

## **PGAxxxEVM-034 User Guide**

The PGAxxxEVM-034 supplies a platform to test the PGA900, PGA300, and PGA305 in the QFN package. The EVM is shipped as either the PGA900EVM-034, the PGA300EVM-034, or the PGA305EVM-034, with the name identifying the signal conditioner included in the EVM package. The PGAxxxEVM-034 supplies an interchangeable platform all of these devices can use.

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## Trademarks

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## 1 Introduction

Figure 1 shows the PGAxixEVM-034 and labels the primary sections.

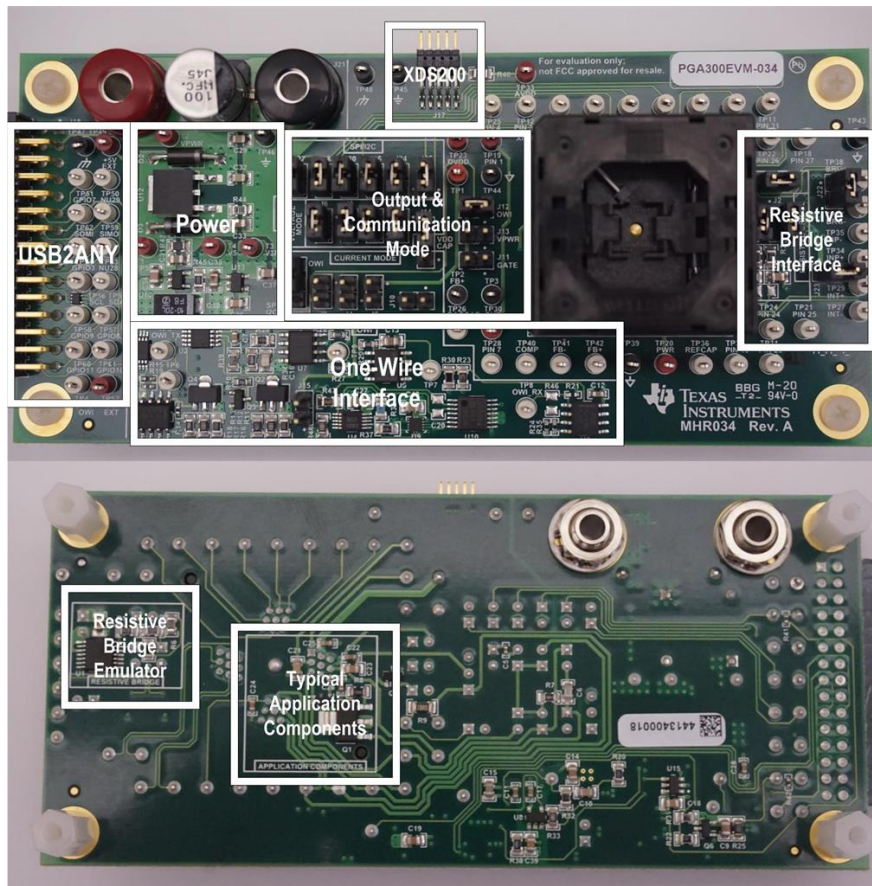


Figure 1. PGAxixEVM-034

The PGAxixEVM-034 is divided into six sections:

1. Interface boards and external power:
  - a. USB2ANY connector
  - b. XDS200 connector (single wire debugger)
  - c. Banana connectors to power up EVM
2. Power:
  - a. 7.5-V, 5-V, and 3.3-V regulators
3. Mode selection:
  - a. 4- to 20-mA loop (current mode)
  - b. Voltage mode
4. OWI circuitry
5. Resistive bridge
6. Application components

The application components section only lists the required components for real-life applications using the PGA900/PGA300/PGA305 device. In this case, the application is configured for current mode.

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**NOTE:** The PGA900, PGA300, and PGA305 have different features and pin functions, and some circuitry and communication features found on the PGAxixEVM-034 are only applicable to the PGA900. Each device also has its own unique Graphical User Interface (GUI) that communicates with the included USB2ANY board.

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## 2 Default Configuration

The EVM requires a 10- to 30-V input applied to J20 and J21. Clamp the power supply current to 100 mA. The shipped EVM is configured for voltage mode as shown in [Table 1](#).

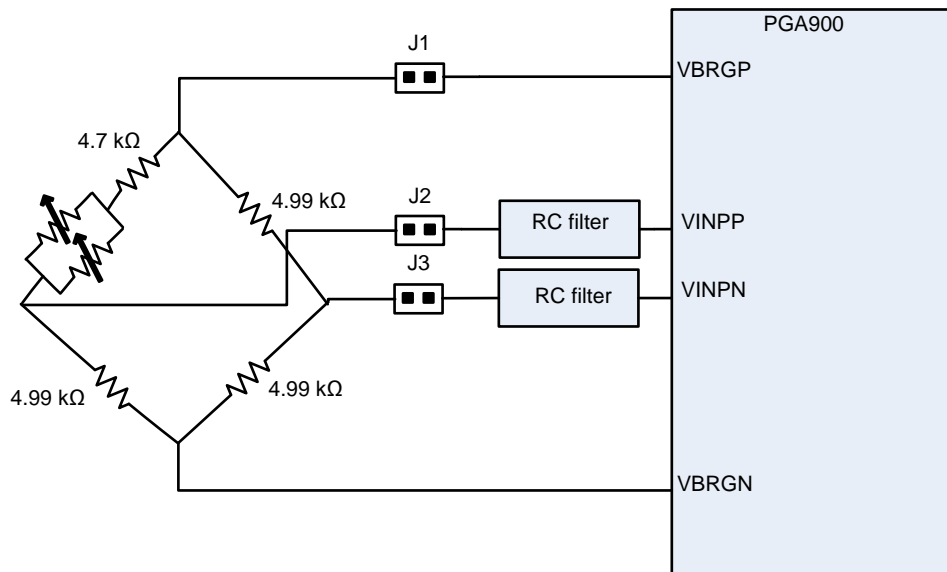
**Table 1. Jumper Settings for PGAxixEVM-034 in Voltage Mode**

Jumper	Setting	Function
J12	Closed	PGAxix powered up from OWI circuitry (VDD = 5 V)
J1, J2, J3	Closed	Connect resistive bridge to PGA900
J6, J7, J8	Closed	Voltage mode with a 100-nF load
J24, J25, J26, J27, J28, J30	Closed	SPI/I <sup>2</sup> C/UART enabled (only applicable to PGA900)
J16	Closed	Connect ASIC_GND to IRETURN
J14	Pins 1-2 closed	Connect VDD cap to ASIC_GND
J19	Pins 2-3 closed	Connect USBGND to IRETURN

### 3 Inputs and Output Configurations

#### 3.1 Pressure Input

The PGAxxxEVM-034 has a resistive bridge where one leg of the bridge can be changed using a digital potentiometer. The changing leg has two digital potentiometers connected in parallel in series with a 4.7-k $\Omega$  resistor. J1 must be closed to connect the bridge voltage from the PGAxxx device to the resistive bridge. The J2 and J3 must also be closed to connect the bridge outputs to the PGAxxx. An RC filter is in series with each of the input pins in the PGAxxx with a cutoff frequency of approximately 106 Hz. [Figure 2](#) shows the pressure stimulus circuit in the PGAxxxEVM-034.



