

Thor96 Camera Interface User Manual

i.MX8MQ Thor96 Reference Design

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The Solutions People



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ACRONYMS AND ABBREVIATIONS

Definition/Acronym/Abbreviation	Description
cd	Change directory
scp	Secure copy over the network
BSP	Board Support Package
USB	Universal Serial Bus
HW	Hardware
FW	Firmware
NV RAM	Non-Volatile Random-Access Memory
API	Application Programming Interface
V4L2	Video for Linux second version
ISP	Image signal processor
SD	Secure Digital
HDMI	High-Definition multimedia interface
LTS	Long Term Support
UART	universal asynchronous receiver-transmitter
PC	Personal computer
FAT	File Allocation Table
FPS	Frames per second

1 INTRODUCTION

1.1 Purpose of the Document

Purpose of this document is to help developers flash firmware and demonstrate camera interface on i.MX8MQ-thor96 firmware. For demo, we have used AP1302 ISP with either one of the following camera sensors:

- SRT-Vision96-AR0430 mezzanine (AP-vision-AR0430)
- SRT-Vision96-ARX3A0 mezzanine (AP-vision-ARX3A0)
- SRT-Vision96-AR1335 mezzanine (AP-vision-AR1335)

1.2 About the System

This system is based on i.MX8MQ processor and supporting multiple interfaces. This can facilitate for Human-Machine Interface experience.

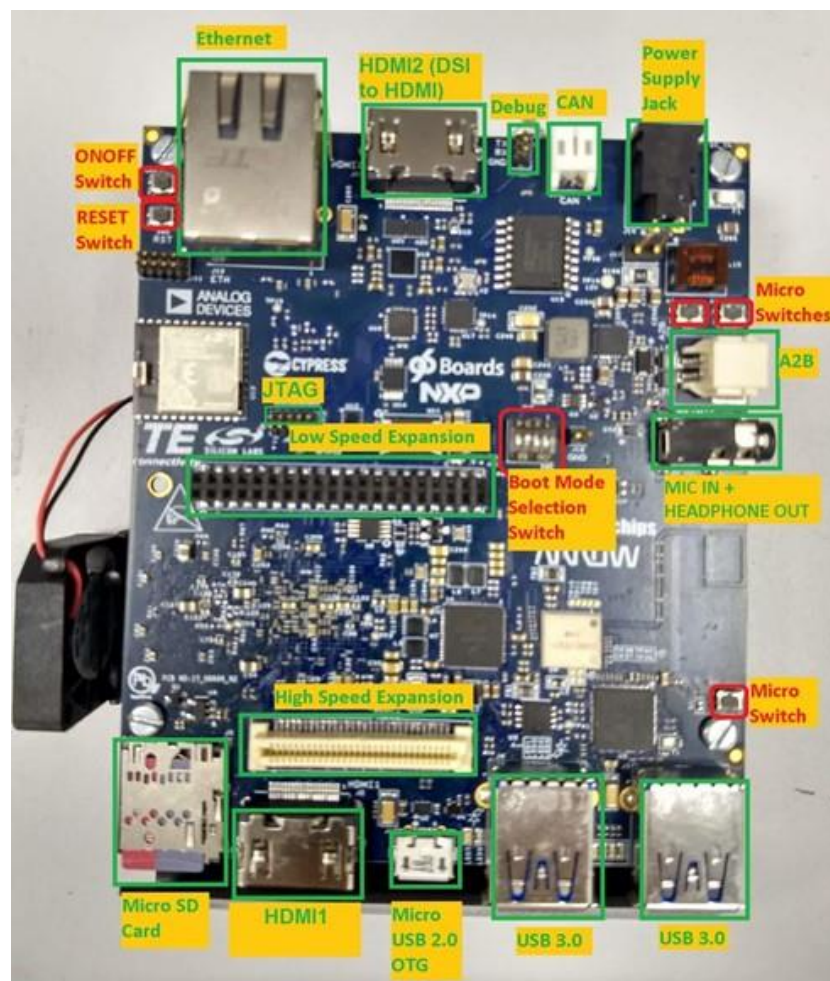


Figure 1: i.MX8MQ Thor96 board

1.3 Intended Audience

This document is for developers and end-users who want to understand/flash/demonstrate camera interface on i.MX8MQ-thor96 firmware.

