



## POWR1014A Breakout Board Evaluation Kit

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**User's Guide**

## Introduction

Thank you for choosing the Lattice Semiconductor POWR1014A Breakout Board Evaluation Kit!

Lattice Semiconductor's Power Manager II ispPAC<sup>®</sup>-POWR1014A device simplifies power supply design by integrating the analog and digital functions of power supply management (sequencing, monitoring, measuring, and reset generation) into a single device. This device provides designers with a rich set of features: precision comparators with a built-in voltage reference, 10-bit ADC for I<sup>2</sup>C monitoring, MOSFET drivers and a programmable logic device (PLD) for sequencing and supervisory logic functions or reset control. Configuration for all subsystems in the POWR1014A device is stored in non-volatile E<sup>2</sup>CMOS<sup>®</sup> memory. Programming is performed via a USB cable. Along with the board and accessories, this kit includes a pre-loaded demonstration design. The on-board POWR1014A device can easily be reprogrammed for customized designs.

*Note: Static electricity can severely shorten the lifespan of electronic components. See the [Storage and Handling](#) section of this document for handling and storage tips.*

## Features

The ispPAC-POWR1014A Breakout Board Evaluation Kit includes:

- **ispPAC-POWR1014A Breakout Board** – The board is a 3" x 3" form factor that features the following on-board components and circuits:
  - ispPAC-POWR1014A-02TN48I Power Manager II device
  - USB mini-B connector for power and programming
  - Nine LEDs
  - 4x15 prototype area
  - Two 2x20 expansion header landings for general I/O, JTAG, and external power
  - 1x8 expansion header landing for JTAG
  - 3.3V supply rail
- **Pre-loaded Demo** – The kit includes a pre-loaded counter design that highlights the use of the embedded POWR1014A oscillator and programmable I/Os configured for LED drive.
- **USB Connector Cable** – The board is powered from the USB mini-B socket when connected to a host PC. The USB channel also provides a programming interface to the POWR1014A JTAG port.
- **Lattice Breakout Board Evaluation Kits Web Page** – Visit [www.latticesemi.com/breakoutboards](http://www.latticesemi.com/breakoutboards) for the latest documentation (including this guide), demo designs, and drivers for the kit.

The content of this user's guide includes demo operation, programming instructions, top-level functional descriptions of the POWR1014A Breakout Board, and a complete set of schematics.

