

# MicroZed™ Carrier Card for Arduino™ Getting Started Guide

Version 1.0

## Document Control

**Document Version:** 1.0

**Document Date:** 7/31/2015

**Document Author(s):** Avnet

### Prior Version History

Version	Date	Comment
1.0	7/31/2015	Initial Release

# Contents

1	Getting Started with MicroZed Carrier Card for Arduino .....	5
2	What's Inside the Box? .....	6
2.1	Arduino Carrier Card Kit contents .....	6
3	What's on the Web?.....	6
3.1	Official Documentation:.....	6
3.2	Tutorials and Reference Designs: .....	6
3.3	Trainings and Videos: .....	6
4	Arduino Carrier Card Key Features.....	7
4.1	Features.....	7
5	Arduino Carrier Card Basic Setup and Operation .....	8
5.1	Procedure.....	8
5.2	Hardware Setup .....	9
5.3	Arduino Shield Interfaces Supported by Carrier Card .....	11
5.4	Example Designs using Shields and Pmods .....	11
6	Example #1: Quad Relay Shield (using GPIO) .....	13
7	Example #2: TFT Touch Display Shield (SPI and I2C) .....	15
7.1	Linux drivers used: .....	15
7.2	Additional Reference Information (TFT Display): .....	17
8	Example #3: Wlink8 Pmod Adaptor (SDIO, UART) .....	17
8.1.1	For Wi-Fi operation:.....	17
8.1.2	For Bluetooth/BLE operation: .....	17
9	Example #4: Zynq Power Rail Control (using MCU GPIO) .....	18
10	Getting Help and Support .....	20
10.1	Avnet Support.....	20
10.2	Xilinx Support .....	21

## Figures

Figure 1 – MicroZed Carrier Card for Arduino (shown with MicroZed SOM mounted)	5
Figure 2 – MicroZed Carrier Card for Arduino Block Diagram .....	7
Figure 3 – MicroZed Carrier Card for Arduino (shown with MicroZed SOM mounted)	9
Figure 4 –Arduino UNO R3 Compatible Shield Connectors .....	11
Figure 5 –Vivado IP Integrator View of Reference Design .....	12
Figure 6 –Zynq I/O Peripherals used to interface to Shield and Pmod Examples .....	12
Figure 7 –Detail of SEEED Studio Quad Relay Shield .....	13
Figure 8 –Adafruit 2.8” Cap Touch TFT Display Shield .....	15
Figure 9 –Adafruit 2.8” Cap Touch TFT Display Shield (rear view) .....	16
Figure 10 – Wilink 8 Eval Module and Avnet Wilink 8 to Pmod Adaptor.....	18
Figure 11 –FRDM-KL46Z Eval board controlling MicroZed’s Power Rails .....	19
Figure 12 –Detail of FRDM-KL46Z I/O utilization .....	20

# 1 Getting Started with MicroZed Carrier Card for Arduino

The MicroZed™ Carrier Card Kit for Arduino™ brings both Shield expansion and Peripheral Module (2x6 pin connectors) expansion to the MicroZed System-On-Module. The carrier card is ideal for building quick prototypes that leverage the large number of Arduino-compatible Shields and Pmod-compatible expansion boards.

This low-cost platform facilitates:

- Expansion of evaluation platform functionality via a wide range of 3rd party Arduino™-compatible “Shields”
- Expansion of evaluation platform functionality via a wide range of 3rd party “Pmod-compatible” boards, interfaced to MicroZed as well as the optional MCU sub-system, via the provided 2x6 Peripheral expansion connectors
- Power management and scheduling of the MicroZed board by an optional Microcontroller board. (Low power design-partitioning can be implemented with the optional MCU offloading some tasks from the Zynq SOC Apps Processor)

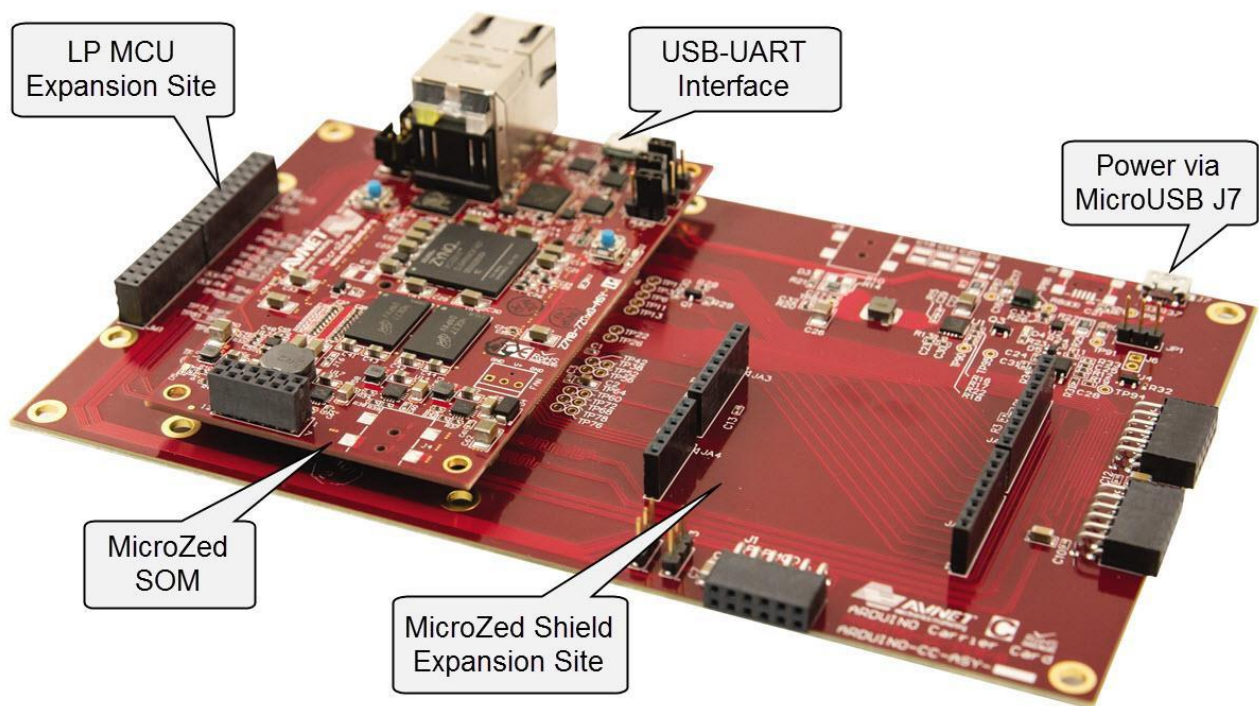


Figure 1 – MicroZed Carrier Card for Arduino (shown with MicroZed SOM mounted)

This *Getting Started Guide* will outline the steps to setup the MicroZed SOM and Arduino Carrier Card hardware. It documents the procedure to run a Linux design on the ARM® dual-core Cortex™-A9 MPCore™ Processing System (PS).

