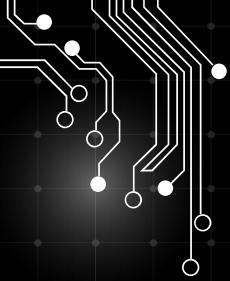




Universal Sensor Design Proposal

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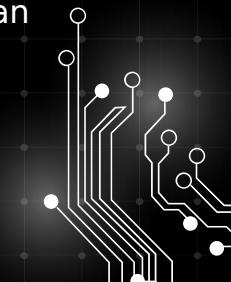
Sensor Concept

The Universal Sensor will be designed around the concept of separating sensing capabilities and communication.

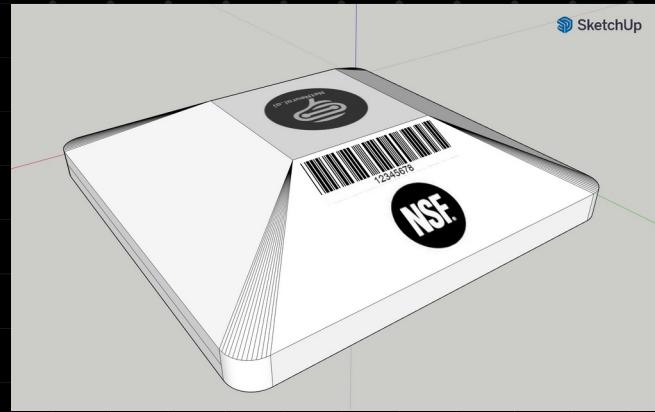
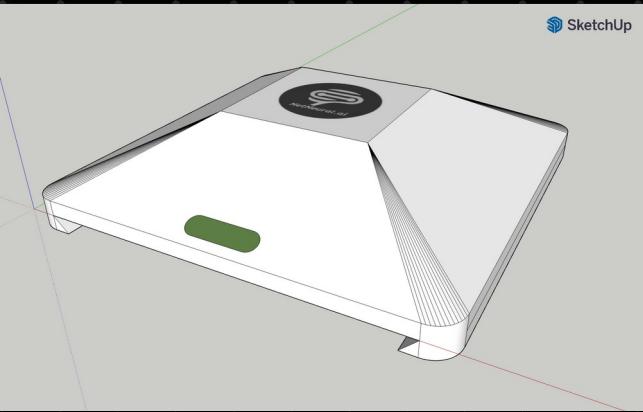
The sensor RF module will provide battery power, RF communications and temperature measurement. Additional sensing capabilities can be added with an optional, attachable “shoe”. The shoe is also the mounting plate and can provide power to the sensor depending on the application.

The initial version of the RF module will be based on a Nordic Semiconductor nRF52840 module. Wireless communication options for this chipset will be BLE, proprietary IEEE 802.15.4, Thread w/wo Matter and Zigbee. These protocols are short range so a gateway will be required.

Additional communication protocols such as LoRaWAN, proprietary 900MHz and/or WiFi can be added with different RF module designs.



RF Module Case Design (1)

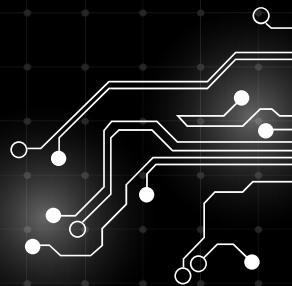
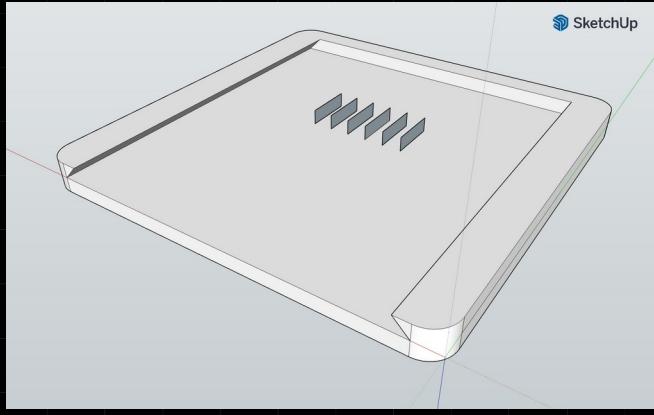


The RF module contains the selected communications module, battery and temperature sensor. The module carrier board is positioned in the bottom of the case to maximize board space and the circular battery attaches to the top of the PC board. This arrangement also keeps the sensor as low profile as possible.

RF Module Case Design (2)

The bottom of the RF module contains the communications connector blades. These blades slide into the sensor shoe contacts on the sensor shoe PC board. These connections provide VCC/GND in all configurations. The other 4 pins can be I2C, UART, SPI or analog depending on the shoe installed. The RF module will need to detect the connected shoe.

