TPL5111EVM User 's Guide

User's Guide

Literature Number: SNAU183
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TPL5111EVM User 's Guide

1 Introduction

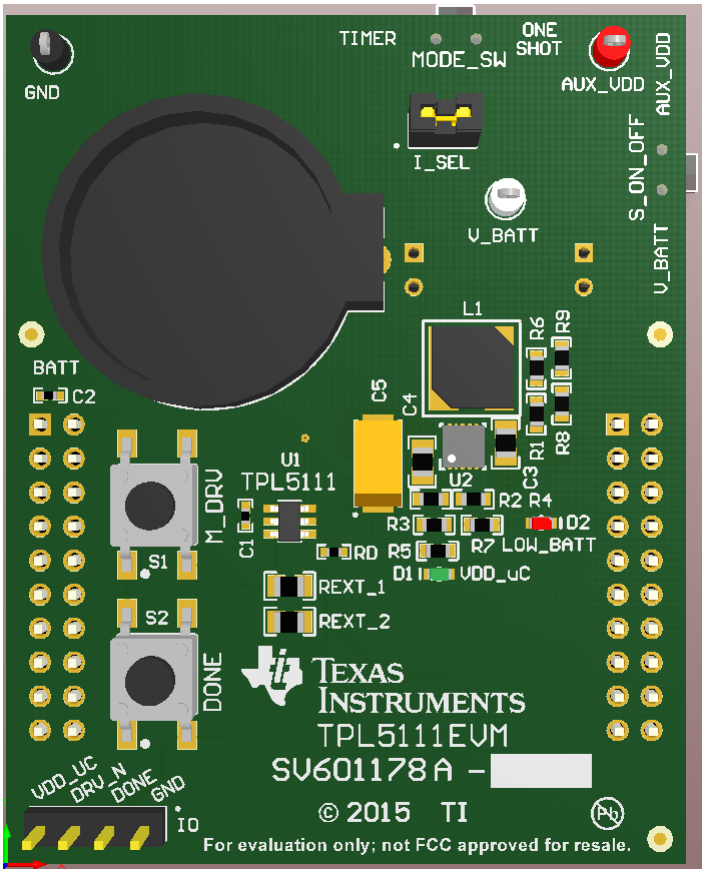

Figure 1. Top View of TPL5111EVM

The Texas Instruments TPL5111EVM evaluation module (EVM) allows a system designer to:

- Configure the timer interval of the TPL5111, using resistors REXT_1 and REXT_2.
- Observe the DRVn, DONE signals
- Measure current consumption
- Exercise the TIMER and ONE_SHOT modes
- Stimulate the DONE input.

The DRVn output of the TPL5111 is connected to the EN (enable) pin of a TI TPS61029 boost converter. The periodic DRVn signal enables/disables the boost converter, demonstrating a power gating implementation. The output of the TPS61029 drives a green LED, indicating when the output voltage is active. The TPL5111EVM may be connected to the MSP430F5529 Launchpad in order to test its watchdog and timer features in a microprocessor system. The output bus of the boost converter is connected to the Launchpad connector to provide gated power to the Launchpad. The EVM may be powered by either an on board battery holder (coin battery) or by an external voltage source.

The EVM contains one TPL5111 timer and one TPS61029 boost converter (See Table 1).

Table 1. Device and Package Configurations

DEVICE	IC	PACKAGE
U1	TPL5111DDC	SOT23-6
U2	TPS61029	VSON(10)

2 Setup

This section describes the jumpers and connectors on the EVM as well and how to properly connect, set up and use the TPL5111EVM.

Input/Output Connector Descriptions

Name	Layer	Description
J1/J3	Bottom	2 x 10 pin receptacle to plug the TPL5111EVM into MSP430F5529 Launchpad.
J4/J2	Bottom	2 x 10 pin receptacle to plug the TPL5111EVM into MSP430F5529 Launchpad.
RST	Bottom	2 pin receptacle to plug the TPL5111EVM into MSP430F5529 Launchpad.
VCC	Bottom	2 pin receptacle to plug the TPL5111EVM into MSP430F5529 Launchpad.
IO	Top	4-pin header connector to bring out VDD_uC, DRVn, DONE and GND signals.

Jumper Description

Name	Layer	Description
I_SEL	Top	The jumper should be installed for normal operation. Remove the jumper and connect a DMM to the terminal pins to measure current.

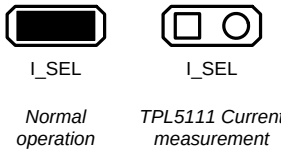

Figure 2. I_SEL Jumper Setting

Table 2. Switch Descriptions

Name	Layer	Description
S_ON_OFF	Bottom	The S_ON_OFF switch ensures that only one voltage source is driving the internal power buses. The common pin (Pin 2) of the switch is directly connected to the input of the TPS61029. V_BATT position selects an installed battery as the voltage source for the board functions. The AUX_VDD position selects the source attached to the AUX_VDD terminal as the voltage source for the board functions.
MODE_SW	Bottom	TIMER position (VDD) selects the TIMER mode of operation for the TPL5111. The ONE_SHOT position (GND) selects the ONE SHOT mode of operation for the TPL5111.
DONE	Top	SPST switch. Generates a DONE pulse when pressed.
M_DRV	Top	SPST switch. When pressed, connects VDD to the DELAY/M_DRV pin to simulate a manual Power ON input to the TPL5111.

Test Point Descriptions

Name	Layer	Description
GND	Layer 2	Ground (GND) test point.
V_BATT	Layer 3	Battery voltage test point
AUX_VDD	Layer 3	Connection for external voltage source

2.1 EVM Configuration

As shipped, the EVM is configured to provide a 2 second timer interval, based on the parallel combination of REXT_1 and REXT_2. The evaluation board can operate as standalone or plugged into the MSP430F5529 Launchpad. For either option, the only configuration that is required is the selection of the voltage source supplied to the board. Use the S_ON_OFF switch to select the voltage source (see Table 2).

