

QUICK START GUIDE
5.4" Iridis[®] Display module

With
Display Connector Board
Sojus 5.5

Part-No. 303040

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1 Safety Points



Warning:

- To avoid risk of electric shock or damage to the display, disconnect the display module from its power source before handling it.
- Do not touch the connections or circuits whilst the display is in operation.



Caution:

- Follow ESD handling procedures to avoid circuit damage. Use a grounded wrist strap.
- Do not press on the display panel or its edges as damage can result.

Important Notice

The Plastic Logic Display Evaluation Kit (“the Kit”) is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY** and is not considered by Plastic Logic to be a finished end-product fit for general consumer use. Persons handling the Kit must have electronics training and observe good engineering practice standards. As such, the kit being provided is not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. The kit does not fall within the scope of the European directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

2 About this document

This document is a quick start guide for the Sojus 5.5 adapter component for driving 5.4” Iridis® Display module.

3 Getting Started

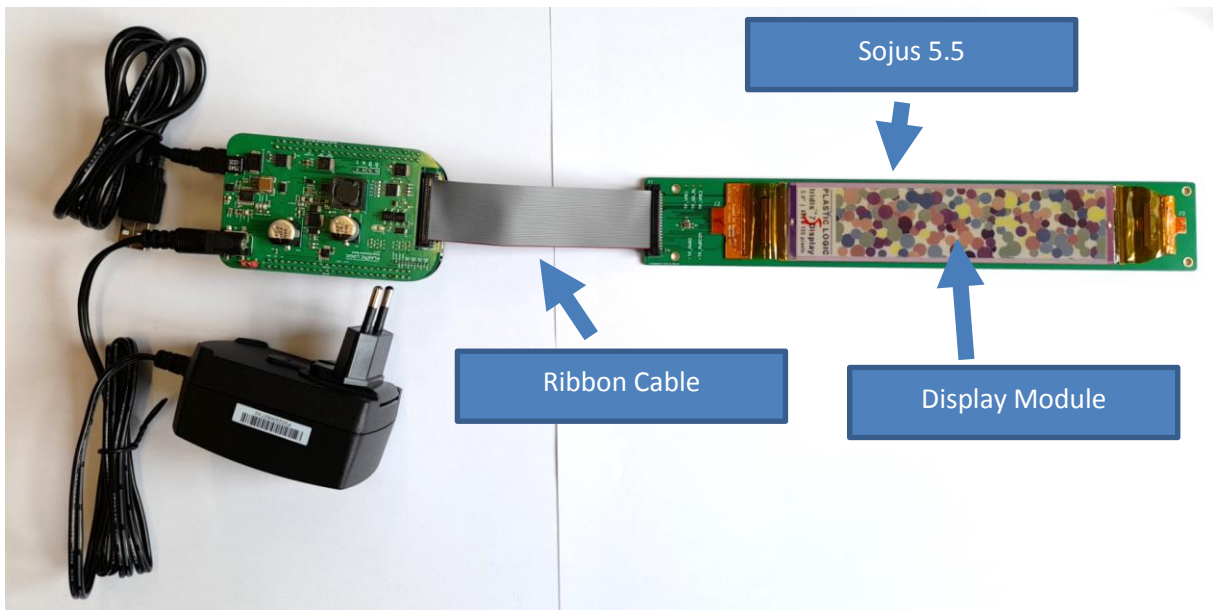
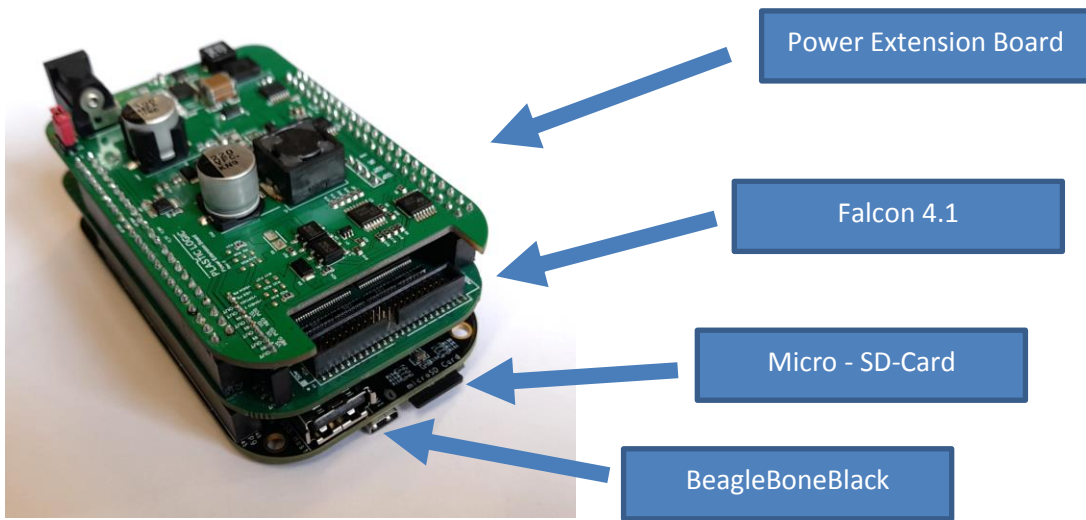
Prior to unpacking the kit, the user is strongly urged to take appropriate ESD and safety precautions.

