

TPL5010 Evaluation Module

This user's guide provides the setup instructions, configuration, and operation of the TPL5010 evaluation module (EVM). Also included are the printed-circuit board (PCB) layouts, schematic, and the bill of materials (BOM).

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LaunchPad is a trademark of Texas Instruments.
 DURACELL is a registered trademark of The Gillette Company.

1 Introduction

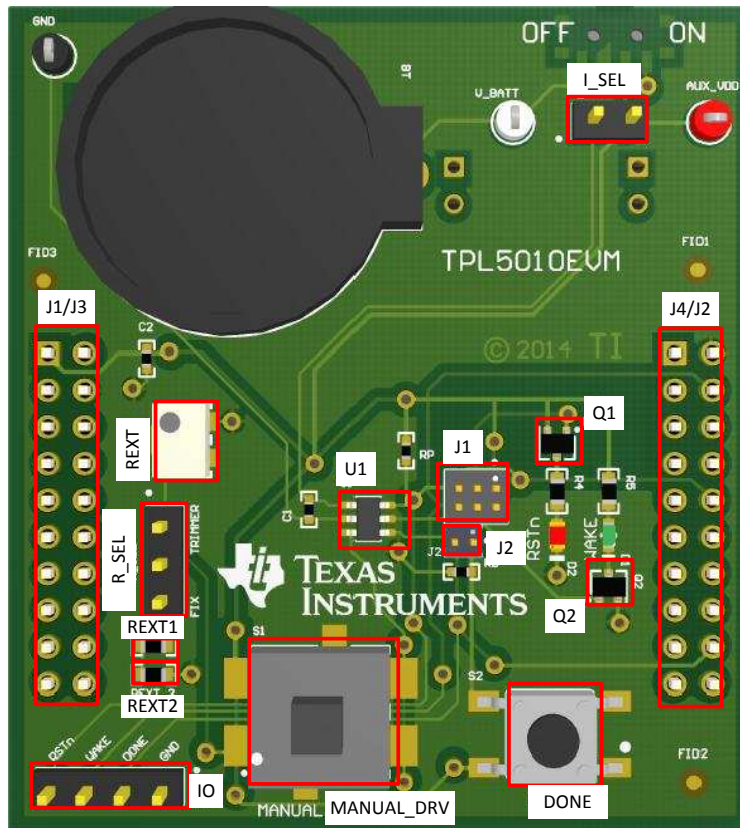


Figure 1. TPL5010EVM

TI's TPL5010EVM evaluation module (EVM) allows a designer to configure the timer intervals of the TPL5010 and measure its very low current consumption. Moreover, the TPL5010EVM is ready to be connected to the LaunchPad™ of the MSP430F5529 in order to test its watchdog and timer features. The EVM has an onboard battery holder (coin battery) to supply the TPL5010 and the microcontroller, if connected.

The EVM contains one TPL5010 (see [Table 1](#)).

Table 1. Device and Package Configurations

| Device | IC | Package |
|--------|------------|---------|
| U1 | TPL5010DDC | SOT23-6 |

2 Setup

Section 2.1 describes the jumpers and connectors on the EVM and Section 2.3 describes how to properly connect, set up, and use the TPL5010EVM.

See Figure 1 for locations of the top layer jumpers and switches.

2.1 Jumpers and Connectors

Table 2 through Table 5 list the input/output connectors description, jumpers description, switches and selectors description, and the test points description.

Table 2. Input/Output Connectors Description

| Name | Layer | Description | | |
|-------|--------|---|------|---|
| J1/J3 | Bottom | 2 × 10 pin receptacle to plug the TPL5010EVM into the MSP430F5529 LaunchPad | | |
| J4/J2 | Bottom | 2 × 10 pin receptacle to plug the TPL5010EVM into the MSP430F5529 LaunchPad | | |
| RST | Bottom | 2-pin receptacle to plug the TPL5010EVM into the MSP430F5529 LaunchPad | | |
| VCC | Bottom | 2-pin receptacle to plug the TPL5010EVM into the MSP430F5529 LaunchPad | | |
| IO | Top | 4-pin header connector to bring out RSTn, WAKE, DONE, and GND signals | | |
| | | IO.1 | GND | Ground |
| | | IO.2 | DONE | DONE signal from external microcontroller |
| | | IO.3 | WAKE | WAKE signal to external microcontroller |
| | | IO.4 | RSTn | RSTn signal to external microcontroller |

Table 3. Jumpers Description

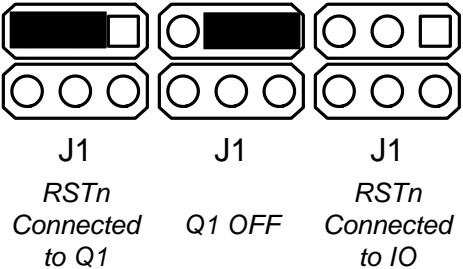
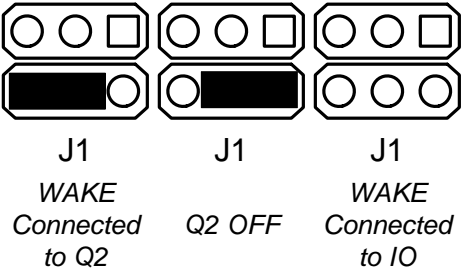
| Name | Layer | Description |
|------|-------|--|
| J1 | Top | <p>J1.5–J1.3 shorted, the RSTn pin of the TPL5010 is connected to the gate of Q1 MOSFET. J1.3–J1.1 shorted, the gate of Q1 MOSFET is connected to VDD (MOSFET OFF).</p>  <p style="text-align: center;">Figure 2. J1 Jumper Setting</p> |
| | | <p>J1.6–J1.4 shorted, the WAKE pin of the TPL5010 is connected to the gate of Q2 MOSFET. J1.4–J1.2 shorted, the gate of Q2 MOSFET is connected to VDD (MOSFET OFF).</p>  <p style="text-align: center;">Figure 3. J1 Jumper Setting</p> |

Table 3. Jumpers Description (continued)