2.1.1 Using a Battery as the Voltage Source

1. Place the S_ON_OFF switch to the AUX_VDD position.
2. Insert a CR2032 coin cell battery in the battery holder (BATT)
3. Place the S_ON_OFF switch in the V_BATT position. This selects the battery as the source for the on-board VDD bus, which powers the TPL5111. The I_SEL jumper must be in place to energize the VDD bus.

2.1.2 Using an External Source as the Voltage Source

1. Place the S_ON_OFF switch in the V_BATT position
2. Connect an external 3 volt source between the AUX_VDD and GND pins.
3. Place the S_ON_OFF switch in the AUX_VDD position.

2.1.3 EVM with Micro Controller

1. Disable power to the TPL5111EVM.
2. Connect a microcontroller system to the EVM using the IO header pins (VDD_uC, DRVn, DONE and GND).
3. Connect a voltage source as described in either Section 2.1.1 or Section 2.1.2 and place the S_ON_OFF switch in the appropriate position.

WARNING

Do NOT use the DONE switch in this configuration. The DONE signal should be supplied by the microcontroller.

2.1.4 EVM with Launchpad

Load the code presented in this section into the MSP430 of the Launchpad. Refer to the MSP430 Launchpad documentation (MSP430 Launchpad (MSP-EXP430F5529) Wiki) for more details.

1. Remove the jumpers VCC and RST of the Launchpad.
2. Plug the EVM into the Launchpad (MSP430F5529) according to the table below:

TPL5111EVM	MSP430 Launchpad
J1/J3	J1/J3
J4/J2	J4/J2
VCC	3V3
RST	SBW RST

3. Connect a voltage source to the TPL5111EVM as described in either Section 2.1.1 or Section 2.1.2.
4. Place the S_ON_OFF switch of the TPL5111EVM in the appropriate position

WARNING

Do NOT use the DONE switch in this configuration. The DONE signal should be supplied by the MSP430 on the Launchpad.

Example Code

Once loaded into the MSP430 of the Launchpad, the code below performs the following functions, in sequence:

- At power on, the green LED present on the Launchpad is turned on.
- Then the red LED present on the Launchpad is turned on
- After that both green and red LEDs are turned off
- The MSP430 sends the DONE signal to the TPL5111

Before launching the code set a timer interval > 5s (REXT_1 || REXT_2 > 8.85KΩ)

```
#include <msp430.h>

int main(void)
{

    WDTCTL = WDTPW+WDTHOLD;            // Stop watchdog timer
    __delay_cycles(50000);            // Set Delay;

    P1DIR |= BIT0;                // Set P1.0 to output direction
    P2DIR |= BIT3;                // Set P2.3 to output direction
    P4DIR |= BIT7;                // Set P4.7 to output direction

    P1OUT &= ~BIT0;                // Set P1.0 RED LED OFF
    P2OUT &= ~BIT3;                // Set P2.3 DONE Low
    P4OUT &= ~BIT7;                // Set P4.7 GREEN LED OFF

    while (1)
    {
   __delay_cycles(10000);            // Set Delay;
       P4OUT |= BIT7;                // Set P4.7 GREEN LED ON
       __delay_cycles(1000000);        // Set Delay;
       P1OUT |= BIT0;                // Set P1.0 RED LED ON
       __delay_cycles(500000);            // Set Delay;
       P1OUT &= ~BIT0;                // Set P1.0 RED LED OFF
       P4OUT &= ~BIT7;                // Set P4.7 GREEN LED OFF
       __delay_cycles(100000);            // Set Delay;
       P2OUT |= BIT3;                // Done High
       __delay_cycles(1000);            // Set Delay;
       P2OUT &= ~BIT3;                // Set P2.3 DONE Low
     }
}
```

3 Operation

Once the EVM is powered ON, the TPL5111 starts running. Refer to the datasheet of the TPL5111 for further details on the timing. The TPL5111 has 2 modes of operation: TIMER mode and ONE SHOT mode.

3.1 Timer Mode

In TIMER mode, the TPL5111 generates a periodic pulse at the DRVn pin. When a DRVn signal is asserted by the TPL5111, the output of the TPS61029 is enabled, and the GREEN LED (D1) is turned on. If the DONE switch is pushed, a DONE pulse is sent to the TPL5111, which de-asserts the DRVn pulse, disabling the TPS61029, and turning off the GREEN LED. If the DONE switch is not pushed, the DRVn pulse length is equal to the programmed value set by REXT_1 and REXT_2, minus 50 ms. When the M_DRV switch is pushed, VDD is connected to the DELAY/M_DRV pin, simulating a manual power on signal to the TPL5111. The length of the DRVn pulse in this case is equal to the amount of time the M_DRV switch is pressed, plus the programmed time interval.

The DRVn pulse may be observed by attaching an oscilloscope probe to the DRV_N pin, as indicated in Figure 3.