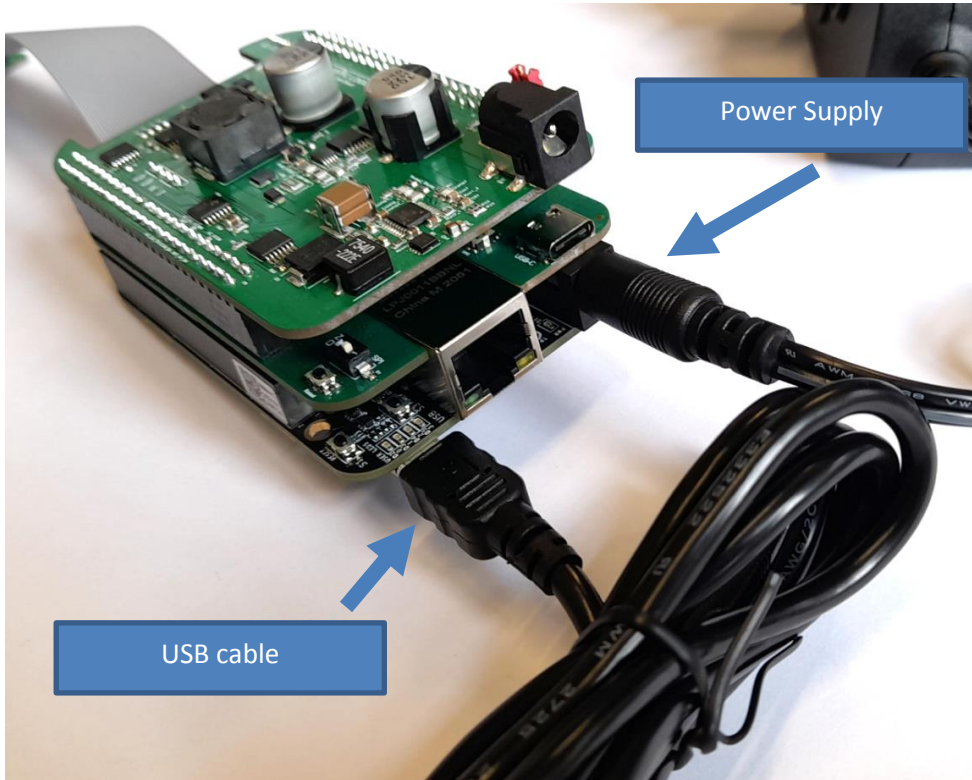
3.1 Unpacking the Kit

The Sojus 5.5 evaluation kit component is part of the Plastic Logic Display Evaluation Kit for 5.4” Iridis® Display module. Please ensure that the items listed have been included in your kit. Remove the kit from the anti-static bags and perform a visual inspection.

PLASTIC LOGIC

No.	Item	Description
1	BeagleBoneBlack	User interface board.
2	Falcon 4.1 Board	Display driver board.
3	Power Extension Board	Additional power board.
	Sojus 5.5 Board	Display connector board.
4	Ribbon Cable (40pin)	Connection between display driver and connector board.
5	Micro - SD Card	Contains slide-show images, display specific waveforms and vcoms, documentation.
6	USB cable	Connection between BeagleBoneBlack and PC.
7	Power Supply	DC 5.0/4A power supply with regional adapters.
8	Display Module	5.4" Iridis® Display module





3.2 Connecting the Display with the Kit

Plug the display into the display connector of the Sojus 5.5 connector board first. It is important to connect the display before powering up the kit to avoid damages of any parts!