## 2 What's Inside the Box?

### 2.1 Arduino Carrier Card Kit contents

- MicroZed Carrier Card for Arduino (AES-ARDUINO-CC-G)
- microUSB cable
- Documentation (not shown)
  - Quick Start Instruction card
  - Welcome Letter

## 3 What's on the Web?

MZ Carrier Card for Arduino is a community-oriented kit, with all materials being made available through the [MicroZed.org](http://MicroZed.org) community website.

### 3.1 Official Documentation:

- Getting started guide
- Hardware user guide
- Schematics
- Bill of materials
- PCB Layout
- PCB net lengths
- Mechanical drawing
- 3D Model
- Board definition files for Vivado integration
- Programmable logic (PL) master user constraints

### 3.2 Tutorials and Reference Designs:

- Introduction to Zynq Design Tutorials
- PetaLinux BSP
- Booting Carrier Card using QSPI and eMMC
- Community projects

### 3.3 Trainings and Videos:

- Introduction to Zynq Software Design
- Introduction to Zynq Hardware Design

## 4 Arduino Carrier Card Key Features

### 4.1 Features

- Carrier Card support for MicroZed SOMs
- Full Arduino™-compatible Shield site with connection to MicroZed PL I/O
- Partial Arduino™-compatible Shield site for connection to optional low-power MCU Eval board sub-system
  - Supports MCU ON/OFF control of MicroZed power
  - Enables offloading of MicroZed tasks to the low-power MCU
  - Facilitates low-power sensor hub functionality, autonomous from MicroZed application processor
- Two 2x6 Pmod™-compatible peripheral interfaces for MicroZed
  - Supports interface for PS based SDIO/SPI
  - Supports interface for PL based I/O
- One 2x6 Pmod™-compatible peripheral interface to low-power MCU connector
  - Supports interface for I2C/UART

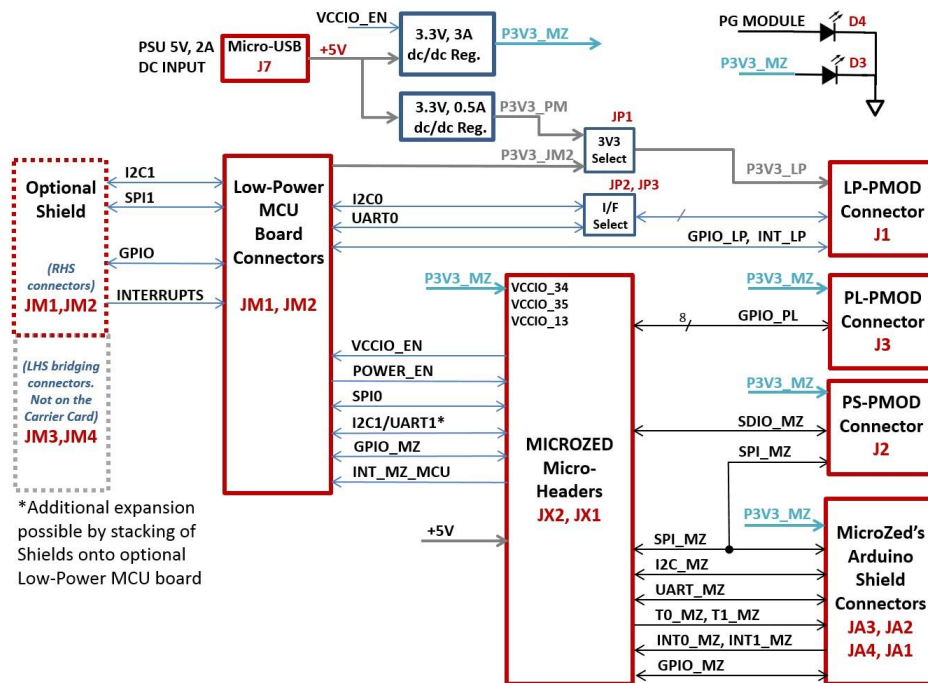


Figure 2 – MicroZed Carrier Card for Arduino Block Diagram

## 5 Arduino Carrier Card Basic Setup and Operation

The functionality of MicroZed, the Carrier Card and whichever shield or Pmod compatible expansion boards are attached, is determined by the application booted from MicroZed's microSD card.

This *Getting Started Guide* provides system developers examples of how to achieve different solutions using MicroZed and this Carrier Card:

- a) MicroZed GPIO control of Relay outputs  
(using Seeed Studio Quad Relay Shield)
- b) MicroZed SPI QVGA TFT Display User Interface (plus I2C Cap Touch)  
(using Adafruit Cap Touch 2.8" QVGA TFT display Shield)
- c) MicroZed SDIO and UART based Wi-Fi and Bluetooth/BLE Interface  
(using Avnet Wilink 8 Pmod Adaptor)
- d) Microcontroller GPIO control of MicroZed power rails  
(using Freescale FRDM-KL46 Freedom board)

Note: Additional hardware is required in order to complete all of the listed examples:

- MicroZed SOM (Z7020 version)
- AC/DC Power Adaptor (microUSB connector, +5V 2A or better)
- Seeed Studio Quad Relay Shield (v2 or v3)
- Adafruit Capacitive Touch 2.8" QVGA TFT display Shield
- Avnet Wilink 8 Pmod Adaptor
- TI WL1835MODCOM8B or WL1837MODCOM8I Wi-Fi and Bluetooth board
- Freescale FRDM-KL46 Freedom MCU Eval board
- microSD card reader/adaptor (for programming MicroZed's uSD flash card)

A photo of the Arduino Carrier Card (plus the required MicroZed SOM) in it's simplest configuration is shown below along with the locations of several key components.

