MachXO2280 Breakout Board Evaluation Kit

User Guide

January 2015
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Introduction

Thank you for choosing the Lattice Semiconductor MachXO™2280 Breakout Board Evaluation Kit!

This user guide describes how to start using the MachXO2280 Breakout Board, an easy-to-use platform for evaluating and designing with the MachXO2280 PLD. Along with the board and accessories, this kit includes a pre-loaded demonstration design. You may also reprogram the on-board MachXO2280 device to review your own custom 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.

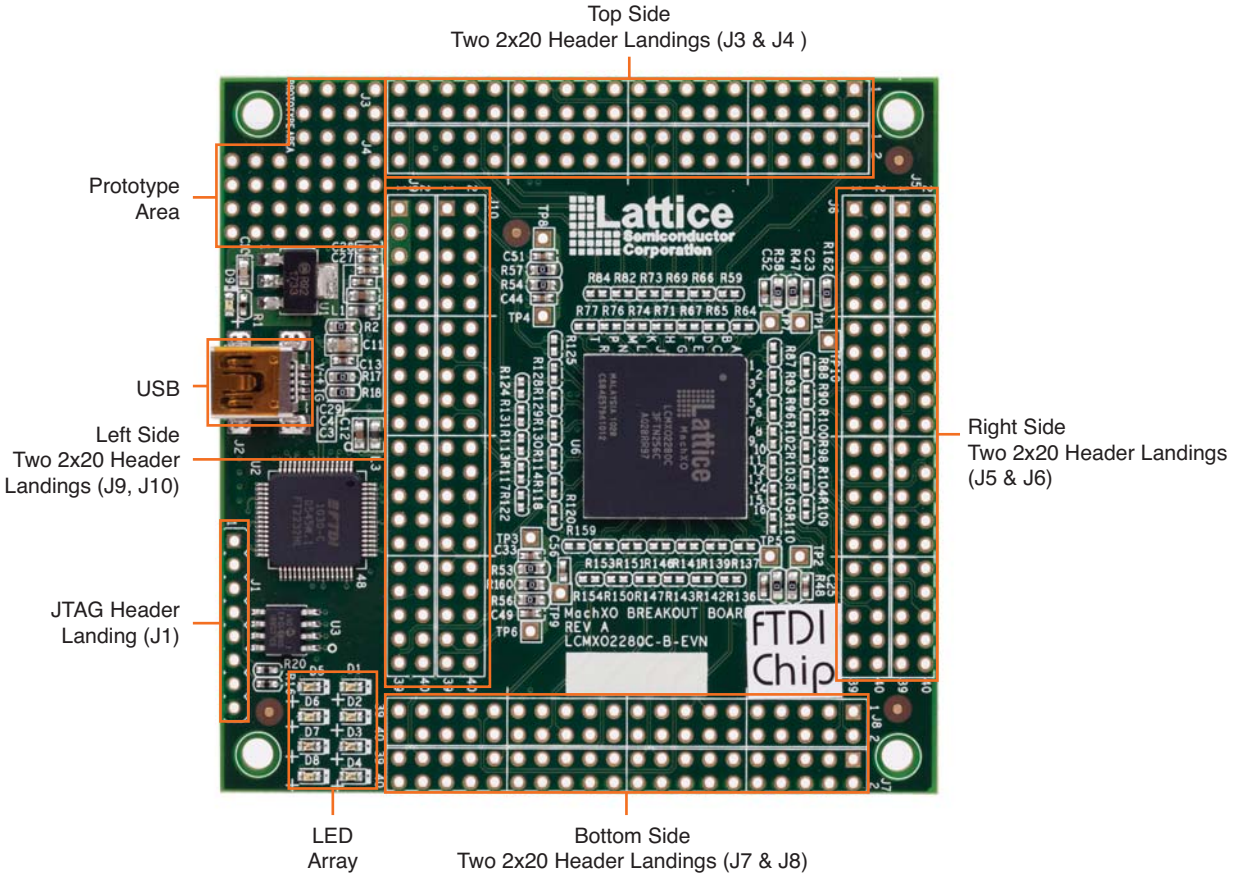
Features

The MachXO2280 Breakout Board Evaluation Kit includes:

- **MachXO2280 Breakout Board** – The board is a 3” x 3” form factor that features the following on-board components and circuits:
  - MachXO2280 PLD (LCMXO2280C-3FTN256C)
  - USB mini-B connector for power and programming
  - Eight LEDs
  - 40-hole prototype area
  - Eight 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 use of the embedded MachXO2280 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 LCMXO2280C JTAG port.
- **Lattice Breakout Board Evaluation Kits Web Page** – Visit www.latticesemi.com/breakoutboards for the latest documentation (including this guide), demo designs, and drivers for the kit.

The content of this user 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. MachXO2280 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 Chip USB Hardware Drivers
- Lattice Diamond™ (MachXO support)
- ispVM System™ 17.9 or later (Required for re-programming)

MachXO2280 Device

This board features the MachXO2280 PLD which offers the benefits of increased system integration by providing over 27Kbits of embedded memory, two built-in PLLs, high performance LVDS I/Os, and a low power sleep mode, all in a single-device. The 256-pin ftBGA package provides 211 user I/Os in a 17mm x 17mm package. A complete description of this device can be found in DS1002, MachXO Family Data Sheet.

Demonstration Design

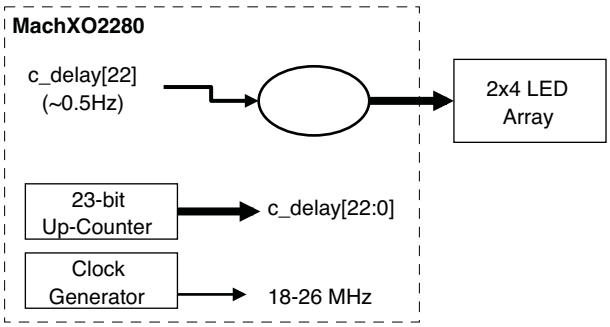
Lattice provides a pre-programmed demo to illustrate basic operation of the MachXO2280 device. The design integrates an up-counter with the on-chip oscillator.

Note: You may obtain your Breakout Board after it has been reprogrammed. To restore the factory default demo and program it with other Lattice-supplied examples see the Download Demo Designs section of this document.

Run the Demonstration Design

The preprogrammed demonstration design is an up-counter to drive an LED array. The program shows a clock generator based on the MachXO2280 on-chip oscillator. The counter module is clocked at ~22 MHz (18-26MHz) to illustrate how low speed timer functions can be implemented with a PLD. The 23-bit up-counter further divides the clock to advance the LED display approximately every 200ms. The resulting light pattern will appear as an alternating pair of lit LEDs per row.

Figure 2. Counter Demo Block Diagram



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 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 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

The counter 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 Evaluation Kits web page (www.latticesemi.com/breakoutboards) of the Lattice web site. Select **MachXO Breakout Board Demo Source** and save the file.
2. Extract the contents of **MachXO2280_BB_Eval_Kit_v01.0.zip** to an accessible location on your hard drive.

The demo design directory **Demo_LED** is unpacked.

Recompile a Demonstration Project with Lattice Diamond

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

1. Install and license Lattice Diamond software.
2. Download the demo source files from the Lattice Breakout Board Evaluation Kits web page.
3. Run Lattice Diamond.
4. Open the **Demo_LED_OSC.ldf** project file.
5. From the **Process** view, select **JEDEC File** from the **Export Files** process.
6. Choose **Export Files**, right-click and choose **Run**.
   After a few moments the JEDEC programming file is output.
7. See section the Programming with ispVM section for details on downloading a programming file to the board.

