UG10244

EXPI-OS08A20 Camera Module on FRDM-IMX Series Boards

Rev. 1.1 — 8 October 2025 User guide

Document information

Information	Content
Keywords	UG10244, OS08A20 sensor, i.MX 8M Plus Image Signal Processor (ISP), FRDM-IMX8MPLUS board
Abstract	This document describes the procedures for using the OS08A20 sensor with FRDM-IMX series boards, including steps for building the NXP kernel and related files, and enabling the ISP and camera module.

1 Introduction

This document describes the steps for using the EXPI-OS08A20 camera module on the i.MX 8M Plus ISP module. It describes the steps for building the NXP kernel and related files, and enabling the ISP and camera module on the FRDM-IMX series boards.

2 EXPI-OS08A20 camera module and board

This section describes the EXPI-OS08A20 camera module and its hardware parameters.

2.1 EXPI-OS08A20 camera module

Figure 1 shows the top and bottom view of the EXPI-OS08A20 camera module.

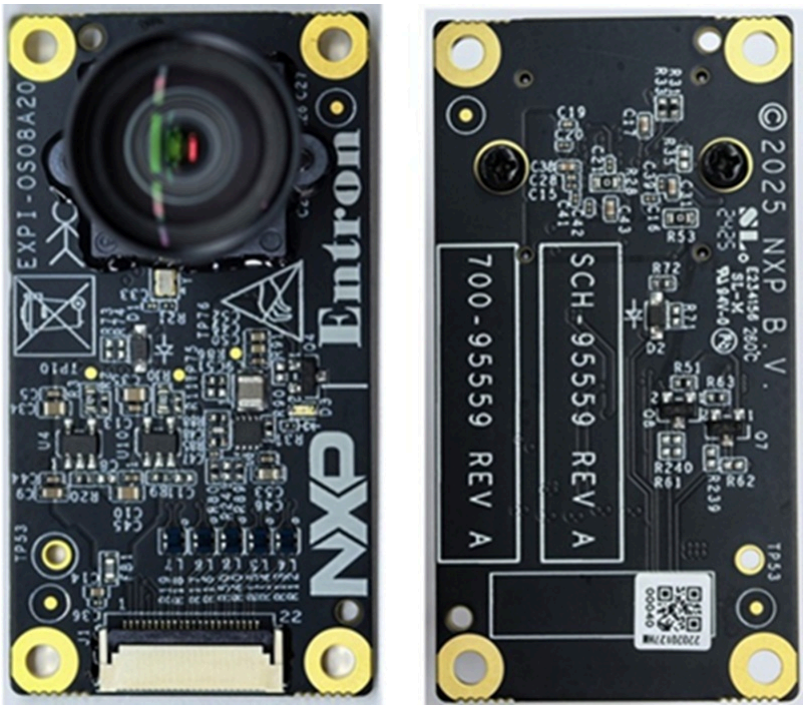

Figure 1. EXPI-OS08A20 camera module

The OS08A20 sensor supports image sizes of 4K, 2K, 1080p, and 720p. The output format is 12-bit/10-bit RAW RGB. The sensor has two-exposure staggered HDR and it supports the frame start input.

Features of the ISP on OS08A20 sensor are as follows:

- ISP supports dual OS08A20 modules
- ISP supports three ISP output formats:
  - YUV422
  - NV16
  - NV12
- ISP supports four sensor modes:
  - 1920 ×1080 10-bit linear mode
  - 1920 × 1080 10-bit HDR mode
  - 3840 × 2160 12-bit linear mode
  - 3840 × 2160 10-bit HDR mode

2.2 Block diagram

Figure 2 shows the EXPI-OS08A20 camera module block diagram.