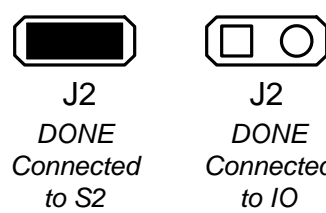
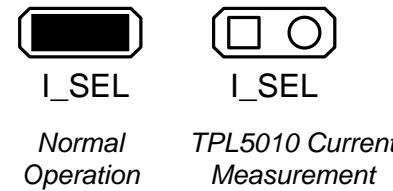
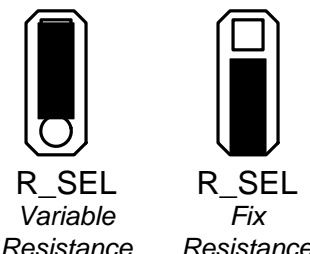
| Name | Layer | Description |
|-------|-------|--|
| J2 | Top | <p>In short configuration, the DONE pin of the TPL5010 is connected to the S2 switch with a pull-down resistor.</p> <div style="text-align: center;">  <p>Figure 4. J2 Jumper Setting</p> </div> |
| I_SEL | Top | <p>In open configuration allows the measurement of the current consumption of the TPL5010.</p> <div style="text-align: center;">  <p>Figure 5. I_SEL Jumper Setting</p> </div> |
| R_SEL | Top | <p>Pin1-2 in short configuration, the variable resistance is used to set the timer interval. Pin2-3 in short configuration, the fix resistance is used to set the timer interval.</p> <div style="text-align: center;">  <p>Figure 6. R_SEL Jumper Setting</p> </div> |

Table 4. Switches and Selectors Description

| Name | Layer | Description |
|----------|--------|--|
| S_ON_OFF | Bottom | In ON position turns ON the EVM, in OFF position turns OFF the EVM |
| S1 | Top | When pushed, the SPST switch generates a DONE pulse |
| S2 | Top | When pushed, the SPDT ON/Momentary switch generates a Manual reset pulse |

Table 5. Test Points Description

| Name | Layer | Description |
|---------|-------|---|
| GND | Top | Test point of the ground, connect the GND of the power supplies |
| V_BATT | Top | Test point to monitor battery voltage |
| AUX_VDD | Top | Test point to connect external supply voltage in alternative to the coin cell battery |

2.2 Battery Requirements

In case the EVM is battery powered, the battery must meet the following requirements:

- Battery type: CR2032 UL-certified battery
- Voltage: 3 V
- Minimum capacity: 220 mAh
- Minimum discharge rate: N/A mA

NOTE: Only insert DURACELL® 2032 Lithium battery type CR2032, or equivalent.

2.3 TPL5010EVM Configuration

The evaluation board can work standalone or plugged into the MSP430F5529 LaunchPad.

2.3.1 Setting the Time Interval Period

Set the Time interval period by tuning the variable resistance (the trimmer can generate resistances in the range between 1 k Ω and 200 k Ω).

To tune the value of the resistance:

1. Connect a DMM between pin 1 of R_SEL and GND.
2. Turn the screw on the top of the trimmer until you reach the desired value.
3. Disconnect the DMM at the end of the operation.

Alternatively, set the DRV pulse interval with the fix resistances (R_EXT1 = 500 Ω , R_EXT2 = 0 Ω). If required, replace the resistances with customized ones.

See [Figure 1](#) for locations of the resistances REXT1 and REXT2.

2.3.2 EVM Standalone Without Microcontroller

The following settings are provided to use the EVM standalone, without a microcontroller:

- Put the S_ON_OFF selector in the OFF position.
- Set the mode of operation through the MODE header (see [Table 3](#)).
- Insert a CR2032 coin cell battery in the battery holder (BT), alternatively, connect a voltage source between the AUX_VDD and GND test points.
- Configure jumper J1 (RSTn connected to Q1, WAKE connected to Q2) and J2 (DONE connected to S2), as explained in [Table 3](#).

NOTE: Do not connect the coin cell battery and the voltage source to supply the evaluation board at same time.

- Put the S_ON_OFF selector in the ON position, or turn on the external voltage source if it is used instead of the coin cell battery.

The DONE and WAKE signals can be monitored at the IO connector (pin 2 and 3, respectively).

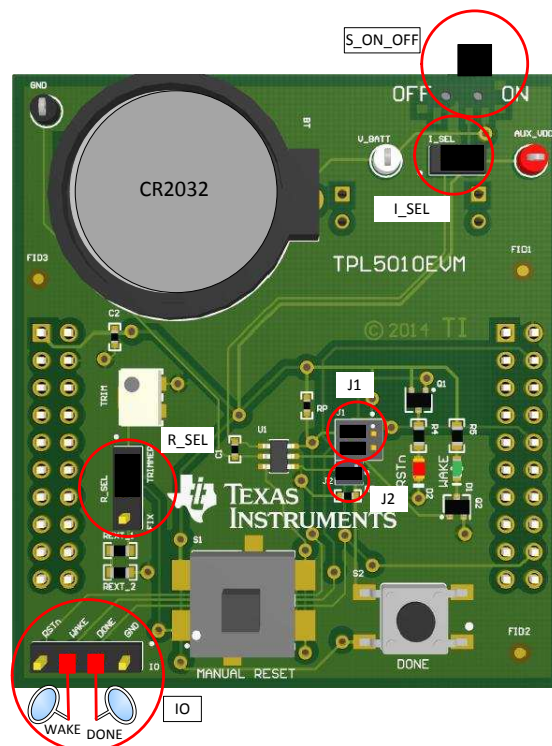


Figure 7. Jumpers Configuration – EVM Standalone Without Microcontroller

2.3.3 EVM With Microcontroller

The following settings are provided to use the EVM with a microcontroller:

- Put the S_ON_OFF selector in the OFF position.
- Set the mode of operation through the MODE header (see [Table 3](#)).
- Connect the microcontroller to the IO header in order to manage the I/O signal of the design under test (DUT).
- Supply the microcontroller, connecting its supply pin to the AUX_VDD test point and the ground to the GND pin of the IO header.
- Insert a CR2032 coin cell battery in the battery holder (BT), alternatively, connect a voltage source between the AUX_VDD and GND test points.
- Configure the jumper J1 (RSTn connected to IO, WAKE connected to IO) and J2 (DONE connected to IO), as explained in [Table 3](#).

