EEE 3088F

Design Proposal

BRYLIA002

STRREI003

VJVFRI001

Power Subsystem

The STM32F0 Discovery board must supplied with a steady 5V power supply. This cannot be done with a computer due to the requirements and therefore a power system must be put in place to power the board without a computer. A battery and associated circuits will need to be used to supply the board with a steady 5V supply.

Specifications:

- 2 x 18650 Lithium-Ion batteries. This will power the microcontroller when it is not plugged into a computer.
- Polarity protection circuit to prevent damages to components in the circuits, in the case where the batteries are put in the wrong way around.
- Under – voltage protection circuit to cut-off the power to the circuit when the voltage from the batteries drops below 5V.
- Regulation circuit to supply a steady 5V to the USB input of the STM32F0 Discovery board.
- Power Switch to turn the power from the batteries on and off.
- Lithium Ion Battery charger circuit to charge the batteries.
    - One orange LED to indicate charging mode
    - One green LED to indicate fully charged batteries
    - Input USB port to charge batteries (USB 3.0 female connector)
    - Export USB port to power STM32F0 Discovery board (In the same way a computer would – USB 3.0 male connector)

When the STM32F0 Discovery board is connected to the computer, the battery circuit is disconnect from the board.

Power Subsystem Draft Bill Of Materials:

Link to GitLab:

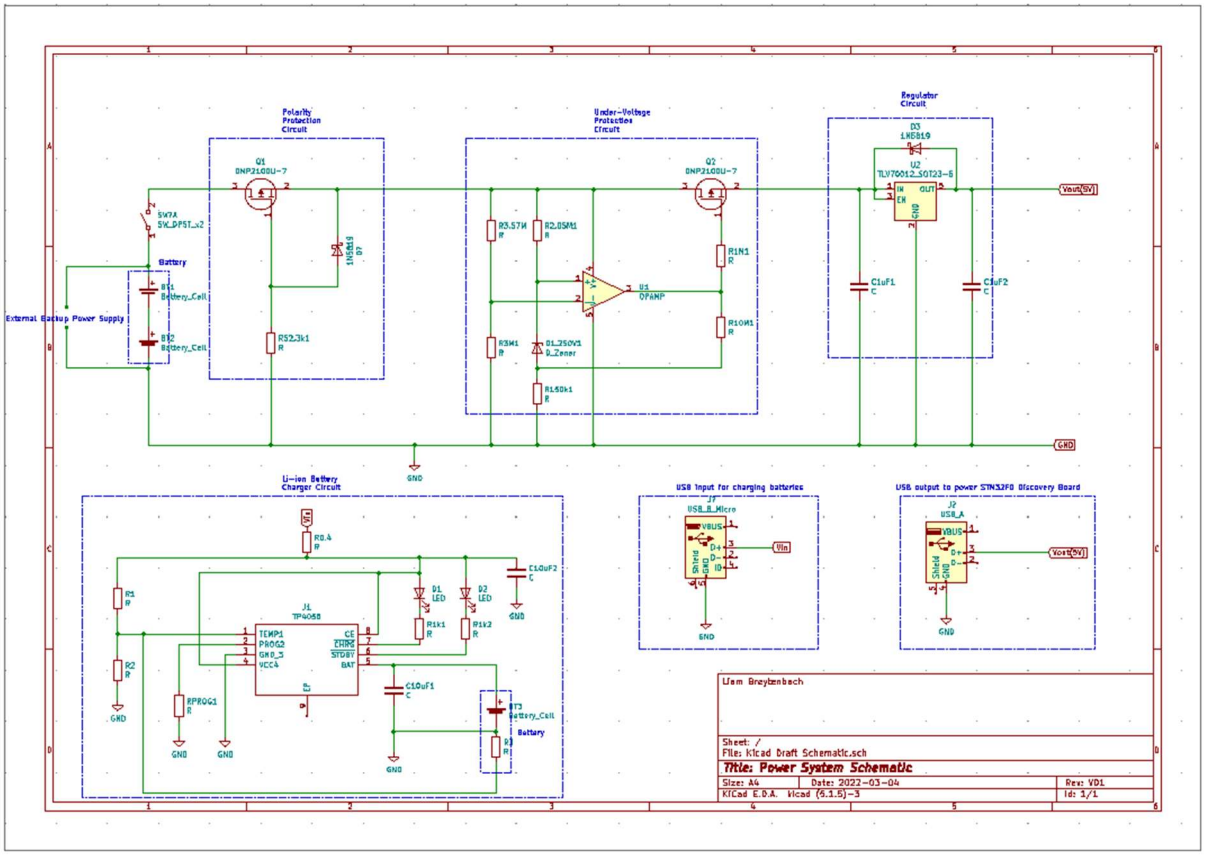
https://gitlab.com/FrisoVijverberg/weather-station-project/-/blob/main/Power_BOM.xlsx

