3 phase bridge driver IC TLE7183QU

Evaluation Board

Application Note

Rev 1.0, 2012-03-30

Automotive Power

1 Abstract

Note: The following information is given as a hint for the implementation of the device only and shall not be regarded as a description or warranty of a certain functionality, condition or quality of the device.

This Application Note is intended to provide information about the TLE7183QU Evaluation Board Revision 1.0. The board is designed to facilitate the evaluation of the Infineon 3 phase bridge driver IC TLE7183QU.

This document includes a board description, a quick start guide, the schematics and the layout of the board. It is assumed that the reader is familiar with the driver IC data sheet.

The board itself can be ordered using the usual Infineon Technologies sales channels.

Please make sure that the revision of your evaluation board and the board revision described in this document (1.0) match before you get started.

2 Board description

Besides the bridge driver IC itself, the TLE7183QU Evaluation Board contains 6 N-Channel Power MOSFETs, a current sense shunt resistor and other additional components like a 5V regulator to allow operation with a minimum of external equipment. It is designed for automotive 12V applications. This chapter describes all parts of the board.

Schematics and layout are covered in detail in **Chapter 4**.

2.1 Overview

Figure 1 contains the top view of the board.

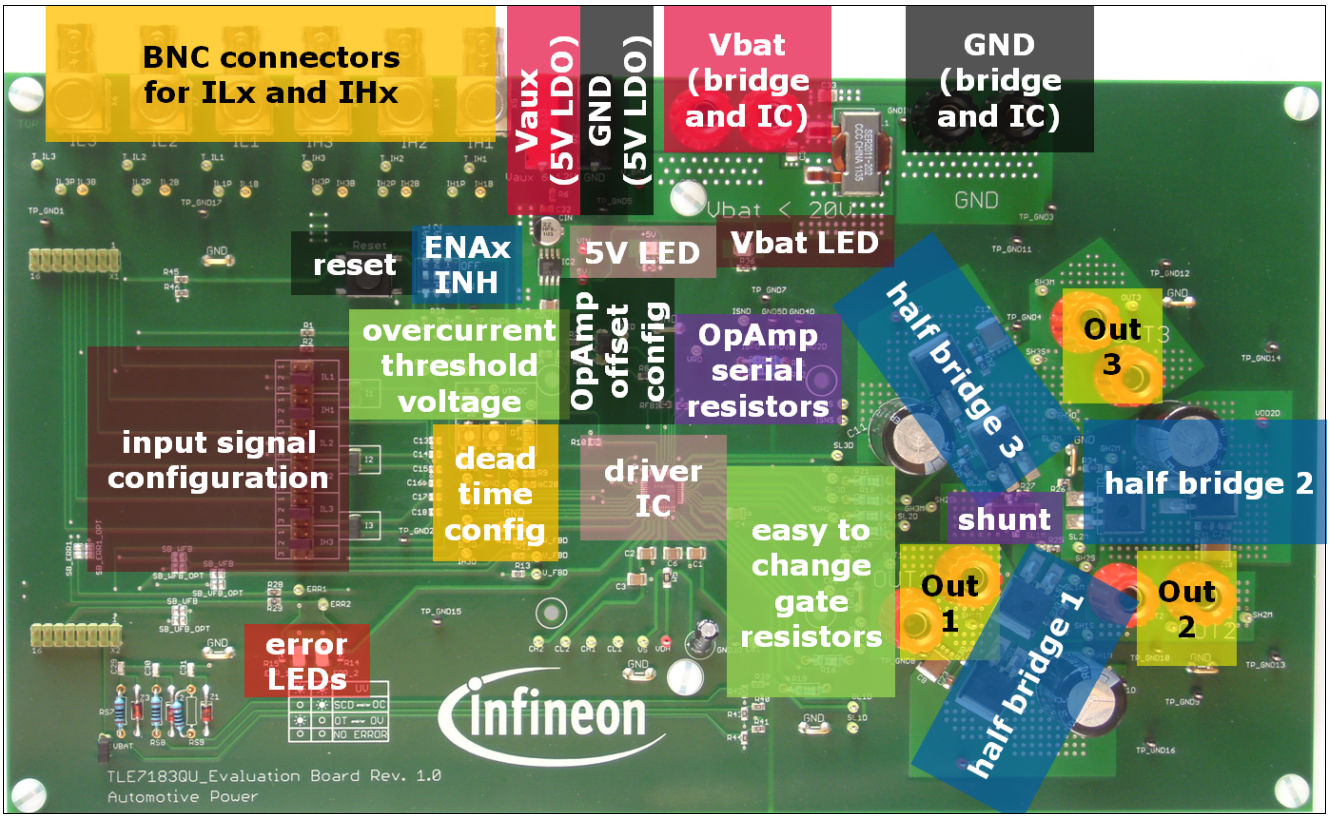

Figure 1 top view of the evaluation board

2.2 TLE7183QU Driver IC

The package type of the driver IC is PG-TQFP-48-8. Different variants of the driver IC are available with different short circuit detection (SCD) levels (please see the driver IC data sheet for details). The type of the driver IC that is mounted by default is SCD2.