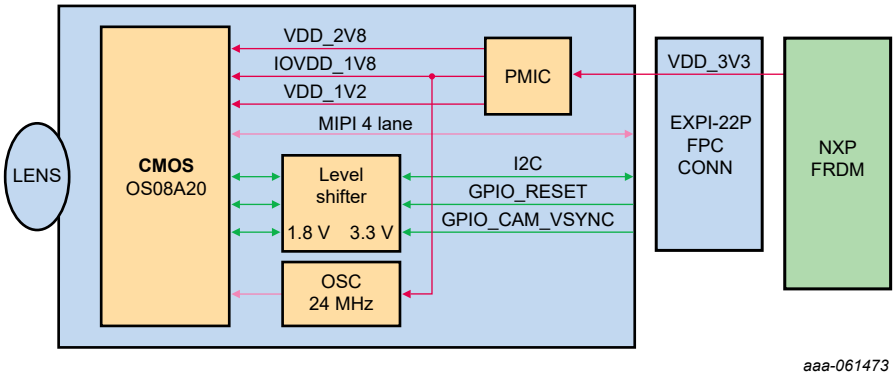

Figure 2. EXPI-OS08A20 camera module block diagram

2.3 Board features

Table 1 lists the features of the EXPI-OS08A20 camera module.

Table 1. EXPI-OS08A20 camera module features

Board feature	Target processor feature used	Description
FPC interface	-	-
Power	3.3 V	The module is powered by 3.3 V from the motherboard
I2C	I2C	• The motherboard configures the camera module through the I2C interface. • The onboard level shifter matches the I2C signal levels on both sides.
MIPI CSI	MIPI CSI	• Compliant with MIPI CSI-2 specification v1.2. • Equipped with four MIPI CSI data lanes and one clock lane.
H_RST_B	GPIO	Reset signal for the camera module
H_VSYNC	GPIO	Vertical sync signal for the camera module

2.4 Lens features

Table 2 shows the depth of field (DOF) measurements, for the YT-3560-H1 camera lens with OS08A20 sensor at various object distances.

Note: *The row highlighted shows the factory default setting. The object distance is 2.20 m with DOF ranging from 1.257 m to 8.802 m (total DOF is 7.545 m).*

Table 2. YT-3560-H1 with OS08A20 depth of field

Object distance (m)	DOF far-limit (m)	DOF near-limit (m)	DOF length (m)
50.00	∞	2.76	∞

Table 2. YT-3560-H1 with OS08A20 depth of field*...continued*

Object distance (m)	DOF far-limit (m)	DOF near-limit (m)	DOF length (m)
40.00	∞	2.73	∞
30.00	∞	2.67	∞
20.00	∞	2.55	∞
10.00	∞	2.26	∞
9.00	∞	2.21	∞
8.00	∞	2.14	∞
7.00	∞	2.06	∞
6.00	∞	1.968	∞
5.00	∞	1.847	∞
4.00	∞	1.691	∞
3.00	∞	1.483	∞
2.50	16.959	1.349	15.609
2.40	13.217	1.320	11.897
2.30	10.660	1.289	9.371
2.20	8.802	1.257	7.545
2.10	7.391	1.224	6.167
2.00	6.283	1.189	5.094
1.90	5.391	1.153	4.237
1.80	4.655	1.116	3.540
1.70	4.040	1.077	2.963
1.60	3.517	1.036	2.481
1.50	3.066	0.993	2.074
1.40	2.675	0.948	1.727
1.30	2.332	0.901	1.431
1.20	2.028	0.852	1.176
1.10	1.758	0.801	0.957
1.00	1.515	0.746	0.769
0.90	1.296	0.689	0.607
0.80	1.098	0.629	0.469
0.70	0.918	0.566	0.352
0.60	0.753	0.499	0.254
0.50	0.602	0.428	0.174
0.40	0.462	0.352	0.110
0.30	0.334	0.273	0.061
0.20	0.214	0.188	0.027
0.10	0.103	0.097	0.006

Table 2. YT-3560-H1 with OS08A20 depth of field*...continued*

Object distance (m)	DOF far-limit (m)	DOF near-limit (m)	DOF length (m)
0.00	0.000	0.000	0.000

2.5 Functional parameters

Table 3 lists the parameters of the EXPI-OS08A20 camera module.