**Figure 2. Pressure Stimulus in the PGAxxxEVM-034**

#### 3.2 Temperature Input

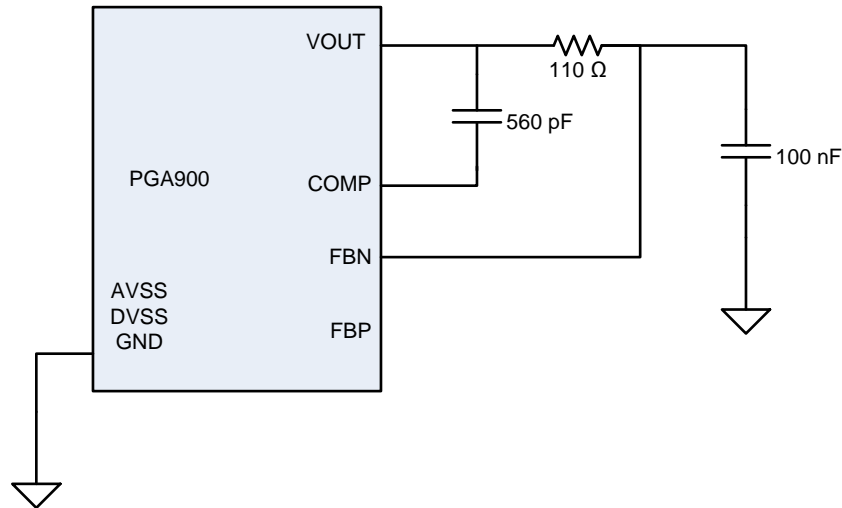
The PGAxxxEVM-034 does not have on-board stimulus for the temperature inputs of the PGAxxx, but the TP27 and TP29 on the far-right side of the board can be used to apply external signals.

#### 3.3 Output

The PGAxxxEVM-034 can be configured for voltage or current mode (4-mA to 20-mA loop). Each mode requires different jumper settings as shown in the following sections.

### 3.4 Voltage Mode

The PGAx<sub>xx</sub>EVM-034 is by default configured in voltage mode with a 100-nF load. A compensation capacitor and an isolation resistor are necessary for stability. Figure 3 shows the PGAx<sub>xx</sub> schematic for voltage mode and Table 1 shows all the jumpers necessary to configure the board in this mode. If the capacitive load is different from 100 nF, then the isolation resistor and compensation capacitor values must be changed. Refer to the application note *PGA900 as a Capacitive Load Driver* (SLDA020) for more information.



**Figure 3. PGA900 in Voltage Mode Configuration**

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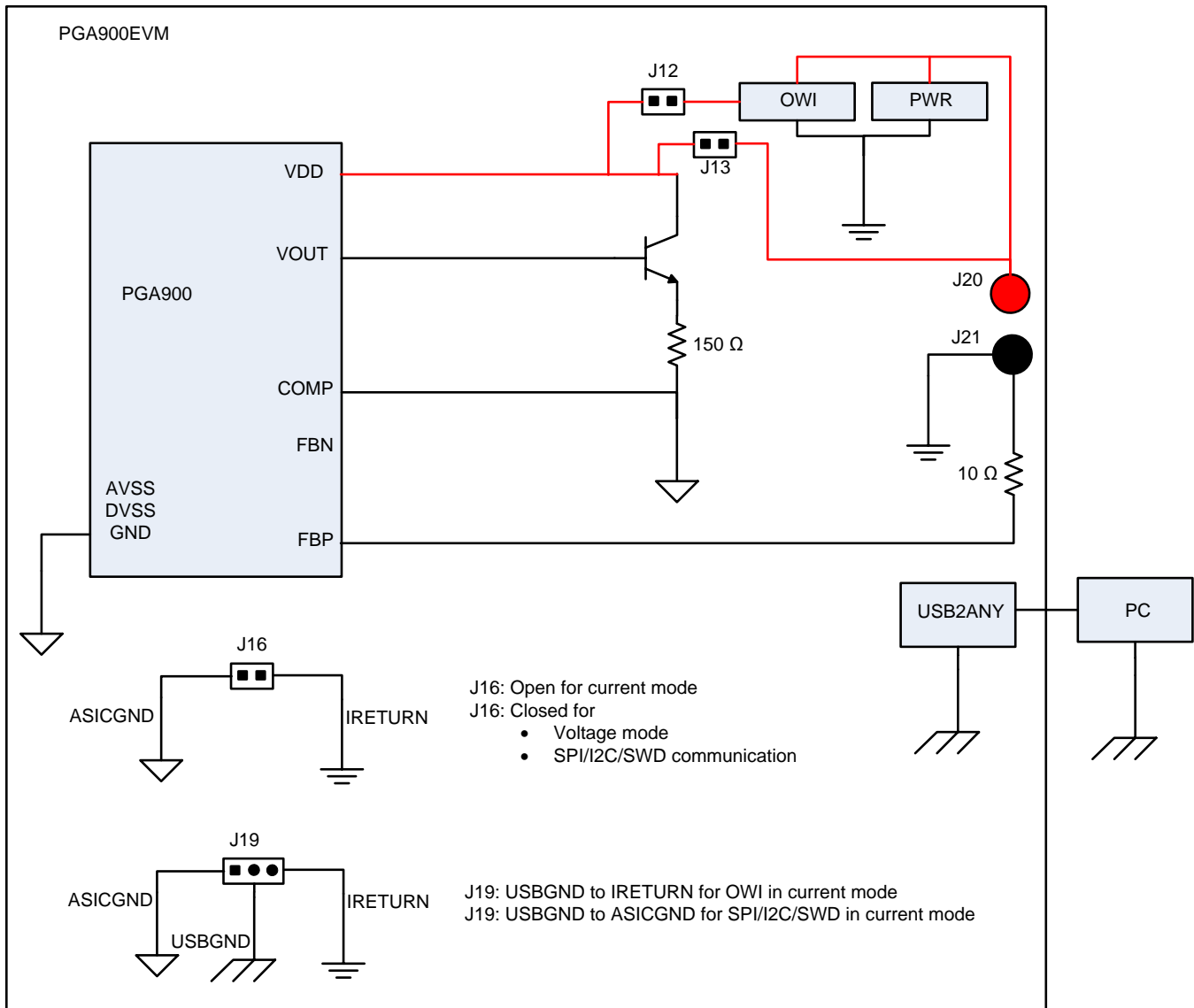
**NOTE:** If the designer wants the VDD to be higher than 5 V in voltage mode, open J12 and close J13. VDD will be equal to the power applied to the PGAx<sub>xx</sub>EVM-034.

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### 3.5 Current Mode

When in current mode, the PGAxxEVM-034 must be properly configured to separate the different negative references for all the voltage levels present in the board. Figure 4 shows the primary connections for current mode. The two scenarios in current mode are:

- Current mode using OWI
- Current mode using SPI/I<sup>2</sup>C/SWD (only applicable to the PGA900 or the PGA305 in I<sup>2</sup>C mode)



**Figure 4. PGAxxEVM-034 in Current Mode**

**NOTE:** When in current mode, the input voltage to the EVM (J20 and J21) should be at least 20 V.

### 3.6 OWI and SPI/I<sup>2</sup>C/SWD in 4-mA to 20-mA Current Loop

Remember that when in current mode, there are two different scenarios depending on whether OWI or SPI/I<sup>2</sup>C/SWD will be used as the type of communication for the PGA900. The PGA300 only allows communication through OWI, so always follow the settings found on [Table 3](#) when using the PGA300 in current mode. [Table 2](#) shows the jumper settings necessary for each of these scenarios. Refer to [Figure 4](#) for the locations of the jumpers. The PGA305 allows communication through OWI or through I<sup>2</sup>C. When using OWI communication with the PGA305 device in current mode, refer to the same settings used for the PGA300 listed earlier. For I<sup>2</sup>C communication with the PGA305 in current mode, use the same settings as those used for I<sup>2</sup>C communication with the PGA900 in current mode.

