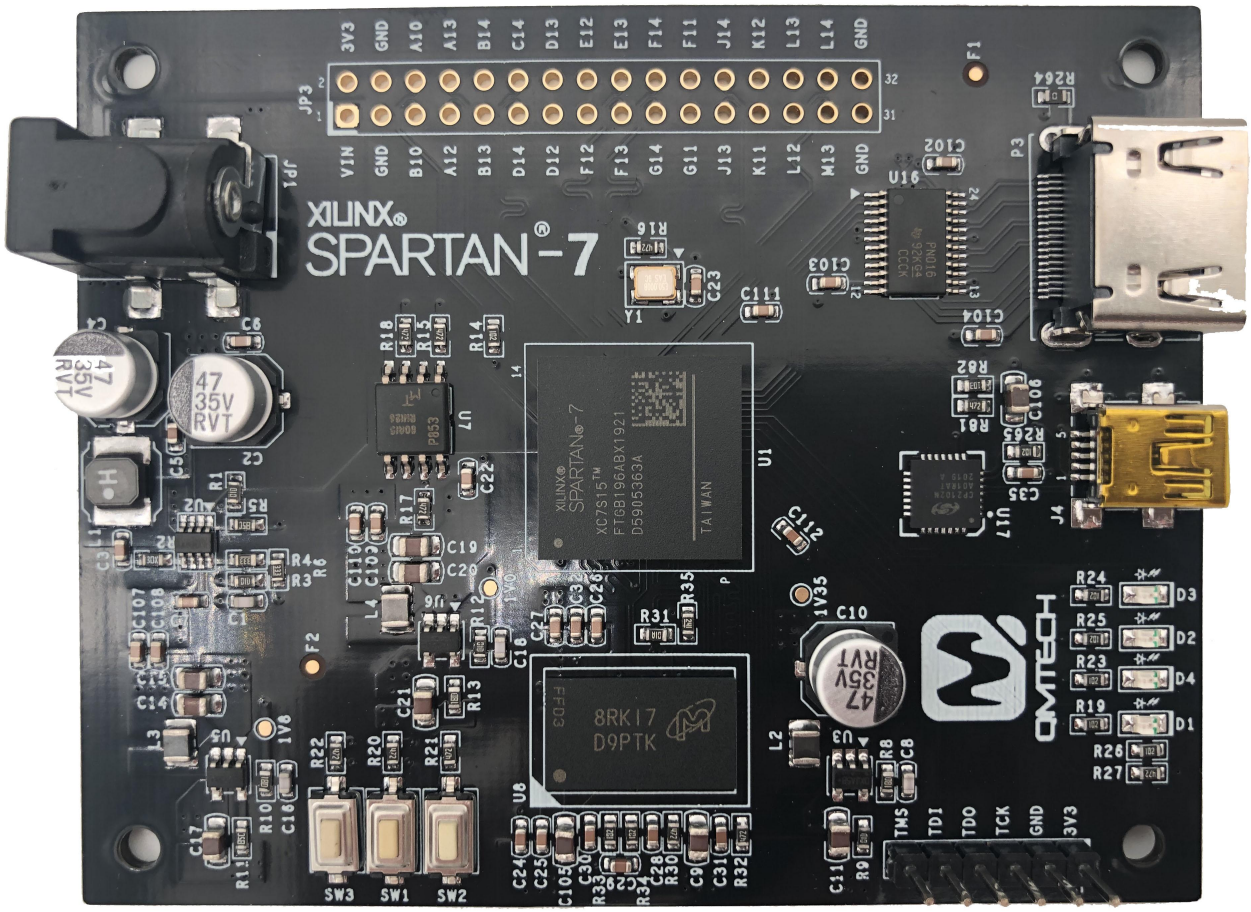
XILINX SPARTAN-7 STARTER KIT

USER MANUAL



Preface

The QMTech® Spartan-7 Starter Kit uses Xilinx XC7S15 device to demonstrate the newest addition to the Cost-Optimized Portfolio, offer the best in class performance per watt, along with small form factor packaging to meet the most stringent requirements. These devices feature a MicroBlaze™ soft processor running over 200 DMIPs with 800Mb/s DDR3 support built on 28nm technology. Additionally, Spartan-7 devices offer an integrated ADC, dedicated security features, and Q-grade (-40 to +125°C) on all commercial devices. These devices are ideally suited for industrial, consumer, and automotive applications including any-to-any connectivity, sensor fusion, and embedded vision.

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1. Introduction

1.1 Document Scope

This demo user manual introduces the QMTECH Spartan-7 Starter Kit and describes how to setup the development board running with application software Xilinx Vivado 2018.3. Users may employee the on board rich logic resource FPGA XC7S15-1FTGB196C to implement various applications. The development board has 26 non-multiplexed FPGA IOs for extending customized modules, such as ADC module, CMOS/CCD camera module etc.

1.2 Kit Overview

Below section lists the parameters of the QMTECH Spartan-7 Starter Kit:

- On-Board FPGA: XC7S15-1FTGB196C;
- On-Board FPGA external crystal frequency: 50MHz;
- XC7S15-1FTGB196C has rich block RAM resource up to 360Kb;
- XC7S15-1FTGB196C has 12,800 logic cells;
- On-Board Micron MT25QL128A SPI Flash, 16M bytes for user configuration code;
- On-Board 256MB Micron DDR3, MT41K128M16JT-125:K;
- On-Board 3.3V power supply for FPGA by using MP2315 wide input range DC/DC;
- QMTECH Spartan-7 Starter Kit provides one 40p, 2.54mm pitch headers for extending user IOs. All IOs are precisely designed with length matching;
- QMTECH Spartan-7 Starter Kit provides 3 user switches;
- QMTECH Spartan-7 Starter Kit provides 4 user LEDs;
- QMTECH Spartan-7 Starter Kit provides JTAG interface, by using 6p, 2.54mm pitch header;
- QMTECH Spartan-7 Starter Kit provides USB to UART Serial Port, by using Silicon Labs' CP2102N.
- QMTECH Spartan-7 Starter Kit provides HDMI display interface;
- QMTECH Spartan-7 Starter Kit PCB size is: 6.7cm x 8.4cm;
- Default power source for board is: 2A@5V DC, the DC header type: DC-050, 5.5mmx2.1mm;

