Getting Started

Mpression Sodia Board

Revision 1.0

2016/02/09
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# Contents

1. **Read This First** .......................................................... 4  
   1.1 Important Information .................................................. 4  
   1.2 Developer Information .................................................. 5  
   1.3 Inquires ............................................................................. 5  

2. **For Ensuring Safe Use** ................................................... 6  
   2.1 Legend ............................................................................ 6  
   2.2 Cautions ......................................................................... 6  

3. **Preparations** ................................................................. 9  
   3.1 About This Manual .......................................................... 9  
   3.2 Preparations ..................................................................... 9  

4. **Setup** ............................................................................. 10  
   4.1 Board Specification .......................................................... 10  
   4.2 Setting Up the Board ......................................................... 14  
      4.2.1 External Connection ................................................. 14  
      4.2.2 Jumper Settings ......................................................... 14  
   4.3 Creating an SD Boot Disk for Sodia .................................. 15  

5. **Executing the Design** ..................................................... 16  
   5.1 Setting Up the USB-to-Serial Interface ............................. 16  
      5.1.1 Installing the Device Driver for USB-to-Serial .......... 16  
      5.1.2 Setting Up Terminal Software ................................. 16  
      5.1.3 Executing Linux ....................................................... 17  

6. **Reference Information** .................................................. 18  

7. **Document Revision History** .......................................... 19
1. Read This First

1.1 Important Information

READ FIRST:
- READ this Getting Started before using this product.
- KEEP the Getting Started handy for future reference.
- Do not attempt to use the product until you fully understand its mechanism.

Purpose of the Product:
- This product is an equipment to support the development and evaluation of a system that uses the Cyclone® V ST SoC, manufactured by Altera® Corporation. It provides support for system development in both software and hardware.
  Be sure to use this product correctly for this purpose.

For Users of This Product:
- This product can only be used by operators who have carefully read and understand this manual and "Reference Manual". Use of this product requires a basic knowledge of FPGAs, logic circuits, electric circuits, and microcomputers.

Precautions to be taken when using This Product:
- This product is to be used for development of a program, and the evaluation stage. You cannot install this Board in your product and cannot use this Board for mass-production. When mass-producing a program you have finished developing, be sure to decide at your own responsibility whether it can be put to practical use by performing integration test, evaluation, or some other experiment.
- In no event shall Macnica Inc. be liable for any consequence arising from the use of this product.
- Macnica Inc. shall make effort to provide a workaround or fix for failures of this product, with or without charge. This does not mean, however, that Macnica Inc. guarantees to provide a workaround or fix under all circumstances.
- Macnica Inc. cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this Getting Started and on the product are therefore not all-inclusive. Use this product correctly and safely at your own responsibility.
- Even if a device installed on this product has a failure, it cannot be replaced.
- Not all types of USB peripheral devices and SD cards are guaranteed to operate with this product.
- Not all types of apparatus are guaranteed to connect with the LAN interface of this product.
- Remodeling or damages caused by the customer is not guaranteed.
- This product is a lead-free mounting product.
- Generally, the brand names carried in this Getting Started each constitute a maker’s trademark or registered trademark.

Improvement Policy:
- Macnica Inc. pursues a policy of continuous improvement in design, performance, and safety of the product. Macnica Inc. reserves the right to change, wholly or partially, specifications, design, Getting Started, and other documentation at any time without notice.
Warranty:

- Macnica Inc. offers exchange of this product free of charge only in a set range of cases of initial trouble for this product, and within 30 days from when the customer received delivery of the Board.

Macnica Inc. cannot exchange products in cases where breakdown is caused for the following reasons:
1. Misuse, abuse of the product or use under abnormal conditions
2. Remodeling or repair
3. A fire, earthquake, fall or other accidents

Figures:

- Some figures in this Getting Started may differ from your system as purchased.