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 MachXO2280 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 **LCMXO2280C** device appears in the device list.
5. Right-click the **LCMXO2280C** 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.

MachXO2280 Breakout Board

This section describes the features of the MachXO2280 Breakout Board in detail.

Overview

The Breakout Board is a complete development platform for the MachXO2280 PLD. The board includes a prototyping area, a USB program/power port, an LED array, and header landings with electrical connections to most of the PLD's 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 the program files using Diamond software and reprogram the board using ispVM software.

Figure 3. MachXO2280 Breakout Board Block Diagram

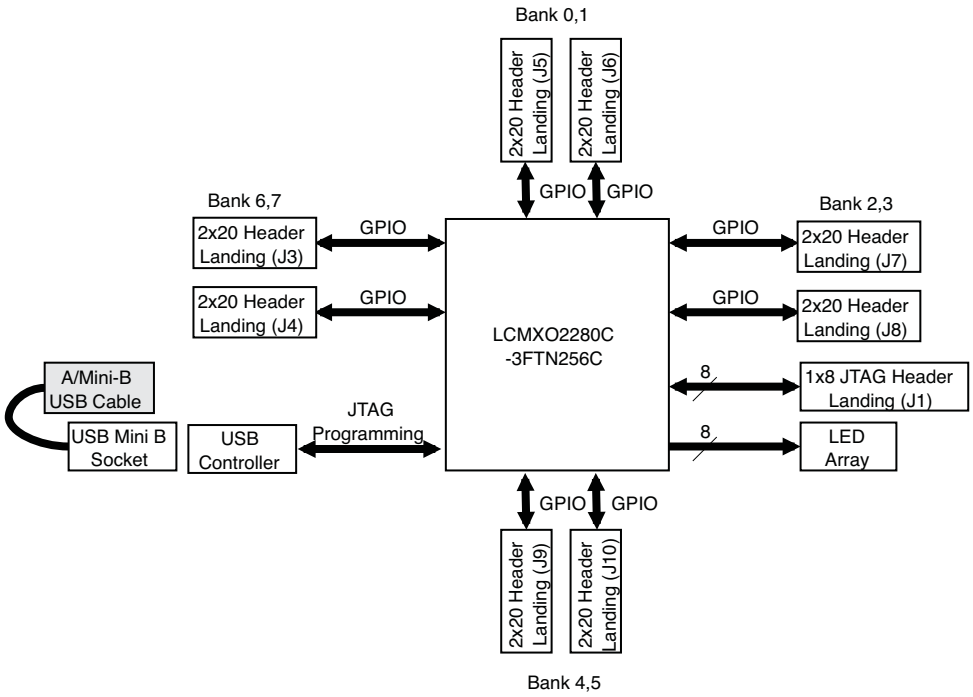


Table 1 describes the components on the board and the interfaces it supports.

Table 1. Breakout Board Components and Interfaces

Component/Interface	Type	Schematic Reference	Description
Circuits			
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
Components			
LCMXO2280C	PLD	U4: LCMXO2280C-3FTN256C	2280-LUT device packaged in a 17 x 17mm, 256-ball ftBGA.
Interfaces			
LED Array	Output	D8-D1	Red LEDs
Eight 2x20 Header Landings	I/O	J3: header_2x20 J4: header_2x20 J5: header_2x20 J6: header_2x20 J7: header_2x20 J8: header_2x20 J9: header_2x20 J10: header_2x20	User-definable I/O
1x8 Header Landing	I/O	J1: header_1x8	Optional JTAG interface
4-Hole Prototype Area			Prototype area 100mil centered holes.

Subsystems

This section describes the principle sub systems for the Breakout Board in alphabetical order.

Clock Sources

All clocks for the counter demonstration designs originate from the MachXO2280 PLD on-chip oscillator. You may use an expansion header landing to drive a PLD input with an external clock source.

Expansion Header Landings

The expansion header landings provide access to user GPIOs, primary inputs, clocks, and VCCO pins of the MachXO2280. 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, J7, J8, J9, J10
Part Number	header_2x20

Table 3. Expansion Header Pin Information (J3)

Pin Number	Function	MachXO2280 Ball
1	PL2A_LV_T	E4
2	PL11A_LV_T	H2
3	PL2B_LV_T	E5
4	PL11B_LV_C	J2
5	GND	n/a
6	GND	n/a
7	PL3A_LV_T	F5
8	PL12A_LV_T	J1
9	PL3B_LV_C	F6
10	PL12B_LV_C	K1
11	GND	n/a
12	GND	n/a
13	PL4A_LV_T	E3
14	PL13A_LV_T	L1
15	PL4B_LV_C	E2
16	PL13B_LV_C	M1
17	GND	n/a
18	GND	n/a
19	PL5A_LV_T	B1
20	PL15A_LV_T	L3
21	PL5B_LV_C	C1
22	PL15B_LV_C	M3
23	GND	n/a
24	GND	n/a
25	PL7A_LV_T	F2
26	PL16A_LV_T	J4
27	PL7B_LV_C	G2
28	PL16B_LV_C	J5

Pin Number	Function	MachXO2280 Ball
29	GND	n/a
30	GND	n/a
31	PL8A_LV_T	G4
32	PL17A_LV_T	K5
33	PL8B_LV_C	G5
34	PL17B_LV_C	K4
35	GND	n/a
36	GND	n/a
37	PL9A_LV_T	H4
38	PL18A_LV_T	M5
39	PL9B_LV_C	H5
40	PL18B_LV_C	M4

Table 4. Expansion Header Pin Information (J4)

Pin Number	Function	MachXO2280 Ball
1	PL3C	F3
2	GND	n/a
3	PL3D	F4
4	GND	n/a
5	PL4C	C3
6	GND	n/a
7	PL4D	C2
8	GND	n/a
9	PL6C	D2
10	GND	n/a
11	PL6D	D1
12	GND	n/a
13	PL7C	E1
14	GND	n/a
15	PL7D	F1
16	GND	n/a
17	PL8C	G3
18	GND	n/a
19	PL8D	H3
20	GND	n/a
21	PL10C	G1
22	GND	n/a
23	PL10D	H1
24	GND	n/a
25	NC	NC
26	PL15C	M2
27	NC	NC
28	PL15D	N2
29	PL11C	J3
30	PL16C	R1
31	PL11D	K3
32	PL16D	R2
33	PL12C	K2
34	PL17C	L5
35	PL12D	L2
36	PL17D	L4
37	PL14C	N1
38	PL19A	N4
39	PL14D	P1
40	PL19B	N3

Table 5. Expansion Header Pin Information (J5)

Pin Number	Function	MachXO2280 Ball
1	PT2C	B2
2	PT9A	D8
3	PT2D	B3
4	PT9C	E8
5	PT3A	A2
6	PT9D	E9
7	PT3B	A3
8	PT10A	A10
9	PT3C	D3
10	PT10C	C9
11	PT3D	D4
12	PT10D	C10
13	PT4A	C4
14	PT10E	D9
15	PT4B	C5
16	PT10F	D10
17	PT5A	D6
18	PT11A	B9
19	PT5B	D5
20	PT11B	B10
21	PT5C	B4
22	PT12A	A11
23	PT5D	B5
24	PT12B	A12
25	PT6E	E7
26	PT12C	B11
27	PT6F	E6
28	PT12D	B12
29	PT6C	A5
30	PT13C	C11
31	PT6D	A4
32	PT13D	C12
33	PT6A	C6
34	PT14A	A13
35	PT6B	C7
36	PT14B	A14
37	PT7A	B6
38	PT14C	D11
39	PT7B	B7
40	PT14D	D12