**Table 2. Jumper Settings for PGA900EVM-034 in Current Mode Using SPI/I<sup>2</sup>C/SWD**

Jumper	Setting	Function
J16	Open	Disconnect ASIC_GND from IRETURN
J19	Pins 1-2 closed	Connect USBGND to ASICGND
J13	Closed	Connect PGA900 VDD pin to EVM input voltage
J6	Open	Disconnect 180 pF between COMP and VOUT
J9	Closed	Connect COMP to ASIC_GND
J4	Closed	Short out resistor at VOUT
J8	Open	Disconnect FBN from VOUT
J5	Closed	Connect VOUT to BJT
J7	Open	Lift 100-nF Voltage-mode load Capacitor at base of BJT
J10	Closed	Connect FBP to IRETURN through 10-Ω resistor
J14	Pins 1-2 closed	100-nF capacitor from VDD to FBP and from DACCAP to FBP
J12	Open	Disconnect PGA900 VDD pin from OWI signal from EVM
J25, J27	Closed	If I <sup>2</sup> C is desired
J24, J26, J28, J30	Closed	If SPI/UART is desired

**Table 3. Jumper Settings for PGAXxxEVM-034 in Current Mode Using OWI**

Jumper	Setting	Function
J16	Open	Disconnect ASIC_GND from IRETURN
J19	Pins 2-3 closed	Connect USBGND to IRETURN
J13	Open	Disconnect PGA900 VDD pin from EVM input voltage
J6	Open	Disconnect 560 pF between COMP and VOUT
J9	Closed	Connect COMP to ASIC_GND
J4	Closed	Short out resistor at VOUT
J8	Open	Disconnect FBN from VOUT
J5	Closed	Connect VOUT to BJT
J7	Open	Lift 100-nF Voltage-mode load Capacitor at base of BJT
J10	Closed	Connect FBP to IRETURN through 10-Ω resistor
J14	Pins 1-2 closed	100-nF capacitor from VDD to FBP and from DACCAP to FBP
J12	Closed	Connect VDD in PGA900 to OWI signal from EVM
J25, J27	Open	Disconnect I <sup>2</sup> C pins between USB2ANY and PGA900
J24, J26, J28, J30	Open	Disconnect SPI/UART pins between USB2ANY and PGA900

The PGA300 and PGA305 are prepared for OWI communication and do not require additional device configuration.

For the PGA900, OWI in current mode can only be used with appropriate firmware programmed in the device. The firmware should:

1. Enable the OWI interrupt and service it when the activation sequence on VDD is received by the device.
2. Set the deglitch time to the 1-ms default time (OWI\_DGL\_CNT\_SEL = 0).
3. Disconnect the DAC output from the loop by setting bit 0 of AMUX\_CTRL to 0.
4. Enable the OWI transceiver and reset M0 by writing 0x03 to MICRO\_INTERFACE\_CONTROL register.

When in 4-mA to 20-mA loop configuration, there is additional current from ASIC\_GND (GND of PGA900) to IRETURN (return path for the loop current) that is caused by the voltage difference created by the 40-Ω resistor inside the PGA900 and the 10-Ω (R9) EVM resistor. This additional current is due to the U11 (when in SPI/I2C/SWD communication) and U1 (digital potentiometer in the resistive bridge). Figure 5 and Figure 6 show this additional current. As a result, the designer should lift J22 and J23 to isolate U1 and should use OWI when using the PGAXxxEVM-034 if they want accurate calibration (firmware required) in 4-mA to 20-mA mode.

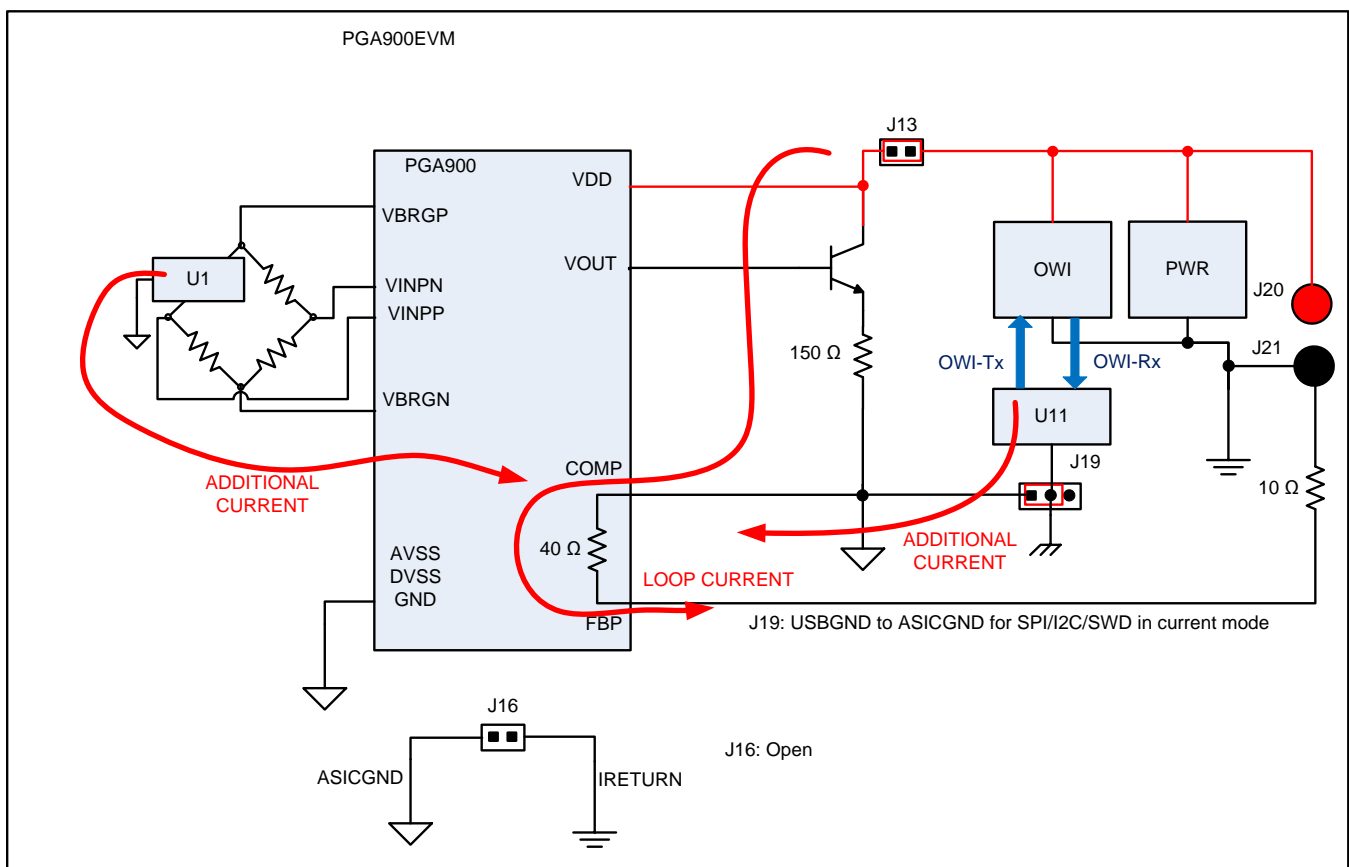


Figure 5. Additional Loop Current in 4-mA to 20-mA Mode When Using SPI/I2C/SWD as Digital Interface