NOTE: Do not connect the coin cell battery and the voltage source to supply the evaluation board at same time.

Do not use the switch S2 (DONE), in this configuration the DONE switch is connected to a digital output pin of the microcontroller.

- Put the S_ON_OFF selector in the ON position, or turn on the external voltage source if it is used instead of the coin cell battery.

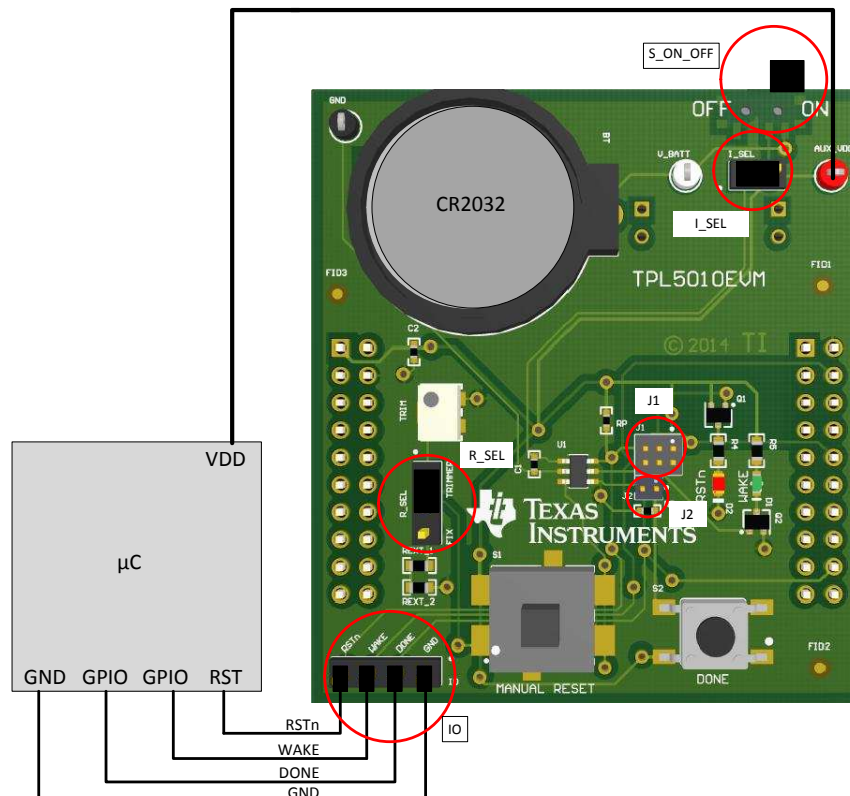


Figure 8. Jumpers Configuration – EVM With Microcontroller

2.3.4 EVM With LaunchPad

Load the code from this section into the MSP430F5529 of the LaunchPad. Refer to [MSP430 LaunchPad \(MSP-EXP430F5529\) Wiki](#) for more details.

- Put the S_ON_OFF selector in the OFF position.
- Set the mode of operation through the MODE header (see [Table 3](#)).
- Remove jumpers VCC and RST of the LaunchPad.
- Plug the EVM into the LaunchPad (MSP430F5529), according to the following table:

| TPL5010EVM | | | MSP430 LaunchPad | | |
|------------|--------|--------|------------------|--------|------|
| J1/J3 | J1.1 | VDD_μC | J1/J3 | pin 1 | 3V3 |
| | pin 4 | GND | | pin 4 | GND |
| J4/J2 | pin 2 | GND | J4/J2 | pin 2 | GND |
| | pin 4 | WAKE | | pin 4 | P2.0 |
| | pin 10 | RSTn | | pin 10 | RST |
| | pin 18 | DONE | | pin 18 | P2.3 |
| VCC | | | 3V3 | | |
| RST | | | SBW RST | | |

- Insert a CR2032 coin cell battery in the battery holder (BT), alternatively, connect a voltage source between the AUX_VDD and GND test points.
- Configure the jumper J1 (RSTn connected to Q1, WAKE connected to Q2) and J2 (DONE connected to IO), as explained in [Table 3](#).

NOTE: Do not connect the coin cell battery and the voltage source to supply the evaluation board at the same time.

Do not use the switch S2 (DONE), in this configuration, the DONE switch is connected to a digital output pin of the microcontroller.

- Put the S_ON_OFF selector in ON position, or turn on the external voltage source if it is used instead of the coin cell battery.