### 5.1 Procedure

1. Navigate to [www.microzed.org/product/arduino-cc](http://www.microzed.org/product/arduino-cc)
  - a) Select Products □□MicroZed Carrier Card Kit for Arduino
  - b) Scroll down and click "View All" to see links to latest documentation
2. Return to [www.microzed.org/product/arduino-cc](http://www.microzed.org/product/arduino-cc)
  - a) Scroll to bottom of page and click on Reference Designs and Tutorials
  - b) Scroll down to MicroZed Carrier Card for Arduino
  - c) Download the provided Getting Started Guide Examples Reference Design
3. Extract all files from this archive and follow the programming instructions provided
4. **Note:** If this your first use of a MicroZed SOM, it is recommended that you download and refer also to the Quick Start Instructions for MicroZed

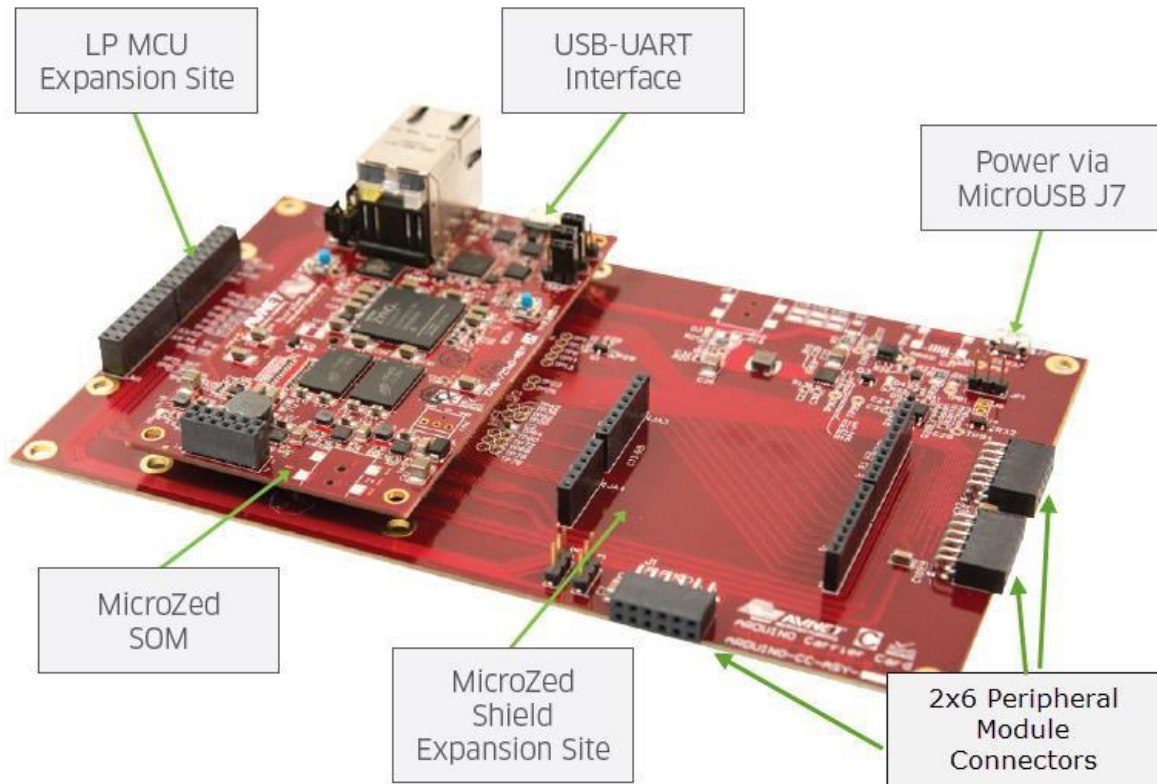


Figure 3 – MicroZed Carrier Card for Arduino (shown with MicroZed SOM mounted)

## 5.2 Hardware Setup

Setup of typical development platform based on MZ Carrier Card for Arduino:

5. Attach Avnet MicroZed-7010 SOM to the Carrier Card
6. Attach target Shield board to JA1, JA2, JA3, JA4 connectors of the MicroZed Shield Expansion site and/or
7. Attach target Pmod board(s) to whichever connectors are designated
8. Attach +5V power using provided cable between the Carrier microUSB connector J7 and laptop computer
9. Attach USB Serial Console connection between MicroZed SOM connector J2 and laptop computer
10. Launch serial console app (Tera Term or equivalent), with the appropriate COM port set to 115200 bps.

### 5.3 Arduino Shield Interfaces Supported by Carrier Card

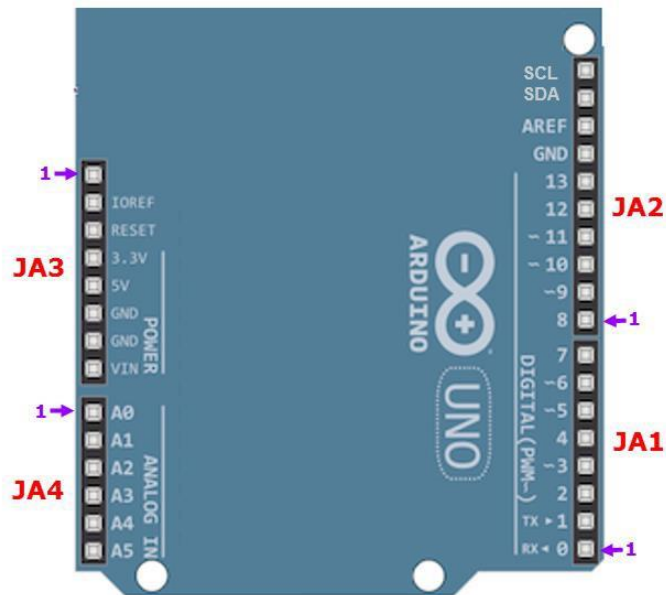


Figure 4 –Arduino UNO R3 Compatible Shield Connectors

### 5.4 Example Designs using Shields and Pmods

In the initial reference design, a single Zynq hardware platform definition is used to facilitate support of the four add-on board examples listed:

- a) Seeed Studio Quad Relay Shield
- b) Adafruit QVGA TFT Display Shield (plus Cap Touch input)
- c) Avnet Wilink8 Wi-Fi and BT/BLE Pmod Adaptor
- d) Freescale KL46 MCU controlling MicroZed power rails and Zynq power modes

The basic design (using Zynq GPIO) controls a Shield with multiple relay outputs and is readily tested as described below.