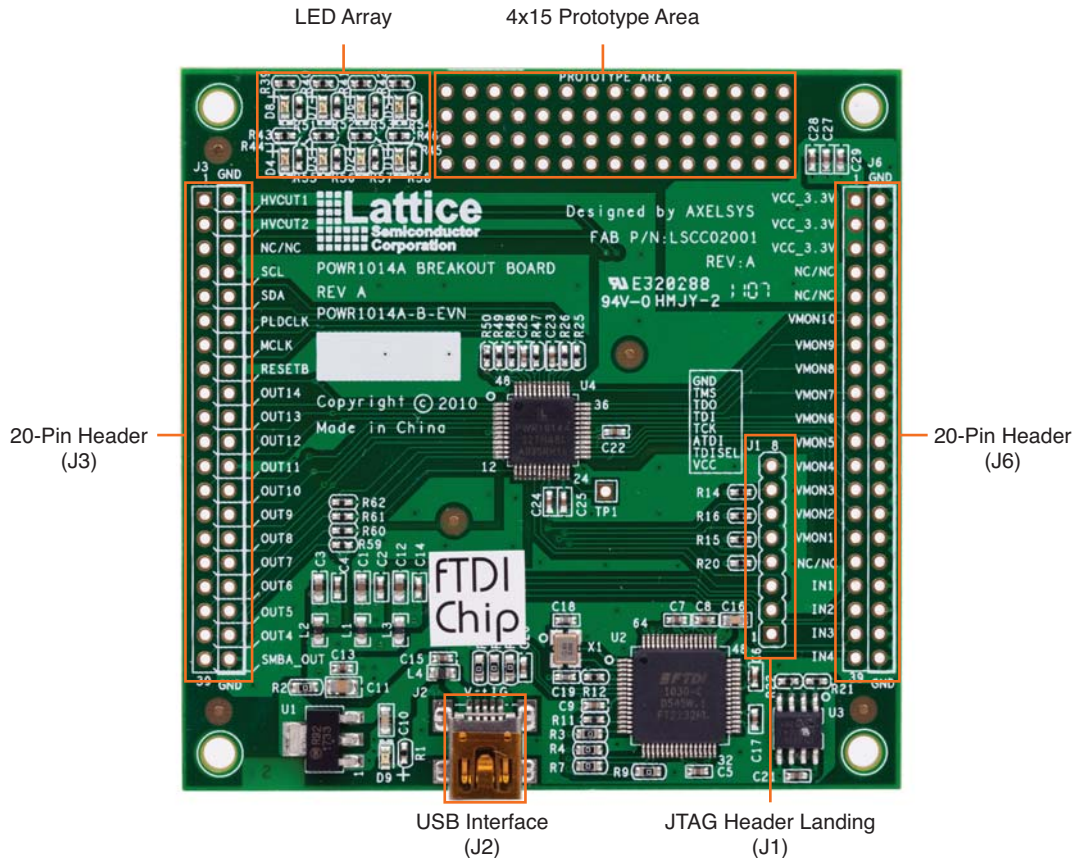
## Input/Output

Connectors are provided for key functions and test points on this evaluation board, as shown in Figure 1. The USB programming cable is connected to the USB port (J2) shown on the bottom of the figure.

Access to the ispPOWR1014A device's I/O pins are available as shown along the right and left edges of the assembly, where two 2x20 blocks of pads (J3 and J6) support the attachment of test probes or a ribbon-cable connector. An array of 60 prototype holes for interfacing is shown at the top of the figure.

Several LEDs on the evaluation board are provided to indicate proper function and as aids to debugging. The green LED (D9) indicates that the on-board 3.3V supply (derived from the input USB voltage) is powered up. Eight red LEDs (D1 through D8) are provided to demonstrate control of digital outputs OUT7 through OUT14 so that a user may easily view the progress of Sequence, Monitor, Reset programs run on the evaluation board.

**Figure 1. POWR1014A Breakout Board, Top Side**



## Storage and Handling

Static electricity can shorten the lifespan of electronic components. Please observe these tips to prevent damage that could occur from electro-static discharge:

- Use anti-static precautions such as operating on an anti-static mat and wearing an anti-static wrist-band.
- Store the evaluation board in the packaging provided.
- Touch a metal USB housing to equalize voltage potential between you and the board.

## Software Requirements

The POWR1014A Breakout Board uses an FTDI USB interface device that requires USB drivers contained in the following software to communicate properly. Initial manual testing (Quick Start) using the computer USB power maybe accomplished before loading the software drivers. For manual testing only, plug the board into the computer USB port and “cancel” when requested to install new hardware. If the incorrect drivers are installed by Windows they may require removal before the FTDI USB drivers can be loaded and the POWR1014A Breakout Board can be recognized by the computer.

- [PAC-Designer](#) design software
- [ispVM™ System](#) device programming software
- [FTDI USB drivers](#)

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## POWR1014A Device

This board features the Power Manager II ispPAC-POWR1014A general-purpose power-supply monitor and sequence controller, incorporating both in-system programmable logic and in-system programmable analog functions implemented in non-volatile E<sup>2</sup>CMOS technology. A complete description of this device can be found in the [ispPAC-POWR1014/A Data Sheet](#).

## Demonstration Design

Lattice provides a pre-programmed demo to illustrate basic operation of the POWR1014A device. The program demonstrates sequencing of the output pins Out4 through Out14. Using an internal timer the program alternates the POWR1014A outputs, illuminating LEDs D1, D3, D5 and D7 then LEDs D2, D4, D6 and D8.

*Note: To restore the factory default demo or program it with other Lattice-supplied examples see the [Download Demo or Create New Designs](#) section of this document.*

## Run the Demonstration Design

### USB Cable Power Connection

[Download USB Hardware Drivers](#): Communication with the POWR1014A Breakout Board with a PC via the USB cable will require the USB hardware drivers contained in the [Software Requirements](#) section. Loading these drivers enables the computer to recognize and program the POWR1014A Breakout Board. To load these USB drivers, use one of the following methods:

Preferred Installation:

1. Run ispVM System and choose **Install/Uninstall LSC USB/Parallel Port Driver** from the **ispTools** tab.

Optional Installation:

1. Connect the USB cable from a USB port on your PC to the board's USB mini-B socket (J2). After connection is made, a green Power LED (D9) will light up indicating the board is powered on.
2. If you are prompted, "Windows may connect to Windows Update" select **No, not this time** from available options and click **Next** to proceed with the installation. Choose the **Install from specific location (Advanced)** option and click **Next**.
3. Browse to the FTDI USB Drivers listed in the [Software Requirements](#) section. Search for the best driver in these locations and click the **Browse** button to browse to the Windows driver folder created in the Download Windows USB Hardware Drivers section. Select the **CDM 2.04.06 WHQL Certified** folder and click **OK**.
4. Click **Next**. A screen will display as Windows copies the required driver files. Windows will display a message indicating that the installation was successful.
5. Click **Finish** to install the USB driver.