Anticipated cost:

Anticipated Cost = (0.0136*2+0.0101*2+0.057*2+0.0181*2+0.0193+0.0013*3+0.0007*2+0.0013+0.0019+0.0017*2+0.0013*2+0.0013+0.1407+0.109)*5

= $2.4245 (for 5)

Power Subsystem Draft Schematic:



Power Subsystem Interfaces:

- LEDs to show the show if the battery is fully charged or still charging.
- USB power supply to STM32F0 Discovery Board.
- USB charging input to batteries.

Micro Controller Interface

Specifications

- The microcontroller (stm32f0-Discovery) is being fed a 5v line which will then be scaled down to 3v3 allowing the sensors and the components on the board which require 3v3 to run.

- The micro controller must be able to read the data from the Ambient Light Sensor, Humidity and Temperature Sensor and Pressure Sensor.

- It must be able to then transfer the data to the EEPROM Memory.

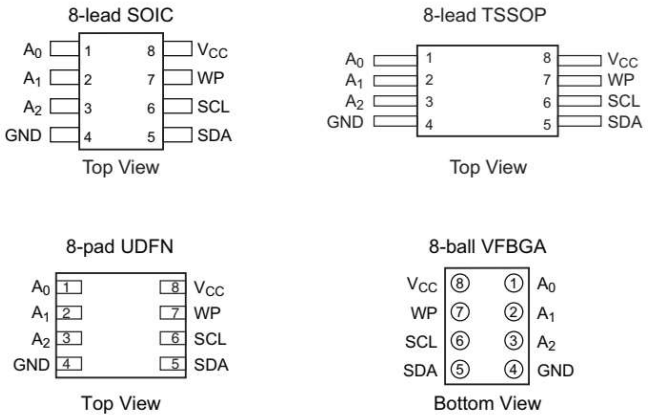
- When the USB is plugged in it should automatically begin uploading the data to the PC.

- While this is happening, it should activate a blue LED for 1s to show the data is being uploaded.

Memory: The EEPROM we have chosen is AT24C256C-SSHL-T this has 256KB and an operating volage of 1.7v-5.5v which is perfect for our needs. The component uses the following pin configuration:

Table 1-1. Pin Configuration

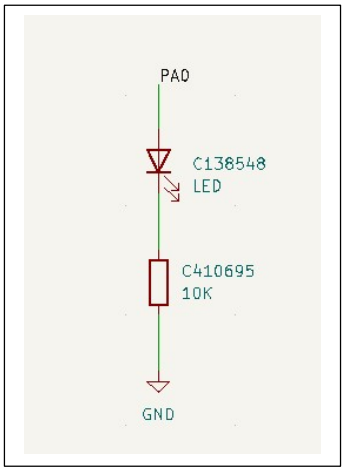
Pin	Function
A_0	Address Input
A_1	Address Input
A_2	Address Input
GND	Ground
SDA	Serial Data
SCL	Serial Clock Input
WP	Write Protect
V_{CC}	Device Power Supply

