



## Reference Manual

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### Mpression Borax Card

Revision 2.0

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# 1. For Ensuring Safe Use



Be sure to follow the instructions given in this Manual which are intended to prevent harm to the user and others as well as material damage.


## 1.1 Legend

 <b>Danger</b>	Indicates an imminent hazardous situation which if not avoided will result in death or serious injury.
 <b>Warning</b>	Indicates a potentially hazardous situation which if not avoided could result in death or serious injury.
 <b>Caution</b>	Indicates a potentially hazardous situation which if not avoided may result in minor or moderate injury or in property damage.

## 1.2 Cautions

 <b>Danger</b>	<p>Make sure to use the AC adapter (included in package) that is specified in this Manual.</p> <p>Using an AC adapter not meeting the specifications described in this Manual will cause the kit to emit heat, explode, or ignite.</p>
 <b>Warning</b>	<p>Do not apply strong impacts or blows to the kit.</p> <p>Doing so may cause the kit to emit heat, explode, or ignite, or the equipment in the kit to fail or malfunction. This may also cause fire.</p>
	<p>Do not put the main unit or the AC adapter in cooking appliances such as microwave ovens, or high-pressure containers.</p> <p>Doing so might cause the main unit or AC adapter to emit heat, explode, ignite, or emit smoke, or its parts to break or warp.</p>
	<p>Do not wrap the main unit that is in use with cloth or other materials that are likely to allow heat to build up inside the wrapping.</p> <p>This will cause heat to build up inside the wrapping which may cause the main unit to ignite or malfunction.</p>
	<p>When disposing of the main unit, do not dispose of it along with general household waste.</p> <p>Throwing the main unit into fire may cause it to explode. Dispose of the main unit following the laws, regulations, and ordinances governing waste disposal.</p> <p>Do not use the kit in places subject to extremely high or low temperatures or severe temperature changes.</p> <p>Doing so may cause the kit to fail or to malfunction.</p> <p>Always be sure to use the kit in a temperatures ranging from 5°C to 35°C and a humidity range of 0% to 85%.</p>

<div data-bbox="226 701 295 763"></div> <div data-bbox="323 678 456 714"><b>Warning</b></div> <div data-bbox="323 728 466 790">(Continued from previous page)</div>	<p>Do not pull the power supply cable with excessive force or place heavy items on it.</p> <p>Do not damage, break, bundle, or tamper with the power supply cable. Damaged parts of the power supply cable might cause a short circuit resulting in fire or accidents involving electrical shock.</p> <p>Do not unplug the power plug with wet or moist hands. This might cause injuries or equipment malfunctions or failures due to electrical shock.</p> <p>Plug the power plug securely into the outlet. If the power plug is not securely plugged into the outlet, it may cause accidents involving electrical shock or fire due to heat emitted.</p> <p>Do not connect many electrical cords to a single socket or connect an AC adapter to an outlet that is not rated for the specified voltage. Failing to do so may cause the equipment to malfunction or fail, or lead to accidents involving electrical shock or fire due to heat emitted.</p> <p>Periodically remove any dust accumulated on the power plug and around the outlet (socket). Do not use a power plug with dust accumulated on it because doing so will lead to insulation failure due to moisture which may lead to fire. Remove any dust on the power plug and around the outlet with dried cloth.</p> <p>Do not place any containers such as cups or vases filled with water or other liquid on this Board. If this Board is exposed to water or other liquids it may cause the Board to malfunction or lead to accidents involving electrical shock. If you spilled water or other liquid on this Board, immediately stop using the Board, turn off the power, and unplug the power plug. If you have any requests for repairs or technical consultation, please contact the Manufacturer.</p>
<div data-bbox="226 1608 295 1671"></div> <div data-bbox="323 1619 443 1655"><b>Caution</b></div>	<p>Do not place the kit on unstable places such as shaky stands or tilted locations. Doing so may cause injuries or cause this Board to malfunction if the Board should fall.</p> <p>Do not attempt to use or leave the kit in places subject to strong direct sunlight or other places subject to high temperatures such as in cars in hot weather. Doing so might cause the kit to emit heat, break, ignite, run out of control, warp, or malfunction. Also, some parts of the equipment might emit heat causing burn injuries.</p> <p>Unplug the power supply cable when carrying out maintenance of devices in which the main unit is embedded. Failure to do so may lead to accidents involving electrical shock.</p> <p>Do not place this Board in locations where excessive force is applied to the Board. Failure to do so may cause the PC board to warp, leading to breakage of the PC board, missing parts or malfunctioning parts.</p> <p>When using the kit together with expansion boards or other peripheral devices, be sure to carefully read each of their manuals and to use them correctly. Manufacturer does not guarantee the operation of specific expansion boards or peripheral devices when used in conjunction with this Board unless they are specifically mentioned in this Manual or their successful operation with this Board has been confirmed in separate documents.</p>

 <b>Caution</b> (Continued from previous page)	Be sure to turn off the power switch when moving this Board to connect to other devices. Failure to do so may cause this Board to fail or lead to accidents involving electrical shock.
	Do not clean this Board by using a rag containing chemicals such as benzine or thinner. Failure to do so will likely to cause this Board to deteriorate. When using a chemical cloth be sure to comply with any directions or warnings.
	Do not immediately turn on the power if you find that water or moisture had condensed onto the main unit after removing the board from the package. Condensation might occur on this Board when taking it out of the box, if the board is cool yet the room temperature is warm. Do not apply power to the Board while water or moisture has condensed on it because the moisture may cause the Board to break or may shorten the service life of the parts.
	When you first take this Board out of the box be sure to leave it at room temperature for a while before using it. If condensation or moisture has occurred on this Board, first wait for the moisture to fully evaporate before installing or connecting the Board to other devices.
	Do not disassemble, dismantle, modify, alter, or recycle parts unless they are clearly described as customizable in this Manual. Although this kit is customizable, if parts not specified in this Manual as customizable are modified in any way, then the overall product operation cannot be guaranteed. Please consult with Manufacturer beforehand if you wish to customize or modify any parts that are not described in this Manual as customizable.

## 1.3 Developer Information

The Developer of this product is:

Cytech Technology LTD.