## Reprogramming Designs

The support demo is preprogrammed into the POWR1014A. It may be desirable to reload the original demo program after any design modification. Lattice distributes the source (JED) and schematic (PAC) files for demonstration designs compatible with the POWR1014A Breakout Board.

Refreshing the programming for U4 POWR1014A will require the demo JEDEC file. This is available directly as a .jed file or can be compiled from the .pac files using PAC-Designer. The .jed files are then loaded into U4 via the USB cable using ispVM software.

### Programming Devices with ispVM

To restore a POWR1014A Breakout Board to factory settings or load an alternative demo design, use the procedures in this section.

For more information see AN6062, [Using ispVM System to Program ispPAC Devices](#).

1. Connect the board to a host PC using the USB port or JTAG header connection.
2. Follow the USB Cable Interface procedure below to program the evaluation board.

**USB Cable Interface Connection:** The POWR1014A Breakout Board is equipped with a built-in USB-based programming circuit. This consists of a USB PHY and a USB connector. When the board is connected to a PC with a USB cable, it is recognized by the ispVM System software as a “USB Download Cable”. The POWR1014A can then be scanned and programmed using the ispVM System software.

**Download Demo or Create New Designs**

1. Browse to the POWR1014A Breakout Board design files.
2. Extract the contents of **PAC\_POWR1014A\_BREAKOUTBOARD.zip** to an accessible location on your hard drive.

The demo design directory (PAC\_POWR1014A\_BREAKOUTBOARD<demo>) is unpacked.

Demo	Directory
PAC_POWR1014A_BLINKER	PAC_POWR1014A_BREAKOUTBOARD
PAC_POWER1014A_BLINKER.JED	

**Create or Modify the <demo>.jed Design by compiling a PAC-Designer using <demo>.PAC file:** Use the procedure below to recompile the demo project for the POWR1014A Breakout Board or modify for a custom design.

1. Run PAC-Designer.
2. From the **File** tab open either the **<demo>.PAC** project file from the Download Demo Designs section or other **>.PAC** file if implementing a custom design.
3. Modification of the I/Os or change of sequencing for custom designs can be done at this step.
4. From the schematic block diagram, double-click the **Sequence Controller block**. The LogiBuilder interface appears.

**Table 1. Demo Design Sequencing Program (for Reference Only)**

Step	Instruction	Outputs	Int.	Comment
0	Begin Startup Sequence		0	POWR1014A reset
1	OUT4 = 1, OUT5 = 0, OUT6 = 1, OUT7 = 0, OUT8 = 0, OUT9 = 0, OUT14 = 0,		0	Initializes outputs
2	Wait for AGOOD	OUT4 = 0, OUT5 = 1, OUT6 = 0, OUT7 = 1, OUT8 = 0, OUT9 = 1, OUT10 = 0, OUT11 = 1, OUT12 = 0, OUT13 = 1, OUT14 = 0,	0	Set outputs 4 through 14, 0 = Hi Z, 1 = Ground, then waits for power good
3	OUT4 = 1, OUT5 = 0, OUT6 = 1, OUT7 = 0, OUT8 = 1, OUT9 = 0, OUT10 = 1, OUT11 = 0, OUT12 = 1, OUT13 = 0, OUT14 = 1,		0	Alternate output settings for OUT4 throughOUT14
4	Wait for 524.29ms using timer 1		0	Wait 0.5 sec
5	OUT3 = 1, OUT4 = 0, OUT5 = 1, OUT6 = 0, OUT7 = 1, OUT8 = 0, OUT9 = 1, OUT10 = 0, OUT11 = 1, OUT12 = 0, OUT13 = 1, OUT14 = 0,		0	Alternate outputs OUT4 through OUT14
6	Wait for 524.29ms using Timer 1		0	Wait 0.5 sec

**Table 1. Demo Design Sequencing Program (for Reference Only)**

Step	Instruction	Outputs	Int.	Comment
7	Go to Step 3		0	Enter loop to alter sequence of OUT4 through OUT14. Flashes odd then even LEDs.
8	Begin shut-down sequence		0	
9	Halt (end-of-program)		0	

5. Choose **Tools > Compile LogiBuilder Design**. After a few moments the JEDEC programming file is output. Click **OK**.
6. From the toolbar launch **JED** to download and save the file.

