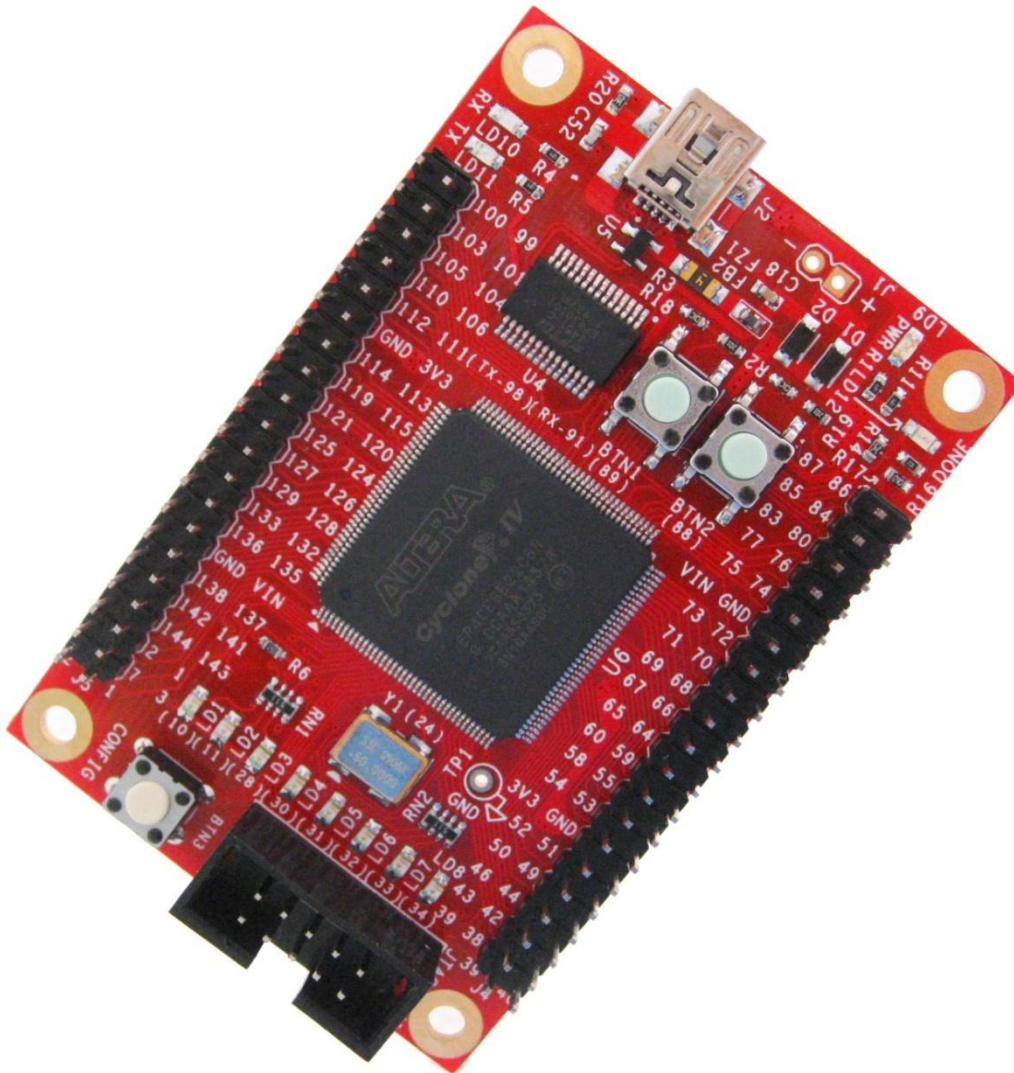# Altera EP4CE6 Mini Board

## Hardware User's Guide

1. Introduction

Thank you for choosing the EP4CE6 Mini Board !

EP4CE6 Mini Board is a compact FPGA board which is designed based on EP4CE6 device. It's a low-cost and easy-to-use platform for learning Altera's Cyclone IV FPGA. This board includes some necessary peripherals to quickly evaluate the FPGA device. Abundant I/Os are provided, you can easily connect a variety of peripherals using a flat ribbon cable. The pocket-sized dimension makes it a good choice for you when a FPGA core board is needed in your project. A USB to UART converter is integrated for easy data communicaiton with PC. This guide will briefly describe the hardware modules on this board, so as to help you make better use of it.

