User Manual

[SBC-PH8700]

Revision History

Rev.	Note	Author
20160902	Initial	Sandy
20160927	Rev01 Release	Sandy

Catalog

Release Note

1. Images Version

SBC-PH8700_Shipment_Image_SDcard_Rev01.img

SBC-PH8700_Shipment_Image_EMMC_Rev01.img

2. Feature List

Feature List	SBC-PH8700			
	Schematic Page#	On-Chip Peripherals	On-Board Peripherals	Detail Functions(existing)
u-boot version	2015.09			Supports kernel boot
kernel version	4.1.6			Supports all below functionality
Filesystem	Debian			Default root file system used by debian
CPU	PH8700-U5	AM3358_ZCZ		Null
DDRAM	PH8700-P8-U12	DDR	MT41K256M16HA-125	Can access read write and run code
PMIC	PH8700-P3-U2	I2C0	TPS65217	Null
eMMC	PH8700-P9-U13	MMC1	MTFC4GLDEA	Can access read write and boot
SDCard	Null			
MicroSD_(TF)	SPH1800-P6-TF1	MMC0	Null	Can access read write and boot
External-RTC	SPH1800-P9-U55	I2C0	RX-8025TUB	can read write and keep time off power
Integrited-RTC	PH8800-u11	RTC	Null	can read write and keep time off power
LEDs	PH8800-p10-D3/D4	gpio	Null	System can control LED to light or not
LCD	SPH1800-P9-J9	RGB	Null	Can show picture on the screen
Backlight	SPH1800-P9-J9	PWM	Null	System can control the LCD backlight
TouchScreen	SPH1800-P9-J9	ADC-TSC	Null	System use touchscreen
EEPROM	PH8800-p8-u14	MMC1	MTFC4GACAAAM-4M IT	Can access read write
CAN	SPH1800-p8-J61	CAN1	MC33901WEF	System can send and receive data

				between two board
UART-0	SPH1800-p7-CN4	UART0	NUll	System can send and receive data in loopback mode
UART-1	SPH1800-p7-J4	UART5	MAX3232CUE+	System can send and receive data in loopback mode
UART-2	SPH1800-p13-J58	UART3	Null	System can send and receive data in loopback mode
UART-4	SPH1800-p13-J58	UART1	MAX3232CUE+	System can send and receive data in loopback mode
RS485-2	SPH1800-p8-u5	SPI0	SC16IS752IPW	System can send and receive data between two board
RS485-3	SPH1800-p8-u5	SPI0	SC16IS752IPW	System can send and receive data between two board
USB-Host	SPH1800-p11-p3	USB1	Null	Can recognize U disk by USB host
USB-OTG	SPH1800-p11-j13	USB0	Null	Can recognize U disk in host mode, and can work as usb ethernet in device mode
Ethernet-1	PH8800-P9-U9	RGMII1	KSZ9031RNXIA	Can ping the server
Ethernet-2	SPH1800-P12-J17	RGMII2	AR8035	Can ping the server
HDMI	SPH1800-P10-U34	I2C0	TDA19988BHN/C1,551	Can show picture on the screen
Audio	SPH1800-P10-U34	I2C0	TDA19988BHN/C1,551	can play wav