*Note: PAC-Designer may not recognize files that have certain characters such as spaces or periods in the directory path.*

To program the device using a <demo>.jed file:

1. From the **Start** menu run **ispVM System**.  
ispVM appears.
2. Choose **Options > Cable and I/O Port Setup...**  
The Cable and I/O Port Setup dialog appears.
3. Make the following selections:  
Cable Type: **USB2**  
Port Setting: **FTUSB-0**  
  
Click **OK**.
4. Choose **ispTools > Scan Chain**.  
The New Scan Configuration Setup window appears. The POWR1014A appears in the device list.
5. Highlight the **POWR1014A**, right-click and choose **Edit Device...**  
The Device Information dialog appears.
6. From the **Set Device Operations** section, click the **Browse** button.  
The Open Data File dialog appears.
7. Download the .jed file either downloaded from the Lattice web site or file compiled using PAC-Designer by browsing to the **<Demo Dir>\project** folder, selecting **<Demo>.jed**, and clicking **OK**.
8. Select the device to be programmed by highlighting and then right-clicking and choose **Set Device Operations**. From the Operation list choose **Flash Erase, Program, Verify**.
9. From the toolbar select **Go** to program device

Programming requires about 20-40 seconds. A small timer window will appear to show elapsed programming time. At the end of programming, the configuration setup window should show a "PASS" in the Status column.

## POWR1014A Breakout Board

This section describes the features of the ispPOWR1014A Breakout board detail.

### POWR1014A

The ispPAC-POWR1014A-02TN48I in the 7x7mm 48-pin TQFP package has the ability to monitor 10 analog inputs and provides 14 digital outputs. Two of the outputs can be configured to provide 6V to 12V MOSFET gate drive.

**Table 2. POWR1014A Interface Reference**

Item	Description
Reference designator	U4
Part number	POWR1014A
Manufacturer	Lattice Semiconductor
Web site	<a href="http://www.latticesemi.com">www.latticesemi.com</a>

### JTAG Interface Circuits

For power and programming, a FTDI USB UART/FIFO IC converter provides a communication interface between a PC host and the JTAG programming chain of the POWR1014A Breakout Board. The USB 5V supply is also used as a source for the 3.3V supply rail. A USB mini-B socket is provided for the USB connector cable.

**Table 3. JTAG Interface Reference**

Item	Description
Reference designator	U2
Part number	FT2232H
Manufacturer	Future Technology Devices International (FTDI)
Web site	<a href="http://www.ftdichip.com">www.ftdichip.com</a>

**Table 4. JTAG Programming Pin Information**

Description	POWR1014A Pin
Test Data Output	Pin 21 TDO
Test Data Output	—
Test Data Input	Pin 18 TDI
Test Mode Select	Pin 16 TMS
Test Clock	Pin 22 TCK

### LEDs

A green LED (D9) is used to indicate USB 5V power and red LEDs (D1 to D8) are used to show the status of the outputs.

**Table 5. User LEDs Reference**

Item	Description
Reference designators	D1 through D9
Part number	LTST-C190KGKT and LTST-C190KRKT
Manufacturer	Lite-On It Corporation
Web site	<a href="http://www.liteonit.com">www.liteonit.com</a>



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## Power Supply

3.3V supply rail is converted from the USB 5V interface by a linear regulator U1 when the board is connected to a host PC.

## Test Points

The ability to program the POWR1014A without enabling the device I/Os can be accomplished by powering the VCCPROG only. After programming, VCCPROG should be left open and VCCA and VCCD should be powered for normal operation. TP1 provides access to VCCPROG. See [Appendix A. Schematics](#) for more details:

- TP1, VCCPROG

## USB Programming and Debug Interface

The USB mini-B socket of the POWR1014A Breakout Board serves as the programming and debug interface.

### JTAG Programming

For JTAG programming a preprogrammed USB PHY peripheral controller is provided on the board to serve as the programming interface to the POWR1014A.

Programming requires ispVM System software.

## Mechanical Specifications

Dimensions: 3 in. [L] x 3 in. [W] x 1/2 in. [H]

## Environmental Requirements

The POWR1014A Breakout Board must be stored between -40° C and 100° C. The recommended operating temperature is between 0° C and 90° C.

The board can be damaged without proper anti-static handling.

## Glossary

**LED:** Light Emitting Diode.

**RoHS:** Restriction of Hazardous Substances Directive.

**USB:** Universal Serial Bus.

**FTDI:** Future Technology Devices International Ltd.

## Troubleshooting

Use the tips in this section to diagnose problems with the POWR1014A Breakout Board.

### LEDs Do Not Flash

If power is applied (LED D9 illuminated) but LEDs D1 through D8 do not flash according to the preprogrammed counter demonstration then it is likely the board has been reprogrammed with a new design. Follow the directions in the [Demonstration Design](#) section to restore the factory default.

### USB Cable Not Detected

If ispVM System cannot detect the USB2 cable type programming interface to the board, the incorrect USB driver may have been installed. This usually occurs if you attach the board to your PC prior to installing the USB driver or ispVM System software.



