TPL5100EVM User's Guide

1 Introduction

The Texas Instruments TPL5100EVM evaluation module (EVM) allows a designer to configure the delay timers of the TPL5100 and measure its very low current consumption. Moreover the TPL5100EVM is ready to be connected to the Launchpads of MSP430, Stellaris and C2000, in order to test its watchdog, timer cycling and power cycling features.

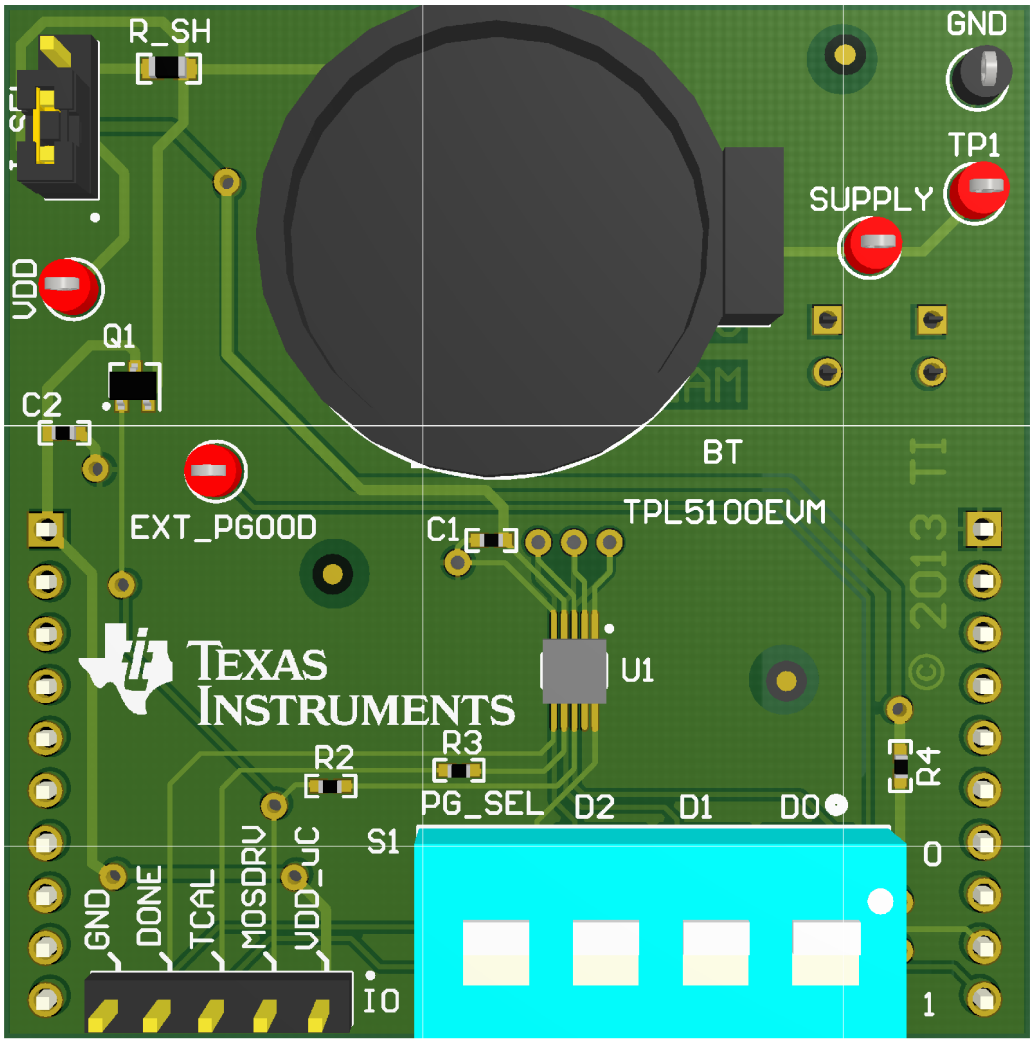


Figure 1. The LMP91010 Evaluation Board

2 Setup

This section describes how to properly connect, set up and use the TPL5100EVM.

2.1 INPUT/OUTPUT CONNECTORS AND JUMPER DESCRIPTION

I_SEL selects the current consumption measurement method: Open, current consumption measured with DMM connected between TP1 and VDD test points. 3-2 shorted, current consumption = Voltage drop on R_SH divided by R_SH 1-2 R_SH bypass

IO 5-pin header connector to bring out MOS_DRV, TCAL, DONE, VDD_µC, and GND signals.