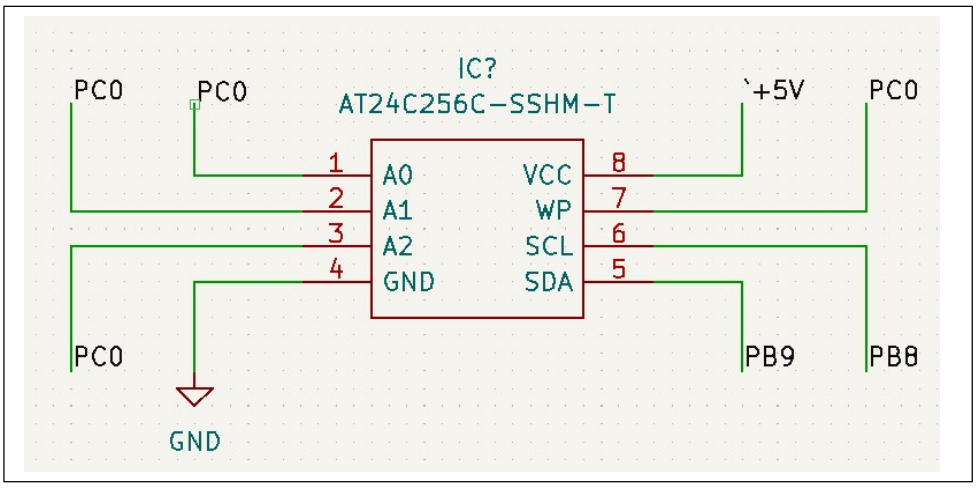


Q2.2 Draft Bill Of Materials (BOM) [10]

https://gitlab.com/FrisoVijverberg/weather-station-project/-/blob/main/BOM.xlsx

Total Anticipated Cost: 1.591 $





Q2.3 Define this submodule's interface(s) [10]

The stm32F0 microcontroller is the heart of the project. It takes in a 5V power supply from the Power Submodule. This will then be used to power the microcontroller and relative sensors/attachments running at any moment in time.

The pins on the EEPROM have been connected based on the following Pin descriptions:

> **Serial Clock (SCL):** The SCL input is used to positive-edge clock data into each EEPROM device and negative-edge clock data out of each device. Connected to Pin 4 (PB8)
>
> **Serial Data (SDA):** The SDA pin is bidirectional for serial data transfer. Connected to pin 3 (PB9).
>
> **Device Addresses (A_2, A_1, A_0):** The A_2, A_1, and A_0 pins are device address inputs that are hard wired (directly to GND or to V_{CC}). When the pins are hard wired, as many as eight 256K devices may be addressed on a single bus system. If these pins are left floating, the A_2, A_1, and A_0 pins will be internally pulled down to GND. They have therefor been connected to pins on the microcontroller that can be configured to a PUPDR.
>
> **Write Protect (WP):** The Write Protect input, when connected to GND, allows normal write operations. When WP is connected directly to V_{CC}, all write operations to the memory are inhibited. If the pin is left floating, the WP pin will be internally pulled down to GND. This has therefor been connected to a pin on the microcontroller that can be configured to a PUPDR.

In addition to this we have added a tester LED circuit that is intended to Light up if the Microcontroller is transporting data to the PC. It was connected to Pin 15 (PA0) which can be configured using the ODR in the microcontroller. (When the USB port goes high, Pin 15 will also go high lighting up the LED).

Sensing

(Sensors have changed from the concept proposal, we have adapted our design to accommodate for this.)

