



## ispMACH 4256ZE Breakout Board Evaluation Kit

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**User's Guide**

## Introduction

Thank you for choosing the Lattice Semiconductor ispMACH® 4256ZE Breakout Board Evaluation Kit!

This user's guide describes how to start using the ispMACH 4256ZE Breakout Board, an easy-to-use platform for evaluating and designing with the ispMACH 4256ZE CPLD. Along with the board and accessories, this kit includes a pre-loaded hardware test program. You may also reprogram the on-board ispMACH 4256ZE device to review your own custom designs.

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

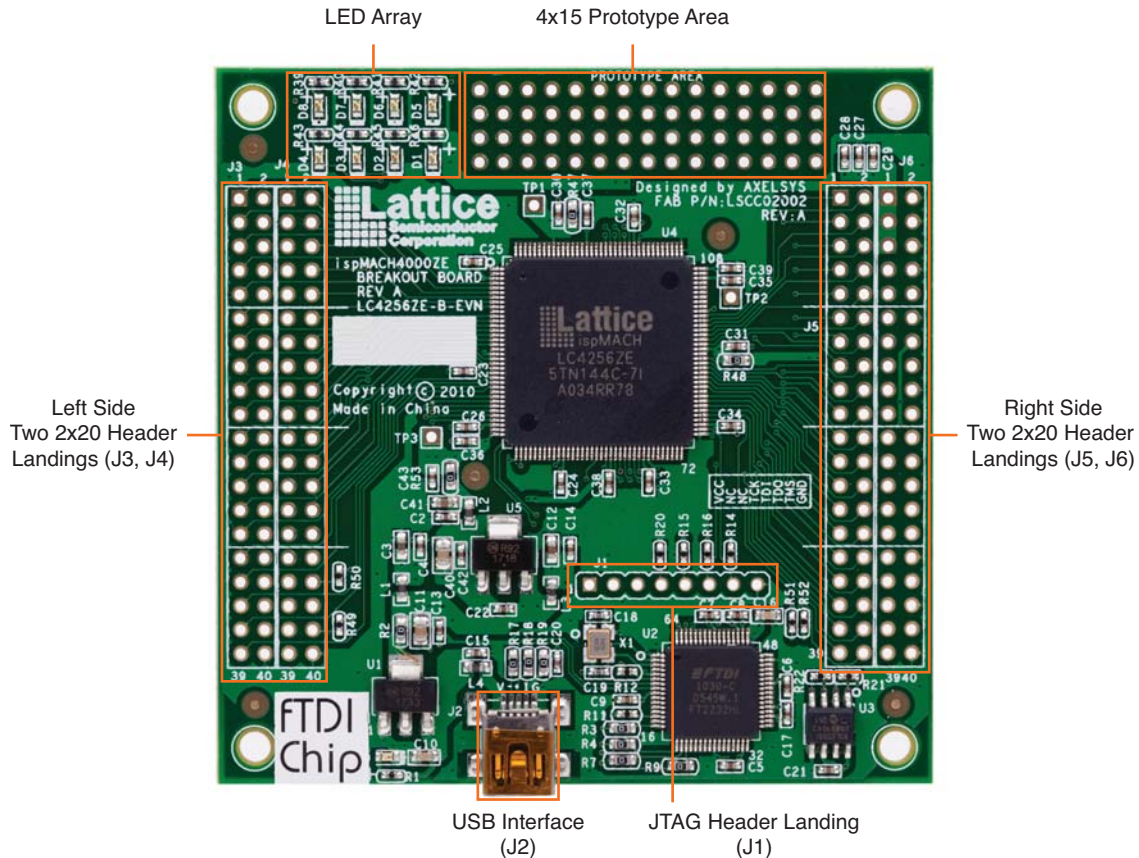
## Features

The ispMACH 4256ZE Breakout Board Evaluation Kit includes:

- **ispMACH 4000ZE Breakout Board** – The board is a 3" x 3" form factor that features the following on-board components and circuits:
  - ispMACH 4256ZE CPLD (LC4256ZE-5TN144C)
  - USB mini-B connector for power and programming
  - Eight LEDs
  - 4x15 prototype area
  - Four 2x20 expansion header landings for general I/O, JTAG, and external power
  - 1x8 expansion header landing for JTAG
  - 3.3V and 1.8V supply rails
- **Pre-loaded Demo** – The kit includes a pre-loaded counter design that highlights use of the embedded ispMACH 4000ZE 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 ispMACH 4256ZE 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 Breakout board, descriptions of the on-board connectors, and a complete set of schematics.

Figure 1. ispMACH 4256ZE 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

You should install the following software before you begin developing new designs for the Breakout board:

- FTDI USB Hardware Drivers ([www.latticesemi.com/breakoutboards](http://www.latticesemi.com/breakoutboards)) or ispVM System 17.9 (required for re-programming)
- Optional: ispLEVER Classic 1.4 (ispMACH 4000ZE CPLD support)

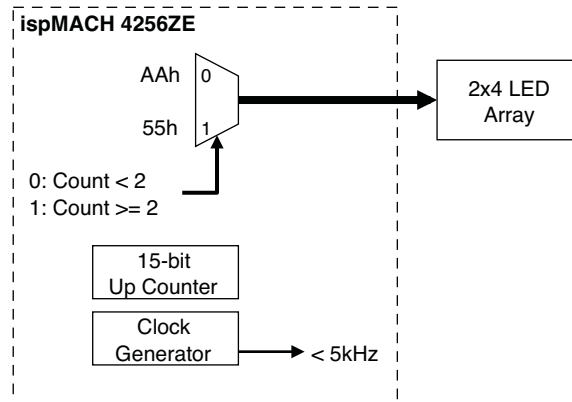
## Demonstration Design

Lattice provides a pre-programmed demo to illustrate basic operation of the ispMACH 4256ZE CPLD device. The design integrates an up-counter with the on-chip oscillator and timer (OSCTIMER) hardware feature. The design alternates to CPLD 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 Designs](#) section of this document.