Blues Dong, John Li, CHINA

<http://www.cytech.com>

## 1.4 Inquiries

In case you have any inquiries about the use this product, please contact your local Macnica company or make inquiries through the contact form in the following web site:

<http://www.m-pressure.com/contact>

Macnica companies:

• China & HK:	Cytech Technology	<a href="http://www.cytech.com/">http://www.cytech.com/</a>
• ASEAN & India:	Cytech Global	<a href="http://www.cytechglobal.com/">http://www.cytechglobal.com/</a>
• Taiwan:	Galaxy Far East Corp.	<a href="http://www.gfec.com.tw/">http://www.gfec.com.tw/</a>
• North America:	Macnica Americas	<a href="http://www.macnica-na.com/">http://www.macnica-na.com/</a>
• Brazil:	Macnica DHW	<a href="http://www.macnicadhw.com.br/en/">http://www.macnicadhw.com.br/en/</a>
• Japan:	Altima	<a href="http://www.altima.co.jp">http://www.altima.co.jp</a>
	Elsena	<a href="http://www.elsena.co.jp">http://www.elsena.co.jp</a>

## 2. Borax Card

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### 2.1 Overview

Borax is an Altera SOC module card, will help us easily to use SOC chip in system design. Consider it as a minimal MCU system, only need expand peripherals what you need on the base board.



### 2.2 Borax card components

- A. CPU, ARM Cortex-A9 dual/solo, It can be selected as dual core or single core chip;
- B. FPGA, CycloneV series, support density from 25K LE to 110K LE;
- C. Nand Flash, default using 1GB SLC, can be up to 4GB;
- D. QSPI Flash, default using 16MB chip, can be up to 128MB;
- E. DDR3 memory, default using 512MB, can be up to 1GB;
- F. One 10/100/1000M Ethernet MAC, RGMII interface with ETH PHY;
- G. One USB OTG PHY;
- H. One RTC, I2C interface with HPS;
- I. HPS user I/O expand, has 8 input/output pins and 14 input only pins;
- J. FPGA user I/O expand, has 123 input/output (including 6 RX LVDS) pins and 12 TX LVDS pins;
- K. Temperature and voltages monitor on board.



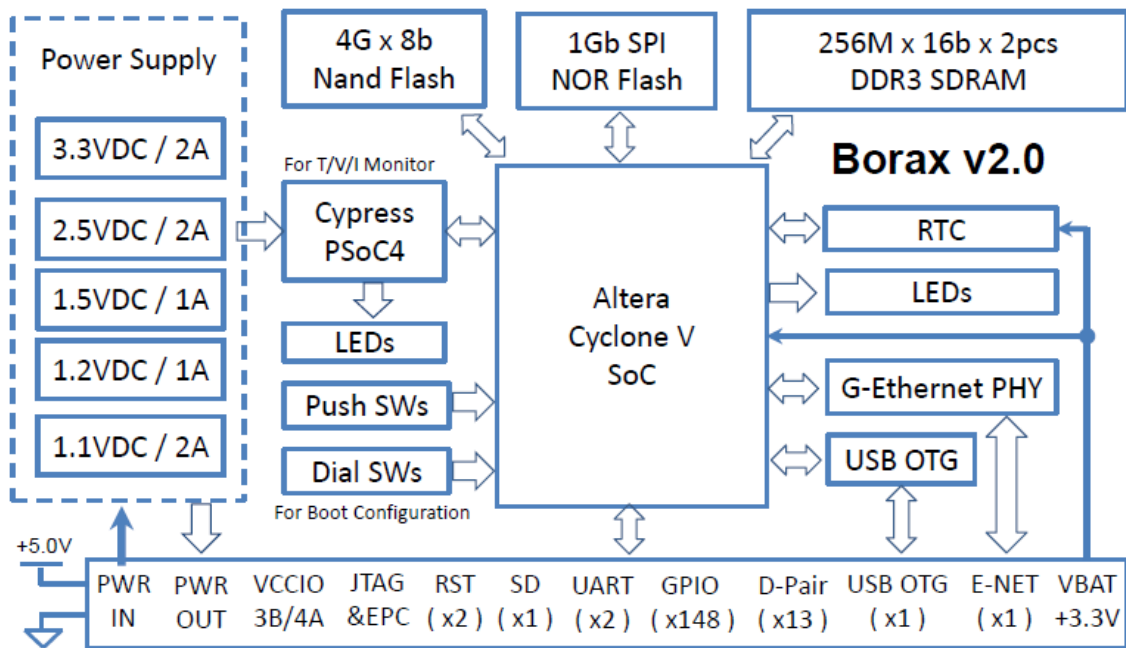


Figure 2-1 Borax block diagram

## 2.3 HPS Memory Features

### 2.3.1 QSPI Flash:

Borax Card boot from QSPI Flash as default. Preloader and UBOOT are saved in it.

Currently, Borax Card used 16MB QSPI Flash on board and the erase block is 64KB. The capacity is supported from 16MB to 128MB.

Because QSPI Flash is NOR flash that has much better reliability than NAND flash, so we used QSPI Flash as boot chip. Also, preloader and UBOOT saved in it for never erasing to preserve card from booting crash.

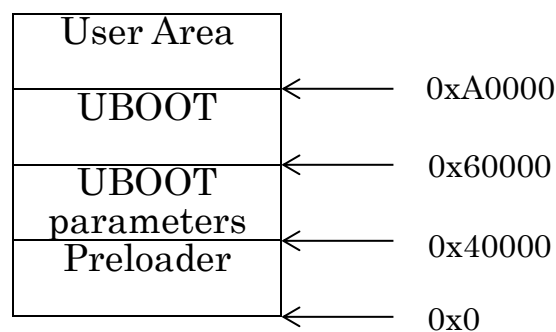


Figure 2-2 QSPI map

## 2.3.2 NAND Flash:

It is used to save Linux device tree file, kernel image, file system and FPGA configuration file. Default, Borax Card used 1GB SLC NAND Flash on board and the erase block is 512KB, page size is 4KB.

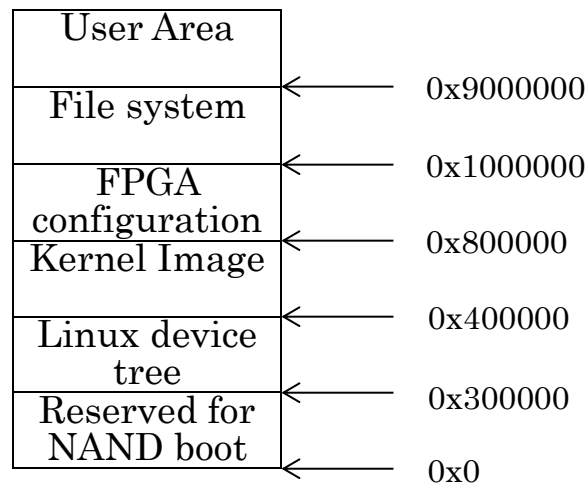


Figure 2-3 NAND map

## 2.3.3 DDR3

Two discrete DDR3 chips; 32 bit data width; 256MB~1GB capacity can be selected; Currently, we used 512MB on board. Support up to 800Mbps data bandwidth.