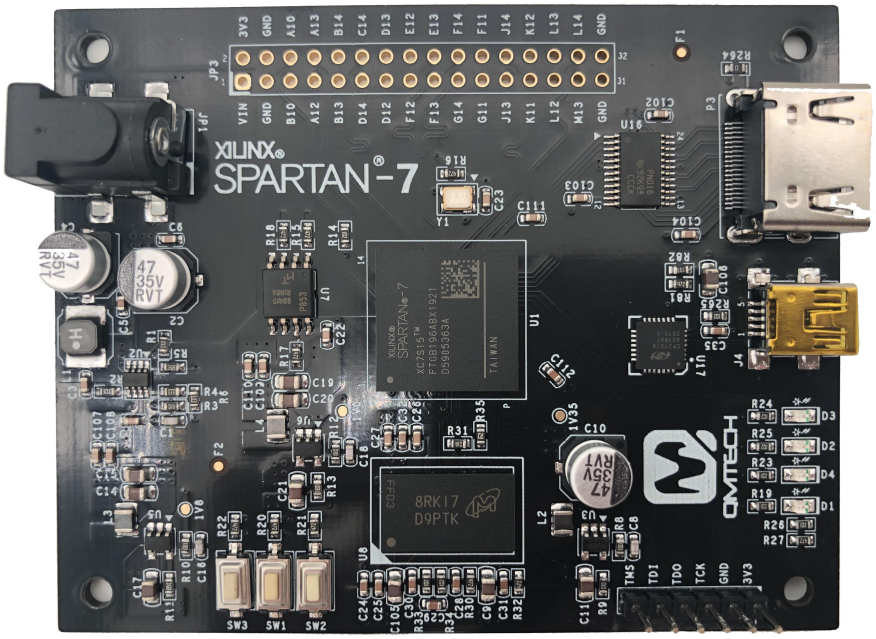

Figure 1-1. QMTECH Spartan-7 Starter Kit Overview

2. Getting Started

Below image shows the dimension of the QMTECH Spartan-7 Starter Kit: 67.1mm x 84.1mm. The unit in below image is millimeter(mm).

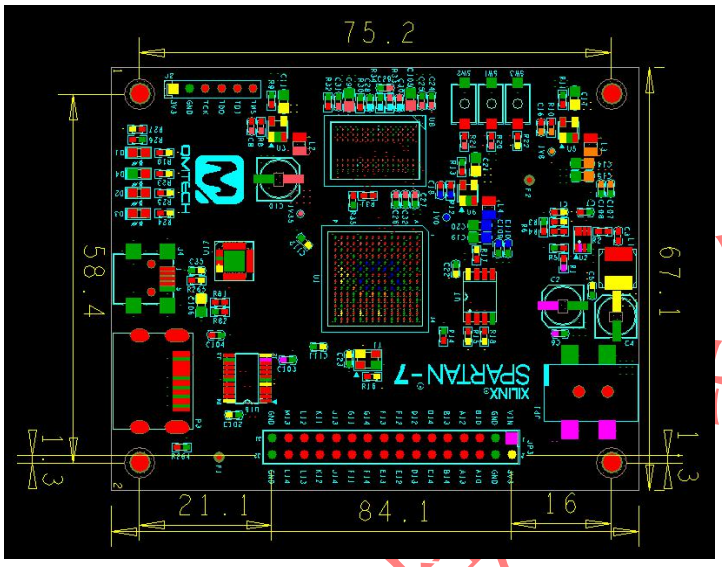

Figure 2-1. QMTECH Spartan-7 Starter Kit Dimension

2.1 Install Development Tools

The QMTECH Spartan-7 Starter Kit tool chain consists of Xilinx Vivado 2018.3, Xilinx USB platform cable, Mini USB cable and 5V DC for power supply. Below image shows the Xilinx Vivado 2018.3 development environment which could be downloaded from Xilinx office website:

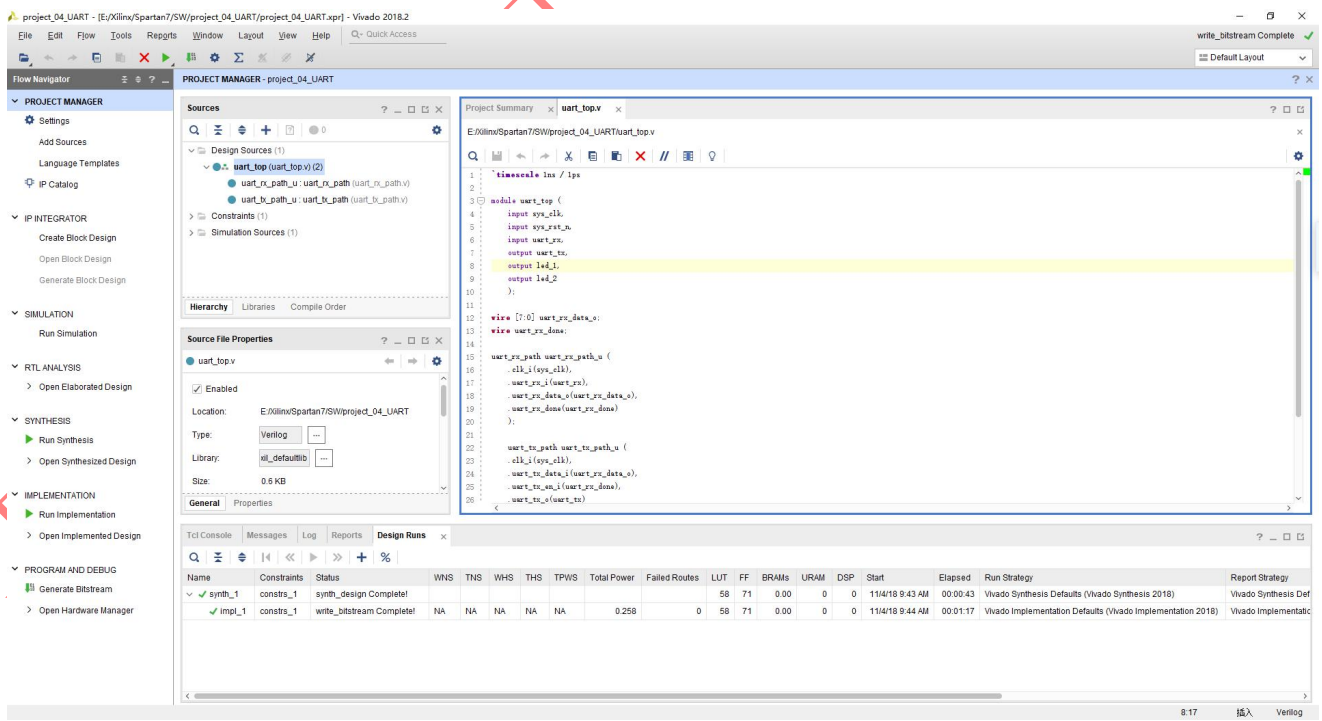

Figure 2-2. Vivado 2018.3

Below image shows the JTAG connection between Xilinx USB platform cable and QMTECH Spartan-7 Starter Kit:

