H-Bridge Driver IC TLE7181EM

Evaluation Board

Application Note

Rev 1.2, 2012-03-20

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 TLE7181EM Evalution Board Revision 1.1. The board is designed to facilitate the evaluation of the Infineon H-bridge driver TLE7181EM.

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 (1.1) match before you get started.

2 Board description

Besides the H-bridge driver itself, the TLE7181EM Evalution Board contains 5 N-Channel Power MOSFETs, a current sense shunt resistor and other additional components like a 5V regulator to allow operation without a lot 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.

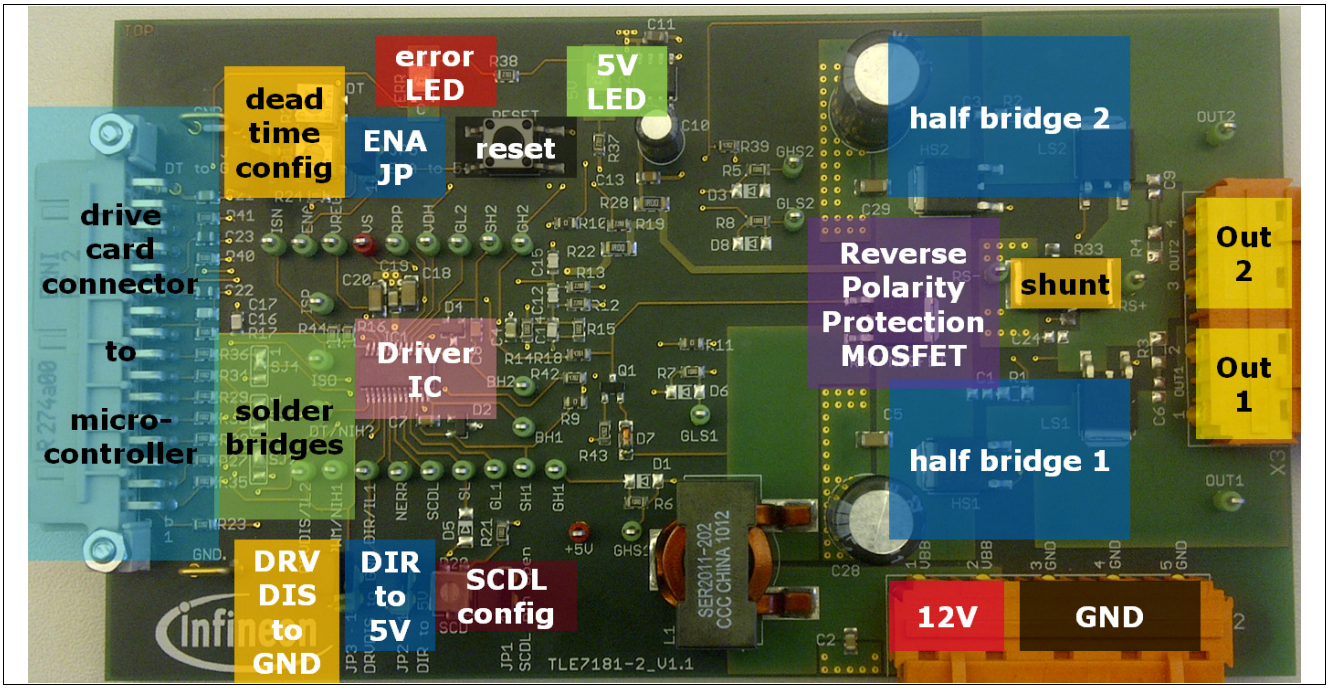

Figure 1 top view of the TLE7181EM Evalution Board

2.2 Power Supply

The power supply of the board and the load (=motor) has to be connected to the connector X2. Please see **Figure 1** for the required polarity.

2.3 Power Stages and Phase Outputs

Each of the two power stages contain two IPD90N04S04-02 n-channel MOSFETs. One of them is used as a low side switch, the other one as a high side switch. Two DC link capacitors (220µF and 2.2µF) have been added. It is possible to add snubber circuits for high side as well as the low side MOSFETs but they are not mounted by default. The phase outputs are available on the connector X3.

Figure 2 shows the power stage components in detail.