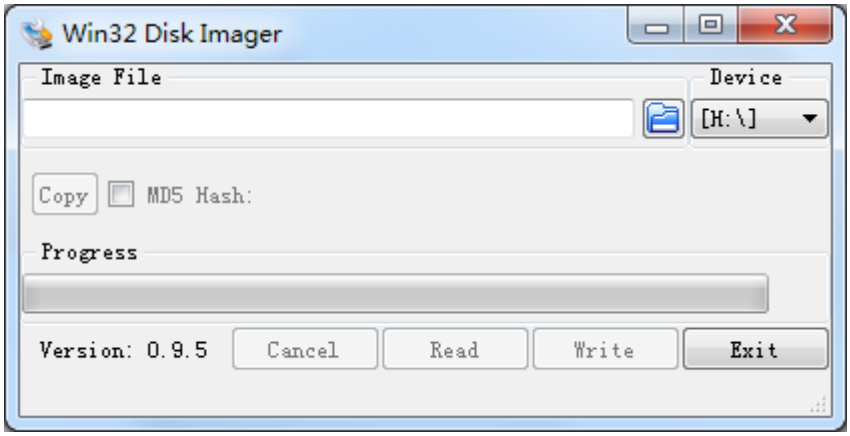
3. Known Issues

Known issue List	Detail
LCD	4.3 inch screen turn white for a while in boot 7 inch screen blink several times when boot
HDMI	Not shown correctly Not support Sony HDMI display

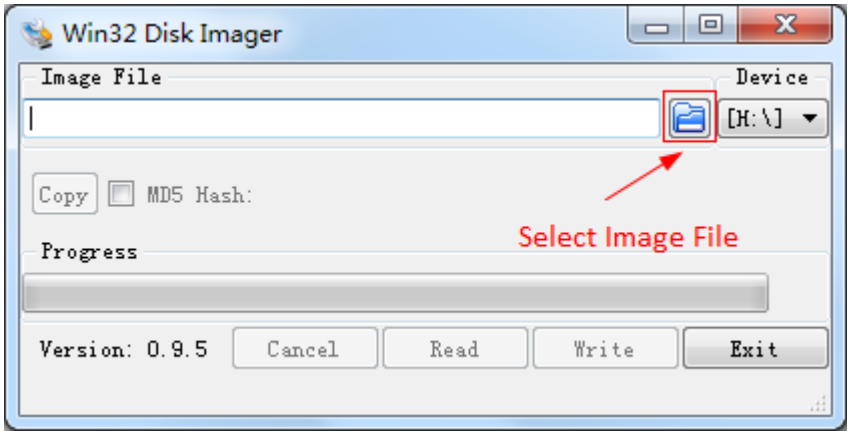
Chapter 1 Quick Start

1.1 Burn the System Images to the SD Card

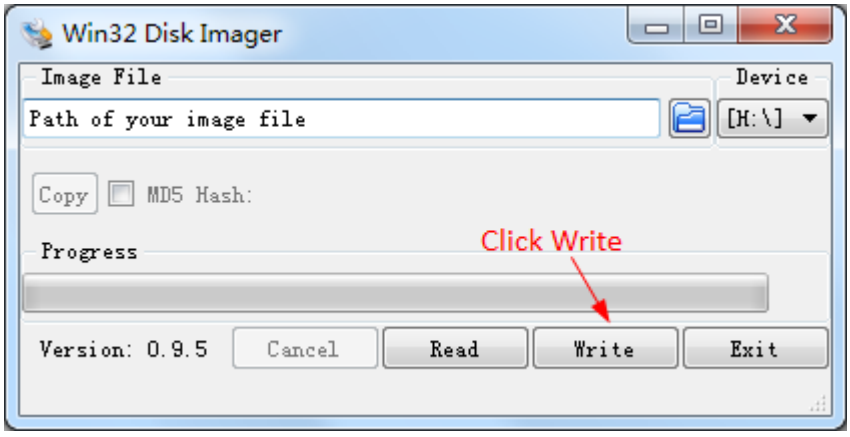
- Firstly, you should prepare a SD card, which is no less than 2GB.
- Then, download and install “Win32 Disk Imager” from https://sourceforge.net/projects/win32diskimager/.