1.2 Developer Information

The Developer of this product is:
Macnica Inc.
1-6-3 Shin-Yokohama, Kouhoku-ku, Yokohama, 222-8561 JAPAN

1.3 Inquires

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.mpression.com/contact

Macnica companies:

- China & HK: Cytech Technology
  http://www.cytech.com/
- ASEAN & India: Cytech Global
  http://www.cytechglobal.com/
- Taiwan: Galaxy Far East Corp.
  http://www.gfec.com.tw/
- North America: Macnica Americas
  http://www.macnica-na.com/
- Brazil: Macnica DHW
- Japan: Altima
  http://www.altima.co.jp
  Elsena
  http://www.elsena.co.jp
2. 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.

2.1 Legend

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="danger.png" alt="Danger" /></td>
<td>Indicates an imminent hazardous situation which if not avoided will result in death or serious injury.</td>
</tr>
<tr>
<td><img src="warning.png" alt="Warning" /></td>
<td>Indicates a potentially hazardous situation which if not avoided could result in death or serious injury.</td>
</tr>
<tr>
<td><img src="caution.png" alt="Caution" /></td>
<td>Indicates a potentially hazardous situation which if not avoided may result in minor or moderate injury or in property damage.</td>
</tr>
</tbody>
</table>

2.2 Cautions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="danger.png" alt="Danger" /></td>
<td>Make sure to use the AC adapter (included in the package) that meets the specification described in this manual. Using an AC adapter not meeting the specifications described in this Manual may cause the kit to emit heat, explode, or ignite.</td>
</tr>
<tr>
<td><img src="warning.png" alt="Warning" /></td>
<td>Do not apply strong impacts or blows to the kit. 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. Do not put the main unit or the AC adapter in cooking appliances such as microwave ovens, or high-pressure containers. 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. 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. This will cause heat to build up inside the wrapping which may cause the main unit to ignite or malfunction.</td>
</tr>
<tr>
<td><img src="caution.png" alt="Caution" /></td>
<td>When disposing of the main unit, do not dispose of it along with general household waste. 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. Do not pull the power supply cable with excessive force or place heavy items on it. 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. Do not plug or unplug the power plug with wet or moist hands. This might cause injuries or equipment malfunctions or failures due to electrical shock.</td>
</tr>
</tbody>
</table>
Warning (Continued from previous page)

- 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.

- 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. Doing so may cause the equipment to malfunction or fail, or lead to accidents involving electrical shock or fire due to heat emitted.

- 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.

- 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 local Macnica company or Mpression inquiry URL.

- Keep this board and accessories out of reach of children. Failure to do so may lead to injuries.

Caution

- 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.

- 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.

- Do not use the kit in places subject to extremely high or low temperatures or severe temperature changes. Doing so may cause the kit to fail or to malfunction. Always be sure to use the kit within a temperature range of 5°C to 35°C and a humidity range of 0% to 85%.

- 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.

- Do not place this Board in locations where excessive force is applied to the Board. Doing so may cause the PC board to warp, leading to breakage of the PC board, missing parts or malfunctioning parts.

- 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. Developer 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.
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 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 contact the local Macnica company or Mpression inquiry URL beforehand if you wish to customize or modify any parts that are not described in this Manual as customizable.
3. Preparations

3.1 About This Manual

This manual explains how to boot Linux using this Board. This manual also describes the following:

- The basic specifications of this Board
- How to write an SD boot disk for the Sodia Board
- How to execute a U-boot and Linux on the Sodia Board

3.2 Preparations

A. Preparing the Reference Design

The reference design to be provided contains the following:

- SD boot disk

The SD boot disk contains the following:

- Preloader
- U-Boot
- U-Boot script for bridge management
- Linux Kernel
- Device Tree Blob
- Root File System
- FPGA Configuration File

- Golden Hardware Reference Design (GHRD)

Board information

The Board information contains the following:

- Circuit diagram
- Components list
- Layout

Download the design described above from the following URL:

http://rocketboards.org/foswiki/view/Documentation/MacnicaSodiaEvaluationBoard

B. Preparing Tools

Prepare the following tools before executing this design:

- Terminal software like TeraTerm (for UART input/output)
- Win32DiskImager (to create SD card boot disk)

http://sourceforge.net/projects/win32diskimager
4. Setup

4.1 Board Specification

This section describes the layout of components on this Board and their specifications. The following shows the layout of components on this Board.