Features:

- Altera Cyclone IV device－EP4CE6E22C8N
- USB to UART (FT232RL) with TXD, RXD activity LED Indicator
- Two groups of 2x20 expansion header (72 I/Os, +3.3V, +5V, GND)
- JTAG programming header, directly connected to Altera USB Blaster
- External serial configuration device: EPCS4
- Two standalone pushbuttons
- One reset pushbutton for reloading configuration file from external flash into FPGA
- Eight LEDs for I/O status indication
- 50 MHz clock oscillator
- USB or external power supply
- Very compact board size: 75(mm) x 49(mm)

XC6SLX9 Mini Board Layout (Top Side)

50 MHz Clock Oscillator   40-Pin GPIO Header
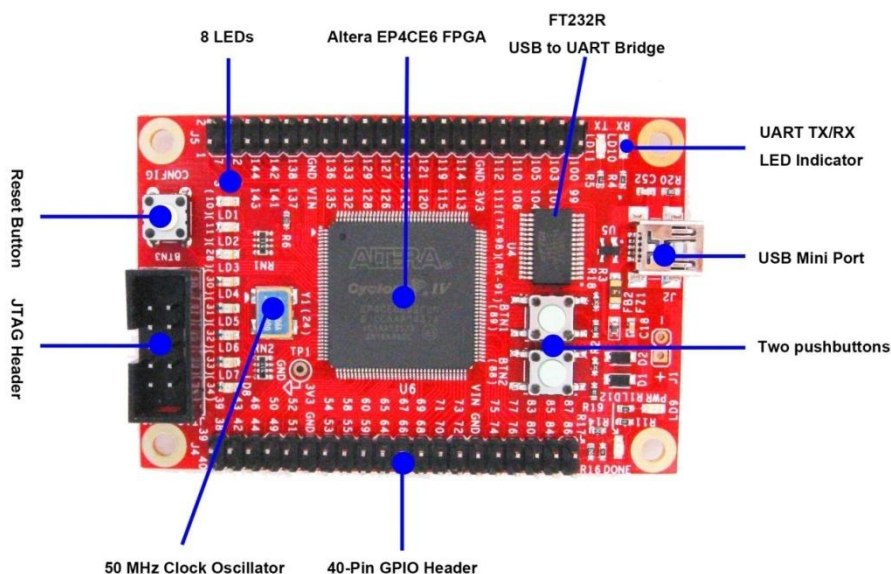
2. Hardware description

EP4CE6 Mini Board contains several parts that are easy to understand. The block diagram shown below depicts the architecture of this board.

EP4CE6 Mini Board Block Diagram
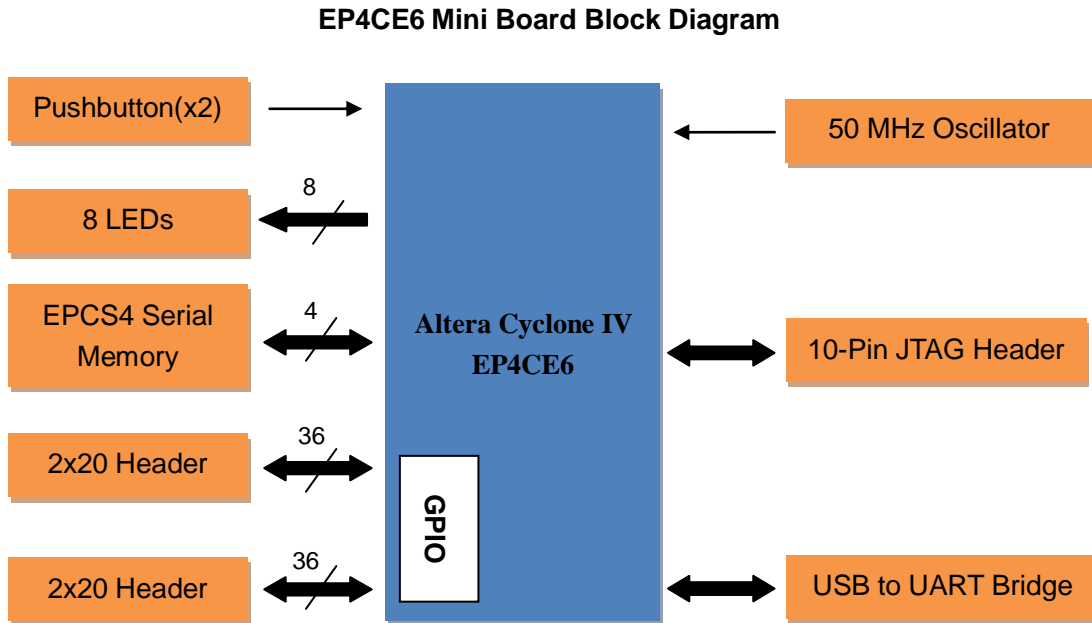
1) Power supply