- Select the system image: SBC-PH8700_Shipment_Image_SDcard_Rev01.img:



- Click “Write” button to burn the images:



1.2 System Boot from SD Card

- Install the Serial Communication software (e.g. SecureCRT), select the corresponding port number, baudrate as 115200, data bits as 8, stop bits as 1, parity as none.
- Connect the DEBUG interface (CN4) to the serial interface of PC with a USB to TTL module.
- Insert the MicroSD card into the card slot (TF1).
- Press S3 button, then powered the board with a 5V, 2A power. Release S3 after the power reset.
- Wait for the system boot up, then the serial output will show the following information:

```
[    4.779552] systemd[1]: Starting Journal Service...
[    4.802315] systemd[1]: Started Journal Service.
[    5.040992] systemd-udevd[144]: starting version 215
[    5.360032] systemd-journald[143]: Received request to flush runtime journal from PID 1
[    6.677796]  remoteproc0: failed to load am335x-pm-firmware.elf
[    6.733794]  remoteproc0: powering up wkup_m3
[    6.739527]  remoteproc0: Direct firmware load for am335x-pm-firmware.elf failed with error
[    6.895292]  remoteproc0: Falling back to user helper
[    7.275365]  remoteproc0: request_firmware failed: -11
[    7.281803]  remoteproc0: rproc_boot failed
[    8.031991] net eth0: initializing cpsw version 1.12 (0)
[    8.114081] net eth0: phy found : id is : 0x4dd072
[    8.140049] net eth1: initializing cpsw version 1.12 (0)
[    8.224126] net eth1: phy found : id is : 0x4dd072
[    8.919773] c_can_platform 481cc000.can can0: bit-timing not yet defined
[    8.973742] c_can_platform 481cc000.can can0: failed to open can device
[    9.665888] random: nonblocking pool is initialized
[   11.114500] cpsw 4a100000.ethernet eth0: Link is Up - 100Mbps/Full - flow control rx/tx

Debian GNU/Linux 8 embest ttyS0

www.embest-tech.com

default username:password is [root:root]

embest login:
```

Enter username and password as “root” to login;

```
Debian GNU/Linux 8 embest ttyS0

www.embest-tech.com

default username:password is [root:root]

embest login: root
Password:
Linux embest 4.1.6 #1 PREEMPT Tue Sep 27 10:47:01 CST 2016 armv7l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
root@embest:~#
```

1.3 System Boot from EMMC

Copy the SBC-PH8700_Shipment_Image_EMMC_Rev01.img to a U-disk.

Refer to 1.2, boot the system from SD Card, then plug the U-disk to P3;

Execute the following instructions on the serial terminal:

```
root@embest:~# ls /dev/sd*
/dev/sda    /dev/sda1
root@embest:~# mount /dev/sda1 /mnt/
root@embest:~# dd if=/mnt/SBC-PH8700_Shipment_Image_EMMC_Rev01.img of=/dev/mmcblk1
```

Note: Burn the EMMC takes a long time, please wait patiently.

Then power reset the board to boot from EMMC (**Don't press S3 anymore**).

Chapter 2 Function test

First of all, please refer to Chapter 1.1 and boot up the system. Then test the functions according to the following guidance.

2.1 LED

User can control LED (D2, D3) indicators on SOM-PH8700 Board. After the system boot up, please execute the following instructions in serial terminal to implement the test; (D2 is attached to user_leds_d2, D3 to user_leds_d3)

Light out LED:

root@embest:~# echo 0 > /sys/class/leds/user_leds_d2/brightness

root@embest:~# echo 0 > /sys/class/leds/user_leds_d3/brightness

Light up LED:

root@embest:~# echo 1 > /sys/class/leds/user_leds_d2/brightness

root@embest:~# echo 1 > /sys/class/leds/user_leds_d3/brightness

2.2 RTC

Execute the following instructions on the serial terminal:

Check the current system time:

root@embest:~# date

Sat Jan 1 00:02:07 UTC 2000

Set current time as 10:46, March 9, 2016

root@embest:~# date 030910462016

Wed Mar 9 10:46:00 UTC 2016

Write system clock into RTC:

root@embest:~# hwclock –w

Read RTC value:

root@embest:~# hwclock

Wed 09 Mar 2016 10:46:23 AM UTC -0.432561 seconds

The above information indicates that the hardware clock-RTC-has been set to March 9, 2016, so the system clock is saved in the hardware clock.