## 2.4 HPS Peripheral Features

### 2.4.1 Ethernet

Borax Card used HPS EMAC0 as primary Ethernet MAC peripheral, and put MICREL KSZ9031RNX PHY on board to connect with it. The output pins via connector to connect base board RJ45 for Ethernet connection.

U2 KSZ9031RNX	J4 Connector
TX_A+	PIN 50
TX_A-	PIN 48
TX_B+	PIN 54
TX_B-	PIN 52
TX_C+	PIN 49
TX_C-	PIN 47
TX_D+	PIN 53
TX_D-	PIN 51

Table 2-1 Ethernet

## 2.4.2 USB OTG

Borax Card set HPS USB0 as USB OTG peripheral, and put USB3300 as PHY chip on the board.

<b>U6</b> USB3300	<b>J3</b> Connector
USB_VBUS	PIN 35
USB_DM	PIN 37
USB_DP	PIN 39
USB_ID	PIN 41

Table 2-2 USB OTG

## 2.4.3 RTC

Borax Card put RTC chip on board via I2C interface connecting with HPS. It is for Linux system date reserving. If you need keep the date after board power off, please connect the RTC power pin to your base board battery source pin.

<b>U27</b> RTC	<b>J3</b> Connector
RTC_BAT	PIN 3

Table 2-3 RTC battery

## 2.4.4 UART

Borax Card used HPS UART0 and UART1, those pins output to the connectors.

Default, we didn't use flow control function, so UART0\_CTS, UART0\_RTS, UART1\_CTS, UART0\_RTS can be used as HPS GPIO.

<b>HPS UART</b>	<b>P1</b> FPGA	<b>J4</b> Connector
UART0_TX	PIN_H17	PIN 1
UART0_RX	PIN_A17	PIN 2
UART0_CTS	PIN_A18	PIN 9
UART0_RTS	PIN_C17	PIN 11
UART1_TX	PIN_B16	PIN 3
UART1_RX	PIN_C19	PIN 4
UART1_CTS	PIN_B18	PIN 10
UART1_RTS	PIN_J17	PIN 12

Table 2-4 UART

## 2.5 HPS Reset, Clock, BSEL, CSEL

### 2.5.1 Reset

HPS has two types external reset pins, cold reset and warm reset.

HPS Reset	P1 FPGA	Connector
HPS_nRST (warm)	PIN_A23	<b>J4</b> PIN_45
HPS_nPOR (cold)	PIN_H19	<b>J3</b> PIN_5

Table 2-5 HPS Reset pins

## 2.5.2 Clock

On board 25MHz OSC for HPS CLK1 and CLK2.

## 2.5.3 BSEL

Default BSEL setting is 3'b111, set QSPI Flash as boot chip.

HPS BSEL	Pull up	Pull down
BSEL 0	R162 (default)	R112
BSEL 1	R163 (default)	R113
BSEL 2	R164 (default)	R131

Table 2-6 HPS MSEL

Note: If you want to use NAND Flash as boot chip, please short J11 pin 5 and pin 6.

## 2.5.4 CSEL

Default CSEL setting is 2'b00.

HPS CSEL	Pull up	Pull down
CSEL 0	R166	R167 (default)
CSEL 1	R170	R172 (default)

Table 2-7 HPS CSEL

## 2.6 I/O Features

### 2.6.1 HPS I/O

There are two types HPS I/O. One is HPS input only pins, the other is HPS in/out pins.

For input only pins, they are located in Bank 6 with DDR3 interface, supporting 1.5V VCCIO.

HPS GPI	P1 FPGA	Connectors
HPS_6A6B_GPI0	PIN_M25	<b>J4</b> PIN_59
HPS_6A6B_GPI1	PIN_K27	<b>J6</b> PIN_1
HPS_6A6B_GPI2	PIN_R20	<b>J4</b> PIN_39
HPS_6A6B_GPI3	PIN_R21	<b>J4</b> PIN_41
HPS_6A6B_GPI4	PIN_R28	<b>J6</b> PIN_5
HPS_6A6B_GPI5	PIN_P26	<b>J6</b> PIN_3
HPS_6A6B_GPI6	PIN_T17	<b>J4</b> PIN_34
HPS_6A6B_GPI7	PIN_T16	<b>J4</b> PIN_29
HPS_6A6B_GPI8	PIN_Y28	<b>J6</b> PIN_6
HPS_6A6B_GPI9	PIN_Y26	<b>J6</b> PIN_4
HPS_6A6B_GPI10	PIN_U15	<b>J4</b> PIN_27
HPS_6A6B_GPI11	PIN_U16	<b>J4</b> PIN_31
HPS_6A6B_GPI12	PIN_AC27	<b>J6</b> PIN_12
HPS_6A6B_GPI13	PIN_V24	<b>J6</b> PIN_2

Table 2-8 HPS GPI

For in/out pins, they are located in Bank 7, supporting 3.3V VCCIO.

HPS GPI	P1 FPGA	Connectors
HPS_7A_IO0	PIN_C21	<b>J4</b> PIN_63
HPS_7A_IO1	PIN_A22	<b>J4</b> PIN_70
HPS_7A_IO2	PIN_B21	<b>J4</b> PIN_67
HPS_7A_IO3	PIN_A21	<b>J4</b> PIN_68
HPS_7A_IO4	PIN_K18	<b>J4</b> PIN_61
HPS_7A_IO5	PIN_A20	<b>J4</b> PIN_62
HPS_7A_IO6	PIN_J18	<b>J4</b> PIN_57
HPS_7A_IO7	PIN_C16	<b>J4</b> PIN_66

Table 2-9 HPS GPIO

### 2.6.2 FPGA I/O

We put Bank3A, 3B, 4A, 5A I/O to the connectors.

For Bank3A, VCCIO 3.3V

<b>P1 FPGA</b>	<b>Connectors</b>
PIN_Y8	<b>J3</b> PIN_11
PIN_Y4	<b>J3</b> PIN_17
PIN_W8	<b>J3</b> PIN_13
PIN_Y5	<b>J3</b> PIN_15
PIN_T8	<b>J3</b> PIN_9
PIN_AB4	<b>J3</b> PIN_19
PIN_U9	<b>J3</b> PIN_7

Table 2-10 FPGA Bank3A GPIO

For Bank3B, VCCIO can be set as you need, default is 3.3V. Also, we reserved 3 pairs LVDS TX pins in this bank, if use them please set the bank VCCIO to 2.5V.