![Figure 1 Layout (Top view)](image-url)
## Getting Started - Mpression Sodia Board

### Table 1 Main Components of this Board

<table>
<thead>
<tr>
<th>Reference No.</th>
<th>Components or Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Devices</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC4</td>
<td>SoC FPGA</td>
<td>Cyclone V ST SoC: 5CSTFD6D5F31I7N 896-pin FBGA</td>
</tr>
<tr>
<td>IC6</td>
<td>Configuration ROM</td>
<td>EPCQ256SI16N</td>
</tr>
<tr>
<td><strong>Configuration/Status LED</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J12</td>
<td>JTAG 10-pin Header</td>
<td>Access port to the HPS of the SoC FPGA and JTAG chain of FPGA. Use a USB-Blaster cable for connection.</td>
</tr>
<tr>
<td>S3</td>
<td>FPGA_Reconfig</td>
<td>FPGA Configuration Reset. Connect to the nCONFIG terminal of the FPGA. Configuration is reset when the switch is pressed.</td>
</tr>
<tr>
<td>LED14</td>
<td>CONF_DONE</td>
<td>When lit, FPGA configuration is ready. When unlit, FPGA configuration is reset.</td>
</tr>
<tr>
<td>LED15</td>
<td>nCONFIG</td>
<td>When unlit, there is abnormality in the configuration status of the FPGA. When lit, there is not abnormality.</td>
</tr>
<tr>
<td>LED16</td>
<td>nSTATUS</td>
<td>When lit, FPGA configuration has been completed. When unlit, FPGA configuration has not been completed.</td>
</tr>
<tr>
<td><strong>Clock Circuit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X2</td>
<td>Clock Generator</td>
<td>570SCC000115DG (Silicon Labs) Generates the REFCLK clock for XCVR described below.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 125MHz</td>
</tr>
<tr>
<td>Reference No.</td>
<td>Components or Specification</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>IC2</td>
<td>Clock Buffer</td>
<td>Si53307-B-GM (Silicon Labs)</td>
</tr>
<tr>
<td>X3</td>
<td>Clock Generator</td>
<td>Si5338C-B05096-GM (Silicon Labs)</td>
</tr>
<tr>
<td>IC3</td>
<td>Clock Buffer</td>
<td>Si53307-B-GM (Silicon Labs)</td>
</tr>
<tr>
<td>X5</td>
<td>Clock Generator</td>
<td>510CCB25M0000AAG (Silicon Labs)</td>
</tr>
<tr>
<td>X8</td>
<td>Clock Generator</td>
<td>530SC1000M000DG (Silicon Labs)</td>
</tr>
<tr>
<td>X9</td>
<td>Clock Generator</td>
<td>530SC148M5000DG (Silicon Labs)</td>
</tr>
<tr>
<td>IC1</td>
<td>RTC</td>
<td>DS1339C-33 (Maxim)</td>
</tr>
<tr>
<td>CN1/CN2</td>
<td>SMA Connector</td>
<td></td>
</tr>
<tr>
<td>S8</td>
<td>Clock input switchover switch</td>
<td></td>
</tr>
</tbody>
</table>

**General-purpose user input/output**

| LED1-4      | User LED                    | LED connected to the FPGA side. Lit when set to Low. |
| LED5-8      | User LED                    | LED connected to the HPS side. Lit when set to Low. |
| S1-2        | User push switches          | Push switches connected to the FPGA side. Input Low when pressed. |
| S10-13      | User push switches          | Push switches connected to the HPS side. Input Low when pressed. |
| S6          | User DIP switch             | DIP switch connected to the FPGA side. Inputs Low on the ON side. |
| S9          | User DIP switch             | DIP switch connected to the HPS side. Inputs Low on the ON side. |
| S4          | Cold reset switch           | COLD RESET: Resets all devices on this Board when the switch is pressed. |
| S5          | Warm reset switch           | WARM RESET: Resets only HPS when the switch is pressed. |
## Components and Specification