The preprogrammed demonstration design is an up counter and an output multiplexer to drive an LED array. The demo shows a clock generator based on the ispMACH 4256ZE on-chip oscillator and timer (OSCTIMER) hardware feature. The counter module is clocked at <5kHz to illustrate the ease at which very low speed timer functions can be implemented with a CPLD. The 15-bit up counter advances each second. An output mux selects between hexadecimal patterns AAh or 55h depending on the count. The resulting light pattern will appear as an alternating pair of lit LEDs per row.

**Figure 2. Counter Demo Block Diagram**



## Run the Demonstration Design

**WARNING:** Do not connect the Breakout Board to your PC before you follow the driver installation procedure of this section.

Communication with the Breakout Board with a PC via the USB connection cable will require the FTDI chip USB hardware drivers contained in the [Software Requirements](#) section. Loading these drivers enables the computer to reliably recognize and program the Breakout Board. Drivers are distributed by Lattice as a stand-alone package or with ispVM System version 17.9 or later. Use one of the two procedures below to install.

To load the FTDI chip USB hardware drivers via ispVM System:

1. Browse to [www.latticesemi.com/breakoutboards](http://www.latticesemi.com/breakoutboards) and download ispVM System software.
2. Install ispVM System software.
3. Run ispVM System. Choose **ispTools > Install/Uninstall LSC USB/Parallel Port Driver**. The LSC 32/64-Bit USB Drivers Install/Uninstall dialog appears.
4. Select **FTDI USB 32-Bit Driver** or **FTDI USB 64-Bit Driver** then click **Install**. After a few moments, ispVM will indicate the installation is complete.
5. Click **OK**, then click **Close** from the LSC 32/64-Bit USB Drivers Install/Uninstall dialog.
6. Choose **File > Exit** to close ispVM System.
7. 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 indicating the board is powered on.
8. Red LEDs will light and start to flash according to the preprogrammed demonstration design.

See the [Troubleshooting](#) section of this guide if the board does not function as expected.

To load the FTDI chip USB hardware drivers via the stand-alone package:

1. Browse to [www.latticesemi.com/breakoutboards](http://www.latticesemi.com/breakoutboards) and download the FTDI chip USB Hardware driver package.
2. Extract the FTDI chip USB Hardware driver package to your PC hard drive.
3. 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 indicating the board is powered on.
4. 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**.
5. 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**.
6. Click **Next**. A screen will display as Windows copies the required driver files. Windows will display a message indicating that the installation was successful.
7. Click **Finish** to install the USB driver.
8. Red LEDs will light and start to flash according to the preprogrammed demonstration design.

See the [Troubleshooting](#) section of this guide if the board does not function as expected.

## Download Demo Designs

A demo is preprogrammed into the Breakout Board, however over time it is likely your board will be modified. Lattice distributes source and programming files for demonstration designs compatible with the Breakout Board.

To download demo designs:

1. Browse to the Lattice Breakout Board web page ([www.latticesemi.com/breakoutboards](http://www.latticesemi.com/breakoutboards)). Select the ispMACH 4256ZE Demo Application download and save the file.
2. Extract the contents of **ispMACH4256ZE\_BB\_Eval\_Kit\_v01.0.zip** to an accessible location on your hard drive.

The demo design directory, **LC4256ZE\_CTL**, is unpacked.

## Recompile a Demonstration Project with ispLEVER Classic

Use the procedure described below to recompile a demo project for the Breakout Board.

1. Install and license ispLEVER Classic software.
2. Run the ispLEVER Classic Project Navigator.
3. Browse to the demo design directory, **LC4256ZE\_CTL**, and open the **LC4256ZE.syn** project file.
4. From the Source in project window, select the target device.  
The Fit Design process appears in the Processes for current source window.
5. Select **Fit Design**, right-click and choose **Start**.  
After a few moments the JEDEC programming file is output.
6. See the [Programming with ispVM](#) section for details on downloading a programming file to the board.

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## Programming with ispVM

A demonstration design is pre-programmed into the Breakout Board by Lattice. To restore a Breakout Board to factory settings or load an alternative demo design, use the procedures in this section.

To install ispVM programming tools:

1. Install and license ispVM System software.
2. Connect the board to a host PC using the USB port header connection.
3. Follow the USB Cable Interface procedure below to program the evaluation board.

The 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 ispMACH 4256ZE can then be scanned and programmed using the ispVM System software.

To program a demo programming file:

1. From the **Start** menu run ispVM System.  
ispVM appears.
2. Choose **Options > Cable and IO 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 **LC4256ZE** device appears in the device list.
5. Right-click the **LC4256ZE** entry and choose **Edit Device...**  
The Device Information dialog appears.
6. From the **Data File** section, click the **Browse** button.  
The Open Data File dialog appears.
7. Browse to the **<Demo Dir>** folder, select **<Demo>.jed**, and click **Open**. From the **Operation** list choose **Erase, Program, Verify** and click **OK**.
8. Choose **Project > Download**.  
ispVM reprograms the evaluation board.

Programming requires about 10 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.

## ispMACH 4256ZE Breakout Board

This section describes the features of the ispMACH 4256ZE Breakout board in detail.

### Overview

The ispMACH 4256ZE Breakout Board is a complete development platform for the ispMACH 4256ZE CPLD. The board includes a prototyping area, a USB program/power port, an LED array, and header landings with electrical connections to most of the CPLDs programmable I/O, power and JTAG pins. The board is powered by the PC's

USB port or optionally with external power. You may create or modify CPLD program files using ispLEVER Classic software and reprogram the board using ispVM software.

**Figure 3. ispMACH 4000ZE Breakout Board Block Diagram**

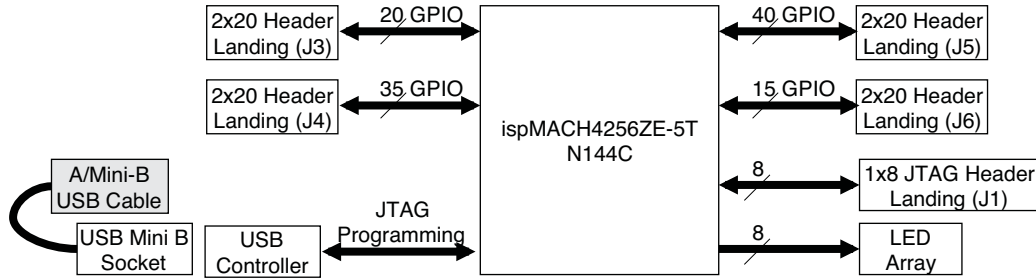


Table 1 describes the components on the board and the interfaces it supports.