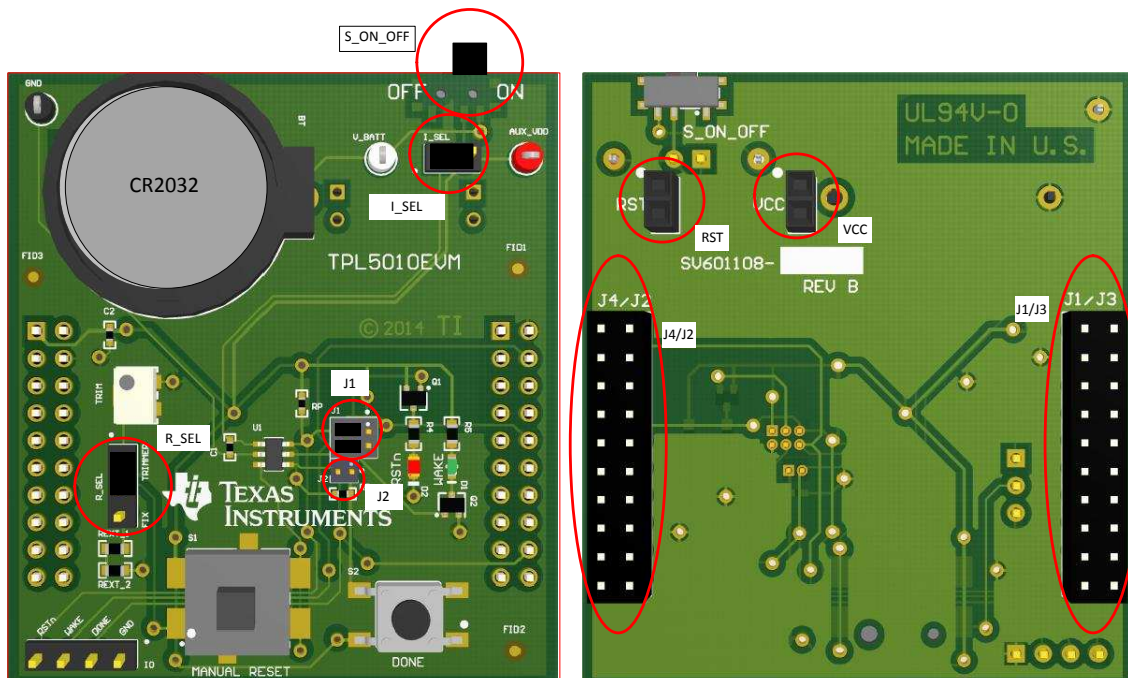


Figure 9. Jumpers Configuration – EVM With LaunchPad

Example code

Once loaded into the MSP430 of the LaunchPad, the code presented in this section performs the following features:

- At power on, the green LED present on the LaunchPad is turned on and turned off.
- When the MSP430 receives a RSTn, the red LED is toggled 5 times, then the green LED is turned ON and OFF and the MSP430 sends a DONE signal to the TPL5010.
- When the MSP430 receives a WAKE pulse, the green LED is turned ON and OFF and the MSP430 sends a DONE signal to the TPL5010.

```
#include <msp430.h>

void main(void) {

    WDTCTL = WDTPW | WDTHOLD;           // Stop watchdog timer

    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

    P2IES &= ~BIT0;                      // P2.0 Lo/Hi edge
    P2IFG &= ~BIT0;                     // P2.0 IFG Cleared
    P2IE  |= BIT0;                       // P2.0 Interrupt Enabled

    SFRSPCR |= SYSNMIIES | SYSNMI;      // Select NMI function for the RST/NMI pin,
                                        // interrupt on falling edge
                                        // (pull-up R on RST/NMI is already enabled after PUC)

    SFRRIE1 |= NMIIE;                   // Set NMI pin interrupt enable

    P4OUT |= BIT7;                       // Set P4.7 GREEN LED ON
    __delay_cycles(500000);              // Set Delay
    P4OUT &= ~BIT7;                      // Set P4.7 GREEN LED OFF

    P2OUT |= BIT3;                       // Done High
    __delay_cycles(100);                 // Set Delay
    P2OUT &= ~BIT3;                      // Done Low

    __bis_SR_register(LPM4_bits + GIE);  // Enter LPM4
}

// Port 2 interrupt service routine
#pragma vector=PORT2_VECTOR
__interrupt void Port_2(void)
{

    volatile unsigned int i;

    P4OUT |= BIT7;                       // GREEN LED ON
    i = 10000;                           // SW Delay
    do i--;
    while(i != 0);
    P4OUT &= ~BIT7;                      // Set P4.7 GREEN LED OFF

    P2OUT |= BIT3;                       // Done High
    __delay_cycles(100);                 // Set Delay
    P2OUT &= ~BIT3;                      // Done Low

    P2IES &= ~BIT0;                      // P2.0 Lo/Hi edge
    P2IFG &= ~BIT0;                     // P2.0 IFG Cleared
    P2IE  |= BIT0;                       // P2.0 Interrupt Enabled
}
```

```

}

// User NMI interrupt service routine
#pragma vector=UNMI_VECTOR
__interrupt void UNMI_ISR (void)
{
    int n=0;
    // Efficiently decode the User NMI interrupt source
    switch (__even_in_range(SYSUNIV, SYSUNIV_SYSBUSIV)) {
        case SYSUNIV_NMIIFG :
            {
                for(n=0; n<10; n++) {
                    volatile unsigned int i;
                    P1OUT ^= 0x01;           // Toggle RED led
                    i = 10000;             // SW Delay
                    do i--;
                    while(i != 0);
                }
                volatile unsigned int i;
                P4OUT |= BIT7;           // GREEN LED ON
                i = 10000;             // SW Delay
                do i--;
                while(i != 0);
                P4OUT &= ~BIT7;         // Set P4.7 GREEN LED OFF

                P2OUT |= BIT3;           // Done High
                __delay_cycles(100);     // Set Delay;
                P2OUT &= ~BIT3;         // Done Low;
            }
            break;
        case SYSUNIV_OFIFG :
        case SYSUNIV_ACCVIFG :
        case SYSUNIV_BUSIFG :
        default :
            break;
    }
}
}

```

3 Operation

Once the EVM is powered ON, the TPL5010 starts working. Refer to the TPL5010 datasheet ([SNAS651](#)) for further details on the timing:

- Configure the trimmer equal to 5 kΩ to set a time interval of 1 s.
- When an RSTn pulse is generated by the TPL5010, the red LED (D2) is turned on. The green LED (D1) is turned on when a WAKE signal is generated by the TPL5010.
- If the DONE switch (S2) is pushed, a DONE pulse is sent to the TPL5010. If the DONE pulse is sent within the programmed time interval, at the next cycle the green LED (D1) is turned ON.
- When the M_RST switch (S1) is pushed, a manual reset pulse is sent to the TPL5010. For both DONE and M_RST pulses, the width of the pulse is proportional to the pressure time. While the M_RST switch is pressed the red LED turns ON.

3.1 Supply Current Measurement

3.1.1 Supply Current Measurement of the TPL5010 Only

First, turn off the EVM (ON/OFF switch to OFF position), then disconnect the EVM from the LaunchPad or microcontroller, in order to not load the digital output pins of the DUT.

- Leave the I_SEL jumper open.
- **Do not leave digital input pins floating;** Short the DONE pin (second pin of IO header) to GND (first pin of IO header), turn OFF the Q1 and Q2 MOSFET (as explained in [Table 3](#)).
- Connect a digital multimeter, configured as the current meter (able to measure nA), between AUX_VDD and pin 1 of I_SEL.
- Turn on the EVM (ON/OFF switch to ON position).
- Read the current consumption on the DMM.

