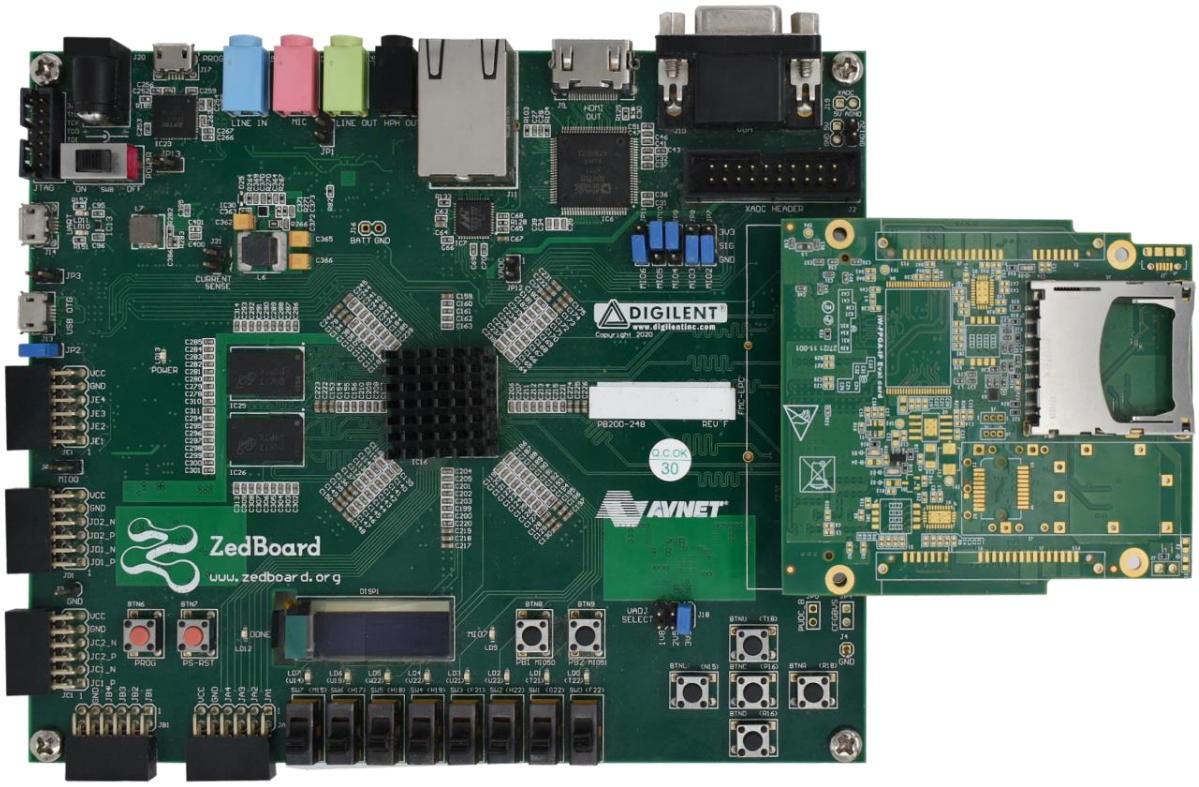
Software User Guide for eMMC Host controller



iWave

Disclaimer

iWave Systems reserves the right to change details in this publication including but not limited to any Product specification without notice.

No warranty of accuracy is given concerning the contents of the information contained in this publication. To the extent permitted by law no liability (including liability to any person by reason of negligence) will be accepted by iWave Systems, its subsidiaries, or employees for any direct or indirect loss or damage caused by omissions from or inaccuracies in this document.

CPU and other major components used in this product may have several silicon errata associated with it. Under no circumstances, iWave Systems shall be liable for the silicon errata and associated issues.

Trademarks

All registered trademarks, product names mentioned in this publication are the property of their respective owners and used for identification purposes only.

Certification

iWave Systems Technologies Pvt. Ltd. is an ISO 9001:2015 Certified Company.

Warranty & RMA

Warranty support for Hardware: 1 Year from iWave or iWave's EMS partner. For warranty terms, go through the below web link, http://www.iwavesystems.com/support/warranty.html
For Return Merchandise Authorization (RMA), go through the below web link, http://www.iwavesystems.com/support/rma.html

Technical Support

iWave Systems technical support team is committed to provide the best possible support for our customers so that our Hardware and Software can be easily migrated and used.

For assistance, contact our Technical Support team at,

Email : ascdi@iwavesystems.com
Website : www.iwavesystems.com
Address : iWave Systems Technologies Pvt. Ltd
7/B, 29th Main, BTM Layout 2nd Stage,
Bangalore, Karnataka,
India – 560076

Table of Contents

List of Figures

List of Tables

1. INTRODUCTION

1.1 Purpose and scope

This document is the Software User Guide for testing eMMC Host Controller. This guide provides detailed procedure to test the eMMC Host Controller.

