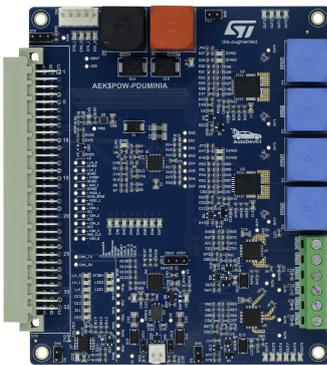# 12 V power distribution unit (PDU) board, featuring 10 channels of which 8 paired with companion p-channels for superb standby performance

Features

- Compact and MCU controllable power distribution unit (PDU) dedicated to 12 V board net
- Thanks to the software running on the MCU, the AEK-POW-PDUMINI can be operated in assembly, parking, and normal driving modes
- E-fuse protected high-side drivers with current capability from 5 to 27 A are present:
  - A pair of 2-channel VNF9D1M5Q, featuring 27 A per channel
  - A 2-channel VNF9D5SF, featuring 13 A per channel
  - A 4-channel VNF9Q20SF, featuring 5 A per channel
- Advanced system standby features are achievable by switching off main STi2Fuse channels and delegating the remaining standby supply to the eight companion P-channels with 400 mA capability belonging to the smart and SPI controllable L99SP08 dedicated IC
- All the devices on the board are SPI controlled by an MCU linked by the automotive unified connector, a standardized 96-pin plug-and-play connector present on the board featuring MCU peripheral and supply pins
- For improved standby performance, the MCU can be switched off during PDU parking mode condition delegating the channel control to the L99SP08 and thanks to the wake-up features of the on-board SPSB081 PMIC featuring, in addition, a CAN-FD physical layer for wake-up from CAN
- The board has a dedicated channel for MCU supply via the automotive unified connector managed by a VN7140AJ high-side driver and useful to power the MCU board from 12 V (VBAT) after a wake-up condition
- To facilitate the debug, a set of disconnectable status LEDs is present on the board. The same LEDs can be disconnected by removing dedicated resistors when measuring the advanced standby performances
- Emergency pins for rapid switch-off of the output channels in case of critical events in normal operation mode bypassing SPI control
- A dedicated 'assembly mode' jumper is present on the board to simulate the assembly mode of the PDU in the car maker factory
- The typical MCU companion board is the AEK-MCU-C4MLIT3 featuring PDU remote access via CAN-FD or the soon available AEK-MCU-C4MLIT2 able to implement PDU additional remote access via 100BASETX or 10BASET1S
- 120 x 100 mm
- Included in the AutoDevKit ecosystem

Description

The power distribution unit (PDU) market is evolving rapidly due to increased electric vehicle (EV) adoption. PDUs manage low-voltage power distribution in vehicles, consolidating connections and protecting circuits in a compact design.

Key trends include the use of 12 and 48 V systems, replacing traditional fuses with e-fuses, and shifting secondary power distribution to zonal architectures.

Product summary	
12 V power distribution unit (PDU) board, featuring 10 channels of which 8 paired with companion p-channels for superb standby performance	AEK-POW-PDUMINI
Smart Octa P-channel for ultra-low current consumption automotive systems	L99SP08TR
High-side driver with MultiSense analog feedback for automotive applications	VN7140AJTR
Automotive Power Management IC with LIN and CAN-FD	SPSB0815-TR
2-channel high-side driver with STi²Fuse protection for automotive power distribution applications	VNF9D1M5QTR

DB5687 - Rev 1 - February 2026
For further information, contact your local STMicroelectronics sales office.

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Product summary	
Battery holder for cylindrical batteries and battery management system node for automotive applications	VNF9D5SFTR
4-channel high-side driver with STi²Fuse protection for automotive power distribution applications	VNF9Q20SFTR
All-in-one, fast-prototyping, user-friendly MCU	AEK-MCU-C4MLIT3
AutoDevKit Studio for 32-bit power architecture MCUs	STSW-AUTODEVKIT
Application	Smart power distribution

A power distribution system supplies and manages electrical power throughout the vehicle. It includes a power rail switch unit (PRS), connecting multiple power sources, a primary PDU distributing power via e-fused channels, and secondary units like ZCUs that handle localized distribution and control, reducing wiring complexity by handling secondary power distribution and control closer to the loads such as lights and sensors.

The AEK-POW-PDUMINI PDU evaluation board aligns with this market trend. It can function as a secondary power distribution unit, closer to the loads, reducing the wire total length, within the zone control unit.

This integration optimizes the power distribution wire harness and the in-vehicle network (IVN).

The AEK-POW-PDUMINI board can also serve as a "building block" for complex primary PDUs.

The on-board high-side drivers have integrated smart e-fuses with a current threshold configurable via SPI to block the channel current drain at a given level.

These latest generation, regenerable, configurable, and precise smart fuses replace standard discrete fuses.

A key feature is STi2Fuse protection (STMicroelectronics' proprietary I²t functionality), an intelligent circuit breaking mechanism designed to protect PCB traces, connectors, and wire harnesses from overheating, without impacting load transients such as inrush currents and capacitance charging.

The protection is embedded in the eFuse devices and does not require MCU intervention for the calculation, thus saving a lot of BOM in the complete system.

The I²t curve parameters can be individually configured for each channel. The dissipated power is limited to a safe level, up to the point of thermal shutdown intervention.