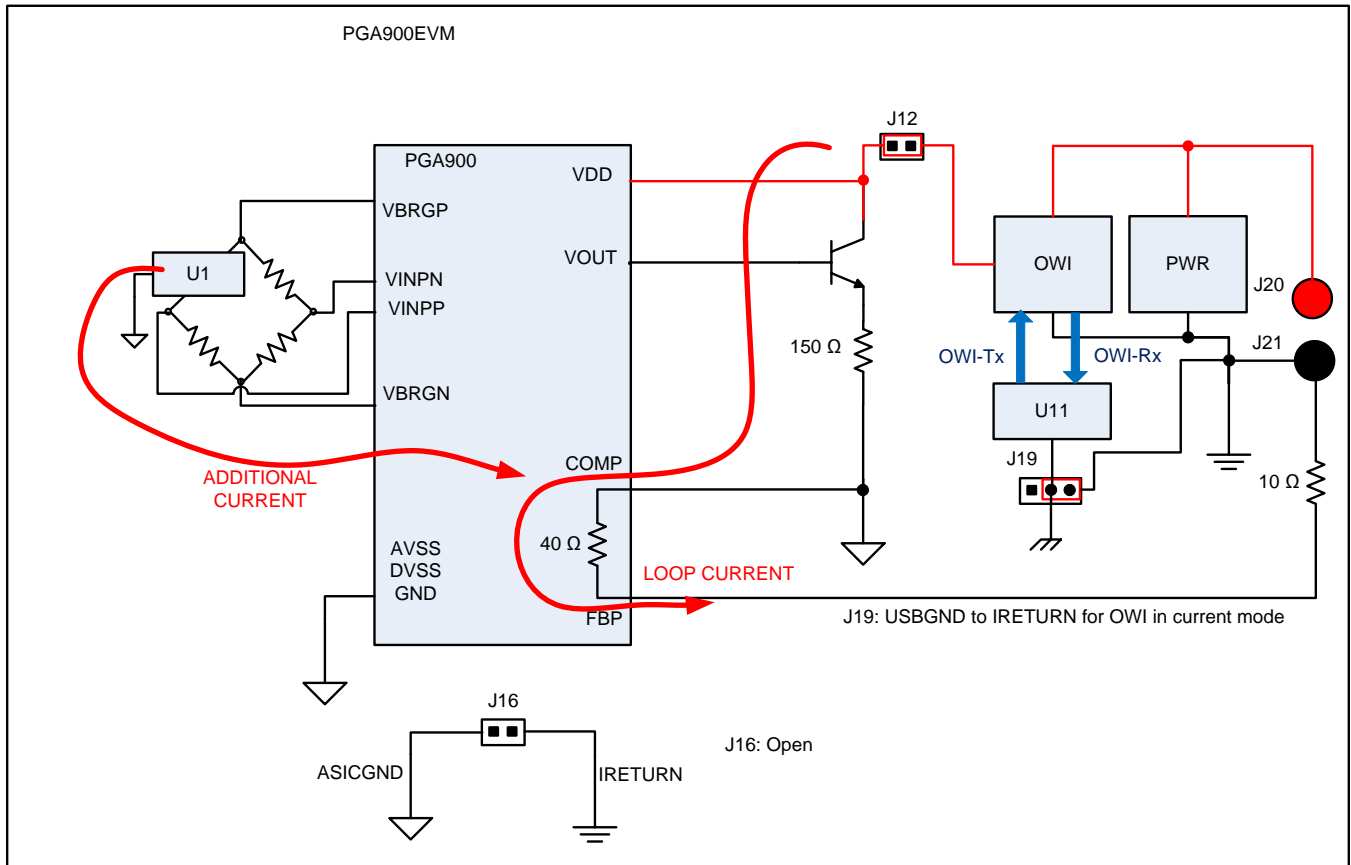
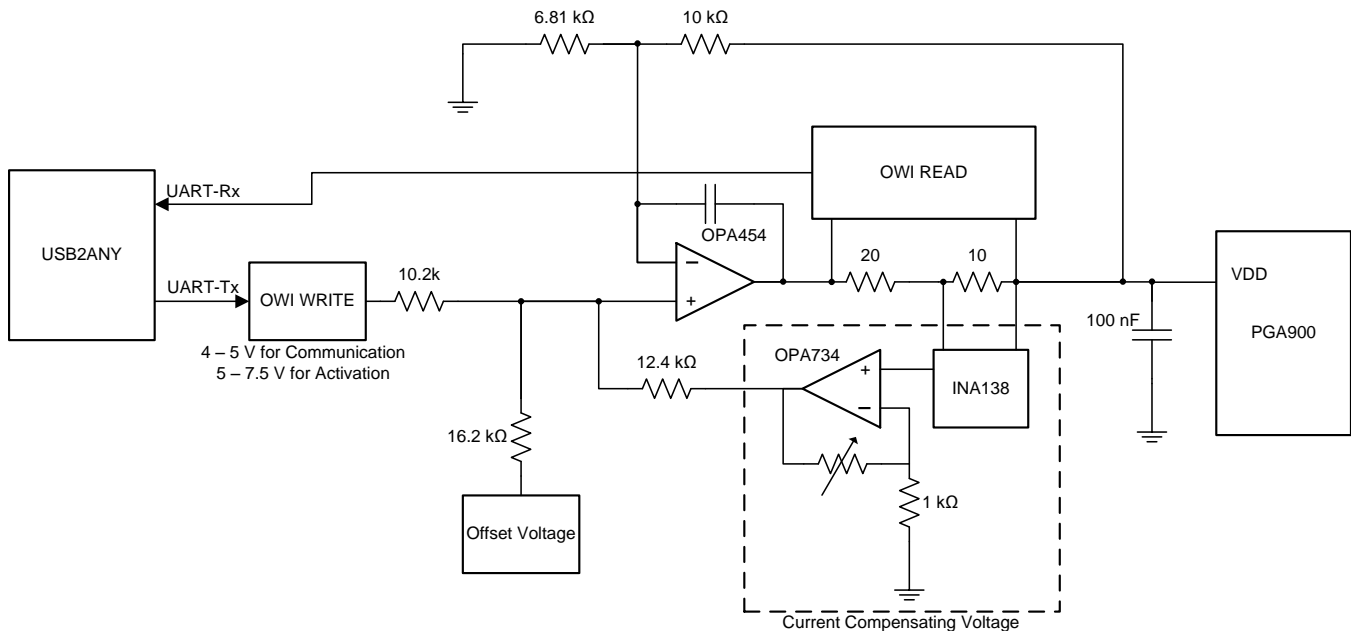


Figure 6. Additional Loop Current in 4-mA to 20-mA Mode When Using OVI as Digital Interface

## 4 OWI

The OWI circuitry in the PGAXxxEVM-034 allows the designer to communicate with the PGA900, PGA300, and PGA305 through voltage level translation and current sensing circuitry. The OWI circuitry is based on a summing amplifier using the OPA454. This is because the current mode application where the GND reference for the PGA900 (ASIC\_GND) is at a higher potential than the reference for the OWI circuitry (IRETURN). This is due to the internal 40-Ω resistor and the 10-Ω (R9) EVM resistor connected to FBP. However, this resistor could be a higher value, and as expected, the potential difference will be larger and is current-dependent. The summing amplifier principle compensates for these voltage differences so that the OWI logic levels (with respect to the ASIC\_GND) always remain the same, regardless of current. The OWI circuitry, shown in [Figure 7](#), consists of four primary blocks:

1. OWI write: UART data and activation pulses level translated to OWI voltage logic levels.
2. Offset voltage: Constant offset voltage selected by the user to compensate for constant drops from components such as diodes. This is only necessary when operating the device in current mode. In voltage mode, the offset voltage should be set to 0 V.
3. Current compensating voltage: This additional voltage is only necessary when operating the device in current mode to compensate for the voltage difference between the PGA900 ground and the OWI circuitry ground due to the loop current. In voltage mode, the gain of the OPA734 should be set to unity gain.
4. OWI read: Current to voltage and voltage level translation to UART voltage logic levels.

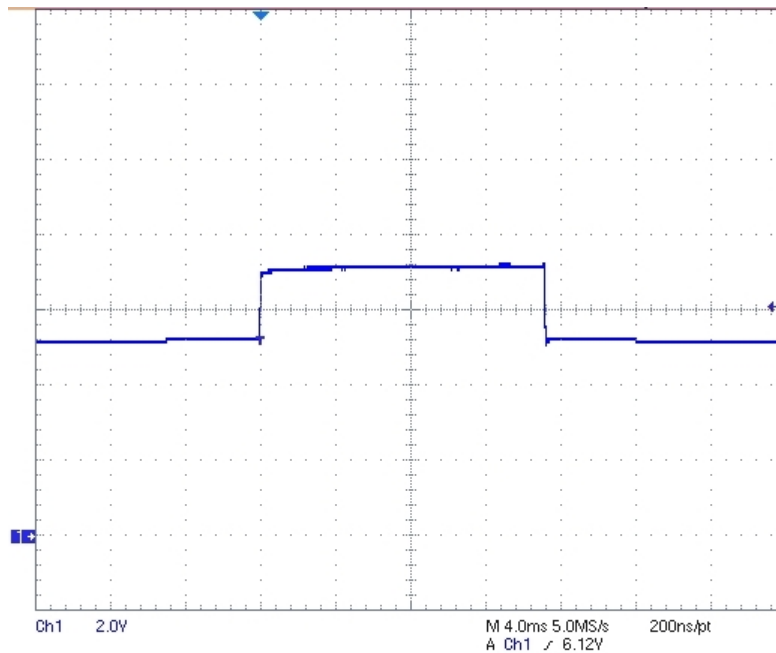


**Figure 7. OWI Block Diagram**

### 4.1 Activation Pulse

The activation pulse generated by the PGAxixEVM-034 generates the OWI interrupt necessary to activate the OWI (with the proper firmware developed by the user). [Figure 8](#) shows the activation pulse from the PGAxixEVM-034.