Reboot the system and check the current system time:

root@embest:~# date

Wed Mar 9 10:46:45 UTC 2016

2.3 EEPROM

Execute the following instructions on the serial terminal:

root@embest:~# ./eeprom_test

data will write to EEPROM at 0x400

00 01 02 03 04 05 06 07 08 09 0a 0b 0c 0d 0e 0f

10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f

20 21 22 23 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f

30 31 32 33 34 35 36 37 38 39 3a 3b 3c 3d 3e 3f

40 41 42 43 44 45 46 47 48 49 4a 4b 4c 4d 4e 4f

50 51 52 53 54 55 56 57 58 59 5a 5b 5c 5d 5e 5f

60 61 62 63 64 65 66 67 68 69 6a 6b 6c 6d 6e 6f

70 71 72 73 74 75 76 77 78 79 7a 7b 7c 7d 7e 7f

80 81 82 83 84 85 86 87 88 89 8a 8b 8c 8d 8e 8f

90 91 92 93 94 95 96 97 98 99 9a 9b 9c 9d 9e 9f

a0 a1 a2 a3 a4 a5 a6 a7 a8 a9 aa ab ac ad ae af

b0 b1 b2 b3 b4 b5 b6 b7 b8 b9 ba bb bc bd be bf

c0 c1 c2 c3 c4 c5 c6 c7 c8 c9 ca cb cc cd ce cf

d0 d1 d2 d3 d4 d5 d6 d7 d8 d9 da db dc dd de df

e0 e1 e2 e3 e4 e5 e6 e7 e8 e9 ea eb ec ed ee ef

f0 f1 f2 f3 f4 f5 f6 f7 f8 f9 fa fb fc fd fe ff

data read from EEPROM at 0x400

00 01 02 03 04 05 06 07 08 09 0a 0b 0c 0d 0e 0f

10 11 12 13 14 15 16 17 18 19 1a 1b 1c 1d 1e 1f

20 21 22 23 24 25 26 27 28 29 2a 2b 2c 2d 2e 2f

30 31 32 33 34 35 36 37 38 39 3a 3b 3c 3d 3e 3f

40 41 42 43 44 45 46 47 48 49 4a 4b 4c 4d 4e 4f

50 51 52 53 54 55 56 57 58 59 5a 5b 5c 5d 5e 5f

60 61 62 63 64 65 66 67 68 69 6a 6b 6c 6d 6e 6f

70 71 72 73 74 75 76 77 78 79 7a 7b 7c 7d 7e 7f

80 81 82 83 84 85 86 87 88 89 8a 8b 8c 8d 8e 8f

90 91 92 93 94 95 96 97 98 99 9a 9b 9c 9d 9e 9f

a0 a1 a2 a3 a4 a5 a6 a7 a8 a9 aa ab ac ad ae af

b0 b1 b2 b3 b4 b5 b6 b7 b8 b9 ba bb bc bd be bf

c0 c1 c2 c3 c4 c5 c6 c7 c8 c9 ca cb cc cd ce cf

d0 d1 d2 d3 d4 d5 d6 d7 d8 d9 da db dc dd de df

e0 e1 e2 e3 e4 e5 e6 e7 e8 e9 ea eb ec ed ee ef

f0 f1 f2 f3 f4 f5 f6 f7 f8 f9 fa fb fc fd fe ff

If write and read data are the same, the test passes.

