About DevBoard-One

0. General information

Almost all pins are labeled on the bottom of the circuit board. V1 of the circuit board has the silkscreen off-by-one on one of the labeled ports.

1. Power supply and power routes

The board has a power supply designed for standard automotive transients and load dump conditions. It has an input filter to minmize conducted noise, a diode to protect against reverse battery connection. A basic buck regulator provides 5V to the rest of the board. (some versions have additional high precision stablized 5V reference). A 3.3V LDO provides power for the ESP32 and other 3.3V chips. Up to 32V DC can be fed into the main power input. The device can be powered by the USB connection for the CP2102 programmer but care is required to not draw more power than the USB power can supply.

2. Core MCU and USB Programming interface

The board has a ESP32-WROVER module on it. The board has a CP2102 USB-UART interface onboard with a USB Micro cable connection. This interface is connected to RXD0 / TXD0 on the MCU to allow programming using the Espressif programmer application or the Arduino studio. Additionally, the DTR and RTS signals are connected to the Boot and Enable pins of the ESP32 in the standard/prescribed manner to facilitate easy programming.

3. CAN

The board has a 5V CAN transceiver. CAN\_RX (transceiver received data) is connected to ESP32 pin IO22 (module pin 36). CAN\_TX (mcu requested transmit data) is connected to ESP32 pin IO21 (module pin 33). JTERM (located near the CANbus connector) can be installed to provide a 120 Ohm termination resistor.

4. Digital Expansion ports

There are two expansion ports which are **RAW UNPROTECTED CONNECTIONS** to the MCU: J5 (SPI) and J6 (I2C). These ports have the entire SPI3 and I2C peripheral pins broken out, along with 3.3V supply and ground. **BE CAREFUL WITH THESE PINS AS YOU CAN EASILY FRY THINGS**. Additionally, the programming pins immediately below the ESP32 (“Programming RAW”) have no protection.

5. Safer I/O

Towards the top left, there are 4 pins (along with a ground signal) which have basic protection (1k series resistance, dual-schottky series diode) and connect to IO32,33,34 and 35 on the MCU. No additional capacitance is added to these pins. These pins can be directly connected to 12V, used as digital inputs or 0-3.3V analog inputs. The protection circuit won’t stop lightning or a direct hit from the secondary side of an ignition coil but is plenty for ESD or 12V hazards. Intended to prevent damage from casual abuse.

6. SPI Expansion and additional Analog Inputs

You might ask, “why are analog inputs being discussed with SPI?” On this board, there are 8 protected analog inputs. 4 of them have an op-amp to divide the 0→5V range down into 0→3.3v. 4 of them are just protected 3.3V inputs. All 8 of these inputs are multiplexed to a single analog input pin on the ESP32 using a HC4051 analog multiplexer. The ‘4051 mux is controlled by the most significant 3 bits of a 74HC595 shift register. The 74HC595 shift register is controlled by the SPI2 peripheral on the ESP32 (IO25, IO26, IO27, IO14, IO13, pins 10-14 and 16 on module).

The 4th bit of the 74HC595 controls a LED.

Bits 0-3 of the 74HC595 are broken out as available digital outputs, with 1k series resistors and dual schottky diodes providing basic protection.

The shift output and latch signals are passed out of the SPI Chain expansion port to allow connection of additional SPI peripherals down the chain from the onboard 74HC595. There is a SPI input pin to read from external SPI peripherals which has a 100 ohm series resitor and a dual schottky diode for basic protection.

Conclusion

This board is intended to be a small, basic, expandable, flexible platform for developing applications using an ESP32 in an automotive environment. It aims to provide enough protection against casual hazards found in an automotive environment that it can be reliable. We’ve already used this board as a starting point for developing automotive applications successfully.

1. Power supply

The primary power supply for the board is a Buck regulator SMPS design. There is reverse battery protection(), an input high frequency filter(), bulk capacitance() on the power supply input. The primary buck output stage is specified to output 5.05V and it is followed by a 0.5% precision voltage regulator.