ALP LAB

MIPI DSI Display + Backlight Bring-up

AN-004 · E1M and E1M-X SoMs

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1 Scope

Bring up an external MIPI DSI display from the SoM and drive its backlight via the on-module driver. Applies to AEN (2-lane DSI, FHD) and V2N / V2N-M1 (2 × 4-lane DSI, up to 1920 × 1200 @ 60 fps per port).

Audience	Firmware engineers integrating an LCD / OLED display into the SoM design.
Prerequisites	**QS-** guide completed; MIPI DSI display panel with a 40-pin FFC or similar; panel-specific init sequence.
Outcome	LVGL widgets demo running on the panel with the on-module backlight driver lit.
Time	30 minutes (panel-specific init lookup is the long pole).
Source	`examples/display/lvgl-widgets-demo/`, `examples/display/lvgl-music-player/` in alp-sdk.

Table 1 Scope summary

2 Hardware Setup

SoM family	DSI interfaces + backlight
E1M-AEN	1 × 2-lane DSI (`DSI0`), up to FHD. On-module backlight driver supporting up to 10 LEDs in series or 2P6S. `BL_LED_A` (A31) anode, `BL_LED_K` (B31) cathode, `BL_PWM` shared.
E1M-X V2N / V2N-M1	2 × 4-lane DSI (`DSI0`, `DSI1`), up to 1920 × 1200 @ 60 fps. Same backlight driver block, same control pins.

Table 2 DSI support per family

The backlight LED current is set by a feedback resistor R_FB:

$$I_{\mathrm{LED}} = 95 \frac{\mathrm{mV}}{R_{\mathrm{FB}}}$$

For a 20 mA LED chain: R_FB = 95 mV / 20 mA = 4.75 Ω.

3 Software Walkthrough

```
west build -b <BOARD> examples/display/lvgl-widgets-demo
west flash
```

The example brings `DSI0` up at the panel-native resolution, draws an LVGL widget grid, and ramps the backlight from 0 — 100 % via `BL_PWM`.

For a custom panel, supply the panel's init sequence to the SDK's `<alp/display.h>` API (vendor-provided DCS write list). The LVGL/GUI binding is in `<alp/gui.h>`; 2D-GPU-accelerated blits use `<alp/gpu2d.h>`.

4 Expected Output

```
[disp] DSI0 init: 4 lanes @ TBD Mbps
[disp] panel init: <panel name> -> OK
[disp] backlight: ramp 0 -> 100% in 1 s
[lvgl] frame 0
[lvgl] frame 60   (1 s elapsed, 60 fps)
```

5 Troubleshooting

- **Blank screen, backlight on**: DSI init sequence mismatch. Print the panel's expected DCS command list and step through the SDK's send log.
- **Screen tearing**: TE (tearing-effect) line not connected or driver running without sync.
- **Backlight not lighting**: feedback resistor open / shorted; the on-module driver enters fault state. Check R_FB value and routing.
- **Image too dim**: BL_PWM duty too low; the SDK defaults to 50 % at boot.

6 References

- **Examples**: `examples/display/lvgl-widgets-demo/`, `examples/display/lvgl-music-player/`, `examples/display/lvgl-benchmark/` in alp-sdk.
- **SDK API**: `<alp/display.h>` (panel / DSI), `<alp/gui.h>` (LVGL binding), `<alp/gpu2d.h>` (2D GPU).
- **Silicon bring-up reg-checks**: `examples/aen/aen-dsi-regcheck/`, `examples/aen/aen-gpu2d-bench/` in alp-sdk.
- **Hardware Design Guides**: **HG-AEN-001** §5.4, **HG-V2N-001** §6.5 (MIPI DSI + backlight design rules).
- **Datasheet DSI 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 paths moved to `examples/display/` (`lvgl-widgets-demo`, `lvgl-music-player`, `lvgl-benchmark`); added `<alp/display.h>` / `<alp/gui.h>` / `<alp/gpu2d.h>` APIs and the `aen-dsi-regcheck` / `aen-gpu2d-bench` silicon reg-checks.	June 2026

Table 3 Revision History