Appendix A

MachXO2 System Overview
A.1 System Overview

The MachXO2 breakout board is an easy-to-use platform for evaluating and designing with the Lattice MachXO2 ultra-low power FPGA. The recommended development software is the Diamond Programmer available free of charge from Lattice. This section will cover the specifics of the board. Further information about the MachXO2 chip or the Lattice Diamond software can be found on the Lattice website.

A.2 Parts of the Logic Board

The various parts of the MachXO2 board are: I/O Connectors, Power and Clock Connectors, LEDs, a 60 hole Prototyping Area, the USB Connector and the Programming Connection. Figure A.1 highlights these parts.
A.3 I/O Connectors

A good rule of thumb when using the I/O ports on the MachXO2 breakout board and any other system is that, if you do not understand it, do some research. Do not use it until you do understand it. The MachXO2 board can be damaged by actions that are hasty or ignorant.

Figure A.2: I/O Connections
A.4 Programming Interface and LED Array

Figure A.3: Programming Pins and LED Array

A.4.1 USB Programming and Debug Interface

The USB mini-B socket of the Breakout Board serves as the programming and debug interface. For JTAG programming, a preprogrammed USB PHY peripheral controller is provided on the Breakout Board to serve as the programming interface to the MachXO2 FPGA. Programming requires the Lattice Diamond or ispVM System software.

A.4.2 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: R5, R6, R7, R8. Header landing J1 provides JTAG signal access for jumper wires or a 1x8 pin header.

A.4.3 LEDs

A green LED (D9) is used to indicate USB 5v power. Eight red LEDs are driven by I/O pins of the Mach XO2. The red LEDs are active low.
A.5 Power Supply

When powered from a USB cable, the 3.3V and 1.2V power supply rails are converted from the 5V line on the USB interface.

A.5.1 Test Points

There are three test points for checking the voltage levels on the MachXO2 board:

TP1: +3.3V
TP2: +1.2V
TP3: GND

A.5.2 Applying External Power

It is possible to power the breakout board from a source besides the USB input, but it is not recommended. The best method is to apply a regulated 5V power source to the USB connector.

⚠️ Your external power source must be regulated to prevent damage to the MachXO2 board.

A.5.3 Auxiliary Power Output

The 3.3V, 1.2V, and GND pins on the MachXO2 board to provide power to external devices. The on board voltage regulators are capable of supplying a maximum current of 1A. Exceeding the specifications of the regulators can cause them to fail. Read the datasheet for a regulator before attaching higher current devices.
Appendix B

Schematics
B.1 MachXO2 Block Diagram

Figure B.1: The Digital Logic Board Schematic
B.2 USB Interface to JTAG

Figure B.2: Power Supplies Schematic
APPENDIX B. SCHEMATICS

B.3 FPGA

Figure B.3: FPGA Schematic
Figure B.4: FPGA Schematic
APPENDIX B. SCHEMATICS

B.5 Power and LEDs

Figure B.5: Power and LED Schematic
B.6 USB Buck Boost Converter

Figure B.6: USB Buck Boost Schematic
B.7 4-digit Seven Segment Display Board

Figure B.7: 4 digit Seven Segment Display Board
B.8 Push Button Board

Figure B.8: Push Button Board Schematic
Appendix C

Silk Screens and Pinouts
This appendix has all the silk screens and pinouts used in this course.

C.1 MachXO2

Figure C.1: The MachXO2 Silkscreen

C.2 USB Buck Boost Converter

Figure C.2: The USB Buck Boost Silkscreen
C.3 4-digit Seven Segment Display Board

Figure C.3: The top silkscreen

Figure C.4: The bottom silkscreen
APPENDIX C. SILK SCREENS AND PINOUTS

C.4 Push Button Board

![Push Button Board Silkscreen](image)

Figure C.5: The Push Button Board Silkscreen
Appendix D

Parts and Suppliers
### APPENDIX D. PARTS AND SUPPLIERS

#### D.1 Parts List

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![Figure D.1: Use these figures to determine which parts to use.](image)

#### D.2 Suppliers List

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<td>(800) 344-4539</td>
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<tr>
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<tr>
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