ALP LAB

CAN-BUS Network Integration

AN-005 · E1M and E1M-X SoMs

Document Number: AN-005 **Revision:** 0.7 **Date:** November 2026 **Status:** Preliminary

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1 Scope

Bring up CAN-FD, terminate the bus correctly, and exchange frames between the SoM and a peer node. On E1M-X V2N / V2N-M1 the CAN transceivers are **on-module** (TI TCAN1044AVDRBRQ1) and the carrier provides only termination and the connector. On the standard E1M-AEN build the transceiver is not fitted, so the carrier must provide it (see the table below).

Audience	Firmware engineers building industrial / automotive applications with CAN networks.
Prerequisites	**QS-** guide completed, second CAN node (e.g. a USB-to-CAN adapter) connected to the EVK's CAN connector with proper termination.
Outcome	Bidirectional CAN-FD frame exchange at 1 Mbps arbitration / 5 Mbps data rate.
Time	15 minutes.
Source	`examples/peripheral-io/can-loopback/` in alp-sdk.

Table 1 Scope summary

2 Hardware Setup

SoM family	CAN ports + on-module transceiver
E1M-AEN	1 × CAN-FD (`CAN0`). The on-module TI TCAN1044AVDRBRQ1 transceiver is an assembly option and is **not fitted** in the standard build: `B18` (`CAN0H`/`CAN0_TX`) and `B19` (`CAN0L`/`CAN0_RX`) then carry the SoC's logic-level CAN0 TX / RX, and the carrier must provide the CAN transceiver (the E1M EVK uses a TI TCAN1044AVDRBRQ1). Only on modules with the on-module PHY fitted are `B18` / `B19` bus-level `CAN0H` / `CAN0L`.
E1M-X V2N / V2N-M1	2 × CAN-FD (`CAN0`, `CAN1`). Same TI transceiver. Carrier exposes both bus-level pairs.

Table 2 CAN support per family

Termination: 120 Ω at each end of the bus, between `CANH` and `CANL`. The E1M EVK has one CAN connector (J9) with a fixed 120 Ω split termination that is always connected; there is no termination jumper. Use the E1M EVK only at a bus end, and do not add a second terminator at its connector. The E1M-X EVK has a jumper-selectable 120 Ω terminator on each port: enable it when that EVK is at the bus end and disable it when in the middle of a multi-drop bus.

Warning: **Check which E1M-AEN assembly variant you have before wiring CAN.** On the standard build (no on-module PHY), `B18` / `B19` are logic-level SoC pins: never connect them directly to a CAN bus, terminator or connector, because bus voltages will damage the SoC. Fit a CAN transceiver on the carrier. Only on a module with the on-module TCAN1044AVDRBRQ1 fitted are `B18` / `B19` bus-level; in that case do not add a second PHY.

Warning: **E1M EVK with an on-module CAN PHY.** The EVK transceiver U6 is always fitted and connects to `B18` / `B19` through 0 Ω resistors R34 / R246. With a module whose on-module PHY is fitted, those pads carry bus-level `CANH` / `CANL`, which would reach the U6 logic pins. Before fitting such a module, remove R34, R246, R247 and R248, and fit R249 and R250 to connect the pads straight to the EVK bus connector J9.

Note: **E1M EVK: no bus activity at all?** `CAN_STBY` (pad `A19`) has no carrier pull resistor, and the TCAN1044AV STB pin has an internal pull-up, so an undriven pad leaves U6 in standby: the driver is off and RXD stays high, with no error from the transceiver. Configure `A19` as an output and drive it low.

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3 Software Walkthrough

```
tan build --project examples/peripheral-io/can-loopback
tan flash examples/peripheral-io/can-loopback
```

The example opens `CAN0` (via the portable `BOARD_CAN0` alias from `<alp/board.h>`) in **loopback** mode at 500 kbps classic CAN, installs a permissive RX filter with a receive callback, sends one 8-byte frame (ID `0x123`), and confirms the controller routes it straight back to its own RX path. Loopback is the canonical bring-up test: it validates clocking, the TX/RX encode-decode paths, and filter dispatch without the bus being wired. Set `loopback = false` (and switch to `ALP_CAN_MODE_FD` with a non-zero `bitrate_data_hz` for CAN-FD) to drive the real differential pair against a peer node.

4 Expected Output

```
[can] open BOARD_CAN0 @ 500 kbps loopback
[can] add_filter -> status=0 fid=0
[can] start -> 0
[can] send id=0x123 -> 0
[can] rx id=0x123 dlc=8 data[0..3]=01 02 03 04
[can] rx_count=1
[can] done
```

5 Troubleshooting

- **No bus activity**: termination missing or wrong (must be 120 Ω at each end; not in the middle).
- **Bus error frames**: bitrate mismatch with peer, or CAN-FD vs classic-CAN mismatch.
- **TX-only, no RX**: peer node not in the same FD configuration, or BRS mismatch.
- **ESD-induced lockup**: add TVS clamp diodes between CANH/CANL and ground on the carrier connector (not on-module).

6 References

- **Example source**: `examples/peripheral-io/can-loopback/` in alp-sdk; portable API in `include/alp/can.h`.
- **Silicon bring-up check**: `examples/aen/aen-can-regcheck/` validates the `alp_can0` devicetree binding on E1M-AEN.
- **Hardware Design Guides**: **HG-AEN-001** §8.5, **HG-V2N-001** §6.6 (CAN-bus routing and termination).
- **Datasheet CAN pin tables**: §2.3 in each datasheet.

7 Revision History

Revision	Changes	Date
0.1	• Initial draft.	May 2026
0.2	• Updated example paths to the reorganised `examples/peripheral-io/can-loopback/` topic folder • added `examples/aen/aen-can-regcheck/` and `include/alp/can.h` as canonical sources • rewrote the software walkthrough and expected-output block to match the actual loopback example (500 kbps classic CAN, `BOARD_CAN0` alias, single-frame self-test).	June 2026
0.3	• Corrected the Alp SDK repository links: the `alpDevs` GitHub organisation does not exist, so every link 404'd; the canonical organisation is `alplabai`.	July 2026
0.4	• E1M-AEN:	October 2026

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Revision	Changes	Date
	▸ documented that the on-module TCAN1044AVDRBRQ1 CAN transceiver is an assembly option and not fitted in the standard build (B18 / B19 are then logic-level CAN0 TX / RX and the carrier must provide the transceiver) ▸ rewrote the scope text and the PHY warning accordingly ▸ software walkthrough now uses `tan build` / `tan flash` ▸ corrected the HG-AEN-001 section reference to §8.5.	
0.5	• E1M EVK termination corrected for the 2641-R3 board: one CAN connector (J9) with a fixed, always-connected 120 Ω termination and no jumper. • Added the E1M EVK rework for modules with an on-module CAN PHY (R34, R246, R247, R248 out; R249, R250 in). • Added the E1M EVK CAN_STBY note: the TCAN1044AV STB pull-up leaves U6 in standby until pad A19 is driven low. • E1M-X EVK wording unchanged.	October 2026
0.6	• Release history: every entry formatted as a bullet list.	October 2026
0.7	• Product name on page 1 links to the product page on alplab.ai.	November 2026

Table 3 Revision History

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