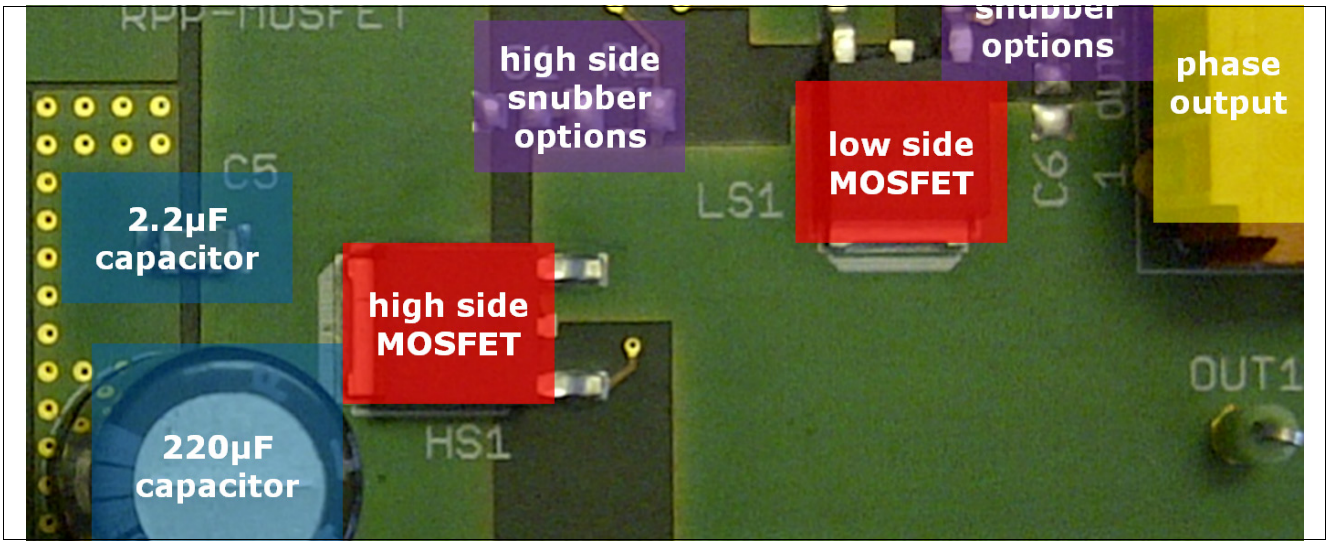

Figure 2 power stage

2.4 Status LEDs

The TLE7181EM Evalution Board has two status LEDs. The green 5V LED indicates that the 5V voltage regulator is working correctly. The red ERR LED will light up if there is a warning or an error indication of the bridge driver.

2.5 Solder Bridges

The PCB of the TLE7181EM Evalution Board is also used for the TLE7182EM Evalution Board. The solder bridges have to be set according to **Figure 3**.

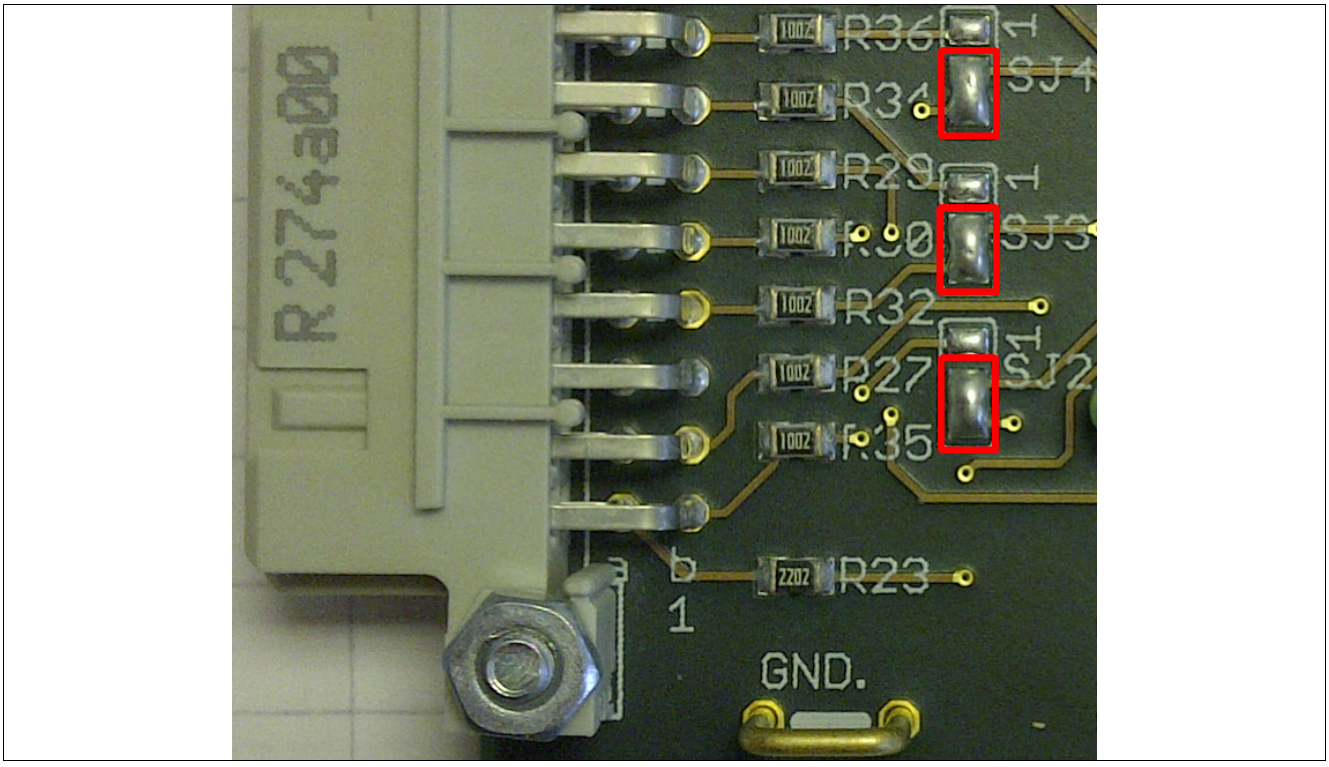

Figure 3 required solder bridges configuration for TLE7181EM

2.6 Drive Card Connector to Microcontroller

The drive card connector is the interface to the microcontroller. It contains the 5V supply voltage for the microcontroller as well as all relevant connections to input and output pins of the bridge driver. Please see the schematics in **Chapter 4** for a detailed pin description. All jumpers except JP1 (SCDL open) have to be open if a microcontroller is used.

2.7 Jumpers, Buttons and Potentiometers

The TLE7181EM Evalution Board has several jumpers to simplify usage without a microcontroller, to allow tweaking of the dead time (DT) and short circuit detection level (SCDL) and for testing purposes.

2.7.1 ENA jumper JP5 and Reset Button

The ENA pin of the driver IC enables it. ENA can be set to 5V by setting the jumper JP5. ENA can be temporarily set to GND by pressing the reset button. This will reset the IC. If the device is used with a microcontroller, JP5 has to be open in order not to override the ENA signal coming from the microcontroller.