<b>FPGA GPIO</b>	<b>P1 FPGA</b>	<b>Connectors</b>
5CSX_3B_IO0	PIN_W11	<b>J5</b> PIN_13
5CSX_3B_IO1	PIN_V11	<b>J5</b> PIN_14
5CSX_3B_IO2	PIN_AF4	<b>J5</b> PIN_25
5CSX_3B_IO3	PIN_AE9	<b>J5</b> PIN_7
5CSX_3B_IO4	PIN_AE4	<b>J5</b> PIN_21
5CSX_3B_IO5	PIN_AD10	<b>J4</b> PIN_7
5CSX_3B_IO6	PIN_U11	<b>J5</b> PIN_11
5CSX_3B_IO7	PIN_AF8	<b>J3</b> PIN_67
5CSX_3B_IO8	PIN_T11	<b>J5</b> PIN_12
5CSX_3B_IO9	PIN_AE7	<b>J5</b> PIN_17
5CSX_3B_IO10	PIN_AF9	<b>J3</b> PIN_68
5CSX_3B_IO11	PIN_AE11	<b>J5</b> PIN_34
5CSX_3B_IO12	PIN_AE8	<b>J5</b> PIN_15
5CSX_3B_IO13	PIN_AD11	<b>J4</b> PIN_8
5CSX_3B_IO14	PIN_AF6	<b>J5</b> PIN_27
5CSX_3B_IO15	PIN_AF5	<b>J5</b> PIN_23
5CSX_3B_IO16	PIN_AG6	<b>J5</b> PIN_29
5CSX_3B_IO17	PIN_AF10	<b>J5</b> PIN_33
5CSX_3B_IO18	PIN_AF7	<b>J3</b> PIN_70
5CSX_3B_IO19	PIN_AF11	<b>J5</b> PIN_31
5CSX_3B_IO20	PIN_T12	<b>J5</b> PIN_9
5CSX_3B_IO21	PIN_T13	<b>J5</b> PIN_10
5CSX_3B_IO22	PIN_AD12	<b>J5</b> PIN_30
5CSX_3B_IO23	PIN_AE12	<b>J5</b> PIN_32

Table 2-11 FPGA Bank3B GPIO

<b>FPGA GPIO</b>	<b>P1 FPGA</b>	<b>Connectors</b>
5CSX_IOP9	PIN_AH6	<b>J3</b> PIN_56
5CSX_IOn9	PIN_AH5	<b>J3</b> PIN_58
5CSX_IOP10	PIN_AH3	<b>J3</b> PIN_61
5CSX_IOn10	PIN_AH2	<b>J3</b> PIN_63
5CSX_IOP11	PIN_AG5	<b>J3</b> PIN_57
5CSX_IOn11	PIN_AH4	<b>J3</b> PIN_59

Table 2-12 FPGA Bank3B LVDS TX

Borax card also reserved 5 pairs LVDS RX channels in Bank 3B that shared with GPIO pins.

<b>LVDS RX</b>	<b>FPGA GPIO</b>	<b>Connectors</b>
RX_IOP0	5CSX_3B_I021	<b>J5</b> PIN_10
RX_IOn0	5CSX_3B_I020	<b>J5</b> PIN_9
RX_IOP1	5CSX_3B_I08	<b>J5</b> PIN_12
RX_IOn1	5CSX_3B_I06	<b>J5</b> PIN_11
RX_IOP2	5CSX_3B_I01	<b>J5</b> PIN_14
RX_IOn2	5CSX_3B_I00	<b>J5</b> PIN_13
RX_IOP3	5CSX_3B_I023	<b>J5</b> PIN_32
RX_IOn3	5CSX_3B_I022	<b>J5</b> PIN_30
RX_IOP4	5CSX_3B_I019	<b>J5</b> PIN_31
RX_IOn4	5CSX_3B_I017	<b>J5</b> PIN_33

Table 2-13 FPGA Bank3B LVDS RX

For Bank4A, VCCIO can be set as you need, default is 3.3V. Also, we reserved 9 pairs LVDS TX pins in this bank, if use them please set the bank VCCIO to 2.5V.

<b>FPGA GPIO</b>	<b>P1 FPGA</b>	<b>Connectors</b>
5CSX_4A_I00	PIN_AF13	<b>J4</b> PIN_32
5CSX_4A_I01	PIN_AG8	<b>J3</b> PIN_65
5CSX_4A_I02	PIN_AG13	<b>J4</b> PIN_30
5CSX_4A_I03	PIN_U13	<b>J4</b> PIN_22
5CSX_4A_I04	PIN_U14	<b>J4</b> PIN_21
5CSX_4A_I05	PIN_AE15	<b>J4</b> PIN_37
5CSX_4A_I06	PIN_AF15	<b>J3</b> PIN_40
5CSX_4A_I07	PIN_AG16	<b>J3</b> PIN_38
5CSX_4A_I08	PIN_AH12	<b>J3</b> PIN_33
5CSX_4A_I09	PIN_AF17	<b>J3</b> PIN_22
5CSX_4A_I010	PIN_V13	<b>J4</b> PIN_20
5CSX_4A_I011	PIN_W14	<b>J4</b> PIN_18
5CSX_4A_I012	PIN_AE17	<b>J6</b> PIN_33
5CSX_4A_I013	PIN_AD17	<b>J4</b> PIN_40
5CSX_4A_I014	PIN_AD19	<b>J4</b> PIN_44
5CSX_4A_I015	PIN_AF18	<b>J3</b> PIN_43
5CSX_4A_I016	PIN_AE19	<b>J6</b> PIN_32
5CSX_4A_I017	PIN_AA18	<b>J6</b> PIN_7