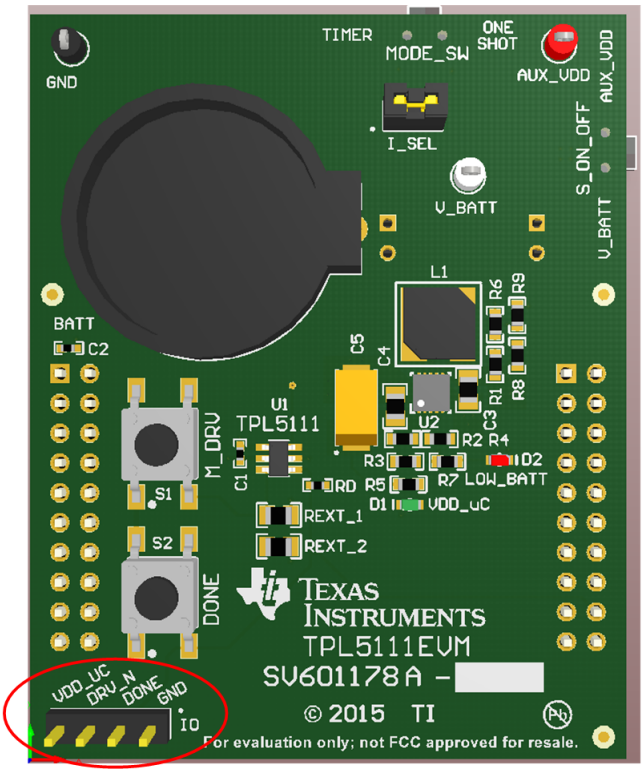

Figure 3. Signal Monitoring Points

3.1.1 DRVn and DONE Operation

To simultaneously observe the timing of the DRVn pulse along with the DONE signal, use a two channel scope to probe the DRV_N and the DONE pins. Ensure that the MODE_SW is in the TIMER position. Immediately after a rising edge of the DRV_N signal, press and release the DONE switch on the board. When the DONE signal is asserted, the DRVn pulse should de-assert.

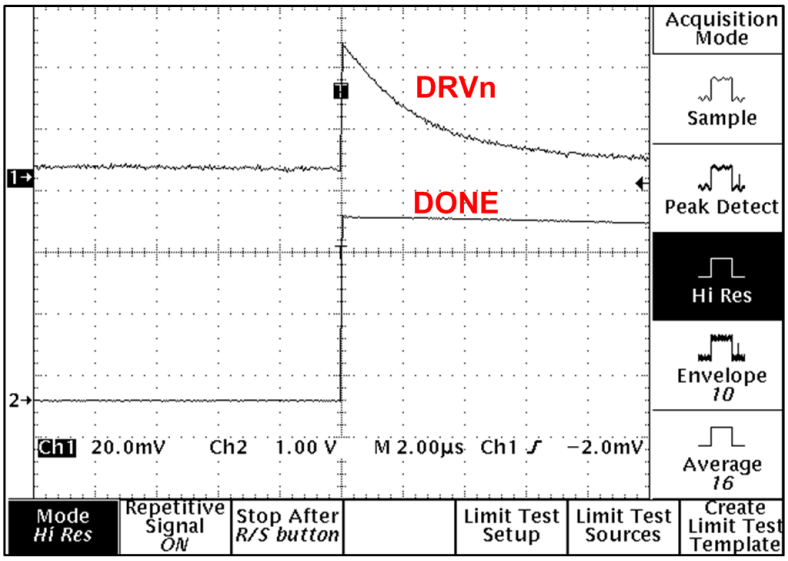

Figure 4. DONE and DRVn Signal Behavior in Timer Mode

3.1.2 DRVn and Boost Converter Output

To simultaneously observe the timing of the DRVn pulse along with the output of the boost converter, use a two channel scope to probe the DRV_N and the VDD_UC pins. Immediately after a rising edge of the DRV_N signal, the output of the boost converter should turn on, with a delay of approximately 2.5 ms to 5 ms. The output level should be approximately 3.3V.

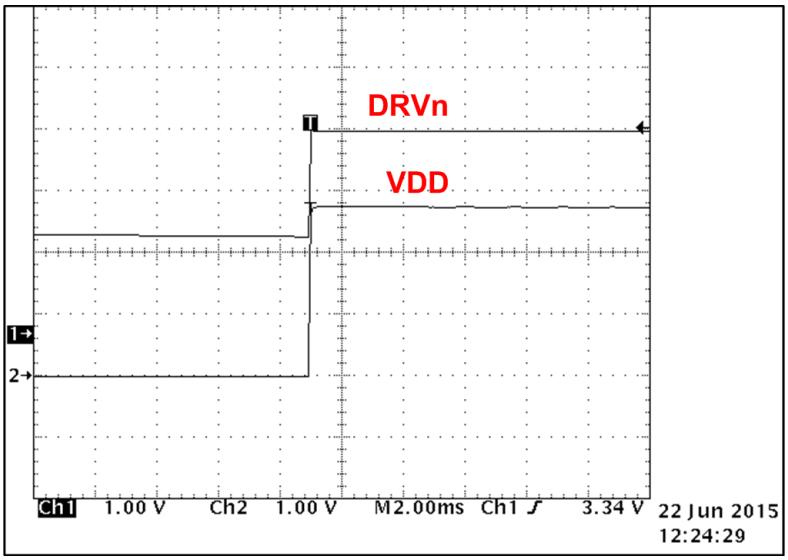

Figure 5. Boost Converter Input (DRVn) and Output (VDD)

3.2 One Shot Mode

In ONE SHOT mode of operation, the TPL5111 asserts the DRVn signal at power on and when M_DRV is asserted. To observe this mode of operation, use a two channel scope to monitor the DRV_N pin and the DONE pin. Place the MODE_SW in the ONE SHOT position. Cycle power on the board in order to reinitiate a power on sequence.

Once the EVM is powered ON, the TPL5111 asserts the DRVn signal, which enables the TPS61029 output, turning on the GREEN LED (D1). If the DONE switch is pushed, a DONE pulse is sent to the TPL5111. The DRVn output is de-asserted and the TPS61029 is disabled and the green LED is shut off. At this point only a manual power on signal (press the M_DRV switch) can trigger another cycle. This mode of operation is useful for on-demand power on.

3.3 Supply Current Measurement

Timer Mode

This procedure is used to only measure the current of the TPL5111 in Timer mode. An external power supply set to 2.5V should be used for this measurement.

WARNING

The EVM should NOT be connected to the MSP430 Launchpad for this measurement.