Avnet's Wilink 8 Wi-Fi & Bluetooth Adaptor connected to Pmod-PS (J2) and Pmod-PL (J3) may be used concurrently with a shield connected to MicroZed's shield connectors

More complex software examples are currently in development, including Linux supported low-cost graphical user interface using QVGA Touch Display (SPI) with Capacitive Touch overlay (I2C).

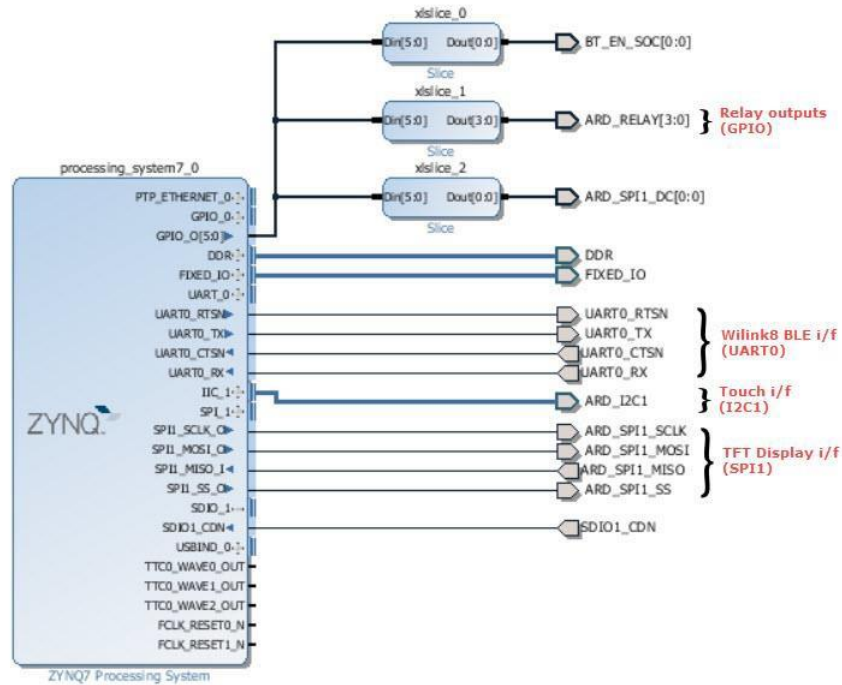


Figure 5 –Vivado IP Integrator View of Reference Design

Peripheral	IO	Signal	IO Type
Application Processor Unit			
I/O Peripherals			
<input checked="" type="checkbox"/> ENET 0	MIO 16 .. 27		
<input type="checkbox"/> ENET 1			
<input checked="" type="checkbox"/> USB 0	MIO 28 .. 39		
<input type="checkbox"/> USB 1			
<input checked="" type="checkbox"/> SD 0	MIO 40 .. 45		
<input checked="" type="checkbox"/> SD 1	MIO 10 .. 15		
<input checked="" type="checkbox"/> UART 0	EMIO		
<input checked="" type="checkbox"/> UART 1	MIO 48 .. 49		
<input type="checkbox"/> I2C 0			
<input checked="" type="checkbox"/> I2C 1	EMIO		
<input type="checkbox"/> SPI 0			
<input checked="" type="checkbox"/> SPI 1	EMIO		
<input type="checkbox"/> CAN 0			
<input type="checkbox"/> CAN 1			
GPIO			
<input checked="" type="checkbox"/> GPIO MIO	MIO		
<input checked="" type="checkbox"/> EMIO GPIO (Width)	6		

Figure 6 –Zynq I/O Peripherals used to interface to Shield and Pmod Examples

## 6 Example #1: Quad Relay Shield (using GPIO)

The simplest expansion example is the addition of a Relay Shield. This allows MicroZed to switch multiple circuits of much higher voltages and currents, controlling devices (eg. motors, actuators, etc) that cannot be directly driven by Zynq's low voltage Digital I/Os.

A popular low-cost Relay Shield (sub \$20) from Seed Studio is used in this example

[http://www.seeedstudio.com/wiki/Relay\\_Shield\\_V2.0](http://www.seeedstudio.com/wiki/Relay_Shield_V2.0)

