ALP LAB

MIPI CSI-2 Camera Bring-up

AN-003 · E1M and E1M-X SoMs

Document Number: AN-003 **Revision:** 0.2 **Date:** June 2026 **Status:** Preliminary

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1 Scope

This application note covers bringing up a MIPI CSI-2 camera on the on-EVK CSI connector: configuring the on-module per-camera LDO, validating the lane routing, and reading the first frame through the SDK's `<alp/camera.h>` API.

Audience	Firmware engineers integrating a camera sensor into vision workloads.
Prerequisites	**QS-** guide completed, RPi-compatible MIPI camera module (e.g. RPi V2 or HQ camera).
Outcome	`ai-camera-viewer` running, streaming live frames to the display.
Time	20 minutes.
Source	`examples/camera-vision/ai-camera-viewer/` in alp-sdk.

Table 1 Scope summary

2 Hardware Setup

SoM family	CSI interfaces + LDO
E1M-AEN	1 × 2-lane CSI (`CSI0`). On-die Alif Ensemble ISP-Pico (VeriSilicon ISP Nano "Pico", DT compatible `vsi,isp-pico`) on E4 / E6 / E8 (not on E3 / E5 / E7). Per-camera LDO: `+V_CAM0` (`Z34`) + `CAM_VFB0` (`Z33`) divider.
E1M-X V2N / V2N-M1	2 × 4-lane CSI (`CSI0`, `CSI1`). On-module ISP. Per-camera LDOs: `+V_CAM0`…`+V_CAM3` with matching `CAM_VFBx` feedback divider.

Table 2 MIPI CSI-2 camera support per family

Place the feedback resistor pair (R1, R2) **close to the SoM `CAM_VFBx` pin**; long feedback traces invite oscillation. The output voltage is set by:

$$V_{\mathrm{CAM}} = 0.6\ \mathrm{V} \times \left(1 + \frac{R_1}{R_2}\right)$$

3 Software Walkthrough

```
west build -b <BOARD> examples/camera-vision/ai-camera-viewer
west flash
```

The example brings up `CSI0`, energises the per-camera LDO, opens an OV5640 stream at 240 × 240 RGB565 via `alp_camera_open()`, and renders the live preview to the display.

4 Expected Output

```
[cam] LDO0 -> 2.8 V (target 2.8 V, divider 220k/82k)
[cam] CSI0 link up, 2 lanes @ TBD Mbps
[cam] streaming 240x240 RGB565 @ 30 fps
```

5 Troubleshooting

- **LDO voltage off**: divider current too low; reduce R1 + R2 until divider current = 100 × worst-case feedback-pin current (see **DS-AEN-001 §7.8** formula).
- **No CSI link**: differential lanes swapped (P/N reversed) or trace impedance not 100 Ω differential.
- **Lane skew errors**: lane-to-lane length mismatch > TBD ps.

6 References

- **Example source**: `examples/camera-vision/ai-camera-viewer/` in alp-sdk; API in `include/alp/camera.h`. Silicon bring-up reg-checks: `examples/aen/aen-camera-regcheck/`, `examples/aen/aen-isp-regcheck/`.
- **Hardware Design Guides**: **HG-AEN-001** §5.5, **HG-V2N-001** §6.4 (MIPI CSI-2 routing rules).
- **Datasheet CSI-2 pin tables**: §2.3 in each datasheet.

7 Revision History

Revision	Changes	Date
0.1	Initial draft.	May 2026
0.2	Updated SDK references to current layout: example path `examples/camera-vision/ai-camera-viewer/`, added `include/alp/camera.h` and the `aen-camera-regcheck` / `aen-isp-regcheck` reg-checks; corrected the AEN on-die ISP to the Alif Ensemble ISP-Pico (`vsi`, `isp-pico`); aligned the stream config with the example (240×240 RGB565).	June 2026

Table 3 Revision History