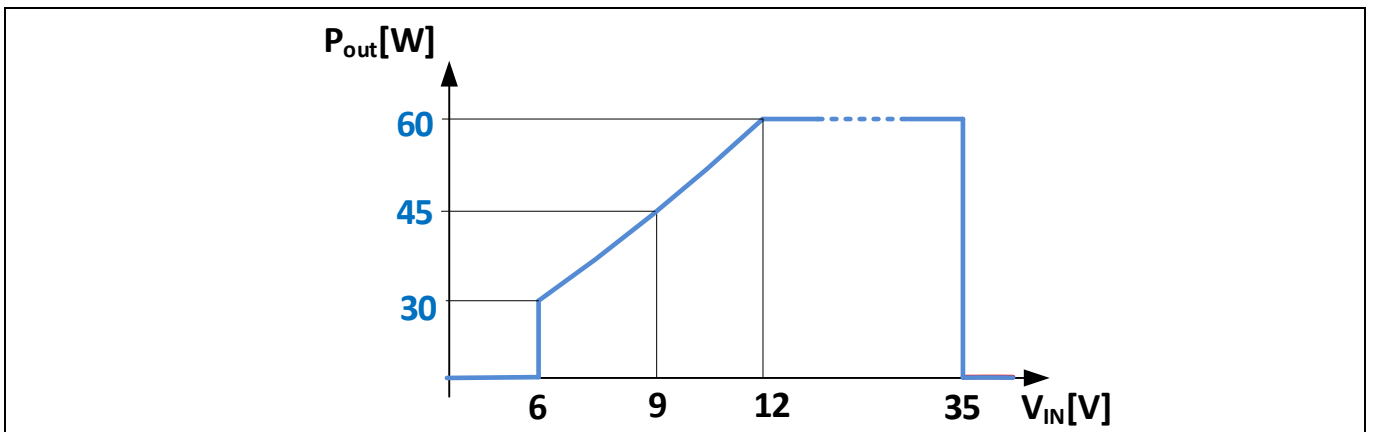


**Figure 22    Output power derating curve ($T_A$ = 25°C )**

# 7 Electrical characteristics

**Table 1        TLD5542-1IVREG-EVAL version S01 P01 – electrical characteristics**

| Parameter | Symbol | Value | | | Unit | Note/Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input voltage | $V_{IN}$ | 5.5 | - | 35 | V | Power derating may occur for $V_{IN} < 9$ V |
| Out voltage | $V_{OUT}$ | 2<br>3.3 | – | 51<br>22.5 | V | LED driver mode<br>Voltage mode |
| Output current | $I_{OUT}$ | 150<br><br>0 | –<br><br>– | 1500<br><br>5 | mA<br><br>A | LED driver mode (up to 6 A by changing RSHO)<br><br>Voltage mode |
| Output power | $P_{OUT}$ | - | 60 | | W | $V_{IN}$ 12 V to 35 V, $T_A = 25$°C<br>see Figure 22 for power derating curve |
| Switching frequency | Switching frequency | – | 385 | – | kHz | Spread spectrum deviation is present |
| PWM frequency | $PWM_{freq}$ | 100 | – | 500 | Hz | |
| System efficiency | Eff | – | 96 | – | % | $V_{IN} = 13.5$ V<br>LED mode: 8 LED, $I_{OUT} = 1500$ mA, |

