INTRO TO DRONE BUILDING

MODULE 10

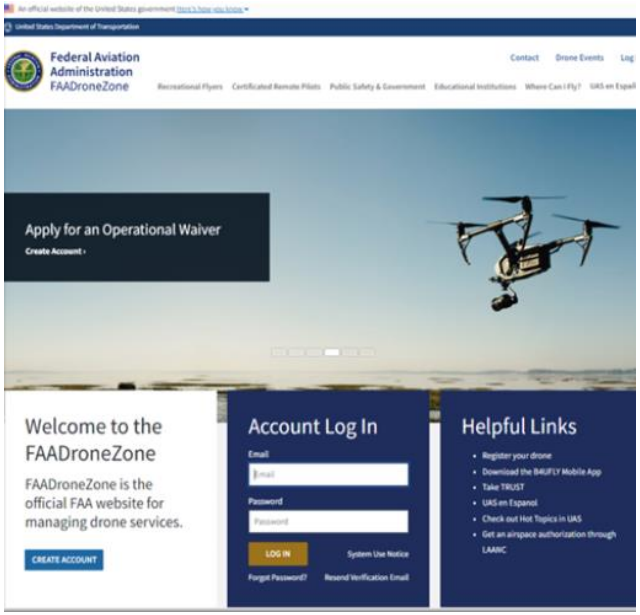
RULES

DRONE SPECIFICATIONS

- **Vehicle must be a quadcopter**
  - 4 motors with one propeller each
  - Propellers must not exceed 12 inches
- **Flight computer must be an ArduPilot-capable system**
- **The entire system must fit in a 36” cube**
  - Includes quadcopter + mechanism + any associated systems
- **Battery must be a lithium polymer (LiPo) battery**
  - No more than 4 cells
- **For safety purposes, the vehicle must have a secure location for attaching a tether**
  - Recommend carabiner clip for easy attachment

DRONE SPECIFICATIONS

- **UAV over 0.55 lbs must be registered with FAA**
  - Technical inspection will check for FAA registration number
- **FAA Website:** https://registermyuas.faa.gov/
  - Must be 13 years or older to register
  - Make an account with the FAA
  - Select "Model Aircraft"
  - Pay $5 registration fee
  - Receive UAS registration number
  - Label your UAS with the registration number
- **See link for how-to instructions:** http://diydrones.com/profiles/blogs/how-to-register-your-drone-with-the-faa



FAADroneZone Site

ELECTRONICS

CONTROLLER COMMUNICATIONS

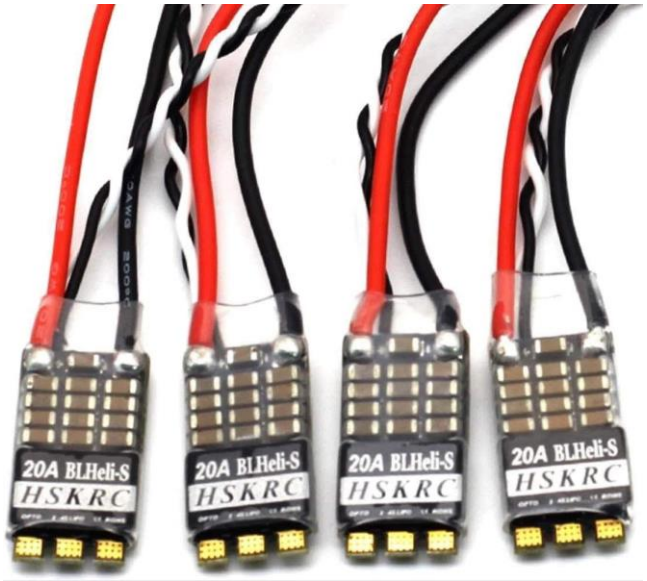
- **Flysky FS-i6X Transmitter**
  - A transmitter (remote control) is used to send control signals from the pilot to the drone
- **Flysky FS-iA6B Receiver**
  - A receiver accepts the transmissions (communications) from the transmitted, then gives the command to the drone

Transmitter/Receiver Kit

TELEMETRY COMMUNICATIONS

- **Telemetry Radio Data Transmission Module**
  - Sends telemetry data to the ground control station
  - Telemetry data is information collected by the sensors (such as altitude, speed, and GPS coordinates)
- **Electronic Speed Controller (ESC)**
  - Accepts commands for motor speed, then alters the power input to increase/decrease motor speed

