CanSat 2024-25

Main Board Codex

## Component Selection

The following key components have been selected

|  |  |  |
| --- | --- | --- |
| **Component** | **Function** | **Qty** |
| Teensy 4.0 | Control | 1 |
| XB24CAWIT-001 | Xbee for comms | 1 |
| CD-PA1616D | GPS Module | 1 |
| BNO085 | Inertial Measurements | 1 |
| BMP581 | Temperature and Pressure | 1 |
| QRE1113GR | Gyro rate sensing | 2 |
| INA260 | Power sensing | 1 |

All additional components can be found on the Main Board BOM

The following components have been selected for the isolated buzzer

|  |  |  |
| --- | --- | --- |
| **Component** | **Function** | **Qty** |
| CR2450 Battery Holder  https://uk.rs-online.com/web/p/battery-holders/2378264 | Battery Holder | 1 |
| KXG1203C | Buzzer | 1 |

## Pin Assignments

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Category | Net name | Teensy Pin | Peripheral Name | Notes |
| Xbee | XBEE\_TX | 15 | Serial 3 – RX3 |  |
|  | XBEE\_RX | 14 | Serial 3 – TX3 |  |
| GPS | GPS\_TX | 7 | Serial 2 – RX2 |  |
|  | GPS\_RX | 8 | Serial 2 – TX2 |  |
| I2C Bus | SCL0 | 19 | SCL0 |  |
|  | SDA0 | 18 | SDA0 |  |
| Gyro | GYRO\_RATE\_EN | 13 |  |  |
|  | GYRO\_RATE\_A | 17 |  | JP to Pin 3 |
|  | GYRO\_RATE\_B | 16 |  | JP to pin 4 |
| Motors | M1\_IN1 | 22 | PWM |  |
|  | M1\_IN2 | 23 | PWM |  |
|  | M1\_ENC\_A | 7 | \* |  |
|  | M1\_ENC\_B | 8 | \* |  |
|  | M2\_IN1 | 12 | PWM |  |
|  | M2\_IN2 | 11 | PWM |  |
|  | M2\_ENC\_A | 3 | \* |  |
|  | M2\_ENC\_B | 4 | \* |  |
|  | M3\_IN1 | 9 | PWM | Shared with SERVO\_2 |
|  | M3\_IN2 | 10 | PWM | Shared with SERVO\_3 |
|  | M3\_ENC\_A | 3 | \* | Can be overwritten by GYRO\_RATE\_A |
|  | M3\_ENC\_B | 4 | \* | Can be overwritten by GYRO\_RATE\_B |
| Servos | SERVO\_1 | 0 | PWM |  |
|  | SERVO\_2 | 9 | PWM | Shared with M3\_IN1 |
|  | SERVO\_3 | 10 | PWM | Shared with M3\_IN2 |
| Interrupts | POWER\_INT | 20 |  | Only when JP |
|  | IMU\_INT | 21 |  | Only when JP |

BMP581, BNO085, INA260, and ESP32 sense are connected to the I2C bus.

## Autogyro Measurements

The autogyro rotation rate is measured through two QE1113GR sensors. GYRO\_RATE\_B is out of phase by 112.5 degrees clockwise when compared to GYRO\_RATE\_A. A 4-pulse encoder wheel should be used resulting in a quadrature output with 4 pulses per revolution.

GYRO\_RATE\_EN turns on both emitters when pulled high, allowing measurements to be taken.

## Power

3.7V – 5.5V should be fed into J1 (labelled MAIN BATT). This is regulated to 3.3v by the teensy and esp32 independently to generate +3v3 (Main) and +3.3VP (Alternate). By default, all peripherals are powered by the Main bus (except the esp32). Jumpers can be used to switch some loads onto the Alternate bus.

**Warning: The alternate bus is generated by a buck converter so could be noisy at high load.**

In addition, Battery voltage is fed to the motor drivers and servo connectors so all DC motors can be driven from unregulated battery voltage.

The Buzzer is powered from an LIR2450 3.7v nominal cell.

## Jumper Configuration

#info will be added once jumper numbers are confirmed#

POWER\_INT and IMU\_INT must be jumpered if used. Otherwise pin 20 and 21 are free for other uses.

Main/Alt jumpers switch the GPS and QE1113GR emitters from the Main 3.3v bus to the Alternate bus

GYRO\_RATE\_A/B can be jumpered to use the M3 hardware quadrature encoder

Add info on JP1?

# For Design of THT Board

I have uploaded the schematics for the SMD board which is probably a good place to go if anything isn’t quite making sense. Asking is also super ok.

<https://drive.google.com/drive/folders/1z2Z06Nm4TSyRETeqouWdsZ6dlYxpo4Es?usp=drive_link>

Some components are already THT and can be used as is:

* Teensy 4.0
* Xbee
* ESP32 Camera (although it is then harder to power when through hole mounted)
* Our custom screw switch
* The Buzzer

Some components are SMD but hand solderable:

* The QRE1113GR’s
* The Buzzer battery holder
* All the 0603 package resistors and capacitors (although I would recommend THT passives if you have the space just because it will be easier to populate)

The rest of the components are SMD without exposed pads, so breakout boards are needed:

* PA1616D (I think Adafruit call it the ultimate GPS)
* INA260
* BMP581
* BNO085
* Motor Drivers
* SD card slot

## Screw Switch Footprint

For the schematic I used the “SW\_Push\_Open\_Dual x2” symbol. This symbol has an A and a B part with two separate switches which is useful to physically separate the two switches on the schematic to make the buzzer isolation clear.

For the PCB footprint I can either share the dimensions of the footprint and you can make it yourself or I can share the custom footprint file, and you can import it like any other footprint.

## RTC Battery

The Teensy Needs a 3v input to keep the RTC running if power is lost. The conventional way of doing this is a coin cell battery. You can take that approach if you want.

To save weight I have used a capacitor and diode to store a small amount of energy that can keep the RTC powered for a few minutes. The capacitor is charged through a diode so that if the 3.3v line goes, the capacitor does not try to power the rest of the board as well as the RTC. The diode also has a 0.3v forward voltage that conveniently limits the capacitor voltage to ~3v. The exact components I have used are SMD but hand solderable so its up to you what you want to do.

## Keepout Areas

Massive layers of copper on the PCB can act a bit like half a faraday cage and block RF signals from radiating properly. This is worth considering when designing the GPS and XBee portions of the PCB.