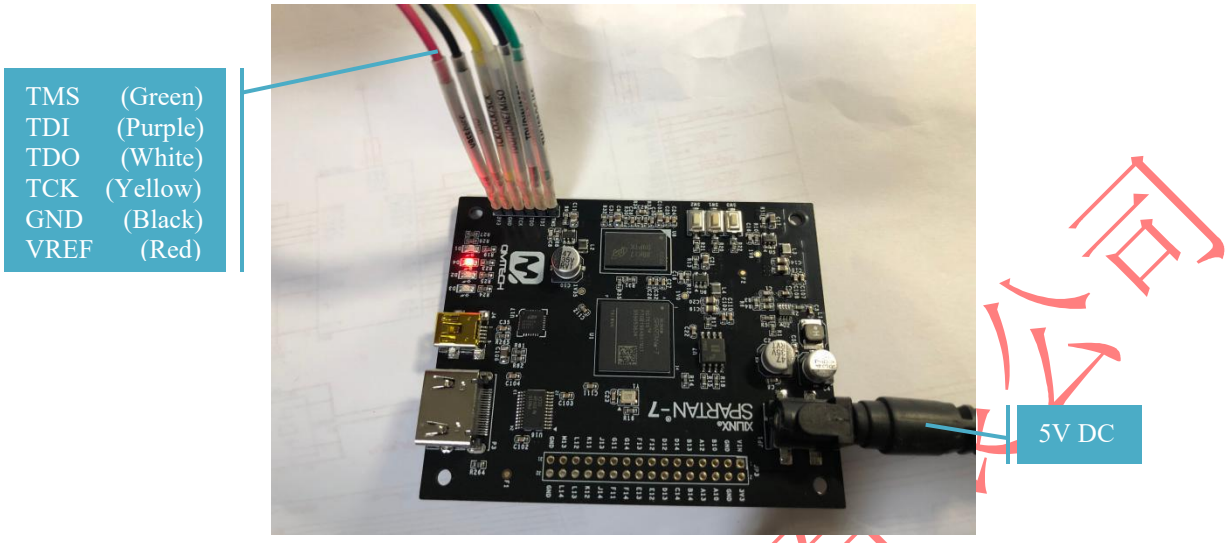

Figure 2-3. JTAG Connection and Power Supply

Once the FPGA test program is correctly 【Synthesized】, 【Implemented】 and 【Generated with Bitstream】, users may click the 【Open Target】 option to connect the XC7S15 FPGA.

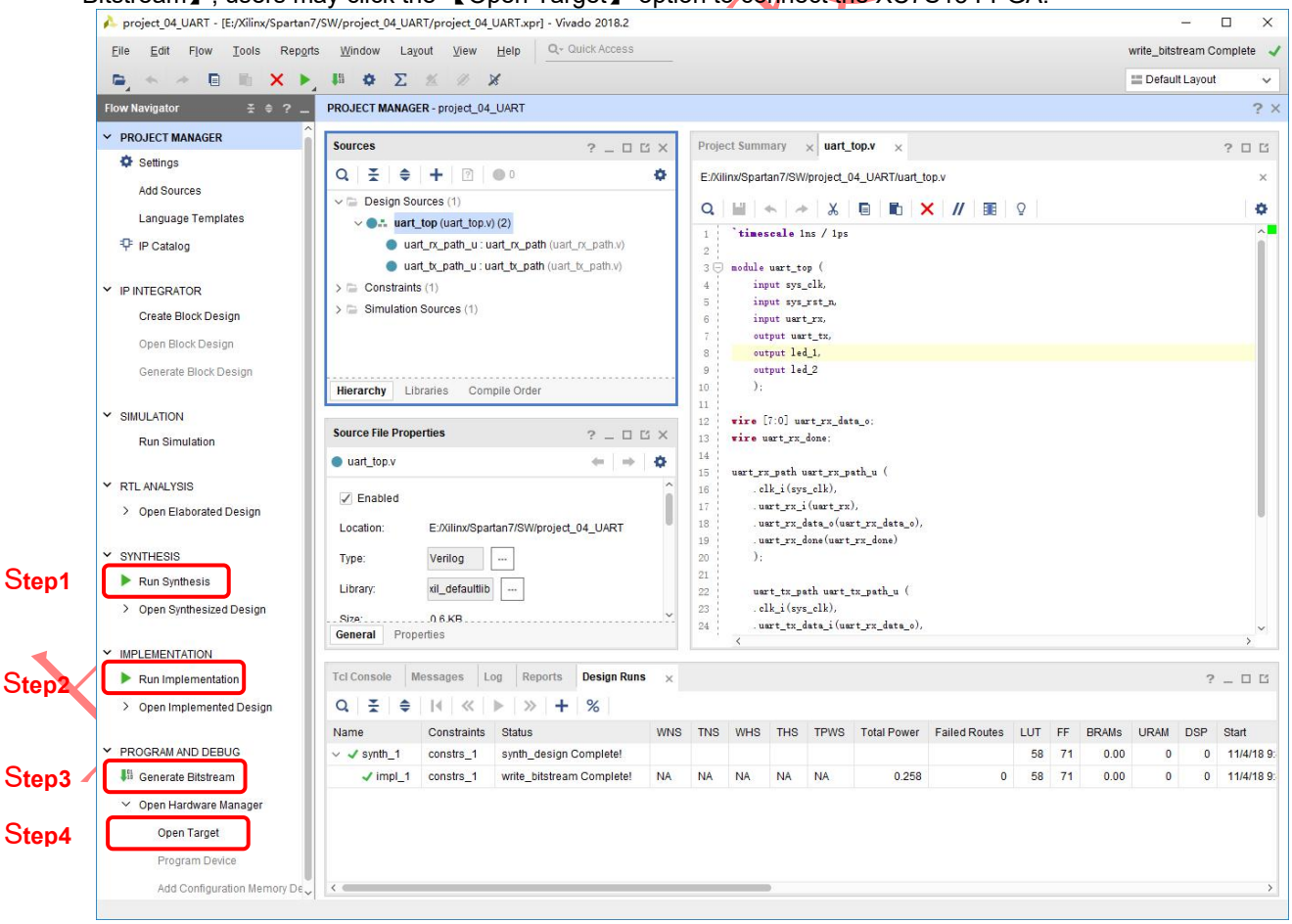

Figure 2-4. Vivado to Connect FPGA

Chip info like xc7s15_0(1) is shown in Hardware Manager as below image. Users then could right click the device to choose 【Program Device】to load the Bitstream *.bit into FPGA or to choose【Add Configuration Memory Device】to program the *.mcs file into on-board SPI flash.