Table 3. EXPI-OS08A20 camera module parameters

Hardware specification		
Image sensor	Part Number	OS08A20-H92A-IC
	Type	Rolling Shutter RGB Bayer Sensor
	Manufacturer	Omnivision
	Output pixels	4K (3840 × 2160 2 µm × 2 µm)
	I2C	0 × 6C(W)/0 × 6D(R)
	Max frame rate	4K at 60 FPS
	Max S/N ratio	39 dB
	Dynamic range	74 dB at 16× gain
	Temperature	-30 ℃ to + 85 ℃
LENS	FOV (adaptive OS08A20)	HFOV = 74 ℃ ± 3 ℃ VFOV = 45 ℃ ± 3 ℃ DFOV = 82 ℃ ± 3 ℃
	Aperture	F2.4 ± 5 %
	Construction	8 Glass + 1 IR
	Focusing range	1.32 m - 13.22 m (at 2.4 m)
	TV distortion	< - 1.4 %

2.6 Connectors

The camera module contains a 22-pin FPC connector (J1) to interface with other boards.

Note: *The FRDM-IMX8MPLUS board provides two MIPI CSI connectors (J13 and J14), allowing connection of up to two EXPI-OS08A20 camera modules.*

2.7 LEDs

The camera module contains one light-emitting diode (LED). Table 4 describes the usage of the LED.

Table 4. EXPI-OS08A20 camera module LED

Part identifier	LED color	LED name	Description (when LED in ON)
D3	Green	Power LED	Indicates that the VCC_3V3 power supply is available. ***Note:*** *VCC_3V3 is supplied to the EXPI-OS08A20 camera module through the 22-pin FPC cable.*

2.8 Power supply

The EXPI-OS08A20 camera module receives the VCC_3V3 supply when connected via one or more MIPI CSI connectors to an FRDM-IMX series board.

One DC buck switching regulator and two low dropout regulators are used:

- The onboard Step-Down DC-DC (U8) converts the VCC_3V3 power supply to VDD_1V2 supply.
- The onboard LDO (U4) converts the VCC_3V3 power supply to VDD_2V8 supply.
- The onboard LDO (U10) converts the VCC_3V3 power supply to IOVDD_1V8 supply.

Table 5 describes different power sources available on the board.

Table 5. EXPI-OS08A20 camera module power sources

Part identifier	Manufacturing part number and manufacturer	Power supply	Description
U4	RT9053AGB	VDD_2V8	Supplies power to: • OS08A20 sensor (U2)
U10	RT9053AGB	IOVDD_1V8	Supplies power to: • OS08A20 sensor (U2) • 24 MHz crystal oscillator (Y1)
U8	MAX20071ATAA	VDD_1V2	Supplies power to: • OS08A20 sensor (U2) • Controls N-channel MOSFET NX3008NBK (Q4)

2.9 Clock

The EXPI-OS08A20 camera module has one crystal oscillator (Y1) that generates the CAM_MCLK clock (24 MHz) for the OS08A20 sensor.

2.10 22-pin FPC/FFC interface

The EXPI-OS08A20 camera module features a 22-pin FPC/FFC connector (J1), which can be interfaced with the FRDM board. The connector's pinout aligns with the 22-pin MIPI-CSI camera connector standard.

Table 6 provides pinout detail.

Table 6. 22-pin FPC/FFC interface definition

Pin number	Net name	Description
1	VDD_3V3	3.3 V power input/output
2	MIPI_CSI_I2C_SDA_3V3	I2C SDA signal
3	MIPI_CSI_I2C_SCL_3V3	I2C SCL signal
4	GND	Ground
5	H_VSYNC	Vertical sync signal for the camera module
6	H_RST_B	Reset signal for the camera module
7	GND	Ground