Table 6. Expansion Header Pin Information (J6)

Pin Number	Function	MachXO2280 Ball
1	VCIO_extB7	G6
2	GND	n/a
3	VCIO_extB6	J6
4	GND	n/a
5	VCIO_extB5	L7
6	GND	n/a
7	VCIO_extB4	L9
8	GND	n/a
9	VCIO_extB3	J11
10	GND	n/a
11	VCIO_extB2	G11
12	GND	n/a
13	VCIO_extB1	F9
14	GND	n/a
15	VCIO_extB0	F7
16	GND	n/a
17	NC	NC
18	NC	NC
19	NC	NC
20	NC	NC
21	NC	NC
22	PT15A	E10
23	NC	NC
24	PT15B	E11
25	NC	NC
26	PT15C	B13
27	NC	NC
28	PT15D	C13
29	PT7C	A6
30	PT16A	B14
31	PT7D	A7
32	PT16B	C14
33	PT8C	B8
34	PT16C	A15
35	PT8D	C8
36	PT16D	B15
37	NC	NC
38	GND	n/a
39	NC	NC
40	GND	n/a

Table 7. Expansion Header Pin Information (J7)

Pin Number	Function	LCMXO2280C Ball
1	PR4C	F13
2	GND	n/a
3	PR4D	F12
4	GND	n/a
5	PR5C	B16
6	GND	n/a
7	PR5D	C16
8	GND	n/a
9	PR6C	D16
10	GND	n/a
11	PR6D	E16
12	GND	n/a
13	PR7C	F16
14	GND	n/a
15	PR7D	G16
16	GND	n/a
17	PR9C	H12
18	GND	n/a
19	PR9D	H13
20	GND	n/a
21	PR10C	G15
22	GND	n/a
23	PR10D	H15
24	GND	n/a
25	NC	NC
26	PR15C	M16
27	NC	NC
28	PR15D	N16
29	PR11C	J12
30	PR16C	L12
31	PR11D	K12
32	PR16D	L13
33	PR13C	J14
34	PR17C	M12
35	PR13D	K14
36	PR17D	M13
37	PR14C	K16
38	PR20A	L11
39	PR14D	L16
40	PR20B	M11

Table 8. Expansion Header Pin Information (J8)

Pin Number	Function	MachXO2280 Ball
1	PR3A_LV_T	D14
2	PR11A_LV_T	H16
3	PR3B_LV_C	D13
4	PR11B_LV_C	J16
5	GND	n/a
6	GND	n/a
7	PR4A_LV_T	E13
8	PR13A_LV_T	J15
9	PR4B_LV_C	E12
10	PR13B_LV_C	K15
11	GND	n/a
12	GND	n/a
13	PR5A_LV_T	E14
14	PR14A_LV_T	J13
15	PR5B_LV_C	F14
16	PR14B_LV_C	K13
17	GND	n/a
18	GND	n/a
19	PR6A_LV_T	C15
20	PR15A_LV_T	L15
21	PR6B_LV_C	D15
22	PR15B_LV_C	M15
23	GND	n/a
24	GND	n/a
25	PR7A_LV_T	E14
26	PR16A_LV_T	L14
27	PR7B_LV_C	F15
28	PR16B_LV_C	M14
29	GND	n/a
30	GND	n/a
31	PR9A_LV_T	G12
32	PR17A_LV_T	N15
33	PR9B_LV_C	G13
34	PR17B_LV_C	N14
35	GND	n/a
36	GND	n/a
37	PR10A_LV_T	G14
38	PR18A_LV_T	N13
39	PR10B_LV_C	H14
40	PR18B_LV_C	N12

Table 9. Expansion Header Pin Information (J9)

Pin Number	Function	MachXO2280 Ball
1	VCC_3.3V	n/a
2	GND	n/a
3	VCC_3.3V	n/a
4	GND	n/a
5	VCC_3.3V	n/a
6	GND	n/a
7	NC	NC
8	GND	n/a
9	NC	NC
10	VCC_CORE	n/a
11	CLK0 (PT9B)	D7
12	GND	n/a
13	CLK1 (PT10B)	A9
14	GND	n/a
15	CLK2 (PB10F)	N9
16	GND	n/a
17	CLK3 (PB10B)	M9
18	GND	n/a
19	NC	NC
20	NC	NC
21	NC	NC
22	NC	NC
23	SLEEPN	P13
24	GND	n/a
25	PB14D	R14
26	GND	n/a
27	PB15A	T14
28	GND	n/a
29	PB15B	T15
30	GND	n/a
31	PB15D	P14
32	GND	n/a
33	PB16A	R15
34	GND	n/a
35	PB16B	R16
36	GND	n/a
37	PB16C	P15
38	GND	n/a
39	PB16D	P16
40	GND	n/a

Table 10. Expansion Header Pin Information (J10)

Pin Number	Function	MachXO2280 Ball
1	PB9B	P8
2	PB2A	P2
3	PB9A	P7
4	PB2B	P3
5	PB10E	N8
6	PB2C	N5
7	PB10C	P9
8	PB2D	N6
9	PB10D	P10
10	PB3A	T2
11	PB10A	M10
12	PB3B	T3
13	PB11C	R9
14	PB3C	R4
15	PB11D	R10
16	PB3D	R5
17	PB12A	T10
18	PB4A	P5
19	PB12B	T11
20	PB4B	P6
21	PB12C	N10
22	PB4C	T5
23	PB12D	N11
24	PB4D	T4
25	PB13A	R11
26	PB5A	R6
27	PB13B	R12
28	PB5B	T6
29	PB13C	P11
30	PB6A	T8
31	PB13D	P12
32	PB6B	T7
33	PB14A	T13
34	PB7C	M7
35	PB14B	T12
36	PB7D	M8
37	PB14C	R13
38	PB8C	R7
39	NC	NC
40	PB8D	R8

Figure 4. J3/J4 Header Landing Callout

J3

1	2
E4	H2
E5	J2
GND	GND
F5	J1
F6	K1
GND	GND
E3	L1
E2	M1
GND	GND
B1	L3
C1	M3
GND	GND
F2	J4
G2	J5
GND	GND
G4	K5
G5	K4
GND	GND
H4	M5
H5	M4
39	40

J4

1	2
F3	GND
F4	GND
C3	GND
C2	GND
D2	GND
D1	GND
E1	GND
F1	GND
G3	GND
H3	GND
G1	GND
H1	GND
NC	M2
NC	N2
J3	R1
K3	R2
K2	L5
L2	L4
N1	N4
PI	N3
39	40