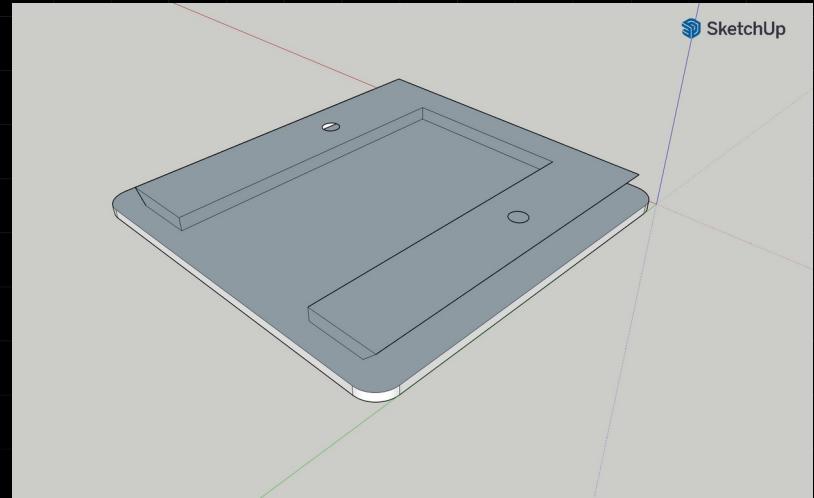
A low cost RF module will be an option that does not have connection blades for temperature sensing only.



Mounting

A basic mounting plate will be the most budget option. This is just a plastic plate for the RF module to be attached. No electronics are included in the mounting plate. Attachment is with 2 flat head screws in countersunk mounting holes.

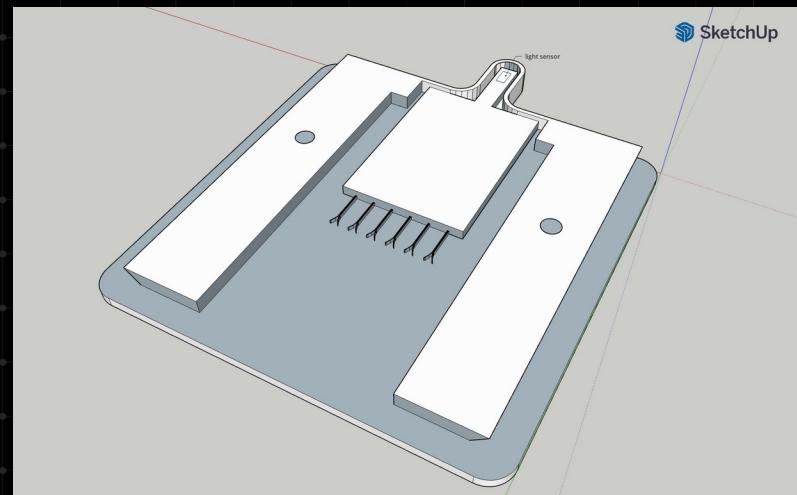
If only basic temperature sensing is needed, this plate can be paired with a RF module with no connection blades.

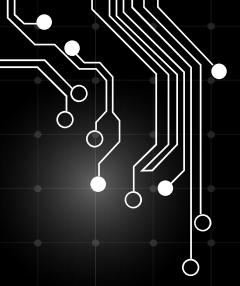


Extensibility

When sensing capabilities beyond temperature are necessary, additional sensors can be added to the mounting shoe. The diagram below shows a configuration for adding light level sensing. The sensor contacts make electrical connection with the RF module blades to provide power and in this case, I2C communication with the sensor. Sensor shoes with I2C devices can also designed to be “stacked” allowing multiple sensors to be connected to a single RF module.

Any I2C enabled sensor can be added to a shoe as well as SPI, UART and analog signals. RF modules will be designed to be interchangeable with sensor shoes. So a light sensor shoe could be added to a BLE RF module or a LoRaWAN RF module with no changes to either component.

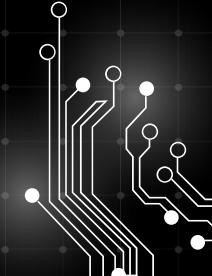




Power

Power will be supplied inside the RF module by a ER32L100 1/6D Lithium Thionyl Chloride (Li-SOCl₂) Battery such as the one from OmniCel shown below.

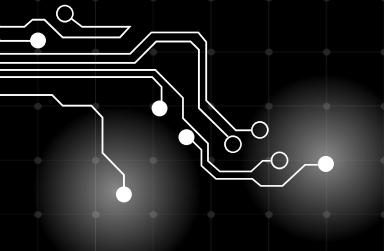
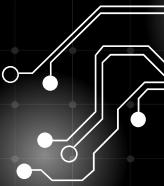
For higher power applications in future RF module versions, an additional power pin will be added so that power to the device can be supplied from the mounting shoe. This opens up options for the sensor to be powered from sources such as a mains power supply, larger Li-SOCl₂ battery (ER34615 3.6V D cell), rechargeable lithium ion battery or common alkaline batteries.



Standard RF Module Features

All RF modules will have a minimum feature set regardless of the chipset used:

- Tri-color LED
- Barcoded device id/serial number on the case and in device memory
- OTA update capability
- NFC
- On-board external memory for data storage



Future

Extensibility options for the sensor are vast.

While temperature will be included by default, the possibilities for future sensing capabilities include:

- Relative humidity
- High temperature readings
- Tilt and vibration
- Light
- Human occupancy
- Soil moisture
- Door monitor
- Weather: wind speed and direction, rainfall, etc
- Gas: Ethylene, CO₂, VOC, etc