Telemetry Kit:
Air & Ground Modules



ESCs:
1 per motor

POWER SOURCES

- **Lithium Polymer (LiPo) Battery**
  - Used to power main drone infrastructure
  - High energy density (lightweight for flying vehicles)
  - See Safety section for info about care and precautions
- **Nickel Metal Hydride (NiMH) Servo Battery**
  - Used to power servo for mechanism
  - Similar to common household batteries (such as AAA)

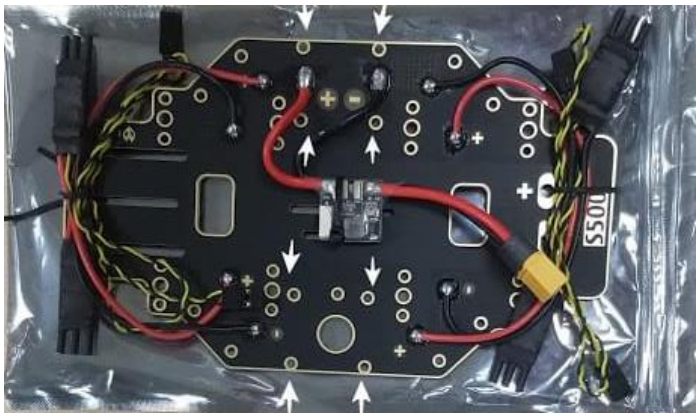
LiPo Battery

NiMH Battery

POWER DISTRIBUTION

- **Power Module**
  - Funnels power from battery to power management board
  - Regulates and monitors power distribution
  - Tracks battery levels
- **Power Management Board (PMB)**
  - Accepts power from power module, then disperses it to components (onboard computer and motors)
  - Drone kit incorporates PMB into the structure

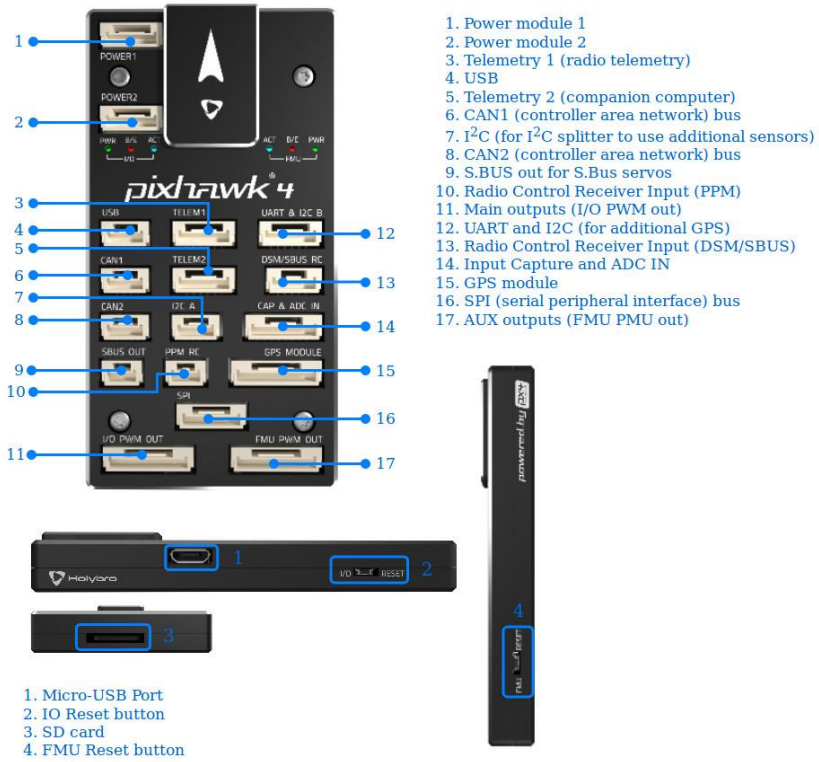
Power Module



PMB

AUTOPILOT

- **Pixhawk PX4 PIX 2.4.8 Flight Controller**
  - Accepts commands from transmitter or ground station, then outputs commands to drone
  - Includes sensors to collect telemetry data



Pixhawk Flight Controller

SENSORS

- **NEO-M8N GPS**
- **IST8310 Magnetometer**
  - Measures magnetic fields (compass)
- **BMI055 Inertial Measurement Unit (IMU)**
  - Measures angular rate and rotation (gyroscope)
- **MS5611 Barometer**
  - Measures atmospheric pressure