5CSX_4A_IO18	PIN_AA19	<b>J6</b> PIN_11
5CSX_4A_IO19	PIN_AD20	<b>J4</b> PIN_46
5CSX_4A_IO20	PIN_AE20	<b>J3</b> PIN_45
5CSX_4A_IO21	PIN_AG20	<b>J3</b> PIN_28
5CSX_4A_IO22	PIN_AF20	<b>J3</b> PIN_30
5CSX_4A_IO23	PIN_AF21	<b>J3</b> PIN_31
5CSX_4A_IO24	PIN_AG21	<b>J3</b> PIN_27
5CSX_4A_IO25	PIN_AF22	<b>J3</b> PIN_25
5CSX_4A_IO26	PIN_AE22	<b>J6</b> PIN_30
5CSX_4A_IO27	PIN_AH21	<b>J3</b> PIN_26
5CSX_4A_IO28	PIN_AD23	<b>J6</b> PIN_25
5CSX_4A_IO29	PIN_AF23	<b>J3</b> PIN_12
5CSX_4A_IO30	PIN_AG23	<b>J3</b> PIN_23
5CSX_4A_IO31	PIN_AH24	<b>J3</b> PIN_21
5CSX_4A_IO32	PIN_AG24	<b>J3</b> PIN_10
5CSX_4A_IO33	PIN_AE23	<b>J3</b> PIN_24
5CSX_4A_IO34	PIN_AG26	<b>J6</b> PIN_31
5CSX_4A_IO35	PIN_AE24	<b>J6</b> PIN_27
5CSX_4A_IO36	PIN_AC23	<b>J6</b> PIN_23
5CSX_4A_IO37	PIN_AH26	<b>J3</b> PIN_6
5CSX_4A_IO38	PIN_AC22	<b>J6</b> PIN_21
5CSX_4A_IO39	PIN_AH27	<b>J3</b> PIN_4
5CSX_4A_IO40	PIN_AG25	<b>J3</b> PIN_8
5CSX_4A_IO41	PIN_AG28	<b>J6</b> PIN_26
5CSX_4A_IO42	PIN_AF25	<b>J6</b> PIN_29
5CSX_4A_IO43	PIN_AF28	<b>J6</b> PIN_22
5CSX_4A_IO44	PIN_AF27	<b>J6</b> PIN_24

Table 2-14 FPGA Bank4A GPIO

<b>FPGA GPIO</b>	<b>P1 FPGA</b>	<b>Connectors</b>
5CSX_IOP0	PIN_AH23	<b>J3</b> PIN_14
5CSX_IOn0	PIN_AH22	<b>J3</b> PIN_16
5CSX_IOP1	PIN_AG19	<b>J3</b> PIN_18
5CSX_IOn1	PIN_AH19	<b>J3</b> PIN_20
5CSX_IOP2	PIN_AG18	<b>J3</b> PIN_46
5CSX_IOn2	PIN_AH18	<b>J3</b> PIN_44
5CSX_IOP3	PIN_AH17	<b>J3</b> PIN_48
5CSX_IOn3	PIN_AH16	<b>J3</b> PIN_50
5CSX_IOP4	PIN_AG15	<b>J3</b> PIN_52
5CSX_IOn4	PIN_AH14	<b>J3</b> PIN_54
5CSX_IOP5	PIN_AG14	<b>J3</b> PIN_53
5CSX_IOn5	PIN_AH13	<b>J3</b> PIN_55
5CSX_IOP6	PIN_AG11	<b>J3</b> PIN_36
5CSX_IOn6	PIN_AH11	<b>J3</b> PIN_34
5CSX_IOP7	PIN_AG10	<b>J3</b> PIN_60
5CSX_IOn7	PIN_AH9	<b>J3</b> PIN_62



5CSX_IOP8	PIN_AG9	<b>J3</b> PIN_64
5CSX_IOn8	PIN_AH8	<b>J3</b> PIN_66

Table 2-15 FPGA Bank4A LVDS TX

For Bank5A, VCCIO can be set as 3.3V or 2.5V, default is 3.3V.

<b>FPGA GPIO</b>	<b>P1 FPGA</b>	<b>Connectors</b>
5CSX_5A_IO0	PIN_AA20	<b>J6</b> PIN_13
5CSX_5A_IO1	PIN_AE26	<b>J6</b> PIN_18
5CSX_5A_IO2	PIN_Y19	<b>J6</b> PIN_9
5CSX_5A_IO3	PIN_AE25	<b>J6</b> PIN_28
5CSX_5A_IO4	PIN_AD26	<b>J6</b> PIN_16
5CSX_5A_IO5	PIN_AC24	<b>J6</b> PIN_14
5CSX_5A_IO6	PIN_AB23	<b>J6</b> PIN_19
5CSX_5A_IO7	PIN_W15	<b>J3</b> PIN_51
5CSX_5A_IO8	PIN_Y17	<b>J4</b> PIN_24
5CSX_5A_IO9	PIN_Y18	<b>J4</b> PIN_42
5CSX_5A_IO10	PIN_Y16	<b>J3</b> PIN_49
5CSX_5A_IO11	PIN_AA24	<b>J6</b> PIN_17
5CSX_5A_IO12	PIN_V16	<b>J4</b> PIN_28
5CSX_5A_IO13	PIN_AA23	<b>J6</b> PIN_15
5CSX_5A_IO14	PIN_V15	<b>J4</b> PIN_25

Table 2-16 FPGA Bank5A GPIO

## 2.6.3 FPGA CLOCK

On board Clock 50MHz input for FPGA fabric located in Bank 5B PIN\_Y24 that only 5CSE A5/A6 chip support. Other FPGA GCLK inputs locate to connectors, including one pair differential clock input located in Bank 4A.

<b>FPGA Clock</b>	<b>P1 FPGA</b>	<b>Connectors</b>
5CSX_CLK0	PIN_W12 (Bank 3B)	<b>J5</b> PIN_22
5CSX_CLK1	PIN_V12 (Bank 3B)	<b>J4</b> PIN_17
5CSX_CLK2	PIN_AA13 (Bank 4A)	<b>J4</b> PIN_35
5CSX_CLK3	PIN_Y13 (Bank 4A)	<b>J5</b> PIN_24
5CSX_CLK4	PIN_D12 (Bank 8A)	<b>J5</b> PIN_2
5CSX_CLK5	PIN_C12 (Bank 8A)	<b>J4</b> PIN_23
5CSX_CLK6	PIN_W21 (Bank 5B)*	<b>J4</b> PIN_38
5CSX_CLK7	PIN_W20 (Bank 5B)*	<b>J4</b> PIN_36
5CSX_CLKp	PIN_Y15 (Bank 4A)	<b>J5</b> PIN_26
5CSX_CLKn	PIN_AA15 (Bank 4A)	<b>J5</b> PIN_28

Table 2-17 FPGA Clocks

**\*: Only 5CSE A5/A6 chip can use these clock input pins!**

## 2.6.4 VCCIO supporting

For I/O using flexibly, Borax has VCCIO options for your selection.