The device enters a fail-safe mode in case of communication loss with the microcontroller, reset of digital memory, or watchdog monitoring time-out event. In fail-safe mode, the output can be directly controlled by dedicated, assignable direct inputs.

To meet the highest automotive safety standards, all eFuse devices include a periodic watchdog operating within a defined time window.

The board operates in three modes: assembly mode, related to vehicle assembly, park mode, related to the vehicle parking state, where the system power consumption is minimized, and running mode, related to the vehicle driving state.

In park mode, the following events trigger a wake-up from standby for the system: a wake-up by a CAN message, current requested on a L99SP08 P-channel above the threshold, or periodic wake-up for active channel monitoring.

The wake-up signal is managed by the SPSB081 PMIC which subsequently wakes the MCU. The MCU then determines the reason for the wake-up and acts accordingly.

Run mode represents the normal operation mode for the PDU system. Once started, the MCU uses its internal NVM configuration to configure and turn on the channels according to the given order and timing. Upon completion, status feedback is provided to other ECUs via CAN communication.

Eight out of 10 high-side driver channels on the AEK-POW-PDUMINI are connected to L99SP08 P-channel outputs. The remaining two channels are independent.

In standby mode (for example, car in park mode), the eight main output channels are switched off, while the coupled L99SP08 P-channels are turned on.

When the power demand exceeds the programmable threshold, the process is reversed: the eight main output channels are turned on, and the P-channels are switched off. This behavior is applicable to any of the eight channels independently.

The board features two power supplies (5 and 3.3 V), provided by a DC-DC converter for higher current capability and an LDO for low current capability but higher precision.

The main AEK-POW-PDUMINI board connector is a 96-pin plug-and-play automotive unified connector dedicated to the MCU.

This connector allows the board to connect to an AEK-MCU-C4LIT3 MCU board, enabling power delivery control through CAN-FD. In the current software implementation, the AEK-POW-PDUMINI board can be addressed via CAN commands, including the diagnostic portion that is implemented based on a stripped version of ISO14229 – UDS protocol.

Finally, the AEK-POW-PDUMINI is a functional block of the AutoDevKit ecosystem, which includes dedicated demos to simplify board configuration and usage.

1 System requirements, hardware and sofware resources

Figure 1. AEK-POW-PDUMINI connected to AEK-MCU-C4MLIT3 MCU board

GPIO - STANDBYN

EMIOS - PWM

GPIO - LPH

GPIO – EM/DIx

EIRQ – LATCHDIAG

SPI

CAN(TX/RX)

AEK-MCU-C4MLIT3
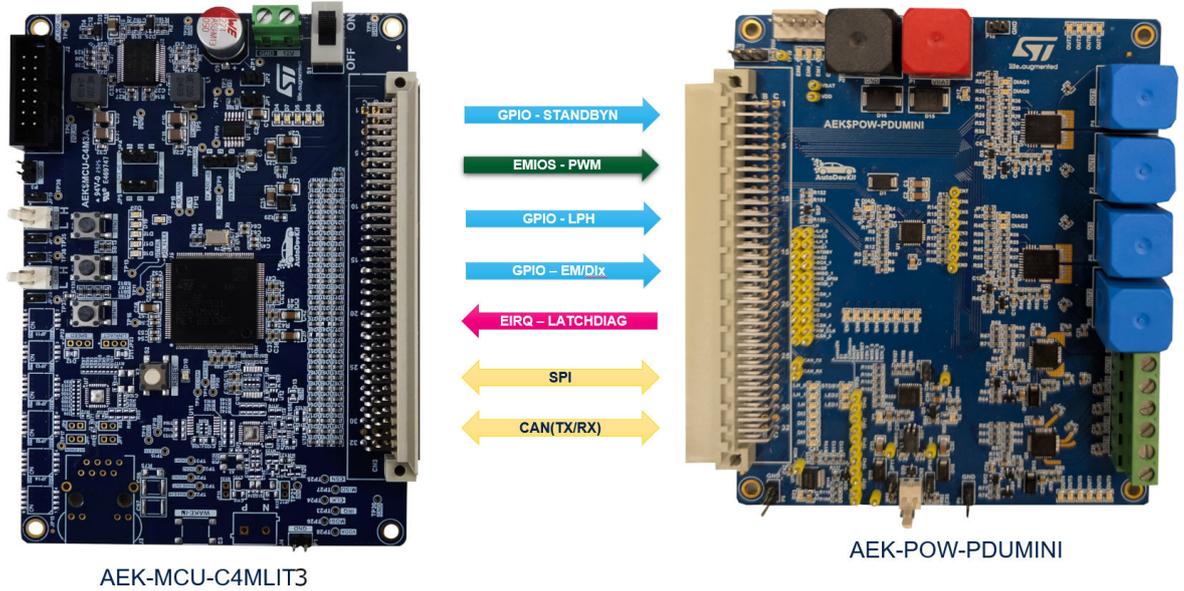
AEK-POW-PDUMINI

Figure 2. AEK-POW-PDUMINI connected to AEK-MCU-C4MLIT3 MCU board: usage example

CAN Messages

Value CAN

Puddle Lights

Seat heating

Infotainment

Motors

MCU programmable through firmware available in AutoDevKit

2 Schematic diagrams

Figure 3. **AEK-POW-PDUMINI circuit schematic (1 of 10)**

Board		L99SP08		STiFuse		
EN0	OUT0	EN7	OUT7	DI1	OUT1	D1M5Q_0
EN1	OUT1	EN6	OUT6	DI0	OUT0	D1M5Q_0
EN2	OUT2	EN5	OUT5	DI1	OUT1	D1M5Q_1
EN3	OUT3	EN4	OUT4	DI0	OUT0	D1M5Q_1
EN4	OUT4	EN3	OUT3	DI1	OUT1	D5F
EN5	OUT5	EN2	OUT2	DI0	OUT0	D5F
EN6	OUT6	EN1	OUT1	x	x	Q20F
EN7	OUT7	EN0	OUT0	x	x	Q20F