EP4CE6 Mini Board could be powered with a +5V－+9V DC supply. Power can be sourced from USB port(500mA MAX,PTC fuse protected) or an external supply through J1 connector(J1 is not stuffed by default). The two power sources are connected in diode-or mode. So, you can power the board with a +7V－+9V supply on J1 connector while USB port is connected for data communication. The two diodes can pass a maximum of 500mA current. There is about 0.3V voltage drop across diode according to the forward current. Also, you can power the board by directly connecting a power source to one of the two VIN pins on J4,J5 headers. Care should be taken that there's no reverse polarity protection in this way.
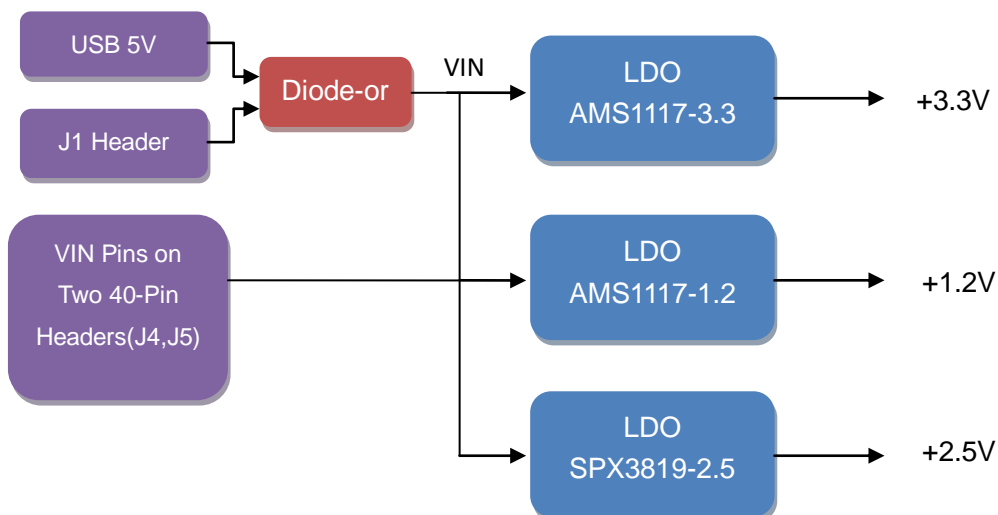
Three LDOs are used to regulate down the input power to +3.3V, +1.2V and +2.5V respectively.

Note: Do not connect a power higher than +10V to this board. This may accidently damage the input capacitors.

2) FPGA device

EP4CE6 Mini Board includes a Cyclone IV FPGA device－EP4CE6E22C8N housed in a 144-Pin TQFP package. This device features higher amount of logic and memory resources compared to older Cyclone devices. You can easily implement hardware multiple logic circuits on this device. NIOS II microcontroller is also supported. The table below has a overview of the resources for this device.

Resources	EP4CE6
Logic elements (LEs)	6,272
Embedded memory (Kbits)	270
Embedded 18 × 18 multipliers	15
General-purpose PLLs	2
Global Clock Networks	10
User I/O Banks	8

The table below shows the power pins connection for this device on EP4CE6 Mini Board.