1.2 References

- Petalinux tool document 2021.2
- Software ATP document “iW-ASCDI-TS-02-R1.0-REL3.0.pdf”

1.3 List of Acronyms

The following acronyms will be used throughout this document.

Table 1 :Acronyms & Abbreviations

Acronyms	Abbreviations
DDR	Dual Data Rate
eMMC	Embedded Multi-Media Card
ext3	Third Extended File System
ext4	Fourth Extended File System
fat32	File Allocation Table32
FMC	FPGA Mezzanine Card
FPGA	Field Programmable Gate Array
HS400ES	HS400 enhanced strobe
JFFS2	Journaling Flash File System version 2
RPMB	Replay Protected Memory Block
SDR	Single Data Rate
UART	Universal Asynchronous Receiver/Transmitter

2. BSP Petalinux Compilation

This section explains procedure and detailed information about compiling PetaLinux for ZedBoard platform

2.1 Host Requirements

- 8 GB RAM.
- 2 GHz CPU clock or equivalent.
- 100 GB free HDD space.
- Linux 64bit host PC (Ubuntu 16.04 or higher).
- Root permission on the Development Host. The PetaLinux tools need to be installed as a non-root user.

2.2 Host Package Installation

PetaLinux requires several standard development tools and libraries to be installed on your Linux host workstation.

- Open a terminal window and install the below packages in host PC

  $ sudo apt-get update

  $ sudo apt-get install sed wget cvs subversion

  $ sudo apt-get install git-core coreutils unzip

  $ sudo apt-get install texi2html texinfo zlib1g:i386

  $ sudo apt-get install libsdl1.2-dev docbook-utils

  $ sudo apt-get install gawk python-pysqlite2 diffstat

  $ sudo apt-get install help2man make gcc vim

  $ sudo apt-get install build-essential g++ desktop-file-utils

  $ sudo apt-get install chrpath libgl1-mesa-dev xvfb repo

  $ sudo apt-get install libglu1-mesa-dev mercurial libssl-dev

  $ sudo apt-get install autoconf automake groff libtool xterm

  $ sudo apt-get install socat tftpd-hpa

  $ sudo apt-get install gcc-multilib libsdl1.2-dev libglib2.0-dev libncurses-dev

2.3 PetaLinux Tool Installation

- Download PetaLinux 2021.2 Tools Installer from the below link
  https://www.xilinx.com/member/forms/download/xef.html?filename=petalinux-v2021.2-final-installer.run
- User need to create an account to download from Xilinx website
- PetaLinux Tools installation is straight-forward. Without any options, the PetaLinux Tools are installed into the current working directory. Alternatively, an installation path may be specified.
- Once the tool is downloaded, execute below commands
  host@host~$ chmod 755 petalinux-v2020.1-final-installer.run
  host@host~$ ./petalinux-v2021.2-final-installer.run
- The above command installs the PetaLinux Tools into the current working directory.
- Read and agree to the PetaLinux End User License Agreement to install PetaLinux.

2.4 PetaLinux Build

- To setup the Petalinux working environment, source the appropriate settings script using below command.
  host@host~$ source <path-to-installed-petalinux>/settings.sh
  host@host~$ export LANG=en_US.UTF-8
- Download the BSP file for the ZedBoard from the below link
  https://www.xilinx.com/member/forms/download/xef.html?filename=avnet-digilent-zedboard-v2021.2-final.bsp
- Once the BSP is downloaded, execute the below command to create a PetaLinux project.
  host@host $ petalinux-create -t project -s avnet-digilent-zedboard-v2021.2-final.bsp
- Change into the directory of your PetaLinux Project.
  host@host~$ cd <path-to- avnet-digilent-zedboard-2021.2>/ avnet-digilent-zedboard-2021.2
- The PetaLinux project-spec patch from deliverables is located in the below path.
  iW-ASCDI-DF-02-R1.0-REL2.0-eMMC_Deliverables/SourceCode/Petalinux/PATCH000-iW-ASCDI-SC-02-R1.0-REL2.0_eMMC_Host_Petalinux_basic_customization.patch
- Copy the PetaLinux patch file, by executing the below command.
  host@host/<Directory>/avnet-digilent-zedboard-2021.2~$ cp <path_to_Patch>/ PATCH000-iW-ASCDI-SC-02-R1.0-REL2.0_eMMC_Host_Petalinux_basic_customization.patch ../
- To apply the patch file, execute the below command.
  host@host/<Directory>/ avnet-digilent-zedboard-2021.2~$ patch -Np1 < ../PATCH000-iW-ASCDI-SC-02-R1.0-REL2.0_eMMC_Host_Petalinux_basic_customization.patch