AEK-POW-PDUMINI
Schematic diagrams

Figure 4. AEK-POW-PDUMINI circuit schematic (2 of 10)

Figure 5. AEK-POW-PDUMINI circuit schematic (3 of 10)

Figure 6. AEK-POW-PDUMINI circuit schematic (4 of 10)

Figure 7. AEK-POW-PDUMINI circuit schematic (5 of 10)
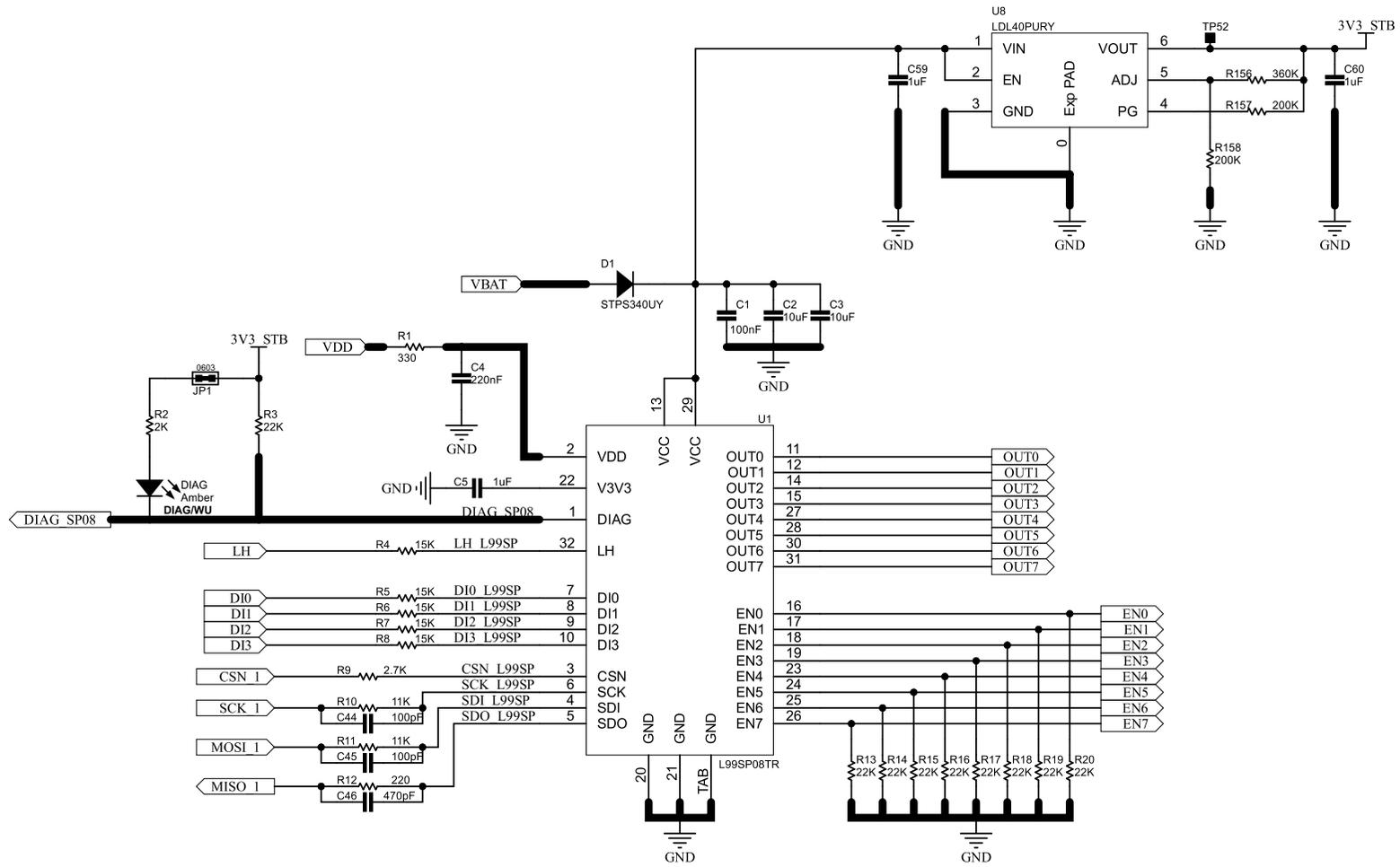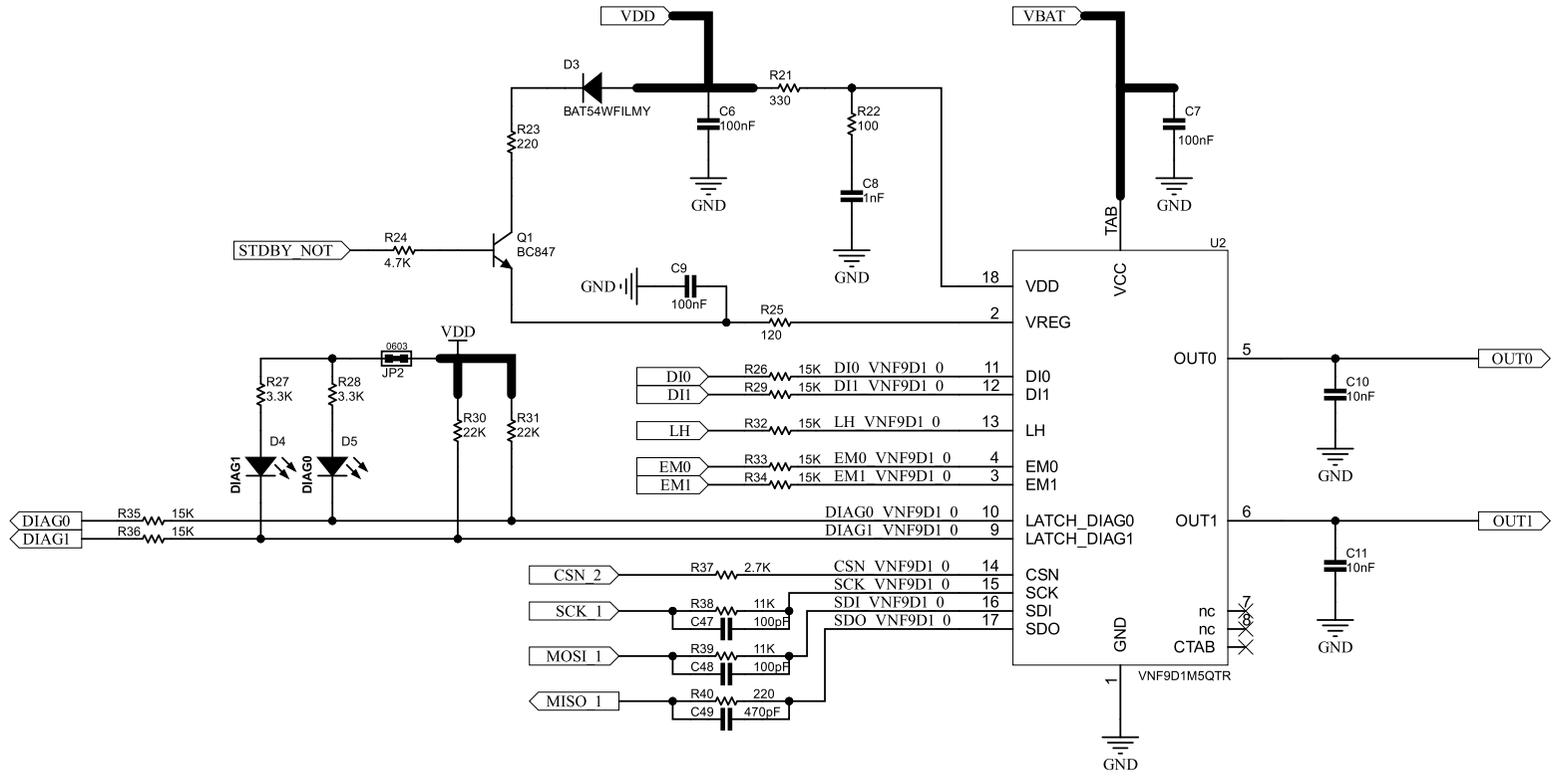