CAM-IMX585-Mono / CAM-IMX585-Color

User Manual

8.3MP 4K MIPI Camera Module — Sony IMX585 Starvis 2

Raspberry Pi 5 · NVIDIA Jetson Orin Nano

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1. Product Overview

The **CAM-IMX585-Mono** and **CAM-IMX585-Color** are professional-grade MIPI camera modules built on the Sony IMX585 Starvis 2 back-illuminated CMOS sensor. The Mono variant delivers enhanced low-light sensitivity and near-infrared response; the Color variant provides full RGB imaging with the same 8.3MP 4K resolution.

Both models connect via a 4-lane MIPI CSI-2 interface and are supported on **Raspberry Pi 5** and **NVIDIA Jetson Orin Nano**. An on-board **FT24C02A EEPROM** (256 bytes, I2C 0x50) is available for calibration data storage.

1.1 Key Features

Feature	Details
Sensor	Sony IMX585 (Mono / Color) — Starvis 2 back-illuminated
Resolution	8.3MP — 3840 × 2160 (4K UHD)
Optical Format	1/1.2”
Pixel Size	2.9 µm × 2.9 µm
RAW Output	10 / 12 / 16-bit (driver-dependent)
Interface	MIPI CSI-2 4-lane, 1.5 Gbps/lane, 22-pin FPC
Lens Mount	CS-mount / M12
Dimensions	38 mm × 38 mm
EEPROM	FT24C02A, 256 bytes, I2C 0x50
Supported Platforms	Raspberry Pi 5 · NVIDIA Jetson Orin Nano

1.2 Industry Applications

- Security & Surveillance — 24/7 monitoring, near-IR night vision (Mono)
- Industrial & Machine Vision — AOI, robotics, precision inspection
- Broadcast & ProAV — live streaming, drone cameras
- Scientific & Medical — microscopy, diagnostics, high-DR imaging
- Automotive — ADAS, surround-view

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2. Video Modes

Normal SDR

Resolution	Frame Rate	Format	Notes
1928 × 1090	60 fps	R12_CSI2P	1080p cropped
3856 × 2180	30 fps	R12_CSI2P	4K all-pixel

ClearHDR

ClearHDR is enabled via the `wide_dynamic_range` V4L2 control (no reboot required).

Resolution	Frame Rate	Format	Media-bus Code	Notes
3856 × 2180	~22 fps	16-bit linear	SRGGB16 / Y16	Smoothest gradation; manual exposure required
3856 × 2180	~22 fps	12-bit CCMP	SRGGB12 / Y12	Wide range compressed to 12-bit; AGC works

> ClearHDR halves the frame rate (VMAX ×2) and reduces the maximum analogue gain to 80. Use `v4l2-ctl --list-ctrls` for live values.

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3. ClearHDR Overview

ClearHDR is the IMX585 sensor's built-in **single-frame wide dynamic range** feature, based on **Dual Conversion Gain (DCG)**. A single exposure is read out simultaneously at High Gain (HG) and Low Gain (LG) and combined inside the sensor — no motion artifacts, no multi-frame blending.

Compared with conventional two-frame alternating (DOL) HDR:

- **Single-exposure combination** — HG and LG come from the same exposure, so there are no motion artifacts. Suitable for scenes with movement.
- **Significantly wider dynamic range** — highlights preserved by LG, shadows lifted by HG (with an extra +12 dB by default).

When ClearHDR is enabled, the driver automatically adjusts the following operating points:

Item	Normal SDR	ClearHDR
WDMODE (0x301a)	Normal (0x00)	Clear HDR (0x10)
Max analogue gain	240	**80**
Max exposure (lines)	set by VMAX	**4484**
VMAX (frame length)	base	**×2** (frame rate halved)
pixel_rate	base	**halved**
Min SHR	8	**16**
Frame rate (4K all-pixel)	30 fps	**~22 fps**

Default Output: 16-bit Linear

When ClearHDR is enabled, libcamera **defaults to 16-bit linear output** (SRGGB16 / Y16). This provides the smoothest highlight gradation, but ISP statistics are not valid at 16-bit — **manual exposure is required**.

Alternative: 12-bit CCMP

For plug-and-play auto-exposure, the **12-bit CCMP output** (SRGGB12 / Y12) compresses the wide dynamic range back into 12-bit, making AGC statistics valid. This is the recommended mode when manual exposure control is not desired.

