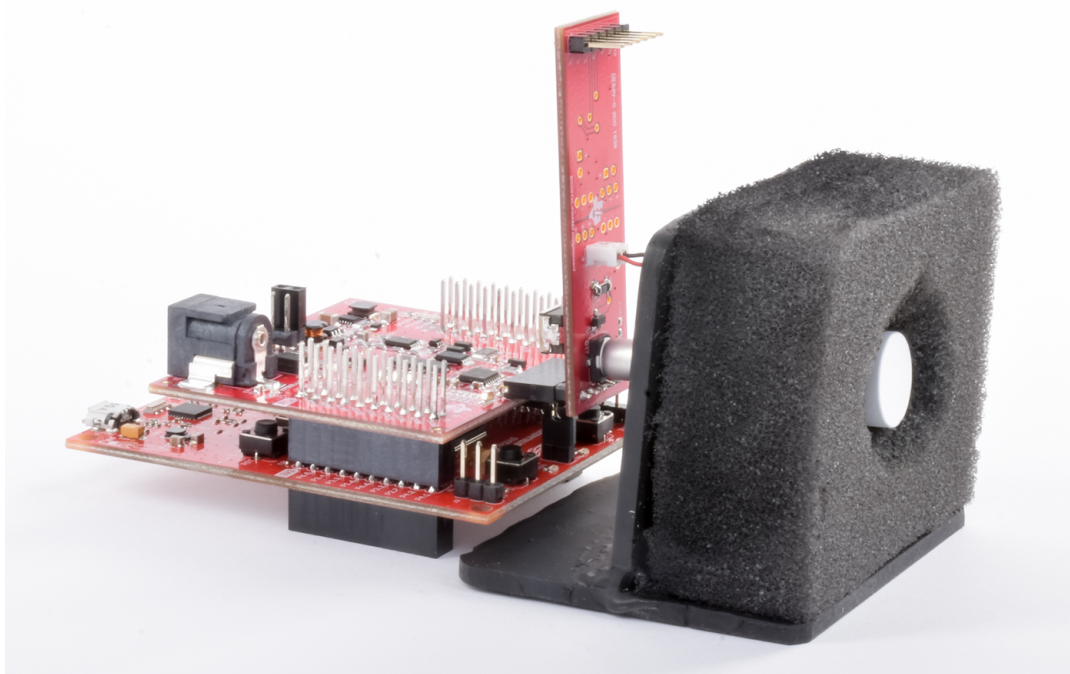


PGA460-Q1 EVM Quick Start Guide

This guide is designed to help with the initial setup of the PGA460-Q1 EVM and GUI. Use this quick start guide as a reference to connect the PGA460 device to an ultrasonic transducer, flash program the USB interface, power on the EVM, use the BOOSTXL-PGA460 GUI to configure the PGA460 ultrasonic signal conditioner IC, and read back ultrasonic echo information. For more information, go to www.ti.com/product/PGA460-Q1 and www.ti.com/tool/PGA460-Q1EVM.



Note: Transducer stand and foam block not included.

Figure 1. BOOSTXL-PGA460 Transformer Driven Mode and Closed-Top Transducer

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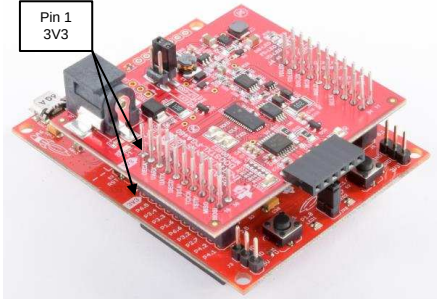
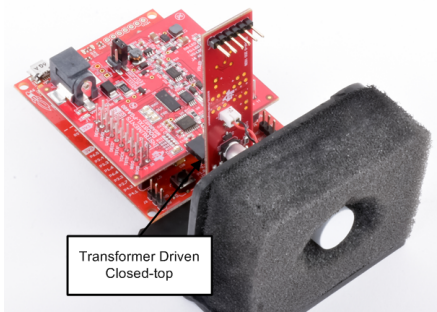
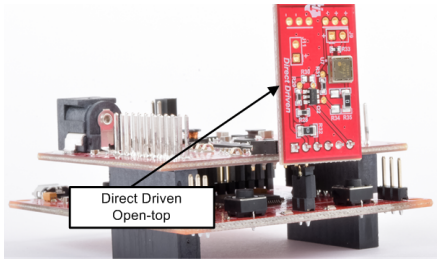
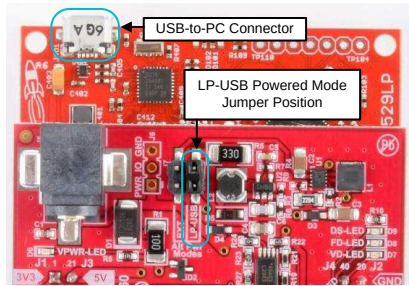
1 Introduction to BOOSTXL-PGA460