**Table 1. Breakout Board Components and Interfaces**

Component/Interface	Type	Schematic Reference	Description
<b>Circuits</b>			
USB Controller	Circuit	U2: FT2232H	USB-to-JTAG interface and dual USB UART/FIFO IC
USB Mini-B Socket	I/O	J1:USB_MINI_B	Programming and debug interface
<b>Components</b>			
LC4256ZE	CPLD	U4: LC4256ZE-5TN144C	256-macrocell CPLD packaged in a 20 x 20mm, 144-pin TQFP
<b>Interfaces</b>			
LED Array	Output	D8-D1	Red LEDs
Four 2x20 header landings	I/O	J3: header_2x20 J4: header_2x20 J5: header_2x20 J6: header_2x20	User-definable I/O
1x8 header landing	I/O	J1: header_1x8	Optional JTAG interface
4x15 prototype area		J9	Prototype area 100mil centered holes

## Subsystems

This section describes the principle subsystems for the ispMACH 4256ZE Breakout Board in alphabetical order.

### Clock Sources

All clocks for the counter demonstration designs originate from the ispMACH 4256ZE CPLD on-chip oscillator and timer (OSCTIMER) block. You may use an expansion header landing to drive a CPLD input with an external clock source.

### Expansion Header Landings

The expansion header landings provide access to user GPIOs, primary inputs, clocks, and Bank 0/1 VCCO pins of the ispMACH 4256ZE. The remaining pins serve as power supplies for external connections. Each landing is configured as one 2x20 100 mil.

**Table 2. Expansion Connector Reference**

Item	Description
Reference Designators	J3, J4, J5, J6
Part Number	header_2x20

**Table 3. Expansion Header Pin Information (J3)**

Pin Number	Function	LC4256ZE Pin
1	IO_C12	4
2	GND	n/a
3	IO_C10	5
4	GND	n/a
5	IO_C8	6
6	GND	n/a
7	IO_C6	7
8	GND	n/a
9	IO_C4	8
10	GND	n/a
11	IO_C2	9
12	GND	n/a
13	IO_D14	11
14	GND	n/a
15	IO_D12	12
16	GND	n/a
17	IO_D10	13
18	GND	n/a
19	IO_D8	14
20	GND	n/a
21	IO_D6	15
22	GND	n/a
23	IO_D4	16
24	GND	n/a
25	IO_IA1	17IN
26	GND	n/a
27	IO_IA2	20IN
28	GND	n/a
29	IO_E2	21
30	GND	n/a
31	IO_E4	22
32	GND	n/a
33	IO_E6	23
34	GND	n/a
35	IO_E8	24
36	GND	n/a
37	IO_E10	25
38	GND	n/a
39	IO_E12	26
40	GND	n/a



**Table 4. Expansion Header Pin Information (J4)**

Pin Number	Function	LC4256ZE Pin
1	IO_F2	28
2	IO_A2	130
3	IO_F4	29
4	IO_A4	131
5	IO_F6	30
6	IO_A6	132
7	IO_F8	31
8	IO_A8	133
9	IO_F10	32
10	IO_A10	134
11	IO_F12	33
12	IO_A12	135
13	IO_G12	39
14	IO_B2	138
15	IO_G10	40
16	IO_B4	139
17	IO_G8	41
18	IO_B6	140
19	IO_G6	42
20	IO_B8	141
21	IO_G4	43
22	IO_B10	142
23	IO_G2	44
24	IO_B12	143
25	IO_IA3	38IN
26	IO_IA5	144IN
27	IO_IA4	45IN
28	GND	n/a
29	IO_H12	48
30	NC	n/a
31	IO_H10	49
32	GND	n/a
33	IO_H8	50
34	CLK1	54CLK
35	IO_H6	51
36	GND	n/a
37	IO_H4	52
38	CLK0	128CLK
39	IO_H2	53
40	GND	n/a

**Table 5. Expansion Header Pin Information (J5)**

Pin Number	Function	LC4256ZE Pin
1	IO_P2	125
2	IO_M12	98
3	IO_P4	124
4	IO_M10	97
5	IO_P6	123
6	IO_M8	96
7	IO_P8	122
8	IO_M6	95
9	IO_P10	121
10	IO_M4	94
11	IO_P12	120
12	IO_M2	93
13	IO_IB10	117IN
14	IO_IB8	92IN
15	IO_IB9	110IN
16	IO_IB7	89IN
17	IO_O2	116
18	IO_L4	88
19	IO_O4	115
20	IO_L6	87
21	IO_O6	114
22	IO_L8	86
23	IO_O8	113
24	IO_L10	85
25	IO_O10	112
26	IO_L12	84
27	IO_O12	111
28	IO_L14	83
29	IO_N12	105
30	IO_K2	81
31	IO_N10	104
32	IO_K4	80
33	IO_N8	103
34	IO_K6	79
35	IO_N6	102
36	IO_K8	78
37	IO_N4	101
38	IO_K10	77
39	IO_N2	100
40	IO_K12	76

**Table 6. Expansion Header Pin Information (J6)**

Pin Number	Function	LC4256ZE Pin
1	VCC_3.3V	VCCO_33
2	GND	GND
3	VCC_3.3V	VCCO_33
4	GND	GND
5	VCC_3.3V	VCCO_33
6	GND	GND
7	NC	NC
8	GND	GND
9	NC	NC
10	V_ext_1_8v	VCC_EXT
11	GND	GND
12	GND	GND
13	IO_J2	66
14	V_ext_B0	VCCO_EXT_0
15	IO_J4	67
16	V_ext_B1	VCCO_EXT_1
17	IO_J6	68
18	GND	GND
19	IO_J8	69
20	NC	NC
21	IO_J10	70
22	NC	NC
23	IO_J12	71
24	NC	NC
25	IO_IB6	72IN
26	NC	NC
27	GND	GND
28	NC	NC
29	IO_I2	58
30	NC	NC
31	IO_I4	59
32	GND	GND
33	IO_I6	60
34	CLK3	126CLK
35	IO_I8	61
36	GND	GND
37	IO_I10	62
38	CLK2	56CLK
39	IO_I12	63
40	GND	GND