Attention: Do not connect or disconnect a display during the kit is powered up!

3.3 System Boot and Image Display

After the display is plugged in use the power supply (DC 5V/4A) to power up the kit. The image slideshow will start after a couple of seconds. Do not run the kit powered from USB only! This will cause errors and malfunction. Though the system boots the display is not going to operate correctly.

3.4 Starting the EPD

Once after startup or after significant changes to the configuration, it is needed to start the EPDC.

Use `epdc-app -start_epdc [nvm-content] [clear screen]`. The Parameters are optional. Set the clear screen option to 1 to clear the screen on epdc init.

3.5 Stopping and Starting the Slideshow

To start the slideshow use the command `slideshow-start.sh`. The slideshow will show the png-images in the images folder `/boot/uboot/[DisplayType*]/img`.

The command `slideshow-stop.sh` stops the slideshow.

To enable the slideshow at startup use the command `slideshow-enable.sh`

To disable the slideshow at startup use the command `slideshow-disable.sh`

The slideshow scripts are located on the SD-Card (/boot/uboot/)epdc/bin.

3.6 Setting Waveform and VCOM

The Waveform and the VCOM are set in the config file `epdc.config` on the `/boot/uboot/[DisplayType*]`

3.7 References

[1] www.chiark.greenend.org.uk/~sgtatham/putty/download.html

[2] <http://beagleboard.org/Products/BeagleBone>

*) See the available display types either on the SD-Card (Display data is stored in folders with the display type name) or in the table in section 4

4 Controlling the Kit from a PC

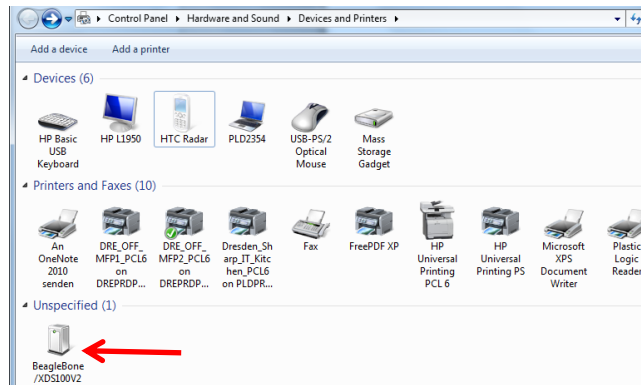
4.1 Connecting the Kit to a PC via USB

To control the kit remotely it is required to set up a connection. It is recommended to use a serial connection over USB. Plug in the included USB cable into the PC first. Plug in the cable into the kit afterwards.

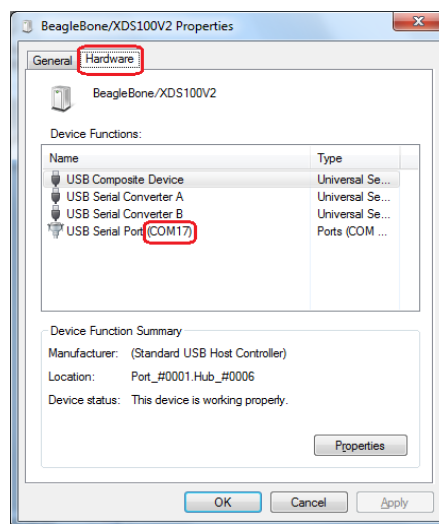
If the connection fails by some reason it is important to remove the mini USB cable from the kit and reconnect it.

Execute the following steps to establish the connection:

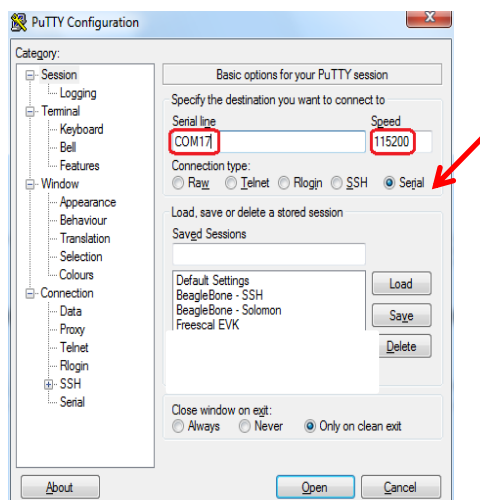
- Click on the Windows “Start” button and select “Devices and Printers”.
- Double-Click “BeagleBone...”.