FPGA VCCIO	Default setting	Optional setting	External setting
Bank 3A	3.3V	--	--
Bank 3B	3.3V	2.5V	<b>J3</b> PIN_47
Bank 4A	3.3V	2.5V	<b>J3</b> PIN_29
Bank 5A	2.5V	3.3V	--
Bank 5B*	2.5V	--	--
Bank 6A/B	1.5V	--	--
Bank 7A/B/C	3.3V	--	--
Bank 7D	2.5V	--	--
Bank 8A	2.5V	--	--

Table 2-18 FPGA VCCIO

**\*: Only 5CSE A5/A6 chip can use Bank 5B pins!**

1. Set Bank 3B/4A VCCIO with 3.3V, put resistors R96, R31 and R98 on board;
2. Set Bank 3B/4A VCCIO with 2.5V, put resistors R160, R97 and R99 on board;
3. Set Bank 3B/4A VCCIO with external VCC supply, put resistors R30, R161 and R99 on board.

Please note that external VCCIO  $\leq$  2.5V.

## 2.6.5 VREF pins

All VREF pins are put to the connectors.

FPGA VCCIO	Connector
5CSX_VREF0	<b>J5</b> PIN_19
5CSX_VREF1	<b>J3</b> PIN_42
5CSX_VREF2	<b>J3</b> PIN_32
5CSX_VREF3	<b>J6</b> PIN_10
5CSX_VREF4	<b>J6</b> PIN_8
5CSX_VREF5	<b>J4</b> PIN_65
5CSX_VREF6	<b>J4</b> PIN_26

Table 2-19 FPGA VCCIO

## 2.7 FPGA Configuration

Borax supports three FPGA configuration modes, JTAG, FPP x16 and AS x1/x4.

### 2.7.1 JTAG

SOC has two JTAG chains for HPS and FPGA debugging and configuration. Borax make two JTAG chains connected serially, so using one JTAG port to touch two chains. JTAG pins send to connectors for external USB-Blaster connecting.

JTAG	Connector
JTAG_TCK	J4 PIN_14
JTAG_TMS	J4 PIN_69
JTAG_TDI	J4 PIN_55
JTAG_TDO	J4 PIN_15
JTAG_TRST	J4 PIN_43

Table 2-20 JTAG pins

### 2.7.2 FPP

Default FPGA configuration mode is FPP x16 compression fast (MSEL=5'b00010). FPGA will be configured after HPS boot up in UBOOT environment. If you want change configuration mode, please modify MSEL selection mode on board.

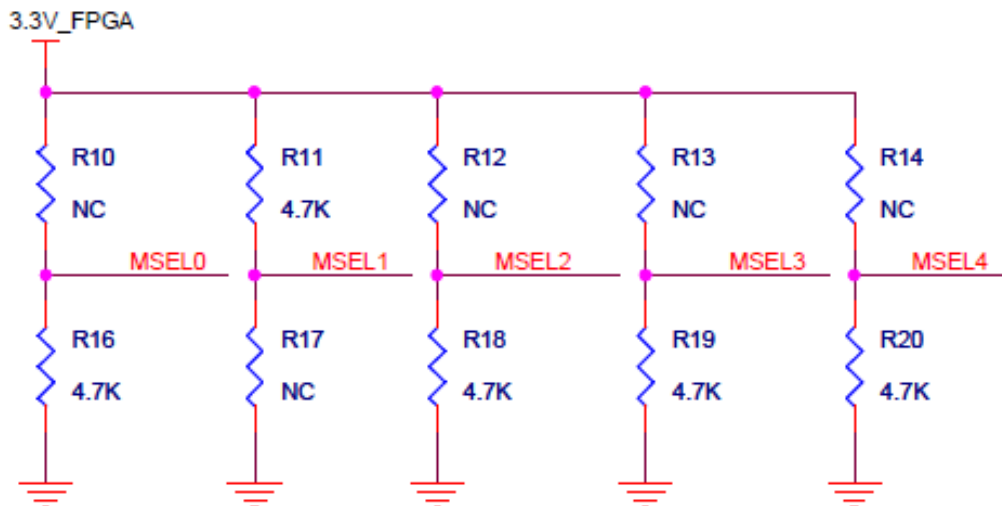


Figure 2-4 MSEL selection

## 2.7.3 AS

Borax put AS configuration pins to connectors for your convenience.

FPGA AS	Connector
EPCS_nCS	<b>J5</b> PIN_5
EPCS_DATA1	<b>J5</b> PIN_6
EPCS_DATA2	<b>J5</b> PIN_18
EPCS_DATA3	<b>J5</b> PIN_8
EPCS_ASDI	<b>J5</b> PIN_3
EPCS_DCLK	<b>J5</b> PIN_4

Table 2-21 FPGA AS configuration pins

## 2.8 System Monitor

Borax card contains a Cypress PSoC4 MCU for system temperature and Voltage monitor. MCU drive LEDs for status display.

Status LED	Items
D 11	Temperature
D 10	3.3 V
D 9	2.5 V
D 8	1.5 V
D 7	1.2 V
D 6	1.1 V

Table 2-22

For Temperature monitor, if board working under 70 ° C, LED D11 will shine smoothly, if higher than it, LED D11 will light still.

For voltage monitor, if they are normal, LED will be dark, if abnormal, LED will be lighting.

## 3. Base Board

### 3.1 Borax Base board components

- A. UART via USB interface;
- B. USB OTG connector;
- C. Ethernet RJ45 with Borax card ETH interface;
- D. HPS EMAC1 connected with PHY via FPGA I/O;
- E. TSE MAC connected with PHY via FPGA I/O;
- F. CAN interface with HPS;
- G. SD card interface with FPGA I/O;
- H. Touch LCD 800\*480;
- I. Five LED;
- J. Four DIP switch;
- K. Four push buttons;
- L. On board USB2-Blaster;