Table 6. 22-pin FPC/FFC interface definition*...continued*

Pin number	Net name	Description
8	MIPI_CSI_DATA3_P	MIPI serial data, lane 3, differential P
9	MIPI_CSI_DATA3_N	MIPI serial data, lane 3, differential N
10	GND	Ground
11	MIPI_CSI_DATA2_P	MIPI serial data, lane 2, differential P
12	MIPI_CSI_DATA2_N	MIPI serial data, lane 2, differential N
13	GND	Ground
14	MIPI_CSI_CLK_P	MIPI serial clock differential P
15	MIPI_CSI_CLK_N	MIPI serial clock differential N
16	GND	Ground
17	MIPI_CSI_DATA1_P	MIPI serial data, lane 1, differential P
18	MIPI_CSI_DATA1_N	MIPI serial data, lane 1, differential N
19	GND	Ground
20	MIPI_CSI_DATA0_P	MIPI serial data, lane 0, differential P
21	MIPI_CSI_DATA0_N	MIPI serial data, lane 0, differential N
22	GND	Ground

Note: *For more information about the EXPI-OS08A20 sensor module, refer to www.nxp.com/EXPI-OS08A20.*

3 Hardware setup

This section describes how a connection can be established between with the EXPI-OS08A20 camera module and FRDM-IMX series boards.

3.1 FRDM-IMX8MPLUS board

To set up the hardware connection between the EXPI-OS08A20 camera module and FRDM-IMX8MPLUS board, see Section 3.1.1 "Boot mode and boot device configuration" and Section 3.1.2 "Connect EXPI-OS08A20 camera module and FRDM-IMX8MPLUS board".

Figure 3 shows the FRDM-IMX8MPLUS board.

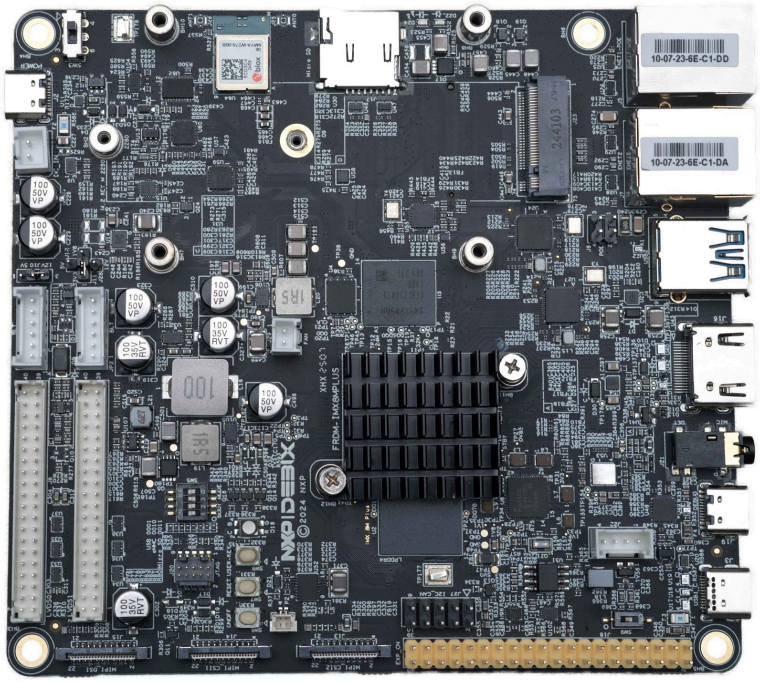

Figure 3. FRDM-IMX8MPLUS board

Note: *For more information about the FRDM-IMX8MPLUS board, refer to FRDM-IMX8MPLUS.*

3.1.1 Boot mode and boot device configuration

The i.MX 8M Plus processor offers multiple boot configurations, selectable by SW5 on the FRDM-IMX8MPLUS board. In addition, the i.MX 8MP can download a program image from a USB connection when configured in serial download mode. The four dedicated boot mode pins are used to select the various boot modes.

Table 7 describes the SW5 values used in different boot modes.

Table 7. SW5 boot mode settings

SW5[1:4]	BOOT_MODE[3:0]	Boot core	Boot device
0001	0001	Cortex-A	Serial downloader (USB)
0010	0010		uSDHC1 8-bit eMMC 5.1
0011	0011		uSDHC2 4-bit SD 3.0

On the FRDM-IMX8MPLUS board, the default boot mode is an eMMC device. The other boot device is the microSD connector.