1.4 Prerequisites

Below are the list of hardware and software needed to demonstrate the Camera interface on I.MX8MQ-Thor96 Board:

- Thor96 Board
- SD-card -32GB
- UART debug cable
- Power Supply - [Power Accessories - 96Boards](#)
- One of the following mezzanine cards
 - SRT-Vision96-AR0430 mezzanine (AP-vision-AR0430)
 - SRT-Vision96-ARX3A0 mezzanine (AP-vision-ARX3A0)
 - SRT-Vision96-AR1335 mezzanine (AP-vision-AR1335)
- HDMI Display
- USB Keyboard
- USB Mouse

2 ENVIRONMENT SETUP

2.1 Hardware Installation

- Place hardware board on a clean anti-static surface
- Insert flashed SD card to J5 SD card slot
- Attach serial cable's micro end to board's J10 Connector (near Ethernet connector) and USB end to host system i.e. x86 PC's USB connector
- Attach Ethernet cable to board's Ethernet connector J12
- Provide 12V-5A power supply (provided with board) to board on J14 DC_IN connector. After all the other hardware setup is done and required interfaces are connected to board, Topview of the board will look like as following:

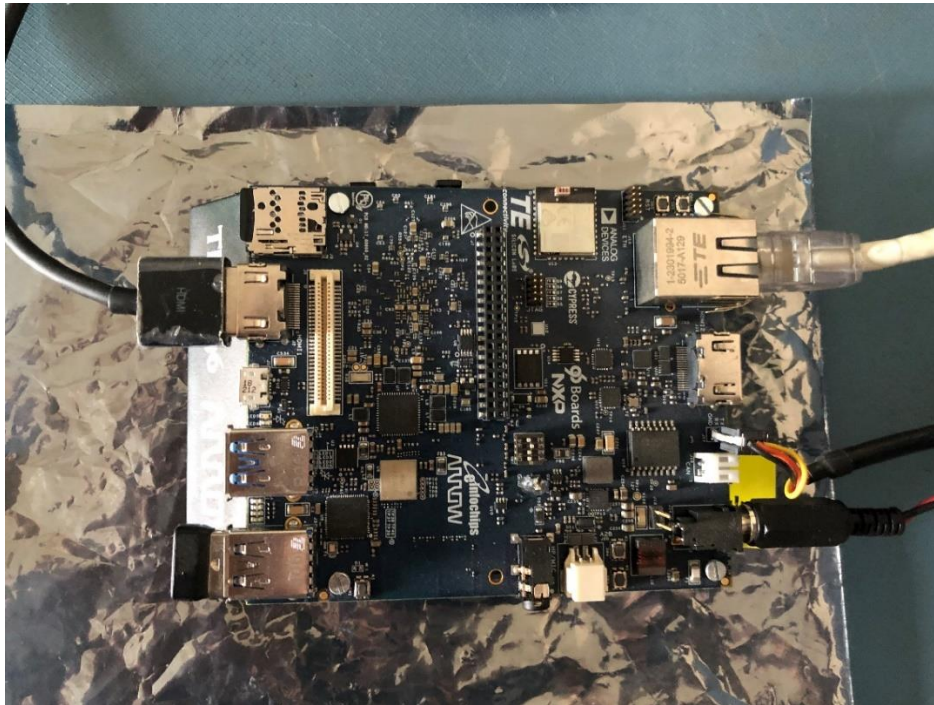


Figure 2 : Thor96 setup

2.2 Open board's terminal- console (minicom) on x86 host PC

- Ensure SD card is flashed, and serial cable is plugged-in to the board as described in hardware setup section as following:

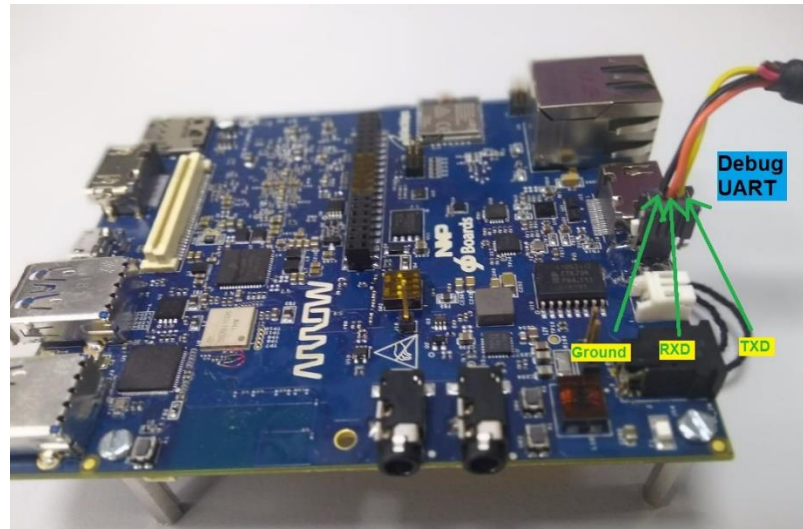


Figure 3 : Thor96 – UART connection

- Attach serial cable's USB end to host x86 PC's USB.
- Ensure minicom is installed in x86 Ubuntu PC (host system)
- Apply below command to open serial command's setting

```
$sudo minicom -s
```

- set baud rate and other setting as per below
 - baud rate=115200,
 - parity=none
 - hardware flow control = none
 - software flow control = none
 - serial device= /dev/ttyUSB0
 - save setup as dfl
- Once board gets powered-up, the above configured terminal will show logs on x86 and can interact with board using this open terminal

3 CAMERA DEMO

3.1 Live stream of AR0430 Camera on HDMI display

- To watch live stream of AR0430 camera sensor over the HDMI, connect HDMI Display, USB keyboard and Mouse to THOR96 board
- Attach **SRT-Vision96-AR0430 mezzanine (AP-vision-AR0430)** camera mezzanine module to high-speed expansion connector as following:



Figure 4 : THOR96 SRT-Vision-AR0430 mezzanine setup

- Make sure the DTB environment is set with **imx8mq-thor96-ap1302-ar0430.dtb**
- Power up the board and go to terminal of x86 host system and open board's console
- Hold boot on u-boot screen by pressing any key on host machine keyboard (immediate after boot within 3 seconds)
- Set DTB environment to **imx8mq-thor96-ap1302-ar0430.dtb** using following command:

```
$ u-boot > setenv fdt_file imx8mq-thor96-ap1302-ar0430.dtb
$ u-boot > saveenv
$ u-boot > boot
```

- From HDMI display, open command prompt of the target
- Then apply below command in the command prompt of the target.

```
$ gst-launch-1.0 v4l2src device=/dev/video0 ! glimagesink render-rectangle='<0, 0, 1920, 1080>'
sync=false
```

- And user will be able to see camera live stream on HDMI display as following:



Figure 5: AR0430 Live stream in HDMI Display

3.2 Live stream of ARX3A0 Camera on HDMI display

- To watch live stream over the HDMI, connect HDMI Display, USB keyboard and Mouse to THOR96 board
- Attach **SRT-Vision96-ARX3A0 mezzanine (AP-vision-ARX3A0)** camera mezzanine module to high-speed expansion connector as shown in the following Figure:

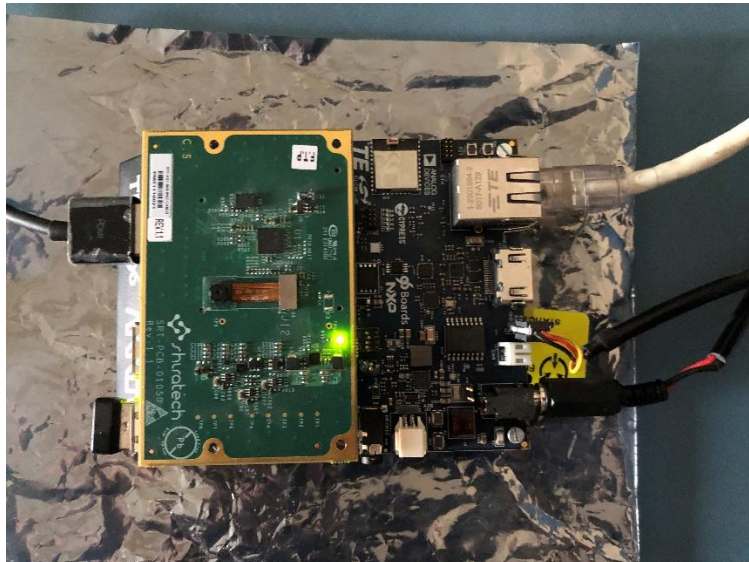


Figure 6 : THOR96 SRT-Vision-ARX3A0 mezzanine setup

- Make sure the DTB environment is set with **imx8mq-thor96-ap1302-arx3a0.dtb**

- Power up the board and go to terminal of x86 host system and open board's console
- Hold boot on u-boot screen by pressing any key on host machine keyboard (immediate after boot within 3 seconds)
- Set DTB environment to **imx8mq-thor96-ap1302-arx3a0.dtb** using following command:

```
$ u-boot > setenv fdt_file imx8mq-thor96-ap1302-arx3a0.dtb  
$ u-boot > saveenv  
$ u-boot > boot
```