S1 4 positions SPDT to set the D0, D1, D2 logic values and the source of PGOOD signal (refer to Table 1)

Table 1. S1 Description

Description	Slider position	Value
PG_SEL	Top	0
	Bottom	1 or External PGOOD
D2	Top	0
	Bottom	1
D1	Top	0
	Bottom	1
D0	Top	0
	Bottom	1

In case the PGOOD is provided by an external power supply, set PG_SEL=1, Remove the REPG resistor and connect a power supply to the EXT_PGOOD test point.

VCC 2- pin female connector to plug the TPL5100EVM into MSP430 launchpad.

RST 2- pin female connector to plug the TPL5100EVM into MSP430 launchpad.

J1_10 10-pin female connector to plug the TPL5100EVM into MSP430 launchpad.

J11_20 10-pin female connector to plug the TPL5100EVM into MSP430 launchpad.

SUPPLY test point to connect external supply voltage in alternative to the coin cell battery.

VDD test point to monitor VDD pin of TPL5100.

TP1 test point to monitor the external supply voltage or coin cell battery voltage.

EXT_PGOOD test point to connect external voltage supply for PGOOD signal.

GND test point of the ground, connect here the GND of the power supplies.

BT coin cell 2032 battery holder.

2.2 EVALUATION BOARD CONFIGURATION

The evaluation board can work standalone or plugged in to MSP430 launchpad, the following steps are in common for both usages.

- Set the desired delay, configuring S1 (from position 2 to 4).
- Set the POWER GOOD source, configuring S1 (position 1), if you set external source connect the voltage source between the EXT_PGOOD and GND test points; do not turn on this voltage source. Refer to the data sheet regarding the allowable voltage range. This can be found on the MSP430 LaunchPad Wiki (MSP430 LaunchPad (MSP-EXP430G2) Wiki).
- Configure I_SEL as explained in Section 2.1.
- Plug the evaluation board into the launchpad according to Table 2

2.2.1 EVM Plugged into MSP430 Launchpad

- Load the code present in Section 5 of this User™s Guide, into the MSP430 of the launchpad. Refer to the MSP430 launchpad documentation (MSP430 LaunchPad (MSP-EXP430G2) Wiki) for more details.

- Remove the jumpers VCC and RST of J3 header of the launchpad
- Set the desired delay, configuring S1 (from position 2 to 4).
- Set the POWER GOOD source, configuring S1 (position 1), if you set external source connect the voltage source between the EXT_PGOOD and GND test points; do not turn on this voltage source. Refer to the data sheet regarding the allowable voltage range. This can be found on the MSP430 LaunchPad Wiki (MSP430 LaunchPad (MSP-EXP430G2) Wiki).
- Configure I_SEL as explained in Section 2.1.
- Plug the eval board in to the launchpad according to Table 2

Table 2. TPL5100EVM to Launchpad Connection

TPL5100EVM	MSP430 Launchpad
J1_10	J1
J11_20	J2
VCC	VCC of J3
RST	RST of J3

- Insert a 2032 coin cell battery in the battery holder (BT) or alternatively connect a voltage source between the SUPPLY and GND test points. **DO NOT CONNECT THE COIN CELL BATTERY AND THE VOLTAGE SOURCE TO SUPPLY THE EVALUATION BOARD AT SAME TIME**.
- Power on the voltage sources connected to the EVM.

2.2.1.1 SOFTWARE OF THE MSP430

The code in Section 5 of this User's Guide, once loaded into the MSP430 of the launchpad, performs the following features:

- At power on, the red LED present on the Launchpad is turned ON.
- The red LED is turned off when the TPL5100 turns off the MSP430.

2.2.2 EVM Standalone

- Connect your micro controller to IO header, in order to manage the I/O signal of the DUT.
- Insert a 2032 coin cell battery in the battery holder (BT), or alternatively connect a voltage source between the **SUPPLY and GND test points. DO NOT CONNECT THE COIN CELL BATTERY AND THE VOLTAGE SOURCE TO SUPPLY THE EVALUATION BOARD AT SAME TIME**.
- Power on the voltage sources connected to the EVM.
- DO NOT LEAVE DONE PIN (4th pin of IO header) FLOATING. If supervisor feature is not needed, connect DONE pin to GND.

3 Supply Current Measurement

The TPL5100EVM offers 2 ways to measure the current consumption of the DUT. First, disconnect the TPL5100 from the launchpad or your micro controller, in order to not load the digital output pins of the DUT.