- To choose uSDHC1 (eMMC) as the boot device, set SW5[1:4] as "0010".
- To choose uSDHC2 (SD), set SW5[1:4] as "0011".
- To enter the USB serial download, set SW5[1:4] as "0001".

3.1.2 Connect EXPI-OS08A20 camera module and FRDM-IMX8MPLUS board

This sensor is designed for maximum flexibility in hardware and software development. The FPC connector can be connected on both top and bottom sides for compatibility with different usages. For FPC cables, the following two types are available:

- Same-side contacts
- Opposite-side contacts

To ensure that the power supply is not reversed, check the schematic and PCB layout before connecting the FPC cable.

Figure 4 illustrates the connection between the EXPI-OS08A20 camera module and the FRDM-IMX8MPLUS board using a same-side contacts FPC cable.

Note: *Pin 22 on the camera module's FPC connector connects to Pin 1 of the FRDM-IMX8MPLUS board FPC connector (J14).*

Figure 4. Single sensor connector setup

4 Software setup

This section describes how to set up the software for the EXPI-OS08A20 camera module.

4.1 Set up OS08A20 sensor on FRDM-IMX8MPLUS board

To set up the OS08A20 sensor, follow the steps below:

1. Section 4.1.1 "Download a prebuilt image"
2. Section 4.1.2 "Update prebuilt image to FRDM-IMX8MPLUS board"

3. Section 4.1.3 "Running EXPI-OS08A20 camera module on FRDM-IMX8MPLUS board"

4.1.1 Download a prebuilt image

The latest prebuilt images for the FRDM-IMX8MPLUS board are available on the FRDM-IMX8MP Demo Images.

An SD card image file (with the *.wic or *.wic.zst) contains a partitioned image (with U-Boot, kernel, rootfs, and so on) suitable for booting the corresponding hardware.

4.1.2 Update prebuilt image to FRDM-IMX8MPLUS board

The method used to update the image varies depending on the boot source. The official UUU tool or third-party software can be used, depending on system requirements and preferences.

Table 8 outlines the differences in capabilities between these options.

Table 8. Flash tool compatibility

Boot sources/Flash tools	UUU	Third-party flash tool
eMMC	Support	No
SD	Support	Support

The following steps explain how to boot from eMMC and SD card using the official UUU tool with a prebuilt image. For other methods, refer *i.MX FRDM Software User Guide* (document UG10195).

1. Download UUU version 1.2.39 or higher from https://github.com/nxp-imx/mfgtools/releases.
2. Connect a USB cable from a computer to the board USB OTG/Type C port for downloading.
   On FRDM-IMX8MPLUS, the USB OTG port is labeled 'USB1_C'. To enable debug message output, connect a USB cable from the USB Type-C connector labeled 'DEBUG' to your host computer.
3. Set the boot pin to Serial download mode.
   Table 9 shows the boot switch settings for FRDM-IMX8MPLUS to enter Serial download mode.

   Table 9. Set up download mode for FRDM-IMX8MPLUS

Switch Name	D1	D2	D3	D4
SW5	0	0	0	1

4. Burn the image:
   - To update prebuilt image to SD card, run the following command:

     ```
     uuu -b sd_all imx-boot-imx8mpfrdm.bin imx-image-full-imx8mpfrdm.rootfs.wic
     ```

   - To update prebuilt image to eMMC, run the following command:

     ```
     uuu -b emmc_all imx-boot-imx8mpfrdm.bin imx-image-full-imx8mpfrdm.rootfs.wic
     ```

5. To boot the board, change the boot switch to eMMC/SD boot mode and reset the board.

   Table 10. Set up SD Boot mode for FRDM-IMX8MPLUS

Switch name	D1	D2	D3	D4
SW5	0	0	1	1

Table 11. Set up eMMC Boot mode for FRDM-IMX8MPLUS

Switch name	D1	D2	D3	D4
SW5	0	0	1	0

4.1.3 Running EXPI-OS08A20 camera module on FRDM-IMX8MPLUS board

This section explains how to configure the device tree, set sensor modes, and run the EXPI-OS08A20 camera module for the EXPI-OS08A20 camera module on the FRDM-IMX8MPLUS board.