2.7.2 Dead Time Configuration and Testing with R25, R31 and JP4

The dead time generated by TLE7181EM depends on the resistor value connected between the DT pin of the IC and GND. Please see the data sheet for the full description. R25 and R31 can be used to tweak the value of this resistor.

Setting JP4 connects the DT pin of the IC directly to GND. In this case the IC will generate the mininum dead time specified in the data sheet.

2.7.3 Short Circuit Detection Level Configuration

The short circuit detection level can be adjusted with the SCD potentiometer next to the jumper JP1. It has to be assured that SCDL is within the range specified in the data sheet.

The jumper JP1 has to be set in normal operation mode. In order to test the SCD open pin detection, JP1 can be removed. In this case the ERR LED has to light up.

2.7.4 DIR Configuration with JP2

TLE7181EM has a PWM/DIR input interface to control the external MOSFETs. The DIR signal is used to control the direction. JP2 can be used to set DIR to high without any external equipment. If the device is used with a microcontroller, JP2 has to be disconnected in order not to override the DIR signal coming from the microcontroller.

2.7.5 DRVDIS Configuration with JP3

DRVDIS set to high switches off all external MOSFETs. The default value is also high, so the MOSFETs are switched off by default. JP3 allows setting DRVDIS to low without external equipment, so switching of the external MOSFETs according to the input patterns is possible. If the device is used with a microcontroller, JP3 has to be disconnected in order not to override the DRVDIS signal coming from the microcontroller.

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 (1.1) match before you get started. The revision number is printed on the PCB as shown in **Figure 4.**

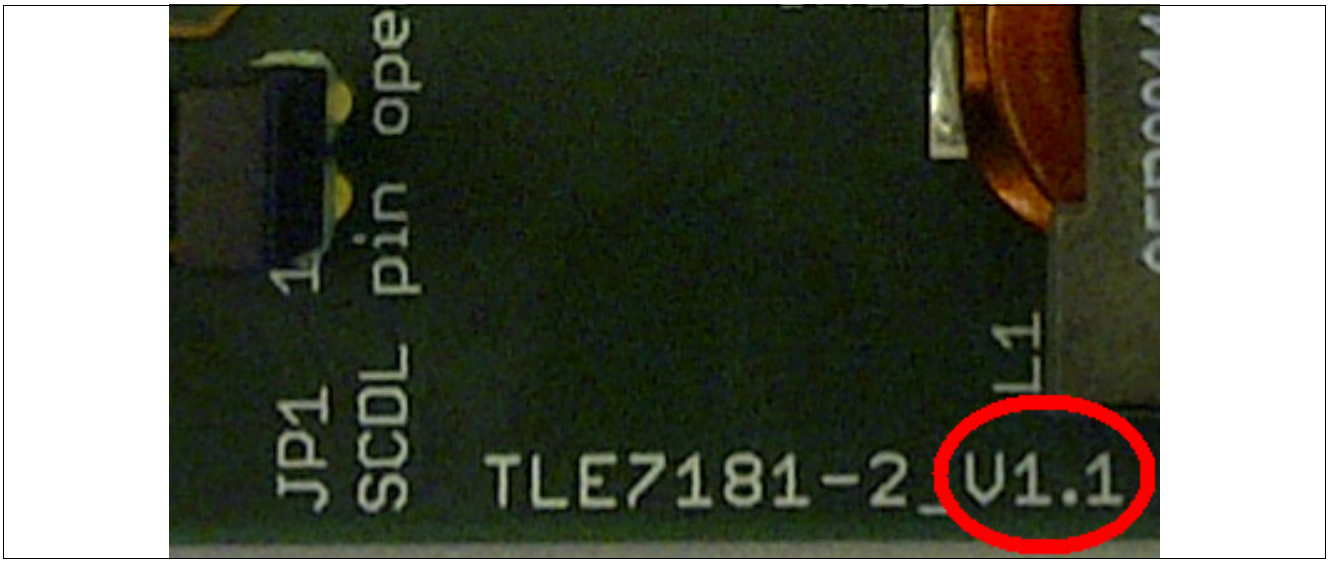

Figure 4 board revision

3.2 Preparation

The same PCB is used for both, the TLE7181EM Evalution Board and the TLE7182EM Evalution Board. Please check whether the correct H-bridge driver IC is mounted on the PCB.

Please set the solder bridges according to **Chapter 2.5**.

3.3 Simple Example without a Microcontroller

To drive an external DC-brush motor at the phase outputs, only a few steps are required.

- set jumper JP1 (see **Chapter 2.7.3**) to avoid the SCDL open pin error
- set jumper JP5 (see **Chapter 2.7.1**) to set the ENA pin to high
- to select a specific direction of the motor, change the DIR jumper JP2 accordingly (see **Chapter 2.7.4**)
- open jumper JP4 (see **Chapter 2.7.2**) to be able use the dead time configuration with the potentiometers at R25 and R31
- connect a 12V power supply according to **Chapter 2.2**
- connect a DC-brush motor to the outputs OUT1 and OUT2
- if the red ERR LED indicates a problem, make sure that the SCDL voltage is within the range specified in the data sheet. At the time of writing this document, the current data sheet defines a valid range from 0.2..2.0V. If the SCDL voltage is not within this range, please change it as described in **Chapter 2.7.3**
- if the red ERR LED still indicates a problem, please go through the error conditions specified in the data sheet. If one or more of them are met, please resolve them
- enable the output stages of the driver IC by setting DRVDIS to low. This can be done by setting the jumper JP3 (see **Chapter 2.7.5**)
- apply a PWM signal with a duty cycle of 50% which meets the requirements defined in the data sheet to the pin X1-B4 of the drive card connector (see **Figure 5**)
- now the MOSFETs should be switching as defined by the input signals