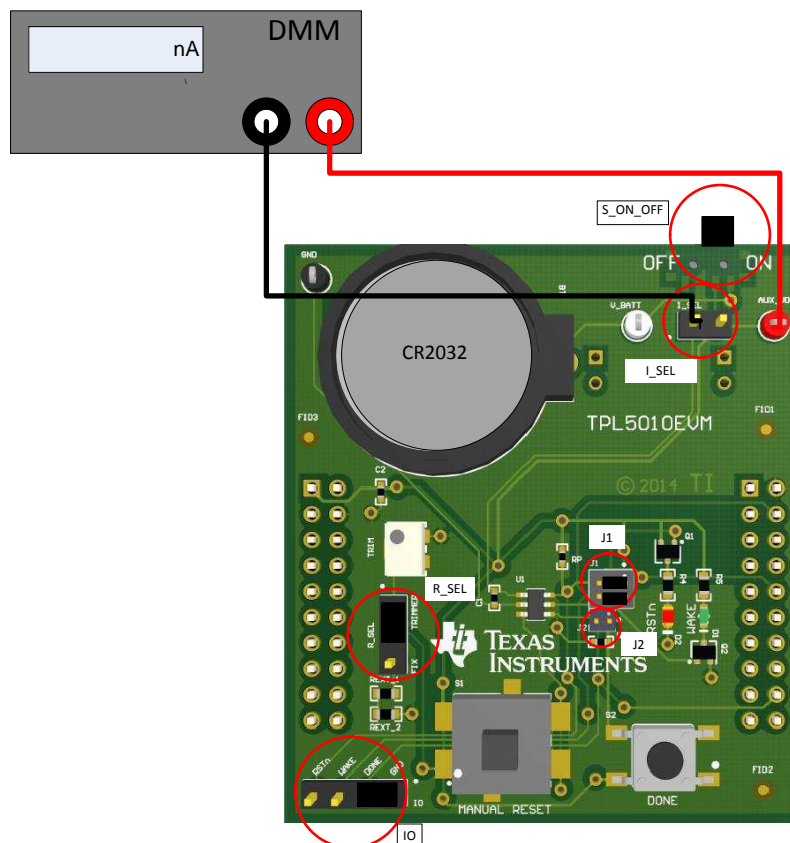


Figure 10. Current Measurement Setup – TPL5010 Only

3.1.2 Supply Current Measurement of the TPL5010 During the Reading of the Resistance

First, turn off the EVM (ON/OFF switch to OFF position), then disconnect the EVM from the LaunchPad or your microcontroller, in order to not load the digital output pins of the DUT.

- Leave the I_SEL jumper open.
- **Do not leave digital input pins floating;** Short the DONE pin (second pin of IO header) to GND (first pin of IO header), turn OFF the Q1 and Q2 MOSFET (as explained in [Table 3](#)).
- Connect a digital multimeter, configured as the current meter (able to measure nA), between AUX_VDD and pin 1 of I_SEL.
- Keep the MANUAL_RST switch pressed while turning ON the EVM.
- Turn on the EVM (ON/OFF switch to ON position).
- Read the current consumption on the DMM.

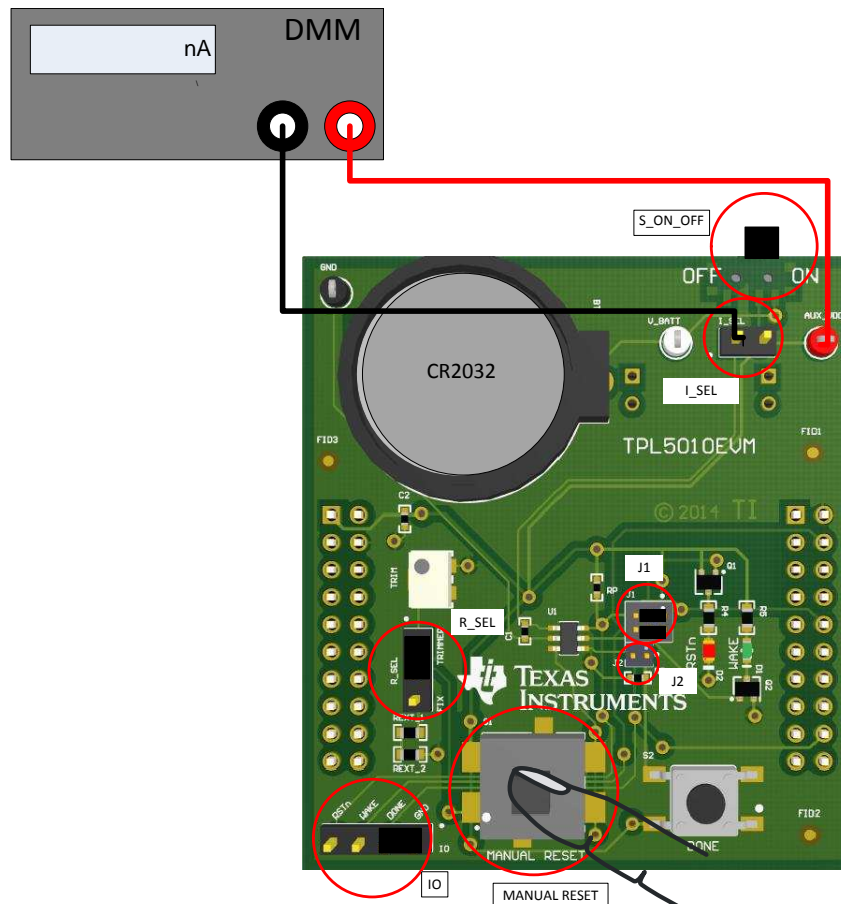


Figure 11. Current Measurement Setup – TPL5010 During the Reading of the Resistance

3.1.3 Supply Current Measurement of the TPL5010 With Microcontroller

First, turn off the EVM (ON/OFF switch to OFF position):

- Load the code into the microcontroller.
- Connect the microcontroller to the EVM, refer to [Section 2.3.3](#).
- Install the I_SEL jumper.
- **Do not leave digital input pins floating**; Ensure that the DONE signal is controlled by the microprocessor, turn OFF the Q1 and Q2 MOSFET (as explained in [Table 3](#)).
- Connect a digital multimeter, configured as the current meter (able to measure nA), between V_BATT test point and AUX_VDD test point.
- Leave the EVM OFF (ON/OFF switch to OFF position).
- Read the current consumption on the DMM while pressing the MANUAL_RESET switch.