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4. Raspberry Pi 5 — Installation

Platform: Raspberry Pi 5 (rp1-cfe + PiSP), kernel 6.12.x, 64-bit (aarch64).

Two installation options are available. Both support the full feature set including ClearHDR.

Option	Method	Best For
Pre-compiled packages	Extract + run `install.sh`	Quick setup on a supported OS/kernel version
Offline source compilation	Build from pkg1 + pkg2	Any kernel version; custom builds

4.1 Pre-compiled Driver (Recommended)

Pre-compiled packages are in `raspberry_pi_driver/precompiler-driver/`. Each package is named with the target OS, platform, and kernel version. Verify your system version before installation:

```
cat /etc/os-release    # check OS version
uname -r               # check kernel version
```

Extract and install the matching package:

```
tar -xzf <package>.tar.gz
chmod +x install.sh
sudo ./install.sh
```

4.2 Offline Source Compilation

Step 1 — Kernel driver (`pkg1-imx585-driver-v1.0-6.12y-offline.tar.gz`):

```
tar -xzf pkg1-imx585-driver-v1.0-6.12y-offline.tar.gz
cd pkg1-imx585-driver
chmod +x install.sh
sudo ./install.sh
```

`install.sh` builds `imx585.ko` , clears stale shadow modules, installs the device-tree overlay, and configures `config.txt` automatically.

Step 2 — libcamera + rpicam-apps (`pkg2-rpicam-libcamera-offline.tar.gz`):

```
tar -xzf pkg2-rpicam-libcamera-offline.tar.gz
cd pkg2-rpicam-offline
chmod +x build.sh
sudo ./build.sh           # Full mode (~30-40 min)
sudo ./build.sh --lite    # Lite mode (~15-20 min)
```

4.3 Device-tree Options

Edit `/boot/firmware/config.txt` (Pi 5) or `/boot/config.txt` (older Pi OS) and reboot:

```
camera_auto_detect=0
dtoverlay=imx585              # default: CAM1, color
dtoverlay=imx585,cam0         # use the CAM0 port
dtoverlay=imx585,mono         # monochrome sensor variant
dtoverlay=imx585,2lane        # 2-lane wiring (default is 4-lane)
dtoverlay=imx585,cam0,mono    # options combine freely
```

4.4 Verify the Camera

After rebooting:

```
modinfo -F filename imx585      # must NOT resolve to a .ko.xz
dmesg | grep imx585
rpicam-hello --list-cameras
rpicam-hello -t 0               # live preview (color)
rpicam-hello -t 0 --tuning-file /usr/local/share/libcamera/ipa/rpi/pisp/imx585_mono.json
```

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5. Raspberry Pi 5 — ClearHDR Quick Start

5.1 Helper Script

A helper script `clearhdr.sh` is included in the driver package:

```
./clearhdr.sh on        # enable ClearHDR
./clearhdr.sh off       # back to normal SDR
./clearhdr.sh status    # current state + exposure/gain ranges
./clearhdr.sh preview   # enable ClearHDR and preview with recommended baseline
```

For a mono camera:

```
TUNING=/usr/local/share/libcamera/ipa/rpi/pisp/imx585_mono.json ./clearhdr.sh preview
```

5.2 Manual Enable / Disable

Locate the IMX585 subdevice node (usually `/dev/v4l-subdev2`):

```
for s in /dev/v4l-subdev*; do
  v4l2-ctl -d "$s" --list-ctrls 2>/dev/null | grep -q wide_dynamic_range && echo "$s"
done
```

Enable / disable:

```
v4l2-ctl -d /dev/v4l-subdev2 --set-ctrl wide_dynamic_range=1   # enable
v4l2-ctl -d /dev/v4l-subdev2 --set-ctrl wide_dynamic_range=0   # disable
v4l2-ctl -d /dev/v4l-subdev2 --get-ctrl wide_dynamic_range     # check state
```

5.3 Exposure Notes

In 16-bit ClearHDR, ISP auto-exposure (AGC) is not reliable — manual exposure is required. ClearHDR also

has a lower maximum exposure (~4484 lines). If `--shutter` exceeds this limit, the result is a fully black frame.