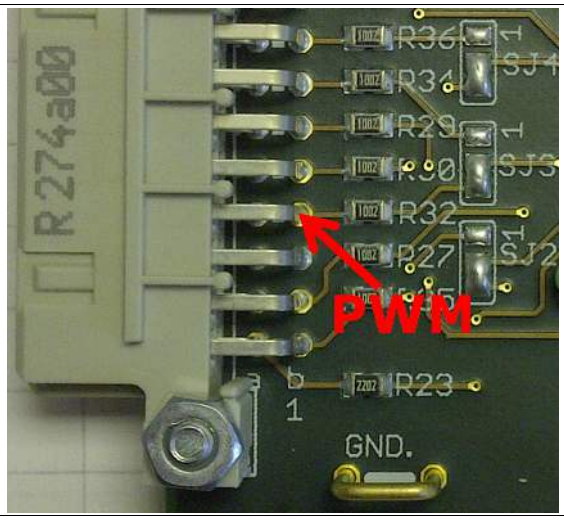

Figure 5 Driver Card Connector PIN for PWM (X1-B4)

4 schematics and layout

Figure 6 contains the schematics. **Table 1** contains the part list.

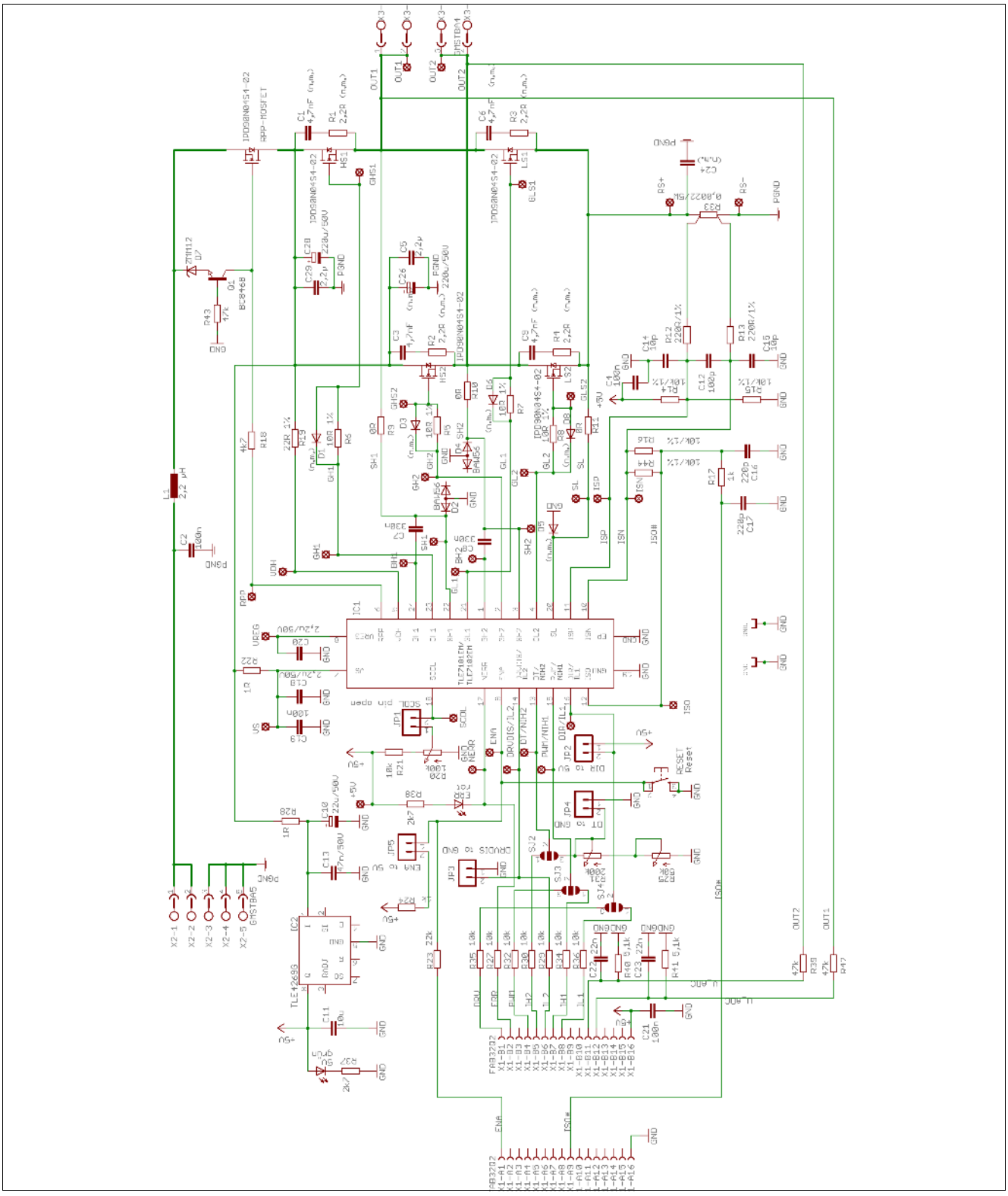

Figure 6 schematics

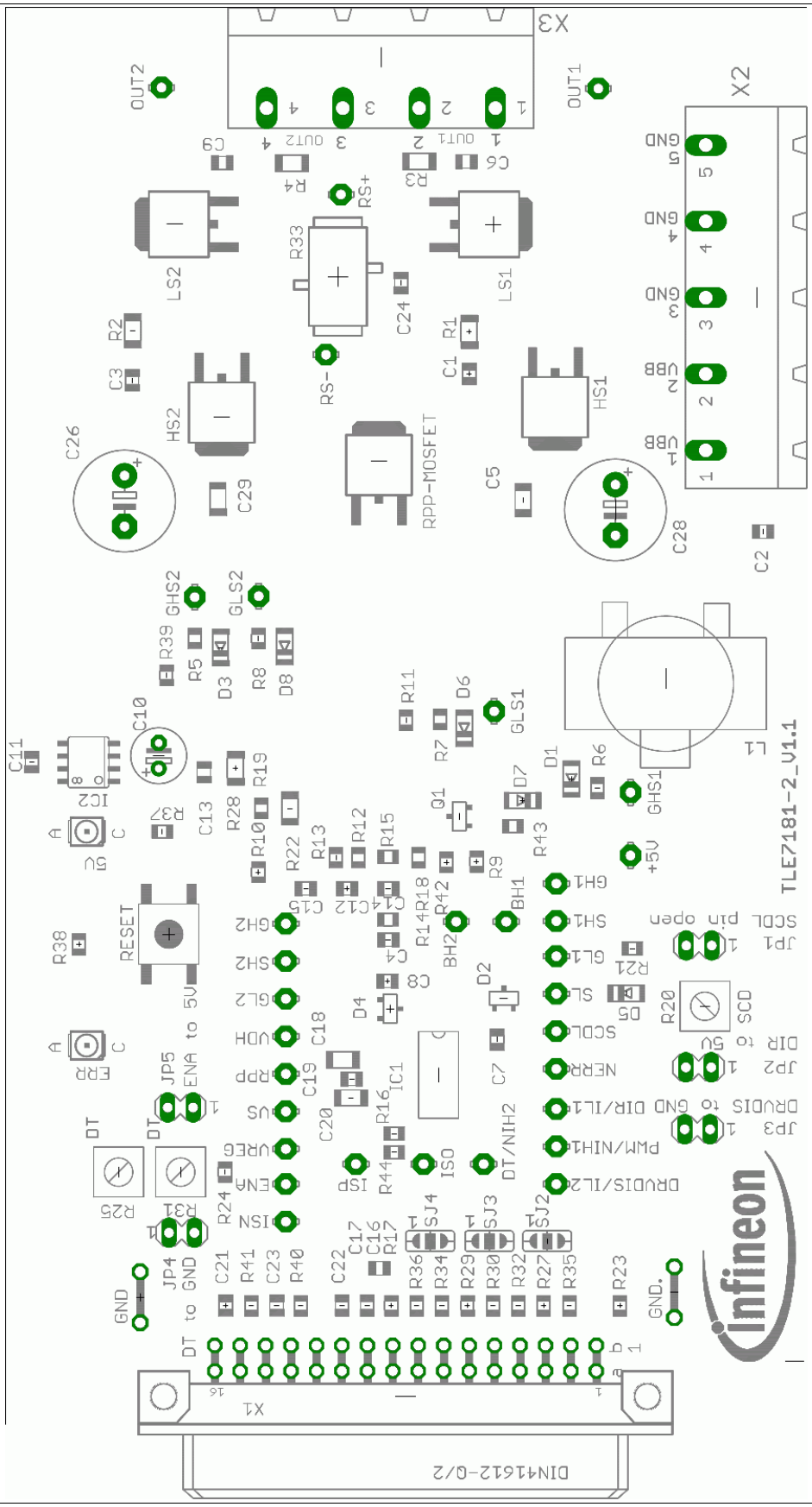

Figure 7 placing of components

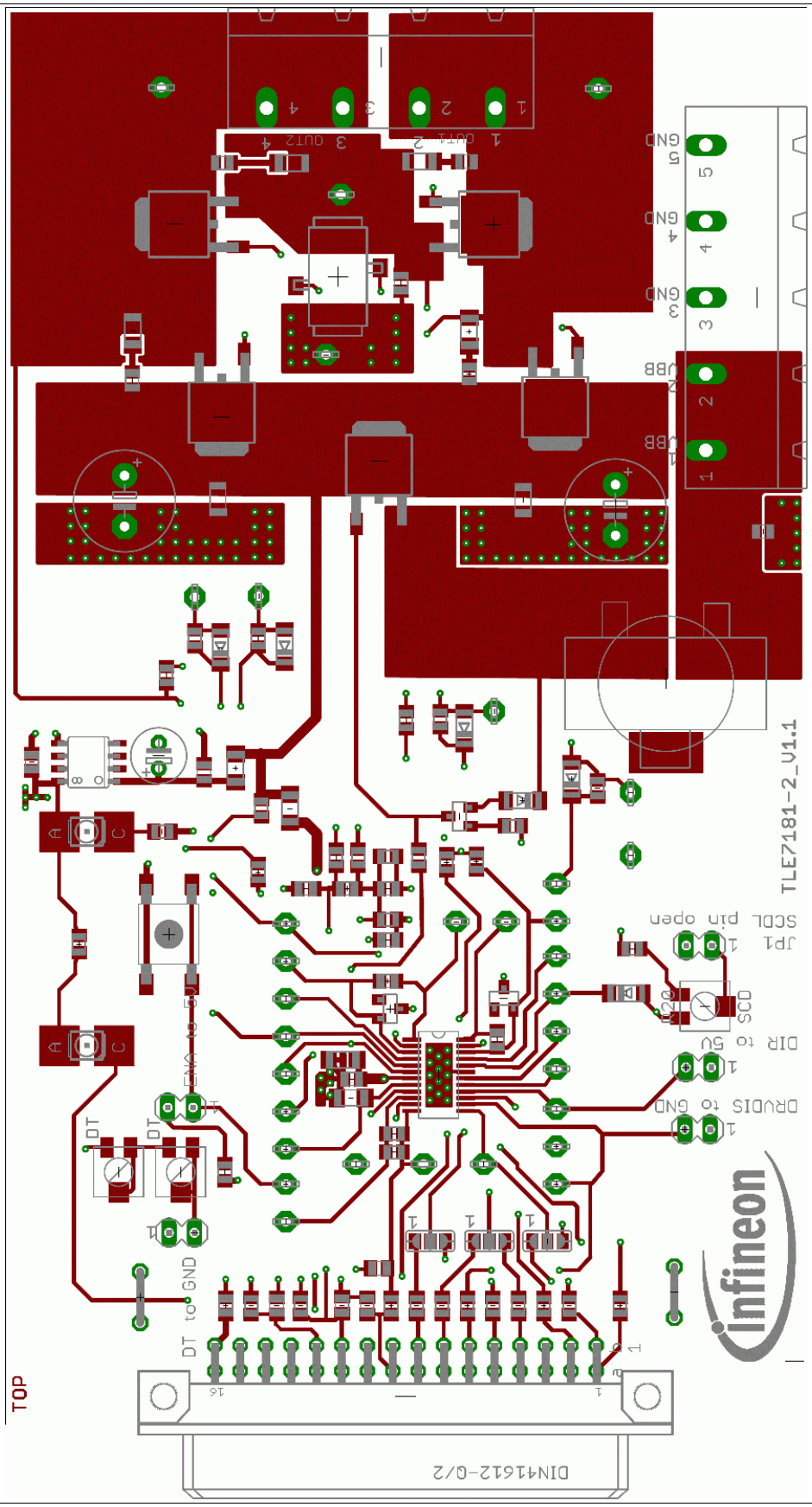

Figure 8 first layer

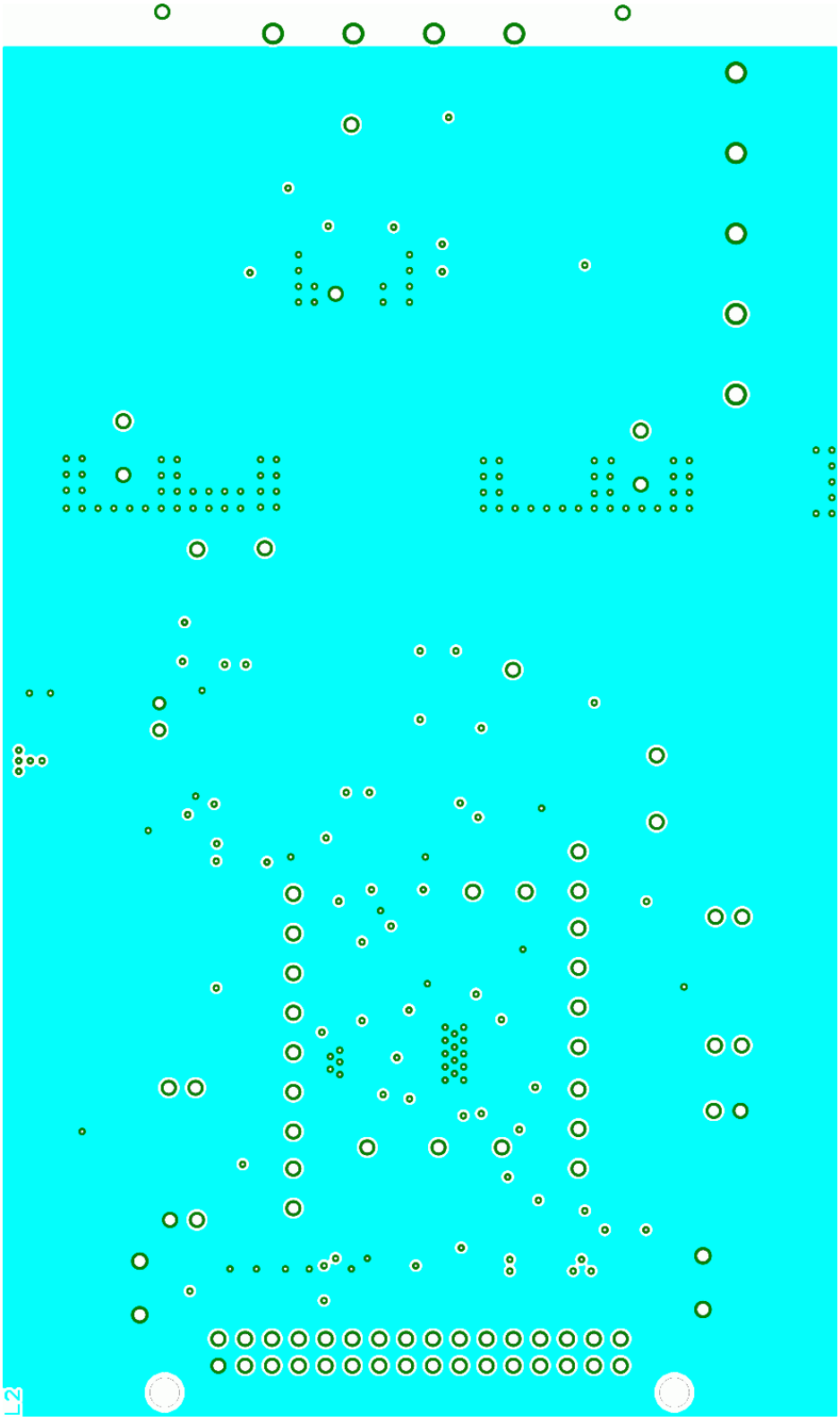

Figure 9 second layer

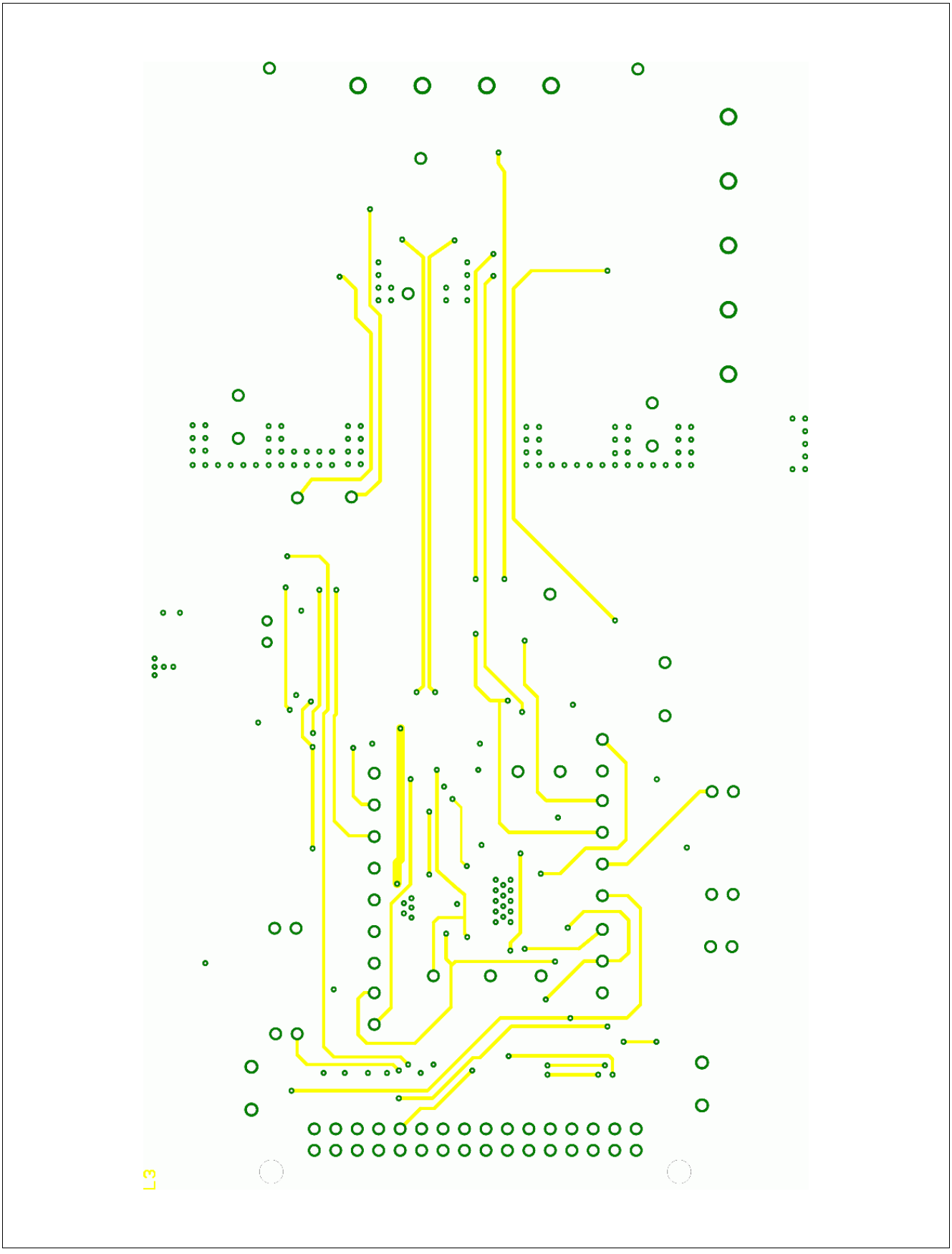

Figure 10 third layer