1. To select a device tree, perform the following steps:
   - `imx8mp-frdm-os08a20.dtb`: Single OS08A20 sensor connected to CSI-1.
   - `imx8mp-frdm-dual-os08a20.dtb`: Dual OS08A20 connected to CSI-1 and CSI-2.

```
u-boot=> setenv fdtfile imx8mp-frdm-os08a20.dtb
u-boot=> saveenv
Saving Environment to MMC... Writing to MMC(2)... OK
u-boot=> boot
```

2. Check that the subdev and video nodes are correct:

```
root@imx8mpfrdm:~# ls /dev
… v4l-subdev0    …     video3
… v4l-subdev1    …
… v4l-subdev2    .
… v4l-subdev3

root@imx8mpfrdm:~# cat /sys/class/video4linux/video3/name
viv_v4l20
```

3. Select Sensor mode. Modify the mode parameter after `run.sh -c`, with one of parameters in Table 12/Table 13 in branch `$NR_DEVICE_TREE_OS08A20` in `start_isp.sh`.
   Save modification and restart ISP service or reboot the board for mode changing.

```
root@imx8mpfrdm:~# cd /opt/imx8-isp/bin/
root@imx8mpfrdm:/opt/imx8-isp/bin# vi start_isp.sh
root@imx8mpfrdm:/opt/imx8-isp/bin# systemctl restart  imx8-isp.service
```

Table 12. Start_isp.sh mode parameters of single sensor table

Mode	Parameter	Data format
1080p_linear	OS08A20_1080p60	RAW10
1080p_hdr0	OS08A20_1080p30hdr	RAW10
4K_linear	OS08A20_4K	RAW12
4K_hdr	OS08A20_4Khdr	RAW10

```
# check if the os08a20 device has been enabled in the device tree
elif [ $NR_DEVICE_TREE_OS08A20 -eq 1 ]; then

        echo "Starting isp_media_server for Single os08a20"

        cd $RUNTIME_DIR

        if [ $NR_DEVICE_TREE_OV5640 -eq 0 ]; then

                # Default configuration for Os08a20: Os08a20_4k
                # Available configurations: Os08a20_4k, Os08a20_1080p60, Os08a20
                exec ./run.sh -c os08a20_4k -lm

        elif [ $NR_DEVICE_TREE_OV5640 -eq 1 ]; then

                # Default configuration for Os08a20: Os08a20_1080p60
                # Available configurations: Os08a20_1080p60, Os08a20_1080p30hdr
                exec ./run.sh -c os08a20_1080p60 -lm
        fi
```

Figure 5. Single sensor parameters in start_isp.sh

Table 13. Start_isp.sh mode parameters of dual sensor table

Mode	Parameter	Data format
Dual 1080p_linear	dual_OS08A20_1080p60	RAW10
Dual 1080p_hdr0	dual_OS08A20_1080p30hd	RAW10

```
elif [ $NR_DEVICE_TREE_OS08A20 -eq 2 ]; then

        echo "Starting isp_media_server for Dual os08a20"

        cd $RUNTIME_DIR
        # Default configuration for Os08a20: dual_Os08a20_1080p60
        # Available configurations: dual_Os08a20_1080p60, dual_Os08a20_1080p30hd
        exec ./run.sh -c dual_os08a20_1080p60 -lm
```

Figure 6. Dual sensor parameters in start_isp.sh

4. Run a sensor module test case:
   - Single sensor:
     - Mode 0: 1080p linear

```
$ gst-launch-1.0 -v v4l2src device=/dev/video3 ! "video/
xraw,format=YUY2,width=1920,height=1080" ! queue ! waylandsink
```

     - Mode 1: 1080p HDR

```
$ gst-launch-1.0 -v v4l2src device=/dev/video3 ! "video/
xraw,format=YUY2,width=1920,height=1080" ! queue ! waylandsink
```