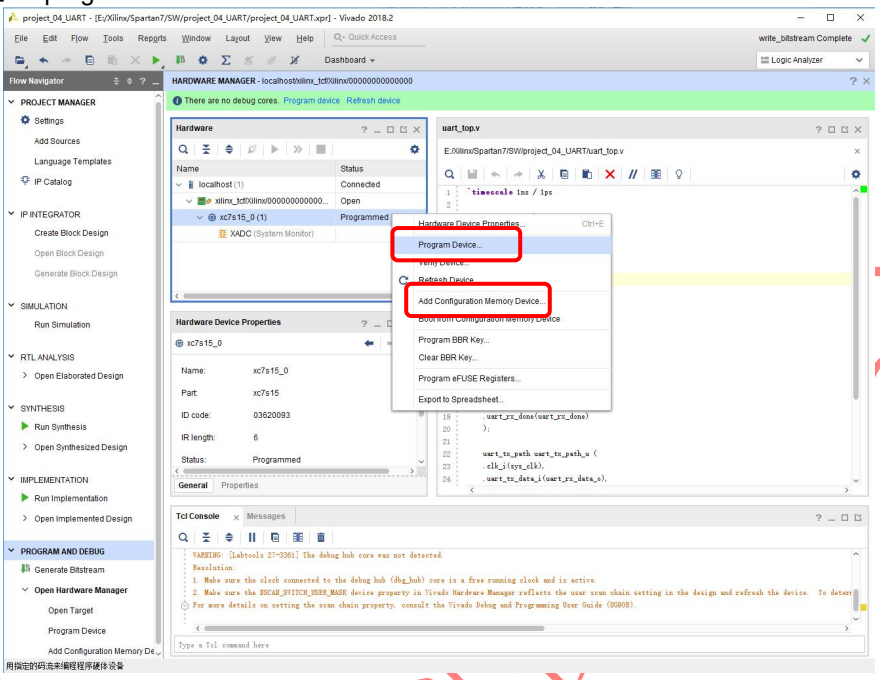

Figure 2-5. Program FPGA

Users could convert the *.bit file into the *.mcs file by using the Vivado tool. Choose the 【Tools】on the menu bar and then select 【Generate Memory Configuration File】, and then configure the parameters shown in below image:

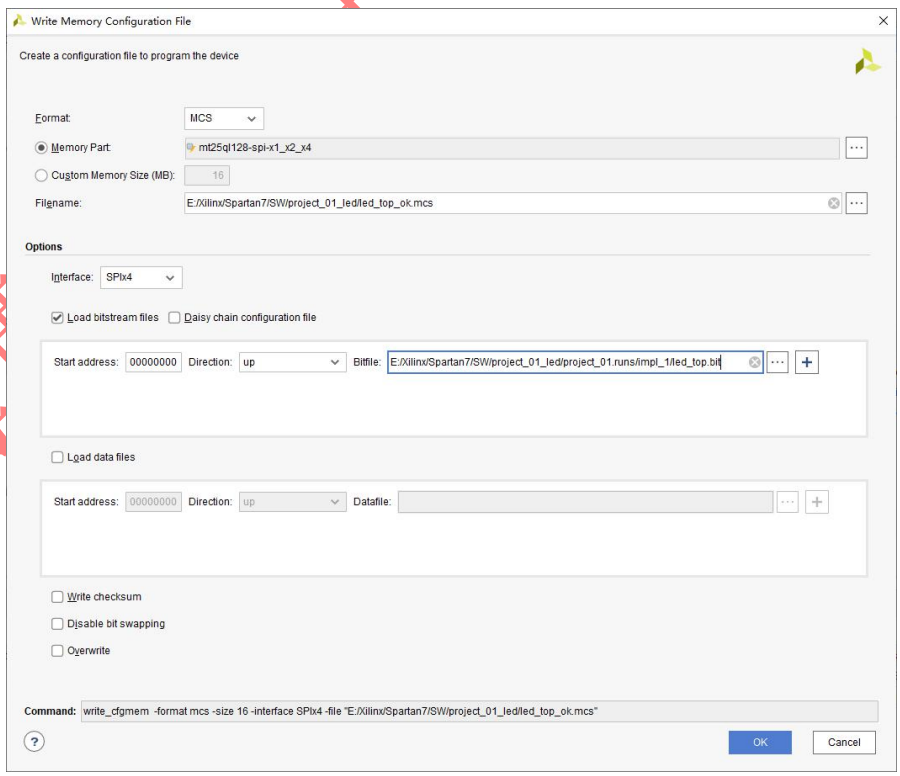

Figure 2-6. Generate *.mcs File

2.2 QMTECH Spartan-7 Starter Kit Hardware Design

2.2.1 QMTECH Spartan-7 Starter Kit Power Supply

The Starter Kit needs 5V DC input as power supply which could be directly injected from JP1 header or the connector JP3. Users may refer to the hardware schematic for the detailed design. The on board LED D4 indicates the 3.3V supply status, 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. Detailed design refer to hardware schematic.

Note: FPGA core supply 1.0V is regulated by On-Semi DC/DC chip NCP1529 which could output maximum 1A current.