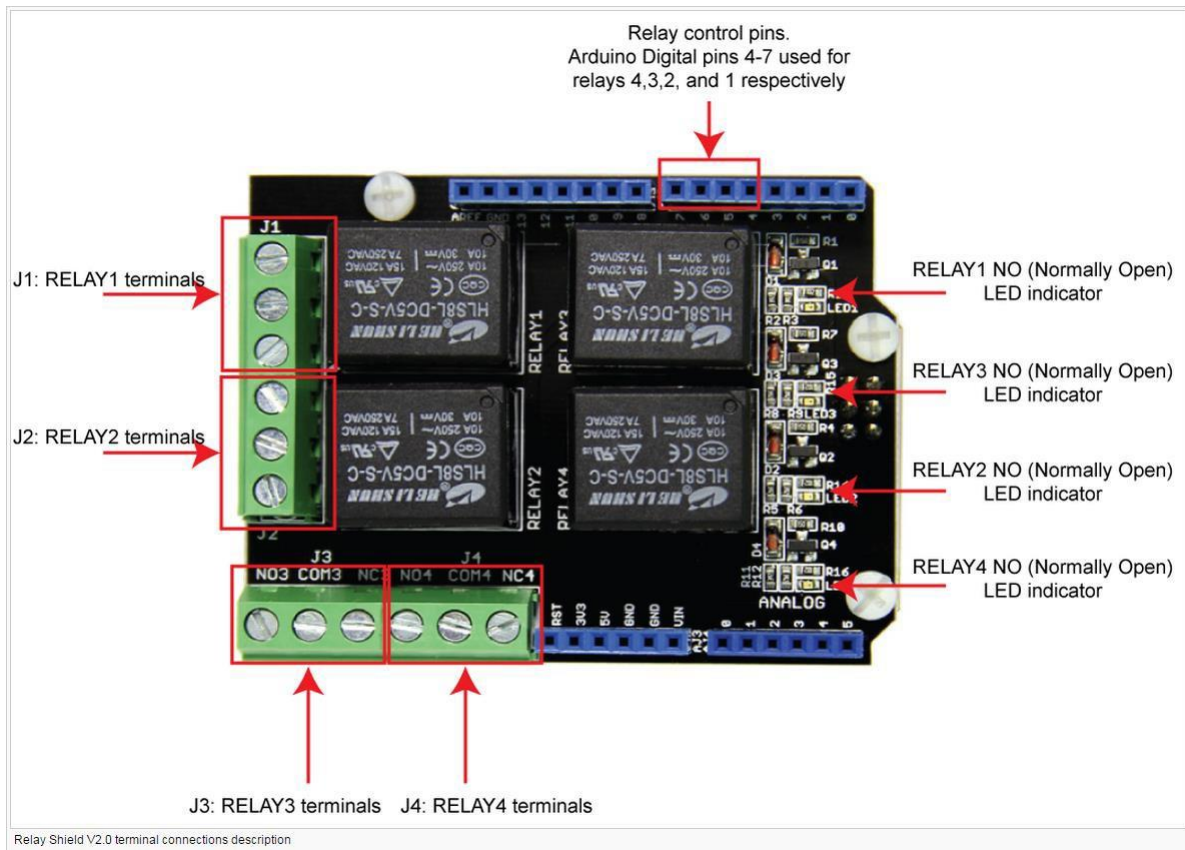


Figure 7 –Detail of SEED Studio Quad Relay Shield

The control interface consists of 4 consecutive GPIO pins on the JA1 shield connector

Microheader Pin #	MicroZed Pin Name	Zynq Pin #	Zynq GPIO #	Shield Pin #	Shield Signal Name	Relay #
JX1, pin 47	JX1_LVDS_12_P	N18	55	JA1-8	ARD_D7	Relay 1
JX1, pin 49	JX1_LVDS_12_N	P19	56	JA1-7	ARD_D6	Relay 2
JX1, pin 48	JX1_LVDS_13_P	N20	57	JA1-6	ARD_D5	Relay 3
JX1, pin 50	JX1_LVDS_13_N	P20	58	JA1-5	ARD_D4	Relay 4

The **SysFs** Linux GPIO driver is used for control of these relays. This is the simplest approach as it does not require additional drivers or changes to the Linux device tree.

To implement this, only a minor addition was made to the default Zynq platform design: Four PS GPIO signals are routed via EMIO to the JX1 Microheader pins that connect to the applicable JA1 Shield connector pins.

Relay 1 can be turned-on directly from the serial console as follows:

```
echo 55 > /sys/class/gpio/export
echo out > /sys/class/gpio/gpio55/direction
echo 1 > /sys/class/gpio/gpio55/value
```

To turn-off Relay 1, write a zero to GPIO 55

```
echo 0 > /sys/class/gpio/gpio55/value
```

To control Relays 2, 3, 4, substitute their GPIO numbers (56, 57, 58) in place of the 55. The state of the Linux GPIO signals may be examined directly from the command line:

```
cat /sys/kernel/debug/gpio
```

Alternatively, this GPIO/relay control may be added to a user space C application (or suitable script or macro...)

## 7 Example #2: TFT Touch Display Shield (SPI and I2C)

A more complex expansion example is the addition of a Shield with QVGA Display (SPI) and Cap Touch overlay (I2C).

This example is currently under development but once released, will facilitate a low-cost (sub-\$45) User Interface for the MicroZed SOM.

From many low-cost TFT Touch Display Shields available from **adafruit**, their new Capacitive Touch 2.8" QVGA display (320x240, 18bit color) is targeted for this example.