To correct a USB driver installation:

1. Start ispVM and choose **Options > Cable and I/O Port Setup**.  
The Cable and I/O Port Setup Dialog appears.
2. Click the **Troubleshooting the USB Driver Installation Guide** link.  
The Troubleshooting the USB Driver Installation Guide document appears in your system's PDF file reader.
3. Follow the instructions in the guide to install the Lattice USB driver.

**Determine the Source of a Pre-Programmed Device**

You may receive your POWR1014A Breakout board after it has been reprogrammed by someone else. To restore the board to the factory default, see the [Download Demo or Create New Designs](#) section for details on downloading and reprogramming the device.

You can also determine which demo design is currently programmed onto the board by comparing the JEDEC checksums against of the programming file with what is read from the programmed device.


To compare JEDEC file checksum:

1. Connect the POWR1014A Breakout Board to a host PC using the USB port.
2. Start ispVM and choose **ispTools > Scan**.  
The device appears in the Device List.
3. Double-click the device row.  
The Device Information dialog appears.
4. Click the **Browse** button.  
The Save as Data File dialog appears.
5. Specify a new JEDEC Data File name and click the **Save** button.
6. From the Operation list choose **Read and Save JEDEC** and click **OK**.
7. Choose **Project > Download**.  
ispVM reads the contents from the device and writes the results to the JEDEC file specified.

Open the JEDEC file into a text editor and page to the bottom of the file.

Note the hexadecimal checksum at the line above the User Electronic Data note line. Compare this value against the checksum of the original JEDEC demo programming files.

**Ordering Information**

Description	Ordering Part Number	China RoHS Environment-Friendly Use Period (EFUP)
POWR1014A Breakout Board Evaluation Kit	POWR1014A-B-EVN	

**Technical Support Assistance**

Hotline: 1-800-LATTICE (North America)  
 +1-503-268-8001 (Outside North America)  
 e-mail: [techsupport@latticesemi.com](mailto:techsupport@latticesemi.com)  
 Internet: [www.latticesemi.com](http://www.latticesemi.com)

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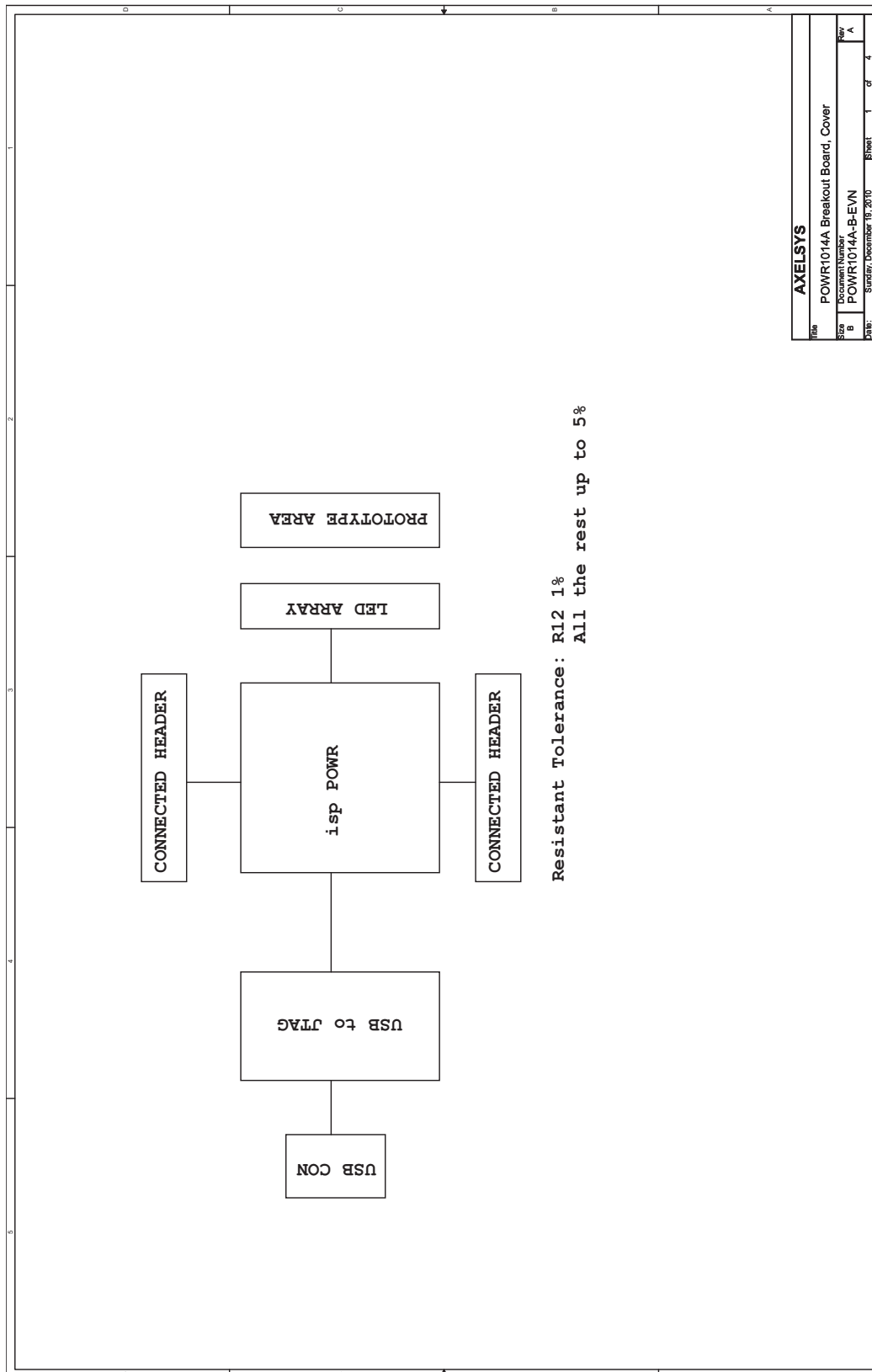
## Revision History