2.3 Power Supply Connectors Vbat and Vaux

The power supply for the driver IC and the bridge has to be connected to Vbat. Vaux is the supply for the 5V linear regulator. There are separate power suppy domains in order not to overstress the 5V regulator when working with higher supply voltages for the bridge. In this case, Vaux can be supplied with a lower voltage instead.

Due to the intrinsic body diodes of the Power MOSFETs, the board is not reverse battery protected, so please see **Figure 1** for the required polarity of Vaux and Vbat before applying external voltages.

2.4 Power Stage

Each of the three power stages contains two n-channel Power MOSFETs. One of them is used as a low side switch, the other one as a high side switch. Two DC link capacitors (1000µF and 2.2µF) have been added. A combination of a 2.2Ohm resistor and a 4.7µF capacitor is used as a snubber circuit. 100kOhm are put in between gate and source.

Figure 2 shows the power stage components in detail.

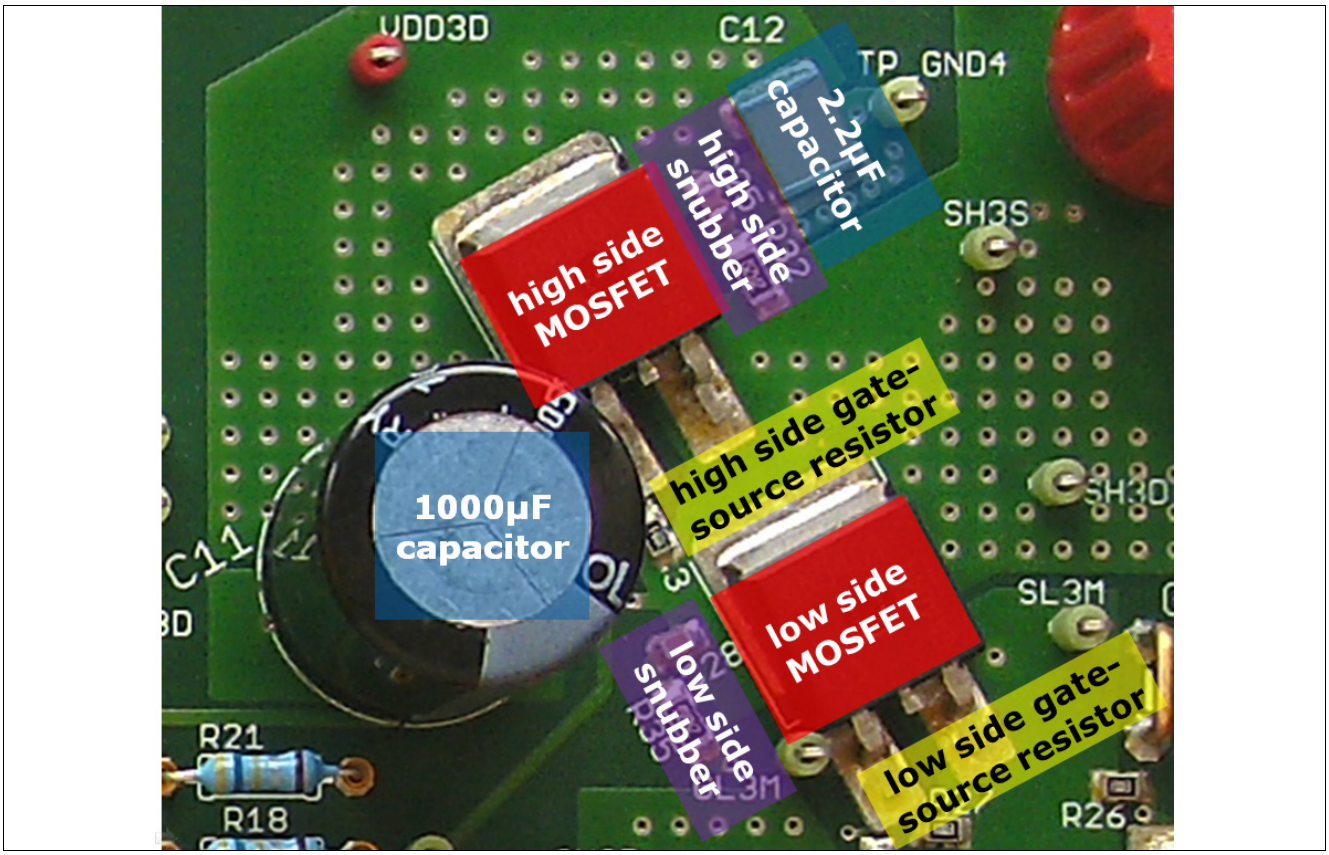

Figure 2 power stage

2.5 Input Signal Configuration

The 5V logic level input signals determine which of the Power MOSFETS are switched on or off. The signals IL1, IL2 and IL3 (ILx) correspond to the low side MOSFETs in half bridge 1,2 and 3. IH1, IH2 and IH3 (IHx) are their counterparts for the high side MOSFETs. The low side MOSFETs are switched on if the corresponding ILx signals are high. The high side MOSFETS are switched on if the corresponding IHx signals arelow.