- The FPGA XSA file from deliverables is located in the below path.
  iW-ASCDI-DF-02-R1.0-REL2.0-eMMC_Deliverables/SourceCode/FPGA/top_test_mod.xsa
- Import the hardware description with petalinux-config command, by giving the path of the directory containing top_test_mod.xsa file as follows:
  host@host/avnet-digilent-zedboard-2021.2~$ petalinux-config --get-hw-description=<path-to-parent-directory-of-xsa- file>
- The above command launches the top system configuration menu as shown below;

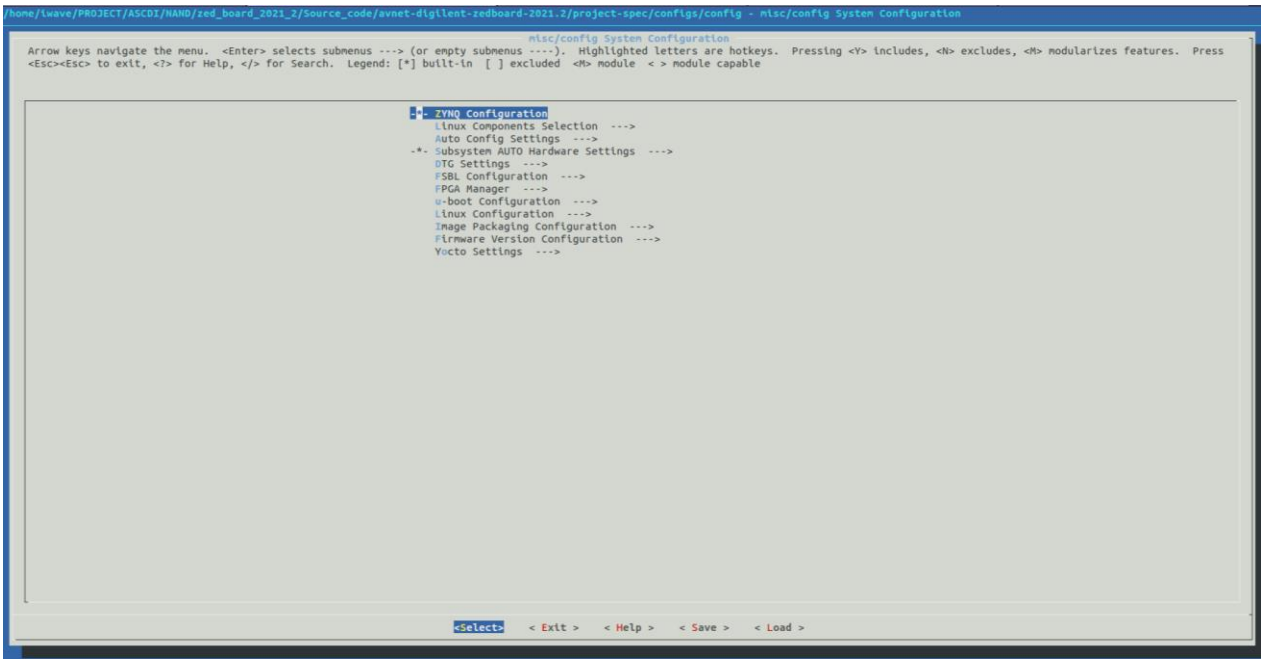


Figure 1: Petalinux system configuration

- Click on save and exit to save the configuration.
- To build the system image, execute the below command.
  host@host/<Directory>/ avnet-digilent-zedboard-2021.2~$ petalinux-build
- After the successful compilation the binaries will be placed in below path.
  ~/<path to avnet-digilent-zedboard-2021.2>/ avnet-digilent-zedboard-2021.2/images/linux/
- The binary files are listed below
  BOOT.bin, system.bit, image.ub, boot.scr
- To create BOOT.bin, execute the below command. The BOOT.bin will be created in images/linux folder.
  host@host/<Directory>/ avnet-digilent-zedboard-2021.2~$ petalinux-package --boot --format BIN --fsbl images/linux/zynq_fsbl.elf --fpga images/linux/system.bit --u-boot images/linux/u-boot.elf -o images/linux/BOOT.bin

Refer the **BINARY PROGRAMMING** section to update the Linux kernel binary

Note: *The section **2.4 Petalinux Build** describes the compilation steps to compile the Petalinux source code and to test all mmc feature except command queue.*

In order to test command queue mmc feature, apply PATCH000-iW-ASCDI-SC-02-R1.0-REL2.0_eMMC_Host_Command_Queue_Petalinux_basic_customization.patch file only to the new Petalinux Source code and compile.

3. BINARY PROGRAMMING

This section explains the procedure and detailed information about programming the binaries into boot device of ZedBoard platform. The programming steps are remains same for both pre-built binaries and user compiled binaries.