Figure 4. J3/J4 Header Landing Callout

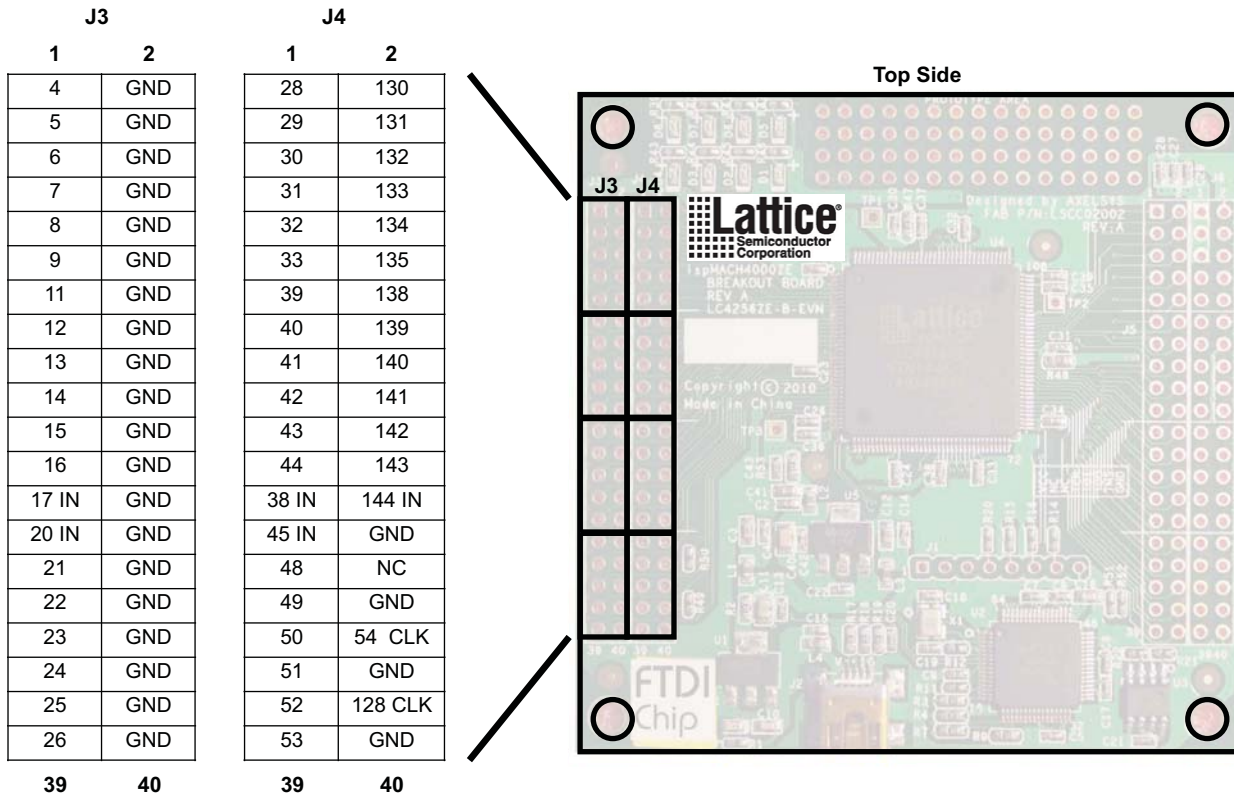


Figure 5. J5/J6 Header Landing Callout

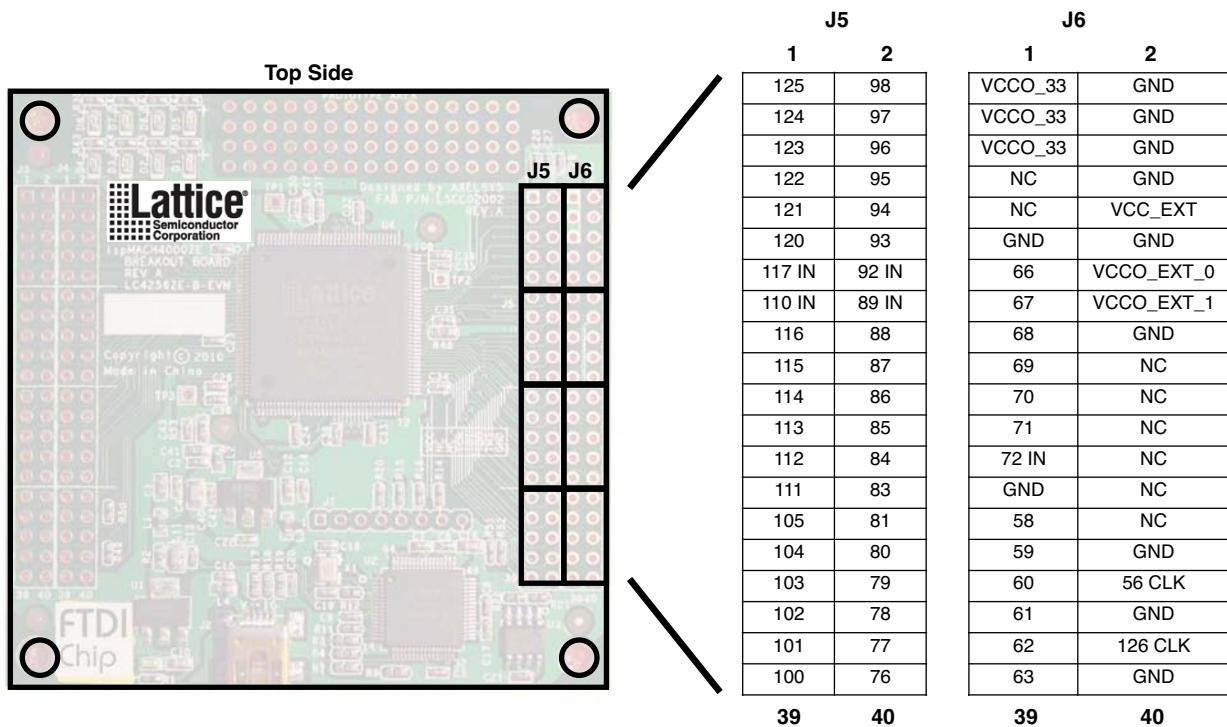
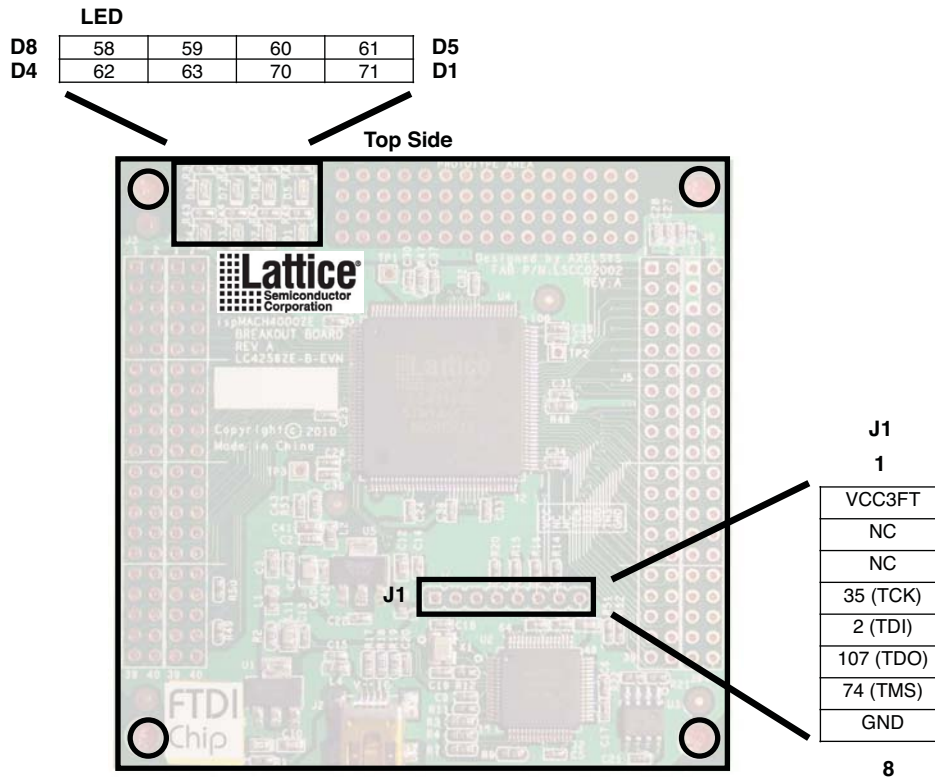