There are three alternative ways of providing these input signals: the microcontroller connector X1, the BNC sockets or the corresponding test pins. **Figure 3** shows all possible options and the matching jumper positions. It is also possible to use a common input signal for high side and low side MOSFET making them switch alternating.

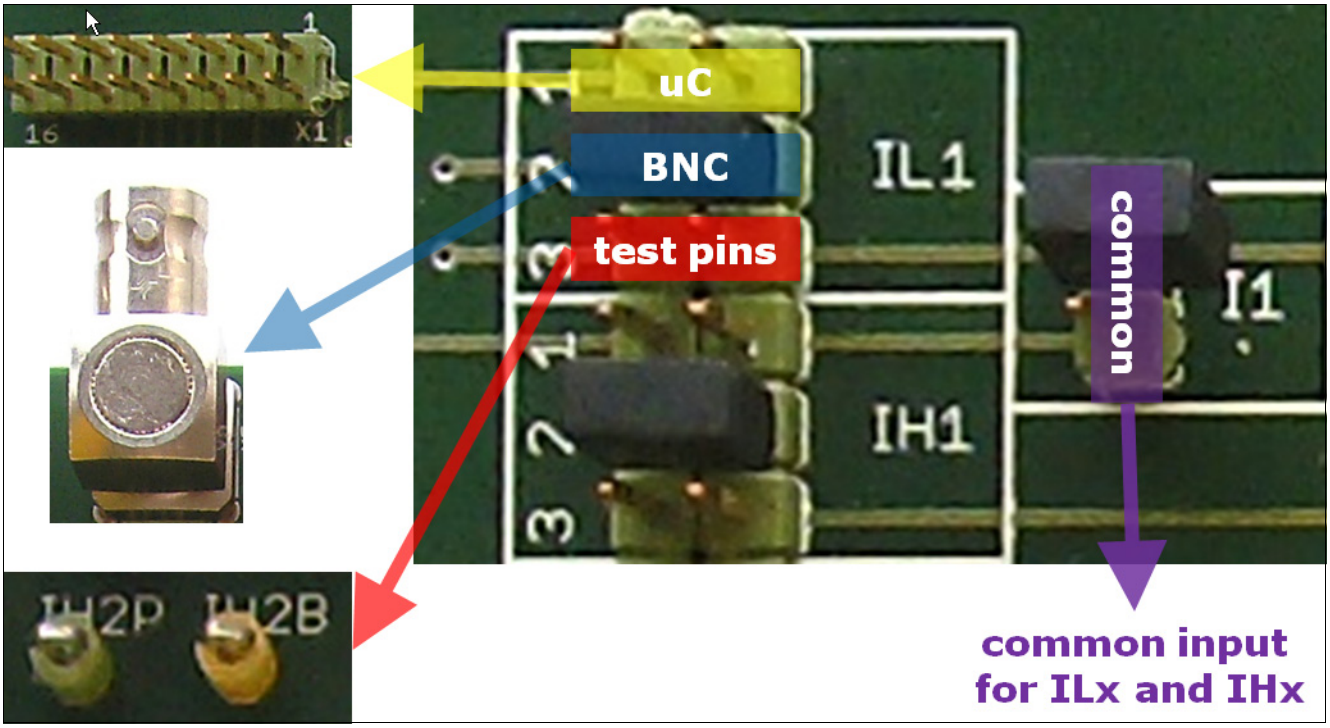

Figure 3 input signal configuration

2.6 Status LEDs

As shown in **Figure 1** the TLE7183QU Evaluation Board has two red LEDs for error and warning indications and two green LEDs to indicate that the supply voltages have been applied at Vbat and Vaux. Vaux supplies the 5V linear regulator. The 5V LED indicates that the 5V linear regulator is working correctly. The Vbat LED indicates that an external voltage has been applied at Vbat.

The red error LEDs are directly connected to the output pins ERR1 and ERR2 of the bridge driver. The error LEDs follow the outputs of the driver IC. The corresponding error conditions are printed on the PCB next to the LEDs.

2.7 Dead Time Configuration with potentiometers P_DT1 and P_DT2

The internally generated minimum dead time of TLE7183QU is determined by the resistor that is put in between the DT pin of the driver IC and GND. The minimum dead time increases with higher resistor values.

The TLE7183QU Evaluation Board has two potentiometers P_DT1 and P_DT2 and a jumper to adapt the minumum dead time to the desired value. Please see **Figure 1** for their position on the PCB.

P_DT1 can be used for values of up to 1MOhm. P_DT2 can be used for fine tuning allowing values of up to 50kOhm. The jumper DT has to be set to position 1-2 to connect the potentiometers to the DT pin of the driver IC.

If the jumper DT is set to position 2-3, there is a direct connection of the DT pin and GND. This will set the dead time to the minimum value defined in the data sheet. Setting the dead time to low values can lead to a situation where high side and low side MOSFET in the same half bridge are switched on at the same time. This has to be avoided in order to make sure that there a no excessive current on board.