### 7.1 Linux drivers used:

Frame Buffer TFT (fbtft\_device) kernel driver

<https://github.com/Xilinx/linux-xlnx/tree/master/drivers/staging/fbftft>

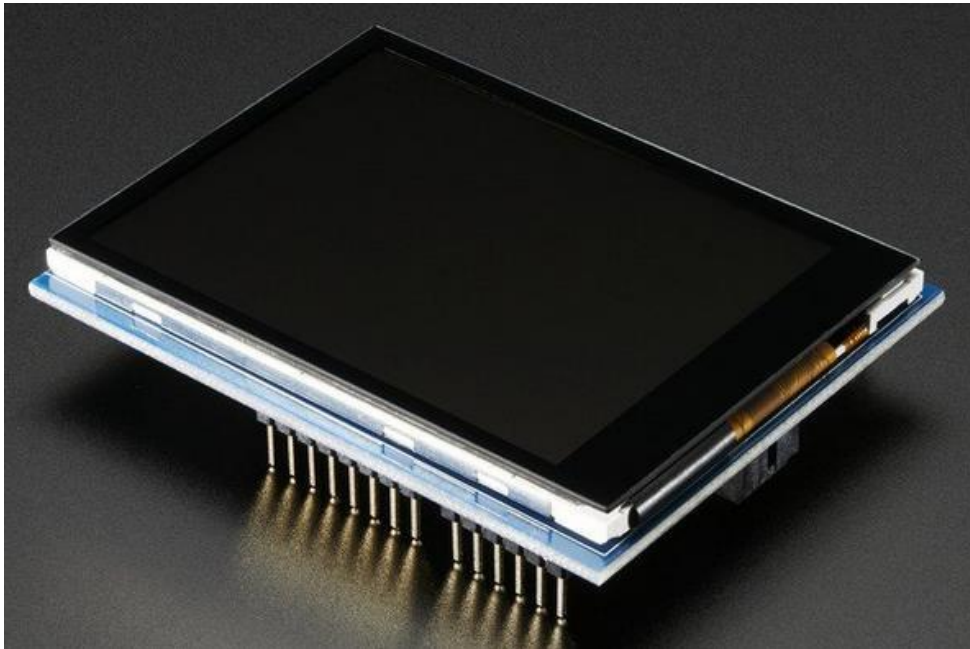


Figure 8 –Adafruit 2.8" Cap Touch TFT Display Shield

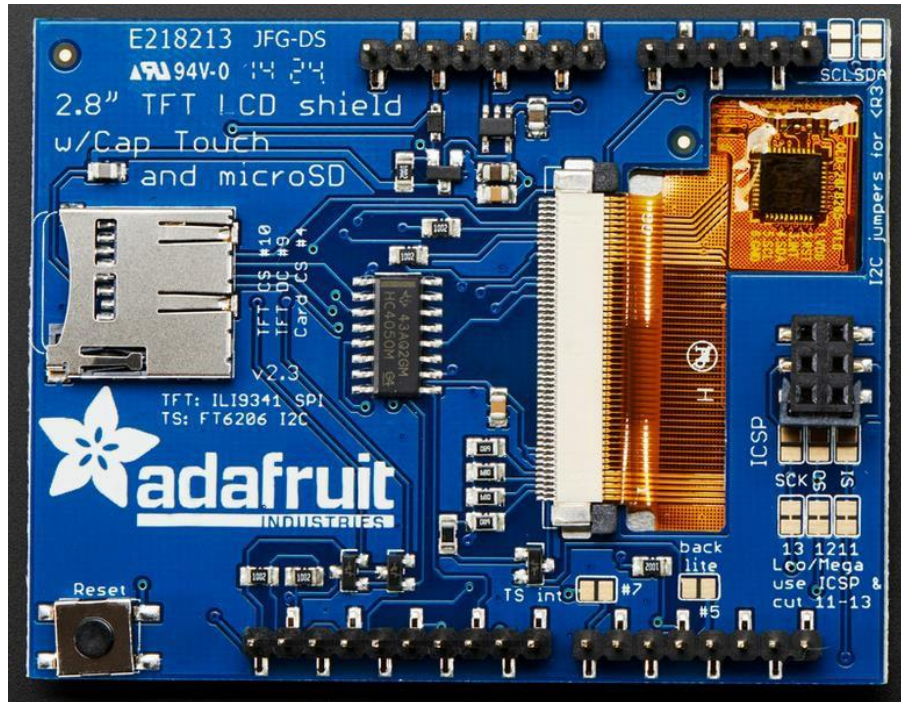


Figure 9 –Adafruit 2.8” Cap Touch TFT Display Shield (rear view)

TFT Display’s SPI interface uses 5 pins on the **JA2** shield connector:

Microheader Pin #	MicroZed Pin Name	Zynq Pin #	Arduino Shield Pin #	Arduino Shield Signal Name	TFT SPI Interface
JX1, pin 30	JB2-3 P	Bank 34, W14	<b>JA2-6</b>	D13	SPI_SCK
JX1, pin 32	JB2-3 N	Bank 34, Y14	<b>JA2-5</b>	D12	SPI_MISO
JX1, pin 35	JB4-5 P	Bank 34, T16	<b>JA2-4</b>	D11	SPI_MOSI
JX1, pin 37	JB4-5 N	Bank 34, U17	<b>JA2-3</b>	D10	SPI_SS
JX1, pin 36	JB6-7 P	Bank 34, V15	<b>JA2-2</b>	D9	SPI_DC

Touch Controller’s I2C interface uses 2 pins on the **JA4** shield connector:

Microheader Pin #	MicroZed Pin Name	Zynq Pin #	Arduino Shield Pin #	Arduino Shield Signal Name	Touch I2C Interface
JX2, pin 14	JX2_SE1	Bank 35, J15	<b>JA4-5</b>	A4	I2C_SDA
JX2, pin 18	JX2_LVDS_1_	Bank 35, B19	<b>JA4-6</b>	A5	I2C_SCL

Detail of the adafruit TFT Touch Shield hardware and software libraries is available at: <https://learn.adafruit.com/downloads/pdf/adafruit-2-8-tft-touch-shield-v2.pdf>

## 7.2 Additional Reference Information (TFT Display):

<https://communities.intel.com/message/266095>

[http://www.acmesystems.it/arietta\\_adafruit\\_lcd28](http://www.acmesystems.it/arietta_adafruit_lcd28)

<https://github.com/notro/fbft/wiki>

Further implementation detail of this solution will be made available shortly

## 8 Example #3: Wlink8 Pmod Adaptor (SDIO, UART)

The Arduino Carrier Card has been designed to accommodate Avnet's Wilink 8 Adaptor.

**Pmod-PS** connector **J2** is used for the Wi-Fi (SDIO host interface)

**Pmod-PL** connector **J3** is used for the Bluetooth/BLE (UART host interface)

A reference design with Linux driver support for WL1835MODCOM8B and WL1837MODCOM8I boards from Texas Instruments is available for download from:

<http://microzed.org/product/wilink-8-adaptor>

### 8.1.1 For Wi-Fi operation:

Same pinout as the design for **MicroZed IO Carrier Card** (as provided on Avnet's Wilink 8 Adaptor page).

### 8.1.2 For Bluetooth/BLE operation:

Pinout constraints in the Vivado design *have been changed* and the **.bit** file and **BOOT.bin** file regenerated, to accommodate this board's different EMIO pinout for the connection between Bluetooth host UART interface and it's PL Pmod connector.

ie.