- Click the “Hardware” tab.
- Find out the COM port of the USB Serial Port.



- Use “PuTTY” to connect the PC to the kit. This is a free SSH implementation for Windows which also supports serial connections. It can be downloaded from: www.chiark.greenend.org.uk/~sgtatham/putty/download.html.
- Choose connection type “Serial” and configure the COM port and the speed (115200).

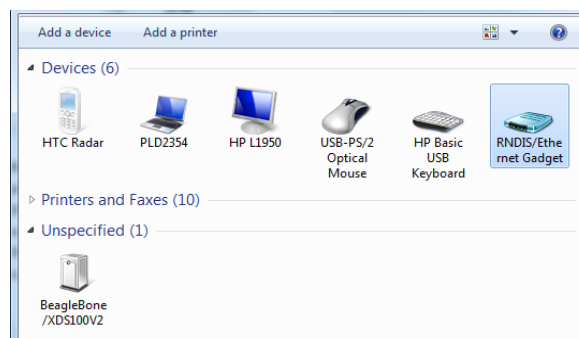


- Click “Open” and a terminal window will appear.
- Press “ENTER” and the Debian Linux login screen appears.
- Log in using the following credentials: login “root”, password “”.
- Now you are successfully logged-in and can use the shell.

5 Transferring Files

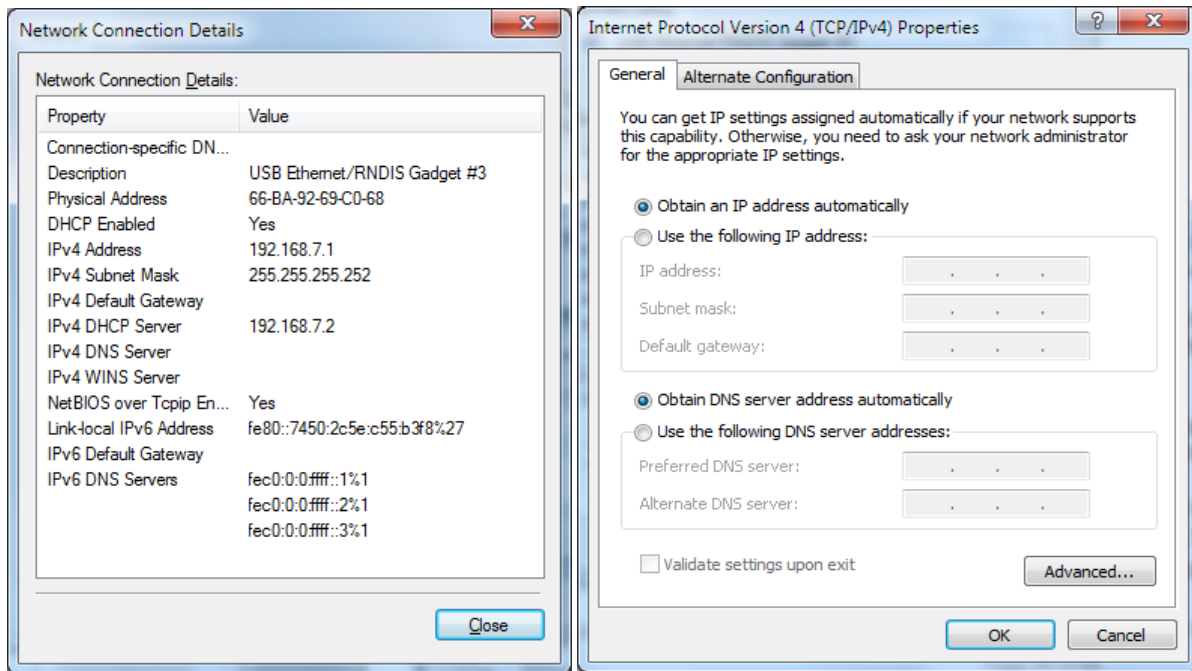
5.1 Ethernet via USB

If the system is powered up and the slideshow is running connect the kit with the provided mini USB cable to your PC. Ethernet over USB will be enabled automatically on the kit after plugging in the USB cable. A USB Ethernet/RNDIS gadget will be installed on the PC automatically. This device can be found in the “Devices and Printers” dialog.



