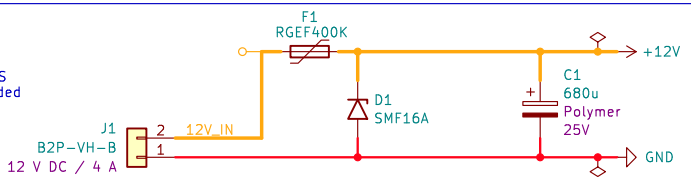
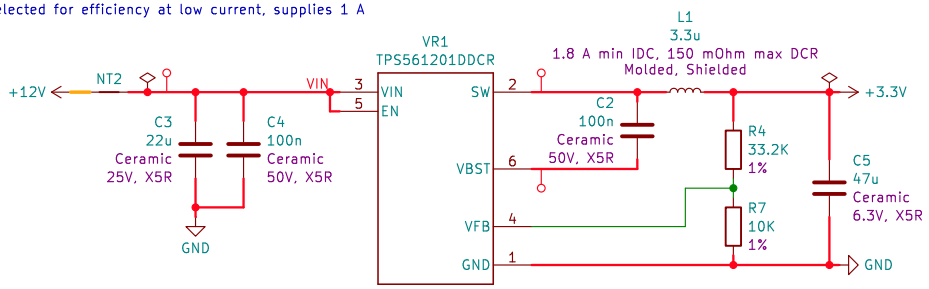
## POWER INPUT

Input must be 9 to 16 V
Circuit protection
– Internal: 4 A polyfuse and TVS
– External: 5 A fuse recommended



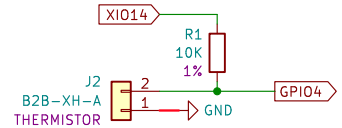

## 3.3 V BUCK CONVERTER

Selected for efficiency at low current, supplies 1 A



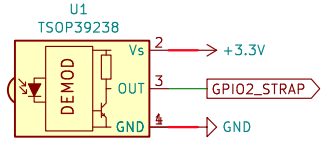

## TEMPERATURE SENSOR

Built-in 10 K NTC thermistor, beta = 3950



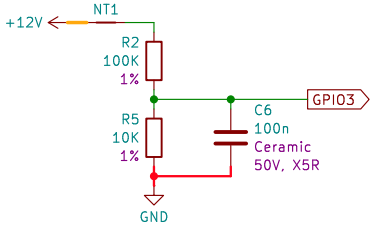

## IR REMOTE RECEIVER

Operates on 38 kHz carrier frequency



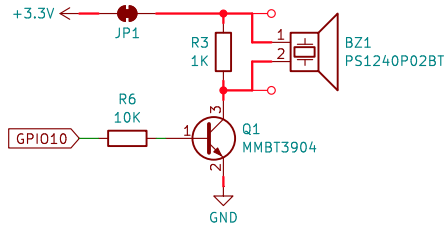

## VOLTAGE SENSOR

Map to ESP32-C3 ADC range of 0 to 2.5 V

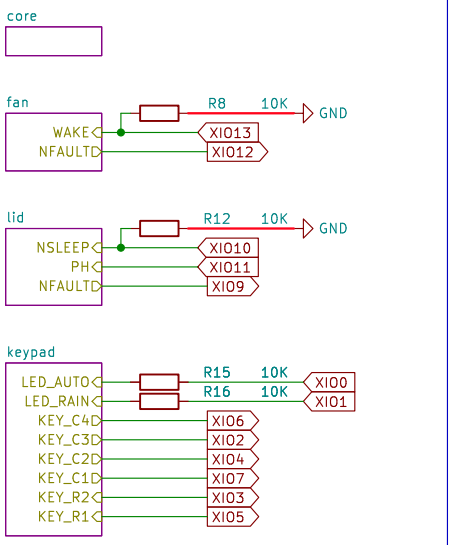



## PIEZO BUZZER

Driven at 3.3 V for politeness (12 V would be louder)
Can be disabled in software or by cutting the solder jumper

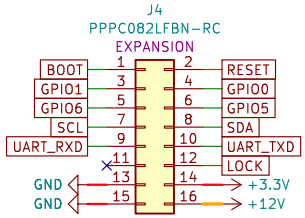



## COMPONENTS



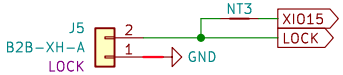

## EXPANSION PORT

Header for accessories and factory programming
– GPIO0, GPIO1, GPIO5, GPIO6 can be used for any purpose
– UART_RXD and UART_TXD provide the serial port
– SCL and SDA provide the I2C bus (QWIIC)
– RESET and BOOT are wired in parallel with their corresponding buttons (active low)
– LOCK engages the safety lock (active low)
– 12 V supply is unregulated, 1 A current available
– 3.3 V supply is regulated, 600 mA current available