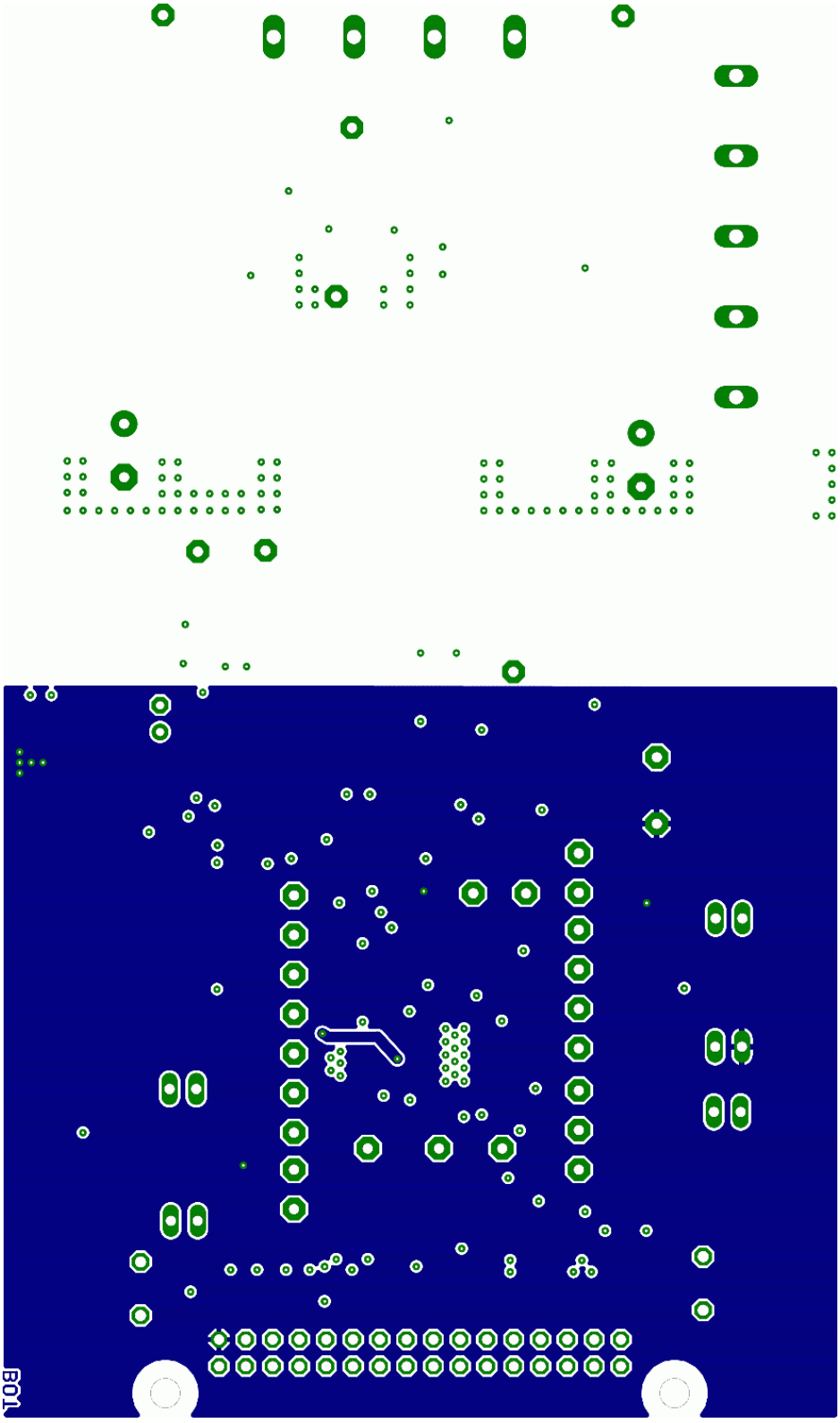

Figure 11 bottom layer

Table 1 part list (major components only)

Part	Value	Package
C1	4,7nF (n.m.)	C0805
C2	100n	C0805
C3	4,7nF (n.m.)	C0805
C4	100n	C0805
C5	2,2µ	C1210
C6	4,7nF (n.m.)	C0805
C7	330n	C0805
C8	330n	C0805
C9	4,7nF (n.m.)	C0805
C10	22u/50V	E2,5-6
C11	10u	C0805
C12	100p	C0805
C13	47n/50V	C1210
C14	10p	C0805
C15	10p	C0805
C16	220p	C0805
C17	220p	C0805
C18	2,2u/50V	C1206
C19	100n	C0805
C20	2,2u/50V	C1206
C21	100n	C0805
C22	22n	C0805
C23	22n	C0805
C24	(n.m.)	C0805
C26	220u/50V	E5-10,5