2.4 EMMC

Execute the following instructions on the serial terminal:

root@embest:~# touch emmc_read emmc_write

Modify emmc_write value:

root@embest:~# vi emmc_write

E.g. Write “emmc write test” into the system

Write emmc instructions:

root@embest:~# dd if=emmc_write of=/dev/mmcblk1

[68.358218] mmcblk1: p1 p2

0+1 records in

0+1 records out

16 bytes (16 B) copied, 0.0273767 s, 0.6 kB/s

Read emmc instructions:

root@embest:~# dd if=/dev/mmcblk1 of=emmc_read bs=1K count=10

10+0 records in

10+0 records out

10240 bytes (10 kB) copied, 0.00800079 s, 1.3 MB/s

Check emmc_read value:

root@embest:~# cat emmc_read

emmc write test

Test passes;

2.5 ADC

Execute the following instructions on the serial terminal to get the sampling values returned:

root@embest:~# cat /sys/bus/platform/devices/TI-am335x-adc/iio\:device0/in_voltage4_raw

571

root@embest:~# cat /sys/bus/platform/devices/TI-am335x-adc/iio\:device0/in_voltage5_raw

863

root@embest:~# cat /sys/bus/platform/devices/TI-am335x-adc/iio\:device0/in_voltage6_raw

863

root@embest:~# cat /sys/bus/platform/devices/TI-am335x-adc/iio\:device0/in_voltage7_raw

879

2.6 HDMI

Open the uEnv.txt file from SD card, modify fdtfile=embest-SOM_PH8700-BB_SPH1800-HDMI.dtb

Connect the display with HDMI cable, then reboot the system;

2.7 HDMI Audio

Connect the HDMI device, execute the following instruction to play the default audio file:

root@embest:~# aplay /boot/firmware/audio_sample.wav

Playing WAVE '/boot/firmware/audio_sample.wav' : Signed 16 bit Little Endian, Rate 22050 Hz, Stereo

2.8 LCD

4.3” LCD:

Open the uEnv.txt file from SD card, modify fdtfile= embest-SOM_PH8700-BB_SPH1800-4.3inch_LCD.dtb

Connect the screen module to J9, then reboot the system.

7” LCD:

Open the uEnv.txt file from SD card, modify fdtfile= embest-SOM_PH8700-BB_SPH1800-7inch_LCD.dtb

Connect the screen module to J9, then reboot the system.

2.9 Backlight

The backlight brightness has a range from 1 to 8, in which 8 means highest brightness, 1 means lowest.

Execute the following instructions on the serial terminal to implement the backlight test:

The darkest:

root@embest:~# echo 1 > /sys/class/backlight/backlight/brightness

The brightest:

root@embest:~# echo 8 > /sys/class/backlight/backlight/brightness

2.10 Touchscreen

Connect the screen module to J9, execute the following instructions on the serial terminal to implement the touch screen calibration program:

root@embest:~# ts_calibrate

Following the notes on LCD, click the “+” icon for five times to complete the calibration.

2.11 Serial

The board has 4 serial interfaces, while the UART0 (CN4) is the debug interface. Execute the following instructions on the serial terminal to test UART 1, UART2 and UART4:

2.11.1 UART1

Short Pin 2 and 3 in J4:

root@embest:~# ./uart_test -d /dev/ttyS1 -b 115200

/dev/ttyS1 SEND: 1234567890

/dev/ttyS1 RECV 10 total

/dev/ttyS1 RECV: 1234567890

2.11.2 UART2

Short Pin 16 and 17 in J58:

root@embest:~# ./uart_test -d /dev/ttyS2 -b 115200

/dev/ttyS2 SEND: 1234567890

/dev/ttyS2 RECV 10 total

/dev/ttyS2 RECV: 1234567890

2.11.3 UART4

Short Pin 14 and 15 in J58:

root@embest:~# ./uart_test -d /dev/ttyS4 -b 115200

/dev/ttyS2 SEND: 1234567890

/dev/ttyS2 RECV 10 total

/dev/ttyS2 RECV: 1234567890

Note: Press “CTRL+C” to exit the serial test.