If the jumper DT is open, the dead time will be set to the maximum value defined in the data sheet.

2.8 Operational Amplifier configuration

The TLE7183QU driver IC incorporates a fast and precise operational amplifier for conditioning and amplification of the current sense shunt signal. The TLE7183QU Evaluation Board makes it easy to adjust its gain, its zero current offset voltage and the threshold voltage that it is used for the overcurrent warning indication.

2.8.1 Zero Current Offset Voltage Configuration with Jumper VRI

Setting the jumper VRI to position 1-2 sets the zero current offset voltage of the operational amplifier to 2.5V. Setting it to position 2-3 sets the offset voltage to 1.65V. Please see **Figure 1** for its position on the PCB.

2.8.2 Gain Configuration with RS1 and RS2

The gain of the operational amplifier is defined by the resistor ratio RFBx/RSx with RS1=RS2 and RFB1=RFB2. The resistors RS1 and RS2 are easily accessible on the TLE7183QU Evaluation Board. Please see **Figure 1** for their position on the PCB. Taking into account the values of RFBx, the gain can be adjusted to the desired value by exchanging the resistors RS1 and RS2.

2.9 Overcurrent Threshold Voltage (VTHOC) Configuration

The output of the operational amplifier of the TLE7183QU driver IC is internally compared to the voltage applied at its pin VTHOC. If the OpAmp output exceeds this threshold, the overcurrent warning is indicated by the ERRx output pins of the driver IC.

The voltage at the pin VTHOC can be adjusted with the potentiometer VTHOC. Please see **Figure 1** for its position on the PCB.

2.10 ENA1, ENA2 and INH switches

There are three switches on the TLE7183QU Evaluation Board. Please see **Figure 1** for their position on the PCB. They correspond to the driver IC input signals ENA1, ENA2 and INH. All three of them have to be set to the position “on” in order to be able to switch the external MOSFETs.

2.11 Easy to Change Gate Resistors

The values of the gate resistors R16-R21 limit the gate current and therefore modify the switching behavior of the external MOSFETs. If required, they can be replaced by smaller/bigger values to make switching faster/slower.

3 Quick Start Guide

3.1 Before You Begin

Please make sure that the revision of your evaluation board and the board revision described in this document (1.0) match before you get started. The revision number is printed on the PCB as shown in **Figure 4**.

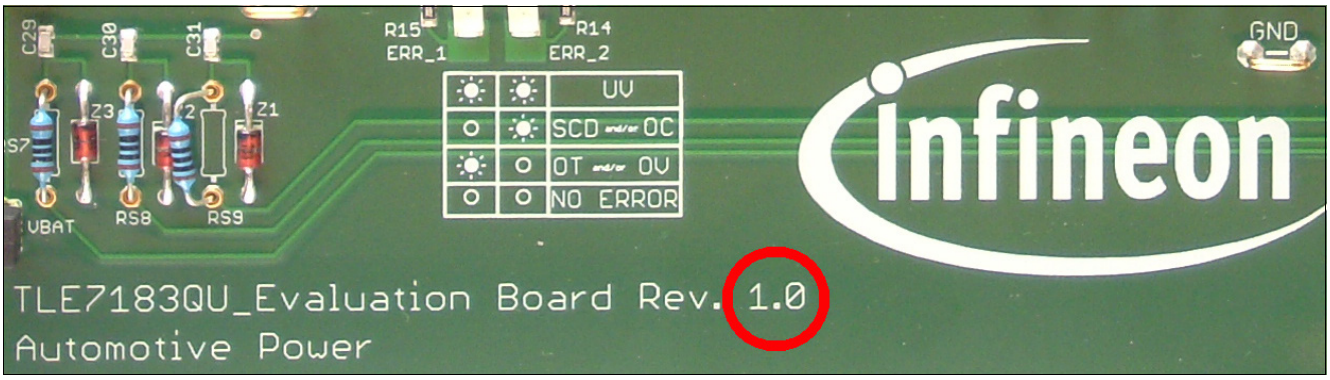

Figure 4 Evaluation Board TLF7183QU revision number

3.2 Example: switching a half bridge with a common BNC input signal

In this example, we switch the low side and the high side MOSFET in half bridge 1 with a single common BNC input signal. This is possible because the input signals ILx are active high and IHx are active low (see **Chapter 2.5**).

- set the switches ENA1, ENA2 and INH to “on” (see **Chapter 2.10**)
- set the jumper IL1 to position 2 to select the BNC input (see **Chapter 2.5**)
- set the jumper I1 to select a common input for IL1 and IH1 (see **Chapter 2.5**)
- connect a signal generator to the BNC input IL1 and apply a valid PWM pattern
- set the jumper VRI according to **Chapter 2.8.1** to configure the zero current offset voltage
- adjust the potentiometers P_DT1, P_DT2 and the jumper DT to configure the minimum dead time (see **Chapter 2.7**)
- adjust the potentiometer VTHOC to configure the overcurrent detection threshold voltage (see **Chapter 2.9**)
- connect 12V power supplies to Vbat and Vaux (see **Chapter 2.3**)

Both green LEDs, the 5V and the VBat LED, should now light up. The MOSFETs should be switching as defined by the common input signal provided at the BNC input IL1. Use an oscilloscope to verify.