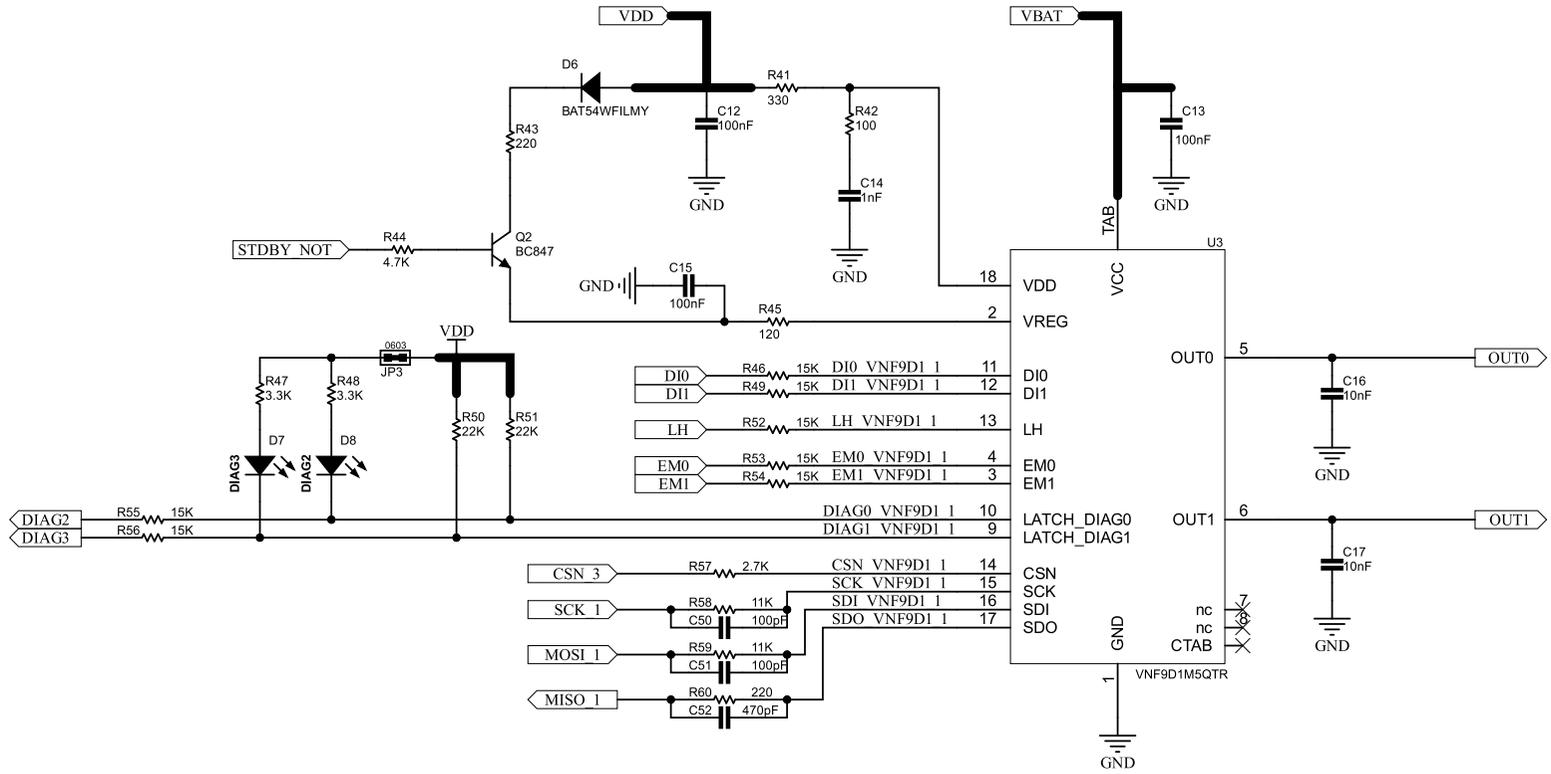
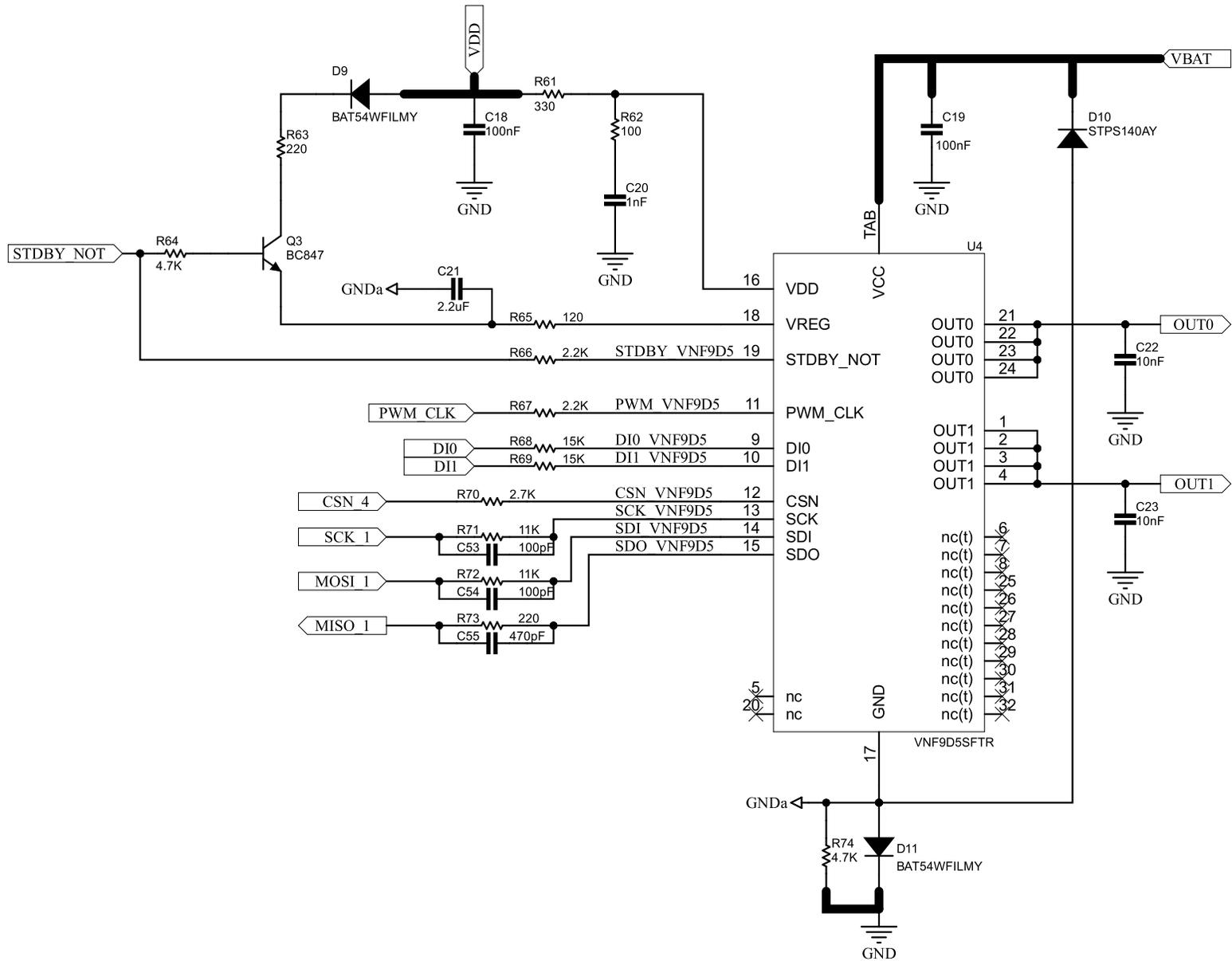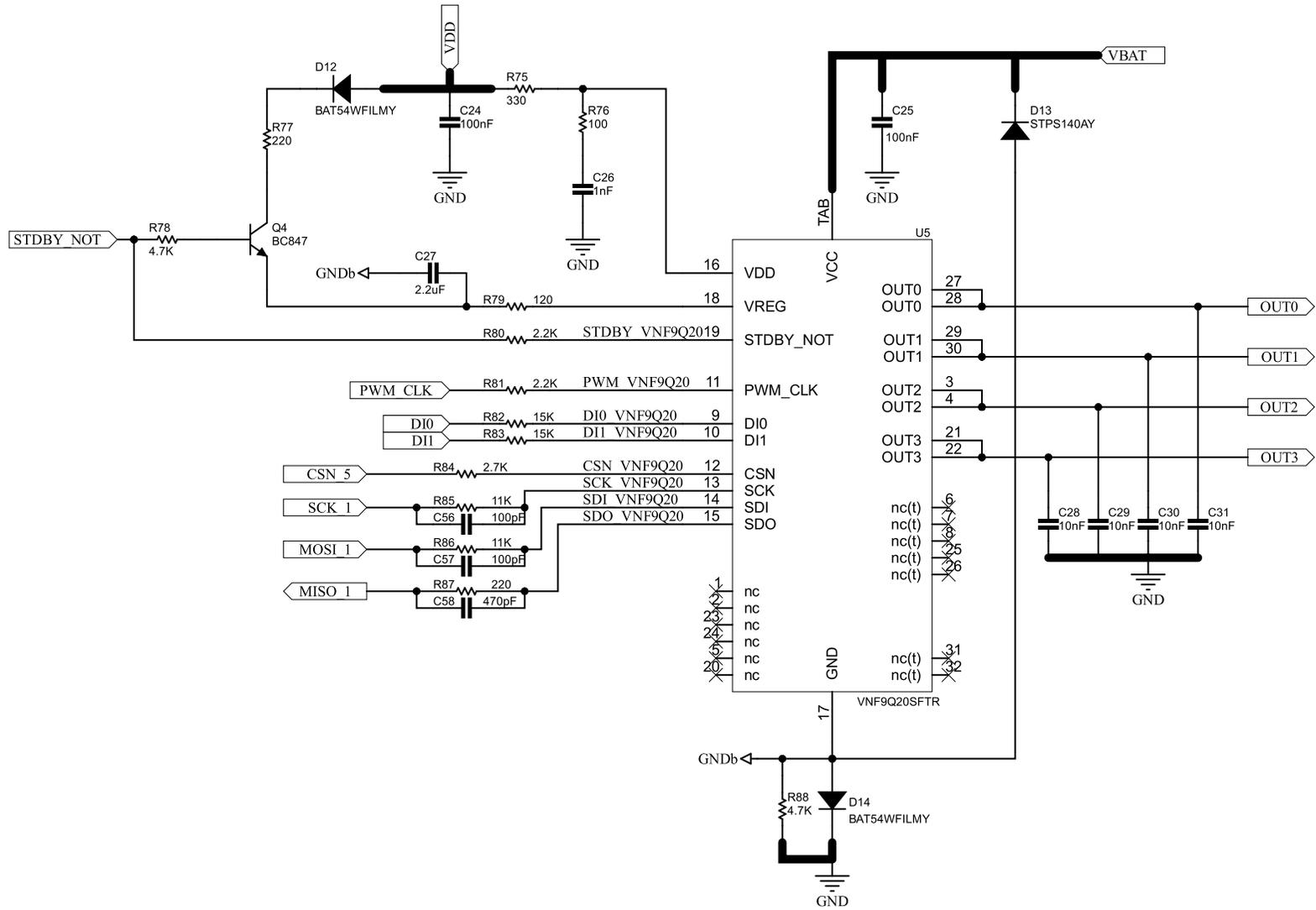**Figure 8. AEK-POW-PDUMINI circuit schematic (6 of 10)**