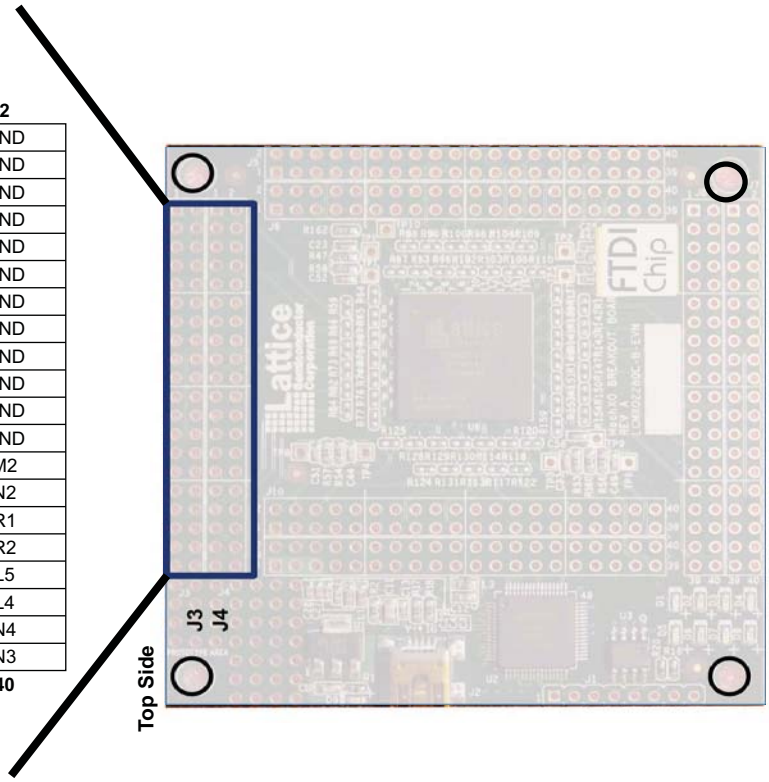
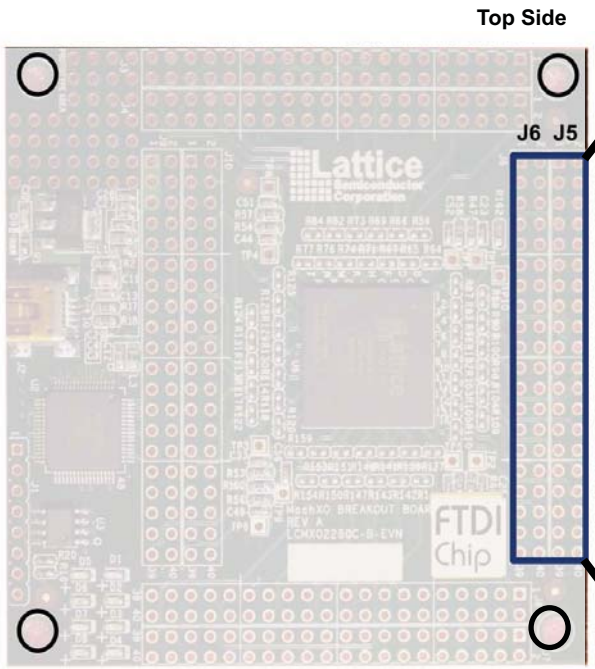


Figure 5. J5/J6 Header Landing Callout



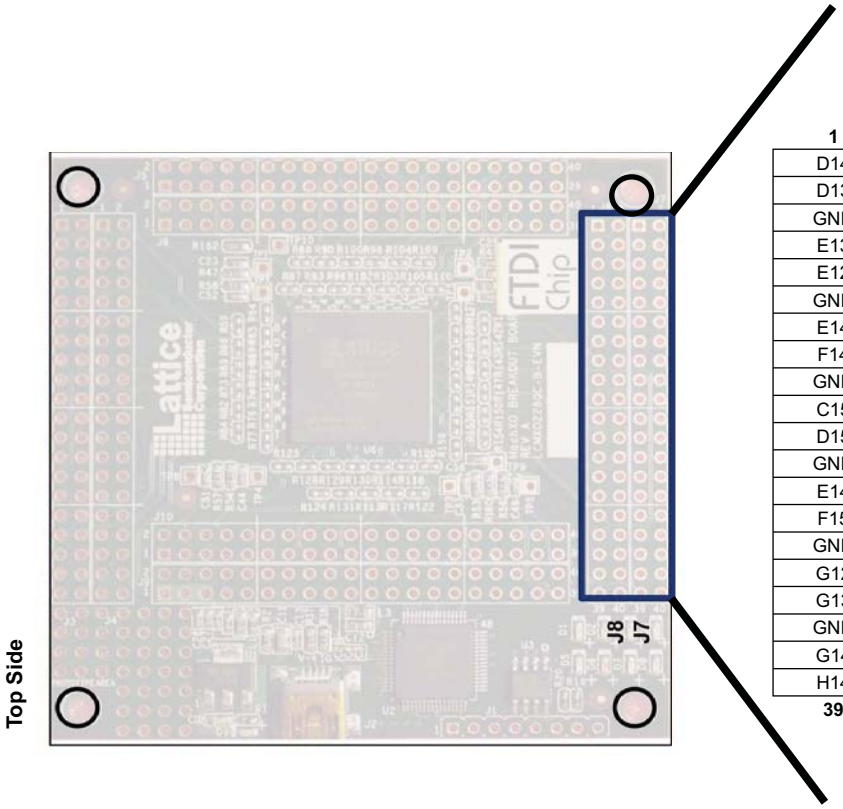
J6

1	2
G6	GND
J6	GND
L7	GND
L9	GND
J11	GND
G11	GND
F9	GND
F7	GND
NC	NC
NC	NC
NC	E10
NC	E11
NC	B13
NC	C13
A6	B14
A7	C14
B8	A15
C8	B15
NC	GND
NC	GND
39	40

J5

1	2
B2	D8
B3	E8
A2	E9
A3	A10
D3	C9
D4	C10
C4	D9
C5	D10
D6	B9
D5	B10
B4	A11
B5	A12
E7	B11
E6	B12
A5	C11
A4	C12
C6	A13
C7	A14
B6	D11
B7	D12
39	40

Figure 6. J7/J8 Header Landing Callout



J8

1	2
D14	H16
D13	J16
GND	GND
E13	J15
E12	K15
GND	GND
E14	J13
F14	K13
GND	GND
C15	L15
D15	M15
GND	GND
E14	L14
F15	M14
GND	GND
G12	N15
G13	N14
GND	GND
G14	N13
H14	N12
39	40

J7

1	2
F13	GND
F12	GND
B16	GND
C16	GND
D16	GND
E16	GND
F16	GND
G16	GND
H12	GND
H13	GND
G15	GND
H15	GND
NC	M16
NC	N16
J12	L12
K12	L13
J14	M12
K14	M13
K16	L11
L16	M11
39	40

Figure 7. J9/J10 Header Landing Callout

J9

1	2
VCC_3.3 V	GND
VCC_3.3 V	GND
VCC_3.3 V	GND
NC	VCC_CORE
NC	GND
D7	GND
A9	GND
N9	GND
M9	GND
NC	NC
NC	NC
P13	GND
R14	GND
T14	GND
T15	GND
P14	GND
R15	GND
R16	GND
P15	GND
P16	GND
39	40

J10

1	2
P8	P2
P7	P3
N8	N5
P9	N6
P10	T2
M10	T3
R9	R4
R10	R5
T10	P5
T11	P6
N10	T5
N11	T4
R11	R6
R12	T6
P11	T8
P12	T7
T13	M7
T12	M8
R13	R7
NC	R8
39	40