Date	Version	Change Summary
March 2011	01.0	Initial release.
February 2012	01.1	Updated document with new corporate logo.

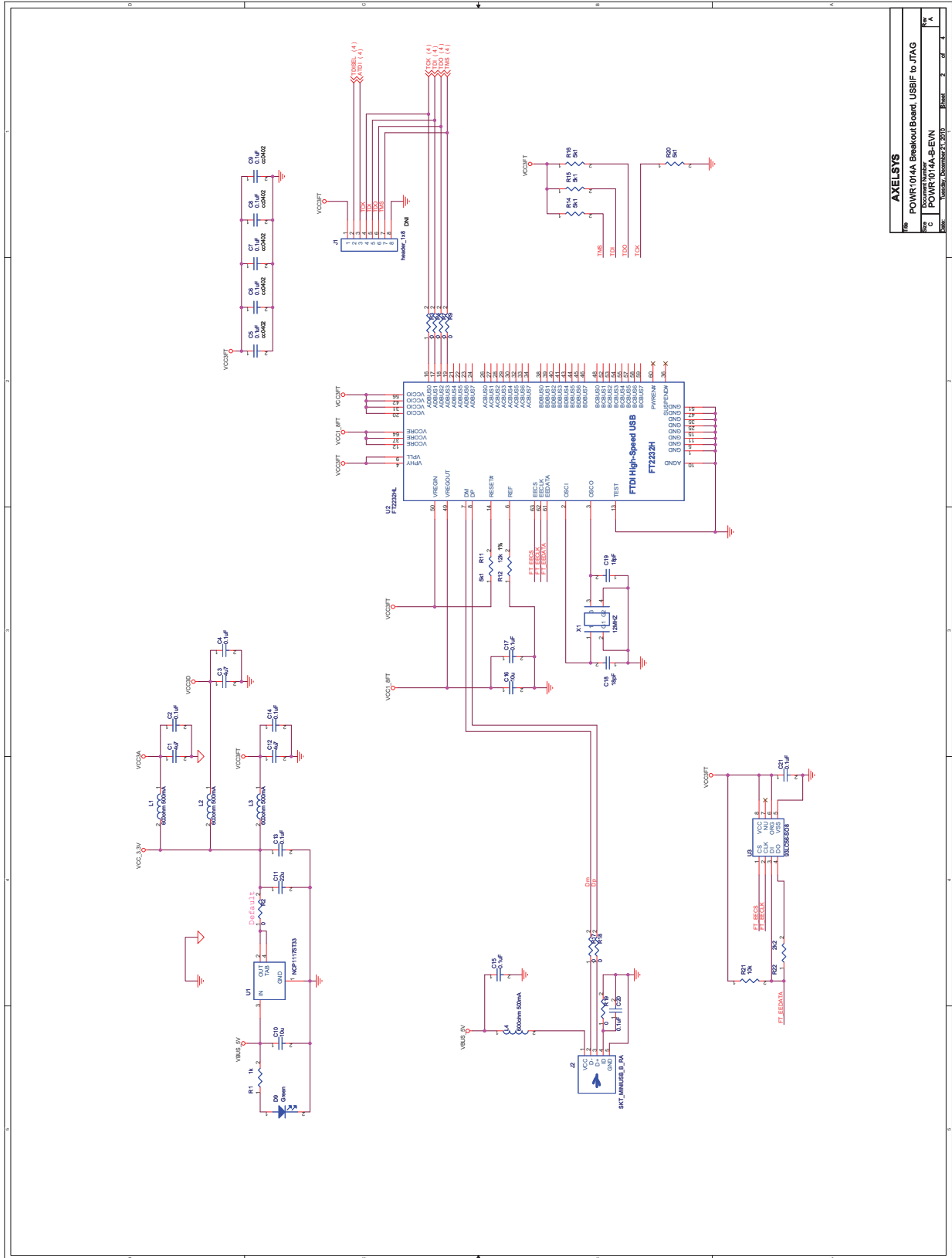
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## Appendix A. Schematics