Power Pins Connection

Power Pin Name	Power Rail	LDO
VCCIO1-VCCIO8	+3.3V	AMS1117-3.3
VCCINT	+1.2V	AMS1117-1.2
VCCA1,VCCA2	+2.5V(Filtered)	SPX3819-2.5
VCCD_PLL1,VCCD_PLL2	+1.2V(Filtered)	AMS1117-1.2

## 3) JTAG Programming Interface and External Serial

Configuration Device

The internal SRAM of FPGA device could be programmed via JTAG interface via a USB blaster cable. The JTAG signals on EP4CE6 Mini Board are buffered before forwarded to FPGA device. This scenario will protect the JTAG pins of FPGA device from damage when overvoltage conditions occur. A nonvolatile serial configuration device EPCS4 is assembled on this board. The configuration file will be programmed to serial device via JTAG interface. In this way, the FPGA device acts as a flash loader. The DONE LED will be turned off when the programming process is active, and turned on after the process is finished. Please refer to the **Quartus II Software Quick Start Guide** for details about how to program the external serial configuration device via JTAG interface.
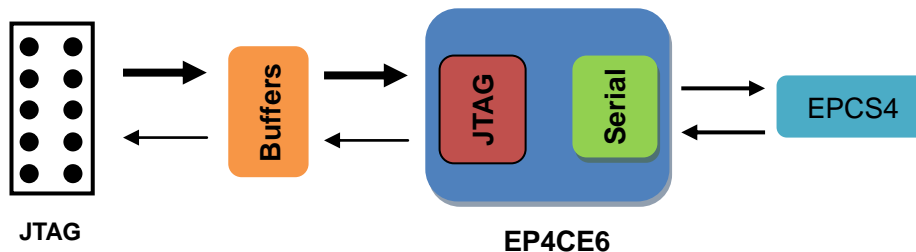

4) CONFIG/Reset Button

A CONFIG/Reset pushbutton is available on EP4CE6 Mini Board. This button is useful when you want to force the FPGA device to reload configuration file from external serial device or globally restart the running of this device. This function is achieved by pulling down the nCONFIG pin of FPGA device for a while and then release it.
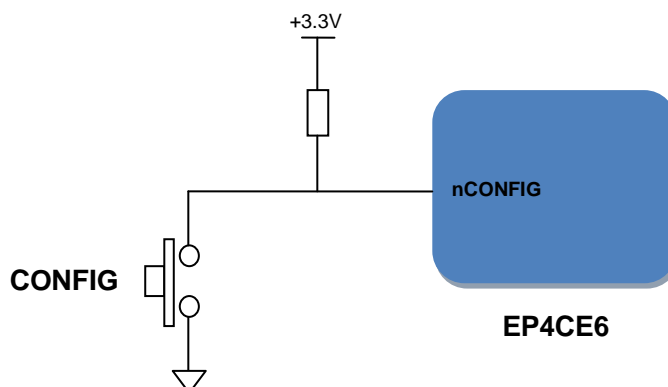
5) Clock Oscillator

EP4CE6 Mini Board includes one 50MHz clock oscillator. It can be used as a global clock source or drive the internal PLL of FPGA device.
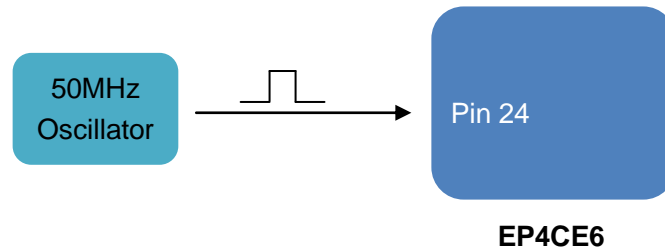

EP4CE6

6) Pushbuttons

The EP4CE6 Mini Board includes two pushbuttons for user input. Because of the characteristic of mechanical contact switch, glitches will be generated when button is pressed or released. You can implement a debounce circuit on FPGA to filter out the noise. A 220ohm resistor is added to protect IOs from overcurrent damage when pins are set as output in low level. In this case, when button pressed, +3.3V will be shorted to GND via the internal transistor path, and damage the output buffer. In default, the button keeps in low level state, when pressed, it will transit to high level state. Release the button the state will return to low level.

