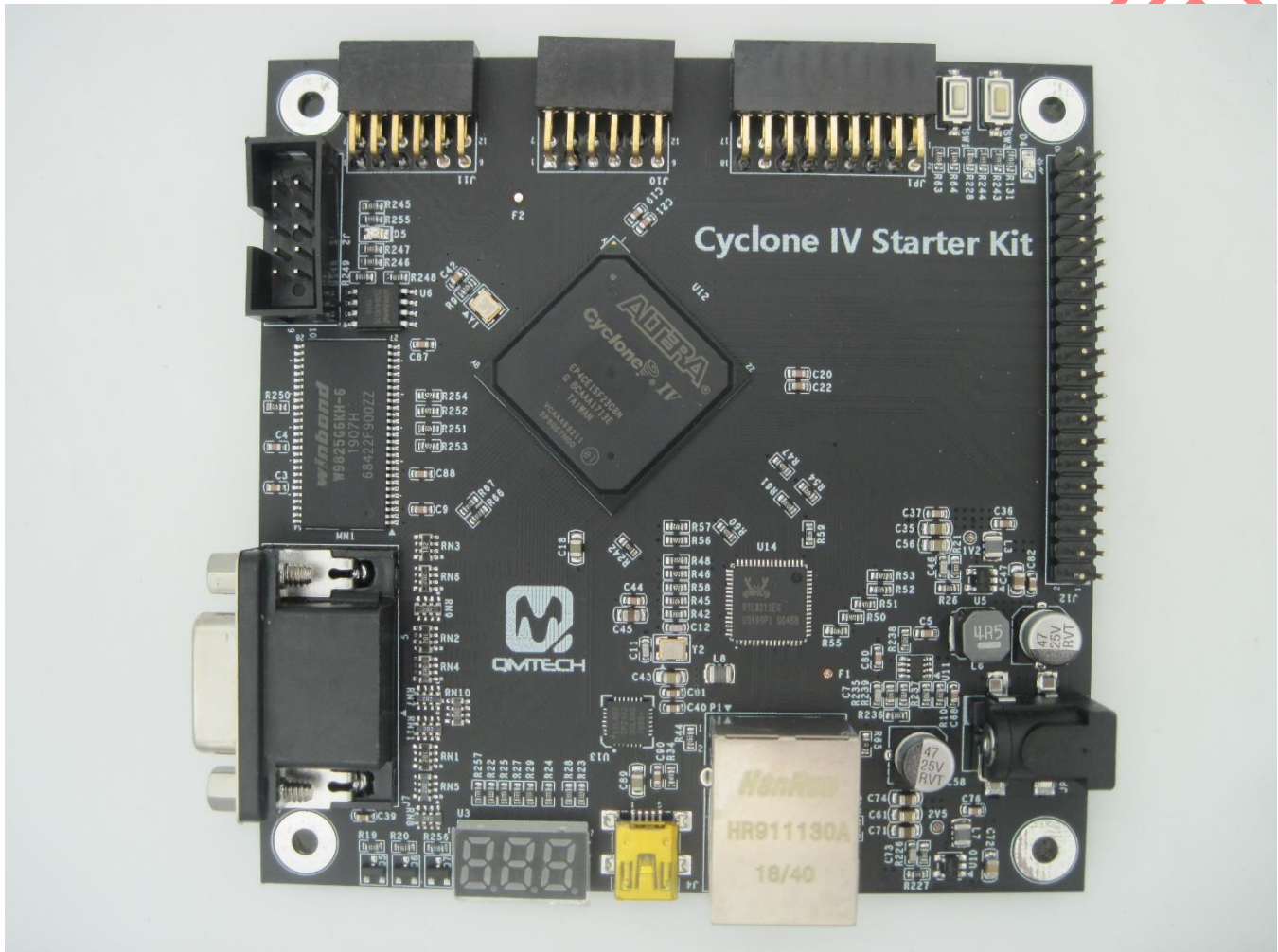# CYCLONE IV EP4CE15 STARTER KIT

USER MANUAL

Preface

The QMTech® Cyclone IV Starter Kit uses Intel(Altera) EP4CE15F23 device to demonstrate Intel's leadership in offering power-efficient FPGAs. With enhanced architecture and silicon, advanced semiconductor process technology, and power management tools, power consumption for Cyclone IV FPGAs has been reduced by up to 25 percent compared to Cyclone® III FPGAs. The result is the lowest power consumption of any comparable FPGA.

Users could visit QMTECH official website from here: http://www.chinaqmtech.com/

Table of Contents

1. Introduction

1.1 Document Scope

This demo user manual introduces the Cyclone IV starter kit and describes how to setup the development board running with application software Altera Quartus II 15.1. Users may employee the on board rich logic resource FPGA EP4CE15F23C8N and large SDRAM memory W9825G6KH-6 to implement various applications. The development board also has many non-multiplexed FPGA IOs for extending customized modules, such as UART module, CMOS/CCD camera module, LCD/HDMI/VGA display module etc.