     - Mode 2: 4K linear

```
$ gst-launch-1.0 -v v4l2src device=/dev/video3 ! "video/
xraw,format=YUY2,width=3840,height=2160" ! queue ! waylandsink
```

     - Mode 3: 4K HDR

```
$ gst-launch-1.0 -v v4l2src device=/dev/video3 ! "video/
xraw,format=YUY2,width=3840,height=2160" ! queue ! waylandsink
```

   - Dual sensor:
     - Mode 0: Dual 1080p linear

```
$ gst-launch-1.0 -v v4l2src device=/dev/video3 ! "video/
xraw,format=YUY2,width=1920,height=1080" ! queue ! waylandsink window-
width=640
window-height=480 --no-position &
```

```
$ gst-launch-1.0 -v v4l2src device=/dev/video4 ! "video/
xraw,format=YUY2,width=1920,height=1080" ! queue ! waylandsink window-
width=640
window-height=480 --no-position &
```

– Mode 1: Dual 1080p HDR

```
$ gst-launch-1.0 -v v4l2src device=/dev/video3 ! "video/
xraw,format=YUY2,width=1920,height=1080" ! queue ! waylandsink window-
width=640
window-height=480 --no-position &
$ gst-launch-1.0 -v v4l2src device=/dev/video4 ! "video/
xraw,format=YUY2,width=1920,height=1080" ! queue ! waylandsink window-
width=640
window-height=480 --no-position &
```

5. Tune xml files at `/opt/imx8-isp/bin` of EXPI-OS08A20 camera module.

Table 14. Tuning files of module

XML file	Description
`OS08A20_8M_10_1080P_linear.xml`	1080p linear tuning parameters
`OS08A20_8M_10_1080P_hdr.xml`	1080p HDR tuning parameters
`OS08A20_8M_10_4K_linear.xml`	4K linear tuning parameters
`OS08A20_8M_10_4K_hdr.xml`	4K HDR tuning parameters

6. Dewarp configure files at `/opt/imx8-isp/bin/dewarp_config` of EXPI-OS08A20 module.

Table 15. Dewarp configure files of module

Dewarp configure files	Description
`sensor_dwe_os08a20_1080P_config.json`	Dewarp configure in 1080p resolution.
`sensor_dwe_bypass_1080P_config.json`	Dewarp bypass in 1080p resolution.
`sensor_dwe_os08a20_4K_config.json`	Dewarp configure in 4K resolution.
`sensor_dwe_bypass_4K_config.json`	Dewarp bypass in 4K resolution.

5 Acronyms

Table 16 lists the acronyms used in this document.

Table 16. Acronyms

Term	Description
CSI	Camera Serial Interface
DOF	Depth of Field
DFOV	Diagonal Field of View
DTB	Device Tree Blob
eMMC	Embedded Multimedia Card
FFC	Flexible Flat Cable
FOV	Field of View

Table 16. Acronyms...*continued*

Term	Description
FPC	Flexible Printed Circuit
GPIO	General-Purpose Input/Output
HDR	High Dynamic Range
HFOV	Horizontal Field of View
I2C	Inter-Integrated Circuit
ISP	Image Signal Processor
LDO	Low Dropout Regulator
LED	Light-Emitting Diode
MIPI	Mobile Industry Processor Interface
OTG	On-The-Go
PMIC	Power Management Integrated Circuit
SD	Secure Digital
USB	Universal Serial Bus
uSDHC	Ultra Secure Digital Host Controller
UUU	Universal Update Utility
VFOV	Vertical Field of View

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7 Revision history

Table 17 summarizes the revisions to this document.

Table 17. Revision history

Document ID	Release date	Description
UG10244 v.1.1	08 October 2025	• Updated web link for EXPI-OS08A20 sensor module in Section 2.10 "22-pin FPC/FFC interface" • Updated Section 5 "Acronyms" • Updated Figure 2
UG10244 v.1.0	17 September 2025	Initial public release

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