This guide is designed to help with the initial setup of the PGA460-Q1 EVM and GUI. Use this quick start guide as a reference to connect the PGA460 device to an ultrasonic transducer, flash program the USB interface, power on the EVM, use the BOOSTXL-PGA460 GUI to configure the PGA460 ultrasonic signal conditioner IC, and read back ultrasonic echo information. All contents and instructions of this guide assume that the user has the MSP-EXP430F5529LP, BOOSTXL-PGA460 motherboard, BOOSTXL-PGA460 daughtercard with an attached ultrasonic sensor, and PGA460-Q1 GUI installed on a PC. To download the GUI, go to www.ti.com/product/PGA460-Q1.

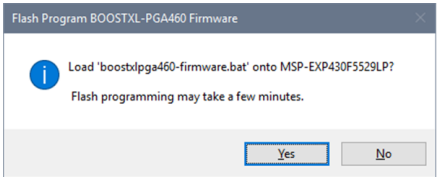
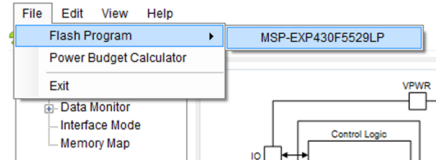
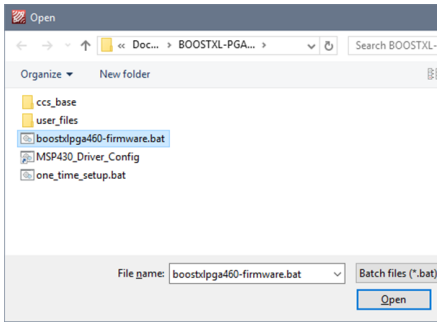
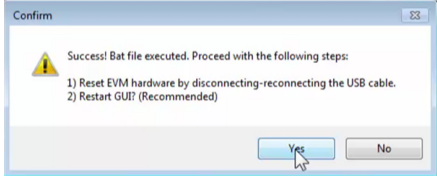
The BOOSTXL-PGA460 EVM kit includes the following:

- Hardware
 - BOOSTXL-PGA460 motherboard
 - PGA460-Q1 ultrasonic sensor signal conditioner IC
 - Optional integrated-switch boost converter, TI's [LMR62421](#), to generate a 7.2 V output to power the PGA460 device when only using USB for power
 - Optional integrated-switch buck converter, TI's [TPS62175](#), to generate a 5 V output to power the MSP-EXP430F5529LP when only using a battery or external supply
 - 8-channel SPDT multiplexer or demultiplexer, TI's [TS3L501E](#), to switch between asynchronous UART, synchronous UART, TCI, or one-wire UART interface communication modes available on the PGA460 device
 - Discrete two-wire to one-wire interface (OWI) transceiver circuit using TI's [LM2903](#) device to enable TCI and one-wire UART communication
 - Onboard external 512 kB of SRAM to store synchronous output data from the PGA460 device
 - BOOSTXL-PGA460 daughtercard
 - Used for multiple test points for key analog, digital, and test signals
 - MSP-EXP430F5529LP
 - Used as the USB-to-PC GUI communication bridge, and example implementation of a master MCU to communicate with the PGA460 device through USART, IO interfaces, or both.
- Printed documents
 - *BOOSTXL-PGA460 Quick Start Guide*
- Miscellaneous
 - One micro-USB 2.0 cable, 2 ft
 - Default, out-of-box, jumper configurations