- The prebuilt binaries are available in the deliverables in the below path.
  iW-ASCDI-DF-02-R1.0-REL2.0-eMMC_Deliverables/Binaries/non_CQE

Note:

In order to test command queue mmc feature binaries are available in the deliverables in the below path.
iW-ASCDI-DF-02-R1.0-REL2.0-eMMC_Deliverables/Binaries/CQE

3.1 Manual Programming

This section explains the step-by-step procedure to program the BOOT.bin, bitstream, kernel image and Linux binaries into ZedBoard platform using a SD card.

3.1.1 Requirements

To program the binaries into ZedBoard platform, following items are required.

- SD card
- Host PC(Linux) for manual binary programming

3.1.2 Linux Binary Programming to SD card

- The prebuilt binaries are available in the deliverables in the below path.
  iW-ASCDI-DF-02-R1.0-REL2.0-eMMC_Deliverables/Binaries/ non_CQE
- The compiled binaries are available in the below path.
  ~/<path to avnet-digilent-zedboard-2021.2>/ avnet-digilent-zedboard-2021.2/images/linux/
- Refer section SD card Partition for partitioning SD card. If the partitions already exist, then remove all the folders/files present inside the SD partitions before copying the binaries.
- Copy the binaries from deliverables to SD partition.
  host@host/<path_to_Binaries>/Binaries~$cp BOOT.bin image.ub boot.scr system.bit /media/<path-to-sd-bootpartition>

Refer the "**iW-ASCDI-TS-02-R1.0-REL2.1.pdf**" document for eMMC Host Controller Feature testing.

4. APPENDIX

4.1 SD card Partition

This section describes the steps to partition the SD card to program the binaries.

- Connect the new SD to the Linux Host system using SD Card Reader.
- Execute the mount command to see the attached nodes and mount points.
- SD may attach to dev nodes either sdb/sdc/sdd in Host PC. Assume the SD is attached to /dev/sdb node.

  $ umount /dev/sdb
- Start partitioning using fdisk command.

  $ sudo fdisk /dev/sdb
- After running fdisk, it will change shell prompt to.

  Command (m for help):
- Press 'p' to view already existing partitions.

  Disk /dev/sdb: 14.6 GiB, 15664676864 bytes, 30595072 sectors

  *Units: sectors of 1 * 512 = 512 bytes*

  Sector size (logical/physical): 512 bytes / 512 bytes

  I/O size (minimum/optimal): 512 bytes / 512 bytes

  Disklabel type: dos

  Disk identifier: 0xe937a7bf

  Device Boot Start End Sectors Size Id Type

  /dev/sdb1 32 30595071 30595040 14.6G c W95 FAT32 (LBA)
- Delete all existing partitions using command ‘d’. Enter individual partitions like 1, 2, 3, etc. until all the partitions are deleted.
- Once all the partitions are deleted, the below message gets displayed.

  Command (m for help):

  Selected partition 1

  Partition 1 has been deleted.

  Command (m for help): d

  No partition is defined yet!
- Press 'n' to create new partition (going to create first partition).

  Command (m for help): n

  Partition type

  p primary (0 primary, 0 extended, 4 free)

e extended (container for logical partitions)

Select (default p): p

Partition number (1-4, default 1):

First sector (2048-30595071, default 2048):

Last sector, +sectors or +size {K, M, G, T, P} (2048-30595071, default 30595071): 6293504

Created a new partition 1 of type 'Linux' and of size 3 GiB.

- Now, set the partition IDs

  Command (m for help): t

  Selected partition 1

  Hex code (type L to list all codes): b

  Changed type of partition 'Linux' to 'W95 FAT32'.

- Check the new partition table and write the changes.

  Command (m for help): p

  Disk /dev/sdb: 14.6 GiB, 15664676864 bytes, 30595072 sectors

  *Units: sectors of 1 * 512 = 512 bytes*

  Sector size (logical/physical): 512 bytes / 512 bytes

  I/O size (minimum/optimal): 512 bytes / 512 bytes

  Disklabel type: dos

  Disk identifier: 0xe937a7bf

  Device Boot Start End Sectors Size Id Type

  /dev/sdb1 2048 6293504 6291457 3G b W95 FAT32

- Now the partitions are created as above. Save these changes by pressing ‘w’.

  Command (m for help): w

  The partition table has been altered.

  Calling ioctl () to re-read partition table.

  Syncing disks.

- Format both the partitions, first partition as VFAT (windows) and second partition as EXT4 (Linux).

  $ sudo mkfs.vfat /dev/sdb1

- Now SD card is ready to use.
- Remove the SD card and insert again, then the respective partitions can be viewed by the below command.

  $ mount