Figure 2. POWR1014A Breakout Board

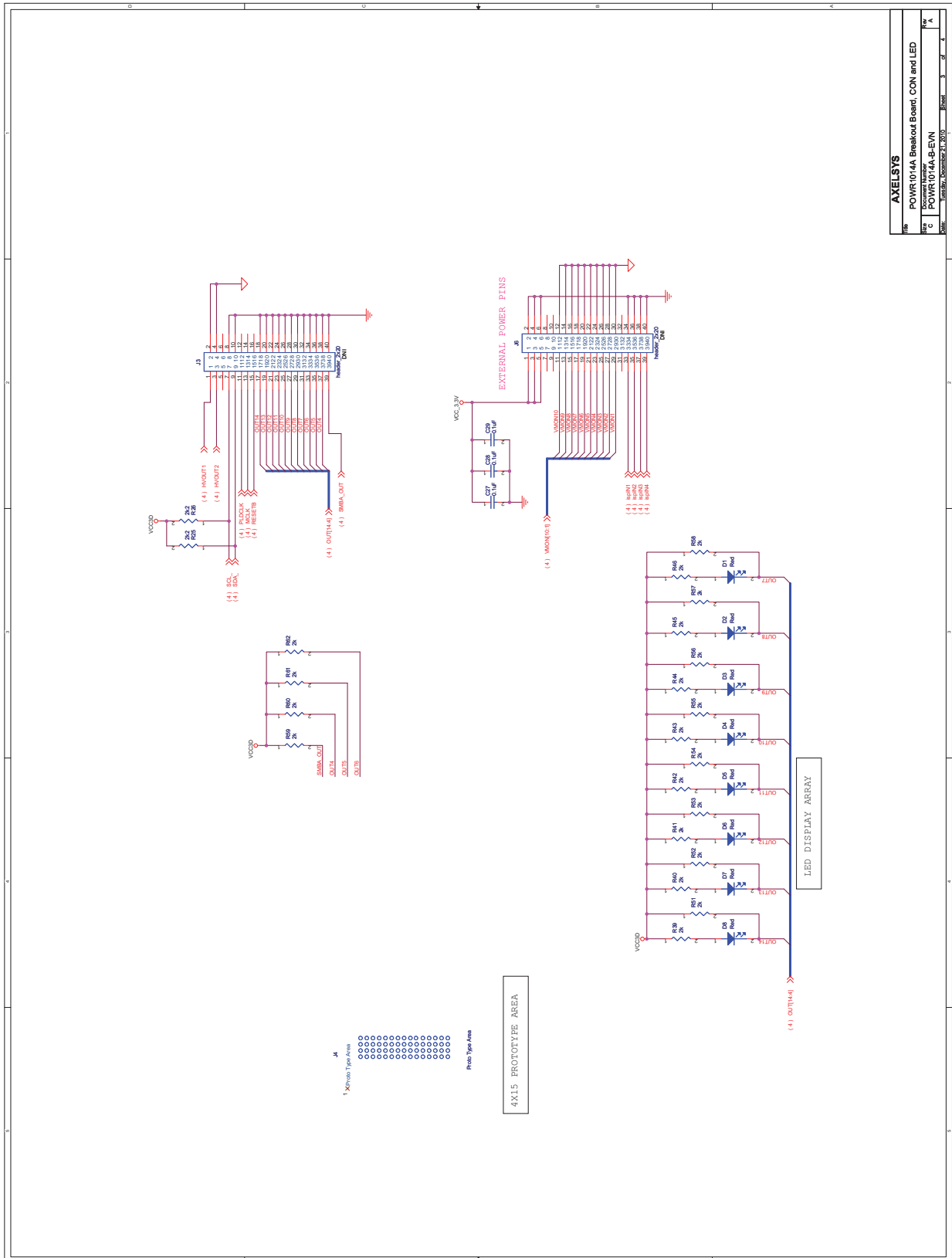


**Figure 3. USB Interface to JTAG**



REV	AXELSYS
1	POWR1014A Breakout Board, USBIF to JTAG
2	POWR1014A-B-EVN
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**Figure 4. Connectors and LEDs**



AXELSYS			
REV	POWR1014A Breakout Board, CON and LED	Sheet	4
DATE	POWR1014A-B-EVN	Rev	1
USER	Yusuf, Yousuf, 01_2015	Rev	1