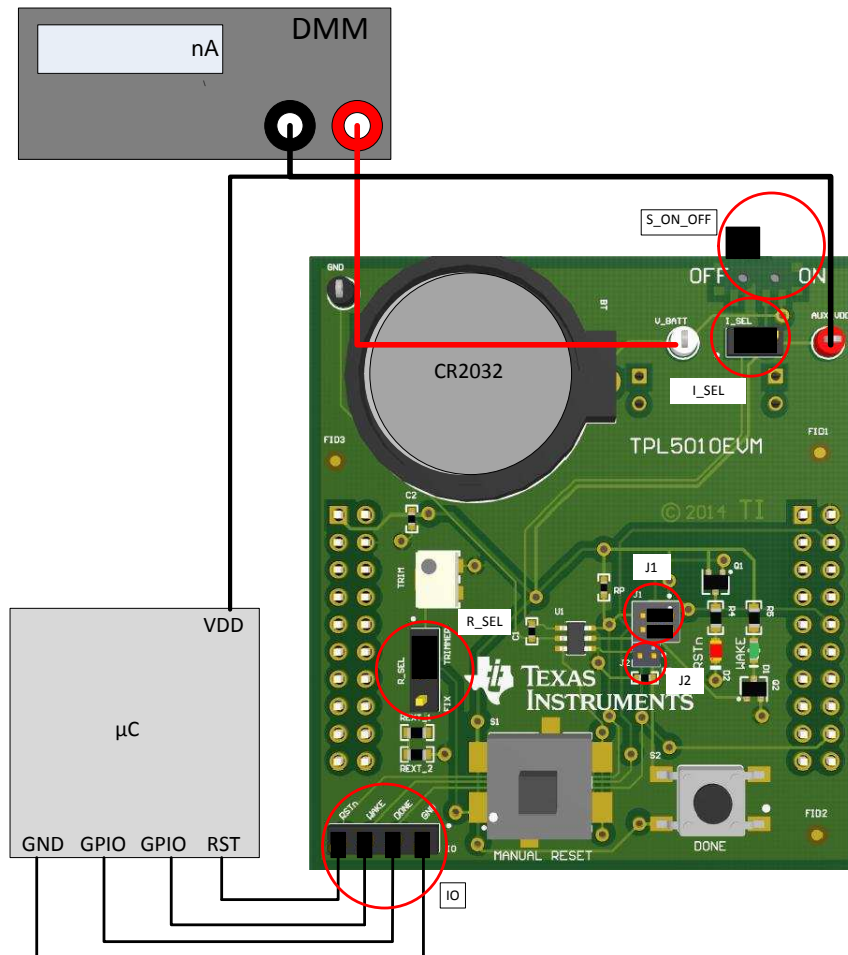


Figure 12. Current Measurement Setup – TPL5010 With Microcontroller

4 Board Layout

Figure 13 and Figure 14 illustrate the TPL5010EVM board layouts.