<table>
<thead>
<tr>
<th>Reference No.</th>
<th>Component Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN4</td>
<td>HSMC connector</td>
<td>HSMC connector Port-A</td>
</tr>
<tr>
<td>CN5</td>
<td>HSMC connector</td>
<td>HSMC connector Port-B</td>
</tr>
</tbody>
</table>

### Memory

<table>
<thead>
<tr>
<th>Reference No.</th>
<th>Component Description</th>
<th>Description</th>
</tr>
</thead>
</table>
| IC16          | QSPI Flash ROM        | N25Q512A83GSF40 (Micron)  
                |                       | QSPI Flash ROM with reset terminals. Connect to QSPI interface on the HPS side. |
| IC9, IC10, IC11| DDR3-SDRAM            | MT41K256M16 (Micron)  
                             |                       | Three MT41K256M16s are loaded in parallel, which are 40bit interface of 32bit + ECC 8bit. Connect to DDR interface on the HPS side. |
| IC7, IC8      | DDR3-SDRAM            | MT41K64M16 (Micron)  
                             |                       | Two MT41K64M16s are loaded in parallel, which is 32bit interface. Connect to the soft controller on the FPGA side. |
| IC17          | EEPROM                | 24LC32A (Microchip)  
                             |                       | Connect to I2C interface on the HPS side. |

### Interface

<table>
<thead>
<tr>
<th>Reference No.</th>
<th>Component Description</th>
<th>Description</th>
</tr>
</thead>
</table>
| CN6, CN7, CN8 | LINE IN jack          | Connect audio signals from IC13 AUDIO Codec WM8731CL (Cirrus Logic).  
                             | MIC IN jack         | Connect WM8731 with the I2S interface on the FPGA side. |
| CN9           | DVI output connector  | Connect TMDS signals from IC14 DVI Transmitter TFP410P (TI).  
                             |                       | Connect TFP410P with the 24bit Digital RGB (8-8-8) interface on the FPGA side. |
| CN10          | Built-in pulse        | Connect Ethernet signals from IC15 Gigabit Ethernet PHY KSZ9021RN (Microchip).  
                             | transformer          | Connect KSZ9021RN with the RGMII interface on the HPS side. |
|               | Gigabit Ethernet      |                       |
|               | RJ45 connector        |                       |
| CN11          | USB type B connector  | Connect USB signals from IC19 USB·UART bridge FT232RQ (FTDI).  
                             | (Function)           | Connect FT232RQ to the UART interface on the HPS side. |
| CN12          | USB type A connector  | Connect USB signals from IC20 USB2.0 On-The-Go PHY USB3300 (Microchip).  
                             | (Host)               | Connect USB3300 to the USB PHY interface on the HPS side. |
| CN13          | SD card slot          | Connect to SD/MMC interface on the HPS side. |

### Power Connector/Power switch

<table>
<thead>
<tr>
<th>Reference No.</th>
<th>Component Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN14</td>
<td>DC jack</td>
<td>Jack connector to input DC 12 V.</td>
</tr>
<tr>
<td>S7</td>
<td>Power switch</td>
<td>Turns ON/OFF the power supply from the DC jack.</td>
</tr>
</tbody>
</table>

### Power Connector for the Cooling Fan

<table>
<thead>
<tr>
<th>Reference No.</th>
<th>Component Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CN15</td>
<td>3-pin Header</td>
<td>Power supply for the cooling fan</td>
</tr>
</tbody>
</table>
4.2 Setting Up the Board

4.2.1 External Connection

Set up this Board before booting the Board. The following describes how to set up the Board.

1) Connect the AC adapter to the DC jack (CN14).
2) Connect the USB cable to CN11 of this Board and the PC.
   ⇒ A serial console is set up.
3) (Optional: unnecessary for normal operation) Connect the USB-Blaster or USB-Blaster II to J12.