- From HDMI display, open command prompt of the target
- Then apply below command in the command prompt of the target.

```
$ gst-launch-1.0 v4l2src device=/dev/video0 ! glimagesink render-rectangle='<0, 0, 1920, 1080>' sync=false
```

- And user will be able to see camera live stream on HDMI display as following:



Figure 7 : ARX3A0 Live Stream on HDMI Display

3.3 Validation of ISP controlled feature of AP1302:

User can check the available v4l2 controls related to the camera from the user space using the below command:

```
root@imx8mqthor96:~# v4l2-ctl -L
```

User Controls

```
brightness 0x00980900 (int) : min=256 max=65535 step=256 default=256 value=256
contrast 0x00980901 (int) : min=256 max=65535 step=256 default=256 value=256
saturation 0x00980902 (int) : min=256 max=65535 step=256 default=4096 value=4096
gamma 0x00980910 (int) : min=256 max=65535 step=256 default=4096 value=4096
exposure 0x00980911 (int) : min=0 max=12 step=1 default=12 value=12
gain 0x00980913 (int) : min=256 max=65535 step=256 default=256 value=256
```

Camera Controls

```
white_balance_auto_preset 0x009a0914 (menu) : min=0 max=1 default=1 value=1
    0: Manual
    1: Auto
```

User will be able to get and set the values for each of the controls using following format.

- To get control value, Run the following command:

```
$ v4l2-ctl --get-ctrl <control_name>
```

- To set control value, Run the following command:

```
$ v4l2-ctl --set-ctrl <control_name> =<control_value>
```

3.3.1 Resolution, FPS and Data format

User can check the current resolution, FPS and data format of AP1302 using the following command.

```
$ v4l2-ctl --list-formats-ext -d /dev/video0
ioctl: VIDIOC_ENUM_FMT
    Type: Video Capture

    [0]: 'UYVY' (UYVY 4:2:2)
        Size: Discrete 2316x1746
        Interval: Discrete 0.033s (30.000 fps)
```



Note: Above output for Resolution, FPS and Data format is taken using AR0430 Camera sensor.

3.3.2 Brightness

- To get the brightness value, Run the following command:

```
$ v4l2-ctl --get-ctrl brightness
```

- To set the brightness value, Run the following command:

```
$ v4l2-ctl --set-ctrl brightness=4096
```

3.3.3 Contrast

- To get the brightness value use the following command

```
$ v4l2-ctl --get-ctrl contrast
```

- To set the brightness value use the following command

```
$ v4l2-ctl --set-ctrl contrast=4096
```

3.3.4 Saturation

- To get the saturation value use the following command

```
$ v4l2-ctl --get-ctrl saturation
```

- To set the saturation value use the following command

```
$ v4l2-ctl --set-ctrl saturation=4096
```

3.3.5 Gamma

- To get the saturation value use the following command

```
$ v4l2-ctl --get-ctrl gamma
```

- To set the gamma value use the following command

```
$ v4l2-ctl --set-ctrl gamma=4096
```

3.3.6 Exposure

- To get the exposure value use the following command

```
$ v4l2-ctl --get-ctrl exposure
```

- To set the exposure value use the following command

```
$ v4l2-ctl --set-ctrl exposure=1
```

3.3.7 Gain

- To get the gain value use the following command

```
$ v4l2-ctl --get-ctrl gain
```

- To set the gain value use the following command

```
$ v4l2-ctl --set-ctrl gain=4096
```

3.3.8 White Balance

- To get the White balance value use the following command

```
$ v4l2-ctl --get-ctrl white_balance_auto_preset
```

- To set the White balance value use the following command

```
$ v4l2-ctl --set-ctrl white_balance_auto_preset =1
```

4 LIMITATION

- Thor96 Board is not supporting VGA resolution (560x560), so it is not validated with ARX3A0 camera sensor.