1.2 Kit Overview

Below section lists the parameters of the Cyclone IV EP4CE15:
- ➢ On-Board FPGA: EP4CE15F23C8N;
- ➢ On-Board FPGA external crystal frequency: 50MHz;
- ➢ EP4CE15F23C8N has rich block RAM resource up to 504Kb;
- ➢ EP4CE15F23C8N has 15K Logic elements;
- ➢ On-Board W25Q64 SPI Flash, 8M bytes for user configuration code;
- ➢ On-Board 32MB Winbond SDRAM, W9825G6KH-6;
- ➢ On-Board 3.3V power supply for FPGA by using MP2315 wide input range DC/DC;
- ➢ Cyclone IV Starter Kit provides camera interface, 2xPMOD headers and 40P Male header for User IOs;
- ➢ Cyclone IV Starter Kit has 2 user switches;
- ➢ Cyclone IV Starter Kit has 2 user LEDs;
- ➢ Cyclone IV Starter Kit has JTAG interface, by using 10p, 2.54mm pitch header;
- ➢ Cyclone IV Starter Kit provides GMII Ethernet by using RealTek RTL8211EG;
- ➢ Cyclone IV Starter Kit provides 7-SEG LEDs;
- ➢ Cyclone IV Starter Kit provides USB to UART serial port by using CP2102-GMR;
- ➢ Cyclone IV Starter Kit provides VGA 5-6-5 interface by using resistor dividers;
- ➢ Cyclone IV Starter Kit PCB size is: 9.96cm x 9.96cm;
- ➢ Default power source for core board is: 1A@5V DC, the DC header type: DC-050, 5.5mmx2.1mm;

1.3 Kit Top View

Figure 1-1. Cyclone IV Starter Kit Top View

2.   Getting Started

Below image shows the dimension of the Cyclone IV Starter Kit: 99.6mm x 99.6mm. The unit in below image is millimeter(mm).
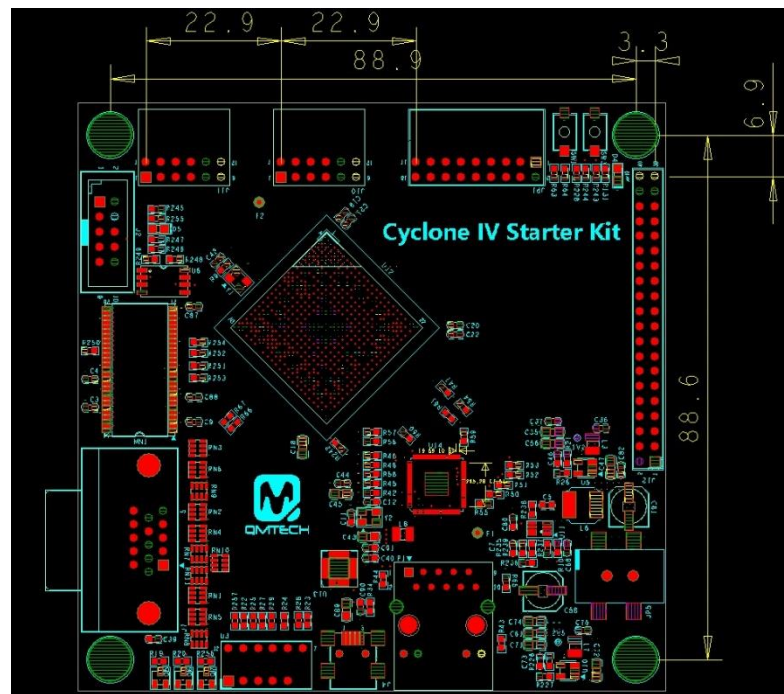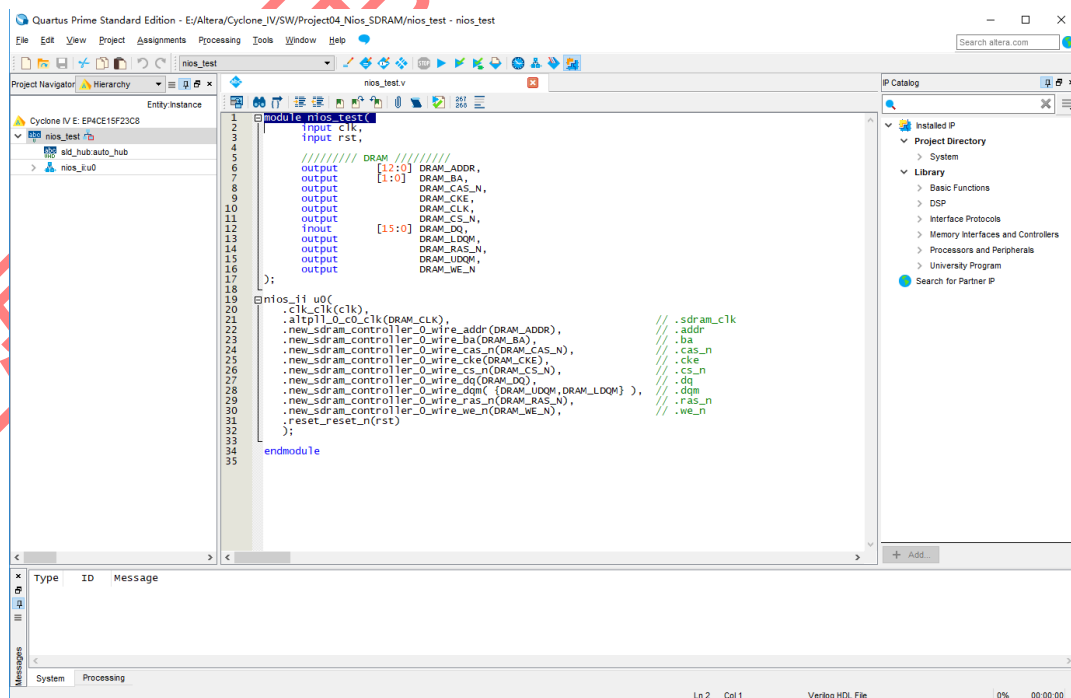