Now your Ethernet connection is enabled. The kit runs a DHCP server so that it is not required to change the network settings of the RNDIS/Ethernet Gadget on the PC. The kit uses the IP address *192.168.7.2* and the PC uses the IP address *192.168.7.1*.

Check the “Network and Sharing Center” to verify the network settings on the PC. Use “Change adapter settings” to list all available network connections. Open the local area connection which belongs to the USB Ethernet/RNDIS Gadget. Open “Details” to check the IP address which is actually used. Close the dialog and open “Properties” and then open the “Internet Protocol Version 4” properties. This should have “Obtain an IP address automatically” selected.



With the Ethernet connection enabled the kit can be accessed via FTP and SSH. The FTP connection does not require a user or a password. The SSH connection uses the same credentials as the serial connection (login “root”, password “”).

5.2 Further Information

The “C_FN2” Evaluation kit is to be used to drive a wide variety of Plasticlogic displays. For detailed information on this components, please refer to their respective documentation.

Please remove the Micro-SD card from the switched off kit and insert it into a PC. Please check the folders “Source” and “Documentation” for further information.

The SD-Card content and source code can be found on github. Make sure to use the same version of both repositories.

5.2.1 Change the display type

To change the display type, remove the SD-Card from the Beaglebones SD-Card slot and open the file config.txt with a text editor. Edit the line “display type [old Display Type]” to “display type [new Display Type]” and restart the application (epdc-app –start_epdc).

6 SD-Card Content

The PLDEK is preinstalled on the shipped SD-Card and runs out of the box. Since the PLDEK is installed on a standard BeagleBone image, there are a lot of files on the SD-Card which are not directly related to the PLDEK content. Furthermore the PLDEK-SD-Card is shared between the microcontroller platform and the BeagleBone Platform, so some files on the SD-Card are necessary for the BeagleBone and not for the microcontroller, for not the BeagleBone and for the microcontroller or both.

Related files and folders are

- Display type folders like D054_T2.1
 - bin:
 - display: contains display specific data like the waveform file and the vcom file (used not on the Beaglebone PLDEK)
 - lmg: Contains slideshow images
 - epdc.config – file: Contains a wide range of basic and advanced settings.
- The epdc folder. This folder contains
 - bin: slideshow scripts, a setup and an autostart script
 - documentation: Documentation for the PLDEK and its components like user guide, technical explanations, schematics and the source code for the epdc-app.
- config.txt: Sets the display type only (for BeagleBone. This file also configures the microcontroller code)
- Note: In case one BeagleBone SD-Card is intended to be used both on Ruddock and Falcon Board, the setup-environment.sh script must be changed to cover the hardware differences.
- Since the Ruddock Board uses SPI and the Falcon board uses the Epson Parallel Interface the SPIDEV0 device tree overlay must be loaded for Ruddock and must not be loaded for Falcon.

```
#!/bin/bash
set -e
#comment out for use with Falcon
echo BB-PL-SPIDEV0 > /sys/devices/bone_capemgr.*/slots
echo BB-PL-SPIDEV1 > /sys/devices/bone_capemgr.*/slots
export PATH=/boot/uboot/epdc/bin:$PATH
sleep 3
epdc-app -start_epdc 0 1
sleep 3
slideshow-start.sh
exit 0
```

The setup-environment.sh script

So the change of the config.txt file may require the setup-environment.sh script to be changed, too. This script is always called during startup from /etc/rc.local .