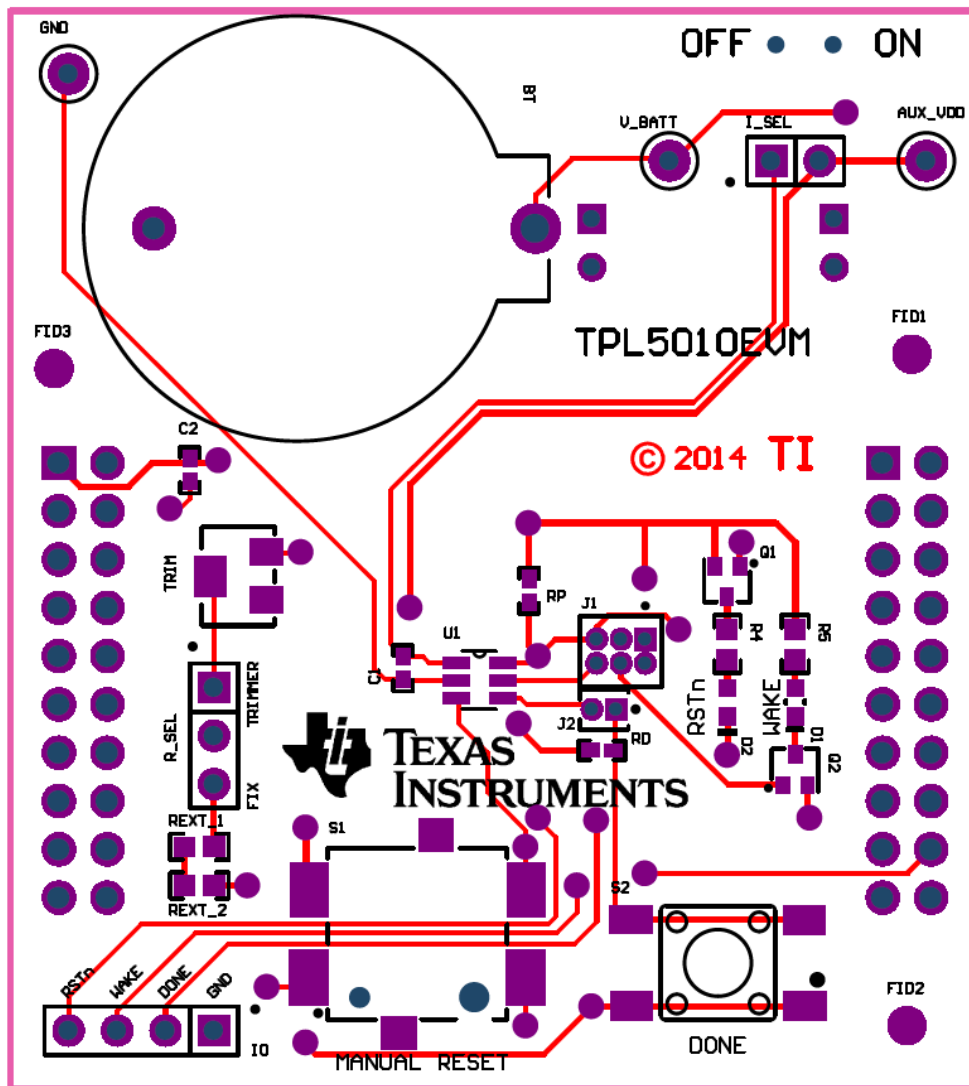


Figure 13. Top Layer

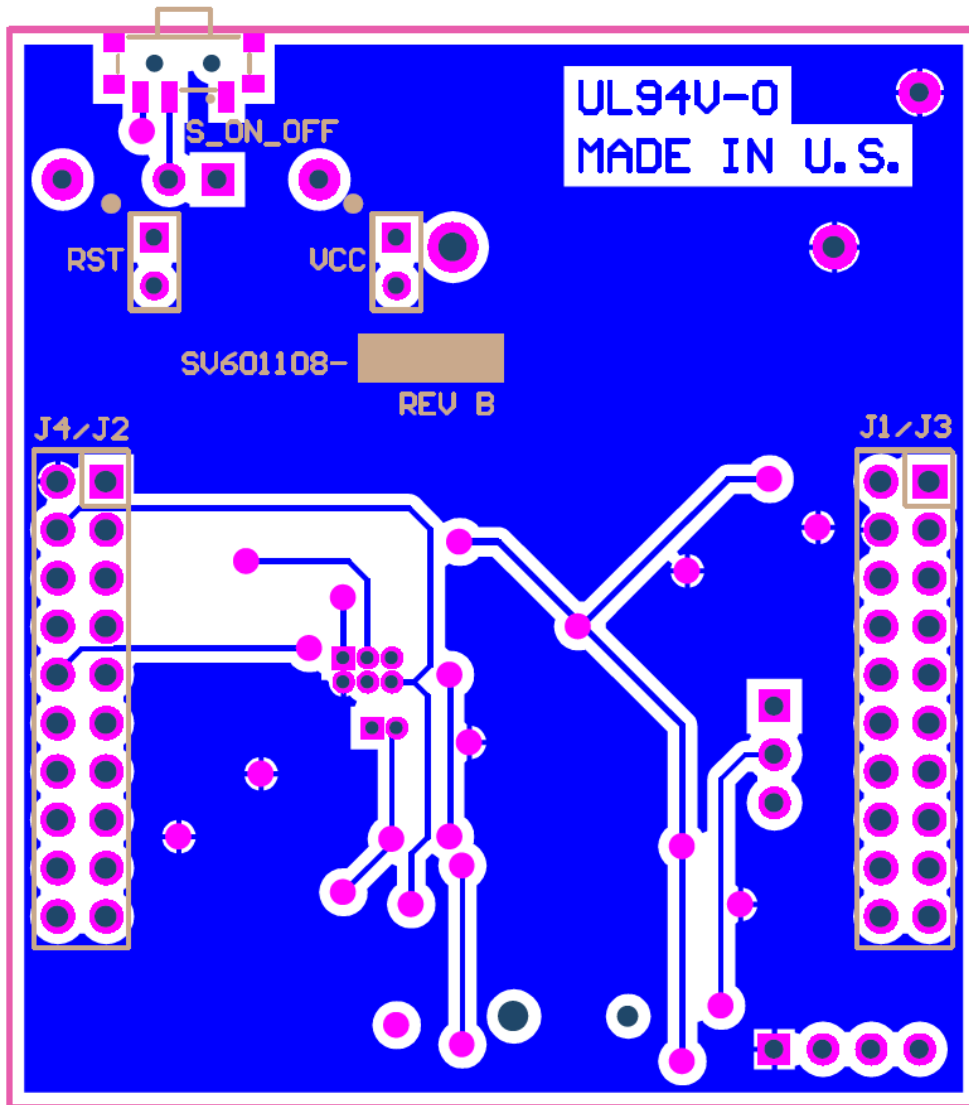


Figure 14. Bottom Layer

5 Schematic

Figure 15 illustrates the TPL5010EVM schematic.