Figure 2-1. Cyclone IV Starter Kit Dimension

The Cyclone IV Starter Kit tool chain consists of Altera Quartus II 15.1, Altera USB Blaster cable, EP4CE15 development board and 5V DC power supply. Below image shows the Altera Quartus II 15.1 development environment which could be downloaded from Altera(Intel) office website:

2.2 Cyclone IV Starter Kit Hardware Design

2.2.1 Cyclone IV EP4CE15 Power Supply

The development board needs 5V DC input as power supply which could be directly injected from power header or the J12 header Pin number 2. Users may refer to the hardware schematic for the detailed design. The on board LED D4 indicates the 3.3V supply, it will be turned on when the 5V power supply is active. In default status, all the FPGA banks IO power level is 3.3V because bank power supply is 3.3V.

Note: FPGA core supply 1.2V is regulated by On-Semi DC/DC chip NCP1529 which could output maximum 1A current.

Figure 2-2. Power Supply for the FPGA

2.2.2 Cyclone IV Starter Kit SDRAM Memory

Cyclone IV Starter Kit has on board 16bit width data bus, 32MB memory size W9825G6KH-6 SDRAM provided by Winbond. Below image shows the detailed hardware design:
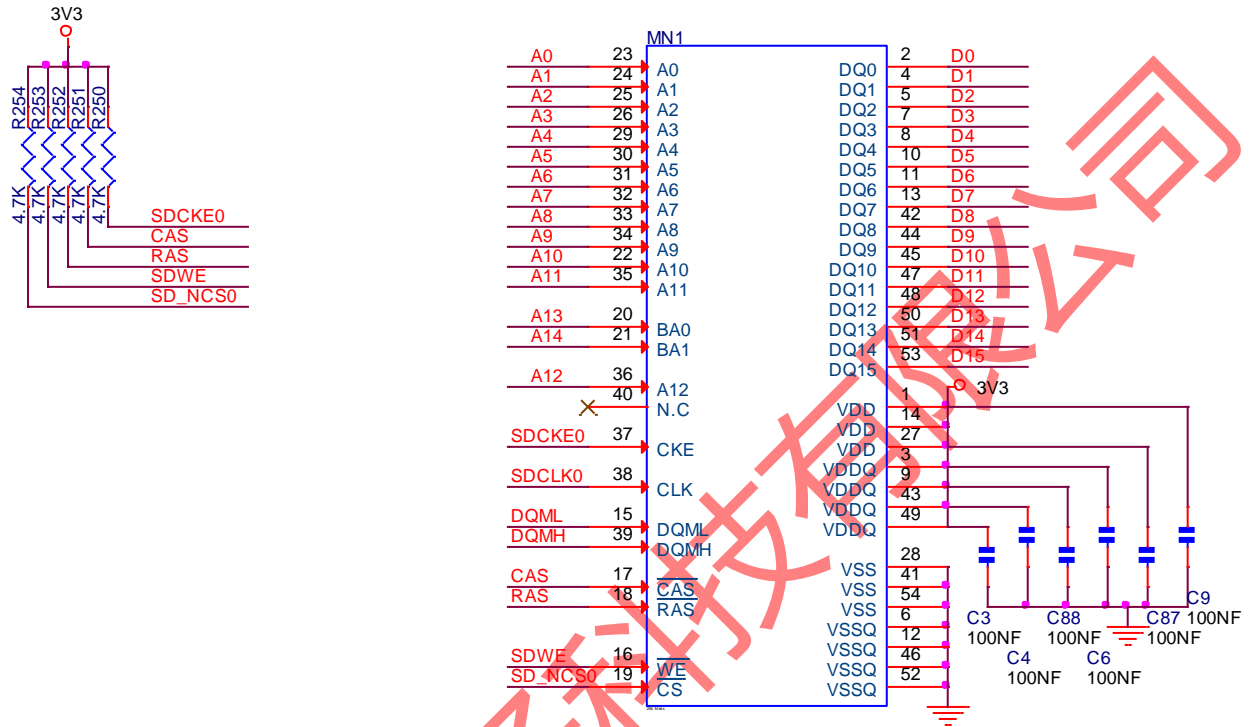

Figure 2-3. SDRAM

2.2.3 Cyclone IV Starter Kit SPI Boot

Cyclone IV EP4CE15 boots from external SPI Flash, detailed hardware design is shown in below figure. The SPI flash is using W25Q64 manufactured by Winbond, with 64Mbit memory storage.
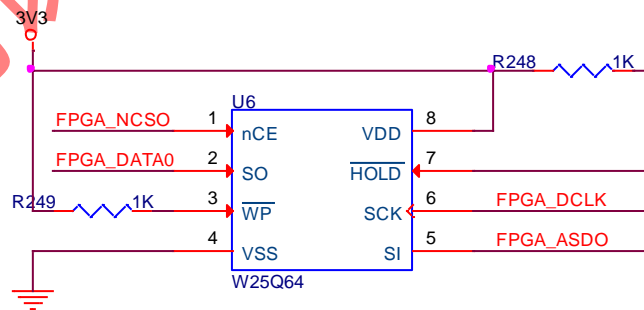
Note: The SPI Flash is designed with x1 mode.