C28	220u/50V	E5-10,5
C29	2,2µ	C1210
D1	(n.m.)	MINIMELF
D2	BAW56	SOT23C
D3	(n.m.)	MINIMELF
D4	BAW56	SOT23C
D5	(n.m.)	MINIMELF
D6	(n.m.)	MINIMELF
D7	ZMM12	MINIMELF
D8	(n.m.)	MINIMELF
HS1	IPD90N04S4-02	TO252-3-1
HS2	IPD90N04S4-02	TO252-3-1
IC1	TLE7181EM	SSPO24_EXPOSED
IC2	TLE4269	P-DSO08
L1	2,2 µH	SER2000

Table 1 part list (major components only)

Part	Value	Package
LS1	IPD90N04S4-02	TO252-3-1
LS2	IPD90N04S4-02	TO252-3-1
Q1	BC846B	SOT23
R1	2,2R (n.m.)	R1206
R2	2,2R (n.m.)	R1206
R3	2,2R (n.m.)	R1206
R4	2,2R (n.m.)	R1206
R5	10R 1%	R0805
R6	10R 1%	R0805
R7	10R 1%	R0805
R8	10R 1%	R0805
R9	0R	R0805
R10	0R	R0805
R11	0R	R0805
R12	220R/1%	R0805
R13	220R/1%	R0805
R14	10k/1%	R0805
R15	10k/1%	R0805
R16	10k/1%	R0805
R17	1k	R0805
R18	4k7	R0805
R19	22R 1%	R0805
R20	100k	TS53Y
R21	10k	R0805
R22	1R	R1206
R23	22k	R0805
R24	1k	R0805
R25	47k	TS53Y
R27	10k	R0805
R28	1R	R1206
R29	10k	R0805
R30	10k	R0805
R31	220k	TS53Y
R32	10k	R0805
R33	0,002/5W	SMV
R34	10k	R0805
R35	10k	R0805
R36	10k	R0805
R37	2k7	R1206
R38	2k7	R1206
R39	47k	R0805

Table 1 part list (major components only)

Part	Value	Package
R40	5,1k	R0805
R41	5,1k	R0805
R42	47k	R0805
R43	47k	R0805
R44	10k/1%	R0805
RPP-MOSFET	IPD90N04S4-02	TO252-3-1

5 Revision History

TLE7181EM Evalution Board

Revision History: Rev 1.2, 2012-03-20

Previous Version(s):1.1

Page	Subjects (major changes since last revision)
-	several changes related to updated Evaluation Board revision 1.1
-	editorial changes

Edition 2012-03-20

Published by
Infineon Technologies AG
81726 Munich, Germany

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