The epdc.config file contains detailed setup data for the display. In most cases no adjustment is necessary.

```
[version]
name = CONFIG_D054_T2.1

[display]
nvm = NULL
nvm_format = NULL
controller = S1D13541; IT8951
temp_mode = MANUAL
instruction_code_file = "/boot/uboot/D054_T2.1/bin/instruction_code-Type34.bin";
default_vcom = 4900
```

```

default_temp = 23
default_waveform = "/boot/uboot/D054_T2.1/display/D054_T2.1_ACeP_Eval_W2_T23_V10_25fps_One.bin";

[general]
driver_board = FALCON_SPI_EXT_EPDC; FALCON_SPI; FALCON_I80;
control_system = BEAGLEBONE_BLACK
i2c_master = BEAGLEBONE; EPDC;
spi_port = 1
epdc_spi_port = 1
nvm_spi_port = 1
DISPLAY_SCRAMBLE_CONFIG          = 418 ; 2 + 32 + 128 + 256 = 418
DISPLAY_SCRAMBLE_XOFFSET = 4
update_image_mode = ACEP_ACVCOM; BW | CFA | ACEP | ACEP_ACVCOM

[vcom]
dac_x1          = 127 ; /* first DAC register value (25% of full scale) */
dac_y1          = 5160 ; /* corresponding first voltage in mV */
dac_x2          = 382 ; /* second DAC register value (75% of full scale) */
dac_y2          = 15260 ; /* corresponding second voltage in mV */
vgpos_mv        = 25080 ; /* VGPOS in mV */
vgneg_mv        = -32300 ; /* VGNEG in mV */
swing_ideal     = 56886
dac_vcoml_slope = -105
dac_vcoml_offset = -1352
vcoml           = -11000
dac_vcomh_slope = 102
dac_vcomh_offset = 1586
vcomh           = 19000

[hv_hardware]
hv_config_vgl = -32300
hv_config_vgh = 25080
hv_config_vsh = 15000
vcom_driver = TPS65185
vcom_config = TPS65185
hv_driver = TPS65185
hv_config = NULL
hv_timing = NULL
vcom_switch = GPIO
TOFFSET_VGL_ON    = 8
TOFFSET_VSL_ON    = 2
TOFFSET_VSH_ON    = 11
TOFFSET_VGH_ON    = 3
TOFFSET_VGH_OFF   = 0
TOFFSET_VSH_OFF   = 0
TOFFSET_VSL_OFF   = 0
TOFFSET_VGL_OFF   = 0

[register_settings]
0x001c=0x0f09; double frame time round about 40ms per frame

```

The epdc.config for D054_T2.1

7 Software Overview

The epdc-app is a command line tool to interface with the Epson S1D135xx EPD-Controller on the Falcon or Ruddock Board and preinstalled on the SD-Card. It can be found on the rootfs in the folder /usr/bin/epdc-app. If the software is recompiled, it's necessary to replace the binary.

The source code is located on the SD-Card in the epdc/documentation folder (epdc-app.zip).

7.1 Steps to set up a customized slideshow

First of all check which display type is used. The commands may differ from display type to display type. In this example display type S115_T1.1 is used. It is also assumed that the SD-Card is mounted on a Windows PC on Disk E:\.

- Connect up the kit and make sure the Plasticlogic slideshow will run on boot.
- Power down the kit, remove the SD-Card from the slot of the Beaglebone and plug the SD-Card to a PC (use an adapter if your PC does not have a SD-Card slot).
- Browse to the folder E:\S115_T1.1\img
- Copy the desired image files in the folder. **For S115_T1.1 it is 1380x96px.** Refer to the display data sheet for the resolution of other display types.
- Remove the Plasticlogic images, if needed.
- Plug the SD-Card to the Beaglebone and power up the kit.
- Enjoy the slideshow

7.2 EPDC-Scripts

The slideshow and the enabler and disabler are simple shell scripts

7.2.1 \$ slideshow_start.sh

```
#!/bin/sh
set -e

# do not run the slideshow if it is disabled
if [ -e /var/tmp/slideshow-disabled ]; then
    echo "Slideshow disabled"
    exit 1
fi

# remove the file which is used to stop the slideshow
rm -f /var/tmp/slideshow-stop

# persist cached changes of file system
sync

# run the slideshow
while true; do
    for f in /var/tmp/slideshow/*.png; do
        if [ -e /var/tmp/slideshow-stop ]
        then
            echo "Stopping slideshow"
            exit 1
        fi
    done
done
```

```
        fi
        epdc-app -update_image $f > /dev/null
        sleep 3
    done
done
exit 0
```

7.2.2 \$ slideshow-stop.sh

```
#!/bin/sh

touch /var/tmp/slideshow-stop
sync
```