1. Disconnect the power source from the EVM. Set the S_ON_OFF switch to the V_BATT position.
2. Set the MODE_SW to the TIMER position.
3. Remove the I_SEL jumper.
4. Connect the EVM, a power supply and a digital multi-meter (DMM) as shown in Figure 6. The output of the power supply should be OFF. The DMM should support 6 digits of resolution.

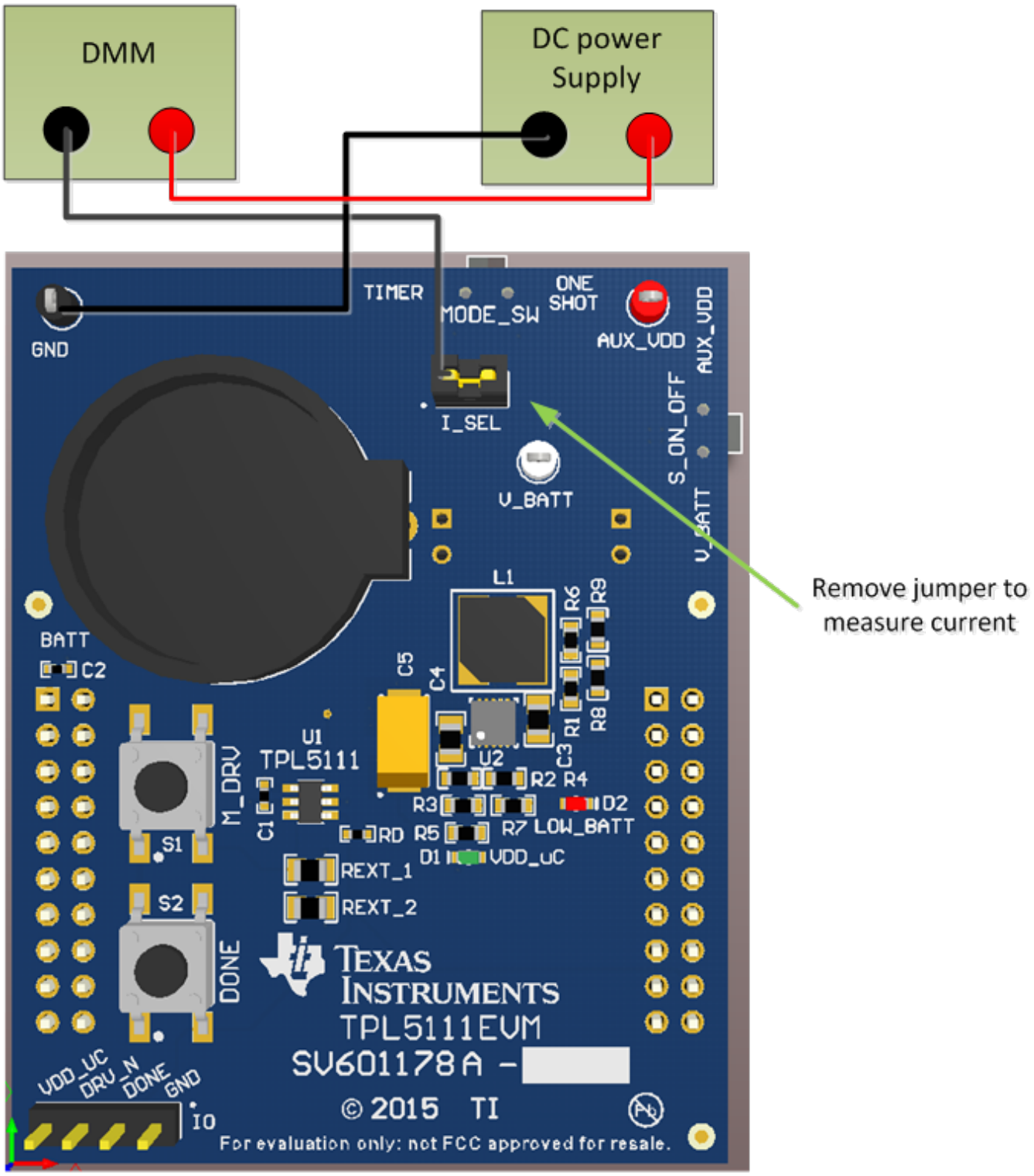

Figure 6. EVM, DMM and Power Supply Connection for TPL5111 Supply Current Measurements

5. Enable the output of the power supply. Ensure that it is set to 2.5V.
6. Set the S_ON_OFF switch of the EVM to AUX_VDD.
7. The current measured by the DMM should be in the range of 20 nA to 50 nA.

3.3.1 Resistance Reading Current

This procedure is used to only measure the current of the TPL5111 in startup mode. An external power supply set to 2.5V should be used for this measurement.

WARNING

The EVM should NOT be connected to the MSP430 Launchpad for this measurement.

1. Disconnect the power source from the EVM. Set the S_ON_OFF switch to the V_BATT position.
2. Set the MODE_SW to the ONE SHOT position.
3. Remove the I_SEL jumper.
4. Connect the EVM, a power supply and a digital multi-meter (DMM) as shown in Figure 4. The output of the power supply should be OFF. The DMM should support 6 digits of resolution.
5. Enable the output of the power supply. Ensure that it is set to 2.5V.
6. Set the S_ON_OFF switch of the EVM to AUX_VDD.
7. Press and hold the M_DRV switch.
8. The current measured by the DMM should be in the range of 330 µA to 400 µA.