Figure 2-4. SPI Flash

Below image shows the hardware configuration of MSEL[3:0]: 0010, in which way will make the FPGA boot from Active Serial (x1 or x4) Standard Mode:
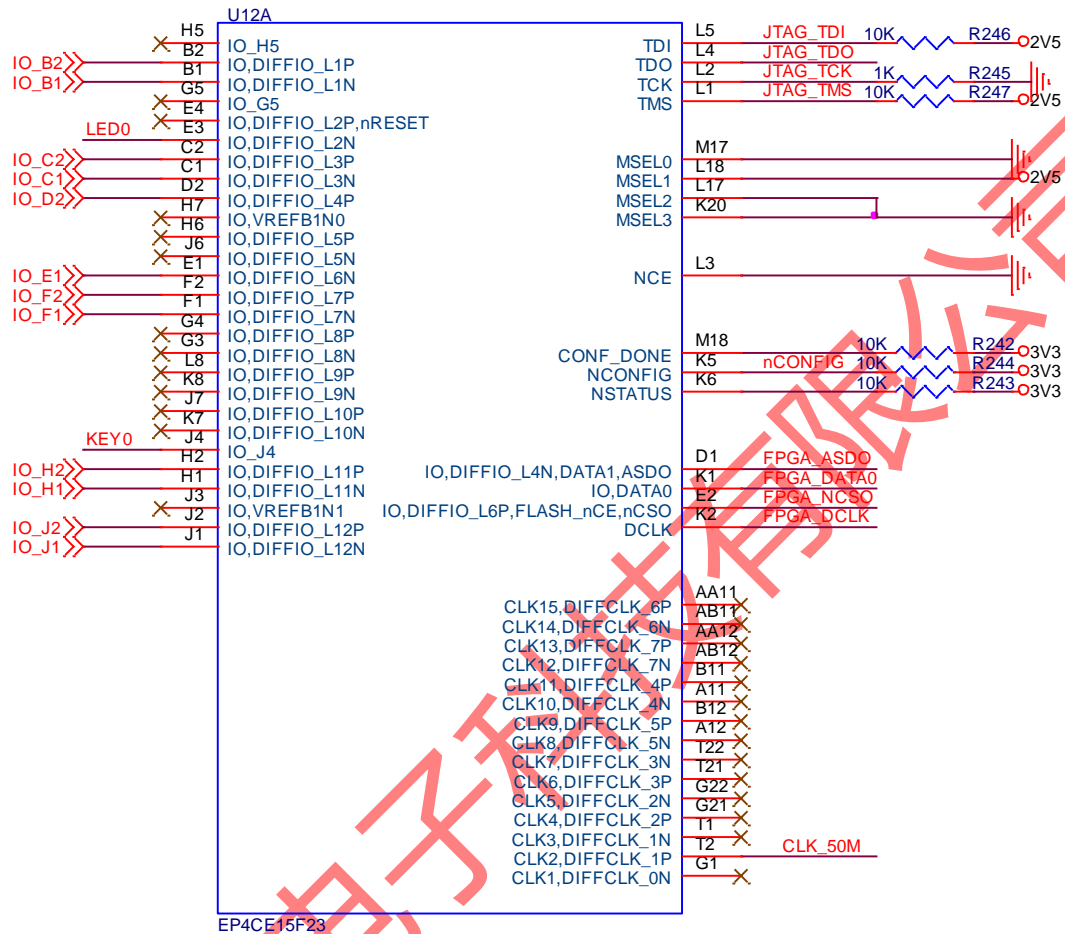
Figure 2-5. MSEL Settings

2.2.4 Cyclone IV Starter Kit System Clock

The Cyclone IV Starter Kit has system clock frequency 50MHz which is directly provided by external crystal. The crystal is designed with high accuracy and stability with low temperature drift 10ppm/°c. Below image shows the detailed hardware design:
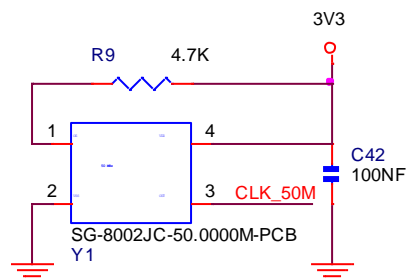

Figure 2-6. 50MHz System Clock

2.2.1 Cyclone IV Starter Kit JTAG Port

The on board JTAG port uses 10P 2.54mm pitch header which could be easily connected to Altera USB blaster cable. Below image shows the hardware design of the JTAG port:
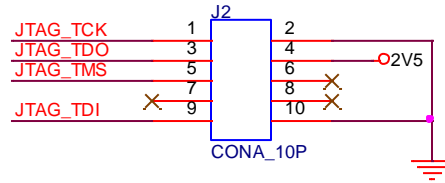