7.2.3 \$ slideshow-select [display-type]

```
#!/bin/sh

set -e

IMG_ROOT=/boot/uboot

display_type="$1"

[ -z "display_type" ] && {
    echo "Error: no directory specified"
    exit 1
}

dir="$IMG_ROOT/$display_type/img"

[ -d "$dir" ] || {
    echo "Invalid directory: $dir"
    exit 1
}

echo "Slideshow directory: $dir"

rm -f /var/tmp/slideshow
ln -s "$dir" /var/tmp/slideshow
sync

exit 0
```

7.2.4 \$ slideshow-enable.sh

```
#!/bin/sh

rm -f /var/tmp/slideshow-disabled
sync
```

7.2.5 \$ slideshow-disable.sh

```
#!/bin/sh
```

```
touch /var/tmp/slideshow-disabled
sync
```

7.2.6 \$ setup-environment.sh

```
#!/bin/bash
set -e
#comment out for use with Falcon
#echo BB-PL-SPIDEV0 > /sys/devices/bone_capemgr.* /slots
echo BB-PL-SPIDEV1 > /sys/devices/bone_capemgr.* /slots
export PATH=/boot/uboot/epdc/bin:$PATH
sleep 3
epdc-app -start_epdc 0 1
sleep 3
slideshow-start.sh
exit 0
```

8 Manual Image Update

For manual image update use the epdc-app command line tool. Caused by restrictions of the epdc waveform design, the image clear sequence is stored under a separate Wfld. For good image results it is very important to execute a Clear Update prior to every Image Update.

8.1 Image Format

The epdc-app can display every image file in PNG (RGB) file format. To achieve the image update best results on the display it is recommended, to reduce the number of colors to and use a dithering algorithm to achieve intermediate colors. The current Iridis Waveform is optimized to display these colors:

	R	G	B
Black	0	0	0
Red	255	0	0
Orange	255	128	0
Yellow	255	255	0
Green	0	255	0
Cyan	0	255	255
Blue	0	0	255
Magenta	255	0	255
White	255	255	255

8.2 Clear Update

The clear update is executed by the `-update_image` command with:

- Image path: `/boot/uboot/D054_T2.1/img/AllColours.png`
- Waveform Id: 1.

```
root@beaglebone:~# epdc-app -update_image /boot/uboot/D054_T2.1/img/AllColours.png 1
```

8.3 Image Update

The image update is executed by `-update_image` command with:

- Image path: `/boot/uboot/D054_T2.1/img/AllColours.png`
- [Optional] Waveform Id: 2.

```
root@beaglebone:~# epdc-app -update_image /boot/uboot/D054_T2.1/img/AllColours.png 2
```

9 Troubleshooting

If the PLDEK is not showing the slideshow on startup, there are a set of steps to sort out what went wrong:

- Check if the Beaglebone is powered correctly. Is the heartbeat LED blinking?
- Check if all connections are properly set up and that the SD-Card is fitted to the SD-Card-Slot
- Check if you can access the Beaglebone's command line.
 - SSH to the Beaglebone (i.e. using PuTTY):
 - Use the USB-Cable and connect to 192.168.7.2:22 or
 - Use the UART-Port to connect to the serial console
- Check if the Beaglebone booted correctly
 - `$ dmesg` will show all messages during the boot process. Check for errors on module load and if the device tree overlays applied correctly
- Check if the process `epdc-app` is running `$ ps aux | grep epdc-app`
 - If it is running, kill the process and restart the `epdc-app`.
 - If not, just restart the `epdc-app` `$ epdc-app -start_epdc 1 1`
 - In case of errors please contact techsupport@plasticlogic.com and specify what was tried and where it failed with which error.
- Check if the slideshow is running correctly:
 - Check if the slideshow starts and if it stops check the image which did not show up correctly.
- Check if the autostart- and slideshow-scripts are in place and enabled.
 - **Note: Unfortunately the SD-Card might be damaged if the Beaglebone is not powered down correctly. That can lead to booting problems.**
 - `$ ls /var/lib/systemd/system/ | grep slideshow`
 - `$ ls /boot/uboot/epdc/bin/ | grep slideshow`
- If nothing seems to work or in case of any other trouble with the kit, please contact techsupport@plasticlogic.com