Figure 5

4 schematics and layout

Figure 6 contains the schematics. All four layers of the board are shown in Figure 7, Figure 8, Figure 9 and Figure 10.

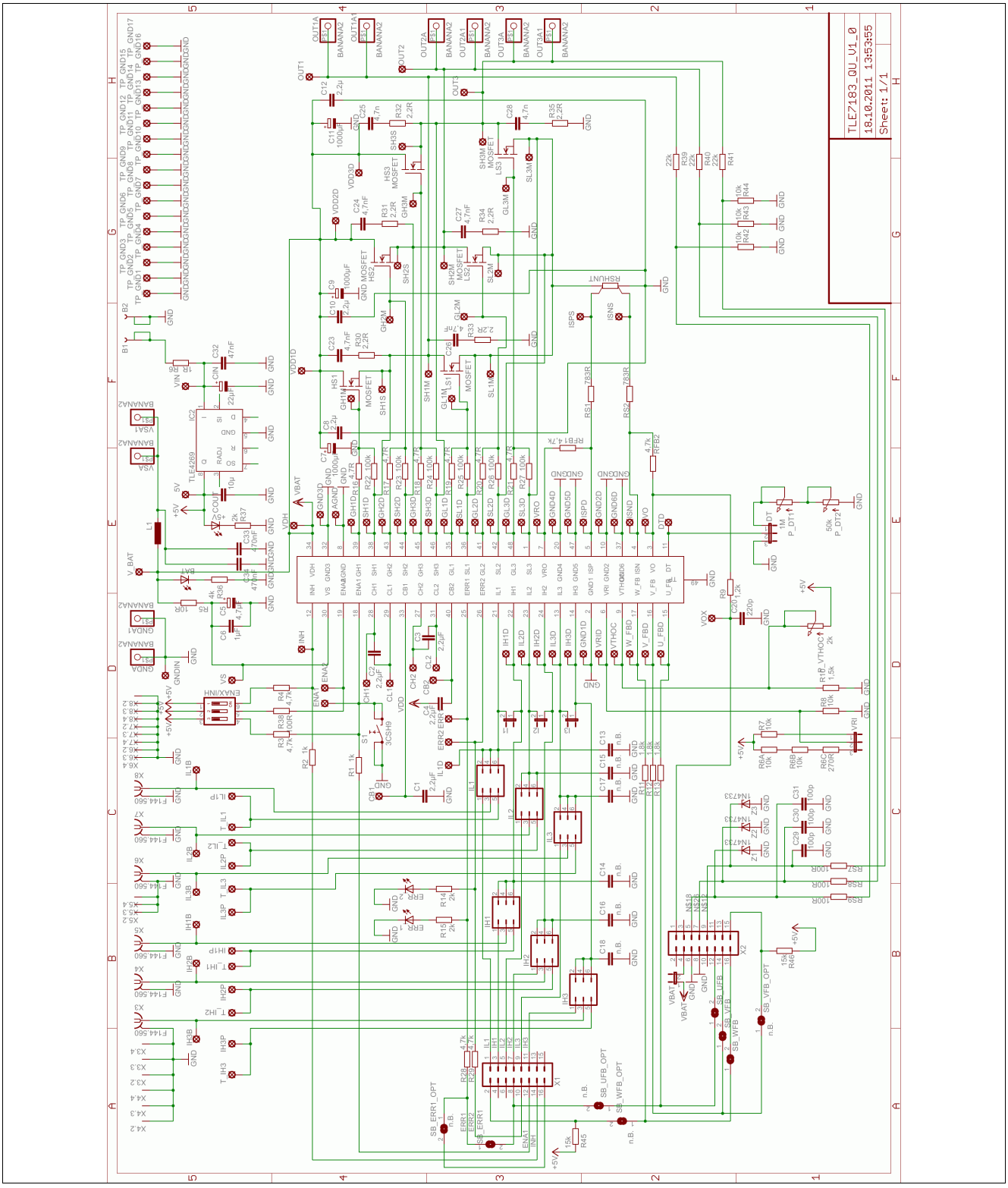

Figure 6 TLE7183QU Evaluation Board schematics