EP4CE6
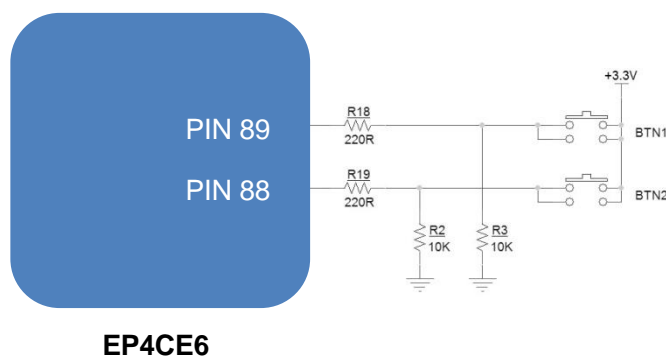
7) LEDs

Eight LEDs are provided on this board. They are driven directly by the FPGA IOs. Setting one pin to high level lights the LED, and drive the pin low will turn it off. LEDs are usually used as status indicators. Also, eight LEDs can be used to display a 8-bit data.
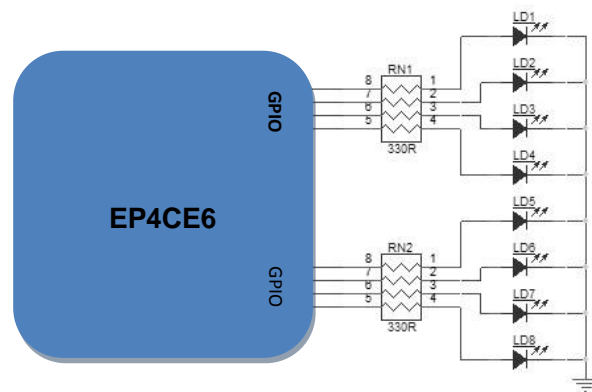

LED Interface

LED	FPGA Pin Location
LD1	10
LD2	11
LD3	28
LD4	30
LD5	31
LD6	32
LD7	33
LD8	34

8) USB to UART Bridge

Serial communication can be easily implemented and is widely used when data exchange is needed between PC and peripherals. Since most new generation PCs are not assembled with an older 9-Pin D-Sub serial port. But USB port is abundant. The USB to UART converter IC solves the problem while retaining the advantage of serial port. FT232R is used in this board to play a role of USB to UART converter. When the driver software is properly installed, it will function as a virtual serial port. In addition, two LEDs are used to indicate the status of the TXD and RXD data path. When valid data transfer is detected, the corresponding LED will blink.
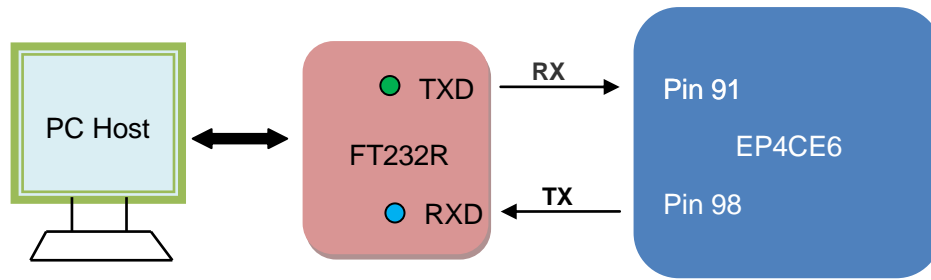
Note: The driver software for FT232R must be installed properly before the device could be successfully recognized and enumerated as a virtual serial port by your PC. Download the driver software from <u>here</u>.

9) Expansion Header

Two groups of expansion header are available. Each header includes 36 I/Os and +5V, +3.3V power supply. The connector type is a 2x20 0.1" center-to-center, male.
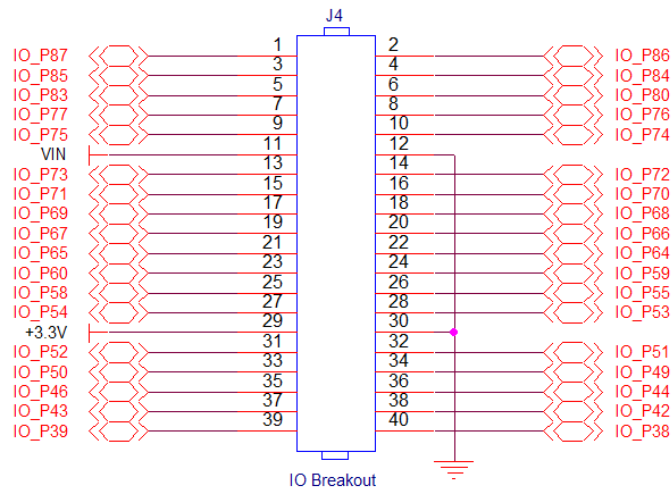
Expansion Connector Pin number	Expansion Connector Signal Name	FPGA Pin Number	Pin Functionality
1	IO_P87	87	I/O
2	IO_P86	86	I/O
3	IO_P85	85	I/O
4	IO_P84	84	I/O
5	IO_P83	83	I/O