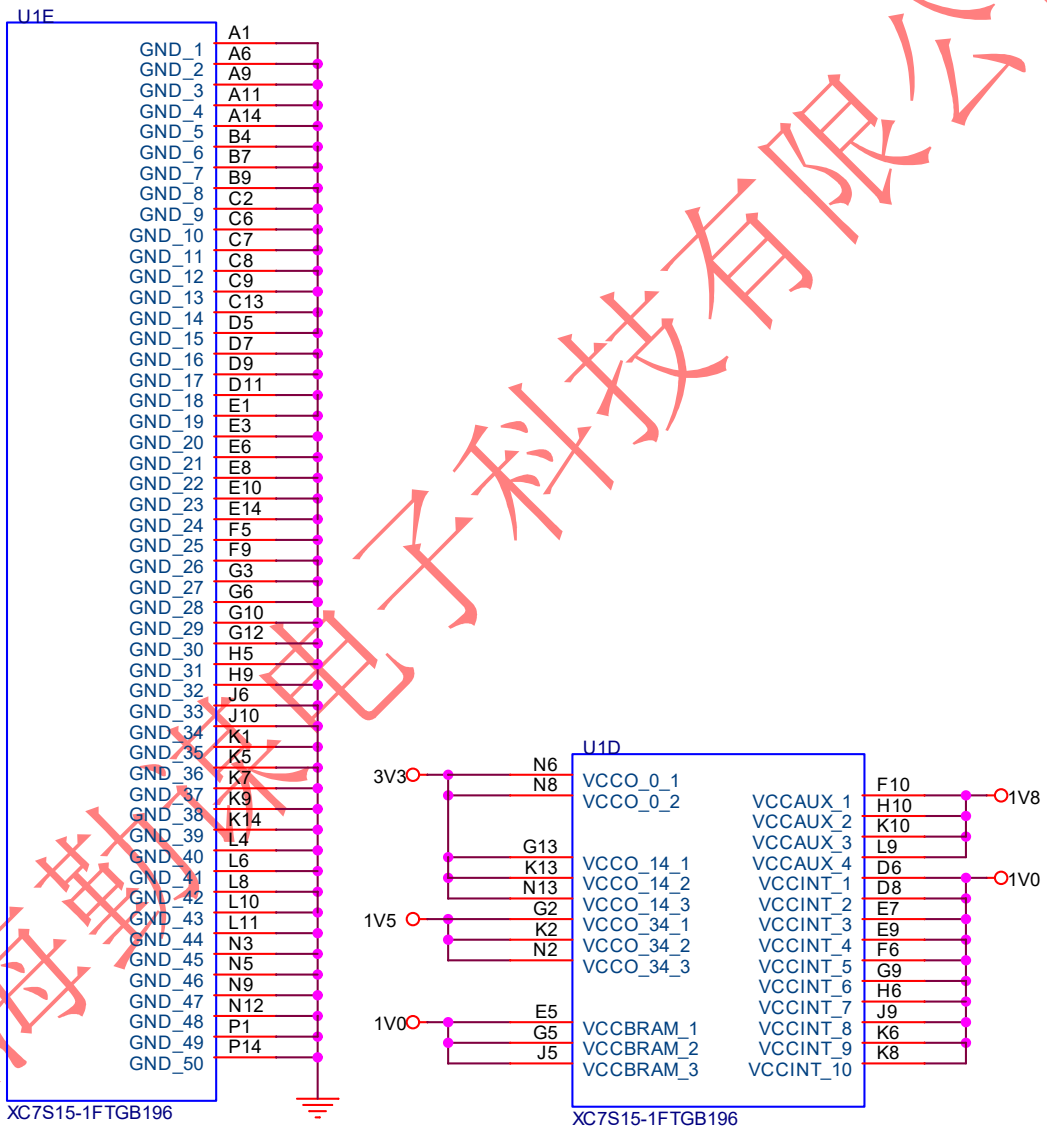

Figure 2-7. Power Supply for the FPGA

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2.2.1 QMTECH Spartan-7 Starter Kit 3.3V 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:

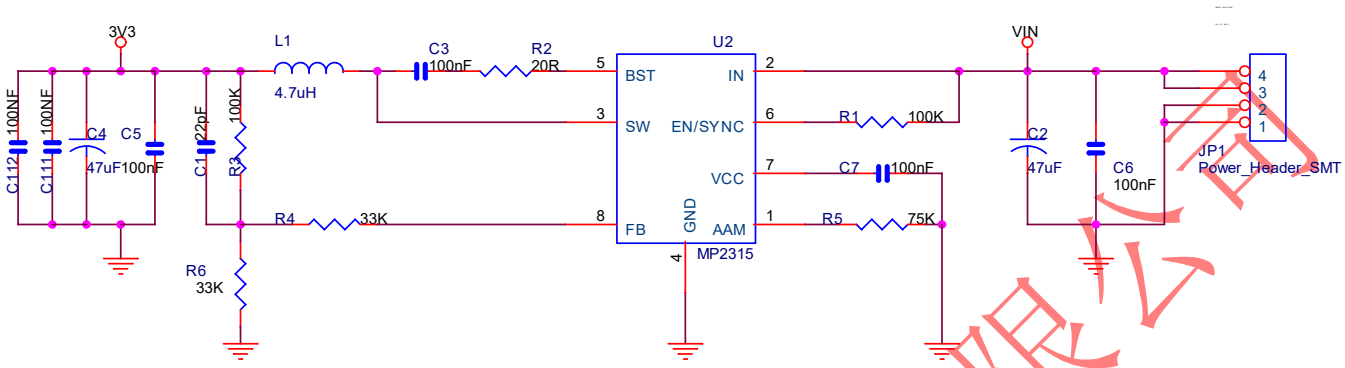

Figure 2-8. MP2315 Hardware Design

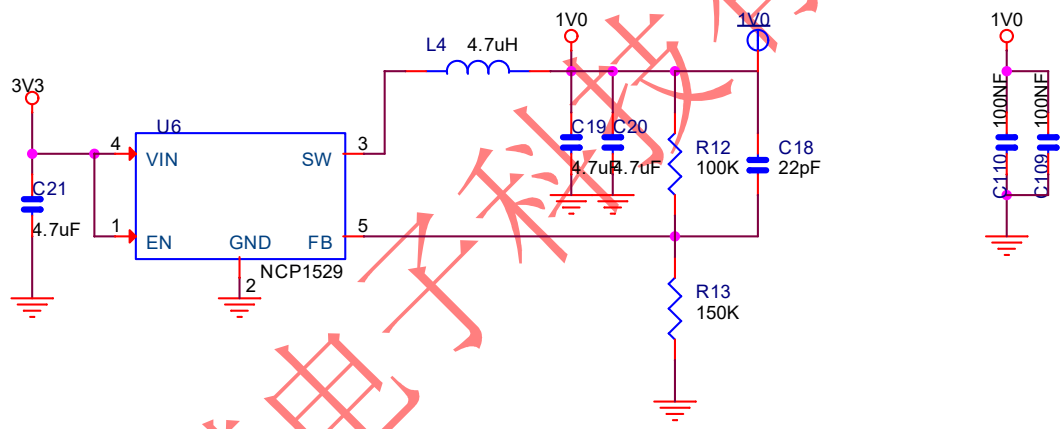

Figure 2-9. 1.0V Core Voltage DC/DC

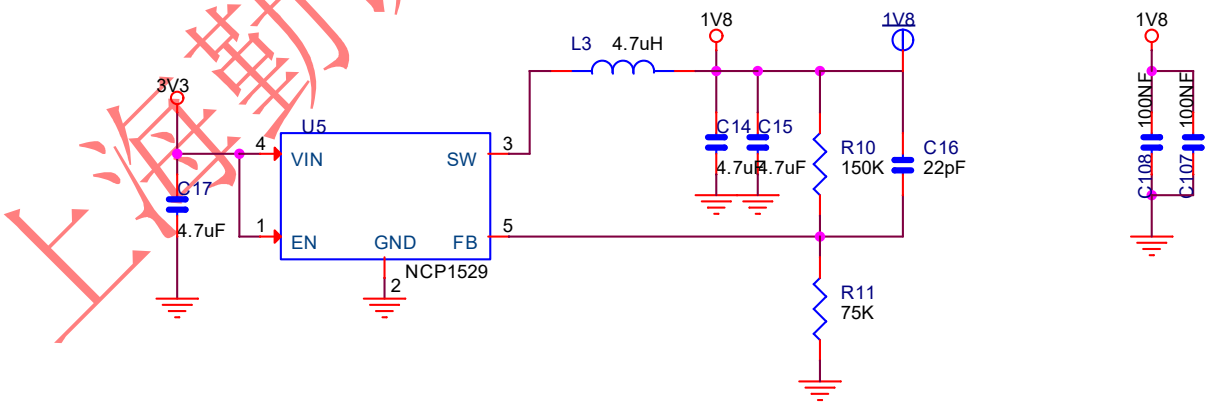

Figure 2-10. 1.8V AUX Voltage DC/DC

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2.2.2 QMTECH Spartan-7 Starter Kit SPI Boot

In default, XC7S15 boots from external SPI Flash, detailed hardware design is shown in below figure. The SPI flash is using MT25QL128A manufactured by Micron, with 128Mbit memory storage.

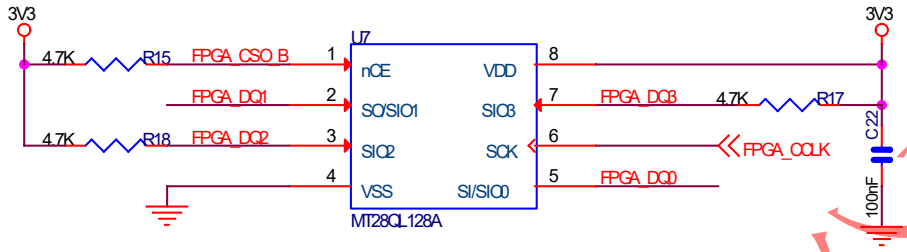

Figure 2-11. SPI Flash

The FPGA boot sequence setting M0:M1:M2 is configured as 1:0:0 which indicates FPGA will boot from SPI Flash after power on.

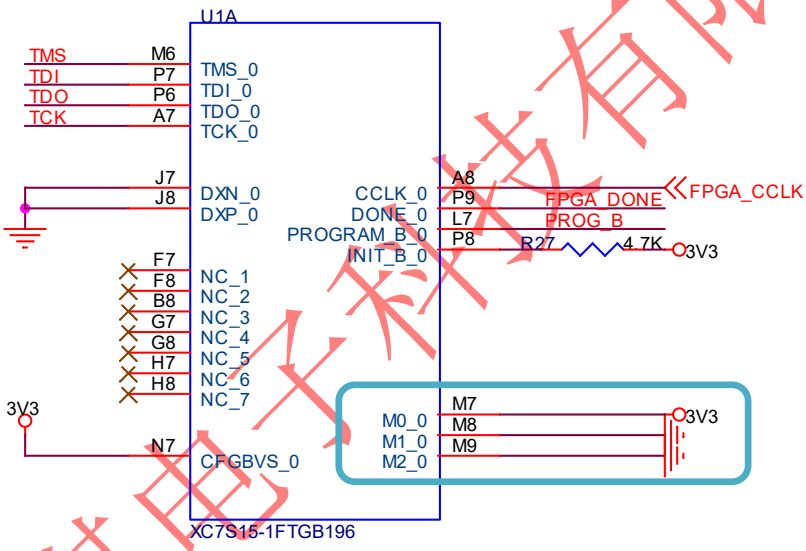

Figure 2-12. M0:M1 Hardware Settings

The LED D1 will be turned on after the FPGA successfully loading configuration file from SPI Flash during power on stage. In this case, LED D1 could be used as FPGA loading status indicator.

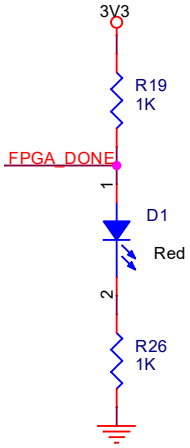

Figure 2-13. FPGA_DONE Status Indicator

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2.2.3 QMTECH Spartan-7 Starter Kit System Clock

FPGA chip XC7S15-1FTGB196C 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:

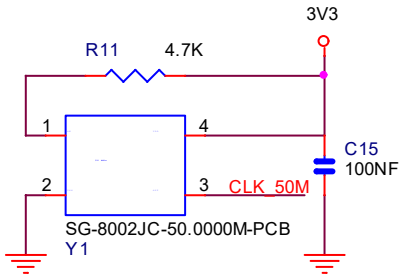

Figure 2-14. 50MHz System Clock

2.2.4 QMTECH Spartan-7 Starter Kit JTAG Port

The on board JTAG port uses 6P 2.54mm pitch header which could be easily connected to Xilinx USB platform cable. Below image shows the hardware design of the JTAG port:

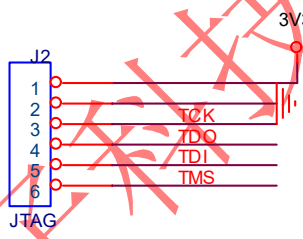

Figure 2-15. JTAG Port

2.2.5 QMTECH Spartan-7 Starter Kit User LEDs

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

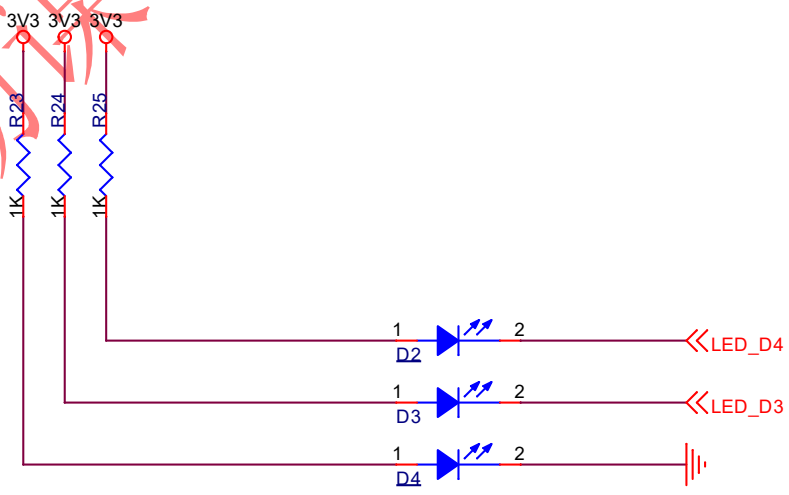

Figure 2-16. LEDs

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2.2.6 QMTECH Spartan-7 Starter Kit Extension IOs

The development board has one 32P 2.54mm pitch headers which are used for extending user modules, such as ADC/DAC module, audio/video module, ethernet module, etc.