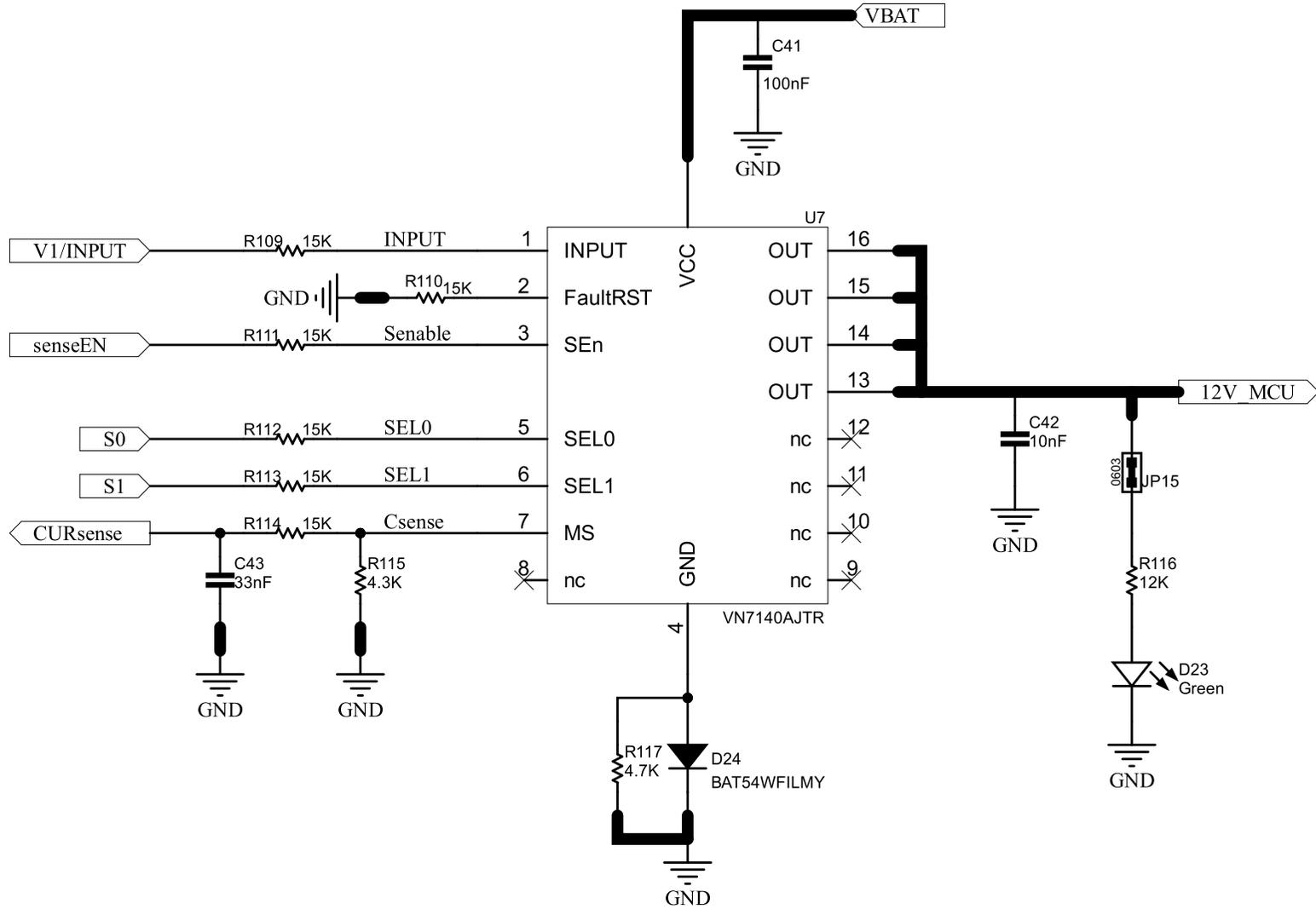## Figure 9. AEK-POW-PDUMINI circuit schematic (7 of 10)