Figure 6. J1 Header Landing and LED Array Callout



### ispMACH4256ZE-TN144 CPLD

The board features the ispMACH 4000ZE CPLD which is ideal for low-power, high-volume portable applications. The on-board ispMACH 4256ZE is the highest capacity device of the family with 256 macrocells (equivalent to about 450 FPGA LUTs). The 144-pin TQFP package provides 96 user I/Os and 4 dedicated inputs in a 20mm x 20mm package. The ispMACH 4256ZE consumes standby current as low as 15µA. A complete description of this device can be found in the [ispMACH 4000ZE Family Data Sheet](#).

Table 7. ispMACH 4256ZE CPLD Interface Reference

Item	Description
Reference Designator	U4
Part Number	LC4256ZE-5TN144C
Manufacturer	Lattice Semiconductor
Web Site	<a href="http://www.latticesemi.com">www.latticesemi.com</a>

### JTAG Interface Circuits (Reference Known Issues)

For power and programming, a FTDI chip USB UART/FIFO IC converter provides a communication interface between a PC host and the JTAG programming chain of the Breakout Board. The USB 5V supply is also used as a source for the 3.3V and 1.8V supply rails. A USB mini-B socket is provided for the USB connector cable.

Table 8. JTAG Interface Reference

Item	Description
Reference Designator	U2
Part Number	FT2232HL
Manufacturer	Future Technology Devices International (FTDI)
Web Site	<a href="http://www.ftdichip.com">www.ftdichip.com</a>

**Table 9. JTAG Programming Pin Information**

Description	ispMACH 4256ZE Pin
Test Data Output	107:TDO
Test Data Input	2:TDI
Test Mode Select	74:TMS
Test Clock	35:TCK

### LEDs

A green LED (D9) is used to indicate USB 5V power. Eight red LEDs are driven by I/O pins of the ispMACH 4256ZE CPLD.

**Table 10. Power and User LEDs Reference**

Item	Description
Reference Designators	D1, D2, D3, D4, D5, D6, D7, D8, D9
Part Number	LTST-C190KRKT (D1-D8) LTST-C190KGKT (D9)
Manufacturer	Lite-On It Corporation
Web Site	<a href="http://www.liteonit.com">www.liteonit.com</a>

### Power Supply

3.3V and 1.8V supply rails are converted from the USB 5V interface when the board is connected to a host PC.

### Test Points

In order to check the various voltage levels used, test points are provided:

- TP1, VCC3D (VCCO Bank 0)
- TP2, VCC3D (VCCO Bank 1)
- TP3, VCC1\_8 (VCC Core)

### USB Programming and Debug Interface

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

**JTAG Programming:** For JTAG programming, a preprogrammed USB PHY peripheral controller is provided on the Breakout Board to serve as the programming interface to the ispMACH 4256ZE CPLD.

Programming requires the ispVM System software.

**Table 11. USB Interface Reference**

Item	Description
Reference Designator	U2
Part Number	FT2232HL
Manufacturer	Future Technology Devices International (FTDI)
Web Site	<a href="http://www.ftdichip.com">www.ftdichip.com</a>

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## Board Modifications

This section describes modifications to the board to change or add functionality.

### Bypassing the USB Programming Interface

The USB programming interface circuit (section 6.2.8 USB Programming and Debug Interface) may be optionally bypassed by removing the 0 ohm resistors: R3, R4, R7, and R9 (See Schematic Sheet 2 of 4, [Appendix A. Schematics](#)). Header landing J1 provides JTAG signal access for jumper wires or a 1x8 pin header.