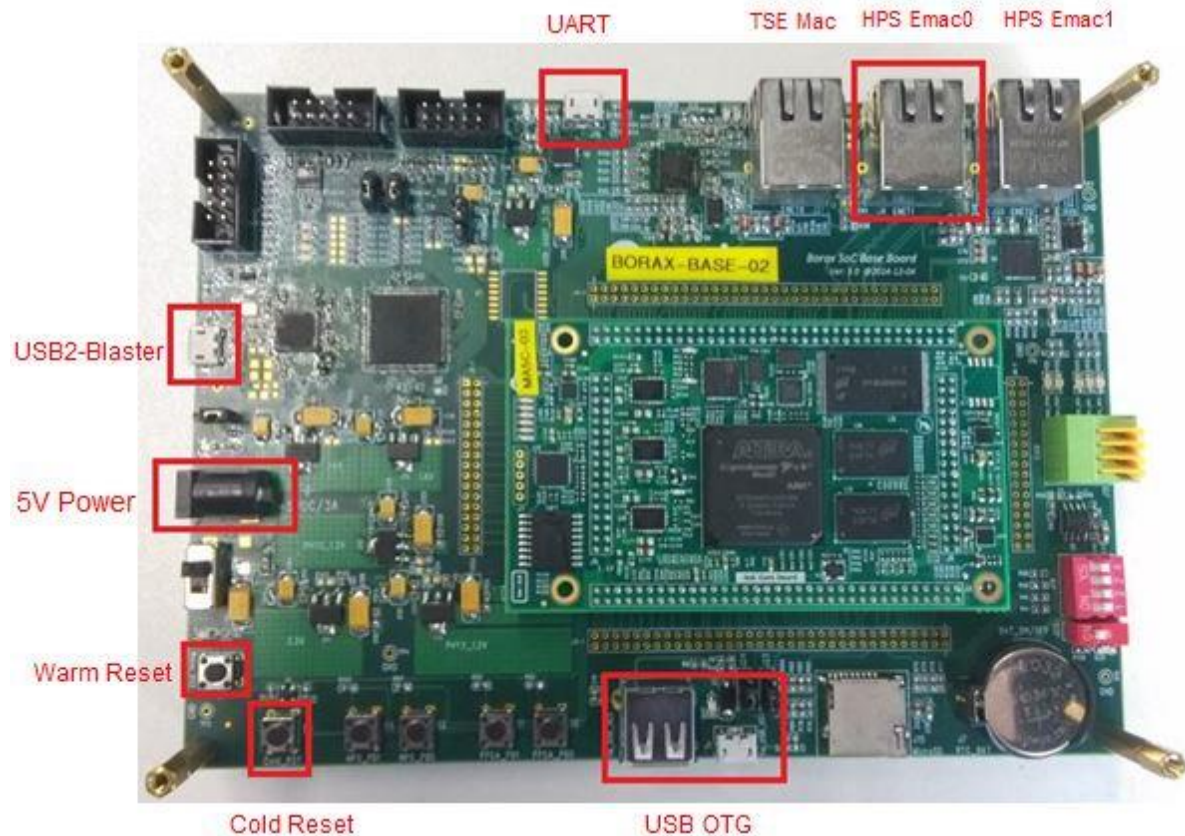


Figure 3-1 Borax base board

## 3.2 Assemble Borax Card

Please be sure that Borax Card connectors J3, J4 connect with base board J3, J4 connectors.

## 3.3 USB2-Blaster

For JTAG chain connection, on board USB2-Blaster or external USB-Blaster can be selected. If using external USB-Blaster, please connect to J14, and set jumpers as below table.

On board USB2-BlasterII
J11 1-2 on
J13 1-2 on

Table 3-1

## 3.4 UART

Base board uses a UART to USB converter for UART expanding. It connects with HPS UART0.

UART	J4 Connector
UART0_TX	PIN 1
UART0_RX	PIN 2

Table 3-2

## 3.5 USB OTG

Base board has a direct connection with Borax USB OTG PHY.

USB OTG	J3 Connector
USB_VBUS	PIN 35
USB_DM	PIN 37
USB_DP	PIN 39
USB_ID	PIN 41

Table 3-3

USB Device connector is using J2. You should set jumper as below table.

USB Device
J23 2-3 on
J24 2-3 on

Table 3-4

USB Host connector is using J1. You should set jumper as below table.

USB Device
J23 1-2 on
J24 1-2 on

Table 3-5

## 3.6 Ethernet

Base board has three Ethernet ports. Port1 (RJ45 ENET1, J8) connect with HPS EMAC0 directly, because Borax card has PHY on board.

Ethernet Port1	J4 Connector
TX_A+	PIN 50
TX_A-	PIN 48
TX_B+	PIN 54
TX_B-	PIN 52
TX_C+	PIN 49
TX_C-	PIN 47
TX_D+	PIN 53
TX_D-	PIN 51

Table 3-6 Port1

Port2 (RJ45 ENET2, J20) is expanded from FPGA I/O with PHY on base board that using HPS EMAC1 through FPGA fabrics.

Ethernet Port2	FPGA GPIO	Connectors
PHY_RXD0	5CSX_5A_IO13	<b>J6</b> PIN_15
PHY_RXD1	5CSX_5A_IO4	<b>J6</b> PIN_16
PHY_RXD2	5CSX_5A_IO11	<b>J6</b> PIN_17
PHY_RXD3	5CSX_5A_IO2	<b>J6</b> PIN_9
PHY_RX_CLK	5CSX_CLK3	<b>J5</b> PIN_24
PHY_RX_DV	5CSX_5A_IO5	<b>J6</b> PIN_14
PHY_TXD0	5CSX_5A_IO9	<b>J4</b> PIN_42
PHY_TXD1	5CSX_5A_IO12	<b>J4</b> PIN_28
PHY_TXD2	5CSX_5A_IO14	<b>J4</b> PIN_25
PHY_TXD3	5CSX_5A_IO8	<b>J4</b> PIN_24
PHY_GTX_CLK	5CSX_CLK2	<b>J4</b> PIN_35
PHY_TX_EN	5CSX_5A_IO0	<b>J6</b> PIN_13
PHY_MDC	5CSX_5A_IO1	<b>J6</b> PIN_18
PHY_MDIO	5CSX_5A_IO6	<b>J6</b> PIN_19
PHY_INTn	5CSX_5A_IO3	<b>J6</b> PIN_28
PHY_RESETn	5CSX_5A_IO10	<b>J3</b> PIN_49

Table 3-7 Port2

Ports0 (RJ45 ENET0, J21) is the interface using FPGA to realize a TSE mac.

<b>Ethernet Port0</b>	<b>FPGA GPIO</b>	<b>Connectors</b>
PHY_RXD0	5CSX_3B_IO16	<b>J5</b> PIN_29
PHY_RXD1	5CSX_3B_IO14	<b>J5</b> PIN_27
PHY_RXD2	5CSX_3B_IO2	<b>J5</b> PIN_25
PHY_RXD3	5CSX_3B_IO15	<b>J5</b> PIN_23
PHY_RX_CLK	5CSX_CLK1	<b>J4</b> PIN_17
PHY_RX_DV	5CSX_3B_IO11	<b>J5</b> PIN_34
PHY_TXD0	5CSX_3B_IO3	<b>J5</b> PIN_7
PHY_TXD1	5CSX_3B_IO12	<b>J5</b> PIN_15
PHY_TXD2	5CSX_3B_IO9	<b>J5</b> PIN_17
PHY_TXD3	5CSX_3B_IO4	<b>J5</b> PIN_21
PHY_GTX_CLK	5CSX_CLK0	<b>J5</b> PIN_22
PHY_TX_EN	5CSX_3B_IO5	<b>J4</b> PIN_7
PHY_MDC	5CSX_3B_IO18	<b>J3</b> PIN_70
PHY_MDIO	5CSX_3B_IO7	<b>J3</b> PIN_67
PHY_INTn	5CSX_3B_IO13	<b>J4</b> PIN_8
PHY_RESETn	5CSX_3B_IO10	<b>J3</b> PIN_68

Table 3-8 Port0

## 3.7 CAN

Base board CAN interface (J18) connect with HPS CAN.