Figure 10. **AEK-POW-PDUMINI circuit schematic (8 of 10)**
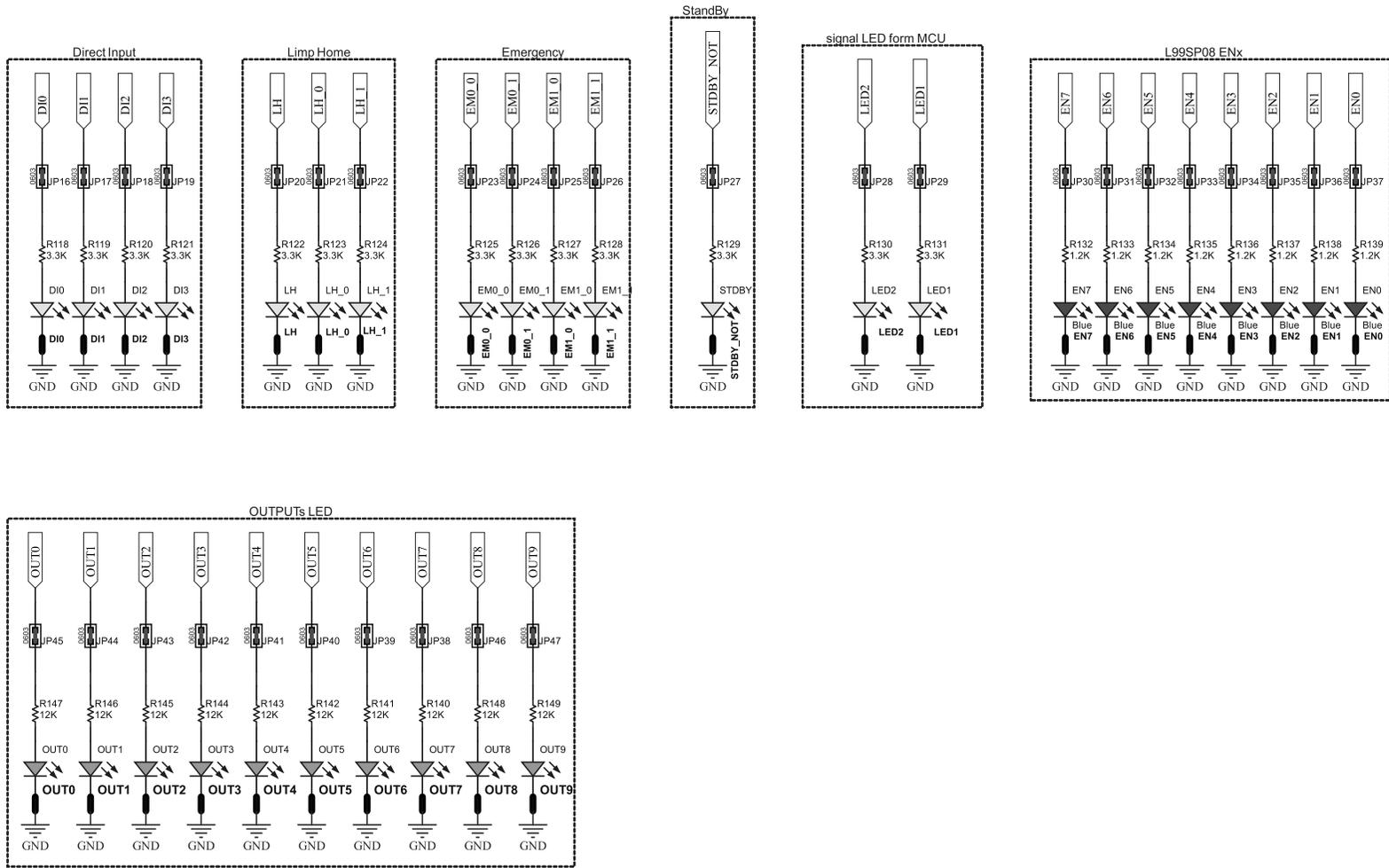
Figure 11. AEK-POW-PDUMINI circuit schematic (9 of 10)