4 Board Layout

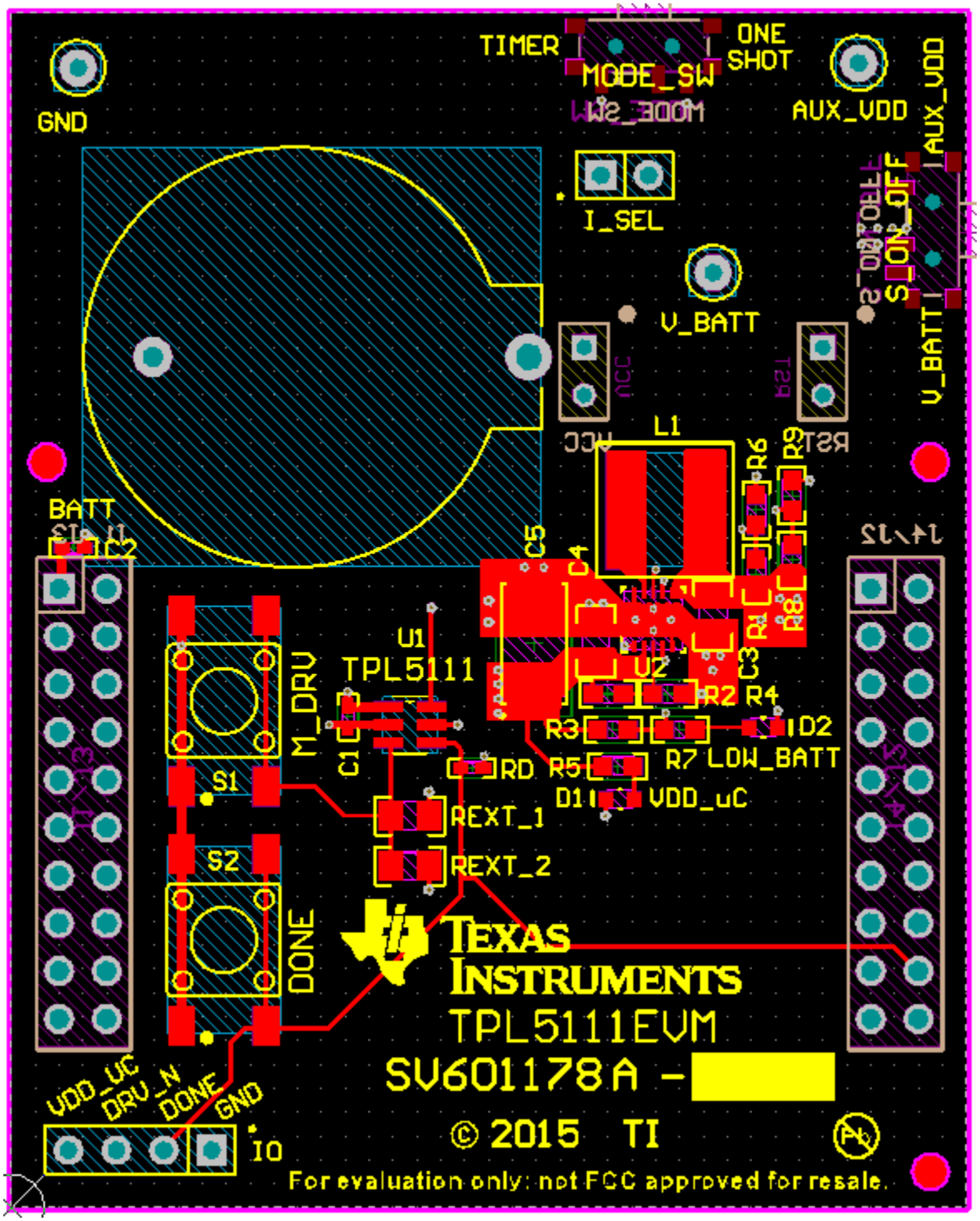

Figure 7. Top Layer

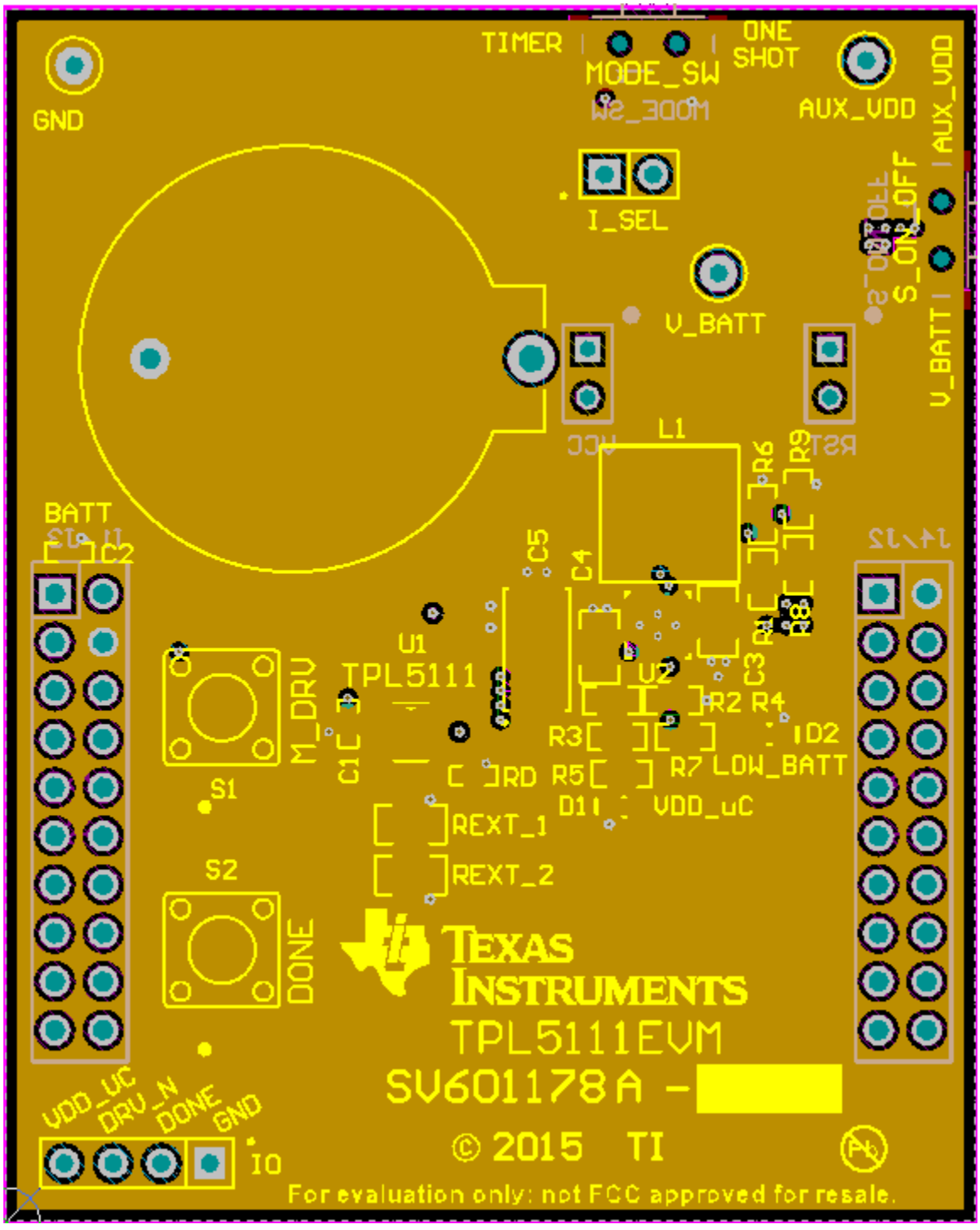

Figure 8. Layer 2, Ground Layer

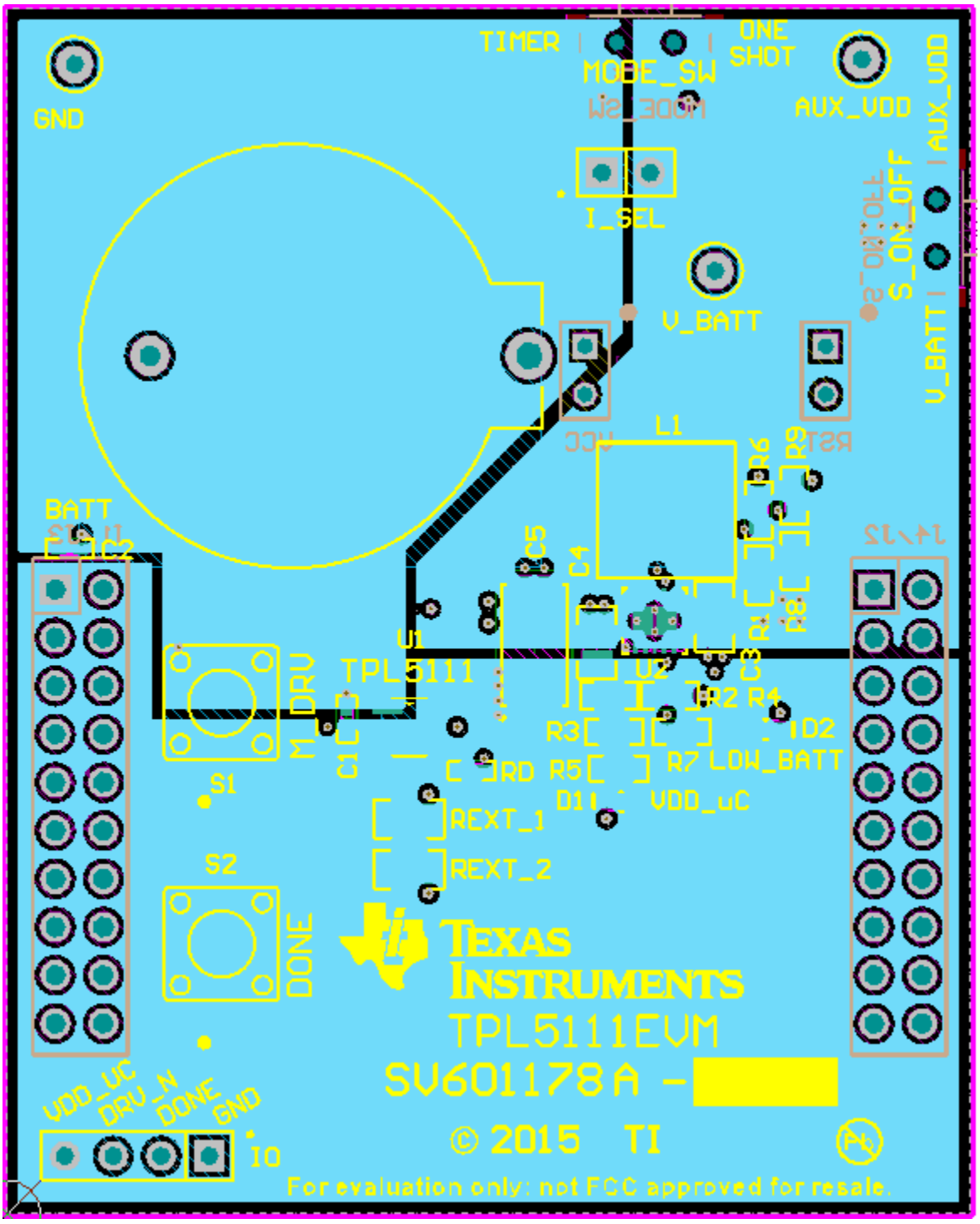

Figure 9. Layer 3, Power Supply Planes

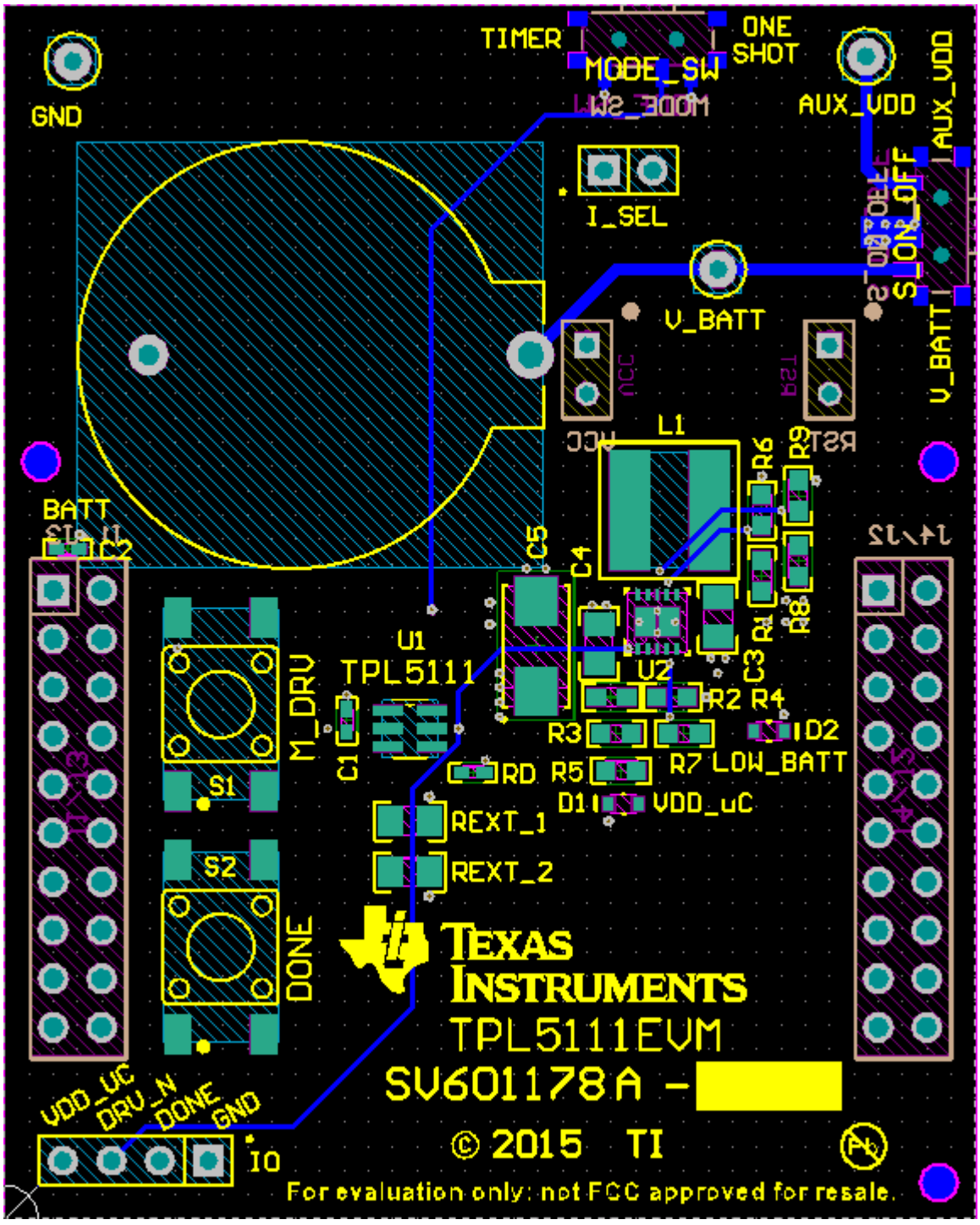

Figure 10. Bottom Layer

5 Schematic

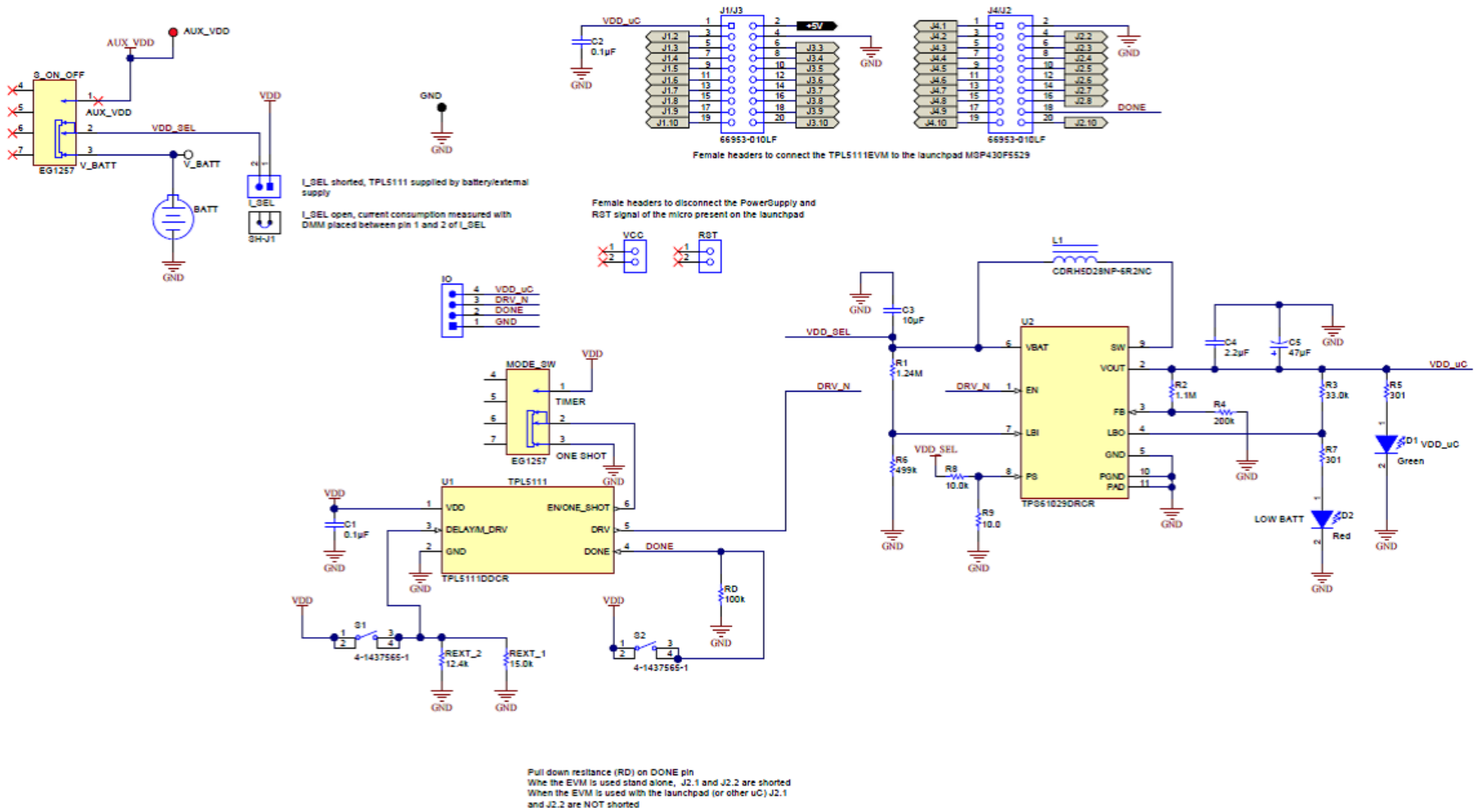

Figure 11. TPL5111EVM Schematic

6 Bill of Materials

Designator	Qty	Value	Description	Part Number	Manufacturer
AUX_VDD	1	Red	Test Point, TH, Miniature, Red	5000	Keystone
BATT	1		Battery Holder, CR2032, Retainer clip, TH	BS-7	Memory Protection Devices
C1, C2	2	0.1uF	CAP, CERM, 0.1uF, 6.3V, +/-10%, X5R, 0402	C1005X5R0J104K	TDK
C3	1	10uF	CAP, CERM, 10 µF, 16 V, +/- 20%, X5R, 0805	0805YD106MAT2A	AVX
C4	1	2.2uF	CAP, CERM, 2.2 µF, 16 V, +/- 10%, X7R, 0805	C0805C225K4RACTU	Kemet
