Apollo v4 control board- requirements

Goal

- Will serve as main controller board for a variety of small/medium PSA systems
- Reliability features: fault detection
- Diagnostics messages displayed on a TFT LCD

PCB design requirements

- Preferably at 10 cm x 8 cm
    - (but it could go higher if not possible such as 10 cm x 10 cm)
- 2 layer PCB preferably (with a ground plane)
    - (4 layer could be OK if ground plane hard to achieve)
- Eagle
- SMD preferred, pick&place will be done in a PCB manufacturer (Jlcpcb, pcbway, allpcb, etc)
- Multiple PCBs that can be stacked in a modular (Cubesat-like)fashion.
- The proposal is to have three boards:
    - Control board
        - Containing the ESP32, the TFT screen connector, battery circuit, buzzer, reset button
    - Valve board
        - Containing the valve drivers and the valve terminals
    - Sensor board
        - Containing JST connectors for the sensors

The project should reuse as much as possible the Apollo v3 control board document. Please see these links:

- Documentation: link
- PCB design:
    - controller board: link
    - MUX sensor board: link

Power

- Power input: 12 .. 24V (external)
- Internal down-converter to 12 V (if 24 V supplied)
- regulator to 5V and 3.3V
- Battery for buzzer activation if power goes down

Valves

- 12V or 24V
- 2-way and 5-way valves

- 1A max

Solenoid control

- 4x solenoids controlled
- Open/short load detection
- Fault detection (overcurrent)
- Max 1A per solenoid (typically 500..700 mA)
- Suggested controller: DRV8806
- Wiring: serial

Main controller

- ESP32 WROOM board
- https://www.amazon.com/HiLetgo-ESP-WROOM-32-Development-Microcontroller-Integrated/dp/B0718T232Z

Display touchscreen

- ILI9341 or similar (2.8” minimum, 3.2” preferable)
- Power requirements: 3.3V or 5V
- Signal: 5V or 3.3V

O2 sensor (flow/concentration)

- Sensor: Cubic Gasboard 7500E (datasheet here)
- Power: 12V
- Connectivity: 5V TTL UART (TX/RX/GND)

Pressure sensors

- Two sensors (one at input, one at output)
- Type: TE or Honeywell (likely TE)
    - TE sensor is I2C - datasheet here
        - Goes up to 30 bar (appropriate for input from compressor)
        - (Need to complete evaluation)
    - Honeywell sensor is SPI or I2C - datasheet here
        - SPI is for high gauge pressure (30 psi max)
        - I2C is only for near-atmospheric pressures
- Apollo Mount board
- Two variants (final one TBD)
- 3.3V signal/power

Buzzer

- Main choice: TBD, but likely Mallory medical compliant
    - https://www.digikey.com/en/ptm/m/mallory-sonalert-products-inc/iec60601-1-8-compliant-medical-alarms
    - IEC60601-1-8 Compliant Medical Alarms
- Alternative: SD1614T5-B5ME

    - Medical rating? (requires contacting Tektronix)
    - 85 dB @ 5V
    - https://media.digikey.com/pdf/Data%20Sheets/TDK%20PDFs/SD1614T5-B5ME_Overview.pdf
    - https://www.digikey.com/product-detail/en/tdk-corporation/SD1614T5-B5ME/445-175287-ND/8017772
- Alternative: AI-3035-TWT-3V-R
    - 100dB @ 3V, 10cm
    - https://www.digikey.com/product-detail/en/pui-audio-inc/AI-3035-TWT-3V-R/668-1204-ND/1745457

Fuse

- Fuse holder link

Buttons/switches

- On/off button (external)
- Buzzer silence push button
- Silencer push button ideally accessible sitting on top (on board) next to the TFT screen
- Board Reset button (already part of the ESP32 board)

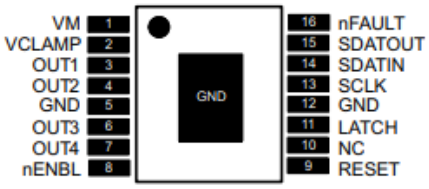
Terminals

- Connectors for ILI9341 who sits on top
- Screwed terminal block for power and solenoid interfacing
- ESP32 board is pluggable
- O2 sensor (terminals TBD – possibly JST-XH or JST-RE?)
- 2x pressure sensors (terminals TBD – possibly JST-XH or JST-RE?)
- 0.1 header for Apollo mux board interfacing (layout same as Apollo Mux board v3)

Appendix 1 – DRV8806

- Datasheet:
https://www.ti.com/lit/ds/symlink/drv8806.pdf?ts=1594425304961&ref_url=https%253A%252F%252Fwww.ti.com%252Fproduct%252FDRV8806

PWP Package
16-Pin HTSSOP
Top View



Pin Functions

PIN		I/O(1)	DESCRIPTION	EXTERNAL COMPONENTS OR CONNECTIONS
NAME	NO.			
POWER AND GROUND				
GND	5, 12, PowerPAD™	—	Device ground	All pins must be connected to GND.
VM	1	—	Device power supply	Connect to motor supply (8.2 V - 40 V).
CONTROL				
LATCH	11	I	Latch input	Rising edge latches shift register to output stage, falling edge latches fault data into output shift register – internal pulldown
nENBL	8	I	Enable input	Active low enables outputs – internal pulldown
RESET	9	I	Reset input	Active-high reset input initializes internal logic – internal pulldown
SCLK	13	I	Serial clock	Serial clock input – internal pulldown
SDATIN	14	I	Serial data input	Serial data input – internal pulldown
SDATOUT	15	OD	Serial data output	Serial data output; push-pull structure; see serial interface section for details
STATUS				
nFAULT	16	OD	Fault	Logic low when in fault condition (overtemperature, overcurrent, open load) - open-drain output
OUTPUT				
OUT1	3	O	Output 1	Connect to load 1
OUT2	4	O	Output 2	Connect to load 2
OUT3	6	O	Output 3	Connect to load 3
OUT4	7	O	Output 4	Connect to load 4
VCLAMP	2	—	Output clamp voltage	Connect to VM supply, or zener diode to VM supply

(1) Directions: I = input, O = output, OD = open-drain output.

Appendix 2 – ILI9341 2.8” TFT display

https://github.com/loboris/ESP32_TFT_library