TEXAS STATE®
INGRAM SCHOOL OF ENGINEERING

M1.01 – Radio Board (Cube Satellite)

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Mission Statement

To design and manufacture the radio communications board for Texas State University's first ever, in-house RF Cube Satellite.

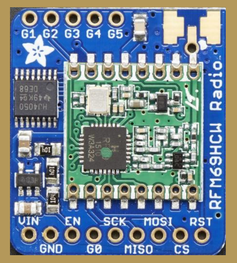
Problem

Texas State university's physics department would like us to create our own radio board design for a CubeSat using interchangeable and available parts, as many parts used in past designs are now discontinued, making it impossible to replicate the designs. Our design is meant to be used as a basis for future satellite designs here at Texas State.

Process

We started by finding affordable components that met our requirements, we then defined our pins and began to plan how we will connect our components. Our final step has been to find and study code so that we can begin to test our design and make necessary adjustments come the start of the fall semester.

Electric Components



Transceiver

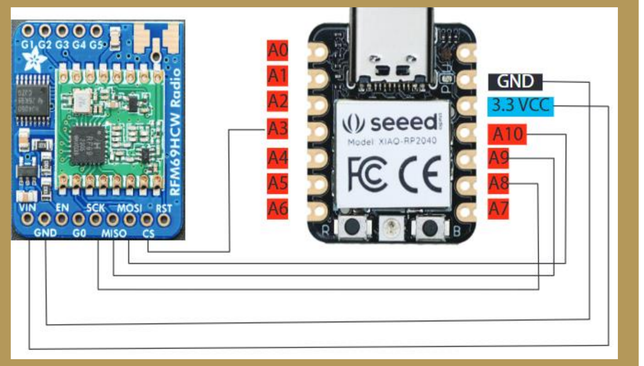
Micro Controller

Power Amplifier

Antenna

Designs and Schematics

Label	Function	Label	Function
G0	timepulse output. it outputs a pulse signal once per second, synchronized with the GPS system's atomic clocks.	RST	this pin is connected to the GPS module's reset pin. It can be used to reset the GPS module.
G1	This pin is connected to the GPS module's FIX LED. It will light up when the module has a fix on GPS signals.	CS	This pin is the Master Out Slave In pin. It is used to transmit data from the master (the microcontroller) to the slave (the GPS module) in the SPI communication protocol.
G2	This pin is connected to the PPS (Pulse Per Second) output of the GPS module. It outputs a pulse signal that is synchronized with the GPS system's atomic clocks.	MOSI	This pin is the Master In Slave Out pin. It is used to transmit data from the slave (the GPS module) to the master (the microcontroller) in the SPI communication protocol.
G3	This pin is connected to the GPS module's TX output. It outputs serial data in NMEA format, which can be used to communicate with the GPS module.	MISO	This pin is the SPI clock pin. It is used to provide a clock signal for synchronizing data transfer between the master and slave devices.
G4	This pin is connected to the GPS module's RX input. It can be used to send commands or data to the GPS module.	SCK	This pin is the SPI clock pin. It is used to provide a clock signal for synchronizing data transfer between the master and slave devices.
G5	This pin is connected to the GPS module's EN (Enable) pin. It can be used to turn the GPS module on or off.	EN	This pin is connected to the GPS module's enable pin. It can be used to turn the GPS module on or off.
Vin	This pin is the input voltage pin. It can be used to supply power to the GPS module and can accept a voltage range of 3.3V to 5.5V DC.	GND	This pin is the ground pin. It should be connected to the ground of the system.



Pinout schematic shows the connections between the transceiver and the micro controller, as well as a table describing the function of each pinout and where it connects to.

Program Code Description

- We have found code that enables wireless communication between two nodes using a RFM69HCW Transceiver with an Arduino, we believe we can modify this code to transmit signals.
- It starts by including libraries for RFM69HCW and defining constants like network ID, node IDs, frequency, and encryption settings
- The setup function initializes serial communication and RFM69HCW module, setting it to high power and a specific power level.
- When encryption is enabled, a key is set for encrypting and decrypting messages.
- If a message is received from another node, it's displayed on the serial monitor along with its corresponding Received Signal Strength Indication (RSSI).

Essential Information

Restraints and Requirements:

- Frequency used: 433 MHz
- Voltage required: 3.3 VCC
- Transceiver Power Output: +13 to +20 dBm
- Power Amplifier Output Gain: +15 dBm
- AX.25 radio packet protocol

Bill of Materials:

- 2x Adafruit RFM69HCW
- 2x Seeed Studio XIAO RP2040
- 2x RFFM6406 Front-End Module
- 2x uFL SMT Antenna Connector

Future Tasks:

- Component testing
- Code testing
- Manufacture PCB Board
- Assembly of Radio Board components onto PCB Board
- Integration of Radio Board into Protocol Frame
- Electrical testing