Direct Input

Limp Home

Emergency

StandBy

signal LED form MCU

L99SP08 ENx

OUTPUTs LED

Figure 12. AEK-POW-PDUMINI circuit schematic (10 of 10)

CN3A — 103-40064TH

Pin	Signal
A1	3V3_L5963
A2	5V_L5963
A3	PM14
A4	PG13
A5	PA4
A6	PA14
A7	PA0
A8	PA10
A9	PE10
A10	PE9
A11	PE8
A12	PE7
A13	PC12
A14	PC11
A15	PC10
A16	PD10(*)
A17	PB1
A18	PB2
A19	nc
A20	PE15/CS0_DSPI6
A21	PE13
A22	PB4
A23	PE14
A24	PB9/CS0_DSPI2
A25	PB11/CS2_DSPI2
A26	PB10
A27	PA3/MISO_DSPI2
A28	PD8
A29	PB8
A30	nc
A31	GND
A32	VBAT

SPSB081 NINT
ASSE_mode
SPSB081 CSN_0
DIAG3
SPSB081 NRESET
EM0_0
SPSB081 MOSI_0
DI1
DI2
DI3
CSN_1
S0
S1
senseEN

(*) by default on the MCU board is not connected. If you wish to use it, you can modify the board.

CN3B — 103-40064TH

Pin	Signal
B1	3V3_L5963
B2	5V_L5963
B3	PF12
B4	PF10
B5	PF9
B6	PF14
B7	PG15
B8	PH2
B9	PD2
B10	PD5
B11	PF8
B12	PA15
B13	PM0
B14	PM2
B15	PF0
B16	PF1
B17	PG9
B18	PG10
B19	PG11
B20	PB7
B21	PG3
B22	PI6
B23	PK1
B24	PI9
B25	PG1
B26	PG5
B27	PI8
B28	PI1
B29	PI3
B30	PI4
B31	GND
B32	VBAT

DIAG1
SPSB081 DIAGN
CSN_2
DIAG_SP08
MISO_1
R159 150K
R151 50
D57
BAT54WFILMY
GND
LED1
EM1_1
DI0
LH
CSN_3
signal LED form MCU
LED2
CURsense
CSN_5
PWM_CLK

CN3C — 103-40064TH

Pin	Signal
C1	HV_IO_MAIN
C2	5V_LDO_L5963
C3	3V3_LDO_L99VR
C4	PF11
C5	PF6
C6	PF15
C7	PD6
C8	PD1
C9	PD4
C10	PF7
C11	PF13
C12	PD7
C13	nc
C14	PG4
C15	PD9
C16	PB0(*)
C17	PB3
C18	PD11
C19	PG12
C20	PB6
C21	PI7
C22	PG6
C23	PG2
C24	PE3
C25	PI5
C26	PK0
C27	PD12(**)
C28	PD13(**)
C29	PE1(**)
C30	PE2(**)
C31	GND
C32	VS

VDD
CAN_RX
EM1_0
SPSB081 SCK_0
LH_0
SCK_1 R150 50
CAN_TX
DIAG0
SPSB081 MISO_0
LH_1
EM0_1
MOSI_1 R152 50
DIAG2
STDBY_NOT
CSN_4

(*) by default on the MCU board is not connected. If you wish to use it, you can modify the board.
(**) level voltage fixed at 3.3V. The connection may be different, check the version of the MCU board in use.

GND
12V_MCU
TP51

P8 P9 P10
GND GND GND

3 Board versions

Table 1. AEK-POW-PDUMINI versions

PCB version	Schematic diagrams	Bill of materials
AEK$POW-PDUMINIA [1]	AEK$POW-PDUMINIA schematic diagrams	AEK$POW-PDUMINIA bill of materials

1. This code identifies the AEK-POW-PDUMINI evaluation board first version. It is printed on the board PCB.

Revision history

Table 2. Document revision history

Date	Revision	Changes
18-Feb-2026	1	Initial release.

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