Specifications:

Light Sensor Specifications - GL5516 - Analog

Max Voltage	150	V
Max Power	90	W
Environmental temp.	-30~70	°C
Light resistance (At 10 Lux)	5-10	KΩ
Dark Resistance	0.5	MΩ
Response time (Increase/Decrease)	30/30	ms

Pressure Sensor Specifications - BPM388 - Digital

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Operating temperature range	T_A	Operational	-40	25	+85	°C
		Full accuracy	0		+85	
Operating pressure range	P	Full Accuracy	300		1250	hPa
Sensor supply voltage	V_{DD}	Ripple max. 50 mV_{pp}	1.65	1.8	3.6	V
Interface supply voltage	V_{DDIO}		1.2	1.8	3.6	V
Idle current	$I_{DD,IDLE}$	V_{DDIO} = 1.8V – 3.6V		2		µA
Peak current	I_{PEAK}	During pressure measurement		700	800	µA
	I_{DDT}	During temp measurement		300	400	µA

Humidity + Temperature Sensor Specifications - SHT40-AD1B-R2 – Digital

Parameter	Symbol	Conditions	Min	Typical	Max	Units	Comments
Supply voltage	V_{DD}		1.08	3.3	3.6	V	
Power up/down levels	V_{por}	Static power supply	0.6	-	1.	V	
Supply current	I_{DD}	Idle state	-	0.1	1.0	µA	At 25 °C
		Measurement	-	350	500		

Power consumpt. At VDD = 1.2V	-	Aver., high repeatability Aver., med. repeatability Aver., low repeatability	- - -	2.9 1.6 0.5	- - -	µW	Aver. Power consumption (continuous operation with one meas. per second
Low level input voltage	V_{IL}	-	0	-	$0.3V_{dd}$	V	
High level input voltage	V_{HL}	-	$0.7V_{dd}$	-	V_{dd}	V	
Pull up resistors	Rp	Vdd<1.62V	820	-	-	Ω	
		Vdd>1.62V	390	-	-	Ω	
Low level output voltage	Vol	VDD < 1.62V, Rpullup > 820 Ω	-	-	0.2Vdd	V	
		VDD = 1.62V … 2.0V, Rpullup > 390 Ω	-	-	0.2Vdd	V	
		VDD > 2.0V, Rpullup > 390 Ω	-	-	0.4	V	
Cap bus load	Cb	RP ≤ 820 Ω: fast mode	-	-	400	pF	
		Rp = 390 Ω, VDD > 1.62 V: fast mode plus	-	-	340	pF	

Draft Bill of Materials:

Link to spreadsheet:

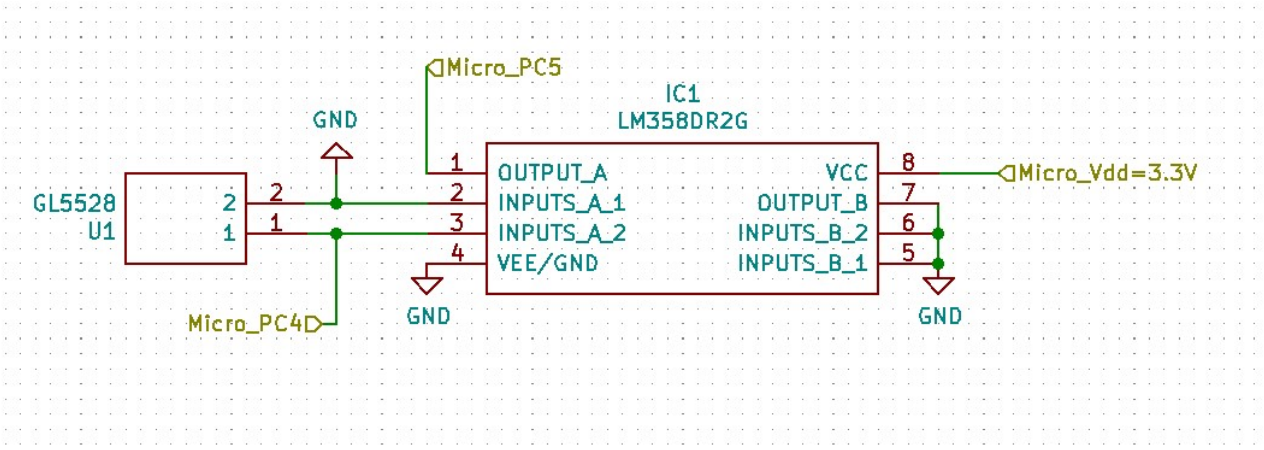
Sensor_BOM.xlsx · main · Friso Vijverberg / Weather Station Project · GitLab