## Appendix B. Bill of Materials

Table 6. POWR1014A Breakout Board Evaluation Kit Bill of Materials

Item	Quantity	Reference	Part	Class	Description	Manufacturer	Manufacturer Part Number	Digikey P/N	PCB Footprint	Assembly
1	3	C1, C3, C12	4u7	Discrete	Cap Cer 4.7uF 6.3V 10% X5R 0603	Panasonic	ECJ-1VB0J475K	PCC2396CT-ND	cc0603	
2	21	C2, C4, C5, C6, C7, C8, C9, C13	0.1uF	Discrete	Cap Cer 0.1uF 16V X7R 0402	Kemet	C0402C104K4RACTU	399-3521-2-ND	cc0402	
		C14, C15, C17, C20, C21, C22								
		C23, C24, C25, C26, C27, C28								
		C29								
3	2	C10, C16	10u	Discrete	Cap Cer 10uF 6.3V 20% X5R 0603	Panasonic	ECJ-1VB0J106M		cc0603	
4	1	C11	22u	Discrete	CAP CER 22UF 10V X5R 0805	Taiyo Yuden	LMK212BJ226M G-T		cc0805	
5	2	C18, C19	18pF	Discrete	CAP CER 18PF 25V C0G 0402	Kemet	C0402C180K3GACTU	C0402C180K3GACTU-ND	cc0402	
6	8	D1, D2, D3, D4, D5, D6, D7, D8	Red	Discrete	LED SUPER RED CLEAR 0603 SMD	Lite-On Inc	LTST-C190KRKT	160-1436-2-ND	led_0603	
7	1	D9	Green	Discrete	LED SUPER GREEN CLEAR 0603 SMD	Lite-On Inc	LTST-C190KGKT		led_0603	
8	1	J1	header_1x8						hdr_amp_87220_8_1x8_100	DNI
9	1	J2	SKT_MINIUSB_B_RA	IO		Neltron	5075BMR-05-SM-CR		skt_miniusb_b_ra	
10	2	J3, J6	header_2x20						hdr_samtec_mtsw_2x20_100	DNI
11	1	J4	Proto Type Area						hdr_th_4x15_100	DNI
12	4	L1, L2, L3, L4	600ohm 500mA	Discrete	Ferrite Bead 600ohm@100MHz 500mA 0603	Murata	BLM18AG601SN1D	490-1014-1-ND	FB0603	
13	1	R1	1k	Discrete	Res 1/16W 1K 1% 0402	Yageo	RC0402FR-071KL	311-1.00KLRTR-ND	cr0402	
14	8	R2, R3, R4, R7, R9, R17, R18	0	Discrete	Res 1/10W 0.0 Ohm 5% 0603	Yageo	RC0603JR-070RL	311-0.0GRTR-ND	cr0603	
		R19								
15	9	R11, R14, R15, R16, R20, R47	5k1	Discrete	Res 1/16W 5.1K 1% 0402	Yageo	RC0402FR-075K1L	311-5.10KLRTR-ND	cr0402	
		R48, R49, R50								
16	1	R12	12k	Discrete	Res 1/16W 12.0K 1% 0402	Yageo	RC0402FR-0712KL	311-12.0KLRTR-ND	cr0402	
17	1	R21	10k	Discrete	Res 1/16W 10.0K 1% 0402	Yageo	RC0402FR-0710KL	311-10.0KLRTR-ND	cr0402	
18	3	R22, R25, R26	2k2	Discrete	Res 1/16W 2.2K 1% 0402	Yageo	RC0402FR-072K2L	311-2.20KLRTR-ND	cr0402	
19	20	R39, R40, R41, R42, R43, R44	2k	Discrete	RES 2.0K OHM 1/16W 5% 0402 SMD	Yageo	RC0402JR-072KL	311-2.0KJRTR-ND	cr0402	
		R45, R46, R51, R52, R53, R54,								
		R55, R56, R57, R58, R59, R60								
		R61, R62								
20	1	TP1	TP_S_40_63	IO	Square test point, 40mil inner diameter, 63mil outer diameter				tp_s_40_63	
21	1	U1	NCP1117ST33			On Semi			sot223_4p	
22	1	U2	FT2232HL			FTDI	FT2232HL		tqfp64_0p5_12p2x12p2_h1p6	
23	1	U3	93LC56-SO8	IC	IC 93LC56 EEPROM	Microchip	93LC56T-I/SN		so8_50_244	
24	1	U4	ispPAC-POWR1014A-02TN48I						tqfp48_0p5_9p2x9p2_h1p7	
25	1	X1	12MHZ			TXC	7M-12.000MAAJ-T		crystal_4p_3p2x2p5	



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