3.1 DIRECT MEASUREMENT

- Leave the I_SEL 3-pin header open.
- DO NOT LEAVE DIGITAL INPUT PINS FLOATING, for instance:
  - Short the DONE pin (4th pin of IO header) to GND
  - Set PGOOD =1 (see Table 1)
- Connect a Digital Multi Meter, configured as the current meter (able to measure nA), between TP1 and VDD test points.
- Read the current consumption on the DMM.

3.2 INDIRECT MEASUREMENT

- Short pin 2 and 3 of I_SEL.
- DO NOT LEAVE DIGITAL INPUT PINS FLOATING, for instance:
  - Short the DONE pin (4th pin of IO header) to GND
  - Set PGOOD =1 (see Table 1)
- Connect a Digital Multi Meter, configured as the voltage meter, between TP1 and VDD test points.
- Read the voltage drop on the R_SH on the DMM.
- The current consumption is simply the voltage drop on R_SH, divided by 1Mohm.

4 Bill of Materials (BOM)

Table 3. Bill of Material TPL5100EVM

DESIGNATOR	DESCRIPTION	PART NUMBER	MANUFACTURER	QUANTITY
BT	HOLDER COINCELL 2032 RETAINRCLIP	BS-7	Memory Protection Devices	1
C1, C2	CAP CER 0.1UF 6.3V 10% X5R 0402	C1005X5R0J104K050BA	TDK	2
EXT_PGOOD, SUPPLY, TP1, VDD	TEST POINT PC MINI .040	5000	Keystone	4
GND	TEST POINT PC MINI .040	5001	Keystone	1
IO	CONN HEADER 5POS .100	TSW-105-07-G-S	Samtec, Inc.	1
I_SEL	CONN HEADER 3POS .100	TSW-103-07-G-S	Samtec, Inc.	1
J1_10, J11_20	Connector, Receptacle, 100mil, 10x1, Gold plated, TH	SSW-110-01-G-S	Samtec, Inc.	2
R2, R3	RES 1.0K OHM 1/16W 5% 0402 SMD	CRCW04021K00JNED	Vishay-Dale	2
R4	RES 49.9K OHM 1/16W 1% 0402 SMD	CRCW040249K9FKED	Vishay-Dale	1
REPG	RES 0.0 OHM 1/16W JUMP 0402 SMD	CRCW04020000Z0ED	Vishay-Dale	1
RST, VCC	CONN RECEPT 2POS .100 VERT DUAL	5-534206-1	TE Connectivity	2
R_SH	RES 1.00M OHM 1/10W 1% 0603 SMD	CRCW06031M00FKEA	Vishay-Dale	1
S1	SWITCH SPDT GOLD	206-124	CTS Electrocomponents	1
SH-J1	SHUNT JUMPER .1	969102-0000-DA	3M	1
U1	Nano Power Programmable Timer	TPL5100DGS	Texas Instruments	1