### Applying External Power

The Breakout Board is powered by the circuit of Schematic Sheet 2 of 4 based on the 5V USB power source. You may disconnect this power source by removing the 0 ohm resistors: R47 (VCCO 3.3V, Bank 0), R48 (VCCO 3.3V, Bank 1), and R53 (VCC 1.8V, Core). Power connections are available from the expansion header landing, J6, Schematic Sheet 3 of 4.

### Measuring Bank and Core Voltages

Test points (TP1, TP2, and TP3) provide access to bank VCCO and VCC core power supplies of the ispMACH 4256ZE CPLD. 0 ohm resistors: R47 (VCCO 3.3V, Bank 0), R48 (VCCO 3.3V, Bank 1), and R53 (VCC 1.8V, Core) can be removed to add a current meter inline or add a resistor shunt to measure voltage across.

## Mechanical Specifications

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

## Environmental Requirements

The evaluation 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

**CPLD:** Complex Programmable Logic Device

**LED:** Light Emitting Diode

**LUT:** Look-Up Table

**PCB:** Printed Circuit Board

**RoHS:** Restriction of Hazardous Substances Directive

**TQFP:** Thin Quad Flat Pack

**USB:** Universal Serial Bus

**WDT:** Watchdog Timer

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## Troubleshooting

Use the tips in this section to diagnose problems with the ispMACH 4256ZE Breakout Board.

### LEDs Do Not Flash

If power is applied but the board does not flash according to the preprogrammed counter demonstration then it is likely that the board has been reprogrammed with a new design. Follow the directions in the [Demonstration Design](#) section of this document to restore the factory default.

### USB Cable Not Detected

If ispVM System does not recognize the USB cable even after installing the Lattice USB Port Drivers and rebooting, 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 access the Troubleshooting the USB Driver Installation Guide:

1. Start ispVM System 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 directions of the guide to install the Lattice USB driver.

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

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

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

To compare JEDEC file checksum:

1. Connect the 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)
ispMACH 4256ZE Breakout Board Evaluation Kit	LC4256ZE-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)

## Revision History

Date	Version	Change Summary
March 2011	01.0	Initial release.
March 2012	01.1	Added Appendix C. Known Issues.