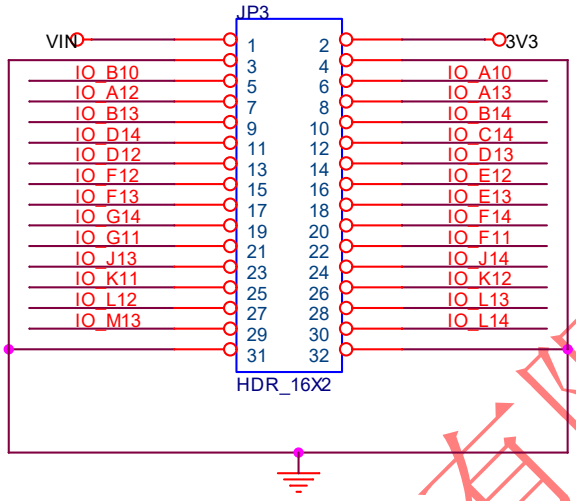

Figure 2-17. Extension IOs

2.2.7 QMTECH Spartan-7 Starter Kit User Keys

Below image shows the PROGRAM_B key and two user keys:

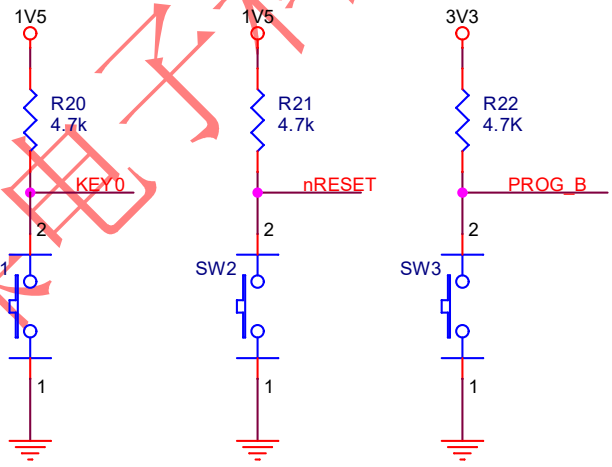

Figure 2-18. Keys

2.2.8 QMTECH Spartan-7 Starter Kit UART Port

The CP2102N is a USB 2.0 to serial port bridge chip designed by Silicon Labs. The CP2102N includes a USB 2.0 full-speed function controller, USB transceiver, oscillator, UART and eliminates the need for other external USB components are required for development. Below figure shows the hardware design of CP2102N on the Starter Kit.

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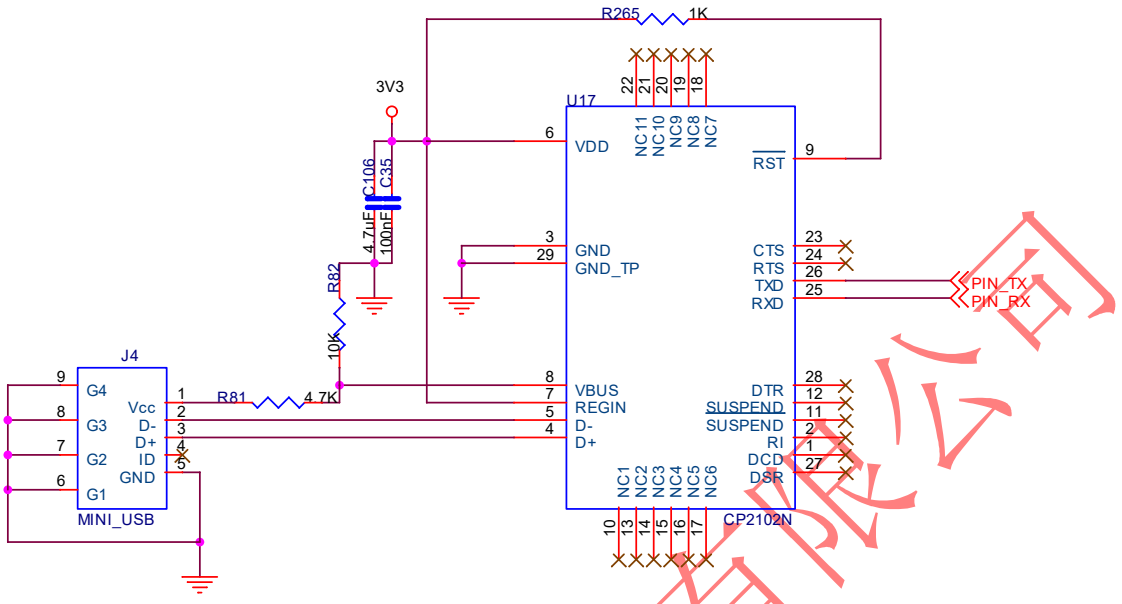

Figure 2-19. UART Port

2.2.1 QMTECH Spartan-7 Starter Kit HDMI Display Port

The Starter Kit provides HDMI interface by using TI's TPD12S016 chip, which is a single-chip High Definition Multimedia Interface (HDMI) device with auto-direction sensing I2C voltage level shift buffers, a load switch, and integrated low capacitance high-speed electrostatic discharge (ESD) transient voltage suppression (TVS) protection diodes. Below image shows the hardware design.