Figure 2-7. JTAG Port

2.2.2 Cyclone IV Starter Kit Power Supply

The development board's 3.3V power supply is using high efficiency DC/DC chip MP2315 provided by MPS Inc. The MP2315 supports wide voltage input range from 4.5V to 24V. In normal use case, 5V DC power supply is suggested to be applied on the board. Below image shows the MP2315 hardware design:
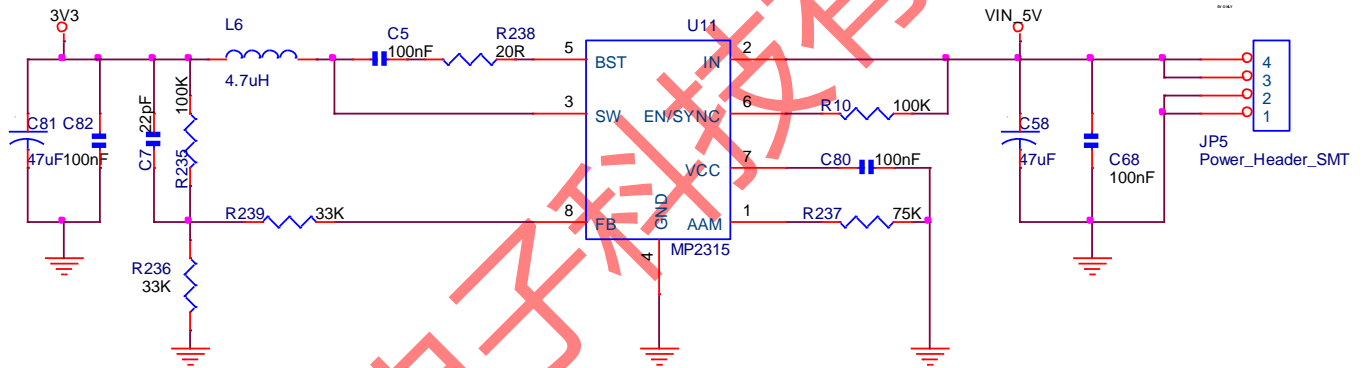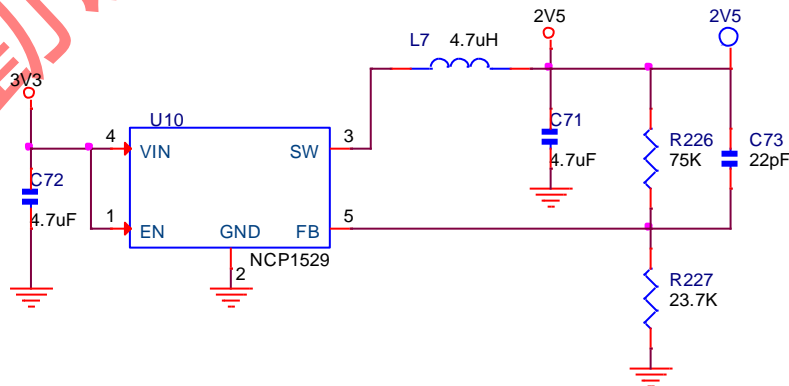

Figure 2-8. MP2315 Hardware Design

The development board's 2.5V and 1.2V FPGA core voltage power supply is using high efficiency DC/DC chip NCP1529 provided by On-Semi Inc.
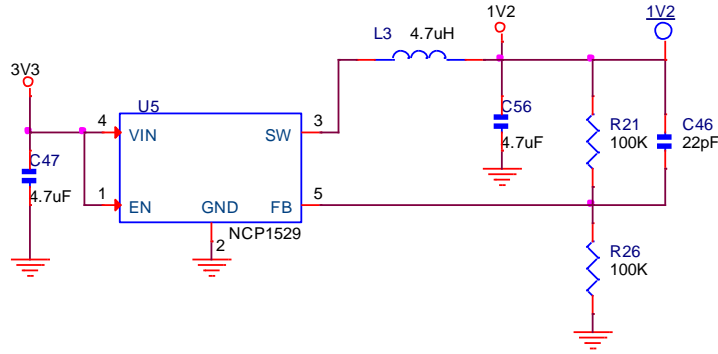
Figure 2-9. NCP1529 Hardware Design