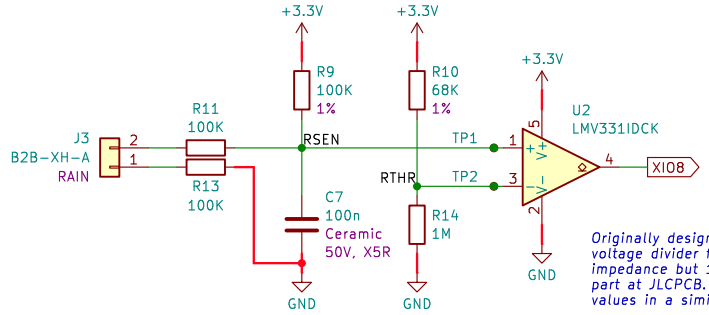

## SAFETY LOCK

While the input is tied to ground, stops the fan, closes the lid, and inhibits operation




## RAIN SENSOR

The rain sensor is only available on model 4500K; these components may be omitted for other models
It is simply a pair of electrodes that are exposed to the environment and whose impedance is about 0.5 to 1.2 Mohm when in contact with water or mist and open circuit when dry
The comparator pulls the output low when V(RSEN) < V(RTHR) + V(OFFSET), where V(OFFSET) is +/– 5 mV for LMV331X




*Originally designed using 100 K / 1.5 M in the voltage divider for symmetry with the input impedance but 1.5 M is not considered a basic part at JLCPCB. Substituted other resistor values in a similar ratio.*

github.com/j9brown/minuet
**Brown Studios LLC**

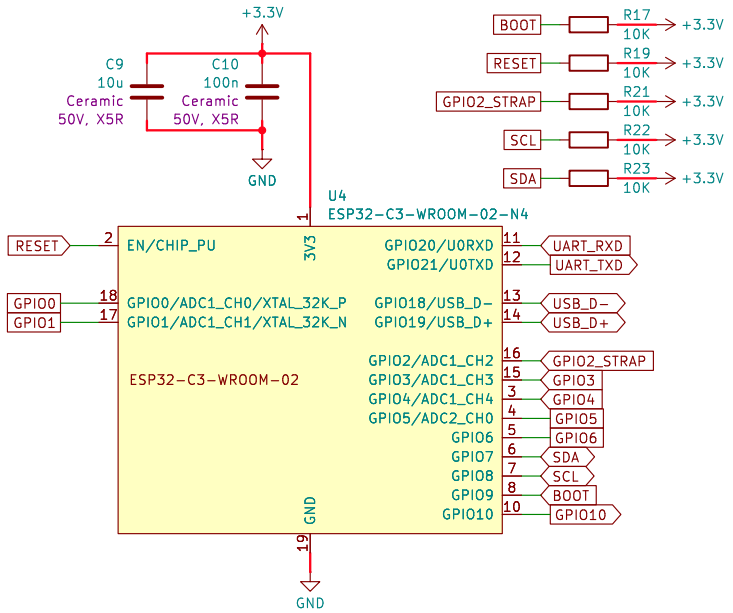
Sheet: /
File: minuet.kicad_sch

**Title: Minuet Fan Controller**

| Size: A4 | Date: 2025-06 | **Rev: v3.0** |
|---|---|---|
| KiCad E.D.A. 8.0.8 | | Id: 1/5 |

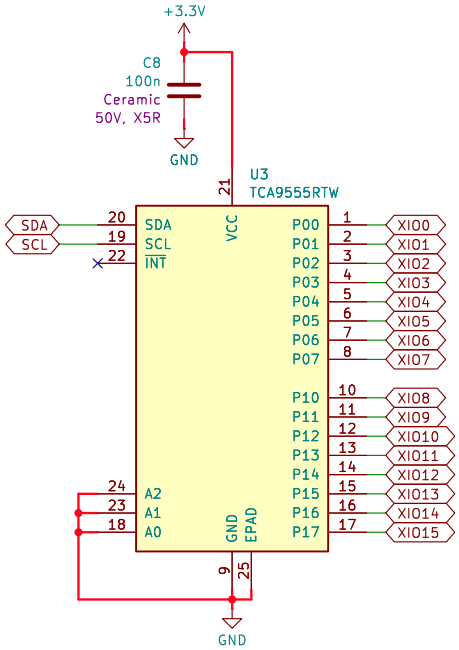
## MICROCONTROLLER

ESP32-C3 strapping pins
- GPIO2 don't care but recommended to pull up anyway to avoid glitches
- GPIO8 must be high for download mode, don't care for SPI mode
- GPIO9 boot select: low for download mode, high for SPI mode
- RESET forms an RC delay circuit with R = 10 Kohm, C = 1 uF to ensure power supply stability