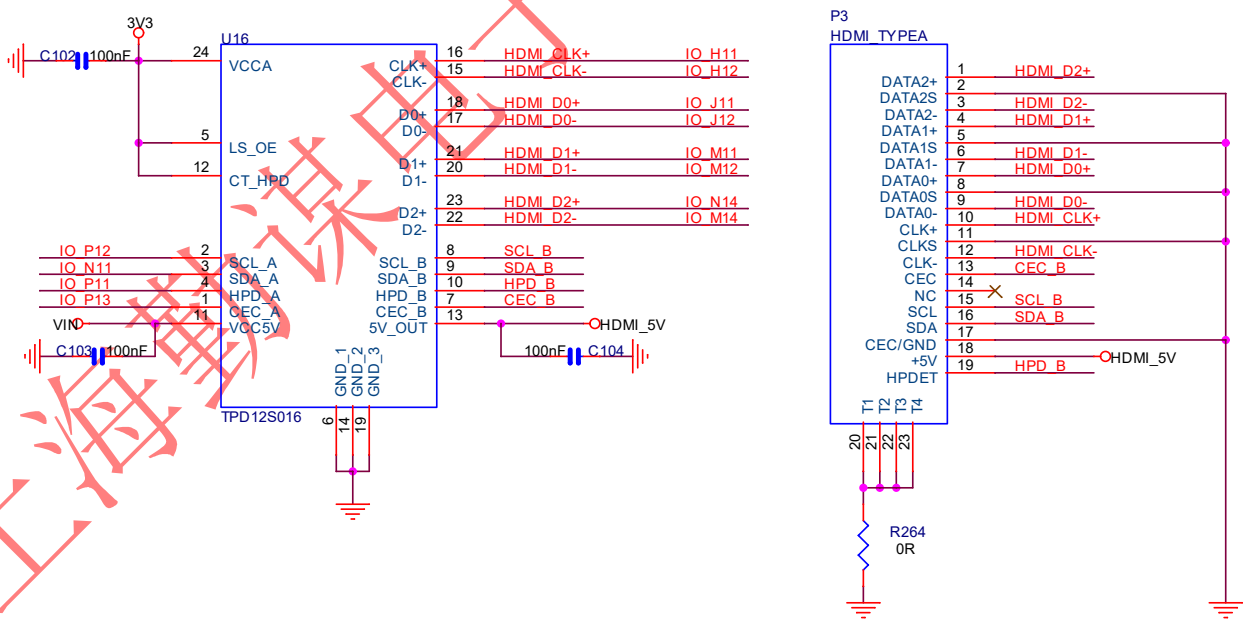

Figure 2-20. HDMI Display Port

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2.2.1 QMTECH Spartan-7 Starter Kit DDR3 Memory

The Starter Kit has on board 16bit width data bus, 256MB memory size DDR3 MT41K128M16JT-125:K provided by Micron. Below image shows the detailed hardware design:

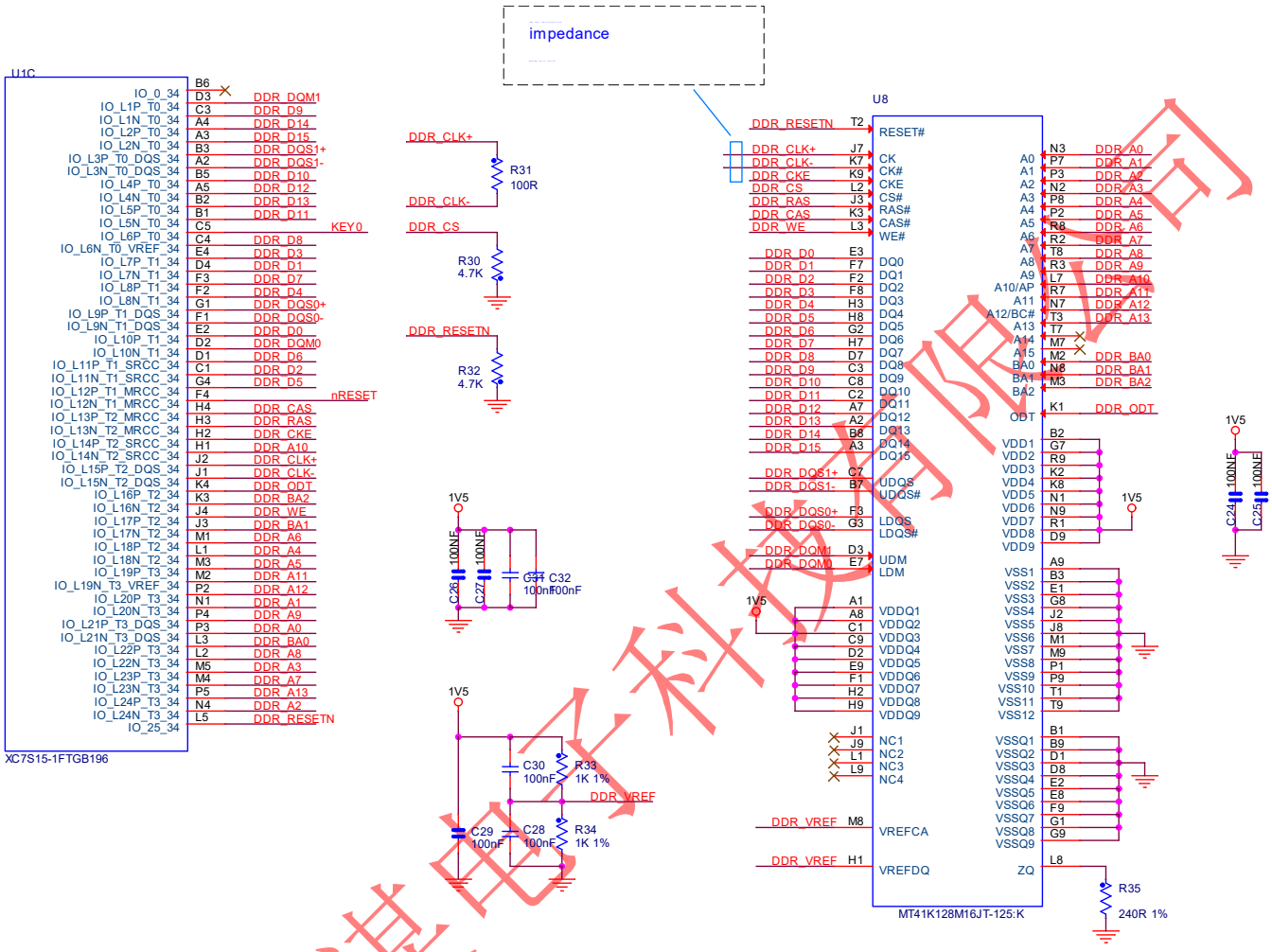

Figure 2-21. DDR3 Memory

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3. Reference

[1] ug470_7Series_Config.pdf
[2] ds181_Artix_7_Data_Sheet.pdf
[3] ug475_7Series_Pkg_Pinout.pdf
[4] MT25QL128A.pdf
[5] MP2315.pdf
[6] NCP1529-D.PDF

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4. Revision

Doc. Rev.	Date	Comments
0.1	05/12/2020	Initial Version.
1.0	06/30/2020	V1.0 Formal Release.

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