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## Appendix A. Schematics

Figure 7. ispMACH 4256ZE Breakout Board, Cover

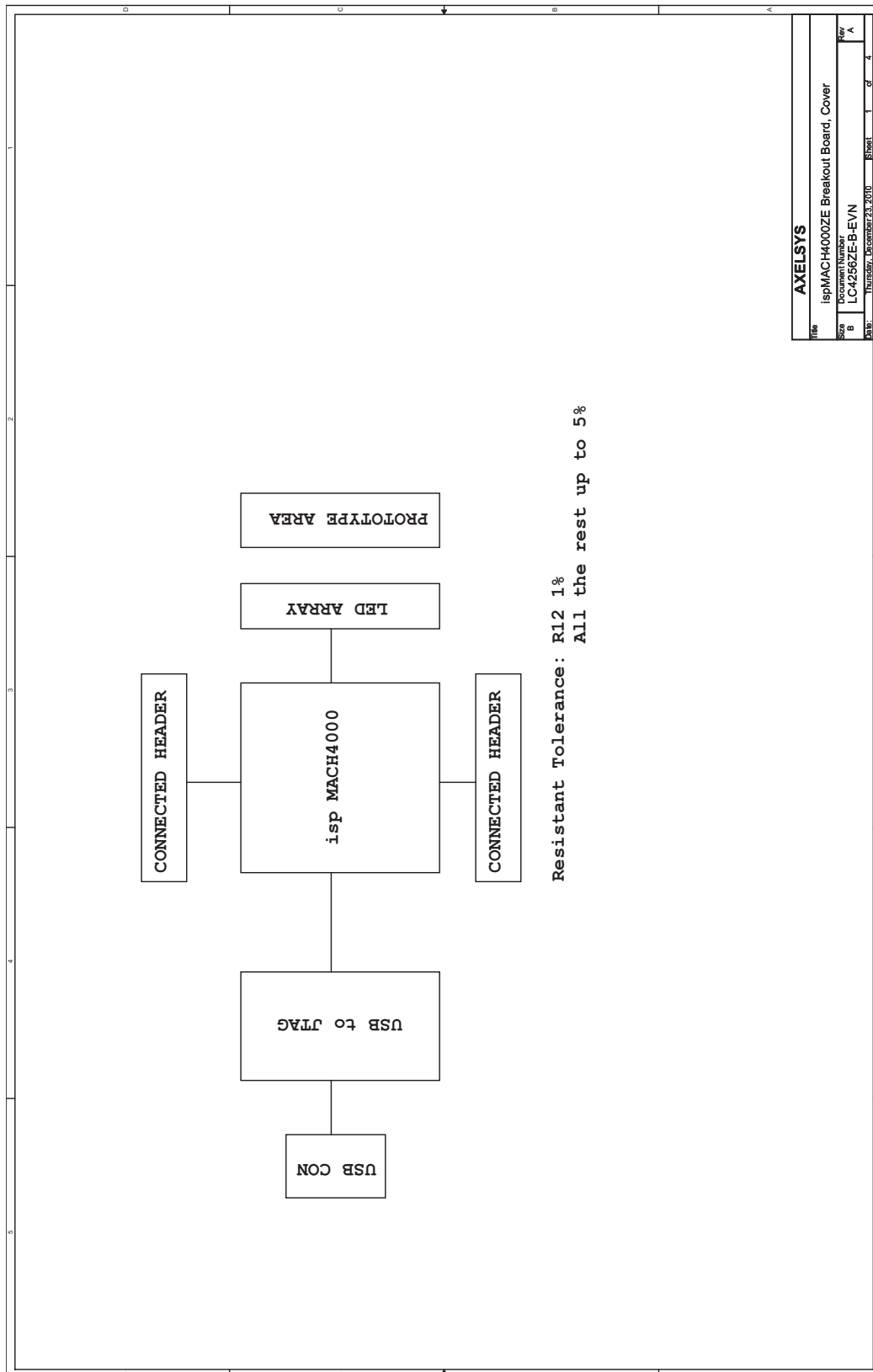
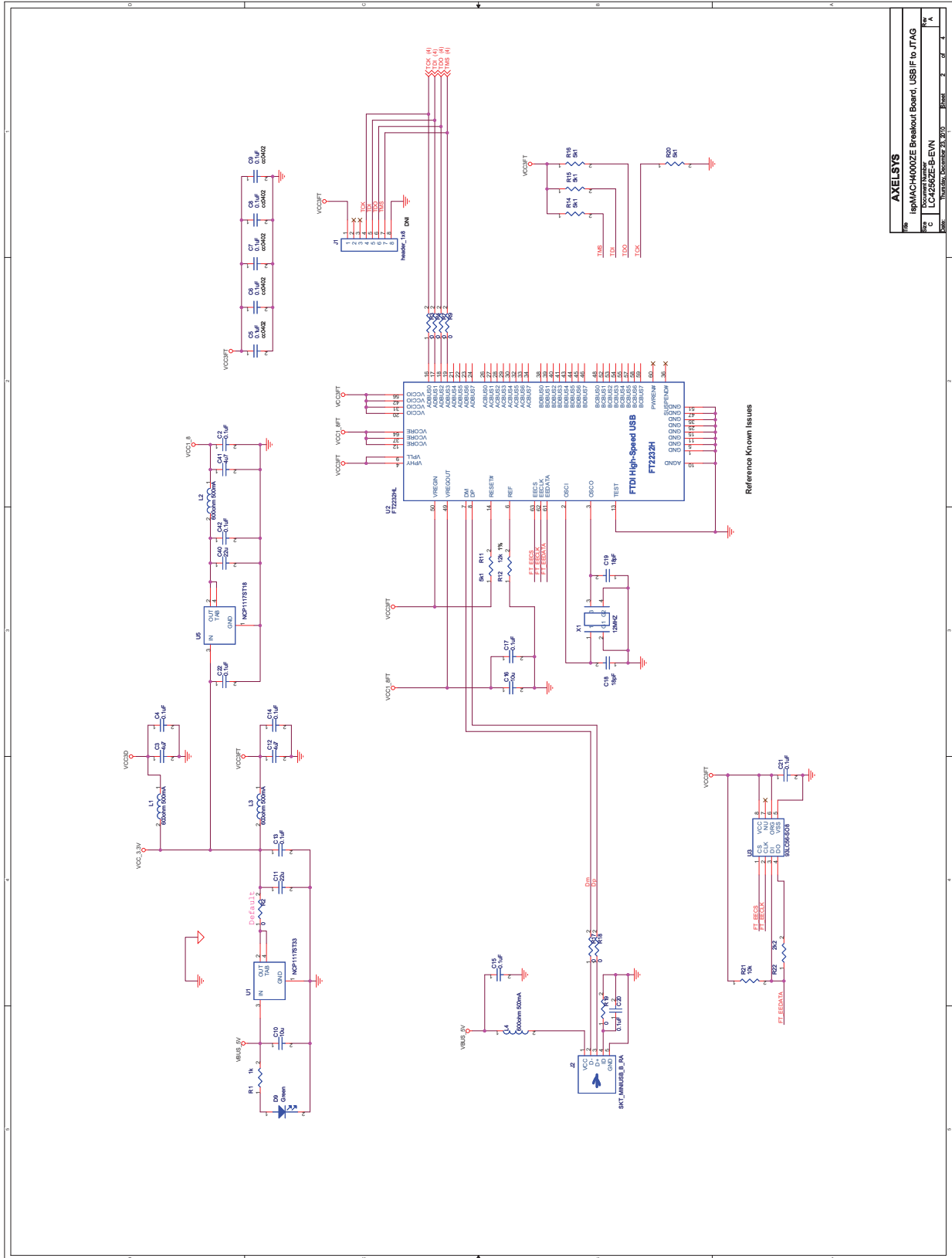
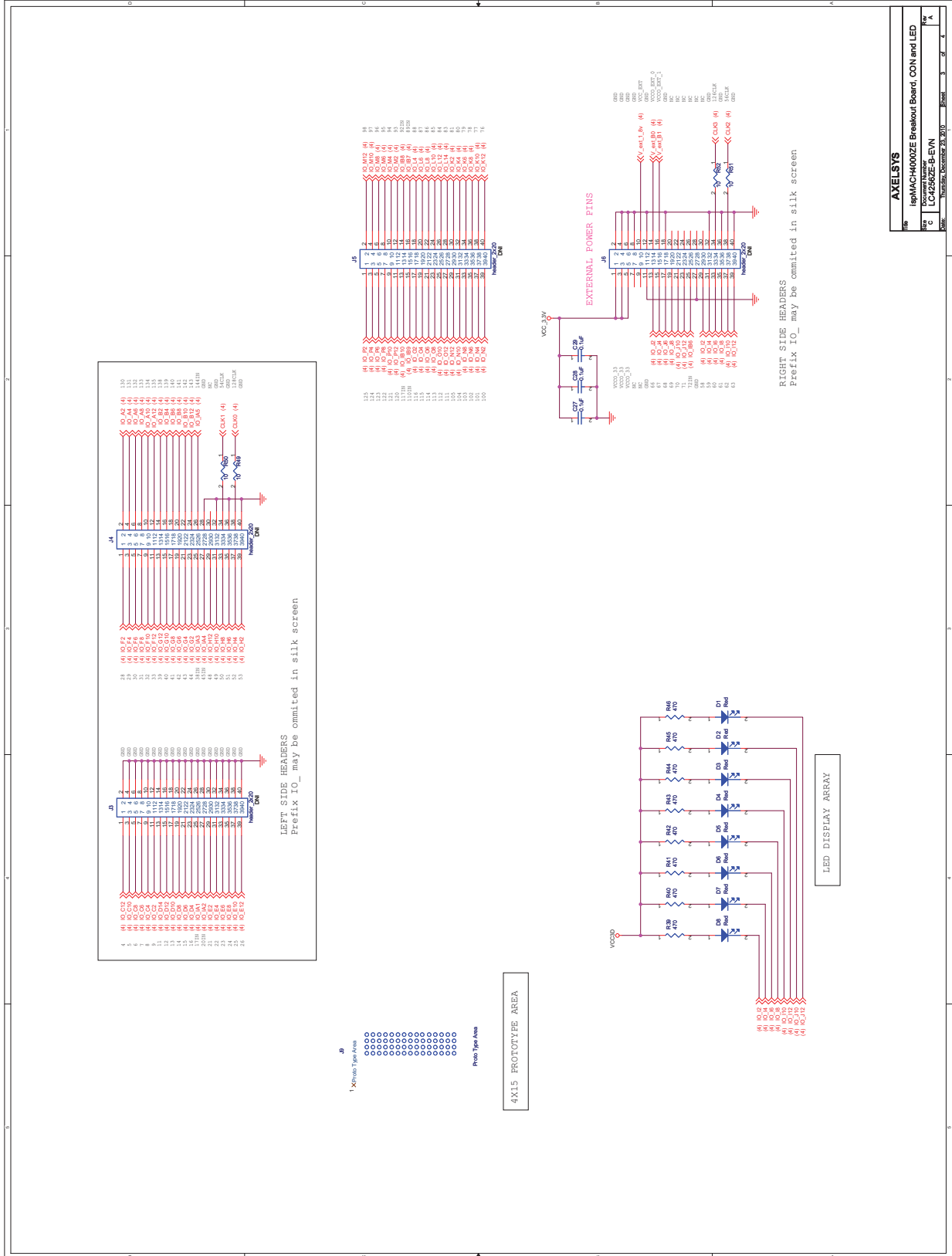