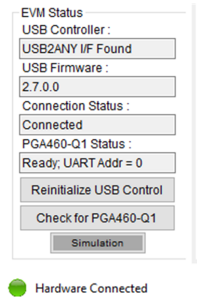
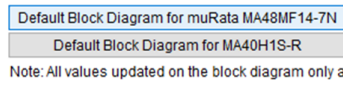
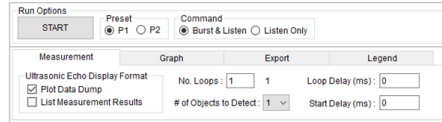
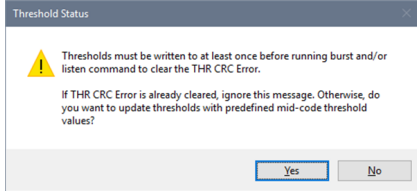
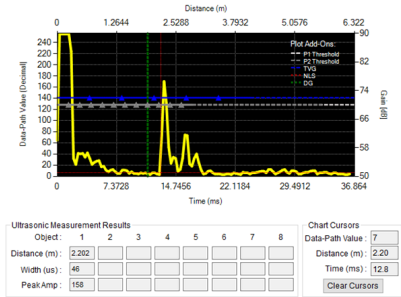
2 Hardware Setup

Description	Image
The BOOSTXL-PGA460 motherboard must stack on top of the MSP-EXP430F5529LP. Ensure pin 1 of the MSP-EXP430F5529LP aligns with pin 1 of the BOOSTXL-PGA460. Figure 2 shows pin 1 on both the MSP-EXP430F5529LP and BOOSTXL-PGA460.	 Figure 2. BOOSTXL-PGA460 Motherboard Stacked on MSP-EXP430F5529LP
The BOOSTXL-PGA460 daughtercard connects perpendicularly to the motherboard at J8 to enable either of the available driver modes and top-type configurations. The transformer-driven closed-top configuration is accessible at J13 of the daughtercard (see Figure 3). The bridge-driven open-top configuration is accessible at J10 of the daughtercard (see Figure 4). If the transformer-driven closed-top configuration is selected, use a sponge-like material to hold the transducer in place (see Figure 3). Aim the transducer in the direction of the target, such as a wall, box, or pole.	 Figure 3. Transformer Driven Mode and Closed-Top Transducer  Figure 4. Direct Driven Mode and Open-Top Transducer
Position the alternative power-mode jumper for the intended use-case. For the purpose of quick startup, set the jumper to LP-USB powered mode (see Figure 5). Connect the micro-USB cable from the MSP-EXP430F5529LP to a PC (see Figure 5). If using an external power supply, turn on the supply.	 Figure 5. LP-USB Powered Mode Jumper Configuration

3 One-Time MSP-EXP430F5529LP Flash Programming

Description	Image
Open the PGA460-Q1 GUI by running the executable (.exe) file. The GUI automatically prompts the user to flash program the MSP-EXP430F5529LP (see Figure 6). This procedure is only required once when the the EVM is connected to the GUI for the first time. The user will not be prompted to flash program the MSP again for future use. If the GUI does not automatically prompt the user to flash program the MSP, the user can manually force the flash programming routine by navigating to the <i>File</i> menu, <i>Flash Program</i>, and <i>MSP-EXP430F5529LP</i>.	 Figure 6. Flash-Programming Prompt for MSP-EXP430F5529LP  Figure 7. Manually Flash-Program MSP-EXP430F5529LP
The file explorer should initialize in the <i>My Documents</i>, <i>BOOSTXL-PGA460</i> folder. Open the batch file (.bat) named <i>boostxlpga460-firmware.bat</i>. This directory and file is created during the installation procedure of the PGA460-Q1 GUI.	 Figure 8. Flash-Programming Batch File
Flash programming the MSP can occur for several minutes (see Figure 9). Do not interact or click on any of the GUI elements until the programming routine is complete. The LED101 and LED102 of the MSP-EXP430F5529LP will toggle red and green during the programming routine. Do not disconnect the USB during the programming routine.	 Figure 9. Flash-Programming Status Indicators
When the batch file has been successfully programmed onto the MSP, the user will be prompted to first disconnect-and-reconnect the USB cable, and then restart the GUI (see Figure 10).	 Figure 10. Prompt to Reset EVM Hardware and GUI