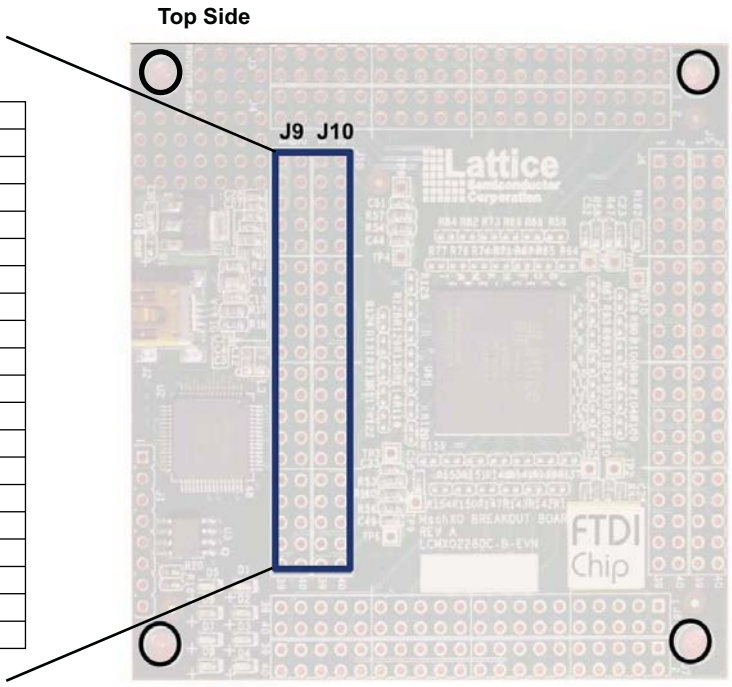
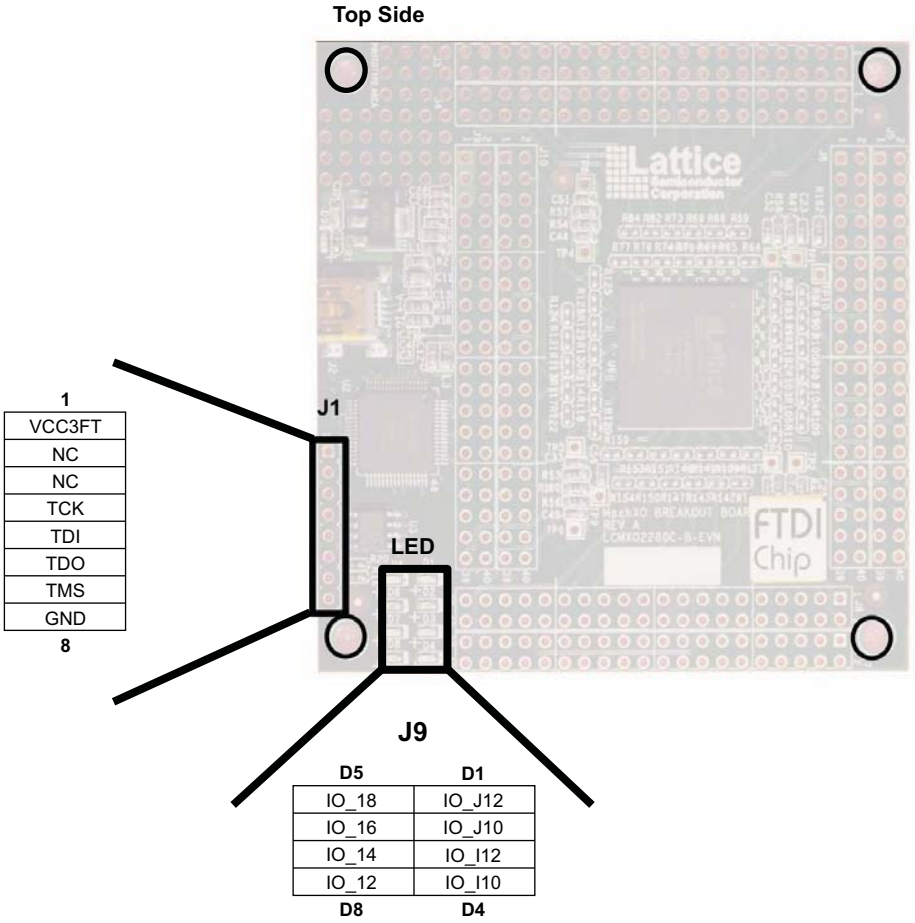


Figure 8. J1 Header Landing and LED Array Callout



MachXO2280 PLD

The LCMXO2280C-3FTN256C is a 256-ball BGA package PLD device which provides 211 I/Os in a 17 x 17mm package.

Table 11. MachXO PLD Interface Reference

Item	Description
Reference Designators	U4
Part Number	LCMXO2280C-3FTN256C
Manufacturer	Lattice Semiconductor
Web Site	www.latticesemi.com

JTAG Interface Circuits

For power and programming an FTDI 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 supply rail. A USB mini-B socket is provided for the USB connector cable.

Table 12. JTAG Interface Reference

Item	Description
Reference Designators	U2
Part Number	FT2232HL
Manufacturer	Future Technology Devices International (FTDI)
Web Site	www.ftdichip.com

Table 13. JTAG Programming Pin Information

Description	MachXO2280 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 MachXO2280 device.

Table 14. 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	www.liteonit.com

Power Supply

3.3V supply rail is 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 (VCCIO Bank 0)
- TP2, VCC3D (VCCIO Bank 1)
- TP3, VCC3D (VCCIO Bank 4)
- TP4, VCC3D (VCCIO Bank 5)
- TP5, VCC3D (VCCIO Bank 2)
- TP6, VCC3D (VCCIO Bank 3)
- TP7, VCC3D (VCCIO Bank 7)
- TP8, VCC3D (VCCIO Bank 6)
- TP9, VCC3D (VCC Core)
- TP10, VCC3D (VCCAUX)

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 MachXO2280 PLD.

Programming requires the ispVM System software.

Table 15. USB Interface Reference

Item	Description
Reference Designators	U2
Part Number	FT2232HL
Manufacturer	Future Technology Devices International (FTDI)
Web Site	www.ftdichip.com

Board Modifications

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

Bypassing the USB Programming Interface

The USB programming interface circuit (USB Programming and Debug Interface section) may be optionally bypassed by removing the 0 ohm resistors: R3, R4, R7, and R9 (See Appendix A. Schematics, Sheet 2 of 5). 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 (VCCIO 3.3V, Bank 0), R48 (VCCIO 3.3V, Bank 1), R53 (VCCIO 3.3V, Bank 4), R54 (VCCIO 3.3V, Bank 5), R55 (VCCIO 3.3V, Bank 2), R56 (VCCIO 3.3V, Bank 3), R57 (VCCIO 3.3V, Bank 6), R58 (VCCIO 3.3V, Bank 7), R160 (VCC core) and R162 (VCCAUX). Power connections are available from the expansion header landing, J9, Schematic Sheet 3 of 5.

Measuring Bank and Core Voltages

Test points (TP1, through TP10) provide access to power supplies of the MachXO2280 PLD. 0 ohm resistors: R47 (VCCIO 3.3V, Bank 0), R48 (VCCIO 3.3V, Bank 1), R53 (VCCIO 3.3V, Bank 4), R54 (VCCIO 3.3V, Bank 5), R55 (VCCIO 3.3V, Bank 2), R56 (VCCIO 3.3V, Bank 3), R57 (VCCIO 3.3V, Bank 6), R58 (VCCIO 3.3V, Bank 7), R160 (VCC core) and R162 (VCCAUX)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

PLD: Programmable Logic Device

DIP: Dual in-line package

LED: Light Emitting Diode.

LUT: Look Up Table

PCB: Printed Circuit Board

RoHS: Restriction of Hazardous Substances Directive

USB: Universal Serial Bus

WDT: Watchdog Timer

Troubleshooting

Use the tips in this section to diagnose problems with the 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 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 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 device.