C5	1	1uF	CAP, TA, 47 µF, 16 V, +/- 10%, 0.35 ohm, SMD	T495C476K016ATE350	Kemet
D1	1	Green	LED, Green, SMD	LG L29K-G2J1-24-Z	OSRAM
D2	0	Red	LED, Red, SMD	LS L29K-G1J2-1-Z	OSRAM
GND	1	Black	Test Point, TH, Miniature, Black	5001	Keystone
IO	1		Header, 100mil, 4x1, Gold, TH	TSW-104-07-G-S	Samtec
I_SEL	1		Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S	Samtec
J1/J3, J4/J2	2		Receptacle, 100mil, 10X2, TH	66953-010LF	FCI
L1	1	6.2uH	Inductor, Shielded Drum Core, Ferrite, 6.2 µH, 1.8 A, 0.045 ohm, SMD	CDRH5D28NP-6R2NC	Sumida
MODE_SW, S_ON_OFF	2		Switch, Slide, SPDT, 0.3A, SMT	EG1257	E-Switch
R1	1	1.24Meg	RES, 1.24 M, 1%, 0.1 W, 0603	CRCW06031M24FKEA	Vishay-Dale
R2	1	1.1Meg	RES, 1.1 M, 5%, 0.1 W, 0603	CRCW06031M10JNEA	Vishay-Dale
R3	0	33.0k	RES, 33.0 k, 1%, 0.1 W, 0603	CRCW060333K0FKEA	Vishay-Dale
R4	1	200k	RES, 200 k, 1%, 0.1 W, 0603	CRCW0603200KFKEA	Vishay-Dale