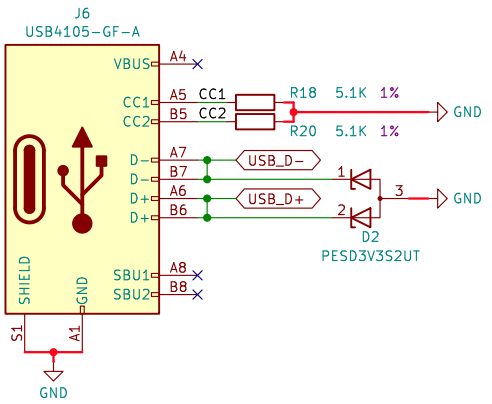

## IO EXPANDER

XIO pins have internal 100 K pull-ups, configured as inputs at reset, cannot be set to Hi-Z, 50 mA push-pull output, 5 V tolerant



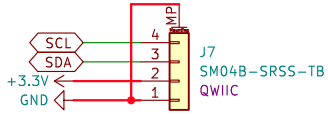

## USB-C INTERFACE

ESP32-C3 only supports full-speed data rate (11 Mbps)




## QWIIC INTERFACE

A great place to plug in off-the-shelf accessories
- Host has pull-ups so accessories don't need their own
- 3.3 V supply is regulated, 600 mA current available



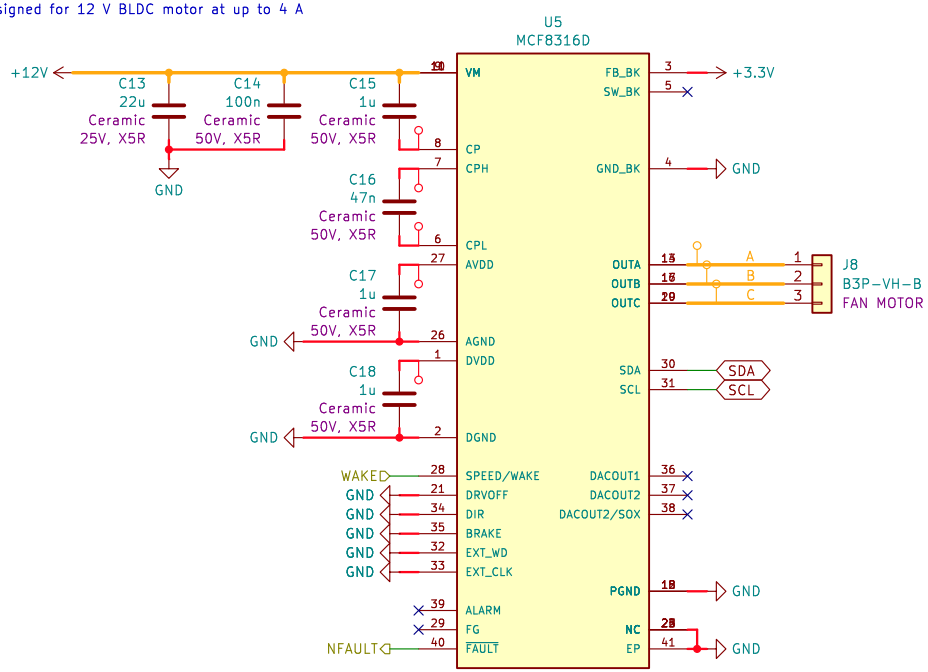

## BUTTONS

Hold BOOT, press/release RESET, then release BOOT to enter the bootloader for firmware updates

| | | |
|---|---|---|
| Sheet: /core/ | | |
| File: core.kicad_sch | | |
| **Title: Minuet Core** | | |
| Size: A4 | Date: | **Rev:** |
| KiCad E.D.A. 8.0.8 | | Id: 2/5 |