Microheader Pin #	MZ Pin Name	Zynq Pin #	Pmod Pin#	PL I/O Name	Zynq Signal Name
JX2, pin 61	JX2_LVDS_14_P	<b>G17</b>	<b>1</b>	D0_P	UART0_RTSN
JX2, pin 63	JX2_LVDS_14_N	<b>G18</b>	<b>2</b>	D0_N	UART0_RX
JX2, pin 62	JX2_LVDS_15_P	<b>F19</b>	<b>3</b>	D1_P	UART0_TX
JX2, pin 64	JX2_LVDS_15_N	<b>F20</b>	<b>4</b>	D1_N	UART0_CTSN
JX2, pin 81	JX2_LVDS_20_P	<b>N15</b>	<b>7</b>	D2_P	BT_EN_SOC

```
# Wilink-8 Bluetooth Interface, implemented in the FPGA fabric
set_property PACKAGE_PIN G17 [get_ports UART0_RTSN]; # BT_HCI_CTS
set_property PACKAGE_PIN G18 [get_ports UART0_RX] ; # BT_HCI_TX
set_property PACKAGE_PIN F19 [get_ports UART0_TX] ; # BT_HCI_RX
set_property PACKAGE_PIN F20 [get_ports UART0_CTSN]; # BT_HCI_RTS
set_property PACKAGE_PIN N15 [get_ports BT_EN_SOC]; # BT_EN_SOC
```

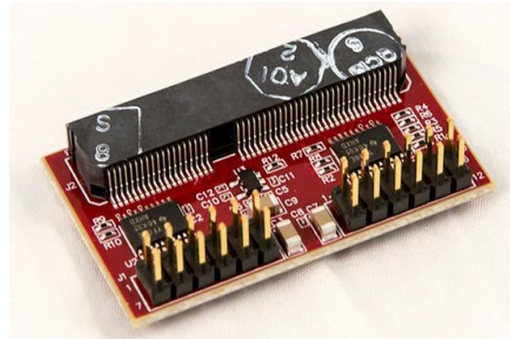


Figure 10 – Wilink 8 Eval Module and Avnet Wilink 8 to Pmod Adaptor

Refer to the **WILINK 8 Getting Started Guide** document for more information.

<http://microzed.org/product/wilink-8-adaptor>

If used together with the Relay Shield (Example #1) plus the built-in Lighttpd webserver, a system level solution can relatively easily be implemented, where the relay outputs can be controlled via Wi-Fi from a remote smartphone or tablet browser interface.

## 9 Example #4: Zynq Power Rail Control (using MCU GPIO)

The Low Power MCU Expansion site (JM1, JM2) on this Carrier Card facilitates the attachment of a companion (Arduino-compatible) microcontroller board to:

- Offload tasks from the Applications Processor to the Low-Power MCU
- Implement Low-Power Sensor Hub data collection and processing
- Power rail switching and Power mode control of the Zynq Apps Processor.

A basic example is available for download. This firmware provides pushbutton On/Off control of MicroZed's power rails, using a Freescale FRDM-KL46 Freedom board. Other more advanced power management schemes (Suspend/Resume, Wake-on-WLAN, etc) are also feasible with the hardware configuration provided.

Refer to the [www.microzed.org/product/arduino-cc](http://www.microzed.org/product/arduino-cc) website for more information

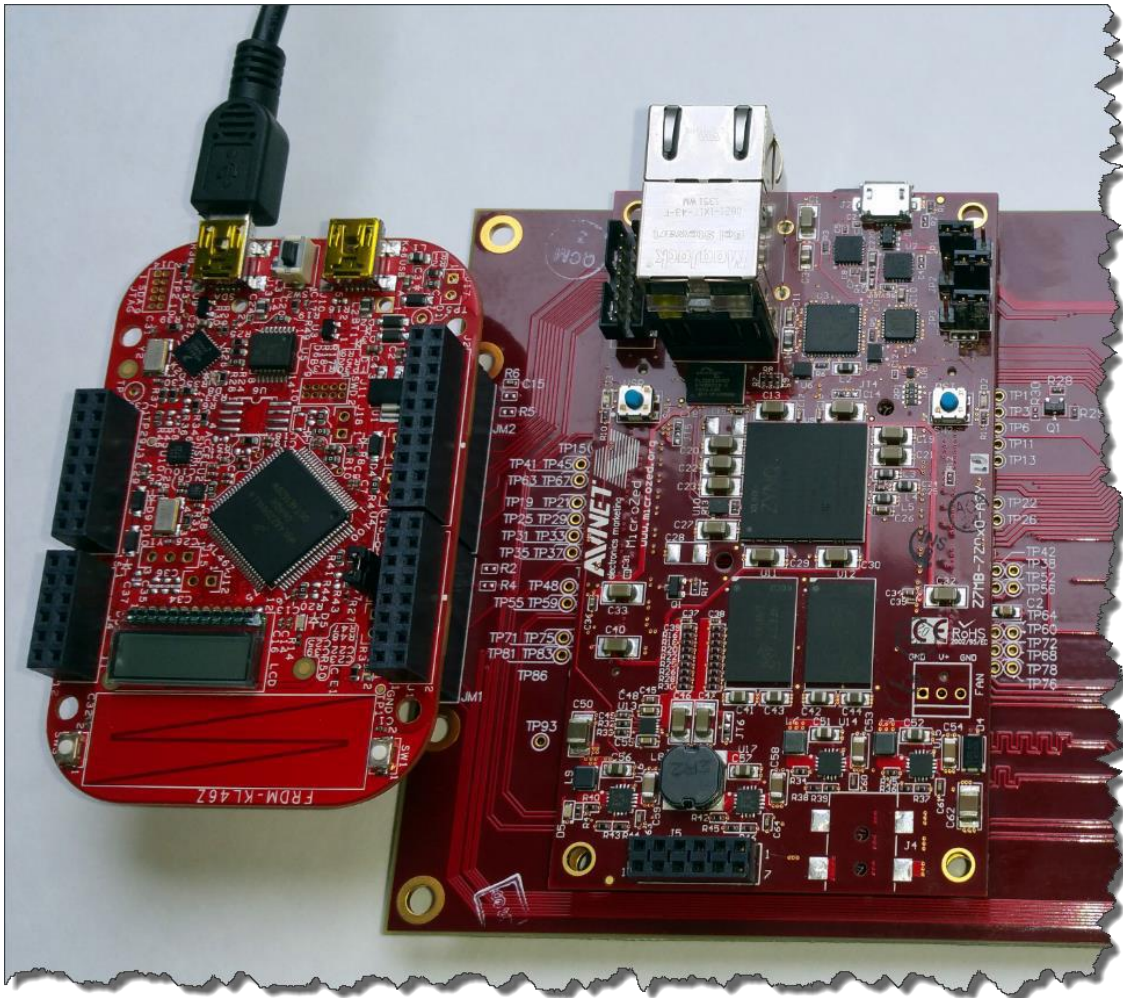


Figure 11 –FRDM-KL46Z Eval board controlling MicroZed's Power Rails

Note: The signals connected between optional Freescale FRDM-K46F Freedom MCU board and this Carrier Card were carefully selected to also accommodate a specific use case where Freescale's FRDM-FXS-MULTI sensor board is stacked below the MCU board