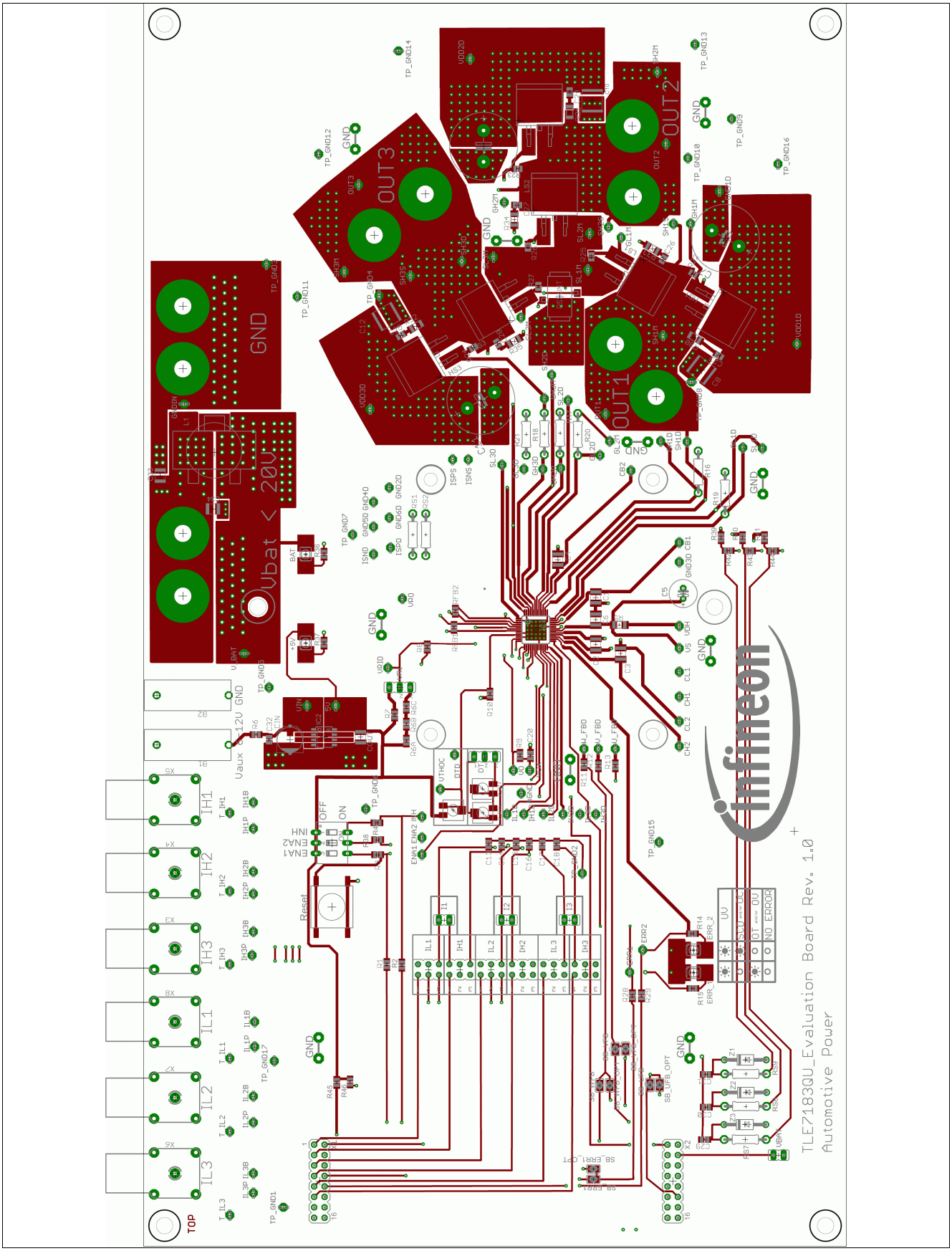

Figure 7 first layer of TLE7183QU Evaluation Board

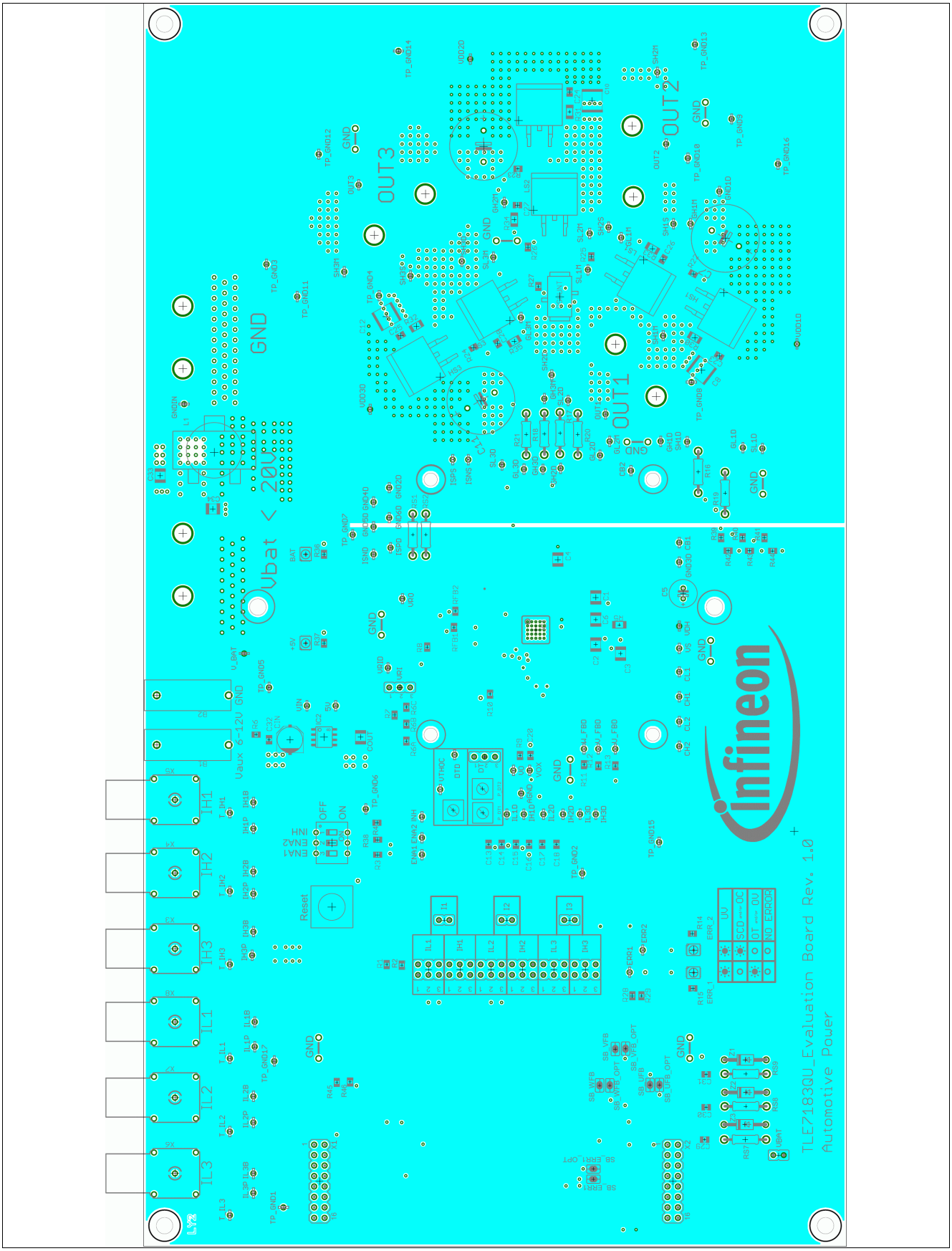

Figure 8 second layer of TLE7183QU Evaluation Board

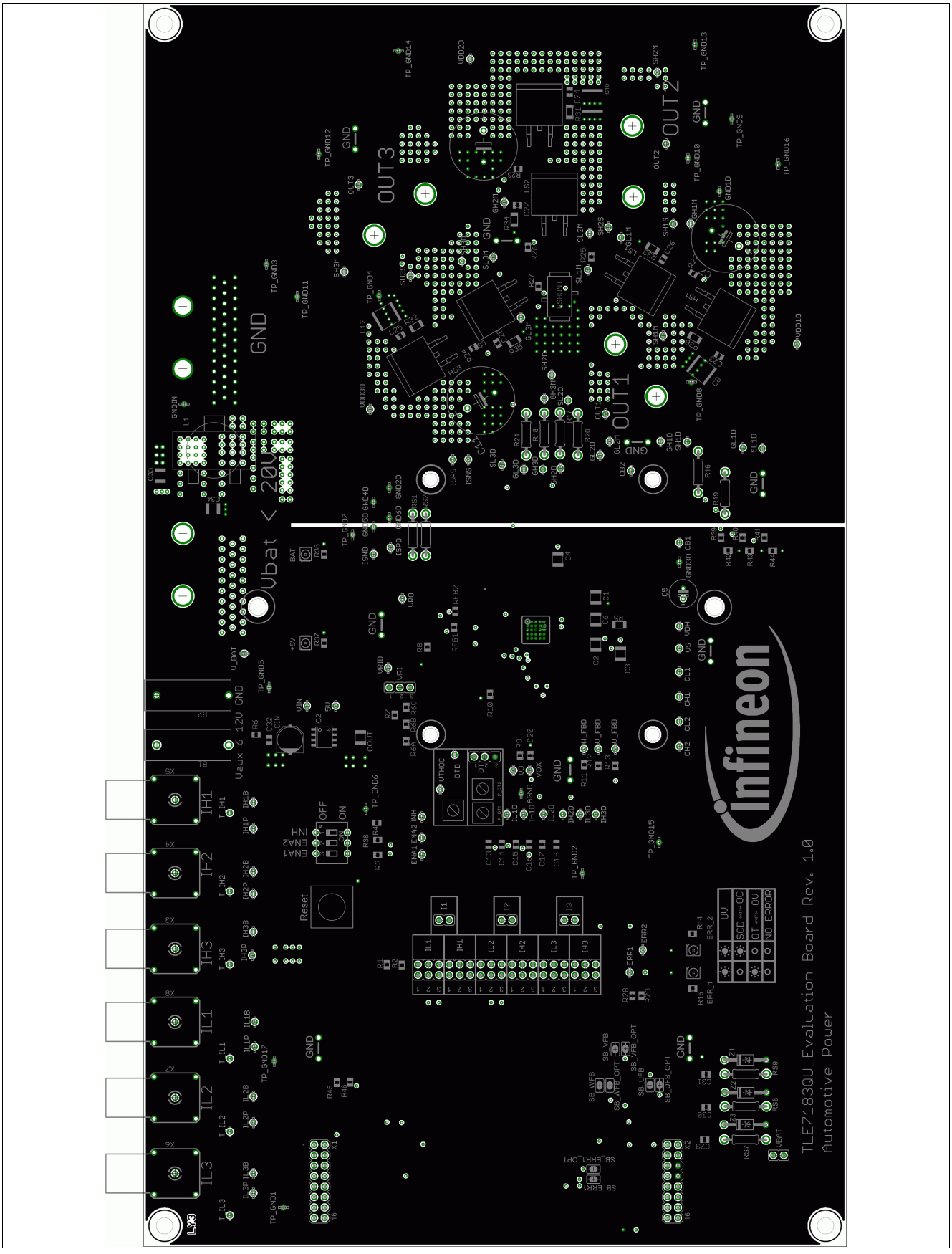