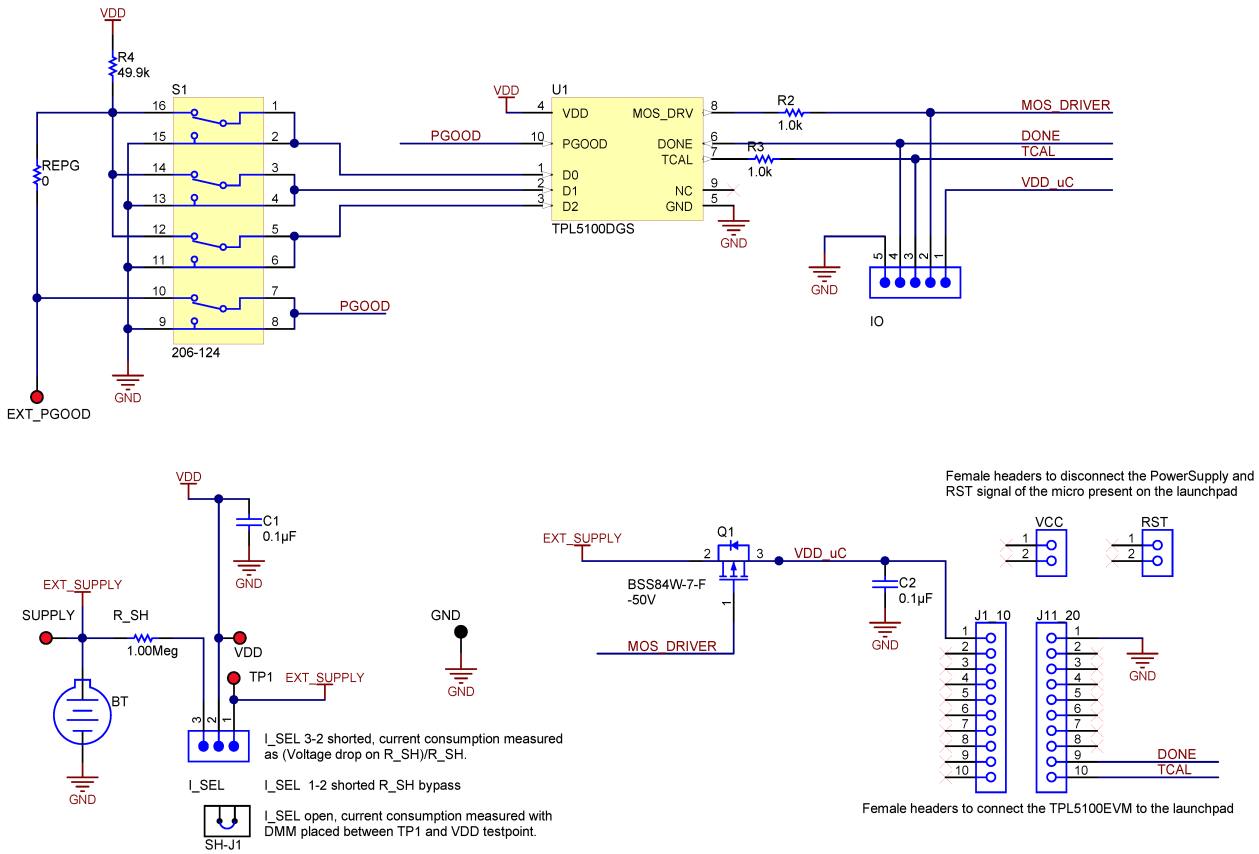
5 Example of Source Code for MSP430 present in the launchpad

```
#include  <msp430g2553.h>

volatile unsigned int DONE=1;

void main(void)
{
  WDTCTL = WDTPW + WDTHOLD + WDTNMI + WDTNMIES;  // WDT off NMI hi/lo

  P1DIR |= BIT0;                                // Set P1.0 to output direction RED LED
  P1DIR |= BIT6;                                // Set P1.6 to output direction GREEN LED
  P1DIR &= ~BIT3;                                // Set P1.3 S2 button to input
  P2DIR &= ~BIT0;                                // Set P2.0 (WAKE) to input
  P2DIR |= BIT4;                                // Set P2.4 (Done) to output direction
```

```
  P1OUT |= BIT0;                            // RED LED ON
  __delay_cycles(25000);                    // delay 25ms
  P1OUT &= ~BIT0;                           // Clear P1.0 RED LED Off

  //BUTTON S2 configuration
  P1REN |= BIT3;                            // Pull-up resistor enabled
  P1IE  |= BIT3;                            // P1.3 interrupt enabled
  P1IES |= BIT3;                            // P1.3 Hi/Lo edge
  P1IFG &= ~BIT3;                           // P1.3 IFG cleared

  // WAKE signal
  P2IE  |= BIT0;                            // P2.0 interrupt enabled
  P2IES &= ~BIT0;                           // P2.0 Lo/Hi edge
  P2IFG &= ~BIT0;                           // P2.0 IFG cleared

  // DONE signal
  P2OUT |= BIT4;                            // Done High
  __delay_cycles(100);                        // delay 100u
  P2OUT &= ~BIT4;                           // Done Low

  IE1 |= NMIIE;                               // Enable NMI

  _BIS_SR(LPM4_bits + GIE);                   // Enter LPM4 with Interrupt enabled
}

#pragma vector=NMI_VECTOR
__interrupt void nmi_ (void)
{
  P1OUT |= BIT0;                          // P1.0 Red Led On
  __delay_cycles(200000);                  // delay 200ms
  P1OUT &= ~BIT0;                          // P1.0 Red Led Off

  if (DONE==1)
    {
      P2OUT |= BIT4;                      // Done On
      __delay_cycles(100);                  // delay 100us
      P2OUT &= ~BIT4;                     // Done Off
    }
  IFG1 &= ~NMIIFG;                        // Re-clear NMI flag in case bounce
  IE1 |= NMIIE;                           // Enable NMI
}

// Port 2 interrupt service routine
#pragma vector=PORT2_VECTOR
__interrupt void Port_2(void)
{
    P1OUT |= BIT6;                        // P1.6 Red Green On
    __delay_cycles(200000);                 // delay 200ms
    P1OUT &= ~BIT6;                         // P1.6 Red Green Off

  if (DONE==1)
  {
      P2OUT |= BIT4;                      // Done On
      __delay_cycles(100);                  // delay 100us
      P2OUT &= ~BIT4;                     // Done Off
  }
  P2IES &= ~BIT0;                         // P1.4 Lo/Hi edge
  P2IFG &= ~BIT0;                         // P1.4 IFG cleared
}


// Port 1 interrupt service routine
#pragma vector=PORT1_VECTOR
__interrupt void Port_1(void)
{
```

```
    if (DONE == 1)                          // enabled/disabled and viceverasa DONE signal
          {
                DONE = 0;
          }
  else
  {
          DONE = 1;
  }
  P1IFG &= ~BIT3;                           // P1.3 IFG cleared
  P1IES |= BIT3;                            // P1.3 Hi/Lo edge
}
```