R5	1	301	RES, 301 ohm, 1%, 0.1W, 0603	CRCW0603301RFKEA	Vishay-Dale
R6	1	499k	RES, 499 k, 1%, 0.1 W, 0603	CRCW0603499KFKEA	Vishay-Dale
R7	0	301	RES, 301, 1%, 0.1 W, 0603	CRCW0603301RFKEA	Vishay-Dale
R8	1	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	CRCW060310K0FKEA	Vishay-Dale
R9	1	10.0	RES, 10.0, 1%, 0.1 W, 0603	CRCW060310R0FKEA	Vishay-Dale
RD	1	100k	RES, 100k ohm, 5%, 0.063W, 0402	CRCW0402100KJNED	Vishay-Dale
REXT_1	1	15.0k	RES, 15.0 k, 1%, 0.125 W, 0805	CRCW080515K0FKEA	Vishay-Dale
REXT_2	1	12.4k	RES, 12.4 k, 1%, 0.125 W, 0805	CRCW080512K4FKEA	Vishay-Dale
RST, VCC	2		Connector, Receptacle, 100mil, 2x1, Gold plated, TH	5-534206-1	TE Connectivity
S1, S2	2		Switch, Tactile, SPST-NO, 0.05A, 12V, SMT	4-1437565-1	TE Connectivity
SH-J1	1	1x2	Shunt, 100mil, Gold plated, Black	969102-0000-DA	3M
U1	1		Nano-power System Timer for Power Gating, DDC0006A	TPL5111DDCR	Texas Instruments
U2	1		Adjustable, 1.8-A Switch, 96% Efficient Boost Converter with Down-Mode, DRC0010A	TPS61029DRCR	Texas Instruments
V_BATT	1	White	Test Point, Miniature, White, TH	5002	Keystone

STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.

   2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

   3.1 *United States*

      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

      CAUTION

      This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

      Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

      FCC Interference Statement for Class A EVM devices

      NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

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4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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