4 Software Setup

Description	Image
Open the BOOSTXL-PGA460 GUI by running the .exe file. Ensure the <i>EVM Status</i> block at the bottom left of the GUI reports that the USB Controller is <i>Connected</i>, and the PGA460 device is <i>Ready</i> (see Figure 11).	 Figure 11. EVM Status Box Showing Successful Connection
The GUI first loads the <i>Block Diagram</i> page by default. Depending on the selected transducer of the daughtercard, the block diagram settings will default according to the associated button at the bottom of the page (see Figure 12).	 Figure 12. Default PGA460 Register Settings Based on Specific Transducer
Navigate to the <i>Data Monitor</i> page and ensure the <i>Run Options</i> are set to Preset <i>P1</i> and Command <i>Burst & Listen</i>. Ensure the <i>Ultrasonic Echo Display Format</i> checkbox, <i>Plot Data Dump</i>, is checked.	 Figure 13. Run Options Required To Display Echo Data Dump
Click the <i>START</i> button. A <i>Threshold Status</i> warning dialog box will appear. To clear the threshold (THR) CRC error, click the <i>Yes</i> button. The device will then be loaded with the mid-code threshold level and timing values. This warning only appears during the first attempt to perform a <i>Burst & Listen</i> command. For more information on manually setting the threshold, refer to the PGA460-Q1 Ultrasonic Signal Conditioner EVM With Transducer User's Guide.	 Figure 14. Prompt to Write Mid-Code Threshold Values
After the run cycle is complete, the echo data dump is plotted against the threshold, time-varying gain, digital gain, and nonlinear scaling. To enable the <i>Ultrasonic Measurement Results</i> table, check the <i>List Measurement Results</i> checkbox in the display format options (see Figure 13), and click the <i>START</i> button again.	 Figure 15. Example of 2.2-m Object Detection on Echo Data Dump

5 Block Diagram Optimization

To further optimize the PGA460 device settings, return to the *Block Diagram* page. The block diagram perspective offers three control groups (see Figure 16).

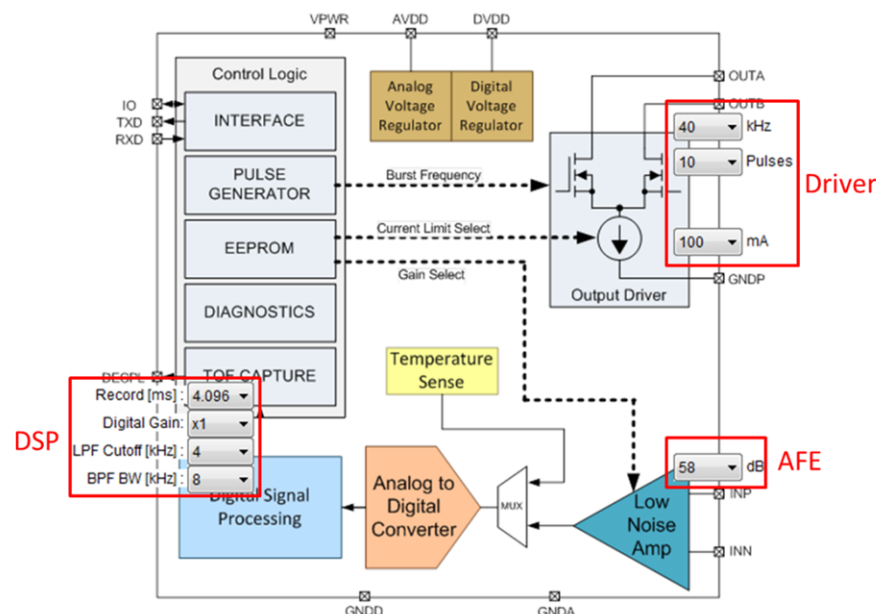


Figure 16. Block Diagram Configuration

Driver — The driving frequency, pulse count, and driving current limit are set with this group. This group is specific to the generation and transmission of an ultrasonic echo. The frequency of a single transducer is fixed, but the drive strength can be reduced or increased using the number of pulses and current limit.

Analog front-end (AFE) — The gain selected on the block diagram view sets all levels of the time-varying gain to the same gain level. This group is specific to amplifying the raw ultrasonic echo received. A small gain is favorable for short range measurements to prevent saturation of the returning ultrasonic signal. A large gain is favorable for long-range measurements.

Digital signal processing (DSP) — The bandpass filter bandwidth, low-pass filter cutoff, short and long range digital gain, and record length are able to process the digitized ultrasonic echo received from the AFE into a coherent data format. The record length time equates to the maximum distance for which the PGA460 device will process incoming information. If the object is far (up to 10 m), maximize the record length setting.

Although the PGA460 has two presets, only Preset 1 is updated when configuring the device from the block-diagram control perspective. Preset 2 must be configured using the *General* page.

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