2.12 RS485

2.12.1 RS485-2 and RS485-3

Short connect Pin 7 and 9, Pin 8 and 10 in J62 (That is RS485-A3 to RS485-A2, RS485-B3 to RS485-B2):

Execute the following instructions on the serial terminal (in the background):

root@embest:~# ./uart_test -d /dev/ttySC1 -b 9600 -s "a" &

Then enter the following:

root@embest:~# ./uart_test -d /dev/ttySC0 -b 9600 -s "c"

/dev/ttySC0 SEND: c

/dev/ttySC1 RECV 1 total

/dev/ttySC1 RECV: c

/dev/ttySC1 SEND: a

/dev/ttySC0 RECV 1 total

/dev/ttySC0 RECV: a

TtySC0, ttySC1 will send data separately, receive data correctly;

2.13 CAN

Test method as below:

Execute the following instructions on the serial terminal:

root@embest:~# ip link set can0 type can bitrate 50000 loopback on

root@embest:~# ip link set can0 up

[1080.870648] c_can_platform 481cc000.can can0: setting BTR=1c1d BRPE=0000

Execute the following instructions to receive data packet in the background:

root@embest:~# candump can0 &

Execute the following instructions to send data packet:

root@embest:~# cansend can0 123#11223344556677

can0 123 [7] 11 22 33 44 55 66 77

can0 123 [7] 11 22 33 44 55 66 77

Shut off the device:

root@embest:~# ip link set can0 down

read: Network is down

root@embest:~# [1280.241265] c_can_platform 481cc000.can can0: setting BTR=1c1d BRPE=0000

2.14 Network

Connect eth cable to J17, execute the following instructions on the serial terminal:

Configure the IP address:

root@embest:~# ifconfig eth0 192.168.2.64

Testing network interface:

root@embest:~# ping 192.168.2.1

To test eth1, you need to disconnect the cable with J17, connect the cable with the external ETH module, then use the above instructions to test. (Change eth0 to eth1).

2.15 USB

2.15.1 USB Host

Insert the U disk to the USB Host interface (P3); serial terminal will display the disk information:

```
[  749.839750] usb 2-1: USB disconnect, device number 2
[  753.033776] usb 2-1: new high-speed USB device number 3 using musb-hdrc
[  753.174244] usb 2-1: New USB device found, idVendor=0781, idProduct=5530
[  753.181112] usb 2-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[  753.189783] usb 2-1: Product: Cruzer
[  753.193454] usb 2-1: Manufacturer: SanDisk
[  753.198779] usb 2-1: SerialNumber: 20060876900F3042FBB5
[  753.207733] usb-storage 2-1:1.0: USB Mass Storage device detected
[  753.218483] scsi host1: usb-storage 2-1:1.0
[  754.224988] scsi 1:0:0:0: Direct-Access     SanDisk  Cruzer           1.26 PQ: 0 ANSI: 5
[  754.248822] sd 1:0:0:0: [sda] 7821312 512-byte logical blocks: (4.00 GB/3.72 GiB)
[  754.261207] sd 1:0:0:0: [sda] Write Protect is off
[  754.269365] sd 1:0:0:0: [sda] Write cache: disabled, read cache: enabled, doesn't support DPO or FUA
[  754.291840]  sda:
[  754.300985] sd 1:0:0:0: [sda] Attached SCSI removable disk
```

Execute the following instructions on the serial terminal:

```
root@embest:~# ls /dev/sd*
/dev/sda
```

Storage nodes locate under /dev;

2.15.2 OTG Test

2.15.2.1 1. MASTER DEVICE

Connect U disk to J13 with an OTG cable:

```
[  777.452379] usb 2-1: USB disconnect, device number 3
[  828.653766] usb 1-1: new high-speed USB device number 2 using musb-hdrc
[  828.794284] usb 1-1: New USB device found, idVendor=0781, idProduct=5530
[  828.801145] usb 1-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[  828.811356] usb 1-1: Product: Cruzer
```