<b>CAN</b>	<b>HPS GPIO</b>	<b>J4 Connector</b>
CAN_TX (J18_PIN2)	HPS_7A_IO6	PIN 57
CAN_RX (J18_PIN3)	HPS_7A_IO5	PIN 62
CAN_GND (J18_PIN4)		

Table 3-9

## 3.8 SD Card

Base board uses FPGA GPIO to expand SD card interface.

<b>SD Card</b>	<b>FPGA</b>	<b>Connectors</b>
SD_DAT0	PIN_Y8	<b>J3</b> PIN_11
SD_DAT1	PIN_Y4	<b>J3</b> PIN_17
SD_DAT2	PIN_W8	<b>J3</b> PIN_13
SD_DAT3	PIN_Y5	<b>J3</b> PIN_15
SD_CMD	PIN_T8	<b>J3</b> PIN_9
SD_CLK	PIN_AB4	<b>J3</b> PIN_19
SD_CD	PIN_U9	<b>J3</b> PIN_7

Table 3-10



## 3.9 LCD Touch Screen

Use FPGA GPIO to expand LCD drive interface.

LCD	FPGA GPIO	Connectors
LCD_VD0	5CSX_4A_IO17	J6 PIN_7
LCD_VD1	5CSX_4A_IO19	J4 PIN_46
LCD_VD2	5CSX_4A_IO14	J4 PIN_44
LCD_VD3	5CSX_4A_IO13	J4 PIN_40
LCD_VD4	5CSX_4A_IO5	J4 PIN_37
LCD_VD5	5CSX_4A_IO0	J4 PIN_32
LCD_VD6	5CSX_4A_IO18	J6 PIN_11
LCD_VD7	5CSX_4A_IO2	J4 PIN_30
LCD_VD8	5CSX_4A_IO3	J4 PIN_22
LCD_VD9	5CSX_4A_IO20	J3 PIN_45
LCD_VD10	5CSX_4A_IO15	J3 PIN_43
LCD_VD11	5CSX_4A_IO6	J3 PIN_40
LCD_VD12	5CSX_4A_IO7	J3 PIN_38
LCD_VD13	5CSX_4A_IO8	J3 PIN_33
LCD_VD14	5CSX_4A_IO23	J3 PIN_31
LCD_VD15	5CSX_4A_IO22	J3 PIN_30
LCD_VD16	5CSX_4A_IO21	J3 PIN_28
LCD_VD17	5CSX_4A_IO24	J3 PIN_27
LCD_VD18	5CSX_4A_IO43	J6 PIN_22
LCD_VD19	5CSX_4A_IO38	J6 PIN_21
LCD_VD20	5CSX_4A_IO44	J6 PIN_24
LCD_VD21	5CSX_4A_IO36	J6 PIN_23
LCD_VD22	5CSX_4A_IO41	J6 PIN_26
LCD_VD23	5CSX_4A_IO28	J6 PIN_25
LCD_VDEN	5CSX_4A_IO34	J6 PIN_31
LCD_HSYNC	5CSX_4A_IO29	J3 PIN_12
LCD_VSYNC	5CSX_4A_IO32	J3 PIN_10
LCD_VCLK	5CSX_4A_IO9	J3 PIN_22
LCD_SCL*	5CSX_4A_IO31	J3 PIN_21
LCD_SDA*	5CSX_4A_IO33	J3 PIN_24
LCD_TS**	5CSX_4A_IO26	J6 PIN_30
LCD_nRESET	5CSX_4A_IO42	J6 PIN_29

Table 3-11

\*: For touch screen of capacitance I2C interface.

\*\*: For touch screen of resistance 1-wire interface.

## 3.10 LED, DIP Switch, Push Button

LED	FPGA GPIO	Connectors
FPGA LED 0	5CSX_4A_IO12	<b>J6</b> PIN_33
FPGA LED 1	5CSX_4A_IO16	<b>J6</b> PIN_32
HPS LED 0	HPS_7A_IO1	<b>J4</b> PIN_70
HPS LED 1	HPS_7A_IO2	<b>J4</b> PIN_67
HPS LED 2	HPS_7A_IO3	<b>J4</b> PIN_68

Table 3-12

DIP Switch	FPGA GPIO	Connectors
Dial_Switch0	5CSX_4A_IO40	<b>J3</b> PIN_8
Dial_Switch1	5CSX_4A_IO37	<b>J3</b> PIN_6
Dial_Switch2	5CSX_4A_IO39	<b>J3</b> PIN_4
Dial_Switch3	5CSX_5A_IO7	<b>J3</b> PIN_51

Table 3-13

Push Button	FPGA GPIO	Connectors
HPS BUTTON 0	HPS_7A_IO0	<b>J4</b> PIN_63
HPS BUTTON 1	HPS_7A_IO4	<b>J4</b> PIN_61
FPGA BUTTON 0	5CSX_4A_IO25	<b>J3</b> PIN_25
FPGA BUTTON 1	5CSX_4A_IO1	<b>J3</b> PIN_65

Table 3-14

## 4. Document Revision History

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Date	Revision	Changes
July 11, 2014	1.0	<ul style="list-style-type: none"><li>• Document created</li></ul>
July 21, 2014	1.1	<ul style="list-style-type: none"><li>• Add system monitor description</li></ul>
Oct 16, 2014	1.2	<ul style="list-style-type: none"><li>• Revised QSPI Flash, NAND Flash, DDR3 default capacity</li></ul>
Oct 16, 2014	1.2	<ul style="list-style-type: none"><li>• Add how to boot from NAND Flash descriptions</li></ul>
Oct 16, 2014	1.2	<ul style="list-style-type: none"><li>• Revised on board USB2-BlasterII table 3-1</li></ul>
Aug 17, 2015	2.0	<ul style="list-style-type: none"><li>• Revised for Base board revision 3.0 changes</li></ul>