Recommended baseline:

```
rpicam-hello -t 0 --gain 80 --shutter 200 --awb auto
rpicam-still -t 1000 --gain 8 --shutter 2000 -r -o hdr16.dng
```

> If the image goes black, reduce `--shutter` (e.g. 200–2000 µs) first. For auto-exposure, use the **12-bit CCMP** output instead — statistics are valid and AGC works.

5.4 Advanced HDR Controls

Control	Type	Range	Default	Purpose
`wide_dynamic_range`	bool	0 / 1	0	ClearHDR master switch
`hdr_gain_adder_db`	menu	0–5	2 (+12 dB)	Extra HG gain over LG
`hdr_data_blending_mode`	menu	0–7	0	HG/LG blend ratio
`hdr_data_selection_threshold`	u16 ×2	0–4095	0	HG/LG selection threshold
`hdr_gradient_compression_thresh`	u32 ×2	0–131071	0	16-bit gradient-compression threshold
`exposure`	int	2–4484	19	Exposure in lines (ClearHDR range)
`analogue_gain`	int	0–80	0	Analogue gain (ClearHDR limit)

`hdr_gain_adder_db` values: 0 = +0 dB, 1 = +6 dB, 2 = +12 dB (default), 3 = +18 dB, 4 = +24 dB, 5 = +29.1 dB.

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6. NVIDIA Jetson Orin Nano — Installation

Driver packages for Jetson Orin Nano are in `jetson-orin-nano-driver/`. Two kernel versions are supported:

Kernel	Package	Availability
5.15.148-tegra (L4T R36.4.4)	`imx585_tegra_binary_1188_working_5.15.148_20260705_v2_0.tar.gz`	Available in repository
5.15.185-tegra	Contact sales	Contact sales@inno-maker.com

Check your kernel version with `uname -r` before selecting a package.

Installation:

```
tar -xzf imx585_tegra_binary_1188_working_5.15.148_20260705_v2_0.tar.gz
cd imx585_tegra_binary_1188_working_5.15.148_20260705_v2_0
sudo ./install_binary.sh
```

Configure CSI overlay with NVIDIA jetson-io:

```
sudo python3 /opt/nvidia/jetson-io/config-by-hardware.py -n '2=Camera IMX585 CAM0'
sudo reboot
```

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7. I2C Tools & EEPROM Access

The camera module includes an on-board **FT24C02A EEPROM** (256 bytes, I2C address 0x50) for storing calibration data. The `i2c-tools/` directory provides a Python utility (`i2c.py`) for reading, writing, and managing EEPROM data.

Which I2C bus to use on Raspberry Pi 5:

CSI Port	Bus Number
CAM1	`--bus 4`
CAM0	`--bus 6`

Quick start:

```
sudo python3 i2c-tools/i2c.py eeprom detect --bus 4
sudo python3 i2c-tools/i2c.py eeprom dump --bus 4 --out eeprom_backup.bin
sudo python3 i2c-tools/i2c.py eeprom read --bus 4 --chip 0x50 --offset 0 --length 16
```

For detailed usage, see `i2c-tools/README.md`.

8. Troubleshooting

Symptom	Cause	Fix
New driver has no effect after rebuild	Leftover `.ko.xz` shadow module loads instead	Use `./install.sh` (clears shadows); check `modinfo -F filename imx585` is not a `.ko.xz`
Fully black after enabling ClearHDR	`--shutter` exceeds ClearHDR exposure limit	Reduce `--shutter` (e.g. 200–2000 µs)
Preview starts fine, then goes dark	16-bit statistics invalid, AGC drives exposure dark	Use manual exposure `--gain` / `--shutter`
Color cast / greenish image	Mono camera using color tuning file	Add `--tuning-file .../imx585_mono.json`
`wide_dynamic_range` toggle has no effect	Wrong subdevice node	Use `./clearhdr.sh status` to find the correct `/dev/v4l-subdevN`
Gain / exposure cannot go higher	ClearHDR has lower limits (gain ≤ 80)	Expected limit — see Section 3

9. Preset OS Image

A pre-configured Raspberry Pi OS image with all drivers pre-installed is available:

Download: https://www.jianguoyun.com/p/DWqJpGAQpdSrBxil9p8GIAA

Password: `exgk55`

10. Support

- **Website**: www.inno-maker.com
- **Email**: support@inno-maker.com
- **Sales**: sales@inno-maker.com