[828.817391] usb 1-1: Manufacturer: SanDisk

[828.823054] usb 1-1: SerialNumber: 20060876900F3042FBB5

[828.834098] usb-storage 1-1:1.0: USB Mass Storage device detected

[828.848209] scsi host2: usb-storage 1-1:1.0

[829.854966] scsi 2:0:0:0: Direct-Access SanDisk Cruzer 1.26 PQ: 0 ANSI: 5

[829.879600] sd 2:0:0:0: [sda] 7821312 512-byte logical blocks: (4.00 GB/3.72 GiB)

[829.893393] sd 2:0:0:0: [sda] Write Protect is off

[829.902869] sd 2:0:0:0: [sda] Write cache: disabled, read cache: enabled, doesn't support DPO or FUA

[829.927923] sda:

[829.939997] sd 2:0:0:0: [sda] Attached SCSI removable disk

Execute the following instructions on the serial terminal:

root@embest:~# ls /dev/sd*

/dev/sda

Storage nodes locate under /dev;

2.15.2.2 2. SLAVE DEVICE

Connect J13 to PC, open the device manager, and check if the following device is recognized:

Chapter 3 System Compilation

3.1 Building Development Environment

Copy the release folder to Linux's $HOME directory (extract the rar files), while the compilation tool gcc-linaro-4.9-2015.05-x86_64_arm-linux-gnueabihf under path $HOME/S5_Tool. Use the following instructions to extract it:

$xz -d gcc-linaro-4.9-2015.05-x86_64_arm-linux-gnueabihf.tar.xz

$tar –xvf gcc-linaro-4.9-2015.05-x86_64_arm-linux-gnueabihf.tar

Import the environment variable:

$export CROSS_COMPILE=$HOME/S5_Tool/gcc-linaro-4.9-2015.05-x86_64_arm-linux-gnueabihf/bin/arm-linux-gnueabihf-

$export ARCH=arm

3.2 Compiling U-Boot

3.2.1 Get the U-Boot Source Code

U-boot source code locates under path $HOME/S4_Sourcecode/, extract the u-boot*.tar.gz:

$ cd $HOME/S4_Sourcecode/

$ tar -zxvf u-boot*.tar.gz

3.2.2 Compile and Burn the Images to SD Card

$ cd $HOME/S4_Sourcecode/u-boot

$ make distclean

$make som_ph8700_defconfig

$make

When the compilation finished, it will generate a MLO and u-boot.img under path $HOME/S4_Sourcecode/u-boot, copy the two files to SD card;

3.2.3 Compile and Burn the Images to EMMC

$ cd $HOME/S4_Sourcecode/u-boot

$ make distclean

$make som_ph8700_emmcboot_defconfig

$make

When the compilation finished, it will generate a MLO and u-boot.img under path $HOME/S4_Sourcecode/u-boot,

burn the two files to EMMC.

3.3 Compiling Kernel

3.3.1 Get Kernel Source Code

The source code of the kernel locate under $HOME/S4_Sourcecode/, extract the linux*.tar.gz

$ tar -zxvf linux*.tar.gz

3.3.2 Compile and Burn the Images to SD Card

$ cd $HOME/S4_Sourcecode/linux

$ make distclean

$ make embest_ti_8700_defconfig

$ make

When the compilation finished, it will generate

- zImage under $HOME/S4_Sourcecode/linux/arch/arm/boot;
- the following 3 files under $HOME/S4_Sourcecode/linux/arch/arm/boot/dts

1. embest-SOM_PH8700-BB_SPH1800-4.3inch_LCD.dtb
2. embest-SOM_PH8700-BB_SPH1800-7inch_LCD.dtb
3. embest-SOM_PH8700-BB_SPH1800-HDMI.dtb

The dtb files are corresponding for 4.3” LCD, 7” LCD and HDMI display. (Refer to HDMI and LCD)

Copy the files to SD Card.