Total anticipated cost:

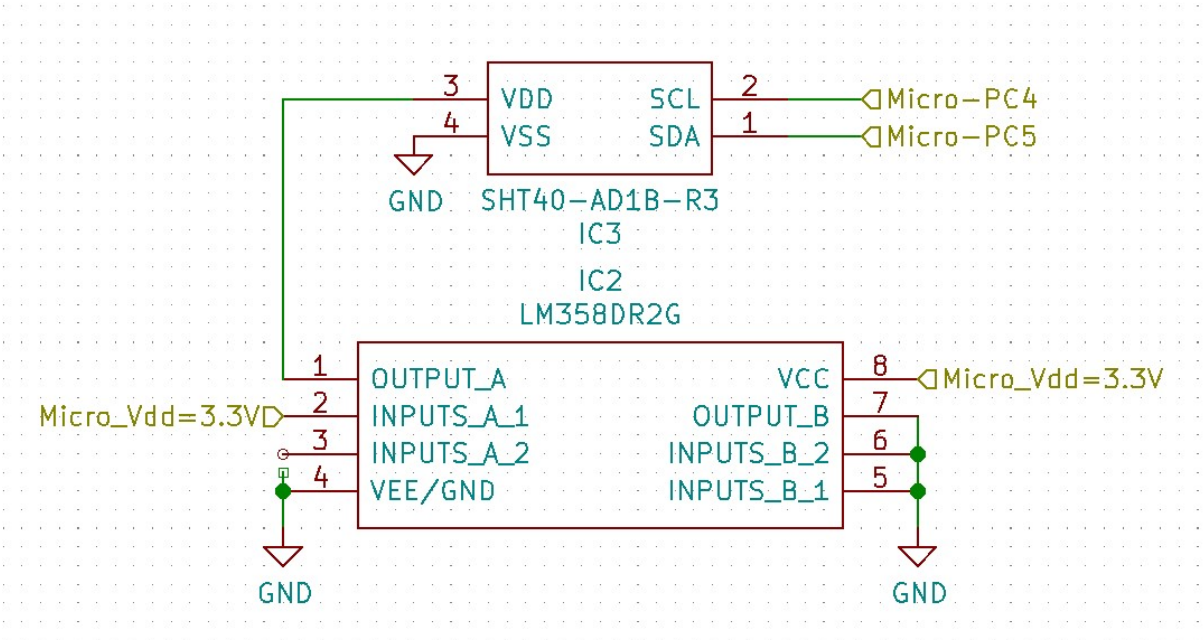
9 + (0.0065*2+0.1407*2+1.1295*2+3.2939+4*0.0007+0.491)*5 =$32.8535 for 5.

Sensing Draft Schematic:

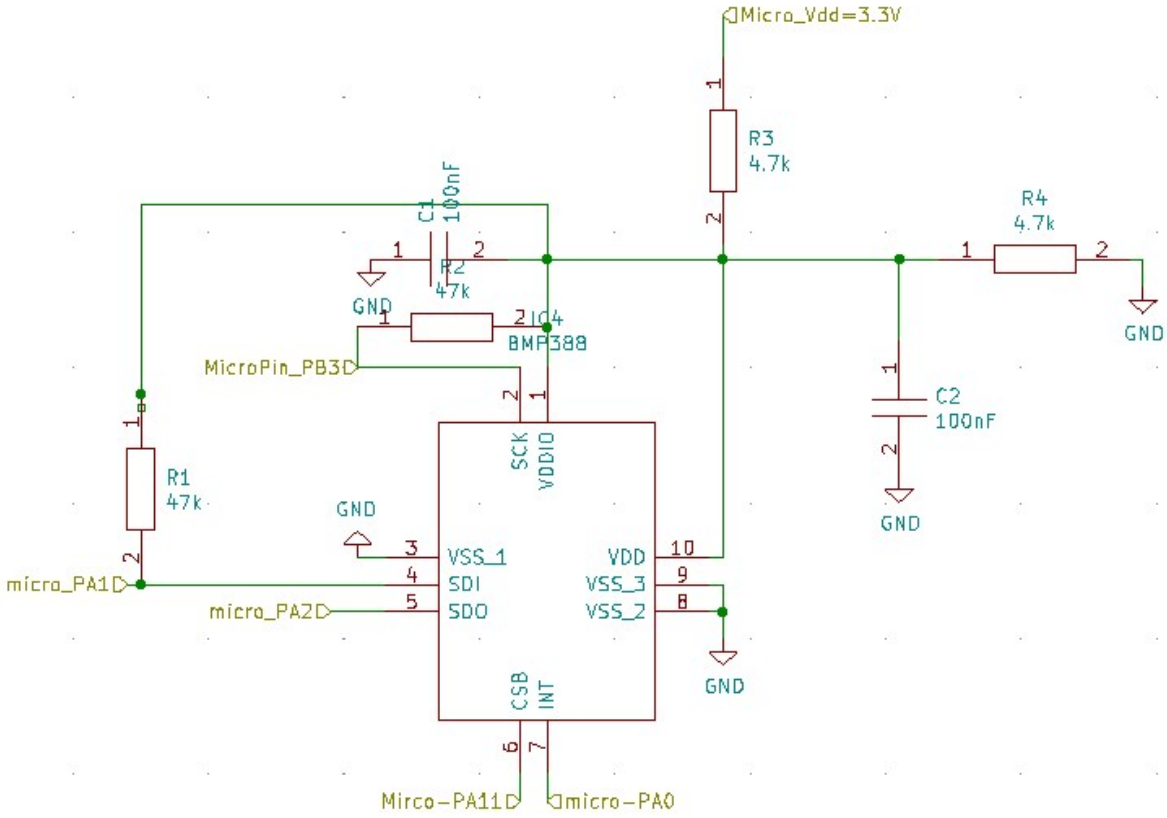
Ambient Light Sensor



Humidity + Temperature Sensor



Pressure Sensor



Sensing Interfaces:

All Sensors interact solely with the microcontroller. The power supply and data are channeled through the microcontroller to their respective locations.

- Digital Sensor Interface

    1. Pressure Sensor

The interface between the pressure sensor and the microcontroller is purely electrical. A 3.3V supply is sent from the microcontroller to the pressure sensor, of which 1.65V reaches the sensor supply voltage (Pin 10 – Vdd) and the internal interface supply voltage (Pin 1 – Vddio). In addition to this, the microcontroller provides a clock data line to Pin 2 – SCK. I/O connections run between the two subsystems at pin 4,5,6 and 7.

    2. Temperature + Humidity

As with the pressure sensor, the interface between the microcontroller and the temperature + humidity sensor is also purely electrical. A 3.3V supply voltage is received at pins 1 and 8 of a buffering op amp, which in turn supplies the sensor with 3.3V at pin 4. Pins 1 (SCL) and 2 (SDA) of the sensor are I/O pins, which send and receive data from the microcontroller.

- Analog Sensor Interface

    1. Light Sensor

The analog light sensor interfaces with the microcontroller is also purely electrical. A 3.3V supply voltage is received at Pin 8 of the Op-amp as the positive rail. In addition to this, a constant voltage is supplied to the non-inverting input through pin PC4 of the microcontroller. The output data, in the form of a ranging voltage, is supplied to Pin PC5 of the microcontroller.