GPS & Magnetometer

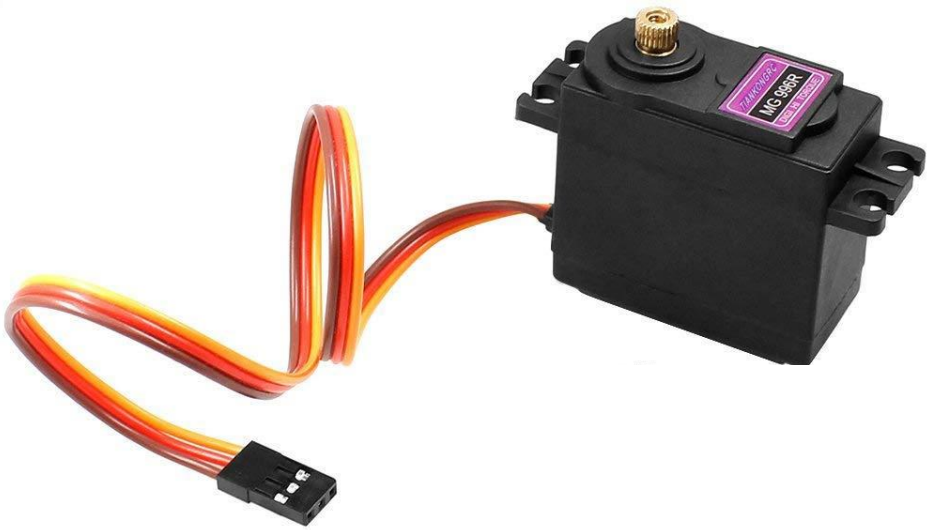
IMU

Barometer

MECHANICAL COMPONENTS

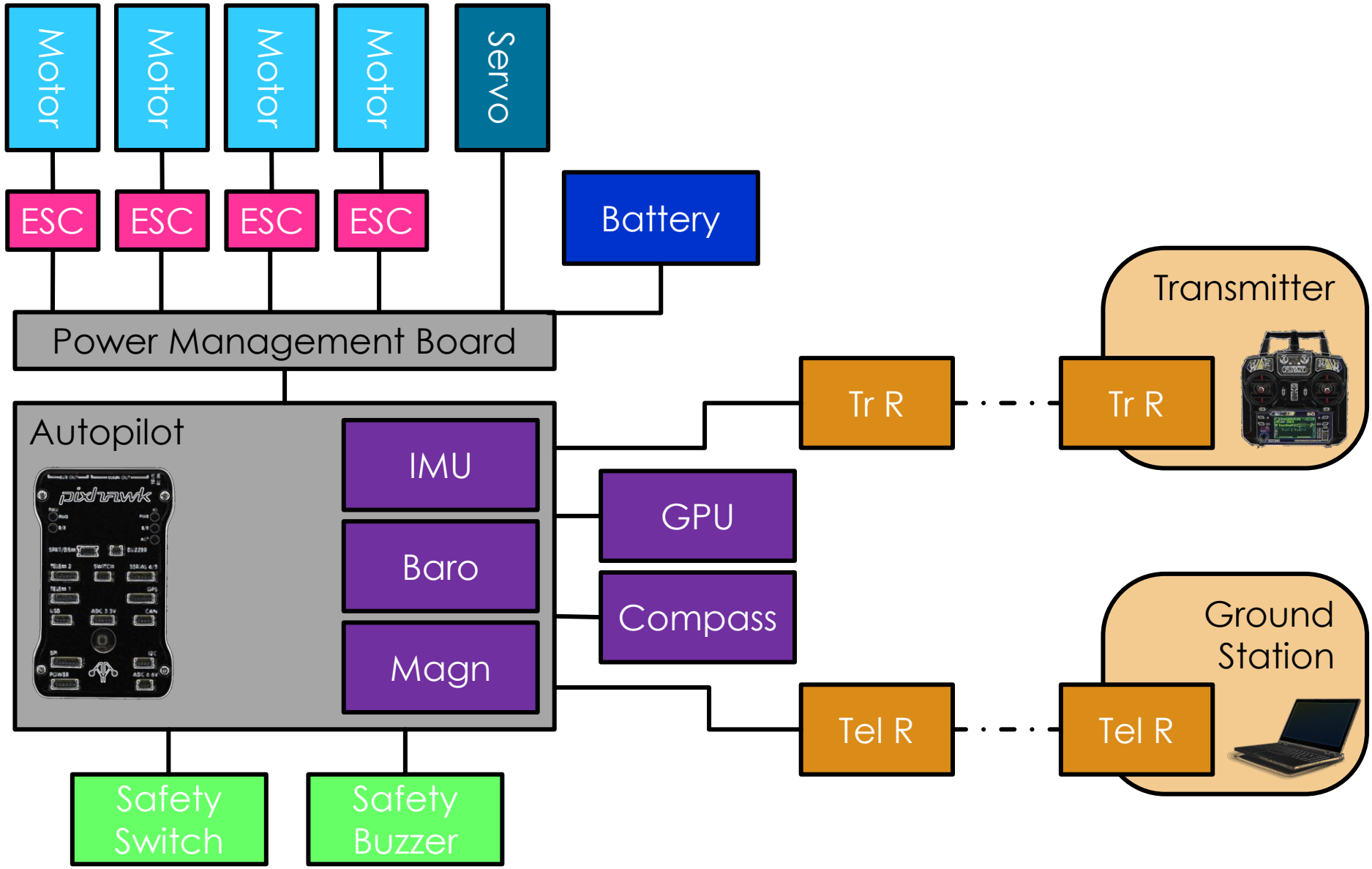
- **Motor**
  - Used to turn propellers (4 total)
  - Controlled by electronic speed controller
- **Metal Gear Torque Servo**
  - Used to activate mechanism