2.2.3 Cyclone IV Starter Kit Extension IO

The development board has one 40P 2.54mm pitch male header which are used for extending user modules, such as ADC/DAC module, audio/video module, ethernet module, etc.
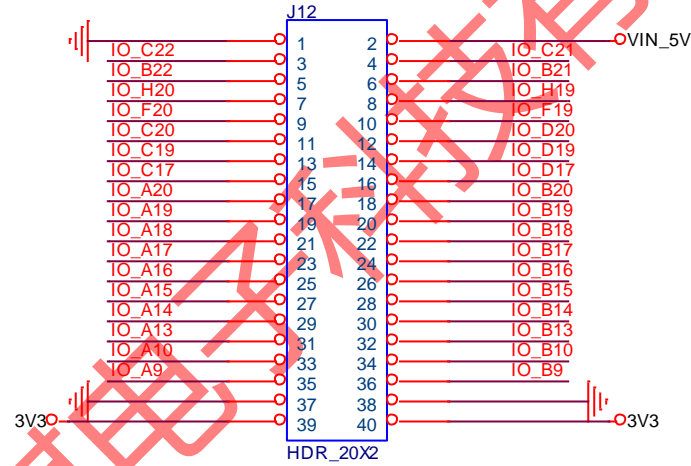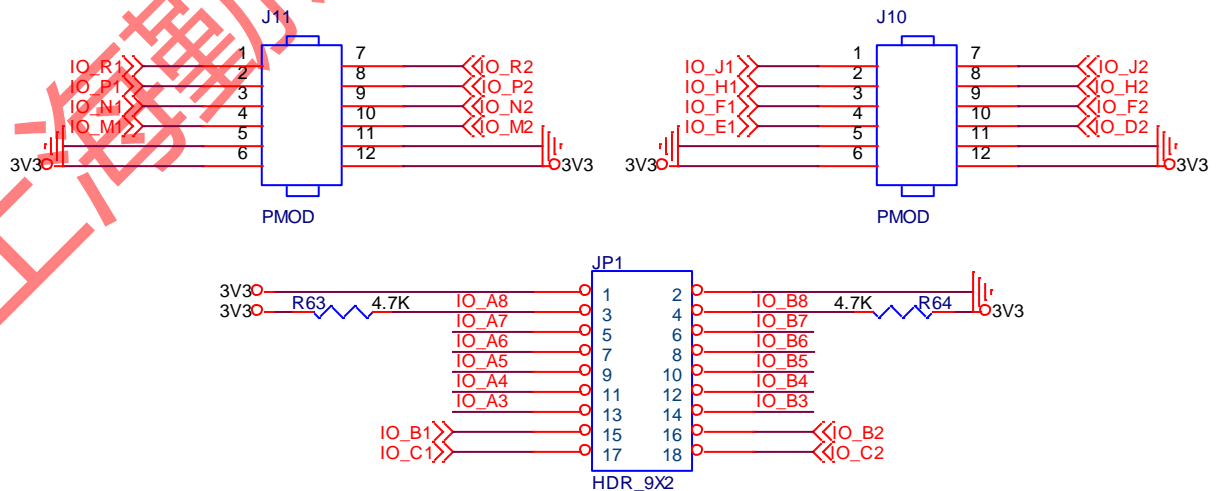

Figure 2-10. Extension IO

The development board has 2 PMOD interface and one camera interface.

2.2.4 Cyclone IV Starter Kit User LED

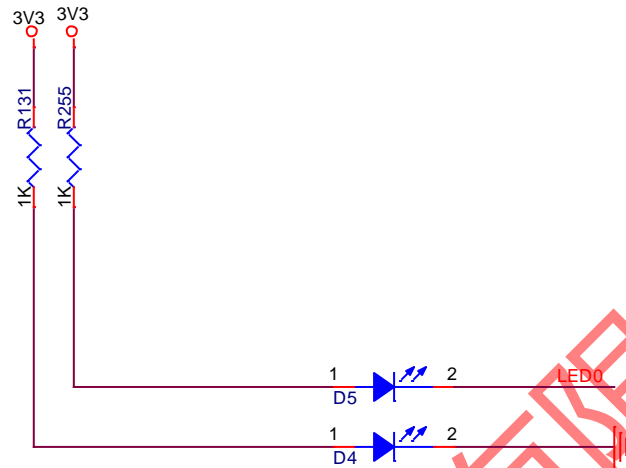Below image shows one user LED and 3.3V power supply indicator:

Figure 2-11. User LEDs

2.2.5 Cyclone IV Starter Kit User Key
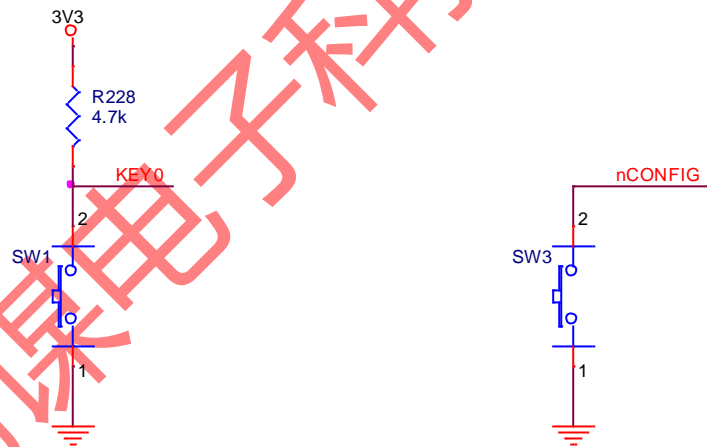
Below image shows the nCONFIG key and one user keys:

Figure 2-12. User Keys

2.2.6 Cyclone IV Starter Kit 7-SEG LEDs

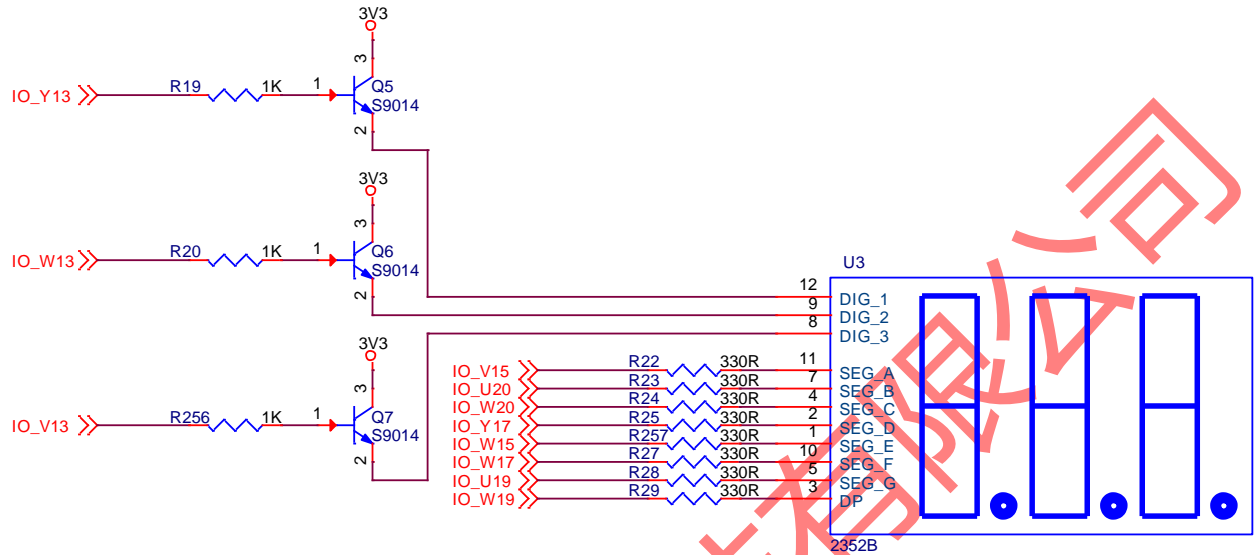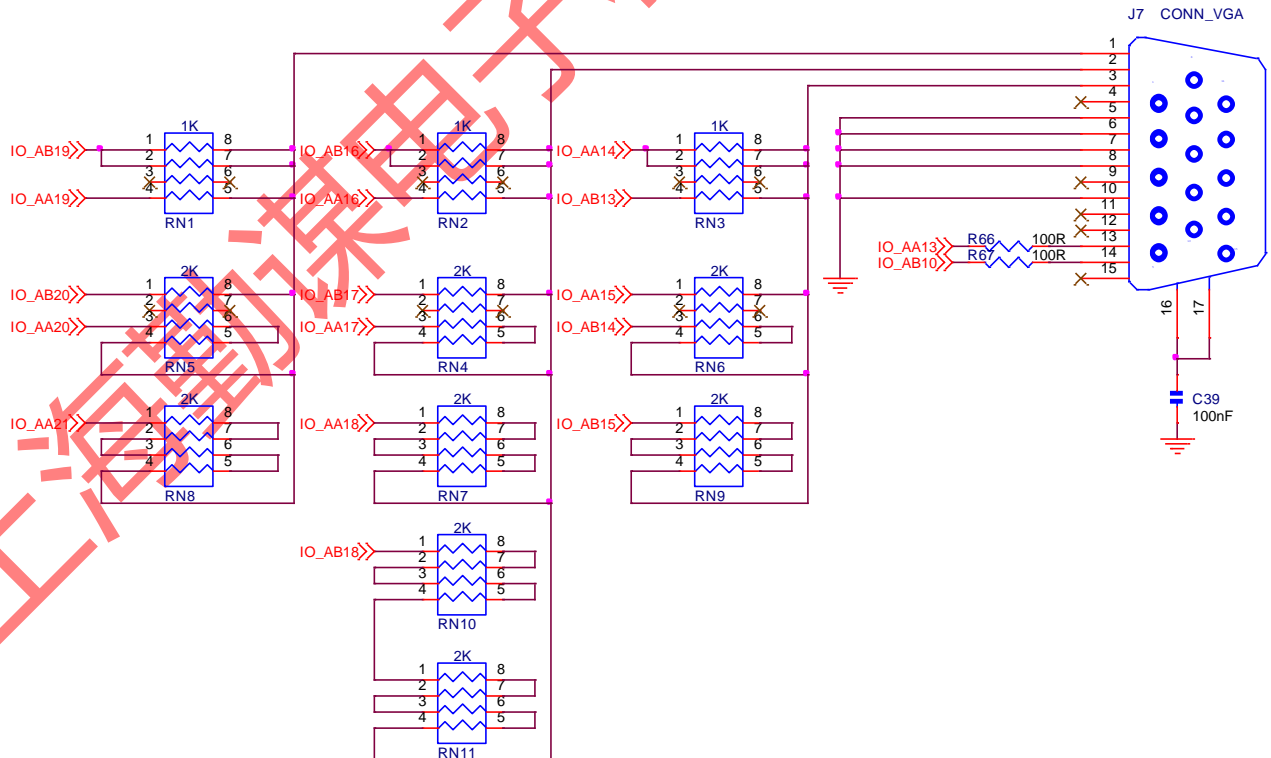Below image shows the circuit design for the 7-SEG LEDs.
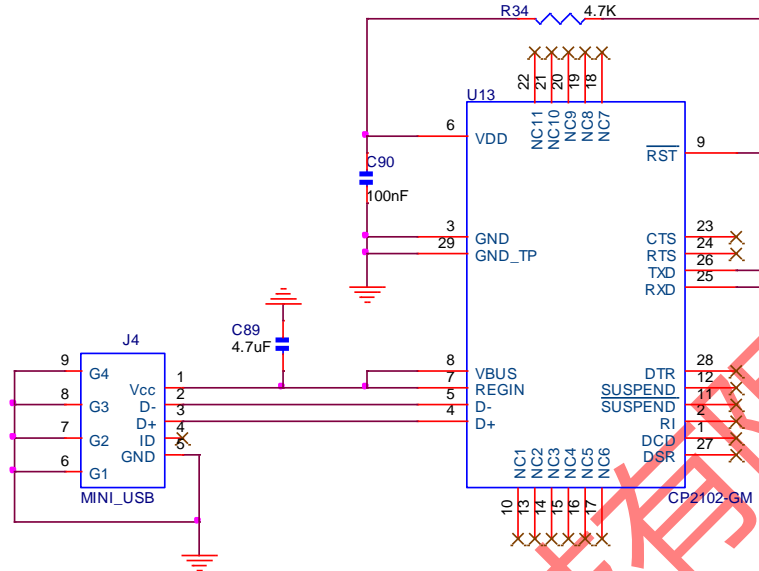