- In the PGA900 and PGA305 GUIs, to use this activation pulse, select the “Through Pulse” option from the “OWI Activation Mode” menu and then click “OWI”. The duration of the activation pulse varies due to software delays, but the minimum requirement of 1 or 10 ms is always met. If the pulse is not necessary, OWI can also be enabled through I<sup>2</sup>C. To select this option, select “Through I2C” from the “OWI Activation Mode” menu, and then click “OWI”.
- In the PGA300 GUI, the activation pulse is sent as soon as the designer presses “Activate OWI”. The pulse is sent as defined in the PGA300 data sheet ([SLDS204](#)).



**Figure 8. OWI Activation Pulse for the PGA900 Generated by the PGAxixEVM-034 in Voltage Mode**

## 4.2 Data Sent Through OWI

Data through OWI can be sent to the PGA900/PGA300/PGA305 at rates between 320 to 9600 bps. Figure 9 shows data sent at 320 bps.

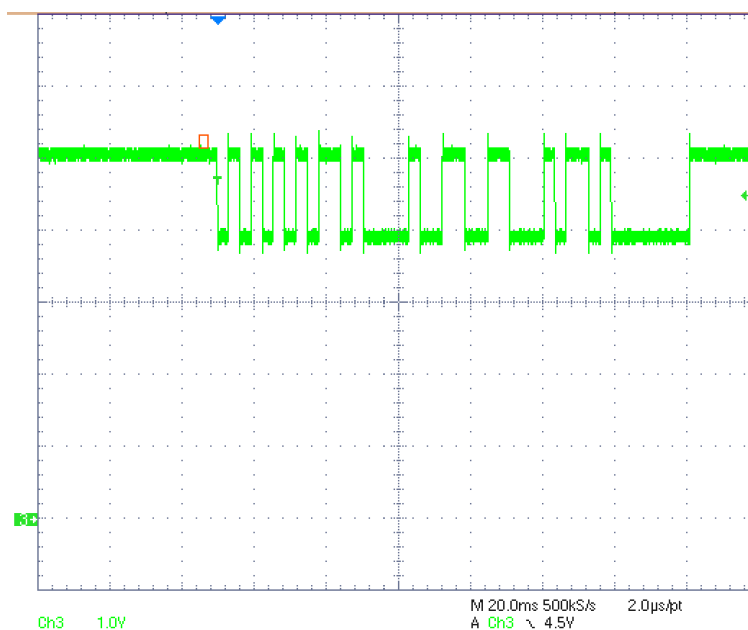
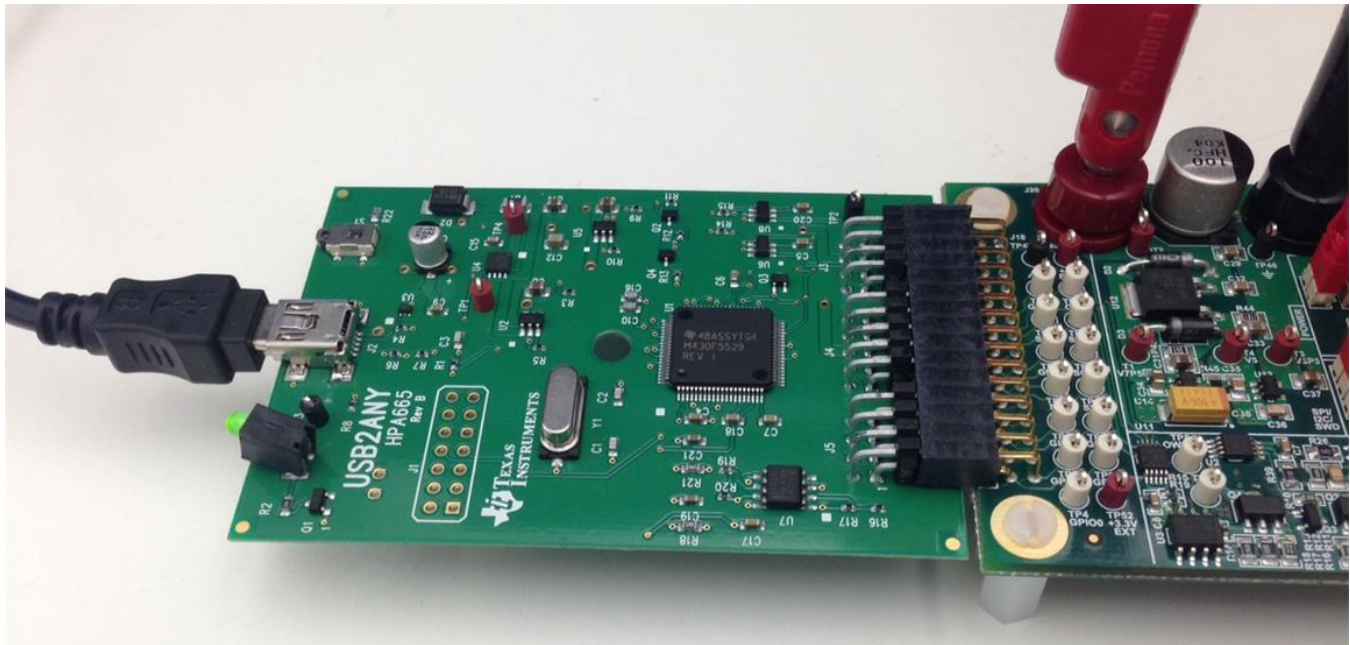


Figure 9. OWI Data at 320 bps; Oscilloscope Probe is Connected at TP20 in the PGAxixEVM-034



The USB2ANY is used for the different communication protocols supplied by the PGA900/PGA300/PGA305. The USB2ANY connects to J18 in the PGAxixEVM-034 as shown in [Figure 11](#). The USB2ANY hardware is based on the TI MSP430F5529, 16-bit microcontroller with integrated USB 2.0. The PCB is a two-layer, single-sided board with minimal component count. There are two versions of the USB2ANY, shown in [Figure 12](#), one enclosed and one open. The functionality is the same for both.



**Figure 11. USB2ANY Connection to the PGAxixEVM-034**



**Figure 12. USB2ANY**

Figure 13 shows the pinout of the USB2ANY. The ribbon cable can only be connected one way to the USB2ANY due to a latch present in the cable. A USB cable is included to connect the device to the PC. No external supply is necessary.