Appendix A Schematic



Appendix B Layout

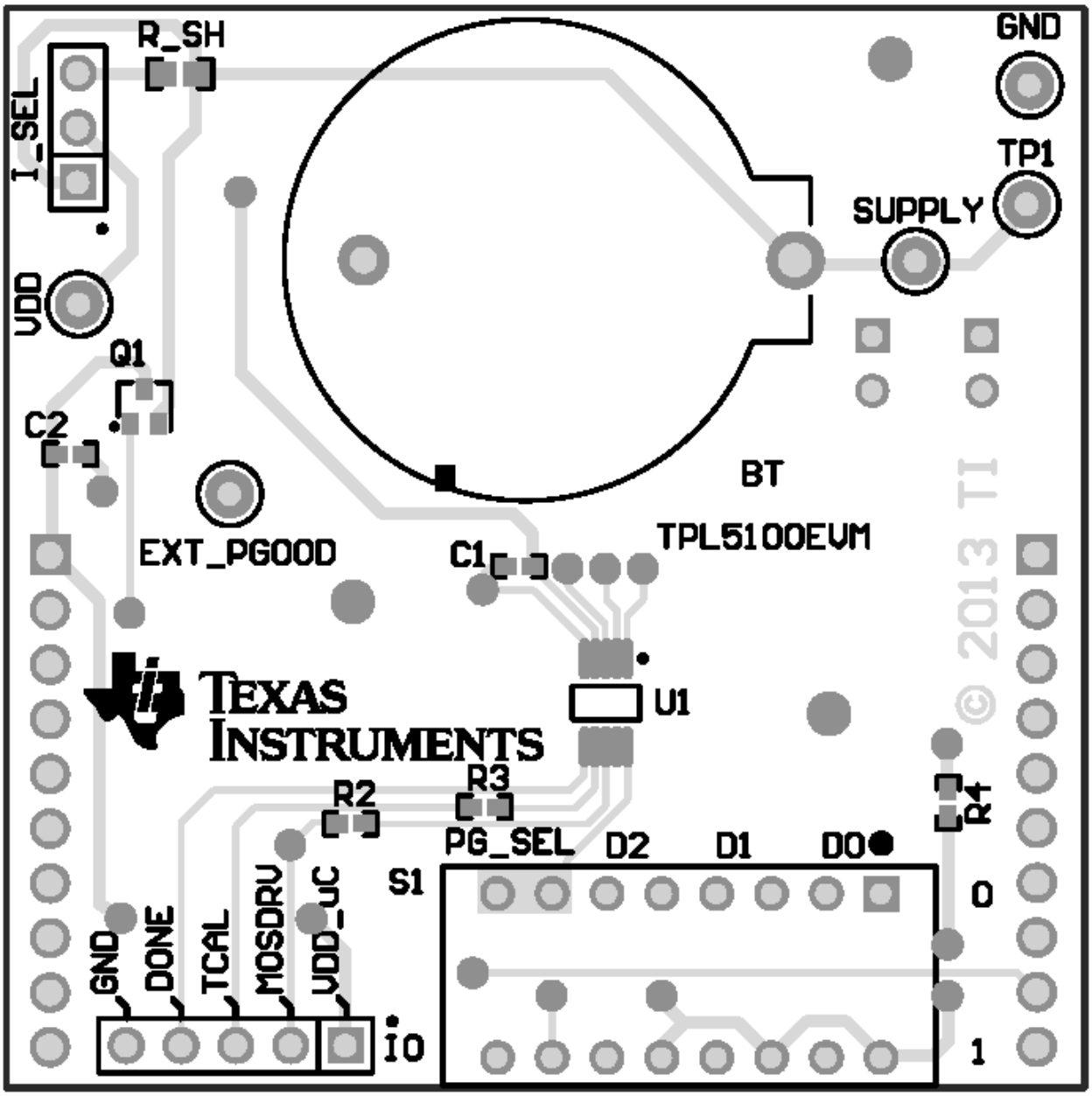


Figure 2. Layout, Top Layer, Silkscreen

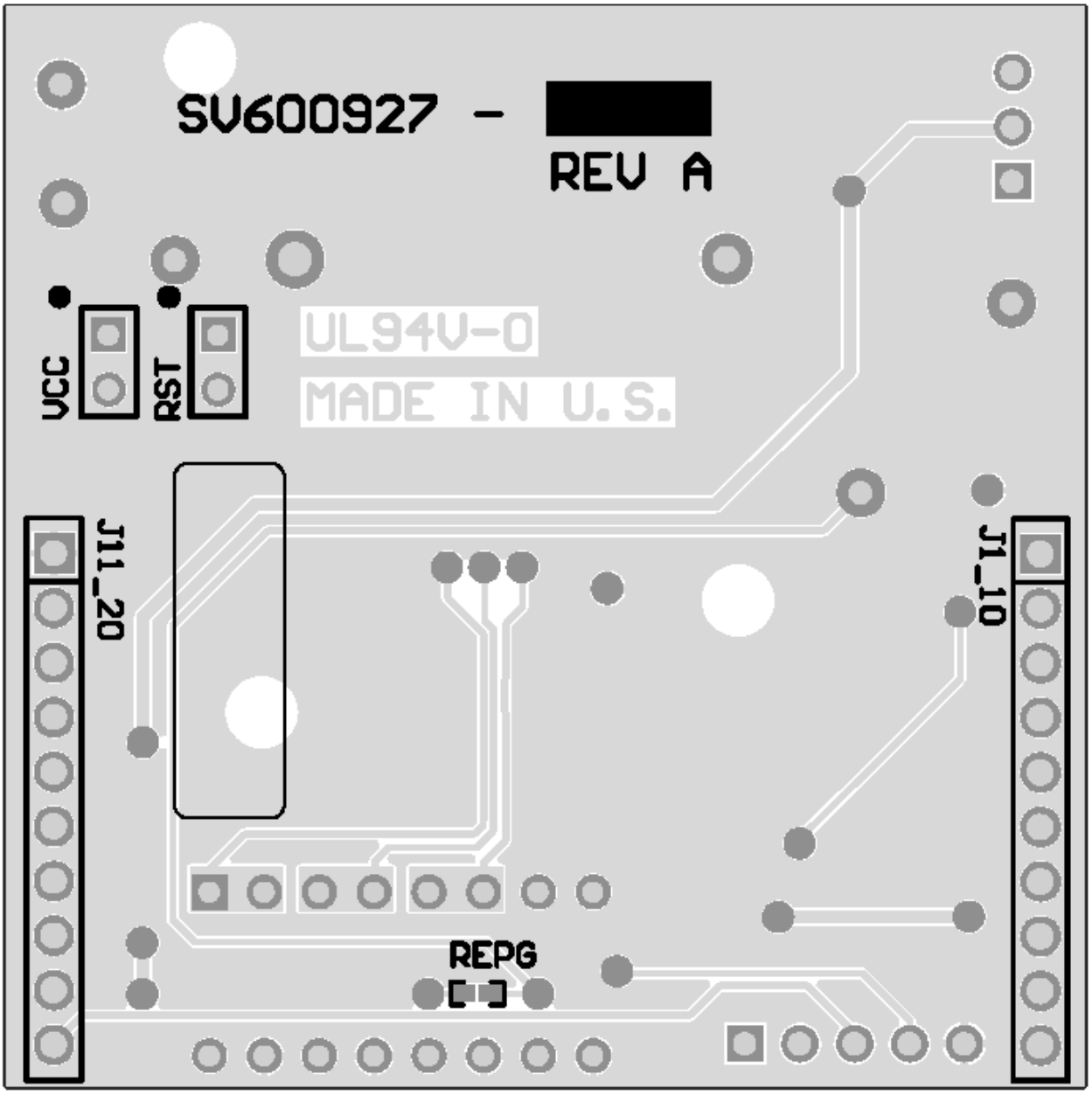


Figure 3. Layout, Bottom Layer, Silkscreen

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As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
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