Figure 8. USBIF to JTAG



AXELSYS			
Rev	ispMACH4000ZE Breakout Board, USBIF to JTAG		
1	LC4256ZE-B-EVN		
2	1	2	3
3	4	5	6
4	7	8	9
5	10	11	12
6	13	14	15
7	16	17	18
8	19	20	21
9	22	23	24
10	25	26	27
11	28	29	30
12	31	32	33
13	34	35	36
14	37	38	39
15	40	41	42
16	43	44	45
17	46	47	48
18	49	50	51
19	52	53	54
20	55	56	57
21	58	59	60
22	61	62	63
23	64	65	66
24	67	68	69
25	70	71	72
26	73	74	75
27	76	77	78
28	79	80	81
29	82	83	84
30	85	86	87
31	88	89	90
32	91	92	93
33	94	95	96
34	97	98	99
35	100	101	102
36	103	104	105
37	106	107	108
38	109	110	111
39	112	113	114
40	115	116	117
41	118	119	120
42	121	122	123
43	124	125	126
44	127	128	129
45	130	131	132
46	133	134	135
47	136	137	138
48	139	140	141
49	142	143	144
50	145	146	147
51	148	149	150
52	151	152	153
53	154	155	156
54	157	158	159
55	160	161	162
56	163	164	165
57	166	167	168
58	169	170	171
59	172	173	174
60	175	176	177
61	178	179	180
62	181	182	183
63	184	185	186
64	187	188	189
65	190	191	192
66	193	194	195
67	196	197	198
68	199	200	201
69	202	203	204
70	205	206	207
71	208	209	210
72	211	212	213
73	214	215	216
74	217	218	219
75	220	221	222
76	223	224	225
77	226	227	228
78	229	230	231
79	232	233	234
80	235	236	237
81	238	239	240
82	241	242	243
83	244	245	246
84	247	248	249
85	250	251	252
86	253	254	255
87	256	257	258
88	259	260	261
89	262	263	264
90	265	266	267
91	268	269	270
92	271	272	273
93	274	275	276
94	277	278	279
95	280	281	282
96	283	284	285
97	286	287	288
98	289	290	291
99	292	293	294
100	295	296	297
101	298	299	300
102	301	302	303
103	304	305	306
104	307	308	309
105	310	311	312
106	313	314	315
107	316	317	318
108	319	320	321
109	322	323	324
110	325	326	327
111	328	329	330
112	331	332	333
113	334	335	336
114	337	338	339
115	340	341	342
116	343	344	345
117	346	347	348
118	349	350	351

Figure 9. Connectors and LEDs





## Appendix B. Bill of Materials

Table 12. Bill of Materials, ispMACH 4256ZE Breakout Board

Item	Quantity	Reference	Part Number
1	33	C2, C4, C5, C6, C7, C8, C9, C13, C14, C15, C17, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C42, C43	C0402C104K4RACTU
2	3	C3, C12, C41	ECJ-1VB0J475K
3	2	C10, C16	ECJ-1VB0J106M
4	2	C11, C40	LMK212BJ226MG-T
5	2	C18, C19	C0402C180K3GACTU
6	8	D1, D2, D3, D4, D5, D6, D7, D8	LTST-C190KRKT
7	1	D9	LTST-C190KGKT
8	1	J1	DNI
9	1	J2	5075BMR-05-SM-CR
10	4	J3, J4, J5, J6	DNI
11	1	J9	DNI
12	4	L1, L2, L3, L4	BLM18AG601SN1D
13	1	R1	RC0402FR-071KL
14	11	R2, R3, R4, R7, R9, R17, R18, R19, R47, R48, R53	RC0603JR-070RL
15	5	R11, R14, R15, R16, R20	RC0402FR-075K1L
16	1	R12	RC0402FR-0712KL
17	1	R21	RC0402FR-0710KL
18	1	R22	RC0402FR-072K2L
19	8	R39, R40, R41, R42, R43, R44, R45, R46	RC0402FR-07470RL
20	4	R49, R50, R51, R52	RC0402FR-0710RL
21	3	TP1, TP2, TP3	DNI
22	1	U1	NCP1117ST33T3G
23	1	U2	FT2232HL
24	1	U3	93LC56T-I/SN
25	1	U4	LC4256ZE-5TN144C
26	1	U5	NCP1117ST18T3G
27	1	X1	7M-12.000MAAJ-T

## Appendix C. Known Issues

1. The ispMACH 4000ZE 1532 interface signals TCK, TMS, TDI and TDO are referenced to VCC=1.8V (logic core). The ispMACH 4256ZE Breakout Board has an issue where the JTAG signals are connected to the FTDI which has a 3.3V interface. This circuit should not be replicated in a production board. As a work-around another FTDI device could be selected or a level translator could be used between the FTDI device and the ispMACH 4000ZE.