6	IO_P80	80	I/O
7	IO_P77	77	I/O
8	IO_P76	76	I/O
9	IO_P75	75	I/O
10	IO_P74	74	I/O
11	VIN	—	Power
12	GND	—	Ground
13	IO_P73	73	I/O
14	IO_P72	72	I/O
15	IO_P71	71	I/O
16	IO_P70	70	I/O
17	IO_P69	69	I/O
18	IO_P68	68	I/O
19	IO_P67	67	I/O
20	IO_P66	66	I/O
21	IO_P65	65	I/O
22	IO_P64	64	I/O
23	IO_P60	60	I/O
24	IO_P59	59	I/O
25	IO_P58	58	I/O
26	IO_P55	88	I/O
27	IO_P54	54	I/O
28	IO_P53	53	I/O
29	+3.3V	—	Power
30	GND	—	Ground
31	IO_P52	82	I/O
32	IO_P51	51	I/O
33	IO_P50	50	I/O
34	IO_P49	49	I/O
35	IO_P46	46	I/O
36	IO_P44	44	I/O
37	IO_P43	43	I/O
38	IO_P42	42	I/O
39	IO_P39	39	I/O
40	IO_P38	38	I/O
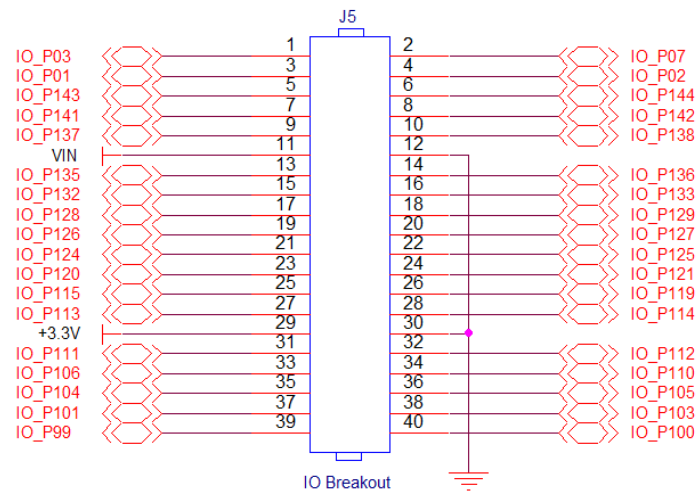
IO Breakout

Expansion Connector Pin number	Expansion Connector Signal Name	FPGA Pin Number	Pin Functionality
1	IO_P03	3	I/O
2	IO_P07	7	I/O
3	IO_P01	1	I/O
4	IO_P02	2	I/O
5	IO_P143	143	I/O
6	IO_P144	144	I/O
7	IO_P141	141	I/O
8	IO_P142	142	I/O
9	IO_P137	137	I/O
10	IO_P138	138	I/O
11	VIN	—	Power
12	GND	—	Ground
13	IO_P135	135	I/O
14	IO_P136	136	I/O
15	IO_P132	132	I/O
16	IO_P133	133	I/O
17	IO_P128	128	I/O
18	IO_P129	129	I/O
19	IO_P126	126	I/O
20	IO_P127	127	I/O
21	IO_P124	124	I/O
22	IO_P125	125	I/O
23	IO_P120	120	I/O
24	IO_P121	121	I/O
25	IO_P115	115	I/O
26	IO_P119	119	I/O

27	IO_P113	113	I/O
28	IO_P114	114	I/O
29	+3.3V	—	Power
30	GND	—	Ground
31	IO_P111	111	I/O
32	IO_P112	112	I/O
33	IO_P106	106	I/O
34	IO_P110	110	I/O
35	IO_P104	104	I/O
36	IO_P105	105	I/O
37	IO_P101	101	I/O
38	IO_P103	103	I/O
39	IO_P99	99	I/O
40	IO_P100	100	I/O