# 8  PCB layout
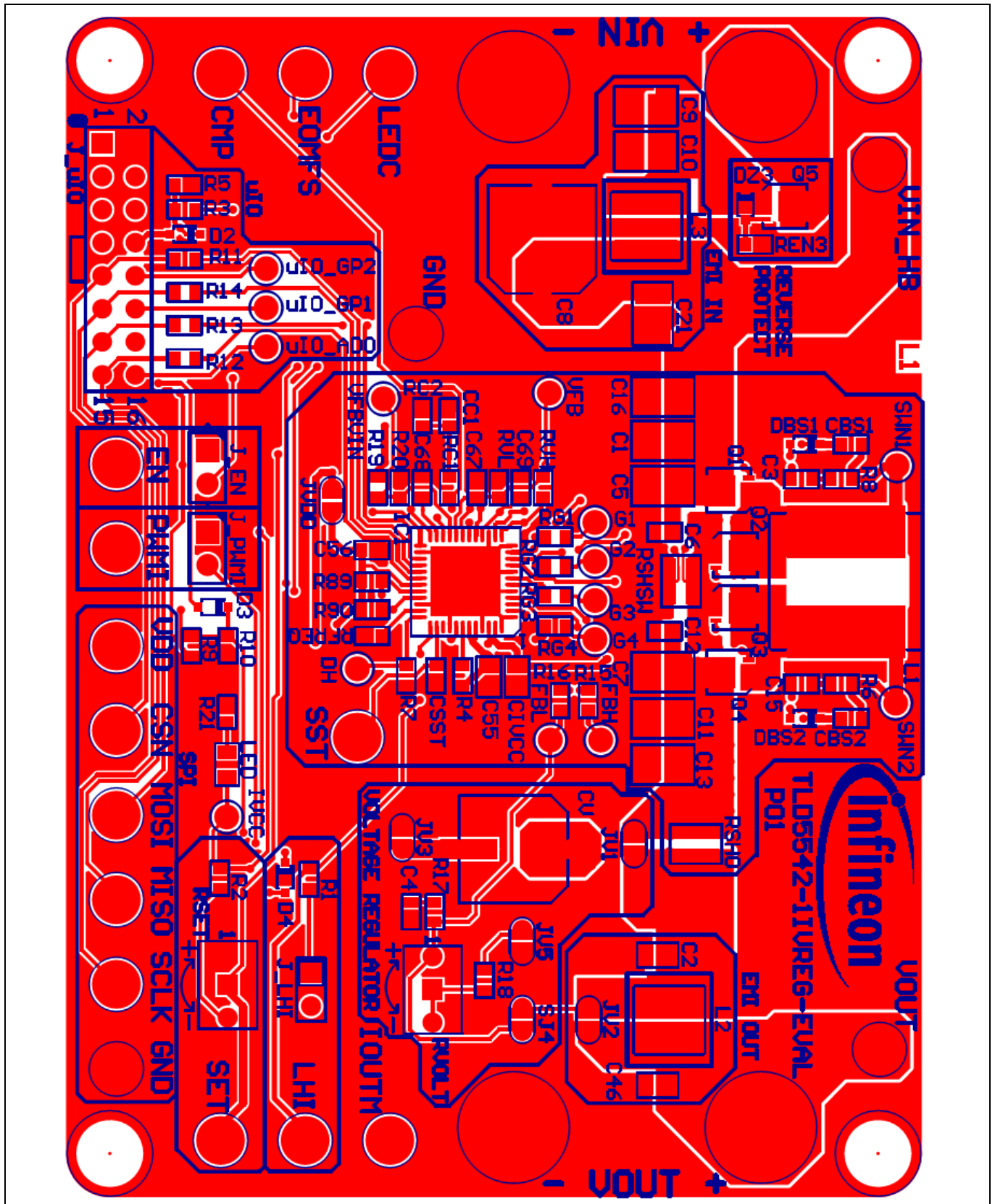


**Figure 23      PCB layout top view**

# 9 Schematic
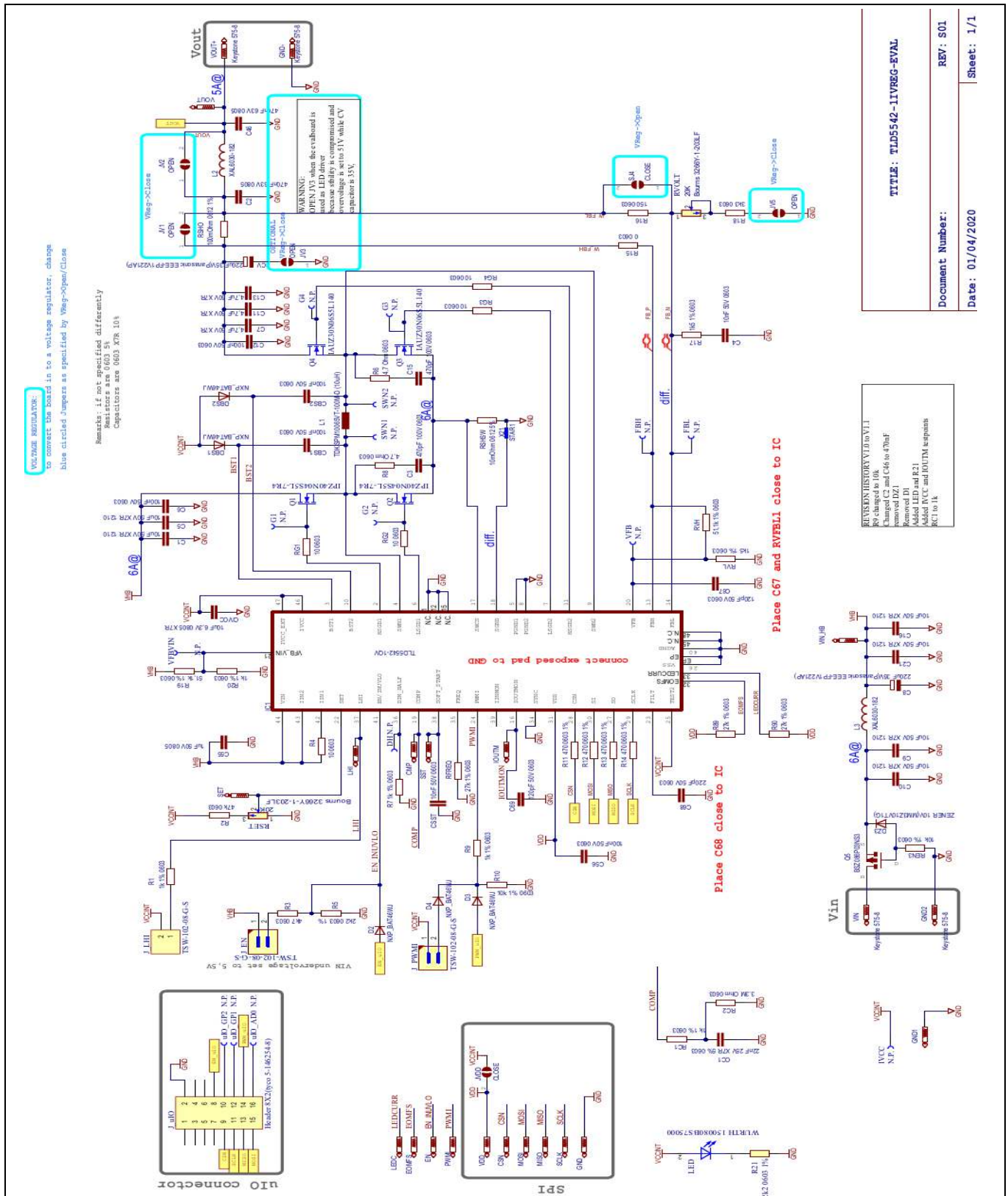


**Figure 24    Schematic**

# Revision history

| Document version | Date of release | Description of changes |
|---|---|---|
| Rev. 1.00 | 2020-05-25 | Initial User Manual |
|  |  |  |
|  |  |  |
|  |  |  |

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