Start sequence of the APEV528 motor controller

Devices:

VCU: ESP32 with eVCU software

MCU: APEV528 motor controller from alpha electrics, CAN matrix available

BMS: emulated by Arduino with CAN board

ICU: hand brake CAN message sent by BMS emulator

Observer: RasPie with CAN board

Setup:

Battery bank provides ~350V without “own will”

HV connection fused with 10A and with old heater element at HV+

Contactor and precharge circuit connect HV to MCU, controlled by VCU

All devices are connected to the CAN bus at 500kbps, same GND, terminated at MCU and observer

Observer runs a program to translate CAN messages into signal names and values

VCU reacts to key position (ACC, ON, START), gear lever (only P and D), throttle, brake

HV interlock line in and out at MCU is connected

On power-up (key position ACC):

* VCU starts sending 0x101: throttle (0), brake (0), gear lever (P), work mode (torque), motor mode (standby), key position (ACC), connectors (open), status signals (all good), counter, checksum
* BMS starts sending 0x1A0: precharge not finished; no error; rest zeros
* ICU starts sending 0x431: park brake released; rest zeros

Event sequence:

|  |  |  |  |
| --- | --- | --- | --- |
| Event | VCU | MCU | BMS |
| Key position ON | 1. Set key pos. ON in 0x101 2. Connect KL15 (MCU enable) 3. Connect precharge circuit, set in 0x101   After 0.5s   1. Connect main contactor, set in 0x101 | On VCU 2.: starts sending  - 0x105: speed (0), torque (0), max torque (0), max neg. torque (0), direction (standby), main state (standby), motor state (standby), work mode (torque), counter, checksum  - 0x106: controller temperature (~21°C), motor temperature (0), faults (all good), counter, checksum  - 0x107: HV voltage (~3), HV current (0), motor current (0)  On VCU 3.: sense HV (in 0x107)  Should set motor main state to precharge, then to ready | On VCU 4.: set precharge finished in 0x1A0 |
| Key position START | 1. Set key pos. START in 0x101 2. Set motor mode drive in 0x101 | On VCU 2.: set motor state drive  Should set max torques, motor main state to running, (direction dep. on gear lever) |  |
| … | … | … |  |
| Key position ACC/OFF | 1. Set key pos. in 0x101 2. Disconnect KL15 3. Disconnect main contactor | On VCU 2.:  Set motor main mode to shutdown  Set motor mode to standby  After 10s: end CAN  On VCU 3.: sense HV dropping |  |