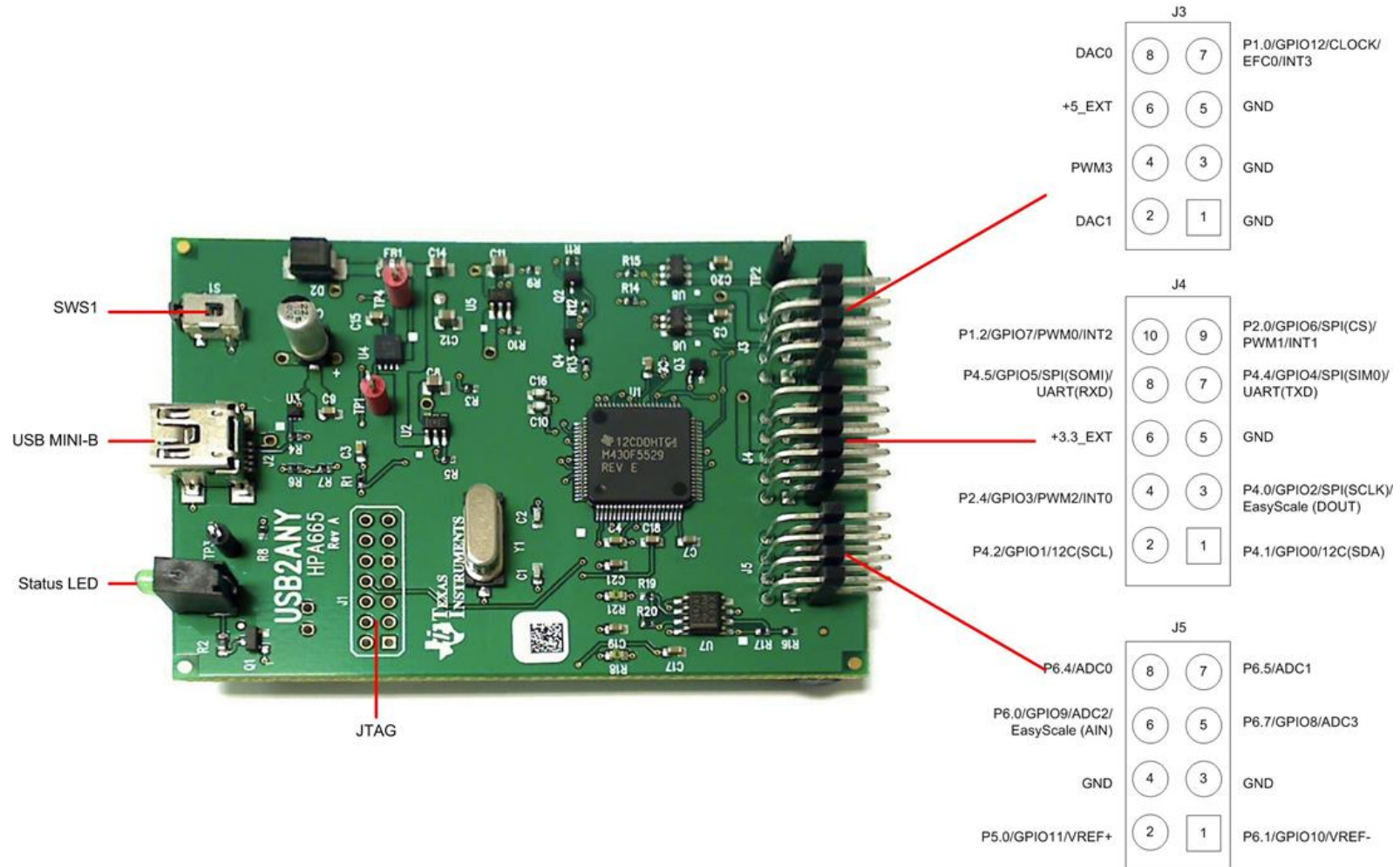
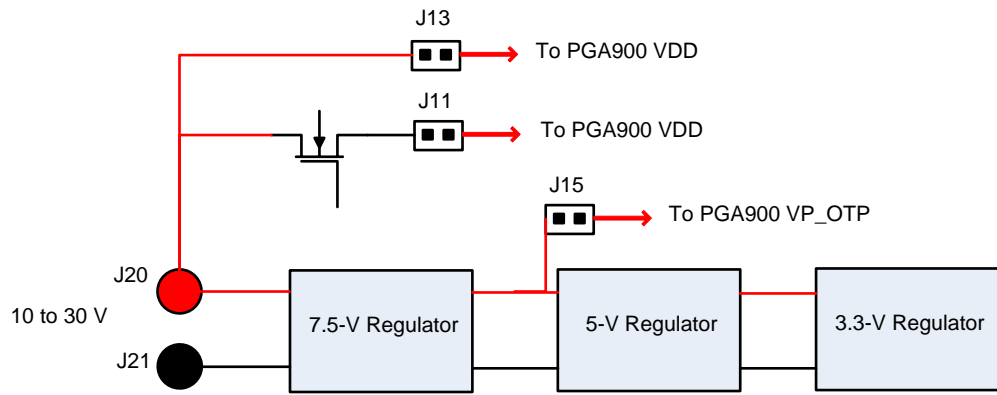


Figure 13. USB2ANY Pinout

## 6 Power Supplies in the PGAxXXEVM-034

The PGAxXXEVM-034 requires an input voltage between 10 V to 30 V to properly operate. [Figure 14](#) shows the different power options in the PGAxXXEVM-034.



**Figure 14. Power Distribution in PGAxXXEVM-034**

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**NOTE:** J15 must be closed during OTP programming. This is only applicable for the PGA900. The PGA300 has no OTP functionality.

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7 Schematics

Figure 15 through Figure 20 show the PGAxxxEVM-034 schematics.

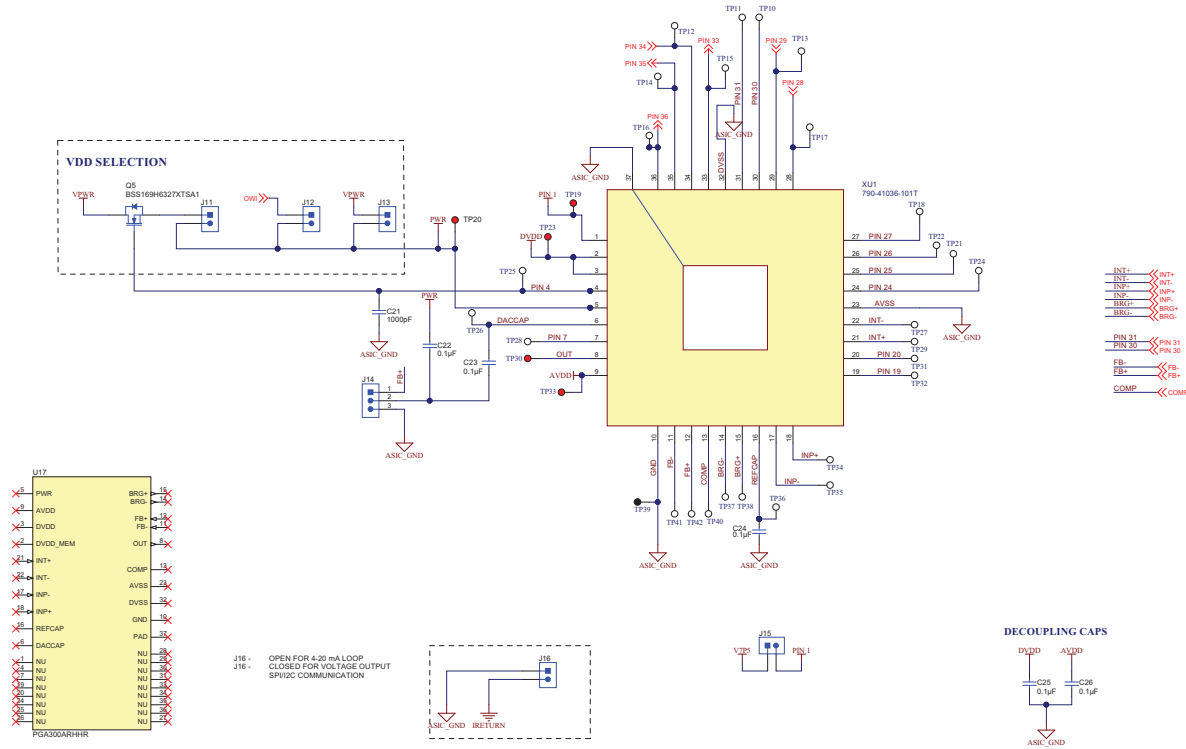
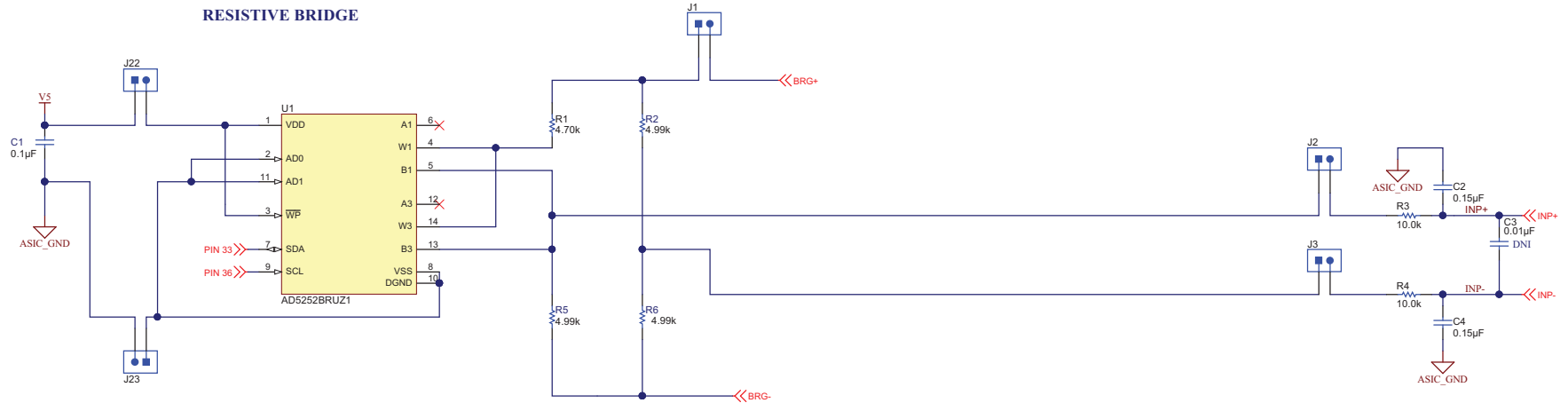