# Connector Detail - FRDM-KL46Z

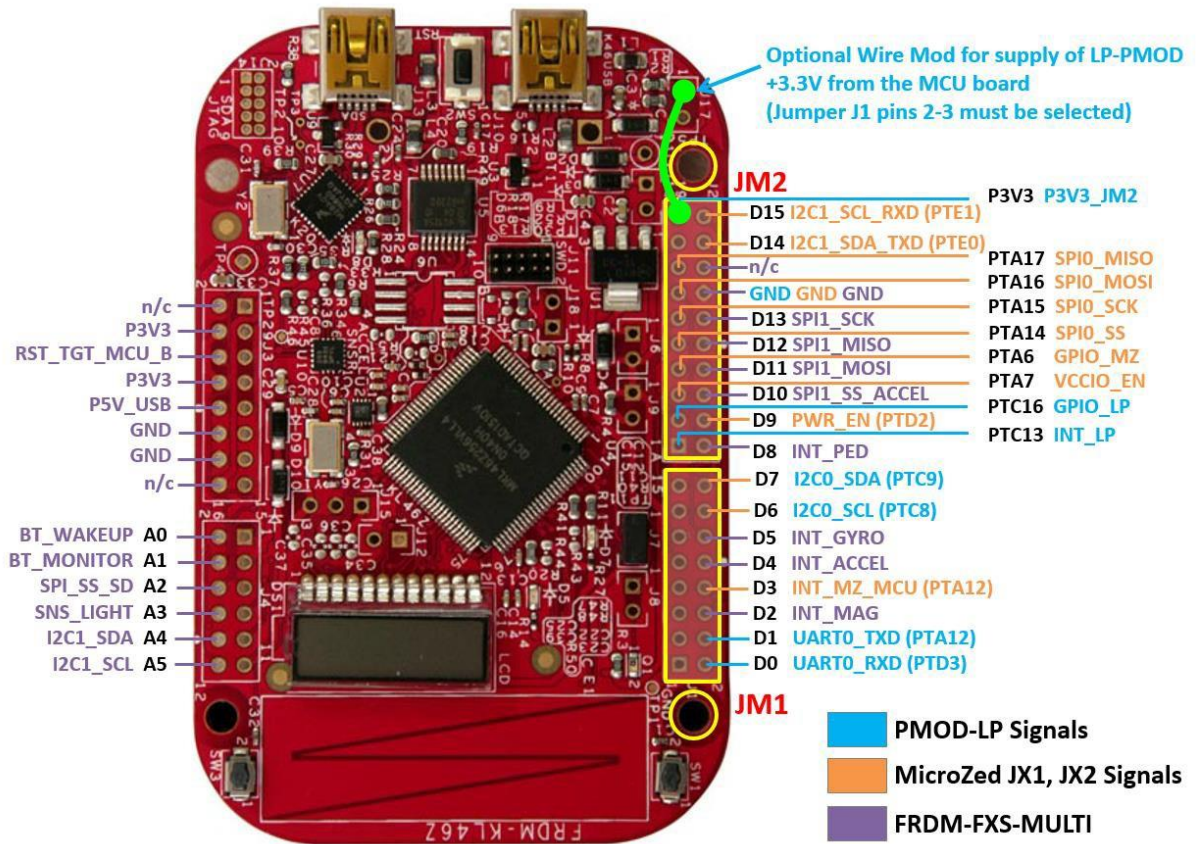


Figure 12 –Detail of FRDM-KL46Z I/O utilization

## 10 Getting Help and Support

### 10.1 Avnet Support

The Arduino Carrier Card is a versatile development kit that extends the evaluation possibilities of the MicroZed SOM. All technical support is offered through the [MicroZed.org](http://MicroZed.org) website support forums. MicroZed users are encouraged to participate in the forums and offer help to others when possible.

<http://MicroZed.org/forums/>

For questions regarding MicroZed community website, please direct any questions to: MicroZed.org Web Master – [webmaster@MicroZed.org](mailto:webmaster@MicroZed.org)

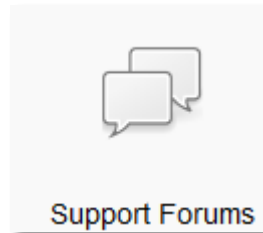
To access the most current collateral please visit the community support page at: [www.MicroZed.org/content/support](http://www.MicroZed.org/content/support)

Once on the [MicroZed.org](http://MicroZed.org) support page:

To access latest Arduino Carrier Card documentation and reference designs, click on the links provided at this board's product webpage: [www.microzed.org/product/arduino-cc](http://www.microzed.org/product/arduino-cc)



To access technical forums or online training and videos, click on the following links...



## 10.2 Xilinx Support

For questions regarding products within the Product Entitlement Account, send an e-mail message to the Customer Service Representative in your region:

- Canada, USA and South America – [isscs\\_cases@xilinx.com](mailto:isscs_cases@xilinx.com)
- Europe, Middle East, and Africa – [eucases@xilinx.com](mailto:eucases@xilinx.com)
- Asia Pacific including Japan – [apaccase@xilinx.com](mailto:apaccase@xilinx.com)

For technical support including the installation and use of the product license file, contact Xilinx Online Technical Support at [www.xilinx.com/support](http://www.xilinx.com/support). The following assistance resources are also available on the website:

- Software, IP and documentation updates
- Access to technical support web tools
- Searchable answer database with over 4,000 solutions
- User forums