Motor



Servo

LAYOUT

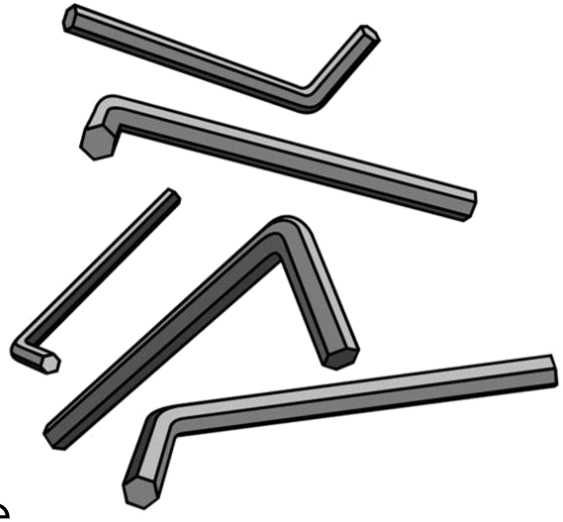


SUPPLIES

TOOLS

- **Structure:**
  - Allen wrenches (hex keys)
  - Adhesives (tape, zip ties)
- **Electronics:**
  - Soldering Iron
  - Solder
  - Electrical Tape
  - Zip Ties
    - Use to organize wiring
- **Other:**
  - Laptop
    - Necessary as ground station
    - Will be used at competition
  - Group chat for team communication
  - Shared Google Drive files
    - Slides – build technical presentation
    - Sheets – track budget, supplies, schedule

Soldering Iron



Allen Wrenches

OTHER RECOMMENDED SUPPLIES

- **Mechanism:**
  - Will need structural materials and fasteners
  - Design mechanism according to budget, available tools, and skill level
  - Gather/purchase supplies early to allow testing and redesign
- **Practice Field Components:**
  - Autonomous:
    - Egg
    - Materials to build egg capsule
    - Practice target (cardboard, etc.)
  - Semi-Autonomous:
    - Tennis balls
    - Practice goals (bucket, hamper, etc.)
- **Safety:**
  - Tether system
    - Heavy base (cinder block, brick, etc.)
    - Tether line (twine, paracord, fishing line, etc.)

SAFETY

BATTERY CARE

- **Charger:**
  - Remove battery as soon as charging is complete
- **Storage:**
  - Store in LiPo bag
  - Do not leave in car, near heat vent, etc.
- **In Case of Emergency:**
  - If drone crashes, wait at a distance before retrieving
  - If battery puffs, set in a plastic bin and do not touch
  - Do not dispose of batteries in trash can (must take to authorized recycling facility)

Battery Charger

LiPo Bag

TESTING/FLIGHT ETIQUETTE

- **E-stop:**
  - Program a button (escape key on computer, switch on transmitter) that will immediately ground drone
- **Tether:**
  - Do not fly until drone is securely tethered
  - All personnel must stay out of tether range during flight
- **Carrying Drone:**
  - Keep hands away from propellors at all times
  - Lift from below and aimed away from face
- **Arming:**
  - Program drone to not fly until arming switch/buzzer are set

RESOURCES

MORE RESOURCES

- **ARC Resources:** https://arc-tutorials.readthedocs.io/en/latest/
  - Includes tutorials and links for kit assembly
  - Lists options and guides for ground station
- **ARC Rule Book:** https://www.aeroroboticscomp.com/20223-competition