Figure 2-13. 7-SEG LEDs

2.2.7 Cyclone IV Starter Kit VGA Port

Below image shows the circuit design for the VGA interface. It uses resistor dividers to implement RGB565 mode VGA port.
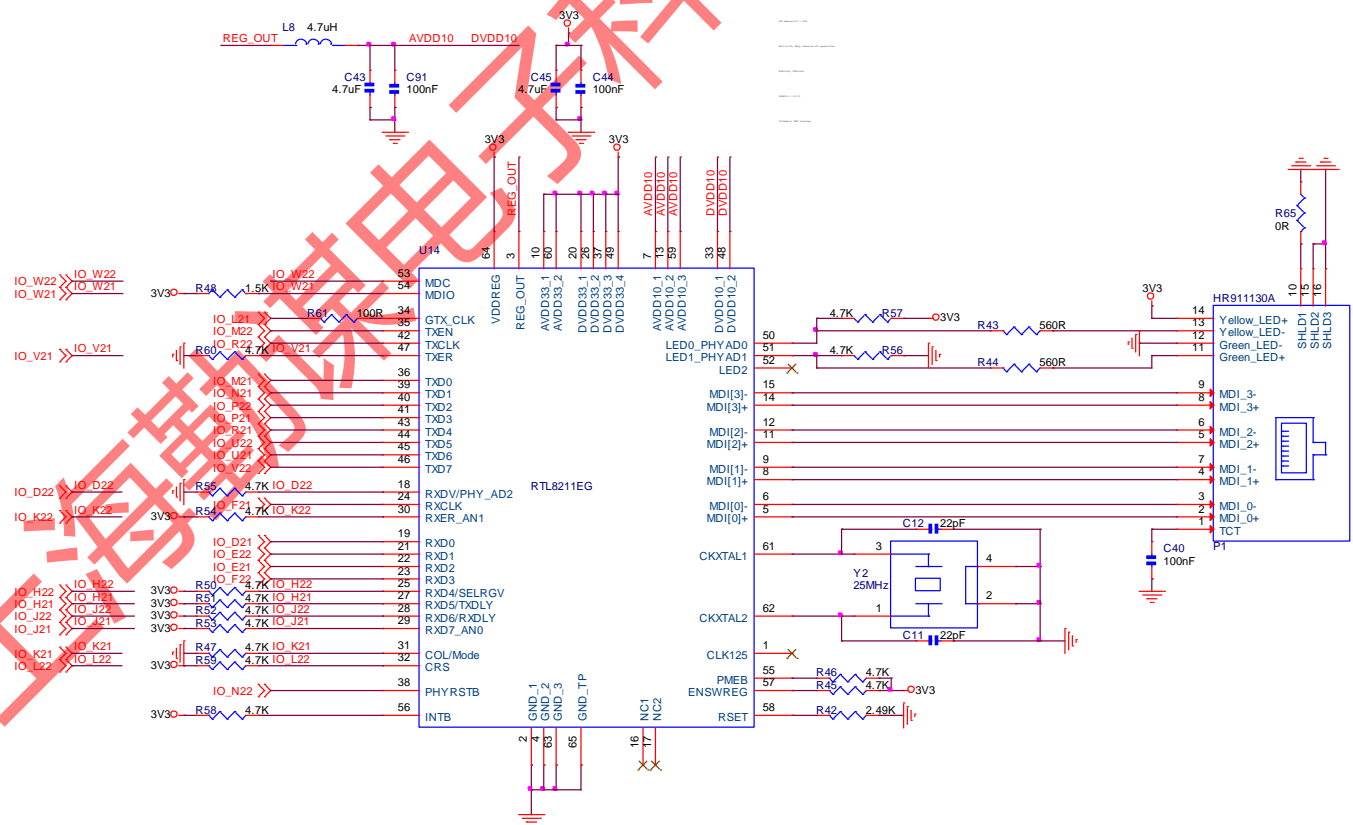
2.2.8   Cyclone IV Starter Kit USB to Serial Port

The development board uses Silicon Labs CP2102 chip to perform USB to Serial interface.

2.2.9   Cyclone IV Starter Kit GMII Interface

Below image shows the hardware design for the GMII interface by using RealTek's RTL8211EG chip.

3. Reference

[1] ep4ce15f23-starter-kit.pdf
[2] an592.pdf
[3] an592_ch.pdf
[4] cyiv-5v1.pdf
[5] cyiv-5v2.pdf
[6] cyiv-5v3.pdf
[7] pcg-01008.pdf

4.   Revision

Doc. Rev.	Date	Comments
0.1	17/04/2018	Initial Version.
1.0	18/04/2018	V1.0 Formal Release.