**FAN MOTOR DRIVER**

Designed for 12 V BLDC motor at up to 4 A



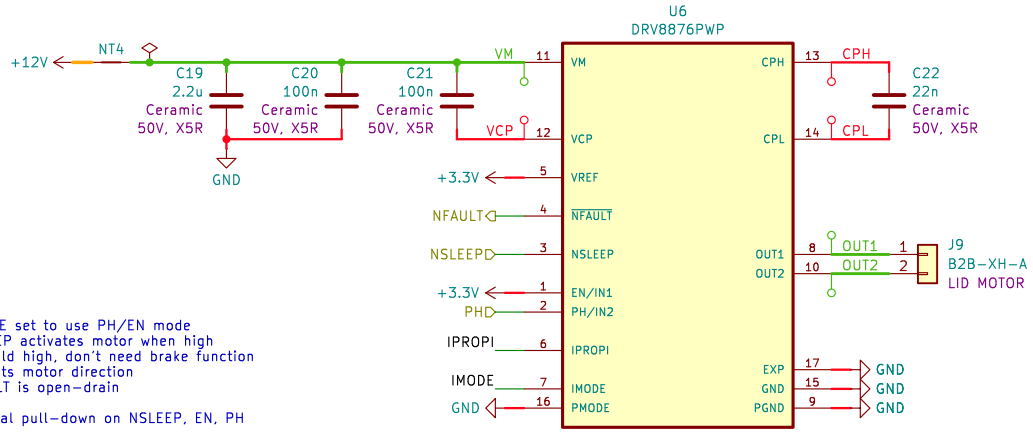

AVDD supplies 3.3 V for internal analog circuitry from VM when not sleeping
DVDD supplies 1.5 V for internal digital logic from FB_BK when not sleeping
FB_BK is externally powered with 3.3 V and the buck converter is disabled to reduce BOM cost per application note SLLA643

NFAULT is open-drain, has an internal pull-up to AVDD that can be disabled via I2C, SLLA643 says never use external and internal pull-up together
SPEED/WAKE has an internal 1 Mohm pull-down for noise immunity and is configured via I2C to wake the device from sleep when high
I2C controls all device functions except wake-up

| | | |
|---|---|---|
| Sheet: /fan/ | | |
| File: fan.kicad_sch | | |
| **Title: Minuet Fan Motor Driver** | | |
| Size: A4 | Date: | **Rev:** |
| KiCad E.D.A. 8.0.8 | | Id: 3/5 |

## LID MOTOR DRIVER

Designed for 12 V DC motor at up to 2 A

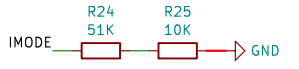



PMODE set to use PH/EN mode
NSLEEP activates motor when high
EN held high, don't need brake function
PH sets motor direction
NFAULT is open-drain

Internal pull-down on NSLEEP, EN, PH

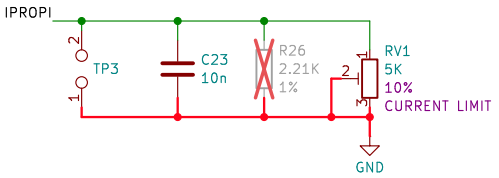
## CURRENT LIMIT

Increasing resistance of the setpoint decreases the current limit




*Make 62 K from JLCPCB basic parts*

Current limit mode 3
When Itrip or Iocp exceeded (motor stall), brake motor, latch outputs off, and assert NFAULT until inputs change




Set overcurrent protection trip current
Itrip (A) = 1000 * Vref (V) / Ripropi (Ω)
Given Vref = 3.3 V, Ripropi = 2.21 K, Itrip = 1.5 A

Must be set high enough to allow the motor to overcome the torque demands of the lid mechanism and ideally should be low enough to detect stall at end of travel. Add a capacitor if there are glitches.

Sheet: /lid/
File: lid.kicad_sch

**Title: Minuet Lid Motor Driver**

Size: A4 | Date: | **Rev:**
KiCad E.D.A. 8.0.8 | Id: 4/5

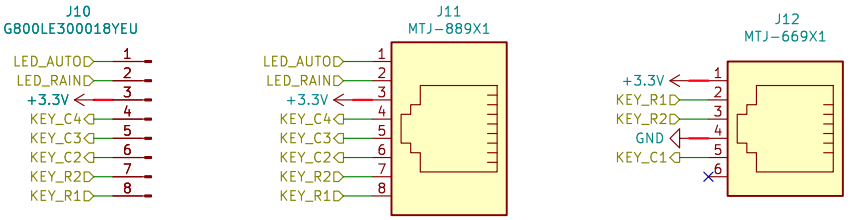
**KEYPAD AND WIRED WALL CONTROL INTERFACE**

Compatible with original equipment

Key matrix
- R1+GND: Close lid
- R2+GND: Open lid
- R1+C1: Fan off
- R1+C2: Fan speed up
- R1+C3: Fan speed down
- R1+C2+C3: Open / close lid
- R1+C4: Toggle rain sensor (only certain models)
- R2+C1: Fan on and cycle speeds
- R2+C2: Fan on / off
- R2+C3: Fan intake / exhaust direction
- R2+C4: Toggle auto thermostat

LEDs
- LED_AUTO: Auto LED cathode, green with 2.4 V voltage drop
- LED_RAIN: Rain LED cathode, red with 2 V voltage drop (only certain models)

KEY_Rx and KEY_Cx inputs need pull-ups
Detect key press when KEY_Rx goes low when undriven (tristate)
Detect key press when KEY_Cx goes low during high-to-low strobe of KEY_Rx
Fan originally provided +5V supply the interface but +3.3V works fine




| | | |
|---|---|---|
| Sheet: /keypad/ | | |
| File: keypad.kicad_sch | | |
| **Title: Minuet Keypad Interface** | | |
| Size: A4 | Date: | **Rev:** |
| KiCad E.D.A. 8.0.8 | | Id: 5/5 |