4.2.2 Jumper Settings

<table>
<thead>
<tr>
<th>Reference</th>
<th>Signal Name</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>J2</td>
<td>BOOT SEL0</td>
<td>1-2</td>
</tr>
<tr>
<td>J3</td>
<td>BOOT SEL1</td>
<td>2-3</td>
</tr>
<tr>
<td>J4</td>
<td>BOOT SEL2</td>
<td>1-2</td>
</tr>
<tr>
<td>J5</td>
<td>CLKSEL0</td>
<td>2-3</td>
</tr>
<tr>
<td>J6</td>
<td>CLKSEL1</td>
<td>2-3</td>
</tr>
<tr>
<td>J7</td>
<td>MSEL4</td>
<td>2-3</td>
</tr>
<tr>
<td>J8</td>
<td>MSEL3</td>
<td>1-2</td>
</tr>
<tr>
<td>J9</td>
<td>MSEL2</td>
<td>2-3</td>
</tr>
<tr>
<td>J10</td>
<td>MSEL1</td>
<td>1-2</td>
</tr>
<tr>
<td>J11</td>
<td>MSEL0</td>
<td>2-3</td>
</tr>
</tbody>
</table>
4.3 Creating an SD Boot Disk for Sodia

The Pre-built ALL in One Image for Sodia is provided as
sodia_gsrd_sdimage_v3.10-ltsi_v15.1.1.tar.gz in a compressed file format by RocketBoards.org.
By decompressing the file above, sodia_gsrd_sdimage_v3.10-ltsi_v15.1.1.img is created.
This image contains the following files that are necessary to run Linux on Sodia:
- Preloader
- U-Boot
- U-Boot script for bridge management
- Linux Kernel
- Device Tree Blob
- Root File System
- FPGA Configuration File

When creating an SD boot disk, start Win32DiskImager.exe on a Windows PC, and follow the steps below.
1) Connect an SD card to the PC.
2) Start Win32Disk Imager.
3) Select All in One SD Image.
4) Click Write.
5. Executing the Design

5.1 Setting Up the USB-to-Serial Interface

This Board has a USB-to-Serial interface that uses FT232R manufactured by FTDI. This Board uses CN 11 as a USB serial console. Install the device driver for the USB console on the console PC device beforehand.

5.1.1 Installing the Device Driver for USB-to-Serial

Download the latest virtual COM port (VCP) driver that is applicable to your console PC environment from the following URL of FTDI, and install the device driver for USB-to-Signal.

http://www.ftdichip.com/Drivers/VCP.htm

* This manual uses Windows 7 as an example.

5.1.2 Setting Up Terminal Software

The following describes how to set up terminal software.

- Baud Rate: 115200
- Parity: none
- Stop: 1 bit
- Flow Control: none

![Terminal Setup Screenshot](image-url)
5.1.3 Executing Linux

Execute Linux by following the steps below.

1) Set up the Board. (Refer to chapter 4.1)
2) Insert the created SD card to CN13 of the Sodia. (Refer to chapter 4.3)
3) Set up the serial console and the terminal. (Refer to chapter 5.1.1 and 5.1.2)
4) Power on the Sodia.
5) When Linux is booted and a login name is asked on the terminal software, log in as root.

![Linux Command Line]

The Angstrom Distribution cyclone5 ttyS0

Angstrom v2014.12 - Kernel 3.10.31-1tsi-05187-g6b67245

cyclone5 login:

root@cyclone5:~#
6. Reference Information

- Mpression Soda Evaluation Board by Macnica
  http://www.rocketboards.org/foswiki/view/Documentation/MacnicaSodiaEvaluationBoard

- Mpression – Solutions by Macnica Group
  http://www.m-pression.com/home

- Altera CycloneV SoC documentation:
  http://www.altera.com/literature/lit-cyclone-v.jsp

- Altera SoC Embedded Software Tools documentation:
  http://www.altera.com/literature/lit-soc.jsp

- Altera SoC Linux Community Portal:
  http://www.rocketboards.org/
7. Document Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>February, 2016</td>
<td>1.0</td>
<td>• Document created</td>
</tr>
<tr>
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<td></td>
<td>•</td>
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</tr>
</tbody>
</table>