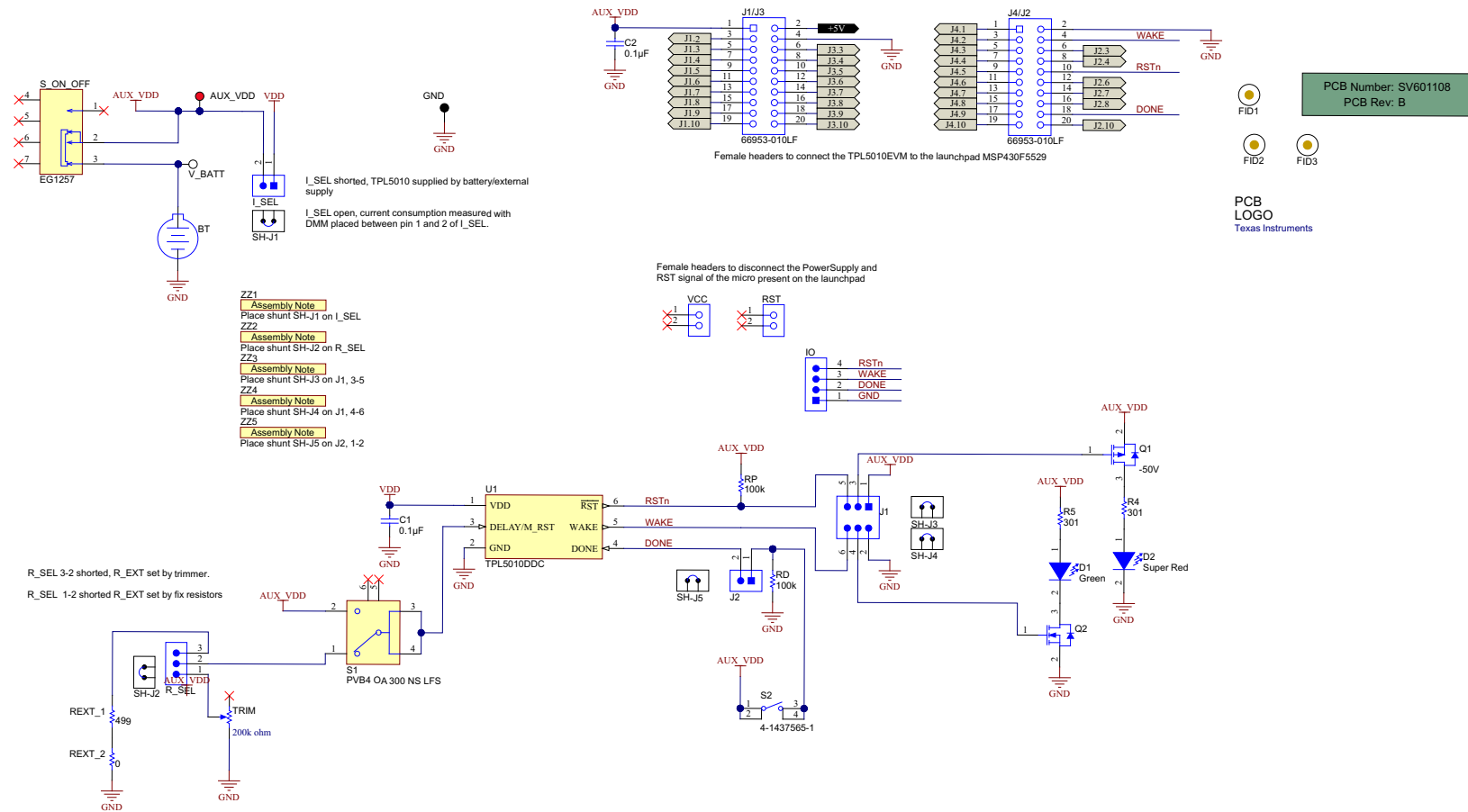


Figure 15. TPL5010EVM Schematic

6 Bill of Materials

Table 6 lists the TPL5010EVM BOM.

Table 6. TPL5010EVM Bill of Materials

| Designator | Description | Manufacturer | Part Number | Quantity |
|---------------------|---|-----------------------------|--------------------|----------|
| AUX_VDD | Test Point, TH, Miniature, Red | Keystone | 5000 | 1 |
| BT | Battery Holder, CR2032, Retainer clip, TH | Memory Protection Devices | BS-7 | 1 |
| C1, C2 | CAP, CERM, 0.1uF, 6.3V, +/-10%, X5R, 0402 | TDK | C1005X5R0J104K | 2 |
| D1 | LED, Green, SMD | OSRAM | LG L29K-G2J1-24-Z | 1 |
| D2 | LED, Super Red, SMD | Lumex | SML-LX0603SRW-TR | 1 |
| GND | Test Point, TH, Miniature, Black | Keystone | 5001 | 1 |
| IO | Header, 100mil, 4x1, Gold, TH | Samtec | TSW-104-07-G-S | 1 |
| I_SEL | Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator | Samtec | TSW-102-07-G-S | 1 |
| J1 | Header, 50mil, 3x2, Gold, TH | Sullins Connector Solutions | GRPB032VWVN-RC | 1 |
| J2 | Header, 50mil, 2x1, Gold, TH | Sullins Connector Solutions | GRPB021VWVN-RC | 1 |
| J1/J3, J4/J2 | Receptacle, 100mil, 10X2, TH | FCI | 66953-010LF | 2 |
| Q1 | MOSFET, P-CH, -50V, -0.13A, SOT-323 | Diodes Inc. | BSS84W-7-F | 1 |
| Q2 | MOSFET, N-CH, 50V, 0.2A, SOT-323 | Diodes Inc. | BSS138W-7-F | 1 |
| R4, R5 | RES, 301 ohm, 1%, 0.1W, 0603 | Vishay-Dale | CRCW0603301RFKEA | 2 |
| REXT_1 | RES, 499 ohm, 0.1%, 0.1W, 0603 | Susumu Co Ltd | RG1608P-4990-B-T5 | 1 |
| REXT_2 | RES, 0 ohm, 5%, 0.1W, 0603 | Vishay-Dale | CRCW06030000Z0EA | 1 |
| RD, RP | RES, 100k ohm, 5%, 0.063W, 0402 | Vishay-Dale | CRCW0402100KJNED | 2 |
| RST, VCC | Connector, Receptacle, 100mil, 2x1, Gold plated, TH | TE Connectivity | 5-534206-1 | 2 |
| R_SEL | Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator | Samtec, Inc. | TSW-103-07-G-S | 1 |
| S1 | Switch, Pushbutton, SPDT, 0.1A 14V | C&K Components | PVB4 OA 300 NS LFS | 1 |
| S2 | Switch, Tactile, SPST-NO, 0.05A, 12V, SMT | TE Connectivity | 4-1437565-1 | 1 |
| SH-J1, SH-J2 | Shunt, 100mil, Gold plated, Black | 3M | 969102-0000-DA | 2 |
| SH-J3, SH-J4, SH-J5 | Mini Shunt, Closed Top, 650 V AC, -45 to 85°C, Pitch 1.27 mm, Height 3 mm, RoHS | Sullins Connector Solutions | NPB02SVAN-RC | 3 |
| S_ON_OFF | Switch, Slide, SPDT, 0.3A, SMT | E-Switch | EG1257 | 1 |
| TRIM | TRIMMER, 200K, 0.25W, SMD | Bourns | 3224W-1-204E | 1 |
| U1 | Ultra-Low Power System Timer with Watchdog functionality and Manual Reset, DDC0006A | Texas Instruments | TPL5010DDC | 1 |
| V_BATT | Test Point, Miniature, White, TH | Keystone | 5002 | 1 |

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 semiconductor 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
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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/lstds/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/lstds/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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2. 実験局の免許を取得後ご使用いただく。
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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/llds/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.

6. *Disclaimers:*
- 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
- 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS AND CONDITIONS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.
7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS AND CONDITIONS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.
8. *Limitations on Damages and Liability:*
- 8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS AND CONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.
- 8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.
9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.
10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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