Figure 9 third layer of TLE7183QU Evaluation Board

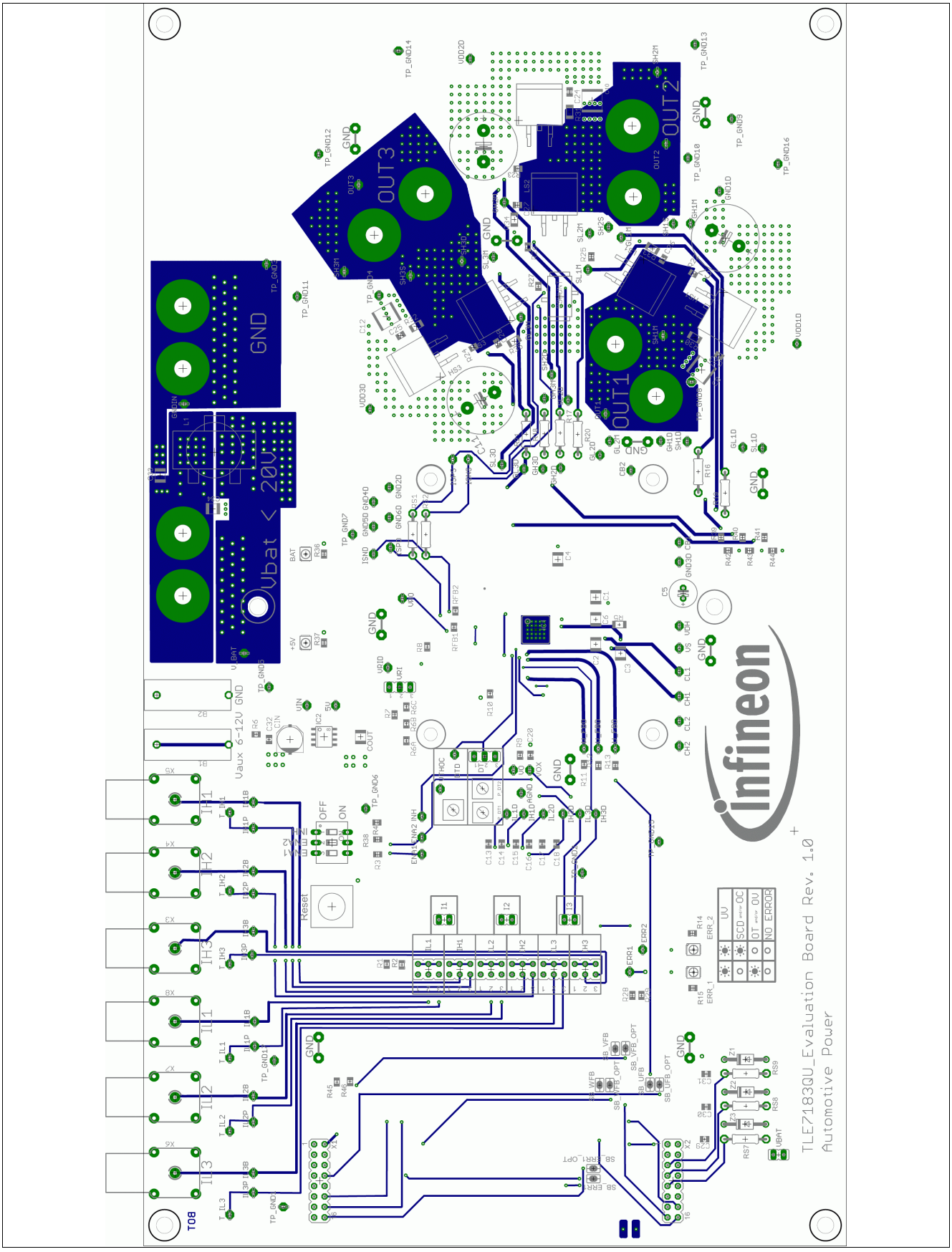

Figure 10 bottom layer of TLE7183QU Evaluation Board

5 Revision History

TLE7183QU Evaluation Board

Revision History: Rev 1.0, 2012-03-30

Previous Version(s):

-

Page	Subjects (major changes since last revision)
-	-

Edition 2012-03-30

Published by
Infineon Technologies AG
81726 Munich, Germany

Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (**www.infineon.com**).

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.