Figure 15. PGAxxxEVM-034 Main Schematic



### DAC OUTPUT CONFIGURATIONS

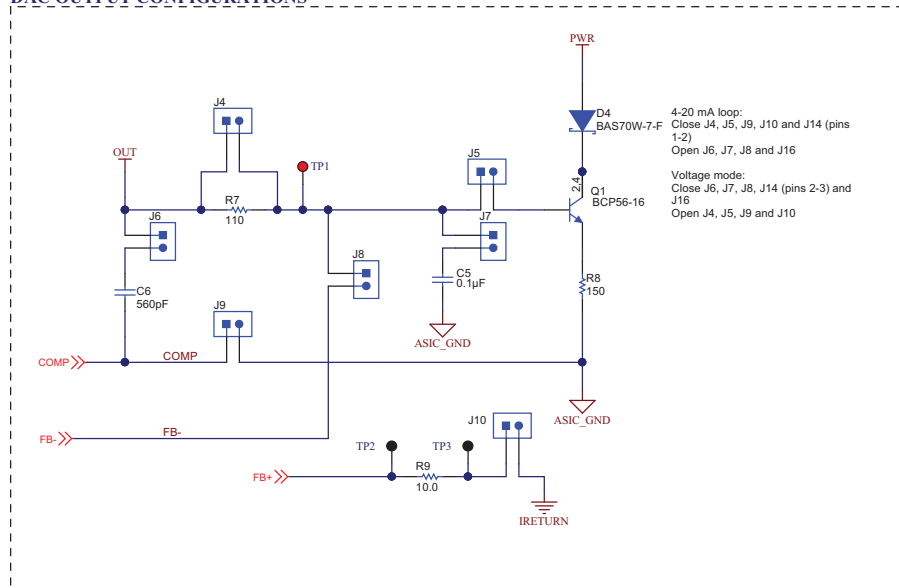
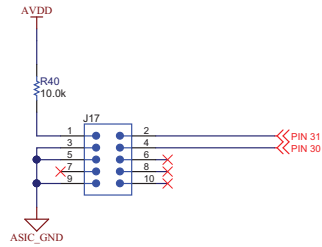
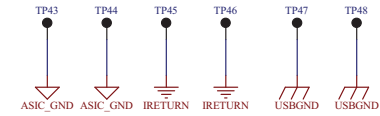