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

Lattice Diamond Programmer Error

Lattice Diamond 1.1 reports “File not valid error” from the Programmer interface.

Diamond 1.1 is not Programmer compatible with the MachXO2280 Breakout Board. To program the device, use ispVM System 17.9 or later.

Ordering Information

Description	Ordering Part Number	China RoHS Environment-Friendly Use Period (EFUP)
MachXO2280 Breakout Board Evaluation Kit	LCMXO2280C-B-EVN	

Technical Support Assistance

e-mail: techsupport@latticesemi.com

Internet: www.latticesemi.com

Revision History

Date	Version	Change Summary
February 2015	1.1	Updated Subsystems section. Revised the following figures: — Figure 4, J3/J4 Header Landing Callout — Figure 5, J5/J6 Header Landing Callout — Figure 6, J7/J8 Header Landing Callout — Figure 7, J9/J10 Header Landing Callout
		Updated Technical Support Assistance information.
		Updated corporate logo.
March 2011	01.0	Initial release.

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Appendix A. Schematics

Figure 9. MachXO2280 Breakout Board

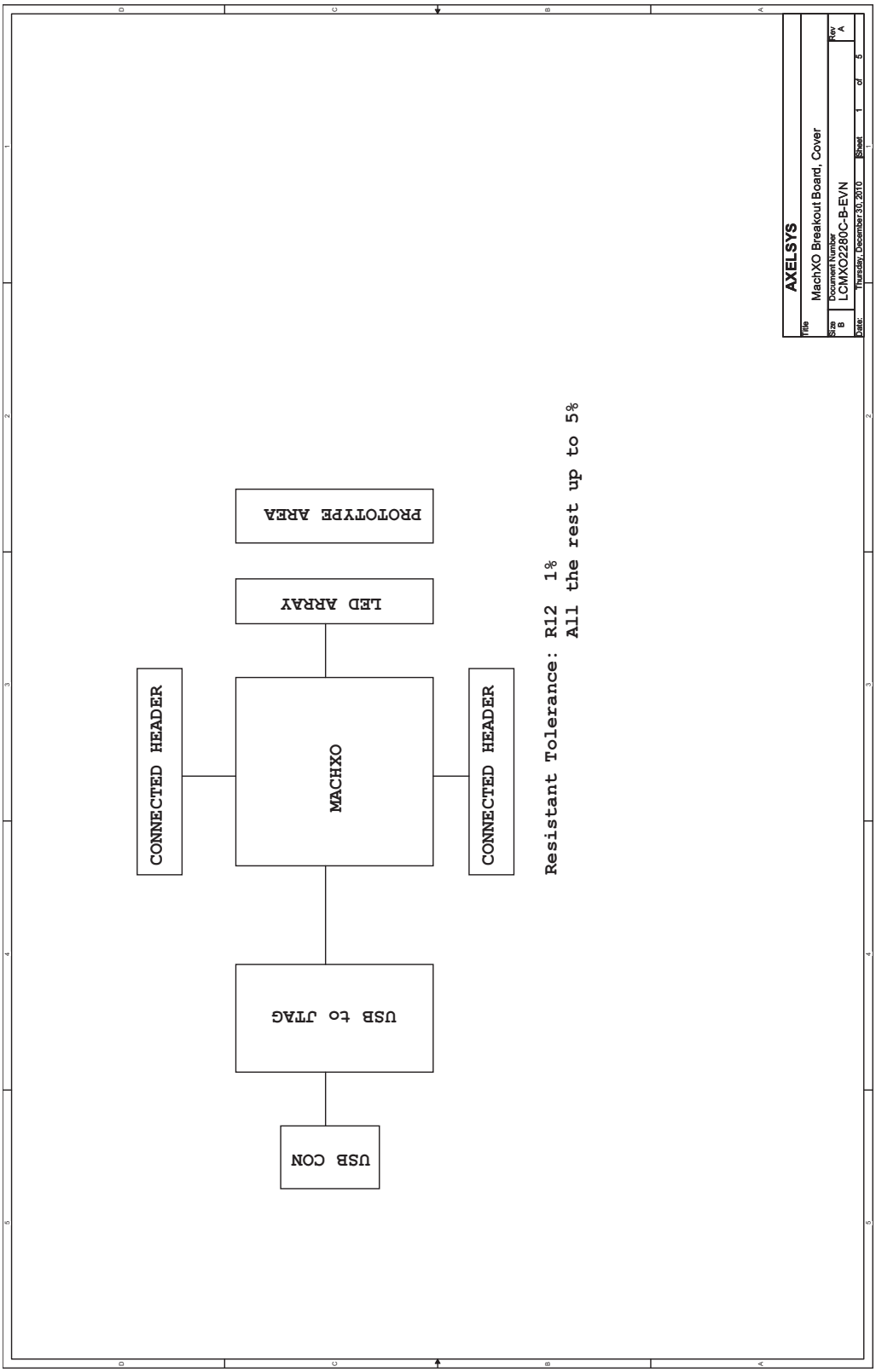


Figure 10. USB Interface to JTAG

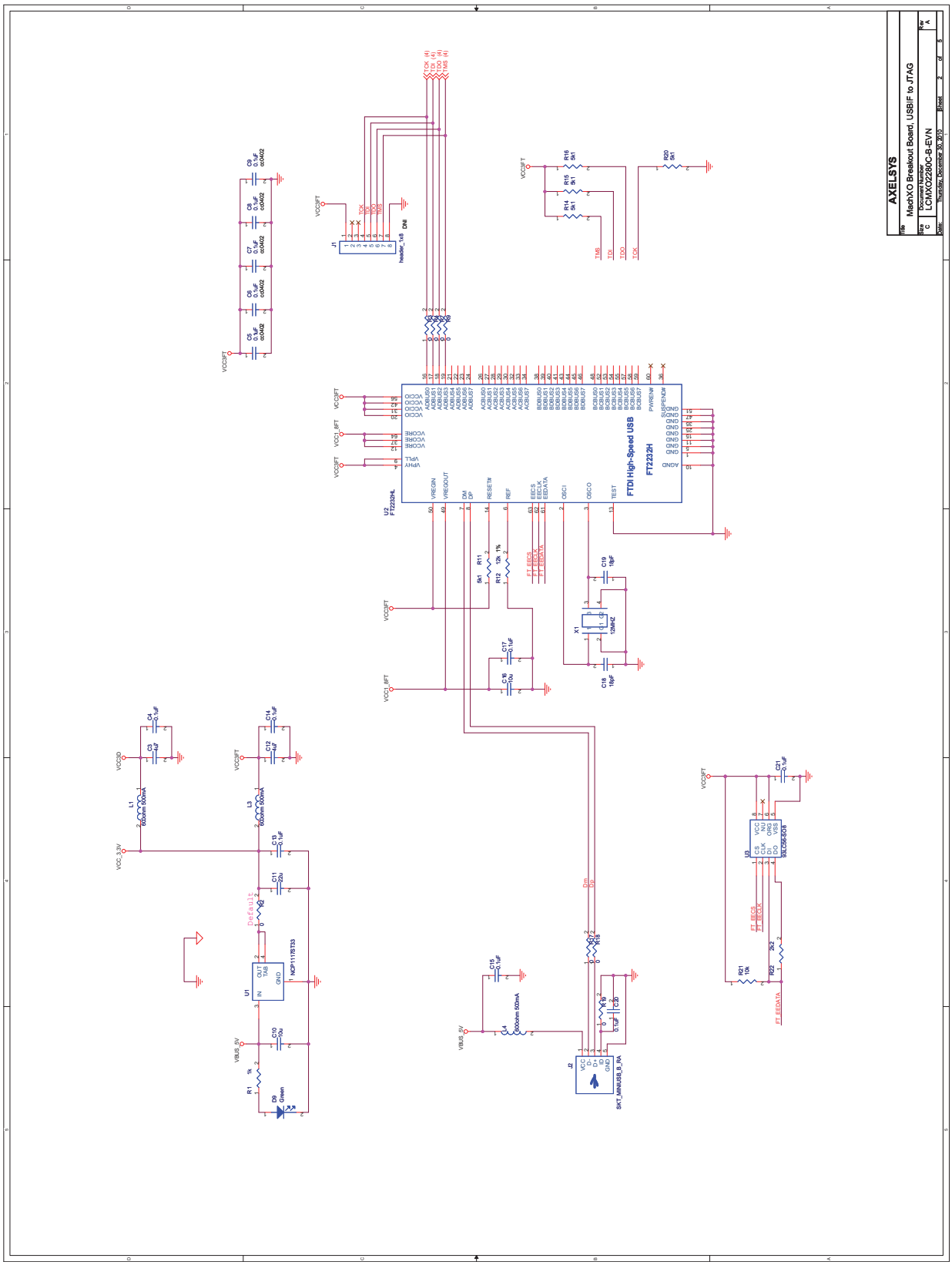


Figure 11. Connectors and LEDs

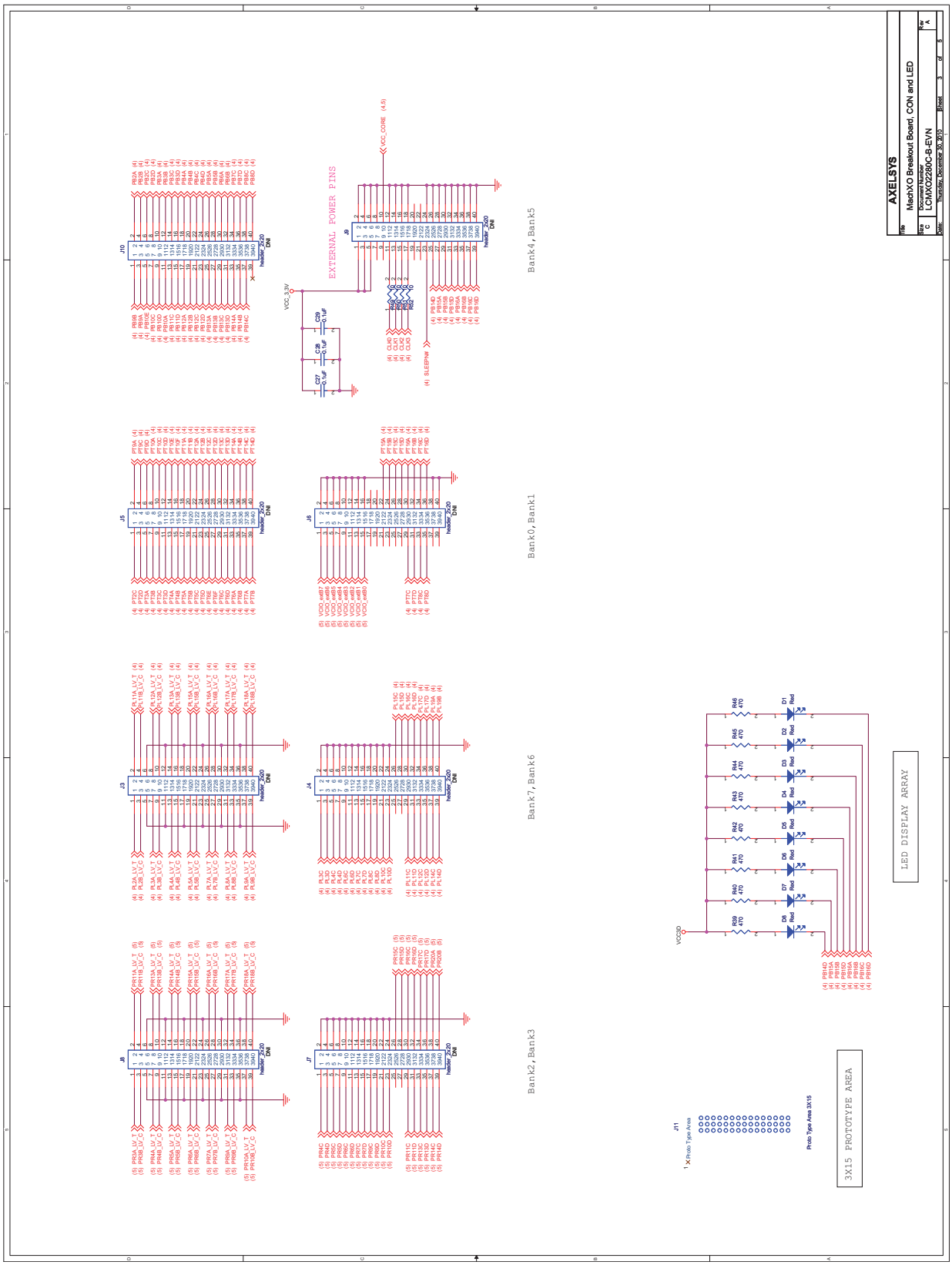


Figure 12. MachXO2280

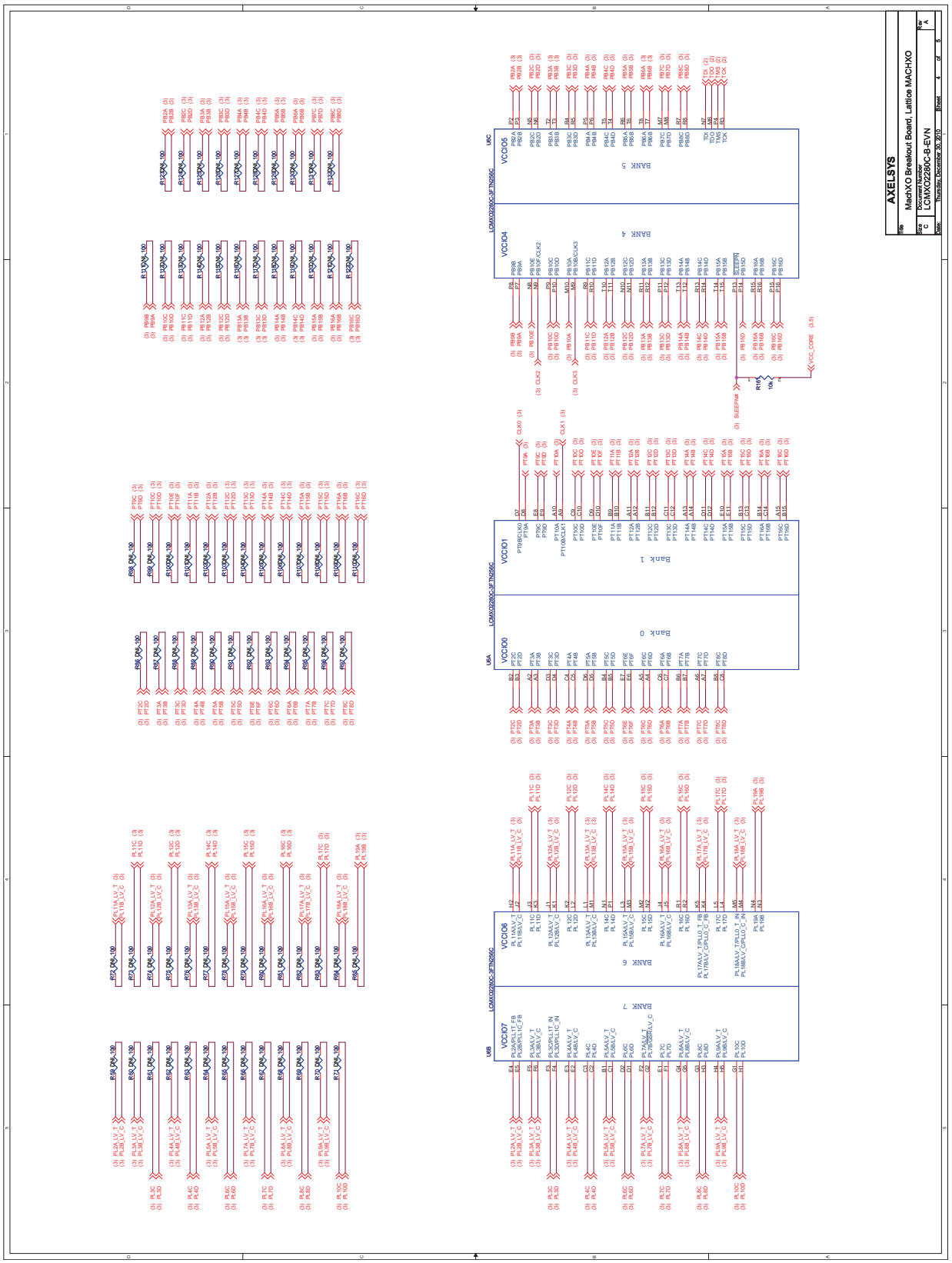
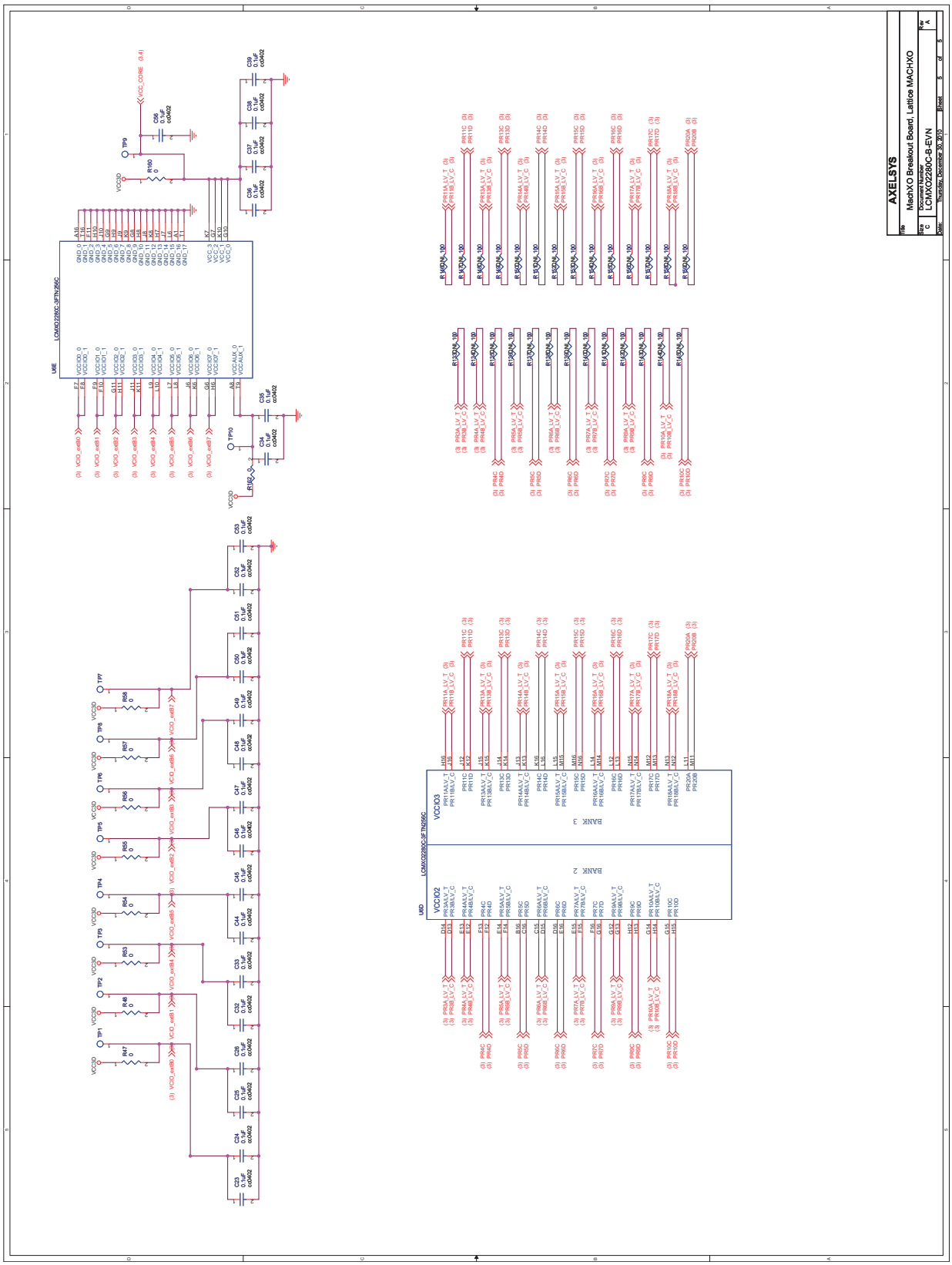


Figure 13. MachXO2280



Appendix B. Bill of Materials

Table 16. MachXO2280 Breakout Board Bill of Materials

Item	Quantity	Reference	Part Number
1	2	C3, C12	ECJ-1VB0J475K
2	38	C4, C5, C6, C7, C8, C9, C13, C14, C15, C17, C20, C21, C23, C24, C25, C26, C27, C28, C29, C32, C33, C34, C35, C36, C37, C38, C39, C44, C45, C46, C47, C48, C49, C50, C51, C52, C53, C56	C0402C104K4RACTU
3	2	C10, C16	ECJ-1VB0J106M
4	1	C11	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	8	J3, J4, J5, J6, J7, J8, J9, J10	DNI
11	1	J11	DNI
12	3	L1, L3, L4	BLM18AG601SN1D
13	1	R1	RC0402FR-071KL
14	18	R2, R3, R4, R7, R9, R17, R18, R19, R47, R48, R53, R54, R55, R56, R57, R58, R160, R162	RC0603JR-070RL
15	5	R11, R14, R15, R16, R20	RC0402FR-075K1L
16	1	R12	RC0402FR-0712KL
17	2	R21, R161	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	101	R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100, R101, R102, R103, R104, R105, R106, R107, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120, R121, R122, R123, R124, R125, R126, R127, R128, R129, R130, R131, R132, R133, R134, R135, R136, R137, R138, R139, R140, R141, R142, R143, R144, R145, R146, R147, R148, R149, R150, R151, R152, R153, R154, R155, R156, R157, R158, R159	RC0402FR-07100RL
22	10	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10	DNI
23	1	U1	NCP1117ST33T3G
24	1	U2	FT2232HL
25	1	U3	93LC56T-I/SN
26	1	U6	DNI
27	1	X1	7M-12.000MAAJ-T