Figure 16. Input and Output Schematic

## XDS200



### GND TEST POINTS



## USB2ANY

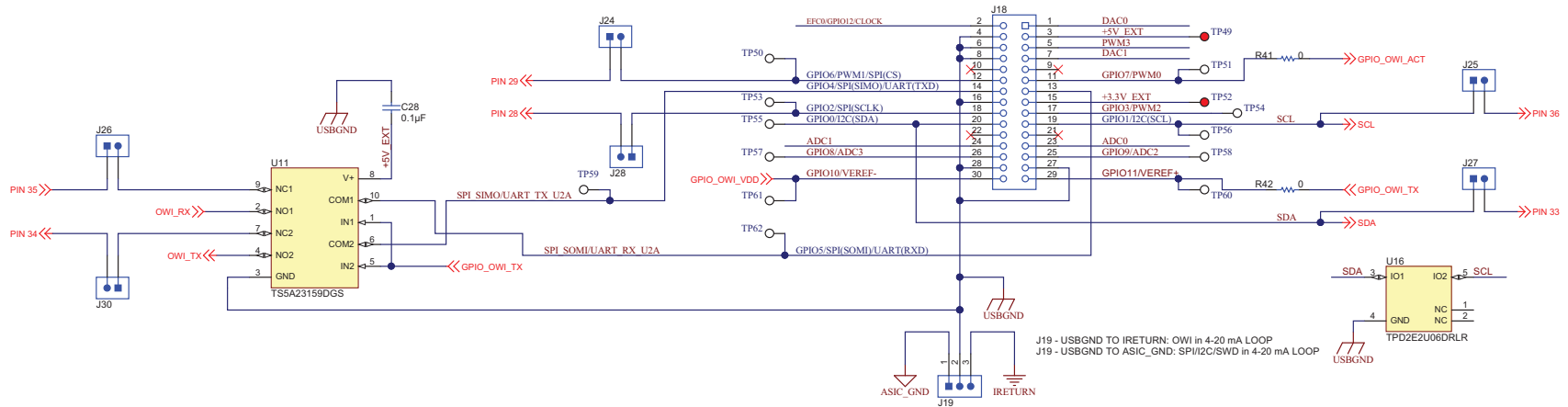


Figure 17. USB2ANY Schematic

## OWI ACTIVATION PULSE AND DATA

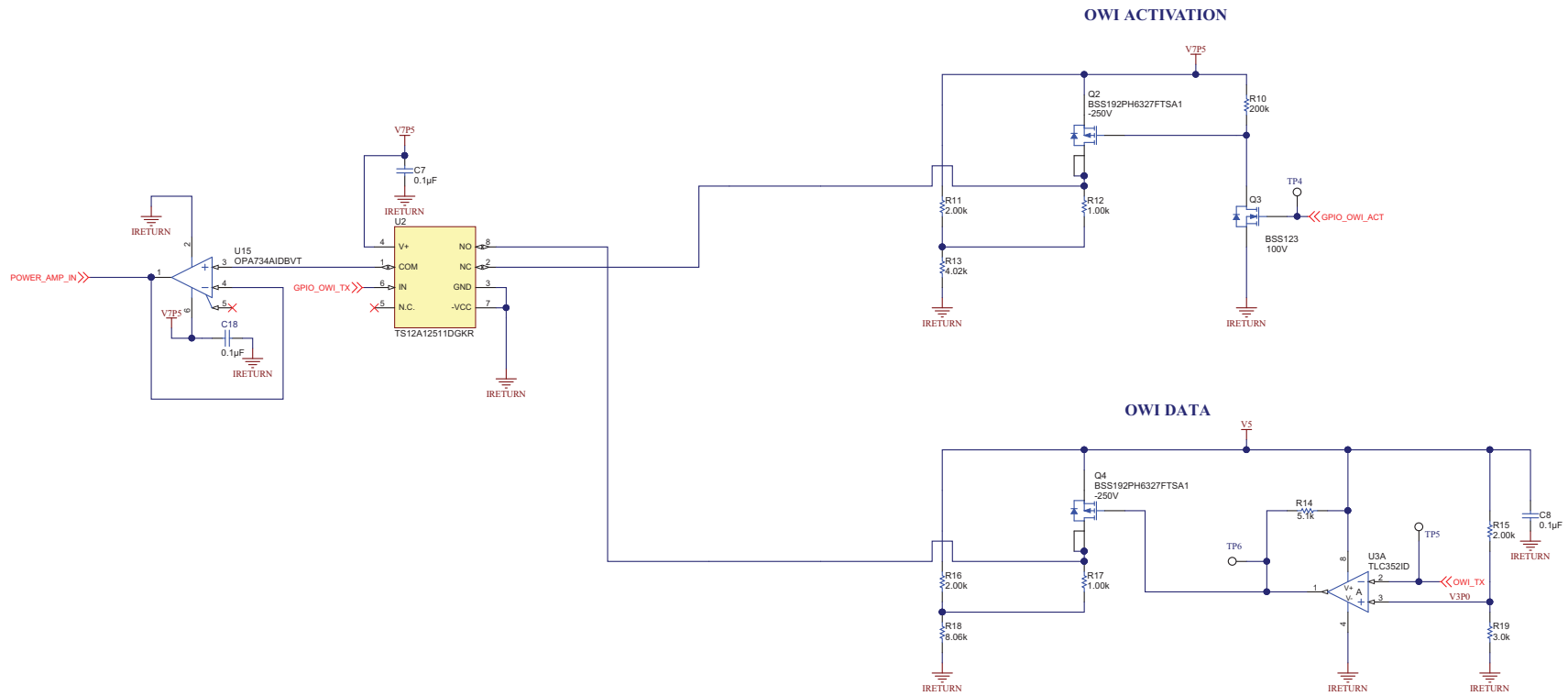


Figure 18. OWI Activation Pulse and Data Schematic

OWI

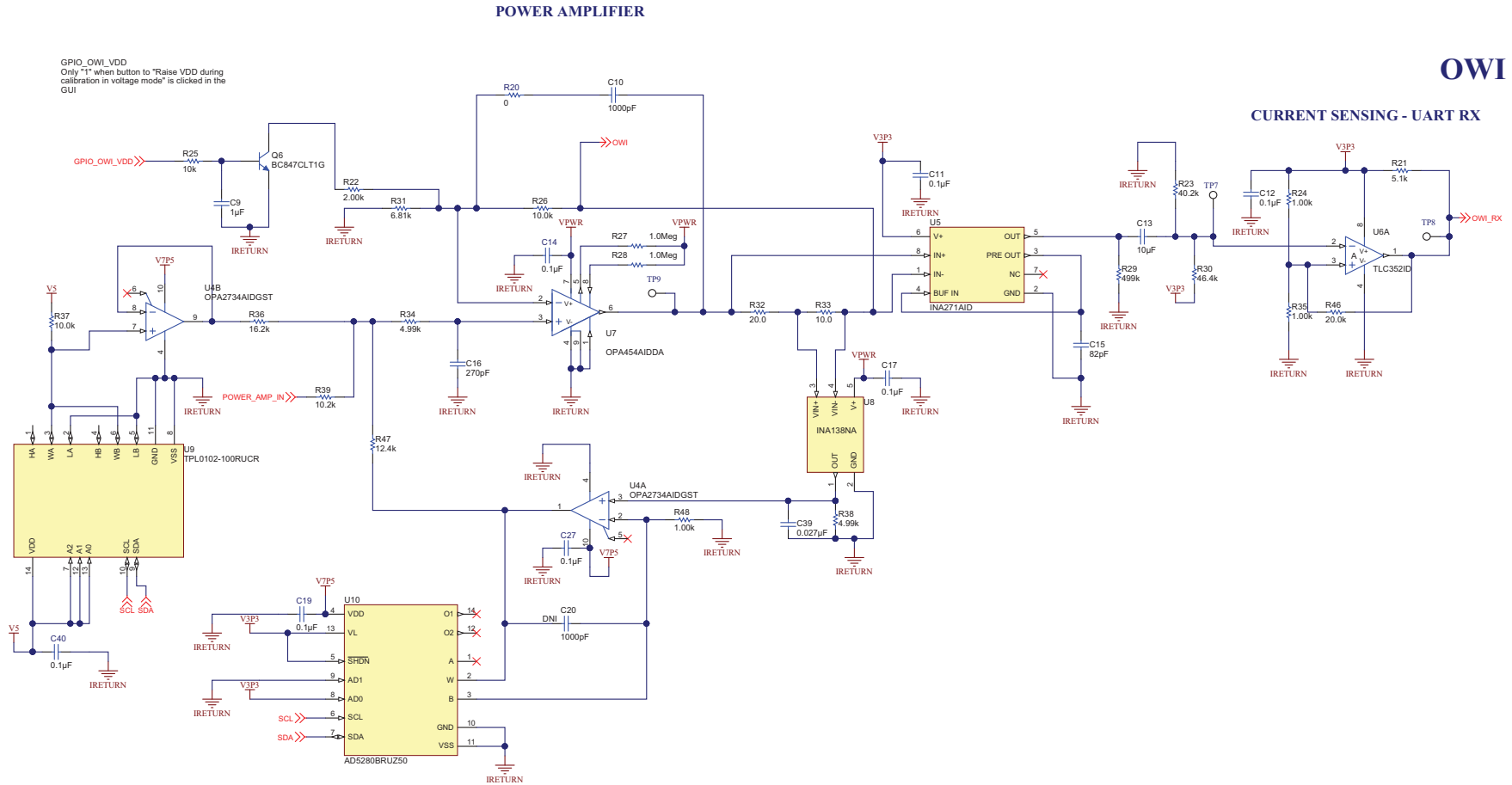
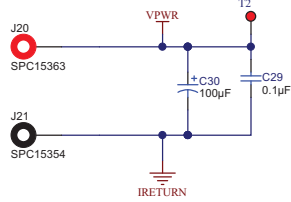


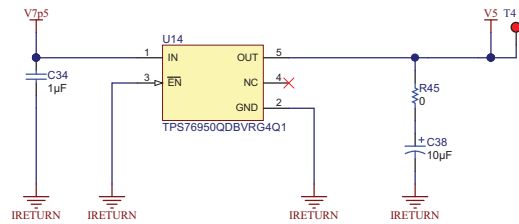
Figure 19. OWI Power Amplifier Schematic

# POWER SUPPLIES

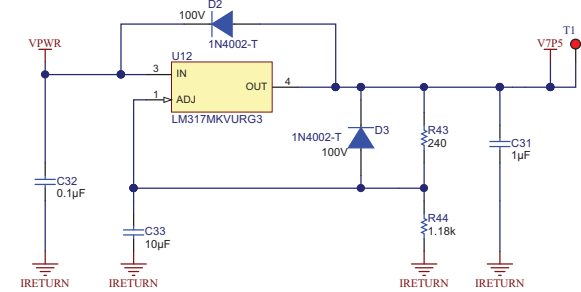
## 10V - 30V PGA900EVM input



## 5V Regulator



## 7.5V Regulator



## 3.3V Regulator

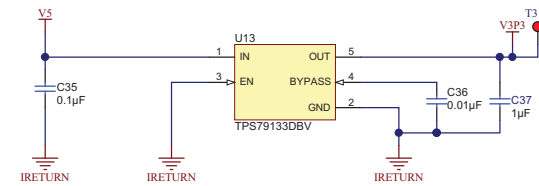


Figure 20. Power Supplies Schematic

## Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

<b>Changes from A Revision (June 2016) to B Revision</b>	<b>Page</b>
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- |                                       |   |
|---------------------------------------|---|
| • Added references for PGA305EVM..... | 1 |
|---------------------------------------|---|

<b>Changes from Original (May 2015) to A Revision</b>	<b>Page</b>
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- |  |    |
|--|----|
| • Updated <a href="#">Table 2</a> .....  | 7  |
| • Added <a href="#">Table 3</a> .....  | 7  |
| • Additional current discussion when in 4-mA to 20-mA mode.....                                | 8  |
| • Added <a href="#">Figure 5</a> .....   | 8  |
| • Added <a href="#">Figure 6</a> .....   | 9  |
| • Added note regarding jumper for OTP voltage.....   | 16 |
| • Updated designator for J16 in <a href="#">Figure 15</a> .....                                | 17 |
| • Updated designators for text in DAC Output Configurations in <a href="#">Figure 16</a> ..... | 18 |
| • Updated designator for J19 in <a href="#">Figure 17</a> .....                                | 19 |

## STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
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  - 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 a nonconforming EVM if (a) the nonconformity was 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, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
  - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, 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:*

**FCC NOTICE:** 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 or RSS-247

#### Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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](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](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 to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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#### 3.4 *European Union*

##### 3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

#### 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 MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS 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 EPIDEMIC FAILURE WARRANTY OR 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.

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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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